GTEC UPS MODEL:

TP130N 1/1,5/2/3 kVA

SERVICE MANUAL

www.gtec-power.eu

TABLE OF CONTENTS

1 General information

Getting start

If you want to know:

? Overview and what special for this UPS, refer to section Introduction.

? Replacing Battery Pack, refer to Replacing The Battery Pack.

? Open external case, refer to Steps to Open the Case.

? Electrical function and principle, refer to Principle of Operation.

? Whether UPS works properly, refer to Alignments.

? What happened to the UPS, refer to Trouble Shooting.

? Electrical performance, refer to Electrical Spec.

Conventions

This service manual uses the following conventions to alert you some important information for safe operation and quick working.

Warning: Denotes a procedure or operation, which, if not perform correctly, may result in personal injury. **Be sure not to continue operation until indicated conditions are fully understood and met**.

Caution: Denotes a procedure or operation, which, if not perform correctly, may cause damage to the UPS. **Be sure not to continue operation until indicated conditions are fully understood and met**.

Information and Tips: There are some tips and skills after this symbol. During service operations, these skills are provided by our design engineers which may help you quickly finish your work.

2 safety instructions

1. **For qualified service personnel only.**
2. **DO NOT** perform any internal service or adjustment of this product unless another person is capable of rendering first aid and resuscitation is present.
3. Dangerous voltage exists at several points in this product. To avoid personal injury, don't touch any exposed connections or components while UPS is active.
4. Turn off the UPS and disconnect input power cord before removing outside protective cover.
5. AC voltage is always present if the input AC power is still available.
6. High voltage may present at DC capacitors. Before opening the outside cover, wait for at least five minutes after turning off the UPS.
7. Verify input source (voltage and frequency) before service.

1. **DO NOT** make internal batteries short-circuited.
2. If the battery connectors are disconnected, be sure to plug in the input power cord and the input power is available before re-connect the battery connectors.
3. After service, verify the polarity of batteries, the tightness of all screws and connectors before restarting the UPS.

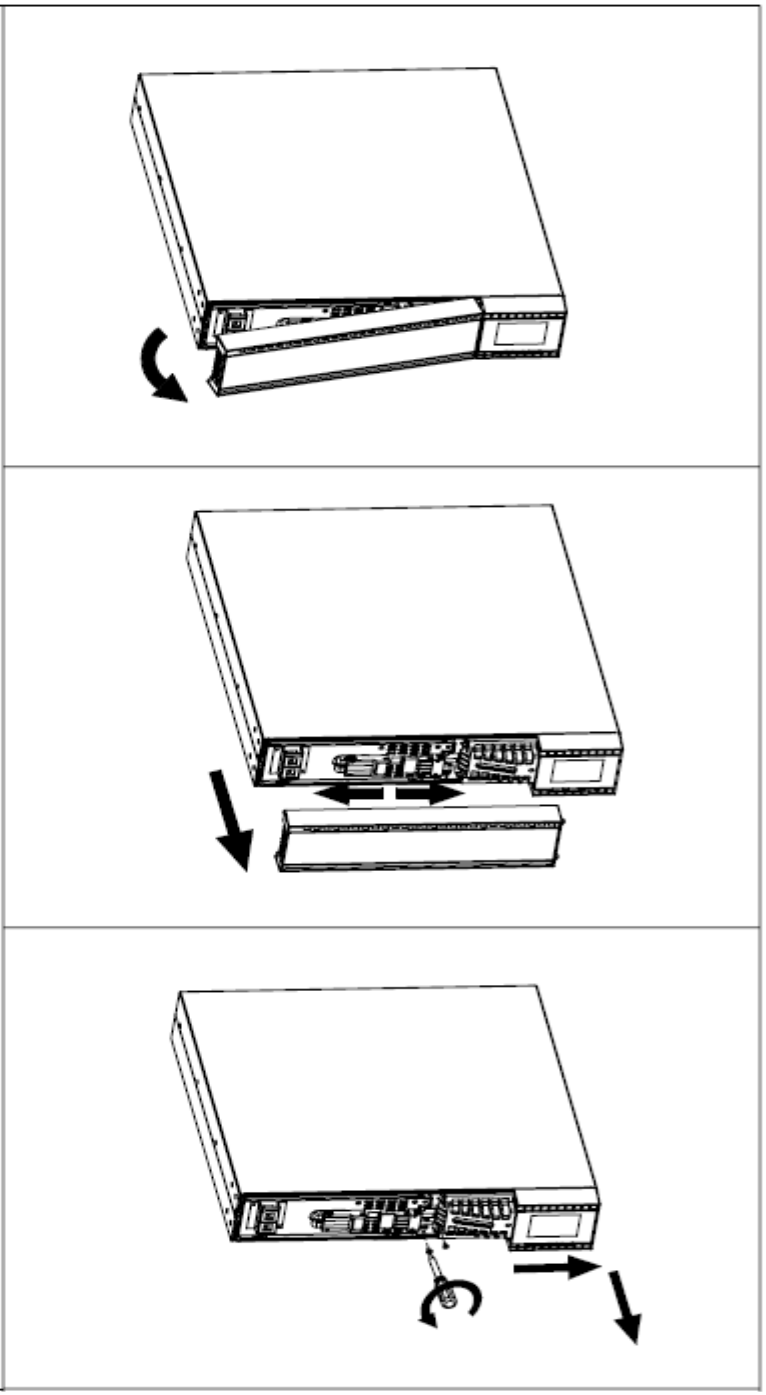
After opening the cover, please always check the tightness of all wires, connectors, and screws first. Then check if there is any de-colored components inside

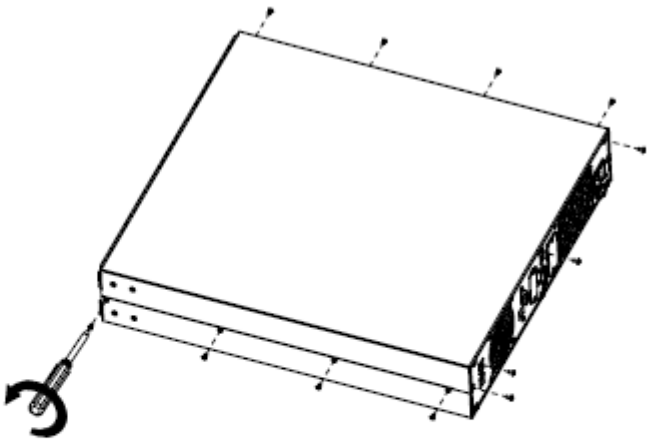
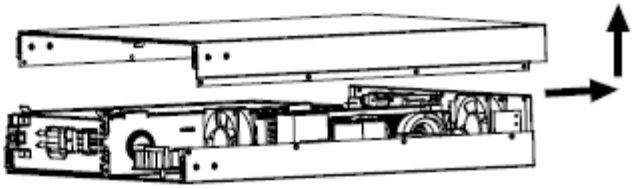
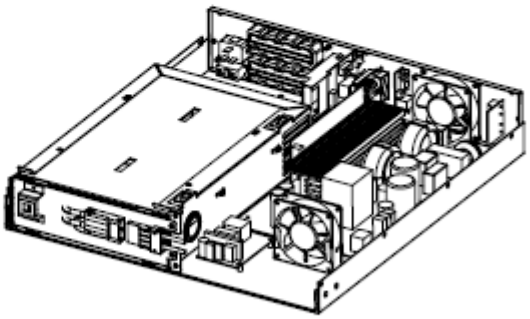
3 Packing and dismounting instructions

STEPS TO OPEN THE CASE

1. Remove the front Panel as shown in STEP1figure.
2. Remove related screws on STEP2 figure.
3. Slide outside cover in the direction shown in STEP3 figure.
4. Done.

