Opto 22 Technical Note

TN9601 Applying Dry Contact Output Modules

In addition to manufacturing solid-state output modules, Opto 22 also manufactures three types of dry contact (mechanical relay) output modules. These are the ODC5R, G4ODC5R, and G4ODC5R5. The two "R" suffix modules are Form A (normally open) mechanical relays; the "R5" suffix denotes a Form B (normally closed) relay. These mechanical relays were introduced to serve applications where solid-state output relays were unusable due to off-state leakage or high on-state impedance. It is important to note that these mechanical relay modules were not designed to be interchangeable with solid-state relays in all applications. Mechanical relays offer several advantages over solid-state relays as used in most Opto 22 output modules, but mechanicals also have several drawbacks to their use. Mechanical relays feature near-zero on-state contact impedance, where an SSR might have an on-state impedance of tenths to tens of Ohms. An SSR might have problems if the supply voltage source has a very high output impedance, or a limited current capacity; this would lead to an excessive series voltage drop across the SSR. A mechanical relay in the same application might not have this problem. In the off-state, mechanical relays exhibit zero current leakage, while an SSR might have a leakage of 1 to 2 mA. This can be a problem when the output relay is driving a very high impedance load. The off-state leakage from a SSR might be sufficient that the controlled load never sees a low enough voltage to turn off, once turned on. Again, a mechanical relay with zero leakage current might be the solution in this case.

Unfortunately, mechanical relays also have several limitations to their use. First, small reed-style relays (as used in the Opto 22 modules) have extremely limited load switching capacity. They also have limited current handling ability. The most important specification to consider when weighing the use of mechanical relay outputs is the VA rating; this is 10VA for all Opto 22 mechanical relay output modules. If at any time, the product of voltage and current is more than 10, the relay is at risk of sticking or even fusing closed. This is due to the roughening of the relay contacts by the high temperatures and sparks generated at the contact when switching larger loads. Note that the 10VA specification is rigid—if at any time, the relay load exceeds 10VA, including inrush and kickback surges, the relay is at risk of failure. This means that the maximum inrush current allowable for a 120V load, for example, is 10VA / 120V = 0.0833 A or about 83 mA, not very much at all! At 5V, the allowable current would rise to 2A. The other major disadvantage to mechanical relays is that they have a finite cycle life; for Opto 22 mechanical relays, lifetime averages 5 million cycles. In an application where the relay is switching very rapidly, such as a pulse-width modulation controlled DC heater, the relay might have a lifetime measured in weeks, or even days. Mechanical relays should also not be used to switch or drive high-speed or non-protected solid-state logic signals or devices. This is because the opening and closing of the mechanical contact can generate short bursts of noise, as well as short voltage spikes. These can damage both data integrity and even the driven device.

Applying mechanical relays is a somewhat more involved process than simply swapping one for an SSR. Many things must be considered, most importantly that the VA product of the switched load never exceeds the VA rating of the relay. There is no clean dividing line between applications where an SSR output or mechanical relay output should be used, though they remain as alternatives to each other. Every application is potentially different, and the application of mechanical relays should be carefully considered.