PDB 200A
12s power supply

Abstract

The abstract introduces a Power Distribution Board (PDB) designed to efficiently manage electrical power in systems requiring a 60V input and providing regulated 2V and 5V outputs. The PDB serves as a crucial component in various Electronics Applications, offering reliable voltage regulation and distribution for diverse circuits.

The PDB incorporates advanced power management technologies to ensure stable and clean power delivery. The 60V input is carefully regulated to produce a constant and precise 12v output, suitable for powering components such as Flight controller, control boards, motor controllers and other peripherals. Additionally, a secondary 5V output is provided to accommodate lower voltage requirements, enhancing the boards versatility for a wide range of electronic devices.

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POWER DISTRIBUTION BOARD

This power distribution board addresses the specific power supply needs of an electronic system requiring 60V input while providing stable and regulated 12V and 5V outputs. It also has an integrated current sensor for measuring the current up to 200A. Its advanced features and compact design make it a valuable component for engineers and developers seeking a versatile and efficient solution for their projects.

1. Applications

A power distribution board designed for a 60V power system can find applications in various industries and settings where a lower voltage level is sufficient for the intended electrical loads.

Drones and VTOLs

Many drones and VTOL used for Agricultural, Industrial, Surveillance, operate at a voltage of 60V. A PDB can be used to distribute power to various components in the systems.

Electrical vehicles (EVs)

Many electric vehicles, including electric cars, bikes, and scooters, Surfboard, Skateboard operate at voltages around 60V. A PDB in this voltage range can be used to distribute power to different components of the vehicle, such as motors, lights, and control systems.

Low voltage lighting systems

60V PDBs can be employed in lighting systems that operate at lower voltages. This includes indoor and outdoor lighting in residential, commercial, and industrial environments.

Telecommunication equipments

Some telecommunications equipment, especially in remote or off-grid locations, may operate at 60V. PDBs in this voltage range can be used to distribute power to communication infrastructure components.

Solar power systems

In certain small-scale solar power systems, especially those designed for off-grid applications, a 60V PDB can be utilized to distribute power from solar panels to batteries, inverters, and other components.

Marine and Boating application

Some marine electronics and equipment operate at lower voltages, and a 60V PDB can be used to distribute power on boats and other marine vessels.

Renewable energy microgrid

In remote areas or microgrid setups powered by renewable energy sources, a 60V PDB can be part of the power distribution infrastructure for local loads.

Agricultural equipments

Some agricultural machinery and equipment, such as certain types of irrigation systems or electric tractors, may operate at 60V. A PDB in this range can facilitate the distribution of power to these systems.

Emergency light system.

Emergency lighting systems, often used in critical facilities, may operate at lower voltages for increased safety. A 60V PDB can distribute power to emergency lights and exit signs.

2. Specifications

No.	Specification	Description
1.	Size	105x105x12 mm
2.	Weight	90g
3.	Input voltage	12V – 60V (14S max)
4.	Current carrying capacity	200 Amps Max
5.	Output voltages	12V 5A and 5V 5A
6.	Connectors	One SM06B-GHS-TB, header pin p14 2.5mm, header pin p6 2.5mm and four XT90
7.	Sensors	200 Amps Current sensor
8.	BEC	12V 5A and 5V 5A

3. Peripheral outputs and inputs

Peripherals	Description
1. XT90	The has four connectors which are the power distribution connectors for connecting the ESC from the board.
2. Header pins 14P 2.5mm	This header pin connector is the 12V/5V output peripheral for powering the Flight control boards, modules, sensors and other microcontroller boards.

3. Header pin 6P 2.5mm	This header pin connector is the 5v output power and analog signals of the current and voltage to the Flight controller.
4. Header pin 2P 2.5mm	This header pin connector is for the switch control of the PDB.

4. POWER SOURCE

The power source can be used as a lithium-ion battery or acid battery with a voltage range from 12V to 60V is supported by the board and it is capable of carrying max 200A current continuously.

5. PDB Connectors

The battery is connected to the board using nuts and bolts and makes sure it is tight.

Choose a wire which can carry at least 250A (Pylon Battery DC Cable recommended) Use a ring connector in the wire tip and insulate using a heat sink. A 3mm bolt is used for wire board connection.A 200uF 100v electrolytic capacitor is recommended to connect with the battery input. The connection example is given in the fig.1 below.

