☑ CTL Provisional DECISION SHEET (PDSH)
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Standard(s) (incl. year)	Subclause(s)	Tracking No.
IEC 62368-1:2014 IEC 62368-1:2018 IEC 62368-1:2023	G.2.1, G.2.2	2303
Category		
ITAV		
Subject	**Keywords**	**Developed by**
Pre-charge relays located in the PS3 circuits directly connected to the mains after the rectifier of switching mode power supplies	Pre-charge relays PS3	ETF 2

Question

1) Could a pre-charge relay located in the PS3 circuits, directly connected to the mains after the rectifier of switching mode power supplies as shown in the figure 1 below, use a contact rating of 250 Vac (resistive load) as defined by IEC 61810-1:2015 for the equipment with a universal input voltage rating of 100-240 Vac?

2) If the relay described above complies with the overload and endurance tests of Clause 11.2 in IEC 61810-1:2015, is it still required to undergo the overload test specified in Clause G.2.2 of IEC 62368-1?

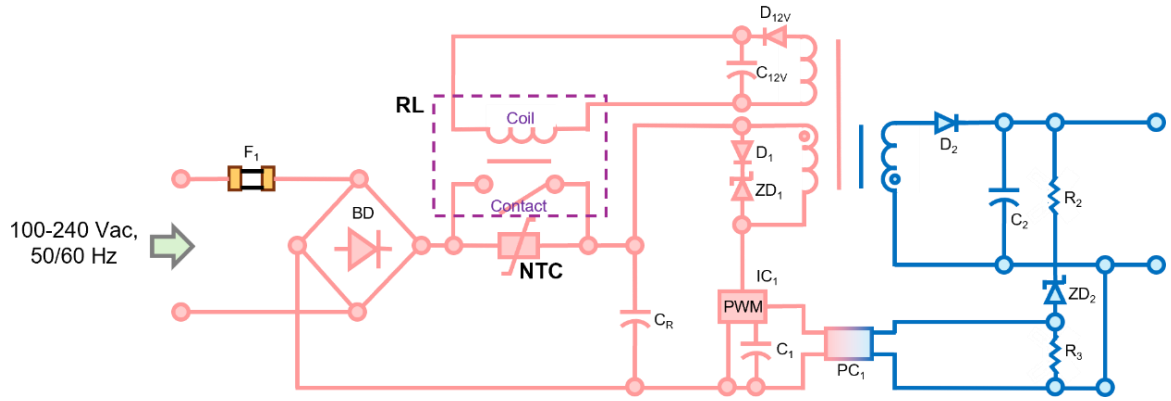


Figure 1 rectifier of switching mode power supplies (example)

Decision

1) Use of a Pre-charge Relay in the Primary Circuit
It is acceptable to use a pre-charge relay located after the rectifier in the primary circuits (as shown in the figure) with a contact rating of 250 Vac (resistive load), as defined in IEC 61810-1, providing that all of the following conditions are met:

   – The current rating of relay contact shall be equal to or greater than the maximum current it carries under normal operating conditions

   – The relay coil shall be energized from the primary circuit, not from an isolated secondary circuit.

   – All other applicable requirement and ratings specified in Clause G.2.1 of IEC 62368-1 shall remain valid.

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– Under any single fault conditions as specified in Clause B.4 of IEC 62368-1, the following conditions shall not occur:

  - The relay contact opens after the coil is energized to make the contact close.
  - The relay contact fails to open when the equipment is powered off.
  - An NTC or the pre-charged resistor should be properly dimensioned and not pose the risk on heating up itself, PCB and adjacent components, in case of unexpected relay contact opens after the product is energized
    (Ma, Rui comment: Unacceptable overheating of the NTC thermistor and/or pre-charge resistor, resulting in a risk of damage to the component itself, the PCB, or adjacent components, shall not occur in the event of an unexpected opening of the relay contact after the equipment has been energized.)

2) It is not necessary to perform the overload test specified in Clause G.2.2 of IEC 62368-1 when the relay complies with the overload and endurance test at 150% of the contact current rating in accordance with Clause 11.2 of IEC 61810-1:2015.
(Ma, Rui comment: Compliance with the overload and endurance test requirements of IEC 61810-1:2015, Clause 11.2, at 150 % of the rated contact current may be accepted in lieu of the overload test specified in IEC 62368-1, Clause G.2.2.)

Explanatory notes

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In typical switching mode power supply (SMPS) designs, an NTC thermistor or a current-limiting resistor is commonly used in the primary circuit to limit inrush current during cold start-up and protect components. However, once steady-state operation is reached, these components continue to dissipate power, reducing overall energy efficiency.

A relay may fail in open contact state or fail to be energized. Long-term running with a resistor may be even worse than with an NTC, as both are rated for short-term use.

To eliminate this unnecessary loss, a pre-charge relay can be connected in parallel with the NTC or current-limiting resistor. During start-up, the relay remains open, and the inrush current is limited by the NTC or resistor. After the bulk capacitors are sufficiently charged, the relay is energized and bypasses the NTC or resistor, thereby eliminating power loss during normal operation.

When the relay is located after the rectifier, the voltage across its contacts corresponds to the peak voltage across the NTC or series resistor. This voltage typically appears as a single pulse or a series of repetitive pulses, rather than a continuous DC voltage. In addition, this relay is not intended to switch between different energy sources. Prior to stabilization, the energy level across this contact gap is fundamentally similar to that before rectification, differing mainly in polarity.

According to Clause G.2.1 of IEC TR 62368-2:2025, relay contacts used in PS2 or PS3 energy sources should not generate arcing that leads to contact damage or welding. However, the pre-charge relay is not designed to perform energy transfer or source switching. It is only intended to operate after input power is removed. Therefore, concerns regarding contact pitting, damage, or welding are not considered applicable in this use case. Its performance under single-fault and overload conditions may be regarded as an acceptable approach.

This assessment is limited to pre-charge relays whose coil voltage is derived from the primary circuit. In such cases, dedicated insulation evaluation between the coil and contacts is not necessarily required, provided that electric shock hazards are otherwise mitigated. Nevertheless, the functional reliability of the relay should still be appropriately monitored.