

Hybrid 15k solar inverter

Service manual

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1. General information

1.1 Getting start

This manual is for Hybrid 15k, it can help service personal perform the basic maintenance and repair service. This manual focus on the service, so you should get the basic operation of the inverter from the user manual, and make sure you had read and understood user manual before you use this service manual.

The manual include 4 sections, as follows

- General Information, this section showed the general information of the service manual.
- Introduction of the inverter and each PCB, this section shows you all the PCBs of the Hybrid 15k.
- Trouble shooting, this section will give you the way to find the trouble
- Appendix, this section showed the information of the critical parts, and how to replace the boards of the inverter.

1.2 Important safety instructions



WARNING: This chapter contains important safety and operating instructions.

1. Before repair the unit, please read this manual carefully.
2. To reduce risk of electric shock, disconnect all wirings before attempting any maintenance. Only turning off the unit will not reduce this risk.
3. Be very cautious when working with metal tools on or around batteries. A potential risk exists to drop a tool to spark or short circuit batteries or other electrical parts and could cause an explosion.
4. **Warning!!** Only qualified service persons are able to service this device.

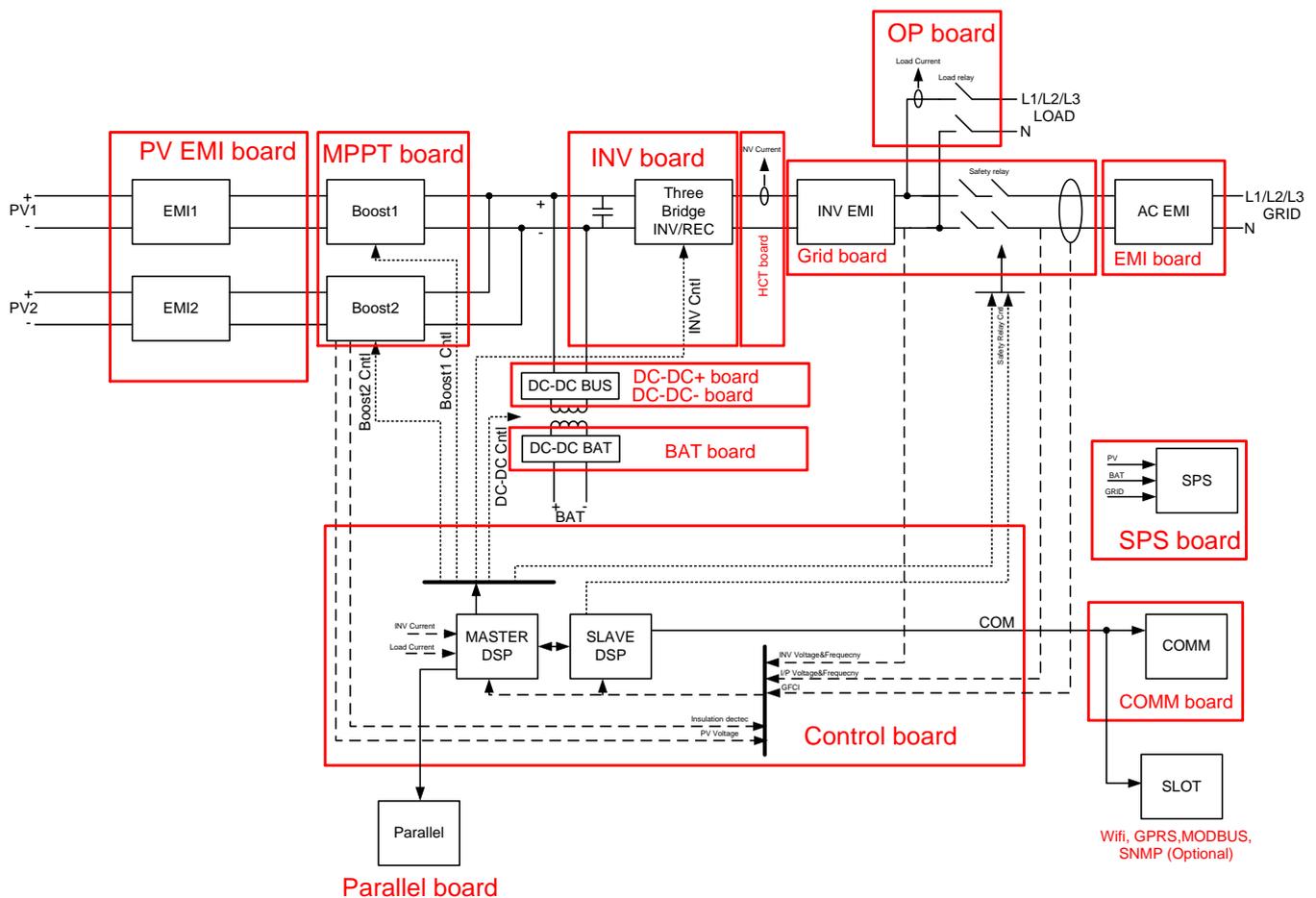
2. Introduction of the inverter

2.1 Basic information

This chapter will introduce the topology and each board of the inverter; it will give us the basic impression of the inverter.

2.2 Functional topology

The topology of the inverter shows as below:



There are four factors of the inverter: PV, battery, grid, and load. PV and load is the single direction, PV only uses for input, and load for output. Batter and grid is the bi-direction, cause the battery can be charged and also can discharge, grid can be input and output. With these factors, we can make several combinations to meet every application, maximum the availability of the power system.

2.3 PCBA board

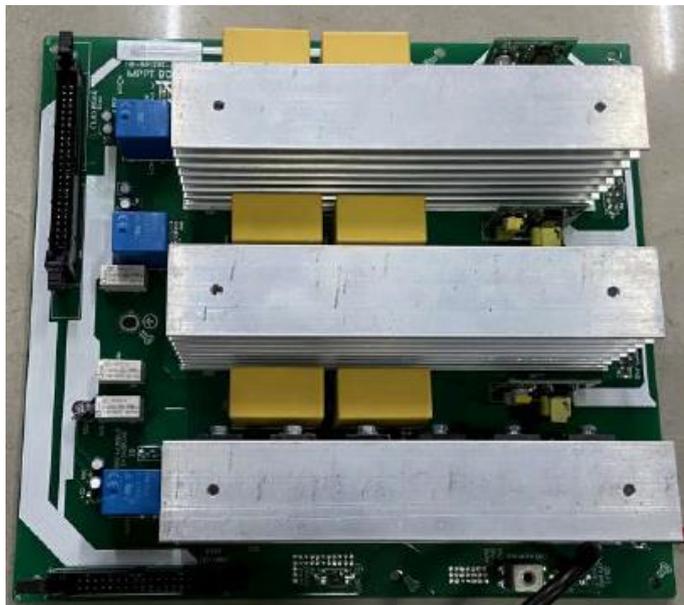
Cntl board



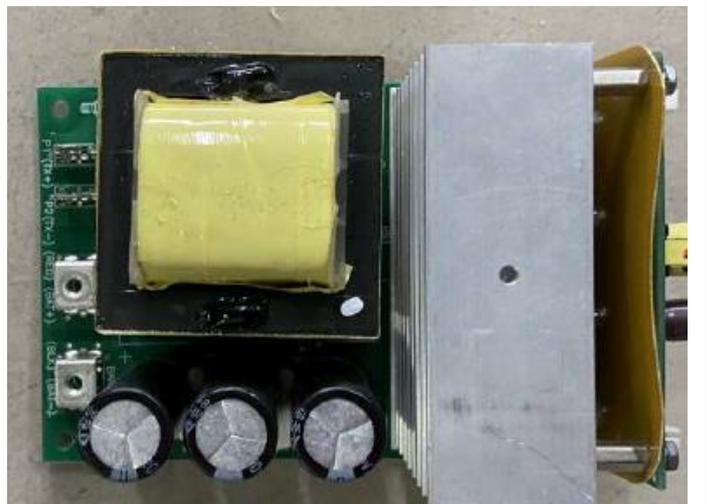
INV board



MPPT board



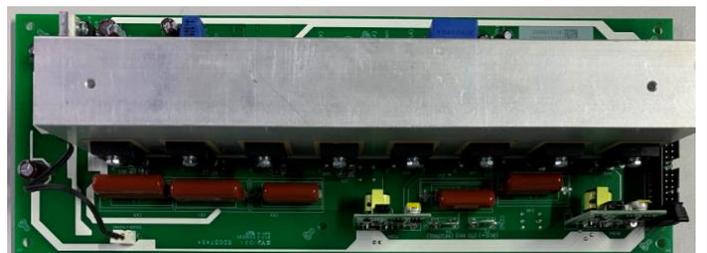
Bat board



DC-DC- board



DC-DC+ board

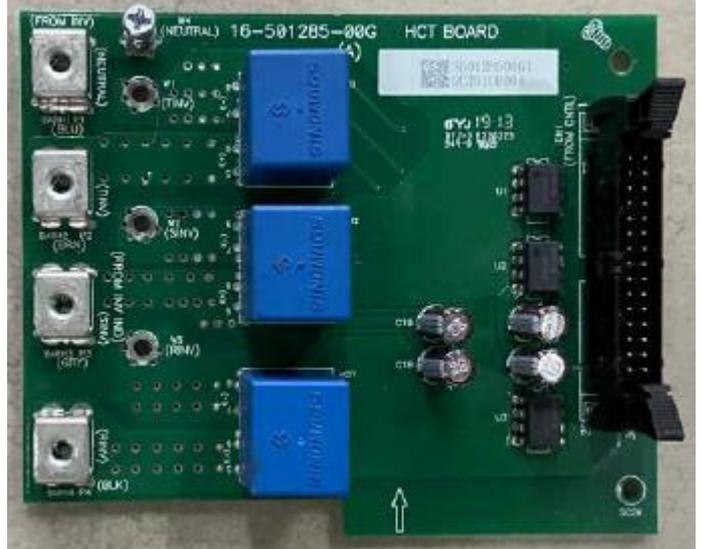


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GRID board



HCT board



OP board



PV EMI board



EMI board



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COMM board



Parallel board



SPS board



3. Trouble shooting

This section describes how to find the trouble when the system is abnormal. We suggest you can follow the service procedure:

- a. Check the system status by LCD display.
- b. Observe the failure board, static checking.
- c. Replace the failure board.
- e. Power up checking.
- f. Test after repair.

Following these sections will help service person to solve most of problem.

3.1 Check the fault information

Please follow the steps as below to find the issues!

