GTEC UPS MODEL:

ZP120N Tower

1K(KS)/ 2K(KS)/ 3K(KS)

1ph in/1ph out

SERVICE MANUAL

www.gtec-power.eu

CONTENT

1. General Information Of This Document

1.1 Getting Start

This is a service manual for ZP120N 1/2/3K(KS), Tower UPS, intend to help service personal perform a maintenance and repair service.

If you want to know:

? **What is special for this UPS from service point of view;** please refer to section characteristic of the product.

? **Construction of the product**; how many pieces of PCB do the product make up, please refer to construction of the product

? **Functional block of the UPS, and operating principle thereof,** please refer to Principle of Operation.

? **What's wrong with the UPS and How to solve the problem**, please refer to Trouble Shooting.

? **Basic information about the product, install and operation instruction,** you may please refer to USER MANUAL

1.2 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 may help you quickly finish your work.

1.3 Important Safety Instructions

1. **For qualified service personnel only.**
2. **DO NOT** performs 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. Discharge the remaining energy at DC capacitors with resistor before disassembling the power board.
7. Verify input source (voltage and frequency) is within the maximum range before service.

1. **DO NOT** short-circuit internal batteries
2. If the battery connectors **[BAT (+), BAT (-)]** 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, fasten 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 are any de-colored components inside

TO DISCHARGE the residue charge on bus capacitor,

For 1k(s) model contact **P07 BAT (-)** terminal and upper lead of **R139** with a 300Ω/10W resistor to discharge +BUS capacitor, contact **P07 BAT (-)** terminal and upper lead of **R129** with a 300Ω/10W resistor to discharge -BUS capacitor

For 2k(s)/3k(s) model, contact **P5/P07 BAT (-)** terminal and upper lead of **R139** with a 300Ω/10W resistor to discharge +BUS capacitor, contact **P5/P07 BAT (-)** terminal and **R129** upper lead with a 300Ω/10W resistor to discharge -BUS capacitor

TO DISCHARGE the energy of charger capacitor, **after disconnect the battery from PSDR/Charger**, you can use a 300Ω/10W resistor contact **BAT (+) terminal** and **BAT (-)** terminal for discharge battery filter capacitor

2. Characteristic Of The Product

For all UPS of this series, they are carefully designed and strictly tested. We always do our best to make our products more reliable and safer, this is also the goal of our company. However, due to the lifetime of electrical components and some unpredictable reasons, there will be unexpected failures may occur to the product, in this case, qualified service is needed. This service manual will guide the technicians to repair and adjust a problematic UPS. If the UPS still does not work properly, please contact with us and we will be glad to solve any problems you met.

Because of the following unique features, this series UPS (Uninterruptible Power System) is very easy to maintain and service.

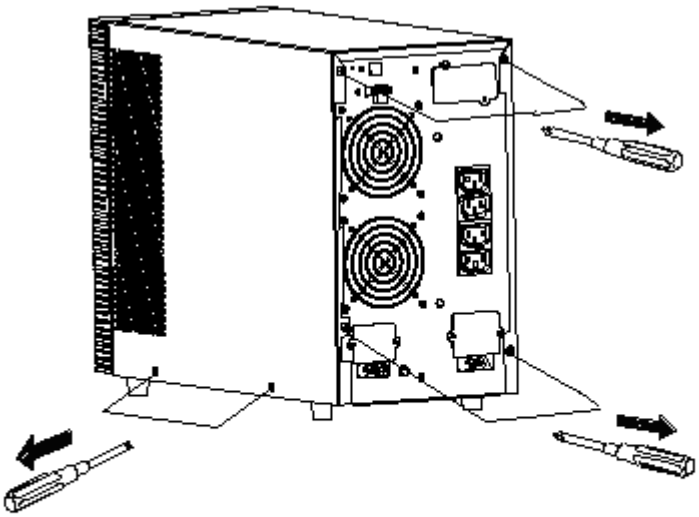
- All major power components are put on PCB.
- Minimum numbers of PCB sub-assembly.
- Major parts are simply connected with flexible insulated wires and plugs.
- All PCBs are interconnected with connectors.
- Most functional sub-circuit become modular, easy to identify the problem and repair by replacing a appropriate module

3. Construction Of The Product

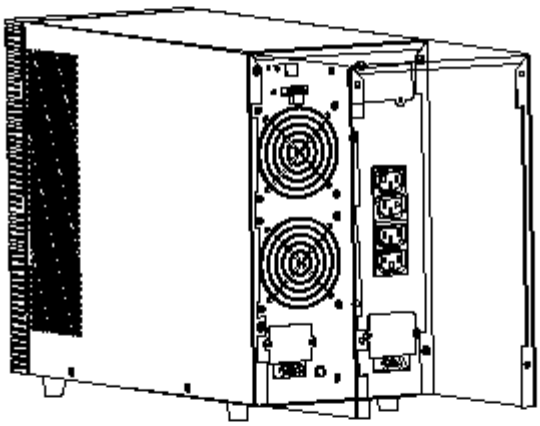
3.1 Open The Outside Cover

To open the outside cover, please follow steps and figures below:

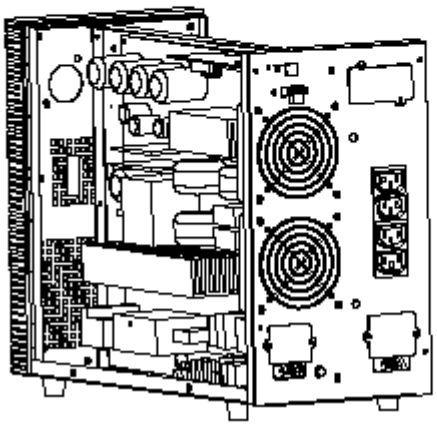
STEP 1: Remove all the screws, including those on the opposite side of the case, refer to Figure 3.1



STEP 2: Slide outside cover backward, as shown in Figure 3.2.



STEP 3: Done, as shown In Figure 3.3.



3.2 Inside The Chassis

Warning:

Before any further operation of service, touch any parts inside the chassis. Please make sure all power supply is cut off, either mains utility or DC power from external battery pack, and discharge the possible residue energy from energy storage component such as capacitor.

3.2.1 1K（S）

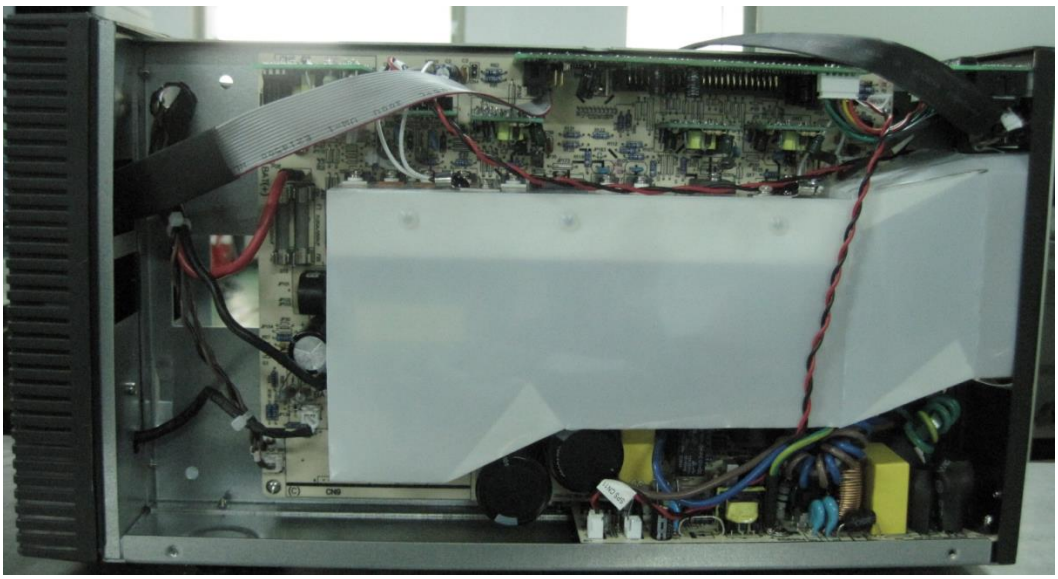


Fig. 3.2.1.1 1K（S） PSDR / CNTL / OVCD

Fig. 3.2.1.2 1K battery

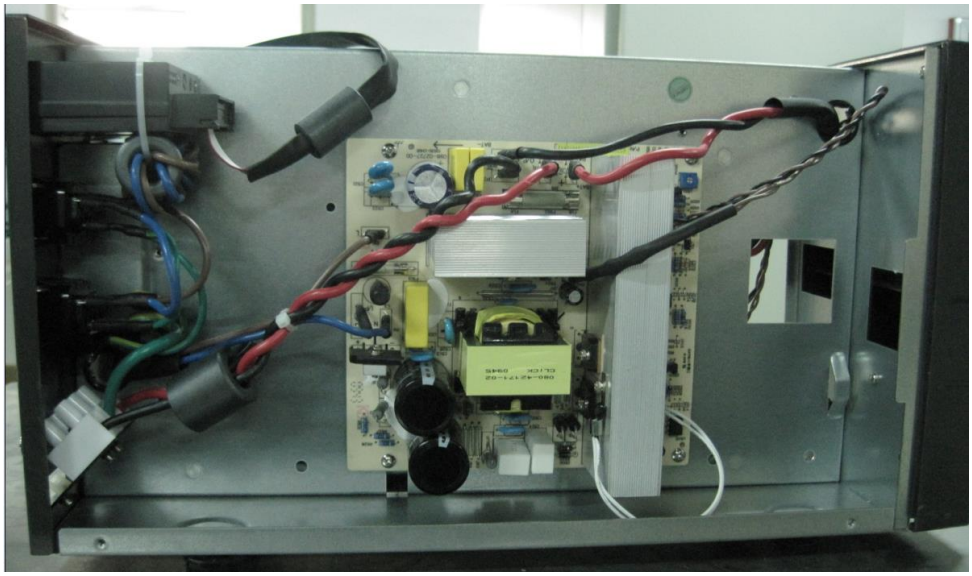


Fig. 3.2.1.3 1KS Super Charger

3.2.2 2/3K(S)

