

# ONFi Analysis Window

User Guide

# Notices

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## Manual Part Number

B4661-97004

## Edition

Fifth Edition, April 2022

Available in electronic format only

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## Overview

To analyze the captured NAND Flash memory data, you can use various tabs available in the **ONFi Analysis** window.

### NOTE

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

#### ONFi Analysis Window - An Overview

Using the ONFi Analysis window, you can perform post processing on the captured NAND Flash memory data to evaluate and troubleshoot your NAND Flash memory devices.

In the different tabs and panes of the ONFi Analysis window, you can:

- compute and view decoded ONFi transactions from the captured data.
- analyze the captured NAND Flash memory traffic statistics categorized on the basis of ONFi commands.
- visualize an ONFi operation as a set of logically grouped ONFi commands in a sequence.
- view the payload for an ONFi command.

#### Supported NAND Flash Interfaces and ONFi Specifications

The ONFi Analysis window supports the ONFi 4.0 and 4.1 specifications.

You can analyze the data captured for the following NAND Flash data interfaces.

- NV-DDR2
- NV DDR3
- SDR

#### Broad Steps for Analyzing ONFi Data

- 1 Capture the NAND Flash memory data. Ensure that the captured data meets the requirements for ONFi analysis so that ONFi transactions are computed accurately.
- 2 Add an ONFi Analysis window instance to the logic analyzer setup with captured data in the Logic and Protocol Analyzer GUI.  
You can add an ONFi Analysis window instance to a logic analyzer module such as U4154A/B or U4164A or a data import module. You should NOT attach it to a Filter tool. Filtering can impair some of the memory analysis features if some data such as clock speeds is filtered.
- 3 Configure ONFi properties in the ONFi Analysis window.
- 4 Customize ONFi decode (if needed) using an XML file.
- 5 Compute the decoded NAND Flash memory transactions and traffic analysis chart from the captured data in the ONFi Analysis window.
- 6 Analyze the data presented in the ONFi Analysis window.
- 7 Customize the chart settings and redraw chart, if required in the ONFi Analysis window.

## Data Capture Requirements for ONFi Analysis

When capturing ONFi data for analysis in the ONFi Analysis window, ensure that the following control and data signals are present in this captured data. These signals are needed for the accurate computation of ONFi data in the ONFi Analysis window.

Control Signals	Data signals
CLE	DQ
ALE	DQS
RE_n	
WE_n	
CE_n	

(For systems with multiple targets, the CE\_n bus/signal contains multiple assigned channels – one per target.)

---

## Configuring ONFi Properties

A NAND Flash memory device may have one or more "Chip Enables" enabled. At times, you may be interested in viewing the decoded ONFi transactions for a particular Chip Enable only. Or some of the Chip Enables of the DUT may not be in use.

In such situations, you can configure ONFi properties to ensure that the ONFi transactions are decoded only for the chip enable(s) of your choice. You need to configure ONFi properties before you start computing ONFi transactions from the captured data.

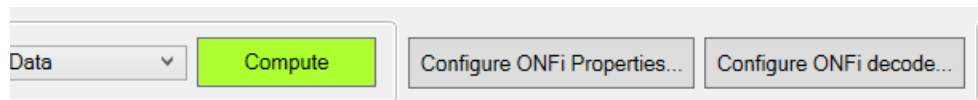
You use the **Configure ONFi Properties** dialog box in the ONFi Analysis window to set up/modify/verify the chip enables for which analysis data is to be computed.

### NOTE

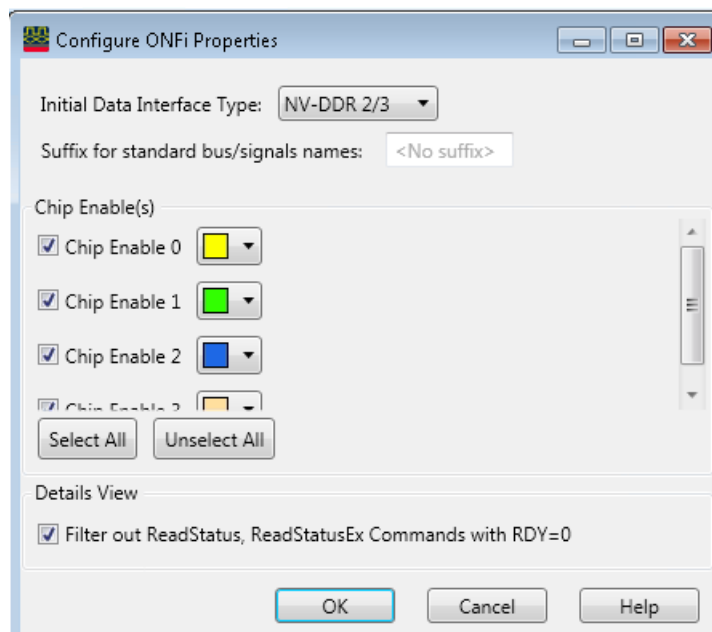
The Chip Enables of the DUT are automatically discovered from the captured data and updated into the Configure ONFi Properties dialog.

To configure ONFi properties

- 1 Click the **Configure ONFi Properties...** button displayed in the ONFi Analysis window's toolbar.



The **Configure ONFi Properties** dialog box is displayed.



- 2 Set the following fields in the dialog box:



Field	Description
Initial Data Interface Type	<p>In the ONFi Analysis window, you can analyze the data captured for the following NAND Flash data interfaces.</p> <ul style="list-style-type: none"> <li>- NV-DDR2</li> <li>- NV DDR3</li> <li>- SDR</li> </ul> <p>This listbox allows you to set the NAND Flash data interface type to be analyzed so that the decoder can use the appropriate decode mode based on this data interface type. This decode mode is the default decode mode set for the decoder. However, if the decoder encounters an ONFi sequence that requires the decode mode other than the default decode mode, the decoder automatically uses the appropriate non-default decode mode.</p> <p>If needed, you can also override the default decode mode for specific OpCode(s) by customizing the ONFi decode. Refer to the &lt;OpCodeModeOverrides&gt; element in the topic "<a href="#">ONFi Decode Customization XML File Structure and Elements</a>" on page 14 to know more.</p>
Suffix for standard bus/signals names	<p>Allows you to specify the suffix that you have used with the standard signal names (labels). Providing the suffix ensures that the decoder looks for this suffix with the signal names and handles only those signals with which this suffix is attached.</p> <p>The suffix usage is optional. However, its usage is needed in situations when you want to capture and analyze data from multiple ONFi buses using a single logic analyzer module. With multiple ONFi buses involved, there is a need to differentiate the signals of an ONFi bus from signals of other ONFi buses using suffixes. To know more about the usage of this suffix, refer to the topic "<a href="#">Capturing and Analyzing Data from Multiple ONFi Buses</a>" on page 10.</p>
Chip Enable	<p>From this section, select the checkboxes for the chip enables for which you want the ONFi transactions and analysis data to be computed. For the transaction decoding to be correct, make sure that the chip enables that are being used in the system must be enabled and unused chip enables must not be enabled.</p> <p>Choose a color for an enabled Chip Enable. The color coding selected for a chip enable is mapped to the color coding used for the corresponding target.</p> <p>This color coding is used in:</p> <ul style="list-style-type: none"> <li>the Target # field of transactions displayed in the upper pane of the ONFi Analysis window.</li> <li>the ONFi command counts plotted for targets in the traffic overview chart.</li> </ul> <p>Changing the color coding in the Configure ONFi Properties dialog box reflects these changes in the Traffic Overview chart color picker legend and vice versa.</p>
Filter Out Read Status and Read Status Enhanced Commands with RDY =0	<p>This checkbox is selected by default.</p> <p>Selecting this checkbox ensures that the software filters out the Read Status and Read Status Enhanced ONFi commands that have the RDY bit set to 0 in their Status Register. The RDY bit set to 0 indicates that the last command issued is still in progress and that another command cannot be accepted. There may be several such commands resulting in clogging your data display. Filtering out such commands can help you focus on the commands that are of significance to you for analysis and debug.</p> <p>These commands are filtered out only from the logically grouped sequential list of commands in the Details tab of the ONFi Analysis window. Filtering out does not filter out these commands from the captured data or from the list of transactions in the upper pane. You can deselect this checkbox to bring these commands back into the Details tab data.</p> <p>This filtering does not filter out the Read Status and Read Status Enhanced ONFi commands that have the RDY bit set to 1 in their Status Register (indicating that another command can be accepted).</p>

Traffic Overview Details Payload View				
ID	Transaction ID	Transaction	Timestamp	Delta Time
0	8	Page Program Multi-plane	63.826 us	0 s
1	9	Change Write Column	90.902 us	27.076 us
2	10	Change Write Column	92.830 us	1.928 us
3	11	Change Write Column	94.676 us	1.846 us
4	12	Change Write Column	119.388 us	24.713 us
5	13	Change Write Column	121.317 us	1.928 us
6	15	Read Status	123.872 us	2.555 us
7	16	Read Status	124.838 us	966 ns
8	17	Read Status	125.804 us	966 ns
9	18	Read Status	126.770 us	966 ns

With Filtering Off

Traffic Overview Details Payload View		
ID	Transaction ID	Transaction
0	8	Page Program Multi-plane
1	9	Change Write Column
2	10	Change Write Column
3	11	Change Write Column
4	12	Change Write Column
5	13	Change Write Column
209	218	Read Status

With Filtering On

## Capturing and Analyzing Data from Multiple ONFi Buses

To capture and analyze data from a single ONFi bus

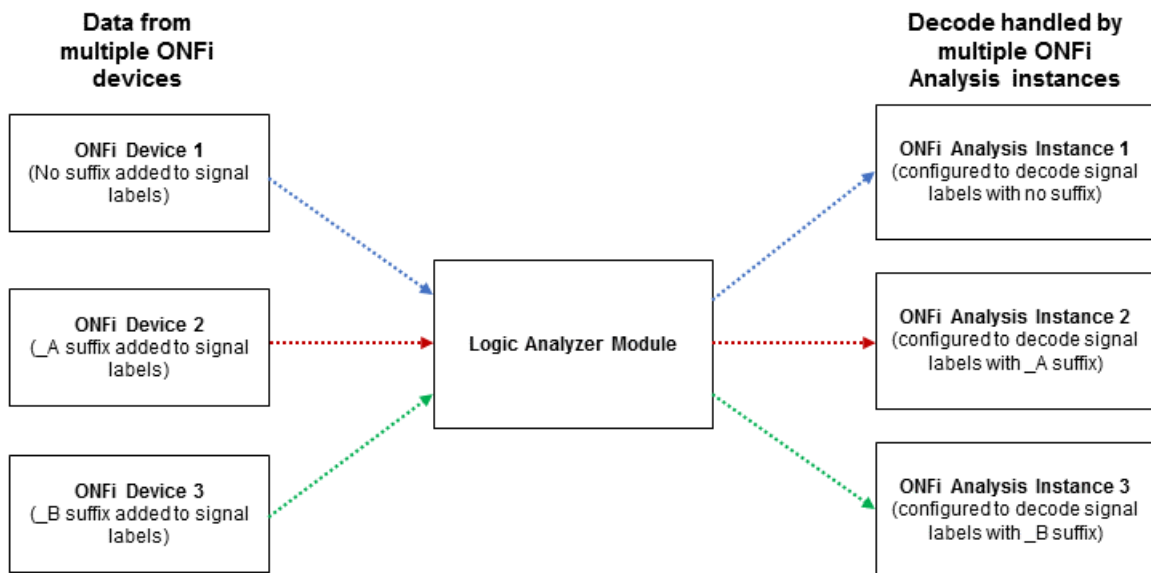
In the Logic and Protocol Analyzer GUI, add a single instance of the ONFi Analysis window to your logic analyzer module.

To capture and analyze data from multiple ONFi buses using a single logic analyzer module

In the Logic and Protocol Analyzer GUI:

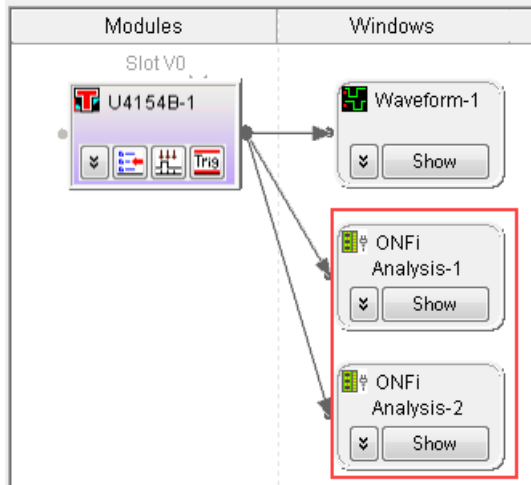
- Add multiple instances of the ONFi Analysis window to your logic analyzer module. Each of these instances will be independently used for decoding data from an ONFi bus.
- As a single logic analyzer module is being used to capture and analyze data from multiple ONFi buses, you need to differentiate the signals of an ONFi bus from signals of other ONFi buses. To do this, you need to add a unique suffix to the signal labels of each of these ONFi buses.
- Then you need to configure each of the added ONFi Analysis instances to use the appropriate suffixes. This ensures that an ONFi Analysis instance is mapped to a single ONFi bus and decodes the data relevant to that ONFi bus only.

The following picture illustrates the decoding of three ONFi buses using a single logic analyzer module.



Example

In the following example, two ONFi Analysis instances have been added to decode two ONFi buses using a logic analyzer module.



The signal names of the two ONFi buses have been differentiated by adding no suffix to the signal names of first ONFi bus and adding `_B` suffix to the signal names of the second ONFi bus.

