GTEC UPS MODEL:

ZP120N 20 K
3ph in / 1ph out

SERVICE MANUAL

www.gtec-power.eu

1. Safety

1.1 General Safety Considerations

1.1.1 Tools, Equipment, and Expendable Field Service Supplies.

When performing service equipment, the following rules must be observed. These rules pertain to tools, testers, solvents, adhesives, and lubricants.

• Ensure that electrical hand tools, such as power drills, are inspected regularly

• Replace worn and broken tools and test equipment with new tools and equipment.

1.1.2 General Safety Rules

Incorporate the following safety rules for working with electrical and mechanical equipment into the maintenance and repair procedures.

1.2 Environmental Safety

Observe the following rules:

WARNING
DO NOT WORK ALONE IN POTENTIALLY HAZARDOUS CONDITIONS OR NEAR EQUIPMENT THAT HAS POTENTIALLY DANGEROUS VOLTAGES.

1. Always inform the appropriate supervisor/manager of conditions or voltages that might pose a threat to safety. Take all steps necessary to maximize safety.
2. Always look for possible hazards such as moist floors, non-grounded extension cables, power supplies, and missing safety grounds.
3. Do not make unauthorized changes or modifications to the equipment. This creates a hazard and unsafe equipment.
4. Before starting the equipment, ensure that other service and customer personnel are not exposed to any unsafe conditions.
5. Do not wear loose clothing that can be trapped in the moving parts of a machine. Ensure sleeves are fastened or rolled above the elbow.
6. If wearing a necktie or scarf insert it into the clothing or fasten it with a nonconductive clip at approximately 8 centimeters (3 inches) from its end. This prevents the tie from being caught by a moving part of the equipment.
7. Fasten long hair to make it safe.
8. Lift the equipment or parts by pushing up with the leg muscles to prevent strain on the back. Do not lift any equipment or parts that cannot be lifted comfortably.
9. Always keep tool kits away from walk areas so as not to present a tripping hazard. If possible, keep the tool kit on or under a table.
10. Observe good housekeeping practices in the area of the UPS while performing maintenance and after completing the job.

11. Place removed UPS covers in a safe place while servicing the UPS. Reinstall the covers before returning the UPS to the customer.
12. Reinstall all safety devices, such as guards, shields, and ground wires. Replace worn or defective safety devices. Remember the safety devices protect personnel from a hazard. Ensure all safety devices are reinstalled when the maintenance/service has been completed.

1.3 Electrical Safety

Observe the following rules when working on electrical machinery:

1. Follow the manual shutdown and maintenance bypass procedures to prevent loss of power to the customer's load. Switch input and logic power off, if recommended in the Service manual:
2. Unless the maintenance documents specifically instruct otherwise, do not make unauthorized changes or modifications to the equipment. This creates a hazard and unsafe equipment.

WARNING
DO NOT SERVICE INPUT, OUTPUT, OR BYPASS CIRCUIT BREAKERS, CONTACTORS, TRANSFORMERS, WITH POWER ON.

3. If working on equipment that has exposed live electric circuits, OBSERVE the following precautions:
   - Ensure another person who is properly trained in the power-off controls is within a close distance at all times to switch off power if necessary
   - Do not wear jewelry, chains, metal frame eyeglasses, or other personal metal objects
   - Use only insulated probe tips or extenders with the proper voltage rating for the circuit you are testing
   - Use one hand while you are working on or near energized equipment. Keep one hand in your pocket or behind the back to prevent electric current flow across the heart
   - Do not touch objects that are grounded, such as metal floor strips, machine frames, or other conductors. Use suitable rubber mats. Obtain the mats locally, if necessary
   - When using test equipment, set the controls as referenced in the operator or service manual. Use only properly insulated probes
4. When working with machines having voltages more than 30 VAC or 42.4 VDC, observe special safety instructions referenced in Field Service Manuals and Bulletins.

WARNING
NEVER ASSUME THAT POWER HAS BEEN REMOVED FROM A CIRCUIT. CHECK AND ENSURE THAT POWER HAS BEEN REMOVED BY USING A KNOWN GOOD VOLTMETER.

5. Do not touch live electric circuits with the surface of a dental mirror. The handle of the mirror is conductive and can cause equipment damage and/or personal injury.
6. If an electrical accident occurs:
    - Use caution; do not become a victim. Switch off the power.
    - Instruct another person to get medical aid

1.4 Mechanical Safety

CAUTION
Do not touch moving mechanical parts at any time (including fans).

1.5 Eye Safety

CAUTION
Safety glasses shall be worn at all times.

Use additional caution when using the following equipment or when performing procedures listed below:

- Using a hammer
- Using a power drill
- Using a spring hook
- Soldering parts
- Cutting wire or removing steel bands
- Using solvents, chemicals, or cleaners to clean parts
- Working in any other condition that might injure the eyes (i.e., a UPS module under power, input, or bypass)
- Do not wear soft contact lenses when working on or around electrical equipment.

1.6 UPS Safety

WARNING
THE OSCILLOSCOPE MUST BE ISOLATED BY USING AN ADAPTER THAT ISOLATES THE SCOPE AND EARTH GROUND. USE EXTREME CAUTION; THE SCOPE WILL HAVE POTENTIAL BETWEEN THE UPS FRAME AND THE SCOPE. DO NOT TOUCH THE UPS AND THE SCOPE AT THE SAME TIME.

1.6.1 Operating Environment

1. Keep surroundings clean and free from excess moisture.
2. Do not operate close to gas or electric heat sources.
3. The system is not intended for outdoor use.

4. Operating environment should be within parameters listed in the Installation & Operation Manual(s).

1.6.2 Normal Operation

1. Keep equipment doors closed to ensure proper cooling air flow, and to protect from dangerous voltages within the unit.
2. Ensure all conduit knockouts and/or unnecessary openings are sealed.
3. Do not make any assumptions about the electrical state of the UPS.

CHECK THE ELECTRICAL STATUS WITH A KNOWN GOOD VOLTMETER!

WARNING
THIS UPS CONTAINS LETHAL VOLTAGES. ALL REPAIRS AND SERVICE SHOULD BE PERFORMED BY AUTHORIZED SERVICE PERSONNEL ONLY.
THERE ARE NO USER SERVICEABLE PARTS INSIDE THE UPS.

The following safety cautions are intended to provide important specific information about the safe operation of the UPS. Violation of these precautions could result in serious damage to the UPS and/or injury or death.

1.6.3 Maintenance/Service

1. Always wear appropriate eye protection.
2. Remove restrictive or loose clothing and remove all jewelry.
3. Use correct documentation and appropriate tools as outlined in this manual.
4. Use a static secured work area and ESD procedures when performing component replacement or modifications
5. Ensure power is disconnected before performing installation or service when possible.
6. Observe all CAUTIONS, WARNINGS, AND DANGER notices fixed to the inside and/or outside of the equipment.
7. Always comply to more detailed safety precautions described in the appropriate section later in this manual.

1.6.4 Batteries

1. Lead-acid batteries are sealed and maintenance-free. No electrolyte/ water can be added.
2. Dangerous voltage is always present at battery terminals.

WARNING
Batteries can present a risk of electrical shock or burn from high short-circuit current and high voltage. Observe proper precautions. Incorrect connection of batteries may cause electrical shock, fire, injury, or death.

3. The battery contains sulfuric acid. If any spillage occurs, take the following precautions:

- Contact with skin:
  – Wash immediately with soap and water
  – Contact a physician if any burn results
- If acid splashes in eyes:
  – Wash for 20 minutes under running water
  –Contact a physician

1.7 Site Safety

UPS personnel are aware of the presence of potentially lethal voltages within the UPS. Observe the following precautions to ensure personnel safety and continued equipment operation.

1. Keep surroundings clean and free from excess moisture.
2. Do not operate near gas or electric heat sources.
3. The system is not intended for outdoor use.
4. Operating environment should be within parameters listed in the Installation & Operation Manual(s).
5. Ensure the site is safe.
6. Inspect power cables and plugs; check for loose, damaged, or worn parts.

WARNING
VOLTAGES ACROSS CHARGED CAPACITORS CAN BE IN EXCESS OF 300 VDC. BE CERTAIN THE FILTER CAPACITORS ARE FULLY DISCHARGED AND INPUT POWER IS OFF BEFORE PERFORMING ANY MAINTENANCE OR TROUBLESHOOTING.

7. Review all procedures in the maintenance documents before removing a part that can hold an electric charge. Carefully discharge the parts exactly as instructed by the procedures.
8. Do not use a normal light (for example, a table lamp) for illumination when performing maintenance on the UPS. Use a flashlight with a nonconductive case.

NOTICE

Note:Never assume that a UPS or a circuit is safe. Follow all procedures and safety precautions in the maintenance documents and all other applicable manufacturers publications.

9. Always be aware of the following potentially hazardous conditions.
   Take the necessary safety steps to protect against the existence of these potential hazards:
   • Power receptacles wired incorrectly
   • Safety devices or features missing or defective
   • Maintenance or change history wrong or incomplete
   • A UPS design problem
   • A damaged UPS due to shipping

- An unsafe change or attachment installed in the UPS
- An engineering change or a sales change installed incorrectly
- A defective part
- Potentially unsafe UPS because the unit is old or operated in an extreme environment

1.8 Summary

Prevention is the key to electrical safety. Always think about electrical safety and use good preventive practices before performing any work on equipment.
These are some of the ways that the condition of the UPS that could affect safety. Before starting maintenance or repair procedures,

USE GOOD
PREVENTIVE JUDGMENT and USE CAUTION; SAFETY COMES FIRST!
DO NOT WORK ALONE IN POTENTIALLY HAZARDOUS CONDITIONS OR NEAR EQUIPMENT THAT HAS POTENTIALLY DANGEROUS VOLTAGES.

1.9 Electrostatic Discharge (ESD) Procedure and Equipment Requirements

1.9.1 Removal of Boards

CAUTION
When removing a board without pull out tabs, handle the board on the edges.Lethal voltage may be present on the traces of the board. Use correct removal procedure to remove all boards from the unit. If the board has pull out tabs, remove the board with the use of these tabs. For boards without pull out tabs, pull the board by grabbing the edge of the board. Do not touch any static sensitive component/device (semiconductors, film resistors, and capacitors, and so on). The following procedure provides guidelines on handling electrostatic sensitive materials.

1. All static-sensitive material shall be packaged in approved anti-static protective packaging.
2. Wrist straps, grounded mats, or a grounded table (with equivalent or better than surface of mat), shall be used when handling static sensitive material.
3. When removing or installing boards in a unit or subassembly, use a wrist strap and connect it to the frame of the unit or subassembly.
4. Rejected boards (returned to factory/rework center) are just as sensitive to electrostatic discharge and shall be handled with the same protection as good/accepted boards (i.e., in a static protected environment).
5. All static-sensitive devices, and boards with such devices, shall be stored/handled in their static protected tubes and bags. Tubes and bags provide a complete Faraday cage which is necessary protection for static-sensitive devices and required at all times.
6. All CSEs are required to use a portable static controlled field service kit when handling static sensitive material.

1.9.2 Packaging of Boards

NOTICE

Note:Packaging of boards, unless otherwise specified, will be packaged in egg-crate type cartons, separating each board with partitions.

2. System Overview

2.1 System view

See Figure 1-1 UPS Front View （left）and back view（right）。

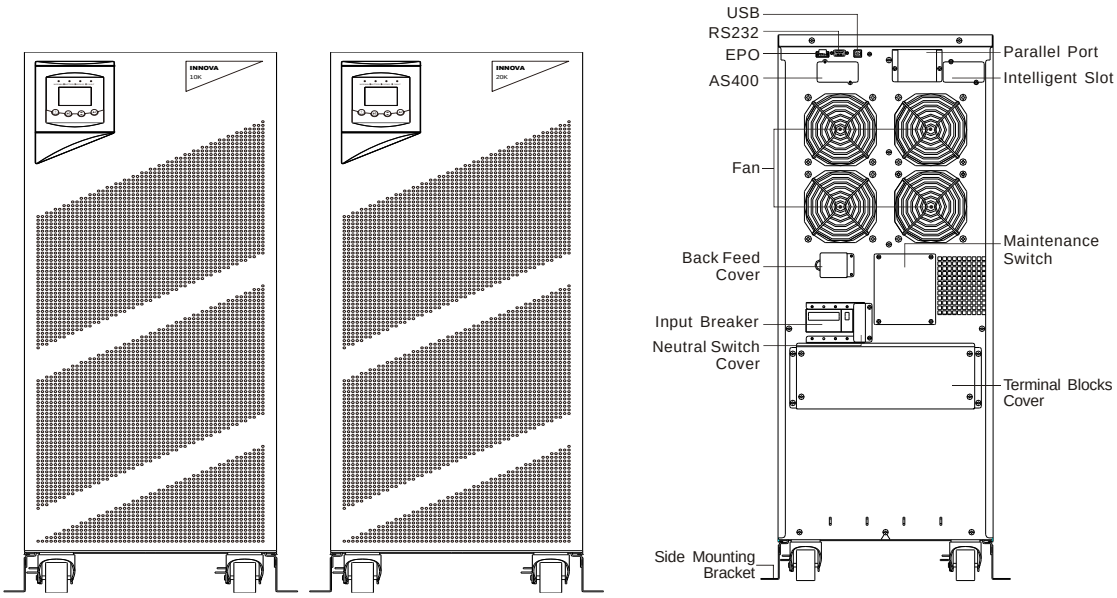


Figure 1-1

2.2 Single Module Systems

The ZP120N 20kva is a true online, continuous-duty, transformer less, double-conversion, solid-state, three-one phase systems that provide conditioned and uninterruptible AC power to the UPS system output protecting the customer’s load from power problems. The UPS module may be configured for stand alone operation or multi-module (parallel redundant “PR” or parallel capacity “PC”) operation. A single module operates independently to support an applied load from the inverter providing conditioned and uninterruptible AC power to the module output. During an outage, the inverter continues to operate, supporting power to the load from the module battery. If the unit requires service, applied loads are transferred to the internal maintenance switch by manually and the load is uninterruptible. (Attention: before change the applied loads to the maintain switch, UPS must be work on bypass mode, and maintain mode is not a protection mode, if there is outage at this time, loads will be outage too).

