SERVICE MANUAL

T1.5K(S) 110V

WARNING

(For qualified service personnel only)

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

CAUTION

1. After opening the cover, please always check the tightness of all wires, connectors, and screws first. Then check if there is any decolored components inside.
2. DO NOT make internal batteries short-circuited.
3. If the battery connectors (P5, P6) are disconnected, be sure to plug in the input power cord and the input power is available before re-connect the battery connectors.
4. After service, verify the polarity of batteries, the tightness of all screws and connectors before restarting the UPS.

STEPS TO OPEN THE CASE

PLEASE FOLLOW THE STEPS TO OPEN THE CASE

I.INTRODUCTION

For all series of UPS, they are strictly tested and carefully designed. We always do our best to make our products more reliable and safer, this is also the goal of our company. However, due to the lifetime of electrical components and some unpredictable reasons, there will be unavoidable failures of this UPS. If this situation occurs, service of qualified person 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 met.

Because of the following unique features of T1.5K(S) UPS (Uninterruptible Power System), it is very easy to maintain and service.

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

This service manual consists of 4 major parts:

1. Introduction.
2. Principle of operation: It describes the functions and principles of each part.
3. Alignments: It describes the locations and methods needed to adjust this UPS.
4. Trouble shooting: This part describes the possible failure conditions and procedures to repair it.

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

II. PRINCIPLE OF OPERATION

1. INTRODUCTION

This 1KVA high input power factor UPS system contains two major pcb assemblies. They are including :

1. PSDR:	contains major parts of (1) charger, (2) DC power supply, (3) unit power factor correction, (4) DC-DCconverter, (5) inverter and (6) output circuits.
2. CNTL :	contains major parts of protection, signaling circuits, regulation and control circuits of inverter

The simplified schematics in figure 1 shows how the major circuits are connected and illustrates the overall system functions. The locations of these assemblies in this machine are shown in figure 2.

The block diagram in figure 3, shows the UPS at normal operation from left to right. When a protection circuit is triggered or a fault condition occurs, the output supply is transferred immediately from inverter to AC mains by a bypass relay. The operation principle will be explained in later section.

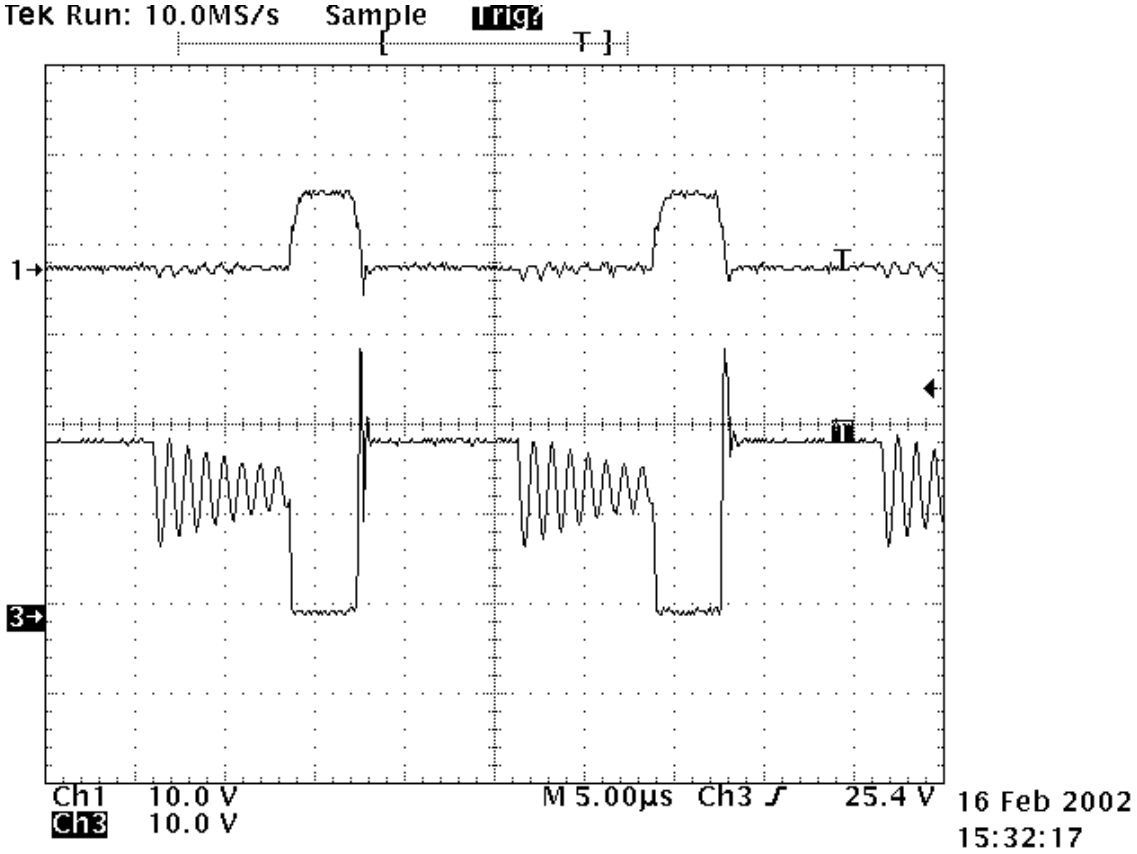
Basically, this ON-LINE UPS system utilizes high frequency PWM techniques to achieve high efficient performance. This UPS can deliver a clean, regulated sine-wave output at any load under full load. The sub-systems are described as below:

