PDA-602B

PoE Powered Device Analyzer

IEEE 802.3at Power-over-Ethernet

Product Overview

Key Features

- ❑ **Automated IEEE 802.3at Powered Device Conformance Testing**
- ❑ **Comprehensive Analysis of Critical PD Performance Parameters**
- ❑ **Flexible 802.3at LLDP Emulation and Analysis**
- ❑ **Powerful Metering: Voltage, Current, & Power Sampling at the PD Interface**
- ❑ **Flexible Emulation of PSE Behaviors and Configurations**
- ❑ **Intuitive Graphical User Interface for Rapid Analysis and Testing**
- ❑ **Powerful Script Automation and Binary API Library for Microsoft Windows**
- ❑ **2-Pair Power Sourcing Exceeding 30W at All PD Input Voltages**
- ❑ **Informative Pop-Up Spreadsheet Reports and Statistics**
- ❑ **Plug'n Play USB Interface to Windows PC's**
- ❑ **LAN Port for External PD Configuration and Control**

Verification, Simplified.

One Box Solution

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

IEEE 802.3at PD's

- **Type-1 (≤ 13W) PD's**
- **Type-2 (≤ 25.5W) PD's including LLDP Power Negotiation**

Assure Maximum Interoperability

- **Automated PD Conformance Testing including LLDP**
- **Real-Time Load Monitoring & Recording including LLDP Power Grants**
- **Automatic Static and Transient Load Limit Violation Analysis**
- **Configurable Waveform Traces with Class, Source, Transient Triggering**
- **LLDP Power Negotiation & Protocol Verification**

Versatile Applications

- **Evaluation & Design**
- **Quality Assurance**
- **Manufacturing Test**
- **EA Certification Testing**
- **Field Service**
- **Energy Standard Rating**

Verification, Simplified.

Overview

The PDA-602B Powered Device Analyzer is a single-box comprehensive solution for testing **IEEE 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 PSE interoperation can be accurately assessed relative to specification requirements, thus fully avoiding the severe deficiencies associated with using 802.3at/802.3bt PSE's for PD testing.

Fully Integrated, One-Box Solution

The PDA-602B 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-602B is used with PDA Interactive software to perform specification compliance analyses of new PD designs and to troubleshoot PD specification compliance problems. The PDA-602B facilitates remote configuration of PD states over the LAN while simultaneously assessing power demand and LLDP processing from a PD. Different PSE behaviors are readily mimicked including detection cycling, single and multi-event classification up to three events, class-to-power timing, and LLDP acknowledgement timing. The PDA-602B includes robust automation development tools including Tcl/Tk scripting and binary API libraries. This versatility allows users to apply the PDA-602B over the full lifecycle of any Powered Device including newer, Type-2, IEEE 802.3at compliant PD's.

Superior Defect Coverage

The PDA-602B 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 connection and polarity configurations. Measurements including DC load versus 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 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 200μsec. The PDA-602B test port links to any PD at 10Base-T, 100Base-Tx, or 1000Base-T link rates.

Flexible Automated Testing of 802.3at PD's

The PDA-602B 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 suite is hosted on a Windows PC and is accessible from PDA Interactive (GUI) software, from the PowerShell PD scripting environment, or from any programming language interfacing Windows DLL's. Test results are automatically captured to informative Microsoft Excel spreadsheet reports that annotate problem areas and provide multi-unit statistics. The 802.3at PD Conformance Test Suite is approved for performing comprehensive EA Gen1 PoE Logo Certification testing in-house.

EA Certified™

Powerful Real-Time Load Monitor and Compliance Analysis

Under PDA Interactive software, the PDA-602B offers powerful real time tools for analysis of PD power draw over arbitrary periods of time to enable limit checking of static and transient PD power-loads relative to PD Class or LLDP-established powering limits. PD's may be remotely configured and controlled while the Load Monitor charts and presents data as well as any limit violations.

Desktop Ready Design

The PDA-602B 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.

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PDA-602B 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 **802.3at** 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-602B.

PD Behavior	PDA-602 Test Coverage	Commercial PSE Coverage
PD Power-Up	✓	✓
Ethernet LAN Link-Up - Auto	✓	✓
ALT-A & ALT-B Powering	✓	✗
MDI & MDI-X Powering	✓	✗
Detection Resistance – Single Cycle	✓	?
Detection Resistance – Repeated Cycles	✓	?
Detection Resistance vs Voltage*	✓	✗
Detection Capacitance – Single Cycle	✓	✗
Detection Capacitance - Repeated Cycles	✓	✗
Classification Signature	✓	?
Classification Signature vs Voltage*	✓	✗
Inrush Loading	✓	✗
Inrush Limiting	✓	✗
Type-2 Power Delay	✓	✗
Turn-On Voltage	✓	✗
Turn-Off Voltage	✓	✗
Average Power Consumption	✓	✗
Instantaneous Peak Power Load	✓	✗
Windowed Peak Power Load	✓	✗
Classification Integrity	✓	✗
Maintain Power Signature - Level	✓	?
Maintain Power Signature – Duty Cycle	✓	?
Load Power over Voltage	✓	✗
Ethernet LAN Link-Up by Rate	✓	✗
LLDP Message Formatting	✓	?
LLDP Allocation Response Time	✓	✗
LLDP Requested Power Integrity	✓	✗

**Not supported on PDA-602A*

Table 1: PDA-602B versus Commercial PSE Coverage

PDA-602B Feature Scalability

The PDA-602B is a scalable instrument for testing IEEE 802.3at PD's. This allows users to choose the best configuration at the lowest possible cost to suit their PD testing requirements.

