GTEC UPS MODEL:

AP160N RT 1/1,5/2/3 kVA

SERVICE MANUAL

www.gtec-power.eu

WARNING

(For qualified service personnel only)

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

CAUTION

1. After opening the cover, please always check the tightness of all wires, connectors, and screws first. Then check if there is any discolored components inside.
2. DO NOT make internal batteries short-circuited.
3. After service, verify the polarity of batteries, the tightness of all screws and connectors before restarting the UPS.

I. OVERVIEW

1. INTRODUCTION

For all UPS of this series, they are strictly tested and carefully designed. 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 unavoidable failures of the UPS. If this situation occurs, service of qualified person is needed. This service manual will guide the technicians to repair and adjust the 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 of UPS (Uninterruptible Power System), it is very easy to maintain and service.

* All major power components are put on PCB.
* Major parts are simply connected with flexible insulated wires and plugs.
* All PCBs are interconnected with connectors.

This service manual consists of 4 major parts:

1. Overview, and it describes mechanical of the UPS.
2. Principle of operation and PCB function, it describes the functions and principles of each part.
3. Front panel, it describes the setting and information by LCD of the UPS.
4. Trouble shooting: This part describes the possible failure conditions and procedures to repair it.

Before starting to serve the UPS, be sure to read this manual carefully for a correct and safe operation.

2. MACHANICAL

(MODEL: AP160N RT 1/1.5/2/3k(S)VA on-line UPS).

THE STEPS TO OPEN THE CASE AND REMOVE PSDR ASSEMBLE.

STEP 1: Take off the LCD box , remove the three screws.(Figure 1.1)

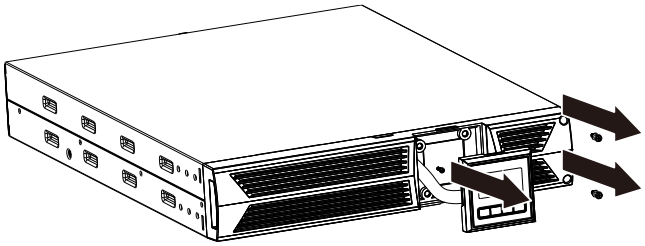


Figure 1.1

STEP 2: Slide and Pull the front panel leftward and then take it off (Figure 1.2).

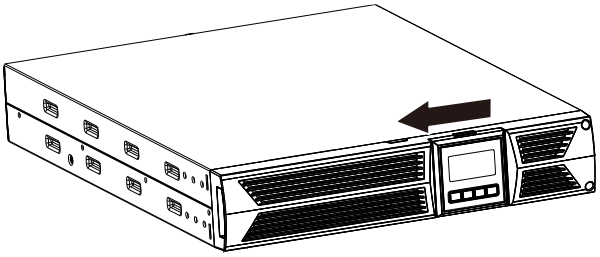


Figure 1.2

STEP 3: Disconnect the cable from the UPS to battery pack. (Figure 1.3)

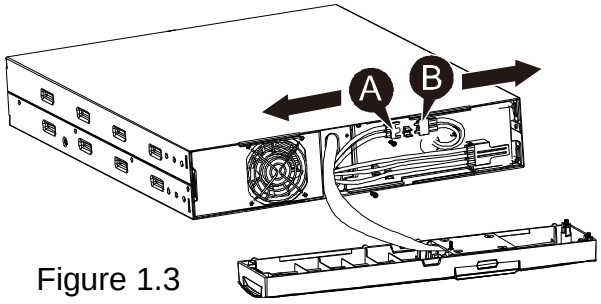


Figure 1.3

STEP 4: Remove all the screws on the top cover, then open the top cover from left side. (Figure 1.4)

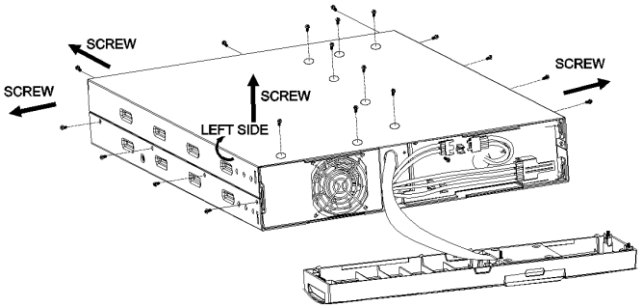
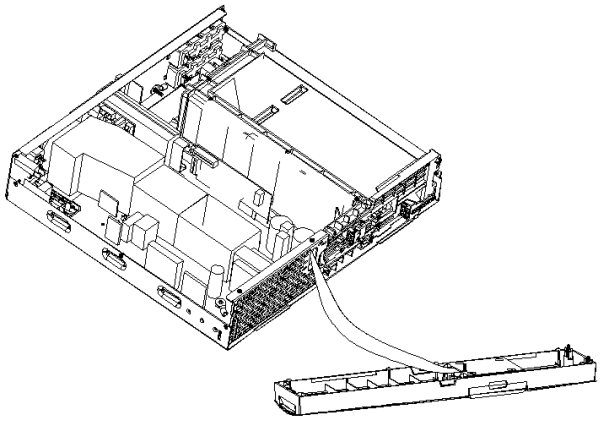


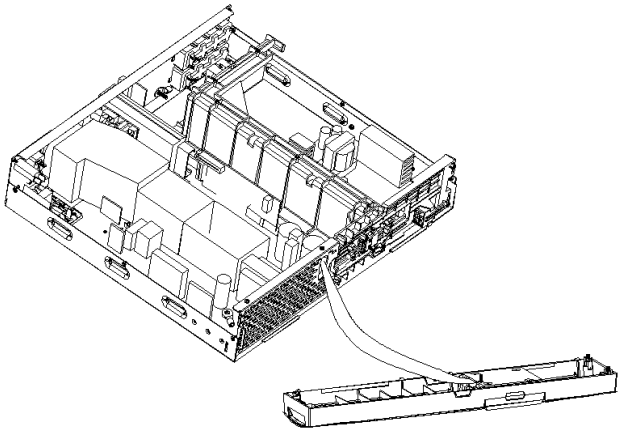
Figure 1.4

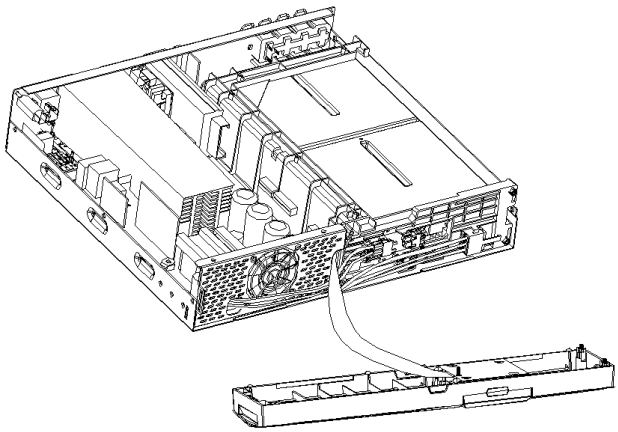
Inner Layout of all models:

