Memory Analysis Window

User Guide

KEYSIGHT TECHNOLOGIES

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CAUTION

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Contents

1 Overview

To analyze the captured DDR/LPDDR memory data, you can use various tabs available in the Memory Analysis window.

NOTE

You need the software license option **B4661A-4FP DDR3/4 and LPDDR2/3/4 Performance Analysis** to get the full feature set and capabilities of the Memory Analysis window. Without this license, it is possible to compute only limited memory transactions from the captured data.

Memory Analysis Window - An Overview

Using the Memory Analysis window, you can perform post processing on the captured memory data. In the different tabs and panes of a Memory Analysis window, you can:

- compute and view decoded memory transactions from the captured data (See page 15).
- analyze the captured memory traffic statistics categorized on the basis of memory commands (See page 21).
- visualize an SDRAM operation as a set of commands sent in a sequence (See page 29).
- obtain an overview of the SDRAM's Refresh and Self-Refresh cycles (See page 35) by analyzing its refresh rate over a period of time.
- obtain a graphically represented overview of memory accesses (Reads and Writes) across memory locations (See page 45).
- obtain a statistical as well as a graphical representation of various performance measurements for data transfer rates and memory utilization.

Supported SDRAMs

In the Memory Analysis window, you can analyze the data captured for the following generations of SDRAMs.

- DDR3
- DDR4
- LPDDR2
- LPDDR3
- LPDDR4

Broad Steps for Analyzing Memory Data

1. Capture the memory data.
2. Add the Memory Analysis window instance to the logic analyzer setup with captured data in the Logic and Protocol Analyzer GUI. You can add a Memory Analysis window instance to a logic analyzer module such as U4154A/B or U4164A, data import module, a DDR Bus Decoder tool or an LPDDR Bus Decoder tool.
3. Configure the SDRAM setup in the Memory Analysis window (See page 11).
4. Compute the decoded memory transactions and memory data analysis charts from the captured data in the Memory Analysis window (See page 15).
5. Analyze the data presented in the Memory Analysis window.
6. Customize the charts settings and redraw charts, if required in the Memory Analysis window.

2 Configuring the SDRAM Setup

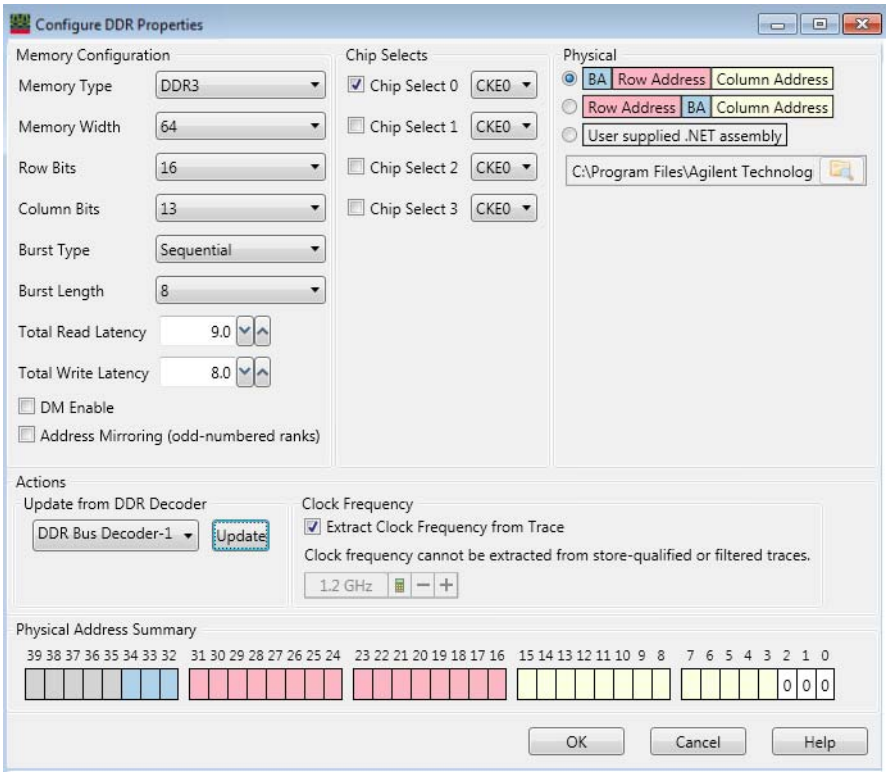
To ensure that the memory transactions are decoded accurately from the captured data, you need to specify the SDRAM configurations applicable for the captured memory data.

You use the **Configure DDR Properties** dialog box in the Memory Analysis window to set up/modify/verify the configuration information about the SDRAM for which data is captured.

NOTE If a DDR/LPDDR Bus Decoder tool is available in your logic analyzer configuration setup, the SDRAM details are automatically updated from this decoder tool into the Configure DDR Properties dialog.

To configure and verify the SDRAM setup

1 Click the **Configure DDR Properties...** button displayed in the Memory Analysis window's toolbar. The **Configure DDR Properties** dialog box is displayed.



2 Set the following fields in the **Memory Configuration** section:

Field	Description
Memory Type	Select the DDR / LPDDR generation to which the SDRAM under test belongs.
Memory Width	This field is used to compute physical addresses. For memory widths greater than 8 bits, the column address is padded with the appropriate number of 0 bits. You can see how this works by examining the Address Summary at the bottom of the dialog as you select different memory widths.
Row Bits	Select the width (in bits) of the row address as supported by your SDRAM under test. The number of bits defines the address mask. The address value cannot exceed the value of the address mask. You may refer to your SDRAM's data-sheet for the number of row address bits.
Column Bits	Select the width (in bits) of the column address as supported by your SDRAM under test. The Column Address bus generally consists of fewer bits than the Row Address. The number of bits defines the address mask. The address value cannot exceed the value of the address mask. You may refer to your SDRAM's data-sheet for the number of column address bits.
Bank Group Bits	Select the number of active Bank Group bits applicable for your SDRAM DIMM. A bank group corresponds to a separate DRAM on a DIMM. This field is only applicable for DDR4 and therefore enabled only when you select **DDR4** from the Memory Type list-box.
Burst Type	Select the order of the bytes after the Read/Write Command (Sequential or Interleaved). While decoding transactions, this setting is used to calculate and display the appropriate physical address for each memory cycle.

Field	Description
Burst Length	Select the burst length applicable for your SDRAM that is, how many data bytes are written to or read from the SDRAM after a write or a read command is given along with row and column address. The burst length options vary depending on the memory type. The option **On the Fly** is available for DDR3 and LPDDR4 and indicates that burst length can vary for each read/write command. If you select this option, the decoding software automatically determines if the burst length of the operation is 16 or 32.
Total Read Latency	Specify the number of full clock cycles between the time that a read command appears on the bus and the time when valid data from SDRAM appears on the data bus. This value represents the total read latency for your system and therefore should include parameters that affect total read latency.
Total Write Latency	Specify the number of full clock cycles between the time that a write command appears on the bus and the time when valid data from SDRAM appears on the data bus. This value represents the total write latency for your system and therefore should include parameters that affect total write latency.
DM Enable	Enables write data masking. This option is available only when the DM_W bus exists. If DM Enable is selected, the decoding software applies the DM_W bits to the DATA_W bits before displaying the write data value in the Memory Analysis window. For example, if: DM = enabled Memory Width = 32 DM_W = 0000 0011 DATA_W = 0123 4567 then the decoded data will be displayed as: mem write 0x 0123 45--
Address Mirroring (Odd Numbered Ranks)	Select this checkbox if the Address Mirroring has been enabled on your SDRAM under test that is, if the address bus is mirrored to achieve optimum routing of the address bus on DDR multi rank modules.
Chip Selects	From this section, select the checkboxes for the chip selects that are being used for the SDRAM. For the transaction decoding to be correct, make sure that the chip selects that are being used in the system must be enabled and unused chip selects must not be enabled. For each of the selected chip select, select the Clock Enable (CKE) control signal applicable for that chip select.
Physical	From this section, select the physical address construction that matches the physical address construction used by your SDRAM. The physical address order indicates the order in which the SDRAM address components (Row address, Column address, Bank address, and Rank) are used together to form the Physical address. If your system constructs addresses using a convention different from the displayed options, you need to create a .NET assembly to translate between a physical address and the various fields which make up a bus address. If this is the case, select **User supplied .NET assembly** to allow you to define a custom physical address order format for the SDRAM. Refer to the topic To customize physical address construction in the DDR Bus Decoder Online help to know more about creating a custom algorithm.
Update from DDR Decoder	If you have a Keysight DDR Decoder or LPDDR Decoder tool added to your Logic Analyzer configuration setup, then the **Update from DDR Decoder** section is displayed in the Configure DDR Properties dialog box. The list-box available in this section allows you to select the DDR or LPDDR Decoder tool's instance available in your logic analyzer setup. Clicking the **Update** button displayed next to this list-box updates the SDRAM configurations from the selected decoder tool's instance to the Configure DDR Properties dialog.
Clock Frequency	You can: ▪ either use the clock frequency as detected and extracted from the captured data, or ▪ manually specify the clock frequency that should be used while decoding memory transactions. When specifying the clock frequency manually, ensure that you specify the maximum clock frequency applicable for the trace. If you have used Store Qualifiers while capturing data or filtered the captured data, then you need to manually specify the clock frequency as some states may have been filtered out.
Physical Address Summary	A pictorial representation of how physical addresses will be constructed based on the inputs that you provide in the Configure DDR Properties dialog box for Memory Width, Row Bits, Column Bits, and physical address construction.

3 Computing Decoded Memory Transactions and Memory Data Analysis Charts

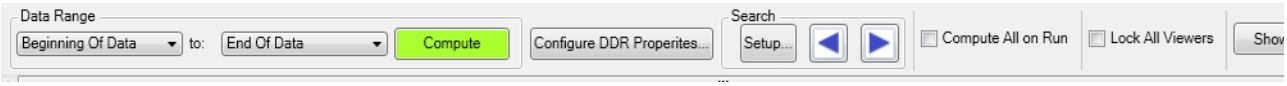
NOTE Before you start computing the decoded transactions and charts, ensure that you have correctly configured the memory settings as per your SDRAM configurations. Failing to do so can result in an inaccurate decoding of transactions.

To compute memory transactions:

1 Click the **Show** button on the Memory Analysis instance in the Overview window to access the Memory Analysis window. The **Memory Analysis** window is displayed.

2 In the **Data Range** group-box, specify the start and end points of the captured memory data for which you want to compute decoded memory transactions and charts. Only the specified range of data is analyzed to compute data. Following options are available for setting this data range.

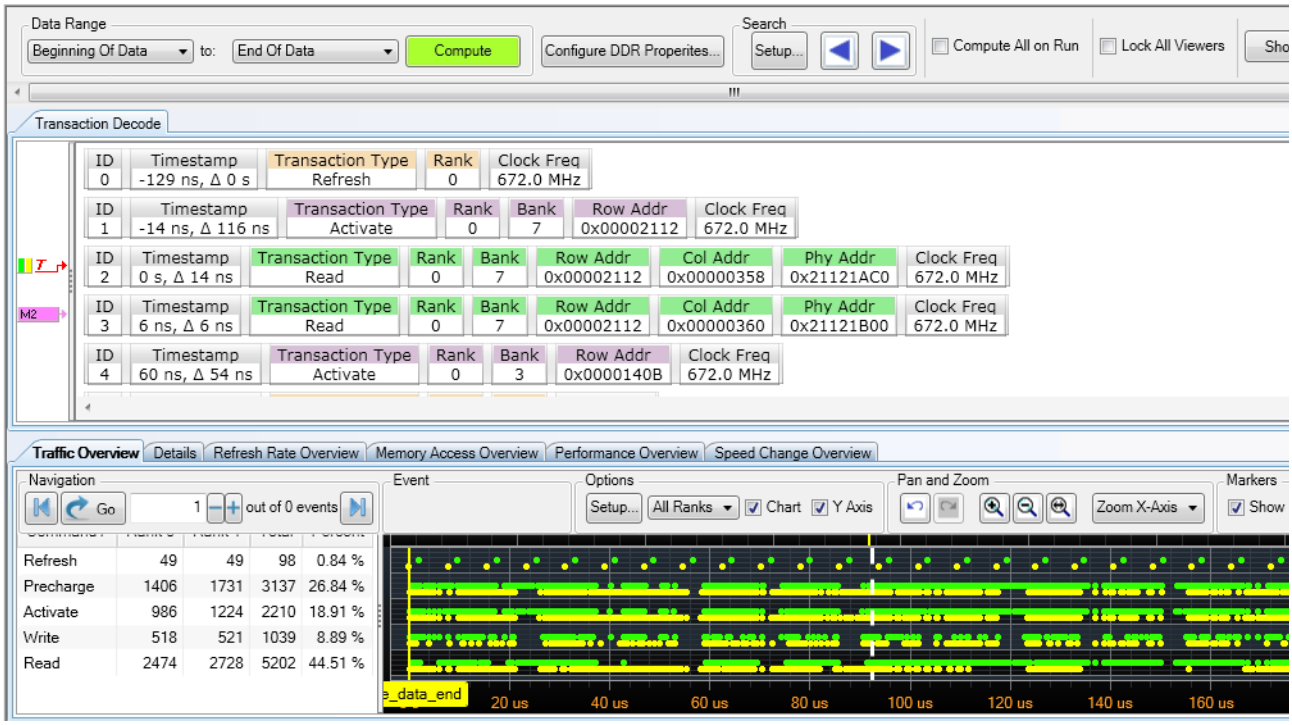
- **Beginning and End of data** - This data range selection ensures that the entire trace is used for the computation of memory transactions and charts.
- **Trigger** - Selecting Trigger in the data range ensures that memory transactions are computed from the point in the captured data where the trigger condition was met.
- **Markers** - Selecting markers in the data range ensures that memory transactions are computed for the specific portion of captured data defined by markers.