The base configuration of the PDA-602B enables emulation of Type-1 PSE's, including zero and one-event classification, and measurements including discrete meters and sampled waveforms of PD interface parameters. The entry level configuration is ideal for rapid inspection and automated production testing of Type-1 PD's.

Table 2 depicts three optional feature licenses, **CT-AT**, **Type-2**, and **LLDP-AT**, that can be combined into five additional configurations of a PDA-602B. These are further described in the sections that follow Table 2.

Feature Option	Description	Features Included		
		Load Monitor	2-Event Class	PoE LLDP
CT-AT	**Type-1** (13W) 802.3at PD Automated Test Suite + **Type-1** Load Monitor + Streaming Traces	✓		
Type-2	**Type-2** (25.5W) **2-Event** 802.3at PD Power-Ups		✓	
CT-AT + **Type-2**	**Type-1** & **Type-2 2-Event** 802.3at PD Automated Test Suite, Load Monitor, & Streaming Traces	✓	✓	
Type-2 + **LLDP-AT***	**Type-2 2-Event** Power-Ups **Type-1 LLDP** & **Type-2 LLDP** PSE Emulation & Protocol Analysis		✓	✓
CT-AT + **Type-2** + **LLDP-AT***	**Type-1**, **Type-2 2-Event**, & **Type-2 LLDP** PD Automated Test Suite, Load Monitor, & Streaming Traces **Type-2 2-Event** Power-Ups **Type-1 LLDP** & **Type-2 LLDP** PSE Emulation & Protocol Analysis	✓	✓	✓

Table 2: PDA-602B Optional Feature Licenses and Option Combinations

***** **LLDP-AT** requires **Type-2** feature option

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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 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 1*).

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

Certified for 1st Party Gen1 EA Logo Testing

The 802.3at PD Conformance Test Suite is certified to support **1st party**, or **in-house**, Ethernet Alliance (EA) PoE logo testing under the EA Gen 1 program. The EA PoE Logo mark assures end customers that PD's will interoperate safely and effectively with any certified, specification compliant PSE in all possible cable and connection environments. In-house testing allows PD developers to push their designs into all possible operational states and loading conditions while running the tests.

EA Certified™

PDA-600 AT TEST REPORT
December 2, 2021 12:57 PM
Product Tested:
Sample Class 4 PD
Cycles: 1
Coverage: ALT A, ALT B, MDI, MDI-X, Type-1, Type-2 PHY, Type-2 LLDP
Color Key: PASS, FAIL, WARN, INFO
Software Version 2.3.0.2
PDA Firmware 2.08
Report Ver: 2.10
Serial Number 602A0001
Sifos Technologies

Detection & Classification — PSE Emulation: Pairs: A Polarity: MDI-X Det_Cycles: 3

Parameter	Cycle: 1	Units	Min.	Max.	Average	Low Lim.	High Lim.	P/F
Rdet	25.33	kohm	25.33	25.33	25.33	23.70	26.30	P
Rdet_final	25.41	kohm	25.41	25.41	25.41	23.70	26.30	P
Rdet_unpwr	>99.00	kohm	99.00	99.00	99.00	<12.00	>45.00	P
Rdet_at_Vmin	25.13	kohm	25.13	25.13	25.13	23.70	26.30	P
Rdet_at_Vmax	25.44	kohm	25.44	25.44	25.44	23.70	26.30	P
Rdet_Voffset	1.0	VDC	1.0	1.0	1.0	0.0	1.9	P
Cdet	0.10	uF	0.10	0.10	0.10	0.05	0.12	P
Cdet_final	0.10	uF	0.10	0.10	0.10	0.05	0.12	P
1 Event Classification								
Iclass	40.1	mA	40.1	40.1	40.1	36.0	44.0	P
ClassNum	4		4	4	-	0	4	P
Tclass	0.0005	sec	0.0005	0.0005	0.0005	0.0005	0.0050	P
ClassStability	1					1	1	P
Iclass_at_Vmin	38.6	mA	38.6	38.6	38.6	36.0	44.0	P
Iclass_at_Vmax	40.4	mA	40.4	40.4	40.4	36.0	44.0	P
2 Event Classification								
Iclass_event1	40.1	mA	40.1	40.1	40.1	36.0	44.0	P
Iclass_event2	40.1	mA	40.1	40.1	40.1	36.0	44.0	P
Mark1	2.14	mA	2.14	2.14	2.14	0.25	4.00	P
ClassNum2	4		4	4	-	0	4	P
Tclass_event1	0.0005	sec	0.0005	0.0005	0.0005	0.0005	0.0050	P
Tclass_event2	0.0005	sec	0.0005	0.0005	0.0005	0.0005	0.0050	P
ClassStability_event1	1					1	1	P
ClassStability_event2	1					1	1	P

