Sifos Technologies

Innovation and Leadership in:

- ✓ **Power over Ethernet Test**
- ✓ **Ethernet Twisted Pair Physical Layer Test**

Verification, *Simplified.*

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Sifos Technologies:

- Founded: 2003
- Location: Andover, Massachusetts USA
- Employee Owned and Operated, Self-Funded

Sifos Technologies
20 miles (32 kM) north of Boston, MA

Principals:

- Deep Backgrounds in Test & Measurement with HP / Agilent Technologies
- Key Contributors to IEEE 802.3 PoE Specifications

Representation / Distribution / Support:

- *North America:* AMASCO (US West), Contech (North Mid-Atlantic), NCS (Midwest), ProTEQ (MidAtlantic), Gillaspy (Southwest, Mountain States) Sunforce (Southeast), Sifos Authorized Rep (Canada), Sifos (New England)
- *Asia:* Paralink (China, Taiwan), Fastech (India), Toyo (Japan), Unitel (Korea), TTS (Australia), TekNoEx (ASEAN)
- *Europe:* FS_Trading & Consulting (Central Europe), Indes (Benelux), EWE (Nordic, Baltic States), RDT (Israel), Netmetrix (Italy & Spain), eNGN (Portugal), Sifos (UK), Sifos Authorized Rep (France), Treatface (CIS)

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PoE Test Solutions from Sifos

PoE Landscape in 2025

- PSE's & PD's Continue to Proliferate
  - Common Feature of Ethernet Switches
  - PD Diversification (Phones, WAPs, Cameras, Terminals, IOT, Lighting, Controls, Displays…)
  - IEEE 802.3at: 2-Pair Powering of Type-1 (13W) and Type-2 (25.5W) PD's
  - IEEE 802.3bt : 4-Pair Powering of Type-3 (51W) and Type-4 (71W) PD's
    2-Pair Powering of Type-3 (13W, 25.5W) PD's
- Interop Testing is Ancient History
  - Wide PSE (802.3at and 802.3bt) Specification Latitude
  - Many Diverse Implementations (PoE Silicon, Power Management Strategies, etc.)
- Silicon Versus Systems
  - PSE Silicon is Highly Programmable – Hardware & Firmware Decide Conformance
  - PSE Specification Conformance Dependent on both Silicon and PSE System Firmware
  - Many PSE Conformance Issues will be Intermittent Behaviors
  - Many Critical PD Conformance Features Not Governed by PD Silicon
  - Many Permutations of PD Power Needs Versus PSE Power Limits
- The LLDP Challenge
  - Layer 2 (MAC) Protocol Required of Type-2 , Type-3, and Type-4 PD's
  - Enables PSE Power Management to 0.1W Per Port
  - Requires PD's to have at least one low power (e.g. 13W loading) state
- The Power Management Challenge
  - PSE's Budget From 1W to 90W per PSE Port
  - Multi-Port System Management Must Allocate Shared Power Resource

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PSE Test Solutions (Instruments)

Sifos® Technologies

COMPLIANCE ■ SYSTEM ■ FINAL TEST

Process

PSL-3424M

8, 16, or 24 Ports

PSL-3424A, PSL-3424L

24 Ports

2/4-Pair Live PD Emulation

2/4-Pair PMA

2-24 Ports

2-Pair CTS

4-Pair CTS

2-Pair PMA

LLDP

PSA-3000

PSL-3000, PSL-3224

2-24 Ports

2-Pair PMA

LLDP

PSA-3402

2 Ports

2-Pair CTS

4-Pair CTS

LLDP

Task

EVALUATION ■ DESIGN ■ VALIDATION ■ MANUFACTURE

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Verification, Simplified.

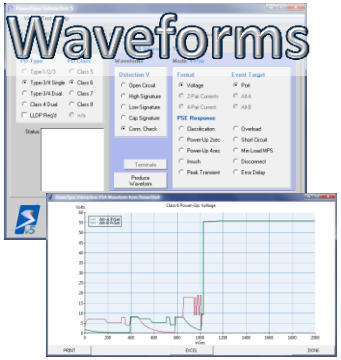
PSE Test Solutions (Automated Tests)

