

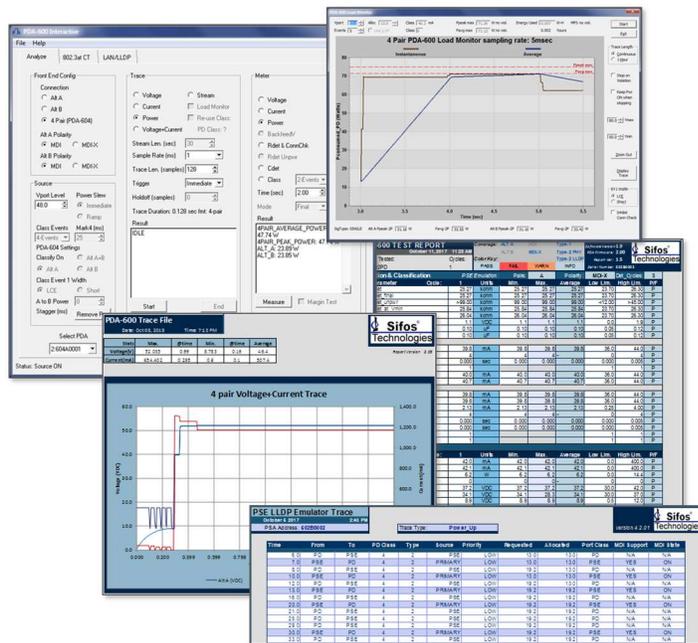


# PDA-604A

## PoE Powered Device Analyzer

IEEE 802.3bt & 802.3at Power-over-Ethernet

**PRELIMINARY**  
Product Overview



Patented  
Technology  
from Sifos

## Key Features

- ❑ 4-Pair and 2-Pair Powering and Analysis of All 802.3bt / 802.3at PD's
- ❑ Fully Configurable Classification and 802.3bt / 802.3at Power Grants
- ❑ Continuous PD Powering to >82 Watts at All PD Input Voltages
- ❑ Comprehensive Analysis of 802.3bt / 802.3at PD Performance Parameters
- ❑ Automated IEEE 802.3at\* Powered Device Conformance Testing
- ❑ Flexible 802.3at\* LLDP Emulation and LLDP Protocol Analysis
- ❑ Powerful Metering: Voltage, Current, & Power Sampling at the PD Interface
- ❑ Intuitive Graphical User Interface for Rapid Analysis and Testing
- ❑ Powerful Script Automation and Binary API Library for Microsoft Windows
- ❑ Informative Pop-Up Spreadsheet Reports and Statistics
- ❑ Plug'n Play USB Interface to Windows PC's
- ❑ LAN Port for External PD Configuration and Control During Testing

**Verification, Simplified.**

## One Box Solution

- Replaces PSE's, DC Supplies, Fixtures, Scopes, Meters, & Protocol Analyzers
- Just Plug and Test

## IEEE 802.3bt & 802.3at PD's

- Type-1 ( $\leq 13W$ ) PD's
- Type-2 ( $\leq 25.5W$ ) PD's including LLDP Power Negotiation
- Type-3 ( $\leq 51W$ ) PD's
- Type-4 ( $\leq 71.3W$ ) PD's

## Assure Full Interoperability

- Emulate 4-Pair and 2-Pair Powering
- Emulate Type-1, 2, 3, and 4 Power Grants to All PD's
- Real-Time Load Monitoring
- Automatic Static and Transient Load Limit Violation Analysis
- Automated 802.3at\* PD Conformance Testing including LLDP
- Configurable Waveform Traces Including Class, Source, Transient Triggering
- 802.3at\* LLDP Power Negotiation Protocol Verification

## Versatile Applications

- Evaluation & Design
- Quality Assurance
- Manufacturing Test
- Field Service
- Energy Standard Rating

## Verification, Simplified.

## Overview

The PDA-604A Powered Device Analyzer is a single-box comprehensive solution for testing **IEEE 802.3bt** and **802.3at** PoE Powered Devices (PD's). It offers one-button, fully automated test sequences\* and limit checking for critical Powered Device PoE characteristics. With measurements performed at the Powered Device network interface, many parameters critical to 802.3at and 802.3bt interoperability can be accurately assessed relative to specification requirements, thus fully avoiding the need for and the severe limitations associated with 802.3at/802.3bt PSE's.

### Fully Integrated, One-Box Solution

The PDA-604A removes the need for specialized instrumentation setups requiring DC power supplies, precision meters, custom test fixtures, protocol analyzers, a variety of PSE's, and custom software. The PDA-604A can be used with PDA Interactive software to perform specification compliance analyses of new PD designs and to troubleshoot PD specification compliance problems. The PDA-604A can facilitate remote configuration of PD states over the LAN while simultaneously assessing power demand and LLDP\* processing from a PD. Different PSE behaviors can readily be mimicked including detection cycling, single and multi-event classification with and without elongated first class events, class-to-power timing, and LLDP\* acknowledgement timing. The PDA-604A includes robust automation development facilities including Tcl/Tk scripting and binary API libraries. This versatility allows users to apply the PDA-604A over the full lifecycle of any Powered Device including newer, Type-3/4, IEEE 802.3bt compliant PD's.

### Superior Defect Coverage

The PDA-604A provides defect coverage far beyond what a commercial PSE or instrument grade DC power supply might offer. It provides power and performs measurements in all possible 2-pair and 4-pair connection and polarity configurations. Measurements including DC load-over-voltage, classification validity, power on-off thresholds, MPS validity, and detection characteristics are readily performed and compared to applicable specification limits. Load currents up to 1A per pairset, or 2A total, can be sourced and sensed with PD input voltages ranging from 28 to 57VDC. Sporadic transient loads can be captured with sampling resolution as granular as 200 $\mu$ sec. The PDA-604A test port can link to any PD at 10Base-T, 100Base-Tx, or 1000Base-T and it can optionally relay multi-gig links up to 10GBase-T between a PD and an external network device.

### Flexible Automated Testing of 802.3at PD's

The PDA-604A offers an optional 802.3at PD Conformance Test Suite\* and associated reporting that may be further optioned for Type-1 or Type-1 & 2 PD testing, including PoE LLDP protocol testing. This "one-button" test suite produces over 50 limit-checked PD parameters. The test suite is accessible from the PDA Interactive (GUI), from the PowerShell PD scripting environment, or from any programming language interfacing Windows DLL's. Test results are produced as colorful Microsoft Excel spreadsheets to annotate problem areas and provide multi-cycle statistics.