Power-Up / Down

Parameter	Cycle: 1	Units	Min.	Max.	Average	Low Lim.	High Lim.	P/F
Inrush1_1	389.1	mA	417.1	417.1	417.1	0.0	400.0	P
Inrush1_2	389.7	mA	416.7	416.7	416.7	0.0	400.0	P
IlimMinViolation	0		0	0	-	0	0	P
Pmax_Tdelay	2.3	W	2.3	2.3	2.3	0.0	14.4	P
Inrush_delayed	0		1	1	-	0	0	P
Von	37.0	VDC	37.0	37.0	37.0	30.0	42.0	P
Voff	33.7	VDC	33.7	33.7	33.7	30.0	42.0	P
Vhyst	3.3	VDC	3.3	3.3	3.3	2.8	12.0	INFO
BackfeedV	0.0	VDC	0.0	0.0	0.0	0.0	2.8	P
ClassRecover	0		0	0	-	0	0	P
SigRecoverTime	0.0	sec	0.0	0.0	0.0	0.0	30.0	P

MDI Powered Type-1 — PSE Emulation: On Time: 20 sec Off Time: 10 sec Vport: 56.0

Parameter	Cycle: 1	Units	Min.	Max.	Average	Low Lim.	High Lim.	P/F
Mint_1	40.5	mA	40.5	40.5	40.5	0.0	258.5	P
Maxt_1	245.0	mA	245.0	245.0	245.0	10.0	258.5	P
Vport_1	55.7	VDC	55.7	55.7	55.7	37.0	57.0	INFO
Ppeak_1	13.65	W	13.65	13.65	13.65	0.0	14.4	P
Pavg_1	12.22	W	12.22	12.22	12.22	0.0	13.0	P
MPSViolation_1	0		0	0	-	0	0	P
TcutWindowViolation_1	0		0	0	-	0	0	P
DutyCycleViolation_1	0		0	0	-	0	0	P

MDI Powered Type-2 PHY — PSE Emulation: On Time: 20 sec Off Time: 10 sec Vport: 43.5

Parameter	Cycle: 1	Units	Min.	Max.	Average	Low Lim.	High Lim.	P/F
Mint_2	39.8	mA	39.8	39.8	39.8	0.0	662.5	P
Maxt_2	638.2	mA	638.2	638.2	638.2	10.0	662.5	P
Vport_2	42.7	VDC	42.7	42.7	42.7	42.5	57.0	INFO
Ppeak_2	27.25	W	27.25	27.25	27.25	0.0	28.3	P
Pavg_2	24.46	W	24.46	24.46	24.46	0.0	25.5	P
MPSViolation_2	0		0	0	-	0	0	P
TcutWindowViolation_2	0		0	0	-	0	0	P
DutyCycleViolation_2	0		0	0	-	0	0	P

MDI Powered Type-2 LLDP — PSE Emulation: On Time: -1 sec Off Time: 10 sec Vport: -1.0

Parameter	Cycle: 1	Units	Min.	Max.	Average	Low Lim.	High Lim.	P/F

NOTE: *Type-2 testing did not include LLDP, so PD Data Link Layer characteristics were not checked.*

Figure 1: PD Conformance Test Report

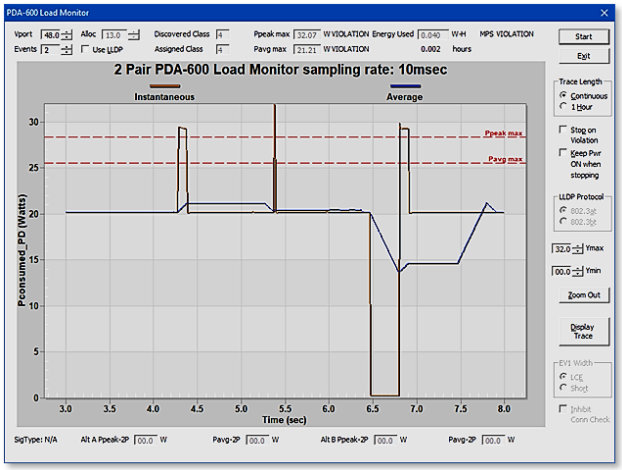

Figure 2: PDA-602B Load Monitor

Load Monitor & Stream Traces

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 optional **CT-AT** license enables a powerful **Load Monitor** (*see Figure 2*) 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 loading limits and to windowed transient limits that are enforced by PSE's. These too are derived from PD advertised classification and any LLDP power requests.

