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Service-Handbuch

GRAFENTHAL

USV PTR-10000

CONTENT

1. General Information

1.1 Getting start

This manual is for Galleon II 6K(L)/10K(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 include 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			
	6K	**6KL**	**10K**	**10KL**
Input				
Input Voltage	176～300 VAC @ Full Load			
	110 VAC @ Half Load			
Input Frequency	46～54 Hz for 50Hz system			
	56～64 Hz for 60Hz system			
Input Power Factor	≥0.99			
Input THD	<4%			
Generator	Support			
Output				
Output Power (VA/Watt)	6000/6000(20 pieces battery)		10000/10000(20 pieces battery)	
	6000/5400(18~19 pieces battery)		10000/9000(18~19 pieces battery)	
	6000/4800(16~17 pieces battery)		10000/8000(16~17 pieces battery)	
Nominal Output Voltage	208/220/230/240VAC			
Voltage Regulation	±1%			
Output Frequency	Follows Bypass Frequency in Line Mode			
	(50/60±0.1) Hz in Battery Mode			
Voltage Distortion	≤6% @ Full Nonlinear Load			
	≤2% @ Full Linear Load			
Current Crest Ratio	3:1			
Transfer Time	0ms @ Line ←→ Battery			
	0ms @ Inverter ←→ Bypass			
	<10ms @ Inverter ←→ ECO			
Short Circuit Protection	Yes			
Battery				
Nominal Battery Voltage	240 VDC			
Nominal Battery Quantity	20 pcs			
Acceptable Battery Quantity	18~20 pcs			
Type/Capacity	12V/7.2Ah		12V/9Ah	
Backup Time	≥6minutes@full load		≥4minutes@full load	
Efficiency				
To Line Mode	>93%			
To Battery Mode	>91%			
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	≤55dB
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

Note: The "Acoustic Noise" row contains two values: ≤55dB and ≤58dB.

3. Functional Block

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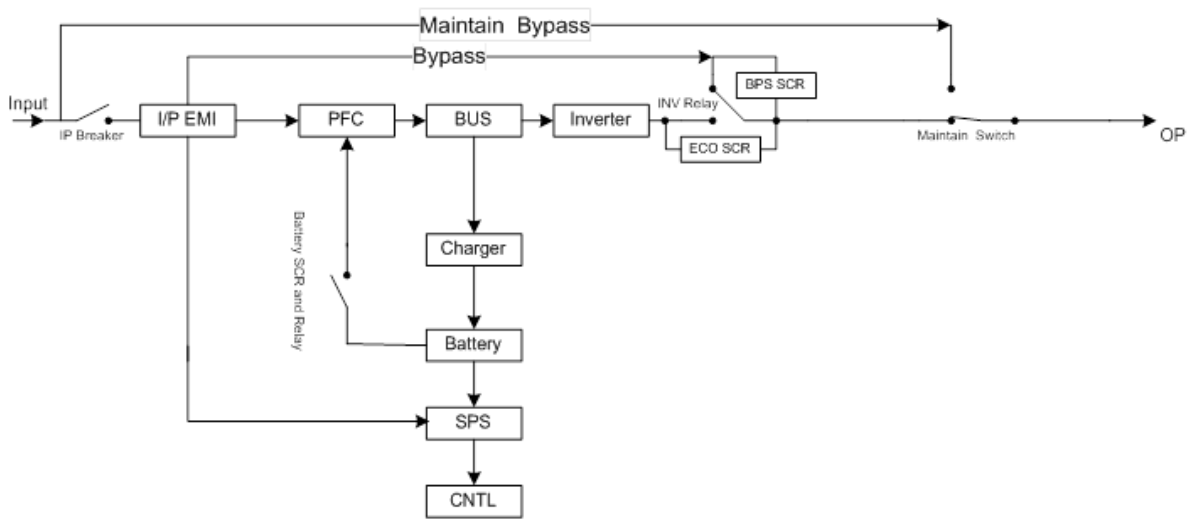

Figure 3.1 Function block Diagram

The CNTL block controls the action of the UPS system. It also provides the communication interface for receiving and executing command from users via the panel or other communication protocol. When the UPS becomes abnormal, in most case, the CNTL can provide basic information indicating the status of the UPS.

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 UPS system is in online model. You can set the current from 1A to 4A by changing the jumper. And you also can choose a different voltage corresponding to different battery pieces by changing the jumper on the CNTL board and the charger board.

The Input EMI section provides EMI filter function. The input 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.

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 grid when the grid voltage is higher than 110V . Or the input source of the SPS is the battery.
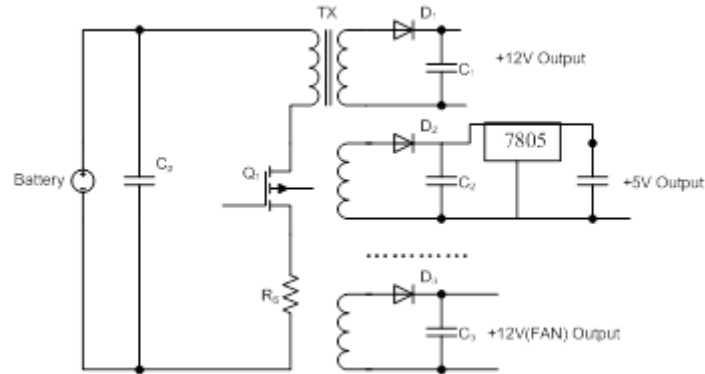

Figure 4.1 Basic circuit of power supply

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 $\pm$15V, +12V, +5V, +12V(Fan), and HFPW$\pm$.

