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MICROCOMPUTER MN10300

MN10300 Series C Source Code Debugger User's Manual

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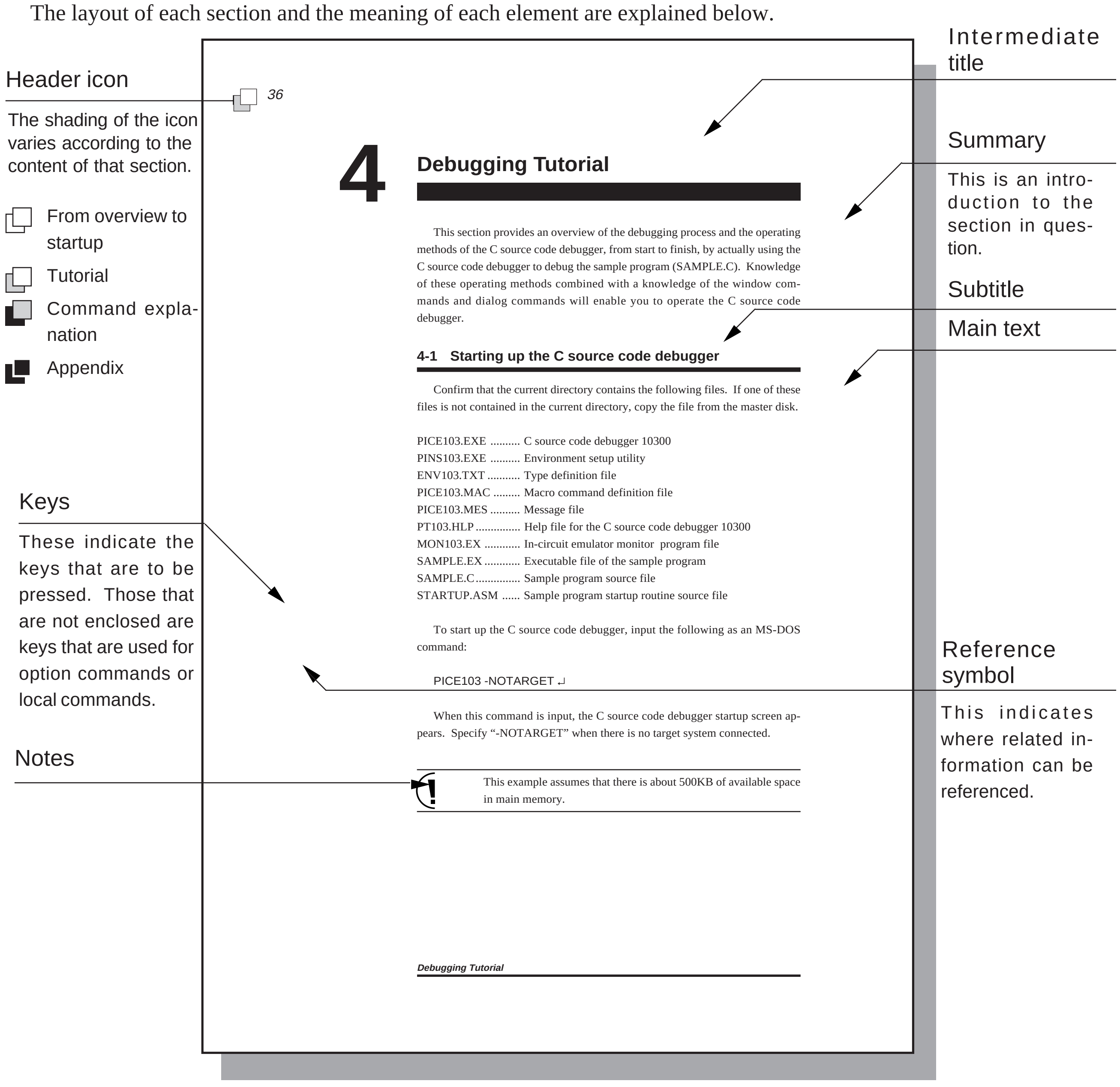
Panasonic

About This Manual

This manual is intended for engineers who will be debugging programs for the MN10300 Series. Chapters 1 through 3 provide an overview of the C Source Code Debugger, describe its organization, and explain how to start it up. Chapter 4, intended for beginners, is a detailed guide to debugging work. Chapter 5 introduces the options that can be specified when starting up the C Source Code Debugger. Chapter 6 explains the window commands, while chapters 7 and 8 explain the dialog commands and macro commands, respectively. These chapters also include specific command execution examples. Chapter 9, an appendix, includes specifications and notes concerning the In-circuit Emulator, probe specifications, an explanation of the operation of the interface board switches, error messages, and a quick reference for the commands.

■ Organization of This Manual

Each section in this manual generally consists of a title, summary, main text, indications of the keys that are used, notes, and reference information. Chapters 7 and 8 also include commands, command patterns, and examples of usage. The layout of each section and the meaning of each element are explained below.



Header icon

The shading of the icon varies according to the content of that section.

From overview to startup

Tutorial

Command explanation

Appendix

Keys

These indicate the keys that are to be pressed. Those that are not enclosed are keys that are used for option commands or local commands.

Notes

Intermediate title

Summary

This is an introduction to the section in question.

Subtitle

Main text

Reference symbol

This indicates where related information can be referenced.

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4 Debugging Tutorial

This section provides an overview of the debugging process and the operating methods of the C source code debugger, from start to finish, by actually using the C source code debugger to debug the sample program (SAMPLE.C). Knowledge of these operating methods combined with a knowledge of the window commands and dialog commands will enable you to operate the C source code debugger.

4-1 Starting up the C source code debugger

Confirm that the current directory contains the following files. If one of these files is not contained in the current directory, copy the file from the master disk.

PICE103.EXE	C source code debugger 10300
PINS103.EXE	Environment setup utility
ENV103.TXT	Type definition file
PICE103.MAC	Macro command definition file
PICE103.MES	Message file
PT103.HLP	Help file for the C source code debugger 10300
MON103.EX	In-circuit emulator monitor program file
SAMPLE.EX	Executable file of the sample program
SAMPLE.C	Sample program source file
STARTUP.ASM	Sample program startup routine source file

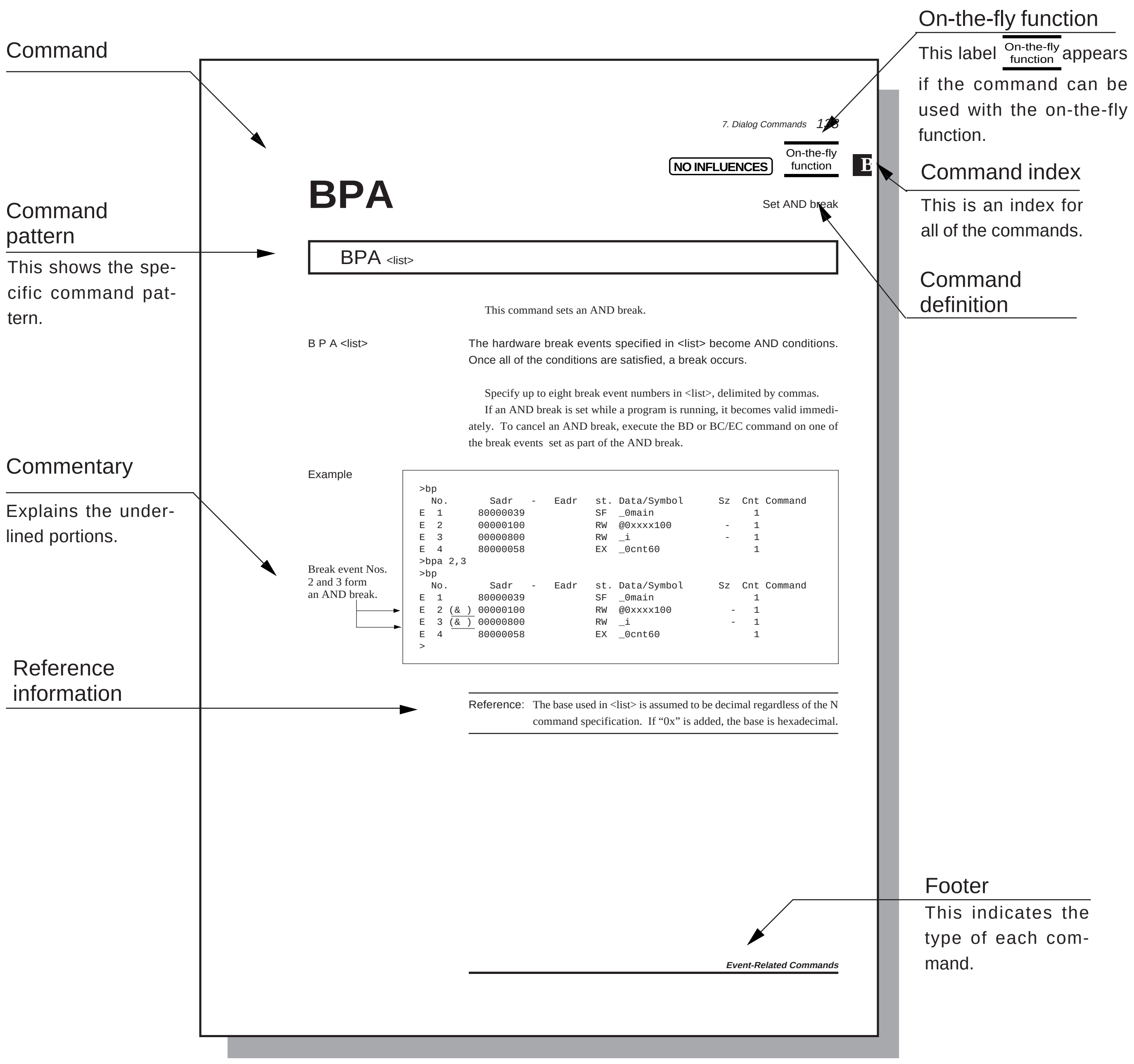
To start up the C source code debugger, input the following as an MS-DOS command:

```
PICE103 -NOTARGET ↵
```

When this command is input, the C source code debugger startup screen appears. Specify "-NOTARGET" when there is no target system connected.

This example assumes that there is about 500KB of available space in main memory.

Debugging Tutorial


Command
Command pattern
This shows the specific command pattern.
Commentary
Explains the underlined portions.
Reference information
On-the-fly function
This label On-the-fly function appears if the command can be used with the on-the-fly function.
Command index
This is an index for all of the commands.
Command definition
Footer
This indicates the type of each command.

7. Dialog Commands 123

NO INFLUENCES On-the-fly function B

BPA

Set AND break

BPA <list>

This command sets an AND break.

B P A <list> The hardware break events specified in <list> become AND conditions. Once all of the conditions are satisfied, a break occurs.

Specify up to eight break event numbers in <list>, delimited by commas.
If an AND break is set while a program is running, it becomes valid immediately. To cancel an AND break, execute the BD or BC/EC command on one of the break events set as part of the AND break.

Example

Break event Nos. 2 and 3 form an AND break.

```
>bp
  No.       Sadr   -   Eadr   st. Data/Symbol      Sz  Cnt Command
E  1      80000039            SF  _0main                1
E  2      00000100            RW  @0xxxx100         -   1
E  3      00000800            RW  _i                -   1
E  4      80000058            EX  _0cnt60               1
>bpa 2,3
>bp
  No.       Sadr   -   Eadr   st. Data/Symbol      Sz  Cnt Command
E  1      80000039            SF  _0main                1
E  2 (& ) 00000100            RW  @0xxxx100          -  1
E  3 (& ) 00000800            RW  _i                 -  1
E  4      80000058            EX  _0cnt60               1
>
```

Reference: The base used in <list> is assumed to be decimal regardless of the N command specification. If “0x” is added, the base is hexadecimal.

Event-Related Commands

■ Finding Information

This manual allows you to find information quickly by one of four methods:

(1) To find the beginning of each chapter, refer to the index at the beginning.
(2) To find the titles, refer to the Table of Contents at the beginning.
(3) Chapter titles are indicated at the top of right-hand pages, while intermediate titles are indicated at the bottom of each page. These can be used to get a quick idea of the content of each section of the manual as you flip through the pages of the manual.
(4) To find a command, refer to the index at the end of the manual. A command index is also indicated on the edge of each right-hand page; this index can be used to find the desired command as you flip through the pages of the manual.

■ Related Manuals

In addition to this manual, Panasonic also provides the following manuals for related products:

"MN103S00 Series Instruction Manual"
<Describes the instruction set>

"MN10300 Series Cross-assembler User's Manual
<Describes the assembler syntax and notation>

"MN10300 Series C Compiler User's Manual: Usage Guide"
<Describes the installation, the commands, and options of the C Compiler>

"MN10300 Series C Compiler User's Manual: Language Description"
<Describes the syntax of the C Compiler>

"MN10300 Series C Compiler User's Manual: Library Reference"
<Describes the the standard library of the C Compiler>

"MN10300 Series C Source Code Debugger for Windows(R) User's Manual"
<Describes the use of the C source code debugger for Windows>

"MN10300 Series Installation Manual"
<Describes the installation of the C compiler, cross-assembler and C source code debugger and the procedure for bringing up the in-circuit emulator>

■ Contact Information

If you have any comments or questions concerning this manual, contact the nearest Semiconductor Design Center. Refer to the list at the back of this manual for addresses, etc.

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CONTENTS

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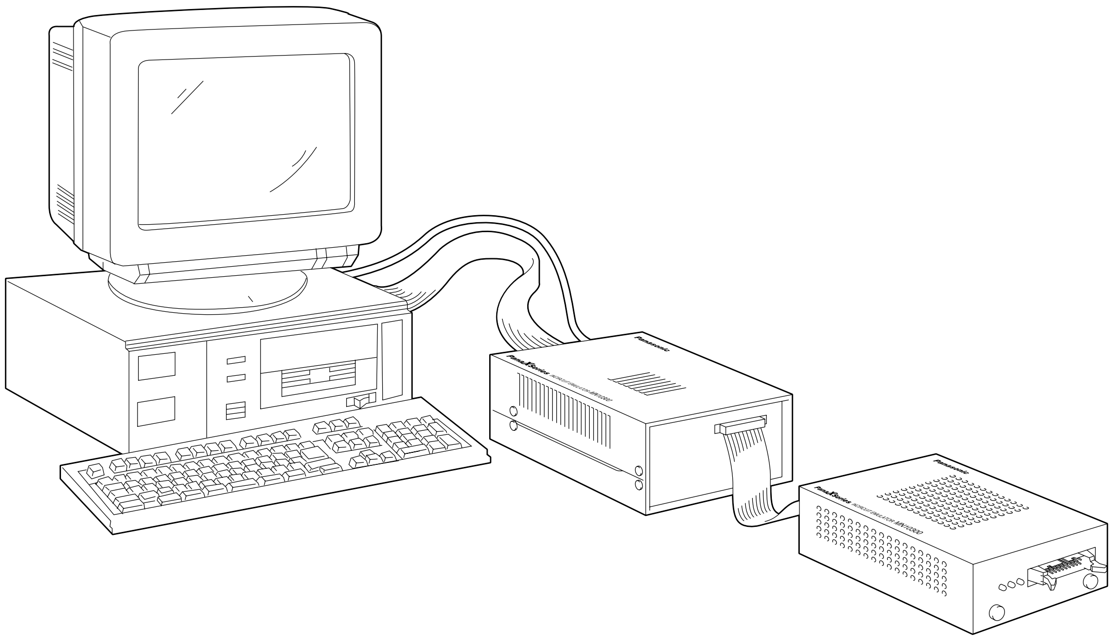
Chapter 1
C Source Code Debugger Overview

1 C Source Code Debugger Overview



C Source Code Debugger Operating Environment

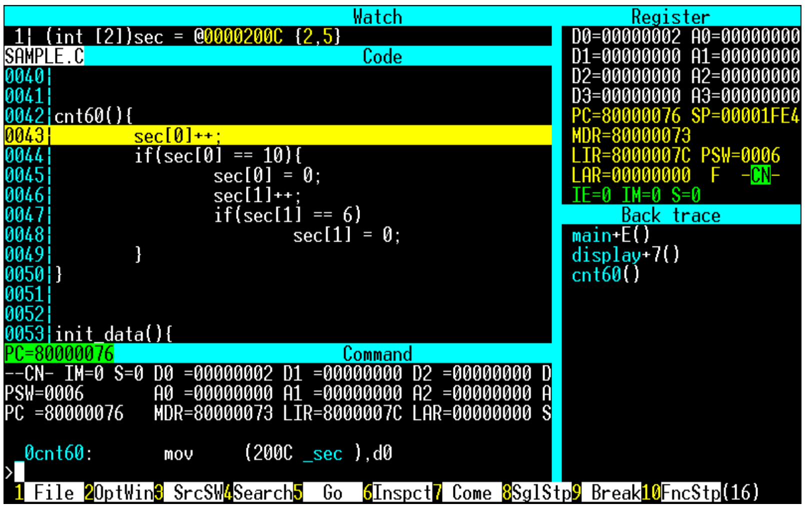
Host computer	PC-9800 Series	PC/AT Series (DOS/V-compatible machine)
Memory	At least 500K	At least 500K
OS	MS-DOS Ver. 3.x or later	MS-DOS Ver. 6.2
Slot	One standard personal computer expansion slot	One standard personal computer expansion slot
Interface systems	I/O system	I/O system

Overview

The C Source Code Debugger and the In-circuit Emulator are integrated Development Tools for Panasonic’s MN10300 Series 32-bit microcomputers. The In-circuit Emulator consists of the main unit and the emulator controller. Because the emulator’s control circuits are implemented on a single chip, it was possible to greatly reduce the size, weight, and power consumption of the emulator.
The control software (the Debugger) permits efficient debugging of C and assembly programs at the source level. The Debugger also offers sophisticated functions and excellent operability with multi-window display, macro functions, multi-job functions, various break functions, memory emulation functions, trace functions, and EMS memory support.

Software Overview

Multi-window



```
                          Watch                          Register
 1| (int [2])sec = @0000200C {2,5}                   D0=00000002 A0=00000000
SAMPLE.C                   Code                      D1=00000000 A1=00000000
                                                     D2=00000000 A2=00000000
                                                     D3=00000000 A3=00000000
cnt60(){                                             PC=80000076 SP=00001FE4
        sec[0]++;                                    MDR=80000073
        if(sec[0] == 10){                            LIR=8000007C PSW=0006
                sec[0] = 0;                          LAR=00000000  F  -CN-
                sec[1]++;                            IE=0 IM=0 S=0
                if(sec[1] == 6)                           Back trace
                        sec[1] = 0;                  main+E()
        }                                            display+7()
}                                                    cnt60()


init_data(){
PC=80000076              Command
--CN- IM=0 S=0 D0 =00000002 D1 =00000000 D2 =00000000 D
PSW=0006       A0 =00000000 A1 =00000000 A2 =00000000 A
PC =80000076   MDR=80000073 LIR=8000007C LAR=00000000 S

  0cnt60:       mov     (200C _sec ),d0
>
```

Five windows (Code, Register, Watch, Command and Option) can be displayed simultaneously. Excellent operability is provided through a wide variety of operation functions including pop-up menus, window commands and dialog commands.

Source level debugging

The software permits source level debugging of C and assembly programs. (Features include specification of breaks by line numbers in the source code, referencing/changing variables specified in the source listing, and step execution at the source level).

Macro function

The software provides a powerful macro function (language) that supports control structures (if, for, while, do, break, etc.) similar to those found in C. The macro function can be used to define new commands that are combinations of multiple commands, and to perform debugging work efficiently when combined with the break function.

Multi-job function

This function makes it possible to execute (and then return from) an MS-DOS command with a single keystroke at any time during debugging work from within the C Source Code Debugger.

Event function

This functions sets up triggers for hardware breaks, trace functions, and time measurement functions. The In-circuit Emulator continually monitors for the occurrence of events without halting user program execution.

There are two types of events:

(1) Execution address event
In this case, an event is generated on the basis of the address of the instruction that was executed. Conditions can be set, such as a specified address range or a count of the number of passes through an address.

(2) Data event
In this case, an event is generated on the basis of the data that was accessed. Conditions can be set, such as a specified address range, specified data, access width, match/no match, or a count.

Events that are conditions for break functions are called “break events;” events that are conditions for starting or stopping tracing are called “trace events;” and events that are conditions for starting or stopping time measurement are called “time measurement events.”

Break functions

These functions halt user program execution.

(1) Software break

Software breaks are implemented by the Debugger by inserting PI codes (0xff) into the user program. Therefore, these breaks can only be set in writable program areas; they cannot be set in data areas and the target ROM space. In addition, because software breaks halt program execution before the instruction in the address where the break was set is executed, it is not possible to set conditions such as a specified address range or a count of the number of passes through an address.

(2) Hardware breaks

This type of break halts execution when an event occurs. Program execution does not actually stop until several instruction cycles after the event.

(3) AND breaks

AND breaks halt program execution once all of the specified events occur, regardless of the sequence in which they occur.

(4) Sequential breaks

Sequential breaks halt program execution once the specified events occur in the specified sequence.

(5) Trace full break

This type of break halts program execution when the trace memory becomes full.

(6) Forced break

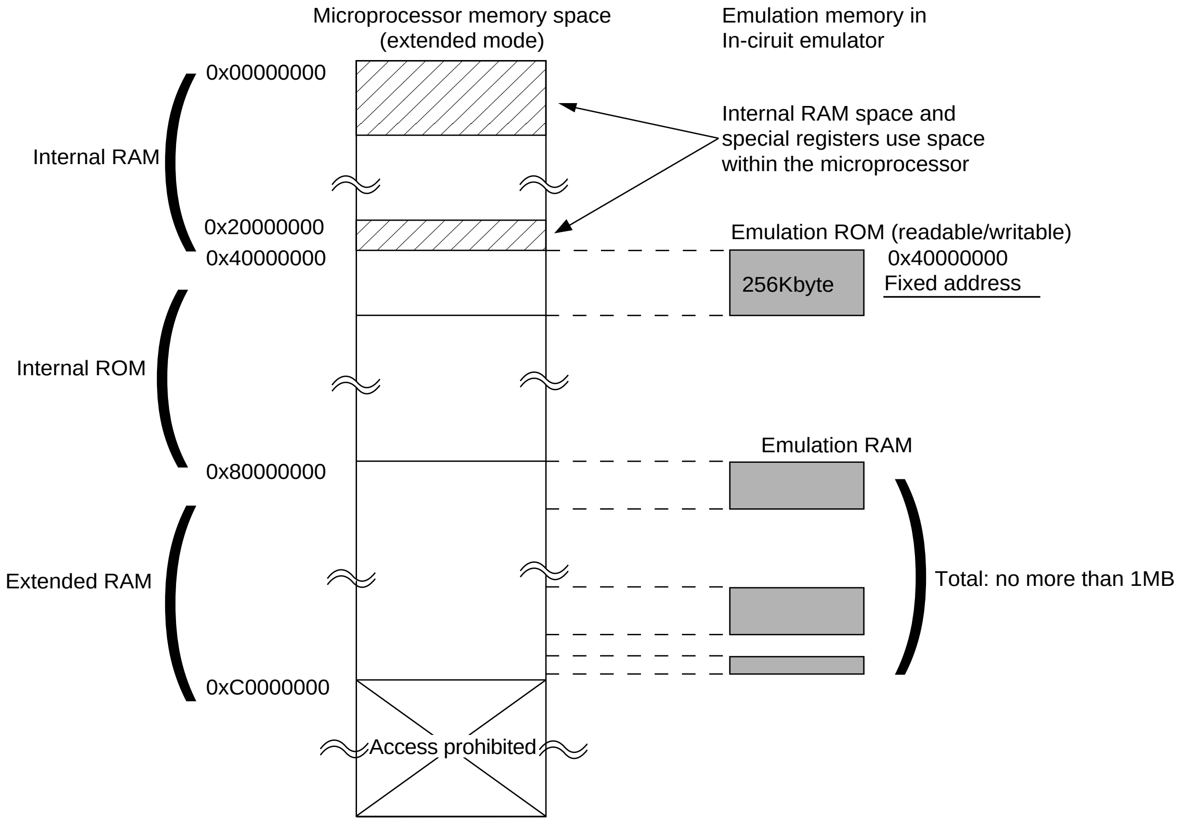
This function forcibly halts execution of the user program when the ESC key on the host computer is pressed.

Memory Emulation Function

This function emulates a microprocessor's internal instruction memory (ROM/RAM) space and the target memory (extended RAM) space with the memory (called "emulation memory") in the In-circuit Emulator. There are two types of emulation memory:

(1) Emulation ROM

This is readable/writable memory (RAM) that emulates the microprocessor's internal ROM (including internal instruction RAM). In the In-circuit Emulator, 256K of RAM is installed (fixed addresses from 0x40000000 to 0x4003FFFF) for use as emulation ROM. Note that emulation ROM is valid only in modes that can use internal ROM (internal instruction RAM), such as when the microprocessor's memory mode is single chip mode or extended mode; emulation ROM cannot be used in processor mode.



(2) Emulation RAM

This is memory (RAM) that emulates memory (extended RAM) in the target. The In-circuit Emulator has two sets of 512K of emulation RAM (for a total of 1MB). One set is used for high-speed dedicated memory, and can operate with no wait cycles with an external bus cycle of up to 20MHz (50nsec). The other set can operate with no wait cycles with an external bus cycle of up to 12MHz (approximately 83nsec).

Emulation RAM permits allocation of ranges of addresses (blocks) in the microprocessor's extended RAM space (0x80000000 to 0xBFFFFFFF in extended mode, and 0x40000000 to 0xBFFFFFFF in processor mode). When an address in the shaded portion of the extended RAM space in Fig. A is accessed, the emulation RAM in the emulator is accessed. This allocation of emulation memory to a portion of the microprocessor's memory space is called "mapping." A continuous segment of mapped memory is called a "block." With this emulator, a maximum of eight blocks can be mapped.

The size of one block can be selected as either 4K, 8K, 16K, 32K, 64K, 128K, 256K, 512K, or 1024K. The address boundaries of blocks must coincide with boundaries for that unit of memory space. For example, if one block is 64K, that block must fall on a 64K boundary in memory.

The aspect of the mapping process that requires the most attention is matching the block size with the boundaries. For example, consider Fig. B, where a continuous 64K space is to be mapped, starting from address 0x80002000 (which is an 8K boundary). Because the block boundary and the block size must match, an 8K block must be mapped from address 0x80002000. Because address 0x80004000 is a 16K boundary, a 16K block must then be mapped from that address. In the end, as shown in the Fig. B, four blocks are actually used in order to allocate this 64K block. Thus, depending on the addresses to which memory is being allocated and the amount of memory being allocated, two or more blocks are sometimes required even though the memory space is continuous.

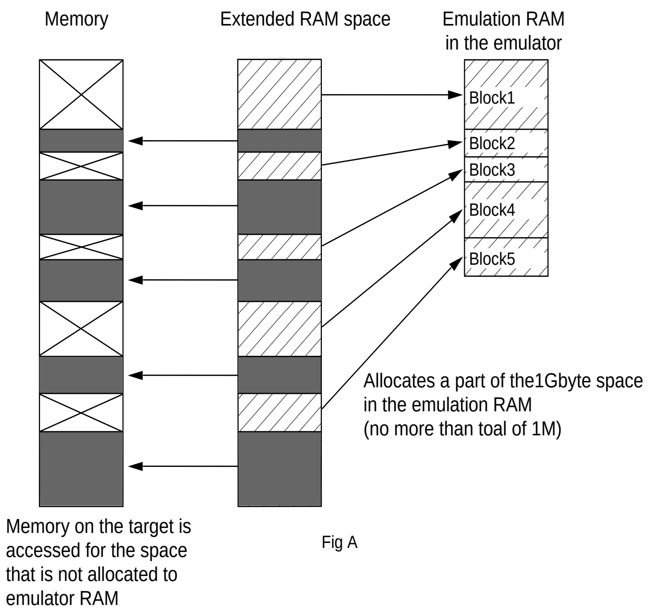

Memory
Extended RAM space
Emulation RAM in the emulator
Block1
Block2
Block3
Block4
Block5
Allocates a part of the1Gbyte space in the emulation RAM (no more than toal of 1M)
Memory on the target is accessed for the space that is not allocated to emulator RAM

Fig A

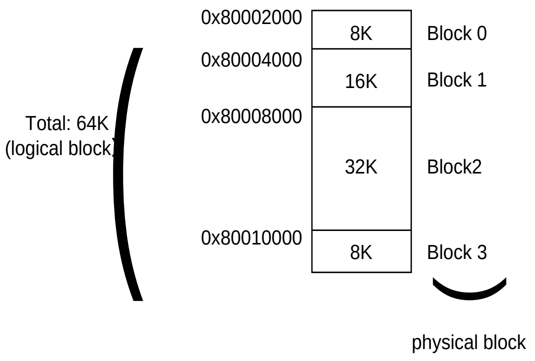


Fig. B

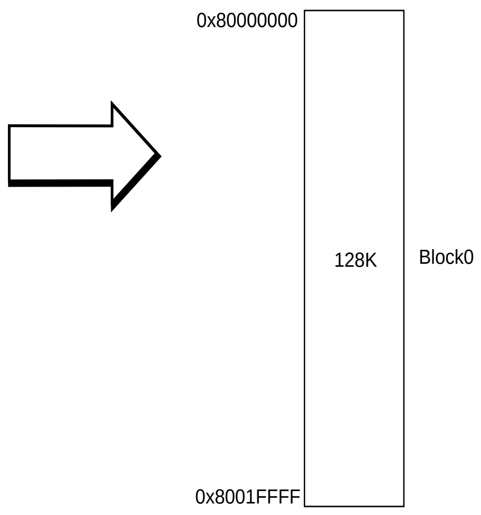


Fig. C

If there are not enough mapping blocks, then in the above example, the shortage can be relived by mapping the space from 0x80000000 to 0x8001FFFF (128K) with a single block, as shown in Fig. C. Finally, note that with the In-circuit Emulator, it is not possible to map internal RAM or special registers to emulation RAM, since these use the microprocessor’s internal resources. [☞ MAP/EX Command]

Trace Function

This function makes it possible to view the execution path of the user program. The data that is traced includes execution addresses, data addresses, data values, and the bus status. Data addresses and data values can be switched between the microprocessor's internal bus (the CPU core bus) and the external bus. The following modes can be selected to establish the trace storage conditions and the trace halt conditions.

- Trace storage conditions

(1) Normal trace (default)

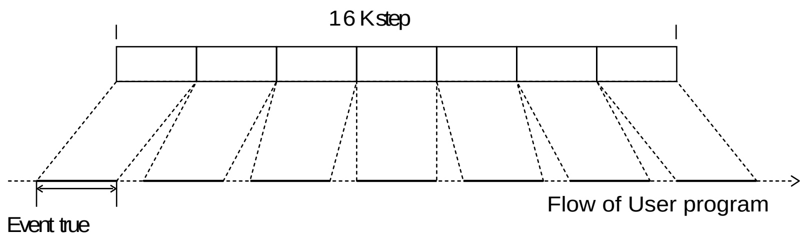
In this mode, all of the microprocessor's execution cycles are traced. Up to 16K steps can be traced.

(2) Branch trace

In this mode, only branch instructions are stored in trace memory, and the software compensates for the portions between branch instructions. As a result, this mode makes it possible to trace longer than in normal mode. However, no tracing information is displayed from the time when tracing starts until the first branch instruction is encountered.

(3) Conditional trace

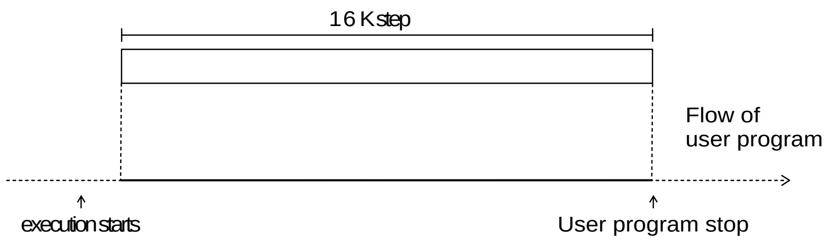
In conditional trace mode, tracing is performed only while a specified event is true.



- Trace halt conditions

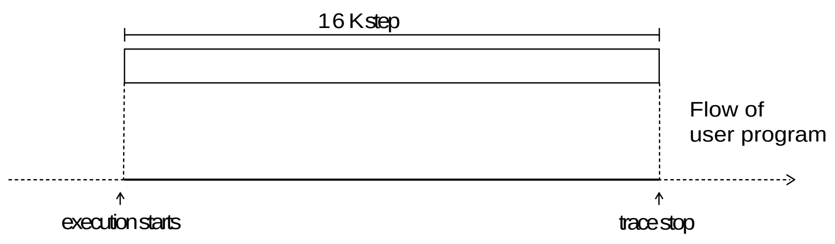
(1) Trace continue mode (default)

In this mode, tracing continues until the user program halts, even if trace memory becomes full. When execution of the user program halts, the last 16K steps remain as trace data.



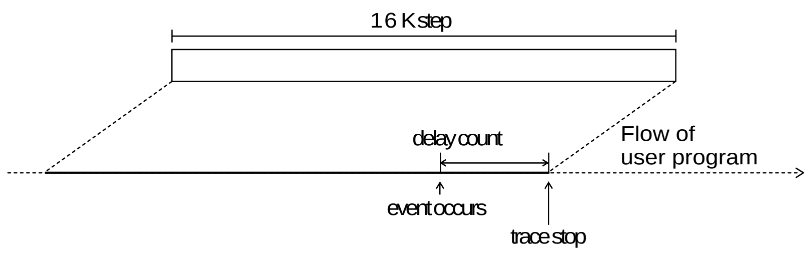
(2) Trace full halt mode

In this mode, tracing begins when user program execution begins (or resumes), and continues until trace memory is full (16K steps). The user program does not halt even if tracing is halted.



(3) Delayed trigger trace

In this mode, once a specified event occurs, tracing halts after a specified number of steps. This mode can be used to monitor the execution status of a program before and after the occurrence of an event.



Time measurement function

This function measures the execution time of a user program. The following modes are available.

(1) Continuous measurement mode

This mode measures the time from the point when user program execution begins (or resumes) to the point when it halts.

(2) Partial measurement modes

These modes measure the time from the occurrence of one event until the occurrence of another event. There are two partial measurement modes.

FIRST mode:	This mode measures the time between two events only for the first time.
MIN/MAX mode:	This mode always measures the time between two events, and then determines the minimum and maximum times.

Profile function

This function measures how much time each function (subroutine) consumed during user program execution.

RAM monitor function

This function monitors accesses to data RAM by the In-circuit Emulator and displays the contents of data RAM on the screen, all without halting user program execution.

On-the-fly function

This function can be used to set break events, set and display tracing, and reference and change memory, all without halting user program execution. These capabilities make it possible to debug programs without halting the operation of the target CPU.

[☞ 2-7 On-the-fly]

Inspect function

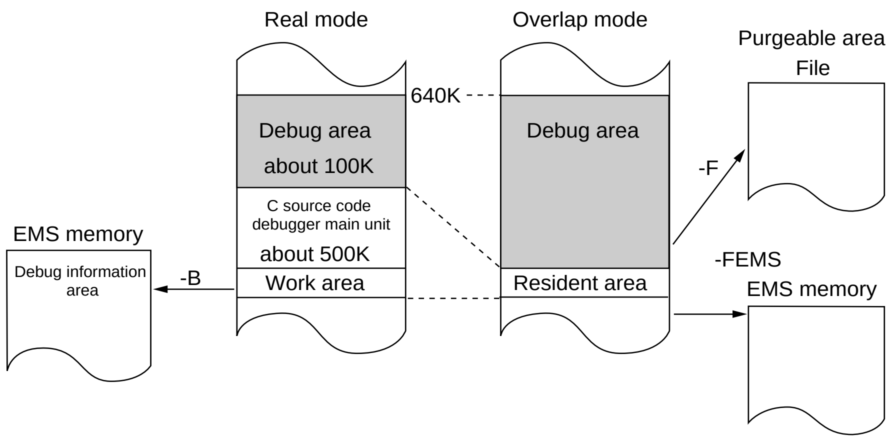
This function makes it possible to reference or change variables, arrays and bit values in a format that reflects the data structure of the variables, just by specifying the source file variables, arrays and bit values displayed in the Code window.

EMS memory support

The C Source Code Debugger allocates work areas in EMS memory for the main body of the debugger, debugging information areas, etc. This ability makes it possible to debug even programs that have large amounts of debugging information.

Overlap function

With this function, only the barest minimum of essential functions for executing the debugging program reside in main memory; the main body of the C Source Code Debugger and the work areas are saved to DOS files or EMS memory. This overlap function is used in order to make it possible to debug very large programs. In order to use this function, specify the -F or -FEMS options when starting up the C Source Code Debugger.



Other functions

History function, Template function, Logging/Batch function, Help function

2 Notes on Use

2-1. Hardware Notes

Notes concerning the use of the In-circuit Emulator in debugging work are indicated below.

- The tip of the probe is manufactured with extreme precision. Handle it carefully so that it is not subjected to any impacts.
- Do not touch any of the boards inside the In-circuit Emulator, the interface board, etc.
- Only separately excited oscillation can be supported when using oscillation signals from the target (OSC, XI).

The In-circuit Emulator will not operate normally in the following cases:

- When the clock is supplied from the target, and the level of the clock waveform is inadequate or there is noise in the clock signal.
- When the target's power is off.
- When the current capacity of the target power supply is inadequate.
- When the bus request signal from the target remains active for more than a certain period of time (approximately 0.1 seconds).
- When the target hardware is not operating normally.

2-2. Software Notes

- Before using the software, make a backup of the C Source Code Debugger floppy disk. Copying this floppy disk is permitted only for maintenance and archival purposes. To copy the disk, use the DISKCOPY command or COPY command in MS-DOS.

2-3. ROM, RAM

- Only eight blocks out of the 4GB address space can be allocated to emulation memory. The total size of the eight blocks of memory must not exceed the size of the memory installed in the In-circuit Emulator (1MB standard). Each block can be set so that it starts and ends in units of 4K of memory.
- Operation is not guaranteed if data accesses to special register areas are not performed with the correct access data size and address boundaries.

2-4. Program Execution

- Programs cannot be executed (including single-step and function-step execution) while the microprocessor is in STOP, HALT, or SLEEP mode.

  [☞ G Command, T Command, P Command]

- The stack pointer (SP register) value must always be set so that its value is a multiple of four.
- The correct value is not displayed when the In-circuit Emulator measures the execution time (TI command) during single-step or function-step execution.

2-5. Breaks

- If a software break is set in other than an op-code, the value of the operand is replaced with the PI code (0xff).
- Because software breaks halt execution before the instruction where the break was set is executed, the pass count specification cannot be made.
- Hardware breaks halt execution after executing as many as nine instructions after executing the instruction for which the break event was set. The actual number of instructions that are executed after the break but before execution stops depends on the specific combination of instructions involved.

2-6. Tracing

- The contents of trace memory are cleared if single-step or function-step execution is performed.
- When fewer than 16K steps were traced, the first instruction that was executed when tracing started might not be included in the trace information.
- When the “trace full” break is used, the last several instructions immediately before the user program was halted might not be included in the trace information.
- A disassembled display of the trace information is not possible when the microprocessor is in STOP, HALT, or SLEEP mode, or if the user target has initiated a reset.
- If the contents of the microprocessor’s internal instruction RAM is overwritten while trace information is being collected or after trace information has been collected, the disassembled display of the trace information from the microprocessor’s internal instruction RAM space will not be correct.
- If an event setting is changed while using the delayed trigger trace, the trace function will operate incorrectly.

2-7. On-the-fly

- If the contents of memory are referenced or changed (including a disassembled display) while a user program is being executed, program execution is halted momentarily. (For a one-byte access to emulation memory, program execution is halted for a maximum of 14 machine cycles; for a one-byte access to the microprocessor's internal special registers, internal data RAM, internal instruction RAM, or external memory in the target, program execution is halted for a maximum of 150 machine cycles.)
- While a user program is executing, the microprocessor is in STOP, HALT, or SLEEP mode, or during a reset initiated by the user target, it is not possible to reference or change the microprocessor's internal special registers, internal data RAM, internal instruction RAM, or external memory in the target, nor is it possible to display disassembled trace information.
- If an event setting is changed while a user program is executing, all "event true" flags that were set up to that point are cleared.
- If a break is set while a user program is executing, there may be a time differential between the occurrence of the cause of the break and the point when program execution breaks.
- Following three icons are used for quick reference of the on-the-fly function.

NO INFLUENCES	:No limitation on command functions. No influences on the program execution.
INFLUENCES	:No limitation on command functions. Some influences on the program execution.
CANNOT BE USED	:On-the-fly function cannot be used.

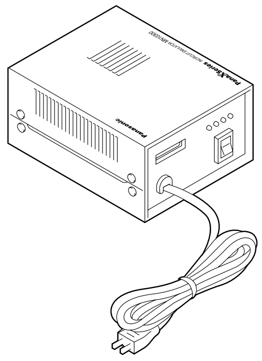
2-8. Miscellaneous

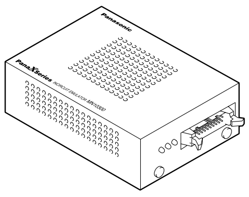
- If the measured execution time is long, a slight amount of error may begin to creep in.
- If using handshake mode, the In-circuit Emulator does not generate an acknowledge signal when the microprocessor accesses an external memory space. Therefore, it is necessary for the user to include a circuit (or other mechanism) that generates an acknowledge signal in all external memory spaces that will be used.

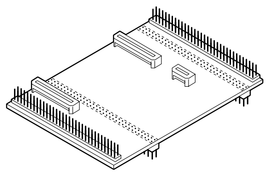
Chapter 2
C Source Code Debugger Structure

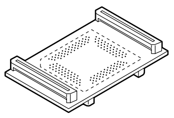
1 Hardware List

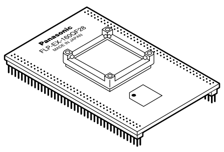
The development environment is configured from the following devices. Confirm that all of this hardware is provided before using this system. If any components are missing or damaged, contact our sales office.

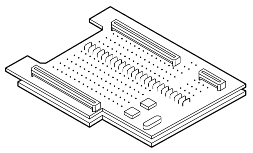

Emulator Controller

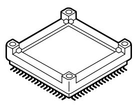

In-circuit Emulator

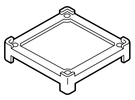

DIL Conversion Board

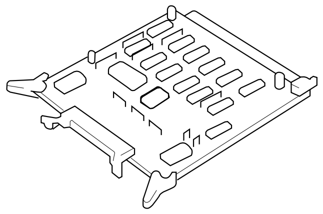

QFP Adapter

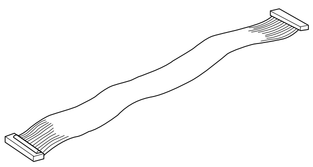

Flat-DIL Conversion Board

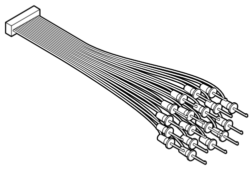

Dummy Adapter

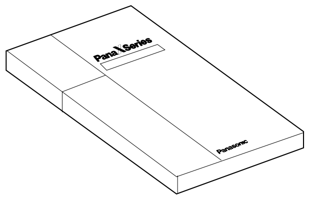

Surface Mount Socket

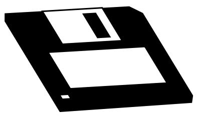

Socket Cover

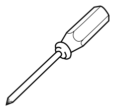

Interface Board


34-wire Flat Cable


Option Probe


Manual
(C Source Code Debugger Installation)


C Source Code 10300 Floppy disk


Micro Driver

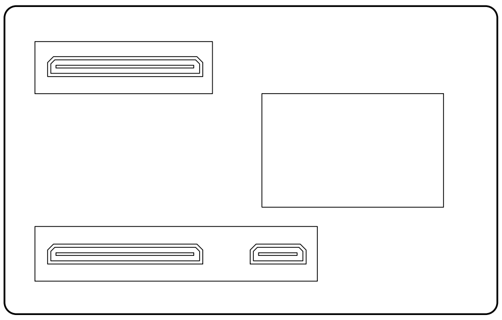
2 Descriptions of Each Device

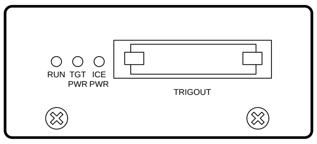
2-1. In-circuit Emulator

■ LED Display

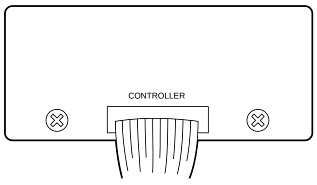
There are three LEDs on the In-circuit Emulator main unit. Their functions are described below.

Red (MEMV):	This LED lights when power is being supplied to the In-circuit Emulator main unit. Note that the power for the In-circuit Emulator is supplied from the Emulator Controller.
Yellow (TVDD):	This LED lights when the power is being supplied to the target (microprocessor).
Green (RUN):	This LED lights when the user program is executing.


