University of New Hampshire InterOperability Laboratory
Power Over Ethernet Consortium

Superseded

As of October 6, 2003 the Power Over Ethernet Consortium Clause 33 Power Sourcing Equipment Parametric Conformance Test Suite version 1.2 has been superseded by the release of the Clause 33 Power Sourcing Equipment Parametric Conformance Test Suite version 1.7. This document along with earlier versions, are available on the Power Over Ethernet Consortium test suite archive page.

Please refer to the following site for both current and superseded test suites:

http://www.iol.unh.edu/testsuites/ethernet/archive.html

Power Over Ethernet

Power Sourcing Equipment
Parametric Test Suite

Technical Document

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MODIFICATION RECORD

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March 3, 2003- Draft 1.1 Veena Venugopal
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INTRODUCTION

Overview

The University of New Hampshire's InterOperability Laboratory (IOL) is an institution designed to improve the interoperability of standards based products by providing an environment where a product can be tested against other implementations of a standard. This suite of tests has been developed to help implementers identify problems that IEEE p802.3af D4.1 devices may have in establishing link and exchanging packets with each other. The tests do not determine if a product conforms to the IEEE p802.3af D4.0 standard. Rather, they provide one method to verify that the two devices can exchange packets within the bit error ratio specifications established by the IEEE p802.3af D4.1 standard when operating over a worst-case compliant channel. The interoperability test suite focuses on two areas of functionality to simulate a real-world environment: the exchange of packets to produce a packet error ratio that is low enough to meet a desired bit error ratio while power is being supplied over the link channel, and the ability to detect and establish a link at the optimal speed between two devices that make up a link segment while power is being supplied over the link channel. A third area covers specific cable testing.

Note: Successful completion of all tests contained in this suite does not guarantee that the tested device will operate with other compliant devices. However, combined with satisfactory operation in the IOL's interoperability test bed, these tests provide a reasonable level of confidence that the Device Under Test (DUT) will function well in most environments.

Cable Plants

The intent of interoperability testing is to ensure that the DUT will perform as expected in a real world network. Testing in a real world network is often variable. Each technology has a standard, which defines the allowable cable characteristics for that technology. To account for all of the possible cable plant scenarios in the real world, a "worst case cable plant" which is very close to the limit of the TIA/EIA cable standards is used. The cable plants are tuned to be between 1-5% above the margins specified in ANSI-TIA-EIA-568-B-2001 or other applicable specifications. A shorter patch cable is also included in testing to insure that short links between devices are also viable.

Organization of Tests

The tests contained in this document are organized to simplify the identification of information related to a test and to facilitate in the actual testing process. Each test contains an identification section that describes the test and provides cross-reference information. The discussion section covers background information and specifies why the test is to be performed. Tests are grouped in order to reduce setup time in the lab environment. Each test contains the following information:

Test Number

The Test Number associated with each test follows a simple grouping structure. Listed first is the Test Group Number followed by the test's number within the group. This allows for the addition of future tests to the appropriate groups of the test suite without requiring the renumbering of the subsequent tests.

Purpose
The purpose is a brief statement outlining what the test attempts to achieve. The test is written at the functional level.

References
The references section lists cross-references to the IEEE p802.3af D4.1 standard and other documentation that might be helpful in understanding and evaluating the test and results.

Resource Requirements
The requirements section specifies the hardware, and test equipment that will be needed to perform the test. The items contained in this section are special test devices or other facilities, which may not be available on all devices.

Last Modification
This specifies the date of the last modification to this test.

Discussion
The discussion covers the assumptions made in the design or implementation of the test as well as known limitations. Other items specific to the test are covered here.

Test Setup
The setup section describes the configuration of the test environment. Small changes in the configuration should be included in the test procedure.

Procedure
The procedure section of the test description contains the step-by-step instructions for carrying out the test. It provides a cookbook approach to testing, and may be interspersed with observable results.

Observable Results
The observable results section lists specific items that can be examined by the tester to verify that the DUT is operating properly. When multiple values are possible for an observable result, this section provides a short discussion on how to interpret them. The determination of a pass or fail for a certain test is often based on the successful (or unsuccessful) detection of a certain observable result.

Possible Problems
This section contains a description of known issues with the test procedure, which may affect test results in certain situations.

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Test Suites Related to PSE parametric testing

Scope: The following tests cover parametric tests specific to Power Sourcing Equipments that support 10BASE-T, 100BASE-TX, and 1000BASE-T devices.

Overview: These tests are designed to identify problems that IEEE p802.3af D4.1compliant devices may have in establishing link and exchanging packets with each other.

