SERVICE MANUAL

ELIPSE SERIES

EL-1.5K/EL-3K 110V

FORZA POWER TECHNOLOGIES

CONTENT

1. General Information of This Document

1.1 Getting started

This is the service manual for the Elipse Series 110V UPS, intended to help service personnel perform maintenance and repair service.

If you want to know:

- **What is special for this UPS from service point of view;** please refer to section "characteristics of the product".
- **Construction of the product**; how many pieces of PCB make up the product, please refer to "construction of the product".
- **Functional block of the UPS, and operating principle,** please refer to "Principles of Operation".
- **What's wrong with the UPS and How to solve the problem**, please refer to "Trouble-Shooting".
- **Basic information about the product, install and operation instruction,** please refer to the USER MANUAL

1.2 Conventions

This service manual uses the following conventions to alert you of important information for safe operation.

Warning: Denotes a procedure or operation, which, if not perform correctly, may result in personal injury. **Be sure not to continue operation until indicated conditions are fully understood and met**.

Caution: Denotes a procedure or operation, which, if not perform correctly, may cause damage to the UPS. **Be sure not to continue operation until indicated conditions are fully understood and met**.

Information and Tips: There are some tips and information after this symbol. During service operations, these tips may help you quickly finish your work.

1.3 Important Safety Instructions

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

1. **DO NOT** short-circuit internal batteries
2. If the battery connectors **[BAT (+), BAT (-)]** are disconnected, be sure to plug in the input power cord and the input power is available before re-connecting the battery connectors.
3. After service, verify the polarity of batteries, fasten all screws and connectors before restarting the UPS.

After opening the cover, please always check the tightness of all wires, connectors, and screws first. Then check if there are any discolored components inside.

2. Characteristics of the Product

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

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

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

3. PRINCIPLES OF OPERATION

3.1 Functional Block of the Product

As a true online UPS, the product employ a double conversion topology, comprised of the following functional blocks:

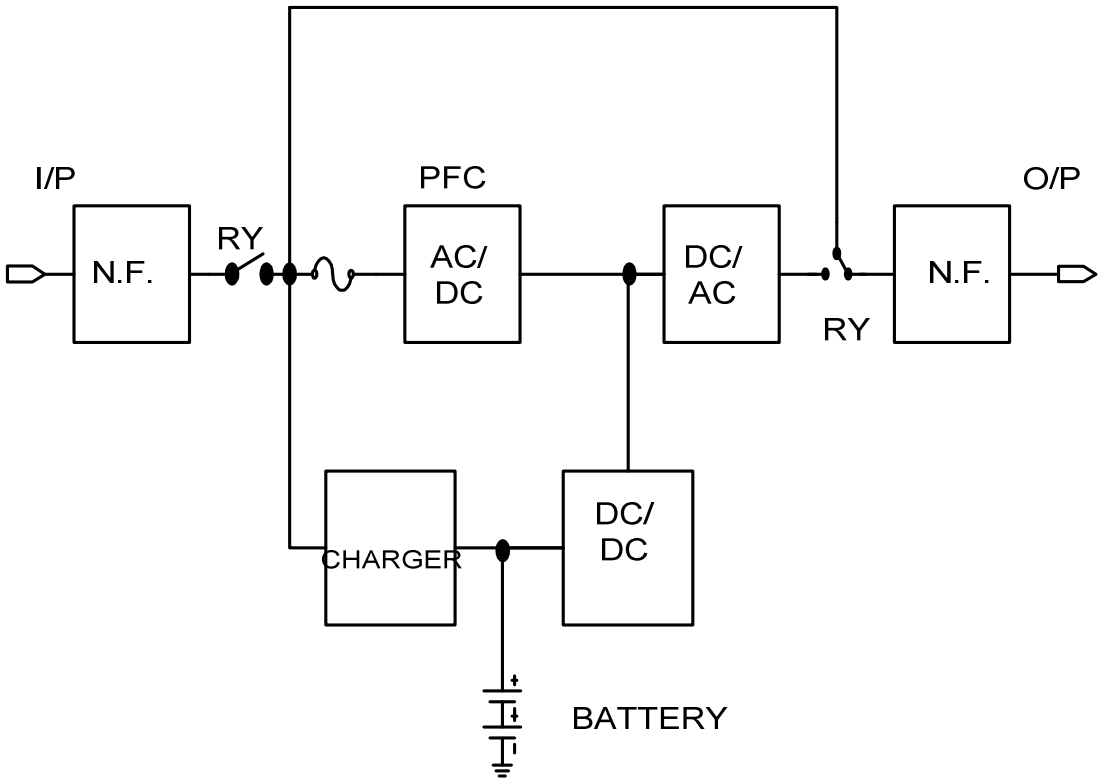


Figure 3.1 Function block Diagram of the product

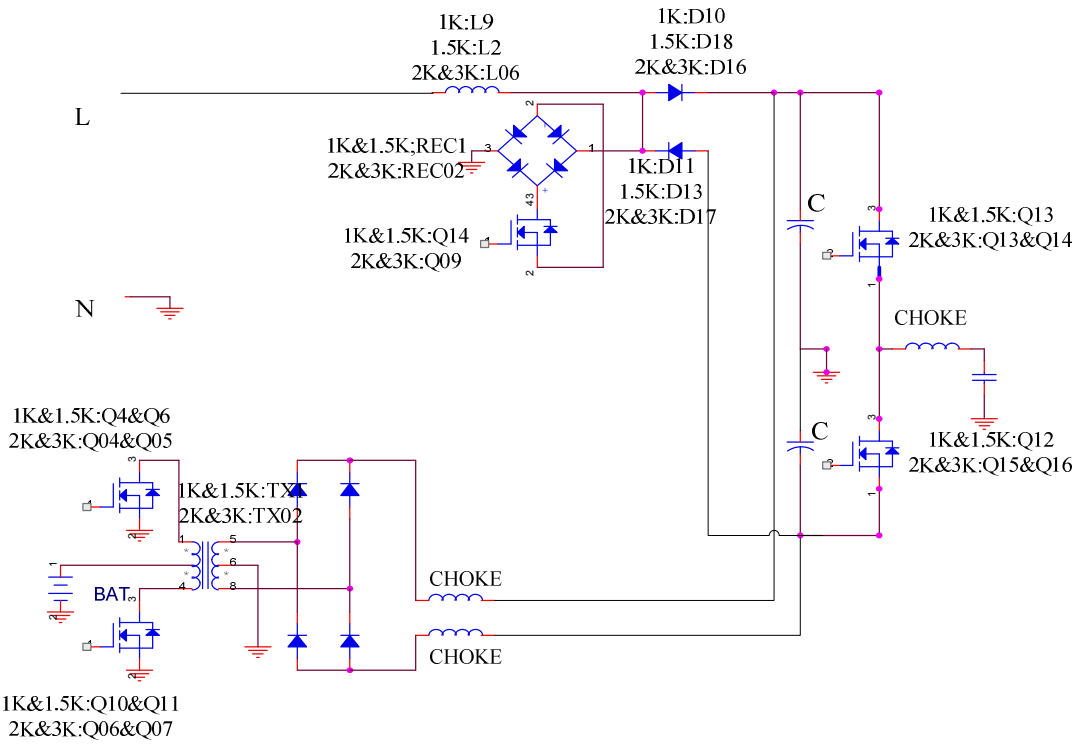


Fig3.2 PSDR functional diagram

In which:

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

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

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

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

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

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

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

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

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

3.2 Operating Principle of the Major Functional Block

3.2.1 AC/DC converter (PFC)

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

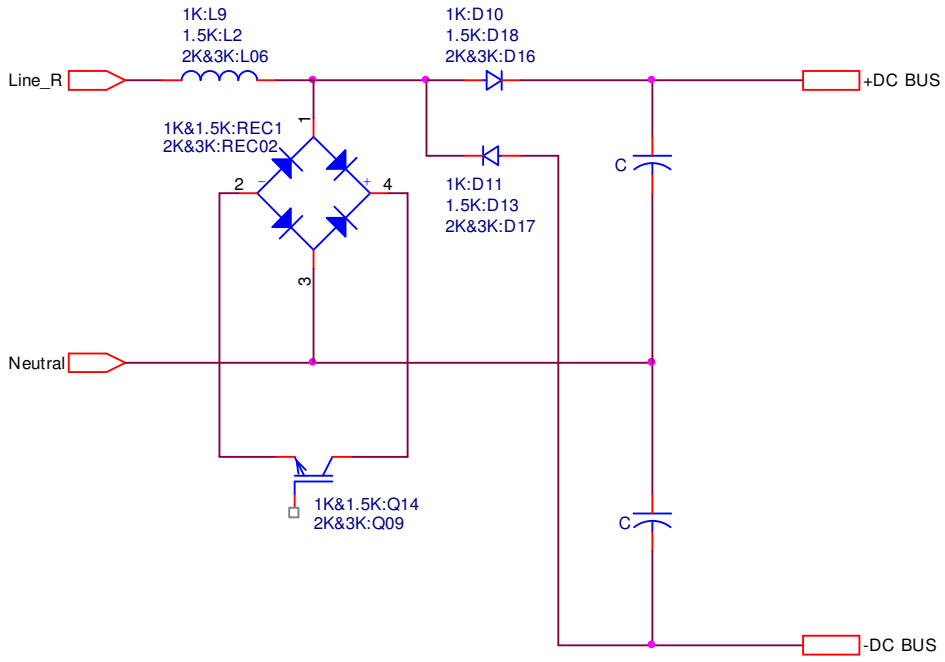


Figure 3.3 showed the topology the PFC converter

When the input AC power cord is plugged in, the AC relay is activated and the AC power goes through the noise filter to the charger and to the line detector. Both DC Buses present Voltages at about 1.4 times of input RMA voltage. When the "ON" switch is pressed, the PFC circuit is enabled and the DC BUS is regulated at for 110VAC serried.

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

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

3.2.2 DC/DC converter (Battery Booster)

In case the AC mains interrupt or go out of tolerance range, the global controller stops the PFC converter and starts the DC/DC converter to converts the DC power from the battery to maintain the DC-BUS voltage, therefore maintaining the output power supply to the load.

