BUS DOCTOR™ RX Analyzer
Protocol, Timing & Statistical Analysis
Data Sheet

Modular 36, 108 and 252 Channel Bus Protocol Analyzers
for Serial, Parallel and Multi-Lane Buses
OVERVIEW
Today’s multi-lane, multiple protocol serial buses present special testing challenges for system designers. As an example, the combination of multiple lanes, OOB (Out of Band) signaling and spread spectrum clocking makes Wide Port SAS (Serial Attached SCSI) an especially difficult bus to analyze. At the same time, legacy bus types such as P-ATA (Parallel ATA) and SCSI require a flexible platform capable of capturing these traffic types, and properly decoding them.

Finisar’s family of 36, 108 and 252 channel analyzers is a unique platform capable of testing almost all serial, parallel and multi-lane bus types. It is an essential tool for engineers working with any bus technology.

PRODUCT DESCRIPTION
The Bus Doctor™ RX is a powerful modular bus protocol Analyzer. With advanced features such as large trace buffers and cross-sequence triggering, the RX is a unique and flexible platform able to analyze high speed, multi-lane, multiprotocol serial buses such as SAS and PCI Express, parallel buses such as SCSI and P-ATA and serial buses such as USB and SATA (Serial ATA).

The RX is compatible with Bus Doctor protocol Analyzer bus pods, the industry’s largest selection. P-ATA, SATA (Serial ATA), SAS (Serial Attached SCSI) and PCI Express are just a handful of the 15 bus pod types the RX supports.

By connecting a Finisar Pod to a RX, the RX becomes a dedicated protocol Analyzer for that bus type supported by the Pod (see Figure 1). For example, connect a 3.0 Gb/s SATA Pod to a RX and the RX becomes a dedicated SATA protocol Analyzer. Connect a PCI Express x8 Pod to a RX and the RX becomes a dedicated PCI Express protocol Analyzer (see Figure 2).

In addition, if there are free memory channels available after the attaching a pod, then Logic Pods can be attached to the RX (RX-108P only) to provide logic analysis capabilities in addition to protocol analysis (see Figure 3).

The RX may be combined with other RX Analyzers to perform multi-analysis on several buses at the same time (see Figure 8). When stacked, they can capture and analyze traffic from multiple buses of the same type or a mixture of different bus types. Stacking multiple analyzers or multi-analysis is a feature unique only to Finisar’s analyzers.

The captured data is interleaved, color-coded and sorted by the common time stamp. This feature makes it possible to perform analysis on a PCI Express bus and a Wide Port SAS bus simultaneously.

For multi-lane bus types, the RX is capable of simultaneous multiple lane analysis with source port identification for every frame per lane.

The RX is controlled by a Microsoft Windows™ PC through a USB 2.0 connection; Finisar’s powerful Bus Doctor Graphical User Interface (GUI) software runs on the PC.

The software provides an easy-to-use interface that allows engineers to configure the instrument, and view and analyze captured data.

High-level dialog boxes provide for the quick creation of powerful triggers and pre- and post-capture filters.

A trigger will stop the analyzer from capturing when a specific event occurs and mark that event in the Bus Doctor display. A trigger is invaluable to make sure a specific event is captured in the current trace.

The Analyzer could be made to stop on an error, a protocol violation, a hang condition, etc. The Bus Doctor comes with several easy to use, pre-programmed triggers.

The Bus Doctor RX also comes with a 12 level trigger sequencer (see Figure 4) that includes counters and timers, allowing users to create their own custom triggers that can find almost any imaginable sequence of events on the bus.

The Bus Doctor has an external trigger in and trigger out to connect...
to equipment such as an oscilloscope or Finisar's SAS or SATA PacketMaker™ II traffic generators.

The Analyzer samples (and captures) incoming data and decides what to do with each sample depending on one of two configurations.

In Timing mode, it keeps any sample that is different than the previous sample, thus capturing all activity while not wasting buffer memory on repetitive unchanging samples.

In State mode, it looks for specific patterns (terms) on the incoming channels, and keeps only those samples that match the pre-programmed terms.

Whenever there is activity on the bus, the Real Time Display window (see Figure 5) can be opened up to show information for up to six terms as they occur along with counters and bar graphs for each term. Each term has the option to be viewed as occurrences per second, total occurrences, or occurrences per other term.

Once data is captured (see Figure 6), the software simplifies analysis by organizing the captured bus data into different displays (see Figure 7).