PSE 1: PSE Detection Circuit

Purpose: To verify the Thevenin equivalent detection circuit of the PSE detection source.

References:

- IEEE *Draft* Std 802.3af/D4.1, 2003 Edition: Sections 33.2.5 and Figures 33-8, 33-9

Resource Requirements:

- 45kΩ test load
- Current Source
- Current Meter
- Oscilloscope

Last Modification: March 4, 2003

Discussion: The PSE should detect the PD via the PSE PI. The PSEs detection circuit should have a Thevenin equivalent circuit consistent with Figure 33-8 or 33-9 in all detection states. This is intended to prevent a PSE to PSE connection from detecting a valid PD signature.

Test Setup:

PSE Detection Source (Figure 33-8): Connect the PSE to the PD simulator with a 1m length of Category 5 cable. An oscilloscope is connected across the PI of the PD simulator. A 45kΩ load is attached to the PDs PI.

Alternative PSE Detection Source (Figure 33-9): Connect the PSE to the PD simulator with a 1m length of Category 5 cable. A current meter is connected to the PI of the PD simulator. A current source is connected to the PI of the PD simulator to inject current to the $V_{detect+}$ port.

Procedure:

1. Connect the current source to the PI
2. Measure the current flowing into the $V_{detect+}$ port of the PSE
3. If current was not accepted in step 2, measure the maximum output voltage of the open circuit PI. Otherwise, the test is complete.
4. Disconnect the current source
5. Connect the 45kΩ test load to the PI
6. Measure the maximum output voltage of the loaded PI

Observable Results:

a. If the DUT does not accept current into the Vdetect+ port, the DUT follows Figure 33-9. Otherwise, the DUT should accept current into the Vdetect+ port, the DUT should show a loaded PI voltage of less than half of the open circuit PI voltage, according to Figure 33-8.

Possible Problems: None

PSE 2: Backdrive Current

Purpose: To verify the detection circuit of the PSE can withstand maximum backdrive current at maximum voltage.

References:

- IEEE *Draft* Std 802.3af/D4.1, 2003 Edition: Subclause 33.2.5, Table 33-5

Resource Requirements:

- Current Source
- PD Simulator

Last Modification: March 4, 2003

Discussion: The PSE must be able to handle a PSE to PSE connection. This is specified as being a backdrive current of 5mA at a voltage corresponding to V_{Port}. In order to test the maximum limits, the maximum value of V_{Port} as specified in table 33-5 should be used. After the maximum backdrive current has been applied, the DUT should still be capable of detecting an attached PD.

Test Setup: Connect the PSE to the PD simulator with a 1m length of Category 5 cable. Connect a current meter to the PI of the PD simulator. Connect a current source to the PI of the PD simulator.

Procedure:

1. Using the 5mA source, inject a current into the PSEs $V_{detect+}$ port for 10 seconds.
2. Disconnect the current source from the PSE and attach a valid PD signature
3. Observe if the PSE correctly detects the PD and supplies power
4. Disconnect the valid PD
5. Re-connect the current source and inject current into the PSEs $V_{detect-}$.
6. Disconnect the current source
7. Re-connect the PSE to a valid PD
8. Observe if the PSE correctly detects the PD and supplies power

Observable Results:

- In step 3, the DUT should properly detect a PD signature.
- In step 5, the DUT should not be affected by the backdrive current.
- In step 8, the DUT should properly detect a PD signature.

Possible Problems: None.

PSE 3: Detector Circuit Output Current

Purpose: To verify that the short circuit output current of the PSE during PD detection conforms to the specifications defined in Table 33-2.

References:

- IEEE *Draft* Std 802.3af/D4.1, 2003 Edition: Subclause 33.2.5, Table 33-2

Resource Requirements:

- PD Simulator
- Oscilloscope
- Current meter

Last Modification: March 4, 2003

Discussion: The PSE should limit its output current during detection such that in the event of a short circuit condition the PSE will not be damaged. The output current for the PSE detection circuit should conform to the values in Table 33-2. This value assures the PSE and any attached media will not be damaged.

Test Setup: Connect the DUT to the PD simulator configured as a short circuit.

Procedure:

1. Using the current probe, measure the short circuit current at the PI.
2. Repeat step 1 for all probe voltages sourced by the DUT.

Observable Results:

- In step 1, the short current should not exceed 5 mA.

Possible Problems: None

PSE 4: Detector Circuit Output Voltage

Purpose: To verify the voltage output of the PSE detection circuit conforms to the specifications defined in Table 33-2.