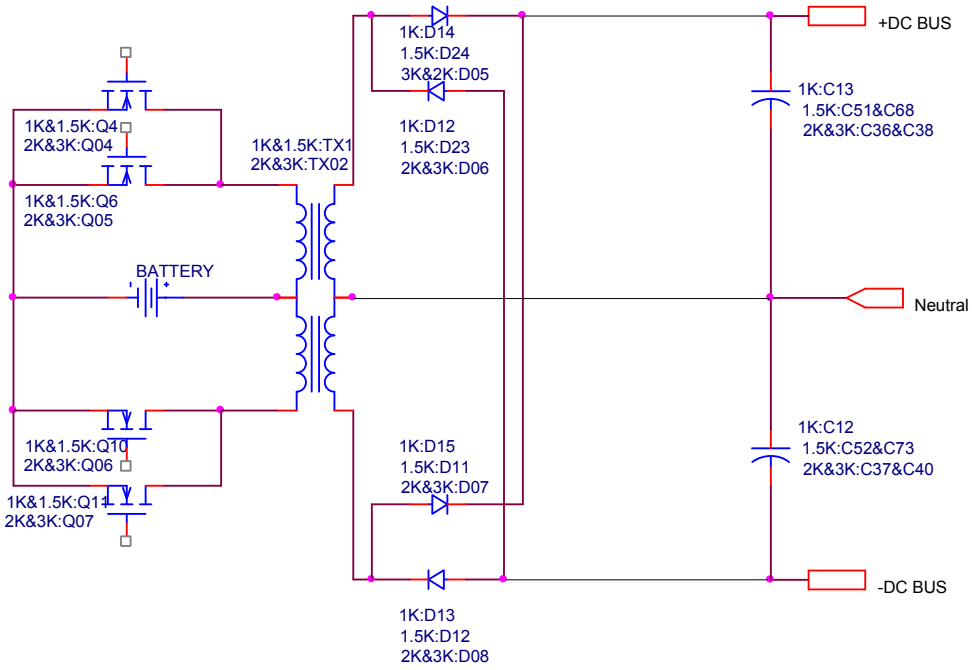


Figure 3.4 DC/DC Converter

The DC/DC converter employes a push-pull power topology, the driving circuit, and the controller. The controller is majorly comprised of ASIC UC3525 and auxiliary circuit.

The DC/DC converter controller drive a pair of switching component, MOSFET used here, turns on in turns, the switch frequency goes above 40kHz. Either of the MOSFET is turned on, there will be power from the Battery transfer to the secondary side of the transformer to charging the DC-BUS. The MOSFETs turn on /off in turn, can prevent the saturation of the transformer and damage of the circuit.

3.2.3 Inverter

The inverter converts the DC power from the DC BUS into the AC output to supply the load. A half bridge topology is employed,

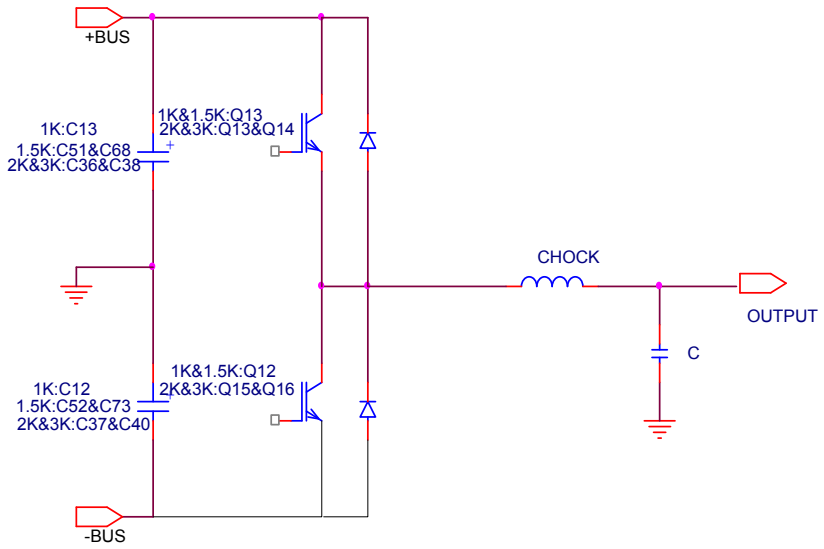


Figure 3.7 Schematics for inverter

The input of the half-bridge inverter topology is in DC Voltage, and the output is in AC voltage. The half bridge inverter is composed of a pair of complementing switching devices, IGBT, a free wheel diode parallel with each IGBT forming a switching leg, a driving circuit for each IGBT, an LC filter, and the controller. In the real circuit, an IGBT with co-pack diode is used to simplify circuit and achieve minimize stray parameters.

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

3.2.4 Global Controller

The Global Controller of the UPS is composed of the following major circuits:

(1) CPU Central Processor Unit

(2) Signal conditioning circuit

(3) Regulation & Protection circuit

(4) Output buffering circuit

(5) Communication interface

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

To control the UPS, the status of the UPS must be monitored. Different kinds of sensors are widely used in the UPS, due to the pure condition of the signal given by the sensors; Signal conditioning circuits are used to attenuate / amplify / filter the signals given so they can become suitable to be processed by the CPU.

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

The global controllers also implement the following protection functions:

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 of integration, the global controller is not designed to be maintained or repaired outside of the manufacturer. There are two methods to identify the status of the 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 to be OK.

3.2.5 Charger

The purpose of the charger is to recharge and to maintain the batteries at fully charged condition. It charges the battery with a constant current at initial stage, as the battery voltage keeps increasing, the charge current decreases accordingly, and the voltage until the floating recharge voltage, and the charger will control the output at a constant level (41.4VDc/1K, 54.9Vdc/1.5K,110Vdc/2k&3k). In this way,

to make the battery fully recharged but not over-charged. This protects and prolongs the lifetime of charged batteries.

