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## Data & Communication Grounding



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## Point of Entrance (POE) Grounding

- Article 800 [2002-2005]
  - Communications Circuits
- Article 810 [2002-2005]
  - Radio & TV Equipment
- Article 820 [2002-2005]
  - Community Antenna Television and Radio Distribution System
- Article 830 [2002-2005]
  - Network Powered Broadband Communications Systems



## Communications Grounding at POE

### ■ NEC recommendation

- Sheath grounding at point of entrance NEC 800-33 [1996,1999]
- NEC 800.33 [2002]
  - The metallic sheath of communications cables entering buildings shall be grounded as close as practicable to the point of entrance or shall be interrupted as close to the point of entrance by an insulating joint or equivalent device.
- NEC 800.2
  - Within a building, the point at which the wire or cable emerges from an external wall, from a concrete floor slab, or from a rigid metal conduit or an intermediate metal conduit grounded to an electrode in accordance with 800.40(B)[2002] & 800.100(B)[2005].



## Cable Sheath Grounding

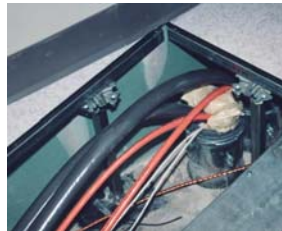
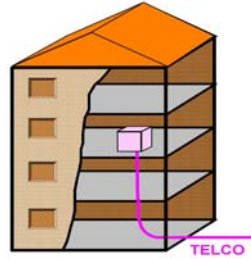
### ■ NEC 800.40(B)[2002] & 800.100(B)[2005]

- 1 Building or structure grounding electrode system
- 2 Grounded interior metal water piping system within 5 ft. from its point of entry into the building [per 250.52 [2005]
- 3 The power service accessible means external to enclosures as covered in 250.94
- 4 The metallic power service raceway
- 5 The service equipment enclosure
- 6 The grounding electrode conductor or the grounding electrode conductor metal enclosure
- 7 The grounding conductor or the grounding electrode of a building or structure disconnecting means that is grounded to an electrode as covered in 250.32.



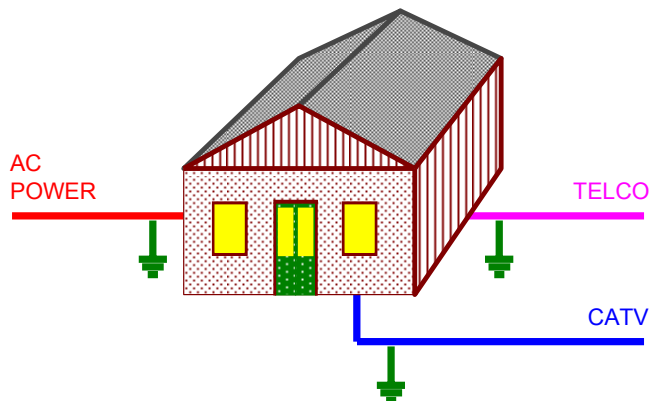
## Telecom Entrance

- Telecom Grounding
  - Bond to GES
    - Sheath
    - Protectors
  - Never bond to the SRG!!!
  - Bond at point of entry
    - Penetration through wall or floor
  - Code Exception
    - Bond at point where cable emerges from rigid conduit
    - This practice brings unwanted interference into building