- **References:** IEEE *Draft* Std 802.3af/D4.1, 2003 Edition: Subclause 33.2.5, Table 33-2

Resource Requirements:
- PD Simulator
- Oscilloscope

Last Modification: March 4, 2003

Discussion: The PSE should detect the PD by probing via the PSE PI. When a valid PD signature is connected, the detection voltage Vdetect should be within the Vvalid voltage range at the PSE PI as specified in Table 33-2. The loaded circuit values are measured with a valid PD signature attached to the PSE. The PSE should make at least 2 measurements with Vdetect values that create at least a ΔVtest difference as specified in Table 33-2. The PSE should measure the voltage or current after Vdetect has settled to within 1% of its steady state condition. These values assure the PSE will not overload an attached device.

Test Setup: Connect the DUT to a high impedance probe to measure the open circuit voltages sourced by the PSEs detection circuit. Connect the PSE to the PD simulator to test the probe voltages when a load is attached.

Procedure:
1. Using the oscilloscope, measure the open circuit voltage at the PI.
2. Attach the PD simulator to the PI.
3. Using the oscilloscope, measure the probe voltage at the PI.
4. Using the oscilloscope, measure the slew rate of the probe voltages.
5. Repeat steps 3 & 4 for each probing voltage supplied by the DUT.

Observable Results:
- In step 1, the open circuit voltage seen at the PI should be less than or equal to 30 volts.
- In step 3, the loaded PI output detection voltages should be between 2.8 and 10 volts.
- In step 4, the slew rate of the probe voltages should be less than or equal to 0.1 V/μs
- In step 5, the voltage difference between consecutive detection probe voltages should be at least 1 volt.

Possible Problems: None

PSE 5: PD Signature Detection Limits

Purpose: To verify that the DUT will properly detect a PD's Signature Impedance.

References:

- IEEE *Draft* Std 802.3af/D4.1, 2003 Edition: Subclause 33.2.6; Figures 33-8, 33-9

Resource Requirements:

- PD Simulator
- Voltmeter

Last Modification: March 4, 2003

Discussion: The PSE should be able to detect the signature impedance of an attached PD. This detection is accomplished by probing the PD via the PI. From this signature, the PSE should determine whether or not to supply power to the attached PD. The PSE should only provide power if the PD presents a signature which is compliant with Table 33-2; otherwise, the PSE should not supply power onto the PI.

Test Setup: Connect the PSE to the PD Simulator with a 1m length of Category 5 cable.

Procedure:

Part a: Input Resistance Minimums

1. Adjust the PD simulator to have a valid input signature capacitance (2nF)
2. Increase the signature resistance from R_{bad}min until the DUT supplies power to the PD
3. Record the value at which the PSE accepts the PD signature resistance.
4. Decrease the signature resistance below R_{good}min until the DUT does not supply power to the PD
5. Record the value at which the PSE rejects the PD signature resistance.

Part b: Input Resistance Maximums

6. Increase the signature resistance above R_{good}max until the DUT does not supply power to the PD
7. Record the value at which the PSE rejects the PD signature resistance.
8. Decrease the signature resistance from R_{bad}max until the DUT supplies power to the PD
9. Record the value at which the PSE accepts the PD signature resistance.

Part c: Input Capacitance "Must Accept"

10. Set the PD signature model to have a resistance between R_{good}min and R_{good}max (22kΩ)
11. Set the PD signature model to have a capacitance of C_{sig}max (119nF)
12. Connect the PD signature model to the PI of the PSE and observe the voltage at the PI

Part d: Input Capacitance "Must Reject"

13. Set the PD signature model to have a capacitance of greater than C_{bad}min (10.5μF)

14. Connect the PD signature model to the PI of the PSE and observe the voltage at the PI

Observable Results:

a. In step 3 and 5, the resistance should be between 15kΩ and 19kΩ
b. In step 7 and 9, the resistance should be between 26.5kΩ and 33kΩ
c. In step 12, the DUT should accept the PD signature and provide power
d. In step 14, the DUT should reject the PD signature and not provide power

PSE 6: PSE Classification

Purpose: To verify a PSE supporting classification properly performs PD class detection.

Reference:

[1] IEEE *Draft* Std 802.3af/D4.1, 2003 Edition: Subclause 33.2.7.1,33.2.7.2, Table 33-4, Table 33-3, Table 33-6, Figure 33C.19, Annex 33C.4.

