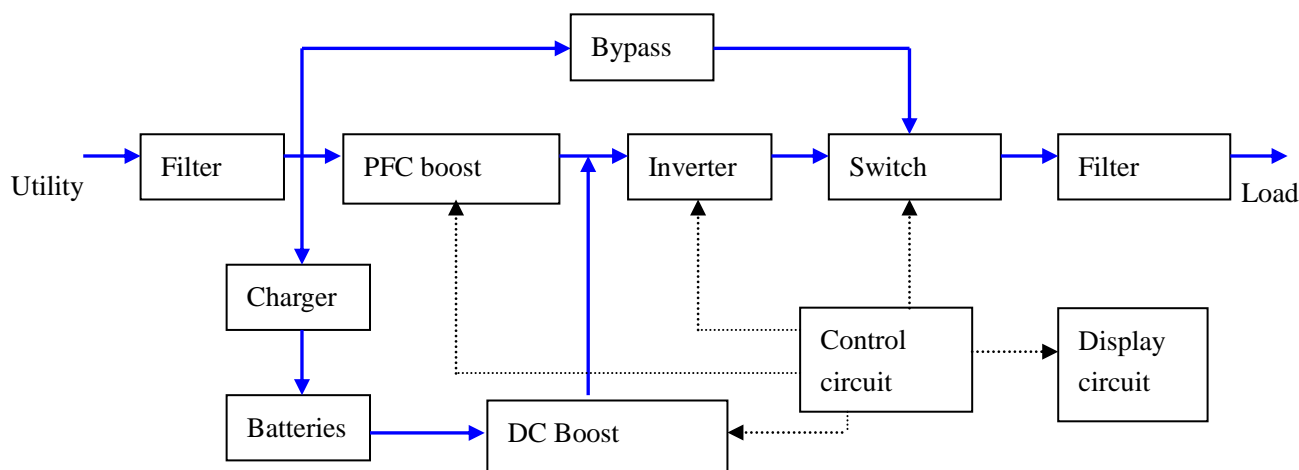


Contents

1. Operation Principle	2
1.1 Principle diagram.....	2
1.2 Working Mode.....	2
1.3 The electrical linking diagram.....	2
2. UPS Structure	4
2.1 UPS internal structure	4
2.2 The function of PCB.....	6
3 The failure UPS debug problem.....	7
3.1 The program explain.....	7
3.2 The program explain.....	7
3.2.1 Ready program.....	7
3.2.2 Measure the working power supply	9
3.2.3 Basic signals test in debugging mode	9
3.2.4 signal test under common working condition	12
4. The familiar symptom and diagnosis program	13
4.1 Abnormal phenomenon 1.....	13
4.1. Diagnosis program	13
4.1.2 Program explanation	14
4.2 Abnormal phenomenon 2.....	15
4.2.1 Diagnosis program	15
4.2.2 Program explanation	16
Abnormal phenomenon.....	15
4.3 Abnormal phenomenon 3.....	16
4.3.1 Diagnosis program	16
4.3.2 Program explanation	17
4.4 Abnormal phenomenon 4.....	17
4.4.1 Diagnosis program	17
4.4.2 Program explanation.....	18
4.5 Abnormal phenomenon 5.....	18
4.5.1 Diagnosis program	18
4.5.2 Program explanation	19

1. Operation Principle

1.1 Principle diagram



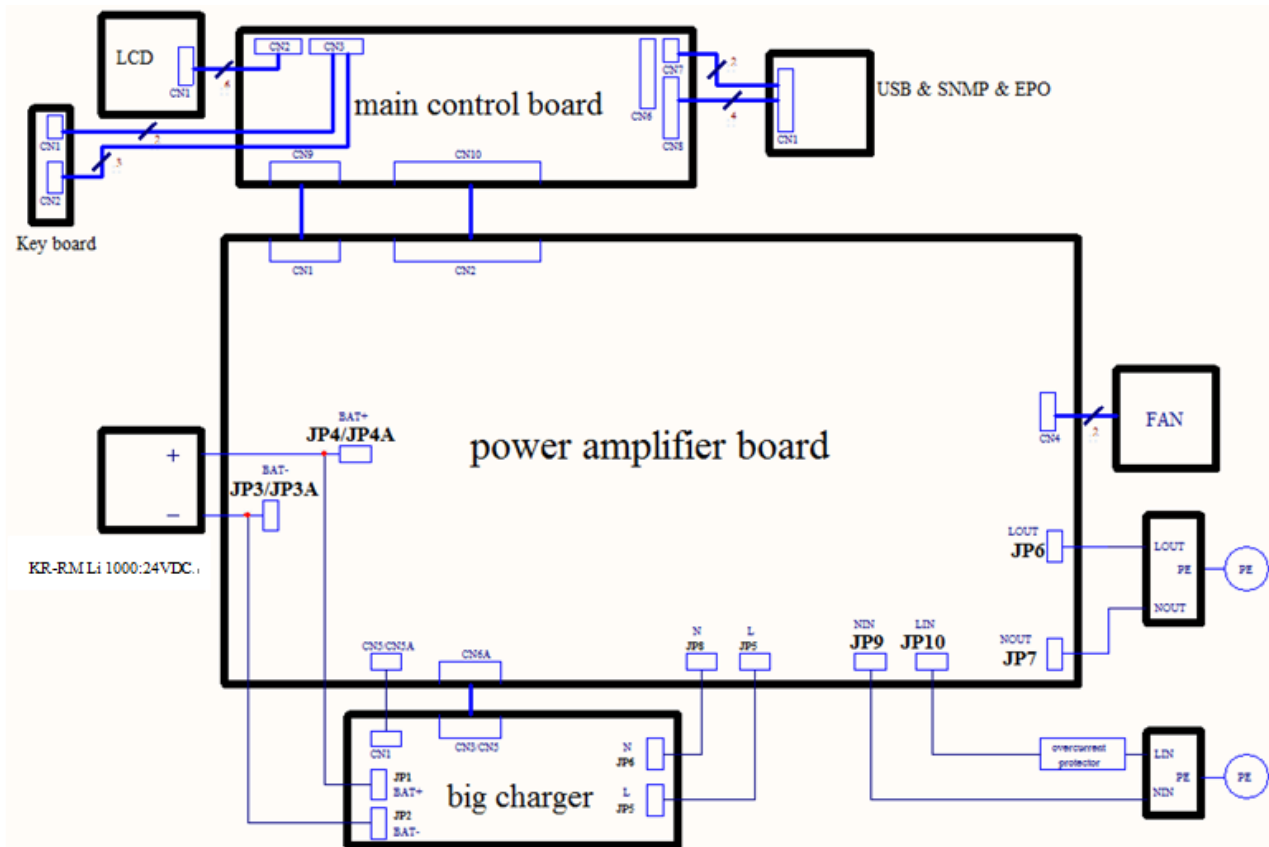
Picture 1: KR-RM lithium-ion UPS series principle diagram

1.2 Working Mode

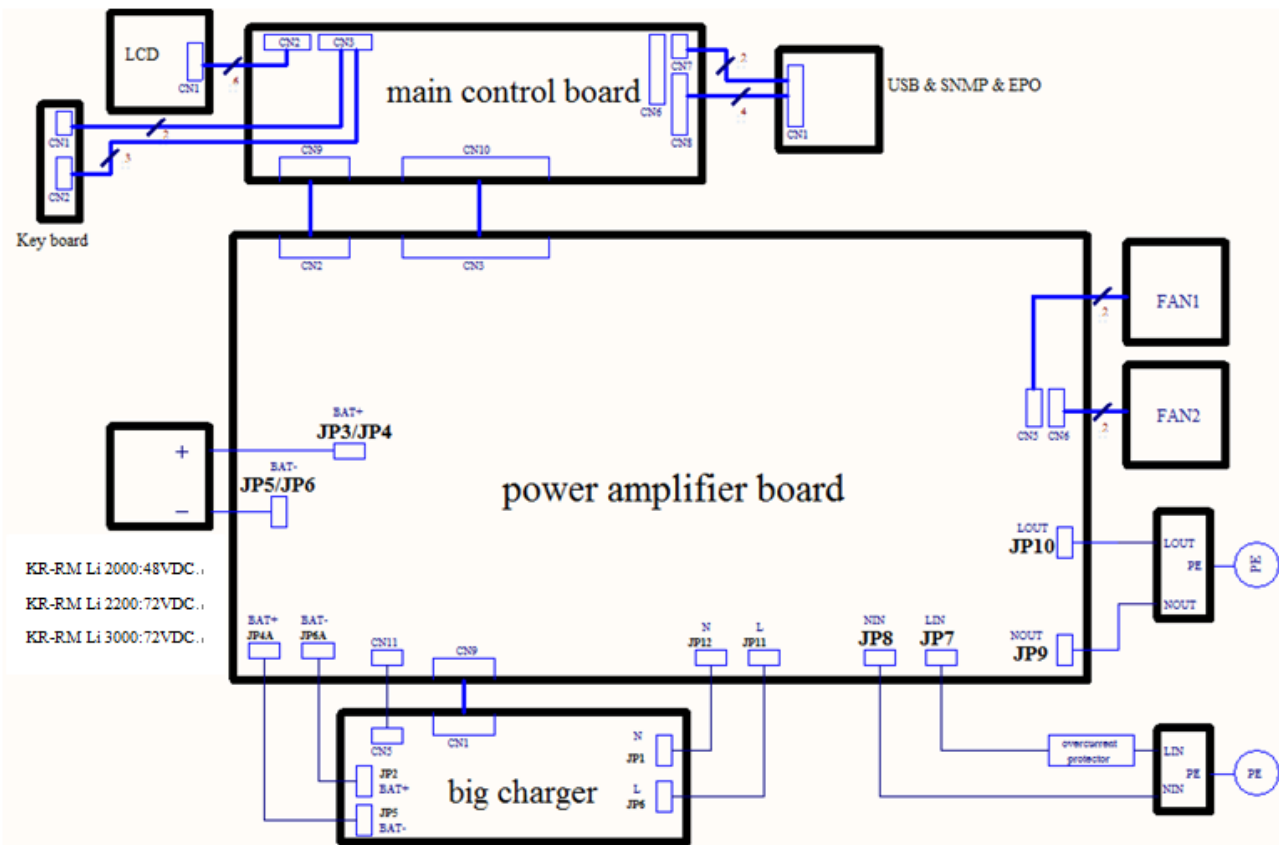
When the mains supply is normal, KR-RM lithium-ion UPS supply DC-AC with mains power through PFC boost voltage, output a stable 230Vac to DC voltage and the mains supply recharge the battery in the meantime. When the mains is abnormal or drops at any time, battery bank supply power to inverter through raised circuit. No transform time from power line supply to battery power supply. While the battery discharging, the battery energy will be soon exhausted, the UPS give an alarm with sound and light, the inverter stop working when coming to the limit point of the battery discharge, grow bleat warning. The UPS still has protection function, when coming to overload (120% rate load), the machine turn to behind bypass station after postponing 60 S appearance, and return automatically while load normally. When occurring seriously overload (more than 150% rate load), UPS immediately stop inverter output and turn to bypass station, at this time front breaker also possible automatic tripping. After the UPS is repaired, turn on the switch, it will return to work after re-start.