Command sequences are summarized in the command listing display. This window shows the Store Numbers of the first event associated with the commands, and specific information about the commands such as source and destination addresses. Color-coding and identifiers help identify the source of the information displayed.

The State Listing displays a chronological list of all captured events. For each event, this display shows reference Store Number, the direction of the data and their values.

The Histogram’s primary purpose is a navigation aid, showing an overall map view of the entire trace. By using the histogram it is easy to see where various types of events are grouped throughout the trace. Commands appear in blue and display where significant activity begins and ends in the trace.

Any errors in the trace are shown in red and can easily be located. Payload data is displayed in green. The Histogram's display of the payload data makes it easy to identify areas where data is transmitted as well as areas of transmission overhead.

The Histogram also has a term shown in purple that can be set by the user to quickly find where various types of events are grouped throughout the trace. The Histogram is a useful way to quickly summarize the entire trace as well as find specific individual events. A tree view organizes packets by their...
tag field. Commands will be shown in the order in which they occur. Each command in the tree view can be expanded to show command responses, status, data, and other information. This is especially helpful for buses that use command queuing where responses could be significantly separated from the commands that had issued them.

Double-clicking in the histogram window, or anywhere in the Command or State Listing synchronizes all displays. Or the Sync on Cursor feature can be used. This option forces the State listing and Command listing to synchronize on any event by a single click in either window. In addition, if the Command listing is the currently active window, the up/down arrows on the keyboard can be used to move through the trace and the State listing will continue to stay synchronized with it.

The Data Block display provides a quick reference for the display of data payloads in both Hex and ASCII values.

The Timing Waveform shows a signal level representation of the trace with each row representing a channel or channel group. The rows can be reordered and the colors can be changed. Data may be displayed in decimal, binary or ASCII formats.
The Command and State Filtering feature acts as a post-capture filter by hiding various events from view. Hiding events in the command listing or state listing is an easy way to simplify the trace display.

Users can specify criteria for commands or states and choose to hide them from view, or to show only events that match the criteria chosen.

The "Show" predefined filter can be used to find every instance of a specific event. Similarly, the "Hide" predefined filter can be used to remove repetitive events that might not be relevant (see Figure 9).

Use "X" and "O" markers to measure the number of captures or amount of time between events, or to specify a range of events to save or print.

Setting the "X" or "O" markers is a simple matter of right-clicking on the command, state or timing waveform section and choosing "Place X Mark Here" or "Place O Mark Here."

The RX's capture memory buffer can be divided into up to 256 smaller segments (see Figure 10). This feature serves to keep traces manageable when occasion requires, as well as keeping different traces in different segments for comparison and when using the Stop on Trigger option (see Figure 11). The Bus Doctor RX may be configured to move from memory segment to memory segment when a trigger condition is encountered, causing the Analyzer to automatically take and save multiple traces in one Analyzer buffer.

This feature is especially useful in capturing multiple examples of a rare event without constant interaction from the user, often times overnight or over a weekend.

Each segment may contain a different example of a common trigger condition, allowing the analyzer to display multiple scenarios that cause a specific event.

The RX is available in three configurations: SLIM, FIT and BUFF. These models have capture buffers of 16, 64 and 256 million events respectively; a 256 million event buffer translates to over 4.6 GBs of physical memory on a RX-108P-BUFF and 9.2 GBs of physical memory on a RX-252P-BUFF.
1. Power LED Indicator
2. AC Power Connector
3. Power Switch
4. BNC Trigger In
5. BNC Trigger Out
6. Analyzer ID
7. USB 2.0 Connector (to connect RX to a Microsoft Windows control PC)
8. RX-108P: 6 Robinson-Nugent 68 Pin Connectors (to connect to Data Transit Pods); on RX-36P, 2 Connectors
9. RX Key Slot (used in stacked RX setup to synchronize the reference clock among RXs)

STORAGE BUSES SUPPORTED

Gigabit Ethernet with iSCSI
Fibre Channel (1.0 & 2.0 Gb/s)
InfiniBand™
ATA/ATAPI
SCSI I-320
Serial Attached SCSI (1.5 & 3.0 Gb/s)
Serial ATA (1.5 & 3.0 Gb/s)

COMPUTING BUSES SUPPORTED

IEEE 1394a (Firewire)
CardBus
Compact Flash
Logic Analysis
PCMCIA
USB (1.1 & 2.0)
PCI Express (x1, x4, x8)
PCI/X
**BUS DOCTOR RX-252P ANALYZER (shown with 4x SAS POD)**