Resource Requirements:

- PD simulator
- Oscilloscope

Last Modification: March 4, 2003

Discussion: The PSE may attempt to classify the PD, and the PD may provide information, to allow features such as load management to be implemented. The PSE should probe the PD with a voltage between 15 and 20 volts limited to 100 mA The PSE should measure I_{Class} and classify the PD based on the observed current as per Table 33-4.

Test Setup: Connect the PSE to the PD simulator with a 1m length of Category 5 cable.

Procedure:

1. Set the load resistance to the minimum.
2. Measure V_{Class} using an oscilloscope before T_{pdc}.
3. Measure the current I_{Class} .
4. Vary the resistance stepwise to draw the different levels of current.
5. After the classification time (T_{pdc}), measure the voltage (V_{Port}) across the PD model.
6. Compute the power at the output of the PSE.

Observable Results:

a. In step 2 the PSE should supply voltage between 15-20 Volts.
b. In step 3 if the I_{Class} is greater than or equal to 47mA the PSE should not power the PD.
c. In step 3 the PSE should accurately classify the PD.
d. In step 4 the PSE should supply current not higher than 100 mA.
e. In step 6 the PSE should supply appropriate power after classification of the PD as per Table 33-3.

Possible Problems: If the PSE does not perform classification, then the PSE should assign the PD to Class 0.

PSE 7: PSE Classification timing

Purpose: To verify that a PSE capable of classifying a PD should complete the classification within Tpdc after successfully completing the detection of a PD.

References:

- IEEE *Draft* Std 802.3af/D4.1, 2003 Edition: Subclause 33.2.8, Table 33-5

Resource Requirements:

- Oscilloscope
- PD Simulator

Last Modification: March 4, 2003

Discussion: After successful detection of a PD, and if the PSE supports classification, then it must complete classification within the time frame of $T_{pdc.}$ The classification should occur anytime within the time frame of T_{pon}. If the PSE fails to power the PD within T_{pon}, it must reinitiate the detection and optional classification sequence.

Test Setup: Connect the PSE to the PD simulator with a 1m length of Category 5 cable.

Procedure:

1. Measure the delay from the time that the DUT initiates classification to the time that it has completed one classification cycle by measuring the width of the classification pulse.

Observable Results:
In step 1 the time delay should be less than T_{pdc}.

Possible Problems: None.

PSE 8: PD MPS Dropout Time Limits (I_{Min} measurement)

Purpose: To verify that the PSE correctly monitors the PD Maintain Power Signature.

References:

- IEEE *Draft* Std 802.3af/D4.1, 2003 Edition: Subclause 33.2.8.6 and Table 33-5

Resource Requirements:

- PD Simulator
- Oscilloscope

Last Modification: March 4, 2003

Discussion: The PSE must monitor the link segment for the PD's Maintain Power Signature, and remove power if it detects that the PD is disconnected. There are two methods specified for determining this: Option "a" ensures detection of a disconnect by monitoring current drawn; Option "b" ensures detection of a disconnect by monitoring the AC impedance. If the PSE implements Option "a", the DUT should remove power from the PI if the current drawn by the PD drops below 5mA for more than T_{MPDO}. This test is only applicable for devices which implement Option "a".

Test Setup: Connect the PSE to the PD Simulator with a 1m length of Category 5 cable.

Procedure:

1. Set the PD Simulator to draw 20mA of current from the PSE
2. Decrease the current draw of the simulated PD to below 9mA for 500ms or more.
3. Observe the output voltage of the DUT.
4. If the PSE has not disconnected power, reduce the current to below 4mA for 500ms or more.
5. Observe the output voltage of the DUT.

Observable Results:

a. In Step 3, the DUT may disconnect power from the PI.
b. In Step 5, the DUT must disconnect power from the PI.

Possible Problems: If the DUT does not implement Option "a", the DUT may never remove power.

PSE 9: PD MPS Dropout Time Limits

Purpose: To verify that the PSE correctly monitors the PD Maintain Power Signature.

References:
- IEEE *Draft* Std 802.3af/D4.1, 2003 Edition: Subclause 33.2.8, 33.2.10 and Table 33-5

Resource Requirements:
- PD Simulator
- Oscilloscope

Last Modification: March 4, 2003

Discussion: The PSE must monitor the link segment for the PD's Maintain Power Signature, and remove power if it detects that the PD is disconnected. There are two methods specified for determining this: Option "a" ensures detection of a disconnect by monitoring current drawn; Option "b" ensures detection of a disconnect by monitoring the AC impedance. If the PSE implements Option "a", the DUT should remove power from the PI if the current drawn by the PD drops below 5mA for more than T_{MPDO}. This test is only applicable for devices which implement Option "a".