Buses/Signals | File Information

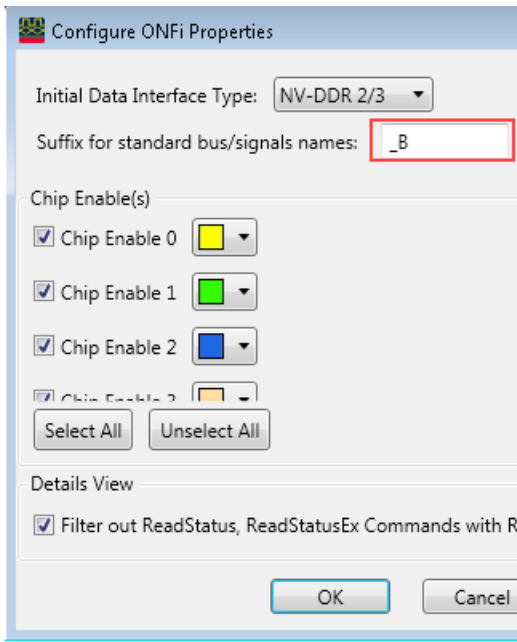
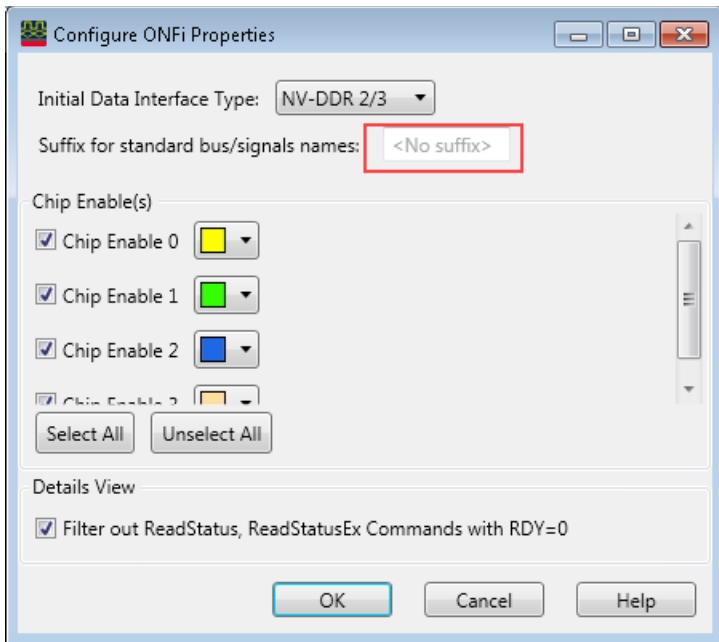
Enter buses and signals and the channels they correspond to:

Bus/Signal Name	Channels Assigned	Width	Channels																								
			C	A	W	R	DQ								D	CE_n			C	A	W	R	DQ				
			0	0	0	0	7	6	5	4	3	2	1	0	0	3	2	1	0	0	0	0	0	7	6	5	4
<input checked="" type="checkbox"/> CLE	CLE[0]	1	✓																								
<input checked="" type="checkbox"/> ALE	ALE[0]	1	✓																								
<input checked="" type="checkbox"/> WE_n	WE_n[0]	1		✓																							
<input checked="" type="checkbox"/> RE_n	RE_n[0]	1			✓																						
<input checked="" type="checkbox"/> DQ	DQ[7:0]	8				✓	✓	✓	✓	✓	✓	✓	✓	✓													
<input checked="" type="checkbox"/> DQS	DQS[0]	1													✓												
<input checked="" type="checkbox"/> CE_n	CE_n[3:0]	4													✓	✓	✓	✓									
<input checked="" type="checkbox"/> CLE_B	CLE_B[0]	1																		✓							
<input checked="" type="checkbox"/> ALE_B	ALE_B[0]	1																			✓						
<input checked="" type="checkbox"/> WE_n_B	WE_n_B[0]	1																				✓					
<input checked="" type="checkbox"/> RE_n_B	RE_n_B[0]	1																					✓				
<input checked="" type="checkbox"/> DQ_B	DQ_B[7:0]	8																					✓	✓	✓	✓	
<input checked="" type="checkbox"/> DQS_B	DQS_B[0]	1																									
<input checked="" type="checkbox"/> CE_n_B	CE_n_B[3:0]	4																									
<input checked="" type="checkbox"/> ONFiToolUseO...	CE_n[3:0], D	17	0	1	3	2	1	1	9	8	7	6	5	4	1	1	1	1	1								
<input checked="" type="checkbox"/> ONFiToolUseOn	CE_n_B[3:0],	17																		0	1	3	2	1	1	9	

No suffix added to the signal names of first ONFi bus

`_B` suffix added to the signal names of second ONFi bus

The properties of the two ONFi Analysis instances have been configured to use the appropriate suffix to allow the decode of signals of a specific ONFi bus only.



## Customizing ONFi Decode

You can customize how the ONFi data is decoded for display in the ONFi Analysis window by specifying the available customization options in an xml data file.

The format for this file should be as per the format provided in the topic [“ONFi Decode Customization XML File Structure and Elements”](#) on page 14. You may also refer to an example of this xml file included in the topic [“ONFi Decode Customization XML File - Example”](#) on page 25.

The ONFi decode customizations that you specify in the XML file allow you to instruct how the decoder should interpret the sequences of commands and addresses and the address space definition as per your specific requirements. The customization options available for ONFi decode are as follows:

Customization	Description
Commands customization	<p>Allows you to include your customizations to commands and sequences so that the decoder can recognize these custom sequences and can accurately interpret and present these in the Viewer. These can be:</p> <ul style="list-style-type: none"> <li>Variations to existing Read and Page Program ONFi commands</li> <li>Completely new command sequences (vendor-defined or reserved OpCodes.)</li> <li>Overriding the default decode mode for specific OpCodes</li> <li>Modifications to the Change Read Column command</li> </ul>
Address Space customization	<p>Allows you to include your own unique address mapping information for specific memory parts that may define address space differently from the standard address mapping. By doing so, you can display the address information in the format that your device specifies.</p>
LUN Indexing Customization	<p>Allows you to index ONFi commands in the Traffic Overview tab by targets and Logical Units (LUNs) combination. By default, the commands are indexed by targets only in the Traffic Overview tab. Once you enable LUN indexing, targets are used as primary indexing criterion and within these targets, LUNs are used as secondary indexing criterion.</p>

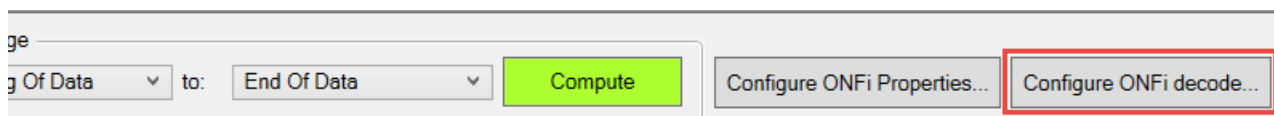
The XML elements used for these customizations are described in detail in the XML file topic that follows this topic.

### NOTE

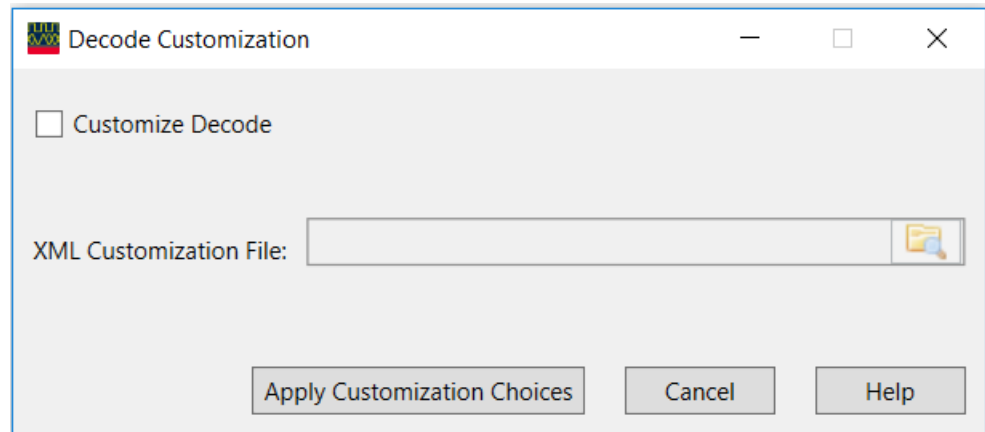
You need to apply the customization options for the ONFi decode before you start computing ONFi transactions from the captured data.

#### To customize ONFi decode

- 1 Click the **Configure ONFi Decode...** button displayed in the ONFi Analysis window's toolbar.



The **Decode Customization** dialog box is displayed.



- 2 Select the **Customize Decode** check box.
- 3 Click the **Browse** button displayed with the XML Customization File field and browse to the location where you have stored the XML file that you want to use for ONFi decode customization.
- 4 Select the XML file and click **Open**.
- 5 Click the **Apply Customization Choices** button.
- 6 Recompute the ONFi decode for the customizations to be applied to the decode.

**To remove customization from the ONFi decode**

- 1 In the Decode Customization dialog box, deselect the **Customize Decode** check box and then click the **Apply Customization Choices** button.
- 2 Recompute the ONFi decode to remove customizations from the decode.

ONFi Decode Customization XML File Structure and Elements

You can create/edit the XML file for customizing ONFi decode using any text editor. This topic describes the format and hierarchy of the XML elements to be followed for this XML file.

(Refer to [“ONFi Decode Customization XML File - Example”](#) on page 25 to get an example of an XML file in the required format.)

XML Elements Hierarchy

```

<ONFiOptions>
  <AddressDefinitions>
    <AddressDefinition>
      <Segment>
        <Bits/>
        <FixedBits/>
      </AddressDefinition>
    </AddressDefinitions>
  <DecoderOptions>
    <CustomSequences>
      <Sequence>
        <MatchCmdValue/>
        <MatchAddrLen/>
        <MatchDataInLen/>
      </Sequence>
    </CustomSequences>
  </DecoderOptions>
</ONFiOptions>

```

```

        <MatchDataOutLen/>
    <CommandSpecificOptions>
        <PageProgramCmdOptions>
            <OpCodesToIgnore>
                <OpCode/>
            <ReadCmdOptions>
                <OpCodesToIgnore>
                    <OpCode/>
        <CommandModifications>
            <ChangeReadColumn>
            <ChangeReadColumnEnhanced>
            <Read>
            <PageProgram>
            <BlockErase>
        <OpCodeModeOverrides>
            <SDROpCodes>
                <OpCode/>
            <DDROpCodes>
                <OpCode/>
    <LUNOptions>
        <LUNAlias/>
        <LUNIndexing/>
        <LUNAddressCommands>
            <LUNAddressCommand/>

```

These XML elements are described in detail in the table below.

#### XML Elements Description

XML Element	Description	Children	Parent	Attributes
<ONFiOptions>	The ONFi decode customization XML file begins with the <ONFiOptions> element.	<AddressDefinitions> <DecoderOptions> <LUNOptions>	-	-
<AddressDefinitions>	Allows you to define a set of one or more customized formats for the address information.	<AddressDefinition>	<ONFiOptions>	-
<AddressDefinition>	Allows you to define customized format of the address segment(s) for commands with the specified length of address bytes.	<Segment>	<AddressDefinitions> >	<b>AppliesToAddrLen</b> - Indicates the length of address, in bytes. The decoder applies the customized address segments format to the commands that have the specified address bytes length. Valid values: 1, 2, 3, 5, 6  Example <AddressDefinition AppliesToAddrLen="5">
<Segment>	Allows you to define the customized format for an address segment such as a block address, page address, LUN address, or an offset. This customized address format can be based on the: <ul style="list-style-type: none"> <li>specified start and end bits from the packet data (using the &lt;Bits/&gt; element)</li> <li>specified fixed value bits of a specified length (using the &lt;FixedBits/&gt; element)</li> </ul>	<Bits/> <FixedBts/>	<AddressDefinition>	<b>DecodeText</b> - The customized name with which you want the address segment to be displayed in the ONFi decode. Valid value: String  Example <Segment DecodeText="Block Address">



XML Element	Description	Children	Parent	Attributes
<Bits/>	<p>Allows you to define the start and end bits from a specific address byte that the decoder should use for the specific address segment.</p> <p>You can also use multiple &lt;Bits/&gt; elements to define the start and end bits that comprise an address segment.</p>	-	<Segment>	<p><b>ByteIndex</b> - Indicates the index of address bytes. The byte index values start with Zero. So, 0 is considered the first address byte and so on.</p> <p><b>StartBit</b> - The bit in the specific address byte that should be used as the starting point for an address segment. The value for this attribute starts with Zero. Therefore, 0 is considered the first bit in the address byte.</p> <p><b>EndBit</b> - The bit in the specific address byte that should be used as the ending point for an address segment. The value for this attribute starts with Zero. The value is inclusive which means that the end bit is also included in the address segment format.</p> <p><b>Examples</b>  &lt;Bits ByteIndex="4" StartBit="0" EndBit="4"/&gt;  (The bits 0-4 of the address byte at the 4th index value are shown as address in the decoded results.)</p> <Bits ByteIndex="0" StartBit="0" EndBit="7" /> (The bits 0-7 of the first address byte are shown as address in the decoded results. In this example, if the address contains just one byte, then the decoder will show this entire byte in the decoded results.)
<FixedBits/>	<p>Allows you to define a fixed value with which you want the decoder to replace the bits marked as "Fixed" in the address bytes. You also need to specify the number of these bits that should be replaced in the address bytes.</p> <p>You can also use a &lt;FixedBits/&gt; element along with &lt;Bits/&gt; elements to define the address format for an address segment. This combination allows you to define the address format based on actual address bits as well as a specified fixed value.</p>	-	<Segment>	<p><b>Value</b> - A 1 bit value with which you want the decoder to replace the bits marked as "Fixed" in the address bytes. Valid values: 0 or 1</p> <p><b>Length</b> - The number of fixed value bits that you want the decoder to replace in the address bytes.</p> <p><b>Example</b>  &lt;FixedBits Value="0" Length="2"/&gt;</p>

XML Element	Description	Children	Parent	Attributes
<DecoderOptions>	<p>Use this element to define a set of one or more customized command and address sequences. These customizations can be:</p> <ul style="list-style-type: none"> <li>Variations to Read and Page Program ONFi commands using the &lt;CommandSpecificOptions&gt; child element</li> <li>Completely new (vendor-defined or reserved OpCodes) command sequences using the &lt;CustomSequences&gt; child element. On encountering a defined custom sequence in the ONFi data, the decoder decodes and presents it as a single packet entry with the customized name and color.</li> <li>Modifications to the number of address bytes expected for the Change Read Column command using the &lt;CommandModifications&gt; child element)</li> <li>Overriding the default decode mode setting for specified OpCode(s) using the &lt;OpCodeModeOverrides&gt; child element</li> </ul>	<CustomSequences> <CommandSpecificOptions> <CommandModifications> <OpCodeModeOverrides>	<ONFiOptions>	-
<CustomSequences>	Use this element to define new custom sequence(s) for the decoder. This is for vendor-specific or reserved OpCodes.	<Sequence>	<DecoderOptions>	-

XML Element	Description	Children	Parent	Attributes
<Sequence>	<p>Defines a custom sequence for the decoder.</p> <p>For a custom sequence, you specify a value in the StartOpCode attribute of this element. When the decoder encounters a command matching this value, it starts the matching process for this custom sequence based on the matching condition that you specified using a child element for this sequence. This matching condition can be:</p> <ul style="list-style-type: none"> <li>▪ A command</li> <li>▪ An address type</li> <li>▪ Length for a Data-In or Data-Out type</li> </ul> <p>If a match for this condition is found in the ONFi data, the decoder applies the customizations (name and color) that you specified in this custom sequence and presents the sequence as a single packet.</p> <p>You can control whether or not the custom sequence should completely replace the standard definition of the OpCode in the decode. You do this using the MergeMatchingStartOpcode attribute.</p>	<MatchCmdValue> <MatchAddrLen> <MatchDataInLen> <MatchDataOutLen>	<CustomSequences>	<p><b>DecodeText:</b> The customized name with which you want the custom sequence packet to be displayed in the ONFi decode. Valid value: String</p> <p><b>MergeMatchingStartOpcode:</b> Indicates whether or not you want the custom definition to completely replace the standard definition of the OpCode. If you specify True for this attribute, the standard and custom definitions of the OpCode can co-exist and both are appropriately decoded by the decoder.  Valid values: True / False</p> <p><b>StartOpCode:</b> The start OpCode of a command on encountering which the decoder starts the matching for the sequence.</p> <p><b>Color:</b> The color that you want to use for displaying the custom sequence packet in the ONFi decode.</p> <p><b>IsLUNLevel:</b> By default, a custom sequence is assumed to be a target-level command. You can use the optional IsLUNLevel attribute to indicate that the custom sequence should be considered as an LUN-level command sequence. As a result, the decoder indexes this custom command according to the currently selected LUN. Valid values: True / False</p> <p><b>Examples</b></p> <pre>&lt;Sequence DecodeText="Short1" MergeMatchingStartOpcode="False" StartOpCode="DA" Color="0000FF"/&gt;</pre> <p><i>A custom sequence to completely replace the standard definition of the 0XDA OpCode with this customized definition.</i></p> <pre>&lt;Sequence DecodeText="ShortAddr" MergeMatchingStartOpcode="True" StartOpCode="00" Color="0000FF"/&gt; &lt;MatchAddrLen Length="1"/&gt;</pre> <p><i>A custom sequence to allow the co-existence of the standard definition of the 0X00 OpCode as well as this customized definition for the 0X00 OpCode in the decode. Both standard and custom command will then appear in the decode.</i></p>

