Sifos® Technologies

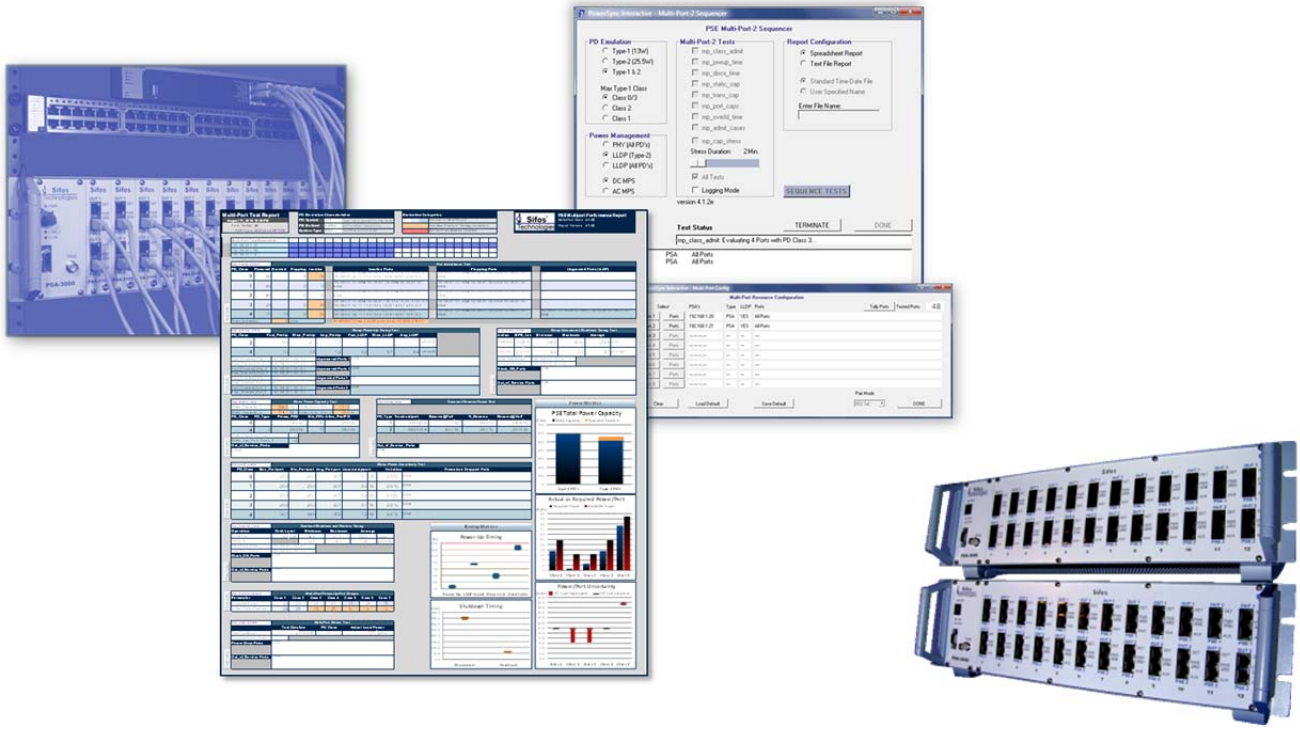
Second Generation IEEE 802.3at

PSE Multi-Port Test Suite

for the

PowerSync® Analyzer & Programmable Load

Product Overview



Key Features

- In-Depth System Testing of IEEE 802.3at PSE's
- Concurrently Analyze Up To 192 PSE Ports
- Fully Automated Testing and Reporting
- Assess PSE Power Administration Decisions
- Assess PSE Power Management Behaviors
- Robust Emulation of Type-1 and/or Type-2 PD's
- PoE LLDP Emulation of Type-1 and/or Type-2 PD's
- Easily Configured, Single Sequence Testing of All PSE's
- Static and Transient Reserve Capacity Analysis
- Formulate PD Powering Uncertainty Metrics
- Formulate PSE Port Uniformity Metrics
- Assess PSE Power Reliability Over Time

Verification, *Simplified.*

IEEE 802.3at PSE's

End-Span PSE's
Type 1 & 2, LLDP, 2-Event

Mid-Span PSE's
Type 1 & 2

PoE/PoE+ Powered Jacks

Fully Automated System Testing

Up to 192 PSE Ports

Easily Configured & Sequenced

Colorful, Informative Reporting with Graphics

Assess Critical System Parameters

Class-Based Processing

Static Power Capacity

Transient Reserve

Multi-Port LLDP Granting

Power Uncertainty

Power Uniformity

Multi-Platform Support

PSA-3000 / PSA-3048

PSL-3000 / PSL-3024

Overview

The **PSE Multi-Port Test Suite** is a component of the **PSE Multi-Port Suite** for PowerSync® Analyzers and Programmable Loads. This fully automated group of tests and reporting takes the PowerSync® Analyzer (PSA) and its proven PSE Conformance Testing Capabilities into the realm of fully automated PSE System Power Management and Multi-Port Behavior testing.