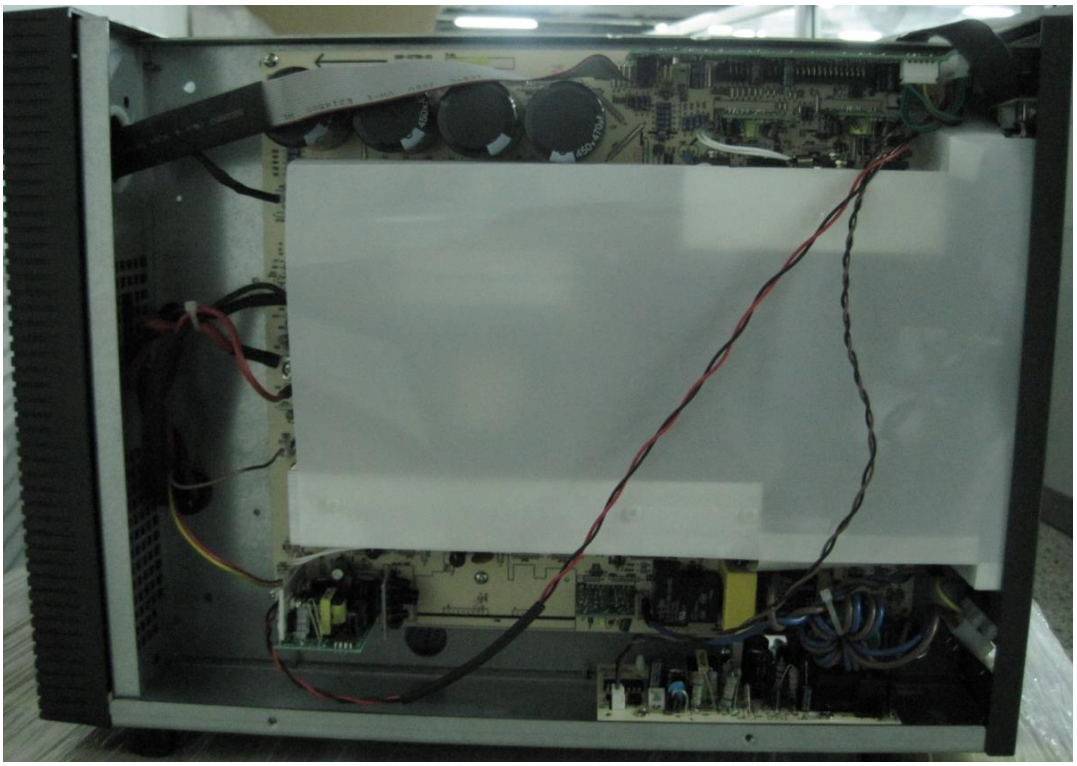


Fig. 3.2.2.1 2/3K(S) PSDR / CNTL / OVCD

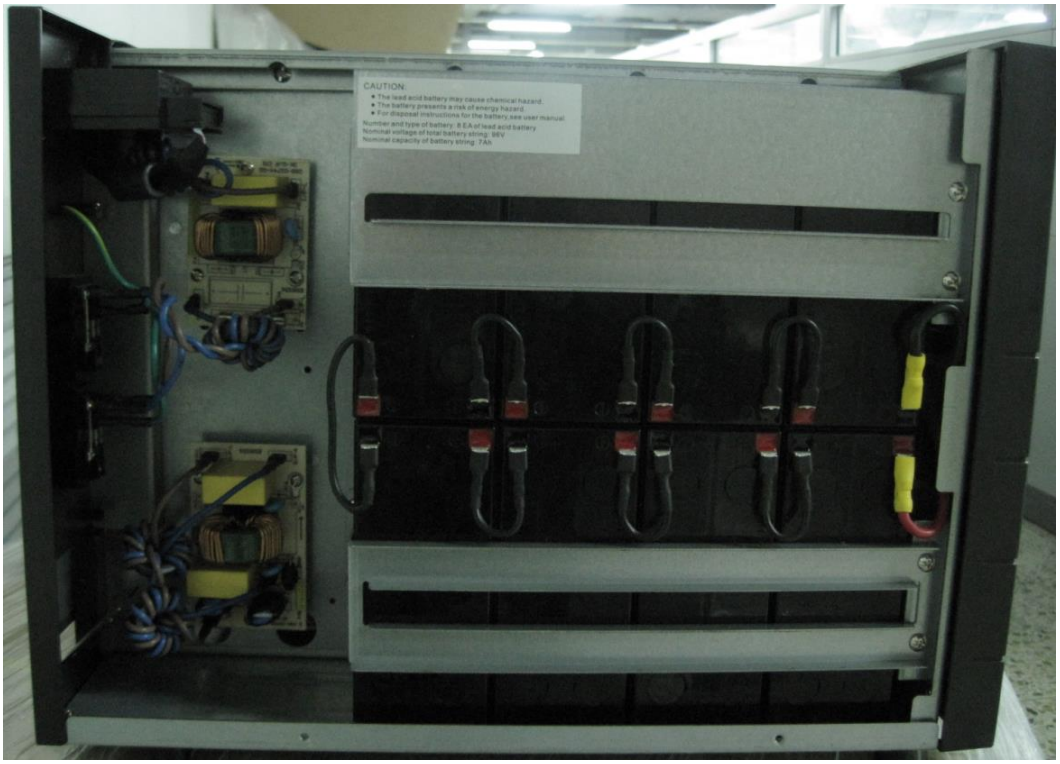


Fig. 3.2.2.2 2/3K Battery / IP EMI / OP EMI

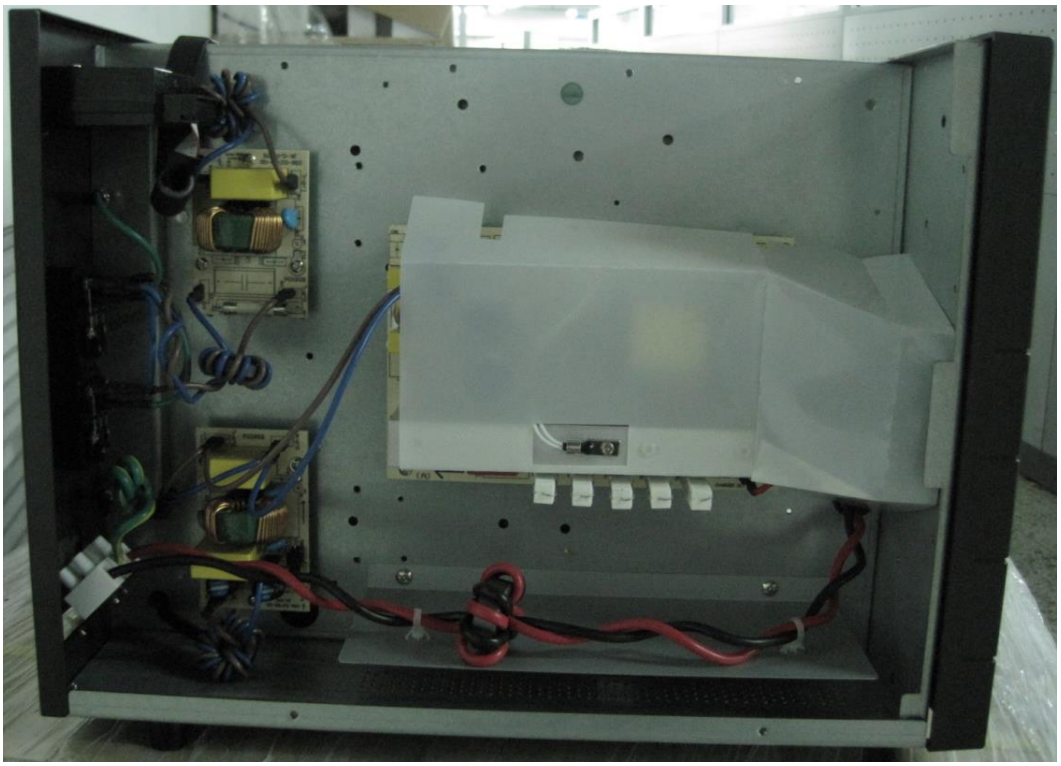


Fig. 3.2.2.3 2/3KS Super Charger / IP EMI / OP EMI

4.Components Location

Below Figures shows location of the main components / modules in the UPS:

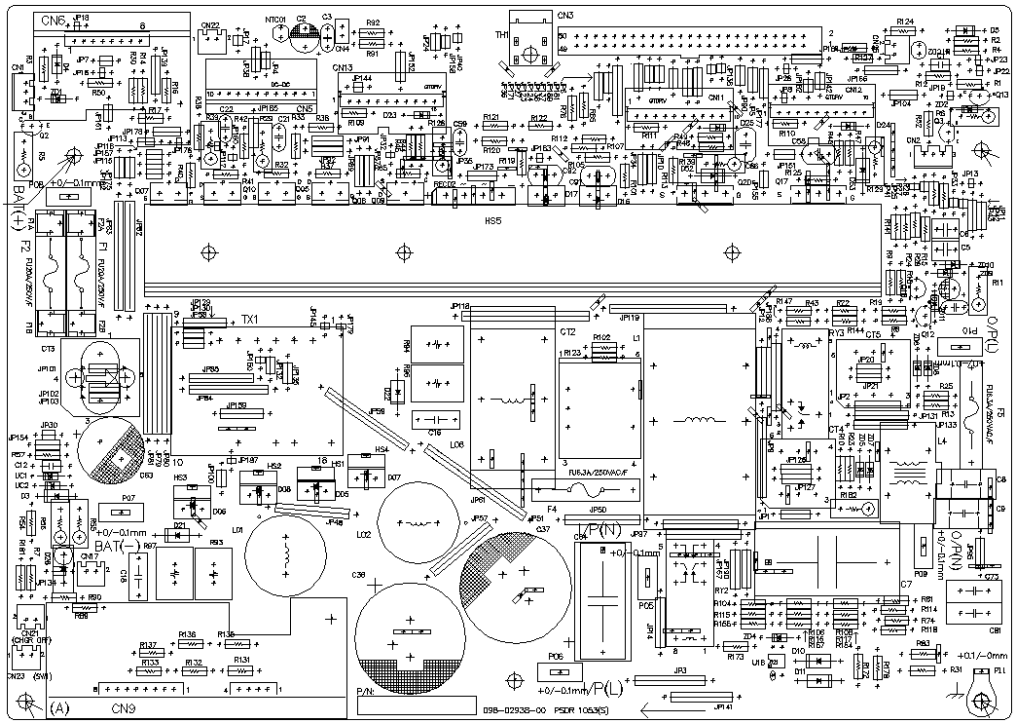


Fig.4.1 1K PSDR MODULE LOCATION

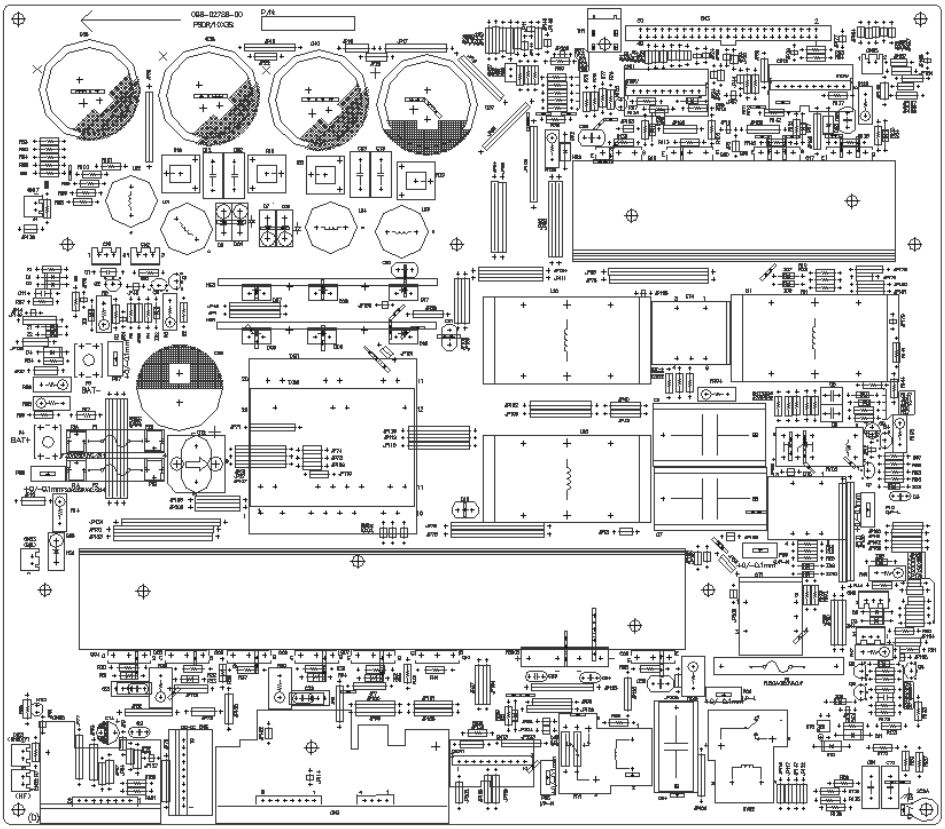


Fig.4.2 2K/3K PSDR MODULE LOCATION

No.	Module Name	Part No.	Quantity	Remark
1.	Charger Module	710-61201	1	1053
		710-61200	1	1073/1083
2.	IGBT Driver	710-61813	3	
3.	SPS Module	710-02745	1	1073(S)/1083(S)
		710-03860	1	1053(S)
4.	DCDC Driver Module	710-02637	1	
5.	Global Controller	712-02854	1	

Note: Here charger module is only for standard model. On Long backup time model UPS PSDR, 1A standard charger Module is NC (Not Connected), 8A super charger is used instead.

