

Troubleshooting Guide for Growatt Off Grid High Frequency Inverters

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Ver1.1		

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General

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

SPF 2000-5000TL HVM,








SPF 3000TL HVM



SPF 5000TL HVM

High Frequency inverter means that the frequency of mosfet switching 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	

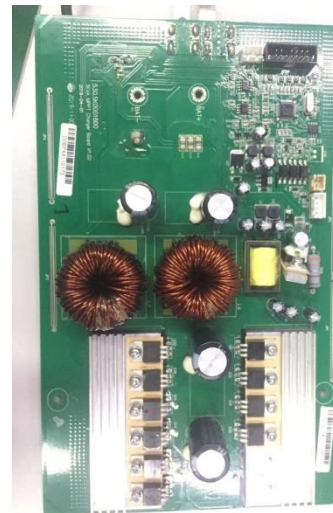
Inverter System introduction:

SPF 2000-3000 TL HVM Inverter System Introduction

Mainboard ,Including DC-DC Circuit, DC-AC Circuit, AC-DC Circuit , mainly used to convert 48V DC to 230V AC



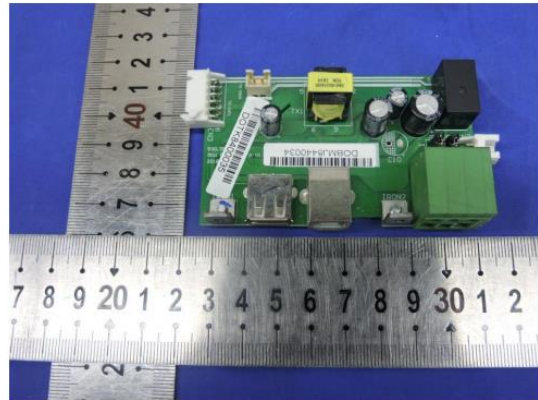
MPPT Board, Including SPS Circuit, Buck Circuit, mainly used to convert PV input voltage into 48V DC



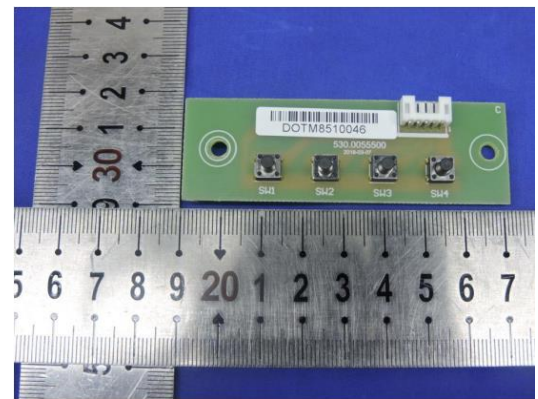
Control Board, mainly used to form PWM wave to drive MOFET and IGBT



COMM Board in charge of Datalogger
Communication



Switch Board



FAN

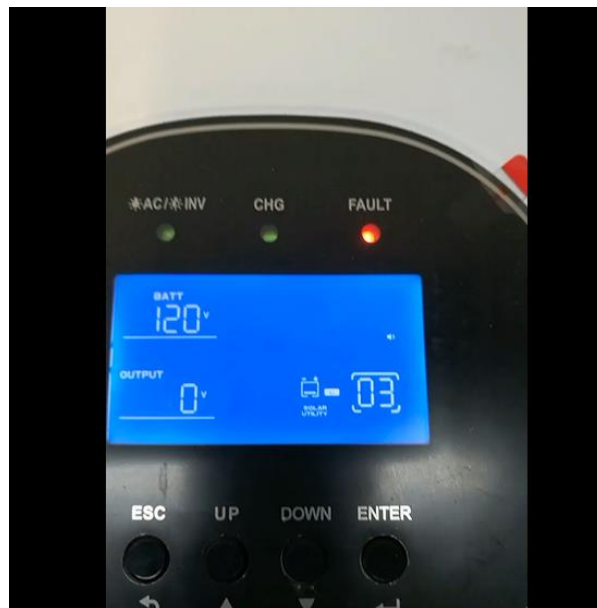


SPF 2000-5000TL HVM Fault condition and Troubleshooting

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 an 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.

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 is 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 delivering some IGBT or Optocouplers to them and try to repair it.

