International Telecommunication Union

ITU-T Study Group 5

Damage to Equipment in the US

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UK

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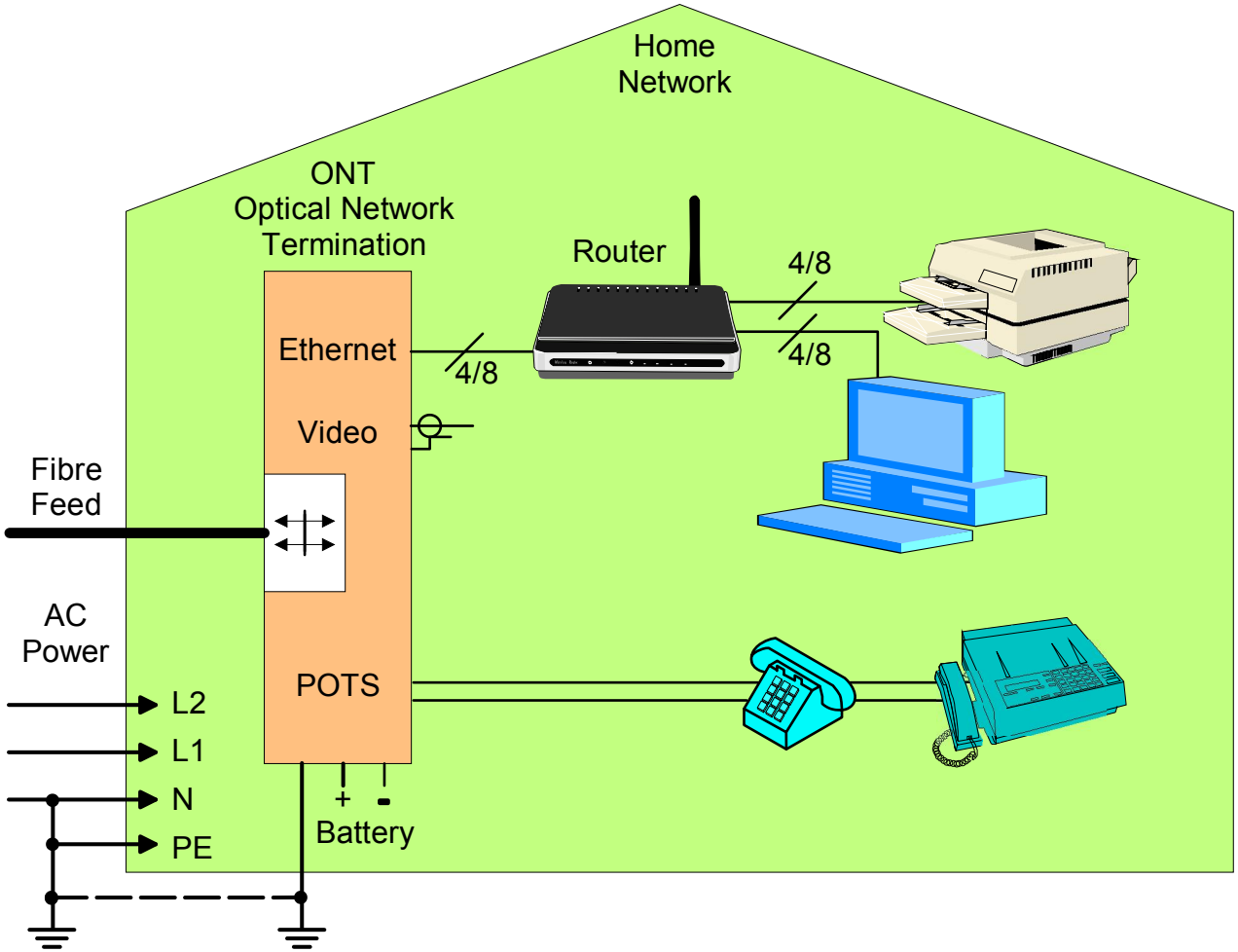
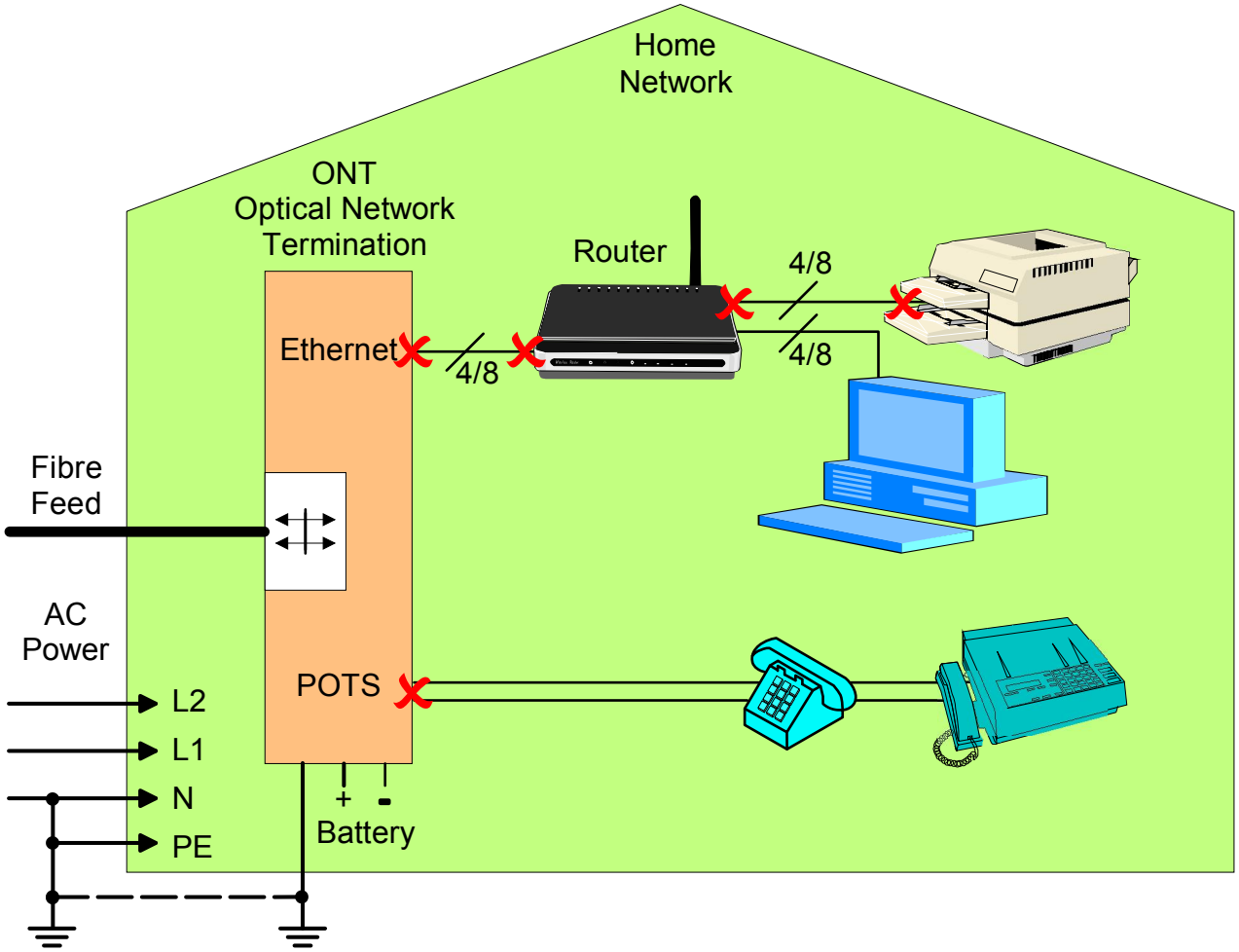
US Fibre Fed Home Network Configuration