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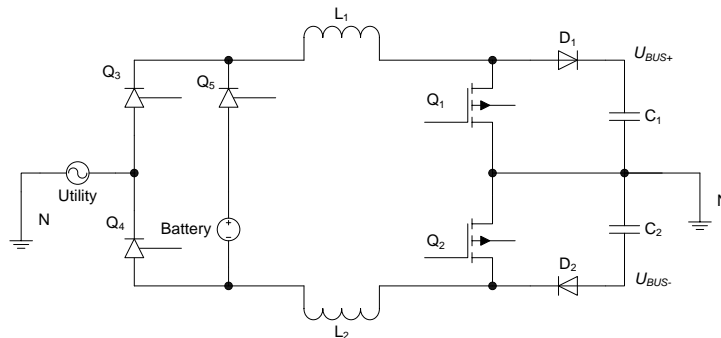
4.2 PFC/Booster

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.

4.3 Inverter

The input of the three level inverter topology is two DC voltages, and the output is an AC voltage, as shown in the Figure 4.3. When Q1/Q2 is on and Q/Q3 is off, the voltage of the bridge midpoint is +BUS. When Q1/Q2 is off and Q3/Q4 is on, the voltage of the midpoint bridge is –BUS. We can get any voltage waveform between $\pm$BUS voltage from LC filter output by regulating the duty cycle of Q1/Q2/Q3/Q4, including sine wave form.
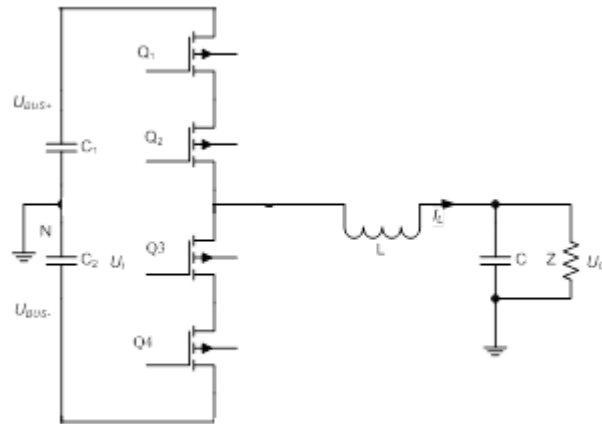
Figure 4.3 Three level inverter bridge

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.
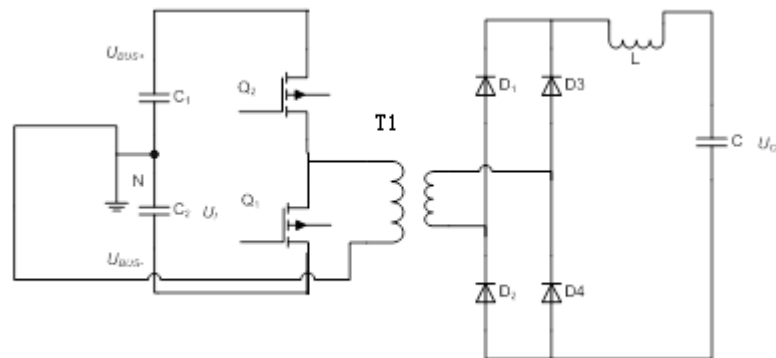

Figure 4.4 Topology of the charger

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 on difference in charger output capacity.

4.5 EMI Board

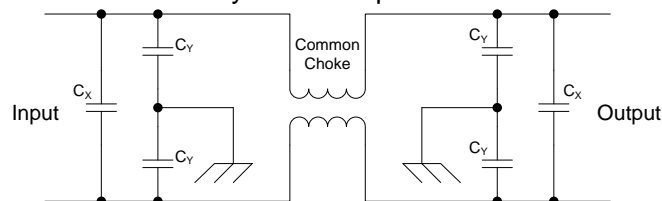Input EMI board is connected between utility and the input of rectifier.

Figure 4.5 Topology of the EMI

5. Function explanations for each PCB

Table 5.1 PCB information of Galleon 6~10k

Item	PCB Name		PCB serial number	Quantity	Remark
1	SPS-Charger	6k	71-302390-XXG	1	For 6kVA model
		10k	71-301757-XXG	1	For 10kVA model
2	CNTL		71-301569-XXG	1	
3	Communication		71-302389-XXG	1	
4	EMI	6K	71-302448-XXG	1	For 6kVA model
		10K	71-302408-XXG	1	For 10kVA model
5	Main Power	6K	71-302114-XXG	1	For 6kVA model
		10K	71-301756-XXG	1	For 10kVA model
6	Para(A)		71-302096-XXG	1	
	Para(B)		71-302097-XXG	1	
7	O/P Relay		71-300026-XXG	1	

Note: "XX" in the serial number is the version of the PCB. It may be modified according to releasing version in the future.

5.1 SPS-Charger board (Power Stage Board)

The PSDR board consists of SPS. It gives the whole UPS system power supply.

You can set the current from 1A to 4A by changing the jumper. And you also can choose a different voltage corresponding to different battery pieces by changing the jumper on the CNTL board and the Charger-Charger board. The charge voltage is controlled by CNTL board.

5.2 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, the display of the LED/LCD, the sound of the buzzer, the communication with the computer, and other important tasks.

5.3 Communication board

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

5.4 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. And the MOV is also on the EMI board which can absorb the surge to protect the UPS system.

5.5 Main Power board

The Main Power board is the most expensive and biggest PCB in the UPS. It converts the AC/DC power to a pure sine waveform. And then it converts the DC/AC power. There are many semiconductors and easy-failure components on the board, so it's required to pay more attention when UPS is abnormal.

5.6 Para(A) and Para(B) board

The Para(A) board and Para(B) board is used for parallel communication when the UPS system is

running in parallel mode.

5.7 O/P Relay board

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

6. Interface

6.1 LED Display

Table 6.1 LED Display

Mode LED	Bypass	Line	Battery	Fault
UPS Startup	●	●	●	●
No Output mode	○	○	○	○
Bypass mode	●	○	○	○
AC mode	○	●	○	○
Battery mode	○	○	●	○
CVCF mode	○	●	○	○
Battery Test	●	●	●	○
ECO mode	●	●	○	○
Fault	○	○	○	●

Note: ● means LED is lighting, and ○ means LED is faded.