Whereas PSE Conformance Testing assesses compliance of each stand-alone PSE port to 802.3at specifications, Multi-Port Testing assesses system-wide behaviors only observable when many PD's are powered by a PSE. The PSE Multi-Port Test Suite will acquire and distill information regarding key behaviors of a PSE including **class-based power administration**, multi-port **LLDP granting**, power-up and LLDP grant timing, **static power** capacity, **transient reserve** capacity, power down timing, power-per-port **uniformity and uncertainty**, and power **stress test** analyses.

The second generation Multi-Port Test Suite is easily configured to cover all required PD emulations such that system testing of Type-2 and Type-1 PSE's is performed in a just a **single sequence**, with up to 38 limit-checked parameters produced on a **single**, **graphic-rich Microsoft Excel report**.

The standard report* generated by the Multi-Port Test Suite organizes all parameters by Multi-Port Test and by PD emulation (e.g. Class 4, Type-1, etc.) with colorful annotations for parameters that represent non-ideal or design-constrained behaviors and, for certain parameters, IEEE 802.3at specification violations.

The **PSE Multi-Port Suite** is available as a feature option to all Sifos PSA-3000 and PSL-3000 chassis-based platforms. The Multi-Port Suite also includes **Live PD Emulation** for use with interactive testing of PSE administrative and power management behaviors. Live PD Emulation is described separately in Sifos datasheet **Multi-Port Live PD Emulation Overview**.

PSE Multi-Port Tests

Class-Based Powering & Granting

Multi-Port Power-Up & LLDP Timing

Multi-Port Disconnect Timing

Static Power Capacity Analysis

Transient Reserve Capacity Analysis

Port Capacity Uniformity & Uncertainty

Multi-Port Overload Response Timing

Port & Class Subset Administration

Power Stress Testing

Multi-Port System Test Automation

Automated Analysis and Reporting up to 192 PSE Ports at a Time

Run Individual Tests from PSA Interactive or PowerShell PSA

Sequence Selected Tests from PSA Interactive or PowerShell PSA

Automated Microsoft Excel Report Generation with Colorful Graphics and Test-Specific Help Information

PSE Multi-Port Test Suite Features

Up to 38 Limit-Checked PSE System Parameters from 9 Automated Tests

Up to 10 802.3at PSE Conformance Parameters Produced from Multi-Port Test Cases

Simple User Configuration – Just Specify PD Emulation (Type 1, 2, or both 1 & 2) and PSE Power Granting Mode (PHY or LLDP)

Comprehensive Diagnostic Logging from Every Test Provides Insight to System Anomalies

Most (8 of 9) Tests Run with Low Cost PSL-3000 Programmable Load Platform

Increased Parameter Coverage and Granularity Available from PSA-3000 PowerSync Analyzer Platform

* *The standard report requires Microsoft Office 2007 or newer*

Multi-Port Tests and Parameters

The following tables introduce each Multi-Port test, describing the basic purpose of each test and the parameters that are measured by each test. Parameters that are accompanied by ***Class N*** are collected and reported per PD Class, that is, Class 0 – Class 4. Parameters that are accompanied by ***Type X*** are collected and reported per PD Type, that is, Type-1 and/or Type-2. Any limitations imposed on each test by the PSL-3000 Programmable Load are also described.

Multi-Port Administrative Decisions and Timing Analysis

mp_class_admit — Power Administration by PD Class and/or LLDP Request

Test Objective

Evaluates PSE powering and power granting strategy as it relates to each PD classification and to (maximum) LLDP-based power requests. Look for instability and inconsistencies accompanying multi-port power-ups, and where applicable, multi-port LLDP negotiations.

Sequence Objective

Provides other Multi-Port tests with expectations regarding how many PSE ports will power to each PD classification and how many PSE ports will grant maximum power requests via LLDP.

Test Parameters *(Retained)*

Powered Count	*Class N*	Count of ports that remain powered after multi-port power-up by PD Class. Retained values: st_admit_phy(N)
Granted Count	*Class N*	Count of ports that receive LLDP power grants for requested power level by PD Class. If Class 4 multi-port LLDP granting behavior is not repeatable (see Grant Stability below), this figure will be determined by sequencing single-port LLDP power-ups with 25.5W power requests. Retained values: st_admit_lldp(N)

Test Parameters *(Local)*

Flap Count	*Class N*	Count of ports that intermittently shut down during the multi-port power-up process by PD Class.
Inactive Count	*Class N*	Count of ports that remain unpowered after multi-port power-up by PD Class.
Inactive Ports	*Class N*	List of PSA chassis' and test ports that remain unpowered by PD Class.
Flapping Ports	*Class N*	List of PSA chassis' and test ports that intermittently shut down during multi-port power-up by PD Class.
Ungranted Ports	*Class N*	List of PSA chassis' and test ports that do not receive LLDP power grants by PD Class.
Grant Instability		Range of ports that provide 25.5W LLDP power grants given PD Class 4 across 4 cycles of powering. Ideally, this range should be zero if multi-port powering with LLDP behavior is repeatable.