Malfunction Reason:

IGBT (STGWT40H6 5DFB)	Q32/Q33/Q34/Q35	Resistance Diode position	>60K CE	short or open
			V_{EC}=0.389V REF	0 or OL
			100K GC	short or open
			49.9K GE	short or open

Fig.3 DC-AC IGBT

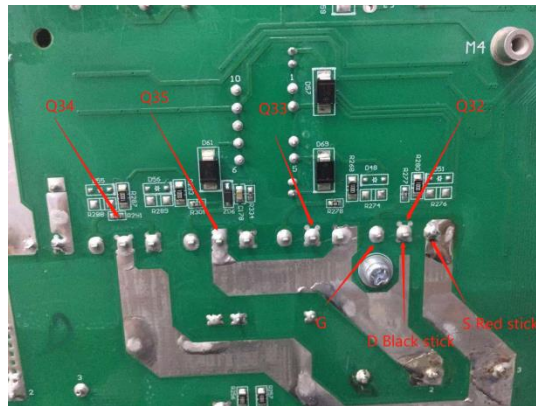


Fig.4 DC-AC IGBT position

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.



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 mainboard 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:

Just connect battery into the inverter. Don't connect Utility input and PV input into the inverter. If the inverter still shows "09 Error" , it means DC-DC circuit on mainboard is something wrong.

Malfunction Reason:

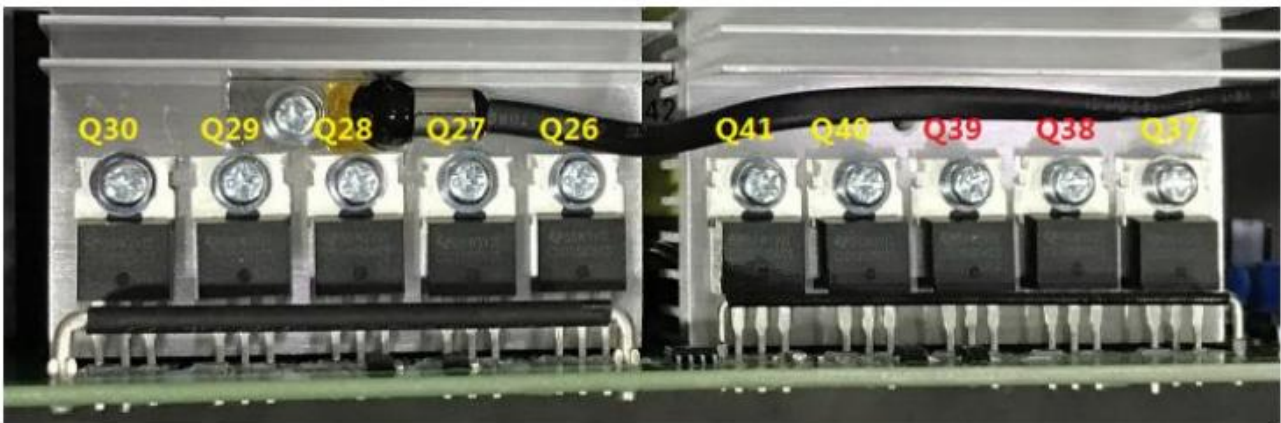


Figure 5.4.1 DC-DC Converter/MOSFET

When BUS voltage exceeds 400V and lasts for 30s. It will have the error. Most of time, it is caused by blown MOSFETS or Driving Circuit of MOSFET

Solution:

For usual client, suggest replacing mainboard

For professional client, suggest delivering 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 (CSD19505KC S)	Q26/Q27/Q28/Q29/Q30/ Q37/Q38/Q39/Q40/Q41	Resistance Diode position	>20k DS	short or open
			$V_{DS}=0.427V$ REF	0 or OL
			5k GD	short or open
			4k 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 delivering some IGBT or Optocouplers to them and try to repair it.

