"The Relay Experts, Building Better Relays"

Smart IoT Applications Require a New Relay

Connecting to the Internet of Things (IoT) demands new relay features

Smart wall plugs and switches, smart HVAC systems and lighting, smart security systems, even smart coffee brewers and pet feeders are all candidates today for connection to the Internet of Things. Increasingly, we appreciate the ability to control these devices either on an automated schedule or on demand from a cellphone, computer, or virtual assistant.

Despite the variation in their functions, all the things we now want to connect to the Internet have two other common characteristics: they typically plug into a wall outlet, and they switch current on and off to control a device.

In the U.S., wall outlets and switches, including occupancy sensors, use 120 VAC and are fused with 15 or 20 amp circuit breakers. The designer of a wall switch must account for the many types of appliances that can be plugged into that circuit, including:

- *Inductive loads* from the motors found in appliances such as hair dryers and dishwashers, as well as larger units such as heating, ventilation, and air conditioning (HVAC) systems
- *Capacitive loads* such as the capacitors used in all the wall-mounted or in-line power supplies in your home or office

Have you ever been in a room where every time a particular appliance turns on, the lights dim? The dimming is caused by the high-inrush current required by that appliance. Both inductive and capacitive loads can generate large, short-term current surges—up to ten times the steady state current. While the surge is very quick—just milliseconds—it generates a significant amount of damaging heat.

Damaging effects of heat

A mechanical relay acting as a switch can be destroyed by heat. Current surges occur at the same time the relay is energizing and its contacts are bouncing. As melted metal from the surface of the contacts migrates in the direction of the electron flow from one contact to another, the contacts become pitted. Pitting degrades the contact, increasing the contact's resistance, and the steady state current heat rises.

In addition, pitting creates opposing hills and valleys on the contact surfaces in the area where melted metal is transferred by the electron flow. Couple these uneven contact surfaces with a small amount of over-travel built into the closing contacts of the relay, and you soon have metal-on-metal ledges lodged against valleys. Combine that with heat via increased contact resistance from applied current, and the contacts will eventually stick.

Sticking contacts mean that the device the relay is switching will not turn off when the relay is de-energized, obviously not an acceptable state for a relay acting as a switch.

Requirements for relays used in IoT applications

For IoT applications, then, relays must:

- Be effective for both inductive and capacitive loads
- Be designed to dissipate heat away from contacts, withstanding inrush surges and keeping contacts cool
- For the U.S., be UL rated for 20 A at 120 VAC

A new design for a sugar cube relay

Picker Components' PC520 and PC521 relays meet these demanding requirements for IoT applications.

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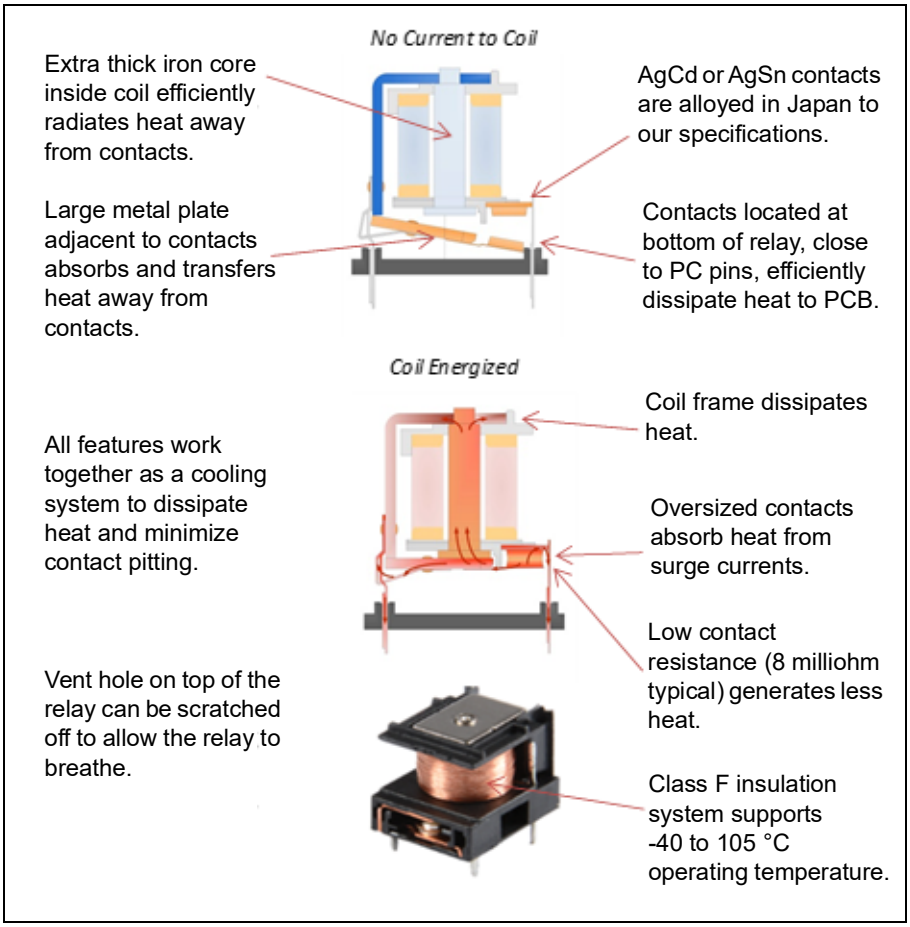
Both are superior small 20 A, 120 VAC relays capable of switching inductive loads common in 120 VAC wall current applications. Housed in an industry-standard "sugar cube" package, the PC520 and PC521 were designed for applications including:

