UNINTERRUPTIBLE POWER SYSTEM

SERVICE MANUAL

Galleon 3P3 10K~30KVA Tower Model

Rev. 3.0

REVISION	DESCRIPTION	Date
Rev. 1.0	Formal Release	2012/4/28
Rev. 2.0		2012/8/23
Rev. 3.0	Add 30KVA unit content	2013/9/3

CONTENT

1. General Information

1.1 Getting start

This manual is for Galleon 3/3 10K(L)~30K(L) tower UPS. It can help service person perform the basic maintenance and repair service.

This manual only focuses on the service section, so you should get the basic operation of the UPS from the user manual, and make sure you had read and understood the user manual before reading the manual.

The manual includes 9 sections:

● **General Information,** this section shows you the general information of the service manual.

● **Electric Specifications,** this section shows you the basic electric specification of the UPS.

● **Functional block,** this section shows you the major functional block of the UPS.

● **Working Principle of the Major Functional Block,** this section shows you the working principle of the major functional block.

● **Function explanations for each PCB,** this section explains you all the PCBs of the UPS system.

● **Interface,** this section shows you the LCD interface, including display and setting.

● **Trouble Shooting,** this section gives you the way to find the problems.

● **Test Step,** this section tells you how to test the UPS after you repair the unit.

● **Appendix,** this section shows you the basic waveforms for reference and the basic communication commands.

1.2 Important Safety Instructions

 For qualified service person only.

 DO NOT perform any internal service or adjustment of this product unless the technical person is well trained and experienced. .

 Dangerous voltage exists at several points in this product. To avoid personal injury, don't touch any exposed connections or components while UPS is on.

 Turn off the UPS and switch off the input breaker before removing protective case.

 AC voltage is always present if the input AC power is still available.

 High voltage may exist at DC capacitors. Before removing the protective case, wait for at least five minutes after turning off the UPS.

 Verify input source (voltage and frequency) is within the maximum range before service.

2. Electric Specifications

MODEL	SPECIFICATION							
	10K	10KL	15K	15KL	20K	20KL	30K	30KL
Input								
Input Voltage	176～276 VAC(L-N)@ Full Load							
	110～300 VAC(L-N) @ Half Load							
Input Frequency	46～54 Hz for 50Hz system							
	56～64 Hz for 60Hz system							
Input Power Factor	≥0.99							
Input THD(Full Load)	<7%		<7%		<7%		<6%	
Generator	Support							
Output								
Output Power (VA/Watt)	10000/8000		15000/12000		20000/16000		30000/24000	
Nominal Output Voltage	208/220/230/240VAC(L-N)							
Voltage Regulation	±1%							
Output Frequency	Follows Bypass Frequency if the bypass is ok(except the convert mode)							
	(50/60±0.1) Hz if bypass is not ok or in convert mode							
Voltage Distortion	≤5% @ Full Nonlinear Load							
	≤2% @ Full Linear Load							
Current Crest Ratio	3:1							
Transfer Time	0ms @ Line ←→ Battery							
	0ms @ Inverter ←→ Bypass When phase lock fails, <4ms interruption occurs from inverter to bypass							
	<10ms @ Inverter ←→ ECO							
Short Circuit Protection	Yes							
Battery								
Nominal Battery Voltage	240 VDC							
Nominal Battery Quantity (PCS)	20	20 *n	20*2	20 *n	20PCS*2	20 *n	20*3	20 *n
Acceptable Battery Quantity (PCS)	18~20	(18~20) *n	(18~20) *2	(18~20) *n	(18~20) *2	(18~20) *n	(18~20) *3	(18~20) *n
Type/Capacity	12V/9Ah		12V/9Ah		12V/9Ah		12V/9Ah	
Backup Time (minutes)	≥4@ full load		≥6.5@ full load		≥4@ full load		≥4@ full load	
Efficiency								
To Line Mode	>89%						>90%	
To Battery Mode	>86%		>88%		>87%		>89%	
To ECO Mode	>96%							
Overload Protection								
100%～110%	Alarm and Transfer To Bypass after 10min @ Line mode							
	Alarm and Cut Off Output after 30s @ Battery mode							
110%～130%	Alarm and Transfer To Bypass after 1min @ Line mode							

	Alarm and Cut Off Output after 10s @ Battery mode							
Over 130%	Alarm and Transfer To Bypass after 1s @ Line mode							
	Alarm and Cut Off Output after 1s @ Battery mode							
	Alarm and Cut Off Output after 1min @ Bypass mode							
Auto Retransfer	Yes							
Interface								
RS232	Yes							
USB 1.1	Yes							
EPO	Yes							
Environment								
OperatingTemperature	0 ℃ to 40℃							
Humidity	<95% (No condensing)							
Acoustic Noise	≤60B		≤65dB		≤65dB		≤65dB	
Standard								
ESD	IEC 61000-4-2 Level 4							
RS	IEC 61000-4-3 Level 3							
EFT	IEC 61000-4-4 Level 4							
Surge	IEC 61000-4-5 Level 4							
Conduction	IEC/EN 62040-2 Category C3							
Radiation								
Safety	IEC62040-1-1							
Drop	ASTM D5276-94							
Vibration	ASTM D4728-87							
Mechanical								
Inlet	Terminal Block							
Outlet	Terminal Block and Receptacle							
Outline Dimension W x H x D (mm^3)	815X250 X826	592X250 X826	815X250 X826	592X250 X826	815X250 X826	592X250 X826	815 X300 X 1000	815X250 X 826
- Net Weight (kg)	109	38	164	40	164	40	233.5	64
- Packaging Dimension W x H x D (mm^3)	920X380 X1025	700X385 X1017	920X380 X1025	700X385 X1017	920X380 X1025	700X385 X1017	920 X430 X 1205	920X380 X 1025
- Gross Weight (kg)	127	45	182	47	182	47	250.5	90

3. Functional Block

As a true online UPS, the product applies a double conversion topology, comprising functional blocks as shown in Figure 3.1

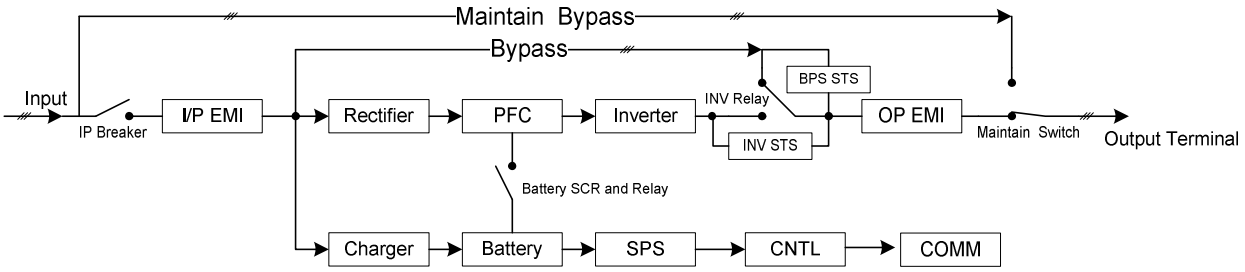


Figure 3.1 Function block Diagram

The CNTL block controls the action of the UPS system. There are two control boards, one for PFC control, another for inverter control. The control boards detect the voltage and current to control PFC and inverter, also they supply the protection for the UPS, When the UPS becomes abnormal, in most case, the CNTL can provide basic information indicating the status of the UPS.

The COMM block provides the communication interface for receiving and executing command from users via the panel or other communication protocol, also provides the LCD display task.

The Rectifier and PFC blocks are the input stage of the UPS. The blocks convert AC input power into two stable DC power stored in the BUS capacitor. In the meantime, PFC (Power Factor Correction) will be executed and allows input current tracking the input voltage waveform. Therefore, the input power factor will be corrected to 1 to achieve maximum efficiency and produce lowest power pollution to the utility.

The PFC block in battery mode, also called Booster, is used to convert the low voltage DC power to higher voltage with stable DC power, stored in the BUS capacitor.

The Inverter block is the output stage of the UPS and used to convert DC power from the BUS capacitor to sine waveform output power.

When the utility is within the acceptable range, the UPS will provide power directly from the utility input and the Rectifier and PFC will be executed at the same time. When the utility is outside of the acceptable range, no matter it's because of input voltage or input frequency, the UPS will shut down the Rectifier and PFC functions and turn on the Battery Booster. In case of sudden interruption from input utility, the controller can detect the interruption in very short time. During the short interval of detecting the interruption, the output power will be provided by the power stored in the BUS capacitor. In this way, there is no any interruption on output power.

The charger charges the battery when the utility is normal. The charger converts AC input power to DC power for recharging the battery. Two types of chargers will be available, one is for the standard model, and the other is for long-run model that connects to external batteries.

The Input and Output EMI section provides EMI filter function. The input and output EMI filters can prevent the UPS from being interference by external electronic/magnetic noise which is generated by other electronic system and prevent other systems from the noise generated inside the UPS system.

The SPS generates DC power supply needed by operation of the circuit of the UPS itself. The Bypass provides a path that utility can power the output directly when the Inverter is not executed. The

Maintenance Bypass provides another path that utility can power the output directly when UPS is in maintenance status. The BYP.STS and ECO.STS blocks are two static transfer switches to make sure the UPS has less or no transfer time.

4. Working Principle of the Major Functional Block

4.1 Switch Power Supply

The Switch Power Supply (SPS) supplies DC power for UPS operation. The input source of the SPS is the battery, or the output of the charger.

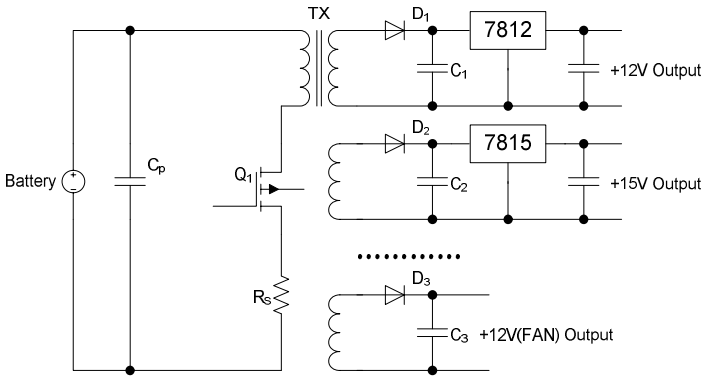


Figure 4.1 Basic circuit of power supply

Figure 4.1 is a flyback converter. When Q1 is on, all rectifier diodes (D1/D2/D3) are on open status and all output capacitors (C1/C2/C3) supply currents to the load. The primary coil of the transformer will become a pure inductor and the primary current will linearly increase to store energy in the coil. When Q1 is off, primary current will stop and all rectifier diodes (D1/D2/D3) will turn to “close” status. It will release the stored energy from the primary coil of the transformer to the secondary coil to supply loads. At the same time, it will charge output capacitors including ±15V, +12V, +5V, +12V(Fan), and HFPW±.