XML Element	Description	Children	Parent	Attributes
<MatchCmdValue/>	Used for defining a command with a specific value. The decoder uses this value as the matching condition for a custom sequence.	-	<Sequence>	<b>Value:</b> Indicates a command that you want the decoder to use as the matching condition for a custom sequence.  Example <MatchCmdValue Value="62"/>
<MatchAddrLen/>	Used for defining an address type with a specific length. The decoder uses this length as the matching condition for a custom sequence.	-	<Sequence>	<b>Length:</b> Indicates the length of an address type that you want the decoder to use as the matching condition for a custom sequence.
<MatchDataInLen/>	Matches Data-In type with the length that you specified in the 'Length' attribute.	-	<Sequence>	<b>Length:</b> Indicates the length of a Data-In type that you want the decoder to use as the matching condition for a custom sequence.  A value of -1 indicates, matching any length.
<MatchDataOutLen/>	Matches Data-Out type with the length that you specified in the 'Length' attribute.	-	<Sequence>	<b>Length:</b> Indicates the length of a Data-Out type that you want the decoder to use as the matching condition for a custom sequence.  A value of -1 indicates, matching any length.
<CommandSpecificOptions>	Use this element to define one or more custom sequences that are variations on the existing Read and Page Program ONFi commands.  To define a variation, you can instruct the decoder to replace the start OpCode or the end OpCode or both start and end OpCodes of the relevant command with the specified OpCode(s).  The decoder then applies the customizations (name, color, and OpCode(s)) that you specified in this custom sequence and presents the sequence as a single packet.	<PageProgramCmdOptions> <ReadCmdOptions>	<DecoderOptions->	-

XML Element	Description	Children	Parent	Attributes
<PageProgramCmdOptions>	Use this element to define a vendor-specific variation of the Page Program ONFi command.	<OpsCodesToIgnore>	<CommandSpecificOptions>	<p><b>DecodeText:</b> The customized name with which you want the custom sequence packet to be displayed in the ONFi decode. Valid value: String</p> <p><b>Color:</b> The color that you want to use for displaying the custom sequence packet in the ONFi decode.</p> <p><b>ReplaceStartOpCode</b> - Indicates whether or not you want the decoder to replace the start OpCode of the custom Page Program command. Valid values: True, False</p> <p><b>StartOpCode:</b> The OpCode with which you want the decode to replace the start OpCode of the custom Page Program command. This is done only if the ReplaceStartOpCode is set to True. If ReplaceStartOpCode is set to False, then set the StartOpCode to the default value "00" so that an XML error is not generated for leaving it blank.</p> <p><b>ReplaceEndOpCode</b> - - Indicates whether or not you want the decoder to replace the end OpCode of the custom Page Program command. Valid values: True, False</p> <p><b>EndOpCode:</b> The OpCode with which you want the decode to replace the end OpCode of the custom Page Program command. This is done only if the ReplaceEndOpCode is set to True. If ReplaceEndOpCode is set to False, then set the EndOpCode to the default value "00" so that an XML error is not generated for leaving it blank.</p> <p>Example  <pre>&lt;PageProgramCmdOptions DecodeText="Fast Write" Color="7FFF8E" ReplaceStartOpCode="False" StartOpCode="00" ReplaceEndOpCode="True" EndOpCode="C0"&gt;</pre></p>

XML Element	Description	Children	Parent	Attributes
<ReadCmdOptions>	Use this element to define a vendor-specific variation of the Read ONFi command.	<OpCodesToIgnore>	<CommandSpecificOptions>	<p><b>DecodeText:</b> The customized name with which you want the custom sequence packet to be displayed in the ONFi decode. Valid value: String</p> <p><b>Color:</b> The color that you want to use for displaying the custom sequence packet in the ONFi decode.</p> <p><b>ReplaceStartOpCode</b> - Indicates whether or not you want the decoder to replace the start OpCode of the custom Read command. Valid values: True, False</p> <p><b>StartOpCode:</b> The OpCode with which you want the decode to replace the start OpCode of the custom Read command. This is done only if the ReplaceStartOpCode is set to True. If ReplaceStartOpCode is set to False, then set the StartOpCode to the default value "00" so that an XML error is not generated for leaving it blank.</p> <p><b>ReplaceEndOpCode</b> - - Indicates whether or not you want the decoder to replace the end opcode of the custom Read command. Valid values: True, False</p> <p><b>EndOpCode:</b> The opcode with which you want the decode to replace the end opcode of the custom Read command. This is done only if the ReplaceEndOpCode is set to True. If ReplaceEndOpCode is set to False, then set the EndOpCode to the default value "00" so that an XML error is not generated for leaving it blank.</p> <p>Example                      &lt;ReadCmdOptions DecodeText="Fast Read" Color="FFD800" ReplaceStartOpCode="False" StartOpCode="00" ReplaceEndOpCode="True" EndOpCode="50"&gt;</p>
<OpCodesToIgnore>	Use this element to create a list of OpCodes that you want the decoder to ignore for a custom sequence. This list ensures that on encountering any of the opcodes from this list, the decoder interprets the sequence to be still in continuation and does not consider the sequence as complete.	<OpCode>	<PageProgramCmdOptions> <ReadCmdOptions>	-
<OpCode>	A specific OpCode that you want the decoder to ignore for a custom sequence.	-	<OpCodesToIgnore>	-

XML Element	Description	Children	Parent	Attributes
<CommandModifications>	Use this element to specify modifications to the specific ONFI commands such as the <i>Change Read Column</i> command.	<ChangeReadColumn> <ChangeReadColumnEnhanced> <Read> <PageProgram> <BlockErase>	<DecoderOptions>	-
<ChangeReadColumn/>	Use this element to override the number of address bytes expected for the Change Read Column command. As per the ONFI specifications, three address bytes are expected for the Change Read Column command. If the decoder encounters any number of address bytes other than three, it reports this as an error. However, if needed, you can override this default behavior and specify the number of address bytes that you want the decoder to expect for the Change Read Column command.	-	<CommandModifications>	AddressLength - The number of address bytes that the decoder should expect for the Change Read Column command.  Example <ChangeReadColumn AddressLength="5" />
<ChangeReadColumnEnhanced/>	Use this element to customize the number of address bytes expected for the Change Read Column Enhanced command. By default, the decoder expects the command's address length to match the length as per the ONFI specifications. However, if needed, you can override this default behavior and specify the number of address bytes that you want the decoder to expect for the Change Read Column Enhanced command.	-	<CommandModifications>	AddressLength - The number of address bytes that the decoder should expect for the Change Read Column Enhanced command.  Example <ChangeReadColumnEnhanced AddressLength="5" />
<Read/>	Use this element to customize the number of address bytes expected for the Read command. By default, the decoder expects the command's address length to match the length as per the ONFI specifications. However, if needed, you can override this default behavior and specify the number of address bytes that you want the decoder to expect for the Read command.	-	<CommandModifications>	AddressLength - The number of address bytes that the decoder should expect for the Read command.  Example <Read AddressLength="5" />
<PageProgram/>	Use this element to customize the number of address bytes expected for the PageProgram command. By default, the decoder expects the command's address length to match the length as per the ONFI specifications. However, if needed, you can override this default behavior and specify the number of address bytes that you want the decoder to expect for the PageProgram command.	-	<CommandModifications>	AddressLength - The number of address bytes that the decoder should expect for the PageProgram command.  Example <PageProgram AddressLength="5" />

XML Element	Description	Children	Parent	Attributes
<BlockErase/>	Use this element to customize the number of address bytes expected for the BlockErase command. By default, the decoder expects the command's address length to match the length as per the ONFi specifications. However, if needed, you can override this default behavior and specify the number of address bytes that you want the decoder to expect for the BlockErase command.	-	<CommandModificat ions>	AddressLength - The number of address bytes that the decoder should expect for the BlockErase command.  Example <BlockErase AddressLength="5" />
<OpCodeModeOverrid es>	Use this element to specify OpCode(s) for which you want the decoder to use the specified decode mode overriding the currently set default decode mode.  On encountering any of the specified OpCodes in a command sequence, the decoder decodes that entire command sequence in the specified decode mode regardless of the default decode mode that you set for decoder.  Note that the entire command sequence in which one of the specified OpCodes is found and any data associated with that sequence is decoded in the specified mode.	<SDROpCodes> <DDROpCodes>	<DecoderOptions>	-
<SDROpCodes>	Use this element to create a list of OpCodes for which you want the decoder to use the SDR decode mode regardless of the default decode mode that you set for decoder.	<OpCode>	<OpCodeModeOverri des>	-
<DDROpCodes>	Use this element to create a list of OpCodes for which you want the decoder to use the DDR2/3 decode mode regardless of the default decode mode that you set for decoder.	<OpCode>	<OpCodeModeOverri des>	-
<OpCode>	Use this element to specify an OpCode for which you want the decoder to override the default decode mode and instead use the specified (SDR or DDR2/3) decode mode. If this element is used as a sub-element of the <DDROpCodes> element, then DDR2/3 is used as the decode mode for that OpCode. If this element is used as a sub-element of the <SDROpCodes> element, then SDR is used as the decode mode for that OpCode.	-	<SDROpCodes> <DDROpCodes>	Example <SDROpCodes> <OpCode>07</OpCode> <OpCode>0C</OpCode> </SDROpCodes> (On detecting the OpCodes 0x07 or 0x0C, the decoder switches to the SDR mode to decode the entire command sequence in which these OpCodes are present.)
<LUNOptions>	Allows you to define the customization options available for indexing the ONFI commands by targets and logical units (LUNs) in the Traffic Overview tab. By default, the commands are indexed by targets only in the Traffic Overview tab.	<LUNAlias> <LUNIndexing> <LUNAAddressComma nds>	<ONFIOptions>	-



XML Element	Description	Children	Parent	Attributes
	<p><b>NOTE:</b> For the LUN indexing related customizations to work, you must define the format of the LUN address segment for commands with the length of address bytes as 3 and 5. The decoder uses this information to correctly decode the LUN address for these commands.</p> <p>Example:</p> <pre>&lt;AddressDefinition AppliesToAddrLen="5"&gt;   &lt;Segment DecodeText="LUN Address"&gt;     &lt;Bits ByteIndex="4" StartBit="5" EndBit="7"/&gt;   &lt;/Segment&gt;</pre>			
<LUNAlias>	An optional element to specify a string that you want the decoder to use instead of "LUN" in the ONFI decode.	-	<LUNOptions>	Example: <LUNAlias>Chip</LUNAlias>
<LUNIndexing>	Allows you to enable/disable the LUN level indexing of ONFI commands in the Traffic Overview tab of the ONFI Analysis window. By default, the indexing is according to targets only. Once you enable LUN indexing, targets are used as primary indexing criterion and within these targets, LUNs are used as secondary indexing criterion.	-	<LUNOptions>	-
<LUNAddressCommands>	Allows you to define one or more vendor-specific commands that select an LUN.	<LUNAddressCommand>	<LUNOptions>	-
<LUNAddressCommand>	Allows you to specify the Opcode and selected LUN for a vendor-specific command.	-	<LUNAddressCommands>	<p>AddressValue - The LUN that the vendor-specific command selects.</p> <p>OpCode - The OpCode of the vendor-specific command that selects an LUN.</p> <p>Example</p> <pre>&lt;LUNAddressCommand AddressValue="0" OpCode="41"/&gt;</pre>

ONFI Decode Customization XML File - Example

This topic includes an example of the XML file created in the required format to customize the ONFI decode. To get a description of each XML element used in this example file, refer to the topic "ONFI Decode Customization XML File Structure and Elements" on page 14.

Sample screens of the ONFI decode computed with and without applying the customization choices included in the XML file are displayed below.

ID	Timestamp	Transaction Type	Target#	Data Interface	OpCode	Row Address		
0	0 s, Δ 0 s	Block Erase Multi-plane (JEDEC)	0	NV-DDR 2/3	0x60	0x006100		
1	879 ns, Δ 879 ns	Vendor Specific	0	NV-DDR 2/3	0xDA			
2	2.340 us, Δ 1.460 us	Page Program Multi-plane	0	NV-DDR 2/3	0x80	0x0030	0x006000	0x11
3	28.162 us, Δ 25.823 us	Change Write Column	0	NV-DDR 2/3	0x85	0x0000		

<Sample screen 1 - ONFi decode computed without customization choices applied>

ID	Timestamp	Transaction Type	Target#	Data Interface	OpCode	Page Address	LUN Address		
0	0 s, Δ 0 s	Block Erase Multi-plane (JEDEC)	0	NV-DDR 2/3	0x60	0x00	0x0061		
1	879 ns, Δ 879 ns	Short1	0	NV-DDR 2/3	0xDA				
2	2.340 us, Δ 1.460 us	Page Program Multi-plane	0	NV-DDR 2/3	0x80	0x600	0x00	0x1800	0x11
3	28.162 us, Δ 25.823 us	Transaction Write Column	0	Data Interface NV-DDR 2/3	OpCode 0x85	Column Address	0x0000		

<Sample screen 2 - ONFi decode computed with customization choices applied>

ID	Timestamp	Transaction Type	Target#	Data Interface	OpCode	Block Address	Page Address	Offset	OpCode 2	Transfer Time	Bytes Transferred
0	0 s, Δ 0 s	Block Erase Multi-plane (JEDEC)	0	NV-DDR 2/3	0x60	0x00	0x00	0x0061			
1	879 ns, Δ 879 ns	Short1	0	NV-DDR 2/3	0xDA						
2	2.340 us, Δ 1.460 us	Page Program Multi-plane	0	SDR	0x80	0x600	0x00	0x1800	0x11	0 s	0

<Sample screen 3 - ONFi decode computed with customization to override the default decode mode for a specific OpCode>

Default indexing of ONFi commands by targets only

LUN indexing enabled to index ONFi commands by targets and LUNs

<Sample screen 4 - ONFi decode computed with customization to index ONFi commands by targets and LUNs instead of the default target only indexing>

ID	Timestamp	Transaction Type	Target#	Data Interface	OpCode	LUN Address
2	-1.084 us, $\Delta$ 463.011 us	LUN Set Features	0	NV-DDR 2/3	0xD5	0x01

ONFi decode without using an LUN alias string

ID	Timestamp	Transaction Type	Target#	Data Interface	OpCode	Chip Address
2	-1.084 us, $\Delta$ 463.011 us	Chip Set Features	0	NV-DDR 2/3	0xD5	0x01

ONFi decode with the string "Chip" used as LUN alias

<Sample screen 5 - ONFi decode computed with customization to include an alias for LUN in the decode results>