1.3 The electrical linking diagram

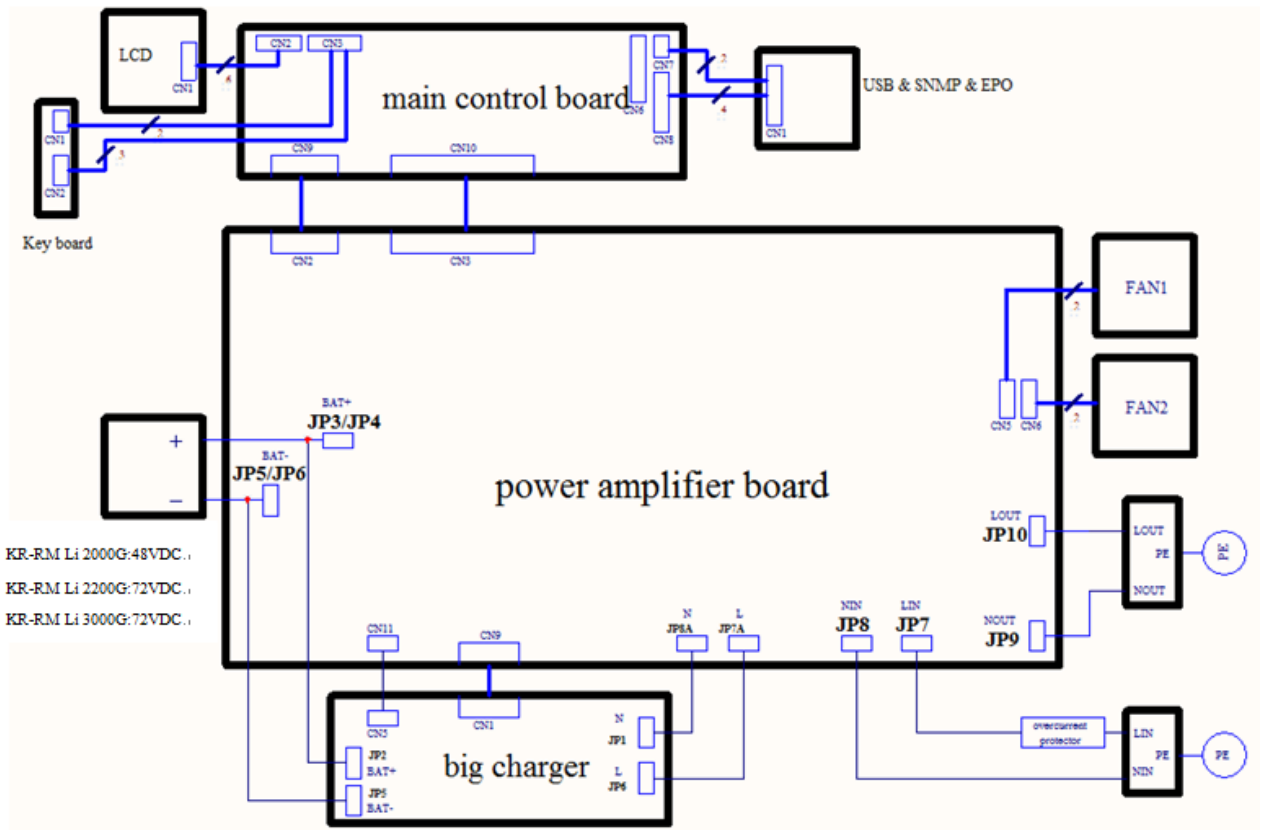
KR-RM lithium-ion UPS series all adopt internal lithium-ion battery and with big current charging board, the electric diagram is blow as picture 2 and picture 3.