### Powerful Real-Time Load Monitor and Compliance Analysis

Under PDA Interactive software, the PDA-604A offers powerful real time tools for analysis of PD power draw over arbitrary periods of time under constraints of user-specified PD power grants, including both class-based and LLDP\* grants. Real time limit checking of average, peak, transient, and MPS power is performed.

### Desktop Ready Design

The PDA-604A is at home on any desktop or lab bench with USB to host PC connectivity and a cooling fan that only runs when powering PD's.

\* Future PDA-604A options will include 802.3bt Conformance Test and 802.3bt LLDP Emulations

## PDA-604A Versus a Commercial PSE

With the ready availability of commercial Power Sourcing Ethernet Switches (PSE), including low cost PSE injectors, a strong temptation exists to utilize these products to test Powered Devices. Coupled with a long spool of cable, a PSE provides a “real world” interface to a PD.

As an “interop” test strategy, this approach overlooks the wide-ranging design flexibility allowed to IEEE **802.3bt** and **802.3at** PSE’s. This attribute of the PoE standard has translated into a vast proliferation of PSE designs and configurations with widely varying tolerances of many critical PD traits. PD’s that interoperate with one or a few PSE’s may fail to properly interoperate with hundreds of other specification compliant PSE’s and cabling networks.

The reality is that PSE’s are not test instruments. A PSE cannot test critical characteristics of a PD that are vital to interoperability over all PoE networks. Even the most sophisticated PSE’s that offer some management reporting of PD classification and power draw offer no insight regarding how the PSE produces those parameters or what they might really mean.

Table 1 illustrates a variety of PD performance parameters that are critical to the broad interoperability of a PD and the respective test coverage that can be expected from a commercial PSE relative to a PDA-604A.

PD Behavior	PDA-602 Test Coverage	Commercial PSE Coverage
PD Power-Ups to Minimum / Maximum Voltages	✓	✗
Ethernet LAN Link-Up / Auto-Neg / Rate Control	✓	?
ALT-A, ALT-B, & 4-Pair Powering	✓	✗
MDI & MDI-X Powering Permutations	✓	✗
Detection Resistance – Single & Multi- Cycle	✓	?
Detection Resistance vs Voltage*	✓	✗
Detection Capacitance – Single & Multi-Cycle	✓	✗
Connection Check/Signature Validation	✓	?
Classification Signature (per Pairset)	✓	?
Classification Signature Per Class Event	✓	✗
Classification Signature vs Voltage*	✓	✗
Mark Loading	✓	✗
Inrush Loading (per PSE Type-1, 2, 3, and 4)	✓	✗
Inrush Limiting (per PSE Type-1, 2, 3, and 4)	✓	✗
Type-2/3/4 Power Delay	✓	✗
Turn-On Voltage	✓	✗
Turn-Off Voltage	✓	✗
Average Power Consumption (per Class Grant)	✓	✗
Instantaneous Peak Power Load (per Class Grant)	✓	✗
Windowed Peak Power Load (per Class Grant)	✓	✗
Classification Integrity	✓	✗
MPS – Level (per PSE Type 1, 2, 3, and 4)	✓	?
MPS – Duty Cycle (per PSE Type 1, 2, 3, and 4)	✓	?
Load Power over Voltage	✓	✗
LLDP Message Formatting	✓	?
LLDP Allocation Response Time	✓	✗
LLDP Requested Power Integrity	✓	✗

Table 1: PDA-604A versus Commercial PSE Coverage

## PDA-604A Feature Scalability

The PDA-604A is a scalable instrument for testing IEEE 802.3bt and 802.3at PD’s. This allows users to choose the best configuration at the lowest possible cost to suit their needs.

The base configuration of the PDA-604A enables both 2-Pair and 4-Pair PD powering, power-ups and metering that provide between zero and three classification events, detection measurements that include 802.3bt connection check, and highly programmable waveform captures of voltage, current, and power in 2-Pair or 4-Pair modes. This configuration supports testing of **802.3at PD’s** with PSE emulations that include both **802.3at** and **802.3bt PSE’s**.

Table 2 depicts licensed feature options for testing high power PD’s, automated test suites, and LLDP emulation and analysis. These are further described in the sections that follow Table 2.

Feature Option	Description	Features Included		Required Features
		Load Monitor (2-Pair & 4-Pair)	Class 5-8, Class 4-5D	
TYPE-3/4	<b>Type-3/4 4-Event</b> and <b>5-Event</b> Power-Ups to support Class 5-8 and Dual Class 4-5 PD’s		✓	
CT-AT	<b>802.3at Type-1/2</b> PD Automated Test Suite, Load Monitor & Streaming Traces for up to Type-4 PD’s	✓		<b>Type-3/4 for Load Mon&gt;Type-2</b>
LLDP-AT	<b>Type-1 LLDP</b> & <b>Type-2 LLDP</b> PSE Emulation & Protocol Analysis			
CT-AT + LLDP-AT	<b>Type-1, Type-2 2-Event</b> , & <b>Type-2 LLDP</b> PD Automated Test Suite, Load Monitor with “at” LLDP	✓		
CT-BT*	<b>802.3at Type-3/4</b> PD Automated Test Suite	✓	✓	<b>Type-3/4, CT-AT</b>
LLDP-BT*	<b>802.3bt Type-3/4 LLDP</b> PSE Emulation & Protocol Analysis		✓	<b>Type-3/4, LLDP-AT</b>
CT-BT + LLDP-BT*	<b>Type-3, Type-4 Multi-Event</b> , & <b>Type-3/4 LLDP</b> PD Automated Test Suite, Load Monitor with “bt” LLDP	✓	✓	<b>Type-3/4, CT-AT, LLDP-AT</b>

Table 2: PDA-604A Feature Options and Combinations. \* Future Product Feature.