Make sure that you can finish all the steps and feedback us the results. Or we may not be able to give you the right solution.

Step 1: Test the bypass mode.

Before turning on the inverter, only connect the utility with the inverter. Without press any buttons, the LCD will light up. Press the "ON" button for at least 3 seconds, and wait for the utility connecting to load.

If the connection is failed, please record the fault code.

Step 2: Test the battery working mode.

Before turning on the inverter, only connect the battery with the inverter which means no solar input and grid input. Press the "ON" button for at least 3 seconds, the LCD will light up and wait for the battery connecting to load.

If the connection is failed, please record the fault code.

Step 3: Test the on-grid mode.

Before turning on the inverter, only connect the utility and solar with the inverter. Without press any buttons, the LCD will light up. And wait for the utility connecting to solar.

If the connection is failed, please record the fault code.

Step 4: Test the solar charging mode.

Before turning on the inverter, only connect the solar and battery with the inverter. Without press any buttons, the LCD will light up. And wait for the solar connecting to battery.

If the connection is failed, please record the fault code.

Note: The numbers with **ERROR** means fault code; with  means warning code. Please clarify them.

➤ **No AC input detected**

If AC input is connected, but there is no voltage showed in the LCD. Please follow the part 3.2.8 to check the AC input fuse.

➤ **No LCD display**

If LCD couldn't light up with battery, solar, or AC input, please replace SPS and control board to solve the issue.

➤ **No load output**

In the LCD display, everything shows normally, but there is not output actually. If this case happened, please replace OP board to have a check.

➤ **Error 01**

Error 01 means BUS voltage is over the limitation. Please disconnect the load, and restart the inverter to have a check.

If the inverter can work normally after the restarting, error 01 is usually caused by the surge from the utility input or the energy feedback from the load.

If the error persists, please check:

If the error 01 happens immediately when the LCD is on, usually this is the control board problem, you can change the control board to have a check.

If the error 01 happens when the output is available or charging, the possible cause is the DC-DC or main board, please contact with us to do the diagnose together.

➤ **Error 02**

Error 02 means BUS voltage is under the limitation. Please disconnect the load, and restart the inverter to have a check.

If the inverter can work normally after the restarting, error 02 is usually caused by the solar or load fluctuation.

If the error persists, the possible cause is the DC-DC board or control board.

➤ **Error 03**

Error 03 means BUS soft start is failed.

The possible causes of error 03 are the surge from the utility, solar or load, energy feedback from the load, high voltage from the utility input.

Before the inverter turns on the output or starts charging, the SPS board will charge the BUS capacitors to 700~800V, and then the DC-DC board will be activated, to keep the BUS voltage at 700~800V. If everything is OK, then the inverter will turn on the inverting module. If the voltage couldn't reach 700~800V or stay at this level, the error 03 will come out.

Error 03 is related to the INV board, DC-DC board, SPS board and control board.

If you have the multimeter, it will help you to find out which board causes the error 03.

First, please find the BUS+, neutral and BUS- on the INV board or DC-DC board, and follow the table as below to do the measurement.

Table 3.1

Red probe	Black probe	Test value	Reference values	Failure status
BUS+	Neutral	Diode voltage	OL	Less than 3V
Neutral	BUS+	Diode voltage	0.4~0.7V	Open or short
Neutral	BUS-	Diode voltage	OL	Less than 3V

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BUS-	Neutral	Diode voltage	0.4~0.7V	Open or short
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If the reading is right, and still error 03, it's usually the control board problem; you can change it and check again.

If the reading is not right, it means that the issue is among the INV board, DC-DC board and SPS board. First, you can unplug this cable on the SPS board,

And then measure the diode voltage on the terminal CN7 of the SPS board by following 3.2.6

If the value is right, it means SPS board is good. You can check the INV and DC-DC board. Please replace the boards that with wrong values, error 03 will be solved.

➤ **Error 04**

Error 04 means inverting soft start is failed.

After bus soft start is finished, and DC-DC board is turned on. The controller will turn on the inverting module, it will output the voltage from 0V to 230V (phase to neutral). If the voltage couldn't reach 230V after a time, the inverter will give error 04.

Error 04 is related to the INV board, and control board.

Please replace the control board and INV board both, it will solve error 04.

➤ **Error 05**

Error 05 means inverting current is over the limitation. Please disconnect the load, and restart the inverter to have a check.

If the inverter can work normally after the restarting, error 05 is usually caused by the surge from the utility input or the energy feedback from the load.

If the error persists, please check:

If the error 05 happens immediately when the LCD is on, the problem is related with SPS board, control board and HCT board.

If the error 05 happens when the output is available or charging, the problem is related with the INV board, please replace it to have a check.

➤ **Error 06**

Error 06 means over temperature. Please disconnect the load, and restart the inverter to have a check.

If the error still persists even the inverter has cooled down, it means the temperature sensors are wrong.

We have the sensors on different board. Please contact with us, we will provide a special firmware for you to diagnose which sensor is wrong.

➤ **Error 07**

Error 07 means relay checking fail. This error is usually caused by the rusting on the board which it is due to the dust and moisture.

This error is related to the grid board, HCT board. Please change these boards, this error will be solved.

➤ **Error 08**

Error 08 means DC current sensors are wrong. We have DC current sensors on MPPT and DC-DC boards. You can contact with us for the special firmware, it will help to identify which sensor is wrong. Or you can follow as below to check which sensor is wrong.

➤ **Error 09**

Error 09 means solar input power is not normal. Please restart the inverter to check. This error is very rare to see, if you face this error, please contact with us.

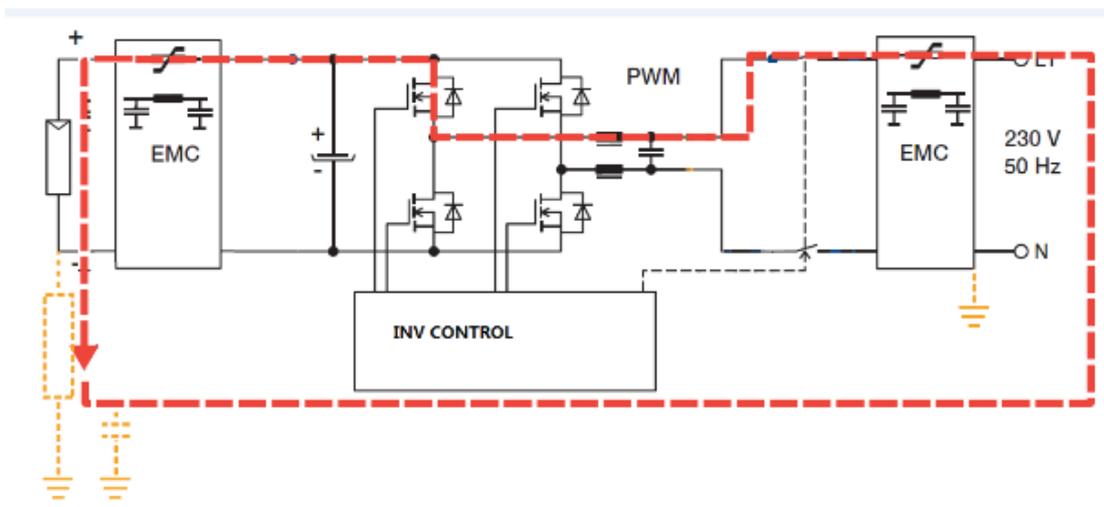
➤ **Error 11**

Error 11 means solar input is over current. This error is very rare to see, if you face this error, please contact with us.

➤ **Error 12**

Error 12 means leakage current is over the limitation.

For our inverter is the transformerless type, it means there is no galvanic isolation between the solar and grid. The loop of the leakage current will be like as below:



Generally the photovoltaic cells are isolated with the ground, but sometimes, it may have the isolation problem, like the cable is broken or sinking in the water, the glass of the panels has something wrong. These factors may cause leakage current from solar panels to ground.

By following the safety standard, the inverter needs to cut off the utility input if the current is over the limitation. Please check the installation of the solar panels to solve this error.

If the error persists without solar panels connected, the sensor of the leakage current is failed; you can change the Grid board to solve it.

➤ **Error 13**

Error 13 means the isolated resistance of the solar panels is too low. If the error persists after you choose "Grid tie with backup" or "Off-grid mode", please contact with us.

➤ **Error 14**

Error 14 means the DC component of the output current is over the limitation when the grid is connected in. This error only happens when the grid is connected in.

If the error persists when you restart the inverter, the error is related to the INV board or HCT board. You can change these boards to have a check.

➤ **Error 16**

Error 16 means the self-checking of the leakage current sensor is failed. Please replace the Grid board to solve the issue.

➤ **Error 17&18**

These two errors usually mean the CPU had something wrong. If you haven't updated any firmware to the control board, please replace control board to solve this issue.

➤ **Error 22**

Error 22 means the battery voltage is too high. Please check the real voltage and the voltage showed in the LCD display.

If the voltage is higher than 62V, this error will happen.

➤ **Error 23**

Error 23 means the overload is activated.

Please check if some loads are too heavy for the inverter. Like air conditioner, pump and motors, this kind of loads demand large inrush current when they start up. The recommended rating of these loads is less than 1/3 rating of the inverter.

➤ **Error 26**

Error 26 means the output is shorted. It is usually caused by the load output connection is shorted.

Please check if the wire connection of the load is shorted, or the load is shorted by itself.

➤ **Error 27**

Error 27 means the fans are blocked. When this error happens, please check if there is any fan stop working. Usually this error is caused by fans stop working. In few cases, it is caused by SPS board.

➤ **Error 32**

Error 32 means the DC-DC output current is over the limitation. Please replace DC-DC board to solve this issue.

➤ **Error 33**

Error 33 means the output voltage is lower than limitation. This error is similar with error 23.

➤ **Error 34**

Error 34 means the output voltage is too high. This error is similar with error 04.

➤ **Error 38**

Error 34 means MPPT 1 or 2 input is shorted. Please replace MPPT board to solve the issue.

➤ **Error 51**

Error 51 means the current of the DC-DC transformer is over the limit.

When error 51 happens, please help to restart the inverter.

If the inverter can continue to work without any error, this error may be caused by the battery or load power fluctuation. The inverter has no problem.

If the error 51 still persist even you restart the inverter, the boards inside may have the problem, please replace DC-DC+ and DC-DC- board to solve the issue.

➤ **Error 52**

Error 52 means the MPPT board detects over temperature.

If error still persists even no power is from solar, please replace MPPT board to solve the issue.