KR-RM Li 1000VA electric diagram



KR-RM Li 2000~3000 electric diagram



KR-RM Li 2000G~3000G electric diagram

2. UPS Structure

2.1 UPS internal structure

Communication interface board

Power amplifier board

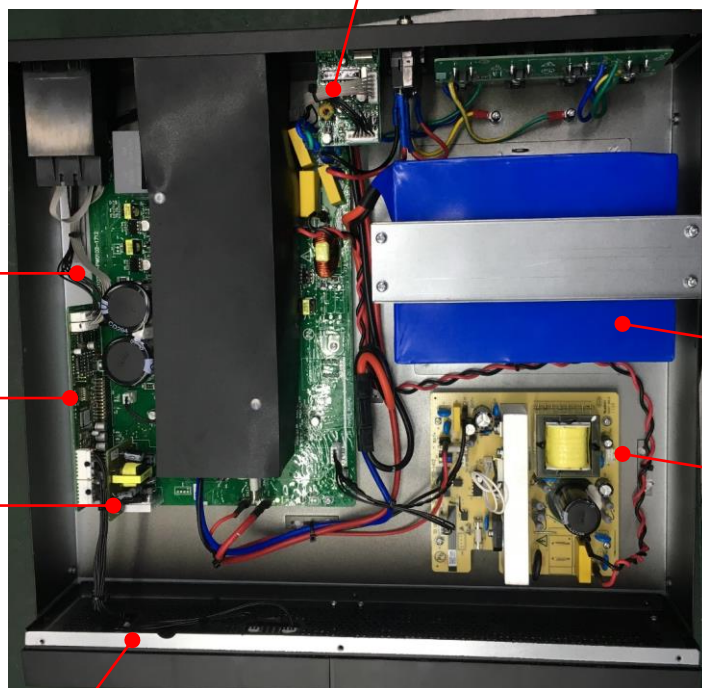
Main control board

Power supply board

LCD board

battery

big charger



Picture 4 KR-RM Li 1000

Communication interface board

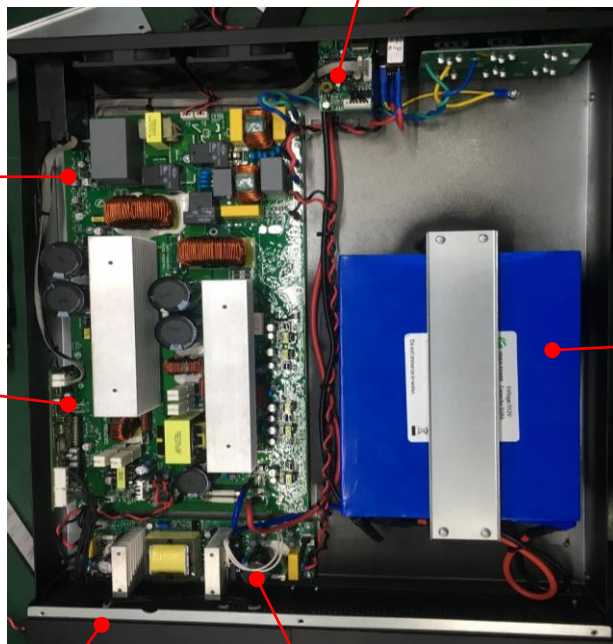
Power amplifier board

Main control board

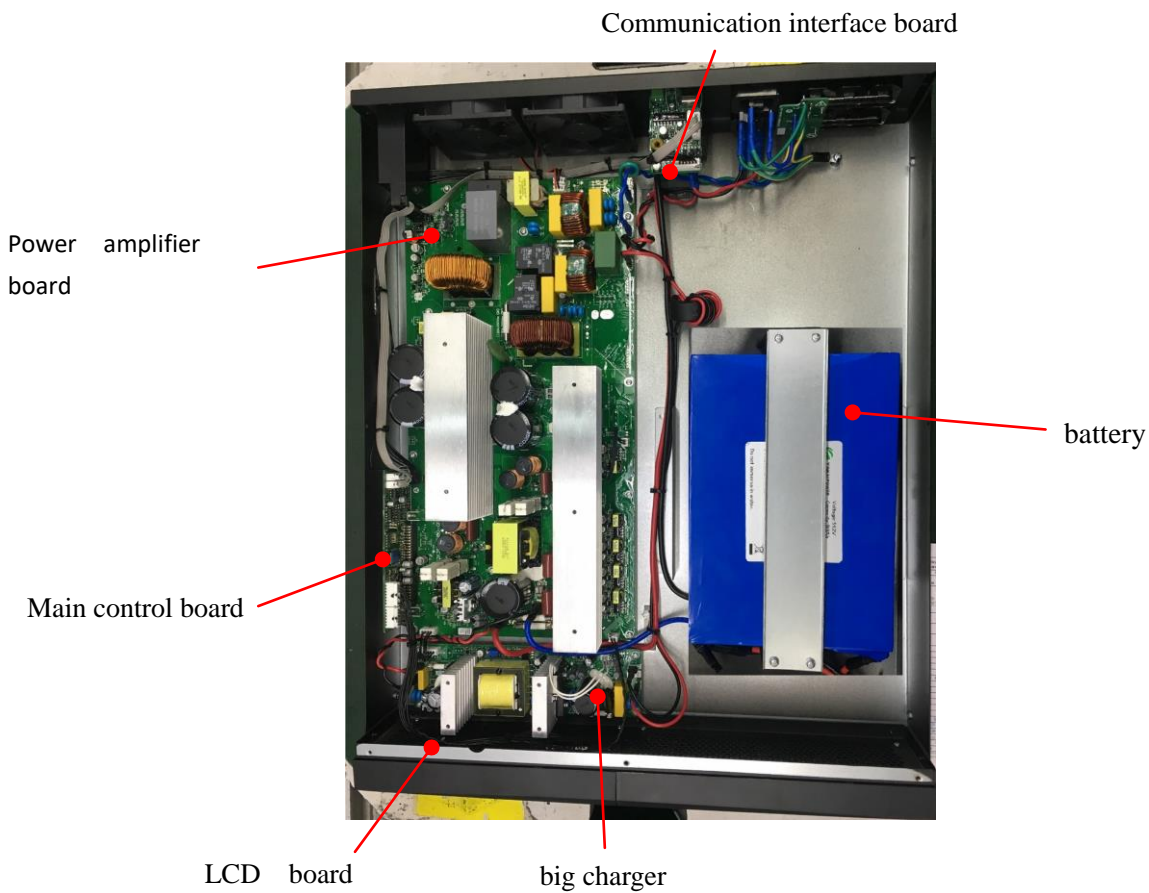
LCD board

big charger

battery



Picture 4 KR-RM Li 2000~3000



Picture 7 KR-RM Li 2000G~3000G

2.2 The function of PCB

A. Main board

Turn on & off control, produce inverter drive signal, panel display and button control, sample measure of invert load and mains voltage, control of output & input relay, communication control, control the float & boost charger, ventilator.

B. Power amplifier board

Mains input and bypass control, invert & battery voltage boost, mains voltage boost& produce the driver signal, small electric current charge.

C. Power supplying board

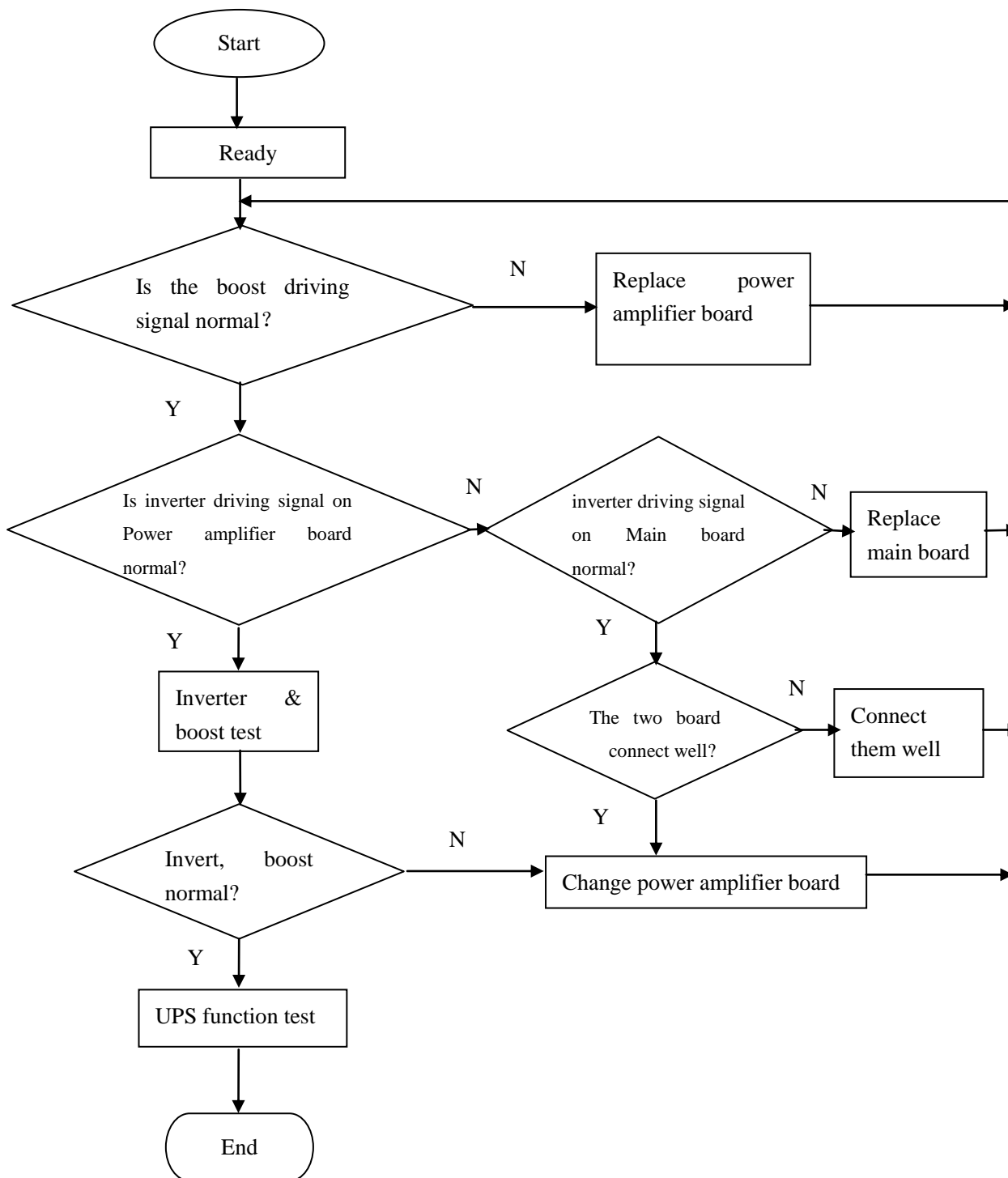
Connect with the power amplifier board, create + 12V voltage.

D. Big electric current charging board:

Supply with 4.0A charge current

3 The failure UPS debug problem

3.1 The program explain



3.2 The program explain

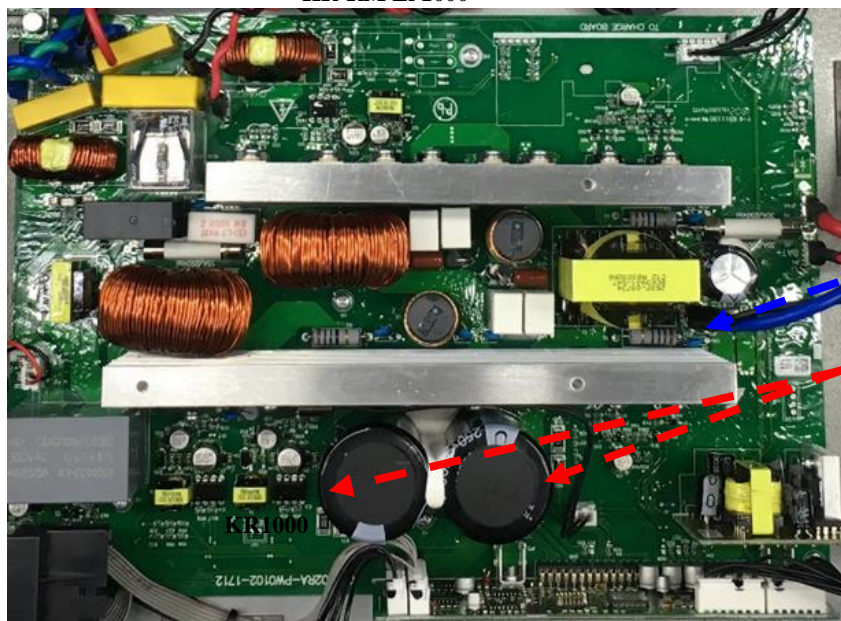
3.2.1 Ready program

- A. Turn off load, turn on UPS, break down UPS input AC power line and battery connect line, Open UPS cabinet.