STEP1



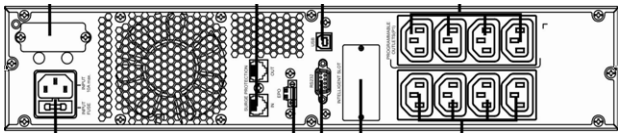
STEP2	
STEP3	
STEP4	

4 External view

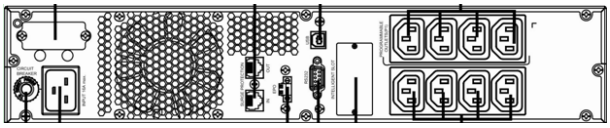
Front panel

Rear panel view

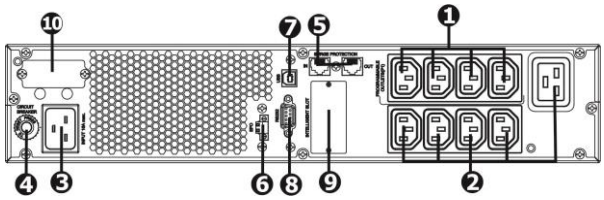
1.1K/1.5K IEC Type



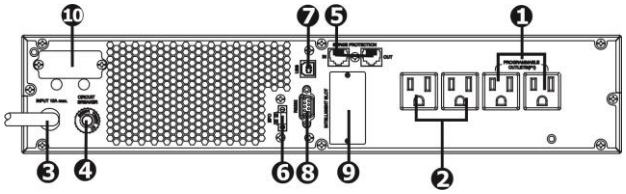
2K IEC Type



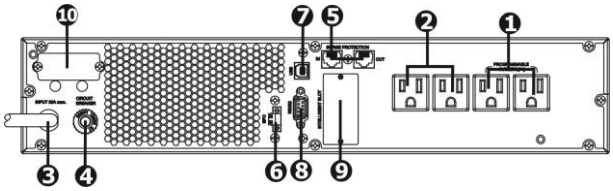
3K IEC Type



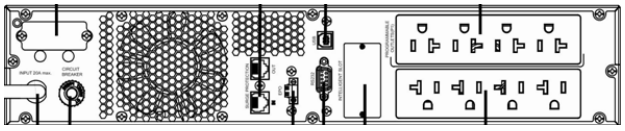
1.1K NEMA Type



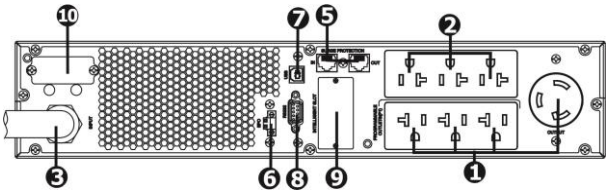
1.5K NEMA Type



2K NEMA Type



3K NEMA Type



1. Programmable outlets: connect to non-critical loads.
2. Output receptacles: connect to mission-critical loads.
3. AC input
4. Input circuit breaker
5. Network/Fax/Modem surge protection
6. Emergency power off function connector (EPO)
7. USB communication port
8. RS-232 communication port
9. SNMP intelligent slot
10. External battery connector (only available for L model)

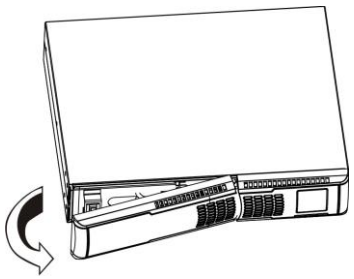
5 Installation instructions

NOTE: Before installation, please inspect the unit. Be sure that nothing inside the package is damaged. Please keep the original package in a safe place for future use.

Install The UPS

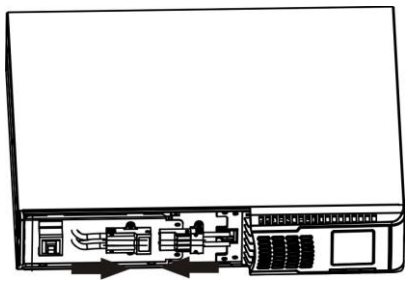
For safety consideration, the UPS is shipped out from factory without connecting battery wires. Before install the UPS, please follow below steps to re-connect battery wires first.

Step 1



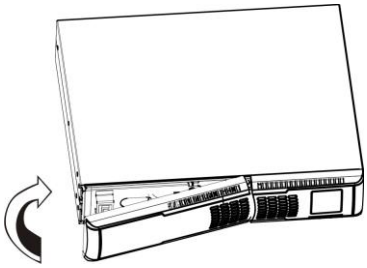
Remove front panel.

Step 2



Connect the AC input and re-connect battery wires.

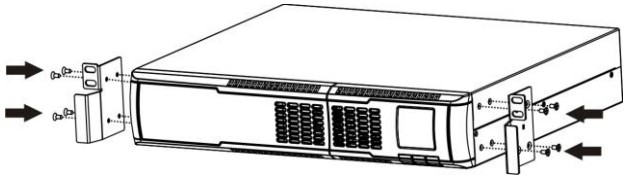
Step 3



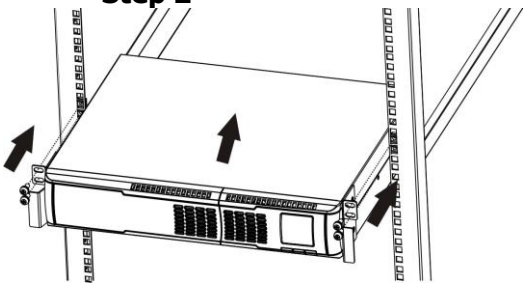
Put the front panel back to the unit.

Rack-mount Installation

Step 1

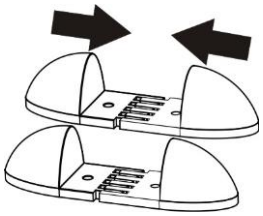


Step 2

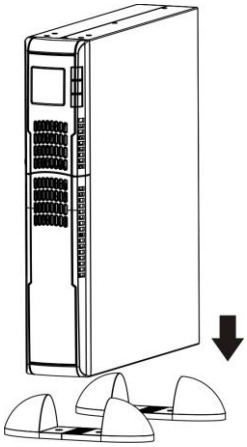


Tower Installation

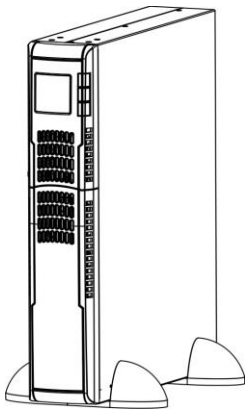
Step 1



Step 2



Step 3



6 Principle of operation

This Online UPS system contains 3 major PCB assemblies. They are including:

1. PSDR:	contains major parts of (1) DC power supply (2) DC-DC converter, (3) inverter (4)Input and output circuits.
2. CNTL :	contains major parts of protection, signaling circuits, regulation and control circuits of inverter
3.CHG	Provide 8A charging current for long run models， Provide 1.5A charging current for standard models

The simplified schematics in figure 1, shows how the major circuits are connected and illustrates the overall system functions.