## Type-3/4 PD Testing with the PDA-604A



Figure 1: 3-Event Classification

The base configuration of the PDA-604A supports 2-Pair and 4-Pair powering and discrete measurements. With the advent of the IEEE 802.3bt standard, many new PSE's will apply 4-Pair powering whether they are powering 802.3at (Type-1/Type-2) PD's or newer 802.3bt Type-3/Type-4 PD's. The PDA-604A base configuration can simulate the detection, classification, and powering characteristics of both 802.3at and 802.3bt PSE's as they interact with 802.3at (Type-1/Type-2) PD's. PD classification can be configured to 0, 1, 2, or 3-Events (see Figure 1) meaning Type-2 PD's can be granted full 25.5 watt power levels via 2-Event or 3-Event classification. Additionally, the first class event may be specified to use the 802.3bt elongated (LCE) class pulse or the "normal" 802.3at compliant class pulse.

The **Type-3/4** feature option extends the classification capability of the PDA-604A to include 4-Event and 5-Event classification required to grant power levels beyond 25.5 watts to 802.3bt compliant PD's. Under the 802.3bt standard, PD's that operate at more than 25.5 watts normally are restricted to draw less than 25.5 watts given 2-Event or 3-Event classification and less than 13 watts given 1-Event classification.



Figure 3: 4-Event Classification of a Class 6 PD

trace of voltage and current to a Class 8 PD drawing just under 1.2 amps of load current. This particular trace, triggered on the start of PD classification, is made possible by the Type-3/4 feature option.

Figure 2 shows a 4-Event classification signature measurement for a Class 6 PD and Figure 3 is a current waveform depicting a 4-Event classification sequence to a Class 6 PD. Measuring 802.3at and 802.3bt PD performance under conditions of "power demotion", that is with various classification event counts, is an essential form of interoperability testing for all Class 4 and higher PD's.

Figure 4 is a 4-Pair power-up

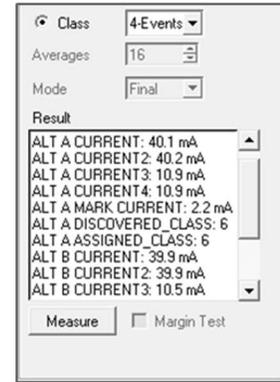


Figure 2: 4-Event Class Meter Measurement



Figure 4: Class 8 PD Power-Up V+I Waveform

## The 802.3at PD Conformance Test Suite & Load Monitor (CT-AT)

The **802.3at PD Conformance Test Suite** is a fully automated 802.3at specification compliance test suite for a PD. The test suite performs many measurements of PD interface parameters that are critical to interoperability with the full range of compliant 802.3at PSE's and connection environments. Testing can optionally be configured to run on a single quadrant (e.g. Alt-A, MDI) or on up to 4 quadrants (Alt-A and B, MDI and MDI-X). Measurements are organized into passive pre-powered parameters and powered state parameters. The test suite automatically produces color-coded Microsoft Excel spreadsheets that are organized by quadrant and test category (see Figure 5).

Test coverage is provided for Type-1 (13W) PD's and Type-2 (25.5W) PD's. Test coverage can be expanded to include Type-2 PD's responding to PoE **LLDP protocols** and PSE power grants with the addition of the **LLDP-AT Emulation and Analysis** feature described below.

### Certified for 1<sup>st</sup> Party EA Logo Testing

The 802.3at PD Conformance Test Suite is certified to support **1<sup>st</sup> party**, or in-house, Ethernet Alliance (EA) PoE logo testing. PD manufacturers seeking to perform **1<sup>st</sup> party** testing may utilize the **EA Cert Mode** available with the PD Conformance Test Suite to run fully automated testing that produces specialized EA test reports required to obtain and update PoE logo certifications for their powered devices.



One of the most critical operating parameters of a powered device is the load power consumed as the device operates in a number of states and under a number of varying conditions. In many instances, the maximum and minimum power consumption levels of a PD cannot be ascertained without over-the-network interactions. Common examples include wireless access points that consume power based on numbers and proximities of wireless users, IP cameras consuming transient power when panned or zoomed in harsh weather conditions, and IP telephones altering power consumption based on server enabling, video display states, and even network interface speed.

The CT-AT option enables a powerful **Load Monitor** (see [Figure 6](#)) offering the capability to continuously monitor instantaneous and average power consumption of a PD over long periods of time while operating conditions of the PD are manipulated. The Load Monitor is accessed from PDA Interactive software. It includes the intelligence to evaluate both static and transient power excursions that may violate 802.3at limits and ultimately cause PSE's to remove power from a PD unexpectedly. Static load power is evaluated to PD advertised physical layer classification or optionally to PD LLDP power request levels. Transient load power is automatically evaluated to peak instantaneous

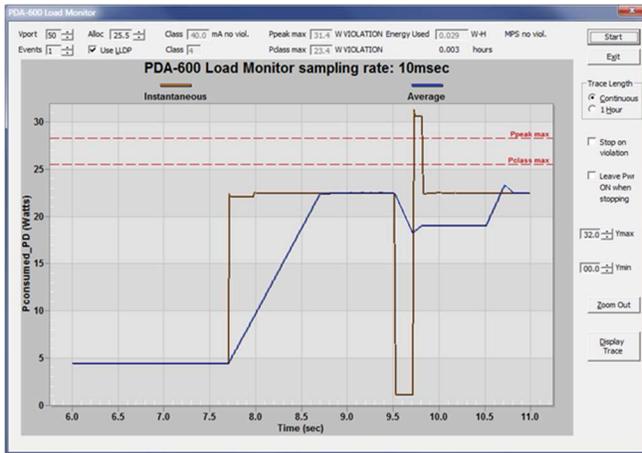


Figure 6: PDA-604A Load Monitor

A third feature of the CT-AT option is the ability to **stream long traces** of instantaneous and average power consumption into spreadsheet reports (see [Figure 7](#)) and data files for subsequent analysis. Streaming traces can collect power consumption samples with sample granularity as small as 5msec over many hours. As with the real-time Load Monitor, the streaming trace report can identify and localize power violations and also report DC MPS (low current) violations.

