

Powered Device Ethernet Interface

Ethernet powered devices such as IP phones, wireless access points, and security cameras commonly implement 10/100Base-T or 10/100/1000Base-T interfaces meaning they can readily take advantage of single connection data and powering offered by Power-over-Ethernet (PoE). The IEEE 802.3at standard for PoE allows for powered devices that draw up to 25.5 watts over interfaces that support 10Base-T, 100Base-Tx, and/or 1000Base-T.

Developers and manufacturers of powered devices (PD) commonly seek to assess network interface viability under conditions of PoE powering and maximum data flow. For devices that have multiple power states, this testing would typically be performed under conditions of high or maximum PD power load. Depending on the type of PD, achieving maximum data flow may also require a particular state of the PD. Since PD's are not typically devices that bridge traffic between two different ports, controlled packet flow testing using a packet analyzer may be difficult or impossible.



The PhyView Analyzer: Better Than Ordinary Packet Flow

This application note will discuss an alternative approach to the assessment of PD network interface integrity under conditions of PoE powering and without the need for any packet flow measurements. The PhyView Analyzer from Sifos Technologies offers more direct and more insightful information about the integrity of a 10/100/1000Base-T Ethernet port by making measurements of the physical layer while also imposing worst case link impairment conditions in order to qualify receiver performance. This is readily done over a powered Ethernet interface as will be described in this paper.

The PhyView Analyzer also provides for fully automated testing of any 10/100/1000Base-T port. For comprehensive port analysis, the PHY Performance Test Suite (PTS), an option to the PhyView Analyzer, will perform a thorough verification of transmission and receiver characteristics and generate colorful and graphical reports that immediately flag any problem areas. Transmission testing includes measurements of wideband transmit power, power spectral distortion, residual distortion, wideband return loss, and wideband crosstalk with complete evaluations of every possible transmission wire pair. Receiver testing includes analysis of 10Base-T, 100Base-Tx, and 1000Base-T performance under conditions of worst case link insertion loss, maximum allowable alien crosstalk levels, maximum frequency offset, and maximum allowable jitter. This testing is provided in both MDI and MDI-X configurations as well as 1000Base-T master and slave modes.

For quicker verification testing, the PhyView Analyzer is provided with a fully automated test program to survey and qualify one to six ports with more limited transmission and receiver coverage as compared to PTS. Users may also generate specialized test scripts to perform just the measurements of interest when qualifying powered Ethernet ports. Further information regarding the PhyView Analyzer is available within Sifos datasheet **PhyView Analyzer 3000 Product Overview**. Further information covering the PHY Performance Test Suite for the PhyView Analyzer is available in Sifos datasheet **PHY Performance Test Suite Product Overview**.

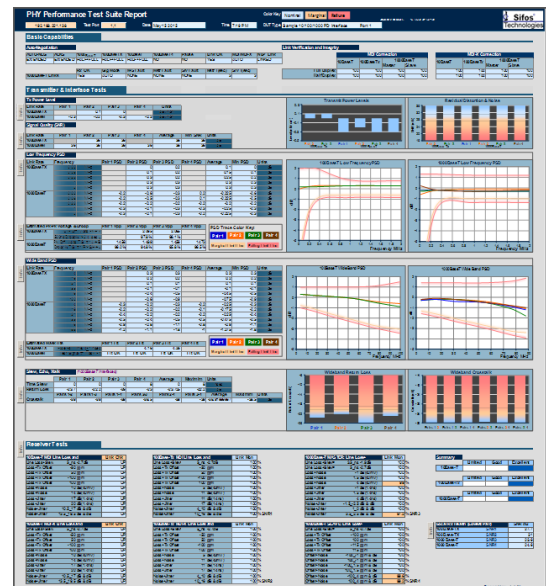


Figure 1: PHY Performance Test Suite Standard Report

PhyView Analyzer Powered Device Test Configuration

In order to test a Powered Device network interface, the PhyView Analyzer must be coupled to a PoE powering port. Two approaches will be discussed in this application note:

1. IEEE 802.3at Compliant Midspan (Injector) PSE
2. Sifos PDA-300 Powered Device Analyzer

IEEE 802.3at Midspan PoE Injector

An IEEE 802.3 midspan PSE is designed to passively connect an Ethernet link to a PD while injecting DC power required by the PD in order to operate. An IEEE 802.3at compliant midspan is essential because it is designed to support 1000Base-T links where all four pairs are utilized for Ethernet communications and because it can power any 802.3at compliant PD including PD's that draw up to 25.5 watts continuously with peak transient loads exceeding 28 watts.