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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 Type-2 PD power monitoring with the **Type-2** feature option and further extended with the **LLDP** feature option to utilize PoE LLDP to acquire and set limits in accordance with LLDP power requests and allocations.

Also included with the **CT-AT** license is the ability to **stream long traces** of instantaneous and average power consumption into spreadsheet reports and data files for subsequent analysis (*see Figure 3*). Streaming traces collect power consumption samples with sample timing as small as 5msec over many hours. As with the real-time Load Monitor, streaming trace report s identify and localize power consumption violations including DC MPS (low current) violations.

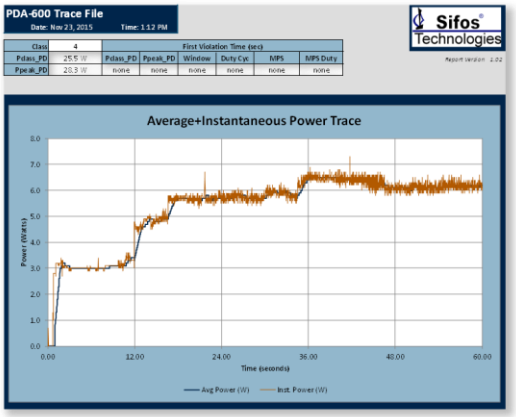


Figure 3: PDA-602 Streaming Trace

Type-2 PD Testing with the PDA-602B (Type-2)

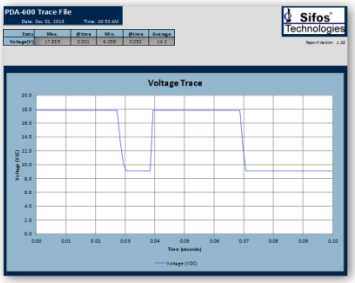


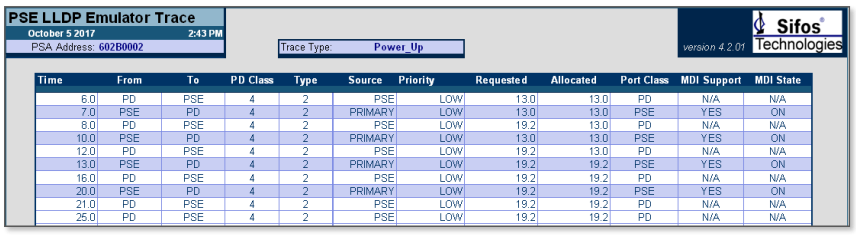
Figure 4: 2-Event Classification

Type-2 IEEE 802.3at compliant PD's must be backward compatible with Type-1 PSE's. This means they must be able to operate indefinitely with power consumption of 13W or below. In order to draw power up to 25.5W, a Type-2 PD must receive "permission" from a Type-2 PSE. That permission comes in one of two forms: 2-Event Classification immediately prior to power-up or PoE LLDP protocol exchanges at some time after power-up.

With the optional **Type-2** license, the PDA-602B can be provisioned to offer 2-Event classifications preceding application of power to a PD (*see Figure 4*). This in turn allows the Type-2 PD to draw its full power almost immediately after receiving power. This feature is essential for testing Type-2 PD's.

PoE LLDP Emulation and Analysis with the PDA-602B (LLDP-AT)

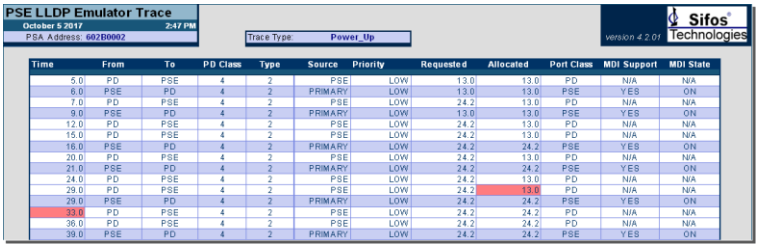
Another requirement of Type-2 PD's under the IEEE 802.3at specification is support of 802.3at PoE extensions to LLDP (link layer discovery) protocol. Many Type-2 PSE's do not provide 2-Event classification but instead, rely on LLDP message exchanges to learn the power demand of a Type-2 PD, then if the 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.