#### ONFi Decode Customization Example XML File

```
<ONFiOptions Version="6.50">
<!-- Address decoding options -->
<AddressDefinitions>
  <AddressDefinition AppliesToAddrLen="5">
    <Segment DecodeText="Block Address">
      <Bits ByteIndex="4" StartBit="0" EndBit="4"/>
      <Bits ByteIndex="3" StartBit="1" EndBit="7"/>
    </Segment>
    <Segment DecodeText="Page Address">
      <Bits ByteIndex="2" StartBit="0" EndBit="7"/>
    </Segment>
    <Segment DecodeText="Offset">
      <Bits ByteIndex="1" StartBit="0" EndBit="6"/>
      <Bits ByteIndex="0" StartBit="0" EndBit="7"/>
    </Segment>
  </AddressDefinition>
  <AddressDefinition AppliesToAddrLen="3">
    <Segment DecodeText="Page Address">
      <Bits ByteIndex="2" StartBit="0" EndBit="7"/>
    </Segment>
    <Segment DecodeText="LUN Address">
      <Bits ByteIndex="1" StartBit="0" EndBit="6"/>
      <Bits ByteIndex="0" StartBit="3" EndBit="7"/>
      <FixedBits Value="0" Length="2"/>
    </Segment>
  </AddressDefinition>
</AddressDefinitions>
```

```

</AddressDefinitions>
<!-- Decoder customization -->
<DecoderOptions>
  <CustomSequences>
    <Sequence DecodeText="Short1" Color="0000FF" StartOpCode="DA"/>
    <Sequence DecodeText="Short2" Color="553333" StartOpCode="DF"/>
    <Sequence DecodeText="Long2" Color="550000" StartOpCode="91">
      <MatchCmdValue Value="62"/>
      <MatchCmdValue Value="A4"/>
      <MatchCmdValue Value="58"/>
      <MatchCmdValue Value="01"/>
    </Sequence>
  </CustomSequences>
  <CommandSpecificOptions>
    <PageProgramCmdOptions DecodeText="Fast Write" Color="7FFF8E"
      ReplaceStartOpCode="False" StartOpCode="81" ReplaceEndOpCode="True"
      EndOpCode="C0">
      <OpCodesToIgnore>
        <OpCode>51</OpCode>
        <OpCode>99</OpCode>
      </OpCodesToIgnore>
    </PageProgramCmdOptions>
    <ReadCmdOptions DecodeText="Fast Read" Color="FFD800"
      ReplaceStartOpCode="False" StartOpCode="00" ReplaceEndOpCode="True"
      EndOpCode="50">
      <OpCodesToIgnore>
        <OpCode>37</OpCode>
        <OpCode>38</OpCode>
      </OpCodesToIgnore>
    </ReadCmdOptions>
  </CommandSpecificOptions>
  <CommandModifications>
    <ChangeReadColumn AddressLength="5" />
  </CommandModifications>
  <OpCodeModeOverrides>
    <SDROpCodes>
      <OpCode>07</OpCode>
      <OpCode>0C</OpCode>
    </SDROpCodes>

```

```
<DDROpCodes>  
  <OpCode>07</OpCode>  
  <OpCode>0C</OpCode>  
</DDROpCodes>  
</OpCodeModeOverrides>  
</DecoderOptions>  
</ONFiOptions>
```

## Computing Decoded ONFi Transactions and Chart

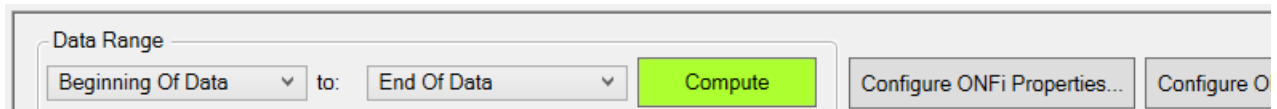
### NOTE

Before you start computing the decoded transactions and chart, ensure that you have:

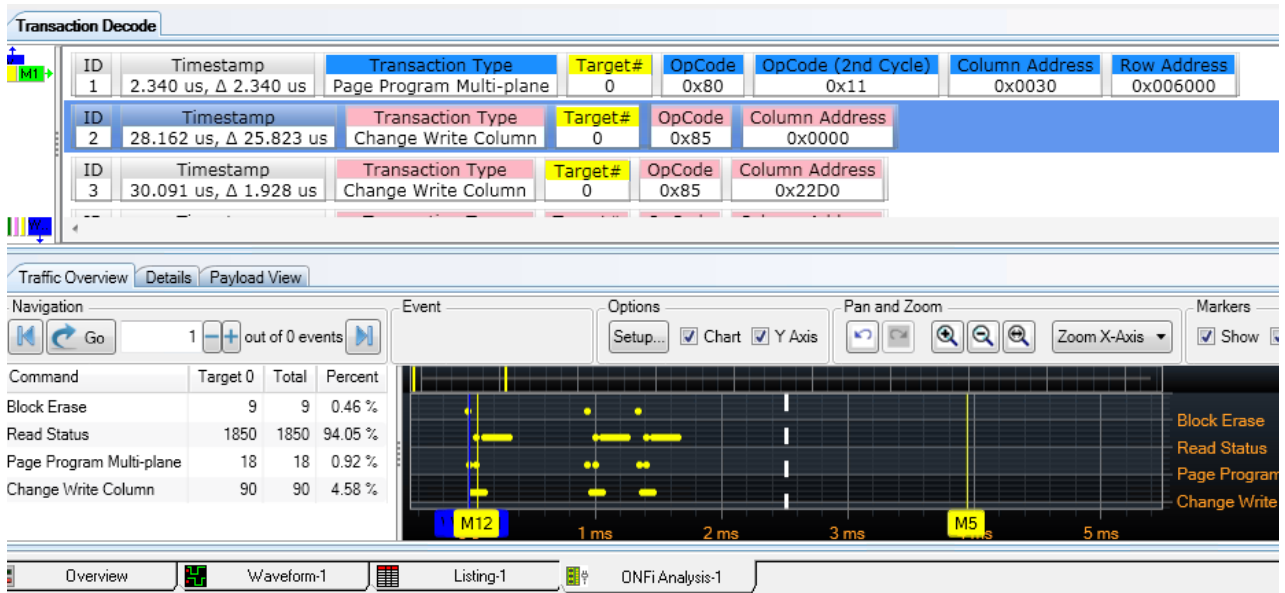
- correctly configured ONFi properties. Failing to do so can result in an inaccurate decoding of transactions.
- applied the decode customization choices (if needed) using an XML file. Failing to do so will result in the transactions being decoded and displayed without your specific customizations.

To compute ONFi transactions

- 1 Click the **Show** button on the ONFi Analysis instance in the **Overview** window to access the ONFi Analysis window.  
The **ONFi Analysis** window is displayed.
- 2 In the **Data Range** groupbox, specify the start and end points of the captured ONFi data for which you want to compute decoded transactions and chart. 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 ONFi transactions and chart.
  - **Trigger** - Selecting Trigger in the data range ensures that ONFi 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 ONFi transactions are computed for the specific portion of captured data defined by markers.



- 3 Click the **Compute** button displayed with the Data Range fields.  
On clicking Compute, the transactions are decoded from the specified data range of ONFi trace. Then, statistics and chart are computed from these decoded transactions and results are displayed.  
The following screen displays the computed transactions for a single-target NAND Flash memory device.

**NOTE**

You can show or hide a specific tab / pane in the ONFi Analysis window using the Show/Hide Tabs drop-down listbox at the top of the ONFi Analysis window.

Hiding a tab using this drop-down listbox 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.

## Filtering Decoded Memory Transactions

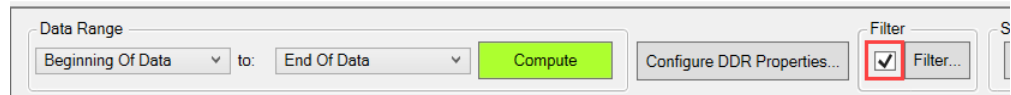
The **Filter** feature allows you to filter the display of the decoded ONFi transactions in the upper pane of the ONFi Analysis window as per the filtering criteria defined by you.

Using this feature, you can show/hide transactions as per your choice and focus on the transactions that are currently of significance to you for analysis and debug.

To enable the Filter feature

By default, the Filter feature is disabled to eliminate the processing time needed for filtering during the Compute process. If you do not need to filter the display, then it is recommended to keep the Filter feature disabled to avoid increasing the Compute time.

- 1 To enable filtering, select the **Filter** checkbox displayed at the top of the ONFi Analysis window.



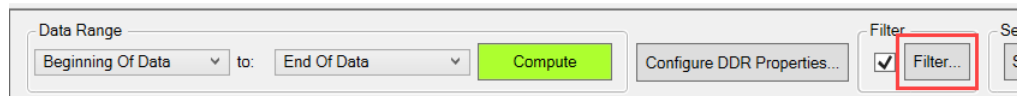
### NOTE

When you enable filtering for the first time for the computed transaction decode of a trace, you need to recompute that transaction decode. This allows the filtering feature to work for the transaction decode of that trace.

To define the filtering criteria

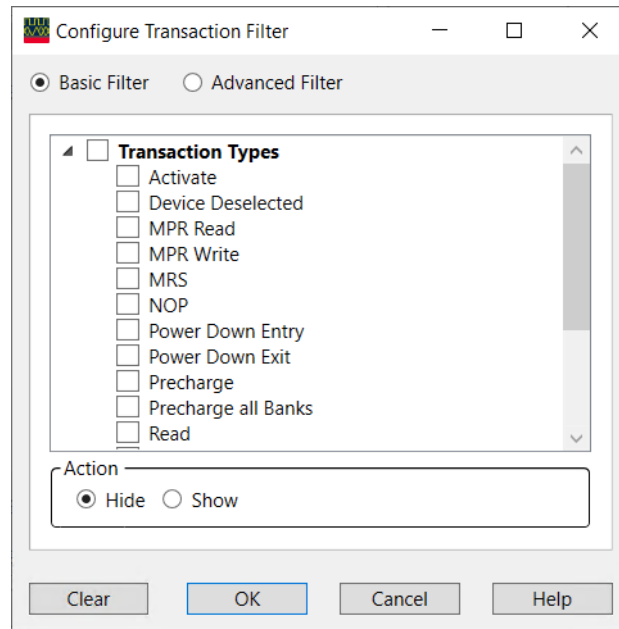
When you select the Filter checkbox, the **Filter** button gets enabled to allow you to define the filtering criteria.

- 1 Click the **Filter** button to configure filtering options.



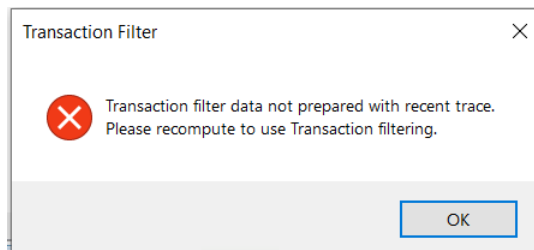
The **Configure Transaction Filter** dialog box is displayed.





- 2 Select the filtering mode, condition(s), and action. See the ["Configure Transaction Filter Dialog"](#) on page 35 for details on basic and advanced filters and examples.

At times, the following error is displayed when you click the Filter button. This indicates that the current transactions decode was computed with the Filter checkbox deselected. Therefore, you need to recompute the decode with the Filter checkbox selected.



#### NOTE

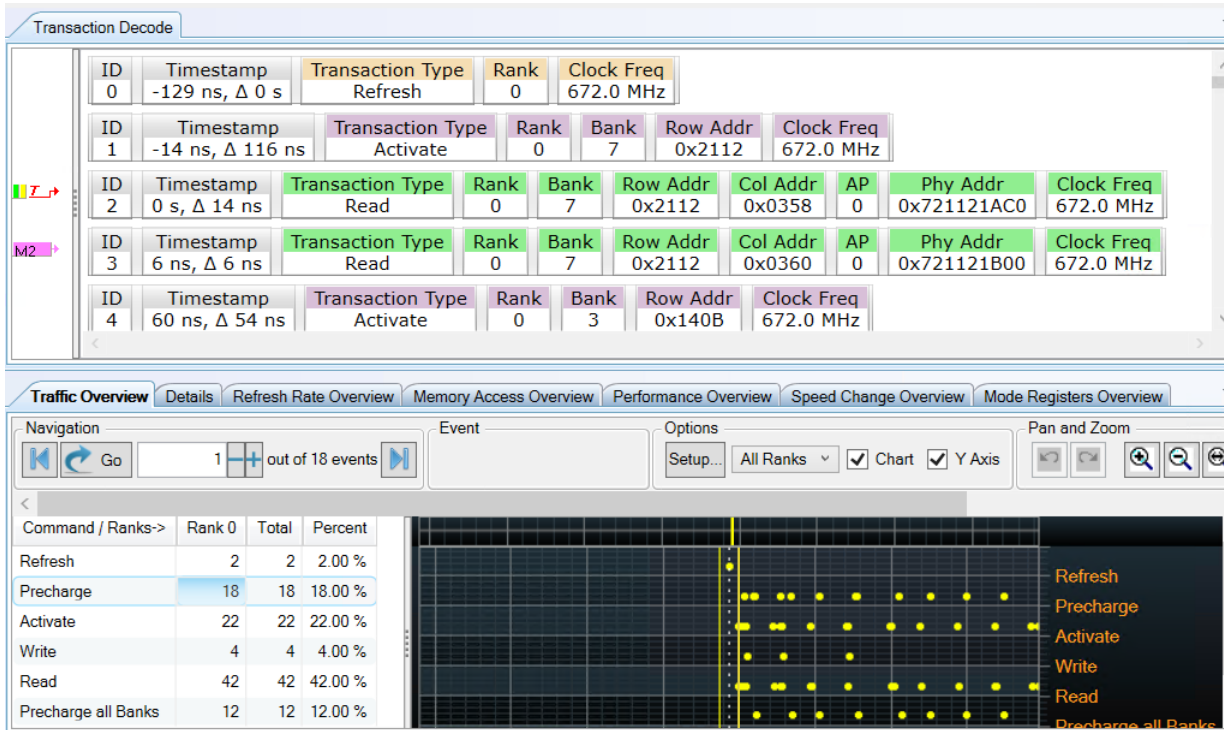
- Filtering does not remove any transactions from the computed list of decoded transactions but only filters the display of transactions as per the defined filtering criteria.
- At any time, you can deselect the Filter checkbox to remove the filter and bring back all the transactions into the display.
- Filtering does not have any impact on the data displayed in the tabs in the lower pane of the ONfi Analysis window. If the transaction corresponding to an event occurrence / marker in the lower tab is filtered, then the navigation takes you to the transaction closest to that filtered transaction in the upper pane.

Filtering Transactions Decode - Example

The screens below show the transactions decode before and after applying a basic filter.

In this example, a simple filter condition has been applied to hide all Read transactions from the display.

Refer to the [“Configure Transaction Filter Dialog”](#) on page 35 for more examples on basic and advanced filters.