3 Click the **Compute** button displayed with the Data Range fields.

NOTE If you want to compute decoded memory transactions and memory data analysis charts and statistics in background while the logic analyzer module is capturing memory data, then select the **Compute All on Run** check box in the Memory Analysis window before starting the data capture. This allows you to perform a compute for all the relevant tabs in the Memory Analysis window automatically after the data capture is complete. It thereby helps you perform a faster compute than performing a compute after the data is captured.

On clicking Compute, the transactions are decoded from the specified data range of memory trace. Then, statistics and charts are computed from these decoded transactions and results are displayed.



NOTE The **Clock Freq** field is displayed for the decoded memory transactions in the upper pane only if you selected the E**xtract Clock Frequency from Trace** checkbox in the Configure DDR Properties dialog box while configuring your SDRAM setup.

Disabling a Memory Analysis Tab

By default, on clicking Compute, the data in all Memory Analysis tabs is computed. In case you do not want to use data in a specific tab, you can disable that tab. This excludes the tab from the Compute operation and thereby eliminates the time taken to compute and draw chart for that tab from the total compute time.

You disable a tab using the Enable/Disable button  displayed in the tab's header. The tabs for which the Disable feature is not available, this button is not displayed.

When you disable a tab, the chart is cleared and any computed data in that tab is lost. You can re-enable a disabled tab and compute again to regenerate the data and chart for that tab.

NOTE

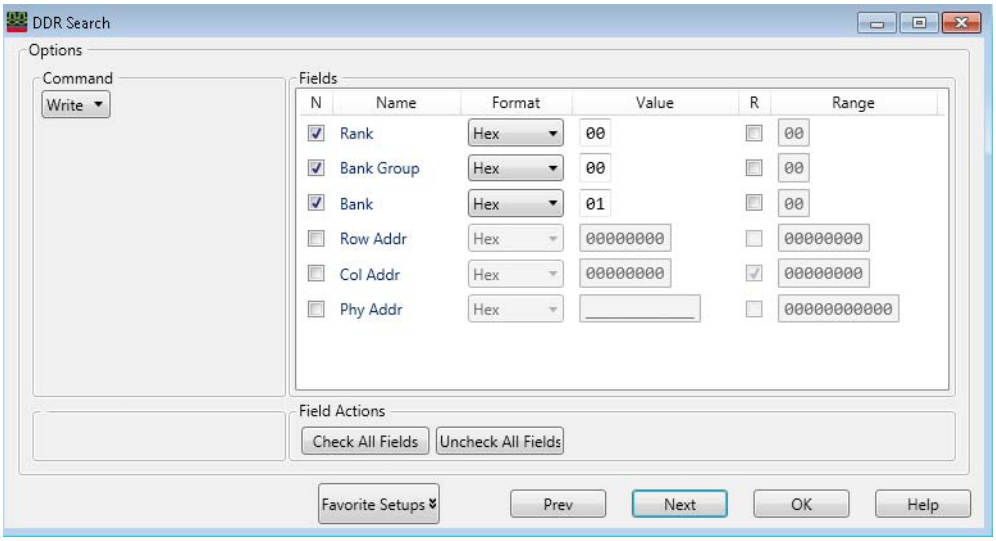
Hiding a tab using the **Show/Hide Tabs** drop-down list-box at the top of the Memory Analysis window does not exclude the hidden tab from the Compute operation. The tab is only hidden from display but its data is still computed when you click Compute.

4 Searching for Specific Memory Commands

You can quickly search for a memory command of interest from the list of decoded memory transactions displayed in the upper pane of the Memory Analysis window. You can use the **Search** section in the Memory Analysis tool-bar to accomplish this.

1 Click **Setup** in the **Search** section to define your search criteria.

The **DDR Search** dialog box is displayed.



2 In the left pane of Search, the **Command** list-box contains a list of memory commands. Select the required memory command to be searched.

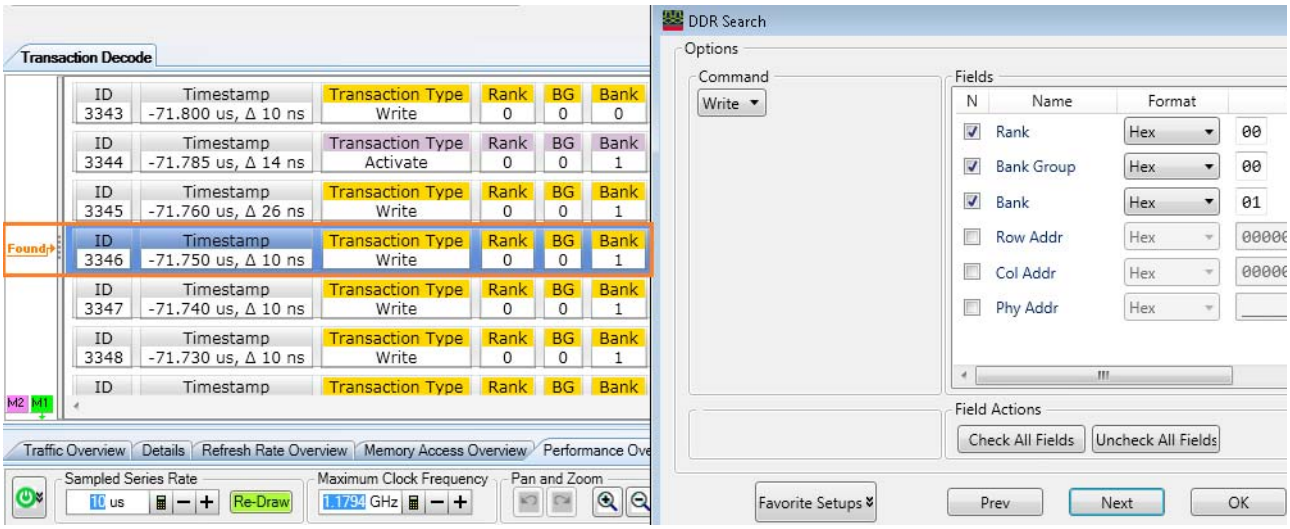
On selecting a memory command, the right pane displays the fields relevant for that memory command. These fields help you refine and narrow down your search criteria for the selected memory command.

3 Select the checkbox displayed with each field that you want to include in the search criteria. Then specify the value of these fields. You can also select the R checkbox with the fields to define the range of field.

4 Click **Next** to begin the search based on the specified criteria.

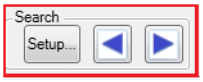
If a memory command matching the search criteria is found in the list of decoded memory transactions, then the first occurrence of that command is highlighted in the upper pane of the Memory Analysis window. A “Found” marker is also placed at this occurrence.

If a memory command matching the search criteria is not found in the list of decoded memory transactions, then a Not Found error message is displayed.



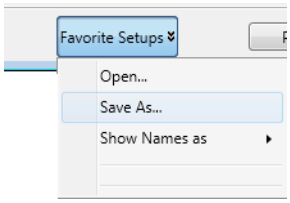
5 Traverse to the next occurrences of the memory command matching the search criteria using the **Next** button in the DDR Search dialog box. Click **Prev** to move to the previous occurrence of command in the list.

6 Click **OK** to close the DDR Search dialog box with the search criteria defined in it and then you can search based on this criteria using the Next and Previous buttons displayed in the Search section.



NOTE

You can save the search criteria that you defined in the DDR Search dialog box for later use. You use the **Save As** option under **Favorite Setups** to save the search criteria in a DDR Search Setup (.dss) file.



You can access a previously saved search setup using the **Open** option under **Favorite Setups**. Also, the recently used search setup files are displayed as a list under **Favorite Setups**. You may choose to display these recently used setup files as only filenames or as complete path and filenames in the list using the **Show Names as** option under **Favorite Setups**.

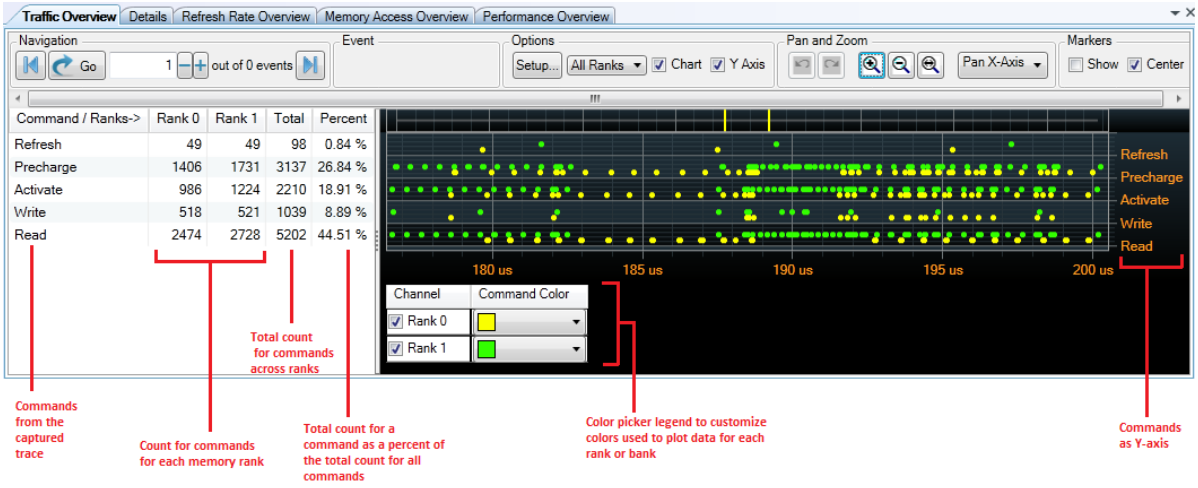
5 Analyzing Memory Traffic Statistics

You can use the **Traffic Overview** tab in the Memory Analysis window to view and analyze the traffic statistics for the memory data captured and displayed in the upper pane of that window.

On clicking the Compute button, the following data is computed in the tab's left and right panes.

- For each memory command found in the captured trace, the tab displays a count of the number of times the memory command was sent to the SDRAM. The count of each command is further categorized on the basis of either memory ranks or on the basis of banks within a particular memory rank to which the command was sent.
- The tab also displays a traffic overview chart in which a count of memory commands found in the captured trace is plotted over the period of time as X-axis and the command types as Y-axis. Different customizable colors are used to plot count of commands for different banks or ranks.

The following screen displays a sample memory traffic statistics categorized on the basis of available memory ranks.



The following subsequent topics in this help book describe the usage of the Traffic Overview tab in detail.

- Selecting the Commands to be Included in Traffic Overview (See page 23)
- Categorizing Memory Traffic Statistics as per Memory Banks or Ranks (See page 24)

- Viewing and Customizing a Traffic Overview Chart (See page 25)
- Navigating Through Traffic Overview and Decoded Memory Transactions (See page 27)

See Also

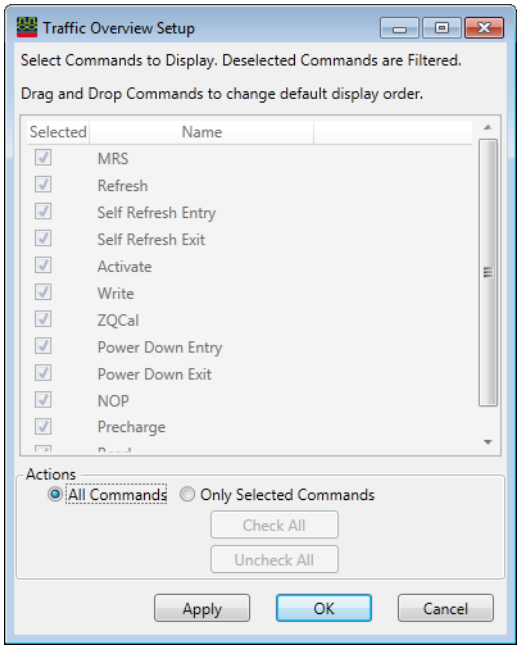
- Placing Markers in a Memory Analysis Chart (See page 67)
- Panning / Zooming a Memory Analysis Chart (See page 69)

Selecting the Commands to be Included in Traffic Overview

You can choose the memory commands for which you want the traffic statistics and traffic overview chart to be displayed in the Traffic Overview tab. By default, all commands are selected for data display.