Time	From	To	PD Class	Type	Source	Priority	Requested	Allocated	Port Class	MDI Support	MDI State
6.0	PD	PSE	4	2	PSE	LOW	13.0	13.0	PD	N/A	N/A
7.0	PSE	PD	4	2	PRIMARY	LOW	13.0	13.0	PSE	YES	ON
8.0	PD	PSE	4	2	PSE	LOW	19.2	13.0	PD	N/A	N/A
10.0	PSE	PD	4	2	PRIMARY	LOW	13.0	13.0	PSE	YES	ON
12.0	PD	PSE	4	2	PSE	LOW	19.2	13.0	PD	N/A	N/A
13.0	PSE	PD	4	2	PRIMARY	LOW	19.2	19.2	PSE	YES	ON
16.0	PD	PSE	4	2	PSE	LOW	19.2	19.2	PD	N/A	N/A
20.0	PSE	PD	4	2	PRIMARY	LOW	19.2	19.2	PSE	YES	ON
21.0	PD	PSE	4	2	PSE	LOW	19.2	19.2	PD	N/A	N/A
25.0	PD	PSE	4	2	PSE	LOW	19.2	19.2	PD	N/A	N/A

Figure 5: LLDP Power-Up Protocol Trace Report

With the optional **LLDP-AT** license, the PDA-602B can flexibly mimic Type-2 PSE's that deploy PoE LLDP. While emulating user-defined PSE LLDP behaviors, the PDA-602B collects and analyzes PoE LLDP protocol and reports any specification violations within that protocol exchange. Figure 5 depicts a specification-compliant LLDP exchange following the power-up of a Type-2 PD that demands 22.3W power. Figure 6 captures LLDP messaging from a PD that is slow to respond to a PSE's power allocation and 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
6.0	PSE	PD	4	2	PRIMARY	LOW	13.0	13.0	PSE	YES	ON
7.0	PD	PSE	4	2	PSE	LOW	24.2	13.0	PD	N/A	N/A
9.0	PSE	PD	4	2	PRIMARY	LOW	13.0	13.0	PSE	YES	ON
12.0	PD	PSE	4	2	PSE	LOW	24.2	13.0	PD	N/A	N/A
15.0	PD	PSE	4	2	PSE	LOW	24.2	13.0	PD	N/A	N/A
16.0	PSE	PD	4	2	PRIMARY	LOW	24.2	24.2	PSE	YES	ON
20.0	PD	PSE	4	2	PSE	LOW	24.2	13.0	PD	N/A	N/A
21.0	PSE	PD	4	2	PRIMARY	LOW	24.2	24.2	PSE	YES	ON
24.0	PD	PSE	4	2	PSE	LOW	24.2	13.0	PD	N/A	N/A
29.0	PD	PSE	4	2	PSE	LOW	24.2	13.0	PD	N/A	N/A
29.0	PSE	PD	4	2	PRIMARY	LOW	24.2	24.2	PSE	YES	ON
33.0	PD	PSE	4	2	PSE	LOW	24.2	24.2	PD	N/A	N/A
36.0	PD	PSE	4	2	PSE	LOW	24.2	24.2	PD	N/A	N/A
39.0	PSE	PD	4	2	PRIMARY	LOW	24.2	24.2	PSE	YES	ON

Figure 6: LLDP Power-Up Trace – PD Timing Violations

Protocol traces 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.

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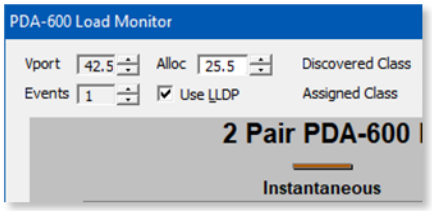

Figure 7: Link Monitor - LLDP Validation

Combining the **LLDP** license with the **CT-AT** license 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 respond to LLDP-supervised Type-2 power-ups and automatically adjust average and peak power limits according to LLDP allocated power levels (*see Figure 7*). The Load Monitor then becomes a powerful tool for assessing and tuning PD LLDP power requests.

With LLDP, the PD Conformance Test Suite adds coverage for LLDP protocols and PD initial power consumption prior to and following the LLDP negotiation (*see Figure 8*). As with the Type-2 feature, **LLDP-AT*** is an essential feature for evaluating Type-2 PD's to all applicable requirements.

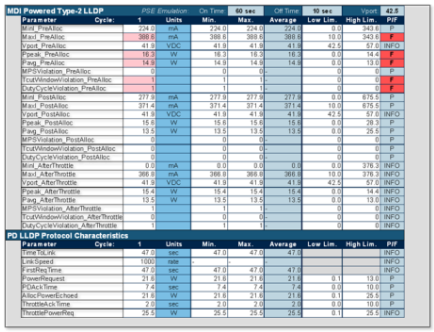

Figure 8: Test Suite with LLDP

PDA Interactive Software

The PDA-602B 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-602B.

PDA Interactive provides several file-tabbed menus:

PSE/PD (*Figure 9*): This menu serves three purposes:

1. Describe characteristics (and limitations) of a "test PSE" that will power and perform measurements on the PD-under-test. Characteristics include powered pairset, polarity, power capacity (15W or 30W), and input voltage to the PD when powered.
2. Discover characteristics, namely general PD signature qualification and PD classification, of the connected PD-under-test.
3. Perform PD detection and classification signature parametric measurements.