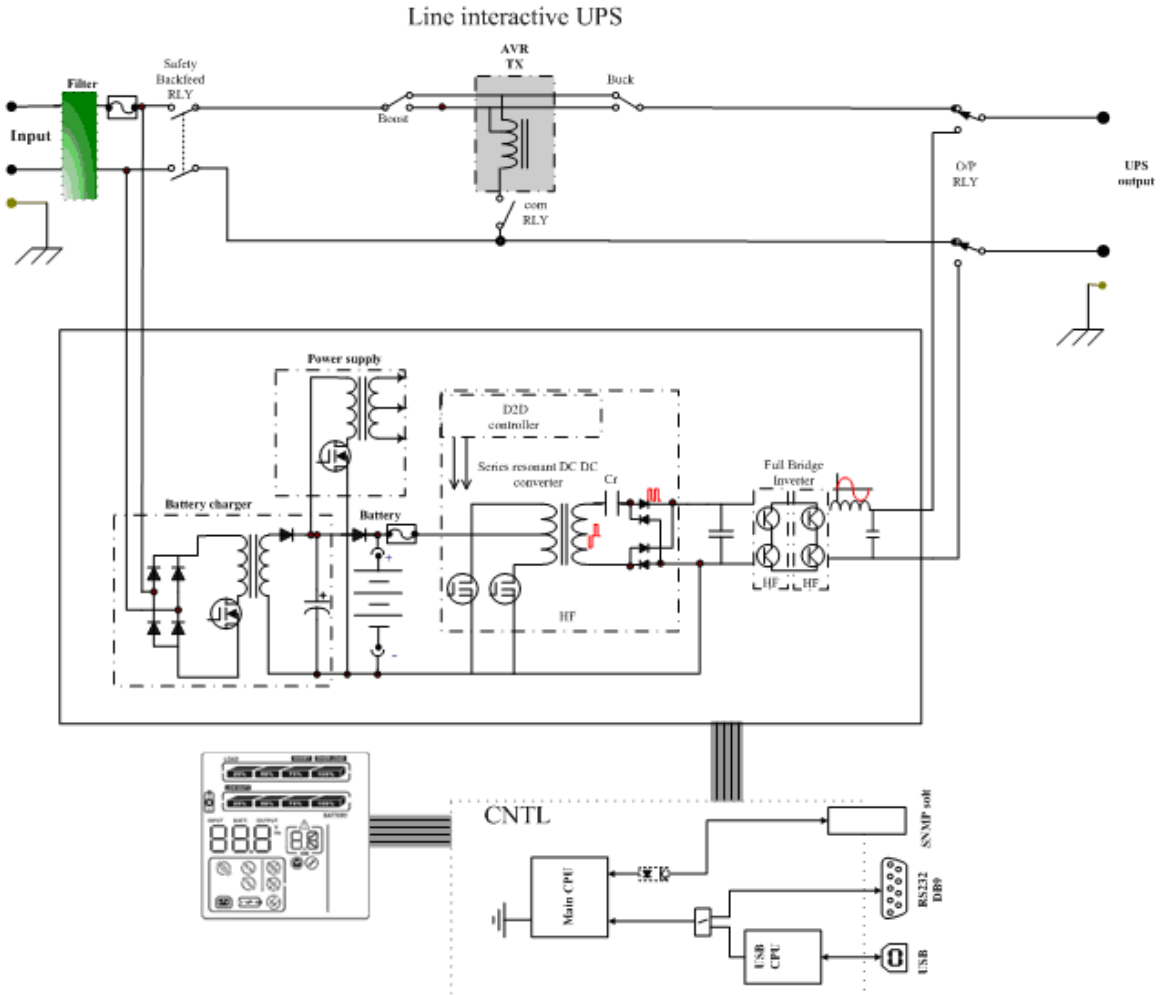


Figure 1:Circuit connection

The block diagram in figure 2, shows the UPS at normal operation from left to right.
The sub-systems are described as below:

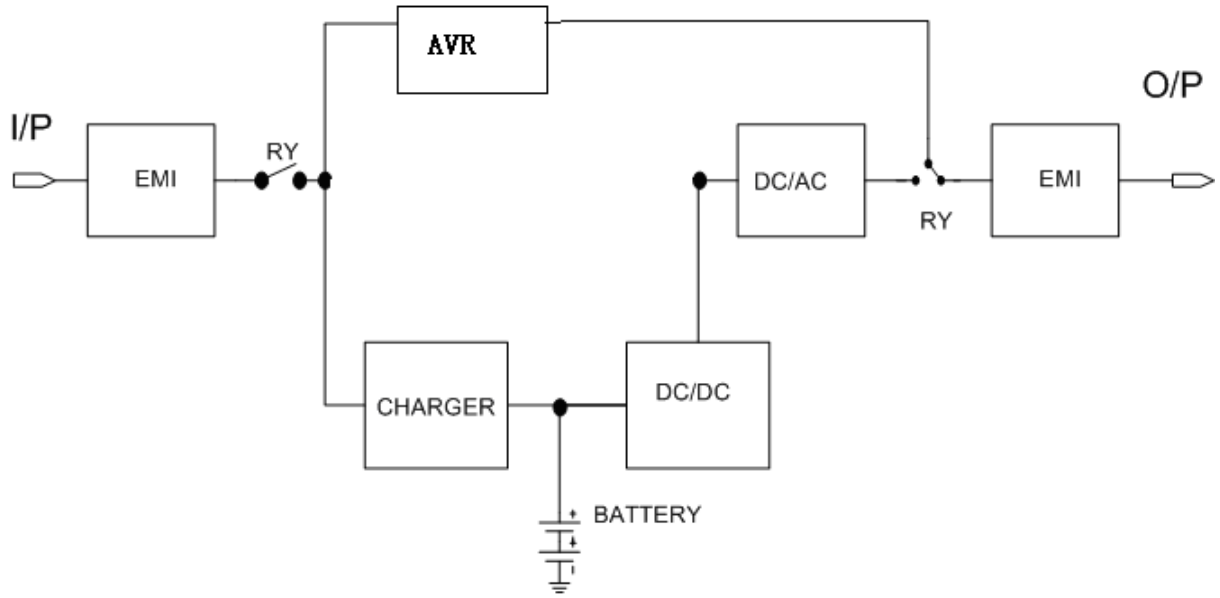


Figure 2: Block Diagram for UPS.

1.POWER STAGE (PSDR)

As shown in figure1,the power stage consists of DC power supply, DC-DC converter, inverter, Input and output circuits.

1-1 DC Power Supply Sub-System:

The input of the DC power supply is connected to the battery bus, i.e., the output of the charger. The output of DC power supplies provide +12 Vdc for the bias supply of IC's working voltage and the fan(s) voltage. The DC power supply works only when the 12 Vdc regulator supplies Vcc to its control IC. To have proper operation of 12 Vdc regulator, its input power is controlled by the switch as indicated in figure 3.

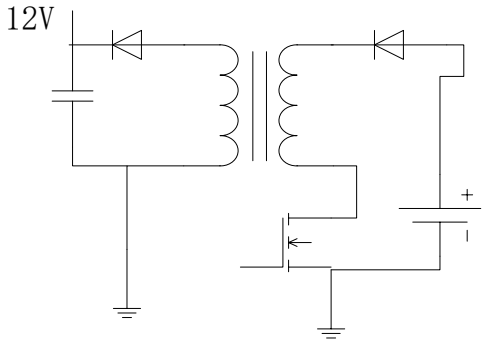


Figure 3: Schematic for DC power supply

1-2 Inverter Sub-System:

The UPS transfers DC bus voltages to the AC output voltage through an inverter of full bridge configuration in battery mode. The schematic diagram of inverter is shown in figure4.

To construct a high frequency (19.2kHz) PWM inverter, the drivers receive switching signals from PWM generation circuit through 2 PWM ICs to trigger the four IGBT alternately. The output of IGBT is filtered by an LC circuit to reduce the o/p voltage harmonics distortion.

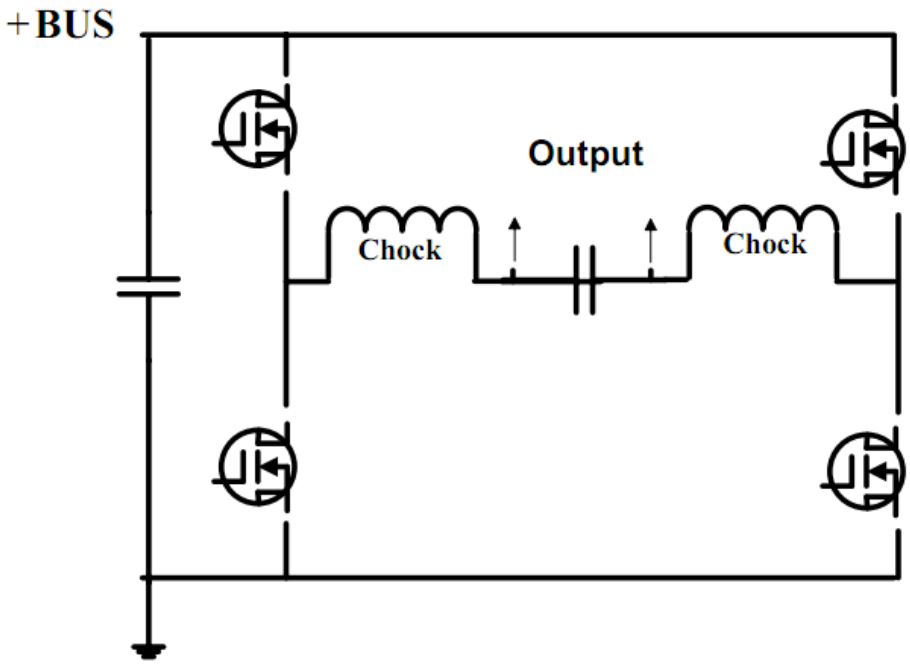


Figure 4: Schematics for inverter

1-3 The Input and Output Sub-System:

All the relays receive signals from control circuit.
The Input relay is a safety relay to switch the mains in or not.
The output relay switch the output of the UPS from bypass to inverter or reverse.
The input and output noise filter circuit blocks EMI noise to the loads.