1 Click the **Setup...** button under the **Options** groupbox in the **Traffic Overview** tab.

The **Traffic Overview Setup** dialog box is displayed with the list of all the available memory commands. The **All Commands** radio button is selected by default which means all commands are selected for display.



2 To filter out commands from the display in the Traffic Overview tab, click the **Only Selected Commands** radio button in the **Actions** groupbox.

3 De-select the checkbox for each command that you do not want to include in the traffic statistics.

NOTE You can also change the order in which a command is displayed in the traffic overview chart's Y-axis. To do so, drag and drop that command in the required sequence in the list of commands shown in the Traffic Overview Setup dialog.

4 Click **Apply** to confirm the changes or click **OK** to confirm the changes and close the dialog box. Click **Cancel** to close the dialog box without applying changes.

The changed selection of commands is reflected in the traffic statistics and chart.

Categorizing Memory Traffic Statistics as per Memory Banks or Ranks

In the Traffic Overview tab, you can categorize memory traffic (commands) statistics on the basis of either memory ranks or on the basis of banks within a particular memory rank.

To change categorization

- From the **Options** gruopbox in the tab, click the **Ranks** drop-down list-box.

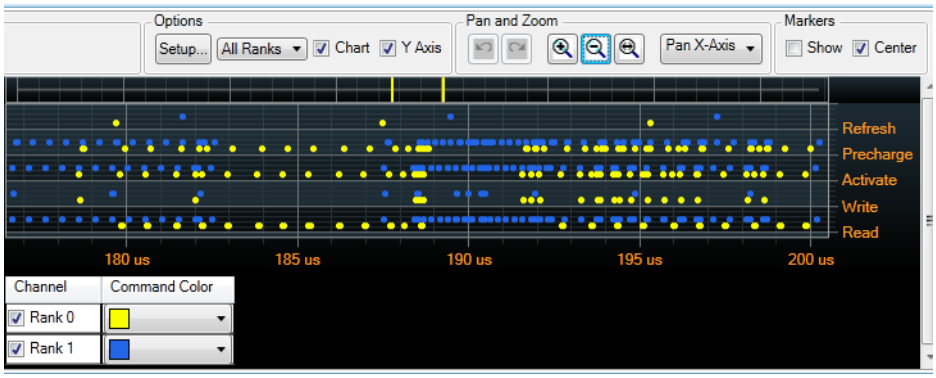
  The **All Ranks** option in the list-box is the default categorization in which the count of the number of times a DDR command was sent is displayed at the rank level. This categorization is useful for a multi-rank memory configuration.

  If you want to change the categorization to individual banks level within a rank, then select that particular rank from the list-box. This categorization is useful to analyze traffic within a particular rank and to drill down to banks level.

Viewing and Customizing a Traffic Overview Chart

The computed memory traffic statistics displayed in the left pane of the **Traffic Overview** tab is also available as a chart in the tab's right pane.

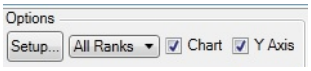
For each memory command type found in the trace, there is a row in the chart. This row is used to plot the number of commands of that type sent over a period of time to individual memory banks or ranks. Color coding is used to differentiate command counts based on ranks or banks (as per your categorization selection). For instance, in the below screen, yellow and blue colors are used to represent command counts for Rank 0 and Rank 1 respectively.



Some of the ways of customizing a traffic overview chart are described in this topic.

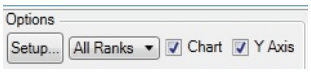
To display a traffic overview chart

By default, the traffic overview chart is displayed. To show/hide this chart, select/de-select the **Chart** checkbox from the **Options** groupbox in the Traffic Overview tab.



To hide the Y-axis (command types) in the traffic overview chart

Deselect the **Y Axis** checkbox from the **Options** groupbox in the **Traffic Overview** tab.

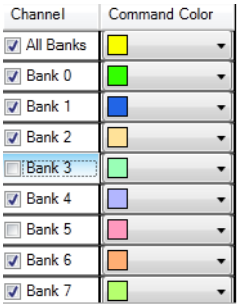


To view or change the color coding used in the traffic overview chart

The Color Picker Legend displays the currently applied color coding for the chart.

1 To display the Color Picker Legend, right-click anywhere in the plotted chart area and select **Show Color Picker Legend**.

The currently used color coding for each bank or rank (as per your categorization choice) is displayed in the Color Picker Legend.



2 To change the color coding for a bank/rank, click the Command Color drop-down and select the new color.

The commands count for that bank/rank is changed to the new color in the chart.

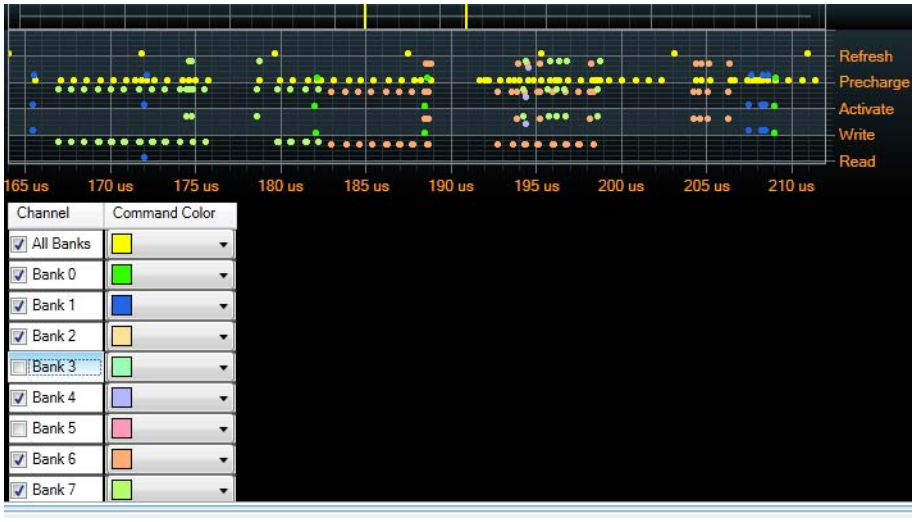
To show/hide data for a bank/rank from the traffic overview chart

By default, the command counts for all the applicable memory banks/ranks are displayed in the chart. You may want to hide the command counts for some of the banks/ranks to focus only on specific bank(s)/rank9s) of interest.

1 Right-click anywhere in the plotted chart area and select **Show Color Picker Legend**.

2 Select/de-select the checkbox for a bank or a rank to show/hide the command counts for that bank/rank in the chart.

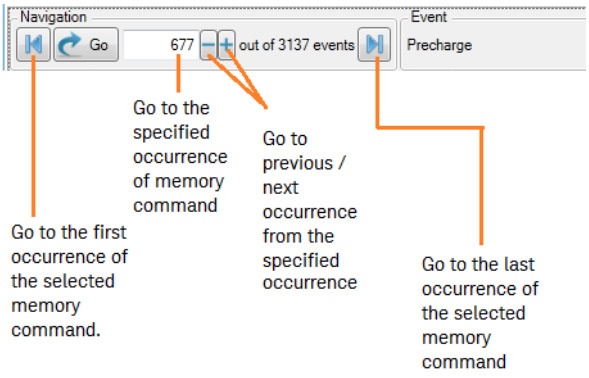
The chart is updated to reflect your selections of banks/ranks.



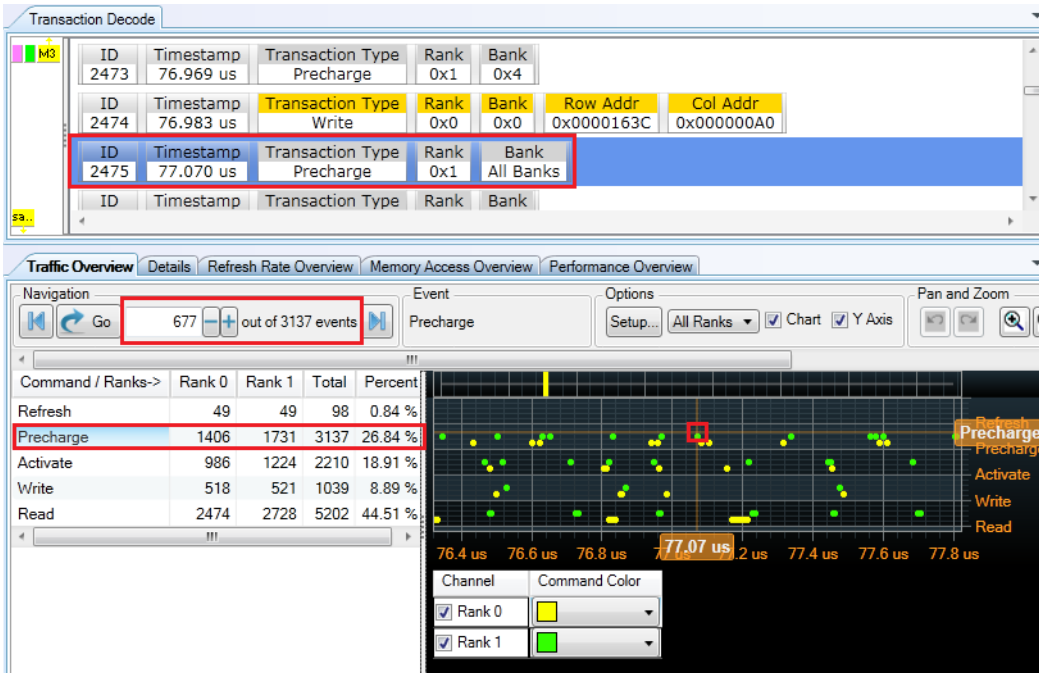
NOTE The **All Banks** option in the Color Picker Legend is used for the memory commands applicable for all the banks of a particular rank.

Navigating Through Traffic Overview and Decoded Memory Transactions

You use the Navigation tool-bar in the Traffic Overview tab to navigate from a specific occurrence of a memory command event to its applicable memory transaction in the upper pane. Simultaneously, the traffic overview chart display also moves to the point at which the specific command event is plotted in the chart.



For instance, in the following screen, there are total 3137 Precharge commands across ranks and you want to navigate directly to the 677th Precharge command in the trace To do so, you can select the Precharge command type in the Traffic Overview left pane and then type 677 in the Navigation text box and click Go. This takes you directly to the 677th Precharge transaction in the upper pane of the Memory Analysis window. The chart display is also simultaneously moved to the 677th occurrence of the Precharge command.

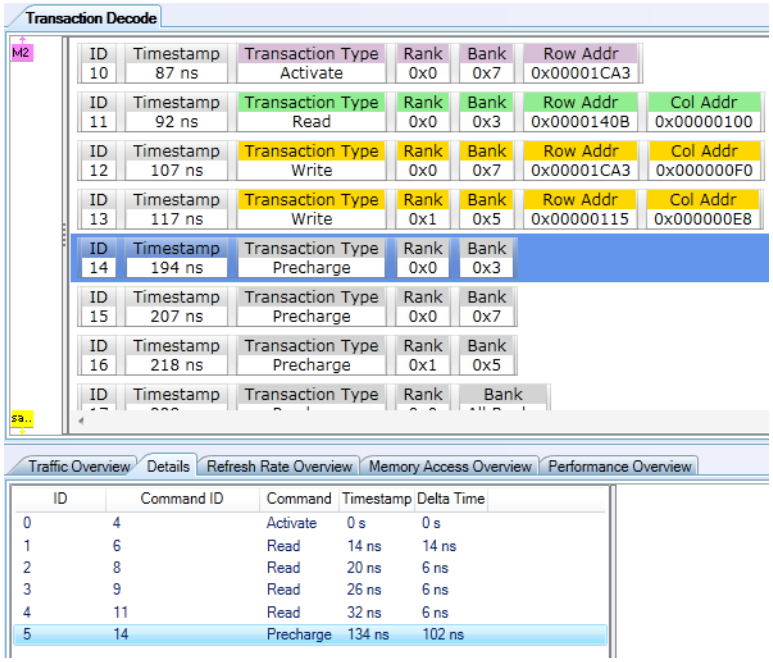


6 Viewing Memory Commands as a Sequential Set

An SDRAM operation comprises of a number of commands sent in a specific sequence. In the upper pane of the Memory Analysis window, memory transactions (commands) are decoded and listed in a time-wise order of their occurrence. At times, you may want a segregated view of the complete sequential set of transactions (commands) that comprise a specific SDRAM operation. You can use the **Details** tab in the Memory Analysis window to view this complete sequential set of commands sent for a specific SDRAM operation.