The power of ±15V, +12V, +5V supplies stable voltage to all kinds of ICs and other devices such as HCT. The +12V (Fan) is supplied to fans and relays. The HFPW± supplies a high frequency power for the switch (SCR/IGBT) driver and some other drive boards.

4.2 PFC/Booster

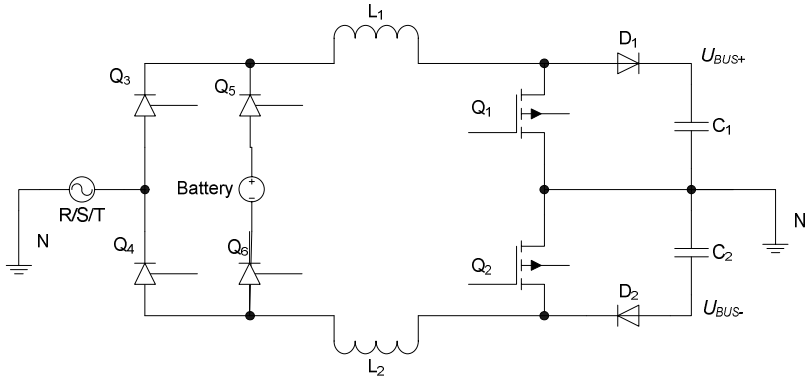


Figure 4.2 PFC/Booster

As shown in the Figure 4.2, when Q1/Q2 is on and D1/D2 is off, the current will increase to store energy in choke(L1/L2). When the Q1/Q2 is off and D1/D2 is on, the choke will release energy. Therefore, we can control the current in chokes (input current) by regulating the time of Q1/Q2 on and off. There are three independent PFC/Booster for each phase.

4.3 Inverter

The input of the half-bridge inverter topology is two DC voltages, and the output is an AC voltage, as shown in the Figure 4.3. When Q1 is on and Q2 is off, the voltage of the bridge midpoint is +BUS. When Q1 is off and Q2 is on, the voltage of the midpoint bridge is –BUS. We can get any voltage waveform between ±BUS voltage from LC filter output by regulating the duty cycle of Q1/Q2, including sine wave form.

The half-bridge inverter requires one snubber circuit to absorb the spike for security of the switches.
The Bypass output power is supplied by R phase, and there is BYP.STS and INV.STS for the transfer time requires.

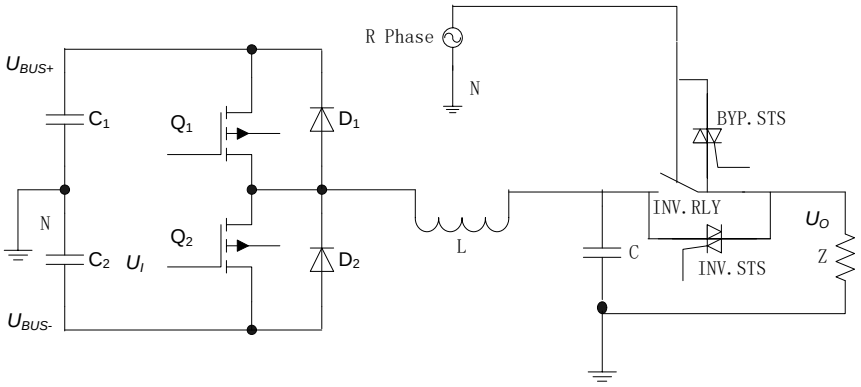


Figure 4.3 Half-bridge inverter

4.4 Charger

The function of charger is to charge and maintain the batteries at fully charged condition. The charger charges the batteries with a constant current at initial stage. At the same time, the battery voltage keeps increasing until reaching the constant charge voltage point. Then, the charge current will decrease accordingly, now it's in second stage. After one hour of constant voltage charging, the charge voltage will change to floating charge voltage, in general, the charger will control the output voltage at a constant level (13.65V±1% per battery) to optimize battery recharge time and prolong the lifetime of batteries without overcharging. As shown in the Figure 4.4, the battery charger applies same flyback topology as the SPS.

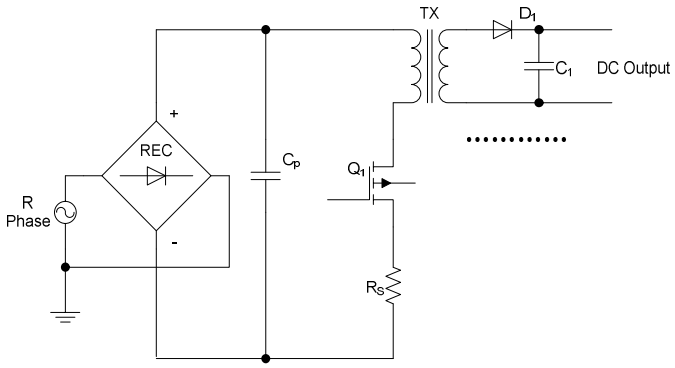


Figure 4.4 Topology of the charger

Note: There are two kinds of chargers for standard model UPS and long-run model UPS. They both apply the same principle, but there is one difference in charger output capacity. For standard model UPS, it's capable of generating 1A current. For long-run model UPS, it has maximum 4A charge current capacity.

4.5 EMI Board

Input EMI board is connected between utility and the input of rectifier. Output EMI board is connected between the output of inverter and output terminal block.

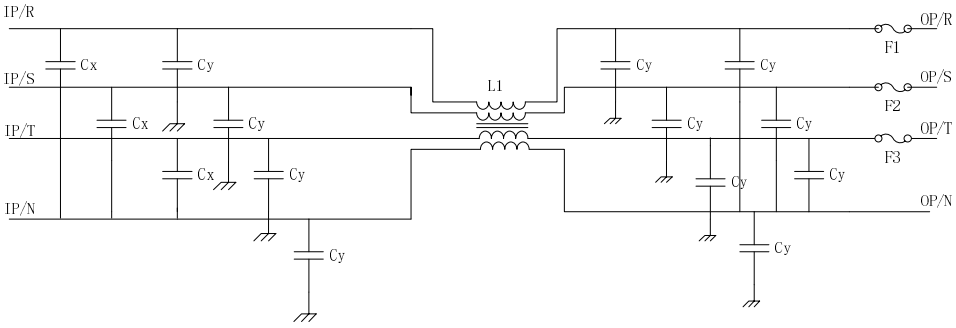


Figure 4.5 Topology of the input/output EMI

5. Function explanations for each PCBA

Table 5.1 PCB information of Galleon 3-3 10~20k

Item	PCBA Name		PCBA serial number	Quantity	Remark
1	PFC	10k	71-300709-00G	1	For 10kVA mode
2		15k/20k	71-300032-01G	1	For 15K/20KVA model
3		30k	71-301015-00G	1	For 30KVA model
4			71-301054-00G	1	
4	INV	10k	71-300705-00G	1	Phase R/S of Inverter
			71-300706-00G	1	Phase T of inverter
5		15k/20k/30k	71-300625-01G	1	Phase R/S of Inverter
			71-300594-01G	1	Phase T of inverter
6	CNTL		71-300620-07G	1	PFC control board
			71-300595-09G	1	INV control board
7	Connector		71-300596-01G	1	For PFC control board
8			71-301014-00G	1	For 30K PFC control board
9	Charger	1A	71-300233-04G	1	For standard 10K model
10		2A		1	For standard 15K/20K model
11		4A	71-300233-04G	1	For long run time 10K model
				1	For long run time 15K/20K model
				1	For standard 30K model
		12A	71-300233-04G	3	For long run time 30K model
10	O/P Relay	10k	71-300026-00G	3	Optional, for 10kVA parallel model
11		15k/20k	71-300043-00G	3	Optional, for 15K/20K/30KA parallel model
12	Communication		71-300621-10G	1	
13	Parallel		71-300609-00G	1	Optional, for parallel model
14	Panel		71-300211-01G	1	
15	EMI	Line I/P	71-300707-00G	1	For 10KVA model
16			71-300034-00G	1	For 15K/20K/30KVA model
17		BAT I/P	71-300704-00G	1	For 10KVA model
18			71-300044-00G	1	For 15K/20K/30KVA model
19		O/P	71-300607-00G	1	
20	MOV		71-300048-00G	1	

Note: “0XG” in the serial number is the version of the PCB. It may be modified according to releasing version in the future.

5.1 PFC board (Power Factor Correct Board)

The PFC board consists of Rectifier and PFC/Booster

When UPS works in line mode, the Rectifier and PFC will work, It changes the AC power to DC power stored in the BUS capacitor. When works in Battery mode, the PFC will only work as boost to get the higher DC power

5.2 INV board (Inverter Board)

The INV Board includes SPS,STS and Inverter. It supplies the power for the system, and it converts the DC power to a pure sine waveform, in the purpose of less or no transfer time, there are two STS.

5.3 CNTL board (Control Board)

The CNTL board is the core of the UPS system. It controls the actions of the semiconductors and other mechanical switches.

5.4 COMM board (Communication Board)

The COMM board is charged of display of the LED/LCD, the control of the buzzer, the communication with the computer, and other important tasks

5.5 Charger board

There are two kinds of chargers, one is for standard model with 1A charge current and the other is for long-run model with 4A charge current. But you can set the current to 2A or 1A by changing the jumper (JP1, short pin1&pin2 is 2A, short pin2&pin3 is 1A). The charge voltage is controlled by CNTL board, but it can still work without CNTL board. In this case, the output DC voltage is about 246V.

5.6 O/P Relay board

The O/P Relay board should be installed for parallel system. For single system, it must be removed.
The board can disconnect the UPS from the output (parallel system).

5.7 Communication board

The Communication board provides RS232/USB interface to the users and in charger of the LCD display, and it also provide one EPO port to cut off the output immediately.

5.8 Parallel board

The Parallel board is used for parallel communication when the UPS system is running in parallel mode.

5.9 Panel board

The Panel board provides LED and LCD display to the users.

5.10 EMI board

The EMI board can prevent the UPS from external electronic/magnetic noise generated by other electronic systems, and also prevent other systems from the noise generated inside of the UPS system.

5.11 MOV board

The MOV board can absorb the surge to protect the UPS system.

6. Interface

6.1 LED Display

Table 6.1 LED Display

MODE / LED	Bypass	Line	Battery	Fault
UPS Startup	●	●	●	●
No output	○	○	○	○
Bypass mode	●	○	○	○
Line mode	○	●	○	○
Battery mode	○	○	●	○
Battery test	●	●	●	○
ECO mode	●	●	○	○
CVCF mode	○	●	○	○
Fault mode	○	○	○	●

●: means LED is lighting.