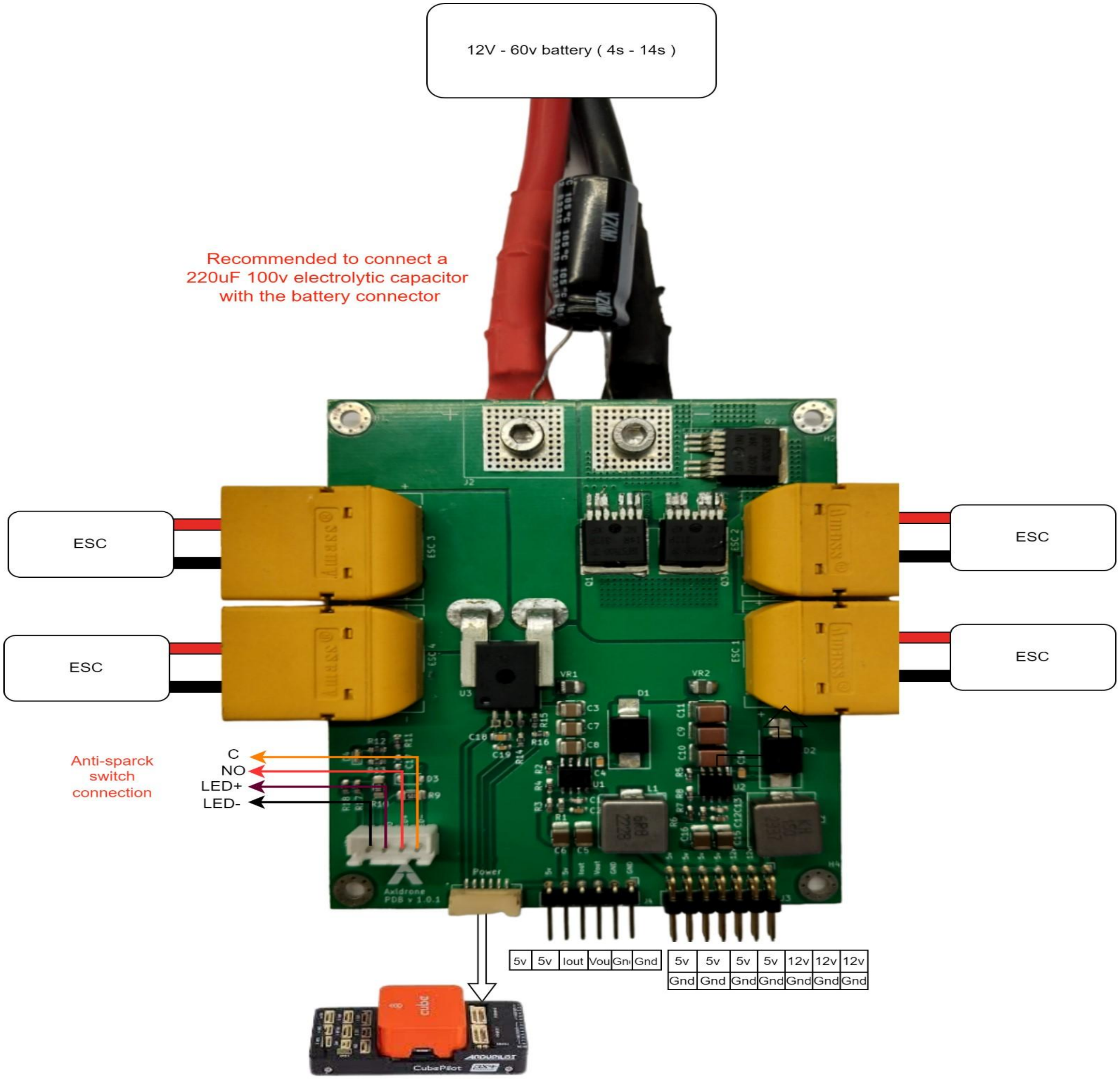

12V - 60v battery (4s - 14s)
Recommended to connect a 220uF 100v electrolytic capacitor with the battery connector
ESC
ESC
ESC
ESC
Anti-sparck switch connection
C
NO
LED+
LED-
5v 5v Iout Vou Gn Gnd
5v 5v 5v 5v 12v 12v 12v
Gnd Gnd Gnd Gnd Gnd Gnd Gnd

Fig.1

Note:- Recommended to add a 220uF 100v capacitor to the source side of the PDB. Do not switch OFF or ON the Anti-spark switch when load is connected to the PDB. It is safe to turn on the switch before adding load.

