Ticket #989

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Subject: **Yale**
09/25/2015 12:58 pm Philip Piper

This question is in regards to EV4.9.3.

Background

We are currently designing a HV control board that will house pre/dis-charge relays, pre/dis-charge resistors, the DC-DC converter, TSMP resistors, and a lot of connectors. We ran into a bit of a problem when trying to size the discharge resistor:

Our car will run at 300V, and our two motor controllers combined have a total DC link capacitance of 1600uF. Therefore we need to be able to discharge at about 66W for 15 seconds (using a 1.35K resistor). To provide a little safety in the discharge time, and seeing as it is difficult to source 1.35K resistors, we decided on using a 1K resistor and taking a small hit in having to dissipate more power. Using a 1K resistor we need to be able to dissipate 89W for 15 seconds per EV4.9.3.

Resistor Choice

Ceramic and wirewound resistors typically have much higher temperature ratings than thin/thick film resistors at the cost of size. You have to worry about a heat sink and air flow with film resistors. Ceramic/wirewound resistors typically have very good overload characteristics that are usually described in the datasheet. Based on these characteristics, we chose to look at ceramic/wirewound resistors.

Question

The problem we hit is that these overload characteristics are almost always defined for 5 seconds rather than 15. For instance we found a 20W 1K resistor that seems to fit our design very well, but it has an overload rating defined as 10 x rated power for 5 seconds. To be very specific, would that resistor pass EV4.9.3 based on the background I gave above? If not, what is the proper way to use the 5 second overload rating?

Best,

Phil

09/25/2015 3:38 pm

Ideally you'd find a resistor that provided a curve of overload rating vs. time, but short of that here's a trick you can use that could be useful in this case:

For a short term overload, some of the heat energy dissipated is stored in the thermal mass of the resistor, and some is dissipated to the air surrounding the resistor. If you put the same amount of energy (not power) into the resistor over a longer period of time, the amount that can be stored in the thermal mass does not change, but the amount that can be dissipated to the air goes up, given the longer time. So if we calculate the energy dissipation capability for 5 second from the rating, the energy dissipation capability for 15 seconds must be at least as much:

E_15 >= E_5 = P_5*(5 s) = 200 * 5 = 1000 J

We can then go back to power:

P_15 = E_15/15 >= 1000 J/15 s = 66.7 W

So the 20 W resistor that has 10X capability for 5 seconds has at least 66.7 W capability for 15 seconds. Sadly that's not quite enough for your 1k design, and we only know it's better than 66.7--we don't know how much better. So you'll need to modify your design but this can give you a simple basis to use the 5 second rating to get a 10 second rating.

You could try to develop a more sophisticated RC thermal model with those two model parameters chosen to fit the two data points you have (continuous and 5 second ratings), and you might be able to use that to prove that a little higher power is OK but that won't get you to 89 W so I suggest simply re-designing with this simpler approach, perhaps using two 20 W resistors, for example.

09/25/2015 6:01 pm Philip Piper

Thanks!

10/03/2015 6:07 pm

Closing

Please Wait!

Please wait... it will take a second!