TESTING PoE FOR TROUBLE-FREE OPERATION

Ensuring Power over Ethernet's Success Through Validation of Provisioning, Compatibility, Infrastructure and More

INTRODUCTION

Power over Ethernet is a critical enabling technology for a large number of smart building applications. Being able to provide power in the same cabling as data saves infrastructure cost and enables smart and efficient power management of the devices. Fig 1 shows a typical building facility with a large number of devices that potentially can benefit from PoE powering.

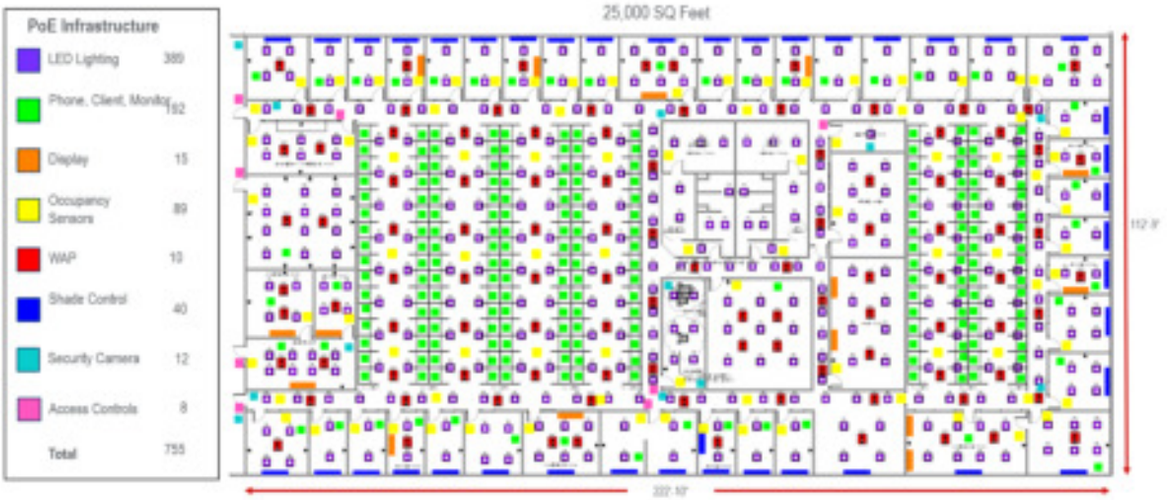


Figure 1: Potential PoE Powered Devices in a Facility

While having these devices PoE powered this makes them easier to install, it is turning the network into a power distribution center. Careful planning is very important for success of PoE infrastructure, and so is accurate measurement of important parameters during installation and operations for PoE. This paper reviews the parameters affecting PoE performance ranging from PSE (PoE power source equipment), PD (PoE powered devices), network connectivity (MultiGigabit Ethernet), and cabling.

WHAT IS NEEDED TO ENSURE SUCCESSFUL POE OPERATION

Provisioning required amount of PoE power source is the most important aspect of PoE operation. PSE network switches must have adequate rating to cater to the power requirement on all the PoE powered ports. Other approaches such as mid-span powering should be considered when the switches do not have required power sourcing capacity.

Equally important is to make sure that the PoE type of the devices and the source are compatible. If the device needs more power than the PSE can supply, the device may malfunction or not work at all. IEEE 802.3bt standard specifies categories of PoE sources depending on their capacity and pairs used.

Adequacy of cabling infrastructure for PoE operation is often overlooked, but equally important, aspect in successful PoE operation. Cabling with high resistance can cause excessive loss along its length, causing inadequate power supply to the end-point device. On the other hand, unbalance in resistance between cable conductors and pairs can cause suboptimal data transmission performance, leading to dropped packets and slow communication.

A well-planned test strategy to ensure the above aspects are properly covered go a long way in ensuring trouble-free PoE operation

TEST STRATEGY

Multifunction cable testers like the TestPro CV100 help organizations overcome these challenges by providing a greater range of test functions that help in deployment, ongoing support and troubleshooting within a single testing system. This saves cost, is less equipment to have to keep track of and delivers significantly more value, making it easier to justify the investment.

There are three main factors to consider when defining the test strategy for PoE operation.