5. Principle Of Operation

5.1 Functional Block Of The Product

As a true online UPS, the product employ a double conversion topology, comprise following functional blocks, as shown in Figure 5.1.1 and Figure 5.1.2. The functional blocks of Figure 5.1.1 are with OVCD, but the functional blocks of Figure 5.1.2 are without OVCD.

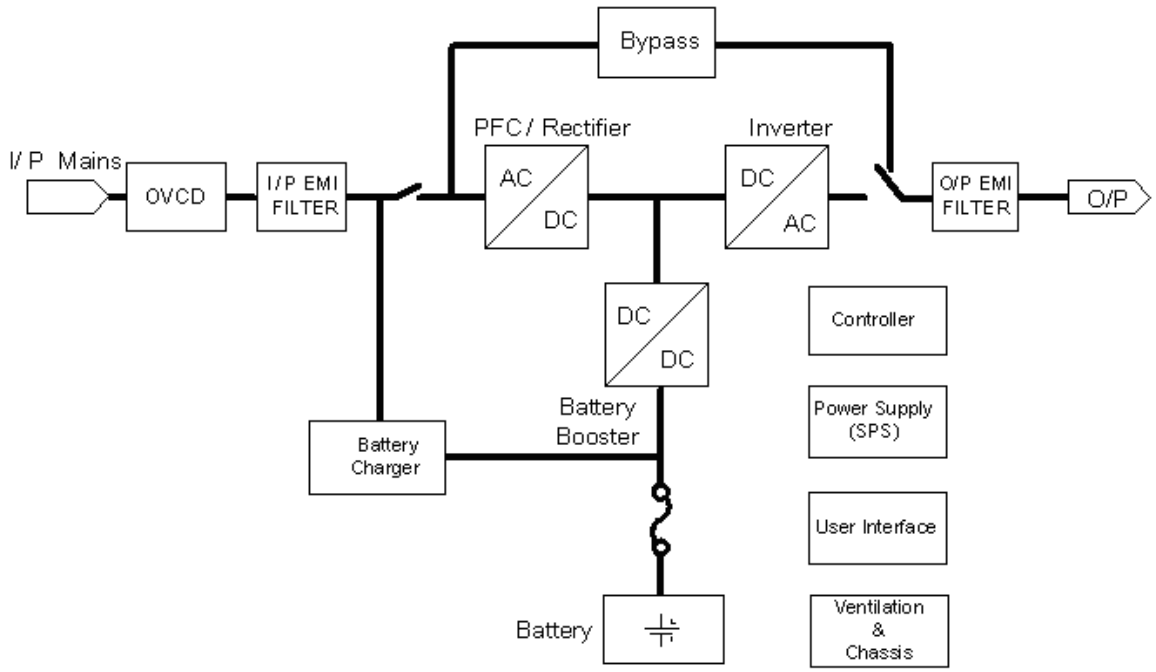


Figure 5.1.1 Function block Diagram of the product (with OVCD)

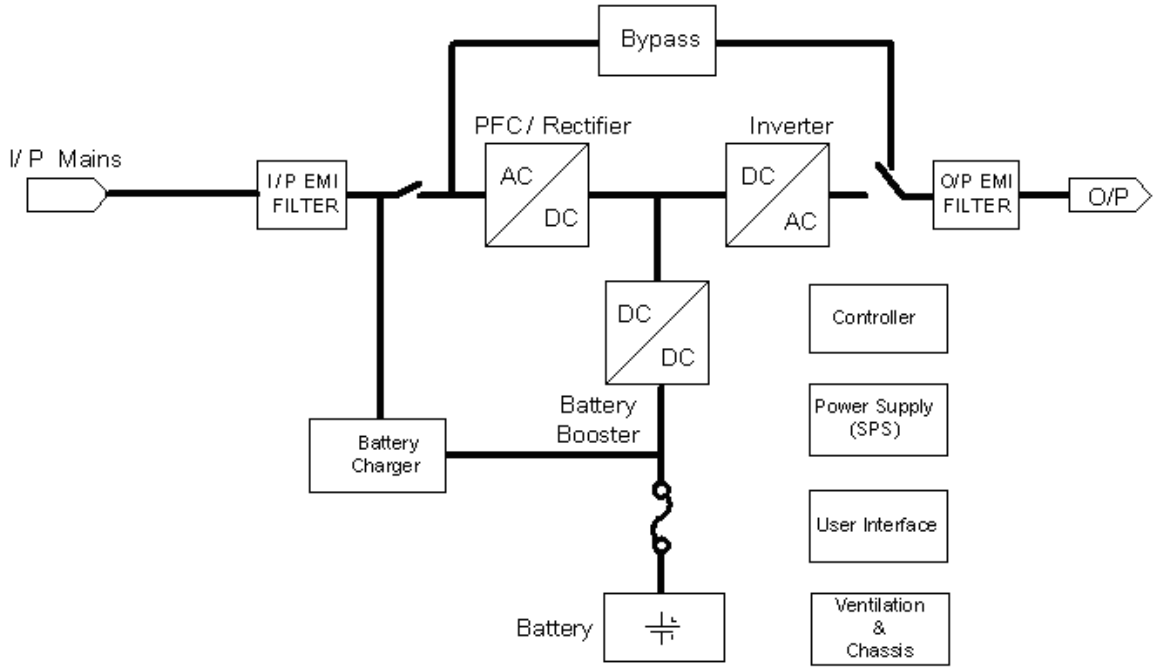


Figure 5.1.2 Function block Diagram of the product (Without OVCD)

In which:

The controller block controls the operation of the whole UPS, the controller block also provides communication interface for receiving and executing command from user via the panel or a preset protocol.

The AC/DC module, called also PFC/rectifier, belongs to input stage of the UPS. The AC/DC converter block converse the AC mains input power into a pair of stable DC power storing on the DC-BUS. In means time, Power Factor Correction is performed, the input current tracking the input voltage waveform, and the input power fact can very close to 1, achieve maximum efficiency and product lowest power pollution to the power supply system.

The DC/DC module, called also Battery Booster, is another part of input stage, used to converse the low level DC power into higher level and more stable DC power, storing on the DC-BUS also.

The DC/AC module, call also inverter, belongs to the output stage of the UPS, used to converse the DC power from the DC-BUS into clean, stable AC output power.

When the mains line is within the tolerance range, the UPS use the mains input, at this time, the AC/DC converter work; In case the mains line supply is output tolerance range, due to either the voltage or the frequency, the UPS will stop the AC/DC converter working and start the DC/DC module. In case the input mains supply interrupts suddenly, the controller can detect the interruption in very short time, and in the interval before detecting the interruption, the output power will be maintain by energy stored in the DC-BUS capacitor, there will never be appear interruption on output.

The battery charger module converse the AC mains input into DC power for recharging the Battery. Two type of charger can be available, one is for the standard model, and another is for long backup time model that connects external battery.

The input EMI filter and output EMI filter are used for two purpose, the first one is to prevent the UPS being interference by external electronic/magnetic noise which generated by the other electronic system, the second is to prevent the noise generated inside the UPS system interference other system.

The OVCD (Over Voltage Cutoff Device) would cut off the input of UPS completely while the mains is abnormally high, to protect the UPS.

The Power supply block generates DC power supply needed by operation of the circuit of the UPS itself.

The internal Bypass provides an alternative path in case the power conversion stage become out of order, to maintain the continuity of output supply.

5.2 Operating Principle Of The Major Functional Block

5.2.1 AC/DC Converter (PFC)

The purpose of AC/DC converter is to generate a stable bipolar DC BUS for inverter, another very important task of AC/DC converter is to make the input current track input voltage waveform therefore achieve a high input power factor close to 1, performing PFC (Power Factor Correction), That is why we also call the AC/DC converter PFC converter.

Figure 5.2.1.1 showed the topology implement the PFC converter.

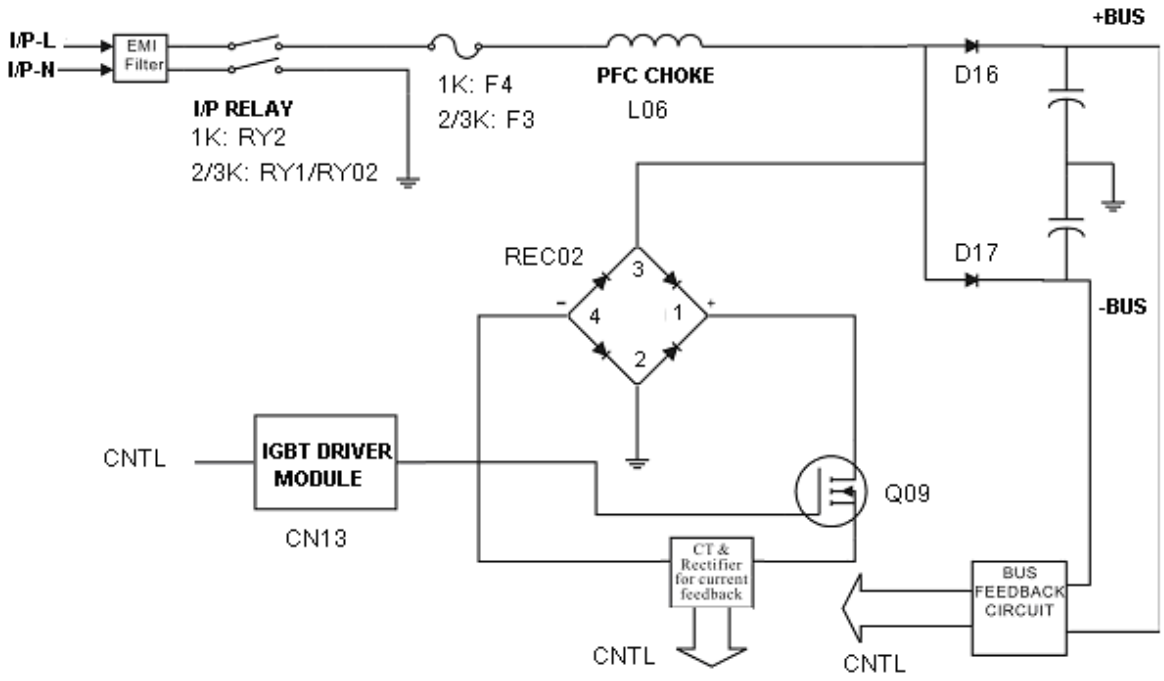


Figure 5.2.1.1 PFC converter

The PFC converter comprise several sub-circuit, the first one is the modified BOOST power topology, the second one is the driving circuit, the third one is the detecting circuit, which can further divided into signal sensor, feedback circuit and the actuator.

