The Ethernet Port Maze Part 1 -
The situation today

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Surge Protection 101 - Part 2

IEEE Std. 802.3 Ethernet ports

— Types, Surge Capability and Applications, PEG 2011

Ethernet ports – Summary

Ethernet port insulation voltage rating is tested with one of the following voltages: 1.5 kV rms AC, 2.25 kV DC, a 2.4 kV 1.2/50 waveform, a 2.4 kV 1.2/50 Annex N generator impulse or a 1.5 kV 10/700 Annex N generator impulse.

Fails if insulation breakdown is observed (voltage limiting action OK see Annex S)

The resistance @ 500 V DC is at least 2 MΩ.

Voltage limiting components may or may not be present in the port circuitry and, if present:

- may or may not have been connected for AC or DC voltage ratings
- remain connected and limit > 500 V (DC resistance) for impulse voltage rating

Unfortunately there isn't a manufacturer's requirement to declare what test values were used and if voltage limiting is present. If the this information was known ports could be broadly classified as

- insulated ports (SELV relying on insulation with no voltage limiting) and
- protected ports (TNV with voltage limiting)

IEEE Std. 802.3 Ethernet ports

— Types, Surge Capability and Applications, PEG 2011

Ethernet port performance standards: now and tomorrow (2012 onwards)

IEEE Std. 802.3 lacks a useful surge performance definition of Ethernet ports. Just too many test voltage options and lack of clarity.

About as useful as describing a car as 'pink" without any reference as to the on road performance.

IEC60950 clause 6 for Protected (TNV) Ethernet ports is better than IEEE 802.3, but misses out transverse surging and a severe environment test level(s).

Stakeholders need a standards organisation to develop a comprehensive Ethernet port surge performance standard to meet the needs of different network environments.

The ITU-T is moving glacially towards perceiving that Ethernet is not an excluded IT port, but a telecommunication (TNV) port. The ITU-T Study Group 5 is receiving many contributions on Home Networking problems, so there is pressure to plug this gap.

Recommendation ITU-T K.44 (05/2012)

Resistibility tests for telecommunication equipment exposed to overvoltages and overcurrents – Basic Recommendation (PREPUBLISHED)

Appendix II

Supplementary information for manufacturers and operators

(This appendix does not form an integral part of this Recommendation)

II.8 Ethernet

II.8.1 Insulation

II.8.2 Ethernet ports

II.8.3 Ethernet Overvoltages

- II.8.3.1 Lightning
- II.8.3.2 Power Fault
- II.8.3.3 Unscreened Twisted Pair (UTP) and Screened Twisted Pair (STP) cables

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- II.8.6.2 Ethernet SPD

Recommendation ITU-T K.44 (05/2012)

Appendix II, II.8 Ethernet

II.8.1 Insulation

Insulation provides separation between two conductive parts at different electrical potentials. Insulation is made up of three components;

- insulation: insulating material interposed between two conductive parts
- creepage distance: shortest distance along the surface of an insulating material between two conductive parts
- clearance: shortest distance in air between two conductive parts

Insulation coordination is the design procedure of making the insulation voltage higher than the expected voltage difference between the separated circuits. The standard impulse used for testing has a 1.2/50 waveshape.

After testing, the port insulation resistance is measured [IEC 60950-1, IEEE 802.3]. The standard requirement is for the 500 V d.c. insulation resistance to be > 2 MΩ.

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II.8.2 Ethernet ports

The IEEE standard for Ethernet ports [IEEE 802.3] uses insulation voltages of 1.5 kV r.m.s., 2.25 kV d.c. and a 2.4 kV 1.2/50 impulse. These voltage levels are for Environment A. Environment A is when a LAN or LAN segment, with all its associated interconnected equipment, is entirely contained within a single low-voltage power distribution system and within a single building.

Insulation electrical strength testing can be done with the equipment unpowered as it will not make any major difference to the insulation withstand. Subsequent tests need to be made to check the insulation resistance value and that the equipment still meets its operation specification.