In-Circuit Emulator Main Unit - Bottom View



In-Circuit Emulator Main Unit - Side View 1



In-Circuit Emulator Main Unit - Side View 2

■ Option Probe Connector (TRIGOUT)

This is the connector for the external trigger output.

2-2. C Source Code Debugger 10300 Floppy Disk

Before using the software, make a backup of the C Source Code Debugger floppy disk. Copying this floppy disk is permitted only for maintenance and archival purposes.

To copy the disk, use the DISKCOPY command or COPY command in MS-DOS.

Files on the floppy disk

(1)	PICE103.EXE	C Source Code Debugger 10300 main program
(2)	PINS103.EXE	Environment setting utility (Installer)
(3)	ENV103.TXT	Model definition file
(4)	PICE103.MAC	Macro instruction definition file
(5)	PICE103.MES	Message file
(6)	PT103.HLP	C Source Code Debugger 10300 help file
(7)	MON103.EX	In-circuit Emulator Monitor Program File
(8)	SAMPLE.EX	Executable sample program file
(9)	SAMPLE.C	Sample program source file
(10)	STARTUP.ASM	Sample program startup routine source file

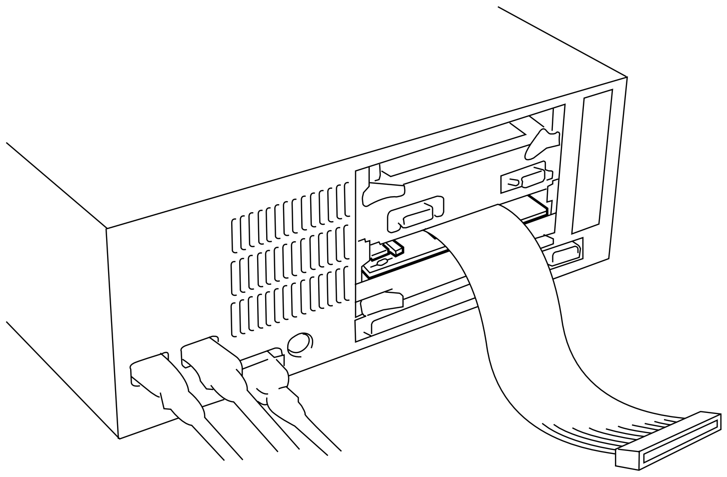
Chapter 3
Connection and Booting

1 Installing the Interface Board

The interface board is installed in the host computer as described below. Set the switches on the interface board before installing it in the host computer.

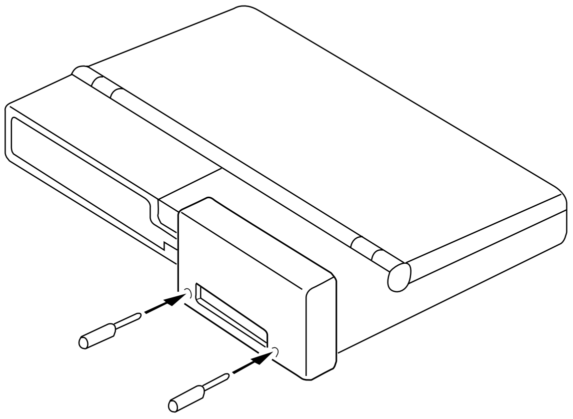
[☞ Chapter 9, section 2, Interface Switch Settings]

1-1. Installation in the PC-9800 Series



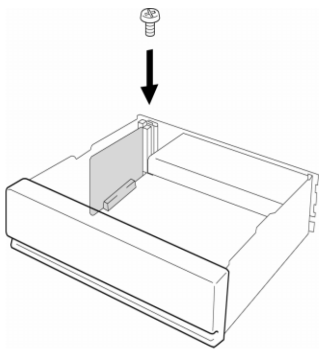
(1) Before beginning, turn the computer off.
(2) Remove the cover from an expansion slot on the rear of the computer.
(3) Connect a 34-wire flat cable to the connector (CN2) on the top side of the interface board.
(4) With the components on the board facing up, align the board with the card guide grooves and then push the board firmly into the slot until it clicks into place. Then pull gently on the board to make sure that it does not come out.

1-2. Installation in the PC-98 NOTE Series



(1) Before beginning, turn the computer off.
(2) Tighten the two screws on the interface board and then pull gently on the board to make sure that it does not come out.
(3) Connect a 34-wire flat cable to the connector (CN2) on the interface board.

1-3. Installation in the PC/AT (DOS/V) Series



(1) Before beginning, turn the computer off.
(2) Remove the top cover.
(3) With the board’s connector facing down, push the connector into the connector inside the computer until the connector is fully seated. Then pull on the board gently to make sure that it does not come out.
(4) Connect the 34-wire flat cable to the connector on the interface board.

2 Connection Procedure

The host computer is connected to the Emulator Controller via a 34-wire flat cable. One of the connectors on the In-circuit Emulator main unit is for connection to the Emulator Controller. The In-circuit Emulator also has a connector (TRIGOUT) for the trigger output.

2-1. Connection Procedure

After confirming that all devices are off, perform the following procedure.

1. Connect the other end of the 34-wire flat cable (1.5m) that is connected to the interface board to the HOST I/F connector on the Emulator Controller.
2. Connect the ICE MODULE connector on the Emulator Controller to the CONTROLLER connector on the In-circuit Emulator main unit.

   [☞ "MN10300 Series PanaX Series Installation Manual"]
3. Attach the dummy adapter (PRB-EX-DMY103XXX) to the In-circuit Emulator main unit. (Do this step only when installing the debugger so that the In-circuit Emulator can run on a standalone basis without connecting a target.)

3 Host Computer Settings

After connecting the equipment, set up the environment for the control software (debugger).

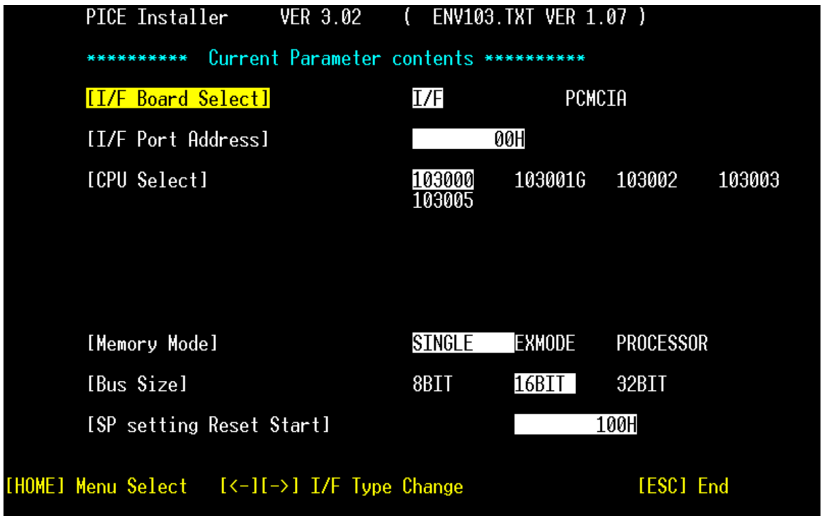
Environment variable settings

The C Source Code Debugger references the following environment variables. If any of these variables need to be set, use the MS-DOS SET command.

PATH	: If COMMAND.COM, MON103.EX, PICE103.MES, or PICE103.MAC is not found in the current directory, the C Source Code Debugger searches for them in the directories indicated by PATH.
HELP	: If the help file (PT103.HLP) is not found in the current directory, the C Source Code Debugger searches for it in the directory indicated by HELP.
PANASRC	: This specifies the directory where the source file for the executable file that is being debugged is stored. The L and V commands, for example, display the source files in the directory indicated by PANASRC. If PANASRC is not set, the source files in the current directory are displayed.
TMP/TEMP	: This specifies the directory where the C Source Code Debugger work files are stored. In order to shorten the debugger's internal processing time, it is recommended that this directory be set up in a RAM disk area. If TMP/TEMP is not set, work files are created in the current directory.

3-1. Starting up the Installer

1. Turn on the host computer.
2. Connect the AC cable for the emulator controller to a 100V AC power source, and turn on the power switch.
3. When the computer is waiting for command input, input PINS103 ↵ .
   Set the following items.



```
        PICE Installer     VER 3.02    (  ENV103.TXT VER 1.07 )

        **********  Current Parameter contents **********

        [I/F Board Select]              I/F            PCMCIA

        [I/F Port Address]                      00H

        [CPU Select]                    103000    103001G   103002    103003
                                        103005




        [Memory Mode]                   SINGLE    EXMODE    PROCESSOR

        [Bus Size]                      8BIT      16BIT     32BIT

        [SP setting Reset Start]                            100H

[HOME] Menu Select   [<-][->] I/F Type Change                 [ESC] End
```

(1) I/F Board Select
   Select the interface method between the host computer and the in-circuit emulator.

(2) I/F Port Address
   Specify the I/O address that was set by a rotary switch on the interface board. Use the arrow keys to specify the low-order address and the SHIFT+arrow keys to specify the high-order address.
   [Rotary switch ☞ Chapter 9, section 2]

(3) CPU Select
   Use the arrow keys to select the CPU being used.

(4) Memory Mode
   Use the arrow keys to select the memory mode.

(5) Bus Size
   Use the arrow keys to select the microprocessor bus size.

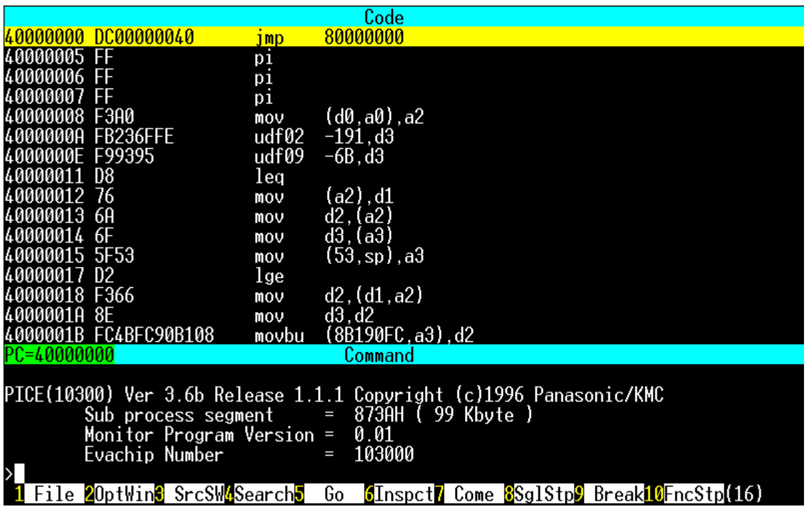
(6) SP setting Reset Start
   Input the initial value for the stack pointer. (It must be set to an address for which physical memory is installed.)

   After setting the above six items, press the ESC key to quit the Installer.

After the Installer has been run, the environment settings file (PICE103.ENV) is created. This file is loaded when the C Source Code Debugger is started up. Be careful to avoid deleting this file accidentally or otherwise changing its contents.

3-2. Debugger Test Startup

4. With the system waiting for an MS-DOS command to be input
   Input “PICE103 -NOTARGET ↵”. Once the screen is displayed and Debugger startup has been confirmed, input “Q ↵ ” to quit.



```
                                Code
40000000 DC00000040         jmp     80000000
40000005 FF                 pi
40000006 FF                 pi
40000007 FF                 pi
40000008 F3A0               mov     (d0,a0),a2
4000000A FB236FFE           udf02   -191,d3
4000000E F99395             udf09   -6B,d3
40000011 D8                 leq
40000012 76                 mov     (a2),d1
40000013 6A                 mov     d2,(a2)
40000014 6F                 mov     d3,(a3)
40000015 5F53               mov     (53,sp),a3
40000017 D2                 lge
40000018 F366               mov     d2,(d1,a2)
4000001A 8E                 mov     d3,d2
4000001B FC4BFC90B108       movbu   (8B190FC,a3),d2
PC=40000000                       Command

PICE(10300) Ver 3.6b Release 1.1.1 Copyright (c)1996 Panasonic/KMC
        Sub process segment     =  873AH ( 99 Kbyte )
        Monitor Program Version =  0.01
        Evachip Number          =  103000
>
 1 File 2OptWin3 SrcSW4Search5  Go  6Inspct7 Come 8SglStp9 Break10FncStp(16)
```

- Specify the “-NOTARGET” option only when the In-circuit Emulator is being used on a stand-alone basis.
  Never specify this option when a target system is connected to the In-circuit Emulator.
  In the worst case, the In-circuit Emulator main unit could be damaged as a result.
- When the C Source Code Debugger is started up, the PICE103.ENV file that was created in item 3 is loaded, as is the In-circuit Emulator monitor file (MON103.EX), the message file (PICE103.MES), and the macro instruction definition file (PICE103.MAC). If MON103.EX, PICE103.MES, and PICE103.MAC are not found in the current directory, they are searched in directories specified by the environment variable PATH. Note that the PICE103.ENV file must be placed in the current directory.

  [C Source Code Debugger Startup Method/Startup Options
  ☞ Chapter 5, section 1]

4 Power On/Off

Turn the power on in the following sequence: host computer, target system, and Emulator Controller. This sequence will prevent overcurrent from flowing in either direction. Note that the In-circuit Emulator is particularly vulnerable to damage from overcurrent.

When using the In-circuit Emulator on a standalone basis (with no target system connected), simply turn on the host computer first and then the Emulator Controller.

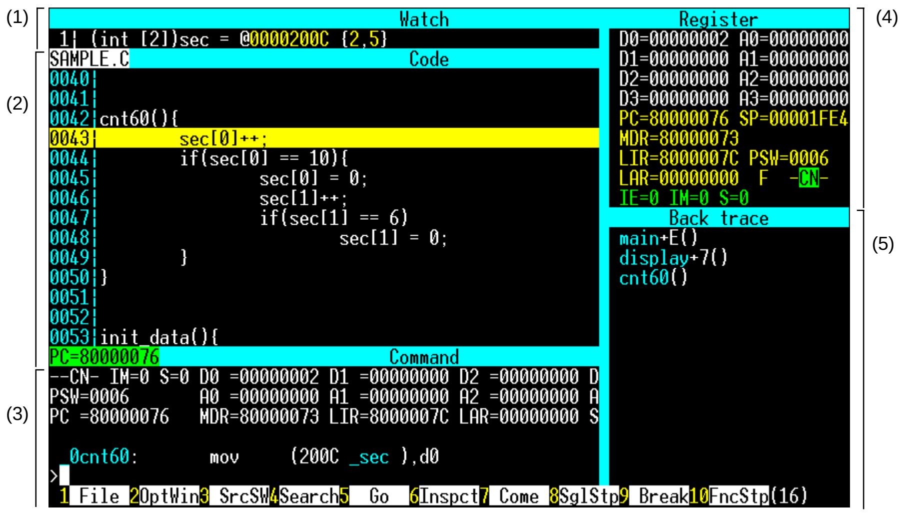
When turning off the power, do so in the reverse sequence (Emulator Controller, target system, and then host computer).

Chapter 4
Characteristic C Source Code Debugger Functions and Their Usage

1 Overview of Window Display

The C source code debugger provides five windows (Watch, Code, Command, Register, and Option) that display information that is required for debugging work.

[☞ Chapter 6-1, "Window Displays"]



```
                         Watch                                      Register
 1¦ (int [2])sec = @0000200C {2,5}                            D0=00000002 A0=00000000
SAMPLE.C                  Code                                D1=00000000 A1=00000000
                                                              D2=00000000 A2=00000000
                                                              D3=00000000 A3=00000000
cnt60(){                                                      PC=80000076 SP=00001FE4
        sec[0]++;                                             MDR=80000073
        if(sec[0] == 10){                                     LIR=8000007C PSW=0006
                sec[0] = 0;                                   LAR=00000000  F  -CN-
                sec[1]++;                                     IE=0 IM=0 S=0
                if(sec[1] == 6)                                    Back trace
                        sec[1] = 0;                           main+E()
        }                                                     display+7()
}                                                             cnt60()


init_data(){
PC=80000076               Command
--CN- IM=0 S=0 D0 =00000002 D1 =00000000 D2 =00000000 D
PSW=0006       A0 =00000000 A1 =00000000 A2 =00000000 A
PC =80000076   MDR=80000073 LIR=8000007C LAR=00000000 S

  0cnt60:        mov      (200C _sec ),d0
>
1 File 2OptWin3 SrcSW4Search5  Go  6Inspct7 Come 8SglStp9 Break10FncStp(16)
```

(1) Watch window

Displays user-specified variables and the contents of memory.

(2) Code window

Displays source code or a combination of assembly and source code.

(3) Command window

Displays and allows input of dialog commands (key input, macros).

(4) Register window

Displays the contents of the registers and the status of the flags.

(5) Option window

Displays either the Memo, Back Trace, Stack, or Local window.

2 Debugging Work Flow

This section uses a simple sample program to describe the work flow of program creation, focusing on debugging work, and also describes the basic operations involved in running the C source code debugger.

1. Creation of program specifications	A program is designed to serve a specific purpose. Typical examples include a program that is used to add a timer-based recording function to a VCR or a program that controls the motor in a washing machine. Normally, these functional specifications determine the program specifications (algorithms).

↓

2. Creation of executable files (editor, compiler, assembler, and linker)	Once the program specifications have been defined, an editor is used to create (code) the source listing. Once the source listing has been created, compiling and linking are performed. If any errors are generated during compiling and linking, make the appropriate corrections in the source listing. In this example, we will assume that the source listing of the sample program shown on the following pages has been created. [☞ Chapter 4, section 3]

↑↓

3. Debugging (debugger)	If no errors occur during the compiling and linking process, debugging work can begin. Steps 2 and 3 are repeated until the program is completed. [☞ Chapter 4, section 4]

↓

4. Program completion

3 Creation of Executable Files

The sample program (SAMPLE.C) is written in C language. This program is a simple one that increments the contents of the sec[ ] variable. sec[0] is incremented each time the cnt60( ) function is called. When the value of sec[0] reaches 10, it is cleared to zero and the value of sec[1] is incremented by one. sec[1] is also cleared to zero when its value reaches 6. This operation is repeated continuously.

Refer to the source listing of SAMPLE.C below.

■ Sample program (SAMPLE.C)

```
/* MN10300 SERIES C SAMPLE PROGRAM */
/* MN10300 COUNTER PROGRAM */

#define       INIT_DISPDATA_L    0x00
#define       INIT_DISPDATA_H    0x00

int  *i;

struct abc {
int tst1;
int tst2;
};

struct abc test;

int  sec[2];

main(){
     struct aaa {
      int a1;
      int a2;
     }tmp;

      initialize();

      for(;;){
            display();
     }
}


initialize(){
     init_data();
}


display(){
     cnt60();
}


cnt60(){
     sec[0]++;
     if(sec[0] == 10){
          sec[0] = 0;
          sec[1]++;
          if(sec[1] == 6)
               sec[1] = 0;
     }
}


init_data(){
     test.tst1=0;
     test.tst2=0;

     sec[0] = INIT_DISPDATA_L;
     sec[1] = INIT_DISPDATA_H;
}
```

The sample program is then compiled and linked, and an executable file is created.

4 Debugging Tutorial

This section provides an overview of the debugging process and the operating methods of the C source code debugger, from start to finish, by actually using the C source code debugger to debug the sample program (SAMPLE.C). Knowledge of these operating methods combined with a knowledge of the window commands and dialog commands will enable you to operate the C source code debugger.

4-1 Starting up the C source code debugger

Confirm that the current directory contains the following files. If one of these files is not contained in the current directory, copy the file from the master disk.

PICE103.EXE	C source code debugger 10300
PINS103.EXE	Environment setup utility
ENV103.TXT	Type definition file
PICE103.MAC	Macro command definition file
PICE103.MES	Message file
PT103.HLP	Help file for the C source code debugger 10300
MON103.EX	In-circuit emulator monitor program file
SAMPLE.EX	Executable file of the sample program
SAMPLE.C	Sample program source file
STARTUP.ASM	Sample program startup routine source file

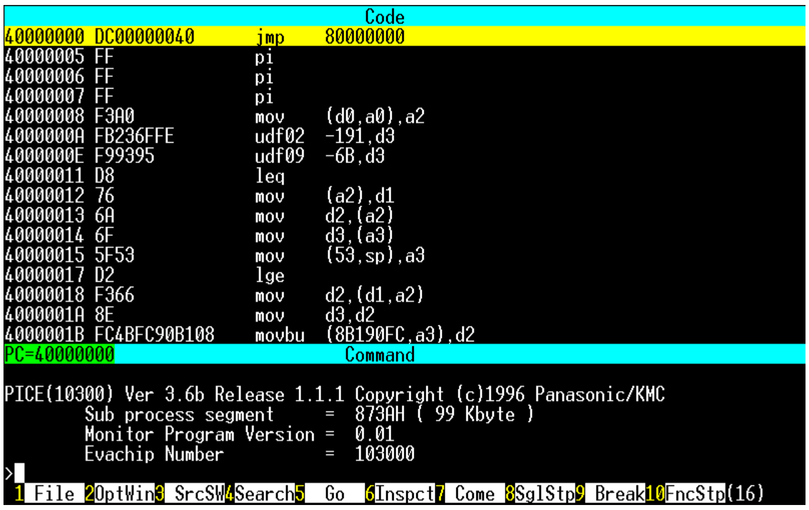
To start up the C source code debugger, input the following as an MS-DOS command:

```
PICE103 -NOTARGET ↵
```

When this command is input, the C source code debugger startup screen appears. Specify “-NOTARGET” when there is no target system connected.

! This example assumes that there is about 500KB of available space in main memory.

The upper portion of the screen, the Code window, displays either the C source code or a disassembled listing of the program.



```
                                    Code
40000000 DC00000040        jmp     80000000
40000005 FF                pi
40000006 FF                pi
40000007 FF                pi
40000008 F3A0              mov     (d0,a0),a2
4000000A FB236FFE          udf02   -191,d3
4000000E F99395            udf09   -6B,d3
40000011 D8                leq
40000012 76                mov     (a2),d1
40000013 6A                mov     d2,(a2)
40000014 6F                mov     d3,(a3)
40000015 5F53              mov     (53,sp),a3
40000017 D2                lge
40000018 F366              mov     d2,(d1,a2)
4000001A 8E                mov     d3,d2
4000001B FC4BFC90B108      movbu   (8B190FC,a3),d2
PC=40000000                       Command

PICE(10300) Ver 3.6b Release 1.1.1 Copyright (c)1996 Panasonic/KMC
        Sub process segment     =  873AH ( 99 Kbyte )
        Monitor Program Version =  0.01
        Evachip Number          =  103000
>
 1 File 2OptWin3 SrcSW4Search5  Go  6Inspct7 Come 8SglStp9 Break10FncStp(16)
```

The lower portion of the screen, the Command window, is used to execute commands input through the keyboard and to display the results of the execution of those commands. Characters that are input through the keyboard are displayed on the screen at the cursor position in the lower left corner of the Command window.

The bottom line of the screen displays the functions of the ten function keys (F1 to F10). These function keys can be used to easily execute a program, set a breakpoint, etc.

4-2 Help

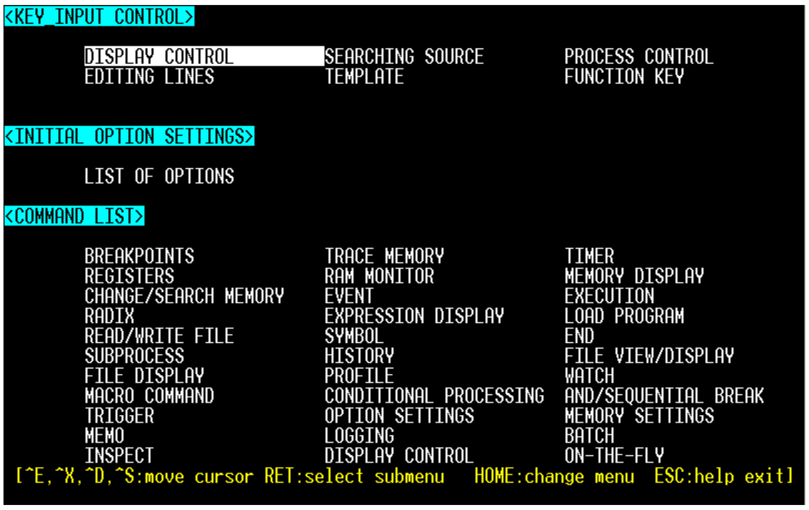
Displaying the Help screen
HELP or W
[☞ page 202]

After starting the C source code debugger, the first step is to load the executable file (SAMPLE.EX in this case). However, you do not yet know how to load a file. In a case such as this, where you do not know how to perform a certain task, either type:

HELP ↵

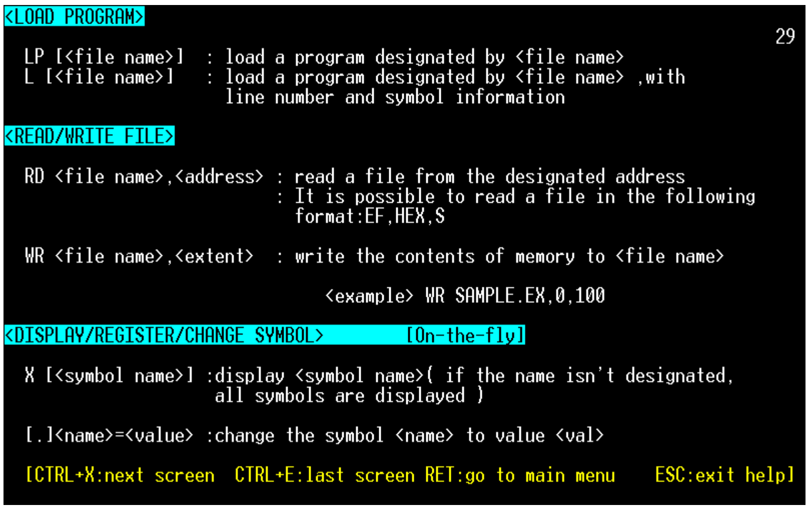
or else press the Help key:

The Help screen now appears.



```
<KEY INPUT CONTROL>

        DISPLAY CONTROL          SEARCHING SOURCE         PROCESS CONTROL
        EDITING LINES            TEMPLATE                 FUNCTION KEY

<INITIAL OPTION SETTINGS>

        LIST OF OPTIONS

<COMMAND LIST>

        BREAKPOINTS              TRACE MEMORY             TIMER
        REGISTERS                RAM MONITOR              MEMORY DISPLAY
        CHANGE/SEARCH MEMORY     EVENT                    EXECUTION
        RADIX                    EXPRESSION DISPLAY       LOAD PROGRAM
        READ/WRITE FILE          SYMBOL                   END
        SUBPROCESS               HISTORY                  FILE VIEW/DISPLAY
        FILE DISPLAY             PROFILE                  WATCH
        MACRO COMMAND            CONDITIONAL PROCESSING   AND/SEQUENTIAL BREAK
        TRIGGER                  OPTION SETTINGS          MEMORY SETTINGS
        MEMO                     LOGGING                  BATCH
        INSPECT                  DISPLAY CONTROL          ON-THE-FLY
 [^E,^X,^D,^S:move cursor RET:select submenu   HOME:change menu  ESC:help exit]
```

Find the item corresponding to the process that you wish to perform. The item “LOAD PROGRAM” appears near the middle of the third column. Use the cursor keys to move the cursor (the highlighted item) to the desired item. Select LOAD PROGRAM by moving the highlighted cursor to LOAD PROGRAM and then pressing the Return key.



```
<LOAD PROGRAM>
                                                                  29
  LP [<file name>]  : load a program designated by <file name>
  L [<file name>]   : load a program designated by <file name> ,with
                      line number and symbol information

<READ/WRITE FILE>

  RD <file name>,<address> : read a file from the designated address
                           : It is possible to read a file in the following
                             format:EF,HEX,S

  WR <file name>,<extent>  : write the contents of memory to <file name>

                                <example> WR SAMPLE.EX,0,100

<DISPLAY/REGISTER/CHANGE SYMBOL>        [On-the-fly]

  X [<symbol name>] :display <symbol name>( if the name isn't designated,
                     all symbols are displayed )

  [.]<name>=<value> :change the symbol <name> to value <val>

  [CTRL+X:next screen  CTRL+E:last screen RET:go to main menu    ESC:exit help]
```

The Help screen changes so that the LOAD PROGRAM help screen is displayed. This screen indicates that the Load command is:

L [<file name>]

Closing the Help screen
ESC

Press the ESC key to return to the original C source code debugger screen.

4-3 Loading executable files

Loading a program
L <file name>
[☞ page 114]

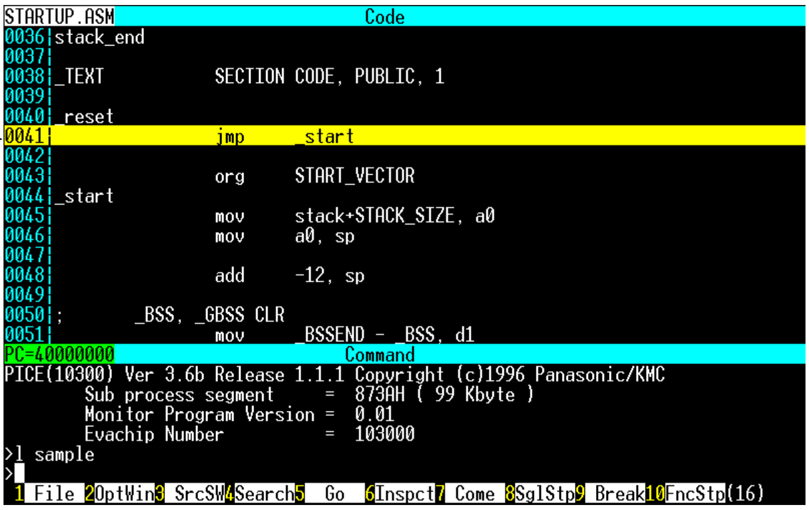
Now that we know that the L command is used to load executable files (SAMPLE.EX in this example), type the following:

L SAMPLE ↵

(If the file extension is omitted from the file specification after the L command, “.EX” is assumed.)

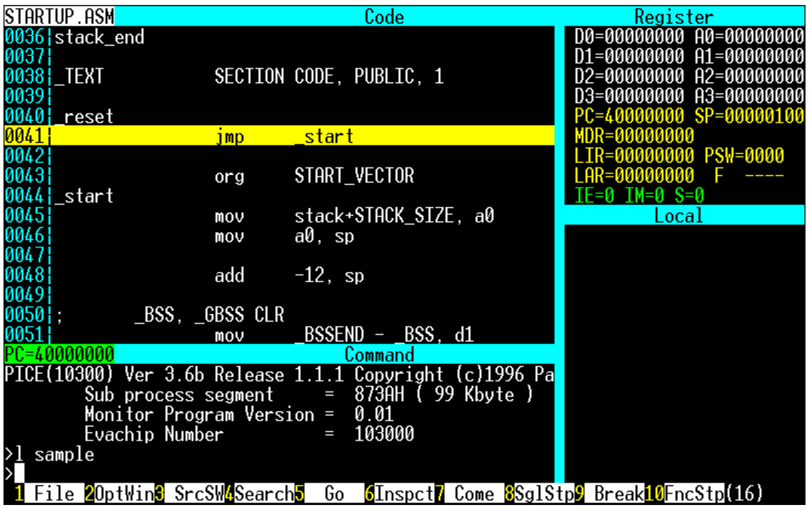
The Code window display now changes to a display of the STARTUP.ASM source listing.

Program counter



```
STARTUP.ASM                         Code
|stack_end
|
|_TEXT           SECTION CODE, PUBLIC, 1
|
|_reset
|                jmp      _start
|
|                org      START_VECTOR
|_start
|                mov      stack+STACK_SIZE, a0
|                mov      a0, sp
|
|                add      -12, sp
|
|;       _BSS, _GBSS CLR
|                mov      _BSSEND - _BSS, d1
PC=40000000                        Command
PICE(10300) Ver 3.6b Release 1.1.1 Copyright (c)1996 Panasonic/KMC
        Sub process segment      =  873AH ( 99 Kbyte )
        Monitor Program Version =  0.01
        Evachip Number           =  103000
>l sample
>
 1 File 2OptWin3 SrcSW4Search5  Go  6Inspct7 Come 8SglStp9 Break10FncStp(16)
```

The source line highlighted in yellow in the Code window indicates the line that is currently pointed to by the program counter (PC register).



```
STARTUP.ASM                        Code                       Register
stack_end                                              D0=00000000 A0=00000000
                                                       D1=00000000 A1=00000000
_TEXT              SECTION CODE, PUBLIC, 1             D2=00000000 A2=00000000
                                                       D3=00000000 A3=00000000
_reset                                                 PC=40000000 SP=00000100
                   jmp      _start                     MDR=00000000
                                                       LIR=00000000 PSW=0000
                   org      START_VECTOR               LAR=00000000  F  ----
_start                                                 IE=0 IM=0 S=0
                   mov      stack+STACK_SIZE, a0               Local
                   mov      a0, sp

                   add      -12, sp

;          _BSS, _GBSS CLR
                   mov       _BSSEND - _BSS, d1
PC=40000000                Command
PICE(10300) Ver 3.6b Release 1.1.1 Copyright (c)1996 Pa
        Sub process segment      =  873AH ( 99 Kbyte )
        Monitor Program Version  =  0.01
        Evachip Number           =  103000
>l sample
>
1 File 2OptWin3 SrcSW4Search5  Go  6Inspct7 Come 8SglStp9 Break10FncStp(16)
```

Opening the Register window and Option window
F2

Next, press the F2 (OptWin) key. A new window appears on the right side of the screen. The top portion of this new window is the Register window, which always displays the current contents of the registers.

Switching the Option window
Ctrl + F2

The bottom portion of this window is used to display one of four windows: the Local window, the Memo window, the Back Trace window, or the Stack window. To select one of these windows, hold down the CTRL key and then press the F2 (OptWin) key. (Note that the Local and Back Trace windows can only be displayed in C debugging mode.)

Closing the Register window and Option window
F2

Press the F2 (OptWin) key again to close this window. The F2 (OptWin) key is used to both open and close the window.

4-4 Screen control/file handling

How do you view the portion of the source listing below the bottom of the Code window?

Moving the cursor between windows
Home
[☞ page 66]

First, press the HOME key. The cursor in the Command window disappears and moves to the Code window. Pressing the HOME key again brings the cursor back to the Command window.

Moving the cursor down and scrolling the screen up
↓
[☞ page 66]

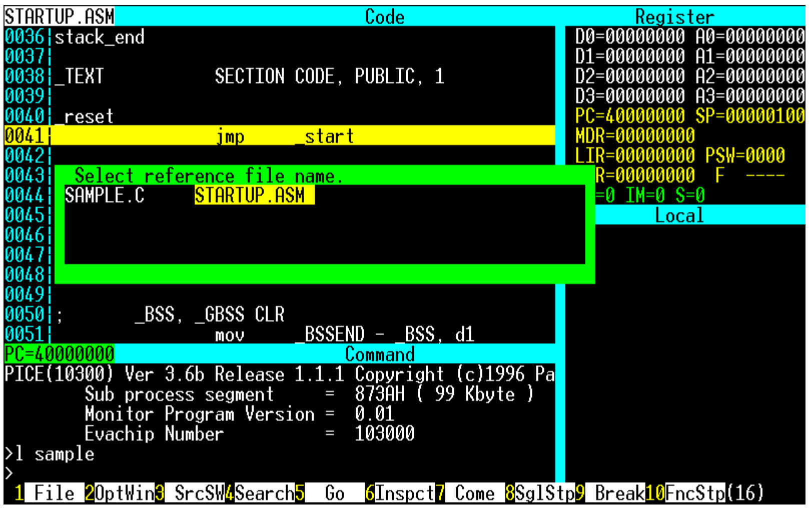
Move the cursor to the Code window (if the cursor is in the Command window, press the HOME key) and then press the Cursor Down key (↓). The cursor moves down one line.

Moving the cursor up and scrolling the screen down
↑
[☞ page 66]

Keep pressing the Cursor Down key. The cursor moves down, line by line. Once the cursor reaches the bottom of the Code window, the Code window display begins to scroll up. Now press the Cursor Up key (↑). The cursor then moves up the screen, and once it reaches the top of the Code window, the Code window display scrolls down. In addition, the ROLL UP and ROLL DOWN keys can be used to control the Code window display in a fashion similar to most screen editors.

Displaying the File Select window
F1
[☞ page 74]
Selecting a file
<program name> ↵

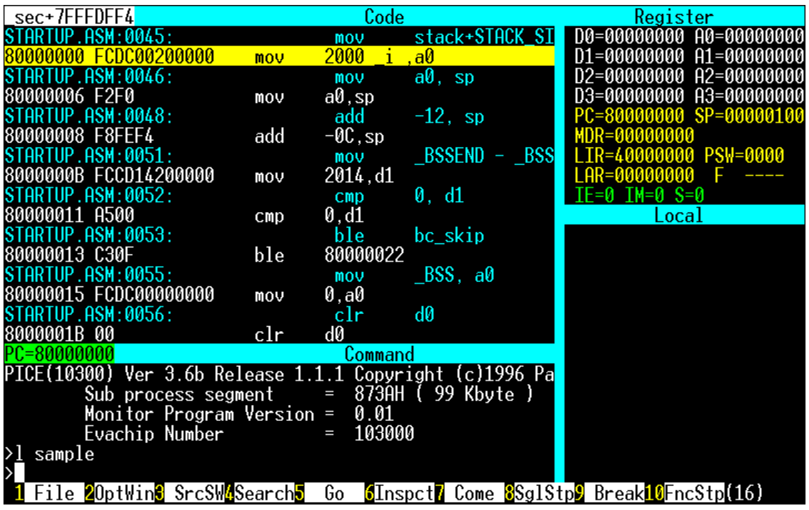
Next, press the F1 (File) key. The File Select window appears on the screen. In this example, the SAMPLE.C and STARTUP.ASM files are displayed. When debugging a program that has more source files, the name of each source file is displayed in this window. After selecting a file by using the cursor keys to highlight the desired file name in yellow, press the Return key. The File Select window then closes and the selected file is displayed in the Code window.



```
STARTUP.ASM                   Code                      Register
stack_end                                         D0=00000000 A0=00000000
                                                  D1=00000000 A1=00000000
_TEXT          SECTION CODE, PUBLIC, 1            D2=00000000 A2=00000000
                                                  D3=00000000 A3=00000000
_reset                                            PC=40000000 SP=00000100
               jmp      _start                    MDR=00000000
                                                  LIR=00000000 PSW=0000
  Select reference file name.                      R=00000000  F  ----
 SAMPLE.C      STARTUP.ASM                         =0 IM=0 S=0
                                                        Local




;         _BSS, _GBSS CLR
               mov      _BSSEND - _BSS, d1
PC=40000000                 Command
PICE(10300) Ver 3.6b Release 1.1.1 Copyright (c)1996 Pa
        Sub process segment     =  873AH ( 99 Kbyte )
        Monitor Program Version =  0.01
        Evachip Number          =  103000
>l sample
>
 1 File 2OptWin3 SrcSW4Search5  Go  6Inspct7 Come 8SglStp9 Break10FncStp(16)
```

Displaying the disassembled code and C source code
F3
[☞ page 69]

Once the Return key has been pressed and the File Select window has been closed, press the F3 (SrcSW) key. The Code window display switches to a mixed display of disassembled code and the C source code. This display is useful for more detailed debugging than is possible with the source listing alone.



```
 sec+7FFFDFF4                 Code                      Register
STARTUP.ASM:0045:                  mov      stack+STACK_SI D0=00000000 A0=00000000
80000000 FCDC00200000    mov    2000 _i ,a0            D1=00000000 A1=00000000
STARTUP.ASM:0046:                  mov      a0, sp     D2=00000000 A2=00000000
80000006 F2F0            mov    a0,sp                  D3=00000000 A3=00000000
STARTUP.ASM:0048:                  add      -12, sp    PC=80000000 SP=00000100
80000008 F8FEF4          add    -0C,sp                 MDR=00000000
STARTUP.ASM:0051:                  mov      _BSSEND - _BSS LIR=40000000 PSW=0000
8000000B FCCD14200000    mov    2014,d1                LAR=00000000  F  ----
STARTUP.ASM:0052:                  cmp      0, d1      IE=0 IM=0 S=0
80000011 A500            cmp    0,d1                         Local
STARTUP.ASM:0053:                  ble      bc_skip
80000013 C30F            ble    80000022
STARTUP.ASM:0055:                  mov      _BSS, a0
80000015 FCDC00000000    mov    0,a0
STARTUP.ASM:0056:                  clr      d0
8000001B 00              clr    d0
PC=80000000                 Command
PICE(10300) Ver 3.6b Release 1.1.1 Copyright (c)1996 Pa
        Sub process segment     =  873AH ( 99 Kbyte )
        Monitor Program Version =  0.01
        Evachip Number          =  103000
>l sample
>
 1 File 2OptWin3 SrcSW4Search5  Go  6Inspct7 Come 8SglStp9 Break10FncStp(16)
```

Press the F3 (SrcSW) key again. Now the display shows the source code only again.

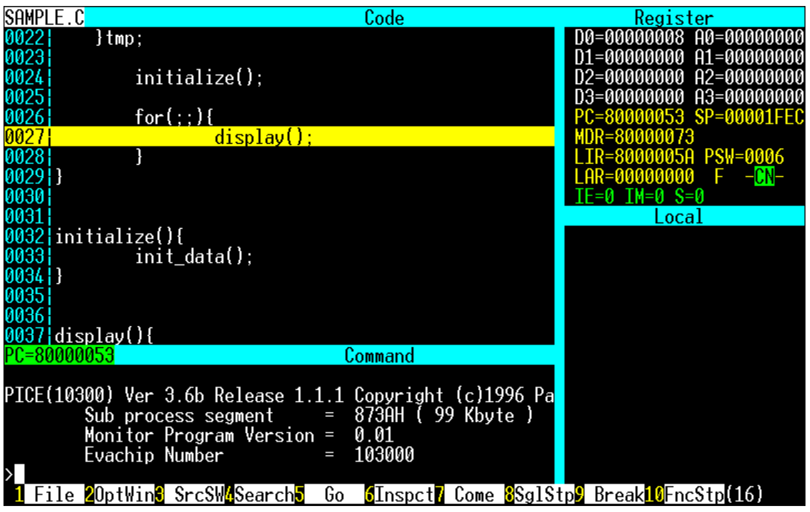
You have loaded the executable file (SAMPLE.EX), and now know about the contents of the windows displayed on the screen. You are now ready to execute the program.

4-5 Program execution and break

This section explains how to execute a program, and how to set and cancel breaks.

Program function step execution
F10
[☞ page 71]

There are two methods for executing a program one line at a time (“step execution”): function step execution and single step execution. First we will try function step execution. Press the F10 (FncStp) key. The current line (the line highlighted in yellow) in the Code window moves down one line. This means that one step has been executed. Press the F10 (FncStp) key several more times. The current line keeps changing one line at a time.



```
SAMPLE.C                       Code
    }tmp;

        initialize();

        for(;;){
                display();
        }
}


initialize(){
        init_data();
}


display(){
PC=80000053                    Command

PICE(10300) Ver 3.6b Release 1.1.1 Copyright (c)1996 Pa
        Sub process segment     =  873AH ( 99 Kbyte )
        Monitor Program Version =  0.01
        Evachip Number          =  103000
>
```

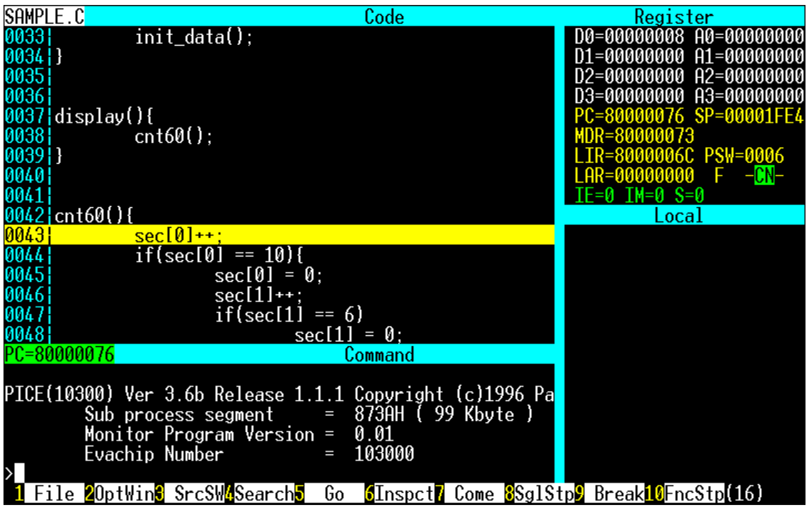
```
          Register
D0=00000008 A0=00000000
D1=00000000 A1=00000000
D2=00000000 A2=00000000
D3=00000000 A3=00000000
PC=80000053 SP=00001FEC
MDR=80000073
LIR=8000005A PSW=0006
LAR=00000000  F  -CN-
IE=0 IM=0 S=0
           Local
```

1 File 2OptWin3 SrcSW4Search5 Go 6Inspct7 Come 8SglStp9 Break10FncStp(16)

Now look at the register display in the Register window. (If the Register window is not displayed on the screen, press the F2 (OptWin) key.) The most recent register values are displayed each time the F10 (FncStp) key is pressed.