Sifos® Technologies

Process

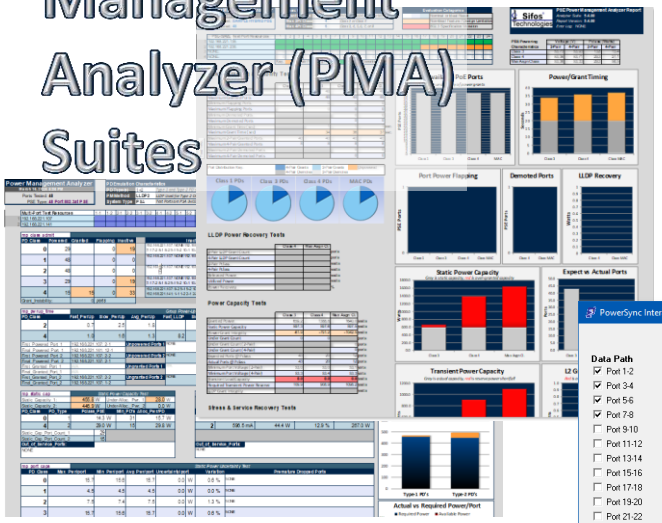
COMPLIANCE ■ SYSTEM ■ FINAL TEST

One-Click PSE Waveforms



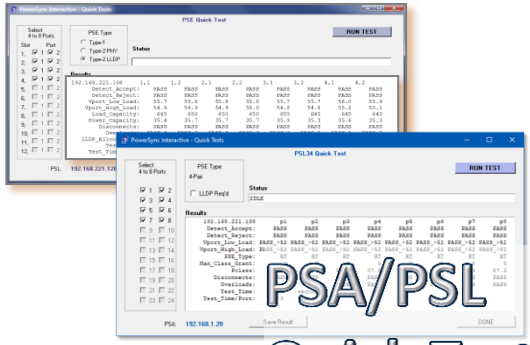
PSA-3000, PSA-3402

PSE Power Management Analyzer (PMA) Suites



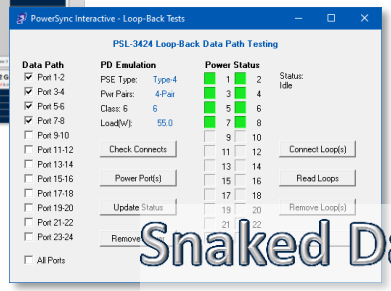
PSL-3424, PSA/PSL-3000

PSA/PSL Quick Tests



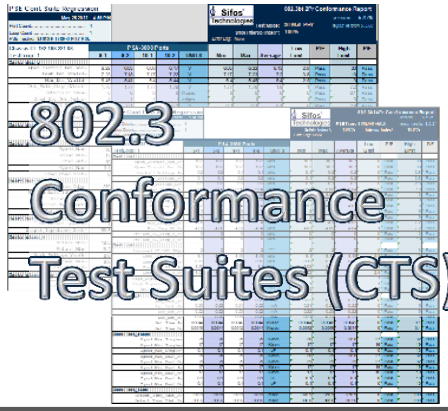
All Instruments

Snaked Data & PoE Testing

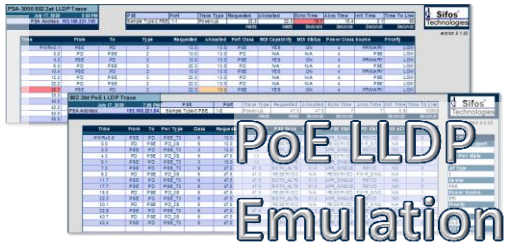


PSL-3424

802.3 Conformance Test Suites (CTS)



PoE LLDP Emulation & Analysis



Task

EVALUATION ■ DESIGN ■ VALIDATION ■ MANUFACTURE

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PSE Test Solutions from Sifos

Sifos® Technologies

PowerSync® Analyzer (PSA-3000, PSA-3402)

- Flexible emulation of 802.3at and 802.3bt PD's with **highly programmable** detection/classification signatures, inrush loads, transient loads, and steady state loads >99W per test slot (>49W per test port) with loading controlled per 4-pair pairset
- Powerful metering and analysis including **one-click stimulus/response waveforms**, flexible trace, average, and peak metering, powerful edge and event triggering, AC ripple noise, and precise time interval measurements.
- **Scalable** from 2 to 24 test ports with intelligent chassis cooling
- PSA Interactive graphical user interface, PowerShell PSA automated scripting software, and comprehensive documentation enables **rapid productivity**
- LAN data THRU port passes LAN data from each test port
- PSA **Quick Test** fully automated, rapid executing functional test for 2 to 8 2-Pair (30W) ports (PSA-3000 only)
- Commercial test equipment **fully certified** for safety and emissions/susceptibility compliance (CSA, CE, FCC) to >99 watt continuous load per slot (or port pair)

Licensed Options

- The "**industry standard**" **2-Pair** powering (802.3at, 802.3bt) and **4-Pair** powering (802.3bt) **fully automated** PSE Conformance Test Suites used by PSE silicon vendors, OEM designers, and PSE vendors worldwide
- Flexible PoE **LLDP emulation and analysis** of 802.3at and 802.3bt PoE LLDP protocols and power granting integrity
- Multi-Port Suite including **Power Management** Analyzer and **Live PD Emulation** for **2-Pair** powering PSE's up to 192 total 15W or 30W ports

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PSE Test Solutions from Sifos

PowerSync® Programmable Load (PSL-3424A, PSL-3424M)

- Flexible emulation of 802.3at and 802.3bt PD's with **programmable** detection/classification signatures, inrush loads, transient loads, and steady state loads up >99W **per test port** (x 24 test ports) with loading per pairset
- DC Metering of **average and peak** voltage, average and peak current (2-pair or 4-pair), and average power (2-pair or 4-pair)
- **Event triggered** meters (voltage, current) may be synchronized to transients and to measurements on multiple test ports
- Flexible **PoE LLDP** emulation and Compliance Testing of 802.3at and 802.3bt PoE LLDP protocols and power granting integrity (***PSL-3424L*** *only*)
- PSA Interactive graphical user interface, PowerShell PSA automated scripting software, and comprehensive documentation enables **rapid productivity**
- LAN data **internal loopback** between odd and even numbered ports on each slot
- Commercial test equipment **fully certified** for safety and emissions/susceptibility compliance (CSA, CE, FCC) to >99 watt continuous load per test port

Licensed Options

- **Live PD Emulation** for 2-Pair, 4-Pair, or hybrid 2-Pair/4-Pair emulation of up to 96 always connected PD's
- Fully automated **Power Management Analyzer** Suite for 2-Pair, 4-Pair, or hybrid 2-Pair/4-Pair powering PSE's up to 96 total ports ranging 15W to 90W each
- PSL-3424 **Quick Test** rapid executing functional test for 2 to 8 2-Pair (30W) or 4-Pair (90W) powering ports combined with graphical user interface menu to establish and verify **PoE loaded snaked data test** configurations

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PSE Test Solutions from Sifos

Sifos® Technologies

PowerSync® Programmable Load (PSL-3000, PSL-3224)

- Flexible emulation of 802.3at and 802.3bt PD's with **highly programmable** detection/classification signatures and steady state loads up >99W per test slot (>49W per test port) with loading controlled per 4-pair pairset
- DC Metering of average voltage, average current (2-pair or 4-pair), and average power (2-pair or 4-pair) with selectable 100msec and 1 second apertures
- PSL-3000 is **scalable** from 2 to 24 test ports with intelligent chassis cooling, PSL-3224 is fixed 24 test ports at lower cost per port
- PSA Interactive graphical user interface, PowerShell PSA automated scripting software, and comprehensive documentation enables **rapid productivity**
- PSL **Quick Test** fully automated, rapid executing functional test for 2 to 8 2-Pair (30W) powering ports
- Commercial test equipment **fully certified** for safety and emissions/susceptibility compliance (CSA, CE, FCC) to >99 watt continuous load per slot (or port pair)

