Weekly Whitepaper
Week #36

Secondary Circuit Design – Protecting the User

The "Designing for Compliance" Series

Our "Designing for Compliance" series of whitepapers will help educate you on the intent of the standards and provide guidance on how to design your product for compliance to UL/CSA/EN/IEC safety product standards.

Secondary Circuit Definition: The definition of a "Secondary Circuit" is any circuit that is electrically isolated from the Mains/Primary Circuit. A Secondary Circuit is, therefore, defined as a circuit that is located on the load side of an isolating device = isolation transformer, relay, or opto-coupler. Secondary circuits are critical for products that need to have user-accessible circuits since mains/primary circuits are prohibited from user contact.

Secondary Circuit Compliance Design Guide: Taking the "6 Hazards of Product Safety" and looking at a summation of all the hazards as they apply to secondary circuits, leads to the following secondary circuit compliance design principles:

a) Accessibility: All user-accessible circuits must be secondary circuits (isolated from the mains circuit). If the user can "access" a circuit, the circuit must not be a Shock or Energy Hazard. A circuit is considered to be user-accessible if it can be contacted by the probes identified in your safety standards. Note that all external connectors other than Listed mains power connectors are considered operator accessible regardless if they are male or female pin configuration. Accessible secondary connectors such as USB ports are one example of an accessible secondary circuit.
   - There are two kinds of accessible circuits = those that you want or need the user to access & those that are accessible through a vent or other opening not intended for user access. Both types of circuits require the same protection.

b) Accessible Voltage Limits: For Shock Hazard protection, the circuit must operate at a voltage that is below the hazardous voltage level (30VRMS in most standards; 25VRMS for medical products) AND, is protected from hazardous voltages by two levels of protection (i.e. meets SELV circuit requirements).

c) Accessible Energy Limits: For Energy Hazard protection, the circuit must not be capable of delivering over 240 VA under any condition of loading. Note that this hazard is starting to be dropped from the few standards that called for this limit. However, if you are designing a high energy product, it's a good limit to follow for accessible circuits if you don't have a need for more energy in the circuit.

d) Access Alternatives: If you are unable to limit below Shock Hazard limits (and Energy Hazard limits if your standard includes this hazard), you must protect the circuit so that it is not accessible by the user = design the product enclosure such that the circuit cannot be contacted by the accessibility probes and, make sure you have no operating instructions telling the user to access the circuit. Keep in mind that all circuits that the user can access without tools are to be opened prior to using the accessibility probes.

e) Enclosure: Secondary circuits, unless specifically designed for Class II or Limited Power requirements, must have a "fire enclosure" to protect from a Risk of Fire. Internal circuits intended to be user accessible must have an access panel, door, or other suitable means to enclose the circuit when in use.

Accessible secondary circuit requirements are a large percentage of the requirements in the product safety standards. Many product developers use certified power supplies with "SELV" outputs (no shock hazard) so that all connected circuits are permitted to be accessible, leaving only the enclosure flammability requirements to address.