On selecting a decoded transaction row in the **Transaction Decode** tab of the Memory Analysis window, the Details tab lists all the memory commands applicable for that transaction in a sequential flow.

The following screen displays the complete sequence of commands applicable for the Precharge transaction highlighted in the upper pane. In this sequence, an Activate command to open the row is followed by Read commands and the SDRAM sequence ends with the Precharge command to close the row.



The following table describes the fields displayed in the Details tab.

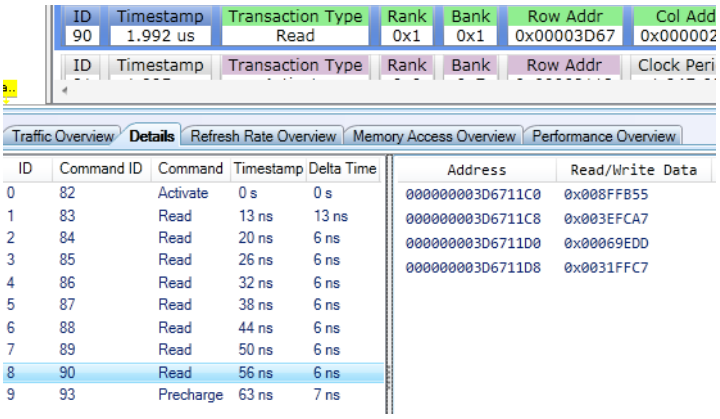
Field	Description
ID	Identifier assigned to a command in the command set to indicate the command's order in the sequential flow for the SDRAM operation.
Command ID	The identifier of the transaction in the upper pane to which the command maps to.
Command	The memory command in the sequential flow.
Timestamp	Displays the timestamp for the command relative to the timestamp of the first command in the set of commands shown in the Details tab. The first command's timestamp is taken as 0s in the command ste shown in the Details tab.
Delta Time	Displays the difference between the timestamp of the command and the previous command in the set of commands shown in the Details tab.

7 Viewing Details of a Read or a Write Transaction

For a Read or a Write Transaction, you can view the details (memory address and Read/Write Data) for the individual Read or Write commands comprising that transaction.

These details are displayed in the **Details** tab of the Memory Analysis window. On selecting a command, its details are displayed in the right pane of the Details tab.

The sample screen below displays the details of a memory Read transaction.



8 Analyzing Refresh Performance of an SDRAM

Overview

To allow you to analyze the performance of refresh cycles and self-refresh operations of an SDRAM, the Memory Analysis window provides the **Refresh Rate Overview** tab.

In this tab, the SDRAM's refresh rate statistics and graphs are generated from the captured trace. These graphs and statistics can help you assess if the SDRAM's refresh rate meets the expected refresh rate requirements. The expected refresh rate is set based on the number of Refresh commands and self-refresh periods required in a sampled Refresh Window.

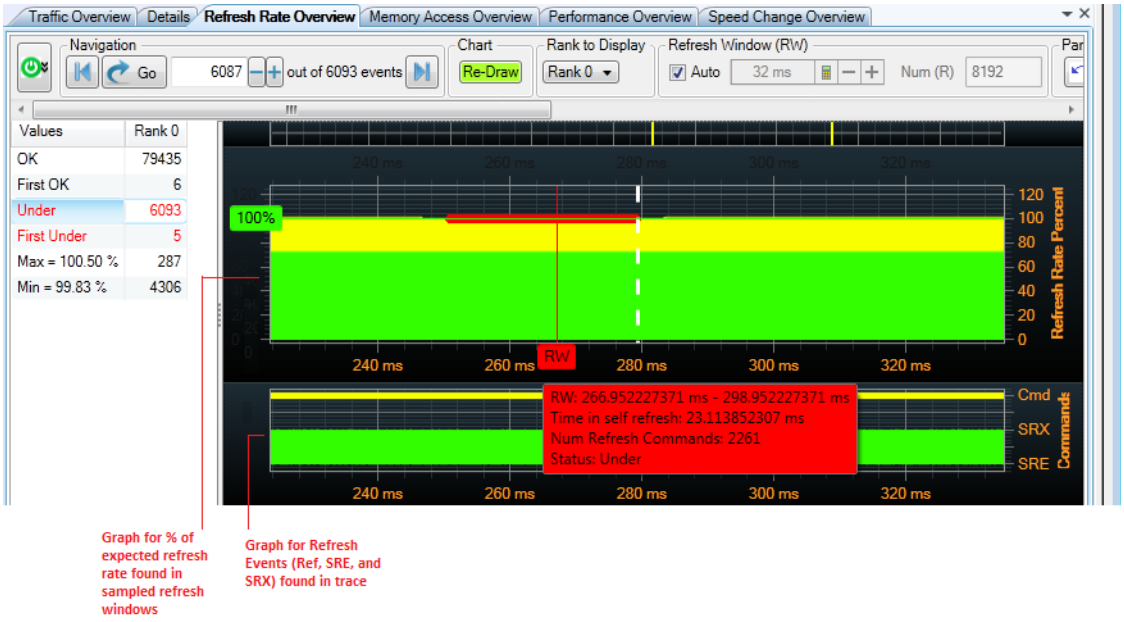
For the generation of graphs, you need to specify the following two inputs in the tab. These inputs are used for the calculation of the expected refresh rate as a percent of which the SDRAM's refresh rate is plotted in the graph.

- **Number of Refresh commands required in a sampled Refresh Window** to make the refresh rate acceptable for that refresh window. For this, you can either use the default value of 8192 for all LPDDR memory types and 4096 for all DDR memory types or specify a number that suits your SDRAM configuration.
- **Width of the Refresh Window** based on which sampling is done and refresh rate is calculated. For this, you can:
  - either use the default value of 32 ms or specify a time interval that suits your SDRAM configuration
  - or allow the software to automatically adjust the Refresh Window width to support SDRAM's changes in the refresh rate as the SDRAM operating temperature changes.

A Refresh (REF) command or an entry/exit from the self refresh mode (SRE and SRX) in the captured trace is considered a Refresh event for these graphs. Consequently, a sample is taken from the captured trace based on the currently set Refresh Window time interval. The refresh rate and refresh events are then plotted in the applicable refresh window in the graphs.

Understanding and Interpreting the Refresh Rate Graphs and Statistics

The sample screen below shows an SDRAM's refresh rate information displayed in the tab's left and right panes.



Refresh rate statistics in the left pane

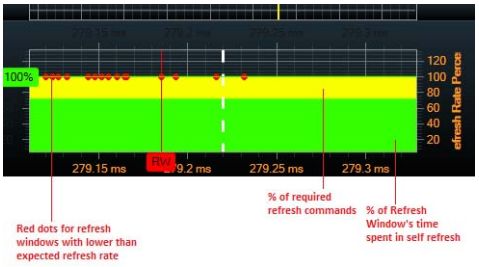
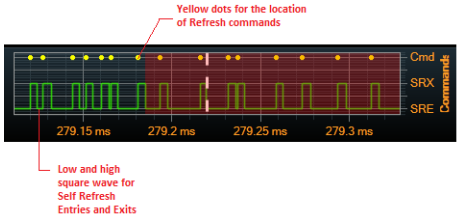
The left pane displays the rank-wise refresh rate statistics for the sampled Refresh Windows. The statistics are displayed as:

Value	Description
OK	Displays the number of sampled Refresh Windows in which refresh rate was equal to or more than the expected refresh rate. That is, the number of Refresh commands and self-refresh period found in each of these Refresh windows is as per the number of Refresh commands and self-refresh period required in a Refresh Window.
First OK	Displays the first Refresh Window in the series of sampled Refresh Windows that has refresh rate equal to or more than the expected refresh rate.
Under	Displays the number of sampled Refresh Windows in which refresh rate was less than the expected refresh rate. That is, the number of Refresh commands and self-refresh period found in each of these Refresh windows is less than the number of Refresh commands and self-refresh period required in a Refresh Window.
First Under	If there are consecutive Refresh Windows with refresh rate lesser than the expected refresh rate, then the first Refresh window from this consecutive series is included in the First Under count. All such first Refresh windows From each such consecutive Refresh Window series found, the first Refresh Window is used to calculate the total count for the First Under value.
Min = %	Shows the minimum refresh rate percentage found in the sampled Refresh Windows of a rank. Also displays the number of sampled Refresh Windows that have the minimum refresh rate percentage.
Max = %	Shows the maximum refresh rate percentage found in the sampled Refresh Windows of a rank. Also displays the number of sampled Refresh Windows that have the maximum refresh rate percentage.

You can also use these statistical values to navigate to a specific Refresh Window of interest in the graph.

Refresh rate graphs in the right pane

The right pane displays the following two graphs for the selected rank.

Top Graph	Bottom Graph
The top graph shows the percentage of expected refresh rate found in each of the sampled Refresh Windows. ▪ The X-axis in the graph represents time and is used for plotting the start time for a sampled Refresh window. ▪ The Y-axis in the graph represents the% of expected refresh rate found in the sampled refresh windows. Refresh windows with lower than the expected refresh rate are represented with red dots at their start point in the graph.	The bottom graph shows the exact locations (time-line) of Refresh events found in the trace, that is, the Refresh Commands and Self-refresh entries and exits. ▪ The X-axis in the graph represents time. ▪ The Y-axis in the graph represents the refresh events found in the trace.
Two different colors are used in the top graph to represent: ▪ the percentage of Refresh Window's time spent in the self-refresh. Notice that the green color has been used in the graph below to represent the percentage of self-refresh periods. ▪ the number of refresh commands found in each Refresh Window as a percent of the number of Refresh commands required in a Refresh window. This is plotted (added) on top of the self-refresh time plotted for a Refresh window. Notice that the yellow color has been used in the graph below to represent the percentage of required Refresh commands found in each sampled Refresh window.	Two different colors are used in the bottom graph to represent: ▪ the locations of Refresh commands over a period of time as dots on the top of the graph. Notice that the yellow color has been used in the graph below to represent the exact locations of Refresh commands. ▪ The Self Refresh Entry and Exit points found in the trace are represented in the graph as a low and high square wave respectively over a period of time. The high wave represents the Self Refresh Exit (SRX) and the low wave represents the Self Refresh Entry (SRE). Notice that the green colored low and high square wave has been used in the graph below to represent the exact locations of Self Refresh Entries and Exits.
	

NOTE

At times, you may notice that some of the Refresh packets towards the end of the trace have not been considered while drawing the Refresh Rate top graph. This happens when towards the end of the trace, there is no longer enough time in the trace to plot a full refresh window out of it. As a result, the Top graph may end a little earlier than the Bottom graph that plots the exact locations of Refresh commands.

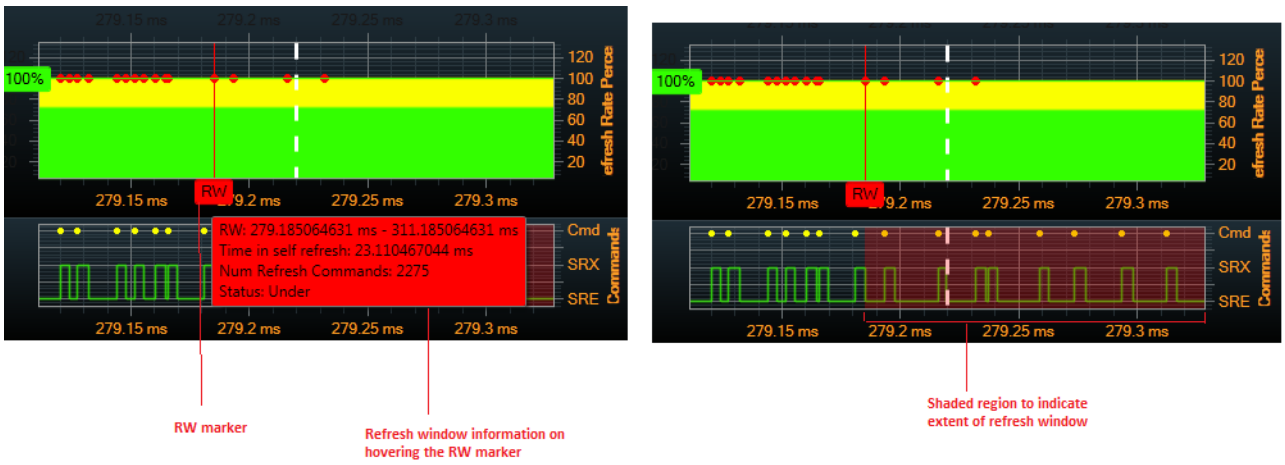
See Also
- Placing Markers in a Memory Analysis Chart (See page 67)
- Panning / Zooming a Memory Analysis Chart (See page 69)

Analyzing the Refresh Windows with Lower Than the Expected Refresh Rate

In the Refresh Rate graph, the refresh windows with lower than the expected refresh rate are plotted as red dots at the start of their window time.