Licensed Options

- Flexible PoE **LLDP emulation and analysis** of 802.3at and 802.3bt PoE LLDP protocols and power granting integrity
- Multi-Port Suite including **Power Management Analyzer** and **Live PD Emulation** for 2-Pair powering PSE's up to 192 total 15W or 30W ports

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PSE Test Solutions from Sifos

PowerSync® Programmable Load Multiplexer (PSL-3424M)

- **Scalable** from 2x4, 2x8, or 2x12 multiplexed ports capable of connecting to 8, 16, or 24 PSE ports and simultaneously loading 4, 8, or 12 PSE ports
- **Very low cost** PoE load architected for PSE test automation strategies
- Flexible emulation of 802.3at and 802.3bt single signature PD's with **selectable** detection/classification signatures, inrush loads, transient loads, and steady state loads up >99W **per test slot** (x 4, 8, or 12 test slots)
- DC Metering of **average and peak** voltage, average and peak current (2-pair or 4-pair), and average power (2-pair or 4-pair)
- **Event triggered** meters (voltage, current) may be synchronized to transients and to measurements on multiple test ports
- PowerShell PSA automated scripting software and comprehensive documentation enables **easy test automation**
- Electrically hardened interfaces to withstand electrical surges from compliance tests
- Commercial test equipment **fully certified** for safety and emissions/susceptibility compliance (CSA, CE, FCC) to >99 watt continuous load per slot (or port pair)

Licensed Options

- (PSL-3424M Quick Test, PSA Interactive Support TBA – 2025)

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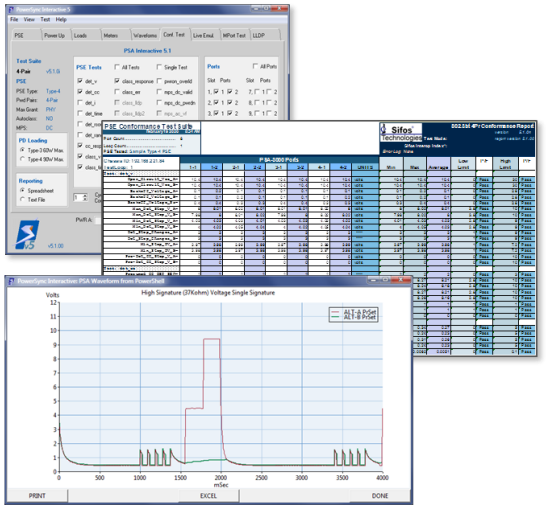
PoE Test Solutions from Sifos

PSE Conformance Test Suite for 4-Pair 802.3bt PSE's

- **Fully automated** port sequencing and statistics to 24 ports/PSA-3000
- **Extensive coverage** of single and dual signature emulations and PSE responses covering all Type-3 and Type-4 PSE's
- Sophisticated 4-Pair signaling capture and analysis processes
- Over **300 parameters** reported per PSE port
- Supports non-LLDP and **LLDP** capable PSE's
- **De facto standard**: Used by PSE silicon vendors, OEM's, and end product vendors worldwide to qualify PSE designs
- Configurable waveform **trace diagnostic** generation and retention
- **Colorful and informative** spreadsheet reporting
- Supported on PSA-3000 and PSA-3402



4-Pair PSE Conformance Test Software & Reporting

Approved for 1st Party Gen2 EA Logo Certification Testing of 802.3bt PSE's!

EA Certified 2.0™

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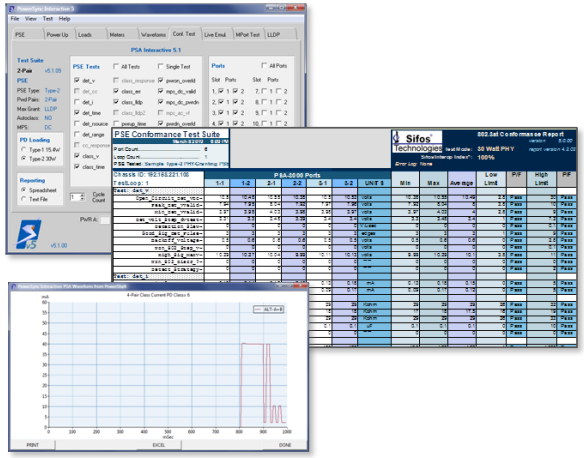
Verification, Simplified.

PoE Test Solutions from Sifos

PSE Conformance Test Suite for 2-Pair 802.3at & 802.3bt PSE's

- **Fully automated** port sequencing and statistics
- Greater than **95%** 802.3at PICS coverage from 23 tests producing more than 70 IEEE 802.3at test parameters per port
- Fully emulates all **Type-1** (PD class 0, 1, 2, or 3) and **Type-2** (PD class 4) PD's including **LLDP-Capable** PD's
- **Adapts** to all prevalent PSE signaling and power behaviors, including proprietary "legacy" detection behaviors
- **De facto standard**: Used by PSE silicon vendors, OEM's, and end product producers worldwide to qualify PSE designs
- Configurable waveform **trace diagnostic** generation and retention
- **Colorful and informative** spreadsheet reporting
- Supported on PSA-3000 and PSA-3402



2-Pair PSE Conformance Test Software & Reporting

Approved for 1st Party Gen1 EA Logo Certification Testing of 802.3at PSE's!

EA Certified™

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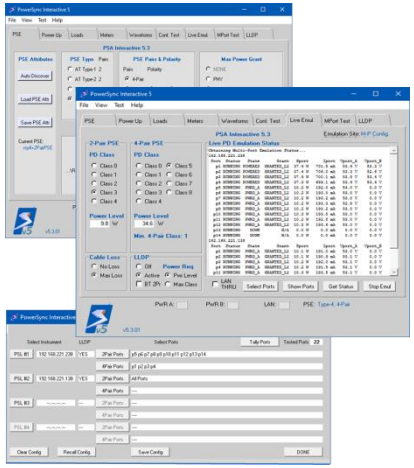
Verification, Simplified.

