Xgig Jammer and Delay Emulator

Version 8.1

User's Guide

Xgig Jammer and Delay Emulator

User's Guide

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Contents

About this Guide

This guide discusses the following Xgig Maestro products:

- Xgig Jammer
- Xgig Delay Emulator

Who Should Read this Guide

This guide is intended for networking professionals in research and development who need to monitor and test network performance. It is assumed that users of this guide have an engineering background.

What this Guide Contains

This guide is organized into three parts:

- PART ONE: Using Xgig Jammer which includes chapters 1 through 9.
- PART TWO: Using Delay Emulator which includes chapters 10 through 13.
- PART THREE: Appendices which includes appendices Athrough E.

The chapters contain the following information:

Chapter 1, “Introducing Xgig Jammer"” describes the Jammer features and capabilities.

Chapter 2, “Using the Jammer Tab"” describes the Jammer tab interface and provides procedures to use it.

Chapter 3, “Creating Jammer Test Configurations for Fibre Channel"” describes the elements on the Xgig Jammer Configuration FC window and how to use them.

Chapter 4, “Creating Jammer Test Configurations for Gigabit Ethernet"” describes the elements on the Xgig Jammer Configuration GE window and how to use them.

Chapter 5, “Creating Jammer Test Configurations for SAS and SATA/STP"” describes the elements on the Xgig Jammer SAS/SATA/STP Configuration window and how to use them.

Chapter 6, “Creating Jammer Test Configurations for 10GigE"” describes the elements in the Xgig Jammer Configuration 10GigE window and how to use them.

Chapter 7, “Creating Jammer Test Configurations for 16G FC"” describes the elements in the Xgig Jammer Configuration 16G Fibre Channel window and how to use them.

Chapter 8, “Creating Jammer Test Configurations for PCIe"” describes the elements in the Xgig Jammer Configuration PCIe window and how to use them.

Chapter 9, “Xgig Jammer Application Notes"” provides examples of how to use the Jammer in practical situations.

Chapter 10, “Introducing Xgig Delay Emulator"” describes the Jammer features and capabilities.

Chapter 11, “Using the Delay Emulator Tab"” describes the Jammer tab interface and provides procedures to use it.

Chapter 12, “Creating Delay Emulator Test Configurations for Delay Mode"” describes the elements on the Xgig Delay Emulator Configuration Delay window and how to use them.

Chapter 13, “Creating Delay Emulator Test Configurations for Reorder Mode"” describes the elements on the Xgig Delay Emulator Configuration Reorder window and how to use them.

Appendix A, "Fibre Channel Ordered Sets - Partial List" contains some of the Ordered Set values that are used in this application.

Appendix B, "8-Bit/10-Bit Mapping" contains three tables: one is legal 8-bit/10-bit characters sorted by 10-bit value; the second is 10-bit values with no 8-bit mapping sorted by 10-bit value; the third is legal 10-bit values sorted by K/D code.

Appendix C, "Fibre Channel Legal Arbitrated Loop Physical Addresses" contains translation tables.

Appendix D, "Gigabit Ethernet Ordered Sets - Partial List" contains a table of these values.

Appendix E, "Primitive Encoding" contains a table of K28.5-based Primitive encoding whose 40-bit values have a Hamming distance of at least 8.

Conventions

The following conventions are used in this guide.

Message Formats

This guide uses the following format to highlight special messages:

Note: This format is used to highlight information of importance or special interest.

Caution: This format is used to highlight information that will help you prevent equipment failure or loss of data.

Typographical Conventions

This guide uses the following typographical conventions:

bold sans serif	Commands
italics	Directory names, book titles, named key, for example the *Enter* key
`courier font`	Screen text, user-typed command-line entries

Technical Assistance

If you require technical assistance, call 1-844-GO-VIAVI (1-844-468-4284) or e-mail Techsupport-snt@viavisolutions.com.

For the latest TAC information, go to http://www.viavisolutions.com/en/services-and-support/support/technical-assistance.

PART ONE: Using Xgig Jammer

Chapter 1

Introducing Xgig Jammer

In this chapter:

Xgig Jammer Overview

The Xgig Jammer includes hardware (Xgig Multi-function Blade) and software that performs real-time data modification for PCIe, Fibre Channel, Gigabit Ethernet, 10GigE, Serial Attached SCSI (SAS), and Serial ATA (SATA) protocols. You can use the Jammer with Xgig Analyzers or Bus Doctor to capture and display the network traffic associated with the data modification.

The Xgig Jammer should be used as a digital retiming device. The Xgig Jammer blade re-times the data and re-transmits it with a new clock transparent to the data link (it passes every bit of data.) The Xgig Jammer blade functions in any PCIe, Fibre Channel, Gigabit Ethernet, 10GigE, SAS, or SATA architecture. It does not log onto a loop, switch, or fabric; it only passes data between two devices. The Xgig Jammer blade can pass PCIe, Fibre Channel, Gigabit Ethernet, 10GigE, SAS, or SATA traffic, or it can recognize an event or event sequence and modify the traffic. The events can be Ordered Sets, frames, Primitives, Control Characters, SOF, or EOF depending on the selected protocol. A specific Ordered Set, series of Ordered Sets, Primitive Sequence, or Control Character can be modified or replaced. A specific frame or series of frames can be modified in many ways: replacing a frame with idles, truncating a frame, inserting a frame, or changing any bits within a frame.

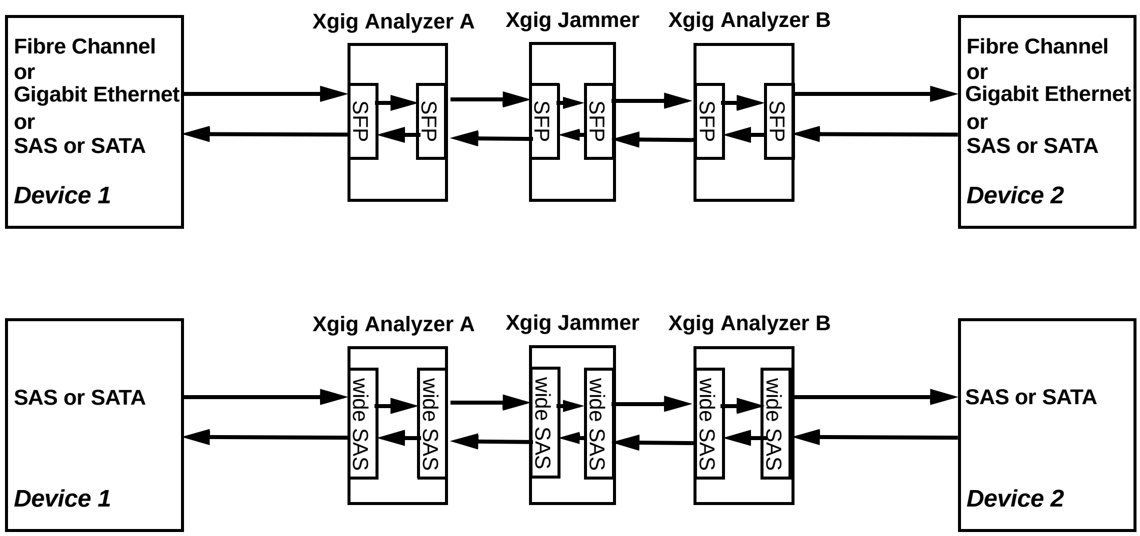
Note: The events and traffic modification options vary with each protocol.

The data modifications are performed on the 8-bit representations of the Ordered Sets, frames, Primitives, Control Characters SOF, and EOF. This ensures that the Xgig Jammer module always produces consistent PCIe, Fibre Channel, Gigabit Ethernet, 10GigE, SAS, and SATA traffic without disparity errors or clock discontinuities. The exception to this is when the Xgig Jammer is used to insert disparity errors or code violations into a frame, Ordered Set, or Primitive.

Figure 1 shows an example of a configuration where the Xgig Jammer and Xgig Analyzer are inserted into a network with two data paths, designated A and B.

The Xgig Jammer module can detect a Trigger Event and modify data in Path A. The response from Device 2 is detected on Path B.

Figure 1: Duplex Xgig Jammer in Crossover Configuration with Xgig Analyzers



Note: When the Jammer is used in a SATA (or Serial ATA Tunneling Protocol—STP) environment, the Jammer is required to modify the traffic automatically in order to support the flow control mechanism. This happens even if the Jammer is not started, and is only passing through traffic. Therefore, SATA_HOLD and SATA_HOLDA Primitive Sequences are usually not passed through the Jammer, but instead, the Jammer generates its own SATA_HOLD and SATA_HOLDA Primitive Sequences on the fly to maintain flow control with Device 1 and Device 2. Consequently, the Jammer does not allow Jamming of SATA_HOLD or SATA_HOLDA Primitive Sequences because it would not be Jamming actual received traffic.

Features

Xgig Jammer has the following features:

Operation

The Xgig Jammer system (hardware and software), allows you to perform the following operations:

- Change predefined network serial traffic patterns to new patterns.

  The Xgig Jammer modifies Trigger Events in the manner you specify. It does not insert or remove network traffic, except for the re-timing circuit that adds or drops appropriate Ordered Sets or Primitives. An exception is in the SAS protocol, where the Jammer might need to rearrange the ordering of Primitives inside a frame so that the first thirty-two, 32-bit words of a frame are not too spread apart for accurate triggering. Another exception is the automatic SATA flow control that is performed.
- Pass traffic, unchanged, that does not match the Trigger Condition pattern.
- Reproduce a pattern change at will.

  You can define multiple, sequential, arbitrary Jam cases by entering each of them into a test suite list. Each case can be unique or you can repeat a case within the suite.

Capabilities

The Xgig Jammer has the following capabilities:

- Operates with Fibre Channel, Gigabit Ethernet, 10GigE, SAS, and SATA protocols

  Depending on the license you purchase, you can select the protocol that your network uses and display the graphical user interface for that protocol.
- Supports the following line rates:
  - Fibre Channel:
    - 1.0625 Gbps
    - 2.1250 Gbps
    - 4.2500 Gbps
    - 8.5000 Gbps
    - 14.0250 Gbps
  - Gigabit Ethernet:
    - 1.2500 Gbps (GigE blades run only at this rate.)
    - 10.3125 Gbps (10GigE blades run only at this rate.)
  - SAS/SATA:
    - 1.5 Gbps
    - 3.0 Gbps
    - 6.0 Gbps
    - 12.0 Gbps (SAS only)

- Operates in digital re-timing mode at all times.
- In SAS and SATA, the Jammer auto negotiates out of band (OOB) with other hardware on your network.

  You can also force the link to perform OOB at any time. You can force the Jammer to speed-negotiate to a particular speed.
- Allows you to generate a test suite with up to 1024 separate Test Cases per run.

  Contains standard editing features such as copy, cut, paste, add, insert, and delete to edit the test suite. An option lets you run the test suite forever in a repeating loop.
- Provides the appropriate MAC (media access control) layer for Fibre Channel, Gigabit Ethernet, 10GigE, or SAS/SATA when you load the application.

Triggering Capabilities

The Xgig Jammer module provides the following Triggering capabilities:

- You have two levels of triggering:
  - Arm (first level)
  - Trigger (second level)
- You can set an Arm condition as a specific Ordered Set, frame, or Primitive Sequence, or as an external Trigger Condition. An external Trigger Condition comes from outside the port (from another port in the same domain or from a TTL-in connector in the same domain).
- You can set the Jammer to repeatedly Arm and/or Trigger on an Ordered Set, frame, Primitive Sequence, Control Character, SOF, or EOF.
- You can set the Jammer to create an external trigger output when the Trigger condition is met. This triggers everything in the same domain as the Jammer port.

Jamming Capabilities

The Xgig Jammer can perform the following types of Jams on the contents of frames:

- Pass a 32-bit word unchanged
- Replace a 32-bit word with a new value, masked nibble by nibble
- Corrupt a 32-bit word with a code violation (Fibre Channel, Gigabit Ethernet, and 10GigE)
- Corrupt a byte with a disparity error or code violation (SAS and SATA only)
- Invert a 32-bit word’s specified bit(s)
- Replace a 32-bit word with a new value, masked bit by bit, according to a preset global definition
- Invert a 32-bit word’s specified bit(s) according to a preset global definition.
- Replace a 32-bit word with a calculated CRC value (Fibre Channel, SAS and SATA only)
- Set a 32-bit word’s specified bit(s) to 1
- Set a 32-bit word’s specified bit(s) to 0
- Replace triggered frame with a 10 bit frame (SAS/SATA only)

- Insert a frame after the triggered frame (10GigE and 16G FC only)
- Insert D.C. Idle into a frame (SAS/SATA only)
- Truncate the target frame to a shorter length
- Duplicate a frame (10GigE and 16G FC only)
- 66-bit Block Jam (16G FC only)
- Insert Dword within frame (10GigE ad 16G FC only)

The Xgig Jammer can perform the following types of Jams on Ordered Sets Primitive Sequences, Control Characters, EOF and SOF:

- Pass the Ordered Set or Primitive Sequence unchanged
- Replace the Ordered Set or Primitive Sequence with another standard or user-defined Ordered Set or Primitive Sequence
- Corrupt the Ordered Set with a code violation (Fibre Channel and Gigabit Ethernet)
- Corrupt any byte(s) in the Primitive Sequence with a disparity error or code violation (SAS and SATA only)
- Replace the 32-bit word containing an /S/ character with idles [/I] (10GigE and 16G FC only).
- Replace the 32-bit word containing an /S/ character with idles [/I] (10GigE and 16G FC only).
- Insert a frame after a standard or user defined Ordered Set (10GigE and 16G FC only)
- Perform FEC error injection (16G FC only)

New Features

The following new features have been released in this version of Xgig Jammer.

- Xgig Jammer32-bit client software is supported on both 32-bit and 64-bit versions of the Windows operating systems. Refer to the *Xgig Maestro Software Installation Guide* for the complete list of supported operating systems.

Chapter 2

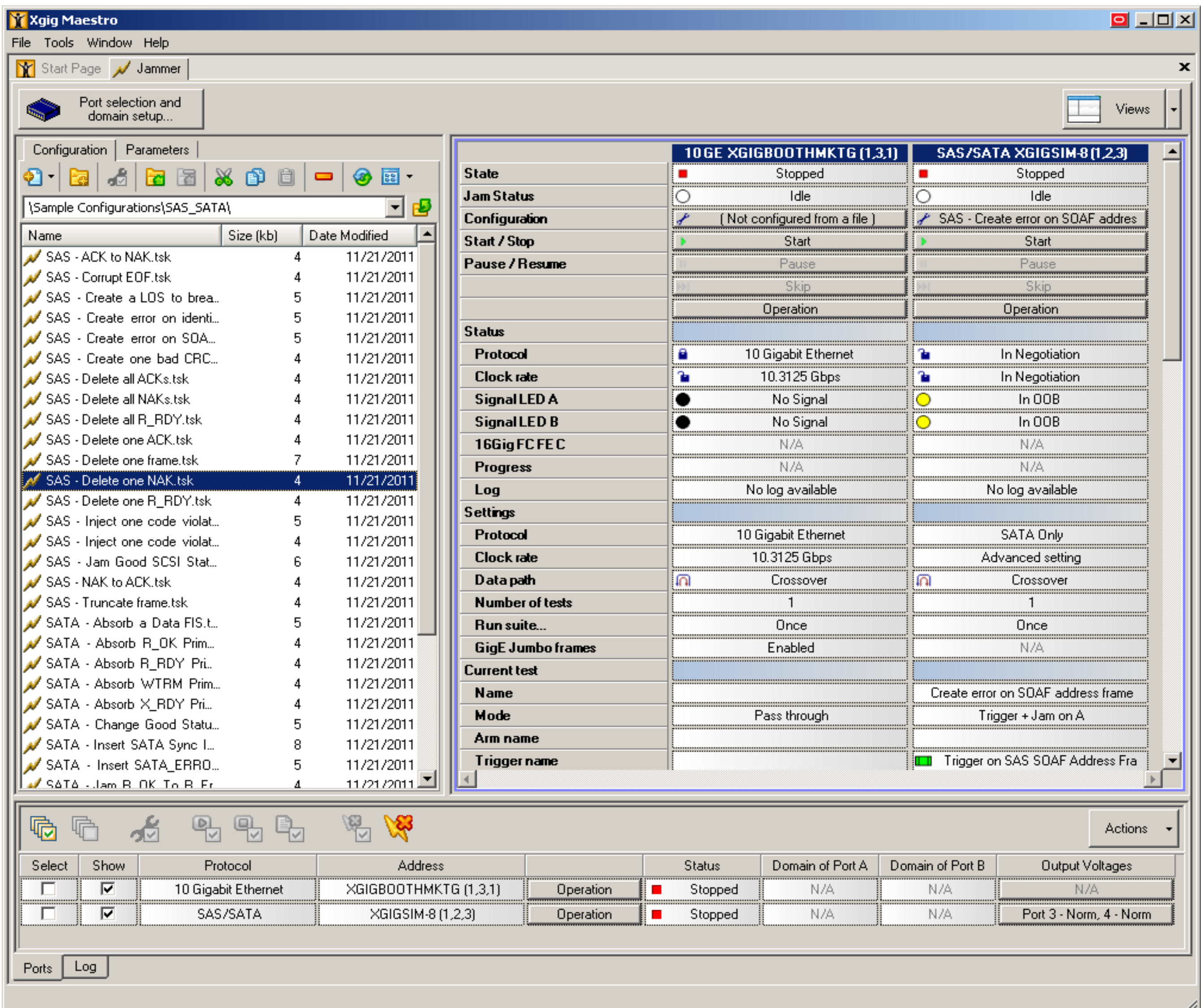
Using the Jammer Tab

In this chapter:

After you have discovered and locked the Jammer ports that you want to use and have set up your capturing and monitoring applications, such as Xgig Analyzer or Bus Doctor, you are ready to run the Xgig Jammer application. This chapter provides an overview of the Jammer tab, on the Xgig Maestro main window, and its functions; it also includes steps to run predefined tests supplied with the Xgig Jammer application or tests you have defined and saved.

You should have launched Xgig Maestro and locked at least one device as described in the *Xgig Maestro Introduction Guide*. The Xgig Maestro window is displayed with the Jammer tab on the right. This tab is where you operate the Jammers you have locked.

Figure 2: Xgig Jammer Tab on Xgig Maestro Window



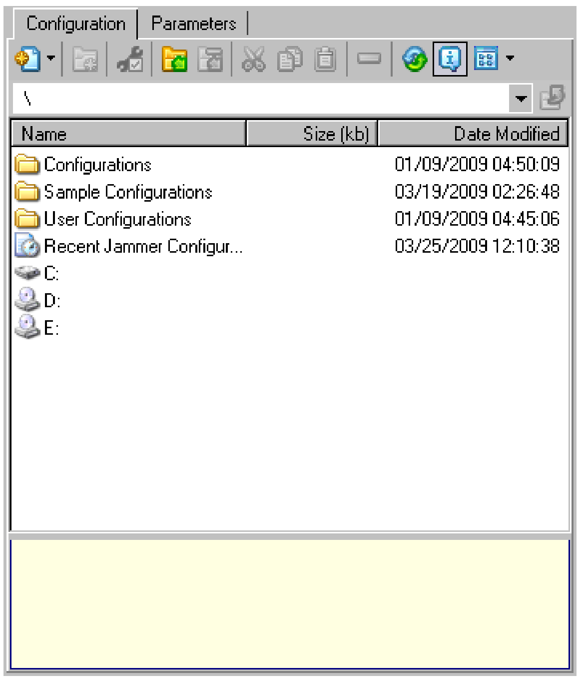
Using the Configuration Manager in Jammer

The Configuration manager (Figure 3) is associated with the device function tab, BERT and Jammer. This window allows you to select the protocol you want to use. This window also displays the configuration files specific to the function tab displayed. The **Sample Configurations** folder includes configurations that are provided with the application. The **User Configurations** folder is where the configurations you create are saved. The **Most Recently Used** folder allows you easy access to those configuration files most recently used. The Configuration Manager also includes a list of all the drives on your system allowing you to locate any configuration files on your system quickly.

The Configuration manager has the following features:

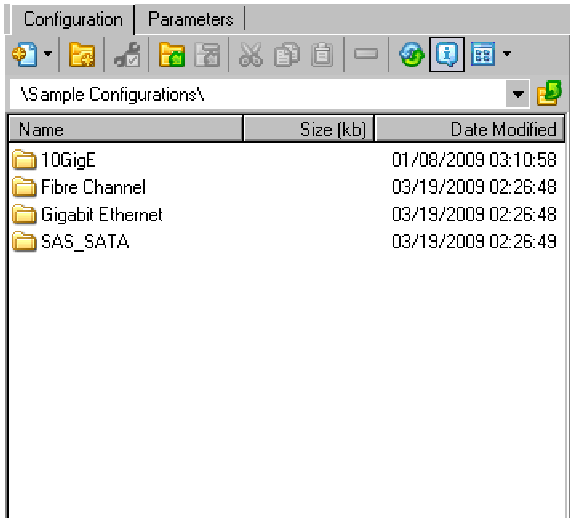
- The Configuration manager provides a list of test configurations organized into folders and lists all the drives on your system allowing you to easily browse to locate all of your configuration files on your system

Figure 3: File Location in Jammer Configuration Manager



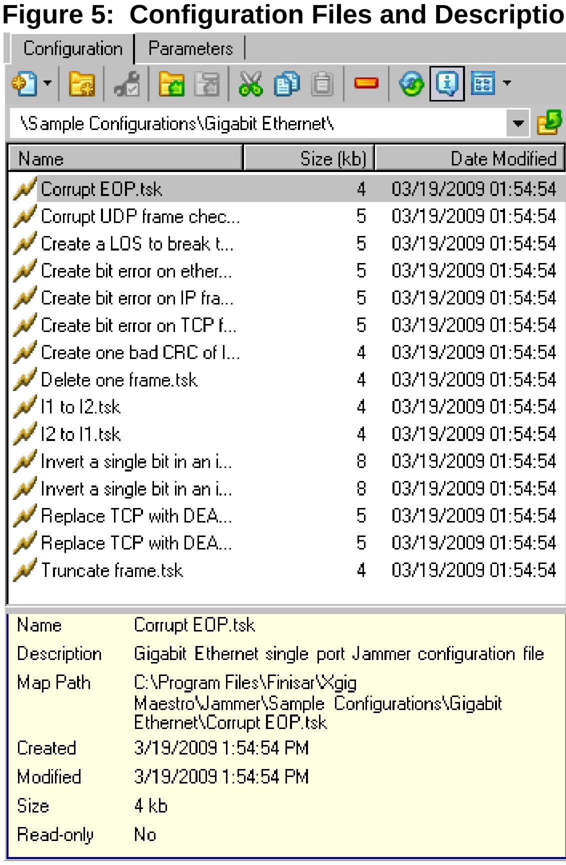
- The configurations files in the **Configurations**, **Sample**, and **User Configurations** folders are organized according to protocol. When you open one of these folders, the Configuration Manager provides you with a list of protocols to select.

Figure 4: Protocol Selection in Jammer Configuration Manager



- List of configuration files in a folder

Figure 5: Configuration Files and Description Pane



- Description pane
  - — When you select a configuration file in the list, a description of the file is displayed in the description pane below. It also displays the name of the file, the path where the file is located, the size of the file, the date and time when the file was created, the date and time the file was modified, whether the file is read-only and the Map path where the file is located on your system.
  - — When you click the Show/Hide button below the Description pane, you display or hide this pane.
- Drag and drop files

  You can drag any configuration from the Configuration manager list onto a device column to load it.
- Tool bar that lets you create, load, copy, cut, and paste configuration files. See "Configuration Manager Tool Bar in Jammer" on page 17 for more information on this tool bar.
- Context menu

  Select a configuration file name, and right-click to display a menu where you can choose to create and edit configuration files, and additional operations. See "Configuration Manager Context Menu in Jammer" on page 18 for more information about these menus.
- Browse to map folders of files stored in locations other than the default Sample and User Configuration folders.

Configuration Manager Tool Bar in Jammer

The Configuration manager tool bar (Figure 6) allows you to perform the following functions:

New Configuration allows you to open the Configuration window and create a new Jammer configuration from scratch.

New Folder allows you to create a new folder.

Load allows you to load a configuration file into a port or ports. This icon is only active when a port has been locked and is selected in the Port Manager. See "Loading Jammer Configuration Files" for details.

Map allows you to select a folder that you want to be listed in the Configuration Manager for the selected function tab.

Unmap allows you to unmap a folder that has been mapped.

Cut allows you to cut a file from its current location. This is not the same as deleting a file.

Copy allows you to copy a file.

Paste allows you to paste a file you have cut or copied.

Delete allows you to delete a file or folder.

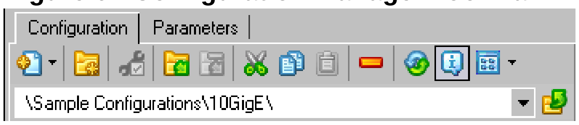
Path allows you to go up one level in the folder tree. This field next to this icon displays the current folder name.

Refresh allows you to refresh the Configuration Files and Description pane.

Show/Hide allows you to show or hide the details for the selected file. These details appear in the lower section of the Configuration Manager pane.

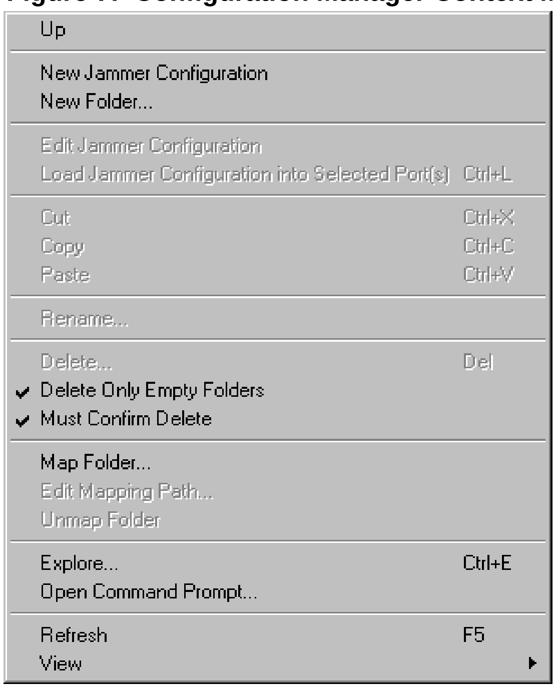
View allows you to view the files in the Configuration Manager as a list including only the file name or to view the details of the files in the list.

Figure 6: Configuration Manager Tool Bar in Jammer



Configuration Manager Context Menu in Jammer

Figure 7: Configuration Manager Context Menu in Jammer



Right-click in the list to choose the following actions from the context-sensitive menu:

- **Up**

  Displays the contents one folder level up from the current display.

- **New Jammer Configuration**

  Opens a new Jammer configuration window for editing.

- **New Folder**

  Opens the Configuration manager dialog where you can enter the name of a new folder you want to add.

- **Edit Jammer Configuration**

  Opens the file highlighted in the list, the same as double-clicking on the file name.

- **Load Jammer Configuration into Selected Port(s)**

  Loads the file highlighted in the list into the port(s) selected in the Ports Manager. See "Using the Ports Manager in Jammer."

- **Cut**

  Removes a selected file or folder from the list.

- **Copy**

  Copies a selected file or folder to a clipboard making it available to paste in another location.

- **Paste**

  Pastes a file or folder you cut or copied to the location you choose.

- **Rename**

  Opens a dialog with the current file or folder name displayed in an entry field that you can modify. It also shows the protocol, path, and current file or folder name.

- **Delete**

  Opens a dialog where you can confirm whether you want to delete the highlighted file (configuration) or folder from the list.

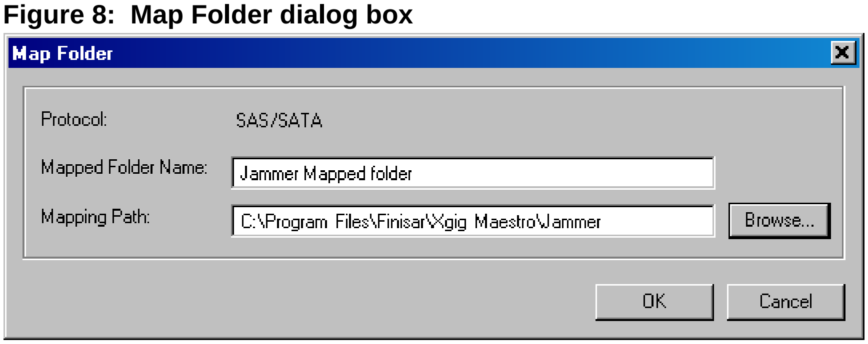
- **Must Confirm Delete**

  Sets this choice as a preference that opens a dialog to confirm that you want to delete a file or folder from the list. When you select it, a check mark is displayed next to it. It is selected by default.

- **Map Folder**

  Opens the Map Folder dialog box that lets you map a folder to a name of your choice.

Figure 8: Map Folder dialog box



  Enter a name of your choice in the Mapped Folder Name field, and use the **Browse** button to select the folder on your system or network you want to map to this name.

- **Edit Mapping Path**

  Allows you to edit the mapping path.

- **Unmap Folder**

  Removes a highlighted mapped folder from the Configuration manager.

- **Explore**

  Opens a Windows Explorer window showing the directory where the current configuration files are located.

- **Open Command Prompt**

  Opens a Windows Command Prompt window showing the directory where the current configuration files are located.

- **Refresh**

  Refreshes the Configuration Manager window.

- **View**

  Has two choices:

  — List

    Displays the list of files or folders in the path you choose.

  — Details

    Displays the list of files or folders with the size and modification date.

Using the Parameters Status Table in Jammer

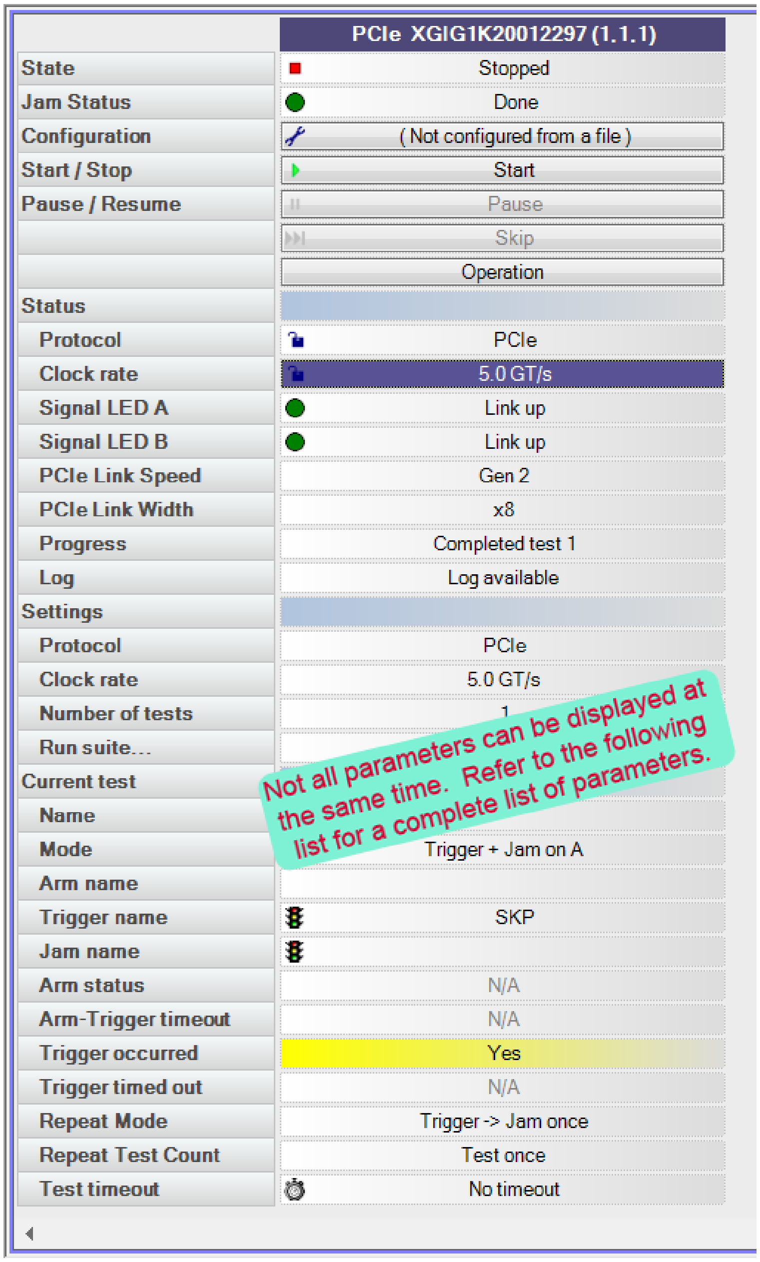
Each Jammer device (a simplex Jammer or a duplex Jammer is considered as one device) is displayed by a column on the Jammer tab (Figure 9). At the top of each column is the protocol, the chassis name, and in parenthesis the chassis number, the slot number and port number(s) in parenthesis.

To configure how to display the ports in the Parameters Status Table, click on the Views button and do the following:

Select or unselect **Configuration** to display or hide the Configurations tab and Parameters tab where you manage Jammer configuration files and select the Parameters to display, respectively.

Click **Ports** to display or hide the Port Status table.

Figure 9: Jammer Parameters Status Table



The first column on the tab is the legend for each row in the device columns and contains the following categories:

- State
- Jam Status
- Configuration
- Status
- Settings
- Current test

Parameters Category Descriptions

State

This row shows the state of the Jammer: Disconnected, Connecting, Paused, Pausing, Running, Skipped, Skipping, Starting, Stopped, or Stopping.

Jam Status

Displays the state of the Jam defined in the currently loaded configuration file: Idle, Waiting for Trigger, Done, Skipped, Timed Out.

Configuration...

Displays the name of the configuration file, if any, loaded into the port.

Start/Stop

Click this button to Start or Stop a test. The green arrow icon indicates you can click the button to Start the test. The red box indicates you can click the button to stop the test.

Pause/Resume

Click this button to pause or resume a test suite that is running.

Skip

Click this button to skip a test that is running and move to the next test in the suite.

Operation

Opens the Operation dialog box.

Status Category

This category gives the status of the test suite that you have loaded into the Jammer.

Protocol

Indicates the protocol of the Jammer: Fibre Channel, Gigabit Ethernet, SAS, or SATA. You choose a protocol in the Port Selection and Domain Setup window when you lock ports. The small lock icon indicates that the protocol cannot be changed at this stage. For SAS and SATA Jammer, you may choose the protocol between SAS and SATA using the **Edit protocol and speed settings** option.

Clock rate

Indicates the Jammer clock rate. The closed lock icon indicates you cannot currently change the clock rate; the open lock icon indicates you can change the clock rate.

In Gigabit Ethernet, the clock rate is always 1.2500 Gbps, therefore, the icon is always locked.

In 10 Gigabit Ethernet, the clock rate can be either 1.0625 or 10.3125 Gbps.

In Fibre Channel, the clock rate can be 1.0625 Gbps, 2.1250 Gbps, 4.2500 Gbps, 8.5000, or 14.0250 Gbps.

In SAS and SATA, you can choose to auto-negotiate to any speed. You can also set the Jammer to force the link to only negotiate to either 1.5 Gbps, 3.0 Gbps, or 6.0 Gbps.

Both ports in a port pair must always be set to the same clock rate. Therefore, if you have two single Jammers, and one of them is running, the clock rate is locked on both.

Signal LED A and Signal LED B

These two indicators change color, green, red, yellow, black, depending on the link status. They also match the **Link** status LEDs on the front panel of the blade in the Xgig chassis. Refer to the table below for the description of each LED color.

Table 1: Xgig Jammer Blade LEDs

Label on Blade	Blade	Parameters Status table-Signal A, Signal B
In Use	• Green when port locked by client application • Black otherwise	
Link (3G) **Signal (6G)**	• Green -FC, GE: when traffic is good • Green-SAS/SATA: Speed set • Yellow -FC, GE: Loss Of Synchronization • Yellow-SAS/SATA: No speed set (Before OOB/In OOB) • Blinking Yellow -SAS/SATA: In OOB • Off-FC, GE:Loss Of Signal • Off-SAS/SATA: No signal (nothing connected)	• Green -FC, GE: when traffic is good • Green-SAS/SATA: Speed set • Yellow -FC, GE: Loss Of Synchronization • Yellow-SAS/SATA: No speed set (Before OOB/In OOB) • Blinking Yellow -SAS/SATA: In OOB • Black-SAS/SATA: No signal (nothing connected
Signal (12G)	• Green (solid) - Link present • Green (flashing) Traffic is coming	

16G FC FEC

This setting is only for 16G FC with the speed set at 14.0250 Gbps. Unlocked indicates that the setting is Auto. This is the default setting. To set this setting, select FEC Mode from the context menu, then select Auto, On, or Off. When this is set to On, the table will read “Locked”, and there will be a green dot next to the table entry.

PCIe Link Speed

Indicates the link speed of the PCIe generation, Gen1 or Gen2.

PCIe Link Width

Indicates the link width of the PCIe link in lanes.

Progress

Indicates where the Jammer is in the test suite while it is running or where it is stopped or paused.

Log

Indicates if a log from the last operation is available for viewing.

Settings Category

This category indicates the current physical setup of the Jammer device. You can change most of the settings in this category by using the Parameters Status context menu for each device you have locked.

Protocol

Indicates the current protocol setting for the Jammer: Fibre Channel, 16G FC, Gigabit Ethernet, 10GigE, SAS, or SATA. To change the Protocol, you must select a device (port) from the port context menu in the Port Selection and Domain Setup window.

For SAS and SATA you can edit the protocol and the speed from the Parameters Status context menu.

Clock Rate

Indicates the Jammer clock rate. The clock rate options and behavior is different for the protocols and speeds. The clock rate options may include 1.0625 Gbps, 1.2500 Gbps, 2.1250 Gbps, 2.5000 Gbps, 4.2500 Gbps, 8.5000, 10.3125, or 14.0250 Gbps, depending on the blade. Both ports in a port pair must always be set to the same clock rate. Therefore, if you have two Jammers, and one of them is running, the clock rate is locked on both of them. See “Changing the Clock Rate of a Jammer” on page 31 for instructions on changing the clock rate.

Number of tests

Displays the number of Test Cases in the currently loaded test suite. You can change the number of Test Cases to run in the Jammer Configuration window.

Run suite…

Indicates if the test suite is set to run only once or to loop forever (until you click **Stop**).

GigE Jumbo Frames

This indicates if Gigabit Ethernet jumbo frame support is enabled. (This is only available in the Gigabit Ethernet Jammer.) When enabled, the Jammer supports jumbo frames up to 16 KB in size, however, the latency through the port is about 136 microseconds. Otherwise, only normal 1500 byte frames are supported, with a latency of about 17 microseconds.

Current Test Category

This group of parameters gives information and status about the current test in the test suite that the Jammer is running or about to run.

Name

Displays the name of the current test.

Mode

Displays the current test mode setting that you set in the Jammer Configuration window.

Arm name, Trigger name, and Jam name

Displays the names given to each of the components of the current test.

Arm status

For a Test Case with an Arm condition, this indicates if that condition has been met.

Arm-Trigger timeout

Displays the number of 32-bit words the Jammer waits for the Trigger condition to be met after the Arm condition has been met. After this expires, the Jammer rolls back to wait again for the Arm condition.

Trigger occurred

Indicates if a trigger and Jam have occurred for this test case.

Trigger timed out

Indicates if the Arm-Trigger timeout has ever occurred for this Test Case.

Repeat Mode

Indicates the Test Case mode and whether or not it is repeated. You set this in the Jammer Configuration window, Test Case Repeat settings dialog.

Repeat Count

Indicates the number of times the Test Case is repeated.

Test Timeout

Indicates the total amount of time you have set the Jammer to wait for a Test Case to fully complete (including all repeats) before aborting and going to the next Test Case, preceded by the amount of time currently left. For example, when the Jammer is in the running state, the timer would show 59 sec/1:30 for a test configured to timeout after one minute, thirty seconds, while 59 seconds remain before the timeout.

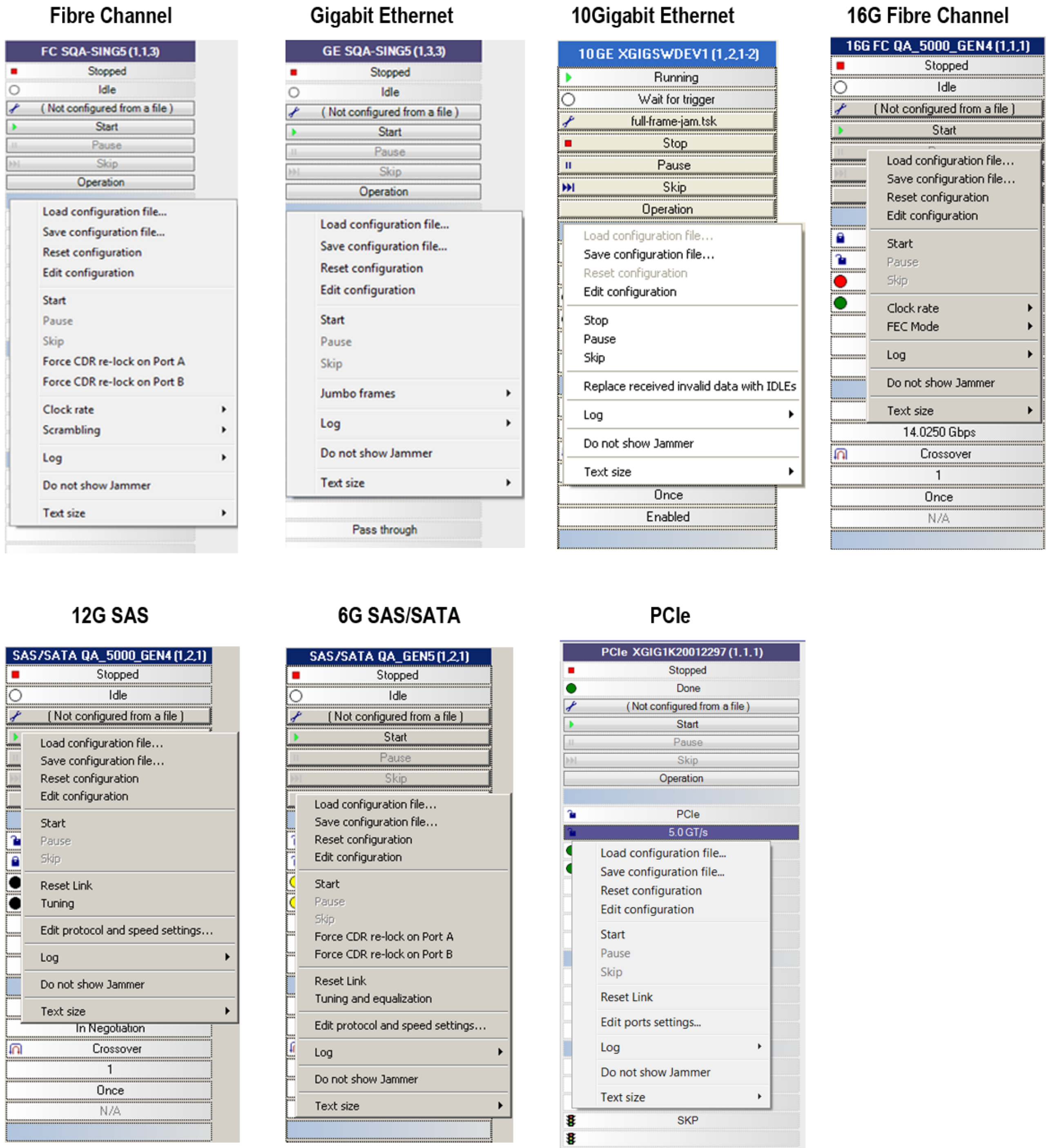
Using the Parameters Status Context Menu in Jammer

Right-click on the Parameters Status table to display the context menus shown in Figure 10. Each protocol has a unique context menu. The available operations are displayed for the column in which you click. This menu provides controls for configuration files, for setting clock rates, allowing jumbo frames, logging test activity, removing a Jammer from the Parameters Status table, and the appearance of the status table.

Refer to the following pages for more information about the how to use the context menu choices:

- "Using the Parameters Status Table in Jammer" on page 21 for information about the parameter settings you make from these menus.
- "Running the Test Suite on a Jammer Device" on page 62 for information about running the Jammer.
- "Using the Log Manager in Jammer" on page 50 for choosing log preferences.
- "Performing Configuration Tasks in Jammer" on page 60 for information about using the Load configuration file, Save configuration file, Reset configuration, and Edit configuration selections from these menus.

Figure 10: Jammer Parameters Status Table Context Menus



Changing the SAS/SATA Protocol Setting of a Jammer

The procedure for changing the SAS/SATA protocol setting depend on the blade’s speed.

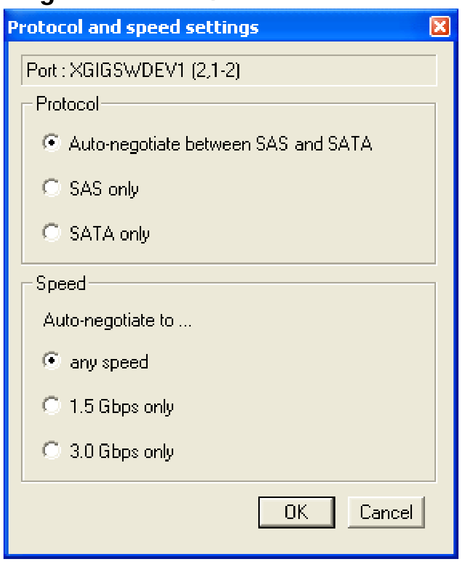
Changing the Protocol Setting for 3G Blades

To edit the SAS and SATA protocol setting on a 3G blade:

1 Select **Edit protocol and speed settings** from the Parameters Status context menu.

A dialog is displayed that lets you choose Auto-Negotiate between SAS and SATA (the default), SAS only, SATA only (Figure 11).

Figure 11: SAS/SATA Protocol Setting Dialog for 3G Blades



2 Click a radio button to choose the protocol.

3 Click **OK** to close the dialog and apply the settings.

You will receive a warning message. Click **OK** to apply the setting and reset the link, or click **Cancel** to discard the changes.

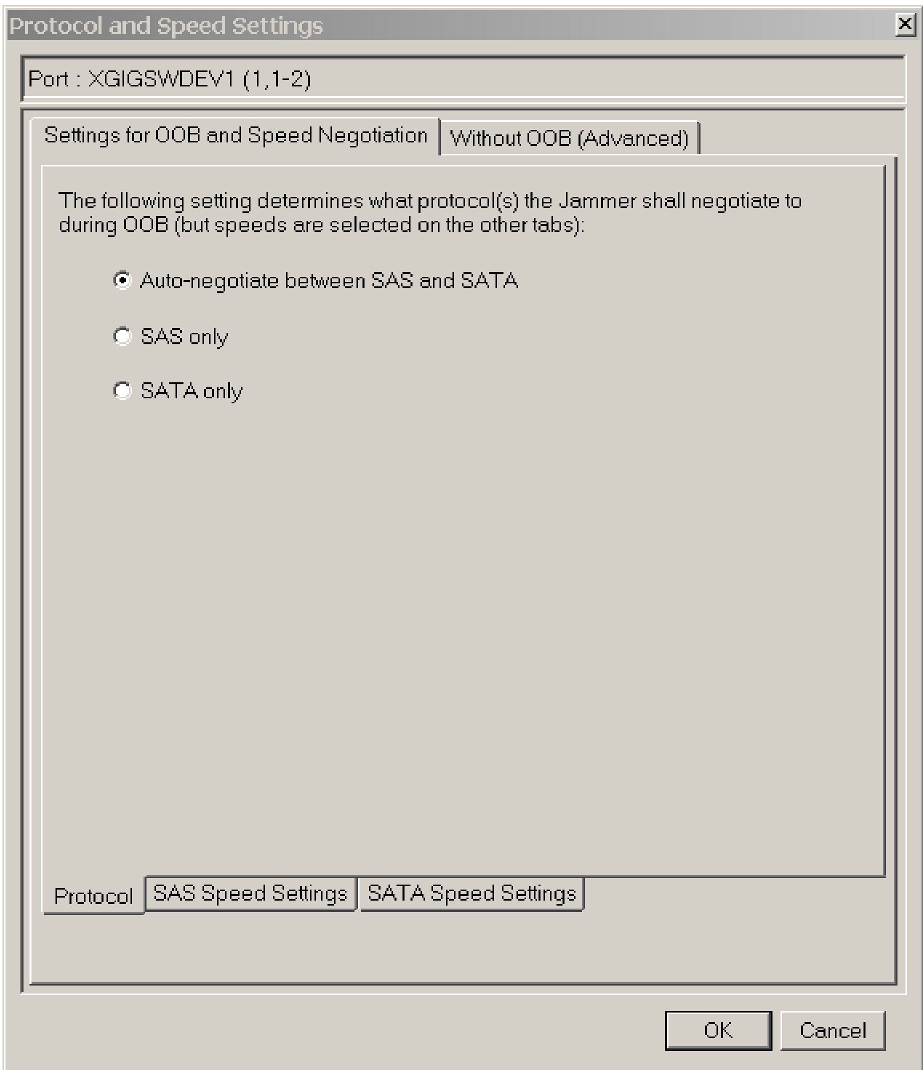
Changing the Protocol Setting for 6G Blades

To edit the SAS and SATA protocol setting on a 6G blade:

1 Select **Edit protocol and speed settings** from the Parameters Status context menu.

A dialog is displayed that lets you choose Auto-Negotiate between SAS and SATA (the default), SAS only, SATA only (Figure 12).

Figure 12: SAS/SATA Protocol Setting Dialog for 6G Blades



2 Click a radio button to choose the protocol on the Protocol tab.

3 If you made a change from the previous setting, the option below will appear at the bottom of the dialog.

Check this check box if you want the link to reset when the change is applied upon clicking **OK**. Otherwise, clicking **OK** will apply the change, but the protocol will not change until the next time OOB initialization occurs.

4 Click **OK** to close the dialog and apply the setting.

Changing the Clock Rate of a Jammer

The procedure for changing the clock rate for a port depend of the blade's speed and selected protocol.

Changing the Fibre Channel Clock Rate for All But 6G Blades

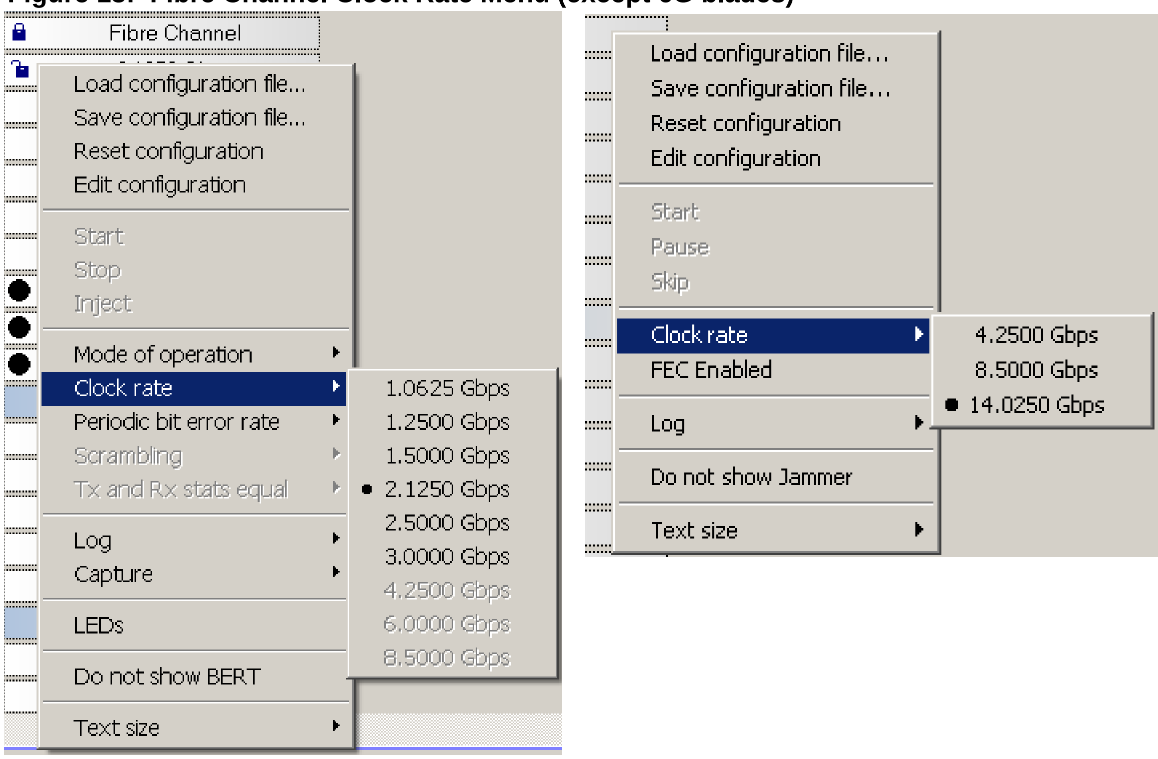
To change the clock rate or speed on all but 6G blades for the Fibre Channel protocol:

1 Right-click anywhere on the specific device column to open the Parameters context menu.

2 Select **Clock rate**.

The speed choices are displayed (Figure 13).

Figure 13: Fibre Channel Clock Rate Menu (except 6G blades)



3 Click to choose one.

A bullet is displayed to the left of the currently operating selection.

4 Click **OK** to close the dialog.

You will receive a warning message. Click **OK** to apply the setting and reset the link, or click **Cancel** to discard the changes.

Changing the Gigabit Ethernet Clock Rate for All But 6G Blades

To change the clock rate or speed on all but 6G blades for the gigabit ethernet protocol:

1 Right-click anywhere on the specific device column to open the Parameters context menu.

2 Select **Clock rate**.

The speed choices are displayed (Figure 13).

3 Click to choose one.

A bullet is displayed to the left of the currently operating selection.

4 Click **OK** to close the dialog.

You will receive a warning message. Click **OK** to apply the setting and reset the link, or click **Cancel** to discard the changes.

Changing the SAS/SATA Clock Rate for 3G Blades

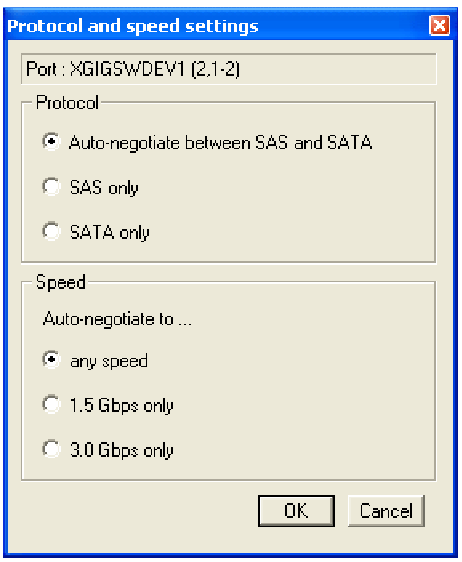
To change the clock rate or speed 3G blades for the SAS/SATA protocol:

1 Right-click anywhere on the specific device column to open the Parameters context menu.

2 Select **Edit Protocol and speed settings** for SAS or SATA Jammer.

The speed choices are displayed (Figure 14).

Figure 14: SAS/SATA 3Gbps Speed Settings Dialog



3 Click to choose one.

You can also specify one or both protocols. Refer to “Protocol” on page 25.

4 Click to choose one.

5 Click a radio button in the in the **Speed** section of the **Protocol and speed setting** dialog.

6 Click **OK** to close the dialog.

You will receive a warning message. Click **OK** to apply the setting and reset the link, or click **Cancel** to discard the changes.

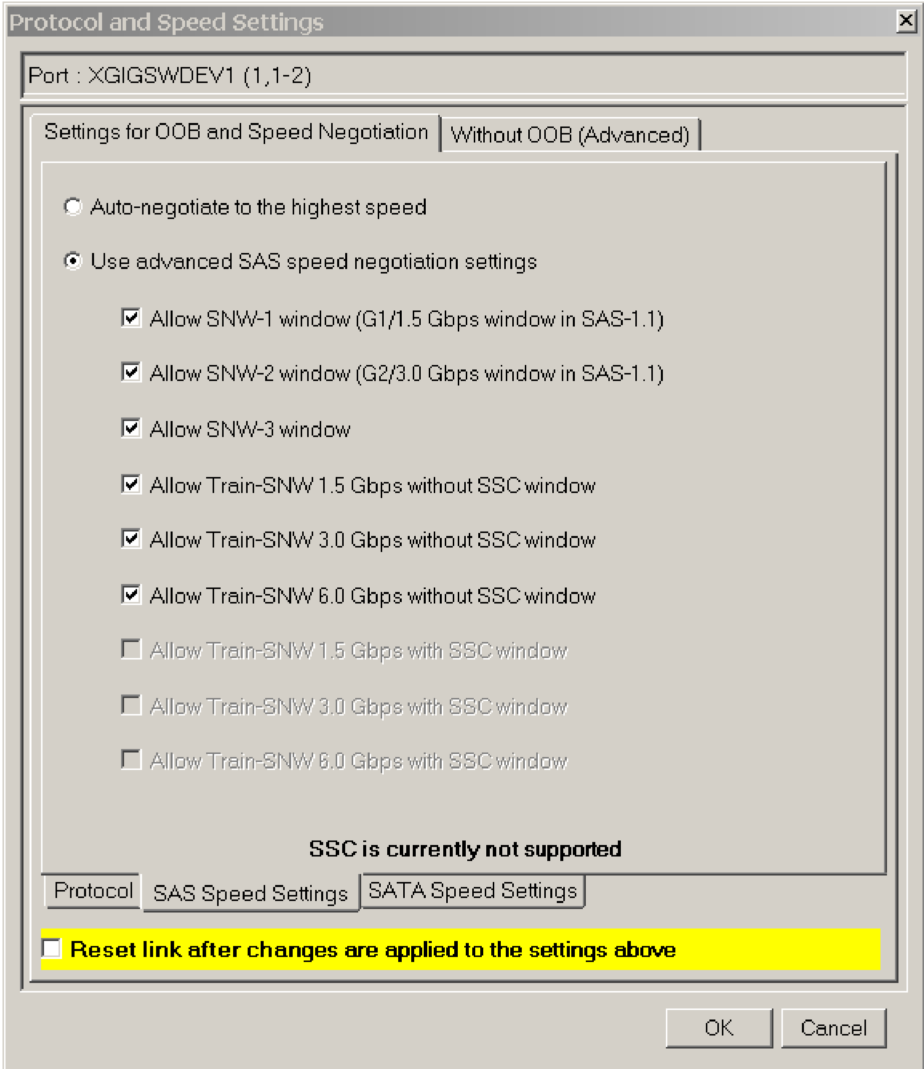
Changing the SAS/SATA Clock Rate for 6Gbps Blades

To change the clock rate or speed 6Gbps blades for the SAS/SATA protocol:

1 Select **Edit protocol and speed settings** from the context menu.

2 The **Protocol and speed settings** dialog appears.

Figure 15: Speed Settings Menu for SAS and SATA on a 6Gbps blade



If you made a change from the previous setting, the option below will appear at the bottom of the dialog.

3 Check this check box if you want the link to reset when the change is applied upon clicking **OK**. Otherwise, clicking **OK** will apply the change, but the protocol will not change until the next time OOB initialization occurs.

4 Select either the SAS Speed Settings or the SATA Speed Settings tab. See Figure 15.

Note: Both ports of the port pair share one protocol and one clock rate; therefore, two adjacent simplex Jammers always have the same protocol and clock rate.

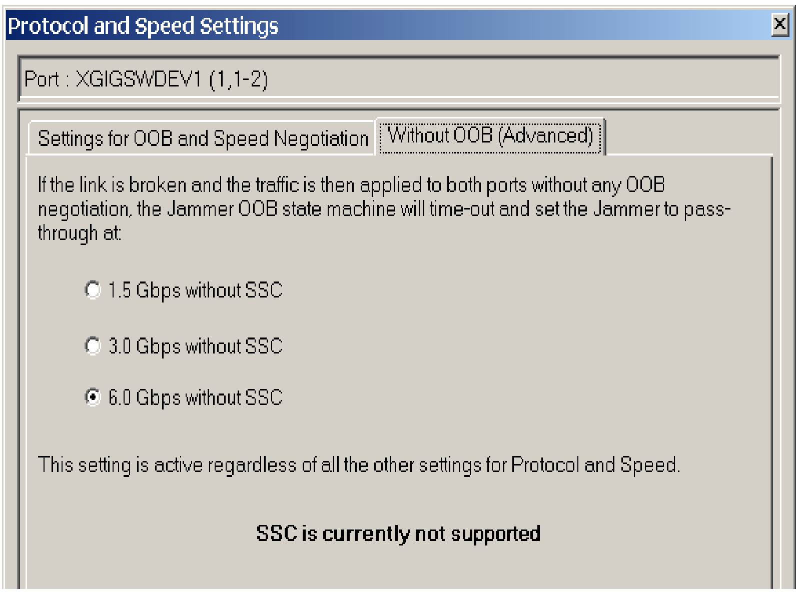
5 Select the speed setting you want for SAS or SATA.

6 Click **OK** to close the dialog and apply the setting.

The 6Gbps blade also has a Without OOB (Advanced) tab at the top of the window see Figure 16. This allows you to set the speed the Jammer if no OOB is detected after a broken link. This can be useful if, for some reason, you want to attach equipment without going through OOB.

Note: For Fibre Channel and SAS/SATA only The clock rate is not saved in the configuration file. This allows Jammer scripts to run independently of the clock rate setting and avoids breaking the link to which the Jammer is connected.

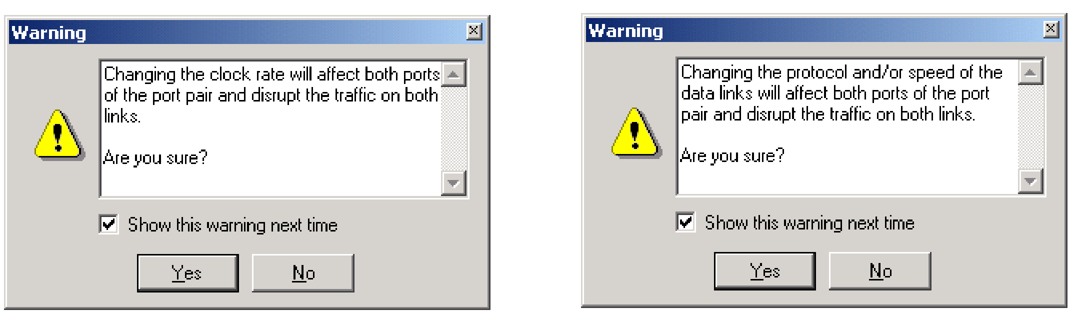
Figure 16: Without OOB (Advanced) Tab 6G



Caution: Changing the clock rate disrupts the traffic passed through the FC and 3 Gbps SAS/ SATA Jammer. A warning message appears when you change the setting (Figure 17).

Figure 17: Changing Clock Rate and Protocol/Speed Warning Dialogs

Fibre Channel and Gigabit Ethernet **SAS and SATA on a 3Gbps Blade**

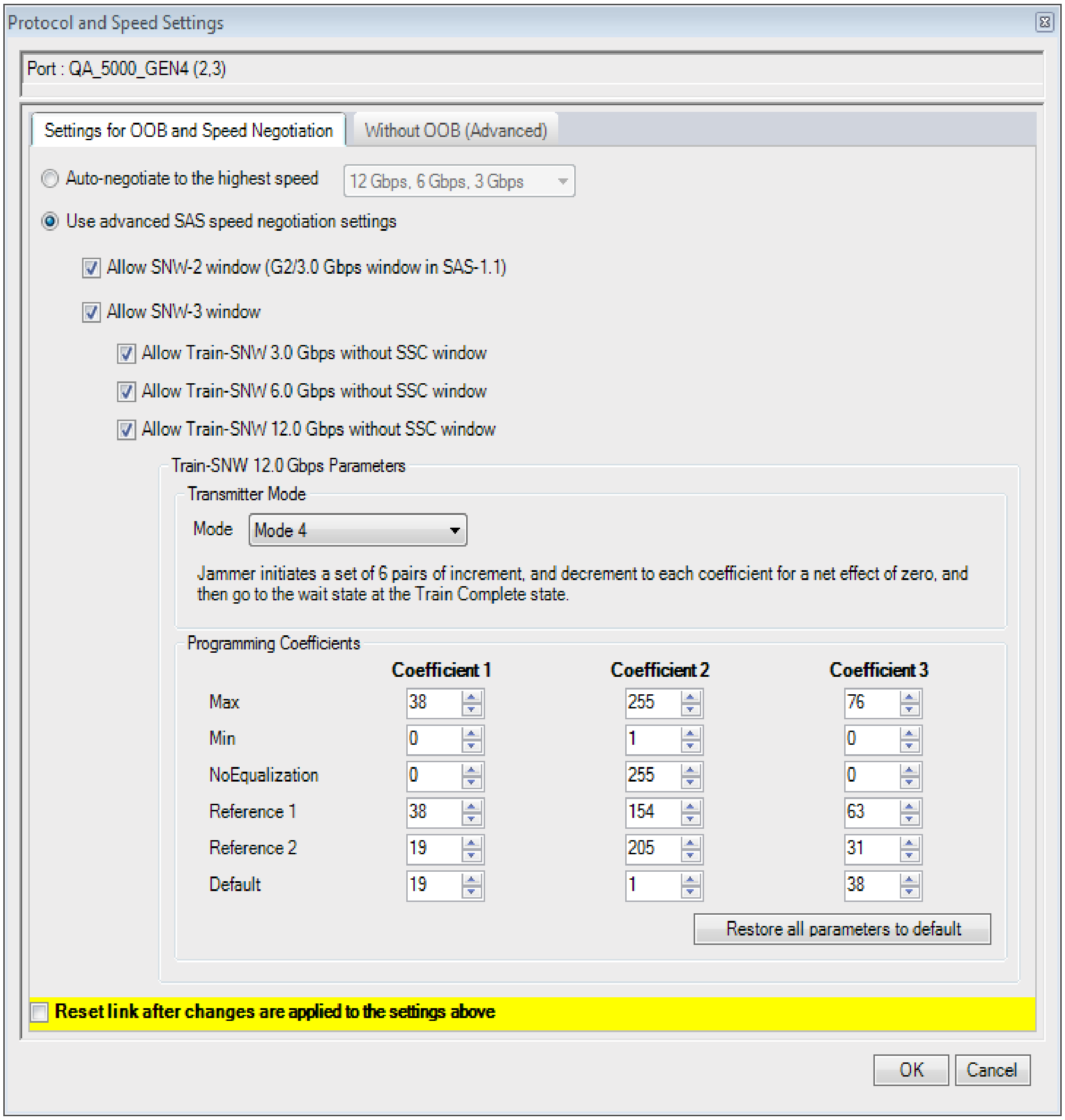


Changing the SAS Clock Rate for 12G Blades

To change the clock rate or speed 12Gbps blades for the SAS protocol:

1. Select **Edit protocol and speed settings** from the context menu.
2. The **Protocol and speed settings** dialog appears.

Figure 18: Speed Settings Menu for SAS on a 12Gbps blade



You can either use the Auto-negotiation settings or the advanced SAS speed negotiation settings. The options available from the **Auto-negotiate to the highest speed** drop-down menu are:

- 12Gbps, 6Gbps, 3Gbps
- 6Gbps, 3Gbps
- 3Gbps

Important: It is recommended that if you have a 6Gbps device, you select the **6Gbps, 3Gbps** option, and if you have a 3Gbps device, you select the **3Gbps** option.

3 Set advanced speed negotiation settings.

For Train-SNW 12.0 Gbps Parameters, you can set the **Transmitter Mode**, which determines how the Tx training transmitter state machine behaves. When you select a transmitter mode, the mode's description appears below the drop-down menu.

You can also set the **Programming Coefficients**. The coefficient values are initially set to the default when you initiate the SAS link reset. The coefficient values will be changed based on requests from devices under test and will be within the range of the Min and Max values. For example, if the device requests that the Jammer to go to Reference 1, the coefficient values will be moved to current Reference 1 values. All coefficient values must be between 0 and 255.

Changing the pointer value for each coefficient does not affect the signal. It is only for logical testing of devices under test.

If you set the coefficients and do not want to keep the new values, click the **Restore all parameters to default** button.

If you made a change from the previous setting, the option below will appear at the bottom of the dialog.

4 Check this check box if you want the link to reset when the change is applied upon clicking **OK**. Otherwise, clicking **OK** will apply the change, but the protocol will not change until the next time OOB initialization occurs..

Note: Both ports of the port pair share one protocol and one clock rate; therefore, two adjacent simplex Jammers always have the same protocol and clock rate.

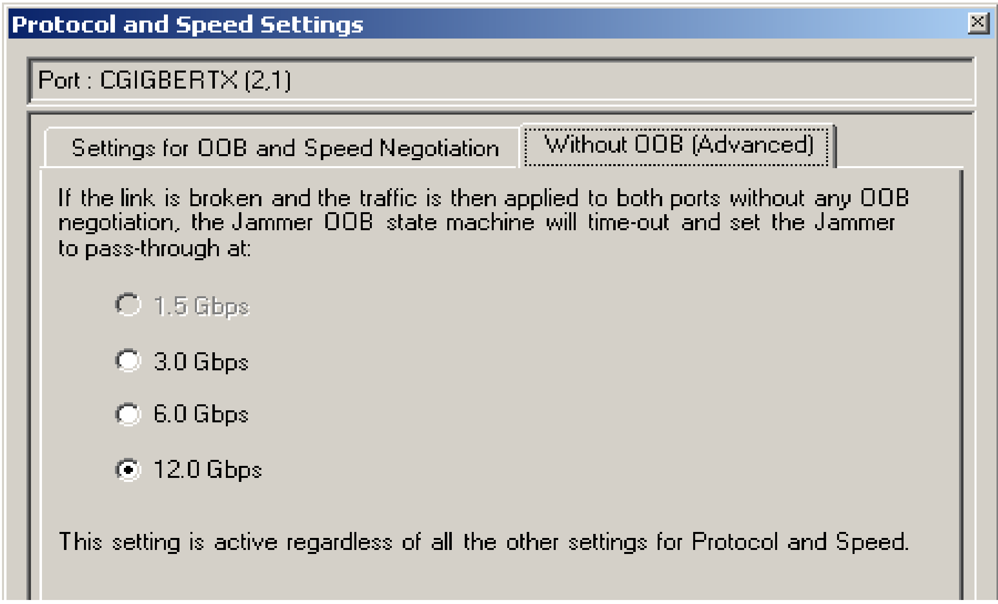
5 Select the speed setting you want for SAS.

6 Click **OK** to close the dialog and apply the setting.

The 12Gbps blade also has a Without OOB (Advanced) tab at the top of the window see Figure 19. This allows you to set the speed the Jammer if no OOB is detected after a broken link. This can be useful if, for some reason, you want to attach equipment without going through OOB.

Note: For Fibre Channel and SAS only The clock rate is not saved in the configuration file. This allows Jammer scripts to run independently of the clock rate setting and avoids breaking the link to which the Jammer is connected.

Figure 19: Without OOB (Advanced) Tab 12G



16G FC FEC

16G FC blades running at 14.0250 Gbps have a FEC (Forward Error Correction) setting that allows you to specify if FEC is enabled on the link. To set, select FEC Mode from the context menu. Then, select On, Off, or Auto. Auto is the default. This setting allows Jammer to automatically detect if FEC is enabled for a link.

Scrambling

Some blades give the option of enabling Fibre Channel Frame Scrambling, which is part of the Fibre Channel Specification for 8.5000 Gbps. You may enable or disable scrambling at any speed. Select **Scrambling** from the Parameters context menu, and then select **Enabled** or **Disabled**. A check mark appears next to the current selection. When Scrambling is enabled, Fibre Channel Frame Scrambling is performed in the Configuration pattern starting after any SOF indicator template and continuing until the next word with a K character (usually EOF).

Note: When changing the clock rate from 8.5000 Gbps to any other speed, Scrambling is automatically set to Disabled. When changing to 8.5000 Gbps, it is automatically set to Enabled. You may then override this setting using the Parameters context menu.

Changing the GigE Jumbo Frames Setting

To change the jumbo frame setting:

1 Open the Parameters context menu (Figure 20).

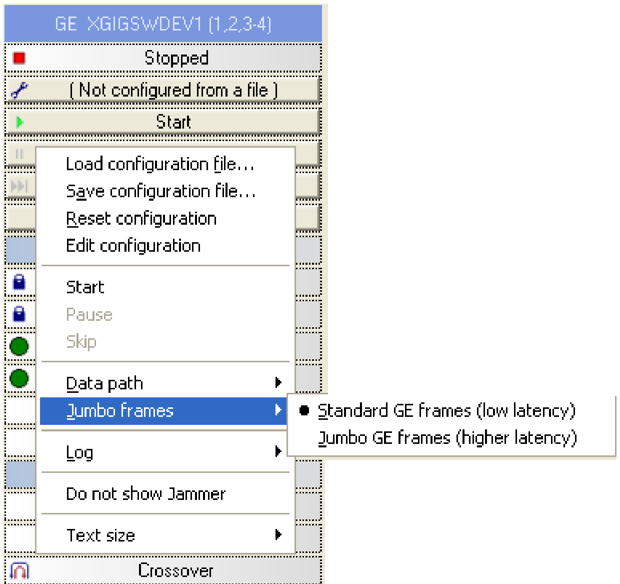
2 Select **Jumbo frames**.

Another menu appears with the two choices.

3 Click to choose one.

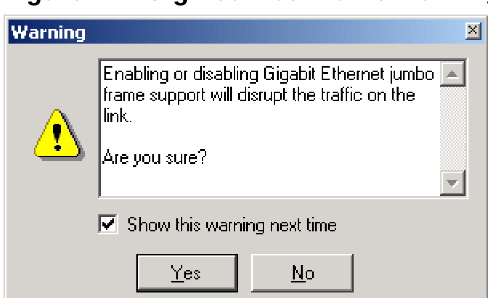
A bullet is displayed to the left of the currently operating selection.

Figure 20: GigE Jumbo Frames Menu



Caution: Changing the supported frame size disrupts the traffic passed through the Jammer. A warning message appears when you change the setting (Figure 21).

Figure 21: GigE Jumbo Frame Warning



Note: The frame size (Gigabit Ethernet only) is not saved in the configuration file. This allows Jammer scripts to run independently of this setting and not disrupt the link when a new configuration is loaded.

Replace Received Invalid Data with Idles

This option is for 10GigE only. It allows you to replace invalid data with Idles before it passes through the Jammer.

Tuning and Equalization

Tuning and Equalization are procedures to optimize ports on the 6G SAS/SATA 4x/Wide-Port Blade for your environment. When you connect the Xgig SAS Analyzer, Jammer, or Generator in a new environment (for example, after changing devices or cable length) we recommend that you run the Tuning procedure detailed in the *Xgig Tuning and Equalization* document. Click **Tuning and Equalization** to open the **Tuning and Equalization** window.

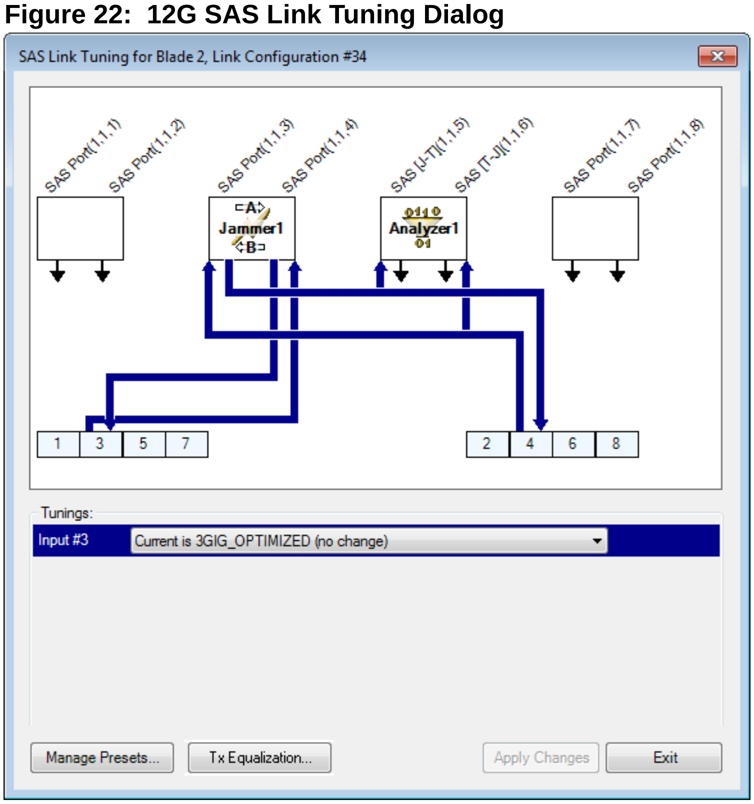
Tuning for 12G SAS

This option is for 12G SAS only. Click **Tuning** to open the **SAS Link Tuning** dialog. If two blades are being used, you must tune each blade independently by launching the **SAS Link Tuning** dialog twice.

The new **12G SAS Link Tuning** dialog introduces a new concept of port groups. It still focuses on the tuning of a single 12G blade, but the ports on the blade are aggregated into port groups. The port groups are named "Input #n" or "Output #n", referring to ports on the mini-SAS connectors. The dialog shows the port group for the selected configuration and allows you to load a preset tuning, auto-select the best preset, or auto-tune.

The top portion of the **12G SAS Link Tuning** dialog displays the lane steering diagram for the current link configuration. It is the same dialog as visible inside the Discovery dialog's Link Configuration, except that the wire colors uniquely identify port groups.

Figure 22: 12G SAS Link Tuning Dialog



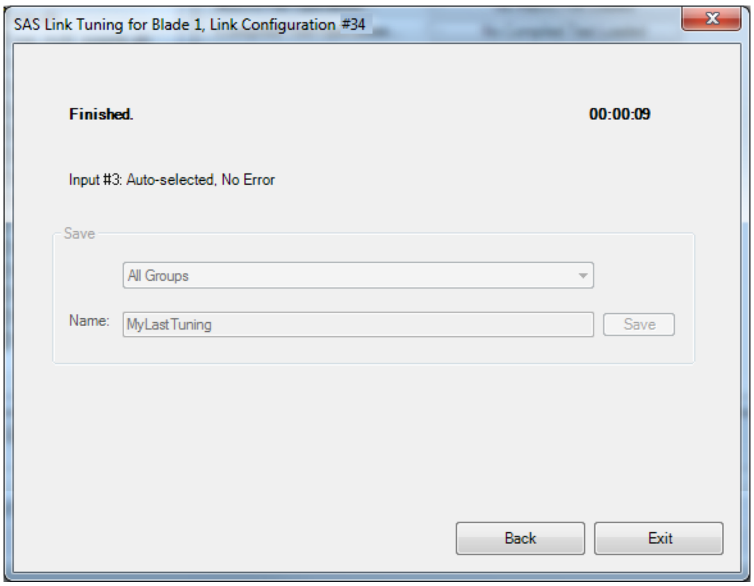
Use the drop-down menu to select a tuning method. You can choose from the following options:

- Auto-select the best preset
- Auto-tune
- Change to [preset name]

Auto-select the best preset

To automatically select the best preset, select **Auto-select the best preset** from the Tunings drop-down menu. Then, click the **Apply Changes** button. The software selects the best preset from the list of saved presets and applies that tuning preset to the hardware. This selection is based on the preset with the lowest bit error rate (BER). When the preset selection is complete, the following dialog is displayed showing the selected preset.

Figure 23: Auto-Select Complete Dialog



The **Save** area is reserved for future use.

Click the **Back** button to close the dialog and returns to the **SAS Link Tuning** dialog where the name of the preset selected is shown as the current tuning.

Click the **Exit** button to close the dialog and return to the **Jammer** tab of the **Xgig Maestro** window.

Auto-tune

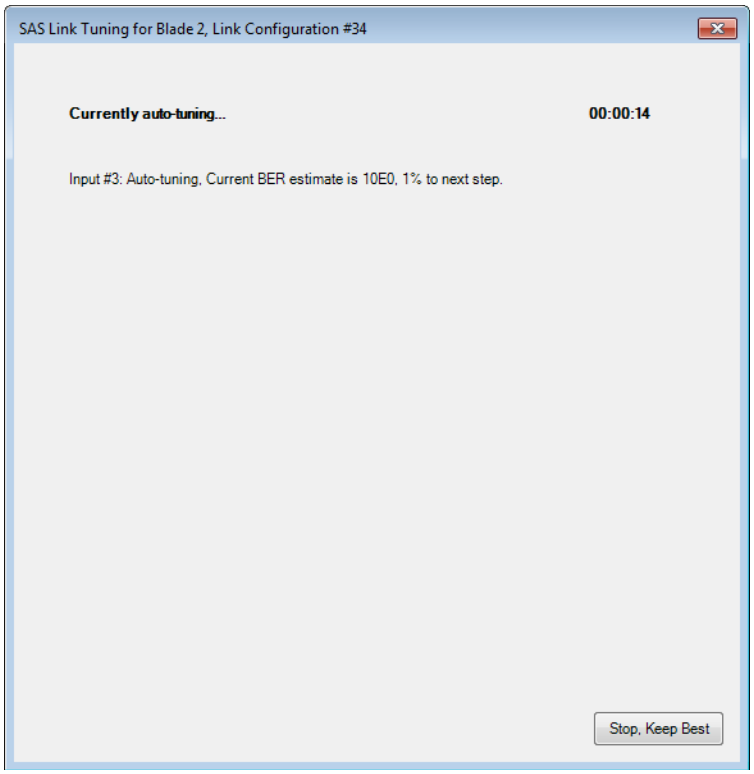
Auto-tuning in Jammer is supported by the following configurations:

#32 – A-J-A,A #34 – J-A #41 – G-J-A,A

Before starting the auto-tuning process, try applying the best preset. If you are not sure which one is best, perform the Auto-Select the best preset process. This may shorten the time it takes to auto-tune. To auto-tune all the ports in the configuration loaded on the hardware for the ports you have selected, select **Auto-tune** from the Tunings drop-down menu. Then, click the **Apply Changes** button to begin the auto-tuning process. Note that when a configuration is selected in the **Discovery** dialog, auto-tuning will tune all the ports in that configuration regardless of whether the other ports in the configuration are locked or not.

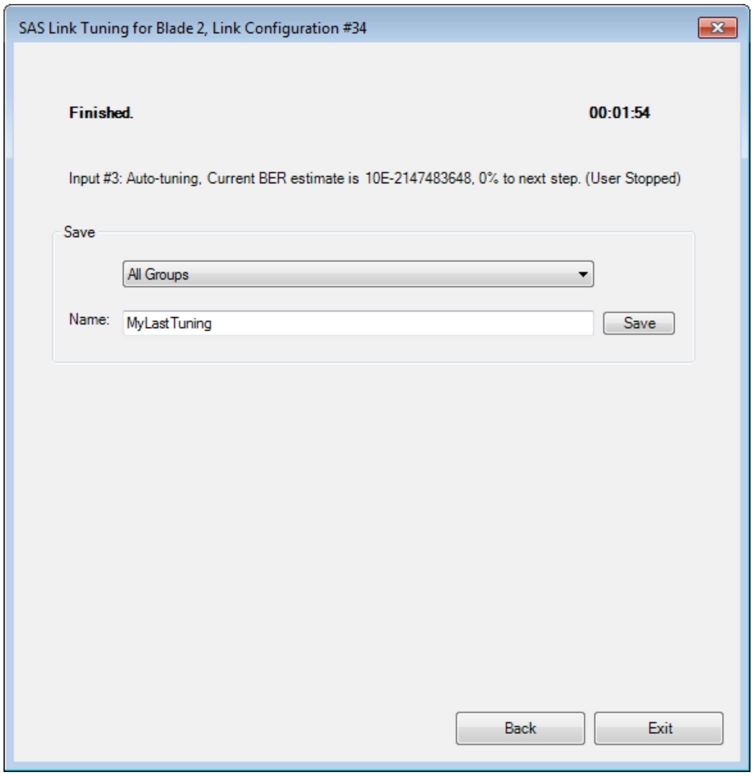
A dialog appears showing the tuning progress. It includes the duration of the tuning and the bit error rate (BER).

Figure 24: Auto-tuning In Progress Dialog



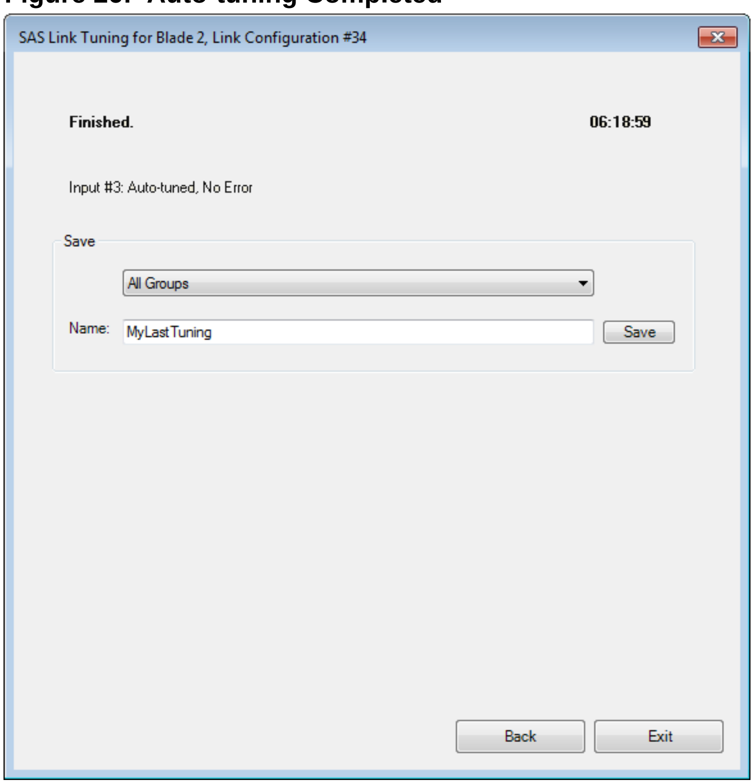
The auto-tuning process concludes only when the ports are error free for the longest of a series of intervals. This may take six hours or more. You can stop the auto-tuning process at any time and keep the best settings found thus far by clicking the **Stop, Keep Best** button.
In this case, the dialog shown in Figure 25 appears.

Figure 25: Auto-tuning Stopped Dialog



When the auto-tuning process has completed, the following dialog appears showing the duration of the process.

Figure 26: Auto-tuning Completed



In the **Save** area, the group and the name of the tuning is displayed. The group is provided by default and is not editable. The default name of the auto-tuning is ***MyLastTuning***. You can change the name by typing another name into the text field. When you enter a new name, a **Save** button is displayed. Click the **Save** button to save the auto-tuning with the new name.

Click the **Back** button to close the dialog and returns to the **SAS Link Tuning** dialog.

Click the **Exit** button to close the dialog and return to the **Jammer** tab of the **Xgig Maestro** window.

Change to [preset name]

To load a preset on the ports in a configuration, click **Change to [preset name]** from the Tunings drop-down list. Then, click the **Apply Changes** button. The software applies the tuned settings of the preset configuration hardware and returns to the **Jammer** tab on **Xgig Maestro** window.

In addition to the default settings, the tuned settings that you have saved after auto-tuning are also available.

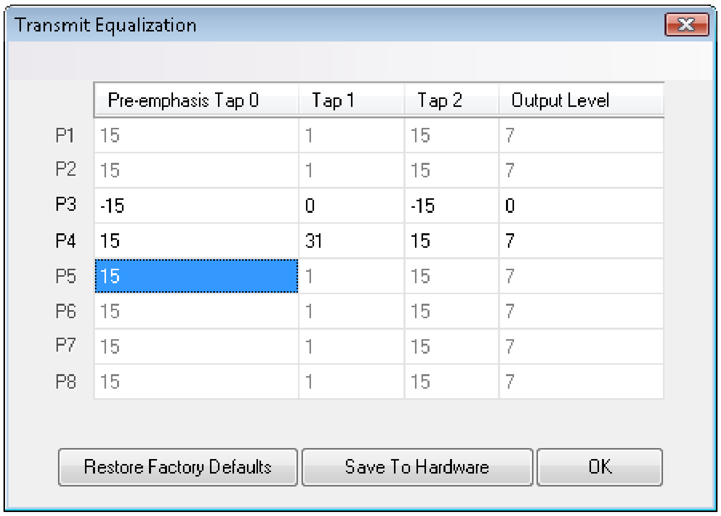
The **Manage Presets...** button opens a dialog allowing you to delete or rename presets.

All the presets are listed in the right column. The left column shows the port groups affected by each preset. You cannot rename or delete the factory provided presets, nor any preset currently in use.

Tx Equalization

Tx Equalization allows you to configure transmitter settings for the Jammer and Generator. Click the **Tx Equalization** button to open the dialog box. For each port, you can specify pre-emphasis and output levels. Tx Equalization is an advanced feature. These settings should normally be left at their defaults, unless changes are recommended by Viavi "Technical Support".

Figure 27: Tx Equalization



The pre-emphasis module in each transmitter boosts high frequencies in the transmit data signal to compensate for attenuation in the transmission media. Three pre-emphasis taps are provided: Tap 0 is the pre-tap, Tap 1 is the first post tap, and Tap 2 is the second post tap.

Tap 0 sets the pre-emphasis on the data bit before each transition. Tap 1 and Tap 2 set the pre-emphasis on the transition bit and the following bit, respectively. Tap 0 and Tap 2 also provide inversion, which is set by using a negative value for the tap setting.

Allowable ranges are -15 to 15 for Tap 0 and Tap 2 and 0 to 31 for Tap 1.

The output level sets the transmitter amplitude. The allowable range is 0 to 7, which corresponds to an amplitude range of approximately 200 – 1200mV.

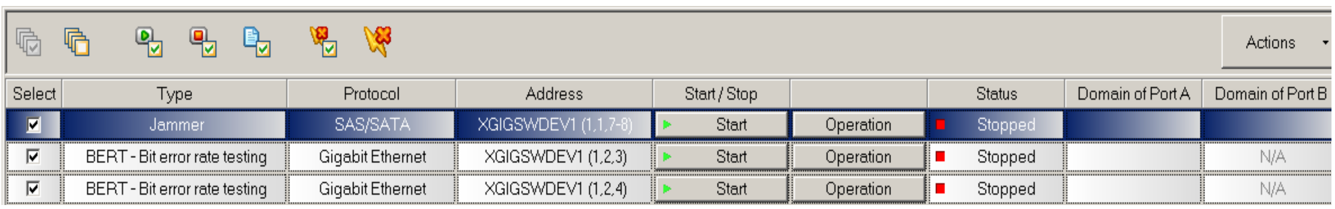
Note that these settings are applied on internal signal paths in the hardware, and the full effect will not normally be seen at the cable outputs.

Using the Ports Manager in Jammer

The Ports manager displays details about the ports you have locked. It shows the protocol, chassis name (with chassis number, slot number, and port numbers), and other port specific information. You can sort the rows from first to last or last to first by clicking the column heading. For more information about Xgig slot positions and numbering, refer to the Xgig Family Hardware Guide included with the product CD.

Note: If you are disconnected due to a network problem, you can reconnect to the ports by using the Port Selection and Domain Setup window.

Figure 28: Jammer Ports Manager



The following icons are displayed on the menu bar:

Select All Ports
Selects all ports in the Ports Manager.

Unselect All Ports
Unselect all ports in the Ports Manager.

Load Configuration to Selected Ports
Load the selected configuration file to all selected ports in the Ports Manager.

Start Selected Ports
Start BERT operation on the selected ports in the Ports Manager.

Stop Selected Ports
Stop BERT operation on the selected ports in the Ports Manager.

Show Properties of Selected Ports
Display the Port Properties dialog box, with information on the selected function, protocol, and clock rate (speed). It also shows the chassis name, IP address, slot and port(s).

Disconnect Selected Ports
Disconnect the selected ports in the Ports Manager.

Disconnect All Ports
Disconnect all ports in the Ports Manager.

Actions Button

The **Actions** button contains menus for **Multiple speed Change** and **Toggle Display.** See Figure 29.

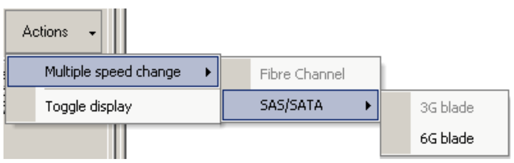
Figure 29: Actions Button Options

Multiple Speed Change

This option allows you to change the speed of multiple Jammer ports simultaneously. If you have the All Devices tab selected, the menu will display BERT, Jammer, and Generator. For Jammer, you can choose to change the speed of 6.0 Gbps and 3.0 Gbps blades.

Select the ports you want to change the speed for, holding the Ctrl key down to select multiple ports, then click the speed you want to change to, and click **OK** to apply the change.

Figure 30: Multiple Speed Change Menu



For Jammer Fibre channel

Select the ports you want to change the speed for, then click the speed you want to change to, and click **OK** to apply the change.

For Jammer SAS/SATA 3.0 Gbps

1 Select the ports you want to change the speed for.

2 Select the protocol you want, Auto-negotiate, SAS only, or SATA only.

3 Select the speed you want to change to.

4 Check the **Reset link after and changes are applied** check box if you want the link to reset when the change is applied upon clicking **OK**. Otherwise, clicking **OK** will apply the change, but the protocol will not change until the next time OOB initialization occurs.

For Jammer SAS/SATA 6.0 Gbps

1 Select the protocol you want, **Auto-negotiate**, **SAS only**, or **SATA only**.

2 Select either the **SAS Speed Settings** or the **SATA Speed Settings** tab.

If you made a change from the previous setting, a check box will appear at the bottom of the dialog highlighted in yellow with a message that reads, **Reset link after and changes are applied to above settings**.

3. Check the **Reset link after and changes are applied** check box if you want the link to reset when the change is applied upon clicking **OK**. Otherwise, clicking **OK** will apply the change, but the protocol will not change until the next time OOB initialization occurs.
4. Select the speed settings you want for SAS or SATA.
5. Click **OK** to close the dialog and apply the setting.

The 6Gbps blade also has a Without OOB (Advanced) tab at the top of the window see. This allows you to set the speed the Jammer if no OOB is detected after a broken link. This can be useful if, for some reason, you want to attach equipment without going through OOB.

Note: For Fibre Channel and SAS/SATA only The clock rate is not saved in the configuration file. This allows Jammer scripts to run independently of the clock rate setting and avoids breaking the link to which the Jammer is connected.

Toggle Display

This option toggles between a horizontal and vertical view of the ports.

Ports Manager Columns

The Ports Manager includes the following columns:

Operation

Operation is a button you press to display the Operation bar for the device you are using. Refer to "Running the Test Suite on a Jammer Device" on page 62 for additional information.

Status

Information in this column displays the state of the device under test.

Domain of Port A and Domain of Port B

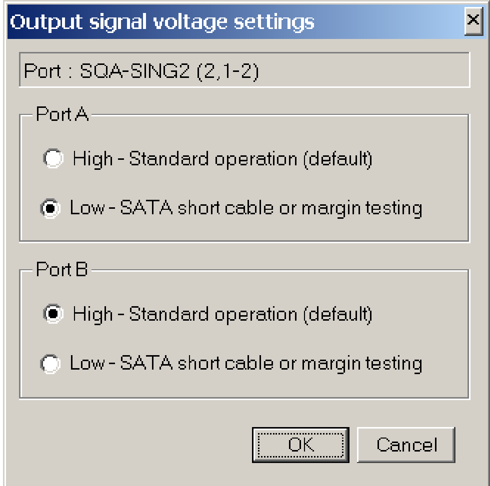
Each of these fields indicates to which domain the respective port belongs. In a simplex Jammer, only port A is relevant. In a duplex Jammer, the lower port number is always port A. You set up domains in the Port Selection and Domain Setup window. Refer to the *Xgig Maestro Introduction Guide* for more information.

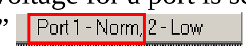
Output Voltages

The Output Voltage settings are for the SAS and SATA protocols and display each port number and the corresponding output voltage setting.

Click on the Output Voltages field in the Port Manager to open the dialog box. This allows you to select the amplitude control for the output voltage buffers. There are two output voltage settings, High and Low.

Figure 31: Output Signal Voltage Dialog

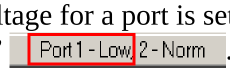


High: The default setting is High. If the output voltage for a port is set to high, then the Output Voltages field in the Port Manager reads "Norm" 

.

The High setting, is useful for driving extended length cables. This setting also provides a pre-emphasis circuit that boosts higher frequency signals to compensate for signal amplitude loss that affects the data eye in long trace length runs.

Caution: For ports on 6G blades using a SATA cable connected to a SATA device, it is possible for the SATA receiver voltage to exceed the maximum specifications. To keep the SATA receiver voltage within the specifications, it is advisable that you set the output voltage for these ports to "Low".

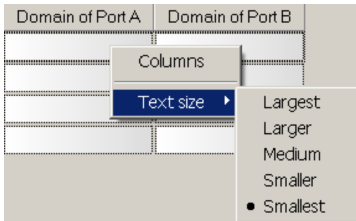
Low: If the output voltage for a port is set to Low, then the Output Voltages field in the Port Manager reads "Low" 

. You can set the signal to Low when you are using short cables with SATA devices.

Using the Ports Manager Context Menu

You can right-click in the Ports Manager to open the context menu (Figure 32).

Figure 32: Ports Manager Context Menu



The menu contains the following choices:

Text Size

Refer to "Changing Text Size" on page 58 for information.

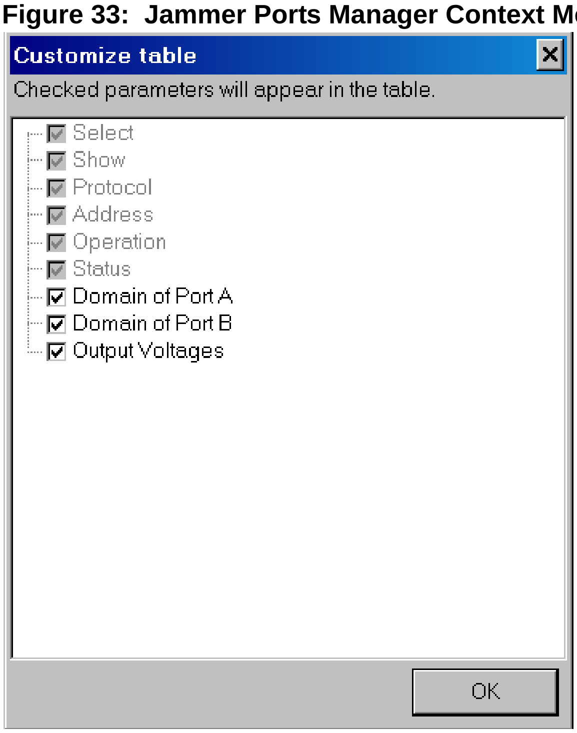
Columns

This choice opens a Customize table dialog (Figure 33) where you can choose to display **Domain of Port A**.

Click the check box next to this item to display this item in the Ports Manager.

The grayed out items are defaults; you cannot clear these items.

Figure 33: Jammer Ports Manager Context Menu Parameters Selection

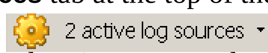


Using the Log Manager in Jammer

To access the Log Manager, click the Log tab at the bottom of the Jammer main window.

The purpose of logging is to automatically create a log that reports which Jam tests have occurred and which ones might have reached the timeout limit while not finding a trigger to Jam. You can view a log with any text editor.

The Filter icons next to the **Type** and **Address** column labels allow you to choose how you want to display device types, by protocol or All, and device addresses, by single address or All devices.

If the **All Devices** tab at the top of the Xgig Maestro main window is selected, then the **Log Source** menu 

shows all log sources as active by default. You can choose to disable BERT logging, Jammer logging, Generator logging, Target Emulator logging, or all four by clicking the **Log Sources** menu and un-checking the selections. If the **BERT-Bit error rate testing, Jammer, or Generator** tabs in the main window are selected, then the Log Manager displays only the log entries for that tab, respectively.

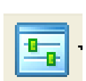
The following icons are displayed on the Log Manager menu bar:

Display Entry Contents
Lets you save the selected log to a file in the device Logs folder (for example: `C:\Program Files\Viavi\Xgig Maestro\Jammer\Logs`) or anywhere you want to save it on the network. Refer to the note on page 54 for information about installation on 64-bit operating systems.

Save All Entries As
Lets you save all the logs in the Log Manager to a file.

Save selected entries as
Lets you save the selected logs to a file.

Select All
Selects all the logs in the Log Manager.



Options
Opens the Log Manager Options dialog where you can enter your preferences for the information you want displayed in the Log Manager (Figure 34).

Clear Filtering
Removes filtering by Type and Address and displays all the devices you have locked.

Clear Selected Entries
Deletes the log entry you have highlighted.

Clear All Entries
Deletes all the log entries in the Log Manager.

Setting Log Options

To have log files automatically named and saved to a specific location:

1 Click the Log Manager Options icon to open the drop-down menu (Figure 34), and select **Jammer logging options**.

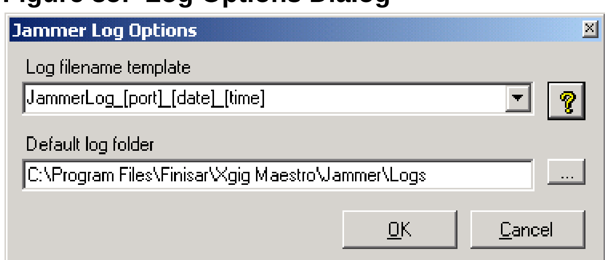
Figure 34: Log Manager Options Menu

Or:

Open the Parameters context menu and select **Options**.

Either of these commands opens the Jammer Log Options dialog (Figure 35). This dialog allows you to set up how you want the log files to be automatically named and the default location where you want them saved. You can also change the filename and folder when you save the log.

Figure 35: Log Options Dialog



2 Select a log filename template from the following choices:

- JammerLog_[port]
- JammerLog_[port]_[date]_[time]
- JammerLog_[date]_[time]
- JammerLog_[date]_[time]_[port]

Or, you can type in your own template. Any [port], [date], and [time] in the template is replaced by the corresponding value. Port is displayed as:

```
protocol (FC, GE, or SAS), chassis name (chassis number in the
cascade, blade number in the chassis, port number on the blade)
```

3 Enter the path to the folder where you want to save the log file.

You can browse to where you want to save the log file by clicking .

4 Click **OK**.

You have set up the log filename template and default folder to save the log.

Note: These settings apply to all Jammer logs. Log options are the same for all Jammer ports.

Viewing a Log

The Jammer log shows the status of each Test Case during the entire length of the test run

To display a log:

>> Click the Log Manager tab at the bottom of the Xgig Maestro main window to view the log in a tabulated format (Figure 36).

Or:

>> Double-click on the log you want to view in the Log Manager to display the Log Entry Display (Figure 37).

Or:

>> Click the **Log** button on the Operation bar (with the appropriate Jammer device selected in the Parameters Status table; a green check mark indicates the device is selected).

Or you can:

>> Open the Parameters context menu and select **Log > View**.

These two latter commands open a window that allows you to quickly view the Xgig Jammer log. (Figure 38). In the case of these two methods, each time you run a Jammer, a new Jammer log is created for the device, and the previous log is discarded. Click **Print** at the bottom of the Jammer log to print a hard copy of the log.

On the other hand, the Log Manager continues to list the logs and display them depending on the Log Manager options you have selected. See “Setting Log Options” on page 51.

You can save a log to a `.txt` file or an HTML file. Refer to “Saving a Log” on page 54.

Figure 36: Log Manager

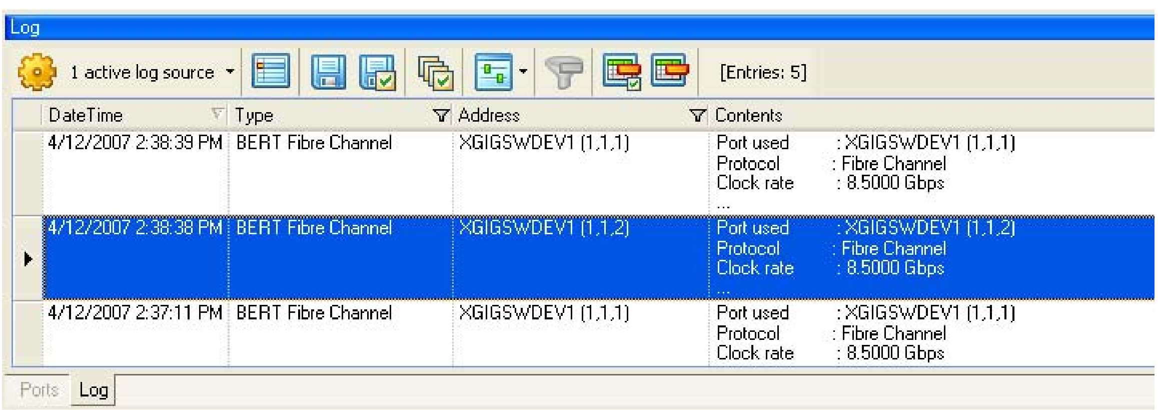


Figure 37: Viewing a Log in the Log Entry Display

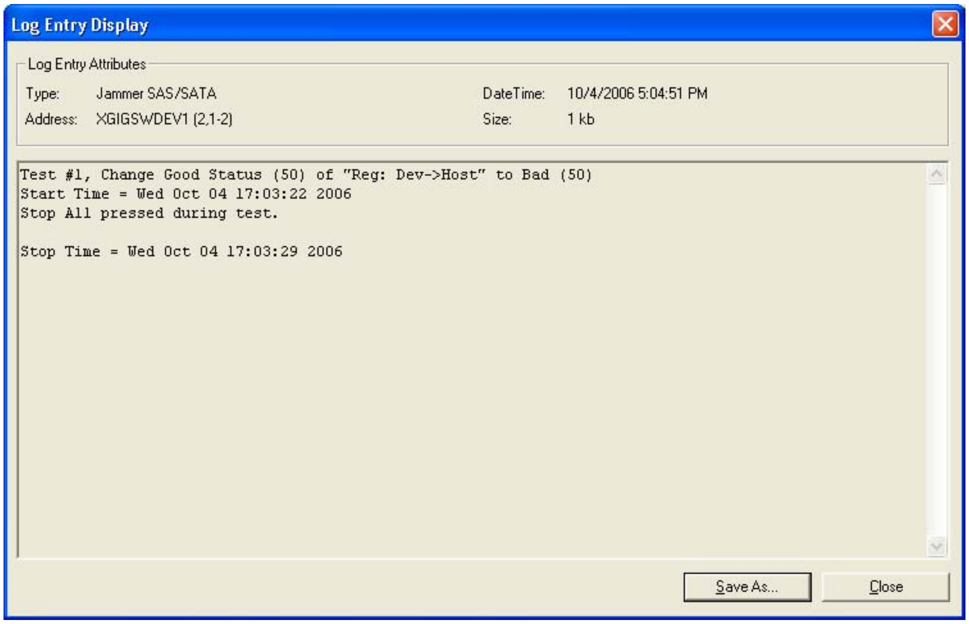
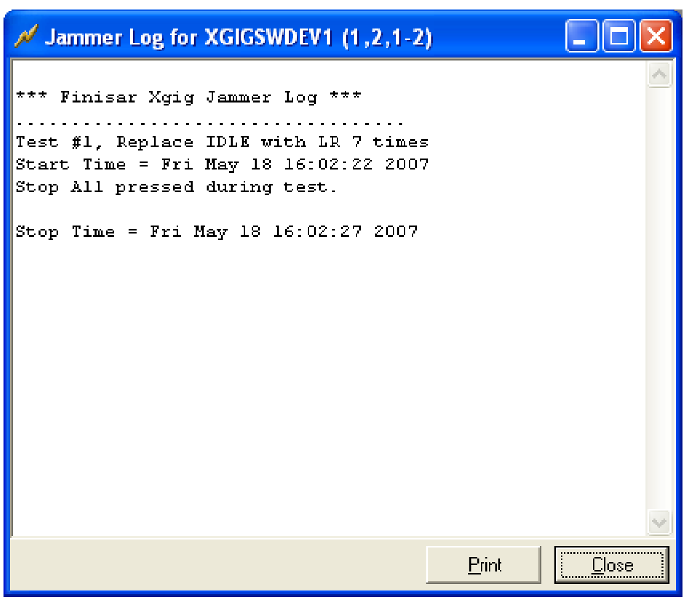


Figure 38: Example of a Jammer Log Display



Saving a Log

You can save a log from the Log Manager tab or the Parameters context menu.

To save a log from the Log Manager tab as an HTML file or text file:

1. Highlight the log you want to save.
2. Click the **Save Selected Entries As**... button.

   The Save Log Manager Contents As window is displayed that lets you name and save the log as an HTML file to the Saved Logs folder or to a location you prefer.

   Or:

\>> Double-click on the log you want to save to display it in the Log Entry Display window (Figure 37), then click **Save As...**

The Save As window is displayed that lets you name and save the log to the Logs folder as a `.txt` file, or to a location you prefer.

To save a log to a `.txt` file using the Parameters context menu:

\>> Open the Parameters context menu (Figure 39) and select **Log > Save As**.

This command opens a File dialog where you can save the log with a file name you assign to it. The default location is `C:\Program Files\Viavi\Xgig Maestro\Jammer\Logs`.

Note: This software application can be loaded on 32-bit or 64-bit Windows operating systems. The path used above is for a 32-bit operating system.
If you are using a 64-bit operating system, the path would be:
`C:\Program Files(x86)\Viavi\Xgig Maestro\Jammer\Logs`

Figure 39: Log Menu

Customizing the Appearance of the Maestro/Jammer Main Window

You can move and rearrange the individual device tabs on your monitor screen as you prefer. You can also select the information you want to display in the Parameters Status table. In addition, you can select the size of displayed text.

Using the Window Menu

The **Window** menu allows you to arrange the window display:

Layout

Layout offers choices for rearranging the Maestro device tab windows. The Ports manager and Log Manager windows are not affected by this menu selection.

Internal Tabs

Allows you to restore the Maestro main window to its default format.

Internal MDI

Internal multiple document interface (MDI) lets you isolate each device tab as a separate window that you can activate by clicking anywhere on the window.

Show Hidden Windows

Restores any windows you have closed while using the Internal Tabs or Internal MDI display arrangement.

Arrange Icons

Arranges the icons for minimized windows at the bottom of the screen. If an open document window is at the bottom of the screen, some or all of the icons will be underneath this document window and will not be visible.

Cascade

Arranges all open windows in a cascade style from the top, left corner of the window.

1 All Devices

Brings the All Devices tab to the front as the active window. This window displays ports from all active devices (BERT, Jammer, Generator, and Target Emulator).

2 BERT - Bit error rate testing

Brings the BERT device tab to the front as the active window

3 BERT - Latency measurement

Brings the BERT Latency measurement device tab to the front as the active window

4 Jammer

Brings the Jammer device tab to the front as the active window

5 Generator

Brings the Generator device tab to the front as the active window

6 Target Emulator

Brings the Target Emulator device tab to the front as the active window

Tile Horizontally

After selecting **Layout > Internal MDI,** this command opens and aligns the BERT, BERT Latency measurement, Jammer, Generator, and Target Emulator device windows horizontally one over the other.

Tile Vertically

After selecting **Layout > Internal MDI**, this command opens and aligns the BERT, BERT Latency measurement, Jammer, and Generator, and Target Emulator device windows vertically one next to the other. You can view the individual device windows by dragging the sides out to resize them.

Minimize All Windows

After selecting **Layout > Internal MDI**, this command minimizes all the open windows. You can restore each window, individually, by using the standard window controls on the header or select **Internal Tabs** to restore the Maestro main window to its default format.

Customizing the Parameters Status table in Jammer

You can change the appearance of the Parameters Status table by:

- Removing columns
- Resizing columns
- Changing the text size
- Displaying and hiding status table parameters

Removing columns

If you have a number of devices locked, you can remove a column that you do not need to view without unlocking the port or affecting the operation.

To remove a column:

1 Right-click on the specific column you want and open the Parameters context menu.

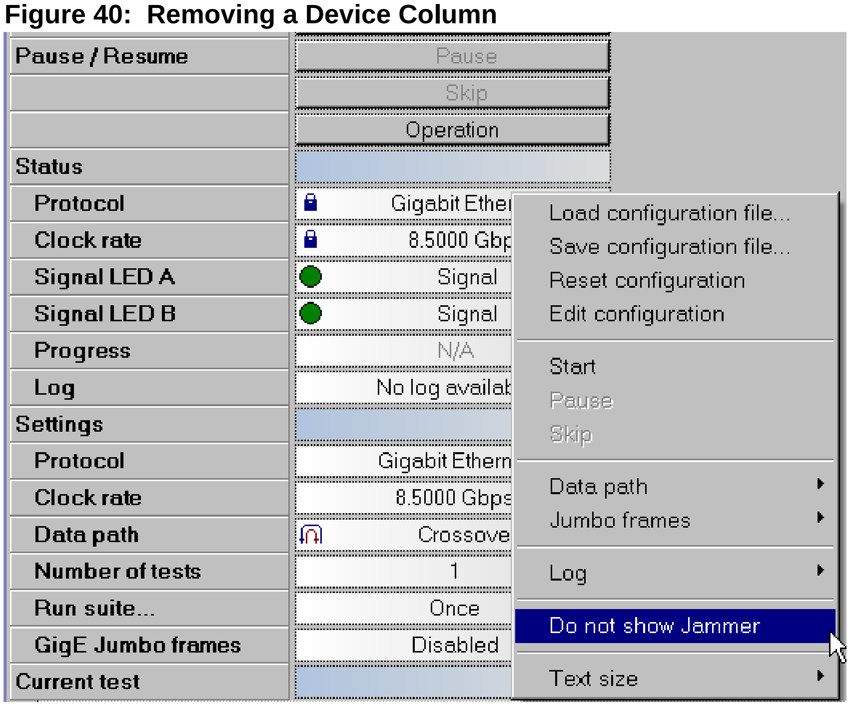
2 Select **Do not show Jammer** (Figure 40).

Or:

In the Ports Manager, clear the **Show** check box next to the device you want to remove.

The column is removed, but the device is still locked ("in use") and displayed in the Ports Manager.

Figure 40: Removing a Device Column



To replace the device column on the Parameters Status table:

>> Click the **Show** check box for the device in the Ports Manager.

Resizing columns

You can resize any of the columns by placing the mouse at the right edge at the top of a column, next to the chassis name. A resizing cursor appears. Hold down the mouse button, and drag the mouse to resize the column.

Changing Text Size

You can choose the text size you want the Parameters Status table or the Ports Manager to display.

Note: You cannot change the text size in the Log Manager.

To change text size:

1. Open the context menu by clicking the right mouse button while the cursor is on the Parameters Status table or the Ports Manager.
2. Select **Text size** (Figure 41).

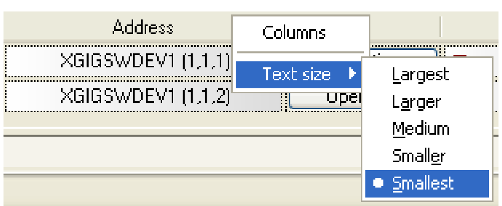
   You have five choices from which to select.

   Smallest is the default size.
3. Select the text size you want.

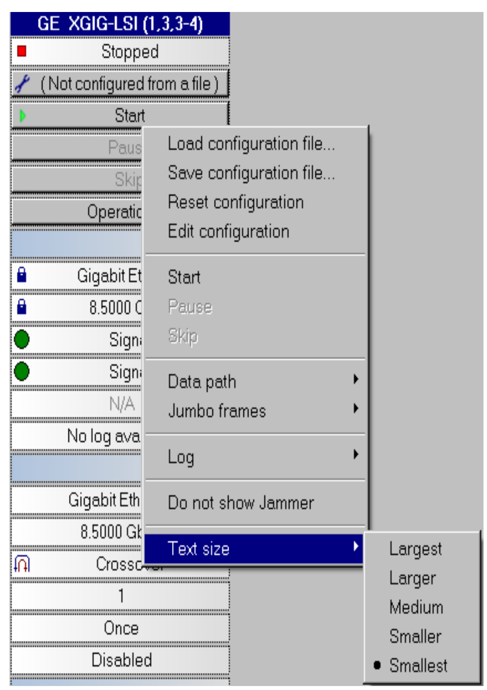
   A bullet is displayed next to the current selection.

Figure 41: Text Size Menu

Context menu over Ports manager



Context menu over device parameters status table



Displaying and Hiding Parameters in Jammer

You can hide specific parameters on the Parameters Status table to simplify the status tables and show only the information in which you are interested.

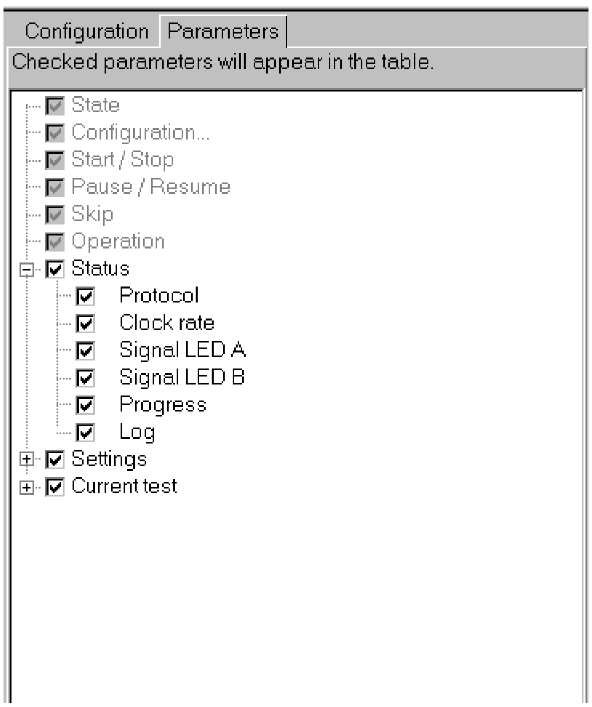
To display or hide parameters on the Parameters Status table:

1. Click the Parameters tab at the top of the Configuration manager pane to switch to the Parameters manager (Figure 42).

   You can expand the categories by clicking the plus signs on the left.

   The default displays most of the parameters.

Figure 42: Jammer Parameters Manager



2. Click check box to set or clear the check mark next to the parameters.

   Checked parameters are displayed.

Performing Configuration Tasks in Jammer

This section describes how to handle configuration files from the Jammer main window.

Loading Jammer Configuration Files

You can load a configuration file on a Jammer using one of the following methods:

From the Configuration Manger:

>> Drag the configuration file from the list in the Configuration Manager onto the Parameters Status table (column for the device) and release the mouse button.

You can drag configuration files from anywhere, including the list of configuration files in the Configuration Manager on the Xgig Maestro window, the system desktop, or Windows Explorer.

From the Parameters Context Menu

1. Right-click on the device column to open the Parameters context menu and select **Load configuration file**.

   An Open File dialog is displayed.

2. Navigate to the Jammer `.tsk` file that you want to use and click **Open**.

   The file is loaded and its name and parameters are displayed in the device column of the Parameters Status table.

From the Ports Manager:

1. Check the **Select** check box(es) in the Ports Manager for the port(s) you want to use.
2. Click the configuration file you want to load from the Configuration Manager.
3. Click the **Load Configuration to Selected Ports** button  . This button is located in the Ports Manager and in the Configuration Manager. Both have the same function.

You can use the above methods to navigate to a mapped folder and load a configuration file.

Saving a Jammer Configuration File

To save a Jammer configuration file you created or edited:

1. Right-click on the device column in the Parameters Status table to open the Parameters context menu, and select **Save configuration file**.

   A Windows Save dialog is displayed.

2. Navigate to where you want to save the configuration file and assign a name to it.

   Xgig Jammer configuration files are saved with a `.tsk` extension.

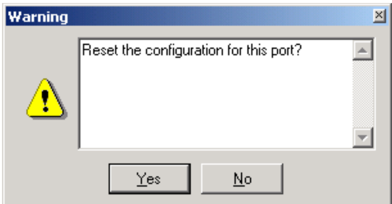
Resetting a Jammer Configuration

To clear the configuration from a device:

1 Right-click on the device column in the Parameters Status table to open the Parameters context menu, and select **Reset configuration**.

A warning dialog may be displayed asking you to confirm the configuration reset.

Figure 43: Reset Configuration Warning Dialog



2 Click **Yes** to clear the configuration from the device.

Editing a Jammer Configuration

To create a configuration file for a device, you can start from a blank default configuration or edit the configuration after you have loaded a configuration file to the device.

You can open the Configuration window using one of the following methods:

1 Right-click on the device column in the Parameters Status table to open the Parameters context menu.

2 Select **Edit configuration**.

Or:

>> Click the **Configuration** button on the Parameters Status table

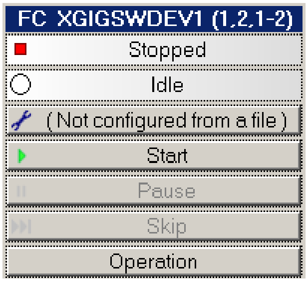
This opens the Configuration window for the device that is currently selected. Refer to or "Using the Jammer Configuration Window" on page 116 for more information.

Running the Test Suite on a Jammer Device

After you have configured a Jammer device, you can start the operation. Three methods are available:

>> Click the **Start** button on the Parameters Status table.

Figure 44: Parameters Status table Start Button



Or you can:

>> Right-click on the device column to open the Parameters context menu where the **Start**, **Pause**, **Skip**, and **Stop** commands are available.

Or:

1 On the Ports manager, select the device.

2 Click the **Start** button  .

Or:

1 On the Ports manager, in the Operation column, click the **Operation** button for the device.

The Operation dialog is displayed (Figure 45, Figure 46, and Figure 47).

2 Click **Start**.

Figure 45: Jammer Tab Operation Bar for Fibre Channel and Gigabit Ethernet

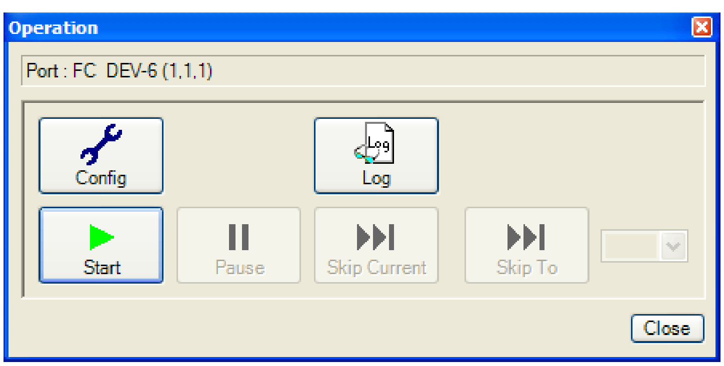


Figure 46: Jammer Operation Dialog for SAS and SATA

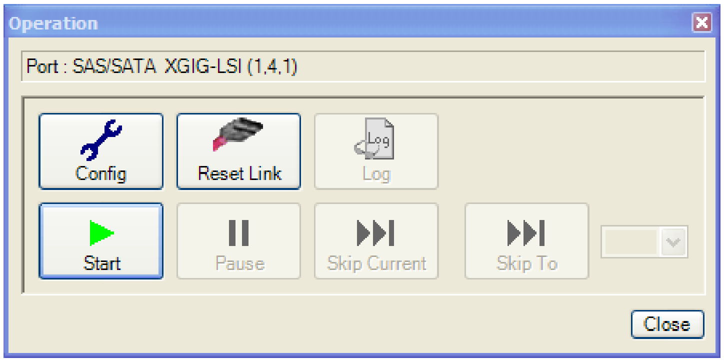
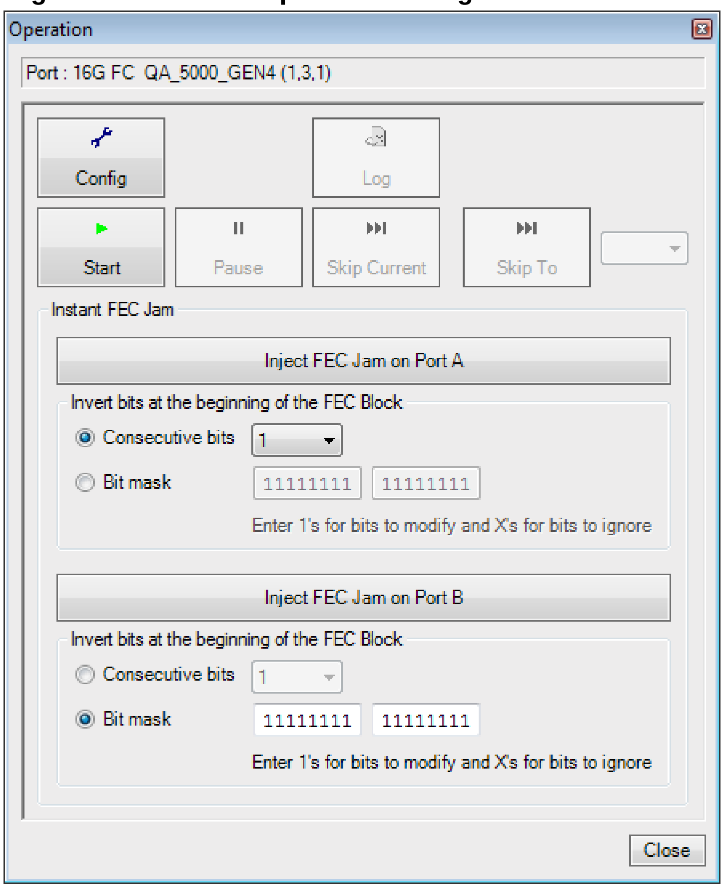


Figure 47: Jammer Operation Dialog for 16G FC



Clicking any of the Operation buttons (including **Config**) takes effect on the Jammer device that is currently selected in the Parameters Status table.

Start runs the Test Suite from the beginning if you click it while the Jammer is stopped. The Start button label becomes a Stop label while the Test Suite is running.

Pause causes the Jammer to pause and not run the next Test Case in the Test Suite when the current Test Case is completed. When you click **Pause**, the State of the Jammer is “Pausing” while the current Test Case is still running. When the current Test Case completes (or is skipped), the Jammer is in the “Paused” state waiting for user intervention.

Skip Current causes the Jammer to abort the current Test Case and move on to the next test in the test case. If the Jammer is “Paused,” you can click **Skip** to jump through your Test Suite without running any Test Cases until you get to the Test Case you want to run and resume testing. If you skip past the last Test Case in the Test Suite and the Test Suite is not set to loop forever, then the Jammer goes to the Stopped state as if the Test Suite completed.

To let a test run to the end and then skip to another test:

1. Click **Pause**.

   Wait for the current test to finish.

2. Click **Skip To** to step through the tests.
3. Observe the progress field on the Parameters Status table to track tests in the queue.
4. Click **Start**.

Skip To allows you to skip to a specific test in the test case.

To skip to a specific test:

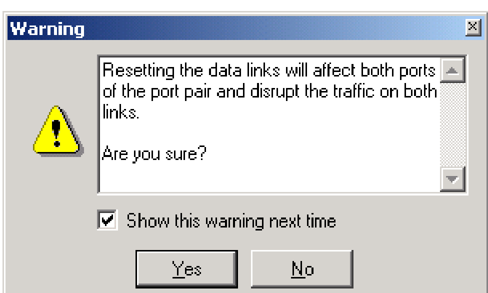
1. Select a test number from the drop-down menu next to the **Skip To** button.
2. Click **Skip To** to skip to the selected test.

Stop causes the Jammer to abort running the entire Test Suite and go to the Stopped state.

Reset Link (SAS and SATA only) causes the Jammer, at any time, to reset the link and enter OOB initialization. This does not affect any of the other buttons nor does it change the running state of the Jammer.

Note: Resetting the link disrupts the traffic passed through the Jammer. A warning message appears when you choose this action (Figure 48).

Figure 48: Reset Warning



Log indicates a log is available for viewing. Click **Log** to view the latest test log.

Instant FEC Jam for 16G FC

When you open the Operation window for 16G FC, the window contains options to perform an instant FEC Jam on port A or port B. See Figure 47. You can select to invert a number (1-16) consecutive bits or use a bit mask to define which bits to invert at the beginning of the FEC block. Note that you cannot perform an instant FEC Jam when you are running a test suite.

Chapter 3

Creating Jammer Test Configurations for Fibre Channel

In this chapter:

Defining Your Own Test Configurations

Xgig Jammer lets you define your own test configurations and save them with or without hardware available.

You can create a configuration from scratch, or you can open and edit an existing configuration. Also, you can edit a configuration in edit only mode, which is independent of any hardware, or you can edit a configuration that is currently loaded to a Jammer device.

To edit a configuration in edit only mode:

>> Double-click on a configuration file in the Configuration manager.

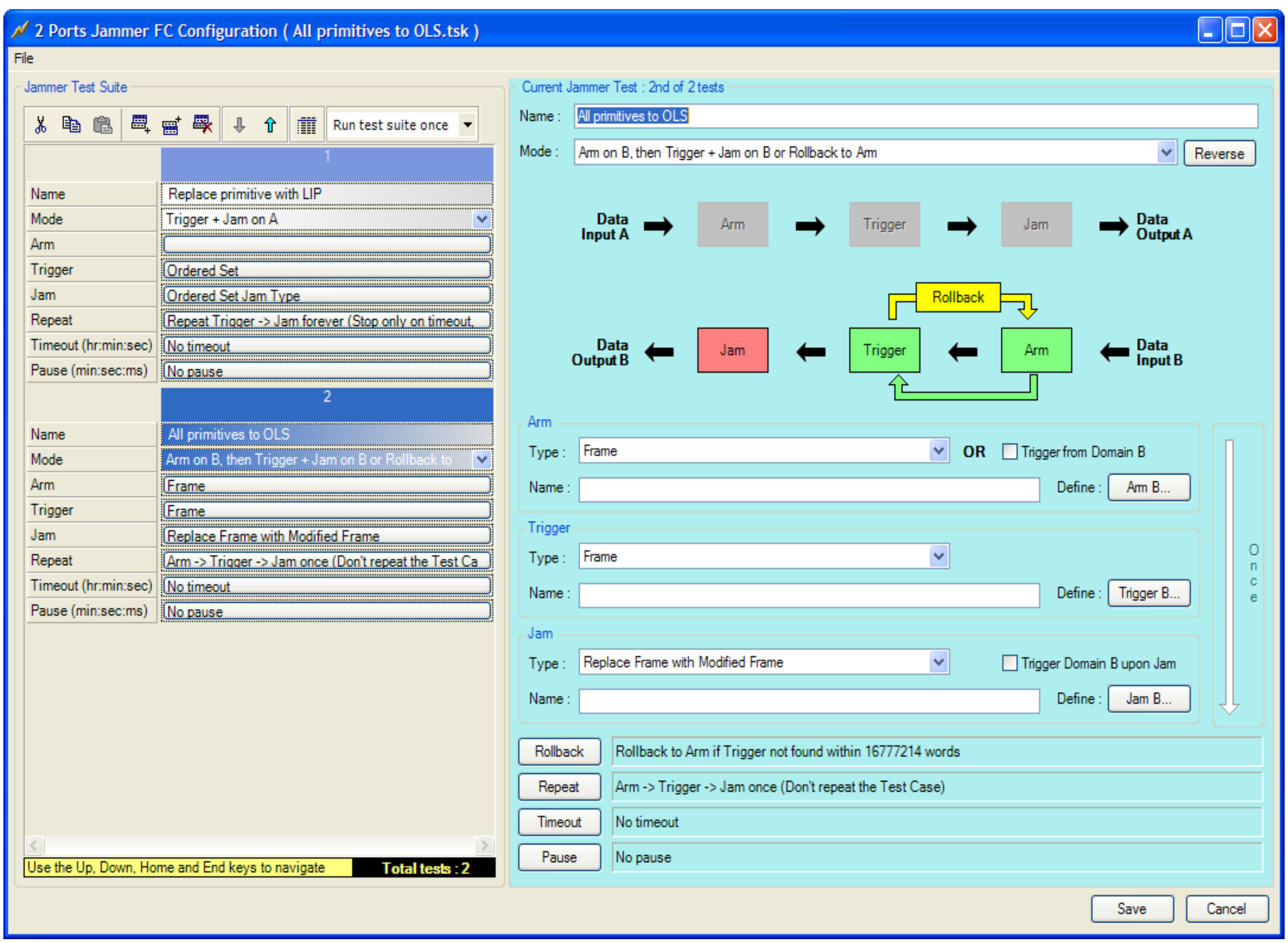
Or:

>> Right-click on the configuration in the Configuration manager and choose **Edit Jammer Configuration** from the context menu.