Malfunction Reason:

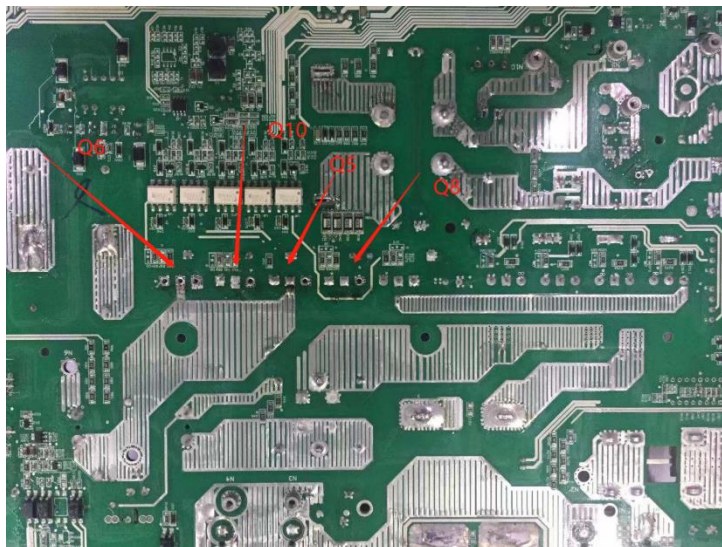
Most of time, it is caused by DC-AC circuit, including IGBT, Driving circuit etc.

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.

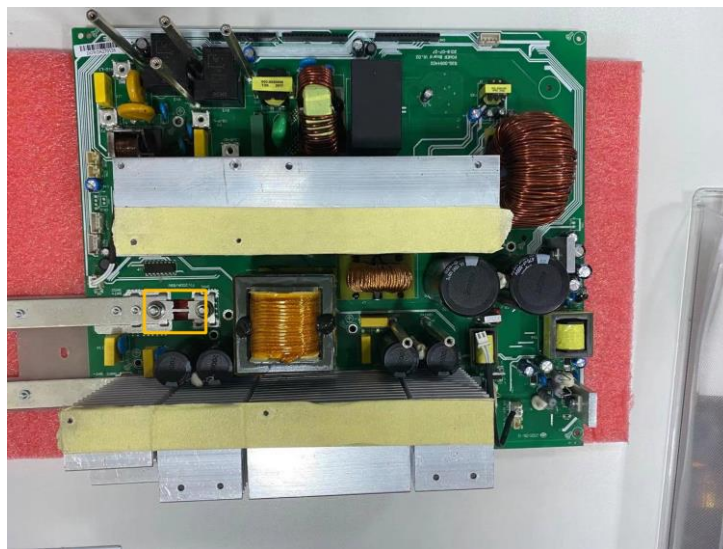
- c. Replace broken IGBT.

10 56fault

56fault means battery connection is open

Testing method:

- a. Switch off battery DC breaker, 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.

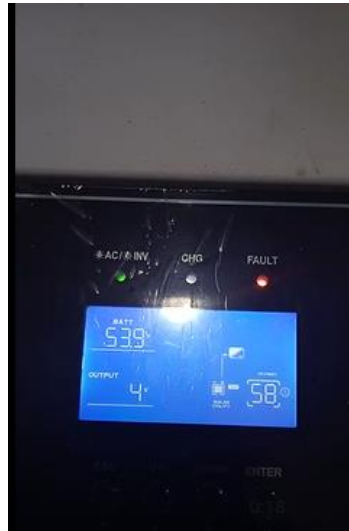
Solution:

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, or faulty mainboard

11 58 Fault



Testing method:

Just connect the 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 delivering some IGBT or Optocouplers to them and try to repair it.

Malfunction Reason:

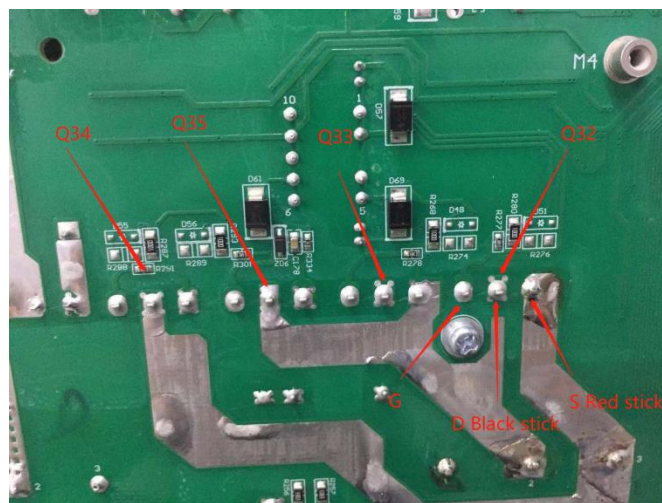
Most of time, it is caused by DC-AC Circuit. Especially, IGBT, driving circuit etc.

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 inverter.