**Combining the Type-3/4 Feature with the CT-AT Feature**  
Because the CT-AT feature enables the **Load Monitor** and **Streaming Traces**, in combination with the **Type-3/4** feature option, the both the Load Monitor and Streaming Trace resources

PDA-600 TEST REPORT									
1/26/2016 7:15 PM					Coverage: ALT A MDH Type-1		Software Version 1.00		
Product Tested: MyClass4PD Cycles: 2					Color Key: PASS FAIL WARN INFO		PDA Firmware: 1.64 Report Ver: 1.06		
Detection & Classification					PSE Emulation: Pass		Serial Number: 6044BDC		
Parameter	Cycle: 1	2	Units	Min.	Max.	Average	Low Lim.	High Lim.	P/F
Rdnet	24.96	24.89	kohm	24.89	24.96	24.93	23.70	26.30	P
Rdnet_final	24.91	24.84	kohm	24.84	24.91	24.88	23.70	26.30	P
Rdnet_unpwr	>99.00	>99.00	kohm	99.00	99.00	99.00	<12.00	>45.00	P
Cdnet	0.09	0.09	uF	0.09	0.09	0.09	0.05	0.12	P
Cdnet_final	0.09	0.09	uF	0.09	0.09	0.09	0.05	0.12	P
1 Event Classification									
Iclass_event1	40.1	40.1	mA	40.1	40.1	40.1	36.0	44.0	P
IclassNum	4	4		4	4		0	4	P
Tclass	0.000	0.000	sec	0.000	0.000	0.000	0.000	0.005	P
ClassStability	1	1					1	1	P
2 Event Classification									
Iclass_event2	40.1	40.1	mA	40.1	40.1	40.1	36.0	44.0	P
Iclass_event2	40.1	40.2	mA	40.1	40.2	40.1	36.0	44.0	P
Mark1	0.99	0.99	mA	0.99	0.99	0.99	0.25	4.00	P
ClassNum2	4	4		4	4		0	4	P
Tclass_event1	0.000	0.000	sec	0.000	0.000	0.000	0.000	0.005	P
Tclass_event2	0.000	0.000	sec	0.000	0.000	0.000	0.000	0.005	P
ClassStability_event1	1	1					1	1	P
ClassStability_event2	1	1					1	1	P
Power-Up / Down									
Parameter	Cycle: 1	2	Units	Min.	Max.	Average	Low Lim.	High Lim.	P/F
Inrush1_1	185.6	120.3	mA	120.3	185.6	152.9	0.0	400.0	P
Inrush1_2	115.4	114.7	mA	114.7	115.4	115.0	0.0	400.0	P
Pmax_Tdelay	4.3	4.7	W	4.3	4.7	4.5	0.0	14.4	P
Inrush_delayed	0	0		0	0	0	0	0	P
Von	37.9	37.9	VDC	37.9	37.9	37.9	30.0	42.0	P
Voff	33.6	33.6	VDC	33.6	33.6	33.6	30.0	37.0	P
Vhyst	4.3	4.3	VDC	4.3	4.3	4.3	1.1	12.0	P
BackfeedV	0.0	0.0	VDC	0.0	0.0	0.0	0.0	2.8	P
ClassRecover	0	0		0	0	0	0	0	P
SisRecoverTime	0.00	0.00	sec	0.00	0.00	0.00	0.00	30.0	P
MDI Powered Type-1									
Parameter	Cycle: 1	2	Units	Min.	Max.	Average	Low Lim.	High Lim.	P/F
Mini_1	45.8	46.3	mA	45.8	46.3	46.0	0.0	253.2	P
Max1_1	117.4	117.7	mA	117.4	117.7	117.6	10.0	253.2	P
Vport_1	56.8	56.8	VDC	56.8	56.8	56.8	37.0	57.0	INFO
Ppeak_1	6.7	6.7	W	6.7	6.7	6.7	0.0	14.4	P
Pavg_1	6.5	6.4	W	6.40	6.50	6.5	0.0	13.0	P
MPSViolation_1	0	0		0	0	0	0	0	P
TcutWindowViolation_1	0	0		0	0	0	0	0	P
DutyCycleViolation_1	0	0		0	0	0	0	0	P
MDI Powered Type-2 PHY									
Parameter	Cycle: 1	2	Units	Min.	Max.	Average	Low Lim.	High Lim.	P/F
Mini_2	45.8	47.2	mA	45.8	47.2	46.5	0.0	257.8	P
Max1_2	117.7	120.0	mA	117.7	120.0	118.8	10.0	457.8	P
Vport_2	56.8	56.8	VDC	56.8	56.8	56.8	42.5	57.0	INFO
Ppeak_2	6.7	6.8	W	6.7	6.8	6.8	0.0	28.3	P
Pavg_2	6.5	6.5	W	6.5	6.5	6.5	0.0	25.5	P
MPSViolation_2	0	0		0	0	0	0	0	P
TcutWindowViolation_2	0	0		0	0	0	0	0	P
DutyCycleViolation_2	0	0		0	0	0	0	0	P
MDI Powered Type-2 LLDP									
Parameter	Cycle: 1	2	Units	Min.	Max.	Average	Low Lim.	High Lim.	P/F

Figure 5: PD Conformance Test Report

loading limits and to windowed transient limits that are enforced by PSE's. These parameters are also derived from PD advertised classification and any LLDP power requests.

The **Load Monitor** is the natural tool for developing assurance that the PD classification (and any PD LLDP power request level) is compliant with actual PD behavior under all operating conditions and for troubleshooting PD's that experience unexpected shutdowns while in service. As with the PD Conformance Test Suite, the Load Monitor can be extended to utilize PoE LLDP (for 802.3at) to acquire and set limits in accordance with PD LLDP power requests and PSE power allocations, given the **LLDP** feature option.



Figure 7: PDA-602 Streaming Trace

become available for analyzing 802.3bt Type-3 and Type-4 PD's including those drawing power to 71 watts or higher. That means that limit checking for PD average, peak, transient window, and MPS violations is available when evaluating **802.3bt Class 5-8** PD's.

In **Figure 8**, a 60 second duration streaming power trace is captured from a Class 6 PD drawing just under 50 watts continuously following various start-up transients. No power violations are flagged during this trace. In **Figure 9**, a 12 second streaming trace from a Class 7 PD is captured indicating both a peak power and a transient power window violation.