1-4 DC-DC Converter Sub-System:

The major function of the UPS is to deliver accurate AC power to the loads connected to it whenever the AC line is correct or fails. In this system, the batteries release the stored energy to supply inverter immediately upon AC line fails.
Refer to figure 5, the battery voltage is transformed through a DC-DC converter to DC BUS for inverter. When the line fails, the BUS DC sources are caught up to supply the power needed by the inverter immediately

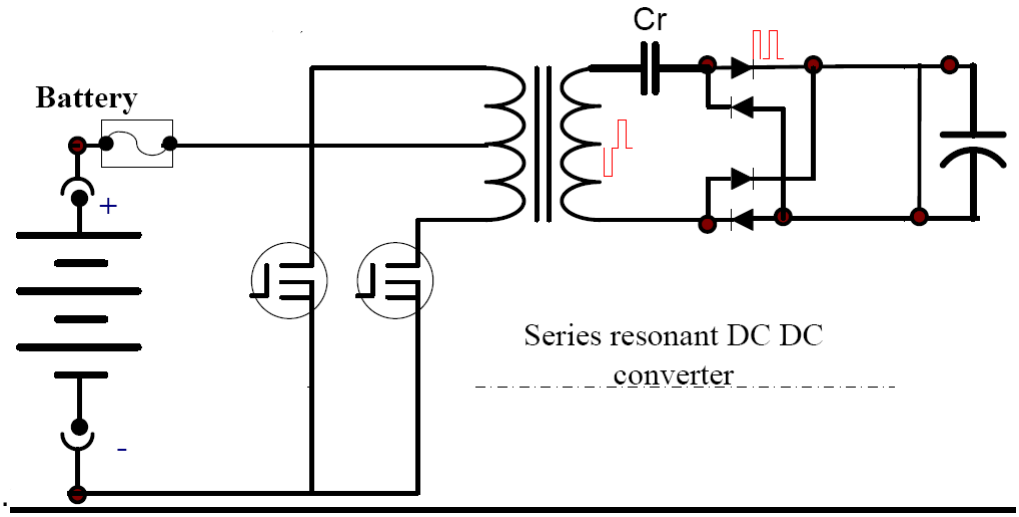


Figure 5 : DC -DC circuit

2. *MAIN CONTROL PCB ASSEMBLIES (CNTL)*

These assemblies are the control center of UPS. It is composed of three major circuits as following.

(1) Regulation & control
(2) Protection
(3) Signaling

2-1 REGULATION & CONTROL SUB-SYSTEM:

This portion can be seen as brain of the UPS. It provides the control pulses to the switching elements which deliver power to the output. The sub-system also regulates the output to ensure that the UPS is delivering constant AC voltage to the loads.

The inverter signal is sensed directly by resistor division. It is compared with a reference signal from sine wave generator. The difference of these two signals (error signal) alter the pulse widths of PWM signals which control the duty cycles of switching elements to regulate the output voltage within specification.

2-2 PROTECTION SUB-SYSTEM:

The UPS provides the following protection circuits :

1. Overload protection

The load detector senses the load current. i.e. the inverter current, and sends the signal by two paths. The UPS will go to failure mode if overload condition happened. The panel will indicate the fault condition. There are two kinds of protection in our UPS:

a. **Overload Protection:** The UPS collects the continuous overload signals through CPU switch the output relay.

In line mode, if the output load is higher than 103% and lower than 110% of rated load (VA ,or Wattage) the UPS will warning, after 5minutes go to fault mode. If the output load is between 110% and 130% of rated load (VA ,or Wattage) the UPS will warning, after 10seconds go to fault mode.. If the output load is higher than 130% of rated load, the UPS will go to fault mode after 1second.

In battery mode, if the output load is higher than 110% and lower than 120% of rated load (VA ,or Wattage) the UPS will warning, after 0.5minutes go to fault mode. If the output load is between 120% and 130% of rated load (VA ,or Wattage) the UPS will warning, after 10seconds go to fault mode.. If the output load is higher than 130% of rated load, the UPS will go to fault mode after 1second.

b. **Cycle by Cycle Current Limit:** When output loads sink a high surge current for a short time, a high inverter current is detected and the inverter switches, i.e. the IGBTs, are turned off pulse by pulse to protect themselves from thermal runaway. The output relay stays at inverter output position unless a continuous overload is detected or an abnormal inverter operation occurs.

2. Battery over or under shut down

Upon the battery voltage declines to battery-under/over level, the UPS will warning and the LCD will display the fault code ,then shut down.

In case of the battery voltage is high voltage, the UPS will warning and the LCD will display the fault code.

3. Inverter output abnormal protection

The inverter failure signal shuts down the inverter immediately, makes the buzzer a continuous alarm, and the LCD displays the fault code.

" The failure signal latches itself unless SW off or battery is empty".

4. Over temperature protection

The thermal switch detects the temperature of PSDR heat sink. The thermal switch is electrically connected to the CPU. An opened thermal switch is thought as temperature failure by the UPS. The LCD will display the fault code.

5. Bus over/under protection

To protect any BUS over/under condition. The LCD will display the fault code.

2-3 Signaling Sub-System:

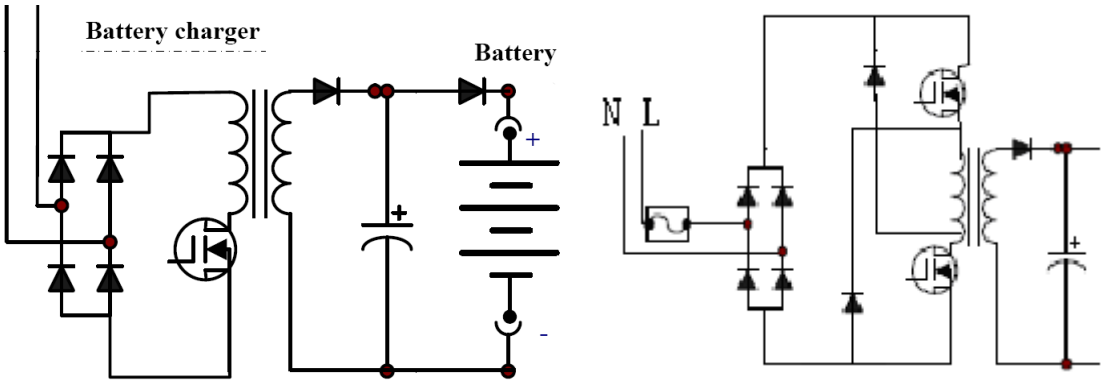
When the AC line is unable to supply, the batteries release energy inside to supply the inverter immediately. At the same time, the buzzer beeps every 4 seconds.

Upon the batteries are discharged to battery-low level, the battery-low signal is activated and the buzzer beeps every 1 second.

Remote shutdown signal is enabled only when the line fails.

3. Charger Sub-System

The purpose of charger is to charge and to maintain the batteries at fully charged condition. Refer to figure 6, the voltage flyback switching power supply provides a constant DC voltage for batteries. Besides providing constant voltage, the power supply also limits the current flowing into batteries and therefore protects and prolongs the life time of charged batteries.

