LeCroy

PROTOCOL SOLUTIONS GROUP
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SAS *InFusion*™ User Manual

Error Injection Platform for

Serial Attached SCSI and Serial ATA

For Software Version 1.2

August 2006

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SAFETY REQUIREMENTS

This section contains information and warnings that must be observed to keep the SAS *InFusion* or SATA *InFusion* operating in a correct and safe condition. You are required to follow generally accepted safety procedures in addition to the safety precautions specified in this section.

Safety Symbols and Terms

Where the following symbols or terms appear on front or rear panels of SAS/SATA *InFusion*, or in this manual, they alert you to important safety considerations.

Symbol	Description
⚠	This symbol is used where caution is required. Refer to accompanying information or documents in order to protect against personal injury or damage to the instrument.
⏚	This symbol is used to denote a safety ground connection.
I	On (Supply)
O	Off (Supply)
∼	This symbol is used to denote "Alternating Current."
CAUTION	The CAUTION sign indicates a potential hazard. It calls attention to a procedure, practice or condition which, if not followed, could possibly cause damage to equipment. If a CAUTION is indicated, do not proceed until its conditions are fully understood and met.
WARNING	The WARNING sign indicates a potential hazard. It calls attention to a procedure, practice or condition which, if not followed, could possibly cause bodily injury or death. If a WARNING is indicated, do not proceed until its conditions are fully understood and met.

Operating Environment

The SAS/SATA *InFusion* is intended for indoor use and should be operated in a clean, dry environment.

NOTE:

Direct sunlight, radiators, and other heat sources should be taken into account when assessing the ambient temperature.

Before using this product, ensure that its operating environment will be maintained within these parameters:

- Temperature: 5 to 40 Centigrade.
- Humidity: Maximum relative humidity 80% for temperatures up to 31 Centigrade, decreasing linearly to 50% relative humidity at 40 Centigrade.
- Altitude: Up to 2,000 m.

WARNING

The SAS/SATA *InFusion* must not be operated in explosive, dusty, or wet atmospheres.

The design of the SAS/SATA *InFusion* has been verified to conform to the applicable safety standards (EN 61010-1:2001, UL 61010-1 2nd Edition and CAN/CSA C22.2 No.61010-1-04) per the following limits:

- Installation (Overvoltage) Category II.
- Pollution Degree 2.
- Protection Class I.

NOTES:

Installation (Overvoltage) Category II refers to local distribution level, which is applicable to equipment connected to main supply (AC power source).

Pollution Degree 2 refers to an operating environment where normally only dry non-conductive pollution occurs. Occasionally, a temporary conductivity caused by condensation must be expected.

Protection Class 1 refers to grounded equipment, in which protection against electric shock is achieved by Basic Insulation and by means of a connection to the protective earthing conductor in the building wiring.

Cooling

The SAS/SATA *InFusion* relies on forced air cooling with internal fans and ventilation openings. Care must be taken to avoid restricting the airflow around the apertures (fan holes). To ensure adequate ventilation, it is required to leave a 10 cm (4 inch) minimum gap around the sides of the instrument.

CAUTION

Do not block ventilation holes located on both sides of SAS/SATA *InFusion.*

AC Power Source

The SAS/SATA *InFusion* operates from a single-phase, 100-240 Vrms (+/-10%) AC power source at 50/60 Hz (+/-5%).

No manual voltage selection is required because the instrument automatically adapts to line voltage.

Depending on the accessories installed (PC port plug-ins, etc.), the instrument can draw up to 55 W (55 VA).

The power supply of the SAS/SATA *InFusion* is protected against short circuit and overload by a 5x20 mm fuse (T1.0 A/250 V). See "Fuse Replacement" in this section for replacement instructions.

NOTE:

The SAS*InFusion*/SATA*InFusion* automatically adapts itself to the AC line input within the following ranges:

Voltage Range: 90 - 264 Vrms.

Frequency Range: 47-63 Hz.

Power and Ground Connections

The SAS/SATA *InFusion* is provided with a grounded cord set containing a molded three-terminal polarized plug and a standard IEC320 (Type C13) connector for making line voltage and safety ground connection. The AC inlet ground terminal is connected directly to the frame of the instrument. For adequate protection against electrical shock hazard, the power cord plug must be inserted into a mating AC outlet containing a safety ground contact.

WARNING

Electrical Shock Hazard!

Any interruption of the protective conductor inside or outside of the SAS/SATA *InFusion,* or disconnection of the safety ground terminal creates a hazardous situation.

Intentional interruption is prohibited.

Fuse Replacement

Set the SAS/SATA *InFusion* power switch to OFF and disconnect the power cord before inspecting or replacing the fuse. Open the black fuse holder using a small, flat-bladed screwdriver. Remove the old fuse, replace it with a new 5x20 mm "T" rated 1.0 A/250 V fuse, and reinstall the fuse holder.

WARNING

For continued fire protection at all line voltages, replace fuse with the specified type and rating only. Disconnect the power cord before replacing fuse.

Cleaning

Clean only the exterior of the SAS/SATA *InFusion*, using a damp, soft cloth. Do not use chemicals or abrasive elements. Under no circumstances allow moisture to penetrate the instrument. To avoid electrical shock, unplug the power cord from the AC outlet before cleaning.

WARNING

No operator serviceable parts inside. Do not remove covers. Refer servicing to qualified personnel.

Chapter 1: Overview

SAS *InFusion* is an error injector and traffic modification tool that allows users to verify real-world fault handling for Serial Attached SCSI (SAS) and Serial ATA (SATA) systems. SAS *InFusion* is designed to sit unobtrusively in the data path on a live system and to programmatically alter or corrupt traffic. This makes SAS *InFusion* the ideal tool for stress-testing systems using actual workloads.

SAS *InFusion* supports SAS SSP, SMP, STP and SATA-based protocols operating across a single 1.5G or 3.0G SAS or SATA link. SAS *Infusion* monitors traffic from both directions in real-time and relies on predefined rules to replace any bit(s), primitive, or parameter with one specified by the user. The SAS *InFusion* system can change traffic when it detects a specific sequence or within a designated time interval, yet it requires no complicated scripts, programming, or simulation tools.

Small, flexible, and easy to use, SAS *InFusion* is specifically designed to verify recovery characteristics within a subsystem. An easy pop-up menu interface allows users to create specific test scenarios in just minutes.

Once a SAS *InFusion* session is started, the system automatically handles protocol handshaking between devices. SAS *InFusion* transmits a faithful copy of the original data stream down to the CRC value which, if needed, it recalculates. SAS *InFusion* allows test engineers to systematically verify error recovery in ways not possible with other test platforms.

Key Features

- **Error Injection**: Can inject CRC, disparity, 8b/10b encoding, framing, and coding errors.
- **Break Link Recovery**: Can programmatically break the connection to test link recovery.
- **Value Replacement**: Can monitor the link for specific values, patterns or primitives (as low as bit level) and replace with user-defined values. You can replace values on every occurrence, after a specified number of occurrences, or after a specified time interval.
- **Packet Drop**: Can remove individual primitives, address frames, or data frames from the stream to verify retry behavior.
- **Primitive Manipulation**: Can replace handshaking and flow control primitives to help validate robustness of a design.
- **Traffic Monitoring:** Can operate as a traffic monitor, collecting statistical data on user-specified parameters. In this mode, data are passed unchanged in both directions.
- **Menu-Driven Interface:** Allows easy set-up of test scenarios.
- **API based on C++:** Allows users to develop custom test applications.

With respect to traffic modification, elements you can modify in the Link Layer include primitives, CRC, scrambled traffic, and SSP, SMP and STP connection events. Elements you can not modify in traffic include clock skew management, OOB & power management, and signal integrity.

Stand-alone vs. Networked Mode

The SAS *InFusion* platform consists of a hardware device that connects to the line under test and a Windows-based software application used to create and download test scripts to the device. You also can use the SAS *InFusion* software application to configure and control the device across an Ethernet link. This is called networked mode.

SAS InFusion test scripts are called scenarios. Scenarios determine how the SAS *InFusion* hardware device monitors and modifies line traffic. You must use the SAS *InFusion* application to create and download scenarios.

However, once you have downloaded scenarios to the SAS *InFusion* device, you can break the Ethernet link to the application and operate the device in stand-alone mode. In stand-alone mode, you can easily relocate the device, and you use the device LCD panel to select and execute scenarios.

Regardless of the mode you choose to control testing, the SAS *InFusion* connections to the line are the same: the device is connected between the SAS/SATA host and the PHY of the test target (DUT).

Chapter 2: General Description

This chapter describes the SAS *InFusion* hardware device.

System Components/Packing List

- SAS *InFusion* hardware device.
- One power cable.
- One BNC cable.
- Two external-to-internal SATA/SAS Cables.
- Two internal-to-external Junction Boards.
- Five internal-to-internal Junction Boards.
- SAS *InFusion* software application program on CD-ROM.
- User Manual.

> **Note:**   For brevity, this manual calls the SAS *InFusion* hardware device the SAS *InFusion* box.

SAS *InFusion* Front Panel

The front panel of the SAS *InFusion* box consists of an LCD panel, three control buttons, two external SAS/SATA connectors, and three LEDs (Figure 1).

Figure 1   **SAS *InFusion* Front Panel**

LCD Panel   The LCD panel displays backlit four-line, twenty-four character messages. It is a menu-driven interface that allows a user to configure the box, view status, select scenarios to run, and stop and start scenarios.

Chapter 6 describes the LCD panel menus. The first menu to appear after boot-up is the Root menu (shown in Figure 1).When SAS *InFusion* box is turned ON for the first time, the LCD panel shows two menu items:

> Box Setup
> SAS Configuration

After you have downloaded some scenarios to the SAS *InFusion* box, the Root menu shows four items:

- Box Setup
- SAS Configuration
- Start Infusion
- Infusion Setup

Front Panel Control Buttons

The control buttons are located on the right side of the control panel. They consist of two buttons to navigate LCD menus, the Up and Down buttons, and a Center button to select menu items.

Initiator and Target SAS/SATA Cable Connectors

The two external SAS/SATA connectors provide high-speed, differential connections to the test initiator (host) and target (device-under-test, or for brevity, DUT). These connectors support the external-to-internal SATA cables provided.

SAS *InFusion* Rear Panel

The SAS *InFusion* rear panel consists of two BNC Input/Output connectors, one USB connector, an Ethernet port, and a power connector (Figure 2).

Figure 2   SAS*InFusion* Rear Panel

BNC Input/Output Connectors

The two BNC connectors are ports for Trigger In and Trigger Out signals for the box. They allow you to daisy-chain the box with other SAS *InFusion* boxes for multi-link tests. They also allow you to connect the SAS *InFusion* box to an external test device, such as an analyzer or oscilloscope.

The Trigger In signal is used to inject an error or other action into the protocol data stream at a specific instance in time, while the Trigger Out signal can be asserted when a pattern match or error injection occurs during SAS *InFusion* operation.

| **Ethernet Connector** | The 10/100 Ethernet host connector allows you to link the SAS *InFusion* box to a PC running the SAS *InFusion* software application. You use this link to download scenarios. If you choose to operate the box in networked mode, you also can use the link to control the box across an Ethernet LAN. |

Scenarios are test scripts that define how the box monitors and modifies line traffic. You can only create scenarios on a PC running the SAS *InFusion* application. You can not create scenarios via the box LCD panel.

Once you have created and downloaded scenarios to the SAS *InFusion* box, you can either use the SAS *InFusion* software on the PC or the LCD panel on the SAS *InFusion* box to select the scenario that you wish to run and to start and stop that scenario.

By default, SAS *InFusion* is set up to use Dynamic Host Control Protocol (DHCP). This means that, under normal circumstances, you will not have to set an IP address and subnet mask. If you prefer to set a static IP address, you can do so via the box LCD panel.

If you want to eventually run SAS *InFusion* in stand-alone mode (without an Ethernet connection), you can do so only after creating the scenarios on the PC and downloading them to the box. However, once you have downloaded scenarios, you can break the Ethernet link between the PC and box and use the box LCD panel to select and execute a scenario.

| **USB Connector** | The USB connector will be enabled in a future release. It will provide an alternative to the Ethernet port for connecting the box to a PC running the SAS *InFusion* application. |

| **Power Supply** | The internal, 125 watt triple-output (+3.3V, +5V, +12V) power supply can accept 110 to 240 VAC at 50 to 60 Hz. |

Chapter 3: Installation and Setup

This chapter describes how to install and setup the SAS *InFusion* software application and hardware device (the SAS *InFusion* box).

PC Requirements

SAS *InFusion* software installs on a Windows XP or Windows 2000 PC.

Refer to the readme file on the installation CD for PC requirements.

PC Firewall and Other Communication Settings

Software firewalls, IP filtering, IP security policies, and other items can limit the types of messages that a PC can receive from the SAS *InFusion*. box. This can particularly affect users attempting to dial-into a network and administer SAS *InFusion* remotely.

> **Note:**   In order for SAS *InFusion* boxes to be visible on the network and to communicate correctly, set communication parameters on the PC as follows.

- Allow to initiate outbound TCP connections using ports 4000 and 4001
- Allow to send UDP broadcast messages using port 4002
- Allow to accept and process UDP messages using ports 4003 and 4004
    (Dial-in users must set communication parameters in the dial-in software.)

> **Note:**   The mechanism by which SAS *InFusion* software discovers (establishes communication with) boxes on the network only allows one instance of the SAS *InFusion* software to run at a time. This limitation includes applications based on the SAS *InFusion* API that the user has created.

Installing SAS *InFusion* Software

SAS *InFusion* software installs on a windows-based PC. To install the software:

Step 1   Insert the SAS *InFusion* software CD into the CD ROM drive of the PC that you will use to create SAS *InFusion* scenarios. The CD software installer application runs.

Step 2   Follow the onscreen instructions for installing the software on the PC hard drive.

Step 3   To start the application, launch the LeCroy SAS *InFusion* program from the Start menu (Start > Programs > LeCroy > InFusion > LeCroy InFusion). The application display appears.
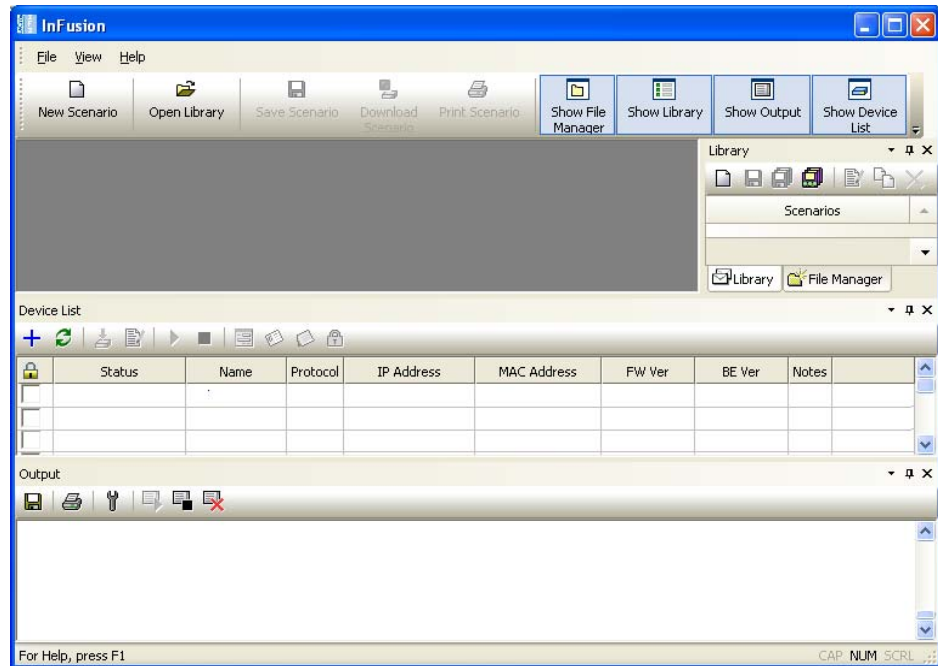
Figure 3   SAS InFusion Software Application Interface

> **Note:**   You can use the software without connecting to a SAS *InFusion* box. When not connected, you can create and store scenarios for later download and use.

Connecting SAS *InFusion* to an Ethernet LAN

An Ethernet connection provides the means to download scenarios from the SAS *InFusion* software to a box. If you intend to run the box in a networked mode, it is also the primary means to control the box.

While many users will probably set up both their Ethernet and SAS/SATA line connections at the same time, it is not necessary to do so. If preferred, you can install SAS *InFusion* anywhere on your LAN, download scenarios to it, and then later move it to your test lab.

Once in the lab, you can run the box in stand-alone mode (without Ethernet) and use the LCD panel to select a scenario and execute it.

To connect SAS *InFusion* via Ethernet:

Step 1   Remove SAS *InFusion* from its shipping container.

Step 2   Connect the unit to a 100-volt to 240-volt, 50 Hz to 60 Hz, 120W power outlet using the power cord provided.

Step 3   Connect a standard Ethernet cable between the Ethernet port on the back of the SAS *InFusion* box and your Ethernet LAN.

Step 4   Turn ON the power switch on the rear of the box. After power is ON, the SAS *InFusion* box boots up. This initialization process lasts a few seconds. During boot-up the box displays initialization messages and beeps once.

If your LAN uses Dynamic Host Connection Protocol (DHCP), plugging the box into your LAN will cause your DHCP server to allocate an IP address and subnet mask and bring SAS *InFusion* up onto the network. If your LAN uses static IP addressing, you will need to use the LCD panel to assign an IP address, subnet mask, and default gateway.

Assigning a Static IP Address Using the LCD Panel

If your network does not use DHCP, you can assign a static IP address via the LCD panel.
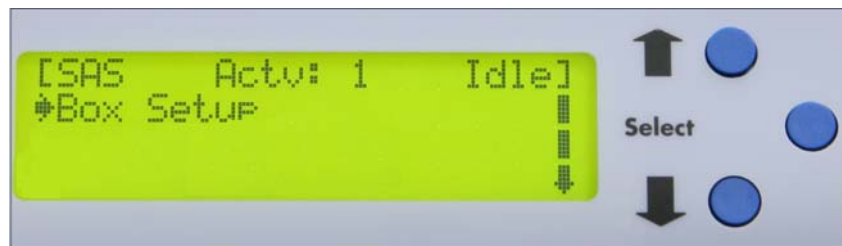
Figure 4   **LCD Panel Root Menu at Initial Set-up**

Step 1   From the Root menu on the LCD panel, press the **Select** (middle) button to go to the Box Setup menu**.** The Box Setup menu appears (Figure 5).

Figure 5   **LCD Panel Box Setup Menu**

Step 2   Press the **Bottom** button once on the LCD panel to move the selection arrow next to **IP Mode**.

Step 3   Press the **Select** button to select **IP Mode**. The IP Mode menu appears (Figure 6). It shows two options: Static and Dynamic. The default selection is Dynamic.

Figure 6   LCD Panel IP Mode Menu

Step 4   Press the **Select** button to select **Static**.

Step 5   Return to the previous menu by pressing the **Bottom** button
               twice to move the Selection arrow to **[Back]**, then press the
               Select button to select it. The Box Setup menu appears
               (Figure 7). The Selection arrow points to **IP Mode**.

Figure 7   LCD Panel Box Setup Menu: Arrow at IP Mode

Step 6   Press the **bottom** button once to move to **IP Address**, and then
               press the **select** button to select it. The IP Address appears
               (Figure 8).
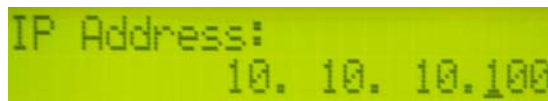
Figure 8   LCD Panel: IP Address Display

Step 7   To edit the IP address, use the buttons as follows:

- Bottom button: To move the cursor.

- Top button: To edit the numbers.

- Select (center) button: To go to the previous menu.

Step 8   When finished editing, press the **Select** button to return to the
               previous menu.

Step 9   Repeat steps 6 and 7 for the subnet mask and default gateway.

Step 10   Once you have completed the IP addressing, reboot the box by
               returning to the Box Setup menu and then pressing the **Bottom**

button until you see Reboot**.**
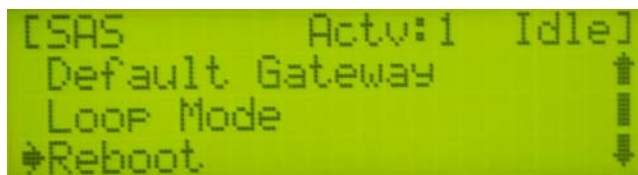
Figure 9   LCD Panel Box Setup Menu: Reboot Display

Step 11   Press Select to select **Reboot** and then select **Confirm** to start the reboot.

Rebooting saves the configurations. **Do not simply power cycle the box.** Power cycling will not save your new settings.

Assuming that the SAS *InFusion* box is physically connected to an Ethernet LAN, and that you have configured it correctly, it should immediately come up on the network.

Checking the IP Address Using the LCD Panel

To verify the box IP address:

Step 1   From the Root menu, press the **Select** button to select **Box Setup.**

Step 2   Press the **Down** button eight times on the front of the SAS *InFusion* device to display **About**.

Step 3   Press the **Enter** button on the front panel to select **About**. Scroll until the IP address of the box appears (Figure 10).
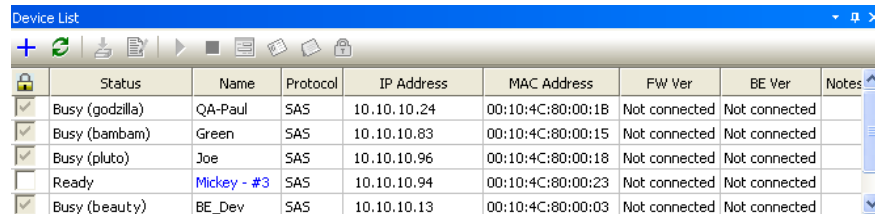
Figure 10   LCD Panel About Menu

Checking the DHCP Setting Using the LCD Panel

The **About** menu now displays the **IP Mode** settings. You can verify that SAS *InFusion* is set to use DHCP by going to the **About** menu (as shown above) and scrolling down to **IP Mode**.

Linking the SAS *InFusion* Device and Software

Once the SAS *InFusion* box is running and has been connected to a LAN, it should be visible in the Device List window in the SAS *InFusion* software. If it is not, you may need to wait or refresh the software in order for the box to appear. To refresh the software, click Refresh Devices button, second from the left on the Device List Window toolbar.

	Status	Name	Protocol	IP Address	MAC Address	FW Ver	BE Ver	Notes
☑	Busy (godzilla)	QA-Paul	SAS	10.10.10.24	00:10:4C:80:00:1B	Not connected	Not connected	
☑	Busy (bambam)	Green	SAS	10.10.10.83	00:10:4C:80:00:15	Not connected	Not connected	
☑	Busy (pluto)	Joe	SAS	10.10.10.96	00:10:4C:80:00:18	Not connected	Not connected	
☐	Ready	Mickey - #3	SAS	10.10.10.94	00:10:4C:80:00:23	Not connected	Not connected	
☑	Busy (beauty)	BE_Dev	SAS	10.10.10.13	00:10:4C:80:00:03	Not connected	Not connected	

Figure 11   Device List Window

Note: To display the Device List window, select View > Views > Devices from the menu or press the Device List button from the application task bar.

Updating Firmware and Bus Engine

In general, when software upgrades are released, the new software requires that you update the SAS *InFusion* firmware and BusEngine.

To update the firmware and the BusEngine:

Step 1   Click in the checkbox in the first column (under the Lock symbol) to select the SAS *InFusion* device (box).

Step 2   After selecting the device, right click and choose **Update Device** from the Popup menu (Figure 12).

Step 3   The software automatically chooses the proper image from the InFusion directory. Click **Update Devices** to begin the update process.

Step 4   The Update Devices window closes and a progress indicator displays status of the update process (Figure 13). When update has completed, the display should reflect the updated firmware and BusEngine rev:
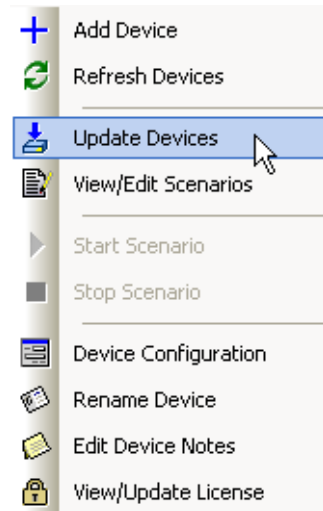
Figure 12   Device Pop-Up Menu
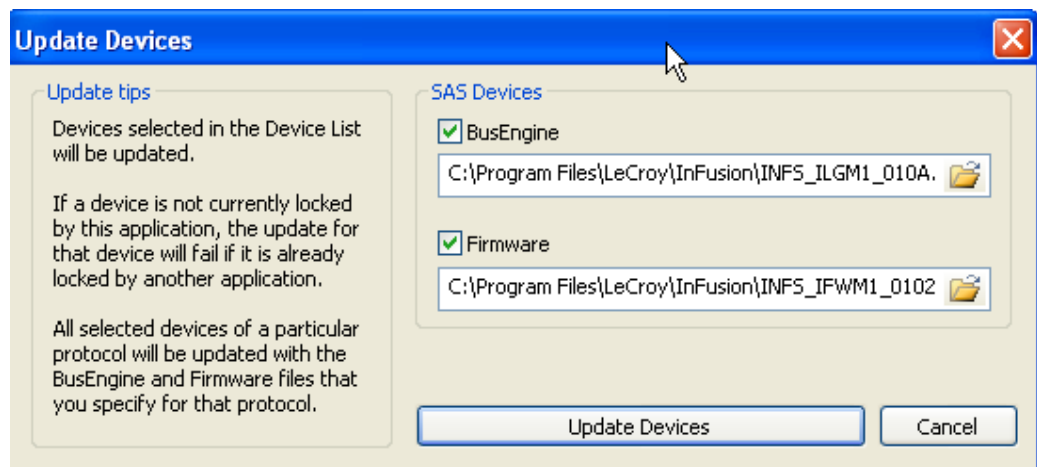
Figure 13   Update Devices Dialog Box

Status	Name	Protocol	IP Address	MAC Address	FW Ver	BE Ver	Notes
Unknown		None	155.155.155.1	Unknown	Unknown (Req: 1.02)	Unknown (Req: 1.10)	Notes
Connected	InFusion	SAS	172.16.128.88 ...	00:10:4C:80:00:54	1.02	.10	
Ready	QA-S	SAS	172.16.128.137 ...	00:10:4C:80:00:6E	Unknown (Req: 1.02)	n (Req: 1.10)	
Ready	ZDougDoug	SAS	172.16.128.173 ...	00:10:4C:80:00			
Busy (butthead)	InFusion	SAS	172.16.128.161	00:10:4C:80:00			
Busy (pluto)	InFusion	SAS	172.16.128.166	00:10:4C:80:00			

FW Ver	BE Ver
Unknown (Req: 1.02)	Unknown (Req: 1.10)
1.02	1.10
Unknown (Req: 1.02)	Unknown (Req: 1.10)

Figure 14   Device List Window: Update Version IDs

Connecting SAS *InFusion* to the SAS/SATA DUT

There are three ways to set-up SAS *InFusion*:

- Direct connect without analyzer
- Direct connect with analyzer
- Multiple connections using octopus cables

Connection without Analyzer

The simplest way to set up SAS *InFusion* is to connect the box over a single line to a device and host (Figure 15).

This set-up uses two external-to-internal SATA cables.

Figure 15   Connection Without Analyzer

Connection with Analyzer: 1-Channel Configuration

You can easily add an analyzer to the configuration above by placing it between the SAS *InFusion* box and the DUT or the box and the host controller.

Figure 16   Connection with Analyzer: One-Channel Configuration

Connection with Analyzer: 2 Channel Configuration

With a two channel analyzer, you can set up the analyzer so that it records traffic before and after modification by the SAS*InFusion* box (Figure 17).

The host controller sends unmodified traffic to the analyzer. The traffic is recorded by the analyzer and then sent to the SASInFusion box where it is modified. Afterwards, the modified traffic is looped back into a second channel on the analyzer and recorded again. From there, the traffic passes back through to the device. The result will be a two-channel recording.

Figure 17   Connection With Analyzer: Two-Channel Configuration

Multiple Connect-ions using "Octopus" Cables

To use internal "octopus" cables with the SAS *InFusion* box you will also need to use LeCroy-provided junction boards and two external SATA cables.

Junction boards function as an interconnect between the external cables and the octopus cables.

Figure 18   Multiple Connections Using "Octopus" Cables

Chapter 4: Software Overview

This chapter describes key features of SAS *InFusion* software.

Starting the SAS *InFusion* Program

To start the SAS *InFusion* Program from the PC Start menu:

Step 1 Click **Start**.

Step 2 Select **Programs**.

Step 3 Select **LeCroy**.