PoE Test Solutions from Sifos

PSL-3424 Power Management Analysis of 2-pair, 4-pair, hybrid 2/4-pair PSE's

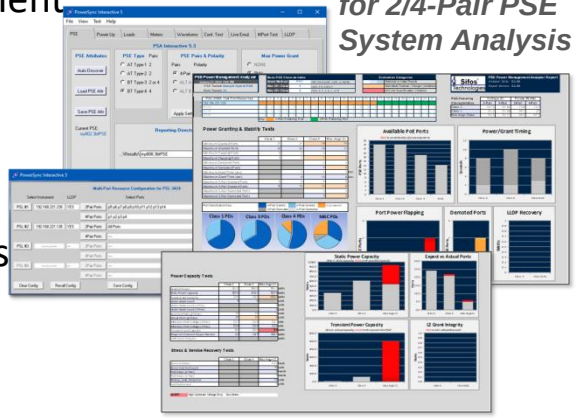
- Analyze PSE's with **any combination** of 2-Pair (30W) and 4-Pair (up to 90W) ports using PSL-3424A or PSL-3424 instruments
- Multi-Port **Live PD Emulation**
  - Flexibly mimic class 0 to class 8 PD per PSL-3424 test port
  - Configure **up to 96 802.3 PD's** with loading up to 100W / Port
  - Evaluate PoE port **administration behaviors** with PD's that are always connected
  - Emulated PD's automatically restrict loads to **assigned class**
  - Optional **cable loss load escalation** based on load and voltage
  - Emulate 802.3at and 802.3bt PoE **LLDP** negotiations and power adjustments (*PSL-3424L only*)
  - Support snaked data path traffic while emulating PD's



Live PD Emulation Configuration & Monitor

- PSL-3424 **Power Management Analyzer** (PMA) Suite
  - One-of-a-kind system for PSE Power Management behavioral analysis
  - **Automatically** assess PM stability & capacity management
  - Tests 802.3at/bt PSE's with **any combination** of 2-Pair and 4-Pair PSE ports
  - Tests PSE's that grant power with multi-event, LLDP, or both multi-event and LLDP
  - **Automatically adapts** to PSE maximum assigned class (MAC) and power demotions on 2-Pair and 4-Pair ports
  - Highly informative reports cover dozens of parameters using colorful graphics
  - Tests PSE's with up to 96 PoE ports

PM Analyzer Suite for 2/4-Pair PSE System Analysis



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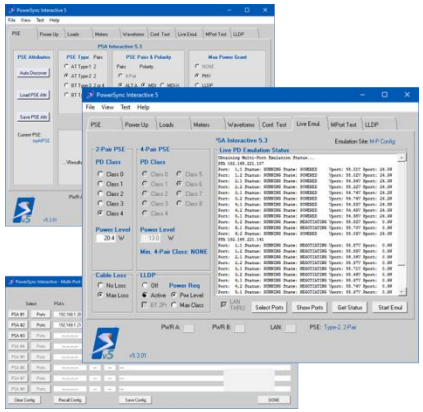
PoE Test Solutions from Sifos

PSA/PSL-3000 Multi-Port Suite for 2-Pair PSE Systems Analysis

- Analyze 2-Pair powering 802.3at and 802.3bt PSE's using PSA-3000 or PSL-3000 instruments
- Multi-Port **Live PD Emulation**
  - Flexibly mimic class 0 to class 4 PD per test port
  - Configure **up to 192 802.3 PD's** with loading up to 34W / Port
  - Evaluate PoE port **administration behaviors** with PD's that are always connected
  - **Configurable cable loss** load escalation based on load and voltage
  - Emulate 802.3at PoE **LLDP** negotiations and power adjustments (*requires LLDP license*)
  - Support snaked data path traffic while emulating PD's
- PSA/PSL-3000 **Power Management Analyzer** (PMA) Suite
  - In-depth system testing of 2-Pair (30W) PSE's
  - Concurrently analyze **up to 192 PSE Ports**
  - **Fully automated** testing and reporting
  - Assess PSE power **administration decisions** and **power management behaviors**
  - Robust emulation of Type-1 or Type-2 PD's including PoE **LLDP** power negotiation emulation
  - **Easily configured**, single sequence testing including static and transient reserve capacity analysis, uncertainty metrics, and uniformity metrics
  - Assess PSE power reliability/durability over time



Live PD Emulation Configuration & Monitor

PM Analyzer Suite for 2-Pair PSE System Analysis

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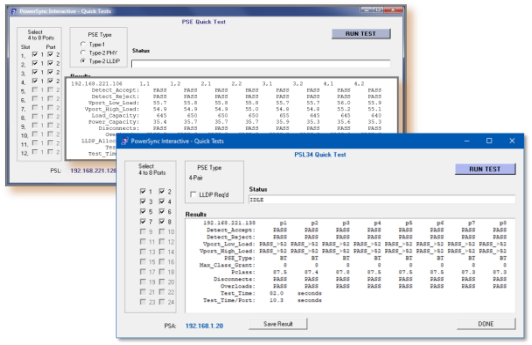
PoE Test Solutions from Sifos

Multi-Port High Throughput PSE Quick Inspection Tests



- **Standard feature** with PSA-3000 and PSL-3000
  - Test 2-Pair 802.3at/802.3bt PSE's
  - Supports optional LLDP* power negotiations
  - Source code provided
  - Test between 4 and 8 ports at a time
- Optional feature with PSL-3424A and PSL-3424L
  - Test 2-Pair and 4-Pair 802.3at/802.3bt PSE's
  - Supports optional LLDP* power negotiation and testing
  - Test between 2 and 8 ports at a time
- Recover critical PoE parameters from PSE ports within as little as 12 seconds (PSA-3000, PSL-3424) or 25 seconds (PSL-3000) per port tested
- Typical Test Coverage:
  - Validate PoE detection acceptance and rejection ranges
  - Measure PSE port voltage at minimum and maximum load conditions
  - Verify PSE port power capacity and integrity
  - Assess disconnect power removal response and timing**
  - Assess overload power removal** and power-type threshold
  - Assess LLDP* power allocations and associated timing
  - PASS/FAIL parameter output provided in formatted text reports