➤ **Error 53**

Error 53 means the MPPT board detects over temperature.

If error still persists even no power is from solar, please replace MPPT board to solve the issue.

➤ **Error 60**

Error 60 means the power is not balanced between each inverter which is working in parallel with each other. Please disconnect the grid input, and check if the load percentage is the same in the LCD display of each inverter.

This error is usually caused by the parallel board.

➤ **Error 72**

Error 72 means the current sharing control is failed.

This error is related with parallel board, sometimes control board also.

When do parallel installation, please make sure that the output neutral of each inverter should be connected always, or it may cause error 72.

➤ **Error 80, 81 and 82**

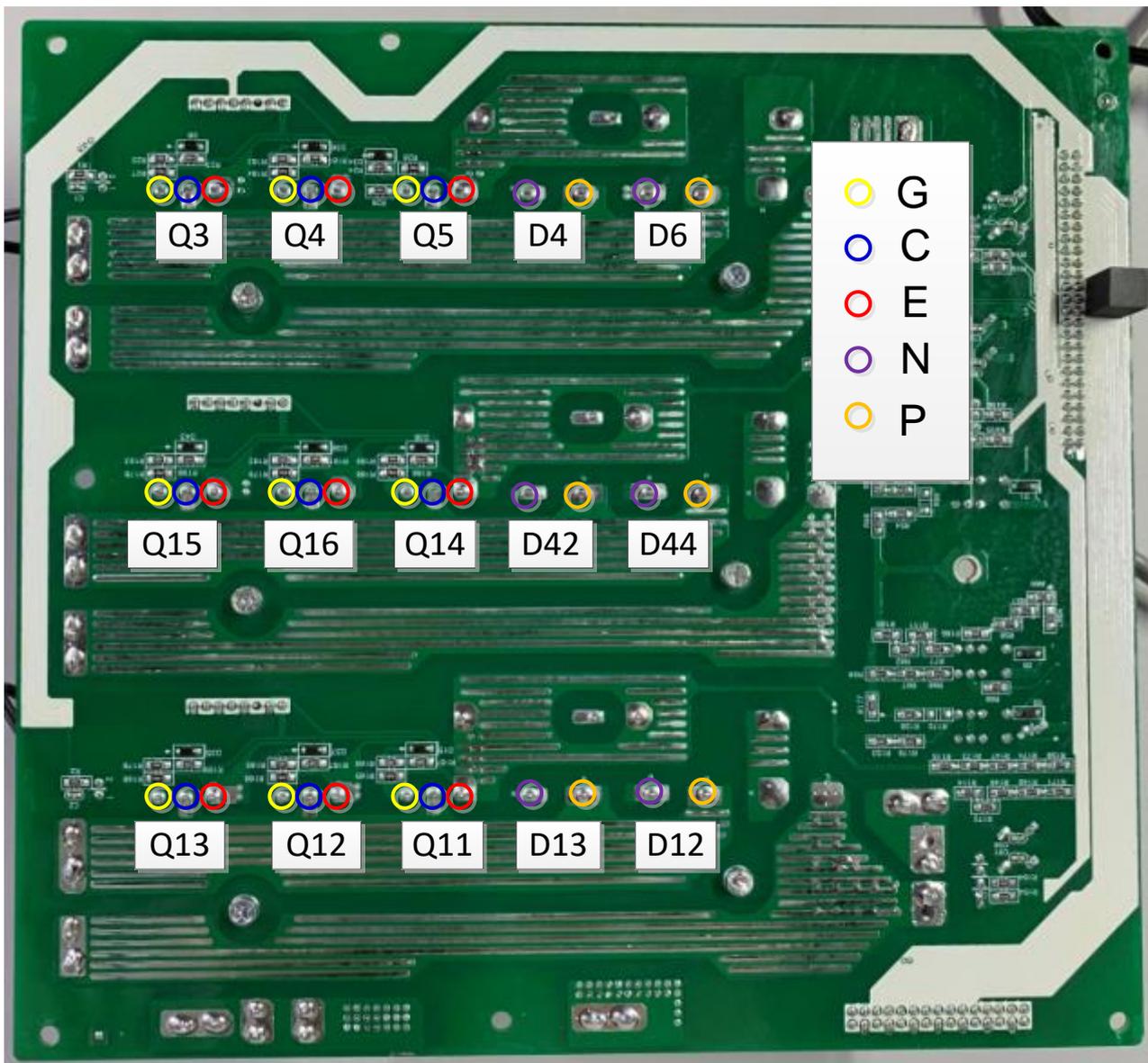
Error 80~82 means parallel CAN communication is lost. Please change the control board.

3.2 Check the PCBs

In most situations, we need to take the PCBs out of the inverter and do some static measurement, then we can realize which part is damaged, and replace the relevant boards or components.

Most fault conditions are due to the damaged of the power board, including main board, DC-DC board, and sometimes SPS board.

3.2.1. MPPT board checking



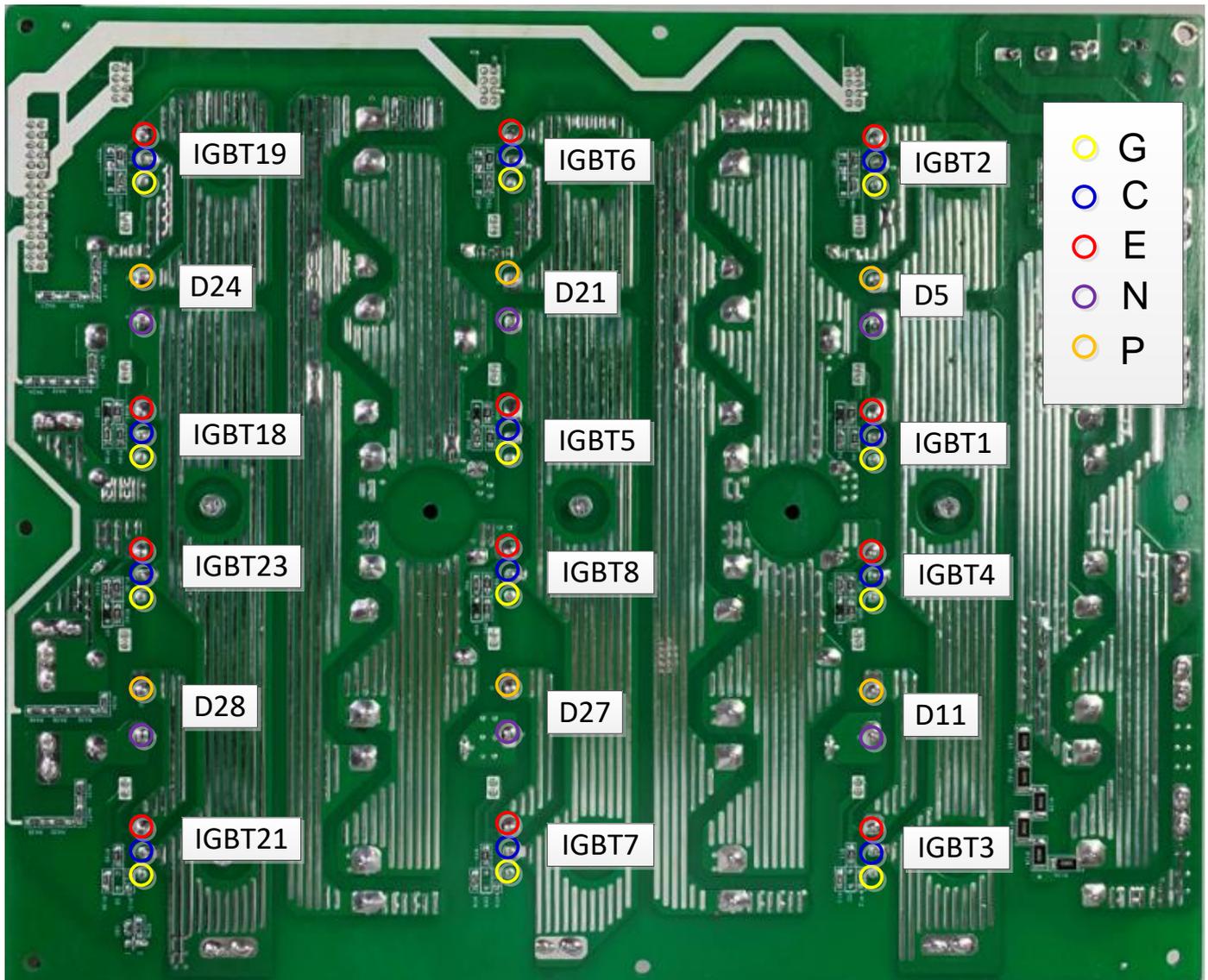
Parts	Attribute	Reference values	Failure status
Q3, Q4, Q5, Q11, Q12, Q13, Q14, Q15, Q16	Resistance	GE: 16.7k	Short or explosion
	Diode	CE: 0.4V	

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		EC: OL	
D4, D6, D12, D13, D44, D42	Diode	P to N: 0.4V N to P: OL	Short or explosion

Note: There is the coating on the board; please use the sharp probe, and press a bit hard to the board, make sure the probe touches the pins to read the right values.