III. POWER STAGE (PSDR)

The power stage consists of charger, unit power factor correction, DC power supply, DC-DC converter, inverter and output circuits. figure 4 shows the block diagram of power stage.

i.CHARGER SUB-SYSTEM:

The purpose of charger is to charge and to maintain the batteries at full charged condition. Refer to figure 5, the voltage flyback switching power supply provides a constant DC voltage (54.9Vdc) for batteries. Besides providing constant voltage, the power supply also limits the current flowing into batteries and therefore protects and prolongs the life time of charged batteries.



CH1 Vgs CH2 Vds

ii. DC POWER SUPPLY SUB-SYSTEM:

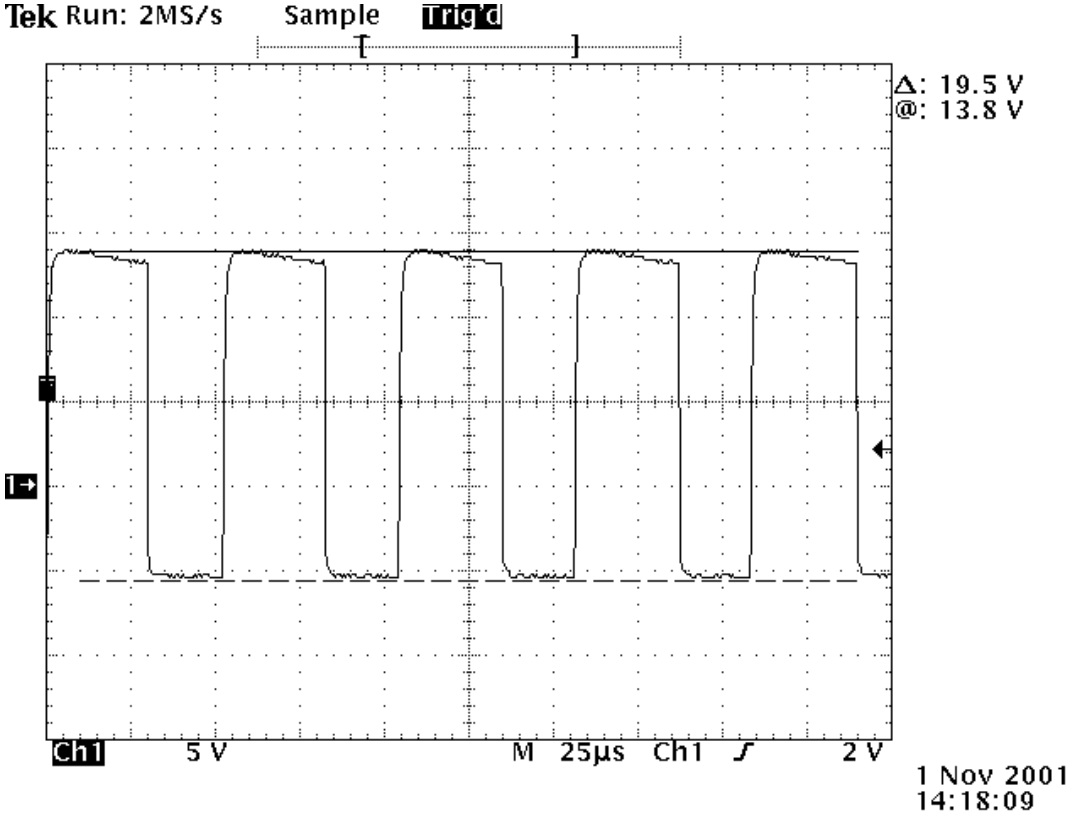
The input of the DC power supply is connected to the battery bus, i.e., the output of the charger. The output of DC power supplies provide +12 Vdc for the bias supply of IC's working voltage and the fan(s) voltage. 5V is used for IC's working voltage. The DC

power supply works only when the 12 Vdc regulator supplies Vcc to its control IC. To have proper operation of 12 Vdc regulator, its input power is controlled by the switch as indicated in figure 6.

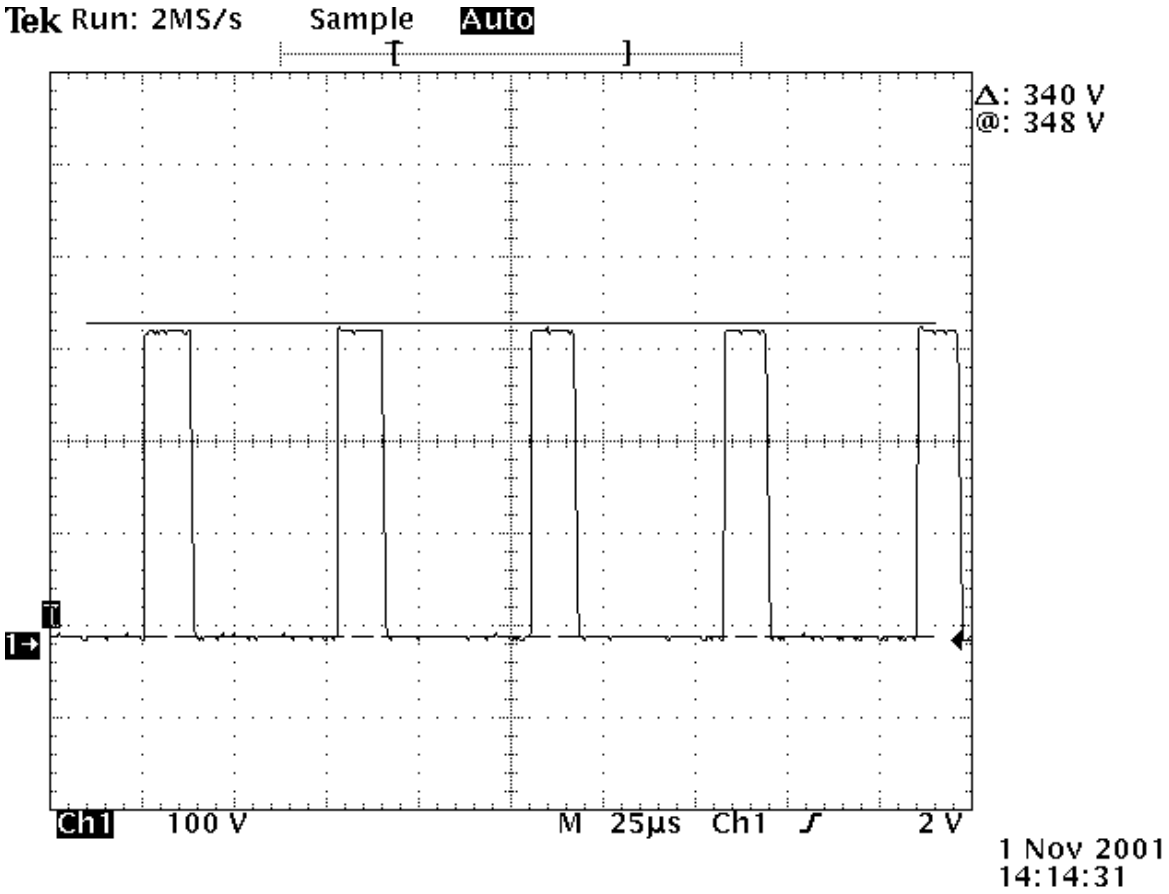
iii.INVERTER SUB-SYSTEM :