Step 4 Select **InFusion**.

Step 5 Click **LeCroy InFusion**.

The application display appears (Figure 19).
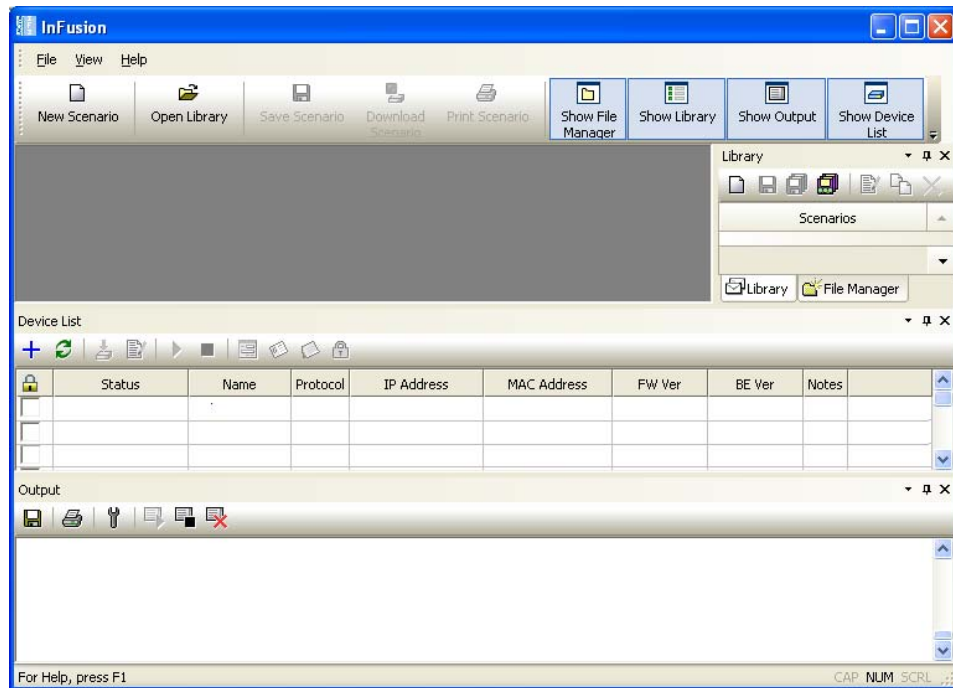
Figure 19   **SAS InFusion Application Display: No Scenarios Open**

Application Layout and Description

The SAS *InFusion* software application presents a multi-windowed interface that consists of the following elements (Figure 20):

- • File manager.
- • Libraries. There are two types: main library (shown below) and device libraries (not shown).
- • Work area.
- • Log window.
- • Device list.

You can choose to hide most of these windows.
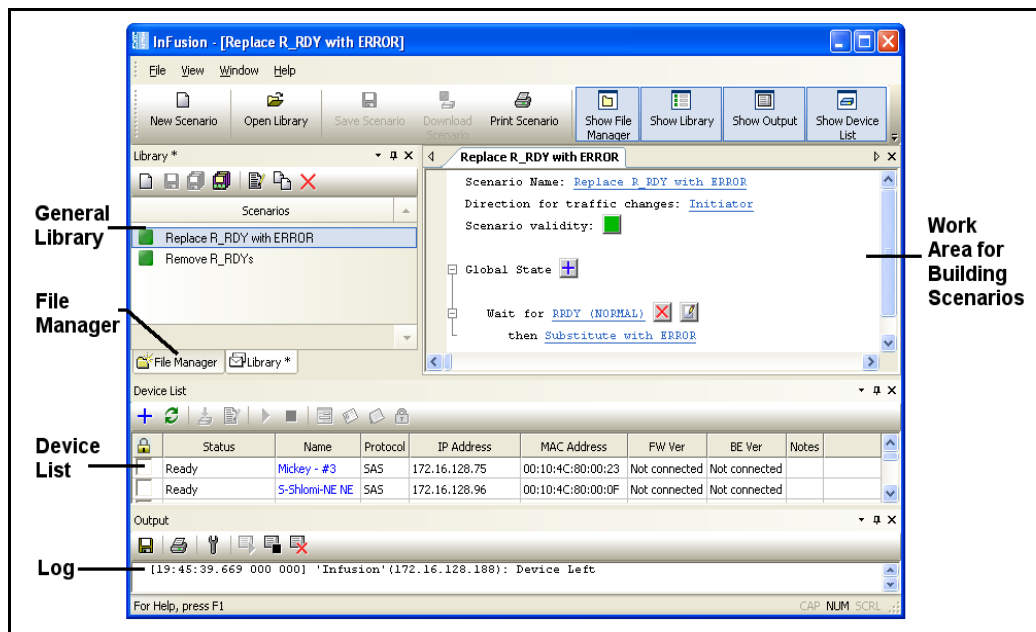
Figure 20   SAS InFusion Application Display: Main Elements

File Manager
File Manager is a tool for navigating to SAS *InFusion* library files (*.infdb) and the folders they are stored in.

Libraries
Libraries are windows responsible for holding scenarios. Scenarios are test scripts that specify how SAS InFusion monitors and modifies line traffic.

There are two types of libraries: device libraries, which are associated with each SAS *InFusion* device, and general libraries that serve as archives. You can download up to ten scenarios to each device library. The software limits you to ten scenarios because ten is the limit that the SAS *InFusion* hardware can store in flash memory.

General libraries can hold any number of scenarios. You can create multiple general libraries and put them at any location on your hard drive.

Table 1   General Library Buttons

	General Library Toolbar		
	Create New Scenario		View/Edit Scenarios. Opens the Scenario window for editing scenario settings.
	Save Scenario		Insert Copy of Selected Item. Makes a copy of selected scenario and adds it to the library.
	Save Library		Delete Selected Scenario
	Save Copy of Library		

Table 2   Device Library Buttons

	Device Library Toolbar		
	Download Scenario to Device		Delete Selected Scenario
	Download All Scenarios To Device		Refresh Scenario
	Save Copy of Library		Start Scenario
	View/Edit Scenarios. Opens the Scenario window for editing scenario settings		Stop Scenario
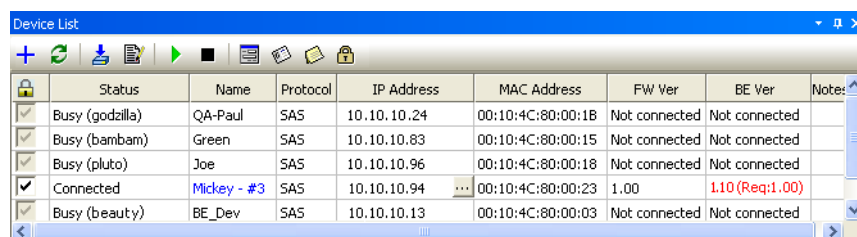
Work Area   The Work Area displays scenario contents. To see scenario contents, Click on the **New Scenario** button or double-click on one of the listed scenarios (if present) in a library.

Output Window   The Output Window logs status on commands and user actions.

<div align="center">**Table 3   Log Buttons**</div>

	Output Toolbar	
💾	Save Log	▣▶ Start Logging
🖨	Print Log	▣■ Stop Logging
🔧	Log Options	▣✗ Clear Log

Device List

<div align="center">**Figure 21   Device List Window**</div>

The Device List window keeps track of SAS *InFusion* boxes that it detects on the Ethernet network (Figure 21). It shows identity information about each box, such as its name, IP address, and license status. It also allows you to change the values in these fields.

Device List Fields
The fields in the Device List window have the following functions:

🔒 : Selects the box for use and locks it so that other users cannot use it. Only one user can control a box at a time.

Status: Indicates if the box is ready for use or busy. For example, if a box has been locked by another user, it will show up in the Status field as Busy. The Status field also shows the name of the host PC connected to the box.

Name: Displays the name of the SAS *InFusion* platform. This is a user-configurable field.

Protocol: Indicates the protocol of the *InFusion* box. At present, SAS is the only option. Future *InFusion* products will be based upon other protocols.

IP Address: Lists the IP address of each device. The little grey box to the right allows you to change the IP address directly from this screen.

MAC Address: Lists the MAC address of the box. The MAC address is a factory-assigned setting that can not be changed. You can confirm the MAC address by looking at the MAC address sticker affixed to the bottom of the SAS *InFusion* box. It is also listed in the LCD menu (Box Setup > About).

Firmware Version: Lists the firmware version of the box.

Bus Engine Version: Lists the BusEngine version of the box.

Notes: Provides a field for adding comments about each device.

Device List Buttons

The Device toolbar lets you change the settings for SAS *InFusion* boxes. It also lets you open the Device List library for a selected box and start traffic modification.

To use the toolbar, first select a device by placing a check in the checkbox in the row representing the box of interest. The same options as shown in the toolbar can also be accessed by right-clicking while the mouse pointer is over the row representing that device within the Device List window.

Selecting a box causes the software to establish an Ethernet connection to the box. When a connection is established, the status for the device will read Connected and the toolbar buttons activate.

Table 4   Device List Buttons

➕ 🔄 📥 📝 ▶ ■ 📋 🗐 🗐 🔒		Device List Toolbar	
➕	Add Device to List. Opens a dialog for entering a static IP address, device name, and notes	■	Stop Scenario
🔄	Refresh Device List. Causes the software to poll the Ethernet LAN for *InFusion* devices and to repopulate the Device List with its findings.	📋	Device Configuration. Opens a dialog for viewing the SATA Hold Handling & Scrambling settings for each device. Also controls swing voltages, SSC, OOB select.
📥	Update Device. Opens a dialog for updating BusEngine & Firmware files.	🗐	Rename Device. Changes the name of the device as it appears in the Device List.
📝	Open Device Library. Opens the Device Library window for the selected SAS *InFusion* device[1]. The Device Library will display a list of scenarios for the device and let you view and edit them.	🗐	Edit Device Notes. Allows notes to be added or edited to the Notes column in the Device List window
▶	Start Scenario. If a Device Library is open and a scenario has been selected, this button will instruct the SAS *InFusion* device to begin modifying traffic.	🔒	View/Update License. Opens a dialog for displaying license status and updating the license. See chapter 7 for an explanation.

[1] You also can open the device library by double-clicking on the device name in the device list.

More detail on some of these selections is shown in the sections below.

Add Device to List

Selecting the **Add Device to List** button will bring up a screen (see below) that will allow you to enter the IP Address (this is the address that was entered into the *InFusion* box in "Assigning a Static IP Address Using the LCD Panel" on page 9).
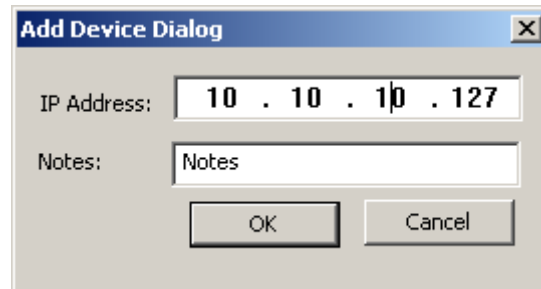
Figure 22   Add Device to List Dialog

Enter any notes you would like associated with this device, and click OK. The device will now appear on the list of available devices.

Update Device

If a device is highlighted in the list, selecting the **Update Device** button will bring up a dialog box to allow you to update the BusEngine and/or the firmware (default setting is to update both). See "Updating Firmware and Bus Engine" on page 12 for more details.

Open Device Library

If a device is highlighted in the list, selecting the **Open Device Library** button will add the device library to the screen (alongside the Main Library).
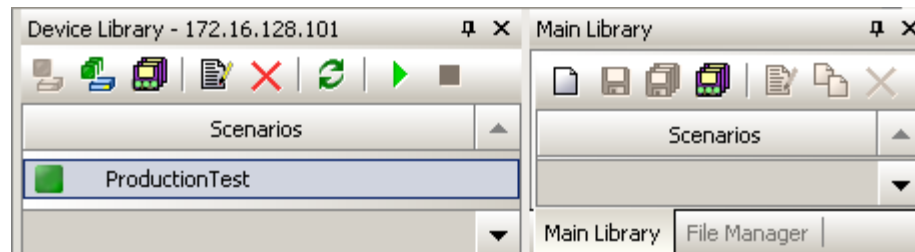
Figure 23   Device Libraries

If the device library contains test cases, these test cases can be selected and run using the arrow button (or stopped using the black square) either on the device list or on the device library screen.

Device Configuration

If a device is highlighted in the device list, selecting **Device Configuration** will bring up a screen allowing you to configure the device. The screen is show below.

Figure 24   Device Configuration

When device configuration options are changed (see below for a description of these options), you may save the new options as the default configurations for that device, or you may save them temporarily by clicking **OK**. If you make a temporary change by clicking **OK**, the new device configurations will remain until the *InFusion* box is powered off (or the options are changed again through the Device Configuration screen).

If you select **Save as Default**, the *InFusion* box will need to be restarted to permanently save the new configuration. A screen will appear as follows:
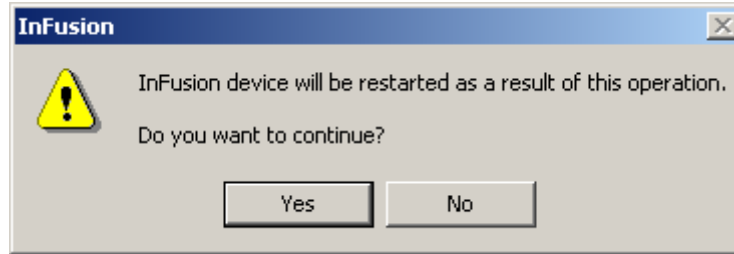
Figure 25   Restart *InFusion* Screen

Click **Yes**. The *InFusion* device will temporarily disappear from the network (and from the list of devices in the Device List), and then will reappear once it has restarted.

An explanation of some of the options available in Device Configuration is as follows:

- **SATA Hold Handling**. Default setting is enabled. When enabled, *InFusion* acts to maintain the data link integrity by intelligently managing HOLD conditions. When disabled is selected, *InFusion* simply retransmits traffic and does not attempt to manage HOLD conditions. For more on this issue, see "SATA Hold Handling in SAS InFusion" on page 25.

- **Scramble data to Target**. Default setting is enabled. When enabled, *InFusion* will scramble frame data going to the target device as specified in the SAS specification. When disabled, the scrambler is bypassed.

- **Descramble data from Target**. Default setting is enabled. When enabled, *InFusion* will descramble frame data coming from the target as specified in the SAS specification. When disabled, the descrambler will be bypassed. Data dword matchers will attempt to match scrambled data, just as if it had been received on the line.

- **Scramble data to Initiator**. Default setting is enabled. When enabled, InFusion will scramble frame data going to the initiator device as specified in the SAS specification. When disabled, the scrambler is bypassed.

- **Descramble data from Initiator**. Default setting is enabled. When enabled, *InFusion* will descramble frame data coming from the initiator as specified in the SAS specification. When disabled, the descrambler will be bypassed. Data dword matchers will attempt to match scrambled data, just as if it had been received on the line.

- **Swing to Initiator.** Default setting is Normal. Controls the peak-to-peak voltage level of the signal sent by InFusion to the Initiator. Normal is 440mV to 660mV peak-to-peak. High is 800mV to 1200mV.

- **Swing to Target.** Default setting is Normal. Controls the peak-to-peak voltage level of the signal sent by InFusion to the Target. Normal is 440mV to 660mV peak-to-peak. High is 800mV to 1200mV.

- **Spread Spectrum Clock to Initiator**. Default setting is Disabled. When disabled, *InFusion* uses a normal (fixed frequency) clock to transmit traffic to the Initiator. When enabled, *InFusion* uses a spread spectrum clock, where the clock frequency varies over time through a small range of frequencies. The intent of a spread spectrum clock is to reduce interference with other devices that might be sensitive to the fixed clock frequency.

- **Spread Spectrum Clock to Target**. Default setting is Disabled. When disabled, *InFusion* uses a normal (fixed frequency) clock to transmit traffic to the Target. When enabled, *InFusion* uses a spread spectrum clock, where the clock frequency varies over time through a small range of frequencies. The intent of a spread spectrum clock is to reduce interference with other devices that might be sensitive to the fixed clock frequency.

- **Out of Band Sensitivity to Initiator.** Default is Normal. When set to Decrease by 30mV or Decrease by 60 mV, the sensitivity of the idle detection circuits are decreased, to enable correct detection of marginal signals.

- **Out of Band Sensitivity to Target.** Default is Normal. When set to Decrease by 30mV or Decrease by 60 mV, the sensitivity of the idle detection circuits are decreased, to enable correct detection of marginal signals.

SATA Hold Handling in SAS *InFusion*

Under normal operation, SAS *InFusion* transmits data traffic in both directions without any modifications at all, other than the specific modifications defined in scenarios and/or test cases which the user has scripted and are currently active. The only normal effect of inserting a SAS *InFusion* box into a data stream is the slight delay as traffic is received by *InFusion* and then retransmitted.

However, there are certain unusual situations where even the slight delay in retransmitting the traffic might cause problems in communication between initiator and target, and one of these is the flow control mechanism defined as a HOLD condition. SATA devices may pause data transfer from another device by issuing a HOLD primitive, which requires the sending device to (very) quickly cease sending traffic and instead transmit HOLDA primitives. Note that, under normal circumstances, the HOLD condition applies to traffic in only one direction, and traffic in the other direction proceeds as usual.

In order to manage this issue, under these conditions *InFusion* will act like an expander (which has to deal with the same issue), and as soon as *InFusion* receives a HOLD primitive from a device, *InFusion* ceases to transmit data to that device and instead transmits HOLDA primitives. To avoid losing data, *InFusion* will simultaneously begin transmitting HOLD primitives to the sending device, and will buffer the small amount of data received until the sending device can respond and cease sending data. When data flow is restored, *InFusion* reestablishes communication including transmitting any data traffic which was buffered before flow could be stopped.

Although highly unlikely, there are some special case scenarios that could develop. If both devices begin sending HOLD primitives at the same time, *InFusion* cannot simply send HOLDA primitives to both devices, since the device can continue to transmit data while receiving HOLDA primitives. Instead, *InFusion* transmits HOLD primitives to one device and HOLDA primitives to the other.

Another unlikely case is when the stream that gets interrupted (the stream flowing towards the sender of HOLD) is already in a CONT condition. SATA has a mechanism to prevent the need for repeated transmission of the same primitive. Instead of repeating the same primitive hundreds or thousands of times, a device can send the primitive twice followed inmmediately by a CONT (continue) primitive, which is a signal for the receiving device to assume the primitive repeated twice is continuing until a new primitive is received. Any traffic that might occur between the CONT and the next valid primitive can be treated as "junk data" and discarded by the receiver.

If traffic in one direction is already in a CONT condition when a HOLD primitive is received in the other direction, the HOLDA primative generated by *InFusion* cancels the CONT. When the HOLD goes away and the data stream can be restarted, the CONT condition must first be restablished. *InFusion* remembers which primitive has been "continued", and reestablishes the CONT condition by sending that primitive twice followed by CONT, before continuing with normal traffic flow.

In all these cases, *InFusion* is acting intelligently to maintain the integrity of the data link under these unusual circumstances. In the vast majority of situations, these actions will go unnoticed by the system and by the user. Only under circumstances where these actions might interfere with the test case in progress (for example, if the HOLD condition itself is under test) would the SAS Hold Handling option need to be disabled.

Modifying Window Layout

You can use SAS *InFusion* windows in three modes: Tabbed style, frame style, and mixed style.

The modes are set apart by the presence/absence of tabs at the bottom of the windows. Tabbed-style windows have tabs. Frame-style windows do not. Mixed-style windows have some windows with tabs and some without.

Tabs are used to navigate from one window to the next.

Tabbed-Style Layout
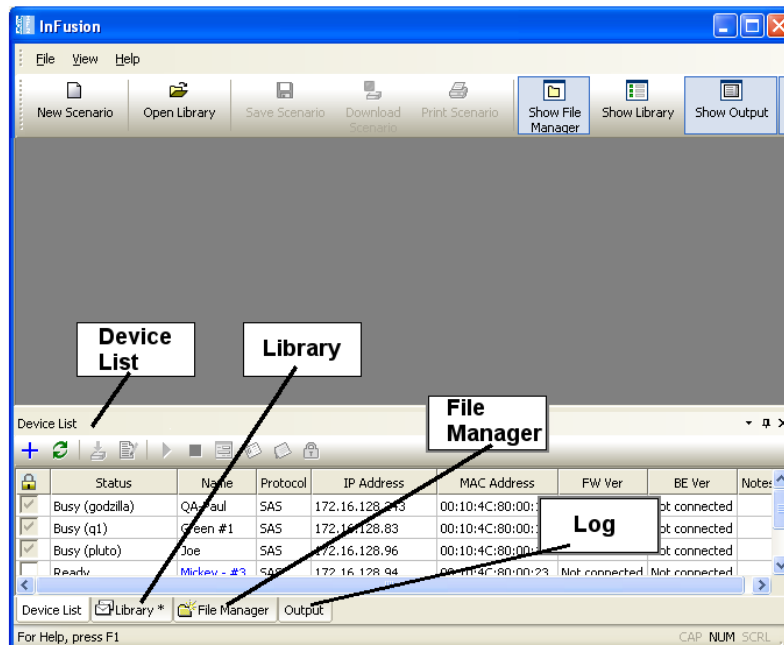
Figure 26   Application Window Layout: Tabbed Style

Tabbed-style windows stack one on top of the other so that only the top window is visible (Figure 26). Tabs allow you to navigate to the underlying windows.

Frame-style windows do not have tabs and appear side-by-side (Figure 27).

Mixed-style windows have some windows that are of a tabbed style and others that are of frame style (Figure 28).

Framed-Style Layout
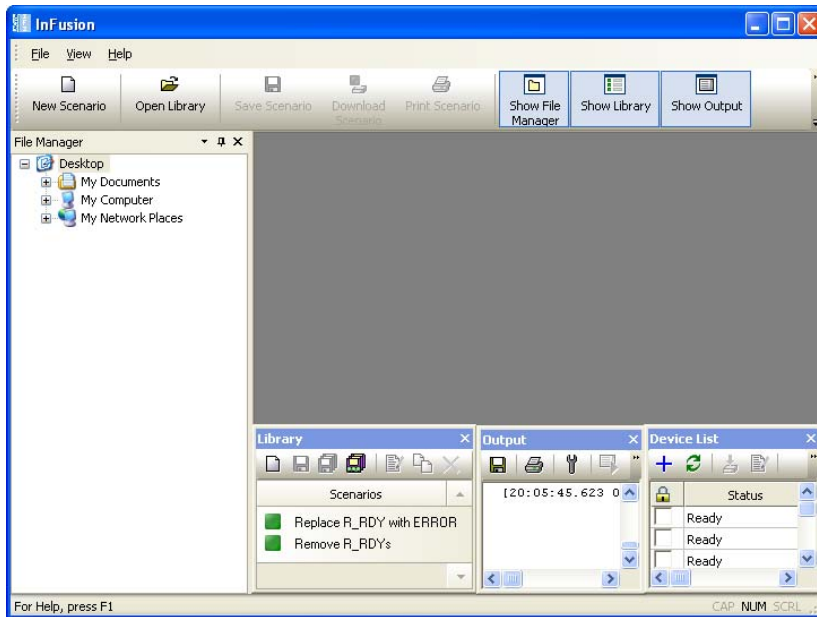
Figure 27   Application Window Layout: Framed Style

Mixed-Style Layout
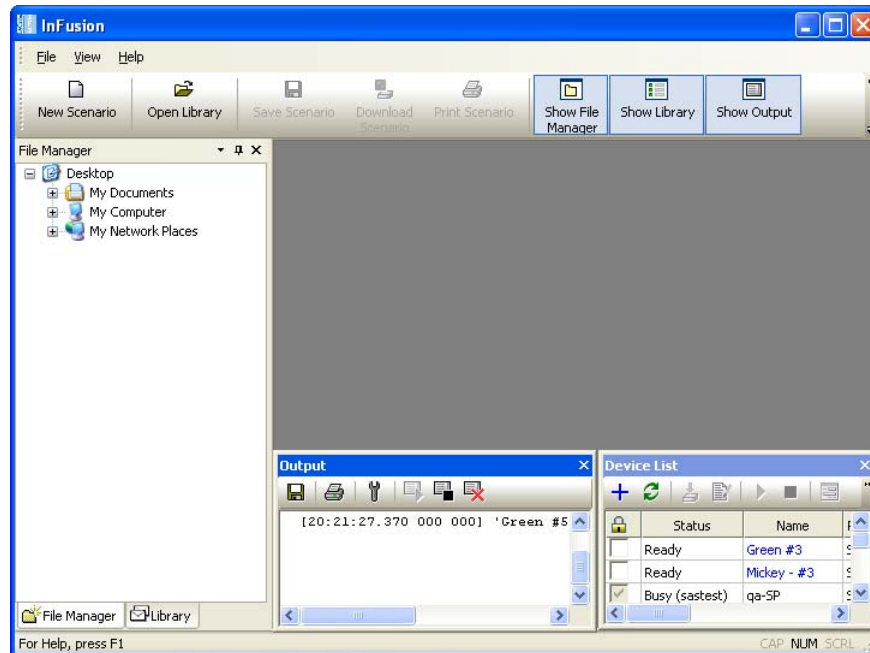
Figure 28   Application Window Display: Mixed Style

Moving Windows with "Smart Docking"

SAS *InFusion* has a window-positioning feature called "Smart Docking" It allows precise positioning of windows within the application. When Smart Docking is enabled, Positioning buttons appear whenever you move a window (Figure 29 and Figure 30).
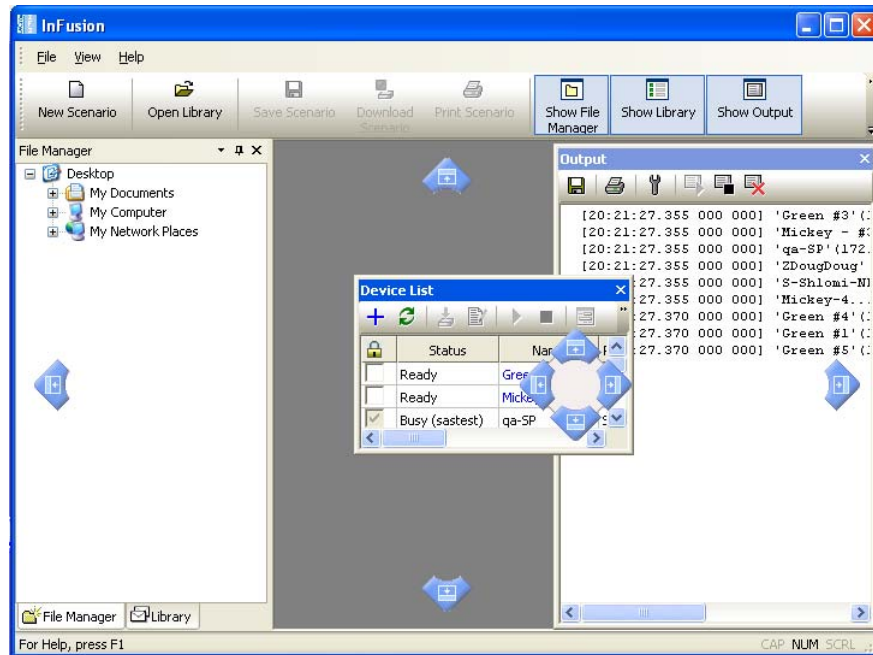
Figure 29   Application Display: Smart Docking Activated
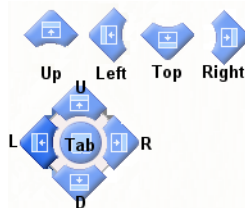
Figure 30   Smart Docking Positioning Buttons

The function of positioning buttons is to allow windows to be precisely positioned within the application.

Smart Docking is enabled by default and can be turned OFF or ON by selecting View > Smart Docking from the application menu.

If enabled, two sizes of buttons appear as soon as you move a window. Small buttons let you move the window in one direction. The larger button lets you position left, right, up or down within the center of the application window.

The larger button can also let you create tabbed windows. To create tabbed windows, drag the mouse over the central part of the positioning button (the Tab button in Figure 30).

To use move a window via the Positioning buttons:

Step 1 Position your mouse pointer over a title bar of a window and click and hold the Mouse button. To reposition a tabbed window, click and hold on the Windows tab. The Positioning buttons appear as shown in Figure 30.

Step 2 Drag the window over one of the Positioning buttons. When the mouse pointer is over the Positioning button, a ghost-like window pane appears (Figure 31). It shows you a preview of the new location of the window.