<Transaction decode before filtering>

No change in transaction IDs after filtering

No impact on data displayed in lower tabs after filtering

ID	Timestamp	Transaction Type	Rank	Bank	Row Addr	Clock Freq
0	-129 ns, Δ 0 s	Refresh	0			672.0 MHz
1	-14 ns, Δ 116 ns	Activate	0	7	0x2112	672.0 MHz
4	60 ns, Δ 54 ns	Activate	0	3	0x140B	672.0 MHz
5	72 ns, Δ 12 ns	Precharge	0	7		672.0 MHz
9	87 ns, Δ 2 ns	Activate	0	7	0x1CA3	672.0 MHz

Command / Ranks->	Rank 0	Total	Percent
Refresh	2	2	2.00 %
Precharge	18	18	18.00 %
Activate	22	22	22.00 %
Write	4	4	4.00 %
Read	42	42	42.00 %

<Transaction decode after filtering>

### Configure Transaction Filter Dialog

Use this dialog box to define the filtering criteria to filter transactions in the upper pane of the Memory Analysis window.

You access this dialog box by clicking the **Filter** button displayed at the top of the Memory Analysis window. This button gets enabled when you select the **Filter** checkbox.

**Configure Transaction Filter**

Basic Filter    Advanced Filter

**Transaction Types**

- Activate
- Device Deselected
- MPR Read
- MPR Write
- MRS
- NOP
- Power Down Entry
- Power Down Exit
- Precharge
- Precharge all Banks
- Read

Action:  Hide    Show

Buttons: Clear, OK, Cancel, Help

### Filtering Modes

The following two modes are available for filtering.

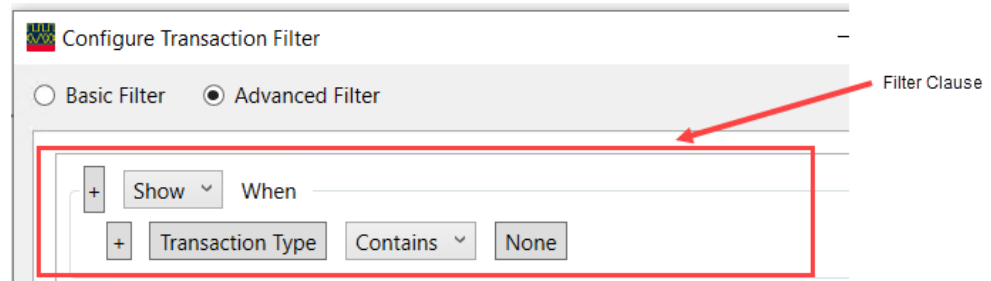
Basic Filter	Advanced Filter
<p>Lets you define simple filtering criteria to support basic filtering based on transaction type(s).</p>	<p>Lets you define complex filtering criteria to support advanced filtering such as:</p> <ul style="list-style-type: none"> <li>- filtering based on specific field(s) in the transactions.</li> <li>- defining multiple filter clauses.</li> <li>- defining multiple filters within a clause.</li> <li>- using custom transaction types in filters (only available when filtering ONFi transactions in the ONFi Analysis window)</li> </ul>
<p>The list of transaction types displayed for the filtering criteria is fixed and predefined as per the memory bus type.</p>	<p>The list of transaction types and fields displayed for the filtering criteria is dynamic and as per the transaction types and fields available in the decode.</p>

#### To define a basic filter

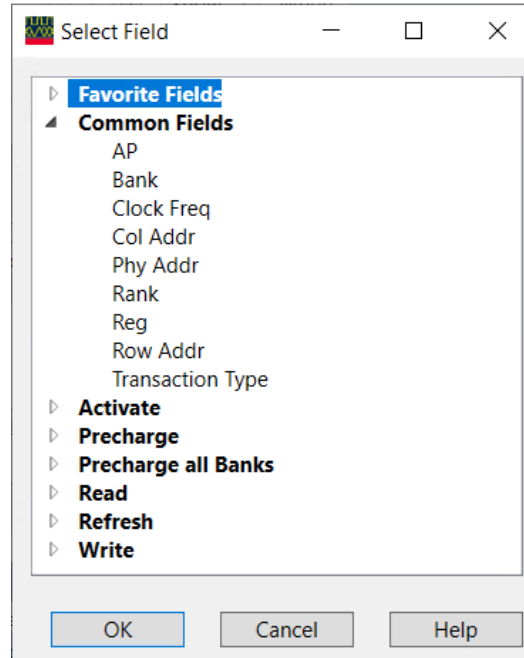
- 1 Click **Basic Filter** in the **Configure Transaction Filter** dialog box.
- 2 Select the transaction type(s) from the list.
- 3 Select either **Show** or **Hide** as the Action to show or hide transactions of the selected transaction type(s).
- 4 Click **OK**.

#### To define an advanced filter

- 1 Click **Advanced Filter** in the **Configure Transaction Filter** dialog box.  
Each filter clause has a filter action (Show / Hide) and filter condition(s).

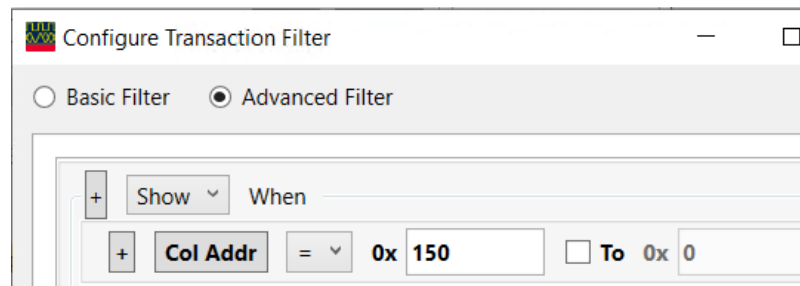


- 2 To define a filter condition, click the **Transaction Type** button in the filter clause.  
The **Select Field** dialog box is displayed. The list of transaction types and their associated fields displayed in this dialog box is as per the transaction types and fields available in the decode.

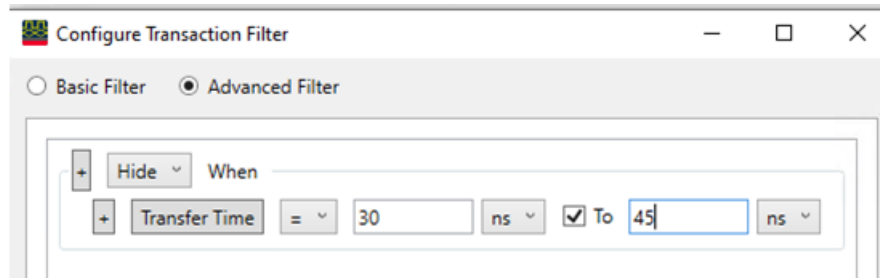
**NOTE**

In this dialog box, the fields are grouped under “Favorite Fields”, “Common Fields”, and individual transaction types. So, it is possible that the same field can appear under more than one grouping in the tree list. Irrespective of the grouping from which you select a field, the filter condition will apply to any transaction that contains that field in the transaction decode. For example, BG and Bank fields are grouped under “Favorite Fields”, “Common Fields” and “Activate”. Regardless of the group from which you select these fields, the resulting filter expression and filter results will be the same.

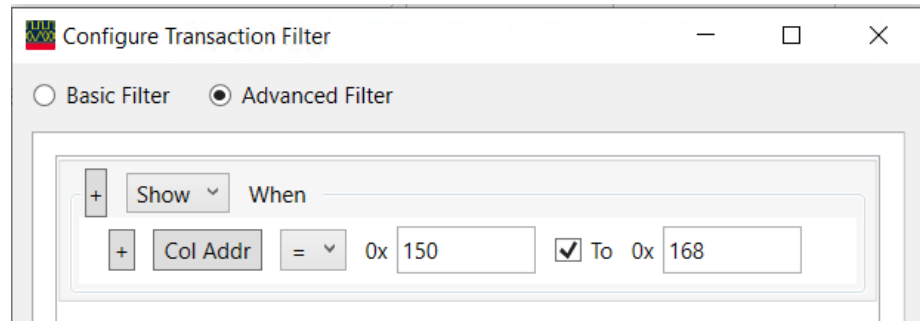
- 3 Select the field on which you want to base the filter condition and click **OK**.
- 4 Select the filter expression operator for the field. Based on the type of field, you have the option of operators such as **Contains**, **Does not Contain**, **=**, or **!=** (not equal).
- 5 Specify the value for the field. Based on the type of field, you can specify values such as:
  - Decimal numbers
  - Hexadecimal numbers (0x prefixed)



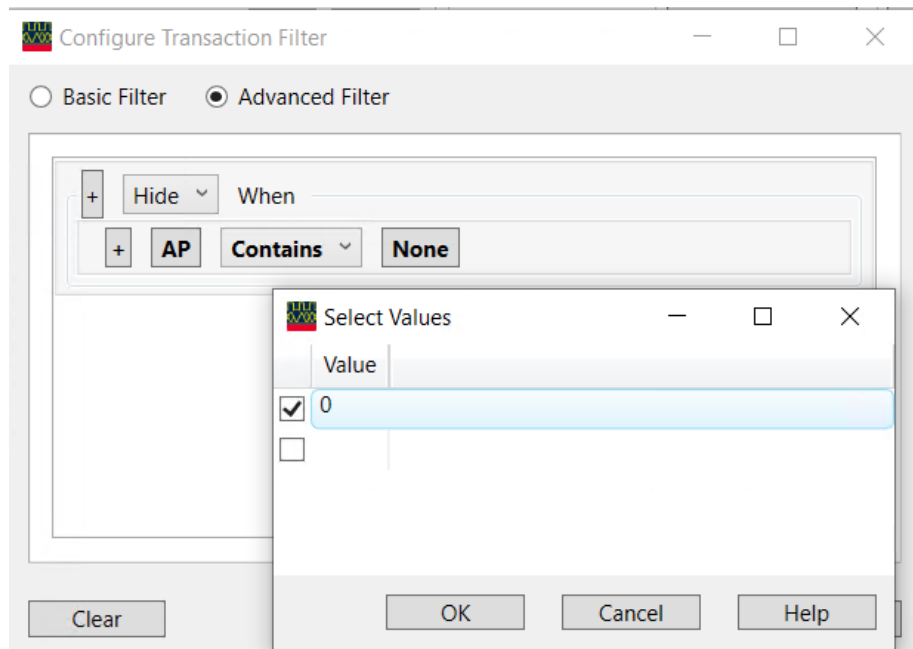
- Time-based (with time units)



- Range of values - To specify a range of values for a field, select the **To** checkbox in the filter expression and specify the start and end values for the range.



- For fields that have relatively small number of possible values, the values are presented as a list in the **Select Value** dialog box. You can access this dialog box by clicking **None** in the filter expression. This list of values is as per the values available for that field in the trace. For example, if the trace has 0 as the value of the AP field, then only 0 will be displayed as an option in this list for the AP field.



You can either select a value from this list or specify your own value by selecting the last empty checkbox in the list.

- 6 Click **OK**.

### To Insert Multiple Filter Conditions Within a Filter Clause

You can insert as many filter conditions as you want in a filter clause.

- 1 Click the **+** sign displayed with the filter condition and select **“Insert Filter After”** or **“Insert Filter Before”**.
- 2 Define the filter clause.
- 3 Select the **“AND”** or **“OR”** as the conditional operator for the filter conditions defined in the filter clause.

#### NOTE

The choice of AND or OR conditional operator is applied across all filter conditions that you define within a filter clause.

The filter clause displayed below shows only those transactions for which all three filter conditions are met.

Configure Transaction Filter

Basic Filter  Advanced Filter

+ Show ▾ When

+ BG = ▾ 0  To 0 AND ▾

+ Rank = ▾ 0  To 0 AND ▾

+ Bank = ▾ 3  To 0

ID	Timestamp	Transaction Type	Rank	BG	Bank	Row Addr	Clock Freq
1	19 ns, Δ 15 ns	Activate	0	0	3	0x02000	1.0 GHz
3	41 ns, Δ 12 ns	Precharge	0	0	3	1.0 GHz	

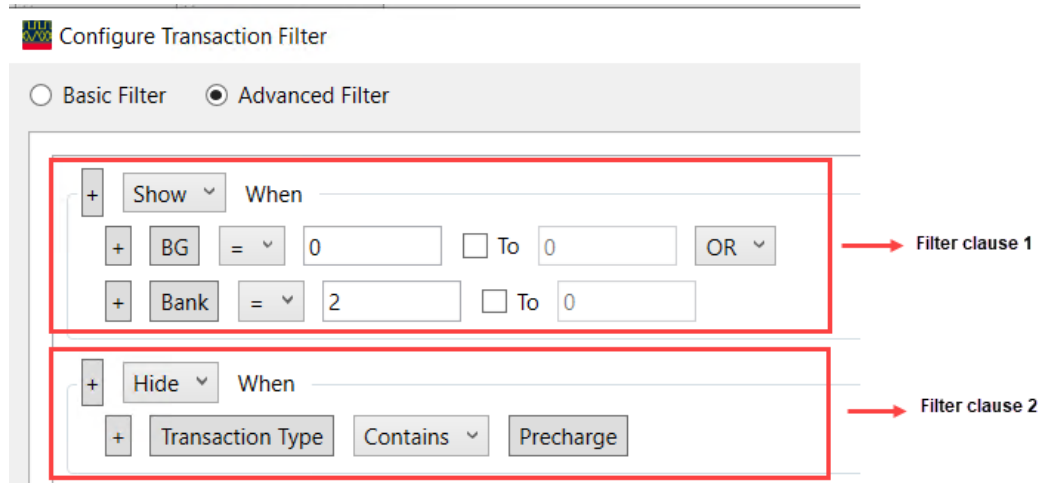
### To Insert Multiple Filter Clauses in the Filtering Criteria

- 1 Click the **+** sign displayed with the filter action and select **Insert Filter Clause After** or **Insert Filter Clause Before**.
- 2 Define filter clauses as per your requirements.

You can define as many filter clauses as you want to support complex filtering expressions which may not be possible using multiple conditions within a single filter clause.

For complex filtering requirements, multiple filter clauses ensure the sequential execution of these filter clauses while also providing the flexibility of using the And or Or conditional operator across conditions of individual filter clauses.

For example, the filter setup shown below has two filter clauses. This filter criteria will show transactions that have either BG = 0 or Bank = 2 and that do not belong to the transaction type Precharge.



### Using custom transaction types in filtering

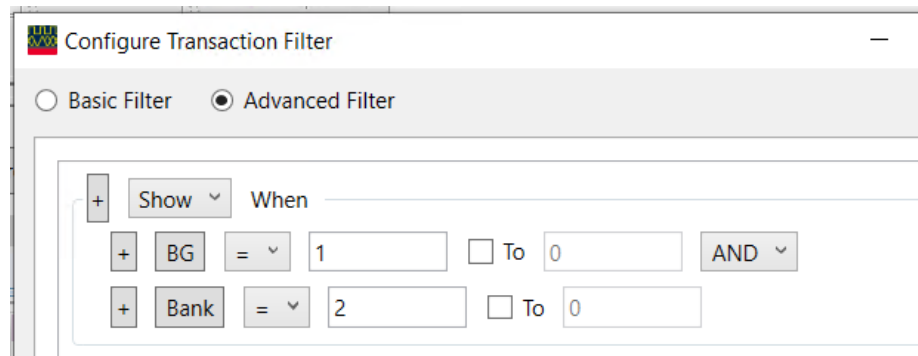
The ONFi decode allows you to define custom transaction types. Therefore, the custom transaction types are included in the transaction types list presented for defining an Advanced filter for an ONFi decode only.

**NOTE** The transaction types list for a basic filter for an ONFi decode is predefined. Custom transaction types are not displayed in this list.

### Advanced Filter Examples

Here are a few examples to describe important aspects of how the advanced filtering works.

