20 March 2011

Interpretation Number: 2-03/11

Topic: Isolation Criteria
Relevant Clause: Clause 12.10.1

Interpretation Request

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Response to Interpretation Request

This request is being returned to you because it was not judged to be a request for an interpretation of 802.3. Interpretations are a unique form of commentary on the standard. They are not statements of what the standard should have done or meant to say. Interpretations cannot change the meaning of a standard as it currently stands. Even if the request points out an error in the standard, the interpretation cannot fix that error.

IEEE 802.3 isolation Test (TVS removal?)
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IEEE Std: IEEE 802.3 - 2008

Standard Title: Part 3: Carrier sense multiple access with Collision Detection (CSMA/CD) Access Method

and Physical Layer Specifications

Topic: Isolation Criteria

This interpretation involves multiple clauses throughout the various 802.3(x) documents, however the one below is provided as an example, and the same interpretation applies to all appearances of this requirement.

12.10.1 Isolation

Each PMA/MDI interface lead shall be isolated from frame ground. This electrical separation shall withstand
at least one of the following electrical strength tests:

a) 1500 V (rms) at 50 to 60 Hz for 60 s, applied as specified in Section 5.3.2 of IEC 60950: 1991.
b) 2250 V (dc) for 60 s, applied as specified in Section 5.3.2 of IEC 60950: 1991.
c) A sequence of ten 2400 V impulses of alternating polarity, applied at intervals of not less than 1 s.

The shape of the impulses shall be 1.2/50 μs (1.2 μs virtual front time, 50 μs virtual time of half value), as defined in IEC 60060.

There shall be no insulation breakdown, as defined in Section 5.3.2 of IEC 60950: 1991, during the test. The
resistance after the test shall be at least 2 MΩ, measured at 500 Vdc.

The Interpretation requested:
In the isolation test described above, is it permissible to remove TVS devices during the test for option "a" and option "b"?

Background:

Option "a" and "b" of this isolation test requirement reference clause 5.3.2 of IEC 60950. This clause of the safety standard is an "insulation test", not an "isolation test" and as such has a note that allows the removal of TVS devices during the test. Option "c" however, references IEC 60060, and does not reference IEC 60950, and as such there is no provision for TVS removal in option "c". This results in a discontinuity or difference in test procedure in terms of the Ethernet interface being tested for isolation between options "a/b" with respect to option "c".

TVS devices are not isolation devices and typically breakover at 10-350 volts, which is well below the isolation voltage of the test specified in IEEE 802.3(x).

Thus, the most common and prevalent opinion is that; no you cannot remove them, as that violates the concept of "isolation". However, a small note in clause 5.3.2 of 60950 (which is tended for safety, not reliability) technically permits it.

Previous interpretations on the isolation test have indicated that the isolation test in 802.3 is not a safety test, but rather a test to minimize the influence of common mode voltages on the Ethernet interface itself (reliability of performance). However, if TVS are in fact permitted to be removed, "isolation" no longer exists and the effects of common mode voltages will be experienced by Ethernet interface.

The inclusion of TVS devices on the line side of the interface (cable side, not PHY) that are connected to ground can cause asymmetric firing due to common mode noise from industrial equipment, hospital equipment, etc as well as lightning induced transients, and ground potential rises (GPR's). This can cause unexpected and PHY damaging transients to occur. In addition, the voltage at the far end of the Ethernet circuit gets doubled, and may need isolation up to 4.8KV (multiple papers from Maytum, Bourns), and the Ethernet isolation specification is only protects to 2.4 KV impulse.

TVS devices also permit currents to flow and become susceptible to damage from lightning induced currents and thus cause the Ethernet interface to fail, due to the shorting of the TVS devices, which reduces reliability. Whereas if the TVS devices to ground did not exist in the circuit no damage would occur.

PHY damage and interface component damage is increasing exponentially due to new and evolving Ethernet applications and may be due to the lack of "isolation" from ground in the circuit.

If in fact the intent of the test is "isolation", there are multiple ways which this can be rectified:

1.) *A simple note in each clause stating that for options "a", "b", and "c", TVS devices are not permitted to be removed for the IEEE 802.3 isolation tests.*
2.) *Removal of the reference to IEC 60950 altogether as it provides no apparent useful information by its inclusion and has caused substantial confusion and questions in the past.*
3.) *A combination of item 1 and 2.*
4.) *A note in the general portion of 802.3 stating that in all clauses with an isolation test, that TVS devices are not permitted to be removed.*

Thank You for your consideration of this important issue,

Jim

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