## AC & Communications Grounding 1

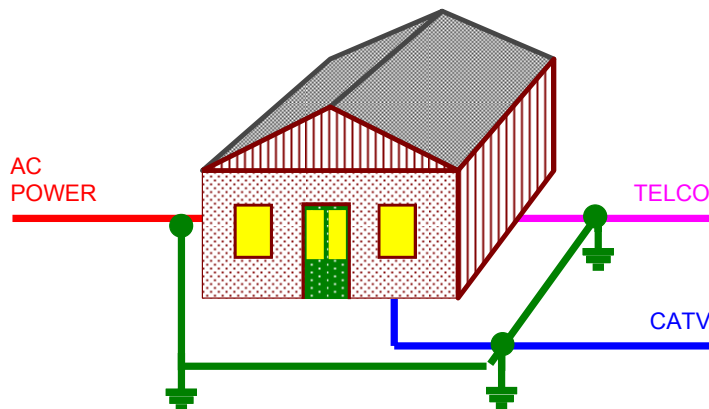
- Very Bad





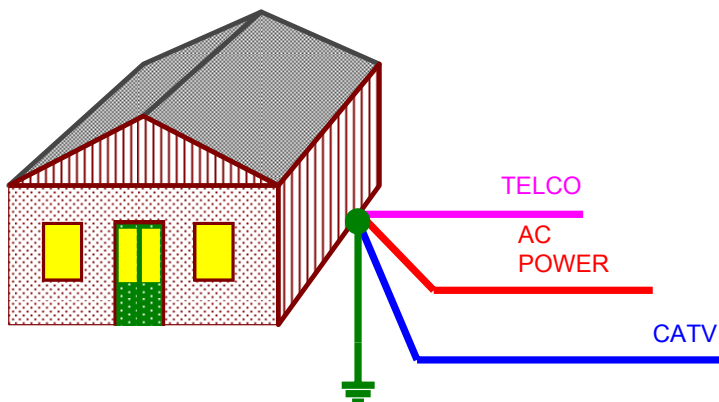
## AC & Communications Grounding 2

- Probably code compliant, but marginal!



## AC & Communications Grounding 3

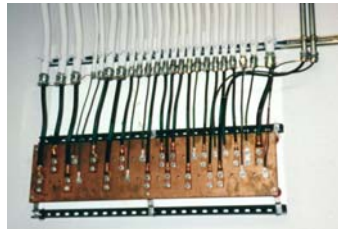
- Single point is the preferred application





## Ground Windows

- Theory
  - All grounding contacts single point
  - Create equipotential grounding
- Reality
  - DC concept
  - Path for circulating currents
  - Small scale application



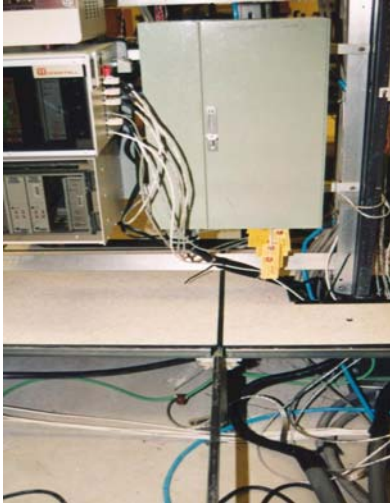
## Telecom Demarcation

- Demarcation is not always the point of entrance
  - Typical - Point where cable emerges from rigid conduit
- Demarcation
  - Point of transfer from Telecom supplier to facility
- Over-voltage-protectors (OVP)
  - Gas tube
  - Carbon block





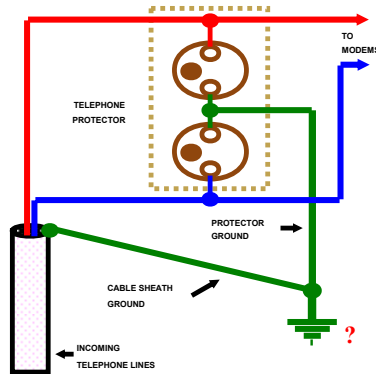
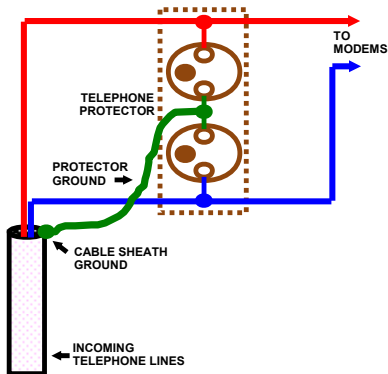
## Protector & Sheath Grounding



## Telco Protector Grounding 1

▪ Will Not Work -- BAD!!!!