Step 3 Release the mouse button. The window repositions itself.
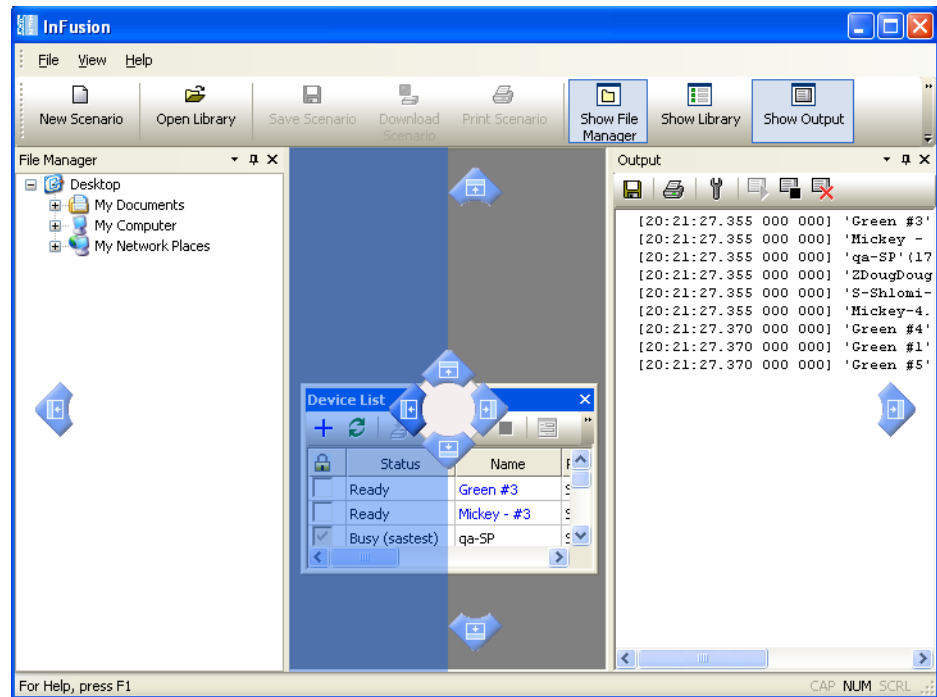
Figure 31   Application Display: New Location of Window

Tool Tips

Throughout the application, Tool Tips provide useful information about buttons on the toolbars. To display a Tool Tip, position the mouse pointer over an item of interest ().
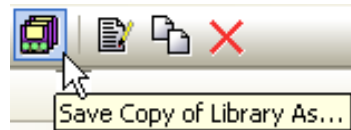
Figure 32   Tool Tip

The Menu Bar

Table 5 lists commands in the SAS *InFusion* menu bar.

Table 5   SAS *InFusion* Menu Bar Menus and Menu Options

Menu/Option	Function
File	
New Scenario	Opens an area for creating a new scenario. Scenarios are test scripts that determine how SAS*InFusion* monitors and modifies traffic.
Open Library ...	Opens a dialog for selecting library files (*.INFDB)
Close Scenario	If open, closes the selected scenario.
Save Scenario	Saves any changes that have been made to an open scenario.
Print Scenario…	Prints part or all of the scenario.
Print Preview	Shows what the scenario will look like when printed.
Print Setup…	Sets up your current or new printer.
Exit	Exits the SAS *InFusion* program.
View	
Views >>	Shows or hides the File Manager, Library, Output and Devices windows. Also has a Customize option for customizing or resetting menus, toolbars and tooltips.
Smart Docking	If enabled, causes Positioning buttons to appear onscreen any time a window is moved. These buttons allow windows to be precisely positioned and docked within the application.
Toolbars	Displays list of available toolbars.
Status Bar	Shows or hides the Status bar.
Window	
New Window	Opens a copy of the current scenario window.
Cascade	Displays all open windows in an overlapping arrangement.
Tile	Displays all open windows as a series of strips across the display.
Arrange Icons	Arranges minimized windows at the bottom of the display.
Windows ...	Displays a list of open windows and provides controls for activating or closing them.
Help	
Help Topics ...	Opens this manual.
About SAS*InFusion*	Displays version information about SAS *InFusion*.
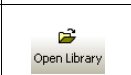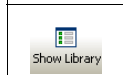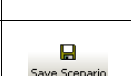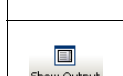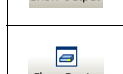
Toolbars

Toolbars provide quick access to most of the SAS *InFusion* software functions. You can learn the function of each button by passing the mouse pointer over them.

Descriptions of the buttons appear on the status bar at the bottom of the window and as tooltips above each button.

The application toolbar allows you to create, save and print scenarios and to open libraries and windows within the application.

Table 6   Application Toolbar Buttons

New Scenario	New Scenario.	Show File Manager	Show File Manager
Open Library	Open Library. Opens a dialog for browsing to a library file (*.INFDB).	Show Library	Show Library
Save Scenario	Save Scenario	Show Output	Show Output
Download Scenario	Download Scenario	Show Device List	Show Device List
Print Scenario	Print Scenario		

Status Bar

The Status bar is located at the bottom of the Main Display window. The Status bar provides status information on SAS *InFusion* and also provides descriptions of buttons in the application whenever the mouse pointer is held over a button.

Set viewing options for the device list

Figure 33   Status Bar

Chapter 5: Test Scenarios

This chapter describes how to create and execute SAS *InFusion* scenarios. A scenario is a test script that defines how the SAS *InFusion* box monitors and modifies line traffic.

Scenarios Overview

You create scenarios on a PC running the SAS *InFusion* application. You then download the scenarios for execution on a SAS *InFusion* box. You can download up to ten scenarios to each SAS *InFusion* box. You can start and stop a scenario either at the box, using the device LCD panel, or at the PC, using the SAS *InFusion* software application.

The SAS *InFusion* application provides a menu-driven interface for building scenarios. The interface prompts you for simple decisions and choices from drop-down menus. As you make your selections, the script takes shape automatically in the scenario window. The script is in the form of simple English sentences. You need not understand any formal scripting language.
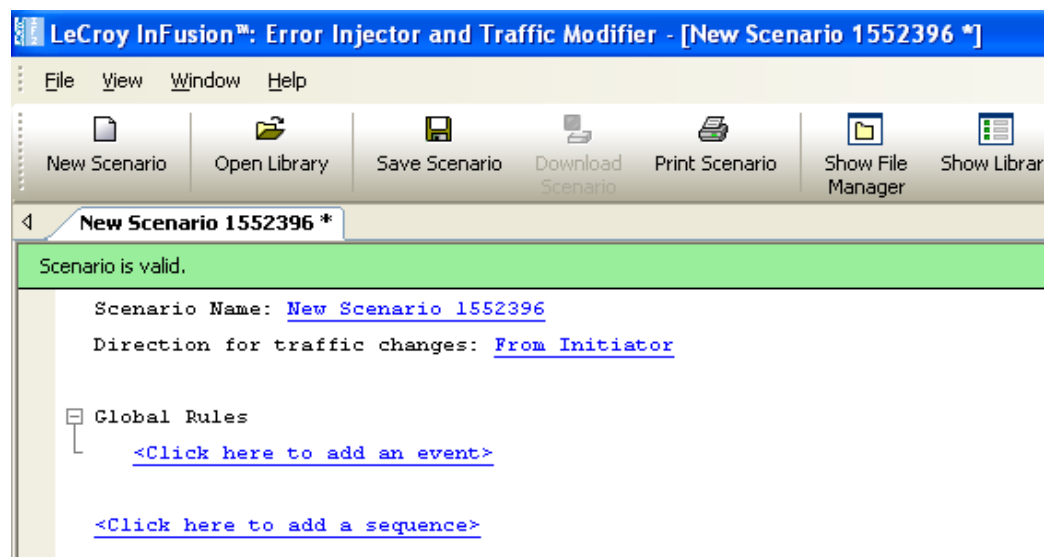
Figure 34   Open Scenario in Application Window

As described later in this chapter, you can create any number of scenarios and store them in libraries on the PC hard drive. Scenario library files are named in the following format:

`<filename>.infdb`

Creating SAS *InFusion* scenarios is easy, but it requires an understanding of the following terms: action, event, combined event, global rules, sequence, and state.

Table 7   **Key Scenario Terms**

Term	Definition
Action	SAS*InFusion* response to an event.
Event	Condition that is detectable by SAS*InFusion.*
Combined Event	Logical OR association of events (for example, event A or event B).
Global Rules	Portion of a scenario that can define a single SAS*InFusion* test state.
Sequence	Portion of a scenario that can define multiple SAS*InFusion* test states. More flexible than the Global Rules, a sequence allows more powerful scenarios that include branching and looping between test states (the Global rules can define only a single test state, so there is no branching).
State	"Behavior" of the Global Rules or a sequence at any point in time. In terms of SAS*InFusion* testing, behavior is "waiting" for a certain set of events and responding with a certain set of actions.

You can think of the Global Rules and each sequence as separate test routine or program operating within the scenario. Each operates independently and in parallel with the others. The purpose of each is to detect events and then respond with the appropriate action or set of actions. In essence, they allow you to operate up to three test states simultaneously within SAS *InFusion*.

Global Rules

Global Rules are a portion of the scenario that can define only one test state. To create the Global Rules, you use the menu-driven interface to enter an event or combined event and the corresponding action or set of actions (the response of SAS *InFusion* hardware to the event).

In the case of a combined event, the action is taken upon occurrence of any of the events stated for the event combination. It is a logical OR association, meaning any of the events will trigger the action.

After you enter the event or combined event, the interface prompts you for actions. An action might be, for example, injecting a particular primitive or error into the traffic stream. You can enter multiple actions, which will take place simultaneously.

After defining the event and actions within the Global Rule area, you can save the scenario and download it to a SAS *InFusion* box.

Sequences

The Global Rules are all you will need for simple test scenarios. However, a scenario also can contain one or two sequences, more powerful programs that can define multiple states and allow branching between states. You also can do looping with a sequence, which allows you to repeat a test state or to execute a test for a specified period of time.

As with Global Rules, the menu-driven interface guides you in building a sequence. Some of the prompts are different, however, because you now are encapsulating groups of events and actions as distinct states. Recall that a state is a combination of events and actions at a specific point in time. If the event or combined event defined by a state occurs, the corresponding action or set of actions follows.
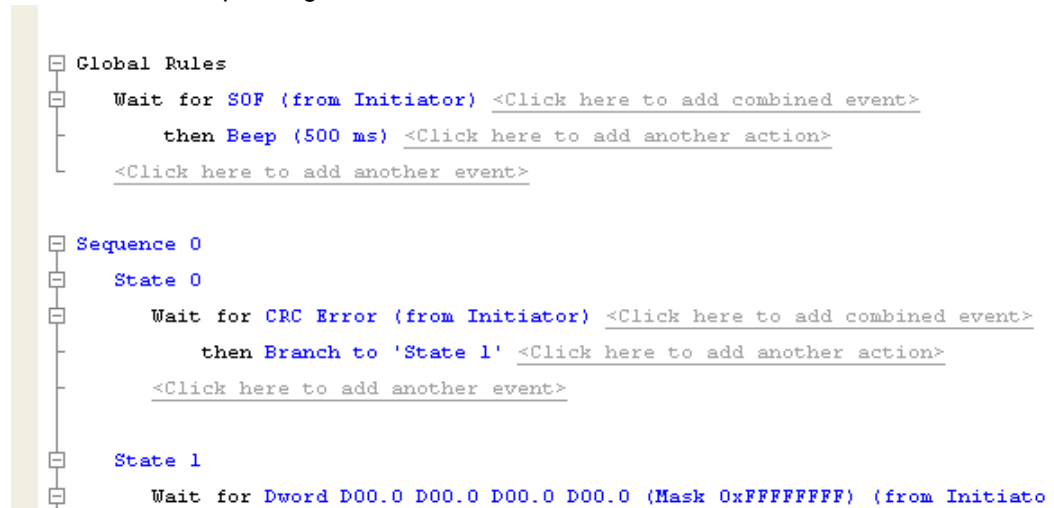
Figure 35   Global Rules and Sequence Areas of a Scenario

SAS *InFusion* hardware provides the capacity to have up to two sequences co-existing in a scenario in addition to the Global Rules. Recall that both the Global Rules and any sequences are active at all times. Each is a separate "state machine," having the behavior of a particular test state at any point in time. Because the Global Rules has the capacity for only one state, you can view it as a "degenerative state machine."

Multi-Link Testing

SAS *Infusion* hardware supports testing of SAS wide-link configurations. Wide-link uses multiple physical links to aggregate traffic from up to four separate lines into one logical link.

Each SAS *InFusion* box has two BNC connectors on its rear panel that allow it to connect to other SAS *InFusion* boxes in a daisy-chain. One connector is for signal input, the other for signal output.

The BNC connectivity allows you develop wide-link test schemes. In such schemes, four boxes are connected in a daisy-chain, with the BNC output on an upstream box linked to the BNC input on its downstream neighbor.

A separate scenario runs on each box, but the scenarios interact through trigger signals exchanged via their BNC ports. For example, you can set the first box in the daisy-chain to send a trigger downstream when it detects a specific line condition. The trigger can cause a state change in the scenario running on the downstream box. That box, in turn, can cause a state change in the scenario running on its neighbor.

Each of the four boxes is monitoring/modifying its own line, but there is a synergy between the four by way of the BNC daisy-chain. In this fashion, you can use a SAS *InFusion* daisy-chain to coordinate error injection across multiple SAS or SATA physical links.

Scenario Libraries

As described, you can create any number of scenarios which you then can archive on your PC hard drive. You also can download up to ten scenarios to each SAS*InFusion* box for test execution. You can think of the libraries as windows that hold scenarios.

Recall that each library is a separate *.infdb file.

Main Library   When you launch the SAS *InFusion* application, it opens a window called the main library. The main library is the default workspace for creating and storing new scenarios. The main library corresponds with the following file in the Infusion folder on the PC hard drive:

                              DEFAULT.INFDB

File Libraries   You can save the main library with a name other than default (while still using the .infdb file extension). The new file becomes a file library that is functionally equivalent to the main library with the following exception: It does not open by default in the Main Library window. You can navigate to other file libraries using the File Manager of the SAS *InFusion* application.

> **Note:**   In this manual, the main library and other .infdb file libraries are collectively called general libraries.

For example, if you select **Open Library** you will see a window similar to the following:
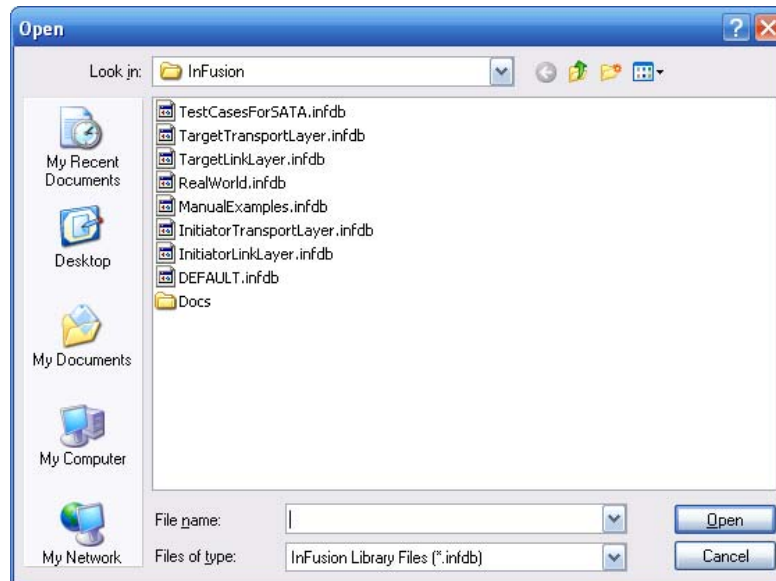
Figure 36   Open Library Listing

By selecting the **TestCasesForSATA.infbd** file, you will get an additional library window with predefined SATA test cases, similar to the following:
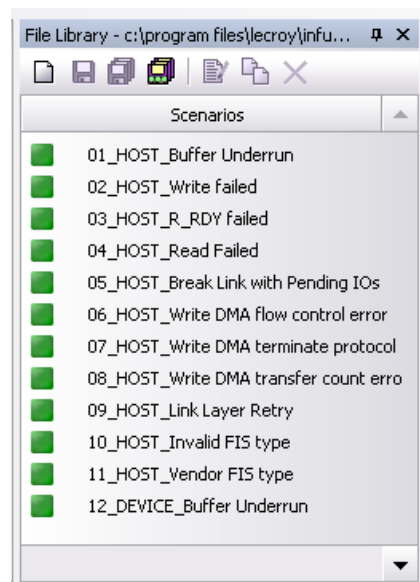
Figure 37   Test Cases for SATA Library

Device Libraries

In addition to general libraries, the application defines device libraries. Each device library is associated with a specific SAS *InFusion* box. Each device library opens in a separate Device Library window and holds up to ten SAS *InFusion* scenarios for the box. When you connect to the box and click on the entry for that box in the Device List, the device library for the box opens automatically.

The scenarios that appear in the device library are those currently stored on the corresponding box. They were uploaded from the box to your PC when you opened the device library. You can click on any of the scenarios listed to open it for editing. When you are finished with your edits, you can use the buttons on the Device Library toolbar to download the revised scenario.

Test Events

As described, a scenario is a script you create using simple mouse clicks and text entries. As you work, the script takes shape in the scenario area of the application display. You can think of the scenario area itself as consisting of two subareas: A Global Rules area at the top, where you create the Global Rules, and a sequence area beneath the Global Rules, where you create any sequences.

Whether you are creating the Global Rules or a sequence, the menu-driven interface prompts you to specify the event(s) for which you want to trigger actions.

While many events are line conditions, an event also can be a condition that occurs within a SAS *InFusion* box (for example, detection of a BNC trigger signal from another box).

Table 8 lists supported events. Note that some events are applicable only in the context of creating sequences (those events appear on the drop-down list only if you are creating a sequence). Sequences can have multiple states, and they allow branching between states.

Table 8   Test State Events

Event	Description
Any Dword	Occurrence of any Dword on the line.
ATA Command	Occurence of a particular ATA Command on the line.
BNC Input	Occurrence of BNC input trigger.
Both Links Up	Occurrence of both line ports active (not idling).
CRC Error	Occurrence of a CRC error on the line.
Dword Matcher	Occurrence of a particular Dword on the line.
FIS	Occurrence of a particular SATA FIS on the line.
Frame	Occurrence of a particular frame on the line.
Invalid 10b Code	Occurrence of an invalid 10b code.
Links Speed 3G	Both lines operating at 3 Gbps.
OOB Signal	Occurrence of OOB signal.
Primitive Group	Occurrence of particular primitive group on the line.
Running Disparity Error	Occurrence of Running Disparity (RD) error.
SAS Data Pattern	Occurrence of a particular data pattern in a SAS frame.
SAS Primitive	Occurrence of a particular SAS primitive.
SATA Data Pattern	Occurrence of a particular data pattern in a SATA frame.
SATA Primitive	Occurrence of a particular SATA primitive.
Timer	Occurrence of a particular elapsed time (time period).

Following sections provide some additional details on three of the events.

Dword Matcher

Dword Matcher is a dword pattern matcher that presents match and mask fields and a K-Code Mask field. K-Codes are control characters that are always used in the first byte of a four-byte primitive. Of the K-Code masks listed in the menu, D-D-D-D is used for data bytes, and K-D-D-D is used for all primitives.

When you create a dword match, keep the following in mind:

- The pattern can be inside or outside of frames (it does not matter if the pattern is inside a frame or not)
- Because the pattern can be inside or outside of frames, there is no offset.
- You can make user-defined primitives. (This is the reason this feature was created.)
- You can use any K/D pattern.

SAS Data Pattern

When you create a SAS data pattern, keep the following in mind:

- The pattern must be defined inside a frame that starts with a SOF or SOAF.
- The pattern must be data only (no K-codes/primitives).
- The pattern must be defined at a specific offset in the frame.
- The pattern and mask must be specified in the same format as specified in the SAS standard.
- 0x12345678 (hex), where "1" is the first digit on the cable and is the MSB as given in the SAS Standard.

For example, for an SMP Request:

> Pattern: 0x40000000
> Mask: 0xFF000000
> Offset: 0
> SOF Type: SOF

SATA Data Pattern

When you create a SATA data pattern, keep the following in mind:

- The pattern must be defined inside a frame that starts with a SATA_SOF
- Must be data only (no K-codes/primitives)
- Must be defined at a specific offset in the frame
- The pattern and mask must be specified in the same format as specified in the SATA Standard.

For example, for Register H -> D FIS:

> Pattern: 0x00000027
> Mask: 0x000000FF
> Offset: 0
> SOF Type: SATA_SOF

Test Actions

After you enter the set of events for a test state, the menu-driven interface prompts you for the corresponding action or set of actions. If you define multiple actions, the actions occur simultaneously. Table 9 lists supported actions. Note that some of these actions only apply to creating sequences.

Table 9   Test State Actions

Action	Description
Beep	Emit audible sound of duration selectable via drop-down list.
BNC Output	Send a signal out the BNC port to the box downstream.
Branch to Existing State[1]	Go to a state in this sequence that is already defined.[1]
Branch to New State[1]	Go to a state in this sequence that is not yet defined (you need to define it).[1]
Capture Data Dword	Captures a data dword into one of four registers.
Disconnect	Put both SAS *InFusion* SAS ports at electrical idle immediately.
Inject CRC Error	Inject a CRC error into the line.
Inject Invalid 10b Code	Inject invalid 10b code into the line.
Inject RD Error	Inject a Running Disparity (RD) error into traffic.
Monitor/Count	Open a window to count the number of events that occur during a session. A session is the time period during which a scenario runs.
Reconnect	Start traffic pass-through immediately. This action is used to restart traffic after a previous disconnect command. Once traffic is passing-through, the initiator and target resume OOB signaling.
Remove[2]	Remove the targeted event from the traffic.[2]
Restart All Sequences[1]	Restart all sequences in the scenario.[1]
Restart Current Sequence[1]	Restart the sequence that contains this action definition. [1]
Stop Scenario	Stop all scenario activity.
Substitute Data Dword	Substitute a data Dword in the traffic.
Substitute SAS Primitive	Substitute a SAS primitive in the traffic.
Substitute SATA Primitive	Substitute a SATA primitive in the traffic.

[1]   Only shown in Action Properties dialog box when creating a sequence.

[2]   In SAS *InFusion*, a Remove primitive action is implemented by replacing the primitive with an idle data dword. A Remove frame action is implemented by replacing the start-of-frame and end-of-frame primitives with an idle data dword.

Using Counters in Events and Actions

Many of the events and actions supported by SAS *InFusion* also support counters which can be used to control functions.

Within events, counters are used to determine how many times the event must occur before the associated actions are triggered. Event counters are typically provided with two properties:

- **Count Randomly**, which can be set to "Yes" or "No" (default value is "No"). If set to "Yes", the event will need to be repeated a random number of times (between 1 and the value set in the property **Max Random Count**, which replaces the property **Counter Value** when "Yes" is selected), before the action is triggered.

- **Counter Value**, which is the number of repeats required when **Count Randomly** is set to "No". The default value is 1.

Within actions, counters are used to determine how many times the action must be called before it will act. Action counters are typically provided with two properties:

- **Random**, which can be set to "Yes" or "No" (default value is "No"). If set to "Yes", the action will need to be triggered for a number of occurrances before the action will take place, That number will range randomly between 1 and the value set in the property **At least every Nth occurrence**, which replaces the property **Every Nth occurrence** when "Yes" is selected).

- **Every Nth occurrence**, which is the number of times the action needs to be called before it will act.

Note that there is some overlap in the way these counters can be used. For example, in the simple case of a single event leading to a single action, it will make no difference whether you specify the event to require 5 repeats before triggering the action, or the action to require 5 occurances before it acts.

However, in the case of combined events and/or actions, the separate counters provide a great deal of flexibility in designing test cases. For example, consider the case where Event_1 OR Event_2 leads to Action. If Event_1 has a counter of 5, then the Action will be triggered either when Event_1 has repeated 5 times or when Event_2 happens the first time, whichever occurs first.

But if the event counters are set to 1 and the Action counter is set to 5, then the Action will happen after 5 occurrences of EITHER Event_1 or Event_2.

Capturing a Data Dword

SAS/SATA *InFusion* provides the ability to capture individual data dwords and provides four different registers to store captured dwords (Dword #0, #1, #2 and #3).

To capture a data dword, select **Capture Data Dword** from the Action Properties screen, as shown below. Select the register to be used to store the dword from the drop-down menu under the **Capture Register** property.
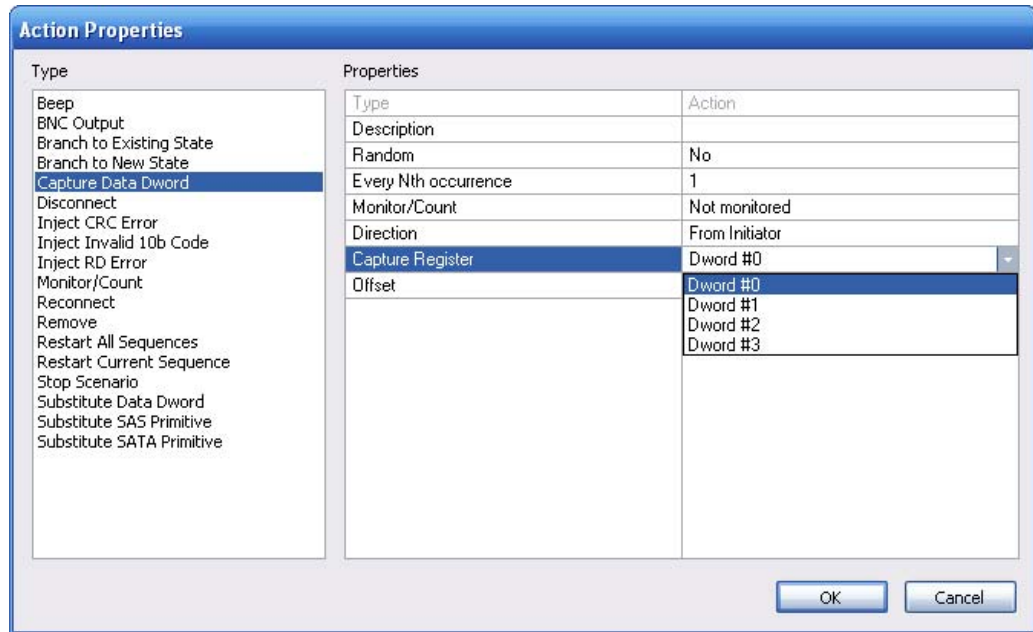
Figure 38   Capturing a Data Dword

**Using
Captured
Data
Dwords**

Captured data dwords can be used in creating events for data that match the captured dword(s), or in creating actions to substitute the captured dword(s) into the data stream.

