

Re: topology suggestions for 3.5kW batt charger?

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On 30 jun, 23:06, "Tesseract" <u35475@uwe> wrote:

Greetings all – just found this site while searching for "boost pfc" and noticed that Winfield Hill has posted here before so I figure the site can't be all that bad ;)

I'm just throwing this out as a sort of curiosity-type question. I have designed quite a few switchmode power supplies over the years but nothing even approaching this power level (600W is the previous maximum). A friend of a friend has one of 492 electric chevy S-10 pickups, and the onboard charger has lost its magic smoke. Frankly, the design of this charger/motor drive pretty much blows, imho, so I'm toying around with the idea of whipping up something new. "Toying" because there is little financial motivation for doing this. However, it is an interesting project and that is motivation enough, sometimes.

There are two banks of batteries in the pack, each containing 26 12V/42Ah batteries. The manufacturer, Genesis, recommends charging them at the 0.4C rate up to a maximum of 2.4V/cell (with -20mV/C of compensation). As this comes out to a rather onerous 6.3kW, I'll either have to go with a less-ambitious charge rate or force the guy to unplug the range every time he needs to plug in (or, of course, have a dedicated 40A. circuit installed). As of now he does have a 240V/20A circuit for this purpose which, if we adhere to the NEC, gives us *just* enough continuous amperage to charge each bank at 0.25C (10.5A) . This means both banks can be sequentially charged in about 8 hours, which is tolerable.

A linear and/or design using 60Hz magnetics is totally out of the question – you won't be able to move the thing around without a forklift. The next simplest thing I can imagine, then, is to use the output of a boost PFC more or less directly. This has some serious safety issues, but it ain't like I'm going to be submitting it for UL approval any time soon. So, these are the various factors/ideas I am contemplating:

quasi-resonant (soft) switching; ZVS or ZCS?
IGBTs or advanced MOSFETs
Boost PFC + full-bridge or some combo to provide isolation

Current mode control is a natural, here. Voltage regulation needs to be

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accurate but there's no need for a lot of loop bandwidth (ie – fast transient response not required). Ideas welcome!

–Jeff

Hello Jeff,

When a switching topology is a mandatory, my first thoughts go to a full bridge forward converter with zero voltage switching where the current limit is determined by the leakage inductance of the transformer (probably a very large set of U cores). This is inherently short circuit proof and you have plenty of time to shut it down. The voltage waveform at the bridge is trapezoidal. dV/dt at the switches is limited by the external capacitors.

Instead of one unit, I would use (depending on components available) 2 or three units. In that case, main charging is done by (for example) 3 units in parallel. As the voltage reaching final level, one or two units are switched off. When you can make one, you can also make three units.

Main advantage for a full bridge circuit is the ripple current in both the primary rectifier and secondary rectifier. There is also efficient utilization of the semiconductors. High dI/dt is avoided because of the leakage inductance of the transformer. The transformer design is somewhat tricky. You might use a separate coil for dI/dt limiting.

Because of the required large sized magnetics, you are limited in maximum operating frequency because of risk on bad flux distribution due to field propagation issues inside the magnetics.

You can drive the IGBT's or MOSFETs with one transformer (with 4 secondary windings).

Best regards,

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