Figure 8: Streaming Power Trace from Class 6 PD



Figure 9: Streaming Power Trace from Class 7 PD

### PoE LLDP Emulation and Analysis\* with the PDA-604A (LLDP-AT)

A mandatory requirement of Type-2 PD's under the IEEE **802.3at** specification is that they support 802.3at PoE extensions to LLDP (link layer discovery) protocol. Many Type-2 PSE's do not provide 2-Event classification but instead, rely on LLDP message exchanges to learn the power demand of a Type-2 PD, then if the power is available, to grant that power demand in the form of a power allocation. This then allows the Type-2 PD to draw power levels up to the communicated power demand. It also allows the PSE to manage power budgets with 0.1 watt power precision per PSE port. Many larger (24 port and higher) managed Type-2 PSE's implement PoE LLDP in order to best utilize shared power resources and assure stable powering to all powered PD's.

With the **LLDP-AT** feature option, the PDA-604A can flexibly mimic Type-2 PSE's that deploy PoE LLDP. While emulating user-defined PSE LLDP behaviors, the PDA-604A can collect and analyze PoE LLDP protocol and report any specification violations within that protocol exchange.

Time	From	To	PD Class	Type	Source	Priority	Requested	Allocated	Port Class	MDI Support	MDI State
6.0	PSE	PD	4	2	PRIMARY	LOW	13.0	13.0	PSE	YES	ON
9.0	PD	PSE	4	2	PSE	LOW	22.3	13.0	PD	N/A	N/A
10.0	PSE	PD	4	2	PRIMARY	LOW	22.3	22.3	PSE	YES	ON
14.0	PD	PSE	4	2	PSE	LOW	22.3	22.3	PD	N/A	N/A
18.0	PD	PSE	4	2	PSE	LOW	22.3	22.3	PD	N/A	N/A
21.0	PD	PSE	4	2	PSE	LOW	22.3	22.3	PD	N/A	N/A
21.0	PSE	PD	4	2	PRIMARY	LOW	22.3	22.3	PSE	YES	ON
27.0	PD	PSE	4	2	PSE	LOW	22.3	22.3	PD	N/A	N/A
30.0	PD	PSE	4	2	PSE	LOW	22.3	22.3	PD	N/A	N/A

Figure 10: LLDP Power-Up Protocol Trace Report

Figure 10 depicts a specification-compliant LLDP exchange following the power-up of a Type-2 PD that demands 22.3W power. Figure 11 captures LLDP messaging from a PD that is slow to respond to a PSE's power allocation and therefore produces a protocol timing violation.

Time	From	To	PD Class	Type	Source	Priority	Requested	Allocated	Port Class	MDI Support	MDI State
5.0	PD	PSE	4	2	PSE	LOW	13.0	13.0	PD	N/A	N/A
9.0	PSE	PD	4	2	PRIMARY	LOW	13.0	13.0	PSE	YES	ON
10.0	PD	PSE	4	2	PSE	LOW	13.0	13.0	PD	N/A	N/A
14.0	PD	PSE	4	2	PSE	LOW	24.3	13.0	PD	N/A	N/A
18.0	PD	PSE	4	2	PSE	LOW	24.3	13.0	PD	N/A	N/A
18.0	PSE	PD	4	2	PRIMARY	LOW	24.3	24.3	PSE	YES	ON
22.0	PD	PSE	4	2	PSE	LOW	24.3	13.0	PD	N/A	N/A
25.0	PSE	PD	4	2	PRIMARY	LOW	24.3	24.3	PSE	YES	ON
27.0	PD	PSE	4	2	PSE	LOW	24.3	13.0	PD	N/A	N/A
30.0	PD	PSE	4	2	PSE	LOW	24.3	13.0	PD	N/A	N/A
34.0	PD	PSE	4	2	PSE	LOW	24.3	24.3	PD	N/A	N/A

Figure 11: LLDP Power-Up Trace – PD Timing Violations

Protocol traces such as these are easily captured and reported in colorful Excel spreadsheet reports that annotate any protocol violations or limitations. Power-Adjust protocol traces are also readily captured to analyze PD responses to delayed power grants and to PSE power throttle-back requests.

\* PoE LLDP Emulation and Analysis for 802.3bt Type-3/4 PD's will be a future license option with the PDA-604A.

Combining the **LLDP** feature option with the **CT-AT** feature option creates powerful capabilities whereby LLDP power-up negotiations become an integral part of the Load Monitor and the PD Conformance Test Suite. The Load Monitor can now respond to LLDP-supervised Type-2 power-ups and automatically adjust average and peak power limit lines according to PD Requested (and PSE Allocated) power levels (see [Figure 12](#)). This makes the Load Monitor a powerful tool for assessing PD LLDP power request levels.

Parameter	Cycle	Units	Min	Max	Average	Low Lim	High Lim	PDF
Vport Level	41.1	V	39.0	43.0	41.0	39.0	43.0	2011
Power Slow	100	ms	100	100	100	100	100	2011
Ramp	100	ms	100	100	100	100	100	2011
Class Events	5	Events	5	5	5	5	5	2011

Figure 13: Test Suite with LLDP

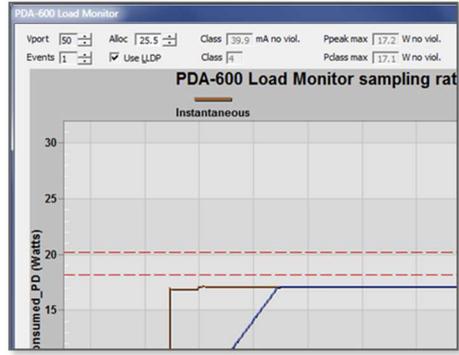


Figure 12: Link Monitor - LLDP Validation

With LLDP, the PD Conformance Test Suite adds coverage for LLDP protocol messaging and PD initial post-power-up power consumption prior to and following the LLDP negotiation (see [Figure 13](#)). As with the Type-2 feature, **LLDP\*** is an essential feature for fully evaluating Type-2 PD's to all applicable requirements.

### PDA Interactive Software

The PDA-604A is a software-managed instrument. The user interface to the instrument is host-based software running on a Windows PC. **PDA Interactive**, a component of PDA-600 software, is an intuitive graphical user interface that can access all of the key features and capabilities of the PDA-604A.