1. Verify the functioning of PSE and compatibility between PSE and PDs.

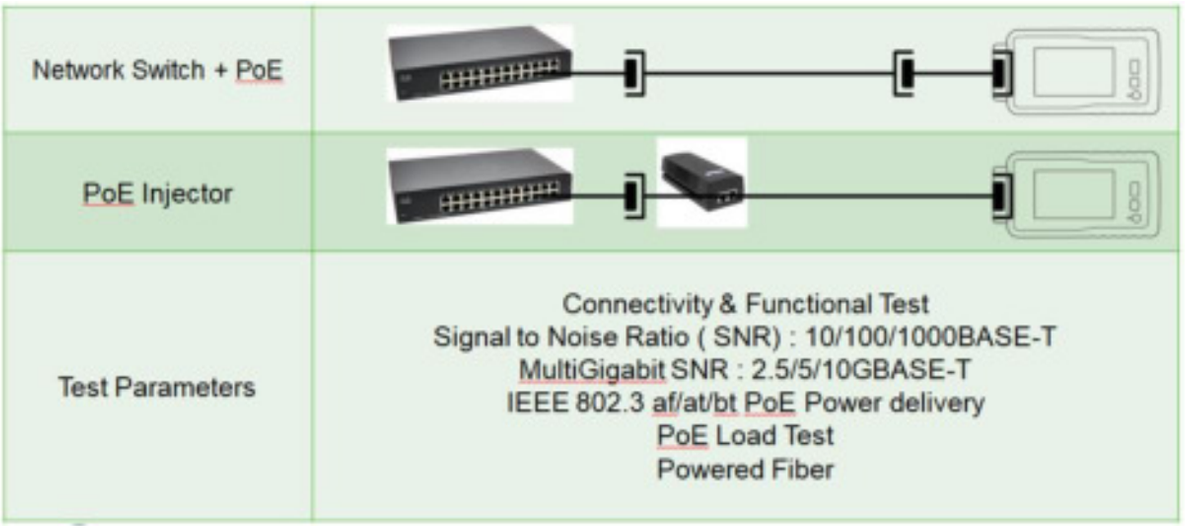


Figure 2: PSE Verification and Functional Test Setup

As shown in Fig 2, TestPro Multifunction Cable tester demonstrating the ability to assess PSE configuration and validate performance through true power load testing from the point where a PD will deploy. By actually applying load, the test instrument confirms that the PSE is able to supply the voltage and power that it advertises. This figure also demonstrates the broad range of test function needed to fully qualify the link under test for both PoE and MultiGigabit link speed while under PoE load, as well as consideration for testing hybrid powered fiber.