3.2.2. INV board checking

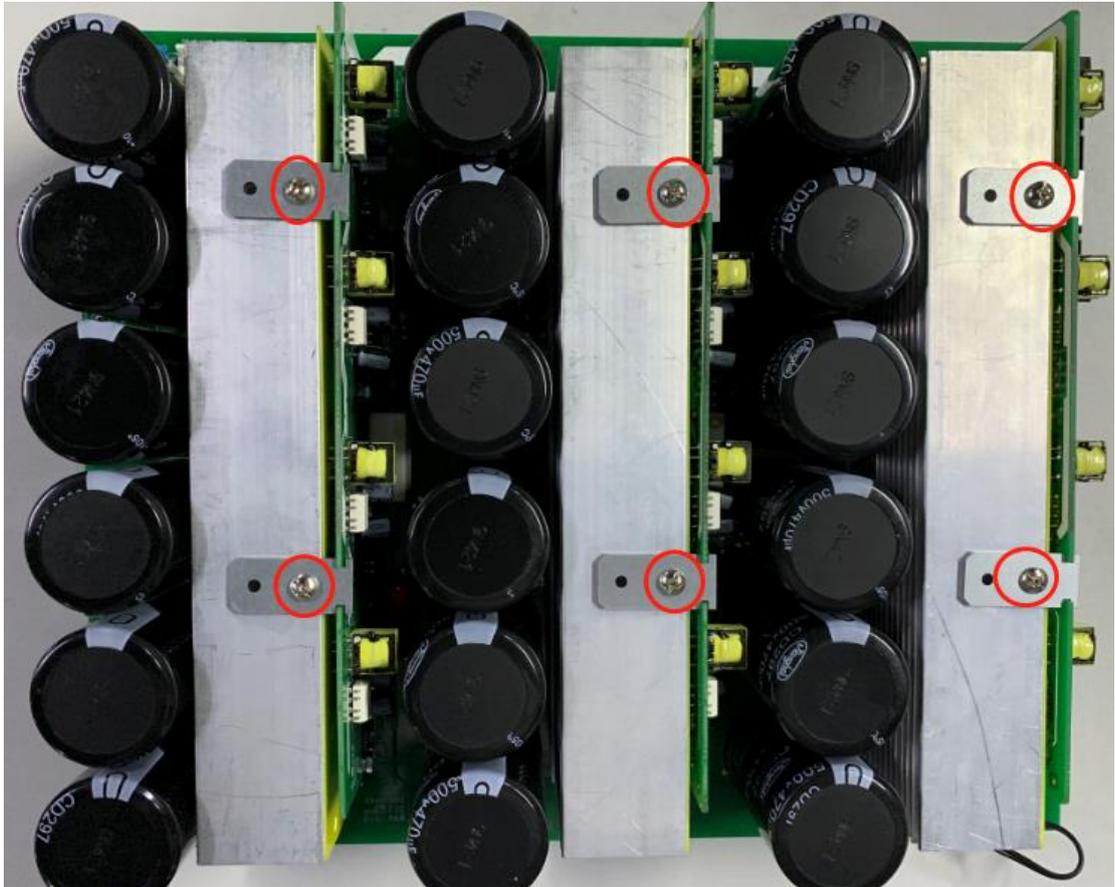


Parts	Attribute	Reference values	Failure status
IGBT2, IGBT3, IGBT6, IGBT7, IGBT19, IGBT21	Resistance	GE: 50k ohm	Short or explosion
	Diode	CE: 0.4V EC: OL	
	Resistance	GE: 50k ohm	Short or explosion

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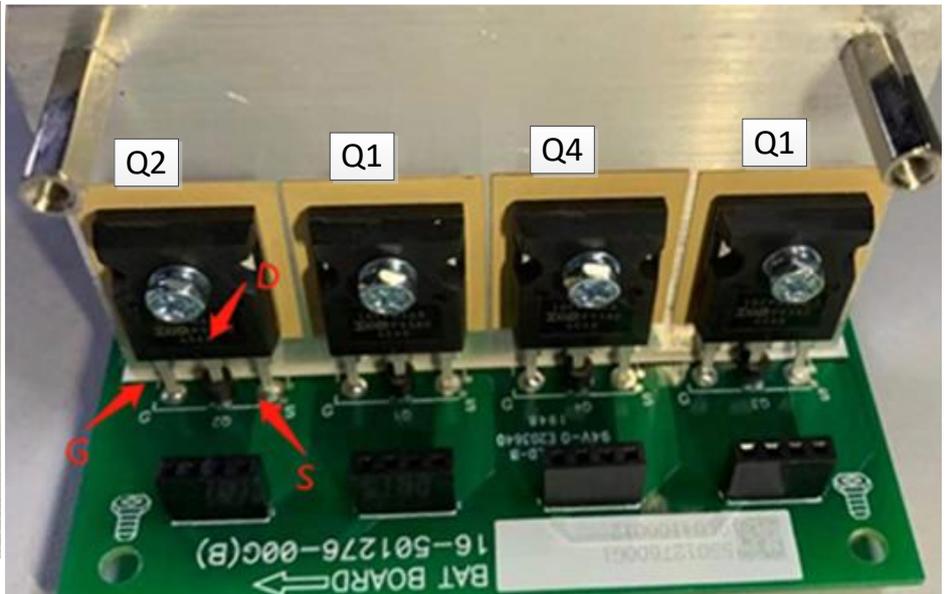
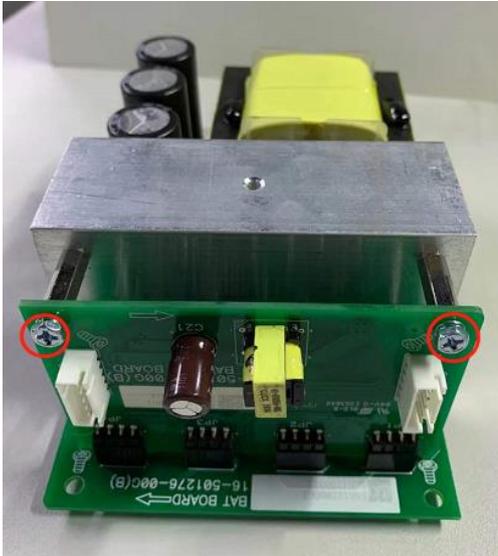
IGBT1, IGBT4, IGBT5, IGBT8, IGBT18, IGBT23	Diode	CE: 0.4V	
D5, D11, D21, D27, D24, D28		EC: OL	Short or explosion

If you want to remove the driver board, please remove the screws below first.



3.2.3. BAT board checking

Please remove the screws as below, and plug out the driver board, and check.

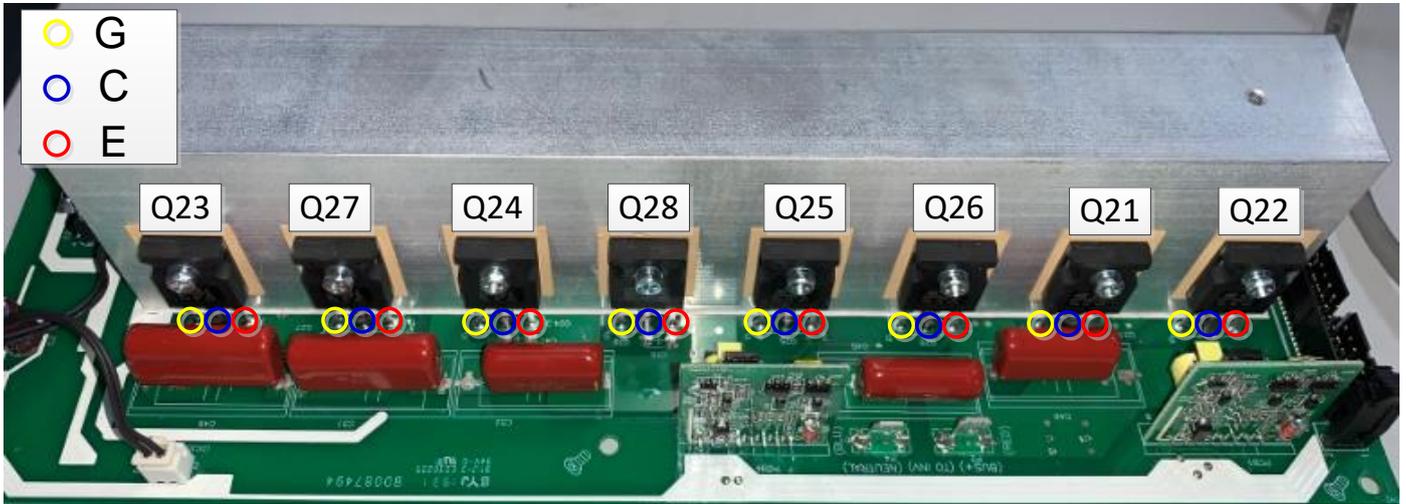


Parts	Attribute	Reference values	Failure status
Q1, Q2, Q3, Q4	Resistance	GS: 23k ohm	Short or explosion
	Diode	SD: 0.41V DS: OL	

In order to read the right value, please discharge the voltage between BAT+ and BAT- to near 0V.