Test Setup: Connect the PSE to the PD Simulator with a 1m length of Category 5 cable.

Procedure:
1. Adjust the PD Simulator to have a current draw of 15mA.
2. Reduce the current drawn by the PD to 2mA for $t < T_{MPDO}$.
3. Observe the voltage output of the PSE at the PI.
4. Repeat Steps 2 and 3, using a reduced t, to find the minimum time which the PSE will continue sourcing power to the PD.

Observable Results:
- The PSE should disconnect power for times greater than 400ms
- The PSE should maintain power for times less than 300ms
- The PSE may disconnect power for times between 300 and 400ms

Possible Problems: If the DUT does not implement Option "a", this test cannot be performed.

PSE 10: Power Feed Ripple and Noise

Purpose: To verify the power feeding ripple and noise are below the specified amount.

References:

- IEEE *Draft* Std 802.3af/D4.1, 2003 Edition: Subclause 33.2.10 and Table 33-5

Resource Requirements:

- Oscilloscope
- PD Simulator
- Voltmeter
- Current Meter

Last Modification: March 4, 2003

Discussion: The PSE should source power at all rated levels with noise and ripple which are below the levels specified in Table 33-5. Excessive noise may cause attached PDs to behave abnormally.

Test Setup: Connect the PSE to the PD simulator with a 1m length of Category 5 cable.

Procedure:

1. Adjust the PD to sink .44 watts.
2. Measure the amount of pair-to-pair ripple and noise voltage at the PD.
3. Measure the amount of common-mode ripple and noise voltage at the PD.
4. Adjust the PD to sink 15.4 watts.
5. Repeat steps 3 and 4.

Observable Results:

- The ripple and noise peak-to-peak voltages, pair-to-pair and common-mode, in the band 0-500Hz will be less than .5 volts
- The ripple and noise peak-to-peak voltages, pair-to-pair and common-mode, in the band 500Hz-150kHz will be less than .2 volts
- The ripple and noise peak-to-peak voltages, pair-to-pair and common-mode, in the band 150kHz-500kHz will be less than .15 volts
- The ripple and noise peak-to-peak voltages, pair-to-pair and common-mode, in the band 500kHz-1MHz will be less than .1 volts

Possible Problems: None.

PSE 11: Load Regulation

Purpose: To verify that the PSE performs load regulation while supplying power to the PI.

References:

- IEEE *Draft* Std 802.3af/D4.1, 2003 Edition: Subclause 33.2.8, Table 33-5

Resource Requirements:

- PD Simulator
- Oscilloscope

Last Modification: March 4, 2003

Discussion: The PSE should perform voltage regulation while supplying power to a PD over the PI. This requires that if the load changes at a maximum rate of 35mA/µs, the output voltage of the PSE should stay between 44 and 57 volts. The PSE must also not produce any transients greater than 3.5V/µs. These requirements prevent the voltage supply from exceeding the operating range of a PD.

Test Setup: Connect the PSE to the PD Simulator with a 1m length of Category 5 cable.

Procedure:

1. Connect the PSE to the PD simulator with a valid signature and the load set to draw 10mA.
2. Connect the Oscilloscope to the PI of the PD.
3. Adjust the current draw of the PD from 10mA to 350mA in less than 9.7µs.
4. Observe the voltage transients and output voltage of the PSE at the PI.

Observable Results:

a. The voltage transients seen should not exceed 3.5V/µs.
b. The PSE output voltage at the PI should be within the range of 44 to 57 volts.

PSE 12: Power turn on timing

Purpose: To verify that the PSE starts applying power within T_{pon} after it has successfully detected the PD.

References:
- IEEE *Draft* Std 802.3af/D4.1, 2003 Edition: Subclause 33.2.8.15, Table 33-5

Resource Requirements:
- Oscilloscope
- PD Simulator

Last Modification: March 4, 2003

Discussion: The PSE must power on the PD after detection and optional classification within T_{pon}. If the PSE supports classification then it must successfully complete classification within the time frame of $T_{pdc.}$ If the PSE fails to power the PD within T_{pon}, it must reinitiate the detection and optional classification sequence.

Test Setup: Connect the PSE to the PD simulator with a 1m length of Category 5 cable.

Procedure:
1. Confirm that the detection of the PD has been successfully completed.
2. Measure the time delay between the end of detection and when the PSE starts applying power.

Observable results:
a. In step 2 the time delay should be less than T_{pon}.

Possible Problems: None.

PSE 13: PSE Apply power

Purpose: To verify that the PSE does not apply power before completing detection of a PD. The PSE must apply power on the same pairs as those used for detection.