The UPS transfers + , - DC bus voltages to the AC output voltage through an inverter of half bridge configuration at normal operation. The schematic diagram of inverter is shown in figure 7.

To construct a high frequency PWM inverter, the drivers receive switching signals from PWM generation circuit through a pair of photo-couplers to trigger the upper IGBT and the lower IGBT alternately. The output of IGBT's is filtered by an LC circuit to reduce the o/p voltage harmonics distortion.



CH1 Vgs



CH1 Vds

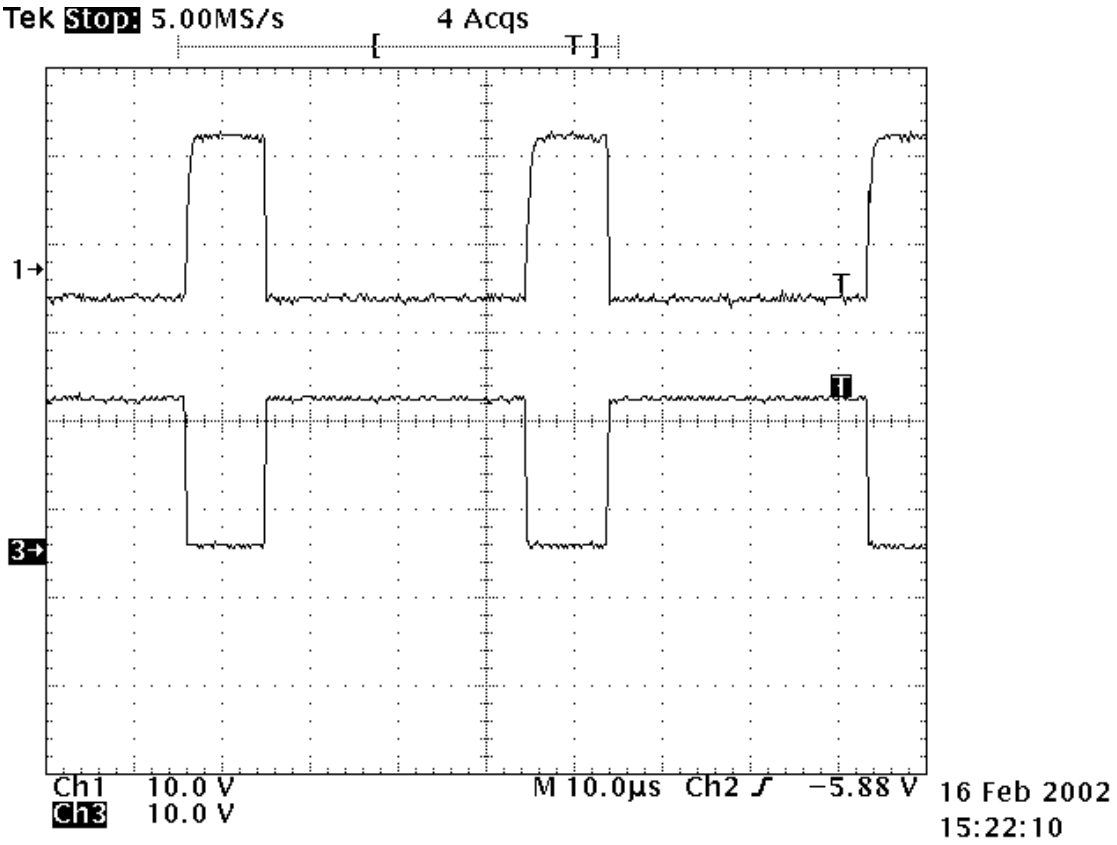
iv.OUTPUT SUB-SYSTEM :