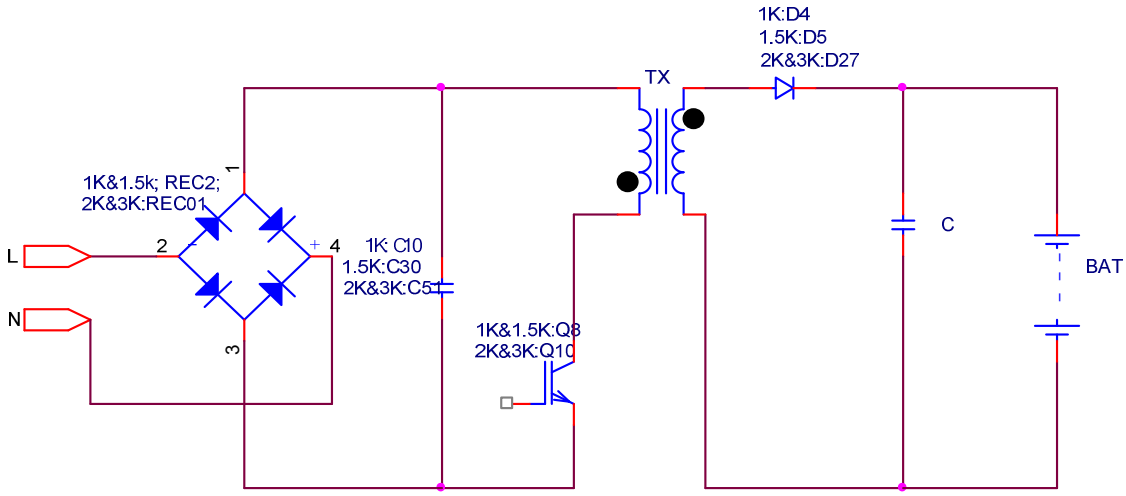


Fig.3.8 Topology of the charger

The battery charger employes a Flyback topology, the switching component MosFET turn on /off, when the MOSFET is turned on, the current in the transformer increases, and a certain amount of energy is stored in the transformer, when the MOSFET turns off, the energy stored in the transformer starts to release from the secondary side of the transformer and charges the output capacitor, by controlling the duty cycle, energy transfer to secondary side of the Flyback circuit can be controlled, and so can the output voltage.

3.2.6 DC Power Supply (SPS)

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

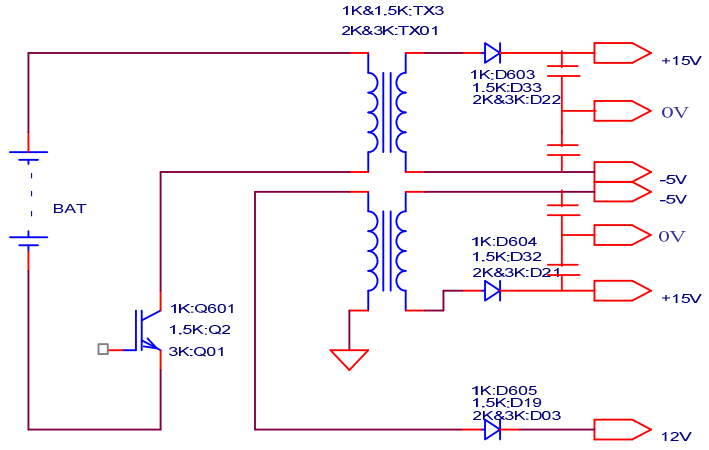


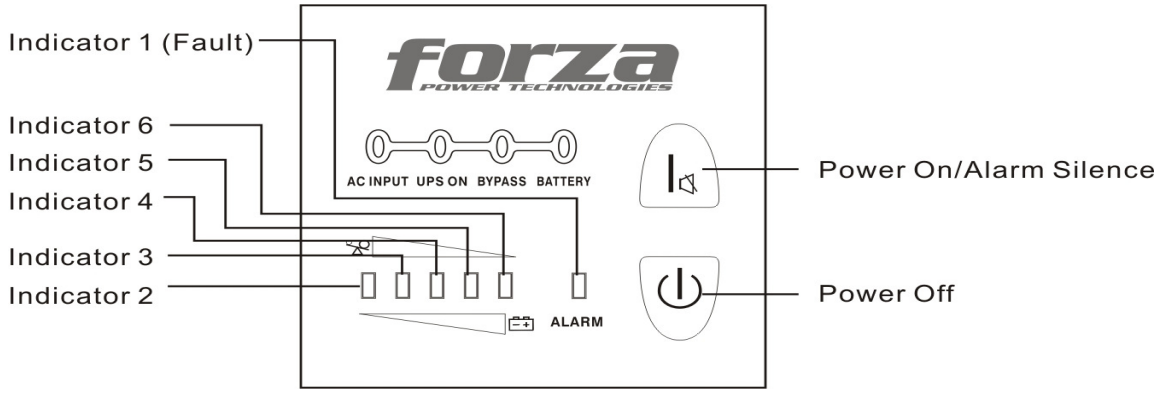
Fig.3.9 Topology of the DC Power Supply

This is a Flyback 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. The SPS module output +15Vdc and a High frequency low level AC power, called H.F power+/ -, +12Cdc mainly used for Relay driving, Signal amplifier, Fans supply, and generate +5V DC power supply for the CPU, And the. H.F.power+/ - is not only the source of IGBT gate drive power but also the source of the isolated power supply for communication ports on the CNTL board. The SPS module works only when the +15 Vdc regulator supplies Vcc to its control IC.

3.2.7 User Interface

3.2.7.1 LED Display



1) LED icon description

Display	Function
AC INPUT LED	The green LINE LED lights up if mains voltage is applied to the UPS input. LINE LED flashes when the phase and neutral conductor have been reversed at the input of the UPS system. If LINE LED and BATTERY-LED light up, the mains power supply is out of tolerance.
BATTERY LED	The orange-coloured BATTERY-LED lights up when the mains power

	has failed and the inverter is being powered by the batteries.
BYPASS LED	The orange-coloured BYPASS LED lights up when the UPS system is supplying voltage provided by the mains power via the bypass.
UPS ON LED	The green-coloured INVERTER LED lights up if the UPS system is supplying voltage provided by the mains power via the inverter.
FAULT LED	The red FAULT LED lights up and an acoustic warning signal is issued every second when the UPS system is in fault condition. Press the Standby switch to turn off the warning tone.
Load and battery capacity LED	These LEDs show the load of the UPS system if the mains power is available (normal operation): **6th LED 1% -35 % 5th LED 36% -55 %** **4th LED 56% -75 % 3rd LED 76%-95 %** **2nd LED 96%-105 %.** In the battery operation, the LEDs indicate the capacity of the batteries: **2nd LED 1 % -35 % 3rd LED 36% -55 %** **4th LED 56% -75 % 5th LED 76% -95 %** **6th LED 96% -100 %.**

3.2.7.2 Communication Interface.

The communication interface provides a means for using computer to manage the UPS, on the rear panel of the UPS, a standard RS232 port and an intelligent slot are provided.

With dedicated software, output voltage, frequency can be set via the RS232 port; also status of the UPS can be monitor.