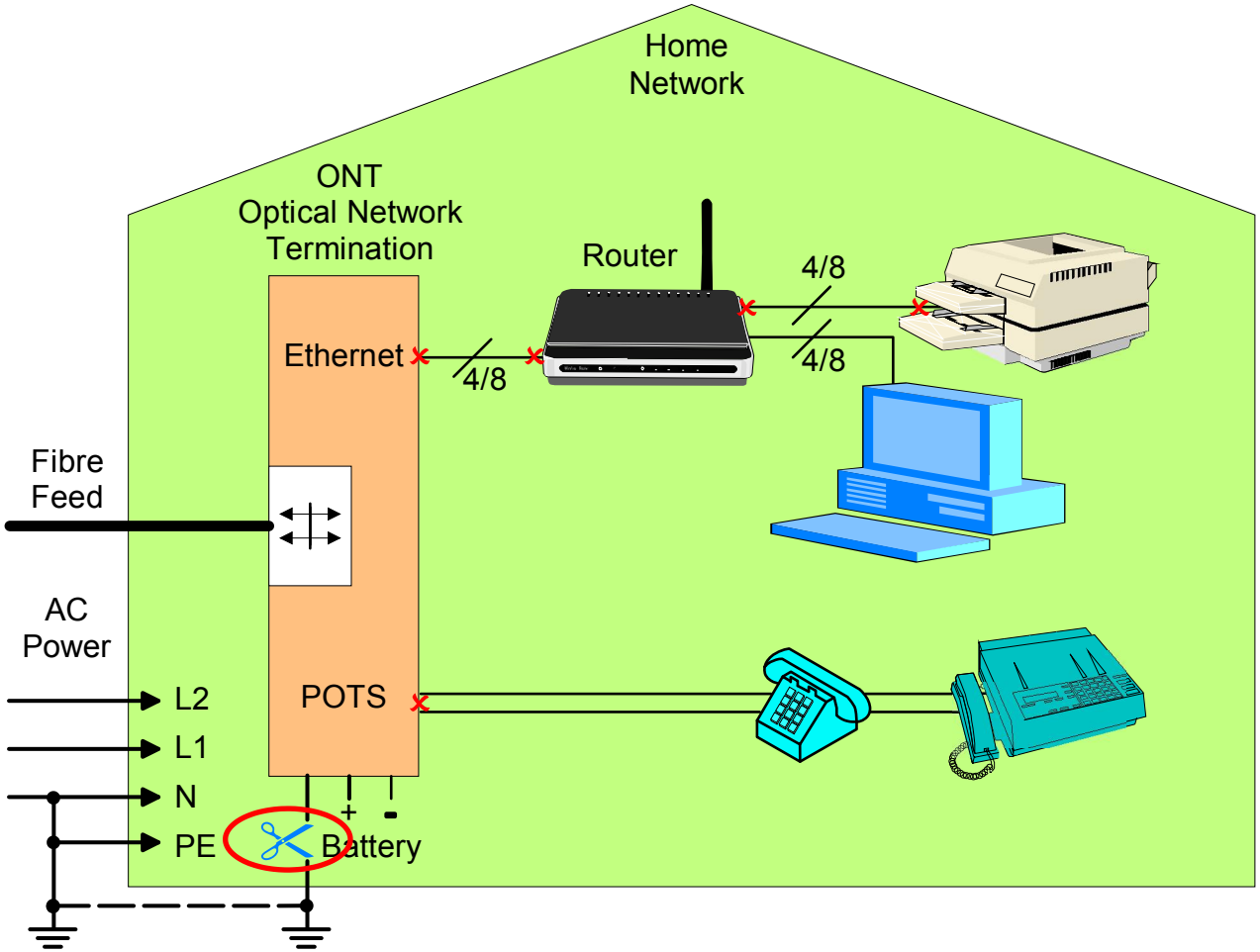
Alternative configuration: (O)NT feeds a Home/Residential Gate-Way outputting Ethernet, POTS and Video

