

User's Manual**AZ4000 Ver.4.00****System Performance Analyzer**

Target Devices**VR4100 Series™****VR4300 Series™****VR5432™****Target Real-Time OS****RX4000 μ ITRON 4.0****Target System Performance Analyzer****AZ4000 Ver. 4.00**

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PREFACE

Target Readers This manual is intended for users who wish to design and develop application systems using the VR4100 Series, VR4300 Series, and VR5432.

Purpose This manual is intended for users to understand the general functions and basic operations of the AZ4000.

Organization This manual contains the following information:

- Overview
- Creation of AZ monitor
- Installation
- Operation methods
- Window reference
- List of error messages
- Index

How to Use This Manual It is assumed that the reader of this manual has general knowledge of microcontrollers, C language, assembly language, and debugging as well as basic knowledge of Windows™ operations.

To understand the hardware functions and instruction functions of the VR4100 Series, VR4300 Series, and VR5432:

→ Refer to the User's Manual for the relevant product.

Conventions

[]:	Indicates a menu.
text :	Indicates a button in a window or dialog box.
<< >>:	Indicates a text string displayed in a window or dialog box.
Data significance:	Higher digits on the left and lower digits on the right
Memory map address:	Higher address on the top and lower address on the bottom
Active low representation:	\overline{xxx} (overscore over pin or signal name)
Note:	Footnote for item marked with Note in the text
Caution:	Information requiring particular attention
Remark:	Supplementary information
Numerical representation:	Binary... XXXX or XXXXB Decimal... XXXX Hexadecimal... 0xXXXX
Prefix indicating the power of 2 (address space, memory capacity):	K (kilo): $2^{10} = 1024$ M (mega): $2^{20} = 1024^2$

Related Documents

When using this manual, the following documents may be referenced.

The related documents indicated in this publication may include preliminary versions.

However, preliminary versions are not marked as such.

Documents related to development tools for VR4100 Series, VR4300 Series, and VR5432 (user's manuals)

Document Name		Document No.
RX4000 μ ITRON4.0 (Real-time OS)	Basics	U14833E
	Technical	U14835E
	Installation	U14834E
RD4000 (Task debugger)		To be prepared
AZ4000 Ver. 4.00 (System performance analyzer)		This manual

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CHAPTER 1 OVERVIEW

As steady progress is made in developing microprocessors with ever higher levels of performance and functionality, user programs are growing in both size and complexity.

Although logical debugging of these user programs can be readily performed using conventional debuggers, timing-related analyses such as analysis of abnormalities due to the timing of processing or evaluation of overall system performance can be difficult and time-consuming.

In response to these market conditions, NEC, as a provider of powerful microprocessors such as the VR4100 Series, VR4300 Series, and VR5432 64-bit microcontrollers, has developed and marketed the **system performance analyzer** (hereafter referred to as “the AZ4000”) to provide support for quantitative performance analysis of user programs.

The AZ4000 is a performance analysis tool that is used to analyze the execution status transitions, CPU execution efficiency, and other performance characteristics of user programs included with the RX4000 real-time OS (hereafter referred to as “the RX4000”).

The AZ4000 can be linked with the debugger to trace information (service calls, interrupt events, etc.) that is specific to the real-time OS, and it provides graphical functions to display the resulting data.

These functions can be used to easily analyze task execution state transitions and access to objects such as event flags and semaphores.

The AZ4000 is compliant with the **tool interface protocol** (hereafter, “TIP”), which means that the AZ4000’s functions can be easily used with any debugger that also complies with this interface.

1.1 Overview

The AZ4000 is a performance analysis tool that is used to analyze the execution state transitions, CPU execution efficiency, and other performance characteristics of user programs included with a RTOS (Real-Time OS), and it provides graphical functions to display the resulting data.

The **AZ trace data** that is collected by the AZ4000 includes detected events (service calls, interrupts, etc.) that controlled the RTOS, and this data can be used to easily analyze task execution state transitions and access to objects such as event flags and semaphores.

The AZ4000 uses a “soft trace form.”

1.2 Functions and Features

The AZ4000's functions and features are described below.

(1) Graphical display of task execution state transition

A graphical display of a task or interrupt's execution state transition (graph's horizontal axis indicates time and vertical axis indicates task or interrupt name, etc.) facilitates analysis of system progress caused by task switching or interrupt events. In addition, symbols are used to indicate the status of access via service calls to various objects to facilitate checking of task execution state transition.

(2) Graphical display of CPU usage

The display of CPU usage status within a specified time period provides histograms that facilitate analysis of the system's overall execution efficiency.

(3) Processing time statistics

Frequency calculations of execution time for any processing related to the user programs can be performed, enabling worst-case values and average values to be obtained.

(4) Operation linked with debugger window

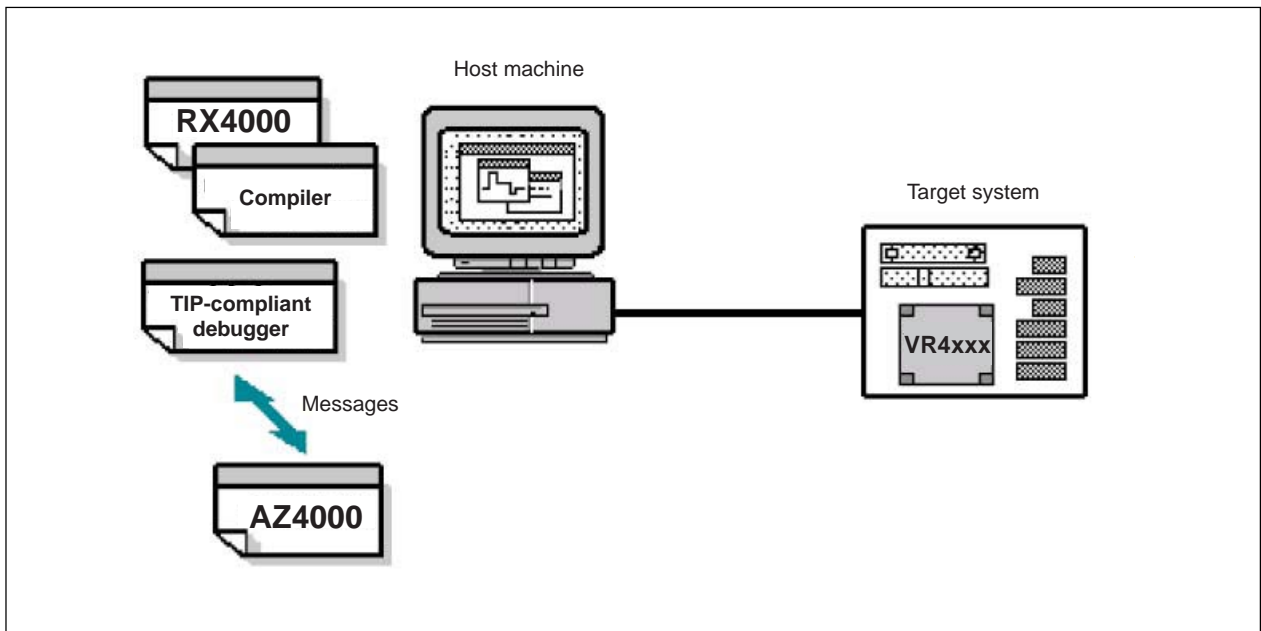
User can jump from the AZ4000's window to a window displaying the debugger's source text, disassembled text, or memory contents to identify problems easily.

1.3 System Configuration

The AZ4000 expands upon the debugger's functions by communicating with the debugger via TIP-compliant messages. The AZ4000's system configuration and supported debug environment are described below.

1.3.1 When using debug monitor

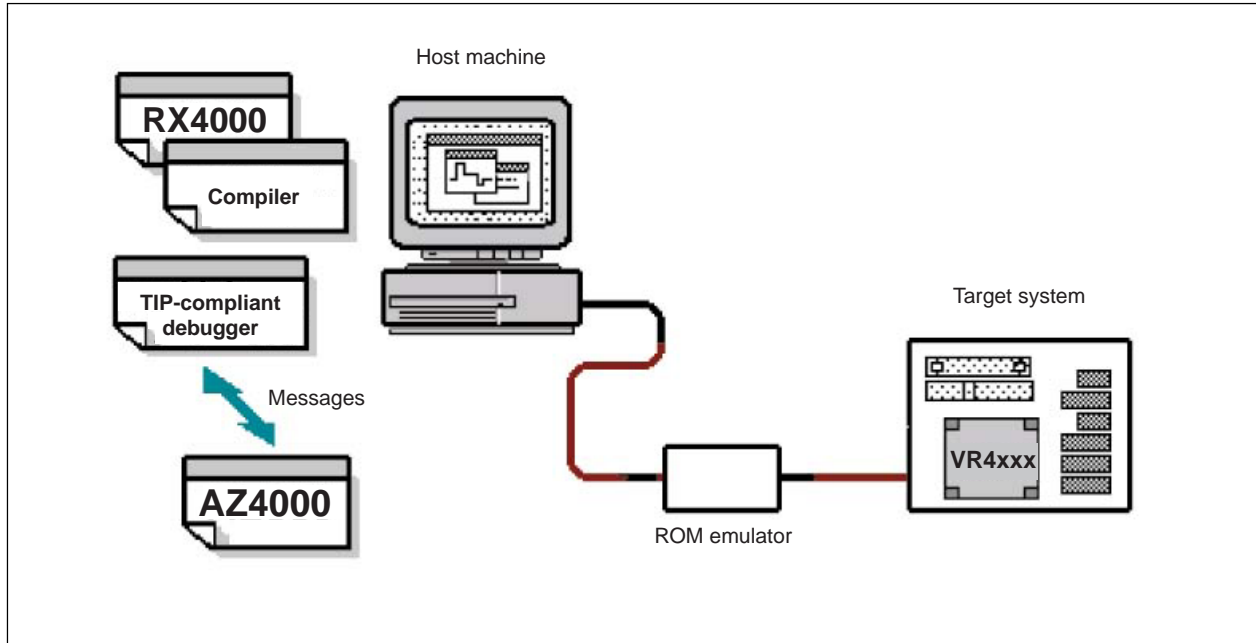
Figure 1-1. System Configuration Diagram (When Using Debug Monitor)



Caution At least one unused timer counter is required on the target system (the VR4100/4300/5432 CP0 register's counter register that is used by the RX4000 can be shared).

1.3.2 When using ROM emulator

Figure 1-2. System Configuration Diagram (When Using ROM Emulator)



Caution At least one unused timer counter is required on the target system (the Vr4100/4300/5432 CP0 register's counter register that is used by the RX4000 can be shared).

1.4 Operating Environment

When using the AZ4000, an operating environment for the debugger is required.

(1) Host machine

PC-9821 Series, PC98-NX Series, or IBM PC/AT™ compatible

- CPU: Pentium™ (100 MHz or above)
- Main memory: 32 MB or above
- OS: Windows 95, Windows 98, or Windows NT™ 4.0
- Screen size: 640 × 400 pixels or greater (800 × 600 pixels or greater is recommended)

(2) Software

- C compiler package
CCMIPE: Manufactured by Green Hills Software™, Inc. (U.S.A.)
- Real-time OS
RX4000 (μITRON4.0)
- Debugger
TIP-compliant debugger

(3) ROM emulator

Any ROM emulator that can be connected to a TIP-compliant debugger.

CHAPTER 2 CREATION OF AZ MONITOR

This chapter describes the method used to create the AZ monitor that is required when using the AZ4000, along with relevant caution points.

2.1 Creation of AZ Monitor (Monitor Program)

When using the AZ4000 with a soft trace form, the AZ4000's AZ monitor (monitor program) collects AZ trace data.

The AZ4000 collects the timing information required for this via the user's target timer counter (the VR4100/4300/5432 CP0 register's counter register that is used by the RX4000 can be shared as the timer counter).

Consequently, the AZ monitor cannot be completed until a monitor program has been created in which the timer counter's control block is coded to suit the user's target (this block is hereafter called the "user's own coding block").

A step-by-step description of the method for creating the AZ monitor is given below.

2.1.1 Creation of user's own coding block

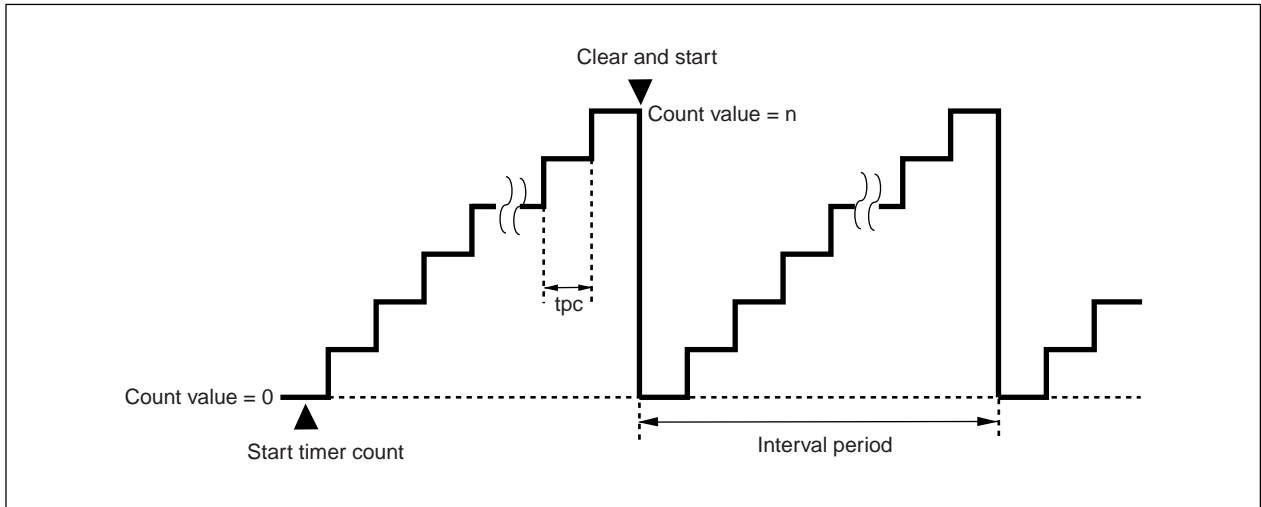
This is the coding of the control block for the target timer counter. When creating this coding block, refer to the sample programs contained in the directories listed below.

- For VR4100
nectools32\smp4100_ghs \az4000\Big\azusr.mip
nectools32\smp4100_ghs \az4000\Little\azusr.mip
- For VR4300
nectools32\smp4300_ghs \az4000\Big\azusr.mip
nectools32\smp4300_ghs \az4000\Little\azusr.mip
- For VR5432
nectools32\smp5000_ghs \az4000\Big\azusr.mip
nectools32\smp5000_ghs \az4000\Little\azusr.mip

[Specification of data and functions in user's own coding block]

An example of the data and functions specified in the user's own coding block is given in **Figure 2-1** (for the target timer counter).

Figure 2-1. Example of Timer Counter Operations (Up Counter)



- **_AZMON_MaxCount (data)**

This specifies the timer's maximum count value (n value in **Figure 2-1**).

Data type: Specify as 4-byte integer type (.word)

→ When RX4000 and timer are sharing counter register: 0x000

- **_AZMON_CountMode (data)**

This specifies the count mode.

Data type: Specify as single-byte integer type (.byte)

Data setting: 0x00 ... Up counter, 0x01 ... Down counter

→ When RX4000 and timer are sharing counter register: 0x00

- **_AZMON_TimePerCount (data)**

This specifies the time per count in microseconds (μs). (See tpc value in **Figure 2-1**.)

Data type: Specify as 4-byte floating decimal type (.float)

→ When RX4000 and timer are sharing counter register: 0.0

- **_AZMON_InitTimer (function)**

This specifies the timer's initialization processing.

Input register: \$ra ... return address

Output register: None

Volatile register: According to C-language call conventions

→ When RX4000 and timer are sharing counter register: Processing is not specified

- **_AZMON_GetCounter (function)**

This specifies the timer's counter value read processing.

Input register: \$ra ... return address

Output register: \$v0 ... Counter value

Volatile register: \$at, \$t4

→ When RX4000 and timer are sharing counter register: Specifies counter register read processing

- Cautions**
1. When sharing the VR4100/4300/5432's CP0 register that is used by the RX4000, do not mask the RX4000's "basic clock interrupt."
 2. The accuracy of times indicated as AZ trace data depends on the _AZMON_TimePerCount value (tpc value in Figure 2-1).
 3. Correct time information will not be displayed if the event interval in the collected AZ trace data is longer than the timer counter's interval.

[Example of user's own coding block (azusr.mip)]

```

.globl __AZMON_MaxCount
.globl __AZMON_CountMode
.globl __AZMON_TimePerCount
.globl __AZMON_InitTimer
.globl __AZMON_GetCounter

.section ".azmon_t", .text
.align 4
__AZMON_MaxCount:
.word 0x0 /* MaxCountValue */ ...Timer's maximum count value

.section ".azmon_t", .text
.align 4
__AZMON_CountMode:
.byte 0 /* CountMode */ ...Timer's count mode

.section ".azmon_t", .text
.align 4
__AZMON_TimePerCount:
.float 0.0 /* TimePerCount */ ...Time per count (unit:  $\mu$ s)

.section ".azmon_t", .text
.align 4
__AZMON_InitTimer:
jr $ra /* The-Code-of-InitTimer */ ...Timer's initialization processing code

.section ".azmon_t", .text
.align 4
__AZMON_GetCounter:
mfc0 $v0, $9 /* The-Code-of-GetCounter */ ...Timer's count value read processing code
nop
nop
jr $ra

```

2.1.2 Creation of AZ monitor

After creating the user's own coding block, perform the following steps to complete the AZ monitor (azmon.o).