Testing method:

- a. Try to disconnect all load from inverter, then observe if 60fault will disappear.
- b. If still abnormal, try to upgrade the inverter.
- c. If upgrading can't solve the issue, try to put control board or mainboard from normal inverter into the inverter.

Solution:

- d. Upgrade the inverter via newest firmware
- e. 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

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, please 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 81fault will disappear. Try to replace parallel board inside the inverter.



Fig.5 Parallel board



Fig.6 Parallel board at the bottom.

Solution:

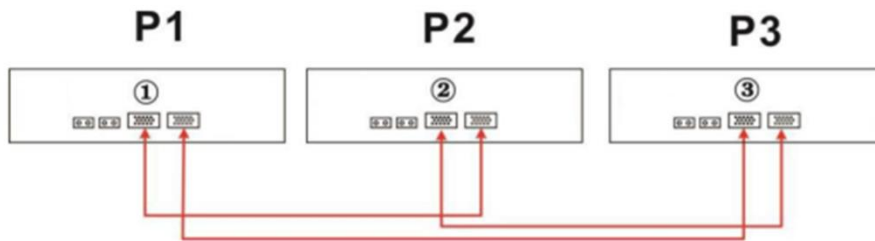
Try to swap parallel cable or parallel board from normal inverter, you can use exclusive method and confirm which part has the malfunction.

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 Parallel 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.

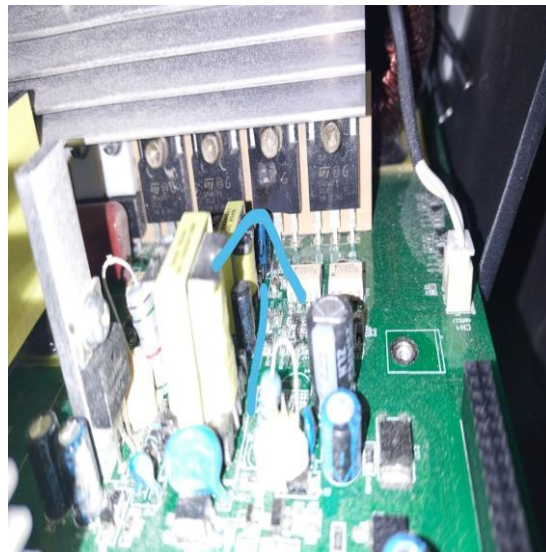
Malfunction Reason:

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, 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	<p>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.</p> <p>Saving mode enable SAVE ENA 004 If enabled, the output of inverter will be off when connected load is pretty low or not detected.</p>
----	----------------------------------	---

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. 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 warning on LCD.

Part II. Warning

1 01warning

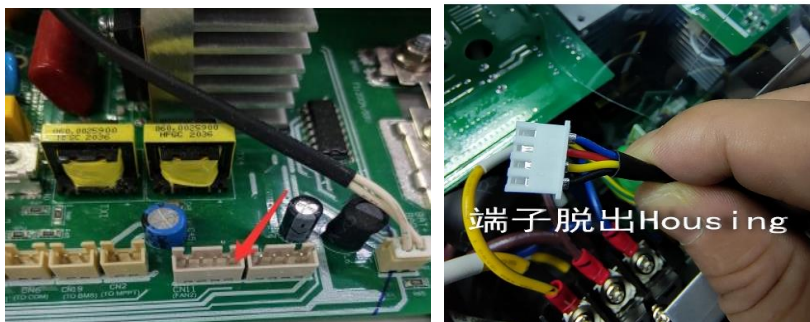
01 warning is related with fans.



Fig.6 01warning

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. The broken line on mainboard may cause this.



Solution:

1. Replace fans or mainboard.
2. reconnect the broken line via electric soldering iron

Malfunction Reason:

1. Maybe fans itself, fan interface on mainboard
2. Like SPF 3000TL HVM 24v, most of time, it is caused by broken line on mainboard.