2.2.1 Basic Single Module System

A single module include MAITAINSWITHCH, EMI, BYPASS, REC, PFC, INVERTOR, STS, SPS and CHARGER, as show as figure 1-2

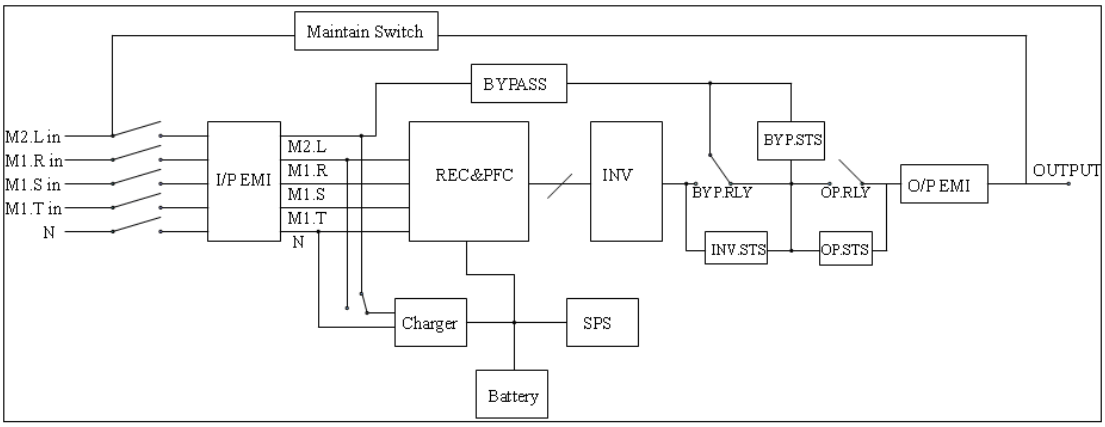


Figure 1-2

2.2.2 Modes of Operation - Single Module

The ZP120N 20KVA will support a critical load in three different modes of operation: Normal mode, Battery mode, and Bypass mode. The UPS can automatically use all three modes, as required, without operator intervention. Sophisticated detection and control logic is used to ensure any change in operating mode is automatic and transparent to the load while internal monitoring systems indicate the current mode of operation. In the next few pages, the three modes of operation will be discussed in more detail using block level diagrams to show the power flow during each mode of operation.

2.2.3 Line Mode

See Figure 1-3, Normal Mode.

During normal UPS operation, power for the system is derived from a utility input source through the rectifier. “Line mode” appears on the front panel and indicates that the critical load is supported by the inverter. Three phase AC input power is converted to DC using SCR and IGBT devices to produce a regulated DC voltage to the inverter. The battery is charged directly from the charger model. The battery charge condition is monitored by the UPS and reported by status indicators located on the LCD monitor panel. The battery is always connected to the UPS and ready to support the inverter should the utility input become unavailable. The inverter produces only single-phase AC output to the critical load without the use of a transformer. The inverter derives regulated DC from the rectifier and uses IGBT devices and pulse-width modulation (PWM) to produce a regulated and filtered AC output. The AC output of the inverter is delivered to the system output through the output EMI. “line mode” appears on the module front panel to indicate that the system is operating normally.

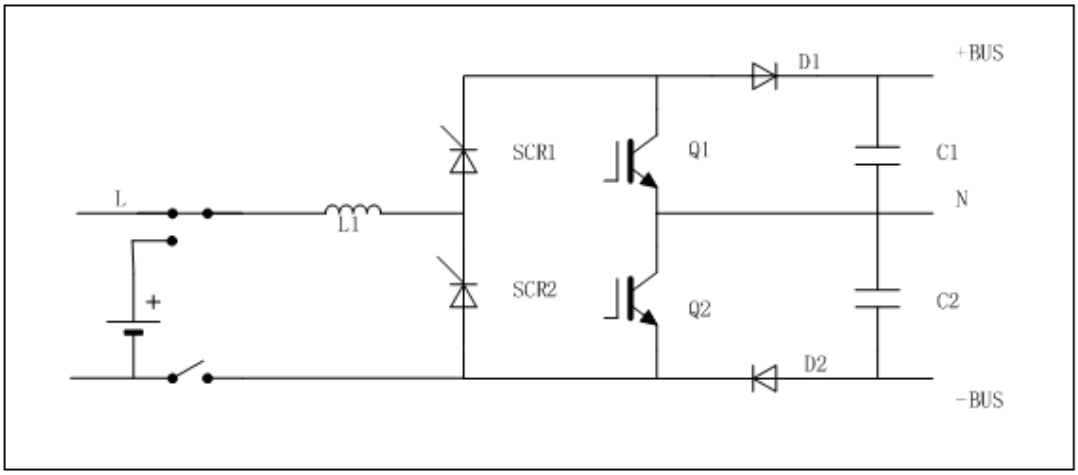


Figure 2-1 PFC

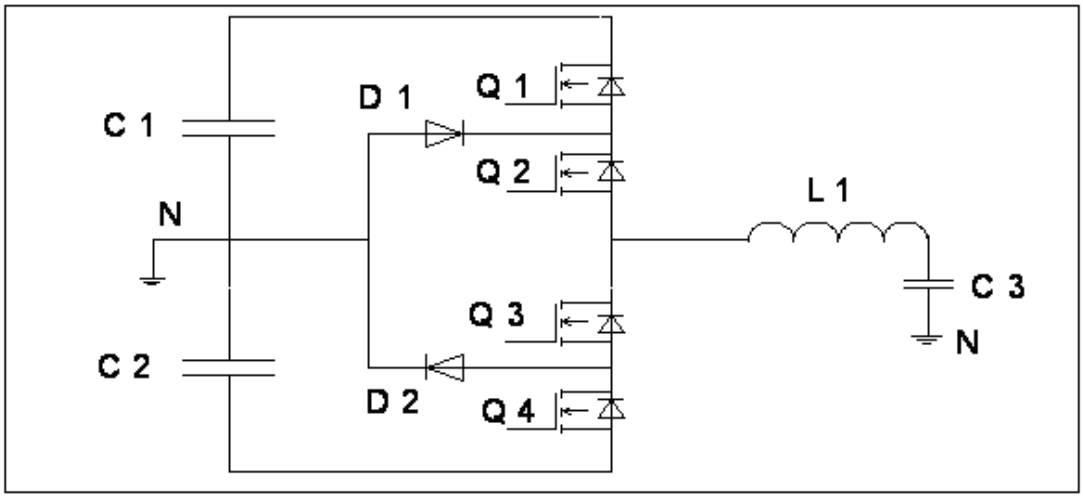


Figure 2-2 INV

2.2.4 Battery Mode

See Figure 2-3, Battery Mode.

The UPS automatically transitions to Battery mode during a utility power failure or if the input power to the rectifier is out of specifications (refer to input specifications). During a utility power failure, the rectifier no longer has an AC utility source to supply the DC output power required to support the inverter. The rectifier is turned off, the input relay will turn to battery, and the flow of DC current to the input of the DC converter transitions from the rectifier to the awaiting battery. Energy stored in the battery is supplied instantaneously to the DC converter so that the inverter can support the customer's load without interruption.

While in Battery Mode, the UPS will sound a horn, light an indicator lamp on the front panel (ON BATTERY). As the battery discharges, the converter and inverter constantly make

minute adjustments to maintain a regulated output. The UPS will remain in this Operating mode until the input power to the rectifier is again within specifications (refer to input specifications). If the input power fails to return or is not within specification for normal operation, the battery will continue discharging until a DC voltage level is reached where the inverter output can no longer support the connected loads. When this occurs, the unit will issue another set of audible and visual alarms indicating SHUTDOWN IMMINENT. Unless the rectifier has a valid input, the output will only be supported for a few minutes before the output of the system shuts down. If at any time during the battery discharge the input power becomes available, input relay will go back to line and the rectifier will gate on and assume the converter and inverter load from the battery. The charger will charge the battery too. At this time, the unit returns to NORMAL operation.

The total system operating time on battery will depend on many factors. Some factors that affect battery support times are battery type and capacity, number of parallel strings, environmental temperatures, age of the battery, and fluctuations in load demand during the discharge. The greater the load, the less support time the battery will have. Decrease the load, and the battery support time will generally increase

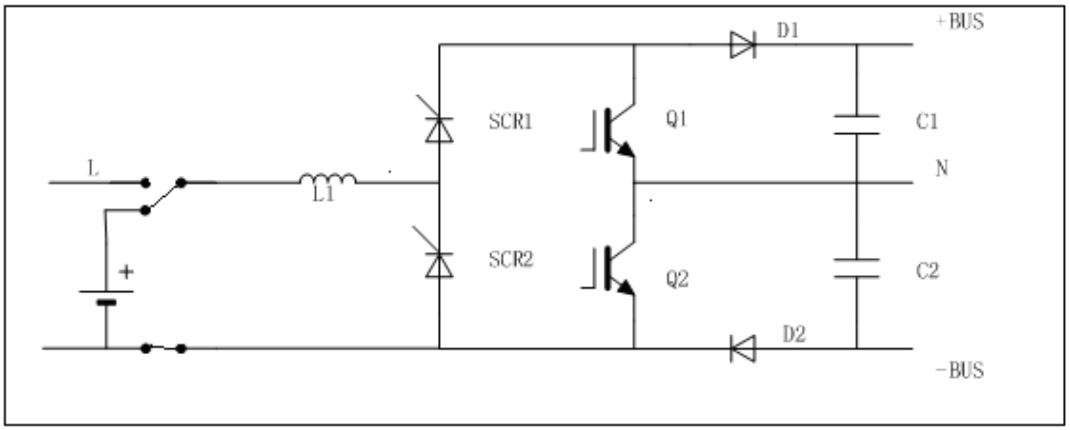


Figure 2-3, Battery Mode BOOST

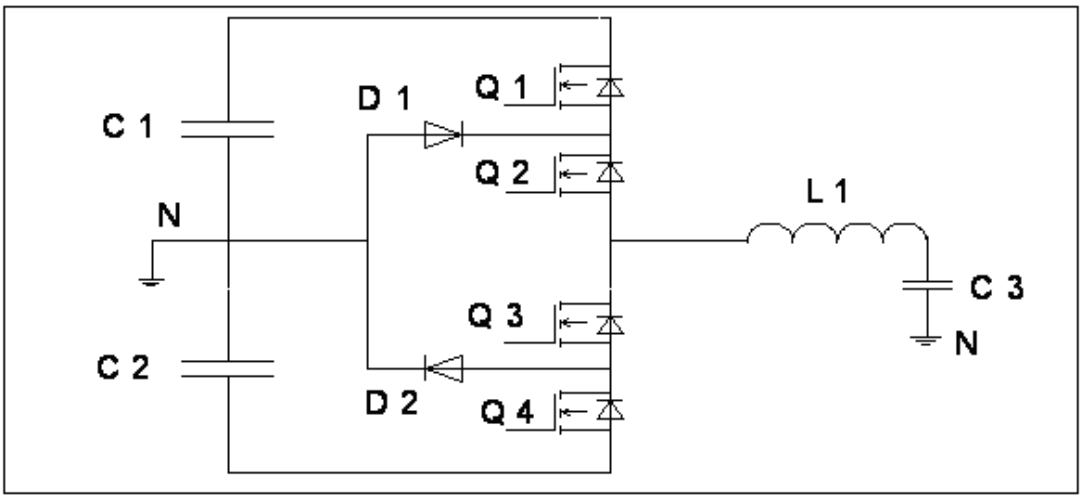


Figure 2-3, Battery Mode INV

2.2.5 Bypass Mode

See Figure 2-4, Bypass Mode.

In Bypass Mode, the output of the system is provided with single-phase AC power directly from the system input. While in this mode, the output of the system is not protected from voltage or frequency fluctuations or power outages from the source. Some power line filtering and spike protection is provided to the load, but no active power conditioning or battery support is available to the output of the system in the bypass mode of operation.

The internal bypass comprises two relay and a static switch (STS) and a back feed protection equipment. The static switch (STS) is a minute-duty device that is used anytime the inverter is unable to support the applied load. The static switch (STS) is wired in series with the back feed protection equipment. Since the static switch is an electronically controlled device, it can be turned on immediately to support the load, and at this time, system will close relay to bypass, and after 20ms, the load will change to relay to support the applied loads. During an outage, transfers to bypass are prohibited. If the inverter is unable to support the load, the UPS will complete a make before- break transfer of the load to bypass. The transfer is initiated by turning on the static switch (STS) and shutdown the inverter. This kind of transfer is normally referred to as a “make-before-break” transfer. The transfer will happen in less than 4 msec (one-quarter cycle) to ensure loads on the system output are not interrupted. The static switch (STS) remains on until the INV relay already change to bypass，some example alarms that cause the output of the system to be transferred automatically to the bypass include: the system is overloaded, or the system experiences an inverter failure. Some kinds of alarm may the UPS initiates a transfer to bypass; the UPS will attempt to restart the inverter (if not running already) and transfer online. Three attempts will be made within ten minutes to bring the inverter back online automatically before the UPS will lock out any further attempts. After three (3) attempts have been made, the UPS will remain in bypass and an alarm condition will be annunciated. The UPS can also be transferred to bypass using the front panel controls

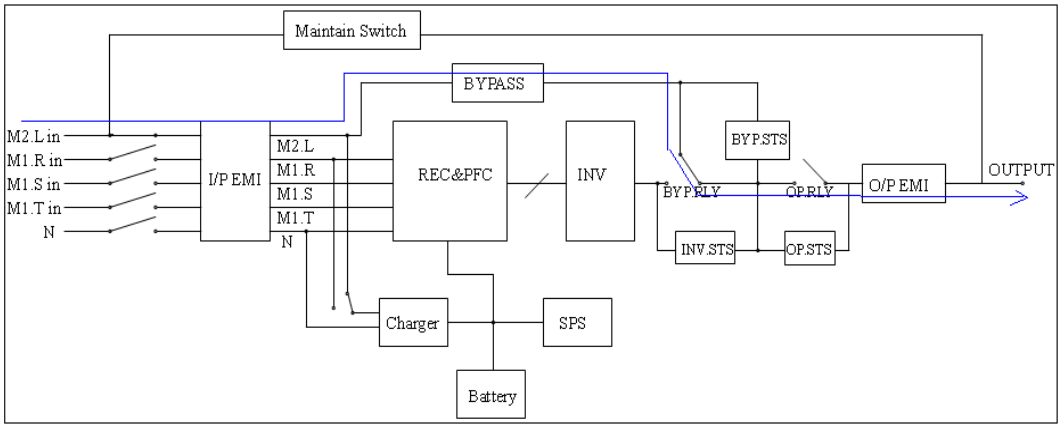


Figure 2-4, Bypass Mode

2.2.6 Maintain switch mode

The CSE has the ability to put the load in the bypass, and than change the load to maintain switch，after you change the load to the maintain switch，CSE can shut down the UPS without interruptible the load。Figure 2-5, maintenance mode.

This procedure is make-before-break to ensure the customer's load remains supported. Transfer to maintain switch before break the bypass switch.

The limitations with this line up are:

• No maintenance can be performed on maintain switch.

• Dangerous voltages remain present in the maintain switch terminal.