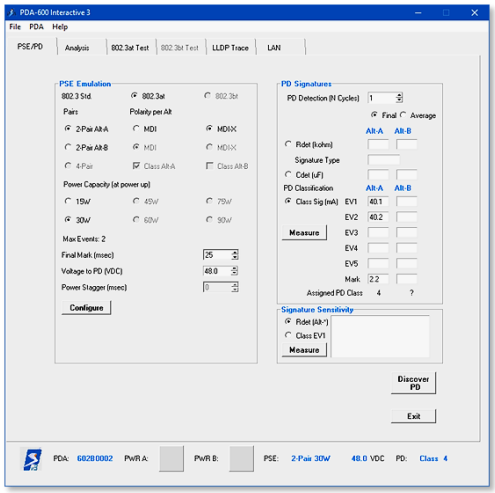

Figure 9: PDA Interactive PSE/PD Menu

In general, the emulated "test PSE" and the basic PD characteristics must be established in advance of any manual testing and troubleshooting supported by other tab menus.

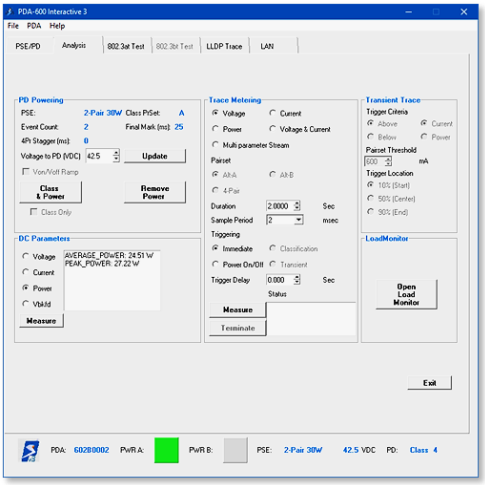

Figure 10: PDA Interactive Analysis Menu

Analysis (*Figure 10*): The Analysis tab menu supports manual application and removal of power to the PD, powered DC parameter measurements, (waveform) trace metering measurements, and access to the Load Monitor.

Manual PD powering always involves a PD classification as required to communicate any power draw grants or limitations to the PD. PD input voltage can be configured anywhere between 28V and 57V and may be revised after powering. A special Von/Voff ramp powering mode enables analyses of PD turn-on and turn-off voltage levels.

DC Parameters are simple one-click meter measurements of voltage, current draw, average/peak power draw, and backfeed voltage.

A powerful set of trace metering resources enables flexible capture and analysis of waveforms depicting PD input voltage, PD current draw, PD power draw, and combined voltage and current. Sample resolution (period) and trace durations are highly configurable. Traces may be immediate triggered, triggered at start of PD classification, PD power-up, or PD power-down. A special meter mode of transient triggering offers flexible scanning for load impulses (power or current) meeting user defined transient criteria. Finally, the PDA-600 Load Monitor is accessed from the Analysis tab menu.

***** The **LLDP-AT** feature license requires that the PDA-602B is also configured with the **Type-2** feature license.

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802.3at Test (*Figure 11*): The 802.3at Test menu s is available to instruments with the optional **CT-AT** license. This menu provides for configuration and control of the IEEE 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 if the **Type-2** feature is licensed, and **Type-2 LLDP** if the **Type-2** and **LLDP** features are licensed.

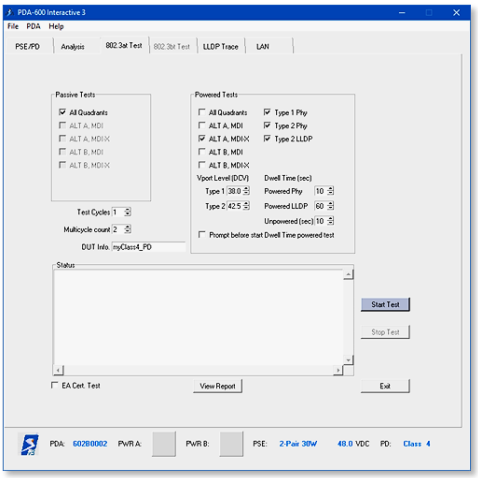

Figure 11: PDA Interactive Test Suite Menu

LLDP Trace (*Figure 12*): This menu accesses the PSE LLDP emulation and LLDP protocol tracing features of a PDA-602B instrument configured with the optional **LLDP-AT** license. 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.

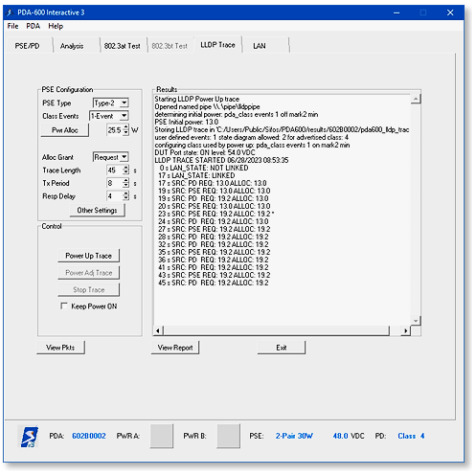

Figure 12: PDA Interactive LLDP Menu

LAN (not shown): This tab menu simply allows the LAN port that facilitates communication between the PD-under-test and an outside network connection to configure for either 10/100/1000Base-T auto-neg. or for a fixed link rate and duplex mode.

