Performance Analyzer User Guide

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About This Manual

This manual is the latest release of instructions relating to the PlayStation® Performance Analyzer as of Run-Time Library release 4.3. The purpose of this manual is to provide general instructions on using the Performance Analyzer software.

Changes Since Last Release

There have been no substantive changes to this manual since the previous release, which described software version 2.04.

Related Documentation

This manual should be read in conjunction with the *Performance Analyzer Technical Reference*.

Manual Structure

Section	Description
Ch. 1: Overview	—
Ch. 2: Tutorial	Describes, using a sample program, the basics of operating the Performance Analyzer (hereafter abbreviated to PA), including measurement using the basic setup and reading the measured results.
Ch. 3: Using the Trigger Function	Describes setting the conditions supported by the trigger function. The use of the trigger function enables the measurement of the target frame.
Ch. 4: Details	Describes the menus, buttons and graphs displayed in the main window.

Developer Reference Series

This manual is part of the *Developer Reference Series*, a series of technical reference volumes covering all aspects of PlayStation development. The complete series is listed below:

Manual	Description
PlayStation Hardware	Describes the PlayStation hardware architecture and overviews its subsystems.
PlayStation Operating System	Describes the PlayStation operating system and related programming fundamentals.
Run-Time Library Overview	Describes the structure and purpose of the run-time libraries provided for PlayStation software development.
Run-Time Library Reference	Defines all available PlayStation run-time library functions, macros and structures.
Inline Programming Reference	Describes in-line programming using DMPSX, GTE inline macro and GTE register information.
SDevTC Development Environment	Describes the SDevTC (formerly "Psy-Q") Development Environment for PlayStation software development.

3D Graphics Tools	Describes how to use the PlayStation 3D Graphics Tools, including the animation and material editors.
Sprite Editor	Describes the Sprite Editor tool for creating sprite data and background picture components.
Sound Artist Tool	Provides installation and operation instructions for the DTL-H800 Sound Artist Board and explains how to use the Sound Artist Tool software.
File Formats	Describes all native PlayStation data formats.
Data Conversion Utilities	Describes all available PlayStation data conversion utilities, including both stand-alone and plug-in programs.
CD Emulator	Provides installation and operation instructions for the CD Emulator subsystem and related software.
CD-ROM Generator	Describes how to use the CD-ROM Generator software to write CD-R discs.
Performance Analyzer User Guide	Provides general instructions for using the Performance Analyzer software.
Performance Analyzer Technical Reference	Describes how to measure software performance and interpret the results using the Performance Analyzer.
DTL-H2000 Installation and Operation	Provides installation and operation instructions for the DTL-H2000 Development System.
DTL-H2500/2700 Installation and Operation	Provides installation and operation instructions for the DTL-H2500/H2700 Development Systems.

Typographic Conventions

Certain Typographic Conventions are used through out this manual to clarify the meaning of the text. The following conventions apply to all narrative text except for structure and function descriptions:

Convention	*Meaning*
`courier`	Indicates literal program code.
Bold	Indicates a document, chapter or section title.

The following conventions apply within structure and function descriptions only:

Convention	*Meaning*
Medium Bold	Denotes structure or function types and names.
Italic	Denotes function arguments and structure members.

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Chapter 1: Overview

Required Equipment, Recommended Hardware

The following equipment is necessary to use the Performance Analyzer:

- PlayStation Board (DTL-H2700),
- PS-X Software Development Tool,
- IBM PC/AT or compatible (with one free ISA bus slot (however, space equal to three slots is required), Windows 95 or Windows NT4.0, at least 32 MB of RAM, 200 MB of free disk space, and a monitor supporting a resolution of 1024 x 768, 16-bit color.)
- Performance Analyzer (DTL-S2710).

Features

The Performance Analyzer provides the following features:

- It incorporates 64 MB of DRAM so that 128-bit data corresponding to about 7.4V blanks (NTSC) or about 6.2V blanks (PAL) can be read per clock and analyzed.
- It can observe most of the external signals of the CPU chips and the video RAM bus of the GPU. As a result, the situations of interrupts, sub bus access and video RAM access can be identified, in addition to the main RAM access status.
- It can easily analyze CPU data duplicate read, write buffer flush, GPU packets, etc.
- It analyzes the main RAM access situation by distinguishing between the normal and DMA transfer of the CPU, GPU, etc. and indicates the bus usage information using colors. This makes it possible for the user to quickly comprehend the bus access situation in a frame section.
- It is capable of displaying waveforms either as a graph or as a listing of figures, in the same way as a logic analyzer.
- It can read map files output from compilers and display the access situation for segments and global symbols.
- It supports the calculation of statistics for a specified range.
- It supports simple mouse-based operation in the GUI environment. Also, thanks to its use of a multi-document configuration and a split-window method, it enables the efficient comparison of large amounts of data, the comparison of data with previously obtained and saved data, and the easy comparison of tuning results.
- An ISA bus add-on board, used as the Performance Analyzer interface, allows measured data to be downloaded quickly.
- The start of measurement can be triggered according to the main RAM bus address and data condition as well as by using the trigger switch.
- It can read and analyze data of up to 6V blanks prior to the trigger position.

Using the Performance Analyzer with the software development tools

The Performance Analyzer can be used with the PlayStation software development tools concurrently, i.e., users can use a tool such as a debugger while running the Performance Analyzer. Both environments work independently. Therefore when the PlayStation CPU is reset, the contents of the trace memory in the Performance Analyzer remains the same.

Chapter 2:
Tutorial

Measurement Using the Basic Setup

The description given in this section covers the installation of PA, how to execute the program to be measured and how to perform measurement using the basic setup.

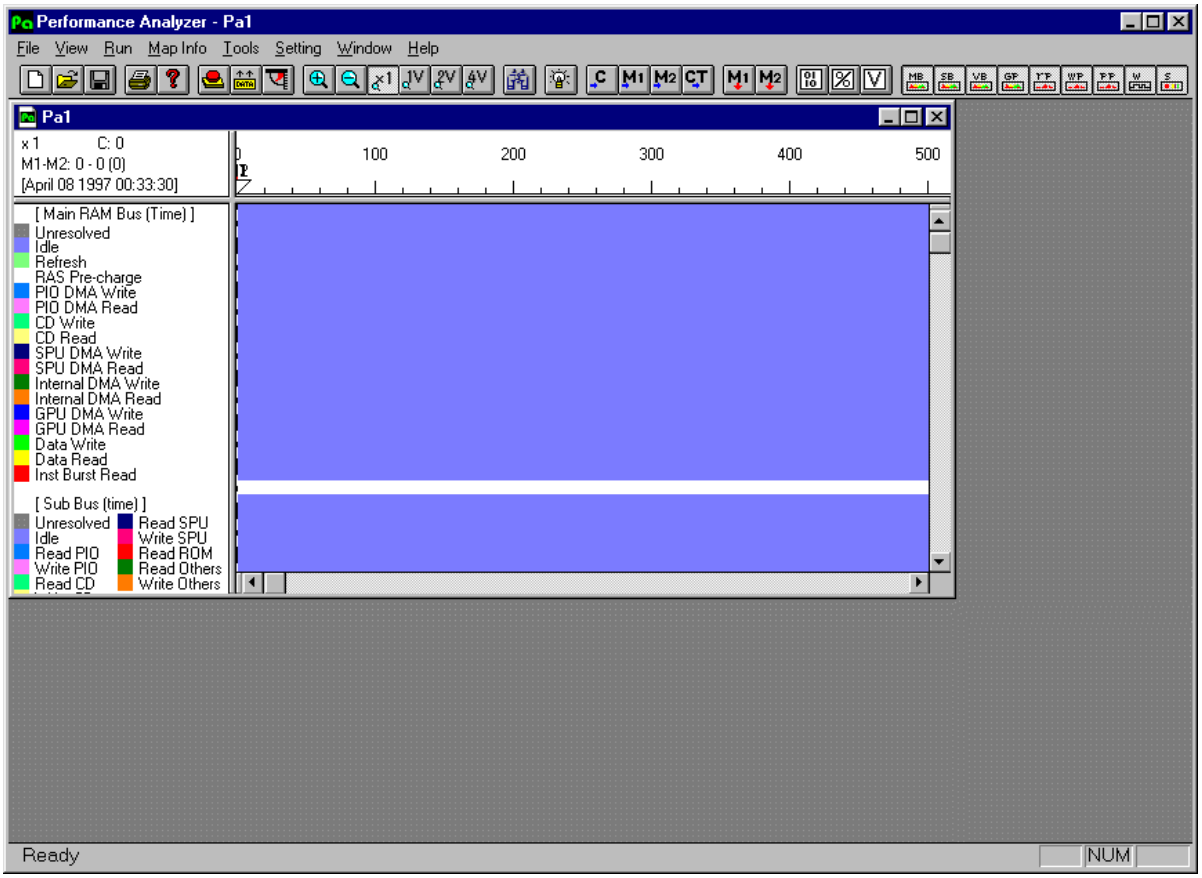
Installing PA and setting up a temporary directory

Read the “\pa\setup_j.txt” file to install driver and execution files. This file is contained in the CD-ROM.

As PA uses a large amount of disk space for its temporary files (up to around 100 MB per data item), the temporary directory must be created on a drive which has a large amount of free space.

Execute PA only after the above settings have been completed.

Figure 2-1 : State of PA before measurement



Executing the program to be measured

The program to be measured with the Performance Analyzer should be executed independently of PA. The program can be executed either from a CD or by downloading. This is outside the scope of this manual, however. Note that the program development environment should be set up before executing the program. For details of setting up and using the program development environment, refer to *DTL-H2500/H2700 Installation and Operation* and *SDevTC Development Environment*.

The following is sample usage with SDevTC combined under the Windows95 environment.
Execute the following command(s) from the DOS prompt.

[When executing a program on a CD]

C:\> resetps 0

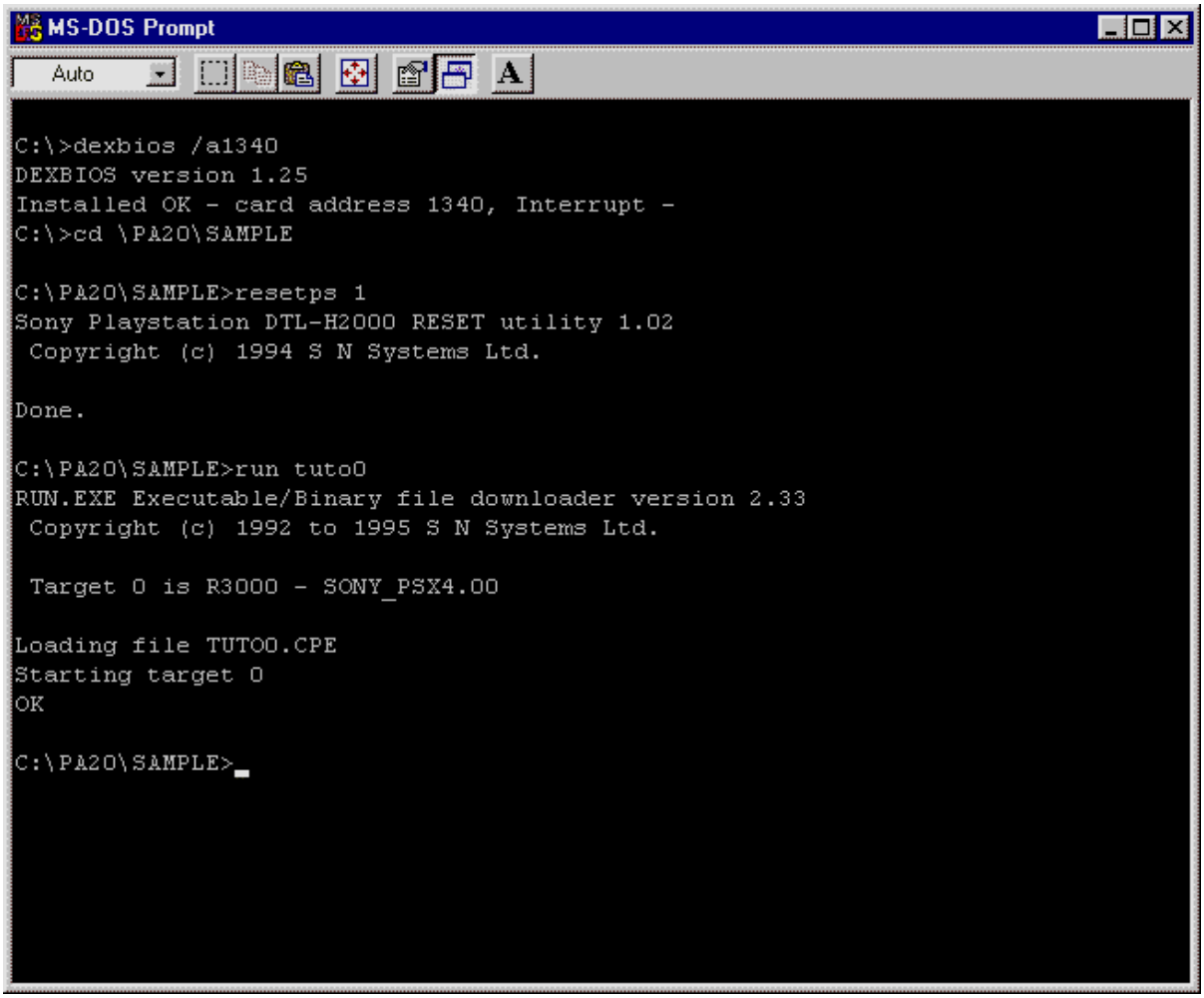
[When downloading a program] (When executing the sample program provided with PA)

C:\> CD \PA20\SAMPLE

C:\PA20\SAMPLE> resetps 1

C:\PA20\SAMPLE> run tuto0

Figure 2-2: Download Screen



The description in the subsequent sections assumes the use of the downloaded sample program.