- Multiple lighting technologies (LED, halogen, mercury vapor, and florescent)
- Small motors such as those found in home appliances (blenders, mixers, printers)
- Power monitoring applications such as uninterruptible power supplies (UPS)
- High-current-demand resistive loads like water heaters, coffee pots, waffle makers, and other heating elements

All these devices can be switched with the PC520 and PC521.



Heat dissipation system

These relays are optimized to transfer heat away from the contacts—both the short-term heat from current surges and the long-term steady state heat from high current applications.

The PC520 and PC521 design utilizes an integrated system of features to dissipate heat and keep contacts cool. The system includes:

- **Oversized contacts** to reduce contact resistance and dissipate heat from high-inrush currents
- A **large metal plate** adjacent to the contacts to transfer heat away from the contacts
- A greatly **oversized iron core** in the middle of the coil, whose mass radiates heat into the coil and frame of the relay
- A **Class F insulation system** that is materials rated at 180 °C

These components work together to do two things. First, they dissipate and radiate short-term heat generated from surge currents, keeping contact temperatures below their melting point. Second, they reduce the long-term effects of heat saturation from the heat generated by both contacts and coil.

In IoT applications, high reliability is required. When you turn off your home air conditioning system while on vacation, you want to know you can trust the relay that controls it. With their system of heat dissipating features, the PC520 and PC521 are a logical choice for

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design engineers wanting to deliver a long-lasting product.

Comparing the PC520 and the PC521

While both the PC520 and the PC521 provide a UL 20 A 120 VAC rating and the advantages of the heat dissipation system, the PC251 offers significant materials upgrades that place it in an ideal position for the most demanding applications.

The PC251 provides:

- **Larger contacts**—The 64% larger contacts in the PC521 lower the typical contact resistance from 2.5 milliohm for the PC520 down to less than 1.0 milliohm for the PC521. Lower resistance means lower voltage drop and less heat generated. Under the same conditions, the PC521 contacts generate just 40% of the heat generated by the PC520, a significant decrease.
- **Larger metal plate**—The 13% larger plate in the PC251 dissipates more heat and transfers more heat to the oversized iron core of the coil.
- **Larger iron core**—The 23% larger iron core in the PC251 is as massive as the contacts and metal plate combined. The core dissipates heat away from the contacts via the oversized metal plate to all corners of the relay, including the metal frame and coil windings.
- **Additional UL Rating**—for Normally Open (NO): 16 A at 250 VAC Resistive and General Purpose for 100,000 Cycles at 105 °C

For complete product details and specifications, see the product data sheets on our website:

- PC520 data sheet
- PC521 data sheet

Contact us for more information and to order:
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