○: means LED is faded.

6.2 LCD Display

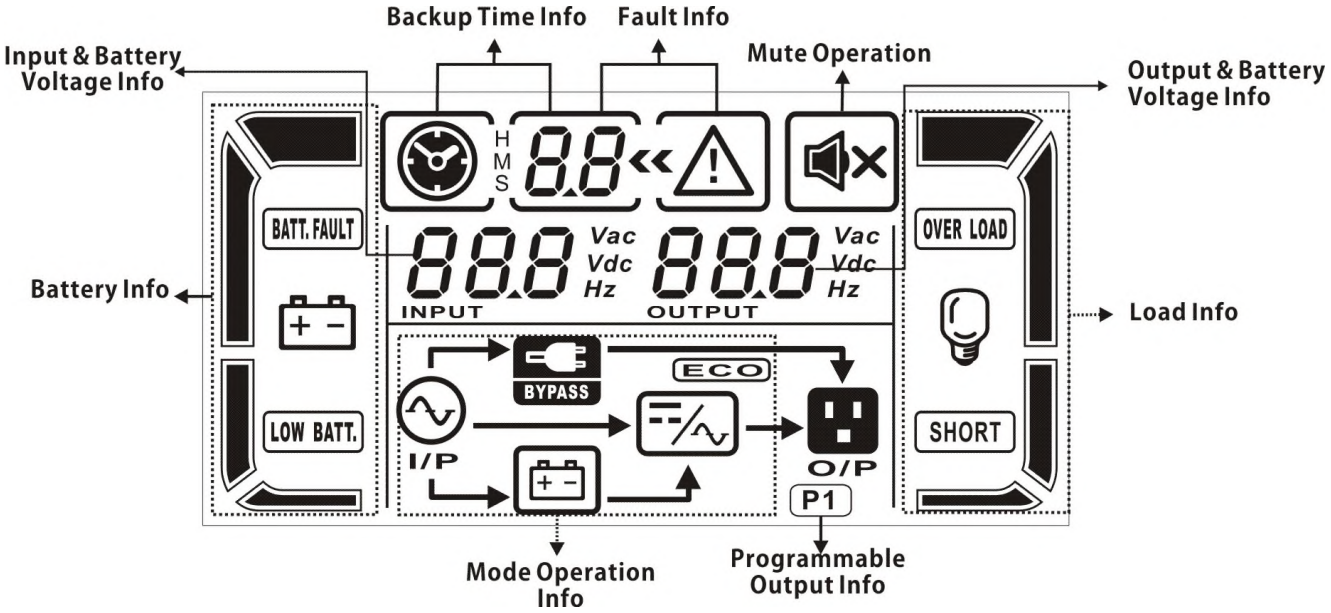
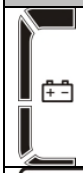


Figure 6.1 LCD Display

6.3 LCD Display Icon

Display	Function
Backup time information	
	Indicates the battery discharge time in numbers. H: hours, M: minutes, S: seconds
Fault information	
	Indicates that the warning and fault occurs.

	Indicates the fault codes, and the codes are listed in details in 7.1.2.
Mute operation	
	Indicates that the UPS alarm is disabled.
Output & Battery voltage information	
	Indicates the output voltage, frequency or battery voltage. Vac: output voltage, Vdc: battery voltage, Hz: frequency
Load information	
	Indicates the load level by 0-25%, 26-50%, 51-75%, and 76-100%.
	Indicates overload.
	Indicates the load or the output is short.
Mode operation information	
	Indicates the UPS connects to the mains.
	Indicates the battery is working.
	Indicates the bypass circuit is working.
	Indicates the ECO mode is enabled.
	Indicates the Inverter circuit is working.
	Indicates the output is working.
Battery information	
	Indicates the Battery capacity by 0-25%, 26-50%, 51-75%, and 76-100%.
	Indicates the battery is unconnected
	Indicates low battery level and low battery voltage.
Input & Battery voltage information	
	Indicates the input voltage or frequency or battery voltage. Vac: Input voltage, Vdc: battery voltage, Hz: input frequency

7. Trouble Shooting

This section describes how to find the troubles when UPS is abnormal. We suggest you to follow the service procedure below:

1. Check the UPS status via LED and LCD display, the sound of the buzzer and get the warning or fault code via the RS232 if possible, otherwise listen to the description of end users.
2. Inspect failure board for static checking.
3. Replace failure components.
4. Static checking.
5. Power-on checking.
6. Test after repair.

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

7.1 LCD Panel Display Pattern Definition

7.1.1 Trouble shooting for warning icon in LCD display

Any warning display implies some abnormity happened to the UPS, indicating that some situation that may endanger the reliability of the UPS has occurred, but these situations don't immediately lead to interruption of power supply.

LCD icon (Flashing)	Code	Alarm	Possible cause	Action
⚠ BATT. FAULT	01	1 Beeping / second	Battery disconnected	Check the battery wiring
⚠	07	1 Beeping / second	Battery/Charger voltage too high	Check the output voltage of the charger/Battery voltage
⚠ LOW BATT.	08	1 Beeping / second	Low battery	Check the battery voltage
⚠ OVER LOAD	09	2 Beeping / second	Over load	Check the loads
⚠ EP	0B	1 Beeping / second	EPO plug or cable not connected	Check the EPO plug and EPO cable
⚠	0A	1 Beeping / second	Fan failure	Check the fans
	0D	1 Beeping / second	high internal temperature	Check the loads, ventilation, ambient temperature
⚠	0E	1 Beeping / second	Charger broken or low output voltage	Check the charger
⚠	10	1 Beeping / second	L1 I/P fuse broken	Check the L1 I/P fuse
	11	1 Beeping / second	L2 I/P fuse broken	Check the L2 I/P fuse

	12	1 Beeping / second	L3 I/P fuse broken	Check the L3 I/P fuse
⚠	02	1 Beeping / second	Input Neutral loss	Check the input wiring
	04	1 Beeping / second	Input phase is abnormal	Check the input wiring
	05	1 Beeping / second	Bypass phase is abnormal	Check the input wiring
	21	1 Beeping / second	Line situations are different in parallel system	Check the input wiring or input breaker
	22	1 Beeping / second	Bypass situations are different in parallel system	Check the input wiring or input breaker or bypass mode setting of each UPS
	33	1 Beeping / second	Over load 3 times in 30min	Check the loads
	34	1 Beeping / second	Converter current unbalance	Check the converter
	35	1 Beeping / second	Battery fuse broken	Check the Battery fuse
	3A	1 Beeping / second	Cover of the maintain switch is open	Check the cover of the maintain switch or 2-pin black/black cable to the power board
	3C	1 Beeping / second	Utility extremely unbalanced	Check the input wiring or you can ignore it when the utility is unbalance indeed
	3D	1 Beeping / second	Bypass is unstable which make the ups switch between no output mode and bypass mode too frequently	Check the bypass or neutral wiring

Note: When the UPS alarms, the UPS is still working on the original mode.

7.1.2 Trouble shooting for fault codes in LCD display

When the UPS is fault, it will transfer to Fault mode.

Code	LCD icon	Fault Event	Description	Action
01	None	BUS soft start failure	When the bus voltage can't reach the setting value in 30s, the fault signal will be displayed.	Check if power components such as IGBT and SCR for the PFC and the utility power SCR are well. Meanwhile, check if the components on the drive circuit are well.
02	None	BUS voltage high	When one of the following conditions occurs, the fault signal will be displayed. 1. +Bus voltage keeps higher than 450V or the –BUS voltage keeps lower than –450V for more than 60 ms.	Maybe the PFC board is damaged; Check if power components such as IGBT and SCR for the PFC and the utility power SCR are well. Meanwhile, check if components on the drive circuit are well.

			2. +Bus voltage keeps higher than 435V or the –BUS voltage keeps lower than –435V for more than 1.5s.	
03	None	BUS voltage low	When +Bus voltage keeps lower than 300V or the –BUS voltage keeps higher than –300V for more than 200ms, the fault signal will be displayed.	Maybe the PFC board is damaged. Check if power components such as IGBT and SCR for the PFC and the utility power SCR are well. Meanwhile, check if components on the drive circuit are well.
04	None	BUS voltage unbalance	When the difference between the ±Bus voltage absolute value keeps more than 100V for 400ms, the fault signal will be sent.	Maybe the PFC board is damaged. Check if power components such as IGBT and SCR for the PFC and the utility power SCR are well. Meanwhile, check if components on the drive circuit are well.
06	None	Converter over current	.When the current of any phase of PFC/Boost is over 60A(for 10K is 30 A), the fault signal will be display	Maybe the PFC board is damaged. Check if power components such as IGBT and SCR for the PFC and the utility power SCR are well. Meanwhile, check if components on the drive circuit are well.
11	None	INV soft start failure	Inverter voltage can't reach the setting value in 30s.	Check the inverter drive circuit.
12	None	INV voltage high	When INV voltage keeps higher than 276V for 400 ms, the fault signal will be displayed.	Check if power components in power INV and on the drive circuit are normal. Check if IGBT protective circuit and some PFC components are normal.
13	None	INV voltage low	When INV voltage keeps lower than 140V for 400 ms, the fault signal will be displayed.	Maybe the INV board is damaged; Check if power components in power INV and on the drive circuit are normal. Check if IGBT protective circuit and some PFC components are normal.
14	SHORT	Phase A(Line to Neutral)Output short circuit	When INV phase A output voltage keeps lower than 50V and output current keeps higher than 30A(for 10K is 20A)for over 4 periods, the fault signal will be displayed.	Remove all the loads. Turn off the UPS. Check whether the output of UPS and loads are short circuited. Make sure the short circuit is removed, and the UPS has no internal faults before turning on again.
15	SHORT	Phase B(Line to Neutral)Output short circuit	When INV phase B output voltage keeps lower than 50V and output current keeps higher than 30A(for 10K is 20A)for over 4 periods, the fault signal will be displayed.	
16	SHORT	Phase C(Line to Neutral)Output short circuit	When INV phase C output voltage keeps lower than 50V and output current keeps higher than 30A(for 10K is 20A)for over 4 periods, the fault signal will be displayed.	
17	SHORT	Phase A-Phase B(Line to line) output short circuit	When INV phase A-phase B(Line to line) voltage keeps lower than 120V and output current keeps higher than 30A(for 10K is 20A) for over 4 periods, the fault signal will be displayed	
18	SHORT	Phase B-Phase C(Line to line) output short circuit	When INV phase B-phase C(Line to line) voltage keeps lower than 120V and output current keeps higher than 30A(for 10K is 20A) for over 4 periods, the fault signal will be displayed	