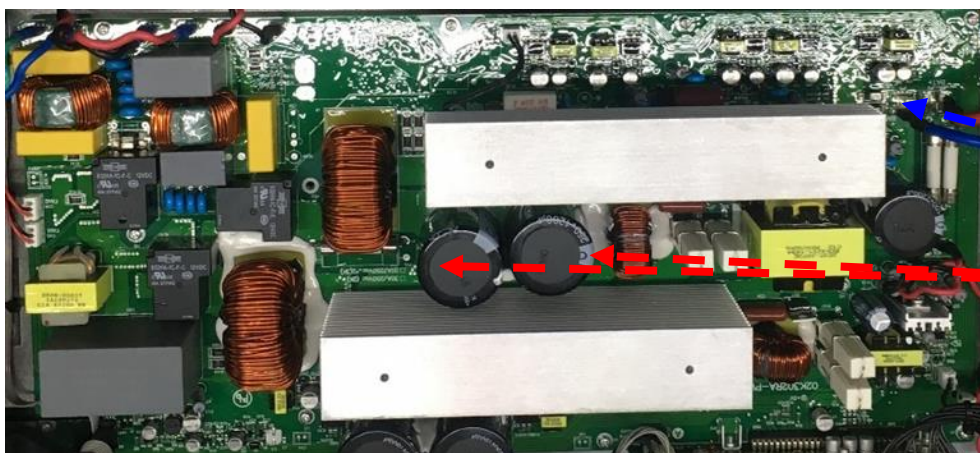
B. Wait for the 5 min, discharge UPS high voltage of the capacitor, or use appropriate resistance(for example 47 Ω /10 W) to discharge the capacitor until the voltage is less than 5 V, as shown in figure 9 (attention, the UPS inside is still existing dangerous high voltage before being discharged);

KR-RM Li 1000	KR-RM Li 2000~3000 KR-RM Li 2000G~3000G
1、 BUS+(first pin of C7) to JP3(BAT-) 2、 BUS-(2th pin of C6) to JP3(BAT-)	1、 BUS+(first pin of C68) to JP5(BAT-) 2、 BUS-(2th pin of C67) to JP5(BAT-)

KR-RM Li 1000



KR-RM Li 2000~3000, KR-RM Li 2000G~3000G

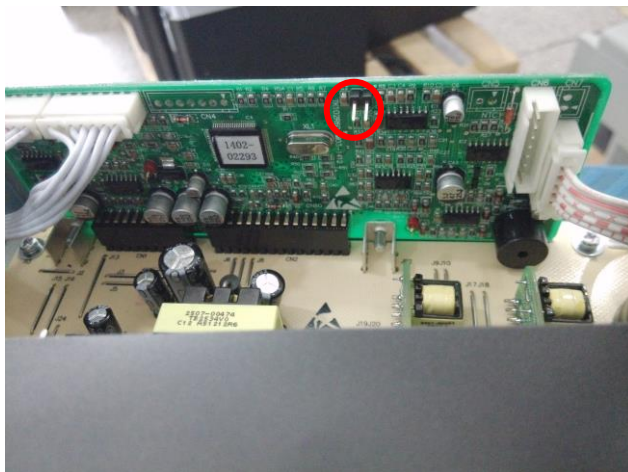


Picture 9: Discharge the capacitor

C. connect AC input and DC input source to the UPS with breakers, using a 2.2 Ω /3W resistor (or 3.15A fuse) to be in series with AC input route and DC input route separately.

model	KR-RM Li 1000	KR-RM Li 2000, KR-RM Li 2000G	KR-RM Li 2200~3000, KR-RM Li 2200G~ 3000G
Battery voltage(V)	36	48	72

D. Short circuit the CN1 of main board, cancel output short circuit protection, show as picture 10.



Picture 10: Main board connector CN1

3.2.2 Measure the working power supply

turn on AC input breaker; tap the "ON" button(less than 1s) , then the power supply circuit will work, but the UPS is still in off mode. then the LCD will be bright and UPS will output in bypass mode.

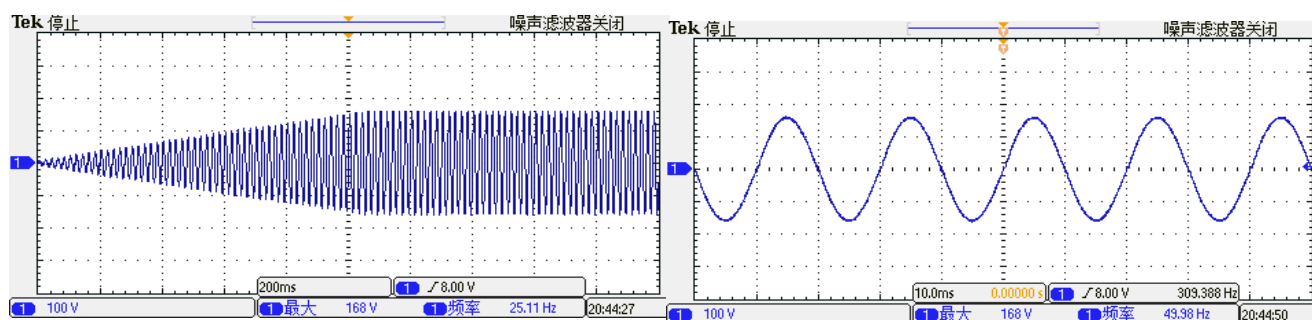
the working power supply of KR-RM Li 1000 should be as below: on power amplifier board, using multi-meter;
 CN6-2P to JP3(BAT-): $3.3 \pm 0.2V$;
 C4-1P to JP3 (BAT-): $12.2 \pm 0.5V$.

the working power supply of KR-RM Li 2000~3000, KR-RM Li 2000G~3000G should be as below: on power amplifier board, using multi-meter;
 “+3.3V” to JP5(BAT-): $3.3 \pm 0.2V$;
 “+12V” to JP5(BAT-): $12.5 \pm 0.5V$.

3.2.3 Basic signals test in debugging mode (KR-RM Li 2000G~3000G)

3.2.3.1 inverter output waveform testing in battery mode

shutdown UPS, turn off AC input breaker. using an oscilloscope to measure the output voltage. turn on DC input breaker, then turn on UPS. the waveform between the probes shall have slow start stage as below:



and the AC output voltage on the power amplifier board should be as below.

	JP6(LOUT) JP7(NOOUT)	to	JP10(LOUT) JP9(NOOUT)	to	JP10(LOUT) JP9(NOOUT)
KR-RM Li 1000	$55 \pm 5Vac$		/		/
KR-RM Li 2000~3000	/		$55 \pm 5Vac$		/
KR-RM Li 2000G~3000G	/		/		$110 \pm 5Vac$

3.2.3.2 DC BUST voltage testing in battery mode

the DC BUS voltage should be as below, the Voltage difference between +BUS and -BUS should be lower than 10V. the buzzer will alarm 3 times per 10s

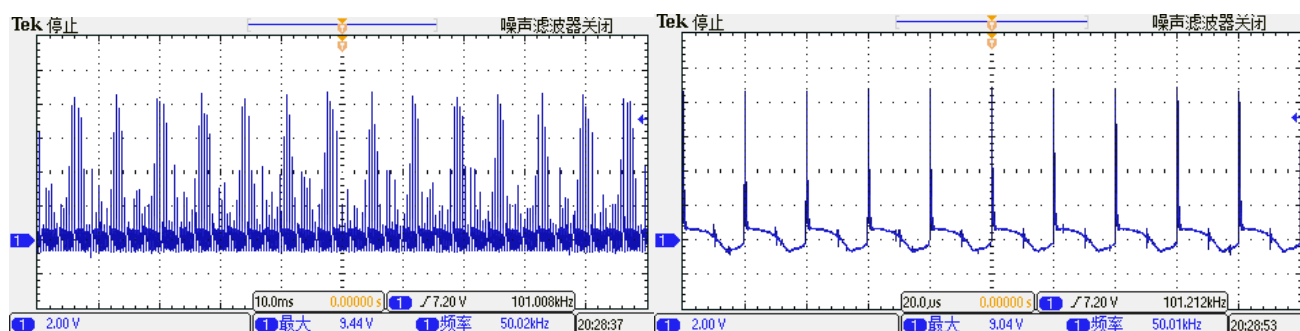
	BUS+(C7-1P) to BAT-(C7-2P)	BUS-(C6-1P) to BAT-(C6-2P)	to	BUS+(C30-1P) to BAT-(C30-2P)	to	BUS-(C29-1P) to BAT-(C29-2P)
KR-RM Li 1000	180±10V	-180±10V	/	/	/	/
KR-RM Li 2000~3000	/	/	/	180±10V	/	-180±10V
KR-RM Li 2000G~3000G	/	/	/	180±10V	/	-180±10V

3.2.3.3 battery boost driving signal test

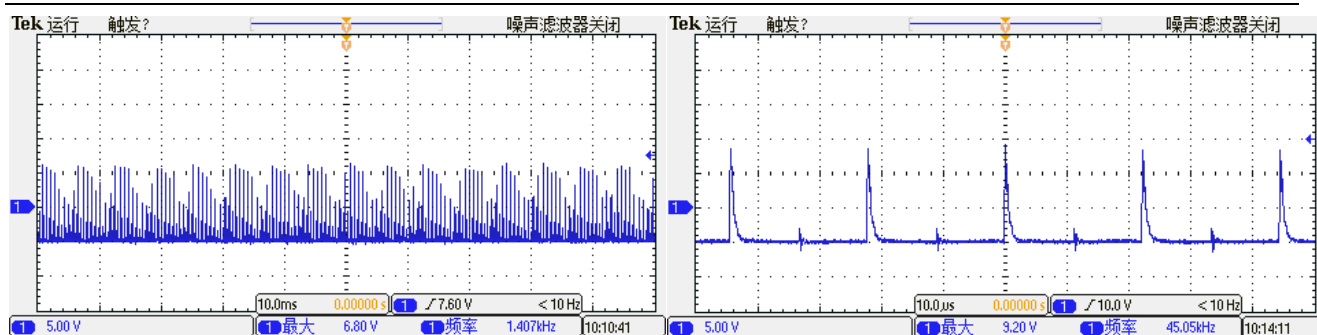
turn off UPS and DC input breaker, using an oscilloscope to measure the driving signal between the G pole and S pole of the MOSFET as below table.