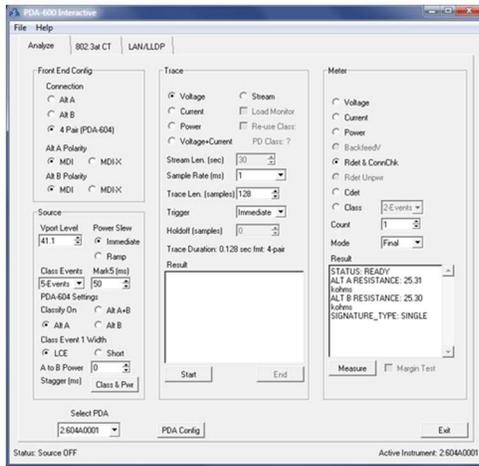


Figure 14: Analyze Menu Rdet Measurement

PDA Interactive provides three file-tabbed menus:

**Analyze:** The Analyze menu (see [Figure 14](#)) supports interactive powering, metering, and waveform trace captures. With the **CT-AT** feature option, it adds access to the Load Monitor and stream tracing features of the PDA-604A. The **Type-3/4** feature option further enhances this menu by allowing 4-Event / 5-Event power-ups and PD Class measurements (see [Figure 15](#)). In general, the Analyze menu enables intuitive methods of manually testing and analyzing many essential characteristics of a PD.

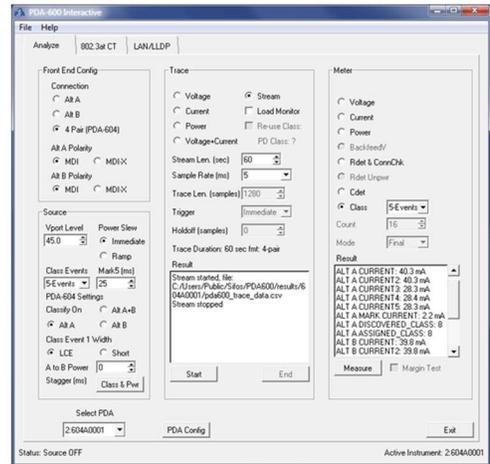


Figure 15: Analyze Menu Class Measurement

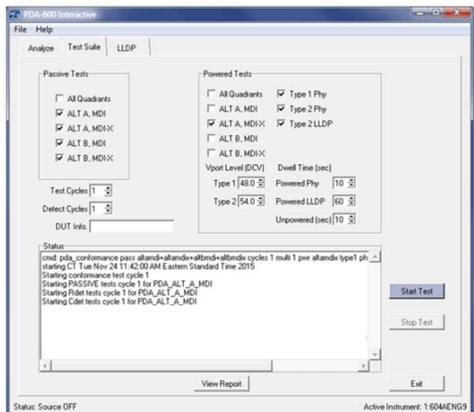


Figure 16: PDA Interactive Test Suite Menu

**Test Suite:** The Test Suite menu shown in [Figure 16](#) is available to instruments with the **CT-AT** feature option. This menu provides for configuration and control of the 802.3at PD Conformance Test Suite. Users can select quadrants (Alt-A,B and MDI,MDI-X) for both unpowered and powered state testing, source voltage levels by PD type, and test coverage options. Test coverage options include **Type-1 Phy PD**, **Type-2 Phy PD**, and **Type-2 LLDP** if the **LLDP-AT** feature option is enabled.

**LLDP:** This menu accesses the PSE LLDP emulation and LLDP protocol tracing features of a PDA-604A given that the instrument is enabled with the **LLDP-AT** feature option. PSE LLDP emulations allow configuration of PSE-controlled message fields, power (available) allocation, power grant logic, transmit period, and response delay between new PD power request values and PSE acknowledgement of those updated values. LLDP trace types include Power Up Trace for evaluation of initial PD LLDP negotiation and Power Adjust Trace for evaluating PD responses to revised PSE power allocations after power-up.

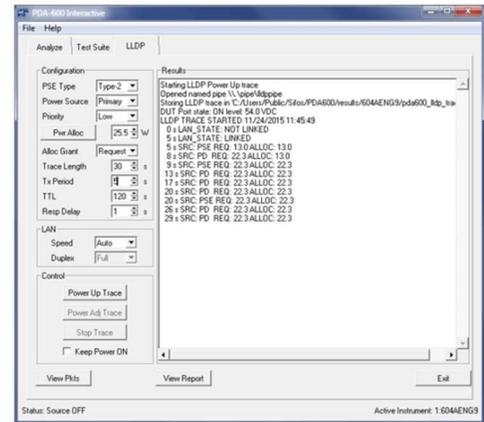


Figure 17: PDA Interactive LLDP Menu

## PowerShell PDA Software

PDA-600 software provides a robust, Tcl/Tk-based script development environment consisting of intuitive commands for configuring PDA-604A resources, performing measurements, running PD Conformance Tests, Load Monitor streams, and LLDP protocol traces. PowerShell

PDA supports interpreted, immediate execute commands and queries from a command shell with the ability to build automated test scripts using both PDA commands and the wealth of programming commands available with Tcl/Tk. Scripting and debugging dedicated, customized test scripts for volume QA or manufacturing is a very natural application for PowerShell PDA.

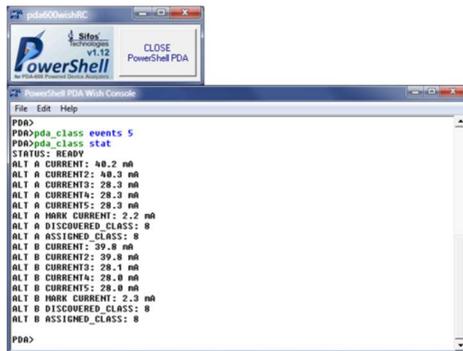


Figure 18: PowerShell PDA Wish Console

When PDA-600 software is installed, two forms of interactive command consoles are offered with corresponding desktop icons. The PowerShell PDA Wish Console in Figure 18 offers a Windows-like command shell supporting typical Windows editing operations. It also enables Tk graphical user interface commands along with Tcl and PDA-600 commands.

When PDA-600 software is installed, two forms of interactive command consoles are offered with corresponding desktop icons. The PowerShell PDA Wish Console in Figure 18 offers a Windows-like command



Figure 19: PowerShell PDA Tcl Console

The PowerShell PDA Tcl Console in Figure 19 is the Windows command prompt shell environment extended with Tcl commands and PDA-600 commands.