Home Network Port Failures



- Connected ONT POTS and Ethernet ports fail.
- Other connected Ethernet equipment fails

ONT Connection to Ground - 1



- **Disconnecting ONT grounding lead greatly reduces failures, but may cause EMC problems**

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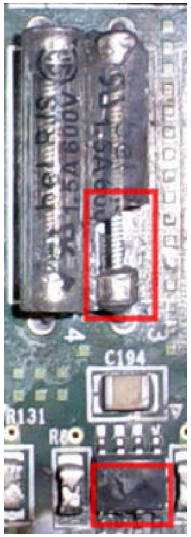
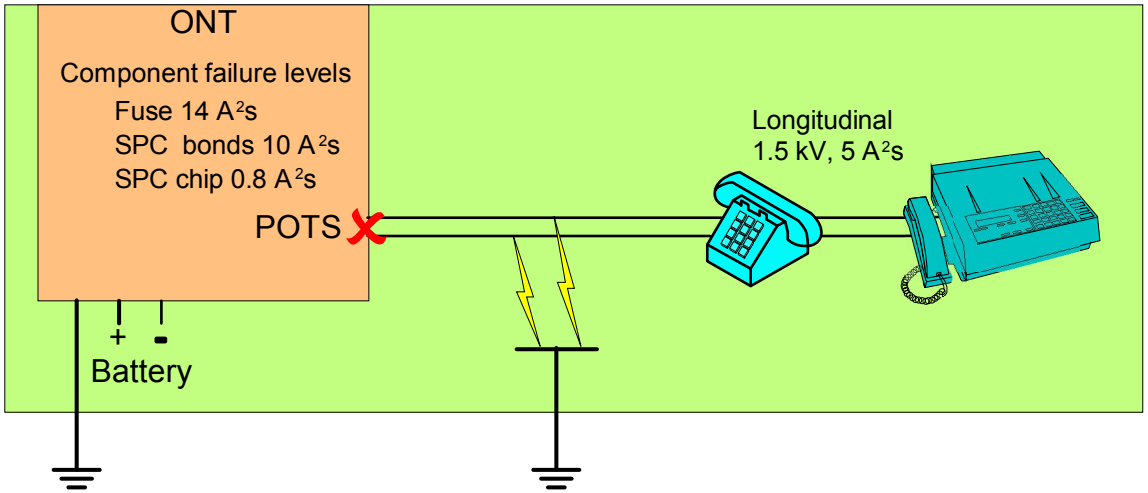
ONT Ground Connection - 2

- Shows ONT ground lead completes the destructive current loop and carries most of that current
- 2008 News Report: Verizon is revisiting NY ONT installs for grounding issues as a 15 % sample showed 59 % had not been grounded and/or bonded
- NEC 800.100 Cable and Primary Protector Grounding.

  Exception: In one- and two-family dwellings where it is not practicable to achieve an overall maximum primary protector grounding conductor length of 6.0 m (20 ft), a separate communications ground rod meeting the minimum dimensional criteria of 800.100(B)(2)(2) shall be driven, the primary protector shall be connected to the communications ground rod in accordance with 800.100(C), and the communications ground rod shall be connected to the power grounding electrode system in accordance with 800.100(D).

