

# Ticket #1254

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<b>Create Date:</b>	03/11/2016 8:43 pm	<b>Phone:</b>	(713) 501-2744
<b>Field of Study:</b>	Electrical Engineering		

Subject: **Yale University**  
**03/11/2016 8:43 pm Philip Piper**

This question is with regards to pre/dis-charge relays. Originally we planned to use the Omron G2RL for both circuits. However upon further investigation of the G2RL datasheet, the maximum contact switching voltage is 300V whereas the nominal contact switching voltage is only 30V. I don't feel confident enough to use this relay at its maximum rating, therefore we are looking at the following change.

We couldn't find a well priced electromechanical relay that fit our needs. All of the high contact switching voltage relays also had high contact current ratings, making them very bulky and expensive. Instead, we want to use a reed relay for the pre-charge circuit and a solid state relay for the dis-charge circuit.

## Pre-charge

From what I can tell, reed relays are typically used as signal relays for their higher switching frequencies than electromechanical relays. One disadvantage I noticed was their smaller contacts, making them easier to weld closed if used with large impulse currents. We plan to use a Littelfuse reed relay rated to 1A with a hold-off voltage of 450VDC which should be large enough to meet our pre-charge circuit, which uses a maximum of 0.3A. We thought about using a solid state relay here, but were a little worried about not meeting the rules. A solid state relay does not galvanically isolate its contacts whenever it is in the open position, and I think this must break some rule (as there would technically always be high voltage, although at a high impedance, on the positive tractive system rail).

## Dis-charge

The dis-charge relay has to be normally closed, and I had a tough time finding a reed relay that meets this requirement. However solid state relays are often sold in normally closed configurations, and we aren't very worried about the ~1uA leakage current that occurs when the relay is open. Additionally solid state relays typically fail closed, which is actually the preferable failure mode for a dis-charge relay.

Does this configuration of reed pre-charge and solid state dis-charge meet EV4.11? Additionally would using a solid state relay in the pre-charge circuit break the rules?

Thanks for your time!

Phil

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**03/11/2016 8:45 pm Philip Piper**

I meant to say EV4.9 in the final paragraph.

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**03/11/2016 11:59 pm**

I appreciate your prudence on your precharge relay selection. The real reliability and failure modes of these parts is often overlooked. That said, we would not flag you for using the relays you originally selected, even if a better design is possible.

Either way, a reed precharge and a SSR discharge will meet the rules assuming that you select appropriately rated components.

Pay careful attention to make and break currents on reed relays. Although their maximum carried current rating may be high enough, they may not be able to switch those loads for very many cycles.

You are correct in thinking that the precharge relay should not be solid state. If you wanted to use a cheaper relay but reduce your chances of welded contacts, you might consider a relay and SSR in series. The relay switches on first, and off last. The relay can offer the galvanic isolation required while the SSR takes the switching load, protecting the relay from welding.

Happy Engineering!

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**Please Wait!**

Please wait... it will take a second!