References:

- IEEE *Draft* Std 802.3af/D4.3, 2002 Edition: Subclause 33.2.4, 33.2.5.

Resource Requirements:

- PD Simulator
- Oscilloscope

Last Modification: July 1, 2003

Discussion: A PSE detects the PD by probing it via the PSE's PI. A PSE should apply power only after it has completed the detection of a PD. The power should be supplied on the same pairs as those used for detection.

Test Setup: Connect the PSE to the PD simulator with a 1m length of Category 5 cable. Connect the oscilloscope to the PD simulator.

Procedure:

1. Supply a valid signature at the DUT's PI for a time approximately equal to T_{det} of the DUT.
2. Observe the waveform on the oscilloscope.
3. Confirm that the DUT performs valid detection sequence before powering the PD simulator.
4. Check the pairs on which DUT supplies power

Observable Results:

- In Step 3, the DUT must power the PD simulator only after a proper detection sequence.
- In Step 4, the DUT should supply power on the same pairs as that it performed detection for the PD simulator.

Possible Problems: None

Test # 33.2.8.6 Overload current detection range and time limit

Purpose: To verify that the PSE waits for at least the minimum MPS validity time

References:
- IEEE *Draft* Std 802.3af/D4.3, 2002 Edition: Subclause 33.2.8.6,33.2.8.7 3.2.10.1.2, Table 33-5, Figure 33C.6

Resource Requirements:
- PD Simulator
- Oscilloscope
- Current probe

Last Modification: July 10, 2003

Discussion:
The PSE monitors the current (I_{Port}) drawn by the PD. If I_{Port} exceeds the overload current detection range I_{CUT} (P_class /44V to 400mA) for greater than T_{ovld}, the PSE should remove power from its PI. If the PSE does not implement classification then I_{CUT} should lie within the range of (15.4/Vport) to 400mA. Please refer to 33C.6 for more details.

Test Setup: Connect the DUT to the PD simulator with a 1m length of Category 5 cable. Connect the oscilloscope to the PD simulator.

Procedure:

Part a: Overload current detection range

3. Verify that the PD is drawing current greater than or equal to I_{Min} from the DUT.
4. Measure the Vport at the PI of the PSE.
5. If 44V<=Vport<=57V then connect the load to the DUT.
6. Decrease the load resistance gradually till the DUT removes power from its PI.
7. Measure the current at which the DUT stops supplying power

Part b: Overload time limit

1. Verify that I_{CUT} is within the permissible limits as specified in the discussion.
2. Reconnect the PD to the DUT with the load set to maximum.
3. Vary the load till the Iport >I_{CUT} .
4. Disconnect the load
5. Set the trigger on the PD simulator to connect the load to the DUT for a period of 50ms.
6. Repeat step 5 and increase the time in steps of 5 ms till 75ms.
7. Record the time interval when the DUT removes power.

Observable Results:

Part a:
1. In Step 2, verify that the voltage at the PI of the DUT is between 44 to 57V(inclusive).
2. In Step 5, if the DUT supports classification, then I_{CUT} should be between P_class/44 to 400mA, else verify that I_{CUT} is between15.4/Vport and 400mA(inclusive).

Part b:

1. In Step 7, T_{ovld} should be between 50ms and 75ms(inclusive).

Possible Problems: None

Test # 33.2.8.5 Inrush current and short circuit time limit

Purpose: To verify that the PSE will start removing power from the PI within T_{LIM} when it detects a short circuit condition.

References:

- IEEE *Draft* Std 802.3af/D4.3, 2002 Edition: Subclause 33.2.8.9, Table 33-5, Figure 33C.6, 33C.4, Annex 33C1.4

Resource Requirements:

- PD Simulator
- Oscilloscope
- Current probe

Last Modification: July 18, 2003

Discussion:
The PSE monitors the current (I_{Port}) drawn by the PD. If the PD detects a short circuit condition, it must start removing power within T_{LIM} and must be done by $T_{Off.}$ The minimum inrush current applies for duration of $T_{LIM.}$ During startup, for PI voltages greater than 30 V the inrush current must be between 400mA and 450mA. For PI voltages between 10V and 30V, the inrush current must be at least 60mA.

Test Setup: Connect the PSE to the PD simulator with a 1m length of Category 5 cable. Refer to Figure 33C.3 for a more detailed test setup.