ONT POTS Port Failures

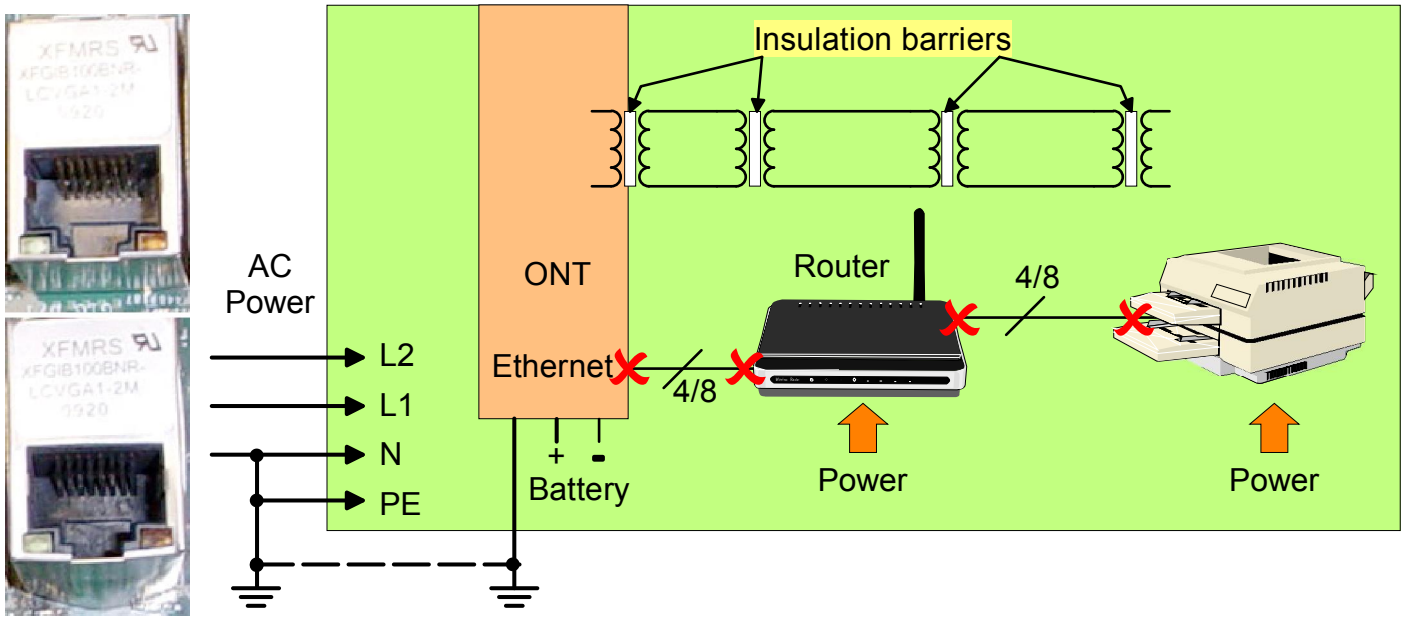




- Connected POTS equipment does not fail
- Sometimes only the ONT port RING or TIP components fail
- Sometimes the fuse may not be damaged
- Most logical explanation is that either one or both POTS wires are breaking down to a local ground.

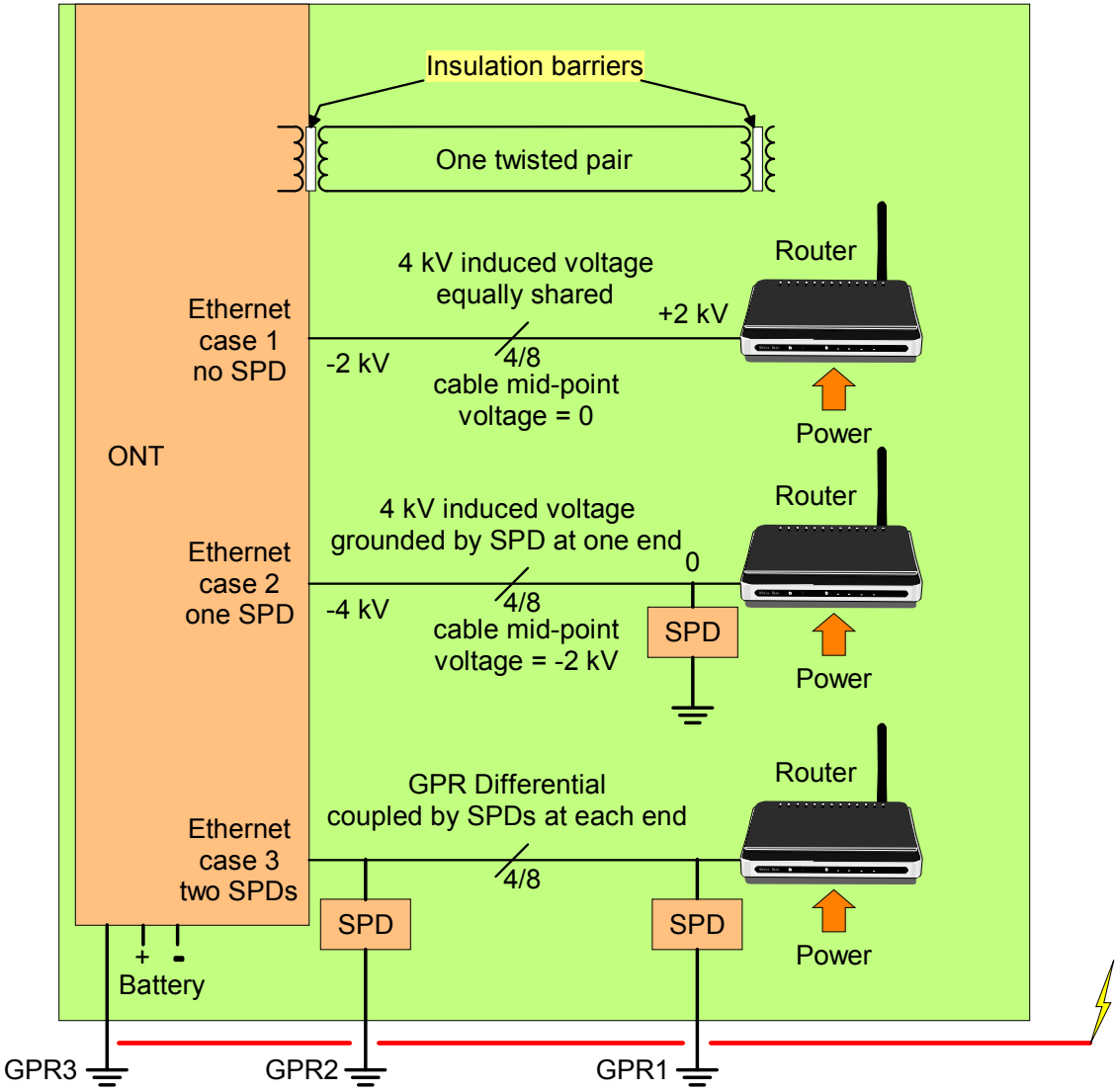
Equivalent single wire 10/700 generator withstand setting of 10 A^2s is 8 kV, 200 A, 5/320