* LLDP testing requires PSA/PSL LLDP feature license (PSA/PSL-3000) or PSL-3424L

** Timing Analysis available with Quick Test for PSA-3000

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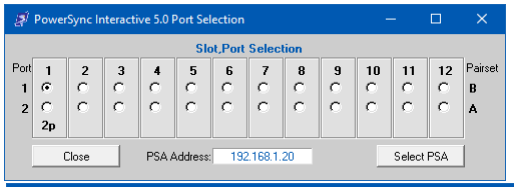
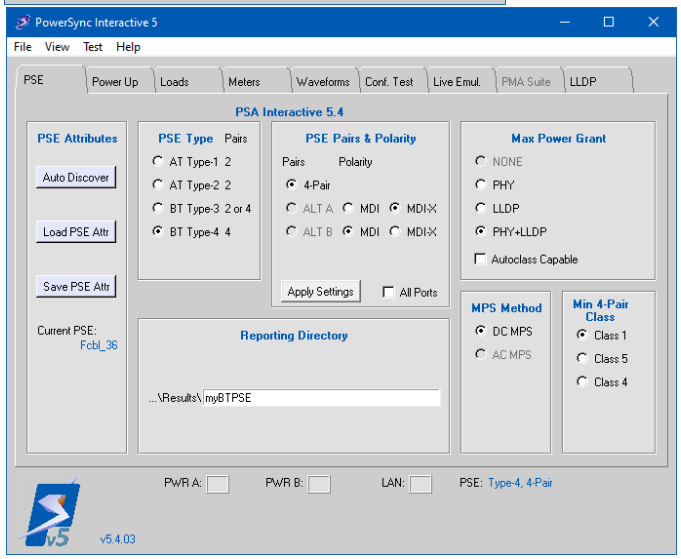
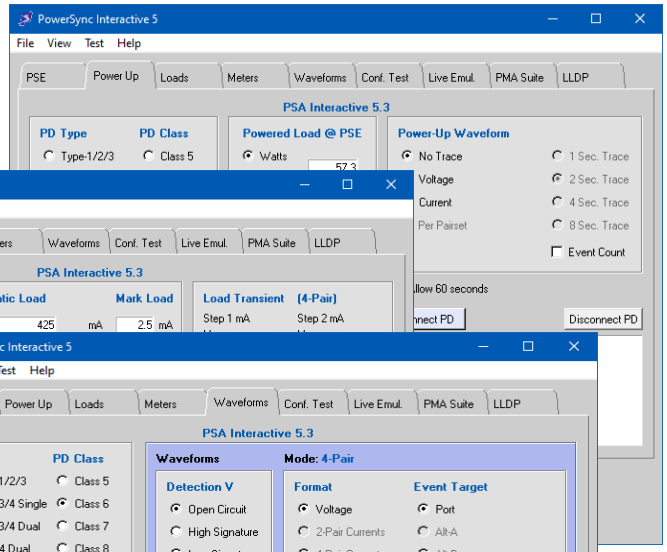
PSA 5.4 Software PSA-3000 & PSL-3000 Platforms

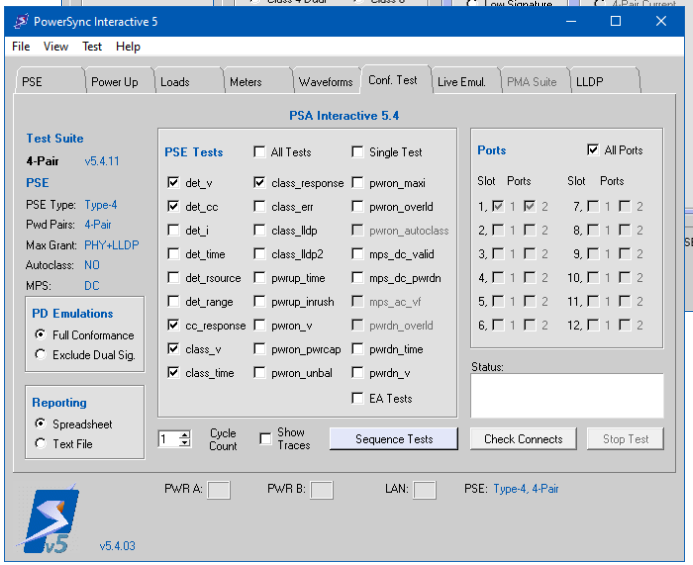
PSA 5.4 Software: *Seamless Integration*

- PSA-3000, PSL-3000, PSL-3424 instruments
- PSA Interactive graphical user interface adapts to each instrument
- PowerShell PSA script development and automation environment including Notepad++ editor for PowerShell PSA









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PD Test Solutions from Sifos

