

# Requirement Specifications

## - General DPS Requirements

1. The DPS shall have a power efficiency of  $>60\%$  on either of the two outputs.
2. The 5 V branch shall have a  $5V \pm 0.15$  V output with a maximum current load of 20mA.
3. The 12 V branch shall have a  $12 \pm 0.8$  V output with a maximum current load of 20mA.
4. The DPS shall operate with a single voltage input of 14 V, as it is not within  $\pm 10\%$  of either of the output voltages (5 V and 12 V).
5. The DPS shall maintain voltage output specifications with an input voltage  $\pm 20\%$  from nominal.
6. The DPS shall have a mass of no more than 25 g including PCB and components (without leads), and the weight of the solar panels and the batteries should not exceed 10 kg.
7. The DPS shall generate a maximum of 30 mA output current under a short circuit condition on either output.
8. The PCB shall be capable of manual assembly within 30 minutes.

## - Environmental specifications

9. The DPS shall not suffer damage at temperatures down to  $-40^{\circ}\text{C}$ .
10. The DPS shall maintain voltage output specifications over a temperature range of  $0-70^{\circ}\text{C}$ .
11. Number of components should be kept minimal, and well as the quantity of solder used. This is due to the materials used in the components and solder having a significant effect on environmental pollution.

## - PCB board and component specifications

12. The DPS shall have header pins for the connection to the battery.
13. The DPS shall have header pins for the output connections.
14. The PCB surface area should be  $4.5 \times 4.5$  cm.
15. Board Type: Double-sided plated through-hole vias, components only on top side.
16. Vias: 0.5 mm with copper pad of 1.2 mm.
17. Track Width: Minimum 0.3 mm.
18. Track to Track / Track to Pad separation: Minimum 0.3 mm.
19. Copper Pour Spacing: 1 mm
20. Track / Via / Pad to Board edge separation: No tracks within 2 mm of edge.
21. Surface mount components only. Resistors and capacitors must be package type 0805.

## - DPS cost estimation

22. The cost of the DPS circuit (excluding power supply) can be estimated as approximately £ 2.4, the price of manufacturing each DPS circuit should not exceed £ 2.5.

Components	Estimated Price (£)	Quantity
PCB board	0.7	1
IC	0.7	2
Additional passive components	0.03	11

## Verification

As a result of the successful construction of the DPS PCB, multiple tests have been conducted in the laboratory to verify if various requirements have been fulfilled.

**1. The DPS shall have a power efficiency of >60% with a 20 mA current load on either of the two outputs.**

This requirement has been fulfilled as the 12 V branch has an efficiency exceeding 60 % with the testing conditions of up to a load of 711  $\Omega$ .

**2. The 5 V branch shall have a  $5V \pm 0.15$  V output with a maximum load of 20 mA.**

This requirement has been fulfilled as the output voltage remains in the desired range and the current reaches 19.72 mA, meaning that the current limit of 20 mA has not been exceeded.

**3. The 12 V branch shall have a  $12 \pm 0.8$  V output with a maximum load of 20 mA.**

This requirement has been fulfilled as the output voltage remains in the desired range and the current reaches 19.601 mA, meaning that the current limit of 20 mA has not been exceeded.

**5. The DPS shall maintain voltage output specifications with an input voltage  $\pm 20\%$  from nominal.**

This requirement has been fulfilled. The nominal input voltage is 14V and  $\pm 20\%$  of 14V is 11.2V-16.8V. However, according to requirement 4, the input voltage cannot go in the range of 10.8V-13.2V. As a result, the lowest value that input voltage can go is 13.2V. Real-life tests have shown that when the input voltage is in the range of 13.2V-16.8V, the circuit is able to supply the desired output specified in requirements 2 and 3.

**10. The DPS shall generate a maximum of 30 mA output current under a short circuit condition on either output.**

This requirement has been fulfilled as the short circuit current for the 5 V branch is 27.45 mA, and for the 12 V branch it is 27.121 mA.