Troubleshooting Guide for Growatt Off Grid High Frequency Inverters

(Ver1.1)
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Ver1.1		

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General

This document is applicable for Off Grid High Frequency inverters, including

SPF 5000TL HVM WPV, SPF 3500ES, SPF 5000ES

SPF 5000ES

SPF 5000TL HVM WPV

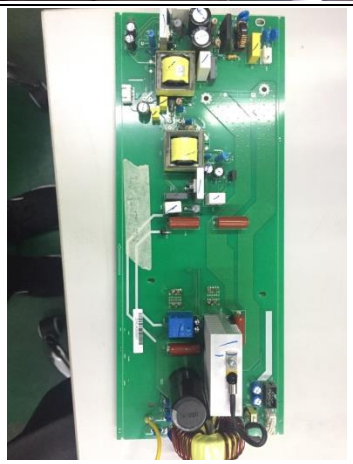
High Frequency inverter means that the frequency of mosfet swiching on and off is pretty high, in usual, it can reach 40KHZ.

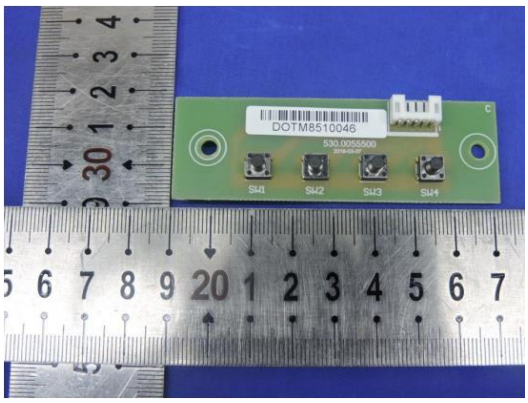
Maintenance tool list

Maintenance Tool		
Computer OS Win10	Used to upgrade the inverter or monitor the inverter via PVkeeper	

Multimeter	Fluke 179C	
USB Cable	Used to upgrade or monitor the inverter	
ISP tool	Upgrade software	
PV Keeper	Monitor the inverter real time data	
cross screwdriver	Used to uncover the inverter	

Inverter System introduction:

SPF 3500-5000 ES System Introduction	
Mainboard ,Including DC-DC Circuit, DC-AC Circuit, SPS Circuit, mainly used to conver 48V DC to 230V AC	
MPPT Board, Including SPS Circuit, Boost Circuit, mainly used to conver PV input voltage into almost 400V BUS voltage	
Control Board, mainly used to form PWM wave to drive MOFET and IGBT	

COMM Board in charge of Datalogger Communication	
Switch Board	
FAN	

SPF 3500-5000 ES SPF 5000TL HVM WPV Fault condition and Troubleshooting

Part I. Fault

1 03fault

03fault means battery voltage is too high.

Testing method:

a. Firstly ,disconnect battery from inverter and test the battery voltage separately
b. If battery voltage is normal, then connect battery into inverter and check battery voltage on LCD. Try to adjust to the battery on LCD via inverter battery voltage setting.

Method:

1. Only connect battery to inverter(Don't connect to utility, PV system and load)
2. Press UP and Down at the same time for 3 seconds and type 111 , then press Enter.
3. Select battery page , S means reduce the voltage, A means increase the voltage.
4. For example, LCD displays 53V and multimeter displays 50V, then type 3V on S state. And press Enter to save it.
5. If above all still can't solve the issue, it may be hardware issue. Try to replace mainboard.

Solution:

If real battery voltage is normal, while, battery voltage on LCD abnormal, you should doubt if battery sample circuit has some trouble. Suggest replacing mainboard.

Malfunction Reason:

Battery voltage sample circuit on mainboard may have some trouble. You can try to uncover the inverter and check inside.

2 05 fault

Output Short Circuit

Testing method:

1. Disconnect load from inverter, then check if 05fault will disappear.

2. If 05fault still occurs, Switch off inverter until black screen, then test the continuity on AC output. If beeping, there is short circuit inside the inverter.

Solution:

Uncover the inverter and check inside.

Malfunction Reason:

Most of time, it is caused by damaged mosfets or IGBT.

3 06 fault

Fig.2 06fault on inverter display

Testing method:

Just connect the inverter to battery system, Switch on the inverter, if 06 still occurs, it means DC-AC circuit has the trouble. When AC output voltage reaches 280V and lasts for 200ms. It will have the error.

Solution:

For usual client, suggest replacing mainboard

For professional client, suggest deliverying some IGBT or Optocouplers to them and try to repair it.

Malfuntion Reason:

IGBT (STGWT80H65DFB)	Q5/Q6/Q8/Q10	Resistance Diode position	>60K CE	short or open
			V_{EC}=0.346V REF	0 or OL
			100K GC	short or open
			49.9K GE	short or open

Fig.3 DC-AC IGBT

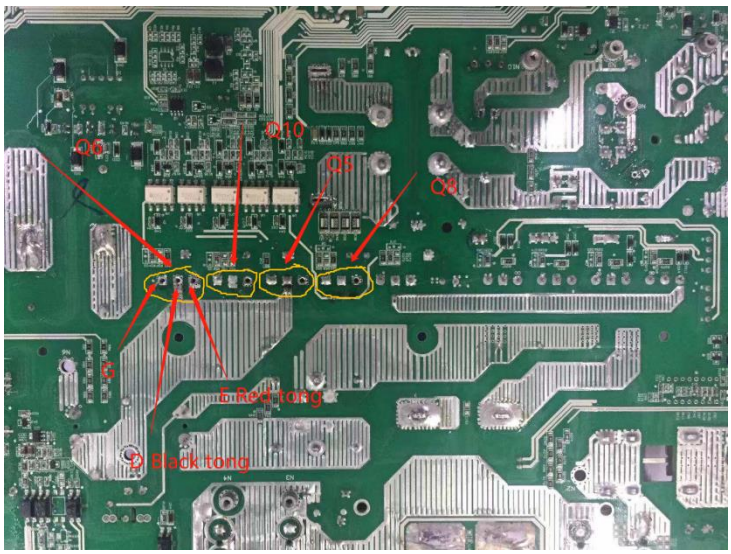


Fig.4 DC-AC IGBT position

Repairing Method:

a. please kindly turn to diode position on multimeter.

Fig.5 Diode Position

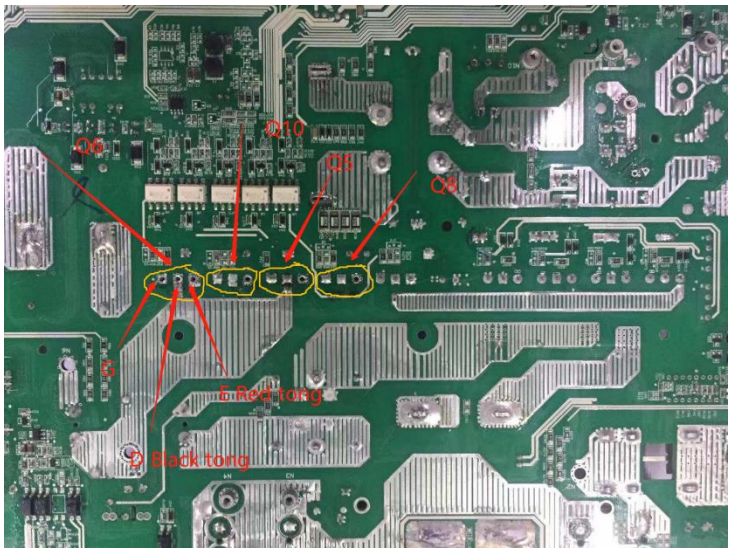


Fig.6 IGBT

b. Every IGBT has 3 pins (G, C, E). Put black tong of multimeter on C pin and Put Red tong of multimeter on E pin.

0.38-0.7V on multimeter is normal. If multimeter display zero, it means the IGBT has short circuit.

4 07 fault

07fault means over load time out.

Testing method:

a. Try to disconnect the load from inverter, then observe if inverter has normal AC output 230V and no 07fault again.

b. If still abnormal, most of time it is caused by control board.

Solution:

After the check of load, try to replace control board or mainboard

Malfunction Reason:

There are 2 conditions that will trigger the fault:

a. Load power has been greater than 112% and lower than 150% and lasted for 10s.
b. Load power has been greater than 150% and lasted for 2s.

One control board had been returned back from client and found one resistor on control board was damaged so that it cause 07 fault.

Fig.6 07fault control board

5 08fault

08fault means BUS voltage too high. It is caused by interaction of inverter and battery.

Fig.6 08fault

Testing method:

a. Try to restart the inverter
b. Try to upgrade special firmware for 08fault. You can request it from Sacolar.
c. After the upgrading, if 08fault still occurs frequently like once several hours, most probably mainbard or control board has some trouble.
d. Try to replace control board or mainboard

Solution:

Replace control board or mainboard

Malfunction Reason:

08 error will occur when BUS voltage is higher than 510V and lasts for 20.8ms or BUS voltage reaches higher than 500V and lasts for 1s.

Based on the experience, if it happens frequently, DC-DC circuit on mainboard or control board has some issues. The reason is complex, research dep. Is analyzing it. When meeting these faulty ones, you can report them to research dep. and assist them to analyze it further.