6.2 LCD Display
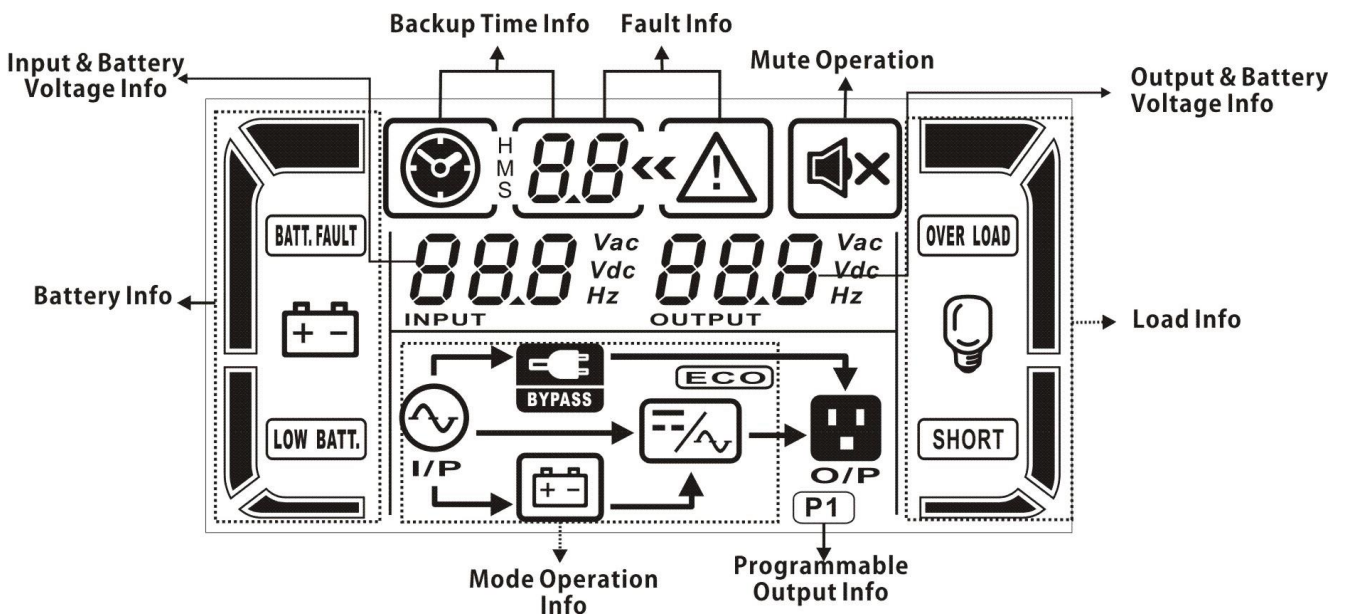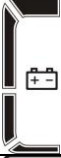
Figure 6.1 LCD Display

6.3 LCD Display Icon

Display	Function

Backup time information	
⊗ (clock icon)	Indicates the backup time in pie chart.
H M S **8.8**	● Indicates the backup time in numbers. H: hours, M: minutes, S: seconds ● When UPS is in Bypass mode, these two numbers indicating the power capacity; 06 for 6K model and 10 for 10K model.

Fault information	
≪ ⚠	Indicates that the warning and fault occurs.
8.8	Indicates the fault codes, and the codes are listed in details in section 7-1.
Mute operation	
🔇×	Indicates that the UPS alarm is disabled.
Output & Battery voltage information	
8.8.8 Vac Vdc Hz OUTPUT	Indicates the output voltage, frequency or battery voltage. Vac: output voltage, Vdc: battery voltage, Hz: frequency
Load information	
(load level icon)	Indicates the load level by 0-25%, 26-50%, 51-75%, and 76-100%.
OVER LOAD	Indicates overload.
SHORT	Indicates the load or the output is short.
Programmable output information	
P1	Indicates that the programmable outputs are working.
Mode operation information	
(~) I/P	Indicates the UPS connects to the utility.
(battery icon)	Indicates the battery is working.
(plug icon) BYPASS	Indicates the bypass circuit is working.
ECO	Indicates the ECO mode is enabled.
⎓/∿	Indicates the Inverter circuit is working.
(outlet icon) O/P	Indicates the output is working.
Battery information	
(battery capacity icon)	Indicates the Battery capacity by 0-25%, 26-50%, 51-75%, and 76-100%.
BATT. FAULT	Indicates the battery is fault.
LOW BATT.	Indicates low battery level and low battery voltage.
Input & Battery voltage information	

888 Vac Vdc Hz INPUT 12	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:
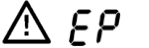
1. Check the UPS status via LED and LCD display, the sound of the buzzer, or listen to the description of end users.
2. Inspect failure board for static checking.
3. Replace failure components.
4. Static checking.
5. Power-on checking.
6. Test after repair.

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)	Alarm	Possible cause	Action
⚠ LOW BATT.	1 Beeping / second	Low battery	Check the battery voltage
⚠ OVER LOAD	2 Beeping / second	Over load	Check the loads
⚠ BATT. FAULT	1 Beeping / second	Battery disconnected	Check the battery wiring
⚠	1 Beeping / second	Battery/Charger voltage too high	Check the output voltage of the battery and the charger
⚠ EP	1 Beeping / second	EPO plug or cable not connected	Check the EPO plug and EPO cable
⚠	1 Beeping / second	Fan failure, or high internal temperature	Check the fans, loads, ventilation, ambient temperature
⚠	1 Beeping / second	Charger broken or low output voltage	Check the charger
⚠ ⟶	1 Beeping / second	I/P fuse broken	Check the I/P fuse
⚠	1 Beeping / second	Overload 3 times in 30min	Check the loads