1K

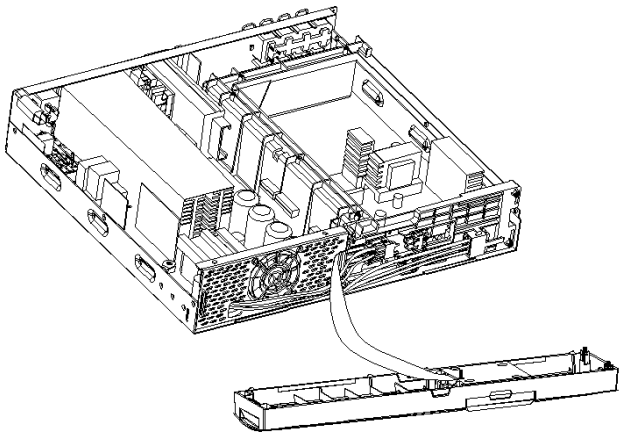


1KS

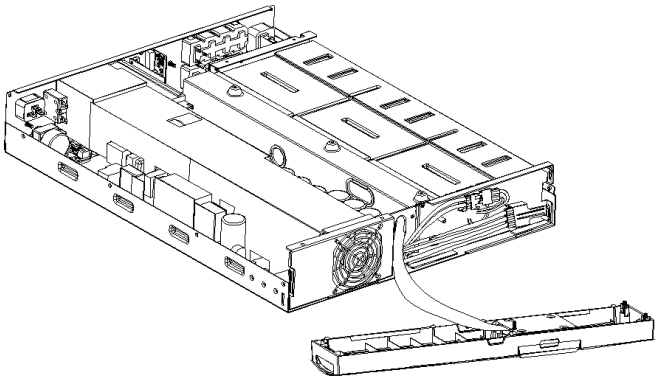




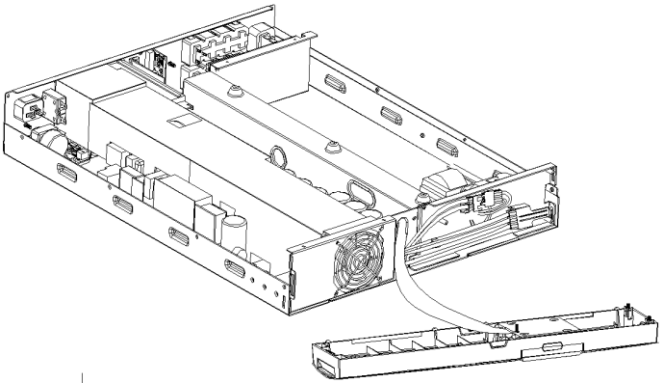
1.5K&2K



1.5KS&2KS



3K



3KS

STEP 5: REMOVE PSDR ASSEMBLE

Remove the screws on the rear panel and pull off the flat cable socket of the control PCBA, then put off rear panel before you remove the PSDR assemble. (Figure 1.5&1.6).