The intelligent slot can accept SMNP, AS400, USB adaptor 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 implemented by the CPU.

3.2.8 Ventilation and Chassis

Ventilation system of the UPS consists 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 provides a strong construction to accommodate all the electrical part, shield for EMC, and safe guard for operator.

Basically, the chassis is comprised of a base plant, an internal support plant, a front support plant, an outside cover, a rear panel, and a front panel.

4. TROUBLE-SHOOTING

Despite of careful design and strict tests, the UPS can malfunction. The designer suggests the following service procedures:

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

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

4.1 LED Panel Display Pattern Definition

4.1.1 Trouble shooting according to warning indication

If there is a warning display given it 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.

Display	Function
AC INPUT LED	LINE LED flashes when the phase and neutral conductor have been reversed at the input of the UPS system. If LINE LED and BATTERY-LED light up, the mains power supply is out of tolerance.
FAULT LED	The red FAULT LED lights up and an acoustic warning signal is issued every second when the UPS system is in fault condition. Press the Standby switch to turn off the warning tone.
Load and battery capacity LED	These LEDs show the load of the UPS system if the mains power is available (normal operation): **6th LED 1% -35 % 5th LED 36% -55 %** **4th LED 56% -75 % 3rd LED 76%-95 %** **2nd LED 96%-105 %.** In the battery operation, the LEDs indicate the capacity of the batteries: **2nd LED 1 % -35 % 3rd LED 36% -55 %**

	4th LED 56% -75 % 5th LED 76% -95 % **6th LED 96% -100 %.**

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

Note 2: At any time, only one normal operating mode or fault mode is presented. But the warning, even several warnings could appear in a certain normal operating mode at one time. And the normal operating mode code and the warning code would be shown circularly.

4.1.2 Trouble shooting according to fault indication

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

Display	Possible cause	Action
#1,#4	bus fault	1. Check the IGBT power components for the PFC converter and DC/DC circuit are well. 2. Check the components on the drive circuit are well.
#1,#3	Internal fault	1. Check the power components for power INV and on the drive circuit are normal 2. Check the IGBT protective circuit and some PFC converter or DC/DC components.
#1,#6	Overload fault	1. Check the loads and remove some non-critical loads. 2. Check whether some loads are failed.
#1,#2	Internal over temperature fault	Check whether the UPS is overloaded, the air vents are blocked, and the ambient temperature is over 40□. If the overload or block is removed, please make the UPS cool down for 10 minutes before turning on again. It is not recommended the UPS is operated at the ambient temperature of over 40□.
#1,#5	Battery over charge	Check the power components for power CHGR
#1	Charger fault	Check the power components for power CHGR

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, only the

fault code wil be presented.

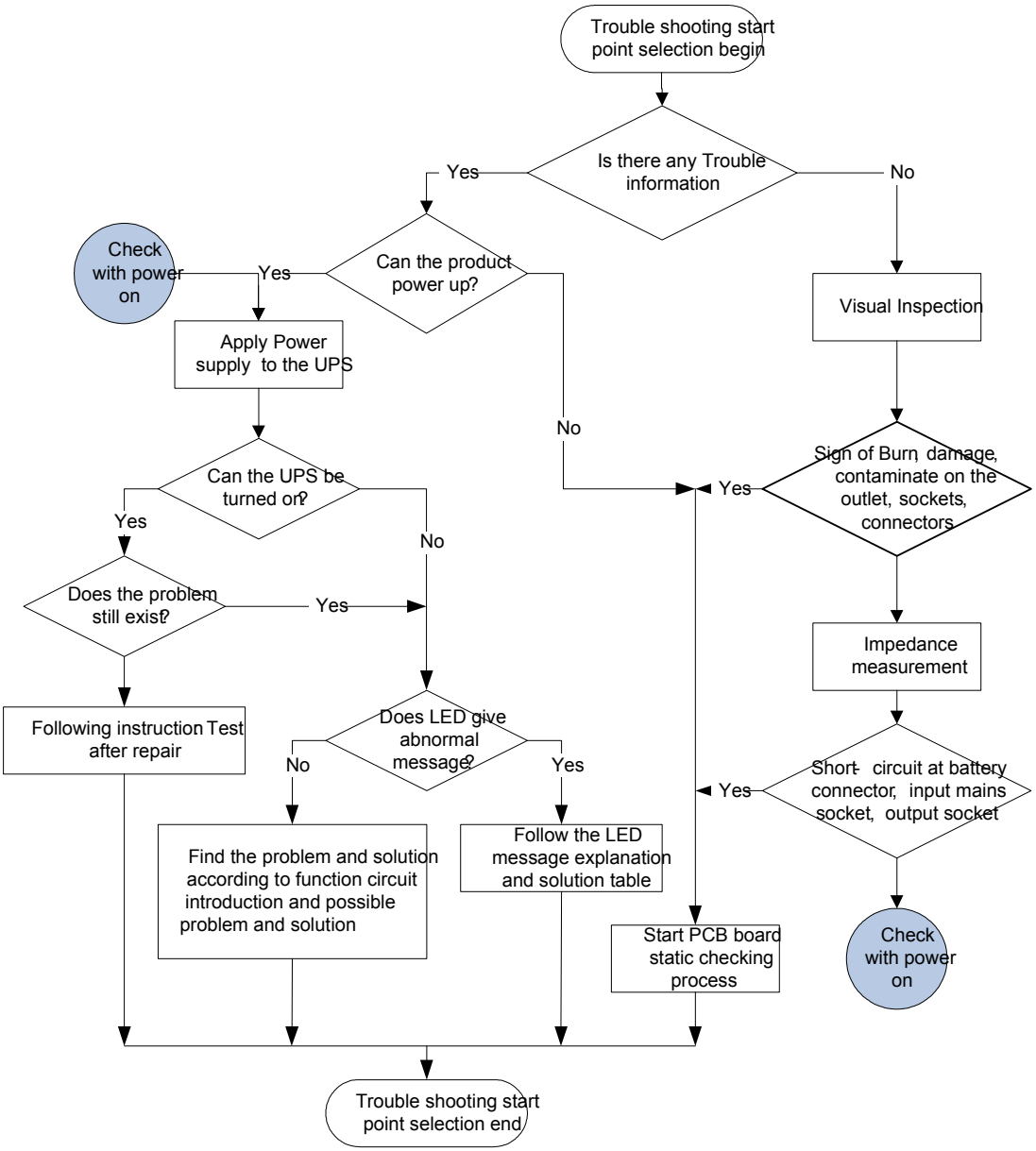
Note 2: when the load or the UPS output is short and the UPS is in inverter fault mode, then “short” would be shown in the display block of the load;