The edit only mode Jammer Configuration window opens (Figure 49).

This window allows you to set up your own Test Cases, name them, organize them, and save them to files so that you can use them again.

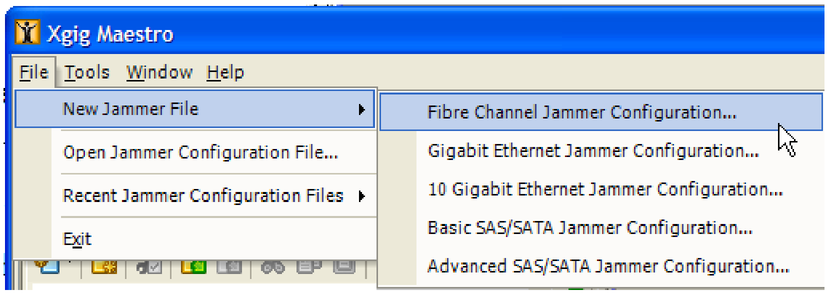
Figure 49: Edit Only Jammer Configuration Window



To start a configuration from scratch in edit only mode:

>> Select **New Jammer Configuration** from the Configuration manager context menu or the File menu (Figure 50) on the Xgig Maestro menu bar.

Figure 50: Maestro File Menu



Or:

>> Click the New Configuration icon  at the top of the Configuration manager.

Or:

>> Right-click the configuration in the Configuration manager and choose **New Fibre Channel Jammer Configuration** from the context menu.

To save your configuration in edit only mode:

>> Click **Save** at the bottom of the Jammer Configuration window or open the File menu at the top of the Jammer Configuration window and select **Save Configuration As...** or **Save Configuration**.

Any changes you make have no effect on actual Jammer devices you control.

To edit a configuration that is loaded to a Jammer port:

>> Click **Configuration...** in the device column.

Or:

>> Right-click in the Parameters Status table in the device column to open the context menu and select **Edit configuration**.

Or:

>> Click **Operation** in the device column to open the Operation dialog, then click **Config**.

The Xgig Jammer Configuration window in hardware edit mode is displayed (Figure 51). This window allows you to set up your own Test Cases, name them, and save them to a file so that you can use them again.

Click **Apply** or **OK** and Jammer accepts the changes. They are immediately reflected in the Parameters Status table and affect the Jammer device the next time you run it.

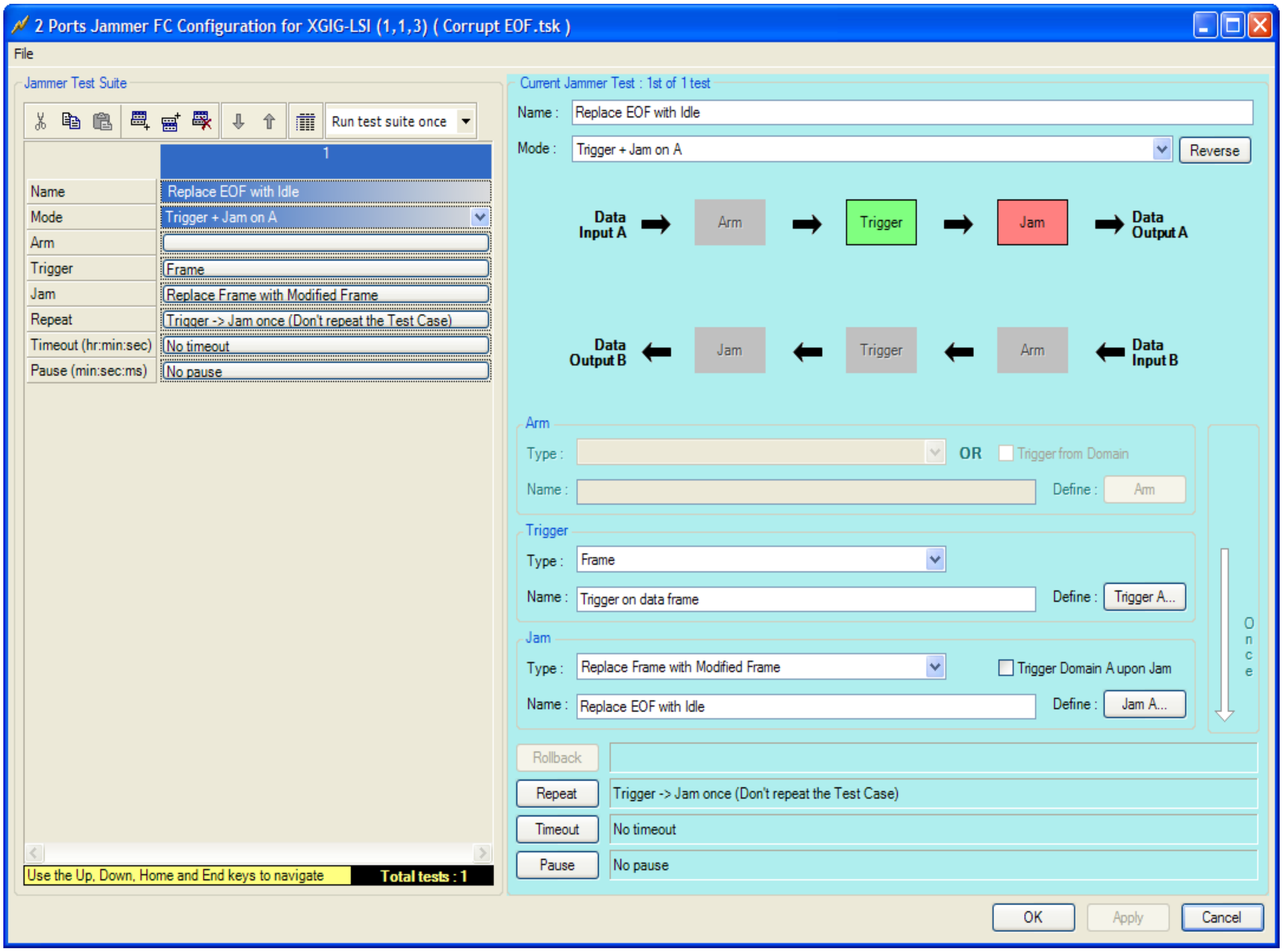
To save your configuration edits:

>> Open the File menu at the top of the Jammer Configuration window and select **Save Configuration As...** or **Save Configuration**.

Or:

>> Right-click in the Parameters Status table in the device column to open the context menu and select **Save configuration file ...**

Figure 51: Xgig Jammer Configuration Window



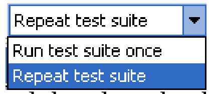
Using the Jammer Configuration Window

The Jammer Configuration window title bar indicates how many ports it is configuring, the protocol, and the configuration file name, if any. If you are using hardware edit mode, the chassis name, chassis number, slot number, and port number are also listed. The elements of the Jammer Configuration window are described in the following sections.

Using the Jammer Test Suite Tools

The Test Suite lists the series of Xgig Jammer tests in the order in which you want them to execute. The suite includes one or more tests. The highlighted test appears as the Current Jammer Test on the upper right side of the window. Each test in the suite executes in sequence with a test reset time of approximately 130 (200 max) milliseconds.

Repeat Test Suite



If you select **Repeat Test Suite** , the Jammer tests continuously run from the top of the Test Suite to the bottom and then loop back to the top until you click **Stop** on the Xgig Jammer Tab in Xgig Maestro.

Creating a Test Suite

When you create a Test Suite you use the edit buttons at the top of the Test Suite window.

The edit button definitions for the Jammer Test Suite are:

Cut	Removes the highlighted test and holds its contents in the memory buffer.
Copy	Copies the highlighted test to the memory buffer.
Paste	Inserts the current memory buffer contents before the currently highlighted test.
Add	Adds a new blank test to the bottom of the suite.
Insert	Inserts a new blank test above the currently highlighted test.
Delete	Removes the highlighted test from the suite. If only one test is present, then the contents of this test are cleared.

To duplicate a test at another point in the Test Suite:

1 Highlight the test you want to duplicate.

2 Click **Copy**.

3 Highlight the test in the suite that is just after the point where you want the duplicate test inserted.

4 Click **Paste**.

The duplicate test is inserted.

Refer to "Configuring Arm and Trigger Conditions" on page 73 and "Configuring the Jam Definition" on page 77 for information about configuring each test.

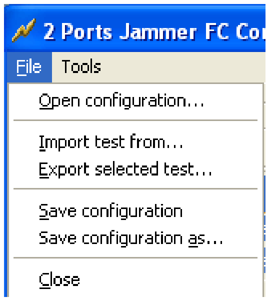
Using the Context Menu

The same operations (Cut, Copy, Paste, etc.) can be performed with the options available in the Context menu. In addition, the direction of an individual test can be reversed by selecting the 'Reverse Current' option. To reverse the direction of all tests, select the 'Reverse All' option.

Using the Configuration File Menu

The File menu is the only menu on the menu bar (Figure 52).

Figure 52: Configuration File Menu



The choices are:

Open Configuration	Open a selected configuration file.
Import to Selected Test	Import a Test Case from a .tst file ot an entire test suite, `.tsk` file, to the currently highlighted position.
Export Selected Test	Export and save the currently highlighted test to a .tst file.
Save Configuration	Save the entire Test Suite to the .tsk file you currently have loaded.
Save Configuration As	Save the entire Test Suite to a .tsk file with a name you assign to it.
Close	Close the Jammer Configuration Window.

The recently used FC Jammer configuration files appear in the file menu and are loaded when selected.

Note: The `.tst` files are only for storing individual Test Cases and swapping them between configuration files. You cannot load `.tst` files directly into a Jammer device on the Xgig Maestro window.

Using the Current Jammer Test Window

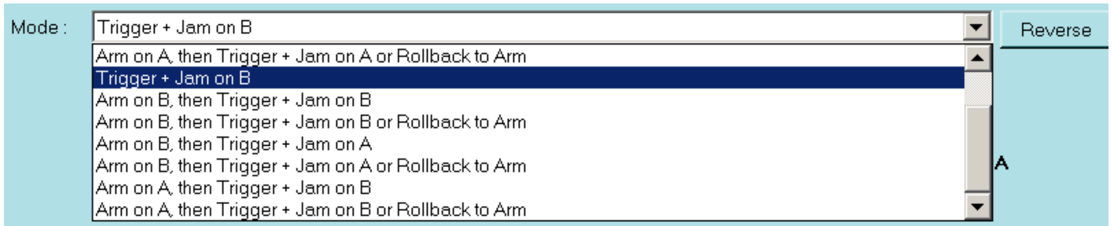
The graphics in this section of the window represent the hardware configuration for the selected test in the Jammer Test Suite.

Mode

Use Mode drop-down (Figure 53) near the top of the window to display a list of the possible configuration choices. In a duplex Jammer all path A and path B options are available. In a simplex Jammer, only path A is available. If you are editing a configuration without any associated Jammer ports, both paths are available.

The input to path A (on top) is always port A and the input to path B (on the bottom) is always port B. The external trigger input and output that are available on path A always are linked to the domain shown on the Xgig Maestro window as “Domain of port A.” The trigger input and output on the bottom on path B are in the “Domain of port B.”

Figure 53: Mode Drop-down Menu



The functions represented by the graphic are:

Reverse

You can reverse the direction of the jam by selecting the Reverse button .

Arm

Use the Arm condition to define the frame or Ordered Set to find prior to the frame or Ordered Set to be modified. You can also use an external trigger input to the Jammer.

Note: If you use an external trigger input to define the Arm condition, then you cannot select the external trigger output for that path in that Test Case, and vice versa. For information regarding using the external trigger input and output during a Test Case, refer to "Using Domains and External Triggering" on page 291." However, you can use an external trigger in on port A with an external trigger out on port B, and vice versa.

Trigger

The Trigger event is the frame or Ordered Set to be modified. The Trigger event can be in the next word after the Arm event.

Jam

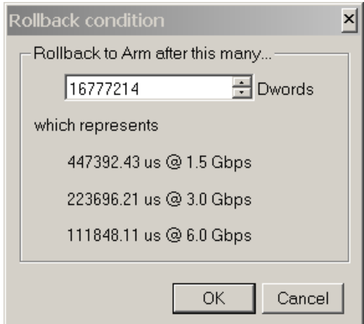
The Jam definition contains modifications to be made to the Trigger event. It is the same type (frame or Ordered Set) as the Trigger event.

Rollback

The Rollback option parameter defines the time or word count parameter between the Arm and Trigger events. If the Trigger does not follow the Arm event in the allotted time or word count, the Xgig Jammer begins looking for the Arm event again. Click **Rollback** to display the dialog box shown in Figure 54.

Note: This value is saved in terms of words, not time, so keep this in mind if you save a Test Case using a device running at 2.125 Gbps and later open the configuration on a Jammer running at 1.0625 Gbps.

Figure 54: Rollback Condition Dialog



Timeout

This  option defines the period of time to wait for a specified test to complete before aborting and proceeding to the next test in the suite.

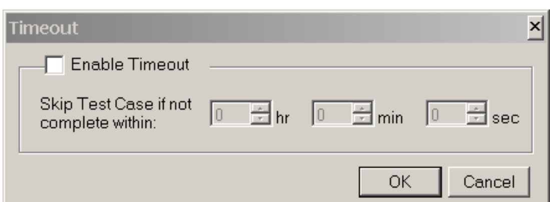
To set the timeout:

1 Click **Timeout** to display the dialog box in Figure 55.

2 Enter the hours, minutes, and seconds you want to wait.

Use the check box to enable or disable this feature.

Figure 55: Timeout Dialog

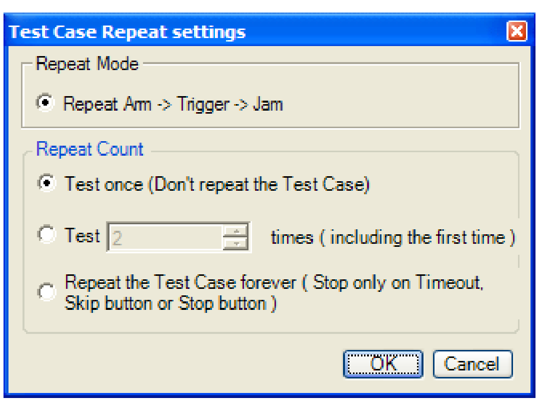


3 Click **OK**.

Repeat

Click this option to repeat the **Arm > Trigger > Jam** sequence once, *n* times, or forever (Figure 56).

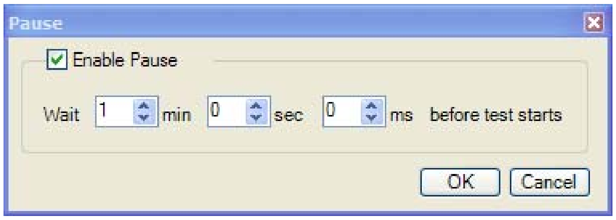
Figure 56: Test Case Repeat Settings



Pause

Click **Pause** to open the dialog shown in Figure 57. The Pause setting allows you to insert a pause before the beginning of a test case.

Figure 57: Pause Test Dialog



Trigger From Domain A (or B)

Click this option to arm when the domain associated with the port is triggered.

Trigger Domain A (or B) upon Jam

Click this option to trigger a domain whenever the Trigger condition is met.

Configuring Arm and Trigger Conditions

Arm and Trigger conditions recognize specific Ordered Sets or frames, depending on the protocol.

In Fibre Channel, you can specify any standard Ordered Set, or a user-defined Ordered Set (K28.5 followed by three data bytes). You can also use a frame as a condition, by specifying the SOF, the 6 word header, and up to the first 25 payload words.

You can save an arm or trigger condition as a `.jmt` file by clicking the **Save** button in the **Arm** or **Trigger** window. You can load a `.jmt` file by clicking the **Load** button in the **Arm** or **Trigger** window.

Depending on the Mode you select, the appropriate graphic diagram shows the Trigger and optional Arm conditions, along with the Jam event. If the Mode you select does not include an Arm condition, the Arm button remains disabled.

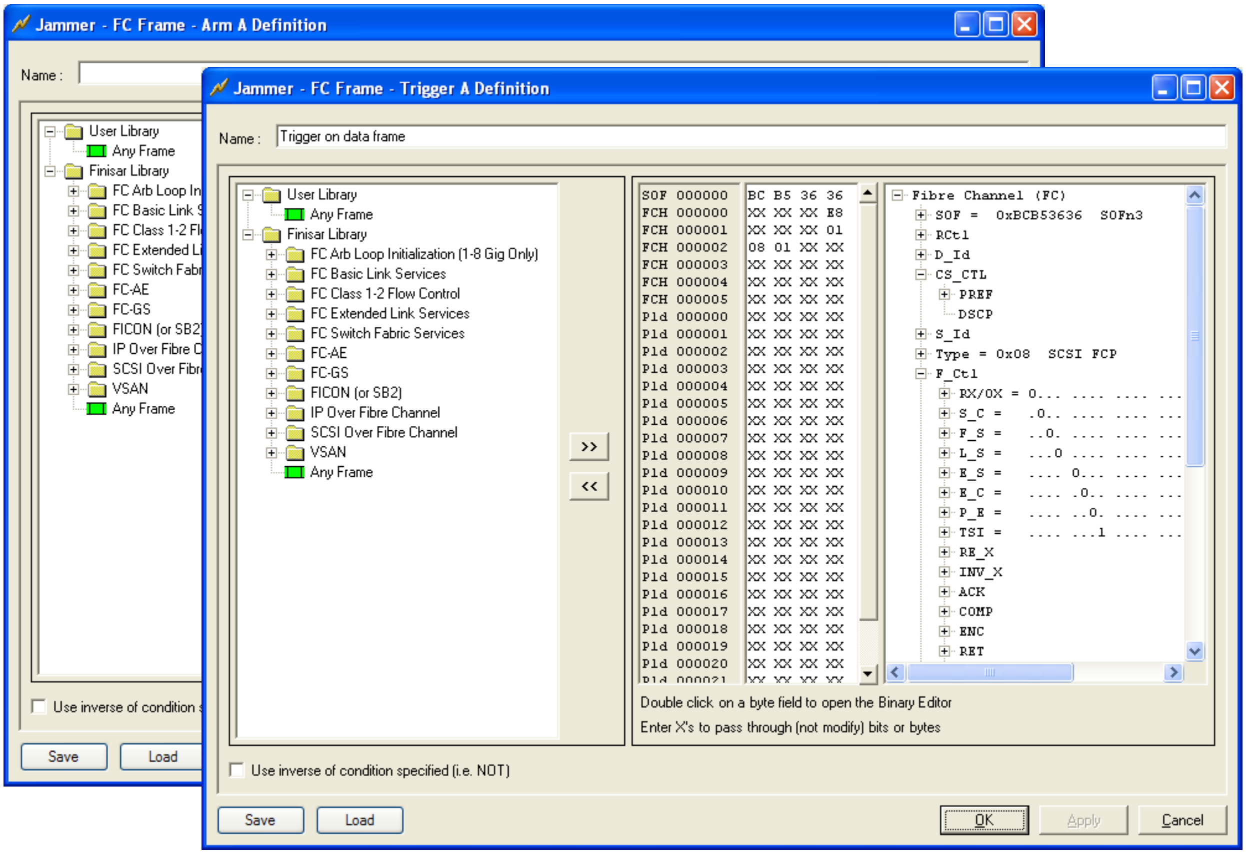
To set Arm and Trigger conditions:

1. For the Arm and/or Trigger, open the Type drop-down on the Current Jammer Test window and select Frame or Ordered Set.
2. Click on the **Arm** or **Trigger** button in the Xgig Jammer Configuration window.

   The window for the condition is displayed (Figure 58). If you are in hardware edit mode, the protocol, chassis name, chassis number, slot number, and port numbers are displayed in the title bar.
3. Set the values as required to specify a unique Arm and Trigger sequence for the specific test.

   The following sections describe the available values.

Figure 58: Fibre Channel Arm and Trigger Windows for Frames



Setting Frame Conditions

You can specify frame conditions in two ways. One way is to load a template from the Template Library tree, and the other way is to manually specify bits in the frame.

To use a template:

1 Select a template from the Template Library tree on the left.

2 Click the double right arrow button to set the Trigger Condition.

The condition is indicated on the right side of the window.

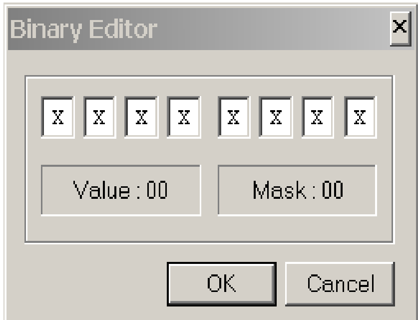
To manually specify a frame:

>> Type hexadecimal values directly into the center column of the window.

An X represents a nibble that can be any value (a “don’t care”).

To set individual bits in any field, double-click on the hex entry to open the Binary Editor (Figure 59). In the hex view, partially defined hex characters appear as question marks: `X001=?`

Figure 59: Binary Editor Dialog



Another way to manually edit the frame condition is to make selections from the tree view in the right window pane.

Saving a Frame Condition

If you create a frame condition that you want to save and make easily available for future use, you can save it into the “User Library” folder in the Template Library tree. To do this:

>> Highlight the folder and click the double left arrow button.

When you check the “Use inverse of condition specified (i.e. NOT)” option, it means that the first frame encountered that does not match what you have specified creates a “condition met” event.

For each frame condition, you can specify an optional name at the top of the window. This name is also shown on the Jammer Configuration window under the Type selection, and on the main Xgig Maestro window.

Setting Ordered Set Conditions

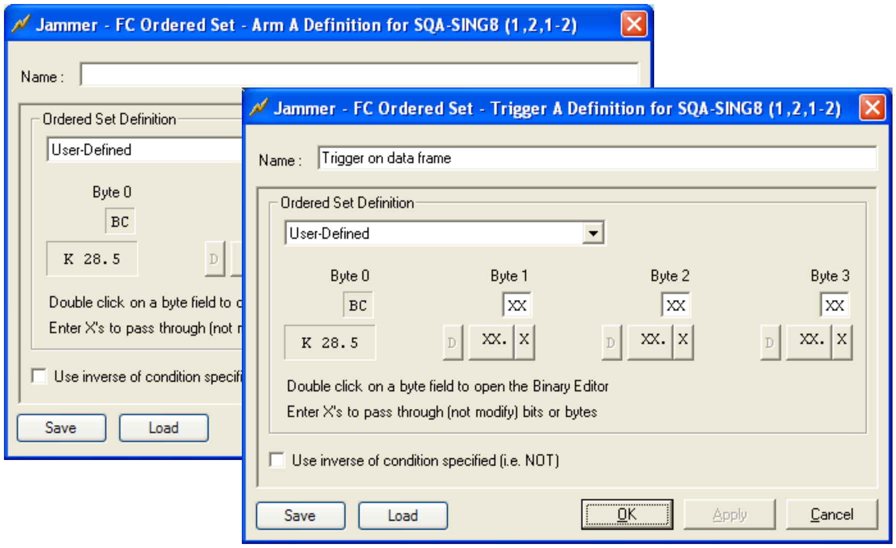
To set an Ordered Set condition, choose a value from the drop-down list. All legal Fibre Channel Ordered Sets are available as well as a User Defined selection at the bottom of the drop-down list as shown in Figure 60.

To edit the user-defined value:

>> Type a hex value into the byte field, or double-click on a byte field to open the Binary Editor.

As in frame conditions, an X indicates “don’t care” and a ? indicates a partially specified hex character. You can also check the “Use inverse of condition specified (i.e. NOT)” option; this means the first word encountered that does not match what you have specified creates a “condition met” event.

Figure 60: Fibre Channel Arm and Trigger Windows-Ordered Sets



To edit the values:

>> Enter a hex value, or double-click the byte field to open the Binary Editor.

As in frame conditions, an X indicates “don’t care” and a ? indicates a partially specified hex character.

As with frame conditions, you can specify an optional name at the top of the window. This name is also shown in the Jammer Configuration window under the Type selection and on the main Xgig Maestro window.

Configuring the Jam Definition

The **Jam Definition** window defines how to modify the event specified on the **Trigger Condition** window.

The Jam is always the same type (frame or Ordered Set) as the Trigger.

For any Jam Definition, you can specify an optional name at the top of the window. This name is also displayed on the Jammer Configuration window under the Type selection and on the main Xgig Maestro window.

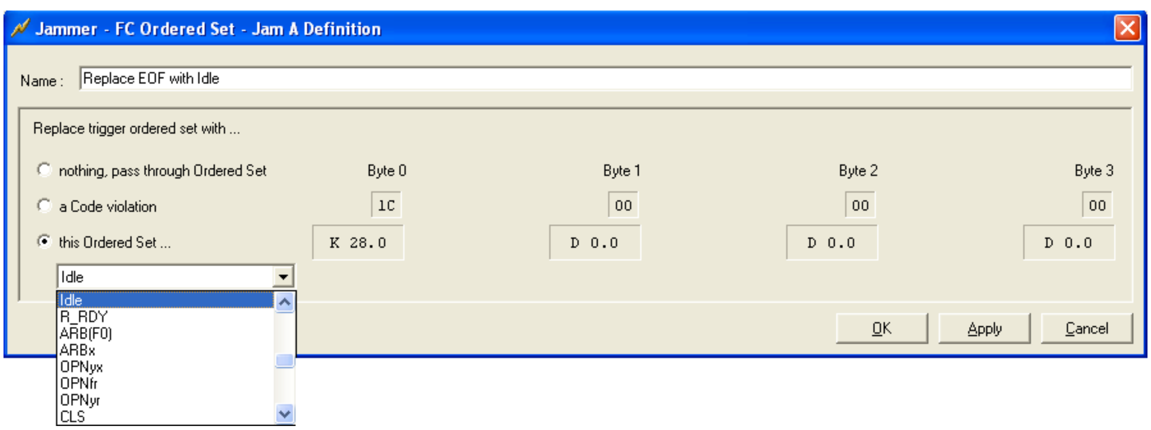
You can save a Jam definition as a `.jmj` file by clicking the **Save** button in the **Jam** window. You can load a `.jmj` file by clicking the **Load** button in the **Jam** window.

Jamming an Ordered Set

If the Trigger Event is an Ordered Set, click the **Jam** button on the Xgig Jammer Configuration window, to open the Ordered Set Jam Definition window (Figure 61).

The Ordered Set Jam Definition window allows you to modify any Ordered Set by replacing it with a different Ordered Set, or by replacing it with a code violation. The code violation is a predefined 10-bit value that replaces the last 10 bits of the target Ordered Set in its 40-bit form. The control to edit the Ordered Set is similar to that in the Trigger Condition window.

Figure 61: Fibre Channel Ordered Set Jam Definition Window



For example, assume that the Trigger Event was a CLS, the Jam was set to replace it with an Idle and the repeat count was set to *forever*. This replaces every CLS in the link traffic with an Idle until you click **Stop** or the specified timeout occurs. Note that the number that you specify in the **Repeat** setting is the number of repetitions that occur including the first Jam. In addition, remember that if an Arm condition is specified, each repeat Jam requires the Arm and Trigger condition be met each time.

Jamming a Frame

To define a Jam for a frame:

1 On the Configuration window, select one of the following from the Type drop-down menu for Jam:

— Replace Frame with Modified Frame

— Replace Frame with Truncated Frame

— Replace Frame with Idles

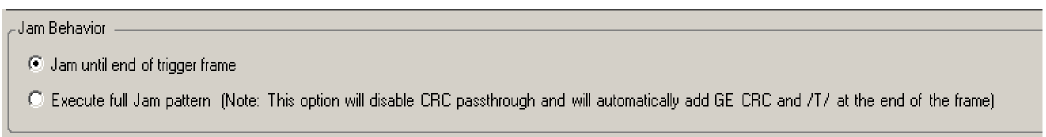
— Replace Frame with ARB(ff)

2 Click the **Jam** button to open the Frame Jam Definition Window.

Jam Behavior

This controls the number of user-defined header/payload Jams performed relative to the target trigger frame. The **Jam Behavio**r section is present on all tabs of the **Frame Jam Definition** window.

Figure 62: Jam Behavior Selection



- **Jam until end of trigger frame**

  Jams defined in the Header and Payload tabs are performed until the end of the target trigger frame (or until an abnormal termination of the frame). All Jams defined that would take place on the original CRC or later are ignored. However, if the frame that is triggered on has more words than the Jams you specify, the remaining words are passed through. This is the standard way to Jam a frame, and is the way the GTX Jammer always Jams frames.

- **Execute full Jam pattern**

  All Header and Payload Jams take place, even if they overwrite beyond the end of the target trigger frame. Use the control at the top of the Payload tab to define how many payload Jams should take place.

  The last defined Jam is the last Payload Jam, unless there are no payload Jams defined then the sixth Header word is the last defined Jam. In any case, when you select this option, the options for modifying the CRC and EOF on the SOF/CRC/EOF tab are unavailable.

  If the target trigger frame is longer than the number of Jams defined, then the portion of the target trigger frame that extends after the last defined Jam is overwritten with Idles. If the target trigger frame is shorter, then the Jammer switches back to pass-through immediately after the last defined Jam.

Note: Be careful when using this option because you may overwrite a portion of important traffic (a frame or Flow Control Ordered Sets).

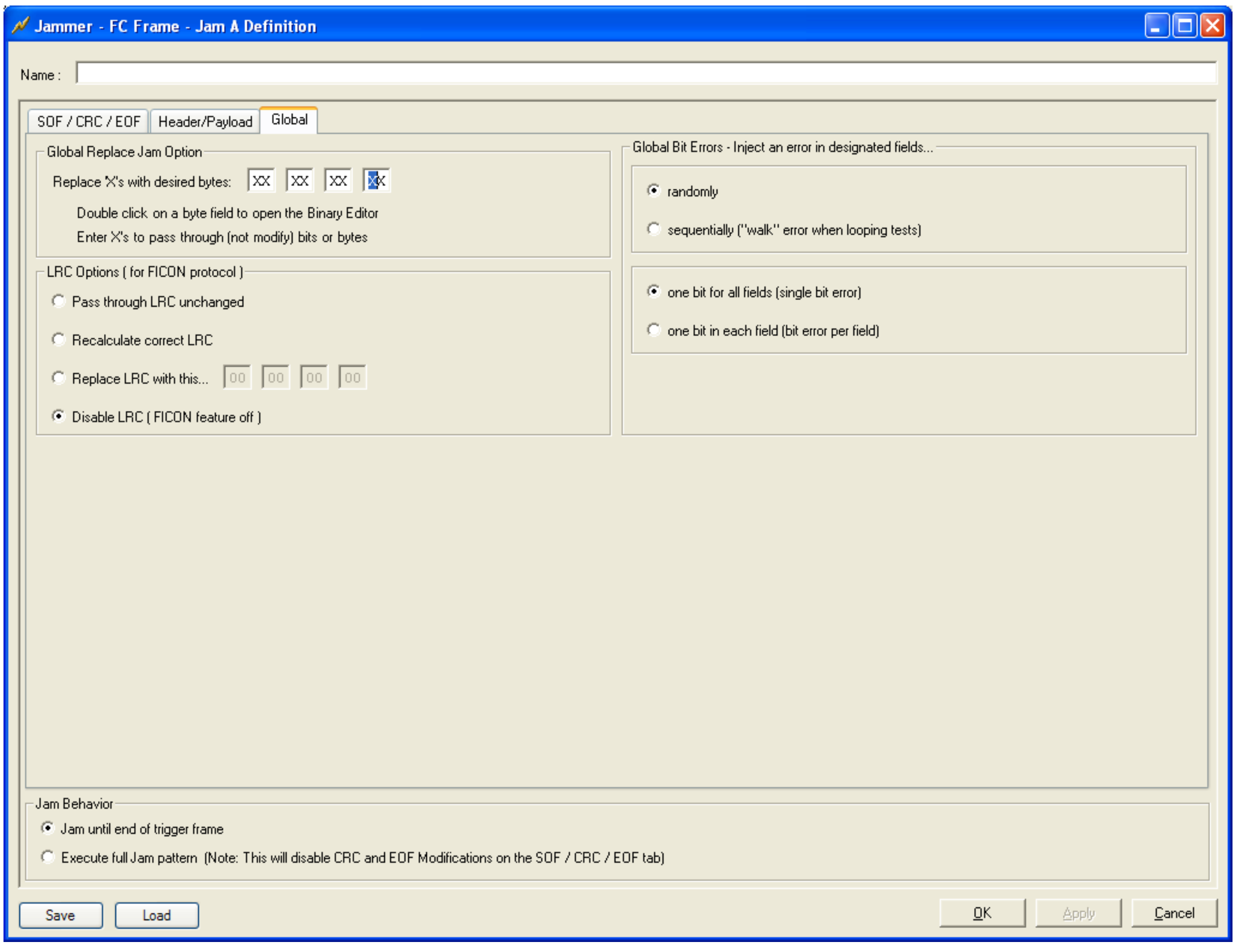
Replace Frame with Modified Frame

Each tab contains options relevant to different frame modifications.

Using the Global Tab

Use this tab (Figure 63) to define Jam parameters that apply globally to the frame.

Figure 63: Fibre Channel Global Tab



Global Replace Jam Option

Use the Global Replace Jam Option to set specific bits in a word to 1 or 0 while passing through the remaining bits. You can apply this change globally to any word in the frame. Define one Global Replace Jam word for each Test Case.

To edit these bits:

>> Enter hex values, or double-click on a byte field to open the Binary Editor.

Any bits left as Xs are passed through.

Global Bit Errors

The Jammer software can introduce bit errors repeatedly in sequential or random fashion to predefined fields. These bit errors are introduced to the 32-bit form of the target words (not the 40-bit form) so code violations are not created. The Global Bit Errors control allows you four options.

- Select **one bit for all fields** and **randomly**. This causes the Jammer to inject a single bit error in the group of all fields selected in the header or payload for a single Test Case. If the Jammer Test Suite is set to *loop*, then single bit errors are randomly injected into these fields, with one bit for each cycle of the Test Suite.
- Select **one bit for all fields** and **sequentially**. This also injects a single bit error in the group of all fields selected in the header or payload. If the Test Suite is set to loop forever, the bit error walks through all the selected fields.
- Select **one bit in each field** and **randomly** does the same thing as the first option; however, there will be one error for each word selected in the header or payload.
- Select **one bit in each field** and **sequentially** does the same thing as the second option; however, there will be one error for each word selected in the header or payload.

LRC Options

This option is only available for Fibre Channel. The FICON protocol uses an LRC which is a special checksum located in the eighth payload word. This option controls what happens to that payload word during the Jam, as well as, for any other words that qualify as being an LRC (that is, if you select Replace Jams with SOFs, then the fourteenth word after each SOF is an LRC word).

- Pass through LRC unchanged

  Whatever word is present in an LRC word is passed through regardless of what you have defined on the Payload tab for that word.
- Recalculate correct LRC

  An LRC is calculated and placed wherever an LRC word occurs. The LRC only functions correctly in valid frames (SOF followed by at least 14 data words).
- Replace LRC with this

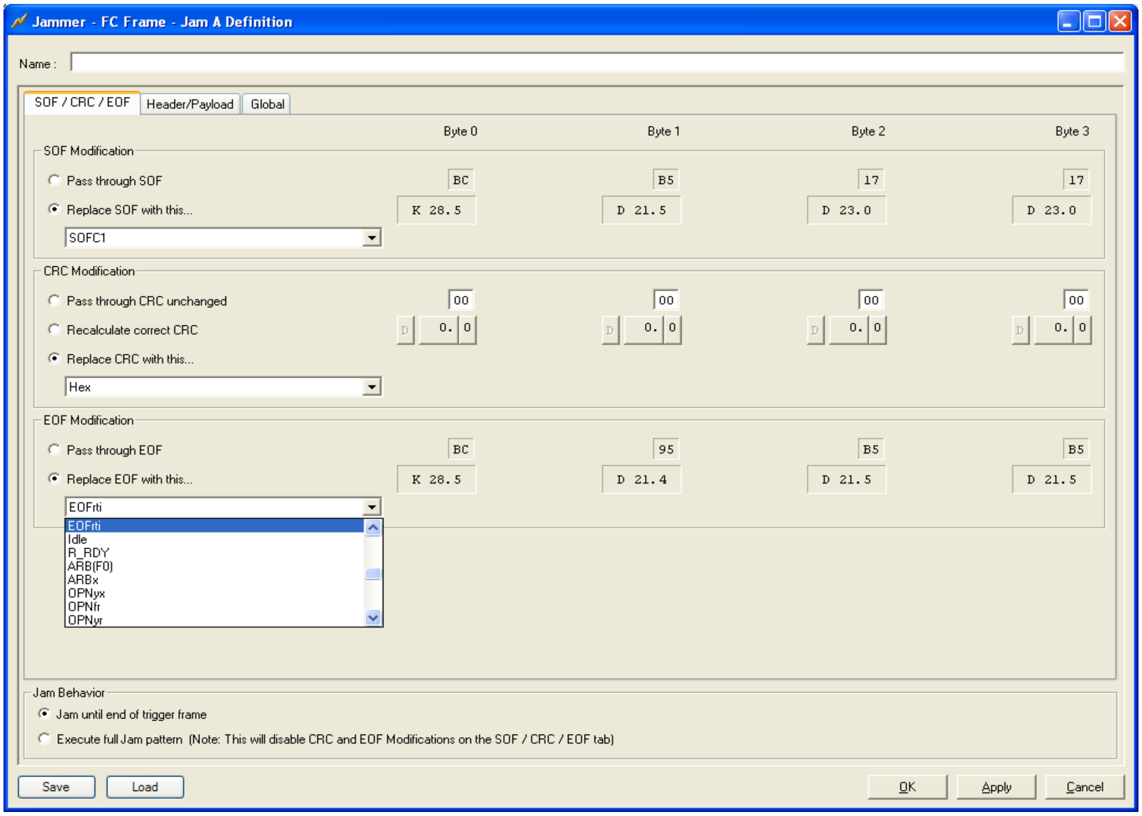
  LRC words are all replaced with this new word, regardless of what you have defined on the Payload tab for that word.
- Disable LRC

  The Jams defined on the Payload tab take place with no special cases for LRC words.

Using the SOF/CRC/EOF Tab for Fibre Channel

Use the choices on this tab to modify the Start of Frame (SOF), Cyclic Redundancy Check (CRC), and End of Frame (EOF) words of the original target frame (Figure 64).

Figure 64: Fibre Channel SOF/CRC/EOF Tab



Modifying SOF/EOF

You can replace the start and end of frame characters with another SOF, EOF, or other Ordered Set. For example, you can change SOFn3 to an SOFi3, which changes a frame from a sequence member to the start of a new sequence.

CRC Options

CRC options include:

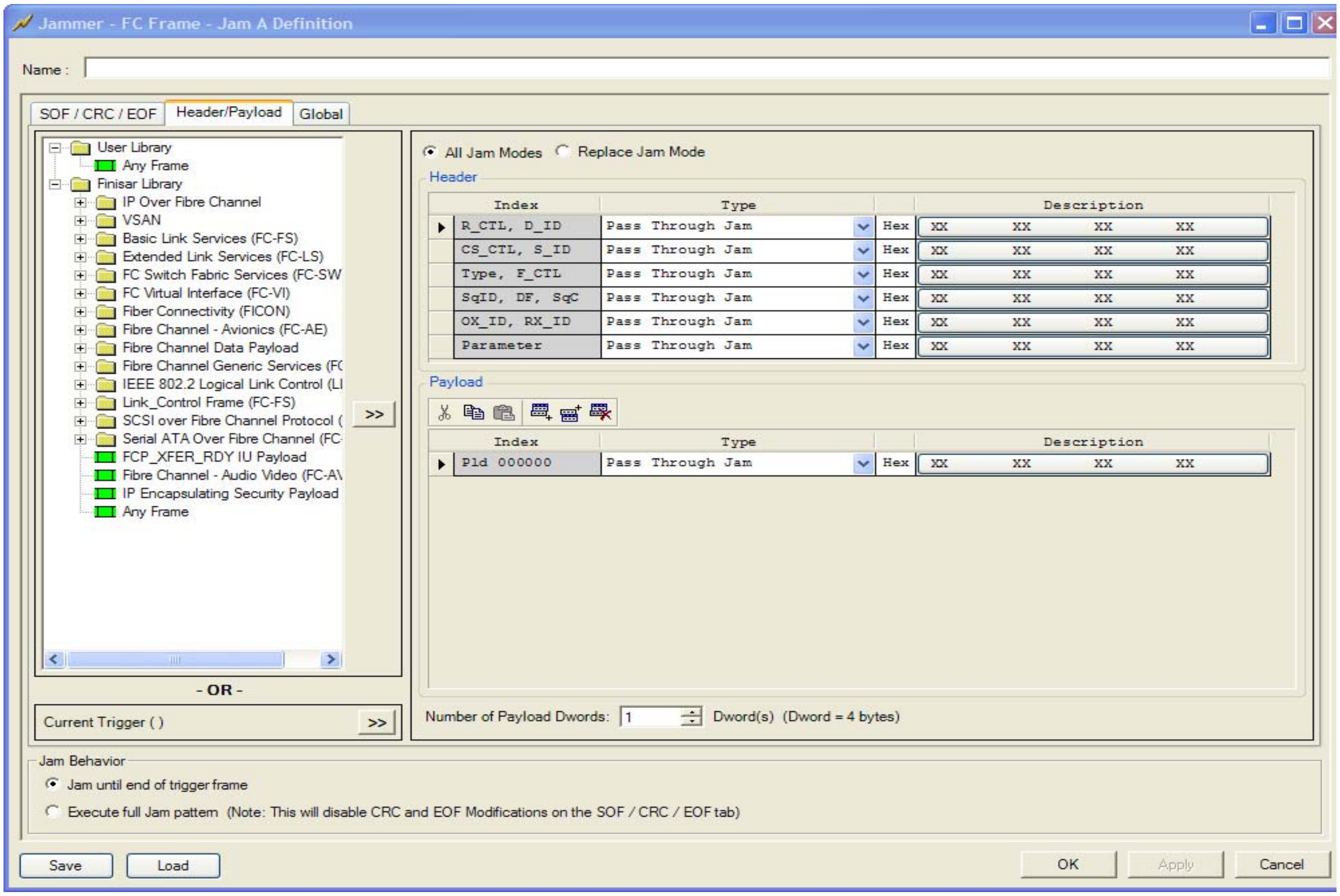
- Pass through CRC unchanged - Not changing the CRC in the original target frame
- Recalculate correct CRC - Recalculating the CRC to make it correct for the modified data
- Replace CRC with this - Replacing with a user-specified data word or Ordered Set

Depending on the changes made to a frame, the old CRC might be invalid. If the CRC is passed through, an invalid Fibre Channel frame might be created. The lowest layer of Fibre Channel error checking should recognize this type of error. The normal system response is to terminate the exchange and start over. If the frame is modified and the CRC is recalculated, a valid frame with modified data is created. If, for example, the modifications are made to SCSI commands embedded in the payload, the SCSI error checking routines should trap and handle the error.

Using the Header/Payload Tab for Fibre Channel

Any parameter in the Fibre Channel header can be modified (Figure 65). Select either the **Replace Jam** or **All Jam Modes** radio button to define the Jam frame.

Figure 65: Fibre Channel Header/Payload Tab



Similar to defining an Arm or Trigger Condition, there are two ways to specify your frame Jam Definition. One way is to load a template from the Template Library tree, and the other way is to manually specify bits in the frame.

To use a template:

1 Highlight a template in the Template Library tree on the left side of the window.

2 Click the double right arrow to display the Jam definition on the right side of the window.

When you use a template, the Jam definition is populated with Replace Jams of the specified data, while all other bits are passed through.

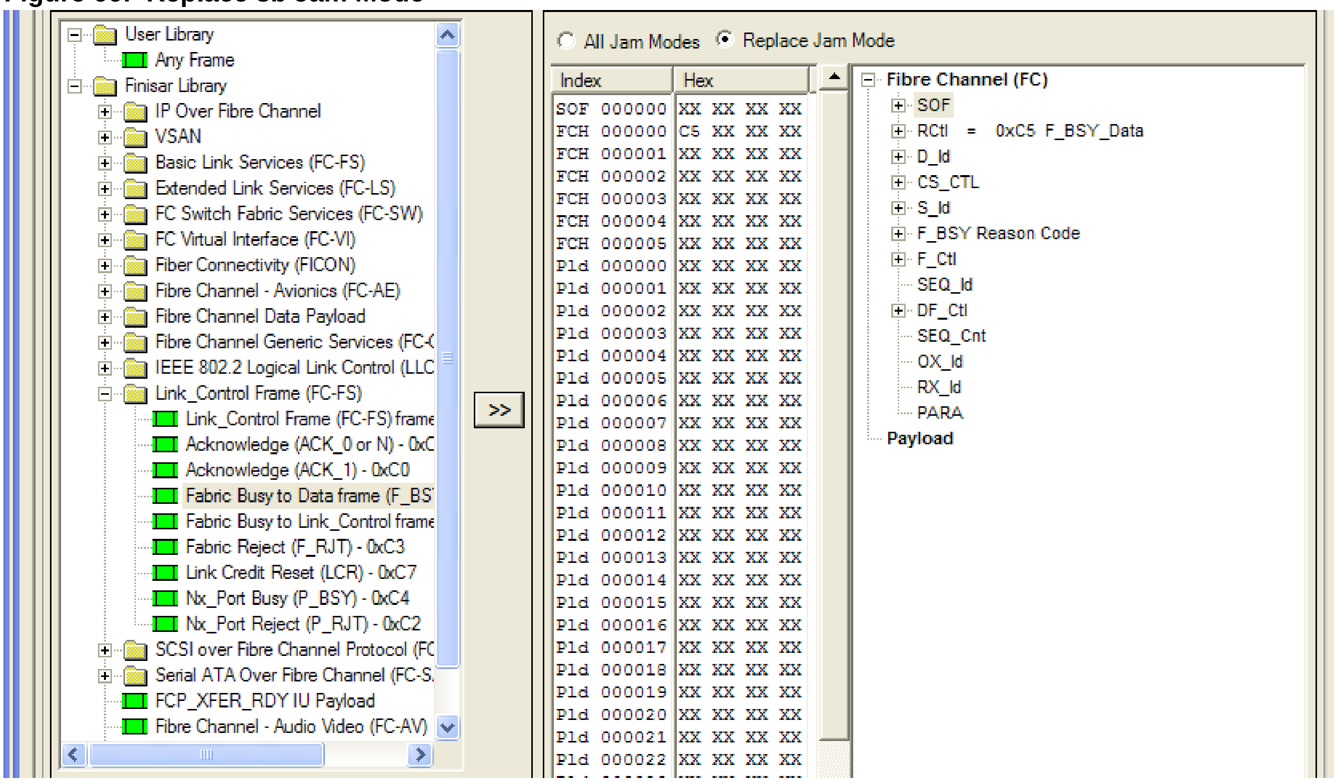
Notice the special choice at the bottom left, “Current Trigger.” This is a copy of the frame condition you have specified for the Trigger. Click the double right arrow to use this.

When you use a template, the Jam definition is populated with Replace Jams of the specified data, while all other bits are passed through.

To manually edit the values, enter a value into the byte field. An **X** in a nibble passes the original value through.

Select the **Replace 8b Jam Mode** radio button to open a dialog that allows you to replace an entire frame either by using a template or manually entering values. The Replace 8b Jam Mode dialog also contains a view of the frame contents, similar to those seen the Arm and Trigger Condition windows. These values correspond to the hex values defined in the center column.

Figure 66: Replace 8b Jam Mode



Select the **All Jam Modes** radio button opens a dialog that provides the following choices for each word in a frame on the Header/Payload tab:

- **Replace 8b Jam -** This function allows you to replace each nibble with a new value. Choose between a standard Ordered Set or a user-defined Ordered Set or data word. For user-defined values, you can specify a value for each nibble.
- **Apply Global Replace Jam** - This function allows individual bits to be set to 1, set to 0 or passed through unchanged according to the Global Replace Jam defined on the Global Tab.
- **Insert Code Violation Jam -** Introduce a pre-defined, fixed code violation to the current word.
- **Invert Jam -** Invert defined bits and pass through the rest. Enter 1s at the appropriate bit locations.
- **Pass Through Jam -** Pass through the current word unchanged.
- **Replace Jam with CRC -** This word contains the current CRC value. CRC calculation is reset and started at the word after any SOF. Note that there should be only valid data words between an SOF and its partner automatic CRC insertion or else the CRC value will be incorrect. Violations of this rule include using Ordered Sets or inserting code violations.

- **Set Bits To 0s Jam-** Set defined bits to 0s and pass through the rest. Enter 0s at the appropriate bit locations.
- **Set Bits To 1s Jam -** Set defined bits to 1s and pass through the rest. Enter 1s at the appropriate bit locations.
- **Apply Global Bit Error Jam -** Apply the Global Bit Error function set on the Global tab. Enter 1s at the appropriate bit locations.

You can modify any and all words in the payload. Decide what portion of the payload you want to modify. The larger the portion of the payload that is selected, the longer the time between Test Cases in the suite. Switching from one Test Case to the next is a software operation, so the time between cases will be on the order of hundreds of milliseconds.

Use the **Number of payload words** counter to define the number of payload Jams (Figure 67). Use the scroll bar to position the display to the desired word.

Figure 67: Selecting Frame Jam Size

The drop-down menus are the same as those found on the Header words. See page 83.

Note: If you place an SOF in header word 2, and an automatic CRC in payload word 10, the CRC is calculated over header words 3 to 6 and continues with payload words 1 to 9.

You can also use the List View controls at the top to cut, copy, paste, add, insert, or delete words.

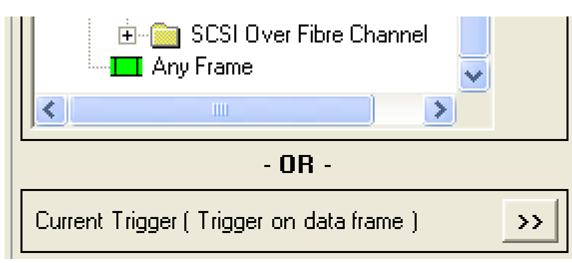
Similar to defining an Arm or Trigger Condition, there are two ways to specify your frame Jam Definition. One way is to load a template from the Template Library tree, and the other way is to manually specify bits in the frame.

To use a template:

1. Highlight a template in the Template Library tree on the left side of the window.
2. Click the double right arrow to display the Jam definition on the right side of the window.

Notice the special choice at the bottom left, Current Trigger (Figure 68). This is a copy of the frame condition you have specified for the Trigger. The name of the Trigger Condition (if any) is shown in parenthesis. Click the double right arrow to use this.

Figure 68: Current Trigger Option



When you use a template, the Jam definition is populated with Replace Jams of the specified data, while all other bits are passed through.

To manually specify a frame word Jam, select a Jam Type from the drop-down menu (under the Type column), then specify any additional definition (if necessary) by clicking on the data field (under the Description column).

Replace Frame with Truncated Frame

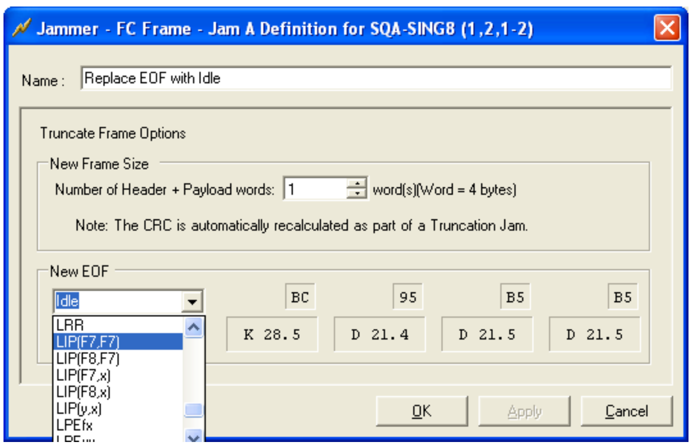
This option truncates the target frame to a shorter length and sends Idles on top of the remainder of the target frame.

To replace a frame with a truncated frame:

>> Use the up and down arrow buttons or type the number of words you want to truncate the frame to (including header and payload, not including SOF, CRC, and EOF).

The CRC is automatically recalculated. If the target frame is already shorter than the specified truncation length, no truncation occurs. In any case, the EOF is always replaced with the new EOF you select from the drop-down menu.

Figure 69: Fibre Channel - Replace Frame with Truncated Frame



Replace Frame with Idles

This option replaces the target frame with Idles.

Replace Frame with ARB(ff)

This option replaces the target frame with ARB(ff).

Chapter 4

Creating Jammer Test Configurations for Gigabit Ethernet

In this chapter:

Defining Your Own Test Configurations

Xgig Jammer lets you define your own test configurations and save them with or without hardware available.

You can create a configuration from scratch, or you can open and edit an existing configuration. Also, you can edit a configuration in edit only mode, which is independent of any hardware, or you can edit a configuration that is currently loaded to a Jammer device.

To edit a configuration in edit only mode:

>> Double-click on a configuration file in the Configuration manager.

Or:

>> Right-click on the configuration in the Configuration manager and choose **Edit Jammer Configuration** from the context menu.

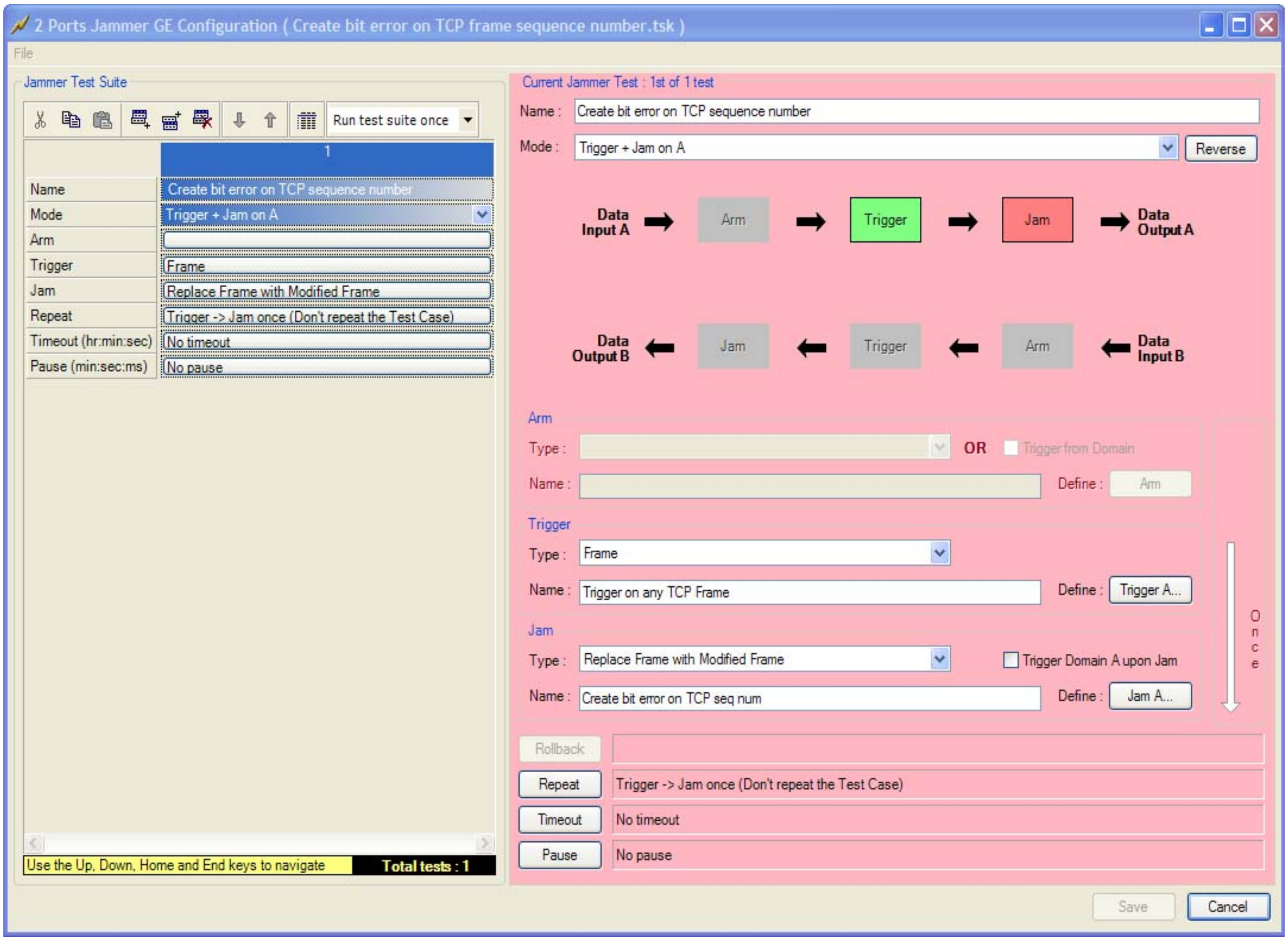
>> Or:

>> Right-click the configuration file in the Configuration manager to open the context menu, and select **Edit Configuration**.

The edit only mode Jammer Configuration window opens (Figure 70).

This window allows you to set up your own Test Cases, name them, organize them, and save them to files so that you can use them again.

Figure 70: Edit Only Jammer Configuration window



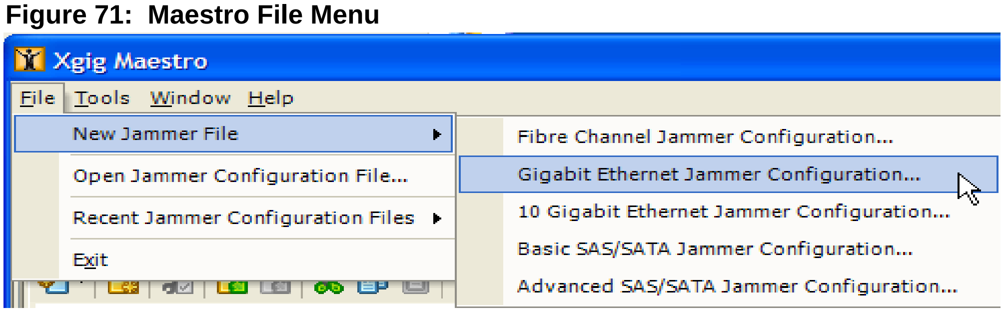
To start a configuration from scratch in edit only mode:

>> Select **New Jammer Configuration** from the context menu or the File menu (Figure 71) on the Xgig Maestro menu bar.

Or:

>> Click the New Configuration icon at the top of the Configuration manager.

Figure 71: Maestro File Menu



To save your configuration in edit only mode:

>> Click **Save** at the bottom of the Jammer Configuration window or open the File menu on the Jammer Configuration window and select **Save Configuration** or **Save Configuration As**.

Any changes you make have no effect on actual Jammer devices you control.

To edit a configuration that is loaded to a Jammer port:

>> Click **Configuration...** in the device column.

Or:

>> Right-click in the Parameters Status table in the device column to open the context menu and select **Edit configuration**.

Or:

>> Click **Operation** in the device column to open the Operation dialog, then click **Config**.

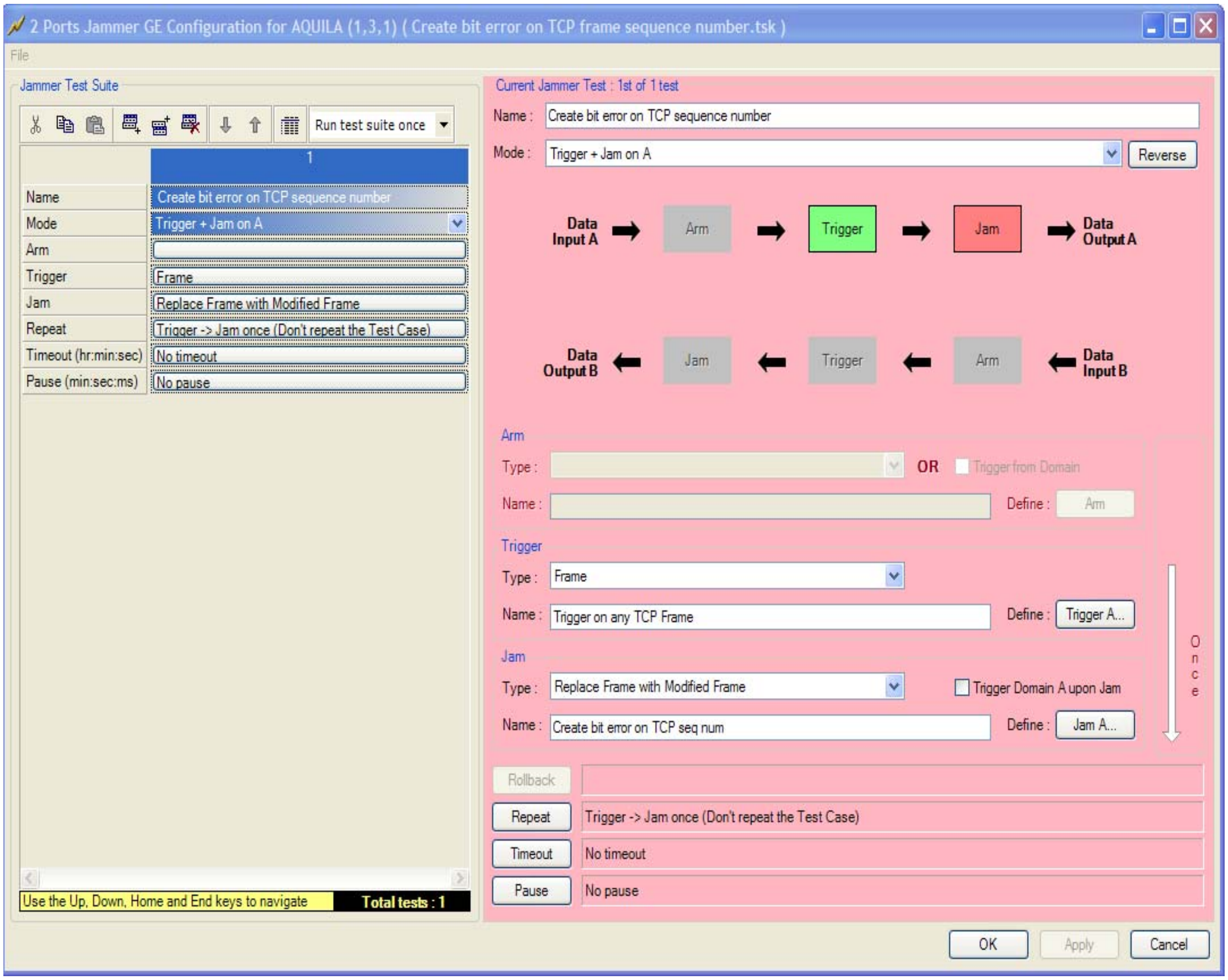
The Xgig Jammer Configuration window in hardware edit mode is displayed (Figure 72). This window allows you to set up your own Test Cases, name them, and save them to a file so that you can use them again.

Click **Apply** or **OK** and Jammer accepts the changes. They are immediately reflected in the Parameters Status table and affect the Jammer device the next time you run it.

To save your configuration edits:

>> Open the File menu at the top of the Jammer Configuration window and select **Save Configuration As...** or **Save Configuration**.

Figure 72: Xgig Jammer Configuration Window



Using the Jammer Configuration Window

The Jammer Configuration window title bar indicates how many ports it is configuring, the protocol, and the configuration file name, if any. If you are using hardware edit mode, the chassis name, chassis number, slot number, and port number are also listed. The elements of the Jammer Configuration window are described in the following sections.

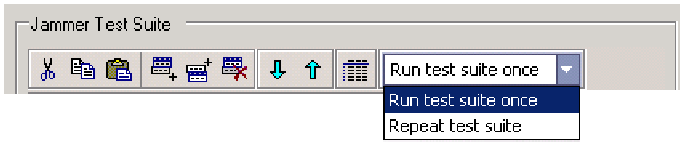
Using the Jammer Test Suite Tools

The Test Suite lists the series of Xgig Jammer tests in the order in which you want them to execute. The suite includes one or more tests. The highlighted test appears as the Current Jammer Test on the upper right side of the window. Each test in the suite executes in sequence with a test reset time of approximately 130 (200 max) milliseconds.

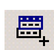
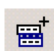
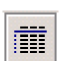
Creating a Test Suite

When you create a Gigabit Ethernet Jammer Test Suite, you use the toolbar in the Jammer Test Suite section of the Configuration window (Figure 73).

Figure 73: 10GigE Jammer Test Suite Toolbar



The following list describes the icons on the toolbar:

	Cut current test	Removes the highlighted test and holds its contents in the memory buffer.
	Copy current text	Copies the highlighted test to the memory buffer.
	Paste last test cut or copied	Inserts the current memory buffer contents before the currently highlighted test.
	Add new test to bottom of stack	Adds a new blank test to the bottom of the suite.
	Insert new test before current test	Inserts a new blank test above the currently highlighted test.
	Delete current test	Removes the highlighted test from the suite. If only one test is present, then the contents of this test are cleared.
	Move current test down the stack	Moves the highlighted test down one in the test order.
	Move current test up the stack	Moves the highlighted test up one in the test order.
	Toggle view	Toggles Test Suite between Card View and List View.
	Run test suite once or Repeat test suite	When you choose Repeat test suite, the tests run according the settings you define in the Jammer Current Test window.

To duplicate a test at another point in the Test Suite:

1 Highlight the test you want to duplicate.

2 Click **Copy**.

3 Highlight the test in the suite that is just after the point where you want the duplicate test inserted.

4 Click **Paste**.

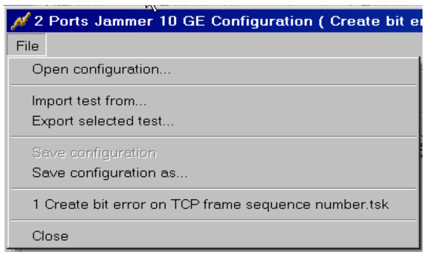
The duplicate test is inserted.

Refer to "Configuring Arm and Trigger Conditions for Gigabit Ethernet" and "Configuring the Jam Definition for Gigabit Ethernet" for information about configuring each test.

Using the Configuration File Menu

The File menu is the only menu on the menu bar (Figure 74).

Figure 74: Configuration File Menu



The choices are:

Open Configuration	Open an existing `.tsk` configuration file.
Import to Selected Test	Import a Test Case from a `.tst` file or an entire test suite, `.tsk` file, to the currently highlighted position. A Test Case is one line in the Jammer Test Suite.
Export Selected Test	Export and save the currently highlighted test to a `.tst` file.
Save Configuration	Save the entire Test Suite to the `.tsk` file you currently have loaded.
Save Configuration As	Save the entire Test Suite to a `.tsk` file with a name you assign to it.
Close	Close the Jammer Configuration Window.

The recently used Gigabit Ethernet Jammer configuration files appear in the file menu and are loaded when selected.

Using the Current Jammer Test Window

Note: The `.tst` files are only for storing individual Test Cases and swapping them between configuration files. You cannot load `.tst` files directly into a Jammer device on the Xgig Maestro window.

The graphics in this section of the window represent the hardware configuration for the selected test in the Jammer Test Suite.

Mode

For 10GigE, Mode menus are available near the top of the Current Jammer Test window (Figure 75) and also near the top of each Test Case in the Jammer Test Suite window (Figure 76).

The input to path A (on top) is always port A and the input to path B (on the bottom) is always port B. The external trigger input and output that is available on path A always are linked to the domain shown on the Xgig Maestro window as “Domain of port A.” The trigger input and output on the bottom on path B are in the “Domain of port B.”

Figure 75: Mode Drop-down Menu in Current Jammer Test - Right Pane

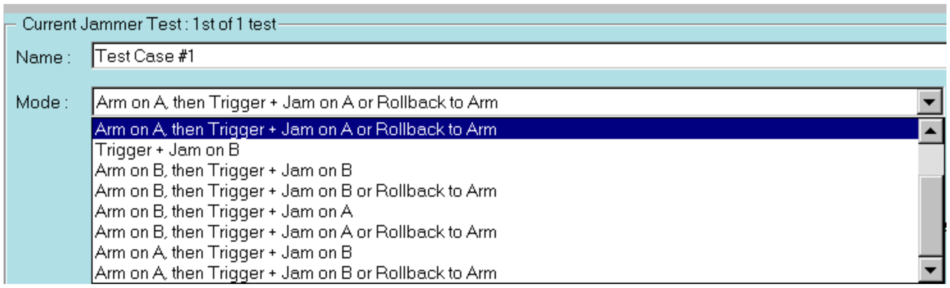
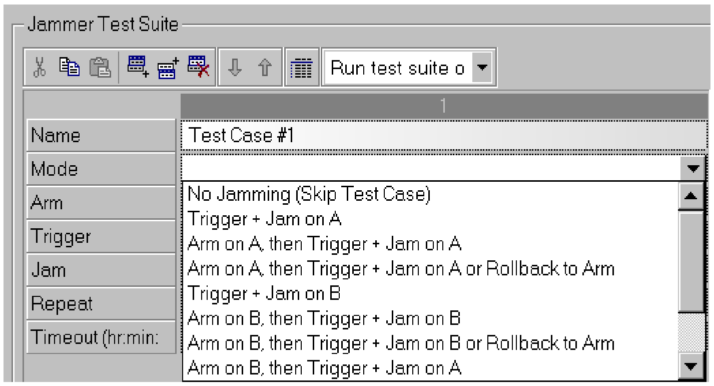


Figure 76: Mode Drop-down Menu in Test Suite - Left Pane



Reverse

You can reverse the direction of the jam by selecting the **Reverse** button.

Arm and Trigger

To define Arm and Trigger conditions, select a respective Type from each drop-down menu. Then click the Arm or Trigger button to open the corresponding definition window.

You can use an external input as an Arm condition. Check Trigger from Domain A (or B) to enable this feature. You must put the corresponding Jammer port into a domain for this to work properly.

The Trigger event can be in the next Dword after the Arm event in the traffic stream.

Jam

To define a Jam:

1 Select a Type from the drop-down menu, if available.

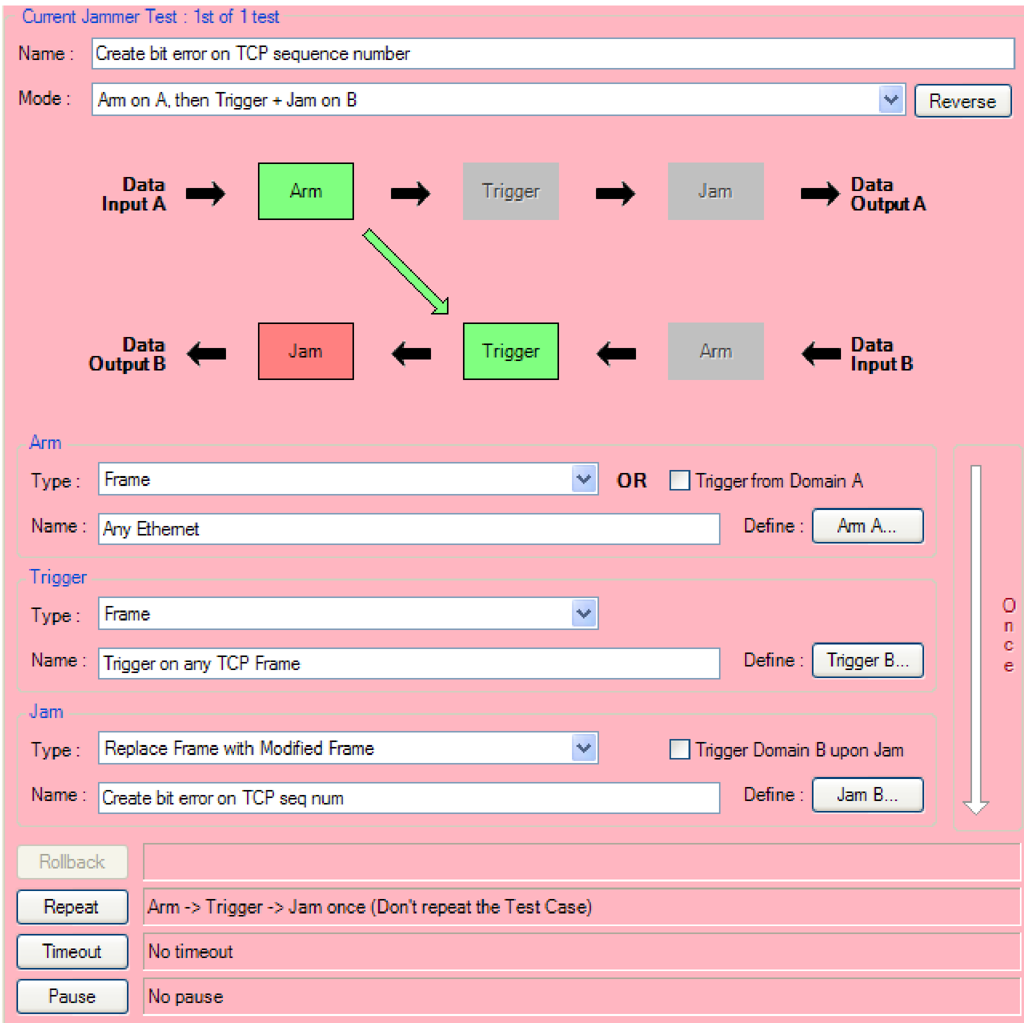
2 Click the Jam button to open the Jam Definition window.

The Jam Definition specifies the modifications to be made to the traffic matching the Trigger Condition.

In addition, the Jammer port can trigger out to the Domain it is in when a Jam takes place. Check Trigger Domain A (or B) upon Jam to enable this feature.

Note: If you use an external trigger input to define the Arm condition, then you cannot select the external trigger output for that path in that Test Case, and vice versa. For information regarding using the trigger input and output during a Test Case, refer to “Using Domains and External Triggering” on page 291. However, you can use an external trigger in on port A with an external trigger out on port B, and vice versa. Figure 77 shows an example.

Figure 77: Trigger In and Trigger Out

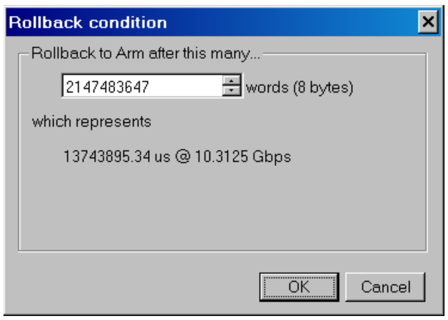


Rollback

The Rollback option defines the time or Dword count parameter between the Arm and Trigger events. If the Trigger does not follow the Arm event in the allotted time or Dword count, the Jammer begins looking for the Arm event again. Click **Rollback** to display the dialog shown in Figure 78.

Note: This value is saved in terms of Dwords, not time, so keep this in mind if you save a Test Case using a device running at 3.0 Gbps and later open the configuration on a Jammer running at 1.5 Gbps.

Figure 78: Rollback Condition Dialog



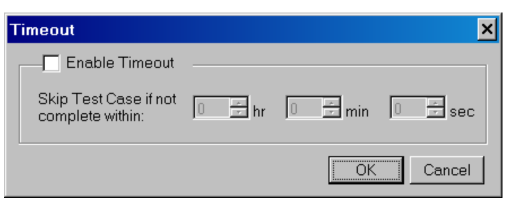
Timeout

The timeout option defines the period of time to wait for a specified test to complete before aborting and proceeding to the next test in the suite.

To set the timeout:

1. Click **Timeout** to display the dialog box in Figure 79.
2. Check **Enable Timeout**.
3. Enter the hours, minutes, and seconds you want to wait.

Figure 79: Timeout Dialog

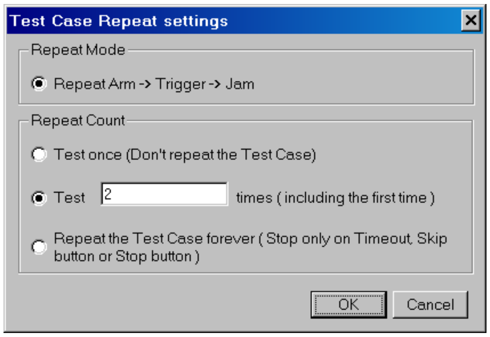


4. Click **OK**.

Repeat

Click **Repeat** to open the dialog shown in Figure 80. The Repeat Mode setting allows you to configure what is repeated when using an Arm condition. The first option means the Jammer will match the Arm condition once, then will repeat matching the Trigger condition as specified by the Repeat Count setting below. The second Repeat Mode option means that the Jammer must match the Arm condition each time before looking for a Trigger.

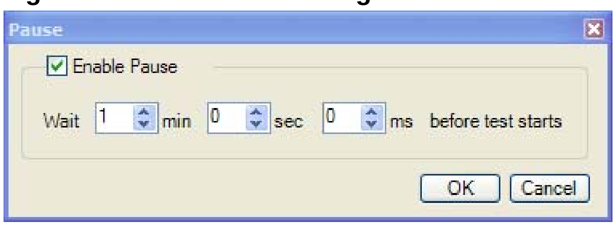
Figure 80: Repeat Test Dialog



Pause

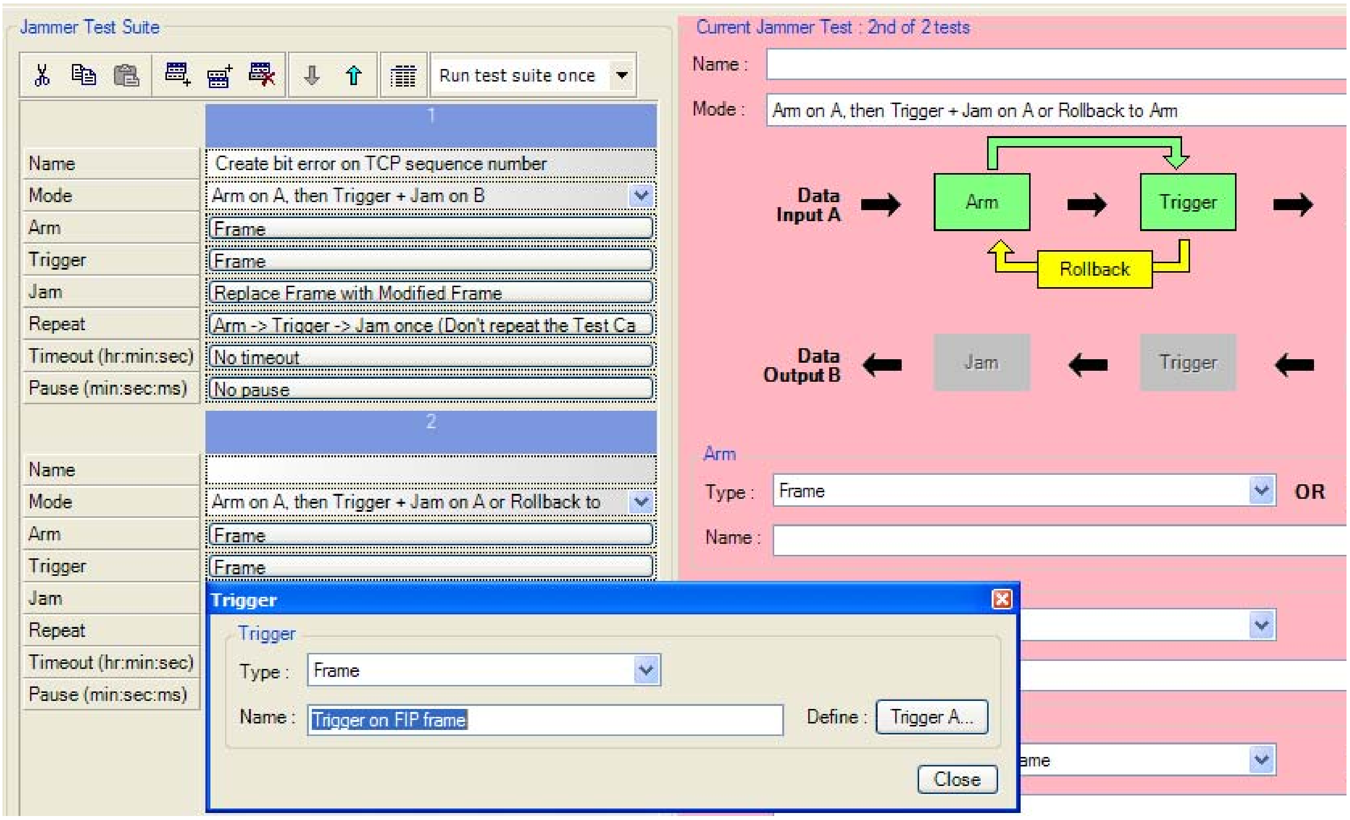
Click **Pause** to open the dialog shown in Figure 81. The Pause setting allows you to insert a pause before the beginning of a test case.

Figure 81: Pause Test Dialog



You can also configure options for each Test Case directly in the Test Suite, instead of clicking in the Current Jammer Test pane. Click on the area of the Test Case you want to modify to open the corresponding dialog (Figure 82).

Figure 82: Configuring Options Directly in the Test Suite



Configuring Arm and Trigger Conditions for Gigabit Ethernet

Arm and Trigger conditions recognize specific Ordered Sets or frames, depending on the protocol.

In Gigabit Ethernet, you can specify any standard Ordered Set or any user-defined one or two bytes of K/D characters (of which standard Ordered Sets are a subset). You can also use a frame, for which you can specify the Gigabit Ethernet header and up to 114 bytes of payload.

You can save an arm or trigger condition as a `.jmt` file by clicking the **Save** button in the **Arm** or **Trigger** window. You can load a `.jmt` file by clicking the **Load** button in the **Arm** or **Trigger** window.

Depending on the Mode you select, the appropriate graphic diagram shows the Trigger and optional Arm conditions, along with the Jam event. If the Mode you select does not include an Arm condition, the Arm button remains disabled.

To set Arm and Trigger conditions:

1. Click on the **Arm** or **Trigger** button in the Xgig Jammer Configuration window.

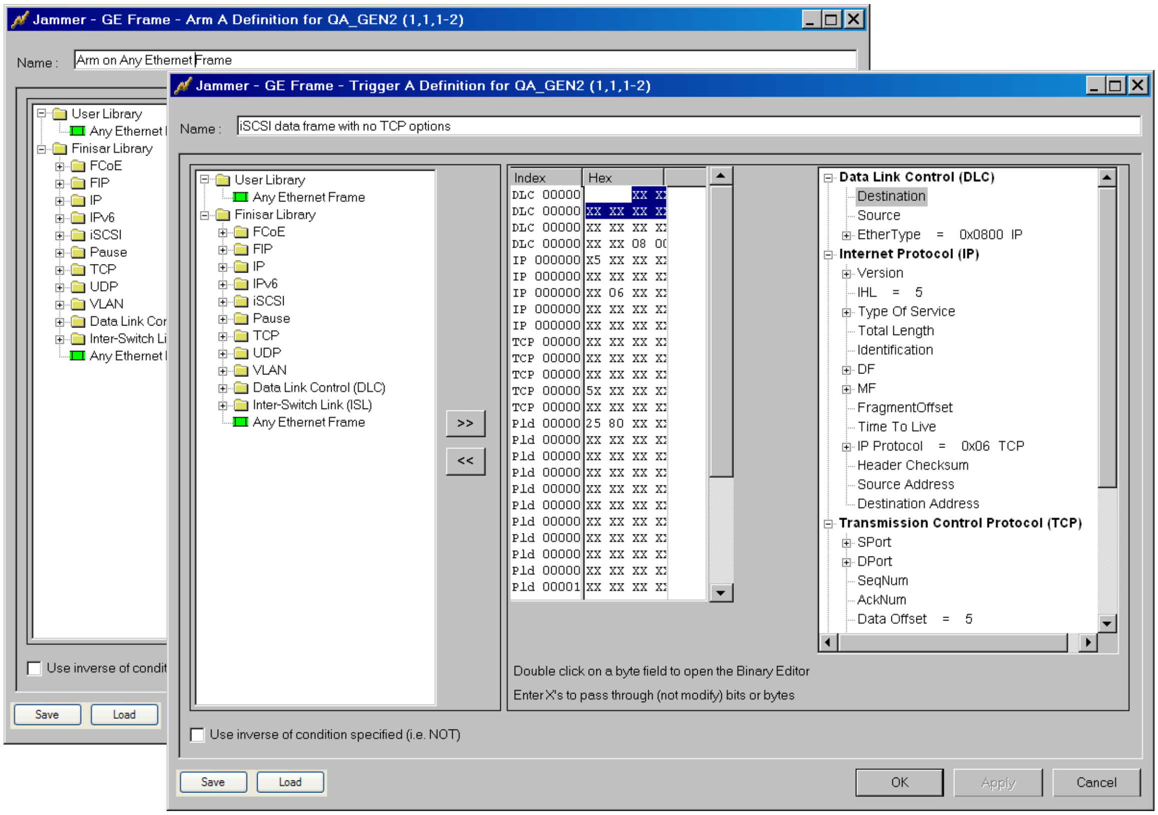
   The window for the condition is displayed (Figure 83). If you are in hardware edit mode, the protocol, chassis name, chassis number, slot number, and port numbers are displayed in the title bar.

2. Open the Type drop-down in the Arm or Trigger Condition window and select Frame or Ordered Set.

3. Set the values as required to specify a unique Arm and Trigger sequence for the specific test.

   The following sections describe the available values.

Figure 83: Gigabit Ethernet Arm and Trigger Windows for Frames



Setting Frame Conditions

You can specify frame conditions in two ways. One way is to load a template from the Template Library tree, and the other way is to manually specify bits in the frame.

To use a template:

1 Select a template from the Template Library tree on the left.

2 Click the double right arrow button to set the Trigger Condition.

The condition is indicated on the right side of the window.

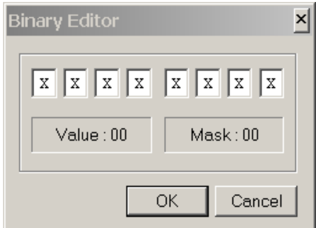
To manually specify a frame:

>> Type hexadecimal values directly into the center column of the window.

An X represents a nibble that can be any value (a “don’t care”).

To set individual bits in any field, double-click on the hex entry to open the Binary Editor (Figure 84). In the hex view, partially defined hex characters appear as question marks: `X001=?`

Figure 84: Binary Editor Dialog



Another way to manually edit the frame condition is to make selections from the tree view in the right window pane.

Saving a Frame Condition

If you create a frame condition that you want to save and make easily available for future use, you can save it into the “User Library” folder in the Template Library tree. To do this:

>> Highlight the folder and click the double left arrow button.

Frame conditions have the option of “Use inverse of condition specified (i.e., NOT).” When you check this option, it means that the first frame encountered that does not match what you have specified creates a “condition met” event.

For each frame condition, you can specify an optional name at the top of the window. This name is also shown on the Jammer Configuration window under the Mode selection, and on the main Xgig Maestro window.

Setting Ordered Set Conditions

To arm or trigger on an Ordered Set:

1 Click on the Arm or Trigger button in the Jammer Configuration window.

2 Open the Type drop-down in the Arm or Trigger Condition window and select Ordered Set.

3 Set the values as required to specify a unique Arm and Trigger sequence for the specific test.

You can choose from any standard Ordered Set or choose user-defined (Figure 85). All choices are either one byte or two bytes. A user-defined condition can use any K/D character(s).

To edit the values:

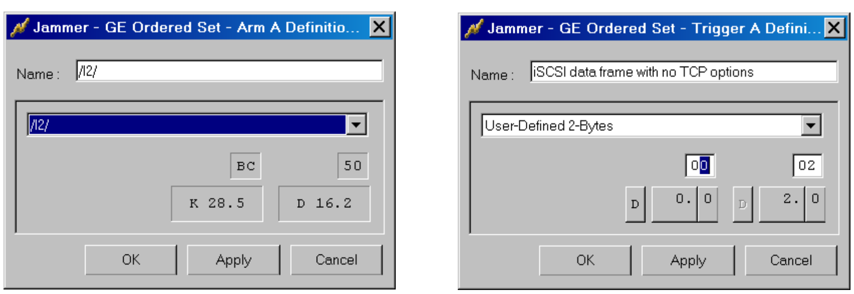
\>> Enter a hex value, or double-click the byte field to open the Binary Editor.

As in frame conditions, an X indicates “don’t care” and a ? indicates a partially specified hex character.

You can also click on the K/D character display (for example, 16.2) to open drop down menus of possible values from which you can select. A period separates the two values. Click the K or D to toggle the Control Characters setting.

Note: In Gigabit Ethernet, if you choose a one byte Ordered Set Trigger condition, then the Jam definition must be one byte. If you choose a two byte Ordered Set, then the Jam must be two bytes.

Figure 85: Gigabit Ethernet Arm and Trigger Windows-Ordered Sets



Note: Two byte Ordered Set conditions are only met when aligned to the normal 16-bit boundary (in alignment with the I2 Ordered Sets). For example, if you specify a condition of 50-K28.5, hoping that the condition would be met by two I2 (K28.5-50-K28.5-50), this condition would not be met.

As with frame conditions, you can specify an optional name at the top of the window. This name is also shown in the Jammer Configuration window under the Mode selection and on the main Xgig Maestro window.

Configuring the Jam Definition for Gigabit Ethernet

The **Jam Definition** window defines how to modify the event specified on the **Trigger Condition** window.

The Jam is always the same type (frame or Ordered Set) as the Trigger.

For any Jam Definition, you can specify an optional name at the top of the window. This name is also displayed on the Jammer Configuration window under Mode selection and on the main Xgig Maestro window.

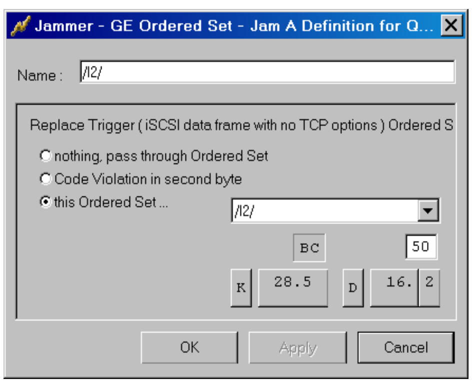
You can save a Jam definition as a `.jmj` file by clicking the **Save** button in the **Jam** window. You can load a `.jmj` file by clicking the **Load** button in the **Jam** window.

Jamming an Ordered Set

If the Trigger Event is an Ordered Set, click the **Jam** button on the Xgig Jammer Configuration window, to open the Ordered Set Jam Definition window (Figure 86).

The Ordered Set Jam Definition window allows you to modify any Ordered Set by replacing it with a different Ordered Set, or by replacing it with a code violation. The code violation is a predefined 10-bit value that replaces the last 10 bits of the target Ordered Set in its 40-bit form. The control to edit the Ordered Set is similar to that in the Trigger Condition window.

Figure 86: Gigabit Ethernet Ordered Set Jam Definition Window



For example, assume that the Trigger Event was an I1, the Jam was set to replace it with an I2 and the repeat count was set to *forever*. This replaces every I1 in the link traffic with an I2 until you click **Stop** or the specified timeout occurs. Note that the number that you specify in the **Repeat** setting is the number of repetitions that occur including the first Jam. In addition, remember that if an Arm condition is specified, each repeat Jam requires the Arm and Trigger condition be met each time. An exception is in Gigabit Ethernet: if the Trigger condition is met more than once in a 32-bit word, then the Jam occurs multiple times in that same word, and then begins looking for the Arm condition, again, on the next word.

Jamming a Frame

To define a Jam for a frame:

1 Click the Jam button on the Xgig Jammer Configuration window to open the Frame Jam Definition window (Figure 87).

2 Under the Jam Type drop-down, choose to:

— Modify traffic

— Truncate a frame

— Replace the frame with Idles (I2)

The following paragraphs describe these choices.

Replace Frame with Modified Frame

Each tab contains options relevant to different frame modifications.

Using the Global Tab

Use this tab (Figure 87) to define Jam parameters that apply globally to the frame.

Global Match/Mask Option

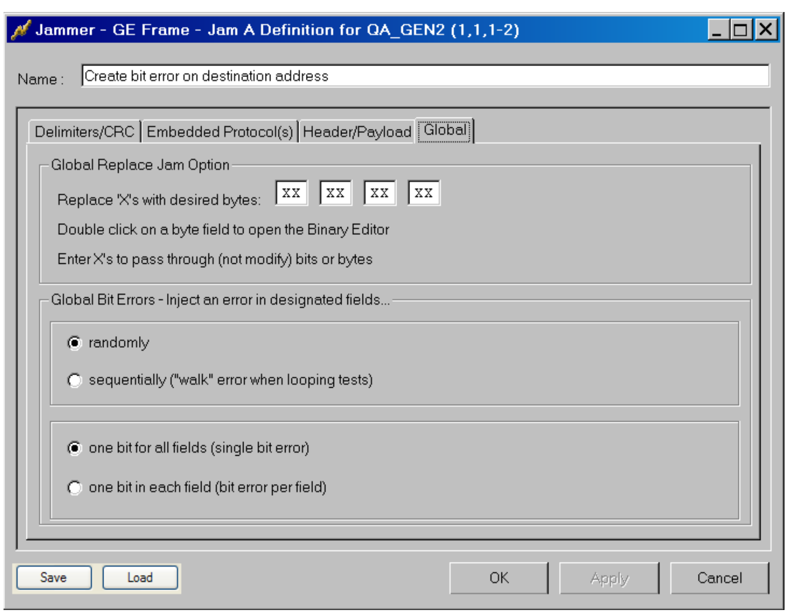
Use the Global Match/Mask word to set specific bits in a word to 1 or 0 while passing through the remaining bits. You can apply this global mask to any word in the frame. Define one Global Match/Mask for each Test Case.

To edit these bits:

>> Enter hex values, or double-click on a byte field to open the Binary Editor.

Any bits left as Xs are passed through.

Figure 87: Gigabit Ethernet Global Tab



Global Bit Errors

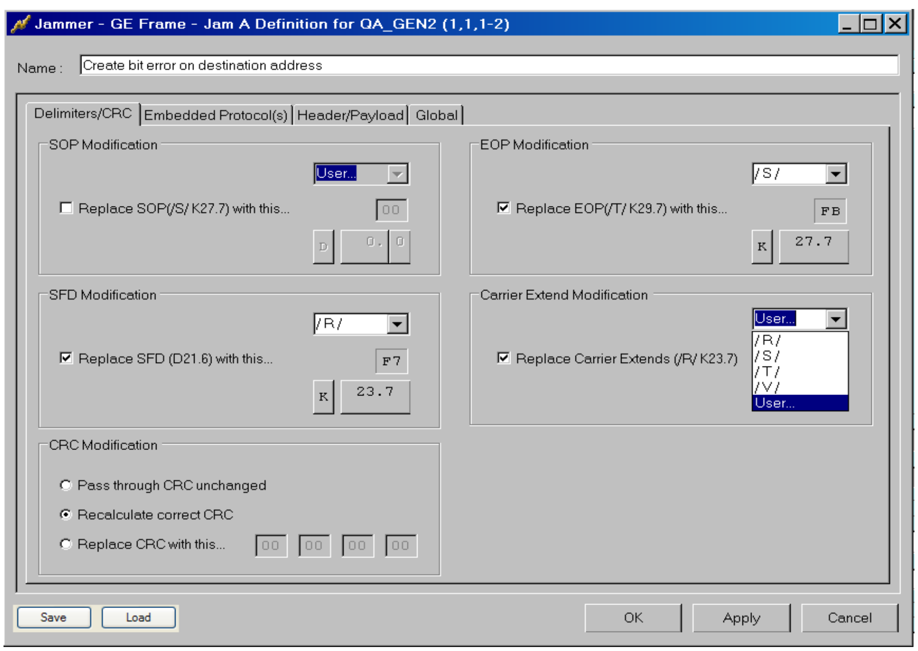
The Jammer software can introduce bit errors repeatedly in sequential or random fashion to predefined fields. These bit errors are introduced to the 32-bit form of the target words (not the 40-bit form) so code violations are not created. The Global Bit Errors control allows you four options.

- Select **one bit for all fields** and **randomly**. This causes the Jammer to inject a single bit error in the group of all fields selected in the header or payload for a single Test Case. If the Jammer Test Suite is set to *loop*, then single bit errors are randomly injected into these fields, with one bit for each cycle of the Test Suite.
- Select **one bit for all fields** and **sequentially**. This also injects a single bit error in the group of all fields selected in the header or payload. If the Test Suite is set to loop forever, the bit error walks through all the selected fields.
- Select **one bit in each field** and **randomly** does the same thing as the first option; however, there will be one error for each word selected in the payload or header.
- Select **one bit in each field** and **sequentially** does the same thing as the second option; however, there will be one error for each word selected in the payload or header.

Using the Delimiters/CRC Tab for Gigabit Ethernet

Use the choices on this tab to modify the Start of Packet (SOP), Start Frame Delimiter (SFD), CRC, End of Packet (EOP), and Carrier Extend(s) of the original frame (Figure 88).

Figure 88: Gigabit Ethernet Delimiters/CRC Tab



Modifying SOP/SFD/EOP/ Carrier Extend(s)

To modify any of these special characters in the target trigger frame:

1 Check the appropriate box to select replacement.

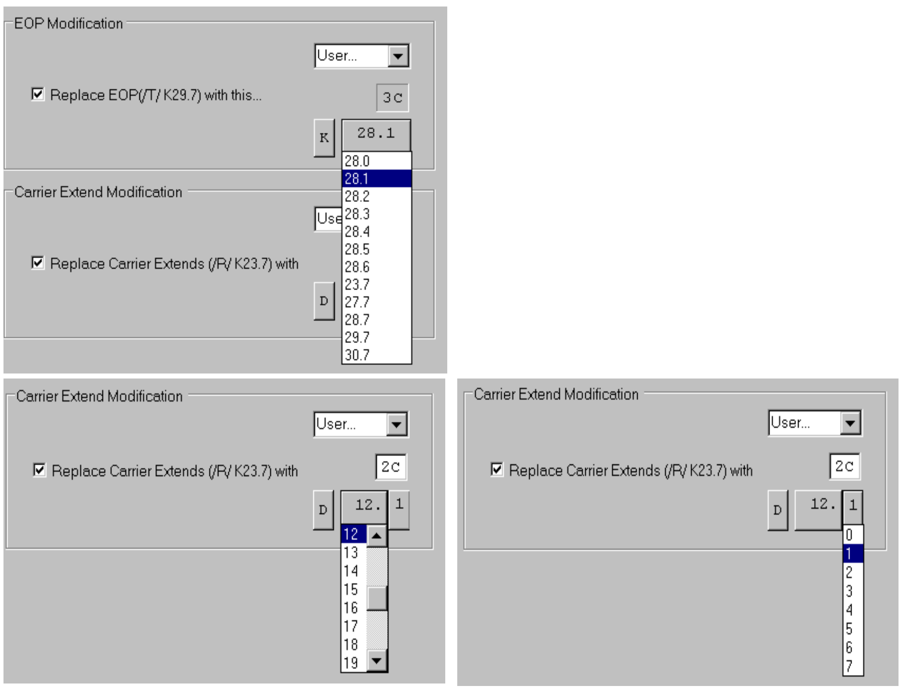
2 Open the drop-down menu and choose a standard Gigabit Ethernet Ordered Set, or select User-defined.

If you choose User-defined, you can specify any value.

To edit the value enter a hex value into the byte field or double-click to display the Binary Editor.

You can also click on the K/D character display (for example, 16.2) to open drop-down menus of possible values from which you can select (Figure 89). A separator (a period) distinguishes the two values. Click the K or D to toggle the Control Character setting.

Figure 89: K/D Character Value Drop-down Menus



CRC Options

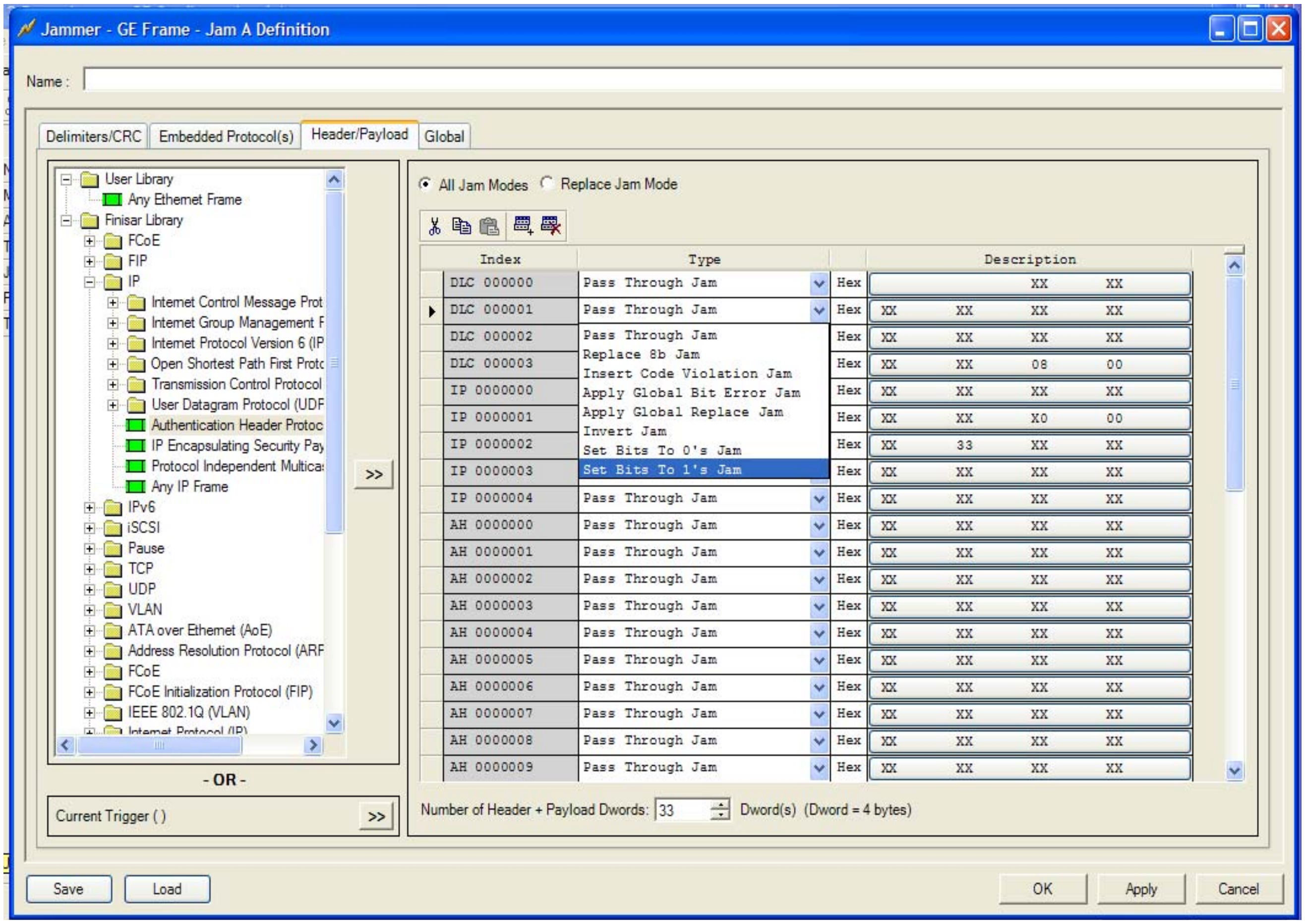
The CRC options include:

- Not changing the CRC in the original target frame
- Recalculating the CRC to make it correct for the modified data
- Replacing with a user-specified data word

Using the Header/Payload Tab for Gigabit Ethernet

You can modify any parameter or word on the Gigabit Ethernet Header/Payload Tab (Figure 90).

Figure 90: Gigabit Ethernet Header/Payload Tab



The Gigabit Ethernet window always shows Jam definitions for the header and 4096 payload words (for the maximum supported 16 Kilobyte jumbo frames). If the frame that is Jammed has less than 4096 payload words, the extra Jam definitions do not take effect. The Jammer does not support Gigabit Ethernet frames larger than 4096 payload words.

Notice the first line of the Jam Definition (Ether 0001) has only the first two bytes of the Destination Address header field. This is to visually orient the frame in the same manner as the Arm and Trigger Condition windows.

Similar to defining an Arm or Trigger Condition, there are two ways to specify your frame Jam Definition. One way is to load a template from the Template Library tree, and the other way is to manually specify bits in the frame.

To use a template:

1 Highlight a template in the Template Library tree on the left side of the window.

2 Click the double right arrow to display the Jam definition on the right side of the window.

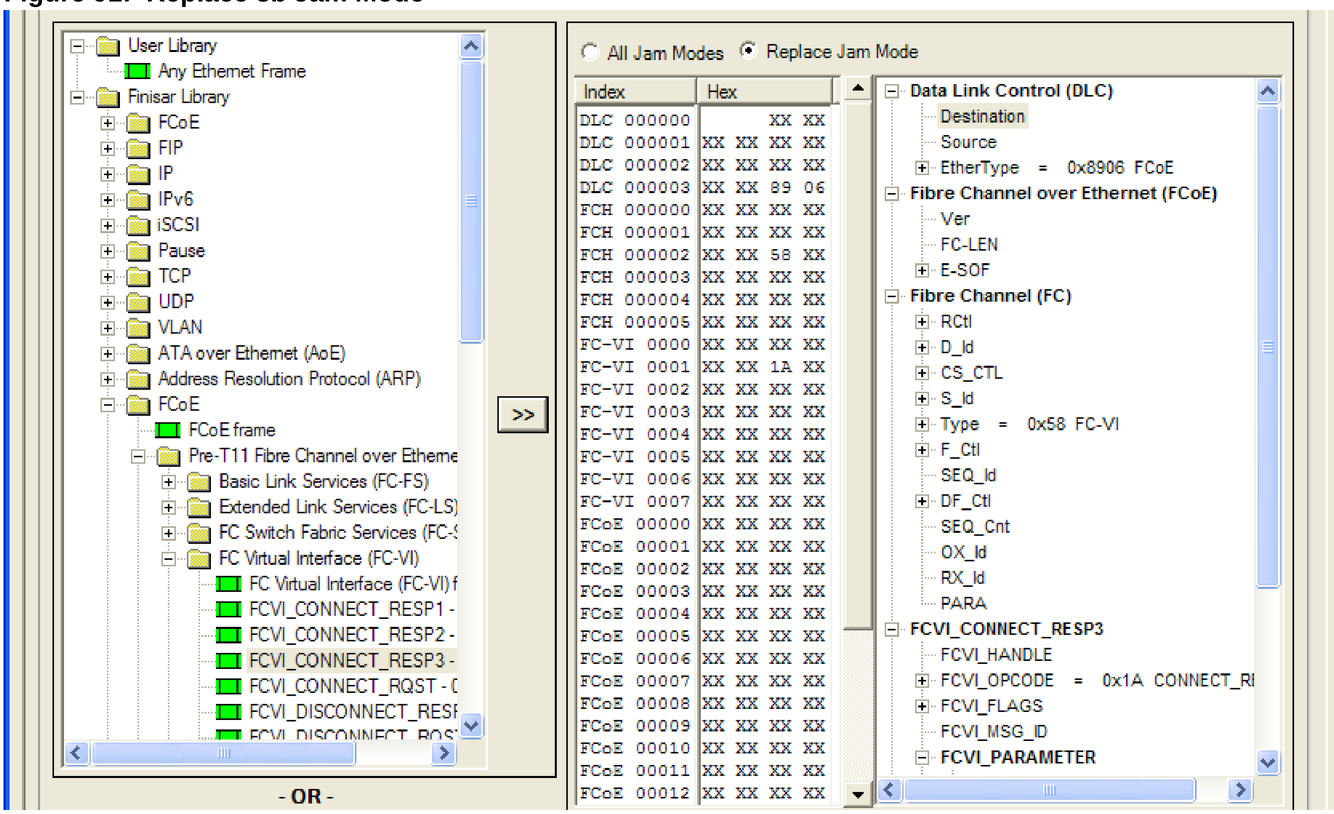
Notice the special choice at the bottom left, “Current Trigger.” This is a copy of the frame condition you have specified for the Trigger. Click the double right arrow to use this.

When you use a template, the Jam definition is populated with Replace Jams of the specified data, while all other bits are passed through.

To manually edit the values, enter a value into the byte field. An **X** in a nibble passes the original value through.

Select the **Replace 8b Jam Mode** radio button to open a dialog that allows you to replace an entire frame either by using a template or manually entering values. The Replace 8b Jam Mode dialog also contains a view of the frame contents, similar to those seen the Arm and Trigger Condition windows. These values correspond to the hex values defined in the center column.

Figure 91: Replace 8b Jam Mode



Selecting the **All Jam Modes** radio button opens a dialog that provides the following choices for each word in a frame on the Header/Payload tab:

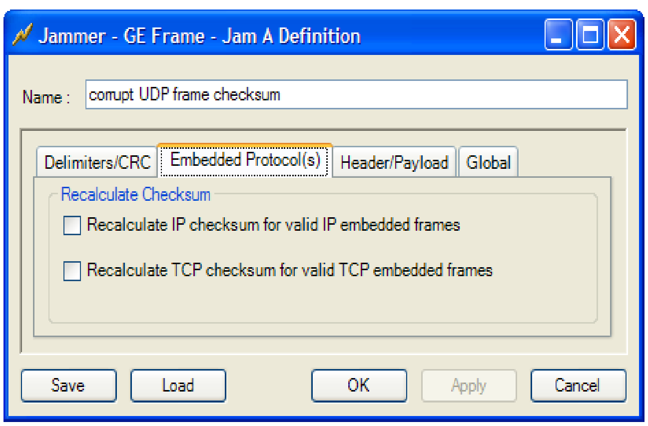
- **Apply Global Match Mask Jam** - This function allows individual bits to be set to 1, set to 0 or passed through unchanged according to the Global Match/Mask defined on the Global tab.
- **Invert Jam -** Invert defined bits and pass through the rest. Enter 1s at the appropriate bit locations.
- **Pass Through Jam -** Pass through the current word unchanged.

- **Replace 8b Jam -** Replace nibbles with new values. Each drop-down represents a byte so you can replace a byte with a standard Ordered Set. If you choose User-defined, you can specify any K/D character. To edit these values, enter a value into the byte field or double-click to display the Binary Editor. If you specify a bit as a 0 or 1, you must specify the values of the other three bits in that nibble also. Any nibbles with an X are passed through.
- **Set Bits To 0s Jam -** Set defined bits to 0s and pass through the rest. Enter 0s at the appropriate bit locations.
- **Set Bits To 1s Jam -** Set defined bits to 1s and pass through the rest. Enter 1s at the appropriate bit locations.
- **Apply Global Bit Error Jam -** Apply the Global Bit Error function set on the Global tab.
- **Insert Code Violation Jam -** Introduce a predefined, fixed code violation to a byte in that word. Which byte is corrupted depends on the alignment orientation of the frame. The Jam Definition of the word before a Code Violation Jam must always be a Pass Through Jam. A Code Violation Jam cannot be placed in the first word of a frame (Ether 0001).

Using the Embedded Protocol(s) Tab for Gigabit Ethernet

Figure 92 shows the Embedded Protocol(s) tab for Gigabit Ethernet. The available functions are described in this section.

Figure 92: Gigabit Ethernet Embedded Protocol(s) Tab



Recalculate Checksum

Select the check boxes to choose recalculation of IP and TCP checksums.

Recalculate IP checksum for valid IP embedded frames

Checking this option replaces the IP checksum in the Jammed frame with a recalculated value. For the checksum to be inserted properly, the frame, after Jamming takes place, must have a Gigabit Ethernet header EtherType field value of 0x0800 and a valid IP header IHL field.

Recalculate TCP checksum for valid TCP embedded frames

Checking this option replaces the TCP checksum in the Jammed frame with a recalculated value. For the checksum to be inserted properly, the frame, after Jamming takes place, must meet the same requirements as those listed for the IP checksum, and, in addition, have an accurate IP header Total Length field, an IP header IP Protocol field value of 0x06, and a valid TCP header Data Offset field.

Also, the Jumbo Frames setting (see “GigE Jumbo Frames” on page 25) must be correct for the TCP checksum insertion to work. If the Jammed frame is “normal size” (1500 Gigabit Ethernet payload bytes or less) then either setting is correct. If the Jammed frame is a jumbo frame (16 KB Gigabit Ethernet payload bytes or less), then you must select the jumbo setting. The Jammer does not support recalculating the TCP checksum for larger frames.

The TCP checksum recalculation is not available when using the Repeat Jam feature.

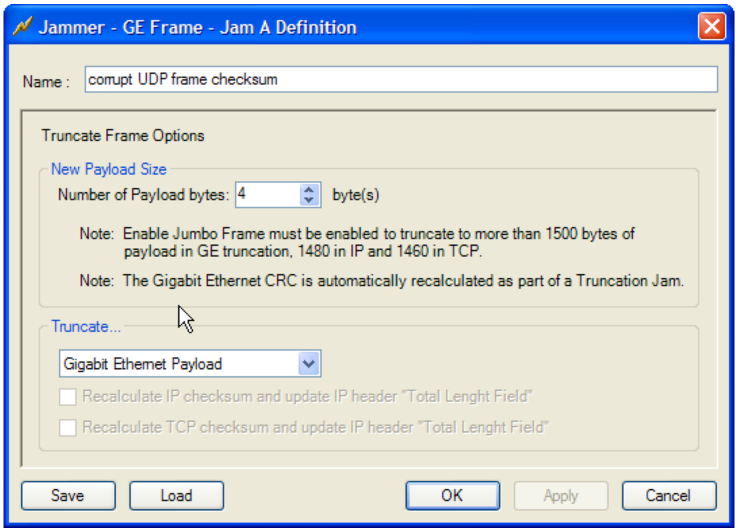
Replace Frame with Truncated Frame

This option truncates the target frame to a shorter length and sends Idles (I2) on top of the remainder of the target frame.

In the Truncate Frame Options window:

1. Choose the type of payload you want to truncate from the drop-down menu:
   - Gigabit Ethernet
   - IP
   - TCP
2. Enter the number of bytes you want the payload to be truncated to (this does not include the CRC or other delimiters).

Figure 93: Replacing a Frame with a Truncated Frame



Gigabit Ethernet Payload

For a Gigabit Ethernet payload, the New Payload Size setting specifies how many bytes to leave after the Gigabit Ethernet header (the first 14 bytes of the frame). For normal sized frame support, you can specify from 0 to 1500 bytes, and for jumbo sized frame support, you can specify from 0 to 16383 bytes. If the target frame is shorter than the specified number of bytes, then no Jamming occurs.

IP Payload

For an IP payload, the New Payload Size setting specifies how many bytes to leave after the IP header. For normal sized frame support you can specify from 0 to 1480 bytes, and for jumbo sized frame support, you can specify from 0 to 16364 bytes. You also have the option to replace the IP checksum with a recalculated value, which also automatically updates the IP header Total Length field.

For the truncation or the IP checksum option to work properly, there are some requirements of the incoming target frame. The frame must have a Gigabit Ethernet header EtherType field value of 0x0800, a valid IP header IHL field, and a valid IP header Total Length field. If the Jammed frame is shorter than the specified number of bytes, then no truncation occurs, but the IP checksum can be recalculated if you select it.

TCP Payload

For a TCP payload, the New Payload Size setting specifies how many bytes to leave after the TCP header. For normal sized frame support you can specify from 0 to 1460 bytes, and for jumbo sized frame support you can specify from 0 to 16344 bytes. You also have the options to replace the IP and/or TCP checksums with recalculated values (either option also automatically updates the IP header Total Length field).

For the truncation to occur and for the checksum options to work, the incoming target frame must meet the same requirements listed earlier for IP payload truncation, and, in addition, have an IP header IP Protocol field value of 0x06 and a valid TCP header Data Offset field. If the Jammed frame is shorter than the specified number of bytes, then no truncation occurs, but the checksums can be recalculated if you select them.

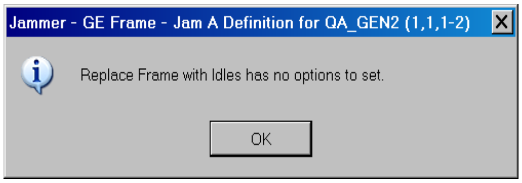
In addition, TCP checksum recalculation is not available when using the Repeat Jam feature.

For any successful truncation, the Gigabit Ethernet CRC is automatically replaced with a recalculated value.

Replace Frame with Idles

This option replaces the target frame with I2 Ordered Sets in the Gigabit Ethernet Jammer.

Figure 94: Gigabit Ethernet - Replace Frame with Idles



Chapter 5

Creating Jammer Test Configurations for SAS and SATA/STP

In this chapter:

Defining Your Own SAS and SATA/STP Test Configurations

Xgig Jammer lets you define your own test configurations and save them with or without hardware available.

You can create a configuration from scratch, or you can open and edit an existing configuration. Also, you can edit a configuration in edit only mode, which is independent of any hardware, or you can edit a configuration that is currently loaded to a Jammer device.

To edit a configuration in edit only mode:

>> Double-click on a configuration file in the Configuration manager.

Or:

>> Right-click on the configuration in the Configuration manager and choose **Edit Jammer Configuration** from the context menu.

The edit only mode Jammer Configuration window opens.

This window allows you to set up your own Test Cases, name them, organize them, and save them to files so that you can use them again.

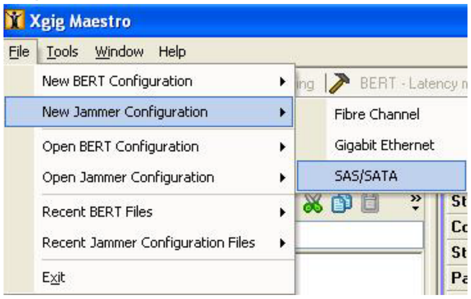
To start a configuration from scratch in edit only mode:

>> Select **New Jammer Configuration** from the context menu or the File menu (Figure 95) on the Xgig Maestro menu bar.

Or:

>> Click the New Configuration icon at the top of the Configuration manager with the appropriate protocol selected next to it.

Figure 95: Maestro File Menu



To save your configuration in edit only mode:

>> Click **Save** at the bottom of the Jammer Configuration window or open the File menu on the Jammer Configuration window and select **Save Configuration** or **Save Configuration As**.

Any changes you make have no effect on actual Jammer devices you control.

To edit a configuration that is loaded to a Jammer port:

>> Click **Configuration...** in the device column on the Parameters Status table.

Or:

>> Right-click in the Parameters Status table in the device column to open the context menu and select **Edit configuration**.

Or:

>> Highlight the configuration file in the Configuration manager, open the context menu, and select **Edit Configuration**.

Or:

>> Click **Operation** in the device column to open the Operation dialog, then click **Config**.

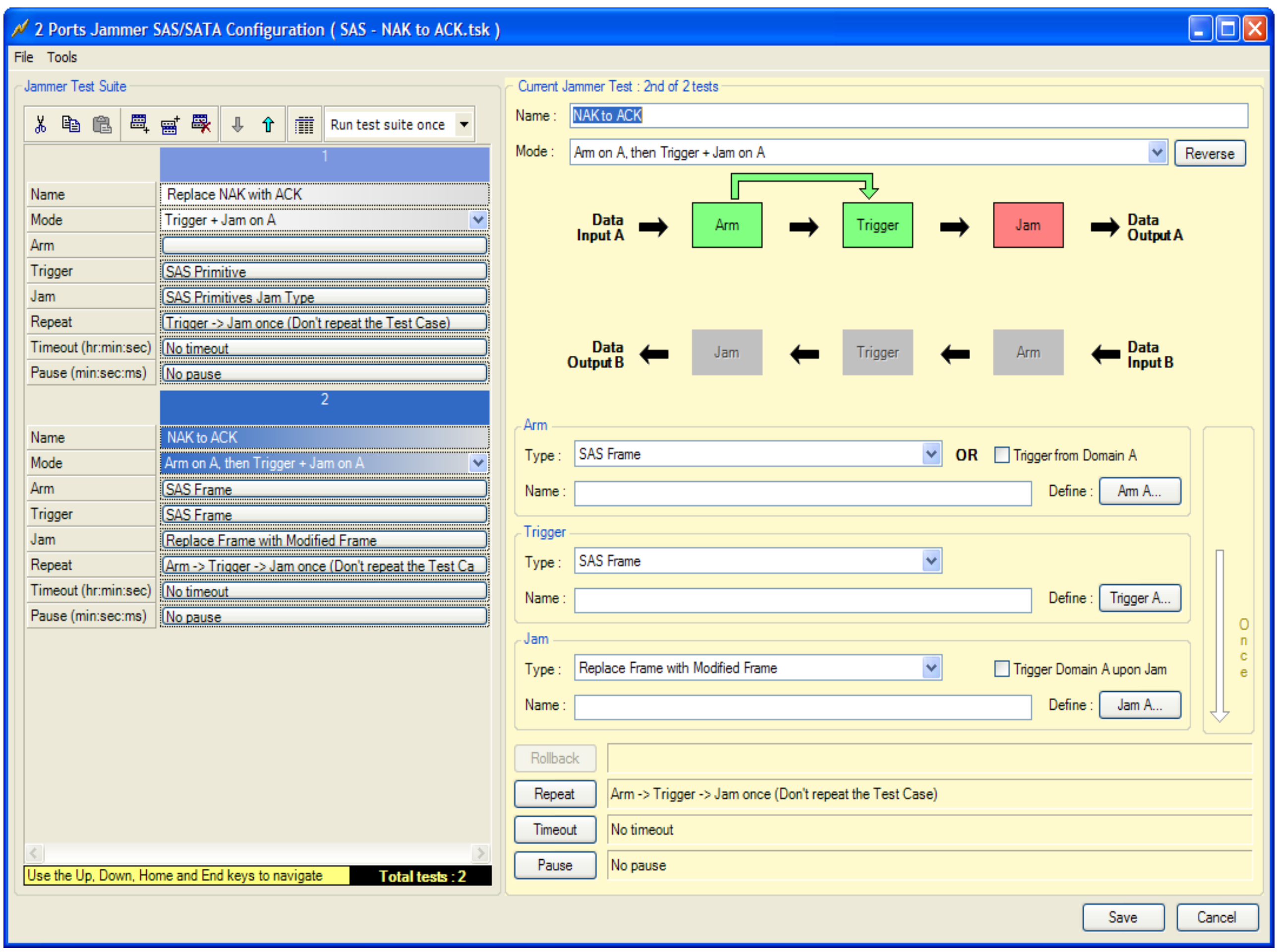
The Xgig Jammer Configuration window in hardware edit mode is displayed (Figure 96). This window allows you to set up your own Test Cases, name them, and save them to a file so that you can use them again.

Click **Apply** or **OK** and Jammer accepts the changes. They are immediately reflected in the Parameters Status table and affect the Jammer device the next time you run it.

To save your configuration edits:

>> Open the File menu at the top of the Jammer Configuration window and select **Save Configuration As...** or **Save Configuration**.

Figure 96: Xgig SAS and SATA/STP Jammer Configuration Window



Using the Jammer Configuration Window

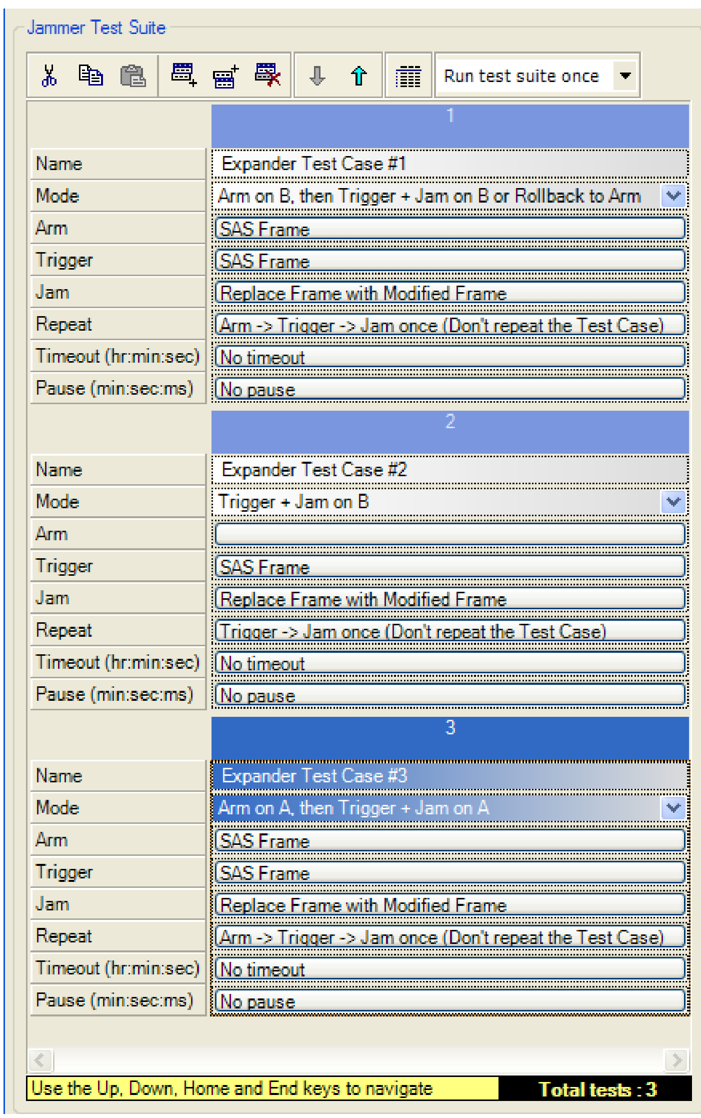
The Jammer Configuration window title bar indicates how many ports it is configuring, the protocol, and the configuration file name, if any. If you are using hardware edit mode, the chassis name, chassis number, slot number, and port numbers are also listed. The components of the Jammer Configuration window are described in the following sections.

Using the Jammer Test Suite Tools

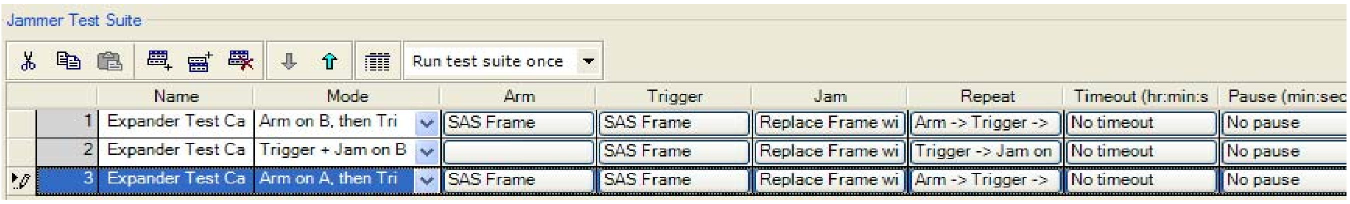
The Test Suite, the pane on the left side of the configuration window, lists the series of Xgig Jammer tests in the order in which you want them to execute (Figure 97). The suite includes one or more tests. The highlighted test appears as the Current Jammer Test on the right side of the window. Each test in the suite executes in sequence with a set up time from the end of one test to the start of the next of approximately 130 (200 max) milliseconds.

Figure 97: SAS/SATA Jammer Test Suite Windows

Card View



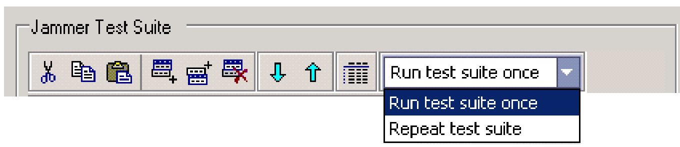
List View



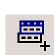
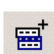
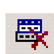
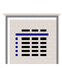
Using the SAS/SATA Jammer Test Suite Toolbar

When you create a SAS/SATA Jammer Test Suite, you use the toolbar in the Jammer Test Suite section of the Configuration window (Figure 98).

Figure 98: SAS/SATA Jammer Test Suite Toolbar



The following list describes the icons on the toolbar:

	Cut current test	Removes the highlighted test and holds its contents in the memory buffer.
	Copy current text	Copies the highlighted test to the memory buffer.
	Paste last test cut or copied	Inserts the current memory buffer contents before the currently highlighted test.
	Add new test to bottom of stack	Adds a new blank test to the bottom of the suite.
	Insert new test before current test	Inserts a new blank test above the currently highlighted test.
	Delete current test	Removes the highlighted test from the suite. If only one test is present, then the contents of this test are cleared.
	Move current test down the stack	Moves the highlighted test down one in the test order.
	Move current test up the stack	Moves the highlighted test up one in the test order.
	Toggle view	Toggles Test Suite between Card View and List View.
	Run test suite once or Repeat test suite	When you choose Repeat test suite, the tests run continuously from the top of the Test Suite to the bottom and loopback to the top until you click stop.

Using the Context Menu

The same operations (Cut, Copy, Paste, etc.) can be performed with the options available in the Context menu. In addition, the direction of an individual test can be reversed by selecting the ‘Reverse Current’ option. To reverse the direction of all tests, select the ‘Reverse All’ option.

Using the Configuration Menus

Two menus are available in the Configuration window: **File** and **Tools**.

The choices on the File menu are:

Import to Selected Test	Import a Test Case from a `.tst` file or an entire test suite, `.tsk` file, to the currently highlighted position. A Test Case is one test in the Jammer Test Suite.
Export Selected Test	Export and save the currently highlighted test to a `.tst` file.
Save Configuration	Save the entire Test Suite to the `.tsk` file you currently have loaded.
Save Configuration As	Save the entire Test Suite to a `.tsk` file with a name you assign to it.
Close	Close the Jammer Configuration Window.

The recently used FC Jammer configuration files appear in the file menu and are loaded when selected.

Note: The `.tst` files are only for storing individual Test Cases and swapping them between configuration files. You cannot load `.tst` files directly into a Jammer device on the Xgig Maestro window.

The Tools menu in the SAS/SATA Configuration window lets you open the SAS Hashed Address Calculator.

The SAS Hashed Address Calculator is also available by clicking the Hashed ID button at the bottom right corner of the SAS Frame Arm or Trigger Condition windows.

