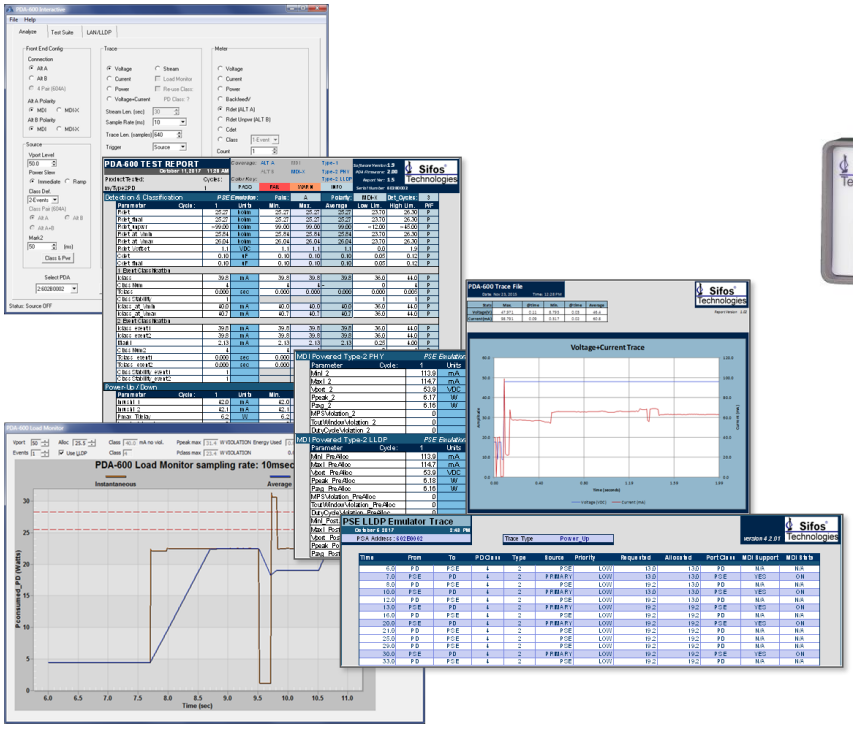
PDA-602B

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 Well Beyond 30W**
- ❑ **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 802.3at 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 Including Class and Source Triggering

LLDP Power Negotiation Protocol and Request-Allocation Verification

Versatile Applications

Evaluation & Design

Quality Assurance

Manufacturing Test

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 IEEE 802.3at interoperation can be accurately assessed relative to specification requirements, thus fully avoiding the need for and limitations associated with interoperability testing using IEEE 802.3at PSE's.

Fully Integrated, One-Box Solution

The PDA-602B removes the need for specialized instrumentation setups requiring DC power supplies, precision meters, specialized test fixtures, protocol analyzers, a variety of PSE's, and custom software. The PDA-602B may be used with PDA Interactive software to develop detailed specification compliance analyses of new PD designs and to troubleshoot PD specification performance issues. The PDA-602B 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 versus 2-event classification, class-to-power timing, and LLDP acknowledgement timing. The PDA-602B also includes a robust set of automation development facilities including Tcl/Tk scripting and binary API libraries with full access to the instrument and automated test suite capabilities. 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 well in excess of what a commercial PSE or instrument grade DC power supply might offer. It performs measurements across each powered pair and polarity combination. Measurements including DC load-over-voltage, classification validity, power on-off thresholds, MPS validity, and detection impedance are readily performed and compared to applicable test limits with no special fixtures or PD programming requirements. Load currents up to 1A can be sourced and sensed with DC supply voltages ranging from 28 to 57VDC. Transient current and voltages can be sampled and traced with sampling resolution as granular as 200µsec. The PDA-602B Test port can link to any PD at 10Base-T, 100Base-Tx, or 1000Base-T.

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.

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 collects and presents data as well as any limit violations. Load power samples can also be streamed to disk files for subsequent off-line processing.

Desktop Ready Design

The PDA-602B is at home on any desktop or lab bench with USB to host PC connectivity and variable speed fan that only runs when powering PD's.