4.1.3 Trouble shooting in other cases

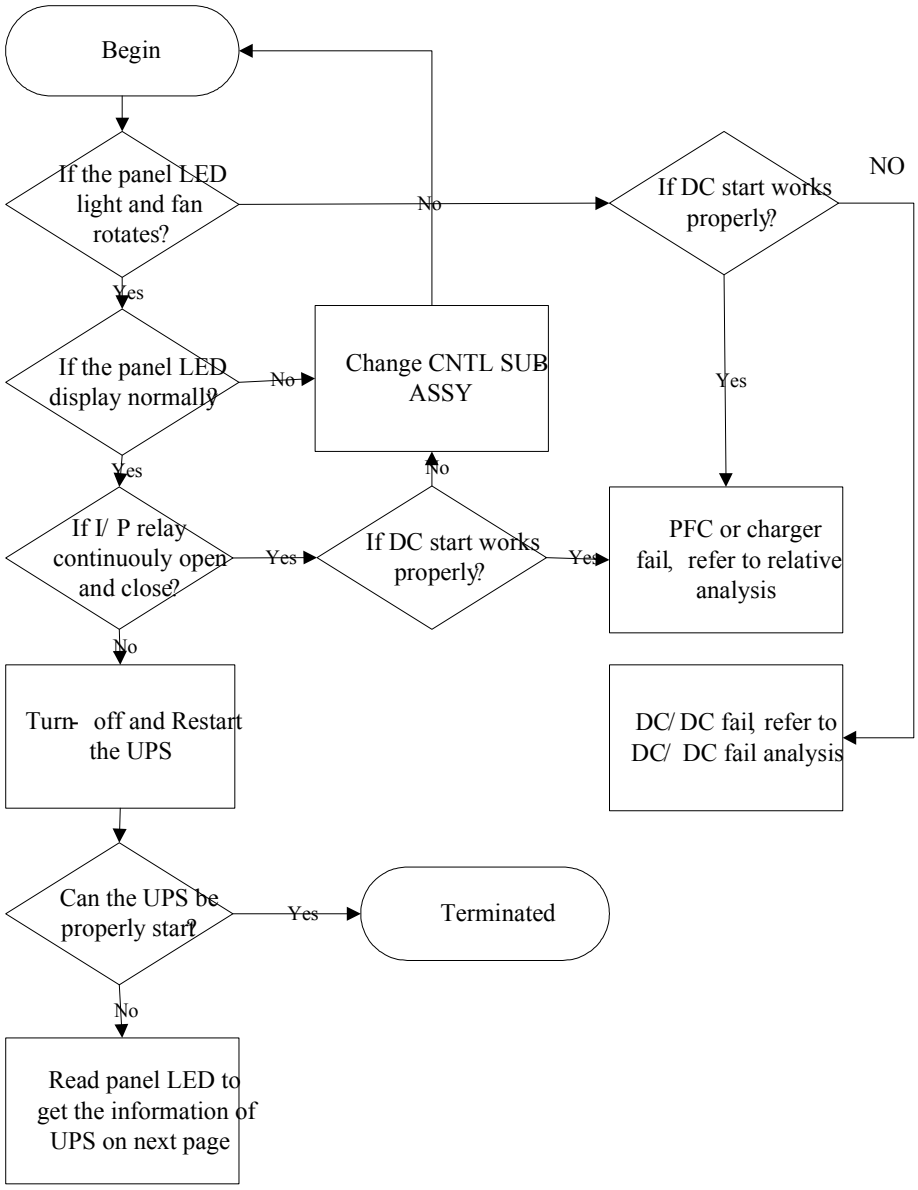
Problem	Possible cause	Action
Battery discharging time diminishes	Battery not yet been fully charged.	Keep UPS connected to utility power persistently for more than 10 hours to recharge the batteries.
	UPS overloaded.	Check the loads and remove some non-critical loads.
	Battery aged.	Replace the batteries.
	Charger failed	Check the charger.
No indication or warning tone though the system is connected to mains	NO input voltage	Check building wiring socket outlet and input cable
The UPS cannot power on after pressing the button	The button is pressed too briefly.	Press the button continuously for more than 2 seconds.
	Battery is not connected or battery voltage is too low, or Charger failed.	Check the charger and battery.

4. 2 Trouble Shooting Procedures

4.2.1 How to Start



4.2.2 Find out the Problem Quickly



4.3 Failure Diagnosis

In this section, some debug skills are listed to help you find the failing components and problems as soon as possible. Before continuing with the following steps listed, we suggest that you should read the problem shooting chart in previous section and 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 instructions strictly to 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.

Before starting service, some tools are necessary, at least: A DMM (Digital Multifunction Meter) meter, screwdrivers and discharge resistor (100Ω/10W recommended). A DC power supply with current limiting (over current protection) function (120VDC/3A at least) is recommended for fast and safe diagnosis.