User written automated test scripts can run in either console, though if those scripts utilize Tk graphical user interface utilities such as message boxes, the Wish console must be used. Multiple PDA-604A instruments can be managed by scripts and commands executed in either PowerShell PDA console.

Every PDA command includes a standard convention to get help with command arguments, that is, valid argument forms and value ranges. A sampling of PowerShell PDA commands is presented in Table 3 below.

Resource Configuration	Meter Commands	Utility Commands	Application Commands
pda_alt	pda_rdet	pda_wait meas	pda_stream
pda_polarity	pda_cdet	pda_stop meas	pda_conformance
pda_source	pda_class	pda_manage trace	pda_ldp
pda_link	pda_ptrace	pda_update_fw	pda_selftest

Table 3: Sampling of PowerShell PDA Commands

## PDA-600 Application Programming Interface

PDA-600 software, including PowerShell PDA and PDA Interactive, are built on top of a binary API library that can be accessed from any programming language able to link Windows DLL's and call Win32 functions. In many cases, there is a one-to-one relationship between PowerShell PDA commands such as those in Table 3 and underlying API calls accessible to other programming languages such as Microsoft Visual Basic, National Instruments LabView, or Python scripting language.

The binary API library is documented in the **PDA-600 API Library Reference Manual** furnished with the PDA-604A.

## PDA-600 Technical Specifications

Input / Output		
Interface	Parameter	Specification
PD Port	Connections	RJ45
	PoE Signaling and Supply Modes: 2-Pair Operation	MODE A MDI, MODE A MDI-X, MODE B MDI, MODE B MDI-X
	PoE Signaling and Supply Modes: 4-Pair Operation	MODE A MDI+ MODE B MDI, MODE A MDI-X+ MODE B MDI, MODE A MDI+ MODE B MDI-X, MODE A MDI-X+ MODE B MDI-X
	Data Rates and Signaling	10/100/1000Base-T
	Impedance	100 $\Omega$ , Balanced
LAN Port	Connections	RJ45
	Modes	Active Switched (for LLDP to PD) or Passive Thru
	Data Rates and Signaling (Active Switched Mode)	10/100/1000Base-T
	Data Rates and Signaling (Passive Thru Mode)	10/100/1000/2.5G/5G/10GBase-T
	Impedance	100 $\Omega$ , Balanced
USB Port	Connections	USB Standard-B
User Interface	Type	USB 2.0 High Speed
	LED's	<b>USB:</b> Connected, host is furnishing 5VDC <b>LLDP:</b> Blinks on to indicate LLDPDU received <b>COM:</b> Blinks when I/O from host occurs <b>ALT A:</b> DC Power Applied to Alt A pairs <b>ALT B:</b> DC Power Applied to Alt B pairs

Source Specifications		
Source	Parameter	Specification
DC Supply	Output Voltage Range	28 VDC to 57 VDC
	Voltage Accuracy (50mA load)	$\pm$ (0.75% + 60 mV)
	Voltage Resolution	0.1 Volt
	Source Resistance (typical)	1.6 $\Omega$
	Maximum Continuous Source Current	1000 mA per Pairset, 2000mA total
PD Detection Resistance	Method	$\Delta V / \Delta I$
	Probing Voltage (typical)	4.4 V – 8.8 V
	Probing Range (Margin Test)	2.7 V - 10.1 V
PD Detection Capacitance	Method	Slew Time
	Probing Voltage (typical)	~4 V – 8 V
PD Classification	Modes	Standard: 1-Event or 2-Event Type-3/4 License: 3-Event, 4-Event, and 5-Event
	First Event Duration	Selectable: T <sub>LCE</sub> 100 msec or T <sub>CEV</sub> 30 msec
	Classification Probing Voltage (typical)	~17.5 V
	Classification Probing Voltage (margin test)	14.5 V, 20.5 V
	Classification Probing Event Duration (typical)	30 msec
	Mark Region Voltage (typical, $\leq$ 6mA load)	7- 9 V
Mark Region Duration (typical)	Mark 1 through 2, 3, or 4: 10 msec each Final Mark: Selectable, 25 to 375 msec	

Measurement Specifications		
Measurement	Parameter	Specification
Detection Resistance (per pairset)	Range	3 K $\Omega$ to 50 K $\Omega$
	Accuracy (19 K $\Omega$ to 26.5 K $\Omega$ , Probing 4.4-8.8V)	$\pm$ 1%
	Accuracy (Full Range, Probing 4.4-8.8V)	$\pm$ 2.5%