When AC mains is in normal condition, after receive the turn on command, the global controller turns on the AC relay and enables PFC converter work, the global controller outputs PWM (Pulse Width Modulation) signal, the PWM signal will be isolated, amplified and use to drive switching component, the IGBT. When The IGBT is turned on, the current flow through the PFC chock increase, the chock is energized, when the IGBT is turned off, the chock de-energize and charge the DC-BUS capacitor. By controlling the Duty Cycle of the PWM signal, the energy charging the DC-BUS capacitor can be controlled, therefore the voltage of the DC BUS can be controlled, at the same time the waveform of the current can also be controlled to track the input voltage waveform, implement the power factor correction.

The P.F.C. output voltage, i.e. the DC BUS voltage, will be regulated at ±350 Vdc, ±365 Vdc, and ±380 Vdc when the UPS output voltage is set to 220Vac, 230V, and 240Vac respectively.

5.2.2 DC/DC Converter (Battery Booster)

In case the AC mains interrupt or being out of tolerance range, the global controller stop the PFC converter and start the DC/DC converter to converse the DC power from the battery to maintain the DC-BUS voltage, therefore maintain the output power supply to the load.

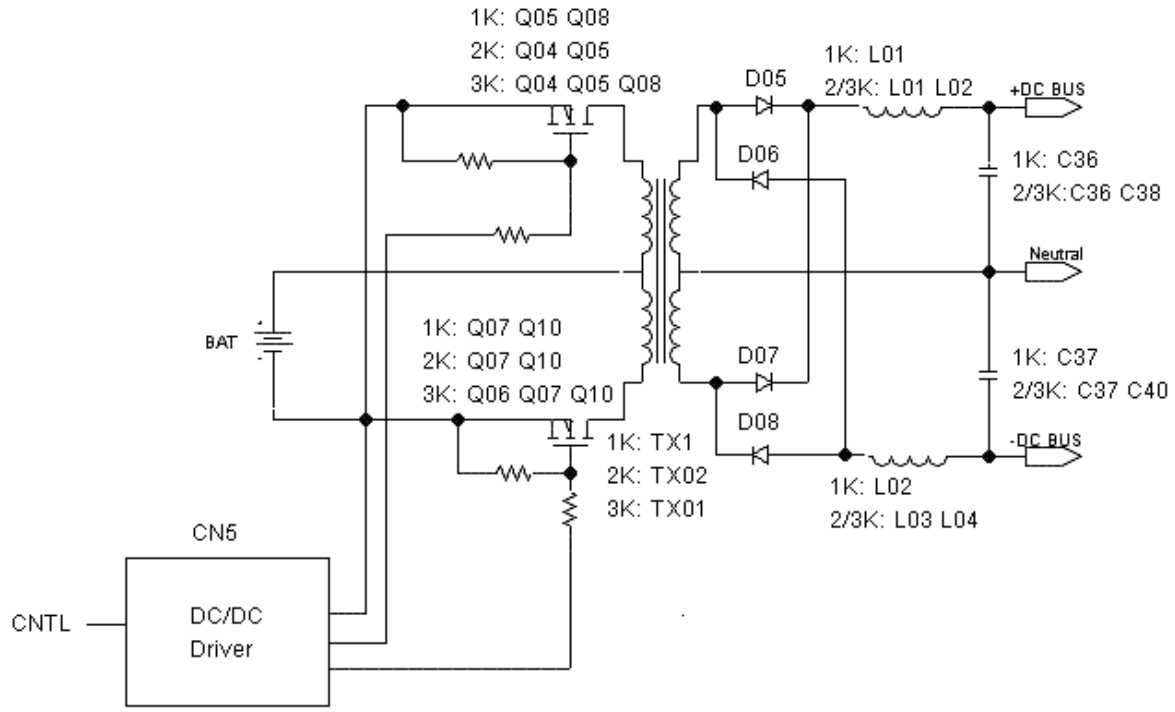


Figure 5.2.2.1 DC/DC Converter

The DC/DC converter employed a push-pull power topology, the driving circuit.

The DC/DC converter controller drive a pair of switching component, MosFET used here, turn on in turns, the switch frequency goes above 45-51kHz. Either of the MosFET is turned on, there will be power from the Battery transfer to the secondary side of the transformer to charging the DC-BUS. The MOSFETs turn on /off in turn, can prevent the saturation of the transformer and damage of the circuit.

Normally, the DC/DC converter output regulated in the range of ±350 Vdc to ±380 Vdc when the UPS output voltage is set to 220Vac, 230V, 240Vac respectively.

5.2.3 Inverter

The inverter converse the DC power from DC BUS into the AC output to supply the load. A half bridge topology employed, Figure 5.2.3.1 shows a diagram of inverter in 1/2/3k product.

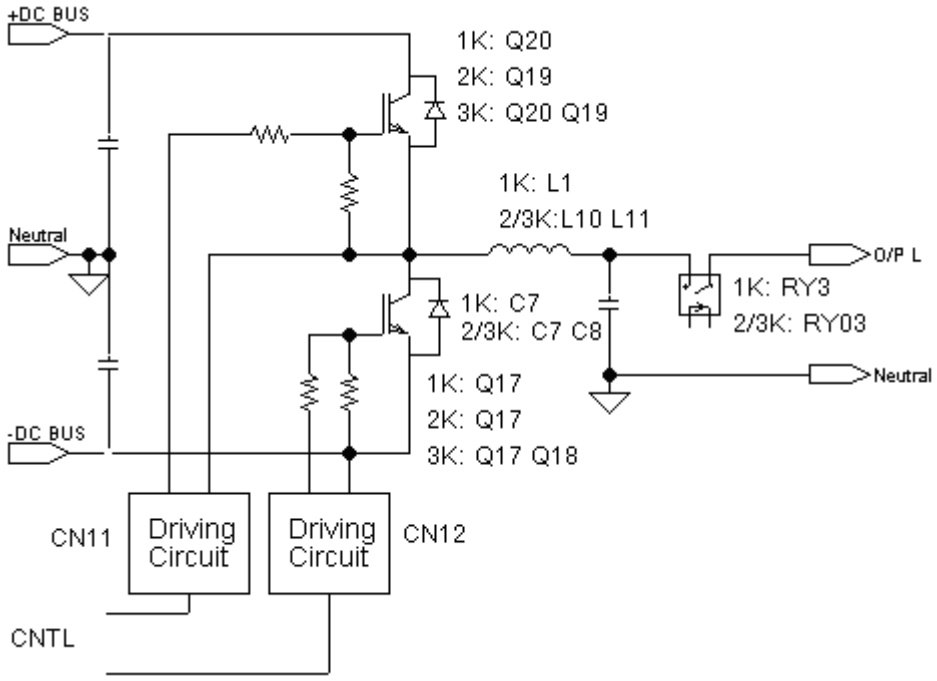


Figure 5.2.3.1 Schematics for inverter

The half bridge inverter comprise a pair of complement switching device, IGBT, a free wheel diode parallel with each IGBT, forming a switching leg, a driving circuit for each IGBT, a LC filter, and the controller. In the real circuit, an IGBT with co-pack diode is used to simplify circuit and achieve minimize stray parameter,

When the positive IGBT is turned on, The output of half bridge is equal to Positive DC BUS voltage, when the positive IGBT is turned off, either the negative IGBT is turn on or the negative free-wheel diode is active, the output of the switching leg is negative DC BUS, so by change the duty cycle, average of output of the switching leg can vary from +BUS voltage to –BUS voltage, the output of the switching leg filtered by a LC filter to get clean and stable sine wave the output voltage.

5.2.4 Global Controller

The Global Controller of UPS composed of following major circuits as following.

(1) CPU Central Processor Unit

(2) Signal conditioning circuit

(3) Regulation & Protection circuit

(4) Output buffering circuit

(5) Communication interface

The CPU can be regards the brains of the UPS, in charge of signal detecting, measurement, processing, timing control, inverter operating control, protection, communication.

To control the UPS, the status of the UPS must be monitored, Difference kinds of sensor are widely used in the UPS, due the pure condition of the signal given but the sensors, so, Signal conditioning circuit is use to attenuate / amplify / filter the signal given by the sensor, became suitable to be processed by the CPU.

The regulation network of the inverter, forming a close loop controller, enable inverter run stably, and get desired performance, such as less distortion, good dynamic response performance, etc.

The global controller also implement following protection function:

1. Overload Protection
2. Cycle by Cycle Current Limitation
3. Battery over or under voltage shut down
4. Inverter output abnormal protection
5. Over temperature protection
6. Bus over-voltage protection
7. Fans lock protection

Due to the high level integration, the global controller is not desired to maintenance or repair out of manufacture factory. There are two methods to identify the status of global controller. The first one is to test with test fixture; the second is to test the global controller on a PSDR that has been verified OK.

5.2.5 Standard Charger And Super Charger

The utility of charger is to recharge and to maintain the batteries at fully charged condition. The charger the battery with a constant current at initial stage, as the battery voltage keep increasing, the charge current decrease accordingly, and the

voltage until the floating recharge voltage, and the charger will control the output at a constant level (2k/3k 110.4 Vdc, 1k 41.2Vdc). In this way, to make the battery full recharged but not over recharge, protects and prolongs the lifetime of charged batteries.

Refer to fig. 5.2.5.1; the battery charger employed a Flyback topology, under controlling of the controller mainly comprise an ASIC uc3845, the switching component MosFET turn on /off at a frequency around 100KHz, when the MOSFET is turn on, the current in the transformer increase, and a certain amount of energy is stored in the transformer, when the MOSFET turn off, the energy stored in the transformer start to release to from the secondary side of the transformer and charge the output capacitor, by controlling the duty cycle, energy transfer to secondary side of the Flyback circuit can be controlled, and so on the output voltage.