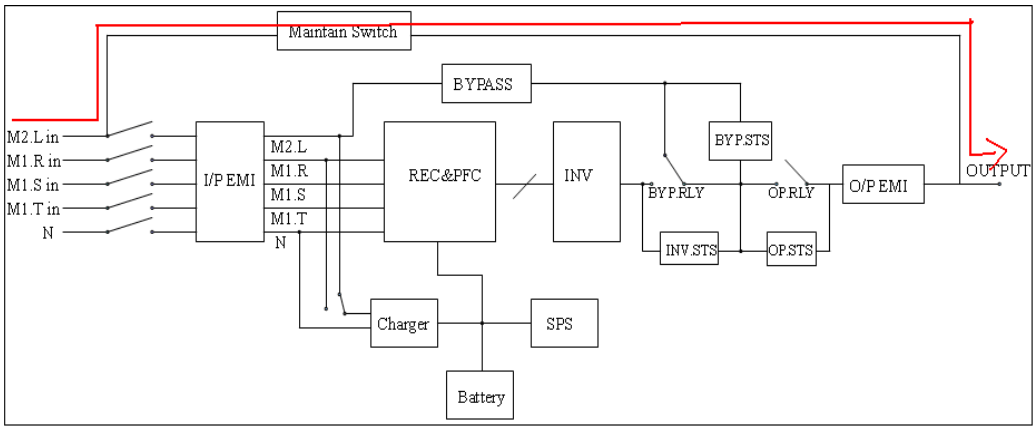


Figure 2-5, maintenance mode

2.3 Parallel Redundant or Capacity.

2.3.1 Multi-Module Parallel Systems

See Figure3-1, Parallel systems

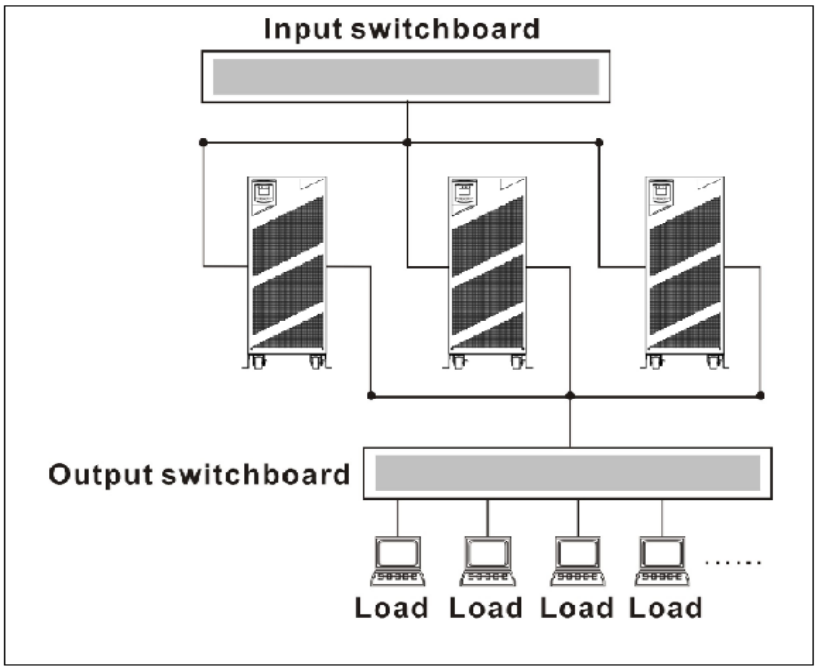


Figure3-1, Parallel systems

Parallel systems include Redundant System (1 + 1) and Parallel Capacity System (2 + 0).

The ZP120N 20KVA can also be configured for either Parallel Redundant or Parallel Capacity operation; Just use the parallel line, the output of one UPS can be tied together with the output of other UPS to support a common output. UPS configured in this manner are considered to be part of a “parallel system.” Up to four units can be paralleled for redundancy or capacity without the need for any additional cabinets. The basic technology provides the ability to parallel units without the use of an external fully-rated static switch or wrap-around contactor. All wiring from the UPS to a common tie point must be of equal lengths to ensure adequate load sharing in the event all UPS are on bypass. A parallel system is redundant (2 + 1) so long as there is always a kVA surplus equivalent to one or more UPS than is required to support the load. A good rule of thumb is (N + #) where N is the number of UPS required to support a given load and # is the number of additional or redundant UPS in the system. In a system where two UPS are paralleled together, and the load can be supported by a single UPS, the system is said to be Redundant (1 + 1). If the load is such that both UPS in the system are required to support the load, then the system is said to be paralleled for Capacity (2 + 0).Two UPS are needed to power the load and no backup ups is available.

Similar to the single ups system, a parallel system will support a critical load in three different modes of operation: Normal, Battery, and Bypass. The system automatically uses all three modes, as required, without operator intervention. ZP120N 20kva can be paralleled in one of several different parallel configurations (1 + 1), (2 + 0), (2 + 1), and so on,

•UPS are of the same voltage and power rating

• maintain switch is still used for service isolation

• Static switch and INV relay in both units can be used to support loads on bypass

• External Control Area Network (ECAN) is used between two ups as a parallel line.

• The same firmware must be installed in all parallel units Parallel for Capacity (2 + 0), (3 + 0) Parallel for Capacity / Redundancy (2 + 1), (3 + 1) is the same as 2(or 3) + 0 with an additional ups for redundancy

2.3.2 Parallel for Redundancy (1 + 1), (2 + 1), (3 + 1)

If two ups are capable of supporting 20 kVA each, and the total load applied on the output of the system was 20 kVA, either ups would be capable of supporting the applied load individually. With each of the two ups in parallel, the load would be shared equally between the two ups (10 kVA each).

2.3.3 Parallel for Capacity (2 + 0), (3 + 0), (4 + 0)

If two ups are capable of supporting 20 kVA each, and the total load applied on the output of the system was 40 kVA, both ups would be required to support the applied load. With each ups in parallel, the load would be shared equally between the two available ups (20kVA each). Additionally, because two ups must be online to support the applied load,

the entire system will transfer to bypass automatically if one ups fails or is taken offline
ZP120N Parallel Systems (Redundant and Capacity) will support a critical load in three different modes of operation: Normal mode, Battery mode, and Bypass mode. The system automatically uses all three modes, as required, without operator intervention. To achieve this, sophisticated detection and control logic located in each ups is used to ensure any change in operating mode is automatic and transparent to the load. Internal monitoring systems located within each ups will indicate the current mode of operation. The individual modules of the parallel system contain the same basic functions as a single module system. Each module contains a rectifier, pfc, inverter, static switch (STS) and INV relay. The operation and power flow through each ups is identical to that of the single module system.

2.3.4 Normal Mode - Parallel

Normal Mode Parallel Redundant (1 + 1), NORMAL Mode Parallel Capacity (2+0).
In Normal mode, each ups conditions the incoming AC power and provides clean, regulated, AC power to a tie and/or distribution panel for parallel systems of up to four modules. The applied load is equally shared among the available ups in the system.

2.3.5 BATTERY Mode - Parallel

BATTERY Mode Parallel Redundant (1 + 1) and BATTERY Mode Parallel Capacity (2 + 0). Battery mode is entered into automatically by each ups during a utility power failure or deviation from voltage and frequency specifications (refer to input specifications listed in the "Installation & Operation" manual). If either of these conditions occurs, each rectifier will turn off and the flow of DC current to the inverters transitions from each rectifier to the batteries. the system output is maintained without interruption to the supported load. While in Battery mode, each ups will activate a horn and an indicator lamp on the front panel (SYSTEM NORMAL, ON BATTERY), The system will remain in this operating mode until the input power to the system is again within voltage and frequency specification. If the input power fails to return or is not within the specifications required for normal rectifier operation, the batteries will continue discharging until a DC voltage level is reached where the inverter output of each UPS can no longer support the shared loads. As this occurs on each UPS, another set of audible and visual alarms indicating a SHUTDOWN IMMINENT WARNING (at this time if bypass is ok, system will go to bypass). Unless the system has a valid input, redundant ups will begin shutting down until there are no longer enough ups online to support the connected load. If at any time during the battery discharge input power becomes available, each rectifier will turn on, support the inverter, and begin recharging the batteries. The system returns to normal operation.
The system's total operating time on the batteries will depend on many factors. Some factors that affect battery support times are battery type and capacity, number of parallel strings, environmental temperatures, age of the battery, and fluctuations in load demand during the discharge. The greater the load, the less support time the battery will have. Decrease the load, and the battery support time will generally increase.

2.3.6 BYPASS Mode - Parallel

In Bypass mode, the output of the system is provided with single-phase AC power directly from the bypass input. The output of the system is not protected from fluctuations, spikes, or power outages from the source. No power filtering, conditioning, or battery support is available to the output of the system in the Bypass mode of operation.

In a parallel redundant or capacity type system, each module operates independently but shares the load in parallel and transfers to bypass with the other ups. The bypass source for the load is passed from the bypass input of both ups through the internal static switch and relay. If one ups is taken offline, the other module remains online to support the load. If the second ups must be taken offline, the load must be transferred to Maintenance

Bypass or shut down. Like a single module, if a parallel system transfers to Bypass for any reason other than operator intervention, each module within the system will attempt to restart (if not running already) and attempt to transfer online to support the output of the system. Three attempts will be made to bring the system back online automatically before the system will lock out any further attempts. After three (3) attempts have been made, the system will remain in Bypass and an alarm condition will be active.

Examples of the three attempts are:

• Inverter overload

The Bypass mode may also be used when the modules in the system must be shut down to perform routine maintenance or repairs.

3. Power Model Functional Descriptions

This chapter provides a functional description for the ZP120N 20kVA power train and the printed circuit boards.

3.1 Power Module

3.1.1 Power PCB

ZP120N 20kVA include follow PCB and main components

1.PFC:	Contains AC/DC&DC/DC converter and necessary sub-circuit for complement and supporting the converter which have been modular, Includes: a) IGBT driver module,b)SCR drive module and appropriate sensors and conditional circuit for the system regulation and protection.
2.inverter:	Contains (1)inverter(2) Bypass、INV converting circuit and necessary sub-circuit for complement and supporting the inverter which have been modular, Includes: a) IGBT driver module, b)SCR drive module and appropriate sensors and conditional circuit for the system regulation and protection.
3.SPS:	supplies DC power for UPS operation
4.Charger	4A for standard model.
5.CNTL:	Contains major parts of protection, signaling circuits, regulation circuits.
6.CCB	Connect the signal between the CNTL and other PCBS
7.I/P EMI	Input EMI filter
8.Panel	The Panel PCB provides system information with LCD indicators, and button for turning ON/OFF and controlling the UPS.
9.ECO STS	Make the interruption time of ECO mode ->other mode less than 10ms
10.EPO	Support the EPO interface and the communication interface of the intelligent slot.
11.USB	Support the USB communication interface.
12.OP RLY	used in parallel system

3.2 PFC board function

PFC circuit of power module is showed as Fig 3.1. The function of main components is described as below:

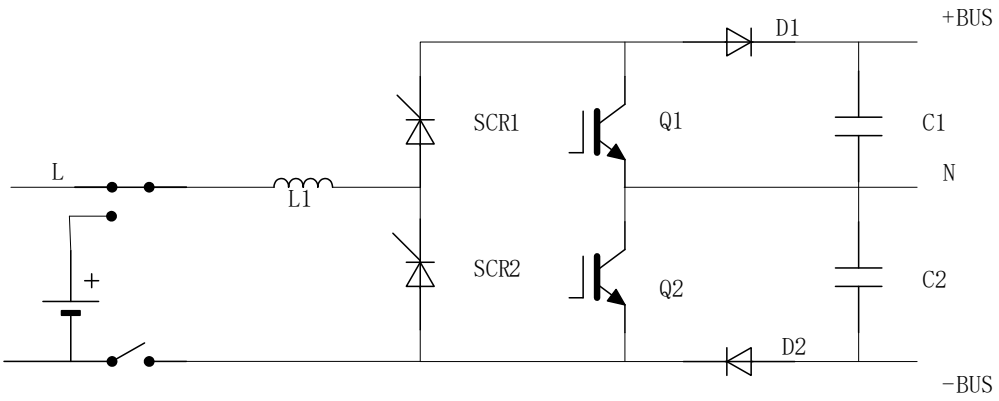


Fig 3.1（a） PFC

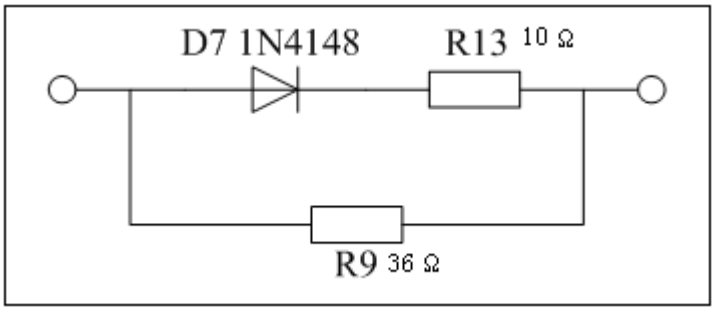


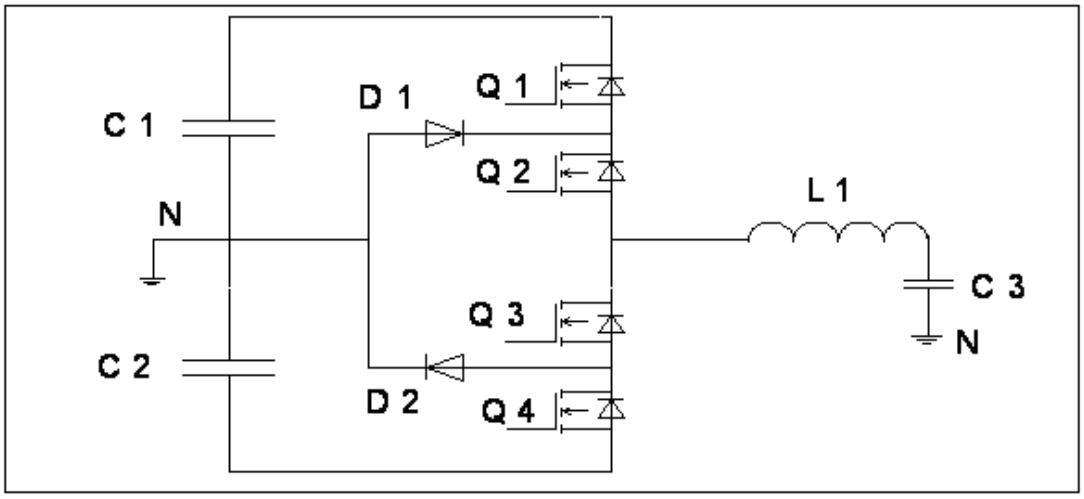
Fig 3.1(b) Drive

1. PFC up board R phase include L1 HCT1 Current Feedback, Q3 and Q4 SCR (Rectifier) , CN1 SCR DRIVER; Q2 and Q7 IGBT, CN3 CN4 IGBT DRIVER D1and D7 Freewheeling DIODE use for R phase AC/DC and DC/DC.
2. PFC down board S phase include L1 HCT1 Current Feedback Q3 and Q4 SCR (Rectifier) , CN2 SCR DRIVER; Q5 and Q6 IGBT, CN3 and CN4 IGBT DRIVER D6and D5 Freewheeling DIODE use for S phase AC/DC and DC/DC.
3. PFC down board T phase L2 HCT2 Current Feedback Q9 and Q10 SCR (Rectifier), CN5 SCR DRIVER; Q11and Q12 IGBT, CN6 and CN7 IGBT DRIVER D11 and D12 Freewheeling DIODE use for T phase AC/DC and DC/DC.

