

IEEE802.3poep Study Group Revision of isolation requirements in IEEE802.3 clause 33.

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Objectives

- To address objective 12 from May 2005, IEEEpoep meeting
- To provide clear definition of isolation requirements and electric strength test procedures in IEEE802.3 clause 33 standard (IEEE802.3af)

What is a hipot test ?

- The hipot test is a nondestructive test that determines the adequacy of electrical insulation for the normally occurring over-voltage transient. This is a high-voltage test that is applied to all devices for a specific time in order to ensure that the insulation is not marginal
- Electrical safety tests can be roughly divided into two areas: those tests carried out during the approvals process by test houses (known as type tests) and those carried out at the end of each production line by the manufacturer (known as routine production tests).
- For type tests hipot applies for 60 sec, it is permitted for routine tests to reduce duration of hipot test to 1 sec

What are the problems

- Definition of isolation requirements in IEEE 802.3af is not clear.
- Removing DC hipot options from latest version of IEEE802.3af caused significant disturbances and misunderstanding in the industry
- Many manufacture believe wrongly that DC hipot testing is not applicable to POE because it was removed from the standard. But in the same time, UL 60950-1 and 10/100/1000 BASE T standards allow to perform DC hipot test.

-Therefore, now we have a conflict :UL, 10/100/1000 BASE T standards and IEEE802.3af are addressing the same safety hazard (over voltage transient) but using different procedures.

Current text of IEEE802.3af Clause 33.4.1 Isolation

33.4.1 Isolation

The PSE shall provide electrical isolation between the PI device circuits, including frame ground (if any), and all PI leads.

The PD shall provide electrical isolation between all external conductors, including frame ground (if any), and all PI leads.

This electrical isolation shall be in accordance with the isolation requirements between SELV circuits and telecommunication network connections in subclause 6.2 of IEC 60950-1:2001.

This electrical isolation shall withstand at least one of the following electrical strength tests:

- a) 1500 Vrms steady-state at 50-60 Hz for 60 seconds, applied as specified in subclause 6.2 of IEC 60950-1:2001.
- b) An impulse test consisting of a 1500 V, 10/700 μ s waveform, applied 10 times, with a 60 second interval between pulses, applied as specified in subclause 6.2 of IEC 60950-1:2001.

DC TEST ALTERNATIVE – WAS DELETED

There shall be no insulation breakdown, as defined in subclause 6.2.2.3 of IEC 60950-1:2001. Conductive link segments that have different isolation and grounding requirements shall have those requirements provided by the port-to-port isolation of network interface devices (NID).

PSE isolation issue

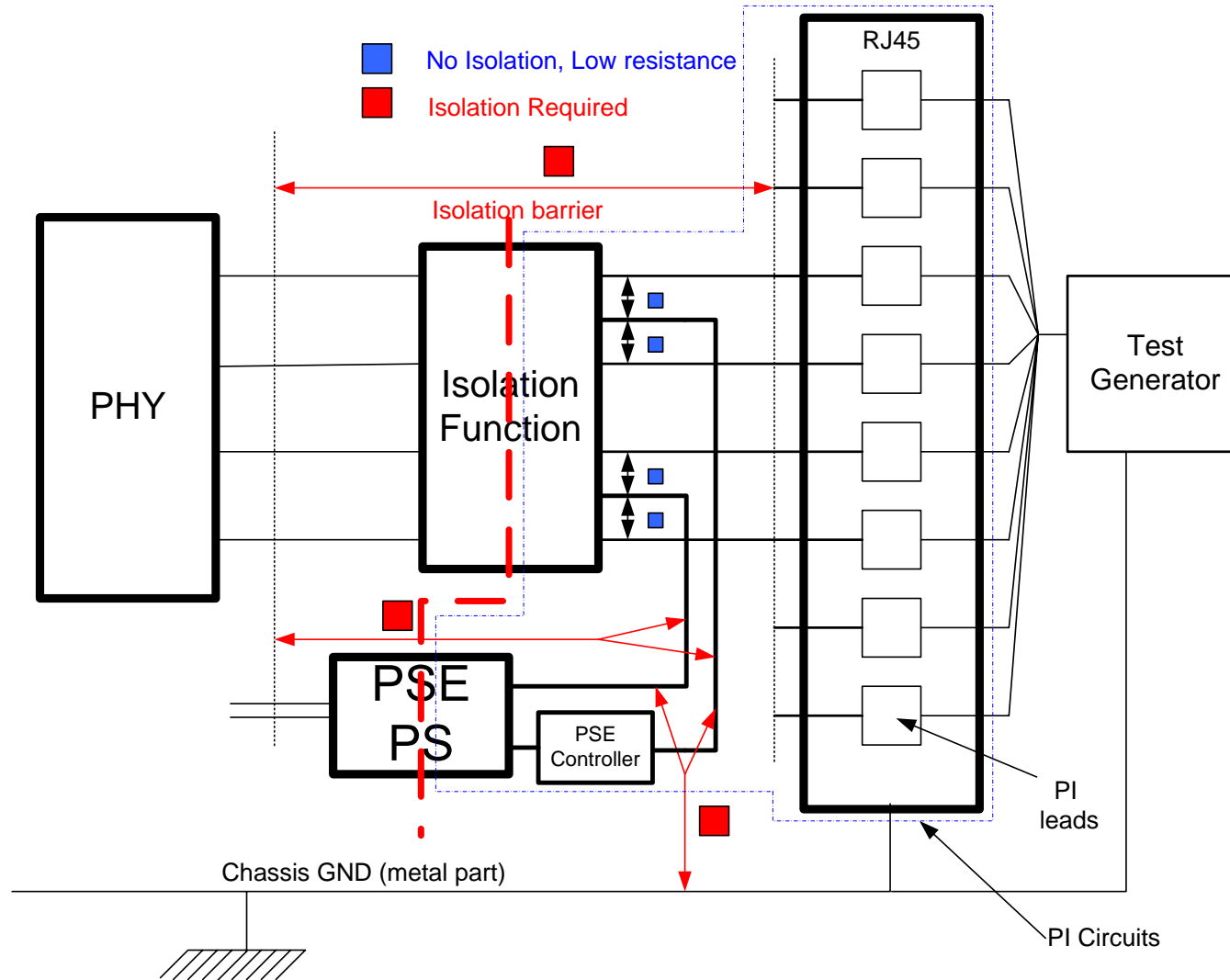
- Statement from IEEE802.3af:

The PSE shall provide electrical isolation between the PI device circuits, including frame ground (if any), and all PI leads.

- What are the PI device circuits? Standard does not provide clear definition.
- Some people confuse PI devices and PSE and interpret that PSE should be isolated from PI which is obviously was not the intent.

Block diagram of PSE and PI

Clarifying the definitions of the system components



Recommendation for PSE isolation requirements:

- Option 1 (Change text similar to PD requirements):
 - The PSE shall provide electrical isolation between
 - a) All PI leads and all **accessible** conductors, including frame ground
 - b) All PI leads and PHY
- Option2 (Text **similar** to 10BASE T standard):

PSE shall provide isolation between DTE Physical Layer circuits including frame ground and all **accessible** MDI leads.

Recommendation for PSE isolation requirements:

The PD shall provide electrical isolation between all **accessible** conductors, including frame ground (if any), and all PI leads.

Note: Accessibility is per safety agency definition

Issue 2

- IEEE802.3af require that isolation shall be in accordance with subclause 6.2 of IEC60950-1-2001
- Further in a text , IEEE802.3af standard very poorly repeats simplified version of subclause 6.2 requirements, which does not contain DC hipot electric strength test procedure and compliance requirements.
- This structure of the standard causing confusion and very often unreasonable requirements for manufactures.

Recommendations for revision, Option1:

- 1.The electrical insulation should be tested in accordance with electric strength test procedure and compliance criterias of safety agencies requirements for protection of equipment users from overvoltages on telecommunication networks (subclause 6.2 of IEC60950-1 or IEC60950 latest version)
- The electrical isolation shall withstand at least one of the following tests:
 - a). Steady state test with AC test voltage 1500V RMS and performed according with 5.2.2 of IEC60950-1(2001) or according to latest version of IEC 60950 electric strength test procedure

Recommendations for revision, Option1:

- b). 2250 VDC test and performed as specified in 5.2.2 of IEC60950-1(2001) or according to latest version of IEC 60950 electric strength test procedure

- c). An impulse test with amplitude 1500V and performed as specified in 5.2.2 of IEC 60950-1(2001) or according to latest version of IEC 60950 electric strength test procedure

Additional Recommendation:

- Note2 from 5.2.2 IEC60950-1 should be included in a standard:

Add the following note to item b:

Where there are capacitors across the insulation under test(for example, radio-frequency filter capacitors), it is recommended that D.C test voltages are used.

(In Addition it is recommended to use in the above note from **recommended** to **preferably** for more clarity, since POE almost always will contain EMI capacitors to ground.)

Recommendations for revision, Option2: (similar to 10Base T text):

- Steady –state tests (AC and DC options) are the same as in Options1 but impulse test is different:
- A sequence of ten 2400V impulses of alternating polarity, applied at intervals of not less than 1s. The shape of the impulses shall be 1.2/50us (1.2us virtual front time, 50 us virtual time of half value), as defined in IEC 60060.
- Comment: Based on ITU-T Recommendation K.17 for simulation lightning interference in the Telecommunication Networks, IEC 60950 is using 10/700uS impulses and not 1.2/50us. [See Annex N of UL 60950-1](#)
- ITU-T Recommendation K.21 is using 1.2/50us pulses to simulate transients in Power Distribution Systems . [See Annex N in UL 60950-1](#)

Summary

- We presented our recommendations to make isolation requirements of IEEE802.3af more clear and to harmonized it with accepted safety industry standards and 10/100/1000 base T standards

Annex 1. Definition of SELV and TNV circuits

	Normal Operating Voltage	
Overvoltages from TELECOMMUNICATION NETWORK possible?	Within SELV CIRCUIT limits	Exceeding SELV CIRCUIT limits but within TNV CIRCUIT limits
YES	TNV-1 CIRCUIT	TNV-3 CIRCUIT
NO	SELV CIRCUIT	TNV-2 CIRCUIT

Annex 2. Advantages of DC hipot test

- One of the advantages of using a dc test voltage is that the leakage current trip can be set to a much lower value than that of an ac test voltage. This would allow a manufacturer to filter those products that have marginal insulation, which would have been passed by an ac tester
- Another advantage of a dc hipot test is that it applies the voltage gradually. By monitoring the current flow as voltages increase, an operator can detect a potential insulation breakdown before it occurs

References:

1. IEEE802.3 Clause 33 (IEEE802.3af)
2. UL60950-1, IEC60950-1
3. ITU-T
4. “Understanding the How and Why of Electrical Product Safety Testing” by Homi Ahmadi in Compliance Engineering Magazine
5. “Power over Ethernet plus isolation requirements” presented by David Law on May IEEE POE plus meeting