To clearly highlight and quickly analyze the refresh windows with lower than the expected refresh rate, you may find the following graph features useful.

- **Use 100% marker** - The 100% marker marks a horizontal green line in the top graph and represents the 100% position of the top graph's Y-axis. This 100% position indicates the expected refresh rate for a refresh window. The 100% marker gives you a quick glance of refresh windows falling below the expected refresh rate.
- **Use Zoom Both Axis** to zoom the areas with red dots to get a detailed zoomed view of these areas that fall "Under 100%".
- **Navigate using the refresh rate statistics on the left** - You can use the **Under** row or the **Min = %** row in the left pane to quickly navigate (See page 43) to the refresh window occurrences in the graph that had below the expected refresh rate or minimum refresh rate. You can also use the **First Under** statistics in the left to navigate to instances where consecutive Refresh Windows with lower than expected refresh rate have been found.
- **Use RW marker** - The RW (Refresh Window) marker marks the start of a Refresh window in the top graph and displays the extent of that Refresh window as a shaded region in the bottom graph. You can manually drag this marker to a refresh window that has a red dot at its start (indicating its shortfall to the expected rate). Once the RW marker is placed on the window, you can hover the mouse on the RW marker label to get the details of the refresh window as shown below. Notice that the RW marker, the extent of the refresh window and the hovered information box are displayed in red for a refresh window with lower than the expected refresh rate.



Changing the Refresh Window Time Interval and Number of Required Refresh Commands

For the calculation of the expected refresh rate against which an SDRAM's refresh rate is plotted in the Refresh Rate Overview graphs, the software by default uses the following values.

- 8192 for all LPDDR memory types and 4096 for all DDR memory types as the number of refresh commands required in a sampled refresh window.
- 32 ms for the time interval of a sampled refresh window.

There may be situations when you want to customize the expected refresh rate as per your specific SDRAM requirements.

To manually change the expected refresh rate

1 In the **Refresh Rate Overview** tab, click the  icon or the  icons displayed in the **Refresh Window (RW)** section to change the Refresh Window time interval.

2 In the **Num (R)** textbox, specify the number of refresh commands required in a sampled refresh window.

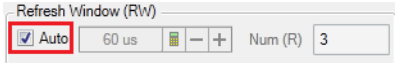
3 Click the **Re-Draw** button to redraw the graphs as per the changes that you made to the expected refresh rate.

To configure the software to automatically adjust the expected refresh rate

You may have to analyze refresh rate under situations when the SDRAM's refresh rate changes as per the changes in its operating temperature. For such situations, you can configure the software to automatically adjust the expected refresh rate as per these changes.

1 In the **Refresh Rate Overview** tab, select the **Auto** checkbox displayed in the **Refresh Window (RW)** section.

The expected refresh rate is now adjusted automatically and therefore the fields used for calculating the expected refresh rate are disabled.



2 Click the Re-Draw button to redraw the graphs as per the automatically adjusted expected refresh rate.

Changing the Rank for which Refresh Rate Graph is Displayed

The left pane of the Refresh Rate Overview tab displays the refresh rate statistics on a per rank basis. The statistics is displayed for all the memory ranks applicable for the captured trace.

The graphs displayed in the right pane are however, specific to the particular rank that you currently selected in the tab.

To change the rank for which graphs are to be displayed

1 In the Refresh Rate Overview tab, select the appropriate rank from the **Rank to Display** listbox.

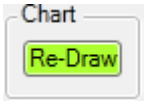
2 Click the **Re-Draw** button to draw the graphs for the changed rank.

Redrawing Refresh Rate Graphs

Once the graphs have been generated in the Refresh Rate Overview tab, you may need to re-draw these graphs so that these graphs reflect the current settings and selections that you made in the tab. Some such scenarios can be:

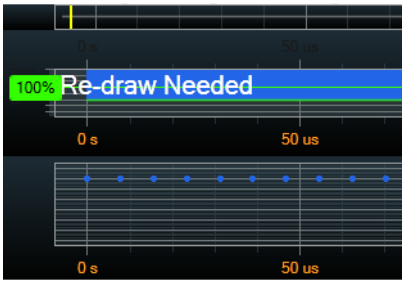
- You have changed the number of required Refresh commands in a Refresh Window.
- You have changed the width of the Refresh Window.
- You have configured the software to automatically adjust the expected refresh rate for a sampled refresh window.
- You have changed the rank for which you want the graphs to be displayed.

To redraw graphs, click the **Re-Draw** button in the Chart section of the tab.

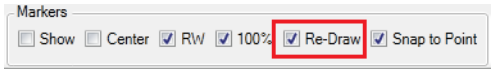


Showing/Hiding the Re-Draw Indicator

Whenever there is a need for redrawing graphs, the software displays the **Re-Draw Needed** indicator at the top-left corner of the graphs.



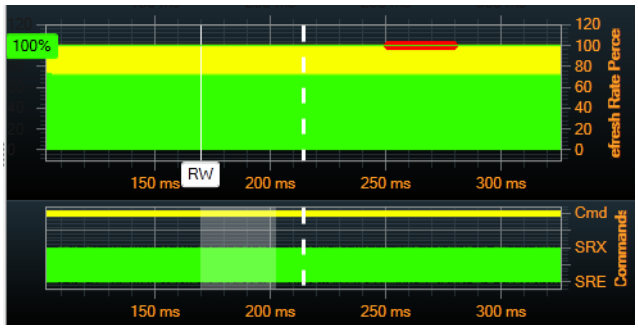
The indicator is displayed only if the **Re-Draw** checkbox is selected.



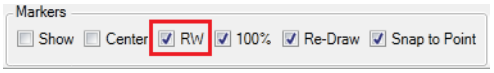
Customizing Refresh Rate Graphs

Showing/Hiding the RW Marker

The **RW** (Refresh Window) marker marks the start of a Refresh window in the top graph and displays the extent of that Refresh window as a shaded region in the bottom graph.



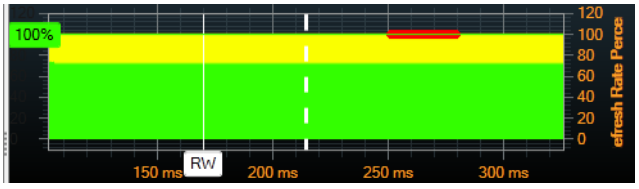
To show/hide this marker from the graphs, use the **RW** checkbox.



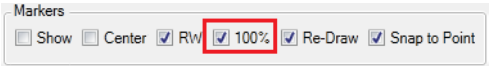
Showing/Hiding the 100% Marker

The 100% marker marks a horizontal green line in the top graph. This line represents the 100% position of the Y-axis of the top graph. This 100% position indicates the expected refresh rate for a refresh window.

The marker is useful to highlight refresh windows experiencing lower than expected refresh rate as well as windows experiencing over-refreshing.



To show/hide this marker from the graphs, use the 100% checkbox.

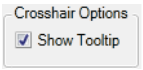


Showing/Hiding Tooltips

On hovering the mouse over the plotted data in the two graphs, tooltips are displayed for the plotted data on which the mouse pointer is currently placed. These tooltips provide the following information:

- The total time spent in self refresh during the Refresh Window. This total time may include multiple separate Self Refresh Enable periods and may include a partial period at the end of the Refresh Window.
- The number of Refresh commands found in the Refresh Window.
- A status of OK or Under based on whether or not the refresh rate for the Refresh window is as per the expected refresh rate.

To show/hide the tooltips, click the **Show Tooltip** checkbox in the **Crosshair Options** section.



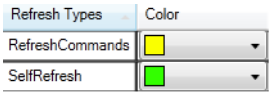
Changing the Colors Used in Graphs

In the top and bottom graphs, two colors are used. Both the graphs show the Refresh commands with one color. The other color is used for self-refresh periods and self-refresh event locations in both the graphs.

The Color Picker Legend displays the currently applied color coding for the graphs.

1 To display the Color Picker Legend, right-click anywhere in the plotted graphs area and select **Show Color Picker Legend**.

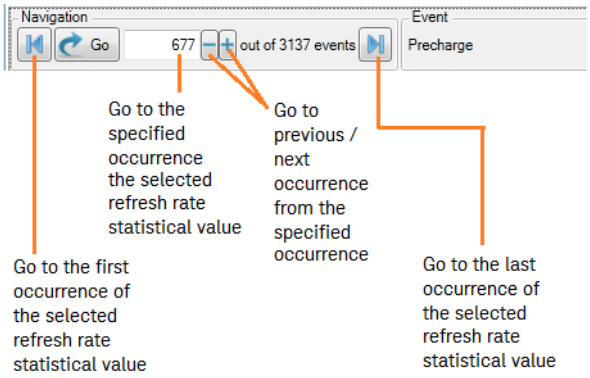
  The currently used color coding for Refresh and Self-Refresh is displayed in the Color Picker Legend.



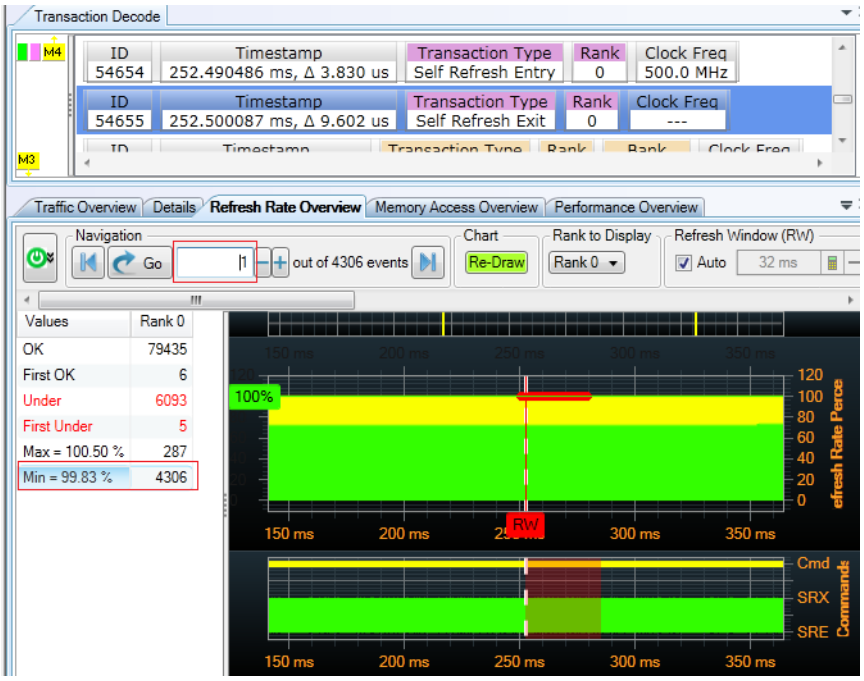
2 To change the color coding, click the **Color** drop-down and select the new color.

Navigating to a Specific Refresh Window in the Graph

You use the Navigation toolbar in the Refresh Rate Overview tab to navigate from a specific refresh rate statistical value to its applicable refresh window in the graphs on the right and its applicable memory transaction in the upper pane.



For instance, in the following screen, there are total 4306 instances of refresh windows for Rank 0 that have the minimum refresh rate percentage. To navigate directly to the 1st instance of such refresh windows in the graphs, you can select the statistical value displayed for Rank 0 in the Min - % row, then type 1 in the Navigation text box and click Go. This takes you directly to the location in the graph applicable for the 1st Refresh window having the minimum percentage of the expected refresh rate. Simultaneously, the Refresh command applicable for this window is also highlighted in the memory transactions listed in the upper pane.



NOTE While using the Navigation Feature, the RW marker can be of great use in clearly highlighting the applicable refresh window in the graph to which you have navigated. If this marker is not visible, you can enable its display by selecting the RW checkbox in the Markers section.

Navigating Through a Graph

To navigate through a graph horizontally, that is X-axis, select the Pan X-axis option displayed at the top of the Refresh Rate Overview charts pane.

To navigate through a graph vertically, that is Y-axis, select the Pan Y-axis option displayed at the top of the Refresh Rate Overview charts pane.

You can then use the mouse to drag the graph's display horizontally/vertically.

9 Viewing Distribution of Read/Write Accesses Across Memory Locations

Overview

The **Memory Access Overview** tab in the Memory Analysis window displays a chart depicting a graphical representation of memory accesses in either of the following two formats (as per your selection).