To create an event using the captured dword, in the Event Properties menu select **SAS Data Pattern** (or **SATA Data Pattern**), and then select any of the 12 dwords (**Dword 0 Type** through **Dword 11 Type**). The drop-down menu provides the choice of a custom dword or any of the four captured dwords. If you select a captured dword, the **Value** field beneath this selection will be hidden (the **Value** field is only used for specifying custom dwords). Note that choice of a mask and an offset are still available when using captured dwords.
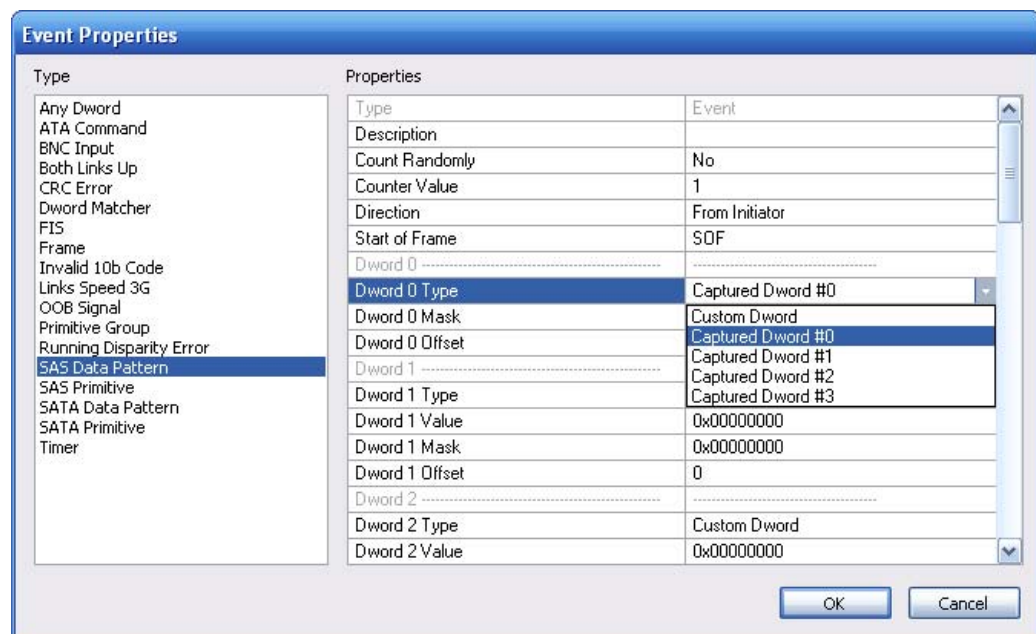
Figure 39   Using a Captured Dword in a SAS Data Pattern

Captured data dwords may also be used in the **Substitute Data Dword** test state action. From the Action Properties screen, choose **Substitute Data Dword** and then select the **Substitute for** property. A drop down menu is provided (see below) that allows the choice of a custom dword or any of the four captured dword registers.
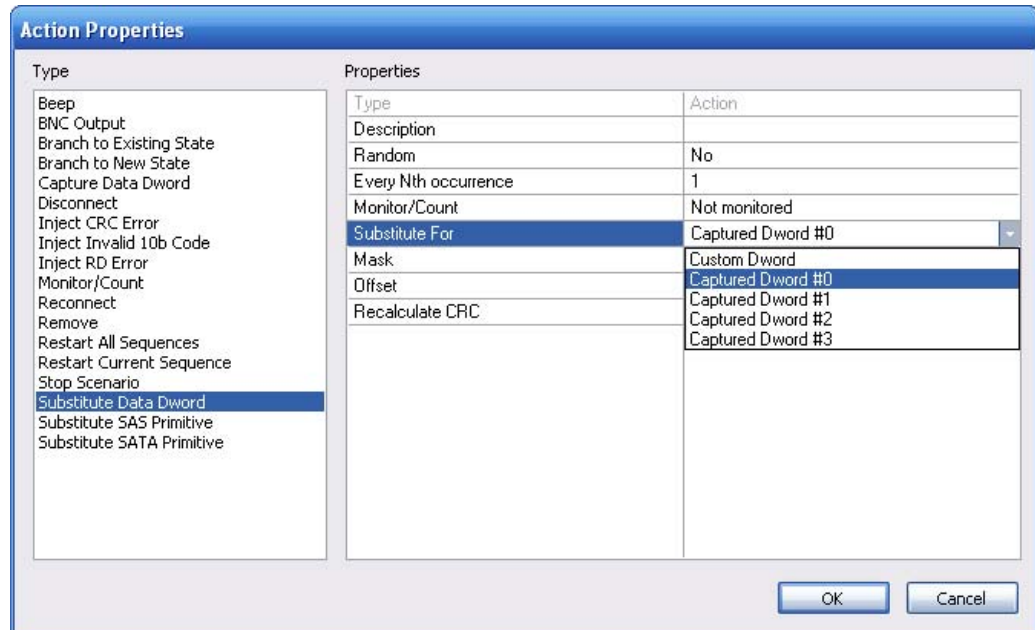
Figure 40   Using a Captured Data Dword in Substitute Dword Test Action

Test Initiator and Target

To begin the scenario creation process, you press the **New Scenario** button in a library window or on the SAS *InFusion* application toolbar. As the first step in creating a scenario, the application prompts you for scenario name, a short description (optional), and the direction of traffic to which any traffic changes apply. Changes are, for example, injection or removal of data or a primitive.

You identify direction of traffic change, or modification, in terms of traffic origin. The application uses the following conventions:

- From Initiator: Change is made to traffic coming from test host (for example, CRC error is injected into traffic stream sent from initiator to target).

- From Target: Modification is made to traffic coming from the target (for example, CRC error is injected into traffic stream sent from target to initiator).

Figure 41 shows the first prompt in the scenario creation process. When you click on it, the Scenario Properties dialog box appears, allowing you to enter the scenario name, a short description, and direction of traffic change (Figure 42).
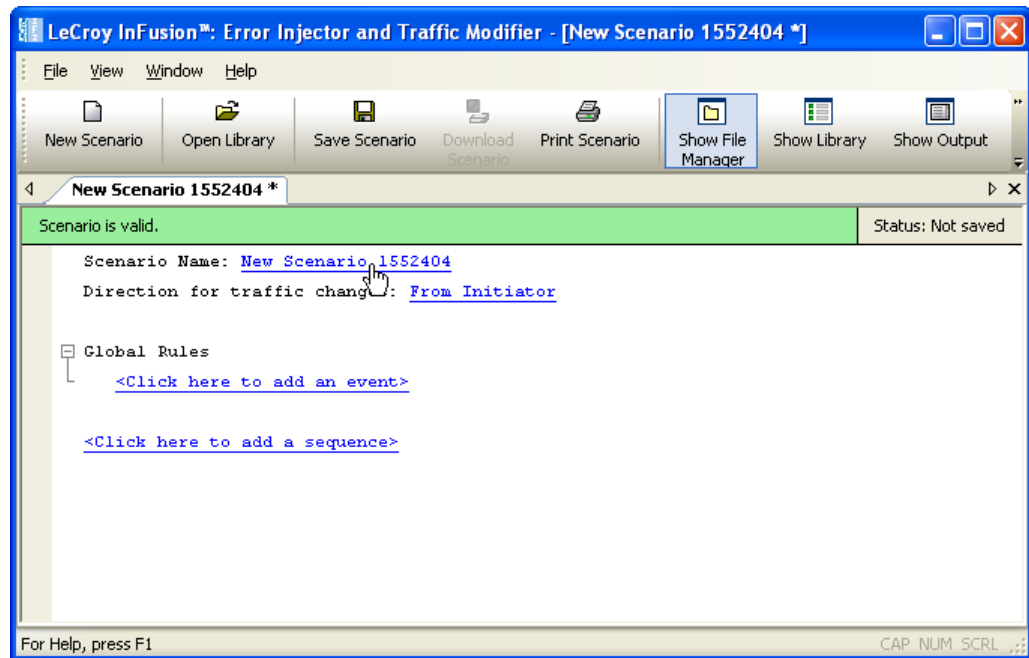
Figure 41   Entering Basic Scenario Information
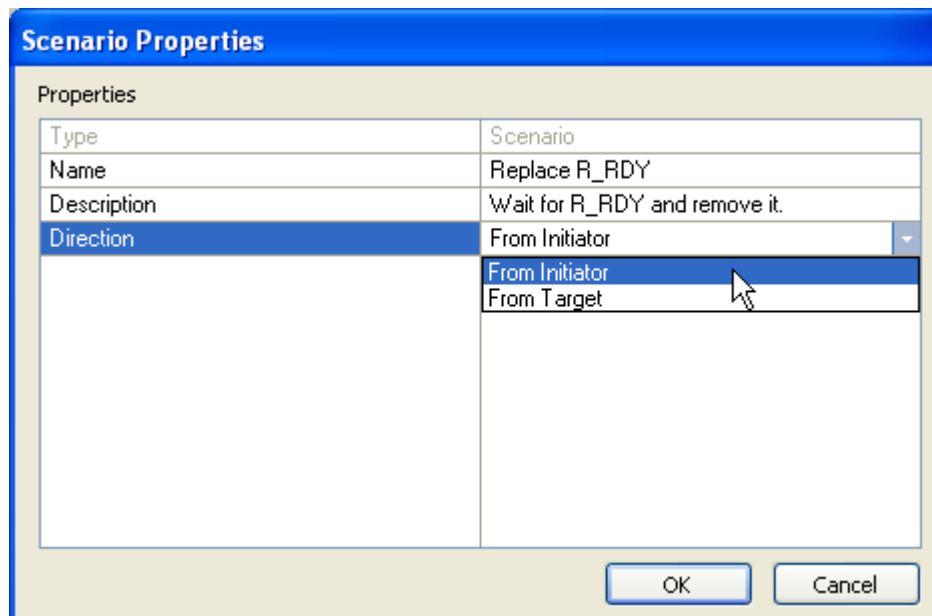
Figure 42   Scenario Properties Dialog Box

> **Note:** You define direction of these traffic changes on a global basis for the entire scenario. In other words, any scenario action that modifies line traffic follows the rule established at the top of the scenario.

Summary of Scenario Creation

The suggested process of creating and executing a scenario is as follows:

Step 1   Create a scenario in the main library.

Step 2   Copy the scenario from main library to the desired device library by drag-and-drop with a mouse. (Each device library is associated with a specific SAS*InFusion* box.)

Step 3   Download all scenarios in device library to the SAS *InFusion* box.

Step 4   Select the scenario in the device library that you want to run on the box.

Step 5   To run the scenario, click the Start Scenario button from the Device Library toolbar. The box will start to monitor/modify traffic.

> **Note:** Step 1 is described in detail for each example in following sections. Steps 2 to 5 are described in detail at the end of this chapter.

Creating Global Rules

This section gives several examples for creating the Global Rules area of a scenario. Recall that the Global Rules area defines a single test state. The Global Rules do not have the capacity for multiple states, so that area of a scenario cannot change state.

In terms of SAS *InFusion* testing, a state defines test "behavior." In this context, behavior is "waiting" for an event and responding with an action or set of actions that happen simultaneously.

Keep in mind that a test state you implement with the Global Rules operates in parallel with the active test state of each sequence in the scenario.

In effect, SAS *InFusion* lets you do up to three line tests at the same time. You can do one test with the Global Rules and a separate test with each sequence you create. You can have up to two sequences in a scenario.

Table 10 summarizes the Global Rules examples that follow.

Table 10   Global Rules Examples

Example	Description
1	Creating a single event and action (removes a primitive).
2	Creating a single event and action (replaces a primitive).
3	Creating a combined event (a logical OR association of multiple events) and an action.
4	Creating multiple triggers and actions.
5	Creating multiple actions on a single event.
6	Using timers.

Example 1: Creating a Single Event and Action (Removes a Primitive)

In this example, the Global Rules area of the scenario waits for each RRDY Normal primitive from the initiator and removes it.

Step 1   Click the **New Scenario** button in the main library or one of the device libraries. At the top of the scenario area, enter general scenario information, including scenario name, description, and direction of traffic change.

Note: For an example of filling in the general scenario information fields, see Figure 41 and Figure 42.

Step 2   In the Global Rules area, click on the prompt to **add an event** (Figure 43).

Step 3   The Event Properties dialog box appears (Figure 44). In the Type column on the left, choose **SAS Primitive**.
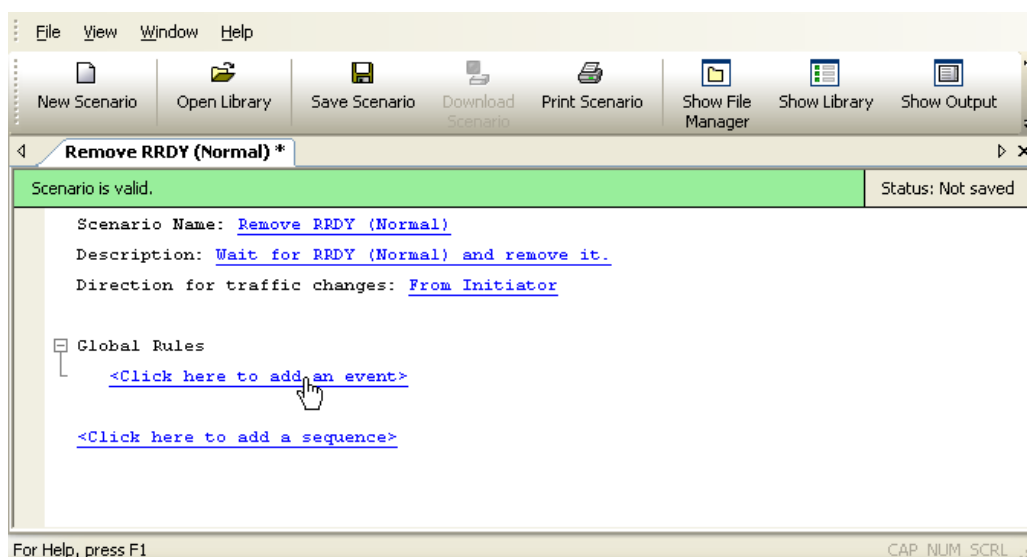
Figure 43   Example 1: Entering an Event
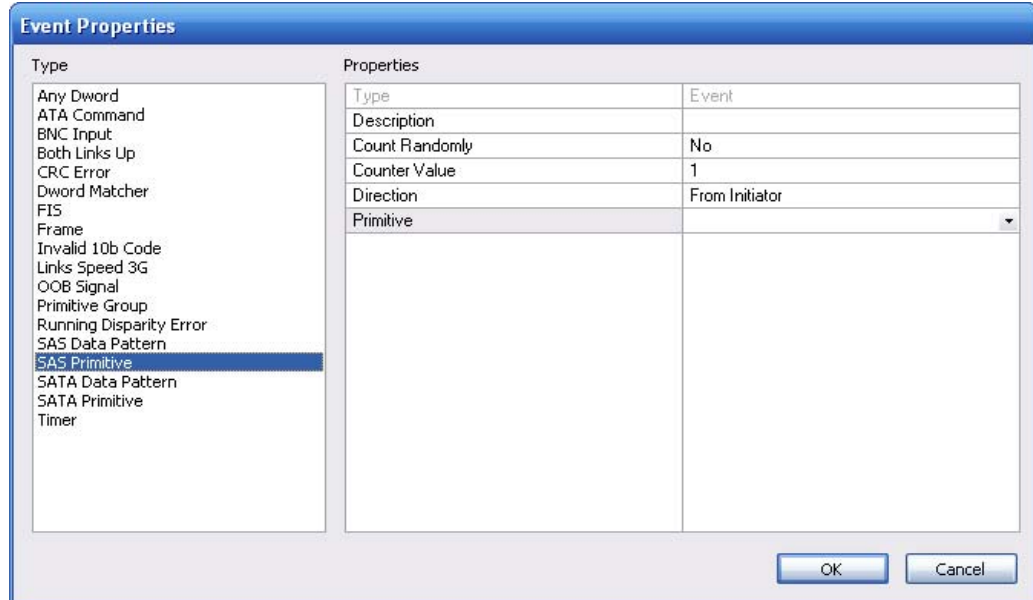
Figure 44   Example 1: Event Properties Dialog Box

Step 4   In the Type column in the middle of the dialog box, click on
              Description if you want to add a description of the event. Click
              on **Direction** to choose the direction of traffic to monitor for the
              selected event (the default is from initiator, which is what you
              want for this example).

Step 5   Still in the middle column of the Event Properties dialog box,
              click on **Primitive** to bring up a drop-down menu that lets you
              choose the type of primitive you want to wait for in this scenario
              (Figure 45). In this example, it is RRDY (Normal).

Step 6   Click **OK** to close the Event Properties dialog box.

Step 7   In the Global Rules area, click on the prompt to add an action
              (Figure 46).

Step 8   The Action Properties dialog box appears (Figure 47). In the
              Type column on the left, choose the action you want to occur
              when an RRDY is detected. In this example, it is the Remove
              action.

Note: In SAS *InFusion*, a Remove primitive action is implemented by
              replacing the primitive with an idle data dword.

Step 9 Click **OK** to close the Action Properties dialog box.

Step 10 In the File menu, select **Save Scenario** to save the scenario.
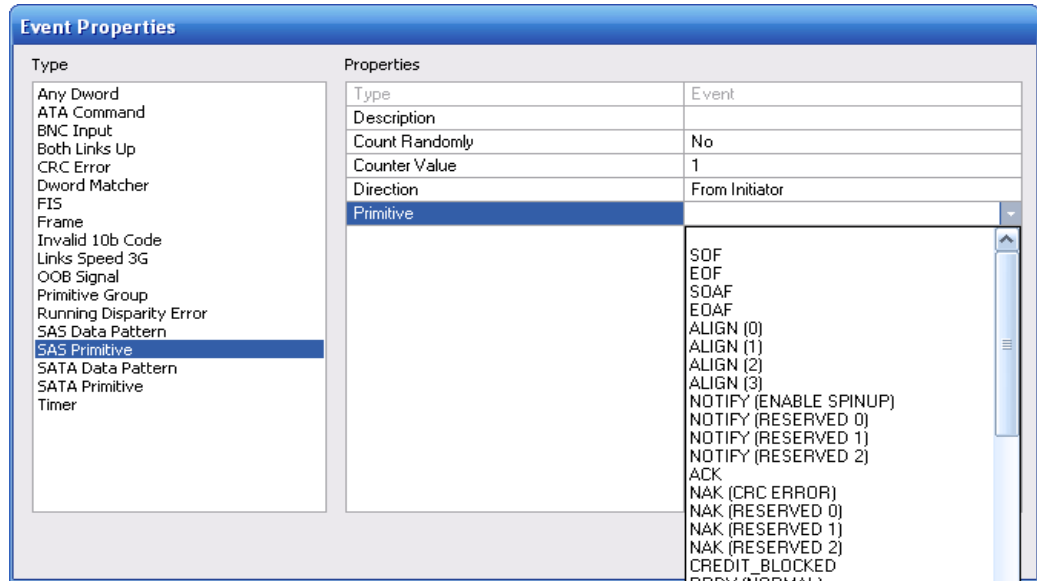
Figure 45 Example 1: Event Drop-Down List
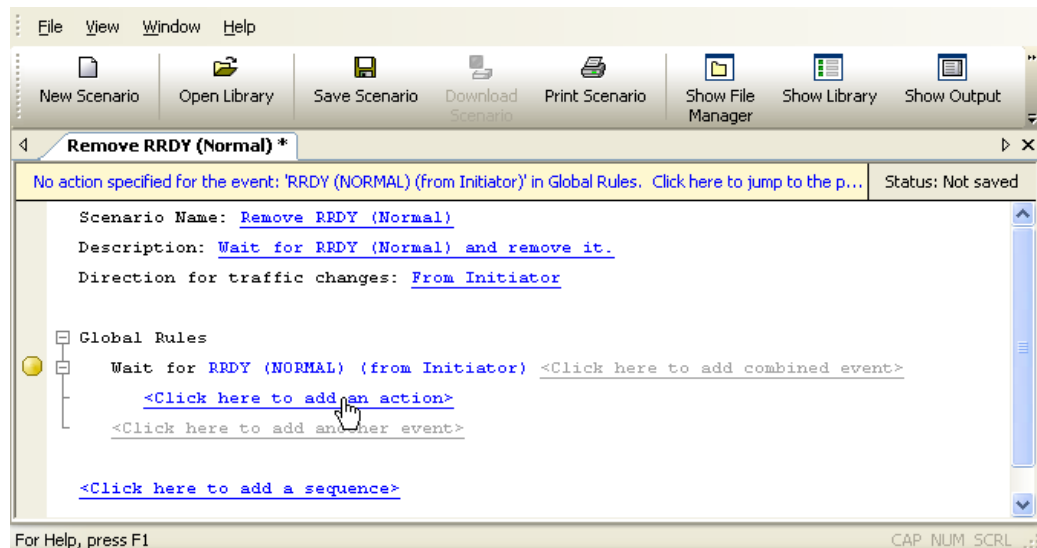
Figure 46 Example 1: Entering an Action
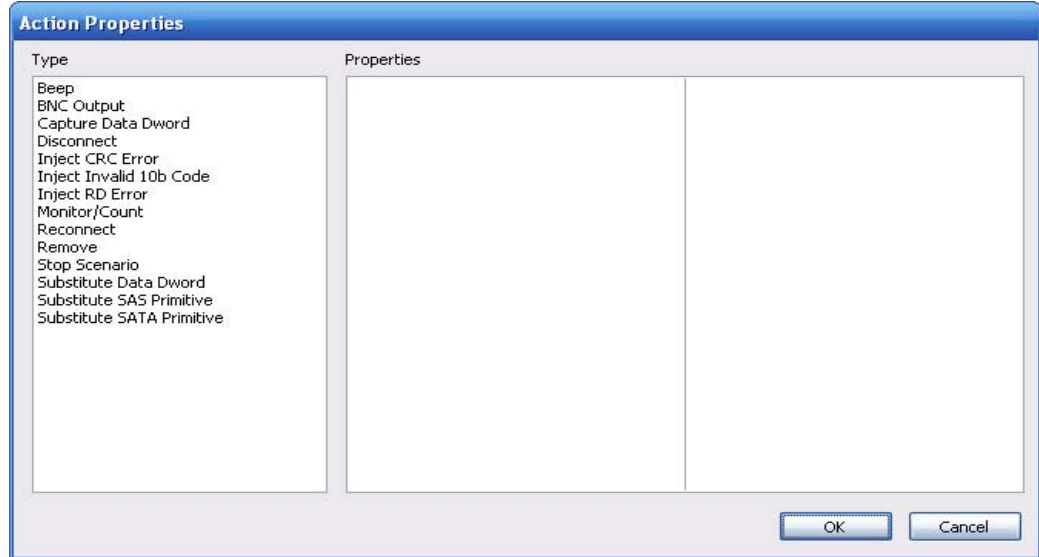
Figure 47   Example 1: Action Properties Dialog Box
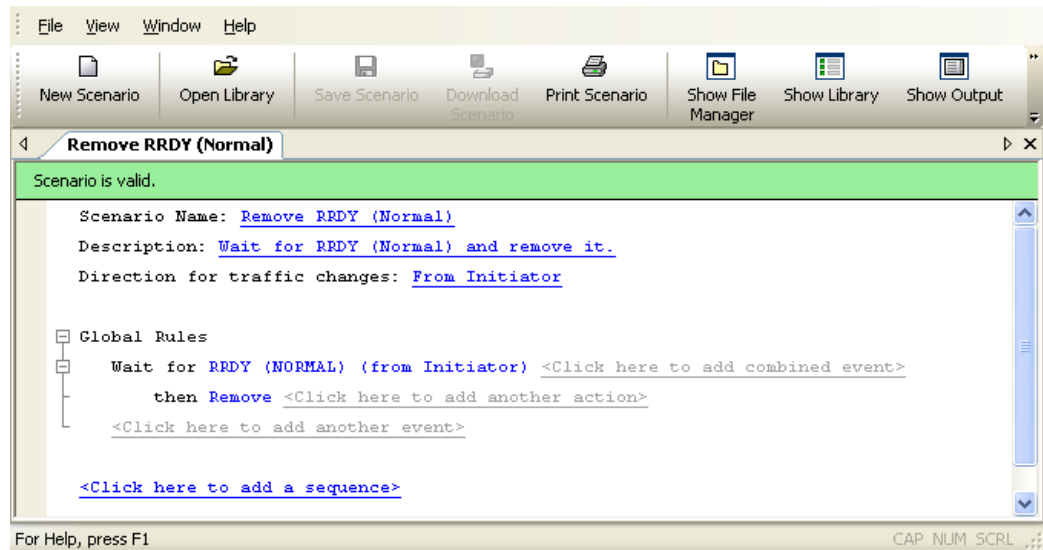
Figure 48   Example1: Complete Scenario

Example 2: Wait for Primitive and Replace It with an Error

In this example, the Global Rules portion of the scenario waits for each RRDY Normal primitive and replaces it with an ERROR primitive.

Step 1 Click the **New Scenario** button in the main library or one of the device libraries. At the top of the scenario area, enter general scenario information, including scenario name, description, and direction of traffic change.

Note: For an example of filling-in the general scenario information fields, see Figure 41 and Figure 42.

Step 2 In the Global Rules area, click on the prompt to **add an event** (Figure 49). This brings up the Event dialog box.

Step 3 As you did in steps 1 through 6 of the previous example, choose RRDY (Normal) as the type of primitive you want to monitor.

Step 4 In the Global Rules area, click on the prompt to **add an action** (Figure 50).

Step 5 The Action Properties dialog box appears (Figure 51). In the Type column on the left, choose **Substitute SAS Primitive** as the action you want when an RRDY (Normal) occurs.

Step 6 In the middle column of the dialog box, click on **Description** if you want to add a description of the action.
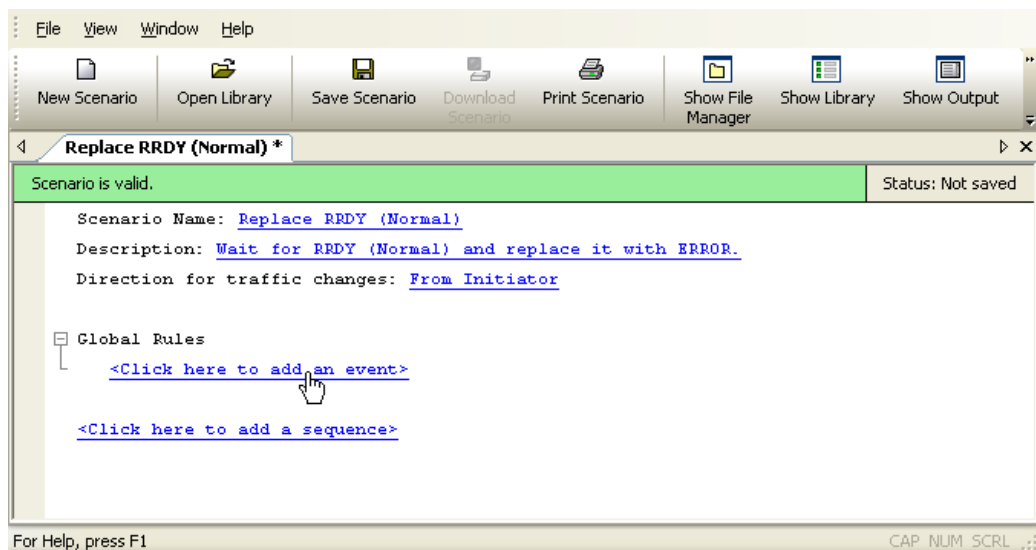
Figure 49   Example 2: Entering the Event
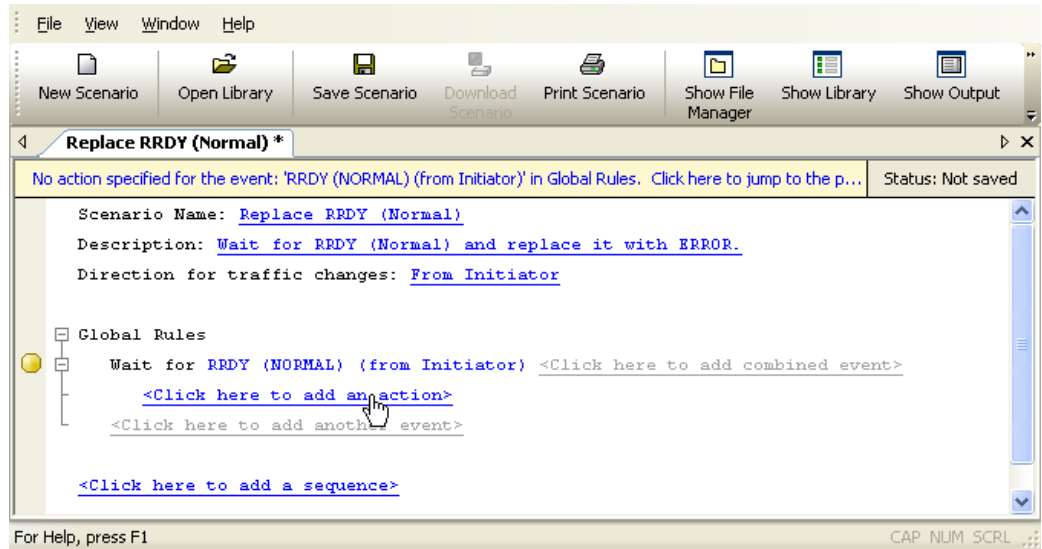
Figure 50   Example 2: Entering the Action
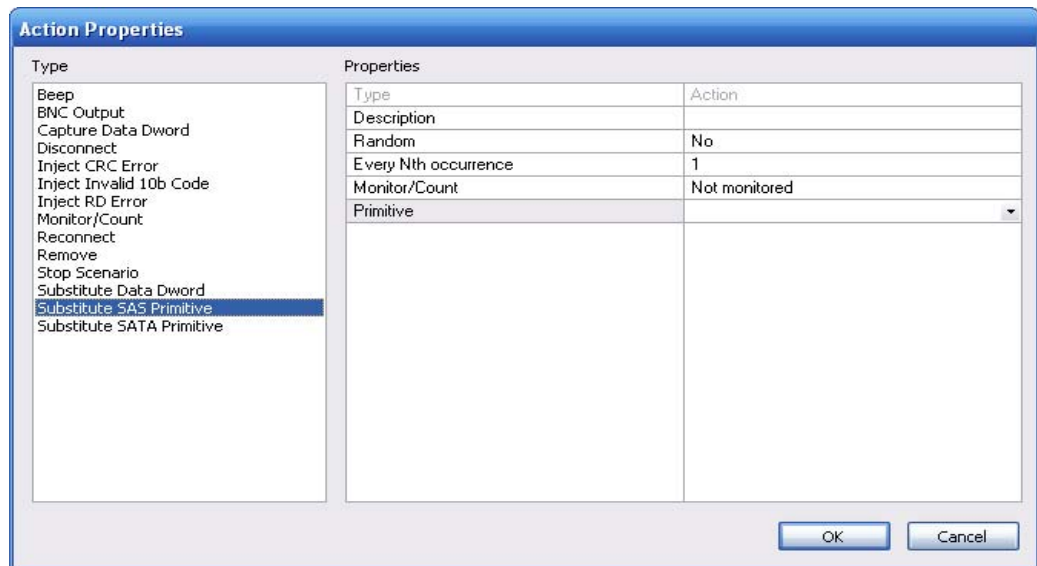
Figure 51   Example 2: Action Properties Dialog Box
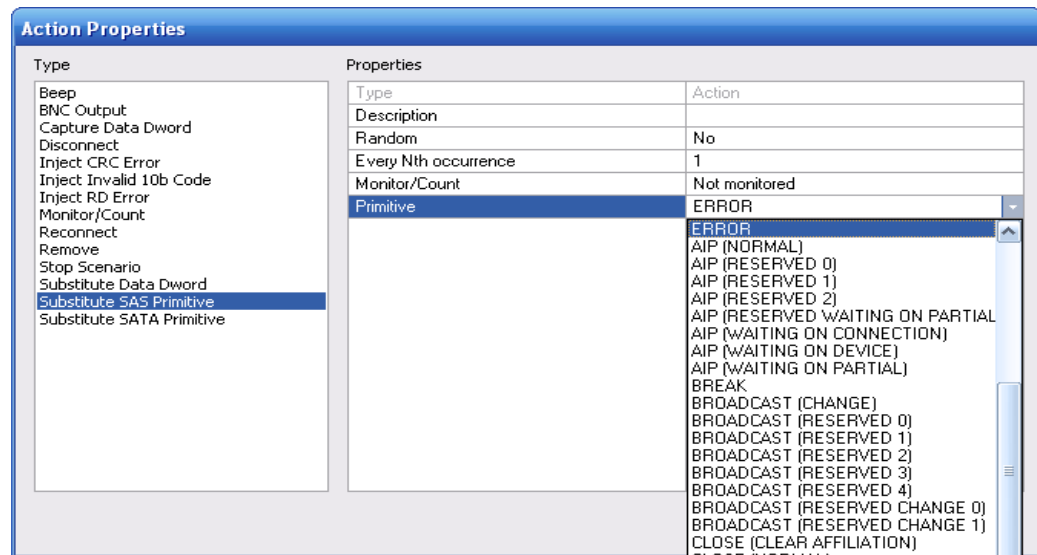
Figure 52   Example 2: Action Drop-Down List

Step 7   Still in the middle column of the Event Properties dialog box, click on **Primitive** to bring up a drop-down menu that lets you choose the type of primitive to substitute for RRDY (Normal) (Figure 52). Choose **ERROR**.