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 50 ms. 2. +Bus voltage keeps higher than 400V or the –BUS voltage keeps lower than –400V for more than 1.5s.	Maybe the PSDR 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.
03	None	BUS voltage low	When +Bus voltage keeps lower than 230V or the –BUS voltage keeps higher than –230V for more than 200ms, the fault signal will be displayed.	Maybe the PSDR 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 40V for 2 minutes, the fault signal will be sent.	Maybe the PSDR 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.
05	None	BUS short circuited	When bus voltage drops to 32V in a period and the situation occurs for more than two periods, the fault signal will be displayed.	Check all the components on power board.
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 128 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 128 ms, the fault signal will be displayed.	Maybe the PSDR 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	Output short circuited	When INV output voltage keeps lower than 50V and output current keeps lower than 20A for over 3 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.
1A	None	Negative power fault	When the output power on the INV terminal is over -800W, 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, Q20,Q25 and their driver circuits) are OK.
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 PSDR board damaged. Check if the battery SCR(Q21)or the battery relay (RY3, RY4) on the PSDR board are well. If PSDR board is ensured ok after checking, it may indicate there is something wrong with charger output. Check if components for the battery drive

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				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 PSDR board is OK.
35	None	Parallel cable failure	When the parallel communication between the UPSs is interrupted, the fault signal will be displayed.	Check 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 the share current cable are normal, and make sure the output be connected together.
41	None	over temperature		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	Internal fault	CPU can not build communication and the control board is damaged.	Replace the CNTL board.
43	OVER LOAD	Overload		Check the loads and remove some non-critical loads. Check whether some loads are failed.

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 multimeter;
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 Port on the Control Board

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

Table 6.1 Model Port Setting List

Model Type	pin1&pin2	pin3&pin4	Battery Number	pin5&pin6	pin7&pin8	pin5&pin6
6K	0	1	16	1	0	0
6KL	0	0	17	0	1	1
10K	1	1	18	0	1	0
10KL	1	0	19	0	0	1
			20	0	0	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 on the Charger board should be configured as follows:

Table 7.3 Charger current Setting List

Charge current (A)	JP06	JP07	JP08
1A	0	0	1
2A	0	1	0
3A	1	0	0
4A	0	0	0

Note： "1" indicates that the jumper is connected;

"0"indicates that nothing is connected

7.2.4 Configuration of the **charge voltage** on the charger Board

Modify charger voltage according to below table to meet the setting number in control board. There are jumpers on the charger board. Please refer to the below table to modify charger voltage.

Table 7.4 Charge Voltage Setting List

Battery Number in series	Charge voltage (V)	JP01	JP02	JP03	JP04	JP05
16	218	0	0	0	1	0
17	232	0	0	1	0	0
18	245	0	1	0	0	0

| 19 | 259 | 1 | 0 | 0 | 0 | 0 |
| 20 | 273 | 0 | 0 | 0 | 0 | 0 |

Note： "1" indicates that the jumper is connected;

"0"indicates that nothing is connected

7.2.5 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.

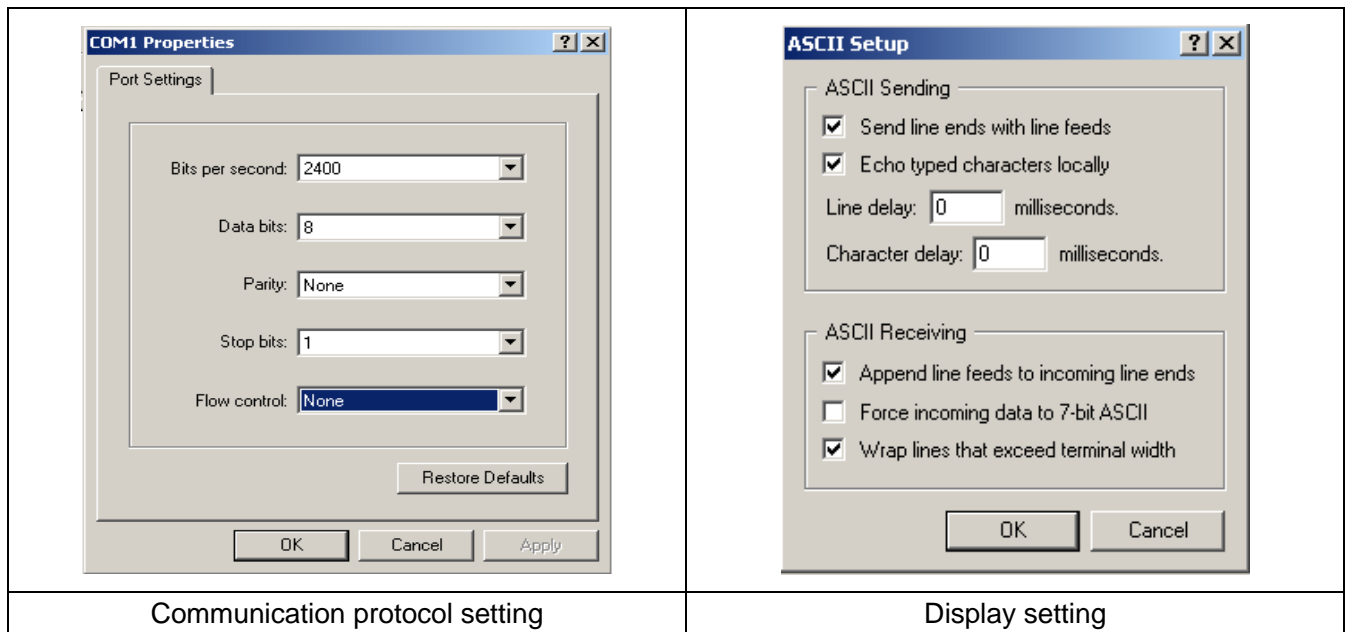| Communication protocol setting	Display setting

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 X.XV.

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 X.XV.

5. INV output voltage regulation: Type "V+/- XX" command (XXis a digit from 00 to 99) Then press the "ENTER" key, and output voltage will rise (drop) about X.XV.

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.

7. Output current regulation: Type "OC+/-XX" command (XX is two digits from 00 to 99). Then press the "ENTER" key, and output current will rise (drop) about X.X A.