- The count of memory accesses (Read/Write commands) across memory cells of a selected rank.

  In this chart, a memory cell is represented as a combination of a row (within a bank) and a column. The Y-axis shows bank and row addresses and the X-axis shows column addresses. For a specific memory cell, its access count is based on the read/write commands found in the trace for that memory cell. The access count for memory cells is depicted in the chart using a defined color coding. The chart can help you analyze the general distribution of memory accesses across memory locations and can also pinpoint the locations experiencing maximum hits (Refer to Chart 1 below).

- The count of memory accesses (Read/Write commands) across rows of a selected rank over a period of time.

  This can give you a quick visibility to a row address that is being highly or most frequently accessed at a particular time and can also help you analyze the order in which row addresses were accessed over a period of time. The Y-axis shows bank and row addresses and the X-axis shows time. For a specific row, its access count is shown over a period of time based on the read/write commands found in the trace for that row. The access count for rows is depicted in the chart using a defined color coding (Refer to Chart 2 below).

NOTE

Depending on the X-Axis that you select for the chart, the data representation in the chart changes to either chart 1 or chart 2 shown below. Refer to the topic Changing the X-axis and Y-axis for the Memory Access Chart to know more (See page 50).

Also, you can place Markers in the chart only when you selected Time as the X-Axis of the chart. Markers can only represent Time and therefore when you select Col Addr as the X-axis, there are no Markers available in the chart.

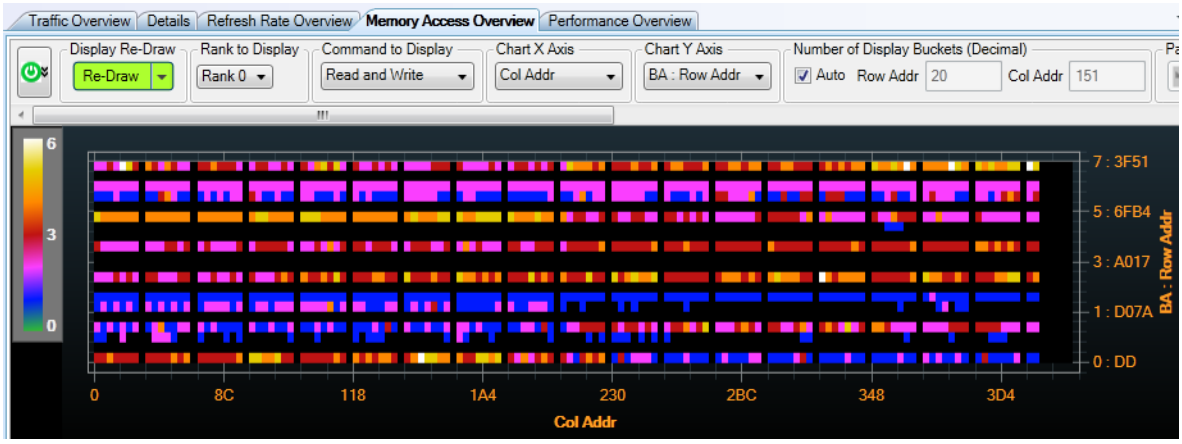


Figure 1 Chart 1 Showing the count of memory accesses across memory cells

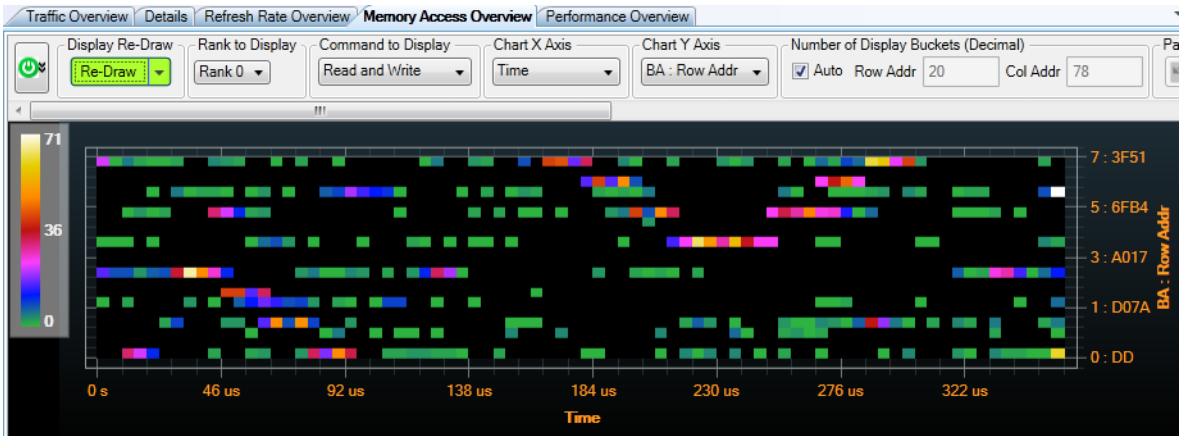
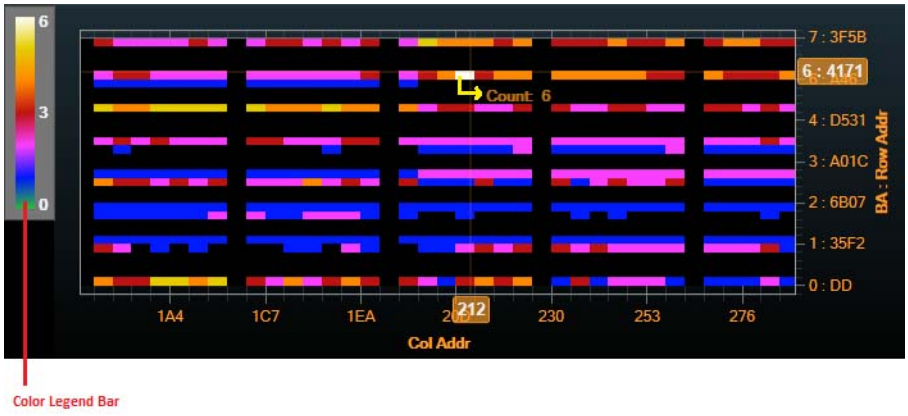


Figure 2 Chart 2 showing the count of memory accesses for rows over a period of time

NOTE Irrespective of the color coding theme that you select for memory access counts, the count of zero is always displayed using the black color.

Viewing the Access Count for a Particular Memory Cell

When you hover the mouse over a plotted memory cell, the row and column applicable for that plotted memory cell in the chart are displayed. If you have enabled the tooltips in the chart, then the count of memory accesses applicable for that memory cell is also displayed. In the following screen, the access count of 6 is shown for the memory cell at the 4171 row in bank 6 and 212 column combination. As per the color legend bar shown in the extreme left of the chart, the count 6 is represented using the White color.



NOTE Though color coding can give you a quick glance of the memory access patterns in the chart, you can also view the exact memory access count for any plotted location in the chart. For this, you can use the memory access count tooltips in the chart. To display these tooltips, select the **Show Tooltip** checkbox in the Memory Access Overview tab.

Viewing the Access Count for a Row at a Specific Time

When you hover the mouse over a plotted memory row, the row and time applicable for that plotted memory area in the chart are displayed. If you have enabled the tooltips in the chart, then the count of memory accesses applicable for that row/time combination is also displayed. In the following screen, the access count of 90 is shown for the 2285 row in bank 7 at 292 us time. As per the color legend bar shown in the extreme left of the chart, the count 90 is represented using the White color.

See Also

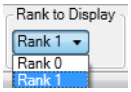
- Placing Markers in a Memory Analysis Chart (See page 67)
- Panning / Zooming a Memory Analysis Chart (See page 69)

Selecting the Rank and Command(s) for which Memory Access Chart is Displayed

To change rank

The chart in the Memory Access Overview tab shows memory accesses for a particular rank.

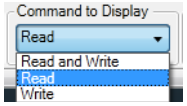
All the applicable memory ranks are displayed in the **Rank to Display** listbox. You can select a rank from this listbox and then click Re-Draw to draw the chart for the changed rank.



To change command

The chart in the Memory Access Overview tab shows memory accesses for Read, Write, or both Read and Write commands.

You can select the command(s) for which you want to plot memory accesses in the chart using the **Command to Display** listbox and then click Re-Draw to draw the chart for the changed command(s).



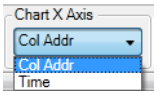
Changing the X-axis and Y-axis for the Memory Access Chart

To change X-axis

By default, the memory access chart has Column address as X-axis and Row Address as Y-axis. This is useful in viewing the count of memory accesses across memory cells.

If, however, you want to view the count of memory accesses for rows over a period of time, then you need to change the X-axis of the chart to Time.

To change the X- axis, use the **Chart X Axis** listbox in the Memory Access Overview tab and then redraw the chart.

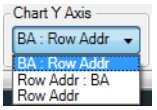


To view how the chart varies on changing the X-axis, refer to Viewing the Distribution of Read/Write Accesses Across Memory Locations (See page 45).

To change Y-axis

The Y-axis always displays row addresses. You can however, change the format in which you want the row addresses to be displayed in the Y-axis.

You choose one of the following three row address formats for Y-axis from the **Chart Y-axis** listbox and then redraw the chart to reflect the change.



- **BA: Row Addr**: Bank number followed by row address
- **Row Addr: BA**: Row address followed by bank address
- **Row Addr**: No bank address is displayed in this option.

Changing the Color Coding Scheme used for Plotting Memory Access Counts

There are three color coding themes available in the Memory Access Overview tab that you can select to represent different memory access counts with different colors.

- **Classic** - The standard color palette is used for the memory access counts.
- **Temperature** - Memory accesses are color-coded on a color scale from cold to hot (blue to red) for lower memory access counts to higher memory access counts.
- **Blue/Red** - Memory accesses are color-coded only in shades of blue and red for lower memory access counts to higher memory access counts.

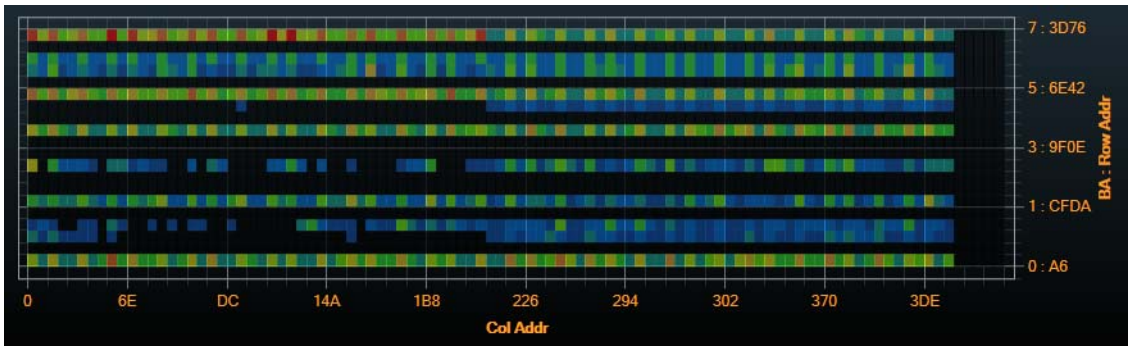
For each of the above-mentioned color coding themes, you can select one of the following color distribution patterns.

- **Linear** - Uses a uniform gradient of colors across the entire range of memory access counts.
- **Logarithmic** - Uses a more elaborate gradient of colors for lower memory access counts.
- **Exponential** - Uses a more elaborate gradient of colors for higher memory access counts.

NOTE Irrespective of the color coding theme that you select for memory access counts, the count of zero is always displayed using the black color.

Viewing the Grid Lines on the Plotted Chart Area

When you want to view the grid lines on the plotted chart area, you can select the **Transparent** checkbox displayed in the **Color Options** section and then re-draw the chart for the grid lines to be visible.



Changing the Number of Display Buckets used in the Chart

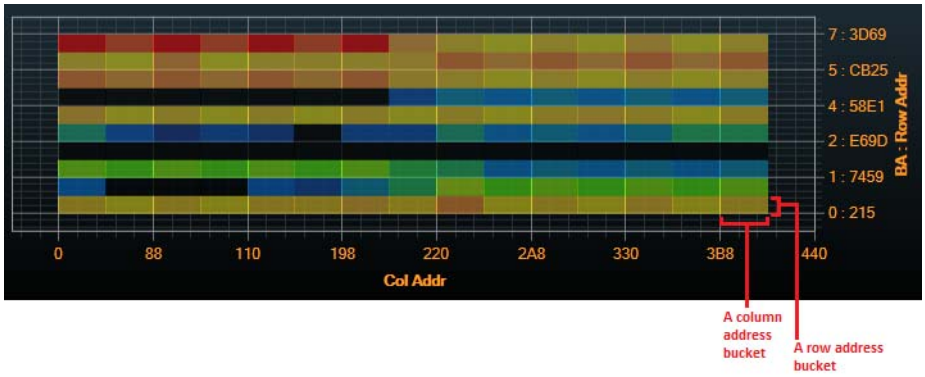
You can customize the number of Row and Column address buckets that should be used in the chart for plotting memory accesses.

