Manufacturing Plan:

Producing 200 Printed Circuit Boards with our design needs:

1. Only one layer of board is needed with our two layers circuit design.
2. Photolithography and drilling the Vias to finish the circuits on the board.
3. Cutting circuits assembly on the large board to small pieces

With machines:

4. Using camera to inspect automatically to check if there is any defect on the board. i.e. the remains of copper between two traces that may cause short circuit.
5. Automated contact electrical testing is used to test the traces and footprints.
6. Machines pick and places the components on the footprints with the soldering paste and send the boards to oven to solder them.
7. Check the connection and performance automatically with machine.

Manually:

4. Checking the footprint with the PCB design graph to verify the circuit correcting.
5. Using the Multimeter to test the test the short circuits caused by copper pouring.
6. Put the soldering paste on the footprints with a plastic cover (same blanks as footprints).
7. Check the components list and put the components on quickly. Put the board in the oven.
8. Using microscope to check details of the board
9. Check the short circuit with components and test the performance with the input.

Before producing all 200 PCBs, it is necessary to produce one prototype and test if it satisfies all the requirements.

The tests needed:

1. Test the Input current and outputs, to find the defect in PCB design. If there is some defects, redesign the PCB and prototype it again.
2. Test the short circuit current to make sure the safety.
3. Test the lifespan of the PCB board. Running the circuit for a long time (i.e. 1 day).
4. freezing the board in a -70℃ freezer. Taking out the PCB and test the circuit immediately to make sure that the board can work in Antarctic environment.
5. Changing the input voltage in a range to verify the flexibility of the board.

Once the prototype performs well, 200 PCBs can be produced together.

Total time:

With machines: prototyping needs approximately 12 hours based on our experience of 2 sessions to finish one producing and testing. 3 prototypes are needed generally. producing large number of PCBs does not manual work, so no time for technicians is needed. But the economic cost is higher with for the machines and production line.

Manually: After 12 hours prototyping, one technician needs about 30mins to produce a PCB by putting components on the board and soldering it. Roughly 100hours are needed to produce all PCBs, with a probability of about 5-10% manual error. One technician in total needs 120 hours (5 days) to finish all PCBs prototyping, producing, and testing.

Costing:

1.Bill of Materials

RESISTORS	PATTERN	QTY+Spare	Cost Each	Supplier
22 5%	0805	2+1	£0.01	MULTICOMP PRO
2K7 5%	0805	1+1	£0.01	MULTICOMP PRO

3K9 5%	0805	1+1	£0.01	MULTICOMP PRO
4K3 5%	0805	1+1	£0.01	MULTICOMP PRO
7K5 5%	0805	1+1	£0.01	MULTICOMP PRO
10K 5%	0805	2+1	£0.01	MULTICOMP PRO
Capacitors	**PATTERN**			
100pF COG 5% 50V	0805	3+1	£0.05	YAGEO
ICS	**PATTERN**			
TL071	SOIC-8	1+0	£0.45	Texas Instrument
UA723CD	SOIC-14	2+0	£0.68	TEXAS INSTRUMENTS
Header Pins				
6 contacts, 1 row		1+1	£0.3	HARWIN

2.Spreadsheet

--2.1 Non-recurring cost

Design cost

Design and verification: Design and verification take roughly 3 workdays to complete. Suppose each workday takes 8 hours, that is 24h in total. £24*40=£960.

Test equipment: Testing components include digital Multimeter (£20), a computer (LEGION Lenovo, around £700) and a test bench DC power supply (£50).

--2.2 Recurring cost

Components: All components take roughly £2.77 per unit.

The PCB board costs £0.67, if manufactured in 1m^2 (493 units in total, each unit area:4.5cm*4.5cm) each time. Production in a larger scale would not save much cost.

Factory: Fairfield	Days of producing:8	Cost/unit: £0.67	Total cost: £330.31

Quality Assurance-Testing

Testing for one board takes 10min maximum, for a £20/hour labour the cost for one PCB would then be £3.33.

--2.3 Total cost per unit

Cost per unit = 2.77+0.67+3.33+(960 +20+700+50)/493 = £10.27

In addition, cost for recommended input voltage(£1/V):14V*1£/V=14£

Risk matrix

Impact of Occurance					
Scale	1.Technical	2.Schedule	3.Operational	4.Safety	5.Supportanility
5	Omission in real operation	Copper lines on PCB board not reconnected	PCB board is not working well	May cause electric shock and scald	Components on the board all dropped down
4	Significant Omission in real operation	Half of one opper lines on PCB is connected	Majority of PCB board not working well	May cause relatively serious injury or illness	Components on the board partially dropped down
3	Moderate Omission in real operation	One copper lines on PCB is connected	Part of PCB board is not working well	May casue minor injury or illness	Three or two components on the board dropped down
2	Little Omission in real operation	Copper lines on PCB basically connected	PCB board can work basically normal	May need water to let the temperature down	Only one component on the board dropped down
1	Minimal consequence	Minimal consequence	Minimal consequence	Minimal consequence	Minimal consequence