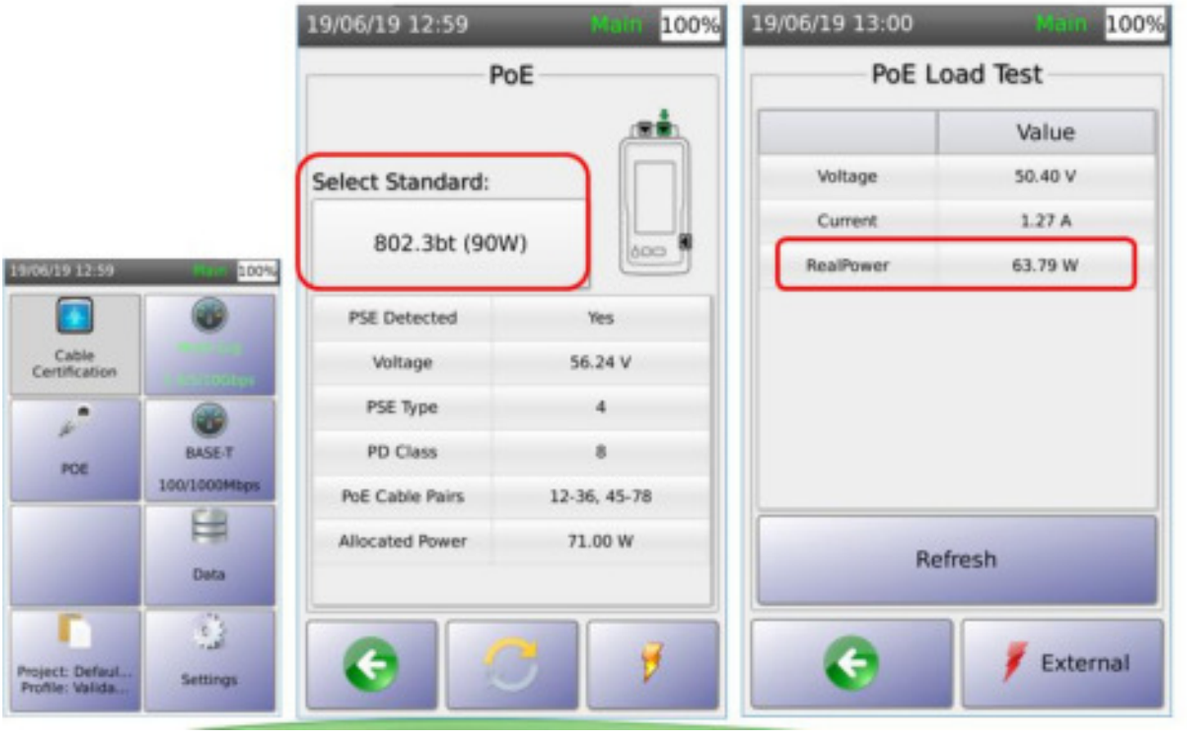


Figure 3: PoE Verification Test Showing PSE's Power Delivery Performance Including Actual Load Testing

2. Ensure that Network Performance is Not Impacted by PoE

Once it is established that the PSE is working properly, the next step is to make sure that network performance is not impacted because of the DC power transfer through the same cable. A test instrument capable of executing network performance test while also consuming PoE power provides this functionality. Performing this test is a direct confirmation that the PoE system actually works. Fig 4 shows a test instrument's screen while performing this test.

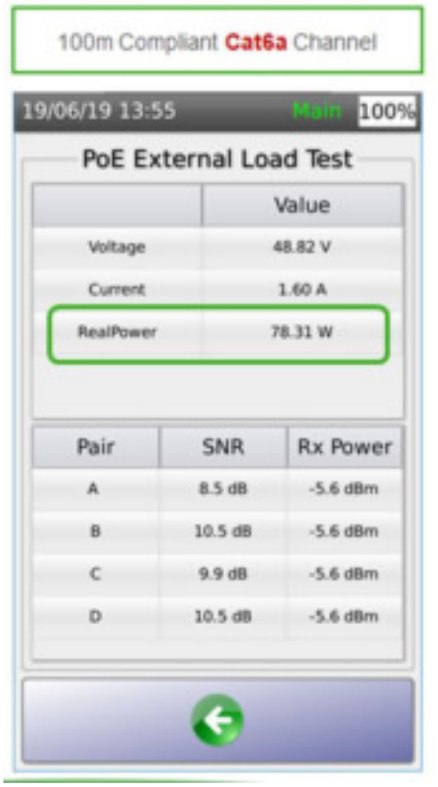


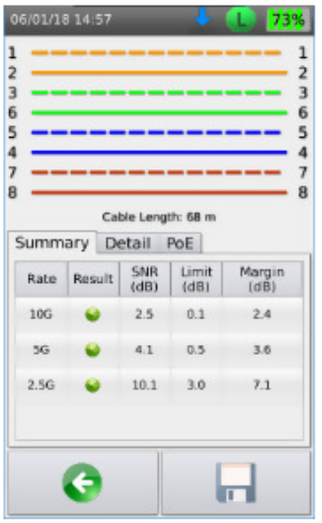
Figure 4: Testing Power Delivery and Network Performance Together

3. Adequacy of Cabling Infrastructure

The cabling must be good for supporting PoE. When working with pre-installed cabling, it is prudent to verify that the transmission performance of the cabling is adequate for network operation. In many cases, deployment of PoE is a part of deployment of multi-gigabit network.

A test instrument providing verification of multi-gigabit performance is the best tool for this purpose. This test can be performed in two ways. The instrument can be connected at the far end of cabling link with switch port connected to the other end. The test instrument offering autotest function can actually cycle through different data rates from 100 Mbps trough 10 Gbps and provide SNR measurements at each of these data rates.