	Negative voltage of driving signal	Q13/Q14/Q15/Q16	Q1/Q2/Q7/Q8	Driving frequency
KR-RM Li 1000	/	/	YES	50.0±0.5kHz
KR-RM Li 2000~3000	-5±0.5V	YES	/	45.0±0.5kHz
KR-RM Li 2000G~3000G	-5±0.5V	YES	/	45.0±0.5kHz

the waveform of 1kVA UPS is as below:



the waveform of 2-3kVA UPS is as below:



3.2.3.4 DC BUS voltage test in mains mode

turn off UPS and DC input breaker, adjust the AC input voltage to $110 \pm 2V$. turn on AC input breaker and DC input breaker, turn on the UPS. check the DC BUS voltage and AC output voltage as below:

	JP7(LOUT) to JP3(BAT-)	JP8(LOUT) to J65(BAT-)
1kVA	$110 \pm 5V_{ac}$	/
2-3kVA	/	$110 \pm 5V_{ac}$

	BUS+(first pin of C7) to JP3(BAT-)	BUS-(2th pin of C6) to JP3(BAT-)	BUS+(J45) to J65(BAT-)	BUS-(top end of R15) to J65(BAT-)
1kVA	$180 \pm 10V$	$-180 \pm 10V$	/	/
2-3kVA	/	/	$180 \pm 10V$	$-180 \pm 10V$

the Voltage difference between +BUS and -BUS should be lower than 10V.

3.2.3.5 AC boost driving signal test

turn off UPS, turn off AC input breaker and DC input breaker. using an oscilloscope to measure signal between the G pole and S pole of IGBT; turn on the AC input breaker and DC input breaker, 10s later, the signal value should be as below:

	positive voltage of driving signal	Negative voltage of driving signal	Q10/Q11	Q9/Q10	Driving frequency
1kVA	$18.0 \pm 2.0V$	$-5 \pm 0.5V$	/	YES	$40.0 \pm 0.5kHz$
2-3kVA	$18.0 \pm 2.0V$	$-5 \pm 0.5V$	YES	/	$40.0 \pm 0.5kHz$

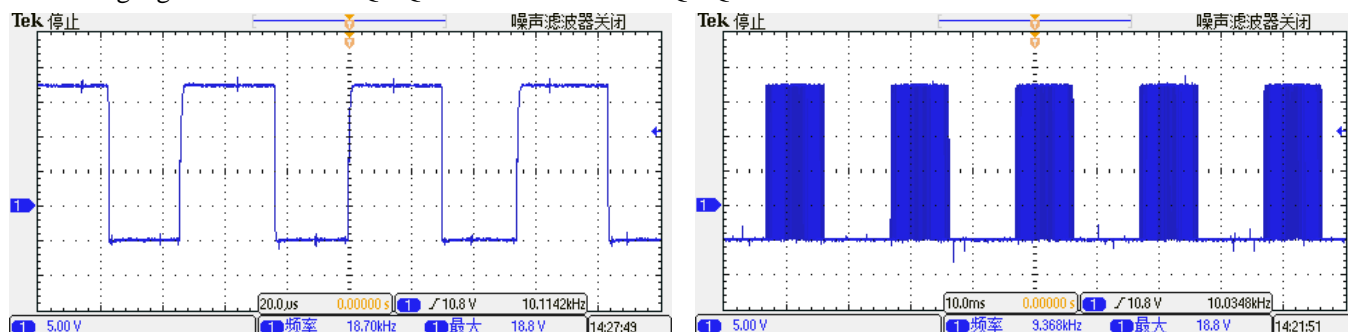
3.2.3.6 inverter driving signal.

turn off UPS, turn off AC input breaker and DC input breaker, using an oscilloscope to measure signal between the G pole and S pole of IGBT. turn on the AC input breaker and DC input breaker, 20s later, the signal value should be as below:

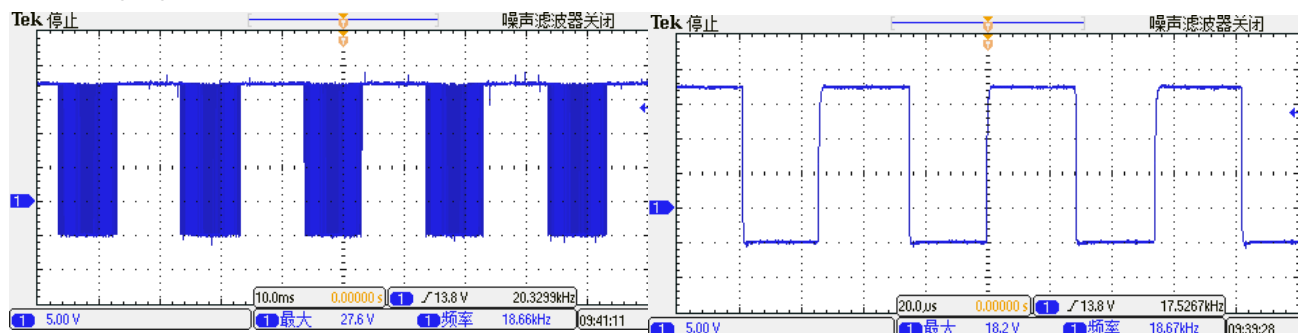
	positive voltage of	Negative voltage	Q3/Q4/Q5/Q6	Q2/Q3/Q4/Q5	Driving frequency
--	---------------------	------------------	-------------	-------------	-------------------

	driving signal	of driving signal			
1kVA	18.0±2.0V	-5±0.5V	YES	/	18.60±0.5kHz
2-3kVA	18.0±2.0V	-5±0.5V	/	YES	18.60±0.5kHz

the driving signal waveform is Q2/Q3 on 2-3kva UPS and Q3/Q6 on 1kva UPS as below:



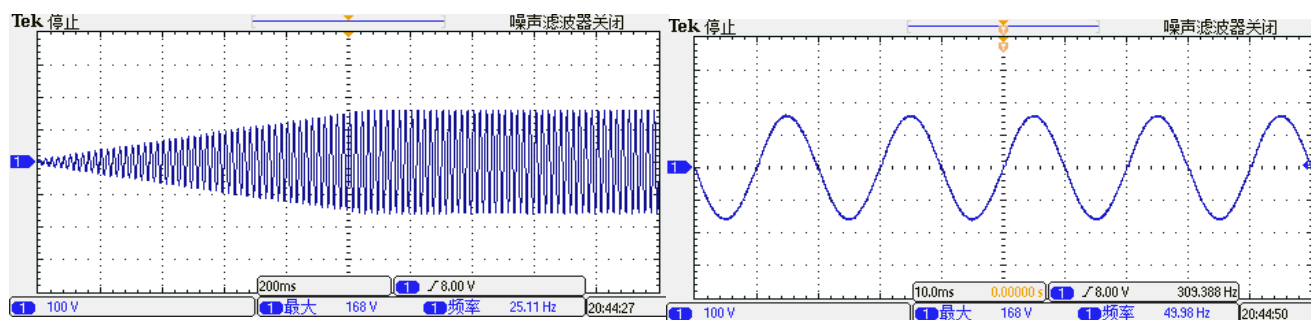
the driving signal waveform is Q4/Q5 on 2-3kva UPS and Q4/Q5 on 1kva UPS as below:



3.2.4 signal test under common working condition

3.2.4.1 inverter output waveform testing in battery mode

shutdown UPS, turn off AC input breaker. remove the jumper on CN1, cancel the 2.2Ω/3W (or 3.5A fuse) in series with AC input and DC input loop. using an oscilloscope to measure the output voltage. turn on DC input breaker, then turn on UPS. the waveform between the probes shall have slow start stage as below:



and the AC output voltage on the power amplifier board should be as below.

	JP7(LOUT) to JP3(BAT-)	JP8(LOUT) to J65(BAT-)
1kVA	220±5Vac	/

2-3kVA	/	220±5Vac
--------	---	----------

3.2.4.2 DC BUS voltage test in battery mode

using a multi-meter to measure the DC BUS voltage, the voltage should be 380±10V, and Buzzer alarms 3 times per 10s;

3.2.4.3 DC BUS voltage test in mains mode

turn on AC input breaker, add 220±2Vac AC input voltage, UPS transfers to mains mode, Buzzer stops alarm; using the voltage should be 380±10V, and Buzzer alarms 3 times per 10s; using a multi-meter to measure the DC BUS voltage, it should be 360±10V,