The **803.3bt Test** tabbed menu is only applicable to PDA-604 instruments.

PowerShell PDA Software

The PDA-602B provides a robust, Tcl/Tk-based script development environment consisting of intuitive commands for configuring PDA-602B 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.

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 13 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.

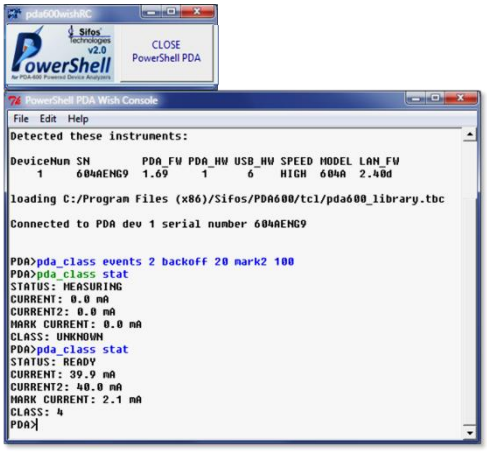

Figure 13: PowerShell PDA Wish Console

The PowerShell PDA Tcl Console in Figure 14 is the Windows command prompt shell environment extended with Tcl commands and PDA-600 commands.

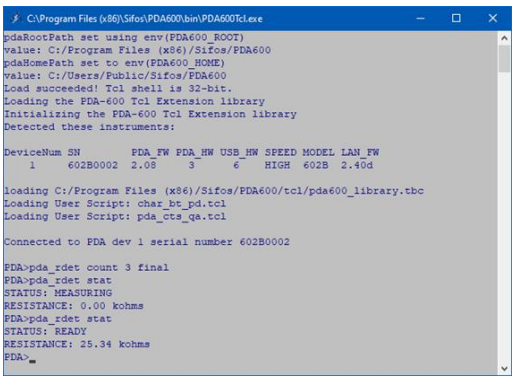

Figure 14: PowerShell PDA Tcl Console

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-602B 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_lldp
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 function 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-602B.

Growth Path to 4-Pair PD's and 802.3bt

As a member of the PDA-600 family, the PDA-602B offers a full range of testing capabilities applicable to 2-pair powered IEEE **802.3at** PD's. Another member of the PDA-600 family, the PDA-604A, expands on these capabilities to offer 4-pair powering and analysis of both IEEE **802.3bt** and 802.3at PD's.

The PDA-602B and the PDA-604A share a common software platform meaning software developed for the PDA-602B is forward compatible to the PDA-604A. As a result, 2-pair (802.3at) testing operations and associated test software will work interchangeably with PDA-602B and PDA-604A test instruments.

PDA-602B Technical Specifications

Input / Output		
Interface	**Parameter**	**Specification**
PD Port	Connections	RJ45
	PoE Signaling and Supply Modes	ALT-A MDI, ALT-A MDI-X, ALT-B MDI, ALT-B MDI-X
	Data Rates and Signaling	10/100/1000Base-T
	Impedance	100 Ω, Balanced
LAN Port	Connections	RJ45
	Data Rates and Signaling	10/100/1000Base-T
	Impedance	100 Ω, Balanced
USB Port	Connections	USB Standard-B
	Type	USB 2.0 High Speed
User Interface	LED's	**USB**: Connected, host is furnishing 5VDC **LLDP**: Blinks on to indicate LLDPDU received **COM**: Blinks when I/O from host occurs **ALT A**: DC Power Applied to Alt A pairs **ALT B**: DC Power Applied to Alt B pairs

Source Specifications		
Source	**Parameter**	**Specification**
DC Supply	Voltage Range	28 VDC to 57 VDC
	Voltage Accuracy (50mA load)	± (0.75% + 60 mV)
	Voltage Resolution	0.1 Volt
	Source Resistance (typical)	1.6 Ω
	Maximum Continuous Source Current	1000 mA (PDA-602B)
PD Detection Resistance	Method	ΔV / ΔI
	Probing Voltage (typical)	4.4 V – 8.8 V
	Probing Range (Margin Test)	2.7 V to 4.2 V and 7.0 V to 10.0 V

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Source Specifications

Source	Parameter	Specification
PD Detection Capacitance	Method	Slew Time
	Probing Voltage (typical)	~4 V – 8 V
PD Classification	Modes: Standard PDA-602	One-Event Classification
	Modes: PDA-602 with **PDA-602-TYPE2**	One-Event and Two-Event Classification
	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, ≤ 6mA load)	7- 9 V
	Mark Region Duration (typical)	Mark 1: 10 msec, Mark 2: Selectable, 25 to 375 msec
Output Voltage Transient	Voltage Level & Duration	~39V for 25 to 250 μsec