1. RX Key Slot (used in stacked RX setup to synchronize the reference clock among RXs)
2. Wide Port SAS POD (SATA Connectors)
3. Bus Doctor RX-252P Analyzer
4. Analyzer ID
5. 2 SMB Trigger Outs
6. 3 SMB Trigger Ins

- AC Power Connector (rear - not shown)
- Power Switch (rear - not shown)
- USB 2.0 Connector (to connect RX to a Microsoft Windows control PC) (rear - not shown)

7. 600 pin Teradyne Connector (to connect to POD)
8. 4 POD Guide Pins

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**STORAGE BUSSES SUPPORTED**

- 4x SAS (1.5 & 3.0 Gb/s) (SATA Connectors)
- Wide Port SAS (1.5 & 3.0 Gb/s) (MicroGiga Connectors)

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**COMPUTING BUSSES SUPPORTED**

- PCI Express (x1, x4, x8, x16)
FEATURES

POWER TRIGGERING
Powerful trigger sequencer with 12 levels, including 2 timer and 2 counter levels.

LARGE CAPTURE BUFFER
Capture up to 256 million events; a 256 million event buffer translates to over 9.2 GBs of physical memory on a RX-252P-BUFF.

SINGLE SOFTWARE INTERFACE
One interface for all bus types means learn one common GUI for testing all 15 bus types supported by Finisar Analyzers.

COMMAND LISTING
Command sequences are summarized in the command listing display.

STATE LISTING
State Listing displays a chronological list of all captured events.

HISTOGRAM DISPLAY
Summarizes the entire trace as well as find specific individual events.

DATA BLOCK DISPLAY
Provides a quick reference for the display of data payloads in both Hex and ASCII values.

TIMING WAVEFORM DISPLAY
Timing Waveform shows a signal level representation of the trace with each row representing a channel or channel group.

MULTI-ANALYSIS
The RX may be combined with other RX Analyzers to perform multi-analysis on several buses simultaneously; this feature is unique to Finisar Analyzers.

SEGMENTED MEMORY
The capture buffer can be divided into up to 256 smaller segments, allowing up to 256 trace files to be captured and saved.

TIMING MODE
Captures every transition or incoming channel change.

STATE MODE
Captures every single term that matches a pre-defined or customer created patterns.

COMMAND/STATE FILTERS
Powerful post-capture filters facilitate analysis.

LOGIC ANALYSIS
In addition to a bus pod, one or more Logic Pods can be connected to a single RX depending on the number of remaining unused memory channels. Logic Pods can be used for general-purpose logic analysis (for RX-108P only).

X TO O MARKERS
Set “X” and “O” markers to measure the number of captures or amount of time between events, or to specify a range of events to save or print.

BOOKMARKS
Create bookmarks to mark and enter information about specific events.

REAL TIME STATISTICS
Shows information for up to six terms as they occur along with counters and bar graphs for each term. Each term has the option to be viewed as occurrences per second, total occurrences, or occurrences per other term.
FEATURES (continued)

POST CAPTURE STATISTICS View statistics about the captured trace; statistics can be calculated on individual terms or on the relationship between two terms.

EXTERNAL TRIGGER IN Bus Doctor triggers may be generated by the internal trigger sequencer, or by external BNC input (RX-36P, RX-108P) or SMB trigger inputs (RX-252P).

EXTERNAL TRIGGER OUT The external BNC trigger out (RX-36P, RX-108P) or SMB trigger outs (RX-252P) can be connected to other equipment such as an oscilloscope; when the Bus Doctor triggers, a signal is sent.

HARDWARE TRIGGERING Hardware implemented triggering functions provide full wire rate triggering capabilities.

HARDWARE FILTERING Hardware implemented filtering functions provide full wire rate filtering capabilities.

DISPLAY SYNCHRONIZATION Double-clicking in the Command Listing, State Listing, Data Block, Timing Waveform or Histogram window synchronizes all displays. Or use the SYNC ON CURSOR option to forces the State listing and Command listing to synchronize on any event by a single click in either window.

CUSTOMIZE VIEWS Customize the command and state listings.

MULTIPLE TRACES Open multiple trace files from a single Bus Doctor application to allow comparisons of trace files.