Setting the IO port address

The IO port address should be set before using the performance analyzer (PA) to analyze the sample program. From version 2.04, the IO Port Address must be set when the driver is installed. For further details, see \pa\setup_j.txt.

Executing measurement using the basic setup

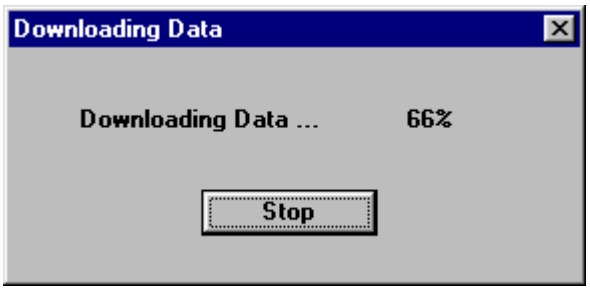
With the default setup, measurement start timing is specified using only a trigger switch (the provided foot switch). Other conditions that can be used for triggering measurement include the main RAM address and data, which can be selected with "Trigger Condition..." on “Setting” menu. For details, see Section 3.1, "Setting the Trigger Conditions."

From “Run” menu, select "Acquisition..." The following dialog box will appear:

Figure 2-3: Measurement Dialog Box

Press the trigger switch when the scene to be measured appears. Data read starts immediately, provided there is no trigger condition other than the trigger switch, as in this example. If trigger conditions other than the trigger switch are specified, the data to be measured once all the conditions are satisfied starts to be read when the switch is pressed.

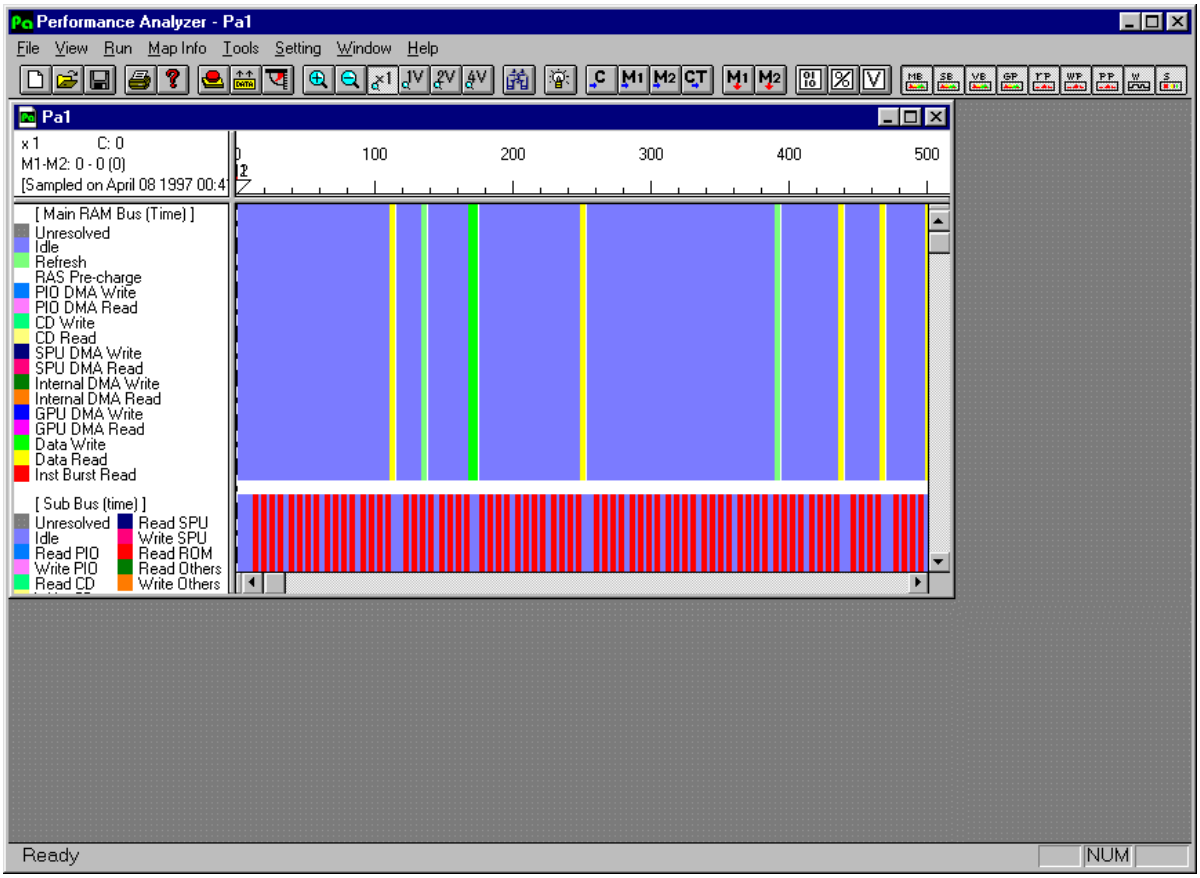
Figure 2-4: Dialog Box During Data Read



Basic Operations

This section describes the basic analysis operations such as main window display setting and cursor manipulation. For details of the graphical display of the analysis, waveform and access, see the "Main Window Description." section of this manual.

Figure 2-5: State of PA After Measurement



Switching the displayed graphs

The graphs that can be displayed are seven analysis displays, a waveform display and two access displays. Although all of the graphs are displayed by default, all can be switched on-off independently using the nine buttons  at the right-hand end of the tool bar. The graph corresponding to each button is displayed while the button is depressed, and not displayed while the button is released.

Upon the completion of measurement, a slight delay is incurred before a graph is displayed. This delay increases as the view size decreases and the view area increases, but can be minimized by "switching off" any graphs which need not be displayed. For example, it is possible to set the buttons so that only the main RAM bus and video RAM bus analysis graphs are displayed. The other graphs are displayed only when required.

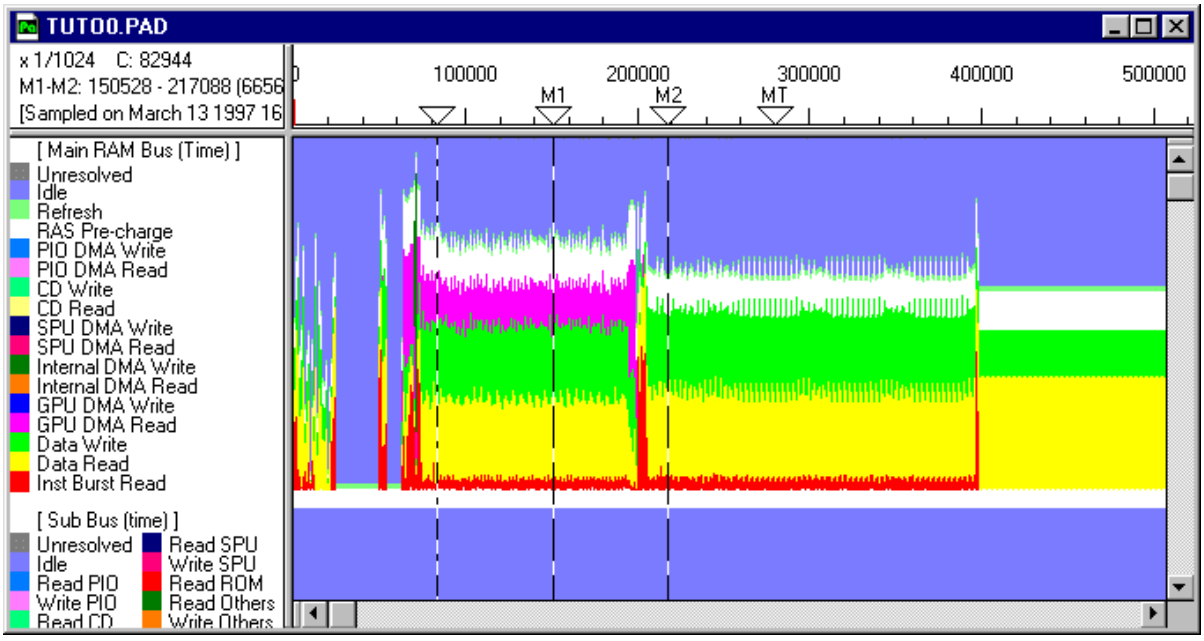
Display switching can also be set using the Option dialog box. By saving the setting, it can be set as the default to be used subsequently. For details, see the "Option Dialog Box." section of this manual.

Using the cursors and markers

Clicking the mouse in the main window causes a vertical line to appear. This is the cursor used to indicate the position currently being examined (the cursor is located at the clock 0 point when the view is created for the first time). Then, click the right-hand graph. You will see that a cursor can be set in it, independently of that in the left graph. Now, open “View” menu and execute "Reset M1 to cursor point." () A marker named M1 is displayed on the scale. Clicking a point close to the marker moves the marker to the clicked point. PA has two markers, named M1 and M2. These markers are used for marking positions and setting a range for which statistical measurement is to be performed. Now, click the mouse, move the cursor to another position and click  on the tool bar; M2 moves to the cursor position. As shown here, the markers can also be moved with the tool bar buttons. It is important to note that, while the window is split, the cursors of the left-hand and right-hand graphs function independently, but M1 and M2 are common to both windows.

After measurement, another marker MT, which is used to indicate the trigger point, is displayed. Clicking  on the tool bar moves the cursor to the trigger point.

Figure 2-6: Cursor, Markers and Trigger Position



Enlarging or reducing the view

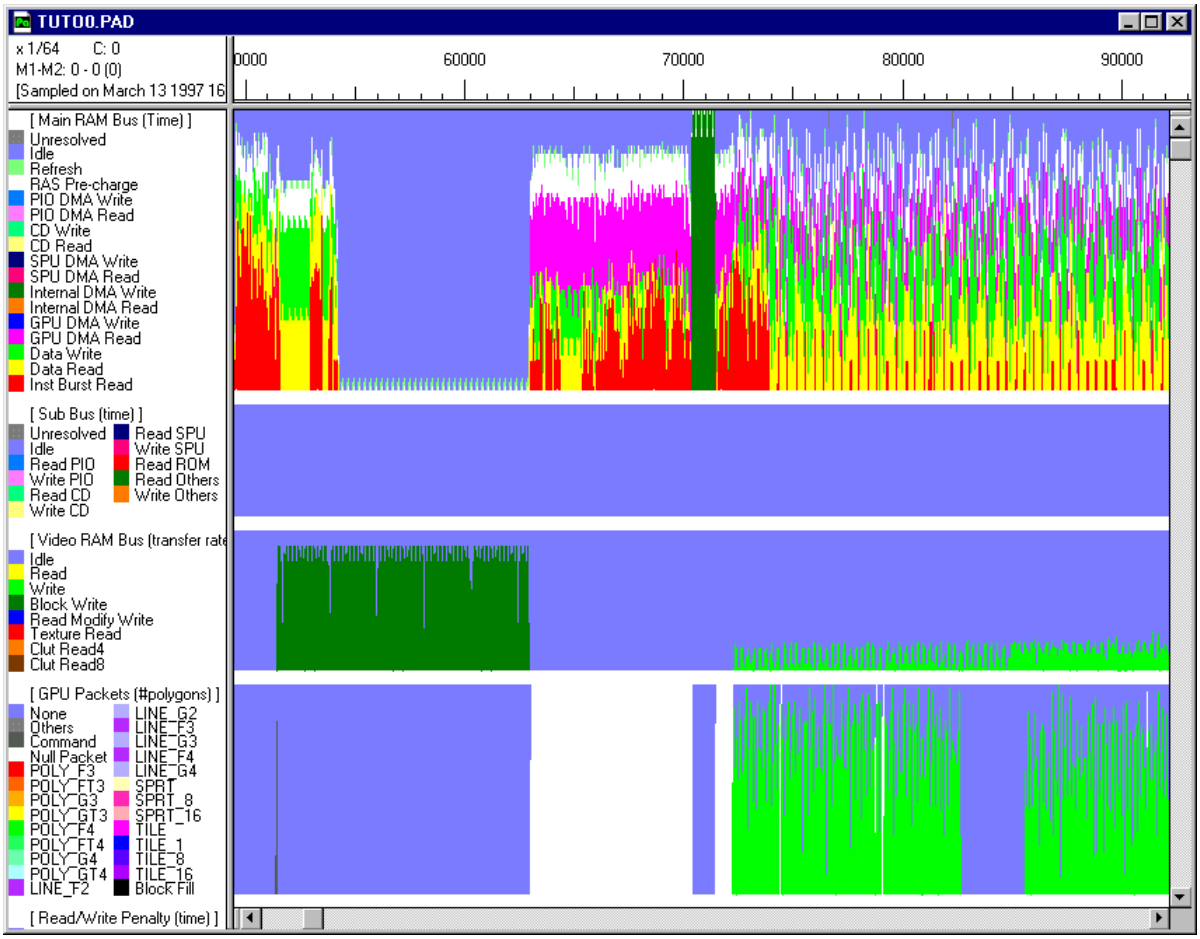
To display a wider area by reducing the view, select "Reduce Scale" from ”View” menu. This opens another menu which allows you to select any of a variety of view sizes. For example, selecting "Zoom Out" reduces the view to half its current size. To enlarge the view, select "Increase Scale" from “View” menu. Then, specify the size in the same way as above. Selecting "Zoom In" enlarges the view to twice its current size. To return to the actual size (where each pixel corresponds to a clock pulse), select "Normal size" from “View” menu. These view size change commands are applicable to all views, even when the window is split. The size is displayed at the top left of the view, and the display is scrolled so that the cursor is centered.