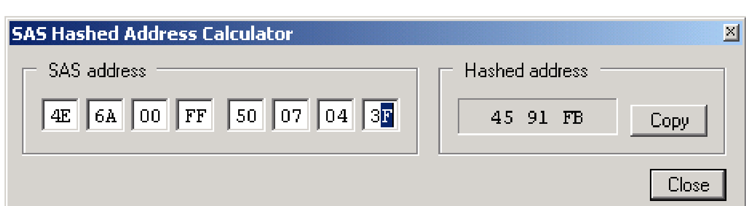
SSP frames use a hashed address that is derived from the SAS device address. The SAS Hashed Address Calculator allows you to calculate the hashed address from the SAS address. You must use the hashed address when setting an Arm Condition, Trigger Condition, or Jam Definition for an SSP frame.

To determine the hashed address:

>> Type the SAS address into the calculator.

The hashed address updates on the right.

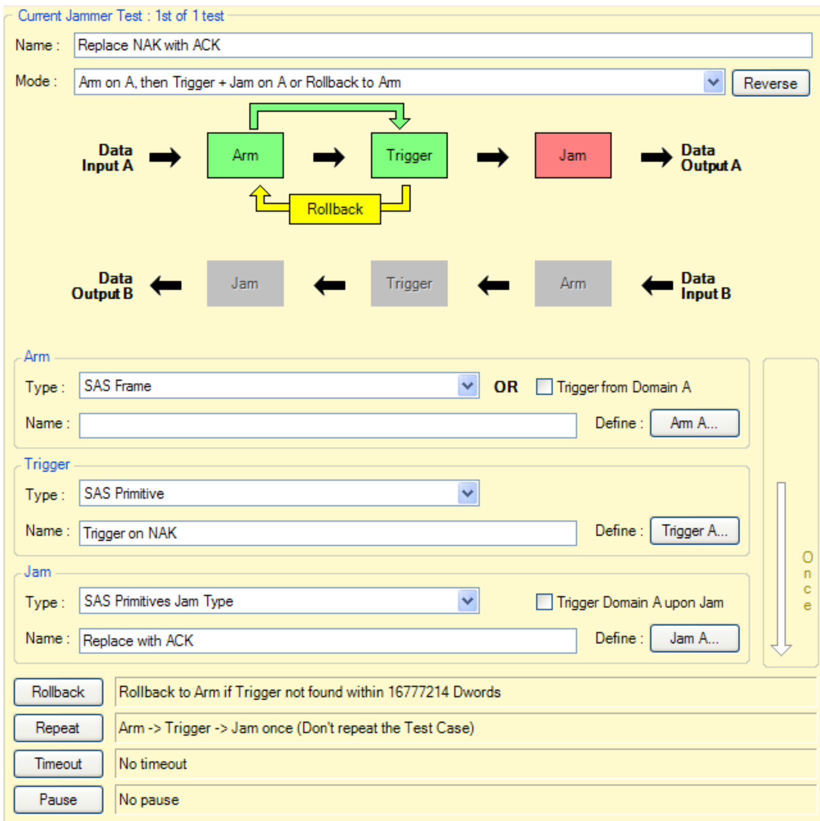
Figure 99: SAS Hashed Address Calculator



Using the Current Jammer Test Window

The graphics in this section of the window represent the hardware configuration for the selected test in the Jammer Test Suite (Figure 100).

Figure 100: Current Jammer Test Window



Mode

For SAS/SATA, Mode menus are available near the top of the Current Jammer Test window (Figure 101) and also near the top of each Test Case in the Jammer Test Suite window (Figure 102).

The input to path A (on top) is always port A and the input to path B (on the bottom) is always port B. The external trigger input and output that are available on path A always are linked to the domain shown on the Xgig Maestro window as “Domain of port A.” The trigger input and output on the bottom on path B are in the “Domain of port B.”

Figure 101: Mode Drop-down Menu in Current Jammer Test - Right Pane

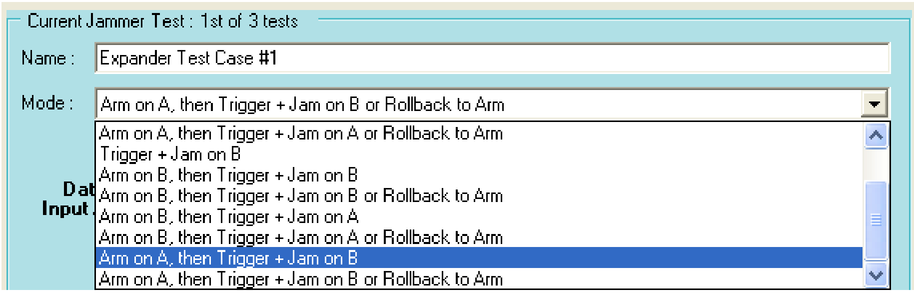
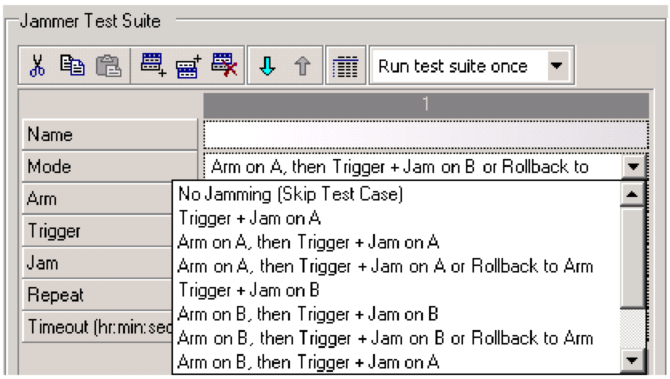


Figure 102: Mode Drop-down Menu in Test Suite - Left Pane



Reverse

You can reverse the direction of the jam by selecting the Reverse button.

Arm and Trigger

To define Arm and Trigger conditions, select a respective Type from each drop-down menu. Then click the Arm or Trigger button to open the corresponding definition window.

You can use an external input as an Arm condition. Check Trigger from Domain A (or B) to enable this feature. You must put the corresponding Jammer port into a domain for this to work properly.

The Trigger event can be in the next Dword after the Arm event in the traffic stream.

Jam

To define a Jam:

1 Select a Type from the drop-down menu, if available.

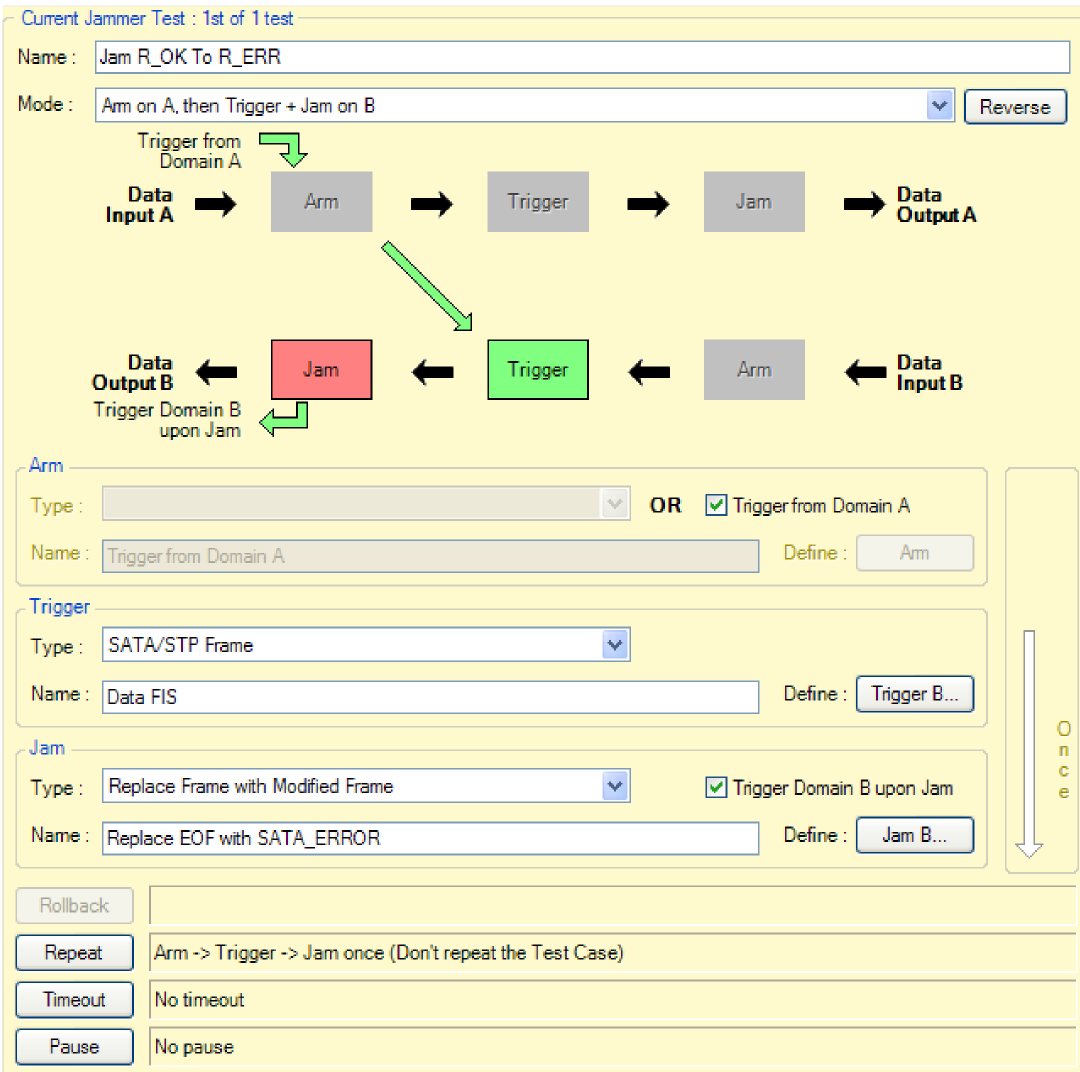
2 Click the Jam button to open the Jam Definition window.

The Jam Definition specifies the modifications to be made to the traffic matching the Trigger Condition.

In addition, the Jammer port can trigger out to the Domain it is in when a Jam takes place. Check Trigger Domain A (or B) upon Jam to enable this feature.

Note: If you use an external trigger input to define the Arm condition, then you cannot select the external trigger output for that path in that Test Case, and vice versa. For information regarding using the trigger input and output during a Test Case, refer to “Using Domains and External Triggering” on page 291. However, you can use an external trigger in on port A with an external trigger out on port B, and vice versa. Figure 103 shows an example.

Figure 103: Trigger In and Trigger Out

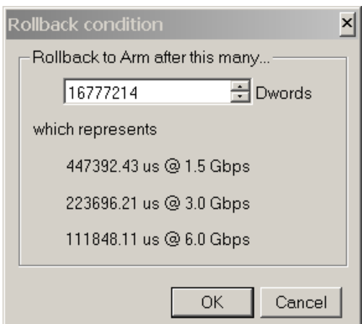


Rollback

The Rollback option defines the time or Dword count parameter between the Arm and Trigger events. If the Trigger does not follow the Arm event in the allotted time or Dword count, the Jammer begins looking for the Arm event again. Click **Rollback** to display the dialog shown in Figure 104.

Note: This value is saved in terms of Dwords, not time, so keep this in mind if you save a Test Case using a device running at 3.0 Gbps and later open the configuration on a Jammer running at 1.5 Gbps.

Figure 104: Rollback Condition Dialog



Timeout

The timeout option defines the period of time to wait for a specified test to complete before aborting and proceeding to the next test in the suite.

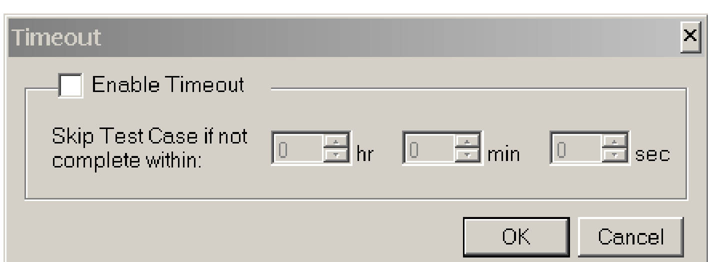
To set the timeout:

1 Click **Timeout** to display the dialog box in Figure 105.

2 Check **Enable Timeout**.

3 Enter the hours, minutes, and seconds you want to wait.

Figure 105: Timeout Dialog

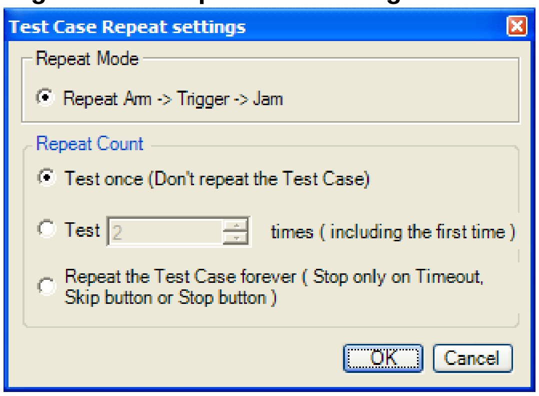


4 Click **OK**.

Repeat

Click **Repeat** to open the dialog shown in Figure 108. For Basic Jammer Configurations, the Repeat Mode setting allows you to configure what is repeated when using an Arm condition. The Repeat Mode option means that the Jammer must match the Arm condition each time before looking for a Trigger. The Repeat Count allows you set the number of times a test case is repeated. The limit for repeating a test for 6G SAS/SATA is 2,147,483,647, and for 12G SAS, the limit is 32,767.

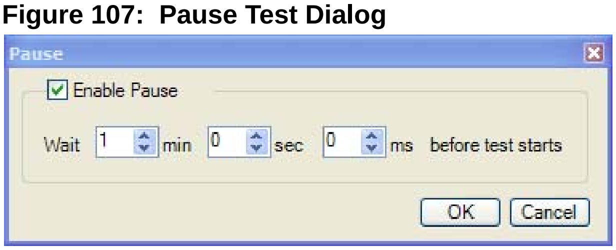
Figure 106: Repeat Test Dialog - Basic Jammer Configuration



Pause

Click **Pause** to open the dialog shown in Figure 107. The Pause setting allows you to insert a pause before the beginning of a test case.

Figure 107: Pause Test Dialog



For Advanced Jammer Configurations, this setting allows you to configure what is repeated when using an Arm or Trigger condition. The **Repeat** dialog uses counters to provide an increased level of control over the Jam allowing you to skip over extraneous instances of the arm or trigger condition and target the precise data you want to Jam.

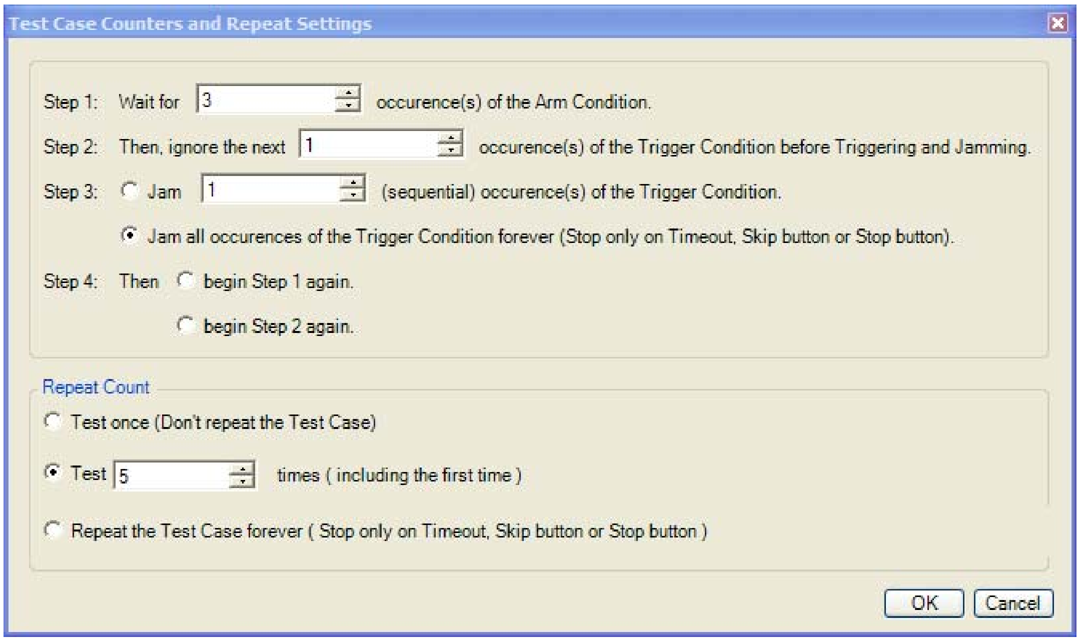
You can force the Jammer to match the Arm condition a given number of times before triggering, and you can skip a given number of occurrences of the trigger before Jamming. Once you reach the Jam, you can Jam all occurrences of the trigger condition forever or jam a given number of sequential occurrences of the trigger condition.

Unless you select to Jam forever, you can choose to repeat all or part of the arm-trigger-Jam process either returning to the pre-armed state waiting for another occurrence of the arm condition or returning to the armed state waiting for another occurrence of the trigger condition.

Note: For 12G SAS blades, there is a eight clock latency between the arm and trigger/jam state and between the jam and arm state.

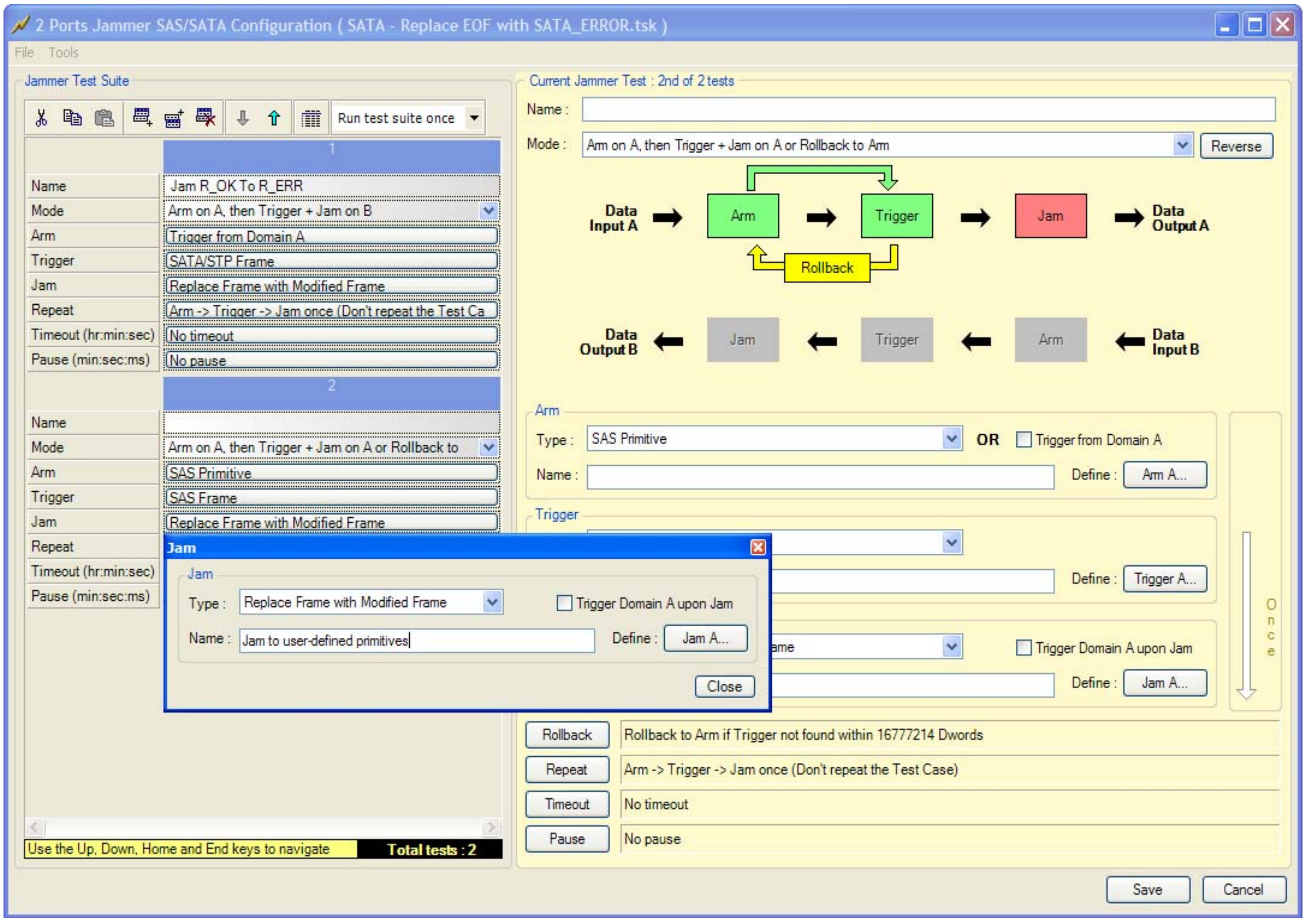
The Repeat Mode option means that the Jammer must match the Arm condition each time before looking for a Trigger. The Repeat Count allows you set the number of times a test case is repeated.

Figure 108: Repeat Test Dialog- Advanced Jammer Configuration



You can also configure options for each Test Case directly in the Test Suite, instead of clicking in the Current Jammer Test pane. Click on the area of the Test Case you want to modify to open the corresponding dialog (Figure 109).

Figure 109: Configuring Options Directly in the Test Suite



Configuring SAS Arm and Trigger Conditions

SAS Arm and Trigger conditions recognize specific frames or Primitives.

For Frame conditions, you can specify SOF, SOAF, or either (use all Xs for “either”). You can specify up to 31 additional Dwords after the SOF or SOAF.

You can also define a wildcard specifying bits to be masked out of an arm word and passed through in the corresponding trigger word.

For Primitive Conditions, you can choose from groups of Single, Extended, Triple, or Redundant Primitive Sequences.

For a Single Primitive Sequence, you can specify any standard Single Primitive Sequence or you can specify any user-defined 4 bytes of K/D characters (of which standard Primitives are a subset). You can also specify where you want the Jammer to look for the matching Dword: only inside frames, only outside frames, or anywhere.

Note: The Jammer does not look for any matching conditions during OOB initialization or Speed Negotiation.

For Triple, Extended, and Redundant Primitive Sequences, you can choose any standard Extended, Triple or Redundant Primitive Sequence. To match the condition, the Jammer only needs to match one valid Primitive.

You can save an arm or trigger condition as a `.jmt` file by clicking the **Save** button in the **Arm** or **Trigger** window. You can load a `.jmt` file by clicking the **Load** button in the **Arm** or **Trigger** window.

The Arm and Trigger windows are identical. In addition, you can select the domain triggered input as an Arm condition.

Depending on the Mode you select, the appropriate graphic diagram shows the Trigger and optional Arm conditions, along with the Jam event. If the Mode you select does not include an Arm condition, the Arm button remains disabled.

To set Arm and Trigger conditions:

1. Click on the **Arm** or **Trigger** button in the Jammer Configuration window.

   The window for the condition is displayed (Figure 110). If you are in hardware edit mode, the protocol, chassis name, chassis number, slot number, and port numbers are displayed in the title bar.

2. Set the values as required to specify a unique Arm and Trigger sequence for the specific test.

   The following sections describe the available values.

Figure 110: SAS Frame Arm and Trigger Window Examples

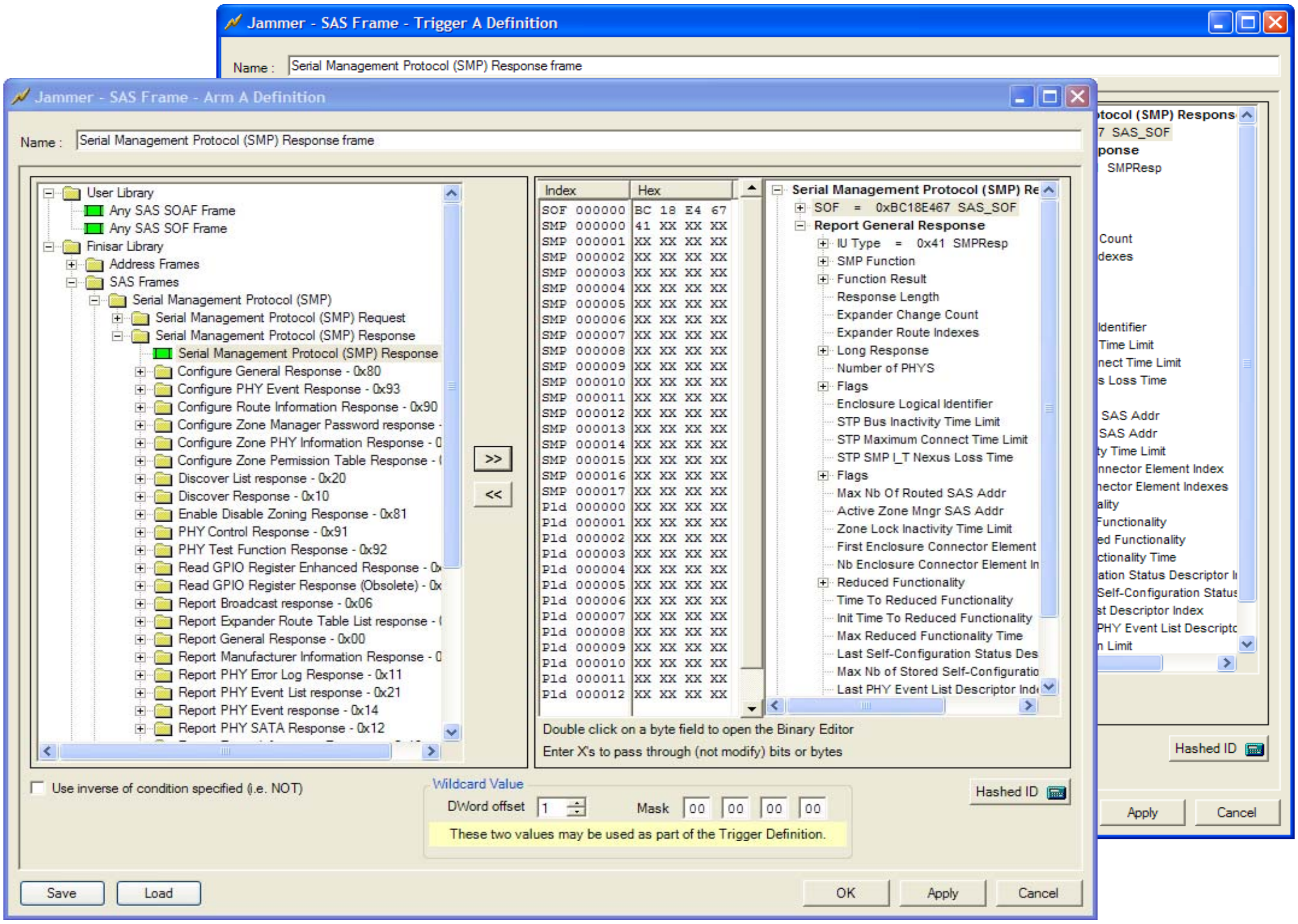
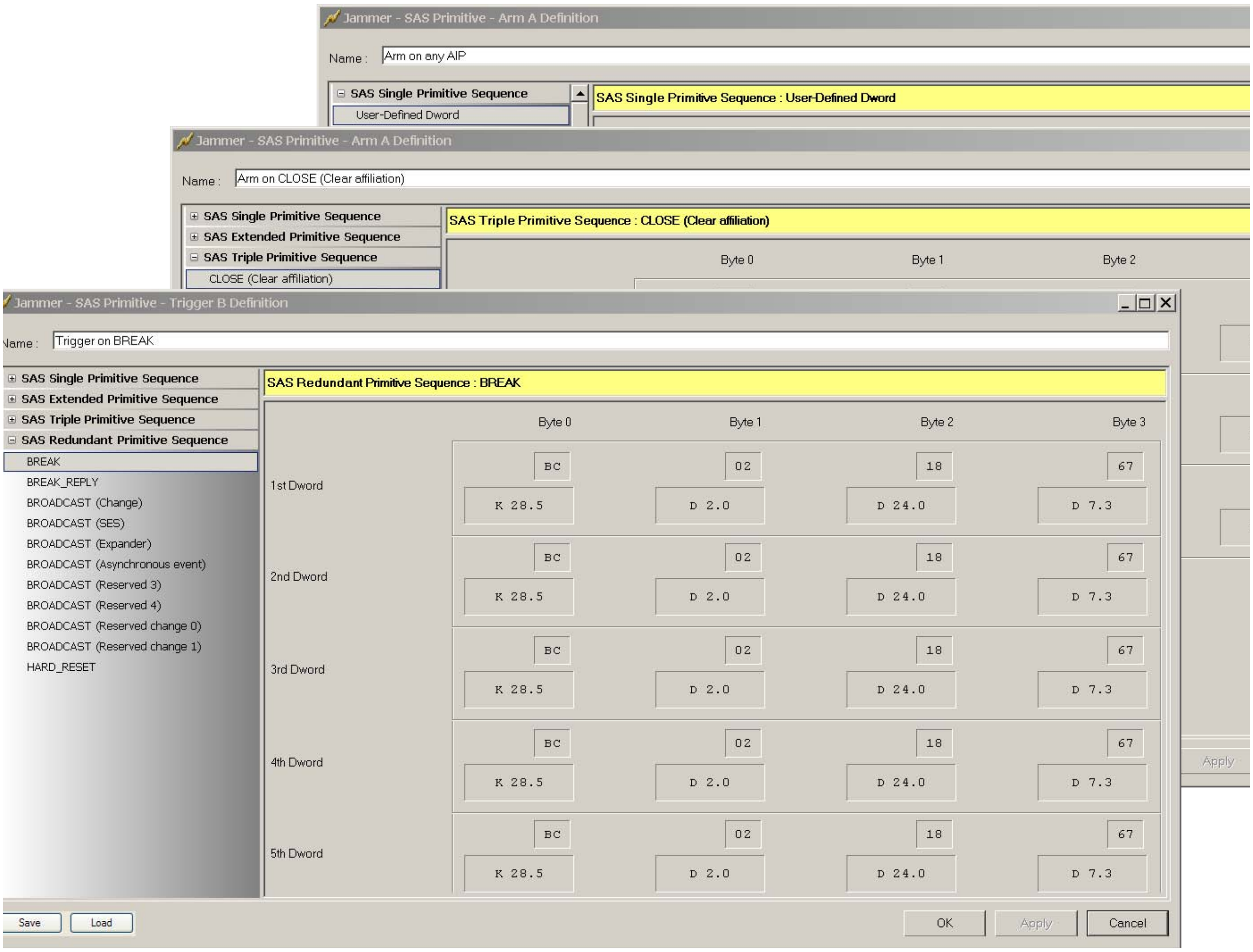


Figure 111: SAS Primitives Arm and Trigger Window Examples



Setting Frame Conditions

You can specify frame conditions in three ways:

- Load a template from the Template Library tree
- Manually specify bits in the frame
- Select fields from the tree view in the right pane

To use a template:

1 Select a template from the Template Library tree on the left.

2 Click the double right arrow button to set the Frame Condition.

The condition is indicated on the right side of the window.

To manually specify a frame:

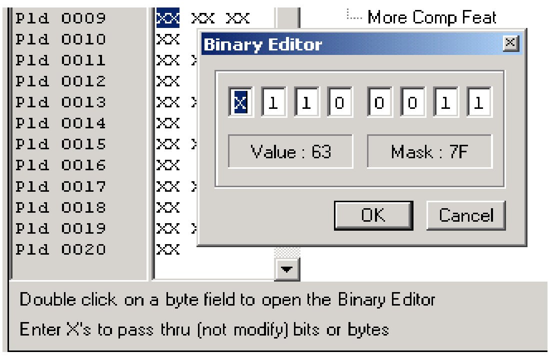
>> Type hexadecimal values directly into the center column of the window.

An X represents a nibble that can by any value (a “don’t care”).

To set individual bits in any field, double-click on the hex entry to open the Binary Editor (Figure 112). In the hex view, partially defined hex characters appear as question marks: `X001=?`

When you use the tree view, values are automatically entered into the center column in the right window pane.

Figure 112: Binary Editor Dialog



Saving a Frame Condition

If you create a frame condition that you want to save and make easily available for future use, you can save it into the “User Library” folder in the Template Library tree. To do this:

>> Click the double left arrow button.

Frame conditions have the option of “Use inverse of condition specified (i.e. NOT).” When you check this option, it means that the first frame encountered that does not match what you have specified creates a “condition met” event.

For each frame condition, you can specify an optional name at the top of the window. This name is also shown on the Jammer Configuration window under the Type selection, and on the main Xgig Maestro window.

Setting Primitive Sequence Conditions

You can choose a Primitive Sequence from any of the categories listed on the left side of the window: Single, Extended, Triple, or Redundant. For Single Primitives, you can also choose where to match: anywhere, only outside of frames, or only inside of frames.

Single Primitives include a User-defined option.

To edit the user-defined value:

>> Type a hex value into the byte field.

Or

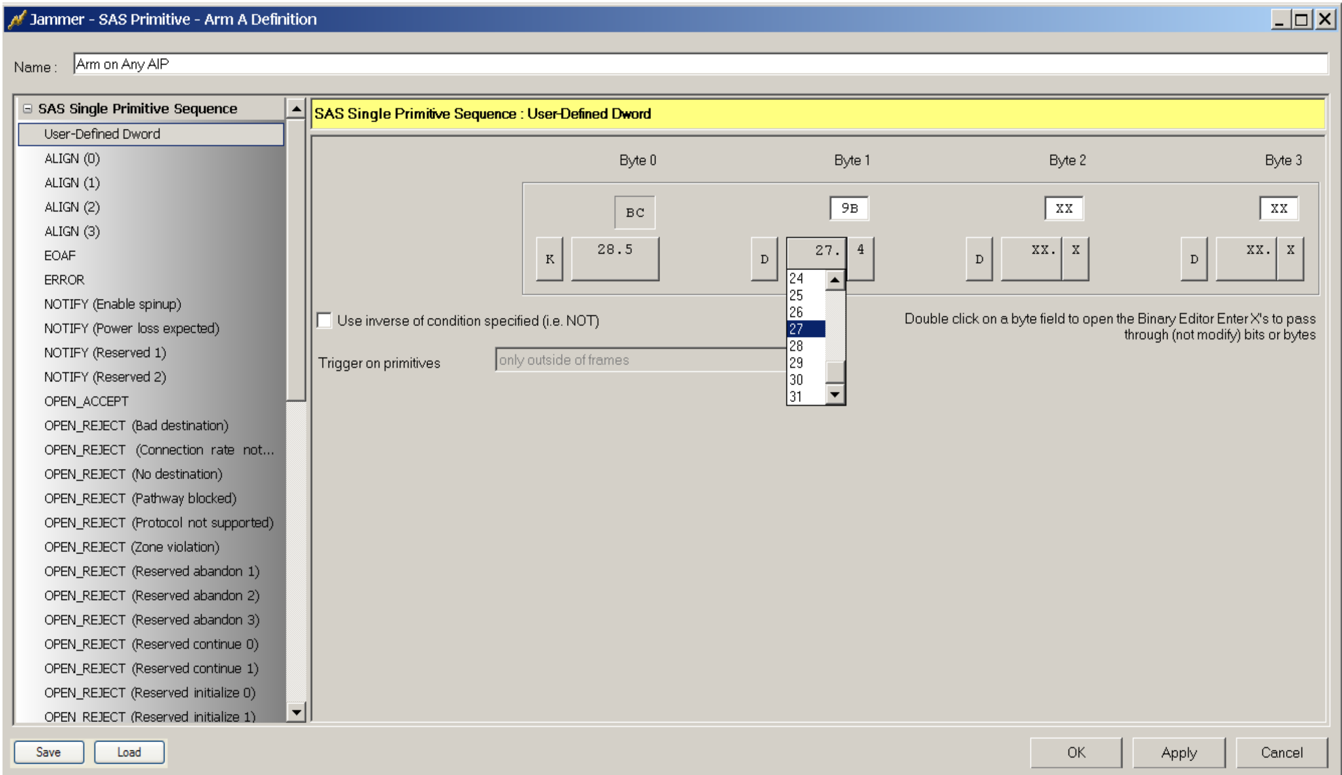
>> Double-click on a byte field to open the Binary Editor.

As in frame conditions, an `X` indicates “don’t care” and a `?` indicates a partially specified hex character.

Or

>> Click to toggle between K and D, and choose data from the drop-down menu of legal 8-bit characters.

Figure 113: Selecting K and D Legal 8-bit Characters



You can also check the "Use inverse of condition specified (i.e. NOT)" option; this means the first word encountered that does not match what you have specified creates a "condition met" event.

As with frame conditions, you can specify an optional name at the top of the window. This name is also shown in the Jammer Configuration window under the Type selection and on the main Xgig Maestro window.

Configuring the SAS Jam Definition

The SAS **Jam Definition** window defines how to modify the event specified on the **Trigger Condition** window.

The Jam is always the same type (frame or Primitive Sequence) as the Trigger.

For any Jam Definition, you can specify an optional name at the top of the window. This name is also displayed on the Jammer Configuration window under the Type selection and on the main Xgig Maestro window.

You can save a Jam definition as a `.jmj` file by clicking the **Save** button in the **Jam** window. You can load a `.jmj` file by clicking the **Load** button in the **Jam** window.

Jamming a Frame

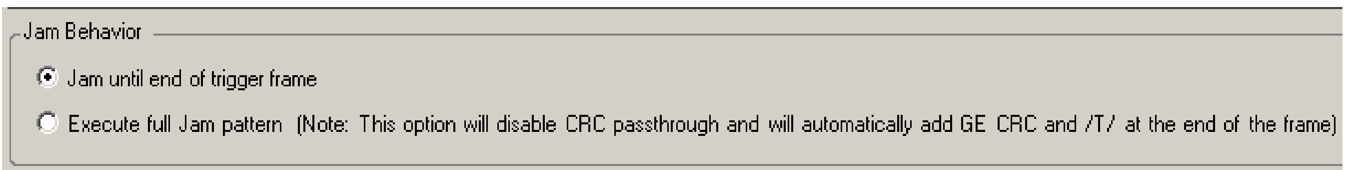
If the Trigger Event is a frame, click the **Jam** button on the Jammer Configuration window to open the Frame Jam Definition window.

The content of the Jam Definition window corresponds to the type of frame Jam you choose on the Jammer Configuration window (modify frame, truncate frame, or replace frame with Idles). The following paragraphs describe these choices.

Jam Behavior

This controls the number of user-defined header/payload Jams performed relative to the target trigger frame. The **Jam Behavior** section is present on all tabs of the **Frame Jam Definition** window.

Figure 114: Jam Behavior Selection



- Jam until end of trigger frame

  Jams defined in the Header/Payload tab are performed until the end of the target trigger frame (or until an abnormal termination of the frame). All Jams defined that would take place on the original CRC or later are ignored. However, if the frame that is triggered on has more Dwords than the Jams you specify, the remaining Dwords are passed through. The CRC and EOF of the original target trigger frame are always jammed according to the CRC and EOF settings on the SOF/CRC/EOF tab. This is the standard way to Jam a frame.

- Execute full Jam pattern

  All header and payload Jams take place, even if they overwrite beyond the end of the target trigger frame. Use the control at the bottom of the Header/Payload tab to define how many Jams should take place.

  The last defined Jam is the last Header/Payload Jam. The options for modifying the CRC and EOF on the SOF/CRC/EOF tab are unavailable.

  If the target trigger frame is longer than the number of Jams defined, then the portion of the target trigger frame that extends after the last defined Jam is overwritten with Idles. If the target trigger frame is shorter, then the Jammer switches back to pass-through immediately after the last defined Jam.

Note: Be careful when using this option because you may overwrite a portion of important traffic (a frame or Flow Control Primitives).

Replace Frame with Modified Frame

Each tab contains options relevant to different frame modifications.

Using the Global Tab

Use this tab (Figure 115) to define Jam parameters that apply globally to the frame.

Global Replace Jam Option

Use the Global Replacement Dword to set specific bits in a Dword to 1 or 0 while passing through the remaining bits. You can apply this global replacement to any Dword in the frame. Define one Global Replacement for each Test Case.

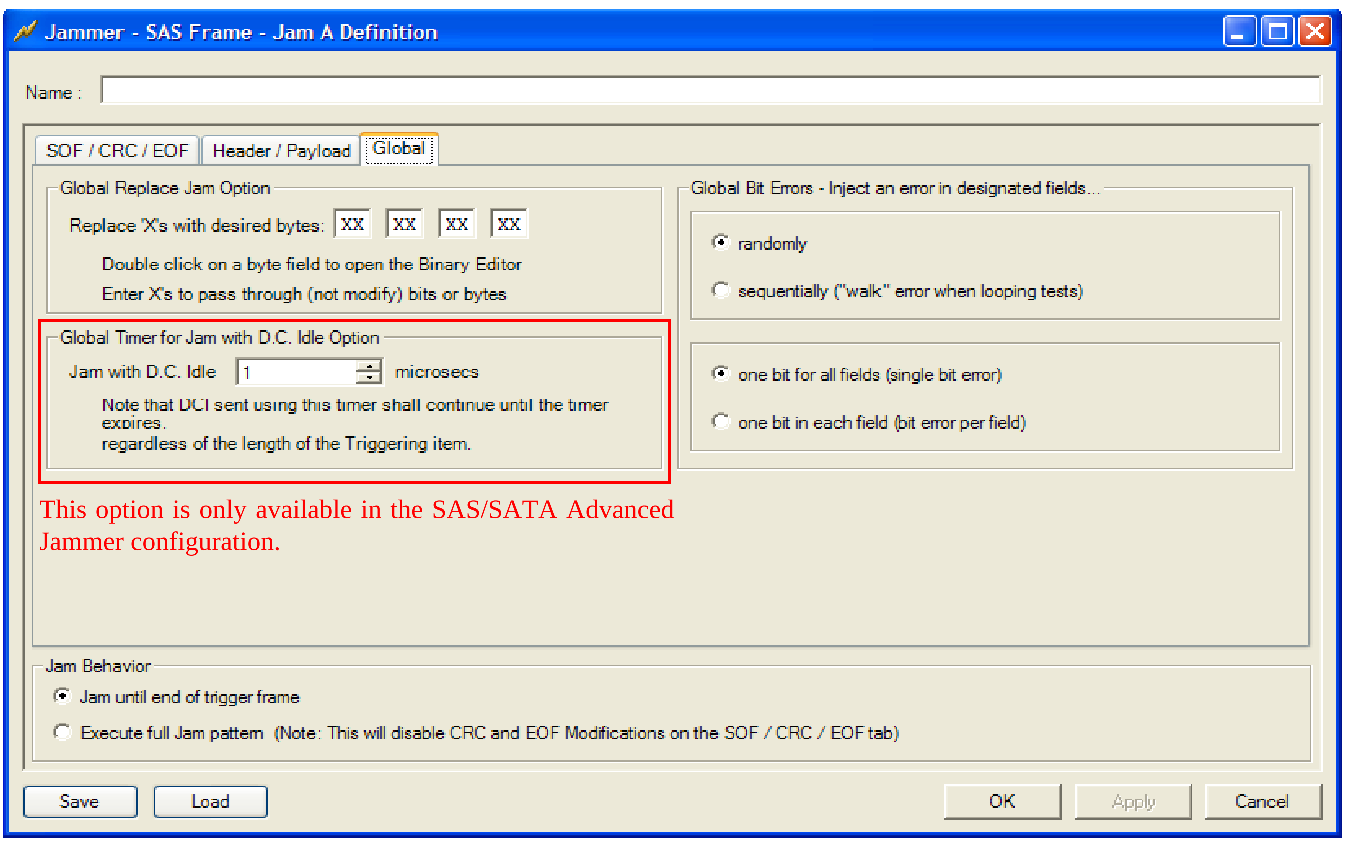
To edit these bits:

>> Enter hex values, or double-click on a byte field to open the Binary Editor.

Any bits left as Xs are passed through.

The difference between this Global Replacement option versus the Replace Dword option found on the Header/Payload tab is that the Global Replacement option allows masking down to the bit level, whereas the other option allows masking at the nibble level.

Figure 115: SAS Global Tab



Global Bit Errors

The Jammer software can introduce bit errors repeatedly in sequential or random fashion to predefined fields. These bit errors are introduced to the 32-bit form of the target Dwords (not the 40-bit form) so code violations are not created. The Global Bit Errors control allows you four options.

- Select **one bit for all fields** and **randomly**. This causes the Jammer to inject a single bit error in the group of all fields selected in the header or payload for a single Test Case. If the Jammer Test Suite is set to *loop*, then single bit errors are randomly injected into these fields, with one bit for each cycle of the Test Suite.
- Select **one bit for all fields** and **sequentially**. This also injects a single bit error in the group of all fields selected in the header or payload. If the Test Suite is set to loop forever, the bit error walks through all the selected fields.
- Select **one bit in each field** and **randomly** does the same thing as the first option; however, there will be one error for each Dword selected in the header or payload.
- Select **one bit in each field** and **sequentially** does the same thing as the second option; however, there will be one error for each Dword selected in the header or payload.

Note: The location of the bit errors are moved each time you run this entire Test Case, not each time you repeat the Jam within the Test Case.

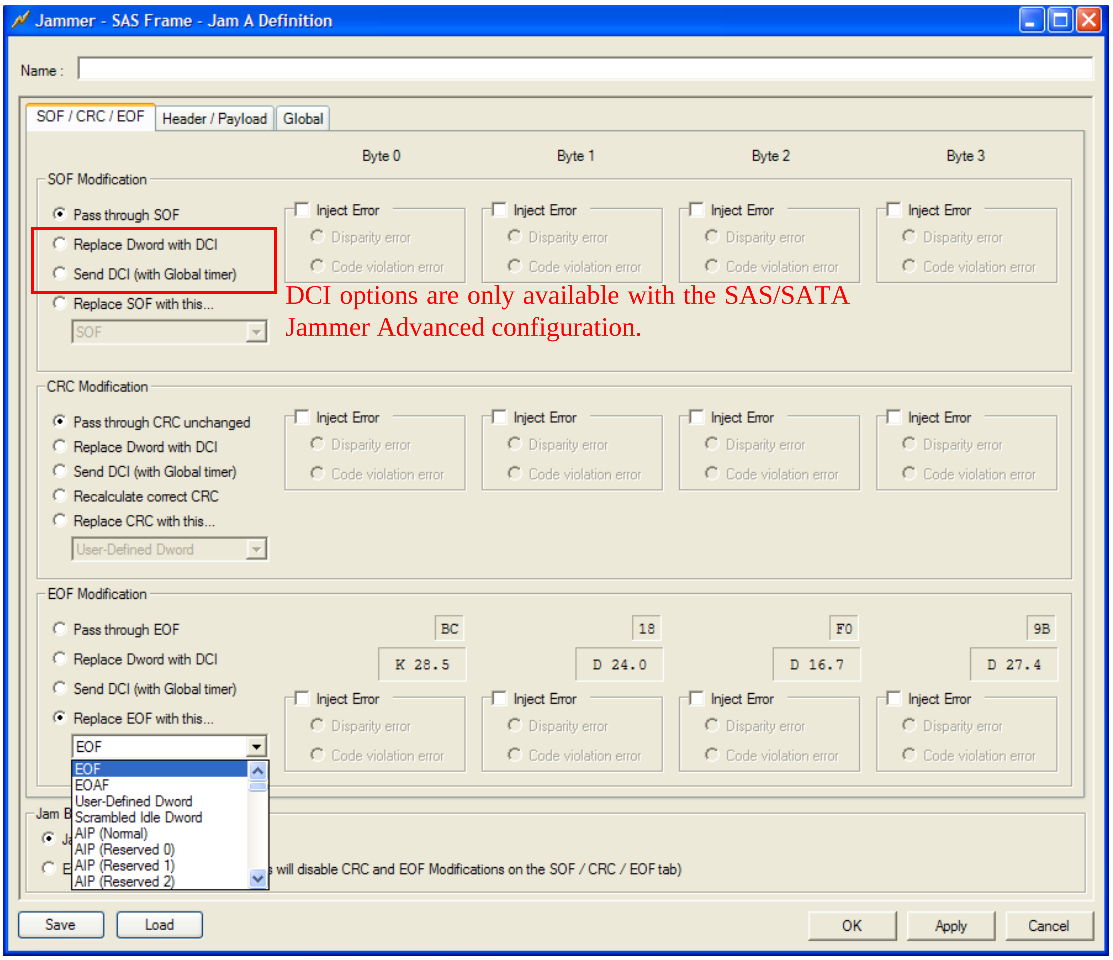
Global Timer for Jam with D.C. Idle

In an Advanced SAS/SATA Jammer configuration, the Jammer software allows you to set a global timer for Jamming with D.C. Idles. When using this option, DCI will continue until the timer expires regardless of the triggering item.

Using the SOF/CRC/EOF Tab

Use the choices on this tab to modify the Start of Frame (SOF), Cyclic Redundancy Check (CRC), and End of Frame (EOF) Dwords of the original target frame (Figure 116).

Figure 116: Serial Attached SCSI SOF/CRC/EOF Tab



SOF/EOF Options

You can pass through or replace the start and end of frame Dwords with another SOF, EOF, another standard Primitive, a Scrambled Idle Dword, or any four user-defined K/D characters. In addition to these options, you can send an error on any byte of the Dwords.

DCI options are available only in the Advanced SAS/SATA Jammer configurations. These allow you to replace a Dword with a DCI or to send DCI with the Global timer set in the Global tab.

Check Inject Error for any byte(s) on which you want to send errors. Then choose Disparity Error or Code Violation. If you choose Disparity Error, the Jammer inverts the running disparity at that byte. If that byte is a neutral 10b character, you might not see the disparity error until a later byte. The Code Violation option replaces the byte with a predefined 10-bit illegal character.

CRC Options

CRC options include:

- Not changing the CRC in the original target frame
- Recalculating the CRC to make it correct for the modified data
- Replace Dword with DCI
- Send DCI (with Global timer)
- Replacing with a user-specified data Dword or Primitive

With the addition of recalculating the CRC, you configure the CRC option in the same way as the SOF/EOF options.

Depending on the changes made to a frame, the old CRC might be invalid. If the CRC is passed through, an invalid frame might be created. The lowest layer of protocol error checking should recognize this type of error. If the frame is modified and the CRC is recalculated, a valid frame with modified data is created. If, for example, the modifications are made to SCSI commands embedded in the payload, the SCSI error checking routines should trap and handle the error.

Recalculating a CRC might not work if you corrupt the frame with illegal Primitives, errors, or Scrambled Idle Dwords.

Using the Header/Payload Tab

You can modify any and all words in the header and payload (Figure 117). Select either the **Replace Jam** or **All Jam Modes** radio button.

Similar to defining an Arm or Trigger Condition, there are two ways to specify your frame Jam Definition. One way is to load a template from the Template Library tree, and the other way is to manually specify bits in the frame.

To use a template:

1. Highlight a template in the Template Library tree on the left side of the window.

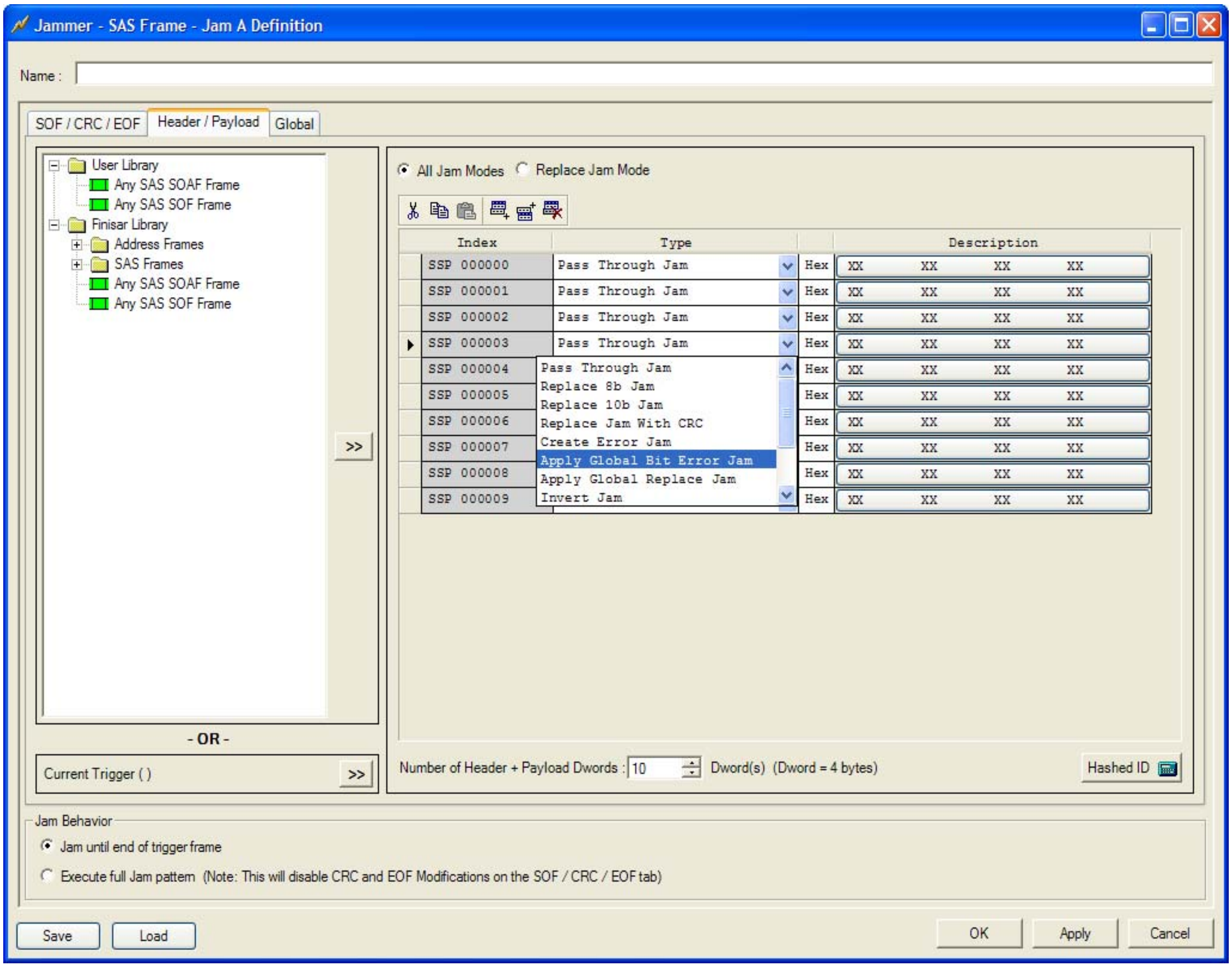
   Tree View is structured similar to the display on the right side of the Arm and Trigger Condition windows. You can make selections from the tree; this creates the appropriate Replace Jams.
2. Click the double right arrow to display the Jam definition on the right side of the window.

When you use a template, the Jam definition is populated with Replace Jams of the specified data, while all other bits are passed through.

To manually edit the values, enter a value into the byte field. An **X** in a nibble passes the original value through.

Note: The more Dwords in a Jam Definition, the longer the time between Test Cases in the suite. Switching from one Test Case to the next is a software operation, so the time between cases will be on the order of hundreds of milliseconds.

Figure 117: SAS Header/Payload Tab



To manually define each nibble, enter a value into the byte field or double-click to display the Binary Editor. If you specify a bit as a 0 or 1, you must specify the values of the other three bits in that nibble as well. An **X** in a nibble passes the original value through. Choose any K/D character for an entire byte by using the drop-down controls. Click on the K or D to toggle this setting.

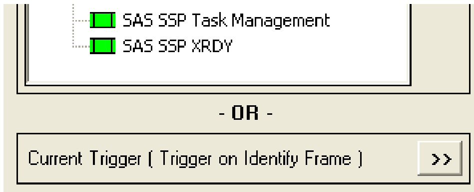
Use the **Number of Header + Payload Dwords** counter to define the number of Dwords to Jam. (Figure 118). Use the scroll bar to position the display to the desired Dword, if necessary.

Figure 118: Setting Header + Payload Size

You can also use the List View controls at the top to cut, copy, paste, add, insert, or delete Dwords.

Notice the special choice at the bottom left, **Current Trigger** (Figure 119). This is a copy of the frame condition you have specified for the Trigger. The name of the Trigger Condition (if any) is shown in parenthesis. Click the double right arrow to use this.

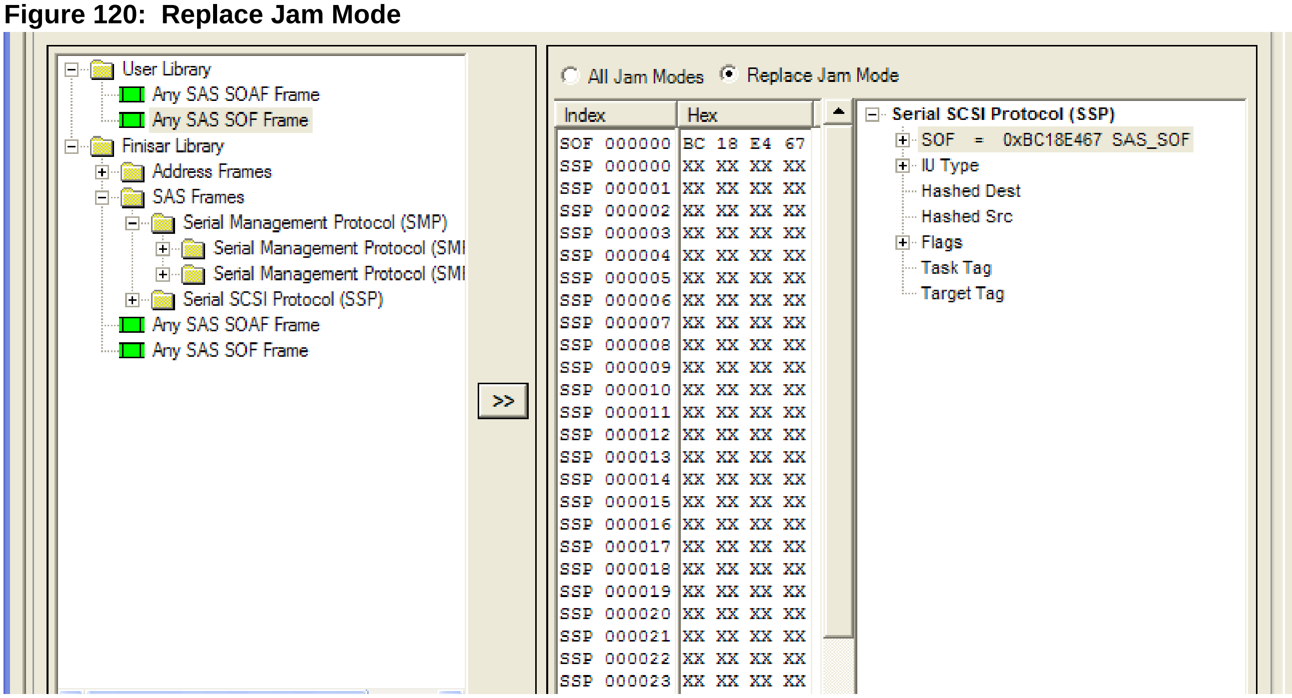
Figure 119: Current Trigger Option



To manually specify a frame Dword Jam, select the **All Jam Modes** radio button. Select a Jam Type from the drop-down menu (under the Type column), then specify any additional definition (if necessary) by clicking on the data field (under the Description column).

Selecting the **Replace Jam Mode** radio button opens a dialog that allows you to replace an entire frame either by using a template or manually entering values. The Replace Jam Mode dialog also contains a view of the frame contents, similar to those seen the Arm and Trigger Condition windows. These values correspond to the hex values defined in the center column.

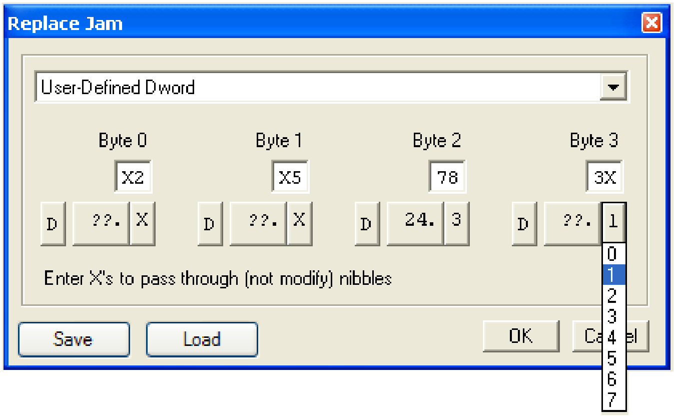
Figure 120: Replace Jam Mode



Selecting the **All Jam Modes** radio button opens a dialog that provides the following choices are available for each Dword in a frame on the Header/Payload tab:

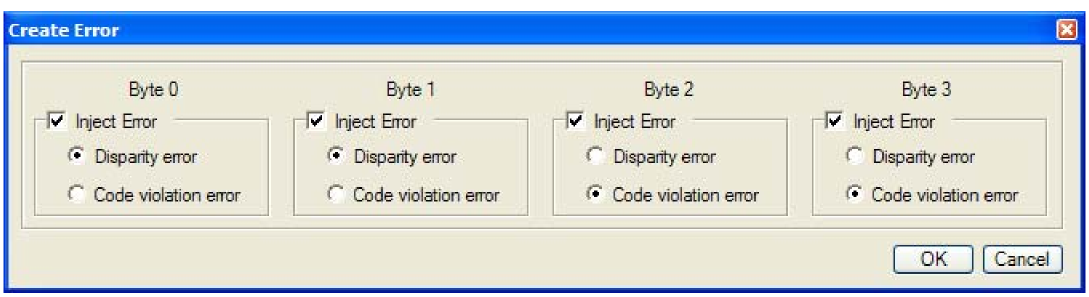
- **Replace 8b Jam Mode -** This function allows you to replace the Dword with any standard Primitive, a Scrambled Idle Dword, or a user-defined Dword (Figure 121).

Figure 121: Replace Jam Dialog



- **Replace 10b Jam** (Advanced Jammer Configurations only) - This function allows you to replace the Dword with any standard Primitive, a Scrambled Idle Dword, or a user-defined Dword.
- **Apply Global Replace Jam** - This function allows individual bits to be set to 1, set to 0 or passed through unchanged according to the Global Replacement Dword defined on the Global Tab.
- **Create Error Jam -** Check Inject Error for any byte(s) on which you want to send errors (Figure 122). Then choose Disparity Error or Code Violation. If you choose Disparity Error, the Jammer inverts the running disparity at that byte. If that byte is a neutral 10b character, you might not see the disparity error until a later byte. The Code Violation option replaces the byte with a predefined 10-bit illegal character.

Figure 122: Create Error Dialog

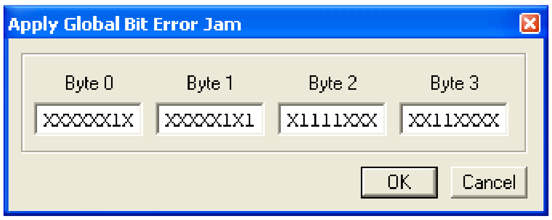


- **Invert Jam -** Invert defined bits and pass through the rest. Enter 1s at the appropriate bit locations.
- **Pass Through Jam** - Pass through the current Dword unchanged.
- **Replace Jam with CRC -** This word contains the current CRC value. CRC calculation is reset and started at the Dword after any SOF. Note that there should be only valid data Dwords between an SOF and its partner automatic CRC insertion or else the CRC value will be incorrect. Violations of this rule include using Primitives, Scrambled Idle Dwords, or code violations.

Note: If you place an SOF in Dword 2, and an automatic CRC in Dword 10, the CRC is calculated over Dwords 3 to 9.

- **Set Bits To 0s Jam-** Set defined bits to 0s and pass through the rest. Enter 0s at the appropriate bit locations.
- **Set Bits To 1s Jam -** Set defined bits to 1s and pass through the rest. Enter 1s at the appropriate bit locations.
- **Apply Global Bit Error Jam -** Apply the Global Bit Error function set on the Global tab. Enter 1s at the appropriate bit locations (Figure 123).

Figure 123: Apply Global Bit Error Jam Bit Location Dialog



Replace Frame with Truncated Frame

This option truncates the target frame to a shorter length and sends Scrambled Idle Dwords on top of the remainder of the target frame (Figure 124).

>> Use the up and down arrow buttons or type the number of Dwords you want to truncate the frame to (including header and payload, not including SOF, CRC, and EOF).

You can pass through or replace the SOF Dword with another SOF, another standard Primitive, a Scrambled Idle Dword, or any four user-defined K/D characters. In addition to these options, you can send an error on any byte of the Dword.

DCI options are available only in the Advanced SAS/SATA Jammer configurations. These allow you to replace a Dword with a DCI or to send DCI with the Global timer set in the Global tab.

The CRC must be replaced or recalculated in one of the following ways:

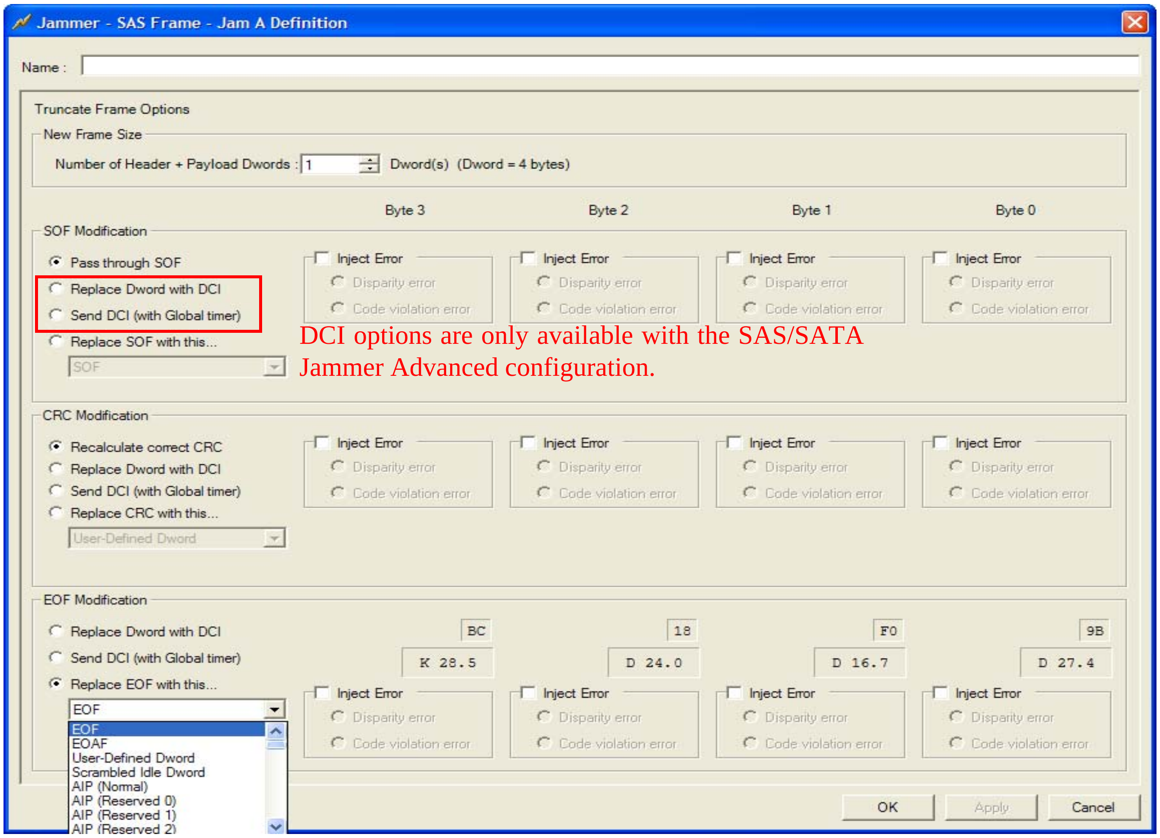
- Recalculating the CRC to make it correct for the modified data
- Replacing with a user-specified data Dword or Primitive
- Replace Dword with DCI
- Send DCI (with Global timer)

Replacing the CRC is specified the same way as the SOF. You can also send an error on any byte.

You must select a replacement Dword for the EOF. This is specified in the same way as the SOF. You can also send an error on any byte.

Check **Inject Error** for any byte(s) on which you want to send errors. Then choose Disparity Error or Code Violation. If you choose Disparity Error, the Jammer inverts the running disparity at that byte. If that byte is a neutral 10b character, you might not see the disparity error until a later byte. The Code Violation option replaces the byte with a predefined 10-bit illegal character.

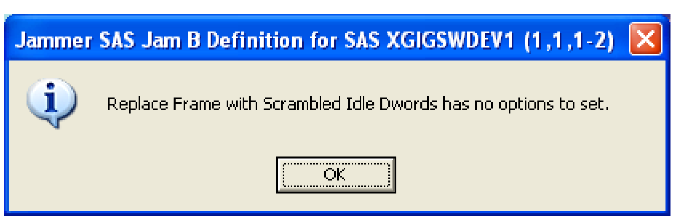
Figure 124: SAS - Replace Frame with Truncated Frame



Replace Frame with Scrambled Idle Dwords

This option replaces the target frame with Scrambled Idle Dwords. The following dialog is displayed (Figure 125).

Figure 125: SAS - Replace Frame with Scrambled Idle Dwords.



Jamming a Primitive Sequence

If the Trigger Event is a Primitive Sequence, click the **Jam** button on the Jammer Configuration window to open the Primitive Sequence Jam Definition window (Figure 126, Figure 127, Figure 128).

Figure 126: Single Primitive Sequence Jam Definition Window

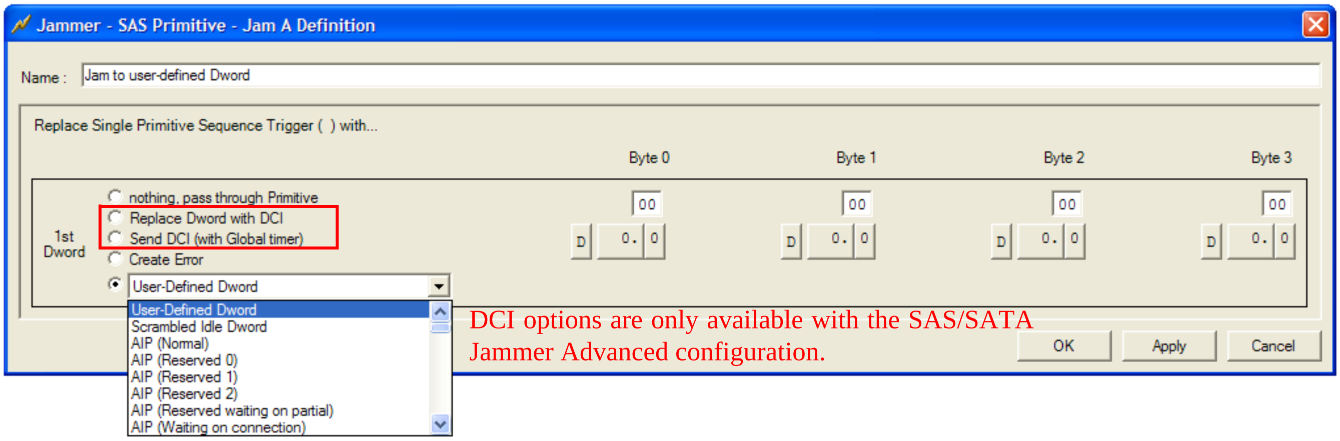


Figure 127: Triple Primitive Sequence Jam Definition Window

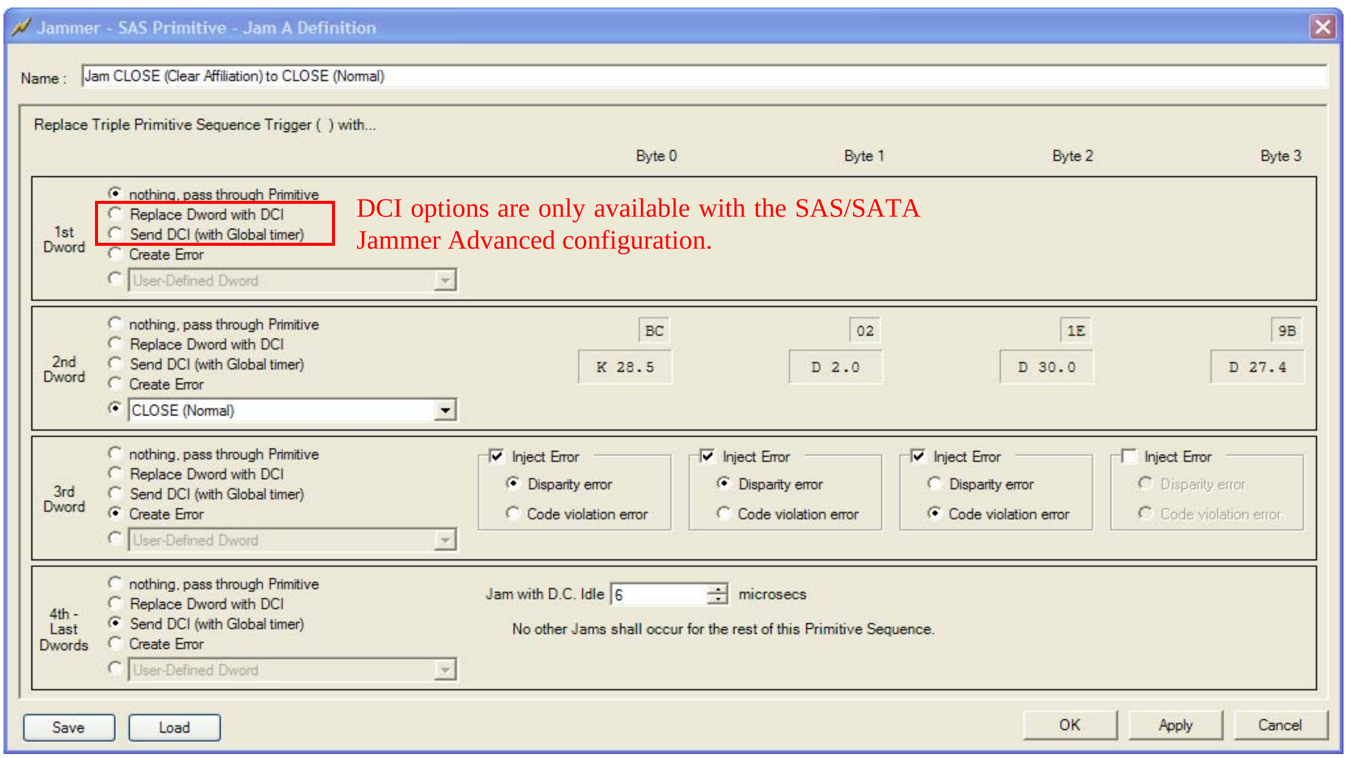
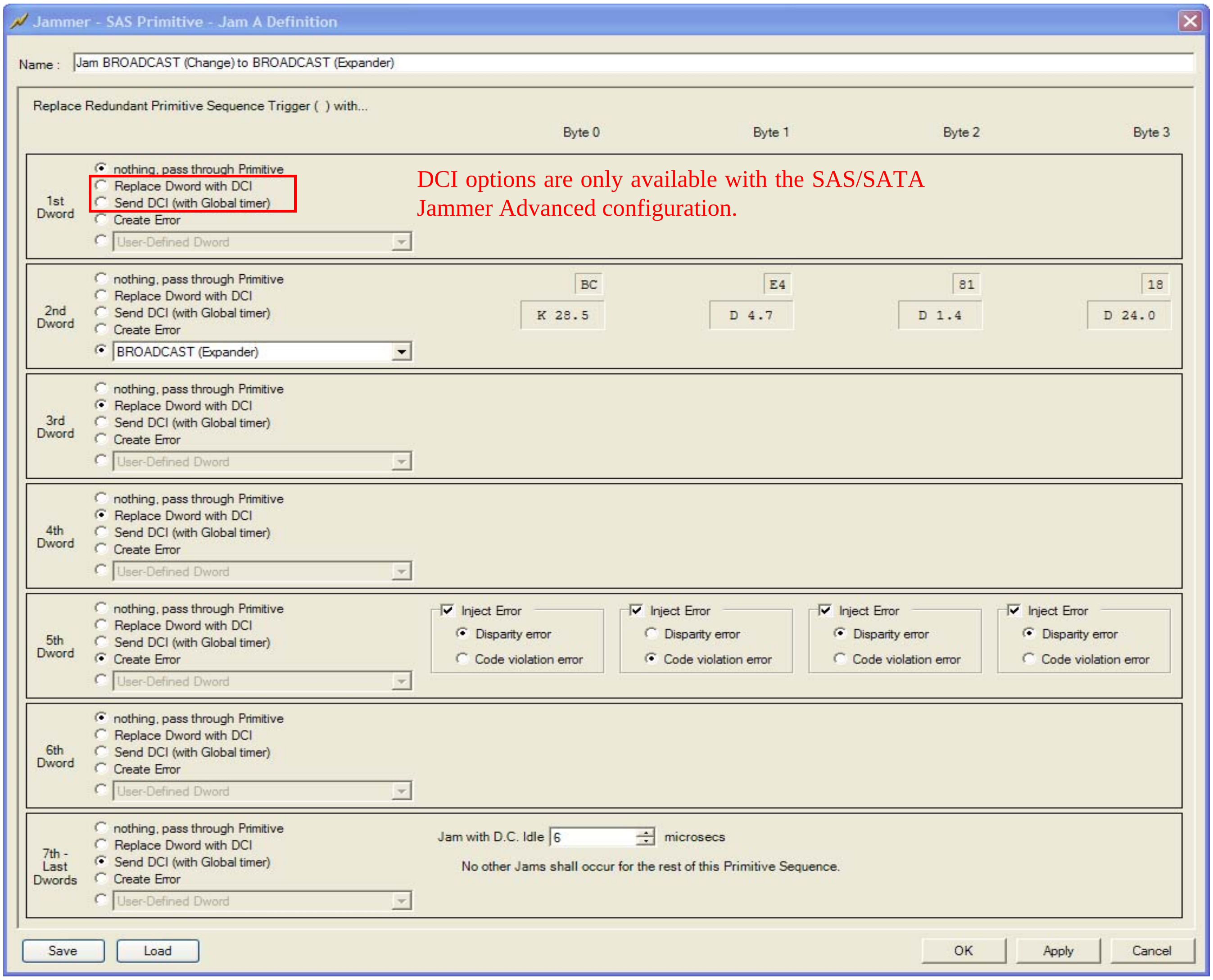


Figure 128: Redundant Primitive Sequence Jam Definition Window



The number of Dwords shown in the Definition window corresponds to the type of Primitive Sequence you specified as the Trigger Condition (one Dword for a Single or Extended, four for a Triple, or seven for a Redundant Primitive Sequence).

Ideally, any Triple or Redundant Sequences that the Jammer triggers on should be three or six Dwords long, respectively. If the Dwords are shorter, then the Jammer does not use all of the Jams specified in this widow. If the Dwords are longer, than any Dword over the ideal third or sixth Dword in the sequence is Jammed according to the fourth or seventh Dword Jam Definition, respectively.

For each Dword, you have three options:

- Pass through the Primitive
- Corrupt any byte(s) with an error
- Replace Dword with DCI
- Send DCI (with Global timer)

- Replace the Primitive with a new Dword

To pass through a Primitive, select the top option for that Dword.

To create an error, select Create Error for that Dword. Then check Inject Error for any byte(s) on which you want to send errors. Then choose Disparity Error or Code Violation. If you choose Disparity Error, the Jammer inverts the running disparity at that byte. If that byte is a neutral 10b character, you might not see the disparity error until a later byte. The Code Violation option replaces the byte with a predefined 10-bit illegal character.

DCI options are available only in the Advanced SAS/SATA Jammer configurations. These allow you to replace a Dword with a DCI or to send DCI with the Global timer set in the Global tab.

You can replace the Dword with any K/D characters, any standard Primitive, or a Scrambled Idle Dword, by selecting the bottom option and choosing from the drop-down list.

Configuring SATA/STP Arm and Trigger Conditions

Arm and Trigger conditions recognize specific frames or Primitives.

For Frame conditions, SATA_SOF is automatically specified. You can specify up to 31 additional Dwords after the SOF.

You can also define a wildcard specifying bits to be masked out of an arm word and passed through in the corresponding trigger word.

For Primitive Conditions, you can choose from groups of Single, Repeated, or Continued Primitive Sequences.

For a Single Primitive Sequence, you can specify any standard Single Primitive Sequence. You can also specify where you want the Jammer to look for the matching Dword: only inside frames, only outside frames, or anywhere.

Note: The Jammer does not look for any matching conditions during OOB initialization or speed negotiation.

For Repeated Primitive Sequences, you can choose either SATA_PMACK or SATA_PMNAK.

For Continued Primitive Sequences, you can choose any standard Continued Primitive Sequence.

The Arm and Trigger windows are identical (Figure 130 and Figure 131). In addition, you can select the domain triggered input as an Arm condition.

Depending on the Mode you select, the appropriate graphic diagram shows the Trigger and optional Arm conditions, along with the Jam event. If the Mode you select does not include an Arm condition, the Arm button remains disabled.

To set Arm and Trigger conditions:

1 Click the **Arm** or **Trigger** button in the Jammer Configuration window.

The window for the condition is displayed (Figure 129). If you are in hardware edit mode, chassis name, chassis number, slot number, and port numbers are displayed in the title bar.

2 Set the values as required to specify a unique Arm and Trigger sequence for the specific test. The following sections describe the available values.

Figure 129: SATA/STP Frame Arm and Trigger Window Examples

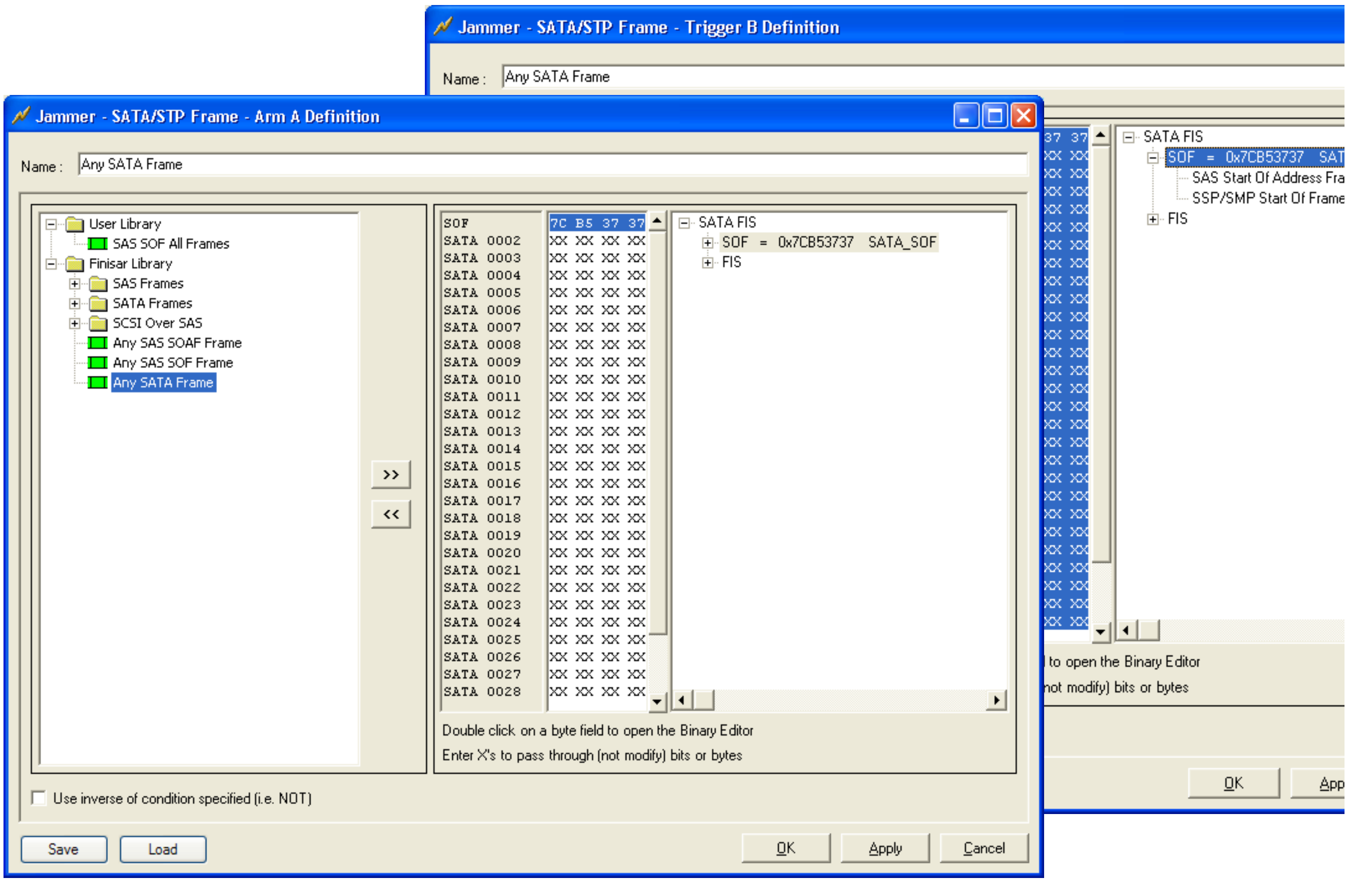


Figure 130: SATA/STP Continued Primitives Arm Window Example

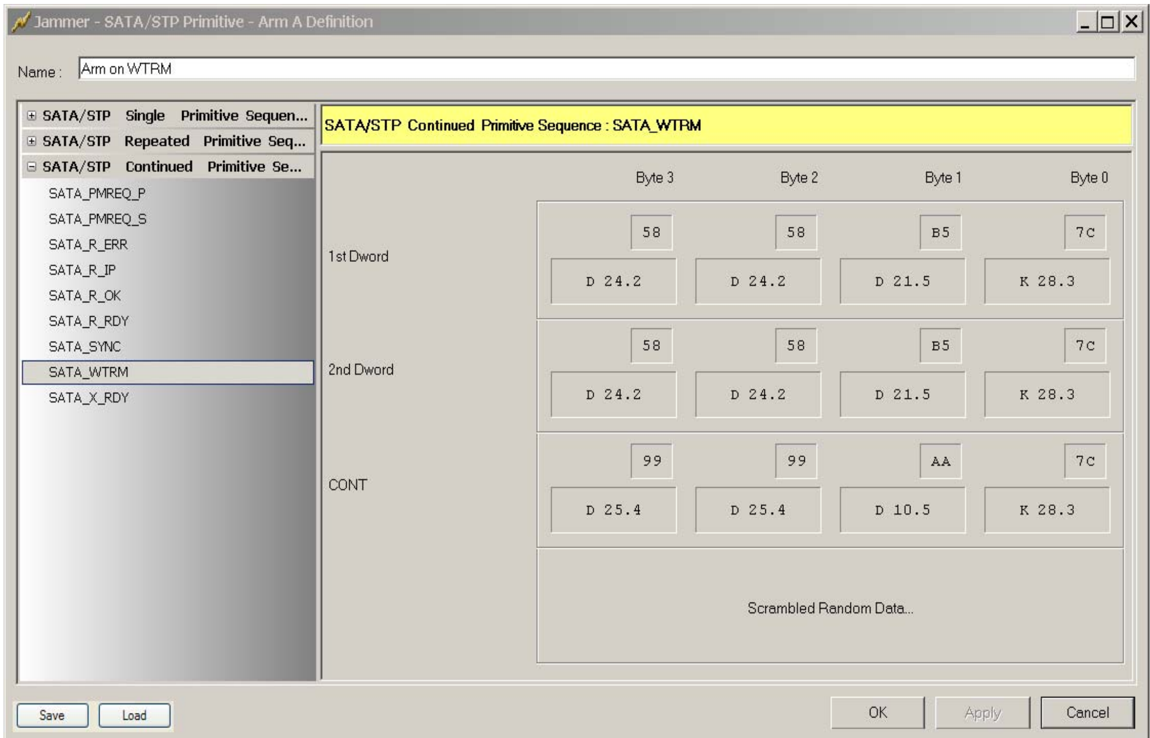


Figure 131: SATA/STP Single Primitive Trigger Window Example

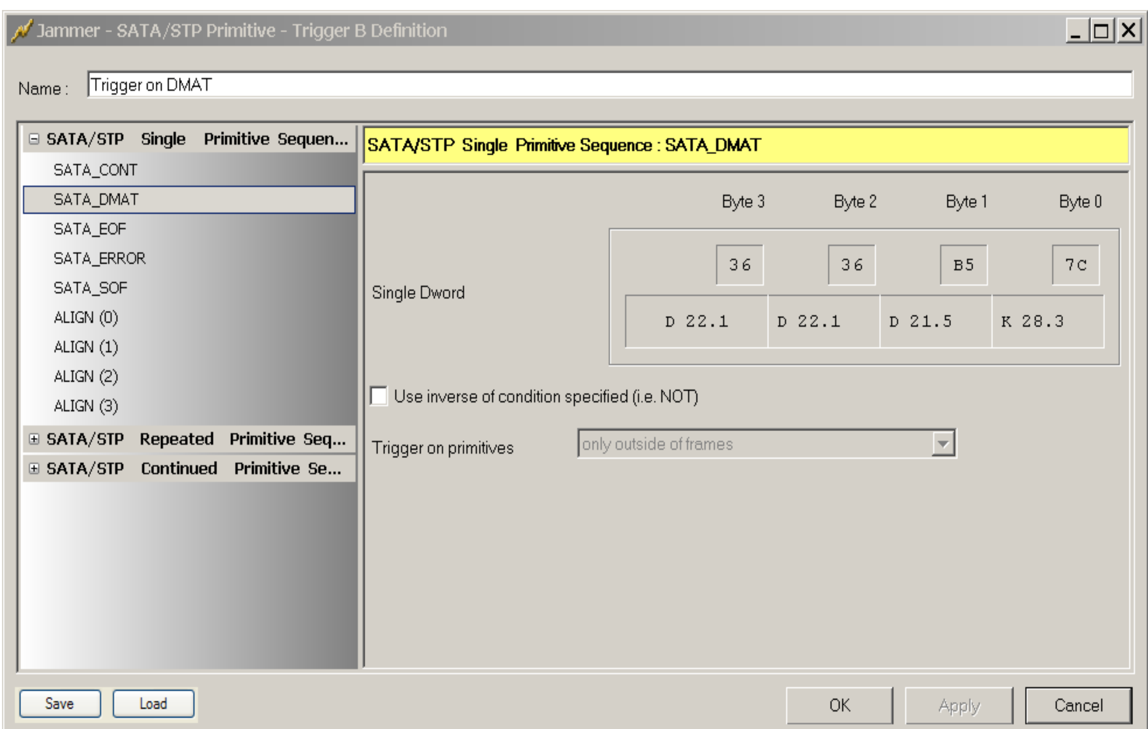
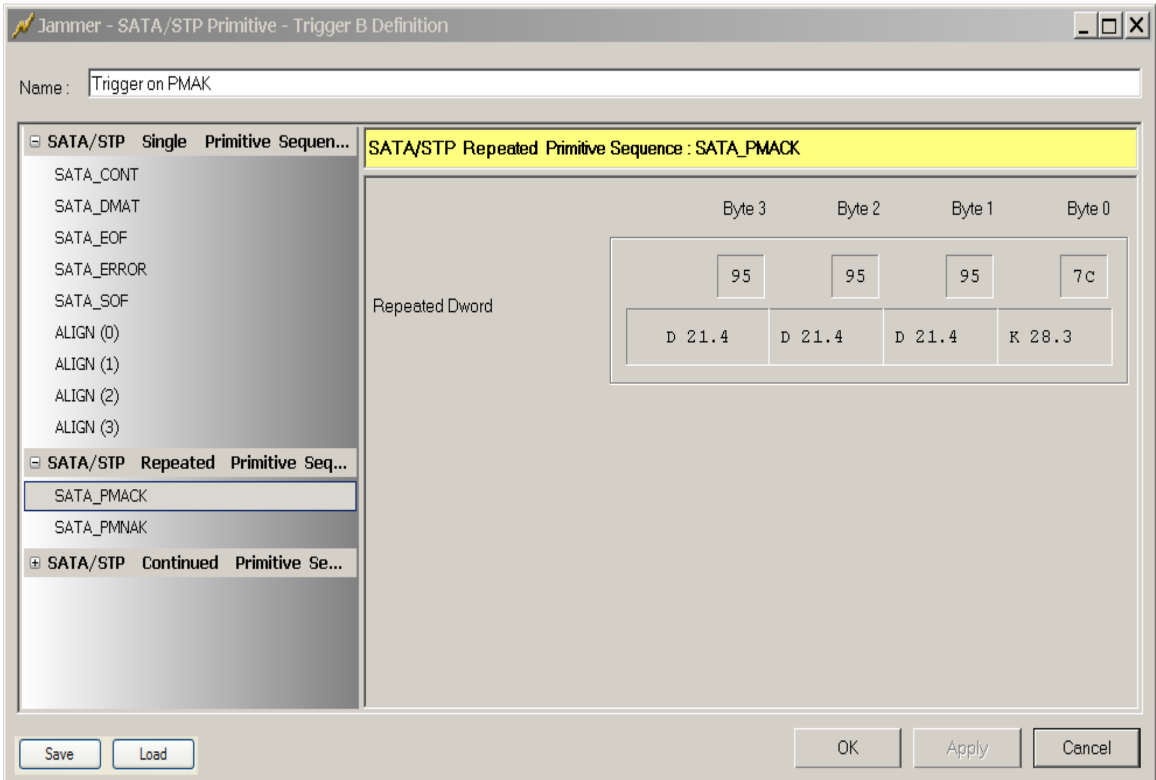


Figure 132: SATA/STP Repeated Primitives Trigger Window Example



Setting Frame Conditions

You can specify frame conditions in three ways:

- Load a template from the Template Library tree
- Manually specify bits in the frame
- Select fields from the tree view in the right pane

To use a template:

1. Select a template from the Template Library tree on the left.
2. Click the double right arrow button to set the Trigger Condition.

   The condition is indicated on the right side of the window.

To manually specify a frame:

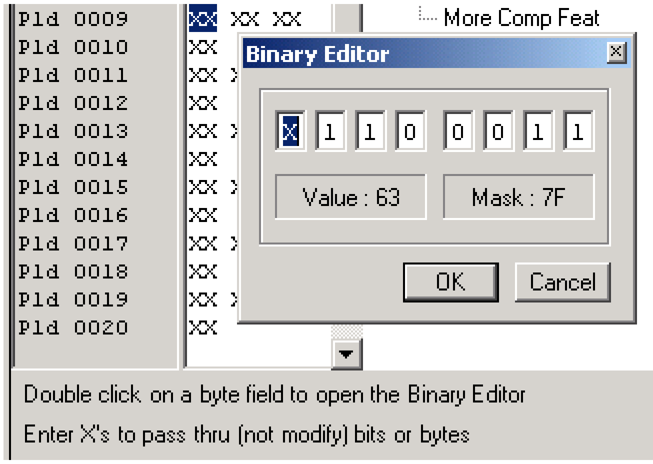
>> Type hexadecimal values directly into the center column of the window.

An X represents a nibble that can be any value (a “don’t care”).

To set individual bits in any field, double-click on the hex entry to open the Binary Editor (Figure 133 on page 147). In the hex view, partially defined hex characters appear as question marks: `X001=?`

When you use the tree view, values are automatically entered into the center column in the right window pane.

Figure 133: Binary Editor Dialog



Saving a Frame Condition

If you create a frame condition that you want to save and make easily available for future use, you can save it into the “User Library” folder in the Template Library tree. To do this:

>> Highlight the folder and click the double left arrow button.

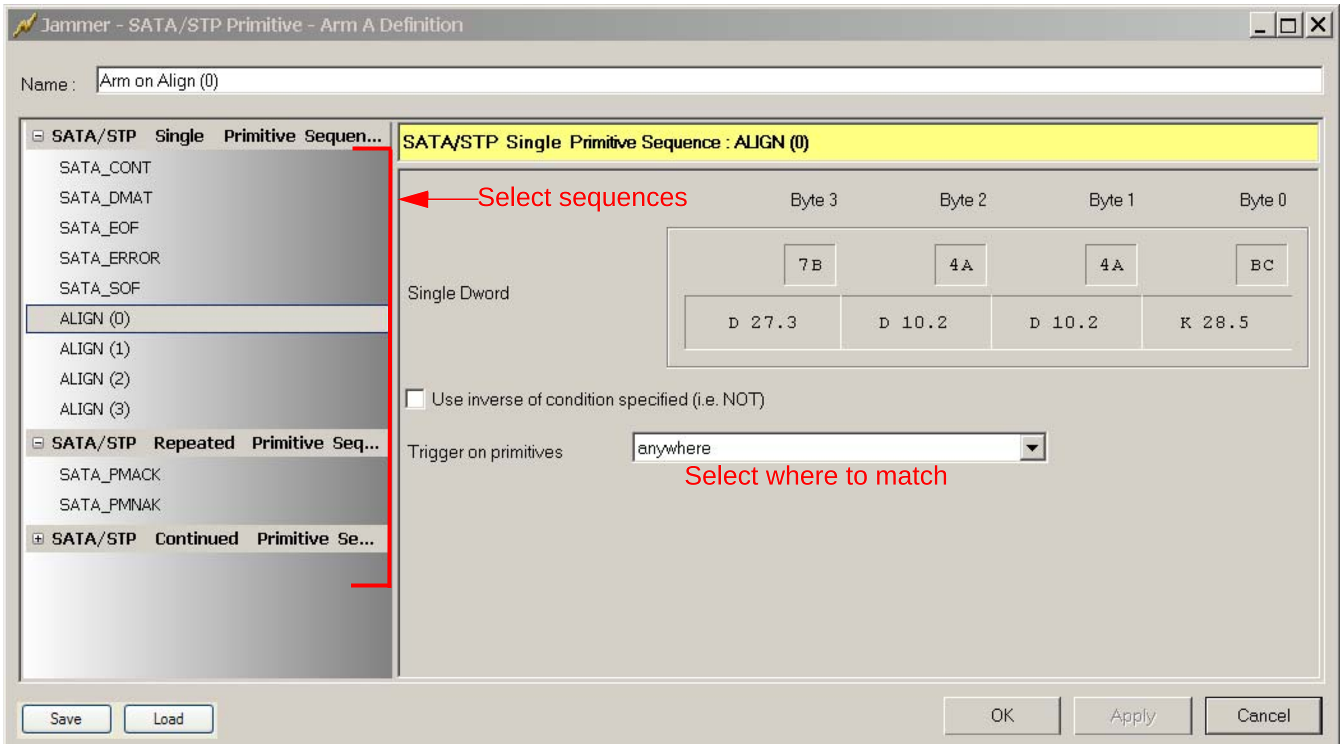
Frame conditions have the option of “Use inverse of condition specified (i.e., NOT).” When you check this option, it means that the first frame encountered that does not match what you have specified creates a “condition met” event.

For each frame condition, you can specify an optional name at the top of the window. This name is also shown on the Jammer Configuration window under the Type selection, and on the main Xgig Maestro window.

Setting Primitive Sequence Conditions

You can choose a Primitive Sequence from any of the categories on the left side of the window: Single, Repeated, or Continued. For Single Primitives, you can also choose where to match: anywhere, only outside of frames, or only inside of frames.

Figure 134: SATA/STP Single Primitive Sequence Conditions Example



You can check the “Use inverse of condition specified (i.e. NOT)” option; this means the first Dword encountered that does not match what you have specified creates a “condition met” event.

As with frame conditions, you can specify an optional name at the top of the window. This name is also shown in the Jammer Configuration window under the Type selection and on the main Xgig Maestro window.

Configuring the SATA/STP Jam Definition

The **Jam Definition** window defines how to modify the event specified on the **Trigger Condition** window.

The Jam is always the same type (frame or Primitive Sequence) as the Trigger.

For any Jam Definition, you can specify an optional name at the top of the window. This name is also displayed on the Jammer Configuration window under the Type selection and on the main Xgig Maestro window.

You can save a Jam definition as a `.jmj` file by clicking the **Save** button in the **Jam** window. You can load a `.jmj` file by clicking the **Load** button in the **Jam** window.

Jamming a Frame

If the Trigger Event is a frame, click the **Jam** button on the Jammer Configuration window to open the Frame Jam Definition window.

The content of the Jam Definition window corresponds to the type of frame Jam you choose on the Jammer Configuration window (modify frame, truncate frame, or replace frame with SATA_SYNC Continued Primitive Sequence). The following paragraphs describe these choices.

Replace Frame with Modified Frame

Each tab contains options relevant to different frame modifications.

Using the Global Tab

Use this tab (Figure 135) to define Jam parameters that apply globally to the frame.

Global Replace Jam Option

Use the Global Replacement Dword to set specific bits in a Dword to 1 or 0 while passing through the remaining bits. You can apply this global replacement to any Dword in the frame. Define one Global Replacement for each Test Case.

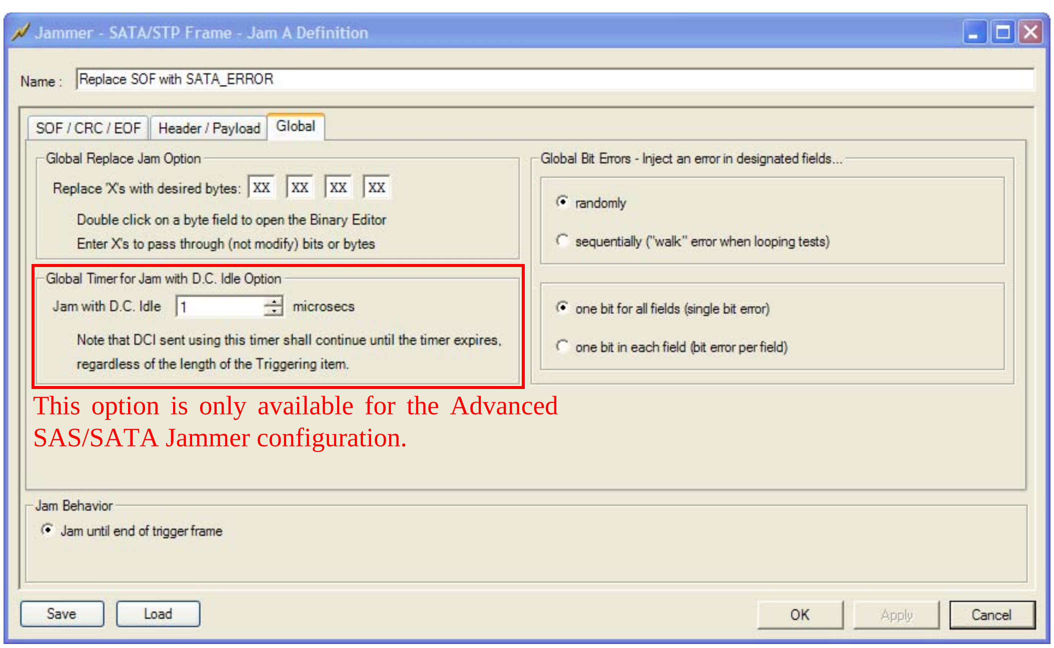
To edit these bits:

>> Enter hex values, or double-click on a byte field to open the Binary Editor.

Any bits left as Xs are passed through.

The difference between this Global Replacement option versus the Replace Dword option found on the Header/Payload tab is that the Global Replacement option allows masking down to the bit level, whereas the other option allows masking at the nibble level.

Figure 135: SATA/STP Global Tab



Global Bit Errors

The Jammer software can introduce bit errors repeatedly in sequential or random fashion to predefined fields. These bit errors are introduced to the 32-bit form of the target Dwords (not the 40-bit form) so code violations are not created. The Global Bit Errors control allows you four options.

- Select **one bit for all fields** and **randomly**. This causes the Jammer to inject a single bit error in the group of all fields selected in the header or payload for a single Test Case. If the Jammer Test Suite is set to *loop*, then single bit errors are randomly injected into these fields, with one bit for each cycle of the Test Suite.
- Select **one bit for all fields** and **sequentially**. This also injects a single bit error in the group of all fields selected in the header or payload. If the Test Suite is set to loop forever, the bit error walks through all the selected fields.
- Select **one bit in each field** and **randomly** does the same thing as the first option; however, there will be one error for each Dword selected in the header or payload.
- Select **one bit in each field** and **sequentially** does the same thing as the second option; however, there will be one error for each Dword selected in the header or payload.

Note: The location of the bit errors are moved each time you run this entire Test Case, not each time you repeat the Jam within the Test Case.

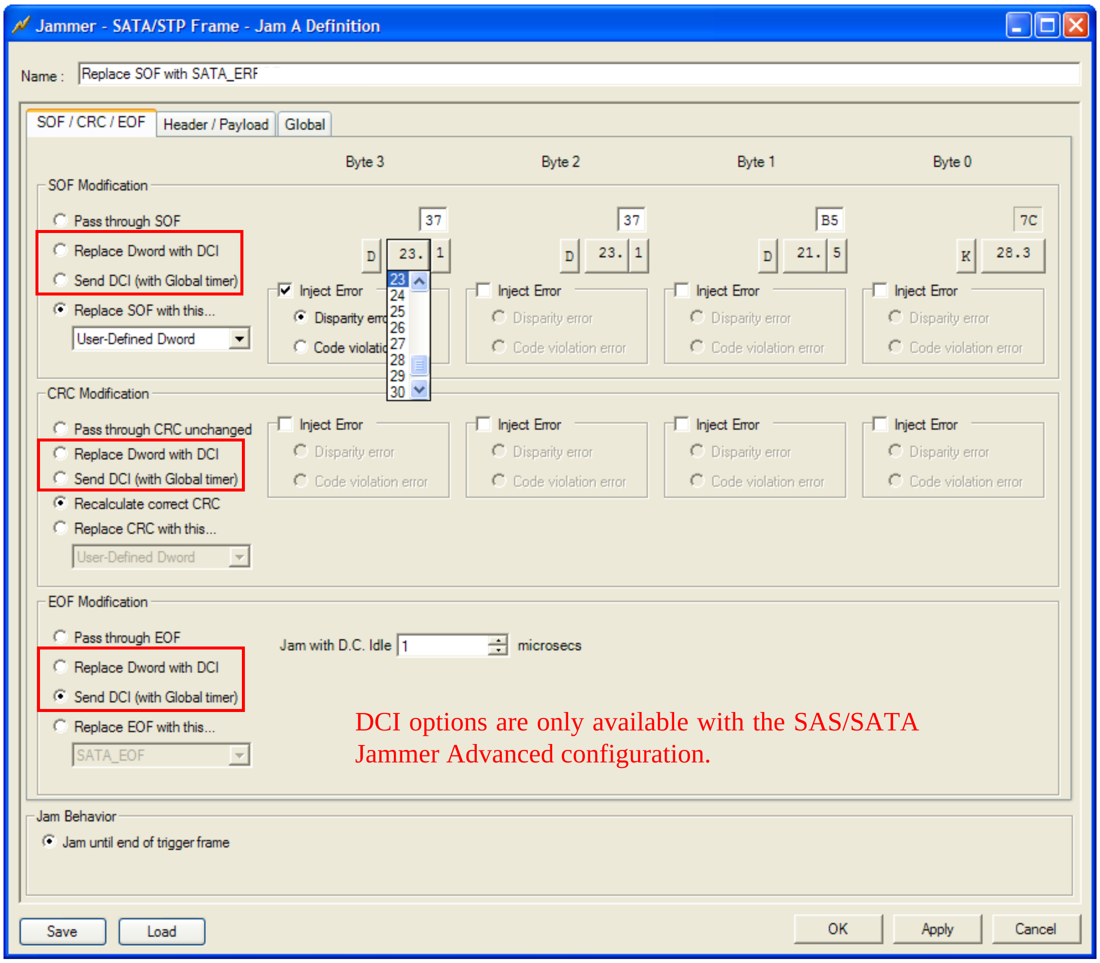
Global Timer for Jam with D.C. Idle

In an Advanced SAS/SATA Jammer configuration, the Jammer software allows you to set a global timer for Jamming with D.C. Idles. When using this option, DCI will continue until the timer expires regardless of the triggering item.

Using the SOF/CRC/EOF Tab

Use the choices on this tab to modify the Start of Frame (SOF), Cyclic Redundancy Check (CRC), and End of Frame (EOF) Dwords of the original target frame (Figure 136).

Figure 136: SATA/STP SOF/CRC/EOF Tab



SOF/EOF Options

You can pass through or replace the start and end of frame Dwords with another standard Primitive, Scrambled Primitive Data, or any four user-defined K/D characters. In addition to these options, you can send an error on any byte of the Dwords.

DCI options are available only in the Advanced SAS/SATA Jammer configurations. These allow you to replace a Dword with a DCI or to send DCI with the Global timer set in the Global tab.

Check Inject Error for any byte(s) on which you want to send errors. Then choose Disparity Error or Code Violation. If you choose Disparity Error, the Jammer inverts the running disparity at that byte. If that byte is a neutral 10b character, you might not see the disparity error until a later byte. The Code Violation option replaces the byte with a predefined 10-bit illegal character.

CRC Options

CRC options include:

- Not changing the CRC in the original target frame
- Replace Dword with DCI
- Send DCI (with Global timer)
- Recalculating the CRC to make it correct for the modified data
- Replacing with a user-specified data Dword, Primitive, or Scrambled Primitive Data

With the addition of recalculating the CRC, you configure the CRC option in the same way as the SOF/EOF options.

Depending on the changes made to a frame, the old CRC might be invalid. If the CRC is passed through, an invalid frame might be created. The lowest layer of protocol error checking should recognize this type of error. If the frame is modified and the CRC is recalculated, a valid frame with modified data is created.

Using the Header/Payload Tab

Similar to defining an Arm or Trigger Condition, there are two ways to specify your frame Jam Definition. One way is to load a template from the Template Library tree, and the other way is to manually specify bits in the frame.

To use a template:

1 Highlight a template in the Template Library tree on the left side of the window.

Tree View is structured similar to the display on the right side of the Arm and Trigger Condition windows. You can make selections from the tree; this creates the appropriate Replace Jams.

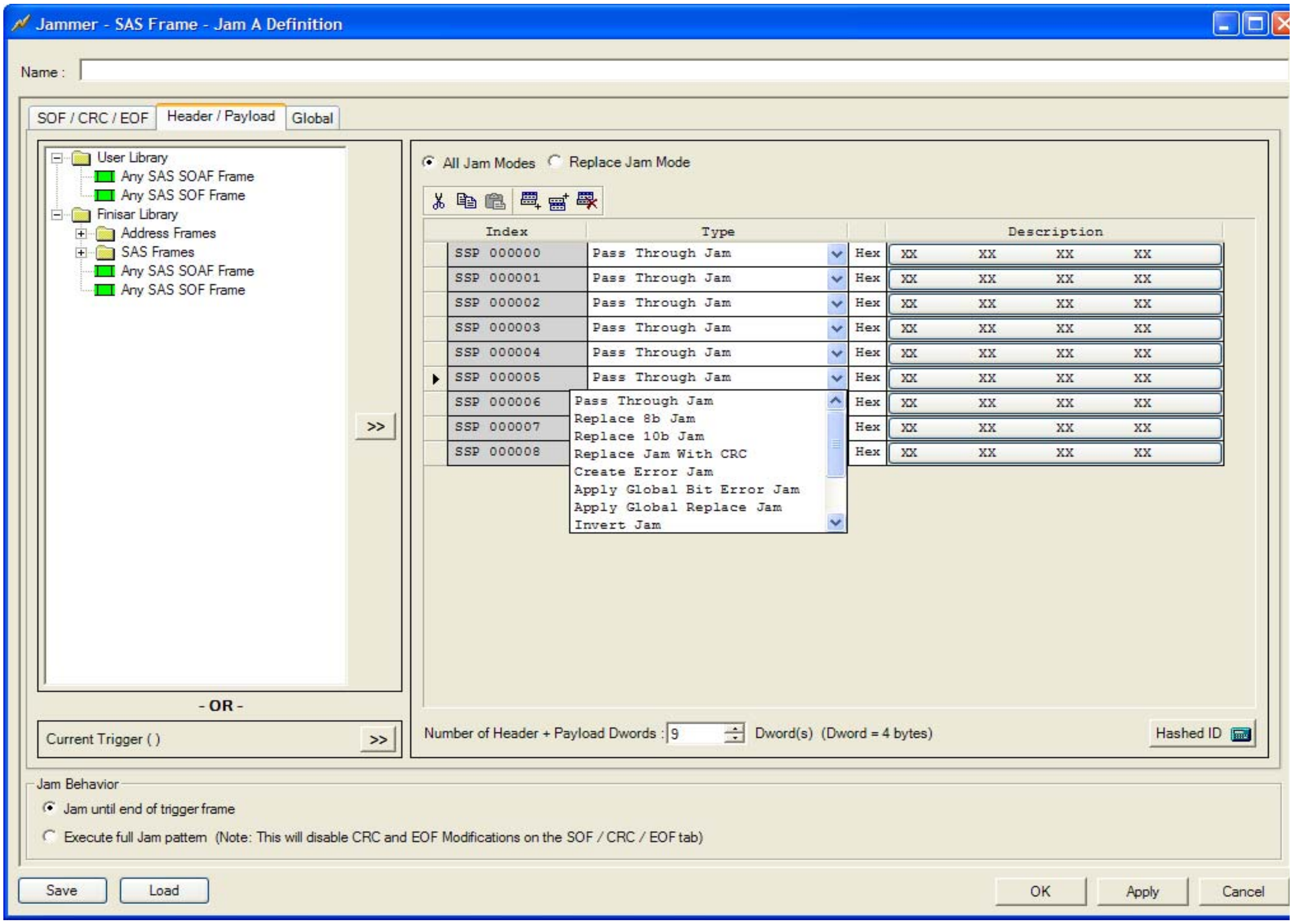
2 Click the double right arrow to display the Jam definition on the right side of the window.

When you use a template, the Jam definition is populated with Replace Jams of the specified data, while all other bits are passed through.

To manually edit the values, enter a value into the byte field. An **X** in a nibble passes the original value through.

Note: The more Dwords in a Jam Definition, the longer the time between Test Cases in the suite. Switching from one Test Case to the next is a software operation, so the time between cases will be on the order of hundreds of milliseconds.

Figure 137: SATA/STP Header/Payload Tab



To manually define each nibble, enter a value into the byte field or double-click to display the Binary Editor. If you specify a bit as a 0 or 1, you must specify the values of the other three bits in that nibble as well. An **X** in a nibble passes the original value through. Choose any K/D character for an entire byte by using the drop-down controls. Click on the K or D to toggle this setting.

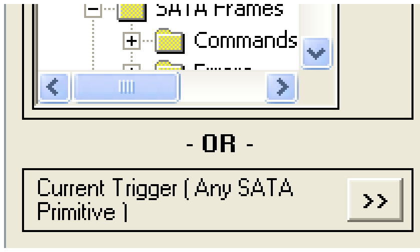
Use the **Number of Header + Payload Dwords** counter to define the number of Dwords to Jam (Figure 138). Use the scroll bar to position the display to the desired Dword, if necessary.

Figure 138: Setting Header + Payload Size

You can also use the List View controls at the top to cut, copy, paste, add, insert, or delete Dwords.

Notice the special choice at the bottom left, **Current Trigger** (Figure 139). This is a copy of the frame condition you have specified for the Trigger. The name of the Trigger Condition (if any) is shown in parenthesis. Click the double right arrow to use this.

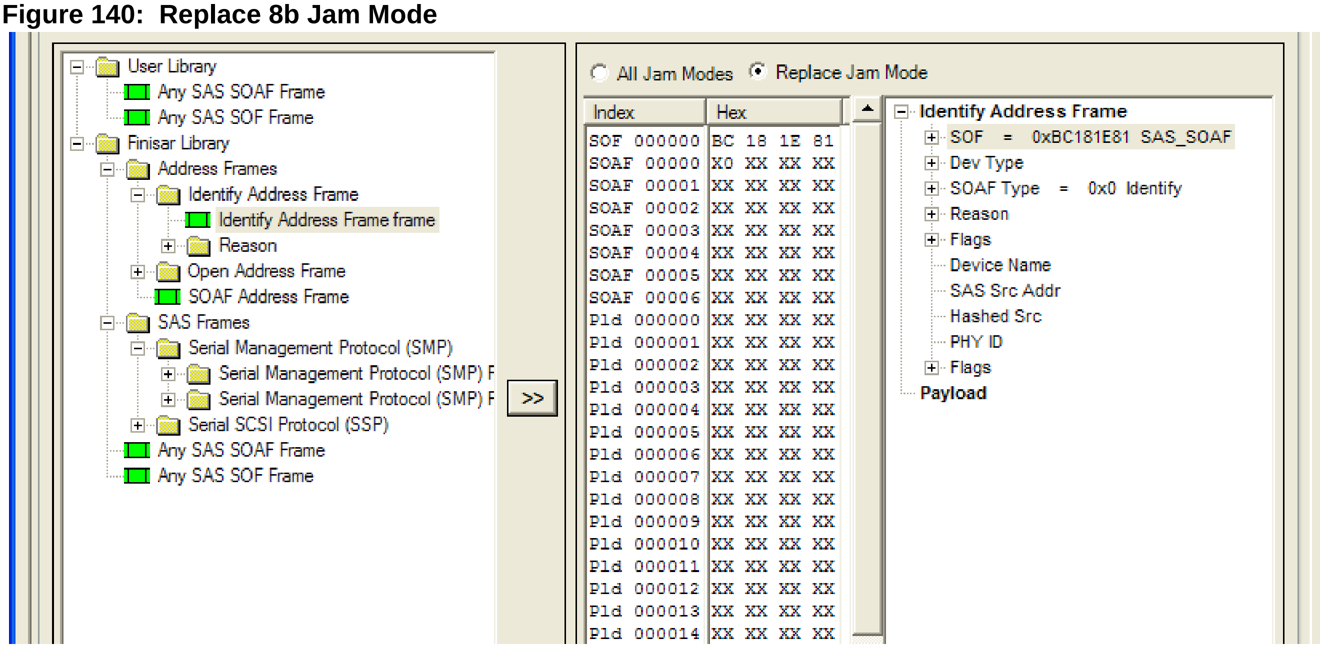
Figure 139: Current Trigger Option



To manually specify a frame Dword Jam, select the **All Jam Modes** radio button. Select a Jam Type from the drop-down menu (under the Type column), then specify any additional definition (if necessary) by clicking on the data field (under the Description column).

Selecting the **Replace Jam Mode** radio button opens a dialog that allows you to replace an entire frame either by using a template or manually entering values. The Replace Jam Mode dialog also contains a view of the frame contents, similar to those seen the Arm and Trigger Condition windows. These values correspond to the hex values defined in the center column.

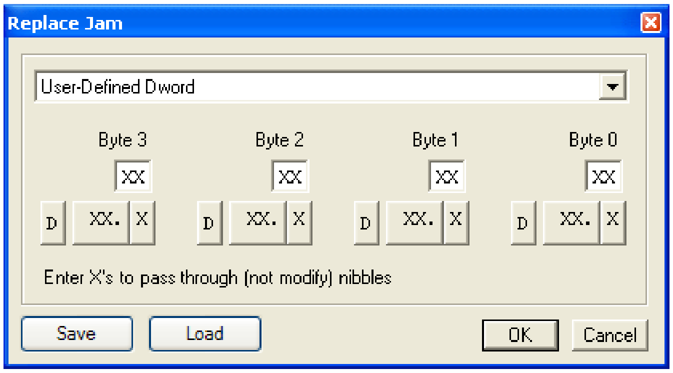
Figure 140: Replace 8b Jam Mode



Selecting the **All Jam Modes** radio button opens a dialog that provides the following choices are available for each Dword in a frame on the Header/Payload tab:

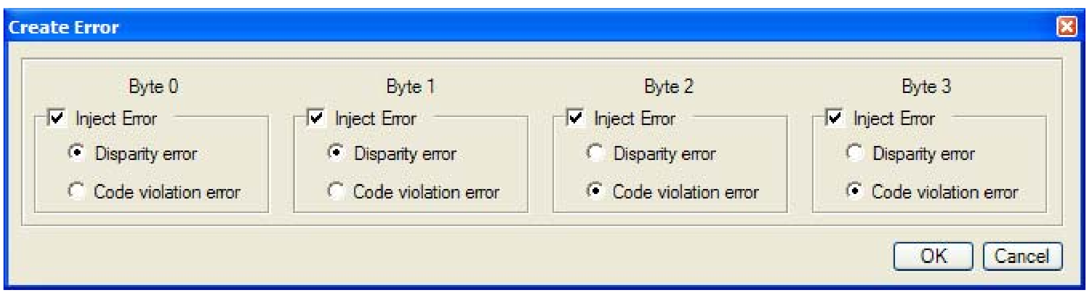
- **Apply Global Replace Jam** - This function allows individual bits to be set to 1, set to 0 or passed through unchanged according to the Global Replacement Dword defined on the Global Tab.
- **Replace 8b Jam Mode -** This function allows you to replace the Dword with any standard Primitive, a Scrambled Idle Dword, or a user-defined Dword (Figure 141).

Figure 141: Replace 8b Jam Dialog



- **Replace 10b Jam** (Advanced Jammer Configurations only) - This function allows you to replace the Dword with any standard Primitive, a Scrambled Idle Dword, or a user-defined Dword (Figure 141).
- **Create Error Jam -** Check Inject Error for any byte(s) on which you want to send errors (Figure 142). Then choose Disparity Error or Code Violation. If you choose Disparity Error, the Jammer inverts the running disparity at that byte. If that byte is a neutral 10b character, you might not see the disparity error until a later byte. The Code Violation option replaces the byte with a predefined 10-bit illegal character.

Figure 142: Create Error Dialog



- **Invert Jam -** Invert defined bits and pass through the rest. Enter 1s at the appropriate bit locations.
- **Pass Through Jam** - Pass through the current Dword unchanged.
- **Replace 8b Jam** - You can replace the Dword with any standard Primitive, Scrambled Primitive Data, or a user-defined Dword (Figure 141).

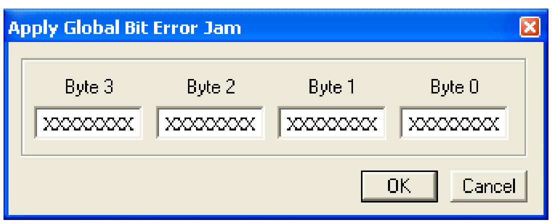
  To define each nibble, enter a value into the byte field or double-click to display the Binary Editor. If you specify a bit as a 0 or 1, you must specify the values of the other three bits in that nibble also. An **X** in a nibble passes the original value through. Choose any K/D character for an entire byte by using the drop-down controls. Click on the K or D to toggle this setting.

- **Replace Jam with CRC -** This word contains the current CRC value. CRC calculation is reset and started at the Dword after any SOF. Note that there should be only valid data Dwords between an SOF and its partner automatic CRC insertion or else the CRC value will be incorrect. Violations of this rule include using Primitives, Scrambled Primitive Data, or code violations.

Note: If you place an SOF in Dword 2, and an automatic CRC in Dword 10, the CRC is calculated over Dwords 3 to 9.

- **Set Bits To 0s Jam-** Set defined bits to 0s and pass through the rest. Enter 0s at the appropriate bit locations.
- **Set Bits To 1s Jam -** Set defined bits to 1s and pass through the rest. Enter 1s at the appropriate bit locations.
- **Apply Global Bit Error Jam -** Apply the Global Bit Error function set on the Global tab. Enter 1s at the appropriate bit locations (Figure 143).

Figure 143: Apply Global Bit Error Jam Bit Location Dialog



Replace Frame with Truncated Frame

This option truncates the target frame to a shorter length and sends SATA_WTRM on top of the remainder of the target frame (Figure 144).

>> Use the up and down arrow buttons or type the number of Dwords you want to truncate the frame to (including header and payload, not including SOF, CRC, and EOF).

You can pass through or replace the SOF Dword with another standard Primitive, Scrambled Primitive Data, or any four user-defined K/D characters. In addition to these options, you can send an error on any byte of the Dword.

DCI options are available only in the Advanced SAS/SATA Jammer configurations. These allow you to replace a Dword with a DCI or to send DCI with the Global timer set in the Global tab.

The CRC must be replaced or recalculated in one of the following ways:

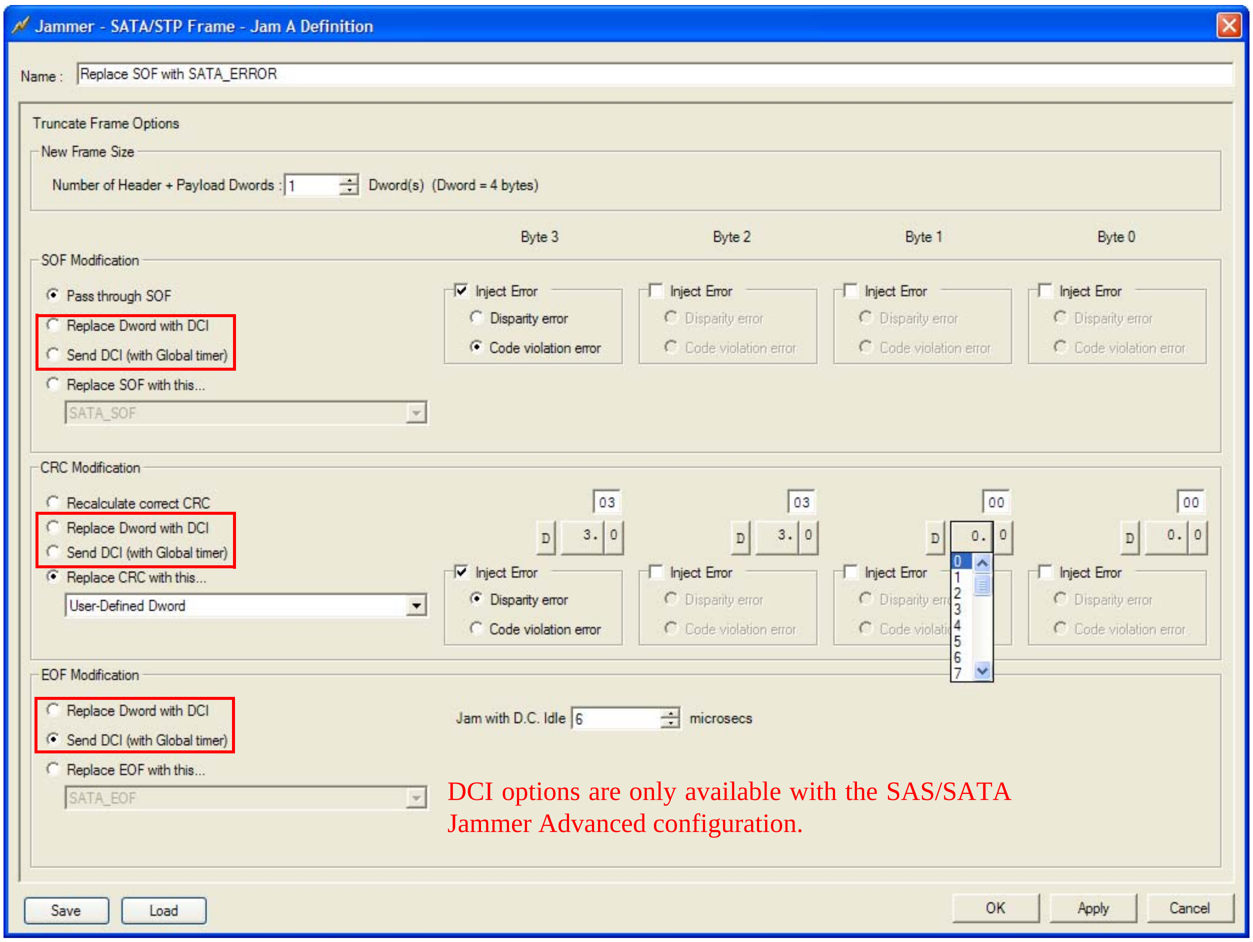
- Recalculating the CRC to make it correct for the modified data
- Replacing with a user-specified data Dword or Primitive
- Relapse Dword with DCI
- Send DCI (with Global timer)

Replacing the CRC is specified the same way as the SOF. You can also send an error on any byte.

You must select a replacement Dword for the EOF. This is specified in the same way as the SOF. You can also send an error on any byte.

Check **Inject Error** for any byte(s) on which you want to send errors. Then choose Disparity Error or Code Violation. If you choose Disparity Error, the Jammer inverts the running disparity at that byte. If that byte is a neutral 10b character, you might not see the disparity error until a later byte. The Code Violation option replaces the byte with a predefined 10-bit illegal character.

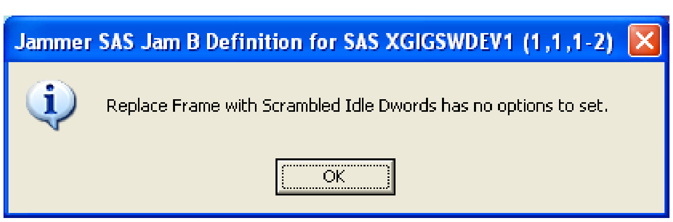
Figure 144: SATA/STP - Replace Frame with Truncated Frame



Replace with Scrambled Idle Dwords

This option replaces the target frame with Scrambled Idle Dwords. The following dialog is displayed (Figure 145).

Figure 145: SAS - Replace Frame with Scrambled Idle Dwords.



Jamming a Primitive Sequence

If the Trigger Event is a Primitive Sequence, click the **Jam** button on the Jammer Configuration window, to open the Primitive Sequence Jam Definition window (Figure 146, Figure 147, Figure 148). A dialog is displayed corresponding to your choice of Trigger Condition Primitive Sequence type.