IEEE 802.3at compliant midspan PSE's are readily available. In this particular study, a PD9001 single-port midspan injector PSE from Microsemi (Power Dsine) is utilized as the power source to the PD.

Figure 2 presents the test configuration for analyzing physical layer characteristics of an IP phone network interface powered from the midspan injector PSE. In this setup, the PhyView Analyzer Test Port is connected to the "Data In" port on the midspan injector, and the "Power+Data Out" port of the midspan injector is connected to the PD-Under-Test. If the PD requires special configuration from a computer to place it into a certain power state, then the PhyView Analyzer (PVA) can be temporarily configured to pass traffic from a host computer through the PVA test port where it then passes through the midspan PSE to the PD. Once the PD is configured, the PVA can switch back to terminate the link and begin physical layer testing.

Figure 2: Ethernet Port Testing with Midspan PSE

PDA-300 Powered Device Analyzer

The PDA-300 is a dedicated instrument for testing the Power-over-Ethernet characteristics and specification compliance of an Ethernet Powered Device. It can be configured to turn on PoE power either statically or during a Load Monitor trace where PD loading power is charted over a user specified period of time. Somewhat like a midspan PSE, the PDA-300 provides a passive "THRU" port that allows the PD-Under-Test to connect with a link partner for 10/100/1000Base-T communication. However, the pass-through characteristics of the PDA-300 do not meet all of the RF signaling requirements of an 802.3at compliant midspan PSE meaning that it will compromise certain physical layer measurements performed by a PhyView Analyzer on the PD.

Figure 3 depicts a test setup for testing both the PoE and the PHY characteristics of an wireless access points network interface. In this setup, the PDA-300 Test Port injects the power. Since the PDA-300 is a test instrument, not a PSE, it will furnish whatever power the PD requires be that 802.3at Type-1 (up to 13 watts) or Type-2 (up to 25.5 watts).

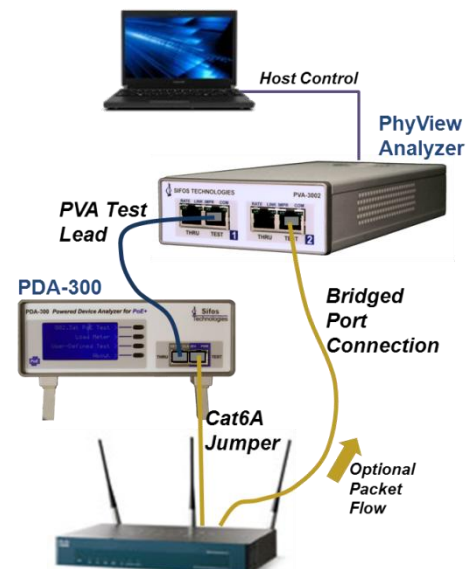


Figure 3: Ethernet Port Testing with PDA-300 PSE

Since the device under test in Figure 3 is a wireless access point, it will typically possess ability to bridge packet traffic to one or more LAN ports. This opens up an alternative for the PhyView Analyzer to utilize *impaired channel* packet flow analysis during receiver tests rather than using the *impaired channel* link monitor method that is deployed when testing stand-alone Ethernet ports. This approach will often produce better defect resolution when testing 10Base-T and 100Base-Tx receiver performance. In this example, the LAN port is routed back to the second PVA test port where the packet counting will take place.

PhyView Analyzer Calibration

Normally, a PhyView Analyzer test port is calibrated by connecting its associated test cable to the opposite test port on the same PhyView Analyzer (PVA-3002) or on the same PVA Test Blade (PVA-3000). Calibrations are managed by host software and are fully automated.

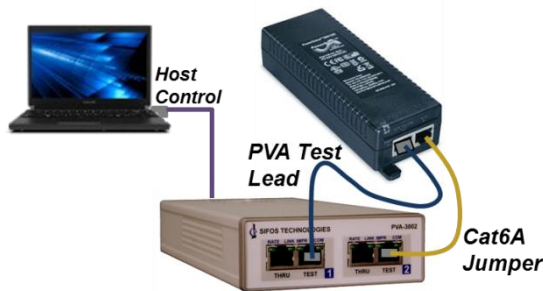


Figure 4: PVA Test Port Calibration – Midspan PSE

In the setups described earlier, there are two additional components in the link between the PhyView Analyzer test port and the PD-Under-Test. First is the midspan injector PSE (or the PDA-300), and second is a short length, preferably Cat6A patch cable between the injector (or PDA-300 test port) and the PD-Under-Test network interface.