- Use CCMPIE (manufactured by Green Hills Software, Inc.)
Start the batch file mkmon.bat^{Note 1}, then create the monitor program azmon.o^{Note 2}. It may be necessary to revise the tool path specified in mkmon.bat to suit the development environment being used.
mkmon.bat specifies the following processing.

1. Assemble azusr.mip^{Note 3}
2. Link to azcore.o and create azmon.o

Notes 1. mkmon.bat (batch file)

- For VR4100
nectools32\smp4100_ghs \az4000\Big\ mkmon.bat
nectools32\smp4100_ghs \az4000\Little\ mkmon.bat
 - For VR4300
nectools32\smp4300_ghs \az4000\Big\ mkmon.bat
nectools32\smp4300_ghs \az4000\Little\ mkmon.bat
 - For VR5432
nectools32\smp5000_ghs \az4000\Big\ mkmon.bat
nectools32\smp5000_ghs \az4000\Little\ mkmon.bat
2. azmon.o (monitor program)
 - For VR4100
nectools32\smp4100_ghs \az4000\Big\ azmon.o
nectools32\smp4100_ghs \az4000\Little\ azmon.o
 - For VR4300
nectools32\smp4300_ghs \az4000\Big\ azmon.o
nectools32\smp4300_ghs \az4000\Little\ azmon.o
 - For VR5432
nectools32\smp5000_ghs \az4000\Big\ azmon.o
nectools32\smp5000_ghs \az4000\Little\ azmon.o
 3. azusr.mip (sample program with user's own coding block)
 - For VR4100
nectools32\smp4100_ghs \az4000\Big\ azusr.mip
nectools32\smp4100_ghs \az4000\Little\ azusr.mip
 - For VR4300
nectools32\smp4300_ghs \az4000\Big\ azusr.mip
nectools32\smp4300_ghs \az4000\Little\ azusr.mip
 - For VR5432
nectools32\smp5000_ghs \az4000\Big\ azusr.mip
nectools32\smp5000_ghs \az4000\Little\ azusr.mip

2.2 Cautions

The following are cautions concerning the use of the soft trace form.

2.2.1 Points to be noted when creating load modules

The link files used when building the load module in two parts are described below.

- ◆ User program's load module
SIT file, user processing program (task, handler), initialization processing file (initialization handler), idle handler, run-time library file, link directive file
- ◆ Kernel load module
SCT file, initialization processing file (hardware initialization block), AZ monitor, RX4000 μ ITRON4.0 library file, entry processing file, link directive file

Caution When creating a kernel load module, the AZ monitor must be specified before the nucleus library (`librx.a`) in the link directive file.

[Specification of sections in AZ monitor]

When creating the load module (or the nucleus load module when the load module is divided in two), be sure to specify the AZ monitor sections shown below in the link directive file.

- `.azmon_b`: AZ monitor's work area
- `.azmon_t`: AZ monitor's text/data area

Caution The `.azmon_b` section must be allocated to a read/write-accessible area of RAM. Do not perform any write operations (initialization processing, etc.), such as via the user program in this RAM area.

[Example of AZ monitor section specifications]

```

.system_entry 0x80000180 :
.system       0x80004000 :
.sct          :
.azmon_t     0x8000c000 : ←This specification is added.
.azmon_b     0x8000d000 : ←This specification is added.

.boot        0xbf000000 :
.text        0x80010000 :
.sit         :
.data        :
.sdata       :
.sbss        :
.bss         :
.stack       0x8002c000 :
```

2.2.2 Points to be noted when debugging

(1) Resources used by AZ4000

- AZ monitor's text/data area: approximately 1600 bytes
- AZ monitor's work area (.bss attribute): 64 bytes
- Trace buffer region: 4 KB to 4 MB (recommended: 64 KB to 1 MB)
- Timer counter: 1 (timing information displayed as AZ trace data is captured from the target's timer counter)

Caution Since timing information is captured from the target's timer counter when collecting trace data, a AZ4000-compatible timer counter is required (the V_R4100/4300/5432 CP0 register's counter register that is used by the RX4000 can be shared).

(2) Trace memory

- To clear the contents of trace memory, select "AZ trace ON"^{Note}.

Note This mode sets the AZ4000's trace function as valid. To set this function, go to the AZ4000 window's menu bar and enter a check next to [AZ Trace ON] in the [Operation] menu. This enables collection of AZ trace data.

(3) Time measurements

- When sharing the timer counter (the V_R4100/4300/5432 CP0 register's counter register) that is used by the RX4000 with the timer counter for capturing the AZ4000's timing information, do not mask the RX4000's "basic clock interrupt."
- The accuracy of times indicated as AZ trace data depends on the timer counter's "count up" time. For example, if the timer counter has a count up time (tpc) of 1 μ s, the unit for times displayed by the AZ4000 is 1 μ s.
- Correct time information will not be displayed if the event interval in the collected AZ trace data is longer than the timer counter's interval.

2.2.3 Points to be noted for AZ trace data

(1) Items that cannot be detected

The items described below cannot be detected as AZ trace data.

- Start and end of cycle start handler
 - Start and end of interrupt service routine that does not operate via the RX4000 (start and end of interrupt service routine registered via cre_isr or acre_isr are detected)
 - Start and end of service call exception handler (occurrence and recovery of CPU exception handler registered via def_exc are detected)
 - Service call (ext_tsk, exd_tsk) address
- Consequently, the jump function cannot be used from this location on the state transition diagram.

CHAPTER 3 INSTALLATION

This chapter describes the AZ4000's installation method and activation/termination methods.

3.1 Installation of AZ4000

Perform the following steps to install the AZ4000.

- <1> The software is provided on CD-ROM media. Insert the CD-ROM disc into the host machine's CD-ROM drive.
- <2> Using a program such as Windows Explorer, start the executable file "setup.exe" in the CD-ROM's "DISK1" directory. Next, follow the instructions given in the displayed message to install the AZ4000.

3.2 Activation and Termination

3.2.1 Activation method

Use either of the following methods to activate the AZ4000.

- Double-click "az4000.exe" in the "nectools32\bin" directory.
- Select the AZ4000 icon from the Windows Start menu.

3.2.2 Termination method

Use either of the following methods to close the AZ4000.

- Select [File] → [E_xit] on the AZ4000 window's menu bar.
- Click the Close button at the upper right part of the AZ4000 window.

CHAPTER 4 OPERATION METHODS

The basic debugging method used with the AZ4000 is described step by step below.

(1) Start debugger

Start the debugger.

(2) Start AZ4000

Start the AZ4000 and open the AZ4000 window.

Make sure that "Connected" is displayed in the <<status view area>>. "Connected" is displayed to indicate a successful connection to the debugger.

(3) Download load module

Download the load module that was created to support the AZ4000.

Make sure that "RX+AZ Loaded" is displayed on the status bar in the AZ4000 window.

(4) Settings in AZ Option dialog box

Open the AZ Option dialog box and set following options.

• Settings in trace buffer region

In the AZ Option dialog box, specify the start and end addresses of the <<Trace Buffer>> region where trace data will be stored.

• Select trace level

For <<Trace Level>>, select the trace level of the AZ trace data to be collected.

In this version, only "Task Level" can be selected for the trace level. Download to the debugger the load module that was created for the AZ4000.

(5) AZ trace mode switching

Set <<AZ Trace ON>> to activate the AZ4000's trace function.

Caution The load module must be downloaded (to load the required symbol information) before the AZ Trace ON setting can be made.

(6) Execute user program

Execute the user program on the debugger.

As the user program is being executed, trace data for the AZ4000 starts accumulating in the trace buffer.

(7) Stop the user program

Stop the user program that is being executed on the debugger (if a breakpoint has been set, wait until the break occurs).

Collection of trace data for the AZ4000 stops when execution of the user program is stopped.


(8) Upload trace data

When uploading, the trace data that has accumulated in the trace buffer is converted to AZ trace data.

(9) Check in Analyze window

Open the Analyze window and check the accumulated AZ trace data in each task's state transition chart.

• How to display the state transition chart

On the AZ4000 window's menu bar, select [Browse] → [Analyze] → [Task Level], or click the  button on the tool bar.

• How to check the operation of objects

Click on any object name to display the "simple search button," then check the specified object's operation.

• How to check task or interrupt state transitions

Use the Pattern Search dialog box that is opened from this window to search for a particular task switching point, interrupt source location, or service call location.

→ The search results are displayed in the state transition chart.

• How to analyze the task or interrupt processing time

Use the Pattern Set dialog box that is opened from this window to search or analyze the previously set pattern (specified processing).

→ The search results are displayed in the state transition chart.

→ The distribution status based on the set pattern's processing time is displayed in the Pattern window.

(10) Check in CPU window

Use the CPU window to verify CPU usage during defined periods.

• How to display the CPU usage rate

Set the up and down cursors at start and end of the target period for displaying the CPU usage rate in the state transition chart.

The displayed CPU usage rate is that for the period between the up and down cursors. After setting these cursors, open the CPU window.

Remark When the CPU window is active, the CPU usage rate is automatically updated when the up cursor or down cursor is moved to another location on the task-level state transition chart.

(11) Check in Pattern window

Use the Pattern window to verify the distribution status of a specified pattern's execution time.

• How to display the pattern distribution**[Display method for any pattern]**

- <1> In the Analyze window, use the up and down cursors to define the period for the pattern distribution to be displayed.
- <2> In the Analyze window, select [Browse] → [Pattern] on the menu bar.
- <3> In the Pattern Set dialog box (which opens automatically), set the conditions for the pattern to be displayed, then click the [OK] button in the dialog box.

[Display method starting from CPU window]

- <1> In the Analyze window, use the up and down cursors to define the period for the pattern distribution to be displayed.
- <2> In the CPU window, select any object in the list, then select [Jump] → [Pattern] on the menu bar.

The pattern distribution displayed via these methods are based on data for the specified object's processing period (i.e., the mode between the start and end points for switching the specified objects).

Remark When the Pattern window is active, the pattern distribution is automatically updated when the up cursor or down cursor is moved to another location on the task-level state transition chart.

(12) Check in Trace View window

More detailed verification of collected AZ trace data can be performed via the Trace View window.

• How to display AZ trace data

- Move the temporary up cursor to the target position in the state transition chart. If the temporary up cursor is not being displayed, it is at the trace data display's start position.
- After setting the cursor, open the Trace View window.

Remark When the Trace View window is active, the AZ trace data display's start position is automatically updated when the up cursor or down cursor is moved to another location on the task-level state transition chart.

When necessary, repeat starting from step (6) to continue debugging.

Remark When using the soft trace form, resetting AZ trace ON clears the trace buffer contents.

CHAPTER 5 WINDOW REFERENCE

This chapter provides a detailed description of the AZ4000's window and dialog box functions.

5.1 Overview of AZ4000 Windows and Dialog Boxes

Table 5-1 lists the AZ4000 windows and dialog boxes.

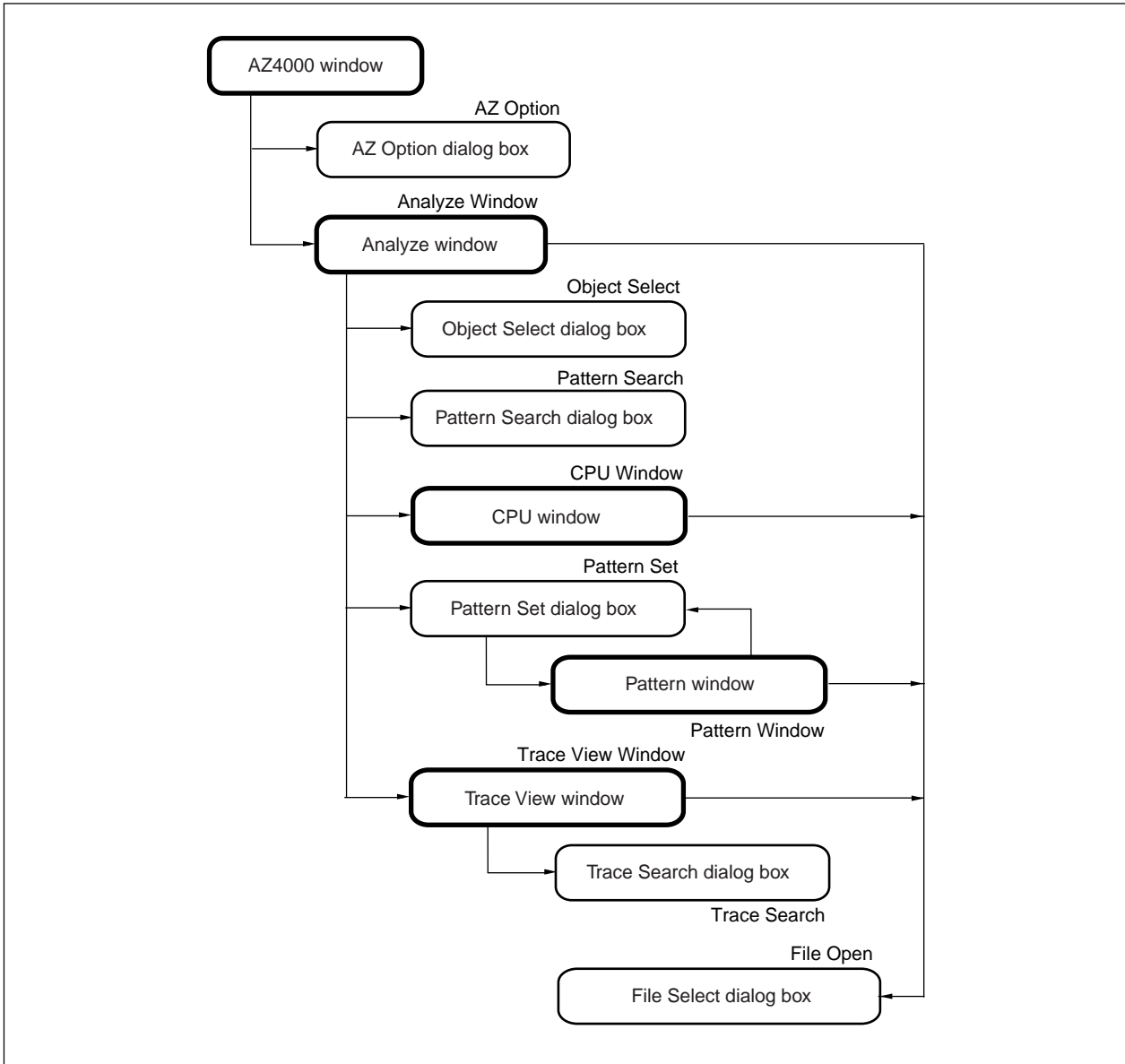
Table 5-1. List of AZ4000 Windows and Dialog Boxes

Window/Dialog Box	Description of Function	Page
AZ4000 window	Used to perform AZ4000's basic operations	p.30
AZ Option dialog box	Used to set trace form, CPU type, and trace level	p.35
Analyze window	Used to display state transition chart of collected AZ trace data	p.37
Object Select dialog box	Used to select objects to display on the state transition chart or to specify changes of order	p.49
Pattern Search dialog box	Used to set search conditions and perform searches in state transition charts	p.52
CPU window	Used to display CPU usage during a specified time range in state transition charts	p.56
Pattern Set dialog box	Used to set patterns to be displayed in Pattern window	p.61
Pattern window	Used to display a histogram of distribution results, based on the execution time length, for the specified pattern in the state transition chart	p.65
Trace View window	Used to display a list of collected AZ trace data	p.72
Trace Search dialog box	Used to set search conditions and perform searches in the Trace View window	p.77
File Select dialog box	Used to load or save contents of various AZ4000 windows to a "view file"	p.80

5.2 Relations among AZ4000 Windows and Dialog Boxes

Figure 5-1 illustrates the relations among AZ4000 windows and dialog boxes.

Figure 5-1. Relations among AZ4000 Windows and Dialog Boxes



5.3 Descriptions of Windows and Dialog Boxes

Windows and dialog boxes are described below using the following format.