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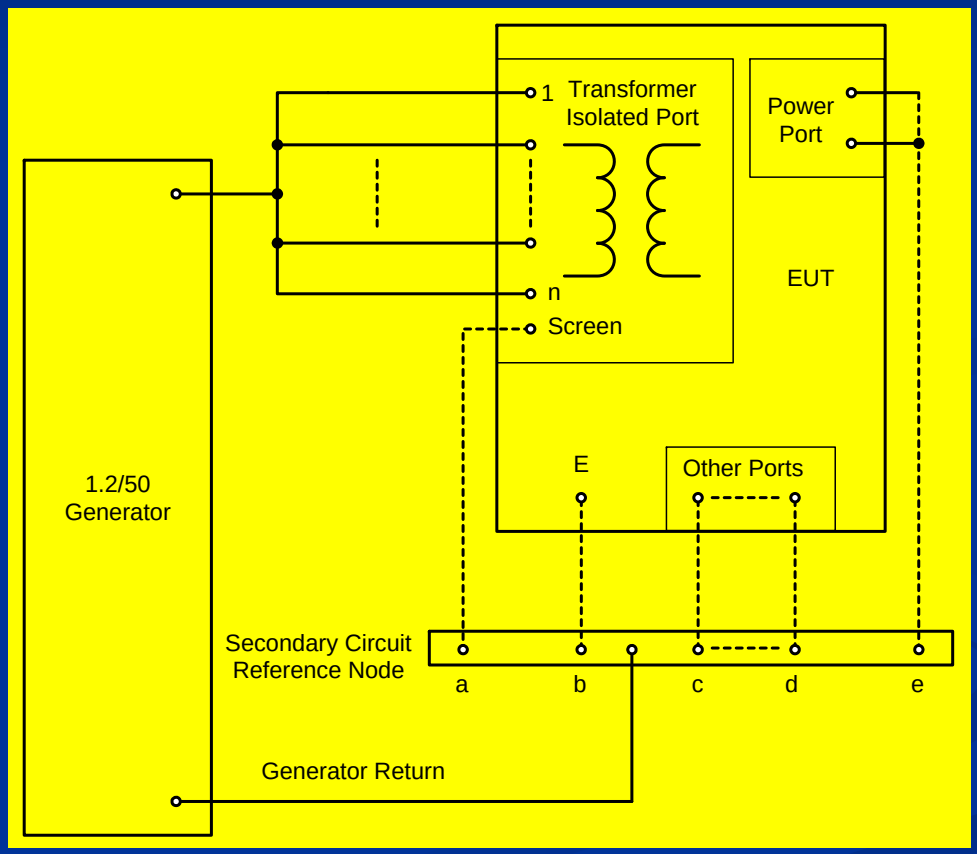
Basic circuit for verifying Ethernet port rated impulse voltage



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II.8.3 Ethernet Overvoltages

An Ethernet LAN connection is direct, from one piece of equipment to another, and limited to 100 m.

II.8.3.1 Lightning

Lightning surges are likely introduced by induction, earth potential rise and via a series insulation barrier. These surges will inherently be longitudinal/common mode in nature. To cater for the transverse/differential surges manufactures can include transverse/differential surge protection on Ethernet ports that rely solely on insulation coordination for longitudinal/common mode surge protection. Power over Ethernet (PoE) equipment must be checked for inter-powering pair surges

Recommendation ITU-T K.44 (05/2012)

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II.8.3 Ethernet Overvoltages

II.8.3.2 Power Fault

The short length of LAN cables means that AC induction voltages from AC faults are likely to be low. Direct contact with the building AC supplies is possible via a direct connection or the failure of a powering source insulation barrier. If the port meets the required insulation resistance value with a test voltage greater than the peak voltage of the local AC mains supply power cross testing is not done.

II.8.3.3 Unscreened Twisted Pair (UTP) and Screened Twisted Pair (STP) cables

The test approach used in this section assumes UTP cables are used. Ethernet ports that provide a cable screen connection are tested for possible insulation breakdown between the screen terminal and the other terminals. Where it is mandated that STP cables are to be used, such arrangements can be tested as a screened cable case.