Ethernet Port Failures



- For failure to occur two or more insulation barriers must breakdown
- For Ethernet ports without voltage limiters the total voltage impulse withstand for 2x1.5 kV rms transformers is likely to be above 5 kV.
- For severe environments 5 kV isn't enough
  One solution being pursued is to use a 5 kV rms withstand transformer to give a 7 kV impulse withstand barrier.

Miss-Guided use of Ethernet SPDs - 1



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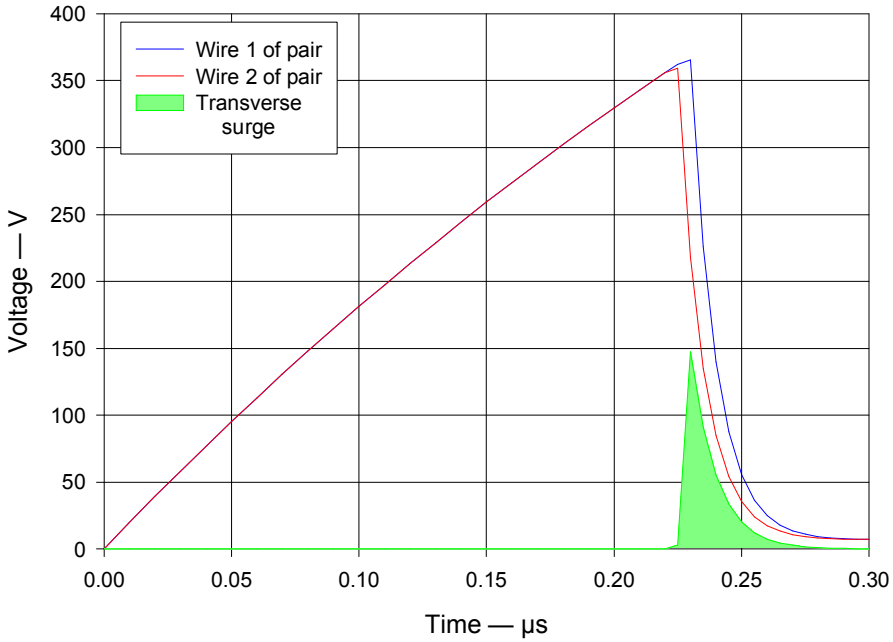
Miss-Guided use of Ethernet SPDs - 2
Transverse Surge Generation



Existing SPD voltage measurements don't cover the generation of transverse voltage surges by the asynchronous SPD operation. Ethernet ports typically have a transverse surge capability below 10 volts and it is important to characterise any SPD intended for Ethernet protection for the level of transverse surge generated.
The longitudinal surge on the twisted pair wires (red trace and blue trace) is converted to an inter-wire transverse surge (green trace) by asynchronous SPD operation.

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Calculated Surge Levels (based on 10/700 generator)

For low failure rates in the environment described, the ONT ports require the following capabilities:

POTS

- **Being low-voltage this port has a current surge**
- **Withstand at least 10 A^2s of surge**
- **Single wire surged with 10/700 generator setting of 8 kV, 200 A**

Ethernet

- **To stop current flow this port needs a high value of insulation voltage**
- **Insulation to withstand at least 7 kV of surge**
- **All port conductors connected and surged with a 7 kV impulse**

Further Study Areas
ONT coaxial video port (no failures), Wire fed home network NTs, Ethernet port with SPCs connected to ground, External SPDs connected to ground – transverse surge generation and surge capability, Surge ingress mechanism– GPR or induced or AC transients or combinations thereof