The bypass relay receives signal from control circuit to switch the output of the UPS from bypass to inverter, and vice versa. The output noise filter circuit blocks EMI noise to the loads.

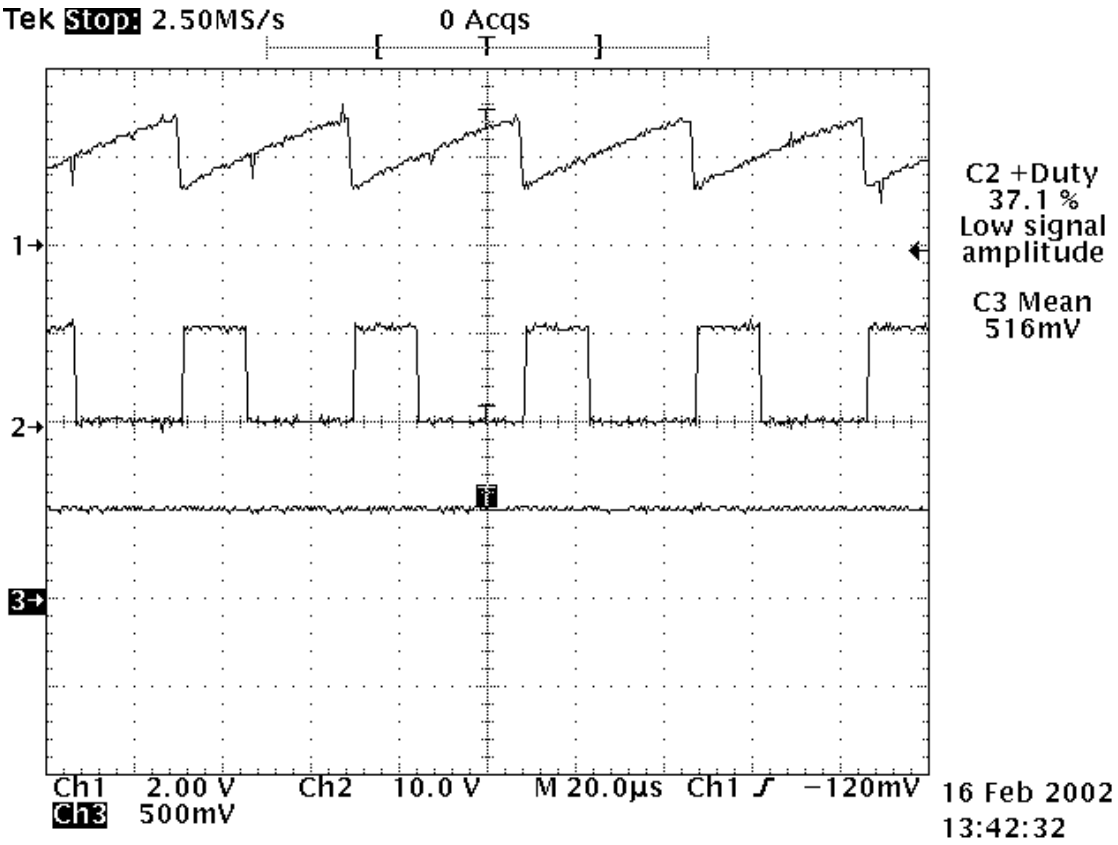
v.INPUT POWER FACTOR CORRECTION SUB-SYSTEM :