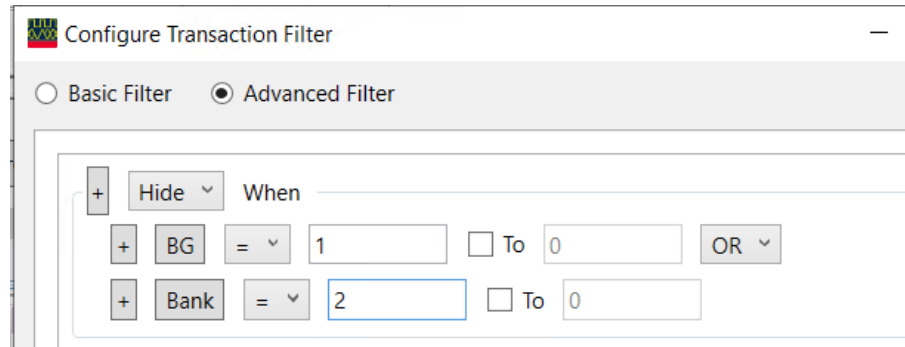
**Example 1** - To show transactions with BG = 1 and Bank = 2





Only transactions with BG=1 and Bank=2 will be shown. The transactions that do not have the fields BG and Bank do not meet the filtering criteria and are therefore not shown.

**Example 2** - To hide transactions with BG = 1 and Bank = 2



Transactions with BG=1 or Bank=2 will be hidden. Also, the transactions that do not have the fields BG or Bank do not meet the filtering criteria and are therefore not hidden.

#### To Clear Filter

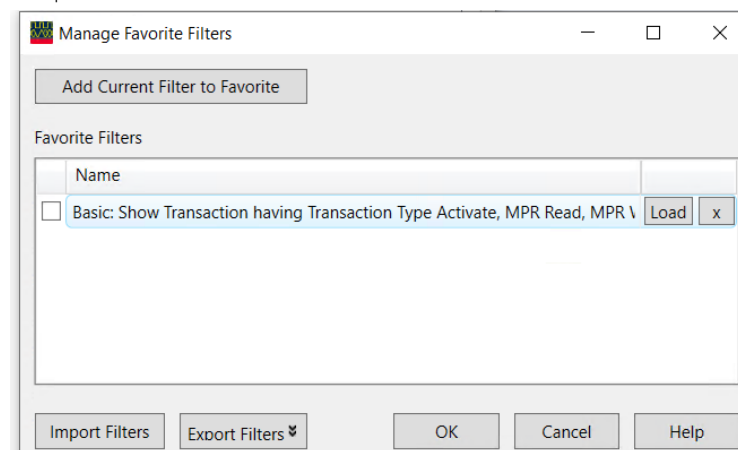
On clicking the **Clear Filter** button at the bottom of the Configure Transaction Filter dialog box:

- all filter settings that you specified for the Basic and Advanced filters are cleared from the dialog box.
- the display of transactions is returned to the unfiltered state.

#### To Manage Filters

To avoid redefining your favorite filters, you can save your filter setups for future use.

- 1 Click the **Manage Filters** button at the bottom of the Configure Transaction Filter dialog box. The **Manage Favorite Filters** dialog box is displayed.
- 2 Click the **Add Current Filter to Favorite** button to add the currently defined Basic and Advanced filter setup to the list of favorite filters for the current trace.



- 3 Accept the default name for the filter in the list or specify a different name.
  - 4 Click **OK** to confirm the addition of filter setup.
  - 5 Click **OK** to confirm the changes to the Configure Transaction Filter dialog box.
- On saving the logic analyzer configuration file, this newly added filter gets saved with it.

#### **To load a saved filter**

When you load a logic analyzer configuration file, the filter(s) that you saved with it are available for use with this configuration file.

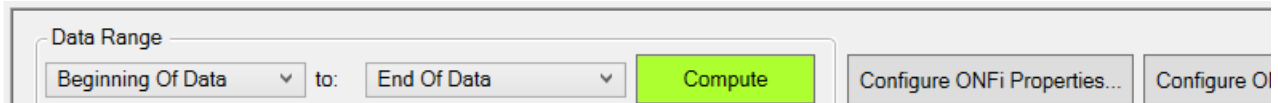
- 1 Click the **Manage Filters** button in the Configure Transaction Filter dialog box.
- 2 Select the filter setup that you want to load from the **Favorite Filters** list and click **Load**.

#### **To export and import filters**

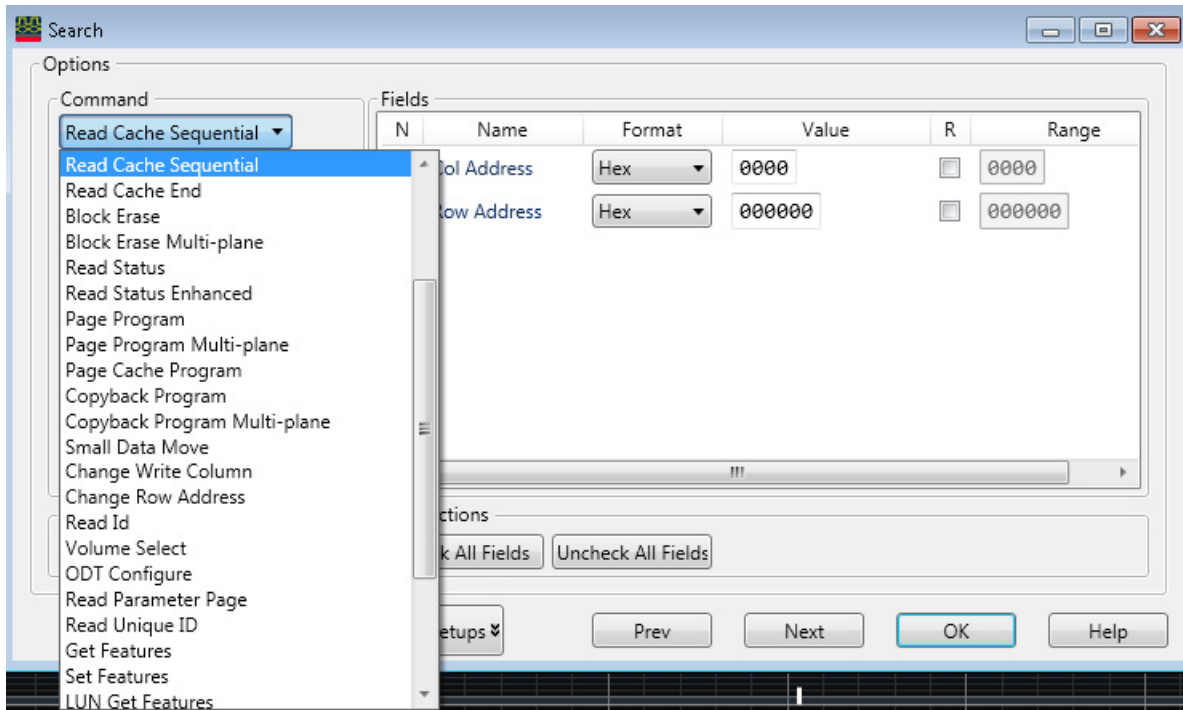
When you save a filter, it is available for use later only with that logic analyzer configuration file with which it was saved. However, if you want to use your favorite filters with other logic analyzer configurations and setups as well, then you can export all or specific filters from the favorite filters list to an .xml file. You use the **Export Filters** button in the Manage Favorite Filters dialog box to accomplish this. To load these later, click the **Import Filters** button in the Manage Favorite Filters dialog box and open the .xml file in which you exported the filters.

## Searching for Specific ONFi Commands

You can quickly search for a particular ONFi command of interest from the list of decoded ONFi transactions displayed in the upper pane of the ONFi Analysis window. You can use the **Search** section in the ONFi Analysis toolbar to accomplish this.



To define your search criteria, you can choose the required ONFi command from the list of available ONFi commands in the Search dialog and further refine this criteria by specifying field values for the selected command.

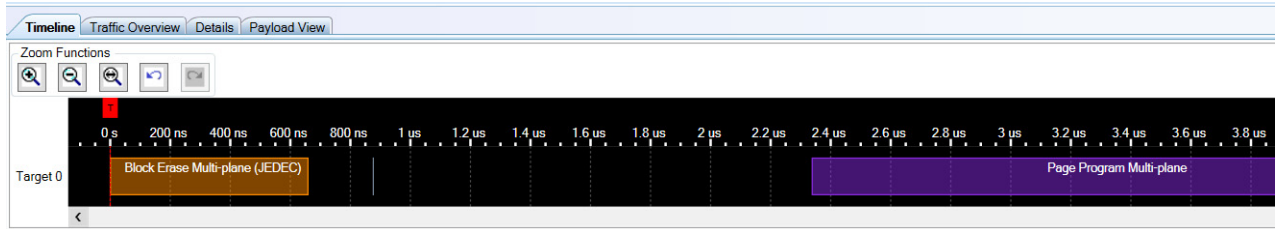


To know how to use the search feature and then view search results, refer to the Search dialog.

## Viewing ONFi Data in a Timeline View

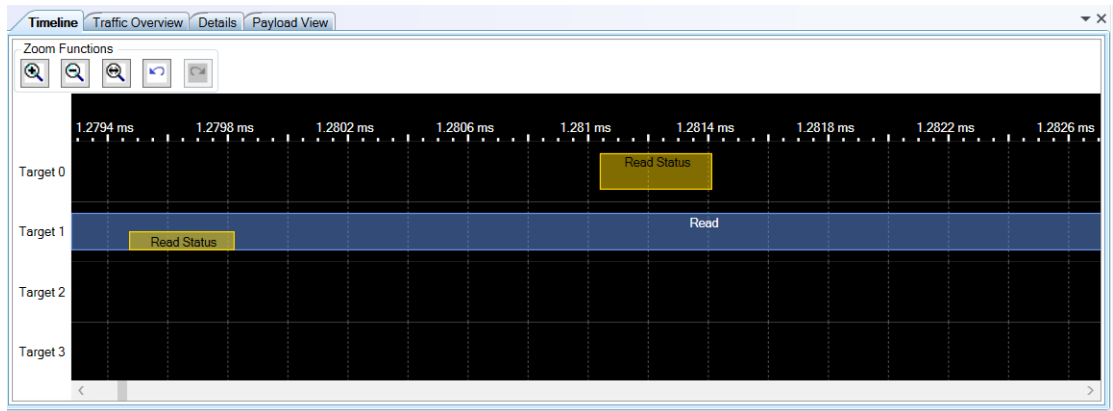
You can use the **Timeline** tab in the ONFi Analysis window to view ONFi transactions on a timeline (in the order in which these have occurred over a period of time). This allows you to get a visual depiction of the activities related to a NAND target on a timeline.

Each ONFi transaction is displayed as a linear bar on the timeline. The time axis used to depict this timeline is shown at the top of the tab.



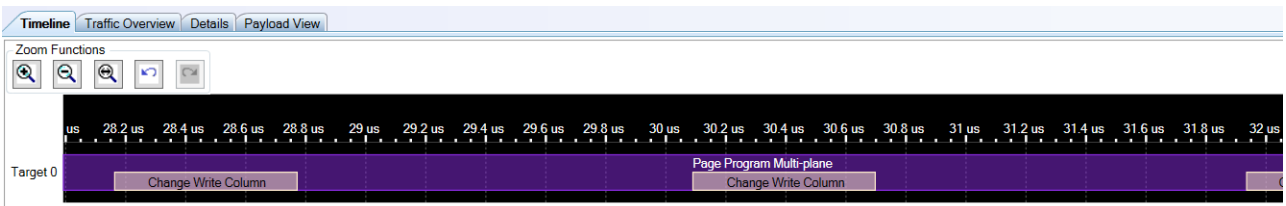
Timeline View for a Multi-target NAND Device

In the Timeline tab, a separate timeline is used to depict ONFi transactions separately for each NAND target.



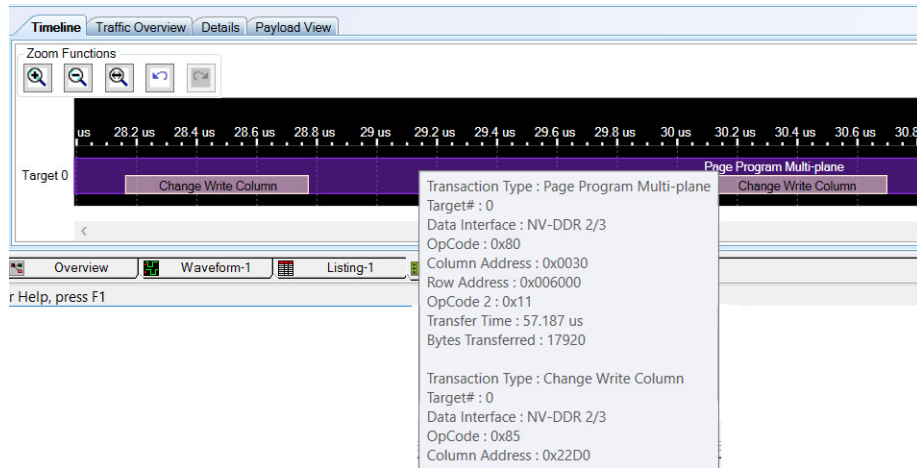
Depicting Concurrent Transactions on a Timeline

There may be situations when multiple transactions are concurrently occurring for a NAND target. One such example can be a Page Program command with the Change Write commands occurring in between. Such concurrent transactions are depicted on a timeline as displayed in the screen below.



## Viewing Transaction Details on the Timeline

You can hover the mouse on a transaction bar in the Timeline view to display details for that particular transaction. For concurrent transactions, the details of the relevant transactions is shown together.



### NOTE

You can zoom in or zoom out the entire data depicted on the timeline(s) using the buttons displayed in the Zoom Functions section of the Timeline tab.

- Zoom In magnifies the center 50% of the timeline to the full width of the timeline.

- Zoom Out doubles the time displayed in the full width of the timeline.

- Zoom Out Full displays the entire range of Computed data across the full width of the timeline.

You can also zoom a defined area in the timeline by drawing a zoom box using the left mouse button. To draw a zoom box, move the mouse pointer to the timeline location from which you want to begin zooming. Then left-click at this location and while keeping the left mouse button pressed, drag the mouse to the timeline location till which you want to zoom the display. When you release the left mouse button, the defined area is zoomed.

You can undo and redo zooms by clicking the and buttons in the Zoom Functions section.

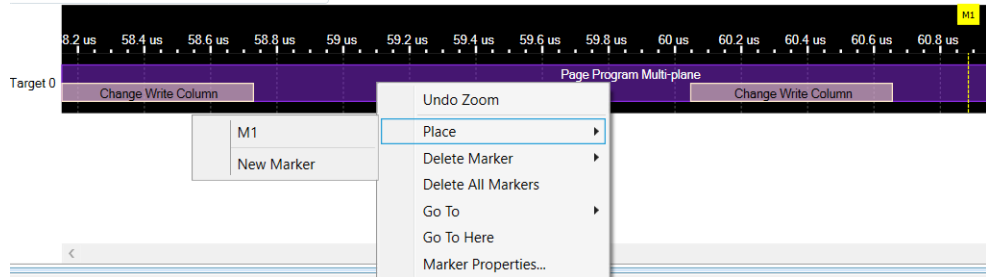
## Placing Markers in a Timeline

You can place markers in a timeline and then use these markers to navigate to the exact trace position that corresponds to that marker location in the timeline.

