



**WATLOW**

# No-arc Relay Operation

**Products Affected: E-SAFE II, EHG II, EZ-ZONE PM**

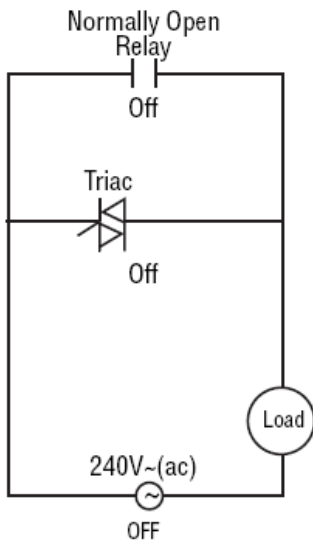
## Background

Shortened mechanical relay life occurs when contacts open while current is flowing through the contacts. This action produces an electrical arc causing metal to transfer from one contact to the other contact. As the metal transfers on each contact opening, the resistance through the contacts increases causing the contacts to increase in temperature. In time, the contacts weld together and the relay remains in the 'ON' state.

## Theory of Operation

The Watlow E-SAFE<sup>®</sup> II, EHG<sup>™</sup> II and EZ-ZONE<sup>™</sup> PM (Option PM6xxxH-xxxxxxx) are hybrid relays, which means these use a mechanical relay for current load and a triac (solid state switch) to initially turn on the load current and at the end of the cycle to turn the load current off, which will minimize the electrical arc across the relay.

The operation is as follows:



**Off State** – when there is no command signal, both the relay and the triac are off.

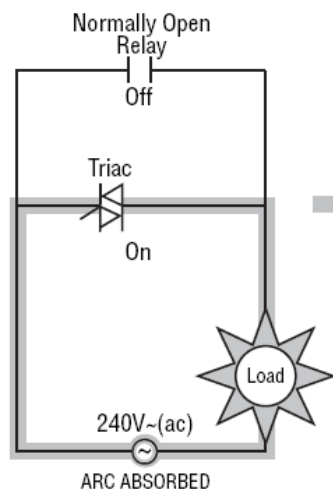
**Off**



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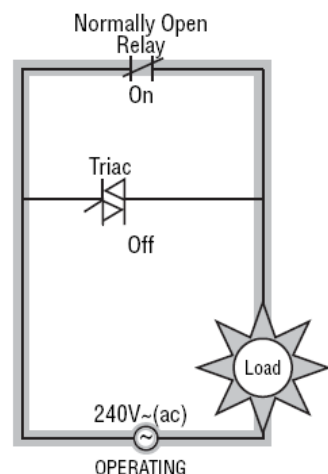
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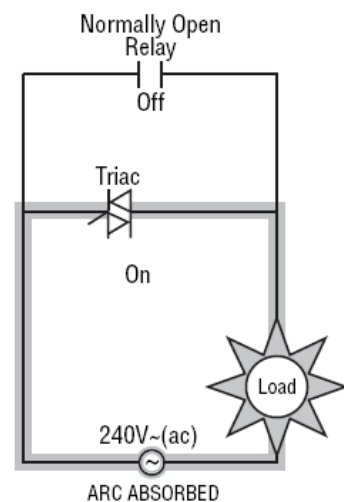
Conduction Path

**Turn On State** – when the command signal is applied to turn on the load, the triac carries the load for the first cycle at turn ‘ON’. The triac, being solid state turns on at zero volts in the sine wave, thereby eliminating the arc.



On

**Conduction State** – at the end of the first cycle, the mechanical relay pulls in to carry the load for the duration of the on signal. The triac is turned off, thereby only the relay carries current.



**Turn Off State** – when the signal is removed, the triac is turned back on and the relay turned off. The triac conducts for the last AC cycle to eliminate any arcing when the relay opens. At zero volts in the sine wave, the triac is turned off.

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### Getting Started

#### All Hybrid Relay Products

**Do not:**

Do not use hybrid relays for limit contactors. A limit or safety device must provide a positive mechanical break on all hot legs simultaneously.

**Do not:**

Do not use DC loads with hybrid relays. The triacs used for arc suppression will only turn off with AC line voltage.

**Do not:**

Do not use hybrid switches to drive any inductive loads such as relay coils, transformers or solenoids.

**Do not:**

Do not use cycle times less than 5 seconds on hybrid switches.

#### E-SAFE® II

The E-SAFE® II hybrid power switch is UL® recognized and requires some testing to verify operational temperatures of the terminals and wire once installed into the panel.

**Do:**

Mount the E-SAFE® II hybrid power switch in the cabinet. Attach power and load wires to E-SAFE® II terminals. Properly torque line and load terminals to 2.25 nm (20 in-lbs). Conduct initial temperature rise tests with a 30-second command signal cycle time.

**Do:**

Attach isolated thermocouples to the ring terminals for the power wiring and to the wire insulation three inches from the terminal. The temperature-measuring device must be rated for an electrical voltage isolation value of twice line voltage for safe operation. As an example, with a 240 volt AC line, the measuring equipment must be rated for  $(2 \times 240) = 480$  volts.

**Do:**

Test application as described below for specific wire insulation or specific wire gauge sizes. Tests shall be performed in the end application under worst-case operating conditions. Operate the system at the maximum specified ambient temperature. Monitor the temperature of terminals, using

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thermocouples between the ring terminal and connectors L1, L2 or L3. Ensure terminal temperatures do not exceed 95° C. Monitor the temperatures of wire insulation, using a thermocouple located 3 inches from the connector. The temperature must not exceed the insulation rating of the wire.

If it is desired to increase the cycle time, the above tests must be repeated. A faster cycle time is permitted provided that the maximum terminal temperatures are not exceeded.

**Do not:**

Do not use a snubber or suppressor device on the E-SAFE® II input. Remove snubber (if used) when replacing a MDR (Mercury Displacement Relay) with the relay. A snubber is a resistor and capacitor in series, which is used to suppress any voltage transients sent from the MDR coil. If snubbers are in the circuit, they will prevent the relay from turning off.

**Do not:**

Do not use an E-SAFE® II on 480 VAC ungrounded wye or delta loads.

## **EZ-ZONE™ PM**

The No-arc relay used on the EZ-ZONE™ PM has already been tested and is UL® Listed.

**Do not:**

Do not use No-arc relays on load voltage less than 85 VAC or greater than 264 VAC.

**Do not:**

Do not use No-arc relays on load current less than 100 mA or greater than 15 amperes.

## **EHG SL10**

**Do not:**

Do not use No-arc relays on load voltage less than 100 VAC or greater than 240 VAC.

**Do not:**

Do not use No-arc relays on load current less than 100 mA or greater than 10 amperes.

**No-arc relay conclusions:** A hybrid switch last much longer than conventional relays, but they do wear out. Consider the required life of the hybrid switch when selecting an appropriate cycle time. A No-arc relay has a life in excess of 2 million cycles. A relay operated 24-hours per day, 7-days per week will accumulate 2 million operations in approximately 115 days with a 5-second cycle time.

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