

Recommended Design Criteria for Surge Withstand Capability of Electronic Signal Equipment for Signal Systems

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A. Purpose

This Manual Part recommends design criteria for surge withstand capability for electronic equipment interfacing to track circuits, line circuits, and ac or dc power circuits for railroad signal systems.

B. General

1. Staged or multiple levels of protection are recommended for line-to-line electronic equipment in signal enclosures, train control rooms, etc. Staged protection consists of primary, secondary, and tertiary levels. Primary protection should be provided closest to the entrance point and should be rated to withstand the brunt of the exposure. Secondary protection should be provided between the primary and tertiary protection. Tertiary protection is normally designed into the electronic signal equipment itself and is referred to as surge withstand capability, as it is a design criterion for the equipment.
2. Effective tertiary protection typically requires isolation impedance between the secondary and tertiary protection to ensure staged operation. Normally, this is provided within the equipment.
3. Equipment surge withstand capability is line-to-line unless otherwise specified.

C. Signal equipment surge withstand capability design

1. Tertiary surge protection for all applications shall incorporate isolation impedance or other design means between secondary and tertiary surge protection to allow the surge voltage to continue to rise and actuate the secondary surge protector, although it has been clamped by the tertiary surge protector.
2. Surge withstand capability criteria for ac power input ports of signal equipment (120/240 or 120/208 volt nominal circuits).
 - a. Equipment shall withstand exposure to three times the nominal ac line voltage rating for at least 80 msec. with no damage. The equipment must suffer no loss of function or return to normal operation without manual intervention.
 - b. Equipment shall withstand line-to-line and line-to-ground let-through voltages from secondary protector, if utilized. See Manual Part

- 11.3.2 Recommended Design Criteria and Functional/Operating Guidelines for Secondary Surge Protectors for Electrical Surge Protection of Signal Systems. If secondary protector is not utilized, equipment shall withstand line-to-line and line-to-ground let-through voltages from primary protector. See Manual Part 11.3.1 Recommended Design Criteria and Functional/Operating Guidelines for Primary Surge Protectors for Electrical Surge Protection of Signal Systems. The equipment must suffer no loss of function or return to normal operation without manual intervention following the surge condition.
- c. If tertiary surge protection can fail as a short circuit, a means of interrupting a short circuit current of more than four times the rated current, but no less than 15 amp. rms continuous, shall be provided.
3. Surge withstand capability requirements for track circuit, vital and non-vital line circuit inputs.
 - a. Equipment shall withstand a surge of three times the maximum circuit voltage rating or 75 volts, whichever is less, for 80 msec., with no damage. The equipment must suffer no loss of function or return to normal operation without manual intervention following the surge condition.
 - b. Equipment shall withstand line-to-line and line-to-ground let-through voltages from secondary protector, if utilized. See Manual Part 11.3.2. If secondary protector is not utilized, equipment shall withstand line-to-line and line-to-ground let-through voltages from primary protector. See Manual Part 11.3.1. The equipment must suffer no loss of function or return to normal operation without manual intervention following the surge condition.
 4. Equipment surge withstand capability requirements for dc power inputs powered from a vital signal battery
 - a. Equipment shall withstand a surge of three times nominal dc voltage rating for no less than 80 msec., with no damage. The equipment must suffer no loss of function or return to normal operation without manual intervention following the surge condition.
 - b. Equipment shall withstand line-to-line and line-to-ground let-through voltages from secondary protector, if utilized. See Manual Part 11.3.2. If secondary protector is not utilized, equipment shall withstand line-to-line and line-to-ground let-through voltages from primary protector. See Manual Part 11.3.1. The equipment must

suffer no loss of function or return to normal operation without manual intervention following the surge condition.

- c. If tertiary surge protection can fail as a short circuit, a means of interrupting a short circuit current of more than four times the rated current shall be provided.

D. Environmental

- 1. Tertiary protection shall meet the environmental requirements as noted in Manual Part 11.5.1, based on the location classification.

E. Equipment surge withstand documentation

The manufacturer should provide the following information in published documentation for each protected circuit input.

- 1. Maximum normal circuit voltage.
- 2. Surge protection breakdown or clamping voltage.
- 3. Maximum surge current and energy handling capability.

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