Measurement Specifications

Measurement	Parameter	Specification
Detection Resistance	Range	3 KΩ to 50 KΩ
	Accuracy (19 KΩ to 26.5 KΩ, Probing 4.4-8.8V)	± 1%
	Accuracy (Full Range, Probing 4.4-8.8V)	± 2.5%
	Detection over Voltage	Band 1: 2.7 V to 4.2 V, Band 2: 7.0 V to 10.0 V
Detection Capacitance	Range	50nF-10μF
	Accuracy (0.05..2 μF)	± (2.5% + 6 nF)
	Accuracy (2.1..10 μF)	± (10% + 6 nF)
Classification	Classification Range	0 mA to 50 mA
	Classification Accuracy (1..15 mA @ ~17.5V)	± (2.5% + 600 μA)
	Classification Accuracy (16..50 mA @ ~17.5V)	± (1.5% + 400 μA)
	Events Measured	1 (standard), 1 or 2 with Type-2 license
	Mark Region Range	0.5 to 5 mA
	Mark Region Accuracy	± (2% + 100 μA)
	Classification over Voltage	14.5 V and 20.5V
Power	Range	0 to 56 Watts
	Resolution	0.01 W
	Accuracy	± (2.0% + 0.1 W)
Load Current	Range	0 to 1000 mA
	Resolution	0.1 mA
	Accuracy (1..15 mA)	± (2% + 600 μA)
	Accuracy (16..50 mA)	± (1.85% + 600 μA)
	Accuracy (51..100 mA)	± (1.0% + 500 μA)
	Accuracy (101..1000 mA)	± (0.75% + 800 μA)
Port Voltage 802.3at Backfeed Voltage	Range	0 VDC to 57 VDC
	Resolution	0.1 V
	Accuracy	± (0.75% + 100 mV)
Trace	Types	Voltage, Current, Power, Voltage & Current
	Trigger Modes	**Immediate**, **Class** (leading edge of first event), **Source** (ON or OFF transition), **Transient** (Current or Power) with Selectable Threshold and Selectable Pre-Trigger Sample Count
	Sample Rate - Immediate, Class, Source triggered traces	0.05 – 20 msec / sample (1-2-5 pattern) Voltage, Current also support 0.025 msec / sample
	Trace Length (Voltage, Current traces)	Selectable up to 5120 points
	Trace Length (Power, Voltage & Current traces)	Selectable up to 2560 points
	Sample Rate - Transient triggered traces	0.2 – 20 msec / sample
	Trace Length – Transient triggered traces	Indefinite – Runs until specified condition
	Trace Trigger Hold-off: Supported Triggers	Class, Source
	Trace Trigger Hold-off	0 to 65535 samples
Streaming Trace	Parameters Included	Voltage, Current, Instantaneous Power, Avg. Power
	Sample Rate	5 msec or 10 msec
	Trace Length (5 msec period)	≤ 1048400 samples (≤ 5242 seconds)

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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.	

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

Description	North America	Europe & International
Safety	CSA Listed (CSA22.2 No. 61010)	EN61010-1 (Test & Measurement Equipment Safety Standard)
Emissions	FCC Part 15, Class A (Industrial Equipment emissions, USA)	EN55011:2016 (Industrial, Scientific Equipment RF emissions, Europe)
		EN 61326-1:2013 (Immunity)
		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)
		ROHS Compliance Directive (2011/65/EU)
		CE Marking Directive (93/68/EEC)
Patents	U.S. Patent 10,060,965	

Ordering Information

PDA-602B	PDA-602B Instrument for 2-Pair Type-1 PD Analysis Including PDA-600 Software
PDA-602-Type2	License for Type-2 (25.5W) PD Powering and Analysis Using 2-Event Classification
PDA-602-CT-AT	License for Automated **802.3at** PD Conformance Test Suite and Load Monitor. Requires **PDA-Type-2** for Type-2 PD Conformance Testing and Load Monitoring.
PDA-LLDP-AT	License for Type-2 PD Powering and Analysis Using 802.3at LLDP. Requires **PDA-Type2**.
RACKKIT-PDA	Rack Mount Kit for PDA-600 Instruments (see below)
CASE-PSA-PDA	Carrying Case for PDA-600 Instruments (see below)
HCopy-Manual	Hardcopy of PDA-602 Technical Reference Manual

Accessories Included with PDA-602B:

- PDA-600 Software (CD, USB Stick)
- PSA Installation Guide (Hardcopy, CD, USB Stick)
- PDA-602 Technical Reference Manual (Softcopy, CD and USB Stick)
- Power Cord
- USB 2.0 Cable
- Cat 5e Patch Cable

Optional Carrying Case for PDA-600

Optional Rack Mount Kit for PDA-600

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