Figure 4 demonstrates a configuration for performing an automated calibration for PVA Test Port #1 where the PD9001 along with a Cat6A jumper cord is part of the measurement circuit. By including these elements in the calibration, they

essentially become transparent during measurements of a PD-Under-Test. The same is true of the PDA-300 and the Cat6A jumper cord in Figure 5. The measurement reference plane is extended from the end of the PVA Test Lead to the end of the Cat6A jumper in this case. The PDA-300 does not meet midspan PSE return loss (impedance match) requirements however and it inserts a return loss above the measurement floor of the PhyView Analyzer, a fact that will compromise the wideband return loss measurements performed on a PD-under-test. So if return loss is deemed an important measurement, an IEEE 802.3at compliant midspan PSE would be a better choice to supply power to the PD while running PHY tests.

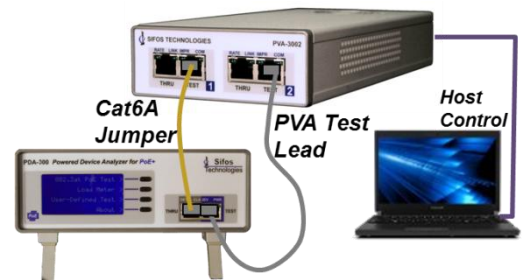


Figure 5: PVA Test Port Calibration - PDA-300

PhyView Metrology Validation

The effectiveness of PhyView Analyzer measurements and testing can readily be established by comparing test data from ordinary (non-PD) devices measured directly with a PhyView Analyzer to test data collected with the calibrated path including the midspan PSE and/or the PDA-300. In this particular instance, the DUT is an ordinary gigabit Ethernet switch port. The table below shows selected comparative test results with any significant deviations flagged.

Test Parameter	Tested Pair	DUT Port #1		DUT Port #2	
		Direct	Via PD9001	Direct	Via PDA-300
Wideband Power – 100Base-Tx	2	0 dB	-0.1 dB	0 dB	-0.4 dB
Wideband Power – 1000Base-T	4	-0.2 dB	-0.4 dB	-0.3 dB	-0.7 dB
Residual Distortion (SNR) – 1000Base-T	3	35.6 dB	35.7 dB	36 dB	34.2 dB
80KHz Power Spectral Distortion – 100Base-Tx	2	0.5 dB	0.4 dB	0.4 dB	0.2 dB
2 MHz Power Spectral Distortion – 1000Base-T	1	-0.1 dB	-0.2 dB	-0.1 dB	-0.3 dB
55 MHz Power Spectral Distortion – 1000Base-T	4	-0.6 dB	-0.7 dB	-0.7 dB	-0.7 dB
Wideband Return Loss – 1000Base-T	4	-23.7 dB	-24.3 dB	-26 dB	-20.8 dB
Wideband Crosstalk – 1000Base-T	1 to 3	-39 dB	-39 dB	-39 dB	-36.5 dB

From these results, we see that there are no significant differences in measurement results with the PD9001 802.3at midspan PSE versus a direct PVA-3000 test lead connection meaning that any calibrations developed in accordance with Figure 4 were successful in removing any detrimental effects of the midspan to PD testing. The PVA-300 did introduce the expected issue with Wideband Return Loss and also presented a small level of deviation in the Wideband Power measurement as a secondary consequence of the potential return loss issue described earlier.

Powered Device Test Summary

The PHY Performance Test Suite for the PhyView Analyzer is now used to evaluate several powered devices (PD's). In this study, three PD's are tested as they are powered by the PD9001 midspan PSE:

1. PD#1: IEEE 802.3at Type-1 Distribution Switch with Gigabit uplink
2. PD#2: IEEE 802.3at Type-2 VoIP Phone with gigabit network interface
3. PD#3: IEEE 802.3at Type-1 Powered Audio Speaker with 10/100 interface