Program single-step execution
F8
[☞ page 71]

There is another method of step execution. Press the F8 (SglStp) key. The current line moves in the same fashion as in function step execution. Press the F8 (SglStp) key several more times. The current line then steps sequentially (one step at a time) through the functions “display( )” and “cnt60( )”.
(This method is referred to as “single-step execution.”)



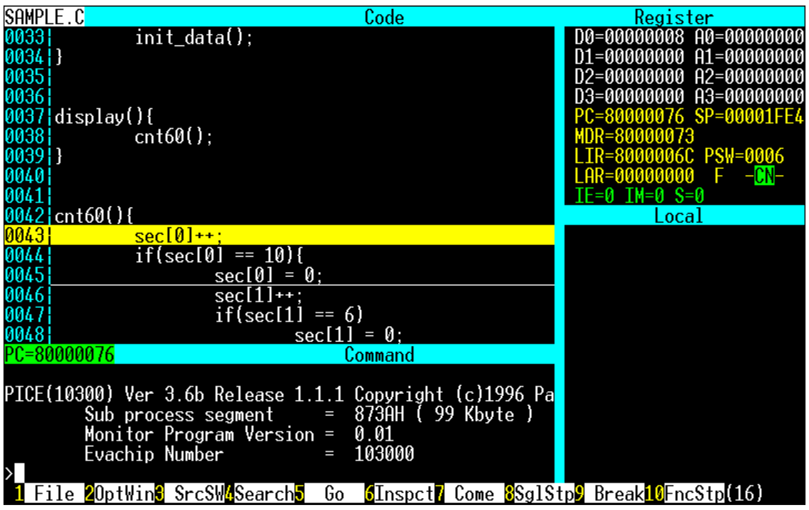
```
SAMPLE.C                         Code                        Register
0033¦        init_data();                              D0=00000008 A0=00000000
0034¦}                                                 D1=00000000 A1=00000000
0035¦                                                  D2=00000000 A2=00000000
0036¦                                                  D3=00000000 A3=00000000
0037¦display(){                                        PC=80000076 SP=00001FE4
0038¦        cnt60();                                  MDR=80000073
0039¦}                                                 LIR=8000006C PSW=0006
0040¦                                                  LAR=00000000  F  -CN-
0041¦                                                  IE=0 IM=0 S=0
0042¦cnt60(){                                                 Local
0043¦        sec[0]++;
0044¦        if(sec[0] == 10){
0045¦                sec[0] = 0;
0046¦                sec[1]++;
0047¦                if(sec[1] == 6)
0048¦                        sec[1] = 0;
PC=80000076                    Command

PICE(10300) Ver 3.6b Release 1.1.1 Copyright (c)1996 Pa
        Sub process segment     =  873AH ( 99 Kbyte )
        Monitor Program Version =  0.01
        Evachip Number          =  103000
>
1 File 2OptWin3 SrcSW4Search5  Go  6Inspct7 Come 8SglStp9 Break10FncStp(16)
```

The difference between function step execution with the F10 (FncStp) key and single-step execution with the F8 (SglStp) key is whether called functions as a whole are regarded as one step, or are also executed internally one step at a time.

Setting/deleting break
(software break)
F9
[☞ page 71]

Next, we will set a break (software break). Move the cursor to the Code window (if the cursor is currently in the Command window, press the HOME key), and move the cursor to the 45th line of the SAMPLE.C file. Once the cursor has been positioned in the 45th line, press the F9 (Break) key. The 45th line is now underlined. A break has now been set in the 45th line of the source listing.

To delete a break, move the cursor back to the line where breakpoint is set, and press the F9 (Break) key. The underline disappears, indicating that the break has been deleted.



```
SAMPLE.C                         Code                        Register
0033¦        init_data();                              D0=00000008 A0=00000000
0034¦}                                                 D1=00000000 A1=00000000
0035¦                                                  D2=00000000 A2=00000000
0036¦                                                  D3=00000000 A3=00000000
0037¦display(){                                        PC=80000076 SP=00001FE4
0038¦        cnt60();                                  MDR=80000073
0039¦}                                                 LIR=8000006C PSW=0006
0040¦                                                  LAR=00000000  F  -CN-
0041¦                                                  IE=0 IM=0 S=0
0042¦cnt60(){                                                 Local
0043¦        sec[0]++;
0044¦        if(sec[0] == 10){
0045¦                sec[0] = 0;
0046¦                sec[1]++;
0047¦                if(sec[1] == 6)
0048¦                        sec[1] = 0;
PC=80000076                    Command

PICE(10300) Ver 3.6b Release 1.1.1 Copyright (c)1996 Pa
        Sub process segment     =  873AH ( 99 Kbyte )
        Monitor Program Version =  0.01
        Evachip Number          =  103000
>
1 File 2OptWin3 SrcSW4Search5  Go  6Inspct7 Come 8SglStp9 Break10FncStp(16)
```

Executing the program
F5
[☞ page 70]

Now we will execute the program by pressing the F5 (Go) key. The program then stops at the 45th line of the source listing, where we set our break (software break).

Deleting all break events
B C *
[☞ page 136]

Input the following from the keyboard:

```
BC* ↵
```

Program forced stop
ESC
[☞ page 71]

This command deletes all break events that were set with the dialog command.

Now press the F5 (Go) key again. Because there is no break event set, execution continues uninterrupted. To interrupt program execution while a program is running, press the ESC key. This forcibly stops program execution.

4-6 Memory referencing

Referencing the contents of memory in the Command window
D <address>
[☞ page 167]

The values of the variables sec[0] and sec[1] are the most important elements in the sample program. To reference the value of sec, input the following from the keyboard:

```
D sec ↲
```

The following values are displayed in the Command window:

```
0000000C    0A   00   00   00   00   .................
```

The contents of sec[0] in address 0x0000000C and of sec[1] in 0x00000010 are displayed in hexadecimal. (sec was declared as type “int”.)

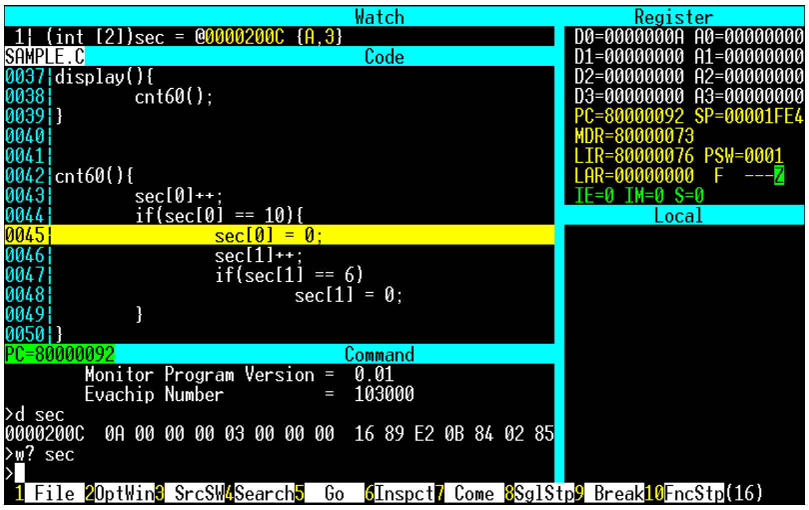
! The values indicated above are examples only, and will not necessarily match the actual values.

Referencing the contents of memory in the Watch window
W ? <symbol>
[☞ page 195]

Input the following from the keyboard:

```
W? sec ↲
```

A new Watch window is opened above the Code window, displaying the declared type, address, and value of sec.



```
                              Watch                          Register
 1| (int [2])sec = @0000200C {A,3}                  D0=0000000A A0=00000000
SAMPLE.C                       Code                 D1=00000000 A1=00000000
display(){                                          D2=00000000 A2=00000000
        cnt60();                                    D3=00000000 A3=00000000
}                                                   PC=80000092 SP=00001FE4
                                                    MDR=80000073
                                                    LIR=80000076 PSW=0001
cnt60(){                                            LAR=00000000  F  ---Z
        sec[0]++;                                   IE=0 IM=0 S=0
        if(sec[0] == 10){                                  Local
                sec[0] = 0;
                sec[1]++;
                if(sec[1] == 6)
                        sec[1] = 0;
        }
}
PC=80000092                  Command
        Monitor Program Version =  0.01
        Evachip Number          =  103000
>d sec
0000200C  0A 00 00 00 03 00 00 00  16 89 E2 0B 84 02 85
>w? sec
>
 1 File 2OptWin3 SrcSW4Search5  Go  6Inspct7 Come 8SglStp9 Break10FncStp(16)
```

The data registered for watching is continuously updated and displayed in the window. As an example, set a break (software break) (using the F9 (Break) key) in the 45th line of the source listing. Next, execute the program using the F5 (Go) key. The Watch window is updated. Continue to press the F5 (Go) key; it should be apparent that the values are updated continuously.

Canceling all Watch windows
Y *
[☞ page 199]

To cancel all Watch windows, input the following from the keyboard:

```
Y* ↵
```

All watch windows disappear from the screen.

4-7 Subprocesses

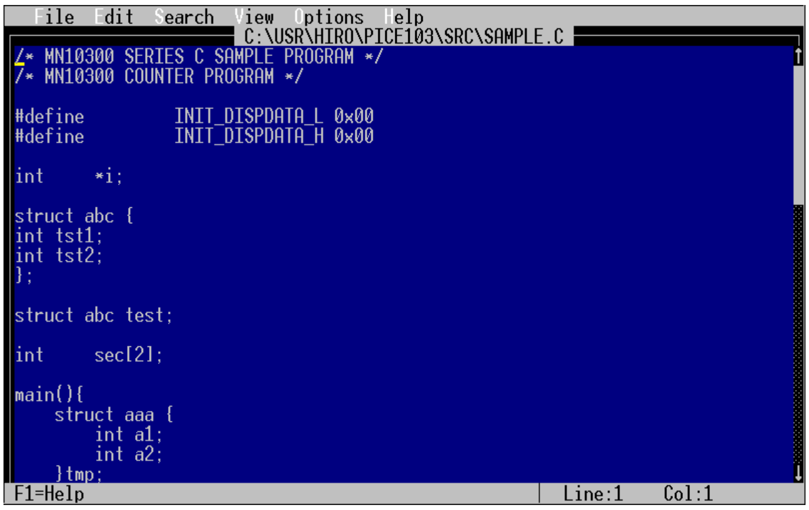
The C source code debugger is equipped with a function that allows another MS-DOS command to be started up while debugging work is in progress, and permits immediate switching between that command and the C source code debugger. In short, it is possible to simultaneously start up the C source code debugger and another MS-DOS command on one computer and switch between the two processes with a simple key operation while debugging is in progress. In the C source code debugger, this second process is called the “subprocess.”

Starting up a subprocess
!
[☞ page 203]

We will now start up a subprocess. To do so, input the following from the keyboard:

! ↵

This causes the MS-DOS command input screen to appear. While in this state, MS-DOS commands can be used normally. Use a text editor to open the SAMPLE.C file that we have been using to practice debugging operations.


File Edit Search View Options Help
C:\USR\HIRO\PICE103\SRC\SAMPLE.C
F1=Help
Line:1 Col:1

```
/* MN10300 SERIES C SAMPLE PROGRAM */
/* MN10300 COUNTER PROGRAM */

#define        INIT_DISPDATA_L 0x00
#define        INIT_DISPDATA_H 0x00

int     *i;

struct abc {
int tst1;
int tst2;
};

struct abc test;

int     sec[2];

main(){
    struct aaa {
        int a1;
        int a2;
    }tmp;
```

If the message “Insufficient Memory” is displayed when shifting to the subprocess, refer to the C source code debugger startup option “-B”.

[☞ Chapter 5, Startup Options]

Returning from a subprocess
Ctrl + 0

Returning to a subprocess
Ctrl + 1
[☞ page 77]

To return to the C source code debugger screen, hold down the CTRL key and then press the “0” key on the numeric keypad. Next, hold down the CTRL key and then press the “1” key on the numeric keypad in order to return to the editor. Simple operations such as these can be used to switch between the C source code debugger and an editor or other MS-DOS commands (applications). This function makes it possible to reference source files and specification document files while debugging, or to correct the portion of a source file where a bug was found.

When switching processes, the C source code debugger does not switch data within the MS-DOS system (such as the current directory, etc.). Therefore, if the current directory, etc., was changed in the subprocess, restore the original status before returning to the C source code debugger. In addition, because there is no exclusive control of files between the two processes, extra caution is required when both processes access the same file.

4-8 Macro commands

The C source code debugger has a macro function that makes it possible to combine several commands in order to create new commands, or to judge conditions. While the macro function may seem daunting to the novice user at first, once it is mastered it makes debugging work easier.

We will create a macro that sets a breakpoint in the 45th line of SAMPLE.C and then, when the value of sec[0] is “9”, displays a dump starting from the address sec.

```
{testmacro
    bp .sample.c:45
    g
    while{__run__
    }
    if{val(sec[0]==9)
        d sec

}
```

The first line of the macro, the declaration, declares the name of the macro as “TESTMACRO”. The second line sets a break (software break) in the 45th line of the source listing. (The BP command can be used to set a break (software break) in the same fashion as the F9 (Break) key.) The third line executes the user program. The fourth and fifth lines form a “while” loop that waits until the user program is stopped (i.e., the break is triggered). The sixth and seven lines consist of the processing that is performed after the break is triggered.

Executing a macro command
“Registered macro name”
[☞ page 223]

In order to execute this macro, simply input the following from the keyboard:

TESTMACRO ↵

The macro previously defined is then executed.

After the user program is executed, the macro waits until the program is stopped; once the program is stopped, if the value of sec[0] is “9”, a dump starting from the address sec is displayed. The macro then terminated.

4-9 Exiting the C source code debugger

The final step is to quit the C source code debugger and return to MS-DOS.

Input the following from the keyboard:

Exiting the C source code debugger
Q
[☞ page 201]

Q ↵

You should now be back at the MS-DOS screen.

If the message “Not terminated subprocess” was displayed, press CTRL + 1 to return to the subprocess and then terminate that program. For example, if the MS-DOS prompt is shown in the subprocess, input the following:

EXIT ↵

The following message is then displayed:

“Please hit the SPACE key to return to PICE.”

Pressing the space bar returns you to the debugger screen. Now that the sub-process has been terminated, input the following again:

Q ↵

Now the C source code debugger terminates and you are returned to the MS-DOS prompt.

4-10 Program completion (gaining familiarity with C source code debugger operation)

In actual program development, completing a program is not a simple matter. The process of editing, compiling, assembling, linking, and debugging will be repeated a number of times before the program is complete.

After operating the C source code debugger as we went through the basic process in this tutorial, you should now have a general understanding of how to use the C source code debugger. Now you are ready to use the C source code debugger on an actual program and discover more advanced uses of the debugger.

Chapter 5
C Source Code Debugger
Startup Method and Options

1 C Source Code Debugger Startup Method and Options

To start up the C source code debugger, input the following at the MS-DOS command level:

```
PICE103 [<option>] [<debug file> [<parameter>]] ↵
```

If the INIT.MCR file is located in the current directory when the C source code debugger is started up, the C source code debugger automatically loads and executes this file. This file is equivalent to an MS-DOS AUTOEXEC.BAT file.

The C source code debugger startup options are listed below. (A space is required between options.)

Startup option	Description of option
-B [<size D>][,<size M>]	Specifies the size of the debugging information area and the macro area.
-BEMS [,<size M>]	Reserves the debugging information area in EMS memory.
-E<extension>	Specifies the default extension.
-F	Specifies overlap mode (save to file).
-FEMS	Specifies overlap mode (save to EMS memory).
-N	Disables indicators.
-TAB<tab size>	Specifies tab size.
-X	Specifies assembler debugging mode.
-XC	Specifies CC103 compiler debugging mode.
-NOTARGET	Specifies startup without target system.

Specifying the size of the debugging information area and the macro area -B

This option specifies the size of the debugging information area and the macro area.

A wide variety of information is stored in the debugging information area, including symbol names and line number information. This information area must be about 1/2 the size of the executable file (the EX file when compiled with all debugging options), including the debugging information. As a result, if the debugging information area is reserved in conventional memory (the memory area up to 640KB), it will be impossible to debug a large program. In such a case, reserve the debugging information area in EMS memory.

-B [<size D>][,<size M>]

Specify numeric values for the size of the debugging information area <size D> and the macro area <size M>.

<size D>	Size (in 16KB units) of the area where the debugging information is to be stored. Reserves an area of the specified size in a memory area of less than 640KB. If omitted, a 64KB area is reserved.
<size M>	Size (in 1KB units, up to a maximum of 32KB) of the macro command registration area. If omitted, a 3KB area is reserved.

Reference: For example, in order to reserve 128KB for the debugging information area and 5KB for the macro area, input the following:

```
PICE103  -B128,5 ↵
```

-BEMS [,<size M>]

This option reserves the debugging information area in EMS memory. Specify a numeric value for the size of the macro area <size M>.

Reference: For example, in order to reserve the debugging information area in EMS memory and also reserve 10KB for the macro area, input the following:

```
PICE103  -BEMS, 10 ↵
```

Specifying overlap mode
-F

This option specifies overlap mode, in which only the bare minimum of essential functions for executing the debugging program are loaded into main memory, while the C source code debugger itself and the work area are saved to EMS memory or to a file.

[☞ Chapter 1, section 1 for the Overlap function]

-F

This option uses a file as the save area for overlapping.

If the -F option is specified, the overlap file is created in the directory specified by the environment variable TMP or TEMP. Therefore, the overlap time can be greatly reduced by specifying a RAM disk for an overlap disk. If this environment variable is not set, the file is created in the current directory.

[☞ Chapter 3, section 3]

-FEMS

This option uses EMS memory as the save area for overlapping.

This option allows faster task swapping than when saving to a file.

Specifying the default extension
-E <extension>

This option specifies the default source file extension.

<extension> becomes the default source file extension. If this option is omitted, .C becomes the default extension.

Disabling indicators
-N

This option disables the display of the indicators that indicate the screen type.

If the indicators are disabled, “S” and “U” (the subprocess screen and user screen indicators) are not displayed in the lower left corner of the screen.
(This option can be specified for the PC-9800 Series only.)

Setting the tab size
-TAB

This option specifies the tab size when displaying a source listing in the Code window.

-TAB (tab size)

The tabs are adjusted to the number specified by the tab size. If this option is omitted, the tab size is set to “8”.

This function is useful for displaying files in which the tab size was changed with an editor.

Reference: To set the tab size to four columns, input the following:

```
PICE103  -TAB4 ↵
```

Specifying assembler debugging mode
-X

This option specifies either the assembler or various C debugging modes.

-X

This option specifies the assembler debugging mode. If the C source code debugger is started up in this mode, commands related to C (stack back tracing, local variables) cannot be used.

-XC (default)

This option specifies the CC103 compiler debugging mode.

Starting up with no target system
-NOTARGET

This option specifies that the in-circuit emulator is to be used by itself (without being connected to a target system).

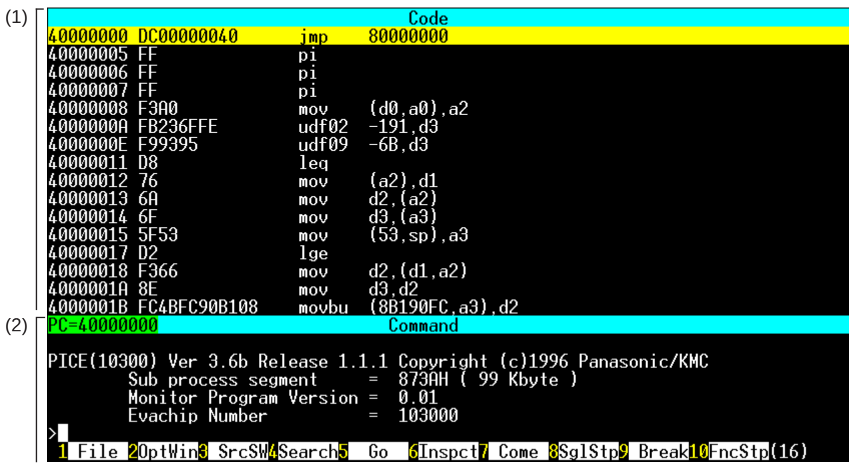
This option must be specified if there is no target system.

! Never specify this option if a target system is connected. Doing so will cause the voltage of the target and that of the in-circuit emulator to be different, causing the in-circuit emulator to operate incorrectly and damaging the system.

Chapter 6
Window Commands

1 Window Displays

The C source code debugger supports two types of command specification, Window commands and Dialog commands, using either the function keys or the Control key. This chapter explains the Window commands and how to use them. For details on Dialog commands, refer to Chapter 7, “Dialog Commands.”



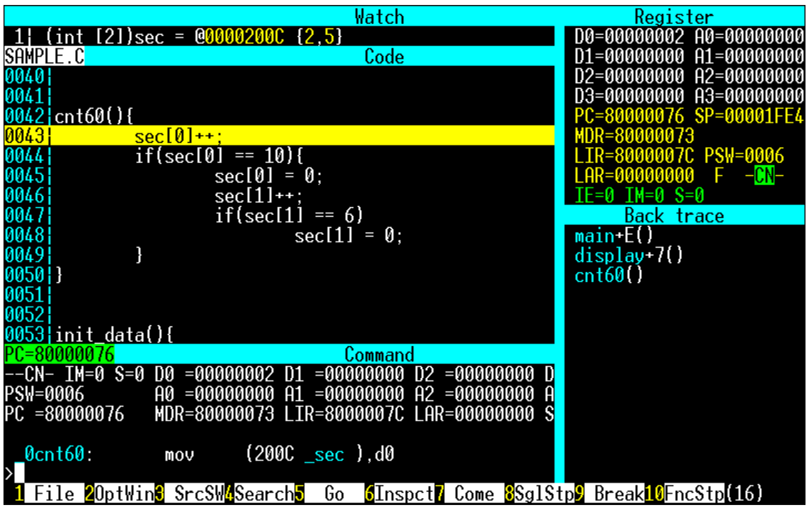
```
                                     Code
40000000 DC00000040       jmp    80000000
40000005 FF               pi
40000006 FF               pi
40000007 FF               pi
40000008 F3A0             mov    (d0,a0),a2
4000000A FB236FFE         udf02  -191,d3
4000000E F99395           udf09  -6B,d3
40000011 D8               leq
40000012 76               mov    (a2),d1
40000013 6A               mov    d2,(a2)
40000014 6F               mov    d3,(a3)
40000015 5F53             mov    (53,sp),a3
40000017 D2               lge
40000018 F366             mov    d2,(d1,a2)
4000001A 8E               mov    d3,d2
4000001B FC4BFC90B108     movbu  (8B190FC,a3),d2
PC=40000000                        Command

PICE(10300) Ver 3.6b Release 1.1.1 Copyright (c)1996 Panasonic/KMC
        Sub process segment      =  873AH ( 99 Kbyte )
        Monitor Program Version =  0.01
        Evachip Number           =  103000
>
 1 File 2OptWin3 SrcSW4Search5  Go  6Inspct7 Come 8SglStp9 Break10FncStp(16)
```

(1) Code window

This window displays either source code or a combination of source code and disassembled code. If the cursor is located in this window, the Window commands can be used to change the display by scrolling the source code up or down, for example, or set/cancel software breaks where the cursor is located.

(2) Command window

This window is used to input Dialog commands and to display commands. This window stores the display contents in the Command window display buffer (reserved as an 8KB area) at the same time that the information is displayed on the screen. If the cursor is located within this window, the cursor keys can be used to scroll the display up and down over the range of the display buffer.



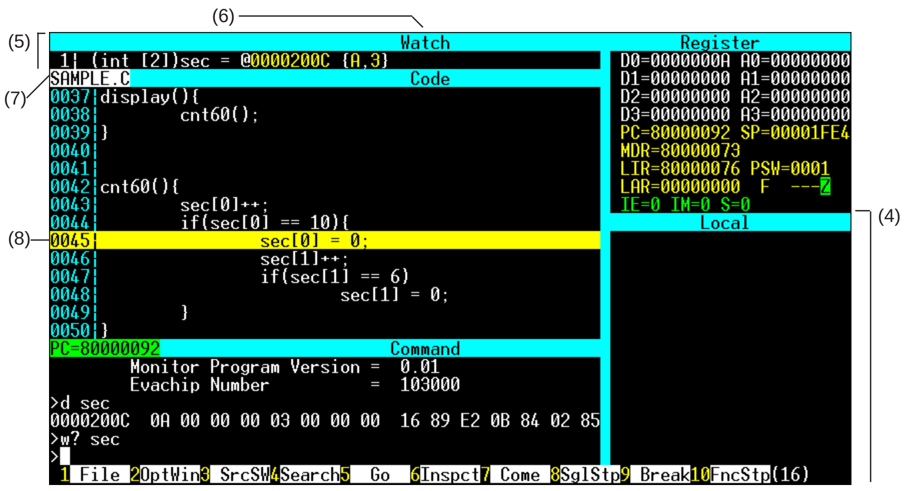
```
Watch
 1| (int [2])sec = @0000200C {2,5}
SAMPLE.C                 Code

cnt60(){
        sec[0]++;
        if(sec[0] == 10){
                sec[0] = 0;
                sec[1]++;
                if(sec[1] == 6)
                        sec[1] = 0;
        }
}


init_data(){
PC=80000076              Command
--CN- IM=0 S=0 D0 =00000002 D1 =00000000 D2 =00000000 D
PSW=0006       A0 =00000000 A1 =00000000 A2 =00000000 A
PC =80000076   MDR=80000073 LIR=8000007C LAR=00000000 S

  @cnt60:        mov     (200C _sec ),d0
>
```

```
Register
D0=00000002 A0=00000000
D1=00000000 A1=00000000
D2=00000000 A2=00000000
D3=00000000 A3=00000000
PC=80000076 SP=00001FE4
MDR=80000073
LIR=8000007C PSW=0006
LAR=00000000  F  -CN-
IE=0 IM=0 S=0
Back trace
main+E()
display+7()
cnt60()
```

1 File 2OptWin3 SrcSW4Search5 Go 6Inspct7 Come 8SglStp9 Break10FncStp(16)
(3)

(3) Register window

This window displays the contents of the registers and the statuses of the flags. This window can be easily opened or closed as necessary.


(4)
(5)
(6)
(7)
(8)
Watch
Register
Code
Local
Command
1 File 2OptWin3 SrcSW4Search5 Go 6Inspct7 Come 8SglStp9 Break10FncStp(16)

```
 1| (int [2])sec = @0000200C {A,3}
SAMPLE.C
display(){
        cnt60();
}


cnt60(){
        sec[0]++;
        if(sec[0] == 10){
                sec[0] = 0;
                sec[1]++;
                if(sec[1] == 6)
                        sec[1] = 0;
        }
}
PC=80000092
        Monitor Program Version =  0.01
        Evachip Number          =  103000
>d sec
0000200C  0A 00 00 00 03 00 00 00  16 89 E2 0B 84 02 85
>w? sec
>
```

```
D0=0000000A A0=00000000
D1=00000000 A1=00000000
D2=00000000 A2=00000000
D3=00000000 A3=00000000
PC=80000092 SP=00001FE4
MDR=80000073
LIR=80000076 PSW=0001
LAR=00000000  F  ---Z
IE=0 IM=0 S=0
```

(4) Option window

One of four windows (Memo, Back Trace, Stack, and Local) can be selected for display in this window. The Back Trace and Local windows can only be displayed in C debugging mode.

Memo window:	Displays the contents of the memos registered by the MEM command.
Back Trace window:	Displays the back trace for the C functions.
Stack window:	Displays the contents of stack memory.
Local window:	Displays the list of local variables for the function where the program counter (PC register) is.

(5) Watch window

This window always displays the most recent values for symbols and memory specified by the W command (the watch registration dialog command).

This window is not displayed if nothing is registered for watching.

(6) Status display area

The causes of breaks are listed below.

(The display messages are shown in parentheses.)

Software break (Break-point No. = xx)

Program execution stops before executing an address where a software break was set by the BP command.

Hardware break (Break-point No. = xx)

Program execution stops when an event that was set by the BP command occurs.

And break (And Break)

Program execution stops when all of the events set by the BPA command occur.

Sequential break (Sequential Break)

Program execution stops when all of the events set by the BPS command occur in sequence.

Trace-full break (Trace-full Break)

Program execution stops when the trace memory is full of data.

Forced break (ESC Break)

User program execution is forcibly stopped when the ESC key on the host computer is pressed.

Undefined instruction break (Illegal Instruction Break)

This type of break occurs when an attempt is made to execute an undefined instruction.

Illegal memory access break (Illegal Memory-access Break)

This type of break occurs when an illegal memory access is made.

RAM error break (RAM Error Break)

This type of break occurs when an attempt is made to access an area for which memory accesses are not allowed.

Data misalignment break (Data Miss-alignment Break)

This type of break occurs when an attempt is made to read or write long-word (32-bit) data in an address that is not a multiple of four, or word (16-bit) data in an odd address.

In addition to messages that indicate the causes of breaks, the following messages are also displayed:

Trace stop

This message is displayed when tracing has stopped (but the user program is still running).

Trace full stop

This message is displayed when tracing has stopped because trace memory is full of data (but the user program is still running).

(7) Title display

In source mode, this displays the name of the source file displayed in the Code window; in assembler mode, this displays the name of the function in the address where the cursor is located and the offset from the start address of the function.

(8) Program counter

The current position pointed to by the program counter is highlighted in yellow.

2 Window Commands

2-1 Screen control

This section explains screen control (cursor movement, scrolling, etc.) in the Command window and the Code window.

Note that the operation of each key differs according to whether the cursor is located in the Command window or the Code window.

[HOME]	Moves the cursor between the Command window and the Code window. When the cursor is in the Command window, pressing this key moves the cursor to the Code window, and when the cursor is in the Code window, pressing this key moves the cursor to the Command window.
[← / Ctrl + S]	Moves the cursor one character to the left.
[→ /Ctrl + D]	Moves the cursor one character to the right.
[↑ / Ctrl + E]	When the cursor is in the Code window, pressing these keys moves the cursor up one line. When the cursor is in the Command window, pressing these key scrolls the window down one line. The contents displayed in the command window are logged in the display buffer (reserved as an 8KB area); any contents remaining in the buffer can be referenced by scrolling the window up or down.
[↓ / Ctrl + X]	When the cursor is in the Code window, pressing these keys moves the cursor down one line. When the cursor is in the Command window, pressing these key scrolls the window up one line. However, immediately after a D or TD command, pressing these keys displays the next line that follows the displayed results of the D or TD command. [☞ D command and TD command]

[Ctrl + A]	When the cursor is in the Code window (with a source listing displayed), pressing these keys moves the cursor one word to the left. When the cursor is in the Command window, pressing these keys moves the cursor to the beginning of the line.
[Ctrl + F]	When the cursor is in the Code window (with a source listing displayed), pressing these keys moves the cursor one word to the right. However, when disassembled code is displayed, pressing these keys moves the cursor in the sequence address to code to mnemonic. When the cursor is in the Command window, pressing these keys moves the cursor to the end of the line.
[Ctrl + Q • S] (press [Ctrl +Q] then [Ctrl +S])	Pressing these keys moves the cursor to the beginning of the line. This command is valid only when a source listing is displayed in the Code window, and the cursor is located in the Code window.
[Ctrl + Q•D]	Pressing these keys moves the cursor to the end of the line. This command is valid only when a source listing is displayed in the Code window, and the cursor is located in the Code window.
[RollUp / Ctrl +C]	When the cursor is located in the Code window, pressing these keys scrolls the contents of the Code window (whether a source listing is displayed or disassembled code is displayed) up one screen. When the cursor is located in the Command window, pressing these keys scrolls the contents of the Command window up one screen. CTRL + C can also be used to interrupt long display operations caused by the D command, and repeated step execution by the T command or the P command.
[RollDown / Ctrl +R]	When the cursor is located in the Code window, pressing these keys scrolls the contents of the Code window (whether a source listing is displayed or disassembled code is displayed) down one screen. When the cursor is located in the Command window, pressing these keys scrolls the contents of the Command window down one screen.

[Ctrl + Q• R]	Pressing these keys moves the cursor to the beginning of the source file that is currently displayed. This command is valid only when a source listing is displayed in the Code window, and the cursor is located in the Code window.
[Ctrl + Q • C]	Pressing these keys moves the cursor to the end of the source file that is currently displayed. This command is valid only when a source listing is displayed in the Code window, and the cursor is located in the Code window.
[Ctrl + ←]	Pressing these keys enlarges the Option window. In other words, this command moves the vertical boundary between the Option window and the Command and Code windows to the left.
[Ctrl + →]	Pressing these keys reduces the Option window. In other words, this command moves the vertical boundary between the Option window and the Command and Code windows to the right.
[Ctrl + ↑]	Pressing these keys enlarges the Command window (and reduces the Code window). In other words, this command moves the boundary between the Command window and the Code window up one line.
[Ctrl + ↓]	Pressing these keys reduces the Command window (and enlarges the Code window). In other words, this command moves the boundary between the Command window and the Code window down one line.
[Ctrl + J]	Pressing these keys redisplays the screen.
[Ctrl + Q •W]	Pressing these keys enlarges the Command window to its maximum size (and reduces the Code window to its minimum size).
[Ctrl + Q • Z]	Pressing these keys reduces the Command window to its minimum size (and enlarges the Code window to its maximum size).
[Ctrl + Q • J]	Pressing these keys restores all windows to their initial window sizes.

[F2(OptWin) / Ctrl + 4]
(Press the "4" on the numeric keypad.)

Pressing these keys turns the Register window and Option window display on and off.
If the Register window is not displayed, pressing these keys causes the Register window to appear. If the Register window is displayed, pressing these keys causes the Register window to disappear.

[Ctrl + F2(Optsw)]
[Ctrl + O]

These keys switch the contents of the Option window display.
This command changes the Option window from the Memo window to the Stack window. (When there is debugging information in the user program, this command changes the Option window in the following cycle: Memo to Back Trace to Stack to Local.)
This command is valid only when the Register window and the Option window are displayed.

F3(SrcSW)

When the Code window is displayed, pressing this key changes the source listing display to the disassembled code display, or changes the disassembled code display to the source listing display.
[☞ page 43]
The code listing is displayed so that the line that the program counter (PC register) is currently pointing at is displayed. However, when displaying a source listing, if there is no source line that corresponds to the current value of the program counter, the last source line that was displayed, is displayed.

[Ctrl + F3(SrcSW1)]

When the Code window is displayed, pressing this key changes the source listing display to the disassembled code display, or changes the disassembled code display to the source listing display.
The screen switches, starting the new display from the line in the Code window where the cursor is currently located. However, when displaying a source listing, if there is no source line that corresponds to the line where the cursor is currently located, the last source line that was displayed, is displayed.

2-2 Execution/Breaks

The C source code debugger can be used to perform debugging work while a program is in progress by using the execution/break commands. The execution/break commands include not only the Window commands described below, but also Dialog commands such as the G and BP commands.

[☞ Chapter 7, sections 2 and 3]

The line pointed to by the program counter (PC register) is highlighted in yellow. Lines where breaks (software breaks) are set are underlined.

In normal debugging work, load the executable file that is to be debugged before using an execution/break command. The executable file can be loaded by the L dialog command, or can be specified when the C source code debugger is started up.

[☞ Chapter 7, section 2 for the L command]

F5 (Go)

Pressing this key executes the user program from the current location indicated by the program counter (PC register).
All enabled break events are valid, and when the user program reaches a break event or is forced to break because the ESC key was pressed, the user program stops executing.

[☞ G command]

Command set with the BP~ and /C <command> cannot be executed.

[F7(Come)]

Pressing this key executes the user program from the current location indicated by the program counter (PC register) to the current cursor location.
All enabled break events are valid, and when the user program reaches a break event or is forced to break because the ESC key was pressed, the user program stops executing.

[☞ G command]

[F8 (Sg1Stp)]

Pressing this key executes single-step execution (in which the program is executed one step at a time, even within called functions (subroutines)).

[☞ T command]

[F9 (Break)]

Pressing this key sets/cancels breaks (software breaks).
When the F9 key is pressed, a break is set at the line where the cursor is located within the Code window; the line is displayed with an underline to indicate the break. If a break is already set at the line where the cursor is located, that breakpoint is cancelled.

[☞ BP command]

[F10 (FncSp)]

Pressing this key executes function step execution (in which called functions (subroutines) are regarded and executed as one step).

[☞ P command]

[Esc]

This key stops (forced break) user program execution.

Reference: The actual operation during function step execution of a subroutine consists of setting a breakpoint after the subroutine call instruction and then executing the user program. Therefore, if there is a breakpoint set within the subroutine, the user program will stop executing there. However, if there is an infinite loop within the subroutine, the user program will not stop since control will not return from the subroutine. (To stop the user program, press the ESC key (forced break).)

[Ctrl + Shift + Graph]

If the microcontroller hangs for some reason and the command that was input does not terminate, press these keys in order to forcibly exit that command.
One possible cause is that the target system is not operating properly.

2-3 Getting/selecting strings

This command uses the cursor to specify character strings (variable names, function names, etc.) displayed in the Code window and then input them in the Command window.

With this command it is possible to get a long variable name simply by specifying it with the cursor, making Dialog command input easier. The Select String (Sel) command makes it possible to use the Inspect, Watch, View, and Memo functions with the selected symbol.

[Ctrl + F9(Get) / Ctrl + G]

Pressing these keys gets a character string in the Code window and inputs it into the Command window.

Move the cursor to the Code window (source code display), and position it at the character string to be gotten. Pressing CTRL + G or CTRL + F9 then copies the character string to the Command window, where the command string has the same validity as if it had been input through the keyboard.

Character strings gotten by this function must consist only of letters [from “a” (“A”) to “z” (“Z”)], the underscore symbol (“_”), and numerals (from “0” to “9”).

[Ctrl + F10(Se1)]

These keys are used to select a character string.
First, move the cursor to the beginning of the character string to be selected, and then press CTRL + F10. The character where the cursor is located is then highlighted in yellow, and the function key display changes to the Select String local command display. Next, move the cursor to the end of the desired character string.

The local commands that are available when selecting a character string are described below.

[F1 -- F5, F10]

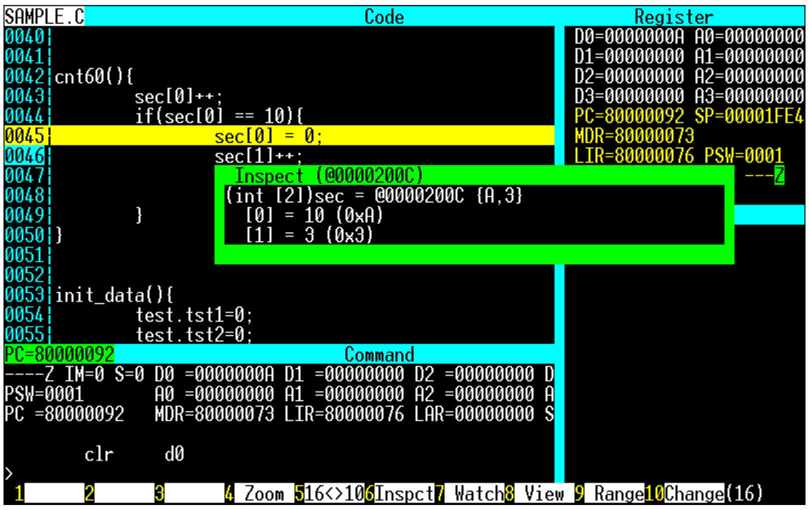
Pressing one of these keys (F1 to F5, and F10) registers the selected character string in a memo number area with the same number as the function key that was pressed.

[☞ MEM command]

[F6(Inspct)/ Ctrl + I / I]

These keys are used to inspect the selected character string as a C expression.

[☞ Chapter 6, section 3-1 "Inspect function"]



```
SAMPLE.C                      Code                          Register
                                                   D0=0000000A A0=00000000
                                                   D1=00000000 A1=00000000
 cnt60(){                                          D2=00000000 A2=00000000
         sec[0]++;                                 D3=00000000 A3=00000000
         if(sec[0] == 10){                         PC=80000092 SP=00001FE4
                 sec[0] = 0;                       MDR=80000073
                 sec[1]++;                         LIR=80000076 PSW=0001
                  Inspect (@0000200C)                       ---Z
                 (int [2])sec = @0000200C {A,3}
         }         [0] = 10 (0xA)
 }                 [1] = 3 (0x3)


 init_data(){
         test.tst1=0;
         test.tst2=0;
PC=80000092                   Command
----Z IM=0 S=0 D0 =0000000A D1 =00000000 D2 =00000000 D
PSW=0001       A0 =00000000 A1 =00000000 A2 =00000000 A
PC =80000092   MDR=80000073 LIR=80000076 LAR=00000000 S

        clr      d0
>
 1       2       3       4 Zoom 516<>106Inspct7 Watch8 View 9 Range10Change(16)
```

[F7(Watch)/ Ctrl +W/ W]

These keys are used to register the selected character string as a C expression in the Watch window.

[☞ Chapter 6, section 3-4 "Watch function"]

[F8(View) / Ctrl +V/ V]

These keys are used to view the selected character string as a C expression.

[☞ Chapter 6, section 3-5 "View function"]

[F9(Get)/ Ctrl + G/ G / ↵]

These keys are used to get the selected character string for input to the Command window.

2-4 File display

This section explains commands for listing/modifying those files that can be referenced and for searching for character strings.

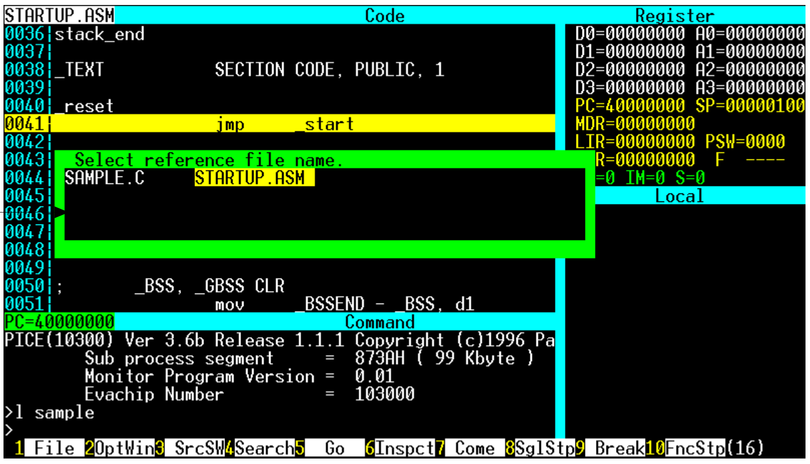
The file display function is valid only when source code is displayed in the Code window and the cursor is located in the Code window.

[Shift + Home]

Pressing these keys switches the Code window display to the next source file display.
This command is valid when source code is displayed in the Code window.

[F1(File)]

Pressing this key opens the file selection window and displays the files that can currently be selected.
The file that is highlighted in the file selection window is the currently selected source file. Use the cursor keys to move the highlighted bar to the name of the desired source file and press the Return key; the contents of the selected source file are then displayed in the Code window.



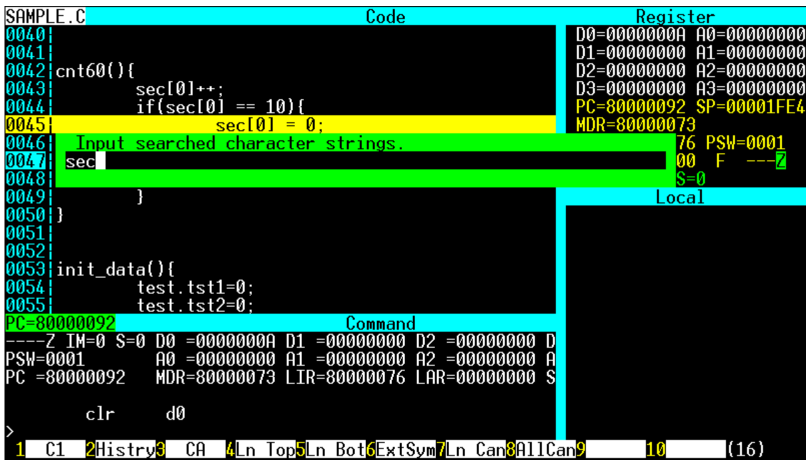
```
STARTUP.ASM                     Code                             Register
0036¦stack_end                                            D0=00000000 A0=00000000
0037¦                                                     D1=00000000 A1=00000000
0038¦_TEXT          SECTION CODE, PUBLIC, 1               D2=00000000 A2=00000000
0039¦                                                     D3=00000000 A3=00000000
0040¦ _reset                                              PC=40000000 SP=00000100
0041¦               jmp       _start                      MDR=00000000
0042¦                                                     LIR=00000000 PSW=0000
0043¦  Select reference file name.                          R=00000000  F  ----
0044¦ SAMPLE.C      STARTUP.ASM                             =0 IM=0 S=0
0045¦                                                            Local
0046¦
0047¦
0048¦
0049¦
0050¦;       _BSS, _GBSS CLR
0051¦               mov       _BSSEND - _BSS, d1
PC=40000000                   Command
PICE(10300) Ver 3.6b Release 1.1.1 Copyright (c)1996 Pa
        Sub process segment     =  873AH ( 99 Kbyte )
        Monitor Program Version =  0.01
        Evachip Number          =  103000
>l sample
>
 1 File 2OptWin3 SrcSW4Search5  Go  6Inspct7 Come 8SglStp9 Break10FncStp(16)
```

In addition, the V command is used to reference the contents of files other than those displayed in the file selection window.