Figure 146: Single Primitive Sequence Jam Definition Window

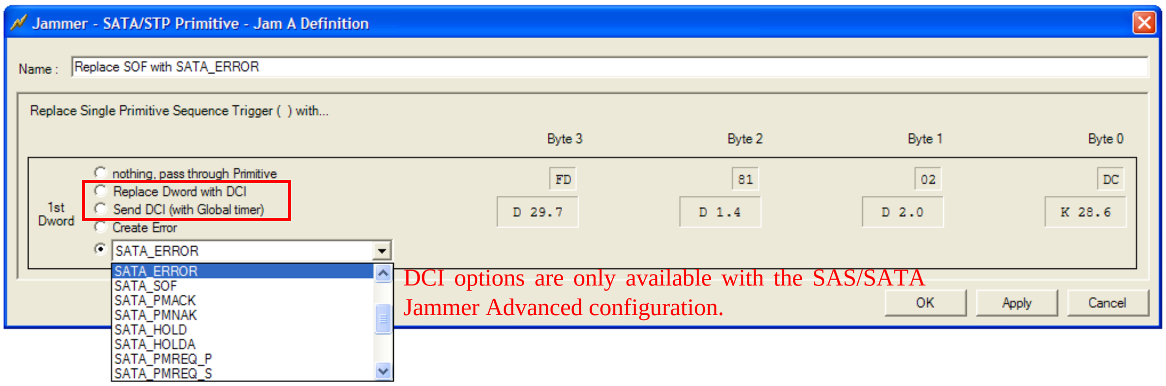


Figure 147: Continued Primitive Sequence Jam Definition Window

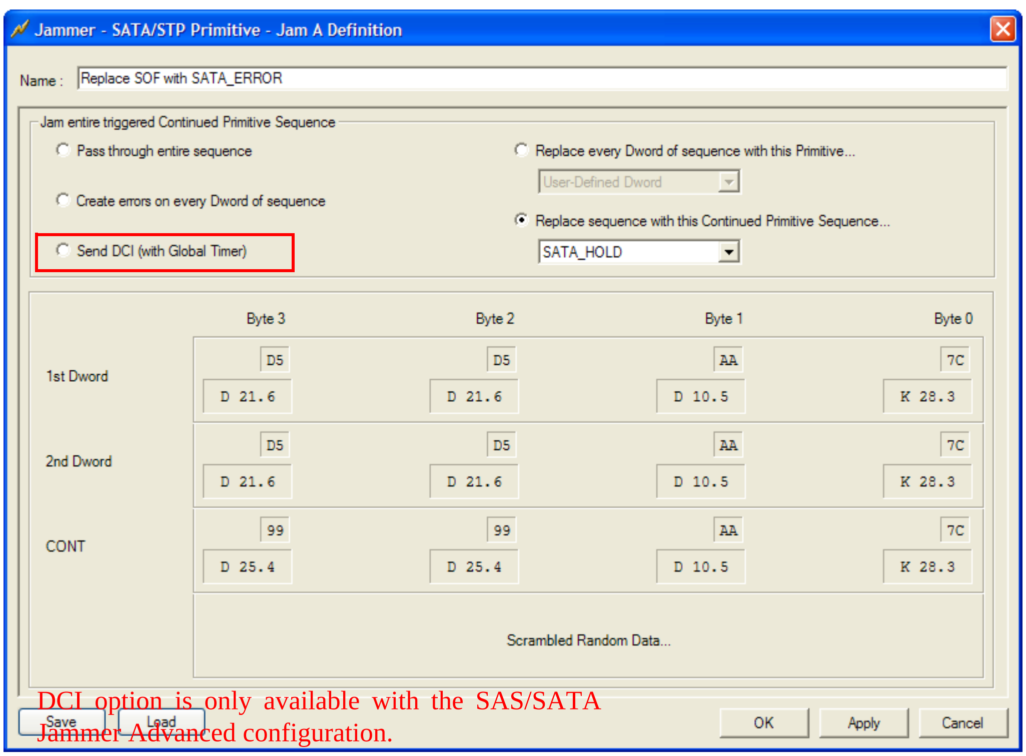
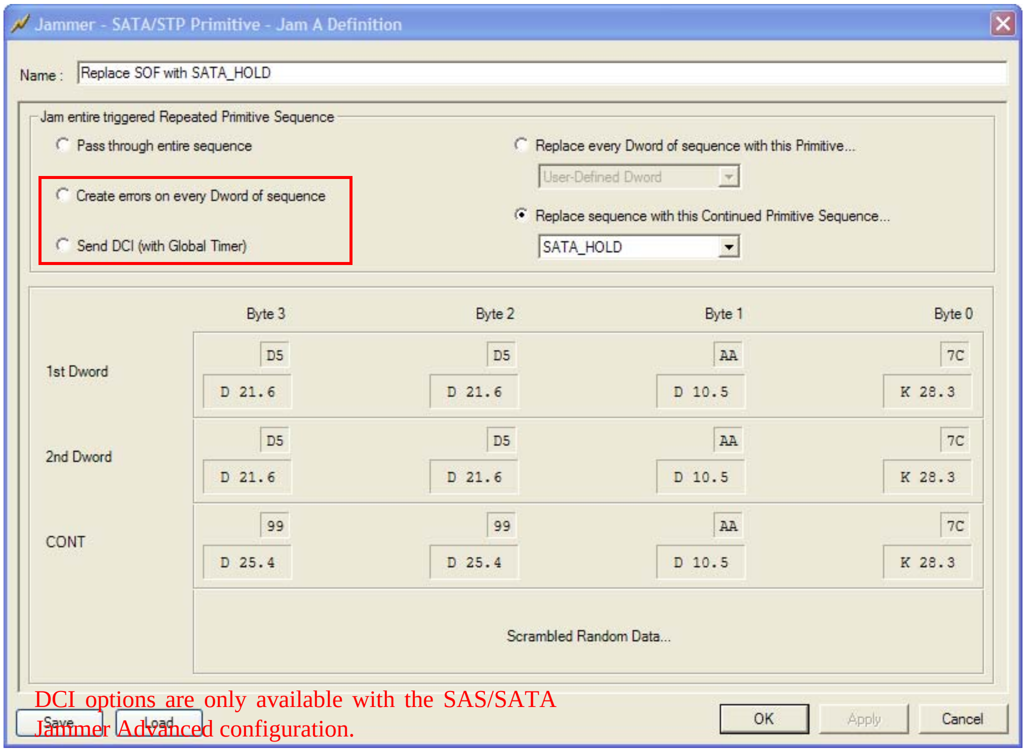


Figure 148: Repeated Primitive Sequence Jam Definition Window



Jamming a Single Primitive Sequence

For the Jam, you have three options:

- Pass through the Primitive
- Corrupt any byte(s) with an error
- Replace the Primitive with a new Dword
- Replace Dword with DCI
- Send DCI (with Global timer)

To pass through the Primitive, select the top option.

To create an error, select Create Error. Then check Inject Error for any byte(s) on which you want to send errors. Then choose Disparity Error or Code Violation. If you choose Disparity Error, the Jammer inverts the running disparity at that byte. If that byte is a neutral 10b character, you might not see the disparity error until a later byte. The Code Violation option replaces the byte with a predefined 10-bit illegal character.

You can replace the Dword with any K/D characters, any standard Primitive, or Scrambled Primitive Data, by selecting the bottom option and choosing from the drop-down list.

DCI options are available only in the Advanced SAS/SATA Jammer configurations. These allow you to replace a Dword with a DCI or to send DCI with the Global timer set in the Global tab.

Jamming a Continued or Repeated Primitive Sequence

Four options allow you to Jam the entire Primitive Sequence:

- Pass through entire sequence
- Create errors on every Dword of the sequence
- Replace every Dword of the sequence with a specific Dword
- Replace sequence with a Continued Primitive Sequence
- Send DCI (with Global timer)

Pass through and Create Errors work the same as Single Primitive Sequences.

You can replace every Dword of the sequence with another specific Dword by choosing **Replace every Dword of sequence with this Primitive...** You can replace the sequence with any K/D characters, any standard Primitives, or Scrambled Primitive Data by choosing from the drop-down menu. Choosing PMACK or PMNAK is equivalent to replacing with a Repeated Primitive Sequence.

You can replace the sequence with a standard Continued Primitive Sequence by choosing **Replace sequence with this Continued Primitive Sequence...** Choose from the drop-down menu.

DCI options are available only in the Advanced SAS/SATA Jammer configurations. These allow you to replace a Dword with a DCI or to send DCI with the Global timer set in the Global tab.

Chapter 6

Creating Jammer Test Configurations for 10GigE

In this chapter:

Defining Your Own Test Configurations for 10GigE

Xgig Jammer lets you define your own test configurations and save them with or without hardware available.

You can create a configuration from scratch, or you can open and edit an existing configuration. Also, you can edit a configuration in edit only mode, which is independent of any hardware, or you can edit a configuration that is currently loaded to a Jammer device.

To edit a configuration in edit only mode:

>> Double-click on a configuration file in the Configuration manager.

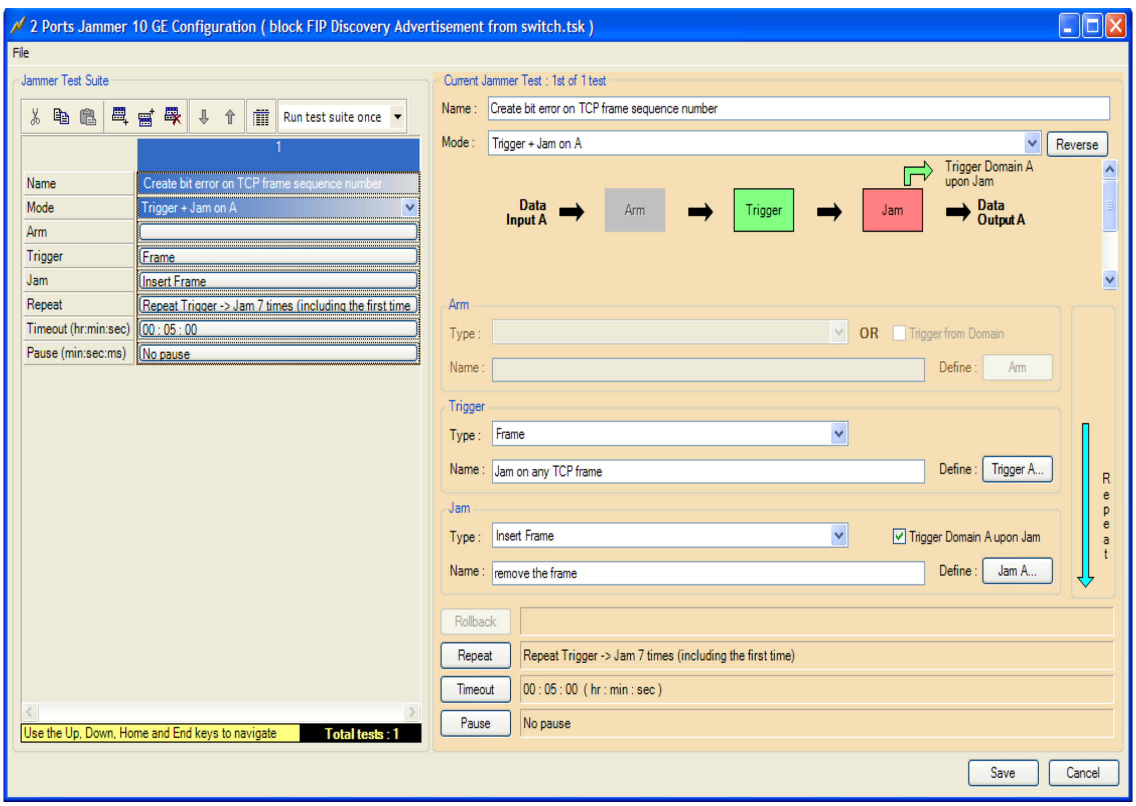
or:

>> Right-click on the configuration file in the Configuration manager and choose **Edit Jammer Configuration** from the context menu.

The edit only mode Jammer Configuration window opens (Figure 149).

This window allows you to set up your own Test Cases, name them, organize them, and save them to files so that you can use them again.

Figure 149: Edit Only Jammer Configuration Window



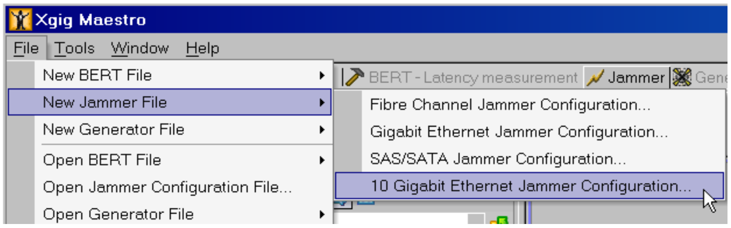
To start a configuration from scratch in edit only mode:

>> Select **New Jammer Configuration** from the context menu or the File menu (Figure 150) on the Xgig Maestro menu bar. Then, select **10 Gigabit Ethernet Jammer** from the drop down menu.

or:

>> Click the New Configuration icon at the top of the Configuration manager.

Figure 150: Maestro File Menu



To save your configuration in edit only mode:

>> Click **Save** at the bottom of the Jammer Configuration window or open the File menu on the Jammer Configuration window and select **Save Configuration** or **Save Configuration As**.

Any changes you make have no effect on actual Jammer devices you control.

To edit a configuration that is loaded to a Jammer port:

>> Click **Configuration...** in the device column.

or:

>> Right-click in the Parameters Status table in the device column to open the context menu and select **Edit configuration**.

or:

>> Click **Operation** in the device column to open the Operation dialog, then click **Config**.

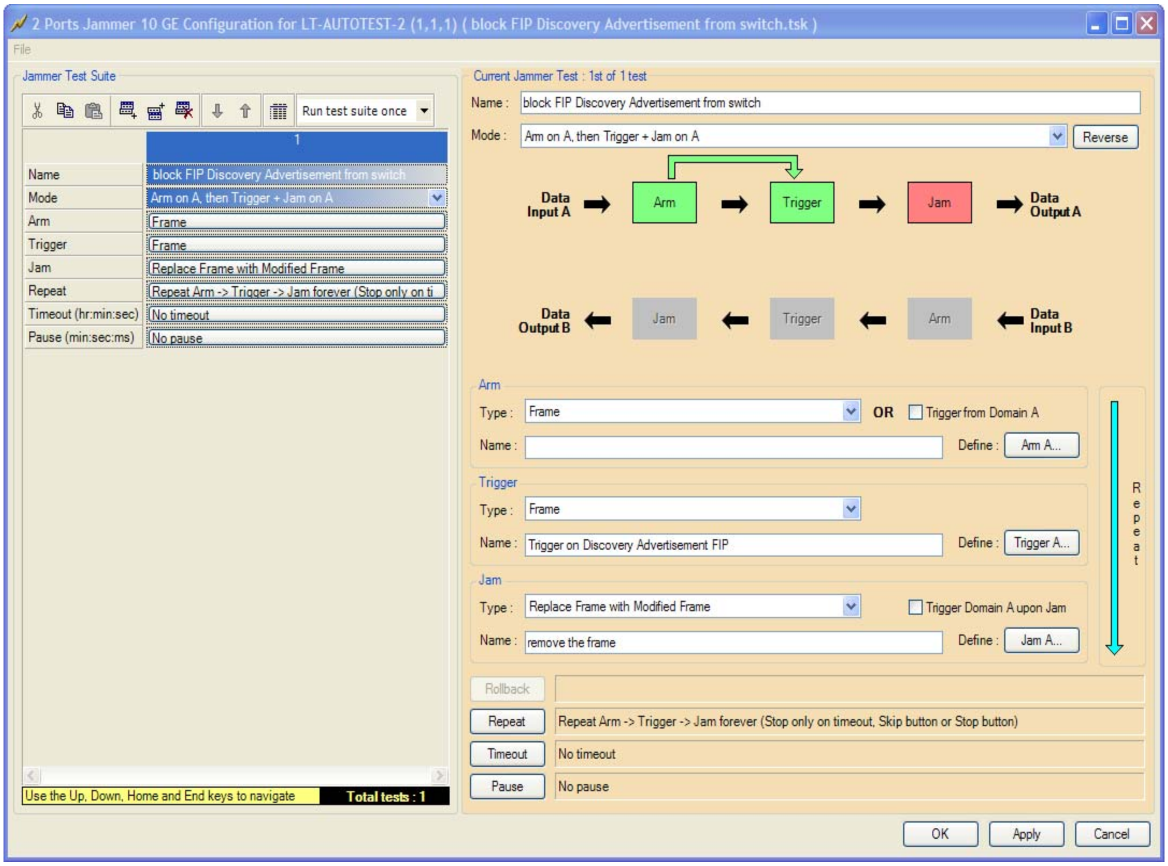
The Xgig Jammer Configuration window in hardware edit mode is displayed (Figure 151). This window allows you to set up your own Test Cases, name them, and save them to a file so that you can use them again.

Click **Apply** or **OK** and Jammer accepts the changes. They are immediately reflected in the Parameters Status table and affect the Jammer device the next time you run it.

To save your configuration edits:

>> Open the File menu at the top of the Jammer Configuration window and select **Save Configuration As...** or **Save Configuration**.

Figure 151: Xgig Jammer Configuration Window



Using the Jammer Configuration Window for 10GigE

The Jammer Configuration window title bar indicates how many ports it is configuring, the protocol, and the configuration file name, if any. If you are using hardware edit mode, the chassis name, chassis number, slot number, and port number are also listed. The elements of the Jammer Configuration window are described in the following sections.

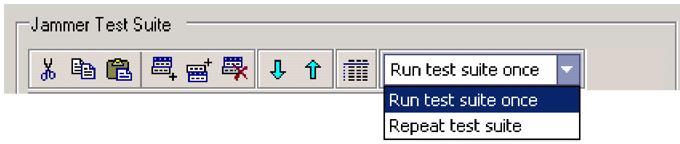
Using the Jammer Test Suite Tools for 10GigE

The Jammer Test Suite (left pane) lists the series of Xgig Jammer tests in the order in which you want them to execute. The suite includes one or more tests. The highlighted test appears as the Current Jammer Test (right pane). Each test in the suite executes in sequence with a test reset time of approximately 130 (200 max) milliseconds.

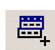
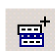
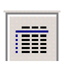
Creating a Test Suite

When you create a 10GigE Jammer Test Suite, you use the toolbar in the Jammer Test Suite section of the Configuration window (Figure 152).

Figure 152: 10GigE Jammer Test Suite Toolbar



The following list describes the icons on the toolbar:

	Cut current test	Removes the highlighted test and holds its contents in the memory buffer.
	Copy current text	Copies the highlighted test to the memory buffer.
	Paste last test cut or copied	Inserts the current memory buffer contents before the currently highlighted test.
	Add new test to bottom of stack	Adds a new blank test to the bottom of the suite.
	Insert new test before current test	Inserts a new blank test above the currently highlighted test.
	Delete current test	Removes the highlighted test from the suite. If only one test is present, then the contents of this test are cleared.
	Move current test down the stack	Moves the highlighted test down one in the test order.
	Move current test up the stack	Moves the highlighted test up one in the test order.
	Toggle view	Toggles Test Suite between Card View and List View.
	Run test suite once or Repeat test suite	When you choose Repeat test suite, the tests run according the settings you define in the Jammer Current Test window.

To duplicate a test at another point in the Test Suite:

1. Highlight the test you want to duplicate.
2. Click **Copy**.
3. Highlight the test in the suite that is just after the point where you want the duplicate test inserted.
4. Click **Paste**.

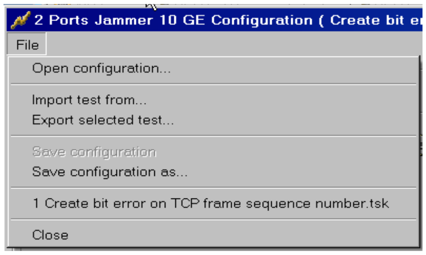
   The duplicate test is inserted.

   Refer to “Configuring the Arm Condition for 10GigE”, “Configuring the Trigger Condition for 10GigE” and “Configuring the Jam Definition for 10GigE” for information about configuring each test.

Using the Configuration File Menu

The File menu is the only menu on the menu bar (Figure 153).

Figure 153: Configuration File Menu



The choices are:

Open Configuration	Open an existing `.tsk` configuration file.
Import to Selected Test	Import a Test Case from a `.tst` file or an entire test suite, `.tsk` file, to the currently highlighted position. A Test Case is one line in the Jammer Test Suite.
Export Selected Test	Export and save the currently highlighted test to a `.tst` file.
Save Configuration	Save the entire Test Suite to the `.tsk` file you currently have loaded.
Save Configuration As	Save the entire Test Suite to a `.tsk` file with a name you assign to it.
Close	Close the Jammer Configuration Window.

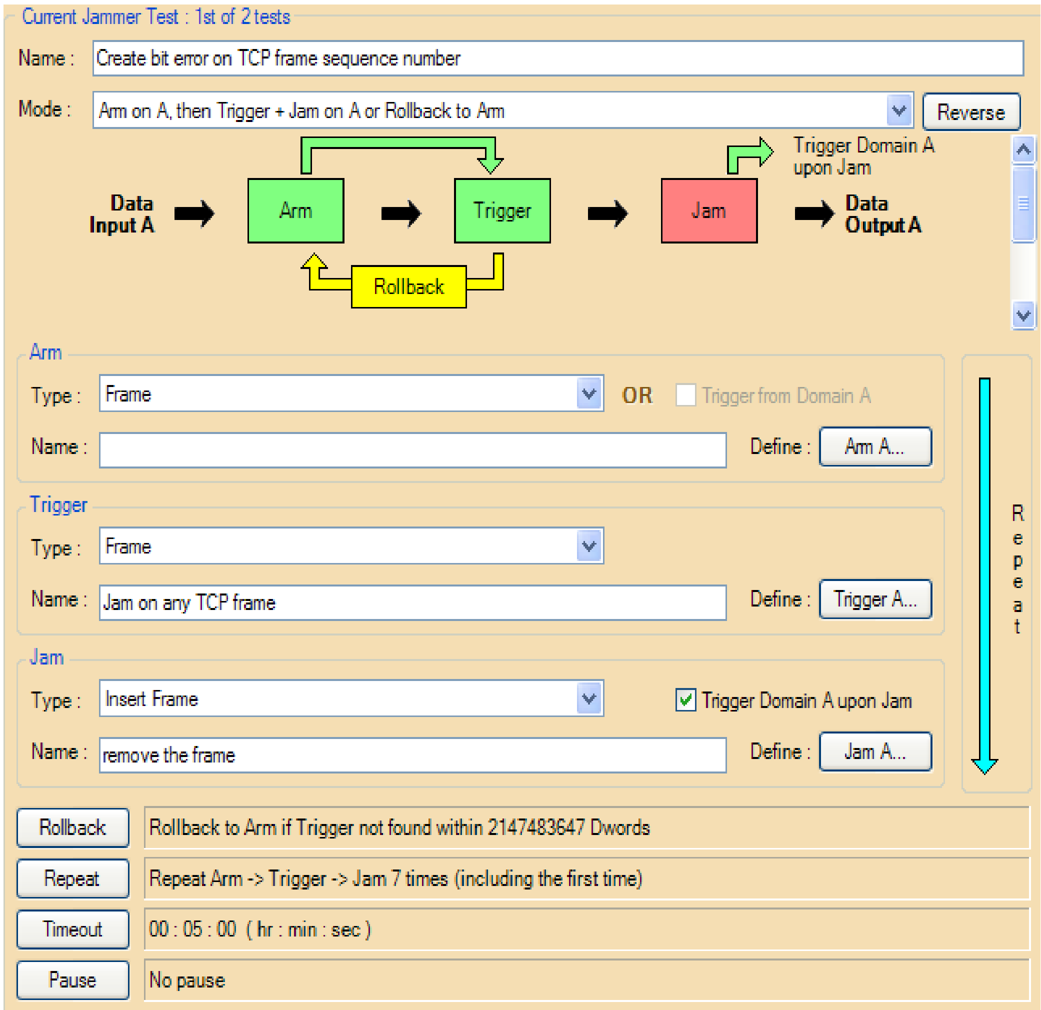
The recently used 10GigE Jammer configuration files appear in the file menu and are loaded when selected.

Note: The `.tst` files are only for storing individual Test Cases and swapping them between configuration files. You cannot load `.tst` files directly into a Jammer device on the Xgig Maestro window.

Using the Current Jammer Test Window for 10GigE

The graphics in this section of the window represent the hardware configuration for the selected test in the Jammer Test Suite (Figure 154).

Figure 154: Current Jammer Test Window



Mode

For 10GigE, Mode menus are available near the top of the Current Jammer Test window (Figure 155) and also near the top of each Test Case in the Jammer Test Suite window (Figure 156).

The input to path A (on top) is always port A and the input to path B (on the bottom) is always port B. The external trigger input and output that are available on path A always are linked to the domain shown on the Xgig Maestro window as "Domain of port A." The trigger input and output on the bottom on path B are in the "Domain of port B."

Figure 155: Mode Drop-down Menu in Current Jammer Test - Right Pane

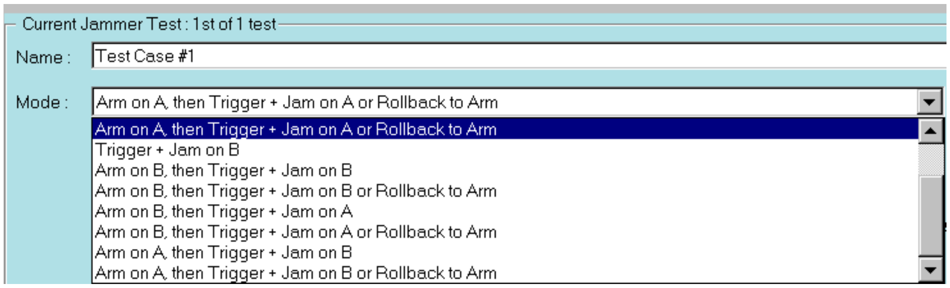
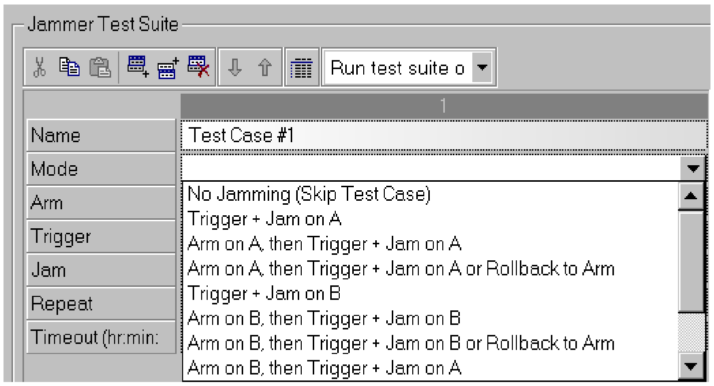


Figure 156: Mode Drop-down Menu in Test Suite - Left Pane



Reverse

You can reverse the direction of the jam by selecting the **Reverse** button.

Arm and Trigger

To define Arm and Trigger conditions, select a respective Type from each drop-down menu. Then click the Arm or Trigger button to open the corresponding definition window.

You can use an external input as an Arm condition. Check Trigger from Domain A (or B) to enable this feature. You must put the corresponding Jammer port into a domain for this to work properly.

The Trigger event can be in the next Dword after the Arm event in the traffic stream.

Jam

To define a Jam:

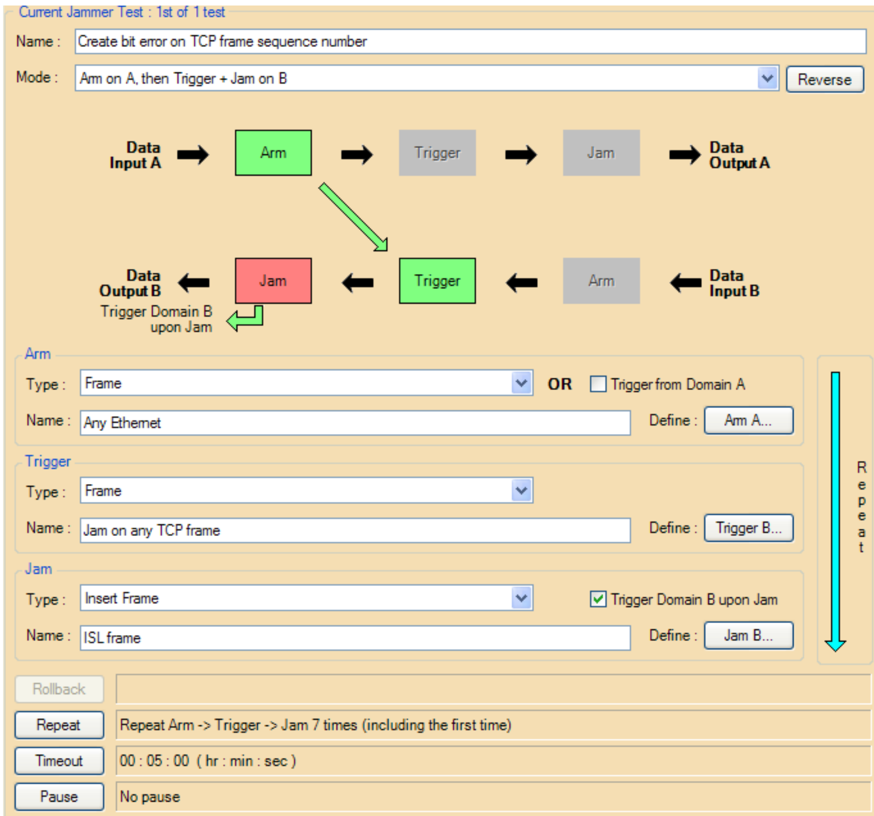
1. Select a Type from the drop-down menu, if available.
2. Click the Jam button to open the Jam Definition window.

   The Jam Definition specifies the modifications to be made to the traffic matching the Trigger Condition.

In addition, the Jammer port can trigger out to the Domain it is in when a Jam takes place. Check Trigger Domain A (or B) upon Jam to enable this feature.

Note: If you use an external trigger input to define the Arm condition, then you cannot select the external trigger output for that path in that Test Case, and vice versa. For information regarding using the trigger input and output during a Test Case, refer to "Using Domains and External Triggering" on page 291. However, you can use an external trigger in on port A with an external trigger out on port B, and vice versa. Figure 157 shows an example.

Figure 157: Trigger In and Trigger Out

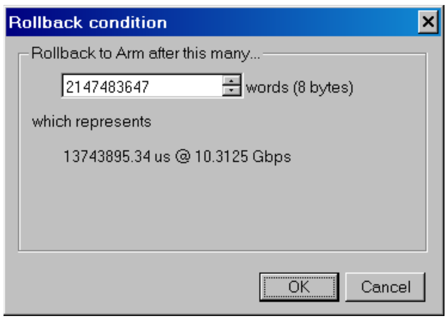


Rollback

The Rollback option defines the time or Dword count parameter between the Arm and Trigger events. If the Trigger does not follow the Arm event in the allotted time or Dword count, the Jammer begins looking for the Arm event again. Click **Rollback** to display the dialog shown in Figure 158.

Note: This value is saved in terms of Dwords, not time, so keep this in mind if you save a Test Case using a device running at 3.0 Gbps and later open the configuration on a Jammer running at 1.5 Gbps.

Figure 158: Rollback Condition Dialog



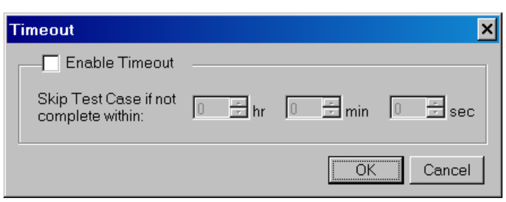
Timeout

The timeout option defines the period of time to wait for a specified test to complete before aborting and proceeding to the next test in the suite.

To set the timeout:

1. Click **Timeout** to display the dialog box in Figure 159.
2. Check **Enable Timeout**.
3. Enter the hours, minutes, and seconds you want to wait.

Figure 159: Timeout Dialog

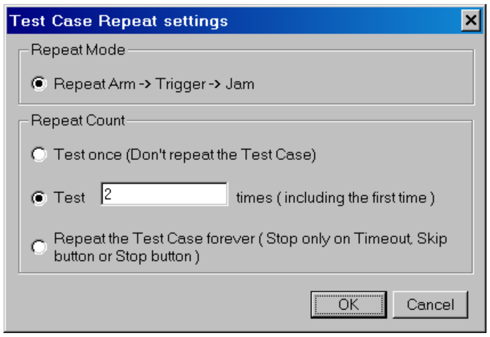


4. Click **OK**.

Repeat

Click **Repeat** to open the dialog shown in Figure 160. The Repeat Mode setting allows you to configure what is repeated when using an Arm condition. The first option means the Jammer will match the Arm condition once, then will repeat matching the Trigger condition as specified by the Repeat Count setting below. The second Repeat Mode option means that the Jammer must match the Arm condition each time before looking for a Trigger.

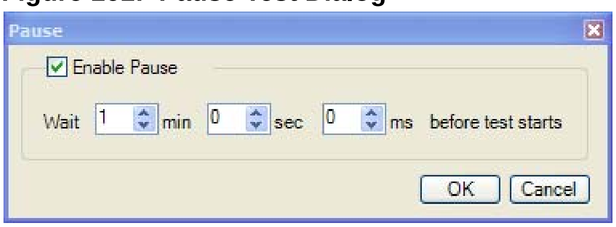
Figure 160: Repeat Test Dialog



Pause

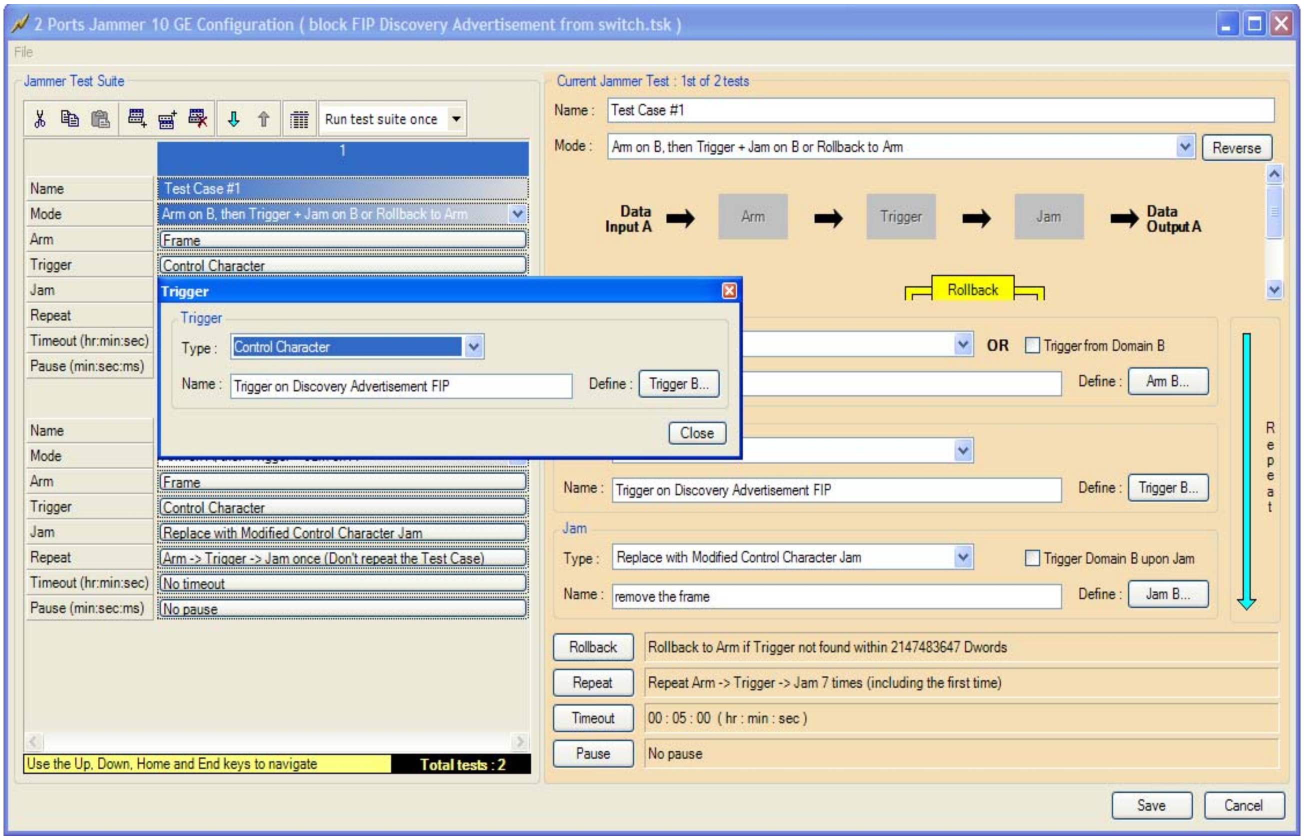
Click **Pause** to open the dialog shown in Figure 161. The Pause setting allows you to insert a pause before the beginning of a test case.

Figure 161: Pause Test Dialog



You can also configure options for each Test Case directly in the Test Suite, instead of clicking in the Current Jammer Test pane. Click on the area of the Test Case you want to modify to open the corresponding dialog (Figure 162).

Figure 162: Configuring Options Directly in the Test Suite



Configuring the Arm Condition for 10GigE

The 10GigE Arm condition recognizes specific ordered sets, control characters, or frames.

In 10GigE, you can select from the following:

- Frame - Allows you to specify the 10GigE header and up to 114 bytes of payload
- Ordered Set - Provides you with predefined ordered sets, or allows you to define a four byte ordered set
- Control Character - Allows you to choose from pre-defined control characters

You can save an arm or trigger condition as a `.jmt` file by clicking the **Save** button in the **Arm** or **Trigger** window. You can load a `.jmt` file by clicking the **Load** button in the **Arm** or **Trigger** window.

Depending on the Mode you select, the appropriate graphic diagram shows the Trigger and optional Arm conditions, along with the Jam event. If the Mode you select does not include an Arm condition, the **Arm** button is disabled.

To set Arm conditions:

1. Select Frame, Ordered Set, or Control Character from the **Type** drop-down menu in the Arm section of the Current Jammer Test window.
2. Click on the **Arm** button to open the Arm window.

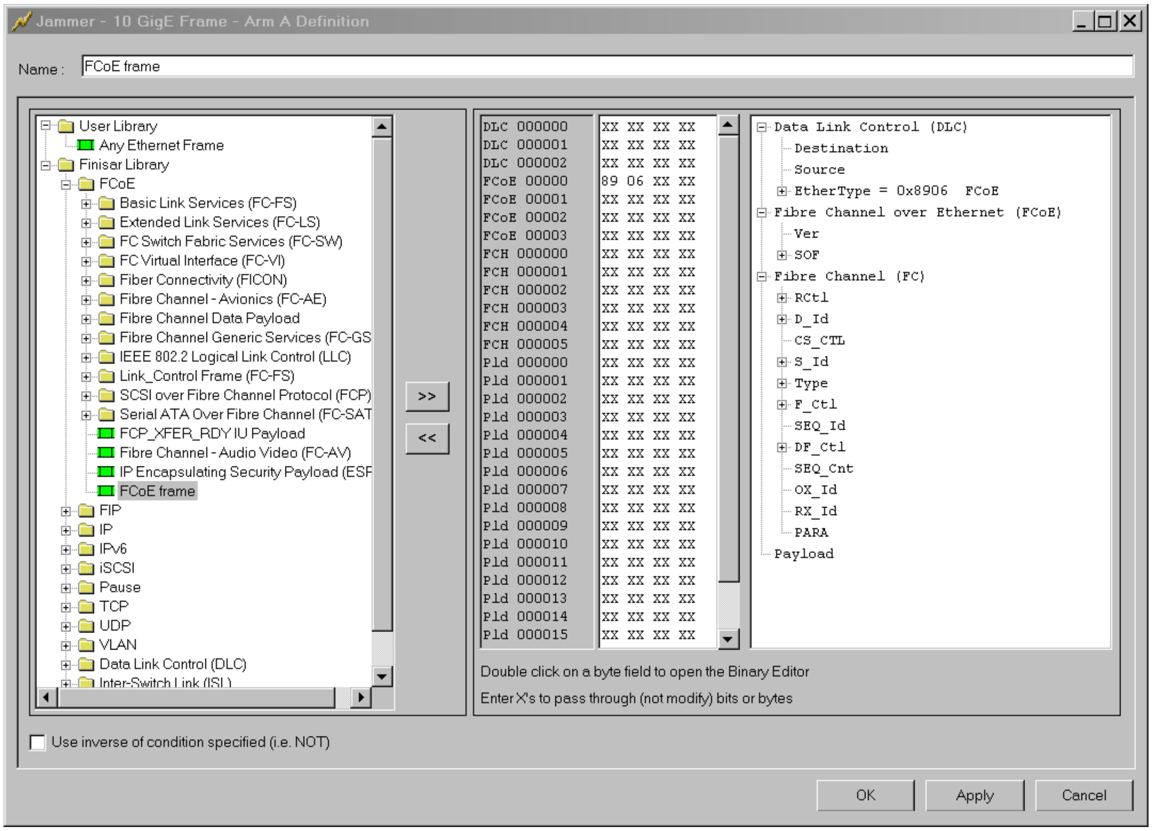
   The window for the condition is displayed (Figure 163). If you are in hardware edit mode, the protocol, chassis name, chassis number, slot number, and port numbers are displayed in the title bar.
3. Set the values as required to specify the Arm condition as part of a unique Arm and Trigger sequence for the specific test.

   The following sections describe the available values.

Setting Frame Conditions for 10GigE Arm

You can specify frame conditions in two ways. One way is to load a template from the Template Library tree, and the other way is to manually specify bits in the frame.

Figure 163: Gigabit Ethernet Arm Window for Frames



To use a template:

1 Select a template from the Template Library tree on the left.

2 Click the double right arrow button to set the Trigger Condition.

The condition is indicated on the right side of the window.

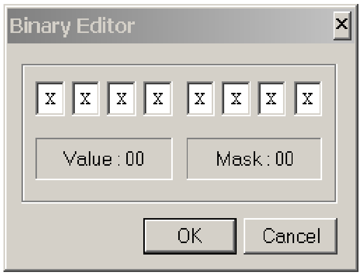
To manually specify a frame:

>> Type hexadecimal values directly into the center column of the window.

An X represents a nibble that can be any value (a “don’t care”).

To set individual bits in any field, double-click on the hex entry to open the Binary Editor (Figure 164). In the hex view, partially defined hex characters appear as question marks: `X001=?`

Figure 164: Binary Editor Dialog



Another way to manually edit the frame condition is to make selections from the tree view in the right window pane.

Saving a Frame Condition

If you create a frame condition that you want to save and make easily available for future use, you can save it into the “User Library” folder in the Template Library tree. To do this:

>> Highlight the folder and click the double left arrow button.

Frame conditions have the option of “Use inverse of condition specified (i.e., NOT).” When you check this option, it means that the first frame encountered that does not match what you have specified creates a “condition met” event.

For each frame condition, you can specify an optional name at the top of the window. This name is also shown on the Jammer Configuration window under the Mode selection, and on the main Xgig Maestro window.

Setting Ordered Set Conditions for 10GigE Arm

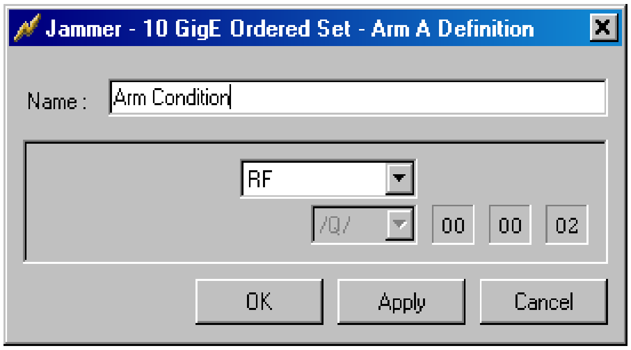
You can choose from a predefined Ordered Set (LF or RF) or choose user-defined (Figure 165). All choices are four bytes. You can select either /Q/ or /Fsig/ for the first byte of a user-defined ordered set. You can enter hex values for the remaining three bytes.

To edit the values:

>> Enter a hex value, or double-click the byte field to open the Binary Editor.

As in frame conditions, an X indicates “don’t care” and a ? indicates a partially specified hex character.

Figure 165: 10GigE Arm Window-Ordered Sets

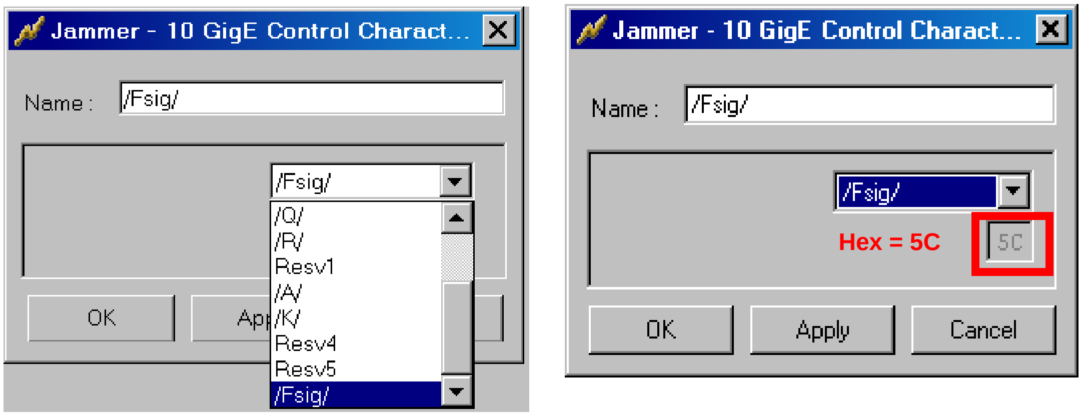


As with frame conditions, you can specify an optional name at the top of the window. This name is also shown in the Jammer Configuration window under the Mode selection and on the main Xgig Maestro window.

Setting Control Character Conditions for 10GigE Arm

You can choose from any standard one byte Control Character (Figure 166). The field below the drop-down menu shows the hex value of the Control Character selected.

Figure 166: 10GigE Arm Window Control Characters



Configuring the Trigger Condition for 10GigE

The 10GigE Trigger condition recognizes specific ordered sets, control characters, frames, SOP, and SOP.

In 10GigE, you can select a trigger from the following options:

- Frame - Allows you to specify the 10GigE header and up to 114 bytes of payload
- Ordered Set - Provides you with predefined ordered sets, or allows you to define a four byte ordered set
- Control Character - Allows you to choose from pre-defined control characters
- SOP - Allows you to trigger at the SOP
- EOP - Allows you to trigger at EOP

Depending on the Mode you select in the **Jammer Configuration** window, the appropriate graphic diagram shows the Trigger and optional Arm conditions, along with the Jam event. If the Mode you select does not include an Arm condition, the Arm button remains disabled.

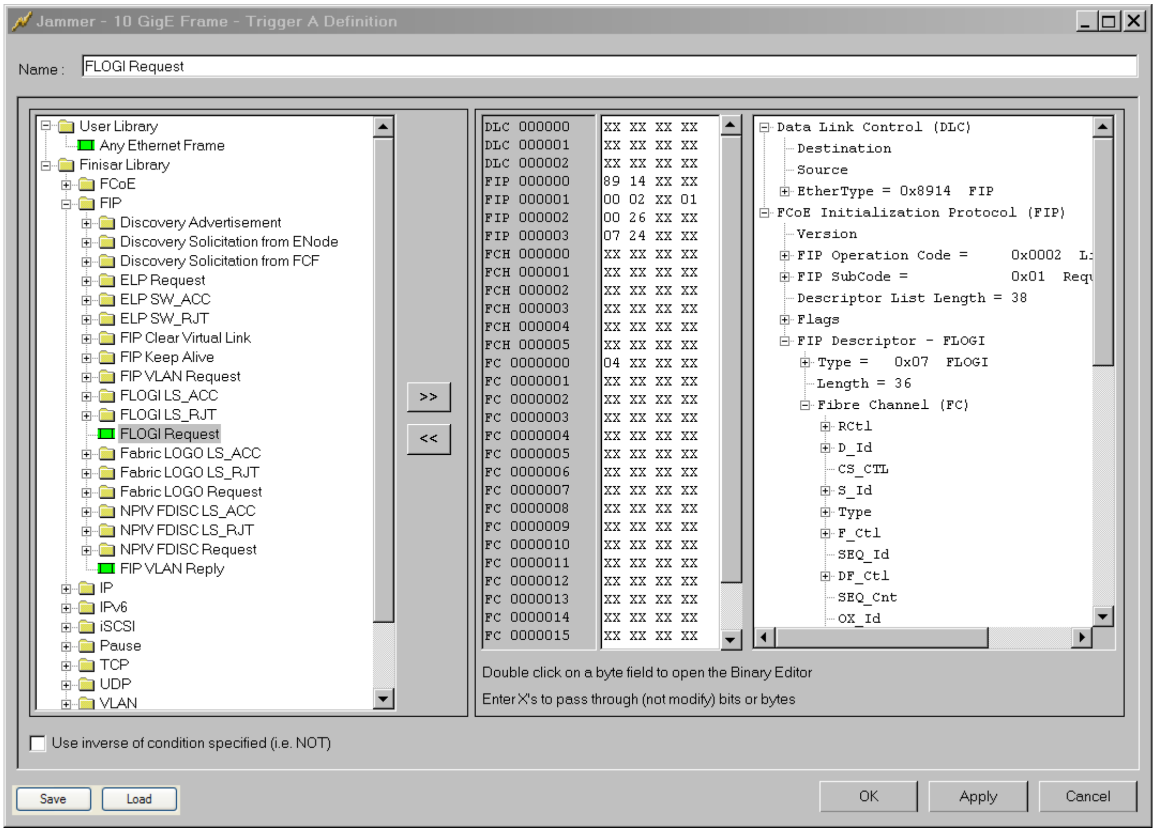
To set Trigger conditions:

1. Open the Type drop-down in the Trigger Condition window, and select Frame, Ordered Set, Control Character, SOP, or EOP.
2. Click the **Trigger** button in the Xgig Jammer Configuration window.

   The window for the condition is displayed (Figure 167). If you are in hardware edit mode, the protocol, chassis name, chassis number, slot number, and port numbers are displayed in the title bar.
3. Set the values as required to specify the Trigger condition as part of a unique Arm and Trigger sequence for the specific test.

   The following sections describe the available values.

Figure 167: 10GigE Trigger Window for Frames



Setting Frame Conditions for a 10GigE Trigger

You can specify frame conditions in two ways. One way is to load a template from the Template Library tree, and the other way is to manually specify bits in the frame.

To use a template:

1 Select a template from the Template Library tree on the left.

2 Click the double right arrow button to set the Trigger Condition.

The condition is indicated on the right side of the window.

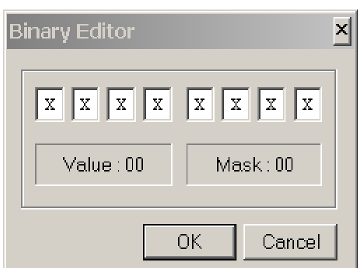
To manually specify a frame:

>> Type hexadecimal values directly into the center column of the window.

An X represents a nibble that can be any value (a “don’t care”).

To set individual bits in any field, double-click on the hex entry to open the Binary Editor (Figure 168). In the hex view, partially defined hex characters appear as question marks: `X001=?`

Figure 168: Binary Editor Dialog

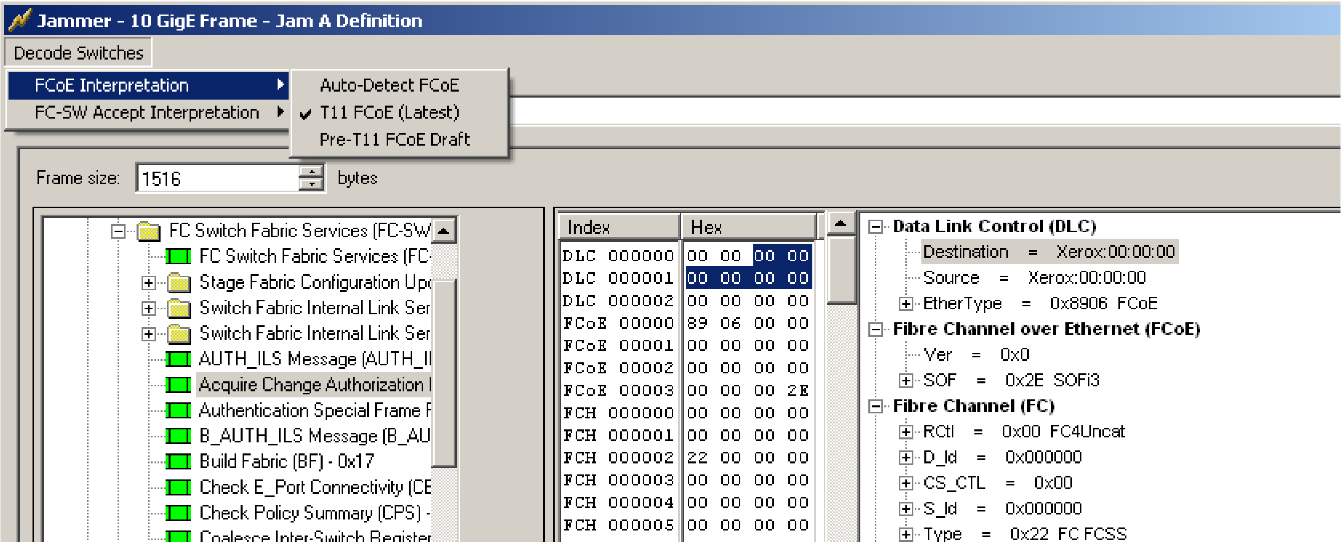


Another way to manually edit the frame condition is to make selections from the tree view in the right window pane.

Decode Switches Menu

Some templates allow you to specify decode switches (Figure 169. When you load a template that has this option, the **Decode Switches Menu** appears in the upper left corner of the window. The decode switches provide detailed contextual options for decode; for example, further decode of response and data frames. The Decode Switches menu is context sensitive and will only show the decode options available for the specific template you are creating.

Figure 169: Decode Switches Menu



Note: Once the **Decode Switches** menu appears, it remains visible. However, if you load a template that has no decode options, the menu is greyed out and inactive.

The **Decode Switches** menu is intended to help you create a user-defined template. When editing a User Library template, Decode Switches are stored inside the template so they are still ON the next time you open this particular template.

Decode switches allow you to further decode Response and Data frames that can't be decoded without knowing what the associated command frame is. Below is a description of the switches available for Jammer's Trigger and Insert Frame conditions:

FCoE Interpretations

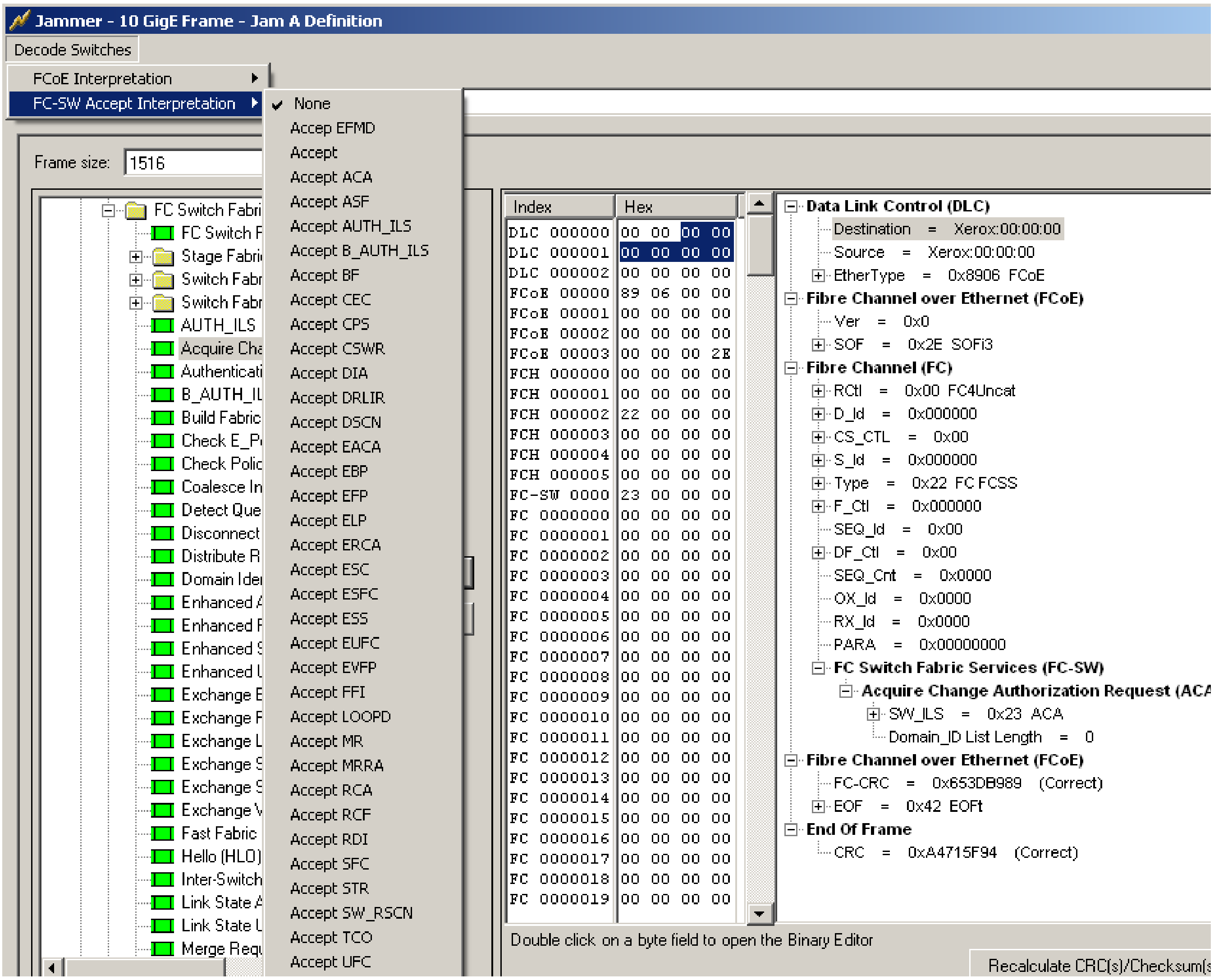
This menu is available for FCoE frames. Fibre Channel over Ethernet (FCoE) is the proposed mapping of Fibre Channel over selected full duplex IEEE 802.3 networks. The **Auto-Detect FCoE** setting automatically detects the version and is the default decode switch. The auto-detect mode works on a per-FCoE frame basis. It assumes that the FCoE frame reserved bits are set to zero and detects which FCoE specification is in use depending on where the zeroes are. If you end up with multiple errors and erroneous decoding of the FCoE frames, it is because the auto-detect mode assumptions do not work with your particular trace. This requires that select manually which FCoE specification to use. Available settings are:

- **Auto-Detect FCoE**
  Automatically detects the specification version by looking at the frame header.
- **T11 FCoE (Latest)**
  Selects the latest draft of the T11 standards committee specification as of this Xgig Analyzer release date.
- **Pre-T11 FCoE Draft**
  Selects the pre-T11 standards committee draft, 07-303v0.pdf.\

FC-SW Accept Interpretation

This menu item is available for FC-SW (Fibre Channel Switch Fabric Internal Link Service) Accept frames. It contains a list of the possible Switch Link Service Accept frame formats.

Figure 170: Decode Switch Options for FC-SW Accept Interpretation



Saving a Frame Condition

If you create a frame condition that you want to save and make easily available for future use, you can save it into the "User Library" folder in the Template Library tree. To do this:

>> Highlight the folder and click the double left arrow button.

Frame conditions have the option of "Use inverse of condition specified (i.e., NOT)." When you check this option, it means that the first frame encountered that does not match what you have specified creates a "condition met" event.

For each frame condition, you can specify an optional name at the top of the window. This name is also shown on the Jammer Configuration window under the Mode selection, and on the main Xgig Maestro window.

Setting Ordered Set Conditions for a 10GigE Trigger

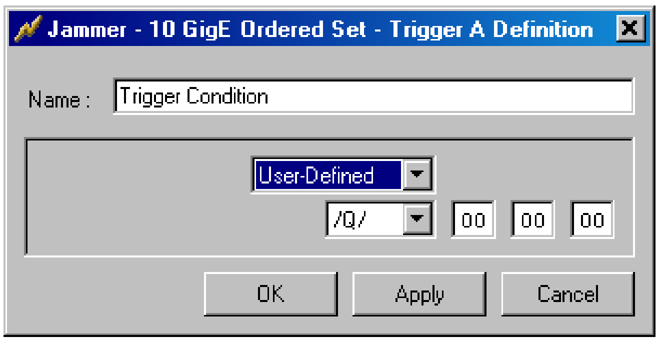
You can choose from a predefined Ordered Set (LF or RF) or choose user-defined (Figure 171). All choices are four bytes. You can select either /Q/ or /Fsig/ for the first byte of a user-defined ordered set. You can enter hex values for the remaining three bytes.

To edit the values:

>> Enter a hex value, or double-click the byte field to open the Binary Editor.

As in frame conditions, an X indicates "don't care" and a ? indicates a partially specified hex character.

Figure 171: 10GigE Trigger Window-Ordered Sets

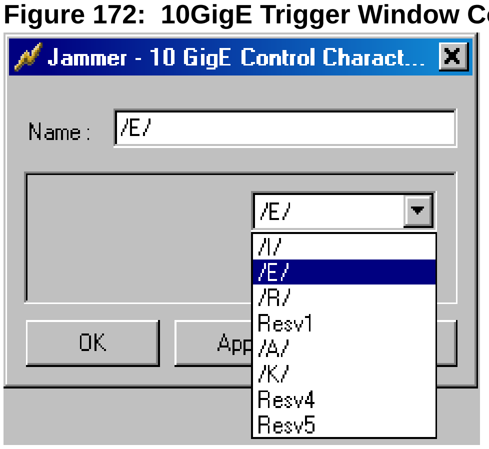


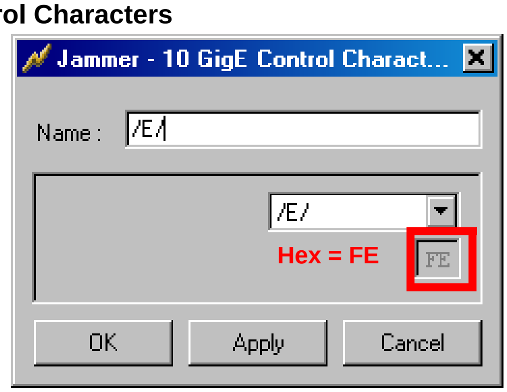
As with frame conditions, you can specify an optional name at the top of the window. This name is also shown in the Jammer Configuration window under the Mode selection and on the main Xgig Maestro window.

Setting Control Character Conditions for a 10GigE Trigger

You can choose from any standard one byte Control Character (Figure 172). The field below the drop-down menu shows the hex value of the Control Character selected.

Figure 172: 10GigE Trigger Window Control Characters

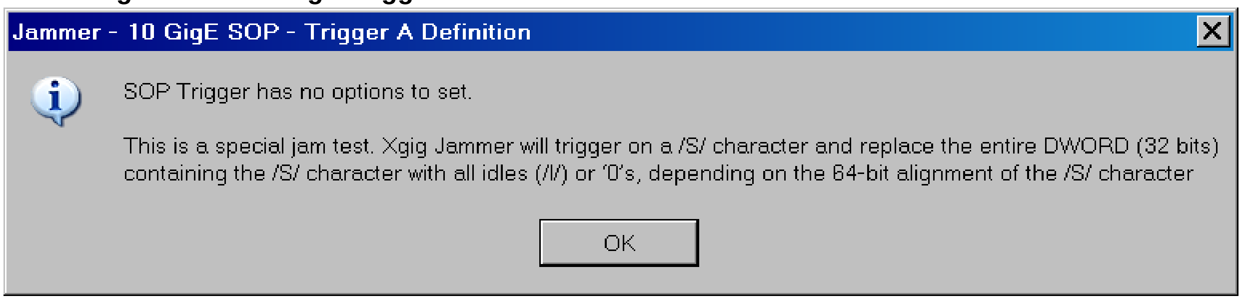




Setting SOP Trigger for 10GigE

The SOP Trigger has no options to set. When you set the test to trigger at the start of the packet (SOP), the following window appears, which states that for this type of jam test, the Jammer will trigger on an /S/ character, and the entire DWORD (32 bits) will be replaced with (/I/)s or “0”s depending on the 64 bit alignment of the /S/ character.

Figure 173: 10GigE Trigger SOP

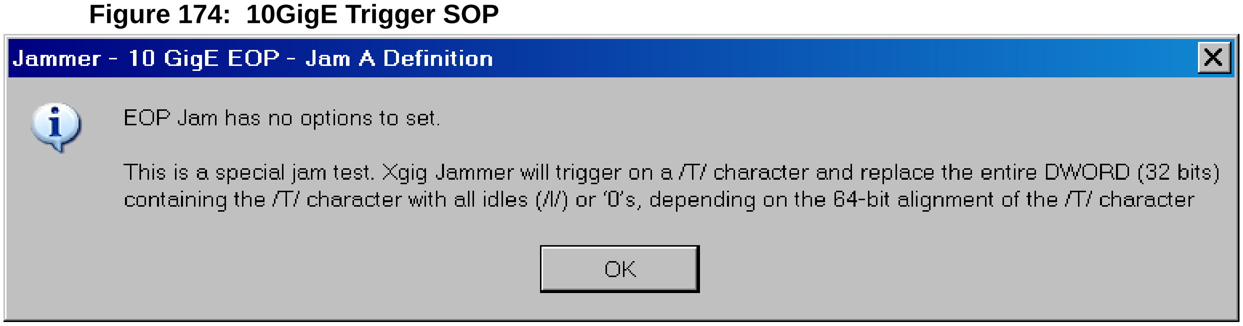


Note: When you select SOP as the trigger, the only jam type available is SOP. The jam window contain a message similar to the one above.

Setting EOP Trigger for 10GigE

The EOP Trigger has no options to set. When you set the test to trigger at the end of the packet (EOP), the following window appears, which states that for this type of jam test, the Jammer will trigger on an /T/ character, and the entire DWORD (32 bits) will be replaced with (/I/)s or “0”s depending on the 64 bit alignment of the /T/ character.

Figure 174: 10GigE Trigger SOP



Note: When you select EOP as the trigger, the only jam type available is EOP. The jam window contain a message similar to the one above.

Configuring the Jam Definition for 10GigE

The **Jam Definition** window defines how to modify the event specified on the **Trigger Condition** window.

The type of Jam available depends on the type of Trigger selected. In the case of SOP and EOP, the Jam is always the same type as the trigger.

For any Jam Definition, you can specify an optional name at the top of the window. This name is also displayed on the Jammer Configuration window under Mode selection and on the main Xgig Maestro window.

You can save a Jam definition as a `.jmj` file by clicking the **Save** button in the **Jam** window. You can load a `.jmj` file by clicking the **Load** button in the **Jam** window.

Jamming an Ordered Set for 10GigE

If the Trigger Event is an Ordered Set, click the **Jam** button on the Xgig Jammer Configuration window, to open the Ordered Set Jam Definition window (Figure 175).

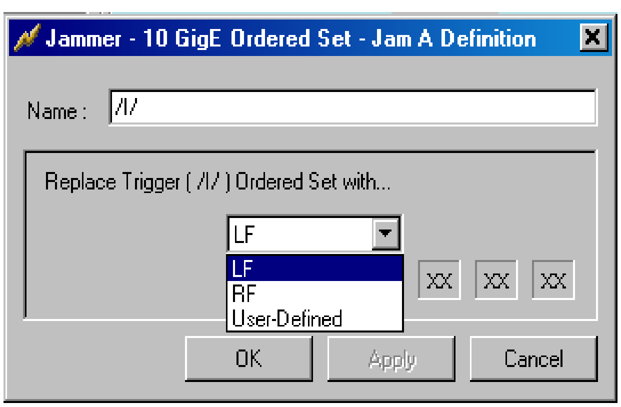
The Ordered Set Jam Definition window allows you to modify any Ordered Set by replacing it with a different Ordered Set. You can choose from a predefined Ordered Set (LF or RF) or choose user-defined (Figure 175). All choices are four bytes. You can select either /Q/ or /Fsig/ for the first byte of a user-defined ordered set. Then, you can enter hex values for the remaining three bytes.

To edit the values:

>> Enter a hex value, or double-click the byte field to open the Binary Editor.

As in frame conditions, an X indicates "don't care" and a ? indicates a partially specified hex character.

Figure 175: 10GigE Ordered Set Jam Definition Window

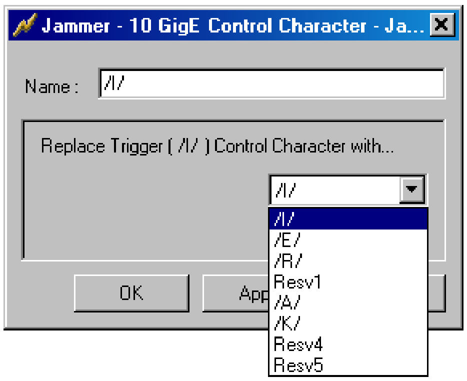


Jamming a Control Character for 10GigE

If the Trigger Event is a Control Character, click the **Jam** button on the Xgig Jammer Configuration window, to open the Control Character Jam Definition window (Figure 176).

The Control Character Jam Definition window allows you to modify any Control Character by replacing it with a different Control Character.

Figure 176: 10GigE Ordered Set Jam Definition Window



Jamming a Frame for 10GigE

To define a Jam for a frame:

1 Select a Jam from the **Jam Type** drop-down menu.

2 Click the **Jam** button to configure the jam.

This section explains the available Jam Types.

— Replace Frame with Modified Frame

— Replace Frame with Truncated Frame

— Replace Frame with Idles

— Insert Frame

— Duplicate Frame

— Insert Dword

Replace Frame with Modified Frame

Each tab of the Modified Frame window contains options relevant to different frame modifications.

— Global

— Delimiters/CRC

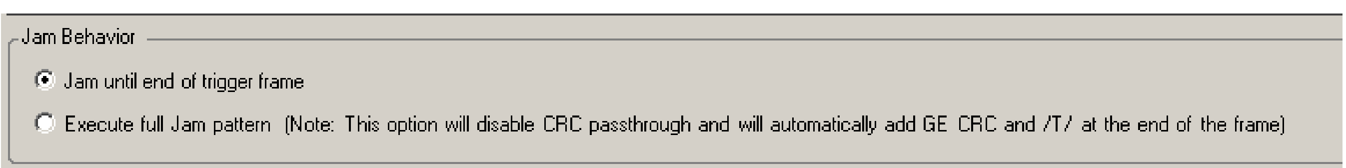
— Header/Payload

— Embedded Protocol(s)

Jam Behavior (All Tabs)

The **Jam Behavior** pane in located at the bottom of each tab in the **Frame Jam Definition** window. The Jam behavior settings control the number of user-defined header/payload Jams performed relative to the target trigger frame.

Figure 177: Jam Behavior Selection



- **Jam until end of trigger frame**

  Jams defined in the Header/Payload tab are performed until the end of the target trigger frame (or until an abnormal termination of the frame). All Jams defined that would take place on the original CRC or later are ignored. However, if the frame that is triggered on has more Dwords than the Jams you specify, the remaining Dwords are passed through. The CRC and EOF of the original target trigger frame are always jammed according to the CRC and EOF settings on the SOF/CRC/EOF tab. This is the standard way to Jam a frame.

- **Execute full Jam pattern**

  All header and payload Jams are executed even if they overwrite beyond the end of the target trigger frame.

  If the target trigger frame is longer than the number of Jams defined, then the portion of the target trigger frame that extends after the last defined Jam is overwritten with /I/. If the target trigger frame is shorter, then the Jammer switches back to pass-through immediately after the last defined Jam. Use the control on the Header/Payload tab at the bottom of the List View pane to define how many payload Jams should take place.

  The Execute full Jam option is supported only when any template from the FCoE library is loaded into the Header/Payload edit area.

  The following **Delimiter** options are supported:

  - FCoE SOF modification
  - FCoE EOF modification (always enabled)
  - FCoE embedded CRC recalculate / replace
  - GigE CRC recalculate/ replace

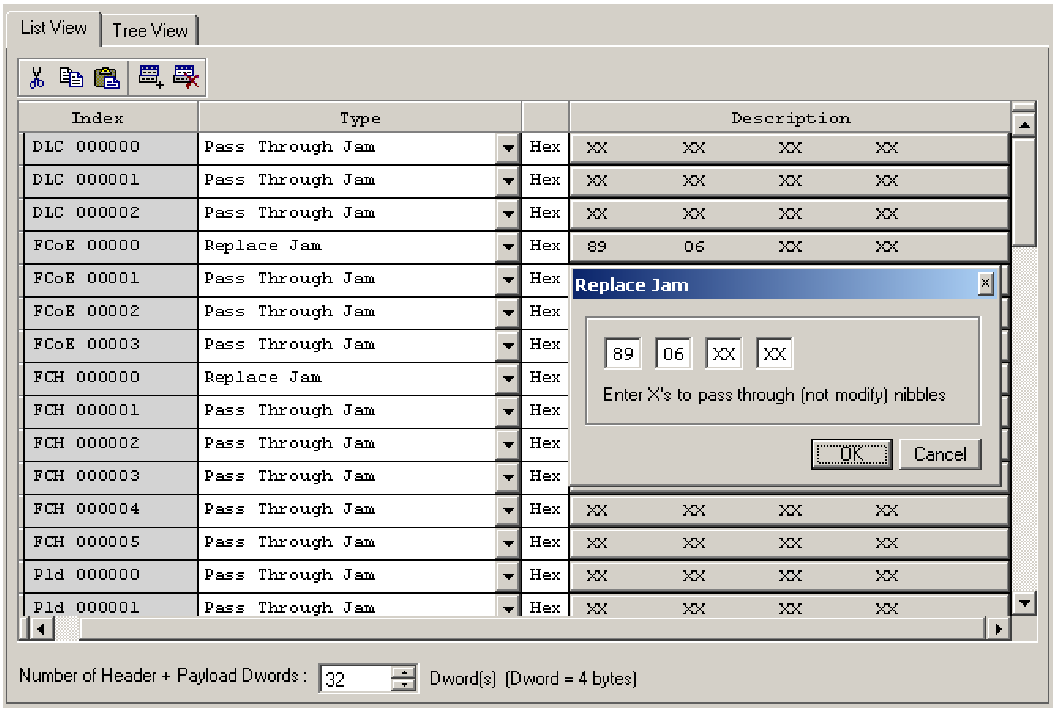
    The GigE CRC is recalculated or replaced based on the user input and appended automatically at the end of the payload.

Note: For correct FCoE recalculation, any number of Header + payload words can be specified as long as the minimum embedded FCoE frame payload size is 2 Dwords.

Non-FCoE Frames

Non-FCoE frames can also be supported by using the **Replace Jam Editor** to change the ether type byte field in the payload area, but you must specify the payload size as a multiple of Dword.

Figure 178: Replace Frame Editor



Important: Currently, when Jamming with modified frame, the delimiter modification may not occur consistently when jamming from a protocol-specific frame to a non-protocol frame and vice-versa. However, the CRC recalculation always occurs.

— For Trigger FCoE -> Jam to Non-FCoE frame, FCoE delimiter modification is applied and overrides the specified field in the Header Payload area. FCoE CRC modification is not applied.

— For Trigger Non-FCoE frame -> Jam to FCoE frame, FCoE delimiter modification is not applied. However, valid FCoE delimiter value can be entered on the Header/Payload tab. FCoE CRC modification is applied.

Using the Global Tab

Use this tab (Figure 179) to define Jam parameters that apply globally to the frame.

Global Replace Jam Option

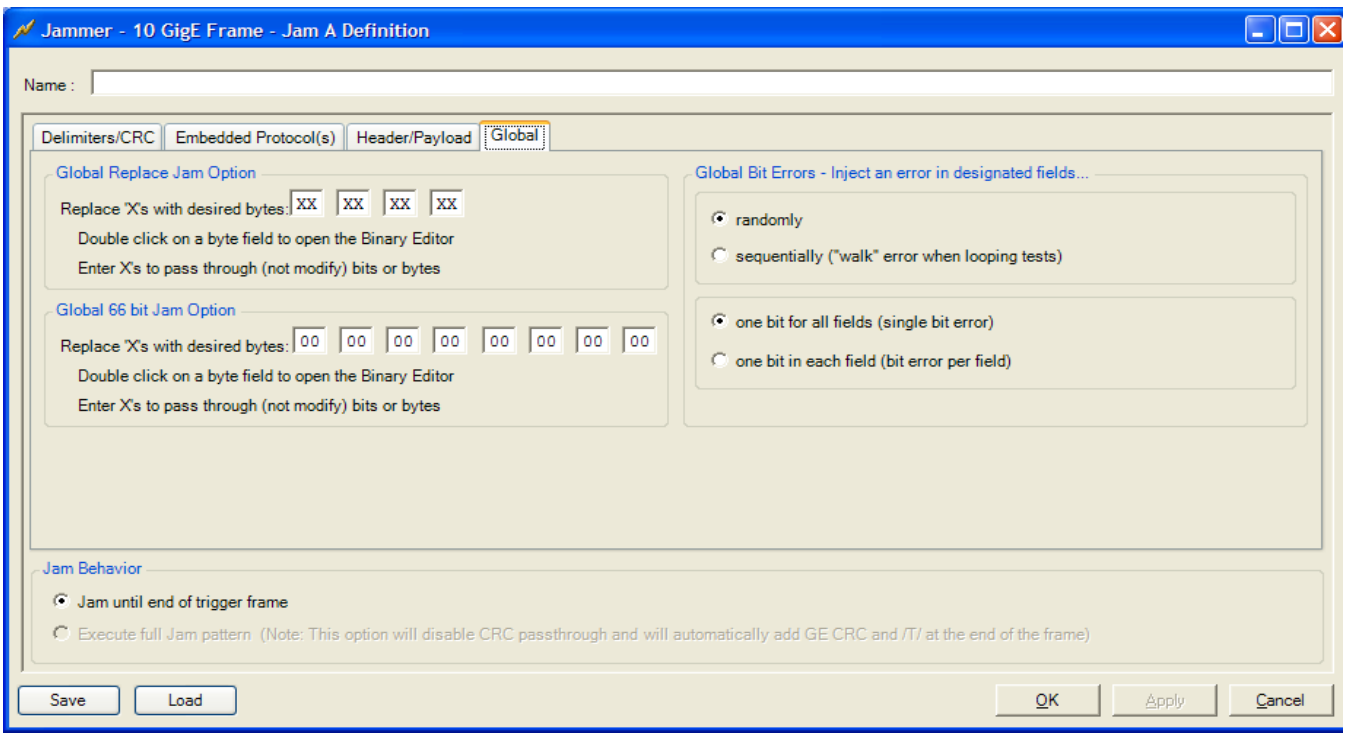
Use the Global Replace Jam Option word to set specific bits on an 8 bit level in a word to 1 or 0 while passing through the remaining bits. You can apply this replace jam option to any word in the frame. Define one Global Replace Jam Option for each Test Case.

To edit these bits:

>> Enter hex values, or double-click on a byte field to open the Binary Editor.

Any bits left as Xs are passed through.

Figure 179: 10GigE Global Tab



Global 66b Jam Option

Use the Global 66b Jam Option word to set specific bits at the 64 bit level in a word to either 1 or 0 while passing through the remaining bits. You can apply this 66b jam option to any word in the frame. Define one Global 66b Jam Option for each Test Case.

To edit these bits:

>> Enter hex values, or double-click on a byte field to open the Binary Editor.

Any bits left as Xs are passed through.

Global Bit Errors

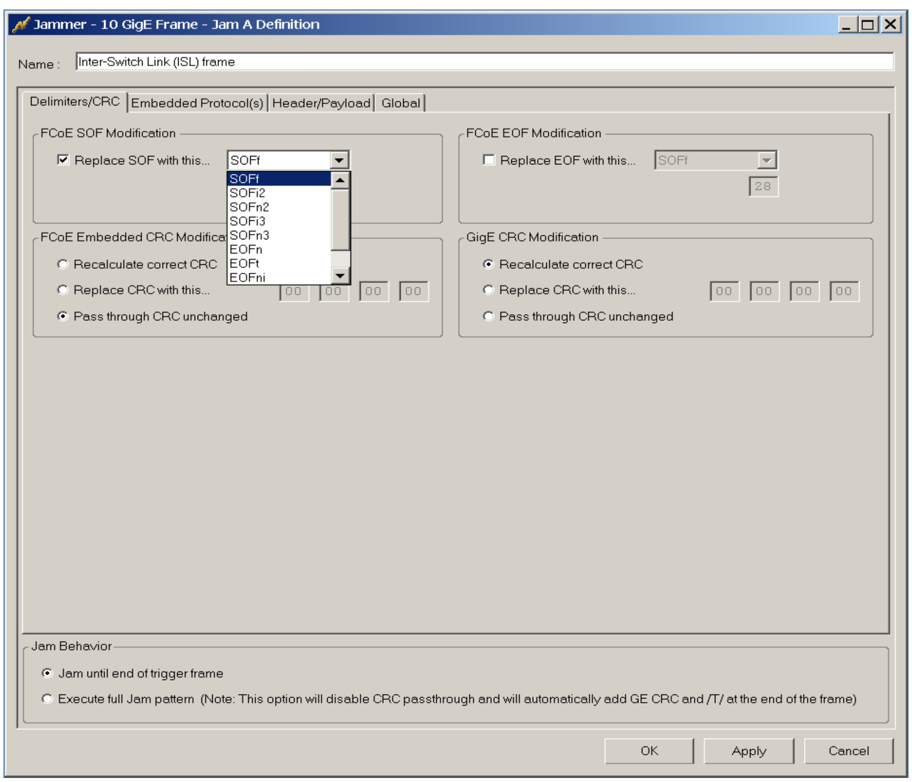
The Jammer software can introduce bit errors repeatedly in sequential or random fashion to predefined fields. These bit errors are introduced to the 32-bit form of the target words (not the 40-bit form) so code violations are not created. The Global Bit Errors control allows you four options.

- Select **one bit for all fields** and **randomly**. This causes the Jammer to inject a single bit error in the group of all fields selected in the header or payload for a single Test Case. If the Jammer Test Suite is set to *loop*, then single bit errors are randomly injected into these fields, with one bit for each cycle of the Test Suite.
- Select **one bit for all fields** and **sequentially**. This also injects a single bit error in the group of all fields selected in the header or payload. If the Test Suite is set to loop forever, the bit error walks through all the selected fields.
- Select **one bit in each field** and **randomly** does the same thing as the first option; however, there will be one error for each word selected in the payload or header.
- Select **one bit in each field** and **sequentially** does the same thing as the second option; however, there will be one error for each word selected in the payload or header.

Using the Delimiters/CRC Tab for Gigabit Ethernet

Use the choices on this tab to modify the FCoE Start of Frame (SOF), FCoE Embedded CRC Modification, FCoE End of Frame (EOF), and GigE Carrier Modification of the original frame (Figure 180).

Figure 180: 10GigE Delimiters/CRC Tab



Modifying SOF/EOF

To modify these special characters in the target trigger frame:

1 Check the appropriate box to select replacement.

2 Open the drop-down menu and choose a standard 10GigE Ordered Set, or select User-defined.

If you choose User-defined, you can specify any value.

To edit the value enter a hex value into the byte field or double-click to display the Binary Editor.

FCoE Embedded CRC/10GigE CRC Options

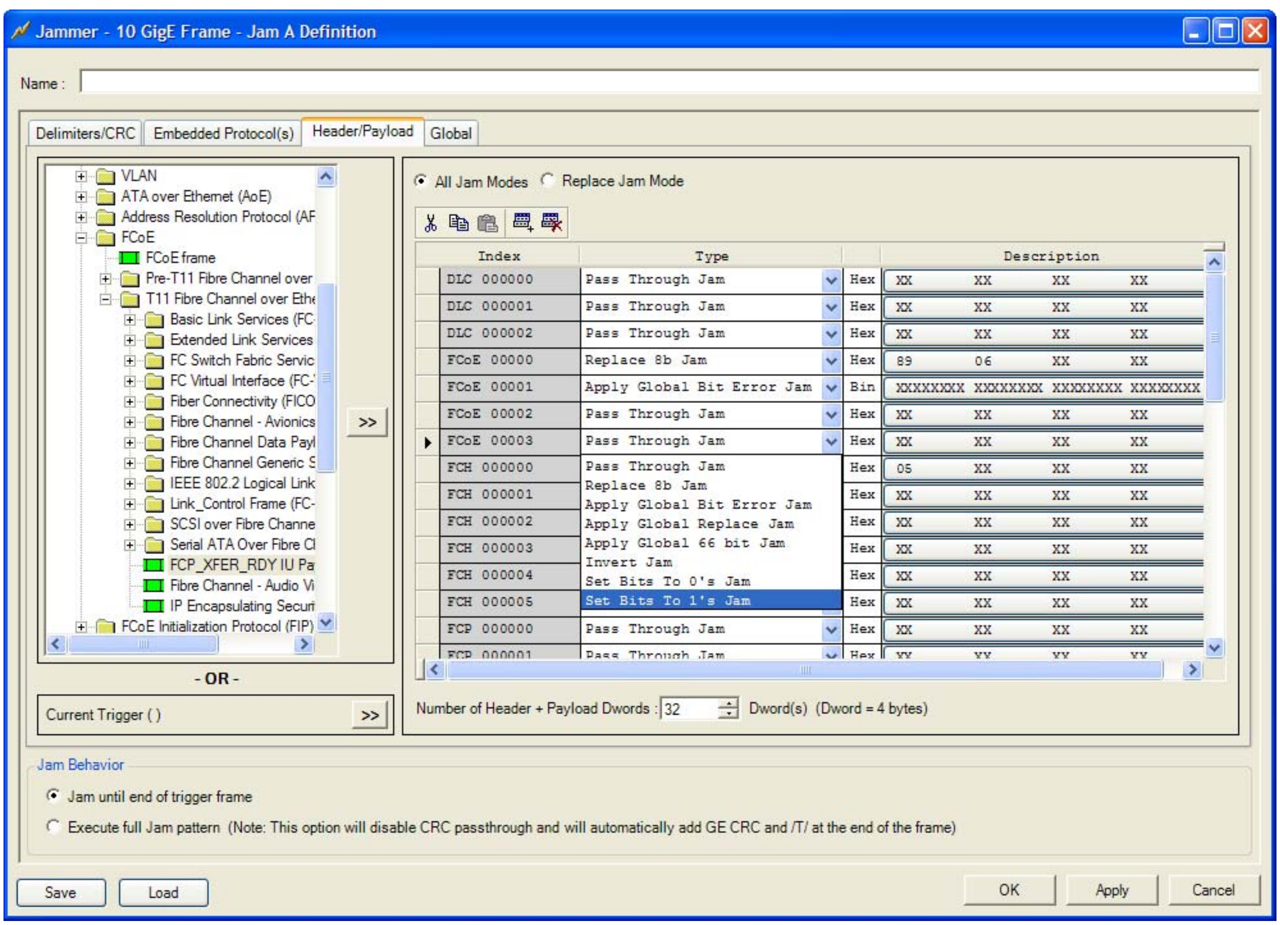
The CRC options include:

- Not changing the CRC in the original target frame
- Recalculating the CRC to make it correct for the modified data
- Replacing with a user-specified data word

Using the Header/Payload Tab for 10GigE

You can modify any parameter or word on the 10GigE Header/Payload Tab (Figure 181).

Figure 181: 10GigE Header/Payload Tab



The 10GigE window always shows Jam definitions for the header and 4096 payload words (for the maximum supported 16 Kilobyte jumbo frames). If the frame that is Jammed has less than 4096 payload words, the extra Jam definitions do not take effect. The Jammer does not support 10GigE frames larger than 4096 payload words.

Notice the first line of the Jam Definition (Ether 0001) has only the first two bytes of the Destination Address header field. This is to visually orient the frame in the same manner as the Arm and Trigger Condition windows.

Similar to defining an Arm or Trigger Condition, there are two ways to specify your frame Jam Definition. One way is to load a template from the Template Library tree, and the other way is to manually specify bits in the frame.

To use a template:

1. Highlight a template in the Template Library tree on the left side of the window.

   Tree View is structured similar to the display on the right side of the Arm and Trigger Condition windows. You can make selections from the tree; this creates the appropriate Replace Jams.

2. Click the double right arrow to display the Jam definition on the right side of the window.

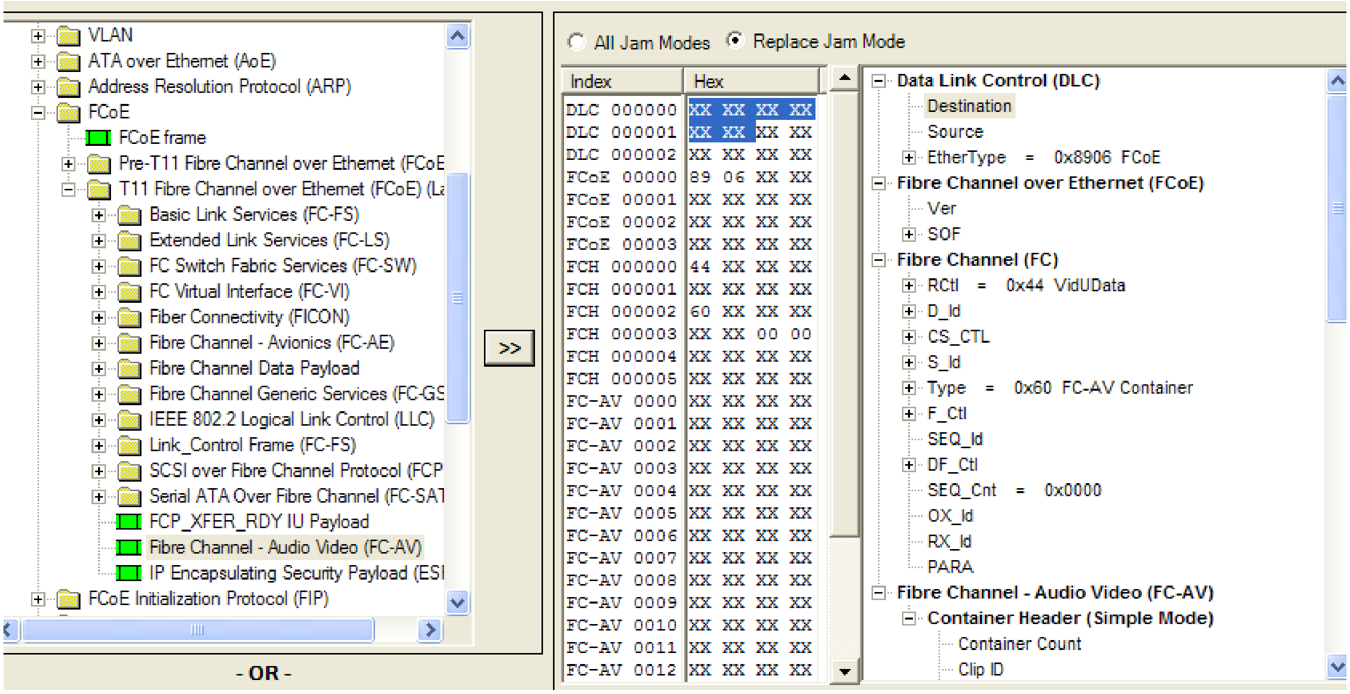
Notice the special choice at the bottom left, “Current Trigger.” This is a copy of the frame condition you have specified for the Trigger. Click the double right arrow to use this.

When you use a template, the Jam definition is populated with Replace Jams of the specified data, while all other bits are passed through.

To manually edit the values, enter a value into the byte field. An **X** in a nibble passes the original value through.

Selecting the **Replace 8b Jam Mode** radio button opens a dialog that allows you to replace an entire frame either by using a template or manually entering values. The Replace 8b Jam Mode dialog also contains a view of the frame contents, similar to those seen the Arm and Trigger Condition windows. These values correspond to the hex values defined in the center column.

Figure 182: Replace 8b Jam Mode



Selecting the **All Jam Modes** radio button opens a dialog that provides the following choices for each word in a frame on the Header/Payload tab:

Replace 66 bit - This function allows individual bits to be set to 1, set to 0 or passed through unchanged according to the **Global 66 Jam** option defined on the Global tab.

Apply Global Replace Jam - This function allows individual bits to be set to 1, set to 0 or passed through unchanged according to the Global Replace Jam option defined on the Global tab.

Invert Jam - Invert defined bits and pass through the rest. Enter 1s at the appropriate bit locations.

Pass Through Jam - Pass through the current word unchanged.

Replace 8b Jam - Replace nibbles with new values. Each drop-down represents a byte so you can replace a byte with a standard Ordered Set. If you choose User-defined, you can specify any K/D character. To edit these values, enter a value into the byte field or double-click to display the Binary Editor. If you specify a bit as a 0 or 1, you must specify the values of the other three bits in that nibble also. Any nibbles with an X are passed through.

Set Bits To 0s Jam - Set defined bits to 0s and pass through the rest. Enter 0s at the appropriate bit locations.

Set Bits To 1s Jam - Set defined bits to 1s and pass through the rest. Enter 1s at the appropriate bit locations.

Apply Global Bit Error Jam - Apply the Global Bit Error function set on the Global tab.

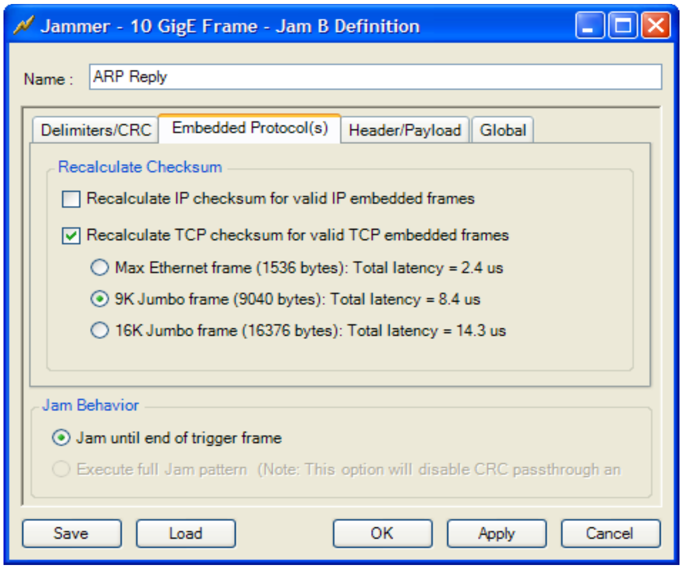
Insert Code Violation Jam - Introduce a predefined, fixed code violation to a byte in that word. Which byte is corrupted depends on the alignment orientation of the frame. The Jam Definition of the word before a Code Violation Jam must always be a Pass Through Jam. A Code Violation Jam cannot be placed in the first word of a frame (Ether 0001).

Tree View - Another way to manually edit or view your Jam Definition is to click the **Switch to** button at the lower right corner to toggle between List View and Tree View. The List View interface is described in the procedures in this chapter. Tree View is structured similar to the display on the right side of the Arm and Trigger Condition windows. You can make selections from the tree; this creates the appropriate Replace Jams.

Using the Embedded Protocol(s) Tab for Gigabit Ethernet

Figure 183 shows the Embedded Protocol(s) tab for Gigabit Ethernet. The available functions are described in this section.

Figure 183: Gigabit Ethernet Embedded Protocol(s) Tab



Recalculate Checksum

Select the check boxes to choose recalculation of IP and TCP checksums.

Recalculate IP checksum for valid IP embedded frames

Checking this option replaces the IP checksum in the Jammed frame with a recalculated value. For the checksum to be inserted properly, the frame, after Jamming takes place, must have a Gigabit Ethernet header EtherType field value of 0x0800 and a valid IP header IHL field.

Recalculate TCP checksum for valid TCP embedded frames

Checking this option replaces the TCP checksum in the Jammed frame with a recalculated value. For the checksum to be inserted properly, the frame, after Jamming takes place, must meet the same requirements as those listed for the IP checksum, and, in addition, have an accurate IP header Total Length field, an IP header IP Protocol field value of 0x06, and a valid TCP header Data Offset field.

Also, the Jumbo Frames setting (see “GigE Jumbo Frames” on page 25) must be correct for the TCP checksum insertion to work. Each setting shows the frame size limits as well as the corresponding latency.

The TCP checksum recalculation is not available when using the Repeat Jam feature.

Replace Frame with Truncated Frame

This option truncates the target frame to a shorter length and sends Idles /I/ on top of the remainder of the target frame.

In the Truncate Frame Options window:

1. Choose the type of payload you want to truncate from the drop-down menu:
    - Gigabit Ethernet
    - IP
    - TCP
    - FCoE
2. Enter the number of bytes you want the payload to be truncated to (this does not include the CRC or other delimiters).

Gigabit Ethernet Payload

For a Gigabit Ethernet payload, the **Number of Payload bytes** setting specifies how many bytes to leave after the Gigabit Ethernet header (the first 14 bytes of the frame). You can specify from 0 to 1500 bytes. If the target frame is shorter than the specified number of bytes, then no Jamming occurs. You also have the option to replace the IP checksum with a recalculated value, which also automatically updates the IP header Total Length field.

For any successful truncation, the Gigabit Ethernet CRC is always replaced with a recalculated value.

IP Payload

For an IP payload, the **Number of Payload bytes** setting specifies how many bytes to leave after the IP header. You can specify from 0 to 1480 bytes. You also have the option to replace the IP checksum with a recalculated value, which also automatically updates the IP header Total Length field.

For the truncation or the IP checksum/IP header option to work properly, there are some requirements of the incoming target frame. The frame must have a Gigabit Ethernet header EtherType field value of 0x0800, a valid IP header IHL field, and a valid IP header Total Length field. If the Jammed frame is shorter than the specified number of bytes, then no truncation occurs, but the IP checksum can be recalculated if you select it.

For any successful truncation, the Gigabit Ethernet CRC is always replaced with a recalculated value.

TCP Payload

For a TCP payload, the **Number of Payload bytes** setting specifies how many bytes to leave after the TCP header. You can specify from 0 to 1460 bytes. You also have the option to replace the IP checksum with a recalculated value, which also automatically updates the IP header Total Length field.

Each setting shows the frame size limits as well as the corresponding latency. In addition to these limits, the target frame must have an IP header IP Protocol field value of 0x06, a valid TCP header Data Offset field, and a valid IP header Total Length field. If the Jammed frame is shorter than the specified number of bytes, then no truncation occurs, but the IP checksum can be recalculated if you select it.

For any successful truncation, the Gigabit Ethernet CRC is automatically replaced with a recalculated value.

FCoE Payload

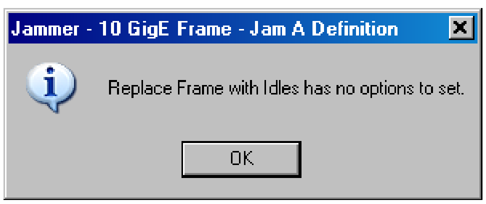
For an FCoE payload, the **Payload Dwords** setting specifies how many Dwords (Dword = 4 bytes) to leave after the FCoE header. You can specify from 1 to 4096 Dwords. You also have to specify an EOF for the FCoE frame.

For any successful truncation, both the FCoE and the Gigabit Ethernet CRCs are always replaced with a recalculated value.

Replace Frame with Idles

This option replaces the target frame with /I/ Ordered Sets in the 10GigE Jammer. There are no options to set for this Jam.

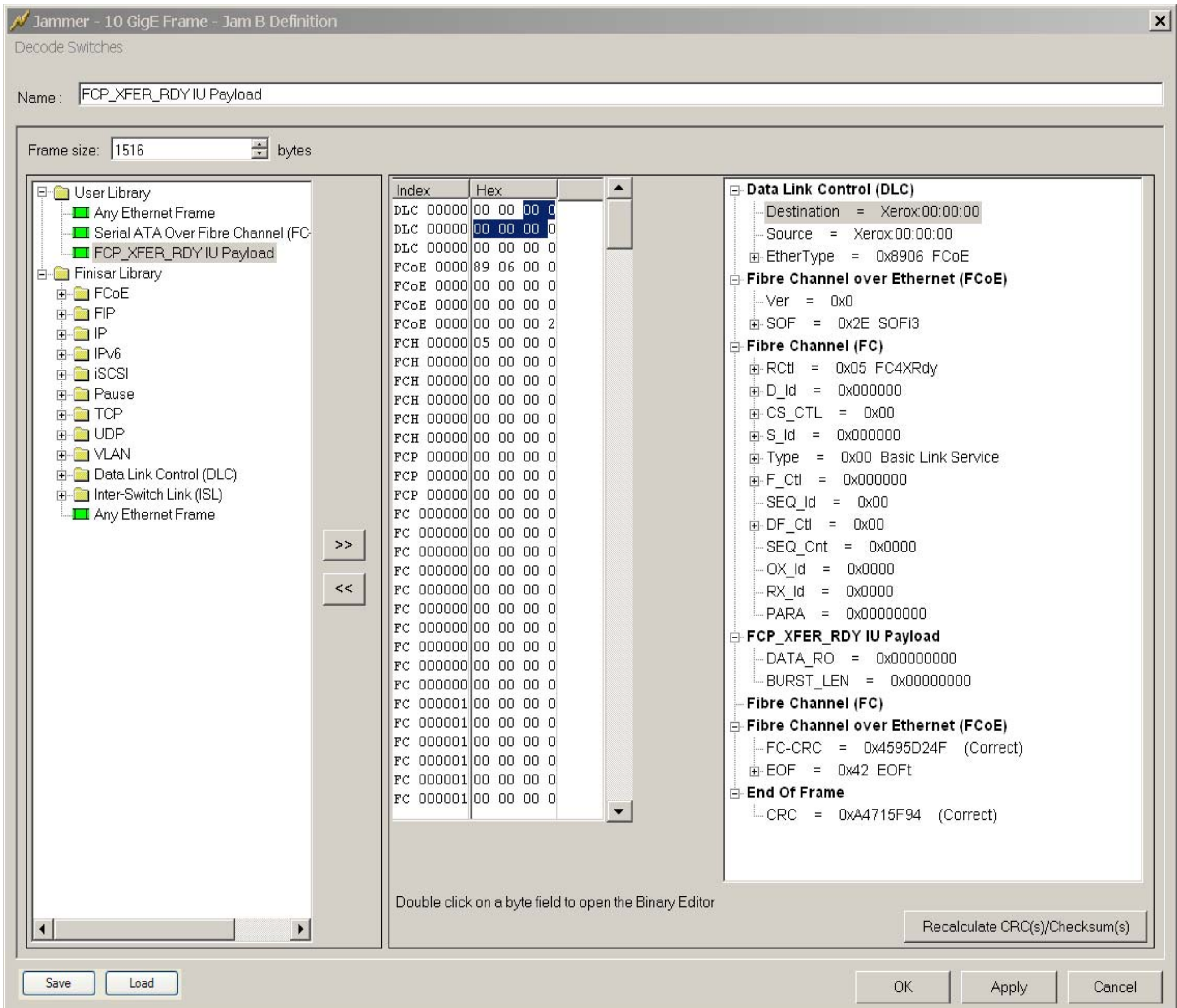
Figure 184: 10GigE - Replace Frame with Idles



Insert Frame

This option allows you to insert a 10GigE frame after the triggered frame. You can define the header and the payload using the Template Tree on the left pane, or you can manually define the frame.

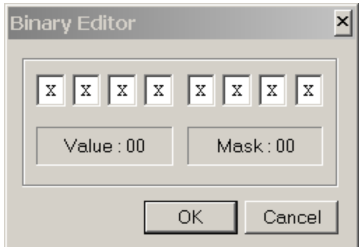
Figure 185: 10GigE Jam - Insert Frame Window



To use a template, click a frame template from the User Library or the Viavi Library in the left pane, then click the double right arrows to apply the template. The frame header and payload information appears on the right side of the window.

To manually define a frame, type hexadecimal values directly into the center column of the window. To set individual bits in any field, double-click on the hex entry to open the Binary Editor (Figure 186). In the hex view, partially defined hex characters appear as question marks: `X001=?`

Figure 186: Binary Editor Dialog



The frame size is indicated at the top of the window. You can adjust the frame size within the limits defined by the protocol and frame content.

The software automatically recalculates the applicable CRCs, and checksums each time you change the frame. If the CRC or checksum is incorrect, an entry is displayed in the frame contents next to the incorrect CRC or checksum showing the correct value of the CRC. To apply the correct recalculation of the CRC and checksum, click the **Recalculate CRC(s)/Checksum(s)** button at the bottom of the Jam Definition window.

Decode Switches Menu

Some templates allow you to specify decode switches. When you load a template that has this option, the **Decode Switches Menu** appears in the upper left corner of the window. The decode switches provide detailed contextual options for decode; for example, further decode of response and data frames. The Decode Switches menu is context sensitive and will only show the decode options available for the specific template you are creating.

Note: Once the **Decode Switches** menu appears, it remains visible. However, if you load a template that has no decode options, the menu is greyed out and inactive.

The **Decode Switches** menu is intended to help you create a user-defined template. When editing a User Library template, Decode Switches are stored inside the template so they are still ON the next time you open this particular template.

Decode switches allow you to further decode Response and Data frames that can't be decoded without knowing what the associated command frame is. Below is a description of the switches available for Jammer’s Trigger and Insert Frame conditions:

FCoE Interpretations

This menu is available for FCoE frames. Fibre Channel over Ethernet (FCoE) is the proposed mapping of Fibre Channel over selected full duplex IEEE 802.3 networks. The **Auto-Detect FCoE** setting automatically detects the version and is the default decode switch. The auto-detect mode works on a per-FCoE frame basis. It assumes that the FCoE frame reserved bits are set to zero and detects which FCoE specification is in use depending on where the zeroes are. If you end up with multiple errors and erroneous decoding of the FCoE frames, it is because the auto-detect mode assumptions do not work with your particular trace. This requires that select manually which FCoE specification to use. Available settings are:

- **Auto-Detect FCoE**
  Automatically detects the specification version by looking at the frame header.

- **T11 FCoE (Latest)**
  Selects the latest draft of the T11 standards committee specification as of this Xgig Analyzer release date.
- **Pre-T11 FCoE Draft**
  Selects the pre-T11 standards committee draft, 07-303v0.pdf.

FC-ELS Accept Interpretation

This menu item is available for FC-ELS (Fibre Channel Extended Link Services) Accept frames. It contains a list of the possible Link Services Accept frame formats.

Saving a Frame

If you create a frame that you want to save and make easily available for future use, you can save it into the "User Library" folder in the Template Library tree. To do this:

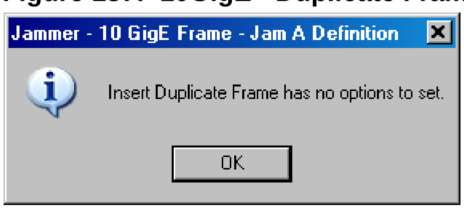
1. Make sure the frame contents are displayed in the right pane.
2. Type a name for the frame, and click the double left arrow button.

   The frame appears in the User Library.

Duplicate Frame

You can duplicate the triggered frame and insert it after the frame. There are no options to set for this Jam.

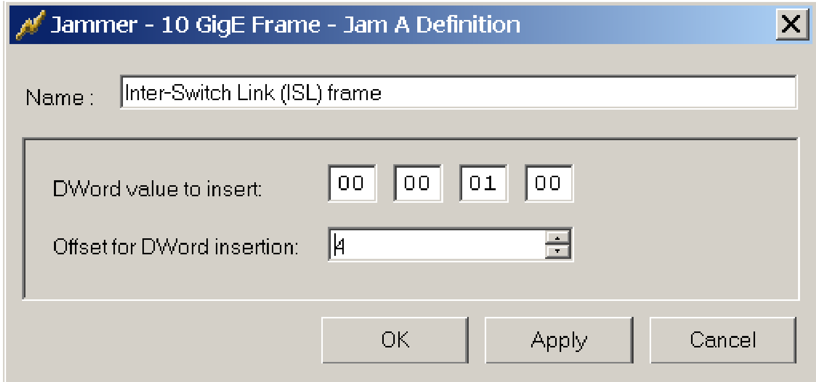
Figure 187: 10GigE - Duplicate Frame



Insert Dword

This option allows you to insert a 32-bit word to the triggered frame at a particular offset. The position of offset 0 begins after the preamble of a frame. The 32-bit data to be inserted is user programmable. Only data characters can be inserted. The GE CRC, FCoE CRC, IP checksum are automatically recalculated.

Figure 188: 10GigE Insert Dword



If the repeat jam option is used for an Insert Dword jam, the IPG between frames must be greater than minimum IPG. If the triggered frames are spaced by minimum IPG, the insertion process may be aborted before the specified number of repeat jams, and you will receive an error notice.

Chapter 7

Creating Jammer Test Configurations for 16G FC

In this chapter:

Defining Your Own Test Configurations for 16G FC

Xgig Jammer lets you define your own test configurations and save them with or without hardware available.

You can create a configuration from scratch, or you can open and edit an existing configuration. Also, you can edit a configuration in edit only mode, which is independent of any hardware, or you can edit a configuration that is currently loaded to a Jammer device.

To edit a configuration in edit only mode:

>> Double-click on a configuration file in the Configuration manager.

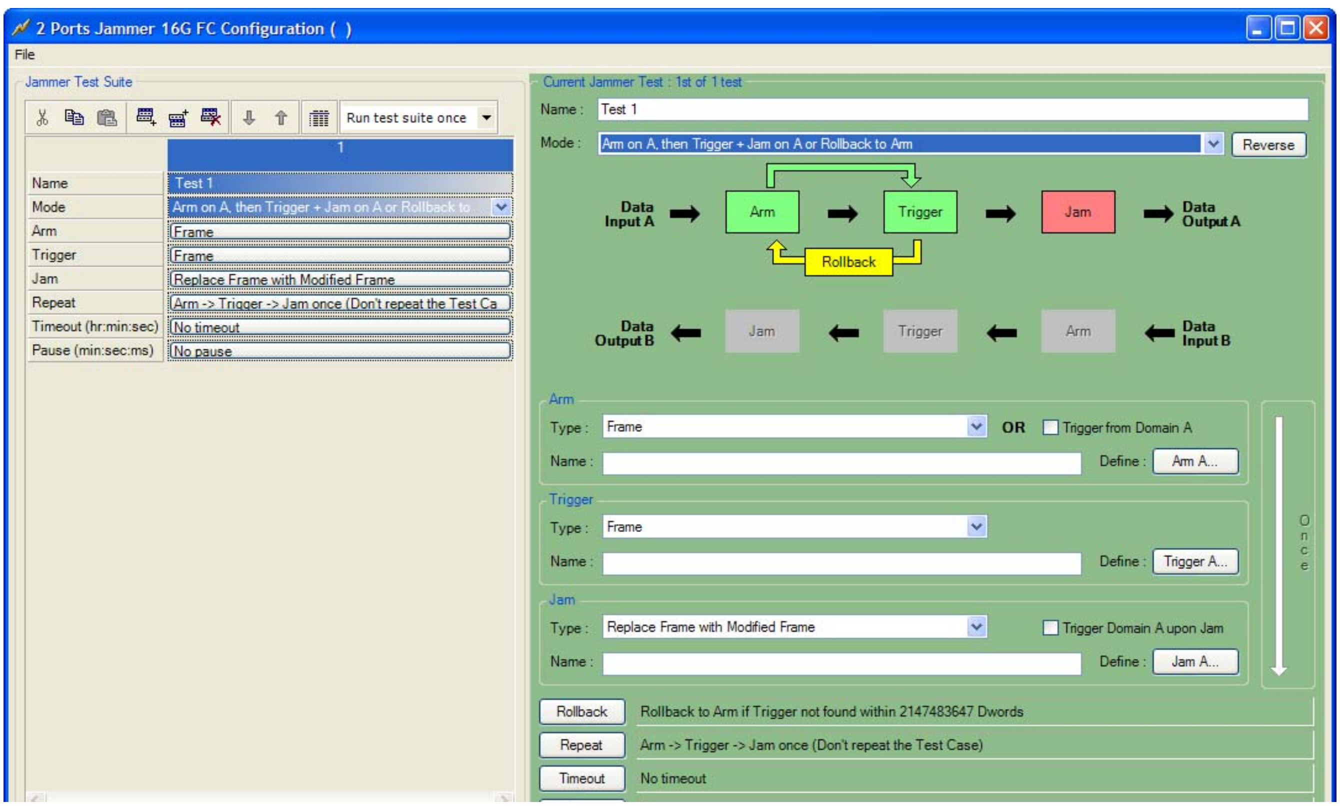
or:

>> Right-click on the configuration file in the Configuration manager and choose **Edit Jammer Configuration** from the context menu.

The edit only mode Jammer Configuration window opens (Figure 189).

This window allows you to set up your own Test Cases, name them, organize them, and save them to files so that you can use them again.

Figure 189: Edit Only Jammer Configuration Window



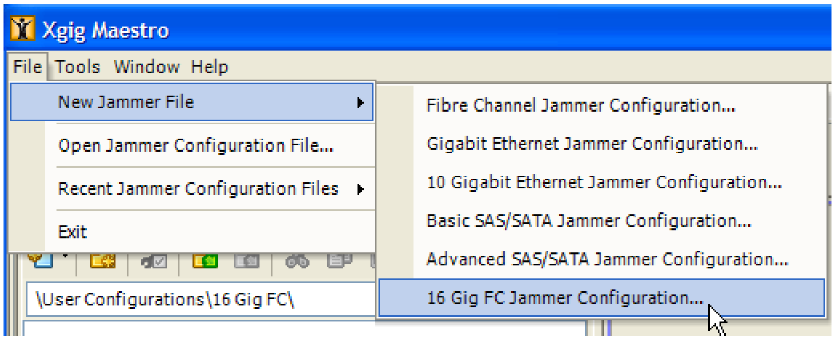
To start a configuration from scratch in edit only mode:

>> Select **New Jammer Configuration** from the context menu or the File menu (Figure 190) on the Xgig Maestro menu bar. Then, select **16 Gig FC Jammer** from the drop down menu.

or:

>> Click the New Configuration icon at the top of the Configuration manager.

Figure 190: Maestro File Menu



To save your configuration in edit only mode:

>> Click **Save** at the bottom of the Jammer Configuration window or open the File menu on the Jammer Configuration window and select **Save Configuration** or **Save Configuration As**.

Any changes you make have no effect on actual Jammer devices you control.

To edit a configuration that is loaded to a Jammer port:

>> Click **Configuration...** in the device column.

or:

>> Right-click in the Parameters Status table in the device column to open the context menu and select **Edit configuration**.

or:

>> Click **Operation** in the device column to open the Operation dialog, then click **Config**.

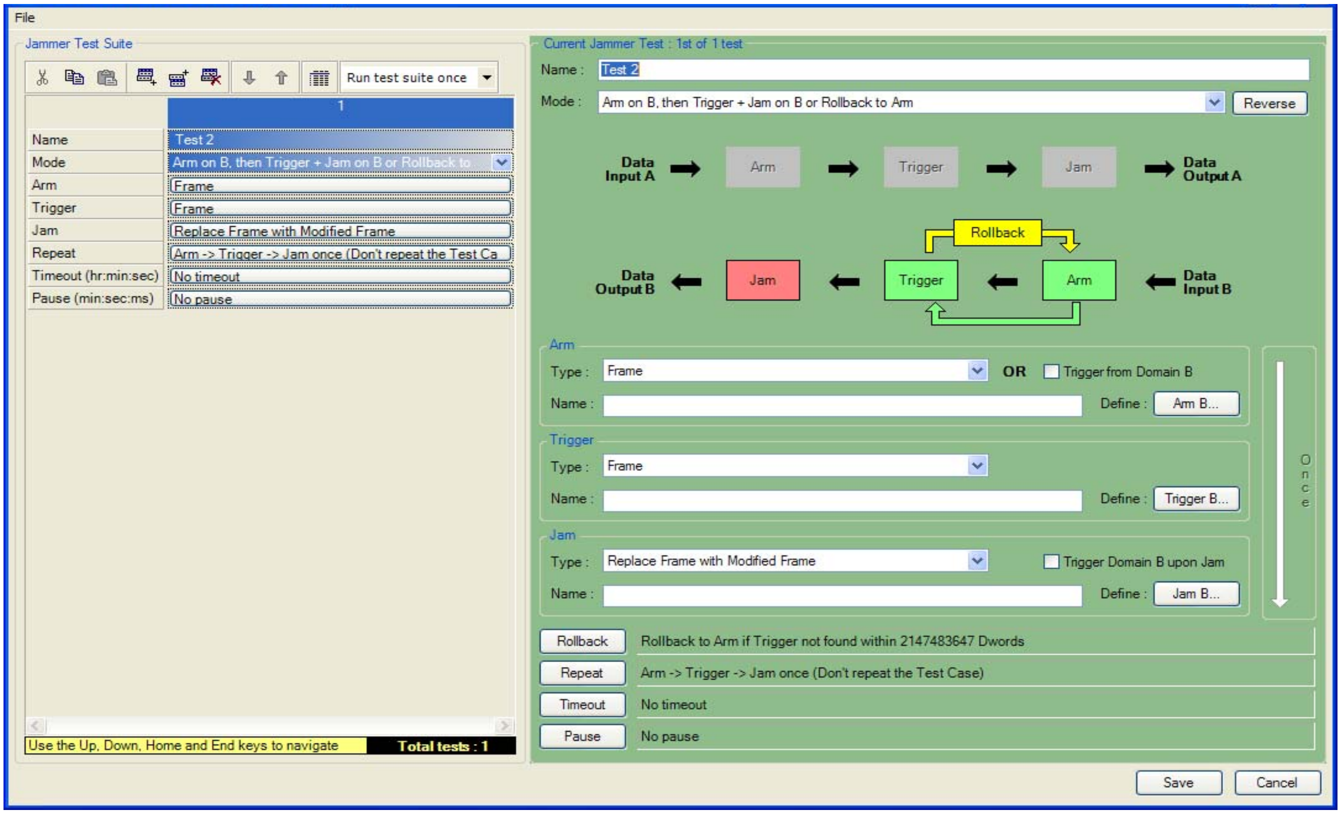
The Xgig Jammer Configuration window in hardware edit mode is displayed (Figure 191). This window allows you to set up your own Test Cases, name them, and save them to a file so that you can use them again.

Click **Apply** or **OK** and Jammer accepts the changes. They are immediately reflected in the Parameters Status table and affect the Jammer device the next time you run it.

To save your configuration edits:

>> Open the File menu at the top of the Jammer Configuration window and select **Save Configuration As...** or **Save Configuration**.

Figure 191: Xgig Jammer Configuration Window



Using the Jammer Configuration Window for 16G FC

The Jammer Configuration window title bar indicates how many ports it is configuring, the protocol, and the configuration file name, if any. If you are using hardware edit mode, the chassis name, chassis number, slot number, and port number are also listed. The elements of the Jammer Configuration window are described in the following sections.

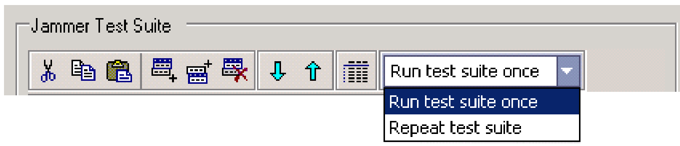
Using the Jammer Test Suite Tools for 16G FC

The Jammer Test Suite (left pane) lists the series of Xgig Jammer tests in the order in which you want them to execute. The suite includes one or more tests. The highlighted test appears as the Current Jammer Test (right pane). Each test in the suite executes in sequence with a test reset time of approximately 130 (200 max) milliseconds.

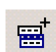
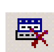
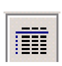
Creating a Test Suite

When you create a 16G FC Jammer Test Suite, you use the toolbar in the Jammer Test Suite section of the Configuration window (Figure 192).

Figure 192: 16G FC Jammer Test Suite Toolbar



The following list describes the icons on the toolbar:

 Cut current test		Removes the highlighted test and holds its contents in the memory buffer.
	Copy current text	Copies the highlighted test to the memory buffer.
	Paste last test cut or copied	Inserts the current memory buffer contents before the currently highlighted test.
	Add new test to bottom of stack	Adds a new blank test to the bottom of the suite.
	Insert new test before current test	Inserts a new blank test above the currently highlighted test.
	Delete current test	Removes the highlighted test from the suite. If only one test is present, then the contents of this test are cleared.
	Move current test down the stack	Moves the highlighted test down one in the test order.
	Move current test up the stack	Moves the highlighted test up one in the test order.
	Toggle view	Toggles Test Suite between Card View and List View.
	Run test suite once or Repeat test suite	When you choose Repeat test suite, the tests run according the settings you define in the Jammer Current Test window.

To duplicate a test at another point in the Test Suite:

1. Highlight the test you want to duplicate.
2. Click **Copy**.
3. Highlight the test in the suite that is just after the point where you want the duplicate test inserted.
4. Click **Paste**.

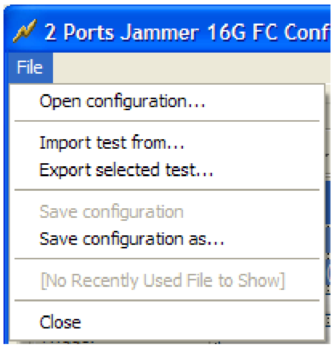
   The duplicate test is inserted.

   Refer to “Configuring the Arm Condition for 16G FC”, “Configuring the Trigger Condition for 16G FC” and “Configuring the Jam Definition for 16G FC” for information about configuring each test.

Using the Configuration File Menu

The File menu is the only menu on the menu bar (Figure 193).

Figure 193: Configuration File Menu



The choices are:

Open Configuration	Open an existing `.tsk` configuration file.
Import to Selected Test	Import a Test Case from a `.tst` file or an entire test suite, `.tsk` file, to the currently highlighted position. A Test Case is one line in the Jammer Test Suite.
Export Selected Test	Export and save the currently highlighted test to a `.tst` file.
Save Configuration	Save the entire Test Suite to the `.tsk` file you currently have loaded.
Save Configuration As	Save the entire Test Suite to a `.tsk` file with a name you assign to it.
Close	Close the Jammer Configuration Window.

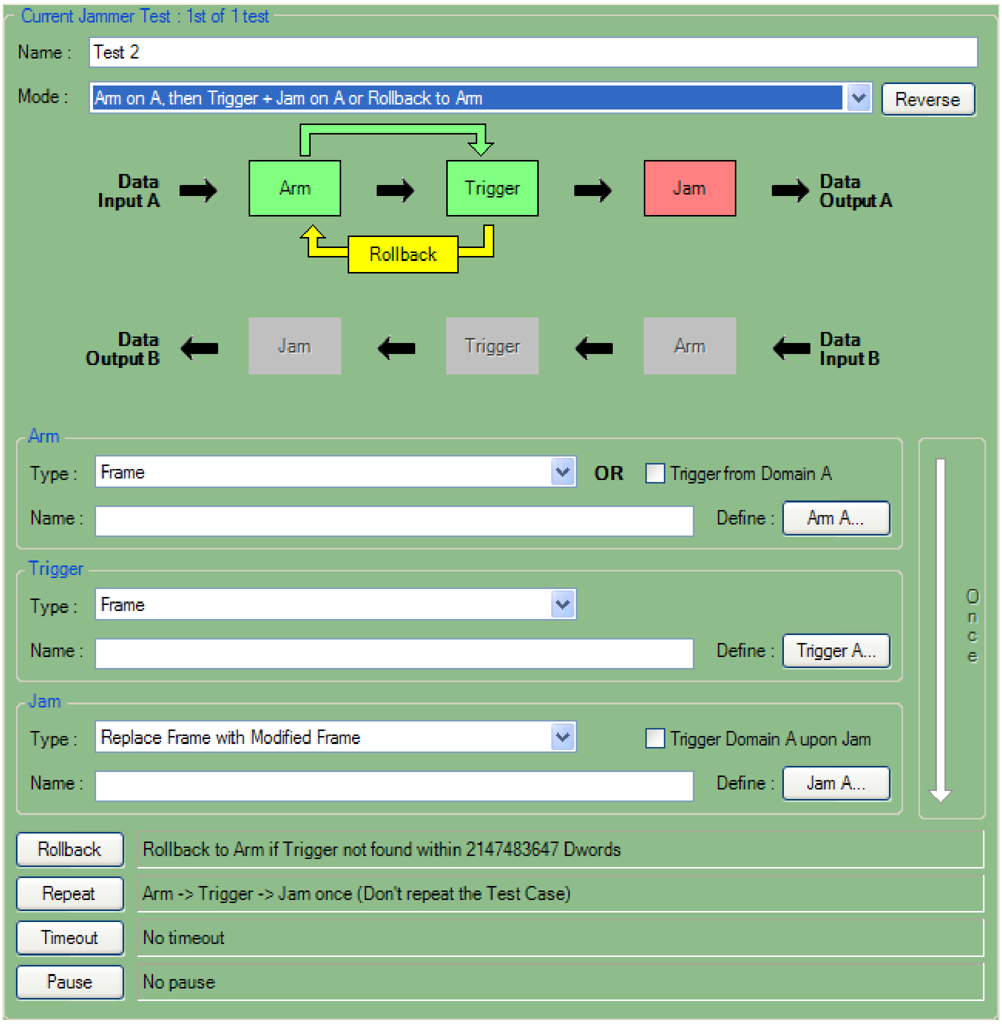
The recently used 16G FC Jammer configuration files appear in the file menu and are loaded when selected.

Note: The `.tst` files are only for storing individual Test Cases and swapping them between configuration files. You cannot load `.tst` files directly into a Jammer device on the Xgig Maestro window.

Using the Current Jammer Test Window for 16G FC

The graphics in this section of the window represent the hardware configuration for the selected test in the Jammer Test Suite (Figure 194).

Figure 194: Current Jammer Test Window



Mode

For 16G FC, Mode menus are available near the top of the Current Jammer Test window (Figure 195) and also near the top of each Test Case in the Jammer Test Suite window (Figure 196).

The input to path A (on top) is always port A and the input to path B (on the bottom) is always port B. The external trigger input and output that are available on path A always are linked to the domain shown on the Xgig Maestro window as “Domain of port A.” The trigger input and output on the bottom on path B are in the “Domain of port B.”

Figure 195: Mode Drop-down Menu in Current Jammer Test - Right Pane

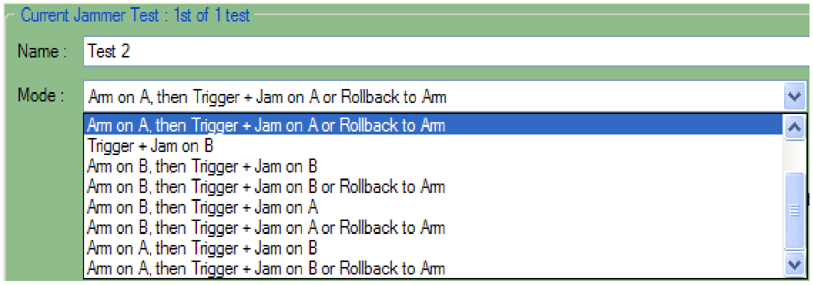
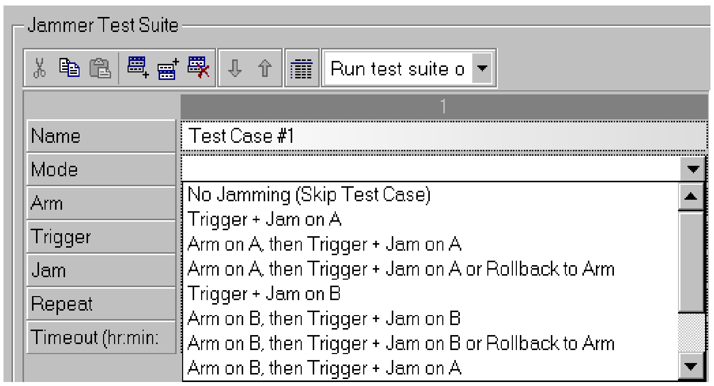


Figure 196: Mode Drop-down Menu in Test Suite - Left Pane



Reverse

You can reverse the direction of the jam by selecting the **Reverse** button.

Arm and Trigger

To define Arm and Trigger conditions, select a respective Type from each drop-down menu. Then click the Arm or Trigger button to open the corresponding definition window.

You can use an external input as an Arm condition. Check Trigger from Domain A (or B) to enable this feature. You must put the corresponding Jammer port into a domain for this to work properly.

The Trigger event can be in the next Dword after the Arm event in the traffic stream.

Jam

To define a Jam:

1 Select a Type from the drop-down menu, if available.

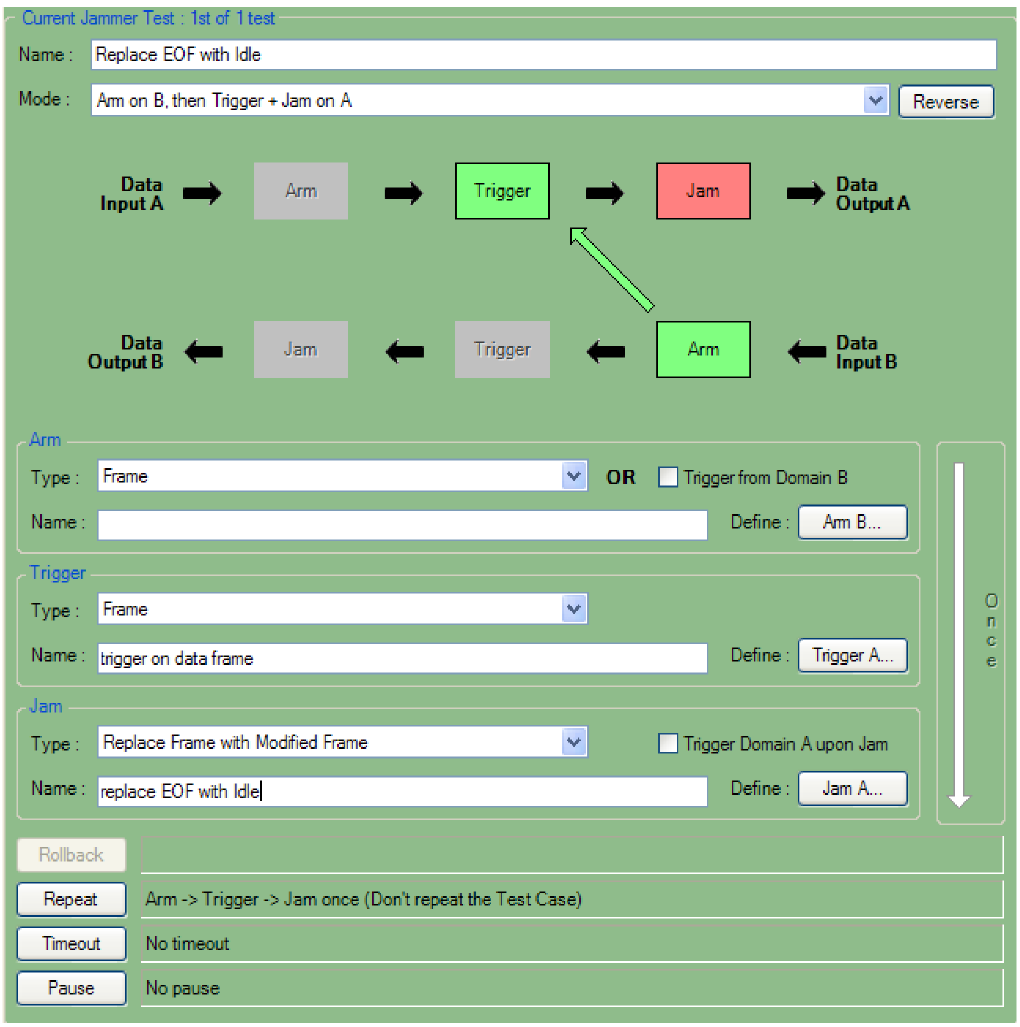
2 Click the Jam button to open the Jam Definition window.

The Jam Definition specifies the modifications to be made to the traffic matching the Trigger Condition.

In addition, the Jammer port can trigger out to the Domain it is in when a Jam takes place. Check Trigger Domain A (or B) upon Jam to enable this feature.

Note: If you use an external trigger input to define the Arm condition, then you cannot select the external trigger output for that path in that Test Case, and vice versa. For information regarding using the trigger input and output during a Test Case, refer to "Using Domains and External Triggering" on page 291. However, you can use an external trigger in on port A with an external trigger out on port B, and vice versa. Figure 197 shows an example.