5. CURRENT AND VOLTAGE SIGNAL

The board has an integrated circuit for measuring the accurate value of battery voltage and current flow which is helpful to calculate the battery power monitoring. The current sensor which is used as the current sensor is ACS770ECB-200U-PFF-T. It is a Hall effect sensor which provides economical and precise solutions for current sensing. Typical applications included motor control, load detection, inverter control and over current fault detection.

The ACS770 outputs an analog signal, Vout, that varies linearly with the bidirectional DC primary current sample. The Quiescent output voltage of the current sensor is about 0.5V This voltage can be attributed to the resolution of the Allegro linear IC quiescent voltage trim, magnetic hysteresis, and thermal drift.

The analog voltage signal is from the voltage divider in the board which is designed based on the maximum voltage (60V) input.

6. CURRENT AND VOLTAGE CALIBRATION WITH QGROUNDCONTROL

Step 1: Power up the board with a battery (12V to 60V).

Step 2: Measure the voltage on the Vout (mV) pin using a multimeter.

Step 3: Then calculate the voltage multiplier value using the measured voltage in the QGC. **Step 4:** Measure the Iout voltage (mV) using a multimeter without any load connected with the board.

Step 5: Add the measured voltage as the Amps Offset voltage in the QGC.

Step 6: Connect some load with the board and measure the current value using any current measuring device.

Step 7: Then calculate the Amps per volt value using the measured current value.

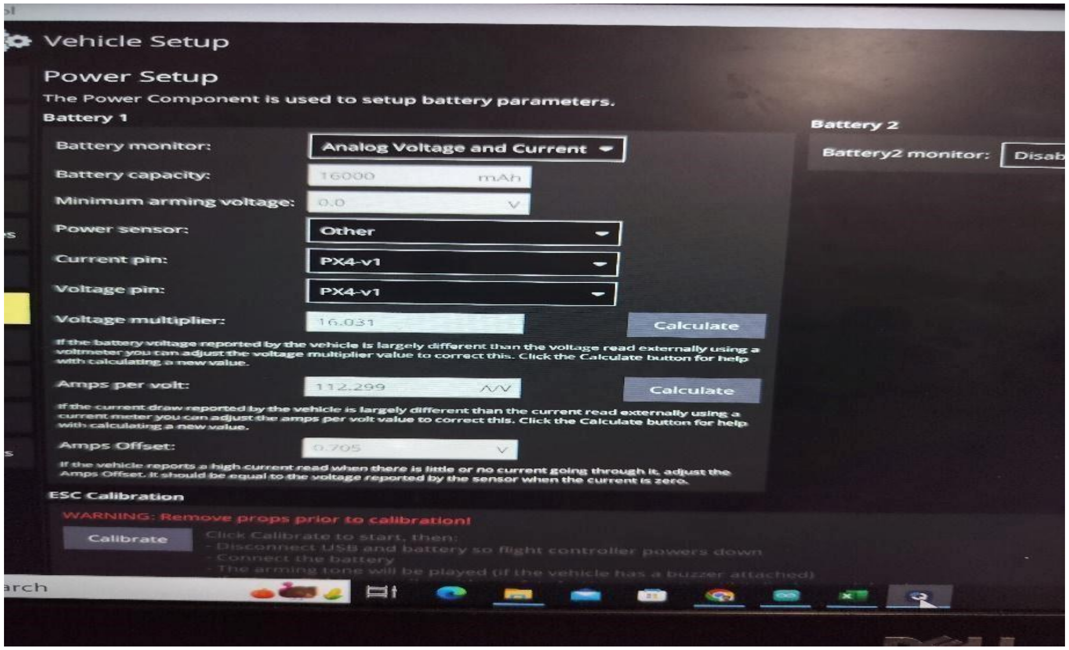


Fig.2

SCHEMATIC

7.1 Schematic of 12V 5A a   ıck convertors

7.