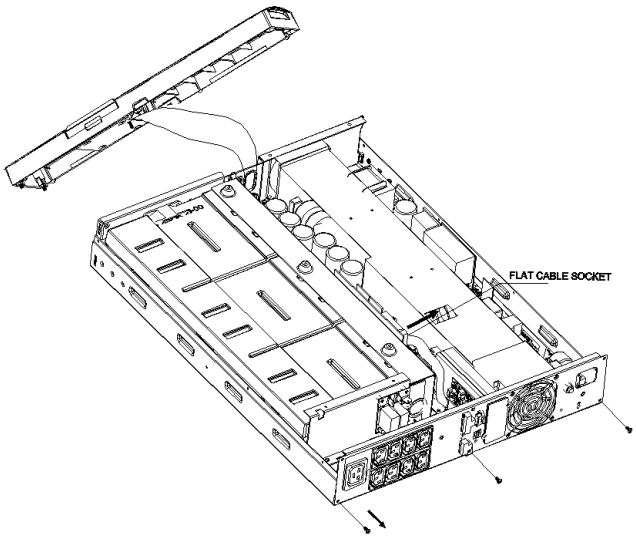


Figure 1.5

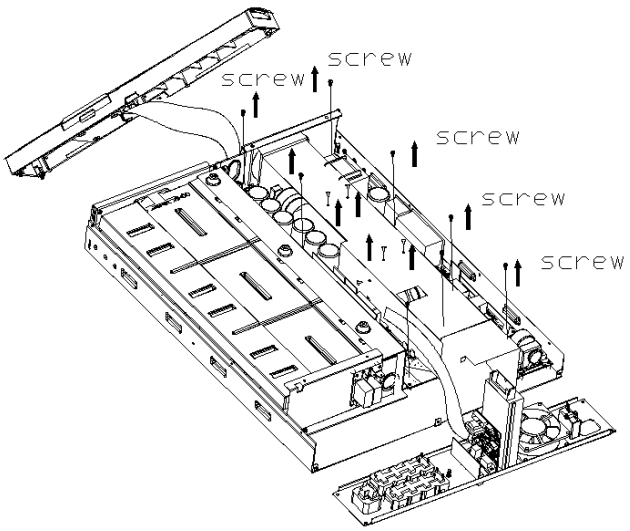


Figure 1.6

II.PRINCIPLE OF OPERATION

1. INTRODUCTION

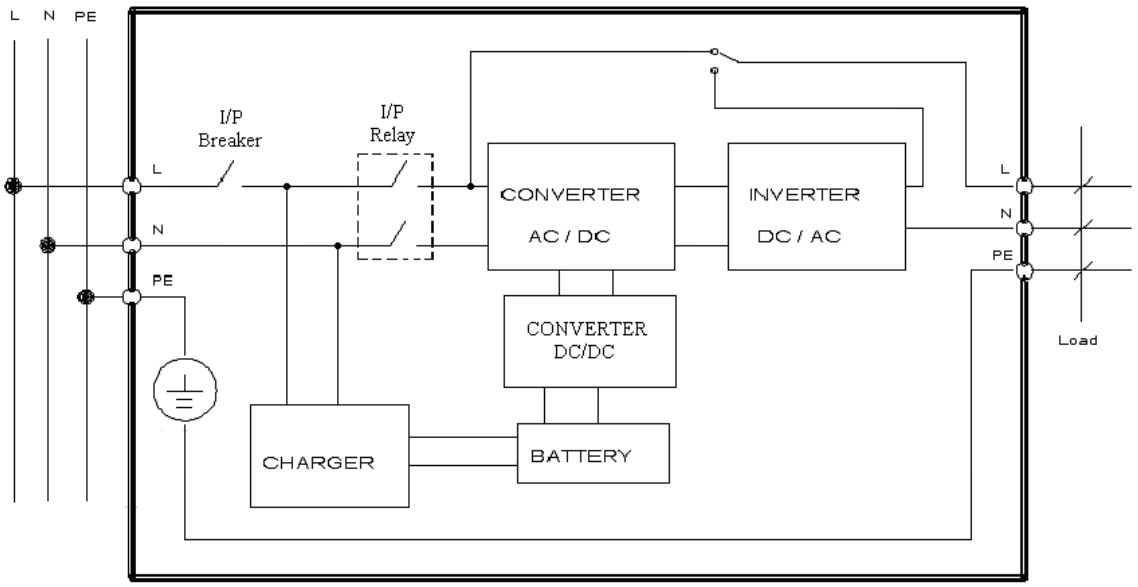


Figure 2.1: BLOCK DIAGRAM

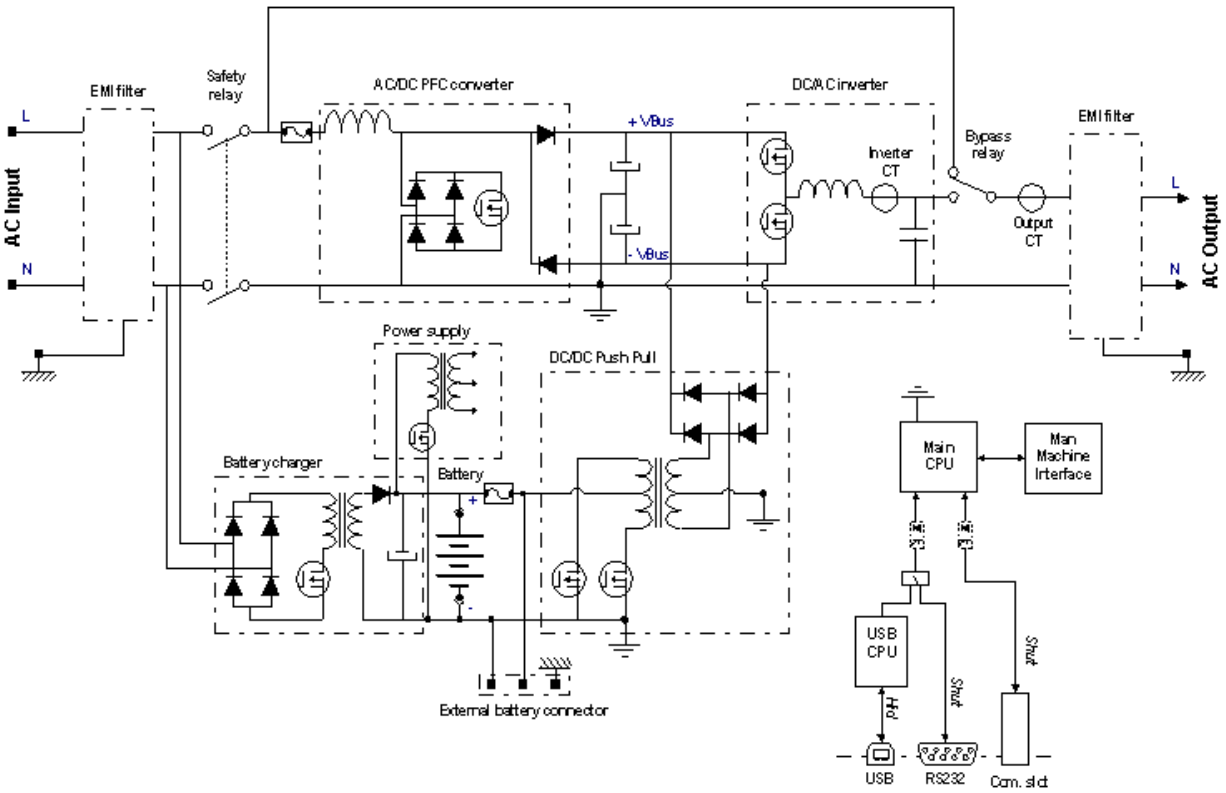


Figure 2.2: Block diagram

The simplified schematic in figure 2.1 and figure 2.2 shows how the major circuits are connected and illustrated the overall system functions. The block diagram in figure 2.2, shows the UPS at normal operation from left to right. When a protection circuit is triggered or a fault condition occurs, the output supply is transferred immediately from inverter to AC mains(bypass).

This ON-LINE UPS system utilizes high frequency PWM techniques to achieve high efficient performance. The UPS can deliver a clean, regulated sine-wave output at any load under full load. The operation principle will be explained in later section.

III.PCB FUNCTION

This 1K(S)/1.5K(S)/2K(S)/3K(S)VA high input power factor system contains three major PCBs assemblies. They are including:

A. PSDR: contains major parts of (1) auxiliary power supply(SPS module), (2) power factor correction, (3) DC/DC converter, (4) inverter
B. CNTL: contains major parts of protection, signaling circuits, regulation and control circuits of inverter. Fixed on PSDR.
C. CHGR module: contains DC-DC regulation and control circuits. CHGR module is fixed on PSDR of stand model, and super CHGR module of S model is fixed in battery room on chassis.

1. POWER STAGE (PSDR)

The power stage consists of auxiliary power supply, power factor correction, DC/DC converter and inverter. The figure 2.2 shows the block diagram of power stage.

(1) Auxiliary power supply(SPS module):

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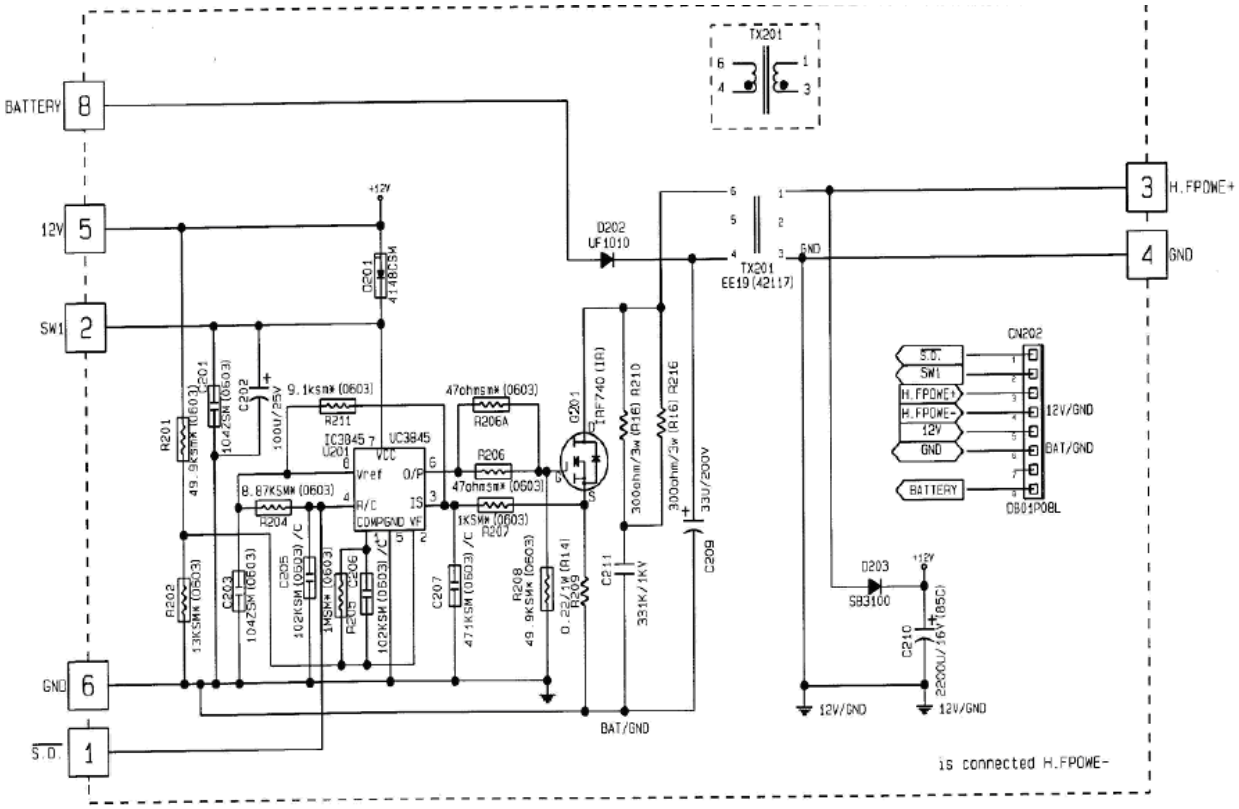


Figure 3.1: SPS module

The input of the SPS is connected to the battery bus, i.e., the output of charger. The SPS provides +12Vdc. +12Vdc is used for the IC's working voltage, the coil of relay and the fan(s) voltage. +12V provides +5V by IC 7805 that fix on PSDR. +5Vdc is used for MCU's working voltage.