Figure 197: Trigger In and Trigger Out

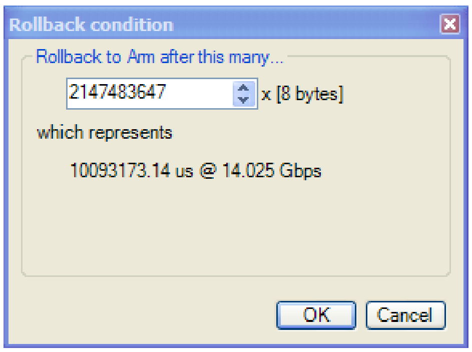


Rollback

The Rollback option defines the time or Dword count parameter between the Arm and Trigger events. If the Trigger does not follow the Arm event in the allotted time or Dword count, the Jammer begins looking for the Arm event again. Click **Rollback** to display the dialog shown in Figure 198.

Note: This value is saved in terms of Dwords, not time, so keep this in mind if you save a Test Case using a device running at 3.0 Gbps and later open the configuration on a Jammer running at 1.5 Gbps.

Figure 198: Rollback Condition Dialog



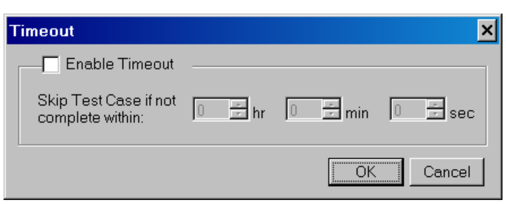
Timeout

The timeout option defines the period of time to wait for a specified test to complete before aborting and proceeding to the next test in the suite.

To set the timeout:

1. Click **Timeout** to display the dialog box in Figure 199.
2. Check **Enable Timeout**.
3. Enter the hours, minutes, and seconds you want to wait.

Figure 199: Timeout Dialog

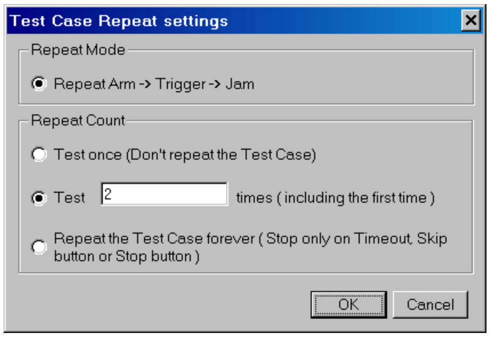


4. Click **OK**.

Repeat

Click **Repeat** to open the dialog shown in Figure 200. The Repeat Mode setting allows you to configure what is repeated when using an Arm condition. The first option means the Jammer will match the Arm condition once, then will repeat matching the Trigger condition as specified by the Repeat Count setting below. The second Repeat Mode option means that the Jammer must match the Arm condition each time before looking for a Trigger.

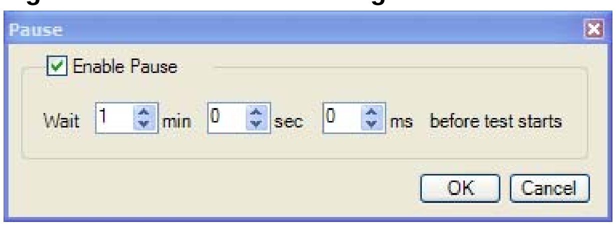
Figure 200: Repeat Test Dialog



Pause

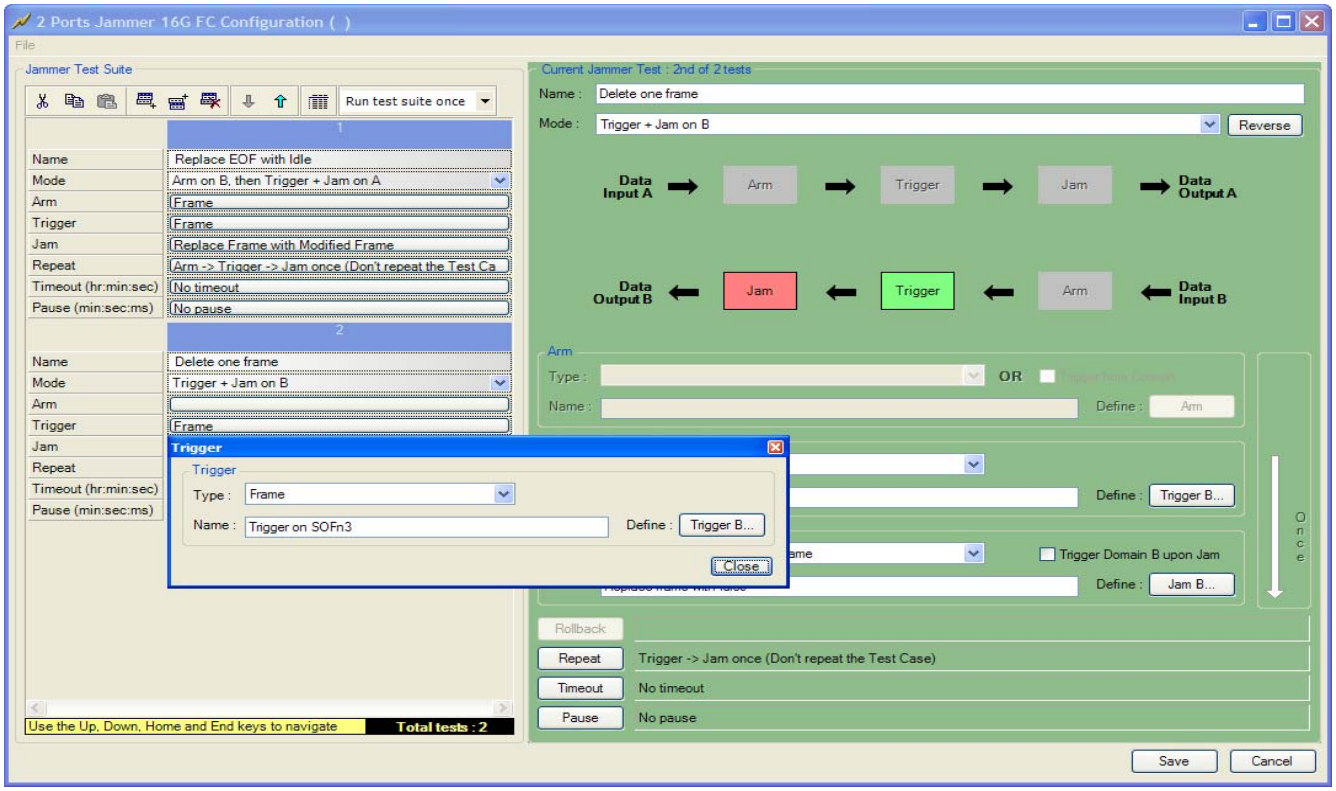
Click **Pause** to open the dialog shown in Figure 201. The Pause setting allows you to insert a pause before the beginning of a test case.

Figure 201: Pause Test Dialog



You can also configure options for each Test Case directly in the Test Suite, instead of clicking in the Current Jammer Test pane. Click on the area of the Test Case you want to modify to open the corresponding dialog (Figure 202).

Figure 202: Configuring Options Directly in the Test Suite



Configuring the Arm Condition for 16G FC

The 16G FC Arm condition recognizes specific ordered sets, control characters, or frames.

In 16G FC, you can select from the following:

- Frame - Allows you to specify the 16G FC header and up to 114 bytes of payload
- Ordered Set - Provides you with predefined ordered sets, or allows you to define a four byte ordered set
- Control Character - Allows you to choose from pre-defined control characters
- SOF - Allows you to arm on the SOF
- EOF - Alows you to arm on the EOF

You can save an arm or trigger condition as a `.jmt` file by clicking the **Save** button in the **Arm** or **Trigger** window. You can load a `.jmt` file by clicking the **Load** button in the **Arm** or **Trigger** window.

Depending on the Mode you select, the appropriate graphic diagram shows the Trigger and optional Arm conditions, along with the Jam event. If the Mode you select does not include an Arm condition, the **Arm** button is disabled.

To set Arm conditions:

1. Select Frame, Ordered Set, Control Character, SOF, or EOF from the **Type** drop-down menu in the Arm section of the Current Jammer Test window.
2. Click on the **Arm** button to open the Arm window.

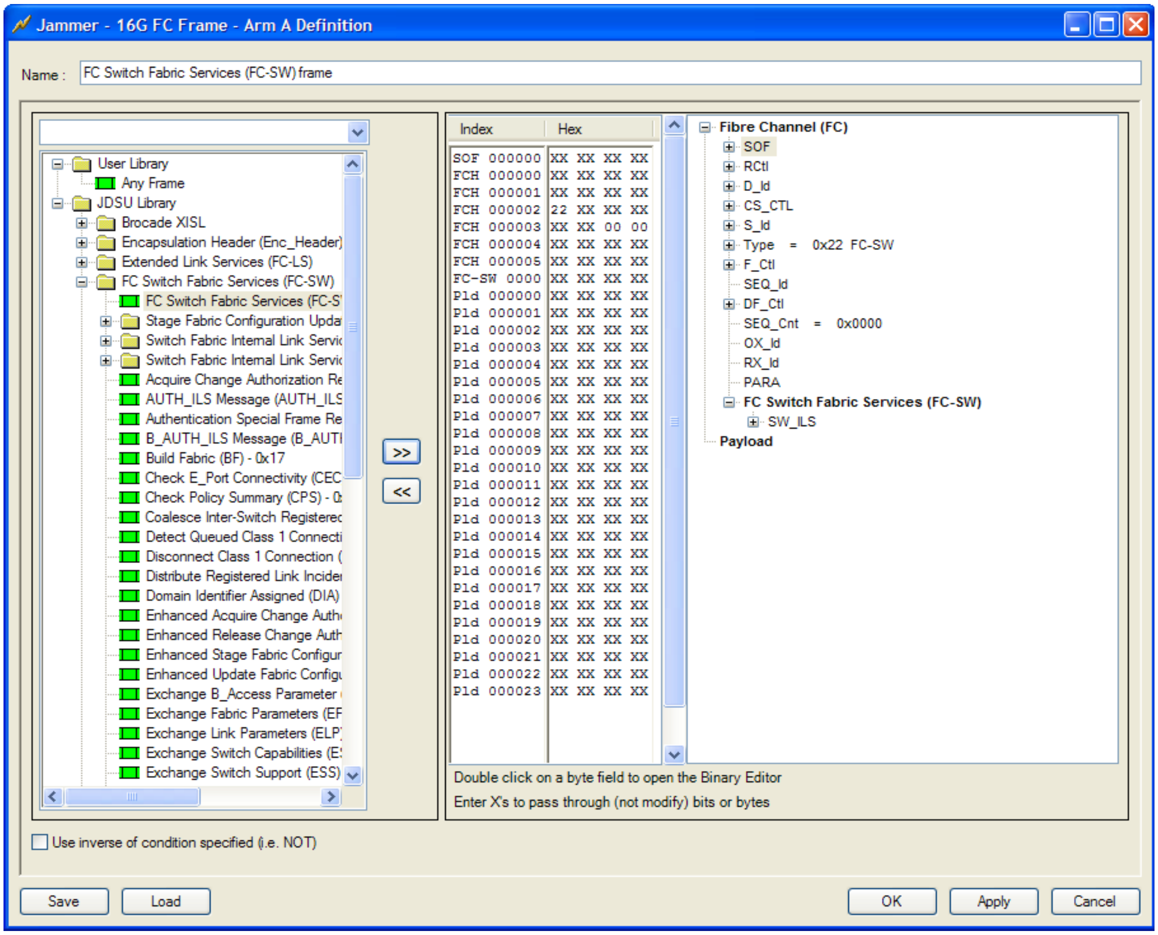
   The window for the condition is displayed (Figure 203). If you are in hardware edit mode, the protocol, chassis name, chassis number, slot number, and port numbers are displayed in the title bar.
3. Set the values as required to specify the Arm condition as part of a unique Arm and Trigger sequence for the specific test.

   The following sections describe the available values.

Setting Frame Conditions for 16G FC Arm

You can specify frame conditions in two ways (Figure 203). One way is to load a template from the Template Library tree, and the other way is to manually specify bits in the frame.

Figure 203: Gigabit Ethernet Arm Window for Frames



To use a template:

1 Select a template from the Template Library tree on the left.

2 Click the double right arrow button to set the Trigger Condition.

The condition is indicated on the right side of the window.

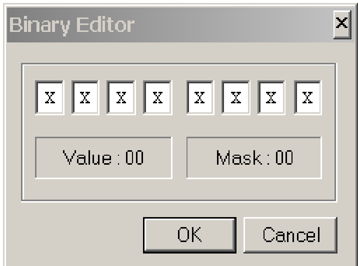
To manually specify a frame:

>> Type hexadecimal values directly into the center column of the window.

An X represents a nibble that can be any value (a “don’t care”).

To set individual bits in any field, double-click on the hex entry to open the Binary Editor (Figure 204). In the hex view, partially defined hex characters appear as question marks: `X001=?`

Figure 204: Binary Editor Dialog



Another way to manually edit the frame condition is to make selections from the tree view in the right window pane.

Saving a Frame Condition

If you create a frame condition that you want to save and make easily available for future use, you can save it into the "User Library" folder in the Template Library tree. To do this:

>> Highlight the folder and click the double left arrow button.

Frame conditions have the option of "Use inverse of condition specified (i.e., NOT)." When you check this option, it means that the first frame encountered that does not match what you have specified creates a "condition met" event.

For each frame condition, you can specify an optional name at the top of the window. This name is also shown on the Jammer Configuration window under the Mode selection, and on the main Xgig Maestro window.

Setting Ordered Set Conditions for 16G FC Arm

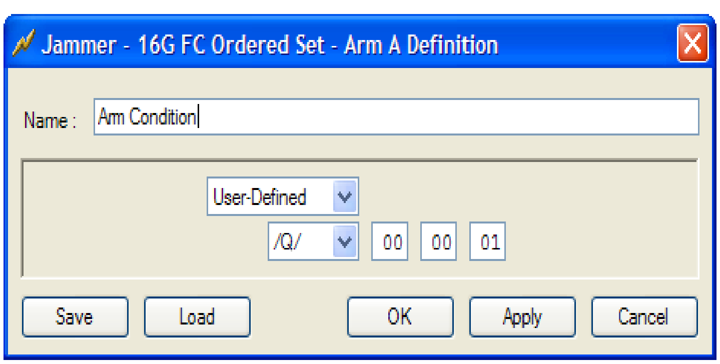
You can choose from a predefined Ordered Set (LF or RF) or choose user-defined (Figure 205). All choices are four bytes. You can select either /Q/ or /Fsig/ for the first byte of a user-defined ordered set. You can enter hex values for the remaining three bytes.

To edit the values:

>> Enter a hex value, or double-click the byte field to open the Binary Editor.

As in frame conditions, an X indicates "don't care" and a ? indicates a partially specified hex character.

Figure 205: 16G FC Arm Window-Ordered Sets

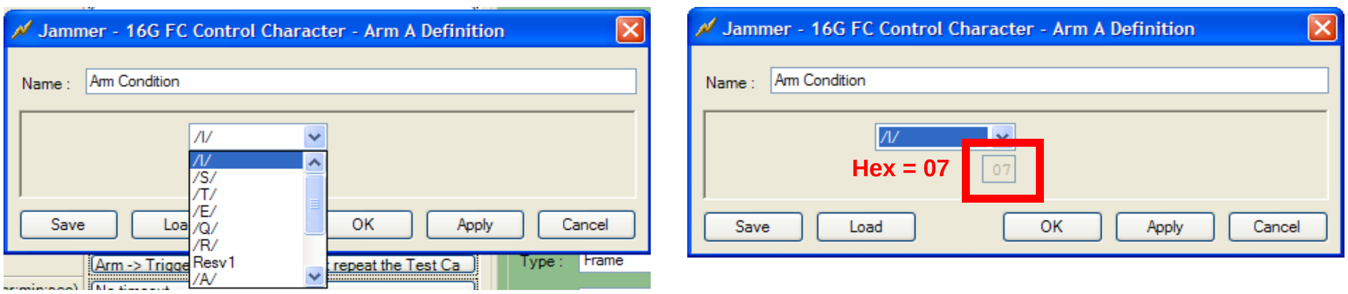


As with frame conditions, you can specify an optional name at the top of the window. This name is also shown in the Jammer Configuration window under the Mode selection and on the main Xgig Maestro window.

Setting Control Character Conditions for 16G FC Arm

You can choose from any standard one byte Control Character (Figure 206). The field below the drop-down menu shows the hex value of the Control Character selected.

Figure 206: 16G FC Arm Window Control Characters



Setting SOF Conditions for 16G FC Arm

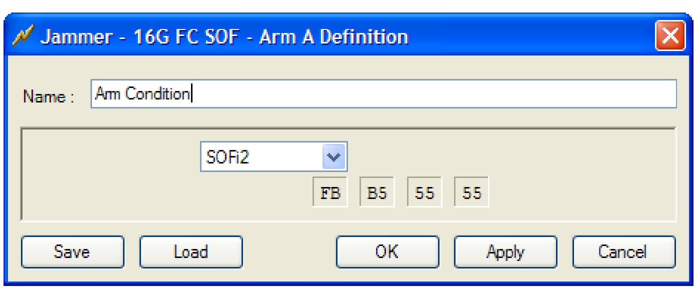
You can choose from a predefined Ordered Set representing the SOF or choose user-defined (Figure 207). All choices are four bytes. You can select either /Q/ or /Fsig/ for the first byte of a user-defined ordered set. You can enter hex values for the remaining three bytes.

To edit the values:

>> Enter a hex value, or double-click the byte field to open the Binary Editor.

As in frame conditions, an X indicates “don’t care” and a ? indicates a partially specified hex character.

Figure 207: 16G FC Arm Window-SOF



As with frame conditions, you can specify an optional name at the top of the window. This name is also shown in the Jammer Configuration window under the Mode selection and on the main Xgig Maestro window.

Setting EOF Conditions for 16G FC Arm

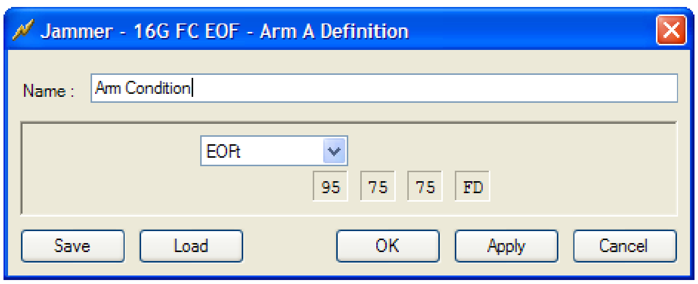
You can choose from a predefined Ordered Set representing the EOF or choose user-defined (Figure 208). All choices are four bytes. You can select either /Q/ or /Fsig/ for the first byte of a user-defined ordered set. You can enter hex values for the remaining three bytes.

To edit the values:

>> Enter a hex value, or double-click the byte field to open the Binary Editor.

As in frame conditions, an X indicates "don't care" and a ? indicates a partially specified hex character.

Figure 208: 16G FC Arm Window-EOF



As with frame conditions, you can specify an optional name at the top of the window. This name is also shown in the Jammer Configuration window under the Mode selection and on the main Xgig Maestro window.

Configuring the Trigger Condition for 16G FC

The 16G FC Trigger condition recognizes specific block type fields, ordered sets, control characters, frames, SOP, and SOP.

In 16G FC, you can select a trigger from the following options:

- Frame - Allows you to specify the 16G FC header and up to 114 bytes of payload
- Ordered Set - Provides you with predefined ordered sets, or allows you to define a four byte ordered set
- Control Character - Allows you to choose from pre-defined control characters
- SOF - Allows you to trigger at the SOF
- EOF - Allows you to trigger at EOF
- 66-bit Block Payload for Ordered Set

Depending on the Mode you select in the **Jammer Configuration** window, the appropriate graphic diagram shows the Trigger and optional Arm conditions, along with the Jam event. If the Mode you select does not include an Arm condition, the Arm button remains disabled.

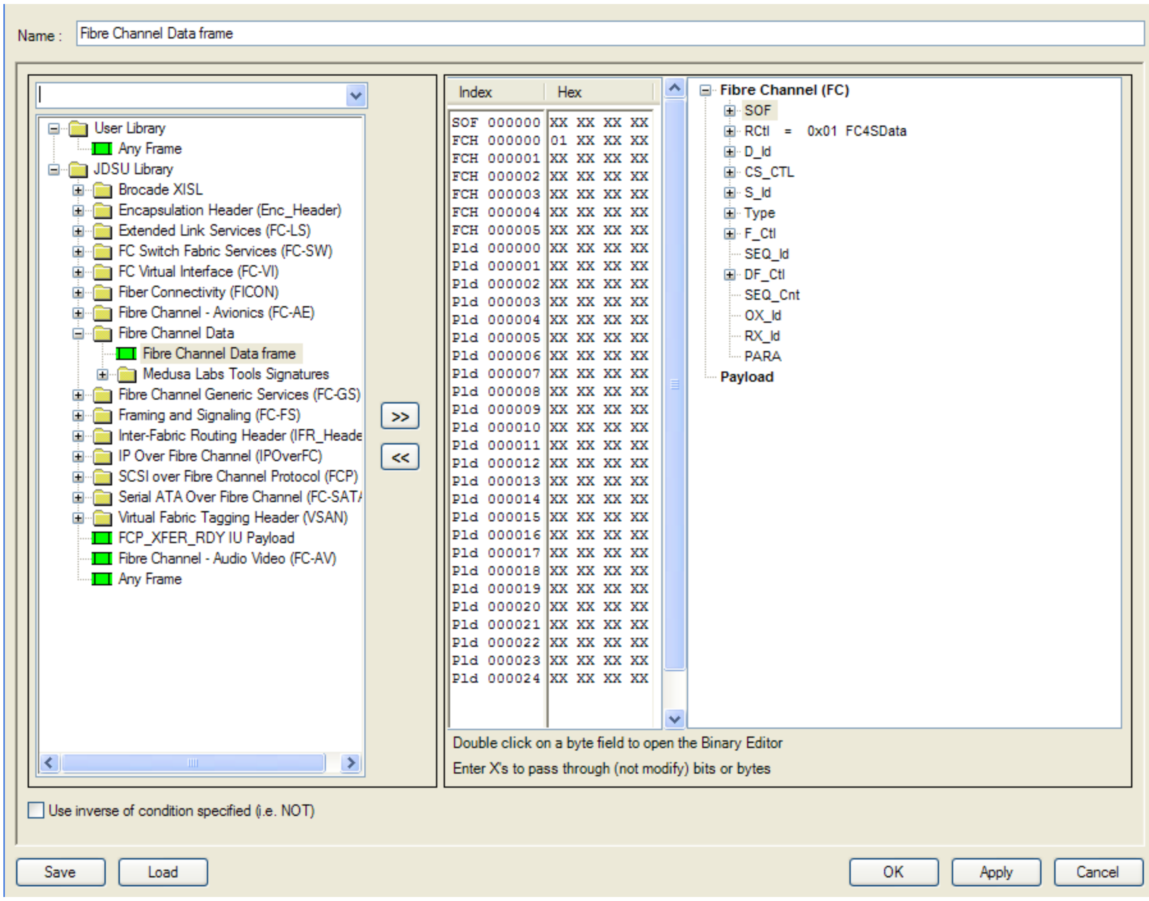
To set Trigger conditions:

1. Open the Type drop-down in the Trigger Condition window, and select Frame, Ordered Set, Control Character, SOP, EOP, or 66-bit Block Payload for Ordered Set.
2. Click the **Trigger** button in the Xgig Jammer Configuration window.

   The window for the condition is displayed (Figure 209). If you are in hardware edit mode, the protocol, chassis name, chassis number, slot number, and port numbers are displayed in the title bar.
3. Set the values as required to specify the Trigger condition as part of a unique Arm and Trigger sequence for the specific test.

   The following sections describe the available values.

Figure 209: 16G FC Trigger Window for Frames



Setting Frame Conditions for a 16G FC Trigger

You can specify frame conditions in two ways. One way is to load a template from the Template Library tree, and the other way is to manually specify bits in the frame.

To use a template:

1 Select a template from the Template Library tree on the left.

2 Click the double right arrow button to set the Trigger Condition.

The condition is indicated on the right side of the window.

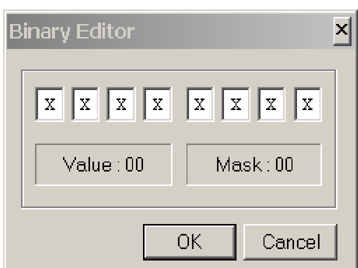
To manually specify a frame:

>> Type hexadecimal values directly into the center column of the window.

An X represents a nibble that can be any value (a “don’t care”).

To set individual bits in any field, double-click on the hex entry to open the Binary Editor (Figure 210). In the hex view, partially defined hex characters appear as question marks: `X001=?`

Figure 210: Binary Editor Dialog



Another way to manually edit the frame condition is to make selections from the tree view in the right window pane.

Decode Switches Menu

Some templates allow you to specify decode switches (Figure 211). When you load a template that has this option, the **Decode Switches Menu** appears in the upper left corner of the window. The decode switches provide detailed contextual options for decode; for example, further decode of response and data frames. The Decode Switches menu is context sensitive and will only show the decode options available for the specific template you are creating.

Note: Once the **Decode Switches** menu appears, it remains visible. However, if you load a template that has no decode options, the menu is greyed out and inactive.

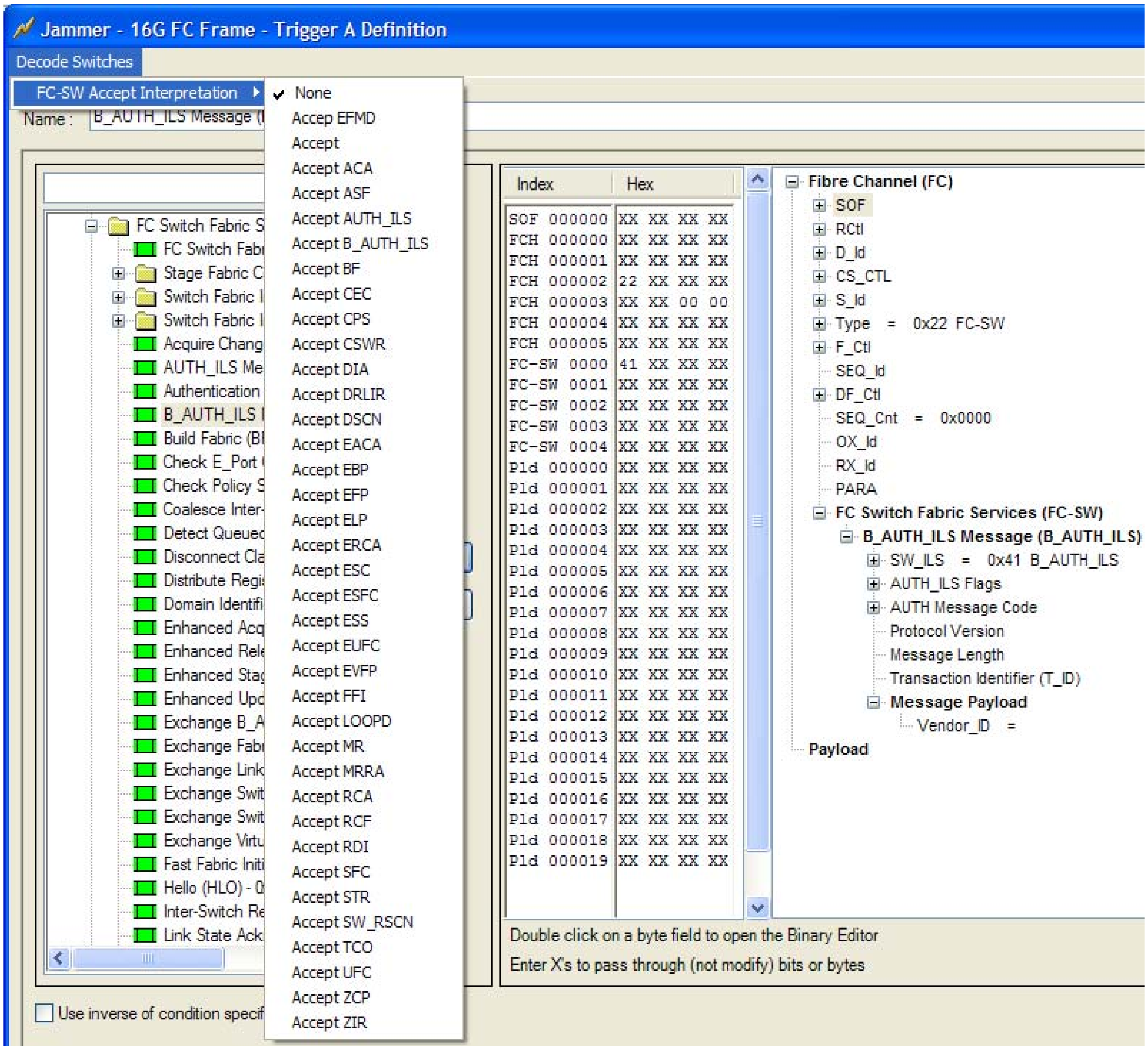
The **Decode Switches** menu is intended to help you create a user-defined template. When editing a User Library template, Decode Switches are stored inside the template so they are still ON the next time you open this particular template.

Decode switches allow you to further decode Response and Data frames that can't be decoded without knowing what the associated command frame is. Below is a description of the switches available for Jammer’s Trigger and Insert Frame conditions:

FC-SW Accept Interpretation

This menu item is available for FC-SW (Fibre Channel Switch Fabric Internal Link Service) Accept frames. It contains a list of the possible Switch Link Service Accept frame formats.

Figure 211: Decode Switch Options for FC-SW Accept Interpretation



Saving a Frame Condition

If you create a frame condition that you want to save and make easily available for future use, you can save it into the “User Library” folder in the Template Library tree. To do this:

>> Highlight the folder and click the double left arrow button.

Frame conditions have the option of “Use inverse of condition specified (i.e., NOT).” When you check this option, it means that the first frame encountered that does not match what you have specified creates a “condition met” event.

For each frame condition, you can specify an optional name at the top of the window. This name is also shown on the Jammer Configuration window under the Mode selection, and on the main Xgig Maestro window.

Setting Ordered Set Conditions for a 16G FC Trigger

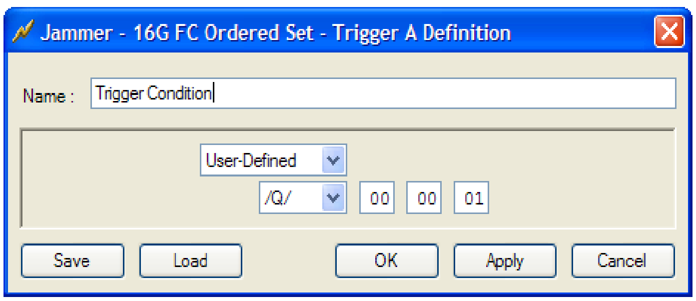
You can choose from a predefined Ordered Set (LF or RF) or choose user-defined (Figure 212). All choices are four bytes. You can select either /Q/ or /Fsig/ for the first byte of a user-defined ordered set. You can enter hex values for the remaining three bytes.

To edit the values:

>> Enter a hex value, or double-click the byte field to open the Binary Editor.

As in frame conditions, an X indicates “don’t care” and a ? indicates a partially specified hex character.

Figure 212: 16G FC Trigger Window-Ordered Sets

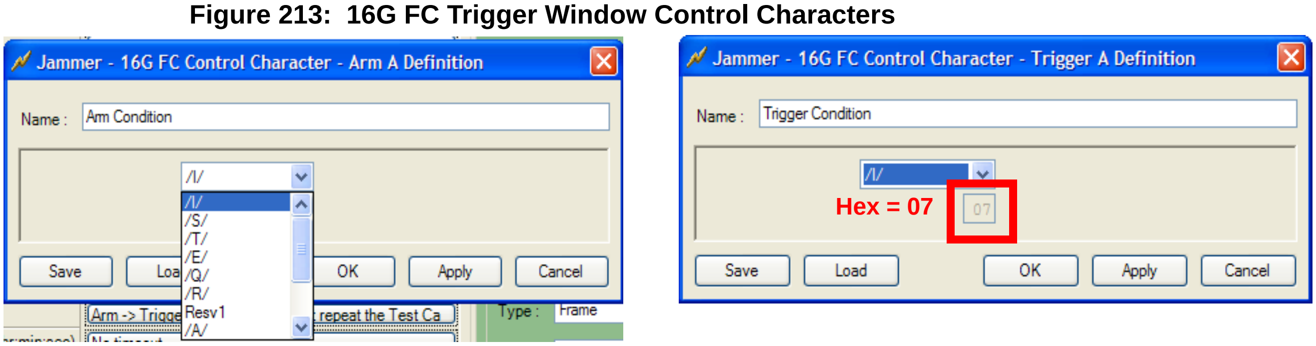


As with frame conditions, you can specify an optional name at the top of the window. This name is also shown in the Jammer Configuration window under the Mode selection and on the main Xgig Maestro window.

Setting Control Character Conditions for a 16G FC Trigger

You can choose from any standard one byte Control Character (Figure 213). The field below the drop-down menu shows the hex value of the Control Character selected.

Figure 213: 16G FC Trigger Window Control Characters



Setting SOF Conditions for 16G FC Trigger

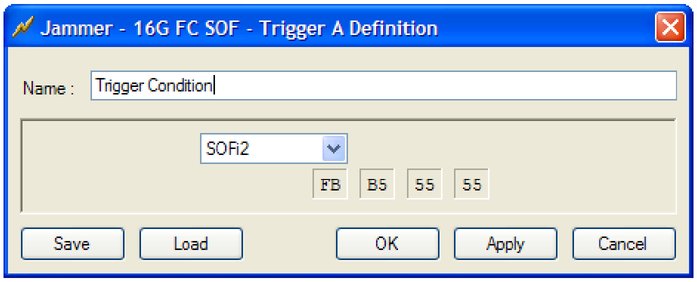
You can choose from a predefined Ordered Set representing the SOF or choose user-defined (Figure 214). All choices are four bytes. You can select either /Q/ or /Fsig/ for the first byte of a user-defined ordered set. You can enter hex values for the remaining three bytes.

To edit the values:

>> Enter a hex value, or double-click the byte field to open the Binary Editor.

As in frame conditions, an X indicates “don’t care” and a ? indicates a partially specified hex character.

Figure 214: 16G FC Trigger Window-SOF



As with frame conditions, you can specify an optional name at the top of the window. This name is also shown in the Jammer Configuration window under the Mode selection and on the main Xgig Maestro window.

Note: When you select SOF as the trigger, the only jam type available is SOF.

Setting EOF Conditions for 16G FC Trigger

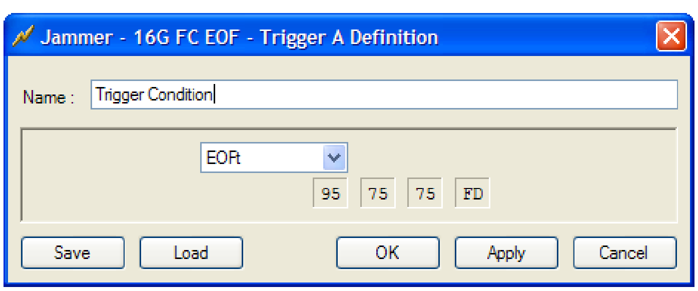
You can choose from a predefined Ordered Set representing the EOF or choose user-defined (Figure 215). All choices are four bytes. You can select either /Q/ or /Fsig/ for the first byte of a user-defined ordered set. You can enter hex values for the remaining three bytes.

To edit the values:

>> Enter a hex value, or double-click the byte field to open the Binary Editor.

As in frame conditions, an X indicates “don’t care” and a ? indicates a partially specified hex character.

Figure 215: 16G FC Trigger Window-EOF



As with frame conditions, you can specify an optional name at the top of the window. This name is also shown in the Jammer Configuration window under the Mode selection and on the main Xgig Maestro window.

Note: When you select EOF as the trigger, the only jam type available is EOF. The jam window contain a message similar to the one above.

Setting 66-bit Block Payload for Ordered Set Conditions for 16G FC Trigger

You can select to compare the block type field only within the block payload, to compare a ordered set within the block payload, or to compare both.

If you select to **Compare block type field only** (See Figure 216) or **Compare both** (See Figure 217), select a block type field from the **Block type field** drop-down menu. If you select **Compare an ordered set only** or **Compare both**, choose from a predefined Ordered Set or **User-Defined** from the **Ordered set** drop-down menu. You can select either /Q/ or /Fsig/ for part of a user-defined ordered set. You can enter hex values for the remainder of the ordered set by typing values into the fields, or you can double-click a value to bring up the Binary Editor.

Figure 216: 66-bit Trigger: Compare Block Type Field Only

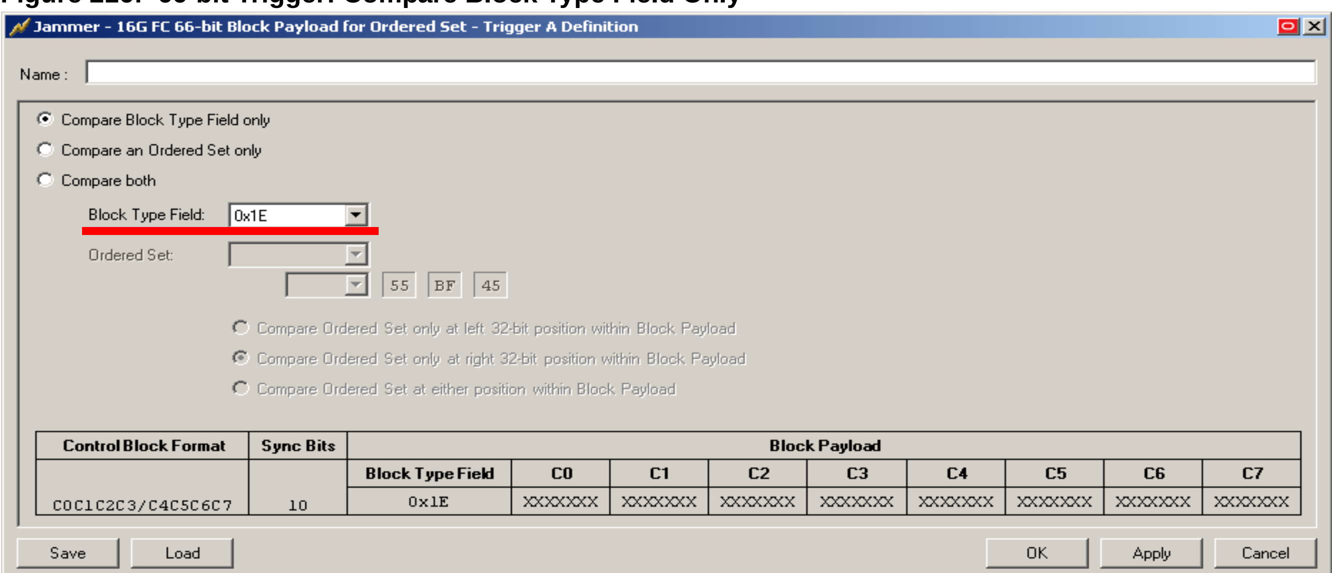
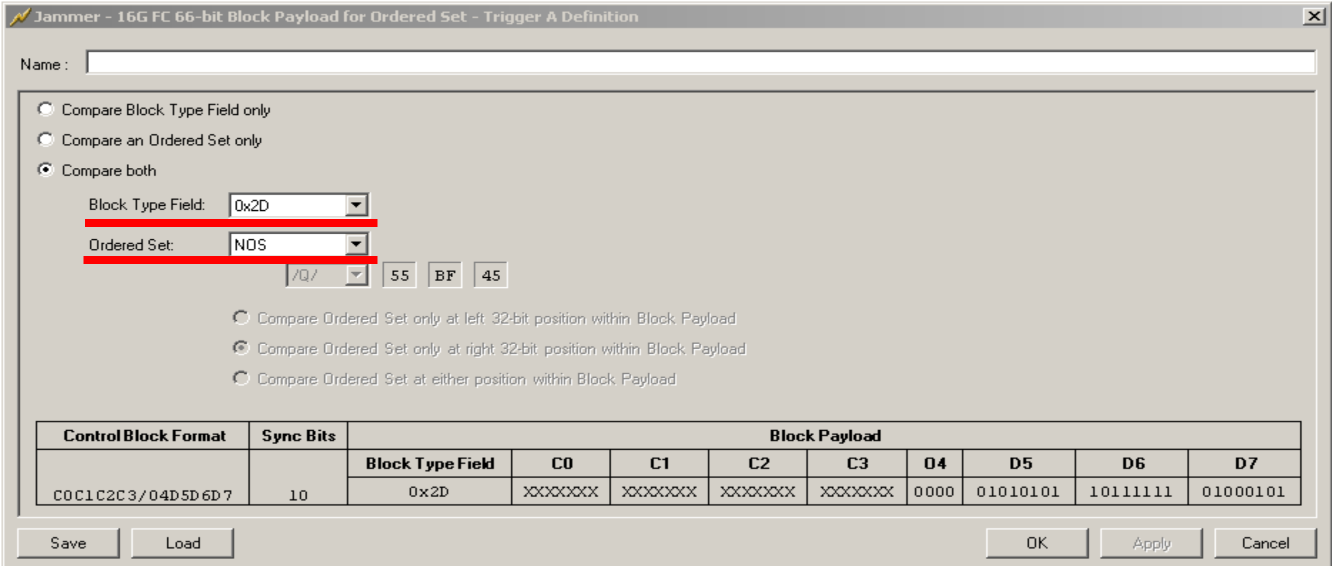
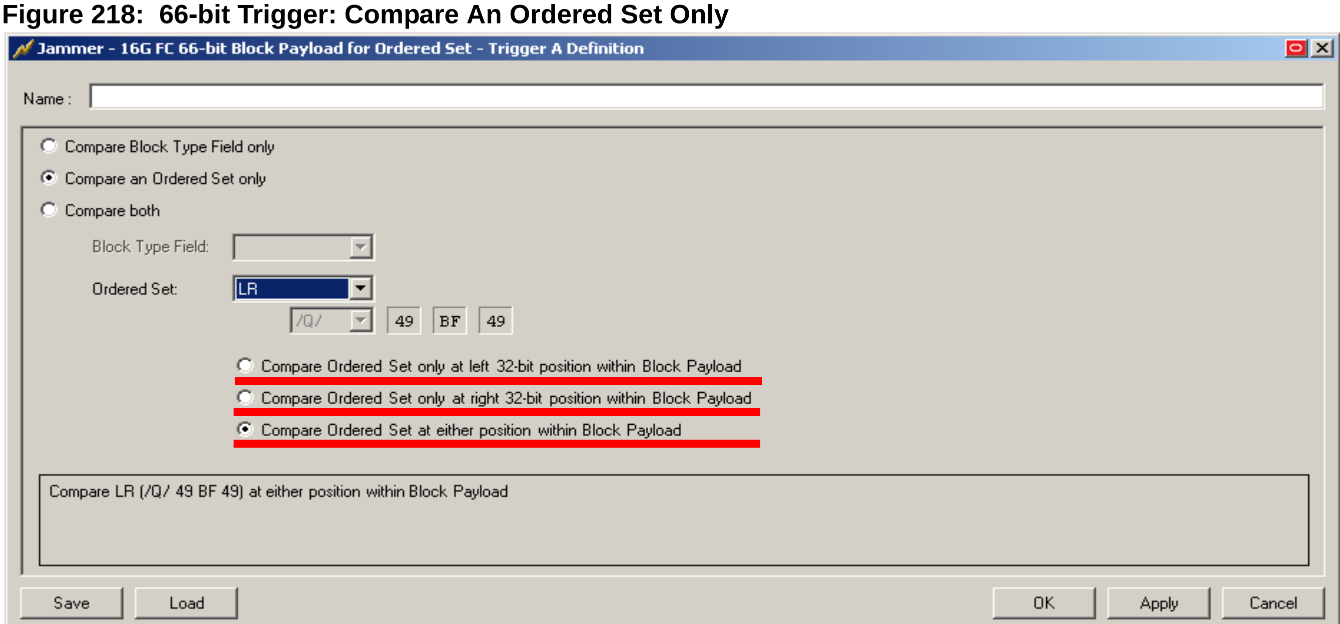


Figure 217: 66-bit Trigger: Compare Both



If you select **Compare an ordered set only** (See Figure 218), you can choose to compare the ordered set only at the left 32-bit position within the block payload, only at the right 32-bit position within the block payload, or at either position within the block payload. If you selected **Compare both** above, then **Compare ordered set only at right 32-bit position within block payload** is automatically selected, and the other selections are grayed out.

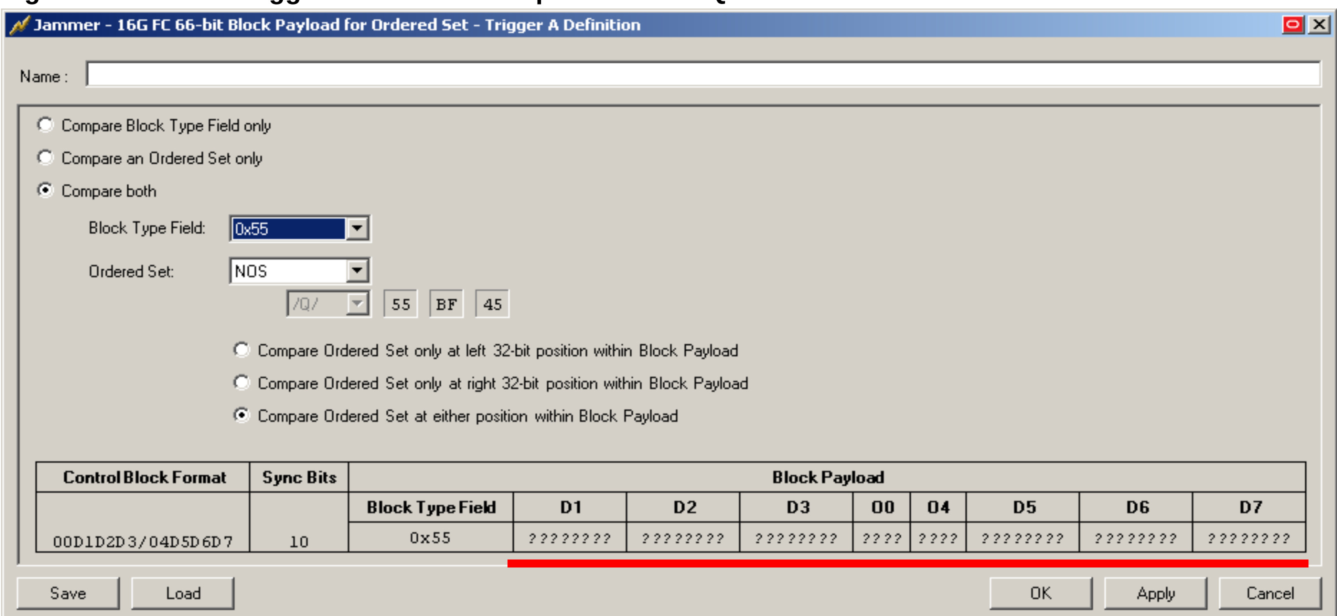
Figure 218: 66-bit Trigger: Compare An Ordered Set Only



The trigger definition you create is shown in a pane at the bottom of the **16G FC 66bit Block Payload for Ordered Set Trigger Definition** window. The trigger definition will also be shown in the **16G FC 66bit Block Payload Jam Definition** window to assist you in defining your jam.

If you selected **Compare both** above, and you selected 0x55 as your **Block type field**, and you selected **Compare ordered set at either position within block payload**, all the values for the block payload are shown as "?" (See Figure 219). The values are represented this way to indicate that if the selected ordered set is encountered either in the right 32-bit position, or in the left 32-bit position, or in both positions, then the values will be compared, as 0x55 in the only block type field that will have an ordered set in both the left and right positions at all times.

Figure 219: 66-bit Trigger: 0x55 Values Represented as Question Marks



Configuring the Jam Definition for 16G FC

The **Jam Definition** window defines how to modify the event specified on the **Trigger Condition** window.

The type of Jam available depends on the type of Trigger selected. In the case of SOF, EOF and 66-bit, the Jam is always the same type as the trigger.

For any Jam Definition, you can specify an optional name at the top of the window. This name is also displayed on the Jammer Configuration window under Mode selection and on the main Xgig Maestro window.

You can save a Jam definition as a `.jmj` file by clicking the **Save** button in the **Jam** window. You can load a `.jmj` file by clicking the **Load** button in the **Jam** window.

Jamming an Ordered Set for 16G FC

If the Trigger Event is an Ordered Set, and you want to Jam with an Ordered Set, select Replace with Modified Ordered Set Jam from the drop-down menu, and click the **Jam** button on the Xgig Jammer Configuration window, to open the Ordered Set Jam Definition window (Figure 220).

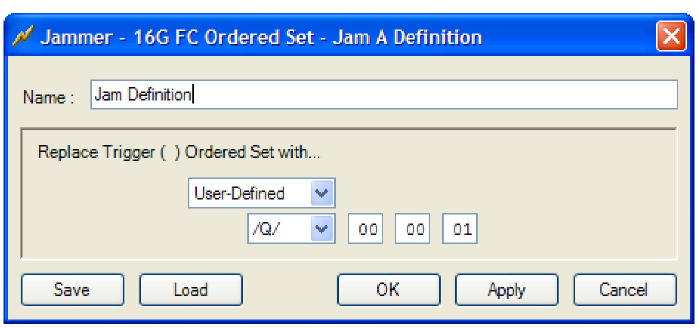
The Ordered Set Jam Definition window allows you to modify any Ordered Set by replacing it with a different Ordered Set. You can choose from a predefined Ordered Set or choose user-defined (Figure 205). All choices are four bytes. You can select either /Q/ or /Fsig/ for the first byte of a user-defined ordered set. Then, you can enter hex values for the remaining three bytes.

To edit the values:

>> Enter a hex value, or double-click the byte field to open the Binary Editor.

As in frame conditions, an X indicates “don’t care” and a ? indicates a partially specified hex character.

Figure 220: 16G FC Ordered Set Jam Definition Window

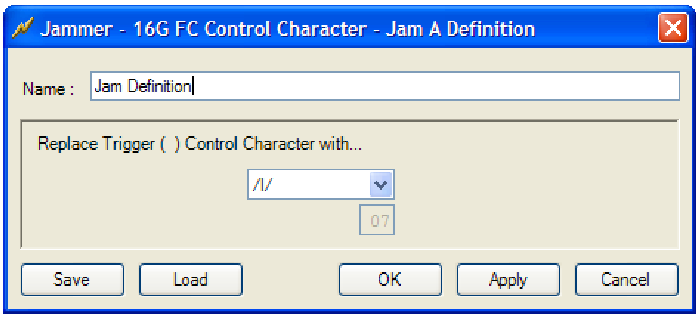


Jamming a Control Character for 16G FC

If the Trigger Event is a Control Character, click the **Jam** button on the Xgig Jammer Configuration window, to open the Control Character Jam Definition window (Figure 220).

The Control Character Jam Definition window allows you to modify any Control Character by replacing it with a different Control Character.

Figure 221: 16G FC Control Character Jam Definition Window



Jamming the SOF for 16G FC

If the Trigger Event is an SOF, click the **Jam** button on the Xgig Jammer Configuration window, to open the SOF Jam Definition window (Figure 220).

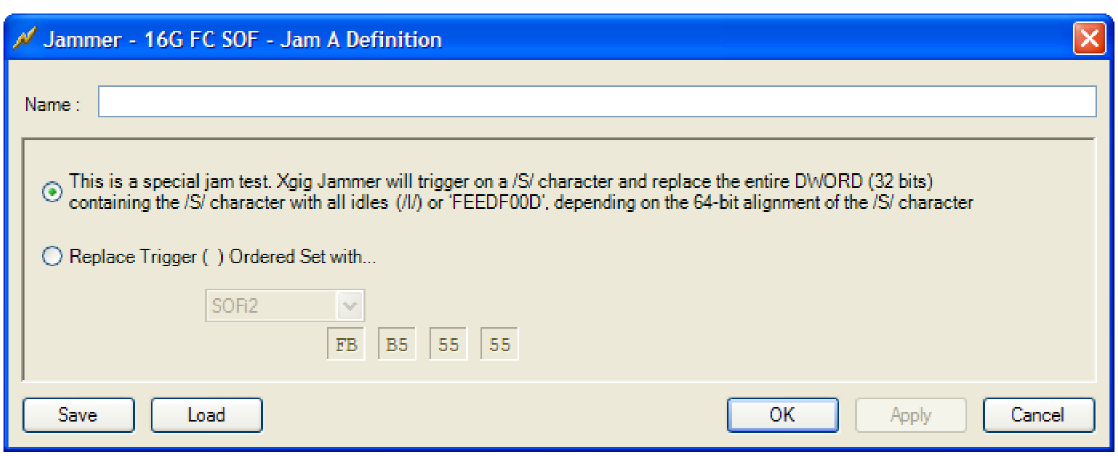
The SOF Jam Definition window allows you to replace the SOF with idles, with a another pre-defined SOF, or with an Ordered Set. You can choose from a predefined Ordered Set or choose user-defined (Figure 205). All choices are four bytes. The first byte is defined as “FB”. You can modify the last three bytes by entering hex values.

To edit the values:

>> Enter a hex value, or double-click the byte field to open the Binary Editor.

As in frame conditions, an X indicates “don’t care” and a ? indicates a partially specified hex character.

Figure 222: 16G FC SOF Jam Definition Window



Jamming the EOF for 16G FC

If the Trigger Event is an EOF, click the **Jam** button on the Xgig Jammer Configuration window, to open the EOF Jam Definition window (Figure 220).

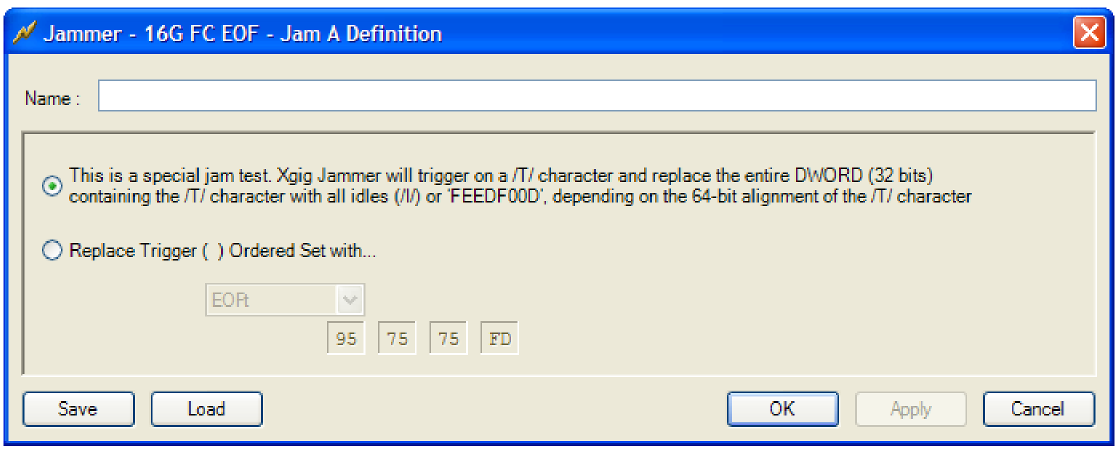
The EOF Jam Definition window allows you to replace the EOF with idles, with a another pre-defined EOF, or with an Ordered Set. You can choose from a predefined Ordered Set or choose user-defined (Figure 205). All choices are four bytes. The last byte is defined as “FD”. You can change the first three bytes by entering hex values.

To edit the values:

>> Enter a hex value, or double-click the byte field to open the Binary Editor.

As in frame conditions, an X indicates “don’t care” and a ? indicates a partially specified hex character.

Figure 223: 16G FC EOF Jam Definition Window



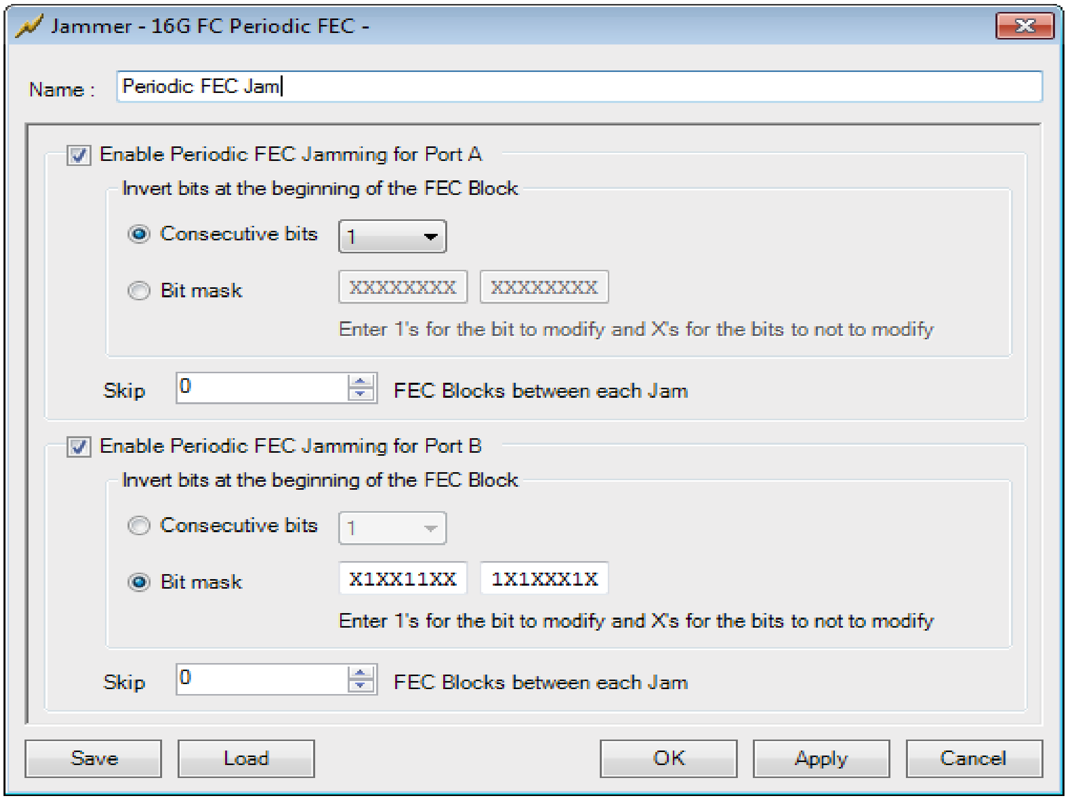
Jamming the Periodic FEC for 16G FC

You can create a test case with Periodic FEC Jam by selecting **Periodic FEC Jam on A and B** from the **Mode** drop-down menu. This mode allows you to configure the number of consecutive bits to be corrupted or define a bit mask to configure which of the first 16 bits will be corrupted. It also allows you to count of the FEC block to be skipped before a FEC Jamming.

A test case with Periodic FEC Jam will not have Arm/Trigger definition. Periodic FEC Jam Type is the only Jam type available for the Jam type. When you click the **Jam** button, the **16G FC Periodic FEC** window appears. This window contains a check box for each port, **Enable Periodic FEC Jamming for Port A** and **Enable Periodic FEC Jamming for Port B**. In addition, you can select to invert a number (1-16) of consecutive bits at the beginning of the FEC Block. You can also skip a number of FEC Blocks between each Jam.

Since Periodic FEC Jamming runs forever, rollback, repeat mode, timeout, and pause settings are disabled for this mode.

Figure 224: 16G FC Periodic FEC Jam Window



Jamming a Frame for 16G FC

To define a Jam for a frame:

1 Select a Jam from the **Jam Type** drop-down menu.

2 Click the **Jam** button to configure the Jam.

This section explains the available Jam Types.

— Replace Frame with Modified Frame
— Insert Frame
— Replace Frame with Truncated Frame
— Replace Frame with Idles
— Duplicate Frame
— Insert Dword

Replace Frame with Modified Frame

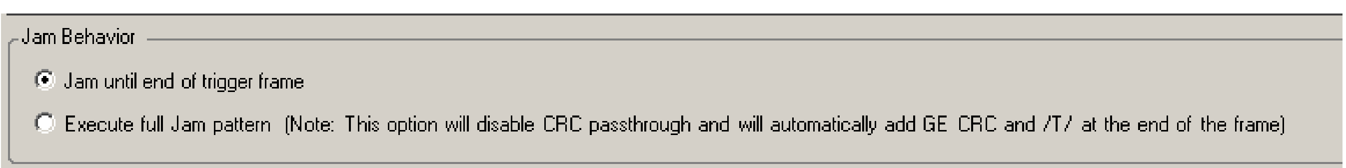
Each tab of the Modified Frame window contains options relevant to different frame modifications.

— Global
— Delimiters/CRC
— Header/Payload
— Embedded Protocol(s)

Jam Behavior (All Tabs)

The **Jam Behavior** pane in located at the bottom of each tab in the **Frame Jam Definition** window. The Jam behavior settings control the number of user-defined header/payload Jams performed relative to the target trigger frame.

Figure 225: Jam Behavior Selection



- **Jam until end of trigger frame**

  Jams defined in the Header/Payload tab are performed until the end of the target trigger frame (or until an abnormal termination of the frame). All Jams defined that would take place on the original CRC or later are ignored. However, if the frame that is triggered on has more Dwords than the Jams you specify, the remaining Dwords are passed through. The CRC and EOF of the original target trigger frame are always jammed according to the CRC and EOF settings on the SOF/CRC/EOF tab. This is the standard way to Jam a frame.

- **Execute full Jam pattern**

  All header and payload Jams are executed even if they overwrite beyond the end of the target trigger frame.

  If the target trigger frame is longer than the number of Jams defined, then the portion of the target trigger frame that extends after the last defined Jam is overwritten with /I/. If the target trigger frame is shorter, then the Jammer switches back to pass-through immediately after the last defined Jam. Use the control on the Header/Payload tab at the bottom of the List View pane to define how many payload Jams should take place.

  The Execute full Jam option is supported only when any template from the FCoE library is loaded into the Header/Payload edit area.

  The following **Delimiter** options are supported:

  - SOF modification
  - EOF modification (always enabled)
  - CRC recalculate / replace / passthrough

Using the Global Tab

Use this tab (Figure 226) to define Jam parameters that apply globally to the frame.

Global Replace Jam Option

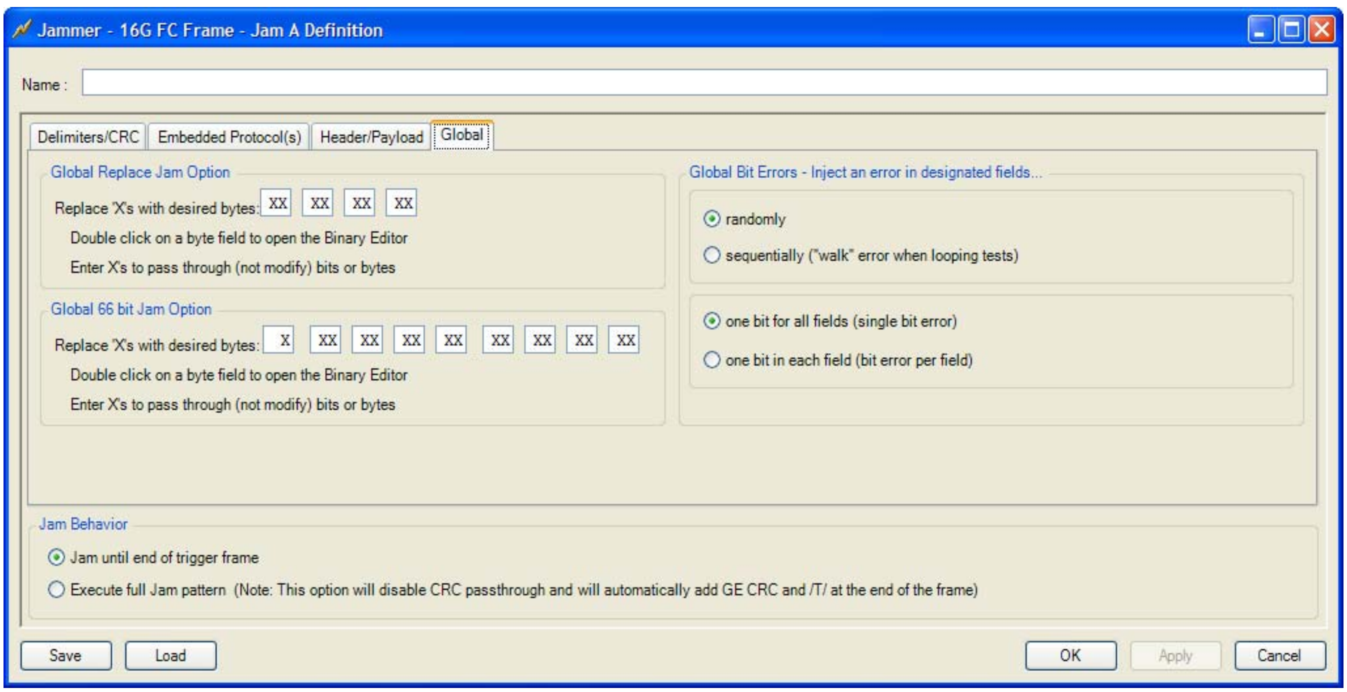
Use the Global Replace Jam Option word to set specific bits on an 8 bit level in a word to 1 or 0 while passing through the remaining bits. You can apply this replace jam option to any word in the frame. Define one Global Replace Jam Option for each Test Case.

To edit these bits:

>> Enter hex values, or double-click on a byte field to open the Binary Editor.

Any bits left as Xs are passed through.

Figure 226: 16G FC Global Tab



Global 66b Jam Option

Use the Global 66b Jam Option word to set specific bits at the 64 bit level in a word to either 1 or 0 while passing through the remaining bits. You can apply this 66b jam option to any word in the frame. Define one Global 66b Jam Option for each Test Case.

To edit these bits:

>> Enter hex values, or double-click on a byte field to open the Binary Editor.

Any bits left as Xs are passed through.

Global Bit Errors

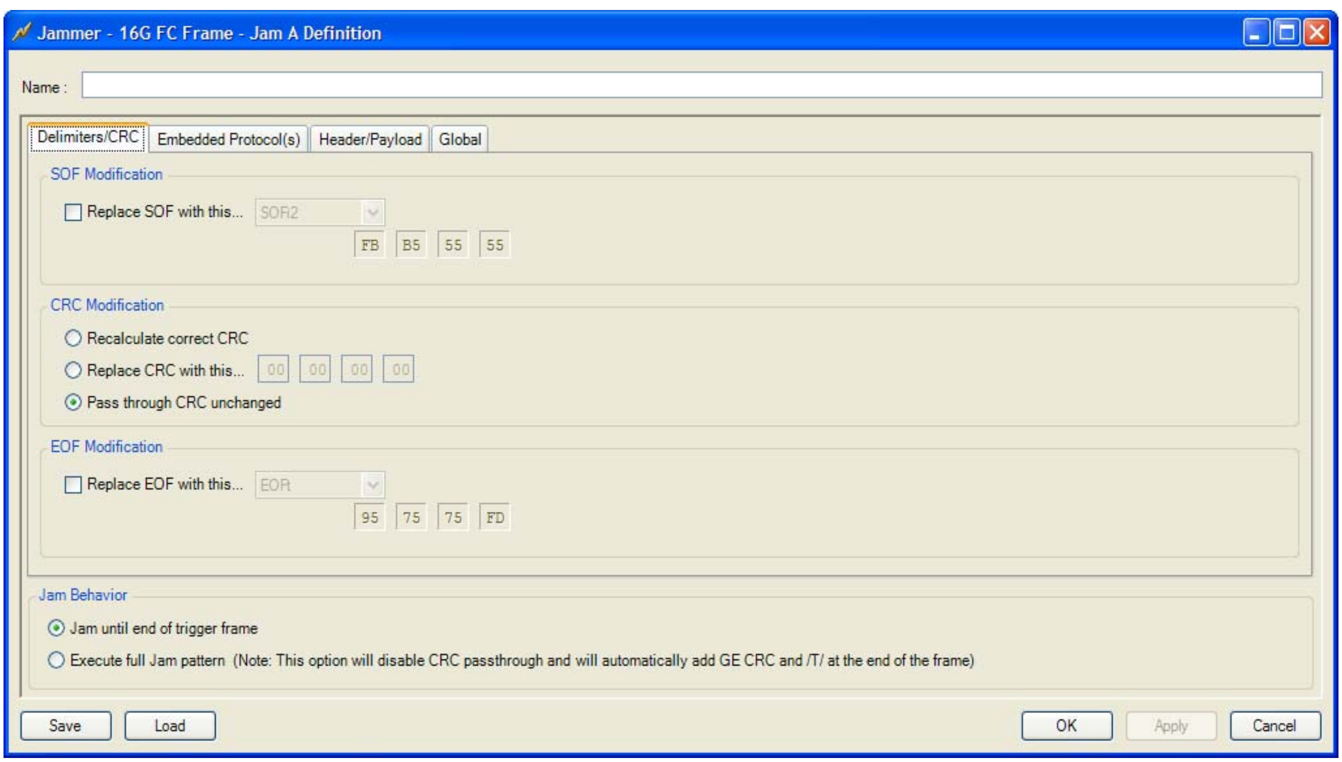
The Jammer software can introduce bit errors repeatedly in sequential or random fashion to predefined fields. These bit errors are introduced to the 32-bit form of the target words (not the 40-bit form) so code violations are not created. The Global Bit Errors control allows you four options.

- Select **one bit for all fields** and **randomly**. This causes the Jammer to inject a single bit error in the group of all fields selected in the header or payload for a single Test Case. If the Jammer Test Suite is set to *loop*, then single bit errors are randomly injected into these fields, with one bit for each cycle of the Test Suite.
- Select **one bit for all fields** and **sequentially**. This also injects a single bit error in the group of all fields selected in the header or payload. If the Test Suite is set to loop forever, the bit error walks through all the selected fields.
- Select **one bit in each field** and **randomly** does the same thing as the first option; however, there will be one error for each word selected in the payload or header.
- Select **one bit in each field** and **sequentially** does the same thing as the second option; however, there will be one error for each word selected in the payload or header.

Using the Delimiters/CRC Tab for Fibre Channel

Use the choices on this tab to modify the Start of Frame (SOF) Modification, CRC Modification, and End of Frame (EOF) Modification (Figure 227).

Figure 227: 16G FC Delimiters/CRC Tab



Modifying SOF/EOF

To modify these special characters in the target trigger frame:

1. Check the appropriate box to select replacement.
2. Open the drop-down menu and choose a standard 16G FC Ordered Set, or select User-defined.

   If you choose User-defined, you can specify any value for the last three bytes for SOF (The first byte is defined as "FB") or the first three bytes for EOF (The last byte is defined as "FD").

   To edit the value enter a hex value into the byte field or double-click to display the Binary Editor.

CRC Options

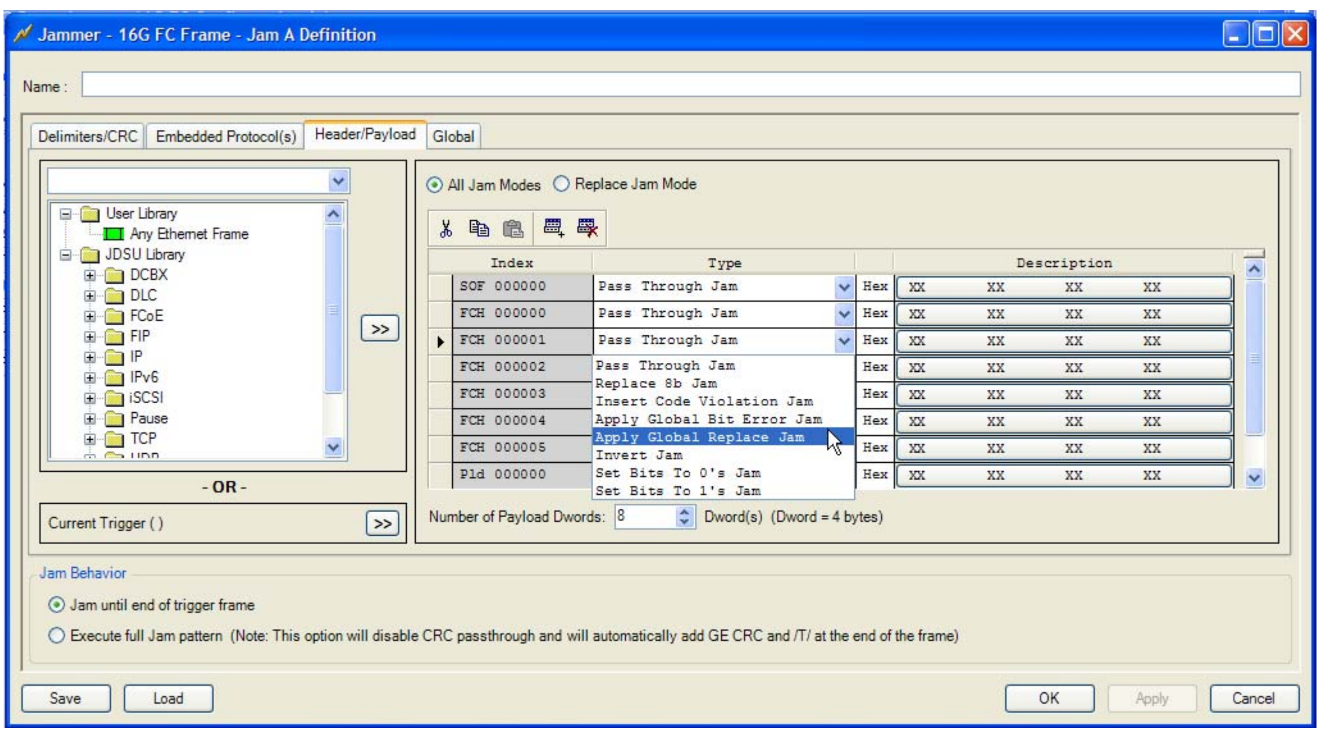
The CRC options include:

- Not changing the CRC in the original target frame
- Recalculating the CRC to make it correct for the modified data
- Replacing with a user-specified data word

Using the Header/Payload Tab for 16G FC

You can modify any parameter or word on the 16G FC Header/Payload Tab (Figure 228). The maximum size for a payload is 2048 payload Dwords.

Figure 228: 16G FC Header/Payload Tab



Notice the first line of the Jam Definition (Ether 0001) has only the first two bytes of the Destination Address header field. This is to visually orient the frame in the same manner as the Arm and Trigger Condition windows.

Similar to defining an Arm or Trigger Condition, there are two ways to specify your frame Jam Definition. One way is to load a template from the Template Library tree, and the other way is to manually specify bits in the frame.

To use a template:

1. Highlight a template in the Template Library tree on the left side of the window.

   Tree View is structured similar to the display on the right side of the Arm and Trigger Condition windows. You can make selections from the tree; this creates the appropriate Replace Jams.

2. Click the double right arrow to display the Jam definition on the right side of the window.

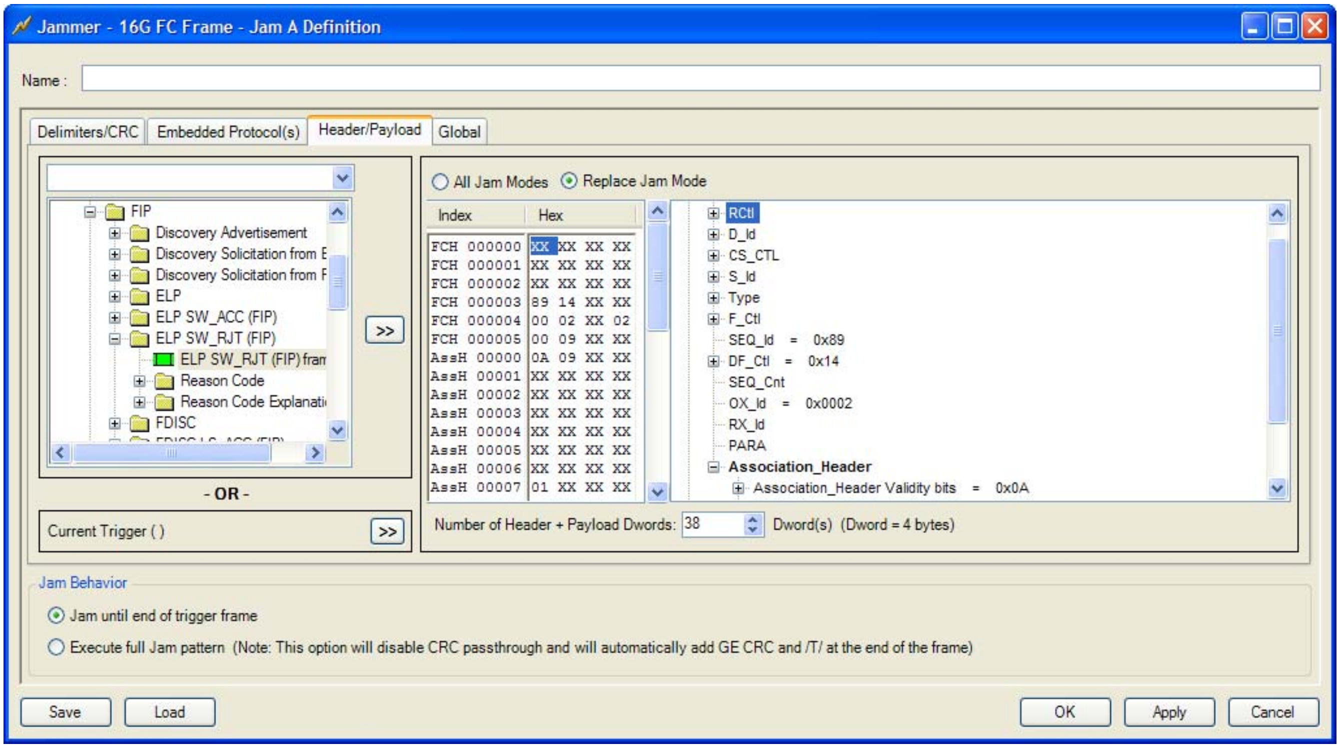
Notice the special choice at the bottom left, “Current Trigger.” This is a copy of the frame condition you have specified for the Trigger. Click the double right arrow to use this.

When you use a template, the Jam definition is populated with Replace Jams of the specified data, while all other bits are passed through.

To manually edit the values, enter a value into the byte field. An **X** in a nibble passes the original value through.

Selecting the **Replace 8b Jam Mode** radio button opens a dialog that allows you to replace an entire frame either by using a template or manually entering values. The Replace 8b Jam Mode dialog also contains a view of the frame contents, similar to those seen the Arm and Trigger Condition windows. These values correspond to the hex values defined in the center column.

Figure 229: Replace 8b Jam Mode



Selecting the **All Jam Modes** radio button opens a dialog that provides the following choices for each word in a frame on the Header/Payload tab:

Apply Global Replace Jam - This function allows individual bits to be set to 1, set to 0 or passed through unchanged according to the Global Replace Jam option defined on the Global tab.

Invert Jam - Invert defined bits and pass through the rest. Enter 1s at the appropriate bit locations.

Pass Through Jam - Pass through the current word unchanged.

Replace 8b Jam - Replace nibbles with new values. Each drop-down represents a byte so you can replace a byte with a standard Ordered Set. If you choose User-defined, you can specify any K/D character. To edit these values, enter a value into the byte field or double-click to display the Binary Editor. If you specify a bit as a 0 or 1, you must specify the values of the other three bits in that nibble also. Any nibbles with an X are passed through.

Set Bits To 0s Jam - Set defined bits to 0s and pass through the rest. Enter 0s at the appropriate bit locations.

Set Bits To 1s Jam - Set defined bits to 1s and pass through the rest. Enter 1s at the appropriate bit locations.

Apply Global Bit Error Jam - Apply the Global Bit Error function set on the Global tab.

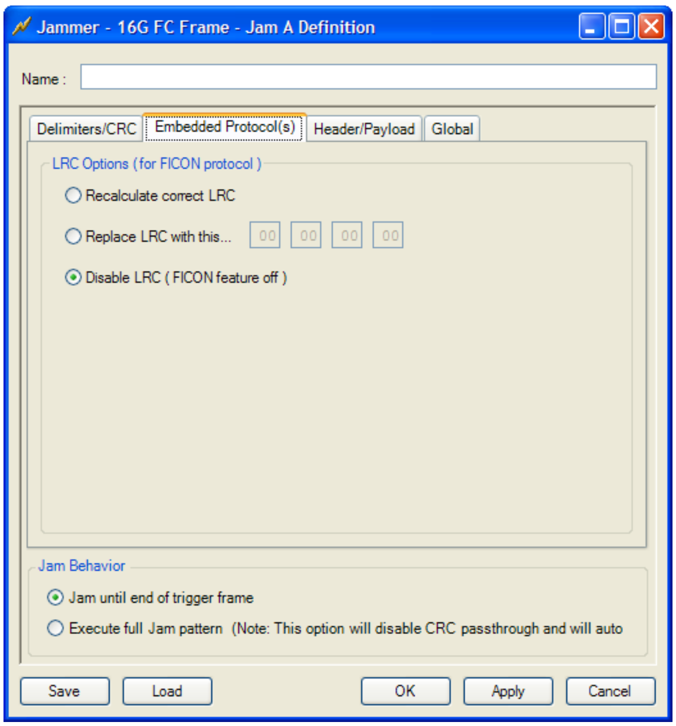
Insert Code Violation Jam - Introduce a predefined, fixed code violation to a byte in that word. Which byte is corrupted depends on the alignment orientation of the frame. The Jam Definition of the word before a Code Violation Jam must always be a Pass Through Jam. A Code Violation Jam cannot be placed in the first word of a frame (Ether 0001).

Tree View - Another way to manually edit or view your Jam Definition is to click the **Switch to** button at the lower right corner to toggle between List View and Tree View. The List View interface is described in the procedures in this chapter. Tree View is structured similar to the display on the right side of the Arm and Trigger Condition windows. You can make selections from the tree; this creates the appropriate Replace Jams.

Using the Embedded Protocol(s) Tab for Fibre Channel

Figure 230 shows the Embedded Protocol(s) tab for 16G FC. The available functions are described in this section.

Figure 230: 16G FC Embedded Protocol(s) Tab



Recalculate LRC

Select the check boxes to choose recalculation of the LRC.

Replace LRC with this...

Checking this option replaces the LRC with a user-defined DWORD.

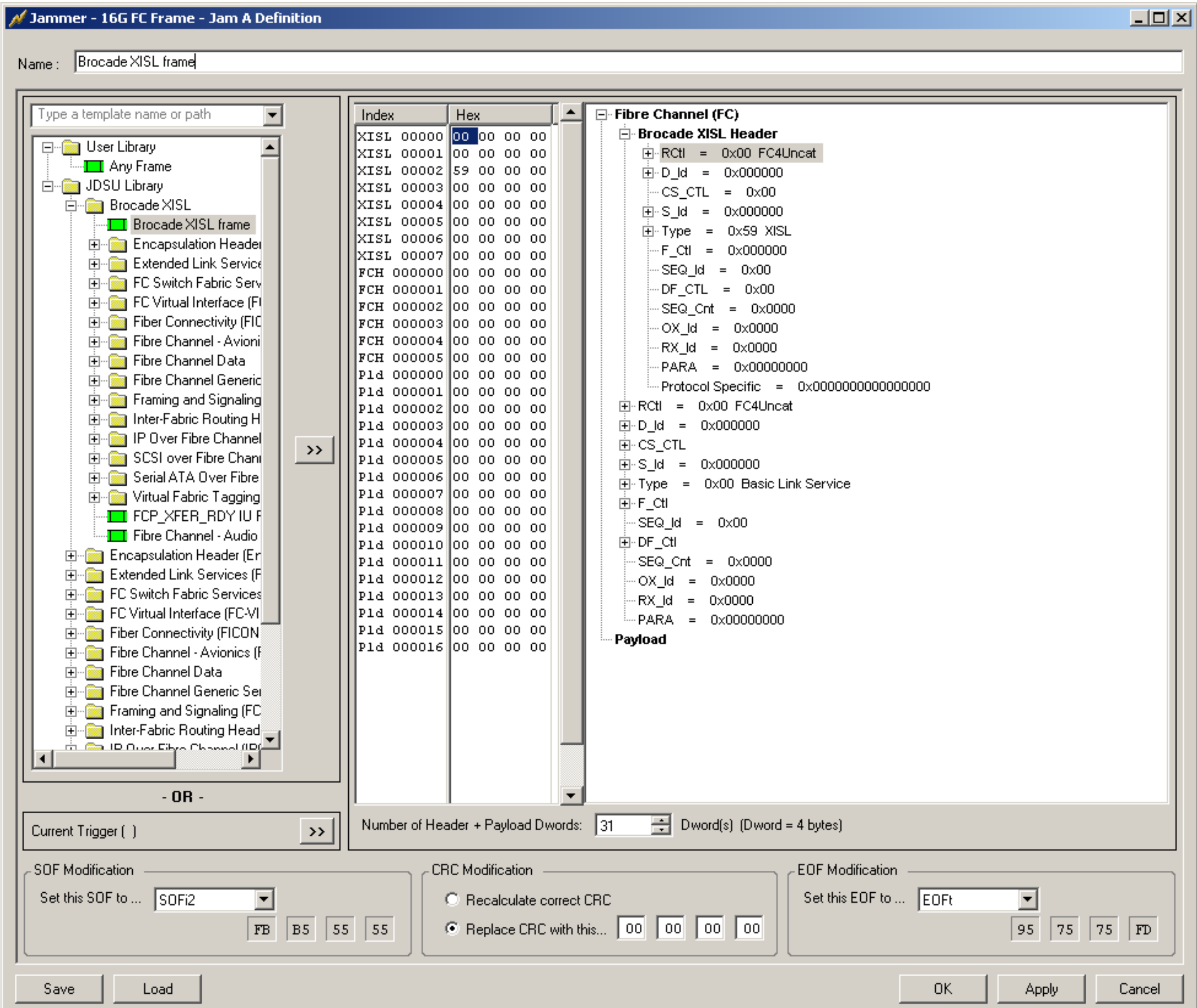
Disable LRC

Checking this option disables the LRC and turns the FICON feature off.

Insert Frame

This option allows you to insert a 16G FC frame after trigger. You can define the header and the payload using the Template Tree on the left pane, or you can manually define the frame.

Figure 231: 16G FC Jam - Insert Frame Window



To use a template, click a frame template from the User Library or the Viavi Library in the left pane, then click the double right arrows to apply the template. The frame header and payload information appears on the right side of the window.

Notice the special choice at the bottom left, “Current Trigger.” This is a copy of the frame condition you have specified for the Trigger. Click the double right arrow to use this.

To manually define a frame, type hexadecimal values directly into the center column of the window.

You can modify any parameter or word in the 16G FC header or payload. The maximum size for a header + payload is 540 Dwords. The minimum size is six Dwords.

SOF Modification

You can choose from a predefined Ordered Set representing the SOF or choose user-defined. All choices are four bytes. For a user-defined ordered set, the first byte is FB. You can enter hex values for the remaining three bytes.

To edit the values:

>> Enter a hex value, or double-click the byte field to open the Binary Editor.

CRC Modification

You can choose to either recalculate the correct CRC to make it correct for the modified data or to replace the CRC with a user-specified DWORD.

To edit the values:

>> Enter a hex value.

EOF Modification

You can choose from a predefined Ordered Set representing the EOF or choose user-defined. All choices are four bytes. For a user-defined ordered set, the last byte is FD. You can enter hex values for the remaining three bytes.

To edit the values:

>> Enter a hex value, or double-click the byte field to open the Binary Editor.

Decode Switches Menu

Some templates allow you to specify decode switches. When you load a template that has this option, the **Decode Switches Menu** appears in the upper left corner of the window. The decode switches provide detailed contextual options for decode; for example, further decode of response and data frames. The Decode Switches menu is context sensitive and will only show the decode options available for the specific template you are creating.

Note: Once the **Decode Switches** menu appears, it remains visible. However, if you load a template that has no decode options, the menu is greyed out and inactive.

The **Decode Switches** menu is intended to help you create a user-defined template. When editing a User Library template, Decode Switches are stored inside the template so they are still ON the next time you open this particular template.

Decode switches allow you to further decode Response and Data frames that can't be decoded without knowing what the associated command frame is. Below is a description of the switches available for Jammer's Trigger and Insert Frame conditions:

FCoE Interpretations

This menu is available for FCoE frames. Fibre Channel over Ethernet (FCoE) is the proposed mapping of Fibre Channel over selected full duplex IEEE 802.3 networks. The **Auto-Detect FCoE** setting automatically detects the version and is the default decode switch. The auto-detect mode works on a per-FCoE frame basis. It assumes that the FCoE frame reserved bits are set to zero and detects which FCoE specification is in use depending on where the zeroes are. If you end up with multiple errors and erroneous decoding of the FCoE frames, it is because the auto-detect mode assumptions do not work with your particular trace. This requires that select manually which FCoE specification to use. Available settings are:

- **Auto-Detect FCoE**
  Automatically detects the specification version by looking at the frame header.
- **T11 FCoE (Latest)**
  Selects the latest draft of the T11 standards committee specification as of this Xgig Analyzer release date.
- **Pre-T11 FCoE Draft**
  Selects the pre-T11 standards committee draft, 07-303v0.pdf.

FC-ELS Accept Interpretation

This menu item is available for FC-ELS (Fibre Channel Extended Link Services) Accept frames. It contains a list of the possible Link Services Accept frame formats.

Saving a Frame

If you create a frame that you want to save and make easily available for future use, you can save it into the “User Library” folder in the Template Library tree. To do this:

1. Make sure the frame contents are displayed in the right pane.
2. Type a name for the frame, and click the double left arrow button.

   The frame appears in the User Library.

Replace Frame with Truncated Frame

This option truncates the target frame to a shorter length and sends Idles /I/ on top of the remainder of the target frame.

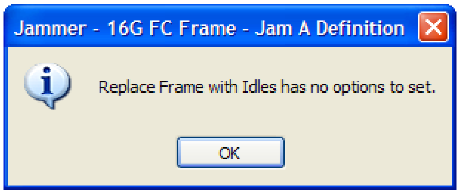
In the Truncate Frame Options window:

1. Enter the number of bytes you want the payload to be truncated to (this does not include the CRC or other delimiters).
2. Select an optional new EOF from the drop-down list, or choose user-defined, and define a four byte EOF.
3. Select LRC options. You can recalculate the LRC, replace the LRC with a user-defined FCoE Payload.

Replace Frame with Idles

This option replaces the target frame with /I/ Ordered Sets in the 16G FC Jammer. There are no options to set for this Jam.

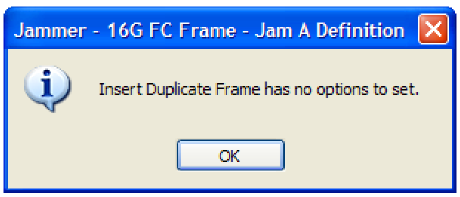
Figure 232: 16G FC - Replace Frame with Idles



Duplicate Frame

You can duplicate the triggered frame and insert it after the frame. There are no options to set for this Jam.

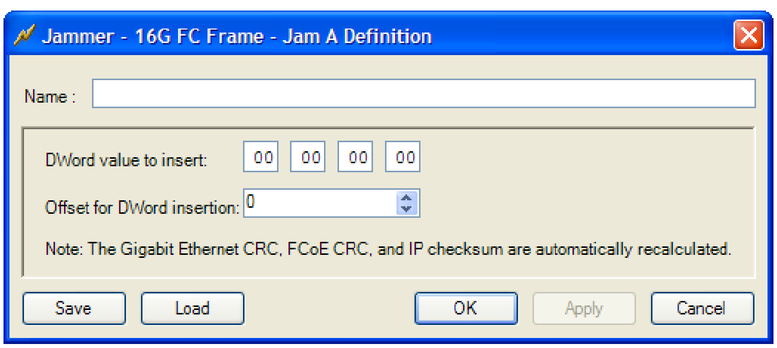
Figure 233: 16G FC - Duplicate Frame



Insert Dword

This option allows you to insert a 32-bit word to the triggered frame at a particular offset. The position of offset 0 begins after the preamble of a frame. The 32-bit data to be inserted is user programmable. Only data characters can be inserted. The GE CRC, FCoE CRC, IP checksum are automatically recalculated.

Figure 234: 16G FC Insert Dword

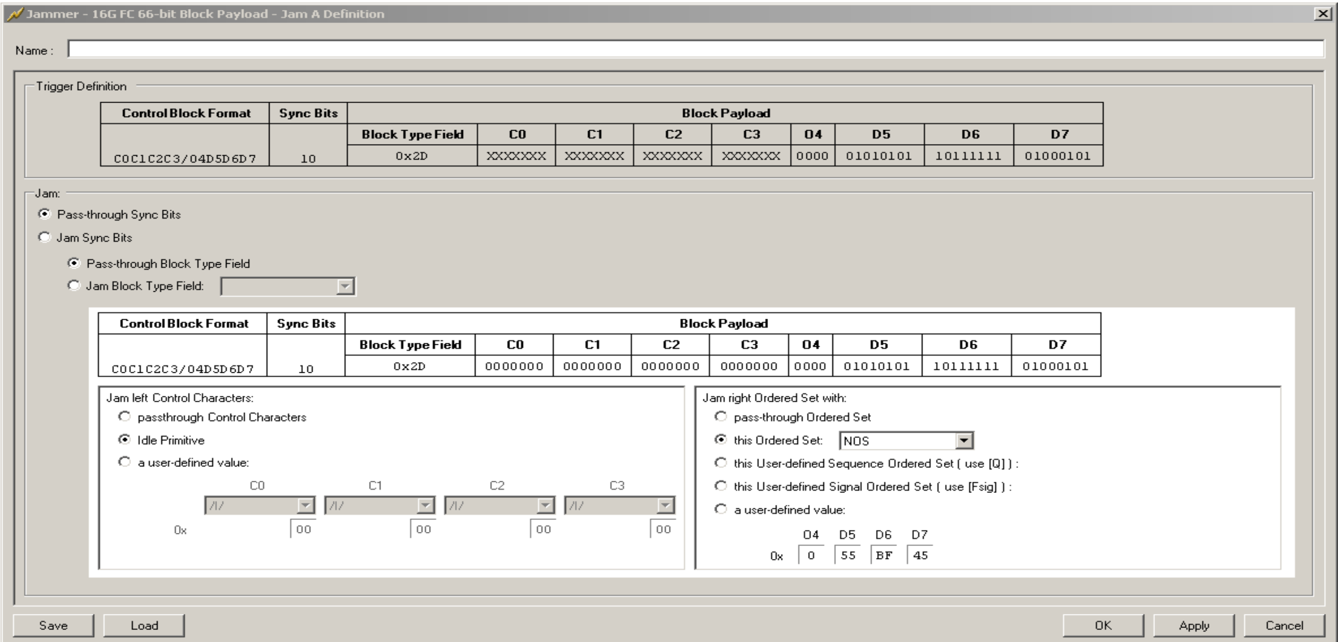


If the repeat jam option is used for an Insert Dword jam, the IPG between frames must be greater than minimum IPG. If the triggered frames are spaced by minimum IPG, the insertion process may be aborted before the specified number of repeat jams, and you will receive an error notice.

Jamming a 66-bit Block Payload for 16G FC

If the trigger event is a 66-bit Block Payload for Ordered Set, click the **Jam** button on the Xgig Jammer Configuration window, to open the **66-bit Block Payload Jam Definition** window (See Figure 235).

Figure 235: 66-bit Block Payload Jam Definition Window



The **Trigger Definition** pane shows the trigger you defined in the **16G FC 66-bit Block Payload for Ordered Set Trigger Definition** window. The information in the trigger definition is what you are going to be replacing with the jam.

Use the **Jam** pane to define which bits you want to jam.

Sync Bits

First, choose either to **Pass-through Sync Bits** or **Jam Sync Bits**. If you choose to **Jam Sync Bits** (See Figure 236), you can define all 66 bits of the jam using the binary editor provided. As in frame conditions, an X indicates "don't care". If you select **Pass-through Sync Bits** (See Figure 237), the pane expands to include details for the block type field.

Figure 236: 66-bit Jam: Jam Sync Bits

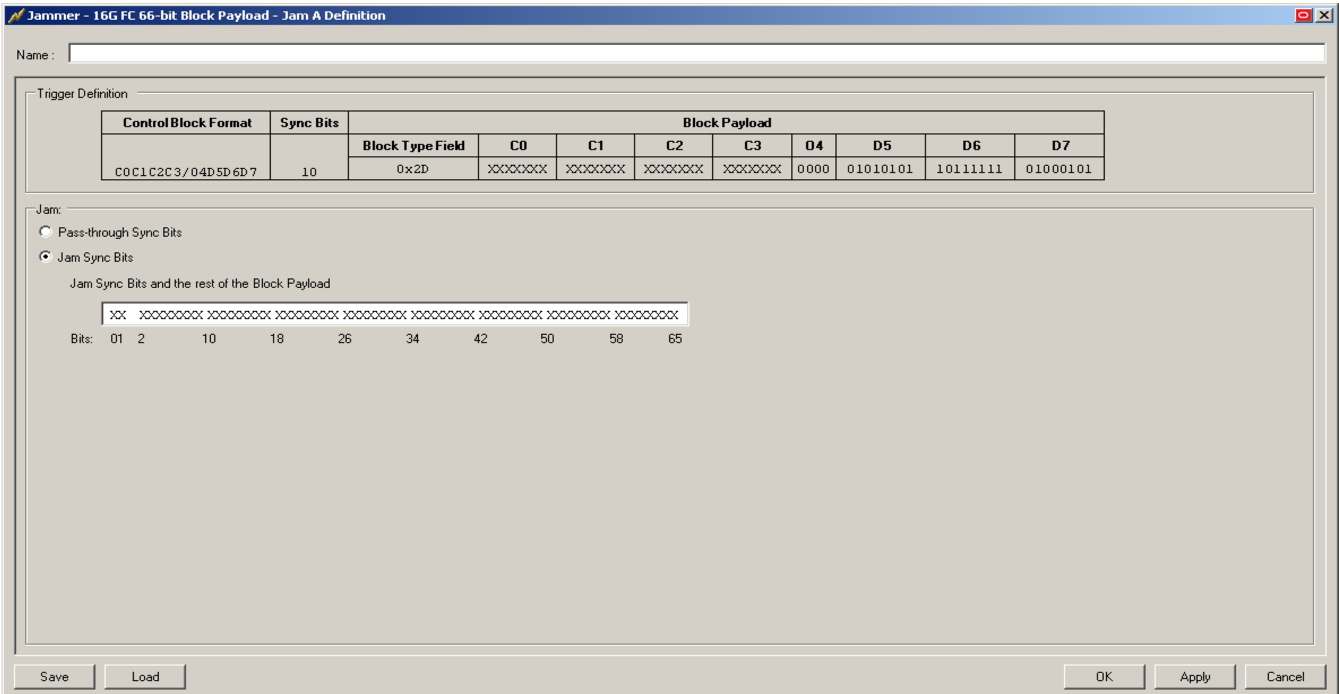
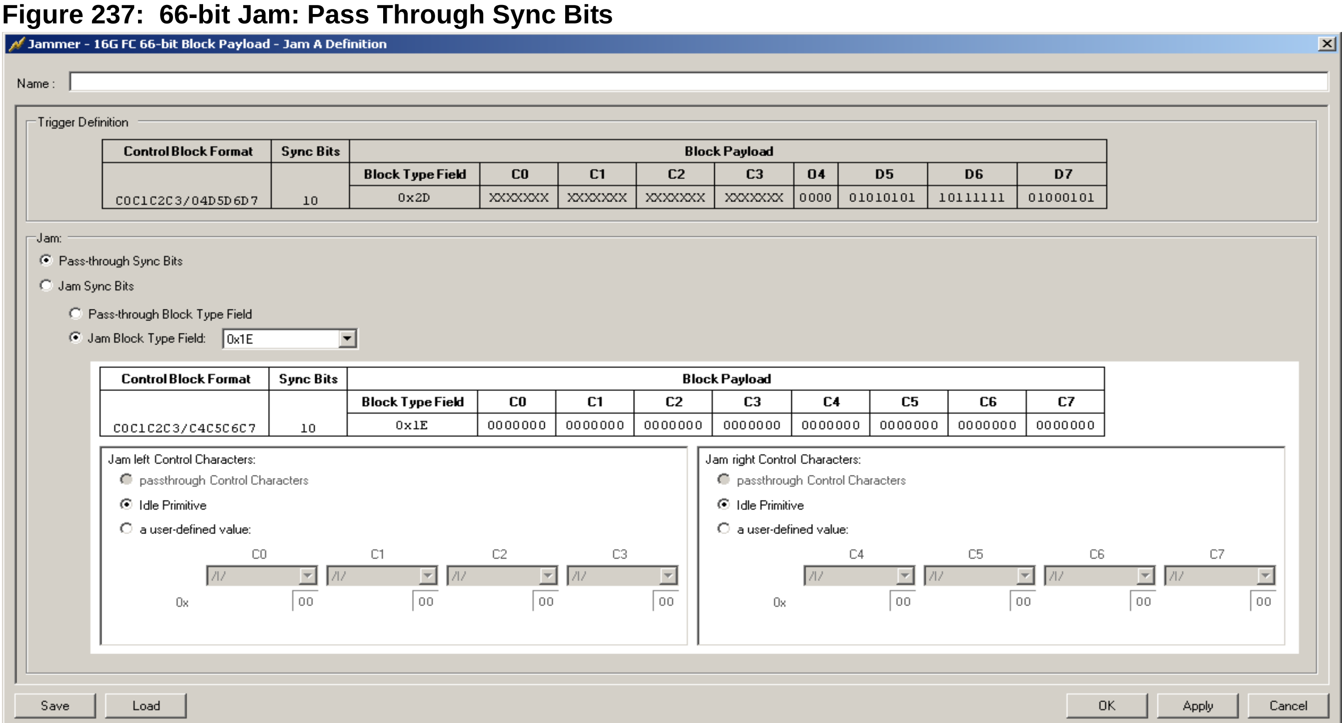


Figure 237: 66-bit Jam: Pass Through Sync Bits



Block Type Field

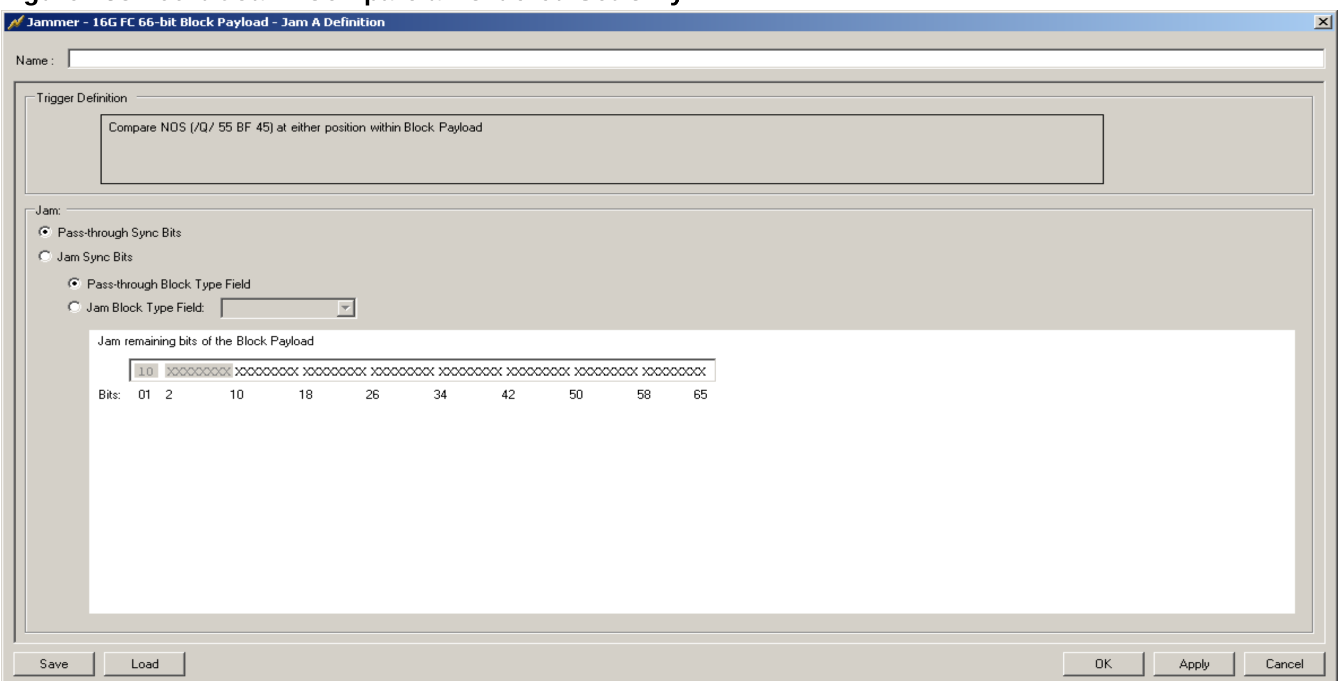
The block type field defines what format of data you are using and which two quantities of data (one at the left 32-bit position and one at the right 32-bit position) are present in the 64-bit block payload you are jamming. The left and right quantities are represented in the panes at the bottom of the window.

Pass-through the Block Type

The options you are presented with in the dialog depend on the trigger definition you have defined.

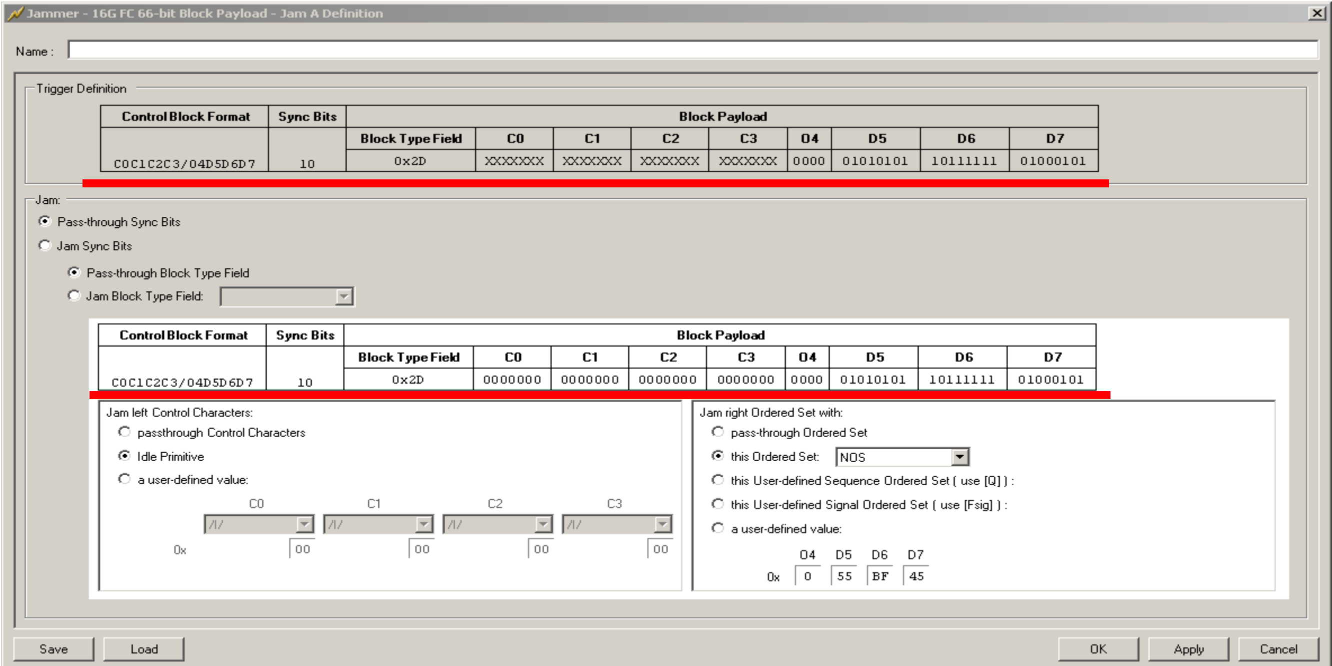
If you select **Pass-through Block Type Field**, and your trigger definition includes **Compare an Ordered Set Only**, then you can define the last 56 bits of the jam using the binary editor provided. As in frame conditions, an X indicates “don’t care”. No panes are shown at the bottom of the window (See Figure 238).

Figure 238: 66-bit Jam: Compare an Ordered Set Only



If you select **Pass-through Block Type Field**, and your trigger definition includes **Compare block type field only** or **Compare both**, then the contents of the panes at the bottom of the window depend on the block type field you selected in the trigger. The values from the trigger block type field are passed through to the jam block type field. Based on this block type field, the corresponding left and right jams are displayed (See Figure 239).

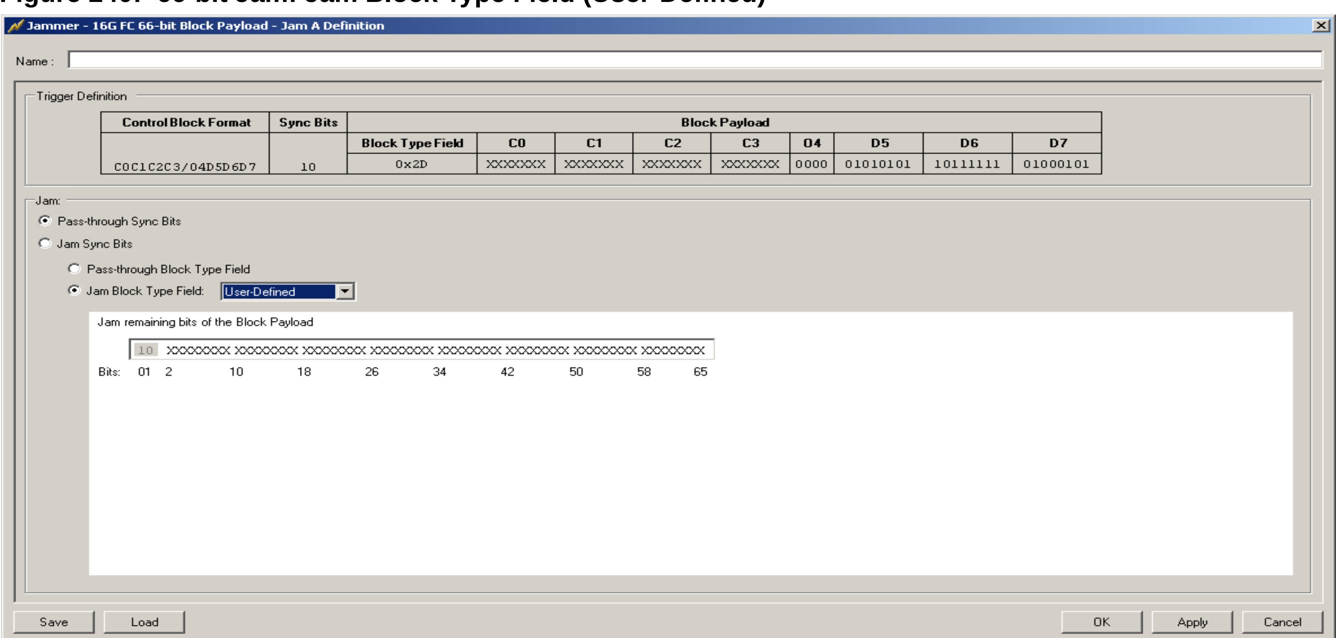
Figure 239: 66-bit Jam: Jam Left/Right Panes Shown



Jam Block Type Field

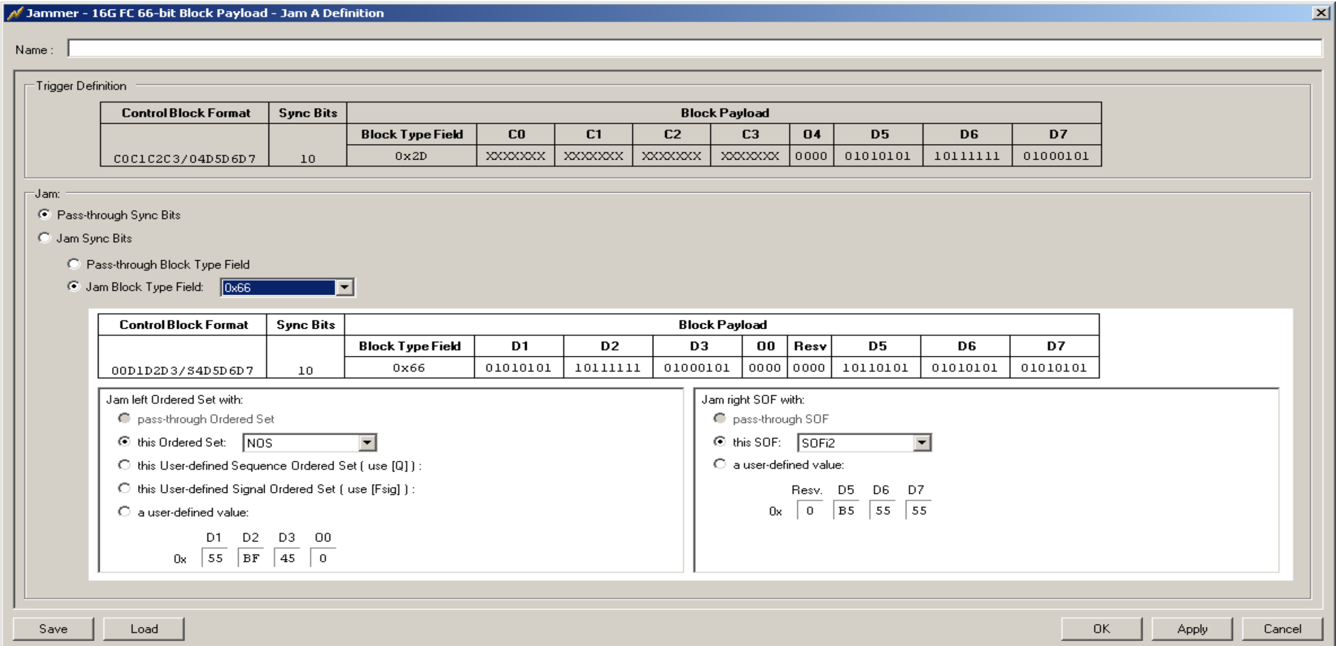
If you select the **Jam Block Type Field**, the bottom panes will change depending on which block type field you select from the drop-down menu. If you select **User-Defined** from the drop-down menu, a binary editor will appear allowing you to define the 64-bit block payload you want to jam (See Figure 240).

Figure 240: 66-bit Jam: Jam Block Type Field (User-Defined)



Below the **Jam Block Type Field** option, a pane shows your jam. As you choose different block type fields, the jam in the pane changes (See Figure 241).

Figure 241: 66-bit Jam: Jam Values Shown in Pane



Left and Right Jam Types

The panes at the bottom of the window provide you with different ways to jam the data at the left 32-bit position and the data at the right 32-bit position in the 64-bit block payload. The pass-through choices are greyed out if your jam definition does not match your trigger definition because the condition is automatically false and, therefore, the values cannot be passed through.

Jam Control Characters with

The following choices are available for jamming control characters:

- **pass-through Control Characters**
- **Idle Primitive**
- a user-defined value

  The user defined values include four seven-bit Ordered Sets for the left or right Idle jam for a total of 28 bits. These Ordered Sets are labeled either C0-C3 (right) or C4-C7 (left). Select a pre-defined Ordered Set from each drop-down menu, or select **User-Defined** to define your own Ordered Set. You can either type hex values directly into the 0x fields, or double-click an 0x field to open the Binary Editor and define each bit value.

Jam Ordered Set with

The following choices are available for jamming an Ordered Set:

- **pass-through Ordered Set**
- **this Ordered Set**

  Select a pre-defined Ordered Set from the drop-down menu.
- **this User-defined Sequence Ordered Set (use [Q])**

Type hex values into the fields at the bottom of the pane, or double-click a value to open the Binary Editor and type in the bit values. The first seven bits of this Ordered Set are not editable.

- **this User-defined Signal Ordered Set (use [Fsig])**

  Type hex values into the fields at the bottom of the pane, or double-click a value to open the Binary Editor and type in the bit values. The first seven bits of this Ordered Set are not editable.

- **a user-defined value**

  Type hex values into the fields, or double-click a value to open the Binary Editor and type in the bit values.

Jam SOF with

- **pass-through SOF**
- **this SOF**

  Select an SOF from the drop-down menu.

- **a user-defined value**

  Type hex values into the fields, or double-click a value to open the Binary Editor and type in the bit values.

Jam EOF with

- **pass-through EOF**
- **this EOF**

  Select an EOF from the drop-down menu.

- **a user-defined value**

  Type hex values into the fields, or double-click a value to open the Binary Editor and type in the bit values.

Jam Data with

- **pass-through value**
- **this value**

  Type hex values into the fields, or double-click a value to open the Binary Editor and type in the bit values.

Chapter 8

Creating Jammer Test Configurations for PCIe

In this chapter:

Defining Your Own Test Configurations for PCIe

Xgig Jammer lets you define your own test configurations and save them with or without hardware available for PCIe Generations 1, 2, and 3.

You can create a configuration from scratch, or you can open and edit an existing configuration. Also, you can edit a configuration in edit only mode, which is independent of any hardware, or you can edit a configuration that is currently loaded to a Jammer device.

To edit a configuration in edit only mode:

>> Double-click on a configuration file in the Configuration manager.

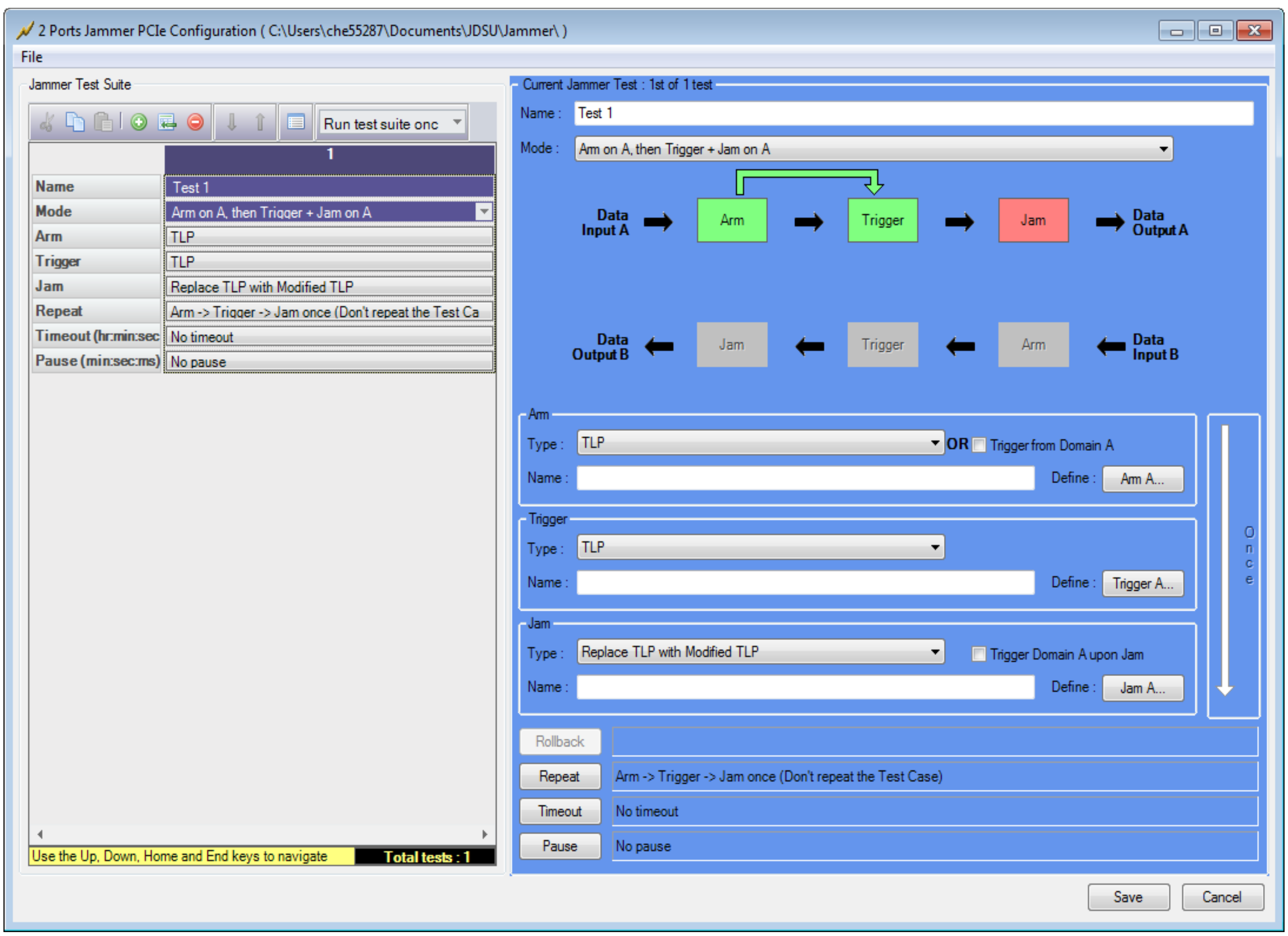
or:

>> Right-click on the configuration file in the Configuration manager and choose **Edit Jammer Configuration** from the context menu.

The edit only mode Jammer Configuration window opens (Figure 242).

This window allows you to set up your own Test Cases, name them, organize them, and save them to files so that you can use them again.

Figure 242: Edit Only Jammer Configuration Window



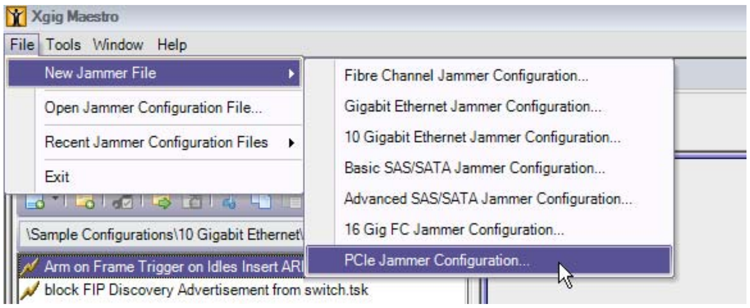
To start a configuration from scratch in edit only mode:

>> Select **New Jammer File** from the context menu or the File menu (Figure 243) on the Xgig Maestro menu bar. Then, select **Pcie Jammer Configuration...** from the drop down menu.

or:

>> Click the New Configuration icon at the top of the Configuration manager.

Figure 243: Maestro File Menu



To save your configuration in edit only mode:

>> Click **Save** at the bottom of the Jammer Configuration window or open the File menu on the Jammer Configuration window and select **Save Configuration** or **Save Configuration As**.

Any changes you make have no effect on actual Jammer devices you control.

To edit a configuration that is loaded to a Jammer port:

>> Click **Configuration...** in the device column.

or:

>> Right-click in the Parameters Status table in the device column to open the context menu and select **Edit configuration**.

or:

>> Click **Operation** in the device column to open the Operation dialog, then click **Config**.

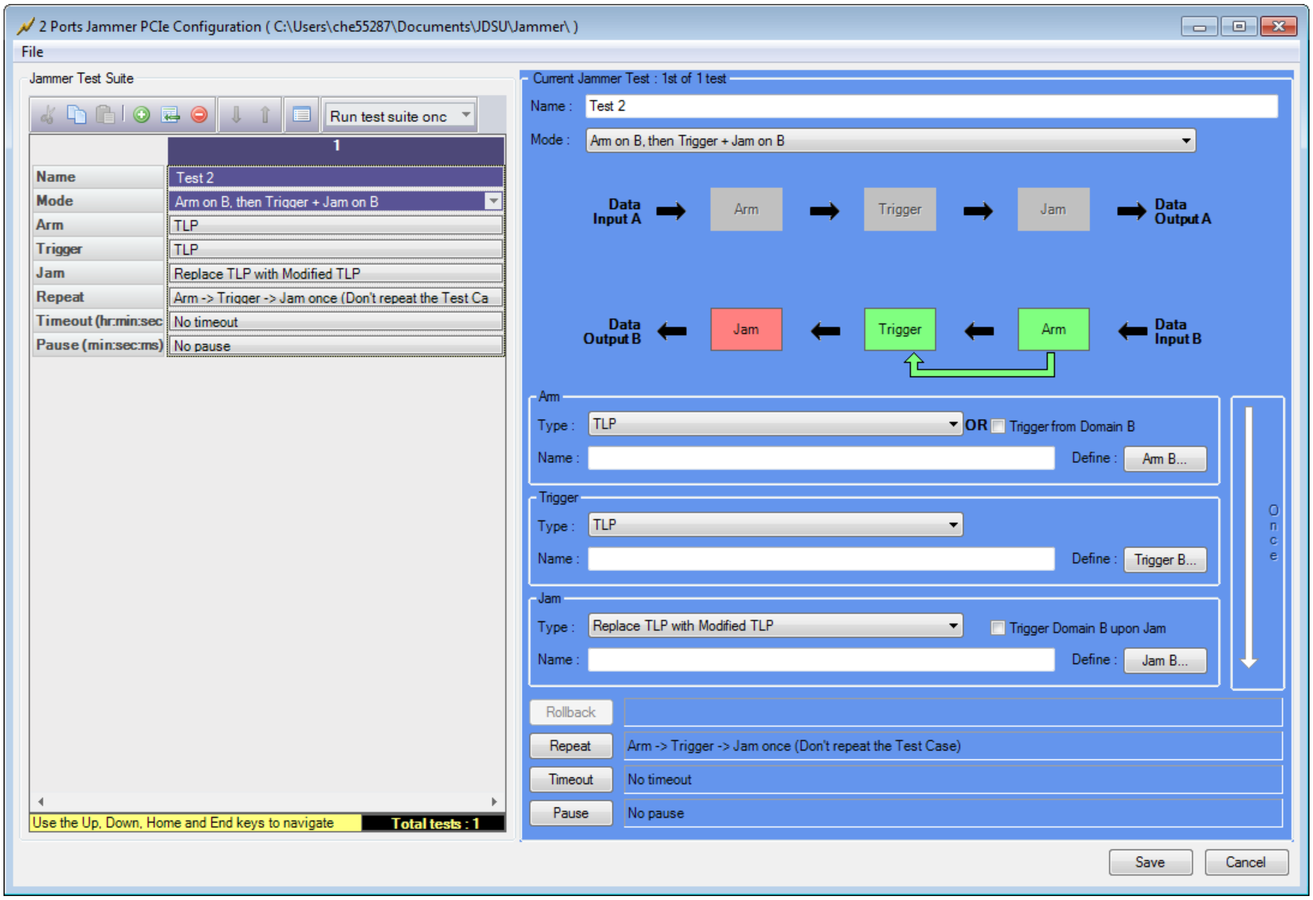
The Xgig Jammer Configuration window in hardware edit mode is displayed (Figure 244). This window allows you to set up your own Test Cases, name them, and save them to a file so that you can use them again.

Click **Apply** or **OK** and Jammer accepts the changes. They are immediately reflected in the Parameters Status table and affect the Jammer device the next time you run it.

To save your configuration edits:

>> Open the File menu at the top of the Jammer Configuration window and select **Save Configuration As...** or **Save Configuration**.

Figure 244: Xgig Jammer Configuration Window



Using the Jammer Configuration Window for PCIe

The Jammer Configuration window title bar indicates how many ports it is configuring, the protocol, and the configuration file name, if any. If you are using hardware edit mode, the chassis name, chassis number, slot number, and port number are also listed. The elements of the Jammer Configuration window are described in the following sections.

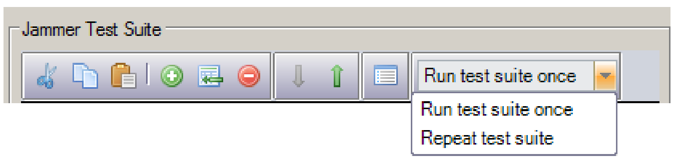
Using the Jammer Test Suite Tools for PCIe

The Jammer Test Suite (left pane) lists the series of Xgig Jammer tests in the order in which you want them to execute. The suite includes one or more tests. The highlighted test appears as the Current Jammer Test (right pane). Each test in the suite executes in sequence with a test reset time of approximately 130 (200 max) milliseconds.

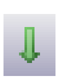
Creating a Test Suite

When you create a PCIe Jammer Test Suite, you use the toolbar in the Jammer Test Suite section of the Configuration window (Figure 245).

Figure 245: PCIe Jammer Test Suite Toolbar



The following list describes the icons on the toolbar:

	Cut current test	Removes the highlighted test and holds its contents in the memory buffer.
	Copy current text	Copies the highlighted test to the memory buffer.
	Paste last test cut or copied	Inserts the current memory buffer contents before the currently highlighted test.
	Add new test to bottom of stack	Adds a new blank test to the bottom of the suite.
	Insert new test before current test	Inserts a new blank test above the currently highlighted test.
	Delete current test	Removes the highlighted test from the suite. If only one test is present, then the contents of this test are cleared.
	Move current test down the stack	Moves the highlighted test down one in the test order.
	Move current test up the stack	Moves the highlighted test up one in the test order.
	Toggle view	Toggles Test Suite between Card View and List View.
	Run test suite once or Repeat test suite	When you choose Repeat test suite, the tests run according the settings you define in the Jammer Current Test window.

To duplicate a test at another point in the Test Suite:

1 Highlight the test you want to duplicate.

2 Click **Copy**.

3 Highlight the test in the suite that is just after the point where you want the duplicate test inserted.

4 Click **Paste**.

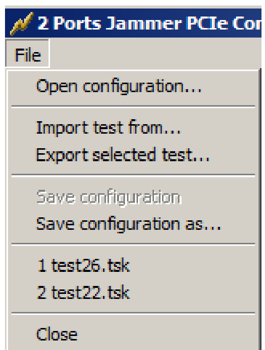
The duplicate test is inserted.

Refer to "Configuring the Arm Condition for PCIe", "Configuring the Trigger Condition for PCIe" and "Configuring the Jam Definition for PCIe" for information about configuring each test.

Using the Configuration File Menu

The File menu is the only menu on the menu bar (Figure 246).

Figure 246: Configuration File Menu



The choices are:

Open Configuration	Open an existing `.tsk` configuration file.
Import to Selected Test	Import a Test Case from a `.tst` file or an entire test suite, `.tsk` file, to the currently highlighted position. A Test Case is one line in the Jammer Test Suite.
Export Selected Test	Export and save the currently highlighted test to a `.tst` file.
Save Configuration	Save the entire Test Suite to the `.tsk` file you currently have loaded.
Save Configuration As	Save the entire Test Suite to a `.tsk` file with a name you assign to it.
Close	Close the Jammer Configuration Window.