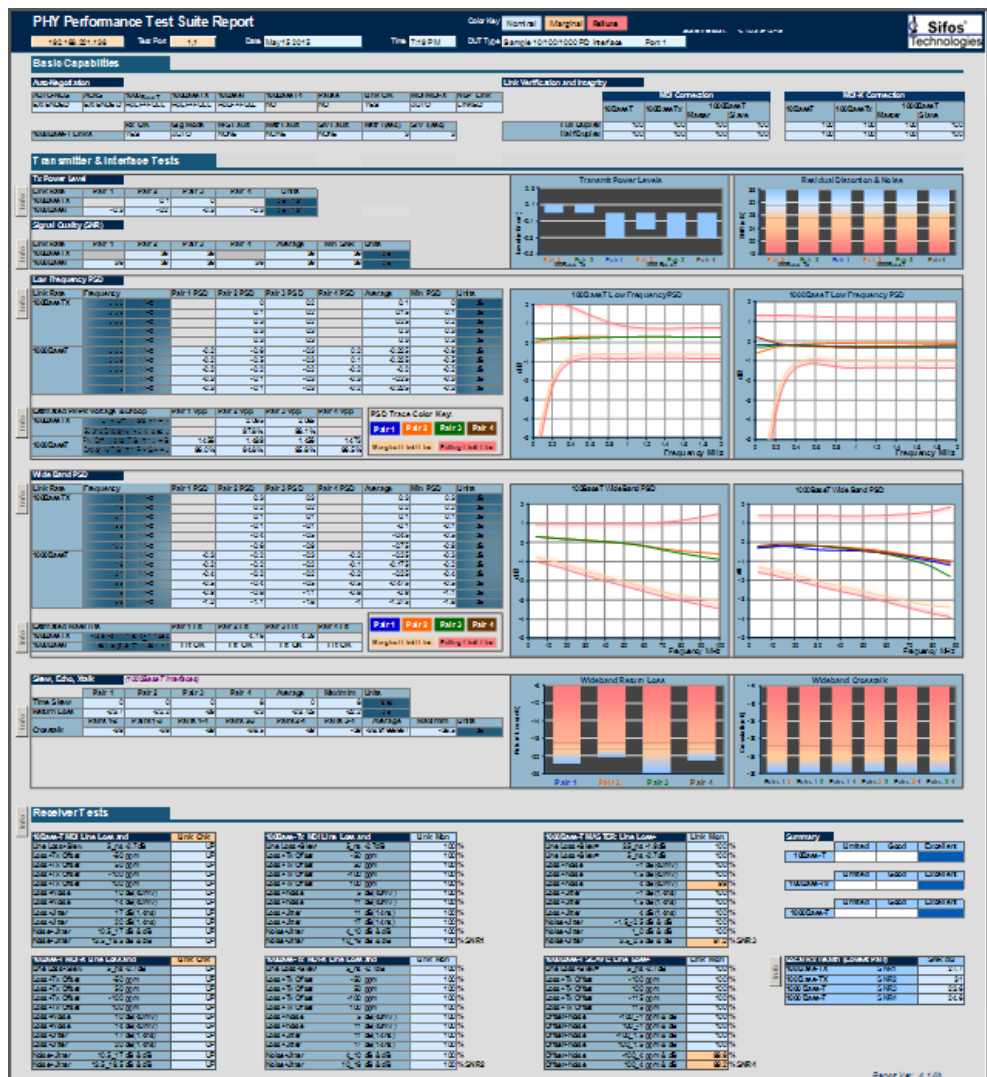


Figure 6: Type-1 Distribution Switch PD Powered by PD9001 Midspan

The Type-1 (13W or less) Ethernet Distribution Switch PD with Gigabit uplink tested nominally with the PHY Performance Test Suite (Figure 6). The uplink interface is very slightly below nominal on Transmission Power and Power Spectral Distortion and is very slightly high on Wideband Return Loss. Overall, it performs quite well.

The Type-2 VoIP Phone with gigabit network interface did not perform as well (Figure 7). First, the phone did not support an MDI-X connection so 10/100Base-T testing is only performed with an MDI connection. Second, the PD is significantly under-powered when in 1000Base-T (gigabit mode). This affects Wideband Power and PSD measurements. Finally, the PD did not tolerate the worst case 10Base-T impairment level and dropped link. The low power behavior may be an intentional feature of this device designed to conserve power, however, it would compromise performance over a long cabling link, perhaps forcing a drop back to 100Base-T.

Figure 8 is the report from the powered speaker PD. This device is restricted to 10/100Base-T and like the VoIP phone, only supports MDI, not MDI-X, that is, no auto-MDI function. Testing of this interface produced nominal results with no evident impact from the midspan PSE in the measurement path.