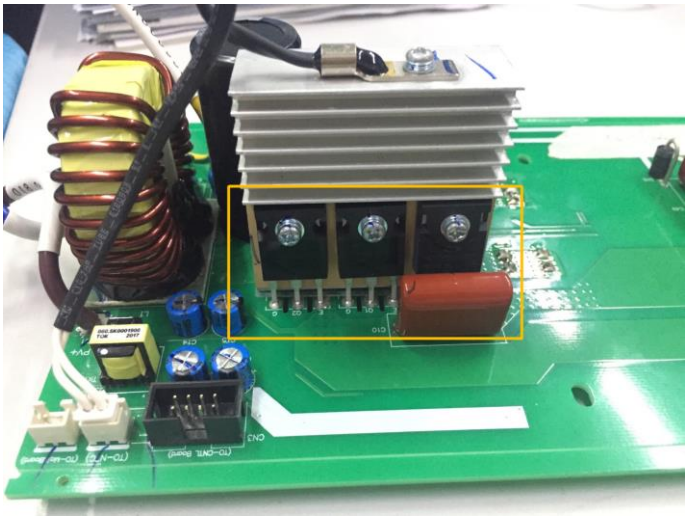
6 09 fault

Testing method:

a. Just connect battery into the inverter. Don't connect Utility input and PV input into the inverter.
b. If the inverter still shows "09 Error" , check MPPT board firstly, you can put MPPT board into normal inverter and confirm if it is ok.
c. If MPPT board is ok, you can replace mainboard directly.

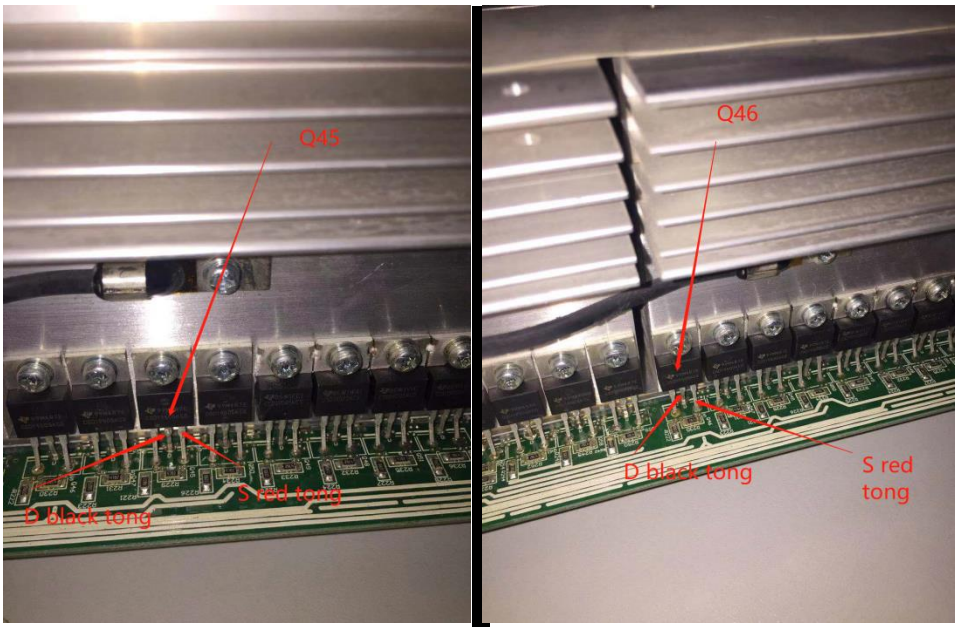
Malfunction Reason:

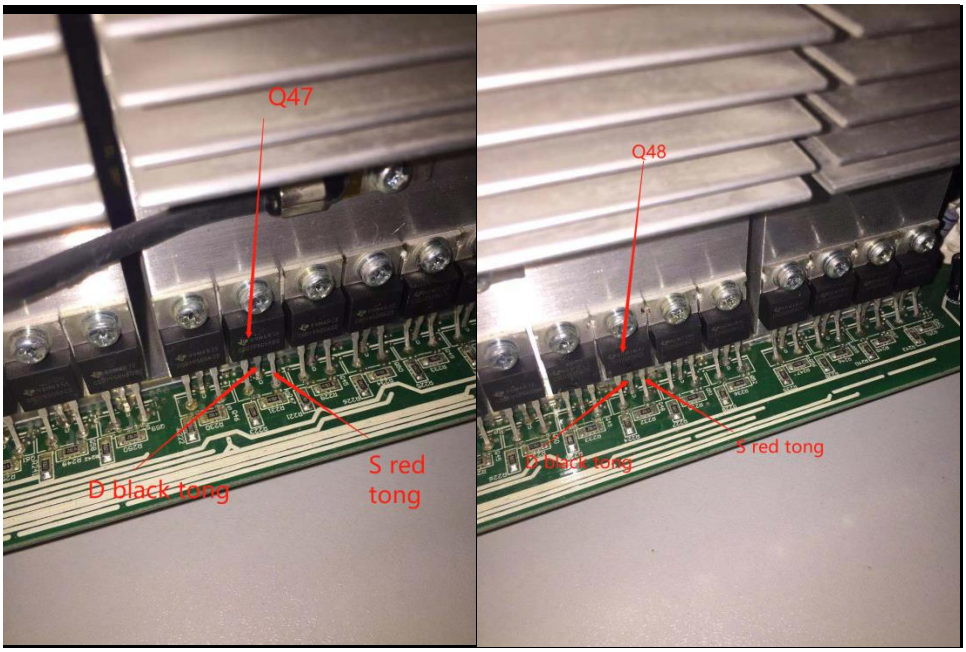
a. Mosfets or Diodes on MPPT board may be damaged.

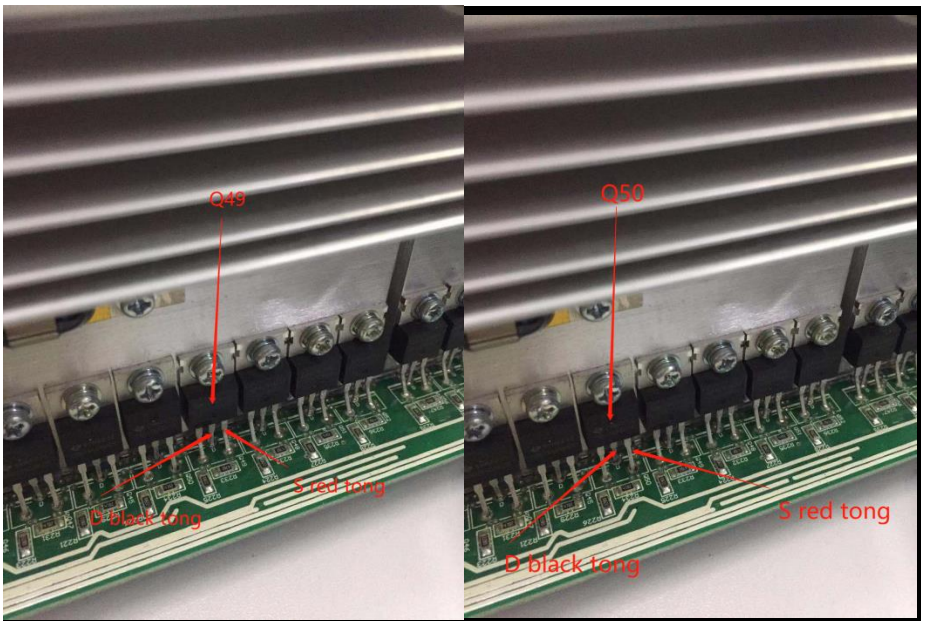


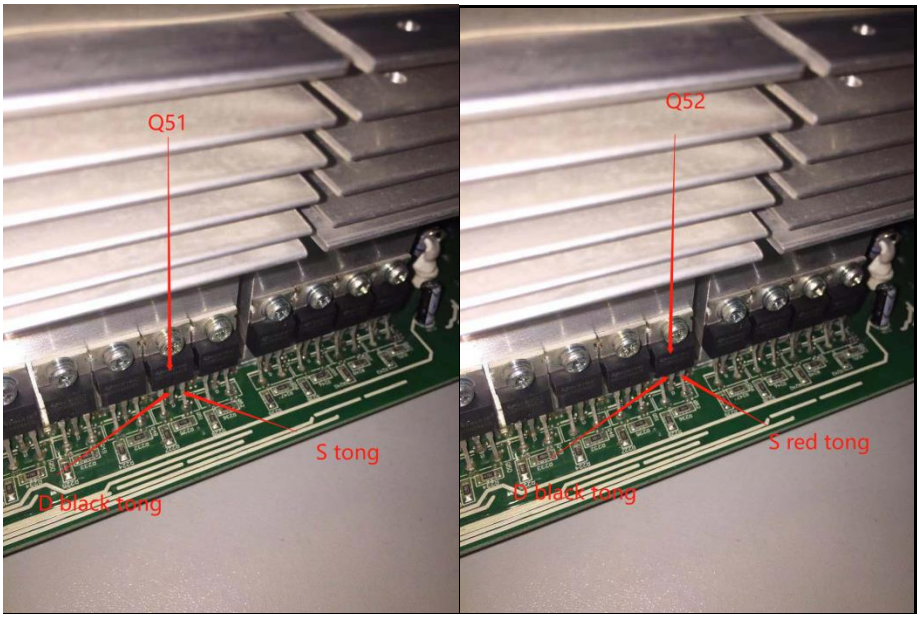
b. Most of time, it is caused by blown MOSFETS or Driving Circit of MOSFET on mainboard