[☞ V command]

[F4(Search)]

When no search string has been specified, this key opens the window that is used to request input of the search string. Once a search string has been input in this window, the function searches for the search string in the forward direction, starting from the current cursor position and proceeding towards the end of the file.
When a search string has already been specified, the function searches for the search string in the forward direction, starting from the current cursor position and proceeding towards the end of the file. Use CTRL + Q or CTRL + F to input a new search string.
If the search string is found, the corresponding string is highlighted and the search is terminated. To continue the search, press the F4 key again. If no search string is found, the message “No Search String Found.” is displayed and the search is interrupted.



```
SAMPLE.C                         Code                         Register
                                                     D0=0000000A A0=00000000
                                                     D1=00000000 A1=00000000
cnt60(){                                             D2=00000000 A2=00000000
        sec[0]++;                                    D3=00000000 A3=00000000
        if(sec[0] == 10){                            PC=80000092 SP=00001FE4
                sec[0] = 0;                          MDR=80000073
  Input searched character strings.                  76 PSW=0001
 sec                                                 00   F   ---Z
                                                     S=0
        }                                                 Local
}


init_data(){
        test.tst1=0;
        test.tst2=0;
PC=80000092                     Command
----Z IM=0 S=0 D0 =0000000A D1 =00000000 D2 =00000000 D
PSW=0001       A0 =00000000 A1 =00000000 A2 =00000000 A
PC =80000092   MDR=80000073 LIR=80000076 LAR=00000000 S

        clr      d0
>
 1  C1  2Histry3  CA  4Ln Top5Ln Bot6ExtSym7Ln Can8AllCan9      10      (16)
```

[Ctrl + Q • F]

Pressing these keys opens the window that is used to request input of the search string.
If a search string was previously input, that string is highlighted. If any key is pressed, the highlighted string is no longer highlighted and the debugger awaits normal input. When inputting a new string, the shell function history and line editing functions can be used. Once the search string has been input, the function searches for the search string in the forward direction, starting from the current cursor position and proceeding towards the end of the file.

[Ctrl + L]

Pressing these keys causes the function to search for the search string (specified previously by using CTRL + Q, CTRL + F, or F4) in the forward direction, starting from the current cursor position and proceeding towards the end of the file.

[Ctrl + F4(Srch↑) / Ctrl + B]	Pressing these keys causes the function to search for the search string (specified previously by using CTRL + Q, CTRL + F, or F4) in the reverse direction, starting from the current cursor position and proceeding towards the beginning of the file.
[Esc]	The message “Searching [Interrupt with ESC key]” is displayed at the top of the screen when a string search is in progress. To interrupt the search, press the ESC key. The message “Cancelling String Search” is displayed and the search is cancelled.

2-5 Process control/RAM monitor

Process control and RAM monitor screen switching are performed using the CTRL key in conjunction with the keys on the numeric keypad.

[Ctrl+ 0]

Pressing these keys while a subprocess is being executed pauses the subprocess and returns control to the C source code debugger.
These keys are valid only while a subprocess is being executed.

[Ctrl + 1]

Pressing these keys while the subprocess is paused pauses the C source code debugger and passes control to the subprocess.
These keys are ignored if the subprocess was not started up by the “!” command.
[☞ Chapter 4, section 4-7 for the “!” command]

[Ctrl + 4]

These keys turn the display of the Register window and Option window on and off.
If the Register window is not displayed, pressing these keys displays the Register window. If the Register window is displayed, pressing these keys closes the Register window. (These keys have the same function as the F2 key.)
[☞ Chapter 6, section 2-1 “Screen control”]

[Ctrl + 5]

Pressing these keys changes the display to the RAM monitor.
To return to the debugger screen, press CTRL + 5 again.

2-6 Shell functions

The C source code debugger registers in sequence all key input other than Window commands in the history buffer (an area of about 1500 characters). The contents of this history buffer can be searched and line edited. Unlike the MS-DOS template functions, the cursor can be moved freely in the line being edited, and characters can be inserted, deleted or changed in a fashion similar to a screen editor. Making full use of the shell functions makes it possible to reduce the volume of keyboard operations during debugging.

Each operation described here is valid for Command window input, search string input (refer to the search function), and inputting the array elements (Range)/changing values (Change) for the Inspect function.

! History search and line editing using the shell commands is possible only when the cursor is located in the Command window.

Reference: In the C source code debugger, when the cursor is in the Code window, pressing the Shift key causes the cursor to shift temporarily to the Command window. Releasing the Shift key causes the cursor to return to the Code window. Therefore, the standard for many shell functions is SHIFT + [key].

[BS / Ctrl + H]

Pressing these keys deletes the last character that was input.

[← / Shift + ← / Ctrl + S]

Pressing these keys moves the cursor to the left.

[→/ Shift + → / Ctrl + D]

Pressing these keys moves the cursor to the right.
If the cursor is already located at the end of the line, the operation is identical to that of SHIFT + F1 (C1).

[Shift + F4(LnTop) / Ctrl +A]

Pressing these keys moves the cursor to the beginning of the line.

[SHIFT +F5)LNBOT) / CTRL+ F]	Pressing these keys moves the cursor to the end of the line. If the cursor is already located at the end of the line, the operation is identical to that of SHIFT + F3 (CA).
[Del / Ctrl + G]	Pressing these keys deletes the character located at the cursor position.
[Shift + F7(ln Can) / Ctrl + U]	Pressing these keys deletes all of the characters in the line currently being edited.
[Ins/ Ctrl + V]	Pressing these keys switches between Insert mode and Replace mode.

[Shift + ↑ / Ctrl + W]

Pressing these keys displays the preceding portion of the history buffer.
In addition, if a character string has been input on the command input line, a search is conducted for a character string beginning with that character string within the history buffer, going from newest to oldest. If a character string that satisfies the conditions is found, it is displayed. If these keys are then pressed again, the search continues in the older part of the history buffer.

[☞ "!" command and "!!" command]

Example

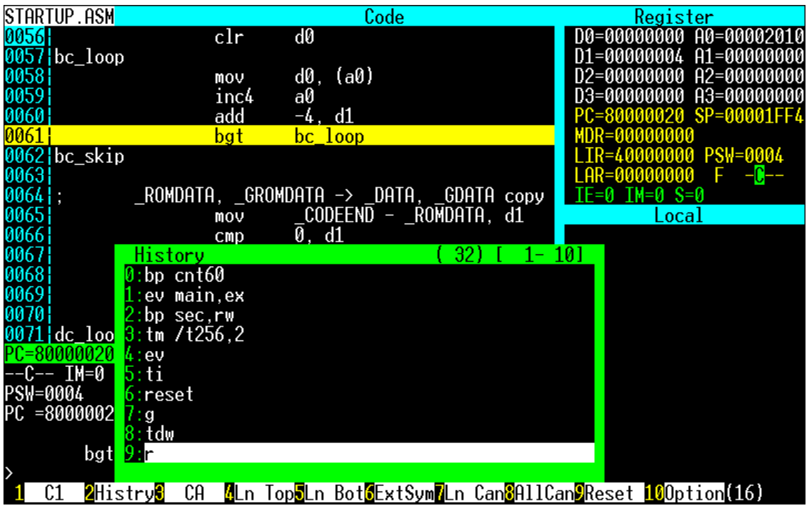
```
>bp tcirq
>U  main
>bp count
>bp ■
```

If SHIFT + ↑ is then pressed, the previously input commands are searched for a character string that begins with “bp”; the character string that is found, “bp count” is then displayed. If SHIFT + ↑ is then pressed again, “bp tcirq” is displayed.

[Shif + ↓ / Ctrl + Z]

Pressing these keys displays the subsequent portion of the history buffer.
In addition, if a character string has been input on the command input line, a search is conducted for a character string beginning with that character string within the history buffer, going from oldest to newest. If a character string that satisfies the conditions is found, it is displayed. If these keys are then pressed again, the search continues in the newer part of the history buffer.

[Shift + F1(C1) / Shift + →/ Ctrl + D]	Pressing these keys copies the character at the current cursor position from the preceding portion of the history buffer and displays it. This function is equivalent to the F1 key of the MS-DOS template functions.
[Shift + F2(Histry)]	Pressing these keys opens the History window and displays the contents of the history buffer. If a character string has been input in the command input line, a character string that begins with that character string is displayed in the History window. The highlighted line in the window is the currently selected line.



```
STARTUP.ASM                  Code                           Register
 |                  clr      d0                         D0=00000000 A0=00002010
 |bc_loop                                               D1=00000004 A1=00000000
 |                  mov      d0, (a0)                   D2=00000000 A2=00000000
 |                  inc4     a0                         D3=00000000 A3=00000000
 |                  add      -4, d1                     PC=80000020 SP=00001FF4
 |                  bgt      bc_loop                    MDR=00000000
 |bc_skip                                               LIR=40000000 PSW=0004
 |                                                      LAR=00000000  F  -C--
 |;        _ROMDATA, _GROMDATA -> _DATA, _GDATA copy    IE=0 IM=0 S=0
 |                  mov      _CODEEND - _ROMDATA, d1            Local
 |                  cmp      0, d1
 |           History                     ( 32) [  1- 10]
 |           0:bp cnt60
 |           1:ev main,ex
 |           2:bp sec,rw
 |dc_loo     3:tm /t256,2
PC=80000020  4:ev
--C-- IM=0   5:ti
PSW=0004     6:reset
PC =8000002  7:g
             8:tdw
         bgt 9:r
>
 1  C1  2Histry3  CA  4Ln Top5Ln Bot6ExtSym7Ln Can8AllCan9Reset 10Option(16)
```

■ Key operations in the History window/Symbol extension window

ESC	Closes the window.
↑/CTRL + E	Moves the selected line up one line.
↓/CTRL + X	Moves the selected line down one line.
ROLL DOWN/CTRL + R	Moves the displayed item up one item.
ROLL UP/CTRL + C	Moves the displayed item down one item.
↵ (Return)	Copies the currently selected line to the command line and then closes the window.
0, 1...9 (Numeric keys)	Selects a line according to the numbers at the left end, copies the line to the command line, and then closes the History window.

[Shift + F3(CA)]

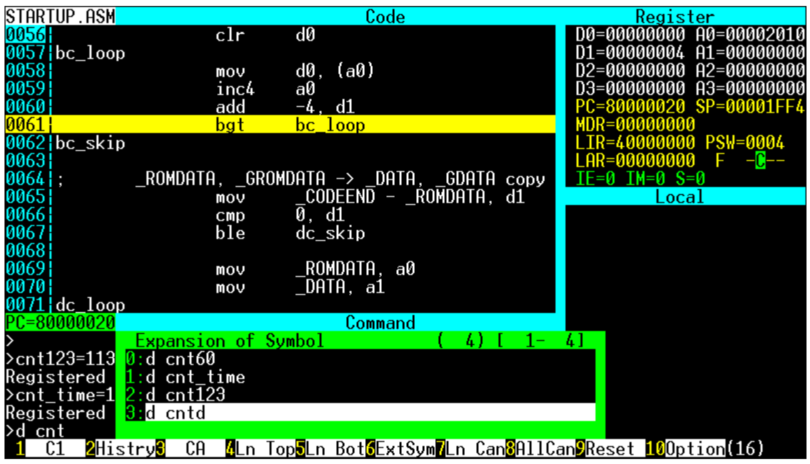
Pressing these keys copies the character string following the current cursor position from the preceding portion of the history buffer and displays it. This function is equivalent to the F3 key of the MS-DOS template functions.

[Shift + F6(ExtSym)]

Pressing these keys opens the Symbol Extension window and displays the symbol extensions.
The function searches for a symbol that begins with the last character string in the command input line and displays it in the window. For example, after inputting the following command:

```
>d cnt
```

pressing SHIFT + F6 starts a search for a symbol name that begins with "cnt" (for example, cntd, cnt123, cnt_time, etc.), which is then displayed.



```
STARTUP.ASM                   Code                          Register
0056|               clr     d0                        D0=00000000 A0=00002010
0057|bc_loop                                          D1=00000004 A1=00000000
0058|               mov     d0, (a0)                  D2=00000000 A2=00000000
0059|               inc4    a0                        D3=00000000 A3=00000000
0060|               add     -4, d1                    PC=80000020 SP=00001FF4
0061|               bgt     bc_loop                   MDR=00000000
0062|bc_skip                                          LIR=40000000 PSW=0004
0063|                                                 LAR=00000000  F  -C--
0064|;       _ROMDATA, _GROMDATA -> _DATA, _GDATA copy IE=0 IM=0 S=0
0065|               mov     _CODEEND - _ROMDATA, d1         Local
0066|               cmp     0, d1
0067|               ble     dc_skip
0068|
0069|               mov     _ROMDATA, a0
0070|               mov     _DATA, a1
0071|dc_loop
PC=80000020                  Command
>          Expansion of Symbol          (  4) [  1-  4]
>cnt123=113 0:d cnt60
Registered  1:d cnt_time
>cnt_time=1 2:d cnt123
Registered  3:d cntd
>d cnt
 1  C1   2Histry3   CA   4Ln Top5Ln Bot6ExtSym7Ln Can8AllCan9Reset 10Option(16)
```

The line that is highlighted in the window is the currently selected line. Key operations within the Symbol Extension window are the same as for the History window.

[Shift + F8(AllCan)]]

Pressing these keys deletes all of the characters in the line that is currently being edited and deletes all of the contents of the history buffer as well.

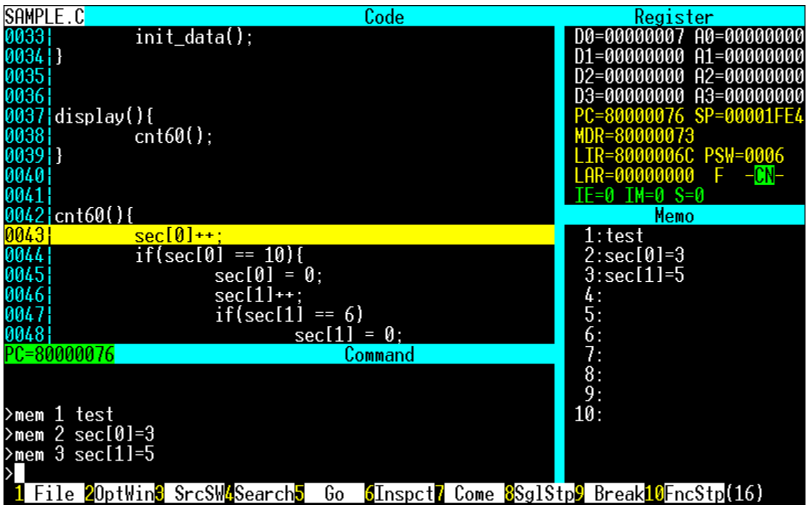
2-7 Memos

The contents of memos (character strings) can be used in line input in the Command window, etc. Frequently used function names and variable names can be easily called up by registering them in memos.

The String Select (Sel) local command and Dialog command MEM is used to register character strings in memos.

[☞ Chapter 6, section 2-3 for the MEM command]

The currently registered memo character strings can be displayed in the function key display by pressing the SHIFT key and the CTRL key simultaneously.



```
SAMPLE.C                     Code                          Register
              init_data();                          D0=00000007 A0=00000000
        }                                           D1=00000000 A1=00000000
                                                    D2=00000000 A2=00000000
                                                    D3=00000000 A3=00000000
        display(){                                  PC=80000076 SP=00001FE4
              cnt60();                              MDR=80000073
        }                                           LIR=8000006C PSW=0006
                                                    LAR=00000000  F  -CN-
                                                    IE=0 IM=0 S=0
        cnt60(){                                            Memo
              sec[0]++;                              1:test
              if(sec[0] == 10){                      2:sec[0]=3
                     sec[0] = 0;                     3:sec[1]=5
                     sec[1]++;                       4:
                     if(sec[1] == 6)                 5:
                            sec[1] = 0;              6:
PC=80000076                  Command                 7:
                                                     8:
>mem 1 test                                          9:
>mem 2 sec[0]=3                                     10:
>mem 3 sec[1]=5
>
 1 File 2OptWin3 SrcSW4Search5  Go  6Inspct7 Come 8SglStp9 Break10FncStp(16)
```

Pressing the function key corresponding to the desired character string causes that character string to be displayed/input in the input portion of the Command window.

[Ctrl + Shift + F1
to
[Ctrl + Shift + F10]

Pressing these keys specifies a memo character string.

The character strings (1 through 10) that were set by the MEM command can be called up by pressing CTRL + SHIFT + function key.

CTRL + SHIFT + F1 calls up memo character string 1, CTRL + SHIFT + F2 calls up memo character string 2, and so on, up to CTRL + SHIFT + F10, which calls up memo character string 10.

[☞ MEM command]

2-8 Other window commands

[Shift + F10(Option)]

Pressing these keys displays and changes the various options.
If these keys are pressed, the Option display window opens and the statuses of the various options are displayed. The ↑ and ↓ keys can be used to select an option item (the selected item is highlighted), and the → and ← keys can be used to change the contents of the option. Press the ESC key or the Return key to close this window.

[☞ OPTION command]

[Esc]

This key is used to forcibly break the program this is running; to stop a macro command or batch function that is currently executing; to stop a search; to exit the Inspect, Help, or Option menus, etc.
The ESC key can be used to interrupt or terminate the majority of Window commands.

[Stop / Ctrl + C]

These keys halt execution of a long display operation initiated by the D command, etc., or interrupt the repeated step execution of a program initiated by the T or P command.

[Ctrl + S]

These keys are used in order to pause the Command window display.
The display resumes when any other key is pressed.

[Ctrl + P]

These keys direct the Command window display output to the printer as well.
These keys are used to toggle printer output on and off.

[Help]

This key saves the debugging screen and displays a help screen.
When this key is pressed, the help screen for the previous Dialog command is displayed. For example, if an input error was made in a Dialog command, pressing this key displays the help screen for that command. If this key is pressed while using the Inspect function or String Select, the help screen for the respective local command is displayed. Press the ESC key to exit the help screen and return to the debugger screen.

[☞ HELP command]

3 Data Reference Functions

The data reference and modification functions are frequently used in conjunction with the execution/break functions. The data reference functions include the Inspect, Watch, and View functions are the most powerful feature of the C source code debugger. The Inspect function in particular can be used to reference and modify data structures simply by using the cursor to specify variables, arrays, structs and unions in the source file displayed in the Code window.

During debugging, first use the execution/break commands to execute the executable file up to the desired position. Next, use the data reference/modification commands to reference the states of variables at that point in order to determine the locations of bugs or confirm that the program is running properly. Then execute the program and reference the data again. The vast majority of debugging work consists of repeating this process. If a bug is found, the file is debugged by repeating the process of correcting the source file, recompiling and reloading the file, executing the file, and referencing the data. It is clear, therefore, that the degree to which the data referencing functions are simple and easy to understand can determine how useful a debugger is. Once the user has a solid understanding of the data referencing functions, this C source code debugger provides an excellent debugging environment.

3-1 Inspect function

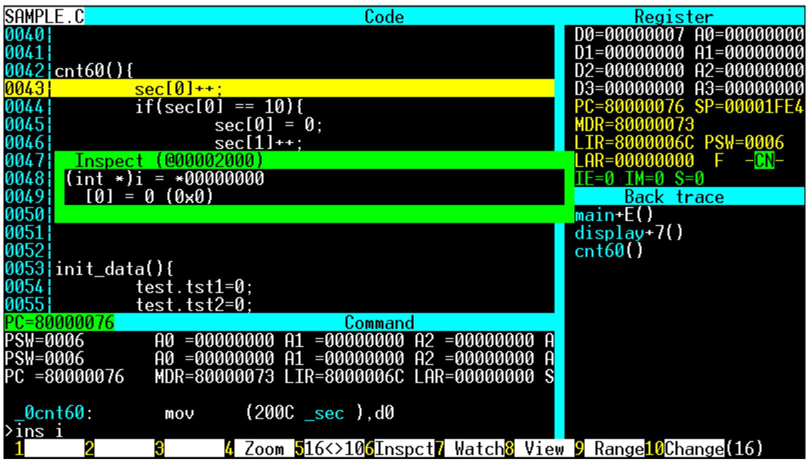
The Inspect function makes it possible to reference or change a variable, array, struct, or union in the source file displayed in the Code window, in a format suited to the data structure of that variable, simply by specifying the variable, array, struct, or union with the cursor.

To do so, move the cursor to the Code window and then position the cursor on the variable to be referenced/changed in the source file. It does not matter which portion of the variable name on which the cursor is positioned. Next, press F6 or CTRL + I. This opens the Inspect window, in which the data structure of the variable in question is displayed. To close the Inspect window, either press the ESC key, or else press the F6 or CTRL + I key. There are four types of Inspect windows: scalar, pointer, array, and struct. The display format and the local commands that can be used differ for each type of Inspect window.

Opening/closing the Inspect window
F6(Inspct) / Ctrl + I
[☞ page 89]

[☞ Chapter 6, section 3-3 for the local commands]

The only variables (symbols) that can be inspected are those that are currently valid. Therefore, local variables that are currently not in use and static variables described in a source file other than the source file currently pointed to by the program counter cannot be inspected.



```
SAMPLE.C                       Code
cnt60(){
        sec[0]++;
        if(sec[0] == 10){
                sec[0] = 0;
                sec[1]++;
 Inspect (@00002000)
(int *)i = *00000000
  [0] = 0 (0x0)

init_data(){
        test.tst1=0;
        test.tst2=0;
PC=80000076                     Command
PSW=0006      A0 =00000000 A1 =00000000 A2 =00000000 A
PSW=0006      A0 =00000000 A1 =00000000 A2 =00000000 A
PC =80000076  MDR=80000073 LIR=8000006C LAR=00000000 S

 _0cnt60:        mov      (200C _sec ),d0
>ins i
```

```
       Register
D0=00000007 A0=00000000
D1=00000000 A1=00000000
D2=00000000 A2=00000000
D3=00000000 A3=00000000
PC=80000076 SP=00001FE4
MDR=80000073
LIR=8000006C PSW=0006
LAR=00000000  F  -CN-
IE=0 IM=0 S=0
     Back trace
main+E()
display+7()
cnt60()
```

1 2 3 4 Zoom 5 16<>10 6 Inspct 7 Watch 8 View 9 Range 10 Change (16)

■ Pointer inspection

Pointer values only hold information on address values within memory. However, the information stored in that address is meaningful.

For example, if:

char *p="MEC";

is coded, the variable "p" stores not string "MEC" itself but the address information where the string "MEC" is stored.

If a variable with the pointer attribute is inspected, the content of that variable (an address value) is displayed in hexadecimal with an asterisk ("*"). The 0th element (the information stored in memory indicated by the variable address) of the pointer is displayed. If the pointer has the character attribute, that element is recognized as a character string, and the characters are displayed as the element until the null character (¥0) is reached. If the pointer has multiple elements, such as a struct array, those elements are enclosed in brackets ("{}") and as much information as possible that fits on one line is displayed.

Example

```
(int)ip=*1500              /*integer pointer*/
  [0]=10       (0xA)       /*pointer element*/
```

```
(Char)p=*1550 "MEC\0"   /*character pointer*/
 [0]='M'       77(0x4D)  /*subsequent character elements*/
 [1]='E'       69(0x45)
 [2]='C'       67(0x43)
 [3]='\0'       0(0x0)
```

■ Array inspection

An array has multiple elements, as the name indicates. There are also a number of variations, such as multidimensional arrays with two or more dimensions, and struct arrays. These arrays can be inspected in an easy and efficient manner.

In array inspection, the array attributes are displayed in cast format, the array elements are enclosed in brackets ("{}"), and as many elements as possible are displayed. In the second and subsequent lines, all of the array elements are displayed in order: 0th, 1st, 2nd, ... nth. If the array has multiple elements, such as a struct array, those elements are enclosed in brackets ("{}") and as much information as possible that fits on one line is displayed.

For example, when inspecting the two-dimensional array int x[3][2], the display appears as shown below.

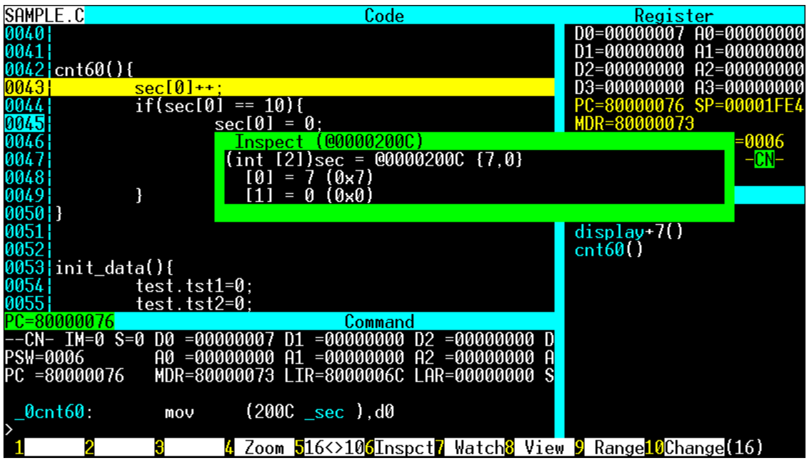
Example

```
(int [3][2])x={{1,2},{3,4},{5,6}} /*array inspection*/
   [0]={1,2}                      /*x[0] element display*/
   [1]={3,4}                      /*x[1] element display*/
   [2]={5,6}                      /*x[2] element display*/
```

When referencing an array with a large number of elements, it can be enlarged with the Zoom function to fill the screen.

[☞ Chapter 6, section 3-3]

■ Inspection display for a variable with an array attribute



```
SAMPLE.C                      Code                          Register
                                                   D0=00000007 A0=00000000
                                                   D1=00000000 A1=00000000
cnt60(){                                           D2=00000000 A2=00000000
        sec[0]++;                                  D3=00000000 A3=00000000
        if(sec[0] == 10){                          PC=80000076 SP=00001FE4
                sec[0] = 0;                        MDR=80000073
                 Inspect (@0000200C)                          =0006
                (int [2])sec = @0000200C {7,0}                 -CN-
                  [0] = 7 (0x7)
        }         [1] = 0 (0x0)
}
                                                   display+7()
                                                   cnt60()
init_data(){
        test.tst1=0;
        test.tst2=0;
PC=80000076                   Command
--CN- IM=0 S=0 D0 =00000007 D1 =00000000 D2 =00000000 D
PSW=0006       A0 =00000000 A1 =00000000 A2 =00000000 A
PC =80000076   MDR=80000073 LIR=8000006C LAR=00000000 S

 _0cnt60:       mov     (200C _sec ),d0
>
 1      2      3      4 Zoom 516<>106Inspct7 Watch8 View 9 Range10Change(16)
```

3-2 Struct and Union Inspection

Structs (including the bit field) and unions allow different types of data structures (scalar, pointer, array, struct, union, etc.) to be combined into one unit which can then be handled as a new data structure.

Using structs and unions makes it extremely easy to handle even complex data structures, which makes it hard for bugs to crop up and also makes the program easier to read.

In struct/union inspection, the attributes are displayed in cast format, the elements (members) are enclosed in brackets ("{}"), and as many elements as possible are displayed. In the second and subsequent lines, all of the element names (member names) and their contents are displayed. If the struct array has multiple elements, those elements are enclosed in brackets ("{}") and as much information as possible that fits on one line is displayed. For example, consider a struct containing members x, y, and z, representing a point in three-dimensional space.

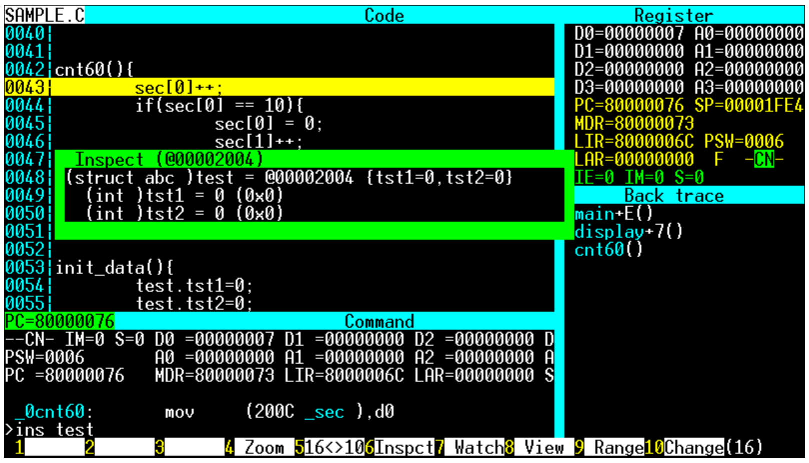
```
struct point {
    int x;          /*X coordinate*/
    int y;          /*Y coordinate*/
    int z;          /*Z coordinate*/
} p;
```

If the variable p is inspected, the following is displayed:

```
(struct point)p = {x=10,y=20,z=30}     /*struct inspection*/
(int)x = 10 (0xA)         /*subsequent struct element display*/
(int)y = 20 (0x14)
(int)z = 30 (0x1E)
```

The only difference in the display format between structs and unions is that the attribute display is either "struct struct-name" or "union union-name".

Inspection display for a variable with the struct attribute



```
SAMPLE.C                        Code
cnt60(){
        sec[0]++;
        if(sec[0] == 10){
                sec[0] = 0;
                sec[1]++;
 Inspect (@00002004)
(struct abc )test = @00002004 {tst1=0,tst2=0}
  (int )tst1 = 0 (0x0)
  (int )tst2 = 0 (0x0)

init_data(){
        test.tst1=0;
        test.tst2=0;
```

```
      Register
D0=00000007 A0=00000000
D1=00000000 A1=00000000
D2=00000000 A2=00000000
D3=00000000 A3=00000000
PC=80000076 SP=00001FE4
MDR=80000073
LIR=8000006C PSW=0006
LAR=00000000  F  -CN-
IE=0 IM=0 S=0
     Back trace
main+E()
display+7()
cnt60()
```

```
PC=80000076                   Command
--CN- IM=0 S=0 D0 =00000007 D1 =00000000 D2 =00000000 D
PSW=0006       A0 =00000000 A1 =00000000 A2 =00000000 A
PC =80000076   MDR=80000073 LIR=8000006C LAR=00000000 S

 _0cnt60:      mov     (200C _sec ),d0
>ins test
 1      2      3      4 Zoom 516<>106Inspct7 Watch8 View 9 Range10Change(16)
```

3-3 Local commands within the Inspect window

If the Inspect window is opened, the contents of the variables are displayed in window; at the same time, the function key display changes, showing the local commands that can be used in the Inspect window. These local commands can be used to find more detailed information on the contents of data structures that have multiple elements, such as arrays and structs. Elements can be selected in the array and struct display with the key operations described below. The currently selected element is highlighted.

↑, CTRL + E	Moves the selected element line up one line.
↓, CTRL + X	Moves the selected element line down one line.
ROLL DOWN, CTRL + R	Moves the displayed item up one item.
ROLL UP, CTRL + C	Moves the displayed item down one item.
ESC	Closes the Inspect window.

There are seven local commands for the Inspect window.

Zoom:	Zooms the window in and out.
Hex/decimal conversion:	Changes the base of the values displayed in the window.
Inspect:	Inspects the contents of the window.
Watch:	Registers items for watching.
Range:	Changes the array/pointer display range.
Change:	Changes the value of an inspected variable.

F4 (Zoom)

When inspecting a pointer, array, or struct, pressing this key enlarges the window to fill the screen.
This function is useful when referencing an array with a large number of elements. Pressing this key again while the window is in the enlarged state returns the window to its original size.

F5 (16 < > 10)

In a scalar display, values are displayed in both hexadecimal and decimal form.
However, when displaying an array or struct with multiple elements, values are displayed only in decimal (default) form or hexadecimal form, in order to display as many elements as possible on one line. The F5 key is used to switch the base for display.

```
(unit [3])abc={4096, 32768, 65535}      /*decimal display*/
(unit [3])abc={1000, 8000, FFFF}        /*hexadecimal display*/
```

F6 (Inspct) / Ctrl + I / I

Pressing these keys displays the array or struct element that was selected by using the cursor keys in a newly opened Inspect window.
The ESC key is used to close one Inspect window at a time.

F7 (Watch) / Ctrl + W / W

Pressing these keys registers either the variable that is being inspected or the selected element for watching in the Watch window.
[☞ Chapter 6, section 3-4 “Watch function”]

F8 (View) / Ctrl + V / V	Pressing these keys displays either the variable that is being inspected or the selected element for viewing in the Command window. [☞ Chapter 6, section 3-5 "View function"]
F9 (Range) / R	These keys are used to change the number of the displayed array or pointer element, and to change the maximum number. When one of these keys is pressed, the window that is used to input the number of the element to be referenced opens, with the element that is currently being displayed and the maximum element number highlighted. Input the display element number and the maximum display element number (may be omitted). During this line input, the History and Line Edit shell functions can be used. This command is an extremely useful function for referencing large arrays and for referencing areas around pointers.
F10 (Change) / C	Pressing these keys changes the value of either the variable that is being inspected or the selected element. The only variables that can be changed with this command are those that have a scalar attribute (char, int, etc.) or the pointer attribute. If these keys are pressed, the window that is used for inputting the numeric value (expression) to be changed opens. Input a C expression or a numeric value in this window; the expression or value is then evaluated, and if no error is found, the value of the variable is changed to that value. (In certain cases, the type of the value is converted.) During line input, the History and Line Edit shell functions can be used.

3-4 Watch functions

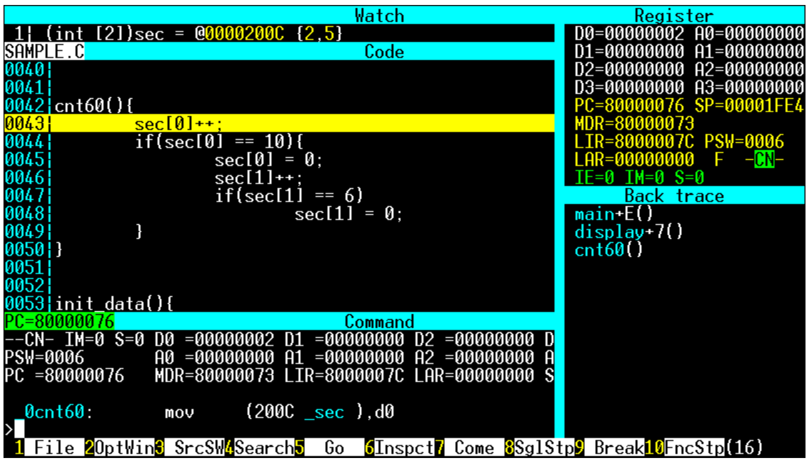
The Watch function is used in order to constantly display the most recent values for important variables, arrays and expressions in the Watch window while debugging is in progress.

The C source code debugger provides two methods for registering items to be watched. One is registration using a Window command (registration is also possible via local commands for Inspect or String Select), and the other is registration using the W command of the Dialog commands. Registration using a Window command is explained in this section.

Watch registration
Ctrl + F7(Watch) / Ctrl + W

Watch registration is accomplished by moving the cursor to the Code window, positioning it on the variable that is to be registered for watching, and then pressing CTRL + F7 or CTRL + W. Once an item is registered for watching, the variable name and its contents (value) are displayed in the Watch window. When the item registered for watching has multiple elements, such as a struct or an array, each element is enclosed in brackets ("{}") and as many items as can be displayed on one line are displayed.

Use the Y command of the Dialog commands to cancel a watch registration.



```
Watch
 1| (int [2])sec = @0000200C {2,5}
SAMPLE.C                    Code
cnt60(){
        sec[0]++;
        if(sec[0] == 10){
                sec[0] = 0;
                sec[1]++;
                if(sec[1] == 6)
                        sec[1] = 0;
        }
}


init_data(){
PC=80000076                 Command
--CN- IM=0 S=0 D0 =00000002 D1 =00000000 D2 =00000000 D
PSW=0006       A0 =00000000 A1 =00000000 A2 =00000000 A
PC =80000076   MDR=80000073 LIR=8000007C LAR=00000000 S

  0cnt60:        mov      (200C _sec ),d0
>
```

```
Register
D0=00000002 A0=00000000
D1=00000000 A1=00000000
D2=00000000 A2=00000000
D3=00000000 A3=00000000
PC=80000076 SP=00001FE4
MDR=80000073
LIR=8000007C PSW=0006
LAR=00000000  F  -CN-
IE=0 IM=0 S=0
Back trace
main+E()
display+7()
cnt60()
```

1 File 2OptWin3 SrcSW4Search5 Go 6Inspct7 Come 8SglStp9 Break10FncStp(16)

A local variable can be registered for watching only while the program counter is pointing within the function in which the local variable was declared. The scope (specification of the range over which the variable can be used) of the local variable registered for watching is naturally limited to the function in which it was declared. Therefore, once the program counter points outside of that function, the display for the variable registered for watching changes to "????".

Static variables also have scope, and so, in the same fashion as local variables, once the program counter points outside of that scope, the display for the variable registered for watching changes to "????".

3-5 View function

The View function is used to display in the Command window the value of the variable or expression where the cursor is located.

Viewing
Ctrl + F8(View) / Ctrl + V

View function is accomplished by moving the cursor to the Code window, positioning it on the symbol that is to be viewed, and then pressing CTRL + F8 or CTRL + V. When a variable is viewed, the variable and its contents are displayed on the last line of the Command window. When the item being viewed has multiple elements, such as a struct or an array, each element is enclosed in brackets ("{}") and as many items as can be displayed on one line are displayed.

The View function is useful for making a temporary record of the current state of a variable and for checking its subsequent changes over time. The View function is also included in the local commands for Inspect or String Select (Sel).

! Only currently valid variables can be viewed. Accordingly, it is not possible to view local variables for a function that is not currently being used, nor is it possible to view static variables defined in a source file other than the one that the program counter is currently pointing to. These restrictions are the same as the restrictions on which variables can be inspected.

Chapter 7
Dialog Commands

1 Rules for Using Dialog Commands

1-1 Conventions used in command explanations

The C source code debugger commands consist of the command name and parameters. (Sometimes, parameters can be omitted. Parameters that can be omitted are enclosed in square brackets ("[...]"). If there are two or more options that may be chosen for a parameter, they are enclosed in rounded brackets ("{}") and are separated by vertical lines, as follows: {...|...}

If a parameter is omitted, the C source code debugger's initial value may be used, or the value used by the last command may be used.

,	Parameter delimiter
[...]	May be omitted
{A|B}	Select either A or B
<u>ABCD</u>	Underlining indicates keyboard input

1-2 Command input format

Dialog commands can be input when the prompt is displayed in the Command window. However, when inputting a macro, the macro input request prompt ("?") is displayed; when the trace display command TD (U) has been input, the subprompt ("*") is displayed.

The C source code debugger command input format is as follows:

```
<command name>[<parameters>] ↵
```

"<command name>" consists of a character string of one or more characters. "<parameter>" can be a numeric value, operational expression, symbol, line number, register name or other item that represents an address or data that the command uses. Uppercase and lowercase characters may be used as desired in the commands and parameters. The number of parameters differs for each command. If there are multiple parameters, they should be delimited by commas (","). In addition, as a general rule, a space should be used to separate the command from the parameters.

1-3 Symbols in the C source code debugger

The C source code debugger can handle two types of symbols: global symbols (which are valid through the entire program) and local symbols (which are valid only within a function). (Local symbols can be either local variables or static variables.)

■ Global symbols

Global symbols are used in place of address values when inputting disassembled labels and addresses. External variables and function names are registered in the global symbols.

If a symbol has the same name as a CPU register, the register name takes precedence. Therefore, it is not possible to reference a symbol that has the same name as a register.

In C, symbol names generally have an underscore ("_") before or after the variable name or function name. However, because it is inconvenient to input an underscore each time a global symbol is input, the C source code debugger is designed to allow the underscore before or after a global symbol to be omitted.
It is also possible to specify whether or not to distinguish between uppercase and lowercase characters.

[☞ OPTION command and SHIFT + F10 (Option)]

For example, assuming a global symbol with the name "_main":

Example

```
>u _main    /*display disassembled label from _main symbol value*/
>u main     /*same as above*/
```

In addition, global symbols also function as C source code debugger internal variables (most commonly used together with the IF command and macro commands).

Example

```
>i=0x10              /*1st line*/
symbol is loaded.
>while{ i!=0         /*2nd line*/
? T                  /*3rd line*/
? i=i-1              /*4th line*/
?}                   /*5th line*/
```

1. This line places the value 0x10 in symbol “i”. (If “i” is an undefined symbol name, “i” is also registered as a symbol.)
2. This line compares the value of the symbol “i” with zero (“0”).
3. In this line, if “i” is not “0”, single-step execution is initiated by the T command.
4. This line decrements the value of “i” by one (“1”).
5. This line ends the “while” command. If this line is executed, the conditional evaluation is made again by the “while” command.

If this command is actually executed, the T command will execute 16 times before exiting the loop of “while” command.

In the above example, the symbol “i” is handled in the same manner as a C variable. When using symbol names, make sure to not duplicate previously registered global symbol names and local symbol names.

■ Local symbols

Local symbols are symbols (names) both for variables that are valid only within a certain function (such as an automatic variable of C or a function argument) and for variables that are statically declared. Local symbols are automatically registered when normal debugging information is loaded.

In addition to address values, local symbols include information on the scope (valid range) and attributes (char, int, long, double, etc.) of the local symbols.

[☞ Inspect function, “?” command, and VAL command]

■ Special symbols

_ _ERR_ _

The value of the special symbol “_ _ERR_ _” is “1” when the command that was just executed generated an error, and is “0” when the last command was executed normally.
“_ _ERR_ _” can be used in error processing within macro commands.

_ _RUN_ _

The value of the special symbol “_ _RUN_ _” is “1” while the user program is executing, and “0” when the program is stopped. This symbol can be used for purposes such as waiting for a user program break in processing within a macro.

1-4 Numbers in the C source code debugger

The C source code debugger can handle binary, octal, decimal, and hexadecimal numbers. The base of a number is identified by a symbol in front of the value. Numeric values for which the symbol indicating the base was omitted are handled according to the base specified by the N command.

[☞ N command]

Symbol	Base
@<numeric value>	Binary
¥<numeric value>	Octal
_<numeric value>	Decimal
$<numeric value>	Hexadecimal
0x<numeric value>	Hexadecimal
numeric value	Accords with the base specification (either hexadecimal or decimal)

For example, @11001010, ¥312, _202, $CA, and 0xCA all represent the same numeric value.

In addition, there are also commands (DS, DL, etc.) that handle 4-and 8-byte real numbers (in IEEE format).

■ Addresses

The address format used by the C source code debugger is shown below:

$\underbrace{\text{XXXXXXXX}}$

Address (32 bits)

Example: >D <u>80001234</u>

Symbol names and line numbers (explained below) can be input as command parameters wherever an address needs to be specified.

■ Line numbers

The C source code debugger supports debugging at the source code level using the line numbers in the source file.

The line numbers are used to specify specific lines within the source file. Line numbers are valid only when the source line information is included within the executable file that was loaded.

There are three line number input formats:

```
Format 1:     [<file name>:]<line number>
Format 2:     ±<line number>
Format 3:     <symbol>±<line number>
```

Line numbers specify a specific source line in the user program as a combination of a decimal number (<line number>) and the file name or symbol name.

Format 1 indicates the absolute line number. If <file name> was input, this format specifies the nth line (where “n” is <line number>) of the specified file. If <file name> is omitted, this format specifies the nth line (where “n” is <line number>) of the current file (the file currently displayed in the Code window).

```
>v .100          /*specifies the 100th line of the currently selected
                   source file*/
>v .test:120     /*specifies the 120th line of test.c*/
```

Format 2 specifies a line in terms of its relative position to the source line currently pointed at by the program counter.

The +<line number> specification points at the line that is <line number> lines beyond the current source line, while the –<line number> specification points at the line that is <line number> lines in front of the current source line.

However, if there is no corresponding source line for the program counter when a format 2 line number specification is made, an input error results.

```
>v .+10          /*specifies the 10th line from the source line currently
                  pointed at by the program counter*/
```

Format 3 specifies a line in terms of its relative position to the source line corresponding to the address value of the specified <symbol>.

The +<line number> specification points at the line that is <line number> lines beyond the corresponding source line, while the –<line number> specification points at the line that is <line number> lines in front of the corresponding source line.