Step 8   Click **OK** to close the Action Properties dialog box.

**Step 9**   In the File menu, select **Save Scenario** to save the scenario.

Note: In this example, you set the substitution action to happen at every occurrence of an RRDY (Normal) (as shown in the Figure, the action is set for every occurrence). However, you can set an action to happen at other multiples of event occurrence (for example 5, 25, 1000 and so on). You also can set the action to happen at random, within a specified number of event occurrences.
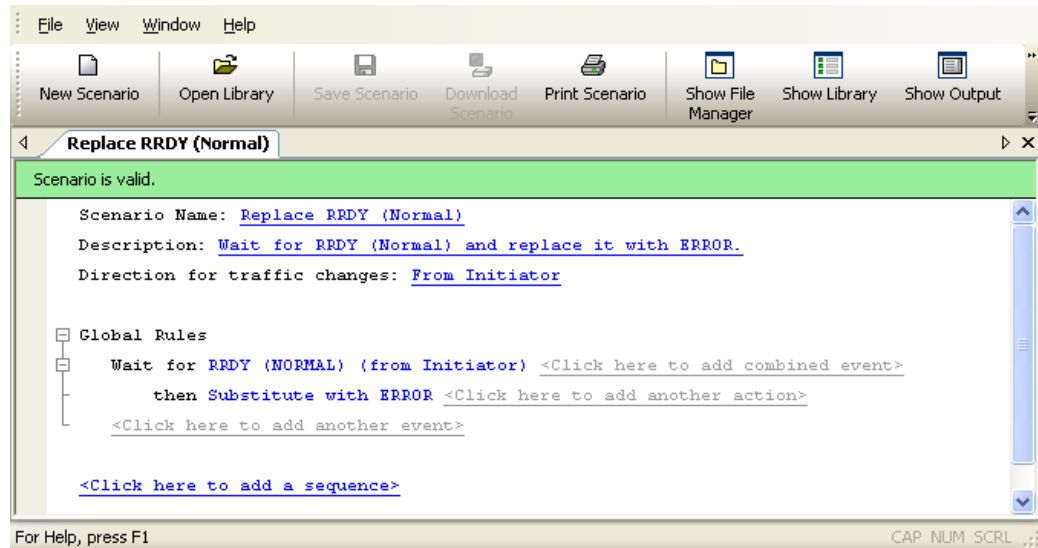
Figure 53   Example 2: Complete Scenario

**Example 3:
Creating OR
Conditions**

In this example, the Global Rules area of the scenario waits for either of two types of RRDY primitive and replaces them with an ERROR primitive.

This example includes a combined event (a logical OR association of two or more single events). Here, the combined event consists of any occurrence of RRDY (Normal) or RRDY (Reserved 0).

Step 1   Click the **New Scenario** button in the main library or one of the device libraries. At the top of the scenario area, enter general scenario information, including scenario name, description, and direction of traffic change.

Note: For an example of filling-in the general scenario information fields, see Figure 41 and Figure 42.

Step 2   In the Global Rules area, click on the prompt to **add an event**.

Step 3   The Event Properties dialog box appears. As you did in example 1 of this chapter, choose **RRDY (Normal)** as the first primitive you want to monitor.

Step 4   Click on the **add combined event** prompt to add a second event (Figure 54).

Step 5   The Event Properties dialog box appears (Figure 55). Choose **RRDY (Reserved 0)** as the second primitive you want to monitor.

Step 6   Click **OK** to close the Event Properties dialog box.

Step 7	In the Global Rules area, click on the prompt to **add an action** (Figure 56).

Step 8	The Action Properties dialog box appears (Figure 57). In the Type list on the left, choose **Substitute SAS Primitive** as the action you want when either RRDY Reserved 0 or RRDY Normal occurs.
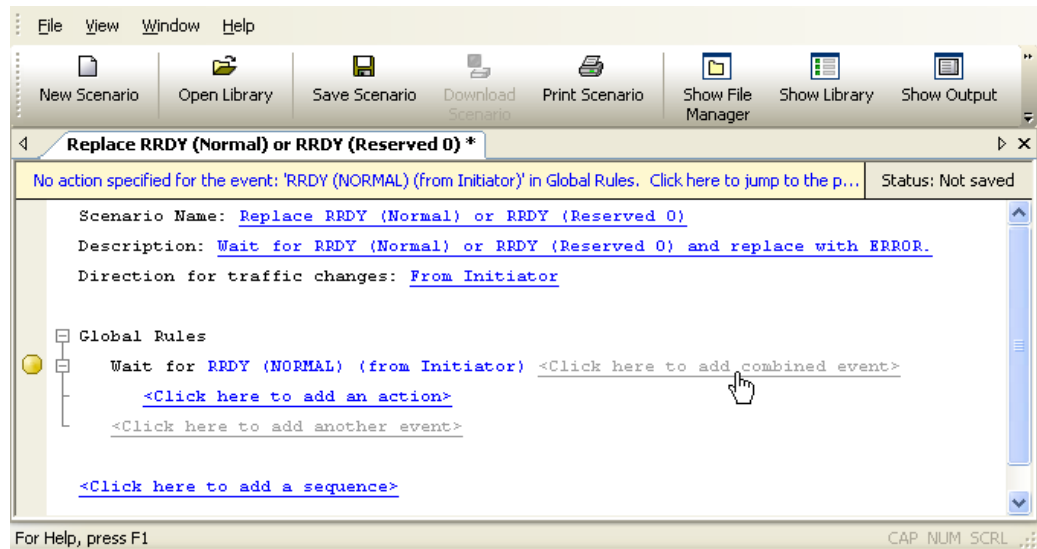
**Figure 54	Example 3: Entering the Second Event**
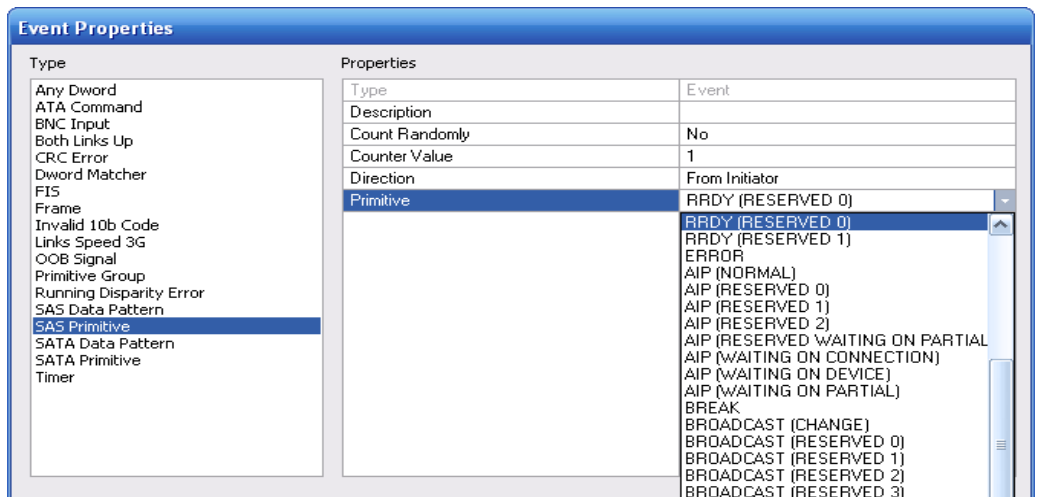
**Figure 55	Example 3: Event Properties Dialog Box**
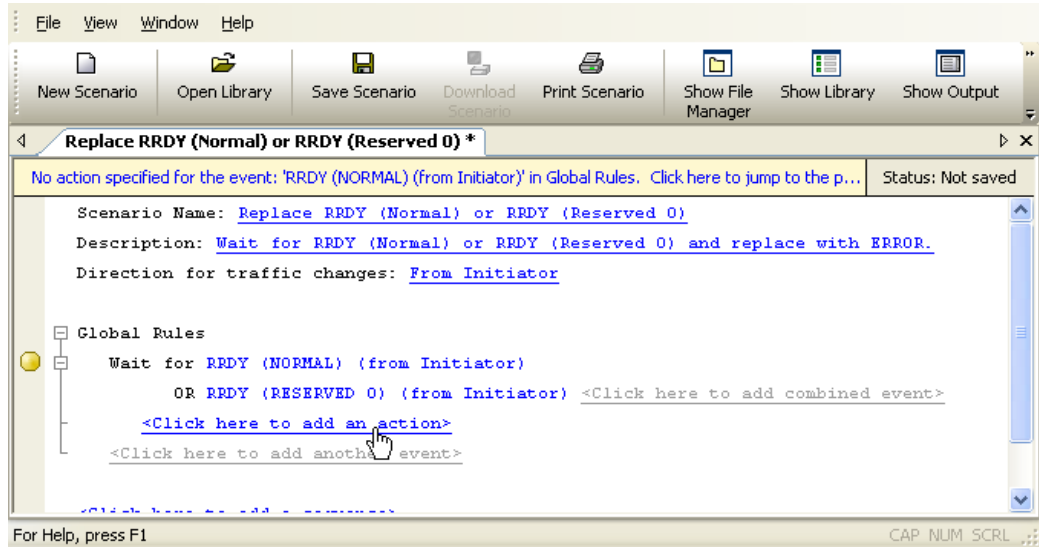
Figure 56   Example 3: Entering the Action
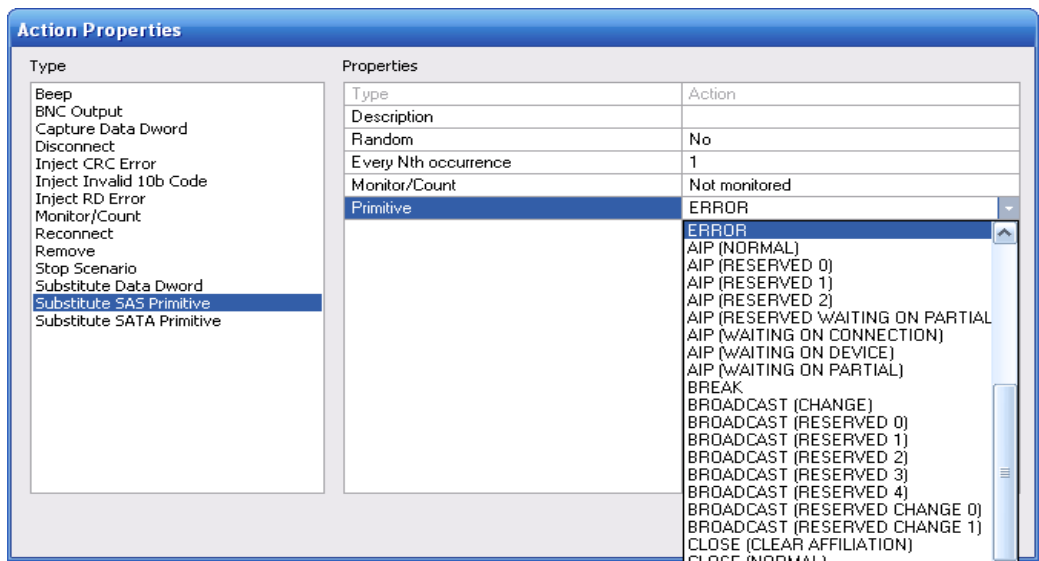
Figure 57   Example 3: Action Drop-Down List

Step 9   Click **OK** to close the Action Properties dialog box.

Step 10   In the File menu, select **Save Scenario** to save the scenario.
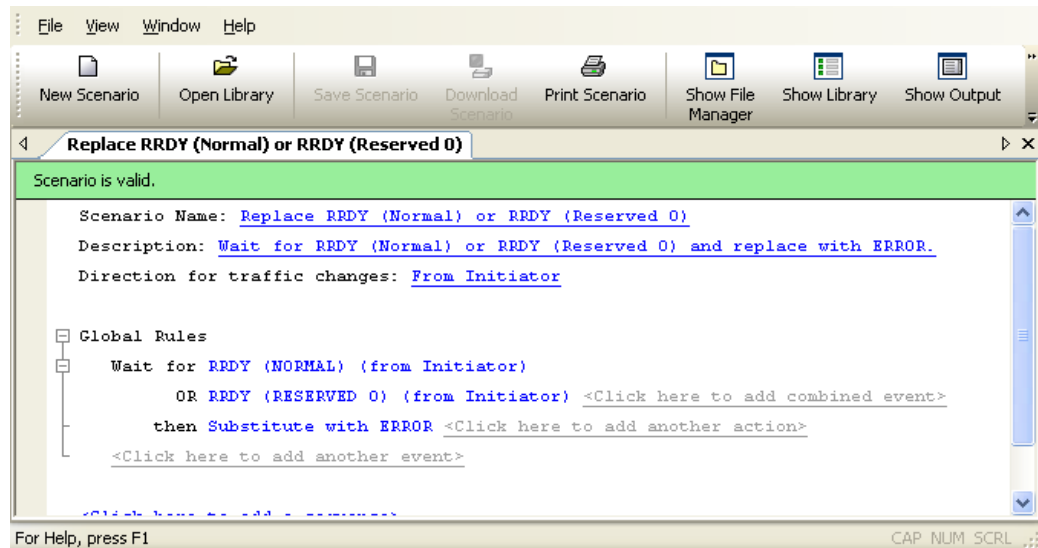
Figure 58   Example 3: Complete Scenario

Example 4: Multiple Triggers and Actions

In this example, the Global Rules area of the scenario waits for two events, each of which triggers a different action.

Step 1   Click the **New Scenario** button in the main library or one of the device libraries. At the top of the scenario area, enter general scenario information, including scenario name, description, and direction of traffic change.

Note: For an example of filling-in the general scenario information fields, see Figure 41 and Figure 42.

Step 2   As you did in example 2, choose **RRDY (Normal)** as the first event to monitor, and substitute with the SAS primitive **ERROR** as action.

Step 3   In the Global Rules area, click on the prompt to **add the next event** (keep in mind this is not a combined event) (Figure 59).

Note: In this example, there is a parallel set of events, but each event is associated with its own action. In a combined event, there is a parallel set of events sharing the same action.

Step 4   The Event Properties dialog box appears. Using the drop-down menu, choose **RRDY (Reserved 0)** as the second event to monitor (Figure 60).

Step 5   Click **OK** to close the Event Properties dialog box.

Step 6   In the Global Rules area, click on the prompt to **add an action** to be triggered by the RRDY (Reserved 0) (Figure 61).
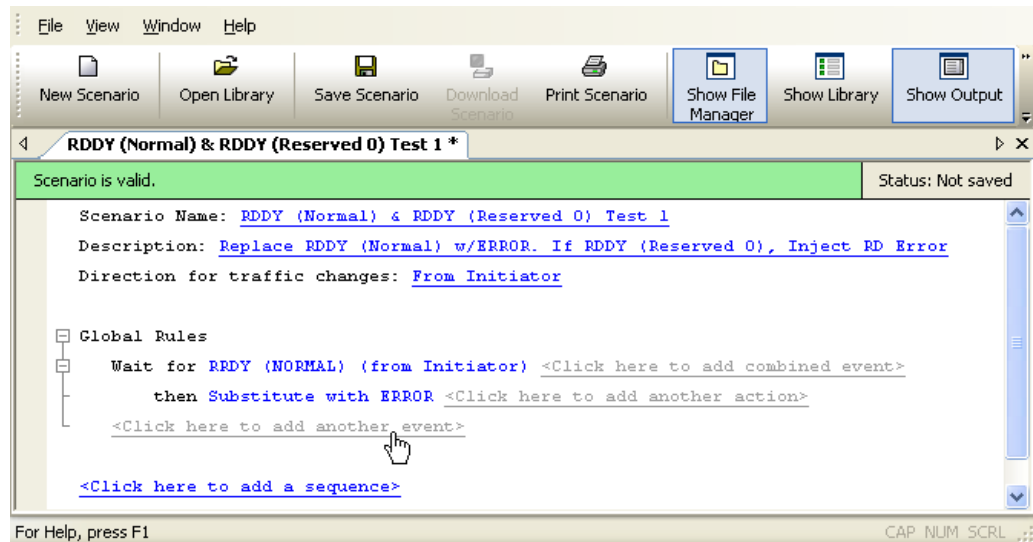
Figure 59   **Example 4: Entering Second Event**
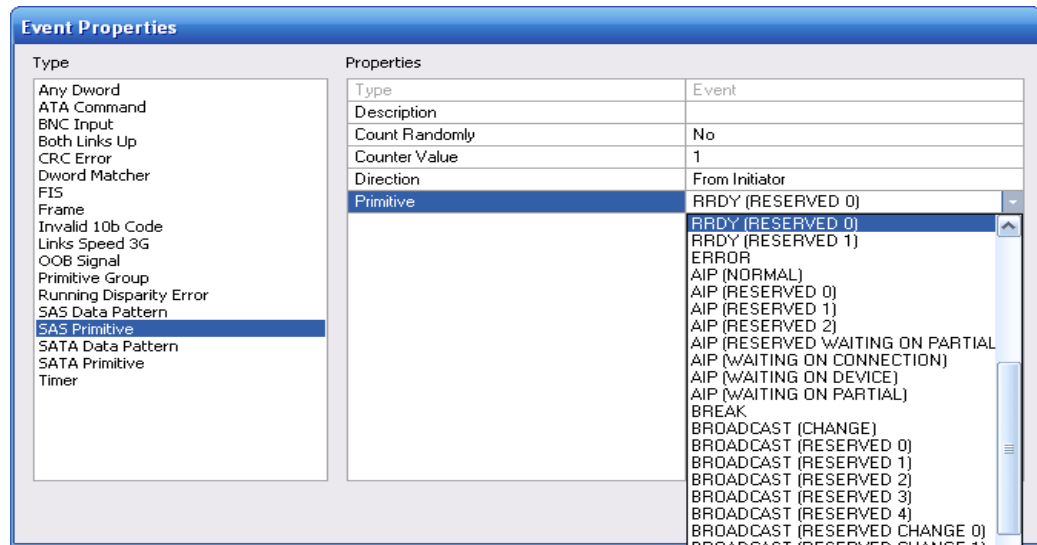
Figure 60   **Example 4: Event Drop-Down List**

Step 7   The Action Properties dialog box appears (Figure 62). Use it to choose **Inject RD Error** as the action triggered by RRDY (Reserved 0).

Step 8   Click **OK** to close the Action Properties dialog box.

Step 9   In the File menu, select **Save Scenario** to save the scenario.
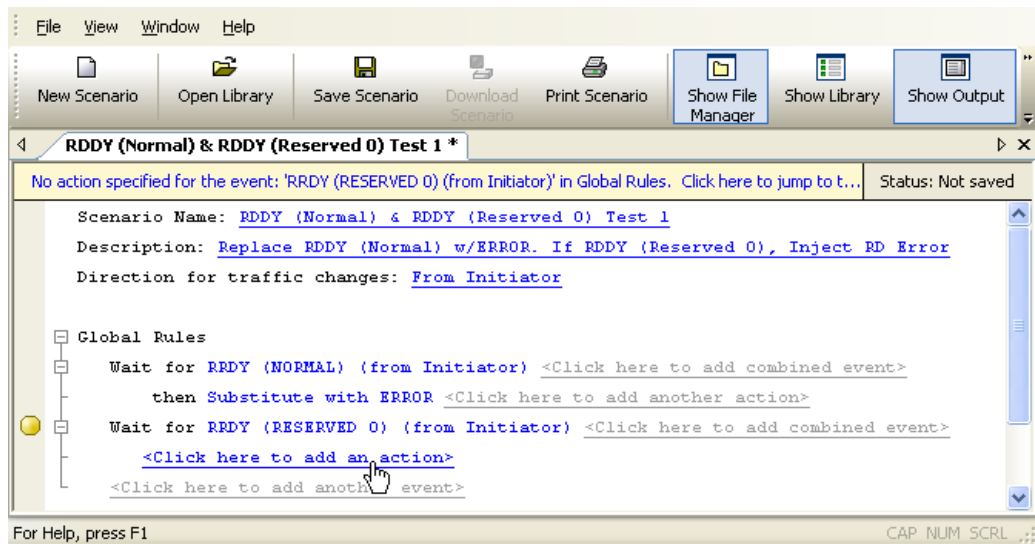
Figure 61   **Example 4: Entering Second Action**
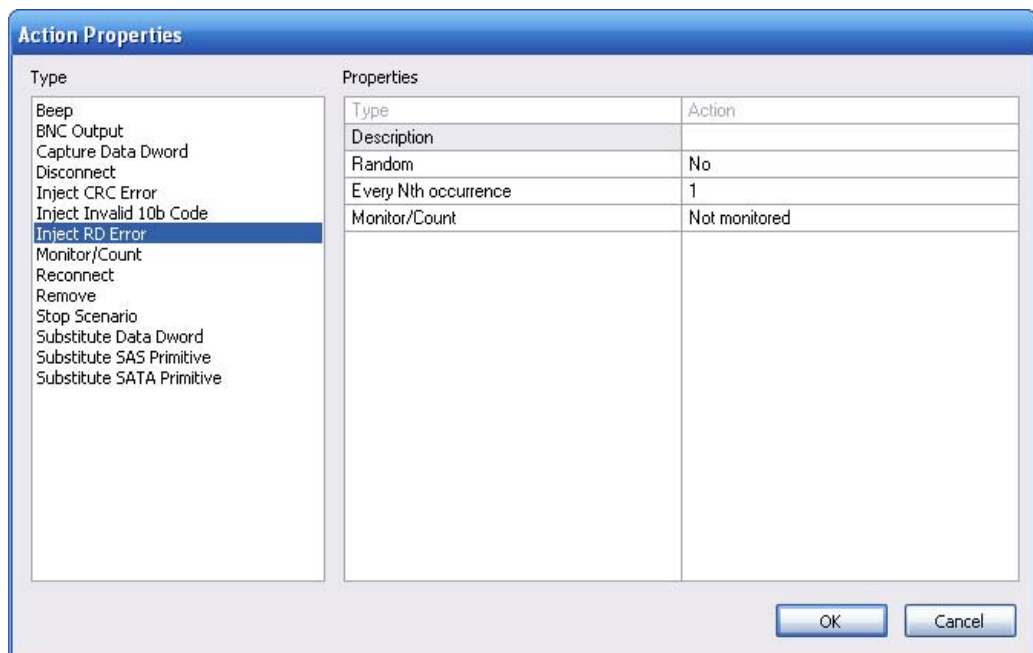
Figure 62   **Example 4: Action Drop-Down List**
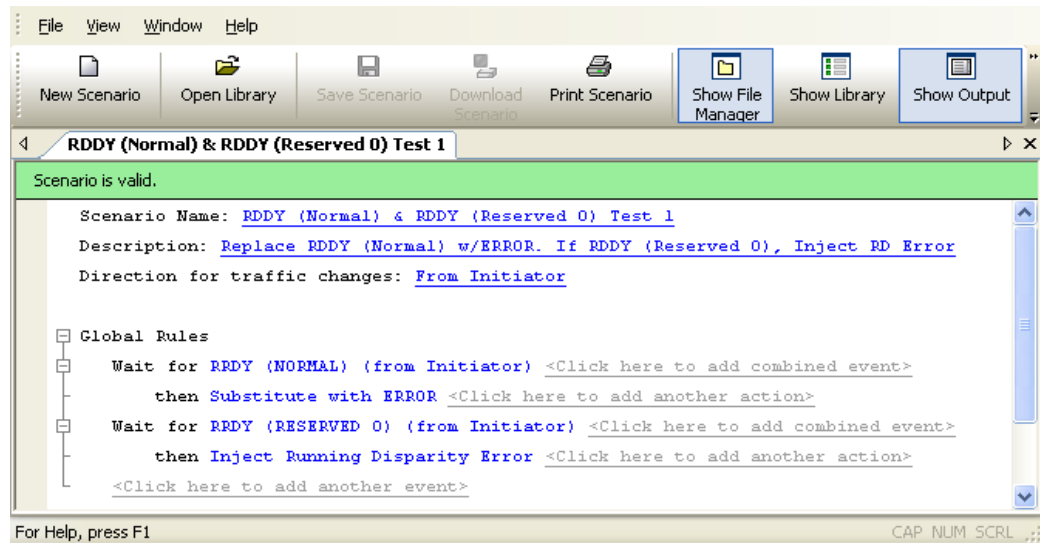
Figure 63   Example 4: Complete Scenario

Example 5: Multiple Actions on a Single Event

In this example, an event triggers a set of actions. The actions occur at the same time. The box waits for an ACK from the initiator. When it occurs, the box beeps, injects an RD error, and increments a counter monitoring for that event (ACK from initiator).

Step 1   Click the **New Scenario** button in the main library or one of the device libraries. At the top of the scenario area, enter general scenario information, including scenario name, description, and direction of traffic change.

> **Note:**   For an example of filling-in the general scenario information fields, see Figure 41 and Figure 42.

Step 2   As in previous examples, configure the first event and its response in the Global Rules area. Choose **ACK** primitive as the event, and **Beep** as the action. From the Action Properties drop-down menu, configure 500 ms as the duration of the beep.

Step 3   Click on the **add another action** prompt to add a second action (Figure 64).

Step 4   The Action Properties dialog box appears. Choose **Inject RD Error** as the second action (Figure 65).

Step 5   Click on the **add another action** prompt to add a third action (Figure 66).

Step 6   The Action Properties dialog box appears. Choose **Monitor/Count** as the third action (Figure 67).

Step 7   Click **OK** to close the Action Properties dialog box.