PDA-602B Versus a Commercial PSE

With the ready availability of commercial Power Sourcing Ethernet Switches (PSE), including low cost PSE's, a strong temptation exists to utilize these products to test Powered Devices. When coupled with long spools of cable or line loss simulators, 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 proliferation of PSE controller implementations and a proliferation of versions within each of those implementations. PSE behaviors in critical processes such as PD detection, PD classification, inrush load processing, overload processing, and disconnect detection vary so widely that it is extremely challenging to assemble an array of PSE's that might fairly represent the universe of 802.3at compliant PSE's.

The reality is that PSE's are not test instruments. A PSE cannot test key characteristics of a PD that are ultimately 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 licensed feature options, **CTS**, **Type-2**, and **LLDP**, 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	LLDP
CTS	**Type-1** PD Automated Test Suite + **Type-1** Load Monitor + Streaming Traces	✓		
Type-2	**Type-2 2-Event** Power-Ups		✓	
CTS + **Type-2**	**Type-1** & **Type-2 2-Event** PD Automated Test Suite, Load Monitor, & Streaming Traces	✓	✓	
Type-2 + **LLDP***	**Type-2 2-Event** Power-Ups **Type-1 LLDP** & **Type-2 LLDP** PSE Emulation & Protocol Analysis		✓	✓
CTS + **Type-2** + **LLDP***	**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 Feature Options and Combinations. *****LLDP requires Type-2 feature.

The 802.3at PD Conformance Test Suite & Load Monitor (CTS)

The **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 testing 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.

The PD Conformance Test Suite can be configured and launched from three different software environments: PDA Interactive (graphical user interface), PowerShell PDA (scripting language), or the PDA-600 API library integrated with PC-based programming languages.

PDA-600 TEST REPORT

October 11, 2017 10:23 AM

Product Tested: myClass4PD | Cycles: 2

Coverage: ALT A, ALT B, MDI, MDI-X, Type-1, Type-2 PHY, Type-2 LLDP

Color Key: PASS, FAIL, WARN, INFO

Software Version 1.9 | PDA Firmware: 2.00 | Report Ver: 1.5 | Serial Number 60280002

Sifos Technologies

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

Parameter	Cycle: 1	2	Units	Min.	Max.	Average	Low Lim.	High Lim.	P/F
Rdet	24.60	24.62	kohm	24.60	24.62	24.61	23.70	26.30	P
Rdet_final	24.62	24.55	kohm	24.55	24.62	24.59	23.70	26.30	P
Rdet_unpwr	>99.00	>99.00	kohm	99.00	99.00	99.00	<12.00	>45.00	P
Rdet_at_Vmin	25.16	25.08	kohm	25.08	25.16	25.12	23.70	26.30	P
Rdet_at_Vmax	25.39	25.24	kohm	25.24	25.39	25.31	23.70	26.30	P
Rdet_Voffset	1.1	1.5	VDC	1.1	1.5	1.3	0.0	1.9	P
Cdet	0.10	0.10	uF	0.10	0.10	0.10	0.05	0.12	P
Cdet_final	0.10	0.10	uF	0.10	0.10	0.10	0.05	0.12	P
1 Event Classification									
Iclass	40.5	40.5	mA	40.5	40.5	40.5	36.0	44.0	P
ClassNum	4	4		4	4	-	0	4	P
Tclass	0.001	0.001	sec	0.001	0.001	0.001	0.000	0.005	P
ClassStability	1	1					1	1	P
Iclass_at_Vmin	41.0	40.7	mA	40.7	41.0	40.9	36.0	44.0	P
Iclass_at_Vmax	41.2	40.8	mA	40.8	41.2	41.0	36.0	44.0	P
2 Event Classification									
Iclass_event1	40.6	40.5	mA	40.5	40.6	40.5	36.0	44.0	P
Iclass_event2	40.6	40.6	mA	40.6	40.6	40.6	36.0	44.0	P
Markl	0.87	0.87	mA	0.87	0.87	0.87	0.25	4.00	P
ClassNum2	4	4		4	4	-	0	4	P
Tclass_event1	0.001	0.001	sec	0.001	0.001	0.001	0.000	0.005	P
Tclass_event2	0.000	0.001	sec	0.000	0.001	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
Inrushl_1	15.7	16.3	mA	15.7	16.3	16.0	0.0	400.0	P
Inrushl_2	16.9	16.9	mA	16.9	16.9	16.9	0.0	400.0	P
Pmax_Tdelay	0.9	0.9	W	0.9	0.9	0.9	0.0	14.4	P
Inrush_delayed	0	0		0	0	-	0	0	P
Von	37.8	37.8	VDC	37.8	37.8	37.8	30.0	42.0	P
Voff	31.3	31.3	VDC	31.3	31.3	31.3	30.0	37.0	P
Vhyst	6.5	6.5	VDC	6.5	6.5	6.5	0.1	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	P
SigRecoverTime	0.0	0.0	sec	0.0	0.0	0.0	0.0	30.0	P