Window/dialog box name

[Window/dialog box name]

[General]

Description of window or dialog box's functions and how it is opened

[Window]

Illustration of window or dialog box's on-screen elements

[Functions]

Detailed description of window or dialog box's functions

[Function buttons]

Description of operations set via window or dialog box's buttons; describes how to select of target operation before clicking a button

[Menu bar]

Description of how functions can be specified by selecting items from pull-down menus under titles in the menu bar

[Caution]

Description of cautions concerning window or dialog box's operations

[Errors]

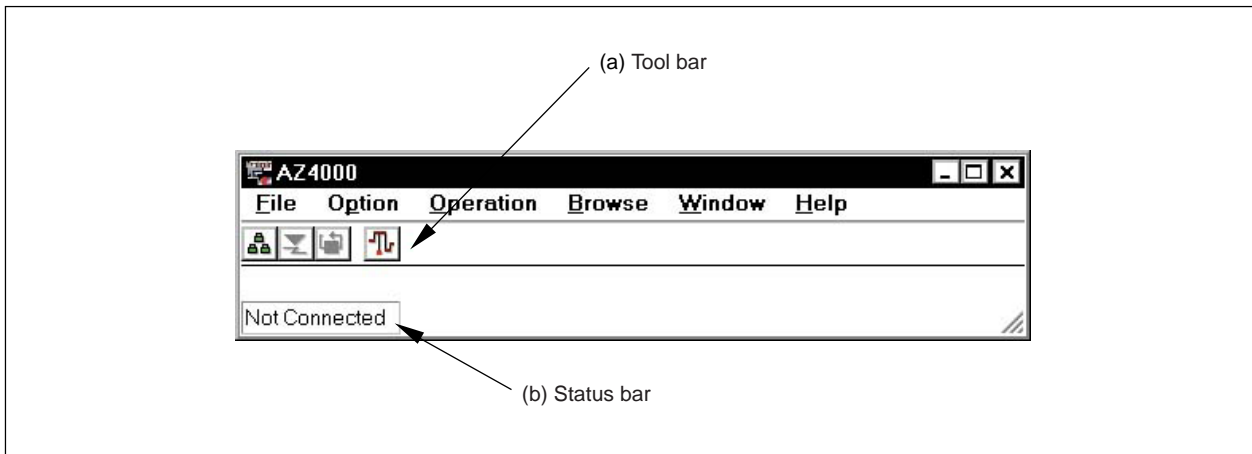
Description of errors or warnings that can occur when window or dialog box's operations are being performed

AZ4000 Window

[AZ4000]

[General]

This window opens automatically after the AZ4000 is started. It contains the AZ4000's basic operations. Start from this window when using the AZ4000.

[Window]**Figure 5-2. AZ4000 Window****[Functions]****(1) Description of areas****(a) Tool bar**

These buttons are clicked once to select and execute frequently used menu items.

- **AZ Option dialog box button** 

Click this button to open the AZ Option dialog box.

Use this dialog box to specify various options for AZ trace operations.


- **[AZ Trace ON/OFF] button** 

This is a toggle button that turns the AZ4000's trace function on and off.

When "AZ Trace ON" has been set, AZ trace data can be collected.

Cautions 1. The "AZ Trace ON" setting cannot be made until downloading of the AZ4000's soft trace form load module has been completed.


2. When using the soft trace form, after switching from "AZ Trace ON" to "AZ Trace OFF", setting "AZ Trace ON" again clears the contents of trace memory.

- **[Upload] button** 

When this button is clicked, trace data obtained by executing a user program is read from trace memory and converted to AZ trace data.

Cautions 1. If the Analyze window is open, clicking on this button updates the state transition chart to display the latest AZ trace data.

2. If there is no trace data in the trace memory, this button cannot be selected.

- **Display Analyze window button** 

Click this button to open the task-level Analyze window.

This window can be used to check state transitions for individual tasks.

(b) Status bar

The status bar is an area used to display various AZ4000 status indicators.

- **Connection status view area (first area from left)**

This area shows the status of the debugger connection.

Connected: Connection with debugger is successful

Not Connected: No connection with debugger

- **Load module status view area (second area from left)**

This area shows the status of the load module that has been loaded into the debugger.

This area is not displayed unless the AZ4000 is connected with a debugger.

RX+AZ None: Both or either of the RTOS and AZ monitors has not been downloaded.

RX+AZ Loaded: Both the RTOS and AZ monitors have been downloaded.

- **Load module execution status view area (third area from left)**

This area displays the execution status of a user program.

This area is not displayed unless the AZ4000 is connected with a debugger.

Running: User program is being executed

Broken: Execution of user program has been stopped (at a breakpoint)

- **Trace mode status view area (fourth area from left)**

This area displays the AZ trace ON/OFF status.

This area is not displayed unless the AZ4000 is connected to a debugger and a load module has been downloaded (i.e., the required symbol data has been downloaded).

AZ Trace ON: Indicates that AZ trace is set to ON

AZ Trace OFF: Indicates that AZ trace is set to OFF

[Menu bar]

(1) [File] menu

File	Option	Operation	Browse	Window	Help
Exit					


Exit: This closes the AZ4000.

(2) [Option] menu

File	Option	Operation	Browse	Window	Help
	✓ Tool Bar ✓ Status Bar Az Option...				

Tool Bar: This selects whether or not to display a tool bar in this window. When selected, a tool bar is displayed.

Status Bar: This selects whether or not to display a status view area in this window. When selected, a status view area is displayed.

Az Option...: This opens the AZ Option dialog box. Use this dialog box to specify various options before performing an AZ trace. This has the same operation as the  button on the tool bar.


(3) [Operation] menu

File	Option	Operation	Browse	Window	Help
		v AZ Trace ON AZ Trace OFF			
		Upload			

AZ Trace ON: This sets the AZ trace mode to “AZ Trace ON”. When this has been selected, “AZ Trace ON” is set and trace data is collected in trace memory as the user program is executed.

AZ Trace OFF: This sets the AZ trace mode to “AZ Trace OFF”. When this has been selected, “AZ Trace OFF” is set and trace data is not collected in trace memory when the user program is executed.

Upload: This uploads trace data. The trace data that was collected during execution of a user program is read from the trace buffer and is converted to AZ trace data. Also, if the Analyze window is open, selecting this menu item updates the state transition chart to display the latest AZ trace data.


This has the same operation as the  button on the tool bar.

- Cautions**
1. [AZ Trace ON] cannot be selected unless the AZ4000 has downloaded both the RTOS and AZ monitor (soft trace form), as indicated by [RX+AZ Loaded] in the status bar.
 2. [AZ Trace ON] cannot be selected while a user program is being executed.
 3. [Upload] cannot be selected unless some trace data exists in the trace buffer.

(4) [Browse] menu

File	Option	Operation	Browse	Window	Help
			Analyze...		
				Task Level...	

Analyze...: This displays a sub menu that is used to open the Analyze window. The following item is shown in the sub menu.

Task Level...: This opens the task-level Analyze window. This has the same operation as the  button on the tool bar.

(5) [Window] menu

<u>F</u> ile	<u>O</u> ption	<u>O</u> peration	<u>B</u> rowse	<u>W</u> indow	<u>H</u> elp
				Close <u>A</u> ll	

Close All: This closes all of the AZ4000's open windows and dialog boxes.

(6) [Help] menu

<u>F</u> ile	<u>O</u> ption	<u>O</u> peration	<u>B</u> rowse	<u>W</u> indow	<u>H</u> elp
				This <u>W</u> indow	
				<u>H</u> elp Topics	
				<u>A</u> bout...	

This Window: This displays help topics about this window.

Help Topics: This opens a dialog box for searching the AZ4000's help contents (topics).

About...: This opens a message box containing the AZ4000's version information.

[Cautions]

- For "AZ Trace ON" to be set, the AZ4000 must download both the RTOS and AZ monitor (soft trace form), as indicated by [RX+AZ Loaded] in the status bar.
- "AZ Trace ON" cannot be set while a user program is being executed.
- When using the soft trace form, setting "AZ Trace ON" clears the contents of trace buffer.
- The AZ4000 window does not change when trace data is uploaded. To view the trace data, open the Analyze window after the trace data has been uploaded.

[Errors]

- When uploading, an Error dialog box will be displayed if there is no trace data in the trace buffer.
- An Error dialog box will be displayed if an error occurs when switching the AZ trace mode.
- An Error dialog box will be displayed if an error occurs during "upload" processing of trace data.


AZ Option Dialog Box

[AZ Option]

[General]

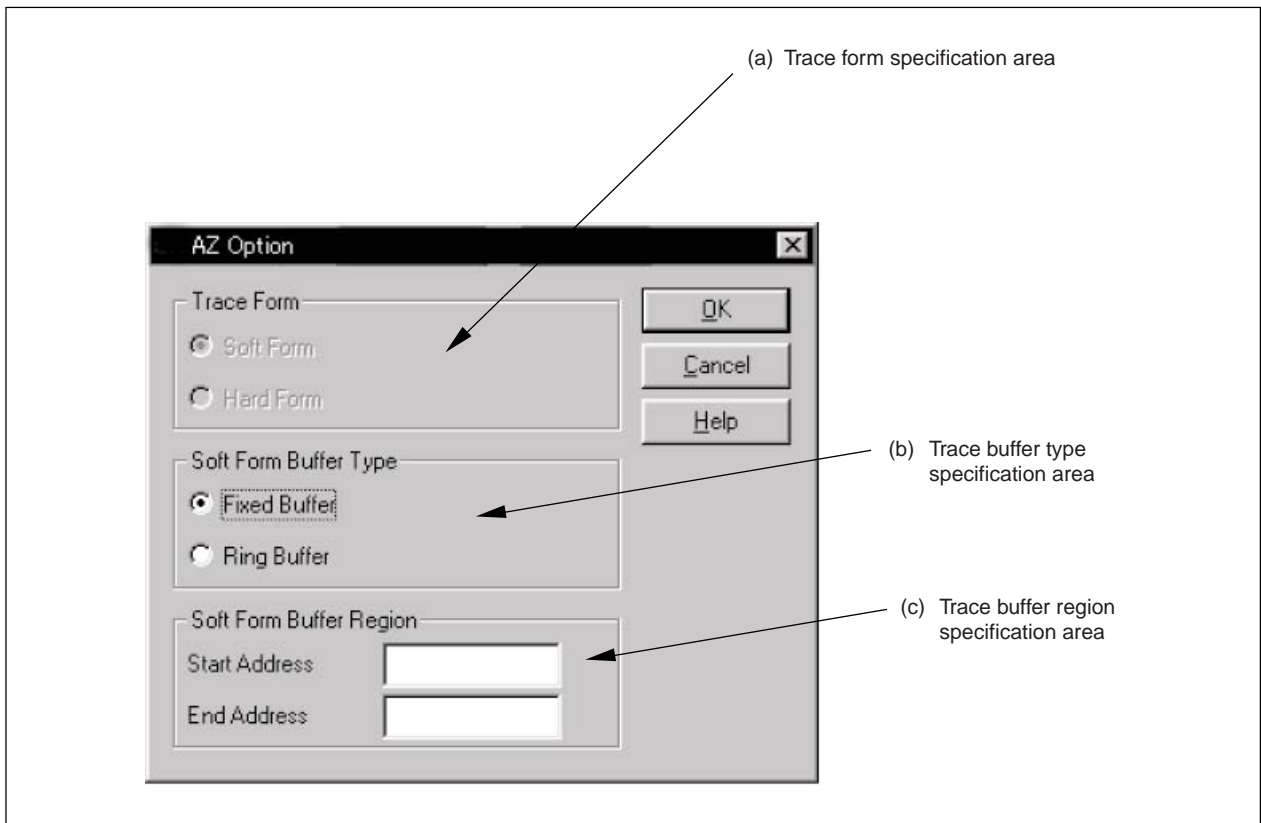
This dialog box is used to specify the AZ4000's trace form, the target real-time OS, the trace buffer type, trace buffer region, and the trace level of the AZ trace data to be collected.

This dialog box can be opened via any of the following operations.

- In the AZ4000 window, select [Option] → [Az Option] on the menu bar.
- In the AZ4000 window, click the  button.
- Press and hold the [Alt] key while pressing the [P] and [Z] keys in that order.

[Window]

Figure 5-3. AZ Option Dialog Box



[Functions]

The areas in this dialog box are described below.

(a) Trace form specification area

Use this area to specify the AZ4000's trace form. In this case, the soft form is specified.

(b) Trace buffer type specification area

When “soft form” has been specified as the trace form, this area is used to specify the trace buffer type. Select the option button for the environment to be used.

- **Fixed Buffer**

This selects fixed buffer as the trace buffer type.

When the trace buffer becomes full, collection of trace data ends. Consequently, there is no guaranty that all trace data until the program is stopped will be collected.

- **Ring Buffer**

This selects ring buffer as the trace buffer type.

Once the trace buffer becomes full, the trace data is overwritten starting from the oldest data.

(c) Trace buffer region specification area

This area is used to specify the trace buffer region to be used with the soft trace form.

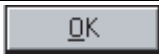


Enter the start address and end address in the text box.

With the soft trace form, the trace data collected by the AZ4000 is first stored in the target memory.


Therefore, an unused area in the target memory must be specified as the trace buffer region.

Specify an area whose size ranges from 4 KB to 4 MB.

[Function buttons]

Target Operation	Button	Function
Condition		Run AZ4000 using the specified trace form, trace buffer region, and trace level.
–		Closes this dialog box.
–		Displays help topics about this dialog box.

[Errors]

- If the address range specified in the trace buffer region specification area is incorrect, the Error dialog box will be displayed once the  button has been clicked.

Analyze Window


[Analyze Window]

[General]

This window displays a task-level state transition chart of the AZ trace data collected during execution of a user program.

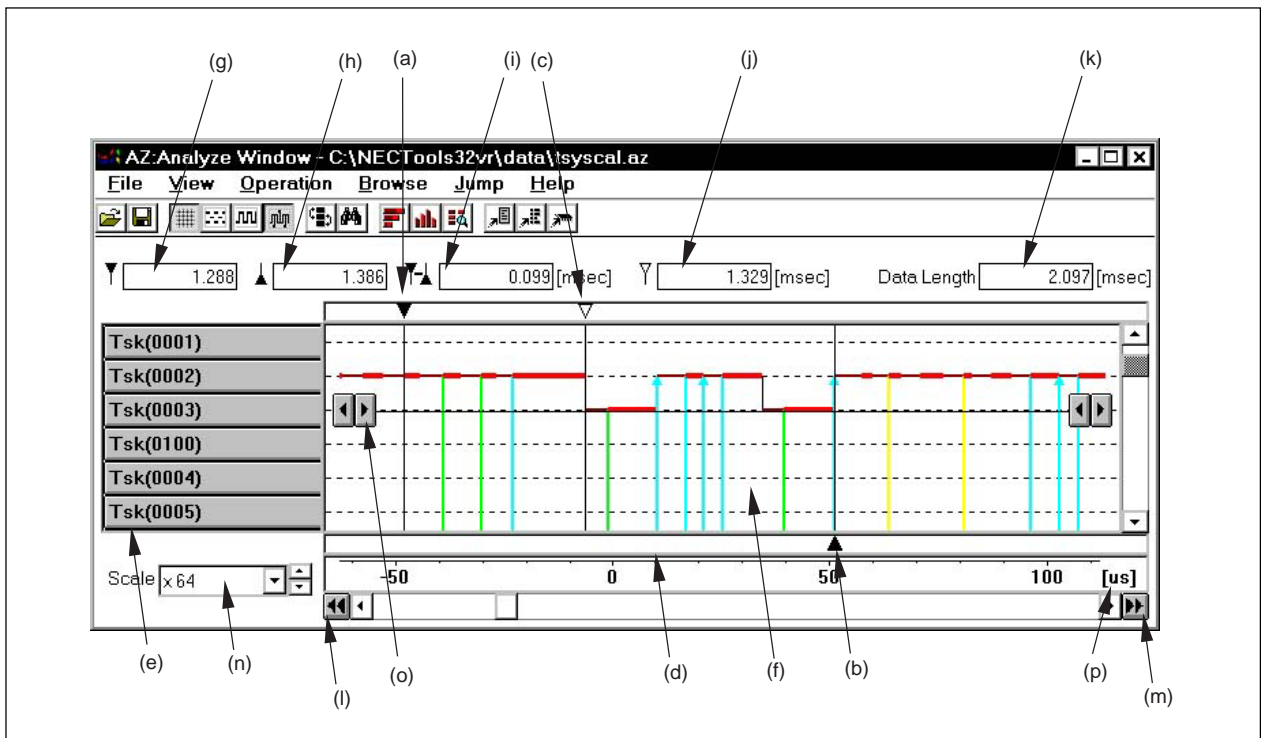
This window and the windows that are displayed via this window can be used to search or analyze system timing errors and the entire system at the task level.

This window can be opened via any of the following operations.

- In the AZ4000 window, select [Browse] → [Analyze] → [Task Level] on the menu bar.
- In the AZ4000 window, click the  button.
- Press and hold the [Alt] key while pressing the [B], [Z], and [T] keys in that order.

[Window]

Figure 5-4. Analyze Window



- | | |
|--|--|
| (a) Up cursor | (i) Time display between cursors |
| (b) Down cursor | (j) Time display at temporary up cursor position |
| (c) Temporary up cursor | (k) Data width |
| (d) Temporary down cursor | (l) "Jump to start" button |
| (e) Object | (m) "Jump to end" button |
| (f) Analysis results (state transition) | (n) Scale change button |
| (g) Time display at up cursor position | (o) Simple search button |
| (h) Time display at down cursor position | (p) Time area |

[Functions]

The following items are described below.

- (1) Description of areas
- (2) Display method for state transition chart
- (3) Object names
- (4) How to read state transition charts
- (5) Search methods for state transition charts

(1) Description of areas**(a) Up cursor**

This cursor is used to specify the range used when checking processing times in AZ trace data or when tabulating various types of data (it specifies the start position for the tabulation range).