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II.8.4 SPCs and SPDs

Some designs include SPCs to protect the insulation barrier against excessive longitudinal/common mode voltage transients and signal and power pairs against transverse/differential transients.

SPCs between wires (not bridging the insulation barrier) should not interact with insulation testing. SPCs that bridge the insulation barrier will draw current once their voltage threshold is exceeded. To allow for SPC operation during insulation testing current limiting and sharing resistors need to be added to the generator output. The number of resistors will be four for ports that only use two of the twisted pairs and eight for ports that use four twisted pairs.

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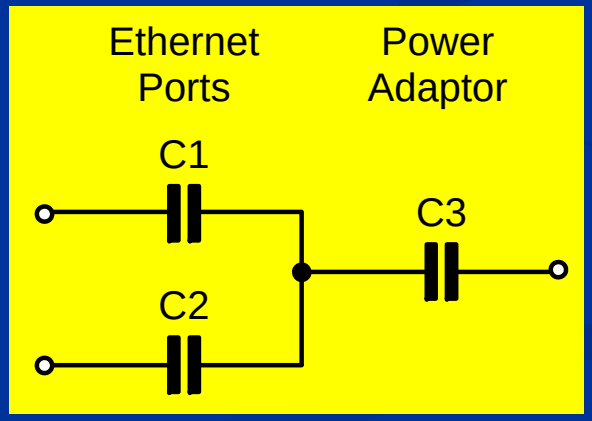
II.8.5 Insulation barriers in series

The voltage sharing across two insulation barriers in series e.g. Ethernet net port and a class II powering adaptor, can be difficult to predict due to dynamic (capacitance and "Smith" circuit) and static (resistive) voltage distribution and is best tested. Ethernet ports with SPCs bridging the insulation barrier or fitted SPDs can increase the stress levels on the associated insulation barriers. In such situations the associated insulation barriers should be rated at the full inter-port requirement.



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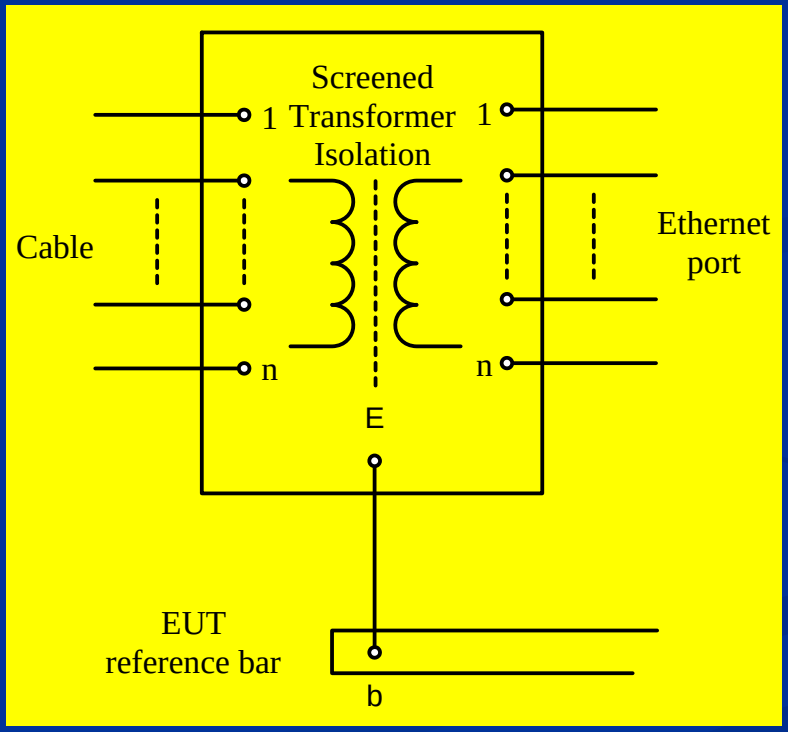
II.8.6 Increasing the rated impulse voltage

II.8.6.1 In-line higher voltage insulation barrier



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II.8.6.2 Ethernet SPD