Fig 3.1 show The AC/DC module, called also PFC/rectifier, belongs to input stage of the UPS. Because the SCR will be ON only if it's positive voltage is higher than its negative voltage, after the utility power is rectified by the full waveform, the current waveform of the diode will appear characteristics of high and tine. Thus current waveform not only contains a great number of harmonics, but also makes the UPS input power factor lower. To improve

this we add a DC/DC PFC after rectifier and correct the input current as a sine wave to make the input power factor is close to 1.As shown in the Fig 3.1 diagram, when the IGBT is on and the DIODE is off, the CHOKE will store energy and the current crossing the choke will increase gradually. When the IGBT is off, the choke releases energy and the DIODE is on, the current of the choke will be descending with time pass. Therefore, we can control the current waveform of chokes (input current) by regulating the time of IGBT on and off.The DC/DC module, called also Battery Booster, is another part of input stage, used to converse the low level DC power into higher level and more stable DC power, storing on the DC-BUS also.

ATTENTIONCE:
F13 F14 F15 : Normal AC (Rectifier) Fuse in EMI board and the F1 on the PFC down board is battery fuse.



3.3 INV board function

INV circuit of power module is showed as Fig 3.2. The function of main components is described as below:

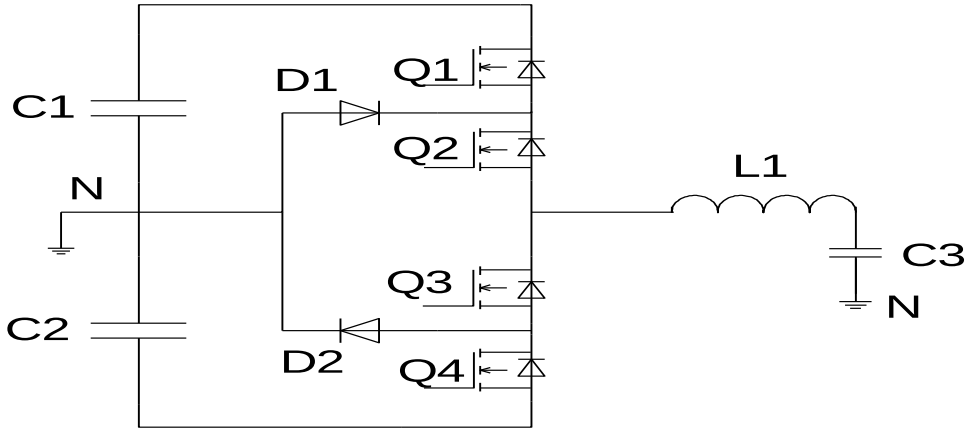


Fig 3.2（a）INV

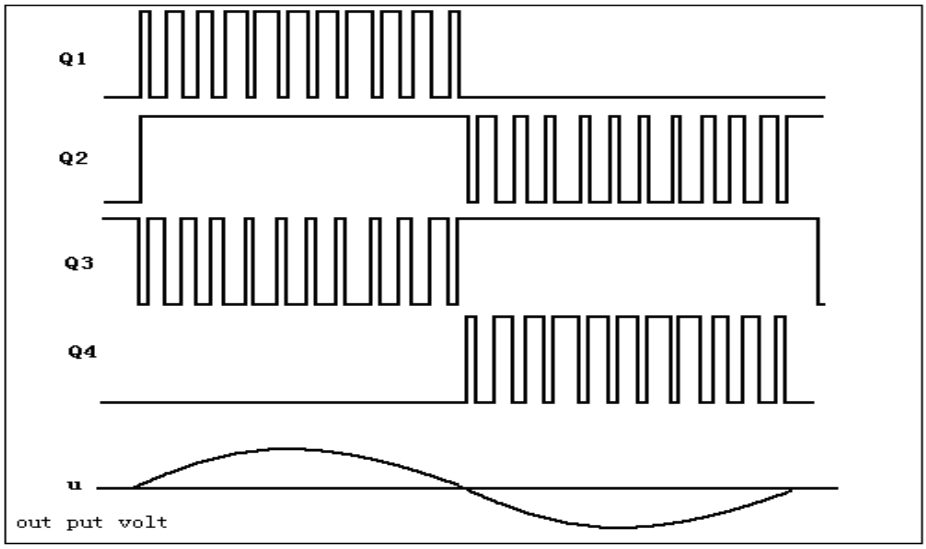


Fig 3.2（b）driver wave

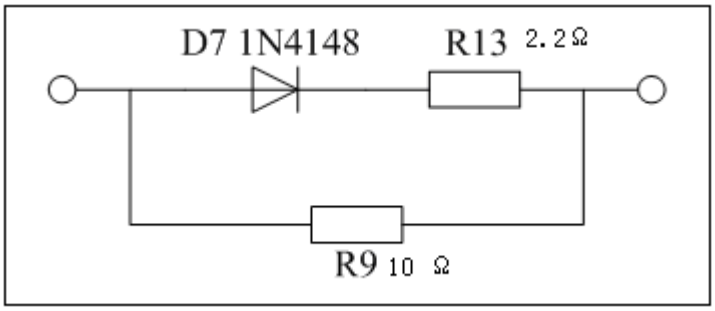


Fig 3.2 （c）part of driver

Three level bridge include IGBT Q1 Q5 and Q9 CN1 IGBT driver Q2 Q6 and Q10 CN2 IGBT driver Q3 Q7 and Q11 CN3 IGBT driver Q4 Q8 and Q12 CN4 IGBT driver L1 L2 Converter Inductance HCT1 HCT2 C1 C52 C36 C53 Converter Capacitors D1 D17 and D2 D18 are freewheeling Diode
C28/C35/C29/C11/C27: DC BUS + Capacitors
C31/C32/C33/C34/C30: DC BUS – Capacitors
Q17 Q18 and PCB1 is BYPASS STS
CT2 D20 D29 D30 D31 AND ZD8 is BACKFEED
RY3 and RY5 is INV RELAY
Q29 Q30 and PCB2 is INVERTOR STS
Q34 Q36 and PCB3 is OP STS
RY4 and RY6 is OP RELAY

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

level half bridge inverter comprise four switching device, IGBT, a free wheel diode parallel with each IGBT, two clamp diodes, forming a switching leg, a driving circuit for each IGBT, a LC filter, and the driver. In the real circuit, an IGBT with co-pack diode is used to simplify circuit and achieve minimize stray parameter, When the two positive IGBT is turned on, The output of half bridge is equal to Positive DC-BUS voltage, when the first positive IGBT is turned off and the second positive IGBT is turned on, either the positive clamp diode is active or the negative clamp diode is active, the output of the switching leg is Neutral, so by change the duty of cycle, average of output of the switching leg can vary from +BUS voltage to Neutral, it is the same that control the two negative IGBT to achieve –Bus voltage to Neutral, than the output of the switching leg filtered by a LC filter to get clean and stable sine wave output voltage.

3.4 CHGR board function

Charger circuit of power module is showed as Fig 3.3. The function of main components is described as below:

The charger is including: BR2 bridge rectifier, L1 Q2 D1 3843 (boost), Q1 Q3 TX1 D2 D3 D4 D6 and 3525 (half-bridge DC-DC), BR1 is a protection diode and F1 is the fuse of charger.

The utility of charger is to recharge and to maintain the batteries at fully charged condition. The charger charges the battery with a constant current at initial stage, at this time the battery voltage keeps increasing, when it gets to 14.4V/PCS, the constant current charging mode changes to constant voltage charging mode, then the charging current decreases, when it get to the current level equal to half of the constant current, the charger get to floating recharger phase, and the charger will control the output voltage at a constant level (13.65V/PCS). In this way, to make the battery full recharged but not over recharge, protects and prolongs the lifetime of the batteries.

The input of the charger is connected to M2 or M1. When the UPS is in line mode or bypass mode, the charger will work. the battery charger employed a boost and half-bridge topology, L1 Q2 D1 and 3843 comprise the boost circuit and Q1 Q3 TX1 D2 D3 D4 D6 and 3525 comprise the half-bridge circuit. the boost circuit is controlled by an ASIC UC3843, the switching component IGBT(MOSFET) turn on/off at a frequency around 19KHz, the output voltage of boost circuit is 400V which is also the input of half-bridge circuit, the half-bridge circuit is controlled by a 3525, the output voltage and charging current is decided by the 3525, the number of battery is 24 cell（12/cell） and the charging current is 4A for standard model.

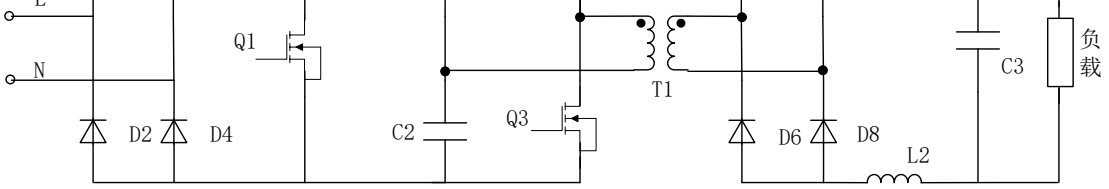


Fig 3.3

3.5 SPS board function

SPS circuit of power module is showed as Fig 3.4. The function of main components is described as below:

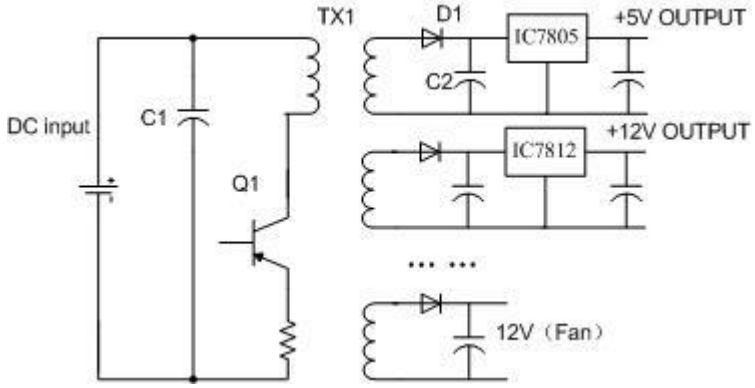


Fig 3.4

The Power Supply (SPS) module supplies DC power for UPS operation. The input of the SPS is the charger input or the battery. This is a fly back converter topology. When the MOSFET is on, all rectifier diodes are reverse-based and all output capacitors supply currents to the load. The primary wire acts like a pure inductor and load current builds up linearly in it to a peak lp. When the MOSFET is off, the primary stored energy is delivered to the secondary to supply load current and replenish the charge on output capacitors that they had lost when the MOSFET was on. This circuit has some output voltages as follows: ±15V, ＋12V, ＋5V, 12V（Fan）. The power of ±15V, ＋12V, ＋5V supply a steady voltage for all kinds of IC and other device. The 12V（Fan）is supplied for fans and relays.

3. 6 CNTL board function

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

(1) CPU Central Processor Unit

(2) Signal conditioning circuit

(3) Regulation & Protection circuit

(4) Output buffering circuit

(5) Communication interface

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

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

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

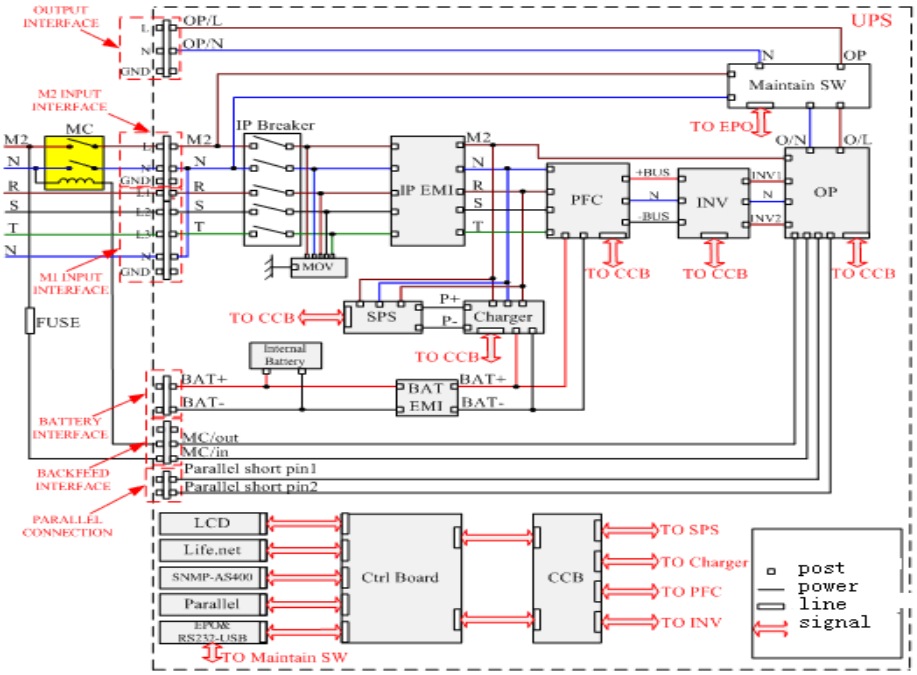
The global controller also implements following protection function:

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

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

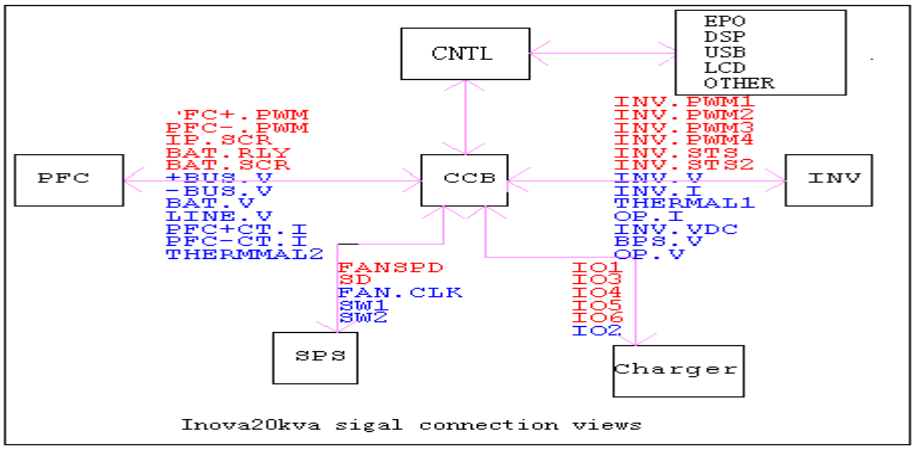
3.7 General connection views

3.7.1 line connection views



Innova 20kva connection views

3.7.2 Signal connection views



Signal connection views

4. Periphery systems

4.1 Front Panel

The front panel consists 2 parts: push button and LCD indicator.
The push button is used to turn on and off and control the UPS.
When UPS is out of order, the LCD will display fault or warning information and the buzzer will beep continuously. In this situation, the panel LCD will indicate which part inside the UPS is out of order. The detailed definition of the indicator can be founded in later section.