19	SHORT	Phase C-Phase A(Line to line) output short circuit	When INV phase C-phase A(Line to line) voltage keeps lower than 120V and output current keeps higher than 30A(for 10K is 20A) for over 4 periods, the fault signal will be displayed	
1A	None	Phase A output negative power fault	When the output power on the INV phase A terminal is over -3000W(for 10k is -1500W) for more than 20ms or -800W(for 10k is -400W) for more than 100ms, the fault signal will be displayed	Check if input and output connections are correct. And then check if INV relay RY5 or STS(Q13, Q14, Q17,Q18 and their driver circuits) are OK. Also please check if the power feedback load connected to the UPS.
1B	None	Phase B output negative power fault	When the output power on the INV phase B terminal is over -3000W(for 10k is -1500W) for more than 20ms or -800W(for 10k is -400W) for more than 100ms, the fault signal will be displayed	Check if input and output connections are correct. And then check if INV relay RY5 or STS(Q19, Q20, Q21,Q22 and their driver circuits) are OK. Also please check if the power feedback load connected to the UPS.
1C	None	Phase C output negative power fault	When the output power on the INV phase C terminal is over -3000W(for 10k is -1500W) for more than 20ms or -800W(for 10k is -400W) for more than 100ms, the fault signal will be displayed	Check if input and output connections are correct. And then check if INV relay RY5 or STS(Q17, Q18, Q19,Q20 and their driver circuits) are OK. Also please check if the power feedback load connected to the UPS.
21	None	Battery SCR short circuited	When battery voltage is more than 310V, the fault signal will be displayed.	It is probably the charger or PFC board damaged. Check if the battery SCR(Q21). If PFC board is ensured ok after checking, it may indicate there is something wrong with charger output. Check if components for the battery drive signals are normal. Check circuit of the utility power SCR part.
24	None	INV relay short circuited	After Bus soft start completes and INV PWM is off, more than 50V INV voltage is detected, the fault signal will be displayed.	Check if INV relay RY5 on INV board is OK.
29	None	Battery fuse broken in Battery mode	When this battery voltage is less than 7V, any other battery voltage is higher than 9V The fault signal will be displayed.	Check the Battery fuse is ok
31	None	Parallel Communication Failure	When the parallel communication between the UPSs is interrupted, the fault signal will be displayed.	Check if the parallel cables between the UPSs are normal, and the cable between the parallel board and the control board are normal.
36	None	Current un-sharing	When sharing current is greater than 5A and sharing current is greater than 5*ILoad or the share current less than 5A and greater than the ILoad+4A in UPS parallel system, the fault signal will be displayed.	Check if the share current cables are normal, and make sure the output be connected together.

41	None	over temperature	The temperature of sink is over the protection setting.	Check if UPS is overloaded, air vents are blocked, and ambient temperature is over 40℃. After overload or block is removed, please keep UPS cool down for 10 minutes before turning on again. It is not recommended to operate the UPS under over 40°C temperature environment.
42	None	DSP communication Failure	When the communication between the INV control board and the PFC control board is interrupted, the fault signal will be displayed.	Check if the 3-pin blown cable between the INV control board and the PFC control board is normal.
43	OVER LOAD	Overload	The load is over the settings for certain time.	Check the loads and remove some non-critical loads. Check whether some loads are failed.
46	None	Incorrect UPS setting	The UPS can not identify the right model.	Check the Model Pin of the Control board is inserted correctly
47	None	MCU communication Failure	When the communication between the INV control board and the COMM board is interrupted, the fault signal will be displayed.	Check if the cable between the INV control board and the COMM board is normal.
48	None	Two DSP firmware versions are incompatible	When these two DSP firmware versions are incompatible, the fault signal will be displayed	Contact the distributor or service people to replace the control board with compatible version.
49	None	Input and output phases are incpmpatible	When the UPS was set as three phase out, but detect only one phase input (Three phases are the same).	Check the input of the UPS.

7.1.3 Trouble shooting

Problem	Possible cause	Action
Battery backup time is shorten	Battery not yet been fully charged.	Keep UPS connected to utility power persistently for more than 10 hours to recharge the batteries.
	UPS overload.	Check the loads and remove some non-critical loads.
	Battery aged.	Replace the batteries.
	Charger fails	Replace the charger.
The UPS cannot power on after pressing the button	The button is not pressed and hold long enough	Press the button continuously for more than 0.5s.
	Battery is not connected or battery voltage is too low, or charger fails.	Check the charger and battery.
	UPS failure.	Repair the UPS.

7.2 Repair

In this section, some debug skills are listed to help you finding the failed components and problems as soon as possible. Before proceeding the following steps, we strongly suggest to read previous section for trouble shooting first. Then check the components listed in section 7.2.4 to find out which block fails.

7.2.1 Basic Instruments and tools

1、One computer with RS232 port and one standard RS232 cable;

2、Wire cutters and clamps;

3、One electric soldering iron;

4、One multi-meter;
5、One oscilloscope(voltage and current probe needed);
6、Diagonal pliers, snipe nose pliers, cross screwdrivers (150mm/75mm length), flat screwdrivers (75mm length) and PVC insulating tapes etc;
7、Make-self tools including Balance voltage test equipments, current limiting resistors, tubes and clamp terminals with different specifications;

7.2.2 Configuration of the Model pin and Battery number on the INV Control Board

The Model Port (JS2,JS3,JS5,JS6) on the INV CNTL board should be configured as follows:

Table 7.1 Model Pin Setting List

Model Type	JS2				JS5	JS6
	Pin1&pin2	Pin3&pin4	Pin5&pin6	Pin7&pin8		
10K	1	0	0	0	0	1
10KL	1	0	0	0	0	0
15K	0	1	0	0	0	1
15KL	0	1	0	0	0	0
20K	0	0	1	0	0	1
20kL	0	0	1	0	0	0
30K	0	0	0	1	0	1
30kL	0	0	0	1	0	0

Table 7.2 Battery Number Setting List

Battery Number	JS3			
	Pin1&pin2	Pin3&pin4	Pin5&pin6	Pin7&pin8
18	1	0	0	0
19	0	1	0	0
20	0	0	1	0

Note： “1” indicates that the jumper is connected;
“0”indicates that nothing is connected,

7.2.3 Configuration of the charger current on the charger Board

The Model Port (JP1) on the Charger board should be configured as follows:

Table 7.3 Charger current Setting List

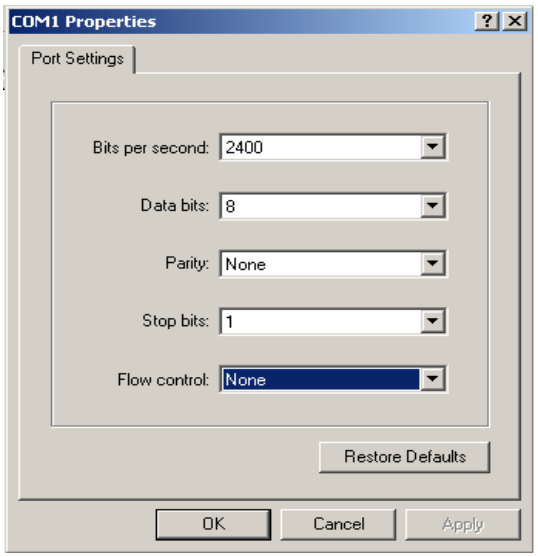
Charger Current(A)	JP1	
	Pin1&pin2	Pin2&pin3
1	0	1
2	1	0
4	0	0

Note：“1” indicates that the jumper is connected;
“0”indicates that nothing is connected

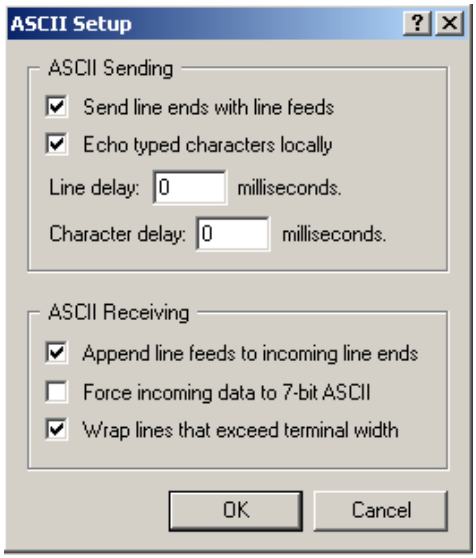
7.2.4 Regulation of the system

Parameter Setting Method:

1. Connect the RS232 port of the UPS to the RS232 port of the computer with RS232 cable. Choose the “Start>>Program>>Accessory>>Communication>>Hyper terminal” and start Hyper terminal application. Set the COM port for “COM1” and the other setting as Figure 7.1.



Communication protocol setting



Display setting

Figure 7.1 Hyper terminal setting

2. After completing the setting, you can type the command in the command area.
3. +BUS voltage regulation: Type “BUSP+/- XX” command (XX is two digits from 00 to 99). Then press the “ENTER” key, and +BUS voltage will rise (drop) about 0.1V. See detail in 9.2.6.
4. -BUS voltage regulation: Type “BUSN+/- XX” command (XX is two digits from 00 to 99). Then press the “ENTER” key, and -BUS voltage will rise (drop) about 0.1V. See detail in 9.2.7.
5. INV output voltage regulation: Type “V(S/T)+/- XX” command (XX is two digits from 00 to 99) Then press the “ENTER” key, and INV output voltage will rise (drop) about 0.1V. See detail in 9.2.3，9.2.4 and 9.2.5.
6. INV output voltage setting: Type “VXXX” command (XXX is 208/220/230/240). Then press the “ENTER” key, and INV output voltage will be set to 208V/220V/230V/240V. See detail in 9.2.3，9.2.2.

Regulation Process for Single UPS

1. BUS voltage regulation: When the UPS run into AC mode, measure ±BUS voltage with the multimeter, and then regulate ±BUS voltages to rated value±0.1V by using BUS regulation command. (BUS voltage can be regulated about 0.1V every point by using BUS regulation command).
2. INV output voltage regulation: When the UPS run into the Inverter mode, measure the output voltage with the multimeter, and regulate the output voltage to rated value±0.1V by using output voltage regulation command. (INV output voltage can be regulated about 0.1V every point by using output voltage regulation command).

Notes:

1. Make sure the ground of the UPS connects to earth safely during parameter regulation.
2. New assembly UPS must be regulated.
3. UPS which have been replaced CNTL/COMM/PFC/INV must be regulated again.
4. All the commands use capital letters.
5. All the above parameter regulation cannot be accumulated.
6. All the regulation will be saved in the flash memory of the CNTL when UPS shutdown with battery connected.

7.2.5 Quick Start

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

Note: Make sure that the capacitor voltage is lower than the safety voltage before disassembling any parts to do checking procedure.