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 360±0.5V 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 230±0.5V by using output voltage regulation command. (INV output voltage can be regulated about 0.1V every point by using output voltage regulation command).

3. Output current regulation: When the UPS run into the Inverter mode with full R load, measure the output current, and regulate the output current which we can read from QGS command to measure value±0.2A by using output current regulation command. (Output current can be regulated about 0.1A 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/PSDR 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.

7.2.6 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 Main Power Section

Circuit Block	Checked components	Component Type	Failure condition
DC FUSE	F3, F4	Fuse	Open
Rectifier	Q27, Q18, Q21	SCR	A-K Short or open
PFC	D33, D35	Diode	Short or open
	Q22, Q23, Q24, Q25	IGBT	C-E short or open
INV	D52, D62	Diode	Short or open

	Q7, Q8, Q9, Q10, Q12, Q15	IGBT	C-E short or open
STS	Q13, Q14, Q20, Q46	SCR	A-K Short or open

6k Main Power Section

Circuit Block	Checked components	Component Type	Failure condition
AC FUSE	F3,F4	Fuse	Open
Rectifier	Q17, Q18, Q21	SCR	A-K Short or open
PFC	D33, D35	Diode	Short or open
	Q22, Q23	IGBT	C-E short or open
INV	D62, D52	Diode	Short or open
	Q7, Q8, Q9, Q10	IGBT	C-E short or open
STS	Q1, Q2, Q3, Q4	SCR	A-K Short or open

SPS-Charger Section

Circuit Block	Checked components	Component Type	Failure condition
Power Semiconductor	D2, D3, D7, D8, D11	Diode	Short or open
	Q1, Q2	MOSFET	D-S short or open
	IC1	Power IC	I-O short or open
Others	Q28	MOSFET	D-S short or open
	F1	Fuse	Open
	REC1	Rectifier Bridge	Short or open
	Q6, Q15, Q28	MOSFET	D-S short or open
	D8, D16, D13, D7, D17, D18 ,D33	Power Diode	Short or open
	U1, U4	Power IC	I-O short or open
	U9, U10	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.

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).
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 note 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.
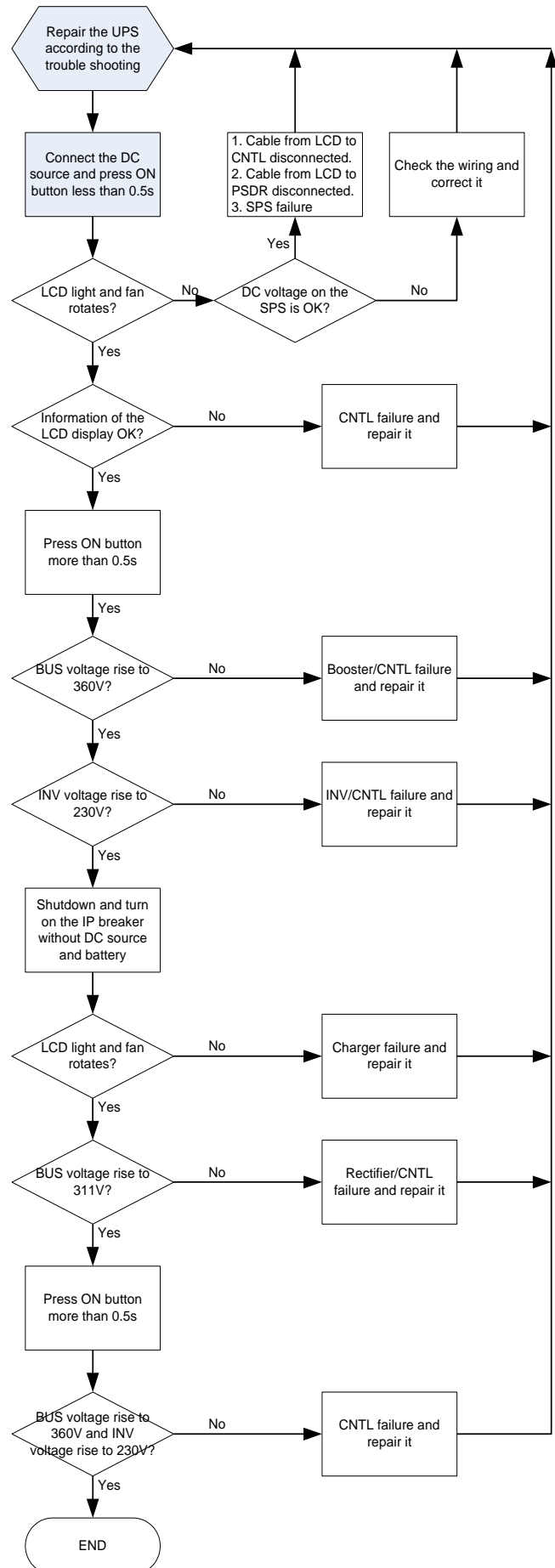
9. Appendix
9.1 Reference Waveform
. Below are some waveform charts to show normal UPS operation. It's a very useful reference to verify the test result in section 8.