(2) POWER FACTOR CORRECTION:

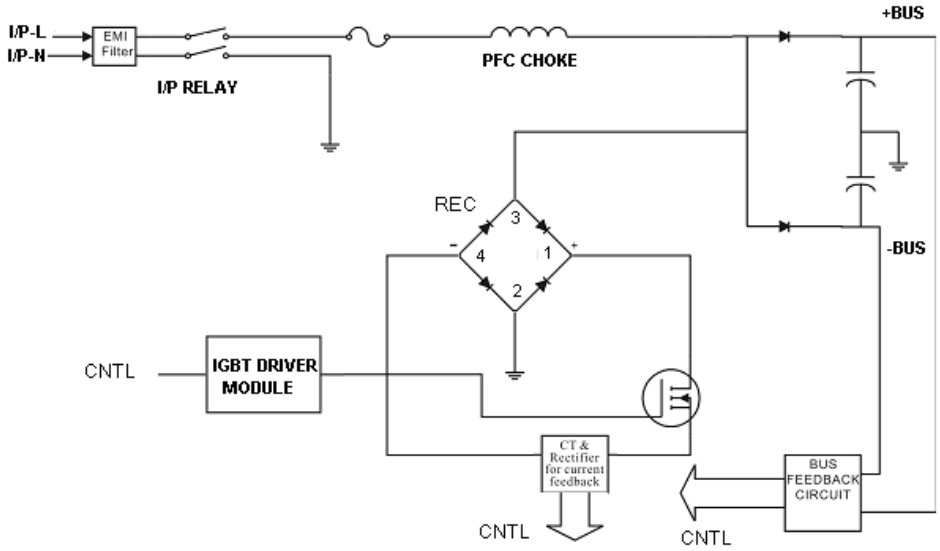


Figure 3.2: PFC converter

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.

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 as below table.

O/P V			
208	220	230	240
350(I/P<220)	350(I/P<235)	360(I/P<245)	380(I/P<250)
380(I/P>225)	380(I/P>240)	380(I/P>250)	390(I/P>255)

(2) DC/DC converter:

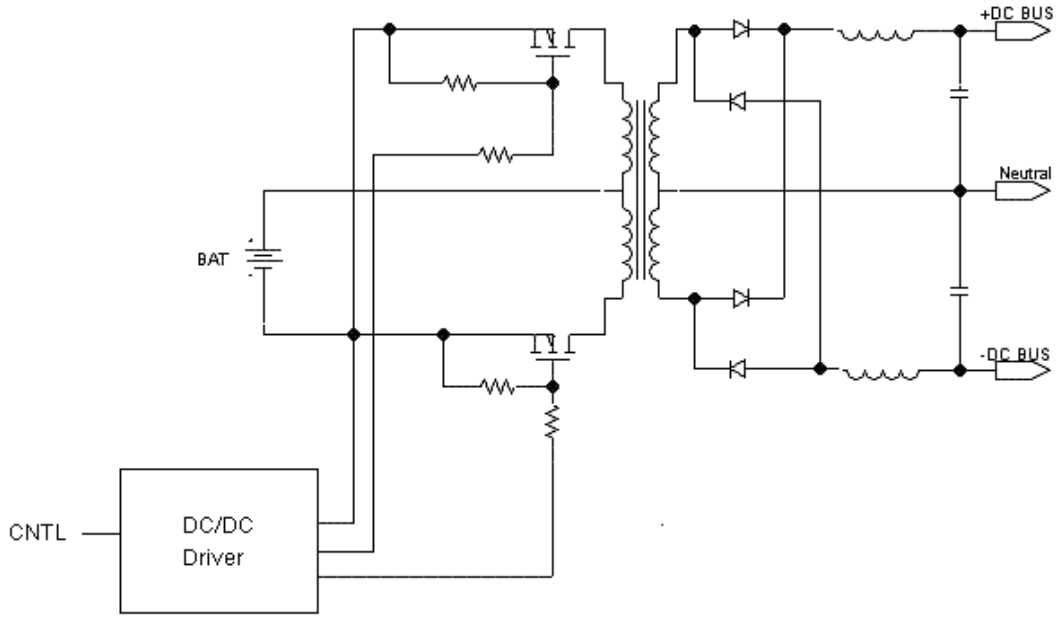


Figure 3.3: DC/DC Converter

In case of 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.

Also DC/DC Converter is used to be soft start. The purpose of soft start is to suppress the AC input inrush current when UPS is start.

The DC/DC converter controller drive a pair of switching component, MosFET used here, turn on in turn, the switch frequency is 66KHz(50KHz for 3K). 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 as below table.

O/P V			
208	220	230	240
1/3K(S) 380V 1.5/2K(S) 350V	1/3K(S) 380V 1.5/2K(S) 370V	1/3K(S) 380V 1.5/2K(S) 370V	1/3K(S) 390V 1.5/2K(S) 380V

(3) INVERTER:

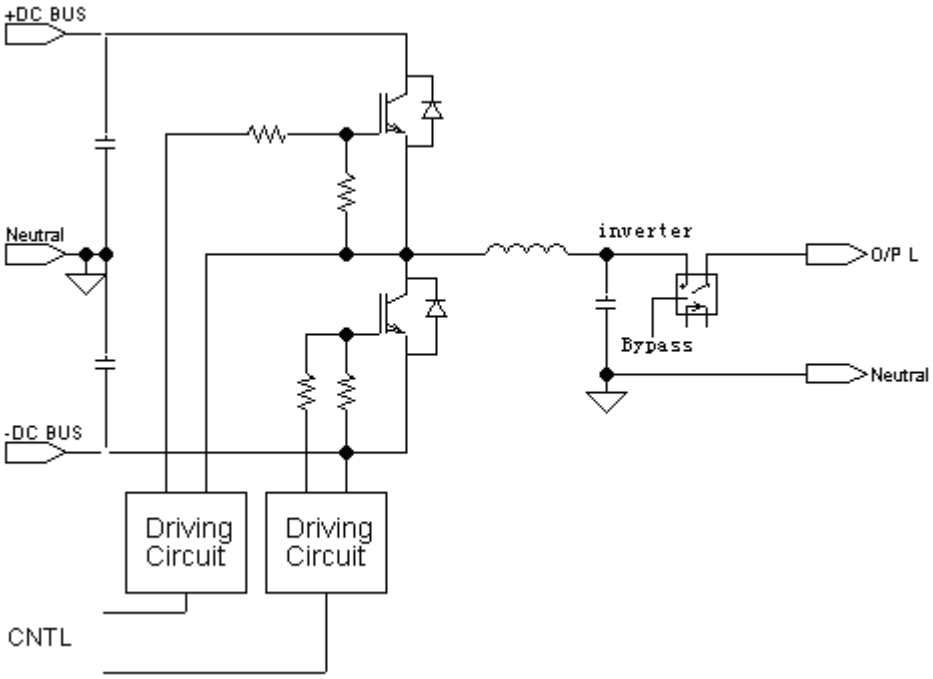


Figure 3.4: Schematics for inverter

The inverter converse the DC power from DC BUS into the AC output to supply the load. A half bridge topology employed, Figure 3.4 shows a diagram of inverter in 1/1.5/2/3k product.