[Operation method]

Press and hold the **Shift** key while clicking the mouse on the state transition chart.

(b) Down cursor

This cursor is used to specify the range used when checking processing times in AZ trace data or when tabulating various types of data (it specifies the end position for the tabulation range).

[Operation method]

Press and hold the **Ctrl** key while clicking the mouse on the state transition chart.

(c) Temporary up cursor

Use this cursor to specify a position for starting a search via the “simple search button”, a position for displaying results of a pattern search, or a start point when jump to the debugger window.

When displaying search results from the Pattern window, use this cursor to indicate the search pattern's start position.

When the up cursor is moved, the temporary up cursor is automatically moved to the same position.

[Operation method]

Click the left mouse button.

(d) Temporary down cursor

When displaying search results from the Pattern window, use this cursor to indicate the search pattern's end position.

When the down cursor is moved, the temporary down cursor is automatically moved to the same position.

(e) Object

These buttons indicate objects in the AZ trace data.

The button labels display RX4000-related objects (resources), such as tasks, event flags, and mailboxes. For further description of object names, see **(3) Object names** below.

Clicking on an object name causes a simple search button to be displayed. Click the object name again to remove the simple search button.

(f) Analysis results (state transition)

This area displays the user program analysis results. For further description of marks shown in the state transition chart, see **(4) How to read state transition charts** below.

(g) Time display at up cursor position

Relative time from the start of AZ trace data collection to the up cursor position is displayed here. The unit of measurement is milliseconds (msec).

(h) Time display at down cursor position

Relative time from the start of AZ trace data collection to the down cursor position is displayed here. The unit of measurement is milliseconds (msec).

(i) Time display between cursors

The length of time between the up cursor and down cursor is displayed here. The unit of measurement is milliseconds (msec).

(j) Time display at temporary up cursor position

Relative time from the start of AZ trace data collection to the temporary up cursor position is displayed here. The unit of measurement is milliseconds (msec).

(k) Data width

This displays the time span between the start and end of the AZ trace data.

(l) “Jump to start” button

This moves the up cursor and display screen to the start of the AZ trace data.


(m) “Jump to end” button


This moves the down cursor and display screen to the end of the AZ trace data.

(n) Scale change button

This changes the scale of the displayed state transition chart. Select the desired display scale from the pull-down menu or using the spin button.

(o) Simple search button

This searches for the specified object. Click on a listed object name, then click on the  button that appears to search an object along the time axis (forward) of the state transition chart. The temporary up cursor is moved to the search position.

Clicking the  button searches the specified object along the time axis's backward direction, and moves the temporary up cursor to the search position.

(p) Time area


This area displays the time unit for the event intervals displayed in the state transition chart. The unit is displayed at the right edge of this area. In Figure 5-4, the unit is milliseconds (msec).


(2) Display method for state transition chart

Perform the operations described below to display a state transition chart of collected AZ trace data in this window.

[Operation method]

<1> Collect AZ trace data.

<2> Open this window (select [Browse] → [Analyze] → [Task Level] on the AZ4000 window's menu bar, or click the  button on the tool bar).


Data in this window is not automatically updated. Consequently, when re-executing a user program, in order to have the newly collected trace data displayed in a state transition chart, select the upload function (select [Operation] → [Upload] on the AZ4000 window's menu bar or click the  button).

(3) Object names









Buttons that indicate object names are displayed as shown below.

- **RX4000 objects**

Idle tasks are displayed as follows.



	Idle task
---	-----------

Resource types and ID numbers are displayed as follows.

	Task (nnnn: task ID No. {hexadecimal})
	Event flag (nnnn: event flag ID No. {hexadecimal})
	Semaphore (nnnn: semaphore ID No. {hexadecimal})
	Mailbox (nnnn: mailbox ID No. {hexadecimal})
	Variable length memory pool (nnnn: memory pool ID No. {hexadecimal})
	Fixed length memory pool (nnnn: memory pool ID No. {hexadecimal})
	Data queue (nnnn: data queue ID No. {hexadecimal})
	Mutex (nnnn: mutex ID No. {hexadecimal})

- **Interrupts**

The interrupt handler name received from the debugger is displayed. However, in cases where the handler name cannot be received from the debugger, the following default names are displayed.

	Maskable interrupt (N: interrupt level {0 to 7})
	Non-maskable interrupt

- **Exceptions**

The exception name is displayed.

Mod	TLB modification exception
TLBL	TLB mismatch exception (load or fetch)
TLBS	TLB mismatch exception (store)
AdEL	Address error exception (load or instruction fetch)
AdES	Address error exception (store)
IBE	Bus error exception (instruction fetch)
DBE	Bus error exception (data load or store)
Bp	Breakpoint exception
RI	Reserved instruction exception
CpU	CPU disable exception
Ov	Operation overflow exception
Tr	Trap exception
FPE	Floating point operation exception
WATCH	Watch exception

- **Other objects**

Etc.	Objects that are not displayed in the Object Select dialog box.
-------------	---

(4) How to read state transition charts

State transition charts have the following three view modes, which can be specified by selecting [View] → [View mode] on the Analyze window's menu bar.

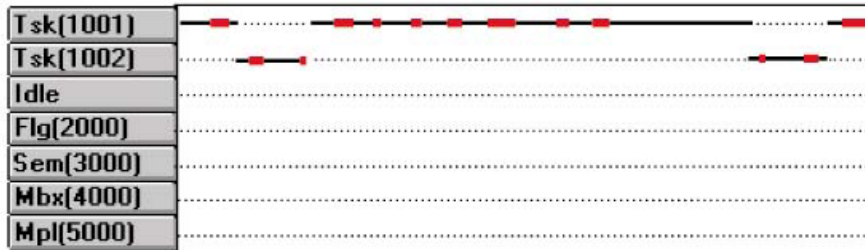
- (a) Delete mode
- (b) Standard mode
- (c) Detail mode (default)

Remark To view or hide grid lines, select [View] → [Grid mode] on this window's menu bar.

(a) Delete mode

Only horizontal lines are used to indicate where CPU operations occur. “Delete mode” is useful when analyzing a wide range of AZ trace data.

Figure 5-5. Analyze Window (Delete Mode)



Remark Dotted lines indicate processing by the user program and bold lines indicate service call processing.

(b) Standard mode

Lines are used to link CPU processing segments.

Figure 5-6. Analyze Window (Standard Mode)

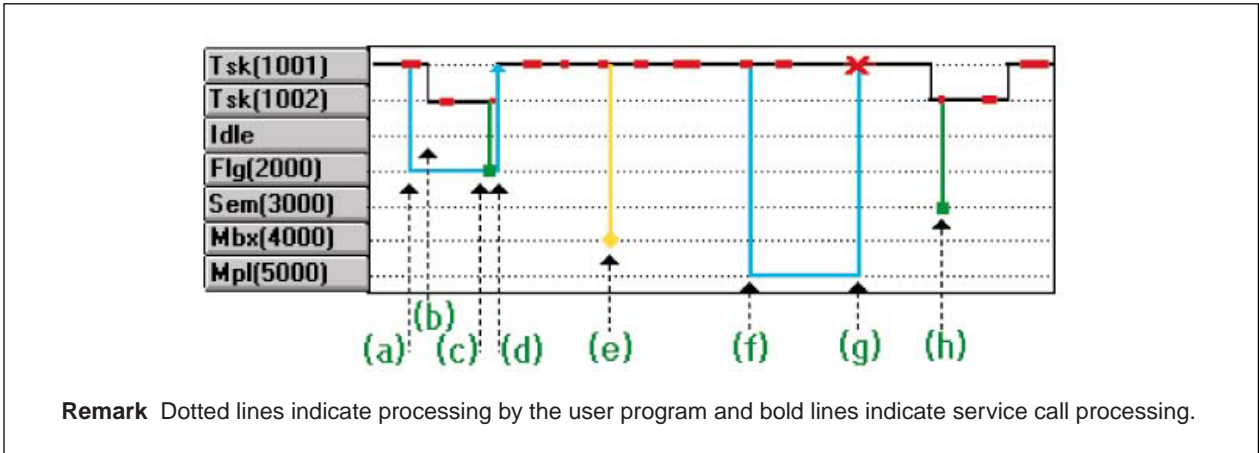


Remark Dotted lines indicate processing by the user program and bold lines indicate service call processing.

(c) Detail mode (default)

In addition to the traces of CPU processing, this mode displays marks that indicate whether service calls of the RX4000 are for memory pool management or the communication control function (see **Table 5-2**). Detail mode is useful when analyzing access to specific objects.

Figure 5-7. Analyze Window (Detail Mode)



Remark Dotted lines indicate processing by the user program and bold lines indicate service call processing.

- (a) Tsk(1001) has issued a wai_flg service call in response to event flag flg(2000).
- (b) Tsk(1001) is in wait mode, so processing is passed to Tsk(1002).
- (c) Tsk(1002) has issued a set_flg service call in response to event flag flg(2000).
- (d) The wait condition for the wai_flg service call issued by Tsk(1001) has been met and wait mode has been canceled.
- (e) Tsk(1001) has issued a del_mbx service call for mailbox mbx(4000).
- (f) Tsk(1001) has issued a get_mpl service call in response to memory pool mpl(5000).
- (g) An error has been returned by the service call described in (f) above.
- (h) Tsk(1002) has issued a sig_sem service call in response to semaphore Sem(3000).

Table 5-2. List of Marks Used in State Transition Charts (When Used in RX4000)

Mark	Access Target	Issued Service Calls	Meaning
↑	Event flag	wai_flg / pol_flg / ipol_flg / twai_flg	Indicates that one of the service calls shown at left was issued for the corresponding access target and a value was returned.
	Semaphore	wai_sem / pol_sem / ipol_sem / twai_sem	
	Mailbox	rcv_mbx / prcv_mbx / iprcv_mbx / trcv_mbx	
	Variable length memory pool	get_mpl / pget_mpl / ipget_mpl / tget_mpl	
	Fixed length memory pool	get_mpf / pget_mpf / ipget_mpf / tget_mpf	
	Data queue	rcv_dtq / prcv_dtq / iprcv_dtq / trcv_dtq / snd_dtq / tsnd_dtq	
	Mutex	loc_mtx / ploc_mtx / tloc_mtx	
↓	Event flag	set_flg / iset_flg / clr_flg / iclr_flg	
	Semaphore	sig_sem / isig_sem	
	Mailbox	snd_mbx / isnd_mbx	
	Variable length memory pool	rel_mpl / irel_mpl	
	Fixed length memory pool	rel_mpf / irel_mpf	
	Data queue	snd_dtq / psnd_dtq / ipsnd_dtq / tsnd_dtq / fsnd_dtq / ifsnd_dtq	
	Mutex	unl_mtx	
◆	Event flag	del_flg	
	Semaphore	del_sem	
	Mailbox	del_mbx	
	Variable length memory pool	del_mpl	
	Fixed length memory pool	del_mpf	
	Data queue	del_dtq	
	Mutex	del_mtx	
X	Indicates an error of an issued service call.		

(5) Search methods for state transition charts



The following methods can be used to search collected AZ trace data in this window.

- (a) Search processing of specific objects
- (b) Search via Pattern Search dialog box
- (c) Search via Pattern window

(a) Search processing of specific objects

Use the “simple search button” to search for processing of a specified object.

[Operation method]

- <1> If a temporary up cursor is displayed in the state transition chart, move the temporary up cursor to the search start position. If it is not displayed, move the up cursor to the search start position.
- <2> Click the button bearing the name of the object whose operation is to be checked. The simple search buttons will appear immediately to the right of the object name and also in the state transition chart.
- <3> Click a simple search button.
 - : Searches for the specified object's processing along the forward direction of the time axis and moves the temporary up cursor to the search position.
 - : Searches for the specified object's processing along the backward direction of the time axis and moves the temporary up cursor to the search position.

If the searched point is not in the currently displayed state transition chart, the graph is shifted so that the point is at the “0” position in the scale.

The simple search button can be removed from the screen by clicking the button bearing the object name again.

(b) Search via Pattern Search dialog box

Use the Pattern Search dialog box to search previously set patterns in state transition charts. The search results are indicated by the temporary up cursor in the state transition chart.















When using the Pattern Search dialog box, the transition status of tasks and interrupts can be searched. For details, see the description of the Pattern Search dialog box.

(c) Search via Pattern window

A pattern that has been set via the Pattern Set dialog box can be searched in the state transition chart displayed in the Pattern window. The search results are indicated by the temporary up cursor in the state transition chart.

When using the Pattern window, the transition status of tasks and interrupts can be searched. For details, see the description of the Pattern window.

[Function buttons]

Target Operation	Button	Function
–		This opens the File Select dialog box. Previously saved trace data from the Analyze window is read and displayed in the state transition chart.
–		This opens the File Select dialog box. Currently displayed trace data (displayed in the Analyze window) is saved to a file.
–		This turns grid mode on and off for the state transition chart.
–		This sets delete mode for the state transition chart.
–		This sets standard mode for the state transition chart.
–		This sets detail mode for the state transition chart.
–		This opens the Object Select dialog box.
–		This opens the Pattern Search dialog box.
–		This opens the CPU window to display the CPU usage rate for the period between the up and down cursors. If a previously active CPU window is being displayed, the contents of that window are updated at this point.
–		This opens the Pattern Set dialog box. Once a pattern condition has been set, a Pattern window displaying the period between the up and down cursors is opened. If a previously active Pattern window is being displayed, the contents of that window are updated at this point.
–		This opens the Trace View window from the position specified by the temporary up cursor. If a previously active Trace View window is being displayed, the contents of that window are updated at this point.
–		This opens the Source Text window from the position specified by the temporary up cursor. If a previously active Source Text window is being displayed, the contents of that window are updated at this point.
–		This opens the Disassemble window from the position specified by the temporary up cursor. If a previously active Disassemble window is being displayed, the contents of that window are updated at this point.
–		This opens the debugger's memory list from the position specified by the temporary up cursor. If a memory list is being displayed in a previously active window, the contents of that window are updated at this point.

[Menu bar]

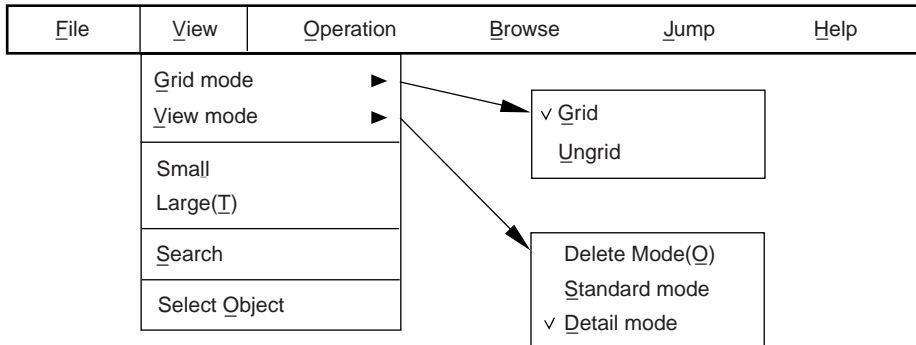
(1) [File] menu


File	View	Operation	Browse	Jump	Help
Open...					
Save					
Save As...					
Print					
Close					





- Open...:** This opens the File Select dialog box. A previously saved file displayed in this window is loaded.
The default file name extension for files displayed in this window is “.az”.
- Save:** This function is not supported in this version.
- Save As...:** This opens the File Select dialog box. Currently displayed data in a state transition chart is updated or renamed and saved to a view file in this window.
The default file name extension for files displayed in this window is “.az”.
- Print:** This function is not supported in this version.
- Close:** This closes this window.

Caution If a state transition chart is not being displayed, the [Save As...] menu item cannot be selected.

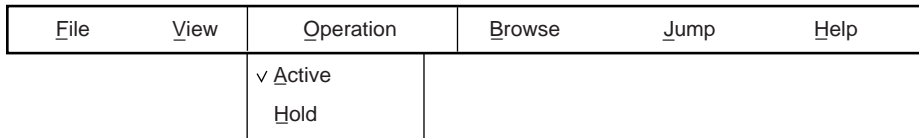
(2) [View] menu



- Grid mode:** This displays a sub menu that is used to specify view/hide for grid lines on the state transition chart.
The following sub menu is displayed.
- Grid:** This views (displays) grid lines.
- Ungrid:** This hides grid lines.
- View mode:** This displays a sub menu for specifying the state transition chart’s display mode.
The following sub menu is displayed.
- Delete Mode(O):** This hides vertical lines in the state transition chart.
This has the same operation as clicking the  button.

