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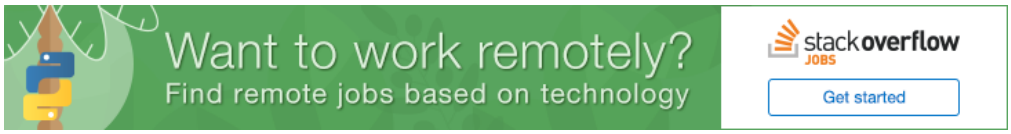
DC-DC converter, 12V to 400V? Is this possible?



To be able to charge a high voltage battery (~400V) from solar panels I need a dc-dc converter that can boost up the voltage from the low voltage system (~12V) to the higher voltage. The power needed is about 400W, or 1A at the output.

I have read that it is not practical to boost more that a factor of 6, and this is a factor of about 30-35.

Would two boost (step-up) converters connected is series work or is there a better solution?

high-voltage dc-dc-converter

edited May 22 '13 at 13:00

asked May 22 '13 at 12:42

Peter Bjarnholt
35 1 1 8

How much charging current are you looking for into the 400V battery? There is no problem going up from 12V to 400V providing you are not looking to source more than a few milliamps. 10mA at 400V is 4W and there are plenty of chips and step-up transformers that will do this job. – Andy aka May 22 '13 at 12:50

About 400 W, so that would be 1A. (added to question by edit) – Peter Bjarnholt May 22 '13 at 12:57

This is the closest thing I have found: aliexpress.com/item/... – Peter Bjarnholt May 22 '13 at 13:06

1 Out of curiosity, what kind of battery is this? Could we see a datasheet or product link, please? – Anindo Ghosh May 22 '13 at 13:20

1 400W would require at least 33A at 12V (50A is probably more realistic). Are you solar panels up to this? – Wouter van Ooijen May 22 '13 at 14:24

4 Answers

In general, a single boost circuit is preferable to using two boosters in series. I say this because, given the powers you require, a transformer is the most efficient way to do the step-up from 12V to 400V.

Not using a transformer will limit the power you can handle in stepping up the voltage. At these sorts of power levels you'd be hard-pushed to find a booster that doesn't use one. Once it is accepted that a transformer is a requirement, any turns ratio from a 100:1 (step-down) to 1:100 (step-up) is just a matter-of-fact (see comment below next paragraph).

Because a transformer is necessary to economically achieve the power output, the turns ratio is going to be an easily achievable 40:1. A 24Vp-p input at a frequency of (say) 10kHz will, under no-load conditions, produce an output of 960Vp-p which after rectification/smoothing is going to be about 475VDC.

But, high turns ratios and efficiencies don't always go hand-in-hand - I'm thinking of X-ray tube power supplies that I've used - they were 50KV/4mA output (200W). The step-up transformer was a large ferrite operating at 50kHz and, with about 1200 turns on the secondary you were starting to hit self-resonance. It *was* a resonant transformer circuit so that was no problem but more than 1200 turns and you were on the downward slope of decreasing efficiency. Input turns, from memory were about 6 so turns-ratio of about 1:200. The output fed a multi-stage cockcroft-walton voltage multiplier to take the output up from about 2000Vrms to 50kV.

More than likely (given the power), you'll need a H-bridge driver which will apply nearly 24Vp-p to your primary winding and the turns ratio will be 40:1 to produce +400VDC. It will need a reasonably sophisticated control system that involves pulse width modulating the drive to the primary and decent monitoring of the output to ensure you stay regulated. I would also say that a secondary shut-down circuit would be needed should a single-fault arise. **Caution - fire hazard, electric shock hazard**

Given the power supply's sophistication I'd be very hesitant to believe that two boosters would be at all more effective than one booster on the grounds of efficiency, performance, physical size or cost.

edited May 22 '13 at 18:44

answered May 22 '13 at 17:11

Andy aka

204k 8 139 333

Dual-stage boost may have a lower cost than a step-up transformer. Appropriate inductors may be cheaper and easier to obtain than the appropriate transformer (which would almost certainly have to be custom-designed). – Nick Alexeev ♦ May 22 '13 at 18:40

1 @NickAlexeev I appreciate what you say but given the power requirements I find it difficult to envisage a design without a H bridge transformer primary. I hinted at 10kHz operation in my answer and given that it will only need to step-up 40:1 I think there won't be too many difficulties with the transformer - but it's likely to be custom for sure. – Andy aka May 22 '13 at 18:46