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.

2. Standard Charger and Super Charger

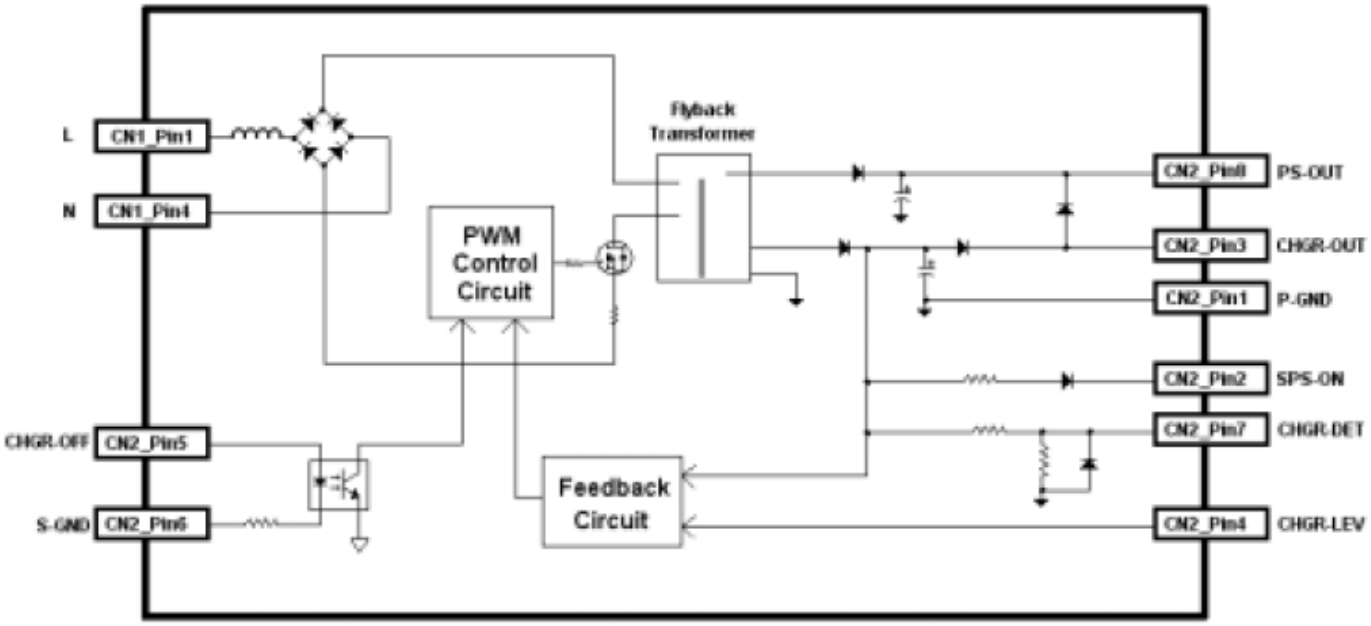


Figure 3.5: charger

The purpose of charger is maintaining the batteries at fully charged condition. The battery charging method or scheme can be selected between ABM(Advanced Battery Management). Refer to figure 3.5, the flyback switching power supply provides the charge power(floating charge voltage: 41.6Vdc for 1k(S)VA, 55.4Vdc for 1.5/2k(S)VA, 83.2Vdc for 3k(S)VA) for batteries. Besides providing constant voltage, the power supply also limits the current flowing into batteries to protect and prolongs the lifetime of batteries.

There are two kind of charger for standard model UPS and long backup time model UPS(S model). Both operating in the same principle, but difference output capacity, the one for standard model UPS capable of outputting 1.2A current, is fixed on the PSDR. A super charger module with maximum 6A/3A selectable charge current capacity, is used in the long backup time model UPS(S model) fix on chassis. Photos of charger can be found in later section.

3. 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

(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.

When the main is applied and the switch is turned on, a 10-seconds timer is triggered. The bypass relay stays at bypass position in this time period. At the end of this period, the bypass signal is removed and the relay transfers to inverter output.

(2) PROTECTION SUB-SYSTEM:

The UPS provides the following protection circuits:

A. Overload protection

The load detector senses the load current. i.e. the inverter current, and sends the signal by two paths. In battery mode, 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 bypass relay.

---- If the output load is between 100% and 102% of rated load (VA or Wattage), the UPS always keeps running on inverter with overload warning.

---- If the output load is between 103% and 130% of rated load, the UPS keeps running on inverter running for 12 seconds.

After 12 seconds: UPS transfer to bypass which if UPS is under line mode.

UPS transfer to failure mode which if UPS is under battery mode.

---- If the output load is higher than 130% of rated load, the UPS transfers to bypass immediately which if UPS is under line mode or shut down which if UPS is under battery mode.

(b)Cycle by Cycle Current Limit: When output loads sink a high surge current, 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.

B. Battery over or under shut down

Upon the battery voltage declines to battery-under level, a signal is generated to cut off the power supply of the whole system, The buzzer becomes silent and all the LCD extinguish. When the utility is coming, the UPS will start up automatically.

C. Inverter output abnormal protection

The inverter failure signal shuts down the inverter immediately, makes the buzzer a continuous alarm. The panel will indicate the fault condition. "The failure signal latches itself unless SW off or battery is empty".

D. Over temperature protection

The thermal switch detected 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 panel will indicate the fault condition.

E. Bus over or under voltage protection

To protect any BUS over or under voltage condition for the abnormal case, the UPS transfers to bypass immediately which if UPS is under line mode or shut down which if UPS is under battery mode. The panel will indicate the fault condition.

(3) SIGNALING SUB-SYSTEM :

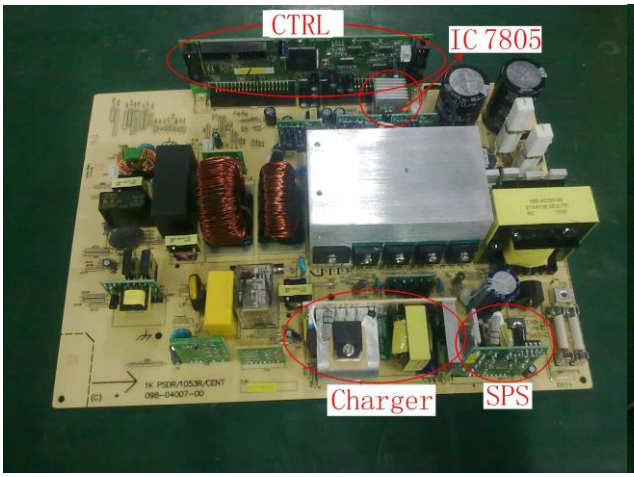
When the AC line is unable to supply, batteries release stored energy to supply the inverter immediately. At the same time, the utility failure relay is activated and the buzzer beeps every four seconds.