3.2.5 fan fault test

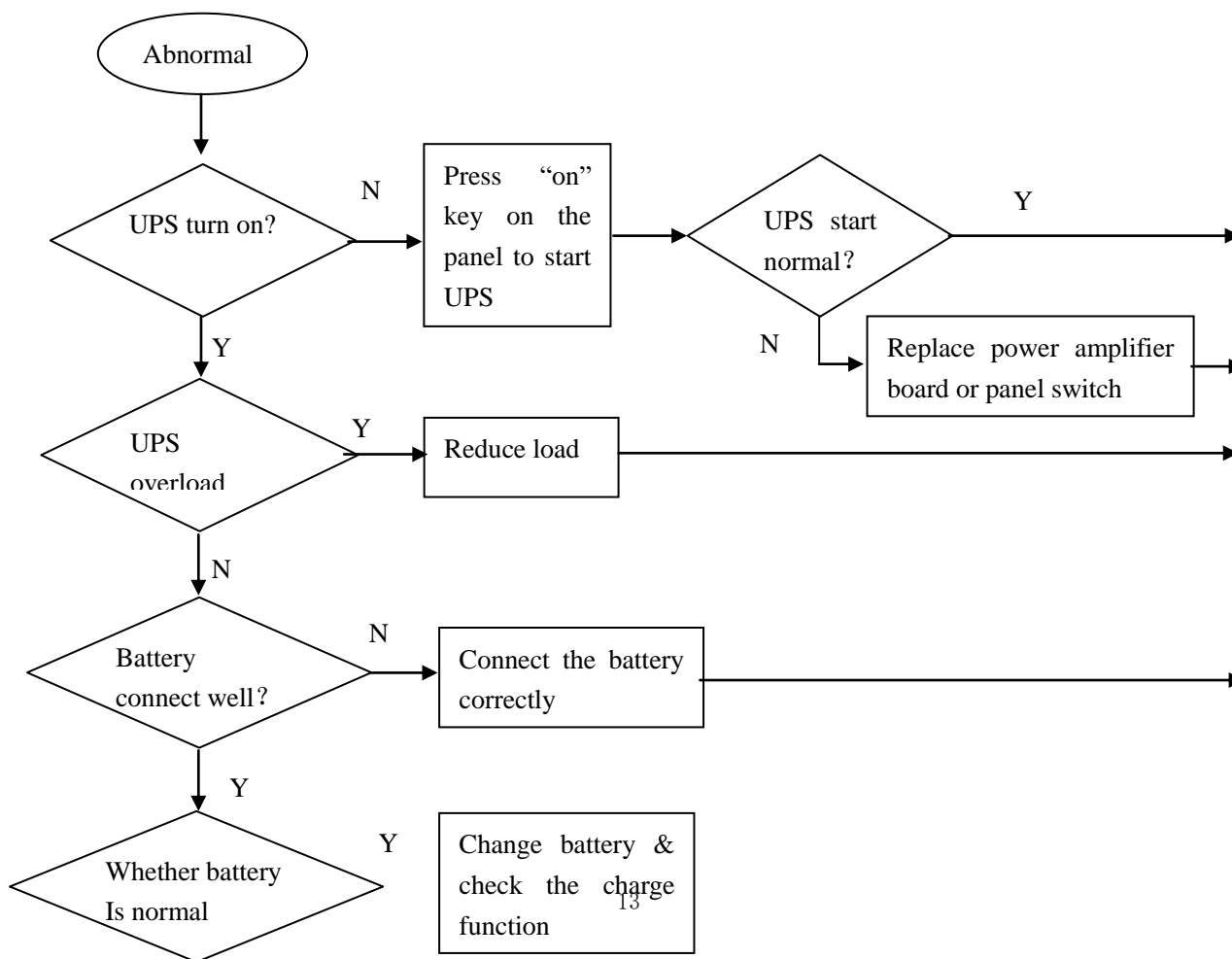
turn off UPS, remove the connection of fan on power amplifier board; turn on UPS, the UPS will alarm for fan fault. recover the connection of fan, alarm disappears.

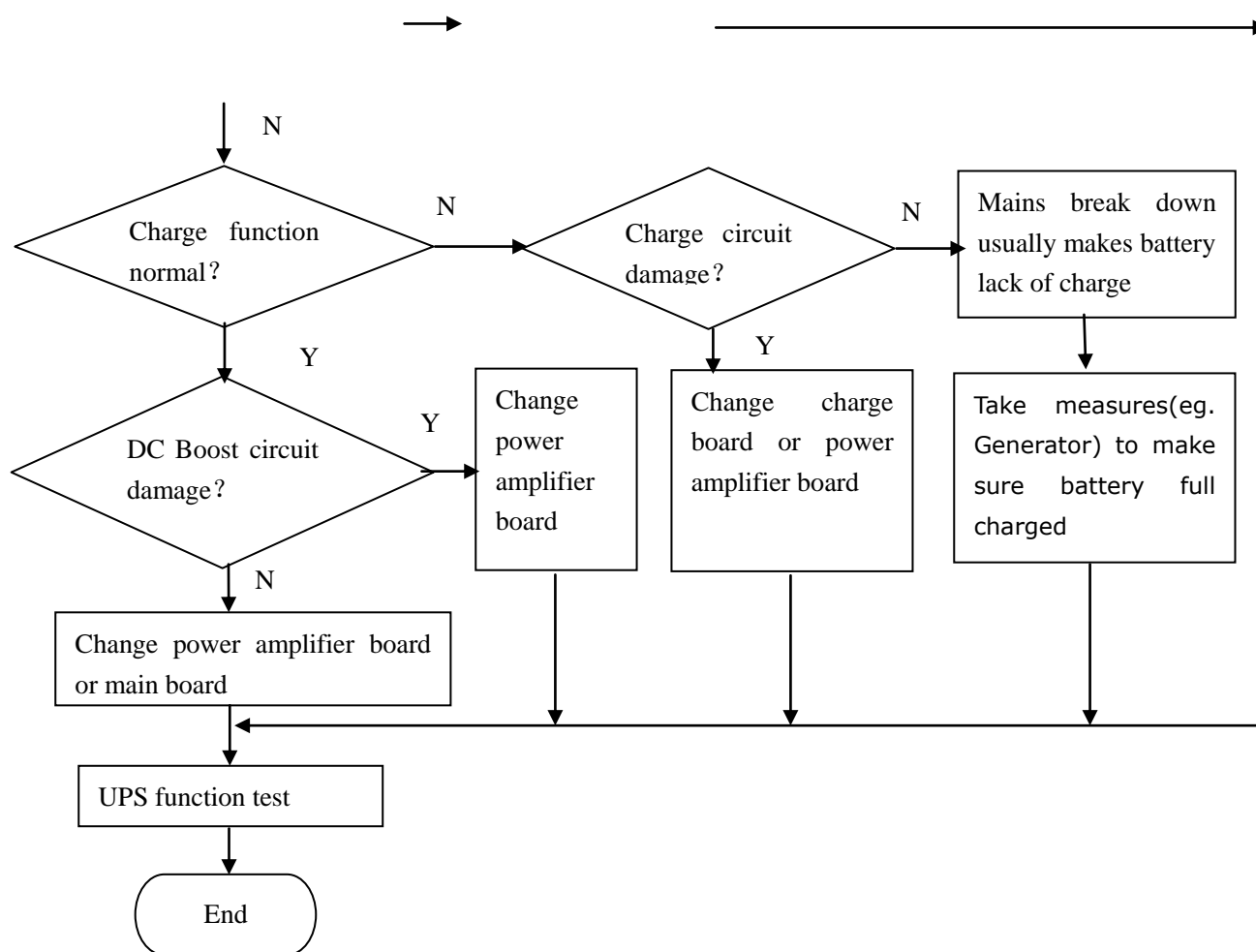
4. The familiar symptom and diagnosis program

4.1 Abnormal phenomenon 1

Mains input is normal, UPS output is normal, but when the mains fail, the UPS stop output immediately.

4.1. Diagnosis program





4.1.2 Program explanation

A. Whether the UPS has already been switched on or not: We can observe the front-panel indicator, the front-panel INV light will be on when the UPS is at normally work station (start shine after switching on the key 3s), but if it is failure, the front-panel FAULT light will be on. If INV and FAULT aren't bright either, then the UPS isn't switched on or the power supply is failure.

B. Whether the UPS is over load: Observe front-panel indicator, if all of the load indicator light is bright in mains supply mode, and the buzzer beep long alarm, the UPS turns to bypass supply mode, the INV light put out, the BYPASS light is bright, the FAULT light is bright, but reduce or turn off the load the UPS will recover normally.

C. Whether the battery connect normal: For UPS with battery inside, check battery connection line inside, for UPS with external battery, pull out UPS battery connect line, use multi-meter to measure battery voltage in DC mode. For KR-RM Li 1000L, the value tested should be 33~41 VDC; For KR-RM Li 2000L or KR-RM Li 3000L the value tested should be 88~109 VDC. If the value is very small (nearly to 0), it should be the problem of battery connecting, check the battery connect line or battery cabinet breaker.

D. Battery damage judgment

① UPS are always equipped with VRLA, which life cycle is about 3~4 years, especially shorter under

high temperature & unstable electronic net.

② Actual test: Over ten hours' normal charge, turn off the breaker of battery, measure the batteries voltage. For the KR-RM Li 1000L, if the battery voltage is lower than 30VDC, that maybe batteries ageing. For the N1C2000L or the N1C3000L, if the battery voltage is lower than 80VDC, that maybe batteries aging. If battery voltage is still 36~41VDC(KR-RM Li 1000L) or 96~109VDC(KR-RM Li 2000L, KR-RM Li 3000L), but presenting dropping obviously when the UPS is working in battery mode, add a little load, then the battery voltage decrease soon; after closing the UPS mains breaker and charge the battery, the voltage will soon arrived at 41 ± 0.3 VDC(KR-RM Li 1000L) or 109 ± 0.3 VDC(KR-RM Li 2000L, KR-RM Li 3000L), that means the batteries is ageing.

E. Charge characteristic test: Turn off the UPS battery breaker when the AC input is normal, voltage should be 41 ± 0.3 VDC(KR-RM Li 1000L) or 109 ± 0.3 VDC(KR-RM Li 2000L, KR-RM Li 3000L), if null voltage, that maybe something wrong with charge board.