Fig.6 01warning

2 02 warning

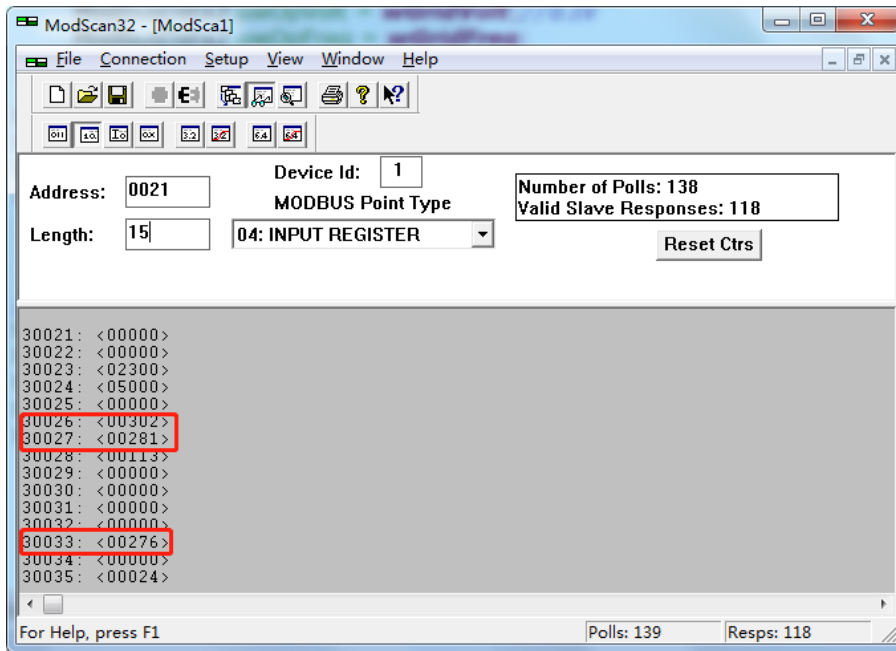
02 warning means over temperature

Testing method:

- a. For SPF 3000TL HVM – 5000TL HVM series, Use modscan32 V7 A004 to read temperature vaule.



modscan32 V7
A004 注册版.rar

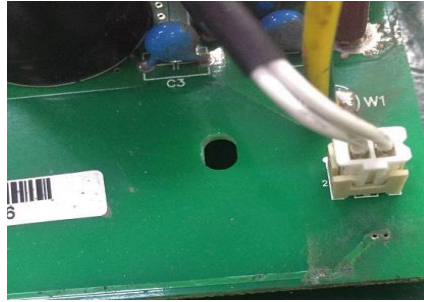


Firstly , read the register address: 30026, 30027, 30033 temperature value, 00302 means 30.2 degree.

- b. If temperature sensors are abnormal on mainboard, Check if CN1 and CN6 on mainboard are connected well. Try to unplug them out and plug them in again. And Test the resistance of CN1 and CN6. The normal resistance is almost 12K.



- c. If temperature sensor are abnormal on MPPT board,
1) Check if CN1 on MPPT board are connected well. Try to unplug them out and plug them in again. And Test the resistance of CN1. The normal resistance is almost 12K.



2) Check if the circuit line that is related with temperature sensor is broken.



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 or repair broken line on MPPT board.

Malfunction Reason:

1. Temperature sensors have the trouble.
2. Circuit that are related with Temperature sensors has the trouble
3. 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. Disconnect battery breaker, test the real battery voltage. And compare to battery voltage on LCD. If

the voltage difference is large, try to adjust the battery voltage based on the procedures below.

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.
3. 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.
4. For Lithium-ion battery, please confirm if lithium-ion battery can communicate with inverter. If the inverter is communicating with battery normally and it has 03 warning, try to contact battery manufacturer and upgrade battery. If battery brand is not in the compatibility list, please request the firmware with US2 option from research dep. (You can set US2 on 5th option, less than 30A for single battery on 2nd option)

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. Try to replace control board or mainboard.

Malfunction Reason:

1. Battery voltage Sample circuit may be something wrong.
2. Incorrect settings for lead acid battery or lithium-ion battery.

4 04 warning

04 warning means low battery. When battery voltage is lower than 44V, it will have the warning.



Testing method:

1. Please confirm the battery type, lead acid battery or lithium-ion battery
2. Disconnect battery breaker, test the real battery voltage. And compare to battery voltage on LCD. If the voltage difference is large, try to adjust to the battery voltage based on the procedures below.

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.
3. If lead acid battery, please test the real battery voltage via multimeter. Too low battery voltage will cause this.
4. 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. (If no US2 option, please request the firmware with US2 from research dep.)
5. 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

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

12warning means solar charger stops due to high PV voltage.