PSL-3000 Limitations

NONE

mp_pwrup_time — Multi-Port Power-Up and LLDP Grant Timing

Test Objective

Gain insight into the efficiency of PSE power management when processing multiple demands for power and LLDP power allocations. Expose scenarios where PD's may be unacceptably delayed in receiving power and/or LLDP allocations. Assess any vulnerability in per-port PoE service to PD group-connect events.

Sequence Objective

This test is not prerequisite to other Multi-Port tests.

Test Parameters *(Local)*

Fast Power-Up, Slow Power-Up, Average Power-Up	*Type X*	Time in seconds between emulated PD connection and application of power to emulated PD. Reported as minimum (or Fast) time, maximum (or Slow) time, and average time across all ports.
First Port Powered	*Type X*	Chassis address and test port that first received power.
Final Port Powered	*Type X*	Chassis address and test port that was the last to receive power.
Fast LLDP, Slow LLDP, Average LLDP	*Type X*	Time in seconds between emulated PD connection and granting of a power request to a emulated PD. Reported as minimum (or Fast) time, maximum (or Slow) time, and average time across all ports.
First Port Granted	*Type X*	Chassis address and test port that first received LLDP power grant.
Final Port Granted	*Type X*	Chassis address and test port that was the last to receive LLDP power grant.
Unpowered Ports	*Type X*	List of PSA chassis addresses and test ports that failed to apply power.
Ungranted Ports	*Type X*	List of PSA chassis addresses and test ports that failed to receive LLDP power grant.

PSL-3000 Limitations

NONE

mp_discx_time — Multi-Port Disconnect Shutdown Timing

Test Objective
Determine that PSE ports are uniformly responding to valid PD disconnect signatures and then autonomously (independently) managing disconnect shutdown timing. Separately, determine if a group-disconnect shutdown event is in any way detrimental to subsequent per-port PoE service under control of PSE power management.

Sequence Objective
This test is not prerequisite to other Multi-Port tests.

Test Parameters *(Local)*

Minimum, Maximum, Average Shutdown Times	Time in milliseconds between emulated PD disconnect and power removal by PSE port. Reported as minimum time, maximum time, and average time across all ports.
First Port Down	Chassis address and test port that first removed power. (PSA-3000 only)
Last Port Down	Chassis address and test port that was the last to remove power. (PSA-3000 only)
Minimum, Maximum, Average Power Re-Cycle Time	Time in seconds between emulated PD disconnect followed by a shutdown and immediate PD re-connect until power is restored by the PSE port.
Stuck On Ports	Ports that fail to remove power given PD disconnects.
Out-of-Service Ports	Ports that initially powered for the disconnect shutdown timing measurements but then fail to recycle power.

PSL-3000 Limitations
Because the PSL-3000 (Programmable Load) does not support programmable load transients, time interval measurements, and cross-chassis triggering, shutdown and power recycle timing is assessed with low resolution ranges. Shutdown states are sampled after 500msec following all port disconnects and then again after 3 seconds. If any ports have removed power at 500msec, then Minimum Range is '500msec'. If all ports remove power at 500msec or at 3 seconds, than that range is reported as the Maximum Range. Recycle power states are assessed at 15 seconds, 35 seconds, then again at 75 seconds following the group disconnect shutdown.

mp_admit_cases — Power Administration by PSE Port Subsets

Test Objective
Ultimately, the purpose of this test is to determine if PSE power management treats all PSE ports, regardless of location, equally and independently when making (class based) power-up decisions and LLDP power grants. Ideally, all ports should be treated independently regardless of physical location on the PSE.

CASE 1: PD Class 1 connected to every ODD port (1st, 3rd, 5th, 7th…) in the Resource Configuration
CASE 2: PD Class 0 on uppermost st_admit_***(0) ports in the Resource Configuration
CASE 3: PD Class 2 on every EVEN port (2nd, 4th, 6th…) in the Resource Configuration
CASE 4: PD Class 3 on a middle set of st_admit_***(3) ports iin the Resource Configuration
CASE 5: PD Class 4 on uppermost st_admit_***(4) ports in the Resource Configuration
CASE 6: PD Class 3 on every ODD port (1st, 3rd, 5th, 7th…) in the Resource Configuration
CASE 7: PD Class 4 on every EVEN port (2nd, 4th, 6th…) in the Resource Configuration

Sequence Objective
This test is not prerequisite to other Multi-Port tests.