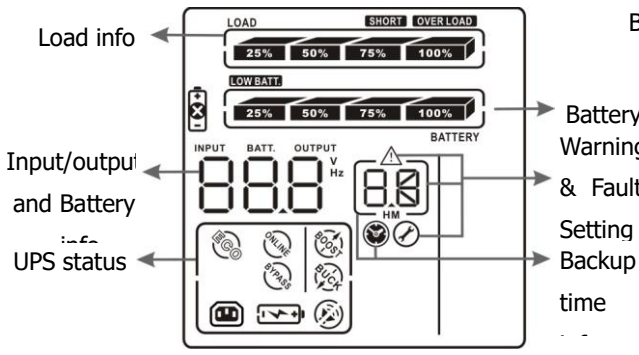


For 1.5A Charger For Super Charger

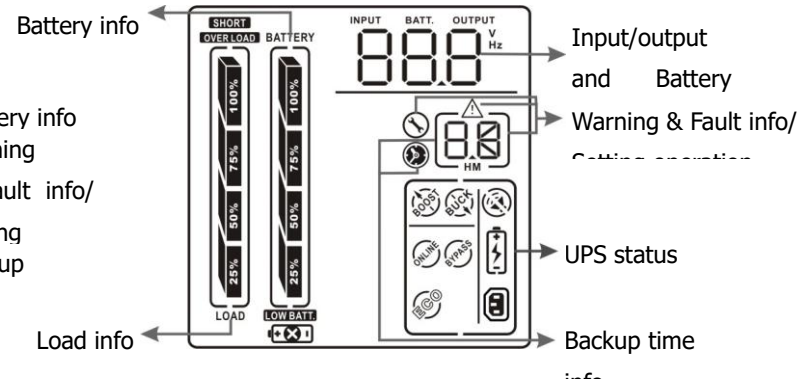
Figure 6: Charger Circuit Diagram

5. Front Panel:

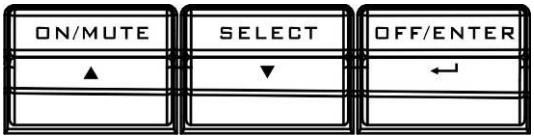
Rack Display



Tower Display



Button operation

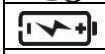
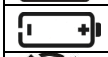


Button View

Button	Function
ON/Mute Button	➢ Turn on the UPS: Press and hold ON/Mute button for at least 2 seconds to turn on the UPS. ➢ Mute the alarm: After the UPS is turned on in battery mode, press and hold this button for at least 5 seconds to disable or enable the alarm system. But it's not applied to the situations when warnings or errors occur. ➢ Up key: Press this button to display previous selection in UPS setting mode. ➢ Switch to UPS self-test mode: Press ON/Mute buttons for 5 seconds to enter UPS self-testing while in AC mode.
OFF/Enter Button	➢ Turn off the UPS: Press and hold this button at least 2 seconds to turn off the UPS . UPS will be in standby mode under power normal. ➢ Confirm selection key: Press this button to confirm selection in UPS setting mode.
Select Button	➢ Switch LCD message: Press this button to change the LCD message for input voltage, input frequency, battery voltage, output voltage, output frequency ➢ Setting mode: Press and hold this button for 5 seconds to enter UPS setting mode when Standby. ➢ Down key: Press this button to display next selection in UPS setting mode.

6.1 Icon define

Display	**Function**
Backup time information	
	Indicates the remaining backup time in pie chart.
	Indicates the remaining backup time in numbers. H: hours, M: minute
Warning & Fault information	
	Indicates that the warning and fault occurs.
	Indicates the warning and fault codes, and the codes are listed in details in "10.6" and "10.7" section.
Setting Operation	
	Indicates the setting operation.

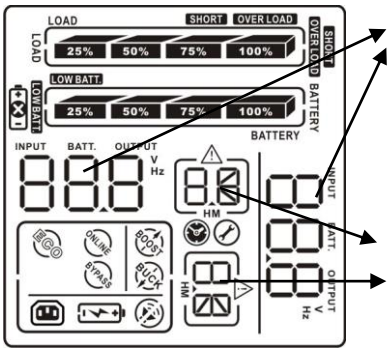
Input/Output & Battery information	
	Indicates the output/input voltage, output/input frequency or battery voltage. V: voltage, Hz: frequency
	Indicates the external battery pack numbers.
Load information	
	Indicates the load level by 0-25%, 26-50%, 51-75%, and 76-100%.
	Indicates overload.
	Indicates the load or the UPS output is short circuited.
UPS status	
	Indicates that programmable management outlets are working.
	Indicates that the UPS alarm is disabled.
	Indicates the UPS powers the output directly from the mains
	Indicates the battery charger is working.
	Indicates the UPS is working in battery mode
	Indicates the UPS is working in boost mode
	Indicates the UPS is working in buck mode
Battery information	
	Indicates the Battery level by 0-25%, 26-50%, 51-75%, and 76-100%.
	Indicates low battery.
	Indicates there is something wrong with battery.

6.2 LCD Display wording index

Abbreviation	Display content	Meaning
ENA		Enable
DIS		Disable
ESC		Escape
RAC		Rack display
TOE		Tower display
SF		Site Fault

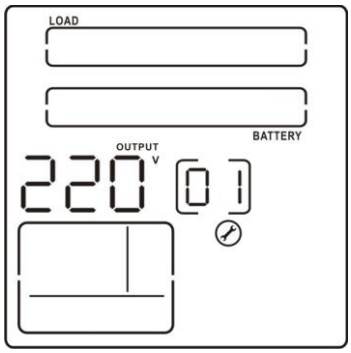
EP	EP	EPO
TP	tP	Temperature
CH	CH	Charger

6.3 UPS setting

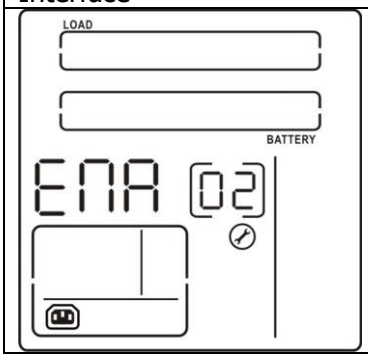


There are two parameters to set up the UPS. Parameter 1: It's for program alternatives. There are 5 programs to set up: output voltage setting, , programmable outlets enable/disable, programmable outlets setting , Charger maximum current setting LCD display direction and exit.

- 01: Output voltage setting

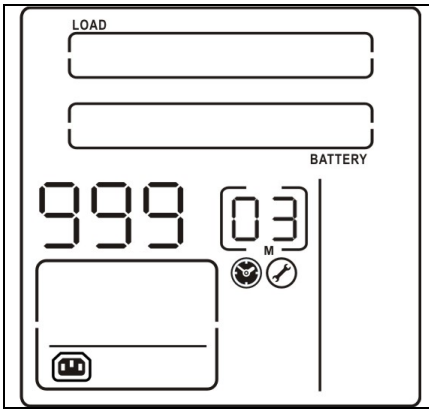
Interface	Setting
	For 208/220/230/240 VAC models, you may choose the following output voltage: 208: presents output voltage is 208Vac 220: presents output voltage is 220Vac 230: presents output voltage is 230Vac(Default) 240: presents output voltage is 240Vac For 110/115/120/127 VAC models, you may choose the following output voltage: 110: presents output voltage is 110Vac 115: presents output voltage is 115Vac 120: presents output voltage is 120Vac(Default) 127: presents output voltage is 127Vac

- 02: Programmable outlets enable/disable

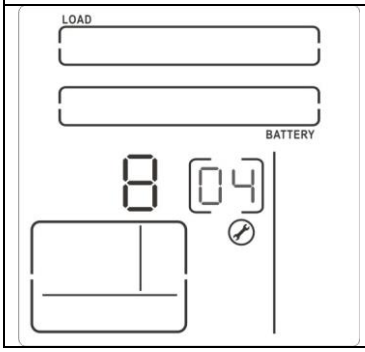
Interface	Setting
	ENA: Programmable outlets enable DIS: Programmable outlets disable(Default)

03: Programmable outlets setting

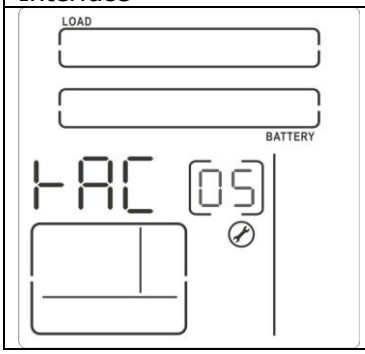
Interface	Setting

	Setting the backup time limits in minutes from 0-999 for programmable outlets which connect to non-critical devices on battery mode. (Default: 999)