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

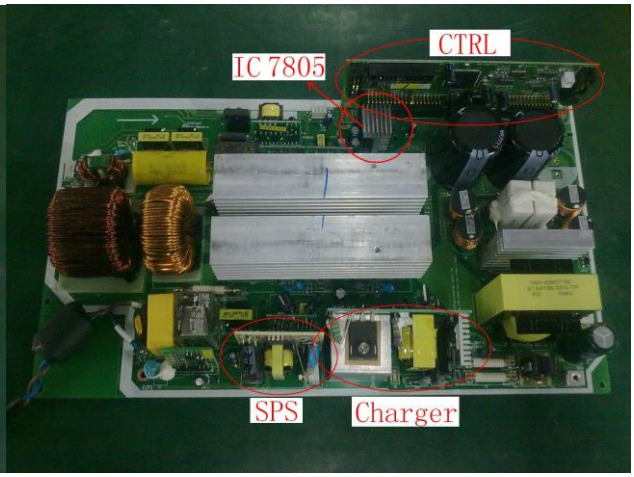
Remote shutdown signal is enabled only when the line fails. The signal is connected to the battery detector. It generates battery-under signal to cut off the bias power supply of the UPS system.

4. Photos of PCB assembly

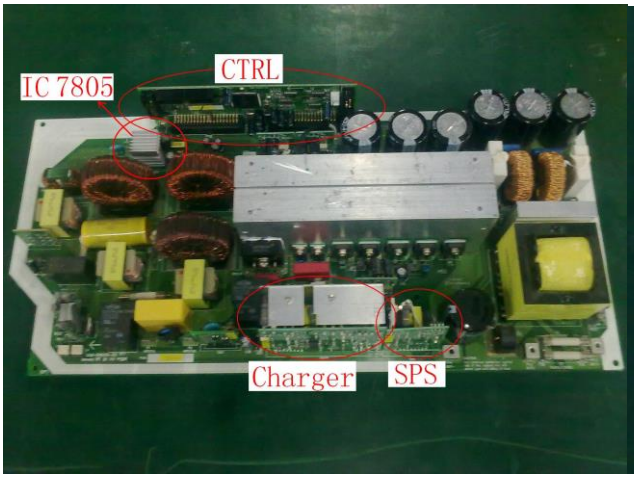
The locations of the assemblies show below:



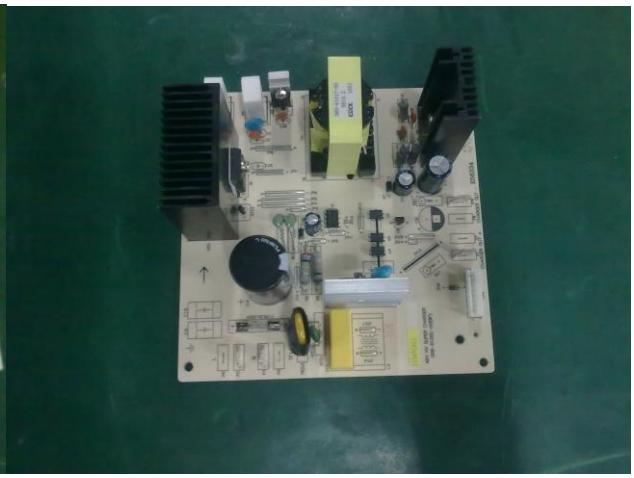
1K PSDR



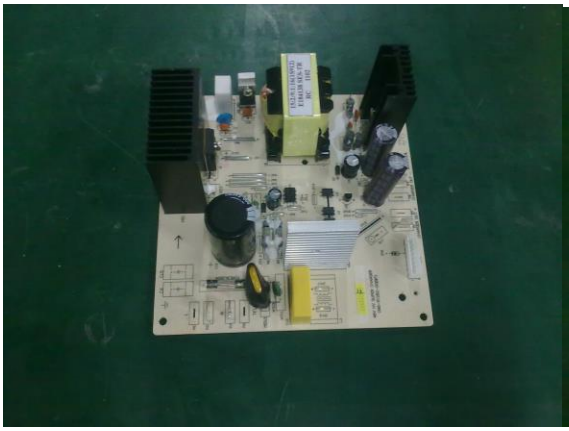
1.5K PSDR (Refer to 2K)



3K PSDR



36V super charger



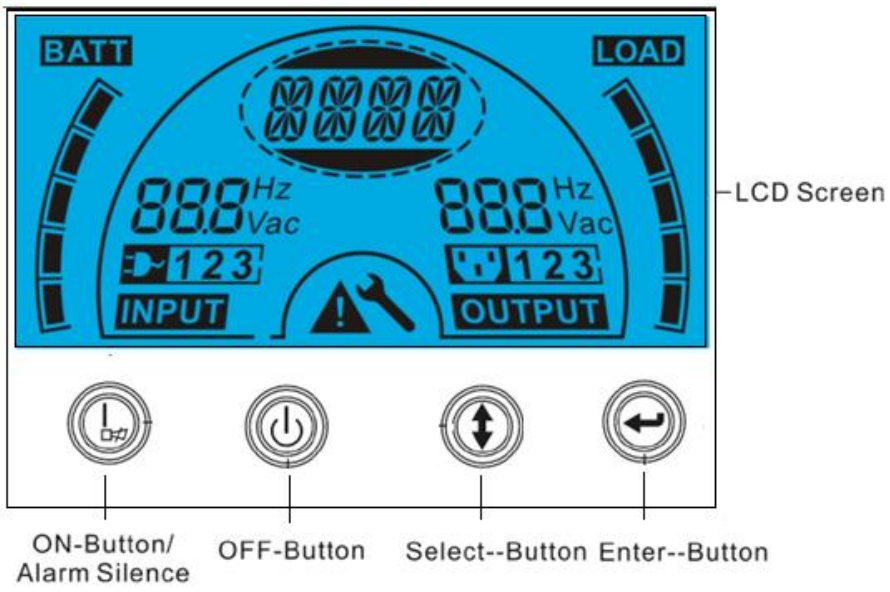
48V super charger

72V super charger

IV. 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.



All UPS information including the input, the output, the battery, the load and the status of UPS are displayed on the LCD screen. 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 listed.

1) Switch

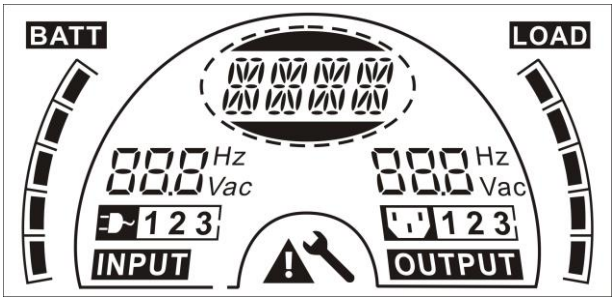
Switch	Function
ON-Button	Turn on UPS system: By pressing the ON-Button “I” the UPS system is turned on. Deactivate acoustic alarm: By pressing this Button an acoustic alarm can be deactivated in the battery mode. By short touch this Button all acoustic alarms can be deactivated in all mode. Do the battery 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. Release the UPS from fault mode and EPO status.
Select-Button	The output voltage, frequency, Bypass disable/enable and operating mode in No output or Bypass mode, Two Load segments in output mode, Battery string in all mode, could be selected by pressing Select-Button, and confirmed by pressing Enter-Button.
Enter-Button	

2) Buzzer

Press any button for 1 second	1 Beep
Normal mode	No beep
Bypass mode	1beep /2min
Bat mode	1beep /4s
Fault mode	Continue beep
Warning	
Overload warning	1 Beep/0.5sec
Other warnings	1 Beep/sec

If Buzzer mute, the buzzer would not alarm even if the fault or warning occurred. The buzzer can be set enable/disable/mute by short touch ON Button.