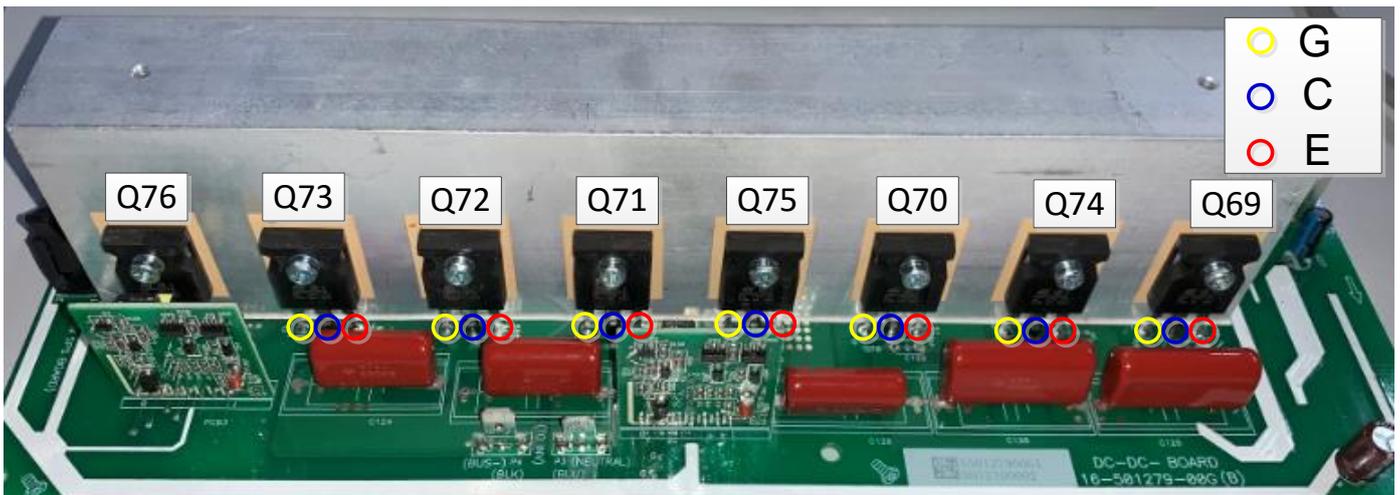


3.2.4. DC-DC+ board checking



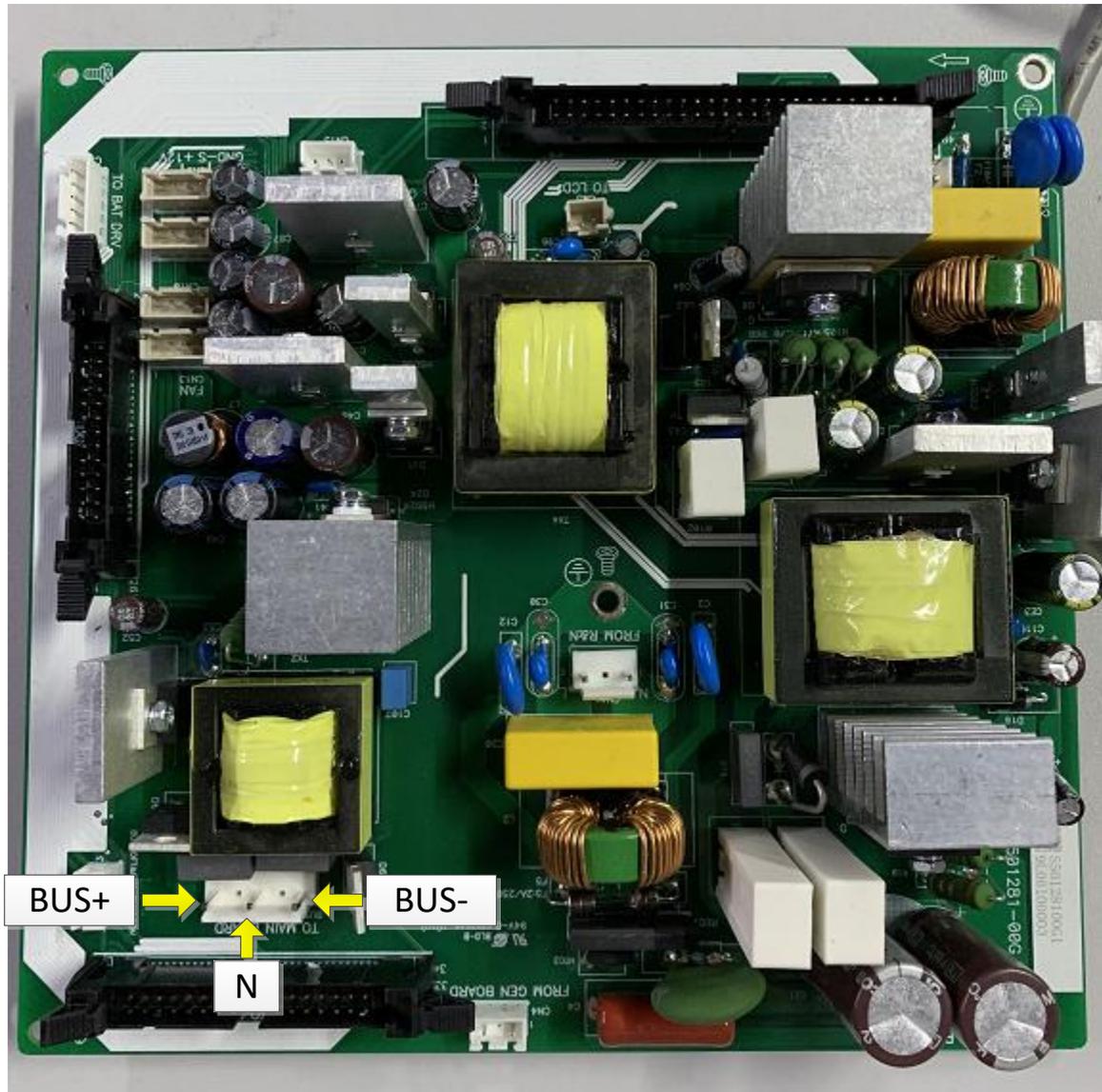
Parts	Attribute	Reference values	Failure status
Q23, Q27, Q24, Q28, Q25, Q26, Q21, Q22	Resistance	GE: 23k ohm	Short or explosion
	Diode	EC: 0.4V CE: OL	

3.2.5. DC-DC- board checking



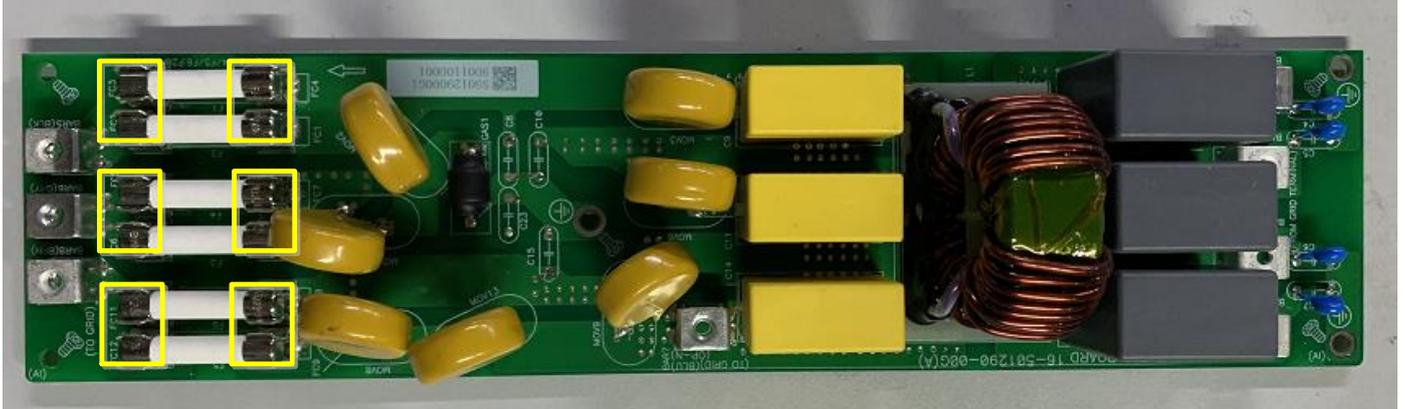
Parts	Attribute	Reference values	Failure status
Q76, Q73, Q72, Q71, Q75, Q70, Q74, Q69	Resistance	GE: 23k ohm	Short or explosion
	Diode	EC: 0.4V CE: OL	

3.2.6. SPS board checking



Red probe	Black probe	Test value	Reference values	Failure status
BUS+	Neutral	Diode voltage	OL	Less than 3V
Neutral	BUS+	Diode voltage	0.4~0.7V	Open or short
Neutral	BUS-	Diode voltage	OL	Less than 3V
BUS-	Neutral	Diode voltage	0.4~0.7V	Open or short

3.2.7. EMI board checking



Please measure the resistance of the two side of the fuse, they should be 0ohm.

4. Appendix

4.1 Disassembly guide

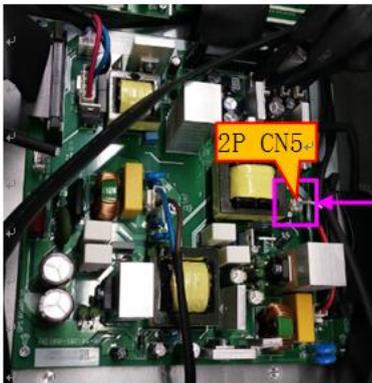
4.2.1. Open the top cover and bottom cover

Open the top cover by removing the screws as below:

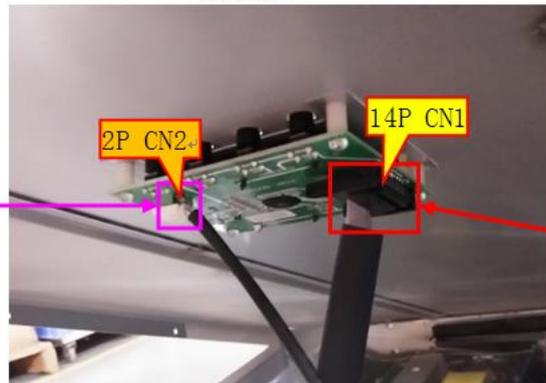


Open the top cover slowly. Before you can open it totally, please don't forget to remove the cables attach the LCD:

SPS board



LCD



Control board

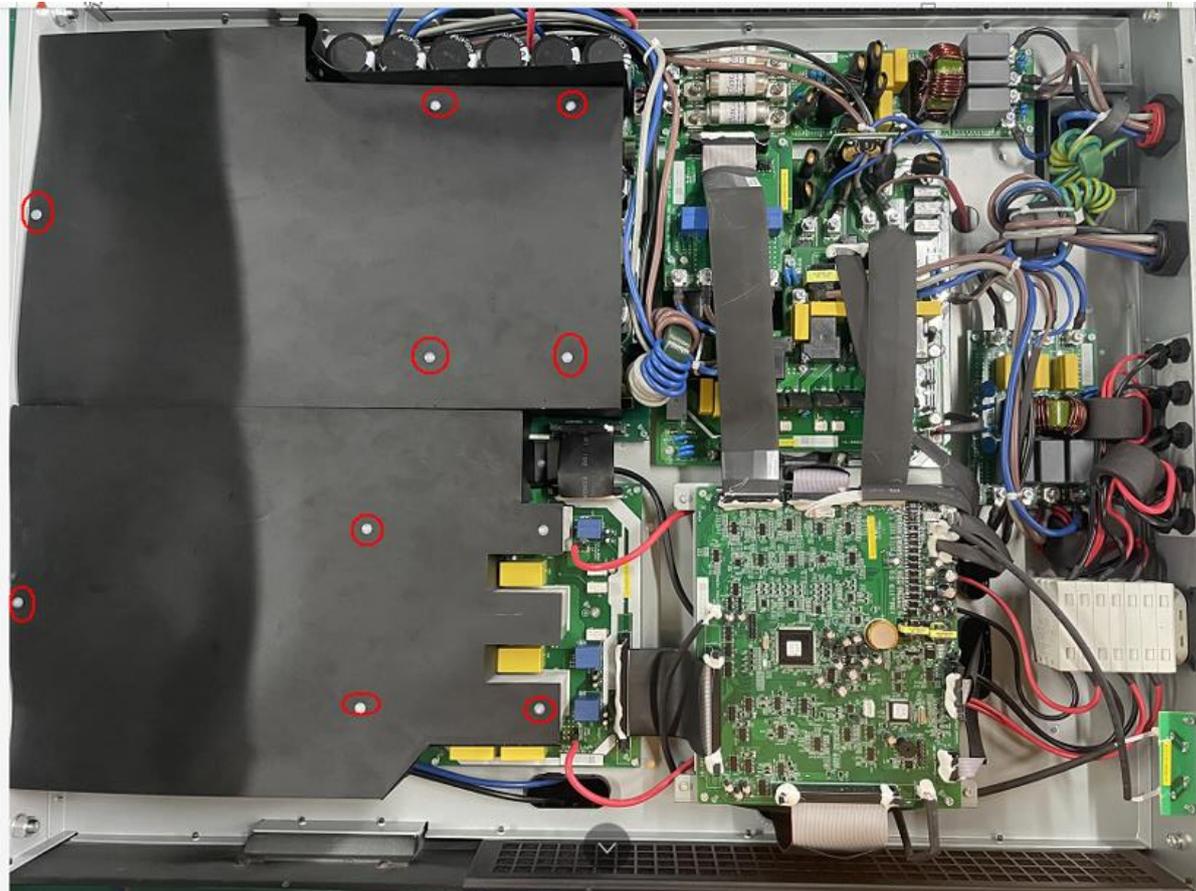
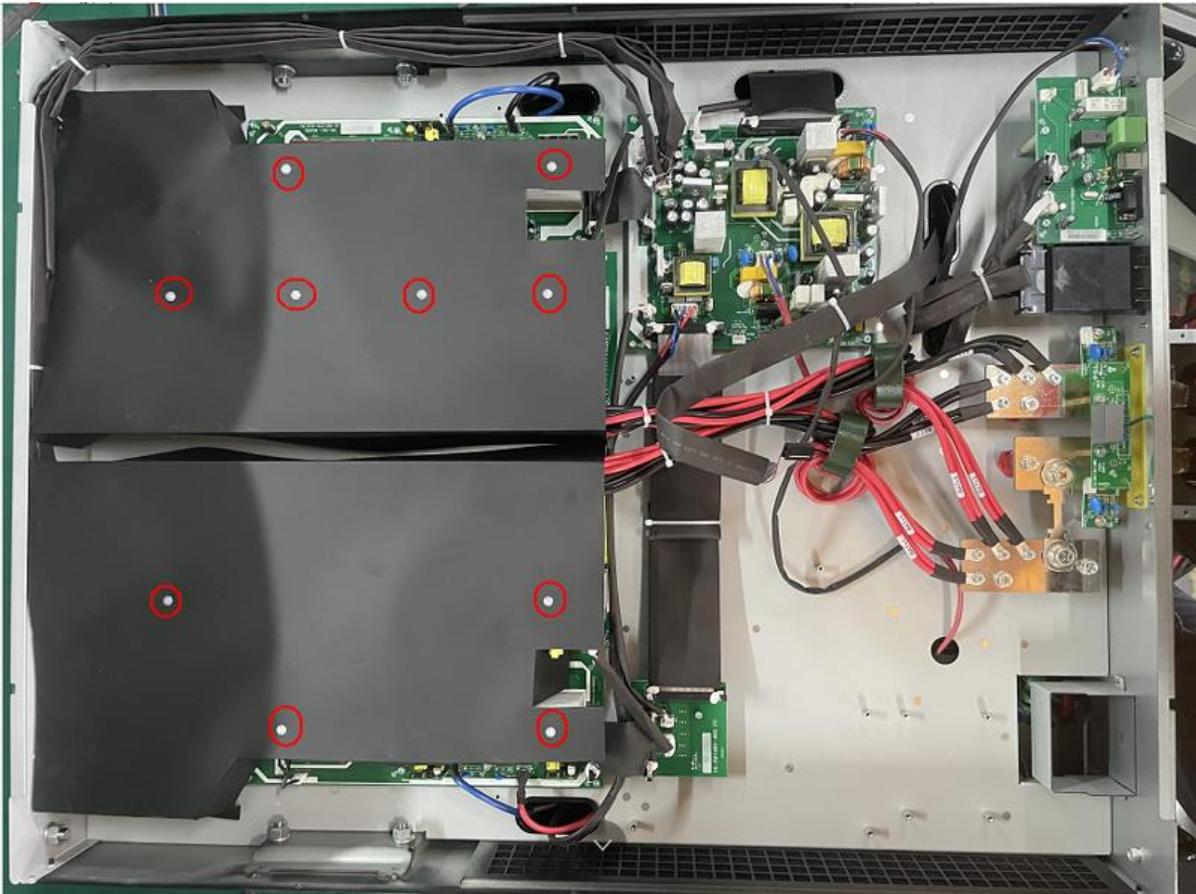


Open the bottom cover by removing the screws as below:



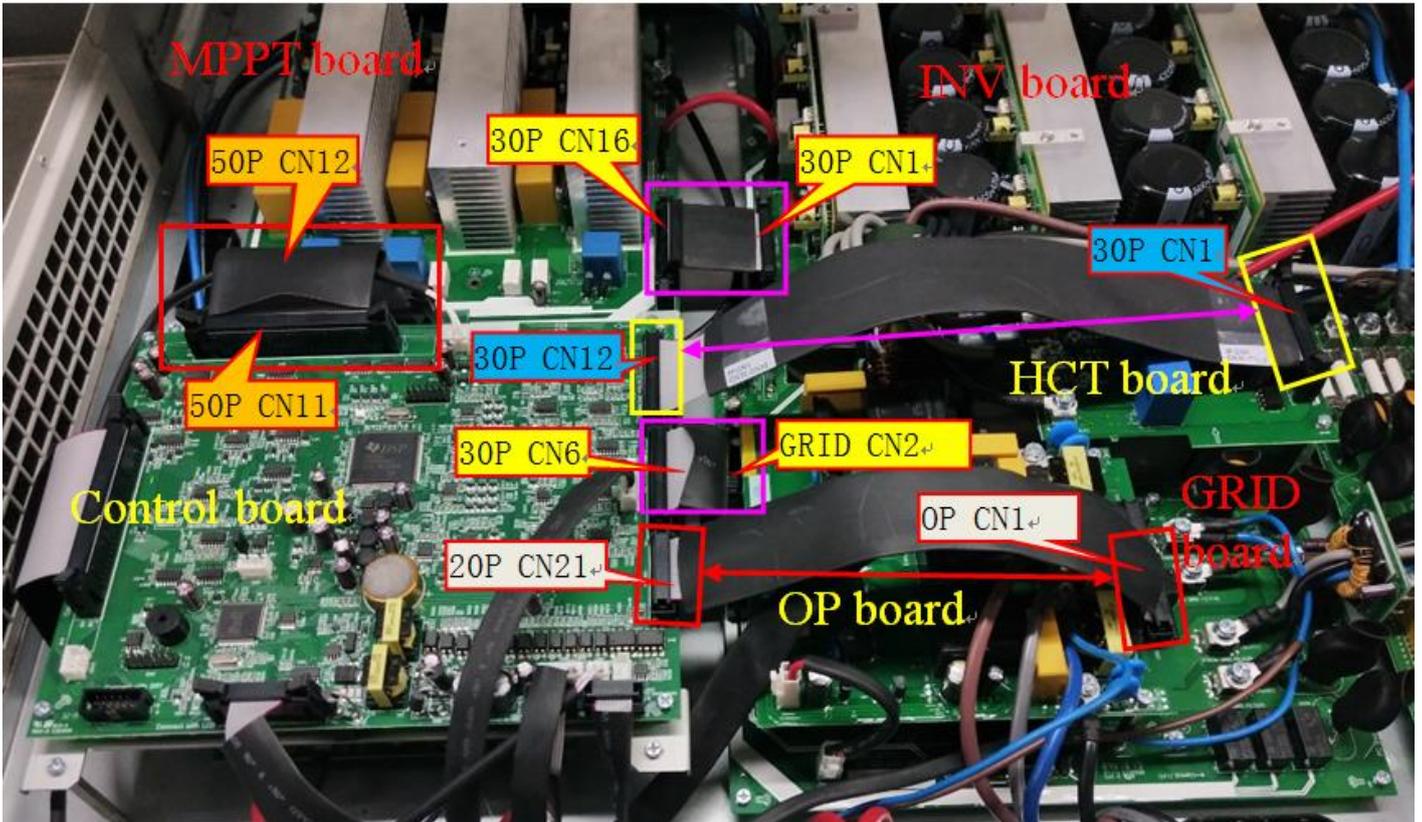
4.2.2. Remove the air flow paper before you want to replace the boards

Take off the plastic nails on the plastic paper to take out the air flow paper.



4.2.3. Remove the PCBA boards

Steps1: Remove the cables which connecting on the board. (We take below as an example. For more detail about the cables connection, please refer to the part 4.2)



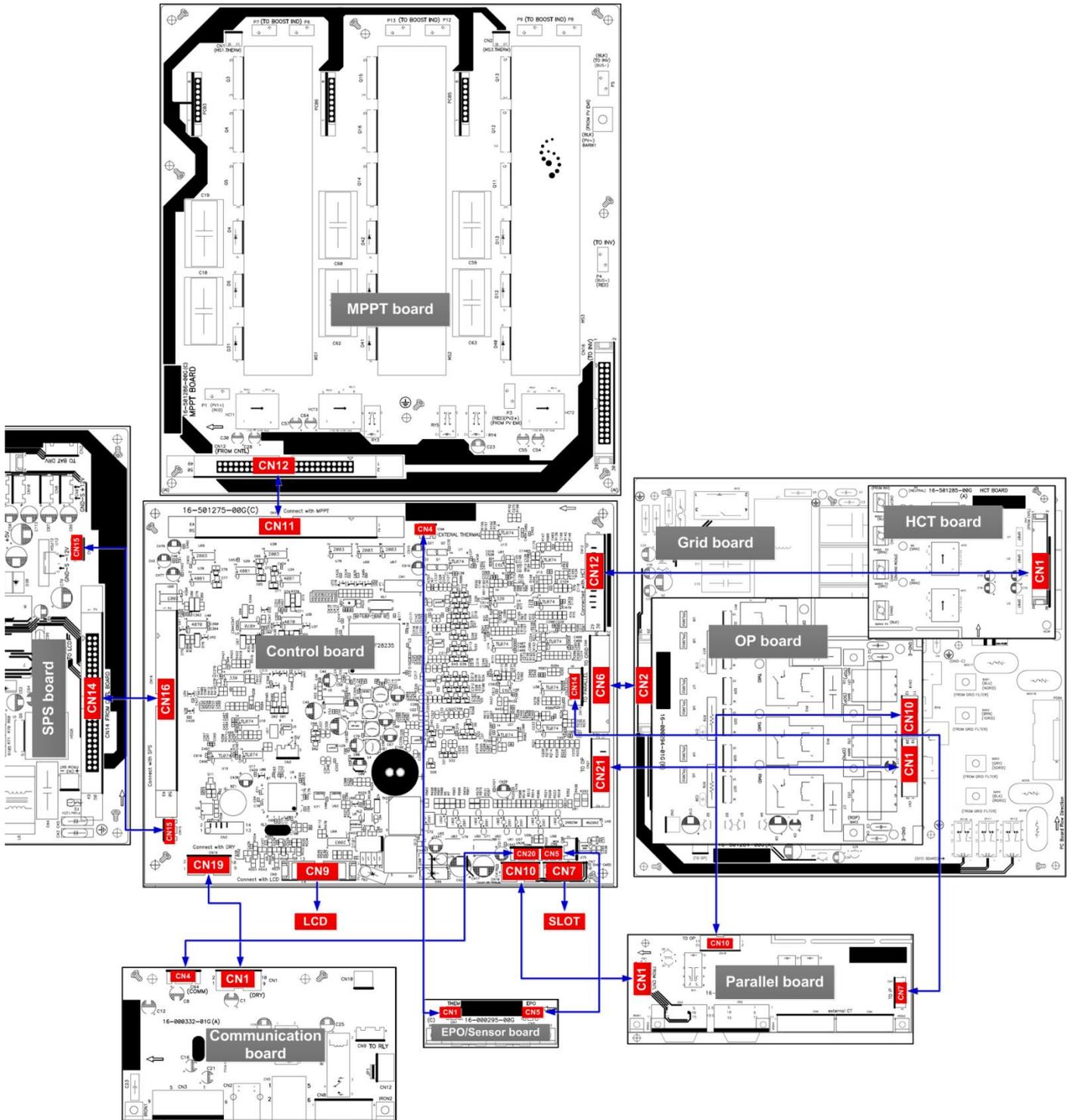
Steps2: Remove the screws which fixing the board.