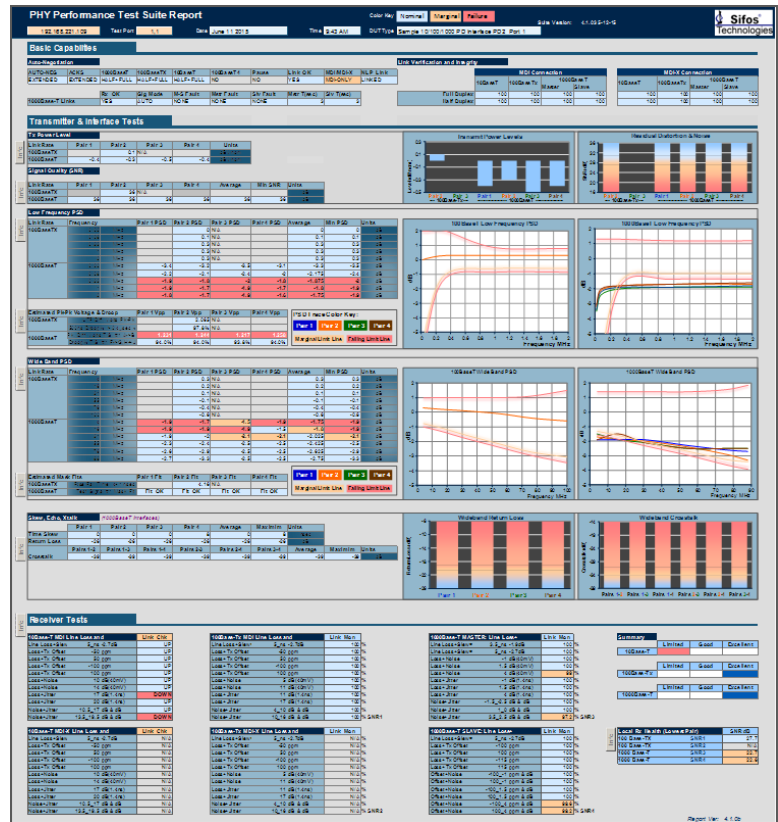


Figure 7: Type-2 VoIP Phone PD Powered by PD9001

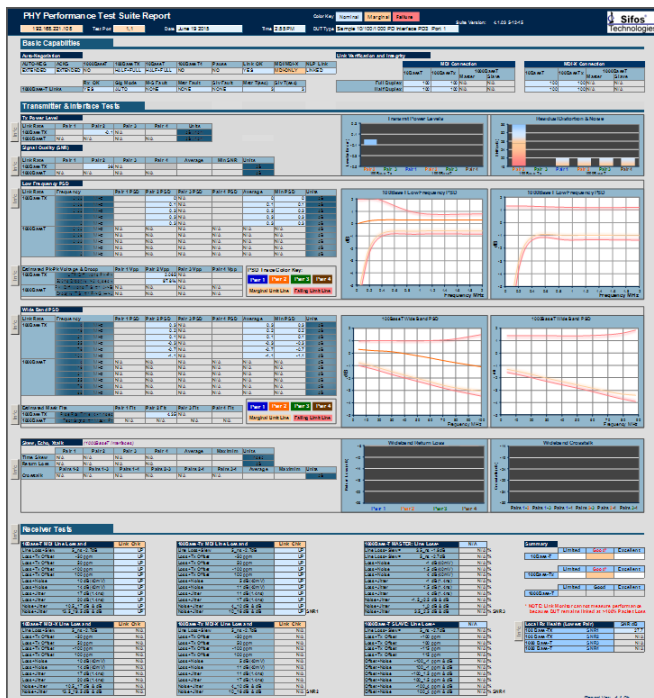


Figure 8: Type-1 Powered Speaker PD Powered by PD9001

Summary

Summarizing, automated physical layer interface testing of a Powered Ethernet Device using the PhyView Analyzer, including the fully automated PHY Performance Test Suite, is readily facilitated given an IEEE 802.3at compliant midspan PSE and the modified calibration procedure depicted in Figure 4.

Testing may also be performed in conjunction with the PDA-300 from Sifos Technologies with the caveat that the calibration process of Figure 5 will not fully correct for the return loss characteristics of the PDA-300 “through” channel.

For further information regarding the **PhyView Analyzer** and the **PHY Performance Test Suite**, including video presentations and demonstrations, visit the Sifos website at www.sifos.com.