Sifos® Technologies

Process

COMPLIANCE ■ SYSTEM ■ FINAL TEST

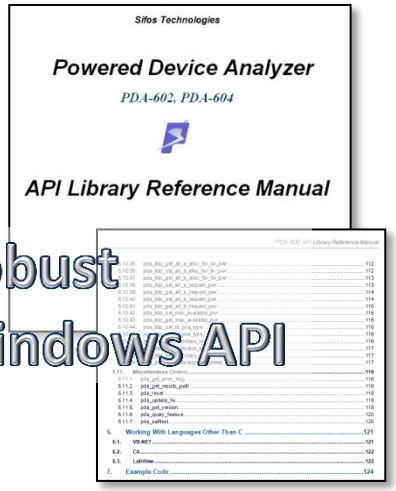
PDA-602B

802.3at PD's

Type-2 Testing

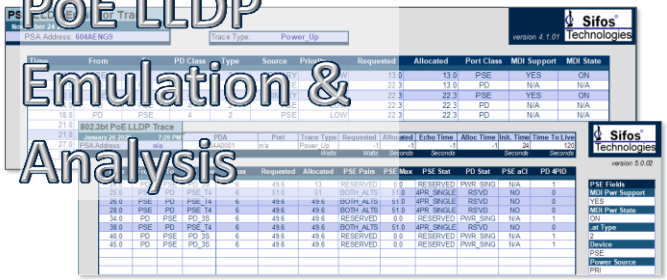
802.3at CTS

802.3at LLDP



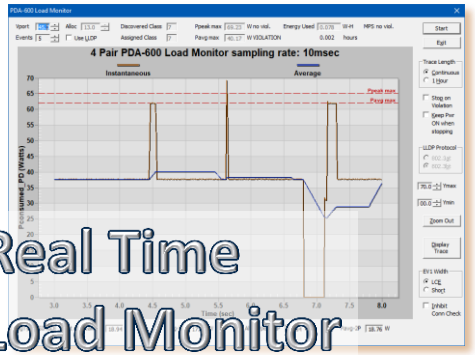
Robust Windows API

PoE LLDP Emulation & Analysis



802.3 Conformance Test Suites

Real Time Load Monitor



PDA-604A

802.3bt PD's

802.3at PD's

Type-3/4 Testing

802.3bt & 802.3at CTS

802.3bt & 802.3at LLDP

Task

EVALUATION ■ DESIGN ■ VALIDATION ■ MANUFACTURE

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Verification, Simplified.

PoE Test Solutions from Sifos

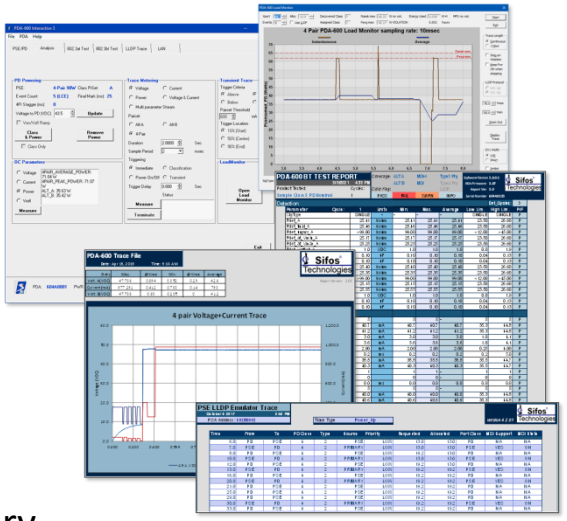
PDA-604A Powered Device Analyzer

- Powered Device Verification for IEEE **802.3at** & **802.3bt** PD's
- **Scalable** Platform:
  - Base Platform: 2-Pair and 4-Pair powering, 802.3at emulations
  - License Option: Type-3/Type-4 power granting & emulations
  - License Option: **802.3at** automated PD conformance test suite
  - License Option: **802.3bt** automated PD conformance test suite
  - License Option: LLDP emulation and analysis for 802.3at
  - License Option: LLDP emulation and analysis for 802.3bt
- Powerful PC hosted graphical user interface software
- **Robust metering** of 2-Pair and 4-Pair voltage, current, and power at the PD interface
- Robust, **fully automated** 802.3at and 802.3bt PD Conformance Test Suites
  - **Real Time Load Monitor** Included with Conformance Test Suites
- Analyzes **PD PoE LLDP** protocols and negotiation integrity with 10/100/1000Base-T PD interface
- 10/100/1000 switched connection for PD management
- LAN bypass mode supports multi-gig links
- **Plug'n Play** USB interface for control
- Tcl scripting automation and Windows (DLL) programming library

Approved for 1st Party Gen1 and Gent2 EA Logo Certification Testing of 802.3at and 802.3bt PD's!

EA Certified 2.0™

PDA Interactive Version 3 Software for 802.3at and 802.3bt PD Analyses



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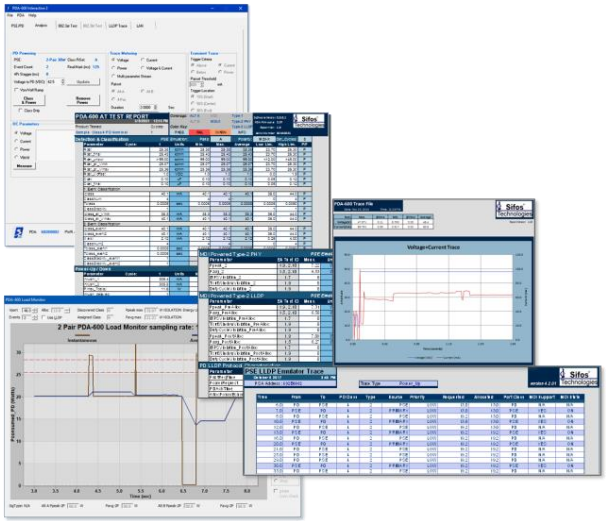
PoE Tests Solutions from Sifos

PDA-602B Powered Device Analyzer

- Powered Device Verification for IEEE 802.3at PD's
- **Scalable** Platform:
  - Base Platform: 802.3at Type-1 emulations and monitoring
  - License Option: 802.3at Type-2 emulations and monitoring
  - License Option: 802.3at Automated conformance test suite
  - License Option: PoE LLDP emulation and protocol analysis
- Powerful PC hosted graphical user interface software
- **Robust metering** of 2-Pair voltage, current, and power at the PD interface
- Robust, **fully automated** 802.3at PD conformance test suite and **real time load monitor**
  - > 85% 802.3at PD PIC's Coverage!
- Analyzes 802.3at **PoE LLDP** Protocols and negotiation integrity with 10/100/1000Base-T PD Interface
- 10/100/1000 switched connection for PD management
- **Plug'n Play** USB interface for control
- Tcl scripting automation and Windows (DLL) programming library

Approved for 1st Party Gen1 EA Logo Certification Testing of 802.3at PD's!