However, if there is no corresponding source line for the specified <symbol> when a format 3 line number specification is made, an input error results.

```
>bp .main+10   /*specifies the 10th line from the symbol “main”*/
```

■ Character strings

The C source code debugger can handle character strings (as ASCII codes) in place of numeric values. A character string is enclosed in single quotes (‘).

```
Example: ‘A’      = 0 x 41
         ‘AB’     = 0 x 4142
         ‘ABCD’ = 0 x 41424344
```

In the E/EB command data input mode (when the data specification in the command line was omitted and the Return key was pressed), up to 16 characters can be set at one time in a character string.

```
>E 1000
address  asc  oct  dec  hex  data
00001000   .     000     0 00    ‘1234567890abcd’
00001010.................
```

■ Register names

In the C source code debugger, the contents of registers can be handled as variables. The register names that can be used are listed below.

Register names	Flag names
D0, D1, D2, D3 (data registers)	CF (carry flag)
A0, A1, A2, A3 (address registers)	ZF (zero flag)
MDR (multiply and divide register)	NF (negative flag)
PC (program counter)	VF (overflow flag)
SP (stack pointer)	IE (interrupt enable flag)
LIR (branch destination instruction register)	IM0, IM1, IM2 (interrupt mask level)
LAR (instruction fetch address register)	
PSW (processor status word)	

Example

```
>while{ _D0!= _D1   /*compare the contents of the D0 register and
                      the D1 register*/
? T                 /*execute trace command*/
? }                 /*end of macro*/
>
```

In the above example, the T (single-step execution command) is executed until D0 and D1 are the same. If a register and a symbol have the same name, the register takes precedence.

1-5 Operational expressions

An operational expression has one value derived from a combination of numeric values, symbols, registers and function arguments linked together by operators. The C source code debugger uses numeric and logical operators that are similar to those in C.

Operational expressions can be used in any command where a value needs to be specified (data or addresses).

The monadic and binary operators that can be used in operational expressions are listed below.

(1) Monadic operators

*	32-bit data at a specified address (pointer or long word)
+	Monadic plus
–	Monadic minus
~	NOT (one's complement)
!	Logical NOT

(2) Binary operators

Priority	Operator	Description
(1)	*	Multiplication
	/	Division
	%	Modulo operation (remainder)
(2)	+	Addition
	–	Subtraction
(3)	>>	Right shift
	<<	Left shift
(4)	<=	Compare operation (1 if right side is greater than or equal to left side, 0 otherwise)
	>=	Compare operation (1 if right side is less than or equal to left side, 0 otherwise)
	<	Compare operation (1 if right side is greater than left side, 0 otherwise)
	>	Compare operation (1 if right side is less than left side, 0 otherwise)
(5)	==	Compare operation (1 if right side is equal to left side, 0 otherwise)
	!=	Compare operation (1 if right side is not equal to left side, 0 otherwise)
(6)	&	AND
(7)	^	XOR
(8)	|	OR
(9)	&&	Logical AND
(10)	||	Logical OR

The numerals in the left-hand column indicate operational priority. If adjacent operators have the same priority, the expression is evaluated from left to right. The priority within an expression can be changed by the use of parentheses, however.

In addition, compare operators and logical AND and logical OR operators are provided for conditional decision processing in macros (FOR and WHILE commands, etc.) and conditional decision processing commands (IF command, etc.) In addition, the compare operators and logical AND and logical OR instructions only use the lower 16 bits in processing their operations.

Example

```
>h  -(1+2*3)
oct              dec     hex      asc          float
37777777771       -7   FFFFFFF9   '. . . .'    -6.805644e+38
```

(3) System function

VAL (C expression)

The contents of the parentheses are evaluated as a C expression.

1-6 Data Expressions at the C Language Level

Up to this point, we have explained expressions that simply compute global symbols and local symbols or line number information as address values. These expressions can be used with most of the Dialog commands. However, because expressions within the user program being debugged are naturally coded according to C conventions, that treatment is inadequate for handling C expressions. Therefore, the C source code debugger has been provided with Window and Dialog commands that can handle C expressions as is. Specifically, inspection-related commands, the watch registration command, the VAL command, and the "?" command can handle C expressions with C syntax.

■ C expressions

Descriptions at the C language level and expressions coded in the manner explained up to this point, even if they appear to be the same expression, are evaluated differently. These differences are explained below, using the C global variable "abc".

Example

```
>d abc        /*memory display from address of variable abc*/
00001000 00 01 02 03 . . . .  0D 0E 0F  . . . . . . . . . . . . . . .

>d abc+10   /*memory display from address +10 of variable abc*/
00001010 10 20 30 40 . . . . D0 E0 F0  .   0@P . . . . . . . . .

>? abc            /*display value of variable abc
(int )  1  (0x1)     (evaluates as C expression)*/


>? abc+10        /*display value of variable abc +10
(int )  11  (0xB)    (evaluated as a C expression) */
```

As this example illustrates, the meaning of the description of "abc" or "abc + 10" is different as a normal expression (as in the case of the D command in the above example) versus a C expression (as in the case of the "?" command above). In the Inspect, Watch, VAL, and "?" commands, "abc" would be evaluated as a C variable; in other commands, the variable "abc" would be evaluated as an address.

■ C variables

The variables and functions that can be used in C expressions are limited to those that were declared in a source file compiled with the option that attaches detailed debugging information. Registers and flags can be used as pseudo-variables. All register pseudo-variables and flag pseudo-variables are of the “unsigned int” type.

Register pseudo-variables	Flag pseudo-variables
_D0 ,,, _D3	_Z
_A0 ,,, _A3	_N
_MDR	_C
_PC	_V
_SP	_IM
_LIR	_IE
_LAR	
_PSW	

■ C variable scope

When writing or debugging a C program, it is necessary to be aware of the scope (available range) of variables. For example, variables declared with “extern” are valid in all program areas. In other words, their scope is the entire program. On the other hand, automatic variables declared within a function are valid only within that function. Therefore, the scope of such a variable is limited to that function.

When a variable declared with “extern” and an automatic variable declared within a function have the same name, within the function only the automatic variable is valid, and the “extern” variable cannot be accessed. In addition, automatic variables of functions not currently being used cannot be viewed.

In the C source code debugger, this type of processing is performed automatically on the basis of the scope information derived from the debugging information.

Constants

The use of constants is exactly the same as in C syntax. (The default base is always base ten, regardless of the setting of the N command (base change command).)

Notation	Base
number	Decimal constant
0xnumber	Hexadecimal constant
0Xnumber	Hexadecimal constant
0number	Octal constant

For example, 4096 (decimal), 0x1000 (hexadecimal), and 010000 (octal) all represent the same value.

The C escape sequence listed below is supported for character constants.

C character	Value	Meaning
'¥a'	0x7	Bell
'¥b'	0x8	Backspace
'¥f'	0xC	Form feed
'¥n'	0xA	Line feed
'¥r'	0xD	Return
'¥t'	0x9	Horizontal tab
'¥v'	0xB	Vertical tab
'¥¥'	0x5C	¥ (Yen) symbol
'¥nnn'	nnn	Octal (8 bits)
'¥xnn'	nn	Hexadecimal (8 bits)

Operators

The same operators as those used in C are supported. However, operators other than the “=” operator (substitution operation) cannot be used with floating point decimals.

The priority ranking of the operators is indicated below.

Priority ranking	Operator
(1)	Function (n) Array [n] n.n n–>n n++ n– –
(2)	&n *n –n ~n !n ++n – –n sizeof n
(3)	(cast)n
(4)	n%n n/n n*n
(5)	n+n n–n
(6)	n<<n n>>n
(7)	n>n n<n n>=n n<=n
(8)	n==n n!=n
(9)	n&n
(10)	n^n
(11)	n|n
(12)	n&&n
(13)	n||n
(14)	nn?nn:nn
(15)	n=n n*=n n/=n n%=n n+=n n–=n n<<=n n>>=n n&=n n^=n n|=n
(16)	n, n

The number indicated in the left-hand column indicates the priority ranking of the operators listed on the right. (The smaller the number, the higher the priority ranking.) If adjacent operators have the same priority, the expression is evaluated from left to right. An exception is the substitution operators (priority ranking (15)), which are evaluated from right to left. The priority within an expression can be altered through the use of parentheses.

■ Expressions with secondary effects

Substitution operators, such as ++, – –, and =, and function calls have secondary effects that change data, such as the contents of variables, in the user program being debugged while processing for that particular operation is performed. While there may be occasions where a substitution operator is used to intentionally change data, the majority of the time during debugging work it is more common to want to simply reference data rather than change it. Therefore, in order to prevent data from being accidentally changed during the evaluation of an expression in an Inspect, Watch, or "?" command, the use of operators with secondary effects is prohibited in the C source code debugger. Operators with secondary effects can only be used in the VAL command.

- When referencing data, use the "?" command or the Inspect command instead of the VAL command. The VAL command should only be used when using an operator that has a secondary effect, such as changing the value of data.

  Function calls using the VAL command are even more dangerous. It is possible that a global variable or static variable could be changed or data in another data area could be changed by a pointer during function processing. It is also possible that an infinite loop could be created within such a function. If the user is unaware of this, it might be impossible to resume execution.
  Use caution when you use a function call with the VAL command.

Example

```
>? abc=1234
Cannot use operators with secondary effects.
>val abc=1234              /*substitutes 1234 in abc*/
(int  )  1234  (0x4D2)
>val fnc=(1, 2, 3)         /*fnc function call*/
(int  )  10  (0xA)
```

Command Index

This is an alphabetized index of the commands.

2 Program Loading/Execution

The commands that are used to load user programs are the L and LP Dialog commands; the commands that are used to execute user programs are the T, P, and G Dialog commands.

L command, LP command

These commands load the program (EX format file) that is to be debugged into memory.

RD command

This command loads either a Motorola S format file, an Intel HEX format file or a binary format files into memory.

WR command

This command writes the contents of memory to a file in either Motorola S format, Intel HEX format or binary format.

T command

When a source file is displayed in the Code window, this command step executes the file one line at a time. When disassembled code is displayed in the Code window, this command step executes the code one instruction at a time. Step execution continues within subroutines (functions). (Single-step execution)

P command

When a source file is displayed in the Code window, this command step executes the file one line at a time. When disassembled code is displayed in the Code window, this command step executes the code one instruction at a time. Subroutines (functions) are also executed as one step. (Function step execution)

G command

This command executes the user program.

RESET command

This command resets the microprocessor.

The screen is updated to reflect the changes in status caused by the execution of each command. The position currently pointed to by the program counter is highlighted in yellow on the Code window. The current register contents are displayed in the Register window. The contents of the Watch window and the Option window are also updated to reflect any changes in status.

L/LP

Load executable file

```
L [<file name>]
LP [<file name>]
```

These commands load an executable file (an EX format file) into memory (either emulation memory, target memory, or internal instruction RAM). A period (".") is displayed in the Command window while the file is being loaded; the number symbol ("#") is displayed while the debugging information is being processed. Press the ESC key in order to interrupt a file load operation while it is in progress. A message asking whether to abort or continue then appears. If "continue" is selected, the loading operation continues from where it was interrupted.

L [<file>]

1. Loads an executable file.
   If the file includes debugging information (symbol information, source line information), the debugging information is automatically loaded into the debugging information area. If the file does not include debugging information, a message is displayed and only the executable file is loaded. If the debugging information is loaded by the L command, all registered debugging information is erased and the new debugging information is registered in its place.
2. The L command deletes all existing break event settings and watch registrations, initializes the trace function, the time measurement function, and the profile function, and resets the user CPU (microprocessor).
   If source line information is included in the file loaded by the L command, the Code window changes to source code display.

L P [<file>]

The LP command loads only the specified executable code and data, and resets the microprocessor.

- If the <file name> specification is omitted, the file with the same file name that was specified for the last L or LP command is loaded.
- Use the RD command when loading a Motorola S format file, an Intel HEX format file or a binary format file.
- When the environment variable PANASRC is set after an executable file has been loaded, the source files in the directory specified by the environment variable are displayed. If PANASRC is not set, the source files in the current directory are displayed.

[☞ RD command and WR command]

RD

Read file into memory

RD <file name{.S|.HEX}>

RD <file name>,<address>

R D <file{.S|.HEX}>

This command loads the specified data or program in either Motorola S format or Intel HEX format.

If the file extension is ".S", the file is treated as a Motorola S format file; if the file extension is ".HEX", the file is treated as an Intel HEX format file.

R D <file>,<address>

This command loads the specified data or program at the specified address in binary format.

Specify a file extension other than "S." or "HEX.".

! EX format file cannot be specified.

Example

```
>rd sample.s
Read SAMPLE.S
80000000 - 80000FFF
Complete
>
```

[☞ WR command and L command]

WR

Write to file

WR <file name>,<address S>,<address E>

This command writes the contents of memory from <address S> to <address E> to a file.

The file name extension can be used to select either Motorola S format, Intel HEX format, or binary format.

Extension	File format
".S"	Motorola S format
".HEX"	Intel HEX format
Other than ".S" or ".HEX"	Binary format

! EX format file cannot be specified.

Example

```
>wr sample.s,80000000,80000fff
Write SAMPLE.S at 80000000-80000FFF
>
```

[☞ L command and RD command]

T

Single-step execution of user program

```
T [<count>]
```

The T command executes one step at a time the number of steps specified by <count> from the address currently pointed to by the program counter. The <count> specification can be made either in decimal or hexadecimal depending on the base. The difference between the P command and the T command is that with the T command called functions (subroutines) are also executed internally one step at a time.

[☞ N command]

The maximum <count> specification is 65,535. (If <count> is omitted, “1” is assumed.)

When C source code is displayed in the Code window, one line of source code is executed as one step; when disassembled code is displayed in the Code window, one instruction is executed as one step.

If another function is called from the current function when executing lines of source code one at a time, single-step execution continues within that function.

Although nothing is displayed in the Command window during single-step execution of source code, the contents of the registers are displayed in the Command window each time a single step is executed during single-step execution of individual instructions.

!

- Single-step execution is not possible when the microprocessor is in STOP, HALT, or SLEEP mode. To perform single-step execution, it is necessary to first overwrite the microprocessor’s CPUM register.
- The contents of trace memory are erased by single-step execution.

Example

```
>T
—— IM=0 S=0      D0 =0X00000000 D1 =0X00000000 D2 =0X00000000 D3 =0X00000000
PSW=0X0000     A0 =0X00000000 A1 =0X00000000 A2 =0X00000000 A3 =0X00000000
PC =0X80000000 MDR=0X00000000 LIR=0X40000000 LAR=0X00000000 SP =0X00000100

 _RESET: JMP   0X80000006
>T
—— IM=0 S=0      D0 =0X00000000 D1 =0X00000000 D2 =0X00000000 D3 =0X00000000
PSW=0X0000     A0 =0X00000000 A1 =0X00000000 A2 =0X00000000 A3 =0X00000000
PC =0X80000006 MDR=0X00000000 LIR=0X80000000 LAR=0X00000000 SP =0X00000100

   MOV   0X100,A0
>T
—— IM=0 S=0      D0 =0X00000000 D1 =0X00000000 D2 =0X00000000 D3 =0X00000000
PSW=0X0000     A0 =0X00000100 A1 =0X00000000 A2 =0X00000000 A3 =0X00000000
PC =0X80000009 MDR=0X00000000 LIR=0X80000006 LAR=0X00000000 SP =0X00000100

   MOV   A0,SP
>T 5
—— IM=0 S=0      D0 =0X00000000 D1 =0X00000000 D2 =0X00000000 D3 =0X00000000
PSW=0X0000     A0 =0X00000100 A1 =0X00000000 A2 =0X00000000 A3 =0X00000000
PC =0X8000000B MDR=0X00000000 LIR=0X80000009 LAR=0X00000000 SP =0X00000100

   MOV   0X0 _I ,A0
—— IM=0 S=0      D0 =0X00000000 D1 =0X00000000 D2 =0X00000000 D3 =0X00000000
PSW=0X0000     A0 =0X00000000 A1 =0X00000000 A2 =0X00000000 A3 =0X00000000
PC =0X8000000D MDR=0X00000000 LIR=0X8000000B LAR=0X00000000 SP =0X00000100

   MOV   0X2000,D1
—— IM=0 S=0      D0 =0X00000000 D1 =0X00002000 D2 =0X00000000 D3 =0X00000000
PSW=0X0000     A0 =0X00000000 A1 =0X00000000 A2 =0X00000000 A3 =0X00000000
PC =0X80000010 MDR=0X00000000 LIR=0X8000000D LAR=0X00000000 SP =0X00000100

   SUB   D0,D0
——Z IM=0 S=0     D0 =0X00000000 D1 =0X00002000 D2 =0X00000000 D3 =0X00000000
PSW=0X0001     A0 =0X00000000 A1 =0X00000000 A2 =0X00000000 A3 =0X00000000
PC =0X80000012 MDR=0X00000000 LIR=0X80000010 LAR=0X00000000 SP =0X00000100

   MOV   D0,(A0)
——Z IM=0 S=0     D0 =0X00000000 D1 =0X00002000 D2 =0X00000000 D3 =0X00000000
PSW=0X0001     A0 =0X00000000 A1 =0X00000000 A2 =0X00000000 A3 =0X00000000
PC =0X80000013 MDR=0X00000000 LIR=0X80000012 LAR=0X00000000 SP =0X00000100

   ADD   0X4 _TEST ,A0
>
```

P

Function step execution of user program

```
P [<count>]
```

The P command executes one step at a time the number of steps specified by <count> from the address currently pointed to by the program counter. The <count> specification can be made either in decimal or hexadecimal depending on the base. The difference between the P command and the T command is that with the P command called functions are executed as one step.

[☞ N command]

The maximum <count> specification is 65,535. (If <count> is omitted, “1” is assumed.)

When C source code is displayed in the Code window, one line of source code is executed as one step; when disassembled code is displayed in the Code window, one instruction is executed as one step.

When executing lines of source code one at a time, function steps within the current function are executed. (When a function is called from the current function, that entire function is executed normally until control returns from that function.) Therefore, a function called from the current function is executed as if it were a single instruction line. When executing instructions one at a time, subroutine calls are executed as if they were a single instruction.

Although nothing is displayed in the Command window during function step execution at the source level, the contents of the registers are displayed in the Command window each time a single step is executed during function step execution of individual instructions.

- Single-step execution is not possible when the microprocessor is in STOP, HALT, or SLEEP mode. To perform single-step execution, it is necessary to first overwrite the microprocessor’s CPUM register.
- The contents of trace memory are erased by single-step execution.

Example

```
>P
—— IM=0 S=0 D0 =0X00000000 D1 =0X00000000 D2 =0X00000000 D3 =0X00000000
PSW=0X0000     A0 =0X00000000 A1 =0X00000000 A2 =0X00000000 A3 =0X00000000
PC =0X80000000 MDR=0X00000000 LIR=0X40000000 LAR=0X00000000 SP =0X00000100

 _RESET: JMP   0X80000006
>P
—— IM=0 S=0 D0 =0X00000000 D1 =0X00000000 D2 =0X00000000 D3 =0X00000000
PSW=0X0000     A0 =0X00000000 A1 =0X00000000 A2 =0X00000000 A3 =0X00000000
PC =0X80000006 MDR=0X00000000 LIR=0X80000000 LAR=0X00000000 SP =0X00000100

   MOV   0X100,A0
>P
—— IM=0 S=0 D0 =0X00000000 D1 =0X00000000 D2 =0X00000000 D3 =0X00000000
PSW=0X0000     A0 =0X00000100 A1 =0X00000000 A2 =0X00000000 A3 =0X00000000
PC =0X80000009 MDR=0X00000000 LIR=0X80000006 LAR=0X00000000 SP =0X00000100

   MOV   A0,SP
>P 5
—— IM=0 S=0 D0 =0X00000000 D1 =0X00000000 D2 =0X00000000 D3 =0X00000000
PSW=0X0000     A0 =0X00000100 A1 =0X00000000 A2 =0X00000000 A3 =0X00000000
PC =0X8000000B MDR=0X00000000 LIR=0X80000009 LAR=0X00000000 SP =0X00000100

   MOV   0X0 _I ,A0
—— IM=0 S=0 D0 =0X00000000 D1 =0X00000000 D2 =0X00000000 D3 =0X00000000
PSW=0X0000     A0 =0X00000000 A1 =0X00000000 A2 =0X00000000 A3 =0X00000000
PC =0X8000000D MDR=0X00000000 LIR=0X8000000B LAR=0X00000000 SP =0X00000100

   MOV   0X2000,D1
—— IM=0 S=0 D0 =0X00000000 D1 =0X00002000 D2 =0X00000000 D3 =0X00000000
PSW=0X0000     A0 =0X00000000 A1 =0X00000000 A2 =0X00000000 A3 =0X00000000
PC =0X80000010 MDR=0X00000000 LIR=0X8000000D LAR=0X00000000 SP =0X00000100

   SUB   D0,D0
——Z IM=0 S=0 D0 =0X00000000 D1 =0X00002000 D2 =0X00000000 D3 =0X00000000
PSW=0X0001     A0 =0X00000000 A1 =0X00000000 A2 =0X00000000 A3 =0X00000000
PC =0X80000012 MDR=0X00000000 LIR=0X80000010 LAR=0X00000000 SP =0X00000100

   MOV   D0,(A0)
——Z IM=0 S=0 D0 =0X00000000 D1 =0X00002000 D2 =0X00000000 D3 =0X00000000
PSW=0X0001     A0 =0X00000000 A1 =0X00000000 A2 =0X00000000 A3 =0X00000000
PC =0X80000013 MDR=0X00000000 LIR=0X80000012 LAR=0X00000000 SP =0X00000100

   ADD   0X4 _TEST ,A0
>
```

G

Execute user program

```
G [=<address S>][,<address B>][,/W]
G@[,/W]
```

The G command is used to execute user programs. With the G command, one temporary software break (<address B>) can be specified. Any break points specified by the BP command are also valid. The ESC key can also be used to interrupt (forcibly break) execution of the user program at any time.

G [=<address S>] [,<address B>][,/W]	The G command initiates execution of the user program from the address specified by <address S> (execution start address), and stops at the address specified by <address B>. <Address B> is a temporary software break.
G [<address B>][,/W]	This command initiates execution of the user program from the address specified by the current program counter value and stops at the address specified by <address B>.
G @ [,/W]	This format is valid only when the C source code debugger was started up in C debugging mode. When the program to be debugged is executed by the G@ command, execution stops once control returns from the function that is currently being executed. This command has the same function as the CTRL + F5 (Return) Window command.

/W	Executes the program, with on-the-fly functions prohibited. In other words, once the user program has begun executing, no other commands will be accepted until execution stops. The screen is also not updated. This option is useful when starting the next command after user program execution stopped within a macro.

Reference:
- While a program is executing, the message “Target executing” is displayed at the division between the Command window and the Code window.
- The C source code debugger has a built-in time measurement function that measures the amount of time that was needed for user program execution.

[☞ TI command]

User program execution is not possible when the microprocessor is in STOP, HALT, or SLEEP mode. In this case, either execute the RESET command or else use the E command to overwrite the microprocessor's CPUM register and then execute the user program.

Example

```
>RESET
>G CNT60
>
——Z IM=0 S=0 D0 =0X00000000 D1 =0X00000000 D2 =0X00000000 D3 =0X00000000
PSW=0X0001     A0 =0X00002000 A1 =0X00000000 A2 =0X00000000 A3 =0X00000000
PC =0X80000056 MDR=0X80000053 LIR=0X40000000 LAR=0X00000000 SP =0X000000EC

 _CNT60: MOV   (0X0C _SEC ),D0
>
>G@
>
>RESET
>G =MAIN,CNT60
>
——Z IM=0 S=0 D0 =0X00000000 D1 =0X00000000 D2 =0X00000000 D3 =0X00000000
PSW=0X0001     A0 =0X00000000 A1 =0X00000000 A2 =0X00000000 A3 =0X00000000
PC =0X80000056 MDR=0X80000053 LIR=0X40000000 LAR=0X00000000 SP =0X000000F0

 _CNT60: MOV   (0X0C _SEC ),D0
>
```

[☞ BP command, BC command, BD command, BE command, F5 (Go), F7 (Come) key (Window command), and SM command]

INFLUENCES

On-the-fly function

RESET

Reset user microprocessor

RESET

This command makes the microprocessor's reset input active.

The program counter (PC register) is set to address 0x40000000.

The value of all of the CPU registers is undefined when a reset is executed. However, with this debugger, the value set by the Installer is set in the stack pointer (SP register).

[☞ "MN10300 Series PanaX Series Installation Manual,"
Hardware volume, section 5, "Installer Startup and Settings."]

This command is used to execute a program from the start, or if the program has hung and the debugger is not able to accept commands.

3 Event-related Commands

Event functions set triggers that initiate hardware breaks, tracing, time measurement functions, etc. The in-circuit emulator monitors the occurrence of events without stopping execution of the user program.

There are two types of events:

(1) Execution address events

An event is generated by the address of the instruction that was executed. Conditions including a range of addresses and a number of passes through an address can be specified. Up to four events can be set.

(2) Data events

An event is generated by a data access. Conditions including read, write, address range, data, access width, match/no match, and number of accesses can be specified. Up to four events can be set in the microprocessor's internal data RAM space and in the external memory space, respectively.

No more than a combined total of eight execution address event and data event points can be set, however.

An event that is a condition for the break function is called a "break event," an event that is a condition for starting or stopping tracing is called a "trace event," and an event that is a condition for starting or stopping time measurement is called a "time measurement event." The respective commands used for setting these events are as follows:

Break events:	BP command
Trace events:	EV command
Time measurement events:	EV command

The BC or EC command is used to delete events.

! Data events can even be set for the microprocessor's internal instruction ROM/RAM space or special register space and areas reserved for the system. However, there is still a limit of four events on the combined total number of events that can be set in these areas and internal data RAM.

The table below indicates which types of events can be used with memory accesses by the microprocessor, internal DMA accesses and external DMA accesses.

Accesses marked with an “X” cannot be used to generate an event.

		Microprocessor memory access	Internal DMA	External DMA
Execution address event		❍	×	×
Data event	Microprocessor’s internal data RAM space	❍	❍	×
	Microprocessor’s internal special register space	❍	×	×
	Microprocessor’s internal instruction ROM/RAM space	❍	❍	×
	External memory space	❍	❍	×
	System reserved space	❍	❍	×

The break function halts user program execution.

The different types of breaks are described below.

(1) Software breaks

These are implemented by inserting PI codes (0xff) into user programs. Therefore, these types of breaks can only be set in a program area, and cannot be set in a data area. When this type of break is set in an external memory space, the address that is set must either be in memory within the emulator or in RAM in the user target; this type of break cannot be set in ROM.

Software breaks stop execution before the instruction in the address that was set is executed. A combined total of 32 software breaks and events can be set. (BP command)

(2) Hardware breaks

The execution address and data accesses are monitored by the hardware, and when the conditions are met, a break is generated externally for the microprocessor. The features of software breaks and hardware breaks are shown below.

	Software break	**Hardware break**
Settable conditions	Emulation memory or external RAM program area	Instruction address break • Possible for both ROM and RAM • Count specification Data break • Address, data, bit mask • Read, write, access • Count specification Others • AND break • Sequential break • Trace full break
Stopping position	Before instruction execution	After execution of several instructions after event conditions are met
Number that can be set	Up to 32, including hardware breaks	Up to four execution address breaks and four data breaks
Implementation	Inserting PI codes in the program	Monitoring of status by external hardware

(3) AND break

This is a type of hardware break.

A break occurs when all of the specified event conditions are satisfied simultaneously. Only one set of AND break conditions can be specified. (BPA command)

(4) Sequential break

This is a type of hardware break.

A break occurs when all of the specified event conditions are satisfied in the sequence in which they were specified. Only one set of sequential break conditions can be specified. (BPS command)

(5) Trace full break

This is a type of hardware break.

A break occurs when the trace memory is filled with data. (TM command)

In addition, a forced break can be executed, forcibly stopping user program execution, by pressing the ESC key on the host computer.

EV command

Sets/displays events.

BP command

Sets/displays hardware breaks and software breaks.

BPA command

Sets AND break.

BPS command

Sets sequential break.

BC/EC command

Cancels events, hardware breaks, and software breaks.

BD command

Temporarily disables events, hardware breaks and software breaks.

BE command

Enables events, hardware breaks and software breaks.

NO INFLUENCES

On-the-fly function

EV

Set/display event

```
EV <address S>[˜<address E>][,<status>][,<data>[,{/B|/W|/D}] [,/N]][,/<count>]
EV/C{<list>|*}
EV
```

E V <address S>[,<~

This command sets an event.

The following table lists the options that can be specified for each event type.

Event type	Execution address event	Data event
<address S>	●	●
<address E>	❍	❍
<status>	EX	RW/R/W
<data>		❍
/B,/W,/D		❍
/N		❍

(●: Required, ❍: may be omitted, blank: may not be specified)

<address S> Specify a memory address or symbol. When specifying a memory range, specify the start address versus the end address in <address E>.

<address E> Specify a memory address or symbol. Specify the end address versus the start address in <address S>.

<status>

EX:	Execution address event
RW:	Data event in read or write operation
R:	Data event in read operation
W:	Data event in write operation
Omitted:	"RW" (data event in read or write operation) is assumed if <data> is specified, and "EX" (execution address event) is assumed if <data> is not specified.

<data>	Specify the data for a data event. If omitted, the data is ignored and only the address becomes the event target. The <data> can be specified in binary format if the "@" symbol is added at the start of the data. If the "@" symbol is omitted, hexadecimal specification is assumed. In addition, as the examples show below, it is also possible to include masked bit specifications. Specify "X" to indicate "don't care" for a bit. The high-order bits are also "don't care."

@10xx	The following values satisfy the condition: @1000, @1001, @1010, and @1011.
C5xx	Any value from C500 to C5FF satisfies the condition.

Symbols can not be used in the <data> specification.

/B, /W, /D	Specify the data access width for a data event: 8-bit data (/B), 16-bit data (/W), or 32-bit data (/D). If omitted, the access width mode is "no specific size/don't care."
/N	Specifies that the event condition is met when the data accessed in the data event did not match the value specified by <data>. If this specification is omitted, the event condition is met when the data does match.
/<count>	In the case of an execution address event, specify the pass count. In the case of a data event, specify the access count. The event occurs after the event condition is met the specified number of times. The maximum setting is 256; if <count> is omitted, 1 is assumed. Regardless of the setting of the N command, the base of the count specification is decimal, unless 0x is added to the value, which makes the base of the count specification hexadecimal.

E V /C {<list>|*}

When an event specified in the <list> occurs, program execution is not halted; instead, all event flags are cleared, the pass count and access count counters are initialized to "0", and the counts are restarted.

This setting is not allowed for AND breaks, sequential breaks, and software breaks. When an event whose number is specified in the <list> occurs, all events are initialized.

EV/C 1, 2, 7 ↵

In the above example, if any one of events 1, 2, or 7 occur, all events are initialized.

Reference: The base used in <list> is assumed to be decimal regardless of the N command specification. If “0x” is added, the base is hexadecimal.

E V

This command displays the events that have been set.

Example

```
>EV MAIN
>EV CNT60,/3
>EV SEC,5
>EV
  NO.       SADR   -   EADR   ST. DATA/SYMBOL         SZ CNT BRK TRC DLY TS TE CLR
E  1      80000039             EX  _0main                  1
E  2      80000058             EX  _cnt60                  3
E  3      0000080C             RW  05                  -   1
>tm 3
>ti max, /s1, /e2
>ev
  NO.       Sadr   -   Eadr   st. Data/Symbol      SZ CNT BRK TRC DLY TS TE CLR
E  1      80000039            EX  _main                 1             *
E  2      80000058            EX  _cnt60                3                 *
E  3      0000080C            RW  05               -    1      *
>
```

Reference:
- “No.” is the number assigned to the event that was set. This number is used by the BC/EC, BD, BE, BPA, BPS, TM, and TI commands for various settings.
- The “E” or “D” indicates whether that event is currently enabled (E) or disabled (D).
- The meanings of the codes in the “st.” column are explained below:

EX:	Execution address event
RW:	Data event in read or write operation
RD:	Data event in read operation
WR:	Data event in write operation

- The "sz" column means the accessive range for data event:

B:	8-bit data
W:	16-bit data
D:	32-bit data
- :	size don't care

- * (asterisk): Indicates that the event in question was assigned to one of the following functions:

BRK:	Break [☞ BP command]
TRC:	Trace with event conditions [☞ TM command]
DLY:	Delayed trigger trace event [☞ TM command]
TS:	Time measurement start event [☞ TI command]
TE:	Time measurement end event [☞ TI command]
CLR:	Event clear [☞ EV/C command]

Set/display sofware break : **NO INFLUENCES**
Set/display sotware break : **INFLUENCES**

On-the-fly function

BP

Set/display break event

```
BP<address S>[˜<address E>][,<status>][,<data>[,{/B|/W|/D}] [,/N]][,/<count>][,/C<command>]
BP
```

B P <address S>[,<~

This command sets an internal event, and that event is set in a hardware break.

The following table lists the options that can be specified for each break type.

Break type	Execution address break	Data break	Software break
<address S>	●	●	●
<address E>	❍	❍	
<status>	EX	RW/R/W	
<data>		❍	
/B,/W,/D		❍	
/N		❍	
/<count>	❍	❍	
/C<command>	❍	❍	❍

(●: required, ❍: may be omitted, blank: may not be specified)

<address S> Specify a memory address or symbol. When specifying a memory range, specify the start address versus the end address in <address E>.

<address E> Specify a memory address or symbol. Specify the end address versus the start address in <address S>.

<status>

EX:	Execution address break
RW:	Data break in read or write operation
R:	Data break in read operation
W:	Data break in write operation
Omitted:	"RW" is assumed if <data> is specified, "EX" is assumed if <data> is not specified and <address E> or <count> is specified, and a software break is assumed in all other cases.

<data>	Specify the data for a data break. If omitted, the data is ignored and only the address becomes the break target. The <data> can be specified in binary format if the "@" symbol is added at the start of the data. If the "@" symbol is omitted, hexadecimal specification is assumed. In addition, as the examples show below, it is also possible to include masked bit specifications. Specify "X" to indicate "don't care" for a bit. The high-order bits are also "don't care."

@10xx	The following values satisfy the condition: @1000, @1001, @1010, and @1011.
C5xx	Any value from C500 to C5FF satisfies the condition.

Symbols can not be used in the <data> specification.

/B, /W, /D	Specify the data access width for a data break: 8-bit data (/B), 16-bit data (/W), or 32-bit data (/D). If omitted, the access width mode is "no specific size/don't care."
/N	Specifies that the break condition is met when the data accessed in the data break did not match the value specified by <data>. If this specification is omitted, the break condition is met when the data does match.
/<count>	In the case of an execution address break, specify the pass count. In the case of a data break, specify the access count. The break occurs after the break condition is met the specified number of times. The maximum setting is 256; if <count> is omitted, 1 is assumed. Regardless of the setting of the N command, the base of the count specification is decimal, unless 0x is added to the value, which makes the base of the count specification hexadecimal.
/C<command>	A C source code debugger command or macro of up to 40 characters can be specified for <command>. If this specification is made, the specified <command> is automatically executed after the break. If execution was initiated by using the F5 key, however, the <command> is not executed after the break.

B P	This command displays the breaks that have been set.

Example

```
>bp main
>bp sec,w,5
>bp 100,rw
>bp
  No.       Sadr   -   Eadr   st. Data/Symbol         Sz Cnt Command
E  1      80000039            SF  _0main                 1
E  2      0000080C            WR  05                  -  1
E  3      00000100            RW                      -  1
>bp cnt60,ex
>bp
  No.       Sadr   -   Eadr   st. Data/Symbol         Sz Cnt Command
E  1      80000039            SF  _0main                 1
E  2      0000080C            WR  05                   - 1
E  3      00000100            RW                       - 1
E  4      80000058            EX  _cnt60                 1
>ev
  No.       Sadr   -   Eadr   st. Data/Symbol    Sz Cnt BRK TRC DLY TS TE CLR
E  2      0000080C            WR  05                   -1   *
E  3      00000100            RW                       -1   *
E  4      80000058            EX  _0cnt60               1   *
>
```

Reference:
- The “No.” column indicates the number applied to the break event. This number is used in the BC/EC, BD, and BE commands to specify the break even to be cancelled, disabled, or enabled.
- The “E” or “D” indication indicates whether the break event is currently enabled (E) or disabled (D).
- The meanings of the codes in the “st.” column are explained below:
  - SF: Software break
  - EX: Execution address break
  - RW:Data break in read or write operation
  - RD: Data break in read operation
  - WR:Data break in write operation
- The "sz" column means the accessive range for data event:
  - B: 8-bit data
  - W: 16-bit data
  - D: 32-bit data
  - - : size don't care

[☞ BC/EC command, BD command, BE command, G command,
L command, or LP command]

NO INFLUENCES

On-the-fly function

BPA

Set AND break

BPA <list>

This command sets an AND break.

B P A <list>

The hardware break events specified in <list> become AND conditions. Once all of the conditions are satisfied, a break occurs.

Specify up to eight break event numbers in <list>, delimited by commas.

If an AND break is set while a program is running, it becomes valid immediately. To cancel an AND break, execute the BD or BC/EC command on one of the break events set as part of the AND break.

Example

Break event Nos. 2 and 3 form an AND break.

```
>bp
  No.       Sadr   -   Eadr   st. Data/Symbol      Sz  Cnt Command
E  1      80000039            SF  _0main                 1
E  2      00000100            RW  @0xxxx100         -    1
E  3      00000800            RW  _i                -    1
E  4      80000058            EX  _0cnt60                1
>bpa 2,3
>bp
  No.       Sadr   -   Eadr   st. Data/Symbol      Sz  Cnt Command
E  1      80000039            SF  _0main                 1
E  2 (& ) 00000100            RW  @0xxxx100          -   1
E  3 (& ) 00000800            RW  _i                 -   1
E  4      80000058            EX  _0cnt60                1
>
```

Reference: The base used in <list> is assumed to be decimal regardless of the N command specification. If “0x” is added, the base is hexadecimal.

NO INFLUENCES

On-the-fly function

BPS

Set sequential break

```
BPS <list>
```

This command sets a sequential break.

B P S <list>

The hardware break events specified in <list> are set as a sequential break.

Multiple break events can be specified in <list>, up to a maximum of eight. A sequential break is generated if the break events occur in the specified sequence. A break event that is used in an AND break can also be used in a sequential break. To cancel a sequential break, execute the BD or BC/EC command on one of the break events set as part of the sequential break.

If a sequential break is set while the user program is being executed (on-the-fly) , all events are temporarily disabled and then are enabled. (There is an interval during which the events are temporarily ignored.)

Example

Break event Nos. 2, 3, and 4 form a sequential break.

```
>bp
  No.       Sadr   -   Eadr   st. Data/Symbol     Sz  Cnt Command
E  1      80000039            SF  _0main                  1
E  2      00000100            RW  @0xxxx100         -     1
E  3      00000800            RW  _i                -     1
E  4      80000058            EX  _0cnt60                 1
>bps 2,3,4
>bp
  No.       Sadr   -   Eadr   st. Data/Symbol      Sz  Cnt Command
E  1      80000039            SF  _0main                  1
E  2 ( 1) 00000100            RW  @0xxxx100          -    1
E  3 ( 2) 00000800            RW  _i                 -    1
E  4 ( 3) 80000058            EX  _0cnt60                 1
>bd*
>be*
>bp
  No.       Sadr   -   Eadr   st. Data/Symbol      Sz  Cnt Command
E  1      80000039            SF  _0main                  1
E  2      00000100            RW  @0xxxx100          -    1
E  3      00000800            RW  _i                 -    1
E  4      80000058            EX  _0cnt60                 1
>
```

Reference: The base used in <list> is assumed to be decimal regardless of the N command specification. If “0x” is added, the base is hexadecimal.

Hardware break: NO INFLUENCES
Software break: INFLUENCES

On-the-fly function

BC/EC

Cancel break event

BC {<list>|*}

EC {<list>|*}

These commands cancel software break/hardware break events that were set by the EV command and BP command.

The BC command can be used to cancel software breaks, and hardware events/breaks. The EC command can only be used to cancel hardware events/breaks. If <list> is specified, the break events with the specified numbers are cancelled. If "*" is specified, all break events that were set are cancelled.

BC 1, 2, 7 ↵

In the above example, break events 1, 2, and 7 are cancelled.

BC * ↵

In the above example, all break events are cancelled.

If a cancelled event is used in an AND break, a sequential break, as a trace event, or as a time measurement event, these functions are also cancelled.

Example

```
>BP
  NO.       SADR   -   EADR   ST. DATA/SYMBOL         CNT COMMAND
E  1      80000029            SF  _MAIN                 1
E  2      00000100            RW  @0XXXX100             1
E  3      00000000            RW  _I                    1
E  4      80000056            EX  _CNT60                1
>BC 1,4
>BP
  NO.       SADR   -   EADR   ST. DATA/SYMBOL         CNT COMMAND
E  2      00000100            RW  @0XXXX100             1
E  3      00000000            RW  _I                    1
>BC 2
>BP
  NO.       SADR   -   EADR   ST. DATA/SYMBOL         CNT COMMAND
E  3      00000000            RW  _I                    1
>
```

Reference: The base used in <list> is assumed to be decimal regardless of the N command specification. If "0x" is added, the base is hexadecimal.

[☞ EV command, BP command, BD command, and BE command]

Hardware break: NO INFLUENCES
Software break: INFLUENCES

On-the-fly function

BD

Temporarily disable break event

```
BD {<list>|*}
```

This command temporarily disables software break/hardware break events that were set by the EV command and BP command.

If <list> is specified, the break events with the specified numbers are disabled. If "*" is specified, all break events that were set are disabled.

```
BD  1, 2, 7 ↵
```

In the above example, break events 1, 2, and 7 are temporarily disabled.

```
BD  * ↵
```

In the above example, all break events are temporarily disabled.

If a disabled event is used in an AND break, a sequential break, as a trace event, or as a time measurement event, these functions are also cancelled. Even if a break event disabled by the BE command is subsequently enabled, these break events remain cancelled.

Example

```
>bp
  No.       Sadr   -   Eadr   st. Data/Symbol      Sz  Cnt Command
E  1      80000039            SF  _0main                1
E  2      00000100            RW  @0xxxx100         -   1
E  3      00000000            RW  05                -   1
E  4      80000058            EX  _0cnt60               1
>bd 2,3
>bp
  No.       Sadr   -   Eadr   st. Data/Symbol      Sz  Cnt Command
E  1      80000039            SF  _0main                1
D  2      00000100            RW  @0xxxx100         -   1
D  3      00000000            RW  05                -   1
E  4      80000058            EX  _0cnt60               1
>bd *
>bp
  No.       Sadr   -   Eadr   st. Data/Symbol      Sz  Cnt Command
D  1      80000039            SF  _0main                1
D  2      00000100            RW  @0xxxx100         -   1
D  3      00000000            RW  05                -   1
D  4      80000058            EX  _0cnt60               1
>
```

Reference: The base used in <list> is assumed to be decimal regardless of the N command specification. If "0x" is added, the base is hexadecimal.

[☞ EV command, BP command, BC/EC command, and BE command]

Hardware break: NO INFLUENCES
Software break: INFLUENCES

On-the-fly function

BE

Enable break event

```
BE {<list>|*}
```

This command enables software break/hardware break events that were temporarily disabled by the BD command.

If <list> is specified, the break events with the specified numbers are enabled. If “*” is specified, all break events that were set are enabled.

```
BE  1, 2, 7 ↵
```

In the above example, break events 1, 2, and 7 are enabled.

```
BE  * ↵
```

In the above example, all break events are enabled.

Example

```
>bp
  No.       Sadr   -   Eadr   st. Data/Symbol      Sz  Cnt Command
D  1      80000039            SF  _0main                 1
D  2      00000100            RW  @0xxxx100         -    1
D  3      00000000            RW  05                -    1
D  4      80000058            EX  _0cnt60                1
>be 1,3
>bp
  No.       Sadr   -   Eadr   st. Data/Symbol      Sz  Cnt Command
E  1      80000039            SF  _0main                 1
D  2      00000100            RW  @0xxxx100        -     1
E  3      00000000            RW  05               -     1
D  4      80000058            EX  _0cnt60                1
>be *
>bp
  No.       Sadr   -   Eadr   st. Data/Symbol      Sz  Cnt Command
E  1      80000039            SF  _0main                 1
E  2      00000100            RW  @0xxxx100        -     1
E  3      00000000            RW  05               -     1
E  4      80000058            EX  _0cnt60                1
>
```

Reference: The base used in <list> is assumed to be decimal regardless of the N command specification. If “0x” is added, the base is hexadecimal.

[☞ EV command, BP command, BC/EC command, and BD command]

4 Other Hardware-related Commands

TM Command

Sets and displays trace mode.

TG command

Starts tracing.

TS command

Stops tracing.

TD command, TDU command

Displays trace information.

TDW command

Displays trace information in a window format.