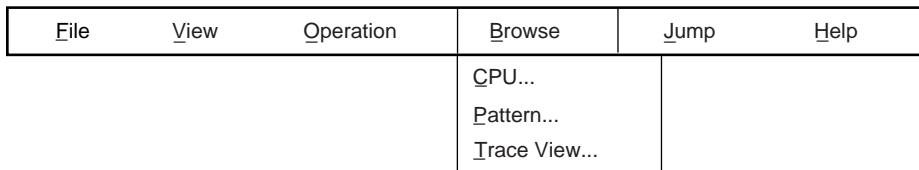
- Standard mode: This displays the CPU's state transitions only.
This has the same operation as clicking the  button.
- Detail mode: This displays the service call access status for the RX4000 real-time OS (default mode).
This has the same operation as clicking the  button.
- Small: This minimizes the display scale of the state transition chart. This has the same operation as the scale change button (see **Figure 5-4**).
- Large(I): This maximizes the display scale of the state transition chart. This has the same operation as the scale change button (see **Figure 5-4**).
- Search: This opens this window's trace-level Pattern Search dialog box.
This has the same operation as clicking the  button.
- Select Object: This opens this window's trace-level Object Select dialog box.
This has the same operation as clicking the  button.




(3) [Operation] menu



- Active: This switches this window from hold mode to active mode.
- Hold: This switches this window from active mode to hold mode.

(4) [Browse] menu




- CPU...: This opens this window's trace-level CPU window. If a previously active CPU window is being displayed, the contents of that window are updated at this point.
This has the same operation as clicking the  button.
- Pattern...: This opens this window's trace-level Pattern Set dialog box. Once a pattern is set via this dialog box, the Pattern window is opened. If a previously active Pattern window is being displayed, the contents of that window are updated at this point.
This has the same operation as clicking the  button.
- Trace View...: This opens this window's trace-level Trace View window. If a previously active Trace View window is being displayed, the contents of that window are updated at this point.
This has the same operation as clicking the  button.


(5) [Jump] menu

File	View	Operation	Browse	Jump	Help
				Source Text...	
				Assemble...	
				Memory...	


Source Text...: This displays the debugger's source text at the position specified using the temporary up cursor. If source text is already being displayed in an active window, the contents of that window are updated at this point.

This has the same operation as clicking the  button.

Assemble...: This displays the debugger's disassembled text at the position specified using the temporary up cursor. If disassembled text is already being displayed in an active window, the contents of that window are updated at this point.

This has the same operation as clicking the  button.

Memory...: This displays the debugger's memory list at the position specified using the temporary up cursor. If a memory list is already being displayed in an active window, the contents of that window are updated at this point.

This has the same operation as clicking the  button.

Caution If there is no address information for the position specified using the temporary up cursor, the items in the [Jump] menu cannot be selected.

(6) [Help] menu

File	View	Operation	Browse	Jump	Help
					This Window
					Help Topics

This **W**indow: This displays help topics about this window.

Help Topics: This opens a dialog box for searching the AZ4000's help contents (topics).

[Cautions]

- Data in this window is not automatically updated. Consequently, when re-executing an application program, in order to have the newly collected trace data displayed in a state transition chart, select the upload function (select [Operation] → [Upload] in the AZ4000 window).
- If there is no address information in the trace data for the position specified using the temporary up cursor, the items in the [Jump] menu cannot be selected.

[Errors]

- An Error dialog box will appear if an active Analyze window already exists when attempting to change a window from hold mode to active mode.
- An Error dialog box will appear if uploaded trace data does not include any task-level trace data.


Object Select Dialog Box

[Object Select]

[General]

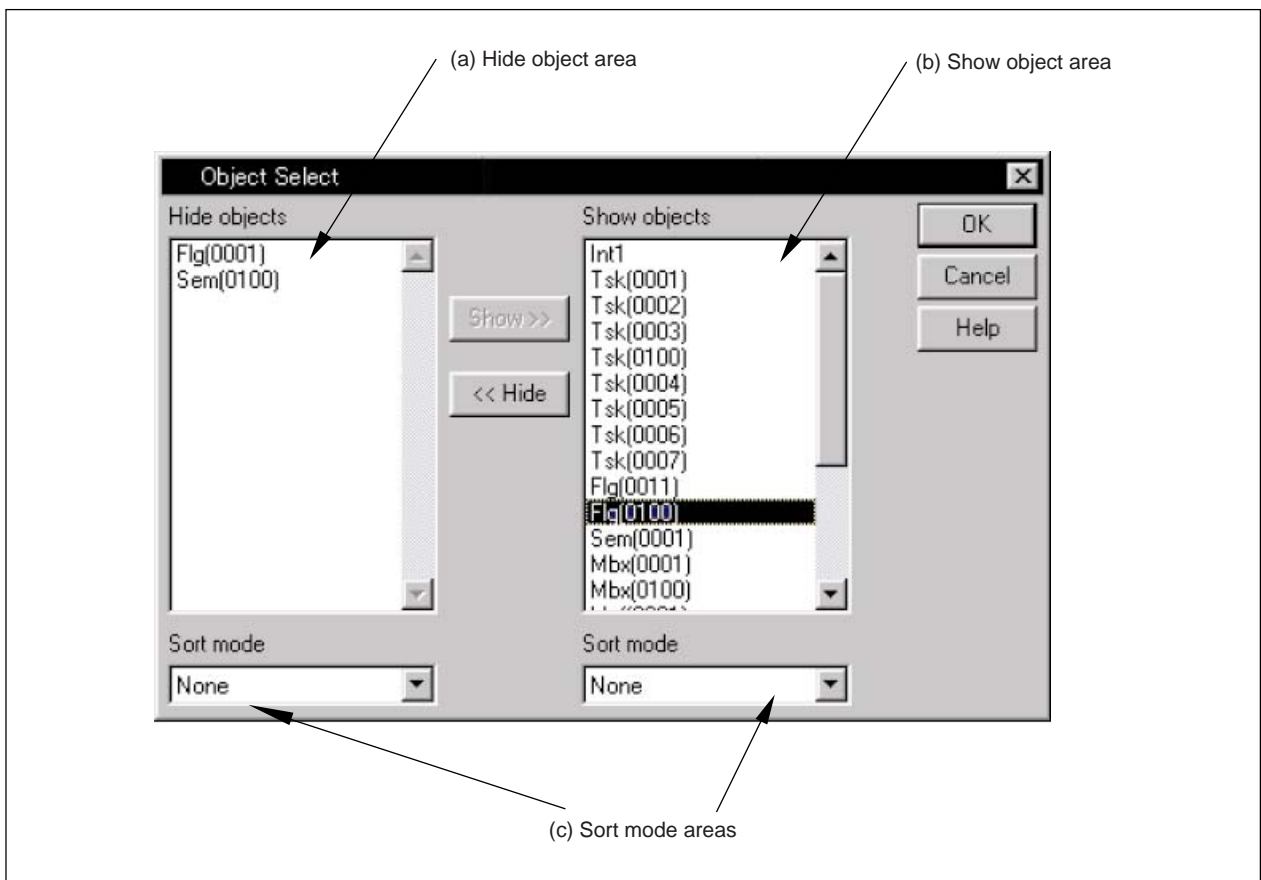
This dialog box is used to select or change the order of objects displayed in a state transition chart in a task-level Analyze window.

This dialog box can be opened via any of the following operations.

- In the Analyze window, select [View] → [Select Object] on the menu bar.
- In the Analyze window, click the  button.
- In the Analyze window, press and hold the [Alt] key while pressing the [V] and [O] keys in that order.

[Window]

Figure 5-8. Object Select Dialog Box



[Functions]

The following items are described below.

- (1) Description of areas
- (2) Limitation of displayed objects
- (3) Addition of displayed objects
- (4) Changing order of displayed objects

(1) Description of areas**(a) Hide object area**

This area displays a list of objects contained in the AZ trace data that are not displayed in the state transition chart.

(b) Show object area

This area displays a list of objects that are displayed in the state transition chart. The default setting is to list all object names included in the AZ trace data.

The objects are listed in this area in the order that they appear in the state transition chart.

(c) Sort mode area

This area is used to select the order for listing objects in the <<hide object area>> and <<show object area>>.

(2) Limitation of displayed objects

The objects displayed in the state transition chart can be limited (curtailed) via the following operations.

<1> Select objects from the show object area that do not need to be shown in the state transition chart.

<2> Click the button. The selected object(s) will be moved to the hide object area. If a move destination has been specified, the object(s) will be inserted immediately before that position. If a move destination was not specified, the object(s) will be inserted at the end of the list.

<3> Click the button to update the state transition chart with these changes.

Remark Hidden objects are displayed collectively on the state transition chart as the object .

(3) Addition of displayed objects

The objects displayed in the state transition chart can be added via the following operations.

<1> In the hide object area, select object(s) to be shown in the state transition chart.

<2> Click the button. The selected object(s) will be moved to the show object area. If a move destination has been specified, the object(s) will be inserted immediately before that position. If a move destination was not specified, the object(s) will be inserted at the end of the list.

<3> Click the button to update the state transition chart with these changes.

(4) Changing order of displayed objects

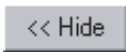
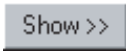
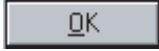
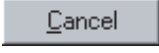

The order in which objects are listed in the hide object area and show object area can be set based on interrupts, tasks, idle status, event flags, semaphores, mailboxes, and memory pools.

To change the listing order, select a sort mode from the sort mode area's drop-down list.

The listing order of show object area will be reflected in the state transition chart.
The selectable sort modes are listed below.

Sort Mode	Description
None	Unsorted mode (default)
Appear	Sorts based on order of appearance in AZ trace data
Name	Sorts based on names in each object type
ID	Sorts based on IDs in each object type

[Function buttons]

Target Operation	Button	Function
Object		This moves the object(s) selected in the show object area to the hide object area. If a move destination has been specified, the object(s) will be inserted immediately before that position. If a move destination was not specified, the object(s) will be inserted at the end of the list.
Object		This moves the selected object(s) in the hide object area to the show object area. If a move destination has been specified, the object(s) will be inserted immediately before that position. If a move destination was not specified, the object(s) will be inserted at the end of the list.
-		This displays objects in the state transition chart according to the list of objects in the show object area.
-		This closes this dialog box.
-		This displays help topics about this dialog box.

Pattern Search Dialog Box


[Pattern Search]

[General]

This dialog box is used to set search conditions when searching for “certain phenomena” in a state transition chart.

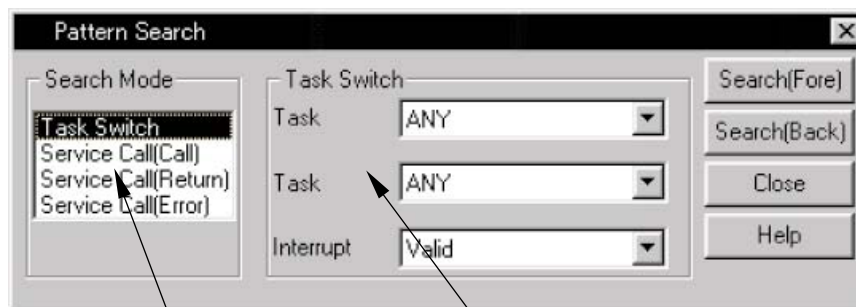
The “certain phenomena” might be a specified task or interrupt, a point for switching to a specified task or interrupt, or a condition for a specified service call.

This dialog box can be opened via any of the following operations.

- In the Analyze window, select [View] → [Search] on the menu bar.
- In the Analyze window, click the  button.
- In the Analyze window, press and hold the [Alt] key while pressing the [V] and [S] keys in that order.

[Window]

Figure 5-9. Pattern Search Dialog Box (When Task Switch Is Selected)



(a) Search mode area

(b) Search condition setting area

[Functions]

The following items are described below.

- (1) Description of areas
- (2) Search methods

(1) Description of areas**(a) Search mode area**

This area is used to select the search mode.

A search mode indicates the type of phenomena to be searched in a state transition chart. The available search modes are listed below.

Table 5-3. Pattern Search Modes

Search Mode	Description
Task Switch	Searches task switching locations
Service Call(Call)	Searches locations of called service calls
Service Call(Return)	Searches locations of returned service calls
Service Call(Error)	Searches locations of service calls with returned errors

(b) Search condition setting area

This area is used to set search conditions for the search mode specified in the <<search mode area>>.

The contents displayed in this area differ according to the specified search mode.

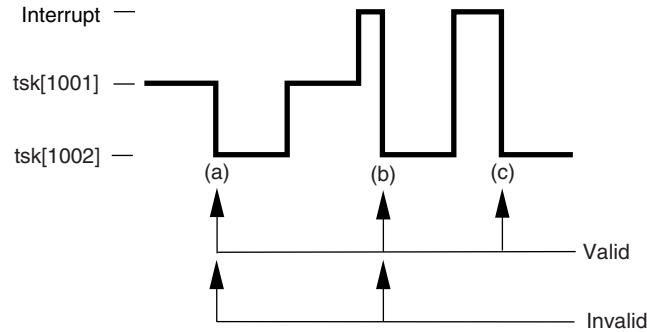
Search conditions set for the items listed below can be directly input from the keyboard or can be selected from a drop-down list.

The available conditions are listed below.

Table 5-4. Pattern Search Conditions (When Search Mode Has Been Set to "Task Switch")

Item	Description of Condition
Task (upper)	Specifies the task name or interrupt name prior to switching. Specify "ANY" if any task or interrupt name can be used.
Task (lower)	Specifies the task name or interrupt name after switching. Specify "ANY" if any task or interrupt name can be used.
Interrupt	Specifies whether or not to search for switches to or from interrupts. Interrupt transitions are searched when "Valid" is selected and they are not searched when "Invalid" is selected.

Remark The difference in search positions for interrupt items according to the Valid/Invalid specification are described below (when switching search condition from [ANY] to [tsk(1002)]).



[(a) in above diagram]

Valid Search occurs when switching from [task1001] to [tsk1002]

Invalid Search occurs when switching from [task1001] to [tsk1002]

[(b) in above diagram]

Valid Search occurs when switching from [Interrupt] to [tsk1002]

Invalid Switching from interrupt servicing is ignored, but search occurs when switching from [tsk1001] to [tsk1002]

[(c) in above diagram]



Valid Search occurs when switching from [Interrupt] to [tsk1002]

Invalid Switching from interrupt servicing is ignored, and is regarded as switching from [tsk1002] to [tsk1002], so search does not occur since there was no switching.


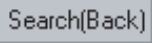
Table 5-5. Pattern Search Conditions
(When “Service Call(Call, Return, Error)” Has Been Specified as Search Mode)

Item	Description of Condition
Task	This specifies the task name or interrupt name for which a service call is issued. Specify “ANY” if any task or interrupt name can be used.
Service Call	This specifies the service call name. Specify “ANY” if any service call name can be used.
Object	This specifies the service call's target object. Specify “ANY” if any object can be used.





(2) Search methods**[Operation method]**

- <1> Specify the position to be used as the search start position.
If the temporary up cursor is shown in the state transition chart, it is moved to the search start position.
If the temporary up cursor is not being displayed, the up cursor is moved to the search start position.
- <2> Select a search mode in the search mode area of this dialog box.
- <3> In the search condition setting area, directly enter a search condition for each item via the keyboard or select search conditions from the drop-down list.
- <4> Click the  button or the  button.

Searches are performed as described below.

- **If the  button has been clicked:**
The search is performed along the forward direction of the time axis, starting from the specified start position, and the temporary up cursor is moved to the search results position.
- **If the  button has been clicked:**
The search is performed along the backward direction of the time axis, starting from the specified start position, and the temporary up cursor is moved to the search results position.

[Function buttons]

Target Operation	Button	Function
Search condition		Searches the state transition chart for locations that match the specified search condition, moving along the forward direction of the time axis starting from the position indicated by the up cursor or temporary up cursor. The temporary up cursor is moved to the search results position in the state transition chart.
Search condition		Searches the state transition chart for locations that match the specified search condition, moving along the backward direction of the time axis starting from the position indicated by the up cursor or temporary up cursor. The temporary up cursor is moved to the search results position in the state transition chart.
-		Closes this dialog box.
-		Displays help topics about this dialog box.

[Errors]

A warning alarm is sounded if no phenomena that match the specified search condition exist in the AZ trace data.

CPU Window


[CPU Window]

[General]

This window displays CPU usage information for the time period between the up cursor and down cursor on the state transition chart.