CH1: IP SCR driver
CH2: IP voltage
CH3: -BUS voltage
CH4: +BUS voltage
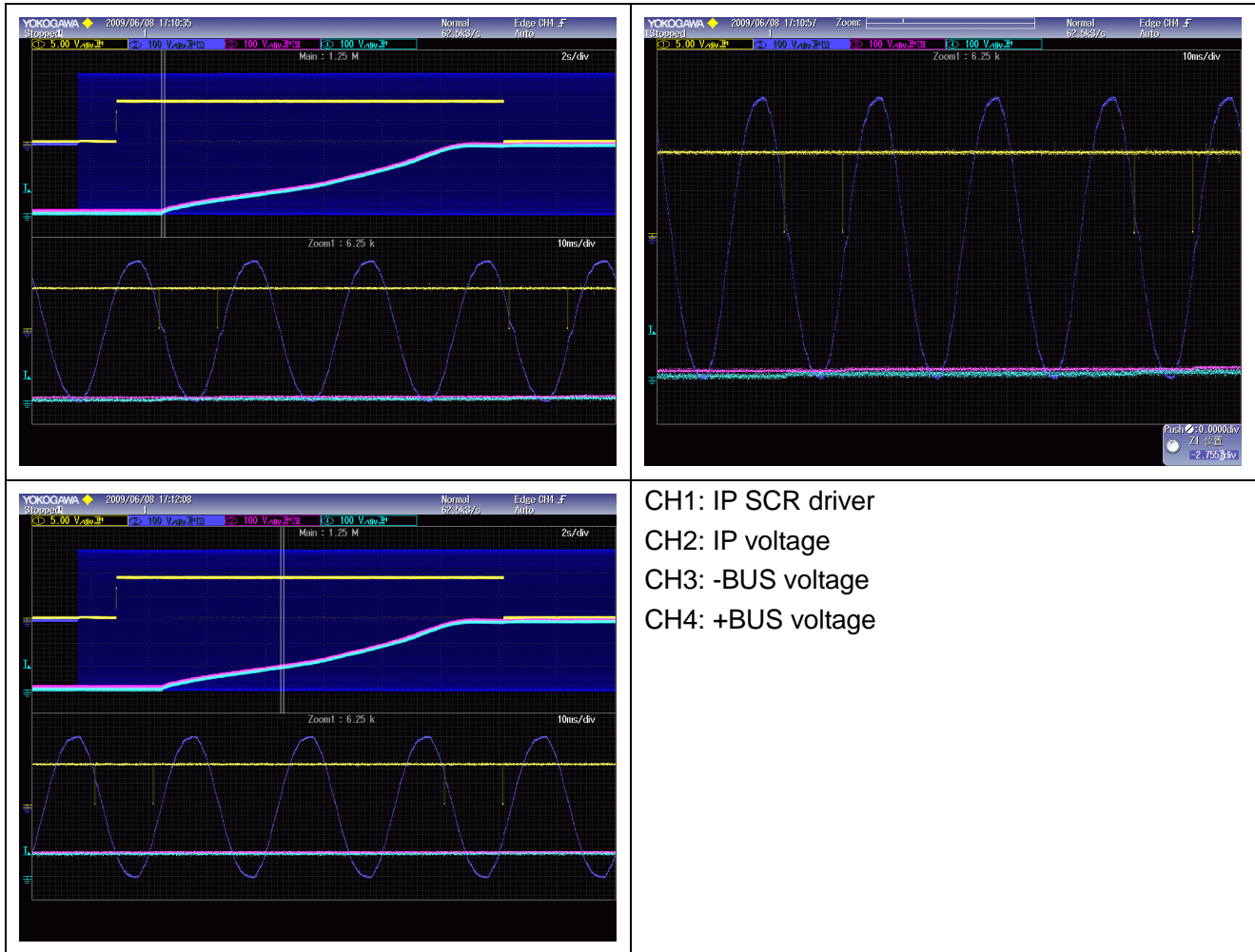
Figure 9.1 Switch on the input breaker without turn on

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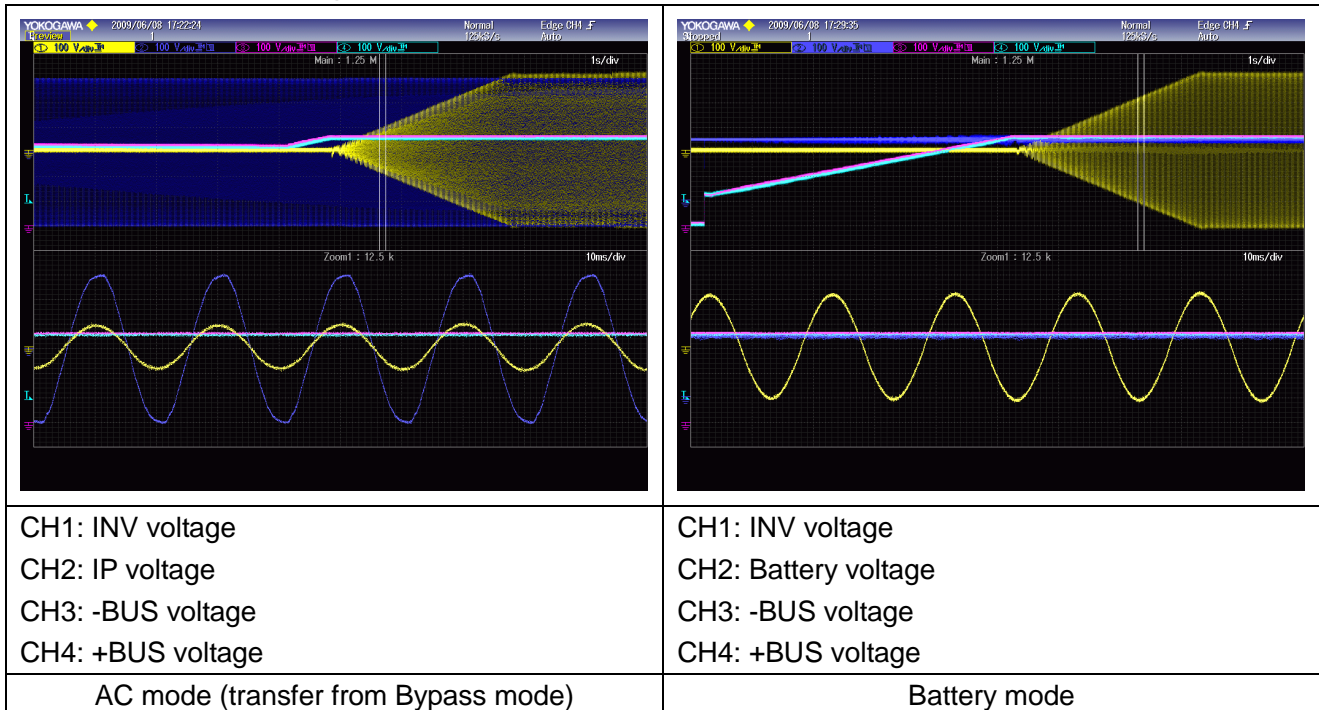
	CH1: INV voltage CH2: IP voltage CH3: V_{GE}-(INV PWM-) CH4: V_{GE}+(INV PWM+)