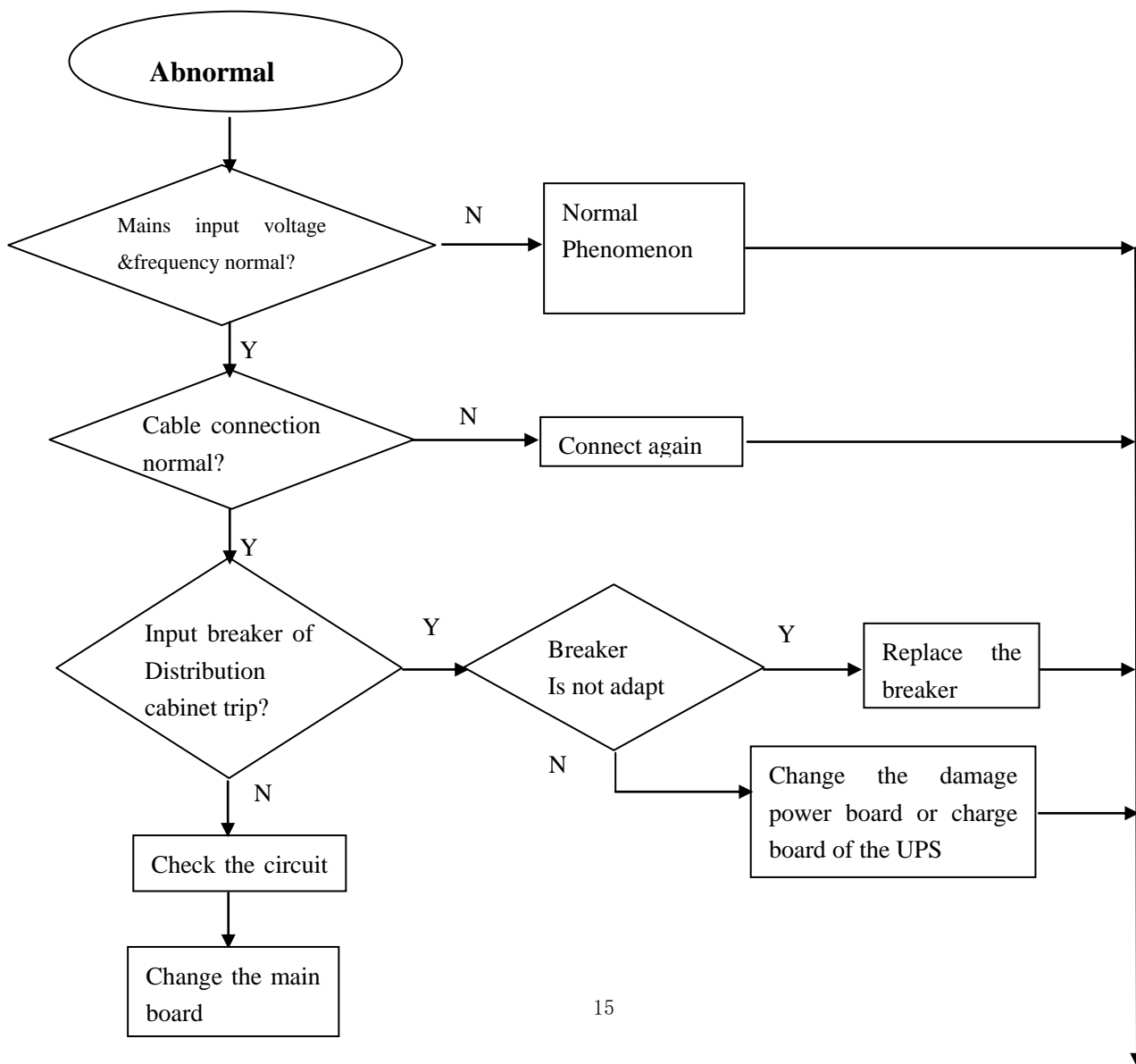
F. Boost circuit damage judgment: judge according to the program described in 3.2.3.

G. UPS function test: According to 3.2.4.

4.2 Abnormal phenomenon 2

UPS alarm when the mains input is normal

4.2.1 Diagnosis program





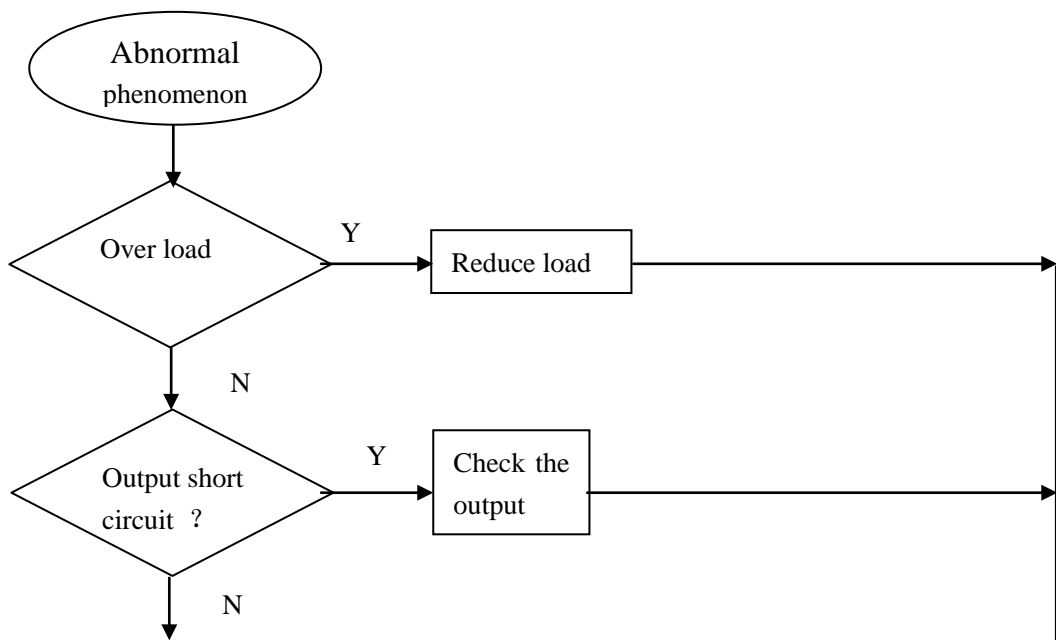
4.2.2 Program explanation

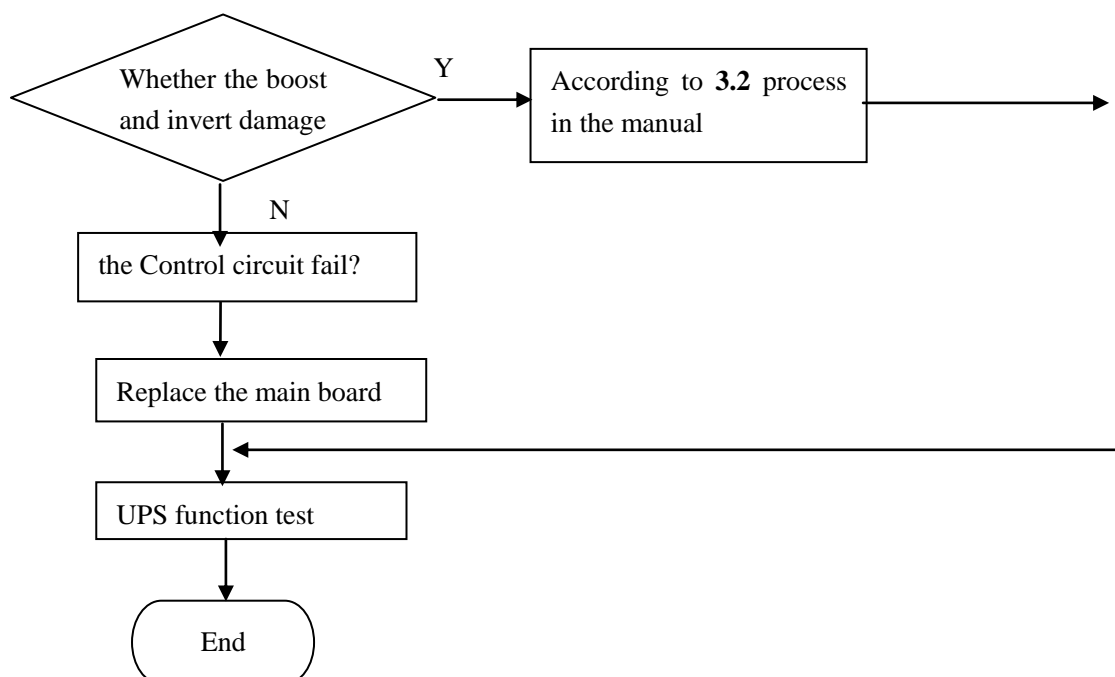
- ① Judge whether the mains input voltage and frequency is normal: use the multimeter to measure the UPS input, the input voltage should be 120~295Vac (half load should be 140~295Vac, full load should be 160~295Vac) , frequency should be 47.5~52.5Hz (or 45~55Hz) . If it is out of the range, the UPS will alarm.
- ② Whether the breaker is meet the request: For the mains instant striking current, should choose the breaker which current should be 1.5~2 times to UPS max mains input current , and never use breaker with leakage current protection.
- ③ UPS inside fault leads to distribution input breaker or UPS mains breaker trip: Turn off UPS charge board mains connect line, as shown in pic24. Then turn on the breaker, if it is normal. There must be something wrong with charge board, replace the board. Or there must be something wrong with the power amplifier board.
- ④ UPS function test: accord to part 3.2.4 program.

4.3 Abnormal phenomenon 3

The UPS buzzer alarm long and panel fault indicator light and bypass indicator light is on.

