



## Selecting Input/Output Relays

When digital scale signals are used to control high-voltage AC equipment through relays, getting it right can be a little like walking through a minefield. Judging from many of our service calls about I/O relay use, it's time to debunk some misconceptions and give some common-sense guidelines for selecting and wiring relays.

I'll cover selecting relays in this column, then finish up in the next issue with wiring guidelines to prevent common interference problems.

### Overview of Relay Theory

A relay, in its simplest form, is an electromagnetic switch that makes or breaks another—usually stronger—electric circuit. A household HVAC wall thermostat is an example of a small 24 VDC relay that senses temperature to open and close a circuit for a larger 120 VAC furnace.

The wall thermostat illustrates two advantages of low-voltage relay switching over line-voltage switching. Low-voltage DC relays are more sensitive controllers with a tighter tolerance band than high-voltage AC controls, and the smaller wire size requires less space.

A weight indicator setpoint firing a 0-5 VDC digital output senses weight rather than temperature. After the output is tripped, a DC-AC relay comes into play just like the home thermostat. The AC circuit closed by the relay is often used to operate large motors, mixers, or conveyors much more powerful than a home furnace motor. That huge difference between the tiny switching signal and the massive operating current is the source of many pitfalls for new installers.

### Relay Types

Relays come in many voltages and input/output configurations, but can be classified generally into either solid-state or mechanical contact relays.

**Solid-state** relays are small, normally-open electronic triacs with no moving parts. They're compact and designed to plug into relay racks inside the indicator case for mix-and-match convenience.

The OPTO 22 solid-state relays offered by Rice Lake come in DC-AC output (0-5 VDC switching input, 120 VAC operating output), and AC-DC input (for digital inputs). They're fused at 4 amps and are designed to operate equipment rated up to 3 amps.

**Mechanical contact** relays use an electro-mechanical solenoid to open or close dry contacts completing a circuit. They usually can be wired either normally-open or normally-closed and come in output or input configuration. Except for the compact OPTO 22-red DC-DC plug-in relay module, these larger and more powerful relays are mounted externally to prevent interference from high-inductance loads.

Some AC-AC dry contact relays can be wired in series after smaller DC-AC relays and used as isolation relays. This separation keeps a large AC current operating field equipment apart from the sensitive switching current at the DC-AC relay. These isolation relays are typically 10 amps or larger and must be mounted outside the indicator enclosure. AC-AC isolation relays are often built into the starter motor circuitry of large industrial motors, eliminating the need for a separate relay.

### General Guidelines

Don't try to operate DC equipment directly from a digital indicator's 5 VDC I/O power supply. This supply is sized only as a switching source, not an operating source. Use a DC-DC relay (OPTO 22-red) and separate DC power source instead.

Low-current equipment (<0.1 A) like small lights may not shut off completely with solid-state relays. The triac components in such relays have a tiny residual current when turned off which may cause lights on the circuit to continue glowing dimly. For absolute on and off states with no residual current, use mechanical contact DC-DC OPTO 22-red relays.

Mount all high-voltage, mechanical contact isolation relays outside the weight indicator enclosure. 120 VAC cables with heavy current draw play havoc with sensitive TTL digital output signals within the enclosure.

These 0-5 VDC TTL signals are not only sensitive to interference, they're also weak—typically less than 20 mA. Don't try to run the cables carrying them more than 10 feet to your relay.

Which brings us to cabling and wiring relays correctly—the subject of my next column. See you then.