Measurement Specifications		
Measurement	Parameter	Specification
Connection Check	Outcomes	SINGLE or DUAL or INVALID PD
	Expected PD Signature for VALID result	21 K $\Omega$ to 28 K $\Omega$ on each pairset
Detection Capacitance (per pairset)	Range	50nF-10 $\mu$ F
	Accuracy (0.05..2 $\mu$ F)	$\pm$ (2.5% + 6 nF)
	Accuracy (2.1..10 $\mu$ F)	$\pm$ (10% + 6 nF)
Classification (per pairset)	Classification Range	0 mA to 50 mA
	Classification Accuracy (1..15 mA @ ~17.5V)	$\pm$ (2.5% + 600 $\mu$ A)
	Classification Accuracy (16..50 mA @ ~17.5V)	$\pm$ (1.5% + 400 $\mu$ A)
	Events Measured	Selectable, 1 to 2 (standard), 3-5 with Type-3/4 license
	Mark Region Range	0.5 to 5 mA
	Mark Region Accuracy	$\pm$ (2% + 100 $\mu$ A)
Power	Range	0 to 56 Watts per pairset, 0 to 112 Watts 4-Pair
	Resolution	0.01 W per pairset, 0.02 W 4-Pair
	Accuracy	$\pm$ (2.0% + 0.1 W) per pairset, $\pm$ (2.0% + 0.2 W) 4-Pair
Load Current	Range	0 to 1000 mA per pairset, 0 to 2000 mA 4-Pair
	Resolution	0.1 mA, 0.2mA 4-Pair
	Accuracy (1..15 mA)	$\pm$ (2.0% + 600 $\mu$ A) per pairset, $\pm$ (2.0% + 1.2mA) 4-Pair
	Accuracy (16..50 mA)	$\pm$ (1.85% + 600 $\mu$ A) per pairset, $\pm$ (1.85% + 1.2mA) 4-Pair
	Accuracy (51..100 mA)	$\pm$ (1.0% + 500 $\mu$ A) per pairset, $\pm$ (1.0% + 1.0mA) 4-Pair
	Accuracy (101..1000 mA)	$\pm$ (0.75% + 800 $\mu$ A) per pairset, $\pm$ (0.75% + 1.6mA) 4-Pair
Port Voltage, Backfeed Voltage with 2-Pair Powering	Range	0 VDC to 57 VDC
	Resolution	0.1 V
	Accuracy	$\pm$ (0.75% + 100 mV) per pairset, $\pm$ (0.75% + 200 mV) 4-Pair
Backfeed Voltage with 3-Pair Powering	Range	TBD
	Resolution	TBD
	Accuracy	TBD
Trace	Types	Voltage, Current, Power, Voltage & Current (V+I)
	Trigger Modes	<b>Immediate, Class</b> (leading edge of first event), <b>Source</b> (ON or OFF transition), <b>Transient</b> (Current or Power) with Selectable (2-Pair) Threshold and Selectable Pre-Trigger Sample Count
	Sample Rate – 2-Pair Traces (Immediate, Class, Source triggered traces)	0.05 – 20 msec / sample (1-2-5 pattern) Voltage, Current also support 0.025 msec/sample
	Sample Rate – 4-Pair Traces (Immediate, Class, Source triggered traces)	1 – 20 msec / sample (1-2-5 pattern)
	Trace Length (Voltage, Current) – 2-Pair Traces	Selectable up to 5120 points
	Trace Length (Voltage, Current) – 4-Pair Traces	Selectable up to 2560 points
	Trace Length (Power, V+I) – 2-Pair Traces	Selectable up to 2560 points
	Trace Length (Power, V+I) – 4-Pair Traces	Selectable up to 1280 points
	Sample Rate – 2-Pair & 4-Pair Transient Triggered Traces	1 – 20 msec / sample (1-2-5 pattern)
	Trace Length – Transient triggered traces	Indefinite – Runs until specified <b>2-Pair</b> current or power condition occurs. In 4-Pair mode, both pairsets are monitored for the 2-Pair current or power condition.
	Trace Trigger Hold-off: Supported Triggers	Class, Source
	Trace Trigger Hold-off – 2-Pair Traces	0 to 65535 samples
	Trace Trigger Hold-off – 4-Pair Traces	0 to 32768 samples
Streaming Trace (2-Pair & 4-Pair modes)	Parameters Included	Voltage, Current, Instantaneous Power, Avg. Power
	Sample Rate	5 msec or 10 msec
	Trace Length (5 msec period)	$\leq$ 1048400 samples ( $\leq$ 5242 seconds)

LLDP (802.3at TLV's)		
Interface	Parameter	Specification
PD Port (with LLDP-AT feature license)	Receive	In-board Ethernet switch is configured to filter for LLDPDUs. Normally parsed to extract the IEEE 802.3at conformant Power-via-MDI TLV; entire raw frame is available for analysis.
	Transmit	LLDPDU containing an IEEE 802.3at conformant Power-via-MDI TLV with programmatically controlled alloc value.
	Trace	Continuous (once started by the user), stores and optionally displays Power-via-MDI TLV content.
LAN Port	No LLDP support.	

LLDP (802.3bt TLV's)		
Interface	Parameter	Specification
PD Port (with LLDP-BT feature license)	Receive	(TBD – Not yet available)
	Transmit	(TBD – Not yet available)
	Trace	(TBD – Not yet available)

Physical and Environment		
Measurement	Parameter	Specification
Physical	Width	7.5"
	Height	3.0"
	Depth	10.0"
	Weight	3.2 lbs
	Power	100VAC – 240VAC, 50-60 Hz, 1.3A Max.
Environmental	Operating Temperature	0°C to 40°C
	Storage Temperature	-20°C to 85°C
	Operating Humidity	5% to 95% RH, Non-Condensing
	Altitude	2000 Meters
	Pollution Degree	2

Certifications	
Category	Specification
Safety	CSA Listed (CSA22.2 No. 61010)
	EN61010-1 (Test & Measurement Equipment Safety Standard)
Emissions	FCC Part 15, Class A (Industrial Equipment emissions, USA)
	EN55011 (Industrial, Scientific Equipment RF emissions, Europe)
	VCCI (Information Technology Equipment emissions, Japan)
	AS/NZS 3548 (Information Technology Equipment emissions, Australia/N.Z.)
European Commission	Low Voltage Directive (2014/35/EU)
	Electromagnetic Compatibility Directive (2014/30/EU)
	CE Marking Directive (93/68/EEC)
Patents	U.S. Patent 10,060,965

## Ordering Information

<b>PDA-604A</b>	PDA-604A Instrument for 2-Pair Type-1 & Type-2 PD Analysis Including PDA-600 Software
<b>PDA-604-CT-AT</b>	License for Automated <b>802.3at</b> PD Conformance Test Suite and Load Monitor applicable to Type-1 (up to 13W) and Type-2 (up to 25.5W) PD's
<b>PDA-LLDP-AT</b>	License for 802.3at (Type-2) PD Powering and Analysis Using 802.3at LLDP.
<b>PDA-Type3/4*</b>	License for 802.3bt Type-3 (51W) and Type-4 (71.3W) PD Powering and Analysis Using 4-Event and 5-Event Classification
<b>PDA-604-CT-BT*</b>	License for Automated <b>802.3bt</b> PD Conformance Test Suite and Load Monitor applicable to Type-3 (up to 51W) and Type-4 (up to 71.3W) PD's
<b>PDA-LLDP-BT*</b>	License for 802.3bt (Type-3/4) PD Powering and Analysis Using 802.3bt LLDP.
<b>RACKKIT-PDA</b>	Rack Mount Kit for PDA-600 Instruments (see below)
<b>CASE-PDA</b>	Carrying Case for PDA-600 Instruments (see below)

\* Feature license not yet available

Accessories Included with PDA-604A:

- PDA-600 Reference Manual
- PDA-600 Software (CD)
- USB Cable
- Power Cord



Carrying Case for PDA-600



Rack Mount Kit for PDA-600

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