The number of Row and Column addresses available in the captured trace may surpass the number of pixels available in the chart for plotting. In such situations, you can define the number of horizontal and vertical buckets to be used in the chart to accommodate plotting for all the applicable row and column addresses.

While creating the chart, all the available row and column addresses to be plotted are spread/contained in the specified number of buckets. For example, if you specify 12 buckets to be used for Row addresses, then the data for all the available row addresses in the trace is organized into 12 equal row address buckets in the chart.

The larger the number of buckets you specify to be used in the chart, the fewer will be the addresses contained in each bucket thereby yielding more granularity but making the plotted data scarce.

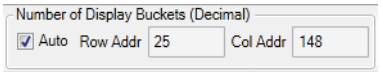
The following screen illustrates an example of 10 row address buckets and 15 column address buckets used in the chart.



Automatically Determining the Number of Display Buckets to be used in the Chart

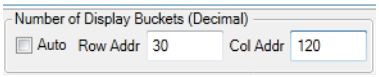
You can select the **Auto** checkbox displayed in the **Number of Display Buckets** section to allow the software to automatically determine the number of row and column address buckets to be used in the chart. When the Auto option is selected, 10 pixels are used for each row and column bucket in the chart.

When the chart is drawn based on the Auto option, the number of display buckets calculated and used in the chart are displayed in the Number of Display Buckets section.



Manually Specifying the Number of Display Buckets to be used in the Chart

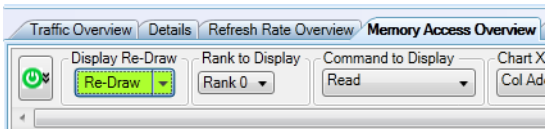
When you deselect the **Auto** checkbox in the **Number of Display Buckets** section, the textboxes for specifying the Row and column address buckets are enabled for editing. You can specify the number of buckets in these textboxes and redraw the chart to reflect the changes.



Redrawing the Memory Access Graph

Once the graph has been generated in the Memory Access Overview tab, you may need to re-draw the graph so that it reflects the current settings and selections that you made in the tab. For instance, changing the rank, x-axis, y-axis, color legend option, or the commands to be displayed in the graph requires you to redraw the graph.

To redraw graphs, click the **Re-Draw** button at the top of the tab.



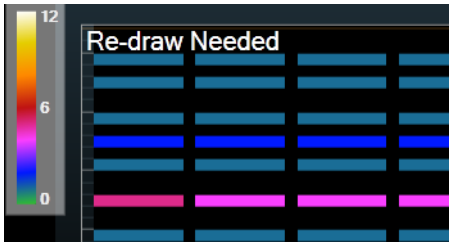
The drop-down displayed with this button provides you two options to redraw:

- **Redraw Current Range** - Redraw Current Range redraws the range of data that is currently displayed. This is particularly useful when, for example, you have selected “Zoom Both Axes” and then zoomed a selected rectangular area of the chart. This makes the buckets bigger. If you then select “Redraw Current Range” it redraws only the range that you zoomed in using the number of currently selected display buckets. This gives you a more detailed, or finer granularity view of the range you zoomed.
- **Redraw Full Range** - Redraw Full Range redraws using the full range of addresses that occur in the trace or the range of the trace that you selected for computing memory data.

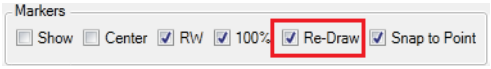
  The “Undo Zoom” and “Redo Zoom” buttons apply only to changes since the last Redraw. You cannot “Undo Zoom” to what you had before the last Redraw.

Showing/Hiding the Re-Draw Indicator

Whenever there is a need for redrawing graphs, the software displays the **Re-Draw Needed** indicator at the top-left corner of the graphs.



The indicator is displayed only if the **Re-Draw** checkbox is selected.



10 Analyzing Memory Performance Measurements

You can use the **Performance Overview** tab in the Memory Analysis window to view and analyze the SDRAM's performance in terms of data transfer rates and percentage of memory utilization over time.

In this tab, various performance measurements are generated from the decoded memory transactions in the upper pane of the Memory Analysis window. Each of these measurements are presented:

- as an overall effective value for a period of time (in the left pane).
- as a chart series showing sampled values for the measurement over the period of time (in the right pane).

To generate these measurements, the captured memory data is sampled as per the specified sampling rate. Statistics is then computed from these samples and the computed measurement for each sample is plotted in the chart series created for that measurement.

By default, a chart series is displayed for each measurement and color coded as per the color selected for that measurement.

If required, you can hide a particular measurement's chart series.

In the following screen, notice the chart types used for graphically presentation of different performance measurements in the Charts pane.

See Also
- Placing Markers in a Memory Analysis Chart (See page 67)
- Panning / Zooming a Memory Analysis Chart (See page 69)

Memory Performance Measurements Definitions

The following table lists the performance measurements available in the **Performance Overview** tab of the Memory Analysis window.

Performance Measurement	Definition	Calculated as...
Total Data Rate	Shows the overall data transfer rate applicable for all the read and write commands in the decoded transactions displayed in the upper pane of the Memory Analysis window.	(Number of Read commands found in trace + Number of Write commands found in trace) * Memory Width (in bytes) times Burst Length / Time between the Timestamp of the first command to the Timestamp of the last command in the decoded transactions This can be represented as: (R + W) * D / T
Read Data Rate	Shows the data transfer rate applicable for all the read commands in the decoded transactions displayed in the upper pane of the Memory Analysis window.	(Number of Read commands found in trace) * Memory Width (in bytes) times Burst Length / Time between the Timestamp of the first command in Transactions to the Timestamp of the last command in the decoded transactions This can be represented as: R * D / T
Read Inst. Data Rate	Shows the instantaneous data transfer rate applicable for a particular read command in the decoded transactions displayed in the upper pane of the Memory Analysis window. For this data rate, the time between the Timestamp of the current instance of the Read command to the Timestamp of the next instance of Read command in the transactions is used. As this measurement aims at the data transfer rate for a specific instance of a read command, an overall effective data rate is not applicable for it. The left pane therefore, does not display any value for this measurement but you can check the instantaneous data rate for each instance of read command in the applicable chart series on the right.	Memory Width (in bytes) times Burst Length / Time between the Timestamp of the current Read command to the Timestamp of the next Read or Write command in the transactions This can be represented as: D / I
Write Data Rate	Shows the data transfer rate applicable for all the write commands in the decoded transactions displayed in the upper pane.	(Number of Write commands found in trace) * Memory Width (in bytes) times Burst Length / Time from the Timestamp of the first command in Transactions to the Timestamp of the last command in the decoded transactions This can be represented as: W * D / T
Write Inst. Data Rate	Shows the instantaneous data transfer rate applicable for a particular write command in the decoded transactions displayed in the upper pane of the Memory Analysis window. For this data rate, the time between the Timestamp of the current instance of the Write command to the Timestamp of the next instance of Write command in the transactions is used. As this measurement aims at the data transfer rate for a specific instance of a write command, an overall effective data rate is not applicable for it. The left pane therefore, does not display any value for this measurement but you can check the instantaneous data rate for each instance of write command in the applicable chart series on the right.	Memory Width (in bytes) times Burst Length / Time between the Timestamp of the current Write command to the Timestamp of the next Read or Write command in the transactions This can be represented as: D / I
Utilization @ <Max clock frequency> (%)	The percentage of memory utilization in read and write commands over the time duration applicable for the decoded transactions. The memory utilization is calculated based on the Clock period. Clock Period is either the maximum clock frequency found in the trace or a clock frequency manually specified by you in the **Maximum Clock Frequency** field at the top of the tab. You should specify a maximum clock frequency value manually if the maximum value is not detected from the trace.	(((Number of Read commands found in trace + Number of Write commands found in trace) * Memory Width (in bytes) times Burst Length) / ((Time between the Timestamp of the first command to the Timestamp of the last command in the decoded transactions / Clock period) * Memory Width in bytes) *100 This can be represented as: ((R + W) * D) / (T / C * M) * 100 (%)

Viewing Instantaneous and Total Data Rates in Memory Performance Charts

For Total Data Rate, Read Data Rate, and Write Data Rate

These are plotted as sampled chart series. Hovering the mouse on a sampled point in the chart highlights the exact time and the data rate (in MBytes/sec) applicable for that sampled point in chart.

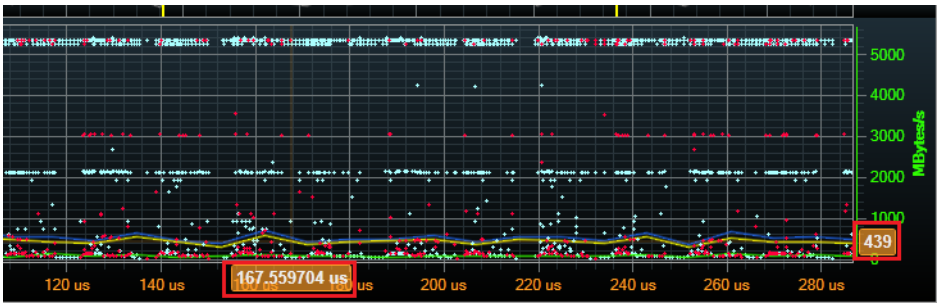


Figure 3 Read Data Rate at a point in time

For Read or Write Instantaneous Data Rates

These are plotted as scatter charts. As these measurements aim at the data transfer rate for a specific instance of read/write command, an overall effective data rate is not applicable for these. The left pane therefore, does not display any value for these measurements. Hovering the mouse on a point in the scatter chart highlights the exact time and instantaneous data rate for that particular instance of read/write command.

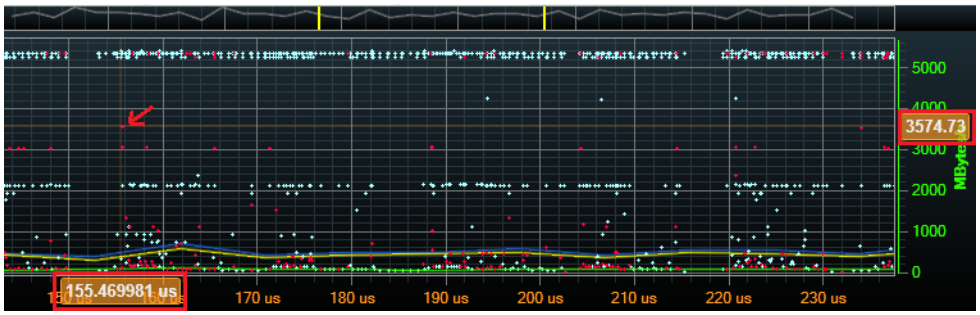


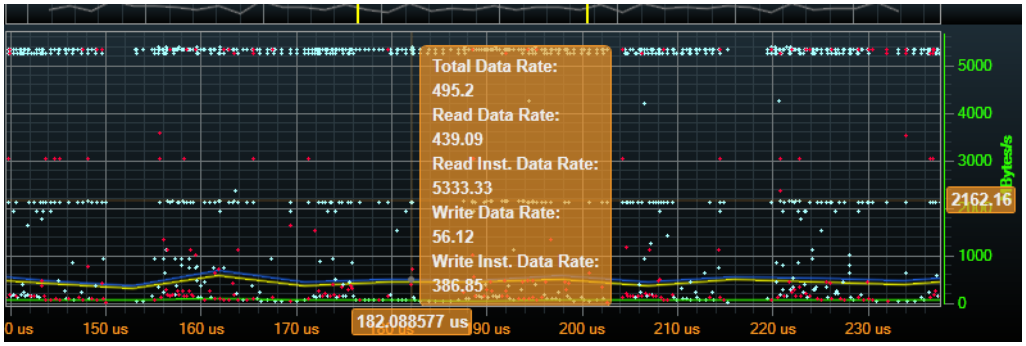
Figure 4 Instantaneous Write Data Rate for an instance of a Write command

Displaying Tooltips in Charts

If you want to view the complete set of data rate measurement values applicable for a particular plotted point in a chart, you can enable the display of tooltips using the **Show Tooltip** checkbox on top of the charts pane.

The data for only those measurements are displayed in tooltips for which charts are displayed.

Notice that all the data rates applicable at the highlighted plotted point in the chart are included in the tooltip.



Changing the Sampling Rate for the Memory Performance Chart

The decoded memory transactions are sampled on the basis of the set sample rate to create memory performance chart series in the Performance Overview tab of the Memory analysis window. Each sample that is computed from the trace is plotted on the chart of that performance measurement.

