

Ticket #990

Ticket Status: Closed

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Field of Study: Electrical Engineering

Subject: Yale

09/25/2015 1:12 pm Philip Piper

This question is in regards to rules EV3.4.7 and EV4.12.2.

EV3.4.7 states that the prominent accumulator LED indicator must be lit for all voltages greater than 30VDC, and EV4.12.2 states that the TSVP indicators must be lit for all voltages greater than 32VDC or 1/3 the tractive system voltage (whichever is higher).

From an efficiency standpoint, both of these indicators should 100% be run off of a step down DC-DC converter. Not to mention that finding a 300VDC light would be very difficult. However I am not sure if there is some safety concern with the prominent accumulator LED indicator that I am missing. EV3.4.7 makes it difficult to use a DC-DC converter, because most high voltage step down converters drop out at around 1/4 to 1/3 of their input voltage. For instance we plan on using this converter from CUI Inc, which is rated for up to 370VDC input and drops out at 100VDC (fails EV3.4.7 and passes EV4.12.2).

Is there any reason for the difference in EV3.4.7 and EV4.12.2, or is it OK for the prominent accumulator LED indicator to drop out at 1/3 the tractive system voltage? If so, how would you suggest designing the prominent accumulator LED indicator without directly attaching it to the 300VDC HV bus?

Best,

Phil

09/25/2015 4:55 pm

There are several reasons for the different rules:

- 1) The indicator is there for people working on the vehicle, who might touch unprotected wires, and so the threshold for what we want to be sure they know about is lower.
- 2) The indicator does not need to be as bright as the TSVP lights, so low-efficiency solutions can be OK (and a dc-dc might not be high efficiency when used for a low-power indicator).
- 3) There's no need for isolation since, unlike the TSVP lights, it's allowable to have the indicator connected to the TS.

An expensive but easy solution is this product:

<http://www.newark.com/grace-engineered-products/r-3w/power-warning-alert-40-750vac/dp/44P9342>

For many teams, there are several containers each at 150 V or less with an indicator on each. I am guessing you have only one container and a maximum charge voltage near 300 V?

09/25/2015 5:53 pm Philip Piper

Wow, that is indeed fairly expensive for a voltage step down, some LEDs, and fancy packaging. Maybe I should drop the car team and start selling voltage safety indicators!

Just as you suspect, we do have a single accumulator container operating near 300V. My issue with directly connecting the LED is that, assuming a "prominent" LED draws above 50mA, we would be wasting 14.8W of power to light up a 0.2W

LED. That is more than the two TSVP lights combined (through the DC-DC of course).

I'll look around a bit more for a DC-DC with a lower dropout, but I didn't have luck looking for one before so we'll probably scrounge together another \$170. Additionally I guess one way to directly light an LED would be to clamp the 300V down with a zener diode and power the LED from there, which we'll also think about.

Best,

Phil

09/27/2015 10:03 am Philip Piper

Here's a potential solution:

Our accumulator is being designed to be completely serviceable while still in the car. However it is also removeable if need be. Can we classify our accumulator as nonremoveable to avoid the indicator in EV3.4.7? Therefore when we charge or work on our accumulator during the competition, it will have to be in the car.

Best,

Phil

09/27/2015 10:28 am

If you go into business selling LED indicators, we'll be happy to recommend them to FH teams.

You could probaly achieve "prominence" with less than 50 mA using high-efficinecy LEDs and using a cluster of them connected in series.

If I undertand your zener diode approach correctly, it would not reduce power dissipation compared to a simple series resistor, unless you combine it with a dc-dc converter.

You can request that the rules committe consider some temporary means of making the box non-removable during the competition. However, your design should be safe for future work back in your shop as well as for work at the competition. We have no way to ensure that teams work safety at home but we want to encourage designs that facilitate that. So you would want to address that question in your petition.

10/03/2015 6:38 pm

Phil - You could also look at the UCC28880 and similar devices from Texas Instruments:

<http://www.ti.com/product/ucc28880>

Although they are rated 85V rms min to start, it may be possible to add a resistor from HV to pin 4 Vdd, with a zener to ground, to make it work to a lower voltage.

I've found TI tech support to be quite helpful on questions like this.

Regards

FHelecRules

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Please wait... it will take a second!