Step 8   In the File menu, select **Save Scenario** to save the scenario.
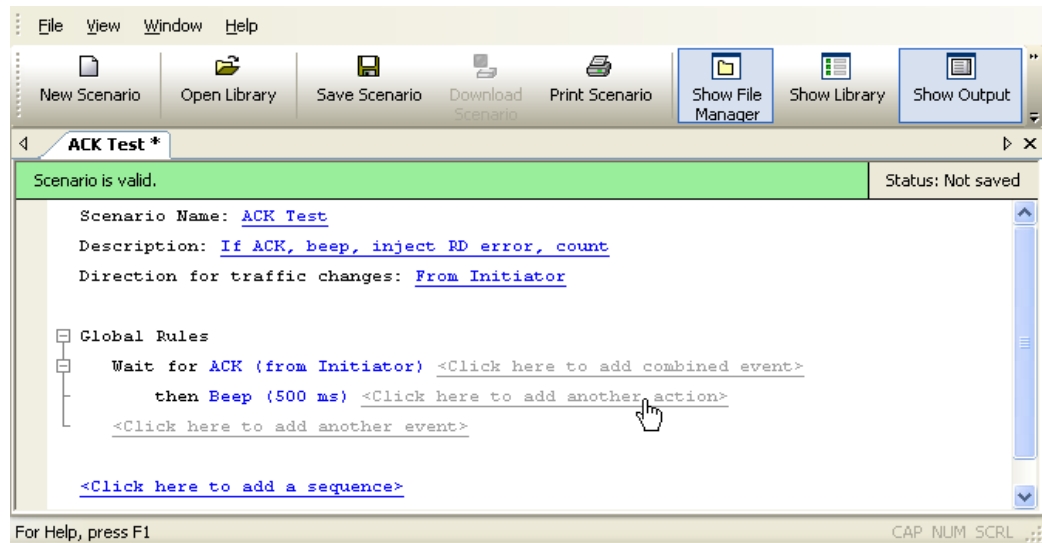
**Figure 64   Example 5: Entering the Second Action**
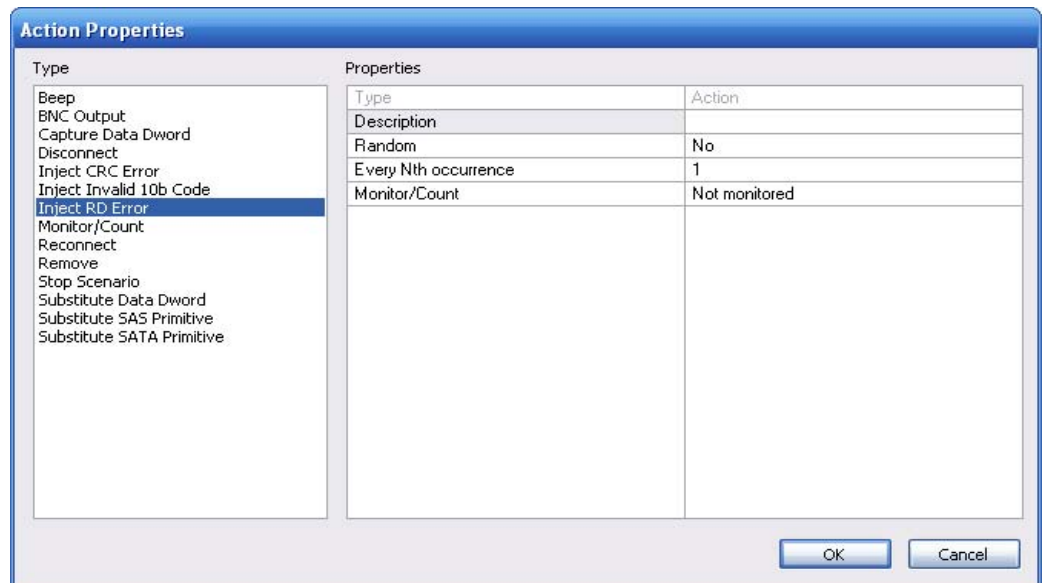
Figure 65   Example 5: Action Drop-Down List (For Second Action)
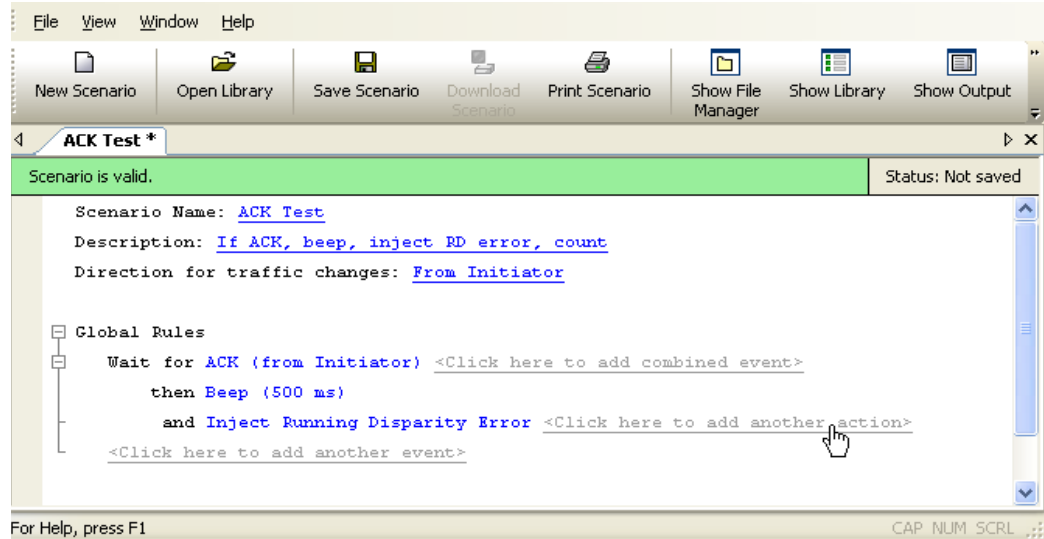
Figure 66   Example 5: Entering the Third Action
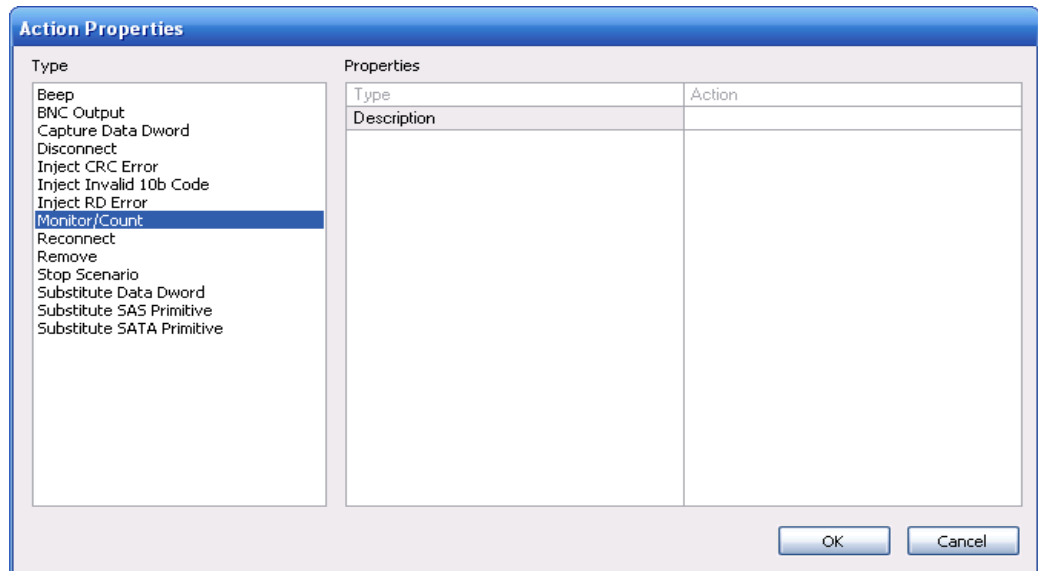
Figure 67   Example 5: Action Drop-Down List (For Third Action)

Note: This example sets the counter to increment at each occurrence of an
ACK (every 1 ACK).
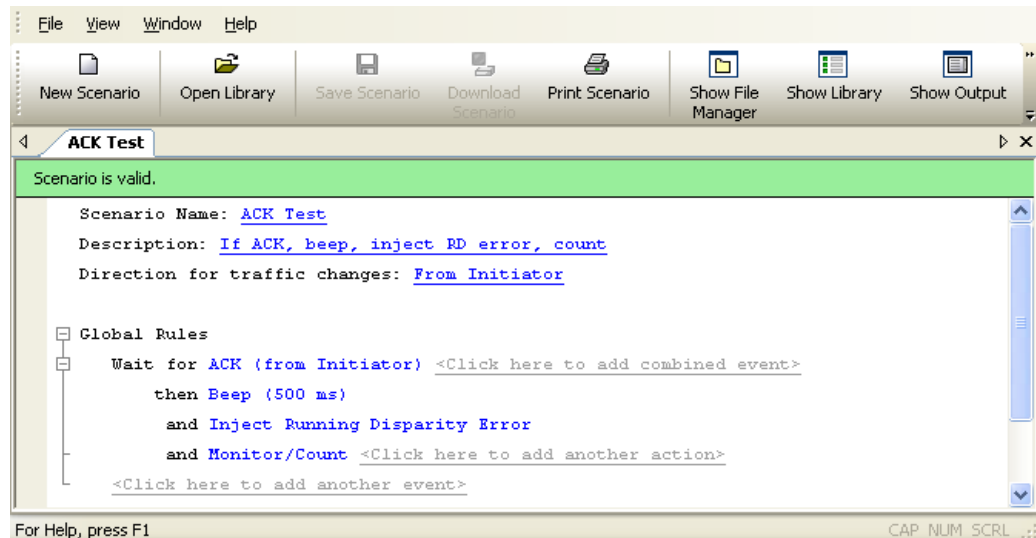
Figure 68   Example 5: Complete Scenario

Example 6: Using Timers

In this example, the Global Rules portion of the scenario waits for an ACK primitive from the initiator. Each time the box detects an ACK, it injects an RD Error into the traffic stream. This state continues for a random period of time, not to exceed 1.790 seconds. After the time period has elapsed (timer times out), the scenario stops.

Note: Although this example sets the timer for a random period, you also can set the timer for known values (2 ms., 5 mins., 1 hr., and so on).

Step 1 Click the **New Scenario** button in the main library or one of the device libraries. At the top of the scenario area, enter general scenario information, including scenario name, description, and direction of traffic change.

Note: For an example of filling-in the general scenario information fields, see Figure 41 and Figure 42.

Step 2 As in previous examples, configure the first event and its response in the Global Rules area. Choose **ACK** primitive as the event, and **Inject RD Error** as the action.

Step 3 Click on the prompt to **add another event** (keep in mind this is not a combined event) (Figure 69).

Step 4 The Event Properties dialog box appears (Figure 70). In the Type column on the left, choose **Timer**. Set the timer for random timing with a maximum time limit of 1.790 seconds.

Step 5 Click **OK** to close the Event Properties dialog box.

Step 6 Click on the prompt to **add an action** to correspond with the second event (Figure 71).

Step 7 The Action Properties dialog box appears (Figure 72). In the Type list on the left, choose **Stop Scenario** as the action you want after the timer has expired.

Step 8 Click **OK** to close the Action Properties dialog box.

Step 9 In the File menu, select **Save Scenario** to save the scenario.
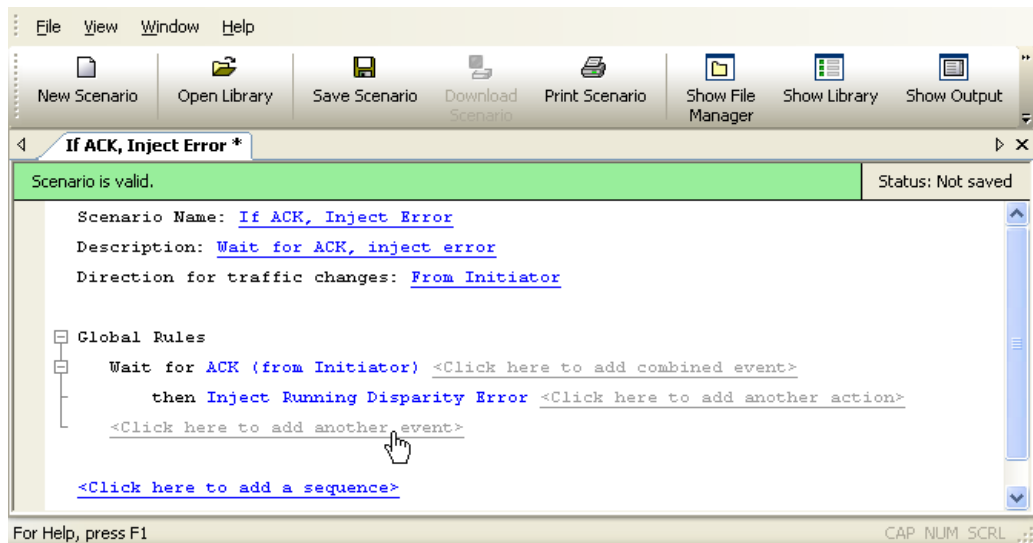
Figure 69   Example 6: Entering the Second Event
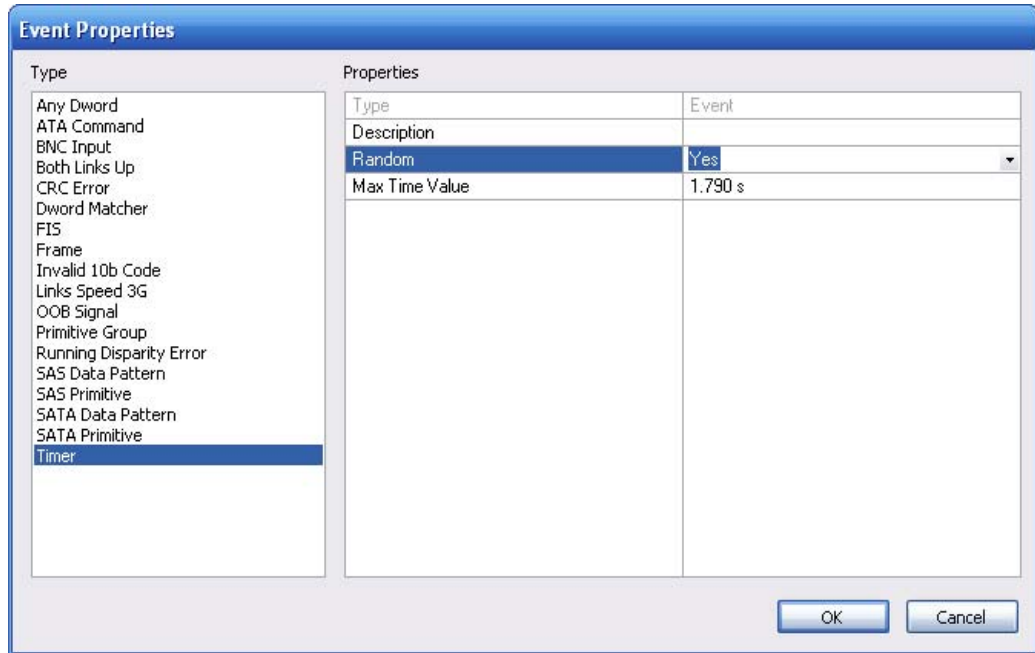
Figure 70   Example 6: Event Drop-Down List
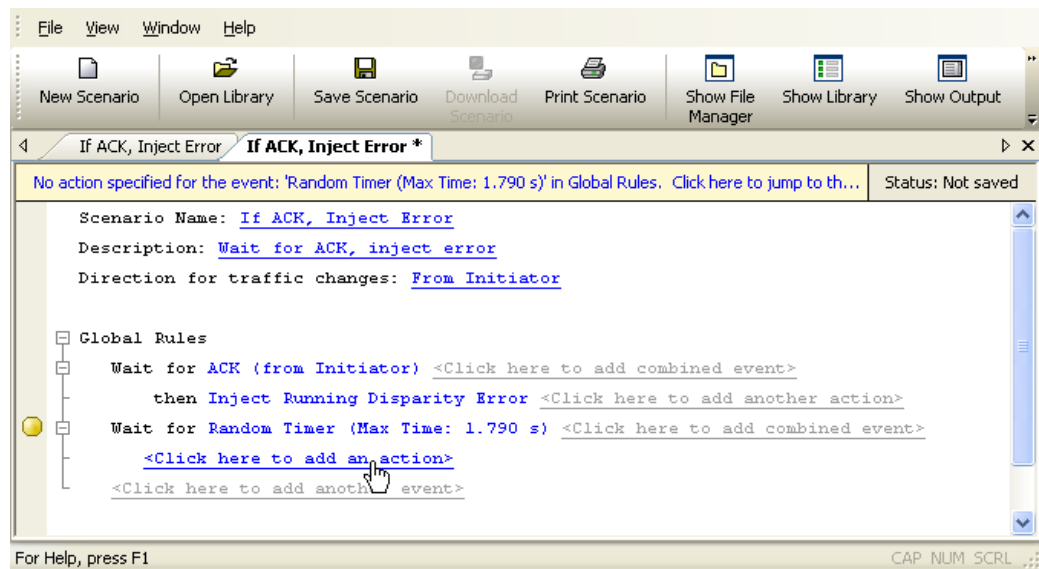
Figure 71   Example 6: Entering Second Action
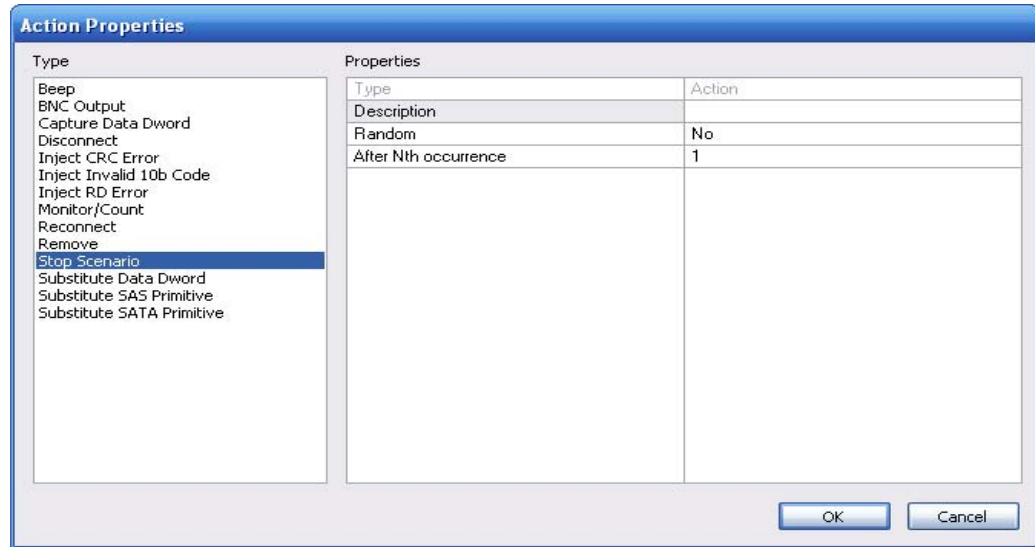
Figure 72   Example 6: Action Drop-Down List
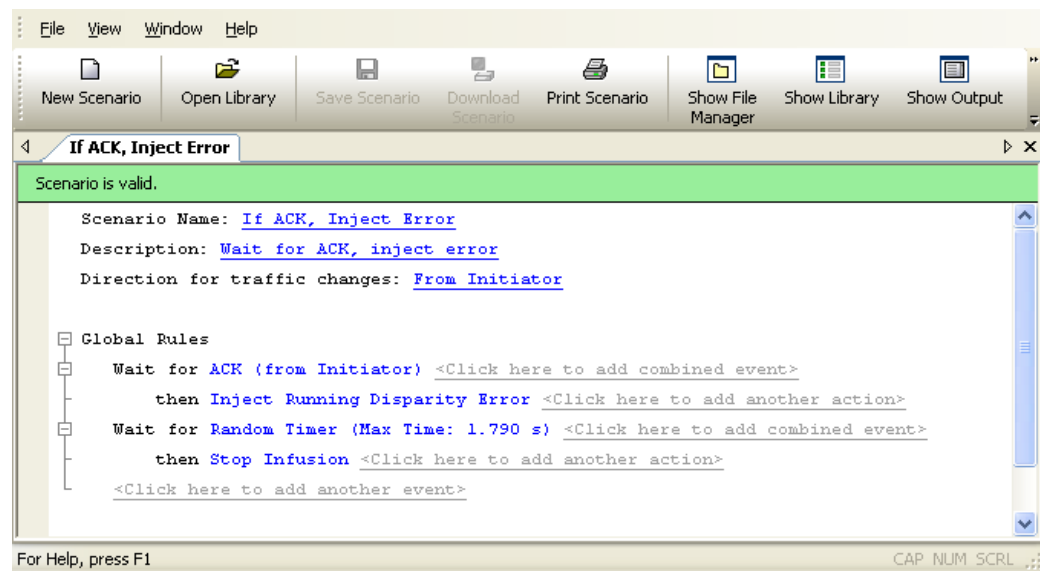
Figure 73   Example 6: Complete Scenario

Creating a Sequence

This section gives several examples for creating sequences. Recall that a sequence can have multiple states, but only one state is active at any time. In other words, at any point in time a sequences "waits" for one event (or combined event), and responds with the corresponding action or set of actions when the event occurs.

A sequence is more powerful than Global Rules, because you can create branching or looping test logic with a sequence.You can include up to two sequences in a scenario, but each is completely independent of the other (there is no branching or other interaction between the two, except through the Restart All Sequences action).

You must follow some simple rules when creating sequences (Table 11):

<p style="text-align:center">Table 11   Sequence Rules</p>

| |
|---|
| You can use only two branch actions per state (When you specify actions for a state, you can only use two instances of "Branch to an Existing State" or "Branch to a New State." If you try to use more than two, a red error message appears in the status area of the application that says "Too Many Actions.") |
| You can use only one restart sequence action per state. (When you specify actions for a state, you can only use one instance of "Restart Current Sequence" or "Restart All Sequences." If you try to use more than one a red error message appears in the status area of the application that says "Too Many Actions.") |
| You can use a maximum of 255 states per sequence. (If you try to use more than 255 states, a red error message appears in the status area of the application.) |

Table 12 summarizes the examples that follow.

<p style="text-align:center">Table 12   Sequence Examples</p>

Example	Description
7	Creating two sequences and Global Rules: This scenario has two objectives that you implement with Global Rules and two sequences. 1) You use Global Rules to replace any of three types of primitives; 2) You use two sequences to detect the order in which a type of frame is received from initiator and target.
8	Creating a sequence with many states #1: The objective of this scenario is to detect an incorrect order of primitives and to cause the box to beep when it happens. You implement this scenario with a single five-state sequence.
9	Creating a sequence with many states #2: This scenario is an enhancement on example 8. In this scenario, the objective is to detect an incorrect order of primitives, fix it, and to cause the box to beep when this happens. As with example 8, you implement this scenario with a single five-state sequence.

Example 7: Creating Two Sequences and Global Rules

In this example, Global Rules substitute an Align (0) primitive for each of the following received from the initiator: Align (1), Align (2), and Align (3). As a separate test operation, two sequences determine the order in which each Identify Address frame is received from initiator and target.

Table 13 and Table 14 summarize the logic implemented by each of the sequences.

Table 13   Example 7: Logic of Sequence 0

State	Description
State 0	If Identify Address frame is detected from initiator, go to State 1; otherwise, continue to check incoming frames (do not change state).
State 1	If next Identity Address frame detected is from target, beep 1 second.

Table 14   Example 7: Logic of Sequence 1

State	Description
State 0	If Identify Address frame is detected from target, go to State 1; otherwise, continue to check incoming frames (do not change state).
State 1	If next Identity Address frame detected is from initiator, beep 2 second.

There is no interaction between the two sequences. Each of them operates independently (and is independent of the Global Rules). However, the two sequences complement each other with their logic. In this sense, they both combine to implement a test objective.

Step 1   Click the **New Scenario** button in the main library or one of the device libraries. At the top of the scenario area, enter general scenario information, including scenario name, description, and direction of traffic change.

> **Note:**   For an example of filling in the general scenario information fields, see Figure 41 and Figure 42.

Step 2   As in previous examples, create the Global Rules area as shown in Figure 74.

Step 3   Click on the prompt to **add a sequence**. Prompts for the sequence appear beneath the Global Rules area. You create a sequence one state at a time. The application numbers states consecutively from 0 up (1, 2, 3, and so on).

By default, the name of the first sequence in a scenario is Sequence 0. The name of the first state is State 0. To change the name of a sequence or state, or to associate a description with it, click on the name of the sequence or state. A dialog box appears that allows you to enter that information.

> **Note:**   The description does not appear onscreen, but you can bring it up by clicking on the name of the sequence or state.

Step 4   In the State 0 area, click on the prompt to **add an event** (Figure 75).

Step 5   The Event Properties dialog box appears (Figure 76). In the Event Properties dialog box, select **Identify Address Frame** as the event.

Step 6   Click OK to close the Event Properties dialog box.

Step 7   In the State 0 area, click on the prompt to **add an action** (Figure 77).
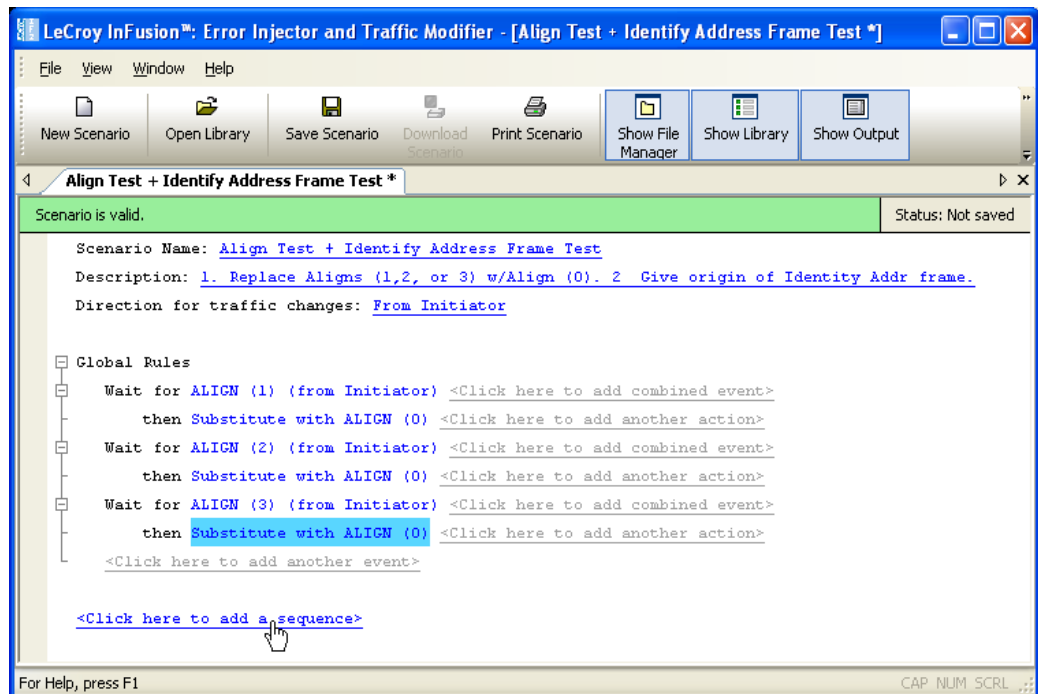
Figure 74   **Example 7: Adding the First Sequence**

Step 8   The Action Properties dialog box appears (Figure 78). For the action, select **Branch to a New State**.

Step 9   Click on the **OK** button to close the Action Properties dialog box. This saves the action and automatically creates an area for State 1 in the scenario.

Step 10   In the State 1 area, click on the prompt to **add an event** (Figure 79).

Step 11   The Event Properties dialog box appears. In the Event Properties dialog box, choose the **Identify Address Frame** event. In the Direction column, select **From Target** (you want State 1 to trigger on an Identify Address frame received from the

target).

Step 12 Click **OK** to close the Event Properties dialog box.

