TEAM PHANTOM:
HV Cincon Buck Design & Test Plan

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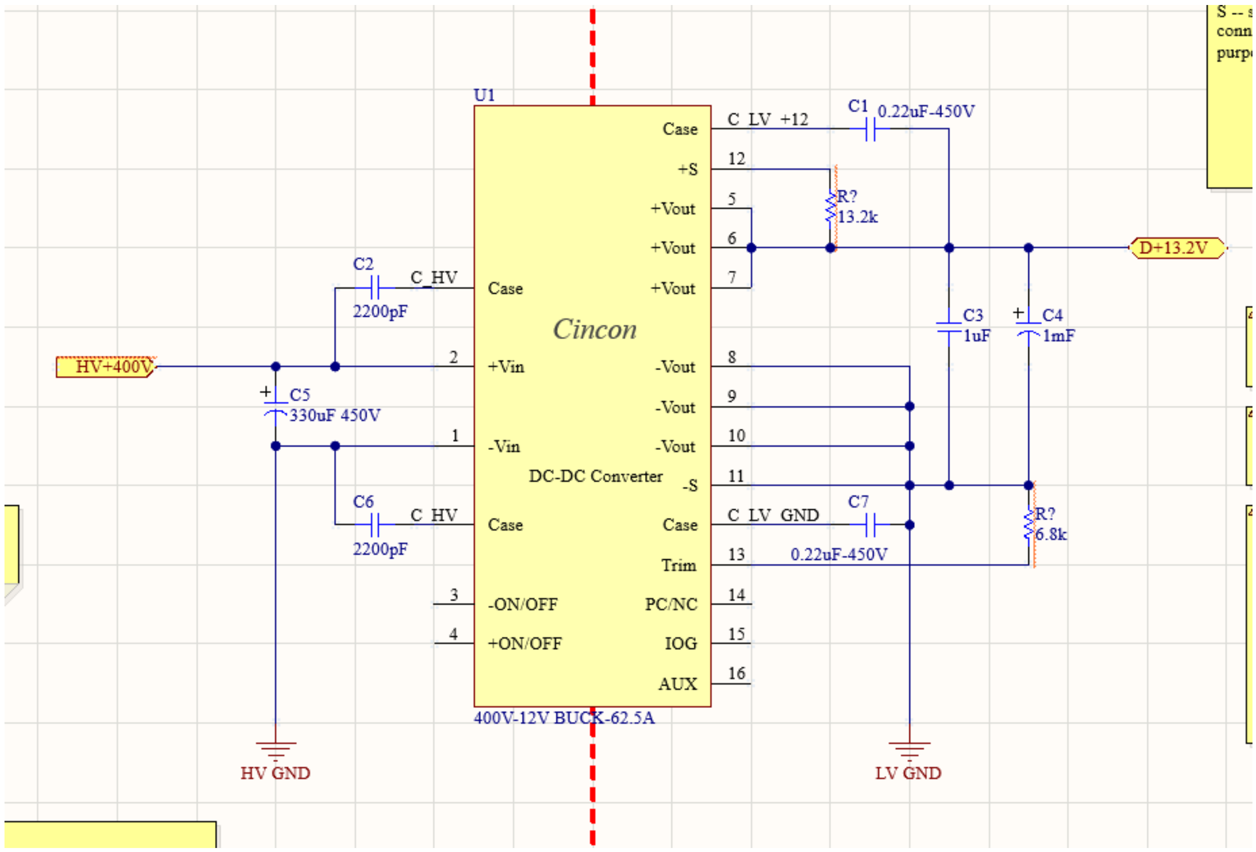
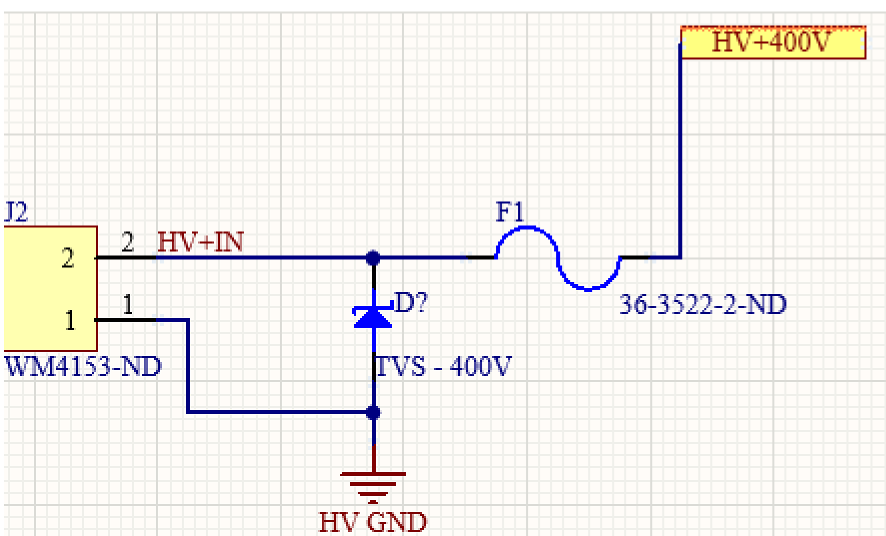
IC Description & Purpose

A 400V to 5V Cincon Buck (described here) will be used to power all low voltage electronics. It will receive ~380V from the car battery and will buck it down to ~13V2. This 13V2 will then be sent to PDB (power distribution) which will then send it out to all electronics. For more information on the HV Board refer here. The Cincon buck can receive 200-425V and is expected to output 12V on its own.