10k PFC Section

Circuit Block	Checked components	Component Type	Failure condition
Rectifier	Q17,Q18,Q21,Q27,Q24,Q25,Q26,Q49,Q44,Q45, Q46,Q58	SCR	A-K Short or open
PFC	D33, D35, D34, D36,D45,D43,D49,D44,D54,D52 D53,D58,	Diode	Short or open
	Q22, Q23,Q32,Q43 ,Q57,Q52	IGBT	C-E short or open

10k Phase R&S INV Section

Circuit Block	Checked components	Component Type	Failure condition
INV	D17, D18,D34,D32	Diode	Short or open
	Q45,Q46,Q42,Q43	IGBT	C-E short or open
STS	Q13, Q14, Q17, Q18,Q19,Q20,Q21,Q22	SCR	A-K Short or open
SPS	F6	Fuse	Open
	Q6, U14,U15	MOSFET	D-S short or open
	D3, D4, D5, D6, D7, D8,D9	Power Diode	Short or open
	U5, U6, U9, U13	Power IC	I-O short or open
	U11	Power Control IC	Vcc short to GND
Others	Q16, Q52, Q12, Q31,Q33,Q30,Q32, Q34 Q3,Q4,Q1,Q2,Q5,Q6	MOSFET	D-S short or open

10k Phase T INV Section

Circuit Block	Checked components	Component Type	Failure condition
INV	D34,D32	Diode	Short or open
	Q45,Q46	IGBT	C-E short or open
STS	Q17, Q18,Q19,Q20	SCR	A-K Short or open

15k/20k PFC Section

Circuit Block	Checked components	Component Type	Failure condition
Rectifier	Q17,Q18,Q21,Q27,Q24,Q25,Q26,Q49,Q44,Q45, Q46,Q58	SCR	A-K Short or open
PFC	D33, D35, D34, D36,D45,D43,D49,D44,D54,D52 D53,D58,	Diode	Short or open

	Q22, Q23,Q59,Q60,Q32,Q43,Q61,Q62,Q57,Q52 Q63,Q64	IGBT	C-E short or open

30k PFC Phase R&S Section

Circuit Block	Checked components	Component Type	Failure condition
Rectifier	Q17,Q18,Q24,Q25,Q21,Q26,Q27,Q49	SCR	A-K Short or open
PFC	D33,D35,D43,D45,D34,D36,D44,D49	Diode	Short or open
	Q22,Q23,Q29,Q32,Q37,Q38,Q42,Q43,Q44,Q45, Q46,Q47	IGBT	C-E short or open

30k PFC Phase T Section

Circuit Block	Checked components	Component Type	Failure condition
Rectifier	Q24,Q25,Q26,Q49	SCR	A-K Short or open
PFC	D43,D45,D44,D49	Diode	Short or open
	Q32,Q43,Q44,Q45,Q46,Q47	IGBT	C-E short or open

15k/20k/30K Phase R&S INV Section

Circuit Block	Checked components	Component Type	Failure condition
INV	D17, D18,D34,D32	Diode	Short or open
	Q8,Q9,Q10,Q11,Q45,Q46,Q42,Q43	IGBT	C-E short or open
STS	Q13, Q14, Q17, Q18,Q19,Q20,Q21,Q22	SCR	A-K Short or open
SPS	F6	Fuse	Open
	Q6, U14,U15	MOSFET	D-S short or open
	D3, D4, D5, D6, D7, D8,D9	Power Diode	Short or open
	U5, U6, U9, U13	Power IC	I-O short or open
	U11	Power Control IC	Vcc short to GND
Others	Q16, Q52, Q12, Q31,Q33,Q30,Q32, Q34 Q3,Q4,Q1,Q2,Q5,Q6	MOSFET	D-S short or open

15k/20k/30K Phase T INV Section

Circuit Block	Checked components	Component Type	Failure condition
INV	D34,D32	Diode	Short or open
	Q9,Q11,Q45,Q46	IGBT	C-E short or open
STS	Q17, Q18,Q19,Q20	SCR	A-K Short or open

10k EMI Section

Circuit Block	Checked components	Component Type	Failure condition
Line I/P EMI	F1,F3,F5	Fuse	Open
BAT I/P EMI	F1 ,F3,F5,F7,F9,F11	Fuse	Open

15k/20k/30K EMI Section

Circuit Block	Checked components	Component Type	Failure condition
Line I/P EMI	F1,F2,F3,F4,F5,F6	Fuse	Open
BAT I/P EMI	F1,F2,F3,F4,F5,F6,F7,F8,F9,F10,F11,F12	Fuse	Open

1A Charger Section

Circuit Block	Checked components	Component Type	Failure condition
DC FUSE	F2, F3, F4	Fuse	Open
AC FUSE	F1	Fuse	Open
Power Semiconductor	REC1, REC2	Rectifier Bridge	Short or open
	D3, D4, D5, D7, D8	Diode	Short or open
	Q8, Q14	MOSFET	D-S short or open
	U10	Power IC	I-O short or open
Others	Q11	MOSFET	D-S short or open
	Q15, Q16, Q7, Q10	Transistor	C-E short or open
	U1	Power Control IC	Vcc short to GND

4A Charger Section

Circuit Block	Checked components	Component Type	Failed condition
DC FUSE	F2, F3, F4	Fuse	Open
AC FUSE	F1	Fuse	Open
Power Semiconductor	REC1, REC2	Rectifier Bridge	Short or open
	D3, D4, D5, D7, D8	Diode	Short or open
	Q8, Q13, Q14	MOSFET	D-S short or open
	U10	Power IC	I-O short or open
Others	Q11	MOSFET	D-S short or open
	Q15, Q16, Q7, Q10	Transistor	C-E short or open
	U1	Power Control IC	Vcc short to GND

Note: If the fuse is in “open” status, don’t replace the fuse only. In most of cases, open fuse is caused by other failed components. Therefore, before restarting the UPS, you must find all failed components and replace them.

7.2.5.1 Major parameters of Rectifier and PFC section

The most likely problems occur on the Rectifier and PFC section including: open fuse, broken IGBT, broken Diode, broken SCR, and broken IGBT/SCR driver resistor. When checking PFC section, directly check the IGBT with Resistance probe or the Diode Voltage Droop probe with multimeter.

10K PFC Section

Checked components		Instrument function	Reference Value	Failed condition
Q17, Q18, Q24,Q25,Q44,Q45	(A, K)	Resistance	≈6MΩ	Short
	(G, K)	Resistance	≈33Ω	Short
Q21,Q27, Q26,Q49, Q46,Q58	(A, K)	Resistance	≈10MΩ	Short
	(G, K)	Resistance	≈33Ω	Short
R102, R105, R116,R158,R181,R178 R185, R205, R226,R229,R233,R248		Resistance	39Ω	Value change
Q22,Q23,Q32,Q43, Q57,Q52	(E, C)	Diode Voltage Droop	≈0.38V	Short or open
	(E, G)	Diode Voltage Droop	≈1.4V	Short or open
	(G, E)	Resistance	≈51KΩ	Short or open
R118, R120, R122, R129,R197,R210,		Resistance	10Ω	Infinite or value change

R161,R162,R163,R164,R198,R222	Resistance	2.2Ω	Infinite or value change
D33, D35,D43,D45,D52,D54	Diode Voltage Droop	≈0.38V	Short or open
D34, D36,D44,D49,D53,D58	Diode Voltage Droop	≈0.38V	Short or open
D69,D70,D71,D72,D73,D74	Diode Voltage Droop	≈0.38V	Short or open
TVS1, TVS2, TVS3, TVS4, TVS5, TVS6 TVS7, TVS8, TVS9, TVS10, TVS11, TVS12 TVS13, TVS14, TVS15, TVS16, TVS17, TVS18	Diode Voltage Droop	≈0.53V	Short or open

15K/20K PFC Section

Checked components		**Instrument function**	**Reference Value**	**Failed condition**
Q17, Q18, Q24,Q25,Q44,Q45	(A, K)	Resistance	≈6MΩ	Short
	(G, K)	Resistance	≈33Ω	Short
Q21,Q27, Q26,Q49, Q46,Q58	(A, K)	Resistance	≈10MΩ	Short
	(G, K)	Resistance	≈33Ω	Short
R102, R105, R116,R158,R181,R178 R185, R205, R226,R229,R233,R248		Resistance	39Ω	Value change
Q22,Q23,Q59,Q60,Q32,Q43, Q61,Q62,Q57,Q52,Q63,Q64	(E, C)	Diode Voltage Droop	≈0.38V	Short or open
	(E, G)	Diode Voltage Droop	≈1.4V	Short or open
	(G, E)	Resistance	≈23.75KΩ	Short or open
R118, R120, R122, R129,R197,R210, R251, R254, R258, R260,R264,R275		Resistance	2.2Ω	Infinite or value change
D33, D35,D43,D45,D52,D54		Diode Voltage Droop	≈0.38V	Short or open
D34, D36,D44,D49,D53,D58		Diode Voltage Droop	≈0.38V	Short or open
D69,D70,D71,D72,D73,D74		Diode Voltage Droop	≈0.38V	Short or open
TVS1, TVS2, TVS3, TVS4, TVS5, TVS6 TVS7, TVS8, TVS9, TVS10, TVS11, TVS12 TVS13, TVS14, TVS15, TVS16, TVS17, TVS18		Diode Voltage Droop	≈0.53V	Short or open

30K PFC Section

Checked components		**Instrument function**	**Reference Value**	**Failed condition**
Q17, Q18, Q24,Q25	(A, K)	Resistance	≈6MΩ	Short
	(G, K)	Resistance	≈33Ω	Short
Q21,Q27, Q26,Q49	(A, K)	Resistance	≈10MΩ	Short
	(G, K)	Resistance	≈33Ω	Short
R103,R111,R116,R158,R178,R181,R185, R205,		Resistance	39Ω	Value change
Q22,Q23,Q29,Q32,Q37,Q38. Q42,Q43,Q44,Q45,Q46,Q47	(E, C)	Diode Voltage Droop	≈0.38V	Short or open
	(E, G)	Diode Voltage Droop	≈1.4V	Short or open
	(G, E)	Resistance	≈17KΩ	Short or open
R118,R120,R182,R190,R196,R197,R198,R206 ,R209,R213,R216,R217		Resistance	10Ω	Infinite or value change

R162,R164,R174,R176,R189,R195,R200,R203 ,R208,R211,R214,R215	Resistance	2.2Ω	
D33, D35,D43,D45	Diode Voltage Droop	≈0.38V	Short or open
D34, D36,D44,D49	Diode Voltage Droop	≈0.38V	Short or open
D69,D70,D71,D72	Diode Voltage Droop	≈0.38V	Short or open
TVS1, TVS2, TVS3, TVS4, TVS5, TVS6 TVS7, TVS8, TVS9, TVS10, TVS11, TVS12	Diode Voltage Droop	≈0.53V	Short or open

30k PFC Phase T Section

Checked components		**Instrument function**	**Reference Value**	**Failed condition**
Q24,Q25	(A, K)	Resistance	≈6MΩ	Short
	(G, K)	Resistance	≈33Ω	Short
Q26,Q49	(A, K)	Resistance	≈10MΩ	Short
	(G, K)	Resistance	≈33Ω	Short
R178,R181,R185, R205		Resistance	39Ω	Value change
Q32, Q43,Q44,Q45,Q46,Q47	(E, C)	Diode Voltage Droop	≈0.38V	Short or open
	(E, G)	Diode Voltage Droop	≈1.4V	Short or open
	(G, E)	Resistance	≈17KΩ	Short or open
R190,R206,R209,R213,R216,R217		Resistance	10Ω	Infinite or value change
R164, R189, R208,R211,R214,R215		Resistance	2.2Ω	
D43,D45		Diode Voltage Droop	≈0.38V	Short or open
D44,D49		Diode Voltage Droop	≈0.38V	Short or open
D71,D72		Diode Voltage Droop	≈0.38V	Short or open
TVS7, TVS8, TVS9, TVS10, TVS11, TVS12		Diode Voltage Droop	≈0.53V	Short or open

Note: If IGBT/SCR is OK, but the parameter is not close to the reference value, it is very possible that the corresponding driver is damaged, so please try to change the IGBT driver component.