Markers placed in the timeline are correlated to markers displayed in the trace data in the upper pane of the ONFi Analysis window.

### To place a marker in a timeline

- 1 Right-click the timeline 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 navigate to a particular marker placed in the timeline

In situations when you have placed multiple markers in the timeline, 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 timeline, select **Go To** and then select the marker to which you want to navigate.

On doing so, the timeline 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.

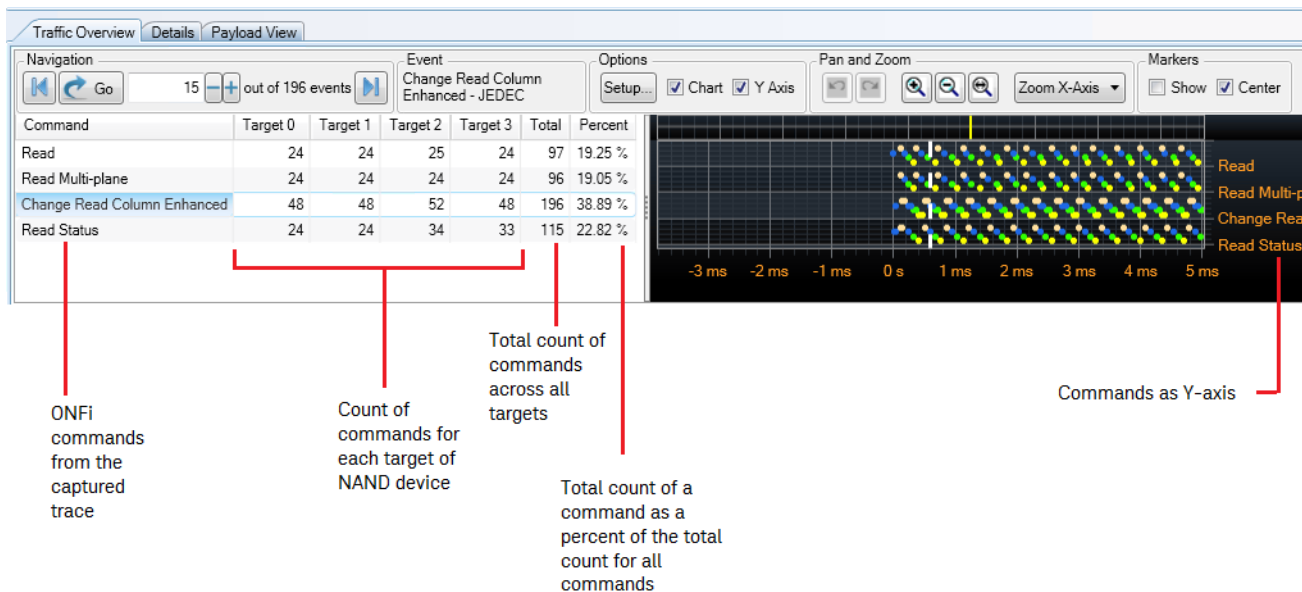
## Analyzing ONFi Traffic Statistics

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

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

Left Pane	Right Pane
<p>For each type of ONFi command found in the captured trace, the left pane displays a count of the number of times that ONFi command was found in the trace.</p> <p>For a multi-target NAND device, the count of each command is further categorized on the basis of these targets.</p> <p>(If required, you can categorize these commands by Logical Units (LUNs). To do this, you need to enable LUN indexing. Refer to the topic <a href="#">"ONFi Decode Customization XML File Structure and Elements"</a> on page 14 to know more about LUN indexing.)</p>	<p>The right pane displays a traffic overview chart in which a count of ONFi commands found in the captured trace is plotted over the period of time as X-axis and the command types as Y-axis.</p>

The following screen displays a sample ONFi traffic statistics for a NAND device with multiple targets.



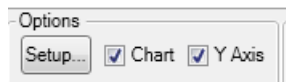
The following subsequent topics in this chapter describe the usage of the Traffic Overview tab in detail.

- Selecting the ONFi Commands to be Included in Traffic Overview
- Viewing and Customizing an ONFi Traffic Overview Chart
- Navigating Between ONFi Traffic Overview and Decoded ONFi Transactions

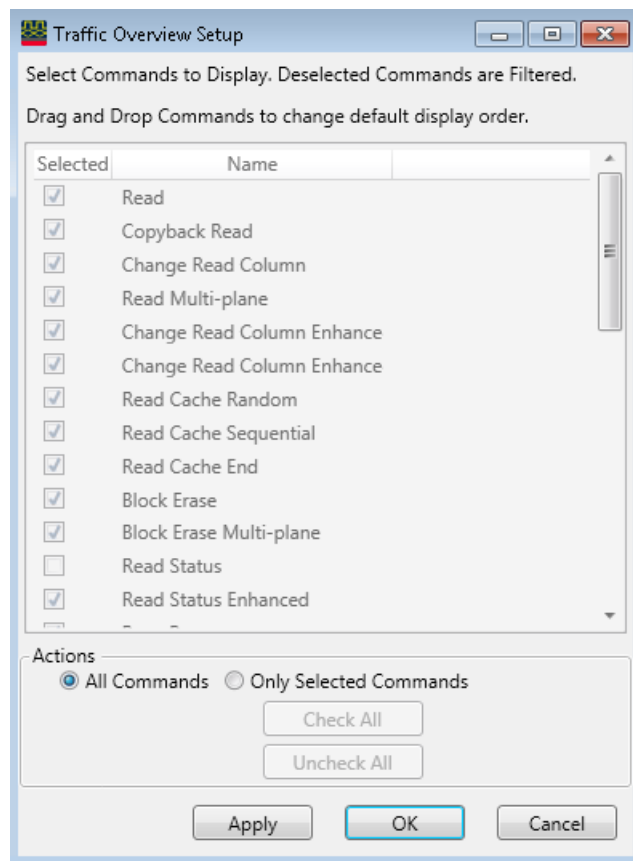
### Selecting the ONFi Commands to be Included in Traffic Overview

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

- 1 Click the **Setup...** button under the **Options** groupbox in the Traffic Overview tab of ONFi Analysis window.



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



- 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 Deselect the checkbox for each ONFi command that you do not want to include in the traffic statistics.



**NOTE**

You can also change the order in which an ONFi 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. On clicking OK, this change gets reflected in the Y-axis of the chart.

- 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.

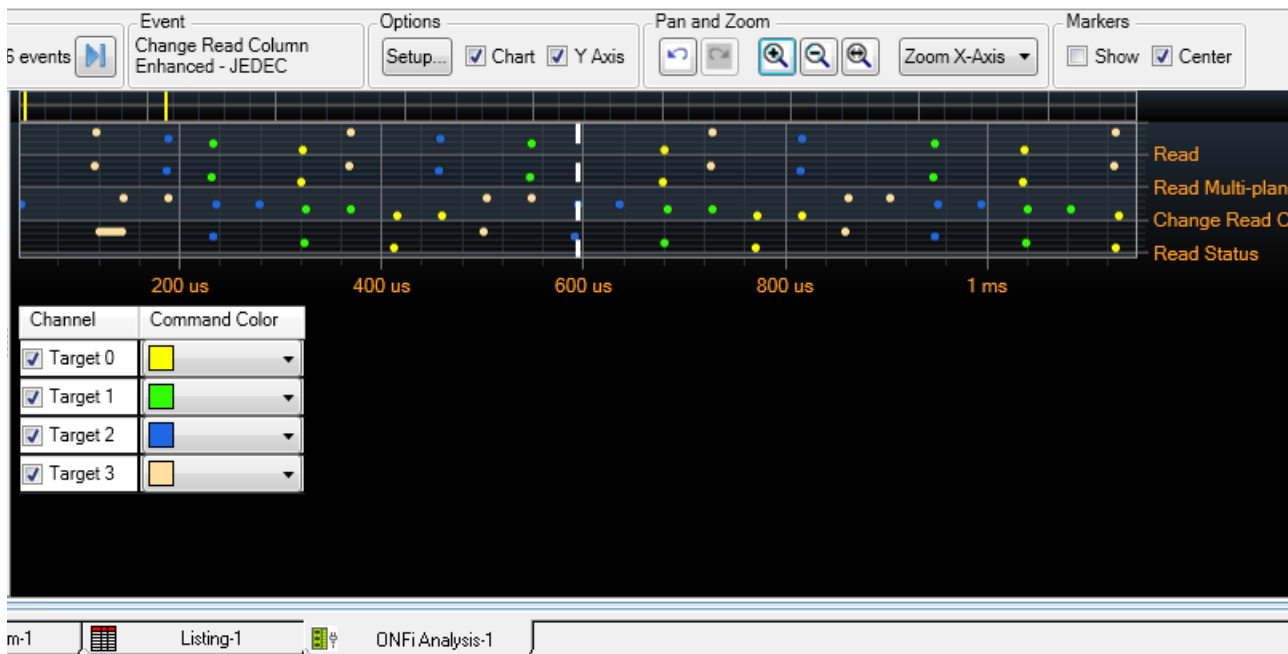
The changed selection of commands is reflected in the traffic statistics and chart.

## Viewing and Customizing an ONFi Traffic Overview Chart

The computed ONFi traffic statistics displayed in the left pane of the **Traffic Overview** tab is also plotted on a chart in the tab's right pane.

For each ONFi 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 NAND targets.

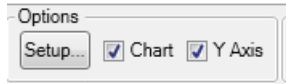
Color coding is used to differentiate ONFi command counts based on targets. For instance, in the below screen, yellow and blue colors are used to represent command counts for Target 0 and 2 respectively.



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

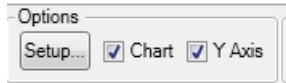
**To display an ONFi traffic overview chart**

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



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

- 1 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 the data plotted for each target is displayed in the Color Picker Legend.

Channel	Command Color
<input checked="" type="checkbox"/> Target 0	<span style="background-color: yellow; border: 1px solid gray; display: inline-block; width: 15px; height: 15px;"></span>
<input checked="" type="checkbox"/> Target 1	<span style="background-color: green; border: 1px solid gray; display: inline-block; width: 15px; height: 15px;"></span>
<input checked="" type="checkbox"/> Target 2	<span style="background-color: blue; border: 1px solid gray; display: inline-block; width: 15px; height: 15px;"></span>
<input checked="" type="checkbox"/> Target 3	<span style="background-color: orange; border: 1px solid gray; display: inline-block; width: 15px; height: 15px;"></span>

- 2 To change the color coding for the data plotted for a particular target, click the **Command Color** drop-down and select the new color.

The commands count for that target is plotted using the new color in the chart.

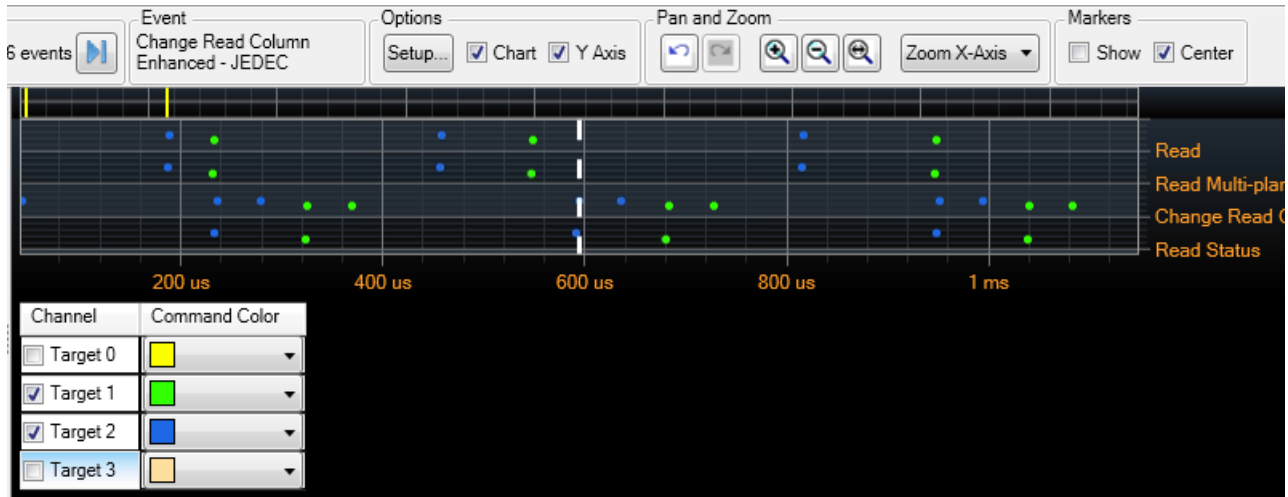
The color coding that you set using the Color Picker Legend is automatically reflected in the Chip Enables color coding in the Configure ONFi Properties dialog box and vice versa.

**To show/hide data for a target from the traffic overview chart**

By default, the command counts for all the applicable NAND targets are displayed in the chart. You may want to hide the command counts for some of the targets to focus only on specific target(s) of interest.

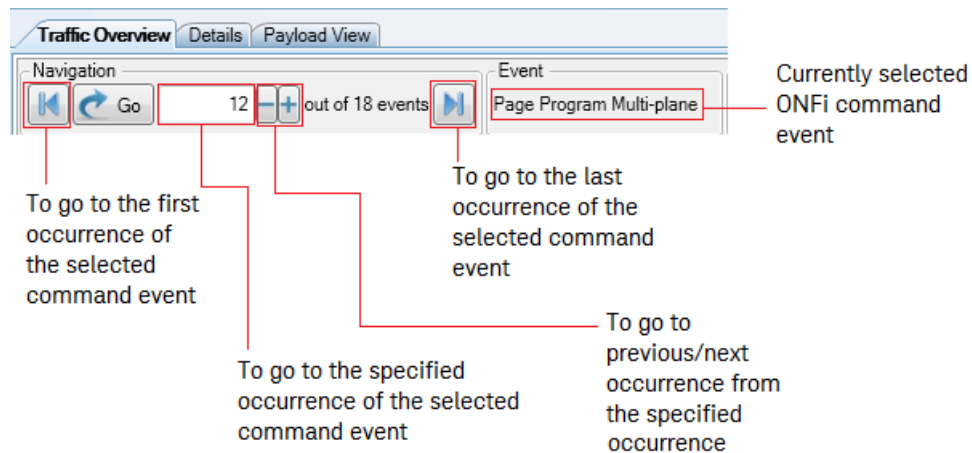
- 1 Right-click anywhere in the plotted chart area and select **Show Color Picker Legend**.
- 2 Select/deselect the checkbox for a target to show/hide the command counts for that target in the chart.

The chart is updated to reflect your selections of targets.

