How to Test an AC Output Solid-State Relay or Power Controller

There are a variety of reasons why someone would want to perform a basic functionality test on a solid state relay. Maybe they're working on a new design and have never used solid state relays, or testing components before they're moved into production, or troubleshooting a field issue, or just simply bored and want to see what happens when electricity is applied to an object. The reason doesn't really matter. What matters is that there's a basic understanding of how a solid state relay works so that it can be properly tested.

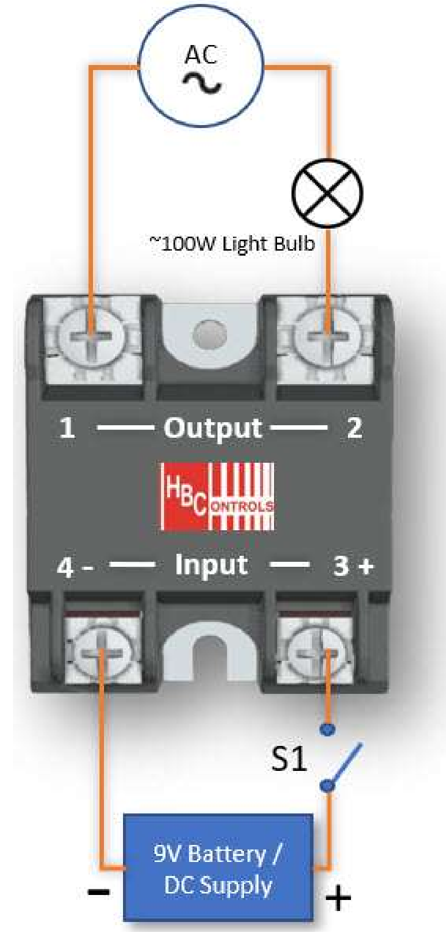

Fig. 1 – DC Input / AC Output Solid State Relay Test Setup

Electromechanical relays and contactors are relatively easy to bench-test; voltage is applied to the coil (input) and there's a mechanical 'click' or 'clack', depending upon your auditory preference. Also, a multimeter set to measure impedance and connected across the output terminals will indicate whether the relay is operating properly. When voltage is applied to the coil, the impedance across the normally-open contacts should be very low (basically a short-circuit) while the impedance across the normally-closed contacts should be very high (open circuit). The measurements reverse when voltage is removed from the coil.

Unlike EMRs and contactors, solid-state relays have no moving parts and use semiconductors to switch load current. Therefore, there is no 'click' or 'clack' to indicate a change in the output state. Furthermore, multimeters cannot provide enough voltage or current to trigger the output semiconductors, which means that the output will always appear to be open, regardless of whether an input signal is applied.

Figure 1 shows a simple method for performing a basic functionality test on a DC input, AC output solid state relay. Most solid state relays only require a few milliamps of input current to trigger the output circuit, so a 9V battery is more than sufficient for the test. If a 9V battery is not available, then any power supply capable of providing 4 to 32Vdc will suffice. When S1 is closed, the output will conduct load current and the light bulb will illuminate. When S1 is opened, the bulb should turn off. A 100W bulb is referenced in the diagram, but any bulb pulling at least 150mA of load current will work.

Bench-testing an AC input solid state relay follows the same process but requires a slightly different wiring configuration for the input circuit. As shown in figure 2 on the following page, the input of the SSR is also connected to the AC mains through S1. The output of the solid state relay begins conducting current when S1 is closed, illuminating the light bulb.

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One important note regarding bench-testing AC input solid state relays – the input connection must be on the AC mains side of the load. The relay will not operate properly if the input circuit is connected directly to the output terminals. This is because the voltage drop across the output terminals is approximately 1Vrms when in the on-state. If the input terminals are connected to the output terminals through S1, input voltage will drop to 1Vrms once the output circuit triggers and the relay will turn off.

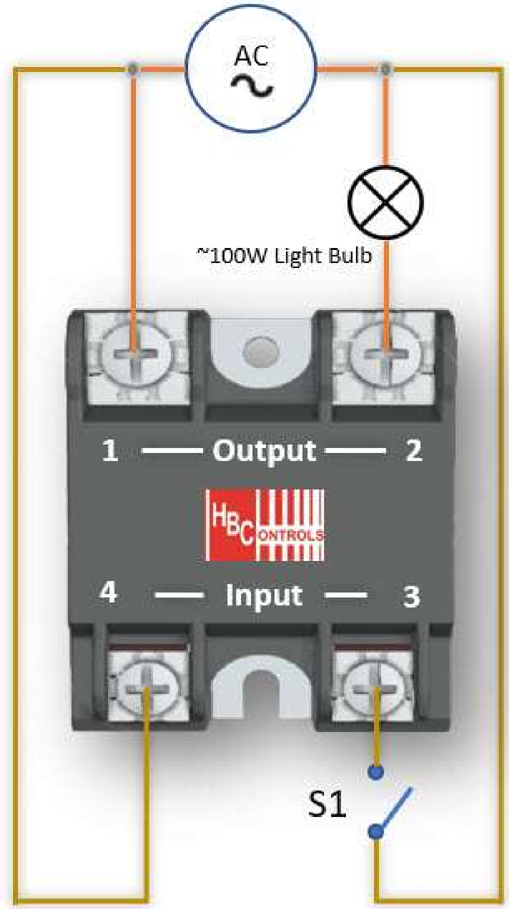

Fig. 2 – AC Input / AC Output Solid State Relay Test Setup

The same process for testing AC output solid state relays can be used to test DC output solid state relays. The only difference is the type of load used. DC motors are commonly used to bench-test DC output solid state relays since they clearly indicate when the relay is on or off. However, unlike AC output solid state relays, the output circuit of a DC output solid state relay is polarity sensitive. If you bench-test a MOSFET output DC solid state relay and reverse the output polarity, the load will always conduct due to the internal characteristics of the MOSFET.

Protection from damage due to back EMF is also an important consideration if using a DC motor as a load. However, this is easily resolved by simply placing a fast recovery diode in reverse parallel with the motor.

If the solid state relay doesn't operate properly using these methods, then there are a few quick troubleshooting steps you can take before contacting us.

1) For DC input SSR bench-testing, make sure that the input supply can provide the required voltage and current per the datasheet, and that the input polarity is correct.
2) For AC input SSR bench-testing, make sure that the input terminals are connected directly to the AC mains – not the output terminals - through the control switch.
3) For either AC or DC input testing, make sure that the load will pull at least 150mA of current at the AC mains voltage being used for the test.
4) For DC output SSRs, make sure that both the output and input polarity is correct, and that the relay is adequately protected from back EMF if the load is inductive.

Please contact our support team @ 800.879.7918 / support@hbcontrols.com if you need assistance with testing a solid state relay or power controller, or if you'd like to further discuss specific technical requirements.