7.2.5.2 Major parameters of Inverter and STS section

The most likely problems occur on the INV section including broken IGBT, broken Diode, broken SCR, damaged IGBT/SCR driver resistor, damaged relative snubber circuit with broken IGBT/SCR, and stuck output relay.

10K Phase R&S INV Section

Checked components		**Instrument function**	**Reference Value**	**Failed Condition**
Q42,Q43,Q45,Q46	(E, C)	Diode Voltage Droop	≈0.38V	Short or open
	(E, G)	Diode Voltage Droop	≈1.4V	Short or open
	(G, E)	Resistance	51KΩ	Short or open
D22, D23, D24, D25 D26,.D27,.D28,.D31 (need be removed from PCB)		Diode Voltage Droop	≈0.61V	Short or open
R45, R46, R52, R53, R131,R137,R124,R127		Resistance	22Ω	Infinite or value change
R47, R48, R54, R55 R125,R130,R123,R129		Resistance	62Ω	Infinite or value change
D17, D18,D32,D34		Diode Voltage Droop	≈0.38V	Short or open

Q13, Q14,Q17,Q18	(A, K)	Resistance	≈0(Short by the INV.RLY)	----
	(G, K)	Resistance	≈33Ω	Short
Q19,Q20,Q21,Q22	(A, K)	Resistance	≈6MΩ	Short
	(G, K)	Resistance	≈33Ω	Short

10K Phase T INV Section

Checked components		**Instrument function**	**Reference Value**	**Failed Condition**
Q45,Q46	(E, C)	Diode Voltage Droop	≈0.38V	Short or open
	(E, G)	Diode Voltage Droop	≈1.4V	Short or open
	(G, E)	Resistance	51KΩ	Short or open
D22, D23, D24, D25 D26,.D27,.D28,.D31 (need be removed from PCB)		Diode Voltage Droop	≈0.61V	Short or open
R45, R46, R52, R53, R131,R137,R124,R127		Resistance	22Ω	Infinite or value change
R47, R48, R54, R55 R125,R130,R123,R129		Resistance	62Ω	Infinite or value change
D32,D34		Diode Voltage Droop	≈0.38V	Short or open
Q13, Q14,Q17,Q18	(A, K)	Resistance	≈0(Short by the INV.RLY)	----
	(G, K)	Resistance	≈33Ω	Short
Q19,Q20,Q21,Q22	(A, K)	Resistance	≈6MΩ	Short
	(G, K)	Resistance	≈33Ω	Short

15K/20K/30K INV Section

Checked components		**Instrument function**	**Reference Value**	**Failed Condition**
Q9, Q10,Q11,Q12, Q42,Q43,Q45,Q46	(E, C)	Diode Voltage Droop	≈0.38V	Short or open
	(E, G)	Diode Voltage Droop	≈1.4V	Short or open
	(G, E)	Resistance	25.5KΩ	Short or open
D22, D23, D24, D25 D26,.D27,.D28,.D31 (need be removed from PCB)		Diode Voltage Droop	≈0.61V	Short or open
R45, R46, R52, R53, R131,R137,R124,R127		Resistance	22Ω	Infinite or value change
R47, R48, R54, R55 R125,R130,R123,R129		Resistance	62Ω	Infinite or value change
D17, D18,D32,D34		Diode Voltage Droop	≈0.38V	Short or open
Q13, Q14,Q17,Q18	(A, K)	Resistance	≈0(Short by the INV.RLY)	----
	(G, K)	Resistance	≈33Ω	Short
Q19,Q20,Q21,Q22	(A, K)	Resistance	≈6MΩ	Short
	(G, K)	Resistance	≈33Ω	Short

Note: If IGBT/SCR is OK, but the parameter is not close to the reference value, it is very possible that the corresponding driver is damaged, so please try to change the IGBT driver component.

7.2.5.3 Major parameters of SPS section

The most likely problems occur on the SPS section including open fuse, broken MOSFET, broken Diode, damaged relative driver resistor with broken MOSFET.

10K/15K/20K /30KSPS Section

Checked components		Instrument function	Reference Value	Failed Condition
F6		Resistance	< 0.5 Ω	Open
Q6	(S, D)	Diode Voltage Droop	≈0.53V	Short or open
	(S, G)	Diode Voltage Droop	≈0.68V	Short or open
	(G, S)	Resistance	≈47.5KΩ	Short or open
R25		Resistance	≈47Ω	Infinite or value change
D4, D5, D6, D7, D8, D9		Diode Voltage Droop	≈0.53V	Short or open
U14,U15	(D, S)	Resistance	≈282KΩ	Short
	(G, S)	Resistance	≈500Ω	Short
U5, U6, U9, U13		Diode Voltage Droop	≈0.6V	Short
U11		Resistance	≈76.4KΩ	Short

7.2.5.4 Major parameters of 1A Charger

The most likely problems occur on the Charger section including open fuse, broken MOSFET, broken Diode, damaged relative driver resistor with broken MOSFET

Checked components		Instrument function	Reference Value	Failed condition
F1.F2.F3.F4		Resistance	<0.5Ω	Open
Q14	(S, D)	Diode Voltage Droop	≈0.46V	Short or open
	(G, S)	Diode Voltage Droop	≈1.7V	Short or open
	(S, G)	Diode Voltage Droop	≈1.05V	Short or open
	(G, D)	Diode Voltage Droop	≈2.1V	Short or open
	(G, S)	Resistance	≈47KΩ	Short or open
R87		Resistance	≈3Ω	Infinite or value change
D11 (need be removed from PCB)		Diode Voltage Droop	≈0.61V	Short or open
Q8	(S, D)	Diode Voltage Droop	≈0.43V	Short or open
	(G, S)	Diode Voltage Droop	≈0.67V	Short or open
	(S, G)	Diode Voltage Droop	≈1.0V	
	(G, D)	Diode Voltage Droop	≈1.1V	
	(G, S)	Resistance	≈10KΩ	Short or open
REC1, REC2	(+,~)	Diode Voltage Droop	≈0.54V	Short or open
	(~,-)	Diode Voltage Droop	≈0.54V	Short or open
D3, D4, D5, D7, D8		Diode	≈0.3~0.5V	Short or open
Q15, Q16, Q7, Q10	(C, E)	Diode Voltage Droop	≈1.0V	Short or open
	(B, E)	Diode Voltage Droop	≈0.67V	Short or open
Q11	(S, D)	Diode Voltage Droop	≈0.67V	Short or open
	(S, G)	Diode Voltage Droop	≈0.7V	Short or open
U1	(Vcc, GND)	Resistance	≈82 KΩ	Short

7.2.5.5 Major parameters of 4A Charger

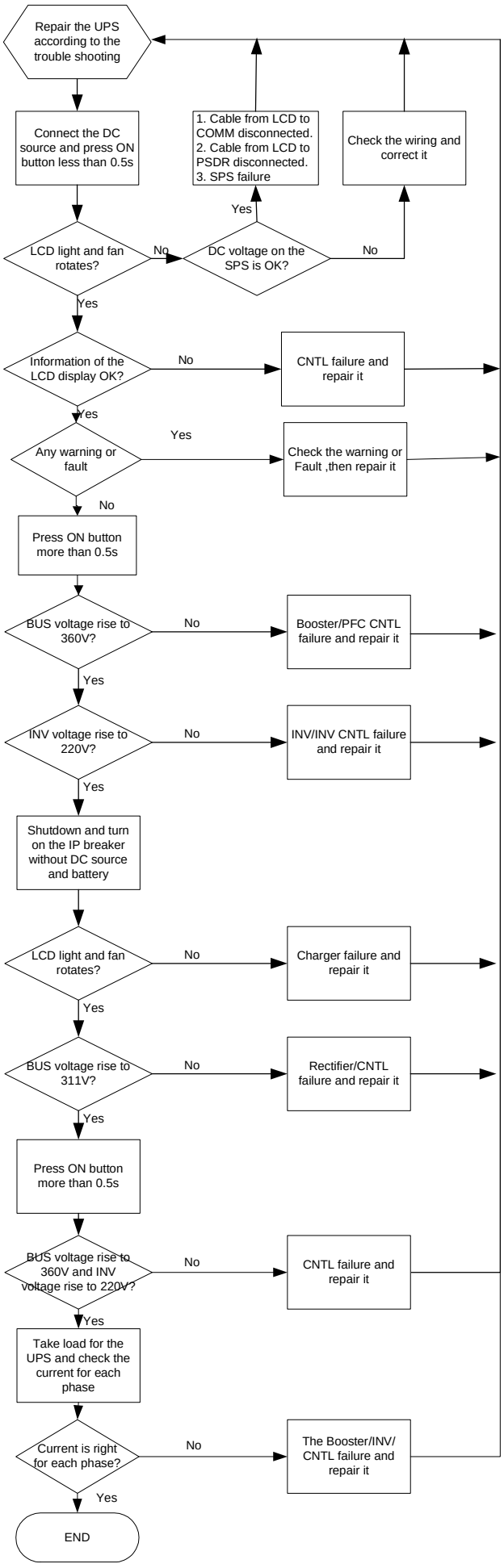
The most likely problems occur on the Charger section including open fuse, broken MOSFET, broken Diode, damaged relative driver resistor with broken MOSFET.