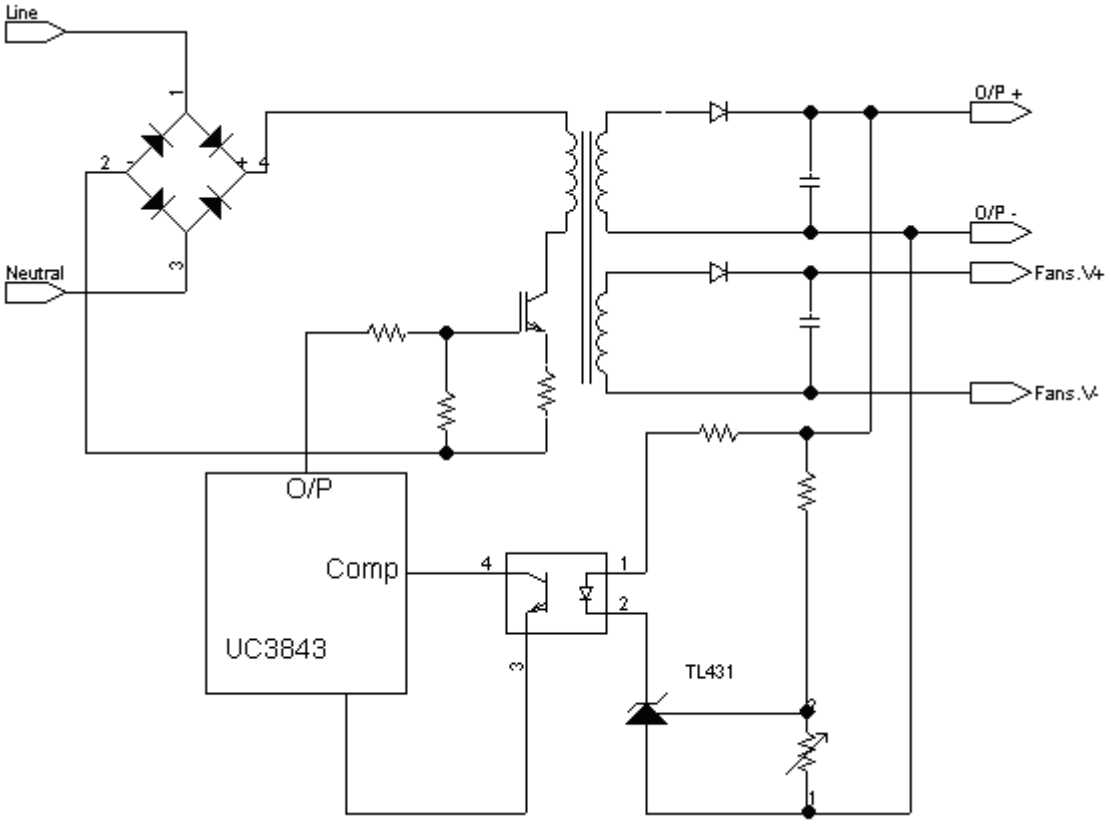
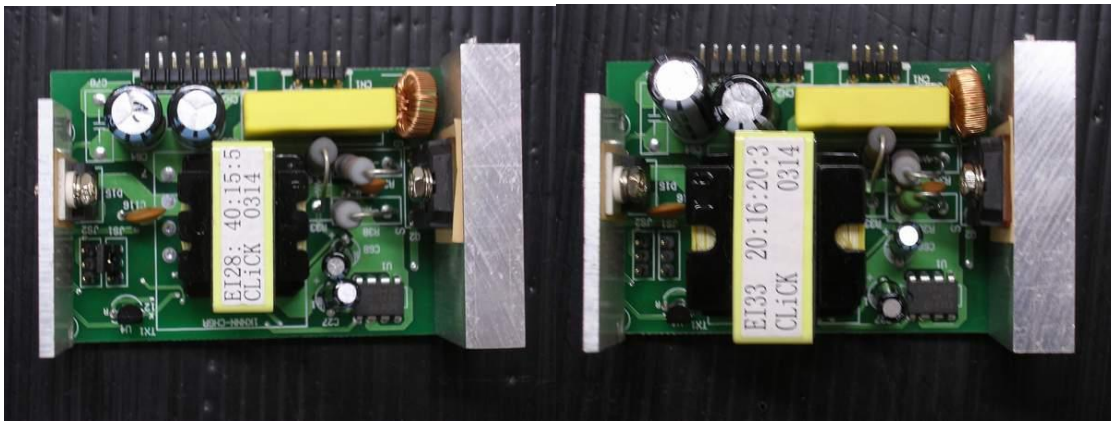


Fig. 5.2.5.1 Topology of the standards and supper charger

There are two kind of charger for standard model UPS and long backup time model UPS. Both operating in the same principle, but difference output capacity, the one for standard model UPS capable of outputting 1A current, is soldered on the PSDR, Fig. 5.2.5.2 shows photo of standard charger. A super charger module with

maximum 8A charge current capacity, is used in the long backup time model UPS. Photos of super charger can be found in Fig. 3.2.1.2 & Fig. 3.2.2.2.



41V CHARGER MODULE 110V CHARGER MODULE

Fig. 5.2.5.2 Standard 1A charger

5.2.6 Auxiliary Power Supply (SPS)

The Auxiliary Power Supply (SPS) module supplies DC power for UPS operation. The input of the SPS is the battery, or the output of the charger. The SPS module output +12 Vdc, -12 Vdc, +5 Vdc and a High frequency low level AC power, called H.F power+/ -. The SPS module works only when the +12 Vdc regulator supplies Vcc to its control IC.

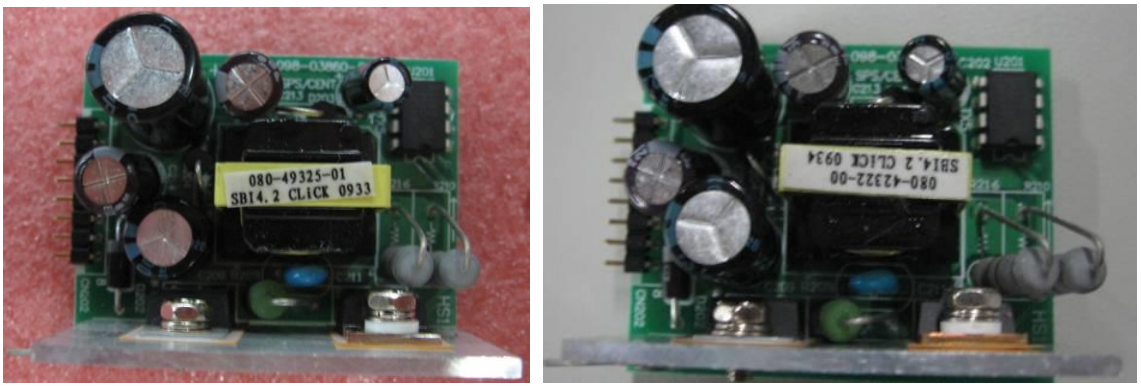
+12 Vdc mainly uses for Relay driving, Signal amplifier, Fans supply, the source of IGBT gate drive power and generates +5 Vdc power supply.

-12 Vdc only uses for signal amplifier.

+5 Vdc uses for buzzer power and generates +3.3 Vdc and +1.8 Vdc power supply for the CPU.

The H.F power+/ - is the source of the isolated power supply for communication ports.

Fig 5.2.6.1 shows SPS module for 1K & 2/3K UPS respectively.



1K SPS 2/3K SPS

Fig.5.2.6.1 SPS Module

5.2.7 User Interface

5.2.7.1 Front Panel

The front panel consists 2 parts: push button and LCD indicator.

The push button is used to turn on and off the UPS, or do some simple setting.

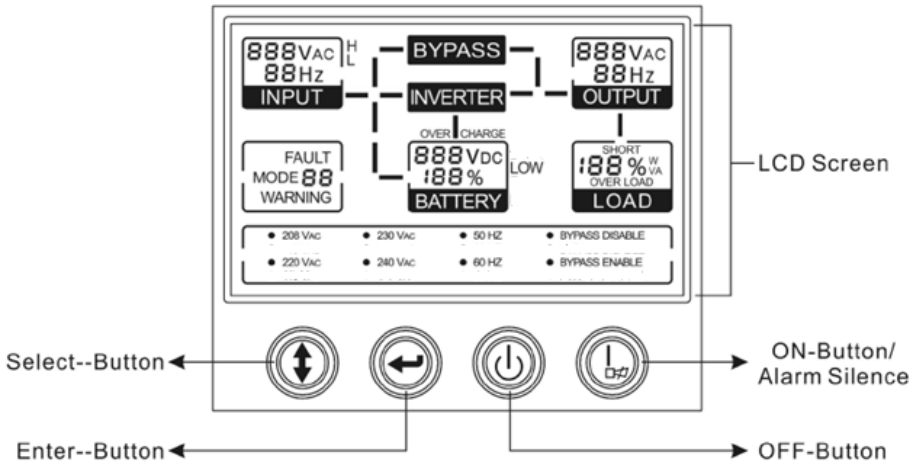


Fig.5.2.7.1 LCD display panel

All UPS information including the input, the output, the battery, the load and the status of UPS are displayed on the LCD screen. The detailed illumination of LCD display can be found in the later section.

When UPS is out of order, the fault code will be displayed and the buzzer will beep continuously. The detailed definition of the warning or fault code can be found in later section.

5.2.7.2 Communication Interface

The communication interface provides a means for using computer to manage the UPS, on the rear panel of the UPS, a USB1.1 port and an intelligent slot are provided.

With dedicated software, output voltage, frequency can be set via the USB port; also status of the UPS can be monitor.

The intelligent slot can accept SMNP, AS400, RS232 adaptor card, for more flexible application solution.

The communication interface circuit provides isolation and voltage level transform function for communication; the communication protocol is implement by the CPU.

5.2.7.3 Emergence Power Off

The Emergence Power Off interface provides an emergence power off function. When the EPO function is enabled, once the EPO port is pulled out, the UPS would shut off the output and enter into EPO mode, and the UPS would not respond anything command unless the port is plugged back.

5.2.8 Ventilation And Chassis

Ventilation system of the UPS consist of air flow guiding insulation paper and fans, The ventilation system keeps the temperature of component of the UPS in safe range, so it is very important for the UPS, To achieve lowest acoustic noise and longest life time of the fans, a fans driver and intelligent fans speed control algorithm is employed.

The chassis of the UPS provide a strong construction accommodate all the electrical part, shield for EMC, and safety guard for operator.

Basically, the chassis comprise a base plant, an internal support plant, a front support plant, an out side cover, a rear panel, and a front panel.

5.3 PCBs Of The UPS

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

1.PSDR	Contains major converter of the UPS (1) PFC converter, (2) DC-DC converter (3) inverter (4) SPS (switching power supply) and necessary sub-circuit for complement and supporting major converter which have been modulized, Includes: a) Standard charger module (for standard model only), b) DCDC driver module, c) PFC/INV IGBT driver module and appropriate sensors and conditional circuit for the system regulation and protection.
2.CNTL	Contains major parts of protection, signaling circuits, regulation and control circuits of UPS.
3.I/P EMI	Input EMI filter
4.O/P EMI	Output EMI Filter
5.OVCD	Over voltage cutoff device
6.Interface	LCD Panel: The Panel PCB provides system information with LCD indicators, and button for turning ON/OFF The UPS.
	USB communication interface and support intelligent slot interface.
	Emergence power off interface.
7 Charger	For Long backup time model product, there is a independent super charger boards

5.4 Interconnection Of The PCBs

The simplified schematics in and Fig.5.4.1 shows how the major circuits are connected, and illustrates the overall system functions. . P/N shown in the Fig.5.4.1 and Fig.5.4.2 may vary according to customer request.