TREE VIEW Organize commands according to their tags with commands shown in the order in which they occur. Each command in the tree view can be expanded to show command responses, status, data, and other information (see Figure 12).

COMMAND/STATE COLUMNS Customize the command or state listing. Fields can be added to the command listing to emphasis important fields for specific analysis, or columns can be removed to simplify the trace display.

![Figure 12: Tree View Listing](image)
# Hardware Specifications

## Model Name

<table>
<thead>
<tr>
<th>Model</th>
<th>RX-36P</th>
<th>RX-108P</th>
<th>RX-252P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mechanical Dimensions</strong></td>
<td>Height: 2 inches (51 mm)</td>
<td>Length: 13 inches (330 mm)</td>
<td>Width: 12.1 inches (308 mm)</td>
</tr>
<tr>
<td><strong>Indicators</strong></td>
<td>Power LED Indicator</td>
<td>Analyzer ID Number</td>
<td></td>
</tr>
</tbody>
</table>

## Environment

- Indoor Operation
- Analyzer is exposed only to temperatures 32° F to 104° F (0° C to 40° C)
- Altitude up to 10,000 feet (3,937 meters)
- Maximum relative humidity 5 to 95 percent relative at +40° C (non-condensing)

## Power Specifications

- **Input Power**
  - 96-132V and 185-264V with an auto-range of 47-63Hz. Auto-switching support.

## Supported Bus Types

### Storage Buses
- ATA/ATAPI
- SCSI I-320

### Computing Buses
- Logic Analysis
- USB 2.0

## Event Buffer Size

### Slim Version
- 16 Million Events

### Fit Version
- 64 Million Events

### Buff Version
- 256 Million Events

## Physical Memory Buffer Size

### Slim Version
- 128 MBs
- 256 MBs
- 512 MBs

### Fit Version
- 1 GBs
- 4.6 GBs
- 2 GBs

### Buff Version
- 4.6 GBs
- 9.2 GBs

## Other

### Timing Source
- Internal

### Control Source
- Microsoft Windows PC

### Maximum Number of Stacked RX Analyzers
- 4

### Time Stamp Resolution
- 4 nanoseconds
PRODUCT ORDERING INFORMATION

Please specify model number, name and quantity when ordering. Please contact Finisar or one of its Sales Representatives or Distributors for the latest pricing and availability.

(1): For bi-directional x8 analysis, 2 RX-108 Analyzers, 2 x8 Pods and 1 x8 Tap Board are required or 1 RX-252 Analyzer, 1 x16 Pod and 1 x8 Tap Board (RX-252 type).

(2): For bi-directional x16 analysis, 2 RX-252 Analyzers, 2 x16 Pods and 1 x16 Tap Board are required.

(3): Includes: PM2 board, GUI control software, user manual and API.

(4): Includes PM-DEV.

(5): Provides 3 SAS/SATA focused PacketMaker II traffic generators that cut the development process and time-to-market of new SAS/SATA devices.
   a) Extreme SCSI issues any SCSI command to any device running the SAS/SATA protocols.
   b) Extreme Manufacturing test environment is designed for SAS/SATA peripheral testing as well as manufacturing, DVT, QRT, incoming inspection and final inspection.
   c) Scriptgen is an easy to use tool for rapidly creating simple or complex test scripts.

(6): Requires a PacketMaker II Traffic Generator.

MODEL NUMBER

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RX-36P-SLIM</td>
<td>Bus Doctor RX, 36 Channels, 16M Events Buffer</td>
</tr>
<tr>
<td>RX-36P-FIT</td>
<td>Bus Doctor RX, 36 Channels, 64M Events Buffer</td>
</tr>
<tr>
<td>RX-36P-BUFF</td>
<td>Bus Doctor RX, 36 Channels, 256M Events Buffer</td>
</tr>
<tr>
<td>RX-108P-SLIM</td>
<td>Bus Doctor RX, 108 Channels, 16M Events Buffer</td>
</tr>
<tr>
<td>RX-108P-FIT</td>
<td>Bus Doctor RX, 108 Channels, 64M Events Buffer</td>
</tr>
<tr>
<td>RX-108P-BUFF</td>
<td>Bus Doctor RX, 108 Channels, 256M Events Buffer</td>
</tr>
<tr>
<td>RX-252P-SLIM</td>
<td>Bus Doctor RX, 252 Channels, 16M Events Buffer</td>
</tr>
<tr>
<td>RX-252P-FIT</td>
<td>Bus Doctor RX, 252 Channels, 64M Events Buffer</td>
</tr>
<tr>
<td>RX-252P-BUFF</td>
<td>Bus Doctor RX, 252 Channels, 256M Events Buffer</td>
</tr>
</tbody>
</table>