Step 13 Click on the prompt to **add an action** for State 1 (Figure 80).
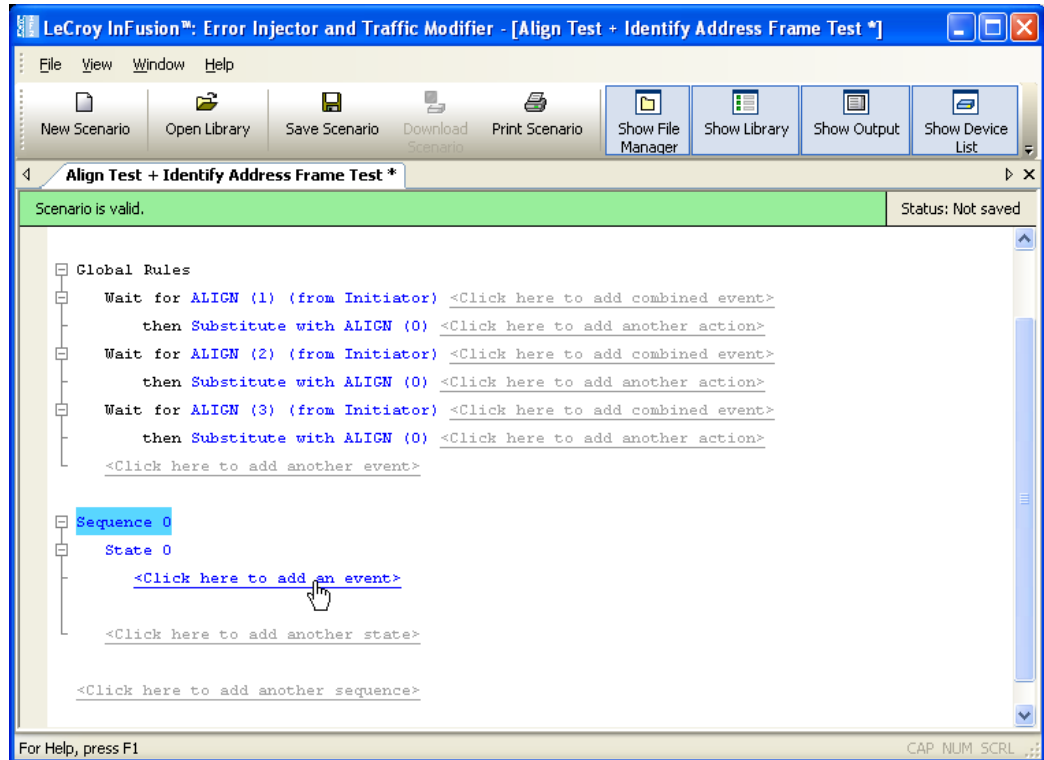
Figure 75   Example 7: Adding an Event for the First State
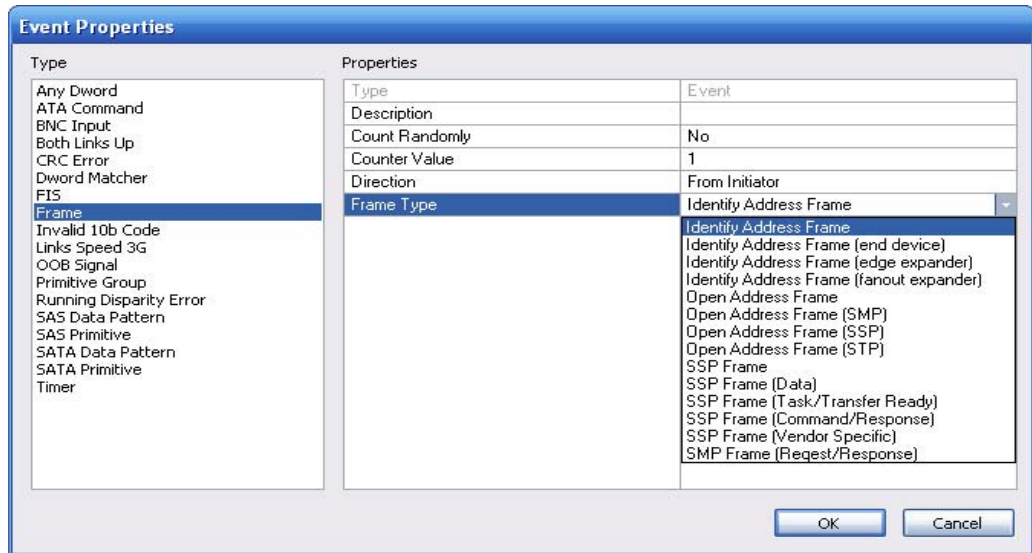
Figure 76   Example 7: Event Properties Dialog Box
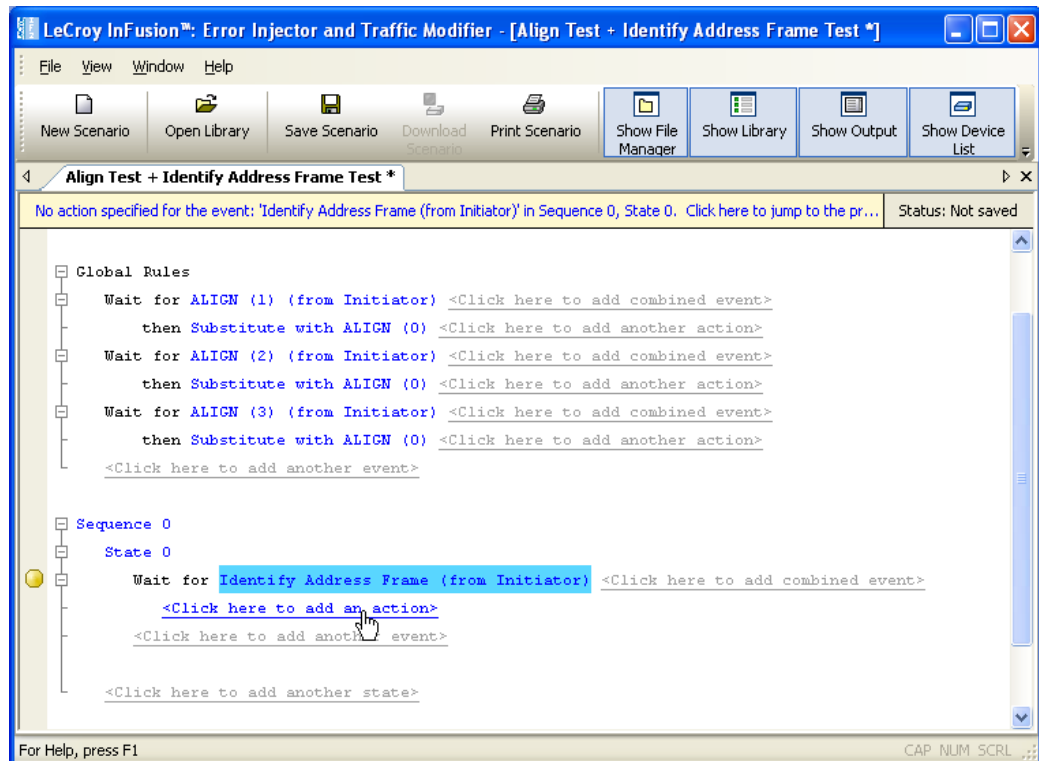
Figure 77   Example 7: Adding an Action for the First State
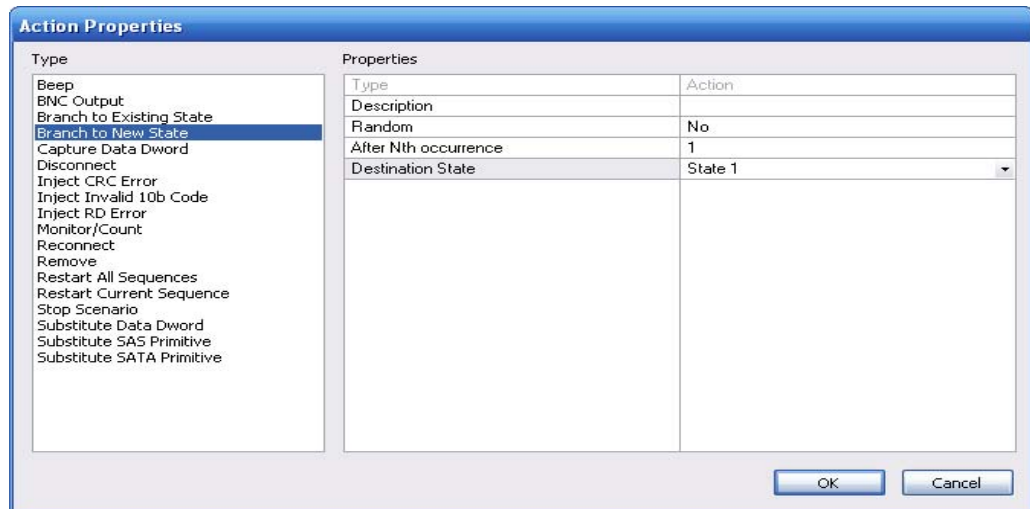
Figure 78   Example 7: Action Properties Dialog Box
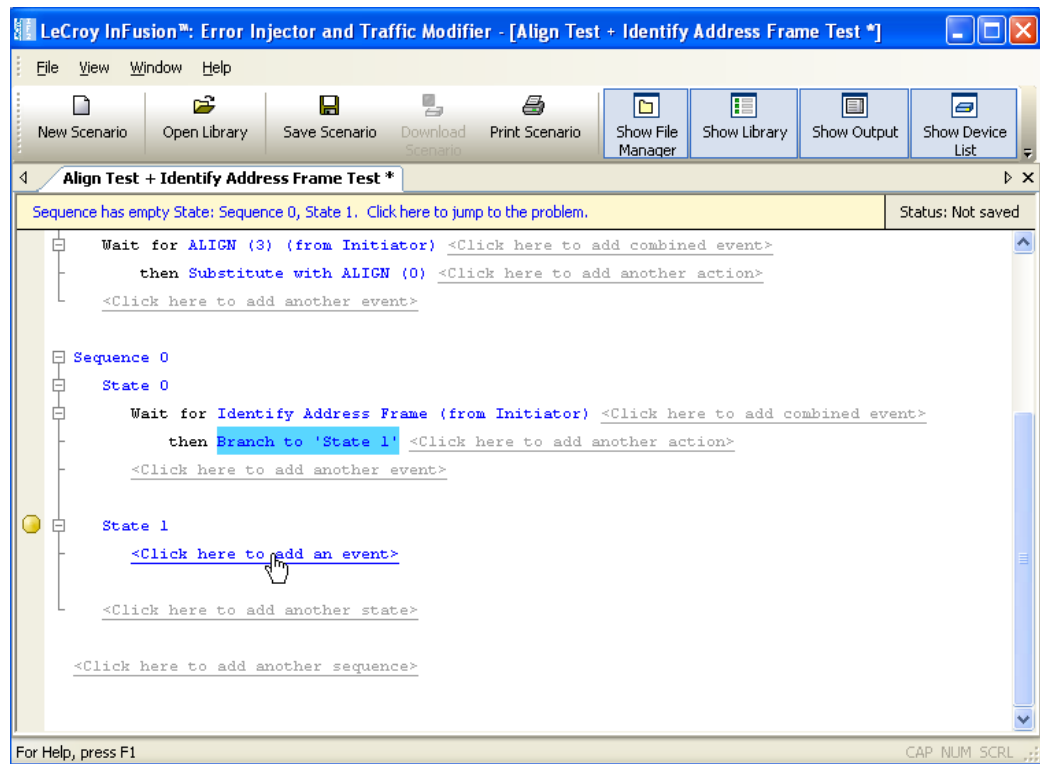
Figure 79   Example 7: Adding an Event for the Second State
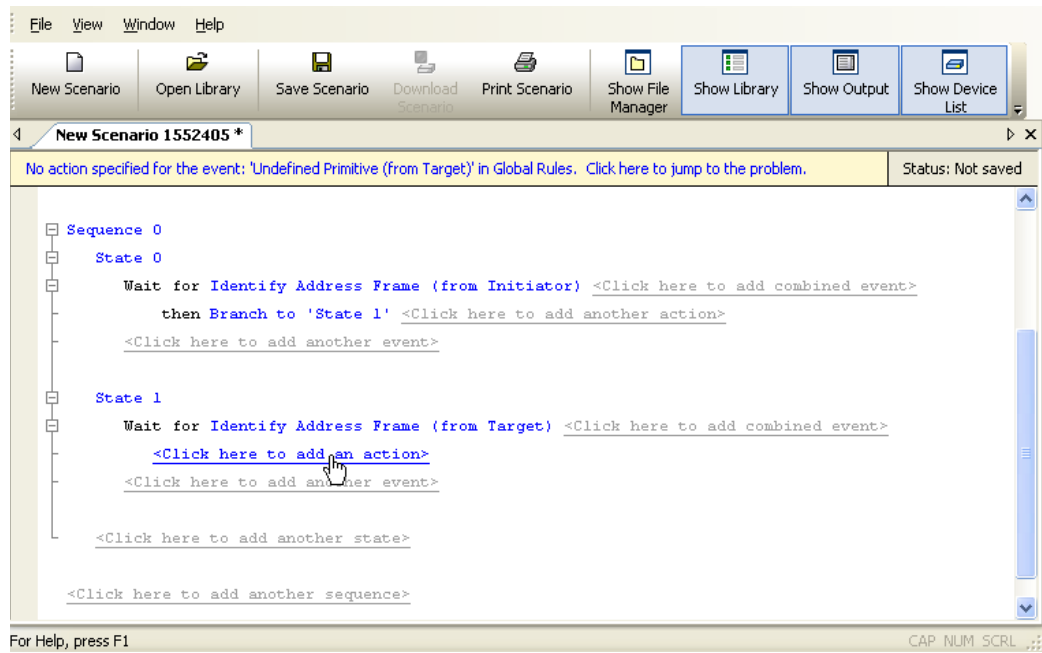
Figure 80   Example 7: Adding an Action to the Second State

Step 14   The Action Properties dialog box appears. In this example, you enter the action **Beep**, and you set the duration of the beep for 1 second.

Step 15   Click on **OK** to close the Action Properties dialog box.

Step 16   You are finished creating the first sequence. Click on the **add another sequence** prompt to create an area in the scenario for the second sequence (Sequence 1) (Figure 81).

Step 17   Create two states in the second sequence with the characteristics shown in Table 15.

Step 18   In the File menu, select **Save Scenario** to save the scenario (Figure 82).

Table 15   Example 7: States for Second Sequence

State	Event	Action
0	Identify Address Frame from Target	Branch to State 1
1	Identify Address Frame from Initiator	Beep for 2 seconds.
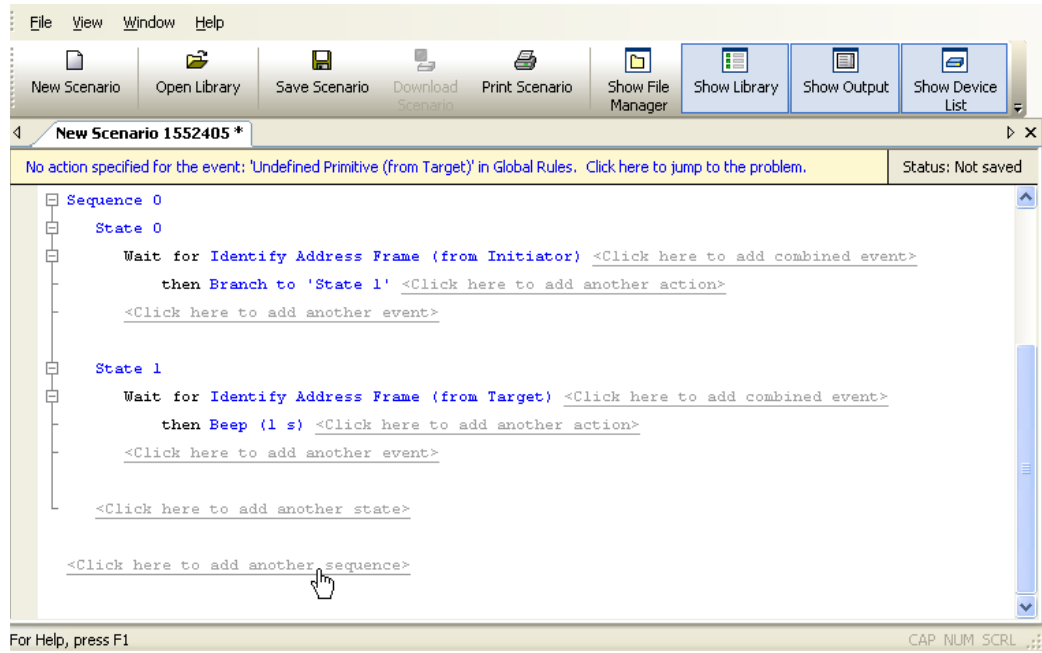
Figure 81   Example 7: Adding a Second Sequence
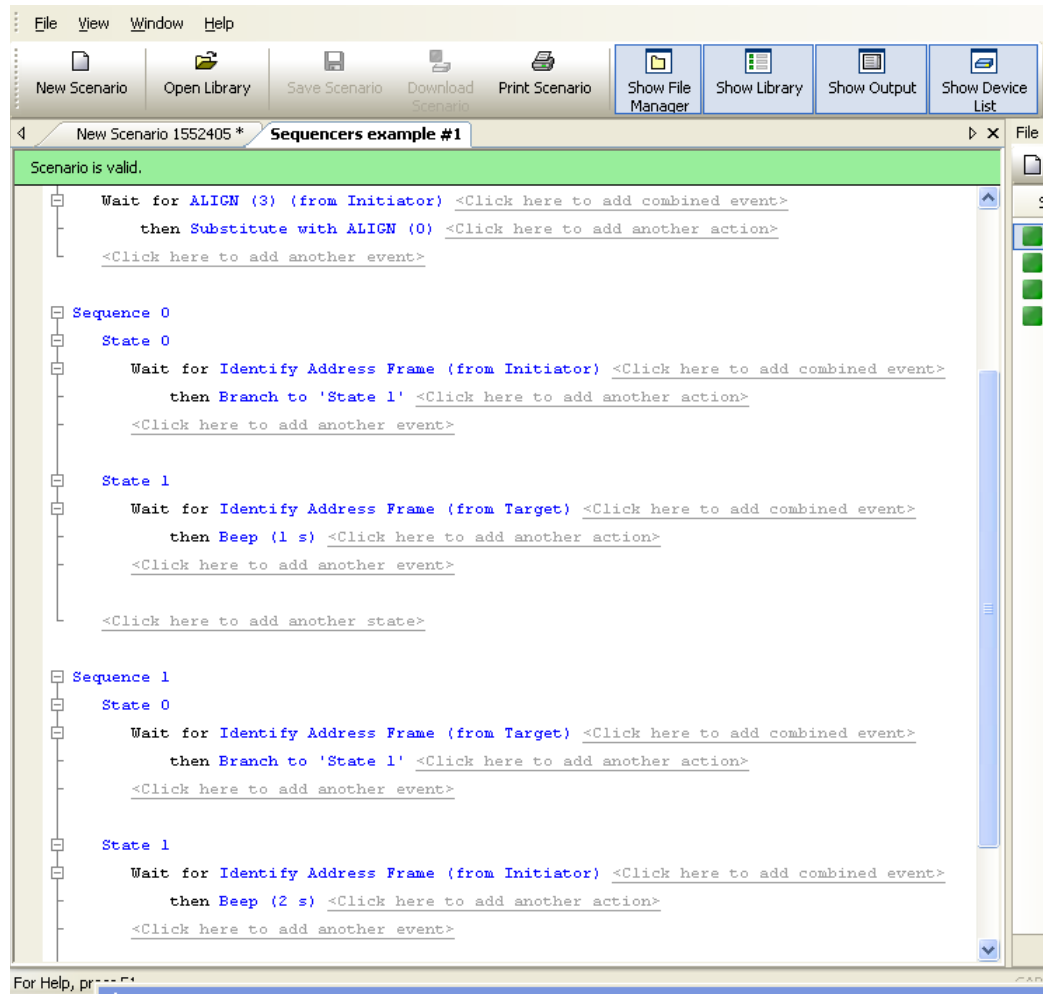
Figure 82   Example 7: Sequence Area of Scenario

Note: Figure 77 shows the Global Rules area of the scenario.

Example 8: Creating a Sequence With Many States #1

In this example, a five-state sequence detects if a group of primitives is received out-of-order from the initiator. The expected order is: Align (0), Align (1), Align (2), Align (3). If this scenario detects any other order of these primitives, it causes the box to beep and the scenario to restart.

This example is designed to give you an idea of the powerful logic that you can implement with sequences.

Note that the states in this sequence have been renamed (do not have their default names). Table 16 summarizes the sequence logic.

Table 16   Example 8: Logic of Sequence 0

State	Description
Wait for Align (0)	When an Align (0) is received, go to Wait for Align (1)
Wait for Align (1)	If an Align (1) is received next, go to Wait for Align (2) otherwise, go to Indicate Error
Wait for Align (2)	If an Align (2) is received next, go to Wait for Align (3); otherwise, go to Indicate Error
Wait for Align (3)	If an Align (3) is received next, restart test; otherwise go to Indicate Error
Indicate Error	Indicate error and restart test

Step 1   Click the **New Scenario** button in the main library or one of the device libraries. At the top of the scenario area, enter general scenario information, including scenario name, description, and direction of traffic change.

> **Note:**   For an example of filling-in the general scenario information fields, see Figure 41 and Figure 42.

Step 2   As in previous examples, create the five states for this sequence.

Step 3   In the File menu, select **Save Scenario** to save the scenario (Figure 83 and Figure 84).

Figure 83   Example 8: Top Half of Scenario

Figure 84   Example 8: Bottom Half of Scenario

Example 9: Creating a Sequence With Many States #2

In this example, a five-state sequence not only detects if a group of primitives is received out-of-order but it fixes any incorrect order. The logic is similar to that of example 8 with a few small changes. Table 17 summarizes each state.

Table 17   Example 9: Logic of Sequence 0

State	Description
Wait for Align (0)	When an Align (0) is received, go to Wait for Align (1)
Wait for Align (1)	If an Align (1) is received next, go to Wait for Align (2); otherwise, replace primitive with Align (1) and go to Indicate Error
Wait for Align (2)	If an Align (2) is received next, go to Wait for Align (3); otherwise, replace primitive with Align (2) and go to Indicate Error
Wait for Align (3)	If an Align (3) is received next, restart test; otherwise, replace primitive with Align (3) and go to Indicate Error
Indicate Error	Indicate error and restart test

Step 1   Click the **New Scenario** button in the main library or one of the device libraries. At the top of the scenario area, enter general scenario information, including scenario name, description, and direction of traffic change.

> **Note:**   For an example of filling-in the general scenario information fields, see Figure 41 and Figure 42.

Step 2   As in previous examples, create the five states for this sequence.

Step 3   In the File menu, select **Save Scenario** to save the scenario (Figure 85 and Figure 86).
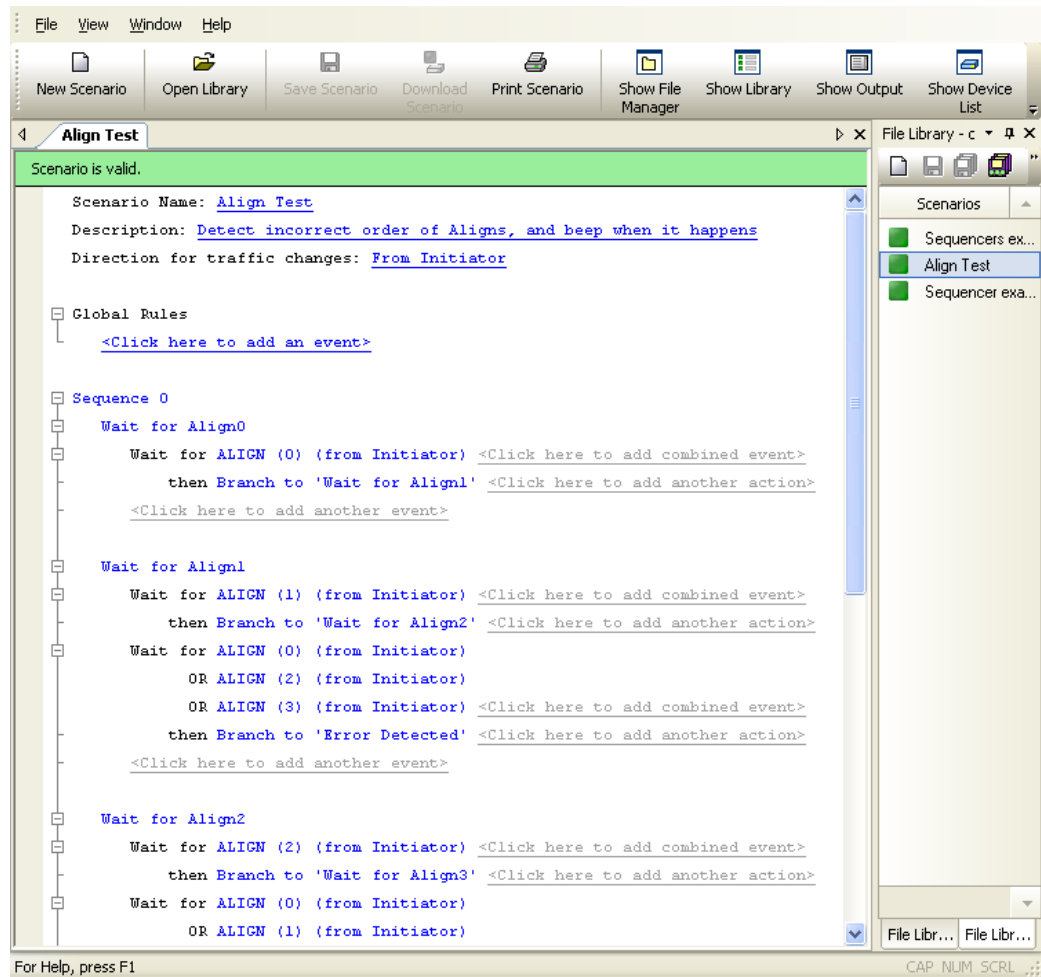
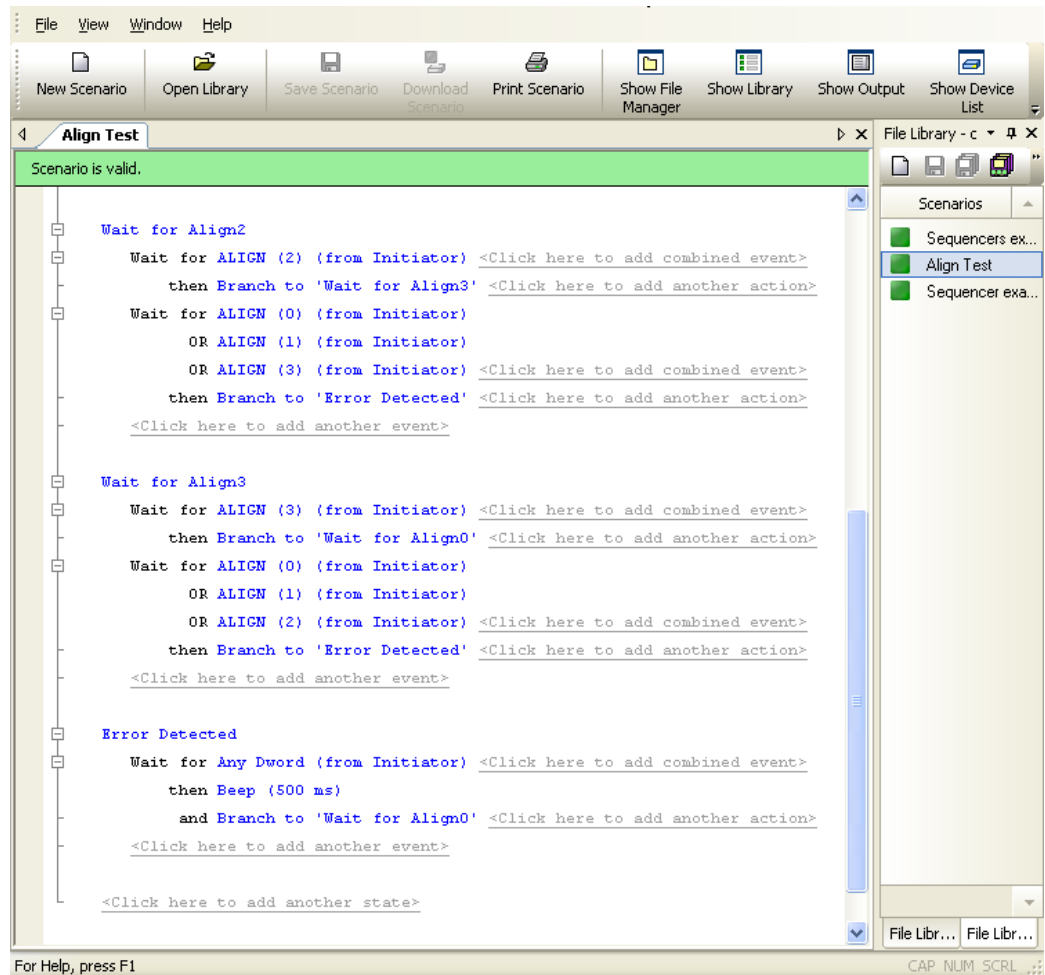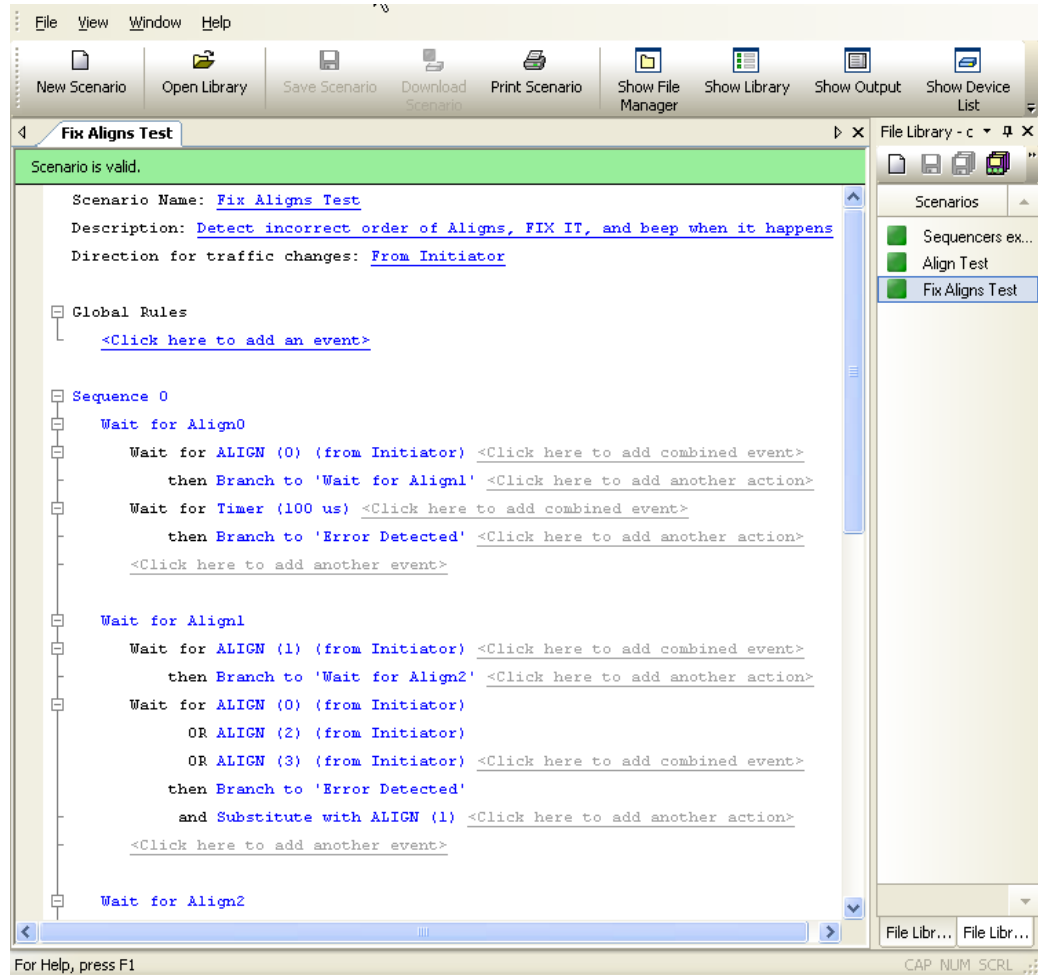**Figure 85   Example 9: Top Half of Scenario**
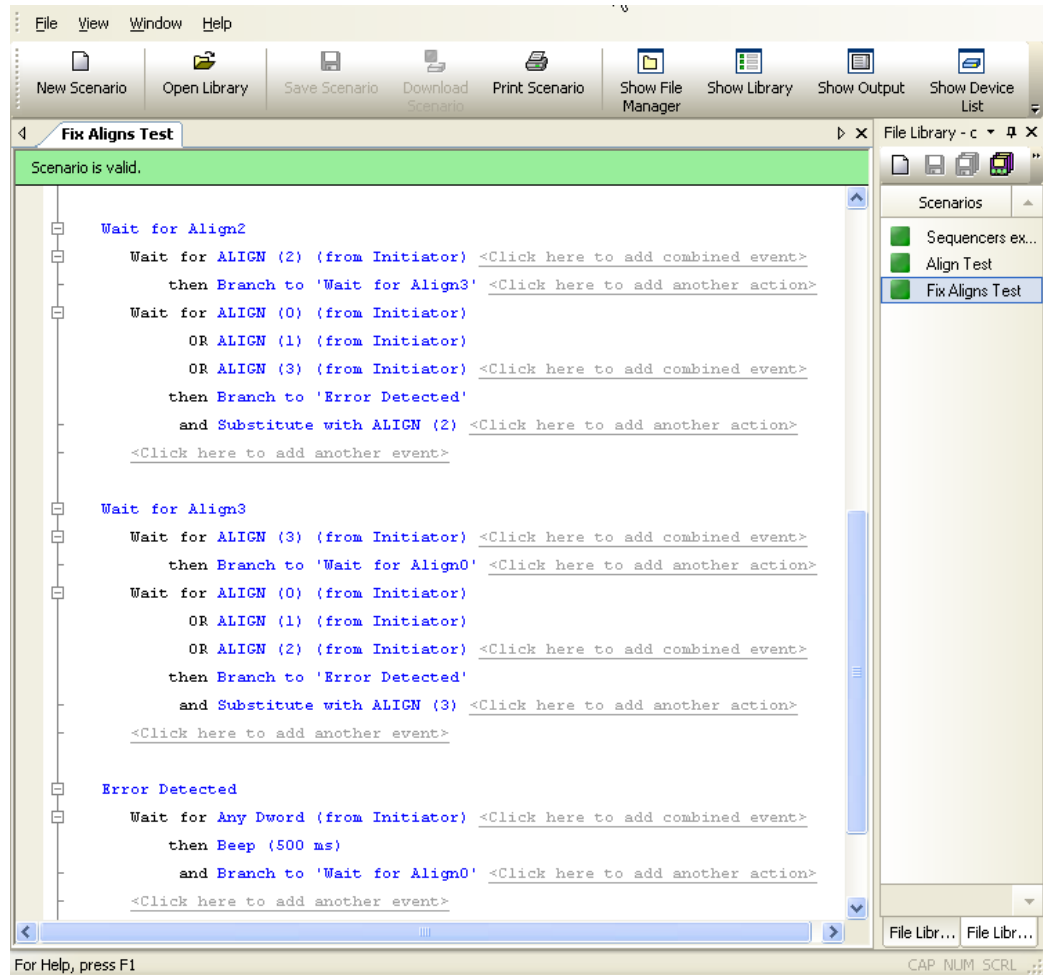
Figure 86   Example 9: Bottom Half of Scenario