4.2 Communication Interface

The communication interface provides a means for using computer to manage the UPS, on the rear panel of the UPS, a standard USB port and an intelligent slot are provided. With dedicated software, output voltage, frequency can be set via the USB port; also status of the UPS can be monitor. The intelligent slot can accept SMNP, AS400, RS232, CMC card, for more flexible application solution. The communication interface circuit is mainly located on the global controller board; the circuit provides isolation and voltage level transforms function for communication; the communication protocol is implementing by the DSP.

4.3 Emergence Power Off

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

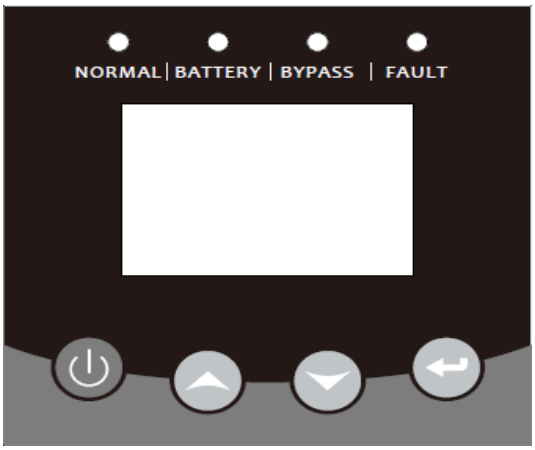
4.4 Ventilation and Chassis

Ventilation system of the UPS consist of air flow guiding insulation paper and fans, The ventilation system keeps the temperature of component of the UPS in safe range, so it is very important for the UPS, To achieve lowest acoustic noise and longest life time of the fans, a fans driver and intelligent fans speed control algorithm is employed. The chassis of the UPS provide a strong construction accommodate all the electrical part, shield for EMC, and safety guard for operator. Basically, the chassis comprise a base plant, an internal support plant, a front support plant, an out side cover, a rear panel, and a front panel.

5 Operation Of UPS

5.1 Display Panel

The UPS has a four-button graphical LCD with dual color backlight. Standard back-light is used to light up the display with white text and a blue background. When the UPS has a critical alarm, the backlight changes the text to dark amber and the background to amber. Besides the graphical LCD, the UPS has four colorized LEDs to provide you more convenient info. See Figure below



There are four buttons on the control panel:

On/Off

Scroll up or back

Scroll down or forward

Select

Control Button Functions

Control Button	Sequence	Function
	Press for more than 3 seconds	ON/OFF UPS
	Press for less than one second	Scroll back or up to130 the previous menu
	Press for more than one second	Return/exit back one menu layer without initiating a command or changing a setting
	Press for more than one second	Scroll forward or down to the next menu option
	Press for less than one second	Select the setting being edited
	Press for longer	Save the setting being edited

	than one second	

To select an option:

1. When scrolling through the settings, the present setting displays for each selection.
2. Press and release the ↵ button to select the option.

   The current setting for the option flashes when selected
3. Use the ▲ or ▼ buttons to select the available options.
4. Set the new option by pressing the ↵ button again for longer than one second. The option wills stops flashing.

There are four LEDs on the control panel:

1. LED definition

LED No	Colour	Name	Function
1	Green	Inverter LED	If it is turned on constantly, it shows that the load current is supplied from utility power or battery via the inverter.
2	Yellow	Battery LED	If it is turned on constantly, it shows that the UPS is in battery mode, and the load current is from battery via the inverter.
3	Yellow	Bypass LED	If it is turned on constantly, it shows that the UPS is in bypass mode, the load current is directly from the utility power
			If it is flashing, it shows the bypass is abnormal
4	Red	Fault LED	If it is turned on constantly, it shows that the UPS is in fault mode;
			If it is flashing, it shows that the UPS is in warning status.

2. LED action summary

No.	Status	LED Display			
		#1Fault	#2Bypass	#3Battery	#4Inverter
1	Poweron mode	△	△	△	△
2	Standby mode		★		
3	Bypass mode ECO mode		●		
4	Line mode				●
5	Bat mode			●	●

6	Battest mode	○	○	○	○
7	Fault mode	●	↑		
8	Warning	★	↑	↑	↑
9	UPS turning on (circulating until turn on OK)	○	○	○	○
10	UPS change setting (circulating only once)	△	△	△	△

Note：

●: Lightened constantly

○: #1-#4Lightened circularly

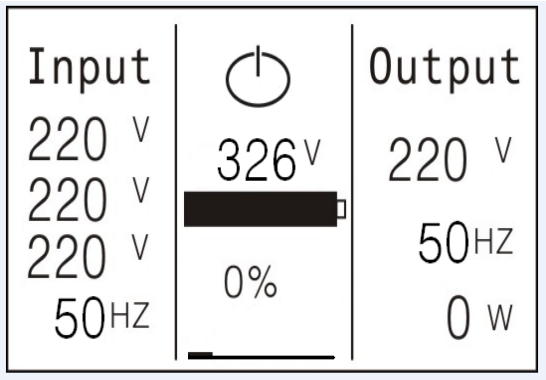
△: #1-#4 Lightened circularly only once

★: Flashing

↑: Depended on the fault/warning status

5.2 Display functions

The UPS provides useful information about UPS itself, load status, events, measurements, identification, and settings through the front panel display.



Startup Screen

During startup, the Welcome logo on startup screen displays for five seconds and then defaults to the UPS status summary screen.

The display automatically returns to the UPS status summary screen when no button has been pressed for 15minutes. When you return to the status summary screen, press the button for longer than one second to exit back to the menu selections. Selecting UPS Status from the main menu list enables you to scroll through all of the UPS status menu screens, including the status summary screen.

UPS Status

A UPS status summary screen replaces the startup screen after the UPS is powered on. The UPS status summary screen displays until you press to go to the first of the main menu selections.

The UPS status provides separate screens for the following information:

- Status summary, including mode and load
- Notice or alarm status, if any are present
- Battery status, including status and charge level

See Table 2 for examples of the UPS status summary screens. The status icon in the middle of each status summary screen conveys the UPS status or mode.

Basic operating modes include:

- Normal mode
- Battery mode
- Bypass mode
- Standby mode

5.3 Turning on the UPS

5.3.1 Turn on the UPS with utility power supplied (in Line mode)

1) Check that power supply connection is correct. Check the breaker of battery pack is in “ON” position (this step only for long backup time model).
2) Set input breaker（M1 & M2） in “ON” position. At this time the fan begins to rotate. LCD will show “**WELCOME**” interface. Then LCD will show the system status menu (Fig. 4-2) after UPS finishing self-test.
3) Press button continuously for more than 1 second, the buzzer will beep for 1s, UPS starts to turn on.
4) A few seconds later, the UPS turns into Line mode (Fig. 4-3). If the utility power is abnormal, the UPS will operate in Battery mode without output interruption of the UPS.

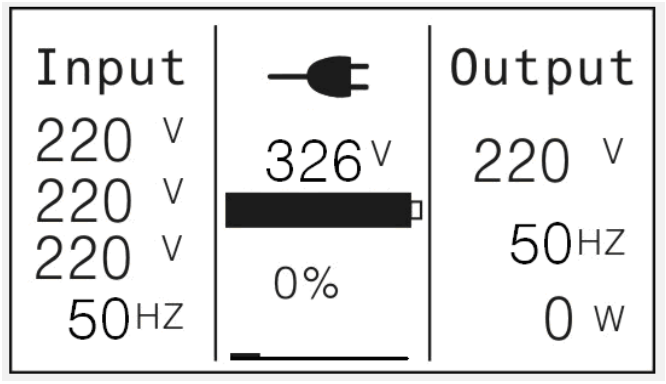


Fig. 4-3

5.3.2. Turn on the UPS with no utility power supplied (in Battery mode)

1) Check the breaker of the battery pack is in “ON” position (this step only for long backup time model).
2) Press button continuously for more than 1 second to power on the UPS, and the buzzer will beep for 1s, UPS starts to turn on.
3) A few seconds later, the UPS turns into Battery mode (Fig. 4-4).

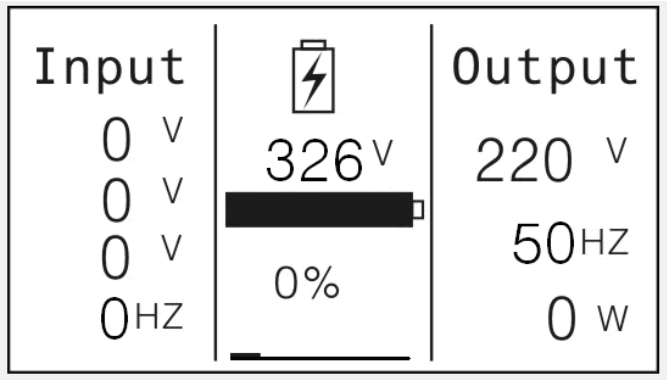


Fig. 4-4

5.4 Turning off the UPS

5.4.1 Turn off the UPS with utility power supplied (in Line mode)

1) To turn off the inverter of UPS by pressing the button continuously for more than 3 seconds and the buzzer will beep for 3s. The UPS will turn into Bypass mode (Fig. 4-5).

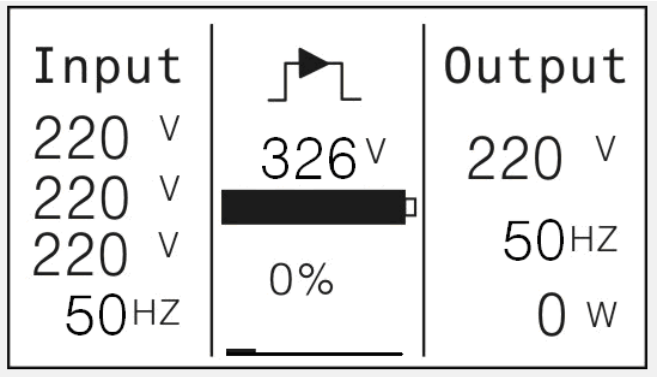


Fig. 4-5

2) When completing the above action, UPS output voltage is still present. In order to cut off the UPS output, simply cut off the utility power supply. A few seconds later, LCD display shuts down and no output voltage is available from the UPS output terminal.

5.4.2 Turn off the UPS with no utility power supplied (in Battery mode)

1) To power off the UPS by pressing the button continuously for more than 3 second, and the buzzer will beep once.

2) When being powered off, the UPS will turn into Standby mode (Fig. 4-6). Finally not any display is shown on the display panel and no voltage is available from the UPS output.

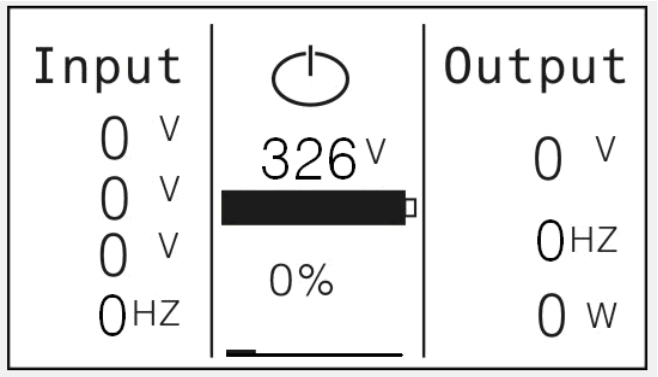


Fig. 4-6

Suggestions: Please turn off the connected loads before turning on the UPS and turn on the loads one by one after the UPS is working in INV mode. Turn off all of the connected loads before turning off the UPS.

5.5 Set up the operation

When the UPS is in “Standby Mode” or “Bypass Mode”, we can use the LCD to setup the UPS operation.

5.5.1 Set up of “Settings”

5.5.1.1 Access the submenu of “Settings”

1). Access the main menu

When LCD displays the system status menu, press button for more than 1 second, we can access the main menu (Fig. 4-7). The main menu includes 6 items: **UPS Status**, **Event Log**, **Measurements**, **Control**, **Identification**, and **Settings**. Press button and button to display one of them.

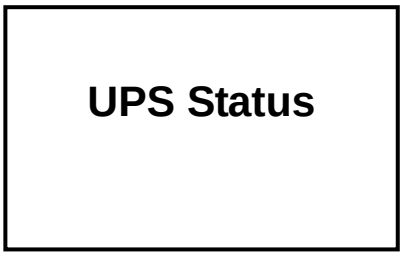


Fig. 4-7

2). Press button and choose “**Settings**” (Fig. 4-8).

Fig. 4-8

3). Press button and LCD displays as Fig. 4-9. Enter the user password（default value is “AAAA”）

Fig. 4-9

4). After entering the password, press button. LCD will display the submenu of “**Settings**” (Fig. 4-10).

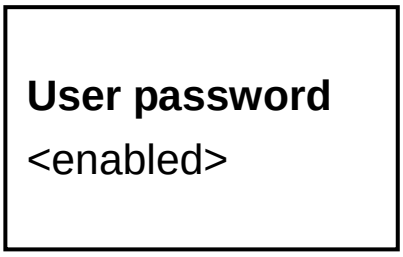


Fig. 4-10

The submenu of “**Settings**” includes 21 items: **User password, Audio Alarms**, **Set UPS Running Time**, **Output voltage**, **Output frequency**, **Power strategy**, **Start on battery**, **Auto Bypass**, **Auto Restart Function**, **Bypass voltage low limit**, **Bypass voltage high limit**, **Bypass frequency High limit**, **Bypass frequency Low limit**, **HE frequency Low Limit**, **HE frequency High Limit**, **HE voltage low limit**, **HE voltage high limit**, **short circuit clearance**, **Volt adjust**, **Clear event log** and **LCD contrast**. Press button and button to display one of them.

5.5.1.2 User password

After you access the **"Settings"** submenu, LCD displays as Fig. 4-10. The value of "**User password**" will be "**<enabled>**" or "**<disabled>**". And **"<enabled>"** means you can change the values of "**Settings"** submenu items. "**<disabled>**" means you can't. It depends on whether you have entered the right password and the UPS status (we are not allowed to change the values of **"Settings"** when UPS is in **"Line Mode"** or **"BAT Mode"**).