3) LCD define



The LCD Display

Display	Function	Display	Function
Input Information		Output Information	
888 Hz Vac	It indicates input voltage/frequency value, which are displayed alternately.	888 Hz Vac	It indicates output voltage/frequency value, which are displayed alternately.
	It indicates the input is connected with mains, and the input power is supplied from the mains.		It indicates the Output plug.
1 2 3	It indicates the Number of the input supplied from the mains.	1 2 3	It indicates the Number of the output connected with load.
Battery Information		Load Information	

	It indicates the battery capacity. Every grid represents the capacity of 20%.		It indicates the load level. Every grid represents the level of 20%.
Mode/Fault/Warning Information		Else	
	It Indicates the operating mode or Fault kind or Warning kind, several warning kinds at the same time could be displayed alternately.		It indicates the UPS is in setting mode.
			It indicates the UPS is in Fault mode or has some warnings.

4) LCD Display

The different string could be displayed on the LCD screen corresponding to their own operating modes, and they are illustrated as the following table. At any time, only one normal operating string or fault string is presented. But the warning, even several warnings could appear in a certain normal operating mode at one time. And the normal operating mode string and the warning string would be shown circularly. Once one fault is come forth, then all previous warnings would not be shown again but only the fault string is presented.

Normal operating mode	**String**	**Normal operating mode**	**String**
No output mode	STbY	Battery test mode	TEST
Bypass mode	bYPA	ECO mode	ECO
Line mode	LINE	Converter mode	CVCF
Battery mode	bATT		

Warning	**String**	**Fault**	**String**
Site fail	SITE	Inverter short	SHOR
Fan fail	FANF	Overload fault	OVLD
Battery over voltage (over charged)	HIGH	Inverter soft start fail	ISFT
Battery low	bLOW	Bus soft start fail	bSFT
Charge fail	CHGF	Over temperature fault	OVTP
Inverter temperature high	TEPH	Inverter Volt Low	INVL
Ambient temperature high	AMbH	Inverter Volt High	INVH
Battery open	bOPN	Bus volt over	bUSH
Overload	OVLD	Bus volt Low	bUSL
EPO	EPO	Bus Unbalance	bUSE
Bat fault	bATF	Inverter NTC open	NTCO

V. TROUBLE SHOOTING

For the reason of safety, you must disconnect UPS to the mains and disconnect battery jumper. Check the components listed below to confirm which block is out of order and follow the procedures listed on the following pages to repair them.

CAUTION:

DO NOT supply UPS with the mains unless you are sure that you have replaced all defective components or module.

1.QUICK CHECK :

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.

Circuit Block	Components to be checked	Fail condition
FUSE	F1,F2,F3 for 1/1.5/2/3k(S)VA	open
PFC	Q5 for 1K(S) Q2 for 1.5/2k(S)VA Q1,Q2 for 3k(S)VA	short or open
	D1,D2,REC1	short or open
DC/DC	Q2,Q3, Q4, Q7 for 1k(S)VA, Q17, Q18, Q19, Q20 for 1.5k/2K(S)VA Q3,Q4, Q5,Q6,Q7,Q8 for 3k(S)VA D37,D38,D39,D43 for 1K(S)VA D14,D16,D21,D22 for 1.5/2K(S)VA D5,D6,D7,D8 for 3K(S)VA	short or open
Inverter IGBT	Q16,Q20 for 1k(S)VA, Q24,Q26 for 1.5/2k(S)VA Q9,Q10,Q11,Q12 for 3k(S)VA	short or open
Charger module	1K(S): CN4 1.5/2K(S): PCB1 3K(S): PCB3	No charge voltage output, or waveform abnormal.
SPS module /IC7805	1K(S): CN3/U6 1.5/2K(S): PCB6/U3 3K(S): CN1/U2	No auxiliary power +12V and +5V, or waveform abnormal. The fan can’t work.
IGBT driver module	1/1.5/2/3K(S): 710-61800-04P	PWM waveform abnormal

2.DYNAMIC CHECK:

When all main components have been replaced, put PSDR board back and fix it then plug all connector back. Check if all connectors and terminals are on correct location.

1. Check auxiliary power supply (SPS) first. 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 72Vdc/5 Amp (limited current) for 3K UPS, 36Vdc/5Amp 1K UPS, 48Vdc/5Amp 1.5K/2K UPS.

Press the ON-Button, SPS(auxiliary power supply) will start, and system will initialize, LCD will be lighted. If ok, continue below steps.

(a) Check whether all fans of the UPS run well, if not, recheck the +12V supply and PART V.

(b) Check voltage of SPS module's +12V. If the waveform abnormal, then recheck the SPS module, or replace it.

(c) Check whether voltage of +5V is OK, if not, check IC7805's pin "I", "O" if it is short. If it yes, replace it.

2. LCD will indicate STANBY after initialize, then press the ON-button for 1 seconds, then UPS should be DC started, If UPS does not start successfully. Please try diagnosing procedure again.

3. 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.

4. If it is ok of steps above, press OFF-Button to close the UPS. Wait for 10 seconds, let LCD extinguish. Then apply AC mains to the UPS, system will initialize and LCD will light automatically. If not, represent the charger module is abnormal. If OK, then try on the UPS, the UPS will come to line mode. If fail you may have start one new round of trouble shooting.

5. Check the output voltage waveform and DC-offset voltage, at no-load and full load condition.

6. In most case result of steps above can represent whether product in normal condition, If possible, for more reliability, perform quick check follow procedure shows in table below would help in know the UPS situation in detail.

7. If possible, do a burn-in test on repaired UPS before return it to customer, the longer the better.

8. If every step is ok, Congratulation, you have finish the maintenance/ repair work.

Tab.

PCB	TEST	TEST POINT	TEST AND ADJUSTMENT SEQUENCE	EXPECTED RESULT
PSDR	DC(+) BUS	1K(S):C14; 1.5/2K(S):C5 or C7; 3K(S):C9	Connect DVM (DC) to test points and turn on I/P NFB, then turn on the switch.	360±5Vdc on line mode,380±5Vdc（370±5Vdc for 1.5K/2K） on battery mode
	DC(-) BUS	1K(S):C11; 1.5/2K(S):C16 or C17; 3K(S):C12	Connect DVM (DC) to test points and turn on I/P NFB, then turn on the switch.	-360±5Vdc on line mode,-380±5Vdc（370±5Vdc for 1.5K/2K） on battery mode
CHGR	CHARGER	P6(+),P9(-) for 1k(S)VA; P1(+),P3(-) for 1.5/2K(S)va P13(+),P14(-) for 3(S)kVA	Disconnect the battery, Then connect DVM (DC) to test points and turn on I/P NFB(25℃ ambient,-3mV/℃/cell).	41.6±1Vdc for 1k(S)VA, 55.2±1Vdc for 1.5/2k(S)VA, 83.2±1Vdc for 3k(S)VA
O/P voltage	O/P voltage	O/P socket	In line mode, battery mode also, Connect DVM (Set to measure AC Volt) to test point, then turn on the UPS; Check reading on DVM.	220Vac (or 230Vac, etc according to the setting)
O/P DC Balance	O/P DC Balance	#O/P line #O/P neutral	In line mode, battery mode also, Connect test circuit as figure V-1; Connect DVM (DC) to test points; Wait for 1 minute. Check reading on DVM.	±100mVdc