Checked components		Instrument function	Reference Value	Failed condition
F1.F2.F3.F4		Resistance	<0.5Ω	Open
Q13, Q14	(S, D)	Diode Voltage Droop	≈0.46V	Short or open
	(G, S)	Diode Voltage Droop	≈1.7V	Short or open
	(S, G)	Diode Voltage Droop	≈1.05V	Short or open
	(G, D)	Diode Voltage Droop	≈2.1V	Short or open
	(G, S)	Resistance	≈23.5KΩ	Short or open
R85, R87		Resistance	≈3Ω	Infinite or value change
D10, D11 (need be removed from PCB)		Diode Voltage Droop	≈0.61V	Short or open
Q8	(S, D)	Diode Voltage Droop	≈0.43V	Short or open
	(G, S)	Diode Voltage Droop	≈0.67V	Short or open
	(S, G)	Diode Voltage Droop	≈1.0V	
	(G, D)	Diode Voltage Droop	≈1.1V	
	(G, S)	Resistance	≈10KΩ	Short or open
REC1, REC2	(+,~)	Diode Voltage Droop	≈0.52V	Short or open
	(~,-)	Diode Voltage Droop	≈0.52V	Short or open
D3, D4, D5, D7, D8		Diode	≈0.3~0.5V	Short or open
Q15, Q16, Q7, Q10	(C, E)	Diode Voltage Droop	≈1.0V	Short or open
	(B, E)	Diode Voltage Droop	≈0.67V	Short or open
Q11	(S, D)	Diode Voltage Droop	≈0.67V	Short or open
	(S, G)	Diode Voltage Droop	≈0.7V	Short or open
U1	(Vcc, GND)	Resistance	≈82 KΩ	Short

8. Test Step

After replacing all defected components, following testing steps can be adopted to verify the repair result and the reliability of the UPS.

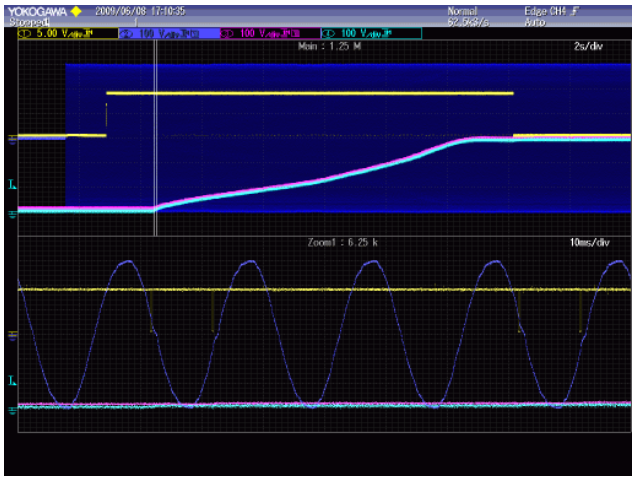
1. Install all of boards/cable/connector.
2. Check the wiring, pay more attention to the charger control cable(3Pin) and the signal wire of maintain switch.
3. Apply DC Power from power source with current limitation function to the battery terminal.
4. Press the ON button on the panel for less than 0.5s, the LCD will be lit and the Fan will rotates, If not, please check the input voltage of the SPS, if the voltage is the DC source output voltage, please repair the SPS again.
5. Press the ON button on the panel for more than 0.5s until you hear the ringing and loosen the button, you will see "current limit" for a short time on the DC source for about only 2 seconds, then UPS should be DC started, If UPS does not start successfully, please repair the PFC or CNTL again.
6. If UPS does not start up for several trying or DC source is on current-limit state continuously, there must be some defected components exists. Please follow trouble-shooting chart to debug again.
7. Turn off the UPS, connect utility to the UPS, turn on the UPS, if fail you may have start one new round of trouble shooting.
8. Check and adjust charge voltage.
9. Check the output voltage waveform and DC-offset voltage, at no-load and full load condition.

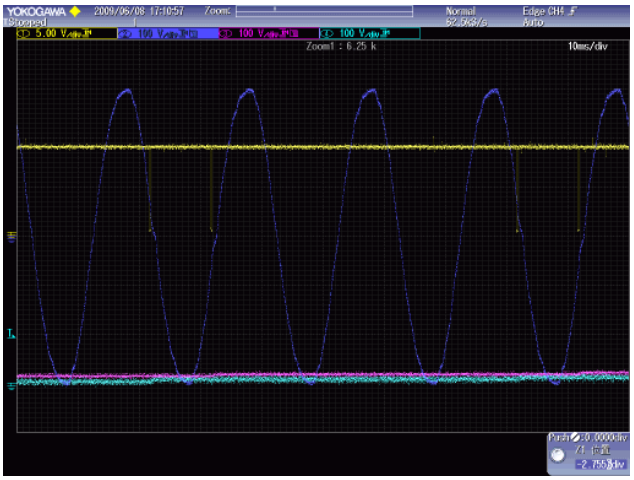


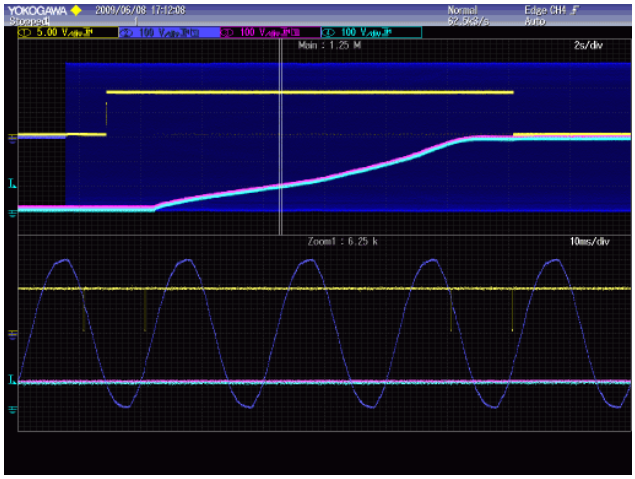
9. Appendix

9.1 Reference Waveform

. Below are some waveform charts to show normal UPS operation. It's a very useful reference to verify the test result in section 8.

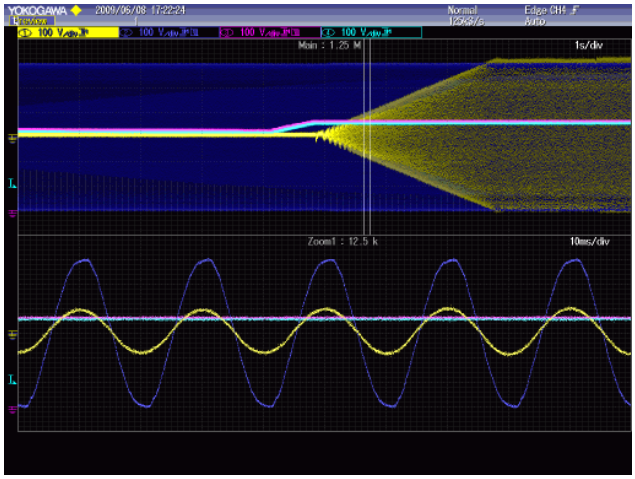






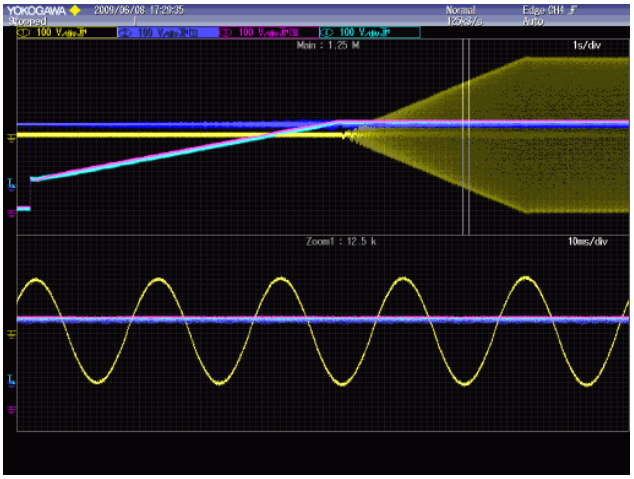
CH1: IP SCR driver
CH2: IP voltage
CH3: -BUS voltage
CH4: +BUS voltage

Figure 9.1 Switch on the input breaker without turn on



CH1: INV voltage
CH2: IP voltage
CH3: -BUS voltage
CH4: +BUS voltage

AC mode (transfer from Bypass mode)



CH1: INV voltage
CH2: Battery voltage
CH3: -BUS voltage
CH4: +BUS voltage

Battery mode

Figure 9.2 Turn on the UPS

	
CH1: IP voltage CH3: V_{GE}-(PFC PWM-) CH4: V_{GE}+(PFC PWM+)	CH1: INV voltage CH2: Battery voltage CH3: V_{GE}-(PFC PWM-) CH4: V_{GE}+(PFC PWM+)
AC mode	Battery mode

Figure 9.3 PFC PWM

	
	CH1: INV voltage CH2: IP voltage CH3: V_{GE}-(INV PWM-) CH4: V_{GE}+(INV PWM+)

Figure 9.4 INV PWM

9.2 Basic communication command

In this section, we will show you some basic communication commands that will help you debug or regulate the UPS system.

9.2.1 QGS

QGS means to request general status parameters of the system. The command format is:

Computer: QGS<cr>

UPS: (MMM.M HH.H LLL.L NN.N QQQ.Q DDD KKK.K VVV.V SSS.S XXX.X TTT.T $b_{11}b_{10}b_9b_8b_7b_6b_5b_4b_3b_2b_1b_0$<cr>

Data	Description	Notes
(	Start byte	
MMM.M	Input voltage	M is an Integer number 0 to 9. The units is V.
HH.H	Input frequency	H is an Integer number 0 to 9. The units is Hz.
LLL.L	Output voltage	L is an Integer number 0 to 9. The units is V.
NN.N	Output frequency	N is an Integer number from 0 to 9. The units is Hz.
QQQ.Q	Output current	QQQ.Q is Maximum current among output A, B and C. Q is an Integer number from 0 to 9. The units is A.
DDD	Output load percent	DDD is Maximum of W% or VA%. VA% is a percent of total power. W% is a percent of total active power.
KKK.K	Positive BUS voltage	K is an Integer ranging from 0 to 9. The units is V.
VVV.V	Negative BUS voltage	V is an Integer ranging from 0 to 9. The units is V.
SSS.S	P Battery voltage	S is an Integer ranging from 0 to 9. The units is V.
XXX.X	N Battery voltage	X is an Integer ranging from 0 to 9. The units is V.
TTT.T	Max Temperature of the detecting pointers	T is an integer ranging from 0 to 9. The units is °C
$b_{11}b_{10}b_9b_8b_7b_6b_5b_4b_3b_2b_1b_0$	Ups status	b_{11},b_{10}: 00: standby; 01: line-interactive; 10: on-line. b_9: Utility Fail b_8: Battery Low b_7: Bypass/Boost Active b_6: UPS Failure b_5: EPO b_4: Test in Progress b_3: Shutdown Active b_2: bat silence b_1: Bat test fail b_0: Bat test OK

Example:

Computer: QGS<cr>

UPS: (225.2 50.0 220.0 50.0 027.0 090 360.8 359.9 241.0 ---.- 045.0 100011000000<cr>

Meanings:

I/P voltage = 225.2V.