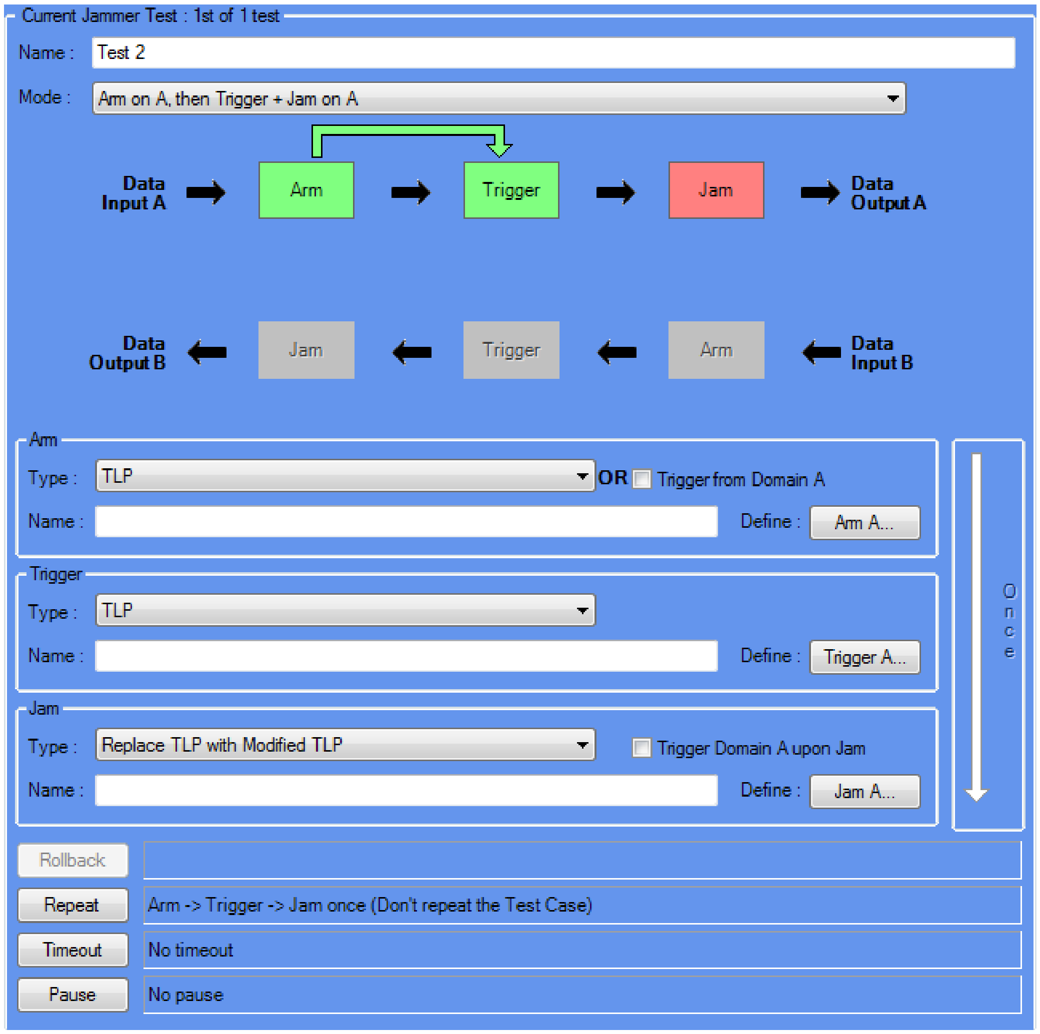
Also, note that the recently used PCIe Jammer configuration files appear in the file menu and are loaded when selected.

Note: The `.tst` files are only for storing individual Test Cases and swapping them between configuration files. You cannot load `.tst` files directly into a Jammer device on the Xgig Maestro window.

Using the Current Jammer Test Window for PCIe

The graphics in this section of the window represent the hardware configuration for the selected test in the Jammer Test Suite (Figure 247).

Figure 247: Current Jammer Test Window



Mode

For PCIe, Mode menus are available near the top of the Current Jammer Test window (Figure 248) and also near the top of each Test Case in the Jammer Test Suite window (Figure 249).

The input to path A (on top) is always port A and the input to path B (on the bottom) is always port B. The external trigger input and output that are available on path A always are linked to the domain shown on the Xgig Maestro window as “Domain of port A.” The trigger input and output on the bottom on path B are in the “Domain of port B.”

Figure 248: Mode Drop-down Menu in Current Jammer Test - Right Pane

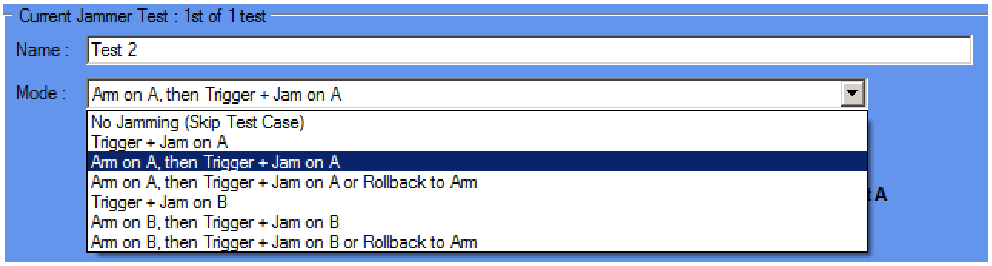
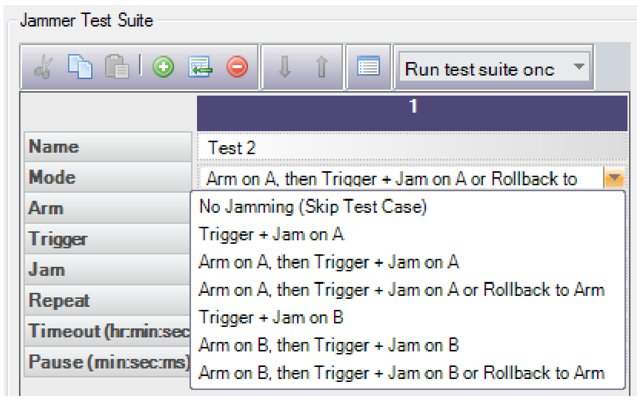


Figure 249: Mode Drop-down Menu in Test Suite - Left Pane



Arm and Trigger

To define Arm and Trigger conditions, select a respective Type from each drop-down menu. Then click the Arm or Trigger button to open the corresponding definition window.

You can use an external input as an Arm condition. Check Trigger from Domain A (or B) to enable this feature. You must put the corresponding Jammer port into a domain for this to work properly.

The Trigger event can be in the next Dword after the Arm event in the traffic stream.

Jam

To define a Jam:

1 Select a Type from the drop-down menu, if available.

2 Click the Jam button to open the Jam Definition window.

   The Jam Definition specifies the modifications to be made to the traffic matching the Trigger Condition.

   In addition, the Jammer port can trigger out to the Domain it is in when a Jam takes place. Check Trigger Domain A (or B) upon Jam to enable this feature.

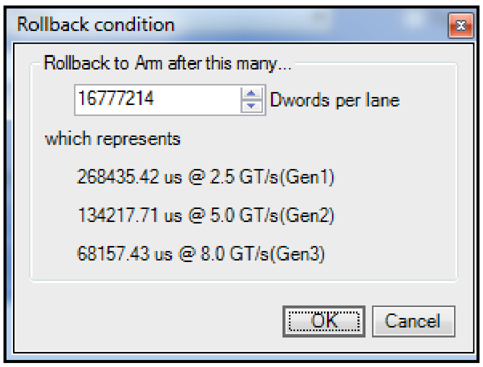
Note: If you use an external trigger input to define the Arm condition, then you cannot select the external trigger output for that path in that test case, and vice versa. For information regarding using the trigger input and output during a test case, refer to “Using Domains and External Triggering” on page 291.

Rollback

The Rollback option  parameter defines the time or word count parameter between the Arm and Trigger events. If the Trigger does not follow the Arm event in the allotted time or word count, the Xgig Jammer begins looking for the Arm event again. Click **Rollback** to display the dialog box shown in Figure 250.

Note: This value is saved in terms of words, not time, so keep this in mind if you save a Test Case using a device running at 2.5 GT/s and later open the configuration on a Jammer running at 5.0 GT/s.

Figure 250: Rollback Condition Dialog

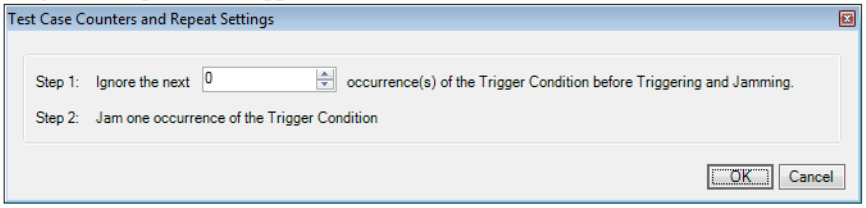


Repeat

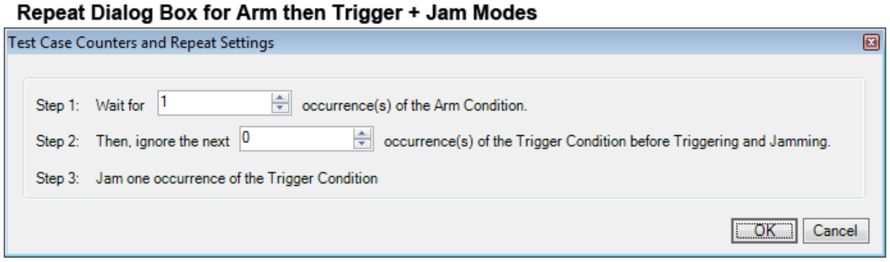
Click the **Repeat** button to open one of the dialog boxes shown in Figure 251. The **Repeat** dialog box uses counters to provide an increased level of control over the Jam allowing you to skip over extraneous instances of the arm or trigger conditions and target the precise data you want to Jam. There are two unique **Repeat** dialog box for PCIe Jammer configuration modes; the “Trigger + Jam” or the “Arm then Trigger + Jam” modes. The Repeat Mode option means that the Jammer must match the specified condition each time before looking for a Trigger.

Figure 251: PCIe Repeat Dialog Boxes

Repeat Dialog Box for Trigger + Jam Modes



Repeat Dialog Box for Arm then Trigger + Jam Modes



A maximum of 32,767 occurrences or the Arm condition can be waited for.

A maximum of 32,767 occurrences of the Trigger condition can be ignored.

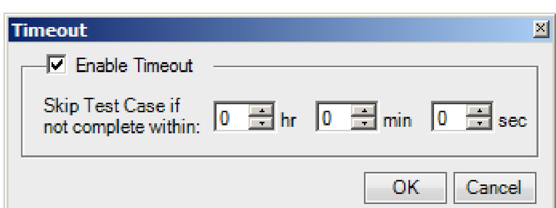
Timeout

The timeout option defines the period of time to wait for a specified test to complete before aborting and proceeding to the next test in the suite.

To set the timeout:

1. Click **Timeout** to display the dialog box in Figure 252.
2. Check **Enable Timeout**.
3. Enter the hours, minutes, and seconds you want to wait.

Figure 252: Timeout Dialog

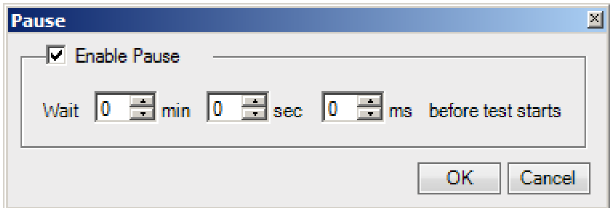


4. Click **OK**.

Pause

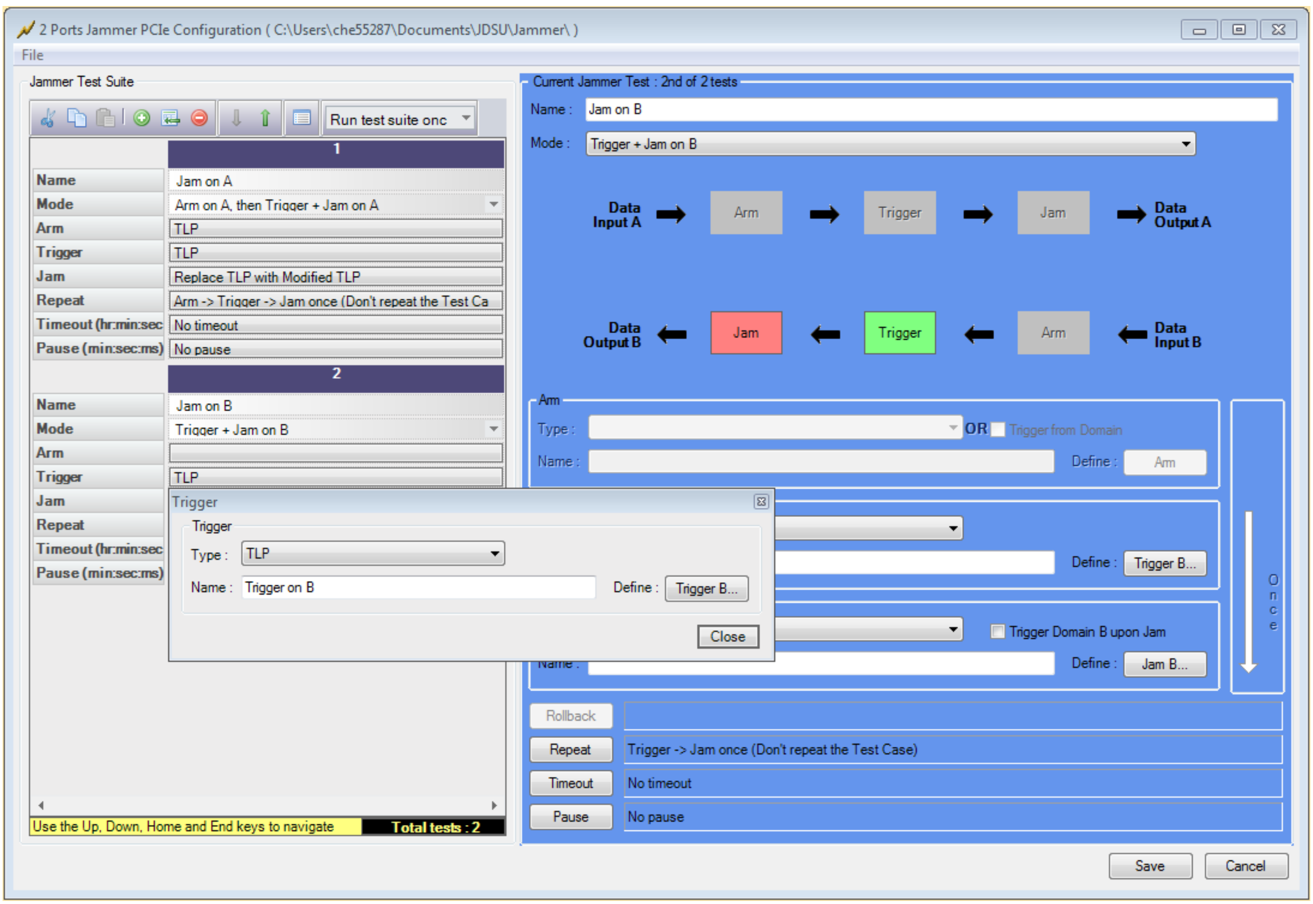
Click **Pause** to open the dialog shown in Figure 253. The Pause setting allows you to insert a pause before the beginning of a test case.

Figure 253: Pause Test Dialog



You can also configure options for each Test Case directly in the Test Suite, instead of clicking in the Current Jammer Test pane. Click on the area of the Test Case you want to modify to open the corresponding dialog (Figure 254).

Figure 254: Configuring Options Directly in the Test Suite



Configuring the Arm Condition for PCIe

The PCIe Arm condition recognizes specific TLPs (Transaction Layer Packets), DLLPs (Data Link Layer Packets), or ordered sets. You can select from the following:

- TLP - Allows you to specify a TLP to set the Arm Condition (see page 261)
- DLLP - Allows you to specify a DLLP to set the Arm Condition (see page 263)
- Ordered Set - Provides you with predefined ordered sets to set the Arm Condition (see page 265)

You can save an arm or trigger condition as a `.jmt` file by clicking the **Save** button in the **Arm** or **Trigger** window. You can load a `.jmt` file by clicking the **Load** button in the **Arm** or **Trigger** window.

Depending on the Mode you select, the appropriate graphic diagram shows the Trigger and optional Arm conditions, along with the Jam event. If the Mode you select does not include an Arm condition, the **Arm** button is disabled.

To set Arm conditions:

1. Select TLP, DLLP, or Ordered Set from the **Type** drop-down menu in the Arm section of the Current Jammer Test window.
2. Click on the **Arm** button to open the Arm window.

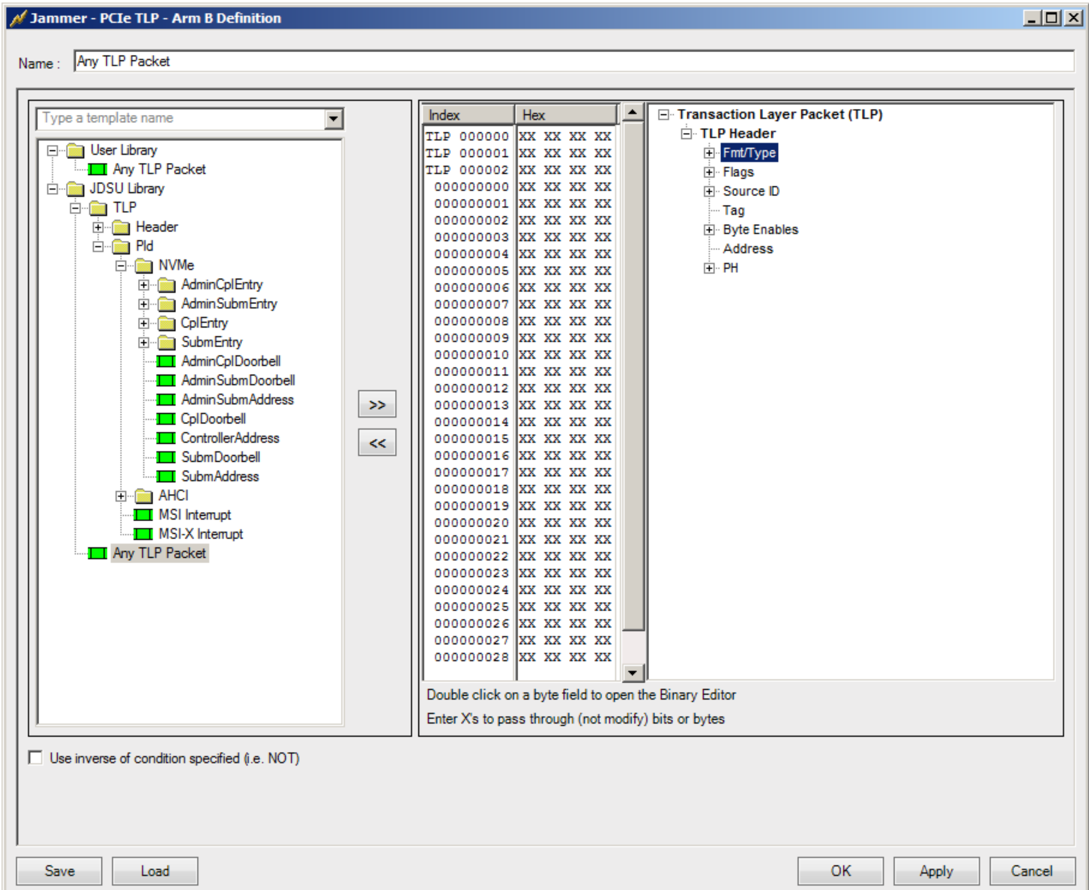
   The window for the condition is displayed (Figure 255). If you are in hardware edit mode, the protocol, chassis name, chassis number, slot number, and port numbers are displayed in the title bar.
3. Set the values as required to specify the Arm condition as part of a unique Arm and Trigger sequence for the specific test.

   The following sections describe the available values.

Setting TLP Conditions for PCIe Arm

You can specify TLP conditions (Figure 255) by loading a template from the Template Library tree. You can manually specify bits in the TLP.

Figure 255: PCIe Arm TLP Definition Window



Selecting a TLP template from the Library list displays the first 32 Dwords of the TLP in the center portion of the window. Depending on the selected template, the first 3 or 4 Dwords of the displayed template are the TLP header.

To use a template:

1 Select a template from the Template Library tree on the left.

2 Click the double right arrow button to set the Arm Condition.

The condition is indicated on the right side of the window.

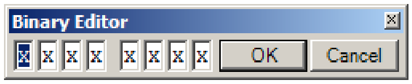
To manually specify a string in the TLP:

>> Type hexadecimal values directly into the center column of the window.

An X represents a nibble that can be any value (a “don’t care”).

To set individual bits in any field, double-click on the hex entry to open the Binary Editor (Figure 256). In the hex view, partially defined hex characters appear as question marks.

Figure 256: Binary Editor Dialog



A way to manually edit the TLP Header is to make selections from the tree view in the right window pane. Selecting all or specific portions of the TLP Header from this tree view will highlight that selection in the Hex code displayed in the center portion of the window.

Saving a TLP Arm Definition

If you create a TLP definition for Arm that you want to save and make easily available for future use, you can save it into the “User Library” folder in the Template Library tree. To do this:

>> Highlight the folder and click the double left arrow button.

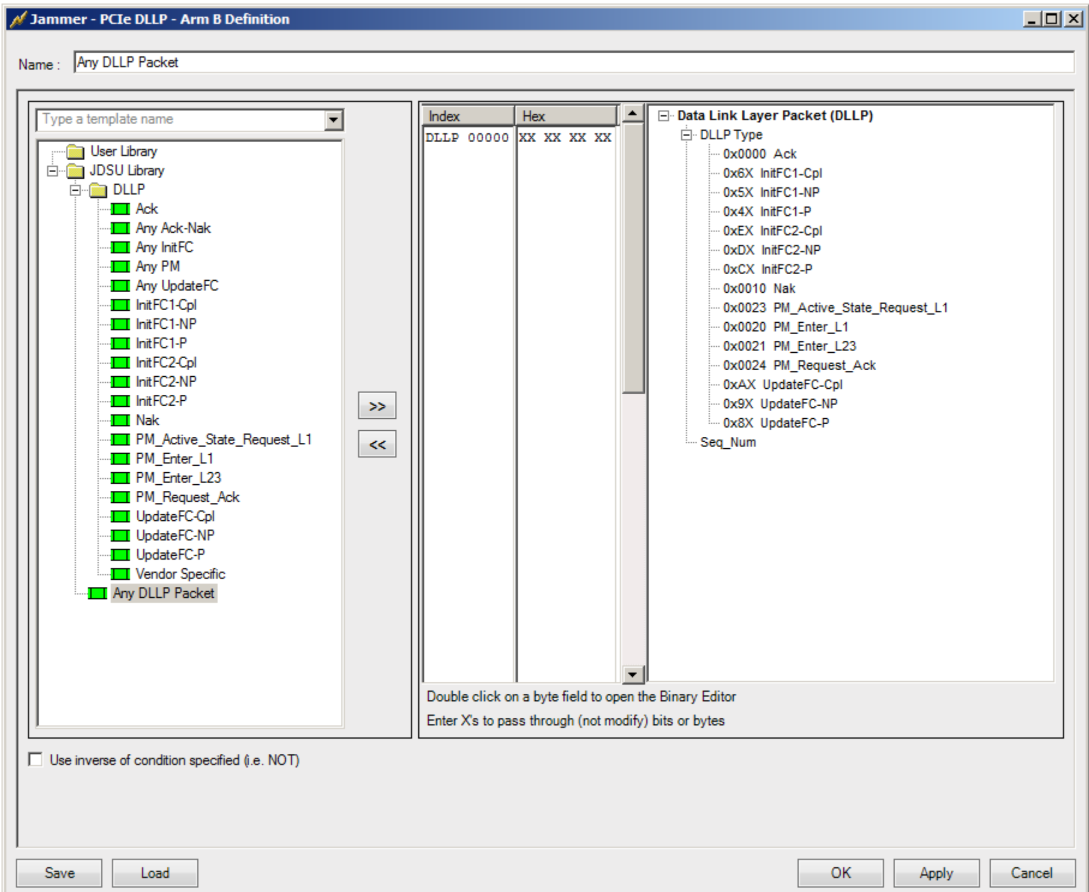
TLP conditions have the option of “Use inverse of condition specified (i.e., NOT).” When you check this option, it means that the first TLP encountered that does not match what you have specified creates a “condition met” event.

For each TLP condition, you can specify an optional name at the top of the window. This name is also shown on the Jammer Configuration window under the Mode selection, and on the main Xgig Maestro window.

Setting DLLP Conditions for PCIe Arm

You can specify DLLP conditions (Figure 257) by loading a template from the Template Library tree. You can manually specify bits in the DLLP.

Figure 257: PCIe Arm DLLP Definition Window



Selecting a DLLP template from the Library list displays the DLLP in the center portion of the window.

To use a template:

1 Select a DLLP template from the Template Library tree on the left.

2 Click the double right arrow button to set the Arm Condition.

The condition is indicated on the right side of the window.

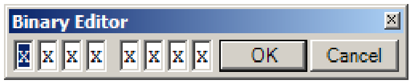
To manually specify a string in the DLLP:

>> Type hexadecimal values directly into the center column of the window.

An X represents a nibble that can be any value (a “don’t care”).

To set individual bits in any field, double-click on the hex entry to open the Binary Editor (Figure 258). In the hex view, partially defined hex characters appear as question marks.

Figure 258: Binary Editor Dialog



A way to manually edit the DLLP is to make selections from the tree view in the right window pane. Selecting all or specific portions of the DLLP from this tree view will highlight that selection in the Hex code displayed in the center portion of the window.

Saving a DLLP Arm Definition

If you create a DLLP definition for Arm that you want to save and make easily available for future use, you can save it into the “User Library” folder in the Template Library tree. To do this:

>> Highlight the folder and click the double left arrow button.

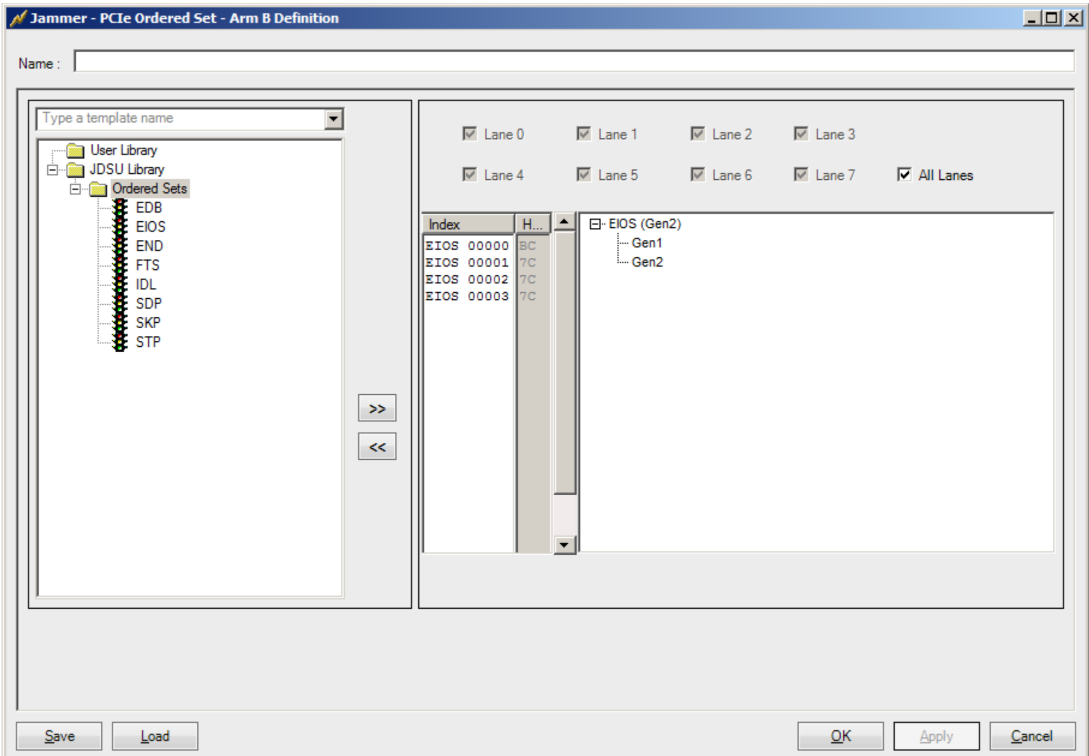
DLLP conditions have the option of “Use inverse of condition specified (i.e., NOT).” When you check this option, it means that the first DLLP encountered that does not match what you have specified creates a “condition met” event.

For each DLLP condition, you can specify an optional name at the top of the window. This name is also shown on the Jammer Configuration window under the Mode selection, and on the main Xgig Maestro window.

Setting Ordered Set Conditions for PCIe Arm

You can choose from predefined Ordered Sets for PCIe Generations 1 and 2. You can select from EDB, EIOS, END, FTS, IDL, SDP, SKP, or STP from the Ordered sets in the Library. All Ordered Set choices are four bytes long and are not editable.

Figure 259: PCIe Arm Ordered Set Definition Window



The Lane selections near the top of the page allow you to monitor any or all of the lanes to identify the selected Ordered Set to meet the ARM condition using one or more lanes.

Specify the PCIe generation from the tree view in the right window pane. Select either Gen 1 or Gen 2.

You can specify an optional name at the top of the window. This name is also shown in the Jammer Configuration window under the Mode selection and on the main Xgig Maestro window.

Configuring the Trigger Condition for PCIe

The PCIe Trigger condition recognizes specific TLPs (Transaction Layer Packets), DLLPs (Data Link Layer Packets), or ordered sets. You can select from the following:

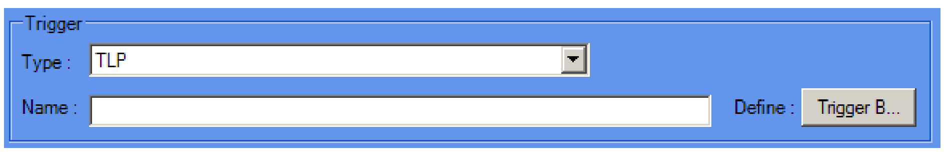
- TLP - Allows you to specify a TLP to set the Trigger Condition (see page 261)
- DLLP - Allows you to specify a DLLP to set the Trigger Condition (see page 263)
- Ordered Set - Provides you with predefined ordered sets to set the Trigger Condition (see page 265)

Depending on the Mode you select in the **Jammer Configuration** window, the appropriate graphic diagram shows the Trigger and optional Arm conditions, along with the Jam event. If the Mode you select does not include an Arm condition, the Arm button remains disabled.

To set Trigger conditions:

1 Open the Type drop-down in the Trigger Condition window, and select TLP, DLLP, or Ordered Set.

2 Click the **Trigger** button in the Xgig Jammer Configuration window.



The window for the condition is displayed. If you are in hardware edit mode, the protocol, chassis name, chassis number, slot number, and port numbers are displayed in the title bar.

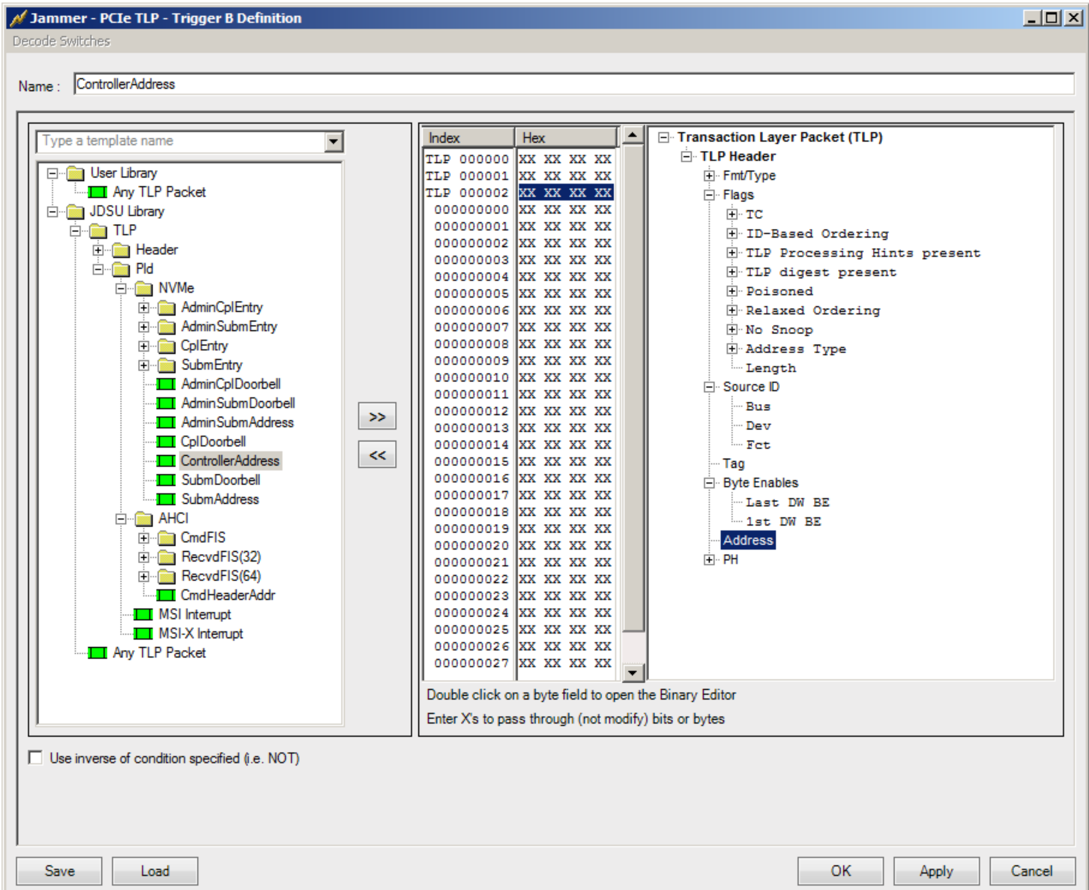
3 Set the values as required to specify the Trigger condition as part of a unique Arm and Trigger sequence for the specific test.

The following sections describe the available Trigger Type values.

Setting TLP Conditions for a PCIe Trigger

You can specify TLP trigger conditions (Figure 260) by loading a template from the template Library tree. You can manually specify bits in the TLP.

Figure 260: PCIe Trigger TLP Definition Window



Selecting a TLP template from the Library list displays the first 32 Dwords of the TLP in the center portion of the window. Depending on the selected template, the first 3 or 4 Dwords of the displayed template are the TLP header.

To use a template:

1 Select a template from the Template Library tree on the left.

2 Click the double right arrow button to set the Trigger Condition.

The condition is indicated on the right side of the window.

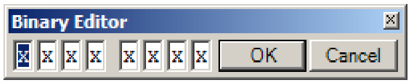
To manually specify a string in the TLP:

>> Type hexadecimal values directly into the center column of the window.

An X represents a nibble that can be any value (a “don’t care”).

To set individual bits in any field, double-click on the hex entry to open the Binary Editor (Figure 261). In the Hex view, partially defined hex characters appear as question marks.

Figure 261: Binary Editor Dialog



A way to manually edit the TLP Header is to make selections from the tree view in the right window pane. Selecting all or specific portions of the TLP Header from this tree view will highlight that selection in the Hex code displayed in the center portion of the window.

Saving a TLP Trigger Definition

If you create a TLP trigger definition that you want to save and make easily available for future use, you can save it into the “User Library” folder in the Template Library tree. To do this:

>> Highlight the folder and click the double left arrow button.

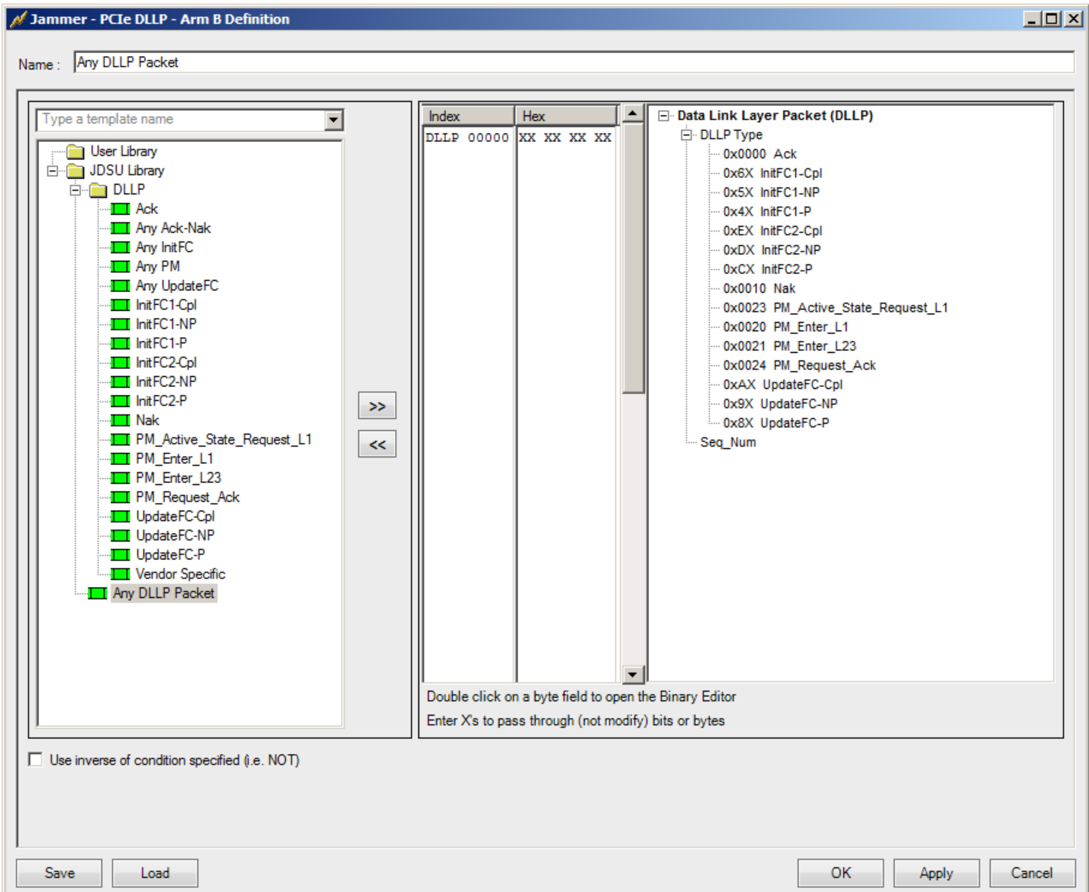
TLP trigger conditions have the option of “Use inverse of condition specified (i.e., NOT).” When you check this option, it means that the first TLP encountered that does not match what you have specified creates a “condition met” event.

For each TLP trigger condition, you can specify an optional name at the top of the window. This name is also shown on the Jammer Configuration window under the Mode selection, and on the main Xgig Maestro window.

Setting DLLP Conditions for a PCIe Trigger

You can specify DLLP conditions (Figure 262) by loading a template from the Template Library tree. You can manually specify bits in the DLLP.

Figure 262: PCIe Trigger DLLP Definition Window



Selecting a DLLP template from the Library list displays the DLLP in the center portion of the window.

To use a template:

1 Select a DLLP trigger template from the Template Library tree on the left.

2 Click the double right arrow button to set the Trigger Condition.

The condition is indicated on the right side of the window.

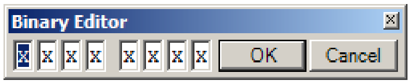
To manually specify a string in the DLLP:

>> Type hexadecimal values directly into the center column of the window.

An X represents a nibble that can be any value (a “don’t care”).

To set individual bits in any field, double-click on the hex entry to open the Binary Editor (Figure 258). In the hex view, partially defined hex characters appear as question marks.

Figure 263: Binary Editor Dialog



A way to manually edit the DLLP is to make selections from the tree view in the right window pane. Selecting all or specific portions of the DLLP from this tree view will highlight that selection in the Hex code displayed in the center portion of the window.

Saving a DLLP Trigger Definition

If you create a DLLP definition for Trigger that you want to save and make easily available for future use, you can save it into the “User Library” folder in the Template Library tree. To do this:

>> Highlight the folder and click the double left arrow button.

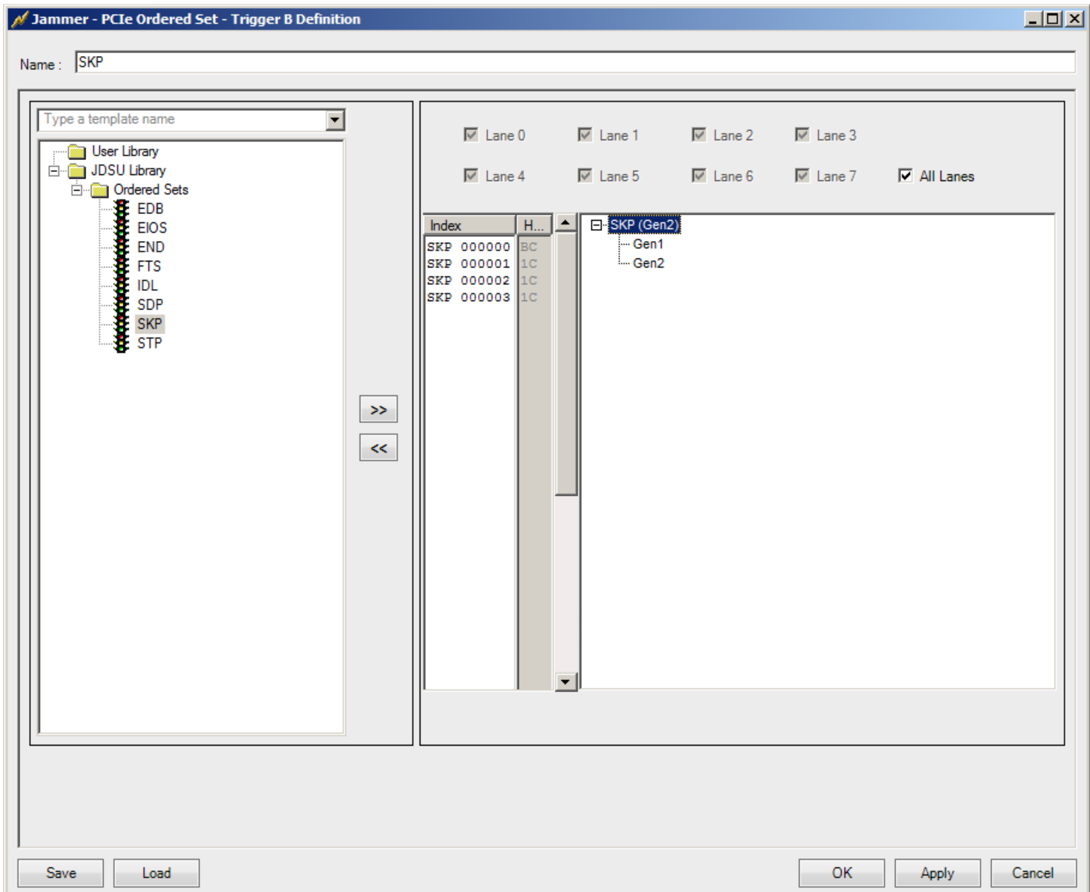
DLLP conditions have the option of “Use inverse of condition specified (i.e., NOT).” When you check this option, it means that the first DLLP encountered that does not match what you have specified creates a “condition met” event.

For each DLLP condition, you can specify an optional name at the top of the window. This name is also shown on the Jammer Configuration window under the Mode selection, and on the main Xgig Maestro window.

Setting Ordered Set Conditions for a PCIe Trigger

You can choose from predefined Ordered Sets for PCIe Generation 1 and Generation 2. You can select from EDB, EIOS, END, FTS, IDL, SDP, SKP, or STP from the Ordered sets in the Library. All Ordered Set choices are four bytes long and are not editable.

Figure 264: PCIe Arm Ordered Set Definition Window



The Lane selections near the top of the page allow you to monitor any or all of the lanes to identify the selected Ordered Set to meet the Trigger condition using one or more lanes.

Specify the PCIe generation from the tree view in the right window pane. Select either Gen 1 or Gen 2.

You can specify an optional name at the top of the window. This name is also shown in the Jammer Configuration window under the Mode selection and on the main Xgig Maestro window.

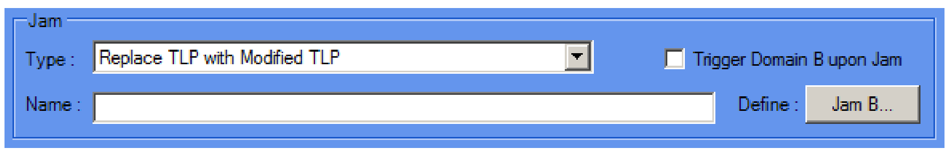
Configuring the Jam Definition for PCIe

The **Jam Definition** window defines how the specified event on the **Trigger Condition** window is modified. The type of Jam that is available depends on the type of Trigger selected.

- Where the Trigger type is TLP, the Jam is always Replace TLP with Modified TLP.
- Where the Trigger type is DLLP, the Jam is always Replace DLLP with Modified DLLP.
- Where the Trigger type is Ordered Set, the Jam is always PCIe Ordered Set Jam Type.

For any Jam definition, you can specify an optional name at the top of the window. This name is also displayed on the Jammer Configuration window under Mode selection and on the main Xgig Maestro window.

Access the Jam definition windows using the Jam button in the Jam area



You can save a Jam definition as a `.jmj` file by clicking the **Save** button in the **Jam** window. You can load a `.jmj` file by clicking the **Load** button in the **Jam** window.

Jamming a TLP for PCIe

With **TLP** as the Trigger Type, the Jam Type is **Replace TLP with Modified TLP**. When you select the **Jam** button, the following Jam Definition window is displayed (Figure 265). This window allows you to define the modified TLP that is used.

There are three tabs: the Header/Payload tab defines the modified TLP;
the Gen1/2 tab sets the SOP and LCRC modification settings for PCIe Generation 1 and 2;
the Gen 3 tab sets the STP and LCRC modification settings for PCIe Generation 3.

Header/Payload Tab

Any parameter in the PCIe header can be modified (Figure 265). Select either the **Replace Jam** or **All Jam Modes** radio button to define the Jam frame.

The Header/Payload tab allows you to select a modified TLP packet from the Library on the left of the window. When the selection is made and you click the “double right arrow” button, the Dwords representing the full PCIe frame are displayed in the Index/Hex columns in the center of the window.

The first 309 Dwords in the Frames Header and Payload are editable. The maximum value of 309 is allowed to be entered. You can set the number of Dwords by changing the value shown below the Index/Hex columns.

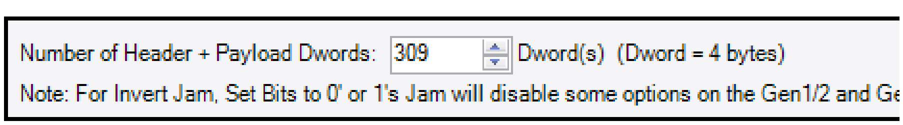
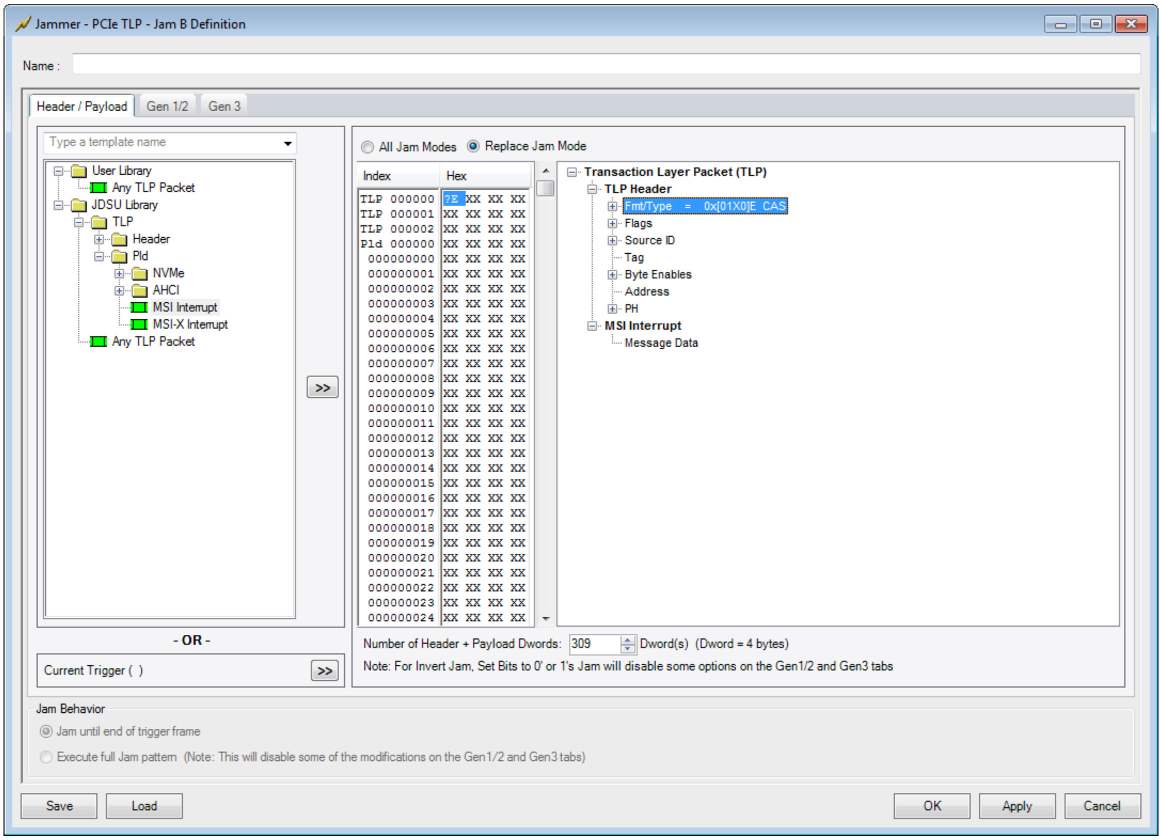


Figure 265: PCIe Jamming TLP Header/Payload Tab Definitions

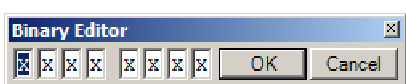


Depending on the selected TLP, the header portion is either the first 3 or 4 Dwords. At the right side of the window, the header portions of the TLP are shown. Selecting a specific header portion highlights corresponding the Hex value.

> In the Hex view, an X represents a nibble that can be any value (a “don’t care”). Partially defined hex characters appear as question marks.

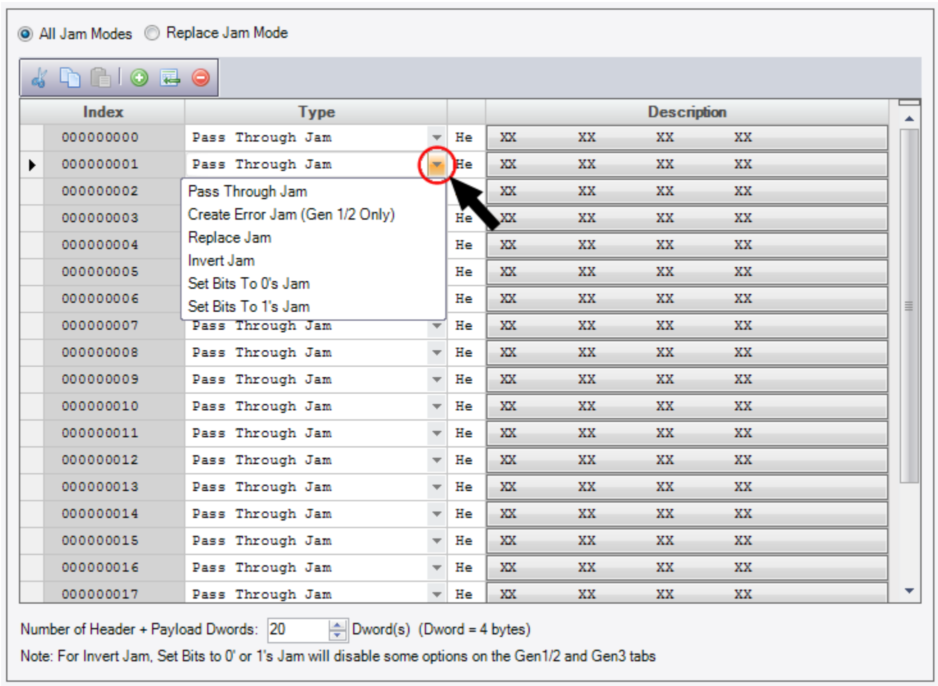
To modify the Hex value of a highlighted string, double-click the string to display the Binary Editor (Figure 266).

Figure 266: Binary Editor Dialog



Select the **All Jam Modes** radio button to open the All Jam Modes screen (see Figure 267). This screen provides access to set the Jam modes. Use the drop down arrow (circled in red) to open the list of available Jam modes.

Figure 267: All Jam Modes for PCIe TLP



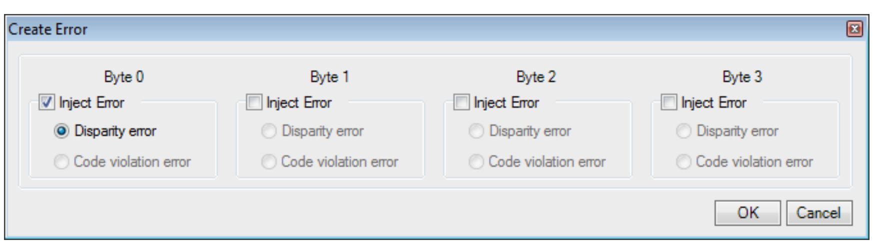
The header portion (index numbers 00000000 through 00000006) has six available Jam options.

Note: Once any option (other than Pass Through Jam and Create Error Jam) is selected for a Dword, only that Jam option plus the Pass Through Jam and Create Error Jam options are available for any of the other Dwords in the header portion.

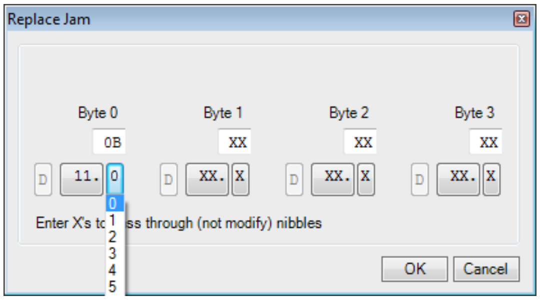
The payload portion (index numbers 00000007 and above) allows only two Jam choices: Pass Through Jam and Replace Jam

Note: If any Dword in the header portion is set to Invert Jam, Set Bit to 0's Jam, or Set Bits to 1's Jam, then only the Pass Through Jam option is available in the payload portion.

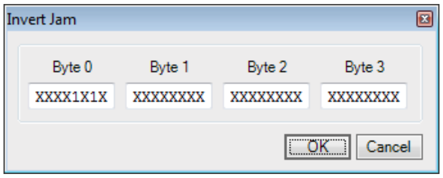
- **Pass Through Jam -** Pass through the current word unchanged.
- **Create Error Jam (Gen1/2 Only) -** Check Inject Error for any byte(s) on which you want to send Disparity Errors. This inverts the running disparity at that byte. Selecting the **Description** column displays the following dialog box to make changes:



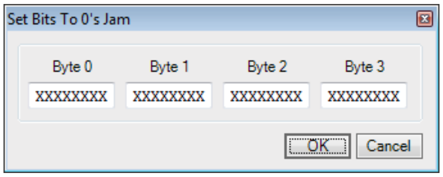
- **Replace Jam -** This function allows you to replace each nibble with a new value. Selecting the **Description** column displays the following dialog box to make changes:



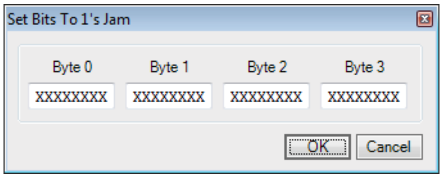
- **Invert Jam -** Invert defined bits and pass through the rest. Enter 1s at the appropriate bit locations. Selecting the **Description** column displays the following dialog box to make changes:



- **Set Bits To 0’s Jam-** Set defined bits to 0’s and pass through the rest. Enter 0’s at the appropriate bit locations. Selecting the **Description** column displays the following dialog box to make changes:



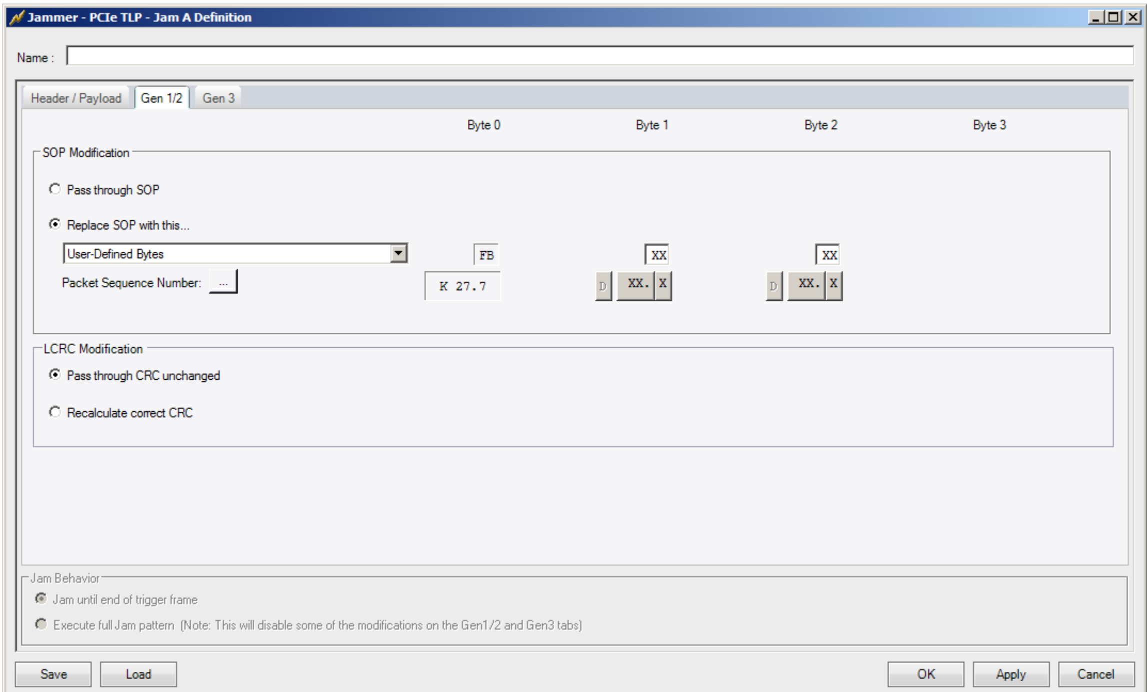
- **Set Bits To 1’s Jam -** Set defined bits to 1’s and pass through the rest. Enter 1’s at the appropriate bit locations. Selecting the **Description** column displays the following dialog box to make changes:



Gen 1/2 Tab

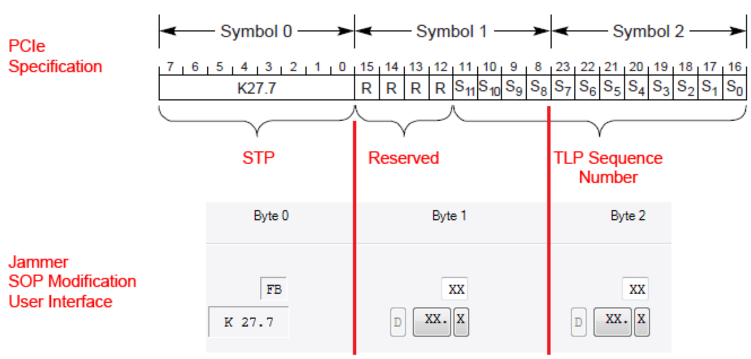
Selecting the Gen 1/2 tab allows you to define whether you want to pass through or change the TLP's SOP (Start Of Packet) and LCRC (Link Cyclical Redundancy Check) values.

Figure 268: PCIe Jamming TLP Gen1/2 Definition Window



SOP Modification: Select either the **Pass through SOP** or **Replace SOP with this...** options. You can replace the SOP with User-Defined Bytes. Byte 0 is fixed and cannot be changed. You can modify Byte 1 and Byte 2 of the SOP. Enter values directly into the byte text boxes.

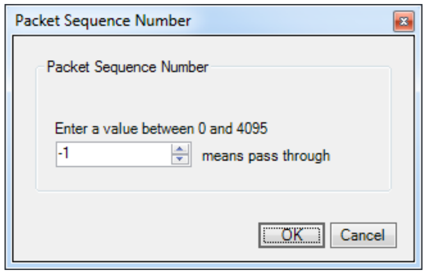
Figure 269: SOP Modification Bytes



Enter values directly into the byte text boxes. The upper 4 bits of Byte 1 are Reserved bits.

As shown in Figure 269, the 12-bit packet sequence number is the lower 4 bits of Byte 1 and the 8 bits of Byte 2. You can also change this number by selecting the **Packet Sequence Number** button to display the Packet Sequence Number dialog box. Enter a value for the packet sequence number into the dialog box and select **OK** to modify the 12-bit value.

Figure 270: Packet Sequence Number Dialog Box

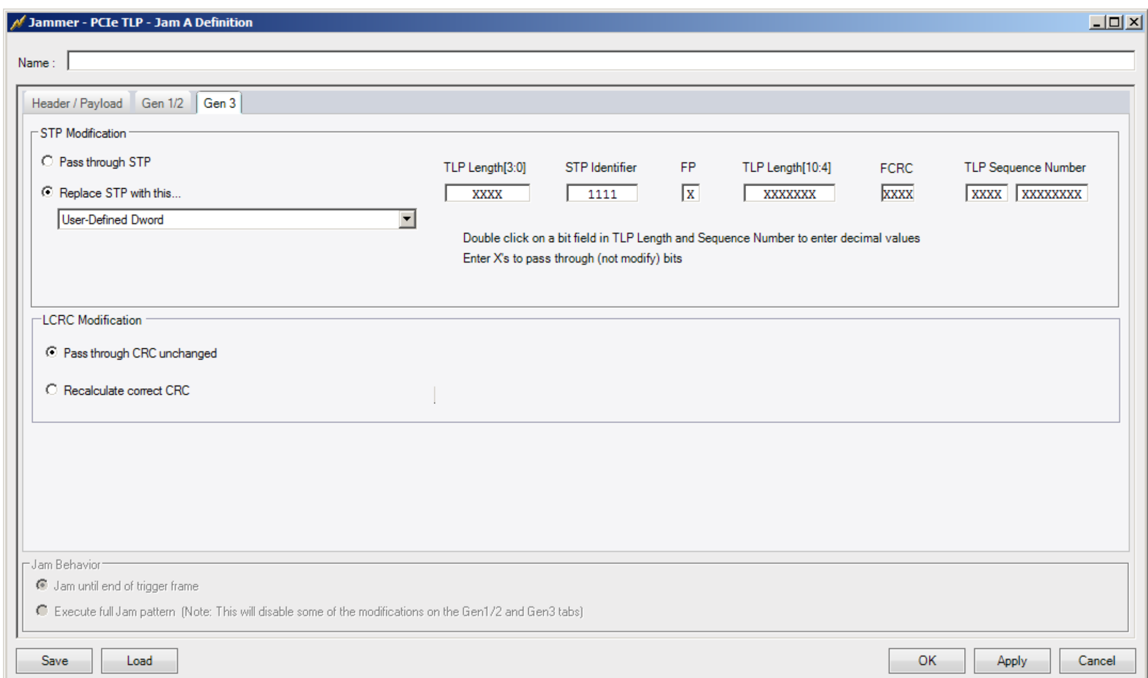


LCRC Modification: Select either the **Pass through CRC unchanged** or **Recalculate correct CRC** options.

Gen 3 Tab

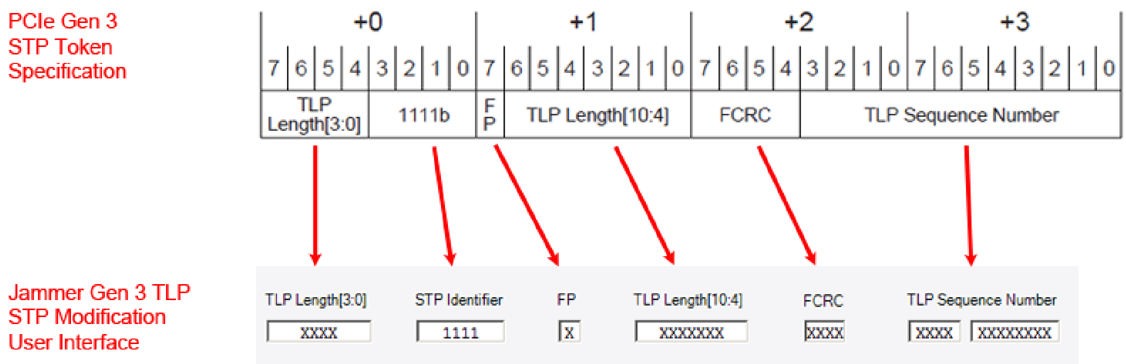
Selecting the Gen 3 tab allows you to define whether you want to pass through or change the TLP's STP (Start Of Packet) and LCRC (Link Cyclical Redundancy Check) values.

Figure 271: PCIe Jamming TLP Gen 3 Definition Window



STP Modification: Select either the **Pass through STP** or **Replace STP with this...** options. You can replace the STP with a User-Defined Dword. Double-click the text boxes to enter bit values into the text boxes.

Figure 272: STP Modification Bytes



LCRC Modification: Select either the **Pass through CRC unchanged** or **Recalculate correct CRC** options.

Jamming a DLLP for PCIe

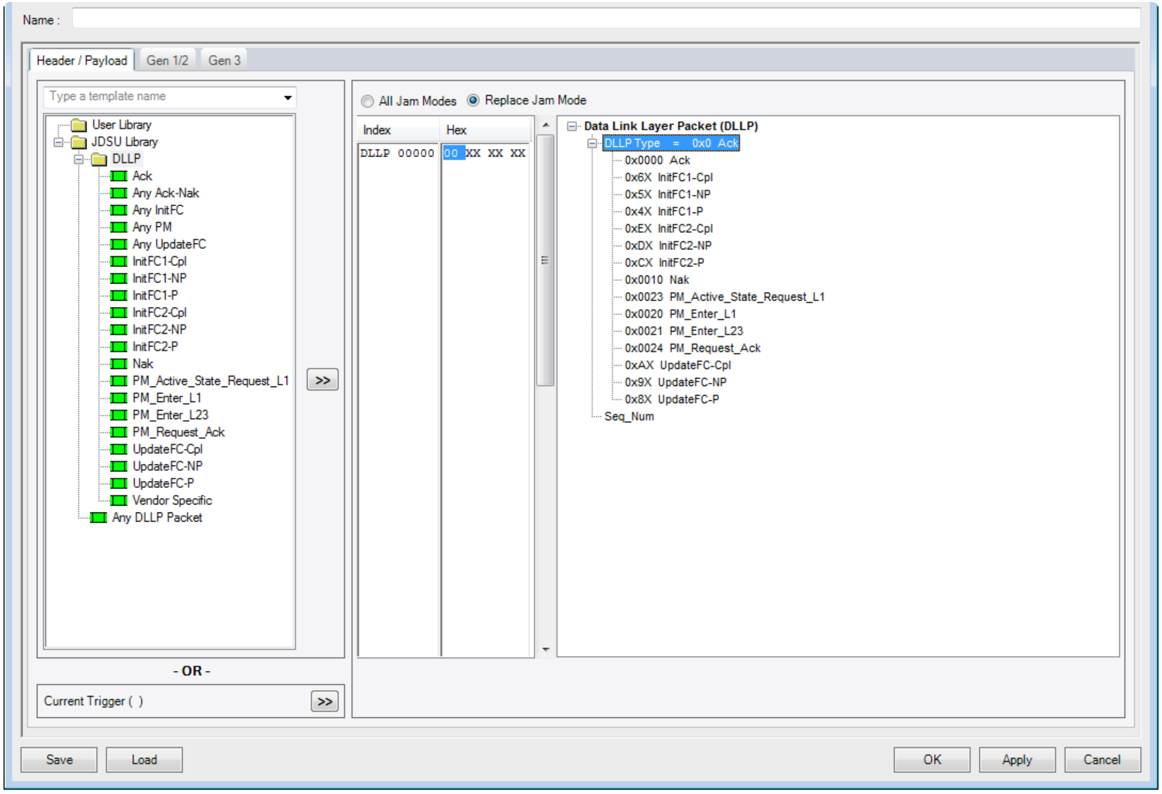
With **DLLP** as the Trigger Type, the Jam Type will be **Replace DLLP with Modified DLLP**. When you select the Jam button, the following Jam Definition window is displayed (Figure 273). This window allows you to define the modified DLLP that is used.

There are three tabs: the Header/Payload tab defines the DLLP, the Gen 1/2 tab sets the CRC modification settings, and the Gen 3 tab sets the CRC modification settings.

Header/Payload Tab

The Header/Payload tab allows you to select a modified DLLP packet from the Library on the left of the window. When the selection is made and you click the “double right arrow” button, the DLLP’s Dword is displayed in the Index/Hex columns in the center of the window.

Figure 273: PCIe Jamming DLLP Header/Payload Tab Definitions

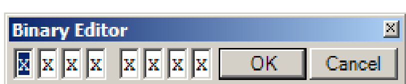


The header portions of the selected DLLP are shown. Selecting a specific header portion highlights corresponding the Hex value.

> In the Hex view, an X represents a nibble that can be any value (a “don’t care”). Partially defined hex characters appear as question marks.

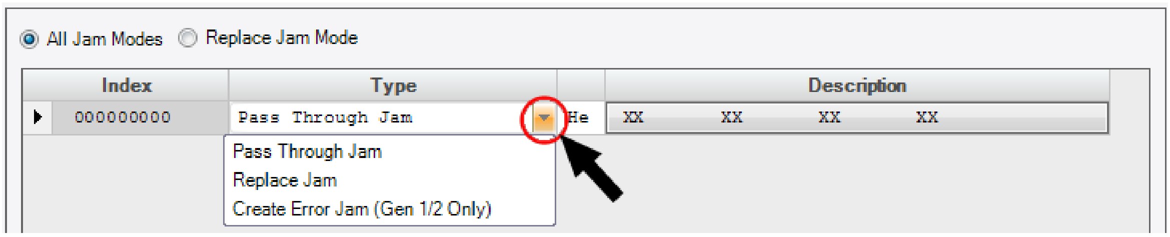
To modify the Hex value of a highlighted string, double-click the string to display the Binary Editor (Figure 274).

Figure 274: Binary Editor Dialog



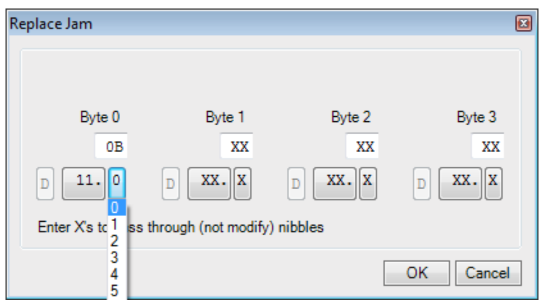
Select the **All Jam Modes** radio button to open the All Jam Modes screen (see Figure 275). This screen provides access to set the Jam modes using the drop down arrow (circled in red).

Figure 275: All Jam Modes for PCIe DLLP

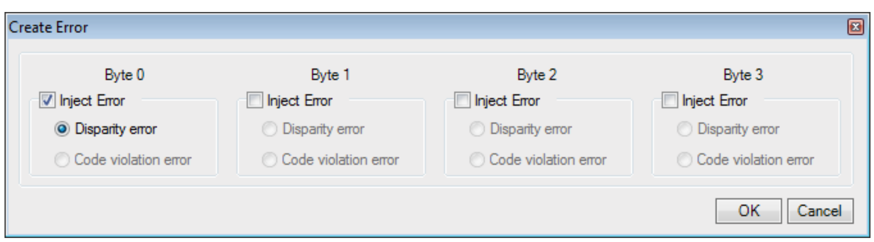


All Jam Modes for DLLP has the following available Jam options.

- **Pass Through Jam -** Pass through the current word unchanged.
- **Replace Jam -** This function allows you to replace each nibble with a new value. Selecting the **Description** column displays the following dialog box to make changes:



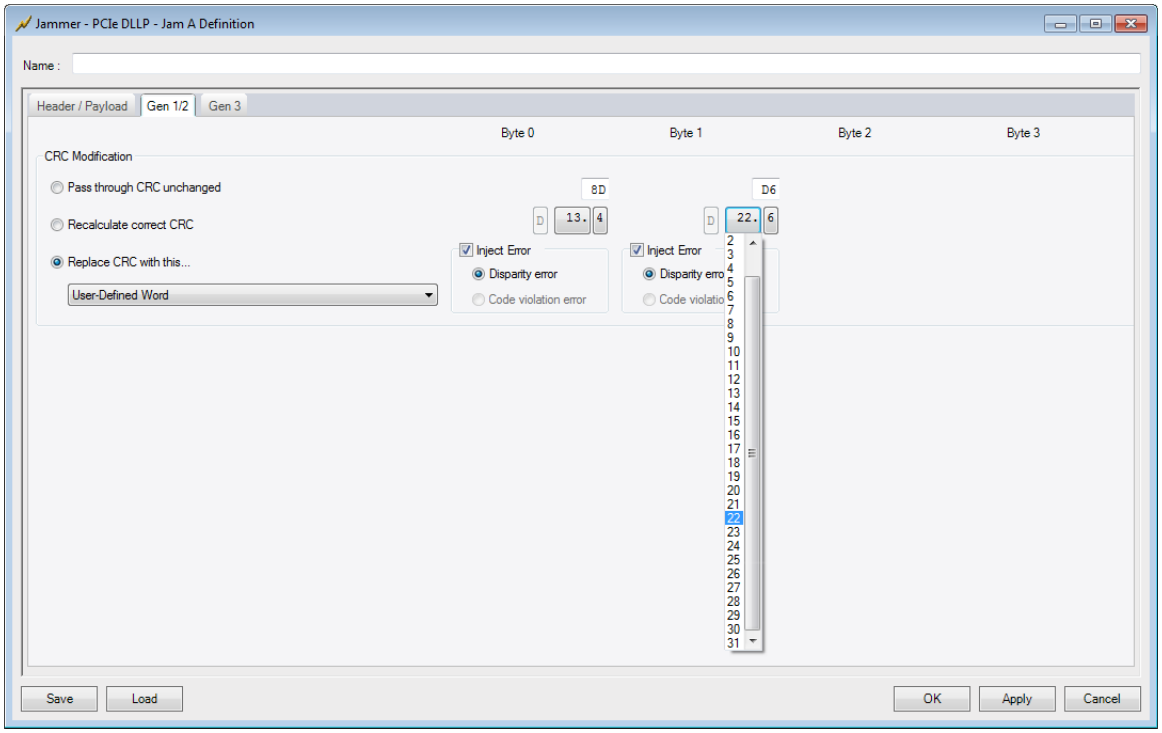
- **Create Error Jam (Gen1/2 Only) -** Check Inject Error for any byte(s) on which you want to send Disparity Errors. This inverts the running disparity at that byte. Selecting the **Description** column displays the following dialog box to make changes:



Gen 1/2 Tab

Selecting the Gen1/2 tab allows you to define whether you want to pass through, recalculate, or replace the DLLP's CRC value with a User-Defined Word. If you select that you want to replace the CRC value with a User-Defined Word, you set the word's 2 bytes using the with the buttons at the right which display a drop-down list to select from. You can also inject disparity error on either Byte 0 or Byte 1by selecting one or both of the **Inject Error** check boxes.

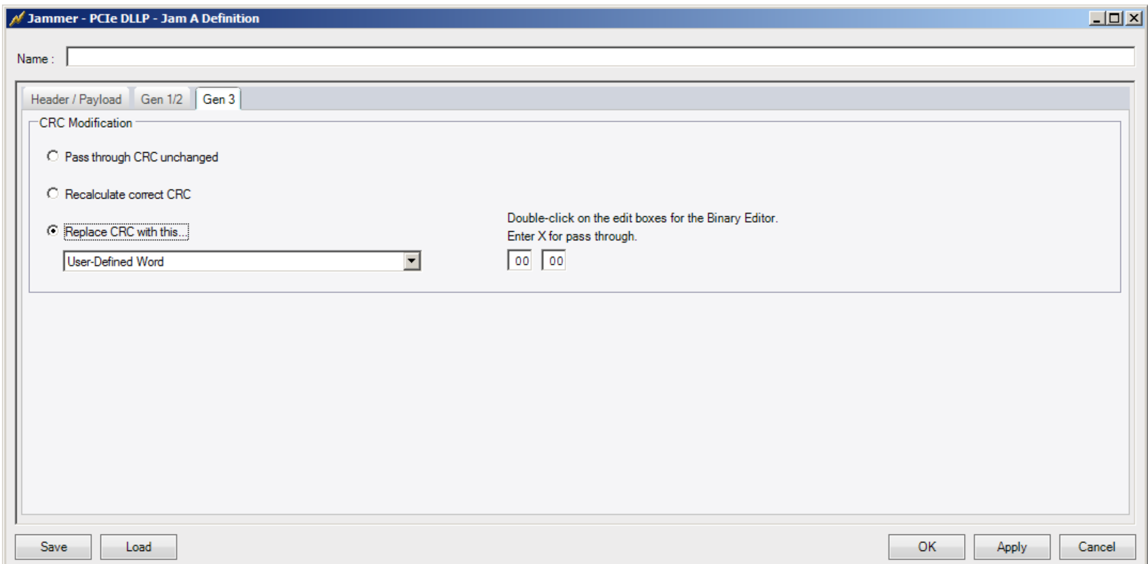
Figure 276: PCIe Jamming DLLP Gen 1/2 CRC Definitions



Gen 3 Tab

Selecting the Gen3 tab allows you to define whether you want to pass through, recalculate, or replace the DLLP's CRC value with a User-Defined Word. If you select that you want to replace the CRC value with a User-Defined Word, you set the word's 2 bytes using the with the buttons at the right which display a drop-down list to select from.

Figure 277: PCIe Jamming DLLP Gen 3 CRC Definitions



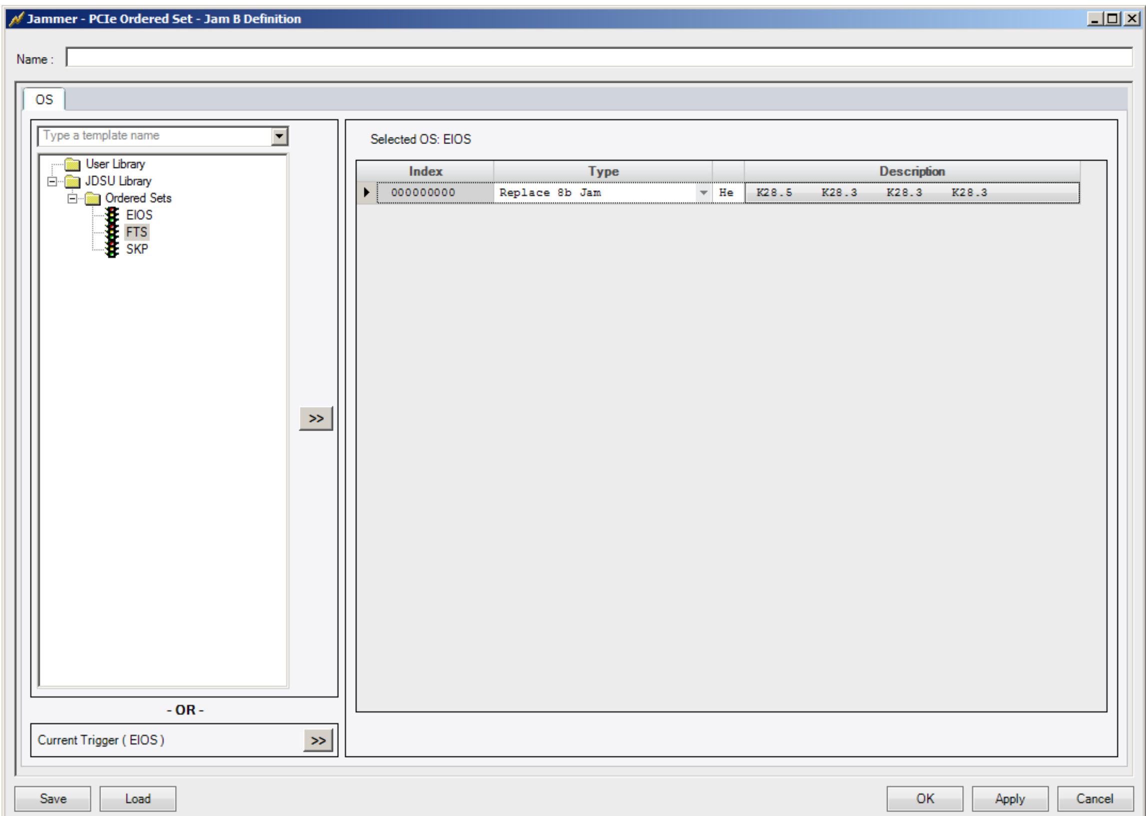
Jamming an Ordered Set for PCIe

If the Trigger Event is an Ordered Set, and you want to Jam with an Ordered Set, select Replace with Modified Ordered Set Jam from the drop-down menu, and click the **Jam** button on the Xgig Jammer Configuration window, to open the Ordered Set Jam Definition window (Figure 278).

With **Ordered Set** as the Trigger Type, the Jam Type will be **PCIe Ordered Set Jam Type**. When you select the Jam button, the following Jam Definition window is displayed (Figure 278). This window allows you to select the modified Ordered Set that is used.

The OS tab allows you to select a modified Ordered Set from the Library on the left of the window. The ordered sets that are available from the library are based on the ordered set that was selected in the Trigger definition. When the ordered set selection is made and you click the "double right arrow" button, the ordered set information (Index, Type, and Description) are displayed on the right side of the window.

Figure 278: PCIe Jamming Ordered Set Definitions



Chapter 9

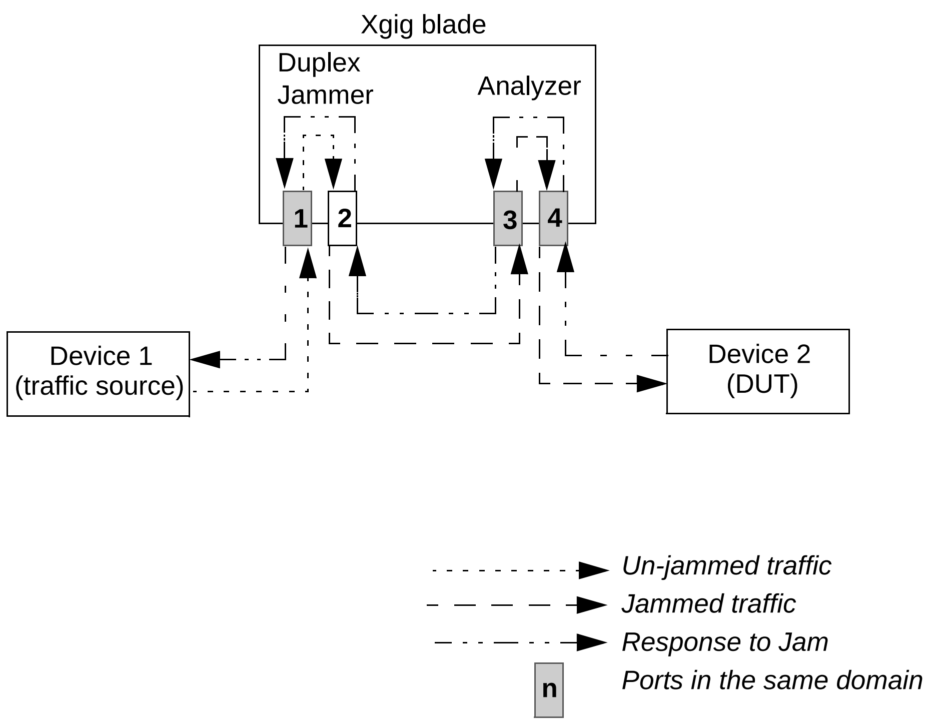
Xgig Jammer Application Notes

In this chapter:

Setting Up the Xgig Jammer and Xgig Analyzer to Capture a Jam

Typically, when setting up a Jammer test, it is customary to have a traffic source, a device under test (DUT), a Jammer and an Analyzer. You can set up the Analyzer to capture the traffic (including the Jam) and the response to the Jam. Figure 279 illustrates the setup.

Figure 279: Xgig Jammer and Analyzer Setup



In this setup, ports 1 and 2 are part of a duplex Jammer configured in crossover. The sequence of events is described as follows:

1. The source traffic goes into port 1, which is Path A in the Jammer configuration.
2. An Arm-Trigger-Jam sequence creates a Jam and the traffic goes out port 2 and then into port 3 of the Analyzer.
3. The Analyzer captures the incoming traffic including the Jam.
4. The traffic goes to the DUT, which responds.
5. The response goes in port 4 of the Analyzer and is also captured.
6. The reply goes all the way back to the traffic source by going through ports 4, 3, 2 and 1.

To see the Jam in the capture, you must stop the Analyzer when the Jam data is in the Analyzer's buffer. You can accomplish this in two ways:

- Configure the Analyzer to trigger on traffic such as the Jam itself or around the Jam.
- Setup the Jammer to trigger the Analyzer.

To setup the Jammer to trigger the Analyzer, the Jammer port that generates the trigger and the Analyzer ports that receive the trigger must be in the same Domain. To set this up:

1. Using Xgig TraceControl (Analyzer), create an Analyzer Domain using ports 3 and 4.
2. Setup port 3 to stop capturing on a trigger, but do not specify a template for the Trigger Condition.
3. Set the clock rate on the Analyzer.
4. Using Xgig Maestro (Jammer), go to **Port > Port Selection and Domain Setup** on the menu bar.
5. Select and Use ports 1 and 2 as a duplex Jammer.
6. Select port 1, right-click, and select **Add to Domain…**, then select the Domain in which the Analyzers are.

   Now ports 1, 3 and 4 are in the same Domain and will receive each other's triggers.

Figure 280: Ports Selected for the Same Domain

7. Use a Jammer configuration that triggers on Path A and triggers Domain A.
8. Start the Analyzer and Jammer.
9. Each time the Jammer Jams, the Analyzer is triggered and stopped.
10. View and save the capture.
11. Restart the Analyzer for the next Jam.

Testing Strategies for the Xgig Jammer

The Xgig Jammer is designed to verify the operation of a Fibre Channel, Gigabit Ethernet, SAS, or SATA/STP based system by introducing errors in a controlled and repeatable way. The Fibre Channel, Gigabit Ethernet, SAS, or SATA/STP devices under test are assumed to be functional and operating properly with or without the Xgig Jammer system inserted in the link.

The goal of Xgig Jammer testing is to modify the traffic moving between the devices, creating errors, which should be recognized and handled correctly by the network. The range of tests that can be created is unlimited. A Fibre Channel test can include:

- Replace an Open (OPN) sent by a host with an Idle. Does the host recognize that the OPN was never received?
- Modify a frame and leave the CRC unchanged. Does the receiving device recognize a bad frame?
- Modify a SCSI command within a frame and correct the CRC. Does the SCSI error checking software recognize a bad command?

The Xgig Jammer can be used both with black-box and white-box test strategies. For black box testing, the Xgig Jammer can be configured to cause a wide range of potential error conditions. The operating environment should trap, handle, and then report the actions the system took for each of these errors. If an error is not trapped or handled correctly, the Xgig Jammer can be configured to redo the specific test. The details of the traffic to and from the offending device are captured by the Xgig Analyzer for examination.

Using the Xgig Jammer for a white-box test strategy requires a two-stage process. Analyze the error checking software in the device and determine the expected response to specific classes of errors. Exercise all the error checking routines by creating the errors with the Xgig Jammer and then verify that the system responds correctly.

Replace Frame with Modified Traffic - Fibre Channel

The Fibre Channel Jammer frame function “Replace w/ Modified Traffic” allows a large number of ways to alter a target frame. These alterations come in four basic types:

- Simple frame modification
- Frame truncation and/or modification
- Replacement of a frame with multiple frames
- Replacement of a frame with Ordered Sets.

Each of these types is described in this application note. All of the following cases assume you are using the Jam behavior option set to “Jam until end of trigger frame.”

Simple Frame Modification

The “Replace w/ Modified Traffic” feature always allows you to modify any word of the target frame. The “SOF/CRC/EOF” tab allows you to edit the SOF, CRC, and EOF. The “Header” tab allows you to define Jamming for the first 6 words of the frame. The “Payload” tab allows you to define Jamming for the rest of the frame, for however many words you decide, up to the maximum legal frame length (528 payload words).

During operation, when the Jammer finds the target frame, it steps through each word performing each requested change, until it reaches the target frame's CRC. At this point, even if you have defined extra words in the “Payload” tab, the Jammer ignores these extra instructions and instead follows your instructions for the CRC word and EOF. On the other hand, if you do not specify as many words in the “Payload” tab as are in the target frame, then the Jammer passes through the remaining payload words until the CRC of the target frame.

An example of a simple modification would be leaving the structure of the target frame intact but changing its data. To do this you would leave the SOF as an SOF, modify the data with other data, keep the position of the CRC, and leave the EOF as an EOF.

Frame Truncation and/or Modification

You can also truncate and modify a frame at the same time. In order to accomplish this, define as many data word modifications as the desired length of the new frame, then select an “Automatic CRC” to be inserted after the data words, followed by an EOF. Fill the rest of the “Payload” tab with “Idles” or some other Ordered Sets. To be safe, define the full amount of 528 words, in case the target frame is very large.

Regardless of how many payload words you specify, or how long the target frame is, when the Jammer reaches the target frame's CRC and EOF, it looks for specific instructions regarding them (on the “SOF/CRC/EOF” tab). Do not forget to replace both the CRC and EOF with the desired Ordered Sets.

This form of truncation does not work correctly if the target frame is shorter than the new frame you have defined. The Jammer would modify the target frame up to the point of its CRC, and then jump to the CRC and EOF instructions, which are defined as other Ordered Sets. The resulting frame fragment would have an SOF, some data words, and then whatever Ordered Sets you defined for the CRC and EOF words.

Another Frame Jamming feature “Replace Frame w/ Truncated Frame” is a simple way to access a subset of this functionality. The feature asks for only two simple inputs from the user:

- The number of words the new frame should have
- A new EOF

The Jammer passes through the original frame (without modifying) until it reaches the specified length, and then sends a good CRC and the user-specified EOF, followed by “Idles” to replace the rest of the target frame. The feature automatically deals safely with the case where the target frame is shorter than the new specified length. In this case, the frame is simply passed through with no changes, but the new EOF is used.

Replacement of Frame with Multiple Frames

Perhaps the most advanced use of the “Replace w/ Modified Traffic” feature is to replace the target frame with more than one frame. This is probably only wise if you know the target frame is large, because the replacement traffic you specify must fit in the space from the SOF to the EOF of the target frame.

To create multiple frames, repeat patterns of SOF, 6 or more data words, an automatic CRC and an EOF, throughout the Jam definition. Make sure to define some number of Ordered Sets, for example, “Idles” between each frame. Remember to specify what to do with the target frame’s SOF, CRC, and EOF (on the “SOF/CRC/EOF” tab). Either use them as part of your smaller frames or replace them with other Ordered Sets. As noted previously, the CRC and EOF functionality take precedence over payload words.

The LRC options you set on the “Global” tab take place for all frames you create or alter. The LRC is the eighth payload word, that is, 14 words after any SOF. Frames shorter than 14 data words are not affected. Any Ordered Set between an SOF and the LRC word cancels the word count, so that the global LRC option is ignored for that “frame” and the Jammer defers to what was specified in the “Payload” tab.

Replacement of Frame with Ordered Sets

Choose Ordered Sets to replace the SOF, CRC, and EOF of the target frame (“SOF/CRC/EOF” tab), as well as all entries in the “Header” and “Payload” tabs. Make sure to specify enough payload words to cover the largest possible expected target frame (defining all 528 payload words is the safest method).

Note that the Frame Jamming feature “Replace Frame w/ Idles” is a simple way to access a subset of this functionality. This feature replaces the target frame with only “Idles.” It automatically adjusts for any size of target frame.

Using Domains and External Triggering

This is a complex example of using domains and external triggering.

For this example, you want to have an Xgig duplex Jammer Arm on a TTL input, then Trigger on a frame and Jam it, and trigger an Xgig Analyzer in the same Sync Group. You want the Jam to occur on port A.

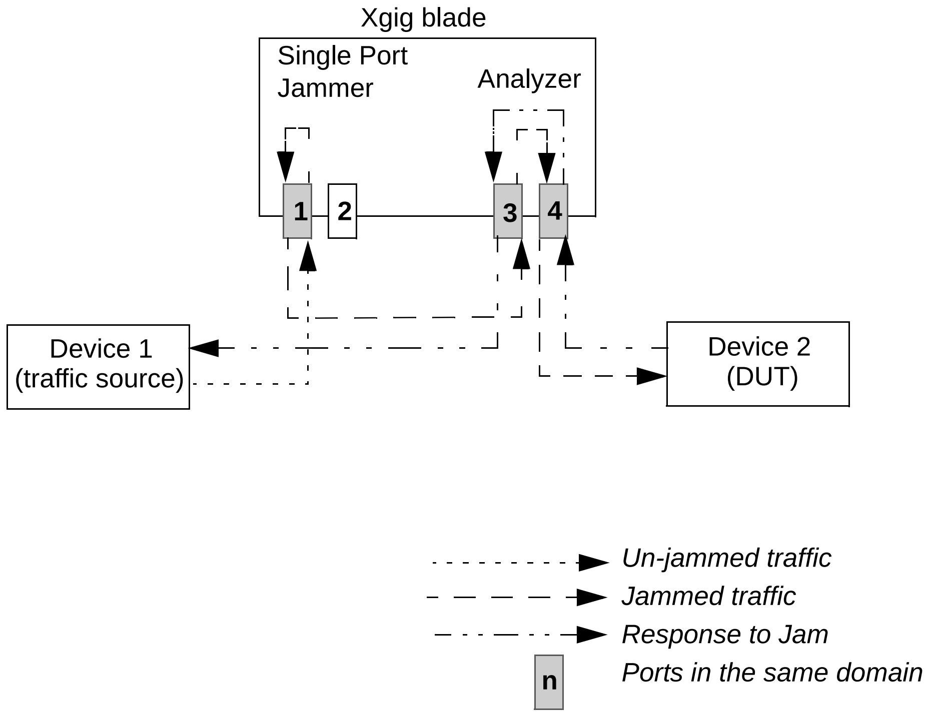
1. Set the Jammer Test Case mode to Arm B Followed by Trigger A Jams A.
2. For the Arm B, check Trigger from Domain B.
3. Set up the desired Trigger condition and Jam definition for the frame.
4. Check Trigger Domain A.
5. In the Port Selection and Domain Setup window, put port B in the same Domain as the TTL input connector.
6. Add port A to the domain of the Xgig Analyzer ports you are using to capture.

When the TTL input connector triggers, it will trigger the domain containing port B and will Arm the Jammer. When the Jammer finds its Trigger condition, it will Jam and then trigger the domain that contains the Analyzer ports.

How to Setup a Single Port Xgig Jammer

When you lock two Jammer ports separately as simplex Jammers, they always have a data path without crossover. To use a Jammer port with an Analyzer on the same blade, the connections would be made as in Figure 281.

Figure 281: Single Port Jammer Setup



The connection at port 1 requires that the transmit path and receive path go to different locations, so the cables must be separate. Therefore this sort of setup is probably not possible with copper connections.

When using a single port Jammer setup, the GUI refers only to path A and port A because the device has only one port. This is still true if you use port 2 as a single port Jammer.

Remember that you could use the Jammer on port 2 as part of another completely different testing setup (however, it must still share the same protocol and clock rate settings).

Note: If you load a duplex Jammer configuration file (one that utilizes path B) to a single port simplex Jammer, you receive a warning that the configuration will be "flattened." This means that any path B settings get transferred to path A. If the duplex port configuration uses both a trigger from domain (input) and trigger domain (output), then only the trigger domain (output) is used after flattening (and therefore you should review such configurations before use).

PART TWO: Using Xgig Delay Emulator

Chapter 10

Introducing Xgig Delay Emulator

In this chapter:

Xgig Delay Emulator Overview

The Xgig Delay Emulator includes hardware (Xgig Multi-function Blade) and software that performs real-time delay modification for the 10GigE protocol. You can use the Delay Emulator with Xgig Analyzers to capture and display the network traffic associated with the delay modification.

The Xgig Delay Emulator should be used as a digital retiming device. The Xgig Delay Emulator blade re-times the data and re-transmits it with a new clock transparent to the data link (it passes every bit of data.) The Xgig Delay Emulator blade functions in any 10GigE architecture. It does not log onto a loop, switch, or fabric; it only passes data between two devices. The Xgig Delay Emulator blade can pass 10GigE traffic, or it can recognize an event or event sequence and modify the traffic. The events must be 10GigE frames. A specific frame or series of frames can be modified in two ways: inserting a variety of delays or reordering a frame.

Features

Xgig Delay Emulator has the following features:

Operation

The Xgig Delay Emulator system (hardware and software), allows you to perform the following operations:

- Emulate network scenarios such as distance, switch processing delay, jitter, and multipath routing.
- Simulate network congestion.

  You can use simulated congestion to help characterize effects on QoS and bandwidth throttle.

Capabilities

The Xgig Delay Emulator has the following capabilities:

- Operates with 10GigE protocol
- Supports the 10.3125 Gbps line rate.
- Supports frames from 64 bytes to 9k jumbo frames.
- Operates in digital re-timing mode at all times.
- Contains standard editing features such as copy, cut, paste, add, insert, and delete to edit the test suite. An option lets you run the test suite forever in a repeating loop.
- Provides the appropriate MAC (media access control) layer when you load the application.

Triggering Capabilities

The Xgig Delay Emulator module provides the following Triggering capabilities:

- You have two levels of triggering:
  - — Arm (first level)
  - — Trigger (second level)
- You can set an Arm condition as a specific DWord within a frame.
- You can set an Trigger condition as a specific DWord within a frame.

Delay Capabilities

- The Xgig Delay Emulator can perform the following types of Delays on the contents of frames:
  - Fixed delay
  - Jitter delay
  - Ramp down delay
  - Ramp up delay
  - Random delay
  - Random Jitter delay
- The minimum delay through the system is approximately 30 microseconds.
- The maximum programmable delay is approximately 1.3 seconds.
- A test supports up to eight queues.
- You can define **Frame Drop** mode and rate.

Reorder Capabilities

The Xgig Delay Emulator can perform the following types of frame reorder:

- Consecutive reorder
- Trigger reorder

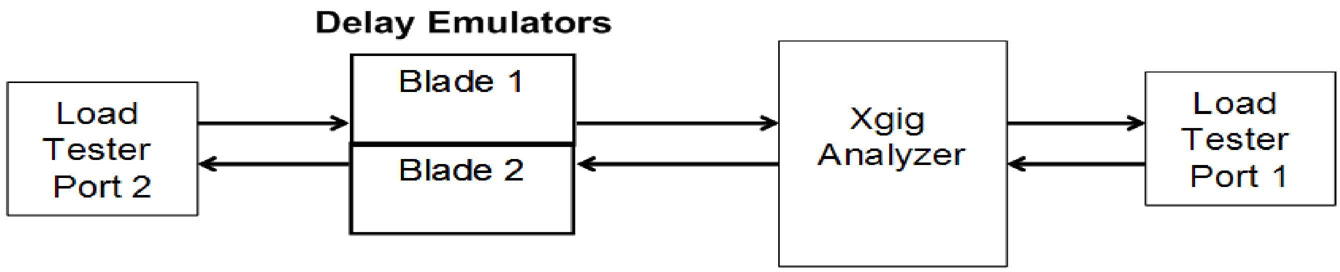
New Features for Xgig Delay Emulator

There are no new features for the Xgig Jammer 8.1 release.

Cabling

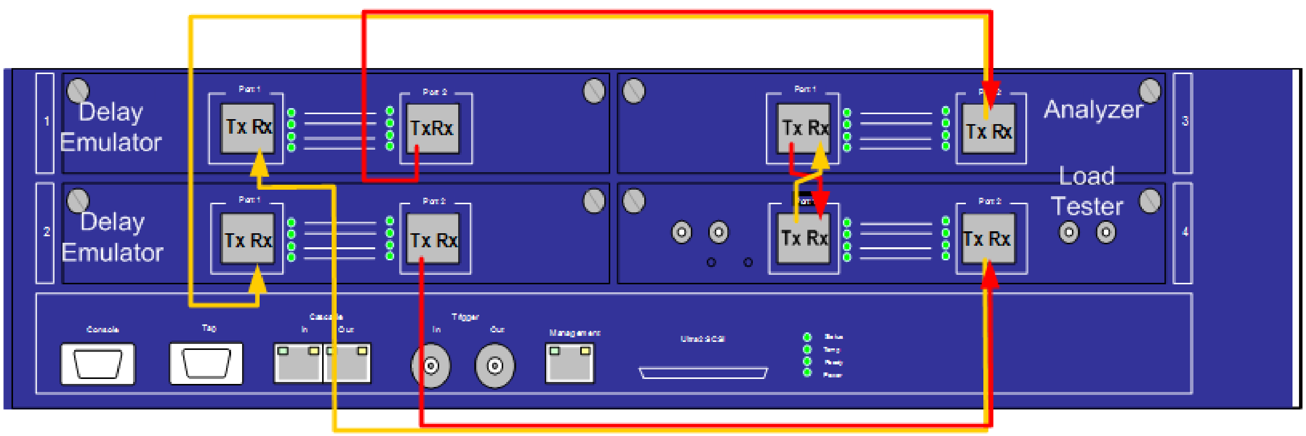
Test Setups containing Delay Emulator require special cabling if you want to use them to test data in both directions. Because Delay Emulator uses only the odd port of a port pair, data flows only from the Rx connector of Port one to the Tx connector of port two. The flow of data in the opposite direction, from the Rx connector of port two to the Tx connector of port one is not possible because port two is not used. Therefore, if you want to perform delay emulation on traffic flowing in both directions between two devices, you must use a second blade running Delay Emulator. See the example below.

Figure 282: Delay Emulator Test Setup



The following diagram shows the cabling for the Delay Emulator in the example above.

Figure 283: Delay Emulator Cabling Diagram



One cable connects the Load Tester to the Delay Emulator. The cable for the Tx Rx connection comes out of port 2 of the Load Tester then splits. The Rx cable plugs into the Tx connector of port 2 of the second Delay Emulator. The Tx cable plugs into the Rx connector of port 1 of the first Delay Emulator.

Another cable connects the Delay Emulator to Analyzer. The cable for the Tx Rx connection comes out of port 2 of the Analyzer then splits. The Rx cable plugs into the Tx connector of port 2 of the first Delay Emulator. The Tx cable plugs into the Rx port of port 1 of the second Delay Emulator.

A third cable connects the Load Tester to the Analyzer through port 1 of both blades.

Chapter 11

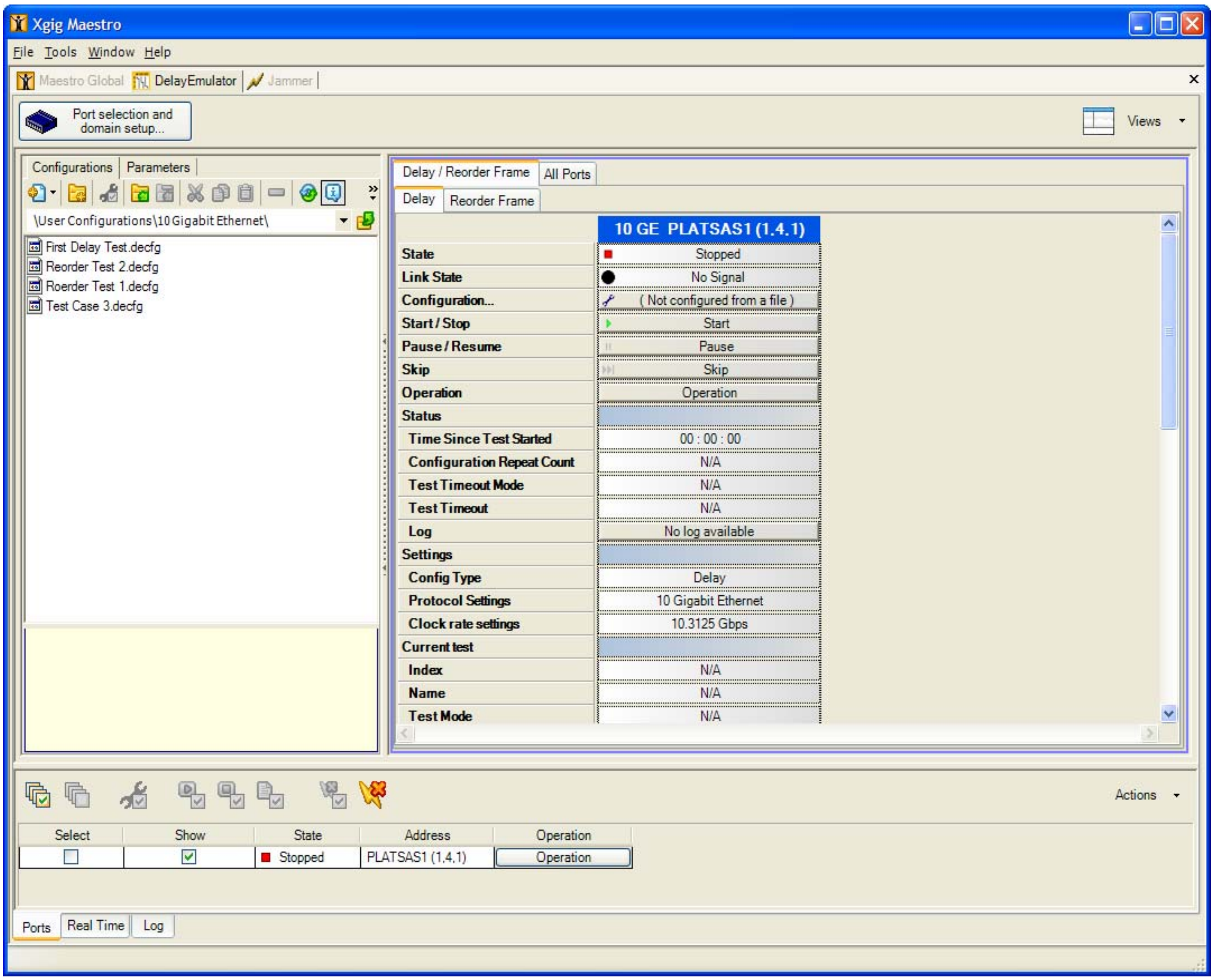
Using the Delay Emulator Tab

In this chapter:

After you have discovered and locked the Delay Emulator ports that you want to use and have set up your capturing and monitoring applications, such as Xgig Analyzer, you are ready to run the Xgig Delay Emulator application. This chapter provides an overview of the Delay Emulator tab, on the Xgig Maestro main window, and its functions; it also includes steps to run predefined tests supplied with the Xgig Delay Emulator application or tests you have defined and saved.

You should have launched Xgig Maestro and locked at least one device as described in the *Xgig Maestro Introduction Guide*. The Xgig Maestro window is displayed with the Delay Emulator tab on the right. This tab is where you operate the Delay Emulators you have locked.

Figure 284: Xgig Delay Emulator Tab on Xgig Maestro Window



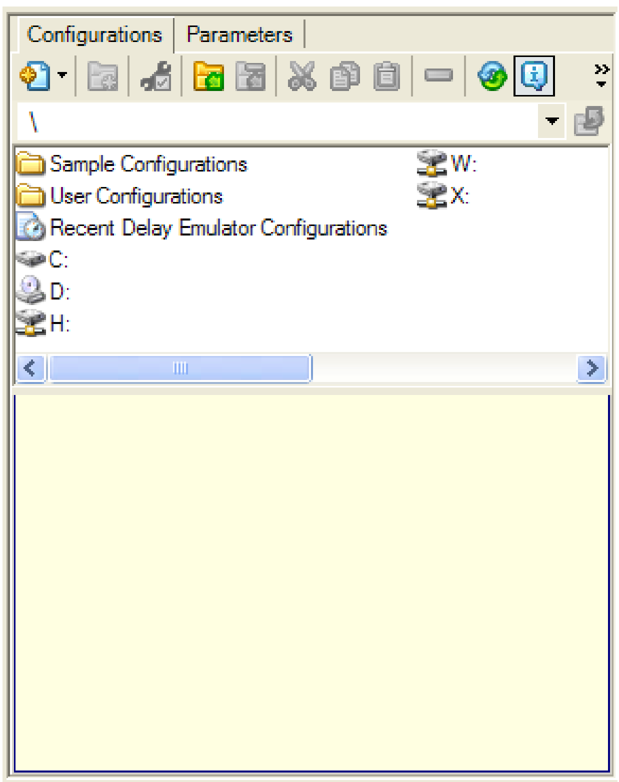
Using the Configuration Manager in Delay Emulator

The Configuration manager (Figure 285) is associated with the device function tab. This window also displays the configuration files specific to the function tab displayed. The **Sample Configurations** folder includes configurations that are provided with the application. The **User Configurations** folder is where the configurations you create are saved. The **Most Recently Used** folder allows you easy access to those configuration files most recently used. The Configuration Manager also includes a list of all the drives on your system allowing you to locate any configuration files on your system quickly.

The Configuration manager has the following features:

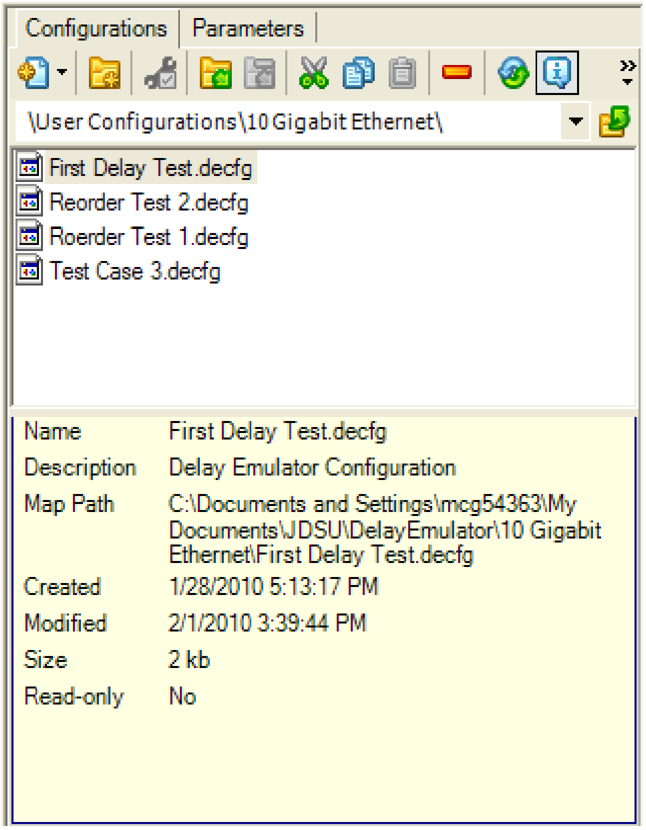
- The Configuration manager provides a list of test configurations organized into folders and lists all the drives on your system allowing you to easily browse to locate all of your configuration files on your system

Figure 285: File Location in Delay Emulator Configuration Manager



- List of configuration files in a folder

Figure 286: Configuration Files and Description Pane



- Description pane
  - When you select a configuration file in the list, a description of the file is displayed in the description pane below. It also displays the name of the file, the path where the file is located, the size of the file, the date and time when the file was created, the date and time the file was modified, whether the file is read-only and the Map path where the file is located on your system.
  - When you click the Show/Hide button below the Description pane, you display or hide this pane.
- Drag and drop files

  You can drag any configuration from the Configuration manager list onto a device column to load it.
- Tool bar that lets you create, load, copy, cut, and paste configuration files. See "Configuration Manager Tool Bar in Delay Emulator" on page 303 for more information on this tool bar.
- Context menu

  Select a configuration file name, and right-click to display a menu where you can choose to create and edit configuration files, and additional operations. See "Configuration Manager Context Menu in Delay Emulator" on page 304 for more information about these menus.
- Browse to map folders of files stored in locations other than the default Sample and User Configuration folders.

Configuration Manager Tool Bar in Delay Emulator

The Configuration manager tool bar (Figure 287) allows you to perform the following functions:

New Configuration allows you to open the Configuration window and create a new Delay Emulator configuration from scratch.

New Folder allows you to create a new folder.

Load allows you to load a configuration file into a port or ports. This icon is only active when a port has been locked and is selected in the Port Manager. See "Loading Delay Emulator Configuration Files" for details.

Map allows you to select a folder that you want to be listed in the Configuration Manager for the selected function tab.

Unmap allows you to unmap a folder that has been mapped.

Cut allows you to cut a file from its current location. This is not the same as deleting a file.

Copy allows you to copy a file.

Paste allows you to paste a file you have cut or copied.

Delete allows you to delete a file or folder.

Path allows you to go up one level in the folder tree. This field next to this icon displays the current folder name.

Refresh allows you to refresh the Configuration Files and Description pane.

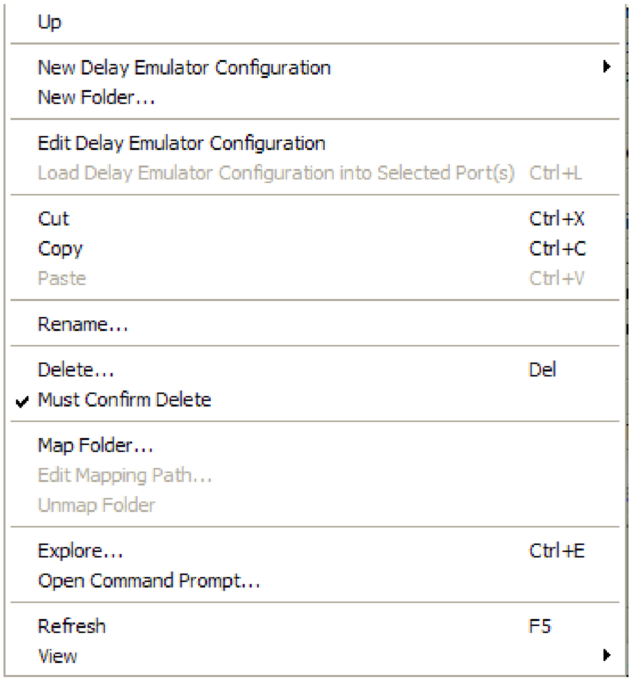
Show/Hide allows you to show or hide the details for the selected file. These details appear in the lower section of the Configuration Manager pane.

View allows you to view the files in the Configuration Manager as a list including only the file name or to view the details of the files in the list.

Figure 287: Configuration Manager Tool Bar in Delay Emulator

Configuration Manager Context Menu in Delay Emulator

Figure 288: Configuration Manager Context Menu in Delay Emulator



Right-click in the list to choose the following actions from the context-sensitive menu:

- **Up**

  Displays the contents one folder level up from the current display.

- **New Delay Emulator Configuration**

  Allows you to open either a new Delay-Mode configuration or a Re-order Mode configuration.

- **New Folder**

  Opens the Configuration manager dialog where you can enter the name of a new folder you want to add.

- **Edit Delay Emulator Configuration**

  Opens the file highlighted in the list, the same as double-clicking on the file name.

- **Load Delay Emulator Configuration into Selected Port(s)**

  Loads the file highlighted in the list into the port(s) selected in the Ports Manager. See “Using the Ports Manager in Delay Emulator.”

- **Cut**

  Removes a selected file or folder from the list.

- **Copy**

  Copies a selected file or folder to a clipboard making it available to paste in another location.

- **Paste**

  Pastes a file or folder you cut or copied to the location you choose.

- **Rename**

  Opens a dialog with the current file or folder name displayed in an entry field that you can modify. It also shows the protocol, path, and current file or folder name.

- **Delete**

  Opens a dialog where you can confirm whether you want to delete the highlighted file (configuration) or folder from the list.

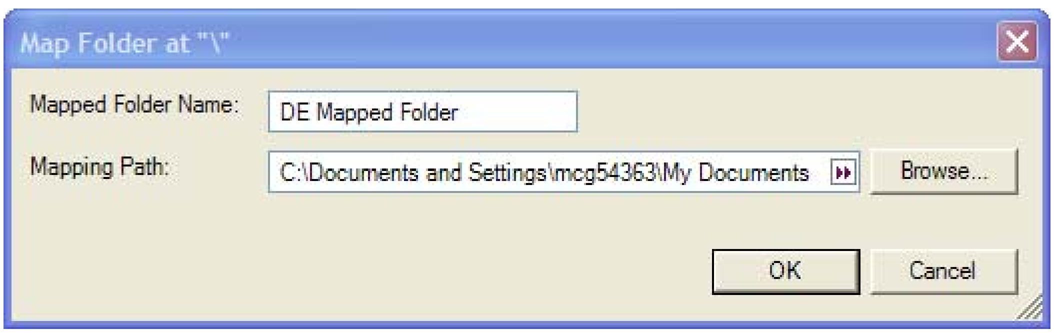
- **Must Confirm Delete**

  Sets this choice as a preference that opens a dialog to confirm that you want to delete a file or folder from the list. When you select it, a check mark is displayed next to it. It is selected by default.

- **Map Folder**

  Opens the Map Folder dialog box that lets you map a folder to a name of your choice.

Figure 289: Map Folder dialog box



  Enter a name of your choice in the Mapped Folder Name field, and use the **Browse** button to select the folder on your system or network you want to map to this name.

- **Edit Mapping Path**

  Allows you to edit the mapping path.

- **Unmap Folder**

  Removes a highlighted mapped folder from the Configuration manager.

- **Explore**

  Opens a Windows Explorer window showing the directory where the current configuration files are located.

- **Open Command Prompt**

  Opens a Windows Command Prompt window showing the directory where the current configuration files are located.

- **Refresh**

  Refreshes the Configuration Manager window.

- **View**

  Has two choices:

  — List

  Displays the list of files or folders in the path you choose.

  — Details

  Displays the list of files or folders with the size and modification date.

Using the Parameters Status Table in Delay Emulator

The Parameters Status pane contains two tabs, **All Ports** and **Delay/Reorder** Frame. The **All Ports** tab shows all devices that have been locked. The **Delay/Reorder Frame** tab shows the devices locked according to their mode. Each Delay Emulator device is displayed by a column on the Delay Emulator tab (Figure 290). At the top of each column is the chassis name and the chassis number, the slot number, and port number(s) in parenthesis.

The locked ports can be divided in a sorted manner in the **Delay/Reorder Frame** tab or displayed unsorted in the **All Ports** tab.

To configure how to display the ports in the Parameters Status Table, click on the Views button and do the following:

Select or unselect **Configuration** to display or hide the Configurations tab and Parameters tab where you manage Delay Emulator configuration files and select the Parameters to display, respectively.

Select or unselect **Port Selection** to display or hide the Port Selection table.

Click **Ports** to display the options for displaying the ports in the Parameters Status Table.

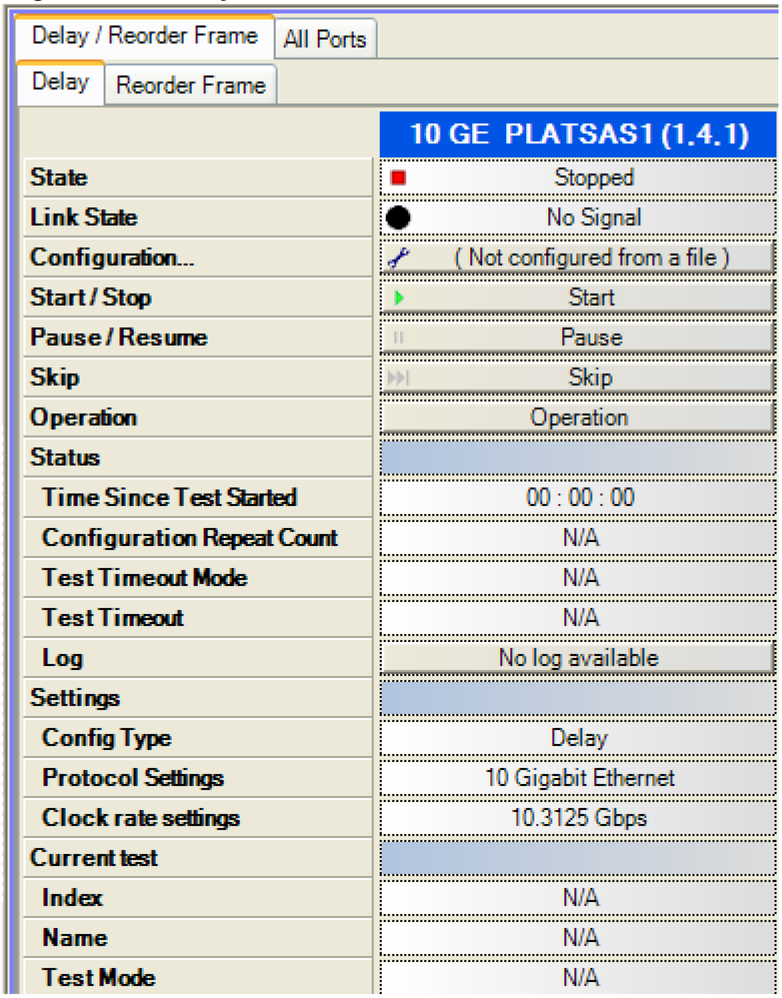
Tile Horizontally - Select this option to display the Delay pane before the Reorder Frame pane. This allows you to drag and drop a port from one mode to the other.

Tile Vertically - Select this option to display the Delay pane beside the Reorder Frame pane. This allows you to drag and drop a port from one mode to the other.

Tabs - Select this option to display the Delay pane and Reorder Frame pane as tabs.

Each Delay Emulator port is displayed by a column on the Parameters Status table (Figure 290). At the top of each column is the protocol, the chassis name, and in parenthesis the chassis number, the slot number and port number(s).

Figure 290: Delay Emulator Parameters Status table



The first column on the tab is the legend for each row in the device columns and contains the following categories for Delay and for Reorder Frame:

- State
- Link State
- Configuration
- Status
- Settings

Parameters Category Descriptions

State

This row shows the state of the Delay Emulator: Disconnected, Connecting, Starting, Running, Stopping, Skipping, Pausing, Paused, Stopped

Link State

Indicating the state of the signal, whether it is present, no signal is present, or the signal has been lost.

Configuration

Displays the name of the configuration file, if any, loaded into the port.

Start/Stop

Click this button to Start or Stop a test. The green arrow icon indicates you can click the button to Start the test. The red box indicates you can click the button to stop the test.

Pause/Resume

Click this button to pause or resume a test suite that is running.

Skip

Click this button to skip a test that is running and move to the next test in the suite.

Operation

Opens the Operation dialog box

Status Category

This category gives the status of the test suite that you have loaded into the Delay Emulator.

Time Since Test Started

Indicates the time elapsed since the current test started.

Configuration Repeat Count

Indicated how many times the test suite has been repeated.

Test Timeout Mode

Indicates whether the timeout option is set.

Test Timeout

Indicates the time value for the timeout option.

Log

Indicates if a log from the last operation is available for viewing.

Settings Category

This category indicates the current physical setup of the Delay Emulator device. You can change most of the settings in this category by using the Parameters Status context menu for each device you have locked.

Config Type

Indicates whether the configuration is delay-mode or reorder-mode.

Protocol

Indicates the current protocol setting for the Delay Emulator.

Clock Rate

Indicates the Delay Emulator clock rate.

Current Test Category

This category shows the condition of the test currently loaded in the Delay Emulator device.

Index

Indicates the number of the test within the queue that is being executed.

Name

Indicates the name of the test currently loaded in the Delay Emulator device.

Test Mode

Indicates whether the test mode is Arm, Trigger or Trigger

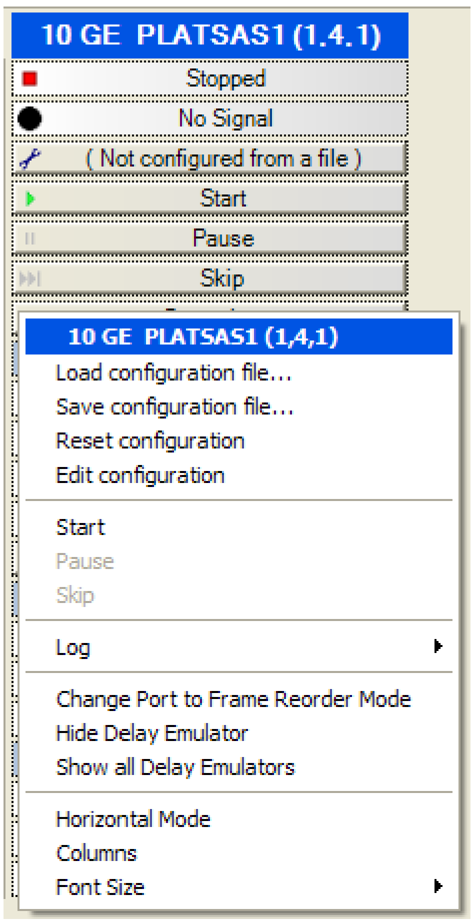
Using the Parameters Status Context Menu in Delay Emulator

Right-click on the Parameters Status table to display the context menus shown in Figure 291. Each protocol has a unique context menu. The available operations are displayed for the column in which you click. This menu provides controls for configuration files, setting the data path, logging test activity, removing a Delay Emulator from the Parameters Status table, and the appearance of the status table.

Refer to the following pages for more information about the how to use the context menu choices:

- "Using the Parameters Status Table in Delay Emulator" on page 307 for information about the parameter settings you make from these menus.
- "Running the Test Suite on a Delay Emulator Device" on page 331 for information about running the Delay Emulator.
- "Using the Log Manager in Delay Emulator" on page 320 for choosing log preferences.
- "Performing Configuration Tasks in Delay Emulator" on page 329 for information about using the Load configuration file, Save configuration file, Reset configuration, and Edit configuration selections from these menus.

Figure 291: Delay Emulator Parameters Status table Context Menus



Log

This setting allows you to view the log, open the options menu for the log, or save the current log.

Change Port to Delay/Reorder Mode

This setting changes the configuration applied to the selected ports to the other mode. If the current configuration is a delay-mode configuration, this setting changes the configuration to reorder-mode and visa versa. The current configuration remains as a saved file. A new blank configuration is applied to the ports containing zero tests.

This option allows you to immediately create a blank configuration and begin editing it while it is loaded into to the hardware.

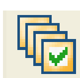
Using the Ports Manager in Delay Emulator

The Ports manager displays details about the ports you have locked. It shows the protocol, chassis name (with chassis number, slot number, and port numbers), and other port specific information. You can sort the rows from first to last or last to first by clicking the column heading. For more information about Xgig slot positions and numbering, refer to the Xgig Family Hardware Guide included with the product CD.

Note: If you are disconnected due to a network problem, you can reconnect to the ports by using the Port Selection and Domain Setup window.

Figure 292: Delay Emulator Ports Manager

The following icons are displayed on the menu bar:



Select All Ports
Selects all ports in the Ports Manager.

Unselect All Ports
Unselect all ports in the Ports Manager.

Load Configuration to Selected Ports
Load the selected configuration file to all selected ports in the Ports Manager.

Start Selected Ports
Start BERT operation on the selected ports in the Ports Manager.

Stop Selected Ports
Stop BERT operation on the selected ports in the Ports Manager.

Show Properties of Selected Ports
Display the Port Properties dialog box, with information on the selected function, protocol, and clock rate (speed). It also shows the chassis name, IP address, slot and port(s).

Disconnect Selected Ports
Disconnect the selected ports in the Ports Manager.

Disconnect All Ports
Disconnect all ports in the Ports Manager.

Actions Button

The **Actions** button contains menus for **Toggle Display**. See Figure 293.

Figure 293: Actions Button Options

Toggle Display

This option toggles between a horizontal and vertical view of the ports.

Ports Manager Columns

The Ports Manager includes the following columns:

Select

Indicates whether you want to select a port pair

Show

Indicates whether you want to show this port pair in the Ports Manager.

Operation

Operation is a button you press to display the Operation bar for the device you are using. Refer to “Running the Test Suite on a Delay Emulator Device” on page 331 for additional information.

State

This column displays the state of the device under test.

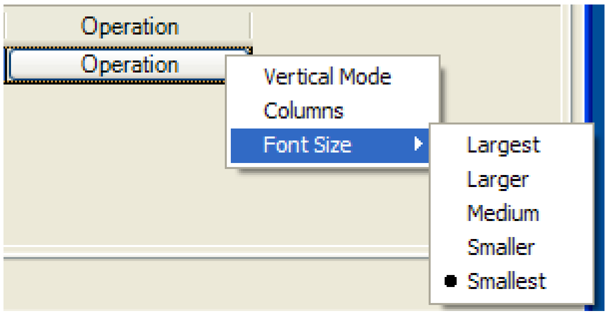
Address

This column displays the chassis name and the chassis number, the slot number, and port number(s) in parenthesis.

Using the Ports Manager Context Menu

You can right-click in the Ports Manager to open the context menu (Figure 294).

Figure 294: Ports Manager Context Menu



The menu contains the following choices:

Text Size

Refer to “Changing Text Size” on page 327 for information.

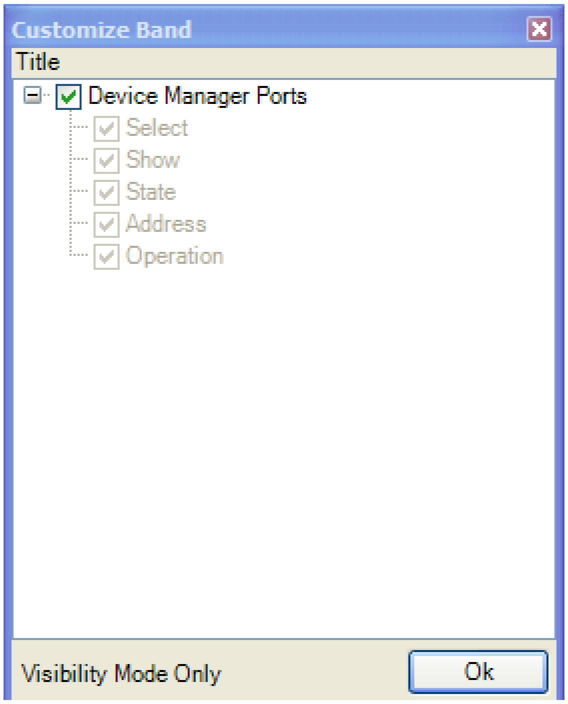
Columns

This choice opens a Customize table dialog (Figure 295) where you can choose which columns you want to display.

Click the check box next to this item to display this item in the Ports Manager.

The grayed out items are defaults; you cannot clear these items.

Figure 295: Delay Emulator Ports Manager Context Menu Parameters Selection



Using the Real Time Tab

To access the real time latency graph, click the **Real Time** tab at the bottom of the Delay Emulator main window.

Delay-Mode

The Real Time window contains a table showing parameters for each device running. The parameters include:

- Port ID

  This includes the chassis number, the slot number, and the port number
- Current Test Index

  Indicates the position of the current test within the test suite
- Test Name

  Indicates the name of the current test
- Time Started

  Indicates when the current test started
- Time Out

  Indicates the timeout value if applicable
- Configuration Repeat Count

  Indicates how many times the configuration has been repeated.

