Grounding and Commons for DCC Systems

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Two Objectives

• To keep you from electrocuting yourself…

• To keep the trains running!!!
High Voltage / Low Voltage

• DCC transformers or power supplies connected to AC mains (120-240 VAC) must provide protection against contact or exposure to high voltages
  – Grounding
  – Insulation
  – Disconnect

• The transformer/power supply output and all voltages on the DCC side are “Safety Extra Low Voltage” (SELV)
  – SELV defined as < 42.4 VAC (Peak) or < 60 VDC
  – No danger if exposed (you can touch it!)
  – Safety “ground” not required

• Isolation between high voltage and low voltage sides is ensured by double insulation (“SELV Class 2”)
  – No possibility of exposure to high voltages on the low voltage side under normal or single fault conditions
Personal Safety

• AC Safety Ground (Center Prong/Green Wire)
  – Provides return path for 120 VAC current in the event of a short from hot or neutral to a metal case
  – Carries no current except under fault conditions

• Insulated case
  – Exposed surfaces are insulated from internal AC wiring
  – Any faults on the AC side are contained within the case and/or cable
  – Three prong plug not required (think hair dryers, soldering irons, etc.)

• Ground Fault Circuit Interrupter (GFCI)
  – An in-line circuit breaker that senses AC current on the hot (black) and neutral (white) wires of the AC mains circuit
  – If not equal, then there is leakage somewhere (i.e., a “ground fault”), and the GFCI trips
  – Provides protection even if there is no center prong (green wire) connection.
DCC Commons and Grounding

• DCC Booster Common
  – Provides a common voltage reference and return path between boosters, power managers and other DCC components
  – Required when locos cross power district boundaries
  – Loconet “ground” wires (26AWG) are too small to be effective

• “Grounding” of Booster Common
  – Can be used to prevent static buildup
    • If done, do so at ONLY ONE point (typically the command station case to command station transformer AC safety ground)
    • Multiple connection points run the risk of creating "ground loops" which can couple AC ground voltage differentials into the DCC low voltage system.
  – Not a DCC “safety” ground (none required for SELV)
  – RF ground performance is questionable due to lead length (many wavelengths at 900 MHz)
Implementation Guidelines
- High Voltage Side -

• Connect the AC safety ground of each booster transformer/power supply to house ground
  – Use center prong of AC line cord (where provided) or direct connection to center screw of wall outlet
  – Not required for insulated cases with two prong plugs (PS 315, PS 515)

• A GFCI may be used if desired to trip the AC supply in the event of AC leakage to undesired return paths.
Implementation Guidelines
- Low Voltage Side -

• Provide a “Booster Common” between the “ground” (case) of the command station and all boosters, PM42s, BDL168s and other DCC components.
  – Loconet “ground” wires are insufficient - Use #14 or better.

• The low voltage side of the power supplies (including the entire DCC system) contains no hazardous voltages and thus needs no safety ground.
  – Booster Common MAY be connected to AC Safety or house ground for static discharge purposes
  – If connected, do so at ONLY ONE point to avoid ground loops