4.3.1 Diagnosis program





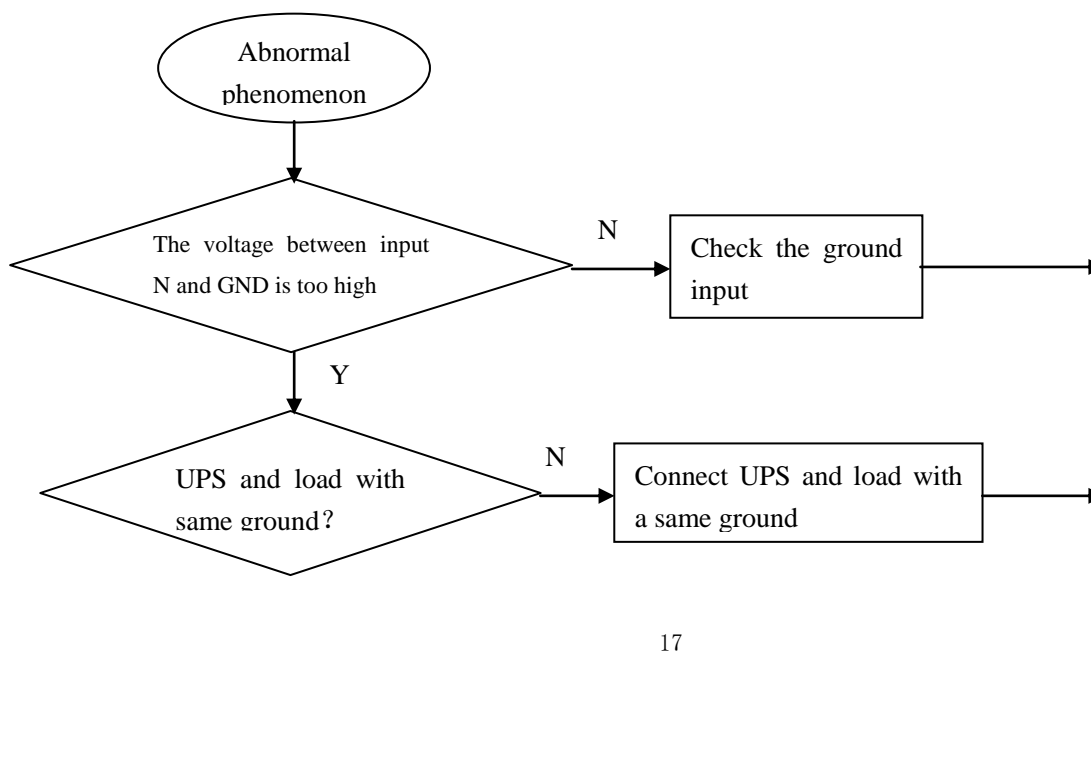
4.3.2 Program explanation

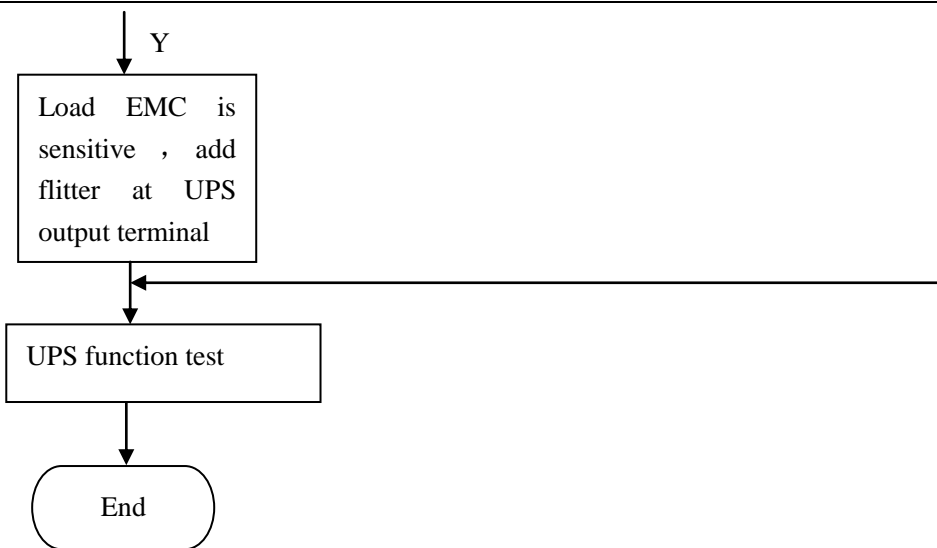
- A. **Over load judge:** Do as 4.1.2
- B. **Output short circuit judge:** Output short circuit may cause distribution input breaker or bypass breaker tripping, and the place short may heat, sparking. Turn off the load, and re-start the UPS, it will work normally.
- C. **Boost、invert damage judge:** Usually obvious from power amplifier board, Burnt out or MOSFET damaged, FUSE burnt out, etc.
- D. **UPS function test:** do as 3.2.4 program.

4.4 Abnormal phenomenon 4

UPS output、 display are normal, but the load with PC always occurs shutting down or re-starting.

4.4.1 Diagnosis program





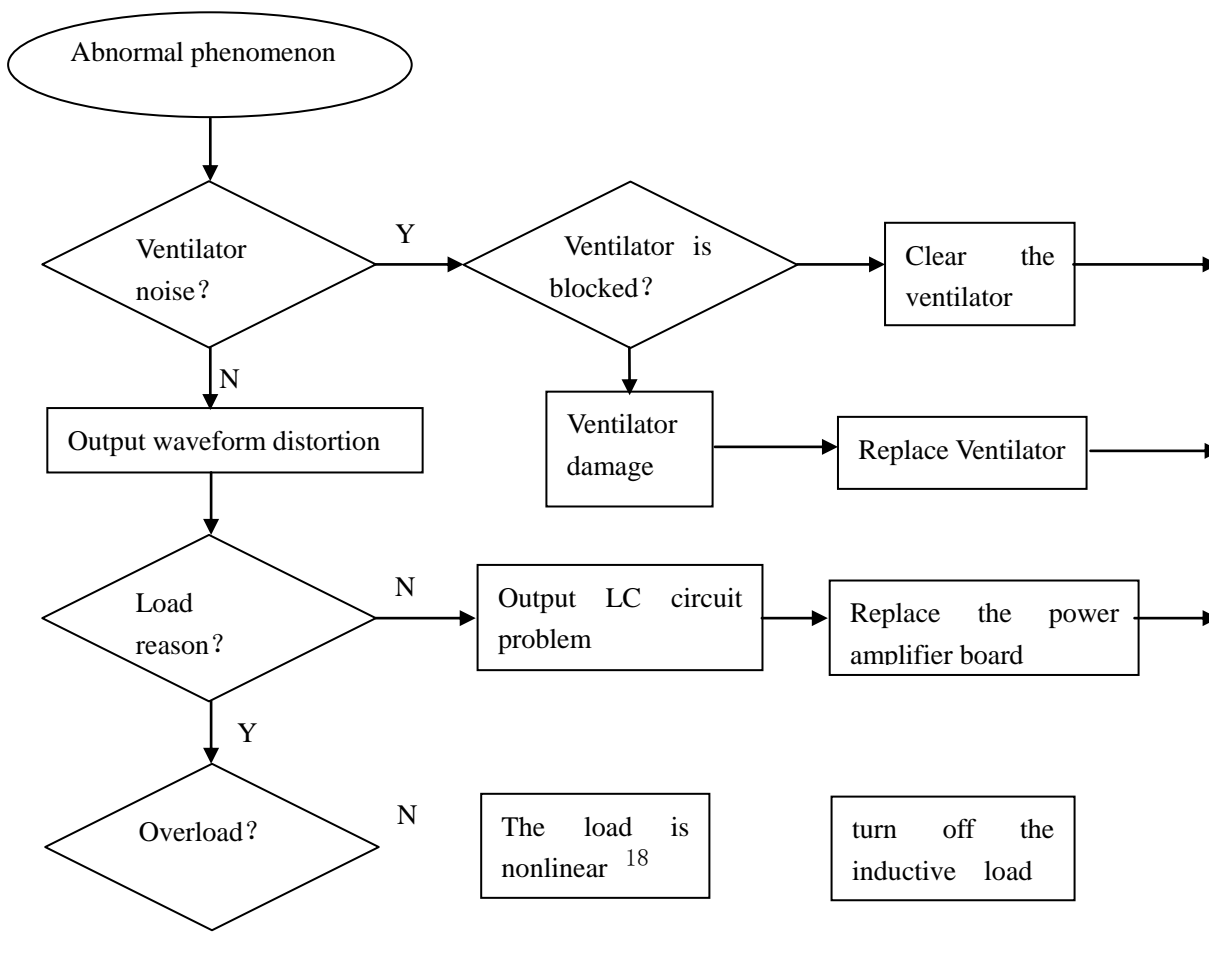
4.4.2 Program explanation

- A. Judge whether the ground electrode is normal: use the multimeter to measure the voltage between input neutral and ground of UPS input terminal, if it is OK, the neutral voltage should lower than 5Vac.
- B. UPS function test: accord to 3.2.5program.

4.5 Abnormal phenomenon 5

UPS output normal, but makes big noise.

4.5.1 Diagnosis program





4.5.2 Program explanation

A. Ventilator position: show as each construction picture of the UPS.

B. Output wave form distortion judge: use oscillograph to test the output waveform, it should be standard sine wave normally.

C. Judge whether it is caused by load: off all the load, measure whether the wave form returned normal, and noise reduce, if yes, that is load fault.

D. Inductive load: The familiar inductive load are fluorescent lamp、currency counter、 and laser printer, and so on.

E. UPS function test: accord to **part 3.2.5** program.