TI command

Sets and displays the timer.

TRIG command

Sets and displays the trigger.

MAP command (EX command)

Assigns memory.

NO INFLUENCES

On-the-fly function

TM

Set/display trace mode

```
TM [<mode>][{/B|/C|/S|/T[<count>],<event number>}]
TM/F
TM
```

The trace function stores a record of the user program execution status in trace memory, allowing the program execution status to be analyzed later. Execution addresses, data addresses, data values, and information on the bus status can be stored for up to 16K steps.

T M [<mode>][{/B|/C~

This command specifies the trace mode. The mode specification items include the bus specification, the trace storage conditions, and the trace stopping conditions; these items can all be specified simultaneously, delimited by commas. If a specification is omitted, the default value for that item is assumed.

Bus specification	Select one of the following:
INT	Internal RAM bus (default) In internal RAM bus tracing, accesses to the microprocessor's internal RAM and special registers and to external memory (excluding internal DMA accesses) can be traced in conjunction with the actual instruction operation timing.
EXT	Extended RAM bus In extended RAM bus tracing, only accesses to the microprocessor's external memory (including internal DMA accesses) can be traced in conjunction with the external bus operation timing. In the MN10300 Series, because the external bus is accessed via the microprocessor's store buffer, operations are performed more slowly than the instruction operation timing.
Trace storage condition	Select one of the following:
ALL	Normal trace mode (default) All cycles executed by the microprocessor are stored in trace memory. Tracing of up to 16K steps is possible.

JMP	Branch trace mode Only branch instructions are stored in trace memory; compensation for the intervals between branch instructions is made by the software, making it possible to appear to trace for a longer time than normal tracing. However, after starting the trace, the trace display does not appear until the first branch instruction appears.
<event number>	Trace mode with event condition In tracing with an event condition, tracing is performed only while the event condition specified by <event number> is satisfied.
Trace stop condition	Select one of the following.
/B	Trace full break mode Tracing stops and user program execution also stops (breaks) when trace memory becomes full.
/C	Trace continue mode (default) Even if the trace memory becomes full, tracing continues until the user program stops. The last 16K of steps executed before the user program stopped then remain as the trace data.
/S	Trace full stop mode Tracing is performed from the start (or resumption) of user program execution until the trace memory becomes full (16K steps). When the trace memory becomes full, tracing stops, but the user program continues.
/T[<count>],<event number>	Delayed trigger trace mode Once the event specified by <event number> occurs, tracing continues for the number of cycles specified by <count>, after which tracing stops. This mode makes it possible to monitor the execution status of a program before and after the occurrence of an event. <count> can be specified over a range from 257 to 16,384. If omitted, “257” is assumed for <count>. <event number> cannot be omitted.

T M / F

This command sets the trace mode to default mode:

Bus selection:	Internal RAM bus
Trace storage condition:	Normal trace mode
Trace stop condition:	Trace continue mode

T M

This command displays the trace mode that have been set.

If a trace event is cancelled or disabled, the emulator stops tracing and trace mode is set to the default mode.

The table below indicates which modes can be used with memory accesses by the microprocessor, internal DMA accesses, and external DMA accesses.

A "X" indicates that the space in question cannot be accessed through that type of access in that mode.

		Microprocessor memory access	Internal DMA	External DMA
INT mode	Microprocessor's internal data RAM space	❍	❍	×
	Microprocessor's internal special register space	❍	❍	×
	Microprocessor's internal instruction ROM/RAM space	❍	❍	×
	External memory space	❍	×	×
EXT mode	Microprocessor's internal data RAM space	×	Δ	×
	Microprocessor's internal special register space	×	Δ	×
	Microprocessor's internal instruction ROM/RAM space	×	Δ	×
	External memory space	❍	❍	×

(Δ: Possible only with a DMA access with an external memory space)

Example

```
>tm
Trigger      = OFF
Trace Full   = Continue
Trace Cycle  = ALL & INT
Sample Event = NONE
>ev main~cnt60,ex
>tm 1
>ev
  No.      Sadr   -   Eadr   st. Data/Symbol     Sz  Cnt BRK TRC DLY TS TE CLR
E  1      80000039 ~ 80000058 EX  _0main                  1   *
>tm
Trigger      = OFF
Trace Full   = Continue
Sample Event = 1
Trace Cycle  = INT
>ev sec,w,5
>tm /t1000,2
>ev
  No.      Sadr   -   Eadr   st. Data/Symbol     Sz  Cnt BRK TRC DLY TS TE CLR
E  1      80000039 ~ 80000058 EX  _0main               1
E  2      0000080C            WR  05             -     1          *
>tm
Trigger      = ON   (Delay=1000/Sample Event=2)
Trace End    = Stop
Trace Cycle  = ALL & INT
Sample Event = NONE
>tm /f
>tm
Trigger      = OFF
Trace Full   = Continue
Trace Cycle  = ALL & INT
Sample Event = NONE
>
```

Reference: The base used in <event number> (trace with event conditions and directory triggered trace) and <count> is assumed to be decimal regardless of the N command specification. If “0x” is added, the base is hexadecimal.

[☞ EV command]

INFLUENCES

On-the-fly function

TG

Start trace

TG

If tracing was stopped due to the TS command or a “trace full” stop while the user program was running, the TG command can be used to restart tracing.

If tracing was stopped by a trigger being tripped in delayed trigger trace mode, the TG command cannot be used to resume tracing. The TG command can only be executed while the user program is running.

Example

```
>tm
Trigger      = OFF
Trace Full   = Continue
Trace Cycle  = ALL & INT
>g
>ts
Trace stop
>tg
>
```

NO INFLUENCES

On-the-fly function

TS

Stop trace

```
TS
```

This command stops tracing while the user program is running.
To restart tracing, use the TG command.

When TS is valid, the message “Trace stop” is output.

! The TS command can only be executed while the user program is running.

Dump :	INFLUENCES	On-the-fly function
Disassemble :	NO INFLUENCES	

TD/TDU

Display trace

```
TD
TDU
```

This command displays a hexadecimal dump (TD) or a disassembled code dump (TDU) of the contents of trace memory every machine cycle.

If the contents of the frame to be displayed are identical to those of the previous frame, a semicolon (“:”) is displayed.

If this command is executed, the number of frames sampled is displayed and trace display mode is initiated. In this mode, the prompt changes to “*” and the system waits for a key to be pressed. The sub-commands that can be used are shown on the following page.

If the TD command is executed while tracing, the message “Stop Trace? (Y/N)” is displayed on the screen. Pressing “Y” stops tracing and displays the contents of trace memory. Pressing “N” does not stop tracing and returns control to the command input state.

If trace display mode is exited while a program is running, the message “Go Trace? (Y/N)” is displayed on the screen. To resume tracing, press “Y”. In delayed trigger trace mode, this message is not displayed because tracing cannot be resumed.

! If the Return key is pressed without pressing any other key, “N” is assumed.

T D	Trace memory hexadecimal dump display
T D U	Trace memory disassembled code display

The available subcommands when the TD command is input are shown below.

B	This command displays the start of trace memory.
-B	This command displays the end of trace memory.
Pn P1	This command moves the display start frame "n" pages, and then displays one page. If a "-" is added in front, this command moves the display back "n" pages. If the number of pages is omitted, "1" is assumed. If only the Return key is pressed, the frame moves to the next page, which is then displayed.
Nn	This command sets the display start frame at "n". The first frame is frame 0, which contains the oldest data.
D [<frame address S>] [,<frame address E>]	This command changes the display mode to hexadecimal display every machine cycle. If "s" and "e" are specified, the data from frame address S to frame address E is displayed.
L [<frame address S>] [,<frame address E>]	This command changes the display mode to disassembled code display. If "s" and "e" are specified, the data from frame address S to frame address E is displayed.
C	This command erases frames indicated by ":" from the screen. If this command is executed again, ":" is displayed.
Q/.	This command quits the trace display mode.

- If less than 16K steps were traced, the first instruction after trace start might not be traced.
- If a "trace full" break was used, several instructions prior to the stopping of the user program might not be traced.

Example

```
>bp sec,rw,5,/d
>g
>
------IM=0 S=0 D0 =00000005 D1 =00000000 D2 =0000001C D3 =00000014
PSW=0000       A0 =00000000 A1 =80000098 A2 =FFFFF870 A3 =20000000
PC =8000005F   MDR=80000055 LIR=02A544F0 LAR=FFFFF0E0 SP =00000FF8
MDRQ=00800000
     mov (80C _sec ),d0
>td
 Sampled Frame Number = 16384
*d 0
Frame       ROM_A         RAM_A       Data   R/W
——————————————————————————————————————————————————————————————————————————————
00000      80000015      00000EE4
00001         :
00002         :
*c 1000
Frame       ROM_A         RAM_A       Data   R/W
——————————————————————————————————————————————————————————————————————————————
01008  E   80000017      00000EFC
01009      80000017      00000EFC
01088  JE  80000013      00000EFC
*u 2000
Frame       Addr.         Mnemo. Opr.               RAM_A       Data R/W
——————————————————————————————————————————————————————————————————————————————
STARTUP.ASM:0058                mov    d0, (a0)
02048  JE  80000013      mov d0,(a0)               00000F14
STARTUP.ASM:0059                inc4   a0
02049  E   80000014      inc4 a0                   00000F18    00000000 (wr)
*
Frame       Addr.         Mnemo. Opr.               RAM_A       Data R/W
——————————————————————————————————————————————————————————————————————————————
STARTUP.ASM:0060                add    -4,d1
02050   E  80000015      add -4,d1               00000F18
02051      80000015                              00000F18
*c
*q
>
```

Dump:	NO INFLUENCES	On-the-fly function
Disassemble:	INFLUENCES	

TDW

Display trace window

TDW

This command displays the contents of the trace memory in a window.

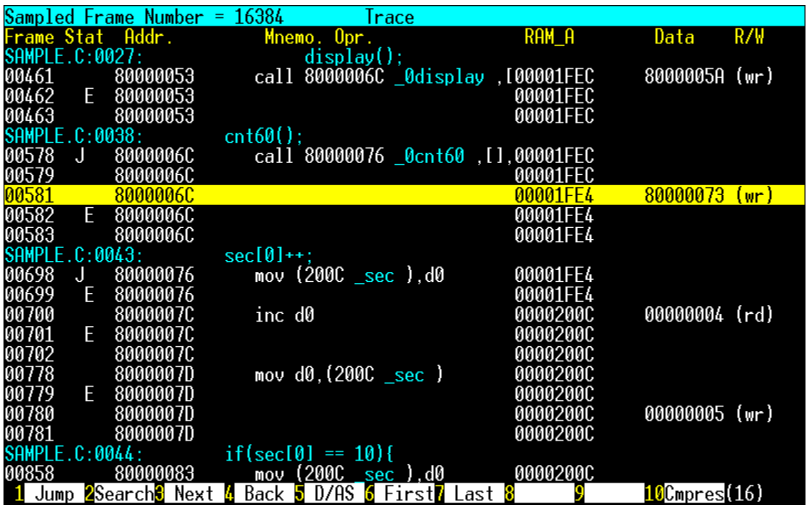
When this command is specified, it is possible to switch between the dump display and the disassembled code display just as with the TD command. The F1 through F10 keys are used for this purpose. If the TDW command is executed during tracing, the message "Stop Trace? (Y/N)" is displayed on the screen. Pressing "Y" stops tracing and displays the contents of trace memory. Pressing "N" does not stop tracing and returns control to the command input state.

If the trace display is exited while a program is running, the message "Go Trace? (Y/N)" is displayed on the screen. To resume tracing, press "Y". Note that in delayed trigger trace mode, this message is not displayed because tracing cannot be resumed.

F1 (Jump)	This function key jumps from the frame that is currently being displayed to the next frame to be viewed.
F2 (Search)	This function key searches for a character string in the trace information. To interrupt the search, press the ESC key.
F3 (Next)	In search mode, this function key searches the trace information for the character string that was specified by the F2 key, searching in the direction of the end of the trace information (the most recent trace information).
F4 (Back)	In search mode, this function key searches the trace information for the specified character string, searching in the direction of the beginning of the trace information.
F5 (D/AS)	This function key switches the display between dump and disassembled code.
F6 (First)	This function key displays the beginning of the trace memory.
F7 (Last)	This function key displays the end of the trace memory.
F10 (Compres)	This function key displays/erases the frames indicated by ":".
ESC	This key quits this mode and returns to the debugging screen of the C source code debugger.

- If less than 16K steps were traced, the first instruction after trace start might not be traced.
- If a “trace full” break was used, several instructions prior to the stopping of the user program might not be traced.
- If the microprocessor’s internal instruction RAM is overwritten while collecting trace information, the trace disassembled code display will be incorrect.

Sample screen



```
Sampled Frame Number = 16384        Trace
Frame Stat  Addr.          Mnemo. Opr.                RAM_A        Data    R/W
SAMPLE.C:0027:                 display();
00461      80000053      call 8000006C _0display ,[00001FEC     8000005A (wr)
00462   E  80000053                                00001FEC
00463      80000053                                00001FEC
SAMPLE.C:0038:        cnt60();
00578  J   8000006C      call 80000076 _0cnt60 ,[],00001FEC
00579      8000006C                                00001FEC
00581      8000006C                                00001FE4     80000073 (wr)
00582   E  8000006C                                00001FE4
00583      8000006C                                00001FE4
SAMPLE.C:0043:        sec[0]++;
00698  J   80000076      mov (200C _sec ),d0       00001FE4
00699   E  80000076                                00001FE4
00700      8000007C      inc d0                    0000200C     00000004 (rd)
00701   E  8000007C                                0000200C
00702      8000007C                                0000200C
00778      8000007D      mov d0,(200C _sec )       0000200C
00779   E  8000007D                                0000200C
00780      8000007D                                0000200C     00000005 (wr)
00781      8000007D                                0000200C
SAMPLE.C:0044:        if(sec[0] == 10){
00858      80000083      mov (200C _sec ),d0       0000200C
 1 Jump 2Search3 Next 4 Back 5 D/AS 6 First7 Last 8      9      10Cmpres(16)
```

NO INFLUENCES

On-the-fly function

* Except TI RUN

TI

Measure/display execution time

```
TI [<mode>][,/S<event number>][,/E<event number>]
TI <clock>
TI STOP
TI
```

These commands measure the user program execution time in units of the timer clock. The maximum error is ± (timer clock). The timer clock can be selected from among 25ns, 50ns, and 100ns. The available modes are described below.

Continuous measurement mode

In this mode, the execution time of the user program is measured from beginning (or resumption) to end.

Partial mode

In this mode, the execution time of the user program is measured from the occurrence of one event until the occurrence of another event. There are two partial measurement modes:

FIRST mode

The execution time is only measured the first time between the two events.

MIN/MAX mode

The execution time is measured continuously between the two events, and then the minimum and maximum execution times are determined.

T I [<mode>~

This command specifies the timer operation mode.

<mode> RUN: Continuous measurement mode

In this mode, the execution time of the program is measured from beginning to end. However, the execution time of the first instruction is not included in the measured time.

! This mode cannot be set while the program is running.

T

FIRST: Partial one-shot mode
This mode measures the execution time between two events one time.

(MIN: Partial minimum/maximum mode
(MAX: This mode measures the execution time continuously between two events, and then determines the minimum and maximum execution times. If the timer clock is 25ns, a maximum time of up to approximately 107 seconds can be measured. The operation is the same, regardless of whether "MAX" or "MIN" is displayed.

/S<event number>
This specifies the time measurement starting event.

/E<event number>
This specifies the time measurement ending event.

• The /S, /E<event number> specification cannot be made in continuous measurement mode.
• If an event being used by the timer is deleted (or disabled), the measurement mode automatically switches to continuous measurement mode.

Reference: The base used in <event number> is assumed to be decimal regardless of the N command specification. If "0x" is added, the base is hexadecimal.

T I <clock>

Clock setting
This command sets the timer clock.

<clock>	/T1:	25ns resolution
	/T2:	50ns resolution
	/T4:	100ns resolution
	/M:	Microprocessor clock

If "/M" is specified, the measured value is the number of machine cycles, not the actual time.

T I S T O P

Timer mode cancellation
This command halts time measurement.

T I

This command displays the timer mode that is currently set and the timer value.

! If the interval between a time measurement ending event and a time measurement starting event is four clocks or less, the execution time will not be measured correctly.

Exapmle

```
>ti
Timer : Stop
>
>ev init_data,ex
>ev sec,rw
>ti max,/s1,/e2
>ev
  No.       Sadr   -   Eadr   st. Data/Symbol    Sz  Cnt BRK TRC DLY TS TE CLR
E  1      80000083            EX  _init_data        1             *
E  2      0000000C            RW  _sec              1                *
>g
>ti
Timer Clock       = 1/1
Timer Start Event = 1
Timer End   Event = 2
MAX TIME = 2,025 (nS)
MIN TIME = 0 (nS)
>
---- IM=0 S=0 D0 =00000005 D1 =00000000 D2 =0000001C D3 =00000014
PSW=0000      A0 =00000000 A1 =80000098 A2 =FFFFF870 A3 =20000000
PC =8000005F  MDR=80000055 LIR=02A544F0 LAR=FFFFF0E0 SP =00000FF8
MDRQ=00800000
Timer Clock       = 1/1
Timer Start Event = 1
Timer End   Event = 2
MAX TIME = 2,025 (nS)
MIN TIME = 0 (nS)
>
>ti stop
>
```

[☞ EV command]

NO INFLUENCES

On-the-fly function

TRIG

Set/display trigger

```
TRIG OUT <data>
TRIG RAM <address>
TRIG EVENT
TRIG
```

These commands set and display trigger output.

TRIG OUT <data>	This command outputs the 8-bit port data <data>.
TRIG RAM <address>	When the microprocessor accesses <address>, this command outputs the contents of <address>.
TRIG EVENT	This command outputs the event occurrence status.

If a sequential break was set with the BPS command, the correspondence between an event output that is output due to a trigger and its event number may change, so use the TRIG command to check the correspondence of the numbers.

TRIG	This command displays the trigger output that is currently set.

Example

```
>trig
Trigger mode = Port Data (00/00000000)
>
>ev cnt60,ex
>ev sec,rw
>ev 80000100,ex
>trig event
>trig
Trigger mode = Event
Trig. No. #7 #6 #5 #4 #3 #2 #1 #0
Event No. — — — — — — — 3  2  1
>
>trig ram sec
>trig
Trigger mode = RAM Monitor
Address      = 0000000C (Data is invalid.)
>
```

Display: NO INFLUENCES

Set: CANNOT BE USED

On-the-fly function

MAP/EX

Assign memory

```
MAPI <address S>,<address E>[,{/F|/S}]
MAPE <address S>,<address E>
MAP
EXI <address S>,<address E>[,{/F|/S}]
EXE <address S>,<address E>
EX
```

These commands specify which memory space will be assigned to in memory within the in-circuit emulator (emulation memory).

The total memory (emulation RAM) assigned to the in-circuit emulator must be less than the installed memory (512KB of standard/fast emulation RAM and 512KB of slow emulation RAM). The start and end of each block can be set in 4KB units. If an attempt is made to set a block in other than a 4KB unit, the debugger will make adjustments automatically.

The MAP command and the EX command have the same function.

MAPI/ EXI <address S>,<address E> [,{/F|/S}]

This command assigns the memory within the specified range so that when it is accessed, the memory inside the in-circuit emulator (emulation memory) is used instead. A maximum of 8 blocks in 4KB units can be specified.

"/F" assigns the memory to fast emulation RAM, and "/S" assigns the memory to slow emulation RAM. If omitted, "/F" (fast emulation RAM) is assumed.

```
MAPI 80000000, 80000FFF, /F
```

In the above example, the 4KB space from address 0x80000000 to 0x80000FFF is assigned to fast emulation RAM inside the in-circuit emulator.

! Depending on the assigned addresses, it may only be possible to set a size that is smaller than the total size of the memory installed in the in-circuit emulator.

[☞ Memory emulation function]

M A P E / E X E
<address S>,
<address E>

This command assigns the memory within the specified range so that when it is accessed, user target system resources are used instead.

When the MAPE (EXE) command is used on the user target system side to assign a space to be used as a stack, RAM must be installed in the user target system for that space.

MAPE 80000000, BFFFFFFF

In the above example, the 1GB space from address 0x80000000 to 0xBFFFFFFF is assigned to a user target system resource (external memory).

M A P / E X

This command displays the current settings.

Reference: The meanings of the codes in the "Memory" column are explained below:

Int RAM:	Internal RAM
Int REG:	Special register
Int ROM:	Internal ROM (or internal instruction RAM)
ICE ROM:	Emulation ROM
ICE RAM (fast):	Fast emulation RAM
ICE RAM (slow):	Slow emulation RAM
TARGET:	User target system memory (external memory)
ERROR:	Access prohibited
MONITOR:	Area used by monitor (reserved for system)

Example

```
>mape 80020000 - 8003ffff
CPU MEMORY MODE : EXMODE
   Sadr   -   Eadr   Memory
 00000000 - 00003FFF :Int RAM
 00004000 - 1FFFFFFF :---
 20000000 - 3FFFFFFF :Int REG
 40000000 - 40003FFF :Int ROM
 40004000 - 7FFFFFFF :---
 80000000 - 8001FFFF :ICE RAM (fast)
 80020000 - BFFFFFFF :TARGET
 C0000000 - FFFFFFFF :MONITOR
>mapi 90000000~9001ffff
CPU MEMORY MODE : EXMODE
   Sadr   -   Eadr   Memory
 00000000 - 00003FFF :Int RAM
 00004000 - 1FFFFFFF :---
 20000000 - 3FFFFFFF :Int REG
 40000000 - 40003FFF :Int ROM
 40004000 - 7FFFFFFF :---
 80000000 - 8001FFFF :ICE RAM (fast)
 90000000 - BFFFFFFF :TARGET
 C0000000 - FFFFFFFF :MONITOR
>
```

5 Performance Measurement

SM command

This command sets/releases the RAM monitor sample area.

PROF command

This command tabulates the access status.

NO INFLUENCES

On-the-fly function

SM

Set/release sample area

```
SM <address>
SMB <address>
SMC <number>
SMW
SM
```

The commands select the RAM monitor function sample area.

The sample area consists of 32 blocks consisting of 64 bits (8 bytes each, for a total of 256 bytes), starting from <address>.

CTRL + 5 can be used to switch between the RAM monitor screen and the C source code debugger screen. To change the sample area while the RAM monitor is displayed, press the SHIFT + arrow keys. (The sample area can be changed only while the user program is running.)

Press CTRL + 5 again to return to the debugger screen.

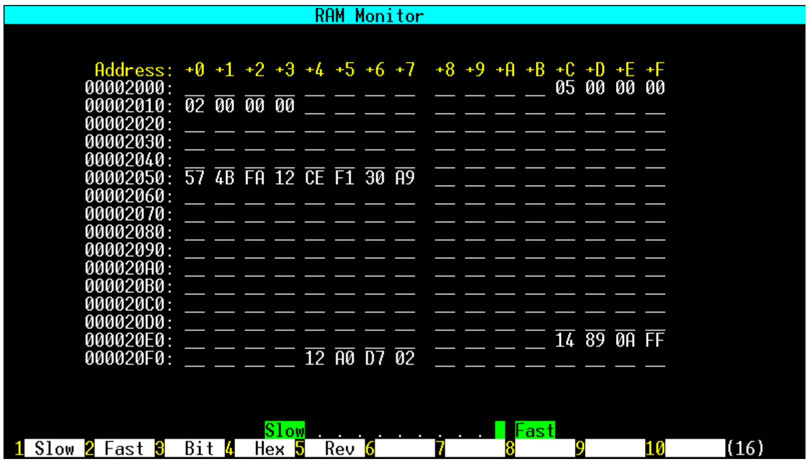
While the user program is running, the memory data area (particularly the RAM area) is sampled at a constant interval, allowing the user to see changes to the data. (This is the RAM monitor function.) This function naturally does not affect the execution of the user program. Only data accessed in memory is monitored and displayed.

The RAM monitor can display changes in data either in hexadecimal or in bit units.

An underscore (_) indicates an address that has not been accessed.

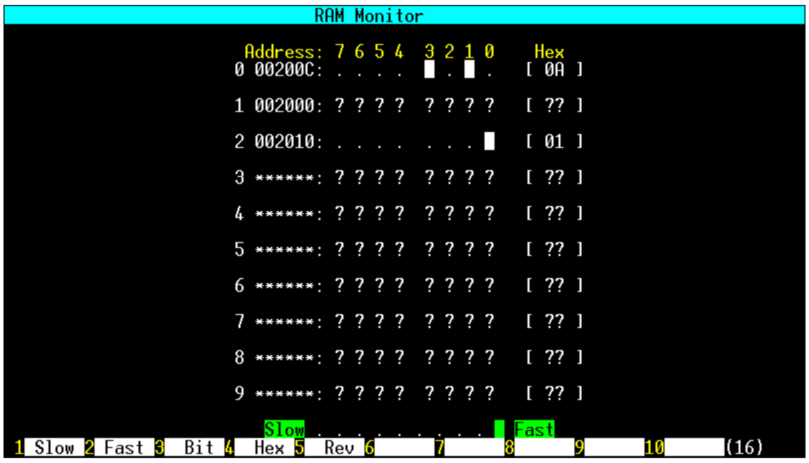
S M <address>	This command specifies the starting address of the sample area.
S M B <address>	This command specifies an address to be displayed in bit units.
S M C <number>	This command clears an address displayed in bit units.
S M W	This command displays the RAM monitor screen.
S M	This command displays the current sample area.

RAM monitor screen
Hexadecimal display example



```
                              RAM Monitor

     Address: +0 +1 +2 +3 +4 +5 +6 +7  +8 +9 +A +B +C +D +E +F
     00002000: __ __ __ __ __ __ __ __  __ __ __ __ 05 00 00 00
     00002010: 02 00 00 00 __ __ __ __  __ __ __ __ __ __ __ __
     00002020: __ __ __ __ __ __ __ __  __ __ __ __ __ __ __ __
     00002030: __ __ __ __ __ __ __ __  __ __ __ __ __ __ __ __
     00002040: __ __ __ __ __ __ __ __  __ __ __ __ __ __ __ __
     00002050: 57 4B FA 12 CE F1 30 A9  __ __ __ __ __ __ __ __
     00002060: __ __ __ __ __ __ __ __  __ __ __ __ __ __ __ __
     00002070: __ __ __ __ __ __ __ __  __ __ __ __ __ __ __ __
     00002080: __ __ __ __ __ __ __ __  __ __ __ __ __ __ __ __
     00002090: __ __ __ __ __ __ __ __  __ __ __ __ __ __ __ __
     000020A0: __ __ __ __ __ __ __ __  __ __ __ __ __ __ __ __
     000020B0: __ __ __ __ __ __ __ __  __ __ __ __ __ __ __ __
     000020C0: __ __ __ __ __ __ __ __  __ __ __ __ __ __ __ __
     000020D0: __ __ __ __ __ __ __ __  __ __ __ __ __ __ __ __
     000020E0: __ __ __ __ __ __ __ __  __ __ __ __ 14 89 0A FF
     000020F0: __ __ __ __ 12 A0 D7 02  __ __ __ __ __ __ __ __

                       Slow . . . . . . . . . . █ Fast
1 Slow 2 Fast 3 Bit 4 Hex 5 Rev 6     7     8     9     10     (16)
```

RAM monitor screen
Bit unit display example



```
                              RAM Monitor
                  Address: 7 6 5 4  3 2 1 0   Hex
                0 00200C: . . . .  █ . █ .  [ 0A ]

                1 002000: ? ? ? ?  ? ? ? ?  [ ?? ]

                2 002010: . . . .  . . . █  [ 01 ]

                3 ******: ? ? ? ?  ? ? ? ?  [ ?? ]

                4 ******: ? ? ? ?  ? ? ? ?  [ ?? ]

                5 ******: ? ? ? ?  ? ? ? ?  [ ?? ]

                6 ******: ? ? ? ?  ? ? ? ?  [ ?? ]

                7 ******: ? ? ? ?  ? ? ? ?  [ ?? ]

                8 ******: ? ? ? ?  ? ? ? ?  [ ?? ]

                9 ******: ? ? ? ?  ? ? ? ?  [ ?? ]
                       Slow . . . . . . . . . . █ Fast
1 Slow 2 Fast 3 Bit 4 Hex 5 Rev 6     7     8     9     10     (16)
```

The following sub-commands can be used when being displayed RAM monitor.

F1 (Slow)	prolongs sampling cycle
F2 (Fast)	shortens sampling cycle
F3 (Bit)	displays in bits
F4 (Hex)	displays in hex
F5 (Rev)	displays in reverse order

```
>sm
 RAM MONITOR MODE

Monitor Area = 00000000 - 000000FF
>sm 0x800
>smb sec
>smb 0x8f0
>sm
 RAM MONITOR MODE

Monitor Area = 00000800 - 000008FF
NO Address
0  0000080C
1  000008F0
>smc 1
>sm
 RAM MONITOR MODE

Monitor Area = 00000800 - 000008FF
NO Address
0  0000080C
>sm 1000
>sm
 RAM MONITOR MODE

Monitor Area = 00001000 - 000010FF
>
```

NO INFLUENCES

On-the-fly function

PROF

Tabulate access status

```
PROF [ON|OFF|CLR]
PROF
```

These commands tabulate which functions (subroutines) are accessed what percentage of the time while the user program is running.

PROF ON	This command specifies the start of tabulation for the profile.
PROF OFF	This command stops tabulation for the profile. This is the state in effect when the C source code debugger is started up.
PROF CLR	This command clears the profile information.
PROF	This command displays, based on the tabulated profile information, the time that each function (subroutine) was executing and the percentage of the total time that each function accounted for. The functions are displayed in order of time consumed, starting from the function that consumed the most time.

Because PROF ON/OFF can be specified whenever desired, it is possible to create profile information concerning only a particular portion of a program.

!

- In order to use the profile function, it is necessary for the debugging information to be loaded beforehand.
- If an overlay load is made to the microprocessor's internal instruction RAM during profile tabulation, the profile information will not be tabulated correctly.

Example

Total number of samples

Number of samples within user program (number used by the debugging program)

Number of samples within in-circuit emulator (time used by the system)

```
>reset
>prof on
>g
>
—— IM=0 S=0 D0 =0001B072 D1 =00000000 D2 =00000000 D3 =00000000
PSW=0000    A0 =00000000 A1 =00000000 A2 =00000000 A3 =00000000
PC=8000007D MDR=8000007A LIR=40000000 LAR=00000000 SP =00001FE0

_0cnt60:    mov  (200C _sec ), d0
>
>prof
 **** Profile ****
Total sampling count =   36784
User sampling count  =   36784    100.%
System sampling count=       0      0.0%


 No. Addr     Name           Percent (Sum)     Samples
  1. 8000007D _0cnt60        44.9% (44.9%)     16541
  2. 8000004B _0main         31.0% (75.9%)     11407
  3. 80000073 _0display      24.0% (100.%)      8836
>
>prof clr
>prof
Sampling was not performed.
>prof off
>
```

P

6 Data Display/Change

The C source code debugger can easily display and change memory, register, and symbol data.

D command

This command displays a dump of the contents of memory. The display can be modified by changing the display base number, etc.

E command

This command changes a value stored in memory to the specified value.

C command

This command compares the specified areas in memory.

F command

This command fills the specified area in memory with one repeated value.

M command

This command performs a block transfer of the specified area in memory.

S command

This command searches for data within the specified area memory.

R command

This command displays/changes the contents of registers.

H command

This command indicates the value of an expression in octal, decimal, hexadecimal and ASCII.

PRINTF/PF command

This command displays data in the specified format. (The format is similar to that of the “printf” function in C.)

X command

This command displays symbols.

. command

This command registers/changes symbols.

INFLUENCES

On-the-fly function

D

Display dump of contents of memory

```
D [<address S>][,<address E>][,<count>][,{/H|/D|/O}]
DB [<address S>][,<address E>][,<count>][,{/H|/D|/O}]
DW [<address S>][,<address E>][,<count>][,{/H|/D|/O}]
DD [<address S>][,<address E>][,<count>][,{/H|/D|/O}]
DS [<address S>][,<address E>]
DL [<address S>][,<address E>]
DA [<address S>][,<address E>][,<count>]
```

These commands display the contents of memory in the specified base (octal, decimal, hexadecimal, or ASCII).

When the C source code debugger is started up, the display base for the D command is hexadecimal. After the D command has been executed, input either the ↓ key or CTRL + X to display the next line of the D command display.

<count> specifies the number of data items to be displayed on one line; the maximum is 29 (0 x 1D).

Option	Use	When omitted
<address S>	Display start address	Starts display from the next address that follows the last displayed address.
<address E>	Display end address	Displays one line.
<count>	Number of data items displayed on one line	Displays either 16, 8, or 4 (however many can fit on one line).
/H	Hexadecimal display specification	Uses the base in effect for the last display.
/D	Decimal display specification	Uses the base in effect for the last display.
/O	Octal display specification	Uses the base in effect for the last display.

D / D B	Byte (8 bits) display
D W	Word (16 bits) display
D D	Double word (32 bits) display
D S	4-byte real number (short floating-point) display
D L	8-byte real number (long floating-point) display
D A	ASCII display

Example

```
>d 100
00000100  86 74 CD 70 E8 95 98 BA  B1 B6 EB D2 7F 2A 99 4E
>d main
80000029  F8 FE F8 DD 16 00 00 00  00 08 DD 19 00 00 00 00
>dw main
80000029  FEF8 DDF8 0016 0000  0800 19DD 0000 0000
>dd main,/o
80000029  33576177370 00000000026  03167204000 00000000000
```

INFLUENCES

On-the-fly function

E

Change specified memory contents

```
E [<address S>][,<data>]
EB [<address S>][,<data>]
EW [<address S>][,<data>]
ED [<address S>][,<data>]
ES [<address S>][,<data>]
```

These commands change the contents of memory at the specified addresses in units of 8 bits, 16 bits, or 32 bits.

When changing the data with a real number, the contents of memory at the specified addresses are replaced with a 4-byte real number.

Option	Use	When omitted
<address>	Start address for change	Starts from the next address that follows the address used for the last E command.
<data>	Data values to be written (up to 16 values)	Enters data input mode, displays the specified address and the current memory contents in ASCII, octal, decimal, or hexadecimal, and waits for the new data to be input.

E /EB	Byte (8 bits) change
E W	Word (16 bits) change
E D	Double word (32 bits) change
E S	4-byte real number (short float) change

Reference: Data input mode rules

(1) After the contents of memory at the specified address are displayed, the function enters data input mode. Up to 16 data values, delimited by commas, can then be input. With the E command it is also possible to input a character string of up to 16 characters enclosed by single quotation marks (').
(2) To proceed to the next address without making any changes, simply press the Return key. The next address and the contents of that address are then displayed, and the function enters data input mode.
(3) To return to the previous address, input a minus sign ("–"). The previous address and the contents of that addrss are then displayed, and the function enters data input mode.
(4) In data input mode, the address can be changed to a specified address by inputting "org<address> ↵", or simply "/<address> ↵".
(5) Input ".↵" to terminate the E command.

Example

```
>e sec
address  asc oct  dec hex data
0000000C '£' 243  -93 A3  0
0000000D '.' 373   -5 FB  0
0000000E '!' 041   33 21  5
0000000F 'I' 111   73 49  -
0000000E '.' 005    5 05  -
0000000D '.' 000    0 00  /100
00000100 '.' 206 -122 86  0
00000101 't' 164  116 74  0
00000102 'Õ' 315  -51 CD  .
>
```

A verify error will occur if a value is changed in data RAM with unmounted bits (such as a special register area), write-only data RAM, or read-only data ROM.

INFLUENCES

On-the-fly function

C

Compare specified memory contents

C <address S>,<address E>,<address D>

This command compares the contents of memory from <address S> to <address E> with the contents of memory starting from <address D>; if a difference is found, the addresses and data are displayed in the Command window.
If the differences do not fit in the window, a message asking whether or not to continue the comparison appears. To stop, press CTRL + C; to continue, press any other key.

Example

```
>d 0,2f
00000000  DC 06 00 00 00 FF 24 00  01 F2 F0 D7 00 2D 00 20
00000010  F1 00 60 20 04 29 FC 08  FB F8 FE FC FC FF 0D 00
00000020  00 00 F8 FE 04 CA F4 CB  CB F8 FE F8 DD 16 00 00
>d 80000000,8000002f
80000000  DC 06 00 00 00 CB 24 00  01 F2 F0 90 00 2D 00 20
80000010  F1 00 60 20 04 29 FC C1  FB F8 FE FC FC FF 0D 00
80000020  00 00 F8 FE 04 CA F4 CB  CB F8 FE F8 DD 16 00 00
>
>c 0,2f,80000000
 Start to compare.
00000005  FF  CB  80000005
0000000B  D7  90  8000000B
00000017  08  C1  80000017
 End to compare.
>
```

INFLUENCES

On-the-fly function

F

Fill specified range of memory with data value

```
F <address S>,<address E>,<data>
FB <address S>,<address E>,<data>
FW <address S>,<address E>,<data>
FD <address S>,<address E>,<data>
```

These commands fill memory from <address S> to <address E> with the value <data>.

When the length of <data> is shorter than the address range, <data> will be repeated until the specified range of memory is filled. From 1 to 16 data items can be specified for <data>.

F / FB	Byte (8 bits) fill
F W	Word (16 bits) fill
F D	Double word (32 bits) fill

! The fill function cannot be used in the special register areas.

Example

```
>d 80000000,8000003f
80000000  DC 06 00 00 00 CB 24 00  01 F2 F0 90 00 2D 00 20
80000010  F1 00 60 20 04 29 FC C1  FB F8 FE FC FC FF 0D 00
80000020  00 00 F8 FE 04 CA F4 CB  CB F8 FE F8 DD 16 00 00
80000030  00 00 08 DD 19 00 00 00  00 08 DC F9 FF FF FF DF
>f 80000000,8000002f,55
>d 80000000,8000003f
80000000  55 55 55 55 55 55 55 55  55 55 55 55 55 55 55 55
80000010  55 55 55 55 55 55 55 55  55 55 55 55 55 55 55 55
80000020  55 55 55 55 55 55 55 55  55 55 55 55 55 55 55 55
80000030  00 00 08 DD 19 00 00 00  00 08 DC F9 FF FF FF DF
>
```

INFLUENCES

On-the-fly function

M

Block transfer of specified range of memory

M <address S>,<address E>,<address D>

This command performs a memory block transfer of the contents of memory from <address S> to <address E> to a position in memory starting at <address D>.

Example

```
>d 0,2f
00000000  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF
00000010  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF
00000020  FF FF FF FF FF FF FF FF  FF FF FF FF FF FF FF FF
>d 80000000,8000002f
80000000  DC 06 00 00 00 CB 24 00  01 F2 F0 90 00 2D 00 20
80000010  F1 00 60 20 04 29 FC C1  FB F8 FE FC FC FF 0D 00
80000020  00 00 F8 FE 04 CA F4 CB  CB F8 FE F8 DD 16 00 00
>m 80000000,8000002f,0
>d 0,2f
00000000  DC 06 00 00 00 CB 24 00  01 F2 F0 90 00 2D 00 20
00000010  F1 00 60 20 04 29 FC C1  FB F8 FE FC FC FF 0D 00
00000020  00 00 F8 FE 04 CA F4 CB  CB F8 FE F8 DD 16 00 00
>
```

A block transfer cannot be made to special regiter areas.

INFLUENCES

On-the-fly function

S

Memory pattern search

```
S <address S>,<address E>,<search pattern>
SB <address S>,<address E>,<search pattern>
SW <address S>,<address E>,<search pattern>
SD <address S>,<address E>,<search pattern>
```

These commands display the addresses in memory, from <address S> to <address E>, where the data matches <search pattern>.

Option	Use
<address S>	Search starting address
<address E>	Search ending address
<search pattern>	Up to 16 items of data can be specified; up to 16 characters enclosed in single quotation marks (') can be specified for <search pattern> in the S and SB commands.

S / SB	Byte (8 bits) search
S W	Word (16 bits) search
S D	Double word (32 bits) search

Example

```
>d 80000000,8000002f
80000000  DC 06 00 00 00 FF 24 00  01 F2 F0 90 00 2D 00 20
80000010  F1 00 60 20 04 29 FC C1  FB F8 FE FC FC FF 0D 00
80000020  00 00 F8 FE 04 CA F4 CB  CB F8 FE F8 DD 16 00 00
>s 80000000,8000002f,ff
80000005
8000001D
>
```

R

Display/change register value

```
R
R {<register name>|<flag name>}
<register name>+REG=<value>
<flag name>+FLG=<value>
```

These commands display and change the contents of registers.

The register and flag names that can be used with the R command are listed below:

<register name>	A0, A1, A2, A3, D0, D1, D2, D3, MDR, LIR, LAR, SP, PC, PSW	
<flag name>	C	(carry flag)
	Z	(zero flag)
	N	(negative flag)
	V	(overflow flag)
	IE	(interrupt enable flag)
	IM	(interrupt mask level)

R

This command displays the contents of all registers and flags in hexadecimal.

R {<register name>~

This command displays the contents of <register name>/<flag name> and then waits for input.

If a value is input at this point, the value in the register is replaced with the new value. Pressing just the Return key returns control to the C source code debugger without changing the value in the register.

<register name>+REG=<value>
<flag name>+FLG=<value>

These commands change the value of the specified register/flag.

To change the status of a flag, code "flag name + FLG". (For example, to change the C flag, use "CFLG".)

Reference: If the Register window is left open (F2 or CTRL + 4), the most recent register contents can always be seen.

Example

```
>r
--- IM=0 S=0 D0 =00000000 D1 =00000000 D2 =00000000 D3 =00000000
PSW=0000     A0 =00000000 A1 =00000000 A2 =00000000 A3 =00000000
PC =40000000 MDR=00000000 LIR=00000000 LAR=00000000 SP =00000100

   jmp   0x80000000
>d0reg=12345678
>r
--- IM=0 S=0 D0 =12345678 D1 =00000000 D2 =00000000 D3 =00000000
PSW=0000     A0 =00000000 A1 =00000000 A2 =00000000 A3 =00000000
PC =40000000 MDR=00000000 LIR=00000000 LAR=00000000 SP =00000100

   jmp   0x80000000
>cflg=1
>r
—C— IM=0 S=0 D0 =12345678 D1 =00000000 D2 =00000000 D3 =00000000
PSW=0004     A0 =00000000 A1 =00000000 A2 =00000000 A3 =00000000
PC =40000000 MDR=00000000 LIR=00000000 LAR=00000000 SP =00000100

   jmp   0x80000000
>_d2=abcdef
>r
—C— IM=0 S=0 D0 =12345678 D1 =00000000 D2 =00ABCDEF D3 =00000000
PSW=0004     A0 =00000000 A1 =00000000 A2 =00000000 A3 =00000000
PC =40000000 MDR=00000000 LIR=00000000 LAR=00000000 SP =00000100

   jmp   80000000
>
```

NO INFLUENCES

On-the-fly function

H

Display expression operation results

```
H <expression>
H <expression 1>,<expression 2>
```

These commands display the expression operations.

H <expression>

This command displays the specified expression in octal, decimal, hexadecimal, and ASCII.

H <expression 1>, <expression 2>

This command displays the results of addition and subtraction of the values of the two expressions <expression 1> and <expression 2>.

In addition, this command also displays the 8-byte real number (long float) value of the two expressions when combined into 64 bits (with <expression 1> as the upper 32 bits and <expression 2> as the lower 32 bits).

! The H command handles all expressions as 32-bit values. For example, when the decimal number “–1” is displayed as a hexadecimal number, it is displayed not as “0xffff” but as “0xffffffff”.

Example

```
>h 1234>>8
          oct          dec       hex      asc
      00000000022       18     00000012   '....'
>h 1a+b
          oct          dec       hex      asc
      00000000045       37     00000025   '...%'
>h 20*5
          oct          dec       hex      asc
      00000000240      160     000000A0   '...†'
>
```

NO INFLUENCES

On-the-fly function

PRINTF/PF

Display format

PRINTF <format>[,<parameter>]

PF <format>[,<parameter>]

This command displays data in a format similar to that of the "printf" function in C.
The PRINTF command and the PF command perform the same function.

<parameter>

Up to 10 data items with a 16-bit data width can be specified.
Two parameters are required for the long (32-bit) format specification.

Minus sign ("–")

This sign is used to left-justify the converted parameter in its field.

Value (decimal indicating the field width)

The converted value or character string is displayed in a field specified by the numeric value. If a numeric value or character string field is shorter than the field width specified by the value, the left end of the field (or the right end if the left-justification specification was made with the minus sign) is filled out with blanks.

Conversion characters

&d	Converts the parameter to a decimal number.
&u	Converts the parameter to an unsigned decimal number.
&x	Converts the parameter to a hexadecimal number.
&o	Converts the parameter to an octal number.
&c	Handles the parameter as a character.
&s	Handles the parameter as a character string.