Creating Multi-Link Tests

As described, each SAS *InFusion* box has two BNC connectors on its rear panel that allow it to connect to other SAS *InFusion* boxes in a daisy-chain. One connector is for signal input, the other for signal output.

The BNC connectivity allows you develop wide-link test schemes. In such schemes, BNC output on an upstream box is linked to the BNC input on its downstream neighbor.

The scenarios that runs on each box interacts with the scenarios that run on its neighbors through trigger signals exchanged via the box BNC ports. The trigger signals are called toggle events: BNC Input Toggle and BNC Output Toggle.

Each of the boxes in the daisy-chain monitors/modifies its own line only, but there is synergy between the boxes by way of the BNC daisy-chain. In this fashion, you can use a SAS *InFusion* daisy-chain to coordinate events and actions across multiple SAS or SATA physical links.

In the example that follows, four boxes are connected in a daisy-chain. In this test, each box runs the same scenario. The boxes are linked as follows:

> Box 1 BNC Output connects to Box 2 BNC Input
>
> Box 2 BNC Output connects to Box 3 BNC Input
>
> Box 3 BNC Output connects to Box 4 BNC Input
>
> Box 4 BNC Output connects to Box 1 BNC Input

Example 10: Multi-Link Test

In this example, the four separate links act as a wide link, and the same scenario runs in each SAS *InFusion* box. This set-up allows detection of an Open Address Frame on any of the four links, that is responded to on any of the other four links. The detected OPEN_ACCEPT, regardless of which link it was detected on, is replaced with OPEN_REJECT.

To achieve this result, the scenario has each box wating either for an Open Address Frame or for a BNC signal from its neighboring box, meaning that it has detected an Open Address Frame. In either case, the BNC output is toggled to signal the next box in the BNC daisy-chain that the Open Address Frame has been detected, and that the box can now transition to its next state (waiting for an OPEN_ACCEPT). This way, as soon as one of the links gets an Open Address Frame, all four boxes will transition to state 1. State 1 waits for an OPEN_ACCEPT and replaces it with OPEN_REJECT, and this will happen regardless of which link it is sent on, because ALL links are waiting for the same event.
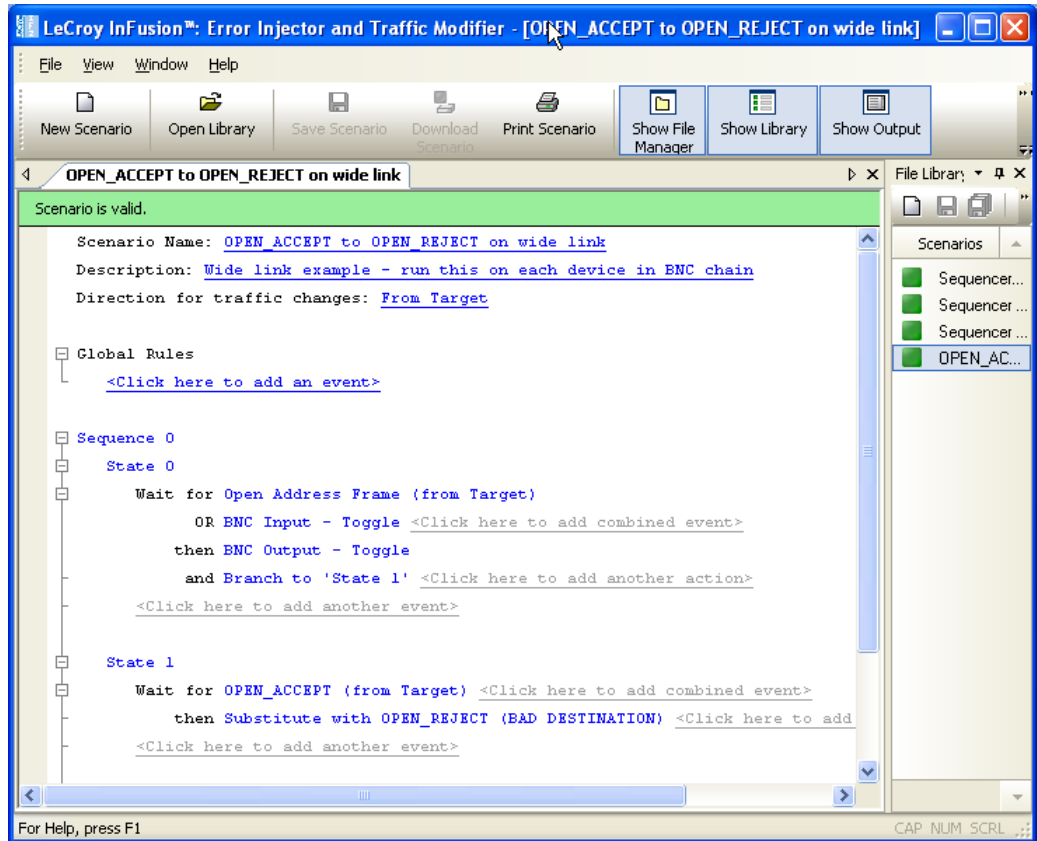
Figure 87   Example 10: Test Scenario for Each Box

Downloading Scenarios

After you have created a scenario, you need to download it to the SAS *InFusion* box for execution.

If you use a general library as a scenario archive, then the process of creating and executing a scenario is as follows:

Step 1   Open the general library (Main library or a File library). Scenarios in the library are listed in the library window (left side Figure 88).

Step 2   Open the Device List window by clicking on the Show Device List button on application toolbar.

Step 3   Open the Device library for the box to which you want to download a scenario or scenarios. You can open the device library in two ways: by clicking on the device library icon in the device list window or by double-clicking on the device name.

Step 4   Copy the scenario from general library to device library by dragging it with the mouse (Figure 88).
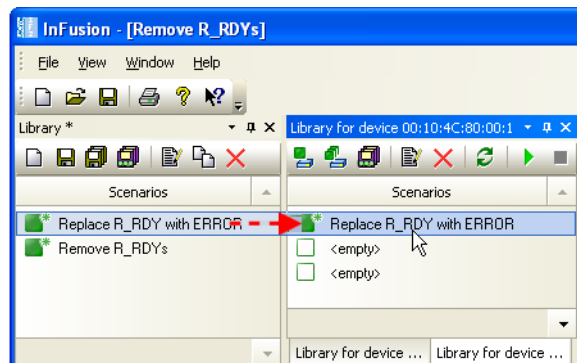
Figure 88   Downloading Scenarios

Step 5   Download all scenarios in device library to the SAS *InFusion* device. To do so, click the **Download all Scenarios** button on the Device library toolbar (second button from left).

Step 6   Select the scenario to be run by clicking it.

Step 7   To run the scenario, click the **Run Scenario** button on the Device library toolbar (second button from the right). The SAS *InFusion* device will then begin its session.

Chapter 6: LCD Panel Menus

This chapter describes menus that appear on the LCD panel of the SAS *InFusion* box.

> **Note:** As described in Chapter 2, the LCD panel displays commands for configuring the device, and for starting and stopping scenarios.

Figure 89   SAS *InFusion* LCD Panel

LCD Panel Overview

If you are using the SAS *InFusion* box in networked mode, you typically use the LCD panel only to set an IP address so the box can be controlled by the SAS *InFusion* software application. However, if you operate SAS *InFusion* box in stand-alone mode, you might continue to use the panel as the primary means to control tests (view status, change configuration options, start and stop scenarios).

> **Note:** Regardless if you operate in stand-alone mode or networked mode, you must use the SAS *InFusion* application to create scenarios. You can not do so using the box LCD panel.

Recall that you can download up to ten scenarios for storage on the box. To download the scenarios, you need an Ethernet link between the box and the PC that runs the SAS *InFusion* software application.

Boot Sequence

The boot sequence for the SAS *InFusion* box takes a few seconds. As the box boots, it initializes itself, beeps, and shows status on the LCD panel. If the box boots successfully, the LCD panel Root menu appears.

During initialization, several status messages flash by in rapid sequence:

> "LeCroy Infusion"
> "Initializing ..."
> "Configuring FPGA"
> "BE Frequency Test"
> "BE Beeper Test"
> "Temp. Sensor Pass"

Booting from Boot-Code

If the SAS *InFusion* box does not boot successfully, or if it becomes non-responsive, you can boot from default settings called boot-code.

Boot-code is a simplified version of SAS *InFusion* firmware. It allows the SAS *InFusion* box to boot to the point where it can communicate with the SAS *InFusion* software application. After communication is established between the box and software application, you can download a different version of firmware and BusEngine files to the box.

> **Note:** You can not download scenarios to the SAS *InFusion* box while operating in boot-code.

To boot from boot-code,

> **Step 1** Press and hold any of the three buttons on the SAS *InFusion* box front panel.
>
> **Step 2** While holding the buttons DOWN, turn the box ON.

After you complete these steps, download the new version of BusEngine and firmware files, then reboot the box from the LCD panel menu (Box Setup > Reboot).

Root Menu

As mentioned, the Root menu appears after successful boot-up. There are submenus beneath the Root menu, but most are just one layer deep (beyond the Root menu). The deepest submenu is just two layers deep.

Figure 89 shows the LCD panel Root menu. Device status is shown on the top line, which includes the following items:

> **[SAS]**:   Indicates the InFusion hardware platform.
>
> **Actv: 1**: This shows which scenario is active, and appears only if scenarios have already been downloaded. The SAS *Infusion* box can hold ten scenarios. The scenarios are numbered 1 through 10. You can use the LCD panel to select the scenario to run via the InFusion Setup menu (Root menu > InFusion Setup)**.**
>
> **Idle**:   Shows traffic generation status. Status can be Idle or Busy. When the box is not running a scenario, status is Idle. When running a scenario, status is Busy.

Submenus

The Root menu has four options:

- Box Setup submenu (Table 18).
- SAS Configuration submenu (Table 19).
- Start Infusion command.
- Infusion Setup submenu (Table 20).

Within each of these submenus are second-level submenus.

> **Note:**   When lists of options are presented in a menu, current selections are indicated with an asterisk

To navigate through submenus, use the **Up Arrow** and **Down Arrow** buttons (top and bottom blue buttons) on the front of the unit. To select or change an option, use the **Select** button (middle button).

Box Setup Submenu

Table 18   **Box Setup Submenu**

Menu	Submenu	Command
IP Mode	Static Dynamic	Static = you assign an IP address Dynamic = A DHCP server assigns an IP address
IP Address		Default is 0.0.0.0. If IP Mode = Dynamic, this field is ignored.
Subnet Mask		Default is 0.0.0.0 If IP Mode = Dynamic, this field is ignored.
Default Gateway		Default is 0.0.0.0 If IP Mode = Dynamic, this field is ignored.
Reboot	Cancel Confirm	Selecting Confirm causes SAS *InFusion* to save the current configuration and reboot.
Shutdown	Cancel Confirm	Selecting Confirm causes SAS *InFusion* to save the current configuration and shutdown.
About		Displays status on the following parameters: Subnet Mask: Default Gateway: BootCode: Firmware: Bus Engine: IP Mode: (Dynamic or Static) Loop Mode: (Infusion) - This option is disabled. NOTE: To go back to the previous menu, press the Select button (i.e., the middle button)
[Back]		Returns to Root menu.

SAS Configuration Submenu

<div align="center">

Table 19   SAS Configuration Submenu

</div>

Menu	Submenu	Command
SATA Hold Handling Scramble To Target Descramble Frm Tar. Scramble To Ini. Descramble Frm. Ini. High Swing To Init. High Swing To Targ. SSC To Initiator SSC To Target OOB Frm Init. OOB Frm Targ. Save & Return Cancel		Lists settings to enable/disable scrambling and SATA Hold handling.

For an explanation of these settings, see "Device List Buttons" on page 21. To change any setting, select the item, make the change, and then select **Save & Return**.

Note that any changes made to these settings are not saved permanently (they will reset if the unit is powered off), unless you reboot the system. To reboot the system and permanently save all current configuration settings, select **Reboot** from the Root menu.

Start InFusion

This command causes SAS *InFusion* to start running the active scenario, which is the one selected in the InFusion Setup menu.

When Start is selected, the menu changes to Stop InFusion.

InFusion Setup Submenu

<div align="center">

Table 20   InFusion Setup Submenu

</div>

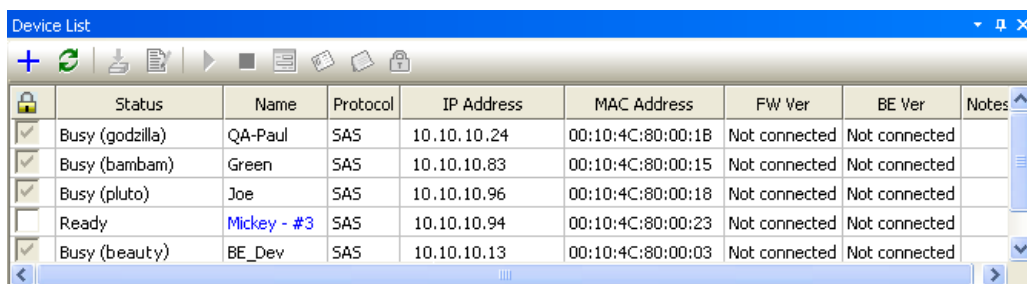| Menu	Submenu	Command
1. <N/A> 2. <N/A> 3. <N/A> 4. <N/A> 5. <N/A> 6. <N/A> 7. <N/A> 8. <N/A> 9. <N/A> 10. <N/A> [Back]		Lists whatever scenarios you downloaded from the SAS *InFusion* application on your PC. If no scenarios have been downloaded, the InFusion Setup menu will not display - only Box Setup menu and SAS Configuration menu will display.

Chapter 7: Licensing

Each SAS *InFusion* box comes with a one year license that entitles the user to software updates. This chapter describes how to view and update the licensing information.

Displaying License Information

You display and update licensing information in the Device List window.

To display the licensing information for your SAS *InFusion* box:

Step 1 If needed, power on your SAS *InFusion* box and make sure that it is attached to your Ethernet LAN. The licensing information for the box is managed via SAS *InFusion* software.

Step 2 In the SAS *InFusion* software, open the Device List (if needed) by selecting View > Views > Devices. The Device List window opens (Figure 90).

Figure 90   Device List Window: Selecting a Box

Step 3 To select your box, click in the checkbox in the first column (under the Lock symbol). Selecting the box creates an Ethernet connection to the device and locks out other users from accessing it.

Selecting the device also activates the buttons on the Device List toolbar and allows the software to read the firmware, BusEngine, and licensing information within the SAS *InFusion* box.

Step 4 Click the Licensing button in the toolbar (looks like a lock). The License dialog box opens (Figure 92).

The dialog shows the expiration date and a list of enabled features.

Figure 91   Device List Window: Box is Selected

Figure 92   Licensing Dialog Box

Updating the License

Before your SAS *InFusion* license expires, contact LeCroy Technical Support to obtain a new one (see How to Contact LeCroy.) A license key file will be emailed to you.

To install the new license key file do the following:

Step 1   Open the License dialog box (Figure 92).

Step 2   When the License Information dialog opens, click the **Update** button. The Update License dialog box opens (Figure 93).
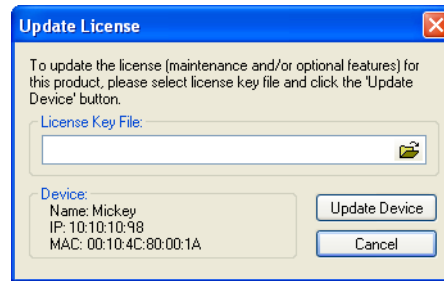
Figure 93   Update License Dialog Box

Step 3   Click the Browse button and browse for the emailed license key
file.

Step 4   Click **Update Device**. The License Key file is transmitted to the
SAS *InFusion* box and will be reflected in the License
information dialog box.

Appendix A: Specifications

Power Requirements

90-264Vrms, 47-63Hz (universal input), 55W (55VA) maximum, internal power supply with detachable cord.

Fuse

Enclosed 5x20mm 1.0A/250V 'T' rated glass fuse. A spare fuse is included in the fuse holder.

Environmental Conditions

Temperature, Operating: 5 to 40 Centigrade.

Temperature, Storage: -20 to 60 Centigrade.

Humidity: Maximum relative humidity 80% for temperatures up to 31 Centigrade, decreasing linearly to 50% relative humidity at 40 Centigrade.

Altitude, Operating: Up to 2,000 m.

Certifications

EC Declaration of Conformity

Meets intent of the European Council Directives 73/23/EEC for product safety and 89/336/EEC for electromagnetic compatibility. This declaration is based upon compliance of the SAS/SATA *InFusion* to the standards listed in Table A.1.

Table 21   EC Declaration of Conformity

EN 61326: 1997 +A1:1998 +A2:2001 +A3:2003 EMC requirements for electrical equipment for measurement, control, and laboratory use.
Emissions: EN 55011: 1998+A2:2002 Radiated & Conducted Emissions (Class A) EN 61000-3-2:2000 Harmonic Current Emissions

Immunity:
EN 61000-4-2:1999 Electrostatic discharge
        (+/-4kV contact discharge; +/-8kV air discharge)
EN 61000-4-3: 2002+A1:2003 RF Radiated Fields
        (3V/m, 80 MHz to 1 GHz, 80% amplitude modulated)
EN 61000-4-4: 2004) Electrical Fast Transient/Burst
        (1 kV on AC mains)
EN 61000-4-5: 1995+A1:2001 Surge
        (1 kV differential mode, 2 kV common mode)

Table A.1   EC Declaration of Conformity *(continued)*

Immunity *(continued)*:
EN 61000-4-6: 1996+A1:2001 RF Conducted Field
        (3 V, 150 kHz to 80 MHz, amplitude modulated with 1kHz sine wave)
EN 61000-4-11: 2004 Mains Dips and Interruptions
        (100% interruption for 1 full AC cycle)

EN 61010-1: 2001 Safety requirements for electrical equipment for measurement control and laboratory use (with the following limits):
        Installation (Overvoltage) Category II
                (Line voltage in equipment and to wall outlet)
        Installation (Overvoltage) Category I
                (All mains isolated terminals)
        Pollution Degree 2
        Protection Class I

UL and cUL Listed   Conforms to UL 61010-1, 2nd Edition and CAN/CSA C22.2 No. 61010-1-04.

How to Contact LeCroy

Type of Service	Contact	
Call for technical support…	US and Canada:	1 (800) 909-2282
	Worldwide:	1 (408) 727-6600
Fax your questions…	Worldwide:	1 (408) 727-6622
Write a letter…	LeCroy Customer Support 3385 Scott Blvd. Santa Clara, CA 95054	
Send e-mail…	support@catc.com	
Visit LeCroy's web site…	http://www.lecroy.com/	

Limited Hardware Warranty

So long as you or your authorized representative ("you" or "your"), fully complete and return the registration card provided with the applicable hardware product or peripheral hardware products (each a "Product") within fifteen days of the date of receipt from LeCroy or one of its authorized representatives, LeCroy warrants that the Product will be free from defects in materials and workmanship for a period of three years (the "Warranty Period"). You may also complete your registration form via the internet by visiting http://www.catc.com/support/register/. The Warranty Period commences on the earlier of the date of delivery by LeCroy of a Product to a common carrier for shipment to you or to LeCroy's authorized representative from whom you purchase the Product.

What this Warranty Does Not Cover

This warranty does not cover damage due to external causes including accident, damage during shipment after delivery to a common carrier by LeCroy, abuse, misuse, problems with electrical power, including power surges and outages, servicing not authorized by LeCroy, usage or operation not in accordance with Product instructions, failure to perform required preventive maintenance, software related problems (whether or not provided by LeCroy), problems caused by use of accessories, parts or components not supplied by LeCroy, Products that have been modified or altered by someone other than LeCroy, Products with missing or altered service tags or serial numbers, and Products for which LeCroy has not received payment in full.

Coverage During Warranty Period

During the Warranty Period, LeCroy or its authorized representatives will repair or replace Products, at LeCroy's sole discretion, covered under this limited warranty that are returned directly to LeCroy's facility or through LeCroy's authorized representatives.

How to Obtain Warranty Service

To request warranty service, you must complete and return the registration card or register via the internet within the fifteen day period described above and report your covered warranty claim by contacting LeCroy Technical Support or its authorized representative.

You can reach LeCroy Technical Support at 800-909-7112 or via email at support@catc.com. You may also refer to the LeCroy website at http://www.lecroy.com for more information on how to contact an authorized representative in your region. If warranty service is required, LeCroy or its authorized representative will issue a Return Material Authorization Number. You must ship the Product back to LeCroy or its authorized representative, in its original or equivalent packaging, prepay shipping charges, and insure the shipment or accept the risk of loss or damage during shipment. LeCroy must receive the Product prior to expiration of the Warranty Period for the repair(s) to be covered. LeCroy or its authorized representative will thereafter ship the repaired or replacement Product to you freight prepaid by LeCroy if you are located in the continental United States. Shipments made outside the continental United States will be sent freight collect.

Please remove any peripheral accessories or parts before you ship the Product. LeCroy does not accept liability for lost or damaged peripheral accessories, data or software.

LeCroy owns all parts removed from Products it repairs. LeCroy may use new and/or reconditioned parts, at its sole discretion, made by various manufacturers in performing warranty repairs. If LeCroy repairs or replaces a Product, the Warranty Period for the Product is not extended.

If LeCroy evaluates and determines there is "no trouble found" in any Product returned or that the returned Product is not eligible for warranty coverage, LeCroy will inform you of its determination. If you thereafter request LeCroy to repair the Product, such labor and service shall be performed under the terms and conditions of LeCroy's then current repair policy. If you chose not to have the Product repaired by LeCroy, you agree to pay LeCroy for the cost to return the Product to you and that LeCroy may require payment in advance of shipment.

General Provisions

THIS LIMITED WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS. YOU MAY HAVE ADDITIONAL RIGHTS THAT VARY BY JURISDICTION. LECROY'S RESPONSIBILITY FOR DEFECTS IN MATERIALS AND WORKMANSHIP IS LIMITED TO REPAIR AND REPLACEMENT AS SET FORTH IN THIS LIMITED WARRANTY STATEMENT. EXCEPT AS EXPRESSLY STATED IN THIS WARRANTY STATEMENT, LECROY DISCLAIMS ALL EXPRESS AND IMPLIED WARRANTIES FOR ANY PRODUCT INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF AND CONDITIONS OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND ANY WARRANTIES THAT MAY ARISE FROM ANY COURSE OF DEALING, COURSE OF PERFORMANCE OR TRADE USAGE. SOME JURISDICTIONS MAY NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE PRECEDING LIMITATION MAY NOT APPLY TO YOU.

LECROY DOES NOT ACCEPT LIABILITY BEYOND THE REMEDIES SET FORTH IN THIS LIMITED WARRANTY STATEMENT OR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDING, WITHOUT LIMITATION, ANY LIABILITY FOR THIRD PARTY CLAIMS AGAINST YOU FOR DAMAGES, PRODUCTS NOT BEING AVAILABLE FOR USE, OR FOR LOST DATA OR SOFTWARE. LECROY'S

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The limited warranty on a Product may be transferred for the remaining term if the then current owner transfers ownership of the Product and notifies LeCroy of the transfer. You may notify LeCroy of the transfer by writing to Technical Support at LeCroy, 3385 Scott Blvd., Santa Clara, CA 95054 USA or by email at: support@catc.com. Please include the transferring owner's name and address, the name and address of the new owner, the date of transfer, and the Product serial number.