EA Certified™



*PDA Interactive **Version 3** Software for 802.3at and 802.3bt PD Analyses*

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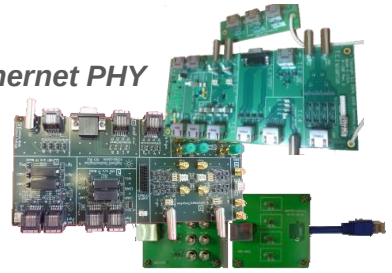
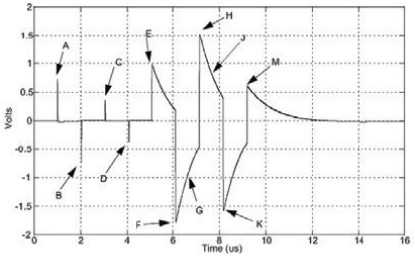
Ethernet PHY Test Solutions from Sifos

Twisted Pair Ethernet Testing Traditions

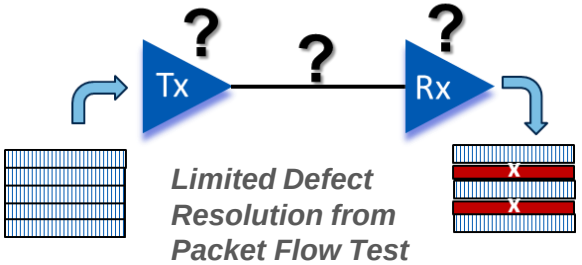
- IEEE 802.3 methods
  - Concentrated on transmitters only
  - Challenging & laborious
    - *High Expertise Required*
  - Difficult to automate
    - *Exotic time domain measurements*
    - *Interfacing and calibration challenges*
  - Requires access to PHY silicon tests modes
    - *Vulnerable to specification "cheating" when test modes are turned off*
- IEEE 802.3 testing practice
  - Silicon vendor "service"
  - Test laboratories (e.g. UNH-IOL)
  - LOW sample testing !
    - *One port or one pair of one port*
- Packet flow testing
  - FUNCTIONAL, but not PHYSICAL
  - No defect visibility
  - Requires multi-port, bridging DUT
  - Vulnerable to defect hiding
    - *1000BaseT FEC*
    - *TCP packet re-transmissions*

Specialized Ethernet PHY Test Fixtures from Scope Vendors





Gigabit Ethernet Test Signal #1 PHY Register 9 Bits 13-15



Limited Defect Resolution from Packet Flow Test

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Ethernet PHY Test Solutions from Sifos

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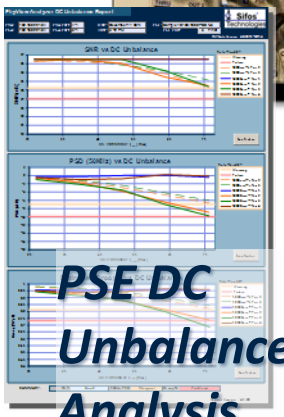
Process

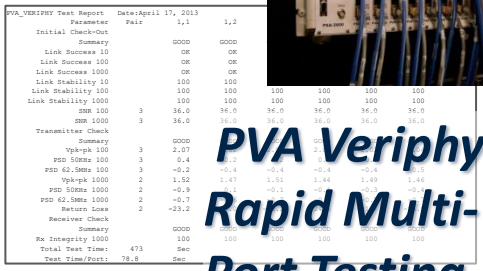
COMPLIANCE ■ SYSTEM ■ FINAL TEST

PVA Fixed Impairment Modules



PSE DC Unbalance Analysis

PHY Performance Test Suite



PVA Veriphy Rapid Multi-Port Testing

PVA-3000

2-24 Ports

PHY Test Suite

PVA-3002

2 Ports

PHY Test Suite

Task

EVALUATION ■ DESIGN ■ VALIDATION ■ MANUFACTURE

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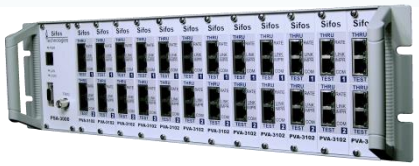
Ethernet PHY Solutions from Sifos

PVA-3000 PhyView Analyzer



PVA-3000
PhyView Analyzer

- Comprehensive **physical** layer testing that **anyone** can perform on **any product**
  - Fully automated, plug ’n play analysis
  - No scopes, fixtures, probes, generators, silicon test modes, or cable spools
  - Unique patented technology (US patent 9,203,730)
- Provides **transmitter**, **receiver**, **auto-negotiation**, and **interface** test coverage on up to 24 DUT ports (96 gigabit pairs) with single button press
  - Transmitter testing during normal linked port operation – avoids test signal “tricks”
  - Stressed receiver testing with controlled passive and active impairments
- Exposes and identifies 10/100/1000 interface defects that are hidden to or undiagnosed by ordinary packet flow testing
- Resolves marginal Ethernet ports **effortlessly** – efficient pre-screen for traditional Ethernet compliance evaluations
- Tests **anything LAN**: Active 10/100/1000BaseT interfaces, cables, service outlet quality, link components, even PoE effects like DC unbalance tolerance!