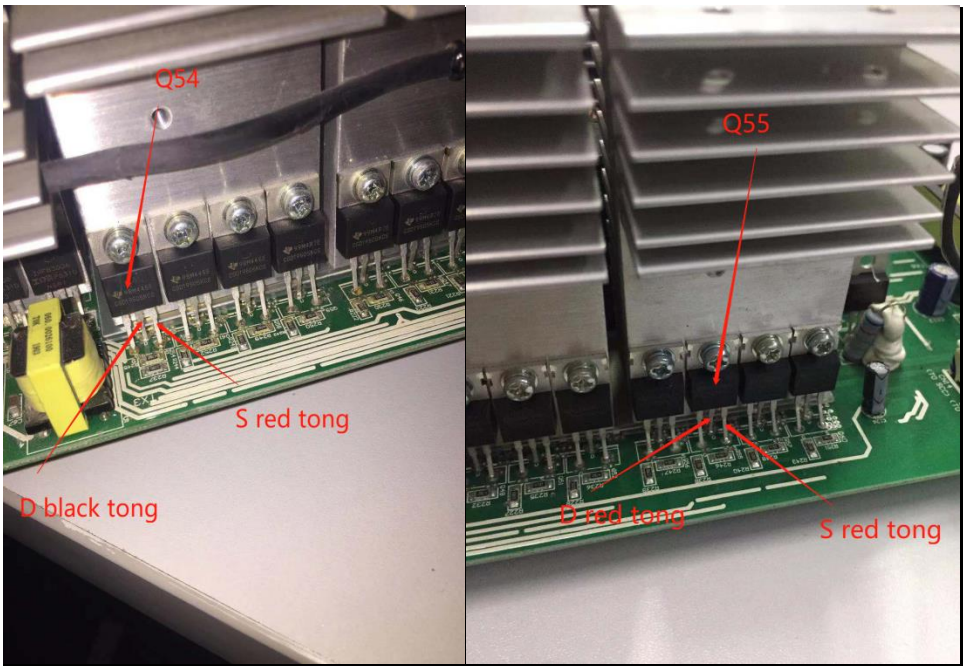
You can test 16 mosfets on DC-DC circuit via multimeter(most of time, the 09fault is caused by these mosfets. If good luck, you can replace mosfet and repair it well.)

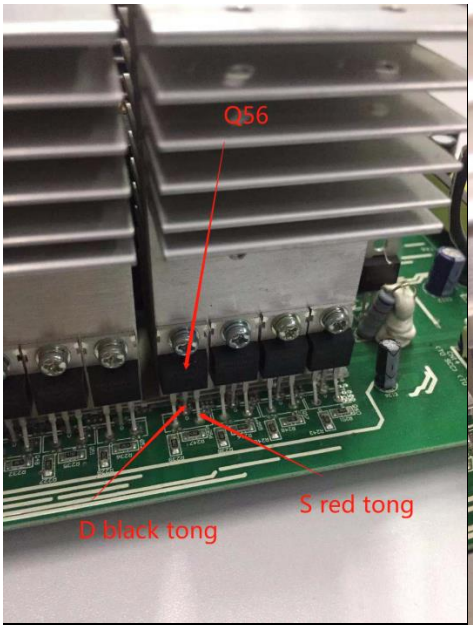


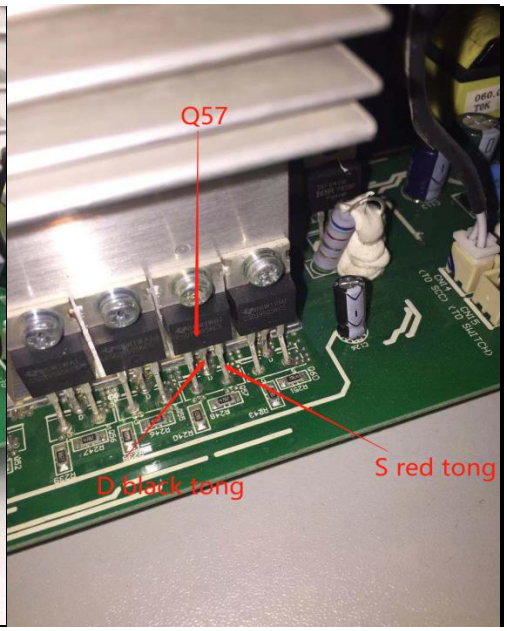

Q47
D black tong
S red tong
Q48
D black tong
S red tong

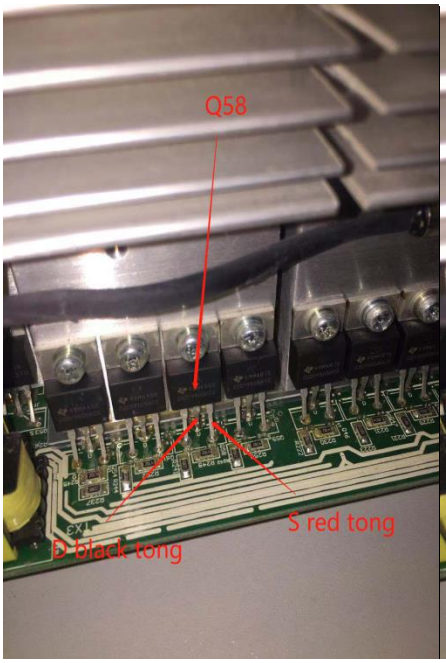

Q49
D black tong
S red tong
Q50
D black tong
S red tong

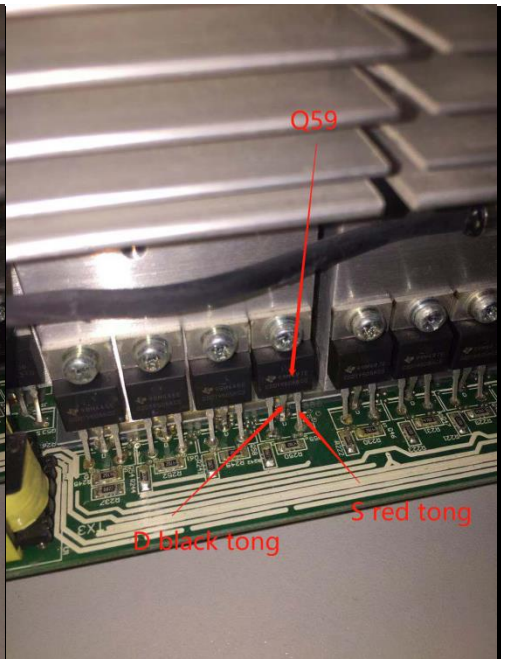

Q51
S tong
D black tong
Q52
S red tong
D black tong

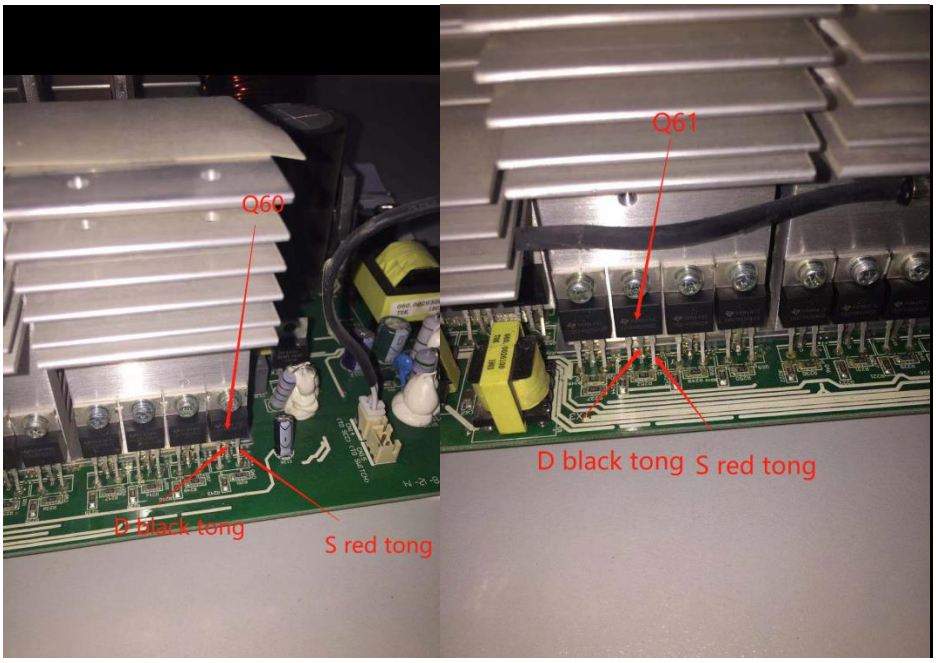

Q54
S red tong
D black tong
Q55
D red tong
S red tong


Q56
S red tong
D black tong


Q57
S red tong
D black tong


Q58
S red tong
D black tong


Q59
S red tong
D black tong



Solution:

For usual client, suggest replacing mainboard

For professional client, suggest deliverying some mosfets or Optocouplers to them and try to repair it.

Repairing Method:

a. please kindly turn to diode position on multimeter.

Fig.1 Diode Posion

b. You can test these mosfets via multimeter(most of time, the 09fault is caused by these mosfets. If good luck, you can replace mosfet and repair it well.

MOSFET (CSD19505KCS)	Q45/Q46/Q47/Q48/Q49/ Q50/Q51/Q52/Q54/Q55/ Q56/Q57/Q58/Q58/Q60/ Q61	Resistance Diode position	>20k DS	short or open
			V_{SD}=0.434V REF	0 or OL
			240k GD	short or open
			11.74k GS	short or open

Fig.2 MOSFET Label

Fig.3 MOSFET Testing

Every mosfet has 3 pins (G, D, S). Put black tong of multimeter on D pin and Put Red tong of multimeter on S pin.

