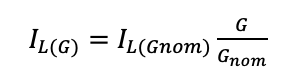
# Justifications for design choices

Any figures that do not have sources have been created by the authors.

**Configuration of solar panels:**

PV cells should not be connected directly in series. In a series connection partial shading can have a huge impact. From lectures we have:



Meaning that if a single PV cell has an incoming irradiance of half the others then the current will be halved and the power of the array will drop to almost half of peak power. On Mars partial shading is expected to occur as dust covers parts of the solar array.

This leaves two configuration total-cross tied connection (TCT) and full parallel. Both configurations are shown below:

Et bilde som inneholder tekst, klokke

Automatisk generert beskrivelse

TCT has the advantage over series connection that the drop off in the current of one cell has a far smaller impact on total output power.

Could also have done two parallel connections of two PV panels in series, but this has the disadvantages of series connection without the advantages of TCT. See linked article to see comparison.

Disadvantage of pure parallel connection is that voltage is lower. To charge the batteries we use the SMPS in a buck configuration, and the voltage is therefore stepped down. Thus, if the voltage of the PV array is not higher than the charging voltage of the battery then we won’t be able to charge at all. The advantage of parallel connections is that a change in the current of one cell will not impact the current of other cells. However, at the maximum power point of the array as a whole, each individual cell might not be operating at its own maximum power point. Disadvantage, SMPS losses might be high at low voltages.

Remember that capacitor on SMPS input will be able to hold some energy. At 62.5 kHz it holds enough power that input power is constant no matter the duty cycle.

What is the maximum power drawn by the batteries? There are 5 batteries and we charge at 250 mA:

In addition to this there will be losses in the circuit. However, the rated power of the PV cells together is:

So we need to draw as much power as possible out of the solar panels. Might not be able to use the full 5 battery cells.

<https://www.sciencedirect.com/science/article/pii/S0360544211001484?casa_token=aN6AlhJsx9IAAAAA:yUMOdvzscbw5ltokpvOcWVfY8IOHd0nr_6eLwivW_ZHVWAsjFMjRJ7ihyQtg2kn25_U9QIG5yg> , configuration of solar panels

<https://www.sciencedirect.com/science/article/pii/S0038092X16300111>

Testing both configurations and comparing them. Test each multiple times.

**Number of batteries:**

Check if charging at a lower current has any effect on capacity, if not, then we can charge more cells, just at a lower rate. Then we can use the full battery-pack.

**Safety mechanisms:**

Needs to shut itself down when too much power has been drawn, if not we might damage batteries.

**MPPT:**

<https://www.sciencedirect.com/science/article/pii/S1364032117305750>