TO DISCHARGE the residue charge on bus capacitor,

For 1k(s) model contact **BAT (-)** terminal and upper lead of **R4** with a 300Ω/10W resistor to discharge +BUS capacitor, contact **BAT (-)** terminal and upper lead of **R1** with a 300Ω/10W resistor to discharge +BUS capacitor.

For 1.5K(S) model contact **BAT (-)** terminal and upper lead of **R58** with a 300Ω/10W resistor to discharge +BUS capacitor, contact **BAT (-)** terminal and upper lead of **R53** with a 300Ω/10W resistor to discharge +BUS capacitor.

For 2k(s)/3k(s) model, contact **BAT (-)** terminal and upper lead of **R104** with a 300Ω/10W resistor to discharge +BUS capacitor, contact **BAT (-)** terminal and **R118** (2k/3k) upper lead with a 300Ω/10W resistor to discharge +BUS capacitor

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

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

4.3.1 Quick Start

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

Related Circuit Block	Components to be checked	Component Type	Fail condition
BAT FUSE	F1/F2	Fuse	Open
I/P FUSE (on PSDR)	F3	Fuse	Open
PFC converter	1K:D10, D11, REC1 1.5K：REC1，D18，D13 3K：REC02，D16，D17	Diode	Short or open
	3K:Q09, 1K/1.5K:Q14	IGBT	C-E short or open
Push-Pull Booster	1K/1.5K:Q4.Q6,Q10,Q11 3K:Q04, Q05,Q06, Q07	MOSFET	D-S short or open
	1K:D12, D13, D14, D15 1.5K:D11,D12,D23.D24.D2.D3 3K:D05.D06.D07.D08.D04.D09	Power Diode	Short or open
Inverter	3K: Q13, Q14, Q15, Q16 1K/1.5K:Q12, Q13	IGBT	C-E short or open
Charger	1K/1.5K:Q8 3K: Q10	MOSFET	D-S short or open
	1K:D1，D4 1.5K: D5,D6 3K: D27	Power Diode	Short or open
DC Power Supply	1K: Q601 1.5K: Q2 3K: Q01	MOSFET	D-S short or open

Related Circuit Block	Components to be checked	Component Type	Fail condition
	1K: D603 , D604 , D605 1.5K: D33.D32.D20 3K: D03.D02.D21.D22	Power Diode	Short or open

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

4.3.2 P.F.C Converter Analysis:

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

Item	Checked components	Instrument function	Reference Value	Failed condition
1	F3	Ω	Short	Open
2	2K/3K:Q09 1K/1.5K:Q14 (S→D)	Diode Voltage Droop	Infinite	Short or open
3	2K/3K:D16, D17 ,D20 1K: D10, D11 1.5K:D13.D18	Diode Voltage Droop	0.44	Short or open
4	2K/3K:R66,R208 1K:R68 1.5K: R52	Ω	47.0	Open or value change
5	2K/3K:REC02 1K/1.5K:REC1 (+,~),(~,-)	Diode Voltage Droop	0.46	Short or open
6	1.5K: D39.D40.D41.D42.D45. D43D44.D47	Diode Voltage Droop	Infinite	Short or open

Item	Checked components	Instrument function	Reference Value	Failed condition
	2K/3K: D35.D36.D37.D38			

If all components listed above are in normal condition and UPS does not work, try to change PFC control module and IGBT driver module

4.3.3 Push-Pull DC-DC Converter Analysis

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

Item	Checked components	Instrument function	Reference Value	Failed Condition
1	F1, F2	Ω	0Ω	Open
2	2K/3K:Q04~Q07 (S→D) 1K/1.5K:Q4, Q6, Q10, Q11 (S→D)	Diode Voltage Droop	0.42V	Short or open
3	1K:R7, R73, R76, R77 1.5K:R32,R11,R33.R39.R40	Ω	10Ω	Open
4	2K/3K:D05,D06,D07, D08 1K:D12, D13, D14, D15 1.5K:D11,D12,D23,D24	Diode Voltage Droop	0.41V	Short or open
5	2K/3K:D09,D04,D12,D13,D14,D15,D26 1.5K:D28,D29,D30,D31 1K;D16,D17	Diode Voltage Droop	0.41V	Short or open
6	1.5K: R6.R7.R8.R9 2K/3K:R32.R30.R40.R35	Resistance(Ω)	49.9K	Short or open

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

If all components listed above are in normal condition and UPS still can't be DC started, try to change DC/DC module.

4.3.4 DC/AC Inverter Analysis

Item	Checked components	Instrument function	Reference Value	Failed Condition
1	F3, F2, F1, F4	Ω	Short	Open
2	2K/3k:Q14,Q13,Q16,Q15 (S→D) 1K/1.5K:Q14, Q13, Q16, Q15 (S→D)	Diode Voltage Droop	infinite	Short or open
3	2K/3k:R107, R109, R116, R120 1.5K: R56,R50 1k: R40, R54	Ω	47.0 10.0 47.0	Open
4	1.5K: D37,D35 2K/3K:D30,D31,D32,D33,D40, D41	Diode Voltage Droop	infinite	Short or open

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

4.3.5 DC Power supply

Item	Checked components	Instrument function	Reference Value	Failed condition
1	1K:Q601 (S, D) 2K/3K:Q01(S.D) 1.5K:Q2(S.D)	Diode Voltage Droop	0.42V	Short or open
2	1K: R607 2K/3K: R05 1.5K; R18	Ω	47	Open

Item	Checked components	Instrument function	Reference Value	Failed condition
3	1K:R601 2K/3K: R08	Ω	0.50	Open
4	2K/3K: F5	Ω	Short	Open
5	2K/3K: D01.D22.D21.D02.D03 1.5K: D33.D32.D20.D19. D10.D1	Diode Voltage Droop	infinite	Short or open

4.3.6 AC/DC charger

Item	Checked components	Instrument function	Reference Value	Failed condition
1	1K/1.5K:Q8 (S, D) 2K/3K:Q10(S.D)	Diode Voltage Droop	0.45V	Short or open
2	1K:R502 2K/3K:R75 1.5K: R42	Ω	47.00	Open
3	1K;R3 1.5K: R45.R45A	Ω	0.75	Open
4	1K;D1.D4, D20, D3, 2K/3K:D27,D28.D29 1.5K: D5.D6.D14.D48.D25.D27	Diode Voltage Droop	0.45	Short or open
5	2K/3K: REC01(+,~),(~,-) 1.5K:REC2(+,~),(~,-)	Diode Voltage Droop	0.46	Short or open

DO NOT let the charger work with full load when the outside cover is removed, without the airflow path forming with cover, it can cause over-heat of TX3, and therefore the other related components will fail again.