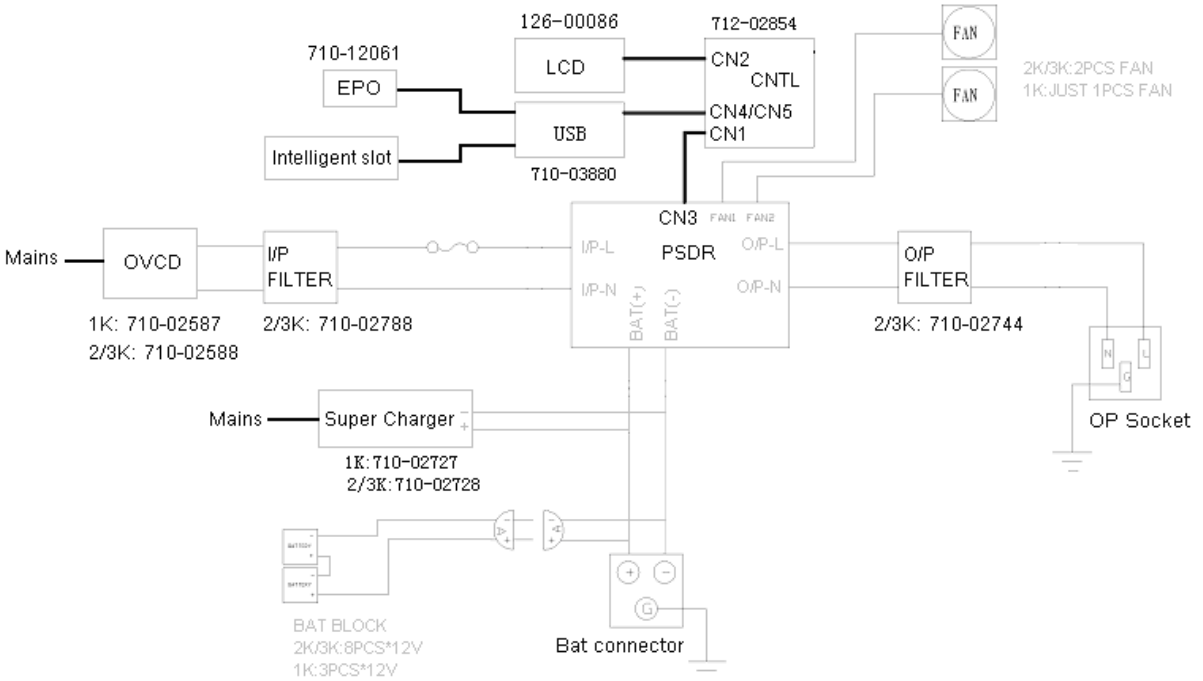


Fig.5.4.1 PCB Interconnection (with OVCD)

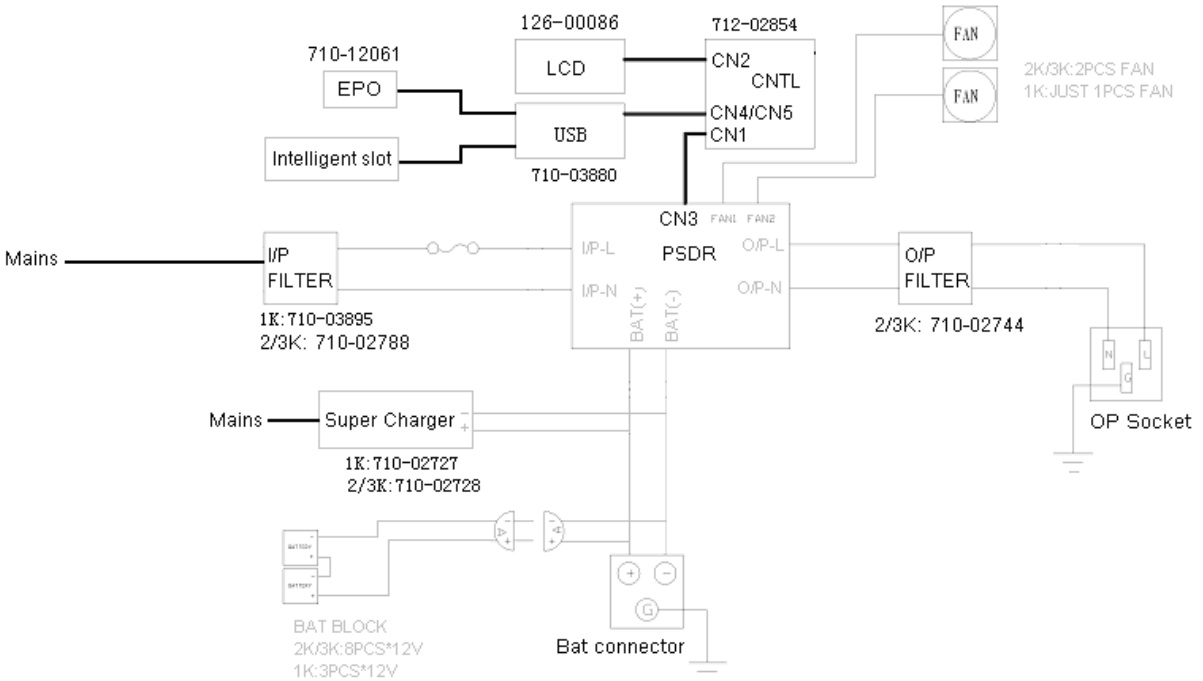


Fig.5.4.2 PCB Interconnection (without OVCD)

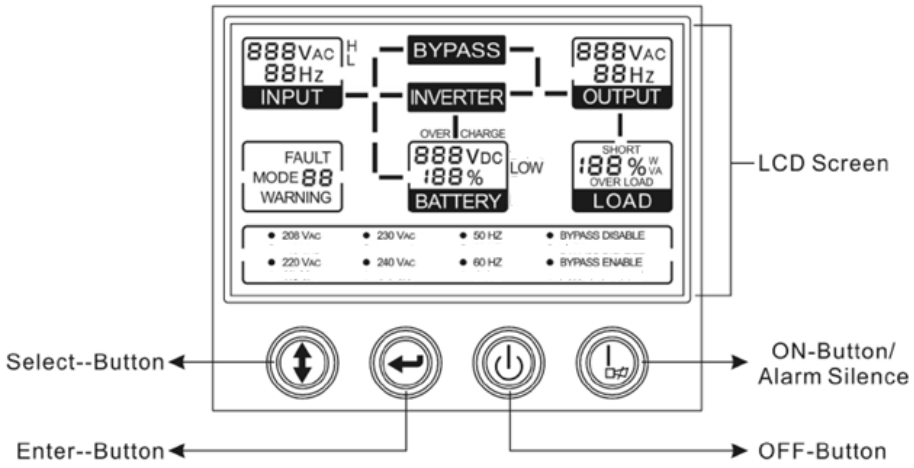
6. Trouble Shooting

Despite of careful design and strict tests, in case UPS become out of order. Basically, designer suggest following service procedure:

1. Check the UPS status by LCD panel display, or listen to the end user description
2. Identify the failure part/boards with the help of failure identify flowchart.
3. Observe the failure board, Static checking
4. Replace the failure components with OK parts
5. Static checking
6. Power up checking
7. Test after repair.

Following section will help service person to solve the most problems.

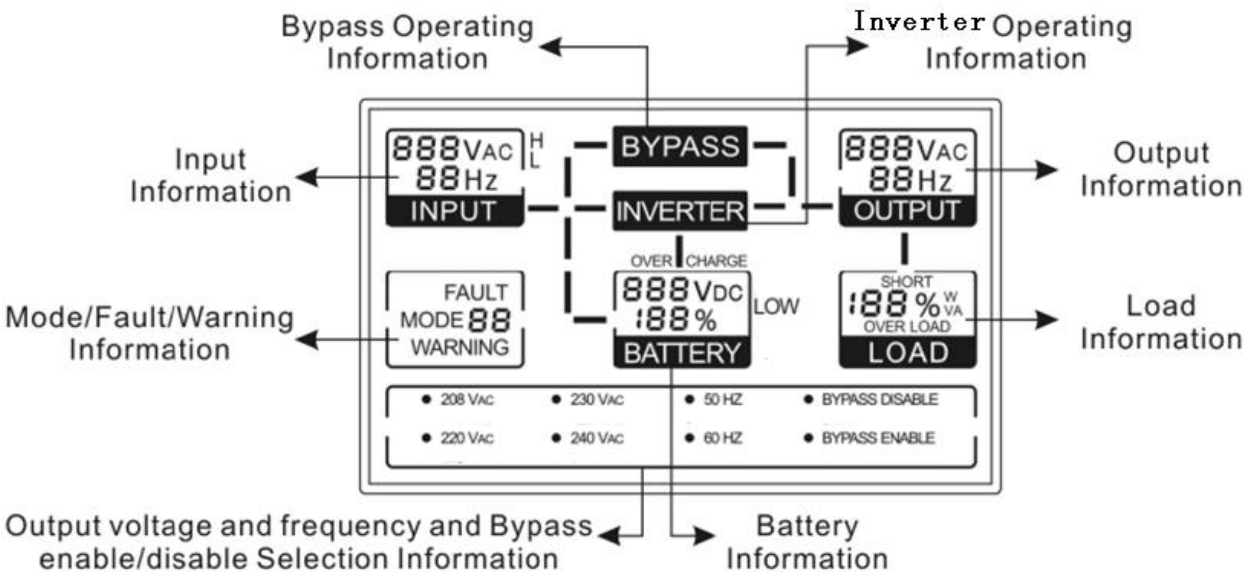
6.1 LCD Panel Display Definition



The Display Panel

Switch	Function
ON-Button	Turn on UPS system: By pressing the ON-Button “I” the UPS system is turned on. Deactivate acoustic alarm: By pressing this Button an acoustic alarm can be deactivated in the battery mode. Do the battery test: By pressing this Button the UPS can do the battery test in the Line mode or ECO mode or Converter mode.

OFF-Button	When mains power is normal, the UPS system switches to No output or Bypass mode by pressing OFF-Button "⏻", and the inverter is off. At this moment, if Bypass is enabled, then the output sockets are supplied with voltage via the bypass if the mains power is available. Deactivate acoustic alarm: By pressing this Button an acoustic alarm can be deactivated in the bypass mode.
Select-Button	If the UPS system is No output or Bypass mode, the output voltage and frequency and Bypass disable/enable and operating mode could be selected by pressing Select-Button, and confirmed by pressing Enter-Button.
Enter-Button	



The LCD Display

Display	Function
Input Information	
888VAC	Indicates the input Line voltage value, which could be displayed from 0 to 999Vac
88Hz	Indicates the frequency value of input Line voltage, which could be displayed from 0 to 99Hz
H	Indicates the input Line voltage is higher than the SPEC range, and the UPS would be working in Battery mode
L	Indicates the input Line voltage is lower than the SPEC range, and the UPS would be working in Battery mode
Output Information	
888VAC	Indicates the UPS output voltage value, which could be displayed from 0 to 999Vac
88Hz	Indicates the frequency value of the UPS output voltage, which could be displayed from 0 to 99Hz
Load Information	
188% W VA	Indicates the load percent in Watt or VA, only the maximum value of them could be displayed from 0 to 199%
SHORT	Indicates the load or the UPS output is short and the UPS would shut down
OVER LOAD	Indicates the load is over the SPEC range
Battery Information	
888 (1) VDC	Indicates the battery voltage value, which could be displayed from 0 to 999Vdc
188%	Indicates the battery capacitance percent, which could be displayed from 0 to 199%
OVER CHARGE	Indicates the battery is over charged, and the UPS would be switched to Battery mode
LOW	Indicates the battery is weak, and the UPS would shut down soon

Mode/Fault/Warning code Information	
FAULT MODE 88 WARNING	Indicates the operating mode of the UPS, Mode code or Fault code or Warning code could be displayed, and the codes are illuminated in detail in the following chapter
Inverter operating Information	
INVERTER	Indicates the circuit of the inverter is working
Bypass operating Information	
BYPASS	Indicates the circuit of Bypass is working
Output voltage and frequency and Bypass disable/enable selection Information	
208 VAC 230 VAC 220 VAC 240 VAC	The four value of the output voltage could be selected when the UPS is in No output or Bypass mode, and only one of them could be active in the same time
50 HZ 60 HZ	The two frequency value of the output voltage could be selected when the UPS is in No output or Bypass mode, and only one of them could be active in the same time
BYPASS DISABLE BYPASS ENABLE	Bypass disable or enable could be selected when the UPS is in No output or Bypass mode, and only one of them could be active in the same time

(1) Here would become UPS, ECO, CVF instead when the user does operating mode of UPS setting.