Reference:
- The symbol “&” is used as the equivalent of the conversion start character “%” in the “printf” function in C.
- The field format can be specified between “&” and the conversion character (“d”, “c”, “s”, etc.).
- Just as in C, the “/” symbol is used as an escape character.

Example

```
>?sec
(int [2]) @0000200C {7, 3}
>pf ‘&x’,sec
200C
>pf ‘&x’,*sec
7
>pf ‘&x’,*sec|10
17
>pf ‘&x’,*sec&4
4
>pf ‘&x’,*sec&8
0
>r
—CN- IM=0 S=0 D0 =00000007 D1 =00000000 D2 =00ABCDEF D3 =00000000
PSW=0006      A0 =00002000 A1 =00000000 A2 =00000000 A3 =00000000
PC=0x80000094 MDR=8000007A LIR=40000000 LAR=00000000 SP =00001FE0

   jmp  800000C3
>pf ‘&x’,mdrreg
8000007A
>
```

NO INFLUENCES

On-the-fly function

X

Display currently registered symbols

```
X
X <symbol name>
```

This command displays the names and contents of the currently registered global symbols.

X	This command displays all symbols.
X <symbol name>	This command displays the symbols specified by <symbol name>.

The wildcard characters "*" and "?" (which function in the same manner as the MS-DOS wildcard characters) can be used in the <symbol name> specification.

*	Matches all patterns
?	Matches all individual characters

Unlike normal symbol description, the underscore character ("_") that the C compiler adds to the front of all symbol names cannot be omitted in the <symbol name> specification.

Example

```
>x
00000000 _i
00000004 _test
0000000C _sec
80000000 _Reset
80000029 _main
8000002C _0main
80000042 _initialize
80000042 _0initialize
8000004C _display
8000004C _0display
80000056 _0cnt60
80000056 _cnt60
8000009F _init_data
8000009F _0init_data
>
>tmp1=80001234
Registered symbol name.
>x
00000000 _i
00000004 _test
0000000C _sec
80000000 _Reset
80000029 _main
8000002C _0main
80000042 _initialize
80000042 _0initialize
8000004C _display
8000004C _0display
80000056 _0cnt60
80000056 _cnt60
8000009F _init_data
8000009F _0init_data
80001234 tmp1
>
>tmp1=*
>x
00000000 _i
00000004 _test
0000000C _sec
80000000 _Reset
80000029 _main
8000002C _0main
80000042 _initialize
80000042 _0initialize
8000004C _display
8000004C _0display
80000056 _0cnt60
80000056 _cnt60
8000009F _init_data
8000009F _0init_data
>__debinf__=*
>x
No debugging information found.
>d 100
00000100  86 74 CD 76 E8 95 98 BA  B1 B6 EB D2 7F 2A 99 4E
>j=*100
Registered symbol name.
>x
76CD7486 j
>
```

NO INFLUENCES

On-the-fly function

■ Register/change/delete symbol

```
[.] <symbol name>=<address>

    <symbol name> ↵ <address>

[.] <symbol name>= *
```

These commands are used to register, change, or delete symbols.
The period [“. ”] at the start of the line may be omitted.

[.] <symbol name> =<address>

This command sets (registers) the immediate <address> for <symbol name>.

. <symbol name> ↵ <address>

This command inputs the symbol name and then its setting value.
If “.<symbol name>” is input in the C source code debugger’s command mode, the mode changes to one-line keyboard input mode, even from within a macro command, and then the program waits for the setting value to be input. This input method is useful when setting data within a macro. In the case of this specification, the period [“.”] may not be omitted.

[.]<symbol name>=*

This command deletes the specified symbol from the symbol table.
The C source code debugger has a special reserved symbol “_ _DEBINF_ _”. If the following line is input:

_ _DEBINF_ _=* ↵

all registered symbols will be deleted. In this case, the source line information is also deleted.

Symbols are used as variables in macro commands. An example is shown below.

Example

```
i=0
do {
T       ; Single-step execution command
i=i+1
} while i<3
```

In this example, the symbol “i” is used as a loop variable in the DO{..}WHILE command. This sample macro code causes three steps to be executed.

When registering a symbol with the same name as a CPU register name [☞ R command], the period (“.”) cannot be omitted. If the period is omitted, the command will be interpreted as a “change register” command.

Example

```
>x
00000000 _i
00000004 _test
0000000C _sec
80000000 _Reset
80000029 _main
8000002C _0main
80000042 _initialize
80000042 _0initialize
8000004C _display
8000004C _0display
80000056 _0cnt60
80000056 _cnt60
8000009F _init_data
8000009F _0init_data
>tmp1=80001234
Registered symbol name.
>tmp1=80000020
Registered symbol name.
>x
00000000 _i
00000004 _test
0000000C _sec
80000000 _Reset
80000020  tmp1
80000029 _main
8000002C _0main
80000042 _initialize
80000042 _0initialize
8000004C _display
8000004C _0display
80000056 _0cnt60
80000056 _cnt60
8000009F _init_data
8000009F _0init_data
80001234 tmp2
>__debinf__=*
>x
No debugging information found.
>
>d 100
00000100  86 74 CD 76 E8 95 98 BA  B1 B6 EB D2 7F 2A 99 4E
>j=*100
Registered symbol name.
>x
76CD7486 j
>k=*100&ffff
Registered symbol name.
>x
00007486 k
76CD7486 j
>
```

7 Code Display/Change

The C source code debugger displays the source code or the results of disassembly in the Code window. Changes in the displayed contents can easily be referenced by using Window commands to switch between the source code and the disassembled code. The V and U Dialog commands can also be used to execute similar processing.

[☞ Chapter 6, “Window Commands”]

V command

This command displays the source code in the Code window.

U command

This command displays the disassembled results in the Code window.

A command

This command performs line assembly.

K command

This command back traces the C stack frame.

NO INFLUENCES

On-the-fly function

V

Display source lines from specified position in Code window

```
V [.][<file name>:][<line>]

V <symbol>
```

These commands display the specified source lines in the Code window.

V [.][<file name>:][<line>]

This command displays the contents of the file specified by <file name>, starting from the specified line.

If the <line> specification is omitted, the first line of the file is assumed. If <file name> is omitted, the source file currently displayed in the Code window is assumed. The V command also permits the specification of a file without source information. In other words, it is possible to load any ASCII file into the Code window, in a similar manner to a text editor.

V <symbol name>

This command displays a source file containing the function specified by <symbol name>.

The F1 Window command can be used to open the file selection window and change the displayed file.

!

- If a file that has no source line information is opened with the V command, source level execution within the file and command input with source line specifications are not possible.
  If the environment variable PANASRC has been set, the V command displays the files in the directory specified by PANASRC. If PANASRC is not set, the V command displays the files in the current directory.
- Even if the line number is omitted, the ":" after the file name is required.

Example

Display the source code in the Code window, starting from the location where the symbol "init_data" is defined.

Displays the file "startup. asm" in the Code window.

```
>v init_data
>v startup.asm:
```

[☞ Chapter 6, Window Commands for the U command]

V

INFLUENCES

On-the-fly function

U

Display disassembled code

```
U [<address>]
UPUSH [<address>]
UPOP
UEND
UX [<address S>][,<address E>]
```

These commands display one screen of disassembled code in memory, starting from <address>, in the Code window or the Command window.

The display of disassembled code in the Code window can be easily scrolled up and down by using the ↑ and ↓ keys, or the ROLL UP and ROLL DOWN keys.

U [<address>]	This command displays the disassembled code, starting from the specified address, in the Code window. Valid symbols can be used in the <address> specification.
U P U S H [<address>]	This command PUSHes the current displayed address onto the address stack (an 8-level internal stack) and then displays the disassembled code, starting from the specified address.
U P O P	This command POPs the last address that was UPUSHed onto the stack and displays the disassembled code, starting from that address.
U E N D	This command displays the disassembled code, starting from the last address that was UPUSHed onto the stack.
U X [<address S>] [<address E>]	This command displays the disassembled code, starting from the specified address, in the Command window. If <address E> is specified, the code is displayed in the Command window up to that address. If <address E> is omitted, as many lines of code as are needed to fill the Command window are displayed. This command is useful for saving the results of disassembly in a file.

[☞ ">" command]

Example

Display the disassembled code in the Command window, starting from the symbol “main”.

Save the disassembled code output in addresses 80000000 to 8000005F in the file “test.log”.

```
>u main
>ux cnt60
_cnt60:
SAMPLE.C:0043:        sec[0]++;
80000056 FCA40C000000    mov  (0x0C _sec ),d0
8000005C 40              inc  d0
8000005D FC810C000000    mov  d0,(0x0C _sec )
>
>>test.log
>ux 80000000,8000005f
>>
>
```

[☞ V command and A command]

Reference: Disassembled code display rules

(1) Differentiating register names and immediate values
In order to differentiate register names from immediate values, immediate values are displayed in upper-case letters.
<Example>

MOV	d0,	a0	D0 register → A0 register
MOV	D0,	a0	Immediate value 0xd0 → A0 register

(2) The display of disassembled code in the Code window can be scrolled up and down by using the ↑ and ↓ keys, or the ROLL UP and ROLL DOWN keys.
However, when the ↑ or ROLL UP key is pressed, if the first address that is displayed happens to be an operand, the display is shifted so that the subsequent instruction is displayed.

A

Input assembly language line

A [<address>]

If the A command is input, the system enters mnemonic input mode, displays the specified address, and waits for a mnemonic to be input.

If the <address> specification is omitted, input starts at the next address following the last address used by the A command.

The mnemonic that is input is then assembled, and the resulting instruction code is stored in memory at the specified address. If the mnemonic that was input is correct, the machine language code that was stored in the address is displayed to the right of the address, and then the system begins waiting for the next input.

Press the [Return] key to return to the C source code debugger's command mode from assembly language input mode.

Reference: Subcommands in assembly language input mode

/<address>	Changes the address.
ORG<address>	Changes the address.
↵ (Return)	Proceeds to the next address.
–	Returns to the previous address
<symbol>:	Registers a symbol.
DB<data>	Stores 8-bit data.
DW<data>	Stores 16-bit data.
DD<data>	Stores 32-bit data.

! In order to differentiate hexadecimal immediate values that begin with the letters "A" through "F" from register names, add a zero in front of the immediate value.

Example

Change the address to 80000062. →

"???" indicates an input error. →

```
>a 80000000
80000000                add 16,sp
80000003                jmp 80000062
80000006                /80000062
80000062                add &ffee,sp
???
80000062                add ffee,sp
80000068                .
>
```

[☞ V command and U command]

K

Back trace

```
K
```

This command back traces the C stack frame and displays the process (addresses) by which the current function was called from the "main" function.

If back tracing is selected for the Option window, the most recent back trace information is always displayed in the Option window.

! The K command is valid only in C debugging mode.

8 Watch Display

The C source code debugger is equipped with a function that displays the contents of memory, variables, and other information important for debugging work in the Watch window in the specified format. This function can be used to continuously display the most recent contents of data at those checkpoints that must be monitored most carefully during debugging. As a result, it is possible carry out debugging work smoothly, without interruption and without the need to input data display commands each time a break or trace is executed, as is required in conventional debuggers.

INS command

This command displays the contents of the specified C expression or symbol.

W command

This command registers the specified memory contents or variables for watching.

VAL/? command

This command displays the contents of a C expression or variable.

Y command

This command deletes the specified watch point.

Global variable: **INFLUENCES**
Local variable: **CANNOT BE USED**

On-the-fly function

INS

Inspect

INS <variable name>[,<function name>]

This command displays the specified variable, array, or bit value in the Inspect window according to the variable data.

Local variables can be displayed by specifying <function name> for the function in which that local variable is used. If <function name> is omitted, the current function is assumed.

The following local commands can be used.

F4 (Zoom)	When inspecting pointers, arrays, or structs, this command enlarges the window to fill the screen. This function is extremely useful when referencing an array with a large number of elements, etc. If this key is pressed again while the window is enlarged to fill the screen, the window is reduced to its original size.
F5 (16 < > 10)	In the scalar display, values are displayed in both decimal and hexadecimal format. However, if the number of elements in an array or struct is such that they cannot all be displayed on one line, they are displayed in either decimal format (default) or hexadecimal format, not both. The F5 key is used to switch the base.
F6 / Ctrl+I / I (Inspct)	This command displays an array or struct element that is selected (highlighted) through the use of the cursor keys in a newly opened Inspect window. The ESC key is used to close the current Inspect window.
F7 / Ctrl +W / W (Watch)	This command registers the variable that is inspected, or the element that is selected, for watching in the Watch window.

F8 / Ctrl + V / V (View)	This command displays the variable that is inspected, or the element that is selected, for viewing in the Command window.
F9 / Ctrl +R / R (Range)	This command changes the array or pointer display element number or the maximum element number.

If these keys are pressed, the window that is used to input the number of the element to be referenced opens. At this point, the current display element and the maximum element number are displayed, highlighted. Input the new display element number and maximum display element number (may be omitted). During line input, the history and line edit shell functions can be used.

This command is extremely useful when referencing a large array or when referencing the area around a pointer.

F10 (Change)	This command changes the value of the variable that is inspected, or the element that is selected. The variables that can be changed by this command must have either the scalar attribute (char, int, etc.) or the pointer attribute.

Pressing this key opens a window that is used to input the new value (expression). Once the expression has been input, it is evaluated; if no errors are found, the value of the variable is changed to the new value. During line input, the history and line edit shell functions can be used.

[☞ Chapter 6, section 2-1 for the Inspect function]

Global variable: **NO INFLUENCES**
Local variable: **CANNOT BE USED**

On-the-fly function

W

Register watch

```
W <address>[,<count>][,{/H|/D|/O}]
WB <address>[,<count>][,{/H|/D|/O}]
WW <address>[,<count>][,{/H|/D|/O}]
WD <address>[,<count>][,{/H|/D|/O}]
WA <address>[,<count>][,{/H|/D|/O}]
WS <address>
W? C expression
```

These commands register the specified memory contents or symbol for watching.

Just as with the D command, the watch specification has a number of display patterns (formats). When an address or symbol is registered for watching, its content is displayed in the Watch window in the specified format.

<count> specifies the number of data items to be displayed in one line, up to a maximum of 29 (0x1D). WA (only) supports a maximum of 99 (0x63).

Option	Use	When omitted
<address>	Watch address	Error
<count>	Number of data items displayed on one line	1 data item is displayed; in the case of WA, 32 characters are displayed
/H	Hexadecimal display specification	Hexadecimal display
/D	Decimal display specification	Hexadecimal display
/O	Octal display specification	Hexadecimal display

W / W B	Byte (8 bits) display
W W	Word (16 bits) display
W D	Double word (32 bits) display
W A	ASCII display (8-bit units)
W S	4-byte real number (short floating point) display
W ?	C expression display

Example

```
>W SEC
>W? SEC[1]
>W 100,5
>
```

[☞ Y command]

Reference: Some C variables, such as local variables, have a limited scope (range of use). As a result, some variables cannot be evaluated, depending on the position of the program counter. In case such as when local variables are assigned to registers automatically by the C compiler, the value of the C expression in the Watch window changes to "????".

Global variable: **NO INFLUENCES**
Local variable: **CANNOT BE USED**

On-the-fly function

VAL/?

Evaluate C expression

```
VAL <C expression>[,<function name>]
VAL <variable name>[,<function name>]
? <C expression>[,<function name>]
? <variable name>[,<function name>]
```

This command displays the contents of a C expression or a variable.

Local variables can be displayed by specifying <function name> for the function in which that local variable is used.

If <function name> is omitted, the current function is assumed.

V A L <C expression>~
? <C expression>~

These commands display the expression type and its value.

V A L <variable name>~
? <variable name>~

These commands display the variable type, variable name, and variable value.

The “*” and “?” wild cards can be used in <variable name>.

*	Matches all patterns
?	Matches all single characters

For example, if the command “? ab*↵” is input, all variables that begin with “ab” are displayed.

When displaying a C expression or variable that has multiple elements, such as an array, the elements are enclosed in rounded brackets (“{}”) and as many elements as will fit on one line are displayed.

The VAL command can use substitution operators and operators with secondary effects, such as “++” or “– –”. If an operator with a secondary effect is used with the “?” command, the message “Operator with possible harmful side effect cannot be used” is displayed and an error is generated.

- When only referencing data, do not use the VAL command; use the “?” command.
- When using an operator that has a secondary effect, such as changing data, use the VAL command. Doing so will eliminate inadvertent changes to variables in a program resulting from mistakes in the evaluation of C expressions (for example, mixing up “==” and “=”).
- In the VAL command and the “?” command, all variables contained in a C expression must be in a usable state.

The following example uses a cast operator as an example of how to use the “?” command. Proper use of the cast operator makes it possible to display the contents of memory in an easy-to-understand format.

Example

```
>d sec
0000000C  08 00 00 00 03 00 00 00  00 00 00 00 00 00 00 00  ................
>? sec
(int [2]) @0000000C {8,3}
>d
0000001C  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  ................
>
```

[☞ Chapter 6, section 3-1 “Inspect function”]

NO INFLUENCES

On-the-fly function

Y

Delete watch

```
Y {<list>|*}
```

This command deletes the watch registrations set with the W command.

If <list> is specified, the watch registrations with the specified numbers are deleted. If “*” was specified, all watch registrations that were set are deleted and the Watch window is closed.

```
Y  1, 2, 7 ↵
```

In the above example, watch registrations 1, 2 and 7 are deleted.

```
Y  * ↵
```

In this example, all watch registrations are deleted and the Watch window is closed.

[☞ W command]

9 System Control Commands

The Dialog commands listed below are provided for system control, such as quitting the C source code debugger, and for help, subprocesses, and history.

Q/EXIT command

This command quits the C source code debugger.

HELP command

This command displays a help message.

! command

This command executes a subprocess.

!!/! command

This command displays/searches the command history.

INFLUENCES

On-the-fly function

Q/EXIT

Quit C source code debugger

```
Q
EXIT
```

E

These commands quit the C source code debugger and return control to MS-DOS.

However, if a subprocess is running when this command is issued, the C source code debugger cannot be terminated. In such a case, the following error message is displayed and control returns to the C source code debugger prompt:

"Not terminated subprocess."

In this case, terminate the subprocess first and then execute the Q/EXIT command.

Q

NO INFLUENCES

On-the-fly function

HELP

Display help screen

HELP

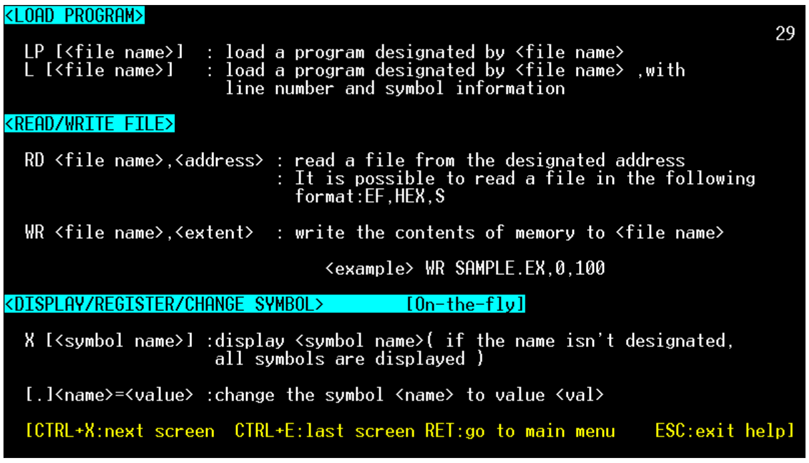
This command switches to the help display screen and displays the help menu. The highlighting on the screen can be moved to the desired menu item by using the →, ←, ↑, or ↓ key.

When the [Return] key is pressed, the content of the item selected on the help menu is displayed. To return to the debugging menu, press the ESC key.

In order to use the C source code debugger's help function, the help file PT103. HLP must be located either in the current directory or in the directory specified by the environment variable HELP.

After the command is input, the screen switches to the help screen.

Sample screen



```
<LOAD PROGRAM>
                                                                      29
  LP [<file name>]   : load a program designated by <file name>
  L [<file name>]    : load a program designated by <file name> ,with
                       line number and symbol information

<READ/WRITE FILE>

  RD <file name>,<address> : read a file from the designated address
                           : It is possible to read a file in the following
                             format:EF,HEX,S

  WR <file name>,<extent>  : write the contents of memory to <file name>

                                <example> WR SAMPLE.EX,0,100

<DISPLAY/REGISTER/CHANGE SYMBOL>        [On-the-fly]

  X [<symbol name>] :display <symbol name>( if the name isn't designated,
                      all symbols are displayed )

  [.]<name>=<value> :change the symbol <name> to value <val>

  [CTRL+X:next screen  CTRL+E:last screen RET:go to main menu    ESC:exit help]
```

On-the-fly function

NO INFLUENCES

!

Execute subprocess

```
!

! ␣ <MS-DOS external command name>
```

It is possible to execute MS-DOS commands in parallel with debugging.

H

An MS-DOS command initiated by the “!” command is called a “subprocess.” Once a subprocess is initiated by the “!” command, it is possible to switch back and forth between the subprocess and the C source code debugger by means of certain key sequences (multi-job function).

CTRL + 1 (numeric keypad):	Shifts from C source code debugger to subprocess
CTRL + 0 (numeric keypad):	Returns from subprocess to C source code debugger

This function makes it possible to startup an editor as a subprocess and perform debugging work while referencing the source listing. In addition, by using the overlap function and correcting and assembling the program in the subprocess, it is possible to load the executable file again.

!	This command executes COMMAND.COM.
! ␣ <MS-DOS external command name>	This command executes the specified MS-DOS external command (.COM, .EXE).

Symbol

- This function does not run processes simultaneously (multi-tasking). The subprocess does not run until control is switched to it. In addition, the different processes do not handle files in an exclusive fashion from each other. Therefore, the subprocess must not modify or delete files that the C source code debugger is using (such as the environment variable TEMP or the TMP work file, etc.). In addition, some applications cannot be used as subprocesses.

- In order to differentiate this command from the history display and search command, always insert at least one space or tab between the "!" and <character string>.

! <MS-DOS external command name>	Subprocess initiation
! <character string>	History display/search

- The message "Insufficient memory" may be output after inputting the "! ␣" command or an MS-DOS external command.
  In this case, if EMS memory is available for use, the problem can be resolved by specifying the -F or -B option when starting up the debugger so that EMS memory is used.

[☞ Chapter 5 for the startup options]

[☞ Chapter 6, section 2-6 "Shell functions"]

NO INFLUENCES

On-the-fly function

!!/!

Display/search history

```
! !

! <character string>
```

The C source code debugger has an internal 16-level command line input buffer that can be used to display up to the last 16 command lines that were input. It is also possible to search for character strings in the buffer, from most recent to oldest. The information displayed by this command can be freely edited within the Command window.

! !	This command displays the previous command that was input (history display).
! <character string>	This command searches for a character string in the history buffer that begins with <character string>, starting from the most recent command. If a character string that meets the condition is found, it is displayed.

In order to differentiate this command from the subprocess initiation command, do not insert a space or tab between the “!” and <character string>.

!␣<MS-DOS external command name>	Subprocess initiation
! <character string>	History display/search

[☞ Chapter 6, section 2-6 “Shell functions”]

10 Other Commands

The C source code debugger is provided with other commands for Command window display control (cursor control, clear screen, etc.), memos, option settings, log output, and batch execution.

CLS command

This command clears the Command window.

HOME command

This command moves the Command window cursor to the home position.

LIST command

This command enables Command window display output.

NLIST command

This command disables Command window display output.

BEL command

This command sounds a beep.

TIME command

This command displays the current time.

WAIT command

This command causes the system to wait.

PRMPT command

This command changes the prompt.

* command

This command specifies comments.

> command

This command outputs a log of the Command window display contents.

< command

This command performs batch processing.

MEM (memo) command

This command displays, registers, and deletes memos.

N command

This command selects the base used for parameters as either decimal or hexadecimal.

OPTION command

This command sets options.

NO INFLUENCES

On-the-fly function

CLS

Clear Command window screen

```
CLS
```

This command clears the Command window.

This command is used in combination with the HOME, PRINTF/PF, LALL, and SALL commands for display control within macro commands.

[☞ HOME command]

NO INFLUENCES

On-the-fly function

HOME

Move cursor to home position

```
HOME
```

This command moves the Command window cursor to the home position (the left end of the command input line).

This command is used in combination with the CLS, PRINTF/PF, LALL, and SALL commands for display control within macro commands.

[☞ CLS command]

On-the-fly function

NO INFLUENCES

LIST

Specify display output

```
LIST
```

This command resumes Command window display output after it has been suppressed by the NLIST command.

The LIST state is the default state when the C source code debugger is started up. The LIST command and the NLIST command have opposing functions.

[☞ NLIST command, SALL command, and LALL command]

On-the-fly function

NO INFLUENCES

NLIST

Suppress display output

```
NLIST
```

This command suppresses Command window display output.

This command can be used to suppress the display of unnecessary data. The NLIST command and the LIST command have opposing functions.

[☞ LIST command, SALL command, and LALL command]

NO INFLUENCES

On-the-fly function

BEL

Sound beep

```
BEL
```

This command causes the host computer to beep.

This command can be used in macro commands, etc., to sound a beep.

NO INFLUENCES

On-the-fly function

TIME

Display current time

```
TIME
```

This command displays the current time in the Command window.

Example

```
>time
11:45:17
>
```

NO INFLUENCES

On-the-fly function

WAIT

Wait

WAIT [<count>]

This command causes the system to wait either until a key is pressed or until the specified time (<count> x 0.1) elapses.

If <count> is omitted, the system waits until a key is pressed.

This command can be used in macros to cause the system to wait.

Example

```
>wait     ;Stops for one second
>wait     ;Waits until a key is pressed
>
```

NO INFLUENCES

On-the-fly function

PRMPT

Change prompt

PRMPT <prompt character>

This command changes the prompt used by the C source code debugger.

When the C source code debugger is first started up, the prompt character is “>”. Only one character can be specified for <prompt character>.

Example

```
>prmpt %
%prmpt !
!prmpt >
>
```

NO INFLUENCES

On-the-fly function

*

Comment

```
* [<character string>]
```

This command allows the use of comments (specified in <character string>).

Therefore, anything may be written in <character string>; it will not affect the operation of the C source code debugger in any way.

Use this command in macros, etc., to include comments in the code.

Example

```
>* This is a comment.
>
```

NO INFLUENCES

On-the-fly function

>

Output log

```
> <file name>

>> <file name>

>
```

The C source code debugger is provided with a log output function that outputs the information that is output to the command window during debugging to a file simultaneously with the screen display.

> <file name>	This command creates a new file with the specified <file name> and begins log output to that file. If the specified file already exists, that file is deleted and a new one is created. The <file name> specification can include a drive name and path name.
> > <file name>	This command adds (appends) the screen output information to an existing file. If the specified file does not already exist, a new file is created. The <file name> specification can include a drive name and path name.
>	This command stops the log output operation.

Example

```
>>test.log
>UX 0,1FF
>>
>>>test1.log
>t 10
>>
>
```

Appends log information to the file "test1.log" → `>>>test1.log`

Stops the log output operation → `>>`

NO INFLUENCES

On-the-fly function

<

Batch

```
< <file name>
```

This batch function inputs and executes a series of commands from a file instead of from the keyboard.

The C source code debugger sequentially executes the commands that it reads from the file that was specified by this command. The file name can include a drive name and path name. This function is similar to batch processing in DOS, and is useful for repeated execution of a predetermined sequence of operations. However, unlike DOS batch processing, it is not possible to pass parameters to this function. If the ability to pass parameters is needed, use a macro function.

In addition, if the INIT.MCR file is located in the current directory when the C source code debugger is started up, the C source code debugger loads and executes automatically. This file is equivalent to the AUTOEXEC.BAT file in DOS.

In other words, by writing any preprocessing (such as loading the user program) essential for program debugging in this file, it is possible to automatically execute that processing when the C source code debugger starts up.

The batch function is useful if used for macro definition (registration). Although macros can be defined from within the C source code debugger, it is also possible to use a text editor to write large macros outside of the C source code debugger, and then use the batch function to register those macros in the C source code debugger.

It is also possible to use the MLIST command to load macros written in a file. Batch execution can be interrupted by pressing the ESC key.

Example

Execute commands from the file “m1.mcr” →

```
><m1.mcr
.
.
.
.
>
```

[☞ MLIST command and macro definition]

NO INFLUENCES

On-the-fly function

MEM

Display/register/delete memo

MEM <number>[,<character string>]
MEM*
MEM

These commands are used to display, register, and delete memos.

The contents of the memos are displayed in the Memo window, one of the Option windows. A character string set by the MEM command can also be called up by the CTRL + SHIFT + function key sequence.

M E M <number> [,<character string>]

This command registers the specified character string in the memo indicated by <number>.

If <character string> is omitted, any memo registered in the specified memo number is deleted.

M E M *

This command deletes all of the memos that are currently registered.

M E M

This command displays the contents of the memos that are currently registered.

Example

```
>mem1,Panasonic
>mem2,PanaX
>mem3,MN10300
>mem
MEMO 1 : Panasonic
MEMO 2 : PanaX
MEMO 3 : MN10300
>mem2
>mem
MEMO 1 : Panasonic
MEMO 3 : MN10300
>mem *
>mem
>
```

[☞ Chapter 6, section 2-7 for the Memo command]

NO INFLUENCES

On-the-fly function

N

Change input format base

N {10|16}

This command changes the base for parameters input in Dialog commands to either decimal or hexadecimal.

When the C source code debugger starts up, the base is 16.

N 10	Changes the input base to 10.
N 16	Changes the input base to 16.

Example

```
>N 10
```

On-the-fly function

NO INFLUENCES

OPTION

Set option

OPTION <reg>[,<code>[,<case>]]

This command can be used to set various C source code debugger options. The items that can be set by this command can also be displayed/changed by using the Window command SHIFT + F10. The options that can be set by this command are listed below.

Option	Parameters	Description
<reg>	(ON|OFF)	Register window display control
<code>	(SRC|ASM)	Code window source/disassembled code display switching
<case>	(ON|OFF)	Symbol name uppercase/lowercase discrimination on/off

Example

```
>option ON,SRC,OFF
>option OFF
>
>
```

Chapter 8
Macro Commands

1 Macro Command Overview

1-1 Macro function

The macro function makes it possible to construct new commands by combining existing commands. In the C source code debugger, it is possible to create sophisticated macro commands by using a wide variety of commands and powerful macro control structures.

The features of the C source code debugger's macro function are listed below.

(1) The macro function supports control structures similar to those used in C, making it possible to describe easy-to-understand macros in a block format without using GOTOs.
(2) It is possible to nest up to 255 IF statements, making it possible to handle different possibilities with tremendous detail.
(3) It is possible to nest up to 15 macros, so that separate macros can be used as subroutines and expanded within other macros.
(4) Up to 10 parameters can be passed to a macro command.
(5) It is possible to define macro commands that use combinations of cursor control commands, the PRINTF/PF command, etc., to create formatted screen output, and that use combinations of symbol definition functions to perform interactive processing.

Macro commands can be used in the same manner as the C source code debugger's internal commands. In other words, there is no special command that is needed in order to execute a macro command. A macro command can be interrupted by using the ESC key.

By using special symbols, execution control commands can be used to make even more efficient debugging possible. Some specific examples are shown below.

Example

```
{test1
bp sec,w
do{
    g
    while{__run__
    }
}while val(sec[0]!=9)
}
```

This macro sets a hardware break at the address assigned to the variable “sec”. The 3rd through 7th lines form a “do{}while” loop, and as long as the condition sec!=9 that follows the “do{}while” loop is not met, the G command is executed.

Example

```
{TEST2
  bp .45
  ti run
  g
  while{_ _run_ _
  }
  if{val(sec[1]==1)
     g
  }
  if {_ _run_ _!=1
       ti
  }else{
       esc
       pf 'Forced break was executed'
  }
}
```

In this example, a break point is set in the 45th line first. The third line measures the execution speed of the timer command. The fourth line initiates execution. Then, in the 9th line, if the user program is stopped, the time required to execute from the 45th line to the 45th line is displayed and the macro is exited. On the other hand, if the user program is running in the 9th line, the macro inputs “ESC”, displays a message indicating that fact, and exits the macro. (User program execution can be interrupted by inputting ESC from within a macro.)

These are just two examples of how macros can be used to make more efficient debugging possible. This function can also be used in durability testing by collecting the results of macro command execution in a file and determining whether the same commands yield the same results.

2 Macro Commands

The following Dialog commands are provided as macro definition/execution commands and as control commands supported by the C source code debugger to provide control structures similar to those in C.

DO{ }WHILE command

This command executes do{..}while macro control.

FOR{ }command

This command executes for{..} macro control.

WHILE{ }command

This command executes while{..} macro control.

REPEAT{ }command

This command executes repeat macro control.

BREAK command

This command exits a macro.

LALL command

This command specifies display output by a macro.

SALL command

This command suppresses display output by a macro.

MLIST command

This command displays the registered macros.

KILL command

This command deletes registered macros.

IF{ } command

This command executes a command under conditional control.

KEYIN command

This command specifies input from the keyboard.

{< > < >}

Execute macro command

```
{<macro name><macro body>}
```

This command defines a macro command.

<macro name> is the name of the macro being defined.

If {<macro name> ↵ is input, the macro input prompt "?" appears and the system waits for the input of the body of the macro being defined.

Multiple internal commands and macro commands can be freely written in the <macro body> portion; there is no limit on the number of commands that can be included, except for the capacity of the macro buffer.

No error checking of the commands is performed while <macro body> is being input. Error checking is performed only when the macro is executed. The input of <macro body> is terminated by inputting "} ↵". If a macro is defined with the same name as an internal command of the C source code debugger, the following error message appears:

"Conflicting Dialog command."

In addition, if a macro is defined with a name that is the same as that of a previously defined macro, the old macro definition is deleted.

A macro command cannot be defined from within a macro command.

In other words, macro commands can only be defined in the C source code debugger command input mode (when the ">" prompt is displayed).

Reference: The user can change the ">" prompt to a different character by using the PRMPT command.

While this command can be used to define simple macro commands after the C source code debugger has been started up, large macro commands can be more easily described by using an editor beforehand and then using the batch function for macro registration.

In addition, in order to save macro commands that were defined within the C source code debugger, it is possible to use the MLIST command to write the macros to a file.

Example

```
>{TEST1
? bp sec, ex
? do{
?      g
?      while{_ _run_ _
?      }
? }while val(sec[0]!=9)
?}
>
```

[☞ < command and MLIST command]

Notes on macro description

(1) An error will result if the description “%0” is made within a macro.

Example of a description that generates an error:

```
{test
while{_ _ run _ _
}
repeat {wi0, wi1, wi2
d %0
}
}
```

In order to implement “%0” in a macro, use “%%”.

Example of a description that does not generate an error:

```
repeat {wi0, wi1, wi2,
d %%0
}
```

(2) In the case of <macro command>{<parameter list, etc.>}, a space between the macro command and the “{” will prevent the macro from being properly recognized. The “{” should follow immediately after the macro command.

Examples where macro is recognized normally:

```
for{<command 1>,<expression>,<command 2>
<macro body>
if{<parameter list>
```

Examples where macro is not recognized normally:

```
for␣{<command 1>,<expression>,<command 2>
<macro body>
if␣{<parameter list>
```

[ ]

Execute macro command

```
<macro name>[<parameter list>]
```

A defined macro can be executed with the same input format as an internal command of the C source code debugger. In other words, there is no special command that is needed in order to execute a macro command. (As long as the C source code debugger prompt is displayed, a macro command can be executed simply by inputting the macro name.)

In addition, up to 10 parameters can be specified for a macro command. The parameters are delimited by commas. The parameters specified in the macro command replace the pseudo-parameters %0, %1, ..., %9 within <macro body> when the command is executed.

%0	Corresponds to the first parameter in the macro command
%1	Corresponds to the second parameter in the macro command
	.
	.
	.
%9	Corresponds to the tenth parameter in the macro command

A macro command that is executing can be interrupted by pressing the ESC key. When specifying parameters, commas (“,”) and single quotation marks (’) can be enclosed in square brackets ([..]) when they are included within a character string so that the string is treated as a single parameter. In this case, the square brackets are deleted from the character string when it is passed to the macro as a parameter.

Example

```
>{calc
?h %0
?}
>calc 1,2
>h 1
      oct     dec       hex      asc      float
00000000001      1  00000001  '....'  0.000000e+00
>calc [1,2]
>h 1,2
      oct     dec       hex      asc      float
+: 00000000003   3  00000003  '....'  0.000000e+00
-: 37777777777  -1  FFFFFFFF  '....'  -6.805647e+38
double: 0.000000000000000e+00
>
```

DO{ }WHILE

Macro control execution

DO {<macro body>} WHILE <expression>

In the same manner as a macro command definition, if “DO{↵” is input, the macro input prompt “?” is displayed and the system enters macro input mode. Multiple commands and macros can be freely written in the <macro body> portion; there is no limit on the number of commands that can be included, except for the capacity of the macro buffer.

The input of <macro body> is terminated by inputting “{WHILE<expression>↵”.

After the entire <macro body> is executed, the value of <expression> is evaluated. If the value is 0, the macro terminates; if the value is not 0, <macro body> is executed again, starting from the beginning. The commands in <macro body> are always executed at least once in a DO{..}WHILE macro.

Example

```
{test3
reset
do{
  t
}while val(sec[0]!=9)
}
```

[☞ Macro command definition]

FOR{ }

Macro control execution

FOR {<command 1>,<expression>,<command 2><macro body>}

In the same manner as a macro command definition, if "FOR{<command 1>,<expression>,<command 2>}↵" is input, the macro input prompt "?" is displayed and the system enters macro input mode. Multiple commands and macros can be freely written in the <macro body> portion; there is no limit on the number of commands that can be included, except for the capacity of the macro buffer.

The input of <macro body> is terminated by inputting "}↵".

In the FOR{..} macro, <command 1 > is executed and then the value of <expression> is evaluated. If the value is 0, the macro terminates; if the value is not 0, <macro body> is executed from the beginning. After <macro body> is executed, <command 2> is executed and then <expression> is evaluated again. <macro body> and <command 2> are then executed in turn until the value of the expression is 0. In the FOR{..} macro, if the value of <expression> is 0 the first time it is evaluated, the commands in <macro body> are not executed even once.

Example

```
{fort
 for{j=0x100,j<0x200,j=j+1
    e j,ff
 }
}
```

This macro command writes the data specified by parameter 3 in every other byte in memory, starting from the address indicated by parameter 1 and continuing to the address indicated by parameter 2.

[☞ Macro command definition]

WHILE{ }

Macro control execution

WHILE {<expression><macro body>}

In the same manner as a macro command definition, if “WHILE{<expression> ↵” is input, the macro input prompt “?” is displayed and the system enters macro input mode. Multiple commands and macros can be freely written in the <macro body> portion; there is no limit on the number of commands that can be included, except for the capacity of the macro buffer.

The input of <macro body> is terminated by inputting “}↵”.

In the WHILE{..} macro, the value of <expression> is evaluated first. If the value is 0, the macro terminates; if the value is not 0, <macro body> is executed from the beginning. After <macro body> is executed, <expression> is evaluated again. <macro body> is executed continually until the value of the expression is 0. In the WHILE{..} macro, if the value of <expression> is 0 the first time it is evaluated, the commands in <macro body> are not executed even once.

Example

```
>while{_PC!= 4000009f
?t
?}
>
>
```

This macro command step executes the program until the PC register reaches 0x4000009f.

[☞ Macro command definition]

REPEAT{ }

REPEAT {..}   Macro control execution

REPEAT {<parameter list><macro body>}

In the same manner as a macro command definition, if “REPEAT{<parameter list>}↵” is input, the macro input prompt “?” is displayed and the system enters macro input mode. Multiple commands and macros can be freely written in the <macro body> portion; there is no limit on the number of commands that can be included, except for the capacity of the macro buffer.

The input of <macro body> is terminated by inputting “}↵”.

In the REPEAT{..} macro, the pseudo-parameter “%0” in <macro body> is replaced by each element in <parameter list>, one by one, as <macro body> is executed. Therefore, <macro body> is repeatedly executed a number of times equal to the number of elements in <parameter list>. The maximum number of parameters that can be specified is 10.

Example

```
>d 80000000
80000000  A3 06 86 00 ED CB 31 00  01 F2 F0 90 00 2D 00 20
>repeat{80000000,80000002,80000004,80000006
?e %0,ff
?}
>e 80000000,ff
>e 80000002,ff
>e 80000004,ff
>e 80000006,ff
>d 80000000
80000000  FF 06 FF 00 FF CB FF 00  01 F2 F0 90 00 2D 00 20
>
```

[☞ Macro command definition]

BREAK

Exit macro

BREAK

This command can only be used within the <macro body> portion of a macro command. If a BREAK command is executed in a macro, that macro is forcibly exited one level.

Example

```
>{chkgo
?bp .45
?while{1
? g
while{__run__
}
? if{val(sec[0]==9)
?  break
? }
?}
?}
>
```

In this example, when the IF condition in the CHKGO macro is satisfied, the BREAK command is used to exit the WHILE loop.

LALL

Macro display output specification

LALL

This command resumes display of the commands within the macro command and of the prompt in the Command window after such display was suppressed by the SALL command.

The C source code debugger is in the LALL state when it is started up. The LALL command and the SALL command have opposite functions.

Example

```
>{test
?sall
?t
?d 80000000
?lall
?t
?d
?}
>test
>sall
—— IM=0 S=0 D0 =00000000 D1 =00000000 D2 =00000000 D3 =00000000
PSW=0000    A0 =00002000 A1 =00000000 A2 =00000000 A3 =00000000
PC=80000008 MDR=00000000 LIR=80000006 LAR=00000000 SP =00002000

   add   -0C,sp
80000000  FC DC 00 20 00 00 F2 F0  F8 FE F4 FC CD 14 20 00
>t
—— IM=0 S=0 D0 =00000000 D1 =00000000 D2 =00000000 D3 =00000000
PSW=0000    A0 =00002000 A1 =00000000 A2 =00000000 A3 =00000000
PC=8000000B MDR=00000000 LIR=80000008 LAR=00000000 SP =00001FF4

   mov   2014,d1
>d
80000010  00 A5 00 C3 0F FC DC 00 00  00 00 00 60 50 29 FC
>
```

[☞ SALL command, LIST command, and NLIST command]

SALL

Macro display suppression specification

SALL

This command suppresses display of the commands within the macro command and of the prompt in the Command window.

The SALL command and the LALL command have opposite functions.

Example

```
>{test
?sall
?t
?d 100
?}
>
>test
>sall
—— IM=0 S=0 D0 =00000000 D1 =00000000 D2 =00000000 D3 =00000000
PSW=0000    A0 =00000000 A1 =00000000 A2 =00000000 A3 =00000000
PC=80000000 MDR=00000000 LIR=40000000 LAR=00000000 SP =00000100


   mov  2000  _i  ,a0
00000100  D7 16 B1 F0 E7 79 FD 7B  DE 1D D2 86 B7 8F 33 D3
>
>
```

[☞ LALL command, LIST command, and NLIST command]

MLIST

Display macros

```
MLIST
MLIST <macro name>
MLIST> <macro file name>
```

These commands display the macros.

MLIST	This command displays all of the macro names currently defined.
MLIST <macro name>	This command displays the macro body (the contents of the macro definition) of the macro command specified by <macro name>.
MLIST> <macro file name>	This command writes the contents of all of the currently defined macros into the file specified by <macoro file name>. This file can be loaded by means of the C source code debugger batch function ("<" command).

Example

```
>mlist
Q
TLALL
TSALL
>mlist tlall
sall
t
d10
lall
t
d
>mlist>macro.log
>
```

[☞ "<" command]

KILL

Delete macro

KILL <macro name>

KILL*

These commands delete currently registered macro commands.

KILL <macro name>	This command deletes the macro command specified by <macro name>.
KILL*	This command deletes all of the macro commands that were defined by the user.

Example

```
>mlist
BKSET
DISP
INIT
Q
RUN
>kill run
>mlist
BKSET
DISP
INIT
Q
>kill*
>mlist
Q
>
```

[☞ Macro command definition]

IF{ }

Conditional execution

IF {<expression><command>[} ELSEIF{<expression>]<command>[} ELSE{]<command>}

This macro command is valid only within a <macro body>. First, <expression> is evaluated, and if the value is not 0, the next <command> is executed. If the evaluated value is 0, the <command> that follows the ELSE that corresponds to the IF is executed.

Example

If the value of the program counter is "0x4000009f", dump the contents of memory, starting from the "sec" symbol address; otherwise execute five steps.

```
{chkgo
 g
 esc
 while{__run__
 }
 if{_PC==0x4000009f
    d sec
 }else{
    t 5
 }
}
```

If the data in address 70 is "8", output the message; otherwise, output the data in address 70.

```
{chkram
 t 5
 if{(*70&0xff)==8
    pf'test OK'
 }else{
    pf'&x',*70&0xff
 }
}
```

KEYIN

Specify input from the keyboard

KEYIN

This command is used within a user-defined macro command to ask for the next line to be input from the keyboard.