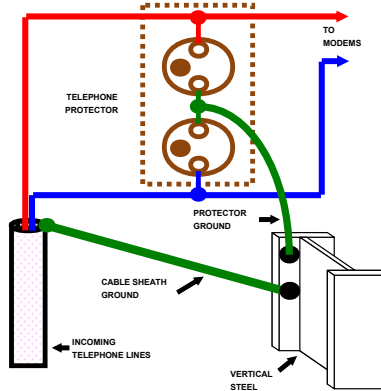
▪ Common -- May Not Work





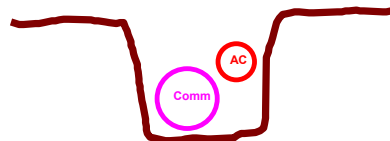
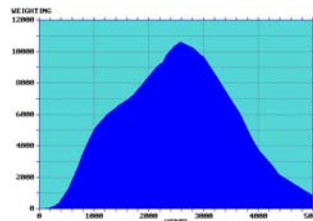
## Telco Protector Grounding

- Better -- Might Even Work!
- Separate grounding paths
  - Sheath & protectors
  - Grounding point part of building grounding electrode system
- Placement is critical
  - Too close to load and secondary protectors will fire rather than intended primary protectors



## Coupling to Communications

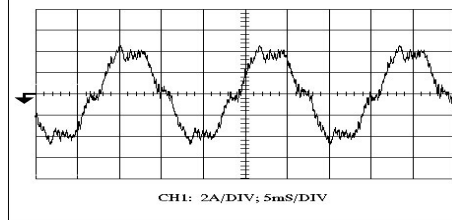
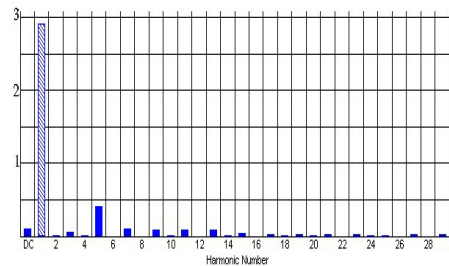
- Common trench
  - Bell recommendations
    - 1 foot separation minimum
    - Bonding every 1K feet
- TIF
  - Telephone Influence Factor
  - Harmonic content affects data and voice signals





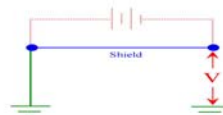
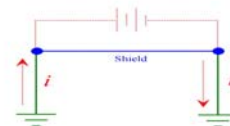
## Telco Sheath Current

- Sheath Grounded
  - 2.8 Amperes RMS
- Sheath Not Grounded
  - 15 Volts RMS
- Interference worse without sheath grounding



## Shield Grounding Dilemma

- Grounding concerns
  - Ground one end or both ends?
  - Ground loops
  - Emissions?
  - Data integrity?
- Grounding Realities
  - Floated at one end causes potential
  - Grounded at both ends causes current

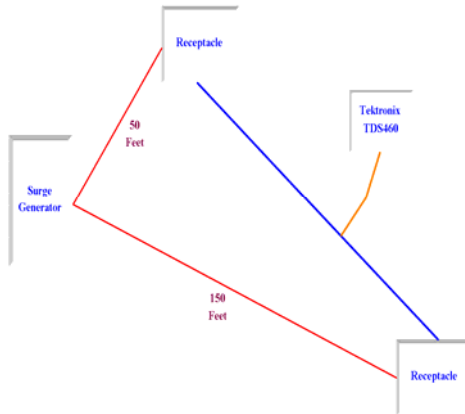






## Shield Grounding Surge Test

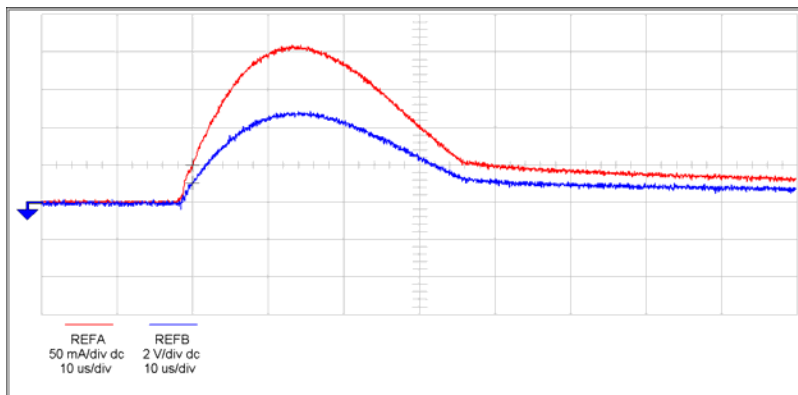
- 8 x 20  $\mu$ S Pulse
  - 1000Vpk
  - 500Apk
- 100kHz Ringwave
  - 6000Vpk
  - 500Apk