In a second configuration, both ends of the cabling link can be connected to test instruments to perform multi-gigabit network autotest. Figure 5 shows test instrument screen displaying result of multi-gigabit test.



Multi-Gig Qualification

- Autotest qualifies which link speeds are supported with pass/fail indication of 1/2.5/5/10GigE data rates, even under sustained PoE++ load
- Per pair Signal-to-Noise Ratio (SNR) and Bit Error Rate (BER) reporting against default or user defined limits
- Integrated traffic generation and loopback to stress test cable links

Figure 5: Multi-Gigabit Autotest

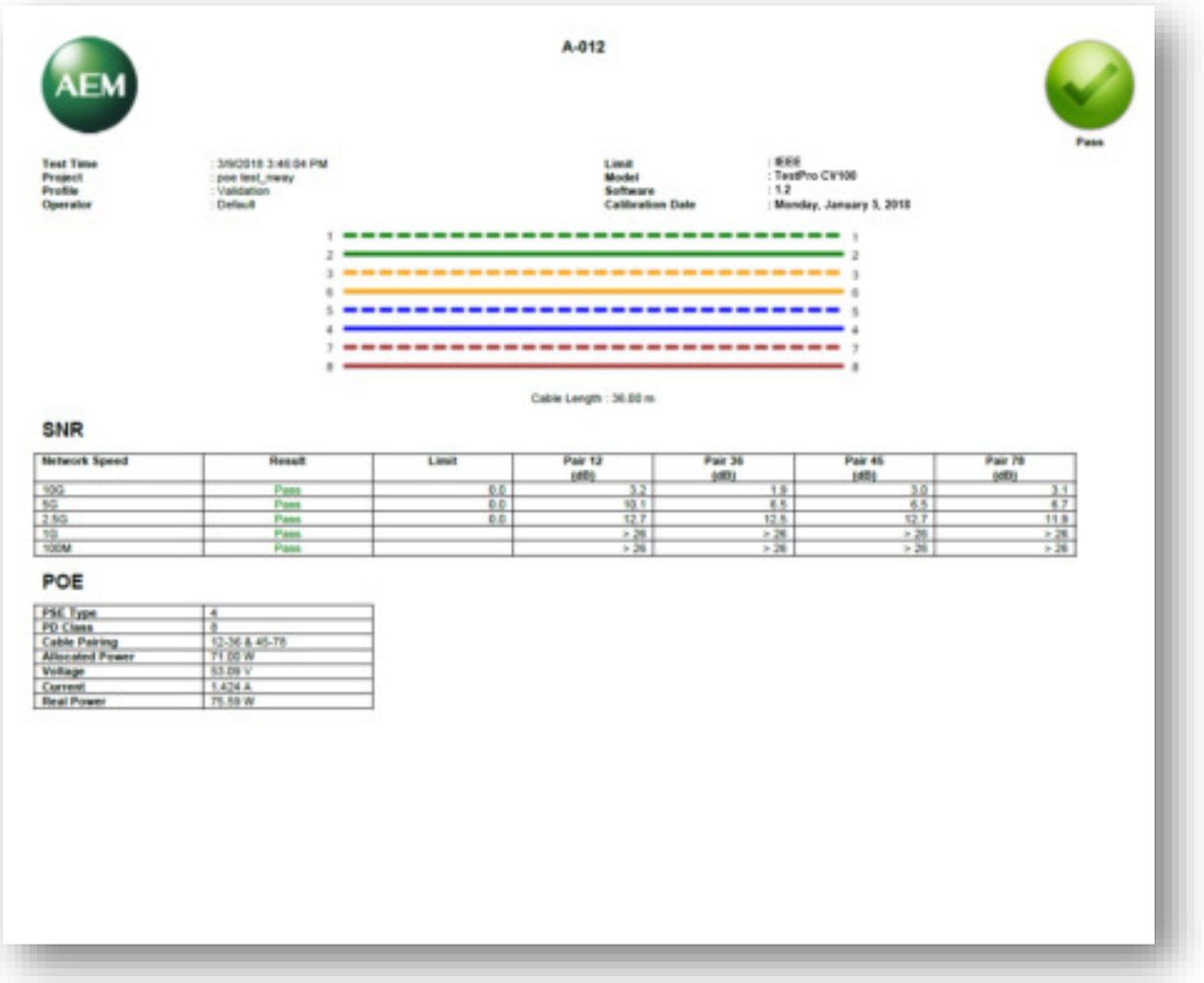
In addition to confirming network performance, ensuring DC resistance of the cable meets the specs for PoE operation is equally important. If pre-installed cabling is used, it was likely not tested for resistance requirements when it was installed (as the previous generation of the standards did not mandate resistance measurement).