Once, I've seen a commercial 30kW grid-tie inverter. The first stage in that unit was a boost. The whole device was light enough that I could lift it. – Nick Alexeev ♦ May 22 '13 at 18:50

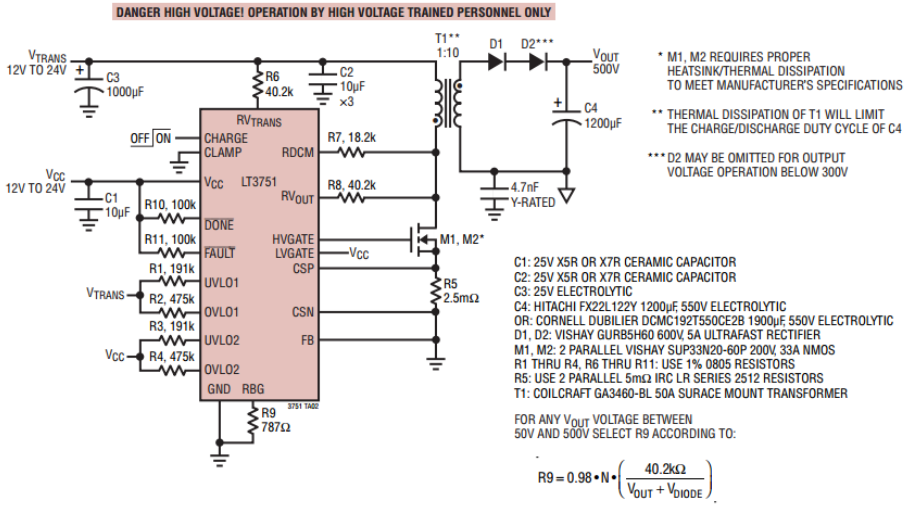
@NickAlexeev - transformers don't have to be heavy!!! – Andy aka May 22 '13 at 18:53

1 My main point was that there is a fighting chance of finding the appropriate inductors off-the shelf, but the appropriate transformer would almost certainly have to be a custom job. I was talking only about cost. Not about size, weight, efficiency. – Nick Alexeev ♦ May 22 '13 at 18:56

LT3751 is a *High Voltage Capacitor Charger* (and I suppose that it can be used for batteries with the help of some protection ICs). I have skimmed the datasheet and it seems that it can handle several tens of amps as input, and can go to 400V output. In any case, you will have to spend some time selecting the magnetics and switches which fit your application:

TYPICAL APPLICATIONS

42A Capacitor Charger



edited May 22 '13 at 19:55

answered May 22 '13 at 19:27

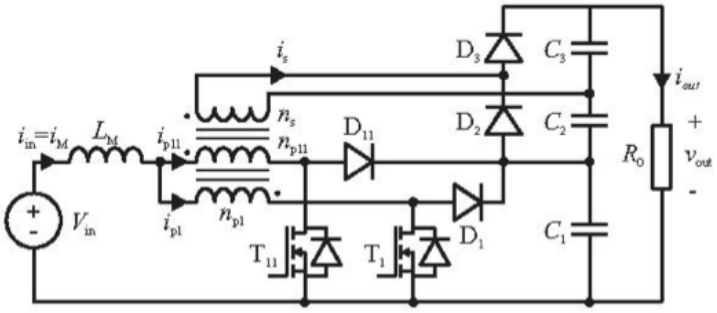
svilches

339 1 3 11

You can achieve this ratio in many ways. Two stage boost is one option, it is definitely the

easy option as you can use off the shelf controllers and you don't need to design a transformer. One stage boost is probably also an option but it will require more know-how and state of the art semiconductors and magnetics (to get ok efficiency). If you choose to use an isolated topology you can probably go with forward or push-pull converter.

You can also use more complex converters boost topologies like this two switch boost with integrated magnetics:



answered May 22 '13 at 18:37

Szymon Bęczkowski
2,309 7 20

Batteries> Mains AC inverter resulting in 240v or 110v AC depending on your country. Then a full wave bridge rectifier with a electrolytic across the DC output. The bigger the inverter the better

answered Jun 19 '17 at 6:54

Allen Clarke
1

1 Why would converting to 110/240VAC be beneficial here? – duskwuff Jun 19 '17 at 7:09