In much the same way as the Move commands, the view size change commands are also registered on the tool bar.  is for zoom in,  is for zoom out, and  is for the normal size.  ,  and  allow the user to change the view size so that the display of the respective frame sections fills the screen (note, however, that the sections may not be displayed correctly when a compact display device is used).

Changing the analysis display and pixel width

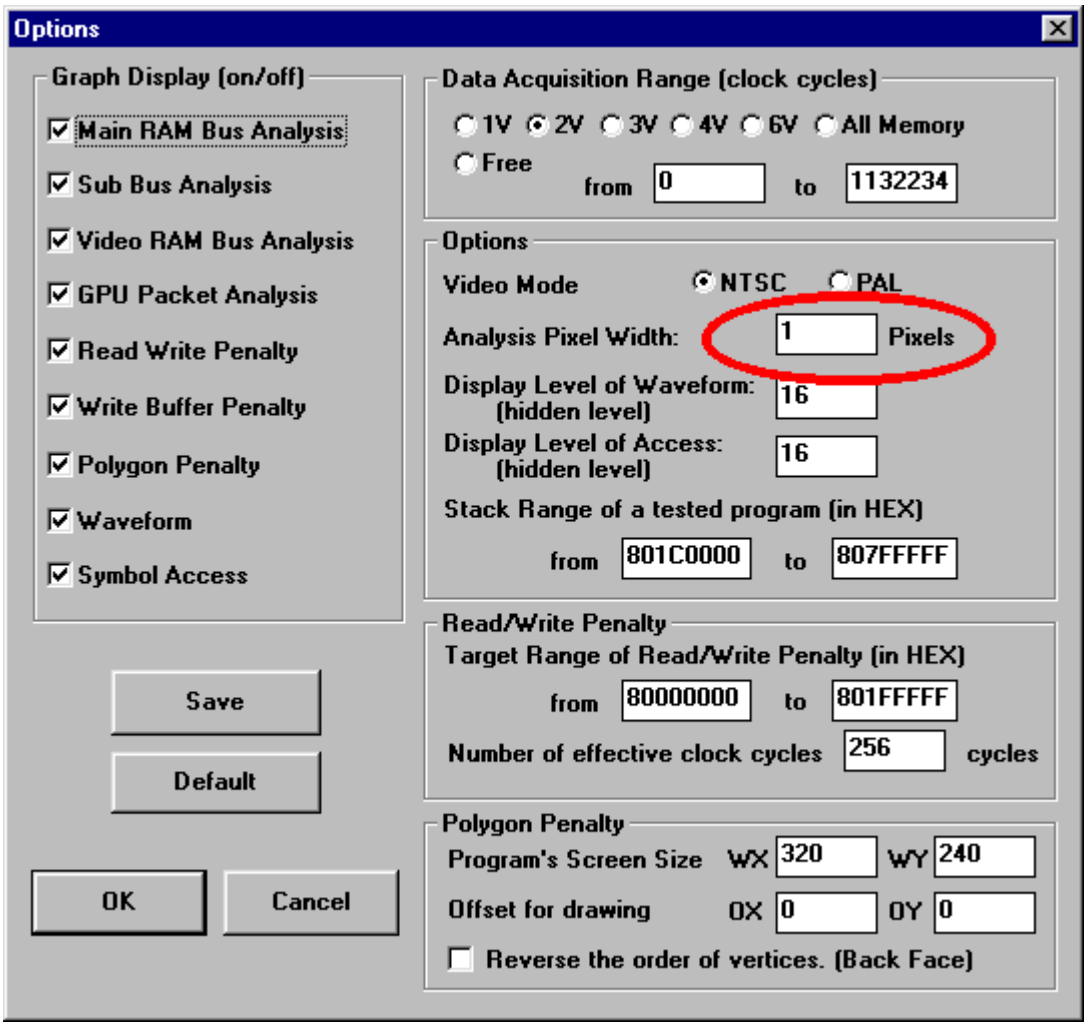
The analysis display is a vertical bar when the view size is set to 1, but reducing the view size turns the one pixel-wide bar into a histogram. For example, when the view size is set to 1/16, the histogram shows the percentage of each status over 16 clocks as a color display (the order in the vertical direction is fixed in the same way as the label on the left). Now, set the view size to 1/512; the histogram is averaged so that the change in the bus usage with respect to time is displayed visually. Next, restore the size to 1/64. The analysis display will be as shown below.

Figure 2-7: Analysis (Size 1/64, Pixel Width 1))



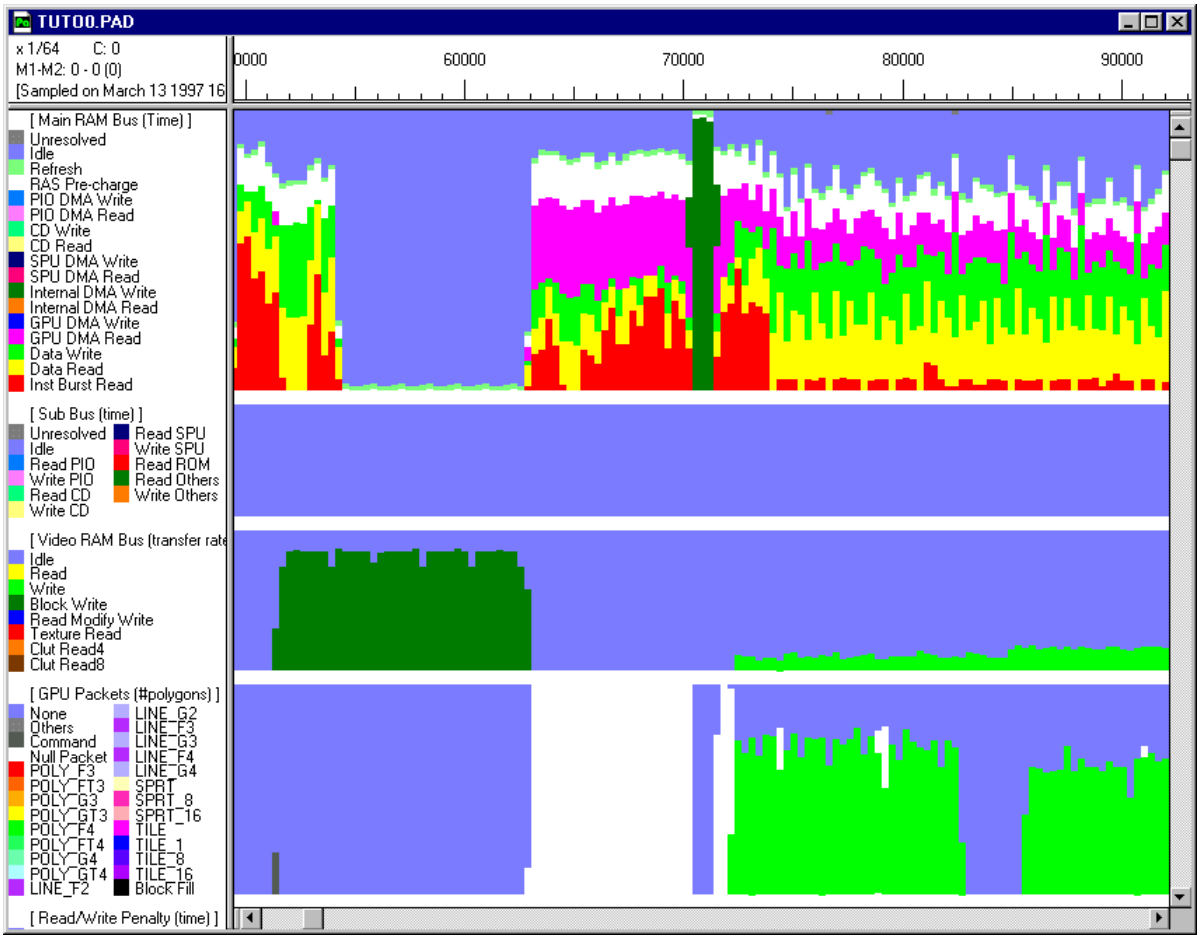
This display is so fine that colors mix with adjacent colors making identification difficult. Therefore, select "Options..." from “Setting” menu and change "Analysis Pixel Width" in the Option dialog box.

Figure 2-8: Setting Analysis Pixel Width (Option Dialog Box))



This option is provided to make the histogram easier to understand by changing the pixel width. The default pixel width is one pixel. If, however, it is changed to five pixels, the analysis display will change as shown below.

Figure 2-9: Analysis (Size 1/64, Pixel Width 5))

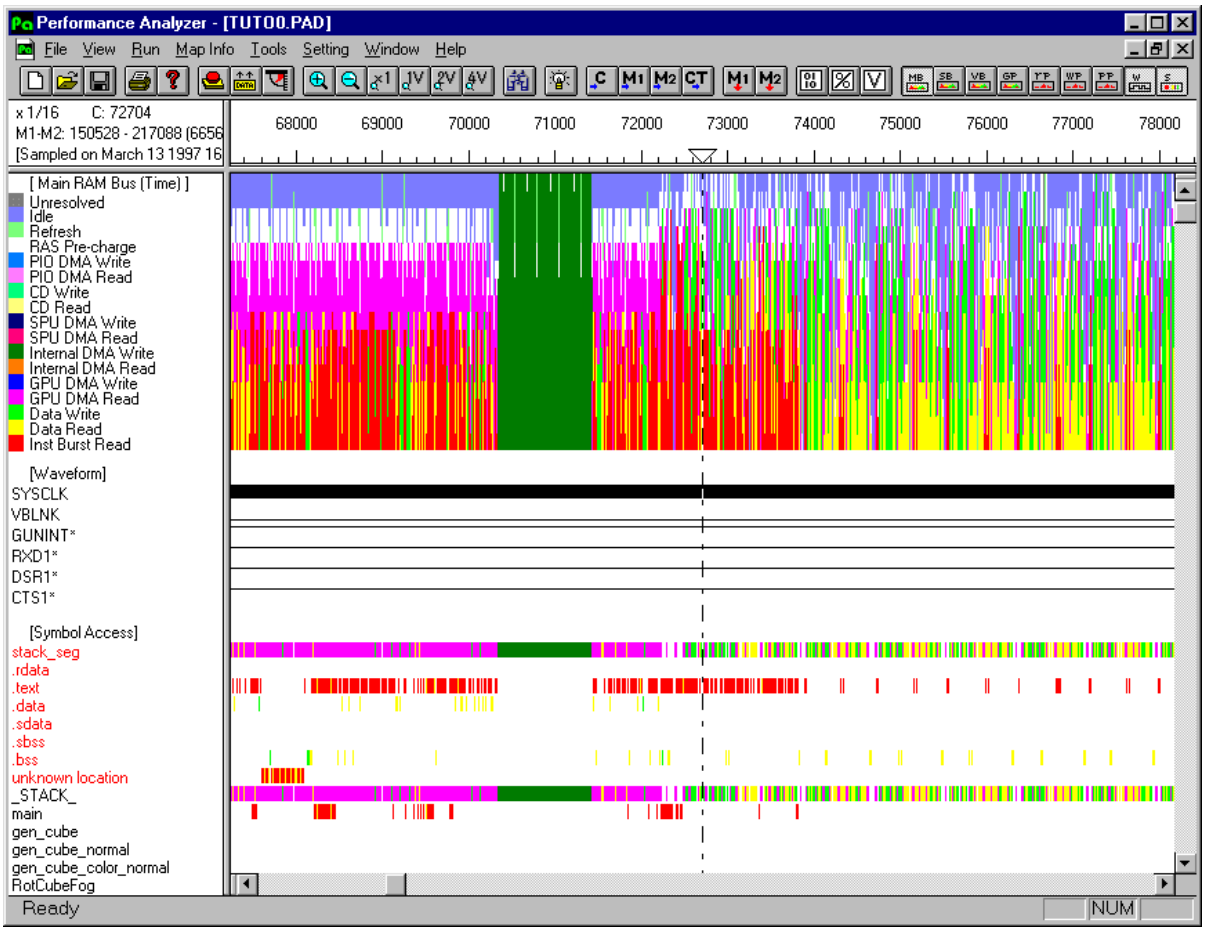


As described above, the pixel width can be changed as desired to make the display easier to understand.

Changing the display levels of the waveform display and access display

The level at which the waveform display is hidden can be set as follows: First, set the view size to 1/16 and click OK. The waveform is displayed. Then, change the view size to 1/8 then back to 1/16. You will notice that the waveform is displayed at 1/8 but not at 1/16. The level at which the waveform display is displayed or hidden can be set by selecting "Options..." from “Setting” menu then changing the level of "Display level of Waveform" in the Option dialog box. The default hidden level is 16, but if you change this level to 32, the waveform is displayed. The level at which the access display is displayed or hidden can also be set by selecting "Options..." from “Setting” menu then changing the level of "Display level of Access" in the Option dialog box.