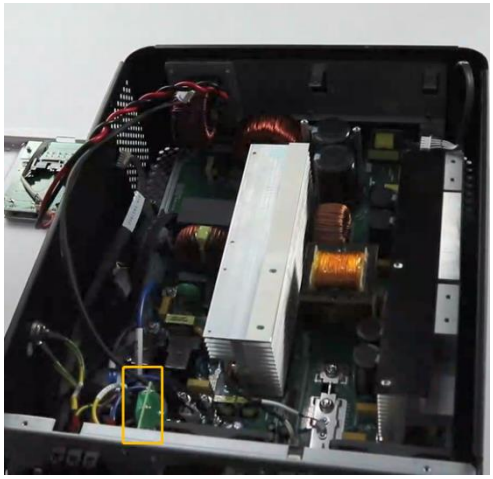
0.38-0.7V on multimeter is normal. If multimeter display zero, it means the mosfet has short circuit.

7 51 fault

51fault means over current fault. Most of time, it is caused by MOV board inside inverter. Mov board is used for SPD and prevent surge from utility input.

Testing method:

a. Try to disconnect all load from inverter. Then observe if 51fault will disappear.
b. Take out MOV board from inverter. Mov board is connected to utility input in parallel.



Solution:

Replace MOV board. Material code: SKB700.0001101LS0

Malfunction Reason:

Lighting strike or Utility input surge may damage MOV board. So replacing MOV board may solve the issue.

8 52fault

52fault means battery voltage is too low.

Testing method:

a. Restart the battery and inverter
b. Try to disconnect all load from inverter. Then observe if it is normal. If YES, it may be caused by load.
c. Try to change battery connection type. Like ARK battery, try to divide them into 2 groups in parallel.

Solution:

Restart the battery and inverter, reduce the load and change battery connection type.

Malfunction Reason:

Most of time, because of heavy load, battery can't supply enough power for load and cause the low

battery voltage. Then 52fault will occur

9 53 fault

Fig.7 53fault

Testing method:

Just connect the inverter to battery system, Switch on the inverter, if 53fault still occurs, it means DC-AC circuit has the trouble. When AC output voltage reaches less than 230V and lasts for 20s. It will have the error.

Solution:

For usual client, suggest replacing mainboard

For professional client, suggest deliverying some IGBT or Optocouplers to them and try to repair it.

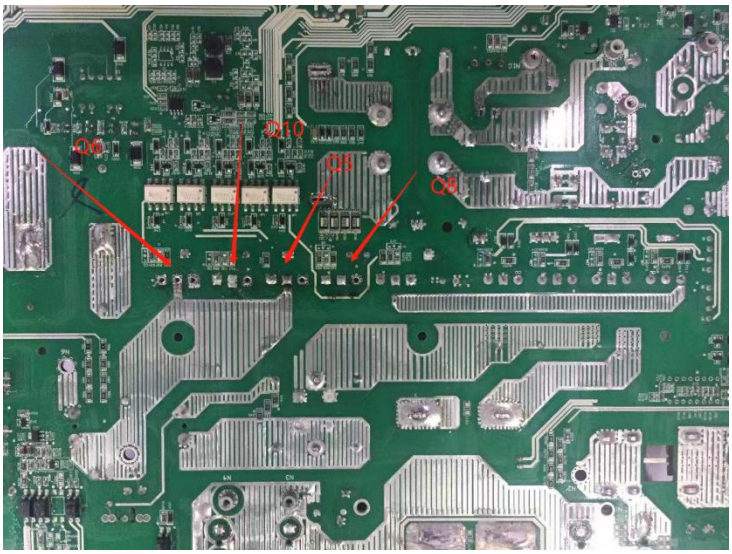
Malfunction Reason:

Most of time, it is caused by DC-AC circuit, including IGBT, Driving circuit etc.

Repairing Method:

a. please kindly turn to diode position on multimeter.

Fig.5 Diode Position



b. Every IGBT has 3 pins (G, C, E). Put black tong of multimeter on C pin and Put Red tong of multimeter on E pin.

0.38-0.7V on multimeter is normal. If multimeter display zero, it means the IGBT has short circuit.

c. Replace broken IGBT.

10 56fault

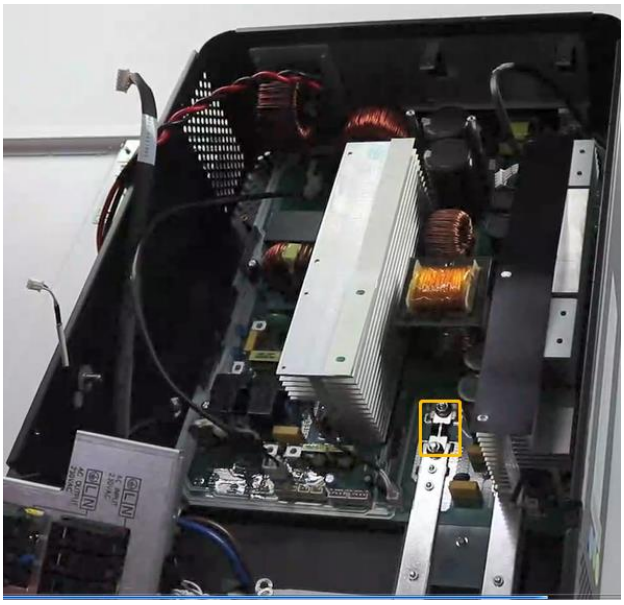
56fault means battery connection is open

Testing method:

a. Test the real battery voltage via multimeter
b. if battery voltage is normal:

1) please confirm the battery type, for lithium-ion battery , please check 2nd and 5th option on inverter. Too large charging current on 2nd option will cause BMS protection on battery so that it will shut down the mosfet inside the battery, then battery connection is open. For lithium-ion battery ,ONLY US2 or Li can be used. If lead acid battery, in usual, charging current is 0.2-0.3C (C means battery capacity).

2) After testing above, if 56fault still occurs. You can doubt if fuse on mainboard is broken. Please uncover the inverter and take out MPPT board, then confirm if fuse is ok.



c. if battery voltage is abnormal, please check battery further.

Solution:

Restart the battery and inverter
OR

replace fuse or mainboard.

Malfunction Reason:

Incorrect charging current on 2nd option ,5th option or broken fuse on mainboard

11 58 Fault

Fig.5 58fault

Testing method:

Just connect inverter to battery system, Switch on the inverter, if 58fault still occurs, it means DC-AC circuit has the trouble. When AC output voltage reaches less than 80V and lasts for 200ms. It will have the error.

Solution:

Based on the experience, 58fault seldom happens. In case judging it by mistake, suggest that you can uncover the inverter.

For usual client, suggest replacing mainboard

For professional client, suggest deliverying some IGBT or Optocouplers to them and try to repair it.

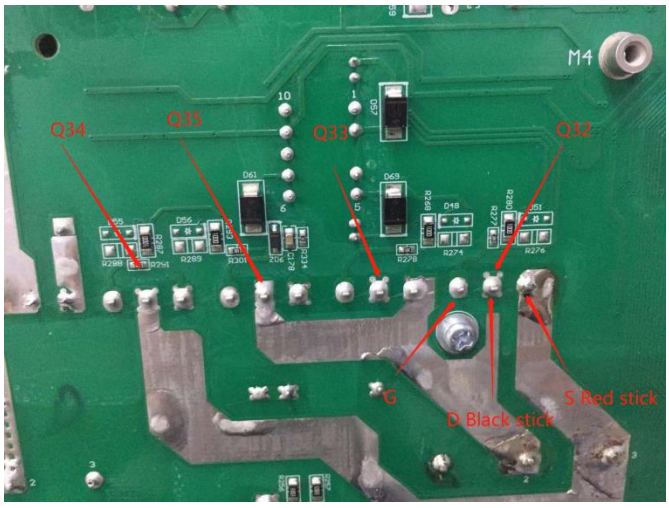
Malfunction Reason:

Most of time, it is caused by DC-AC Circuit. Especially, IGBT, driving circuit etc.

Repairing Method:

a. please kindly turn to diode position on multimeter.

Fig.5 Diode Position



b. Every IGBT has 3 pins (G, C, E). Put black tong of multimeter on C pin and Put Red tong of multimeter on E pin.

0.38-0.7V on multimeter is normal. If multimeter display zero, it means the IGBT has short circuit.

d. Replace broken IGBT

12 60 fault

Negative power fault means energy flows from load into load into inverter.

Testing method:

a. Try to disconnect all load from inverter, then observe if 60fault will disappear.
b. Check whether the output voltage setting in program 8 of all the Inverters in parallel are the same.
c. Check whether the current sharing cables are connected well in the same parallel phases.

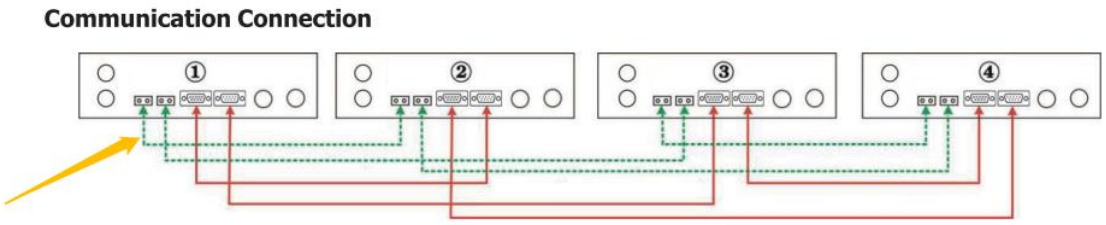


Fig.6 Current sharing cables

d. Check whether all the neutral wires of each unit in a parallel system are connected together.
e. If still abnormal, try to upgrade the inverter.
f. If upgrading can't solve the issue, try to put control board or mainboard from normal inverter into the inverter.

Solution:

a. Check 8th option on LCD for all inverters
b. Check current sharing cables
c. Try to replace control board or mainboard.