"UPS" means the setting of normal inverter mode (Line mode).

"ECO" means the setting of economy mode.

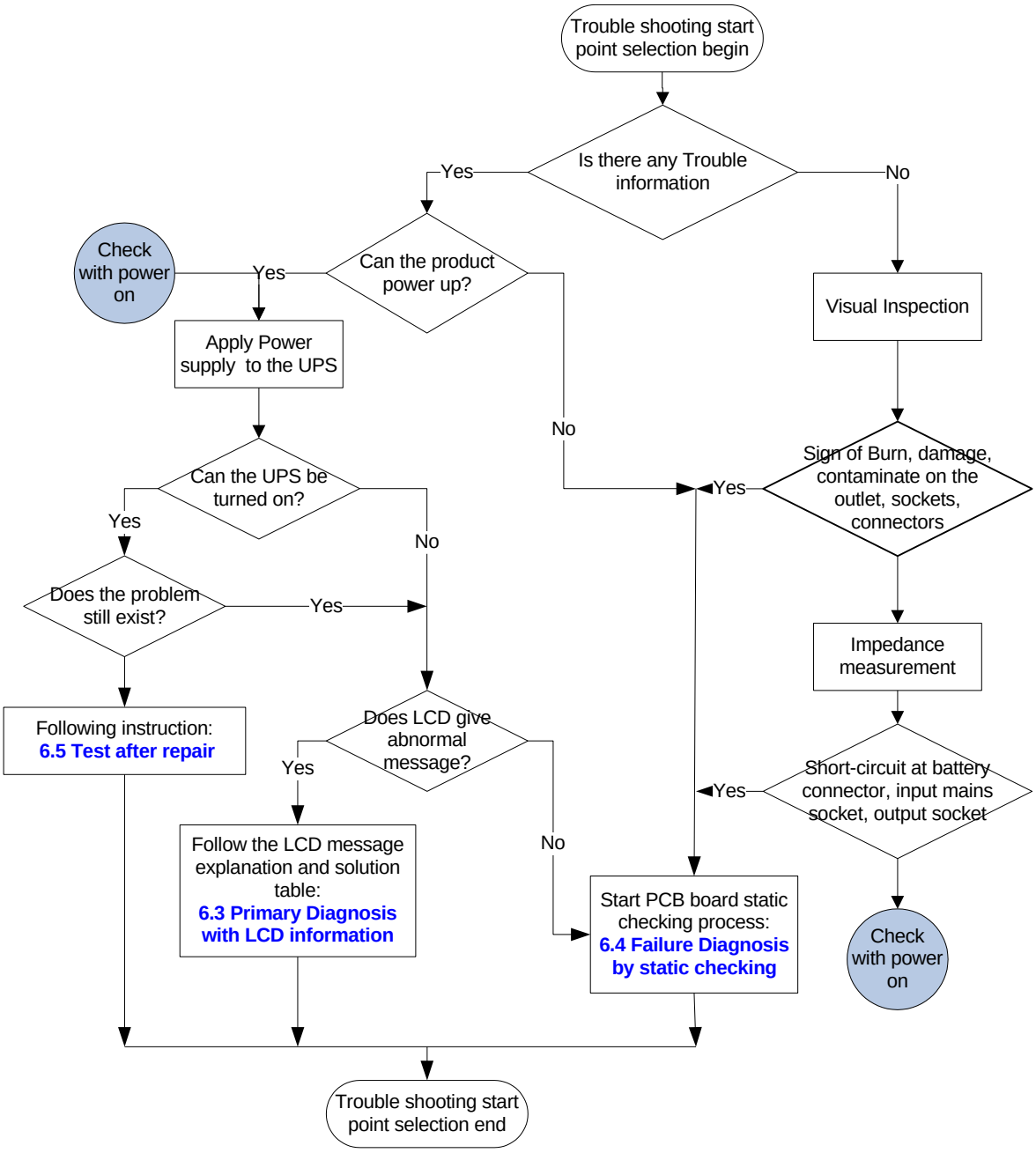
"CVF" means the setting of converter mode.

The detail illustration of the three modes and the operation of the setting would be presented in the following section.

If the UPS system does not operate correctly, please check the operating status on the LCD display which is very important to indicate the potential problem in the UPS.

Normal operating mode	Code
No output mode	0
Bypass mode	1
Line mode	2
Battery mode	3
Battery test mode	4
ECO mode	5
Converter mode	6
Warning	**Code**
Site fail	09
Fan fail	10
Battery over voltage (over charged)	11
Battery low	12
Charge fail	13
DC-DC temperature high	21
Inverter temperature high	24
Ambient temperature high	25
Line voltage high (OVCD action)	26
Battery open	27
Overload	29
EPO	30
Fault	**Code**
Bus fault	05
Inverter fault	06
Overload fault	07
Over temperature fault	08
Inverter short	14
Bus short	28

6. 2 How To Start



6.3 Primary Diagnosis With LCD Information

If the UPS system does not operate correctly, and you could get the failure information on the LCD display, here are some possible causes and remedies in the table below.

6.3.1 Trouble Shooting According To Warning Indication

Type	Possible cause	Action
Overload	Over load	1. Check the loads and remove some non-critical loads. 2. Check whether some loads are failed. 3. Check the detective circuit on the PSDR board.
Over Charge	The battery voltage too high	1. Check the battery number. 2. Check whether the charger is failed.
Charger Fail	The charger is broken	1. Check the charger circuit.
Fan Fail	Fan abnormal	1. Check if the fan is running normally. 2. Replace the fans. 3. Check the fan driver circuit on the PSDR board.
Site Fail	Phase and neutral conductor at input of UPS system are reversed	1. Check the input cord of UPS system, rotate mains power connection. 2. Check the site fail detecting circuit on the PSDR board.
Bat Open	The battery bank have not been connected	1. Check the battery bank is connected to the UPS. 2. Check the battery breaker is turn on. 3. Check the detecting circuit on the PSDR board.
Over Temp	Over temperature	1. Check if the UPS is overloaded, the air vents are blocked, and the ambient temperature is over 45℃. 2. Check the NTC and the thermal detecting circuit on the PSDR board.
Battery Low	The battery voltage is low	1. The battery capacity is low, and the UPS would shut down soon. The battery should be recharged. 2. The battery life time is over, replace new ones.
Line voltage high	The mains voltage is too high	1. Check the utility and wire connection. 2. If the mains is normal, check the OVCD board.

6.3.2 Trouble Shooting According To Fault Indication

Type	Possible cause	Action
BUS Fail	Bus is over voltage; Bus softstart fails;	1. Check if the load is inductive and too large. 2. Check the DC/DC part or PFC part on the PSDR board. 3. Check the INV part on the PSDR board.
INV Fail	INV voltage is too low or high; INV fails;	1. Check if the load is inductive and too large. 2. Check the INV part on the PSDR board. 3. Check the detecting circuit on the PSDR board.
Output Short	Output short circuit	1. Check if the load is short circuit. 2. Check the output part of the UPS. 3. Check the INV part on the PSDR board.
Over Temp.	Internal over temperature	1. Check whether the UPS is overloaded, the air vents are blocked, and the ambient temperature is over 45℃. 2. Check the NTC and the thermal detecting circuit on the PSDR board.
Overload	Over load	1. Check the loads and remove some non-critical loads. 2. Check whether some loads are failed. 3. Check the detective circuit on the PSDR board.
BUS Short	INV is failure	1. Check the INV, DC/DC, PFC part on the PSDR board.

6.3.3 Trouble Shooting In Else Cases

Problem	Possible cause	Action
Battery discharging time diminishes	Battery not yet been fully charged.	Keep UPS connected to utility power persistently for more than 5 hours (depend on the battery capacitance) to recharge the batteries.
	UPS overloaded.	Check the loads and remove some non-critical loads.
	Battery aged.	Replace the batteries.
	Charger failed	Check and replace the charger.
The UPS cannot be turned on after pressing the button	The button is pressed too briefly.	Press the button continuously for more than 1 second.
	Battery is not connected or battery voltage is too low, or Charger failed.	Check the charger and battery.
	SPS failed	Check and replace the power supply module on the PSDR board.

No indication, no warning tone even though system is connected to mains power supply	No input voltage	Check building wiring socket outlet and input cable.
	Charger failed	Check and replace the charger.
	SPS failed	Check and replace the power supply module on the PSDR board.
EPO Active	EPO function is enabled	1. Pull the EPO connector out. 2. Check and replace the EPO board, check wiring in the UPS. 3. Check and replace the USB board. 4. Replace the control board.
Communication fails	Communication circuit fails; Power supply fails;	1. Check the power supply on the PSDR board. 2. Check and replace the USB board. 3. Replace the control board.

6.4 Failure Diagnosis By Static Checking

In this section, some debug skills are listed to help you finding the failure components and problems as soon as possible. Before continuing the following steps listed, we suggest that you should read problem shooting chart in previous section then check the components listed in ***Quick Start*** to find out which block is out of order, in order to shorten the service time.

For the reason of safety, please follow safety instruction to begin your work

High Voltage Danger: Some components contain residue charge and remain dangerous high voltage even if the external power supply is cut of, operator should follow following instruction strictly avoid risk of electrical shock.

1.Unplug the power cord from the utility.

2.Open outside case shown in the beginning of this manual

3.Remove connectors from battery, for long backup time model, unplug battery cabinet connector to UPS.

4.Discharge energy in BUS CAPACITORS, and BATTERY CAPACITORS

5.Disassemble cable from connectors, if required.

6.Disassemble PCB if required.

Before starting service, some tools are necessary, at least: A DMM (Digital Multifunction Meter) meter, screwdrivers and discharge resistor (300Ω/10W recommended). A DC power supply with current limiting (over current protection) function (120VDC/3A at least) is recommended for fast and safe diagnosis.