Procedure:

8. Connect the large capacitive load by closing switch S1.
9. Measure V_{Port} at the PI of the PD.
10. Set Vz to 30 V.
11. Measure I_{Port} at the PI of the DUT.
12. Discharge capacitive load and reset S1.
13. Set Vz to 10 V.
14. Measure I_{Port} at the PI of the DUT.

Observable Results:

1. Verify that the PSE removes power within T_{LIM} after the switch S1 was closed.
2. In Step 4, the inrush current at the PI of the DUT must be between 400 to 450mA (inclusive).
3. In Step 7, verify that the inrush current is at least 60mA.

Possible Problems: None

Test # 33.2.10.1.2 PD MPS time for validity (DC MPS component)

Purpose: To verify that the PSE waits for at least the minimum MPS validity time

References:
- IEEE *Draft* Std 802.3af/D4.3, 2002 Edition: Subclause 33.2.10, 3.2.10.1.2, Table 33-5, Figure 33-7

Resource Requirements:
- PD Simulator
- Oscilloscope
- Current probe

Last Modification: July 8, 2003

Discussion: The specification for T_{MPS} applies only to PSE that monitors DC MPS component. The PSE must not remove power if the current drawn by a PD is greater than or equal to the maximum value of I_{Min2} (10mA) for at least T_{MPS} every T_{MPS} +T_{MPDO} (60+300msec).

Test Setup: Connect the PSE to the PD simulator with a 1m length of Category 5 cable. Connect the oscilloscope to the PD simulator.

Procedure:

15. Verify that the DUT is supplying power to the PD simulator.
16. Confirm that the PD simulator is drawing more than 10 mA.
17. Set the PD simulator to draw less than 5 mA for 300ms.
18. Set the PD simulator to draw more than 10 mA for a period of 65ms and then drop the current back to less than 5 mA for the next 300ms.
19. Repeat step 3 and 4.
20. Measure the Vport at the PI of the DUT.

Observable Results:
- In Step 6, the DUT must not remove power from its PI.

Possible Problems: This test does not apply if the DUT performs only MPS AC disconnect.

PSE 10: PSE PI Voltage (AC Disconnect Detection)

Purpose: To verify that the PSE that implements AC MPS component meets the PSE PI voltages during AC disconnect detection.

References:

- IEEE *Draft* Std 802.3af/D4.3, 2003 Edition: Subclause 33.2.10.1.1 and Table 33-5, 33-6, Figure 33-10,33-11.

Resource Requirements:

- PD Simulator
- Oscilloscope

Last Modification: July 23,2003

Discussion: The PSE must monitor the link segment for the PD's Maintain Power Signature, and remove power if it detects that the PD is disconnected. The PSE may monitor either AC MPS component or the DC MPS component or both. A PSE that monitors the AC MPS component should meet the PSE PI voltage during AC disconnect detection as specified in group 3a and 3b of Table 33-6.

Test Setup: Connect the DUT to the PD Simulator with a 1m length of Category 5 cable.

Procedure:

6. Attach a valid signature (less than or equal to |Zac1|) to the PI of the DUT.
7. Confirm that the DUT is supplying power at its PI.
8. Measure the ripple voltage at the PI of the DUT.

Observable Results:

c. In Step 2, the DUT should supply power to the PD simulator.
d. In Step 2, the voltage at the PI of the DUT should be less than 60V.
e. In Step 3, the ac ripple voltage should be less than 0.5Vpp.

Possible Problems: This test does not apply to PSE that monitors only DC MPS components.

Test 33.2.10.1.2-3: PSE AC MPS Signature

Purpose: To verify that the PSE that implements AC MPS component correctly monitors the PD Maintain Power Signature.

References:

- IEEE *Draft* Std 802.3af/D4.3, 2003 Edition: Subclause 33.2.10.1.1 and Table 33-5, 33-6, Figure 33-10,33-11.

Resource Requirements:

- PD Simulator
- Oscilloscope

Last Modification: June 27,2003

Discussion: The PSE must monitor the link segment for the PD's Maintain Power Signature, and remove power if it detects that the PD is disconnected. The PSE may monitor either AC MPS component or the DC MPS component or both. A PSE that monitors AC MPS component will remove power it if detects an AC impedance at the PI equal to or greater than |Zac2| as defined in Table 33-6. It may or may not remove power if it detects an AC impedance between |Zac1| and |Zac2|. The PSE will maintain power if it detects an impendence less than or equal to |Zac1|.

Test Setup: Connect the DUT to the PD Simulator with a 1m length of Category 5 cable.