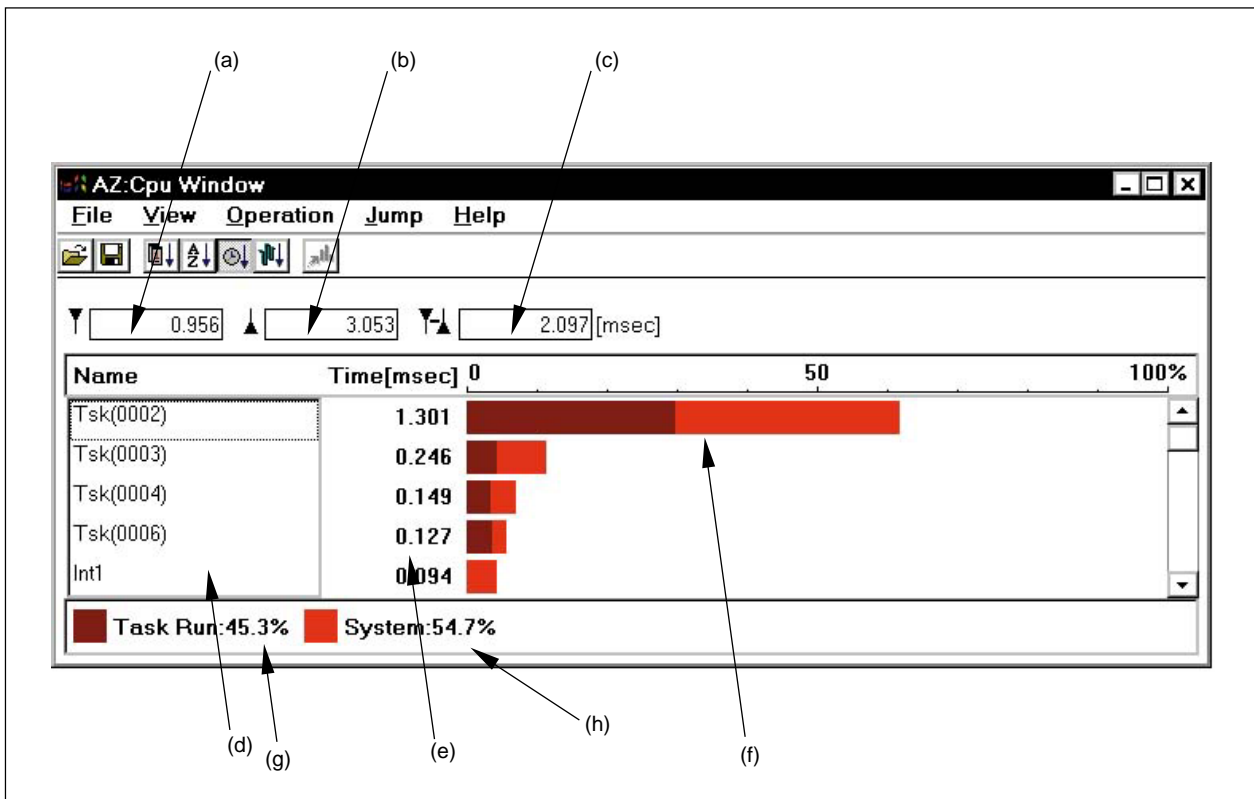
Use this window to check the execution time of a specified task or interrupt or to evaluate the performance of target data based on idle time or interrupt time information.

This window can be opened via any of the following operations.

- In the Analyze window, select [Browse] → [CPU] on the menu bar.
- In the Analyze window, click the  button.
- In the Analyze window, press and hold the [Alt] key while pressing the [B] and [C] keys in that order.

[Window]

Figure 5-10. CPU Window



- | | |
|--|---|
| (a) Time display at up cursor position | (e) Object's total execution time |
| (b) Time display at down cursor position | (f) Graph display of CPU usage |
| (c) Time display between up and down cursors | (g) Percentage display of task execution time |
| (d) Object name | (h) Percentage display of system execution time |

[Functions]

The following items are described below.

- (1) Description of areas
- (2) CPU usage display method
- (3) Jump function from CPU window

(1) Description of areas**(a) Time display at up cursor position**

This displays the time when collection of CPU usage data began.

Relative time from the start of AZ trace data collection to the up cursor position is displayed here. The unit of measurement is milliseconds (msec).

(b) Time display at down cursor position

This displays the time when collection of CPU usage data ended.

Relative time from the start of AZ trace data collection to the down cursor position is displayed here. The unit of measurement is milliseconds (msec).

(c) Time display between up and down cursors

This displays the length of time used to collect CPU usage data.

The length of time between the up cursor and down cursor is displayed here. The unit of measurement is milliseconds (msec).

(d) Object name

This is a list of object names that existed within the collected time.

(e) Object's total execution time

The total task execution time for task or interrupts within the data collection time is displayed along with the total system processing time.

(f) Graph display of CPU usage

A bar graph indicates the CPU usage for objects existing within the data collection time. The bars have two sections, one indicating the task execution share and the other indicating the system processing share.

(g) Percentage display of task execution time

The share of task execution time within the data collection time is shown as a percentage.

(h) Percentage display of system execution time

The share of system execution time within the data collection time is shown as a percentage.

(2) CPU usage display method

The CPU usage data is collected during the time period between the up and down cursors in the state transition chart.

[Operation method]

<1> Set the up cursor and down cursor to the positions in the state transition chart that mark the start and end of the period for CPU usage data collection.

<2> Select [Browse] → [CPU] on the Analyze window's menu bar to open this window.

Remark When the CPU window is open, the CPU usage data is automatically updated when the up cursor or down cursor is moved to another location on the state transition chart.

(3) Jump function from CPU window

After using the mouse to specify an object in the list, select an item from the [Jump] menu to open the following window.








• **Pattern window**

This window displays pattern distribution during the specified object's processing time. The displayed pattern is set automatically as described below.

Start point: Task Switch from [ANY] to [Specified task]; [Valid]

End point: Task Switch from [Specified task] to [ANY]; [Valid]

[Function buttons]

Target Operation	Button	Function
-		This opens the File Select dialog box. The previously saved CPU window's display data is read and displayed.
-		This opens the File Select dialog box. The data shown in the current CPU window is saved to a file.
-		This sorts the contents of the graph display according to order of appearance of trace data.
-		This sorts the contents of the graph display in alphabetical order of the object names.
-		This sorts the contents of the graph display according to length of execution time.
-		This sorts the contents of the graph display according to order of appearance in the Analyze window.
Object		This displays the Pattern window corresponding to the specified object. If an active Pattern window is already being displayed, the contents of that window are updated at this point.

[Menu bar]

(1) [File] menu





File	View	Operation	Jump	Help
Open...				
Save As...				
Print				
Close				

- Open...:** This opens the File Select dialog box. A previously saved file displayed in this window is loaded.
The default file name extension for files displayed in this window is “.azc”.
- Save As...:** This opens the File Select dialog box. Currently displayed data is updated or renamed and saved to a view file in this window.
The default file name extension for files displayed in this window is “.azc”.
- Print:** This function is not supported in this version.
- Close:** This closes this window.

Caution If a CPU usage graph is not being displayed, the [Save As...] menu item cannot be selected.

(2) [View] menu

File	View	Operation	Jump	Help
	Sort Appear			
	Sort Name			
	Sort Time			
	Sort Restore			

- Sort Appear:** This sorts the contents of the graph display according to order of appearance of AZ trace data.
This has the same operation as clicking the  button.
- Sort Name:** This sorts the contents of the graph display according to the alphabetical order of object names.
This has the same operation as clicking the  button.
- Sort Time:** This sorts the contents of the graph display according to length of execution time (default setting).
This has the same operation as clicking the  button.
- Sort Restore:** This sorts the contents of the graph display according to the order of appearance in the state transition chart.
This has the same operation as clicking the  button.

(3) [Operation] menu

File	View	Operation	Jump	Help
		v Active Hold		

Active: This switches this window from hold mode to active mode.

Hold: This switches this window from active mode to hold mode.

(4) [Jump] menu


File	View	Operation	Jump	Help
			Pattern...	

Pattern...: This window opens the Pattern window corresponding to the specified object. If an active Pattern window is already being displayed, its contents are automatically updated at this point.

The displayed pattern is set automatically as described below.

Start point: Task Switch from [ANY] to [Specified object]; [Valid]

End point: Task Switch from [Specified object] to [ANY]; [Valid]

This has the same operation as clicking the  button.

(5) [Help] menu

File	View	Operation	Jump	Help
				This Window Help Topics

This Window: This displays help topics about this window.

Help Topics: This opens a dialog box for searching the AZ4000's help contents (topics).

[Caution]

- This window is closed when the task-level Analyze window is closed.

[Errors]

- An Error dialog box will appear if an active CPU window already exists when attempting to change a window from hold mode to active mode.

Pattern Set Dialog Box



[Pattern Set]

[General]

This dialog box is used to set a pattern mode and pattern conditions as pattern settings to be displayed in the Pattern window.

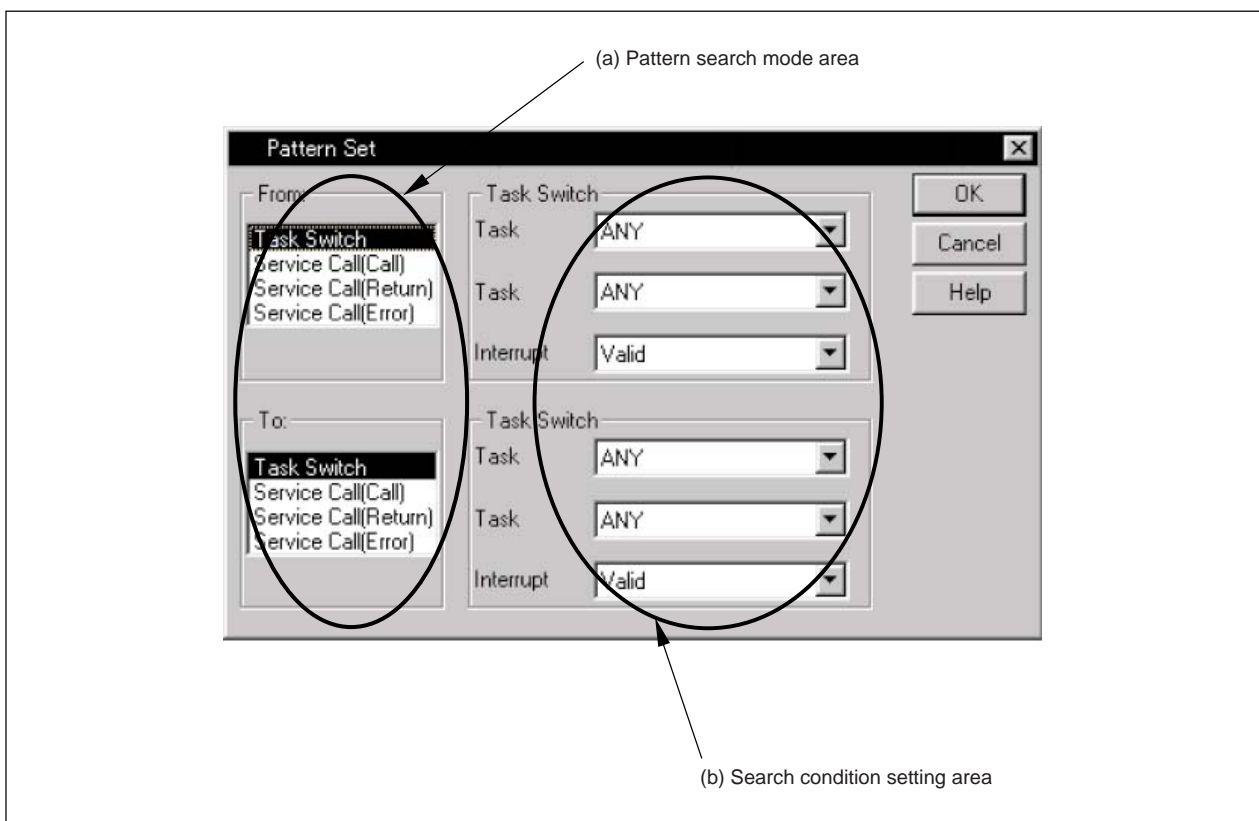
A pattern consists of events that occur between the time a certain event (task switch, interrupt, service call condition, etc.) occurs and the time when that event ends, or that occur during the processing period (CPU execution period) until another event occurs.

This dialog box can be opened via any of the following operations.

- In the Analyze window, select [Browse] → [Pattern] on the menu bar.
- In the Analyze window, click the  button.
- In the Analyze window, press and hold the [Alt] key while pressing the [B] and [P] keys in that order.
- In the Pattern window, select [Option] → [Pattern Set] on the menu bar.
- In the Pattern window, press and hold the [Alt] key while pressing the [P] and [S] keys in that order.
- In the Pattern window, click the  button.

[Window]

Figure 5-11. Pattern Set Dialog Box (When Task Switch Is Selected)



Caution The items displayed in the <<search condition setting area>> differ according to what has been selected in the pattern search mode area.

[Functions]

The following items are described below.

- (1) Description of areas
- (2) Pattern search/tabulation methods

(1) Description of areas

(a) Pattern search mode area

This area is used to select the pattern mode.

A pattern mode indicates the type of event to be tabulated between the start (From:) and end (To:) points in the Pattern window.

The available pattern modes are listed below.

Table 5-6. Pattern Modes

Pattern Mode	Description
Task Switch	Uses task switching locations as start and end points
Service Call(Call)	Uses locations of called service calls as start and end points
Service Call(Return)	Uses locations of returned service calls as start and end points
Service Call(Error)	Uses locations of service calls with returned errors as start and end points

(b) Search condition setting area

This area is used to set search conditions for the pattern mode specified in the pattern search mode area (a).

The contents displayed in this area differ according to the specified pattern mode.

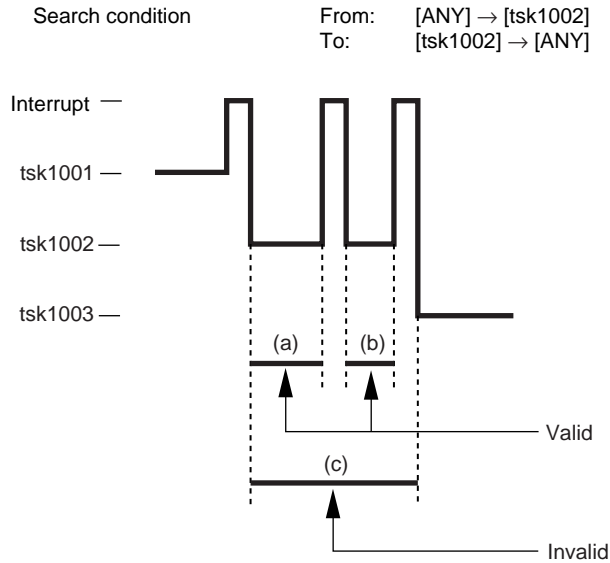
Search conditions set for the items listed below can be directly input from the keyboard or can be selected from a drop-down list.

The available conditions are listed below.

Table 5-7. Pattern Search Conditions (When Search Mode Has Been Set to “Task Switch”)

Item	Description of Condition
Task (upper)	Specifies the task name or interrupt name prior to switching. Specify “ANY” if any task or interrupt name can be used.
Task (lower)	Specifies the task name or interrupt name after switching. Specify “ANY” if any task or interrupt name can be used.
Interrupt	Specifies whether or not to search for switches to or from interrupts. Interrupt transitions are searched when “Valid” is selected and they are not searched when “Invalid” is selected.

Remark The difference in search positions for interrupt items according to the Valid/Invalid specification are described below.



When “Valid” has been specified:

Events during (a) and (b) are detected as a pattern since an interrupt was detected as a target for switching.

When “Invalid” has been specified:

Events during (c) are detected as a pattern since no interrupt was detected as a target for switching. In this case, the time of the interrupt’s appearance is used to calculate the pattern’s start and end times and the interrupt time is included in the pattern’s execution time.

Table 5-8. Pattern Search Conditions
(When “Service Call(Call, Return, Error)” Has Been Specified as Search Mode)

Item	Description of Condition
Task	This specifies the task name or interrupt name for which a service call is issued. Specify “ANY” if any task or interrupt name can be used.
Service Call	This specifies the service call name. Specify “ANY” if any service call name can be used.
Object	This specifies the service call’s target object. Specify “ANY” if any object can be used.

Remark The following are some typical pattern settings.

[Analysis of interrupt servicing time]

From: Task Switch [ANY]→[INTP10];[Valid]

To: Task Switch [INTP10]→[ANY];[Valid]

[Analysis of service call processing time] (analysis of processing time between wai_sem service call issued by tsk(1001) and acquisition of resources from sem(1000))

From: Service Call(Call) [tsk(1001)]→[wai_sem];[sem(1000)]

To: Service Call(Return) [tsk(1001)]→[wai_sem];[sem(1000)]

[Analysis of processing time between issuance of service call and wake of other task] (analysis of processing time between slp_tsk issued by tsk(1001) and passing of processing to tsk(1002))

From: Service Call(Call) [tsk(1001)]→[slp_tsk]

To: Task Switch [ANY]→[tsk(1002)]

[Analysis of error return interval] (analysis of interval between locations where error is returned for tsk(1001))

From: Service Call(Error) [tsk(1001)]→[ANY];[ANY]

To: Service Call(Error) [tsk(1001)]→[ANY];[ANY]

(2) Pattern search/tabulation methods

Perform the following operations to search and tabulate a previously set pattern in a specified area and to open the Pattern window.

[Operation method]

- <1> On the state transition chart, set the up cursor and down cursor to define the pattern distribution area to be tabulated. This dialog box will then appear.
- <2> In the "From:" area, select the pattern mode for the start point of the pattern to be tabulated.
- <3> In the "To:" area, select the pattern mode for the end point of the pattern to be tabulated.
- <4> In the <<search condition setting area>>, enter pattern search conditions for the "From:" and "To:" items, either by directly inputting them via the keyboard or by selecting them from a drop-down list.
- <5> Click the button.

[Function buttons]

Target Operation	Button	Function
Pattern search condition	<input type="button" value="OK"/>	Searches and tabulates the previously set pattern in the state transition chart for the time range between the up cursor and down cursor, then opens the Pattern window.
-	<input type="button" value="Cancel"/>	Closes this dialog box.
-	<input type="button" value="Help"/>	Displays help topics about this dialog box.