MDI Powered Type-1 — PSE Emulation: | On Time: 10 sec | Off Time: 10 sec | Vport: 37.0

Parameter	Cycle: 1	2	Units	Min.	Max.	Average	Low Lim.	High Lim.	P/F
Minl_1	8.7	8.7	mA	8.7	8.7	8.7	0.0	394.5	P
Maxl_1	278.5	278.4	mA	278.4	278.5	278.4	10.0	394.5	P
Vport_1	36.5	36.5	VDC	36.5	36.5	36.5	37.0	57.0	INFO
Ppeak_1	10.17	10.16	W	10.16	10.17	10.16	0.0	14.4	P
Pavg_1	10.15	10.15	W	10.15	10.15	10.15	0.0	13.0	P
MPSViolation_1	0	0		0	0	-	0	0	P
TcutWindowViolation_1	0	0		0	0	-	0	0	P
DutyCycleViolation_1	0	0		0	0	-	0	0	P

MDI Powered Type-2 PHY — PSE Emulation: | On Time: 10 sec | Off Time: 10 sec | Vport: 42.5

Parameter	Cycle: 1	2	Units	Min.	Max.	Average	Low Lim.	High Lim.	P/F
Minl_2	9.9	10.3	mA	9.9	10.3	10.1	0.0	675.0	P
Maxl_2	320.5	320.5	mA	320.5	320.8	320.6	10.0	675.0	P
Vport_2	42.0	42.0	VDC	42.0	42.0	42.0	42.5	57.0	INFO
Ppeak_2	13.45	13.45	W	13.45	13.45	13.45	0.0	28.3	P
Pavg_2	13.43	13.43	W	13.43	13.43	13.43	0.0	25.5	P
MPSViolation_2	0	0		0	0	-	0	0	P
TcutWindowViolation_2	0	0		0	0	-	0	0	P
DutyCycleViolation_2	0	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	2	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

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.

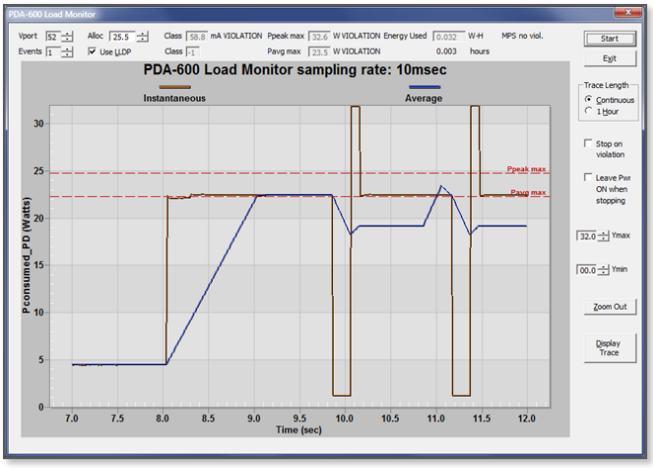


Figure 2: PDA-602B Load Monitor

The **CTS** option 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.

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 to utilize PoE LLDP to acquire and set limits in accordance with PD LLDP power requests and PSE power allocations, given the **LLDP** feature option.

Also included with the CTS option is the ability to **stream long traces** of instantaneous and average power consumption into spreadsheet reports (see Figure 3) 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.