Test Parameters *(Local)*

Expected Ports	*Case M*	Count of ports that are expected to power up (and, if applicable, provide LLDP grant) given the class-specific power-up (and, if applicable, LLDP grant) counts.
Actual Ports Powered	*Case M*	Count of ports that actually powered up (and, if applicable, provided LLDP grant).

PSL-3000 Limitations
NONE

Multi-Port Power Capacity Analysis

mp_static_cap — Power Administration by PD Class and/or LLDP Request

Test Objective
Measure static (or steady-state) total power available and determine if PSE is correctly and efficiently allocating all available steady-state power to powered PSE ports.

Sequence Objective
Provide other Multi-Port tests with values for maximum steady state power available to Type-1 and/or Type-2 PD's along with $\mathbf{P_{class}}$, the minimum steady

Test Parameters *(Retained)*

Static_Capacity	*Type-X*	Peak total steady state output power measured given Type-X (1 or 2) PD emulation measured across all test ports. Peak power point may appear prior to or after one or more individual PSE ports start to overload and are shut down. Retained values: st_static_cap(X)
Pclass_PSE	*Class N*	Given the PSE port voltage at full PSE power capacity, this is the individual steady-state power capacity required on each port in order to meet IEEE 802.3at steady-state power capacity requirements. Retained values: st_pclass(N)

Test Parameters ***(Retained)***	**Alloc_Power/PD**	*Class N*	Given the number of powered ports, this is essentially the total static power capacity spread to each of those ports. In the case of LLDP power grants, this figure is the total static power available to just those ports that were granted their requested power level (e.g. 25.5 watts). Retained values: st_alloc_port_power(N)
Test Parameters ***(Local)***	**Min_PD's**	*Type-X*	This is the number of PD's that could receive maximum allowed power given PD classification, PSE static power capacity, and PSE port voltage. For Class 0, that power would be 13 watts at the PD interface, or $P_{class}(0)$ at the PSE interface, and for Class 4, that power is 25.5W at the PD interface, or $P_{class}(4)$ at the PSE interface.
	Static_Cap_Port_ Count	*Type-X*	This is the count of powered ports when the peak static power capacity, Static_Capacity_(Type-X), is measured. This may be the same or less than the number of ports originally powered with Type-X emulation.
	Under-Alloc._Pwr._1		Excess power available for powering additional Type-1 PD's based on PSE capacity, Pclass (Type-1), and also considering any differences in capacity between Type-2 powering and Type-1 powering.
	Under-Alloc._Pwr._2		Excess power available for powering additional Type-2 PD's based on PSE capacity, Pclass(Type-2), and also considering any differences in capacity between Type-1 powering and Type-2 powering.
	Out-of-Service Ports		This is a list of chassis addresses and test ports that refuse to power up to PD Class 1 emulation following completion of the static power capacity measurements.
PSL-3000 Limitations	NONE		

mp_trans_cap — Multi-Port Transient Reserve Power

Test Objective	Determine if PSE is keeping power in reserve to meet IEEE 802.3at allowed PD transient loads (e.g. I_{peak}). If PSE allocates all available power to static (steady state) loads, there is the risk that one or more allowable PD load transients will cause one or more PSE ports to remove power, including ports that do not experience the load transient.		
Sequence Objective	This test is not prerequisite to other Multi-Port tests.		
Test Parameters ***(Local)***	**Transient/port**	*Type X*	The transient load current that is applied for 45 msec given Type-1 emulation and either 45 msec or 9.5 msec given Type-2 emulation. It will not be lower than IEEE 802.3at I_{peak}(PD Class= N) and will not be higher than I_{lim_min} (PD Type 1 or 2). It is computed from st_pclass(N) and st_alloc_port_power(N).
	Reserve@Full	*Type X*	The total power reserve in watts available to support load transients for Type-1 and/or Type-2 PD emulation given a PSE operating at its maximum static power capacity. It is plotted in the PSE Total Power Capacity bar graph as gold-colored region above the dark blue static power capacity for Type-1 and Type-2 PD emulation. While it is measured starting at 90% total static power capacity, it is computed by removing the remaining 10% from the measured transient load power in order to assess just the transient reserve ABOVE 100% static load capacity.
	%_Reserve	*Type X*	This is the percentage of power ABOVE static power capacity requirement ($P_{class}(N)$) available to support short load transients of at least $I_{peak}(N)$ on all powered (and granted, if using LLDP) ports. Both $P_{class}(N)$ and $I_{peak}(N)$ are computed using the PSE output voltage measured at full power capacity. This parameter may range negative on PSE's that have no reserve because they cannot furnish required static power capacity, $P_{class}(N)$.
	Reserve@Half	*Type X*	Total power reserve in watts available to support load transients for Type-1 and/or Type-2 PD emulation given a PSE operating at one half of its maximum static power capacity.
	Out-of-Service Ports	*Type X*	This is a list of chassis addresses and test ports that refuse to power up to PD Class 1 emulation prior to assessment of Transient Reserve power. The test requires that all but one of the expected ports (=st_admit_****(N)) MUST power up and if using LLDP, grant the power request.
PSL-3000 Limitations	Because this test requires programmable Load Transients, it is only available to PSA-3000 test ports and is not available to PSL-3000's.		