- 04: Charger maximum current setting

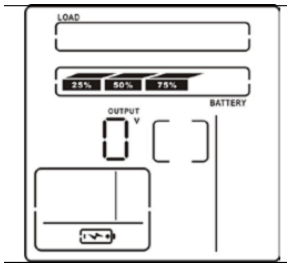
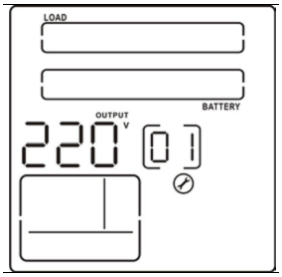
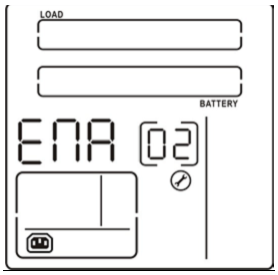
Interface	Setting
	Parameter 2: Set up the charger maximum current. 1/2/4/6/8: setting the charger maximum current 1/2/4/6/8 in Ampere. (Default: 8A) Note: the setting is only effective for super charger

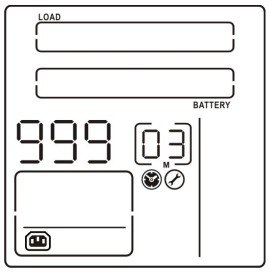
- 05: LCD display direction setting

Interface	Setting
	RAC: the LCD display is horizontal. TOE: the LCD display is vertical.

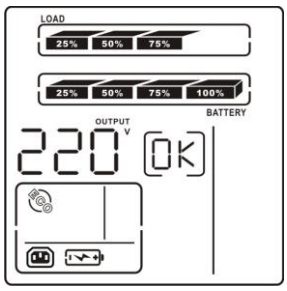
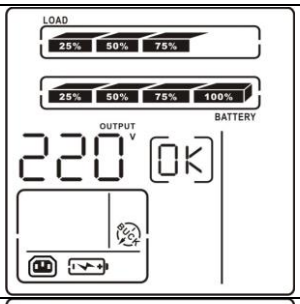
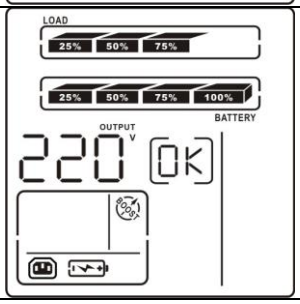
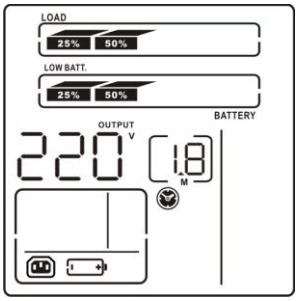
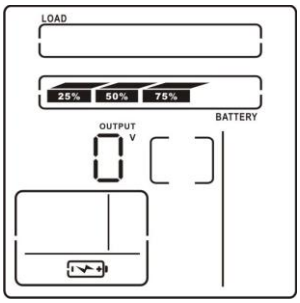
- 00: Exit setting

Steps for setting programmable outlet

Step 1: Before entering setting mode, the UPS should be in Stand-by mode (off-charging) and make sure the battery is connected. The LCD display is shown as right.	
Step 2: Press and hold the "Selection" button for 5 seconds to enter Setting mode.	
Step 3: Press the "Up" button (ON/MUTE) to switch to "02" of program list. Then press "Enter" button to enter value setting of parameter 2. Press the "Up" button to change the value to "ENA" to enable the programmable outlet function. Then press "Enter" button again to confirm the setting.	

Step 4: Press the "Up" button (ON/MUTE) again to switch to "03" of program list. Then press "Enter" button for setting programmable outlet time. Push "Up" button to change the value of backup time according your demand. Then press "Enter" to confirm the setting.	
Step 5: Press "Up" button (ON/MUTE) to switch to "00" of program list. Then press "Enter" button to exit setting menu.	
Step 6: Disconnect AC input and wait until the LCD display is off. The new setting will be activated when turning on the UPS again.	

6.4 Operating mode description

Operating mode	Description	LCD display
ECO mode	When the input voltage is within voltage regulated range, UPS will power the output directly from the mains. ECO is an abbreviation of Efficiency Corrective Optimizer. In this mode, when battery is fully charged, the fan will stop working for energy saving.	
Buck mode when AC is normal.	When the input voltage is higher than the voltage regulation range but lower than high loss point, the buck AVR will be activated.	
Boost mode when AC is normal.	When the input voltage is lower than the voltage regulation range but higher than low loss point, the boost AVR will be activated.	
Battery mode	When the input voltage is beyond the acceptable range or power failure and alarm is sounding every 4 seconds, UPS will backup power from battery.	
Standby mode	UPS is powered off and no output supply power, but still can charge batteries.	

6.5 Fault Reference code

Fault event	Fault code	Icon	Fault event	Fault code	Icon
Bus start fail	01	x	Inverter voltage Low	13	x
Bus voltage over	02	x	Inverter output short	14	SHORT
Bus voltage under	03	x	Battery voltage too high	27	
Bus short-circuited	05	x	Battery voltage too low	28	
Inverter soft start fail	11	x	Over temperature	41	x
Inverter voltage high	12	x	Over load	43	OVER LOAD

6.6 Warning Indicator

Warning	**Icon (flashing)**	**Alarm**
Low Battery		Sounding every second
Overload		Sounding twice every second
Battery is not connected		Sounding every second
Overcharge		Sounding every second
Site wiring fault		Sounding every second
EPO enable		Sounding every second
Over temperature		Sounding every second
Charger failure		Sounding every second
Battery Fault		Sounding every second
Battery replace		Sounding every 2 second

▪

ALIGNMENTS

List below are some test points and procedures when a qualified service person wants to check whether EUT (Equipment Under Test) will works properly. Before beginning following procedures, please ***make sure that EUT is OFF and disconnected from Utility.***

TEST ITEM	TEST POINT	TEST AND ADJUSTMENT SEQUENCE	EXPECTED RESULT
Charger Voltage	External battery connector for Long run model,.	1. Disconnect Battery connection wires (RED BLK) from main board respectively. 2. Connect DVM (set to measure DC) to test pins and plug input power cord to utility.	1. Cooling fans on back panel begin to rotate. 2. harger Voltage (13.7Vdc±0.1V)/ PCS
DC Bus Voltage @ Battery Mode	BUS+, GND	1. Connect DVM (Set to measure DC) to test point. 2. Disconnect input power cord to utility. 3. Press "ON" button for 2 seconds to turn EUT on. 4. Waiting for 10 seconds to make sure the EUT work in Battery mode according to the LCD display. 5. Check reading on DVM.	+175~220VDC (LV) +360~420VDC (HV)
O/P DC Balance @ Battery Mode	O/P socket	1. Keeping UPS on @ Battery mode. 2. Connect DC measurement tool[1] to O/P socket. 3. Check reading on DVM.	230mV max.

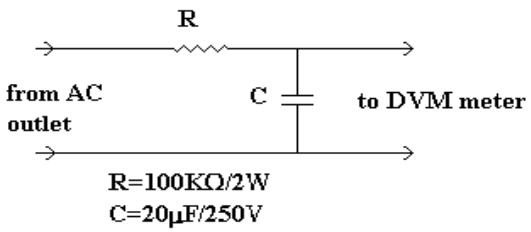


Figure 9 : Circuit for test output balance

7 Maintain instructions

The UPS system operates with hazardous voltages. Repairs may be carried out only by qualified maintenance personnel.

Caution - risk of electric shock. Even after the unit is disconnected from the mains (building wiring outlet), components inside the UPS system are still connected to the battery and electrically live and dangerous.

Before carrying out any kind of service and/or maintenance, disconnect the batteries and verify that no current is present and no hazardous voltage exists in the terminals of high capability capacitor such as BUS-capacitors.

Only persons are adequately familiar with batteries and with the required precautionary measures may replace batteries and supervise operations. Unauthorized persons must be kept well away from the batteries.

Caution - risk of electric shock. The battery circuit is not isolated from the input voltage. Hazardous voltages may occur between the battery terminals and the ground. Before touching, please verify that no voltage is present!

Batteries may cause electric shock and have a high short-circuit current. Please take the precautionary measures specified below and any other measures necessary when working with batteries:

- —remove wristwatches, rings and other metal objects
- —use only tools with insulated grips and handles.