Figure 2-10: Waveform and Access Display (Size 1/16, Display Level 32))



Reading the map file

To read a map file, select "Read file" from “Map Info” menu.

The system currently supports the reading of the following three kinds of map files.

Remember, however, that segment information cannot be obtained with map files other than 1).

1) Map files created in the SDevTC development environment (*.map).

   Example: ccpsx -O3 -Xo$80010000 /m tuto0.obj-otuto0.cpe,tuto0.sym,tuto0.map

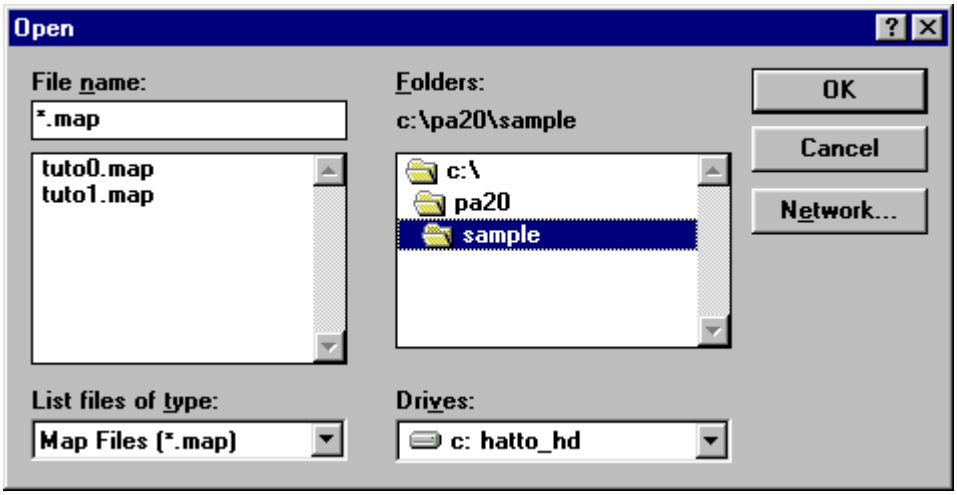
2) Symbol files (*.dsm) created using dumpsym from symbol files created in the SDevTC development environment (*.sym).

   Example:ccpsx -O3 -Xo$80010000 tuto0.obj-otuto0.cpe,tuto0.sym
   dumpsym tuto0.sym > tuto0.dsm

3) Symbol files created using nm in a development environment such as NEWS (*.nm).

   Example: nm a.out > a.nm

Figure 2-11: Read Map File Dialog Box

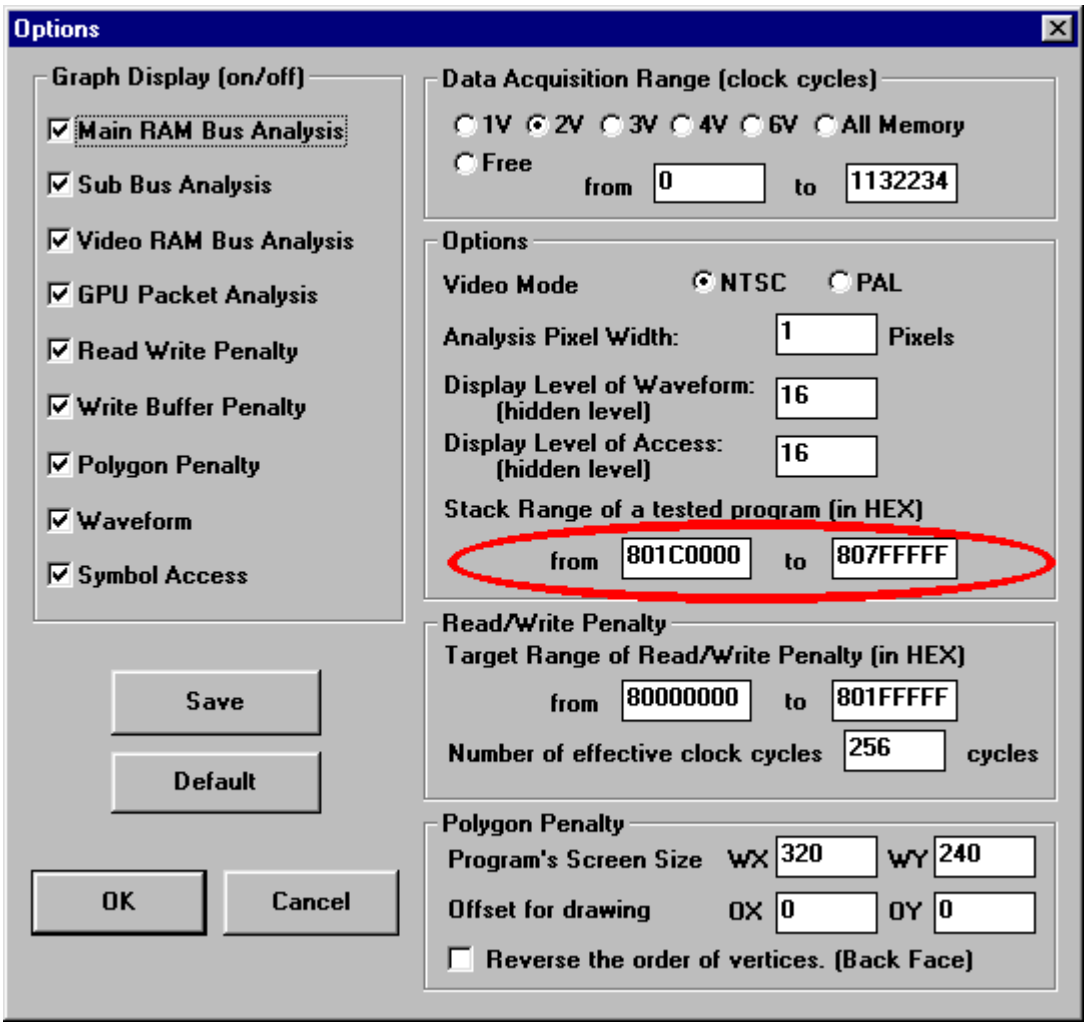


Setting the Stack Range

In the PlayStation, the stack area is set by the kernel, by the linker or by the user program. The default range of the stack area is from 0x801C0000 to 0x80FFFFFF. These values should be changed to specify the correct stack area for each program to show the access display correctly.

From “Setting” menu, select "Options..." then change "Stack Range of a tested program" in the Option dialog box.

Figure 2-12: Option Dialog Box - Stack Range of a Tested Program



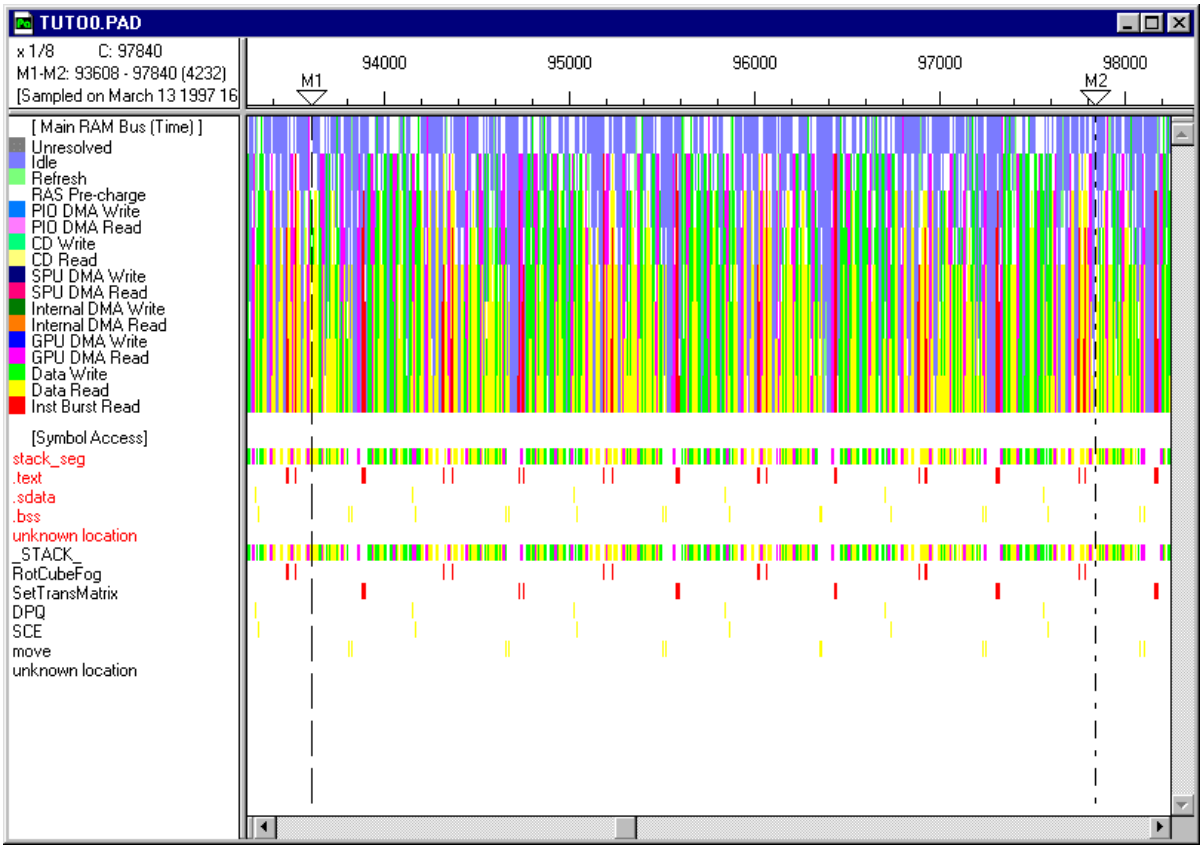
Identifying the Functions Causing Cache Misses (Use Filter)

First, specify the range of the main RAM bus where instruction burst read (cache misses) is noticeable (see Section 2.2.2, "Using the cursors and markers").

Next, check "Use filter" in “Map Info” menu. This displays the global symbols accessed within a specified range. Among the global symbol accesses, those for which the main RAM bus is in the instruction bus read state are the functions for which cache misses occur.

Every time the above range specification is changed, it is necessary to repeat filtering by selecting "Filtering" from “Map Info” menu.

Figure 2-13: Use Filter



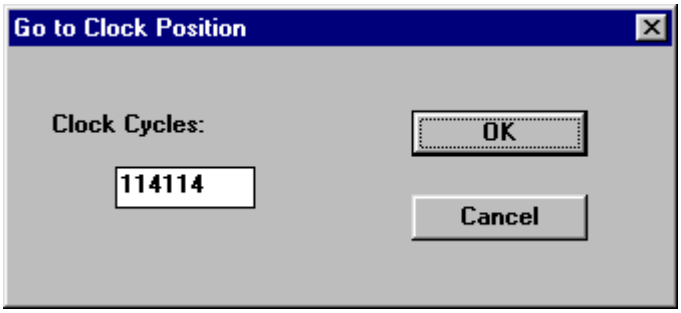
Move and Search Move

When the pull-down “View” menu is displayed, you will see items including "Go to cursor" (), "Go to M1" (), "Go to M2" (), “Move cursor to Trigger point” (), "Move V Blank point" and "Move in Clocks." These menu items are used to move the view on the screen. Some are registered as tool bar button commands so that they can be executed directly. When the window is split, these move commands are applied to the current view, that is, they scroll that graph on which the mouse was last clicked. When "Move in Clocks" is selected, the dialog box described below appears.

Specify the move destination as a clock position, then click OK to move to that point (the initial value is the current cursor position). Note that "Move V Blank point" and "Move in Clocks" scroll the view by moving the cursor position. The view is scrolled so that the move destination is placed at the center of the screen.

"Reset M1 to Origin" and "Reset M2 to Origin" in “View” menu move M1 and M2, respectively, to the origin coordinate. These items do not perform scrolling. "Redraw" on “View” menu is used to refresh the view.