This Cincon buck has various important and useful pins explained here. While the buck can be set at distinct voltages, the Trim will be used to get very close to 13V2. Since this is HV to LV, isolation is needed which is provided by the IC so no further precaution is necessary. This buck will produce quite a lot of heat so thermal considerations MUST be taken in terms of thermal pads and heat sink (elaborated on the datasheet here, pg 12). A fuse is required at the input to account for excess current (in series with input) and a TVS diode is required (in parallel with input) to account for overvoltage and sensitivity.

Schematic Design





As of writing this documentation, the above schematic will be tested. The fuse is rated for 500V 20A. The red dotted line is to differentiate HV side (left of line) and LV side (right of line)

All capacitance values for capacitors C1-C7 are recommended by the datasheet, and the voltage ratings are 450V on both sides to account for the possibility of errors in isolation.

The on/off pins refer to remotely turning on and off the Cincon buck, which is not required in this version. To disable it, the pins need to be left open. Similarly, the PC pin, IOG and Aux will be left open because it will not be used. The Aux pin should, however, be checked – it can act as a smaller DC power supply which might be useful for another part in the HV Board.

Since 13V2 is required from 12V, the Cincon buck has trim up options which can be implemented by adding a resistor between S+ and Vout+ and another between S- and Trim. 10% trim up is required to get from 12V to 13V2

$$13.2 - 12 = 1.2\text{V}$$

$$12 * 10\% = 1.2\text{V}$$

The Cincon datasheet recommends 13.14 kΩ for 10% trim up (here, pg 17), which can only be found as 13.2 kΩ. The Cincon also recommends using a resistor value of 6.8 kΩ (here, pg 16).

Additional trace and pads that allows for the placing of exactly 13.14kΩ resistor has been added to the schematic as a DNP variant, in the event that 13.2kΩ configuration yields some undesirable results, the variant could be used.

Testing

The design choices of this Cincon buck is limited as described above because the data sheet provides all the recommendations. This IC is also store bought and is unlikely to have many faults. The main purpose of testing is to ensure a consistent 13V2 output and to examine thermal considerations. A heat measurement device (of any kind) should be used to determine the heat produced from the device.

PCB constructions are difficult, and therefore all components will be purchased as through-hole to test on a stripboardshould any quick changes need to be made. Considering isolation, two separate stripboard will be used, one for the HV side and one for the LV side. A HV PSU will be used for input, an ammeter in series with the input, jumper wires to connect to stripboard and the pins of the Cincon, and a voltmeter at the output. At this time, no proper electronic load is available so current measurement at the output is likely not needed.

Assuming a properly configured power supply, a TVS diode and fuse is likely not needed.

Materials

- HV power supply
- Thermal Camera (or alternate heat measurement device)
- Jumper wires
- 2 strip boards
- An ammeter
- A voltmeter

Components (Through-hole components)

- 2x 2200pF 450V capacitor
- 330 uF 450V electrolytic capacitor
- 2x 0.22uF 450V capacitor
- 1uF 450V capacitor
- 1mF 450V electrolytic capacitor
- 13.2k resistor
- 6.8k resistor

* Or the next closest available component

Procedure

1. Obtain all components in the above schematic with the exception of the TVS diode and the fuse as through hole components
2. Create a stripboard circuit of the HV side of the Cincon Buck with the through hole components
3. Create a stripboard circuit of the LV side on a <u>separate stripboard</u>
4. When connecting the Cincon, place it on its side to allow ventilation
5. Connect an ammeter in series with the HV stripboard
6. Connect a voltmeter across Vout+ and Vout-
7. Connect the power supply to the HV stripboard **without turning it on**
8. Double check all the wiring to ensure proper and secure connections and isolation of the HV and LV side
9. Turn on the power supply to 5V. Turn on the thermal camera to observe any shorts. If none, continue. If any, repeat step 7.
10. The following table will be filled out during testing

Input Voltage (V)	Output Voltage	Device Temperature	Aux Pin Voltage
100			
200			
250			
300			
350			
400			

11. In addition, the Cincon has a UVLO (it does not turn on if the input is below a specific value) This value is approximately 200V, but tests should be made to find the specific value

UVLO Value ______ V

12. Turn off the power supply and wait at least 10s before disassembling. The Cincon is likely very hot, so proceed with caution