When changing batteries, install the same number and same type of batteries.

Do not attempt to dispose of batteries by burning them. This could cause battery explosion.

Do not open or destroy batteries. Escaping electrolyte can cause injury to the skin and eyes. It may be toxic.

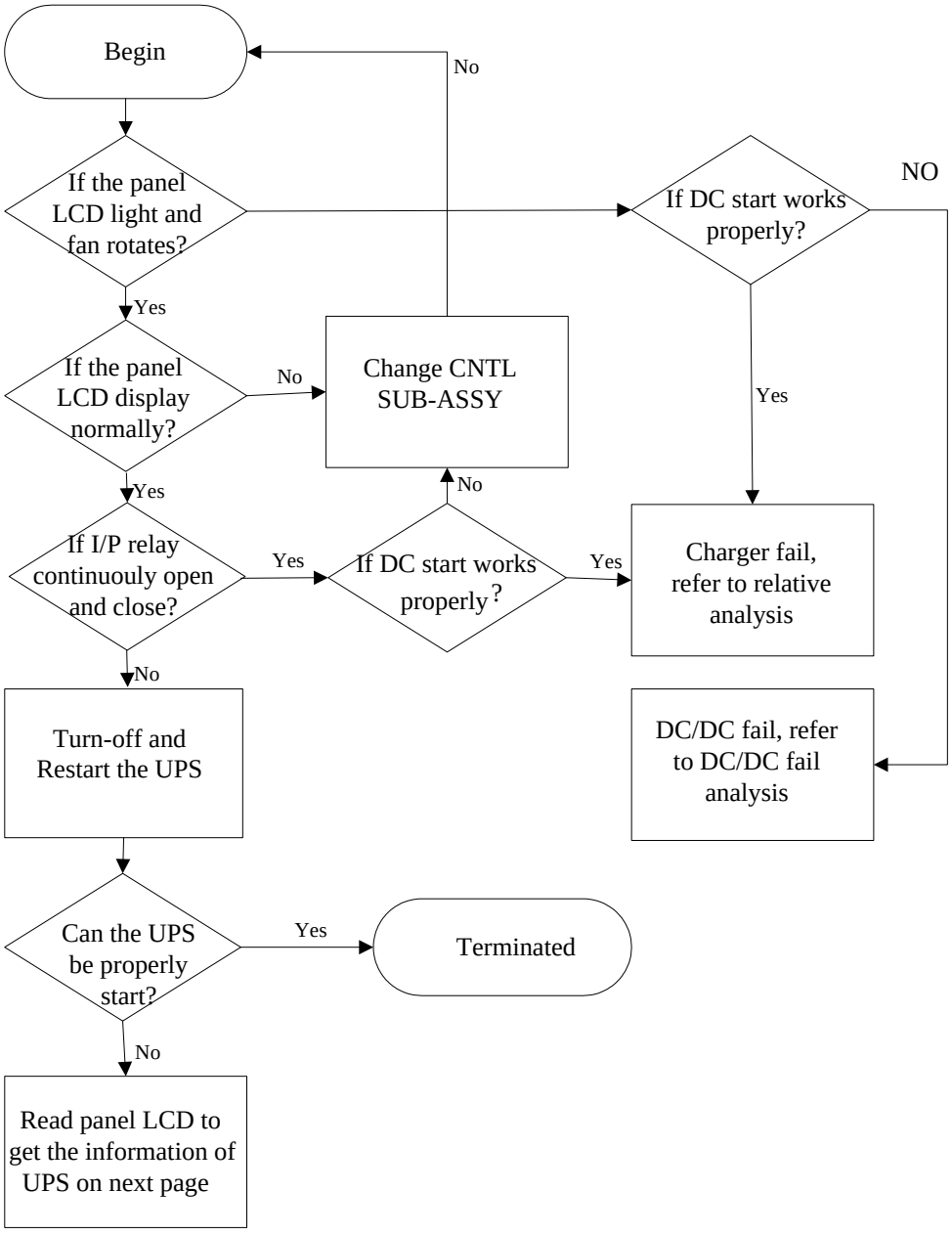
Please replace the fuse only with the same type and amperage in order to avoid fire hazards.

Do not dismantle the UPS system.