Malfunction Reason:

The inverter will have the error when negative power exceeds 3000W and lasts for more than 100ms

13 62fault

Fig.5 62fault

Testing method:

a) Restart the inverter, check if 62fault will disappear.

b) After restarting it, if it is still not solved. Please uncover the inverter, check if control board is plugged into mainboard sufficiently and connection wire is loose.

c) If above all are normal, pleases try to swap control board from normal inverter. Based on the experience, 62fault is often caused by control board. But sometimes, mainboard that is damaged may cause 62fault. Please kindly note this.

14 80 fault

80 fault means Parallel CAN fault, it just happens on parallel mode.

Testing method:

a. Firstly, check if parallel cable is connected sufficiently and restart the inverter, and see if it can become normal.

b. Secondly, after the check of parallel cable, if still abnormal, try to replace parallel cable

a. Thirdly, if above all methods can't solve the issue, try to make inverters run separately, then observe if 80fault will disappear. Try to replace parallel board inside the inverter.

Fig.5 Parallel board

Fig.6 Parrallel board at the bottom.

Solution:

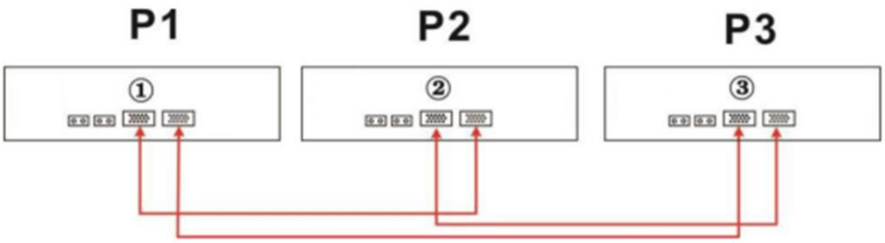
Try to swap parallel cable or parallel board from normal inverter, you can use exclusive method and confirm which part has the malfunction.

Malfunction Reason:

The inverter will alarm about 80 error when on parallel mode, host can't be detected for more than 1 seconds.

15 81 fault

81 fault means Host loss, it just happens on parallel mode.



Testing method:

b. Firstly, check if parallel cable is connected sufficiently and restart the inverter, and see if it can become normal.

c. Secondly, after the check of parallel cable, if still abnormal, try to replace parallel cable

d. Thirdly, if above all methods can't solve the issue, try to make inverters run separately, then observe if 81fault will disappear. Try to replace parallel board inside the inverter.

Fig.5 Parallel board

Fig.6 Parrallel board at the bottom.

Solution:

Try to swap parallel cable or parallel board from normal inverter, you can use exclusive method and confirm which part has the malfunction.

Malfunction Reason:

The inverter will alarm about 81 error when on parallel mode, host can't be detected for more than 8 seconds.

16 No fault on LCD, but board really has the trouble

In some cases, although there is no fault or alarm on LCD, but board is damaged.

For example:

Testing method:

1. Make sure that saving mode on 4th option is disabled. Or inverter won't have 230V AC output. It will affect your judgement.

04	Power saving mode enable/disable	Saving mode disable (default) SAVE dIS 004 If disabled, no matter connected load is low or high, the on/off status of inverter output will not be effected. Saving mode enable SAVE ENA 004 If enabled, the output of inverter will be off when connected load is pretty low or not detected.

2. Check if 1-21th options are reasonable, PV and battery side is normal.
3. After the confirmation, you can doubt that board may be damaged.
4. You can uncover the inverter and confirm it further. In usual, most probably mosfets or IGBT on mainboard are broken. About how to test mosfet or IGBT , please read 09fault, 53fault.

Solution:

Replace damaged board, most probably damaged mosfets or IGBT on mainboard

Malfunction Reason:

Based on experience, most of time, mainboard is broken. Software can't detect the malfunction so that it can't have the fault or waring on LCD.

Part II. Warning

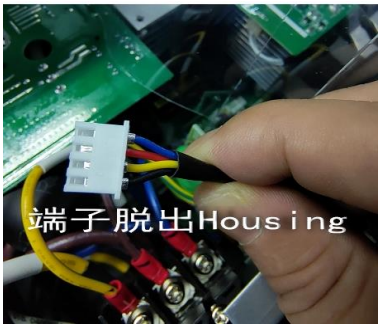
1 01warning

01 warning is related with fans.

Testing method:

1. Check if 2 fans inside the inverter are working.
   a. If fans are working, you can upgrade 01warning firmware to clear it. Please note that this method is just to hide 01warning and it is not solved basically.
   b. If fans are not working

   1) Check CN10,CN11 fan interface on mainboard. Confirm if they are connected well.



   2) try to swap fans from normal inverter. Then observe if fans can work normally.

   3) If fans have been replaced and fans are still not working. Try to replace mainboard.

Solution:

Replace fans or mainboard.

Malfunction Reason:

1. Maybe fans itself.

2. Mainboard issue.

2 02 warning

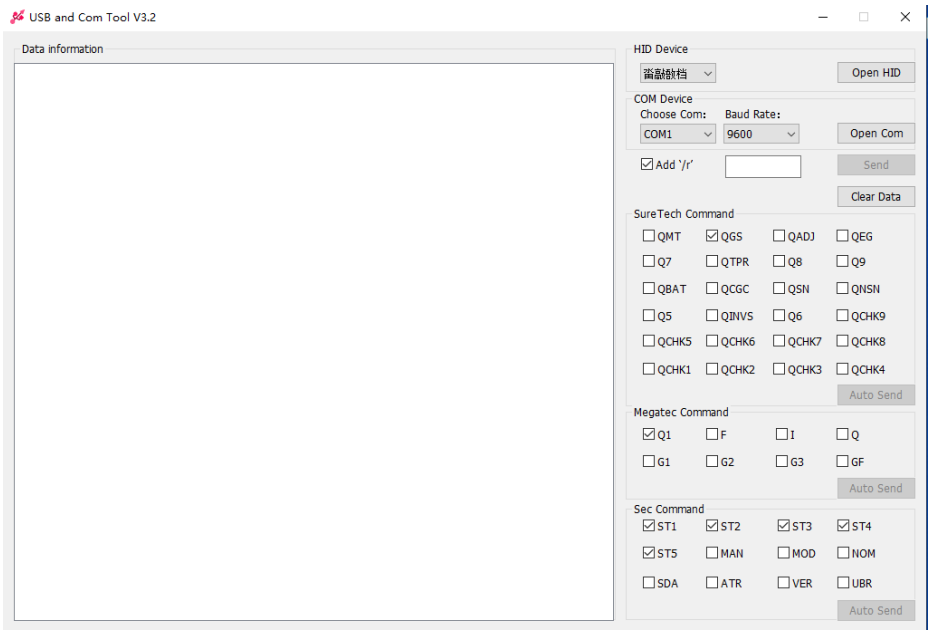
02 warning means over temperature

Testing method:

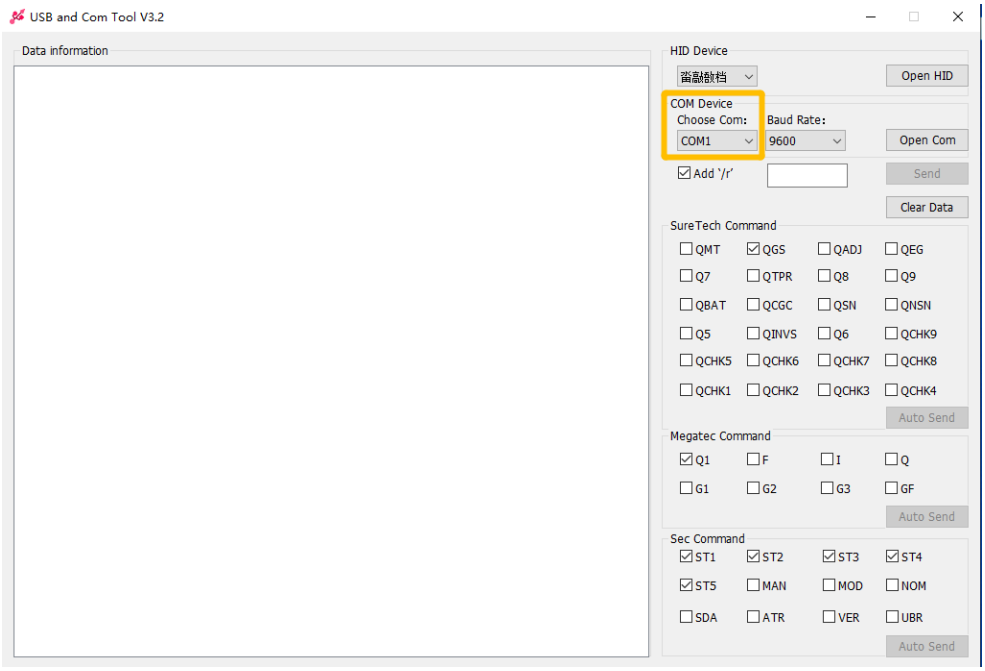
a. For SPF 3500ES, 5000ES, SPF 5000TL HVM WPV, Use Comtool to read temperature vaule.