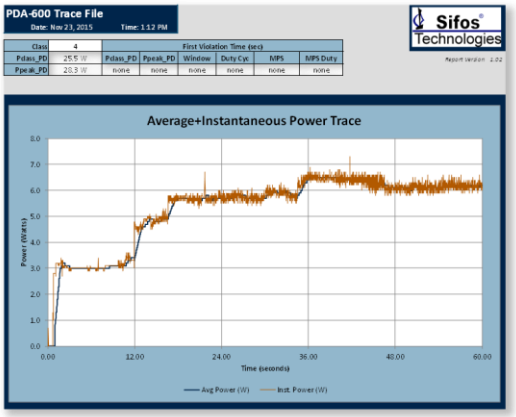


Figure 3: PDA-602 Streaming Trace

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

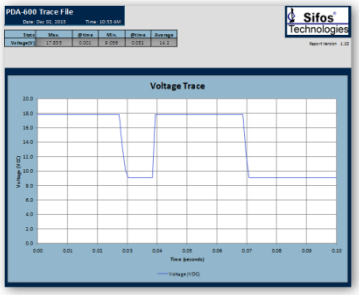


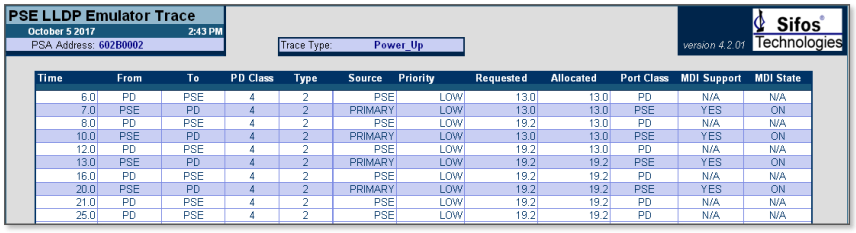
Figure 4: 2-Event Classification

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 **Type-2** feature option, 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 with the PDA-602B.

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

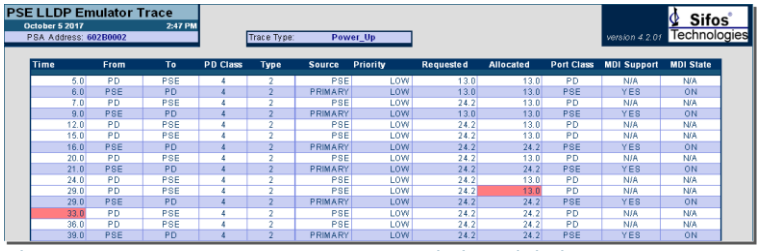
Another requirement of Type-2 PD's under the IEEE 802.3at specification is that they support 802.3at PoE extensions to LLDP (link layer discovery) protocol. Many Type-2 PSE's do not provide 2-Event classification but instead, rely on LLDP message exchanges to learn the power demand of a Type-2 PD, then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



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 **LLDP** feature option, the PDA-602B can flexibly mimic Type-2 PSE's that deploy PoE LLDP. While emulating user-defined PSE LLDP behaviors, the PDA-602B can collect and analyze PoE LLDP protocol and report 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 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
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 such as this 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.

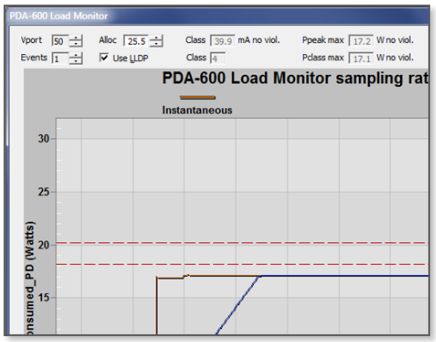


Figure 7: Link Monitor - LLDP Validation

Combining the **LLDP** feature option with the **CTS** 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 7). This makes the Load Monitor a powerful tool for assessing PD LLDP power request levels.

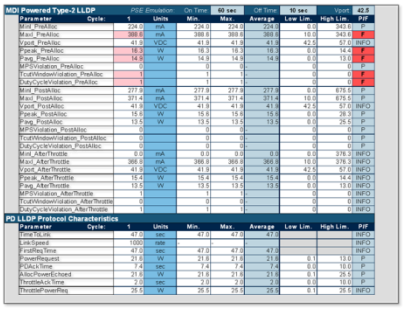


Figure 8: Test Suite with LLDP

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 8). 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-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.