## Test Pulse

Coax Current = 42Apk

Center pin voltage = 4.88Vpk

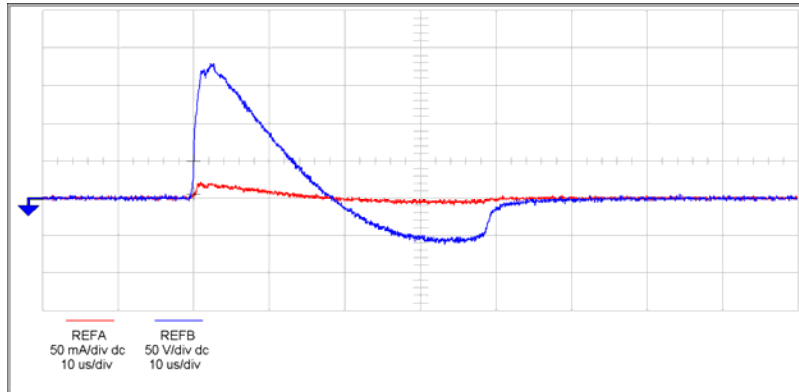




## Open Shield

Coax Current = 4.4Apk

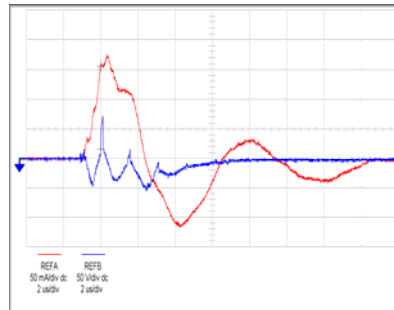
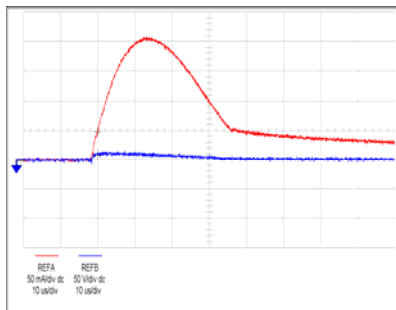
Center pin voltage = 180Vpk



## 2" Drain Wire (Pig Tail)

- 8 x 20 uS Unipolar
- Coax Current = 41.6Apk
- Center pin voltage = 16Vpk

- 100kHz Ringwave
- Coax Current = 35.2Apk
- Center pin voltage = 72Vpk

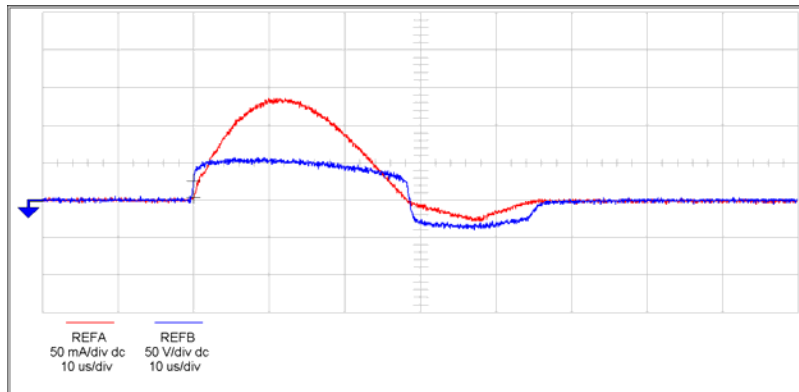




## MOV

Coax Current = 27.2Apk

Center pin voltage = 58Vpk



## Shield Grounding Concerns

- Shields are intended to carry current
  - Current must flow to chassis without interruption
- Floated shields
  - May flash over
  - May leak high frequencies into "protected" circuits
- FCC testing
  - Usually performed with shields grounded at each end
- Data circuit may be grounded at both ends
  - RS-232 & RS-423