mp_port_caps — PSE Port Power Uncertainty and Variations by PD Class

Test Objective

From a PD's perspective, total power uncertainty is the range of possible power levels available to any PD powering at a particular classification. It is dependent on PSE power allocation to other PD's and on individual overload tolerance variation by PSE port. This test produces figures for total power uncertainty by PD class and PSE port variation in that figure.

Sequence Objective

Provide other Multi-Port Tests with maximum per-port static power capacity as a function of PD Class.

Test Parameters (*Retained*)

Max_Pwr/port	*Class N*	The maximum static power tolerated before port shutdown on all sampled ports at each PD class. st_admit_***(N) ports are initially powered to low power and overload thresholds are scanned just one port at a time. Retained value: st_max_port_power(N)

Test Parameters (*Local*)

Min_Pwr/port	*Class N*	The minimum static power tolerated before port shutdown on all sampled ports at each PD class. st_admit_***(N) ports are initially powered to low power and overload thresholds are scanned just one port at a time.
Average_Pwr/port	*Class N*	The average power tolerated before port shutdown across all sampled ports at each PD class.
Uncertainty/port	*Class N*	The total uncertainty range of power available to any Class N PD connecting to any port of the PSE. This is a function of power management power allocation decisions and a function of I_{cut} overload threshold variation.
Variation	*Class N*	The percentage variation in power available to any Class N PD. This variation is purely a function of I_{cut} overload threshold variation across PSE ports.
Premature Dropped Ports	*Class N*	List of chassis addresses and test ports where individual port power capacity was heavily affected by the presence of other ports operating at minimum static power levels.

PSL-3000 Limitations

NONE

Multi-Port Load and Overload Stressing

mp_overld_time — Multi-Port Group Overload Response

Test Objective

Determine that PSE ports are uniformly responding to overload conditions and then autonomously (or independently) managing overload shutdown timing. Separately, determine if a group-overload event is in any way detrimental to subsequent per-port PoE service under control of PSE power management.

Sequence Objective

This test is not prerequisite to other Multi-Port tests.

Test Parameters *(Local)*

Minimum, Maximum, and Average Shutdown Time	Time in milliseconds between emulated PD overload and power removal by PSE port. Reported as minimum time, maximum time, and average time across all ports. PD overload applied is calculated using maximum observed individual port overload, st_max_port_power(N), in mp_port_caps. PD Class emulation is one of Class 0, Class 1, Class 2, or Class 3 selected to maximize both the overload level and the initially powered port count.
First Port Down	Chassis address and test port that first removed power. (*PSA-3000 only*)
Last Port Down	Chassis address and test port that was the last to remove power. (*PSA-3000 only*)
Minimum, Maximum, and Average Power Re-Cycle Time	Time in seconds between emulated PD group overload shutdown event until power is restored by the PSE port. Overload magnitude and duration are determined from initial overload shutdown timing measurements.
Stuck On Ports	List of chassis addresses and test ports that fail to remove power given PD overloads.
Out-of-Service Ports	List of chassis addresses and test ports that initially powered for the disconnect shutdown timing measurements but then fail to recycle power.

PSL-3000 Limitations

Because the PSL-3000 (Programmable Load) does not support programmable load transients, time interval measurements, and cross-chassis triggering, shutdown and power recycle timing is assessed with low resolution ranges. Shutdown states are sampled after 500msec following all port disconnects and then again after 3 seconds. If any ports have removed power at 500msec, then Minimum Range is '500msec'. If all ports remove power at 500msec or at 3 seconds, than that range is reported as the Maximum Range. Recycle power states are assessed at 15 seconds, 35 seconds, then again at 75 seconds following the group disconnect shutdown.

mp_cap_stress	**Multi-Port Full Power Stress Test**	
Test Objective	Demonstrate that the PSE withstands a high static power load over a long duration of time without causing ports to drop power either temporarily or permanently.	
Sequence Objective	This test is not prerequisite to other Multi-Port tests.	
Test Parameters *(Local)*	**Actual Load Power**	This is the actual total PSE power established while trying to attain 95% of previously measured static power capacity. The test automatically selects PD Class that enables powering to 95% of st_static_cap(N), the maximum steady state load capacity, with as many PSE ports as possible.
	Dropped Power Count	The count of events where a port removed power over the course of testing. Each shutdown on each port is deemed a power removal event.
	Power Drop Ports	The list of ports that experienced one or more power drops during the course of testing. Use the log file to get further details concering how many times each port dropped power and when those drop-outs occurred.
	Out-of-Service Ports	Since the test is only powering the number of ports expected to power based on st_admit_***(N), this is a list of ports that were expected to power up initially, but failed to power or provide expected LLDP power grant.
PSL-3000 Limitations	NONE	

Configuring and Running the Multi-Port Test Suite

The PSE Multi-Port Suite can be accessed from either PSA Interactive Software (GUI) or PowerShell PSA, an extended Tcl/Tk command line shell.