Figure 6: Resistance and Resistance Unbalance Measurement

If newly installed cable is used, it is necessary to perform full certification autotest to ensure required DC and RF performance for PoE and network operation. A test instrument that integrates verification of PoE together with certification testing is ideally suited for this purpose.

REPORTING THE TEST RESULTS

It is important to report the PoE verification tests as well as certification test if performed. A test instrument that provides simple but informative test reporting for PSE verification provides traceability for future reference, in addition to providing a formal way to sign-off on projects. Fig 7 shows a typical PoE verification test report.



A-012

Pass

Test Time	: 3/9/2018 3:46:04 PM	Limit	: IEEE	
Project	: poe test_rway	Model	: TestPro CW100	
Profile	: Validation	Software	: 1.2	
Operator	: Default	Calibration Date	: Monday, January 1, 2018	

Cable Length : 36.00 m

SNR

Network Speed	Result	Limit	Pair 12 (dB)	Pair 36 (dB)	Pair 45 (dB)	Pair 78 (dB)
10G	Pass	0.0	3.2	1.9	3.0	3.1
5G	Pass	0.0	10.1	6.5	6.5	6.7
2.5G	Pass	0.0	12.7	12.5	12.7	11.9
1G	Pass		> 26	> 26	> 26	> 26
100M	Pass		> 26	> 26	> 26	> 26

POE

PSE Type	4
PD Class	8
Cable Pairing	12-36 & 45-78
Allocated Power	71.00 W
Voltage	53.09 V
Current	1.424 A
Real Power	75.59 W

Figure 7: PoE and Multi-gig Verification Test Report

CHALLENGES AND THE BLAME GAME

When PDs fail to work, the network admin, PoE device installer and cable certifier often find themselves arguing about who's at fault. To reduce this friction, network admins need to know the power demands being placed on their network, and the cabling contractors need to know how much power each of the devices will require and verify that the cables will be able to deliver that power (without impacting the data that's also flowing down the cable). If the PoE powering malfunctions, a combination of one or more of the following reasons might be at play.

- The switch is not able to provide the required power (it could be faulty, over-provisioned, or over-specified).
- The PD is consuming more power than specification.
- The cable is dissipating more power than expected or specified, which could be due to high resistance, link length exceeding specs, or thermal stress in the cable bundle.

If the PoE seems to work but the device does not achieve required data throughput, finding root cause can be even more challenging. Among many possible reasons, an unbalance of resistance between different conductors of the cable is known to be a major source of transformer saturation in the network interfaces. This degrades data throughput.

A well devised test strategy and the right choice of multifunction test instrument is key to avoid this blame game, and to find and fix problems quickly.

POWERED FIBER CABLING

Powered fiber cabling is increasingly used today. These cables comprise of a pair of fiber optic cables with a pair of copper conductors running in the same jacket for power delivery. New test instruments support fiber adapters that provide both fiber certification, and the ability to measure voltage on adjacent copper conductors carrying electrical voltage.