I/P frequency = 50.0Hz

O/P voltage = 220.0V

O/P frequency = 50.0Hz.

O/P current = 27.0A

O/P load = 90%

Positive BUS voltage = 360.8V

Negative BUS voltage = 359.9V

P Battery voltage = 241.0V.

N Battery voltage is ---.-V. It means it is a single battery-type UPS. The negative battery voltage does not exist.

Temperature = 45.0 degrees of centigrade.

On-line mode, Utility OK, Bypass Active, UPS failure.

9.2.2 V<n>

This command is to set the nominal output voltage. The format is:

Computer: V<n><cr>

UPS: (ACK or (NAK<cr>*

*: If UPS accepts this command, responds ACK. Otherwise, responds NAK

Output Voltage: <n>. n is 208,220,230,240.

Default status: Nominal output voltage 220V. (It can be set only in bypass or no output mode)

For example:

Computer: V230<cr>

UPS: (ACK<cr>

Meanings: set output nominal voltage to 230V.

9.2.3 V±<n>

This command is to adjust the inverter phase A voltage. The format is:

Computer: V±<n><cr>

UPS: (ACK or (NAK<cr>*

*: If UPS accepts this command, responds ACK. Otherwise, responds NAK

Voltage adjust step: <n>. n=00, 01……, 99.

For example:

Computer: V+05<cr>

UPS: (ACK<cr>

Meanings: The inverter phase A voltage will increase about 0.5 Volt.

9.2.4 VS±<n>

This command is to adjust the inverter phase B voltage. The format is:

Computer: VS±<n><cr>

UPS: (ACK or (NAK<cr>*

*: If UPS accepts this command, responds ACK. Otherwise, responds NAK

Voltage adjust step: <n>. n=00, 01……, 99.

For example:

Computer: VS+05<cr>

UPS: (ACK<cr>

Meanings: The inverter phase B voltage will increase about 0.5 Volt.

9.2.5 VT±<n>

This command is to adjust the inverter phase C voltage. The format is:

Computer: VT±<n><cr>

UPS: (ACK or (NAK<cr>*

*: If UPS accepts this command, responds ACK. Otherwise, responds NAK

Voltage adjust step: <n>. n=00, 01……, 99.

For example:

Computer: VT+05<cr>

UPS: (ACK<cr>

Meanings: The inverter phase C voltage will increase about 0.5 Volt.

9.2.6 BUSP±<n>

This command is to adjust the positive BUS voltage, the format is:

Computer: BUSP±<n><cr>

UPS: (ACK or (NAK<cr>*

*: If UPS accepts this command, responds ACK. Otherwise, responds NAK

Voltage adjustment step: <n>. n=00, 01……, 99.

For example:

Computer: BUSP-01<cr>

UPS: (ACK<cr>

Meanings: Positive BUS voltage will decrease about 0.1 Volt.

9.2.7 BUSN±<n>

This command is to adjust the negative BUS voltage, the format is:

Computer: BUSN±<n><cr>

UPS: (ACK or (NAK<cr>*

*: If UPS accepts this command, responds ACK. Otherwise, responds NAK

Voltage adjustment step: <n>. n=00, 01……, 99.

For example:

Computer: BUSN+02<Enter>

UPS: (ACK

Meanings: Negative BUS voltage will increase about 0.2 Volt.

9.2.8 VB±<n>

This command is to adjust the battery voltage sampling value. You can adjust the battery voltage sampling value displayed on LCD equal to the real battery voltage. The format is:

Computer: VB±<n><cr>

UPS: (ACK or (NAK<cr>*

*: If UPS accepts this command, responds ACK. Otherwise, responds NAK

Voltage adjustment step: <n>. n=00, 01……, 99.

For example:

Computer: VB-01<Enter>

UPS: (ACK

Meanings: Battery sampling voltage will decrease about 0.1 Volt.

9.2.9 QVFW

QVFW means to request the version of the INV CNTL board firmware. The command format is:

Computer: QVFW<cr>

UPS: (VERFW: <NNNNN.NN><cr>

<N> is a HEX number from 0...9 or A…F.

Example:

Computer: QVFW<cr>

UPS: (VERFW: <00426.01><cr>

Meanings: 00426 is the firmware series number and 01 is the version.

9.2.10 QVFW2

QVFW2 means to request the version of the Communication board firmware. The command format is:

Computer: QVFW2<cr>

UPS: (VERFW2: <NNNNN.NN><cr>

<N> is a HEX number from 0...9 or A…F.

Example:

Computer: QVFW2<cr>

UPS: (VERFW2: <00425.01><cr>

Meanings: 00425 is the firmware series number and 01 is the version.

9.2.11 QVFW3

QVFW3 means to request the version of the PFC CNTL board firmware. The command format is:

Computer: QVFW3<cr>

UPS: (VERFW3: <NNNNN.NN><cr>

<N> is a HEX number from 0...9 or A…F.

Example:

Computer: QVFW3<cr>

UPS: (VERFW2: <00426.01><cr>

Meanings: 00426 is the firmware series number and 01 is the version.

9.2.12 Q3PV

Q3PV means to request the input three phase voltage. The command format is:

Computer：Q3PV<cr>

UPS: (RRR.R SSS.S TTT.T AAA.A BBB.B CCC.C<cr>

	Data	Description	Notes
a	(	Start byte	
b	RRR.R	R voltage	R is an Integer number 0 to 9. The units is V.
c	SSS.S	S voltage	S is an Integer number 0 to 9. The units is V.
d	TTT.T	T voltage	T is an Integer number 0 to 9. The units is V.
e	AAA.A	Line voltage of RS	A is an Integer number 0 to 9. The units is V.
f	BBB.B	Line voltage of ST	B is an Integer number 0 to 9. The units is V.
g	CCC.C	Line voltage of TR	C is an Integer number 0 to 9. The units is V.

Example:

Computer: Q3PV<cr>

UPS: (220.2 215.3 222.1 381.4 373.2 384.6<cr>

Means:

R line voltage is 220.2V.

S line voltage is 215.3V.

T line voltage is 222.1V.

Line voltage of RS is 381.4V.

Line voltage of ST is 373.2V.

Line voltage of TR is 384.6V.

9.2.13 Q3OV

Q3OV means to request output three phase voltage. The command format is:

Computer：Q3OV<cr>

UPS: (RRR.R SSS.S TTT.T AAA.A BBB.B CCC.C<cr>

	Data	Description	Notes
a	(	Start byte	
b	RRR.R	R phase Output voltage	R is an Integer number 0 to 9. The units is V.
c	SSS.S	S phase Output voltage	S is an Integer number 0 to 9. The units is V.
d	TTT.T	T phase Output voltage	T is an Integer number 0 to 9. The units is V.
e	AAA.A	output voltage of RS	A is an Integer number 0 to 9. The units is V.
f	BBB.B	output voltage of ST	B is an Integer number 0 to 9. The units is V.
g	CCC.C	output voltage of TR	C is an Integer number 0 to 9. The units is V.

Example:

Computer: Q3OV<cr>

UPS: (220.0 220.0 220.0 380.0 380.0 380.0<cr>

Means:

R output voltage is 220.0V.

S output voltage is 220.0V.

T output voltage is 220.0V.

Output voltage of RS is 380.0V.

Output voltage of ST is 380.0V.

Output voltage of TR is 380.0V.

9.2.14 Q3YV

Q3YV means to request the bypass three phase voltage. The command format is:

Computer：Q3YV<cr>

UPS: (RRR.R SSS.S TTT.T AAA.A BBB.B CCC.C <cr>

	Data	Description	Notes
a	(	Start byte	
b	RRR.R	R voltage of bypass	R is an Integer number 0 to 9. The units is V.
c	SSS.S	S voltage of bypass	S is an Integer number 0 to 9. The units is V.
d	TTT.T	T voltage of bypass	T is an Integer number 0 to 9. The units is V.
e	AAA.A	bypass voltage of RS	A is an Integer number 0 to 9. The units is V.
f	BBB.B	bypass voltage of ST	B is an Integer number 0 to 9. The units is V.
g	CCC.C	bypass voltage of TR	C is an Integer number 0 to 9. The units is V.

Example:

Computer: Q3YV<cr>

UPS: (220.0 220.0 220.0 380.0 380.0 380.0<cr>

Means:

R bypass voltage is 220.0V.

S bypass voltage is 220.0V.

T bypass voltage is 220.0V.

Bypass voltage of RS is 380.0V.

Bypass voltage of ST is 380.0V.

Bypass voltage of TR is 380.0V.

9.2.15 Q3LD

Q3LD means to request the three phase load and the whole load. The command format is:

Computer：Q3LD<cr>

UPS: (RRR SSS TTT AAA<cr>

	Data	Description	Notes
a	(	Start byte	
b	RRR.R	R phase of load	R is an Integer number 0 to 9. The units is %.
c	SSS.S	S phase of load	S is an Integer number 0 to 9. The units is %.
d	TTT.T	T phase of load	T is an Integer number 0 to 9. The units is %.
e	AAA.A	The whole load	A is an Integer number 0 to 9. The units is %.

Example:

Computer: Q3LD<cr>

UPS: (046.2 042.4 000.0 044.3<cr>

Means:

R phase load percent is 46.2%.

S phase load percent is 42.4%.

T phase load percent is 00.0%.

The whole load percent is 44.3%

9.2.16 Q3OC

Q3OC means to request the output three phase current. The command format is:

Computer：Q3OC<cr>

UPS: (RRR.R SSS.S TTT.T <cr>

	Data	Description	Notes
a	(	Start byte	
b	RRR.R	R phase Output current	R is an Integer number 0 to 9. The units is A.
c	SSS.S	S phase Output current	S is an Integer number 0 to 9. The units is A.
d	TTT.T	T phase output current	T is an Integer number 0 to 9. The units is A.

Example:

Computer: Q3OC<cr>

UPS: (022.2 018.4 000.0<cr>

Means:

R phase output current is 22.2A.

S phase output current is 18.4A.

T phase output current is 00.0A.