Solution:

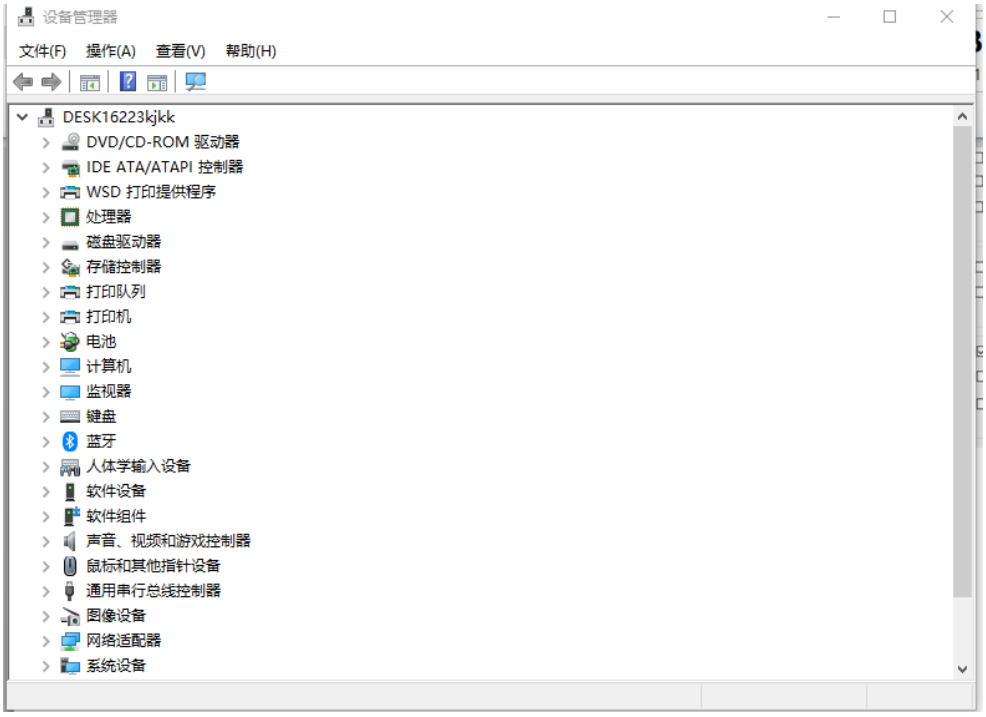
Based on the abnormal temperature value, you can confirm which board or temperature sensor has the trouble. Then replace temperature sensor or mainboard or MPPT board.



1. Connect your USB wire from computer to inverter.
2. Confirm your COM port. You need to check it on device manager.

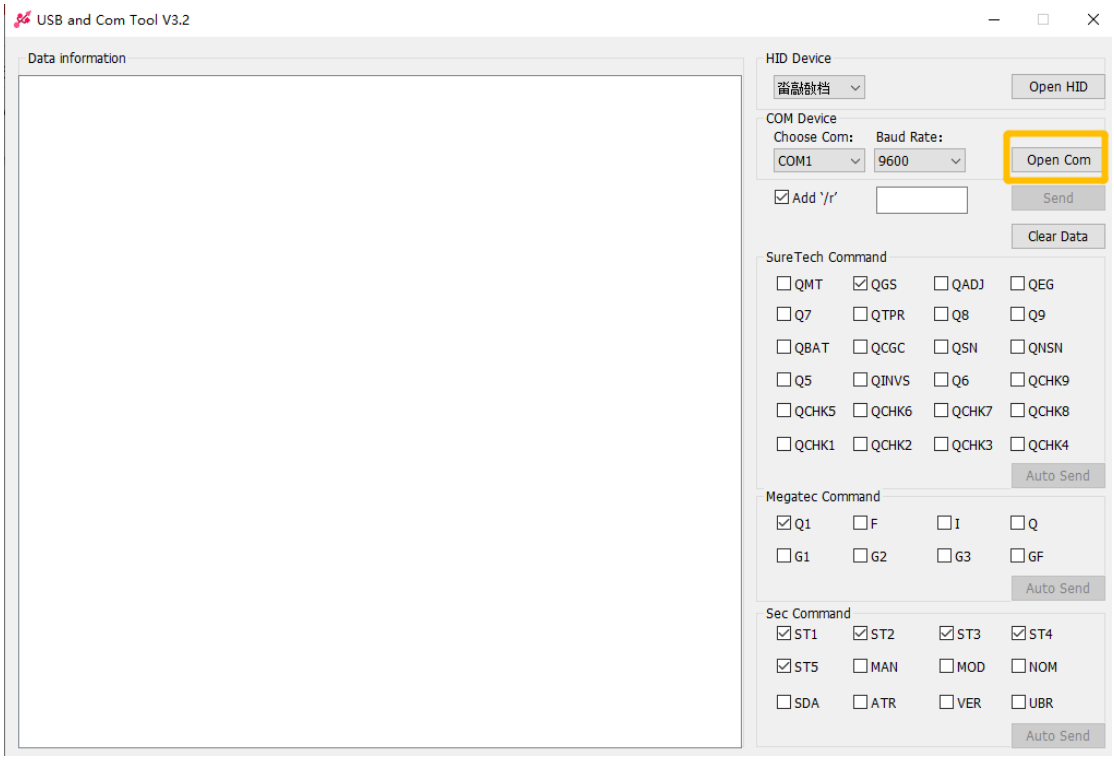


Device Manager Below:



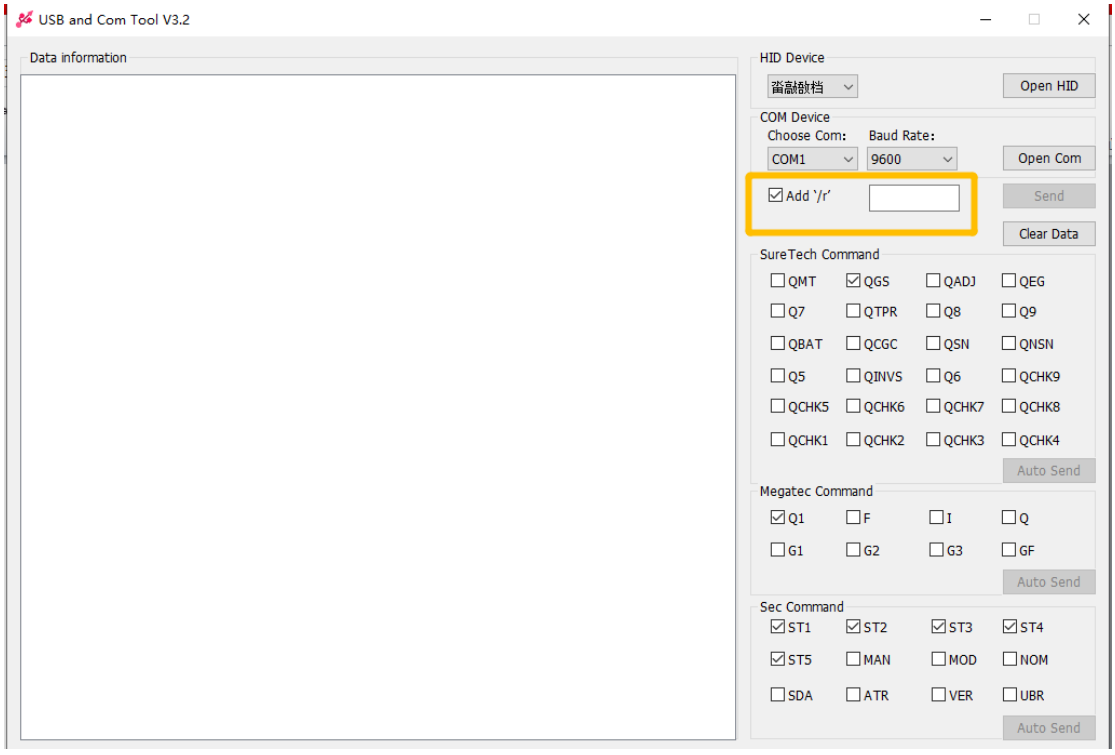
If you don't know how to check the com port on Device manager, please search it on the Google.

