



SAS AND SATA PROTOCOL SOLUTIONS FOR TESTING AND VERIFICATION

SAS InFusion™ and SATA InFusion™ Error Injector and Traffic Modifier



The screenshot displays the software interface for the LeCroy InFusion device. It features a 'File Library' window with a list of scenarios for testing:

- Insert SOF inside SSP Data frame
- Inject CRC Error after 500 CMDs
- Change 1st ACK to NAK
- Break Link every 10 sec
- Remove Response IU where LBA=C15
- Change R_RDY to Credit Blocked
- Change frame type to STP in SSP conn
- Change Tag in Response IU from "16"

Below the scenarios is a table showing device connections:

Name	Protocol	IP Address	MAC Address	FW Ver	BE Ver	Notes
qa-SP	SAS	172.16.128.164	00:10:4C:80:00:09	1.00	1.00	
(mancuso2)	joe	SAS	172.16.128.88	00:10:4C:80:00:18	Not connected	Not connected
active	Green #11	SAS	172.16.128.218	00:10:4C:80:00:10	1.00	1.00
(sastest)	Green #3	SAS	172.16.128.100	00:10:4C:80:00:05	Not connected	Not connected
dv	7DownDown	SAS	172.16.128.211	00:10:4C:80:00:1A	Not connected	Not connected

At the bottom, a log window shows the following messages:

```
[14:31:58.267 000 000] 'BE_Dev#05' (172.16.128.177): Device Ready  
[14:31:58.267 000 000] 'BE_Dev#05' (172.16.128.177): Device Left  
[14:32:09.877 000 000] 'Green #11' (172.16.128.218): Session started  
[14:32:10.002 000 000] 'Green #11' (172.16.128.218): Session started  
[14:32:10.127 000 000] 'Green #11' (172.16.128.218): Hardware status changed  
[14:32:14.330 000 000] 'BE_Dev#05' (172.16.128.177): Device Joined  
[14:32:14.377 000 000] 'BE_Dev#05' (172.16.128.177): Device Busy  
[14:32:20.534 000 000] 'Green #5' (172.16.128.163): Device Ready  
[14:32:20.565 000 000] 'Green #5' (172.16.128.163): Device Left
```

LeCroy®, a worldwide leader in serial data test solutions, creates advanced instruments that drive product innovation by quickly measuring, analyzing and verifying complex electronic signals. With systems available for both physical and protocol layer testing, LeCroy offers a complete solution to meet the high demands of Serial Attached SCSI (SAS) and Serial ATA (SATA) technologies.

Developed by the Protocol Solutions Group of LeCroy (formerly CATC), the SAS InFusion™ and SATA InFusion™ systems are the first of their kind. These systems allow you to inject errors and modify traffic in order to verify real-world fault handling. While sitting in the data path on a live system, they can programmatically alter or corrupt traffic. The InFusion systems are the ideal tool for stress testing systems while running real traffic and actual workloads.



The InFusion traffic modifier is designed to verify recovery characteristics within a sub-system. In just minutes, an easy-to-use pop up menu interface allows you to create test scenarios. You can change any field, within any frame, as the data moves across the bus. Any primitive or data pattern can be intercepted and changed to a different pattern you specify. This allows for unprecedented corner case and protocol level error injection for SAS and SATA traffic.

Powerful Error Injection and Traffic Modification Abilities

The InFusion system supports a single 3.0G or 1.5G SAS or SATA link and monitors traffic from both directions. Once the InFusion system has been added to a SAS or SATA link, it automatically passes the boot up sequence and preserves protocol handshaking between devices. It silently monitors the line while transmitting a faithful copy of the

original data stream. The system will wait for a specific time interval or count a particular event that you designate before it begins modifying frames or injecting errors. InFusion can be configured to send a single error, multiple errors, or random errors.

When changing fields within a frame, the InFusion traffic modifier will preserve the outbound frame

structure, including recalculating the CRC if needed. The response transmitted from the device-under-test will pass through the InFusion system, without modification. This allows true end-to-end system testing. And, the InFusion system will maintain a log that contains a summary of the exchange.