Steps3: Take the board out.

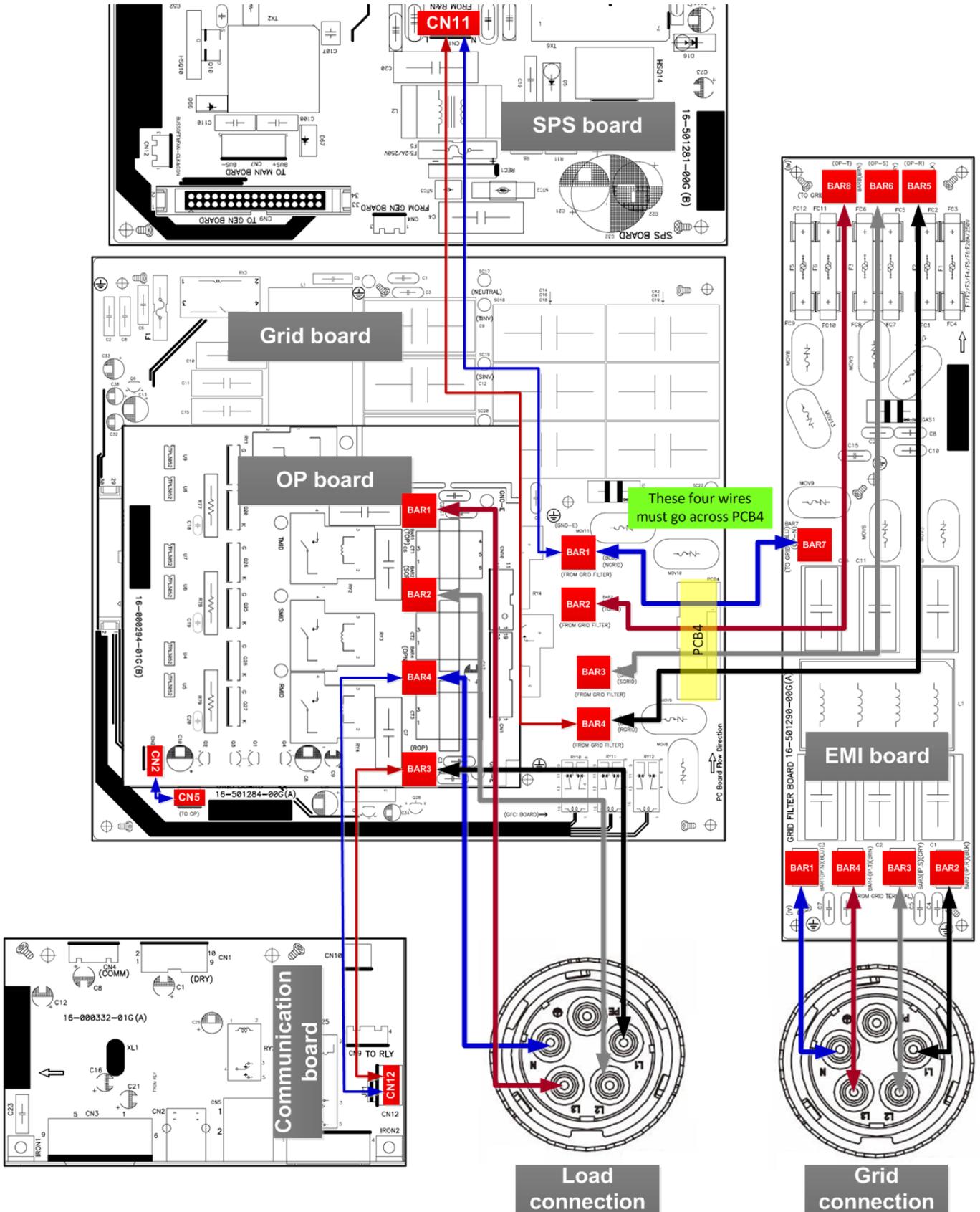
4.2 Cables connection guideline

- Control board



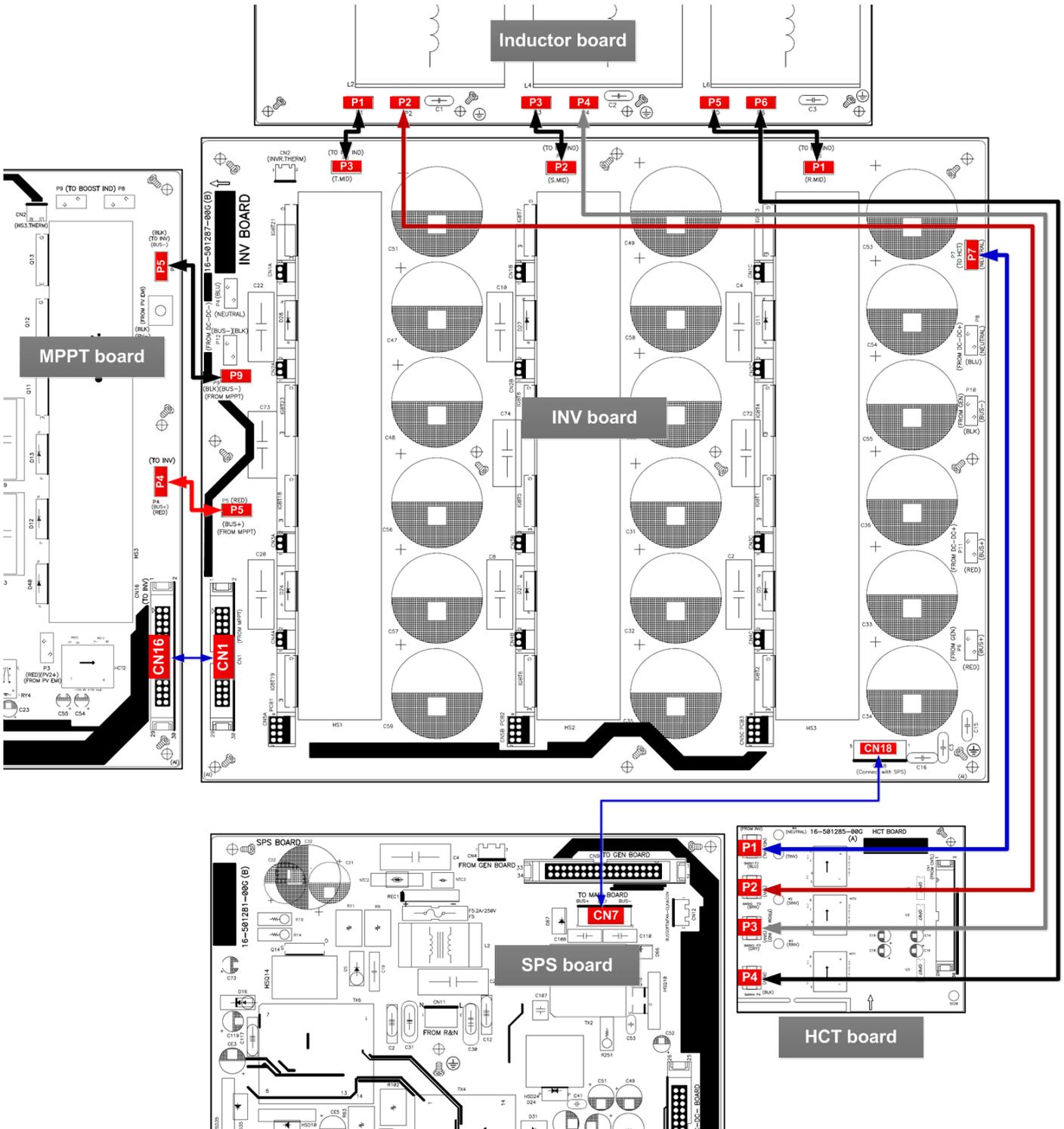
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- Grid & EMI board