5.5.1.3 Set up of "Output voltage"

1). Press button or button to choose **"Output voltage"** (Fig. 4-11). Press button and the cursor will flash on **"<220v>".**

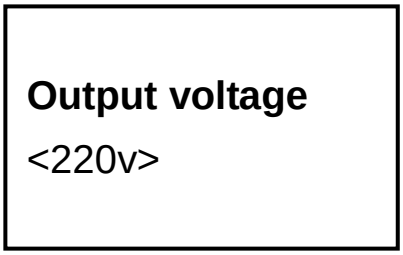


Fig. 4-11

2). Press button or button to choose output voltage value. The value can be set as **208V**, **220V**, **230V** or **240V**.
Press button for longer than1 second, the output voltage value will be saved. The UPS output voltage will follow this value when the UPS turns on at next time.

5.5.1.4 Set up of "Output frequency"

1). Press button or button to choose **"Output frequency"** (Fig. 4-12). Press button and the cursor will flash on **"<50Hz>".**

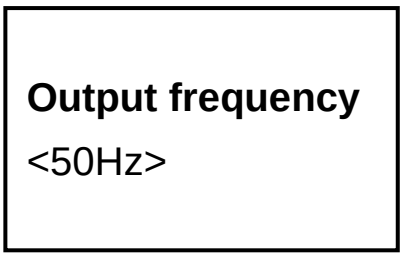


Fig. 4-12

2). Press button or button to choose output frequency value. The value can be set as **50Hz** or **60Hz**. Press button for longer than1 second. The output frequency

value will be saved. The UPS output frequency will follow this value when the UPS turns on at next time.

5.5.1.5 Set up of "Audio Alarms"

1). Press button or button to choose **"Audio Alarms"** (Fig. 4-13). Press button and the cursor will flash on **"< enable >".**

Fig. 4-13

2). Press button or button to choose "**Audio Alarms"** as **"< enable >"** or **"<disable >".**

Press button for longer than1 second to save "**Audio Alarms"** value.

5.5.1.6 Set up of the others submenu items of "Settings"

The others submenu items of "Settings" can be set up by the similar method above (4.5.1.3~4.5.1.5).

The following table shows the values of the others "Settings" submenu items.

Submenu item	Values	Remark
Set UPS Running Time	Day; Hour; Minute; Second.	
Power strategy.	normal/high efficiency/ converter	
Start on battery	disabled/enable	
Auto Bypass	disabled/enable	
Auto Restart Function	enabled/disabled	
Bypass voltage low limit	176~205V	
Bypass voltage high limit	235~276V	
Bypass frequency High limit	1%~10%	
Bypass frequency Low limit	1% ~10%	
HE frequency Low Limit	1% ~10%	
HE frequency High Limit	1% ~10%	
HE voltage low limit	1% ~10%	
HE voltage high limit	1% ~10%	
short circuit clearance	disabled/Enable	
Volt adjust		
Clear event log		

LCD contrast	-5~+5

5.5.2 Set up of “Control”

1). The main menu includes 6 items: **UPS Status**, **Event Log**, **Measurements**, **Control**, **Identification**, and **Settings**.

Press button or button to choose “**Control**” (Fig. 4-14).

Fig. 4-14

2). Press button and enter the submenu of “**Control**” (Fig. 4-15).

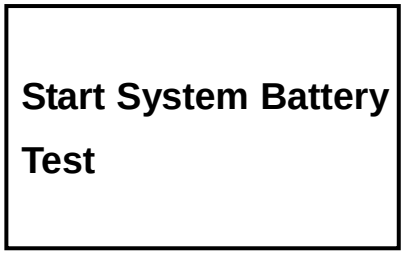


Fig. 4-15

The submenu of “**Control**” includes 8 items: **Start System Battery Test**, **Start Battery Test**, **Cancel Battery Test**, **Clear Fault**, **Clear EPO Active Status**, **Buzzer Mute**, **Restore factory settings** and **Single UPS turn off.**

Press button and button to display one of them. Press button to choose one of them.

5.5.2.1 Battery Test

Under Battery Test status the UPS will transfer to the battery mode to check whether the battery is normal or not. The UPS can run in parallel system and single system. “**Start System Battery Test”** for Battery Test of parallel system and “**Start Battery Test**” for the UPS self Battery Test.

1). Start System Battery Test

The first item of the submenu of "**Control**" is **Start System Battery Test** (Fig. 4-15). Press ↵ button and LCD displays as Fig. 4-16.

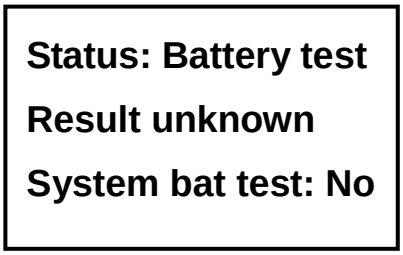


Fig. 4-16

Press ↵ button and the cursor will flash on **"No".** Press ▼ button or ▲ button to choose "**System bat test"** as **"No"** or **"Yes".** Choose **"Yes"** and press ↵ button for less than 1 second. The System Battery Test will start. All batteries of the parallel UPS will be checked.

2). Start Battery Test

Press ▼ button to access "**Start Battery Test**" menu (Fig. 4-17).

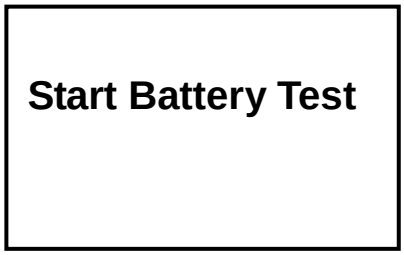


Fig. 4-17

Press ↵ button and LCD displays as Fig. 4-18.

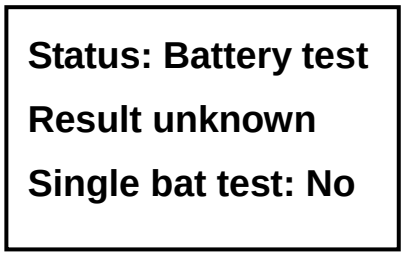


Fig. 4-18

Press ↵ button and the cursor will flash on **"No".** Press ▲ button or ▼ button to ↵

choose “**Single bat test”** as **“No”** or **“Yes”.** Choose **“Yes”** and press button for less than 1 second. The Single Battery Test will start. The UPS self’s battery will be checked.

5.5.2.2 Single UPS turn off.

In the UPS parallel system, single UPS can be turned off by this menu.
Press button or button to access “**Single UPS turn off**” menu (Fig. 4-19).

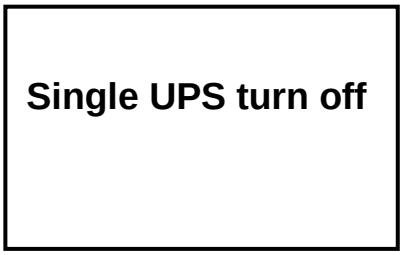


Fig. 4-19

Press button and LCD displays as Fig. 4-20.

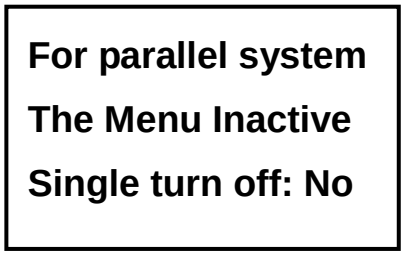


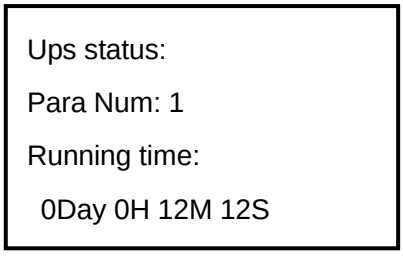
Fig. 4-20

Press button and the cursor will flash on **“No”.** Press button or button to choose “**Single UPS turn off”** as **“No”** or **“Yes”.**

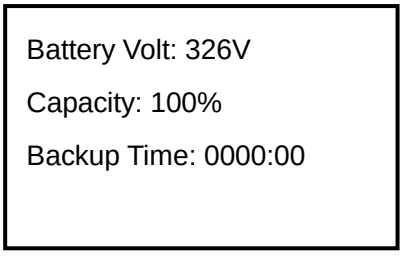
Choose **“Yes”** and press button for less than 1 second. The single UPS will be turned off. And there is no effect on other UPS machines of the parallel system.

5.5.3 Submenus of “UPS Status”

Enter the “**UPS Status**” menu, press button, LCD displays as Fig. 4-21.
Press button, LCD displays changing from Fig. 4-1 to Fig. 4-21(a), and then to Fig. 4-21(b)



(a)



(b)

Fig. 4-21

5.5.4 Submenus of “Measurements”

Enter the “**Measurements**” menu, press button, LCD displays as Fig. 4-22.

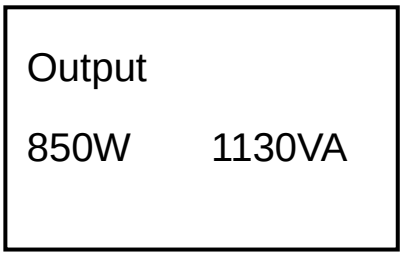


Fig. 4-22

The “**Measurements**” menu includes 8 submenu items: output power, output current, output voltage, input voltage, bypass, battery, DC bus and temperature. Press button or button, LCD will display one item.

5.5.5 Submenus of “Event Log”

The “**Event Log**” menu has two submenus: “**Warning logging**” and “**Fault logging**”.

Enter the “**Event Log**” menu, press button, LCD displays as Fig. 4-23.

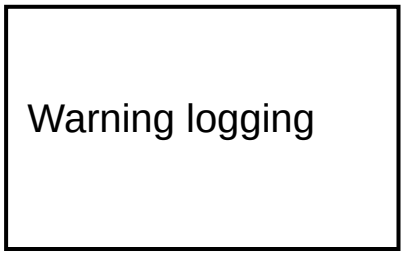
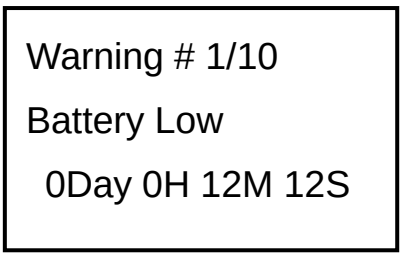
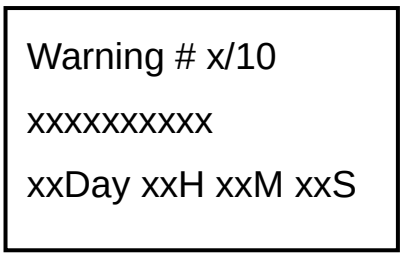


Fig. 4-23

Press button or button, LCD will display “**Fault logging**”.

“**Warning logging**” menu has two submenus (Fig.4-24). Press button or button, LCD will display one of them.





(a) (b)

Fig. 4-24

“**Fault logging**” menu also has two submenus (Fig.4-25). Press button or button, LCD will display one of them.

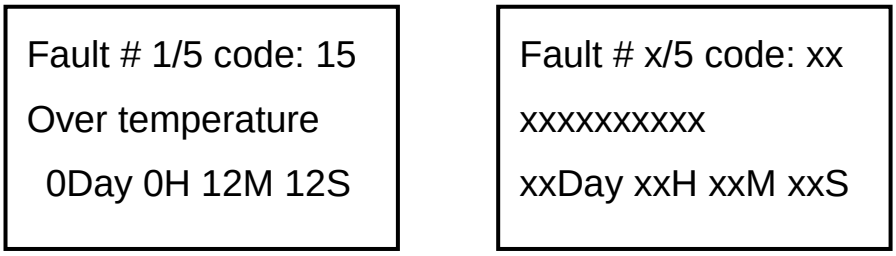


Fig. 4-25

6 POWER UP behavior

6 .1 BYPASS MODE

When you close the bypass switch (M2), no matter you connect the batteries or not, output terminal will be applies by M2 power, than charger, SPS, CNTL will be work , and at the same time LCD will be light up and the fan work too. At this time, if the M1 POWER is available, positive and negative BUS will be charge gradually till it get to the peak of the line (near 310V). At this mode, if M2 is outage, output will lost at the same time. So if you want to protect you load, please turn on the UPS.

6.2 ONLINE MODE

When M1 POWER is available, positive and negative BUS will be charge gradually till it get to the peak of the line (near 310V).When you turn on the UPS, system will start PFC, BUS will UP to 360 gradually, and than start the inverter, INV voltage will
Gradually rise up to bypass voltage, if phase lock is OK, system will go to line mode.

6.3 BETTERLY MODE

The system support cold start, when you turn on UPS without M1, BUS will precharge through RLY, when the BUS voltage rise up the half voltage of the batteries, system will start boost, BUS rise up to batteries voltage and than up to 360V, after that it will start the inverter, INV voltage will Gradually rise up to bypass voltage, if phase lock is OK, system will go to line mode.

6.4 SHUT DOWN

In line mode or battery mode, when you shut down UPS, system will go to bypass mode (with output voltage) or standby mode (no output voltage), and than close the M2 and M1, system will discharge the BUS voltage, after a few minute, system will shutdown totally.

7 Troubleshooting and Maintenance

7.1 Parallel Troubleshooting Procedures

How to install a new parallel UPS system:

1) Before installing a new parallel UPS system, user need to prepare the input and output wires, the output breaker, and the parallel cable.

2) Turn off the input breaker and output breaker, Remove the front panel and open the battery pack DC connectors each UPS. Connect the input wires, output wires and battery wires. Remove the short connection wire between JP1 and JP2 on the terminal block. Remove the maintenance cover plate of each UPS and set the maintenance switch from “UPS” to “BPS”.

3) Remove the cover plate of the parallel port on the UPS, connect each UPS one by one with the parallel cable, screw the cover plate and cover from your accessories of the parallel port back again.

4) Reconnect the DC cables and turn on the input breaker of the each UPS, measure the difference voltage between the output line wires of each UPS to check if the voltage difference between them is less than 1V. If the difference is less than 1V, close the output breaker. If the difference is more than 1V, check if the wirings are abnormal.

5) Close the input breakers of all of the UPS in the parallel system. After all of the UPS transfer to the Bypass mode, screw the maintenance cover plate back again.

6) Turn on each UPS in turn and observe their display. Make sure that each UPS displays normal and all the UPS transfer to the INV mode together. Measure the voltage on the JP1 and JP2 on the terminal block of each UPS to check if the voltage difference between them is less than 1V. If the voltage difference is more than 1V, the output relay of the UPS may not be closed.

7) Measure the voltage of each JP2 on each UPS to check if the voltage value is less than 5V (Generally 2V). If the difference is more than 5V, that means the UPS needs to be regulated again or you need to check that the parallel cable of the parallel kit are normal.