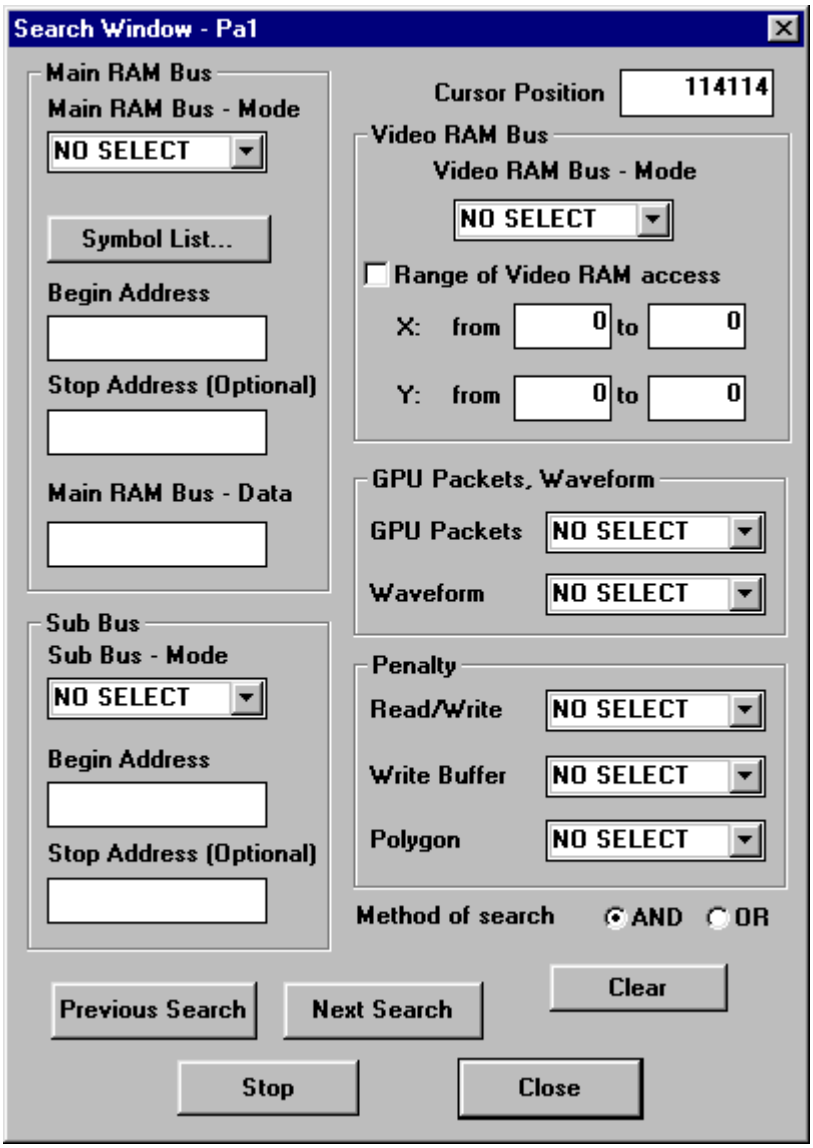
Figure 2-14: Move to Clock Point Dialog Box



"Move to Search point" enables movement to the point where the desired conditions are satisfied, among the seven analysis displays, waveform display and access displays. Selecting "Move to Search point" on “View” menu allows you to specify the following search conditions:

1) Main RAM bus condition (instruction burst read, etc.).
2) Access to an arbitrarily specified address on the main RAM bus.
3) Arbitrarily specified data on the main RAM bus.
4) Sub bus condition.
5) Video RAM bus condition.
6) Range of Video RAM access (location where an access in the specified range occurred)
7) Note: Check “Range of Video RAM access” radio button to enable the condition.
8) GPU packet type.
9) Signal waveform (search according to changes such as positive-going and negative-going).
10) Read/Write penalty stall cycle position.
11) Write buffer penalty stall cycle position.
12) Polygon penalty position.

Figure 2-15: Search Dialog Box



Click "Previous Search" button or "Next Search" button to start search. To cancel search, click "Stop" button. Use "AND" and "OR" buttons to combine the search conditions.

Descriptions of the buttons are as follows:

“Method of Search” - AND/OR	“AND”: Search the position satisfying all conditions. “OR”: Search the position satisfying at least one condition.
“Previous Search” button	Search the previous position satisfying the desired conditions.
“Next Search” button	Search the next position satisfying the desired conditions.
“Stop” button	Stop searching.
“Clear” button	Clear search conditions.
“Close” button	Close the search dialog box.

Using the Window (Data Comparison)

The split bar separates views. Dragging the split bar allows to change the dimensions of the view areas. To temporarily hide split window display, move the split bar to the top/bottom or left/right edge of the screen. The split bar can also be erased completely to return a split window to the original, non-split window by double-clicking the split bar. If the window is split by both vertical and horizontal split bars, the original window can be re-displayed simply by double-clicking the intersection of the vertical and horizontal split bars. Next, if you double-click the small bar at the end of the scroll arrow of the original window, the view is split into two views. While dragging the split bar enables the splitting of the view into arbitrarily sized areas, this operation splits the view into two views of equal areas.

The Performance Analyzer supports a multi-document configuration, that is, it is capable of displaying several data items simultaneously to enable their comparison. You can either open and display a previously saved file, or you can select "Open new window" from “Window” menu to display a copy of the data already being displayed. You can also select "New" from “File” menu, measure signals, and select "Tile" in “Window” menu. This will result in the display of the screen shown below.

Figure 2-16: Comparing Data

By combining these functions and the split window function, programs can be tuned while comparing data.

Operation of Analysis Tools

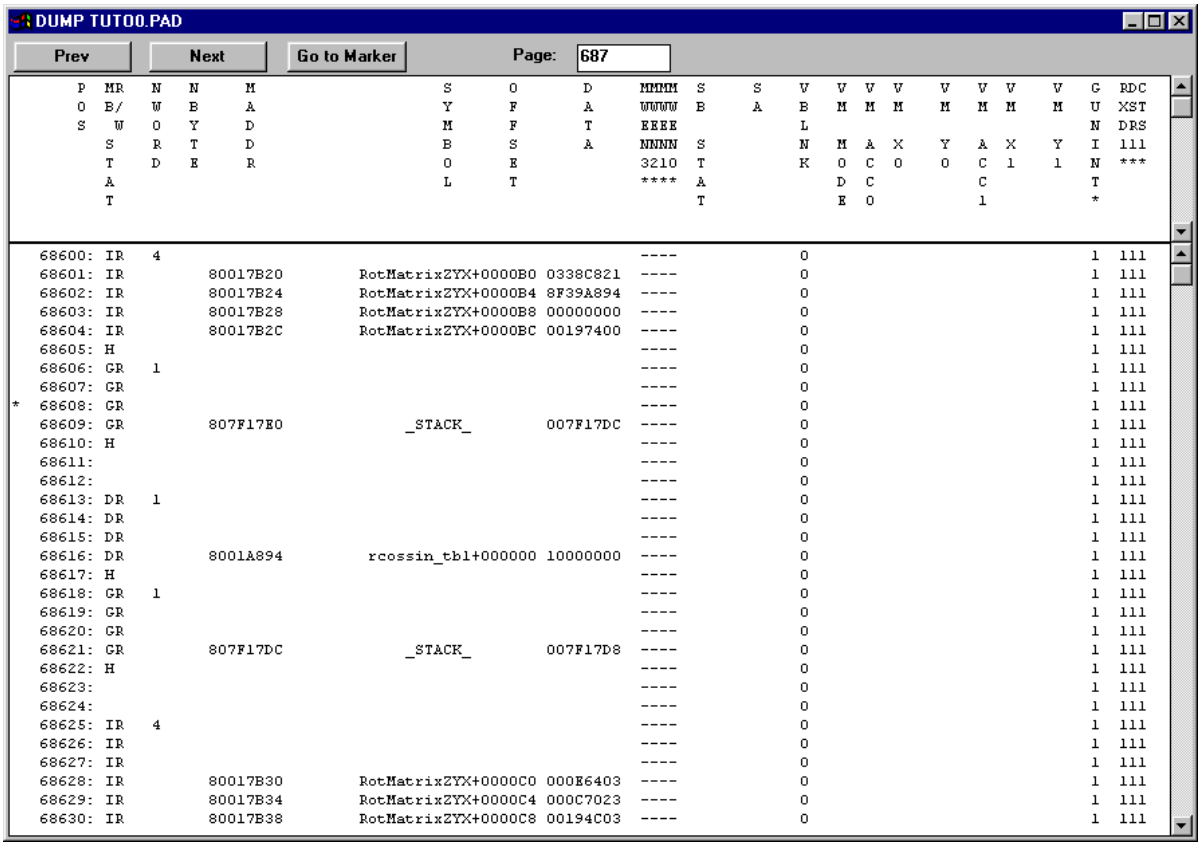
PA incorporates three analysis tools: Dump data, Statistical amount and Video RAM viewer.

Dump Data

This tool displays the data around the cursor by data dumping.

Select "Dump data..." from “Tool” menu, press the Dump data button  on the tool bar or double-click the desired position in the main window.

Figure 2-17: Dump Data



The dumped data contents are as follows:

POS:	Indicates the clock position.
MB STAT, R/W:	Indicates the main RAM bus status.
<Blank>:	Idle.
IR:	Instruction burst read.
DR:	CPU data read access.
DW:	CPU data write access.
GR:	GPU DMA data read access.
GW:	GPU DMA data write access.
CR:	CD read access.
CW:	CD write access.
SR:	SPU DMA read access.
SW:	SPU DMA write access.
MR:	Internal DMA read access. (Includes MDEC and OT clear).
MW:	Internal DMA write access. (Includes MDEC and OT clear).
PR:	PIO DMA read access.
PW:	PIO DMA write access.
H:	RAS pre-charge period. (An extra cycle required to access the main memory.)
R:	Refresh cycle.
U:	Undefined.
NWORD:	Total number of words transferred in RAS cycle.
NBYTE:	Total number of bytes transferred in RAS cycle. (Only write is significant.)
MADDR:	Main RAM bus address. (0x80000000 is assumed as the start address.)
SYMBOL:	MADDR global symbol display.
OFFSET:	Offset in SYMBOL. (hex notation. Not displayed in stack.)
MWEN0-3:	Bytes which are written in a word. ("w": written, "-": not written.)
SB STAT, R/W:	Sub bus status.

<Blank>:	Idle.
RP:	Read access to PIO. WP: Write access to PIO. RC: Read access to CD. WC: Write access to CD. RS: Read access to SPU. WS: Write access to SPU. RR: Read access to ROM. RO: Read access to other devices. WO: Write access to other devices. U: Undefined. SA: Sub bus address. VM MODE: Video RAM bus mode.
R/W:	Pixel read/write access.
RMW:	Pixel read modify write (semi-transparent) access.
TXR:	Texture read access
CR4:	4-bit (16-color) palette read access.
CR8:	8-bit (256-color) palette read access.
SPC:	Control video RAM cycle.
VM ACC0:	Access of video RAM chip 0.
VM X0:	X coordinate of video RAM chip 0.
VM Y0:	Y coordinate of video RAM chip 0.
VM ACC1:	Access of video RAM chip 1.
VM X1:	X coordinate of video RAM chip 1.
VM Y1:	Y coordinate of video RAM chip 1.
GUNINT*:	Interrupt request from Gun.
RXD1*:	Link cable signal (received data).
DSR1*:	Link cable signal (Data Set Ready).
	CTS1*: Link cable signal (Clear To Send).

Note: "*" indicates a negative logic signal.

Note: If the stack range is not set properly, the global symbol having the highest address may sometimes be mistakenly identified and displayed as the stack address.

Statistical Amount

Statistics enable the investigation of the share of main RAM bus, the memory access penalty frequency and the number of each polygon type drawn within the specified range.

First, specify the statistic investigation range as a range between cursors M1 and M2. Then, select "Statistics..." from “Tool” menu or press the Statistics button  on the tool bar. The range confirmation dialog box is displayed. Click OK if the range specified with the markers is satisfactory.

Figure 2-18: Range Confirmation Dialog Box

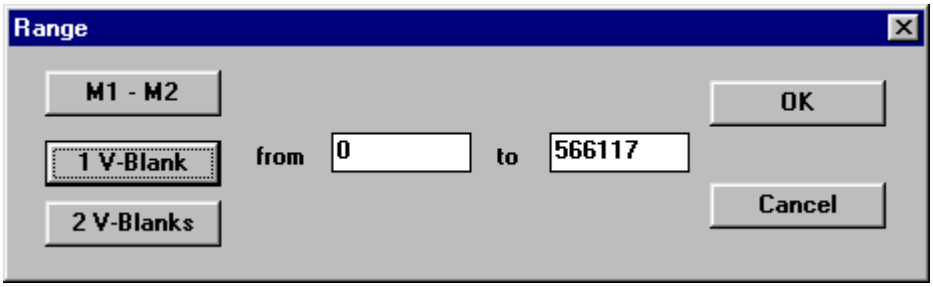
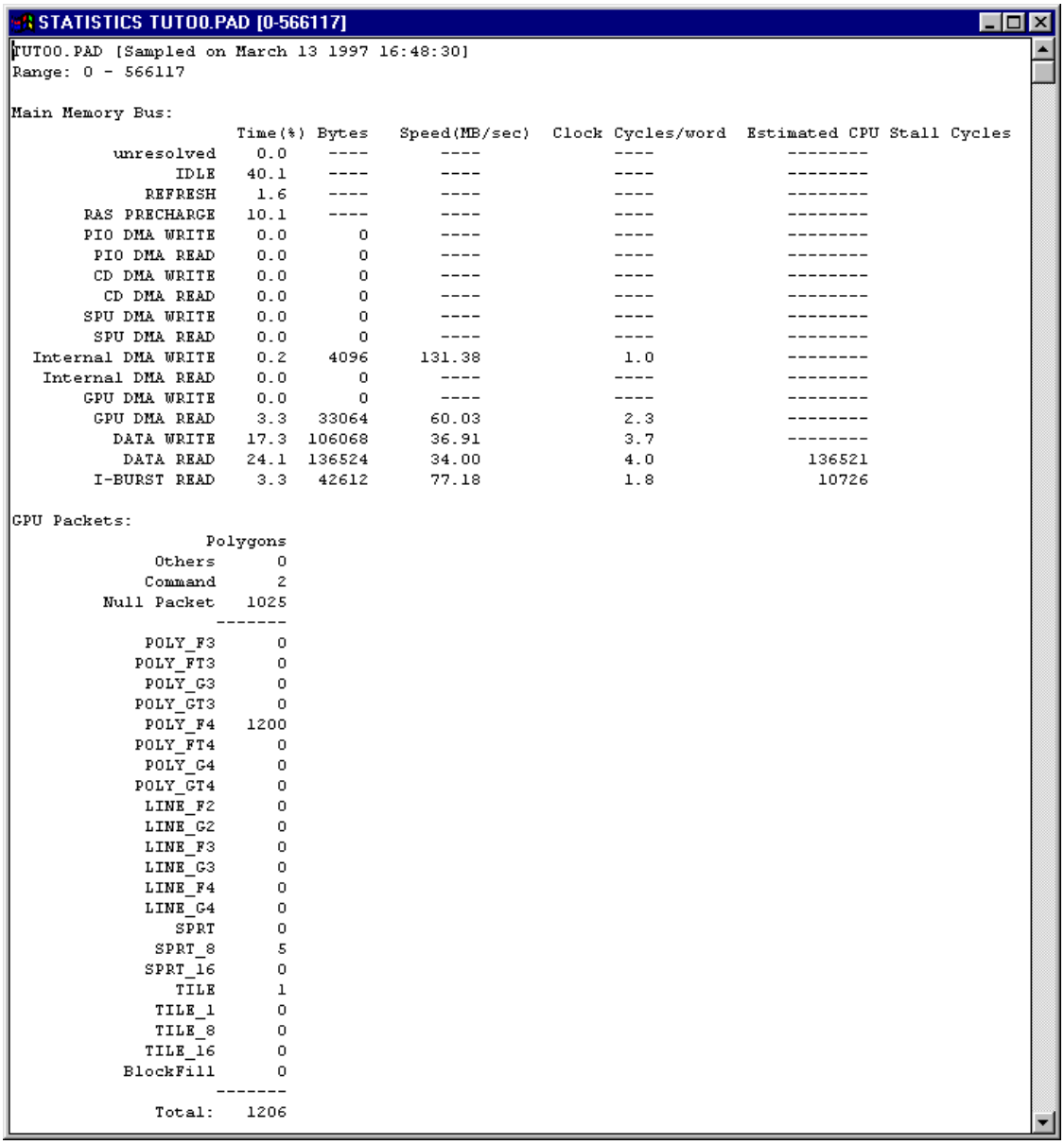