The following parameters are present for each queue when you expand the configuration table”

- Operation Status

  Indicates the state of the port, started, triggered stopped, etc.
- Operation Mode

  Indicates the type of delay
- Frame Drop

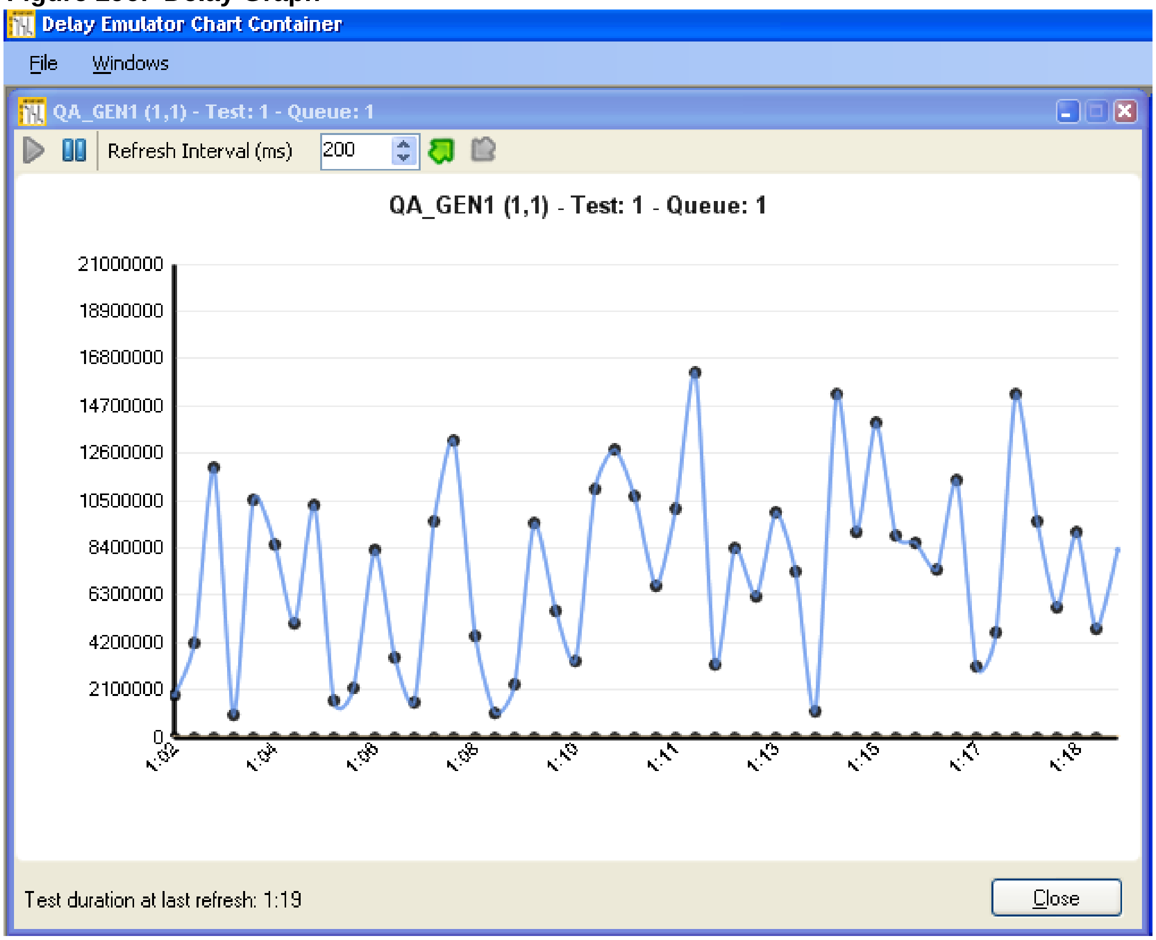
  Indicates how many will be dropped. You can change this value by clicking the arrow at the right of the field and sliding the slider to the desired value.

When a test is running, the device’s ports appear in table in the upper half of the window. If multiple test are running, each device appears in the table. To expand the an entry in the table to view the queues for that test, click the plus sign on the left. This opens the delay control.

Delay Graph

To access the delay graph, click the button in the **Delay** field. This graph allows you to view the delay change in real time. The graph has a control at the top of the window that allows you to set the latency value in nanoseconds. You can either type a value in the field or click the up/down buttons to change the value in increments of one. Id the delay type is “Fixed Delay”, you can change the delay value while a test is running. If you would like to pause the graph, click the Pause button in the top left corner of the window. To resume, click the Play button. To undock the graph, click the green undock button. You can close this window and reopen it at any time while the test is running.

Figure 296: Delay Graph



Reorder-Mode

The Real Time window contains a table showing parameters for each device running. The parameters include:

- Port ID

  This includes the chassis number, the slot number, and the port number
- Current Test Index

  Indicates the position of the current test within the test suite
- Test Name

  Indicates the name of the current test
- Time Started

  Indicates when the current test started
- Time Out

  Indicates the timeout value if applicable
- Configuration Repeat Count

  Indicates how many times the configuration has been repeated.
- Frames Reordered

  Indicates the number of frames that have been reordered
- Operation Status

  Indicates the state of the port, started, triggered stopped, etc.
- Operation Mode

  Indicates the type of delay

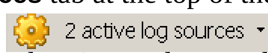
When a test is running, the device’s ports for the device appear in a table in the lower half of the window. If multiple test are running, each device appears in the table.

Using the Log Manager in Delay Emulator

To access the Log Manager, click the **Log** tab at the bottom of the Delay Emulator main window.

The purpose of logging is to automatically create a log that reports which delay or reorder tests have occurred and which ones might have reached the timeout limit while not finding a trigger. You can view a log with any text editor.

The Filter icons next to the **Type** and **Address** column labels allow you to choose how you want to display device types, by protocol or All, and device addresses, by single address or All devices.

If the **All Devices** tab at the top of the Xgig Maestro main window is selected, then the **Log Source** menu 

shows all log sources as active by default. You can choose to disable BERT logging, Delay Emulator logging, Generator logging, Target Emulator logging, or all four by clicking the **Log Sources** menu and un-checking the selections. If the **BERT-Bit error rate testing, Jammer, Target Emulator, or Generator** tabs in the main window are selected, then the Log Manager displays only the log entries for that tab, respectively.

The following icons are displayed on the Log Manager menu bar:

Display Entry Contents
Lets you save the selected log to a file in the device Logs folder (for example: `C:\Program Files\Viavi\Xgig Maestro\Delay Emulator\Logs`) or anywhere you want to save it on the network. Refer to the note on page 323 for information about installation on 64-bit operating systems.

Save All Entries As
Lets you save all the logs in the Log Manager to a file.

Save selected entries as
Lets you save the selected logs to a file.

Select All
Selects all the logs in the Log Manager.

Options
Opens the Log Manager Options dialog where you can enter your preferences for the information you want displayed in the Log Manager (Figure 297).

Clear Filtering
Removes filtering by Type and Address and displays all the devices you have locked.

Clear Selected Entries
Deletes the log entry you have highlighted.

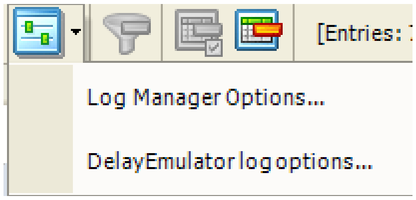
Clear All Entries
Deletes all the log entries in the Log Manager.

Setting Log Options

To have log files automatically named and saved to a specific location:

1 Click the Log Manager Options icon to open the drop-down menu (Figure 297), and select **Delay Emulator logging options**.

Figure 297: Log Manager Options Menu

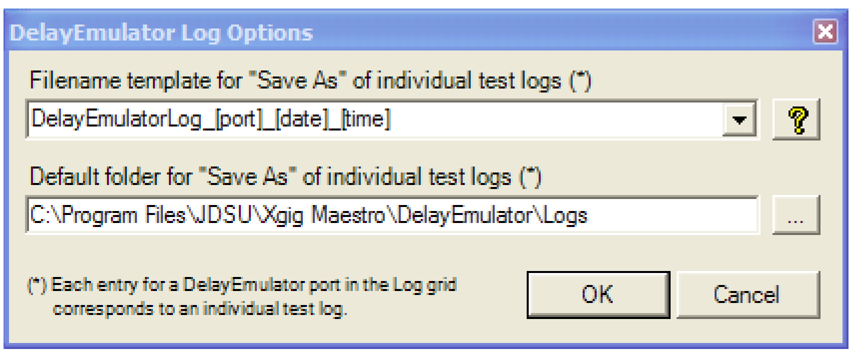


Or:

Open the Parameters context menu and select **Options**.

Either of these commands opens the Delay Emulator Log Options dialog (Figure 298). This dialog allows you to set up how you want the log files to be automatically named and the default location where you want them saved. You can also change the filename and folder when you save the log.

Figure 298: Delay Emulator Log Options Dialog



2 Select a log filename template from the following choices:

- Delay EmulatorLog_[port]
- Delay EmulatorLog_[port]_[date]_[time]
- Delay EmulatorLog_[date]_[time]
- Delay EmulatorLog_[date]_[time]_[port]

Or, you can type in your own template. Any [port], [date], and [time] in the template is replaced by the corresponding value. Port is displayed as:

```
protocol, chassis name (chassis number in the cascade, blade
number in the chassis, port number on the blade)
```

3 Enter the path to the folder where you want to save the log file.

You can browse to where you want to save the log file by clicking .

4 Click **OK**.

You have set up the log filename template and default folder to save the log.

Note: These settings apply to all Delay Emulator logs. Log options are the same for all Delay Emulator ports.

Viewing a Log

The Delay Emulator log shows the status of each Test Case during the entire length of the test run

To display a log:

>> Click the Log Manager tab at the bottom of the Xgig Maestro main window to view the log in a tabulated format (Figure 299).

Or:

>> Click the **Log** button on the Operation bar (with the appropriate Delay Emulator device selected in the Parameters Status table; a green check mark indicates the device is selected).

Or you can:

>> Open the Parameters context menu and select **Log > View**.

These two latter commands open a window that allows you to quickly view the Xgig Delay Emulator log. (Figure 300). In the case of these two methods, each time you run a Delay Emulator, a new Delay Emulator log is created for the device, and the previous log is discarded. Click **Print** at the bottom of the Delay Emulator log to print a hard copy of the log.

On the other hand, the Log Manager continues to list the logs and display them depending on the Log Manager options you have selected. See “Setting Log Options” on page 321.

You can save a log to a `.txt` file or an HTML file. Refer to “Saving a Log” on page 323.

Figure 299: Log Manager

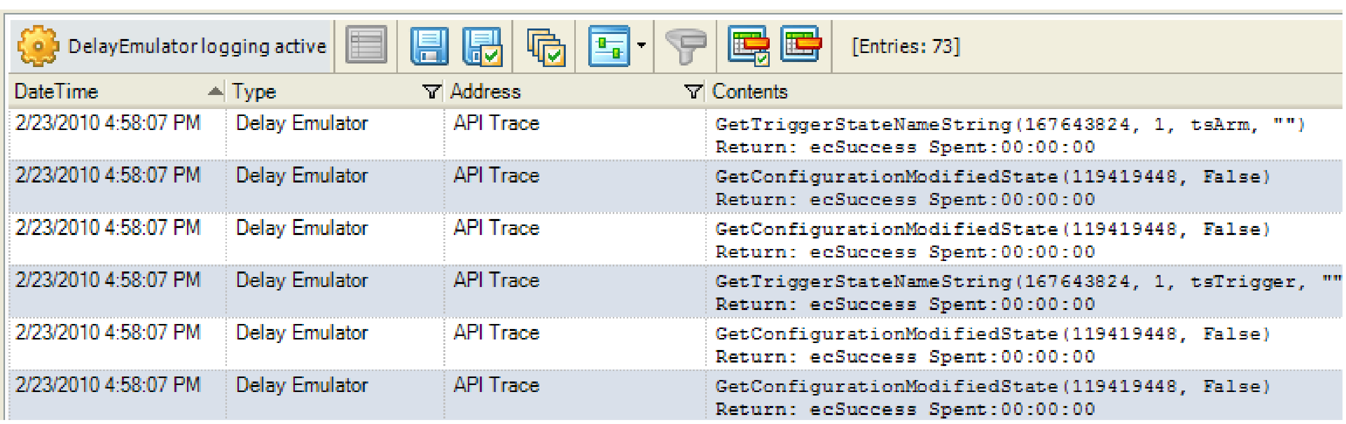
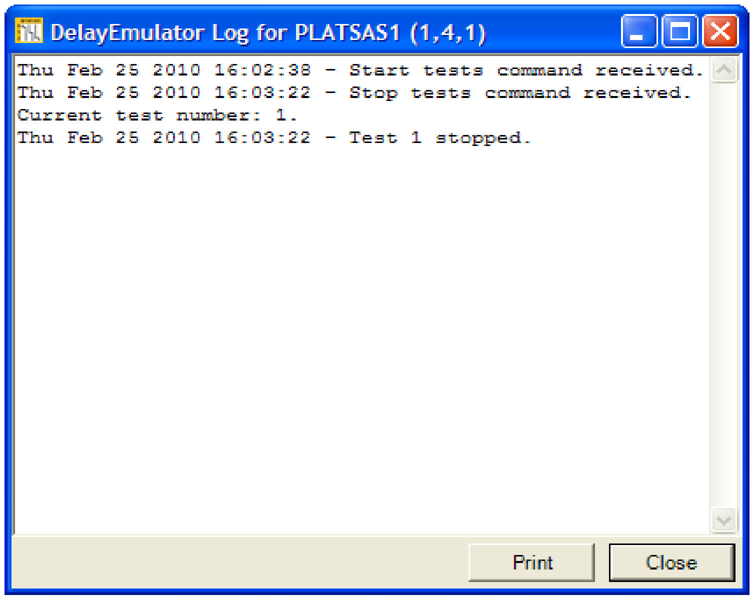


Figure 300: Example of a Delay Emulator Log Display



Saving a Log

You can save a log from the Log Manager tab or the Parameters context menu.

To save a log from the Log Manager tab as an HTML file or text file:

1 Highlight the log you want to save.

2 Click the **Save Selected Entries As**... button.

The Save Log Manager Contents As window is displayed that lets you name and save the log as an HTML file to the Saved Logs folder or to a location you prefer.

To save a log to a `.txt` file using the Parameters context menu:

>> Open the Parameters context menu (Figure 301) and select **Log > Save As**.

This command opens a File dialog where you can save the log with a file name you assign to it. The default location is:
`C:\Program Files\Viavi\Xgig Maestro\Delay Emulator\Logs`

Note: This software application can be loaded on 32-bit or 64-bit Windows operating systems. The path used above is for a 32-bit operating system.
If you are using a 64-bit operating system, the path would be:
`C:\Program Files(x86)\Viavi\Xgig Maestro\Delay Emulator\Logs`

Figure 301: Log Menu

Customizing the Appearance of the Maestro/Delay Emulator Main Window

You can move and rearrange the individual device tabs on your monitor screen as you prefer. You can also select the information you want to display in the Parameters Status table. In addition, you can select the size of displayed text.

Using the Window Menu

The **Window** menu allows you to arrange the window display:

Layout

Layout offers choices for rearranging the Maestro device tab windows. The Ports manager and Log Manager windows are not affected by this menu selection.

Internal Tabs

Allows you to restore the Maestro main window to its default format.

Internal MDI

Internal multiple document interface (MDI) lets you isolate each device tab as a separate window that you can activate by clicking anywhere on the window.

Show Hidden Windows

Restores any windows you have closed while using the Internal Tabs or Internal MDI display arrangement.

Arrange Icons

Arranges the icons for minimized windows at the bottom of the screen. If an open document window is at the bottom of the screen, some or all of the icons will be underneath this document window and will not be visible.

Cascade

Arranges all open windows in a cascade style from the top, left corner of the window.

1 All Devices

Brings the All Devices tab to the front as the active window. This window displays ports from all active devices (BERT, Delay Emulator, Generator, and Target Emulator).

2 BERT - Bit error rate testing

Brings the BERT device tab to the front as the active window

3 BERT - Latency measurement

Brings the BERT Latency measurement device tab to the front as the active window

4 Jammer

Brings the Delay Emulator device tab to the front as the active window

5 Generator

Brings the Generator device tab to the front as the active window

6 Target Emulator

Brings the Target Emulator device tab to the front as the active window

7 Delay Emulator

Brings the Delay Emulator device tab to the front as the active window.

Tile Horizontally

After selecting **Layout > Internal MDI,** this command opens and aligns the BERT, BERT Latency measurement, Delay Emulator, Generator, and Target Emulator device windows horizontally one over the other.

Tile Vertically

After selecting **Layout > Internal MDI**, this command opens and aligns the BERT, BERT Latency measurement, Delay Emulator, and Generator, and Target Emulator device windows vertically one next to the other. You can view the individual device windows by dragging the sides out to resize them.

Minimize All Windows

After selecting **Layout > Internal MDI**, this command minimizes all the open windows. You can restore each window, individually, by using the standard window controls on the header or select **Internal Tabs** to restore the Maestro main window to its default format.

Customizing the Parameters Status table in Delay Emulator

You can change the appearance of the Parameters Status table by:

- Removing columns
- Resizing columns
- Changing the text size
- Displaying and hiding status table parameters

Removing columns

If you have a number of devices locked, you can remove a column that you do not need to view without unlocking the port or affecting the operation.

To remove a column:

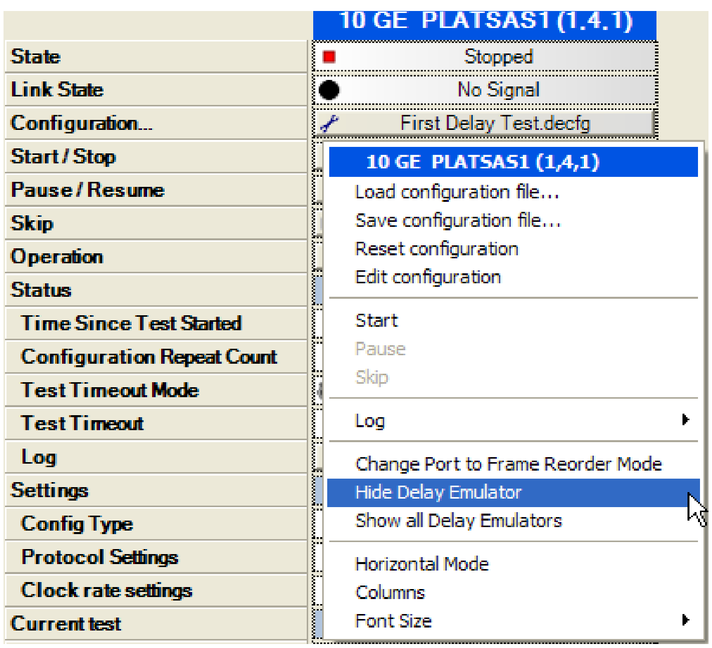
1. Right-click on the specific column you want and open the Parameters context menu.
2. Select **Hide Delay Emulator** (Figure 302).

   Or:

   In the Ports Manager, clear the **Show** check box next to the device you want to remove.

   The column is removed, but the device is still locked ("in use") and displayed in the Ports Manager.

Figure 302: Removing a Device Column



To replace the device column on the Parameters Status table:

>> Click the **Show** check box for the device in the Ports Manager.

Resizing columns

You can resize any of the columns by placing the mouse at the right edge at the top of a column, next to the chassis name. A resizing cursor appears. Hold down the mouse button, and drag the mouse to resize the column.

Changing Text Size

You can choose the text size you want the Parameters Status table or the Ports Manager to display.

Note: You cannot change the text size in the Log Manager.

To change text size:

1 Open the context menu by clicking the right mouse button while the cursor is on the Parameters Status table or the Ports Manager.

2 Select **Text size** (Figure 303).

You have five choices from which to select.

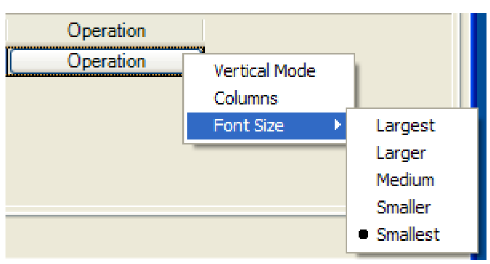
Smallest is the default size.

3 Select the text size you want.

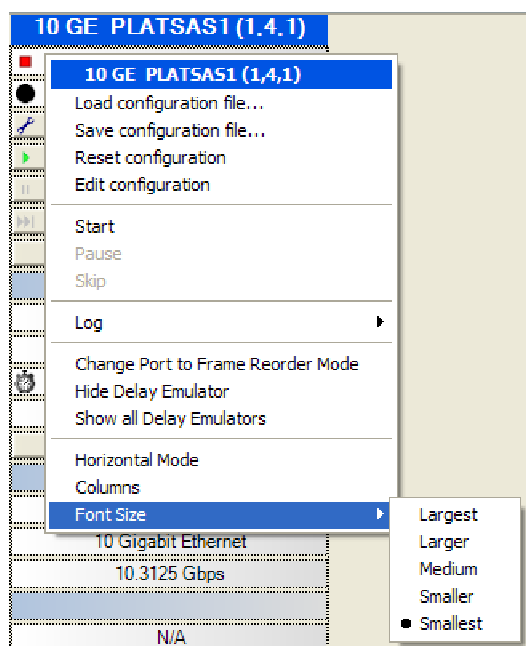
A bullet is displayed next to the current selection.

Figure 303: Text Size Menu

Context menu over Ports manager



Context menu over device parameters status table



Displaying and Hiding Parameters in Delay Emulator

You can hide specific parameters on the Parameters Status table to simplify the status tables and show only the information in which you are interested.

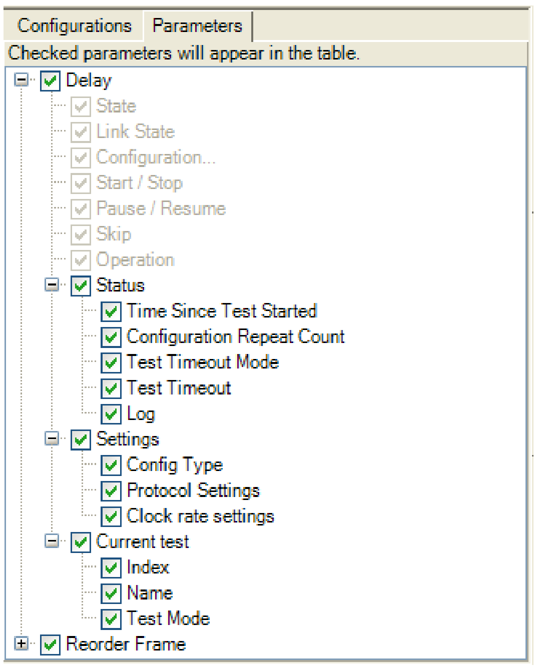
To display or hide parameters on the Parameters Status table:

1 Click the Parameters tab at the top of the Configuration manager pane to switch to the Parameters manager (Figure 304).

You can expand the categories by clicking the plus signs on the left.

The default displays most of the parameters.

Figure 304: Delay Emulator Parameters Manager



2 Click check box to set or clear the check mark next to the parameters.

Checked parameters are displayed.

Performing Configuration Tasks in Delay Emulator

This section describes how to handle configuration files from the Delay Emulator main window.

Loading Delay Emulator Configuration Files

You can load a configuration file on a Delay Emulator using one of the following methods:

From the Configuration Manger:

>> Drag the configuration file from the list in the Configuration Manager onto the Parameters Status table (column for the device) and release the mouse button.

You can drag configuration files from anywhere, including the list of configuration files in the Configuration Manager on the Xgig Maestro window, the system desktop, or Windows Explorer.

From the Parameters Context Menu

1 Right-click on the device column to open the Parameters context menu and select **Load configuration file**.

An Open File dialog is displayed.

2 Navigate to the Delay Emulator `.decfg` file that you want to use and click **Open**.

The file is loaded and its name and parameters are displayed in the device column of the Parameters Status table.

From the Ports Manager:

1 Check the **Select** check box(es) in the Ports Manager for the port(s) you want to use.

2 Click the configuration file you want to load from the Configuration Manager.

3 Click the **Load Configuration to Selected Ports** button  . This button is located in the Ports Manager and in the Configuration Manager. Both have the same function.

You can use the above methods to navigate to a mapped folder and load a configuration file.

Saving a Delay Emulator Configuration File

To save a Delay Emulator configuration file you created or edited:

1 Right-click on the device column in the Parameters Status table to open the Parameters context menu, and select **Save configuration file**.

A Windows Save dialog is displayed.

2 Navigate to where you want to save the configuration file and assign a name to it.

Xgig Delay Emulator configuration files are saved with a `.decfg` extension.

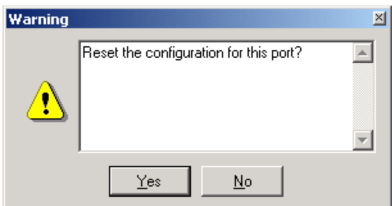
Resetting a Delay Emulator Configuration

To clear the configuration from a device:

1 Right-click on the device column in the Parameters Status table to open the Parameters context menu, and select **Reset configuration**.

A warning dialog may be displayed asking you to confirm the configuration reset.

Figure 305: Reset Configuration Warning Dialog



2 Click **Yes** to clear the configuration from the device.

Editing a Delay Emulator Configuration

To create a configuration file for a device, you can start from a blank default configuration or edit the configuration after you have loaded a configuration file to the device.

You can open the Configuration window using one of the following methods:

1 Right-click on the device column in the Parameters Status table to open the Parameters context menu.

2 Select **Edit configuration**.

Or:

>> Click the **Configuration** button on the Parameters Status table

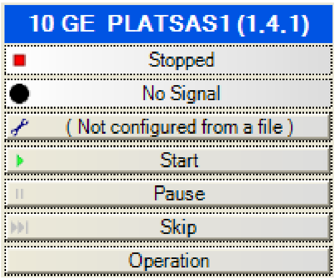
This opens the Configuration window for the device that is currently selected. Refer to or "Using the Jammer Configuration Window" on page 116 for more information.

Running the Test Suite on a Delay Emulator Device

After you have configured a Delay Emulator device, you can start the operation. Three methods are available:

>> Click the **Start** button on the Parameters Status table.

Figure 306: Parameters Status table Start Button



Or you can:

>> Right-click on the device column to open the Parameters context menu where the **Start**, **Pause**, **Skip**, and **Stop** commands are available.

Or:

1 On the Ports manager, select the device.

2 Click the **Start** button  .

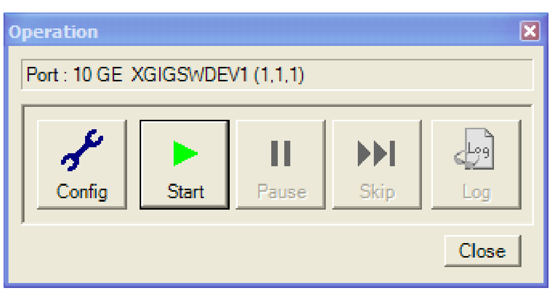
Or:

1 On the Ports manager, in the Operation column, click the **Operation** button for the device.

The Operation dialog is displayed (Figure 307).

2 Click **Start**.

Figure 307: Delay Emulator Tab Operation Bar



Clicking any of the Operation buttons (including **Config**) takes effect on the Delay Emulator device that is currently selected in the Parameters Status table.

Start runs the Test Suite from the beginning if you click it while the Delay Emulator is stopped. The Start button label becomes a Stop label while the Test Suite is running.

Pause causes the Delay Emulator to pause and not run the next Test Case in the Test Suite when the current Test Case is completed. When you click **Pause**, the State of the Delay Emulator is “Pausing” while the current Test Case is still running. When the current Test Case completes (or is skipped), the Delay Emulator is in the “Paused” state waiting for user intervention.

Skip causes the Delay Emulator to abort the current Test Case and move on to the next one. If the Delay Emulator is “Paused,” you can click **Skip** to jump through your Test Suite without running any Test Cases until you get to the Test Case you want to run and resume testing. If you skip past the last Test Case in the Test Suite and the Test Suite is not set to loop forever, then the Delay Emulator goes to the Stopped state as if the Test Suite completed.

To let a test run to the end and then skip to another test:

1. Click **Pause**.

   Wait for the current test to finish.

2. Click **Skip** to step through the tests.
3. Observe the progress field on the Parameters Status table to track tests in the queue.
4. Click **Start**.

Stop causes the Delay Emulator to abort running the entire Test Suite and go to the Stopped state.

Log indicates a log is available for viewing. Click **Log** to view the latest test log.

Chapter 12

Creating Delay Emulator Test Configurations for Delay Mode

In this chapter:

Defining Your Own Test Configurations for Delay Mode

Xgig Delay Emulator lets you define your own test configurations and save them with or without hardware available.

You can create a configuration from scratch, or you can open and edit an existing configuration. Also, you can edit a configuration in edit only mode, which is independent of any hardware, or you can edit a configuration that is currently loaded to a Delay Emulator device.

To edit a configuration in edit only mode:

>> Double-click a configuration file in the Configuration manager.

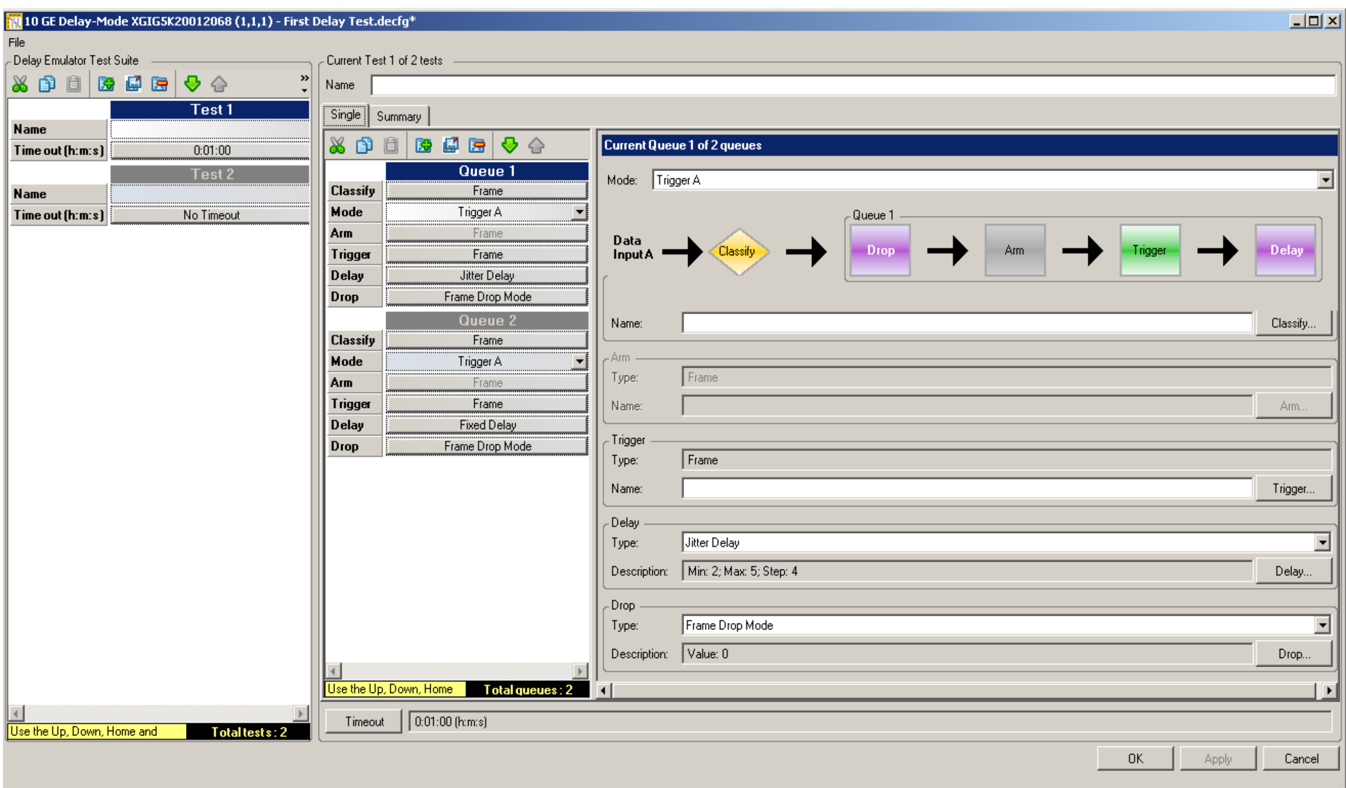
or:

>> Right-click the configuration file in the Configuration manager, and choose **Edit Delay Emulator Configuration** from the context menu.

The edit only mode Delay Emulator Configuration window opens (Figure 308).

This window allows you to set up your own Test Cases, name them, organize them, and save them to files so that you can use them again.

Figure 308: Edit Only Delay Emulator Configuration Window



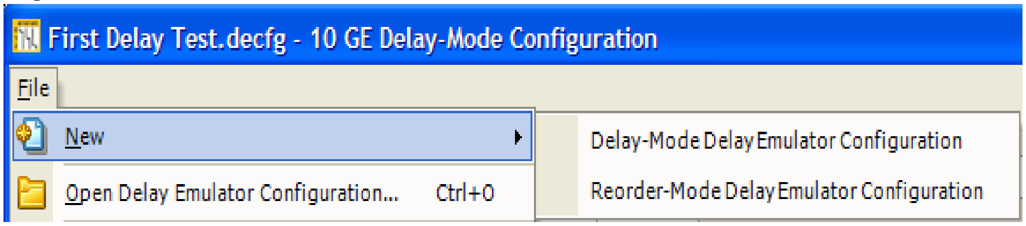
To start a configuration from scratch in edit only mode:

>> Select **New Delay Emulator Configuration** from the context menu or the File menu (Figure 309) on the Xgig Maestro menu bar. Then, select **Delay-Mode or Reorder-Mode Delay Emulator Configuration** from the drop down menu.

or:

>> Click the New Configuration icon at the top of the Configuration manager.

Figure 309: Maestro File Menu



To save your configuration in edit only mode:

>> Click **Save** at the bottom of the Delay Emulator Configuration window, or open the File menu on the Delay Emulator Configuration window and select **Save Delay Emulator Configuration** or **Save Delay Emulator Configuration As**.

Any changes you make have no effect on actual Delay Emulator devices you control.

To edit a configuration that is loaded to a Delay Emulator port:

>> Click **Configuration...** in the device column.

or:

>> Right-click in the Parameters Status table in the device column to open the context menu and select **Edit configuration**.

or:

>> Click **Operation** in the device column to open the Operation dialog, then click **Config**.

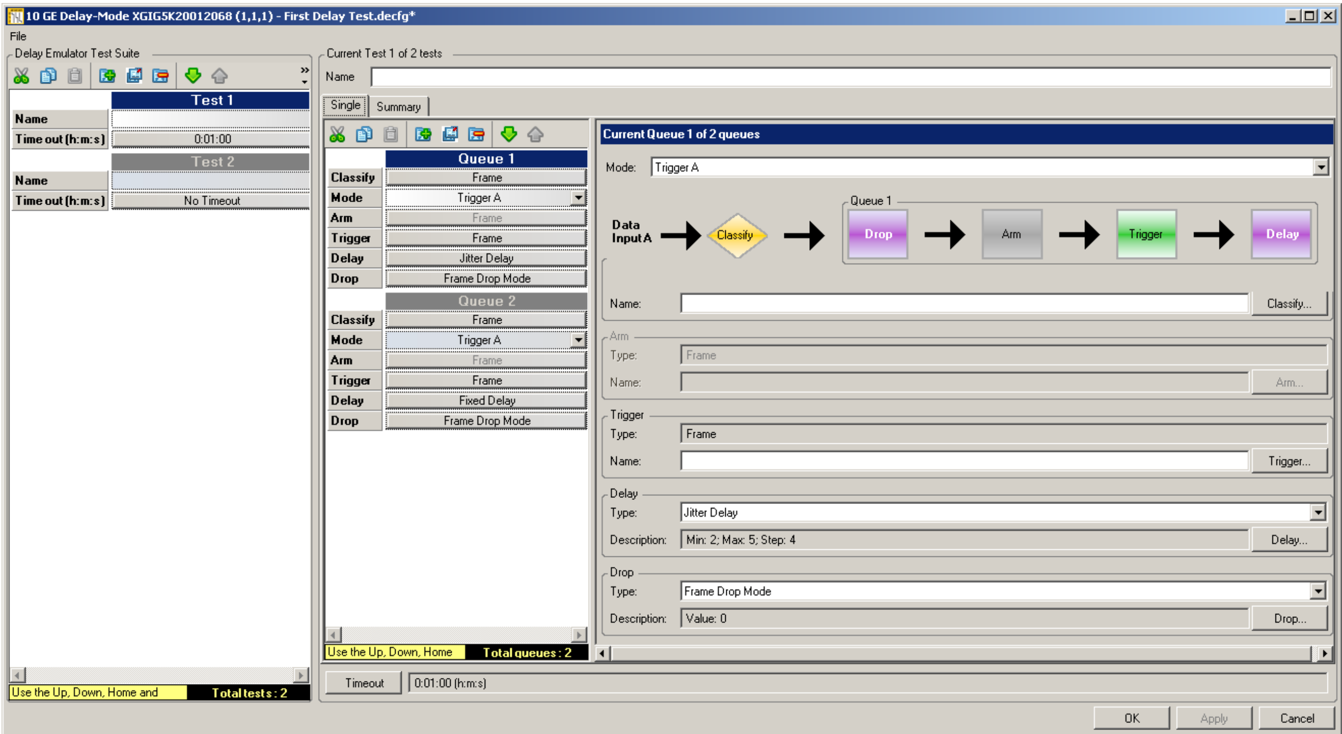
The Xgig Delay Emulator Configuration window in hardware edit mode is displayed (Figure 310). This window allows you to set up your own Test Cases, name them, and save them to a file so that you can use them again.

Click **Apply** or **OK** and Delay Emulator accepts the changes. They are immediately reflected in the Parameters Status table and affect the Delay Emulator device the next time you run it.

To save your configuration edits:

>> Open the File menu at the top of the Delay Emulator Configuration window and select **Save Delay Emulator Configuration** or **Save Delay Emulator Configuration As**.

Figure 310: Xgig Delay Emulator Configuration Window



Using the Delay-Mode Configuration Window

The Delay Emulator Configuration window title bar indicates how many ports it is configuring, the protocol, and the configuration file name, if any. If you are using hardware edit mode, the chassis name, chassis number, slot number, and port number are also listed. The elements of the Delay Emulator Configuration window are described in the following sections.

Using the Delay Emulator Test Suite Tools

The Delay Emulator Test Suite (left pane) lists the series of Xgig Delay Emulator tests in the order in which you want them to execute. The number of tests in a test suite has no limit. Each test can contain between one and eight queues. The highlighted test appears as the Current Delay Emulator Test (right pane). Each test in the suite executes in sequence.

Creating a Test Suite

When you create a Delay Emulator Test Suite, you use the toolbar in the Delay Emulator Test Suite section of the Configuration window (Figure 311).

Figure 311: 10GigE Delay Emulator Test Suite Toolbar

The following list describes the icons on the toolbar:

	Cut current test	Removes the highlighted test and holds its contents in the memory buffer.
	Copy current text	Copies the highlighted test to the memory buffer.
	Paste last test cut or copied	Inserts the current memory buffer contents before the currently highlighted test.
	Add new test to bottom of stack	Adds a new blank test to the bottom of the suite.
	Insert new test before current test	Inserts a new blank test above the currently highlighted test.
	Delete current test	Removes the highlighted test from the suite. If only one test is present, then the contents of this test are cleared.
	Move current test down the stack	Moves the highlighted test down one in the test order.
	Move current test up the stack	Moves the highlighted test up one in the test order.
	Run test suite once or Repeat test suite	When you choose Repeat test suite, the tests run according the settings you define in the Delay Emulator Current Test window. You can also type a number in this field to indicate you want the test suite to repeat a certain number of times.

To duplicate a test at another point in the Test Suite:

1 Highlight the test you want to duplicate.

2 Click **Copy**.

3 Highlight the test in the suite that is just after the point where you want the duplicate test inserted.

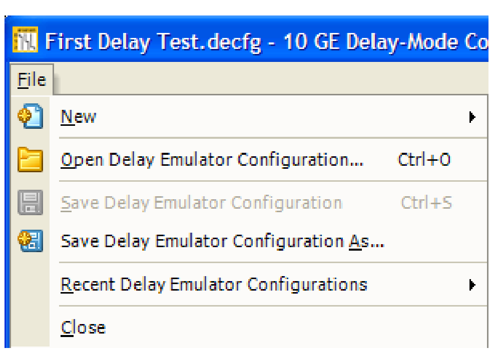
4 Click **Paste**.

The duplicate test is inserted.

Using the Configuration File Menu

The File menu is the only menu on the menu bar (Figure 312).

Figure 312: Configuration File Menu



The choices are:

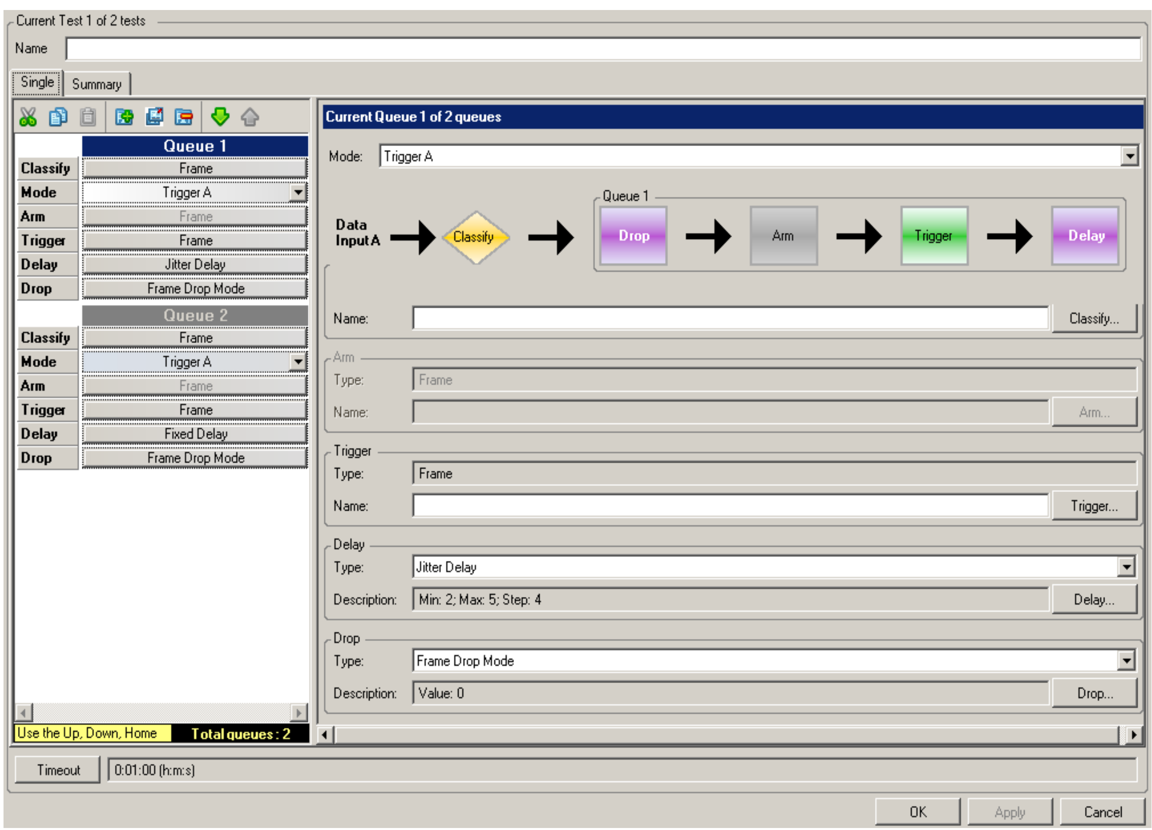
New Configuration	Creates a new delay or reorder `.decfg` configuration file.
Open Configuration	Open an existing `.decfg` configuration file.
Save Configuration	Save the entire Test Suite to the `.decfg` file you currently have loaded.
Save Configuration As	Save the entire Test Suite to a `.decfg` file with a name you assign to it.
Recent Configuration	Open a recently opened `.decfg` configuration file.
Close	Close the Delay Emulator Configuration Window.

The recently used Delay Emulator configuration files appear in the file menu and are loaded when selected.

Using the Current Delay Emulator Test Window: Delay-Mode

The graphics in this section of the window represent the hardware configuration for the selected test in the Delay Emulator Test Suite (Figure 313).

Figure 313: Current Delay Emulator Test Window



Single Tab

The **Single** tab shows the contents for a single test within the test suite. A test is comprised of queues, which are delays. A test can have up to eight queues. Each queue has its own settings. To populate a test, you must create queues. Use the toolbar to create and control queues within a test. The toolbar on the **Single** tab contains the same functions for queues as the left pane has for tests.

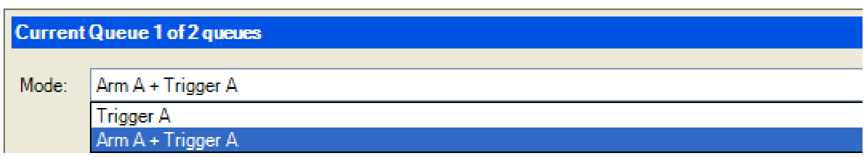
Create a Queue

To create a queue within a test, click the **Add Queue** button. The queue appears below the toolbar. The following sections illustrate the process of defining the parameters for a queue.

Mode

The Mode menu is available near the top of the Current Delay Emulator Test window (Figure 314) and also near the top of each queue in the Delay Emulator **Single** tab (Figure 310).

Figure 314: Mode Drop-down Menu in Current Delay Emulator Test



Classify

The Classify menu are available in the left pane of the Current Delay Emulator Test window and also in each queue in the Delay Emulator **Single** tab. To define Classify condition, click the Classify button in the queue or in the left pane to open the corresponding definition window.

Arm and Trigger

The Arm and Trigger menus are available in the left pane of the Current Delay Emulator Test window and also in each queue in the Delay Emulator **Single** tab. To define Arm and Trigger conditions, click the Arm or Trigger **Frame** button in the queue. Now, click the Arm or Trigger button in the queue or in the left pane to open the corresponding definition window.

Delay

The Delay menu allows you to select what type of delay you want. Click the Delay button to access the Delay dialog. All delays are in addition to the smallest delay of 30ms and are rounded up or down to the nearest 6ns increment.

Select the type of delay you want from the drop-down menu.

Fixed Delay

Emulates a fixed delay for each buffer segment

For Fixed Delay, type the delay value in nanoseconds.

Jitter Delay

Emulates inter-packet gap variations for each buffer segment

For Jitter Delay, type the min. and max. values as well as the step size in nanoseconds.

Ramp Down Delay

Emulates delays that decrease with each buffer segment

For Ramp Down Delay, type the min. and max. values as well as the step size in nanoseconds.

Ramp Up Delay

Emulates delays that increase with each buffer segment

For Ramp Up Delay, type the min. and max. values as well as the step size in nanoseconds.

Random Delay

Emulates random inter-packet gap variations for each buffer segment

For random delay, type the min. and max. delay values in nanoseconds.

Random Jitter Delay

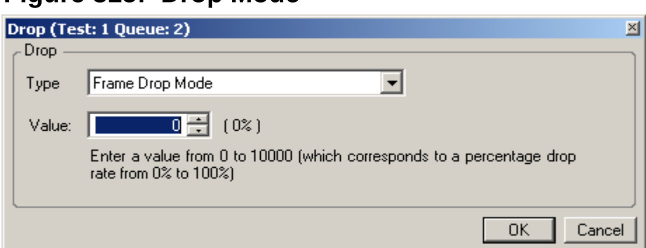
Emulate random inter-packet gap variations for each buffer segment

For Random Jitter Delay, type the mean value in nanoseconds and the percentage of change in value to define your range. For example. If your mean is 1000ns, and your percentage is 5, then your delay values will range from 950 to 1050ns

Drop Mode

You can define frame drop mode and rate in a delay queue. You can also choose **Frame Drop Mode** or **Byte Drop Mode** from the **Type** drop-down menu of the **Drop** dialog. The Drop mode defines whether the drop rate will be based on number of frames or number of bytes in frames. **Byte Drop Mode** is only available for the first queue. The frame drop rate defines the ration to drop, and it has precision to 0.01%.

Figure 315: Drop Mode



Timeout

The timeout option defines the period of time to wait for a specified test to complete before aborting and proceeding to the next test in the suite.

To set the timeout:

1 Click **Timeout** to display the dialog box in Figure 316.

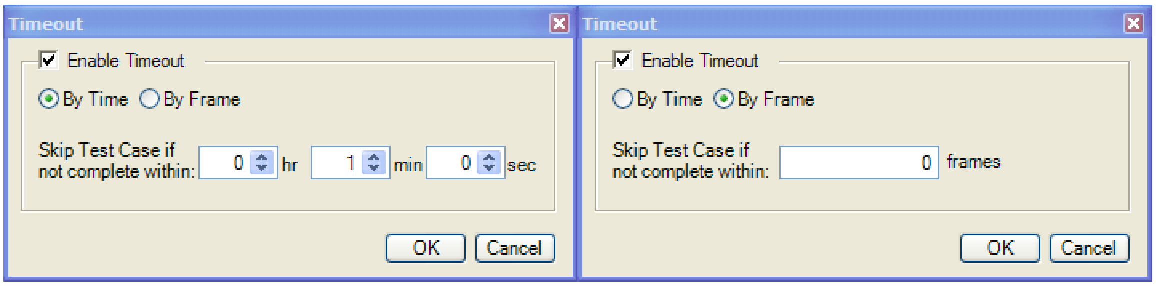
2 Check **Enable Timeout**.

3 Select either By Time or By Frame.

4 For By Time, enter the hours, minutes, and seconds you want to wait.

5 For By Frame, enter the number of frames you want to wait for.

Figure 316: Timeout Dialog



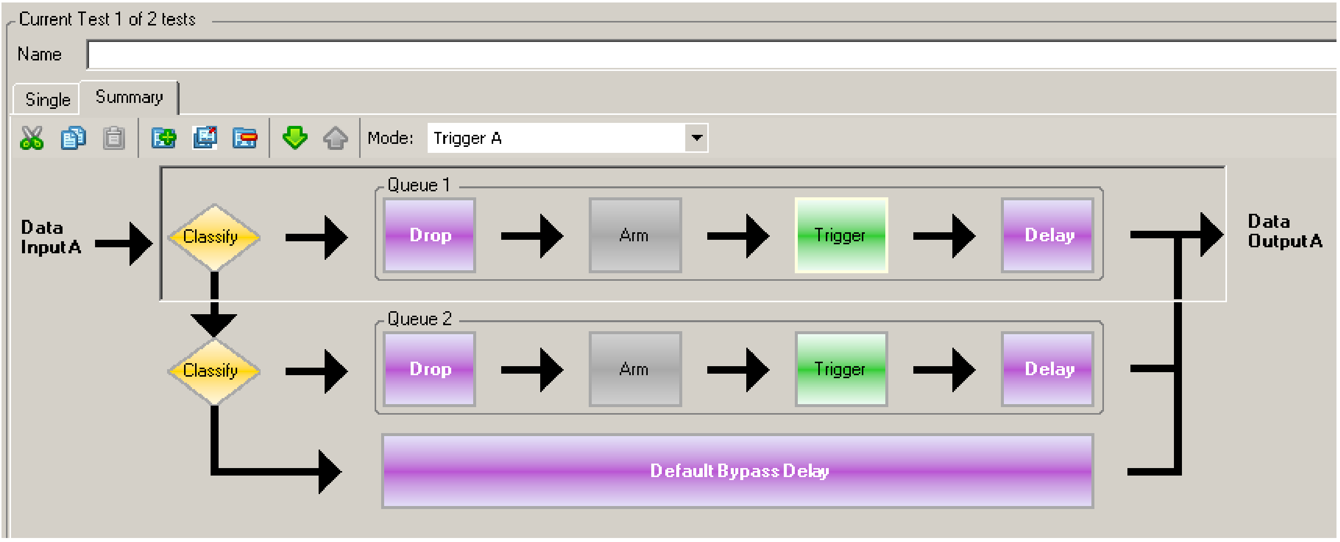
6 Click **OK**.

Summary Tab

The Summary tab provides a graphical representation of all the queues in a test. The flow of information goes from the classify condition to the Arm and/or Trigger condition. If the Classify condition for a queue is not met, the Classify condition for the next queue is compared. If none of the Classify conditions in the test are met, the process defaults to the bypass delay.

The bypass delay is a fixed delay set at 30 microseconds, which is the smallest delay possible.

Figure 317: Summary Tab



Configuring the Classify Condition in Delay-Mode

The Classify condition of a queue is compared first. If it is met, the queue process begins. The queue process consists of either Arm and Trigger or just Trigger. If the Classify condition is not met, the Classify condition of the next queue is compared. The Classify condition recognizes specific DWords within frames.

Note: If none of the Classify conditions in the queue are met, the software uses the default bypass delay, which acts as a catch all for traffic that doesn't go through the queues. This flow is represented on the Summary tab of the **Delay Emulator Configuration** window.

Depending on the Mode you select in the **Delay Emulator Configuration** window, the appropriate graphic diagram shows the Classify condition, the Trigger and optional Arm conditions, and the Delay. If the Mode you select does not include an Arm condition, the Arm button remains disabled.

To set Classify conditions:

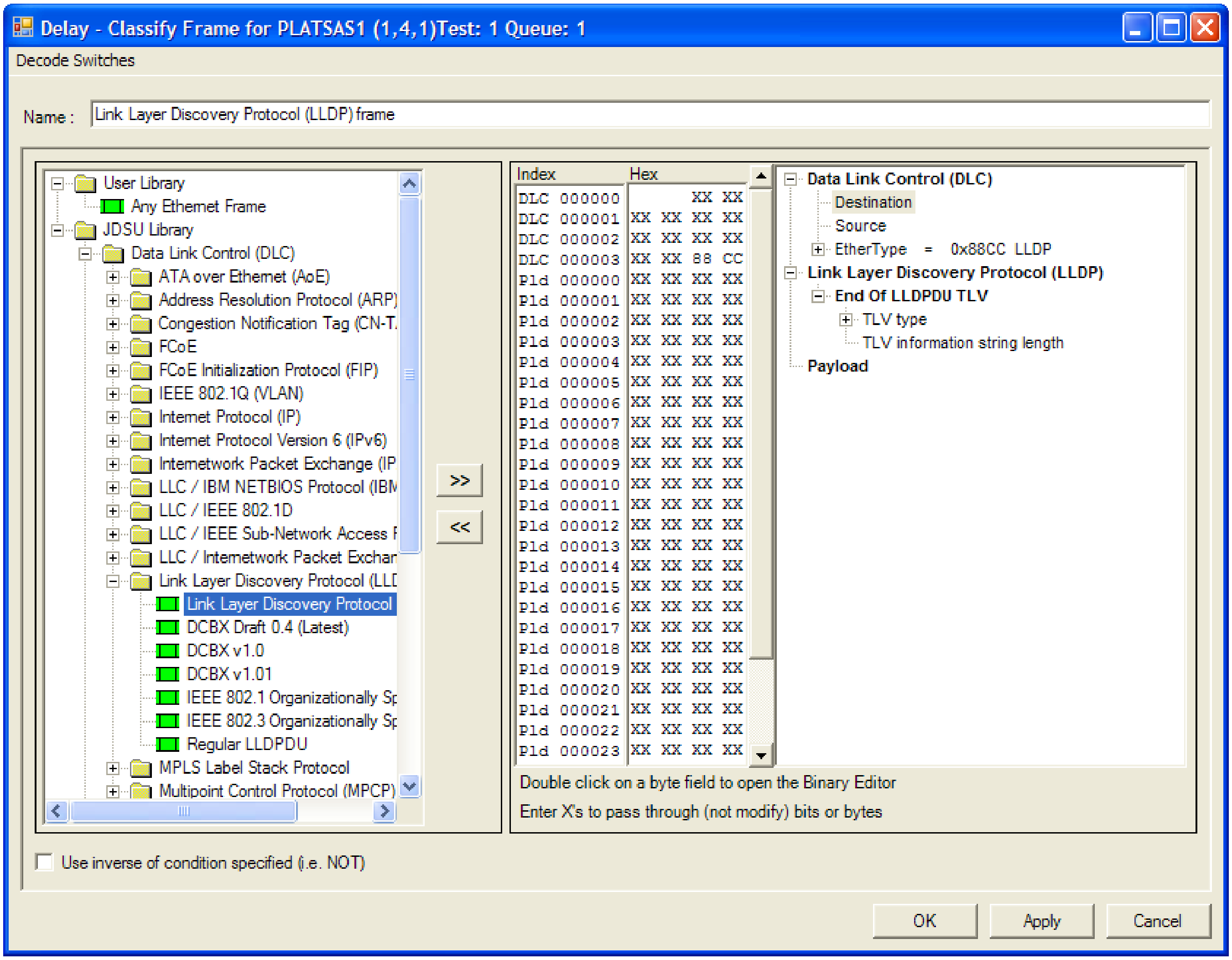
1 Click the **Classify** button in the Xgig Delay Emulator Configuration window.

The window for the condition is displayed (Figure 318). If you are in hardware edit mode, the protocol, chassis name, chassis number, slot number, and port numbers are displayed in the title bar.

2 Set the values as required to specify the Classify condition as part of a unique Classify, Arm and Trigger sequence for the specific test.

The following sections describe the available values.

Figure 318: Classify Window for Delay



Setting Frame Conditions for Classify in Delay-Mode

You can specify frame conditions in two ways. One way is to load a template from the Template Library tree, and the other way is to manually specify bits in the frame.

To use a template:

1 Select a template from the Template Library tree on the left.

2 Click the double right arrow button to set the Trigger Condition.

The condition is indicated on the right side of the window.

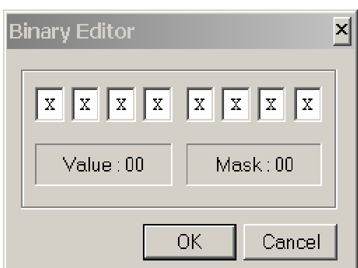
To manually specify a frame:

>> Type hexadecimal values directly into the center column of the window.

An X represents a nibble that can be any value (a “don’t care”).

To set individual bits in any field, double-click on the hex entry to open the Binary Editor (Figure 319). In the hex view, partially defined hex characters appear as question marks: `X001=?`

Figure 319: Binary Editor Dialog

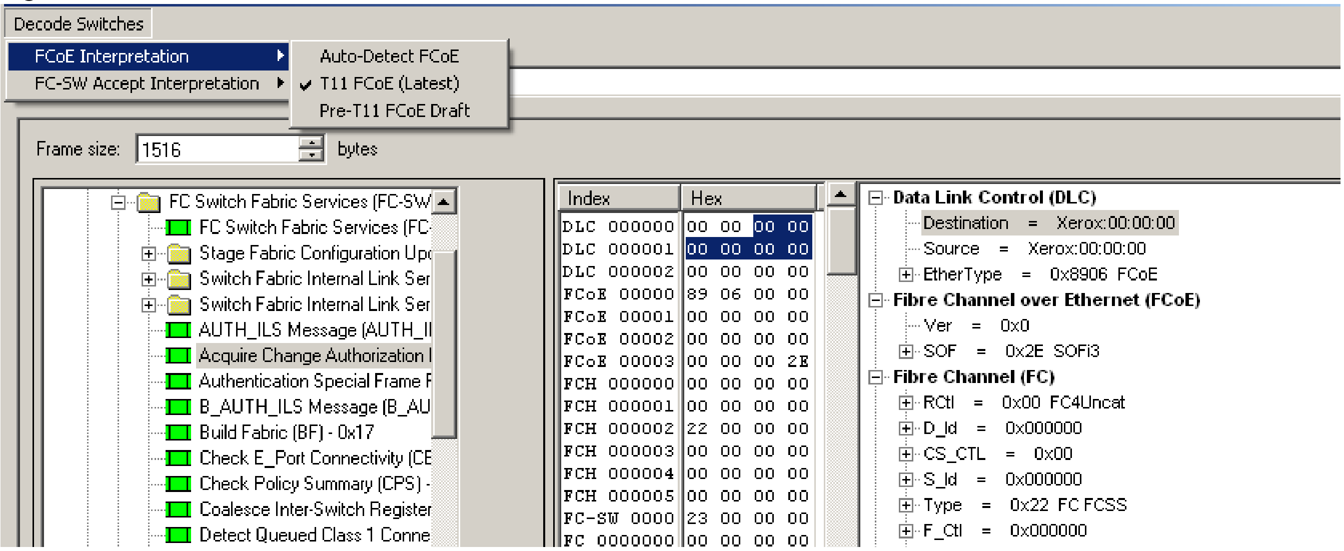


Another way to manually edit the frame condition is to make selections from the tree view in the right window pane.

Decode Switches Menu

Some templates allow you to specify decode switches. When you load a template that has this option, the **Decode Switches Menu** appears in the upper left corner of the window. The decode switches provide detailed contextual options for decode; for example, further decode of response and data frames. The Decode Switches menu is context sensitive and will only show the decode options available for the specific template you are creating.

Figure 320: Decode Switches Menu

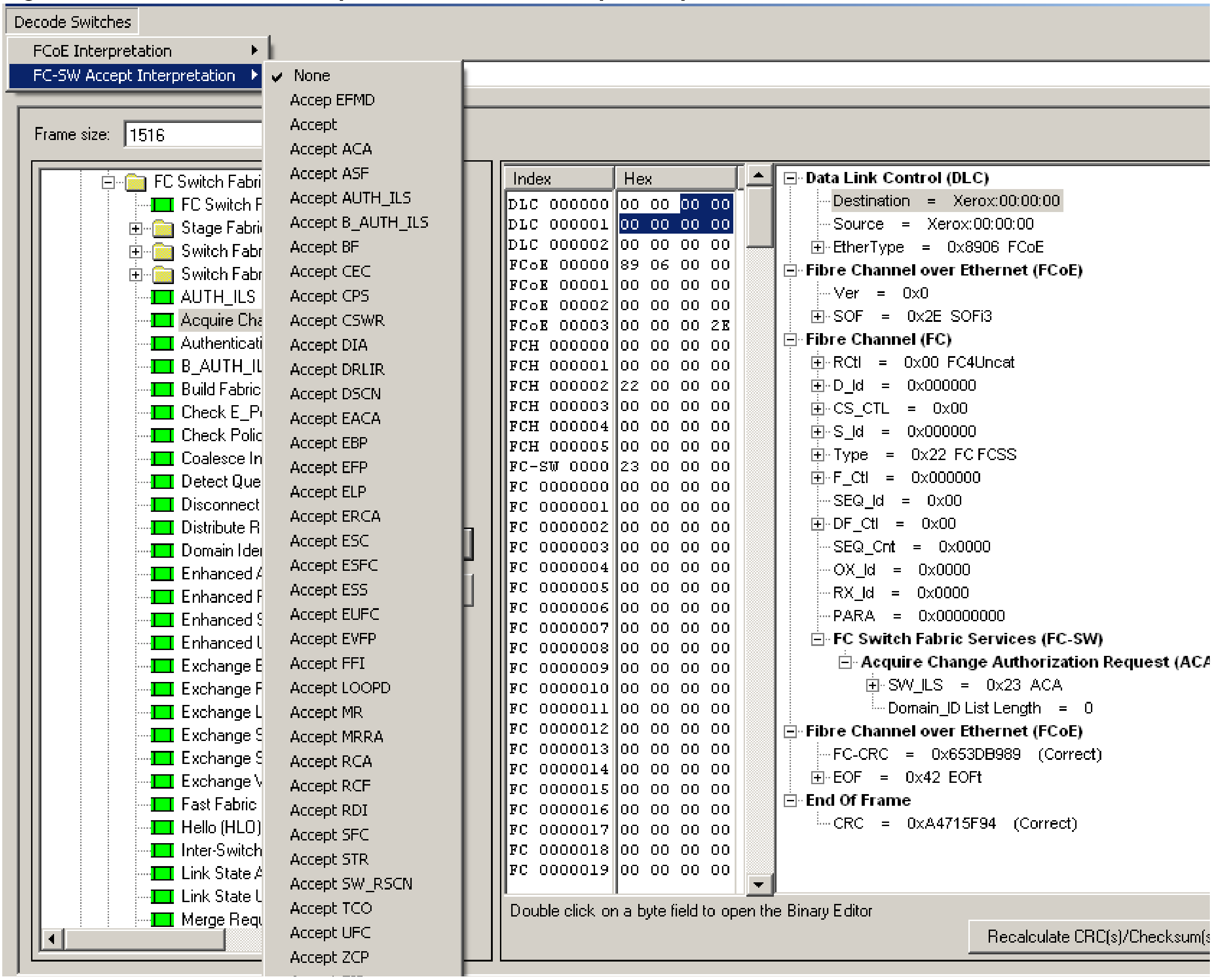


Note: Once the **Decode Switches** menu appears, it remains visible. However, if you load a template that has no decode options, the menu is greyed out and inactive.

The **Decode Switches** menu is intended to help you create a user-defined template. When editing a User Library template, Decode Switches are stored inside the template so they are still ON the next time you open this particular template.

Decode switches allow you to further decode Response and Data frames that can't be decoded without knowing what the associated command frame is. Below is a description of the switches avaFC-SW Accept Interpretation

Figure 321: Decode Switch Options for FC-SW Accept Interpretation



Saving a Frame Condition

If you create a frame condition that you want to save and make easily available for future use, you can save it into the “User Library” folder in the Template Library tree. To do this:

>> Highlight the folder and click the double left arrow button.

Frame conditions have the option of “Use inverse of condition specified (i.e., NOT).” When you check this option, it means that the first frame encountered that does not match what you have specified creates a “condition met” event.

For each frame condition, you can specify an optional name at the top of the window. This name is also shown on the Delay Emulator Configuration window under the Mode selection, and on the main Xgig Maestro window.

Configuring the Arm Condition in Delay-Mode

The Arm condition recognizes specific DWords within frames.

Depending on the Mode you select, the appropriate graphic diagram shows the Classify condition, the Trigger and optional Arm conditions, and the Delay. If the Mode you select does not include an Arm condition, the **Arm** button is disabled.

To set Arm conditions:

1 Click on the **Arm** button to open the Arm window.

   The window for the condition is displayed (Figure 322). If you are in hardware edit mode, the protocol, chassis name, chassis number, slot number, and port numbers are displayed in the title bar.

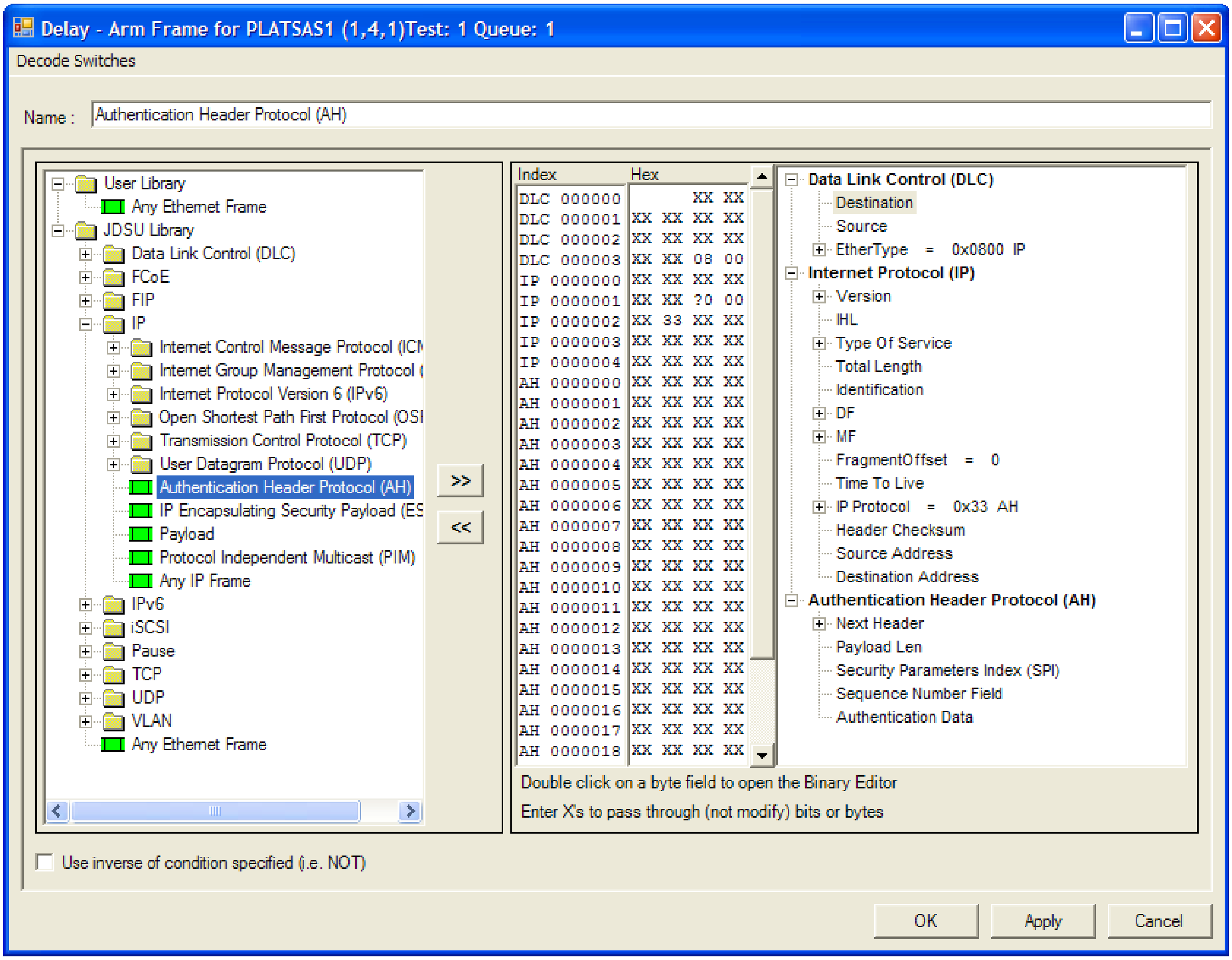
2 Set the values as required to specify the Arm condition as part of a unique Arm and Trigger sequence for the specific test.

   The following sections describe the available values.

Setting Frame Conditions for Arm in Delay-Mode

You can specify frame conditions in two ways. One way is to load a template from the Template Library tree, and the other way is to manually specify bits in the frame.

Figure 322: Arm Window for Delay



To use a template:

1 Select a template from the Template Library tree on the left.

2 Click the double right arrow button to set the Trigger Condition.

The condition is indicated on the right side of the window.

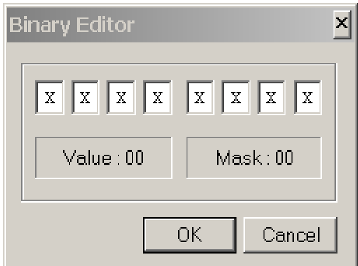
To manually specify a frame:

>> Type hexadecimal values directly into the center column of the window.

An X represents a nibble that can be any value (a “don’t care”).

To set individual bits in any field, double-click on the hex entry to open the Binary Editor (Figure 323). In the hex view, partially defined hex characters appear as question marks: `X001=?`

Figure 323: Binary Editor Dialog



Another way to manually edit the frame condition is to make selections from the tree view in the right window pane.

Saving a Frame Condition

If you create a frame condition that you want to save and make easily available for future use, you can save it into the "User Library" folder in the Template Library tree. To do this:

>> Highlight the folder and click the double left arrow button.

Frame conditions have the option of "Use inverse of condition specified (i.e., NOT)." When you check this option, it means that the first frame encountered that does not match what you have specified creates a "condition met" event.

For each frame condition, you can specify an optional name at the top of the window. This name is also shown on the Delay Emulator Configuration window under the Mode selection, and on the main Xgig Maestro window.

Configuring the Trigger Condition in Delay-Mode

The Trigger condition recognizes specific DWords within frames.

Depending on the Mode you select in the **Delay Emulator Configuration** window, the appropriate graphic diagram shows the Classify condition, the Trigger and optional Arm conditions, and the Delay. If the Mode you select does not include an Arm condition, the Arm button remains disabled.

To set Trigger conditions:

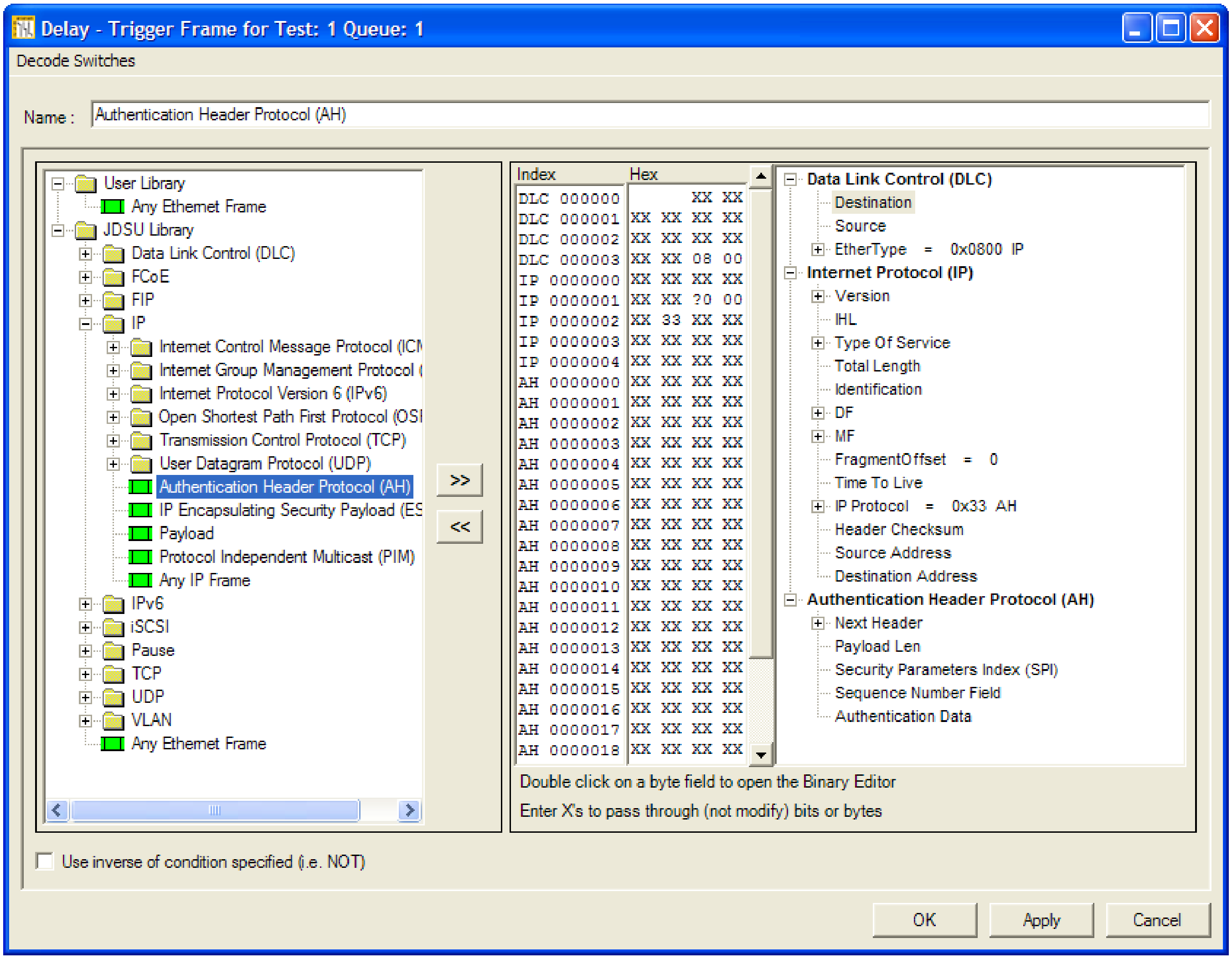
1 Click the **Trigger** button in the Xgig Delay Emulator Configuration window.

   The window for the condition is displayed (Figure 324). If you are in hardware edit mode, the protocol, chassis name, chassis number, slot number, and port numbers are displayed in the title bar.

2 Set the values as required to specify the Trigger condition as part of a unique Arm and Trigger sequence for the specific test. The default setting for the Trigger condition is to trigger on any frame.

   The following sections describe the available values.

Figure 324: 10GigE Trigger Window for Frames



Setting Frame Conditions for a Trigger in Delay-Mode

You can specify frame conditions in two ways. One way is to load a template from the Template Library tree, and the other way is to manually specify bits in the frame.

To use a template:

1 Select a template from the Template Library tree on the left.

2 Click the double right arrow button to set the Trigger Condition.

The condition is indicated on the right side of the window.

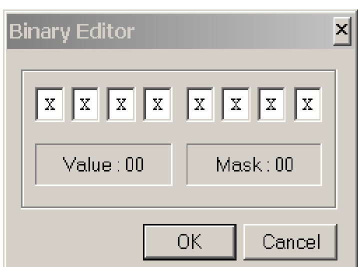
To manually specify a frame:

>> Type hexadecimal values directly into the center column of the window.

An X represents a nibble that can be any value (a "don't care").

To set individual bits in any field, double-click on the hex entry to open the Binary Editor (Figure 325). In the hex view, partially defined hex characters appear as question marks: `X001=?`

Figure 325: Binary Editor Dialog

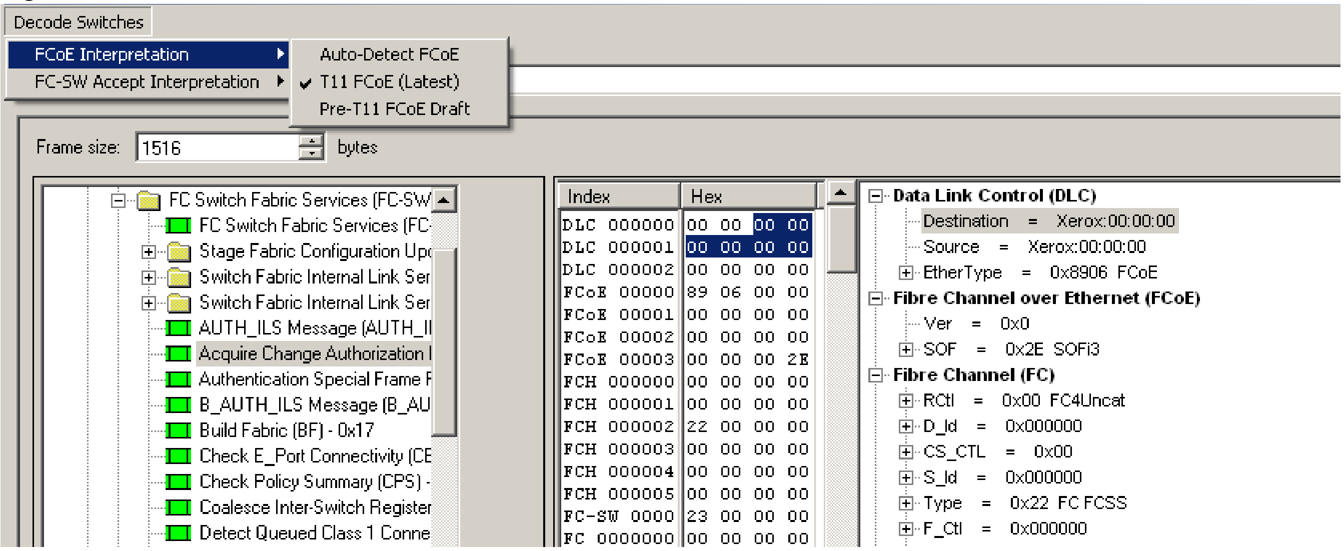


Another way to manually edit the frame condition is to make selections from the tree view in the right window pane.

Decode Switches Menu

Some templates allow you to specify decode switches. When you load a template that has this option, the **Decode Switches Menu** appears in the upper left corner of the window. The decode switches provide detailed contextual options for decode; for example, further decode of response and data frames. The Decode Switches menu is context sensitive and will only show the decode options available for the specific template you are creating.

Figure 326: Decode Switches Menu

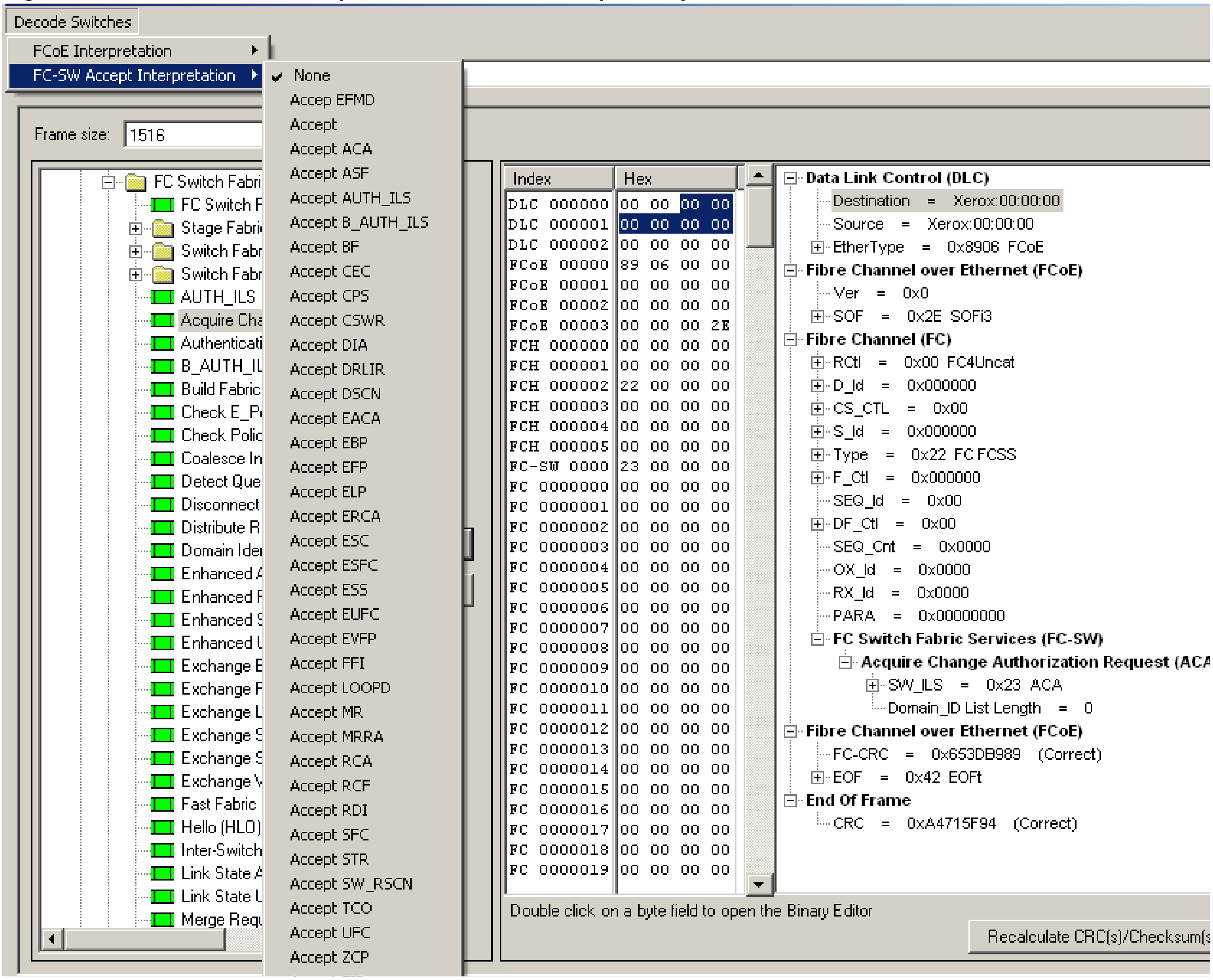


Note: Once the **Decode Switches** menu appears, it remains visible. However, if you load a template that has no decode options, the menu is grayed out and inactive.

The **Decode Switches** menu is intended to help you create a user-defined template. When editing a User Library template, Decode Switches are stored inside the template so they are still ON the next time you open this particular template.

Decode switches allow you to further decode Response and Data frames that can't be decoded without knowing what the associated command frame is. Below is a description of the switches avaFC-SW Accept Interpretation

Figure 327: Decode Switch Options for FC-SW Accept Interpretation



Saving a Frame Condition

If you create a frame condition that you want to save and make easily available for future use, you can save it into the “User Library” folder in the Template Library tree. To do this:

>> Highlight the folder and click the double left arrow button.

Frame conditions have the option of “Use inverse of condition specified (i.e., NOT).” When you check this option, it means that the first frame encountered that does not match what you have specified creates a “condition met” event.

For each frame condition, you can specify an optional name at the top of the window. This name is also shown on the Delay Emulator Configuration window under the Mode selection, and on the main Xgig Maestro window.

Chapter 13

Creating Delay Emulator Test Configurations for Reorder Mode

In this chapter:

Defining Your Own Test Configurations for Reorder Mode

Xgig Delay Emulator lets you define your own test configurations and save them with or without hardware available.

You can create a configuration from scratch, or you can open and edit an existing configuration. Also, you can edit a configuration in edit only mode, which is independent of any hardware, or you can edit a configuration that is currently loaded to a Delay Emulator device.

To edit a configuration in edit only mode:

>> Double-click a configuration file in the Configuration manager.

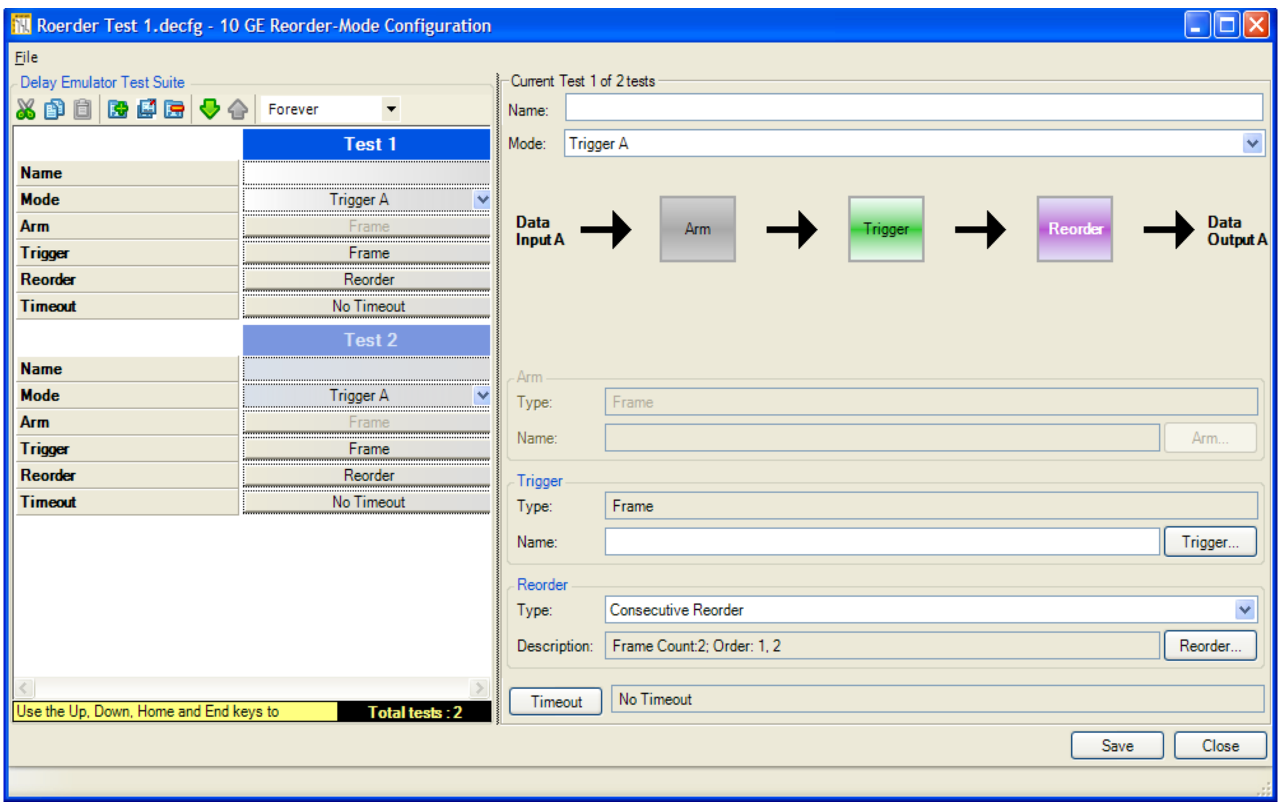
or:

>> Right-click the configuration file in the Configuration manager, and choose **Edit Delay Emulator Configuration** from the context menu.

The edit only mode Delay Emulator Configuration window opens (Figure 328).

This window allows you to set up your own Test Cases, name them, organize them, and save them to files so that you can use them again.

Figure 328: Edit Only Delay Emulator Configuration Window



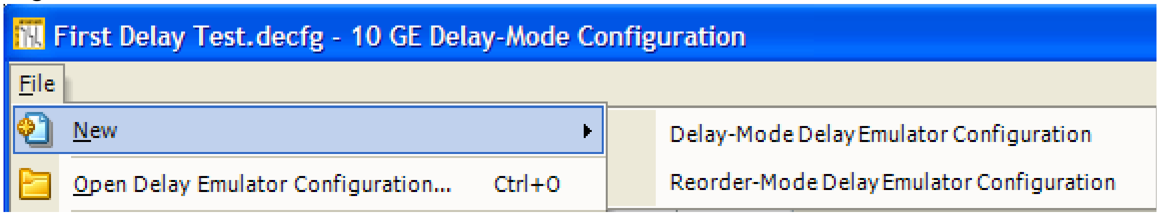
To start a configuration from scratch in edit only mode:

>> Select **New Delay Emulator Configuration** from the context menu or the File menu (Figure 329) on the Xgig Maestro menu bar. Then, select **Delay-Mode or Reorder-Mode Delay Emulator Configuration** from the drop down menu.

or:

>> Click the New Configuration icon at the top of the Configuration manager.

Figure 329: Maestro File Menu



To save your configuration in edit only mode:

>> Click **Save** at the bottom of the Delay Emulator Configuration window, or open the File menu on the Delay Emulator Configuration window and select **Save Delay Emulator Configuration** or **Save Delay Emulator Configuration As**.

Any changes you make have no effect on actual Delay Emulator devices you control.

To edit a configuration that is loaded to a Delay Emulator port:

>> Click **Configuration...** in the device column.

or:

>> Right-click in the Parameters Status table in the device column to open the context menu and select **Edit configuration**.

or:

>> Click **Operation** in the device column to open the Operation dialog, then click **Config**.

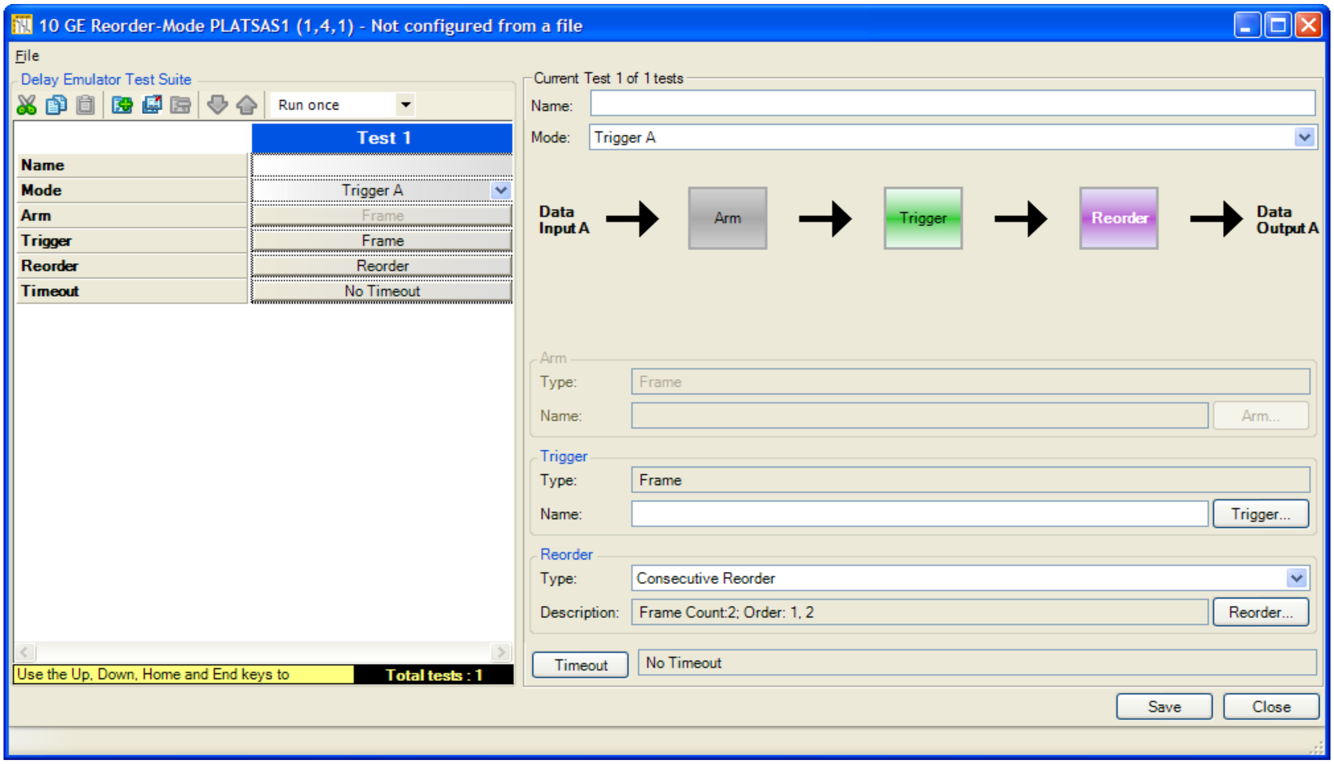
The Xgig Delay Emulator Configuration window in hardware edit mode is displayed (Figure 330). This window allows you to set up your own Test Cases, name them, and save them to a file so that you can use them again.

Click **Apply** or **OK** and Delay Emulator accepts the changes. They are immediately reflected in the Parameters Status table and affect the Delay Emulator device the next time you run it.

To save your configuration edits:

>> Open the File menu at the top of the Delay Emulator Configuration window and select **Save Delay Emulator Configuration** or **Save Delay Emulator Configuration As**.

Figure 330: Xgig Delay Emulator Configuration Window



Using the Reorder-Mode Configuration Window

The Delay Emulator Configuration window title bar indicates how many ports it is configuring, the protocol, and the configuration file name, if any. If you are using hardware edit mode, the chassis name, chassis number, slot number, and port number are also listed. The elements of the Delay Emulator Configuration window are described in the following sections.

Using the Delay Emulator Test Suite Tools in Reorder-Mode

The Delay Emulator Test Suite (left pane) lists the series of Xgig Delay Emulator tests in the order in which you want them to execute. The number of test in the test suite has no limit. Each test can contain between two and eight frames to be reordered. The highlighted test appears as the Current Delay Emulator Test (right pane). Each test in the suite executes in sequence.

Creating a Test Suite

When you create a Delay Emulator Test Suite, you use the toolbar in the Delay Emulator Test Suite section of the Configuration window (Figure 331).

Figure 331: 10GigE Delay Emulator Test Suite Toolbar

The following list describes the icons on the toolbar:

	Cut current test	Removes the highlighted test and holds its contents in the memory buffer.
	Copy current text	Copies the highlighted test to the memory buffer.
	Paste last test cut or copied	Inserts the current memory buffer contents before the currently highlighted test.
	Add new test to bottom of stack	Adds a new blank test to the bottom of the suite.
	Insert new test before current test	Inserts a new blank test above the currently highlighted test.
	Delete current test	Removes the highlighted test from the suite. If only one test is present, then the contents of this test are cleared.
	Move current test down the stack	Moves the highlighted test down one in the test order.
	Move current test up the stack	Moves the highlighted test up one in the test order.
	Run test suite once or Repeat test suite	When you choose Repeat test suite, the tests run according the settings you define in the Delay Emulator Current Test window. You can also type a number in this field to indicate that you want the test suite to repeat a certain number of times.

To duplicate a test at another point in the Test Suite:

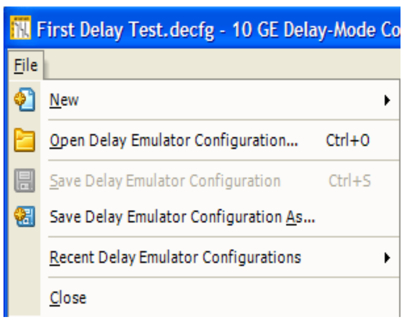
1. Highlight the test you want to duplicate.
2. Click **Copy**.
3. Highlight the test in the suite that is just after the point where you want the duplicate test inserted.
4. Click **Paste**.

   The duplicate test is inserted.

Using the Configuration File Menu

The File menu is the only menu on the menu bar (Figure 332).

Figure 332: Configuration File Menu



The choices are:

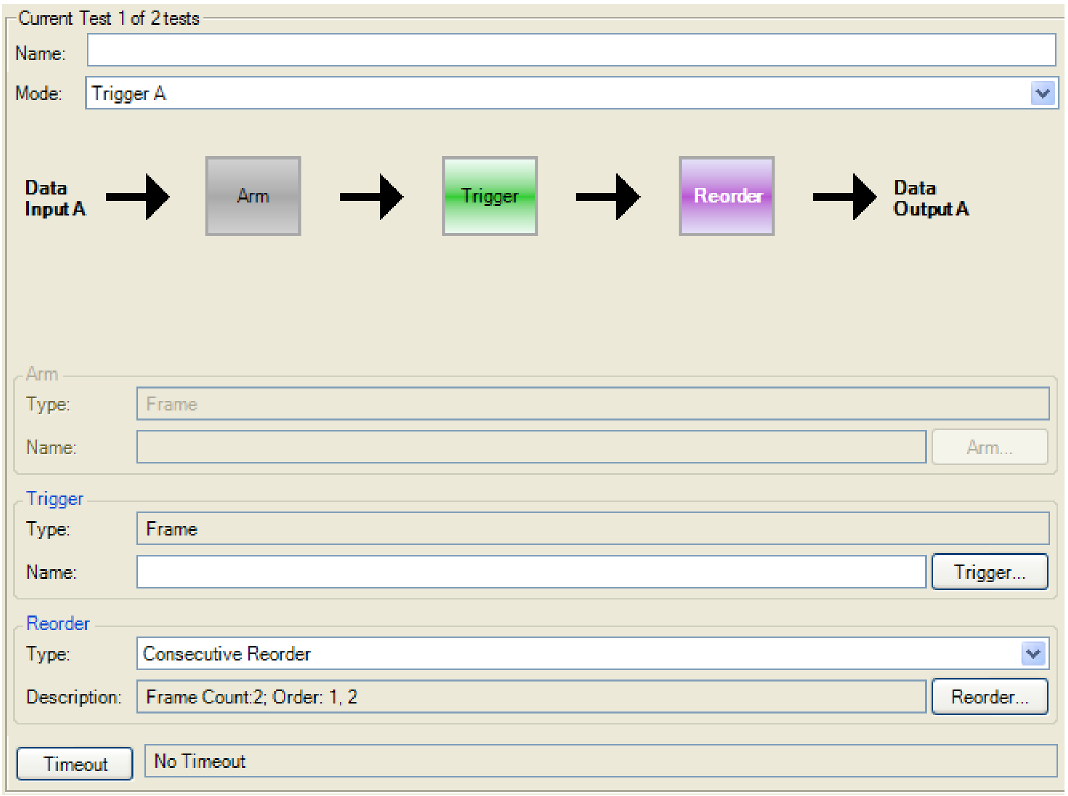
New Configuration	Creates a new delay or reorder `.decfg` configuration file.
Open Configuration	Open an existing `.decfg` configuration file.
Save Configuration	Save the entire Test Suite to the `.decfg` file you currently have loaded.
Save Configuration As	Save the entire Test Suite to a `.decfg` file with a name you assign to it.
Recent Configuration	Open a recently opened `.decfg` configuration file.
Close	Close the Delay Emulator Configuration Window.

The recently used Delay Emulator configuration files appear in the file menu and are loaded when selected.

Using the Current Delay Emulator Test Window: Reorder-Mode

The graphics in this section of the window represent the hardware configuration for the selected test in the Delay Emulator Test Suite (Figure 333).

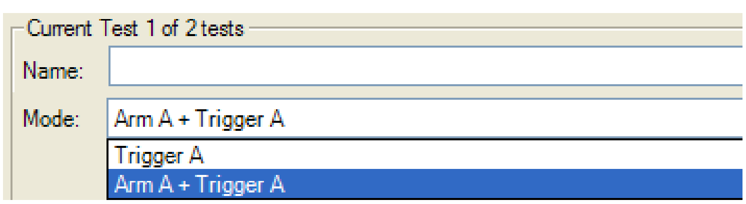
Figure 333: Current Delay Emulator Test Window



Mode

The Mode menu is available near the top of the Current Delay Emulator Test window (Figure 334).

Figure 334: Mode Drop-down Menu in Current Delay Emulator Test - Right Pane



Arm and Trigger

The Arm and Trigger buttons are located in the right pane of the Current Delay Emulator Test window. To define Arm and Trigger conditions, click the Arm or Trigger button.

Reorder

The Reorder button is located in the right pane of the Current Delay Emulator Test window. To define the Reorder condition, click the Reorder button.

Timeout

The timeout option defines the period of time to wait for a specified test to complete before aborting and proceeding to the next test in the suite.

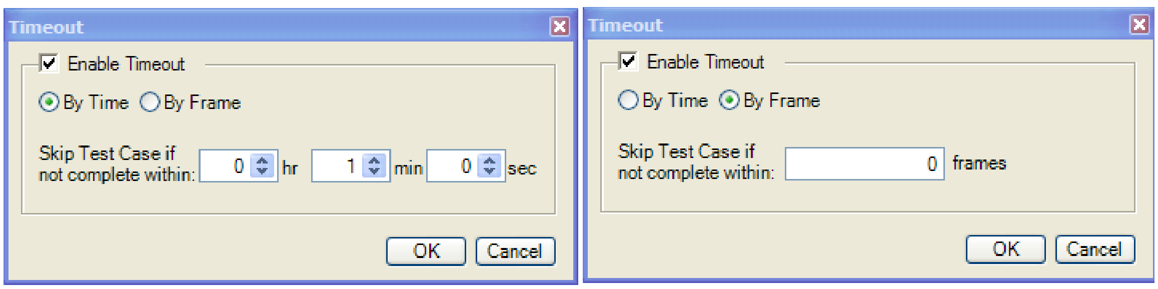
To set the timeout:

1 Click **Timeout** to display the dialog box in Figure 335.

2 Check **Enable Timeout**.

3 Enter the hours, minutes, and seconds you want to wait.

Figure 335: Timeout Dialog



4 Click **OK**.

Configuring the Arm Condition in Reorder-Mode

The Arm condition recognizes specific DWords within frames.

Depending on the Mode you select, the appropriate graphic diagram shows the Trigger and optional Arm conditions. If the Mode you select does not include an Arm condition, the **Arm** button is disabled.

To set Arm conditions:

1. Click on the **Arm** button to open the Arm window.

   The window for the condition is displayed (Figure 336). If you are in hardware edit mode, the protocol, chassis name, chassis number, slot number, and port numbers are displayed in the title bar.

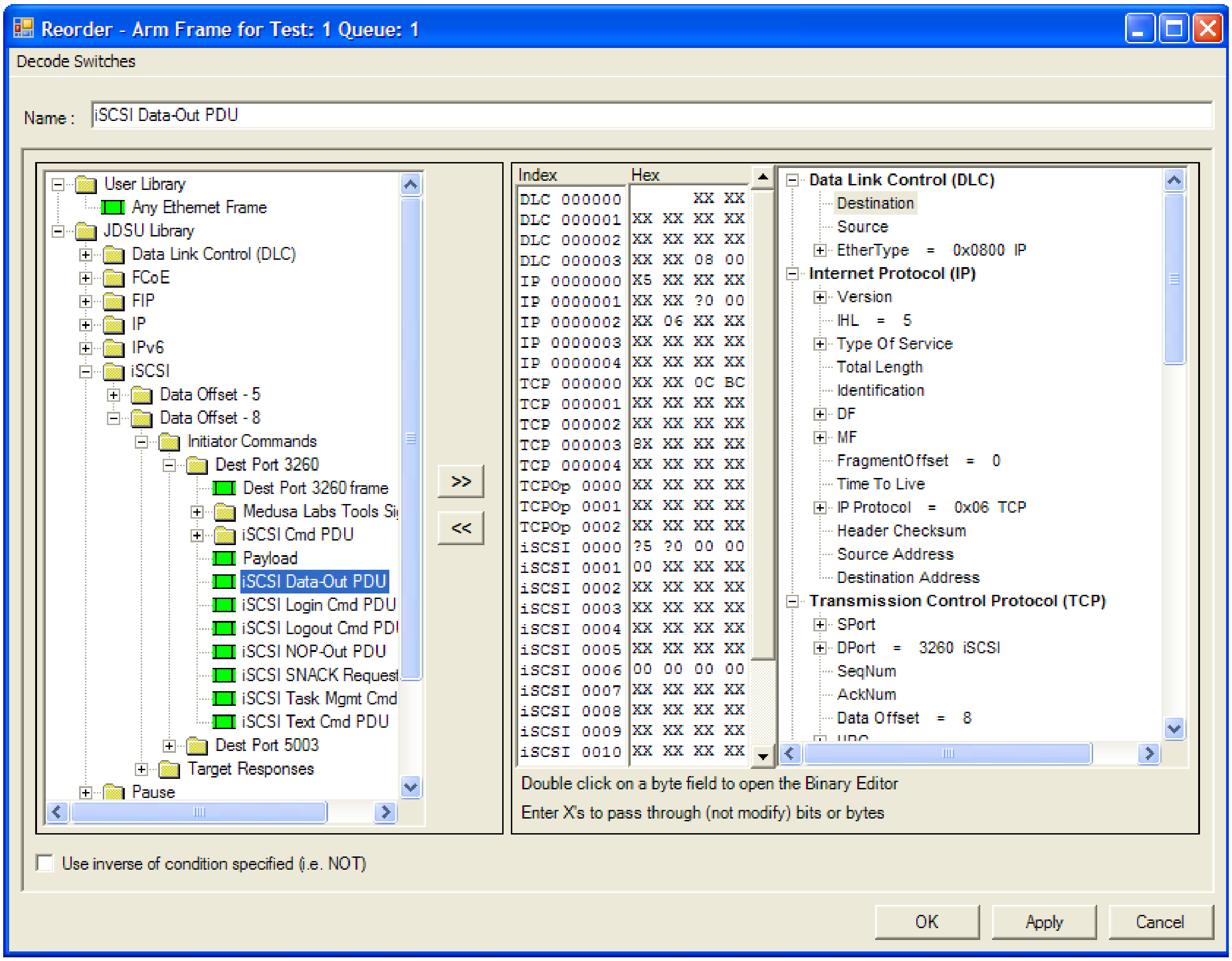
2. Set the values as required to specify the Arm condition as part of a unique Arm and Trigger sequence for the specific test.

   The following sections describe the available values.

Setting Frame Conditions for Arm for Reorder

You can specify frame conditions in two ways. One way is to load a template from the Template Library tree, and the other way is to manually specify bits in the frame.

Figure 336: Arm Window for Frames



To use a template:

1 Select a template from the Template Library tree on the left.

2 Click the double right arrow button to set the Trigger Condition.

The condition is indicated on the right side of the window.

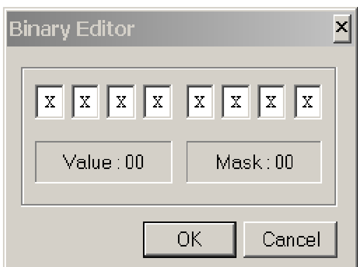
To manually specify a frame:

>> Type hexadecimal values directly into the center column of the window.

An X represents a nibble that can be any value (a "don't care").

To set individual bits in any field, double-click on the hex entry to open the Binary Editor (Figure 337). In the hex view, partially defined hex characters appear as question marks: `X001=?`

Figure 337: Binary Editor Dialog



Another way to manually edit the frame condition is to make selections from the tree view in the right window pane.

Saving a Frame Condition

If you create a frame condition that you want to save and make easily available for future use, you can save it into the "User Library" folder in the Template Library tree. To do this:

>> Highlight the folder and click the double left arrow button.

Frame conditions have the option of "Use inverse of condition specified (i.e., NOT)." When you check this option, it means that the first frame encountered that does not match what you have specified creates a "condition met" event.

For each frame condition, you can specify an optional name at the top of the window. This name is also shown on the Delay Emulator Configuration window under the Mode selection, and on the main Xgig Maestro window.

Configuring the Trigger Condition in Reorder-Mode

The Trigger condition recognizes DWords within frames.

Depending on the Mode you select in the **Delay Emulator Configuration** window, the appropriate graphic diagram shows the Trigger and optional Arm conditions, along with the Delay. If the Mode you select does not include an Arm condition, the Arm button remains disabled.

To set Trigger conditions:

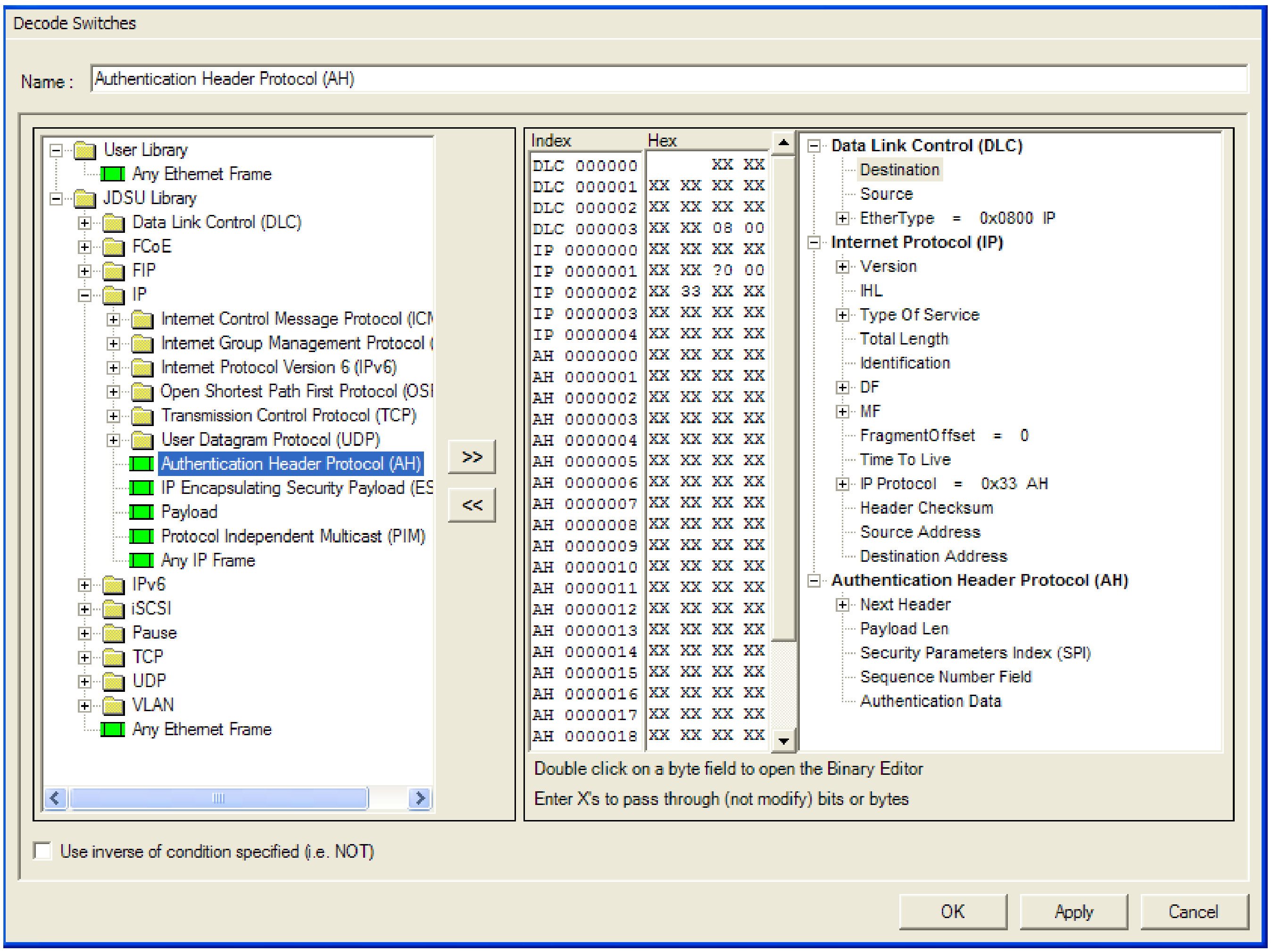
1 Click the **Trigger** button in the Xgig Delay Emulator Configuration window.

The window for the condition is displayed (Figure 338). If you are in hardware edit mode, the protocol, chassis name, chassis number, slot number, and port numbers are displayed in the title bar.

2 Set the values as required to specify the Trigger condition as part of a unique Arm and Trigger sequence for the specific test.

The following sections describe the available values.

Figure 338: Trigger Window for Frames



Setting Frame Conditions for a Trigger in Reorder-Mode

You can specify frame conditions in two ways. One way is to load a template from the Template Library tree, and the other way is to manually specify bits in the frame.

To use a template:

1 Select a template from the Template Library tree on the left.

2 Click the double right arrow button to set the Trigger Condition.

The condition is indicated on the right side of the window.

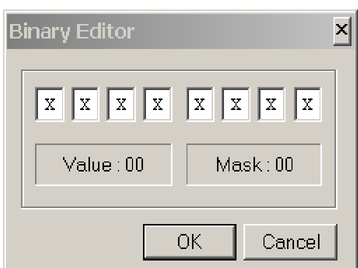
To manually specify a frame:

>> Type hexadecimal values directly into the center column of the window.

An X represents a nibble that can be any value (a “don’t care”).

To set individual bits in any field, double-click on the hex entry to open the Binary Editor (Figure 339). In the hex view, partially defined hex characters appear as question marks: `X001=?`

Figure 339: Binary Editor Dialog

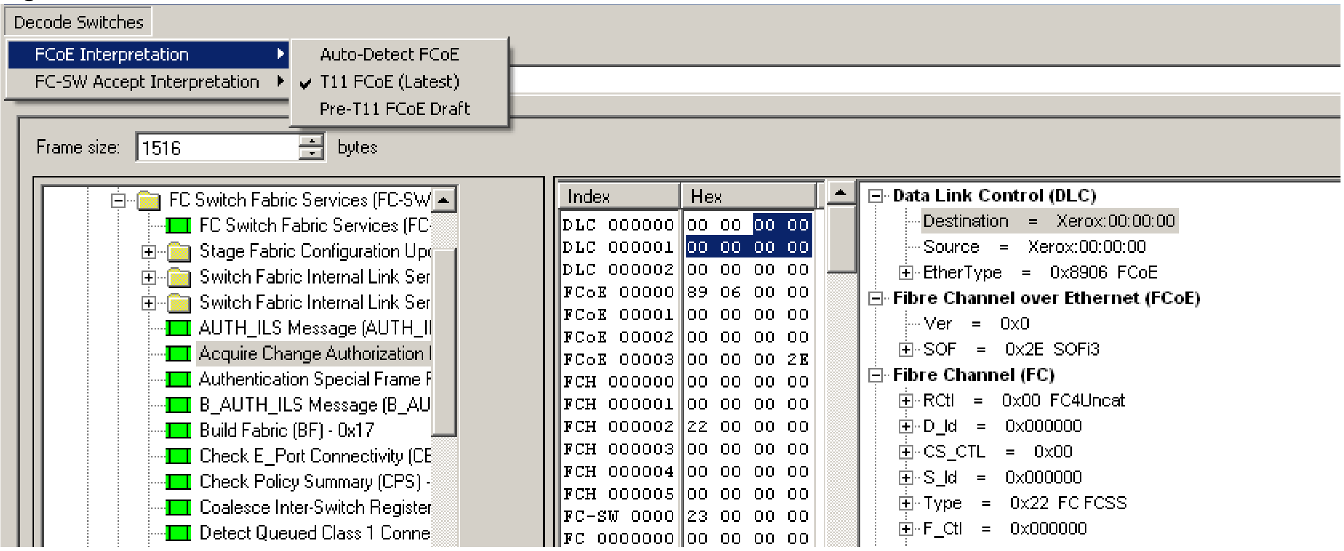


Another way to manually edit the frame condition is to make selections from the tree view in the right window pane.

Decode Switches Menu

Some templates allow you to specify decode switches. When you load a template that has this option, the **Decode Switches Menu** appears in the upper left corner of the window. The decode switches provide detailed contextual options for decode; for example, further decode of response and data frames. The Decode Switches menu is context sensitive and will only show the decode options available for the specific template you are creating.

Figure 340: Decode Switches Menu

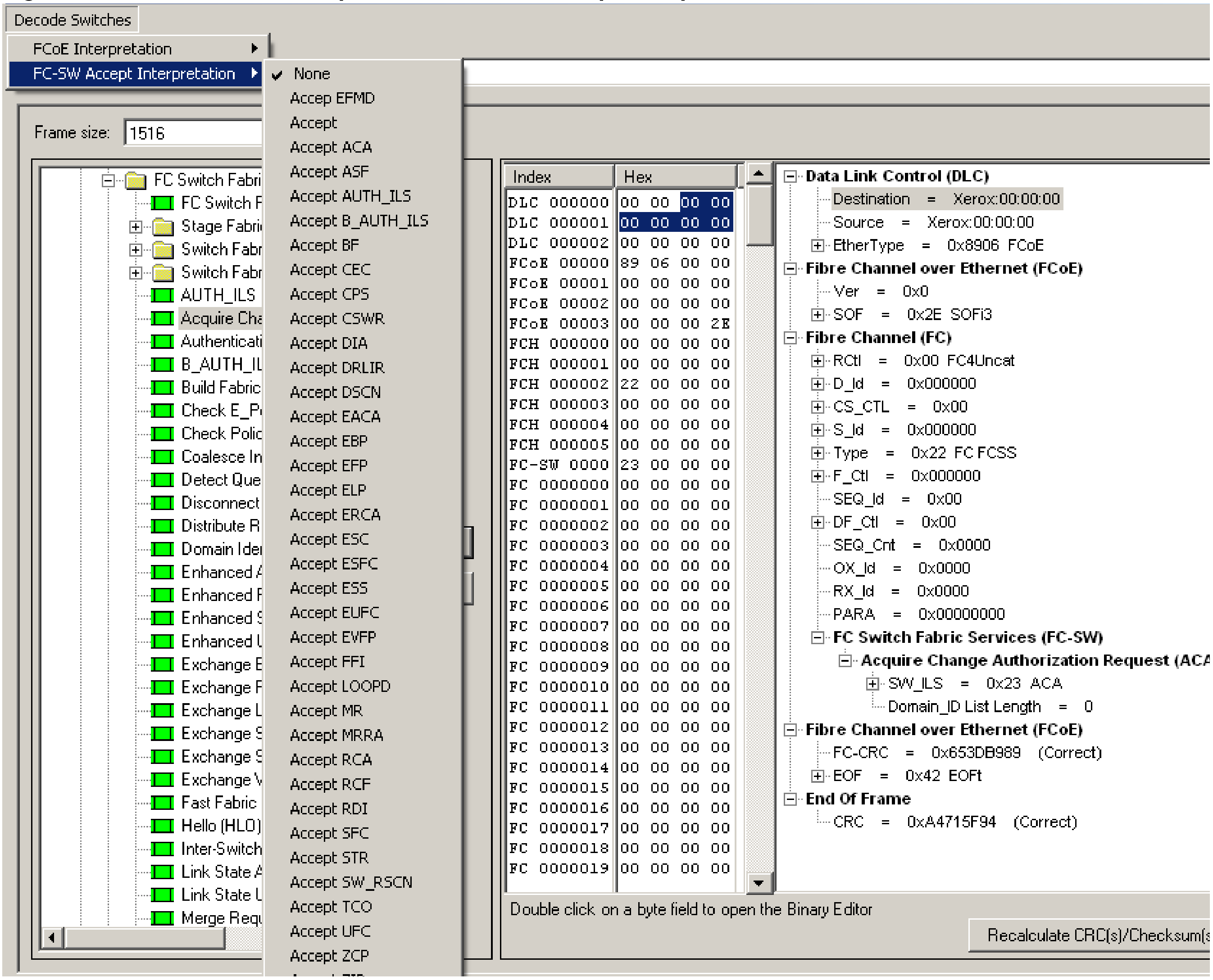


Note: Once the **Decode Switches** menu appears, it remains visible. However, if you load a template that has no decode options, the menu is greyed out and inactive.

The **Decode Switches** menu is intended to help you create a user-defined template. When editing a User Library template, Decode Switches are stored inside the template so they are still ON the next time you open this particular template.

Decode switches allow you to further decode Response and Data frames that can't be decoded without knowing what the associated command frame is. Below is a description of the switches avaFC-SW Accept Interpretation

Figure 341: Decode Switch Options for FC-SW Accept Interpretation



Saving a Frame Condition

If you create a frame condition that you want to save and make easily available for future use, you can save it into the “User Library” folder in the Template Library tree. To do this:

>> Highlight the folder and click the double left arrow button.

Frame conditions have the option of “Use inverse of condition specified (i.e., NOT).” When you check this option, it means that the first frame encountered that does not match what you have specified creates a “condition met” event.

For each frame condition, you can specify an optional name at the top of the window. This name is also shown on the Delay Emulator Configuration window under the Mode selection, and on the main Xgig Maestro window.

Configuring the Reorder Condition

The Reorder definition tells the software the way you want to reorder frames, how many frames to reorder, and in which order to place them.

Depending on the Mode you select, the appropriate graphic diagram shows the Trigger and optional Arm conditions. If the Mode you select does not include an Arm condition, the **Arm** button is disabled.

To define the Reorder:

1. Click the **Reorder** button to open the Reorder window.

   The Reorder window is displayed (Figure 336).

2. Select the type of reorder you want.

   - Consecutive Reorder

   For a consecutive reorder, every frame including the trigger frame is reordered.

   - Trigger Reorder

   For a trigger reorder, all frames of the type specified in the trigger are reordered beginning with the frame including the trigger frame.

3. Select the number of frames you want to reorder, between two and eight.
4. Drag the frames to reorder them.
5. Click OK.

PART THREE: Appendices

Appendix A

Fibre Channel Ordered Sets - Partial List

Fibre Channel defines certain combinations of characters called Ordered Sets. The table in this appendix shows a partial list. The following abbreviations are used in the table:

SOF Start-of-frame delimiter

EOF End-of-frame delimiter

ALPA, D, S, Type Arbitrated Loop Physical Address, Destination, Source, Mark Type. These are limited to 127 specific hex values.

Name	Function	Beginning RD	Ordered Set	8 Bit Hex
SOFc1	SOF Connect Class 1	Negative	K28.5 D21.5 D23.0 D23.0	K28.5 B5 17 17
SOFi1	SOF Initiate Class 1	Negative	K28.5 D21.5 D23.2 D23.2	K28.5 B5 57 57
SOFn1	SOF Normal Class 1	Negative	K28.5 D21.5 D23.1 D23.1	K28.5 B5 37 37
SOFi2	SOF Initiate Class 2	Negative	K28.5 D21.5 D21.2 D21.2	K28.5 B5 55 55
SOFn2	SOF Normal Class 2	Negative	K28.5 D21.5 D21.1 D21.1	K28.5 B5 35 35
SOFi3	SOF Initiate Class 3	Negative	K28.5 D21.5 D22.2 D22.2	K28.5 B5 56 56
SOFn3	SOF Normal Class 3	Negative	K28.5 D21.5 D22.1 D22.1	K28.5 B5 36 36
SOFf	SOF Fabric	Negative	K28.5 D21.5 D24.2 D24.2	K28.5 B5 58 58
SOFc4	SOF Activate Class 4	Negative	K28.5 D21.5 D25.0 D25.0	K28.5 B5 19 19
SOFi4	SOF Initiate Class 4	Negative	K28.5 D21.5 D25.2 D25.2	K28.5 B5 59 59
SOFn4	SOF Normal Class 4	Negative	K28.5 D21.5 D25.1 D25.1	K28.5 B5 39 39

Name	Function	Beginning RD	Ordered Set	8 Bit Hex
EOFt	EOF Terminate	Negative Positive	K28.5 D21.4 D21.3 D21.3 K28.5 D21.5 D21.3 D21.3	K28.5 95 75 75 K28.5 B5 75 75
EOFdt	EOF Disconnect-Terminate	Negative Positive	K28.5 D21.4 D21.4 D21.4 K28.5 D21.5 D21.4 D21.4	K28.5 95 95 95 K28.5 B5 95 95
EOFa	EOF Abort	Negative Positive	K28.5 D21.4 D21.7 D21.7 K28.5 D21.5 D21.7 D21.7	K28.5 95 F5 F5 K28.5 B5 F5 F5
EOFn	EOF Normal	Negative Positive	K28.5 D21.4 D21.6 D21.6 K28.5 D21.5 D21.6 D21.6	K28.5 95 D5 D5 K28.5 B5 D5 D5
EOFdti	EOF Disconnect-Terminate-Invalid	Negative Positive	K28.5 D10.4 D21.4 D21.4 K28.5 D10.5 D21.4 D21.4	K28.5 8A 95 95 K28.5 AA 95 95
EOFni	EOF Normal-Invalid	Negative Positive	K28.5 D10.4 D21.6 D21.6 K28.5 D10.5 D21.6 D21.6	K28.5 8A D5 D5 K28.5 AA D5 D5
EOFrt	EOF Remove-Terminate Class 4	Negative Positive	K28.5 D21.4 D25.4 D25.4 K28.5 D21.5 D25.4 D25.4	K28.5 95 99 99 K28.5 B5 99 99
EOFrti	EOF Remove-Terminate Invalid Class 4	Negative Positive	K28.5 D10.4 D25.4 D25.4 K28.5 D10.5 D25.4 D25.4	K28.5 8A 99 99 K28.5 AA 99 99
IDLE	Idle	Negative	K28.5 D21.4 D21.5 D21.5	K28.5 95 B5 B5
R_RDY	Receiver_Ready	Negative	K28.5 D21.4 D10.2 D10.2	K28.5 95 4A 4A5
VC_RDY	Virtual Circuit Ready	Negative	K28.5 D21.7 VC.ID VC.ID	K28.5 F5 xx xx
BB_SCs	Buffer-to-buffer State Change (SOF)	Negative	K28.5 D21.4 D22.4 D22.4	K28.5 95 96 96
BB_SCr	Buffer-to-buffer State Change (R_RDY)	Negative	K28.5 D21.4 D22.6 D22.6	K28.5 95 D6 D6
SYNx	Clock Synchronization Word x	Negative	K28.5 D31.3 CS_x CS_x	K28.5 7F xx xx
SYNy	Clock Synchronization Word y	Negative	K28.5 D31.3 CS_y CS_y	K28.5 7F xx xx
SYNz	Clock Synchronization Word z	Negative	K28.5 D31.3 CS_z CS_z	K28.5 7F xx xx
OLS	Offline	Negative	K28.5 D21.1 D10.4 D21.2	K28.5 35 8A 55
NOS	Not_Operational	Negative	K28.5 D21.2 D31.5 D5.2	K28.5 55 BF 45
LR	Link_Reset	Negative	K28.5 D9.2 D31.5 D9.2	K28.5 49 BF 49
LRR	Link_Reset_Response	Negative	K28.5 D21.1 D31.5 D9.2	K28.5 55 BF 49
OPNyx	Open Loop Port	Negative	K28.5 D17.4 ALPD ALPS	K28.5 91 xx xx
OPNfr	Open Loop Port	Negative	K28.5 D17.4 D31.7 D31.7	K28.5 91 FF FF
CLS	Close Loop Port	Negative	K28.5 D5.4 D21.5 D21.5	K28.5 85 B5 B5
MRK	Mark	Negative	K28.5 D31.2 type ALPS	K28.5 5F xx xx
LIP	Loop Initialization, Acquire PA	Negative	K28.5 D21.0 D23.7 D23.7	K28.5 15 F7 F7
LIP	Loop Initialization, Rcvr Fail	Negative	K28.5 D21.0 D24.7 D23.7	K28.5 15 F8 F7
LIP	Loop Initialization, Reinitialize	Negative	K28.5 D21.0 D23.7 ALPS	K28.5 15 F7 xx
LIP	Loop Initialization, Fail at PS	Negative	K28.5 D21.0 D24.7 ALPS	K28.5 15 F8 xx
LIP	Loop Initialization, Reset PD	Negative	K28.5 D21.0 ALPD ALPS	K28.5 15 xx xx
LPEyx	Loop Port Enable, enable PD	Negative	K28.5 D5.0 ALPD ALPS	K28.5 05 xx xx
LPEfx	Loop Port Enable, enable all	Negative	K28.5 D5.0 D31.7 ALPS	K28.5 05 FF xx
LPByx	Loop Port Bypass, bypass PD	Negative	K28.5 D9.0 ALPD ALPS	K28.5 09 xx xx
ARBx	Arbitrate For Loop	Negative	K28.5 D20.4 ALPS ALPS	K28.5 94 xx xx
ARB(F0)	Arbitrate For Loop, fairness	Negative	K28.5 D20.4 D16.7 D16.7	K28.5 94 F0 F0

Appendix B

8-Bit/10-Bit Mapping

This appendix contains tables sorted by values for 8-bit/10-bit mapping.