[Errors]

- An Error dialog box appears if the AZ trace data does not include any patterns that meet the previously set search conditions.

Pattern Window

[Pattern Window]



[General]

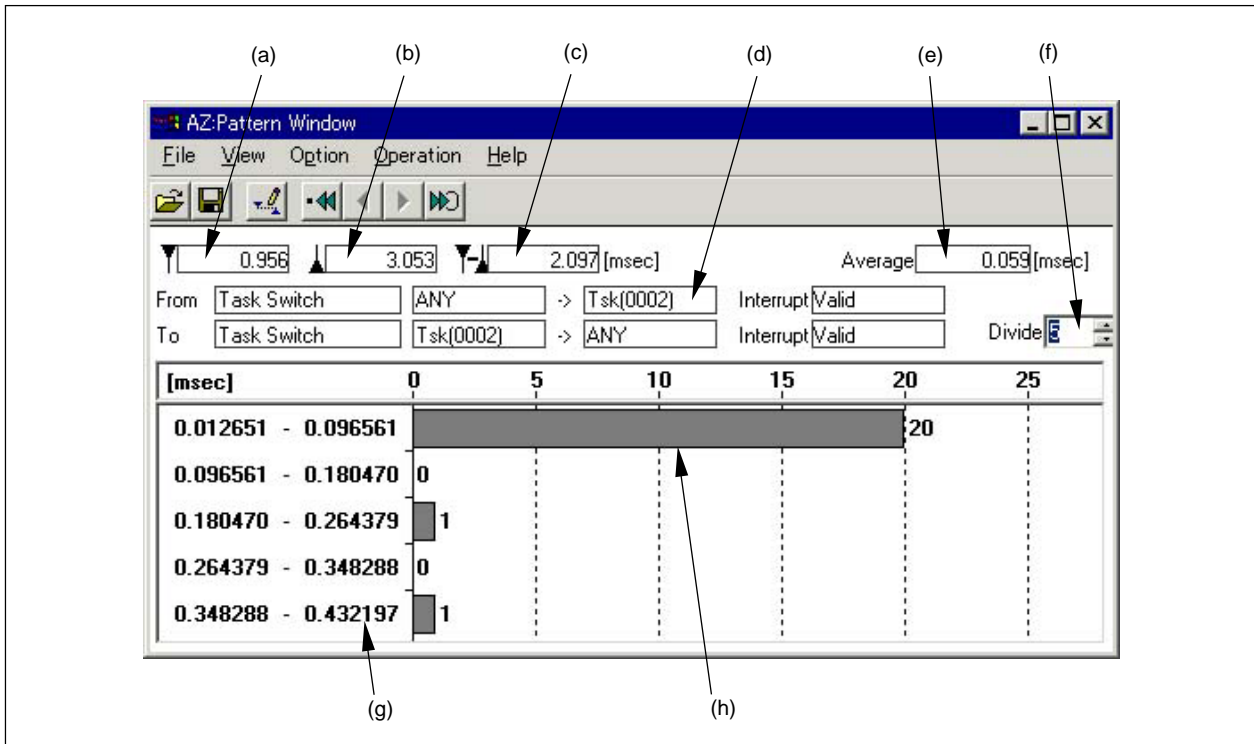
In this window, a pattern that has been set via the Pattern Set dialog box as within the time range between the up and down cursors on the state transition chart is searched, and the appearance of the pattern is tabulated based on the execution time period and is displayed on a histogram.

A pattern consists of events that occur between the time a certain event (task switch, interrupt, service call condition, etc.) occurs and the time when that event ends, or that occur during the processing period (CPU execution period) until another event occurs.

This window can be used to obtain worst-case values, average values, or other values for the execution time of processing in any user program.

This window can be opened via any of the following operations.

- In the Analyze window, select [Browse] → [Pattern] on the menu bar, then set conditions via the Pattern Set dialog box.
- In the Analyze window, click the  button, then set conditions via the Pattern Set dialog box.
- In the Analyze window, press and hold the [Alt] key while pressing the [B] and [P] keys in that order, then set conditions via the Pattern Set dialog box.
- In the CPU window, select [Jump] → [Pattern] on the menu bar.
- In the CPU window, click the  button.

[Window]**Figure 5-12. Pattern Window**

- | | |
|--|------------------------------------|
| (a) Time display at up cursor position | (e) Average value display |
| (b) Time display at down cursor position | (f) Histogram divisor display |
| (c) Time display between up and down cursors | (g) Processing time view area |
| (d) Pattern condition display | (h) Pattern distribution view area |

[Functions]

The following items are described below.

- (1) Description of areas
- (2) Pattern display method
- (3) How to read patterns
- (4) Searching from the Pattern window

(1) Description of areas**(a) Time display at up cursor position**

This displays the time when tabulation of pattern distribution began.

Relative time from the start of AZ trace data collection to the up cursor position is displayed in the state transition chart. The unit of measurement is milliseconds (msec).

(b) Time display at down cursor position

This displays the time when tabulation of pattern distribution ended.

Relative time from the start of AZ trace data collection to the down cursor position is displayed in the state transition chart. The unit of measurement is milliseconds (msec).

(c) Time display between up and down cursors

This displays the length of time used to tabulate pattern data.

The length of time between the up cursor and down cursor is displayed here. The unit of measurement is milliseconds (msec).

(d) Pattern condition display

This displays the pattern conditions that were set via the Pattern Set dialog box.

(e) Average value display

This displays an average value of the previously set pattern's execution time. The unit of measurement is milliseconds (msec).

(f) Histogram divisor display

This displays the histogram divisor. The divisor value can be set in a range from 1 to 100 by clicking the up and down buttons to the right of this display.

(g) Processing time view area

This displays the length of time required for processing of the previously set pattern.

(h) Pattern distribution view area

This displays a histogram of the tabulation results for the previously set pattern's processing time in the period between the up and down cursors on the state transition chart.

(2) Pattern display method

Patterns are tabulated within the period between the up and down cursors on the state transition chart.

[Operation methods]

<1> In the state transition chart, set the up cursor and down cursor to demarcate the section in which pattern data is to be tabulated.

<2> In the Analyze window, select [Browse] → [Pattern] on the menu bar.

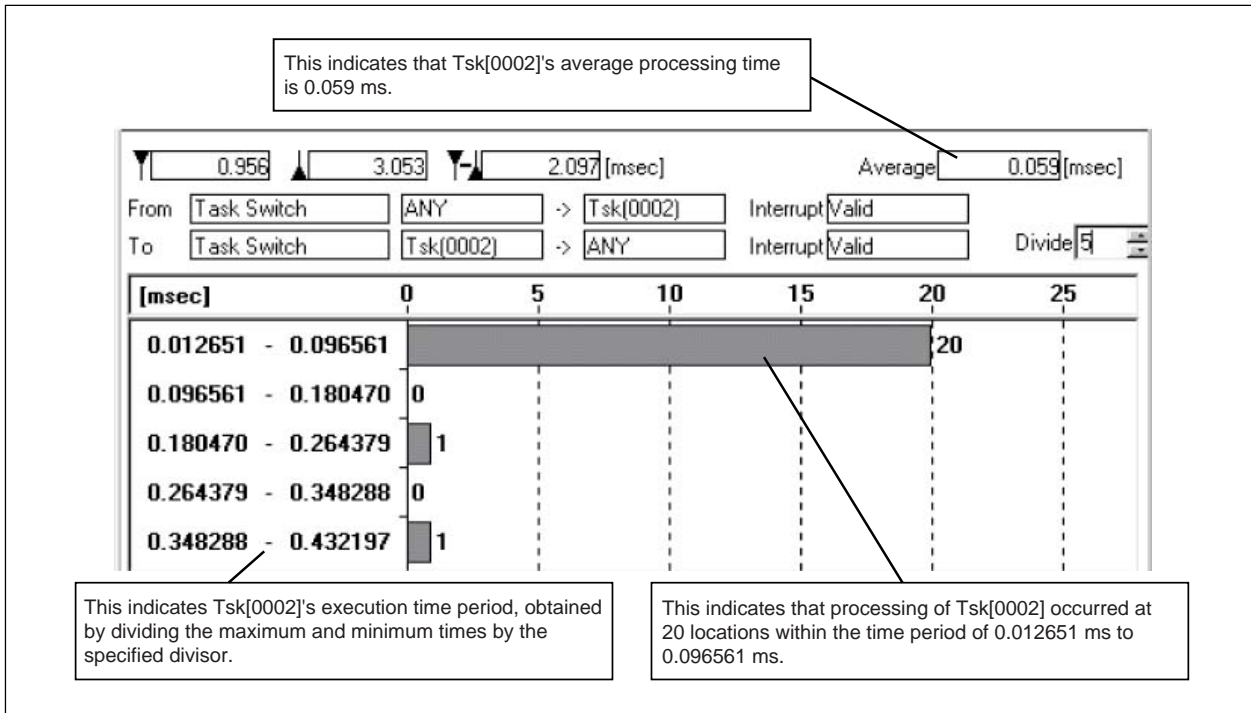
<3> In the Pattern Set dialog box (which opens automatically), set the conditions for the pattern to be tabulated and displayed, then click the button.

Remark If the up cursor or down cursor is moved in the state transition chart while the Pattern window is open, the pattern display is automatically updated.

(3) How to read patterns

Figure 5-13 shows an example of a pattern used for analysis of Tsk[0002]'s processing time.

Figure 5-13. How to Read Patterns



(4) Searching from the Pattern window

The "function buttons" in the Pattern window are used to search the maximum and minimum execution time (or ascending order of time periods) in the processing time for the previously set pattern. The search results are displayed in a state transition chart in this window.

The temporary up cursor is moved to the start position of the searched pattern and the temporary down cursor is moved to the end position.

[Function buttons]

Target Operation	Button	Function
-		This opens the File Select dialog box. The previously saved Pattern window's display data is read and displayed.
-		This opens the File Select dialog box. The data shown in the current Pattern window is saved to a file.
-		This opens the Pattern Set dialog box.
-		This displays the location of the minimum execution time period in the searched pattern in the Analyze window.
-		This searches for the location with the next-shortest execution time period compared to the currently searched location.
-		This searches for the location with the next-longest execution time period compared to the currently searched location.
-		This displays the location of the maximum execution time period in the searched pattern in the Analyze window.

[Menu bar]

(1) [File] menu

File	View	Option	Operation	Help
Open...				
Save As...				
Print				
Close				

Open...: This opens the File Select dialog box. A previously saved file displayed in this window is loaded.

The default file name extension for files displayed in this window is “.azp”.

Save As...: This opens the File Select dialog box. Currently displayed data in this window is updated or renamed and saved to a view file in this window.

The default file name extension for files displayed in this window is “.azp”.

Print: This function is not supported in this version.

Close: This closes this window.

(2) [View] menu

File	View	Option	Operation	Help
	Divide(+)(I)			
	Divide(-)(D)			

Divide(+)(I): This increments (by one) the histogram’s divisor.

Divide(-)(D): This decrements (by one) the histogram’s divisor.







(3) [Option] menu

File	View	Option	Operation	Help
		Pattern Set...		

Pattern Set...: This opens this window’s trace-level Pattern Set dialog box.

(4) [Operation] menu

<u>F</u> ile	<u>V</u> iew	<u>O</u> ption	<u>O</u> peration	<u>H</u> elp
			√ <u>A</u> ctive <u>H</u> old	
			Search (<u>M</u> in) Search (<u>M</u> ax) Search (<u>F</u> ore) Search (<u>B</u> ack)	

- Active: This switches this window from hold mode to active mode.
- Hold: This switches this window from active mode to hold mode.
- Search (Min): The location of the shortest execution time in the tabulated pattern is displayed in the state transition chart.
 The temporary up cursor is moved to the start position of the searched pattern and the temporary down cursor is moved to the end position.
 This has the same operation as clicking the  button.
- Search (Max): The location of the longest execution time in the tabulated pattern is displayed in the state transition chart.
 The temporary up cursor is moved to the start position of the searched pattern and the temporary down cursor is moved to the end position.
 This has the same operation as clicking the  button.
- Search (Fore): After [Search (Min)] has been selected or the  button has been clicked, the location with the next-shortest execution time period compared to the currently searched location is searched.
 The temporary up cursor is moved to the start position of the searched pattern and the temporary down cursor is moved to the end position.
 This has the same operation as clicking the  button.
- Search (Back): After [Search (Max)] has been selected or the  button has been clicked, the location with the next-longest execution time period compared to the currently searched location is searched.
 The temporary up cursor is moved to the start position of the searched pattern and the temporary down cursor is moved to the end position.
 This has the same operation as clicking the  button.

(5) [Help] menu

<u>F</u> ile	<u>V</u> iew	<u>O</u> peration	<u>J</u> ump	<u>H</u> elp
				This <u>W</u> indow
				<u>H</u> elp Topics

- This Window: This displays help topics about this window.
- Help Topics: This opens a dialog box for searching the AZ4000's help contents (topics).

[Caution]

- The Pattern window is closed when the Analyze window is closed.

[Errors]

- An Error dialog box will appear if an active Pattern window already exists when attempting to change a window from hold mode to active mode.

Trace View Window


[Trace View Window]

[General]

This window displays a list of the AZ trace data that is shown in a state transition chart.

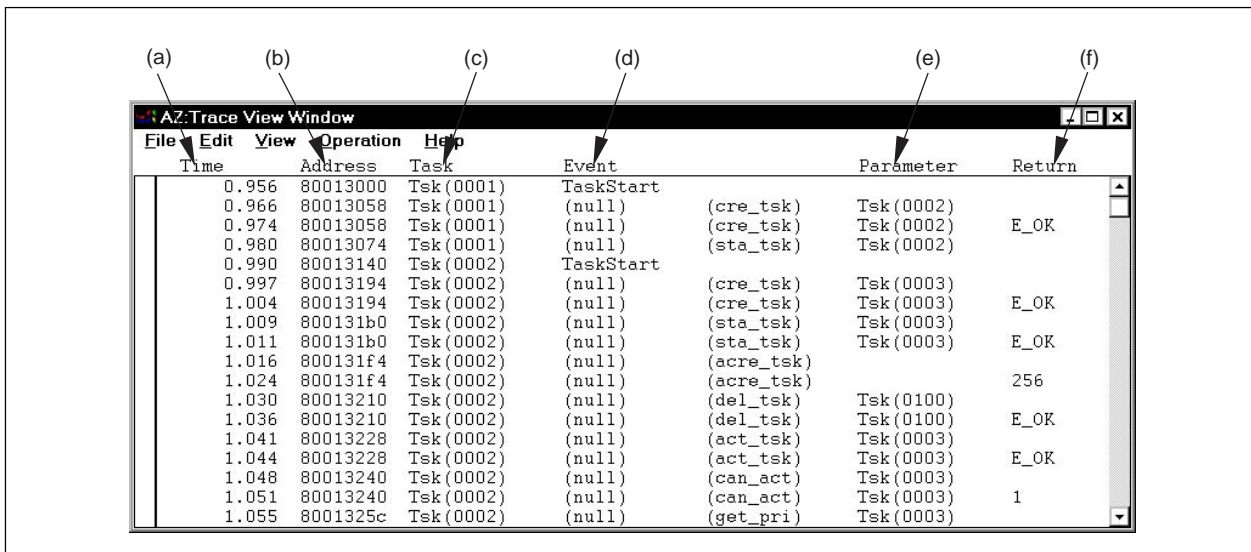
When this window is opened from the Analyze window, it can be used for detailed checking of AZ trace data.

This window can be opened via any of the following operations.

- In the Analyze window, select [Browse] → [Trace View] on the menu bar.
- In the Analyze window, click the  button.
- In the Analyze window, press and hold the [Alt] key while pressing the [B] and [T] keys in that order.

[Window]

Figure 5-14. Trace View Window



- (a) Time view area
 (b) Address view area
 (c) Task view area
 (d) Event view area
 (e) Parameter view area
 (f) Return view area

[Functions]

The following items are described below.

- (1) Description of areas
- (2) AZ trace data display method
- (3) How to read AZ trace data
- (4) AZ trace data search method

(1) Description of areas

(a) Time view area

This area shows the relative time from the start of the AZ trace. The unit is milliseconds (msec).

(b) Address view area

This area shows the user program's execution address. This address is the start address of the next instruction after the actual event occurred.

(c) Task view area

This area shows the task or interrupt name for each event.

(d) Event view area

This area shows the types of events in the AZ trace data. These event types are listed below.

- **ServiceCall**

This indicates a service call. The name of the service call is shown in parentheses.

- **ServiceRet**

This indicates a returned service call. The name of the returned service call is shown in parentheses.

- **Int**

This indicates the start of an interrupt. The name of the interrupt request is shown in parentheses.

- **IntRet**

This indicates the end of an interrupt. The name of the interrupt request is shown in parentheses.

- **TaskStart**

This indicates a task's initial start.

- **Idle**

This indicates a switch to idle mode.

(e) Parameter view area

If the AZ trace data is a service call, this indicates the service call's target object.

(f) Return view area

If the AZ trace data is a returned service call, this indicates the service call's return value.

(2) AZ trace data display method

The AZ trace data is shown at the specified position on the state transition chart.

[Operation methods]

<1> Specify the view start position for the AZ trace data.