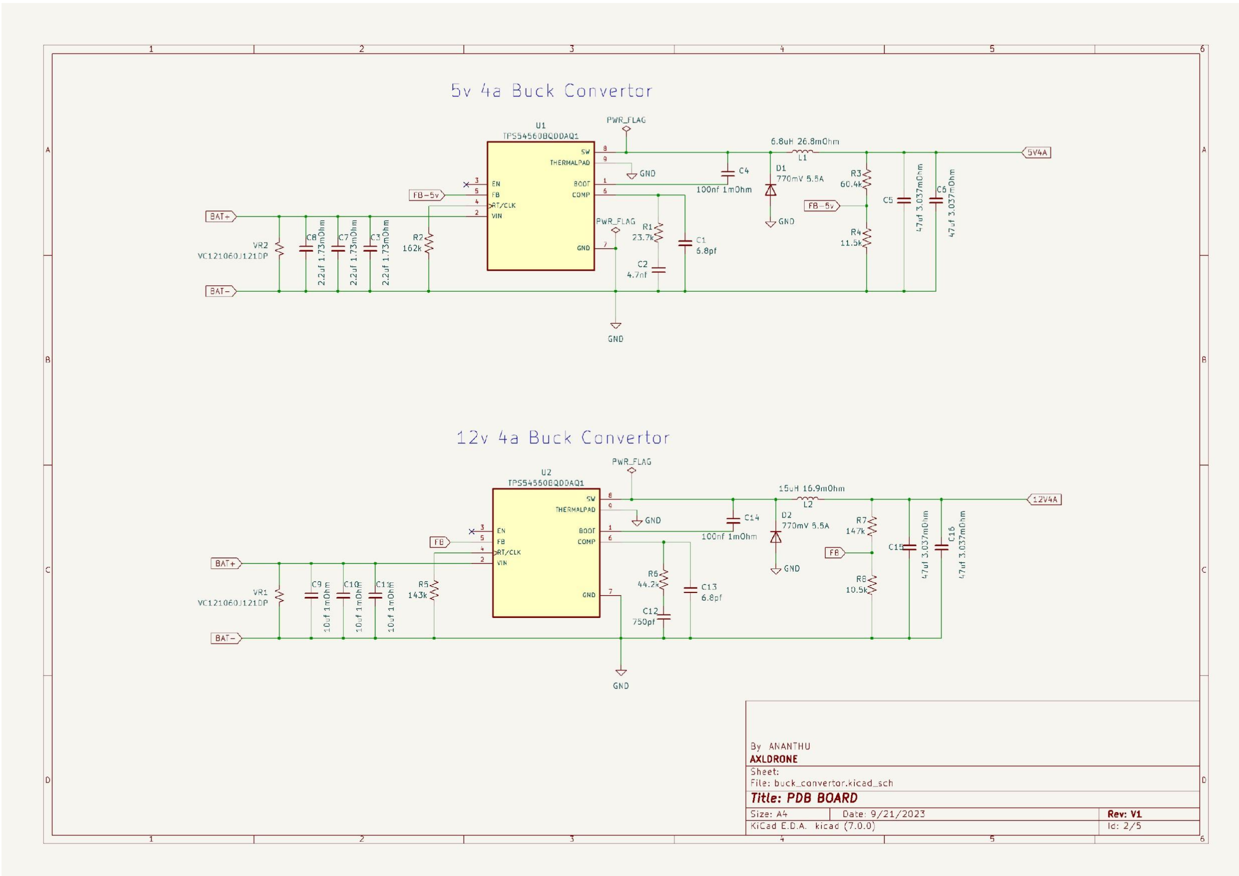


Fig. 3

The Buck converter circuit design is referred from the Texas Instruments manufactures which gives the switching output for 12v and 5v conversion. The output efficiency is 82% and gives a precise and regulated output power. TPS54560 IC is used in this buck converter for DC – DC conversion the input voltage is from 12V to 60V supported.