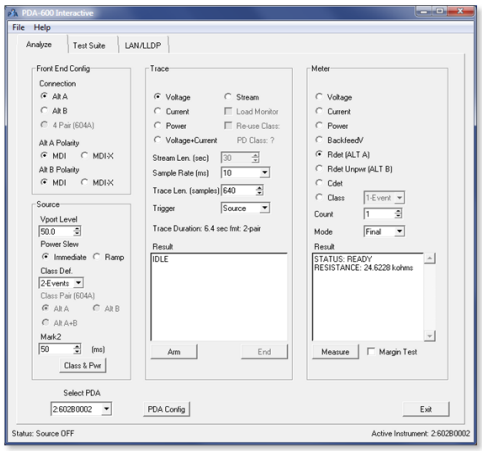


Figure 9: PDA Interactive Analyze Menu

PDA Interactive provides three file-tabbed menus:

Analyze: This menu (see Figure 9) supports interactive powering, metering, and waveform trace captures. With the **CTS** feature option, it adds access to the Load Monitor and stream tracing features of the PDA-602B. The Type-2 feature option further enhances this menu by allowing 2-Event Power-Ups and 2-Event PD Class measurements. In general, the Analyze menu enables intuitive methods of manually testing and analyzing many characteristics of a PD.

Test Suite: The Test Suite menu shown in Figure 10 is available to instruments with the CTS feature option. This menu provides for configuration and control of the 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 option is enabled, and **Type-2 LLDP** if the **Type-2** and **LLDP** feature options are enabled.

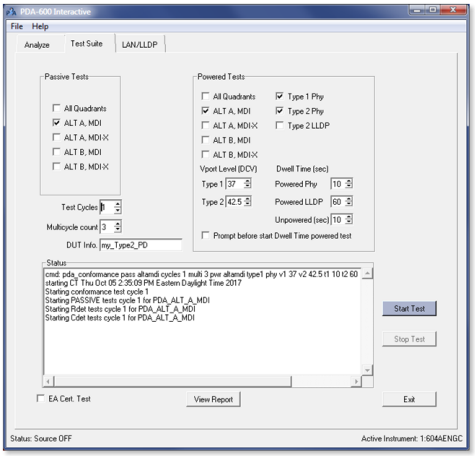


Figure 10: PDA Interactive Test Suite Menu

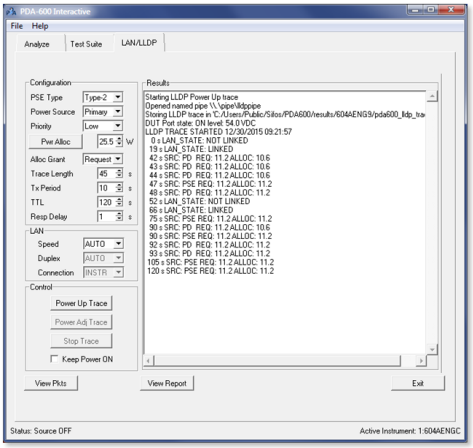


Figure 11: PDA Interactive LLDP Menu

LLDP: This menu access the PSE LLDP emulation and LLDP protocol tracing features of a PDA-602B given that the instrument is enabled with the **LLDP** 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.

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

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 12 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.

The PowerShell PDA Tcl Console in Figure 13 is the Windows command prompt shell environment extended with Tcl commands and PDA-600 commands.