PSA Interactive provides three top level menus: **Multi-Port Live PD Emulation***, **Multi-Port PSE Tests**, and **Multi-Port Sequencer**. Each top level menu then provides access to the **Multi-Port Resource Configuration** menu (*see Figure 1*). Resource Configuration is used to define the field of instruments and test ports to be used in Multi-Port Testing. Resource Configuration automatically determines if the instrument type is a **PSA**-3000 PowerSync Analyzer or a **PSL**-3000 Programmable Load. Any mixture of PSA-3000 and PSL-3000 instruments will be treated as a **PSL**-3000 Programmable Load with corresponding test limitations.

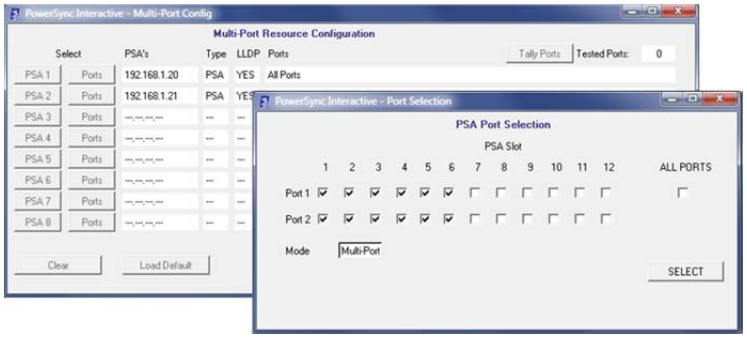


Figure 1: **Multi-Port Resource Configuration Menus**

Resource Configuration also determines if **LLDP** is available to all instruments in the Resource Configuration. If every instrument supports the LLDP emulation feature, then the test menus will enable use of Power Management modes **LLDP2** and **LLDP**.

Once the Multi-Port Resource Configuration is defined and validated by PSA Interactive, users can run individual Multi-Port tests from the **PSE Multi-Port-2 Tests** menu (*see Figure 2*). This menu displays the Multi-Port Resource Configuration and provides several configuration options for running Multi-Port tests. These options exist within two categories:

- PD Emulation
- Power Management

PD Emulation is specified as **Type-1**, **Type-2**, or **Type-1 & 2**. **Type-1** means testing will run with PD Classes 0-3 emulated. This is the appropriate setting for Type-1 (15.4 Watt) PSE's. **Type-2** results in only PD Class 4 emulations. **Type-1 & 2** deploys PD Class 0-4

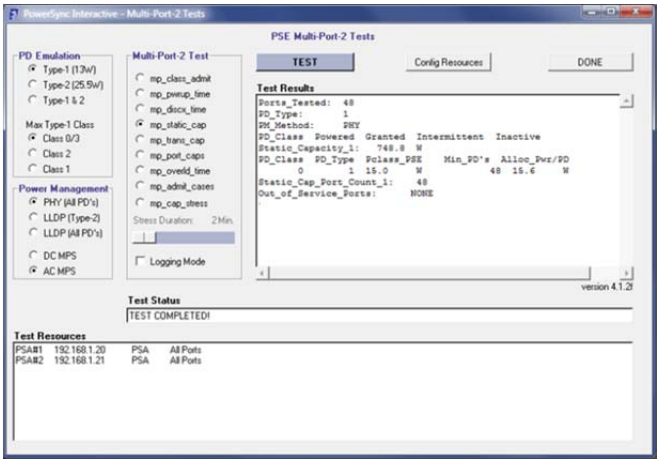


Figure 2: **Multi-Port PSE Tests Menu**

* *Live PD Emulation is described further in Sifos datasheet **Multi-Port Live PD Emulation Overview***

emulations and is the *recommended configuration* for Type-2 (30 Watt) PSE's.

The test suite has been designed to work with Type-1 PSE's that may only be enabled for PD Class 1 and/or PD Class 2 support. Given a **Type-1** PD Emulation mode, users may select the maximum allowable PD Class as **Class 0/3**, **Class 2**, or **Class 1**. **Class 0/3** would be the *typical* selection for most Type-1 PSE's.