Easy and Versatile to Use

The InFusion system was designed to modify existing traffic between a host and a target, which better reflects real world operating conditions compared to script based simulations. Test scenarios are independent of hardware setup and rarely need to be tuned for different configurations.

Firmware or components in the system-under-test can be modified when needed, and then re-verified using the InFusion system.

Sophisticated error injection strategies are now possible using the dual sequencers with up to 256 sequential wait states per sequence. Each state can be configured to check for

different conditions or inject different errors before branching to the next state. Looping allows the error injection sequence to repeat at specific intervals. Each sequential state can also include timers and counters to better isolate specific link conditions.

You can setup the InFusion traffic modifier by attaching the system to a LAN using an Ethernet connection. The pop up menu allows you to create custom test scenarios on the PC, and download to the InFusion hardware's memory. You then can detach the InFusion system and move it around your lab so that it may function as a stand-alone instrument. The

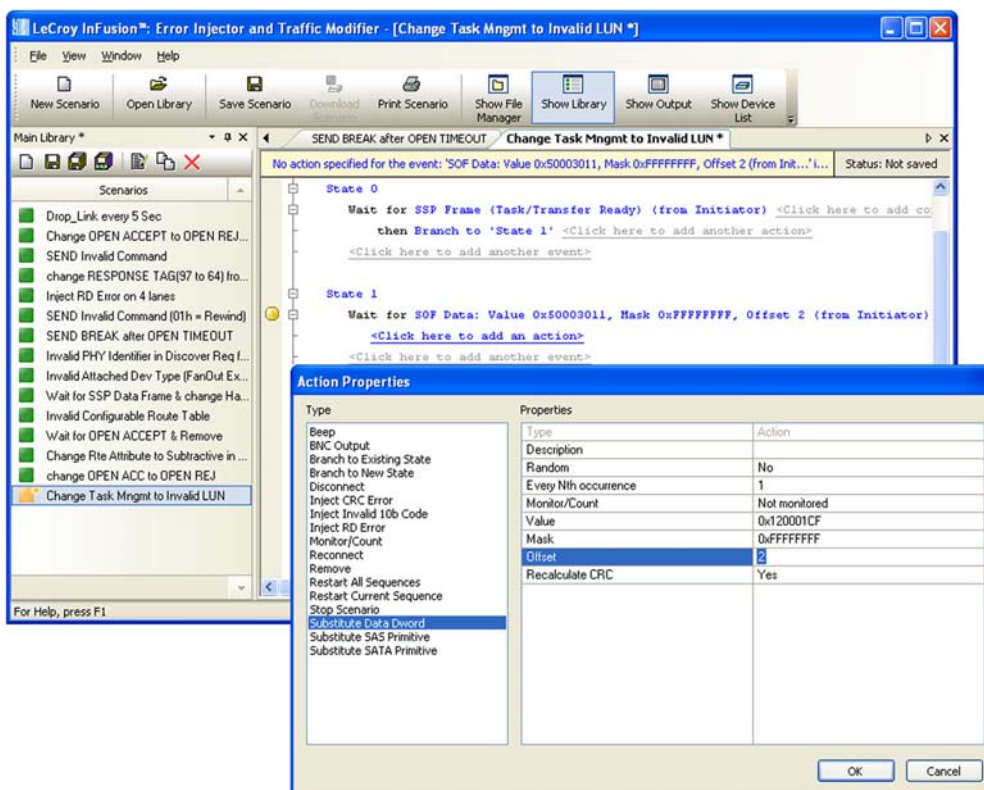
built in LCD and keypad allows you to start, stop, and control the InFusion session. InFusion can also be controlled with a comprehensive C++ programming API (Windows DLL). InFusion can also coordinate error injection across multiple SAS Links. Up to 4 InFusion systems can be cascaded together (using BNC connectors) to validate fault recovery on SAS "wide" ports.

A Comprehensive Solution for SAS and SATA

LeCroy's SAS and SATA solutions provide you with advanced features necessary to ease the development and deployment of SAS and SATA devices. By combining the functionality and power of a SAS *Tracer*™ or SA *Tracer*™ analyzer, SAS *Trainer*™ or SA *Trainer*™ exerciser, and InFusion traffic modifier, you have a complete system that gives you the most in-depth analysis, testing, and validation available for SAS and SATA.