Figure 2-19: Statistical Amount



STATISTICS TUT00.PAD [0-566117]

```
TUT00.PAD [Sampled on March 13 1997 16:48:30]
Range: 0 - 566117

Main Memory Bus:
                     Time(%) Bytes   Speed(MB/sec)  Clock Cycles/word  Estimated CPU Stall Cycles
          unresolved    0.0    ----       ----             ----              --------
                IDLE   40.1    ----       ----             ----              --------
             REFRESH    1.6    ----       ----             ----              --------
       RAS PRECHARGE   10.1    ----       ----             ----              --------
       PIO DMA WRITE    0.0       0       ----             ----              --------
        PIO DMA READ    0.0       0       ----             ----              --------
        CD DMA WRITE    0.0       0       ----             ----              --------
         CD DMA READ    0.0       0       ----             ----              --------
       SPU DMA WRITE    0.0       0       ----             ----              --------
        SPU DMA READ    0.0       0       ----             ----              --------
  Internal DMA WRITE    0.2    4096     131.38              1.0              --------
   Internal DMA READ    0.0       0       ----             ----              --------
       GPU DMA WRITE    0.0       0       ----             ----              --------
        GPU DMA READ    3.3   33064      60.03              2.3              --------
          DATA WRITE   17.3  106068      36.91              3.7              --------
           DATA READ   24.1  136524      34.00              4.0                136521
         I-BURST READ    3.3   42612      77.18              1.8                 10726

GPU Packets:
                   Polygons
               Others      0
              Command      2
         Null Packet   1025
                      -------
              POLY_F3      0
             POLY_FT3      0
              POLY_G3      0
             POLY_GT3      0
              POLY_F4   1200
             POLY_FT4      0
              POLY_G4      0
             POLY_GT4      0
              LINE_F2      0
              LINE_G2      0
              LINE_F3      0
              LINE_G3      0
              LINE_F4      0
              LINE_G4      0
                 SPRT      0
               SPRT_8      5
              SPRT_16      0
                 TILE      1
               TILE_1      0
               TILE_8      0
              TILE_16      0
            BlockFill      0
                      -------
                Total:   1206
```

Main RAM Bus:

Time(%): Indicates the percentage of the required time.

Bytes: Indicates the total number of bytes that have been transferred. However, in a read cycle which consists only of word accesses, they are regarded as 4-byte accesses.

Speed(MB/sec): Indicates the average transfer speed in each cycle. The maximum value is136 MB/sec.

Clock Cycles/word: Indicates the average number of clocks required to transfer a word in each cycle.

Estimated CPU Stall Cycles: These are the stall cycles estimated for the Data Read and Instruction Burst Read status.

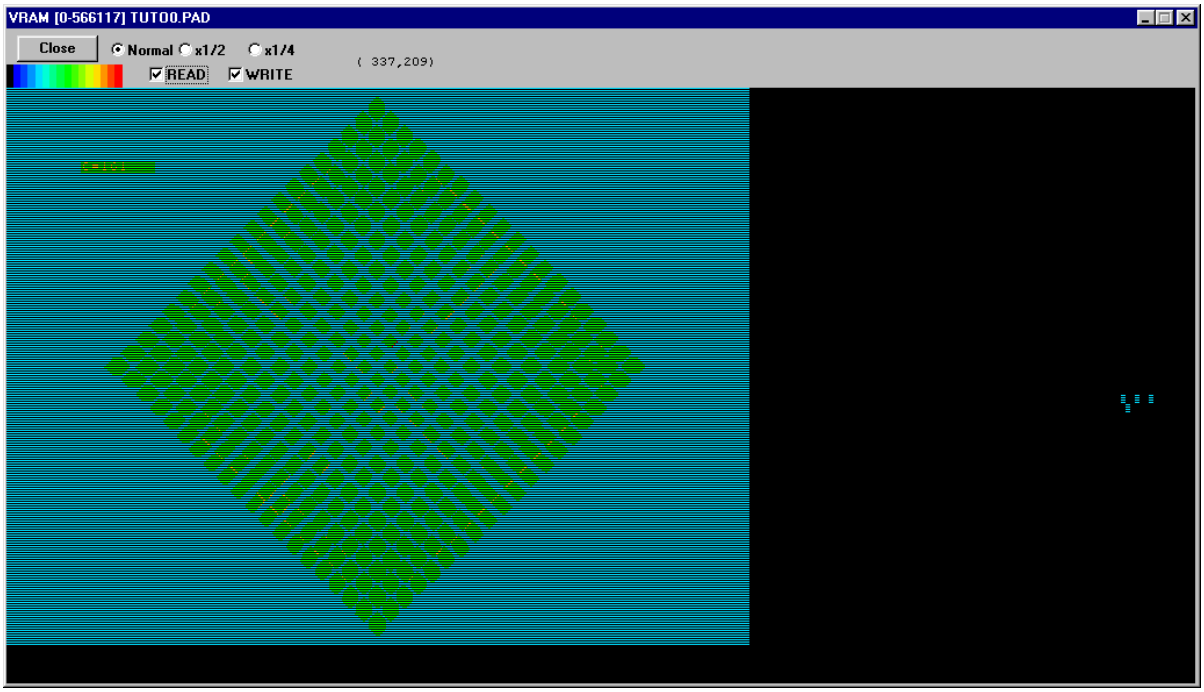
GPU Packets: Lists the total number of packets of each polygon type.

Video RAM Viewer

The video RAM viewer enables the confirmation of the video RAM positions actually accessed by the CPU within the specified range, in terms of frame buffer images.

First, specify the range to be investigated as a section between cursors M1 and M2. Then, select "Video RAM viewer..." from “Tool” menu or press the Video RAM viewer button  on the tool bar.

Figure 2-20: Video RAM Viewer



The accessed pixels are displayed in palette colors according to the access frequency (Low: Blue, High: Red). It is also possible to display read and write accesses separately by selecting the Read/Write checkbox accordingly. This makes it possible to read the sections where polygons are drawn, the texture and CLUT as well as to identify the sections to be subject to semi-transparent processing.

Chapter 3:
Using the Trigger Function

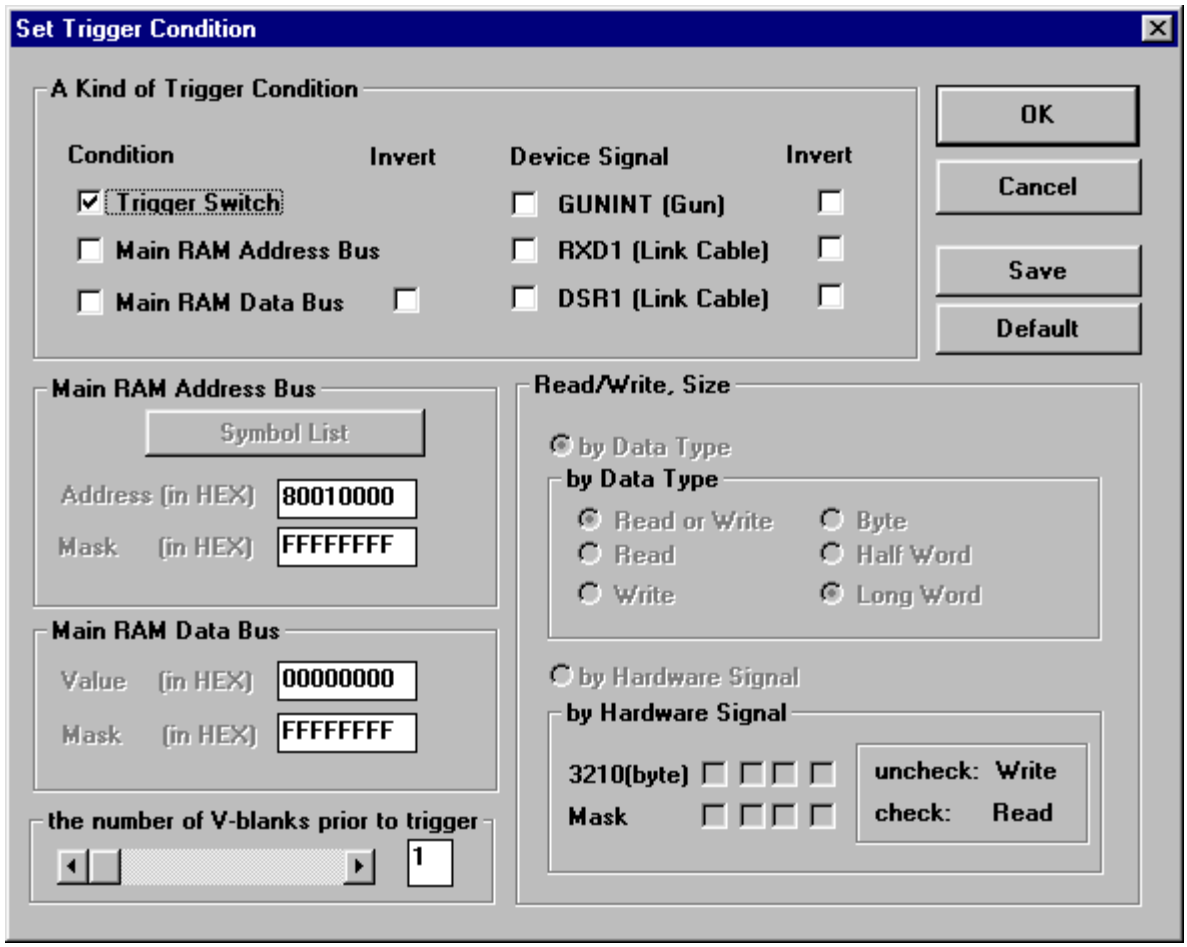
Setting the Trigger Conditions

The trigger conditions should be set to specify the timing at which the actual measurement will be started. The default trigger condition is set only to the trigger switch (foot switch).

The trigger conditions include the trigger switch, main RAM address bus, main RAM data bus, device signal (from the Gun or link cable). Any number of conditions can be specified. When more than one trigger condition is specified, the reading of measurement data starts from the position where all of the specified conditions are satisfied. It is also possible to use the measurement data of up to 6V prior to the trigger position where the trigger conditions are satisfied.

Clicking the OK button after changing the parameters applies them to the current file. Clicking the “Save” button applies the changed parameters to new files that are next created.

Figure 3-1: Set Trigger Condition Dialog Box



Types of trigger conditions

First, select the trigger conditions to be used from the six conditions listed below (more than one can be selected).

For "Main RAM address bus" and "Main RAM data bus" the related items can be entered only when they are selected here. The conditions can be inverted except for "Trigger switch" and "Main RAM address bus". By inverting a condition, the condition is satisfied whenever the original condition is not satisfied.

Trigger switch:	Adds the trigger switch to the trigger conditions.
Main RAM address bus:	Adds the main RAM address to the trigger conditions.
Main RAM data bus:	Adds the main RAM data value to the trigger conditions.
Gun (GUNINT):	Adds the Gun-related interrupt request signal to the trigger conditions.
Link cable (RXD1):	Adds the link cable signal (received data) to the trigger conditions.
Link cable (DSR1):	Adds the link cable signal (Data Set Ready) to the trigger conditions.