On the Super charger, adjust the value of **VR1** can adjust the output voltage of the charger.

4.3.7 Others

In previous sections, we pay attention to the components on PSDR, in this section, we are trying to list some possible failure phenomenons not stated before and on control PCB sub-assembly. They are the following:

problem	Phenomenon	Action
Bus over-voltage	1.Bus over-voltage fault alarm and display occur 2.Bus voltage doesn't meet spec.	Check PFC IGBT and Driver module
Inverter Softstart fail	Inverter fault alarm and display occur.	Check INV IGBT and Driver module
UPS can't start, but not the problem stated before.	It is active randomly or abnormally.	Replace CNTL
Start-up	1.UPS is bypass after the mains is on. 2.No response after press ON button.	1. Check PSDR IGBT 2. Replace CNTL
O/P DC balance	O/P DC balance is out of spec.	1. Check IGBT and Driver module on PSDR 2. Replace CNTL

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

5. Test and Finish

After replacing all defective components on power stage (PSDR), the following test steps can be performed to verify the repair results and the reliability of the UPS.

1. Connect all boards, cables, and connectors.
2. Check the Wiring
3. Apply DC Power from power source with current limitation function to the BAT terminal on the PSDR, the voltage of DC power should be 96-110Vdc/3 Amp (limited current) for 2/3K UPS, 36~41Vdc/3Amp for 1K UPS, 48～54Vdc/3 Amp;
4. Press the ON-switch on front panel for 2 seconds, you will see "current limit" for a short time on the DC power supply for about only 2 seconds, and then UPS should be DC started, If UPS does not start successfully, please try diagnosing procedure again.
5. If UPS does not start up for several tries or DC power supply is on current-limit state continuously, there must still be some defective components present. Please follow trouble-shooting chart to debug again.
6. Stop the UPS; apply AC mains to the UPS module. Try on the UPS. If it fails 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, at no-load and full load condition.
9. In most case result of step 7 and 8 can represent whether product is in normal condition. If possible, however, for better reliability, perform a quick check using th procedures in the table below.

TEST ITEM	TEST POINT	TEST AND ADJUSTMENT SEQUENCE	EXPECTED RESULT
Charger Voltage	BAT (+) BAT (-)	1. Disconnect BAT (+) and BAT (-) wires from pins respectively. 2. Connect DVM (Set to measure DC) to test points and plug input power cord to utility. Adjust VR1 slowly to expected value.	1. Cooling fans on back panel begin to rotate. 2.2K/3K 110Vdc±0.4V 3. 1K 41.2Vdc±0.3V 4.1.5K 54.9Vdc±0.4V
+DC Bus Voltage @ Line Mode	2K/3K:R104Top (+) and GND 1K: R4 Top (+) and GND 1.5K: R58 Top(+) and GND	1. Connect DVM (Set to measure DC Volt) to test point. 2. Plug input power cord to utility. 3. Press ON bottom for 2 seconds to turn the UPS on. 4. Waiting for 10 seconds to make sure the Inverter LED lights. Check measurement result on DVM	+170VDC±10V
-DC Bus Voltage @ Line Mode	2K/3K:R118 Top (+) and GND 1K: R1 Top (+) and GND 1.5K: R53 Top (+) and GND		-170VDC±10V
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.	200mV max.
+/-DC Bus Voltage @ Backup Mode	2K/2K:R104Top (+) and GND 1K: R4 Top (+) and GND 2K/3K:R118 Top (+) and GND 1K: R1 Top (+) and GND	1. Disconnect Input power cord from utility and press OFF bottom for 2 seconds to turn UPS off. 2. Connect DVM (Set to measure DC) to test point. 3. Plug input power cord to utility. 4. Press ON bottom for 2 seconds to turn EUT on. 5. Waiting for 10 seconds to make sure the Inverter LED lights. 6. Check reading on DVM	+/-170VDC±10V

8.If possible, do a burn-in test on repaired UPS before return it to customer… the longer the better. If every step is ok, **congratulations**, you have finished the maintenance/ repair work.

Appendix

I. DC Offset Measurement Fixture

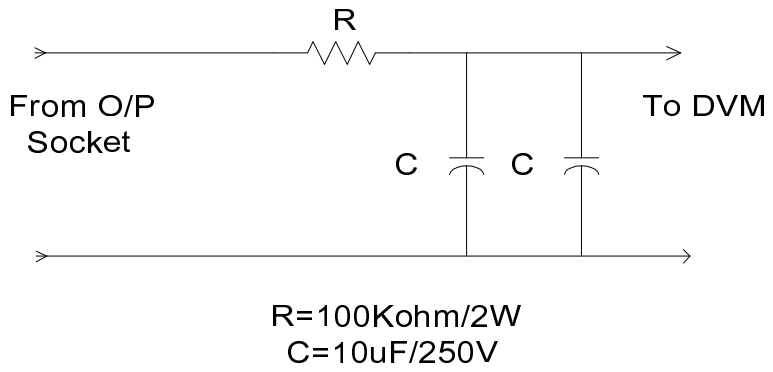


Fig.A.I.1 DC Offset Measurement Fixture