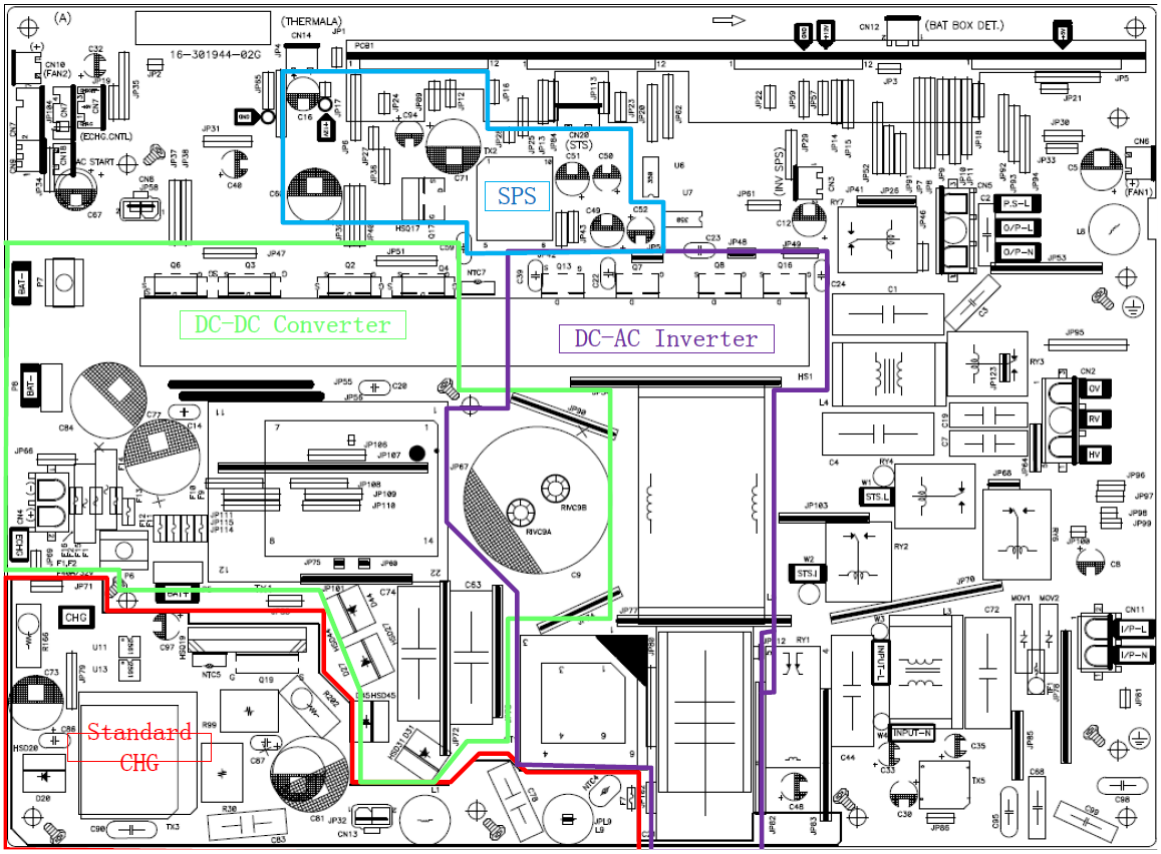
8 Trouble shooting

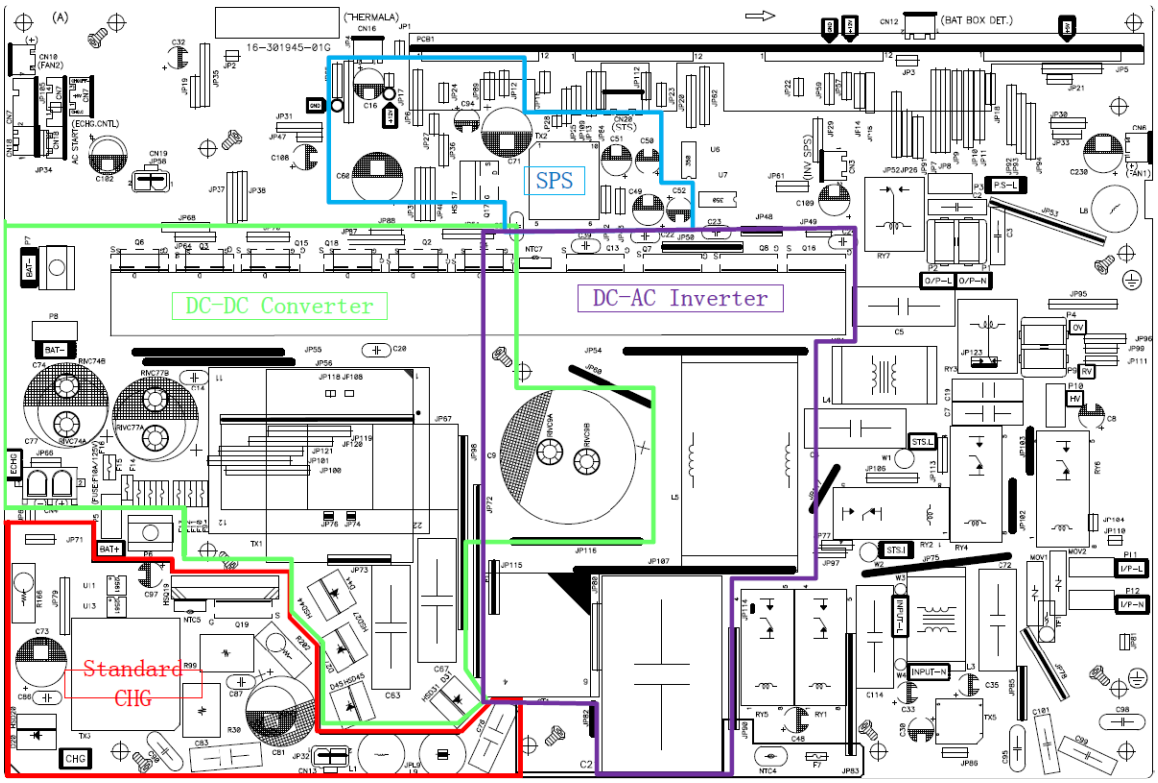
Due to careful design and strict tests of our products, fail of UPS seldom occurs. However, once they do fail in some situations, please check them according to **Trouble Shooting Chart**, that will help you solve the most problems on UPS.

Trouble Shooting Chart



Failure Diagnosis





1. OVERVIEW :

Circuit Block	Components to be checked	Fail condition
Battery FUSE	F9~F15	short or open
DC-DC Booster	Q2,Q3,Q4,Q6 Q15 Q18,	D-S short or open
	D27,D31, D44 D45	short or open
Inverter	Q7,Q8, Q13,Q16	D-S short or open
DC Power Supply	Q17	D-S short or open

2. DC-DC CONVERTER:

Step	Checked components	Instrument function	Reference Value	Failed condition
1	F9~F15	Ω	short	open
2	Q2,Q3,Q4,Q6 Q15 Q18	DIODE	0.46	short or open
3	R56,R32,R64,R66,R31,R54,	Ω	22	open
4	D27,D31, D44 D45	DIODE	0.42	short or open

3.DC/AC INVERTER:

Step	Checked components	Instrument function	Reference Value	Failed condition
1	Q7,Q8, Q13,Q16	DIODE	0.47	short or open
2	R113, R69 R108, R246	Ω	22Ω	open

4.DC POWER SUPPLY :

Step	Checked components	*Instrument function	Reference Value	Failed condition
1	Q17(D,S)	DIODE	0.47	short or open
2	R146	Ω	10	open
3	R191，R192	Ω	0.1	open
4	U1(1252) PIN ： 5-6 5-7 5-8 6-8	Ω	38k 4K 412k 415K	too low

AC/DC CHARGER :

Long-run charger

Step	Checked components	Instrument function	Reference Value	Failed condition
1	Q301,Q306 (D,S)	DIODE	0.49	short or open
2	R303 ,R313	Ω	10	open
3	R326	Ω	0.22Ω	open
4	U300(1252) PIN 5-6 5-7 5-8 6-8	Ω	38k 4K 412k 415K	too low
5	D305	DIODE	0.57	short or open

1.5A charger

Step	Checked components	*Instrument function	Reference Value	Failed condition
1	Q19	DIODE	0.49	short or open
2	R155	Ω	33	open
3	R202	Ω	0.1Ω	open
4	U14(1252) PIN 5-6 5-7 5-8 6-8	Ω	38k 4K 412k 415K	too low
5	D14, D20,	DIODE	0.57	short or open
6	C81, C73	Ω visual	open	short deformed

After you have replaced all defect components on power stage (PSDR), connect with control board. Supply appropriate DC voltage 3Amp (limited current) with DC power via P6+ and P8-, then turn on the switch on panel, you will see "current limit" on the DC power supply for about 2 seconds (If not, there are some defective components you have not found).

When everything seems good, turn off the switch on panel and remove DC power supply. Plug in the power cord and supply UPS with the mains. Test the output voltage of charger is OK or not. The fan will also active. If there is no problem in charger, connect the batteries via P6, P7. Finally, turn on the switch on panel again and follow the maintenance circuit diagram to check the voltage on DC bus, output voltage, or other signals.

CAUTION： **DO NOT** supply UPS with the mains unless you are sure that you have replaced all defective components

9 Engineering specification

MODEL		1.1K(L)	1.5K	2K(L)	3K(L)
CAPACITY		1100 VA / 990 W	1500 VA / 1350 W	2000 VA / 1800 W	3000 VA / 2700 W
INPUT					
Acceptable Voltage Range		81-145 VAC or 162-290 VAC			
Frequency Range		60/50 Hz (auto sensing)			
OUTPUT					
Voltage Regulation (AC Mode)		110/115/120/127 VAC or 208/220/230/240 VAC			
Voltage Regulation (Batt. Mode)		±3%(before battery alarm)			
Frequency Range (Batt. Mode)		50 Hz or 60 Hz ± 1 Hz			
Current Crest Ratio		3:1			
Harmonic Distortion		8% max @ 100% linear load, 15% max @ 100% non-linear load (before alarm)			
Transfer Time		Typical 2-6 ms, 10ms max.			
Waveform (Batt. Mode)		Pure Sine Wave			
EFFICIENCY					
AC Mode		97%	97%		97%
Buck & Boost Mode		94%	94%		94%
Battery Mode		89%	90%		91%
BATTERY					
Standard Model	Battery Type & Number	12 V/9 Ah x 2	12 V/7 Ah x4	12 V/9 Ah x4	12 V/9 Ah x6
	Charging Voltage	27.4 VDC ± 1%	54.8 VDC ± 1%		82.1 VDC ± 1%
	Recharge Time	4 hours recover to 90% capacity			
Long-run Model	Charging Current	1A/2A/4A/8A	N/A	1A/2A/4A/8A	1A/2A/4A/8A
	Charging Voltage	27.4 VDC ± 1%		54.8 VDC ± 1%	82.1 VDC ± 1%
PROTECTION					
Full Protection		Overload, short, discharge, and overcharge protection			
ALARM					
Battery Mode		Sounding every 10 seconds			
Low Battery		Sounding every second			
Overload		Sounding every 0.5 second			
Battery Replacement Alarm		Sounding every second			
Fault		Continuously sounding			
PHYSICAL					
Standard Model	Dimension, DXWXH (mm)	410 x 438 x 88	510 x 438 x 88		630 x 438 x 88
	Net Weight (kg)	13.4	19.5	21.5	29.3
Long-run Model	Dimension, DXWXH (mm)	410 x 438 x 88	N/A	410 x 438 x 88	510 x 438 x 88
	Net Weight (kg)	10.8		14	18

ENVIRONMENT	
Operating Humidity	0-90 % RH @ 0- 40°C (non-condensing)
Noise Level	Less than 45dB
MANAGEMENT	
Smart RS-232/USB	Supports Windows® 2000/2003/XP/Vista/2008, Windows® 7, Linux, Unix, and MAC
Optional SNMP	Power management from SNMP manager and web browser

Wiring diagram

Otima II Wiring.pdf