Note: When more than one condition is set, the main RAM address bus and data bus are compared at the same timing but GUNINT, RXD1 and DSR1 are compared upon the occurrence of timing errors of a few cycles. When the trigger switch is added to the trigger conditions, other conditions are checked after the trigger switch is pressed. Therefore, it is not necessary to keep the trigger switch held down.

Main RAM Address Bus

The address value obtained from the main RAM address bus can be specified as a trigger condition. This address covers all main RAM accesses including instruction burst read, data read and data write. The input should be a hex number and the setting range be between 80000000 and 807FFFFF. The lower two bits are invalid if a size is not specified (the size specification is explained below). The mask input should also use a hex number. When the mask bit is 1, the bit of the corresponding address becomes a valid condition. When the mask bit is 0, it is not included in the condition.

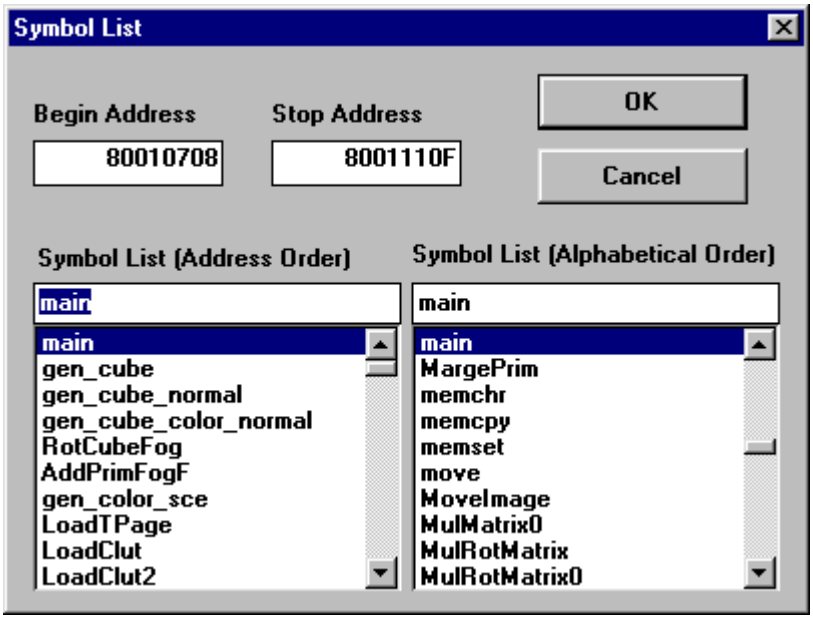
Example: To specify 80010000 to 8001FFFF

Address: 80010000

Mask: FFFF0000

The address value can also be read from the symbol list, provided the map file has been read.

Figure 3-2: Reading from the Symbol List



Note: Care is required when you use the address of a function as a trigger condition, as the Performance Analyzer cannot observe the functions in the instruction cache. This is because it can measure the status appearing on the bus, but cannot measure the status within the CPU. Therefore, while it is

possible to use a function which always causes a cache miss as a trigger condition, it is safer to use a data address as the condition.

Main RAM Data Bus

The data value obtained from the main RAM data bus can be specified as a trigger condition. This data covers all of the main RAM accesses including instruction burst read, data read and data write. The read/write distinction and size can also be specified but, when a size is specified, a mask appropriate for the size should be used.

Example: To specify half-word access with a value of 1234 (hex number)

Data value: 00001234

Mask: 0000FFFF

Read/write and size specifications

When the "Main RAM address bus" or "Main RAM data bus", described above, is specified as a trigger condition, the read/write distinction and size of the access can be added to the conditions. This can be set either automatically or manually. Note that the size specification is valid only for write accesses.

Specification by data type

Read/write specification, which can be set from Read or Write, Read, and Write.
Size specification, which can be selected from Byte, Half Word and Long Word. (The size specification can be made only with Write.)
(When Byte or Half Word is specified, the word boundary is dependent on the lower two bits of the address. To set Byte or Half Word, which is different from the word boundary of Long Word, as the data condition without specifying the address condition, use manual setup.)

Specification by hardware signal

Read/write can be specified using four bytes in a word.
The checkbox to the right of "3210(byte)" indicates write when checked and read when not checked. As masks are provided below it, check those for which you wish to validate the setup. Those positions for which the masks are not checked are not included in the condition.

NFV (Number of V blanks Before the Conditions are Satisfied) Setting

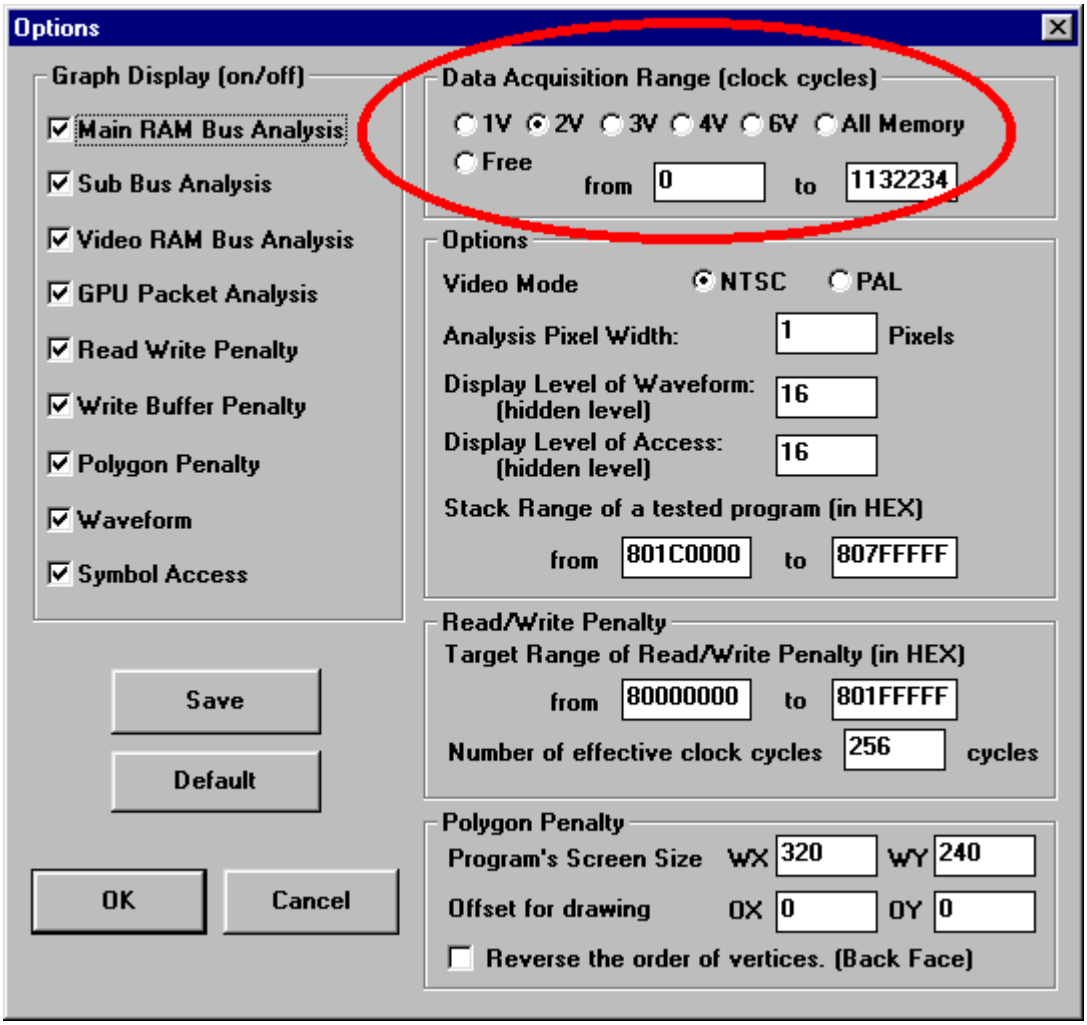
This enables the specification of the number of V blanks, before the conditions are satisfied, that are to be included in the data measurement. A value of between 1 and 6 can be set. The default is 1, where the data in the V blank containing the triggering position is measured.

Setting the Measurement Range

The measurements performed up to this point have been done within the default range (over 2V blanks).

To change the measurement range, select "Options..." from “Setting” menu then setting “Data Acquisition Range” in the Option dialog box.

Figure 3-3: Setting the Measurement Range (Option Dialog Box)



Clicking one of the radio buttons the corresponding clock range. The All memory radio button corresponds to the measurement of about 7.4V blanks (NTSC) or about 6.2V blanks (PAL). Increasing the measurement range enables the analysis of a larger amount of data, but the time taken for data read and hard disk consumption increase accordingly.

Techniques

Measurement can be started from the head of a frame or can be started automatically from the position where a frame error occurs, simply by changing the trigger conditions or modifying the program to be measured.

For details, refer to the *Performance Analyzer Technical Reference*.

Chapter 4:
Details

Menus and Buttons

Description of menus

The pull-down menus, displayed by selecting menu items, are as follows:

File: The items in this menu are mainly used for file-related operations.

New:	Create a new file for measuring and saving data.
Open:	Open a previously saved file.
Close:	Close the current window.
Save:	Save the current file, overwriting an existing file.
Save as:	Save the current file after assigning another name.
Print:	Print the main graphs.
Preview:	Display a preview of the main graphs as they will be printed.
Printer setup:	Set up the printer.
Previously opened file:	Open one of the files in the list.
Exit:	Terminate the Performance Analyzer.

View: The items in this menu are used to enlarge or reduce the view size and to manipulate the cursors.

Reduce Scale:	A pull-down menu for reducing the view to one of the following sizes.
Zoom Out	
x1/2	
x1/4	
..	
x1/4096	
Normal Size:	Display each clock as one pixel.
Increase Scale:	A pull-down menu for enlarging the view to one of the following sizes.
Zoom In	
x2	
x4	
x8	
x16	
Redraw:	Refresh the screen by drawing the view again.
Go to cursor:	Scroll to the cursor position.
Go to M1:	Scroll to marker M1.
Go to M2:	Scroll to marker M2.
Move cursor to Trigger point:	Move the cursor to the trigger position.
Move V Blank point:	Move to the origin.
1V blank:	Move the cursor to the 1V blank point.
2V blank:	Move the cursor to the 2V blank point.
3V blank:	Move the cursor to the 3V blank point.
4V blank:	Move the cursor to the 4V blank point.
5V blank:	Move the cursor to the 5V blank point.
6V blank:	Move the cursor to the 6V blank point.
7V blank:	Move the cursor to the 7V blank point.
Move to Clock point:	Move the cursor to a point specified in terms of clocks.
Move to Search point:	Search for a point according to the set conditions and moves to that point.
Reset M1 to cursor point:	Move M1 to the most recently set cursor position.
Reset M2 to cursor point:	Move M2 to the most recently set cursor position.

Reset M1 to Origin:	Move M1 to the origin.
Reset M2 to Origin:	Move M2 to the origin.
Tool bar:	Switch the tool bar display on/off.
Status bar:	Switch the status bar display on/off.

Run: The items in this menu are used to execute measurement and set up triggering.

Acquisition...:	Displays a dialog box with a trigger button. Pressing the trigger causes the sampling of data to begin immediately following the end of the next V blank period. The data is then transferred into the computer to be displayed. A dialog displays data transfer status. Clicking the cancel button will abort the transfer, but any previous data will be lost.
Read data only:	Read previously sampled data.

Map Info: The items in this menu are related to the program segments and global symbol information.

Read file:	Read the map file output by the linker during compilation to enable symbolic address display.
Use Filter:	Display only the global symbols obtained by filtering.
Filtering:	Obtain the accessed global symbols in the section between M1 and M2.

Note: Executing “Filtering” automatically enables "Use filter".

Tools

Dump data...:	Dump the data in the window in text format. (Data can also be dumped by double-clicking the cursor position.)
Statistics...:	Calculate and displays bus usage statistics for the specified range.
Video RAM viewer...:	Display VRAM accesses within the specified range.

Setting: The items in this menu are used to perform setup.

Trigger Condition...:	Set up the conditions that trigger the start of measurement.
Options...:	Set up the environment.
IO Port Address...:	Set up the IO address.

Window

New Window:	Open a new window which uses the same file (data).
Cascade:	Cascade the displayed windows.
Tile:	Tile the displayed windows.
Arrange icon:	Arrange the icons.

Help

About PA:	Show title, credits, build date, and version.

Description of buttons

In addition to selecting a command from a pull-down menu, frequently used commands can also be executed directly by clicking buttons. The button commands are displayed below the menu bar.

 Open a new file.

 Open a previously saved file.

 Save a file.

 Start printing.

 Output the version information.

 Start measurement.

 Read data.

 Set up the triggering.

 Double the view size.

 Half the view size.

 Reset the view size to 1.

 Change the view size so that the entire data for about 1V blank can be displayed.

 Change the view size so that the entire data for about 2V blank can be displayed.

 Change the view size so that the entire data for about 4V blank can be displayed.

 Search for a point according to the set conditions and moves to that point.

 Redraw the view.

 Move to the cursor position.

 Scroll to M1.

 Scroll to M2.

 Move the cursor to the trigger position.

 Move M1 to the cursor position.

 Move M2 to the cursor position.

 Dump data in the window in the text format.

 Calculate and displays the statistical amounts.

 Display VRAM accesses within the specified range.

 Switch the main RAM bus analysis display on-off.