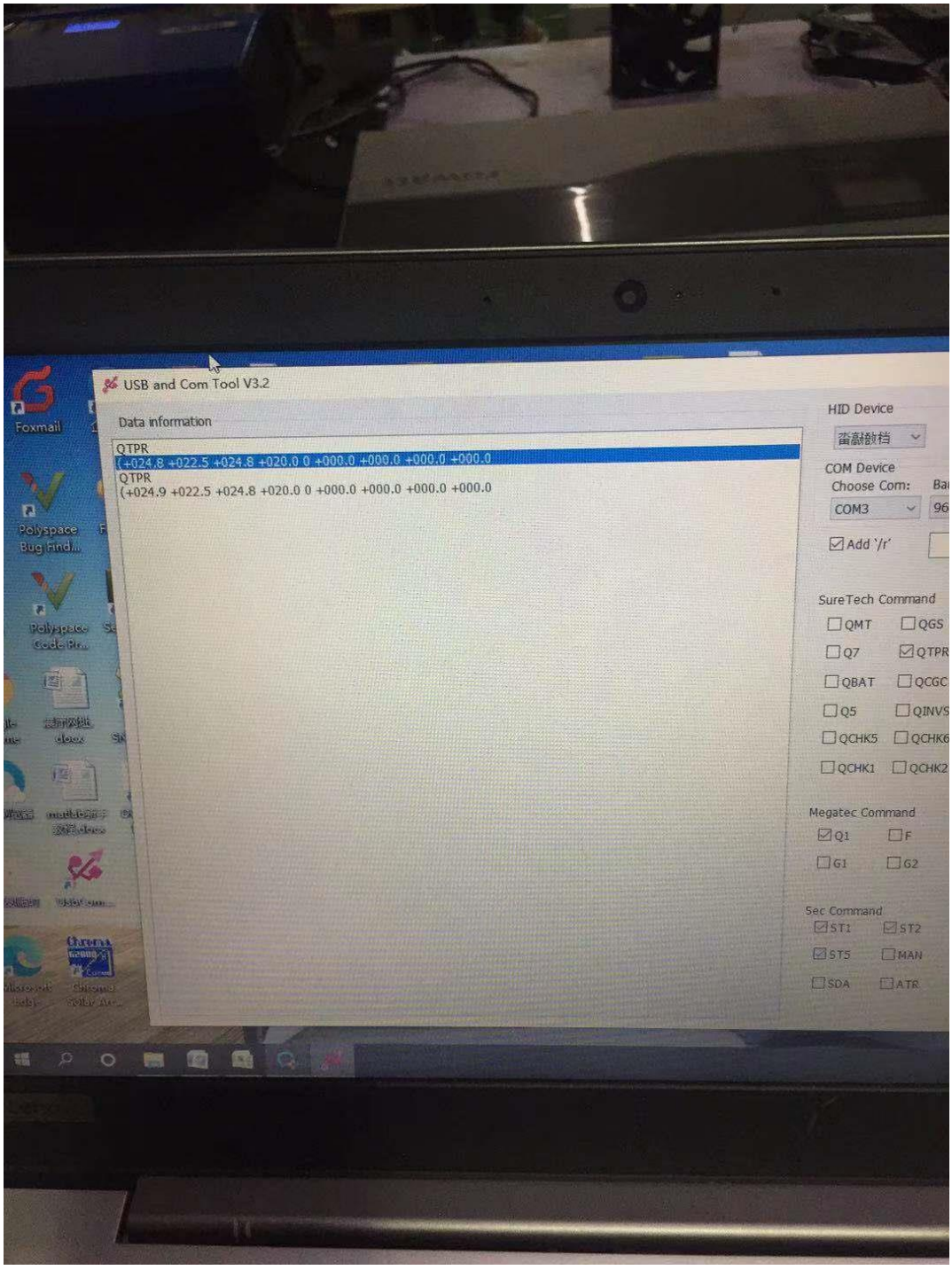
3 Open Com



If it fails, Please kindly check the port on device manager or your USB wire.

3. Type QTPR in white textbox





4. Data Display
(+024.8 +022.5 +024.8 +020.0 +000.0 +000.0 +000.0 +000.0)

The fourth data +20.0 is the MPPT temperature sensor value. The previous 3 data +024.8 +022.5 +024.8 is the Mainboard temperature sensor value. The +000.0 +000.0 +000.0 +000.0 means that the

inverter has the 02 warning /fault, it will record the last value)

5. When you confirm the issue, you can choose to upgrade it or change board so that you can solve the issue.

Malfunction Reason:

1. Temperature sensors have the trouble.
2. Mainboard or MPPT board have the trouble.

3 03 warning

03 warning means Battery is over-charged.

Testing method:

1. Firstly, confirm battery type, lead acid battery or lithium-ion battery.

2. For lead acid battery, please check 19th ,20th option on LCD. The issue may be caused by too high Bulk Charging voltage or floating voltage.

3. For Lithium-ion battery, please confirm if lithium-ion battery can communicate with inverter. if the inverter is communicating with battery and it has 03warning, try to contact battery manufacturer and upgrade battery. If it has no communication, please make sure that US2 on 5th option, less than 30A on 2nd option for single battery are set.

Solution:

Based on battery type, if lead acid battery ,adjust to 19th, 20th option. If lithium-ion battery, try to upgrade battery or inverter.

What if you have excluded above all, you should think about if mainboard or control board has some trouble.

4 04 warning

04 warning means low battery.

Testing method:

1. Please confirm the battery type, lead acid battery or lithium-ion battery
2. If lead acid battery, please test the real battery voltage via multimeter. Too low battery voltage will cause this.
3. If lithium-ion battery, confirm if battery brand can communicate with inverter, if yes, it may be caused by abnormal communication.So check communication between inverter and battery. Most of time,04 warning is caused by communication issue. If no, try to set US2 on 5th option, less than 30A on 2nd option.
4. If you can exclude above all and 04 warning still can't be cleared. You should doubt if it is caused by broken sample circuit on mainboard or control board.

Solution:

Based on the experience, most of time, it is caused by lithium-ion battery communication issue. So try to solve communication issue firstly.

Besides, if you figure out all possibilities based on testing method, try to replace mainboard or control board.

Malfunction Reason:

Abnormal communication or too low battery voltage or abnormal sample circuit

5 20 warning

20 warning means BMS communication error.

Solution:

Based on the experience, most of time, it is caused by lithium-ion battery communication issue. So try to solve communication issue firstly.

Malfunction Reason:

Abnormal communication often causes the warning.

6 07 warning

07warning means over load time out.

Testing method:

c. Try to disconnect the load from inverter, then observe if inverter has normal AC output 230V and no 07fault again.

d. If still abnormal, most of time it is caused by control board.

Solution:

Reduce the load

OR

Try to replace control board

7 10 warning

10warning means output power degrading

Testing method:

e. Try to disconnect the load from inverter, then observe if inverter has normal AC output 230V and no 10 again.

f. If still abnormal, most of time it is caused by control board or mainboard.

Solution:

If it is not caused by load, you can try to replace control board or mainboard.

8 13 warning

13warning means solar charger stops due to high PV voltage.

Testing method:

a. For SPF 5000ES , SPF 5000TL HVM WPV, max PV open circuit voltage is 450V; Please test the real PV input voltage via multimeter.

Solution:

Reduce solar panels until it is lower than allowed max PV input voltage

9 15,16 warning

15,16 warning are related with parallel input utility.

Testing method:

b. Check if connection wire of utility input is installed correctly.
c. Check if utility input breaker is ok

Solution:

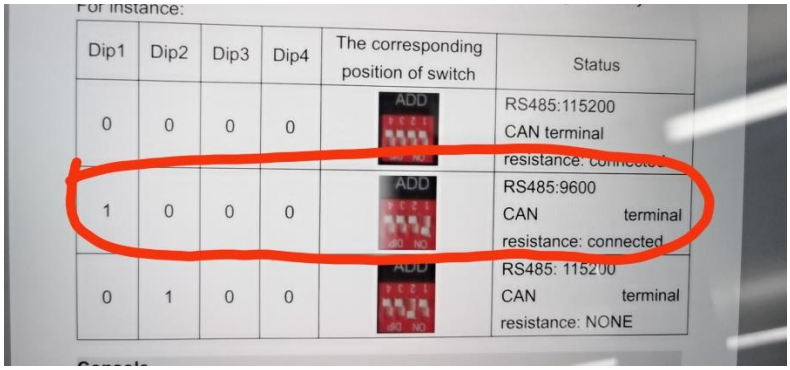
Try to replace utility input connection wire or breaker.

Part III. Battery Communication

1 Pylontech Battery

a. 485 Communication

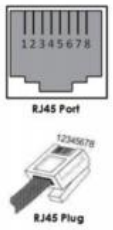
1) For 485 communication, Please set Li 05 on 5th option, L04 on 36th option. On battery dip switch, please set 1000(ON OFF OFF OFF)



2) 485 Pinout：

Definition of RJ45 Port Pin (Battery side)

No.	RS485 Pin
1	--
2	--
3	--
4	--
5	--
6	GND
7	RS485A
8	RS485B



Definition of RJ45 Port Pin (Inverter side)

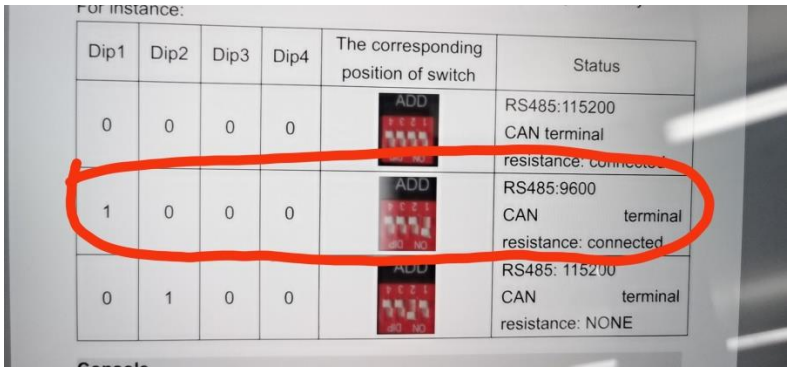
No.	RS485Pin
1	RS485B
2	RS485A
3	--
4	--
5	--
6	--
7	--
8	--

- Make sure it's using a cross PIN communication cable follow above table, to connect between battery and inverter.

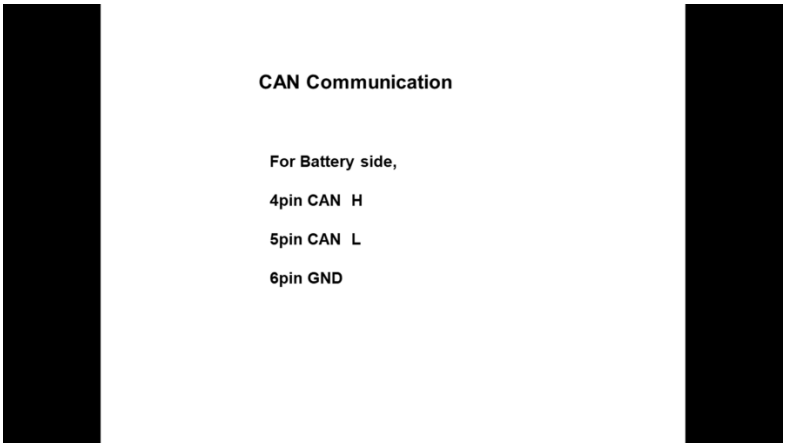
12 485 wire should be plugged into BMS port on inverter. 485 port on inverter is prepared for future use.

b. CAN Communication

1) For CAN communication, Please set Li 05 on 5th option, L52 on 36th option. On battery dip switch, please set 1000(ON OFF OFF OFF)



2) CAN Communication Pinout



Both Battery and inverter side are same.