Testing method:

SPF 2000-3000TL HVM 24V , max PV open circuit voltage is 102V; SPF 2000-3000TL HVM 48V,SPF 5000 TL HVM ,max PV open circuit voltage is 145V. 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:

1. Check if connection wire of utility input is installed correctly.
2. Check if utility input breaker is ok

Solution:

Replace utility input connection wire or breaker on utility input




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(OFF OFF OFF OFF)

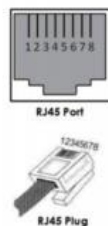
For instance:

Dip1	Dip2	Dip3	Dip4	The corresponding position of switch	Status
0	0	0	0		RS485:115200 CAN terminal resistance: connected
1	0	0	0		RS485:9600 CAN terminal resistance: connected
0	1	0	0		RS485: 115200 CAN terminal resistance: NONE

1) 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.	RS485 Pin
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.

2) 485 wire should be plugged into BMS port on inverter. 485 port on inverter is prepared for future use.

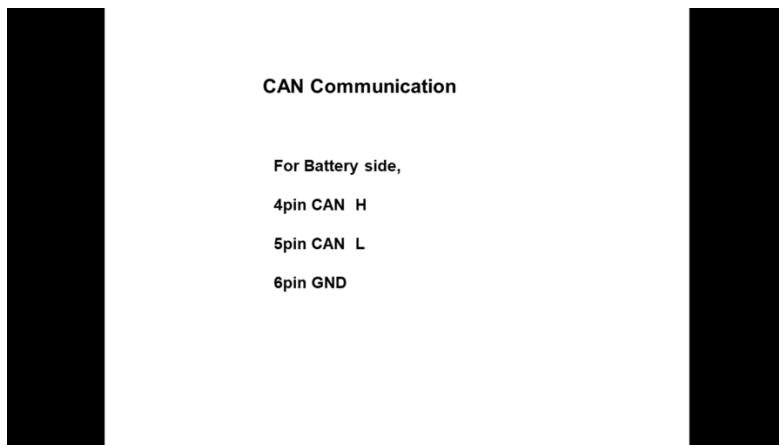
b. CAN Communication

- 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)

For instance:

Dip1	Dip2	Dip3	Dip4	The corresponding position of switch	Status
0	0	0	0		RS485:115200 CAN terminal resistance: connecte
1	0	0	0		RS485:9600 CAN terminal resistance: connected
0	1	0	0		RS485: 115200 CAN terminal resistance: NONE

- 2) CAN Communication Pinout



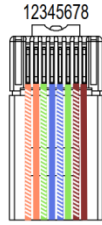
Both Battery and inverter side are same.

2 Dyness Battery

a. 485 Communication

- 1) communication protocol type: L01 ; Battery Dip Switch: 0110(off on on off)
- 2) 485 Pinout

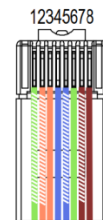
BATTERY-Dyness



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.

SPF 2000-5000TL HVM doesn't have CAN port, if client insists on CAN communication, you can delivery newest com board to client.



4 EVE Battery

Model GBLI5010, can't be used in parallel

485 Communication protocol type: L01

5 Shoto Battery

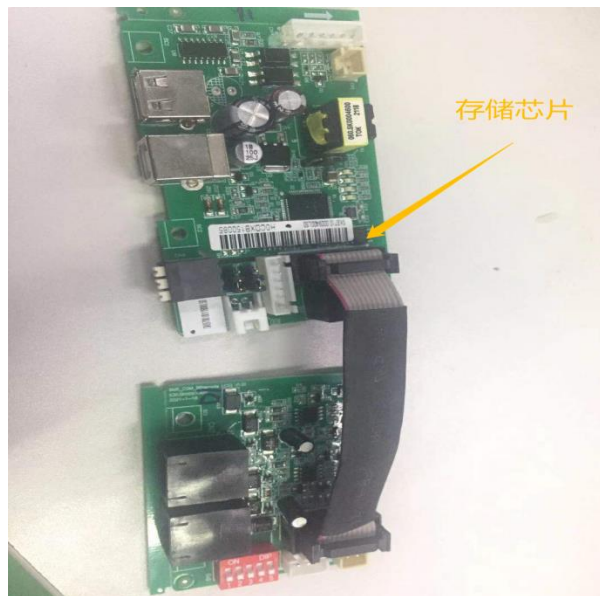
Model: SDA10-48100, can't be used in parallel

485 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.