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Subject: Initial Shunt Ckt Testing
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KC

Dale, Alana – I've spent the last two days testing out the Vicor Maxi Carrier board with emphasis on the shunt regulation circuit.

Initial Board Testing

For initial testing, I removed the surge resistor to isolate the shunt circuit. The Vicor came up with no problems. The open circuit voltage is 48.12V. The 15Vdc regulator was oscillating due to an insufficient load. I added a resistor in parallel with the filtering cap – it's much happier now. I will update the schematic once testing is complete.

Shunt Circuit Testing

Now, the fun part. To simulate voltage regeneration on the +48Vdc bus, I decided to vary the input to the comparator rather than mucking around with superimposing signals onto the 48V bus. I removed the 1.25V zener fixed reference and soldered test wires to allow injection of various waveforms to the negative input of the comparator. My goal at this stage was to see what this PulsEater resistor could handle.

I've attached the datasheet for the PulsEater – there are a few more details on Ohmite's website. But, the important number for us is the energy (not wattage) dissipation. The AY series can handle 1.4kJ. While the shunt circuit is activated, the 4.7 ohm PulsEater is placed in parallel with the load, essentially shorting the entire 48V bus through it and the power mosfet. 600W/48V = 12.5A. The average power dissipated by the PulsEater is (12.5)^2 * 4.7ohm = 735Watts. The actual energy dissipated is this wattage multiplied by the pulse width.

After some initial testing, I injected a pulse train at 2kHz with a 20% duty cycle. This is a 100usec pulse. The per pulse energy is 74mJ. Way below 1.4kJ for sure. I felt confident letting this run. After about 20 seconds, the PulsEater began to smoke.

After replacing the resistor, I switched to a different pulse generator which would allow much smaller duty cycles and single pulse events. I tried a series of low duty cycle pulse trains; the circuit fired as expected. I then sent a series of single pulses to the circuit: 1000ms, 1500ms, and 1800ms. I gave a 5-10 minute rest period between pulses to allow for cooling of the PulsEater. While I did not use a thermocouple, the old finger test revealed the resistor getting incrementally hotter after each pulse width increase. At 1800ms, it was too hot to even touch. 735W * 1800ms = 1.32kJ. That's close to its rated value and it's temperature empirically agrees with that.

Looking back at my 20% duty cycle test, I believe I was experiencing temperature derated performance. While this is difficult to quantify, 1.4kJ/74mJ = 18,900 pulses. With a frequency of 2kHz (T=500us), that is about 9.5 seconds. The 20 seconds above was not timed and was a guess. I would believe that things started going downhill after 10 seconds or so….

So, I feel pretty confident in this resistor meeting its specifications. The question is now, is our actual implementation going to exceed them? [One thing we have in our favor is that during my bench testing, there was no cooling of the PulsEater. We can expect slightly better performance when cooled]. The next step should be to hook up the board to an actual ELMO + motor. Do we have any idea of the

voltage rise due to regeneration? Was this observed during your previous testing? In any case, this is the time to test hard.

I have a couple of design reviews tomorrow and Friday (one is mine) so I'll be a bit busy, but let me know what your time frame for motor testing is.

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Ohmite A Series Resistors.pdf