PhyView Analyzer Wins 2012 Best in Test T&M World

PVA-3002
Compact PhyView Analyzer

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Ethernet PHY Solutions from Sifos

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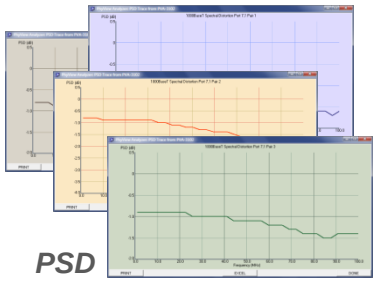
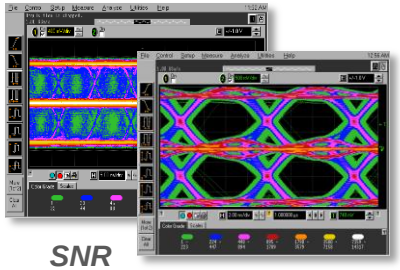
PhyView Analyzer Metrology

- Link configuration and link assessment
  - Link status and stability
  - Link partner capability / adaptability
  - Auto-negotiation and link-up timing
- Transmission measurements
  - Power spectral distortion (PSD)
  - Residual distortion (SNR)
  - Wideband transmit power level
  - Pair timing skew
- Interface measurements
  - Wideband (bulk) return loss
  - Wideband (bulk) crosstalk



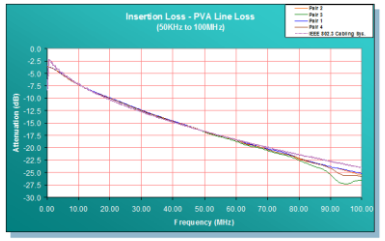
PSD Measurements Color-Coded by Pair



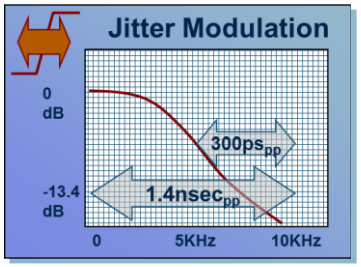
SNR Depicts Residual Distortion & Noise

PhyView Analyzer Receiver Testing

- Precisely controlled impairments
  - IEEE 802.3 maximum insertion loss
  - Alien crosstalk ingress noise
  - Programmable timing offset
  - Programmable Tx jitter impairment
  - Programmable Tx level & slew
  - Fixed mismatch impairment
- Link stability under impairment
  - Single port or multi-port DUT's
  - Gigabit remote receiver error tally
  - Link up status tally
- Packet flow under impairment
  - Layer 2 frame counting/packet loss



IEEE Worst Case Line Insertion Loss Emulation



Programmable Jitter Impairment Profile

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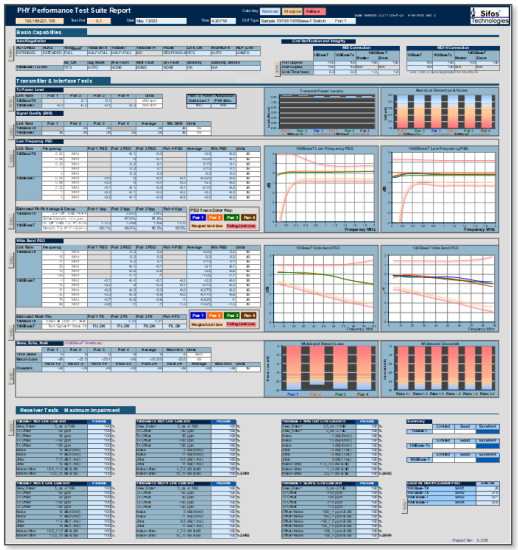
Ethernet PHY Test Solutions from Sifos

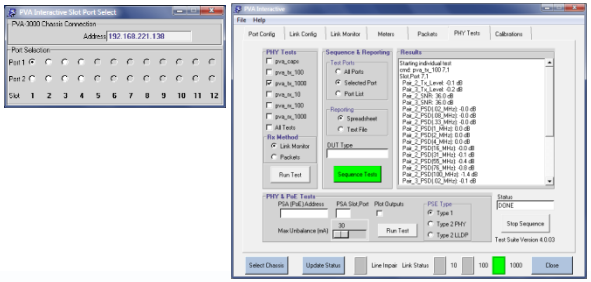
The PHY Performance Test Suite

By far…the most automated 10/100/1000BaseT PHY test…In the world.

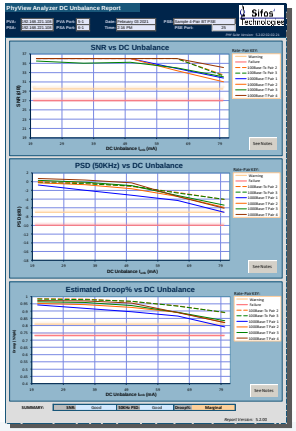
- Link-up and **Auto-Negotiation** analysis
- **Transmission**, **Interface**, and **Impaired Receiver** tests
- Automatically adaptive to DUT capabilities
  - 10/100/1000BaseT
  - MDI/MDI-X/MDI+MDI-X
  - Master/Slave/Master+Slave
- Fully sequence-able
  - 1 – 24 ports per sequence
  - User test selection
  - Just one mouse click
- **Colorful**, **informative** pop-up reporting
  - Microsoft Excel spreadsheets
  - Pass/Fail limit checking & notation
  - Graphical presentations
  - Synthesized estimations of 802.3 parameters



PHY Performance Test Report (one page per port tested)



One-Button Test Sequencing & Reporting In PVA Interactive host software



Fully Automated DC Unbalance Test for 2-Pair and 4-Pair PSE's !

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Ethernet PHY Solutions from Sifos

PVA-VeriPhy Automated Testing

- **Rapid screening** of 10/100/1000Base-T ports on multi-port devices
  - Test 1 to 6 DUT ports at a time
  - Screen 10/100/1000Base-T ports in as little as 75 seconds per port
  - Screen 10/100Base-T ports in as little as 30 seconds per port
- Evaluate **transmission**, **interface**, and **receiver performance** parameters with full automation
  - Link function and link stability testing
  - Transmission assessment: SNR, Vpk-pk, low band PSD, wideband PSD
  - Interface assessment: Wideband return loss
  - Receiver assessment: Link performance at 802.3 maximum physical impairments
- Tabular text formatted report that adapts to the link rates (10, 100, and/or 1000) and produces summary results by test
  - Develops GOOD – MARGINAL – FAIL appraisal
  - Optional user control of test parameter criteria
- **Standard feature** with all PVA-3000's and PVA-3002's

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