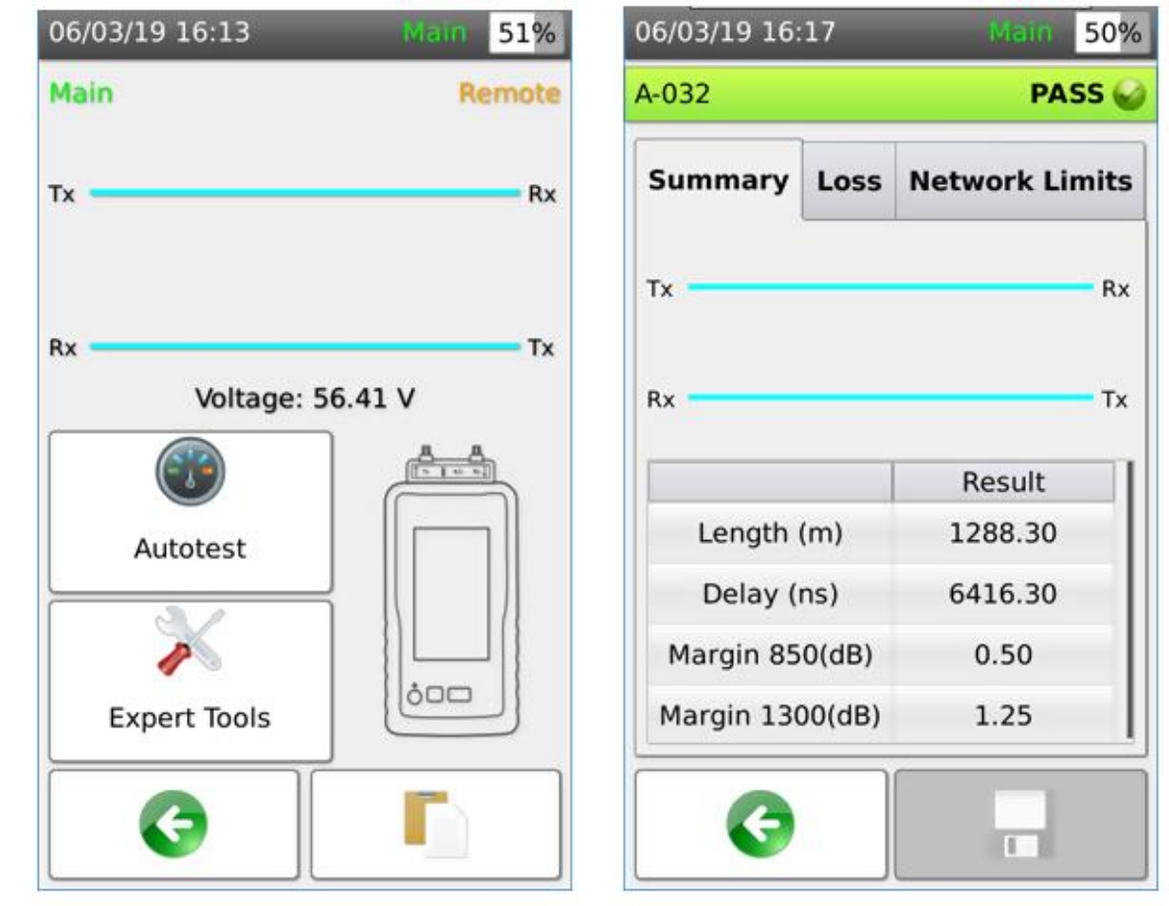


Figure 8: Testing Powered Fiber Cabling

FINALLY, KEY TIPS FOR INSTALLERS

What should you look for when shopping for a new multifunction cable tester? First, be sure it offers the most comprehensive set of capabilities, or that “triple crown” approach. For certifying cables, look for a tester that certifies as fast as possible (more links laid means more money, after all). Consider if you’ll have wireless internet access at the job site before you choose a cloud-based tool. For validating PoE, find a tester that supports all IEEE PoE standards, which include 802.3af/at/bt up to 90W to futureproof your investment. Here are some other key questions to consider when choosing a multifunction cable tester.

- Does it detect basic connectivity issues instantly with live wire map testing?
- Does it certify all cabling types you use?
- Can it test cable under power load to see how its properties change even over a sustained time period?
- Does it report power sourcing equipment configuration and powered pairs, voltage, current, and real power?
- Is it able to qualify multiple link speeds in order to qualify and support varying needs, such as 1/2.5/5/10 Gbits/sec?
- Does it offer stress testing of cable links?

Let’s face it, today’s networks are becoming more and more complex with the proliferation of IoT devices that require PoE and, in some cases, a specific link speed to operate. Therefore, more is needed from the test equipment you rely on to run your business and support your customers.

Without adequate testing for PoE and multi-gig link speed, you may wind up on the hook for an IoT device problem over which you have no control.

Make sure the cable testers you are using offer the features you need to support today’s digital infrastructure.

For More Information Visit Us Online at

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