The following table lists:

Legal 8-Bit/10-Bit Characters Sorted by 10-Bit Value

10B Dec	8B Dec	ASCII+	HEX	Previous Disparity	Data Byte Name	10 B	Comment
85	87	W	57	RD +	D23.2	00 0101 0101	
86	215	×	D7	RD +	D23.6	00 0101 0110	
87	247	÷	F7	RD +	K23.7	00 0101 0111	
89	55	7	37	RD +	D23.1	00 0101 1001	
90	183	·	B7	RD +	D23.5	00 0101 1010	
91	23	ETB	17	RD +	D23.0	00 0101 1011	
92	119	w	77	RD +	D23.3	00 0101 1100	
93	151	—	97	RD +	D23.4	00 0101 1101	
94	247	÷	F7	RD +	D23.7	00 0101 1110	
101	72	H	48	RD +	D8.2	00 0110 0101	
102	200	È	C8	RD +	D8.6	00 0110 0110	
105	40	(	28	RD +	D8.1	00 0110 1001	
106	168	¨	A8	RD +	D8.5	00 0110 1010	
107	8	BS	08	RD +	D8.0	00 0110 1011	
108	104	h	68	RD +	D8.3	00 0110 1100	
109	136	ˆ	88	RD +	D8.4	00 0110 1101	
110	232	è	E8	RD +	D8.7	00 0110 1110	
113	231	ç	E7	RD +	D7.7	00 0111 0001	
114	135	‡	87	RD +	D7.4	00 0111 0010	
115	103	g	67	RD +	D7.3	00 0111 0011	
116	7	BEL	07	RD +	D7.0	00 0111 0100	
117	71	G	47	RD +	D7.2	00 0111 0101	
118	199	Ç	C7	RD +	D7.6	00 0111 0110	
121	39	'	27	RD +	D7.1	00 0111 1001	
122	167	§	A7	RD +	D7.5	00 0111 1010	
149	91	[	5B	RD +	D27.2	00 1001 0101	
150	219	Û	DB	RD +	D27.6	00 1001 0110	
151	251	û	FB	RD +	K27.7	00 1001 0111	
153	59	;	3B	RD +	D27.1	00 1001 1001	
154	187	»	BB	RD +	D27.5	00 1001 1010	
155	27	ESC	1B	RD +	D27.0	00 1001 1011	
156	123	{	7B	RD +	D27.3	00 1001 1100	
157	155	›	9B	RD +	D27.4	00 1001 1101	
158	251	û	FB	RD +	D27.7	00 1001 1110	
165	68	D	44	RD +	D4.2	00 1010 0101	
166	196	Ä	C4	RD +	D4.6	00 1010 0110	
169	36	$	24	RD +	D4.1	00 1010 1001	
170	164	¤	A4	RD +	D4.5	00 1010 1010	
171	4	EOT	04	RD +	D4.0	00 1010 1011	
172	100	d	64	RD +	D4.3	00 1010 1100	
173	132	„	84	RD +	D4.4	00 1010 1101	
174	228	ä	E4	RD +	D4.7	00 1010 1110	
177	244	ô	F4	RD +	D20.7	00 1011 0001	
178	148	”	94	RD +	D20.4	00 1011 0010	
179	116	t	74	RD +	D20.3	00 1011 0011	
180	20	DC4	14	RD +	D20.0	00 1011 0100	
181	84	T	54	RD+/--	D20.2	00 1011 0101	
182	212	Ô	D4	RD+/--	D20.6	00 1011 0110	
183	244	ô	F4	RD--	D20.7	00 1011 0111	
185	52	4	34	RD+/--	D20.1	00 1011 1001	
186	180	´	B4	RD+/--	D20.5	00 1011 1010	
187	20	DC4	14	RD--	D20.0	00 1011 1011	
188	116	t	74	RD--	D20.3	00 1011 1100	
189	148	”	94	RD--	D20.4	00 1011 1101	
197	88	X	58	RD +	D24.2	00 1100 0101	
198	216	Ø	D8	RD +	D24.6	00 1100 0110	
201	56	8	38	RD +	D24.1	00 1100 1001	
202	184	¸	B8	RD +	D24.5	00 1100 1010	
203	24	CAN	18	RD +	D24.0	00 1100 1011	
204	120	x	78	RD +	D24.3	00 1100 1100	
205	152	˜	98	RD +	D24.4	00 1100 1101	
206	248	ø	F8	RD +	D24.7	00 1100 1110	
209	236	ì	EC	RD +	D12.7	00 1101 0001	
210	140	Œ	8C	RD +	D12.4	00 1101 0010	
211	108	l	6C	RD +	D12.3	00 1101 0011	
212	12	FF	0C	RD +	D12.0	00 1101 0100	
213	76	L	4C	RD+/--	D12.2	00 1101 0101	
214	204	Ì	CC	RD+/--	D12.6	00 1101 0110	
217	44	,	2C	RD+/--	D12.1	00 1101 1001	
218	172	¬	AC	RD+/--	D12.5	00 1101 1010	
219	12	FF	0C	RD--	D12.0	00 1101 1011	
220	108	l	6C	RD--	D12.3	00 1101 1100	
221	140	Œ	8C	RD--	D12.4	00 1101 1101	
222	236	ì	EC	RD--	D12.7	00 1101 1110	
225	252	ü	FC	RD +	D28.7	00 1110 0001	
226	156	œ	9C	RD +	D28.4	00 1110 0010	
227	124	|	7C	RD +	D28.3	00 1110 0011	
228	28	FS	1C	RD +	D28.0	00 1110 0100	
229	92	\	5C	RD+/--	D28.2	00 1110 0101	
230	220	Ü	DC	RD+/--	D28.6	00 1110 0110	
233	60	<	3C	RD+/--	D28.1	00 1110 1001	
234	188	¼	BC	RD+/--	D28.5	00 1110 1010	
235	28	FS	1C	RD--	D28.0	00 1110 1011	
236	124	|	7C	RD--	D28.3	00 1110 1100	
237	156	œ	9C	RD--	D28.4	00 1110 1101	
238	252	ü	FC	RD--	D28.7	00 1110 1110	
242	156	œ	9C	RD --	K28.4	00 1111 0010	Reserved*
243	124	|	7C	RD --	K28.3	00 1111 0011	Reserved*
244	28	FS	1C	RD --	K28.0	00 1111 0100	Reserved*
245	92	\	5C	RD --	K28.2	00 1111 0101	Reserved*
246	220	Ü	DC	RD --	K28.6	00 1111 0110	Reserved*
248	252	ü	FC	RD --	K28.7	00 1111 1000	Test
249	60	<	3C	RD --	K28.1	00 1111 1001	Reserved*
250	188	¼	BC	RD --	K28.5	00 1111 1010	Sync
277	93	]	5D	RD +	D29.2	01 0001 0101	
278	221	Ý	DD	RD +	D29.6	01 0001 0110	
279	253	ý	FD	RD +	K29.7	01 0001 0111	
281	61	=	3D	RD +	D29.1	01 0001 1001	
282	189	½	BD	RD +	D29.5	01 0001 1010	
283	29	GS	1D	RD +	D29.0	01 0001 1011	
284	125	}	7D	RD +	D29.3	01 0001 1100	
285	157	_	9D	RD +	D29.4	01 0001 1101	
286	253	ý	FD	RD +	D29.7	01 0001 1110	
293	66	B	42	RD +	D2.2	01 0010 0101	
294	194	Â	C2	RD +	D2.6	01 0010 0110	
297	34	"	22	RD +	D2.1	01 0010 1001	
298	162	¢	A2	RD +	D2.5	01 0010 1010	
299	2	STX	02	RD +	D2.0	01 0010 1011	
300	98	b	62	RD +	D2.3	01 0010 1100	
301	130	‚	82	RD +	D2.4	01 0010 1101	
302	226	â	E2	RD +	D2.7	01 0010 1110	
305	242	ò	F2	RD +	D18.7	01 0011 0001	
306	146	’	92	RD +	D18.4	01 0011 0010	
307	114	r	72	RD +	D18.3	01 0011 0011	
308	18	DC2	12	RD +	D18.0	01 0011 0100	
309	82	R	52	RD+/--	D18.2	01 0011 0101	
310	210	Ò	D2	RD+/--	D18.6	01 0011 0110	
311	242	ò	F2	RD--	D18.7	01 0011 0111	
313	50	2	32	RD+/--	D18.1	01 0011 1001	
314	178	²	B2	RD+/--	D18.5	01 0011 1010	
315	18	DC2	12	RD--	D18.0	01 0011 1011	
316	114	r	72	RD--	D18.3	01 0011 1100	
317	146	’	92	RD--	D18.4	01 0011 1101	
325	95	_	5F	RD +	D31.2	01 0100 0101	
326	223	ß	DF	RD +	D31.6	01 0100 0110	
329	63	?	3F	RD +	D31.1	01 0100 1001	
330	191	¿	BF	RD +	D31.5	01 0100 1010	
331	31	US	1F	RD +	D31.0	01 0100 1011	
332	127	DELETE	7F	RD +	D31.3	01 0100 1100	
333	159	Ÿ	9F	RD +	D31.4	01 0100 1101	
334	255	ÿ	FF	RD +	D31.7	01 0100 1110	

337	234	ê	EA	RD +	D10.7	01 0101 0001
338	138	Š	8A	RD +	D10.4	01 0101 0010
339	106	j	6A	RD +	D10.3	01 0101 0011
340	10	LF	0A	RD +	D10.0	01 0101 0100
341	74	J	4A	RD+/--	D10.2	01 0101 0101
342	202	Ê	CA	RD+/--	D10.6	01 0101 0110
345	42	*	2A	RD+/--	D10.1	01 0101 1001
346	170	ª	AA	RD+/--	D10.5	01 0101 1010
347	10	LF	0A	RD--	D10.0	01 0101 1011
348	106	j	6A	RD--	D10.3	01 0101 1100
349	138	Š	8A	RD--	D10.4	01 0101 1101
350	234	ê	EA	RD--	D10.7	01 0101 1110
353	250	ú	FA	RD +	D26.7	01 0110 0001
354	154	š	9A	RD +	D26.4	01 0110 0010
355	122	z	7A	RD +	D26.3	01 0110 0011
356	26	SUB	1A	RD +	D26.0	01 0110 0100
357	90	Z	5A	RD+/--	D26.2	01 0110 0101
358	218	Ú	DA	RD+/--	D26.6	01 0110 0110
361	58	:	3A	RD+/--	D26.1	01 0110 1001
362	186	º	BA	RD+/--	D26.5	01 0110 1010
363	26	SUB	1A	RD--	D26.0	01 0110 1011
364	122	z	7A	RD--	D26.3	01 0110 1100
365	154	š	9A	RD--	D26.4	01 0110 1101
366	250	ú	FA	RD--	D26.7	01 0110 1110
369	239	ï	EF	RD--	D15.7	01 0111 0001
370	143	_	8F	RD--	D15.4	01 0111 0010
371	111	o	6F	RD--	D15.3	01 0111 0011
372	15	SI	0F	RD--	D15.0	01 0111 0100
373	79	O	4F	RD--	D15.2	01 0111 0101
374	207	Ï	CF	RD--	D15.6	01 0111 0110
377	47	/	2F	RD--	D15.1	01 0111 1001
378	175	¯	AF	RD--	D15.5	01 0111 1010
389	64	@	40	RD +	D0.2	01 1000 0101
390	192	À	C0	RD +	D0.6	01 1000 0110
393	32	SPACE	20	RD +	D0.1	01 1000 1001
394	160		A0	RD +	D0.5	01 1000 1010
395	0	NUL	00	RD +	D0.0	01 1000 1011
396	96	`	60	RD +	D0.3	01 1000 1100
397	128	_	80	RD +	D0.4	01 1000 1101
398	224	à	E0	RD +	D0.7	01 1000 1110
401	230	æ	E6	RD +	D6.7	01 1001 0001
402	134	†	86	RD +	D6.4	01 1001 0010
403	102	f	66	RD +	D6.3	01 1001 0011
404	6	ACK	06	RD +	D6.0	01 1001 0100
405	70	F	46	RD+/--	D6.2	01 1001 0101
406	198	Æ	C6	RD+/--	D6.6	01 1001 0110
409	38	&	26	RD+/--	D6.1	01 1001 1001
410	166	¦	A6	RD+/--	D6.5	01 1001 1010
411	6	ACK	06	RD--	D6.0	01 1001 1011
412	102	f	66	RD--	D6.3	01 1001 1100
413	134	†	86	RD--	D6.4	01 1001 1101
414	230	æ	E6	RD--	D6.7	01 1001 1110
417	246	ö	F6	RD +	D22.7	01 1010 0001
418	150	–	96	RD +	D22.4	01 1010 0010
419	118	v	76	RD +	D22.3	01 1010 0011
420	22	SYN	16	RD +	D22.0	01 1010 0100
421	86	V	56	RD+/--	D22.2	01 1010 0101
422	214	Ö	D6	RD+/--	D22.6	01 1010 0110
425	54	6	36	RD+/--	D22.1	01 1010 1001
426	182	¶	B6	RD+/--	D22.5	01 1010 1010
427	22	SYN	16	RD--	D22.0	01 1010 1011
428	118	v	76	RD--	D22.3	01 1010 1100
429	150	–	96	RD--	D22.4	01 1010 1101
430	246	ö	F6	RD--	D22.7	01 1010 1110
433	240	ð	F0	RD--	D16.7	01 1011 0001
434	144	_	90	RD--	D16.4	01 1011 0010
435	112	p	70	RD--	D16.3	01 1011 0011
436	16	DLE	10	RD--	D16.0	01 1011 0100
437	80	P	50	RD--	D16.2	01 1011 0101
438	208	Ð	D0	RD--	D16.6	01 1011 0110
441	48	0	30	RD--	D16.1	01 1011 1001

442	176	°	B0	RD--	D16.5	01 1011 1010	
450	142	_	8E	RD +	D14.4	01 1100 0010	
451	110	n	6E	RD +	D14.3	01 1100 0011	
452	14	SO	0E	RD +	D14.0	01 1100 0100	
453	78	N	4E	RD+/--	D14.2	01 1100 0101	
454	206	Î	CE	RD+/--	D14.6	01 1100 0110	
456	238	î	EE	RD +	D14.7	01 1100 1000	
457	46	.	2E	RD+/--	D14.1	01 1100 1001	
458	174	®	AE	RD+/--	D14.5	01 1100 1010	
459	14	SO	0E	RD--	D14.0	01 1100 1011	
460	110	n	6E	RD--	D14.3	01 1100 1100	
461	142	_	8E	RD--	D14.4	01 1100 1101	
462	238	î	EE	RD--	D14.7	01 1100 1110	
465	225	á	E1	RD--	D1.7	01 1101 0001	
466	129	_	81	RD--	D1.4	01 1101 0010	
467	97	a	61	RD--	D1.3	01 1101 0011	
468	1	SOH	01	RD--	D1.0	01 1101 0100	
469	65	A	41	RD--	D1.2	01 1101 0101	
470	193	Á	C1	RD--	D1.6	01 1101 0110	
473	33	!	21	RD--	D1.1	01 1101 1001	
474	161	¡	A1	RD--	D1.5	01 1101 1010	
481	254	þ	FE	RD--	D30.7	01 1110 0001	
482	158	_	9E	RD--	D30.4	01 1110 0010	
483	126	~	7E	RD--	D30.3	01 1110 0011	
484	30	RS	1E	RD--	D30.0	01 1110 0100	
485	94	^	5E	RD--	D30.2	01 1110 0101	
486	222	Þ	DE	RD--	D30.6	01 1110 0110	
488	254	þ	FE	RD --	K30.7	01 1110 1000	Reserved*
489	62	>	3E	RD--	D30.1	01 1110 1001	
490	190	¾	BE	RD--	D30.5	01 1110 1010	
533	94	^	5E	RD +	D30.2	10 0001 0101	
534	222	Þ	DE	RD +	D30.6	10 0001 0110	
535	254	þ	FE	RD +	K30.7	10 0001 0111	
537	62	>	3E	RD +	D30.1	10 0001 1001	
538	190	¾	BE	RD +	D30.5	10 0001 1010	
539	30	RS	1E	RD +	D30.0	10 0001 1011	
540	126	~	7E	RD +	D30.3	10 0001 1100	
541	158	_	9E	RD +	D30.4	10 0001 1101	
542	254	þ	FE	RD +	D30.7	10 0001 1110	
549	65	A	41	RD +	D1.2	10 0010 0101	
550	193	Á	C1	RD +	D1.6	10 0010 0110	
553	33	!	21	RD +	D1.1	10 0010 1001	
554	161	¡	A1	RD +	D1.5	10 0010 1010	
555	1	SOH	01	RD +	D1.0	10 0010 1011	
556	97	a	61	RD +	D1.3	10 0010 1100	
557	129	_	81	RD +	D1.4	10 0010 1101	
558	225	á	E1	RD +	D1.7	10 0010 1110	
561	241	ñ	F1	RD +	D17.7	10 0011 0001	
562	145	‘	91	RD +	D17.4	10 0011 0010	
563	113	q	71	RD +	D17.3	10 0011 0011	
564	17	DC1	11	RD +	D17.0	10 0011 0100	
565	81	Q	51	RD+/--	D17.2	10 0011 0101	
566	209	Ñ	D1	RD+/--	D17.6	10 0011 0110	
567	241	ñ	F1	RD--	D17.7	10 0011 0111	
569	49	1	31	RD+/--	D17.1	10 0011 1001	
570	177	±	B1	RD+/--	D17.5	10 0011 1010	
571	17	DC1	11	RD--	D17.0	10 0011 1011	
572	113	q	71	RD--	D17.3	10 0011 1100	
573	145	‘	91	RD--	D17.4	10 0011 1101	
581	80	P	50	RD +	D16.2	10 0100 0101	
582	208	Ð	D0	RD +	D16.6	10 0100 0110	
585	48	0	30	RD +	D16.1	10 0100 1001	
586	176	°	B0	RD +	D16.5	10 0100 1010	
587	16	DLE	10	RD +	D16.0	10 0100 1011	
588	112	p	70	RD +	D16.3	10 0100 1100	
589	144	_	90	RD +	D16.4	10 0100 1101	
590	240	ð	F0	RD +	D16.7	10 0100 1110	
593	233	é	E9	RD +	D9.7	10 0101 0001	
594	137	‰	89	RD +	D9.4	10 0101 0010	
595	105	i	69	RD +	D9.3	10 0101 0011	
596	9	HT	09	RD +	D9.0	10 0101 0100	
597	73	I	49	RD+/--	D9.2	10 0101 0101	
598	201	É	C9	RD+/--	D9.6	10 0101 0110	

601	41	)	29	RD+/--	D9.1	10 0101 1001
602	169	©	A9	RD+/--	D9.5	10 0101 1010
603	9	HT	09	RD--	D9.0	10 0101 1011
604	105	i	69	RD--	D9.3	10 0101 1100
605	137	‰	89	RD--	D9.4	10 0101 1101
606	233	é	E9	RD--	D9.7	10 0101 1110
609	249	ù	F9	RD +	D25.7	10 0110 0001
610	153	™	99	RD +	D25.4	10 0110 0010
611	121	y	79	RD +	D25.3	10 0110 0011
612	25	EM	19	RD +	D25.0	10 0110 0100
613	89	Y	59	RD+/--	D25.2	10 0110 0101
614	217	Ù	D9	RD+/--	D25.6	10 0110 0110
617	57	9	39	RD+/--	D25.1	10 0110 1001
618	185	¹	B9	RD+/--	D25.5	10 0110 1010
619	25	EM	19	RD--	D25.0	10 0110 1011
620	121	y	79	RD--	D25.3	10 0110 1100
621	153	™	99	RD--	D25.4	10 0110 1101
622	249	ù	F9	RD--	D25.7	10 0110 1110
625	224	à	E0	RD--	D0.7	10 0111 0001
626	128	_	80	RD--	D0.4	10 0111 0010
627	96	`	60	RD--	D0.3	10 0111 0011
628	0	NUL	00	RD--	D0.0	10 0111 0100
629	64	@	40	RD--	D0.2	10 0111 0101
630	192	À	C0	RD--	D0.6	10 0111 0110
633	32	SPACE	20	RD--	D0.1	10 0111 1001
634	160		A0	RD--	D0.5	10 0111 1010
645	79	O	4F	RD +	D15.2	10 1000 0101
646	207	Ï	CF	RD +	D15.6	10 1000 0110
649	47	/	2F	RD +	D15.1	10 1000 1001
650	175	¯	AF	RD +	D15.5	10 1000 1010
651	15	SI	0F	RD +	D15.0	10 1000 1011
652	111	o	6F	RD +	D15.3	10 1000 1100
653	143	_	8F	RD +	D15.4	10 1000 1101
654	239	ï	EF	RD +	D15.7	10 1000 1110
657	229	å	E5	RD +	D5.7	10 1001 0001
658	133	…	85	RD +	D5.4	10 1001 0010
659	101	e	65	RD +	D5.3	10 1001 0011
660	5	ENQ	05	RD +	D5.0	10 1001 0100
661	69	E	45	RD+/--	D5.2	10 1001 0101
662	197	Å	C5	RD+/--	D5.6	10 1001 0110
665	37	%	25	RD+/--	D5.1	10 1001 1001
666	165	¥	A5	RD+/--	D5.5	10 1001 1010
667	5	ENQ	05	RD--	D5.0	10 1001 1011
668	101	e	65	RD--	D5.3	10 1001 1100
669	133	…	85	RD--	D5.4	10 1001 1101
670	229	å	E5	RD--	D5.7	10 1001 1110
673	245	õ	F5	RD +	D21.7	10 1010 0001
674	149	•	95	RD +	D21.4	10 1010 0010
675	117	u	75	RD +	D21.3	10 1010 0011
676	21	NAK	15	RD +	D21.0	10 1010 0100
677	85	U	55	RD+/--	D21.2	10 1010 0101
678	213	Õ	D5	RD+/--	D21.6	10 1010 0110
681	53	5	35	RD+/--	D21.1	10 1010 1001
682	181	µ	B5	RD+/--	D21.5	10 1010 1010
683	21	NAK	15	RD--	D21.0	10 1010 1011
684	117	u	75	RD--	D21.3	10 1010 1100
685	149	•	95	RD--	D21.4	10 1010 1101
686	245	õ	F5	RD--	D21.7	10 1010 1110
689	255	ÿ	FF	RD--	D31.7	10 1011 0001
690	159	Ÿ	9F	RD--	D31.4	10 1011 0010
691	127	DELETE	7F	RD--	D31.3	10 1011 0011
692	31	US	1F	RD--	D31.0	10 1011 0100
693	95	_	5F	RD--	D31.2	10 1011 0101
694	223	ß	DF	RD--	D31.6	10 1011 0110
697	63	?	3F	RD--	D31.1	10 1011 1001
698	191	¿	BF	RD--	D31.5	10 1011 1010
706	141	_	8D	RD +	D13.4	10 1100 0010
707	109	m	6D	RD +	D13.3	10 1100 0011
708	13	CR	0D	RD +	D13.0	10 1100 0100
709	77	M	4D	RD+/--	D13.2	10 1100 0101
710	205	Í	CD	RD+/--	D13.6	10 1100 0110
712	237	í	ED	RD +	D13.7	10 1100 1000

713	45	-	2D	RD+/--	D13.1	10 1100 1001	
714	173	-	AD	RD+/--	D13.5	10 1100 1010	
715	13	CR	0D	RD--	D13.0	10 1100 1011	
716	109	m	6D	RD--	D13.3	10 1100 1100	
717	141	_	8D	RD--	D13.4	10 1100 1101	
718	237	í	ED	RD--	D13.7	10 1100 1110	
721	226	â	E2	RD--	D2.7	10 1101 0001	
722	130	‚	82	RD--	D2.4	10 1101 0010	
723	98	b	62	RD--	D2.3	10 1101 0011	
724	2	STX	02	RD--	D2.0	10 1101 0100	
725	66	B	42	RD--	D2.2	10 1101 0101	
726	194	Â	C2	RD--	D2.6	10 1101 0110	
729	34	"	22	RD--	D2.1	10 1101 1001	
730	162	¢	A2	RD--	D2.5	10 1101 1010	
737	253	ý	FD	RD--	D29.7	10 1110 0001	
738	157	_	9D	RD--	D29.4	10 1110 0010	
739	125	}	7D	RD--	D29.3	10 1110 0011	
740	29	GS	1D	RD--	D29.0	10 1110 0100	
741	93	]	5D	RD--	D29.2	10 1110 0101	
742	221	Ý	DD	RD--	D29.6	10 1110 0110	
744	253	ý	FD	RD --	K29.7	10 1110 1000	Reserved*
745	61	=	3D	RD--	D29.1	10 1110 1001	
746	189	½	BD	RD--	D29.5	10 1110 1010	
773	188	¼	BC	RD +	K28.5	11 0000 0101	(Not Used)
774	60	<	3C	RD +	K28.1	11 0000 0110	
775	252	ü	FC	RD +	K28.7	11 0000 0111	
777	220	Ü	DC	RD +	K28.6	11 0000 1001	
778	92	\	5C	RD +	K28.2	11 0000 1010	
779	28	FS	1C	RD +	K28.0	11 0000 1011	
780	124	|	7C	RD +	K28.3	11 0000 1100	
781	156	œ	9C	RD +	K28.4	11 0000 1101	
785	227	ã	E3	RD +	D3.7	11 0001 0001	
786	131	ƒ	83	RD +	D3.4	11 0001 0010	
787	99	c	63	RD +	D3.3	11 0001 0011	
788	3	ETX	03	RD +	D3.0	11 0001 0100	
789	67	C	43	RD+/--	D3.2	11 0001 0101	
790	195	Ã	C3	RD+/--	D3.6	11 0001 0110	
793	35	#	23	RD+/--	D3.1	11 0001 1001	
794	163	£	A3	RD+/--	D3.5	11 0001 1010	
795	3	ETX	03	RD--	D3.0	11 0001 1011	
796	99	c	63	RD--	D3.3	11 0001 1100	
797	131	ƒ	83	RD--	D3.4	11 0001 1101	
798	227	ã	E3	RD--	D3.7	11 0001 1110	
801	243	ó	F3	RD +	D19.7	11 0010 0001	
802	147	“	93	RD +	D19.4	11 0010 0010	
803	115	s	73	RD +	D19.3	11 0010 0011	
804	19	DC3	13	RD +	D19.0	11 0010 0100	
805	83	S	53	RD+/--	D19.2	11 0010 0101	
806	211	Ó	D3	RD+/--	D19.6	11 0010 0110	
809	51	3	33	RD+/--	D19.1	11 0010 1001	
810	179	³	B3	RD+/--	D19.5	11 0010 1010	
811	19	DC3	13	RD--	D19.0	11 0010 1011	
812	115	s	73	RD--	D19.3	11 0010 1100	
813	147	“	93	RD--	D19.4	11 0010 1101	
814	243	ó	F3	RD--	D19.7	11 0010 1110	
817	248	ø	F8	RD--	D24.7	11 0011 0001	
818	152	˜	98	RD--	D24.4	11 0011 0010	
819	120	x	78	RD--	D24.3	11 0011 0011	
820	24	CAN	18	RD--	D24.0	11 0011 0100	
821	88	X	58	RD--	D24.2	11 0011 0101	
822	216	Ø	D8	RD--	D24.6	11 0011 0110	
825	56	8	38	RD--	D24.1	11 0011 1001	
826	184	¸	B8	RD--	D24.5	11 0011 1010	
834	139	‹	8B	RD +	D11.4	11 0100 0010	
835	107	k	6B	RD +	D11.3	11 0100 0011	
836	11	VT	0B	RD +	D11.0	11 0100 0100	
837	75	K	4B	RD+/--	D11.2	11 0100 0101	
838	203	Ë	CB	RD+/--	D11.6	11 0100 0110	
840	235	ë	EB	RD +	D11.7	11 0100 1000	
841	43	+	2B	RD+/--	D11.1	11 0100 1001	
842	171	«	AB	RD+/--	D11.5	11 0100 1010	
843	11	VT	0B	RD--	D11.0	11 0100 1011	

844	107	k	6B	RD--	D11.3	11 0100 1100	
845	139	‹	8B	RD--	D11.4	11 0100 1101	
846	235	ë	EB	RD--	D11.7	11 0100 1110	
849	228	ä	E4	RD--	D4.7	11 0101 0001	
850	132	„	84	RD--	D4.4	11 0101 0010	
851	100	d	64	RD--	D4.3	11 0101 0011	
852	4	EOT	04	RD--	D4.0	11 0101 0100	
853	68	D	44	RD--	D4.2	11 0101 0101	
854	196	Ä	C4	RD--	D4.6	11 0101 0110	
857	36	$	24	RD--	D4.1	11 0101 1001	
858	164	¤	A4	RD--	D4.5	11 0101 1010	
865	251	û	FB	RD--	D27.7	11 0110 0001	
866	155	›	9B	RD--	D27.4	11 0110 0010	
867	123	{	7B	RD--	D27.3	11 0110 0011	
868	27	ESC	1B	RD--	D27.0	11 0110 0100	
869	91	[	5B	RD--	D27.2	11 0110 0101	
870	219	Û	DB	RD--	D27.6	11 0110 0110	
872	251	û	FB	RD --	K27.7	11 0110 1000	Reserved*
873	59	;	3B	RD--	D27.1	11 0110 1001	
874	187	»	BB	RD--	D27.5	11 0110 1010	
901	71	G	47	RD--	D7.2	11 1000 0101	
902	199	Ç	C7	RD--	D7.6	11 1000 0110	
905	39	'	27	RD--	D7.1	11 1000 1001	
906	167	§	A7	RD--	D7.5	11 1000 1010	
907	7	BEL	07	RD--	D7.0	11 1000 1011	
908	103	g	67	RD--	D7.3	11 1000 1100	
909	135	‡	87	RD--	D7.4	11 1000 1101	
910	231	ç	E7	RD--	D7.7	11 1000 1110	
913	232	è	E8	RD--	D8.7	11 1001 0001	
914	136	ˆ	88	RD--	D8.4	11 1001 0010	
915	104	h	68	RD--	D8.3	11 1001 0011	
916	8	BS	08	RD--	D8.0	11 1001 0100	
917	72	H	48	RD--	D8.2	11 1001 0101	
918	200	È	C8	RD--	D8.6	11 1001 0110	
921	40	(	28	RD--	D8.1	11 1001 1001	
922	168	¨	A8	RD--	D8.5	11 1001 1010	
929	247	÷	F7	RD--	D23.7	11 1010 0001	
930	151	—	97	RD--	D23.4	11 1010 0010	
931	119	w	77	RD--	D23.3	11 1010 0011	
932	23	ETB	17	RD--	D23.0	11 1010 0100	
933	87	W	57	RD--	D23.2	11 1010 0101	
934	215	×	D7	RD--	D23.6	11 1010 0110	
936	247	÷	F7	RD --	K23.7	11 1010 1000	Reserved*
937	55	7	37	RD--	D23.1	11 1010 1001	
938	183	·	B7	RD--	D23.5	11 1010 1010	

The following table lists:

10-Bit Values with No 8-bit Mapping Sorted by 10-Bit Value

10B Dec	10 B	COMMENT
0	00 0000 0000	ILLEGAL
1	00 0000 0001	ILLEGAL
2	00 0000 0010	ILLEGAL
3	00 0000 0011	ILLEGAL
4	00 0000 0100	ILLEGAL
5	00 0000 0101	ILLEGAL
6	00 0000 0110	ILLEGAL
7	00 0000 0111	ILLEGAL
8	00 0000 1000	ILLEGAL
9	00 0000 1001	ILLEGAL
10	00 0000 1010	ILLEGAL
11	00 0000 1011	ILLEGAL
12	00 0000 1100	ILLEGAL
13	00 0000 1101	ILLEGAL
14	00 0000 1110	ILLEGAL
15	00 0000 1111	ILLEGAL
16	00 0001 0000	ILLEGAL
17	00 0001 0001	ILLEGAL
18	00 0001 0010	ILLEGAL
19	00 0001 0011	ILLEGAL
20	00 0001 0100	ILLEGAL
21	00 0001 0101	ILLEGAL
22	00 0001 0110	ILLEGAL
23	00 0001 0111	ILLEGAL
24	00 0001 1000	ILLEGAL
25	00 0001 1001	ILLEGAL
26	00 0001 1010	ILLEGAL
27	00 0001 1011	ILLEGAL
28	00 0001 1100	ILLEGAL
29	00 0001 1101	ILLEGAL
30	00 0001 1110	ILLEGAL
31	00 0001 1111	ILLEGAL
32	00 0010 0000	ILLEGAL
33	00 0010 0001	ILLEGAL
34	00 0010 0010	ILLEGAL
35	00 0010 0011	ILLEGAL
36	00 0010 0100	ILLEGAL
37	00 0010 0101	ILLEGAL
38	00 0010 0110	ILLEGAL
39	00 0010 0111	ILLEGAL
40	00 0010 1000	ILLEGAL
41	00 0010 1001	ILLEGAL
42	00 0010 1010	ILLEGAL
43	00 0010 1011	ILLEGAL
44	00 0010 1100	ILLEGAL
45	00 0010 1101	ILLEGAL
46	00 0010 1110	ILLEGAL
47	00 0010 1111	ILLEGAL
48	00 0011 0000	ILLEGAL
49	00 0011 0001	ILLEGAL
50	00 0011 0010	ILLEGAL
51	00 0011 0011	ILLEGAL
52	00 0011 0100	ILLEGAL
53	00 0011 0101	ILLEGAL
54	00 0011 0110	ILLEGAL
55	00 0011 0111	ILLEGAL
56	00 0011 1000	ILLEGAL
57	00 0011 1001	ILLEGAL
58	00 0011 1010	ILLEGAL
59	00 0011 1011	ILLEGAL
60	00 0011 1100	ILLEGAL
61	00 0011 1101	ILLEGAL
62	00 0011 1110	ILLEGAL
63	00 0011 1111	ILLEGAL
64	00 0100 0000	ILLEGAL
65	00 0100 0001	ILLEGAL
66	00 0100 0010	ILLEGAL
67	00 0100 0011	ILLEGAL
68	00 0100 0100	ILLEGAL
69	00 0100 0101	ILLEGAL
70	00 0100 0110	ILLEGAL
71	00 0100 0111	ILLEGAL
72	00 0100 1000	ILLEGAL
73	00 0100 1001	ILLEGAL
74	00 0100 1010	ILLEGAL
75	00 0100 1011	ILLEGAL
76	00 0100 1100	ILLEGAL
77	00 0100 1101	ILLEGAL
78	00 0100 1110	ILLEGAL
79	00 0100 1111	ILLEGAL
80	00 0101 0000	ILLEGAL
81	00 0101 0001	ILLEGAL
82	00 0101 0010	ILLEGAL
83	00 0101 0011	ILLEGAL
84	00 0101 0100	ILLEGAL
88	00 0101 1000	ILLEGAL
95	00 0101 1111	ILLEGAL
96	00 0110 0000	ILLEGAL
97	00 0110 0001	ILLEGAL
98	00 0110 0010	ILLEGAL
99	00 0110 0011	ILLEGAL
100	00 0110 0100	ILLEGAL
103	00 0110 0111	ILLEGAL
104	00 0110 1000	ILLEGAL
111	00 0110 1111	ILLEGAL
112	00 0111 0000	ILLEGAL
119	00 0111 0111	ILLEGAL
120	00 0111 1000	ILLEGAL
123	00 0111 1011	ILLEGAL
124	00 0111 1100	ILLEGAL
125	00 0111 1101	ILLEGAL
126	00 0111 1110	ILLEGAL
127	00 0111 1111	ILLEGAL
128	00 1000 0000	ILLEGAL
129	00 1000 0001	ILLEGAL
130	00 1000 0010	ILLEGAL
131	00 1000 0011	ILLEGAL
132	00 1000 0100	ILLEGAL
133	00 1000 0101	ILLEGAL
134	00 1000 0110	ILLEGAL
135	00 1000 0111	ILLEGAL
136	00 1000 1000	ILLEGAL
137	00 1000 1001	ILLEGAL
138	00 1000 1010	ILLEGAL
139	00 1000 1011	ILLEGAL
140	00 1000 1100	ILLEGAL
141	00 1000 1101	ILLEGAL

142	00 1000 1110	ILLEGAL
143	00 1000 1111	ILLEGAL
144	00 1001 0000	ILLEGAL
145	00 1001 0001	ILLEGAL
146	00 1001 0010	ILLEGAL
147	00 1001 0011	ILLEGAL
148	00 1001 0100	ILLEGAL
152	00 1001 1000	ILLEGAL
159	00 1001 1111	ILLEGAL
160	00 1010 0000	ILLEGAL
161	00 1010 0001	ILLEGAL
162	00 1010 0010	ILLEGAL
163	00 1010 0011	ILLEGAL
164	00 1010 0100	ILLEGAL
167	00 1010 0111	ILLEGAL
168	00 1010 1000	ILLEGAL
175	00 1010 1111	ILLEGAL
176	00 1011 0000	ILLEGAL
184	00 1011 1000	ILLEGAL
190	00 1011 1110	ILLEGAL
191	00 1011 1111	ILLEGAL
192	00 1100 0000	ILLEGAL
193	00 1100 0001	ILLEGAL
194	00 1100 0010	ILLEGAL
195	00 1100 0011	ILLEGAL
196	00 1100 0100	ILLEGAL
199	00 1100 0111	ILLEGAL
200	00 1100 1000	ILLEGAL
207	00 1100 1111	ILLEGAL
208	00 1101 0000	ILLEGAL
215	00 1101 0111	ILLEGAL
216	00 1101 1000	ILLEGAL
223	00 1101 1111	ILLEGAL
224	00 1110 0000	ILLEGAL
231	00 1110 0111	ILLEGAL
232	00 1110 1000	ILLEGAL
239	00 1110 1111	ILLEGAL
240	00 1111 0000	ILLEGAL
241	00 1111 0001	ILLEGAL
247	00 1111 0111	ILLEGAL
251	00 1111 1011	ILLEGAL
252	00 1111 1100	ILLEGAL
253	00 1111 1101	ILLEGAL
254	00 1111 1110	ILLEGAL
255	00 1111 1111	ILLEGAL
256	01 0000 0000	ILLEGAL
257	01 0000 0001	ILLEGAL
258	01 0000 0010	ILLEGAL
259	01 0000 0011	ILLEGAL
260	01 0000 0100	ILLEGAL
261	01 0000 0101	ILLEGAL
262	01 0000 0110	ILLEGAL
263	01 0000 0111	ILLEGAL
264	01 0000 1000	ILLEGAL
265	01 0000 1001	ILLEGAL
266	01 0000 1010	ILLEGAL
267	01 0000 1011	ILLEGAL
268	01 0000 1100	ILLEGAL
269	01 0000 1101	ILLEGAL
270	01 0000 1110	ILLEGAL
271	01 0000 1111	ILLEGAL
272	01 0001 0000	ILLEGAL
273	01 0001 0001	ILLEGAL
274	01 0001 0010	ILLEGAL
275	01 0001 0011	ILLEGAL
276	01 0001 0100	ILLEGAL
280	01 0001 1000	ILLEGAL
287	01 0001 1111	ILLEGAL
288	01 0010 0000	ILLEGAL
289	01 0010 0001	ILLEGAL
290	01 0010 0010	ILLEGAL
291	01 0010 0011	ILLEGAL
292	01 0010 0100	ILLEGAL
295	01 0010 0111	ILLEGAL
296	01 0010 1000	ILLEGAL
303	01 0010 1111	ILLEGAL
304	01 0011 0000	ILLEGAL
312	01 0011 1000	ILLEGAL
318	01 0011 1110	ILLEGAL
319	01 0011 1111	ILLEGAL
320	01 0100 0000	ILLEGAL
321	01 0100 0001	ILLEGAL
322	01 0100 0010	ILLEGAL
323	01 0100 0011	ILLEGAL
324	01 0100 0100	ILLEGAL
327	01 0100 0111	ILLEGAL
328	01 0100 1000	ILLEGAL
335	01 0100 1111	ILLEGAL
336	01 0101 0000	ILLEGAL
343	01 0101 0111	ILLEGAL
344	01 0101 1000	ILLEGAL
351	01 0101 1111	ILLEGAL
352	01 0110 0000	ILLEGAL
359	01 0110 0111	ILLEGAL
360	01 0110 1000	ILLEGAL
367	01 0110 1111	ILLEGAL
368	01 0111 0000	ILLEGAL
375	01 0111 0111	ILLEGAL
376	01 0111 1000	ILLEGAL
379	01 0111 1011	ILLEGAL
380	01 0111 1100	ILLEGAL
381	01 0111 1101	ILLEGAL
382	01 0111 1110	ILLEGAL
383	01 0111 1111	ILLEGAL
384	01 1000 0000	ILLEGAL
385	01 1000 0001	ILLEGAL
386	01 1000 0010	ILLEGAL
387	01 1000 0011	ILLEGAL
388	01 1000 0100	ILLEGAL
391	01 1000 0111	ILLEGAL
392	01 1000 1000	ILLEGAL
399	01 1000 1111	ILLEGAL
400	01 1001 0000	ILLEGAL
407	01 1001 0111	ILLEGAL
408	01 1001 1000	ILLEGAL
415	01 1001 1111	ILLEGAL
416	01 1010 0000	ILLEGAL
423	01 1010 0111	ILLEGAL
424	01 1010 1000	ILLEGAL
431	01 1010 1111	ILLEGAL
432	01 1011 0000	ILLEGAL
439	01 1011 0111	ILLEGAL
440	01 1011 1000	ILLEGAL
443	01 1011 1011	ILLEGAL
444	01 1011 1100	ILLEGAL
445	01 1011 1101	ILLEGAL
446	01 1011 1110	ILLEGAL
447	01 1011 1111	ILLEGAL
448	01 1100 0000	ILLEGAL
449	01 1100 0001	ILLEGAL

455	01 1100 0111	ILLEGAL
463	01 1100 1111	ILLEGAL
464	01 1101 0000	ILLEGAL
471	01 1101 0111	ILLEGAL
472	01 1101 1000	ILLEGAL
475	01 1101 1011	ILLEGAL
476	01 1101 1100	ILLEGAL
477	01 1101 1101	ILLEGAL
478	01 1101 1110	ILLEGAL
479	01 1101 1111	ILLEGAL
480	01 1110 0000	ILLEGAL
487	01 1110 0111	ILLEGAL
491	01 1110 1011	ILLEGAL
492	01 1110 1100	ILLEGAL
493	01 1110 1101	ILLEGAL
494	01 1110 1110	ILLEGAL
495	01 1110 1111	ILLEGAL
496	01 1111 0000	ILLEGAL
497	01 1111 0001	ILLEGAL
498	01 1111 0010	ILLEGAL
499	01 1111 0011	ILLEGAL
500	01 1111 0100	ILLEGAL
501	01 1111 0101	ILLEGAL
502	01 1111 0110	ILLEGAL
503	01 1111 0111	ILLEGAL
504	01 1111 1000	ILLEGAL
505	01 1111 1001	ILLEGAL
506	01 1111 1010	ILLEGAL
507	01 1111 1011	ILLEGAL
508	01 1111 1100	ILLEGAL
509	01 1111 1101	ILLEGAL
510	01 1111 1110	ILLEGAL
511	01 1111 1111	ILLEGAL
512	10 0000 0000	ILLEGAL
513	10 0000 0001	ILLEGAL
514	10 0000 0010	ILLEGAL
515	10 0000 0011	ILLEGAL
516	10 0000 0100	ILLEGAL
517	10 0000 0101	ILLEGAL
518	10 0000 0110	ILLEGAL
519	10 0000 0111	ILLEGAL
520	10 0000 1000	ILLEGAL
521	10 0000 1001	ILLEGAL
522	10 0000 1010	ILLEGAL
523	10 0000 1011	ILLEGAL
524	10 0000 1100	ILLEGAL
525	10 0000 1101	ILLEGAL
526	10 0000 1110	ILLEGAL
527	10 0000 1111	ILLEGAL
528	10 0001 0000	ILLEGAL
529	10 0001 0001	ILLEGAL
530	10 0001 0010	ILLEGAL
531	10 0001 0011	ILLEGAL
532	10 0001 0100	ILLEGAL
536	10 0001 1000	ILLEGAL
543	10 0001 1111	ILLEGAL
544	10 0010 0000	ILLEGAL
545	10 0010 0001	ILLEGAL
546	10 0010 0010	ILLEGAL
547	10 0010 0011	ILLEGAL
548	10 0010 0100	ILLEGAL
551	10 0010 0111	ILLEGAL
552	10 0010 1000	ILLEGAL
559	10 0010 1111	ILLEGAL
560	10 0011 0000	ILLEGAL
568	10 0011 1000	ILLEGAL
574	10 0011 1110	ILLEGAL
575	10 0011 1111	ILLEGAL
576	10 0100 0000	ILLEGAL
577	10 0100 0001	ILLEGAL
578	10 0100 0010	ILLEGAL
579	10 0100 0011	ILLEGAL
580	10 0100 0100	ILLEGAL
583	10 0100 0111	ILLEGAL
584	10 0100 1000	ILLEGAL
591	10 0100 1111	ILLEGAL
592	10 0101 0000	ILLEGAL
599	10 0101 0111	ILLEGAL
600	10 0101 1000	ILLEGAL
607	10 0101 1111	ILLEGAL
608	10 0110 0000	ILLEGAL
615	10 0110 0111	ILLEGAL
616	10 0110 1000	ILLEGAL
623	10 0110 1111	ILLEGAL
624	10 0111 0000	ILLEGAL
631	10 0111 0111	ILLEGAL
632	10 0111 1000	ILLEGAL
635	10 0111 1011	ILLEGAL
636	10 0111 1100	ILLEGAL
637	10 0111 1101	ILLEGAL
638	10 0111 1110	ILLEGAL
639	10 0111 1111	ILLEGAL
640	10 1000 0000	ILLEGAL
641	10 1000 0001	ILLEGAL
642	10 1000 0010	ILLEGAL
643	10 1000 0011	ILLEGAL
644	10 1000 0100	ILLEGAL
647	10 1000 0111	ILLEGAL
648	10 1000 1000	ILLEGAL
655	10 1000 1111	ILLEGAL
656	10 1001 0000	ILLEGAL
663	10 1001 0111	ILLEGAL
664	10 1001 1000	ILLEGAL
671	10 1001 1111	ILLEGAL
672	10 1010 0000	ILLEGAL
679	10 1010 0111	ILLEGAL
680	10 1010 1000	ILLEGAL
687	10 1010 1111	ILLEGAL
688	10 1011 0000	ILLEGAL
695	10 1011 0111	ILLEGAL
696	10 1011 1000	ILLEGAL
699	10 1011 1011	ILLEGAL
700	10 1011 1100	ILLEGAL
701	10 1011 1101	ILLEGAL
702	10 1011 1110	ILLEGAL
703	10 1011 1111	ILLEGAL
704	10 1100 0000	ILLEGAL
705	10 1100 0001	ILLEGAL
711	10 1100 0111	ILLEGAL
719	10 1100 1111	ILLEGAL
720	10 1101 0000	ILLEGAL
727	10 1101 0111	ILLEGAL
728	10 1101 1000	ILLEGAL
731	10 1101 1011	ILLEGAL
732	10 1101 1100	ILLEGAL
733	10 1101 1101	ILLEGAL
734	10 1101 1110	ILLEGAL
735	10 1101 1111	ILLEGAL
736	10 1110 0000	ILLEGAL
743	10 1110 0111	ILLEGAL

747	10 1110 1011	ILLEGAL
748	10 1110 1100	ILLEGAL
749	10 1110 1101	ILLEGAL
750	10 1110 1110	ILLEGAL
751	10 1110 1111	ILLEGAL
752	10 1111 0000	ILLEGAL
753	10 1111 0001	ILLEGAL
754	10 1111 0010	ILLEGAL
755	10 1111 0011	ILLEGAL
756	10 1111 0100	ILLEGAL
757	10 1111 0101	ILLEGAL
758	10 1111 0110	ILLEGAL
759	10 1111 0111	ILLEGAL
760	10 1111 1000	ILLEGAL
761	10 1111 1001	ILLEGAL
762	10 1111 1010	ILLEGAL
763	10 1111 1011	ILLEGAL
764	10 1111 1100	ILLEGAL
765	10 1111 1101	ILLEGAL
766	10 1111 1110	ILLEGAL
767	10 1111 1111	ILLEGAL
768	11 0000 0000	ILLEGAL
769	11 0000 0001	ILLEGAL
770	11 0000 0010	ILLEGAL
771	11 0000 0011	ILLEGAL
772	11 0000 0100	ILLEGAL
776	11 0000 1000	ILLEGAL
782	11 0000 1110	ILLEGAL
783	11 0000 1111	ILLEGAL
784	11 0001 0000	ILLEGAL
791	11 0001 0111	ILLEGAL
792	11 0001 1000	ILLEGAL
799	11 0001 1111	ILLEGAL
800	11 0010 0000	ILLEGAL
807	11 0010 0111	ILLEGAL
808	11 0010 1000	ILLEGAL
815	11 0010 1111	ILLEGAL
816	11 0011 0000	ILLEGAL
823	11 0011 0111	ILLEGAL
824	11 0011 1000	ILLEGAL
827	11 0011 1011	ILLEGAL
828	11 0011 1100	ILLEGAL
829	11 0011 1101	ILLEGAL
830	11 0011 1110	ILLEGAL
831	11 0011 1111	ILLEGAL
832	11 0100 0000	ILLEGAL
833	11 0100 0001	ILLEGAL
839	11 0100 0111	ILLEGAL
847	11 0100 1111	ILLEGAL
848	11 0101 0000	ILLEGAL
855	11 0101 0111	ILLEGAL
856	11 0101 1000	ILLEGAL
859	11 0101 1011	ILLEGAL
860	11 0101 1100	ILLEGAL
861	11 0101 1101	ILLEGAL
862	11 0101 1110	ILLEGAL
863	11 0101 1111	ILLEGAL
864	11 0110 0000	ILLEGAL
871	11 0110 0111	ILLEGAL
875	11 0110 1011	ILLEGAL
876	11 0110 1100	ILLEGAL
877	11 0110 1101	ILLEGAL
878	11 0110 1110	ILLEGAL
879	11 0110 1111	ILLEGAL
880	11 0111 0000	ILLEGAL
881	11 0111 0001	ILLEGAL
882	11 0111 0010	ILLEGAL
883	11 0111 0011	ILLEGAL
884	11 0111 0100	ILLEGAL
885	11 0111 0101	ILLEGAL
886	11 0111 0110	ILLEGAL
887	11 0111 0111	ILLEGAL
888	11 0111 1000	ILLEGAL
889	11 0111 1001	ILLEGAL
890	11 0111 1010	ILLEGAL
891	11 0111 1011	ILLEGAL
892	11 0111 1100	ILLEGAL
893	11 0111 1101	ILLEGAL
894	11 0111 1110	ILLEGAL
895	11 0111 1111	ILLEGAL
896	11 1000 0000	ILLEGAL
897	11 1000 0001	ILLEGAL
898	11 1000 0010	ILLEGAL
899	11 1000 0011	ILLEGAL
900	11 1000 0100	ILLEGAL
903	11 1000 0111	ILLEGAL
904	11 1000 1000	ILLEGAL
911	11 1000 1111	ILLEGAL
912	11 1001 0000	ILLEGAL
919	11 1001 0111	ILLEGAL
920	11 1001 1000	ILLEGAL
923	11 1001 1011	ILLEGAL
924	11 1001 1100	ILLEGAL
925	11 1001 1101	ILLEGAL
926	11 1001 1110	ILLEGAL
927	11 1001 1111	ILLEGAL
928	11 1010 0000	ILLEGAL
935	11 1010 0111	ILLEGAL
939	11 1010 1011	ILLEGAL
940	11 1010 1100	ILLEGAL
941	11 1010 1101	ILLEGAL
942	11 1010 1110	ILLEGAL
943	11 1010 1111	ILLEGAL
944	11 1011 0000	ILLEGAL
945	11 1011 0001	ILLEGAL
946	11 1011 0010	ILLEGAL
947	11 1011 0011	ILLEGAL
948	11 1011 0100	ILLEGAL
949	11 1011 0101	ILLEGAL
950	11 1011 0110	ILLEGAL
951	11 1011 0111	ILLEGAL
952	11 1011 1000	ILLEGAL
953	11 1011 1001	ILLEGAL
954	11 1011 1010	ILLEGAL
955	11 1011 1011	ILLEGAL
956	11 1011 1100	ILLEGAL
957	11 1011 1101	ILLEGAL
958	11 1011 1110	ILLEGAL
959	11 1011 1111	ILLEGAL
960	11 1100 0000	ILLEGAL
961	11 1100 0001	ILLEGAL
962	11 1100 0010	ILLEGAL
963	11 1100 0011	ILLEGAL
964	11 1100 0100	ILLEGAL
965	11 1100 0101	ILLEGAL
966	11 1100 0110	ILLEGAL
967	11 1100 0111	ILLEGAL
968	11 1100 1000	ILLEGAL
969	11 1100 1001	ILLEGAL
970	11 1100 1010	ILLEGAL

971	11 1100 1011	ILLEGAL
972	11 1100 1100	ILLEGAL
973	11 1100 1101	ILLEGAL
974	11 1100 1110	ILLEGAL
975	11 1100 1111	ILLEGAL
976	11 1101 0000	ILLEGAL
977	11 1101 0001	ILLEGAL
978	11 1101 0010	ILLEGAL
979	11 1101 0011	ILLEGAL
980	11 1101 0100	ILLEGAL
981	11 1101 0101	ILLEGAL
982	11 1101 0110	ILLEGAL
983	11 1101 0111	ILLEGAL
984	11 1101 1000	ILLEGAL
985	11 1101 1001	ILLEGAL
986	11 1101 1010	ILLEGAL
987	11 1101 1011	ILLEGAL
988	11 1101 1100	ILLEGAL
989	11 1101 1101	ILLEGAL
990	11 1101 1110	ILLEGAL
991	11 1101 1111	ILLEGAL
992	11 1110 0000	ILLEGAL
993	11 1110 0001	ILLEGAL
994	11 1110 0010	ILLEGAL
995	11 1110 0011	ILLEGAL
996	11 1110 0100	ILLEGAL
997	11 1110 0101	ILLEGAL
998	11 1110 0110	ILLEGAL
999	11 1110 0111	ILLEGAL
1000	11 1110 1000	ILLEGAL
1001	11 1110 1001	ILLEGAL
1002	11 1110 1010	ILLEGAL
1003	11 1110 1011	ILLEGAL
1004	11 1110 1100	ILLEGAL
1005	11 1110 1101	ILLEGAL
1006	11 1110 1110	ILLEGAL
1007	11 1110 1111	ILLEGAL
1008	11 1111 0000	ILLEGAL
1009	11 1111 0001	ILLEGAL
1010	11 1111 0010	ILLEGAL
1011	11 1111 0011	ILLEGAL
1012	11 1111 0100	ILLEGAL
1013	11 1111 0101	ILLEGAL
1014	11 1111 0110	ILLEGAL
1015	11 1111 0111	ILLEGAL
1016	11 1111 1000	ILLEGAL
1017	11 1111 1001	ILLEGAL
1018	11 1111 1010	ILLEGAL
1019	11 1111 1011	ILLEGAL
1020	11 1111 1100	ILLEGAL
1021	11 1111 1101	ILLEGAL
1022	11 1111 1110	ILLEGAL
1023	11 1111 1111	ILLEGAL

The following table lists:

Legal 10-Bit Values Sorted by 8-Bit Hex Code

10B Dec	8B Dec	ASCII+	HEX	Previous Disparity	Data Byte Name	FC	10 B	COMMENT
395	0	NUL	00	RD +	D0.0		01 1000 1011	
628	0	NUL	00	RD--	D0.0		10 0111 0100	
468	1	SOH	01	RD--	D1.0		01 1101 0100	
555	1	SOH	01	RD +	D1.0		10 0010 1011	
299	2	STX	02	RD +	D2.0		01 0010 1011	
724	2	STX	02	RD--	D2.0		10 1101 0100	
788	3	ETX	03	RD +	D3.0		11 0001 0100	
795	3	ETX	03	RD--	D3.0		11 0001 1011	
171	4	EOT	04	RD +	D4.0		00 1010 1011	
852	4	EOT	04	RD--	D4.0		11 0101 0100	
660	5	ENQ	05	RD +	D5.0		10 1001 0100	
667	5	ENQ	05	RD--	D5.0		10 1001 1011	
404	6	ACK	06	RD +	D6.0		01 1001 0100	
411	6	ACK	06	RD--	D6.0		01 1001 1011	
116	7	BEL	07	RD +	D7.0		00 0111 0100	
907	7	BEL	07	RD--	D7.0		11 1000 1011	
107	8	BS	08	RD +	D8.0		00 0110 1011	
916	8	BS	08	RD--	D8.0		11 1001 0100	
596	9	HT	09	RD +	D9.0		10 0101 0100	
603	9	HT	09	RD--	D9.0		10 0101 1011	
436	16	DLE	10	RD--	D16.0		01 1011 0100	
587	16	DLE	10	RD +	D16.0		10 0100 1011	
564	17	DC1	11	RD +	D17.0		10 0011 0100	
571	17	DC1	11	RD--	D17.0		10 0011 1011	
308	18	DC2	12	RD +	D18.0		01 0011 0100	
315	18	DC2	12	RD--	D18.0		01 0011 1011	
804	19	DC3	13	RD +	D19.0		11 0010 0100	
811	19	DC3	13	RD--	D19.0		11 0010 1011	
180	20	DC4	14	RD +	D20.0		00 1011 0100	
187	20	DC4	14	RD--	D20.0		00 1011 1011	
676	21	NAK	15	RD +	D21.0		10 1010 0100	
683	21	NAK	15	RD--	D21.0		10 1010 1011	
420	22	SYN	16	RD +	D22.0		01 1010 0100	
427	22	SYN	16	RD--	D22.0		01 1010 1011	
91	23	ETB	17	RD +	D23.0		00 0101 1011	
932	23	ETB	17	RD--	D23.0		11 1010 0100	
203	24	CAN	18	RD +	D24.0		00 1100 1011	
820	24	CAN	18	RD--	D24.0		11 0011 0100	
612	25	EM	19	RD +	D25.0		10 0110 0100	
619	25	EM	19	RD--	D25.0		10 0110 1011	
393	32	SPACE	20	RD +	D0.1		01 1000 1001	
633	32	SPACE	20	RD--	D0.1		10 0111 1001	
473	33	!	21	RD--	D1.1		01 1101 1001	
553	33	!	21	RD +	D1.1		10 0010 1001	
297	34	"	22	RD +	D2.1		01 0010 1001	
729	34	"	22	RD--	D2.1		10 1101 1001	
793	35	#	23	RD+/--	D3.1		11 0001 1001	
169	36	$	24	RD +	D4.1		00 1010 1001	
857	36	$	24	RD--	D4.1		11 0101 1001	
665	37	%	25	RD+/--	D5.1		10 1001 1001	
409	38	&	26	RD+/--	D6.1		01 1001 1001	
121	39	'	27	RD +	D7.1		00 0111 1001	
905	39	'	27	RD--	D7.1		11 1000 1001	
105	40	(	28	RD +	D8.1		00 0110 1001	
921	40	(	28	RD--	D8.1		11 1001 1001	
601	41	)	29	RD+/--	D9.1		10 0101 1001	
441	48	0	30	RD--	D16.1		01 1011 1001	
585	48	0	30	RD +	D16.1		10 0100 1001	
569	49	1	31	RD+/--	D17.1		10 0011 1001	
313	50	2	32	RD+/--	D18.1		01 0011 1001	
809	51	3	33	RD+/--	D19.1		11 0010 1001	
185	52	4	34	RD+/--	D20.1		00 1011 1001	
681	53	5	35	RD+/--	D21.1		10 1010 1001	
425	54	6	36	RD+/--	D22.1		01 1010 1001	
89	55	7	37	RD +	D23.1		00 0101 1001	
937	55	7	37	RD--	D23.1		11 1010 1001	
201	56	8	38	RD +	D24.1		00 1100 1001	
825	56	8	38	RD--	D24.1		11 0011 1001	
617	57	9	39	RD+/--	D25.1		10 0110 1001	
389	64	@	40	RD +	D0.2		01 1000 0101	
629	64	@	40	RD--	D0.2		10 0111 0101	
469	65	A	41	RD--	D1.2		01 1101 0101	
549	65	A	41	RD +	D1.2		10 0010 0101	
293	66	B	42	RD +	D2.2		01 0010 0101	
725	66	B	42	RD--	D2.2		10 1101 0101	
789	67	C	43	RD+/--	D3.2		11 0001 0101	
165	68	D	44	RD +	D4.2		00 1010 0101	
853	68	D	44	RD--	D4.2		11 0101 0101	
661	69	E	45	RD+/--	D5.2		10 1001 0101	
405	70	F	46	RD+/--	D6.2		01 1001 0101	
117	71	G	47	RD +	D7.2		00 0111 0101	
901	71	G	47	RD--	D7.2		11 1000 0101	
101	72	H	48	RD +	D8.2		00 0110 0101	
917	72	H	48	RD--	D8.2		11 1001 0101	
597	73	I	49	RD+/--	D9.2		10 0101 0101	
437	80	P	50	RD--	D16.2		01 1011 0101	
581	80	P	50	RD +	D16.2		10 0100 0101	
565	81	Q	51	RD+/--	D17.2		10 0011 0101	
309	82	R	52	RD+/--	D18.2		01 0011 0101	
805	83	S	53	RD+/--	D19.2		11 0010 0101	
181	84	T	54	RD+/--	D20.2		00 1011 0101	
677	85	U	55	RD+/--	D21.2		10 1010 0101	
421	86	V	56	RD+/--	D22.2		01 1010 0101	
85	87	W	57	RD +	D23.2		00 0101 0101	
933	87	W	57	RD--	D23.2		11 1010 0101	
197	88	X	58	RD +	D24.2		00 1100 0101	
821	88	X	58	RD--	D24.2		11 0011 0101	
613	89	Y	59	RD+/--	D25.2		10 0110 0101	
396	96	`	60	RD +	D0.3		01 1000 1100	
627	96	`	60	RD--	D0.3		10 0111 0011	
467	97	a	61	RD--	D1.3		01 1101 0011	
556	97	a	61	RD +	D1.3		10 0010 1100	
300	98	b	62	RD +	D2.3		01 0010 1100	
723	98	b	62	RD--	D2.3		10 1101 0011	
787	99	c	63	RD +	D3.3		11 0001 0011	
796	99	c	63	RD--	D3.3		11 0001 1100	
172	100	d	64	RD +	D4.3		00 1010 1100	
851	100	d	64	RD--	D4.3		11 0101 0011	

659	101	e	65	RD +	D5.3	10 1001 0011	
668	101	e	65	RD--	D5.3	10 1001 1100	
403	102	f	66	RD +	D6.3	01 1001 0011	
412	102	f	66	RD--	D6.3	01 1001 1100	
115	103	g	67	RD +	D7.3	00 0111 0011	
908	103	g	67	RD--	D7.3	11 1000 1100	
108	104	h	68	RD +	D8.3	00 0110 1100	
915	104	h	68	RD--	D8.3	11 1001 0011	
595	105	i	69	RD +	D9.3	10 0101 0011	
604	105	i	69	RD--	D9.3	10 0101 1100	
435	112	p	70	RD--	D16.3	01 1011 0011	
588	112	p	70	RD +	D16.3	10 0100 1100	
563	113	q	71	RD +	D17.3	10 0011 0011	
572	113	q	71	RD--	D17.3	10 0011 1100	
307	114	r	72	RD +	D18.3	01 0011 0011	
316	114	r	72	RD--	D18.3	01 0011 1100	
803	115	s	73	RD +	D19.3	11 0010 0011	
812	115	s	73	RD--	D19.3	11 0010 1100	
179	116	t	74	RD +	D20.3	00 1011 0011	
188	116	t	74	RD--	D20.3	00 1011 1100	
675	117	u	75	RD +	D21.3	10 1010 0011	
684	117	u	75	RD--	D21.3	10 1010 1100	
419	118	v	76	RD +	D22.3	01 1010 0011	
428	118	v	76	RD--	D22.3	01 1010 1100	
92	119	w	77	RD +	D23.3	00 0101 1100	
931	119	w	77	RD--	D23.3	11 1010 0011	
204	120	x	78	RD +	D24.3	00 1100 1100	
819	120	x	78	RD--	D24.3	11 0011 0011	
611	121	y	79	RD +	D25.3	10 0110 0011	
620	121	y	79	RD--	D25.3	10 0110 1100	
397	128	_	80	RD +	D0.4	01 1000 1101	
626	128	_	80	RD--	D0.4	10 0111 0010	
466	129	_	81	RD--	D1.4	01 1101 0010	
557	129	_	81	RD +	D1.4	10 0010 1101	
301	130	‚	82	RD +	D2.4	01 0010 1101	
722	130	‚	82	RD--	D2.4	10 1101 0010	
786	131	ƒ	83	RD +	D3.4	11 0001 0010	
797	131	ƒ	83	RD--	D3.4	11 0001 1101	
173	132	„	84	RD +	D4.4	00 1010 1101	
850	132	„	84	RD--	D4.4	11 0101 0010	
658	133	…	85	RD +	D5.4	10 1001 0010	
669	133	…	85	RD--	D5.4	10 1001 1101	
402	134	†	86	RD +	D6.4	01 1001 0010	
413	134	†	86	RD--	D6.4	01 1001 1101	
114	135	‡	87	RD +	D7.4	00 0111 0010	
909	135	‡	87	RD--	D7.4	11 1000 1101	
109	136	ˆ	88	RD +	D8.4	00 0110 1101	
914	136	ˆ	88	RD--	D8.4	11 1001 0010	
594	137	‰	89	RD +	D9.4	10 0101 0010	
605	137	‰	89	RD--	D9.4	10 0101 1101	
434	144	_	90	RD--	D16.4	01 1011 0010	
589	144	_	90	RD +	D16.4	10 0100 1101	
562	145	‘	91	RD +	D17.4	10 0011 0010	
573	145	‘	91	RD--	D17.4	10 0011 1101	
306	146	’	92	RD +	D18.4	01 0011 0010	
317	146	’	92	RD--	D18.4	01 0011 1101	
802	147	“	93	RD +	D19.4	11 0010 0010	
813	147	“	93	RD--	D19.4	11 0010 1101	
178	148	”	94	RD +	D20.4	00 1011 0010	
189	148	”	94	RD--	D20.4	00 1011 1101	
674	149	•	95	RD +	D21.4	10 1010 0010	
685	149	•	95	RD--	D21.4	10 1010 1101	
418	150	–	96	RD +	D22.4	01 1010 0010	
429	150	–	96	RD--	D22.4	01 1010 1101	
93	151	—	97	RD +	D23.4	00 0101 1101	
930	151	—	97	RD--	D23.4	11 1010 0010	
205	152	˜	98	RD +	D24.4	00 1100 1101	
818	152	˜	98	RD--	D24.4	11 0011 0010	
610	153	™	99	RD +	D25.4	10 0110 0010	
621	153	™	99	RD--	D25.4	10 0110 1101	
340	10	LF	0A	RD +	D10.0	01 0101 0100	
347	10	LF	0A	RD--	D10.0	01 0101 1011	
836	11	VT	0B	RD +	D11.0	11 0100 0100	
843	11	VT	0B	RD--	D11.0	11 0100 1011	
212	12	FF	0C	RD +	D12.0	00 1101 0100	
219	12	FF	0C	RD--	D12.0	00 1101 1011	
708	13	CR	0D	RD +	D13.0	10 1100 0100	
715	13	CR	0D	RD--	D13.0	10 1100 1011	
452	14	SO	0E	RD +	D14.0	01 1100 0100	
459	14	SO	0E	RD--	D14.0	01 1100 1011	
372	15	SI	0F	RD--	D15.0	01 0111 0100	
651	15	SI	0F	RD +	D15.0	10 1000 1011	
356	26	SUB	1A	RD +	D26.0	01 0110 0100	
363	26	SUB	1A	RD--	D26.0	01 0110 1011	
155	27	ESC	1B	RD +	D27.0	00 1001 1011	
868	27	ESC	1B	RD--	D27.0	11 0110 0100	
228	28	FS	1C	RD +	D28.0	00 1110 0100	
235	28	FS	1C	RD--	D28.0	00 1110 1011	
244	28	FS	1C	RD --	K28.0	00 1111 0100	Reserved*
779	28	FS	1C	RD +	K28.0	11 0000 1011	
283	29	GS	1D	RD +	D29.0	01 0001 1011	
740	29	GS	1D	RD--	D29.0	10 1110 0100	
484	30	RS	1E	RD--	D30.0	01 1110 0100	
539	30	RS	1E	RD +	D30.0	10 0001 1011	
331	31	US	1F	RD +	D31.0	01 0100 1011	
692	31	US	1F	RD--	D31.0	10 1011 0100	
345	42	*	2A	RD+/--	D10.1	01 0101 1001	
841	43	+	2B	RD+/--	D11.1	11 0100 1001	
217	44	,	2C	RD+/--	D12.1	00 1101 1001	
713	45	-	2D	RD+/--	D13.1	10 1100 1001	
457	46	.	2E	RD+/--	D14.1	01 1100 1001	
377	47	/	2F	RD--	D15.1	01 0111 1001	
649	47	/	2F	RD +	D15.1	10 1000 1001	
361	58	:	3A	RD+/--	D26.1	01 0110 1001	
153	59	;	3B	RD +	D27.1	00 1001 1001	
873	59	;	3B	RD--	D27.1	11 0110 1001	
233	60	<	3C	RD+/--	D28.1	00 1110 1001	
249	60	<	3C	RD --	K28.1	00 1111 1001	Reserved*
774	60	<	3C	RD +	K28.1	11 0000 0110	
281	61	=	3D	RD +	D29.1	01 0001 1001	
745	61	=	3D	RD--	D29.1	10 1110 1001	
489	62	>	3E	RD--	D30.1	01 1110 1001	
537	62	>	3E	RD +	D30.1	10 0001 1001	
329	63	?	3F	RD +	D31.1	01 0100 1001	
697	63	?	3F	RD--	D31.1	10 1011 1001	
341	74	J	4A	RD+/--	D10.2	01 0101 0101	
837	75	K	4B	RD+/--	D11.2	11 0100 0101	
213	76	L	4C	RD+/--	D12.2	00 1101 0101	
709	77	M	4D	RD+/--	D13.2	10 1100 0101	
453	78	N	4E	RD+/--	D14.2	01 1100 0101	
373	79	O	4F	RD--	D15.2	01 0111 0101	
645	79	O	4F	RD +	D15.2	10 1000 0101	
357	90	Z	5A	RD+/--	D26.2	01 0110 0101	
149	91	[	5B	RD +	D27.2	00 1001 0101	
869	91	[	5B	RD--	D27.2	11 0110 0101	
229	92	\	5C	RD+/--	D28.2	00 1110 0101	
245	92	\	5C	RD --	K28.2	00 1111 0101	Reserved*
778	92	\	5C	RD +	K28.2	11 0000 1010	
277	93	]	5D	RD +	D29.2	01 0001 0101	
741	93	]	5D	RD--	D29.2	10 1110 0101	
485	94	^	5E	RD--	D30.2	01 1110 0101	

533	94	^	5E	RD +	D30.2	10 0001 0101	
325	95	_	5F	RD +	D31.2	01 0100 0101	
693	95	_	5F	RD--	D31.2	10 1011 0101	
339	106	j	6A	RD +	D10.3	01 0101 0011	
348	106	j	6A	RD--	D10.3	01 0101 1100	
835	107	k	6B	RD +	D11.3	11 0100 0011	
844	107	k	6B	RD--	D11.3	11 0100 1100	
211	108	l	6C	RD +	D12.3	00 1101 0011	
220	108	l	6C	RD--	D12.3	00 1101 1100	
707	109	m	6D	RD +	D13.3	10 1100 0011	
716	109	m	6D	RD--	D13.3	10 1100 1100	
451	110	n	6E	RD +	D14.3	01 1100 0011	
460	110	n	6E	RD--	D14.3	01 1100 1100	
371	111	o	6F	RD--	D15.3	01 0111 0011	
652	111	o	6F	RD +	D15.3	10 1000 1100	
355	122	z	7A	RD +	D26.3	01 0110 0011	
364	122	z	7A	RD--	D26.3	01 0110 1100	
156	123	{	7B	RD +	D27.3	00 1001 1100	
867	123	{	7B	RD--	D27.3	11 0110 0011	
227	124	|	7C	RD +	D28.3	00 1110 0011	
236	124	|	7C	RD--	D28.3	00 1110 1100	
243	124	|	7C	RD --	K28.3	00 1111 0011	Reserved*
780	124	|	7C	RD +	K28.3	11 0000 1100	
284	125	}	7D	RD +	D29.3	01 0001 1100	
739	125	}	7D	RD--	D29.3	10 1110 0011	
483	126	~	7E	RD--	D30.3	01 1110 0011	
540	126	~	7E	RD +	D30.3	10 0001 1100	
332	127	DELETE	7F	RD +	D31.3	01 0100 1100	
691	127	DELETE	7F	RD--	D31.3	10 1011 0011	
338	138	Š	8A	RD +	D10.4	01 0101 0010	
349	138	Š	8A	RD--	D10.4	01 0101 1101	
834	139	‹	8B	RD +	D11.4	11 0100 0010	
845	139	‹	8B	RD--	D11.4	11 0100 1101	
210	140	Œ	8C	RD +	D12.4	00 1101 0010	
221	140	Œ	8C	RD--	D12.4	00 1101 1101	
706	141	_	8D	RD +	D13.4	10 1100 0010	
717	141	_	8D	RD--	D13.4	10 1100 1101	
450	142	_	8E	RD +	D14.4	01 1100 0010	
461	142	_	8E	RD--	D14.4	01 1100 1101	
370	143	_	8F	RD--	D15.4	01 0111 0010	
653	143	_	8F	RD +	D15.4	10 1000 1101	
354	154	š	9A	RD +	D26.4	01 0110 0010	
365	154	š	9A	RD--	D26.4	01 0110 1101	
157	155	›	9B	RD +	D27.4	00 1001 1101	
866	155	›	9B	RD--	D27.4	11 0110 0010	
226	156	œ	9C	RD +	D28.4	00 1110 0010	
237	156	œ	9C	RD--	D28.4	00 1110 1101	
242	156	œ	9C	RD --	K28.4	00 1111 0010	Reserved*
781	156	œ	9C	RD +	K28.4	11 0000 1101	
285	157	_	9D	RD +	D29.4	01 0001 1101	
738	157	_	9D	RD--	D29.4	10 1110 0010	
482	158	_	9E	RD--	D30.4	01 1110 0010	
541	158	_	9E	RD +	D30.4	10 0001 1101	
333	159	Ÿ	9F	RD +	D31.4	01 0100 1101	
690	159	Ÿ	9F	RD--	D31.4	10 1011 0010	
394	160		A0	RD +	D0.5	01 1000 1010	
634	160		A0	RD--	D0.5	10 0111 1010	
474	161	¡	A1	RD--	D1.5	01 1101 1010	
554	161	¡	A1	RD +	D1.5	10 0010 1010	
298	162	¢	A2	RD +	D2.5	01 0010 1010	
730	162	¢	A2	RD--	D2.5	10 1101 1010	
794	163	£	A3	RD+/--	D3.5	11 0001 1010	
170	164	¤	A4	RD +	D4.5	00 1010 1010	
858	164	¤	A4	RD--	D4.5	11 0101 1010	
666	165	¥	A5	RD+/--	D5.5	10 1001 1010	
410	166	¦	A6	RD+/--	D6.5	01 1001 1010	
122	167	§	A7	RD +	D7.5	00 0111 1010	
906	167	§	A7	RD--	D7.5	11 1000 1010	
106	168	¨	A8	RD +	D8.5	00 0110 1010	
922	168	¨	A8	RD--	D8.5	11 1001 1010	
602	169	©	A9	RD+/--	D9.5	10 0101 1010	
346	170	ª	AA	RD+/--	D10.5	01 0101 1010	
842	171	«	AB	RD+/--	D11.5	11 0100 1010	
218	172	¬	AC	RD+/--	D12.5	00 1101 1010	
714	173	-	AD	RD+/--	D13.5	10 1100 1010	
458	174	®	AE	RD+/--	D14.5	01 1100 1010	
378	175	¯	AF	RD--	D15.5	01 0111 1010	
650	175	¯	AF	RD +	D15.5	10 1000 1010	
442	176	°	B0	RD--	D16.5	01 1011 1010	
586	176	°	B0	RD +	D16.5	10 0100 1010	
570	177	±	B1	RD+/--	D17.5	10 0011 1010	
314	178	²	B2	RD+/--	D18.5	01 0011 1010	
810	179	³	B3	RD+/--	D19.5	11 0010 1010	
186	180	´	B4	RD+/--	D20.5	00 1011 1010	
682	181	µ	B5	RD+/--	D21.5	10 1010 1010	
426	182	¶	B6	RD+/--	D22.5	01 1010 1010	
90	183	·	B7	RD +	D23.5	00 0101 1010	
938	183	·	B7	RD--	D23.5	11 1010 1010	
202	184	¸	B8	RD +	D24.5	00 1100 1010	
826	184	¸	B8	RD--	D24.5	11 0011 1010	
618	185	¹	B9	RD+/--	D25.5	10 0110 1010	
362	186	º	BA	RD+/--	D26.5	01 0110 1010	
154	187	»	BB	RD +	D27.5	00 1001 1010	
874	187	»	BB	RD--	D27.5	11 0110 1010	
234	188	¼	BC	RD+/--	D28.5	00 1110 1010	
250	188	¼	BC	RD --	K28.5	00 1111 1010	Sync
773	188	¼	BC	RD +	K28.5	11 0000 0101	(Not Used)
282	189	½	BD	RD +	D29.5	01 0001 1010	
746	189	½	BD	RD--	D29.5	10 1110 1010	
490	190	¾	BE	RD--	D30.5	01 1110 1010	
538	190	¾	BE	RD +	D30.5	10 0001 1010	
330	191	¿	BF	RD +	D31.5	01 0100 1010	
698	191	¿	BF	RD--	D31.5	10 1011 1010	
390	192	À	C0	RD +	D0.6	01 1000 0110	
630	192	À	C0	RD--	D0.6	10 0111 0110	
470	193	Á	C1	RD--	D1.6	01 1101 0110	
550	193	Á	C1	RD +	D1.6	10 0010 0110	
294	194	Â	C2	RD +	D2.6	01 0010 0110	
726	194	Â	C2	RD--	D2.6	10 1101 0110	
790	195	Ã	C3	RD+/--	D3.6	11 0001 0110	
166	196	Ä	C4	RD +	D4.6	00 1010 0110	
854	196	Ä	C4	RD--	D4.6	11 0101 0110	
662	197	Å	C5	RD+/--	D5.6	10 1001 0110	
406	198	Æ	C6	RD+/--	D6.6	01 1001 0110	
118	199	Ç	C7	RD +	D7.6	00 0111 0110	
902	199	Ç	C7	RD--	D7.6	11 1000 0110	
102	200	È	C8	RD +	D8.6	00 0110 0110	
918	200	È	C8	RD--	D8.6	11 1001 0110	
598	201	É	C9	RD+/--	D9.6	10 0101 0110	
342	202	Ê	CA	RD+/--	D10.6	01 0101 0110	
838	203	Ë	CB	RD+/--	D11.6	11 0100 0110	
214	204	Ì	CC	RD+/--	D12.6	00 1101 0110	
710	205	Í	CD	RD+/--	D13.6	10 1100 0110	
454	206	Î	CE	RD+/--	D14.6	01 1100 0110	
374	207	Ï	CF	RD--	D15.6	01 0111 0110	
646	207	Ï	CF	RD +	D15.6	10 1000 0110	
438	208	Ð	D0	RD--	D16.6	01 1011 0110	
582	208	Ð	D0	RD +	D16.6	10 0100 0110	

566	209	Ñ	D1	RD+/--	D17.6	10 0011 0110	
310	210	Ò	D2	RD+/--	D18.6	01 0011 0110	
806	211	Ó	D3	RD+/--	D19.6	11 0010 0110	
182	212	Ô	D4	RD+/--	D20.6	00 1011 0110	
678	213	Õ	D5	RD+/--	D21.6	10 1010 0110	
422	214	Ö	D6	RD+/--	D22.6	01 1010 0110	
86	215	×	D7	RD +	D23.6	00 0101 0110	
934	215	×	D7	RD--	D23.6	11 1010 0110	
198	216	Ø	D8	RD +	D24.6	00 1100 0110	
822	216	Ø	D8	RD--	D24.6	11 0011 0110	
614	217	Ù	D9	RD+/--	D25.6	10 0110 0110	
358	218	Ú	DA	RD+/--	D26.6	01 0110 0110	
150	219	Û	DB	RD +	D27.6	00 1001 0110	
870	219	Û	DB	RD--	D27.6	11 0110 0110	
230	220	Ü	DC	RD+/--	D28.6	00 1110 0110	
246	220	Ü	DC	RD --	K28.6	00 1111 0110	Reserved*
777	220	Ü	DC	RD +	K28.6	11 0000 1001	
278	221	Ý	DD	RD +	D29.6	01 0001 0110	
742	221	Ý	DD	RD--	D29.6	10 1110 0110	
486	222	Þ	DE	RD--	D30.6	01 1110 0110	
534	222	Þ	DE	RD +	D30.6	10 0001 0110	
326	223	ß	DF	RD +	D31.6	01 0100 0110	
694	223	ß	DF	RD--	D31.6	10 1011 0110	
398	224	à	E0	RD +	D0.7	01 1000 1110	
625	224	à	E0	RD--	D0.7	10 0111 0001	
465	225	á	E1	RD--	D1.7	01 1101 0001	
558	225	á	E1	RD +	D1.7	10 0010 1110	
302	226	â	E2	RD +	D2.7	01 0010 1110	
721	226	â	E2	RD--	D2.7	10 1101 0001	
785	227	ã	E3	RD +	D3.7	11 0001 0001	
798	227	ã	E3	RD--	D3.7	11 0001 1110	
174	228	ä	E4	RD +	D4.7	00 1010 1110	
849	228	ä	E4	RD--	D4.7	11 0101 0001	
657	229	å	E5	RD +	D5.7	10 1001 0001	
670	229	å	E5	RD--	D5.7	10 1001 1110	
401	230	æ	E6	RD +	D6.7	01 1001 0001	
414	230	æ	E6	RD--	D6.7	01 1001 1110	
113	231	ç	E7	RD +	D7.7	00 0111 0001	
910	231	ç	E7	RD--	D7.7	11 1000 1110	
110	232	è	E8	RD +	D8.7	00 0110 1110	
913	232	è	E8	RD--	D8.7	11 1001 0001	
593	233	é	E9	RD +	D9.7	10 0101 0001	
606	233	é	E9	RD--	D9.7	10 0101 1110	
337	234	ê	EA	RD +	D10.7	01 0101 0001	
350	234	ê	EA	RD--	D10.7	01 0101 1110	
840	235	ë	EB	RD +	D11.7	11 0100 1000	
846	235	ë	EB	RD--	D11.7	11 0100 1110	
209	236	ì	EC	RD +	D12.7	00 1101 0001	
222	236	ì	EC	RD--	D12.7	00 1101 1110	
712	237	í	ED	RD +	D13.7	10 1100 1000	
718	237	í	ED	RD--	D13.7	10 1100 1110	
456	238	î	EE	RD +	D14.7	01 1100 1000	
462	238	î	EE	RD--	D14.7	01 1100 1110	
369	239	ï	EF	RD--	D15.7	01 0111 0001	
654	239	ï	EF	RD +	D15.7	10 1000 1110	
433	240	ð	F0	RD--	D16.7	01 1011 0001	
590	240	ð	F0	RD +	D16.7	10 0100 1110	
561	241	ñ	F1	RD +	D17.7	10 0011 0001	
567	241	ñ	F1	RD--	D17.7	10 0011 0111	
305	242	ò	F2	RD +	D18.7	01 0011 0001	
311	242	ò	F2	RD--	D18.7	01 0011 0111	
801	243	ó	F3	RD +	D19.7	11 0010 0001	
814	243	ó	F3	RD--	D19.7	11 0010 1110	
177	244	ô	F4	RD +	D20.7	00 1011 0001	
183	244	ô	F4	RD--	D20.7	00 1011 0111	
673	245	õ	F5	RD +	D21.7	10 1010 0001	
686	245	õ	F5	RD--	D21.7	10 1010 1110	
417	246	ö	F6	RD +	D22.7	01 1010 0001	
430	246	ö	F6	RD--	D22.7	01 1010 1110	
87	247	÷	F7	RD +	K23.7	00 0101 0111	
94	247	÷	F7	RD +	D23.7	00 0101 1110	
929	247	÷	F7	RD--	D23.7	11 1010 0001	
936	247	÷	F7	RD --	K23.7	11 1010 1000	Reserved*
206	248	ø	F8	RD +	D24.7	00 1100 1110	
817	248	ø	F8	RD--	D24.7	11 0011 0001	
609	249	ù	F9	RD +	D25.7	10 0110 0001	
622	249	ù	F9	RD--	D25.7	10 0110 1110	
353	250	ú	FA	RD +	D26.7	01 0110 0001	
366	250	ú	FA	RD--	D26.7	01 0110 1110	
151	251	û	FB	RD +	K27.7	00 1001 0111	
158	251	û	FB	RD +	D27.7	00 1001 1110	
865	251	û	FB	RD--	D27.7	11 0110 0001	
872	251	û	FB	RD --	K27.7	11 0110 1000	Reserved*
225	252	ü	FC	RD +	D28.7	00 1110 0001	
238	252	ü	FC	RD--	D28.7	00 1110 1110	
248	252	ü	FC	RD --	K28.7	00 1111 1000	Test
775	252	ü	FC	RD +	K28.7	11 0000 0111	
279	253	ý	FD	RD +	K29.7	01 0001 0111	
286	253	ý	FD	RD +	D29.7	01 0001 1110	
737	253	ý	FD	RD--	D29.7	10 1110 0001	
744	253	ý	FD	RD --	K29.7	10 1110 1000	Reserved*
481	254	þ	FE	RD--	D30.7	01 1110 0001	
488	254	þ	FE	RD --	K30.7	01 1110 1000	Reserved*
535	254	þ	FE	RD +	K30.7	10 0001 0111	
542	254	þ	FE	RD +	D30.7	10 0001 1110	
334	255	ÿ	FF	RD +	D31.7	01 0100 1110	
689	255	ÿ	FF	RD--	D31.7	10 1011 0001	

The following table lists:

Legal 10-bit Values Sorted by K/D Code

10B Dec	8B Dec	ASCII+	HEX	Previous Disparity	Data Byte FC Name	10 B	COMMENT
395	0	NUL	00	RD +	D0.0	01 1000 1011	
628	0	NUL	00	RD--	D0.0	10 0111 0100	
393	32	SPACE	20	RD +	D0.1	01 1000 1001	
633	32	SPACE	20	RD--	D0.1	10 0111 1001	
389	64	@	40	RD +	D0.2	01 1000 0101	
629	64	@	40	RD--	D0.2	10 0111 0101	
396	96	`	60	RD +	D0.3	01 1000 1100	
627	96	`	60	RD--	D0.3	10 0111 0011	
397	128	_	80	RD +	D0.4	01 1000 1101	
626	128	_	80	RD--	D0.4	10 0111 0010	
394	160		A0	RD +	D0.5	01 1000 1010	
634	160		A0	RD--	D0.5	10 0111 1010	
390	192	À	C0	RD +	D0.6	01 1000 0110	
630	192	À	C0	RD--	D0.6	10 0111 0110	
398	224	à	E0	RD +	D0.7	01 1000 1110	
625	224	à	E0	RD--	D0.7	10 0111 0001	
468	1	SOH	01	RD--	D1.0	01 1101 0100	
555	1	SOH	01	RD +	D1.0	10 0010 1011	
473	33	!	21	RD--	D1.1	01 1101 1001	
553	33	!	21	RD +	D1.1	10 0010 1001	
469	65	A	41	RD--	D1.2	01 1101 0101	
549	65	A	41	RD +	D1.2	10 0010 0101	
467	97	a	61	RD--	D1.3	01 1101 0011	
556	97	a	61	RD +	D1.3	10 0010 1100	
466	129	_	81	RD--	D1.4	01 1101 0010	
557	129	_	81	RD +	D1.4	10 0010 1101	
474	161	¡	A1	RD--	D1.5	01 1101 1010	
554	161	¡	A1	RD +	D1.5	10 0010 1010	
470	193	Á	C1	RD--	D1.6	01 1101 0110	
550	193	Á	C1	RD +	D1.6	10 0010 0110	
465	225	á	E1	RD--	D1.7	01 1101 0001	
558	225	á	E1	RD +	D1.7	10 0010 1110	
340	10	LF	0A	RD +	D10.0	01 0101 0100	
347	10	LF	0A	RD--	D10.0	01 0101 1011	
345	42	*	2A	RD+/--	D10.1	01 0101 1001	
341	74	J	4A	RD+/--	D10.2	01 0101 0101	
339	106	j	6A	RD +	D10.3	01 0101 0011	
348	106	j	6A	RD--	D10.3	01 0101 1100	
338	138	Š	8A	RD +	D10.4	01 0101 0010	
349	138	Š	8A	RD--	D10.4	01 0101 1101	
346	170	ª	AA	RD+/--	D10.5	01 0101 1010	
342	202	Ê	CA	RD+/--	D10.6	01 0101 0110	
337	234	ê	EA	RD +	D10.7	01 0101 0001	
350	234	ê	EA	RD--	D10.7	01 0101 1110	
836	11	VT	0B	RD +	D11.0	11 0100 0100	
843	11	VT	0B	RD--	D11.0	11 0100 1011	
841	43	+	2B	RD+/--	D11.1	11 0100 1001	
837	75	K	4B	RD+/--	D11.2	11 0100 0101	
835	107	k	6B	RD +	D11.3	11 0100 0011	
844	107	k	6B	RD--	D11.3	11 0100 1100	
834	139	‹	8B	RD +	D11.4	11 0100 0010	
845	139	‹	8B	RD--	D11.4	11 0100 1101	
842	171	«	AB	RD+/--	D11.5	11 0100 1010	
838	203	Ë	CB	RD+/--	D11.6	11 0100 0110	
840	235	ë	EB	RD +	D11.7	11 0100 1000	
846	235	ë	EB	RD--	D11.7	11 0100 1110	
212	12	FF	0C	RD +	D12.0	00 1101 0100	
219	12	FF	0C	RD--	D12.0	00 1101 1011	
217	44	,	2C	RD+/--	D12.1	00 1101 1001	
213	76	L	4C	RD+/--	D12.2	00 1101 0101	
211	108	l	6C	RD +	D12.3	00 1101 0011	
220	108	l	6C	RD--	D12.3	00 1101 1100	
210	140	Œ	8C	RD +	D12.4	00 1101 0010	
221	140	Œ	8C	RD--	D12.4	00 1101 1101	
218	172	¬	AC	RD+/--	D12.5	00 1101 1010	
214	204	Ì	CC	RD+/--	D12.6	00 1101 0110	
209	236	ì	EC	RD +	D12.7	00 1101 0001	
222	236	ì	EC	RD--	D12.7	00 1101 1110	
708	13	CR	0D	RD +	D13.0	10 1100 0100	
715	13	CR	0D	RD--	D13.0	10 1100 1011	
713	45	-	2D	RD+/--	D13.1	10 1100 1001	
709	77	M	4D	RD+/--	D13.2	10 1100 0101	
707	109	m	6D	RD +	D13.3	10 1100 0011	
716	109	m	6D	RD--	D13.3	10 1100 1100	
706	141	_	8D	RD +	D13.4	10 1100 0010	
717	141	_	8D	RD--	D13.4	10 1100 1101	
714	173	-	AD	RD+/--	D13.5	10 1100 1010	
710	205	Í	CD	RD+/--	D13.6	10 1100 0110	
712	237	í	ED	RD +	D13.7	10 1100 1000	
718	237	í	ED	RD--	D13.7	10 1100 1110	
452	14	SO	0E	RD +	D14.0	01 1100 0100	
459	14	SO	0E	RD--	D14.0	01 1100 1011	
457	46	.	2E	RD+/--	D14.1	01 1100 1001	
453	78	N	4E	RD+/--	D14.2	01 1100 0101	
451	110	n	6E	RD +	D14.3	01 1100 0011	
460	110	n	6E	RD--	D14.3	01 1100 1100	
450	142	_	8E	RD +	D14.4	01 1100 0010	
461	142	_	8E	RD--	D14.4	01 1100 1101	
458	174	®	AE	RD+/--	D14.5	01 1100 1010	
454	206	Î	CE	RD+/--	D14.6	01 1100 0110	
456	238	î	EE	RD +	D14.7	01 1100 1000	
462	238	î	EE	RD--	D14.7	01 1100 1110	
372	15	SI	0F	RD--	D15.0	01 0111 0100	
651	15	SI	0F	RD +	D15.0	10 1000 1011	
377	47	/	2F	RD--	D15.1	01 0111 1001	
649	47	/	2F	RD +	D15.1	10 1000 1001	
373	79	O	4F	RD--	D15.2	01 0111 0101	
645	79	O	4F	RD +	D15.2	10 1000 0101	
371	111	o	6F	RD--	D15.3	01 0111 0011	
652	111	o	6F	RD +	D15.3	10 1000 1100	
370	143	_	8F	RD--	D15.4	01 0111 0010	
653	143	_	8F	RD +	D15.4	10 1000 1101	
378	175	¯	AF	RD--	D15.5	01 0111 1010	
650	175	¯	AF	RD +	D15.5	10 1000 1010	
374	207	Ï	CF	RD--	D15.6	01 0111 0110	
646	207	Ï	CF	RD +	D15.6	10 1000 0110	
369	239	ï	EF	RD--	D15.7	01 0111 0001	
654	239	ï	EF	RD +	D15.7	10 1000 1110	
436	16	DLE	10	RD--	D16.0	01 1011 0100	
587	16	DLE	10	RD +	D16.0	10 0100 1011	
441	48	0	30	RD--	D16.1	01 1011 1001	
585	48	0	30	RD +	D16.1	10 0100 1001	
437	80	P	50	RD--	D16.2	01 1011 0101	
581	80	P	50	RD +	D16.2	10 0100 0101	
435	112	p	70	RD--	D16.3	01 1011 0011	
588	112	p	70	RD +	D16.3	10 0100 1100	
434	144	_	90	RD--	D16.4	01 1011 0010	
589	144	_	90	RD +	D16.4	10 0100 1101	
442	176	°	B0	RD--	D16.5	01 1011 1010	
586	176	°	B0	RD +	D16.5	10 0100 1010	
438	208	Ð	D0	RD--	D16.6	01 1011 0110	
582	208	Ð	D0	RD +	D16.6	10 0100 0110	
433	240	ð	F0	RD--	D16.7	01 1011 0001	
590	240	ð	F0	RD +	D16.7	10 0100 1110	
564	17	DC1	11	RD +	D17.0	10 0011 0100	
571	17	DC1	11	RD--	D17.0	10 0011 1011	
569	49	1	31	RD+/--	D17.1	10 0011 1001	
565	81	Q	51	RD+/--	D17.2	10 0011 0101	
563	113	q	71	RD +	D17.3	10 0011 0011	
572	113	q	71	RD--	D17.3	10 0011 1100	
562	145	‘	91	RD +	D17.4	10 0011 0010	

573	145	‘	91	RD--	D17.4	10 0011 1101
570	177	±	B1	RD+/--	D17.5	10 0011 1010
566	209	Ñ	D1	RD+/--	D17.6	10 0011 0110
561	241	ñ	F1	RD +	D17.7	10 0011 0001
567	241	ñ	F1	RD--	D17.7	10 0011 0111
308	18	DC2	12	RD +	D18.0	01 0011 0100
315	18	DC2	12	RD--	D18.0	01 0011 1011
313	50	2	32	RD+/--	D18.1	01 0011 1001
309	82	R	52	RD+/--	D18.2	01 0011 0101
307	114	r	72	RD +	D18.3	01 0011 0011
316	114	r	72	RD--	D18.3	01 0011 1100
306	146	’	92	RD +	D18.4	01 0011 0010
317	146	’	92	RD--	D18.4	01 0011 1101
314	178	²	B2	RD+/--	D18.5	01 0011 1010
310	210	Ò	D2	RD+/--	D18.6	01 0011 0110
305	242	ò	F2	RD +	D18.7	01 0011 0001
311	242	ò	F2	RD--	D18.7	01 0011 0111
804	19	DC3	13	RD +	D19.0	11 0010 0100
811	19	DC3	13	RD--	D19.0	11 0010 1011
809	51	3	33	RD+/--	D19.1	11 0010 1001
805	83	S	53	RD+/--	D19.2	11 0010 0101
803	115	s	73	RD +	D19.3	11 0010 0011
812	115	s	73	RD--	D19.3	11 0010 1100
802	147	“	93	RD +	D19.4	11 0010 0010
813	147	“	93	RD--	D19.4	11 0010 1101
810	179	³	B3	RD+/--	D19.5	11 0010 1010
806	211	Ó	D3	RD+/--	D19.6	11 0010 0110
801	243	ó	F3	RD +	D19.7	11 0010 0001
814	243	ó	F3	RD--	D19.7	11 0010 1110
299	2	STX	02	RD +	D2.0	01 0010 1011
724	2	STX	02	RD--	D2.0	10 1101 0100
297	34	"	22	RD +	D2.1	01 0010 1001
729	34	"	22	RD--	D2.1	10 1101 1001
293	66	B	42	RD +	D2.2	01 0010 0101
725	66	B	42	RD--	D2.2	10 1101 0101
300	98	b	62	RD +	D2.3	01 0010 1100
723	98	b	62	RD--	D2.3	10 1101 0011
301	130	‚	82	RD +	D2.4	01 0010 1101
722	130	‚	82	RD--	D2.4	10 1101 0010
298	162	¢	A2	RD +	D2.5	01 0010 1010
730	162	¢	A2	RD--	D2.5	10 1101 1010
294	194	Â	C2	RD +	D2.6	01 0010 0110
726	194	Â	C2	RD--	D2.6	10 1101 0110
302	226	â	E2	RD +	D2.7	01 0010 1110
721	226	â	E2	RD--	D2.7	10 1101 0001
180	20	DC4	14	RD +	D20.0	00 1011 0100
187	20	DC4	14	RD--	D20.0	00 1011 1011
185	52	4	34	RD+/--	D20.1	00 1011 1001
181	84	T	54	RD+/--	D20.2	00 1011 0101
179	116	t	74	RD +	D20.3	00 1011 0011
188	116	t	74	RD--	D20.3	00 1011 1100
178	148	”	94	RD +	D20.4	00 1011 0010
189	148	”	94	RD--	D20.4	00 1011 1101
186	180	´	B4	RD+/--	D20.5	00 1011 1010
182	212	Ô	D4	RD+/--	D20.6	00 1011 0110
177	244	ô	F4	RD +	D20.7	00 1011 0001
183	244	ô	F4	RD--	D20.7	00 1011 0111
676	21	NAK	15	RD +	D21.0	10 1010 0100
683	21	NAK	15	RD--	D21.0	10 1010 1011
681	53	5	35	RD+/--	D21.1	10 1010 1001
677	85	U	55	RD+/--	D21.2	10 1010 0101
675	117	u	75	RD +	D21.3	10 1010 0011
684	117	u	75	RD--	D21.3	10 1010 1100
674	149	•	95	RD +	D21.4	10 1010 0010
685	149	•	95	RD--	D21.4	10 1010 1101
682	181	µ	B5	RD+/--	D21.5	10 1010 1010
678	213	Õ	D5	RD+/--	D21.6	10 1010 0110
673	245	õ	F5	RD +	D21.7	10 1010 0001
686	245	õ	F5	RD--	D21.7	10 1010 1110
420	22	SYN	16	RD +	D22.0	01 1010 0100
427	22	SYN	16	RD--	D22.0	01 1010 1011
425	54	6	36	RD+/--	D22.1	01 1010 1001
421	86	V	56	RD+/--	D22.2	01 1010 0101
419	118	v	76	RD +	D22.3	01 1010 0011
428	118	v	76	RD--	D22.3	01 1010 1100
418	150	–	96	RD +	D22.4	01 1010 0010
429	150	–	96	RD--	D22.4	01 1010 1101
426	182	¶	B6	RD+/--	D22.5	01 1010 1010
422	214	Ö	D6	RD+/--	D22.6	01 1010 0110
417	246	ö	F6	RD +	D22.7	01 1010 0001
430	246	ö	F6	RD--	D22.7	01 1010 1110
91	23	ETB	17	RD +	D23.0	00 0101 1011
932	23	ETB	17	RD--	D23.0	11 1010 0100
89	55	7	37	RD +	D23.1	00 0101 1001
937	55	7	37	RD--	D23.1	11 1010 1001
85	87	W	57	RD +	D23.2	00 0101 0101
933	87	W	57	RD--	D23.2	11 1010 0101
92	119	w	77	RD +	D23.3	00 0101 1100
931	119	w	77	RD--	D23.3	11 1010 0011
93	151	—	97	RD +	D23.4	00 0101 1101
930	151	—	97	RD--	D23.4	11 1010 0010
90	183	·	B7	RD +	D23.5	00 0101 1010
938	183	·	B7	RD--	D23.5	11 1010 1010
86	215	×	D7	RD +	D23.6	00 0101 0110
934	215	×	D7	RD--	D23.6	11 1010 0110
94	247	÷	F7	RD +	D23.7	00 0101 1110
929	247	÷	F7	RD--	D23.7	11 1010 0001
203	24	CAN	18	RD +	D24.0	00 1100 1011
820	24	CAN	18	RD--	D24.0	11 0011 0100
201	56	8	38	RD +	D24.1	00 1100 1001
825	56	8	38	RD--	D24.1	11 0011 1001
197	88	X	58	RD +	D24.2	00 1100 0101
821	88	X	58	RD--	D24.2	11 0011 0101
204	120	x	78	RD +	D24.3	00 1100 1100
819	120	x	78	RD--	D24.3	11 0011 0011
205	152	˜	98	RD +	D24.4	00 1100 1101
818	152	˜	98	RD--	D24.4	11 0011 0010
202	184	¸	B8	RD +	D24.5	00 1100 1010
826	184	¸	B8	RD--	D24.5	11 0011 1010
198	216	Ø	D8	RD +	D24.6	00 1100 0110
822	216	Ø	D8	RD--	D24.6	11 0011 0110
206	248	ø	F8	RD +	D24.7	00 1100 1110
817	248	ø	F8	RD--	D24.7	11 0011 0001
612	25	EM	19	RD +	D25.0	10 0110 0100
619	25	EM	19	RD--	D25.0	10 0110 1011
617	57	9	39	RD+/--	D25.1	10 0110 1001
613	89	Y	59	RD+/--	D25.2	10 0110 0101
611	121	y	79	RD +	D25.3	10 0110 0011
620	121	y	79	RD--	D25.3	10 0110 1100
610	153	™	99	RD +	D25.4	10 0110 0010
621	153	™	99	RD--	D25.4	10 0110 1101
618	185	¹	B9	RD+/--	D25.5	10 0110 1010
614	217	Ù	D9	RD+/--	D25.6	10 0110 0110
609	249	ù	F9	RD +	D25.7	10 0110 0001
622	249	ù	F9	RD--	D25.7	10 0110 1110
356	26	SUB	1A	RD +	D26.0	01 0110 0100
363	26	SUB	1A	RD--	D26.0	01 0110 1011
361	58	:	3A	RD+/--	D26.1	01 0110 1001
357	90	Z	5A	RD+/--	D26.2	01 0110 0101
355	122	z	7A	RD +	D26.3	01 0110 0011
364	122	z	7A	RD--	D26.3	01 0110 1100
354	154	š	9A	RD +	D26.4	01 0110 0010
365	154	š	9A	RD--	D26.4	01 0110 1101
362	186	º	BA	RD+/--	D26.5	01 0110 1010
358	218	Ú	DA	RD+/--	D26.6	01 0110 0110
353	250	ú	FA	RD +	D26.7	01 0110 0001
366	250	ú	FA	RD--	D26.7	01 0110 1110
155	27	ESC	1B	RD +	D27.0	00 1001 1011
868	27	ESC	1B	RD--	D27.0	11 0110 0100
153	59	;	3B	RD +	D27.1	00 1001 1001
873	59	;	3B	RD--	D27.1	11 0110 1001
149	91	[	5B	RD +	D27.2	00 1001 0101
869	91	[	5B	RD--	D27.2	11 0110 0101
156	123	{	7B	RD +	D27.3	00 1001 1100
867	123	{	7B	RD--	D27.3	11 0110 0011
157	155	›	9B	RD +	D27.4	00 1001 1101

866	155	›	9B	RD--	D27.4	11 0110 0010
154	187	»	BB	RD +	D27.5	00 1001 1010
874	187	»	BB	RD--	D27.5	11 0110 1010
150	219	Û	DB	RD +	D27.6	00 1001 0110
870	219	Û	DB	RD--	D27.6	11 0110 0110
158	251	û	FB	RD +	D27.7	00 1001 1110
865	251	û	FB	RD--	D27.7	11 0110 0001
228	28	FS	1C	RD +	D28.0	00 1110 0100
235	28	FS	1C	RD--	D28.0	00 1110 1011
233	60	<	3C	RD+/--	D28.1	00 1110 1001
229	92	\	5C	RD+/--	D28.2	00 1110 0101
227	124	|	7C	RD +	D28.3	00 1110 0011
236	124	|	7C	RD--	D28.3	00 1110 1100
226	156	œ	9C	RD +	D28.4	00 1110 0010
237	156	œ	9C	RD--	D28.4	00 1110 1101
234	188	¼	BC	RD+/--	D28.5	00 1110 1010
230	220	Ü	DC	RD+/--	D28.6	00 1110 0110
225	252	ü	FC	RD +	D28.7	00 1110 0001
238	252	ü	FC	RD--	D28.7	00 1110 1110
283	29	GS	1D	RD +	D29.0	01 0001 1011
740	29	GS	1D	RD--	D29.0	10 1110 0100
281	61	=	3D	RD +	D29.1	01 0001 1001
745	61	=	3D	RD--	D29.1	10 1110 1001
277	93	]	5D	RD +	D29.2	01 0001 0101
741	93	]	5D	RD--	D29.2	10 1110 0101
284	125	}	7D	RD +	D29.3	01 0001 1100
739	125	}	7D	RD--	D29.3	10 1110 0011
285	157	_	9D	RD +	D29.4	01 0001 1101
738	157	_	9D	RD--	D29.4	10 1110 0010
282	189	½	BD	RD +	D29.5	01 0001 1010
746	189	½	BD	RD--	D29.5	10 1110 1010
278	221	Ý	DD	RD +	D29.6	01 0001 0110
742	221	Ý	DD	RD--	D29.6	10 1110 0110
286	253	ý	FD	RD +	D29.7	01 0001 1110
737	253	ý	FD	RD--	D29.7	10 1110 0001
788	3	ETX	03	RD +	D3.0	11 0001 0100
795	3	ETX	03	RD--	D3.0	11 0001 1011
793	35	#	23	RD+/--	D3.1	11 0001 1001
789	67	C	43	RD+/--	D3.2	11 0001 0101
787	99	c	63	RD +	D3.3	11 0001 0011
796	99	c	63	RD--	D3.3	11 0001 1100
786	131	ƒ	83	RD +	D3.4	11 0001 0010
797	131	ƒ	83	RD--	D3.4	11 0001 1101
794	163	£	A3	RD+/--	D3.5	11 0001 1010
790	195	Ã	C3	RD+/--	D3.6	11 0001 0110
785	227	ã	E3	RD +	D3.7	11 0001 0001
798	227	ã	E3	RD--	D3.7	11 0001 1110
484	30	RS	1E	RD--	D30.0	01 1110 0100
539	30	RS	1E	RD +	D30.0	10 0001 1011
489	62	>	3E	RD--	D30.1	01 1110 1001
537	62	>	3E	RD +	D30.1	10 0001 1001
485	94	^	5E	RD--	D30.2	01 1110 0101
533	94	^	5E	RD +	D30.2	10 0001 0101
483	126	~	7E	RD--	D30.3	01 1110 0011
540	126	~	7E	RD +	D30.3	10 0001 1100
482	158	_	9E	RD--	D30.4	01 1110 0010
541	158	_	9E	RD +	D30.4	10 0001 1101
490	190	¾	BE	RD--	D30.5	01 1110 1010
538	190	¾	BE	RD +	D30.5	10 0001 1010
486	222	Þ	DE	RD--	D30.6	01 1110 0110
534	222	Þ	DE	RD +	D30.6	10 0001 0110
481	254	þ	FE	RD--	D30.7	01 1110 0001
542	254	þ	FE	RD +	D30.7	10 0001 1110
331	31	US	1F	RD +	D31.0	01 0100 1011
692	31	US	1F	RD--	D31.0	10 1011 0100
329	63	?	3F	RD +	D31.1	01 0100 1001
697	63	?	3F	RD--	D31.1	10 1011 1001
325	95	_	5F	RD +	D31.2	01 0100 0101
693	95	_	5F	RD--	D31.2	10 1011 0101
332	127	DELETE	7F	RD +	D31.3	01 0100 1100
691	127	DELETE	7F	RD--	D31.3	10 1011 0011
333	159	Ÿ	9F	RD +	D31.4	01 0100 1101
690	159	Ÿ	9F	RD--	D31.4	10 1011 0010
330	191	¿	BF	RD +	D31.5	01 0100 1010
698	191	¿	BF	RD--	D31.5	10 1011 1010
326	223	ß	DF	RD +	D31.6	01 0100 0110
694	223	ß	DF	RD--	D31.6	10 1011 0110
334	255	ÿ	FF	RD +	D31.7	01 0100 1110
689	255	ÿ	FF	RD--	D31.7	10 1011 0001
171	4	EOT	04	RD +	D4.0	00 1010 1011
852	4	EOT	04	RD--	D4.0	11 0101 0100
169	36	$	24	RD +	D4.1	00 1010 1001
857	36	$	24	RD--	D4.1	11 0101 1001
165	68	D	44	RD +	D4.2	00 1010 0101
853	68	D	44	RD--	D4.2	11 0101 0101
172	100	d	64	RD +	D4.3	00 1010 1100
851	100	d	64	RD--	D4.3	11 0101 0011
173	132	„	84	RD +	D4.4	00 1010 1101
850	132	„	84	RD--	D4.4	11 0101 0010
170	164	¤	A4	RD +	D4.5	00 1010 1010
858	164	¤	A4	RD--	D4.5	11 0101 1010
166	196	Ä	C4	RD +	D4.6	00 1010 0110
854	196	Ä	C4	RD--	D4.6	11 0101 0110
174	228	ä	E4	RD +	D4.7	00 1010 1110
849	228	ä	E4	RD--	D4.7	11 0101 0001
660	5	ENQ	05	RD +	D5.0	10 1001 0100
667	5	ENQ	05	RD--	D5.0	10 1001 1011
665	37	%	25	RD+/--	D5.1	10 1001 1001
661	69	E	45	RD+/--	D5.2	10 1001 0101
659	101	e	65	RD +	D5.3	10 1001 0011
668	101	e	65	RD--	D5.3	10 1001 1100
658	133	…	85	RD +	D5.4	10 1001 0010
669	133	…	85	RD--	D5.4	10 1001 1101
666	165	¥	A5	RD+/--	D5.5	10 1001 1010
662	197	Å	C5	RD+/--	D5.6	10 1001 0110
657	229	å	E5	RD +	D5.7	10 1001 0001
670	229	å	E5	RD--	D5.7	10 1001 1110
404	6	ACK	06	RD +	D6.0	01 1001 0100
411	6	ACK	06	RD--	D6.0	01 1001 1011
409	38	&	26	RD+/--	D6.1	01 1001 1001
405	70	F	46	RD+/--	D6.2	01 1001 0101
403	102	f	66	RD +	D6.3	01 1001 0011
412	102	f	66	RD--	D6.3	01 1001 1100
402	134	†	86	RD +	D6.4	01 1001 0010
413	134	†	86	RD--	D6.4	01 1001 1101
410	166	¦	A6	RD+/--	D6.5	01 1001 1010
406	198	Æ	C6	RD+/--	D6.6	01 1001 0110
401	230	æ	E6	RD +	D6.7	01 1001 0001
414	230	æ	E6	RD--	D6.7	01 1001 1110
116	7	BEL	07	RD +	D7.0	00 0111 0100
907	7	BEL	07	RD--	D7.0	11 1000 1011
121	39	'	27	RD +	D7.1	00 0111 1001
905	39	'	27	RD--	D7.1	11 1000 1001
117	71	G	47	RD +	D7.2	00 0111 0101
901	71	G	47	RD--	D7.2	11 1000 0101
115	103	g	67	RD +	D7.3	00 0111 0011
908	103	g	67	RD--	D7.3	11 1000 1100
114	135	‡	87	RD +	D7.4	00 0111 0010
909	135	‡	87	RD--	D7.4	11 1000 1101
122	167	§	A7	RD +	D7.5	00 0111 1010
906	167	§	A7	RD--	D7.5	11 1000 1010
118	199	Ç	C7	RD +	D7.6	00 0111 0110
902	199	Ç	C7	RD--	D7.6	11 1000 0110
113	231	ç	E7	RD +	D7.7	00 0111 0001
910	231	ç	E7	RD--	D7.7	11 1000 1110
107	8	BS	08	RD +	D8.0	00 0110 1011
916	8	BS	08	RD--	D8.0	11 1001 0100
105	40	(	28	RD +	D8.1	00 0110 1001
921	40	(	28	RD--	D8.1	11 1001 1001
101	72	H	48	RD +	D8.2	00 0110 0101
917	72	H	48	RD--	D8.2	11 1001 0101
108	104	h	68	RD +	D8.3	00 0110 1100
915	104	h	68	RD--	D8.3	11 1001 0011
109	136	ˆ	88	RD +	D8.4	00 0110 1101
914	136	ˆ	88	RD--	D8.4	11 1001 0010
106	168	¨	A8	RD +	D8.5	00 0110 1010

922	168	¨	A8	RD--	D8.5	11 1001 1010	
102	200	È	C8	RD +	D8.6	00 0110 0110	
918	200	È	C8	RD--	D8.6	11 1001 0110	
110	232	è	E8	RD +	D8.7	00 0110 1110	
913	232	è	E8	RD--	D8.7	11 1001 0001	
596	9	HT	09	RD +	D9.0	10 0101 0100	
603	9	HT	09	RD--	D9.0	10 0101 1011	
601	41	)	29	RD+/--	D9.1	10 0101 1001	
597	73	I	49	RD+/--	D9.2	10 0101 0101	
595	105	i	69	RD +	D9.3	10 0101 0011	
604	105	i	69	RD--	D9.3	10 0101 1100	
594	137	‰	89	RD +	D9.4	10 0101 0010	
605	137	‰	89	RD--	D9.4	10 0101 1101	
602	169	©	A9	RD+/--	D9.5	10 0101 1010	
598	201	É	C9	RD+/--	D9.6	10 0101 0110	
593	233	é	E9	RD +	D9.7	10 0101 0001	
606	233	é	E9	RD--	D9.7	10 0101 1110	
87	247	÷	F7	RD +	K23.7	00 0101 0111	
936	247	÷	F7	RD --	K23.7	11 1010 1000	Reserved*
151	251	û	FB	RD +	K27.7	00 1001 0111	
872	251	û	FB	RD --	K27.7	11 0110 1000	Reserved*
244	28	FS	1C	RD --	K28.0	00 1111 0100	Reserved*
779	28	FS	1C	RD +	K28.0	11 0000 1011	
249	60	<	3C	RD --	K28.1	00 1111 1001	Reserved*
774	60	<	3C	RD +	K28.1	11 0000 0110	
245	92	\	5C	RD --	K28.2	00 1111 0101	Reserved*
778	92	\	5C	RD +	K28.2	11 0000 1010	
243	124	|	7C	RD --	K28.3	00 1111 0011	Reserved*
780	124	|	7C	RD +	K28.3	11 0000 1100	
242	156	œ	9C	RD --	K28.4	00 1111 0010	Reserved*
781	156	œ	9C	RD +	K28.4	11 0000 1101	
250	188	¼	BC	RD --	K28.5	00 1111 1010	Sync
773	188	¼	BC	RD +	K28.5	11 0000 0101	(Not Used)
246	220	Ü	DC	RD --	K28.6	00 1111 0110	Reserved*
777	220	Ü	DC	RD +	K28.6	11 0000 1001	
248	252	ü	FC	RD --	K28.7	00 1111 1000	Test
775	252	ü	FC	RD +	K28.7	11 0000 0111	
279	253	ý	FD	RD +	K29.7	01 0001 0111	
744	253	ý	FD	RD --	K29.7	10 1110 1000	Reserved*
488	254	þ	FE	RD --	K30.7	01 1110 1000	Reserved*
535	254	þ	FE	RD +	K30.7	10 0001 0111	

Appendix C

Fibre Channel Legal Arbitrated Loop Physical Addresses

This appendix contains legal (neutral disparity) arbitrated loop physical addresses (APLAs) sorted from highest (at the top) to the lowest (at the bottom) priority.

Loop ID	ALPAA HEX	Name	RD -- Code	RD-/+ Code	Previous Running Disparity RD+ Code
7E	00	D0.0	10 0111 0100		01 1000 1011
7D	01	D1.0	01 1101 0100		10 0010 1011
7C	02	D2.0	10 1101 0100		01 0010 1011
7B	04	D4.0	11 0101 0100		00 1010 1011
7A	08	D8.0	11 1001 0100		00 0110 1011
79	0F	D15.0	01 0111 0100		10 1000 1011
78	10	D16.0	01 1011 0100		10 0100 1011
77	17	D23.0	11 1010 0100		00 0101 1011
76	18	D24.0	11 0011 0100		00 1100 1011
75	1B	D27.0	11 0110 0100		00 1001 1011
74	1D	D29.0	10 1110 0100		01 0001 1011
73	1E	D30.0	01 1110 0100		10 0001 1011
72	1F	D31.0	10 1011 0100		01 0100 1011
71	23	D3.1		11 0001 1001	
70	25	D5.1		10 1001 1001	
6F	26	D6.1		01 1001 1001	
6E	27	D7.1	11 1000 1001		00 0111 1001
6D	29	D9.1		10 0101 1001	
6C	2A	D10.1		01 0101 1001	
6B	2B	D11.1		11 0100 1001	
6A	2C	D12.1		00 1101 1001	
69	2D	D13.1		10 1100 1001	
68	2E	D14.1		01 1100 1001	
67	31	D17.1		10 0011 1001	
66	32	D18.1		01 0011 1001	
65	33	D19.1		11 0010 1001	
64	34	D20.1		00 1011 1001	
63	35	D21.1		10 1010 1001	
62	36	D22.1		01 1010 1001	
61	39	D25.1		10 0110 1001	
60	3A	D26.1		01 0110 1001	
5F	3C	D28.1		00 1110 1001	
5E	43	D3.2		11 0001 0101	
5D	45	D5.2		10 1001 0101	
5C	46	D6.2		01 1001 0101	
5B	47	D7.2	11 1000 0101		00 0111 0101
5A	49	D9.2		10 0101 0101	
59	4A	D10.2		01 0101 0101	
58	4B	D11.2		11 0100 0101	
57	4C	D12.2		00 1101 0101	
56	4D	D13.2		10 1100 0101	
55	4E	D14.2		01 1100 0101	
54	51	D17.2		10 0011 0101	
53	52	D18.2		01 0011 0101	
52	53	D19.2		11 0010 0101	
51	54	D20.2		00 1011 0101	
50	55	D21.2		10 1010 0101	
4F	56	D22.2		01 1010 0101	
4E	59	D25.2		10 0110 0101	
4D	5A	D26.2		01 0110 0101	
4C	5C	D28.2		00 1110 0101	
4B	63	D3.3	11 0001 1100		11 0001 0011
4A	65	D5.3	10 1001 1100		10 1001 0011
49	66	D6.3	01 1001 1100		01 1001 0011
48	67	D7.3	11 1000 1100		00 0111 0011
47	69	D9.3	10 0101 1100		10 0101 0011
46	6A	D10.3	01 0101 1100		01 0101 0011
45	6B	D11.3	11 0100 1100		11 0100 0011
44	6C	D12.3	00 1101 1100		00 1101 0011
43	6D	D13.3	10 1100 1100		10 1100 0011
42	6E	D14.3	01 1100 1100		01 1100 0011
41	71	D17.3	10 0011 1100		10 0011 0011
40	72	D18.3	01 0011 1100		01 0011 0011
3F	73	D19.3	11 0010 1100		11 0010 0011
3E	74	D20.3	00 1011 1100		00 1011 0011
3D	75	D21.3	10 1010 1100		10 1010 0011
3C	76	D22.3	01 1010 1100		01 1010 0011
3B	79	D25.3	10 0110 1100		10 0110 0011
3A	7A	D26.3	01 0110 1100		01 0110 0011
39	7C	D28.3	00 1110 1100		00 1110 0011
38	80	D0.4	10 0111 0010		01 1000 1101
37	81	D1.4	01 1101 0010		10 0010 1101
36	82	D2.4	10 1101 0010		01 0010 1101
35	84	D4.4	11 0101 0010		00 1010 1101
34	88	D8.4	11 1001 0010		00 0110 1101
33	8F	D15.4	01 0111 0010		10 1000 1101
32	90	D16.4	01 1011 0010		10 0100 1101
31	97	D23.4	11 1010 0010		00 0101 1101
30	98	D24.4	11 0011 0010		00 1100 1101
2F	9B	D27.4	11 0110 0010		00 1001 1101
2E	9D	D29.4	10 1110 0010		01 0001 1101
2D	9E	D30.4	01 1110 0010		10 0001 1101
2C	9F	D31.4	10 1011 0010		01 0100 1101
2B	A3	D3.5		11 0001 1010	
2A	A5	D5.5		10 1001 1010	
29	A6	D6.5		01 1001 1010	
28	A7	D7.5	11 1000 1010		00 0111 1010
27	A9	D9.5		10 0101 1010	
26	AA	D10.5		01 0101 1010	
25	AB	D11.5		11 0100 1010	
24	AC	D12.5		00 1101 1010	
23	AD	D13.5		10 1100 1010	
22	AE	D14.5		01 1100 1010	
21	B1	D17.5		10 0011 1010	
20	B2	D18.5		01 0011 1010	
1F	B3	D19.5		11 0010 1010	
1E	B4	D20.5		00 1011 1010	
1D	B5	D21.5		10 1010 1010	
1C	B6	D22.5		01 1010 1010	
1B	B9	D25.5		10 0110 1010	
1A	BA	D26.5		01 0110 1010	
19	BC	D28.5		00 1110 1010	
18	C3	D3.6		11 0001 0110	
17	C5	D5.6		10 1001 0110	
16	C6	D6.6		01 1001 0110	
15	C7	D7.6	11 1000 0110		00 0111 0110
14	C9	D9.6		10 0101 0110	
13	CA	D10.6		01 0101 0110	
12	CB	D11.6		11 0100 0110	
11	CC	D12.6		00 1101 0110	
10	CD	D13.6		10 1100 0110	
0F	CE	D14.6		01 1100 0110	
0E	D1	D17.6		10 0011 0110	
0D	D2	D18.6		01 0011 0110	
0C	D3	D19.6		11 0010 0110	
0B	D4	D20.6		00 1011 0110	
0A	D5	D21.6		10 1010 0110	
09	D6	D22.6		01 1010 0110	
08	D9	D25.6		10 0110 0110	
07	DA	D26.6		01 0110 0110	
06	DC	D28.6		00 1110 0110	
05	E0	D0.7	10 0111 0001		01 1000 1110
04	E1	D1.7	01 1101 0001		10 0010 1110
03	E2	D2.7	10 1101 0001		01 0010 1110
02	E4	D4.7	11 0101 0001		00 1010 1110
01	E8	D8.7	11 1001 0001		00 0110 1110
00	EF	D15.7	01 0111 0001		10 1000 1110

Appendix D

Gigabit Ethernet Ordered Sets - Partial List

Gigabit Ethernet defines certain combinations of characters called Ordered Sets. The table in this appendix shows a partial list.

Name	Function	Beginning RD	Ordered Set	8 Bit Hex
C1	Configuration - flip disparity	Positive	K28.5 D21.5 config_reg[7:0] config_reg[15:8]	
C2	Configuration - sustain disparity	Negative	K28.5 D2.2 config_reg	
I1	Idle - correct disparity	Positive	K28.5 D5.6	0xBC 0xC5
I2	Idle - preserve disparity	Negative	K28.5 D16.2	0xBC 0x50
R	Carrier extend	Negative Positive	K23.7	0xF7
S	Start of packet	Negative	K27.7	0xFB
T	End of packet	Negative Positive	K29.7	0xFD
V	Error propagation	Negative Positive	K30.7	0xFE

Appendix E

Primitive Encoding

The table in this appendix (Table 2) describes a set of the K28.5-based Primitive encoding whose 40-bit values (after 8b10b encoding with either starting running disparity) have a Hamming distance (that is, the number of bits different in two patterns) of at least 8. Unassigned encodings might be used by future versions of this standard (Reprinted from American National Standard T10/1562-D).

Table 2: Primitives with Hamming Distance of 8

1st	2nd	3rd	4th	Assignment
K28.5	D01.3	D01.3	D01.3	ALIGN (2)
K28.5	D01.4	D01.4	D01.4	ACK
K28.5	D01.4	D02.0	D31.4	RRDY (RESERVED 0)
K28.5	D01.4	D04.7	D24.0	NAK (RESERVED 1)
K28.5	D01.4	D07.3	D30.0	CREDIT_BLOCKED
K28.5	D01.4	D16.7	D07.3	NAK (RESERVED 2)
K28.5	D01.4	D24.0	D16.7	RRDY (NORMAL)
K28.5	D01.4	D27.4	D04.7	NAK (CRC ERROR)
K28.5	D01.4	D30.0	D02.0	RRDY (RESERVED 1)
K28.5	D01.4	D31.4	D29.7	NAK (RESERVED 0)

Table 2: Primitives with Hamming Distance of 8

1st	2nd	3rd	4th	Assignment
K28.5	D02.0	D01.4	D29.7	ERROR
K28.5	D02.0	D02.0	D02.0	HARD_RESET
K28.5	D02.0	D04.7	D01.4	CLOSE (RESERVED 1)
K28.5	D02.0	D07.3	D04.7	CLOSE (CLEAR AFFILIATION)
K28.5	D02.0	D16.7	D31.4	
K28.5	D02.0	D24.0	D07.3	BREAK
K28.5	D02.0	D29.7	D16.7	
K28.5	D02.0	D30.0	D27.4	CLOSE (NORMAL)
K28.5	D02.0	D31.4	D30.0	CLOSE (RESERVED 0)
K28.5	D04.7	D01.4	D24.0	BROADCAST (RESERVED 1)
K28.5	D04.7	D02.0	D01.4	BROADCAST (CHANGE)
K28.5	D04.7	D04.7	D04.7	BROADCAST (RESERVED 2)
K28.5	D04.7	D07.3	D29.7	BROADCAST (RESERVED 0)
K28.5	D04.7	D16.7	D02.0	BROADCAST (RESERVED 3)
K28.5	D04.7	D24.0	D31.4	BROADCAST (RESERVED CHANGE 0)
K28.5	D04.7	D27.4	D07.3	BROADCAST (RESERVED CHANGE 1)
K28.5	D04.7	D29.7	D30.0	BROADCAST (RESERVED 4)
K28.5	D04.7	D31.4	D27.4	
K28.5	D07.0	D07.0	D07.0	ALIGN (1)
K28.5	D07.3	D01.4	D31.4	
K28.5	D07.3	D02.0	D04.7	
K28.5	D07.3	D04.7	D30.0	
K28.5	D07.3	D07.3	D07.3	
K28.5	D07.3	D24.0	D29.7	
K28.5	D07.3	D27.4	D16.7	
K28.5	D07.3	D29.7	D27.4	
K28.5	D07.3	D30.0	D24.0	
K28.5	D07.3	D31.4	D02.0	
K28.5	D10.2	D10.2	D27.3	ALIGN (0)
K28.5	D16.7	D01.4	D02.0	
K28.5	D16.7	D02.0	D07.3	
K28.5	D16.7	D04.7	D31.4	

Table 2: Primitives with Hamming Distance of 8

1st	2nd	3rd	4th	Assignment
K28.5	D16.7	D16.7	D16.7	OPEN_ACCEPT
K28.5	D16.7	D24.0	D27.4	
K28.5	D16.7	D27.4	D30.0	
K28.5	D16.7	D29.7	D24.0	
K28.5	D16.7	D30.0	D04.7	
K28.5	D16.7	D31.4	D01.4	
K28.5	D24.0	D01.4	D16.7	
K28.5	D24.0	D02.0	D29.7	
K28.5	D24.0	D04.7	D07.3	SOF
K28.5	D24.0	D07.3	D31.4	EOAF
K28.5	D24.0	D16.7	D27.4	EOF
K28.5	D24.0	D24.0	D24.0	
K28.5	D24.0	D27.4	D02.0	
K28.5	D24.0	D29.7	D04.7	
K28.5	D24.0	D30.0	D01.4	SOAF
K28.5	D27.3	D27.3	D27.3	ALIGN (3)
K28.5	D27.4	D01.4	D07.3	AIP (RESERVED WAITING ON PARTIAL)
K28.5	D27.4	D04.7	D02.0	
K28.5	D27.4	D07.3	D24.0	AIP (WAITING ON CONNECTION)
K28.5	D27.4	D16.7	D30.0	AIP (RESERVED 1)
K28.5	D27.4	D24.0	D04.7	AIP (WAITING ON PARTIAL)
K28.5	D27.4	D27.4	D27.4	AIP (NORMAL)
K28.5	D27.4	D29.7	D01.4	AIP (RESERVED 2)
K28.5	D27.4	D30.0	D29.7	AIP (WAITING ON DEVICE)
K28.5	D27.4	D31.4	D16.7	AIP (RESERVED 0)
K28.5	D29.7	D02.0	D30.0	OPEN_REJECT (RESERVED CONTINUE 0)
K28.5	D29.7	D04.7	D27.4	OPEN_REJECT (RESERVED STOP 1)
K28.5	D29.7	D07.3	D16.7	OPEN_REJECT (RESERVED INITIALIZE 1)
K28.5	D29.7	D16.7	D04.7	OPEN_REJECT (PATHWAY BLOCKED)
K28.5	D29.7	D24.0	D01.4	OPEN_REJECT (RESERVED CONTINUE 1)
K28.5	D29.7	D27.4	D24.0	OPEN_REJECT (RETRY)
K28.5	D29.7	D29.7	D29.7	OPEN_REJECT (NO DESTINATION)

Table 2: Primitives with Hamming Distance of 8

1st	2nd	3rd	4th	Assignment
K28.5	D29.7	D30.0	D31.4	OPEN_REJECT (RESERVED INITIALIZE 0)
K28.5	D29.7	D31.4	D07.3	OPEN_REJECT (RESERVED STOP 0)
K28.5	D30.0	D01.4	D04.7	DONE (ACK/NAK TIMEOUT)
K28.5	D30.0	D02.0	D16.7	
K28.5	D30.0	D07.3	D27.4	DONE (CREDIT TIMEOUT)
K28.5	D30.0	D16.7	D01.4	DONE (RESERVED 0)
K28.5	D30.0	D24.0	D02.0	
K28.5	D30.0	D27.4	D29.7	DONE (RESERVED TIMEOUT 0)
K28.5	D30.0	D29.7	D31.4	DONE (RESERVED 1)
K28.5	D30.0	D30.0	D30.0	DONE (NORMAL)
K28.5	D30.0	D31.4	D24.0	DONE (RESERVED TIMEOUT 1)
K28.5	D31.3	D01.3	D07.0	NOTIFY (RESERVED 1)
K28.5	D31.3	D07.0	D01.3	NOTIFY (RESERVED 0)
K28.5	D31.3	D10.2	D10.2	NOTIFY (RESERVED 2)
K28.5	D31.3	D31.3	D31.3	NOTIFY (ENABLE SPINUP)
K28.5	D31.4	D01.4	D30.0	OPEN_REJECT (RESERVED ABANDON 3)
K28.5	D31.4	D02.0	D27.4	OPEN_REJECT (RESERVED ABANDON 0)
K28.5	D31.4	D04.7	D29.7	OPEN_REJECT (CONNECTION RATE NOT SUPPORTED)
K28.5	D31.4	D07.3	D02.0	OPEN_REJECT (RESERVED ABANDON 2)
K28.5	D31.4	D16.7	D24.0	OPEN_REJECT (WRONG DESTINATION)
K28.5	D31.4	D27.4	D01.4	OPEN_REJECT (STP RESOURCES BUSY)
K28.5	D31.4	D29.7	D07.3	OPEN_REJECT (PROTOCOL NOT SUPPORTED)
K28.5	D31.4	D30.0	D16.7	OPEN_REJECT (RESERVED ABANDON 1)
K28.5	D31.4	D31.4	D31.4	OPEN_REJECT (BAD DESTINATION)

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