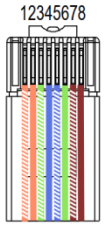
2 Dyness Battery

a. 485 Communication

1) communication protocol type： L01 ; Battery Dip Switch：0110(off on on off)

2) 485 Pinout

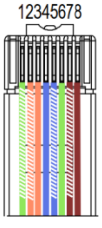
BATTERY-Dyness



Battery （RJ45 IN）			
PIN	Color	Definition	
1	Orange/white	485_A	
2	Orange	XGND	
3	Green/white	485_B	
4	Blue	CANH	
5	Blue/white	CANL	
6	Green	X+5V	
7	Brown/white	XIN	
8	Brown	NC	

INVERTER-GROWATT

Inverter			
PIN	Color	Definition	
1	Green/white	485_B	
2	Orange/white	485_A	
3	Orange	NC	
4	Blue	NC	
5	Blue/white	NC	
6	Green	NC	
7	Brown/white	NC	
8	Brown	NC	



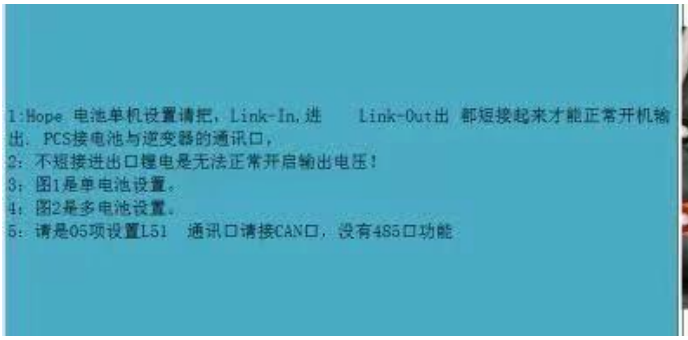
3 Hope Battery

Please note that hope battery only has CAN communication. And hope battery just can work when BMS communicaton with inverter is normal. Or it will shut off automatically.

CAN Communication

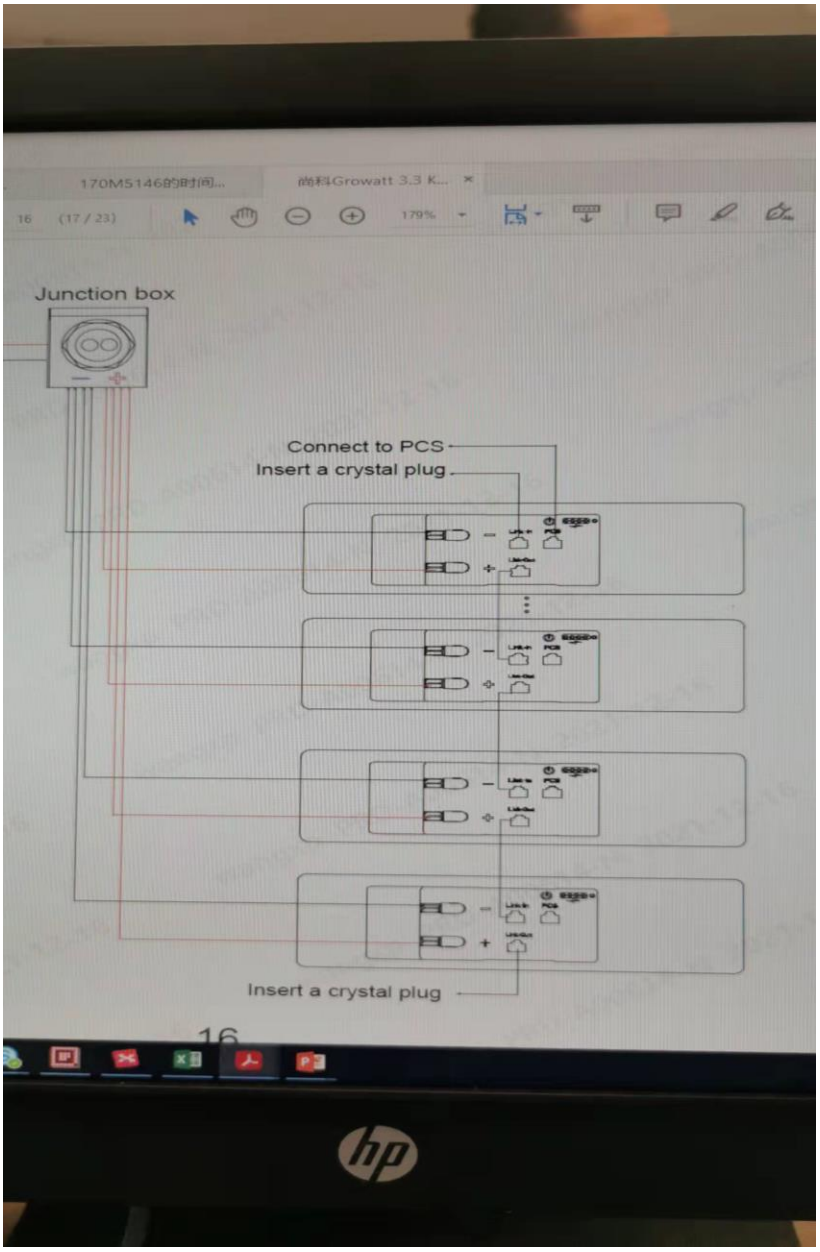
1) communication protocol type： L51；

For single battery：

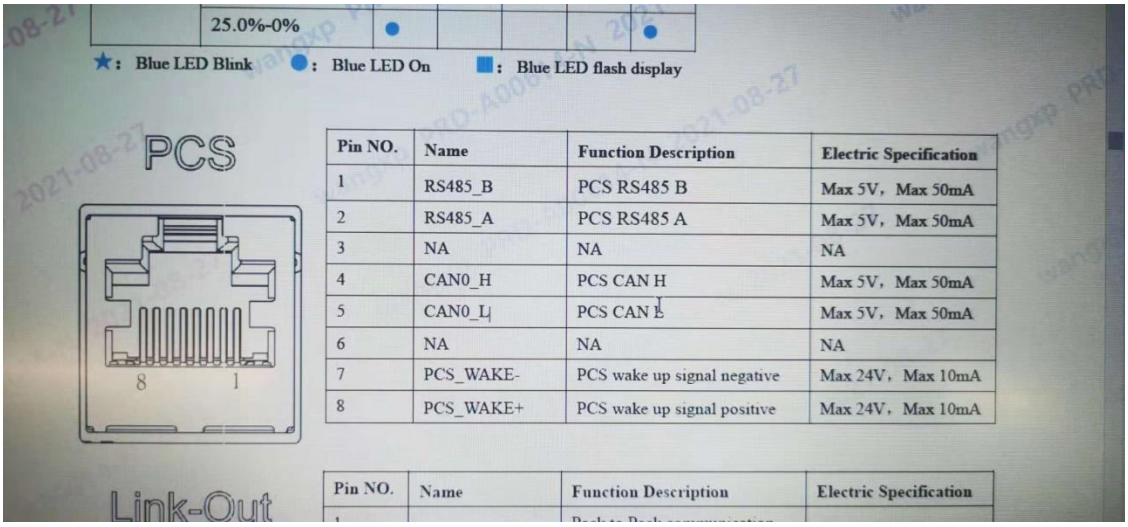


You must use crystal plug to connect them into Link-in and Link-out separately, or battery can't work.

For several batteries in parallel:


Junction box
Connect to PCS
Insert a crystal plug
Insert a crystal plug

2) CAN Pinout



Both inverter and battery side are the same

4 Growatt Battery

Communication protocol type：L51

5 EVE Battery

Model GBLI5010, can't be used in parallel

Communication protocol type：L01

6 Shoto Battery

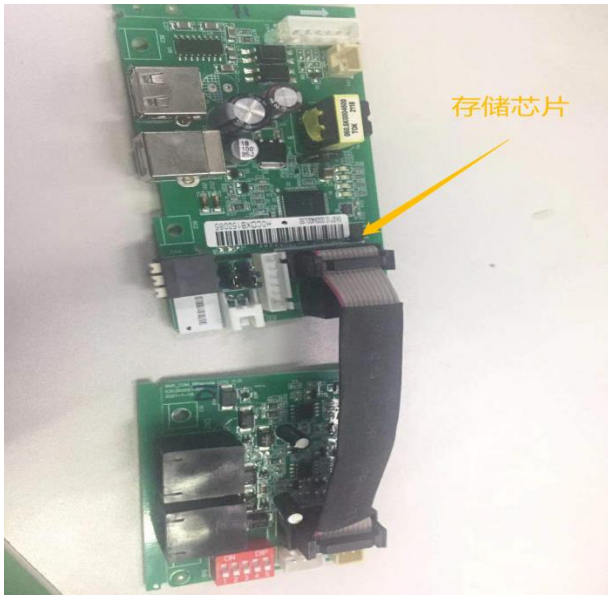
Model: SDA10-48100, can't be used in parallel

Communication protocol type：L07

Attention:

The difference between newest com board and old com board:

1. Newest one has shorter distance between 2 interfaces below, and it has 12pins.



2. Newest com board has both 485 and CAN function , while old one just has 485 function. SPF 5000TL HVM assembles with old com board, so it just has 485 communication.

3.

The red dip switch is used for LCD Display for low frequency inverter, it can prolong the length of

connection wire.

4. Several inverters in parallel, if newest com board is assembled with each inverter, you can connect communication cable from battery to one of inverters and don't need communication Hub.