7.2 Current sensor and voltage divider schematic

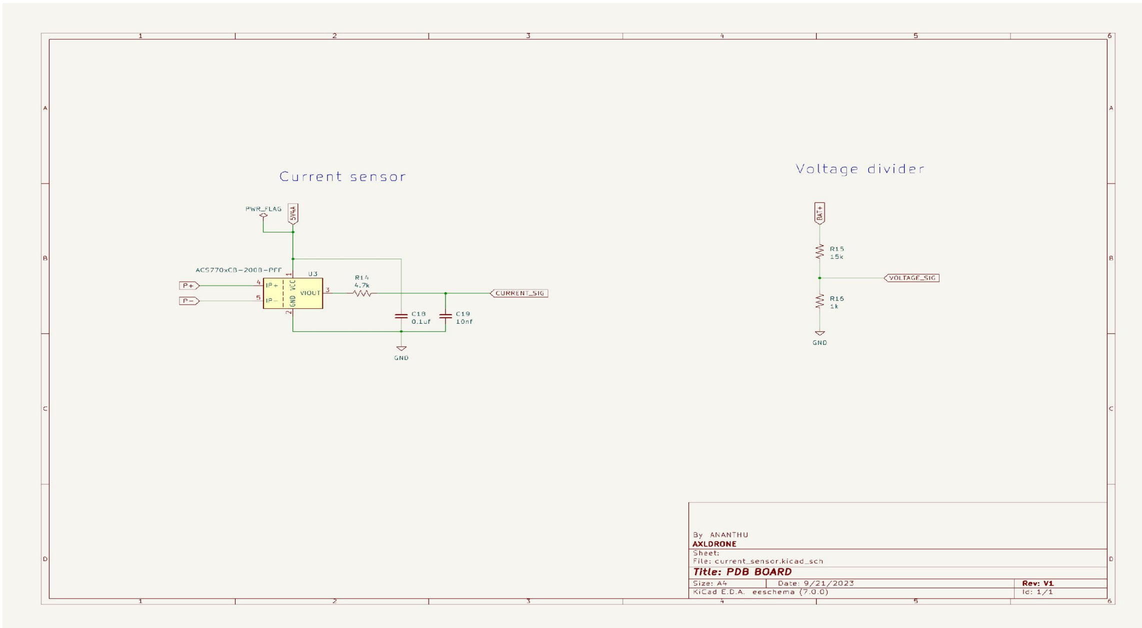


Fig. 4 7.3 Anti-Spark switch

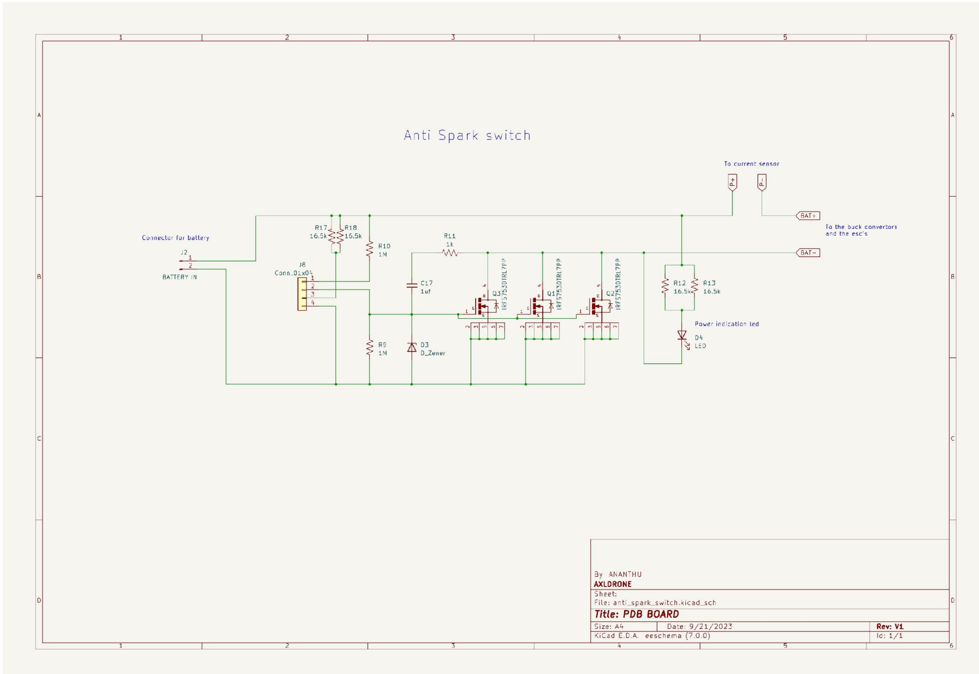


Fig. 5

8. TEST CASES

Follow the test cases as described below and do not skip any test cases.

8.1 Board Quality Check

It is a primary test when the board arrives in a good condition. Visually inspect each and every corner and components of the board that the components placements, soldering are good and check the components values are the same as we gave and make sure that the board don’t have any damages or crack.