Power Management is specified as **PHY**, **LLDP (Type-2)**, or **LLDP (All PD's)**. Generally, this setting pertains to the method used by a PSE to allow Type-2 power levels, that is, above 13 watts, to Type-2 PD's. A Type-2 PSE that utilizes 2-Event classification would require the **PHY** selection. A Type-2 PSE that uses PoE LLDP to grant full power to Type-2 PD's would generally be tested with the **LLDP (Type-2)** setting. LLDP capable PSE's can also be tested using LLDP power negotiation at all PD Class levels (0-4) by selecting the **LLDP (All PD's)** setting.

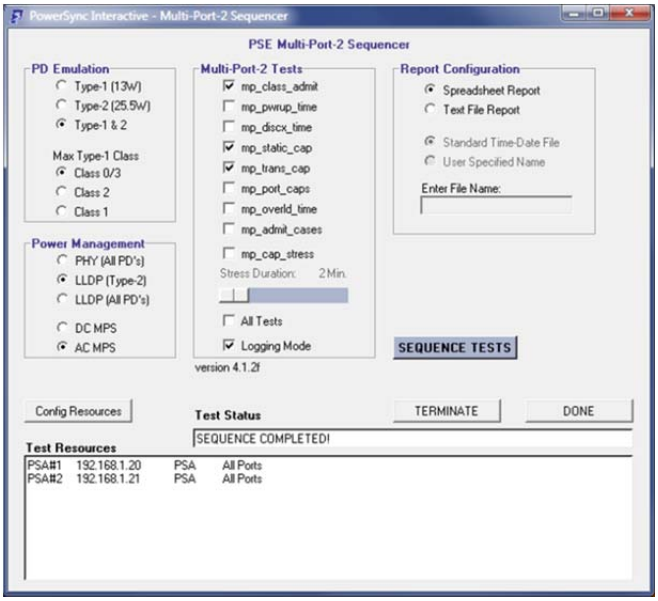


Figure 3: **Multi-Port Sequencer Menu**

Users should also declare whether the PSE uses the **DC MPS** method or the less common **AC MPS** method for processing PD disconnect shutdowns.

The Multi-Port Test Suite can be automatically sequenced to a standard spreadsheet report using the **Multi-Port-2 Sequencer** menu (*see Figure 3*). Like the Multi-Port-2 Tests menu, this menu displays the Multi-Port Resource Configuration and provides setting selections for **PD Emulation** and **Power Management** characteristics of the PSE. These settings are retained between the two test menus.

From the sequencer menu, users select the tests to sequence and then initiate the sequence. Upon completion, the standard report automatically appears. Both menus allow the optional selection of a **Logging Mode** where many details of each Multi-Port test are recorded to log files named for those specific tests. These files are very useful for troubleshooting system anomalies that may appear in the final test results. One portion of an Multi-Port Test log file is shown in Figure 4 below.

```
mp_trans_cap TEST LOG Recorded August 12, 2014 1:19:23 AM

mp_trans_cap: st_admit_phy(0)= 15 st_static_cap(1)= 172.6, st_alloc_port_power(0)= 11.5  st_pclass(0)= 14.4 53.2
mp_trans_cap: st_admit_lldp(4)= 15 st_static_cap(2)= 171.6, st_alloc_port_power(4)= 11.4 st_pclass(4)= 29.3 53.1
mp_trans_cap: Assuring availability of all PSE ports and removing power...

mp_trans_cap: PD CLASS 0 TESTING at Full CAPACITY...
mp_trans_cap: Powering PSE to 90% of 172.6 W = 155.3 W total power...
mp_trans_cap: PSE powered 15 of 15 ports to measured power 158.6 W for transient reserve at Full power.
mp_trans_cap: At Full power, Multi-Port power-up measured typical Vport= 53.2 V, Iport= 198.7 mA.
mp_trans_cap: 802.3at Ipeak for class 0 computes to 305.8 mA for this PSE.
mp_trans_cap: 45msec, 305.8 mA Load Transients will be applied to PSE ports. This is the IEEE 802.3at 'Ipeak' value.
 . . . . .
```

Figure 4: **Diagnostic Log Excerpt** (from **mp_trans_cap**)

The Multi-Port Test Suite can also be configured and executed from **PowerShell PSA** using simple yet flexible commands (*see Figure 5*). All features of the test suite described above are available using PowerShell PSA commands. In addition, added flexibility in the form of scripts to *sequence Multi-Port sequences* allows engineers and technicians to easily capture and analyze PSE system behaviors that may be erratic or unstable across multiple cycles of the Multi-Port Test Suite.