8) Turn off each UPS in turn and after all of them transfer to the Bypass mode, remove the maintenance cover plate of each UPS and set the maintenance switch from “BPS” to “UPS” and screw the maintenance cover plate back again.

9) Turn on the UPS in the Line mode to perform the parallel operation.

How to join a new UPS:

1) Before joining a new UPS, user need to prepare the input and output wires, the output breaker, and the parallel cable.

2) Turn off the input breaker and output breaker, Remove the front panel and open the battery pack DC connectors of the new unit. Connect the input wires, output wires and battery wires. Remove the short connection wire between JP1 and JP2 on the terminal block.

3) Turn off the UPS systems that are running. After all of the running UPSs transfer to the Bypass mode, remove the maintenance cover plate of each UPS and set the maintenance switch from “UPS” to “BPS”, then turn off the input breaker of each UPS.

4) If the UPS system that is running is a stand-alone UPS, you need to remove the short connection wire between JP1 and JP2 on the terminal block.

5) Remove the cover plate of the parallel port on the new UPS, push one end of the parallel cable into the slot of the parallel kit and screw up the connector; screw the cover plate of the parallel port back again.

6) Remove the maintenance cover plate of the new UPS and set the maintenance switch from “UPS” to “BPS”.

7) Turn on the input breaker and Reconnect the battery pack cable of the new UPS; measure the difference voltage between the output line wires of new UPS and the parallel system to check if the voltage difference between them is less than 1V. If the difference is less than 1V, close the output breaker. If the difference is more than 1V, check if the wirings are abnormal.

8) Remove the cover plate of the parallel port located on the UPS which has transferred to the maintenance bypass and push the other end of the parallel cable into the slot of the parallel kit and fasten the connector. Screw the cover plate of the parallel port back again.

9) Close the input breakers of all of the UPS (including the new UPS) in the parallel system. After all of the UPS transfer to the Bypass mode, screw the maintenance cover plate back again.

10) Turn on each UPS in turn and observe their display. Make sure that each UPS displays normal and all the UPSs transfer to the INV mode together. Measure the voltage on the JP1 and JP2 on the terminal block of each UPS to check if the voltage difference between them is less than 1V. If the voltage difference is more than 1V, the output relay of the UPS may not be closed.

11) Measure the voltage of each JP2 on each UPS to check if the voltage value is less than 5V (Generally 2V). If the difference is more than 5V, that means the new UPS needs to be regulated again or you need to check that the parallel cable of the

parallel kit are normal.

12) Turn off each UPS in turn and after all of them transfer to the Bypass mode, remove the maintenance cover plate of each UPS and set the maintenance switch from “BPS” to “UPS” and screw the maintenance cover plate back again.

13) Turn on the UPSs in the Line mode to perform the parallel operation.

Note: If the UPS is abnormal in the above debugging, please perform maintenance according to the steps of removing a stand-alone.

How to remove a single UPS from the parallel system:

1) If you need to remove one UPS of the UPSs parallel system which is on normal running, press the OFF button of the UPS that is confirmed to be removed twice continuously and the UPS will cut off its output immediately.

2) Turn off the input breaker, the external mains input breaker, the output breaker and the battery connector of the UPS that will be removed.

3) Press the others UPSs’s OFF button. After all of them transfer to the Bypass mode, remove the cover plate of each UPS and set the maintenance switch from “UPS” to “BPS” and then turn off the input breaker of each UPS.

4) After you remove one UPS, you need to connect the short connection wire of the JP1 and JP2 located on the Terminal block of the UPS if the remained UPS system only remain one UPS runs by itself

5) After all panels of the UPS do not display anything any more, remove the cover plate of the parallel port on the UPS connected with the parallel cable of the UPS that need to be removed. Remove the parallel cable and screw the cover plate of the parallel port back again.

6) Remove the cover plate of the parallel port located on the UPS that need to be removed and remove the parallel cable, and then screw the cover plate back again.

7) Close all of the input mains breakers of the remained UPS. After all UPS transfer to the Bypass mode, set the UPS maintenance switch from “BPS” to “UPS” and screw the maintenance cover plate back again. Then turn on all of the UPS in the Line mode to perform the parallel operation.

8) If the removed UPS will be used in a stand-alone mode, then JP1 and JP2 on the terminal block should be connected with a short connection wire.

- **Combine machine warning:**

1) When UPS combine system work at inverter mode, make sure that all UPS maintain switches at the same place, that is to say, be at the position of “UPS”, or be at the position of “BPS”.
2) When turning on the UPS combine system before enter into inverter mode, UPS

output breaker must at the “OFF” position.

3) When UPS combine system work at inverter model, please do not operate any UPS maintain switch.

7.2 Single system Troubleshooting Procedures

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

1. Check the UPS status by LCD panel display, or listen to the end user description
2. turn the ups to the maintain mode if necessary, and shutdown system by the procedure, and remember before taking further action, discharge BUS voltage first!
   (Attention: this mode is not protection, when outage the is happen, load will be drop too.)
3. Identify the failure part/boards with the help of failure identify flowchart.
4. Observe the failure board, Static checking
5. Replace the failure components with OK parts
6. Static checking
7. Power up checking
8. Test after repair.

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

7.3 warning

There is warning display given means some abnormity happened in 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.

Type	Possible cause	Action
Overload	Over load	1. check if the load is more than 100% 2. Check the loads and remove some non-critical loads. 3. Check whether some loads are failed. 4. Check the detective circuit on the PSDR board.
Over Charge	The battery voltage too high	1. Check if BAT voltage is highter than 348Vdc 2. Check the battery number and the setting is suit for the real battery bank. 3. Check whether the charger is failed.
Charger Fail	The charger is broken	Check the charger circuit. F1 F2 and temperature of charger,CN1 or CN2 connection with CCB

Fan Lock	Fan abnormal	1. Check the fan is connection and running. 2. Check the fan is ok! 3. Check and replace the fan driver module on SPS.
Epo Active	EPO function is enabled	1. Check the EPO jumper is connection. 2. Check the wiring of EPO connection. 3. Check and replace the communication board.
Maintain on	The maintain bypass is enabled	1. Check the maintain switch cover is close. 2. Check CNTL- COM wiring is ok.
PARA Female / Male disconnect	Parallel cable abnormal	1. Check the parallel cable be connected tighten. 2. Check wiring in the UPS. 3. Check and replace the parallel card.
Bat Open	The battery bank have not been connected	1. Check the battery bank is connected to the UPS. 2. Check the battery breaker is turn on. 3. Check BAT FUSE is ok 4. Check the detecting circuit on the PSDR board.
Bat Differ	The battery different in the parallel system	1. For parallel UPS, any two ups battery connect different
Line Differ Bypass Differ	The utility different in the parallel system	1. Check the system wiring is OK. 2. Check input breaker is the same 3. Check input FUSE is OK. 4. Check the UPS can be start in single mode. 5. Check the wiring in the UPS.
NTC Fail	Internal warning	1. Check the NTC and the thermal detecting circuit on the PSDR board.
N or G loss	N OR G loss	1. check Neutral is connection well 2. check Ground is connection well 3. check CCB board is ok
Over Temp	Over temperature	4. Check whether the UPS is overloaded, the air vents are blocked, and the ambient temperature is over 45℃. 5. Check fan work ok! 6. Check all cover is cover well. 7. Check the NTC and the thermal detecting circuit on the PSDR board.

Battery Low	The battery voltage is low	1. The battery capacity is low, and the UPS would shut down soon. The battery should be recharged.
ModelNo Fail	Model pin set wrong	1. Check the Model pin set is right

Note 1: When the UPS warning, the UPS is still working on the original mode with the original display.

Note 2: Several warnings could appear in a certain normal operating mode at one time.

7.4 Fault

When the UPS is fault, the UPS will transfer to Fault Mode. Beware that there may sill output voltage that can endanger the operator safe, due to the Bypass.

Type	Possible cause	Action
BUS Soft Fail	BUS voltage sharply DOWN	1. Check PFC board. 2. check INV board
INV Soft Fail	INV is short	1. Check if output is short. 2. Check load is ok! 3. Check the INV board is ok.
Bus voltage over	BUS voltage is more than 440V	1. Check input voltage is normal 2. Check if the load is inductive or too large. 3. Check the PFC board is ok.
BUS Under	BUS VOLT is less than 280V	1. Check if the load is inductive and too large. 2. Check the PFC board is ok
BUS Unbalance	It is different more than 100V between PBUS and NBUS	1. Check if the load is inductive and too large. 2. Check PFC board. 3. Check the INV board.
INV.V Low	Inverter voltage too low <140V	1. Check if the load is too large。 2. Check the INV board. 3. Check the detecting circuit on the INV board.
INV.V High	Inverter voltage too high >270V	1. Check if the load is too large。 2. Check the INV board. 3. Check the detecting circuit on the INV board.

Over Temp.	Internal over temperature	1. Check whether the UPS is overloaded, the air vents are blocked, and the ambient temperature is over 45℃. 2. Check fan is ok. 3. still fault after without load? 4. Check the NTC and the thermal detecting circuit.
INV Neg.Pow.	Load negative power fault	1. Check the input/output wiring. 2. Check if the load is inductive and too large.
BUS software Fail	BUS VOLT can't rise up rightly within 30s	1. check input is ok 2. check CCB-PFC connection is ok 3. check BUS screw is install.
INV software fail	INV VOLT can't rise up rightly within 90s	1. check if the bypass frequency is ok! 2. check if INV is ok?
Overload Fault	Overload Fault	1. check if load is more than 100%. 2. unload the load less than 70% to check.
INV Relay short	INV Relay short	1. check if INV relay is OK?
Model set Fault	Model PIN set error	4. Check the model set circuit on the CCB board.
PARA Communication LOSS	Parallel cable abnormal	1. Check the parallel cable be connected tighten. 2. Check and replace the parallel card. 3. Check wiring in the UPS.

Note 1: At any time, only one normal operating mode or fault mode is presented. Once one fault is come forth, then all previous warnings would not be shown again but only the fault code is presented.

7.5 Trouble shooting in else cases

Problem	Possible cause	Action
Battery discharging time diminishes	Battery not yet been fully charged.	Keep UPS connected to utility power persistently for more than 10 hours to recharge the batteries.
	UPS overloaded.	Check the loads and remove some non-critical loads.
	Battery aged.	Replace the batteries.
	Charger failed	Check and replace the charger.
The UPS cannot be turned on after pressing the button	The button is pressed too briefly.	Press the button continuously for more than 1 second.
	M1 loss and Battery is not connected or	Check battery and M1 breaker.
NO indication, no warning tone even though system is connected to mains power supply	NO input voltage	Check building wiring socket outlet and input cable.
	M2 M1 breaker is not close	Check M2 M1 breaker is close rightly.

7.6 Failure Diagnosis

7.6.1 Failure checks procedure.

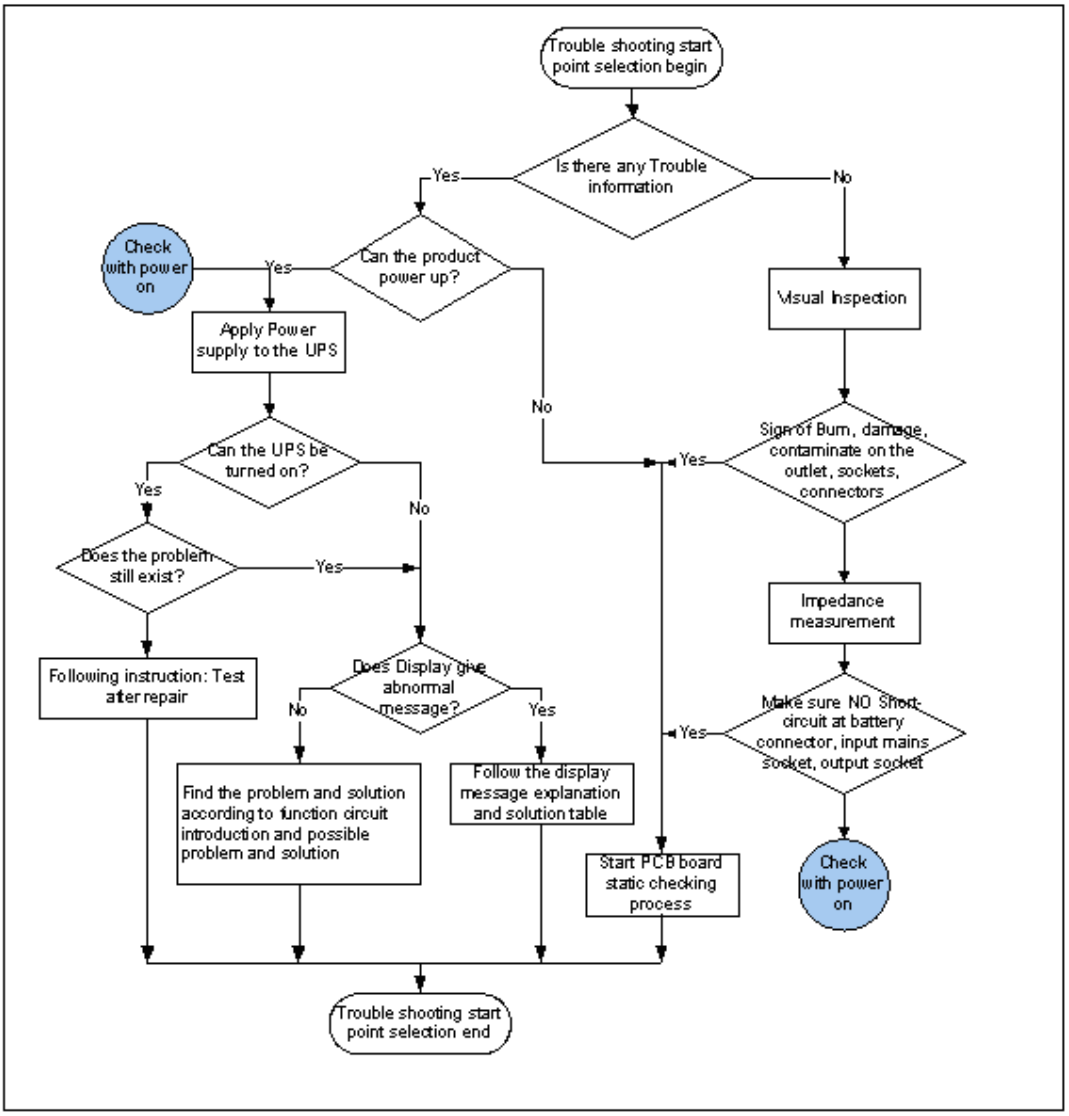


Fig 7.6.1 General Guidance to start a trouble shooting process

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

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

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

1.Unplug the power cord from the utility.
2.Open outside case shown in the beginning of this manual
3.Remove connectors from battery, for long backup time model, unplug battery cabinet connector to UPS.
4.Discharge energy in BUS CAPACITORS, and CHARGER CAPACITORS
5.Disassemble cable from connectors, if required.
6.Disassemble PCB if required.