Let LeCroy's Serial Data Solutions peel back the layers of SAS and SATA to solve your test and verification challenges.

Pop-up menu software interface provides easy and fast setup of IF-Then Traffic modification scenarios



The SAS and SATA InFusion systems provide many benefits, including:

Error Injection	Inject CRC, disparity, 8b/10b encoding errors, framing errors, or invalid primitives
Value Replacement	Monitor the link for specific values, patterns or primitives (as low as bit level) and replace with user-defined values
Packet Drop	Remove individual primitives or frames from the stream to verify expected behavior
Primitive Manipulation	Replace handshaking and flow control primitives to help validate robustness of a design
Break Link Recovery	Programmatically break the connection to test link recovery

Example Usage Cases

Every Queue Tag = "0x32" To verify Incomplete Command recovery (Invalid Tag)	replace	With Queue Tag = "0x64"
Every 1.00 sec wait for R-RDY then To verify credit blocked condition	replace	With ALIGN
Every 5000 XFR_RDY IU To verify Link Recovery (with pending IOs)	insert	BREAK LINK
Every 100 SOF count 7 DWORDs then To verify broken frame detection	insert	EOF
Every 100 data frames - wait for ALIGN then To verify SYNC_ACQUIRE recovery	replace	With IDLE
Every 10.00 Sec, wait for Hashed Address = "xxxxx" then To verify OPEN_REJECT (NO DESTINATION)	replace	With Hashed Address = "yyyyy"
Every 500 SMP PHY CONTROL request wait for Clear Affiliation field = "0"; then To verify target STP OPEN_REJECT (STP RESOURCES BUSY).	replace	With Clear Affiliation field = "1"

Features:

- Pop-up menu user interface – allows easy setup of IF-THEN traffic modification scenarios.
- C++ based API for custom programming of InFusion system
- Alter replacement frequency:
 - Every occurrence
 - After a specified number of occurrences
 - After a specified time interval
 - Random
 - Combination of random, occurrence and time interval
- Looping allows repeating test cases at specific intervals
- Cascading multiple InFusion systems allows synchronized error injection on wide links
- InFusion log and statistics can be captured and displayed for each InFusion session
- Supports a single link of SAS or SATA 1.5 Gbps or 3 Gbps
- Supports SAS SSP, SMP, STP and SATA-based switching protocols
- Modifiable elements of SAS / SATA protocol
 - All Primitives (including user-defined)
 - CRC
 - SSP, SMP, and STP Connection events
 - Frame headers including address and tag
 - Disparity Errors
 - Payload data, including CDB and Logical Block Address
- The system is not intended to corrupt Physical Layer events. Clock skew management, OOB and Power management, and Signal integrity can not be modified.



Specifications

Dimensions	57 mm x 152 mm x 203 mm (2.25" x 6" x 8")
Net Weight	1.42 kg (3.2 lbs)
Power	100 – 220 volts, Internal power supply with detachable cord
Connectors	Two external SATA connectors with external-to-internal conversion cables
LCD	LCD control panel allows instrument to operate as standalone device
Memory	32MB internal Flash for storage of up to 10 preconfigured test scenarios;
Firmware	Field upgradeable firmware
Interface to Host	RJ45 10/100 Ethernet connector for communication to Host
Supported Configuration	Operate in Any Topology with Any Upper-Level SATA or SAS protocol including SSP, SMP, STP or native SATA

Ordering Information

[Serial Attached SCSI \(SAS\) Systems](#)

SAS InFusion 4 System Bundle	IF003UTA-X
SAS InFusion 4 System Software Maintenance	IF003UTA-M
SAS InFusion 1 Port System	IF001UTA-X
SAS InFusion 1 Port Software Maintenance	IF001UTA-M

[Serial ATA \(SATA\) Systems](#)

SATA InFusion 1 Port System	IF002UTA-X
SATA InFusion 1 Port Software Maintenance	IF002UTA-M



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