Switch the sub RAM bus analysis display on-off.

Switch the video RAM analysis display on-off.

Switch the GPU packet analysis display on-off.

Switch the read/write penalty display on-off.

Switch the write buffer penalty display on-off.

Switch the polygon penalty display on-off.

Switch the waveform display on-off.

Switch the access display on-off.

Main Window Description

This section describes the graph items.

Names of parts

A scale is displayed at the top of each view. The figures on the scale indicate the number of clock pulses relative to the start of measurement (positive-going of the V blank). (A red line is inserted every 1V blank.)

The measured data is displayed below the scale. Vertical color stripes in the display indicate the analyses. There are seven analyses, those for the main RAM bus, sub bus, video RAM, GPU packet, redundant read, write buffer and bad polygon analyses. Small, colored boxes and labels to the left of the analyses indicate the relationship between each color and the corresponding status.

The signal waveforms are displayed below the measured data. The signal names are displayed to the left of the waveforms. Below the signal waveforms is the access display for each segment and function, which indicate the status of access to each symbol. The functions of these parts are described in the following sections.

Figure 4-1: Main Window

Main RAM Bus Analysis

The main RAM bus analysis displays the main RAM bus status as a histogram.

The main RAM bus status is as listed below. The area of each item corresponds to the duration it occupies the bus.

Unresolved:	A pattern which cannot be analyzed.
Idle:	Idle status (this does not mean that the CPU itself is idle.)
Refresh:	Main RAM refresh cycle.
RAS Pre-charge:	RAS pre-charge period of main RAM. (Hardware's memory access overhead)
PIO DMA Write:	DMA write cycle of PIO.
PIO DMA Read:	DMA read cycle of PIO.
CD Write:	Write cycle of CD.
CD Read:	Read cycle of CD.
SPU DMA Write:	DMA write cycle of SPU.
SPU DMA Read:	DMA read cycle of SPU.
Internal DMA Write:	Internal DMA write cycle (MDEC, OT clear, etc.).
Internal DMA Read:	Internal DMA read cycle (MDEC, OT clear, etc.).
GPU DMA Write:	DMA write cycle of GPU.
GPU DMA Read:	DMA read cycle of GPU.
Data Write:	Data write cycle of CPU.
Data Read:	Data read cycle of CPU.
Inst Burst Read:	Instruction burst read cycle of CPU.

Sub Bus Analysis

The sub bus analysis displays the sub bus status as a histogram.

The sub bus status is as listed below. The area of each item represents the time it occupies the bus.

Unresolved:	A pattern which cannot be analyzed.
Idle:	Idle status.
Read PIO:	Read access to PIO.
Write PIO:	Write access to PIO.
Read CD:	Read access to CD.
Write CD:	Write access to CD.
Read SPU:	Read access to SPU.
Write SPU:	Write access to SPU.
Read ROM:	Read access to ROM.
Read Others:	Read access to other devices.
Write Others:	Write access to other devices.

Video RAM Analysis

The VRAM analysis displays the video RAM bus status as a histogram.

The sub bus status is as listed below. The area of each item corresponds to the amount of data that has been transferred. Therefore, a high pattern value indicates that the data transfer rate is high.

Note: Since the CLUT transfer is identified based on the number bytes transferred in a read access, when some other transactions with the same amount of data occur, wrong analysis may result.

Idle:	Idle status.
Write:	Pixel write cycle.
Read:	Pixel read cycle.
Read Modify Write:	Pixel read modify write (semi-transparent) cycle.
Texture Read:	Texture read cycle.
Clut Read4:	4-bit (16-color) palette read cycle.
Clut Read8:	8-bit (256-color) palette read cycle.

GPU Packet Analysis

The GPU packet analysis displays the GPU packet execution status as a histogram.

The GPU packet status is as listed below. The area of each item corresponds to the number of packets. Therefore, a high pattern value indicates that the packet transfer rate is high.

Note: The GPU packet display and the actual drawing on the video RAM bus may deviate in some points. This is due to the presence of a packet buffer within the GPU.

None:	A cycle in which the GPU packet is not processed.
Unknown:	A packet which cannot be analyzed.
Command:	Command packet.
Empty:	Empty packet.
POLY_F3:	Triangle polygon, flat.
POLY_FT3:	Triangle polygon, flat texture.
POLY_G3:	Triangle polygon, glow.
POLY_GT3:	Triangle polygon, glow texture.
POLY_F4:	Quadrangle polygon, flat.
POLY_FT4:	Quadrangle polygon, flat texture.
POLY_G4:	Quadrangle polygon, glow.
POLY_GT4:	Quadrangle polygon, glow texture.
LINE_F2:	Non-concatenated line.
LINE_G2:	Non-concatenated line, with gradation.
LINE_F3:	3-point concatenated line.
LINE_G3:	3-point concatenated line, with gradation.
LINE_F4:	4-point concatenated line.
LINE_G4:	4-point concatenated line, with gradation.
SPRT:	Sprite (free size).
SPRT_8:	Sprite (8 x 8).
SPRT_16:	Sprite (16 x 16).
TILE:	Single-color tile (free size).
TILE1:	Dot (1 x 1).
TILE8:	Single-color tile (8 x 8).
TILE16:	Single-color tile (16 x 16).
Block Fill:	Block fill.

Read/Write Penalty

The read/write penalty analysis displays duplicate read accesses.

A duplicate read is recognized when the valid range (256 cycles by default) is read despite no write operation having been performed since it was read last. The number of cycles in this range and the range of the target data area can be set using the Option dialog box (the default data area is all of main RAM).

A typical cause of duplicate read is when data which is not assigned to a register is assigned to a stack and read several times. But, duplicate read is also recognized when the same address has been read continuously for polling. The area of each item corresponds to the CPU stall cycle time due to duplicate read.

None:	Normal status.
Duplicate Read:	Duplicate data read cycles.

Write Buffer Penalty

The write buffer penalty analysis displays the stall cycles caused by buffer flush at the instant a write cycle completes. This analysis enables the detection of those read/write patterns which adversely affect the write buffer efficiency. The area of each item corresponds to the CPU stall cycle time caused by write buffer flush.

Note: The areas indicated for write buffer penalty analysis do not always mean that the CPU has stalled for the corresponding period. For details, refer to the *Performance Analyzer Technical Reference*.

None:	Normal status.
Flush Penalty:	Write buffer flush penalty.

Polygon Penalty

Polygon penalty analysis calculates and displays the wasted cycles by evaluating the pre-processing time and redundant drawing time for each of the polygons which protruded from the frame, which have an area of 0, or which have not been subjected to normal clipping. The default screen size and offset value for clipping are 320 x 240 and (0, 0). When the program uses different values, the new screen size and offset value should be specified in the Option dialog box.

Note: Those penalties are estimated values and they are not accurate. Please use them as references.

None:	Normal status.
Outside Frame:	Polygon which is entirely outside the frame (pre-processing time + drawing time).
Scissoring:	Polygon which protrudes outside the left or top edge of the frame (redundant drawing time).
Back Face:	Back-face polygon (pre-processing time + drawing time).
Zero Area:	Polygon with an area of 0 (pre-processing time only).

Waveform Display

SYSCLK:	System clock.
VBLNK:	V blank signal.
GUNINT*:	Interrupt request from Gun.
RXD1*:	Link cable signal.
DSR1*:	Link cable signal.
CTS1*:	Link cable signal.

Note: "*" indicates a negative logic signal.

Access Display

The following four access displays are shown in the status existing immediately before reading the map file.

The colors of the access displays correspond to those of the labels for the main RAM bus status.

<Segment accesses>

stack_seg:	Access to a stack segment.
...	(The segment is displayed when the map file has been read.)
unknown location:	Access to a segment other than a stack.

<Global symbol accesses>

STACK:	Access to a stack.
...	(The global symbol is displayed when the map file has been read.)
unknown location:	Access to a global symbol other than a stack.

Note: When the stack range is not set properly, the global symbol having the highest address may sometimes be mistakenly identified and displayed as the stack address.

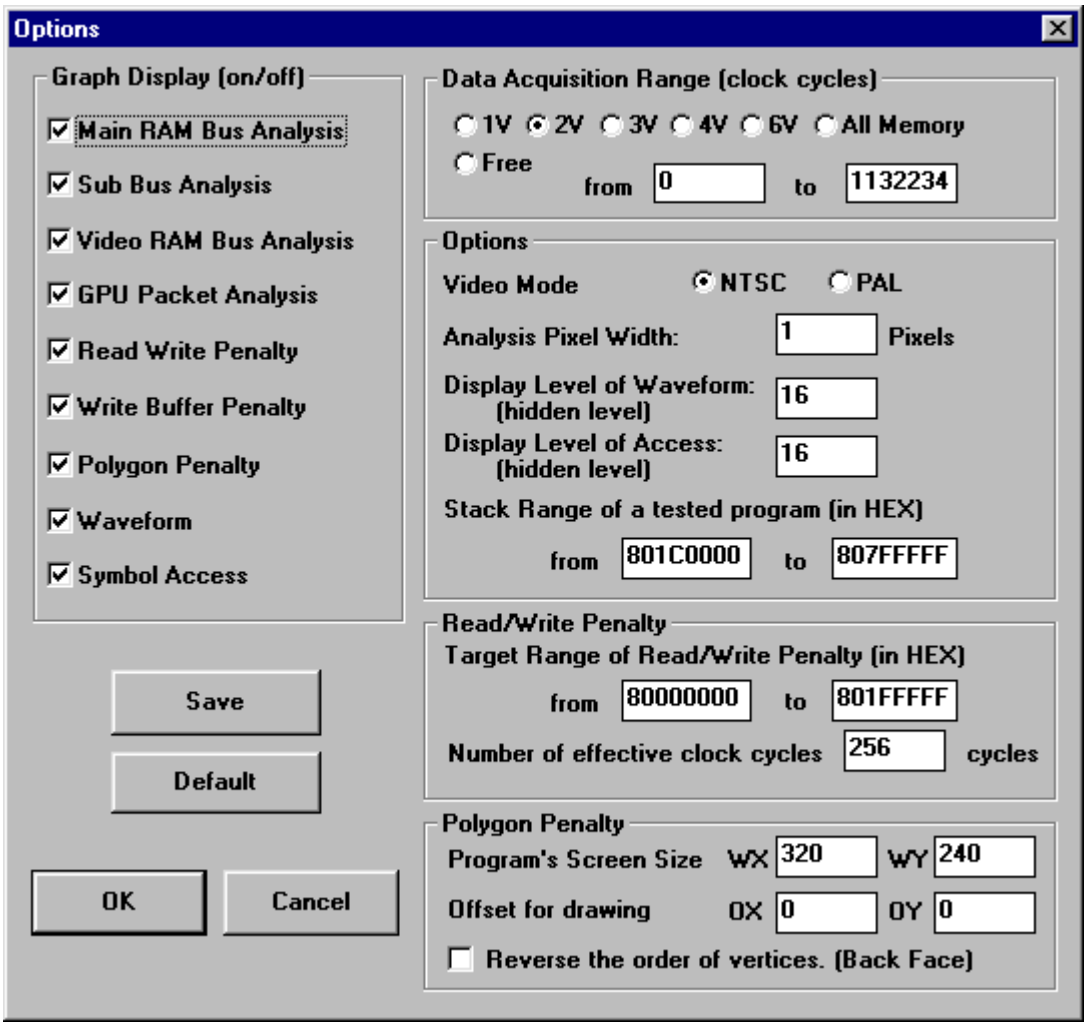
Option Setup

This section describes the dialog box used for setting the display and changing the measurement range, etc.

Option dialog box

From “Setting” menu, select "Options..." to open the Option dialog box. This dialog box is used to change or save the display-related parameters, measurement range, etc. Clicking the OK button after changing the parameters applies them to the current file. Clicking the “Save” button applies the changed parameters to new files that are next created.

Figure 4-2: Option Dialog Box



Graph Display (on/off)	Switch the nine graph display on-off. (see Section 2.2.1 Switching the displayed graphs)
Data Acquisition Range:	Set the range in which data is to be measured and read. This setting is applied from the next measurement. (see Section 3.2 Setting the Measurement Range)
Video Mode	Select NTSC or PAL.
Analysis Pixel Width:	Set the pixel width of the analysis showing the main RAM bus status. (see Section 2.2.4 Changing the analysis display and pixel width)

Display Level of Waveform:	Specify the view size with which the waveform display should begin. (see Section 2.2.5 Changing the display levels of the waveform display and access display)
Display Level of Access:	Specify the view size with which the access display should begin. (see Section 2.2.5 Changing the display levels of the waveform display and access display)
Stack Range of a tested program:	Set the stack range of the program to be measured. (see Section 2.2.7 Setting the stack range)
Target Range of Read/Write Penalty:	Set the main RAM area which becomes the target of read/write penalty. (see Section 4.2.6 Read/Write Penalty)
The Number of effective clock cycles:	Set the number of effective clock cycles for read/write penalty. (see Section 4.2.6 Read/Write Penalty)
Program's Screen Size:	Set screen size for polygon penalty. (see Section 4.2.8 Polygon Penalty)
Offset for drawing:	Set offset for polygon penalty. (see Section 4.2.8 Polygon Penalty)
Reverse the order of vertices (Back Face):	Check the box if you reverse the order of vertices for polygon penalty. (see Section 4.2.8 Polygon Penalty)