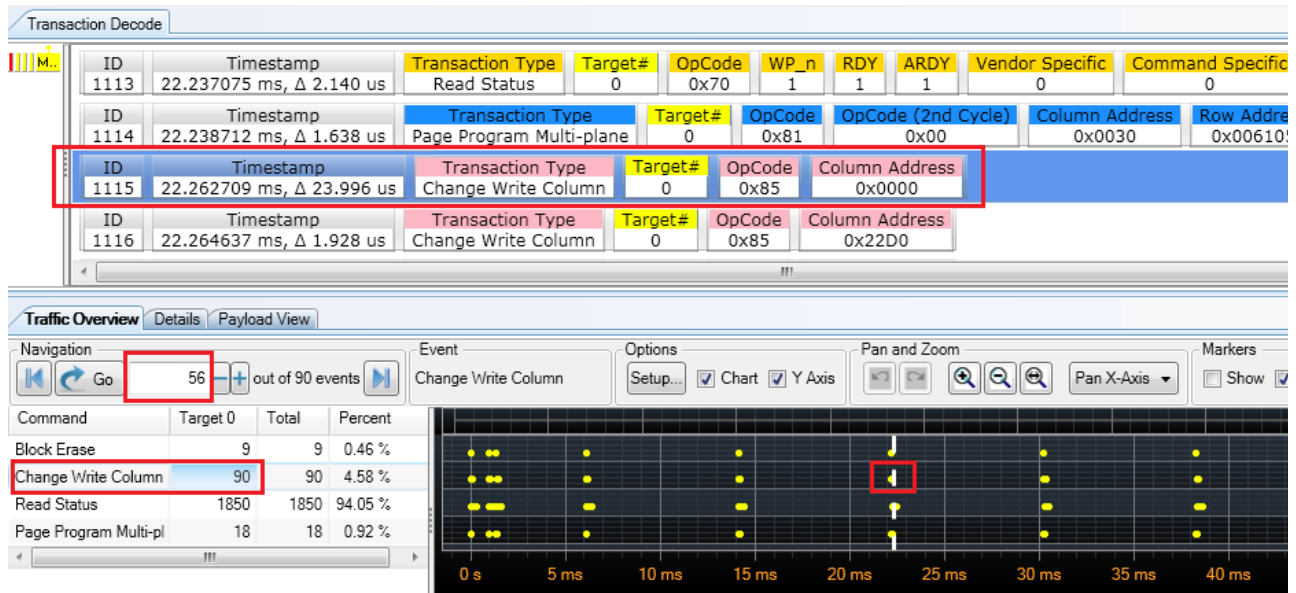


### Navigating Between Traffic Overview and Decoded ONFi Transactions

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



For instance, in the following screen, there are total 90 occurrences of the Change Write Column commands and you want to navigate directly to the 56th Change Write Column command in the trace To do so, you can select the Change Write Column command type in the Traffic Overview left pane and then type 56 in the Navigation text box and click Go. This takes you directly to the 56th Change Write Column transaction in the upper pane of the ONFi Analysis window. The chart display is also simultaneously moved to bring the 56th occurrence of this command to the center position in the chart.



### Placing Markers in an ONFi Analysis Chart

You can place markers in the Traffic overview chart displayed in the ONFi analysis window and use these markers to navigate to the ONFi 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 ONFi Analysis window.

#### To place a marker in an ONFi analysis chart

- 1 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.

## Panning / Zooming an ONFi Analysis Chart

### Using the Pan Option to Navigate Through an ONFi Analysis Chart

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

### Zooming an ONFi 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 gray.

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

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.

## Viewing ONFi Transactions as a Logically Grouped Sequential Set

An ONFi operation comprises of a number of commands issued in a specific sequence. In the upper pane of the ONFi Analysis window, ONFi 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 ONFi operation. You can use the **Details** tab in the ONFi Analysis window to view this logically grouped sequential set of commands issued for a specific ONFi operation.

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

### Example - A complete set of transactions for a Multi-plane Program operation

The following screen displays the complete sequence of commands applicable for the Page Program Multi-plane transaction highlighted in the upper pane.

In this sequence:

- The Page Program command transfers a page of data identified by a column address to the page register. The contents of the page register are then programmed into the Flash array at the row address indicated.
- The Change Write Column commands change the column addresses being written to in the page register.
- After several Read Status commands (with RDY bit set to 0), the ONFi sequence ends with the Read Status commands (with RDY bit set to 1) indicating that another command can be accepted.

(In this sequence, all the Read Status commands with the RDY bit set to 0 have been filtered out using the Configure ONFi properties dialog.)

The screenshot shows the ONFi Analysis Window with the 'Transaction Decode' tab selected. The table below lists several transactions, with ID 8 highlighted. Below the table, the 'Details' tab is active, showing a sequential list of commands for the selected transaction (ID 8).

ID	Timestamp	Transaction Type	Target#	OpCode	Column Address
5	58.121 us, Δ 26.185 us	Change Write Column	0	0x85	0x2300
6	60.049 us, Δ 1.928 us	Change Write Column	0	0x85	0x45D0
7	62.189 us, Δ 2.140 us	Read Status	0	0x70	1 1 1 0
8	63.826 us, Δ 1.638 us	Page Program Multi-plane	0	0x81	0x00 0x0030
9	90.902 us, Δ 27.076 us	Change Write Column	0	0x85	0x0000
10	92.830 us, Δ 1.928 us	Change Write Column	0	0x85	0x22D0
11	94.676 us, Δ 1.846 us	Change Write Column	0	0x85	0x22D0
12	119.388 us, Δ 24.713 us	Change Write Column	0	0x85	0x22D0
13	121.317 us, Δ 1.928 us	Change Write Column	0	0x85	0x22D0
209	319.977 us, Δ 198.660 us	Read Status	0	0x70	1 1 1 0

ID	Transaction ID	Transaction	Timestamp	Delta Time
0	8	Page Program Multi-plane	63.826 us	0 s
1	9	Change Write Column	90.902 us	27.076 us
2	10	Change Write Column	92.830 us	1.928 us
3	11	Change Write Column	94.676 us	1.846 us
4	12	Change Write Column	119.388 us	24.713 us
5	13	Change Write Column	121.317 us	1.928 us
209	218	Read Status	319.977 us	198.660 us

Target# = 0  
 OpCode = 0x81  
 OpCode (2nd Cycle) = 0x00  
 Column Address = 0x0030  
 Row Address = 0x006100  
 Transfer Time = 56.983 us  
 Bytes Transferred = 17920

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

Field	Description
ID	Identifier assigned to an ONFi transaction in the logically grouped sequential set to indicate the transaction's order in the sequential flow.
Transaction ID	The identifier used for the ONFi transaction in the upper pane.
Transaction	The ONFi transaction name in the sequential flow.
Timestamp	Displays the timestamp for the transaction relative to the timestamp of the first transaction in the sequential set displayed in the Details tab.
Delta Time	Displays the difference between the timestamp of the transaction and the previous transaction in the sequential set shown in the Details tab.

## Viewing Details of an ONFI Transaction

Besides displaying a logically grouped sequential set of transactions in the left pane, the **Details** tab of the ONFI Analysis window also displays the details of the currently selected transaction in its right pane.

The details of a transaction shown in the right pane also includes additional information about the transaction such as:

- Error information
- Transfer Time
- Bytes Transferred

The sample screen below displays the details of the currently selected ONFI transaction - Read.

The screenshot shows the ONFI Analysis Window with the 'Details' tab selected. The main table displays a list of transactions, with ID 31 selected. The details pane on the right shows the following information:

ID	Timestamp	Transaction Type	Target#	OpCode	OpCode (2nd Cycle)	Column Address	Row Address
31	816.475 us, Δ 1.450 us	Read	2	0x00	0x30	0x0040	0
32	948.825 us, Δ 132.350 us	Read Status	2	0x70			

Transaction Details:

- Target# = 2
- OpCode = 0x00
- OpCode (2nd Cycle) = 0x30
- Column Address = 0x0040
- Row Address = 0x00D9CD
- Transfer Time = 83.486 us
- Bytes Transferred = 71328

Error information in the Details tab

In the Details tab, you can also view the error information (if any) pertaining to a particular transaction.

The screenshot shows the ONFI Analysis Window with the 'Details' tab selected. The main table displays a list of transactions, with ID 34 selected. The details pane on the right shows the following information:

ID	Timestamp	Transaction Type	Target#	OpCode	OpCode (2nd Cycle)	Column Address	Row Address
34	993.767 us, Δ 42.301 us	Change Read Column Enhanced - JEDEC	2	0x00	0x05		
35	1.172580 ms, Δ 178.813 us	Undefined	2	0xDF			

Transaction Details:

- Target# = 2
- OpCode = 0x00
- OpCode (2nd Cycle) = 0x05
- Column Address = 0x001C
- Row Address = 0x00D9CD
- Error(s) = Address too long



## Viewing the Payload of an ONFi Transaction

You can use the **Payload View** tab in the ONFi Analysis window to view the payload data comprising an ONFi transaction such as a Read or a Write transaction.

On selecting an ONFi transaction in the upper pane of the ONFi Analysis window, its payload data (if applicable) is displayed in the Payload View tab.

You can select:

- The unit that you want to use for the Word size in the payload.
- The number of columns to be used for displaying the payload.
- The format (Big Endian or Little Endian) in which you want the Words to be represented in the payload.

The sample screen below displays the payload data for a Read ONFi transaction.

The screenshot displays the ONFi Analysis Window interface. At the top, a table shows transaction details:

ID	Timestamp	Transaction Type	Target#	OpCode	OpCode (2nd Cycle)	Column Address
127	6.537989 ms, Δ 1.450 us	Read	2	0x00	0x30	0x0040

Below this, another table shows the selected transaction's details:

ID	Timestamp	Transaction Type	Target#	OpCode	WP_n	RDY	ARDY	Vendor Specific
128	6.670442 ms, Δ 132.453 us	Read Status	2	0x70	1	1	1	0

The main window shows the **Payload View** tab. The controls include:

- Word Size: **DWord**
- Number of Columns: **4**
- Endianness: **Little Endian** (selected)

The payload data is displayed as a hex dump with ASCII characters:

```

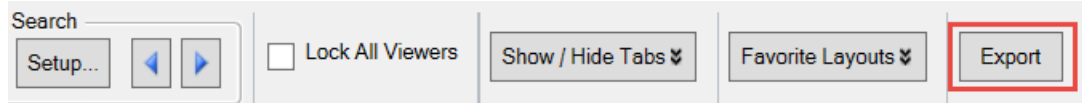
0000: A2855D5D 5D5D9AA2 9AA2A285 5D871515 ..]]]].....]...
0010: 08082D5D 851A1A18 BFE26060 1C1CF2BF ..-].....]...
0020: D9F2F293 0D07EEEE 7C7CC40D 0C515158 .....QOQX
0030: A8C74545 8C8C0DA8 390C0C81 506D8787 ..EE....9...Pm..
0040: 22229650 982E2E61 B3185959 848475B3 ""'.P...a..YY..u.
0050: 397878BE 13753A3A 6D6D3C13 7BFFFFAF 9xx..u::mm..{...
0060: 9134ACAC 6A6A0891 12363661 E702D7D7 .4..jj...66a....
0070: 050518E7 6606069F 51333737 4A4ACE51 ....f...Q377JJ.Q
0080: 66818115 9CF4E4E4 1818DB9C 20C5C5AF f.....]...
0090: 384BE2E2 2626EC38 BFE8E86C 39EC9C9C 8K...&&.8...19...
00A0: 0303B939 C80D0DB2 D93A6565 C7C7A0D9 ...9.....:ee....
00B0: A7010164 313FB8B8 32323A31 C131315A ...d1?...22:1.11Z
00C0: B958EDED 5A5ADDB9 B0D2D297 18276060 .X..ZZ.....'..
00D0: 0D0DBD18 A3555564 98BC7171 9E9E8898 .....UUd..qq....
00E0: 01020241 ACCE1414 4E4E05AC 61131306 ...A....NN..a...
00F0: 2EA40202 E1E1CB2E 947F7F2C 59409393 .....Y@..
0100: 4C4C6859 4C15153A FD9B8989 585821FD LLhYL.....XX!.
0110: 88A9A985 5A8C5353 3A3A1A5A 94818104 ....Z.SS:::Z....
0120: E239CDDC 4040B9E2 FF9C9CB8 61CFF5F5 .9..@@.....a...
  
```

## Exporting ONFi Data to a CSV File

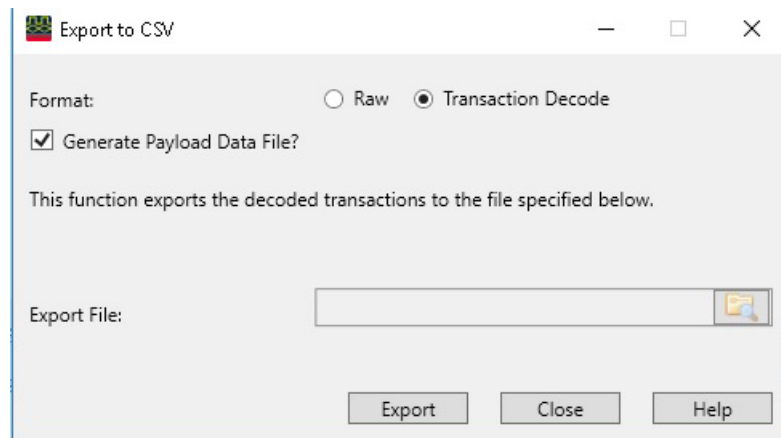
You can export the ONFi data displayed in the ONFi Analysis window to a specified .csv file and use it later in other analysis tools.

### To export ONFi data

- 1 Click the **Export** button displayed in the ONFi Analysis window's toolbar.



The **Export to CSV** dialog box is displayed.



- 2 From the following two options, select the Format in which you want to export ONFi data.
  - **Raw** - Exports the raw (uninterpreted) command, address, and data information from the computed ONFi data. This export format does not include the decoded transactions.
  - **Transaction Decode** - Exports the decoded ONFi transactions data from the computed ONFi data. This export format includes the transactions data displayed in the Transaction Decode tab of the ONFi Analysis window.
- 3 Click the **Browse** button displayed with the Export File field and browse to the location where you want to save the main export (.CSV) file.
- 4 If you select the **Transaction Decode** export format, the **Generate Payload Data File** checkbox is enabled. Selecting this checkbox allows you to export the payload data for all the transactions included in the trace to a separate binary file (in addition to the main export .csv file). This binary file is saved at the location that you specify for the main export file. The following naming convention is used for this binary file:
 

```
<name of the main export file>_payload.bin
```

The payload data is exported to the binary file in the order of its occurrence in the trace. Therefore, to correctly interpret and analyze the payload data in the binary file, examine this data along with the transactions in the main export file. For analyzing the payload data of a specific transaction, you can ascertain the number of bytes of the payload data from that transaction and then use this information to assess the start and end of the payload data for that specific transaction in the binary file.
- 5 Click **Save**.
- 6 Click **Export**.

A sample of the raw ONFi data exported to a .csv file is displayed.

S#	Timestamp	Target#	Type	Hex/Length	Timestamp End
1	0 s	0	Command	60	
2	272 ns	0	Address	00	
3	472 ns	0	Address	61	
4	660 ns	0	Address	00	
5	879 ns	0	Command	DA	
6	2.340 us	0	Command	80	
7	2.619 us	0	Address	30	
8	2.834 us	0	Address	00	
9	3.192 us	0	Address	00	
10	3.392 us	0	Address	60	
11	3.581 us	0	Address	00	
12	3.900 us	0	DataInLong	22A0	27.313 us
13	28.162 us	0	Command	85	
14	28.555 us	0	Address	00	
15	28.770 us	0	Address	00	
16	29.089 us	0	DataInLong	30	29.200 us
17	30.091 us	0	Command	85	
18	30.483 us	0	Address	D0	
19	30.698 us	0	Address	22	
20	31.017 us	0	DataInLong	30	31.128 us