NOTE **Though sampling is done for all performance measurements, the instantaneous measurements are an exception to sampling. The Read Inst. Data Rate and Write Inst. Data Rate measurements are not sampled. Rather these are computed and plotted as scatter charts for each and every instance of Read and Write commands found in the decoded transactions.**

By default, the sample rate is set to 10 us. You can change this sample rate and can re-sample the trace as per the changed sample rate.

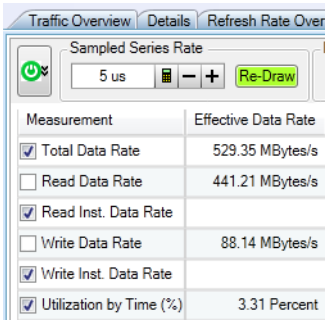
- To change the sample rate for a memory performance chart
  a Access the **Performance Overview** tab.
  b Click the  button displayed in the **Sampled Series Rate** section on the top of the tab.
  c In the **Time** dialog box, specify the value and unit for the sample rate. The permissible range for sample rate is 1 us to 100 ms.
  d Click **OK**.
- To regenerate the chart based on the new sample rate, click the **Re-Draw** button displayed with the **Sampled Series Rate** field at the top of the tab.

Displaying or Hiding Chart Series for a Memory Performance Measurement

By default, a chart is displayed for each performance measurement in the Performance Overview tab of the Memory Analysis window.

In situations, when you want to focus only on specific measurement(s), you can hide the chart series for the other measurements which are currently not of interest.

To hide the chart series of a performance measurement, deselect the checkbox displayed with that measurement in the left pane.



To display the chart series again, select the checkbox for that measurement.

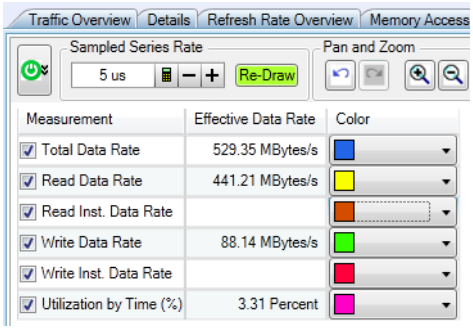
NOTE

You may hide the percent chart area displayed for the Utilization @ <Max clock frequency> % measurement by right-clicking anywhere in the Charts pane and selecting **Hide Percent Chart**.

If the Percent Chart area is hidden, then selecting or deselecting the checkbox displayed with the Utilization @ <Max clock frequency> % measurement does not display or hide its percent chart.

Changing the Color Coding for a Memory Performance Chart

For each performance measurement, the currently assigned color for its charting is displayed in the **Color** listbox. You can change this color and select a new color from the listbox. The color used for its charting is instantly changed as per your new color selection.



11 Analyzing Clock Speed Changes for an SDRAM

You can analyze the clock speed changes for an SDRAM using the **Speed Change Overview** tab in the Memory Analysis window.

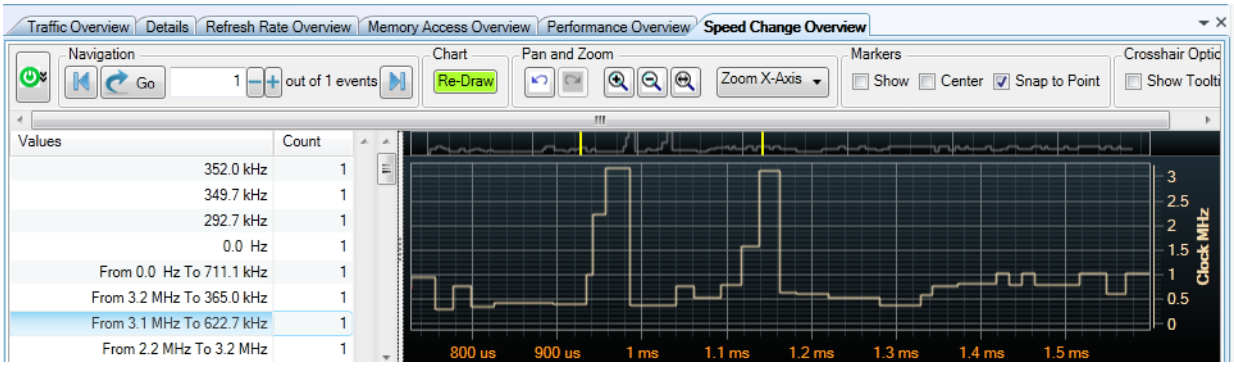
In this tab, the statistics for SDRAM's clock frequencies and frequency changes are detected from the captured trace and displayed as a chart over a period of time.

NOTE

If you have used Store Qualifiers or Filters for the captured data, then all states may not be available in the trace. This may impact the correct calculation of clock frequency and frequency changes in the Speed Change Overview tab.

Also, the Clock Speed Change chart is useful only when you have selected the **Clock Frequency from Trace** checkbox in the Configure DDR Properties dialog box and if there are frequency changes in the trace. In the absence of these two, the Clock Speed Change chart will only be a straight line indicating the same frequency.

The sample screen below shows an SDRAM's clock speed changes over a period of time.



KEYSIGHT TECHNOLOGIES

Left Pane

The left pane in the Speed Change Overview tab displays:

- the values for the clock frequencies found in the captured data.
- the transitions from one clock frequency to another found in the captured data.

For each of these clock frequency values and clock frequency transitions, the number of occurrences found in the trace are displayed under the **Count** column in the left pane.

Right Pane

The right pane in the Speed Change Overview tab displays a chart of entry points to various clock frequencies found in the trace as well as transitions from one clock frequency to another over a period time.

Navigating to an Entry Point or a Transition Point for a Specific Clock Frequency

From a clock frequency value displayed in the left pane, you can navigate quickly to an occurrence in the chart for the entry / transition into that clock frequency value. You use the Navigation bar to accomplish this.

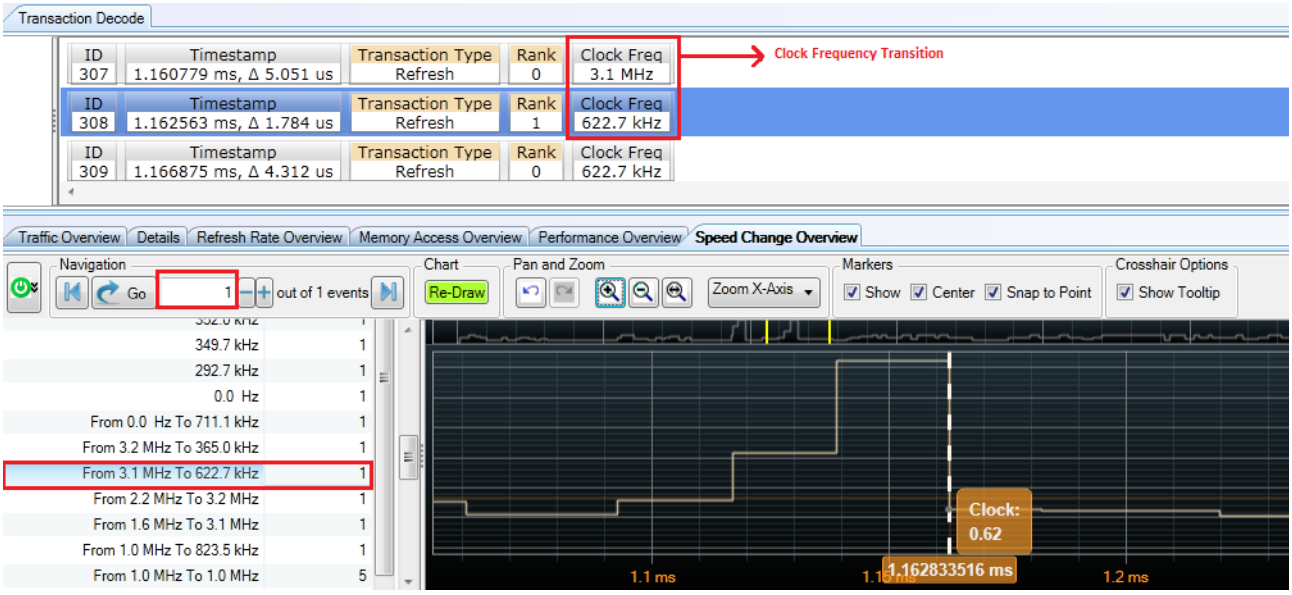
1 Click the clock frequency value or a clock frequency transition from the list in the left pane to which you want to navigate.

2 In the Navigation bar, type the occurrence number for the clock frequency value / transition to which you want to navigate.

3 Click **Go**.

The location in the chart applicable for the specified occurrence of the selected clock frequency / transition is shown in the center of the chart. If you have selected the Center marker, then this exact location is marked using the Center marker making it easy for you to locate it.

Simultaneously, the memory command applicable for this clock frequency entry point / clock frequency transition is also highlighted in the memory transactions listed in the upper pane.



See Also
- Placing Markers in a Memory Analysis Chart (See page 67)
- Panning / Zooming a Memory Analysis Chart (See page 69)

12 Placing Markers in a Memory Analysis Chart

You can place markers in any of the charts displayed in different tabs of the Memory analysis window and use these markers to navigate to the memory transaction associated with the chart location at which you placed a marker. This helps you navigate to the exact trace position that corresponds to that chart location. Markers placed in the chart are correlated to markers displayed in the trace data in the upper pane of the Memory Analysis window.

To place a marker in a memory analysis chart

Double-click the location in the chart at which you want to place a marker. A new marker is added to that chart location as a yellow vertical line and at the corresponding trace location in the upper pane.

Alternatively, right-click the chart location where you want to place a marker. Then select **Place** > **New Marker** or select an existing marker to place that marker at the current location.

To change the position of a marker

You can change the position of a marker by dragging/dropping markers.

1 Hover the mouse over the marker vertical line.

A double arrow will appear indicating that the marker is selected.

2 Left-click to drag and release to drop.

To navigate to a particular marker placed in the chart

In situations when you have placed multiple markers in the chart, you may want to navigate to a particular marker and its associated trace position in the upper pane. To do so, right-click anywhere in the chart, select **Go To** and then select the marker to which you want to navigate.

On doing so, the chart display moves to the point at which the selected marker is located. Also, the trace position corresponding to the selected marker is highlighted in the upper pane.

Using the Center marker

When you use the list in the left pane of a tab to navigate to a particular occurrence of an event in the chart on the right, the chart display moves to the point of the occurrence's location. The location is centered in the chart. To clearly identify the location, you can use the Center marker by selecting the Center checkbox from the top of the Chart pane. This marker is always displayed at the center of the charts display.

NOTE

If the markers are not displayed in a chart, click the **Show** checkbox in the **Markers** section at the top of the chart pane.

In the Memory Access Overview tab, markers are available in a chart only when you selected Time as the X-Axis of the chart. Markers can only represent Time and therefore when you select Col Addr as the X-axis, there are no Markers available in the chart.

13 Panning / Zooming a Memory Analysis Chart

Using the Pan Option to Navigate Through a Memory Analysis Chart

To navigate through a chart horizontally, that is X-axis, select the **Pan X-axis** option from the Pan and Zoom section.

To navigate through a chart horizontally and vertically, that is both axes, select the **Pan Both Axes** option from the Pan and Zoom section.

Zooming a Memory Analysis Chart

You can zoom in or zoom out a defined area in the chart or the complete chart.

To zoom X-Axis for a defined area in the chart

1 Click the **Zoom X-Axis** option from the combo box displayed in the **Pan and Zoom** section of the charts pane to make it active.
2 Move the mouse pointer to the chart location from which you want to begin zooming.
3 Left-click at this location and while keeping the left mouse button pressed, drag the mouse to the chart location till which you want to zoom the display. As you move the mouse, the zooming extent is defined in chart and highlighted with grey.

When you release the left mouse button, the defined X-axis area is zoomed.

Similarly, you can zoom both X and Y axes of the defined area in the chart by selecting the **Zoom Both Axes** option from the combo box displayed in the **Pan and Zoom** section.

NOTE The X-axis zoom applies to all the displayed charts where as the Y-axis zoom (in both axis zoom) applies only to the chart in which you define the area to zoom.

You can also zoom in or zoom out complete charts. To do this, use the following buttons in the **Pan and Zoom** section of the charts pane.

-  - **Zoom In** magnifies the center 50% of the chart to the full width of the chart.
-  - **Zoom Out** doubles the time displayed in the full width of the chart.
-  - **Zoom Out Full** displays the entire range of Computed data across the full width of the chart.

NOTE You can undo and redo zooms by clicking the  and  buttons in the **Pan and Zoom** section of the charts pane.

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