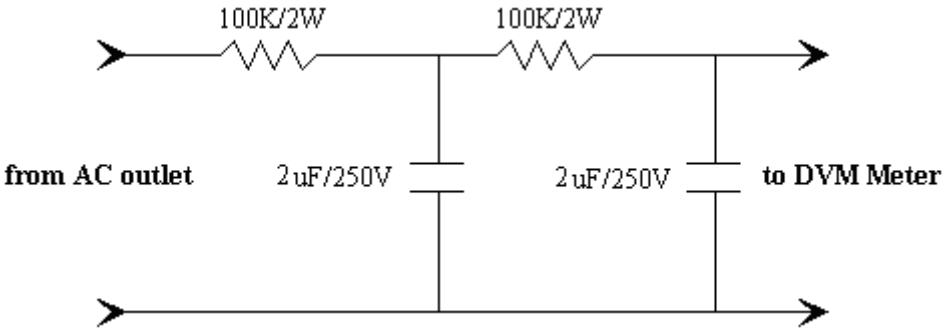


Figure V-1 : Circuit for test output balance

3. TROUBLE SHOOTING 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. There include two case, Warning and Fault.

LCD indicate	Possible cause	Action
OVLD	Over load / over load fault	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.
HIGH	Over Charge	1. Check the battery number. 2. Check whether the charger is failed.
CHGF	Charger Fail	1. Check the charger circuit.
FANF	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	Site fault, Phase and neutral conductor at input of UPS system are reversed, or the earth line abnormal.	1. Check the input cord of UPS system, rotate mains power connection. 2. Check the earth line. 3. Check the site fail detecting circuit on the PSDR board.
bOPN	Battery 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.

AMbH	Ambient temperature high	1. Check the air vents of UPS are blocked, and the ambient temperature is over 40℃. 2. Check the NTC and the thermal detecting circuit on the PSDR board.
TEMP/ OVTP	Heat sink temperature high / over temperature protection.	1. Check the air vents of UPS are blocked, and the ambient temperature. 2. Check if the fan is running well. 3. Check the NTC and the thermal detecting circuit on the PSDR board.
NTCO	NTC open	1. Check the ambient NTC if abnormal 2. Check the heat sink NTC if abnormal or not connect.
bLOW	The battery voltage is low	The battery capacity is low, and the UPS would shut down soon.
bUSH / bUSL / bUSE	Bus is over voltage; Bus is under voltage; Bus is unbalance;	1. Check if the load is half wave load 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.
INVH / INVL	INV voltage is too low or high; INV fault;	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.
SHOR	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.
bSFT	BUS soft start fault	Check the DC/DC part or PFC part on the PSDR board.
ISFT	Inverter soft start fault	Check the INV part on the PSDR board.
EPO	EPO fault	1. Check EPO circuit if it is open. 2. Check communication board if it is connected.
bATF	Battery fault, battery abnormal.	1. Check the battery if it is abnormal; 2. Check the charger if it is abnormal.

3. Trouble Shooting In other 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 auxiliary 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 COMM board. 3. Replace the control board.

APPENDIX I : COMMUNICATION

1. RS232

The RS232 provides proprietary command sequence for the computer to monitor the line and UPS status and to control the UPS. The data format is listed as following:

PIN TYPE .....: male
BAUD RATE ..... : 2400 bps
DATA LENGTH ..... : 8 bits
STOP BIT ..... : 1 bit
PARITY ..... : NONE

The pin assignment and description are listed in the following table and the interface configuration is indicated in **Figure VI-1**. Note that, the computer will control information exchange by a query followed by <cr> (Character Return). UPS will respond with information followed by a <cr> or action. UPS data will be provided at 2400 baud rate and consist of 8 data bits, 1 stop bit, and no parity bit. All the information is provided in ASCII format.

Pin	Signal name	Function	Direction from the UPS
1		Unused	Not applicable
2	Tx	Transmit to external device	Out
3	Rx	Receive from external device	In
4		Unused	Not applicable
5	GND	Signal common (tied to chassis)	Not applicable
6		Unused	Not applicable
7		Unused	Not applicable
8		Unused	Not applicable
9		Unused	Not applicable

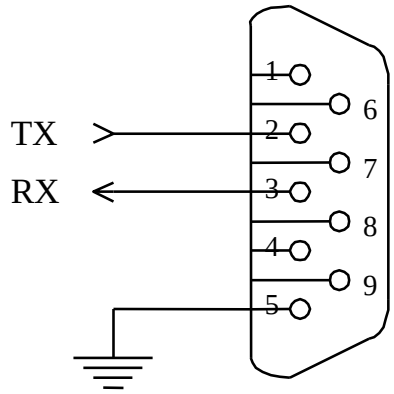
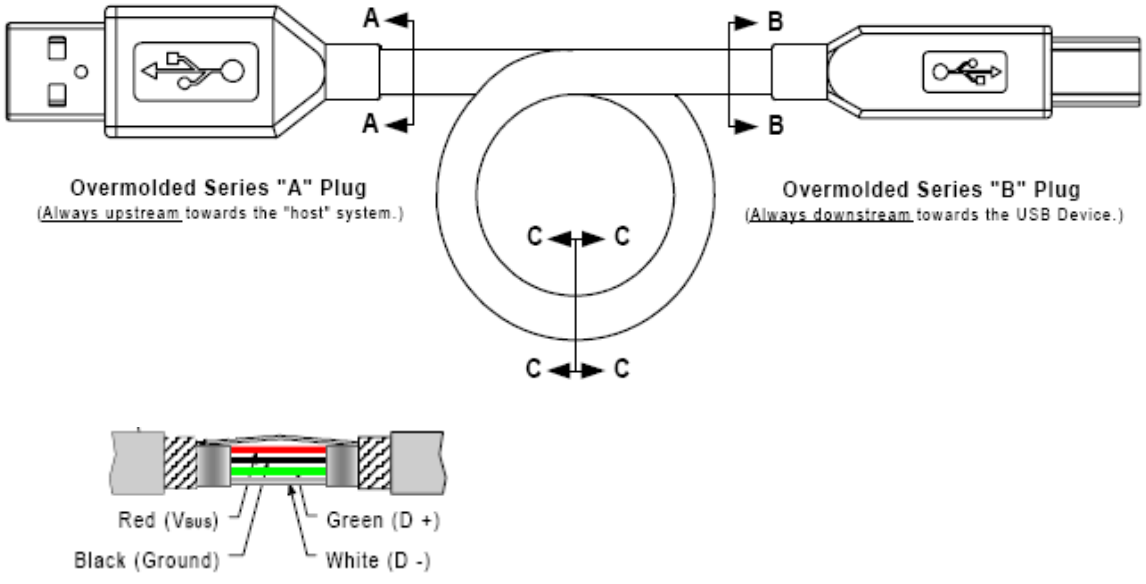


Figure VI-1 : RS232 connection

2. USB

AP160N RT UPS is a low-speed USB device, so it accords to the Universal Serial Bus Specification Rev 1.1.

A detachable USB cable used for communication must be full speed. It consists of a series ‘A’ plug, a series ‘B’ plug, two data line lines (D+ and D-), a ground line and a VBUS line. See the following pictures.



3. Intelligent CARD

On the rear panel of the UPS, an intelligent slot is provided. The intelligent slot can accept SMNP, AS400, RS232 adaptor card, for more flexible application solution. For more information about the Serial Network Management Card, see the Serial Network Management Card User's Guide.