BUS DOCTOR RX PODS

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DR-GBE-1250</td>
<td>Gigabit Ethernet with iSCSI Pod</td>
</tr>
<tr>
<td>DR-FCS-2000</td>
<td>Fibre Channel Pod (1.0 &amp; 2.0 Gb/s)</td>
</tr>
<tr>
<td>DR-INF-2500</td>
<td>InfinBand Pod</td>
</tr>
<tr>
<td>DR-ATA-133</td>
<td>ATA/ATAPI Pod</td>
</tr>
<tr>
<td>DR-SCSI-320</td>
<td>SCSI I-320 Pod</td>
</tr>
<tr>
<td>DR-SAS-1500</td>
<td>Serial Attached SCSI Pod (1.5 Gb/s)</td>
</tr>
<tr>
<td>DR-SAS-3000</td>
<td>Serial Attached SCSI Pod, 1 Phy Link, (1.5 &amp; 3.0 Gb/s)</td>
</tr>
<tr>
<td>DR-SAS-3004</td>
<td>4x SAS Pod, SATA Connectors, (1.5 &amp; 3.0 Gb/s)</td>
</tr>
<tr>
<td>DR-SAS-30W4</td>
<td>Wide Port SAS Pod, MicroGiga Connectors (1.5 &amp; 3.0 Gb/s)</td>
</tr>
<tr>
<td>DR-SATA-1500S</td>
<td>Serial ATA Pod (1.5 Gb/s)</td>
</tr>
<tr>
<td>DR-SATA-3000</td>
<td>Serial ATA Pod (1.5 &amp; 3.0 Gb/s)</td>
</tr>
<tr>
<td>DR-1394-400</td>
<td>1394a (Firewire) Pod</td>
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<tr>
<td>DR-CARDBUS</td>
<td>CardBus Pod</td>
</tr>
<tr>
<td>DR-CFA</td>
<td>Compact Flash Pod</td>
</tr>
<tr>
<td>DR-LOG</td>
<td>Logic Analysis Pod</td>
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<tr>
<td>DR-PCMIA</td>
<td>PCMIA Pod</td>
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<tr>
<td>DR-USB-2.0</td>
<td>USB 2.0 Pod</td>
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<tr>
<td>DR-PCI-E-X8</td>
<td>PCI Express x1, x4, x8 Pod (DR-PCI-E-X1/4/8TAP)</td>
</tr>
<tr>
<td>DR-PCI-E-X16</td>
<td>PCI Express x1, x4, x8, x16 Pod (DR-PCI-E-X1/4/8/16TAP)</td>
</tr>
<tr>
<td>DR-PCI-X-3.3V</td>
<td>PCI/X with 3.3V connector Pod</td>
</tr>
<tr>
<td>DR-PCI-X-5V</td>
<td>PCI/X with 5V connector Pod</td>
</tr>
<tr>
<td>PM-SAS-1501e</td>
<td>SAS PacketMaker II Traffic Generator</td>
</tr>
<tr>
<td>PM-SAS-1504e</td>
<td>SAS PacketMaker II, 4 Phy Link, (1.5 Gb/s)</td>
</tr>
<tr>
<td>PM-SAS-1504e</td>
<td>SAS PacketMaker II, 4 Phy Link, H/W Emulation, (1.5 Gb/s)</td>
</tr>
<tr>
<td>PM-SAS-3001e</td>
<td>SAS PacketMaker II, 1 Phy Link, (1.5 &amp; 3.0 Gb/s)</td>
</tr>
<tr>
<td>PM-SAS-3002e</td>
<td>SAS PacketMaker II, 2 Phy Link, (1.5 &amp; 3.0 Gb/s)</td>
</tr>
</tbody>
</table>

MINIMUM SYSTEM REQUIREMENTS

- Windows XP Professional or Windows 2000 Professional operating system
- Intel® Pentium® 4, 1.7 GHz
- Minimum of 512 MBs system RAM
- 400 MBs of hard drive space for program files
- 1024 x 768 graphics
- USB 2.0 (USB 1.1 can also be used -- but USB 2.0 will provide optimal performance)