Figure 9.4 INV PWM

9.2 Basic communication command

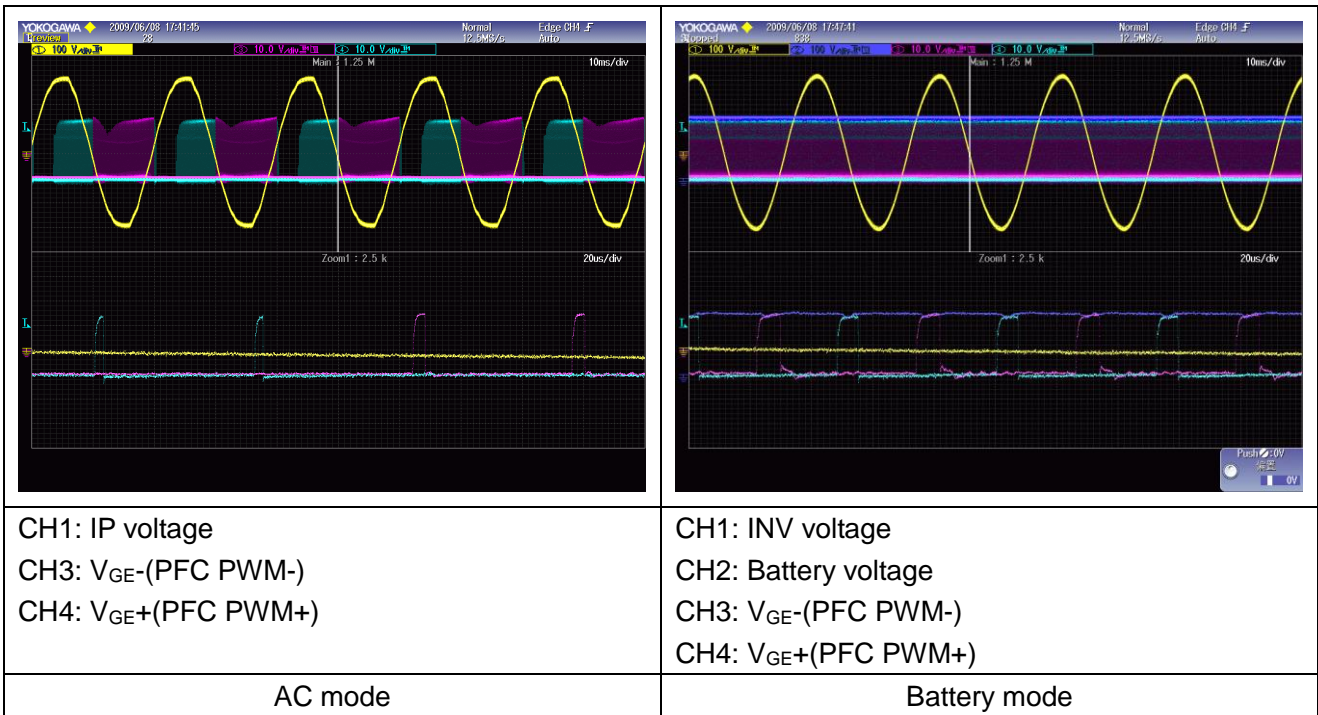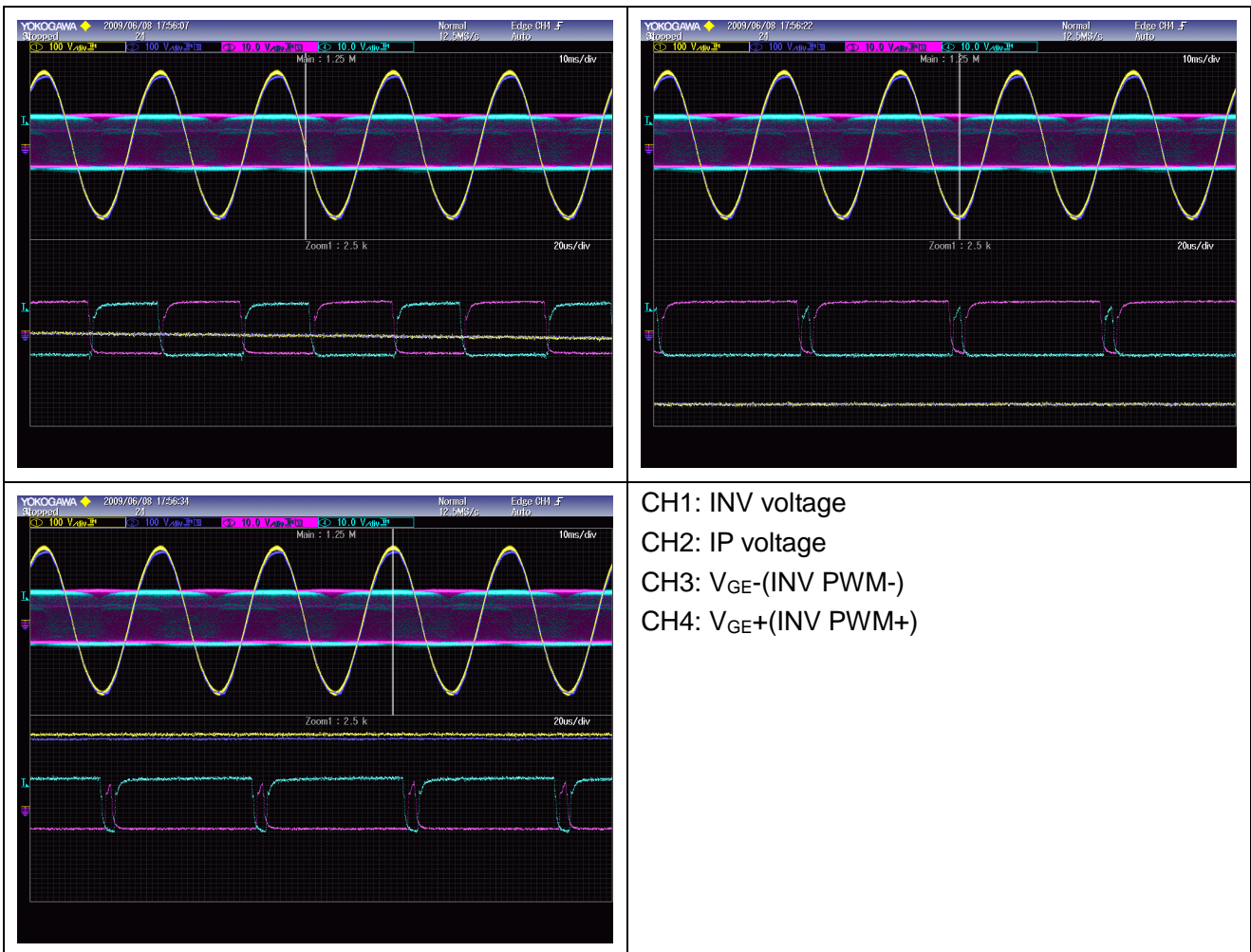In this section, we will show you some basic communication commands that will help you debug or regulate the UPS system.