Attention: site maintain (for uninterruptable power maintain) must applies the load to the maintain mode first, and than show down the systems.

Before starting service, some tools are necessary, at least: A DMM (Digital Multifunction Meter) meter, screwdrivers and discharge resistor (300Ω/10W recommended). A DC power supply with current limiting (over current protection) function (288VDC/5A at least) is recommended for fast and safe diagnosis.

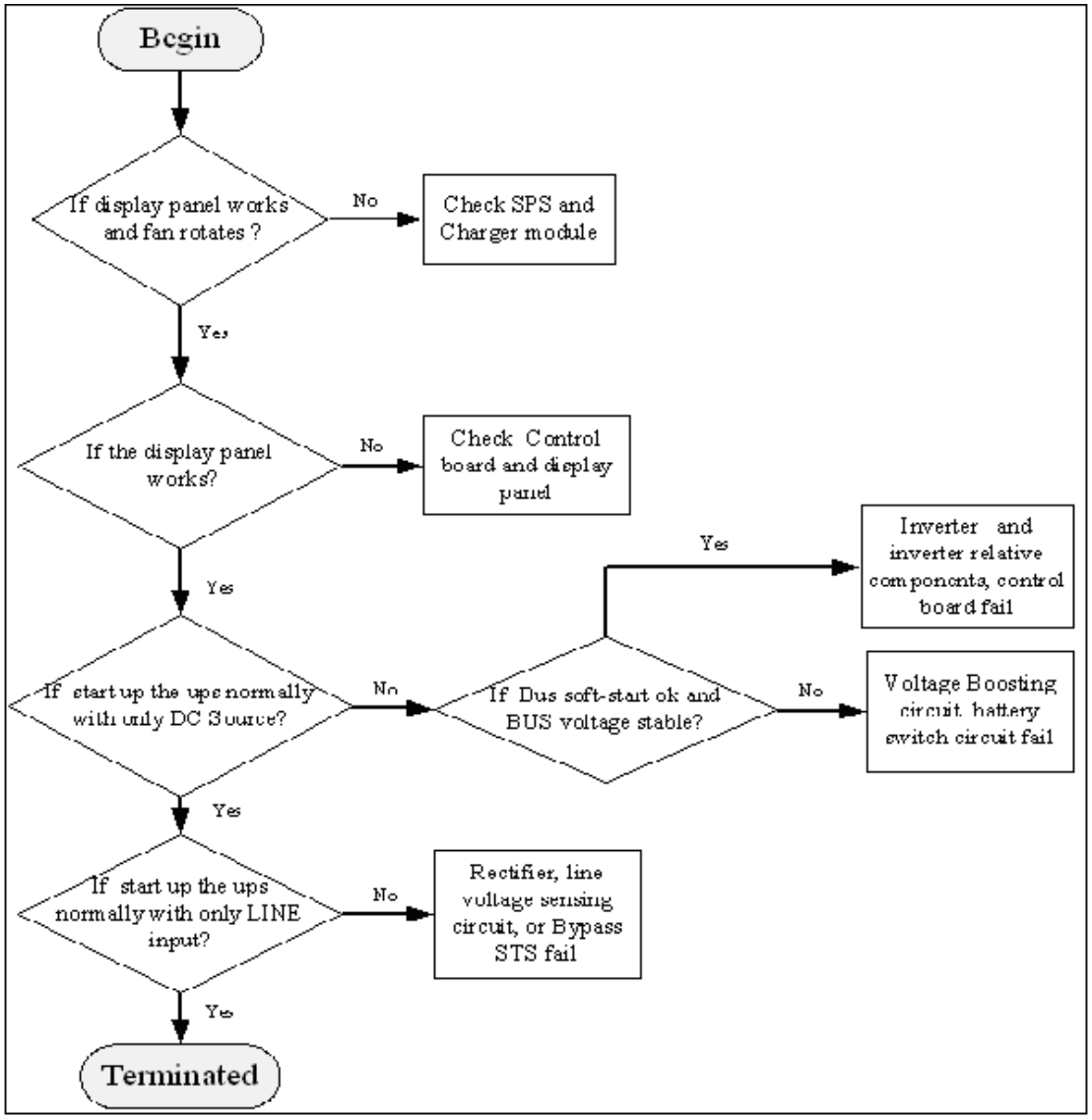
TO DISCHARGE the residue charge on bus capacitor,

contact **Anode and Cathode of the +BUS** capacitor with a 300Ω/10W resistor to discharge +BUS capacitor, contact **Anode and Cathode of the -BUS** with a 300Ω/10W resistor to discharge -BUS capacitor

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

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

Quick Check


Begin
If display panel works and fan rotates ?
No
Check SPS and Charger module
Yes
If the display panel works?
No
Check Control board and display panel
Yes
If start up the ups normally with only DC Source?
No
If Bus soft-start ok and BUS voltage stable?
Yes
Inverter and inverter relative components, control board fail
No
Voltage Boosting circuit, battery switch circuit fail
Yes
If start up the ups normally with only LINE input?
No
Rectifier, line voltage sensing circuit, or Bypass STS fail
Yes
Terminated

Related Circuit Block	Components to be checked	Component Type	Fail condition
BAT FUSE	F1	Fuse	Open
I/P FUSE (on EMI board)	F1 F2 F3	Fuse	Open
PFC converter	D1,D7,D5,D6,D11,D12	Power Diode	Short or open P-N (nearly 0.4V)
	Q3,Q4,Q9,Q10	SCR	Short or open G-E(nearly 25 ohm)
	Q2,Q7,Q5,Q6,Q11,Q12	IGBT	C-E short or open GE (nearly 46kOhm),E-C (nearly 0.4V)
Inverter	Q1,Q5, Q9 Q2,Q6,Q10 Q3, Q7, Q11 Q4, Q8,Q12	IGBT	C-E short or open GE (nearly 15kOhm),E-C (nearly 0.4V)
	D1,D2,D17,D18	Power Diode	Short or open P-N (nearly 0.4V)
Charger module	**Q2 Q1 Q3**	CMOS	D-S short or open
	D1	DIODE	Short or open
	BR1 2	DIODE BRIDGE	Short or open
SPS module	Q3	MOSFET	D-S short or open
	F1	FUSE	open

Fig 7.7.1Quick problem identification process.

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

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

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

8. Test and Finish

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

1. Connect all of boards, cable, and connector right to place.
2. Check the Wiring.
3. Apply DC Power from power source with current limitation function to the BAT terminal on the BAT EMI, the voltage of the DC power should be 214-288Vdc/3 Amp (limited current).
4. Press the ON-switch on front panel for 1 second, you will see "current limit" for a short time on the DC power supply for about only 2 seconds, then UPS should be DC started, If UPS does not start successfully, no LED or LCD indicator is lightened. Please try diagnosing procedure again.
5. If UPS does not start up for several trying or DC power supply is on current-limit state continuously, there must be some defected components exists. Please follow trouble-shooting chart to debug again.
6. Stop the UPS; apply AC mains to the UPS module. Try on the UPS. If fail you may have start one new round of trouble shooting
7. Check and adjust Charging Voltage
8. Check the output voltage waveform and DC-offset voltage.
9. In most case result of step7, 8 can represent whether product in normal condition, If possible, however, for more reliability, perform quick check follow procedure shows in table would help in know the UPS situation in detail.
10. If possible, do a burn-in test on repaired UPS before return it to customer, the longer the better.

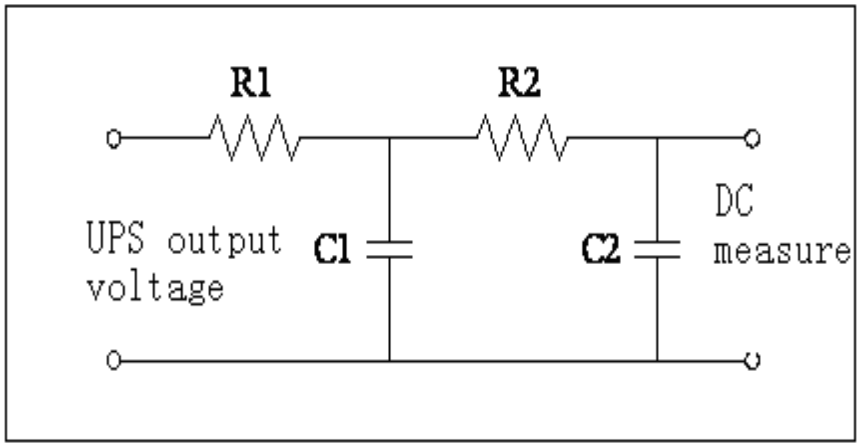
If every step is ok, Congratulation, you have finish the maintenance/ repair work

9 Appendix

1 Tab

TEST ITEM	TEST POINT	TEST AND ADJUSTMENT SEQUENCE	EXPECTED RESULT
+/-DC Bus Voltage @ Backup Mode	Anode and Cathode of the +BUS Anode and Cathode of the -BUS	1. Connect DVM (Set to measure DC) to test point. 2. Plug A DC power supply with current limiting to battery socket 3. Press enter button to turn on the UPS 4. Waiting for 20 seconds to make sure the Inverter LED lights. 5. Check reading on DVM	+360VDC
+/-DC Bus Voltage @ Line Mode	Anode and Cathode of the +BUS Anode and Cathode of the -BUS	1. plug input power cord to utility 2. Waiting for 10 seconds to make sure the UPS to normal mode. Check reading on DVM	+360VDC
O/P DC Balance @ Line Mode	O/P socket	1. Keeping UPS on @ Line mode. 2. Connect DC measurement fixture to O/P socket. 3. Check reading on DVM.	100mV max.
Charger Voltage	BAT (+) BAT (-)	1. Connect DVM (Set to measure DC) to test points 2. Check reading on DVM Adjust VR1 slowly to expected value.	13.6V/PCS

2 DC Offset Measurement Fixture



R1、R2 is 100K/2W；C1、C2 is 25uF/350V

Fig 9.1 DC measure equipment

3 Model Pin Configurations

To detection and control difference model of UPS, The controller need correct model pin configuration for recognizing the UPS model.

The MODEL PORT on the CCB board should be configured as follows：

Note：“1” indicates that the jumper is connected;

“0”indicates that nothing is connected;

For the pin plugs that are not listed here are not connected.

ModPin / Power Level	MODEL1 pin 17	MODEL2 pin 16	MODEL3 pin 15	MODEL4 pin 14
cModel3c20k	0	0	1	0
cModel3c20ks	0	0	1	1

4 Line mode BUS soft start view

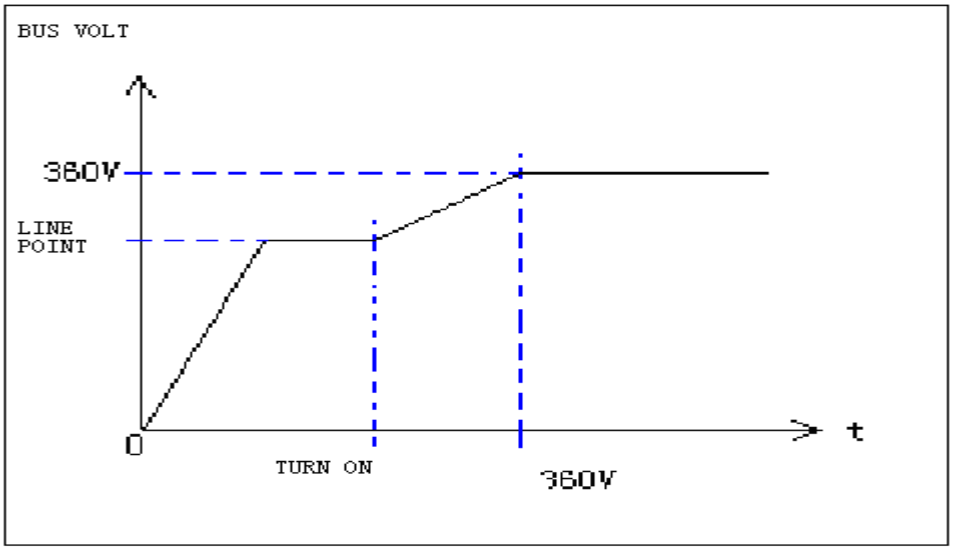


Fig 9.2 BUS soft start in line mode

5 Bat mode BUS soft start view

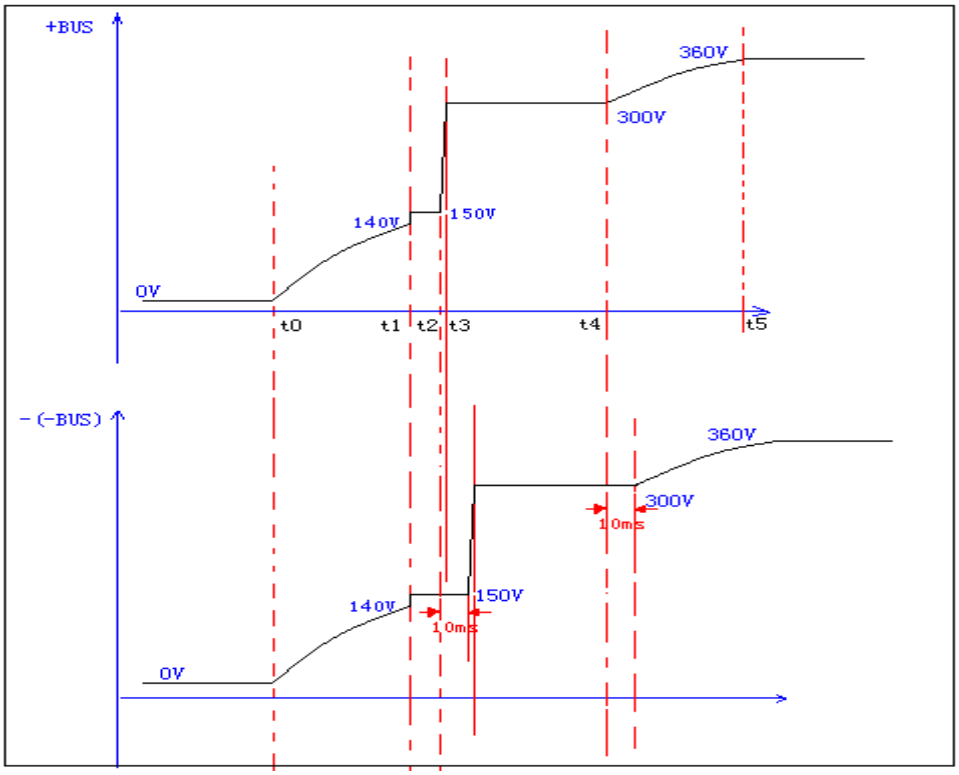


Fig 9.3 BUS soft start in Bat mode