Procedure:

9. Attach a valid signature (less than or equal to |Zac1|) to the PI of the DUT.
10. Confirm that the DUT is supplying power at its PI.
11. Increase the impedance connected to the PI of the DUT from 25KΩ to 2MΩ.
12. Measure the Vport after 400msec.
13. If 44V<= Vport<=60V then repeat step 11 and 12.
14. Record the value of impedance (Z) at which the DUT removes power from its PI.

Observable Results:

f. In Step 2, the DUT should supply power to the PD simulator.
g. In Step 14, the DUT removes power within $T_{MPDO.}$
h. In Step 14, the impedance (Z) should be between 27KΩ and 1980KΩ (inclusive).

Possible Problems: If the DUT does not implement AC MPS disconnect it may never remove power.

Test # 33.2.4 PSE Apply power

Purpose: To verify that the PSE does not apply power before completing detection of a PD. The PSE must apply power on the same pairs as those used for detection.

References:

- IEEE *Draft* Std 802.3af/D4.3, 2002 Edition: Subclause 33.2.4, 33.2.5.

Resource Requirements:

- PD Simulator
- Oscilloscope

Last Modification: July 1, 2003

Discussion: A PSE detects the PD by probing it via the PSE's PI. A PSE should apply power only after it has completed the detection of a PD. The power should be supplied on the same pairs as those used for detection.

Test Setup: Connect the PSE to the PD simulator with a 1m length of Category 5 cable. Connect the oscilloscope to the PD simulator.

Procedure:

21. Supply a valid signature at the DUT's PI for a time approximately equal to T_{det} of the DUT.
22. Observe the waveform on the oscilloscope.
23. Confirm that the DUT performs valid detection sequence before powering the PD simulator.
24. Check the pairs on which DUT supplies power

Observable Results:

- In Step 3, the DUT must power the PD simulator only after a proper detection sequence.
- In Step 4, the DUT should supply power on the same pairs as that it performed detection for the PD simulator.

Possible Problems: None

Test # 33.2.3.1 New Detection Cycle

Purpose: To verify that if the PSE is unable to supply power within T_{pon} then, it initiates and successfully completes a new detection cycle before powering on.

References:

- IEEE *Draft* Std 802.3af/D4.3, 2002 Edition: Subclause 33.2.3.1, Table 33-5.

Resource Requirements:

- PD Simulator
- Oscilloscope
- Digital Multimeter

Last Modification: May 1, 2003

Discussion: The PSE may apply power after a valid sequence of detection and optional classification. However if the PSE is unable to supply power within a time interval of Tpon, then it must initiate a new valid detection cycle before applying power.

Test Setup: Connect the PSE to the PD simulator with a 1m length of Category 5 cable. Connect the oscilloscope to the PD simulator.

Procedure:

25. Supply a valid signature at the DUT's PI for a time approximately lesser than the Tpon of the DUT.
26. Connect an invalid signature at the DUT's PI for at least 2sec.
27. Reconnect the valid signature at the DUT's PI.
28. Observe the waveform on the oscilloscope.
29. Measure the detection time.
30. Measure the Tpon

Observable Results:

- In step 4, the DUT must initiate a new valid detection cycle before it attempts to power the PD simulator.
- In step 5, the detection time must be less than or equal to 500ms.
- In step 6,Tpon must be less than or equal to 400ms.

Possible Problems: None

Test # 33.2.3.1-2 Alternative B Backoff Cycle

Purpose: To verify that if the PSE that implements Alternative B fails to detect a valid detection signature at its PI, it will back off for no less than T_{dbo} and apply a voltage less that 2.8Vdc during the backoff .

References:

- IEEE *Draft* Std 802.3af/D4.3, 2002 Edition: Subclause 33.2.3.1, Table 33-5.

Resource Requirements:

- PD Simulator
- Oscilloscope
- Digital Multimeter

Last Modification: May 1, 2003

Discussion: A PSE that implements Alternative B will backoff for a time interval greater than T_{dbo} if it fails to detect a valid signature at its PI. During this time period, the PSE must not apply a voltage greater than 2.8Vdc to the PI. The PSE that implements Alternative B detection must not resume detection mode until at least one backoff cycle has elapsed.

Test Setup: Connect the PSE to the PD simulator with a 1m length of Category 5 cable. Connect the oscilloscope to the PD simulator.

Procedure:

31. Connect an invalid signature at the DUT's PI.
32. Measure the time between consecutive detection sequences.

Observable Results:

- In step 2, the DUT must not apply a voltage greater than 2.8 Vdc at its PI.
- In step 2, the DUT must not resume detection before 2 sec

Possible Problems: This test does not apply to a PSE that is implementing Alternative A.