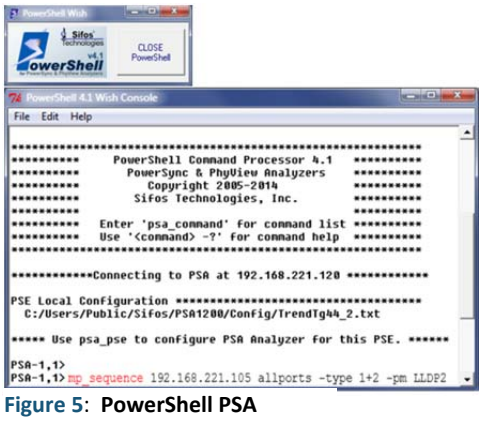


Figure 5: **PowerShell PSA**

Standard Multi-Port System Test Report

The PSE Multi-Port Test Suite provides a standard Microsoft Excel spreadsheet report* that is automatically produced upon the completion of any sequence of Multi-Port tests. The report offers both tabular and graphical presentations of many key parameters with extensive "behind the scenes" limit checking logic to draw attention to any potential problem areas. A sample report is shown in Figure 6.

Figure 6: Sample Test Report: 48-Port, Type-2, LLDP Granting PSE

The report includes header information describing the test configuration including Multi-Port Test Resources (chassis addresses and utilized test ports), chassis type (**PSA** vs **PSL**), PD Emulation (Type **1**, **2**, or **1+2**), and Power Management Mode (**PHY**, **LLDP**, or **LLDP2**). Also included is time-date information and PSE-under-test description including the number of PSE ports tested.

* *The standard spreadsheet report requires Microsoft Office 2007 or later with macro processing enabled.*

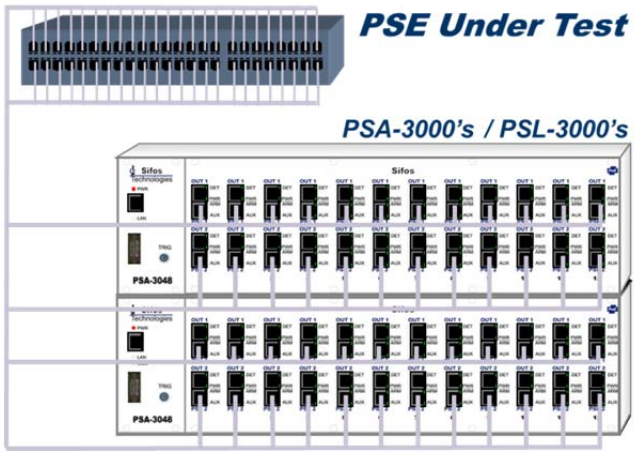
Test data is organized by Multi-Port test following the ordinary sequence of testing. Many tabular parameters are evaluated against low and/or high test limits and if a value falls outside those limits, the parameter field is colored to reflect the category of limit exception. Two categories are provided as shown in Figure 6. The first category is a Non-Ideal Feature / Design Limitation. Parameters highlighted with this color indicate a less-than ideal PSE behavior that may or may not affect end user experiences with the PSE. A very simple example of this would be inability to offer full Type-1 or Type-2 power demands on every PSE port. A second example would be over-allocation of power to PD's where the power allocated may be more than the power available. These behaviors should ***not*** be interpreted as failures to some particular standard. The IEEE 802.3 clause 33 standard governing PSE's does not address behaviors of PSE's beyond just a single port.

There are also a number of parameters across several Multi-Port tests that have direct connections to single-port PSE behavior as described by IEEE 802.3 clause 33. One example would be the **Maximum**, **Minimum**, and **Average Shutdown Times** measured in **mp_discx_time**. These times are specified such that disconnect shutdowns, regardless of how many are performed simultaneously, should occur between 300msec and 400msec after virtual PD disconnect. A **Minimum Shutdown** time less than 300 msec or a Maximum Shutdown time greater than 400 msec will be highlighted in this color to reflect an 802.3at Specification Violation.

The standard spreadsheet test report includes several graphs that visually depict various tabular parameters. One series of graphs renders various Power Metrics including static and transient load capacity, static capacity versus required static capacity, and power uncertainty encountered by various classes of PD's. A second series of graphs displays Timing Metrics related to initial and recycle power-ups, disconnect shutdowns, and overload shutdowns. The graphs provide a convenient means to rapidly spot problems and to compare results between test cycles.

The standard report also includes a page that details all of the test limits and their origins. Users are free to manipulate or refine those limits to fit their goals. Additionally, there is a page with detailed explanations of all test parameters and associated test limit strategies. A **Test Info** button on the test results page accompanies each test and when pressed, acts like a hotlink to the corresponding test information.

Multi-Port Test Configuration (48 Port Example)



Ordering Information

PSA-MPT PSE Multi-Port Suite including Multi-Port Live PD Emulation and the Multi-Port Test Suite, per PSA Controller*
PSA-QTD PowerSync Analyzer Test Suite Multi-Chassis Discount (Single P.O.)

* The Multi-Port Suite may be added to previously installed PSA-30xx and PSL-30xx systems using an enabling key code purchased from Sifos Technologies.

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