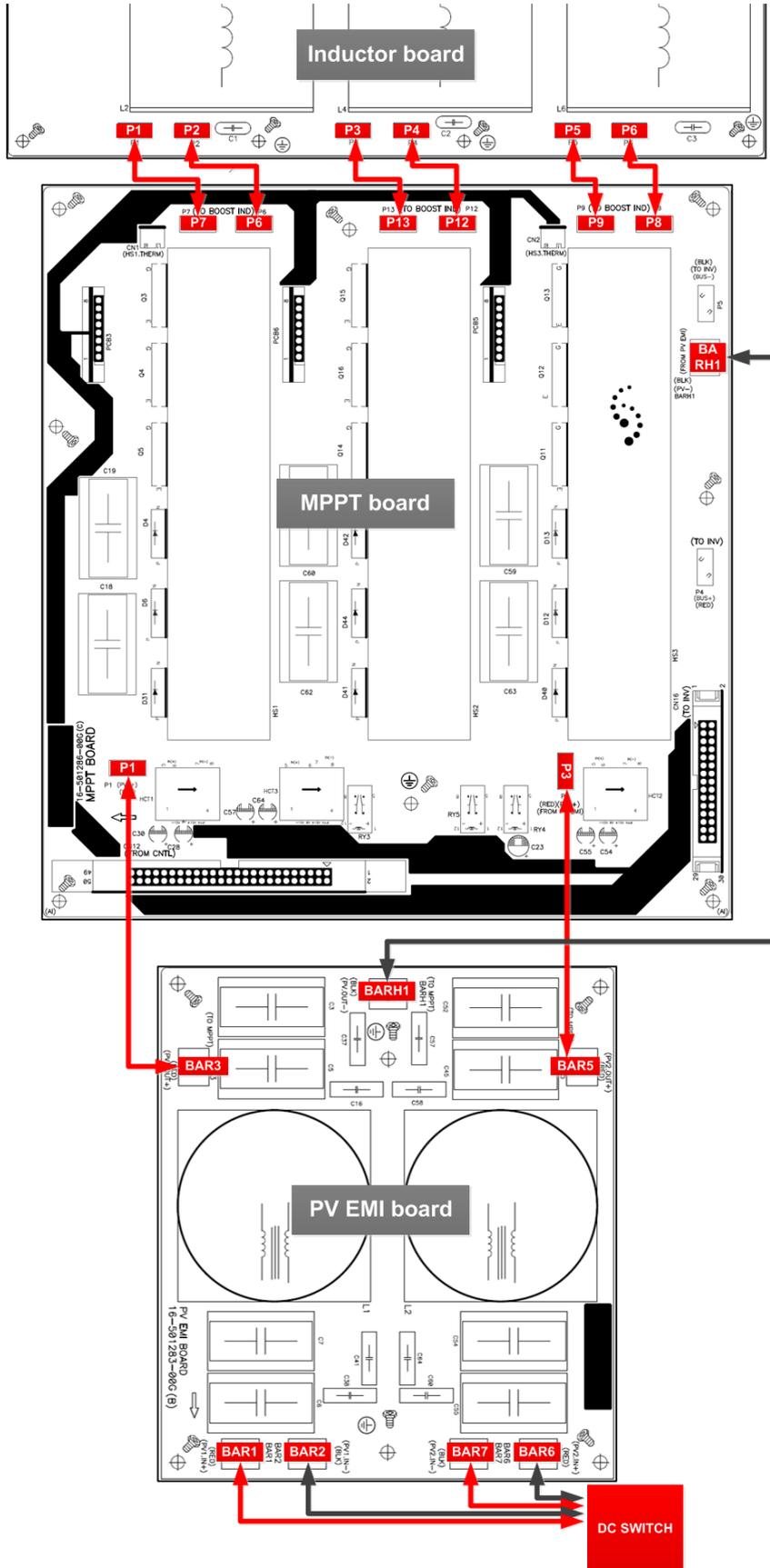
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● INV board



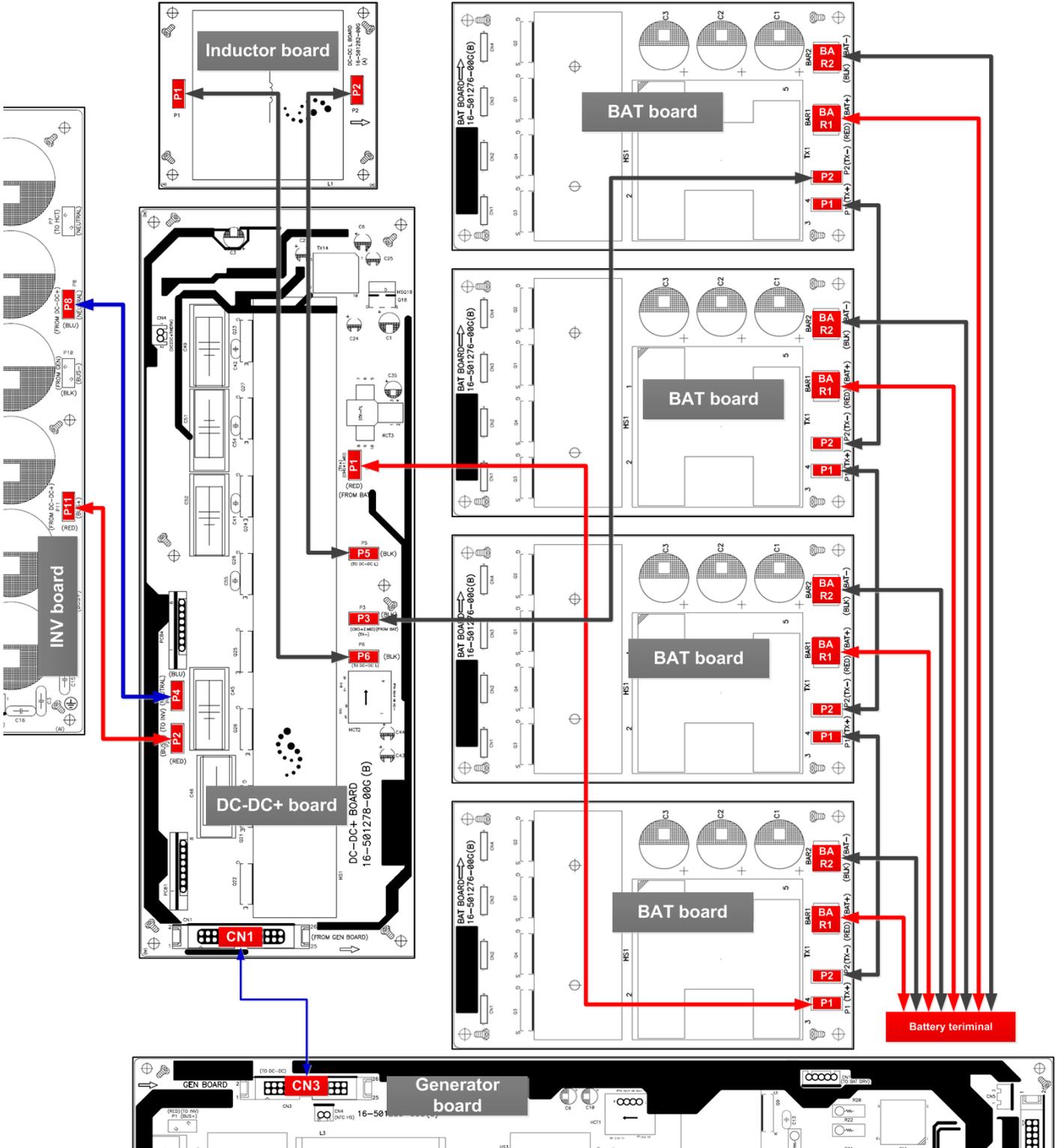
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- MPPT & PV EMI board

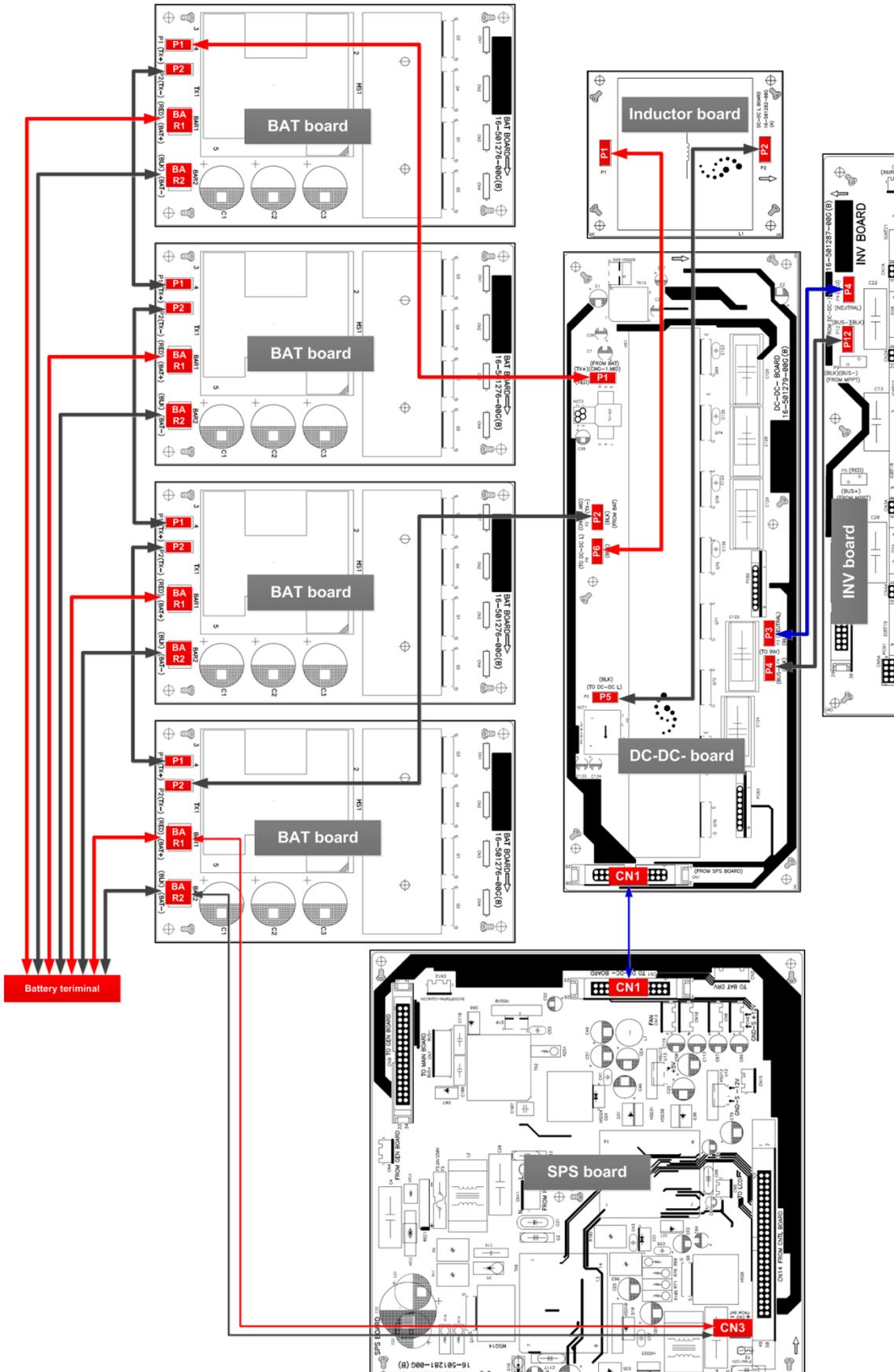


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● DC-DC+ board



- DC-DC- board



● BAT driver board