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 b9b8b7b6b5b4b3b2b1b0a0a1<cr>

	Data	Description	Notes
a	(	Start byte	
b	MMM.M	Input voltage	M is an Integer number 0 to 9. The units is V.
c	HH.H	Input frequency	H is an Integer number 0 to 9. The units is Hz.
d	LLL.L	Output voltage	L is an Integer number 0 to 9. The units is V.
e	NN.N	Output frequency	N is an Integer number from 0 to 9. The units is Hz.
g	QQQ.Q	Output current	Q is an Integer number from 0 to 9. The units is A.
h	DDD	Output load percent	For Off-line UPS: DDD is a percent of maximum VA, not an absolute value. For On-line UPS: DDD is Maximum of W% or VA%. VA% is a percent of maximum VA. W% is a percent of maximum real power.
j	KKK.K	Positive BUS voltage	K is an Integer ranging from 0 to 9. The units is V.
k	VVV.V	Negative BUS voltage	V is an Integer ranging from 0 to 9. The units is V.
l	SSS.S	P Battery voltage	S is an Integer ranging from 0 to 9. The units is V.
m	XXX.X	N Battery voltage	X is an Integer ranging from 0 to 9. The units is V.
n	TTT.T	Max Temperature of the detecting pointers	T is an integer ranging from 0 to 9. The units is °C
o	b9b8b7b6 b5b4b3b2 b1b0 a0a1	Ups status	B9,b8: 00: standy; 01: line-interactive; 10: on-line. B7: Utility Fail b6: Battery Low b5: Bypass/Boost Active b4: UPS Failed b3: EPO b2: Test in Progress b1: Shutdown Active b0: bat silence a0: Bat test fail a1: Bat test OK

Example:

Computer: QGS<cr>

UPS: (220.2 50.0 220.0 50.0 027.0 100 345.8 344.9 241.0 241.5 045.0 100011000000<cr>

Means:

I/P voltage is 220.2V.

I/P frequency is 50.0Hz

O/P voltage is 220.0V

O/P frequency is 50.0Hz.

O/P current is 27.0A

O/P load 100%

Positive BUS voltage is 345.8V

Negative BUS voltage is 344.9V

P Battery voltage is 241.0V.

N Battery voltage is 241.5V.

Temperature is 45.0 degrees of centigrade.

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

9.2.2 V<n>

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

Computer: V<n><Enter>

UPS: (ACK or (NAK*

*: 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 mode)

For example:

    Computer: V230<Enter>

    UPS: (ACK

Meanings: set output nominal voltage to 230V.

9.2.3 V±<n>

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

Computer: V±<n><Enter>

UPS: (ACK or (NAK*

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

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

For example:

    Computer: V+01<Enter>

    UPS: (ACK

Meanings: Inverter voltage will increase about 0.1Volt.

9.2.4 BUSP±<n>

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

Computer: BUSP±<n><Enter>

UPS: (ACK or (NAK*

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

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

For example:

Computer: BUSP-01<Enter>

UPS: (ACK

Meanings: Positive BUS voltage will decrease about 0.1Volt.

9. 2.5 BUSN±<n>

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

Computer: BUSN±<n><Enter>

UPS: (ACK or (NAK*

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

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

For example:

Computer: BUSN+01<Enter>

UPS: (ACK

Meanings: Negative BUS voltage will increase about 0.1 Volt.

9. 2.6 VB±<n>

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

Computer: VB±<n><Enter>

UPS: (ACK or (NAK*

*: 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 0.1Volt.

9.2.7 QVFW

QVFM means to request the version of the firmware. The command format is:

Computer: QVFM<Enter>

UPS: (VERFW: <NNNNN.NN>

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

Example:

Computer: QVFW<Enter>

UPS: (VERFW: <00123.01>

Meanings: 00123 is the firmware series number and 01 is the version.

9.2.8 OC±<n>

This command is to adjust the output current sampling value. The format is:

Computer: OC+<n>< Enter >

UPS: (ACK<cr> if UPS accepts this command, otherwise, responds (NAK<cr>

Computer: OC-<n>< Enter >

UPS: (ACK<cr> if UPS accepts this command, otherwise, responds (NAK<cr>

<n> is a number which ranging from 00, 01…… to99. 99 means 9.9A

For example:

Computer: OC-01<Enter>

UPS: (ACK

Meanings: Output current sampling value will decrease about 0.1A.