TO DISCHARGE the residue charge on bus capacitor,

For 1k(s) model contact **P07 BAT (-)** terminal and upper lead of **R139** with a 300Ω/10W resistor to discharge +BUS capacitor, contact **P07 BAT (-)** terminal and upper lead of **R129** with a 300Ω/10W resistor to discharge -BUS capacitor

For 2k(s)/3k(s) model, contact **P5/P07 BAT (-)** terminal and upper lead of **R139** with a 300Ω/10W resistor to discharge +BUS capacitor, contact **P5/P07 BAT (-)** terminal and **R129** upper lead with a 300Ω/10W resistor to discharge -BUS capacitor

TO DISCHARGE the energy of battery capacitor, **after disconnect the battery from PSDR/Charger**, you can use a 300Ω/10W resistor contact **BAT (+) terminal** and **BAT (-)** terminal for discharge battery filter capacitor

If the module is damaged, it is not recommended to change components on the module, just replace the whole module.

DO NOT power up UPS with the mains unless you are sure that you have replaced all defective components.

6.4.1 Quick Start

Before any detail check of UPS, please check the components listed in the following table. This action could help you find problem quickly and make following debug procedures go smoothly.

Related Circuit Block	Components to be checked	Component Type	Fail condition
BAT FUSE	1K/3K: F1/F2 2K: F1	Fuse	Open
I/P FUSE (on PSDR)	1K: F4 2/3K: F3	Fuse	Open
PFC converter	D16, D17, REC02	Power Diode	Short or open
	Q09	IGBT	C-E short or open
Push-Pull Booster	1K: Q05, Q07, Q08, Q10 2K: Q04, Q05, Q07, Q10 3K: Q04, Q05, Q06, Q07, Q08, Q10	MOSFET	D-S short or open
	D05, D06, D07, D08	Power Diode	Short or open
Inverter	1K: Q17, Q20 2K: Q17, Q19 3K: Q17, Q18, Q19, Q20	IGBT	C-E short or open
Super Charger	1K: F501, F502 2/3K: F2, F1	Fuse	Open
	1K: Q501, Q502 2/3K: Q1, Q3	MOSFET	D-S short or open
	1K: D501, D502, D507, REC501 2/3K: D2, D3, REC1	Power Diode	Short or open
OVCD	F1	Fuse	Open
	Q1	MOSFET	D-S short or open
	D5, REC1	Power Diode	Short or open

If the fuse is open, replacing fuse only **DOES NOT** mean you have solved the problem. In most case, open of fuse is caused by other failure of components; therefore, before restart that UPS, you must find the real failure components and replace them!

6.4.2 PFC Converter Analysis:

In this section, some components you could check to see if failure occurs to P.F.C Converter. **General speaking**, OPEN of fuse F4/F3 indicates failure of this block. Please replace all fail to check components then utility can be connected to your UPS.

Item	Checked components	Instrument function	Reference Value	Failed condition
1	1K: F4 2/3K: F3	Ω	Short	Open
2	Q09 (C→E)	Diode Voltage Droop	Infinite	Short or open
3	D16, D17	Diode Voltage Droop	0.44	Short or open
4	1K:R45 / R44 2K/3K:R66 / R209	Ω	1K: 10.0/22.0 2/3K: 22.0/47.0	Open or value change
5	REC02 (+,～),(～,-)	Diode Voltage Droop	0.46	Short or open

If fail condition stated in item 4 occurs, it is very possible that the corresponding PFC IGBT driver module is damaged, so please try to change the PFC IGBT driver module

6.4.3 Push-Pull DC-DC Converter Analysis

General speaking, the most obvious phenomenon of failure on the section is open of F1 and F2. Knowing this will be very helpful to repair them.

Item	Checked components	Instrument function	Reference Value	Failed Condition
1	F1, F2	Ω	0Ω	Open
2	1K: Q05, Q07, Q08, Q10 2K: Q04, Q05, Q07, Q10 3K: Q04, Q05, Q06, Q07, Q08, Q10	(S→D) Diode Voltage Droop	0.42V	Short or open
		(D→S) Diode Voltage Droop	Infinite	Short or open

3	1K: R33, R36, R38, R42 2K: R31, R33, R42, R36 3K: R31, R33, R34, R36, R38, R42	Ω	1K: 10Ω 2K: 36Ω 3K: 36Ω	Open or value change
4	D05, D06, D07, D08	Diode Voltage Droop	0.41V	Short or open

BE SURE TO use fuse with same spec as original ones to replace failure ones, otherwise, unpredictable danger could happen.

If fail condition stated in item 3 occurs, it is very possible that the corresponding DCDC driver module is damaged, so please try to change the DCDC driver module.

6.4.4 DC/AC Inverter Analysis

Item	Checked components	Instrument function	Reference Value	Failed Condition
1	1K: Q17, Q20 2K: Q17, Q19 3K: Q17, Q18, Q19, Q20	(E→C) Diode Voltage Droop	0.4	Short or open
		(C→E) Diode Voltage Droop	Infinite	Short
2	1K: R49, R46 / R47, R48 2K: R124, R127 / R128, R123 3K: R124, R127, R105, R142 / R128, R123, R112, R121	Ω	1K: 10.0/22.0 2K: 10.0/27.0 3K: 10.0/27.0	Open or value change

If fail condition stated in item 2 occurs, it is very possible that the corresponding INV IGBT driver module is damaged, so please try to change the INV IGBT driver module.

6.4.5 Super Charger

Item	Checked components	Instrument function	Reference Value	Failed condition
1	1K: F501, F502 2/3K: F2, F1	Ω	0	Open
2	1k: REC501 (~→+)/(-→~) 2K/3K: REC1 (~→+)/(-→~)	Diode Voltage Droop	0.4V	Short or open
3	1K: Q501, Q502 (S→D) 2K/3K: Q1, Q3 (S→D)	Diode Voltage Droop	0.4V	Short or open
4	1K: D501, D502, D507 2/3K: D2, D3	Diode Voltage Droop	0.45	Short or open
5	1K: R515 / R516 2/3K: R25, R27 / R26, R28	Ω	0.22 / 0.3	Short or open
6	1K: R522, R507 2/3K: R20, R15	Ω	1K: 22 2/3K: 10	Short or open

If all components listed above are in normal condition and charger still can't work, try to change U502 (1K) 3845 or U1 (2/3K) 3843.

6.4.6 OVCD

Item	Checked components	Instrument function	Reference Value	Failed condition
1	F1	Ω	0	Open
2	Q1 (S→D)	Diode Voltage Droop	0.4V	Short or open
3	D5	Diode Voltage Droop	0.4V	Short or open
4	REC1 (~→+)/(-→~)	Diode Voltage Droop	0.4V	Short or open
5	R9	Ω	47	Short or open

If all components listed above are in normal condition and OVCD still can't work, try to change U1 3845.

6.4.7 Others

For O/P DC balance problem, it is almost caused by incorrect bus voltage. If this indeed happen, please try to find which mode the problem arise. For example, if it happens under Line mode, you must measure bus voltages to see if they are correct. After doing this, debug the corresponding circuit. If unfortunately, both modes are incorrect, two possible circuits should be check: Bus feedback loop (on PSDR) and auto-balance circuit (on CNTL).

6.5 Test And Finish

After replace all defected components on power stage (PSDR), following test the steps can be adopted to verify the repair result and the reliability of the UPS.

1. Connect all of boards, cable, and connector right to place.
2. Check the Wiring
3. Apply DC Power from power source with current limitation function to the BAT terminal on the PSDR, the voltage of the DC power should be 96-110Vdc/3 Amp (limited current) for 2/3K UPS, 36~41Vdc/3Amp 1K UPS
4. Press the ON-switch on front panel for 2 seconds, then UPS should be DC started, If UPS does not start successfully. Please try diagnosing procedure again.
5. If UPS does not start up for several trying or DC power supply is on current-limit state continuously, there must be some defected components exists. Please follow trouble-shooting chart to debug again.
6. Stop the UPS; apply AC mains to the UPS module. Try on the UPS. If fail you may have start one new round of trouble shooting
7. Check the output voltage waveform and DC-offset voltage, at no-load and full load condition.
8. In most case result of step7, 8 can represent whether product in normal condition, If possible, however, for more reliability, perform quick check follow procedure shows in table would help in know the UPS situation in detail.
9. If possible, do a burn-in test on repaired UPS before return it to customer, the longer the better.
10. If every step is ok, Congratulation, you have finish the maintenance/ repair work.

Tab.

TEST ITEM	TEST POINT	TEST AND ADJUSTMENT SEQUENCE	EXPECTED RESULT
+DC Bus Voltage @ Battery Mode	R139Top (+) and GND	1. Connect DVM (Set to measure DC Volt) to test point. 2. Connect BAT wires and turn on DC source. 3. Press ON bottom for 2 seconds to turn the UPS on. 4. Waiting for 10 seconds to make sure the UPS is in battery mode. 5. Check measurement result on DVM	+350VDC to +380VDC
-DC Bus Voltage @ Battery Mode	R129 Top (+) and GND		-350VDC to -380VDC
O/P voltage	O/P socket	1. Keeping UPS on @ Battery mode. 2. Connect DVM (Set to measure AC Volt) to test point. 3. Check reading on DVM	220Vac (or 230Vac, etc according to the setting)
O/P DC Balance @ Battery Mode	O/P socket	1. Keeping UPS on @ Battery mode. 2. Connect DC measurement fixture to O/P socket. 3. Check reading on DVM.	100mV max.
+DC Bus Voltage @ Line Mode	R139Top (+) and GND	1. Connect input power cord to utility. 2. Waiting for several seconds to make sure the UPS transfers to Line mode. 3. Check reading on DVM	+350VDC to +380VDC
-DC Bus Voltage @ Line Mode	R129 Top (+) and GND		-350VDC to -380VDC
O/P voltage	O/P socket	1. Keeping UPS on @ Line mode. 2. Connect DVM (Set to measure AC Volt) to test point. 3. Check reading on DVM	220Vac (or 230Vac, etc according to the setting)
O/P DC Balance @ Line Mode	O/P socket	1. Keeping UPS on @ Line mode. 2. Connect DC measurement fixture to O/P socket. 3. Check reading on DVM.	100mV max.

Appendix

DC Offset Measurement Fixture

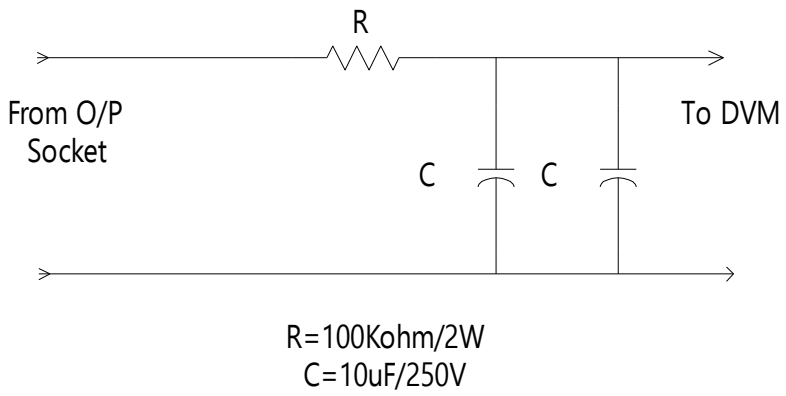


Fig.A.I.1 DC Offset Measurement Fixture