8.2 Power up test

Power up the PDB using a lipo battery with a maximum of 60V. Measure the pin voltages of the connector and verify the voltage is the same as mentioned in the above Fig. 1. Then check the values in the Iout and Vout pin voltages the Iout voltage is from 400mV to 750mV and the Vout voltage range is from 0V to 3.3V. Also measures the ACS770 IC pin 1 voltage should be 5V which affects the current analog voltage.

8.3 Load test

The load test for verifying that the board can withstand at which load. For this we used a resistive load bank with a load current of 200A. Connect the resistive load bank with the PDB and switch the load one by one with an interval of 5min and measure the temperature rise before switching another load.

Load test Records

No.	Load Current (Amps)	Time (Min)
1.	42	25
2.	55	17

8.4 Sensor Calibration test

The calibration test is to verify that the current value and voltage values are accurate with the real value. For this test we are using another current measuring sensor connected parallel in between the battery and board. Then establish a connection with QGC using the Flight controller such as Pixhawk or cube. Then calculate the value with another sensor value that we connected parallel. Then change the load resistor to verify the change in the current value is the same on board the sensors and the QGC.

9. CAUTION

9.1 PCB Assembly or Repair

If PCB calls for hands-on work, wear gloves. If you need to transport the board then use a protective bag to prevent damage. You should also meticulously clean the surface before PCB placement. This can help prevent debris from getting on the board and causing damage. Avoid PCB assembly where there are items that can cause static, such as carpets, rugs, etc.
this can also cause damage to the board.

9.2 PCB Storing

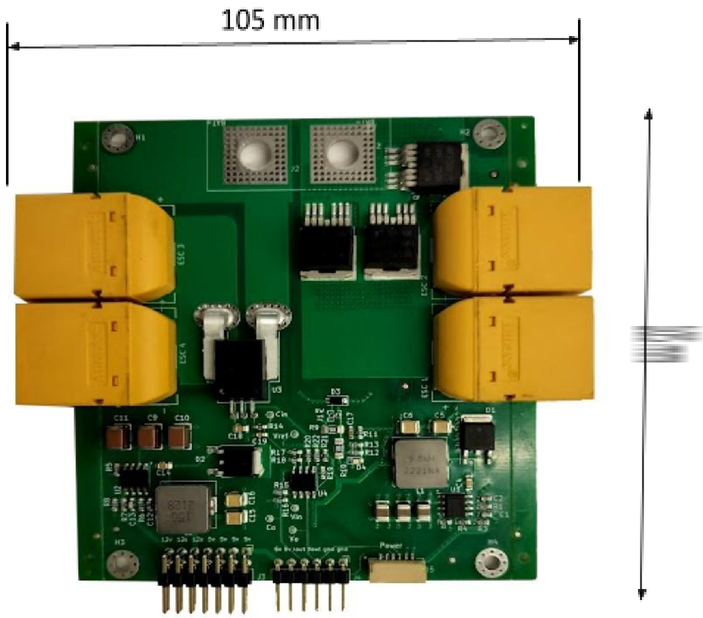
PCBs are delicate electrical components and need special care and attention. Any minimal change in the environment can cause problems with the board. Moisture, Heat, and cold air can damage a PCB, so you need to be cautious about where you are storing your PCB.

Due to these challenges PCB should be stored in warm, dry space with a consistent temperature and minimal humidity. You can use barrier bags or similar packing types to provide optical protection. It's also best not to store PCB for long periods.

9.3. Connection

Add a 220uF 100v electrolytic capacitor on the source side is recommended.

10. Dimension of PDB



11. PDB Packing

11.1 Bubble wrap

The bubble wrap is used for packing the board for protecting and minimizing the damage that is caused by the transportation. It can only protect a simple PCB if your PCB is more complex and uses something more robust to protect your board.

11.2 ESD Bags

An ESD bag is the best packing choice if the board has any ESD components. You should have the ESD sharp boards into separate bags to prevent static shocking during shipping.

11.3 Silica gel

Silica gel absorbs moisture from the surrounding air and makes it dry. This property of silica is used for packing PCB to keep dry and away from moisture or any liquid contents.

11.4 Cardboard Box

Cardboard packaging is designed to protect whatever is stored inside it, and it does this job particularly well.