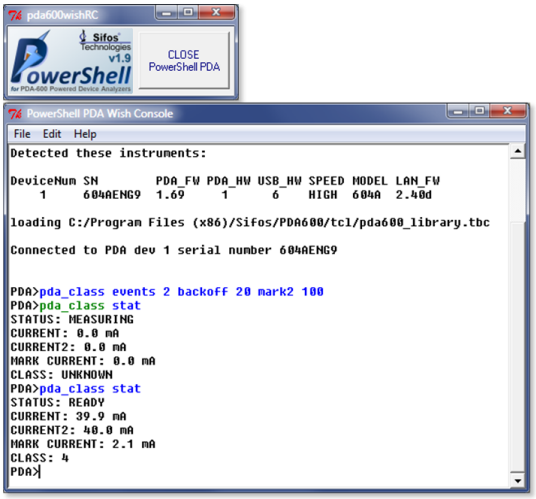


Figure 12: PowerShell PDA Wish Console

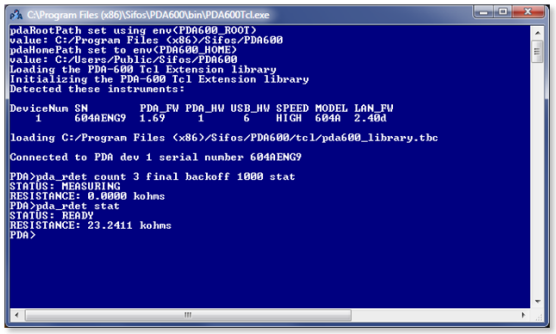


Figure 13: PowerShell PDA Tcl Console

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 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

The PDA-602 is the first member of the PDA-600 instrument family. As the PoE market evolves toward 4-pair PD's that draw up to 75 watts or more, the PDA-604 will be introduced to address 4-Pair PD testing including eventual PD Conformance Testing in accordance with the emerging IEEE 802.3bt standard expected in 2018. The PDA-602 and the PDA-604 will share a common software platform meaning software developed for the PDA-602 will be forward compatible to the PDA-604.

PDA-600 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	± (0.75% + 60 mV) NOTE: with 50mA load imposed
	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
PD Detection Capacitance	Method	Slew Time
	Probing Voltage (typical)	~4 V – 8 V
PD Classification	Modes	One-Event and Two-Event (with type2 feature license)
	Classification Probing Voltage (typical)	~17.5 V
	Classification Probing Event Duration (typical)	25ms nominal
	Mark Region Voltage (typical)	~7- 9 V @ ≥ 6 msec
	Mark Region Duration (typical)	Mark 1:10 ms, Mark 2: User Defined
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)	± 1%
	Accuracy (Full Range)	± 2.5%
	Detection over Voltage (*PDA-602B only*)	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)	± (2.5% + 600 μA)
	Classification Accuracy (16..50 mA)	± (1.5% + 400 μA)
	Mark Region Range	0.5 to 5 mA
	Mark Region Accuracy	± (2% + 100 μA)
	Classification over Voltage (*PDA-602B only*)	14.5 V and 20.5V
Power	Range	0 to 56 Watts
	Resolution	0.01 W
	Accuracy	± (2.0% + 0.1 W)

Measurement Specifications

Measurement	Parameter	Specification
Load Current	Range	0 to 1000 mA (PDA-602B)
	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, Backfeed Voltage	Range	0 VDC to 57 VDC
	Resolution	0.1 V
	Accuracy	± (0.75% + 100 mV)
Trace	Types	Voltage, Current, Power, Voltage & Current
	Sample Rate (all Trace Meters)	0.05 – 20 msec / sample (1-2-5 pattern) **Transient** Triggered Traces: 0.2 – 20 msec / sample
	Trace Length (Voltage, Current)	Selectable up to 5120 points
	Trace Length (Power, Voltage+Current)	Selectable up to 2560 points
	Trigger Modes	**Immediate**, (Start of) **Class**, **Source** (ON or OFF transition), (Current or Power) **Transient** with Selectable Threshold & Pre-Trigger Sample Count
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)

LLDP

Interface	Parameter	Specification
PD Port (with LLDP 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

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)

Ordering Information

PDA-602B	PDA-602B Instrument for 2-Pair Type-1 PD Analysis Including PDA-600 Software
PDA-Type2	License for Type-2 (25.5W) PD Powering and Analysis Using 2-Event Classification
PDA-CTS	License for Automated 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-602B (see below)
CASE-PDA	Carrying Case for PDA-602B (see below)

Accessories Included:

PDA-602B Reference Manual	PDA-600 Software (CD)
USB Cable	Power Cord

Carrying Case for PDA-602B

Rack Mount Kit for PDA-602B

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Verification, Simplified.