If a temporary up cursor is displayed on the state transition chart, the temporary up cursor marks the view start position. If it is not shown, the start of the trace data marks the view start position.

<2> In the Analyze window, select [**B**rowse] → [**T**race View] on the menu bar to open this window.

Remark If the temporary up cursor is moved in the state transition chart while the Trace View window is open, the AZ trace data's view position is automatically updated.

(3) How to read AZ trace data

Figure 5-15 presents a guide for reading AZ trace data.

Figure 5-15. How to Read AZ Trace Data

Time	Address	Task	Event	Parameter	Return
0.956	80013000	Tsk(0001)	TaskStart		
0.966	80013058	Tsk(0001)	(null)	(cre_tsk)	Tsk(0002)
0.974	80013058	Tsk(0001)	(null)	(cre_tsk)	Tsk(0002)
0.980	80013074	Tsk(0001)	(null)	(sta_tsk)	Tsk(0002)
0.990	80013140	Tsk(0002)	TaskStart		
0.997	80013194	Tsk(0002)	(null)	(cre_tsk)	Tsk(0003)
1.004	80013194	Tsk(0002)	(null)	(cre_tsk)	Tsk(0003)
1.009	800131b0	Tsk(0002)	(null)	(sta_tsk)	Tsk(0003)
1.011	800131b0	Tsk(0002)	(null)	(sta_tsk)	Tsk(0003)
1.016	800131f4	Tsk(0002)	(null)	(acre_tsk)	
1.024	800131f4	Tsk(0002)	(null)	(acre_tsk)	256
1.030	80013210	Tsk(0002)	(null)	(del_tsk)	Tsk(0100)
1.036	80013210	Tsk(0002)	(null)	(del_tsk)	Tsk(0100)
1.041	80013228	Tsk(0002)	(null)	(act_tsk)	Tsk(0003)
1.044	80013228	Tsk(0002)	(null)	(act_tsk)	Tsk(0003)
1.048	80013240	Tsk(0002)	(null)	(can_act)	Tsk(0003)
1.051	80013240	Tsk(0002)	(null)	(can_act)	Tsk(0003)
1.055	8001325c	Tsk(0002)	(null)	(get_pri)	Tsk(0003)

(a) This indicates that 1.009 ms after the system was started, the service call “sta_tsk” was issued at address 0x800131b0 by the task “Tsk(0002)” for the task “Tsk(0003)”.

(b) This indicates that 1.011 ms after the system was started, the value “E_OK” was returned in relation to service call “sta_tsk” at address 0x800131b0.

For details of returned values, see the RX4000 User’s Manual.

Remark For “ServiceRet”, if the corresponding service call event does not exist in the trace memory, a blank space will be shown between the parentheses. This can happen when the service call is executed from within a user program.

(4) AZ trace data search method

The Trace Search dialog box, which can be opened via this window’s menu bar, can be used to search conditions such as execution task names, interrupt names, event types, or service call arguments.

For details of the search method, see the description of the Trace Search dialog box.

[Operation methods]

<1> Select [View] → [Search] via this window’s menu bar.

<2> Set the search conditions in the Trace Search dialog box that appears automatically.

<3> Click the **Search(Fore)** button in the Trace Search dialog box to start searching in the direction of newer trace times, or click the **Search(Back)** button in the Trace Search dialog box to start searching in the direction of older trace times.

<4> Update the AZ trace data view position at the start of the searched location.

[Menu bar]

(1) [File] menu

<u>F</u> ile	<u>E</u> dit	<u>V</u> iew	<u>O</u> peration	<u>H</u> elp
<u>O</u> pen... Save <u>A</u> s...				
<u>P</u> rint				
<u>C</u> lose				

- Open...: This function is not supported in this version.
- Save As...: This opens the File Select dialog box. Currently displayed data in this window is updated or renamed and saved to a view file in this window. The default file name extension for files displayed in this window is “.azt”.
- Print: This function is not supported in this version.
- Close: This closes this window.

(2) [Edit] menu

<u>F</u> ile	<u>E</u> dit	<u>V</u> iew	<u>O</u> peration	<u>H</u> elp
<u>C</u> opy				

- Copy: This function is not supported in this version.

(3) [View] menu

<u>F</u> ile	<u>E</u> dit	<u>V</u> iew	<u>O</u> peration	<u>H</u> elp	
		<u>S</u> earch...			
		<u>T</u> imetag ▶ <u>A</u> ddress ▶ <u>T</u> ask ▶ <u>E</u> vent ▶ <u>P</u> arameter ▶ <u>R</u> eturn ▶	} → <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td> v <u>S</u>how <u>H</u>ide </td> </tr> </table>		v <u>S</u> how <u>H</u> ide
v <u>S</u> how <u>H</u> ide					

- Search...: This opens the Trace Search dialog box.
- Timetag: This specifies show or hide mode for the “Time” item. Select [Show] or [Hide] from the sub menu.
- Address: This specifies show or hide mode for the “Address” item. Select [Show] or [Hide] from the sub menu.
- Task: This specifies show or hide mode for the “Task” item. Select [Show] or [Hide] from the sub menu.
- Event: This specifies show or hide mode for the “Event” item. Select [Show] or [Hide] from the sub menu.

Parameter: This specifies show or hide mode for the “Parameter” item.
 Select [Show] or [Hide] from the sub menu.

Return: This specifies show or hide mode for the “Return” item.
 Select [Show] or [Hide] from the sub menu.

(4) [O]peration menu

<u>F</u> ile	<u>E</u> dit	<u>V</u> iew	<u>O</u> peration	<u>H</u> elp
			√ <u>A</u> ctive <u>H</u> old	

Active: This switches this window from hold mode to active mode.
Hold: This switches this window from active mode to hold mode.

(5) [H]elp menu

<u>F</u> ile	<u>E</u> dit	<u>V</u> iew	<u>O</u> peration	<u>H</u> elp
			This <u>W</u> indow	
			<u>H</u> elp Topics	

This Window: This displays help topics about this window.
Help Topics: This opens a dialog box for searching the AZ4000’s help contents (topics).

[Cautions]

- This window is closed when the Analyze window is closed.
- For “ServiceRet”, if the corresponding service call event does not exist in the trace buffer, a blank space will be shown between the parentheses. This can happen when the service call is executed from within a user program.

[Errors]

- An Error dialog box will appear if an active Trace View window already exists when attempting to change a window from hold mode to active mode.

Trace Search Dialog Box

[Trace Search]

[General]

This dialog box is used to set search conditions before searching AZ trace data via the Trace View window.

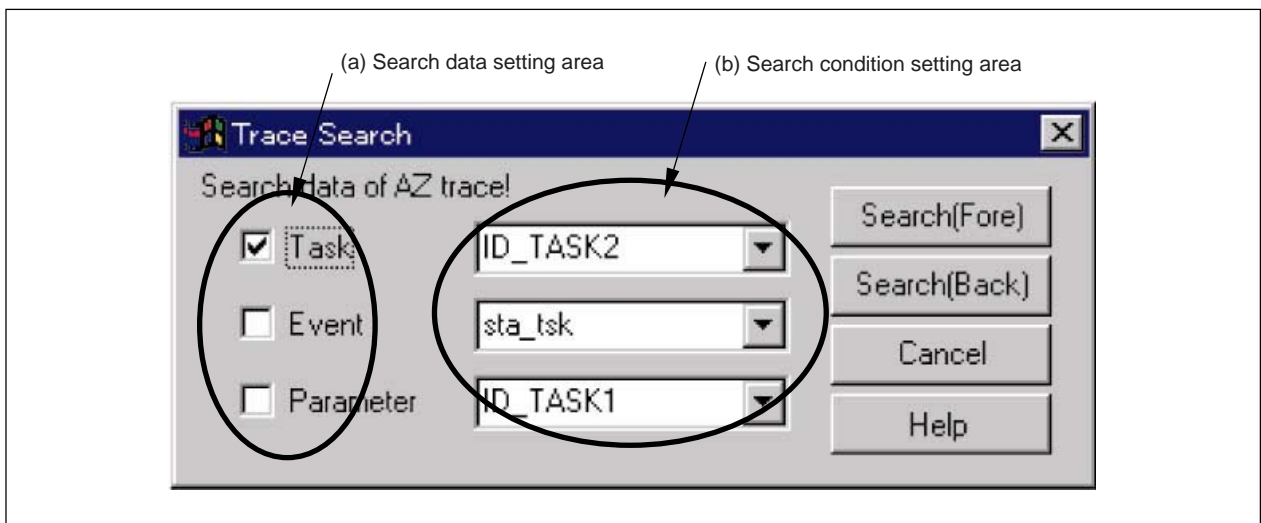
The search conditions that can be set include execution task names, interrupt names, event types, or service call arguments.

This dialog box can be opened via any of the following operations.

- In the Trace View window, select [View] → [Search] on the menu bar.
- In the Trace View window, press and hold the [Alt] key while pressing the [V] and [S] keys in that order.

[Window]

Figure 5-16. Trace Search Dialog Box



[Functions]

The following items are described below.

- (1) Description of areas
- (2) Search methods

(1) Description of areas

(a) Search data setting area

This area is used to specify search items in the AZ trace data shown in the Trace View window.

Select the check box next to the desired search item. Several items can be selected.

Task: Select this when searching task names or interrupt names.

Event: Select this when searching event types.

Parameter: Select this when searching service call arguments.

(b) Search condition setting area

This area is used to specify search conditions for each search item.

From each drop-down list, select a task name, interrupt name, event type, or service call argument that exists in the collected AZ trace data.

(2) Search methods**[Operation methods]**

<1> In the <<search data setting area>>, select the target item to be searched. Several items can be selected.

<2> Search conditions in the <<search condition setting area>> can be directly input from the keyboard or can be selected from a drop-down list.

<3> Click the **Search(Fore)** button or the **Search(Back)** button.

Searches are performed as described below.

- If the **Search(Fore)** button has been clicked:
A search of locations that match the previously set search conditions is performed in the direction of newer trace times, and the Trace View window is displayed starting at the first search location.
- If the **Search(Back)** button has been clicked:
A search of locations that match the previously set search conditions is performed in the direction of older trace times, and the Trace View window is displayed starting at the first search location.

The following are some examples of search condition settings in the Trace Search dialog box.

Figure 5-17. Example of Trace Search Settings (When Searching for Task “Tsk(1001)”)

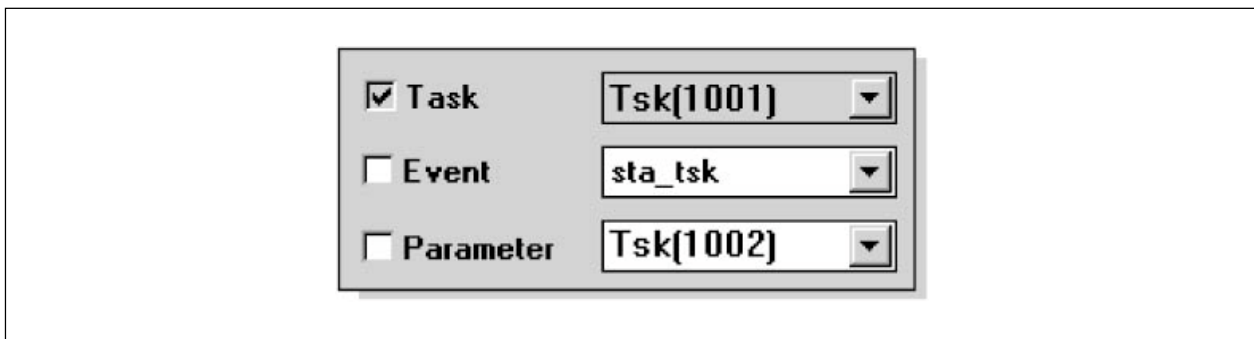


Figure 5-18. Example of Trace Search Settings (When Task “Tsk(1001)” Searches for Location Where Service Call “sta_tsk” Was Issued)

Figure 5-19. Example of Trace Search Settings (When Task “Tsk(1001)” Searches for Location Where Service Call “sta_tsk” Was Issued for Task “Tsk(1002)”)

[Function buttons]

Target Operation	Button	Function
Search condition	Search(Fore)	Locations matching the previously set search conditions are searched in the direction of newer trace times, and the Trace View window is displayed starting at the first search location.
Search condition	Search(Back)	Locations matching the previously set search conditions are searched in the direction of older trace times, and the Trace View window is displayed starting at the first search location.
-	Cancel	Closes this dialog box.
-	Help	Displays help topics about this dialog box.

[Errors]



- A warning alarm is sounded if no phenomena that match the specified search condition exist in the AZ trace data.
- A warning alarm is sounded if the Search(Fore) or Search(Back) button has been clicked without first selecting at least one item from the <<search data setting area>>.

File Select Dialog Box

[File Open]

[General]

This dialog box is used to select a view file to be loaded or saved.
This dialog box can be opened via any of the following operations.

- In any window, select [File] → [Open] on the menu bar.
- In any window, select [File] → [Save As] on the menu bar.
- In any window, click the  button.
- In any window, click the  button.
- In any window, click the **Alt** key while pressing the **F** and **O** keys in that order.
- In any window, click the **Alt** key while pressing the **F** and **A** keys in that order.

[Window]**Figure 5-20. File Select Dialog Box**

[Functions]

The following items are described below.

- (1) View file extensions and file formats
- (2) Retrieval of view information

(1) View file extensions and file formats

View file types vary according to the window being used, and the various types can be identified by their file name extensions.

The default extensions used for different types of view files used in various AZ4000 windows are listed in Table 5-9 below.

Table 5-9. View File Types and Extensions

View File Type	Extension	File Format
Analyze window	.AZ	Binary format
CPU window	.AZC	CSV format
Pattern window	.AZP	
Trace View window	.AZT	

(2) Retrieval of view information

The way that view information is retrieved by loading a view file differs according to the window, as described below.

(a) Analyze window

View information is retrieved into the currently open Analyze window.



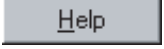
Consequently, to retain the currently displayed state transition chart, set the currently open Analyze window to “hold” mode, then open a new Analyze window and load a view file.

(b) Other windows

A new window is opened in “hold mode” and the view information is retrieved into that window.

Consequently, the open window’s view information is retained as it is on the screen.

[Function buttons]

Target Operation	Button	Function
Select file		Loads or saves the selected view file.
–		Closes this dialog box.
–		Displays help topics about this dialog box (this button is displayed only when the AZ4000’s help file has been installed).

[Errors]

- An Error dialog box appears if the specified file name's format is incorrect.
- An Error dialog box appears if an attempt is made to load a non-existent file.
- An Error dialog box appears if an attempt is made to save a write-protected file.
- An overwrite warning message appears if an attempt is made to save a new file with the same name as an older file.
- An Error dialog box appears if an attempt is made to load data that cannot be handled by the current window.

APPENDIX A ERROR MESSAGES

The AZ4000's error messages are listed using the following format.

Error No.	Error message
Error No.	Action by user

(1/2)

1000	Not enough memory.
	There is not enough available memory on the machine. Close unnecessary windows, then retry execution.
1001	Internal error.
	An unexpected error has occurred. Retry execution from the start.
1010	Can't change to active mode.
	Another window is already open in active mode, so this window cannot be changed to active mode. Either change the other (active) window to hold mode or close it, then change this window to active mode.
1020	Illegal file name.
	An illegal character, character string, or format was used in a file name. Check the file name and retry execution.
1021	Not exist file.
	The specified file name does not exist. Specify a valid file name.
1022	Can't write file.
	Cannot write to file, either due to a lack of disk space or because the target file is a read-only file. Specify a file on another disk or a file that is not a read-only file.
1023	Illegal file format.
	The target file does not have the correct format and therefore cannot be read. Check the file's contents.
1100	Not implement AZ interface.
	Cannot connect to debugger because the AZ interface has not been implemented on the debugger. Confirm that the debugger is TIP-compliant.
1110	Can't switch trace mode.
	An error occurred during AZ trace ON/OFF switching. Data in the RX4000 or AZ monitor may have been corrupted. Either reload the load module or restart the debugger and the AZ4000.
1118	Not specified trace buffer region.
	AZ trace ON is set in a state where the trace buffer region is not specified. In the AZ Option dialog box, specify a trace buffer region, then set AZ trace ON.
1120	Can't upload.
	An error occurred during processing to upload trace data. The trace memory region setting may be incorrect. Confirm whether or not correct addresses were specified for the trace memory region. Also, make sure that the memory information addresses specified during configuration of the RTOS do not overlap with the AZ monitor's region.
1121	No trace data.
	The executed data does not include any trace data. Set AZ trace ON again, then execute the user program and upload trace data.

1122	<p>Illegal trace data.</p> <p>The time tag in the trace data may be incorrect. Make sure that the user's own coding block has been coded correctly.</p>
1210	<p>Illegal trace buffer address.</p> <p>Address range specified by trace buffer region specification is not correct. Specify a correct address range for the trace buffer region.</p>
1400	<p>Not exist pattern.</p> <p>The specified pattern does not exist in the trace data between the up cursor and down cursor. Extend the width between the up and down cursors and retry execution. If this error occurs even when the maximum width has been set, the specified pattern does not exist at all in the trace data.</p>

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