Example

```
>{setd
?e 80000100
?11
?22
?33
?44
?keyin
?66
?.
?}
>setd
>e 80000100
address  asc oct  dec hex data
80000100 ‘.’ 370   -8 F8  11
80000101 ‘.’ 347  -25 E7  22
80000102 ‘.’ 003    3 03  33
80000103 ‘$’ 044   36 24  44
80000104 ‘¡’ 301  -63 C1  55
80000105 ‘&’ 046   38 26  66
80000106 ‘{‘ 173  123 7B  .
>
```

In this example, the “55” in address 80000104 was input from the keyboard; all of the other data was input through macro expansion.

Chapter 9
Appendix

1 In-circuit Emulator Specifications

1-1. Functional Specifications

Item		Specifications
Target device	MN10300 Series	
Memory capacity	Emulation memory	1024K (standard) (high-speed memory:512K, low-speed memor:512K) 2560K (maximum) (high-speed memory:512K, low-speed memory:2048K)
Break functions	Execution address breaks	4 events maximum Conditions: area specification, pass count specification
	Data breaks	4 events maximum Conditions: area specification, pass count specification, bit mask, read/write/access specification, data width specification, match/no match specification
	AND breaks	Available
	Sequential breaks	8 levels
	"Trace full" breaks	Available
	External breaks	None
Trace functions	Trace memory capacity	16K steps
	Data acquired through tracing	Execution address, data address, data, bus status information
	Trace mode	Normal mode, branch trace mode, event condition trace mode
Timer functions	Measurement mode	Continuous measurement mode, maximum/minimum execution time measurement mode
	Time measurement resolution	Switchable among 25ns/50ns/ 100ns
Trigger output function	Trigger outputs	8 signals
RAM monitor function	Sample memory	256 bytes
	Display mode	Dump list mode Bitmap mode
Performance measurement function	Profile measurement	Execution ratio (%) display
Clock	OSC1	Target side (separate excitation only)
XI	Target side	(separate excitation only)

1-2. Electrical Specifications

Item	Rating
Emulator and probe supply voltage	0.5 to 3.6V
Trigger output voltage	-0.3 to 3.6V
Trigger output current	±4mA

1-3. Environment Specifications

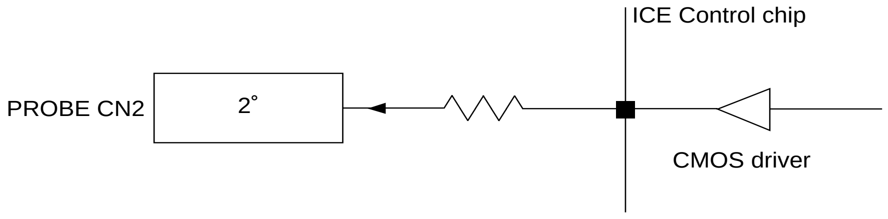
Item		Rating
Temperature	During operation During storage	10°C to 30°C 0°C to 45°C
Humidity	During operation During storage	20% to 80% No more than 90%

1-4. External Dimensions

Length x Width x Height	130mm x 100mm x 40mm

1-5. Target Interface

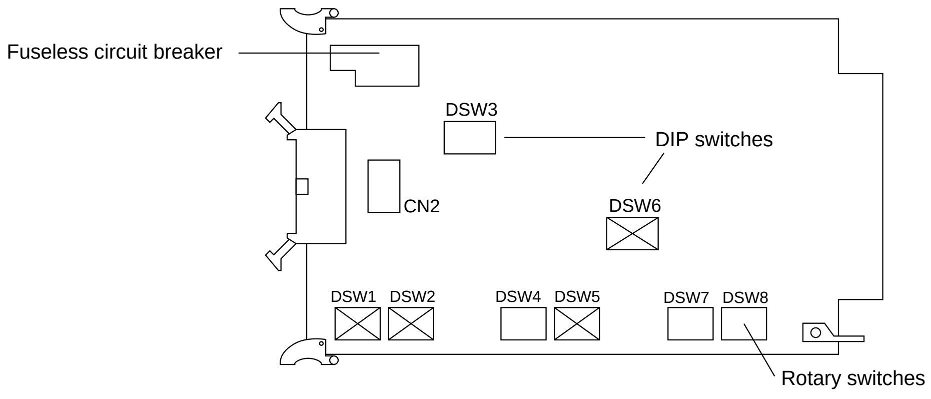
Trigger output section (PROBE CN2)



2 Interface Board Switch Settings

The interface between the host computer and the In-circuit Emulator uses one byte of I/O space in the host computer. Only the lower eight bits of the I/O address are decoded. The upper eight bits are used within the board. Set the interface board switches in accordance with the computer system being used. Although any address may be used as an I/O address, as long as it is an unused address, the addresses shown in the table that follows should normally be set.

2-1. When the Host Computer is the PC-9800 Series



The function of the fuseless circuit breaker is to protect the 5V power supply from damage due to overcurrent. If overcurrent flows through the breaker for any reason, the white button pops out and the current is interrupted. If the fuseless circuit breaker is tripped, determine what the cause was before pushing the white button back in. When pushing the white button, do not use too much force.
The white button is deemed to have popped out when it extends 1 or 2 mm out from the fuseless circuit breaker when viewed from above.

• Rotary switch settings (DSW1,2,4,5,7,8)

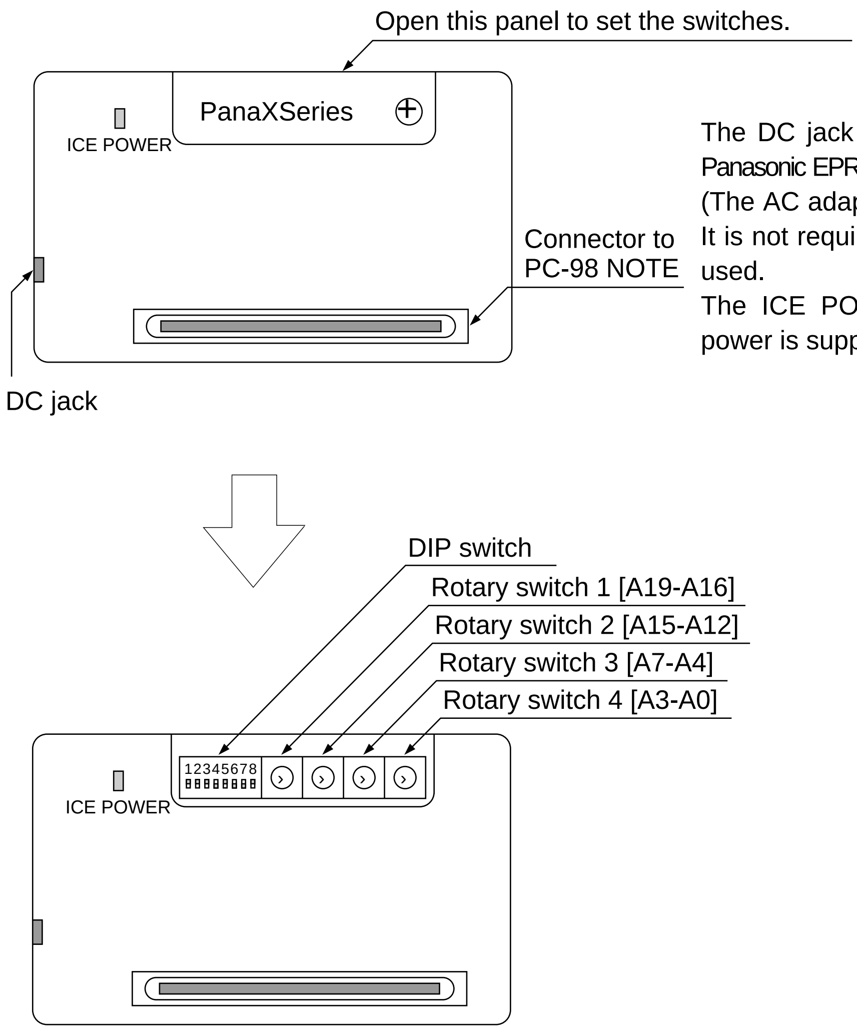
I/O address	DSW1	DSW2	DSW4	DSW5	DSW7	DSW8
xxD0H	--	--	0	--	D	0
xxD1H	--	--	0	--	D	1
:	:	:	:	:	:	:
xxDFH	--	--	0	--	D	F
xxE0H	--	--	0	--	D	F
xxE1H	--	--	0	--	E	1
:	:	:	:	:	:	:
xxEFH	--	--	0	--	E	F

Note: "The "-" indicates any position is fine.
Set an unused address from xxD0H to xxEFH as the I/O address.

• DIP switch (DSW3, 6) settings

	1	2	3	4
DSW3	OFF	OFF	ON	ON
DSW6	OFF	OFF	OFF	ON

2-2. When the Host Computer is the PC-98 NOTE Series



The DC jack is used to supply the power for Panasonic EPROM programmers used independently. (The AC adapter, sold separately, is required.) It is not required when the power for PanaX is used.
The ICE POWER indicator lights when the power is supplied from the DC jack.

- Rotary Switch (DSW1 to 4) settings

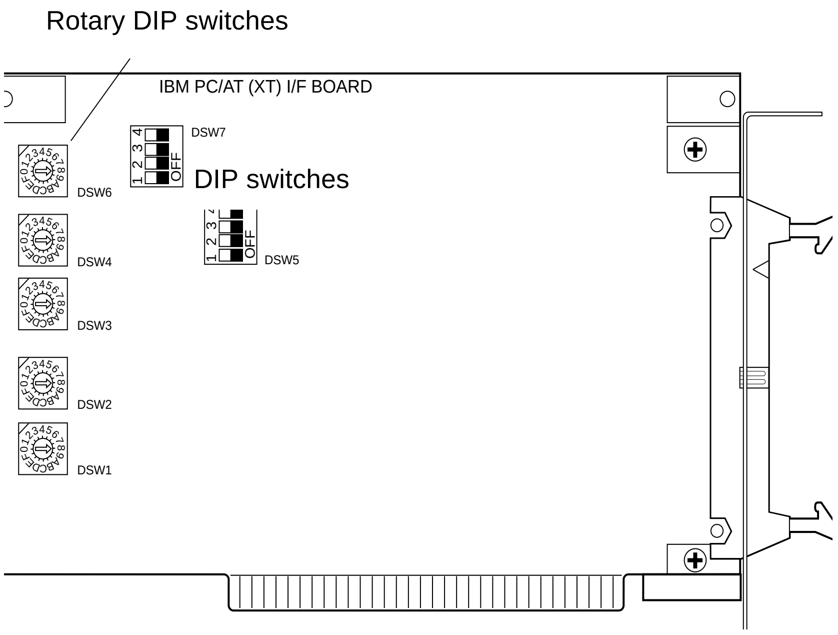
I/O address	DSW1	DSW2	DSW3	DSW4
xxD0H	–	–	D	0
xxD1H	–	–	D	1
:	:	:	:	:
xxDFH	–	–	D	F
xxE0H	–	–	E	0
xxE1H	–	–	E	1
:	:	:	:	:
xxEFH	–	–	E	F

Note: The “-” indicates any position is fine.
Set an unused address from xxD0H to xxEFH as the I/O address.

- DIP switch settings

1	2	3	4	5	6	7	8
ON	ON	OFF	OFF	ON	ON	ON	OFF

2-3. When the Host Computer Is a PC/AT (DOS/V Series) Machine



- Rotary switch (DSW1, 2, 3, 4, 6) settings

I/O address	DSW3	DSW2	DSW1	DSW4	DSW6
0300H	3	0	0	–	–
0301H	3	0	1	–	–
:	:	:	:	:	:
030FH	3	0	F	–	–
0310H	3	1	0	–	–
0311H	3	1	1	–	–
:	:	:	:	:	:
03FFH	3	F	F	–	–

Note: "-" indicates any position is fine.
Set an unused address from 0300 to 03FFH as the I/O address.

- DIP switch (DSW5, 7) settings

	1	2	3	4
DSW5	OFF	OFF	OFF	ON
DSW7	OFF	ON	ON	ON

3 Special Notes on the Probe

3-1. Electrical Specifications

The absolute maximum ratings and electrical characteristics are the same as those of the microcomputer inside the probe. When power is supplied from the target, the supply voltage must be between -0.5V and 3.6V, and while the unit is in operation, stable voltage between 2.5V and 3.6V must be supplied. Operation is not guaranteed if the supply voltage is not stable.

3-2. Environment Specifications

Item		Ratings
Temperature	During operation	10°C to 30°C
	During storage	0°C to 45°C
Humidity	During operation	20% to 80%
	During storage	No more than 90%

4 C Source Code Debugger Error Messages

The C source code debugger displays an error message when an error is found in a command that was input by the user.
The C source code debugger error messages are explained below.

Not enough memory.

The C source code debugger could not be started up because there is not enough available memory. Restart the C source code debugger with the -B or -F option.

EMS driver not found./Not enough free space in EMS.

This error message appears when an attempt was made to use EMS memory as a work area with the -FEMS or -BEMS option, but either the EMS driver could not be found or there was not enough free space in the EMS memory. Check the EMS-related settings in the CONFIG.SYS file.

Help file not found.

The PT103.HLP file was not found. Place the PT103.HLP file either in the current directory or in the directory specified by the environment variable HELP.

The Emulator is operating abnormally (free-run timer error).

The timer in the in-circuit emulator is not operating properly. If this error occurs, contact us at the address indicated at the end of this manual.

The Emulator is operating abnormally (profile address latch error).

The profile address latch function (get execution address function) in the in-circuit emulator is not operating properly. If this error occurs, regardless of whether or not the target system is operating correctly, contact us at the address indicated at the end of this manual.

The emulator controller power is off.

The in-circuit emulator could not be started up because the emulator controller power is off. Turn the power adapter on and restart the C source code debugger.

The target system power is off.

The target system power is off. Turn the target system on and restart the C source code debugger. When starting up the C source code debugger without a target system, use the -NOTARGET option.

The “-NOTARGET” option cannot be specified while a target system is connected.

Only specify the “-NOTARGET” option when using the in-circuit emulator by itself without connecting a target system. The “-NOTARGET” option cannot be specified while a target system is connected.

The emulator controller is not outputting any voltage.

The C source code debugger could not be started up because the emulator controller is not outputting any voltage. If this error occurs, contact us at the address indicated at the end of this manual.

Check for an address conflict, etc., with the interface board.

Check to see whether the interface board address and the address set by the Installer (PINS103.EXE) are the same.

Monitor program loading failed.

The loading of the Monitor program (MON103.EX) failed. There is most likely a problem either in the hardware or in the Monitor program file.

Monitor program (MON103.EX) not found.

The Monitor program file (MON103.EX), which is needed in order to start up the C source code debugger, was not found. Copy the MON103.EX file either into the current directory or into the directory specified by the environment variable PATH.

Monitor program initialization failed.

The Monitor program was not started up. There is most likely a problem either in the hardware or in the Monitor program file.

Wrong Monitor program version.

The C source code debugger could not be started up because the Monitor program is the wrong version. Copy the Monitor program file that is suited to this Debugger either into the current directory or into the directory specified by the environment variable PATH.

Overvoltage from the target system was detected.
Turn off all power, eliminate the cause of the problem, and then restart.

Overvoltage from the target system was detected. Turn off all power, and then check the target system for any problems.

An error occurred in communications between the Emulator and the microcontroller.

An error occurred in communications between the in-circuit emulator and the microcontroller. Check whether the microcontroller is hung up or if there is a problem in the target system.

Quit the Debugger.

A problem occurred in the in-circuit emulator, microcontroller, or emulator controller (including cases where the power is off). Quit the Debugger immediately.

Execute the INIT command.

Execute the INIT command to initialize the in-circuit emulator because a problem occurred in the in-circuit emulator.

Execute the RESET command.

Execute the RESET command to initialize the microcontroller because a problem occurred in the microcontroller.

Insufficient overlap area.

There is insufficient overlap area (free disk space). Either use the -B option to reduce the size of the debugging information area or the macro registration area, or else allocate free space on the disk.

Cannot be used in overlap mode.

An attempt was made to execute a command that cannot be used in overlap mode.

Illegal command name.

The specified command name could not be recognized as a C source code debugger internal command or as a macro command.

Illegal command format.

The command input format, parameter specification method or number of parameters is incorrect.

Illegal parameter.

The parameter specification method or number of parameters is incorrect.

Illegal address specification.

This error occurs when either an address that is not appropriate for the address input field was input, or the start address and end address are reversed. This error also occurs when an unregistered symbol name was used.

Illegal data specification.

This error occurs when a value that is not appropriate for the data specification field (because it is outside of the allowable range, etc.) was specified. This error also occurs when an unregistered symbol name was used.

Illegal alignment.

This error occurs when the address alignment for the F or S command is not correct (i.e., an odd address was specified for 16-bit data or an address that is not a multiple of four was specified for 32-bit data).

C equation calculation error.

An error occurred in a C equation calculation in the “?” command or the VAL command.

C variable not found.

The C variable specified by the “?” command or the VAL command was not found.

Operators with secondary effects cannot be used.

Operators with secondary effects (=, +=, –=, etc.) cannot be used in the “?” command. Use the VAL command with operators with secondary effects.

A macro cannot be defined within a macro.

Define macro commands at the C source code debugger command level. Macro commands cannot be defined within a macro command.

A macro cannot be deleted within a macro.

Delete macro commands at the C source code debugger command level. Macro commands cannot be deleted within a macro command.

Macro name duplicates an internal command.

The macro name that was being defined matches the name of an internal command of the C source code debugger. Use a different macro name.

Insufficient macro registration area.

Either the macro command registration area is full, or else too many macro commands are being defined. Use the -B option to expand the macro command registration area and then start up the C source code debugger.

Macro command definition was not terminated properly. { }

There is an error in the correspondence of the brackets ("{}") within the macro command definition.

Macro nesting has exceeded 15 levels.

Macro commands can be nested (i.e., a macro command can be executed from within a macro command) up to a maximum of 15 levels.

Specified file not found.

The specified file was not found.

Specified file cannot be opened.

The specified file could not be opened. Confirm that the file exists. This error also occurs if there are too many files open at one time.

File cannot be created.

The file could not be created, either because there is not enough free disk space, or because there are too many files open at one time. First, confirm the amount of free disk space; if there is adequate disk space, close any unnecessary files.

Insufficient free disk space.

There is not enough free disk space.

Checksum error.

A loading operation failed because there is a problem in a Motorola S format or Intel HEX format file.

Illegal file format.

Subprocess execution failed because of a problem in the contents of the MS-DOS command file (execution format: .COM/.EXE).

No debugging information found.

The debugging information was not found when an execution format file (Matsushita EX format) was loaded with the L command. Compile/assemble the file with the option that outputs debugging information.

Bad debugging information.

There is a problem in the format of the debugging information. This error should normally not occur; if it does occur and it is reproducible, contact us at the address indicated at the end of this manual.

Insufficient debugging information area.

There is no free space in the debugging information area. Use the -B option to enlarge the debugging information area and then start up the C source code debugger.

Subprocess not terminated.

When a subprocess has been started up, the C source code debugger cannot be quit before the subprocess is terminated. Terminate the subprocess first, before quitting the C source code debugger.

Cannot return to PICE without terminating the subprocess.
(Press the space bar to return to the subprocess.)

It was not possible to return to the C source code debugger because the subprocess is using too much memory. Terminate the subprocess first, before returning to the C source code debugger.

Corresponding command does not exist.

The help screen could not be displayed because the specified command does not exist.

User program cannot be executed because the reset pin is low.

A user program could not be executed because the user reset pin is low. Set the user reset pin high before executing the user program.

User program cannot be executed.

The user program cannot be executed. Check the target system for any problems.

The stack pointer cannot be set to an address that is not a multiple of four.

The stack pointer must be set to an address that is a multiple of four. This error occurs if the stack pointer is set to an address that is not a multiple of four and an attempt is made to execute a user program.

Stack pointer cannot be set to internal ROM area./
Stack pointer cannot be set to special register area./
Stack pointer cannot be set to an unmounted area.

The stack pointer can only be set to internal RAM, external memory, and emulation RAM areas. These errors occur if the stack pointer is set to any other area and then an attempt is made to execute a user program.

User reset was generated.

This warning message is displayed when a user reset was generated in the target system.

Data strobe error.

This error is generated when an external bus access in a user program does not terminate within a certain period of time.

Forced break failed.

Although a forced break was issued, the user program did not terminate. Check the target system for problems.

User program is running.

This error occurs when an attempt was made to execute a command that does not have an on-the-fly function while a user program was running.

User program is halted.

The TG and TS commands cannot be executed while the user program is halted.

Tracing is in progress.

The trace results cannot be displayed without halting the tracing operation.

Tracing has already been halted.

Because tracing has already been halted, the TS command cannot be used to halt tracing.

Tracing has not been halted.

Because tracing did not halt even though the trace halt processing was executed, the trace results cannot be displayed. Because it is likely that there is a problem with the in-circuit emulator, contact us at the address indicated at the end of this manual.

Trace contents have been cleared.

If the trace contents have been cleared or if tracing has not been performed even once since the C source code debugger was started up, the commands that display the trace results (TD and TDW) cannot be executed.

The delay counter specification is not correct.

An attempt was made to specify a value for the delay counter that was outside of the permitted range from 257 to 16,384.

Cannot be used after delay trigger has been tripped.

In delay trigger trace mode, tracing cannot be resumed (with the TG command) once tracing was halted because the conditions were met.

Canceling a trace event.

This warning message indicates that a trace event is being cancelled or disabled.

Event/break cannot be set. (32 maximum)

No more than 32 software breaks and hardware breaks in total can be set.

Software break has already been set at the same address.

A software break has already been set at the specified address. Multiple software breaks cannot be set at the same address.

Command cannot be registered.

A command could not be registered because there was insufficient area to register <command> with the BP ~ or /C<command> command.

No further events/breaks can be set.

Up to four execution address events can be set, up to four data events each can be set in internal data RAM and the external memory space, respectively, and a further 8 events total can be set. These numbers cannot be exceeded. (The same applies to hardware breaks.)

Event/break was not set.

This error occurs if a nonexistent break number was specified, or if a software break was specified in a location that calls for a hardware event/break.

Event status does not change.

Hardware events/breaks cannot be set or changed while the microcontroller is in a state where it does not operate, such as STOP, HALT, or SLEEP.

Could not map to the specified area.

An attempt was made to map emulation memory/extend memory to an area (internal RAM, special register area, etc.) that can not be mapped.

Could not map due to insufficient mapping blocks./
Could not map due to insufficient emulation blocks.

An attempt was made to map in excess of 8 emulation blocks.

Could not map due to insufficient emulation memory.

An attempt was made to map emulation memory in excess of the memory capacity installed in the in-circuit emulator.

Changing mapping addresses to 4KB units.

Although mapping is performed in 4KB units, if the addresses were specified in other than 4KB units, the C source code debugger adjusts the addresses so that they are in 4KB units before mapping. This warning message is displayed in such a case.

Changing time measurement to continuous mode.

This warning message indicates that time measurement was changed to continuous mode because a timer event was cancelled or disabled.

Paused time measurement.

Time measurement is paused if a timer event was changed while the user program was running with time measurement in partial mode. Furthermore, the measured results up to that point are cleared. This warning message is displayed in such a case.

Time measurement error occurred.

While the time measurement mode was partial mode, the length of time that the in-circuit emulator can measure was exceeded.

Time measurement not completed.

While the time measurement mode was partial mode, time measurement was not completed because a timer event (time measurement start/stop events) did not occur.

Time measurement events not set.

The time measurement start and stop events were not set when the time measurement mode was set as partial mode (measurement of time from the occurrence of one event until the occurrence of a different event).

Memory access failed. (timeout)

An emulation memory read or write operation failed. If this error occurs frequently, it is likely that there is a problem with the in-circuit emulator, so contact us at the address indicated at the end of this manual.

Verify error.

Data was not written to memory properly. This error occurs when data was written to an address in memory that has not been installed, or if a write was made to write-only I/O, etc.

Cannot write special registers.

A fill and block transfer (F or M command) cannot be made to the special register area.

Duplicate watch point specification.

A watch point specification with the same contents has already been made.

Watch point cannot be set.

This error occurs when an attempt was made to set more than 16 watch points.

Specified setting does not exist.

The watch point registration that was to be deleted by the Y command does not exist.

Sampling was not performed.

An attempt was made to display profile results before sampling the execution status of each function with the profile function.

PICE internal error.

This error message is displayed when an error occurs in the C source code debugger's internal processing. This error should normally not occur; if it does occur and it is reproducible, contact us at the address indicated at the end of this manual.

5 Quick Reference

5-1. Window Commands

■ Screen Control

Switch cursor (command/code)	HOME	
Move cursor one character to left	←	(CTRL+S)
Move cursor one character to right	→	(CTRL+D)
Move cursor up one line	↑	(CTRL+E)
Move cursor down one line	↓	(CTRL+X)
Move cursor one word to left	CTRL+A	
Move cursor one word to right	CTRL+F	
Move cursor to beginning of line	CTRL+Q•S	
Move cursor to end of line	CTRL+Q•D	
Scroll up one screen	ROLL UP	(CTRL+C)
Scroll down one screen	ROLL DOWN	(CTRL+R)
Move cursor to beginning of text	CTRL+Q•R	
Move cursor to end of text	CTRL+Q•C	
Enlarge Option window	CTRL+←	
Reduce Option window	CTRL+→	
Enlarge Command window	CTRL+↑	
Reduce Command window	CTRL+↓	
Redisplay screen	CTRL+J	
Maximize Command window	CTRL+Q•W	
Minimize Command window	CTRL+Q•Z	
Redisplay screen (and restore window to initial size)	CTRL+Q•J	
Display/hide Option window	F2	(CTRL+4)
Switch option window	CTRL+F2	(CTRL+O)
Switch between source and disassembled display	F3	
Switch between source and disassembled display (cursor specification)	CTRL+F3	

■ Execution/Breaks

Execute (Go)	F5
Execute up to cursor position (Come)	F7
Single-step execution (SglStp)	F8
Set/cancel break (software break) (Break)	F9
Function-step execution (FncStp)	F10
Forced break	ESC
Forcibly terminate command	CTRL+SHIFT+GRPH

■ Get/Select Text String

Get text string at cursor position (Get)	CTRL+F9	(CTRL+G)	
Select text string according to cursor position (Sel)	CTRL+F10		
Local commands for text string selection			
Register memo (Memo)	F1~F5,F10		
Inspect (Inspct)	F6	(CTRL+I)	(I)
Register watch (Watch)	F7	(CTRL+W)	(W)
Display view (View)	F8	(CTRL+V)	(V)
Get text string (Get)	F9	(CTRL+G)	(G)

■ File-related Commands

Switch source file	SHIFT+HOME	
Select file (File)	F1	
Search for text string (down↓) (Search)	F4	(CTRL+L)
Input/search for text string (down↓)	CTRL+Q•F	
Search for text string (up↑) (Srch↑)	CTRL+F4	(CTRL+B)
Stop search	ESC	

Process Control

Return to Debugger	CTRL+0
Go to subprocess	CTRL+1
Display/hide Option window	CTRL+4
Display/hide RAM monitor	CTRL+5

Shell

Backspace (delete one character)	BS		(CTRL+H)
Move cursor one character to left	←	SHIFT+←	(CTRL+S)
Move cursor one character to right	→	SHIFT+→	(CTRL+D)
Move cursor to beginning of line (Ln Top)	SHIFT+F4		(CTRL+A)
Move cursor to end of line (Ln Bot)	SHIFT+F5		(CTRL+F)
Delete one character at cursor position	DEL		(CTRL+G)
Delete all characters (Ln Can)	SHIFT+F7		(CTRL+U)
Switch between insert mode and replace mode	INS		(CTRL+V)
Display/find last history buffer	SHIFT+↑		(CTRL+W)
Display/find next history buffer	SHIFT+↓		(CTRL+Z)
Copy one character from history buffer (C1)	SHIFT+F1	SHIFT+→	(CTRL+D)
Display History window (Histry)	SHIFT+F2		
Copy from history buffer (CA)	SHIFT+F3		
Display Extended Symbol window (ExtSym)	SHIFT+F6		
Clear history buffer (All Can)	SHIFT+F8		

■ Others

Specify memo text string	CTRL+SHIFT+F1~F10	
Display/change option menu (Option)	SHIFT+F10	
Interrupt/quit Window command	ESC	
Interrupt display, interrupt step execution, etc.	STOP	(CTRL+C)
Pause/resume Command window display	CTRL+S	
Echo output to printer	CTRL+P	
Display help	HELP	

■ Referencing/changing data

Inspect variables (Inspct)	F6	(CTRL+I)	
Local commands for Inspection			
Zoom in/out (Zoom)	F4		
Change base (16<>10)	F5		
Inspect (Inspct)	F6	(CTRL+I)	(I)
Register watch (Watch)	F7	(CTRL+W)	(W)
Display view (View)	F8	(CTRL+V)	(V)
Specify array range (Range)	F9		(R)
Change value (Change)	F10		(C)
Register variable watch (Watch)	CTRL+F7	(CTRL+W)	
Display variable view (View)	CTRL+F8	(CTRL+V)	

5-2. Dialog Commands

■ Loading Programs

L [<file name>]	Loads both the program that is to be debugged and the debugging information for that program.
LP [<file name>]	Loads just the program that is to be debugged.

■ Reading/Writing Files

RD<file name>[,<address>]
: Loads the specified file at the specified address.

WR<file name>,<address S>,<address E>
: Writes the contents of memory in the specified range of addresses to the specified file.

■ Running Programs

T [<count>]	Runs a program under single-step execution. (F8)
P [<count>]	Runs a program under function-step execution. (F10)

G [=<address S>][,<address B>][,/W]
: Runs a user program. (F5, F7)
: /W : Runs a user program, with the on-the-fly functions disabled.

RESET	Resets the microprocessor.

■ Breaks/Events

EV<address S>[~<addressE>][,<status>][,<data>[,{/B|/W|/D}][,/N]][,/<count>]
: Sets an event.

<status>	EX	: Execution address event
	RW	: A data event is generated upon a read or write operation
	R	: A data event is generated upon a read operation
	W	: A data event is generated upon a write operation
	Omitted	: If <data> is specified, RW (a data event is generated upon a read or write operation) is assumed. If <data> is not specified, EX (execution address event) is assumed.
<access width>	Specifies the data access width for a data event.	
	/B	: An event is generated upon a 8-bit data access
	/W	: An event is generated upon a 16-bit data access
	/D	: An event is generated upon a 32-bit data access
	Omitted	: Access width does not matter

/N	An event is generated when the data does not match <data>.
EV /C {<list|*>}	When the specified event is generated, all event generation flags and counters are cleared.
EV	Displays the events that have been set.

BP <address S>[~<address E>][,<status>][,<data>[,{/B|/W|/D}] [,/N]][,/<count>] [,/C<command>]

Sets a break event. (F9)

<status>	EX	: Execution address break
	RW	: A data break is generated upon a read or write operation
	R	: A data break is generated upon a read operation
	W	: A data break is generated upon a write operation
	Omitted	: If <data> is specified, RW is assumed. If <data> is not specified, and <address E> or <count> is specified, EX is assumed. Otherwise, a software break is assumed.
<access width>	Specifies the data access width for a data break.	
	/B	: A break is generated upon an 8-bit data access
	/W	: A break is generated upon a 16-bit data access
	/D	: A break is generated upon a 32-bit data access
	Omitted	: Access width does not matter

/N	A break is generated when the data does not match <data>.
/C <command>	Executes <command> automatically after the break.
BP	Displays the breaks that have been set.
BPA <list>	Sets the break events specified in the list as AND breaks.
BPS <list>	Sets the break events specified in the list as sequential breaks.
BC/EC {<list>|*}	Cancels the break events specified in the list.
BD {<list>|*}	Temporarily disables the break events specified in the list.
BE {<list>|*}	Enables the break events specified in the list.

■ Hardware-related

TM [<mode>][{/B|/C|/S|/T[<count>],<event number>}]

Sets the trace mode.

<mode>	INT	: Internal RAM bus (default)
	EXT	: Extended RAM bus
	ALL	: Normal trace mode (default)
	JMP	: Branch trace mode
	<event number>	: Event conditional trace mode

/B	Breaks when the trace memory becomes full.
/C	Tracing continues until program execution is halted.
/S	Only tracing halts when the trace memory becomes full. (User program execution does not halt.)
/T [<count>],<event number>	After the event condition specified by <event number> has been met the number of times specified by <count>, tracing halts.
TM /F	Sets the default trace mode (INT,ALL,/C)
TM	Displays the current trace mode settings.
TG	Resumes tracing.
TS	Halts tracing.
TD	Displays the contents of trace memory (as a hex dump).
TDU	Displays the disassembled contents of trace memory.
Subcommands for trace display mode:	
[-]B	Displays the top (bottom) of trace memory.
P <pages>	Moves the display start frame the number of pages specified by <pages>, and then displays one page.
N <frame address>	Sets the display start frame to <frame address>.
D [<frame address S>][<frame address E>]	Displays the contents of the range of frames in hexadecimal.
L [<frame address S>][<frame address E>]	Displays the disassembled contents of the range of frames.
C	Hides frames labelled with “:”. Executing this command displays frames labelled with “:” again.
Q/.	Terminates trace display mode.
TDW	Displays the contents of trace memory in window mode.
TI [<mode>]	Sets the timer mode.
<mode>	RUN : Measures the time from the start of program execution until it halts.
	FIRST : Measures the time between events once.
	MIN/MAX : Continuously measures the time between events, and determines the maximum and minimum times.
/S<event number>	Specifies the event at which time measurement is to start.
/E<event number>	Specifies the event at which time measurement is to end.
TI <clock>	Sets the timer clock.
<clock>	/T1 : 25ns resolution
	/T2 : 50ns resolution
	/T4 : 100ns resolution
	/M : Microprocessor clock

TI STOP	Cancels timer mode.
TI	Displays the current timer mode and the timer value.
TRIG OUT <data>	Outputs the 8-bit port data <data>.
TRIG RAM <address>	Outputs the contents of <address> when the microprocessor accesses <address>.
TRIG EVENT	Outputs the event status.
TRIG	Displays the trigger outputs that are currently set.
MAPI/EXI <address S>,<address E>[,{/F|/S}]	Allocates memory to emulation RAM.
/F	Fast emulation RAM
/S	Slow emulation RAM
MAPE/EXE <address S>,<address E>	Allocates memory to a resource in the user target.
MAP/EX	Displays the memory allocation settings.

■ Measuring Performance

SM [<address>]	Specifies the starting address of the sample area.
SMB [<address>]	Specifies the address to be displayed at the bit level.
SMC <number>	Clears the address to be displayed at the bit level.
SMW	Displays the RAM monitor screen.
SM	Displays the current sample area.
PROF [<mode>]	Tabulates the subroutine access status. (Profile function)
<mode>	ON : Profile ON
	OFF : Profile OFF
	CLR : Clears the profile results.
PROF	Displays the profile results.

Memory

D [<type>][<address S>,<address E>][,<count>][,<base>]		
	Displays the contents of memory from <address S> to <address E> in the specified base.	
<type>	B	: Byte (8 bits) display
	W	: Word (16 bits) display
	D	: Double-word (32 bits) display
	S	: 4-byte real number (short floating point) display
	L	: 8-byte real number (long floating point) display
	A	: ASCII display
<base>	/H	: Hexadecimal display specification
	/D	: Decimal display specification
	/O	: Octal display specification
E [<type>][<address>][<data>]		
	Changes the contents of memory, starting from the specified address, to the format specified by <type>.	
<type>	B	: Changes format to byte (8 bits) format.
	W	: Changes format to word (16 bits) format.
	D	: Changes format to double-word (32 bits) format.
	S	: Changes format to 4-byte real number (short floating point) format.
C <address S>,<address E>,<address D>		
	Compares the contents of memory extending from <address S> to <address E> with the contents of memory starting at <address D>.	
F [<type>]<address S>,<address E>,<data>		
	Fills the specified range of addresses with the value <data> in the format specified by <type>.	
<type>	B	: Byte (8 bits) fill
	W	: Word (16 bits) fill
	D	: Double-word (32 bits) fill
M <address S>,<address E>,<address D>		
	Transfers the memory block extending from <address S> to <address E> to the position in memory starting at <address D>.	
S [<type>]<address S>,<address E>,<target pattern>		
	Displays the memory addresses within the range of addresses whose contents match <target pattern>.	
<type>	B	: Byte (8 bits) search
	W	: Word (16 bits) search
	D	: Double-word (32 bits) search

■ Registers

R	Displays the contents of all flags and registers in hexadecimal.
R <register name>	Changes the contents of <register name>/<flag name>.
<register>+REG=<value>	Changes the value of the specified register.
<flag>+FLG=<value>	Changes the value of the specified flag.

■ Displaying Expressions

H <expression>	Displays the value of <expression> in octal, decimal, hexadecimal and ASCII.
H <expression 1>,<expression 2>	Displays the sum and difference of <expression 1> and <expression 2>.
PRINTF/PF <format>[,<parameter>]	Displays in the same format as the “printf” function in C.

■ Symbols

X <symbol name>	Displays <symbol name>. (All symbols are displayed if none is specified.)
[.]<symbol name>=<address>	Sets (registers) the immediate value <address> in <symbol name>.
[.]<symbol name>=*	Deletes <symbol name> from the symbol table.

■ Displaying Code

V[.][<file name>:][<line>]	Displays the specified line of the specified file in the Code window.
V <symbol name>	Displays the source file for the specified symbol in the Code window.
U [<address>]	Displays disassembled code starting from the specified address in the Code window.
UPUSH [<address>]	Pushes the currently displayed address onto the address stack and then displays disassembled code starting from the specified address in the Code window.
UPOP	Displays disassembled code starting from the last address that was UPUSHed, and pops the address from the address stack.
UEND	Displays disassembled code starting from the last address that was UPUSHed.
UX [<address S>] [,<address E>]	Displays disassembled code starting from the specified address in the Command window.
K	Function backtrace

Assembly

A [<address>]	Assembles code starting from the specified address and expands it directly in memory.

Referencing/Changing C Data

INS <variable name>[,<function name>]		
		Displays (inspects) the variable, array, etc., specified by variable name.
W [<type>]<address>[,<count>][,<base>]		
		Registers an address for watching.
<type>	B	Byte (8 bits) display
	W	Word (16 bits) display
	D	Double-word (32 bits) display
	A	ASCII display (units of 8 bits)
	S	4-byte real number (short floating point) display
<base>	/H	Hexadecimal display specification
	/D	Decimal display specification
	/O	Octal display specification
W? <C expression>		Registers the C expression display for watching.
VAL/? <C expression>[,<function name>]		
		Evaluates and displays the C expression.
Y {<list>|*}		Deletes the watch registrations specified by the list.

System

Q/EXIT	Quits the C source code debugger.
HELP	Displays the Help screen.
!<command>	Executes <command>.
!!	Displays history.
!<character string>	Searches for the history indicated by <character string>

Screen Control/Miscellaneous

CLS	Clears the Command window.
HOME	Moves the Command window cursor to the Home position.
LIST	Command window display output specification
NLIST	Command window display output suppression specification
BEL	Rings the bell.
TIME	Displays the current time (HH:MM:SS).
WAIT	Pauses the system.
PRMPT <prompt character>	Changes the system prompt to the specified character.
*	Comment line specification

■ Log Output/Batch Processing

> <file name>	Outputs the Command window display/input log to the specified file. (Log Output function)
>> <file name>	Appends log output to the specified file.
>	Halts log output (closes the log file).
<<file name>	Reads Command window input from a file (batch function). Batch processing can be interrupted by the ESC key.

■ Memo

MEM <number>[,<character string>]	Registers the character string in the memo indicated by <number>.
MEM *	Deletes all memos that are currently registered.
MEM	Displays the contents of all memos that are currently registered.

■ Changing Base

N {10|16}	Changes the input base to either decimal or hexadecimal.

■ Setting Options

OPTION <reg>[,<code>[,<case>]]

Sets various options. (SHIFT+F10)

<reg>	{ON|OFF}	: Suppresses Register window display.
<code>	{SRC|ASM}	: Switches the Code window between source and disassembled code.
<case>	{ON|OFF}	: Controls discrimination between upper- and lower-case characters in symbol names.

Macro Commands

{<macro name><macro body>}	Defines the macro body for a macro name.
DO {<macro body>} WHILE <expression>	A macro command similar to the "do...while" statement in C.
FOR {<command 1>,<expression>,<command 2><macro body>}	A macro command similar to the "for" statement in C.
WHILE {<expression><macro body>}	A macro command similar to the "while" statement in C.
REPEAT {<parameter list><macro body>}	Repeat macro command.
BREAK	Exits the macro.
LALL	Display output specification in a macro.
SALL	Display output suppression specification in a macro.
MLIST<macro name>	Displays <macro name>.
MLIST ><file name>	Writes all macros that are currently defined to the specified file.
KILL <macro name>	Deletes <macro name>.
IF {<expression><command>[} ELSEIF {<expression>]<command>[} ELSE {]<command>}	Conditional control command similar to the "if, elseif, else" statement in C.
KEYIN	Instructs that the next line is to be input from the keyboard.
<{file name}	Loads a macro from the specified macro file.

Special Symbols

__ERR__	"1" when the previously executed command generated an error, "0" when the command was executed normally.
__RUN__	"1" while a user program is running, "0" otherwise.
__DEBINF__	Special debugger symbol that is used delete all symbols.

6 Supplement for the PC/AT (DOS/V) Version

This section explains the differences in keyboard functions when using the PC/AT (DOS/V) version of the C Source Code Debugger, as compared to those of the PC-9800 Series version.
* The key combinations shown in parentheses are those used in the PC-9800 Series.

6-1. Screen Operations

PageUp / Ctrl + C
(RollUp / Ctrl + C)
[☞ p67]

When the cursor is located in the Code window, pressing these keys scrolls the contents of the Code window up one screen. (Applies to both C source code display and disassembled code display.)

PageDown / Ctrl + R
(RollDown / Ctrl + R)
[☞ p67]

When the cursor is located in the Code window, pressing these keys scrolls the contents of the Code window down one screen. (Applies to both C source code display and disassembled code display.)

Alt + F1
(Ctrl+ ←)
[☞ p68]

Pressing these keys enlarges the Option window. In other words, the vertical division between the Option window and the Command/Code window moves to the left.

Alt + F2
(Ctrl + →)
[☞ P 68)

Pressing these keys reduces the Option window. In other words, the vertical division between the Option window and the Command/Code window moves to the right.

Alt + F3
(Ctrl + ↑)
[☞ P68]

Pressing these keys enlarges the Command window (and reduces the Code window). In other words, the division between the Command window and the Code window moves up one line.

Alt + F4
(Ctrl + ↓)
[p68]

Pressing these keys reduces the Command window (and enlarges the Code window). In other words, the division between the Command window and the Code window moves down one line.

6-2. Data Change/Reference Commands

Local commands within the Inspect window

PageUp / Ctrl + R (RollUp / Ctrl + R) [☞ p89]	Pressing these keys moves the displayed item up one item.
PageDown / Ctrl + C (RollDown / Ctrl + C) [☞ p89]	Pressing these keys moves the displayed item down one item.

6-3. Process Control Commands

Ctrl + Pause / Ctrl + Break (Ctrl + 0) [☞ p77]	Pressing these keys while a subprocess is being executed pauses (halts) the subprocess and returns control to the C Source Code Debugger.
Ctrl + 1(ten-key pad) Alt + 1 (Ctrl + 1) [☞ P 77)	Pressing these keys while a subprocess is paused pauses (halts) the C Source Code Debugger and passes control to the subprocess.
Ctrl+ 4(ten-key pad) Alt + 4 (Ctrl + 4) [☞ P77]	These keys are used to hide and display the Register window and the Option window. If the Register window and Option window are not currently displayed, pressing these keys displays the windows. If the windows are currently displayed, pressing these keys hides the windows. (These keys function in the same manner as the F2 key.)
Alt + 5 (Ctrl + 5) [☞ p77]	Pressing these keys switches to the RAM monitor display. To return to the Debugger screen display, press "Alt+5" again.

6-4. Shell Commands

Key operations for the History window and the Extended Symbol window

PageUp / Ctrl + R (RollDown / Ctrl + R) [☞ p80]	Pressing these keys scrolls the displayed items up one page.
PageDown / Ctrl + C (RollUp / Ctrl + C) [☞ p80]	Pressing these keys scrolls the displayed items down one page.

6-5. Other Window Commands

End (Help) [☞ p83]	Pressing this key saves the debugging screen and displays help. When this key is pressed, help for the last dialog command is displayed. For example, if this key is pressed after there was an input error in a dialog command, the help screen for the dialog command in question is displayed. In addition, if this key is pressed during an Inspect operation or during character string selection (Sel), help is displayed for the various local commands. To close the help screen, press the ESC key. [☞HELP command]
Ctrl + Shift + Alt (Ctrl + Shift + Grph) [☞ P 71)	If the microprocessor is hung up for some reason and the command that was input will not terminate, press these keys in order to forcibly terminate the command.

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MN10300 Series
C Source Code Debugger User's Manual

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