The purpose of power factor correction (P.F.C.) circuit is to make the input current and voltage in phase and therefore achieve a high input power factor. The schematic is indicated in figure 8.

When the input AC power cord is plugged in, the AC relay is activated and the AC power goes through noise filter to the charger and to the line detector. Both DC buses present voltages at about 1.4 times of input RMS voltage. When the "on" switch is pressed, the P.F.C. circuit is enabled and the DC buses are regulated at for 110VAC series.



CH1 Vgs CH2 Vds

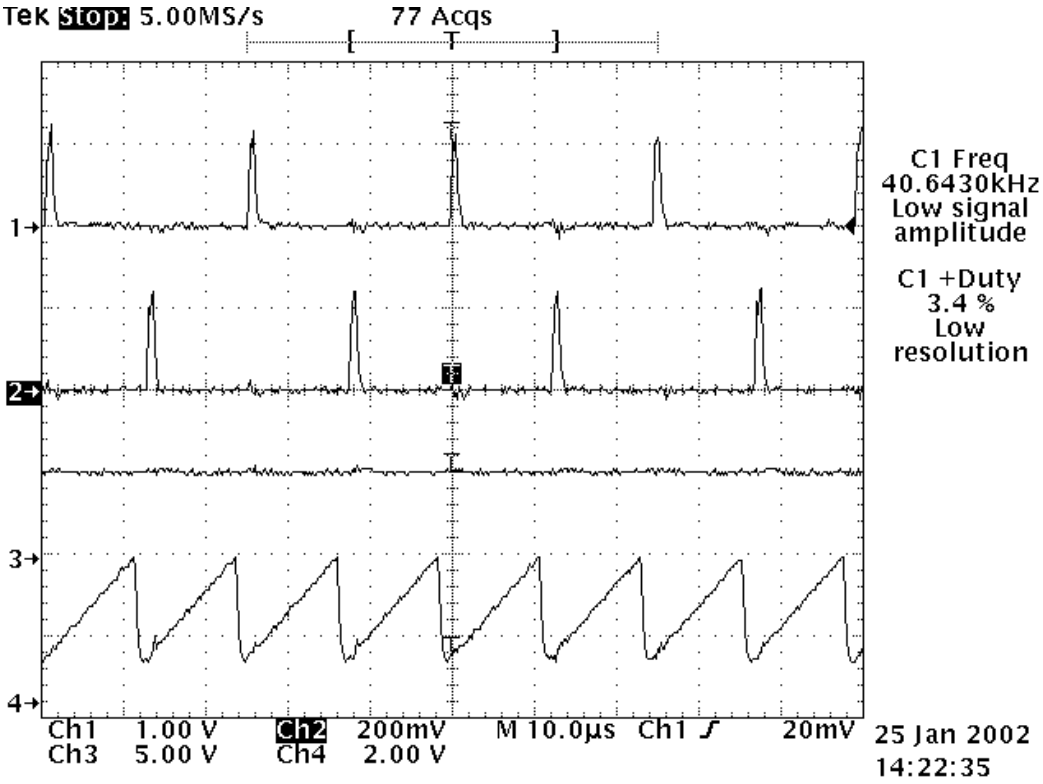


CH1 3854PIN14 CH2 3854PIN16 CH3 3854PIN9

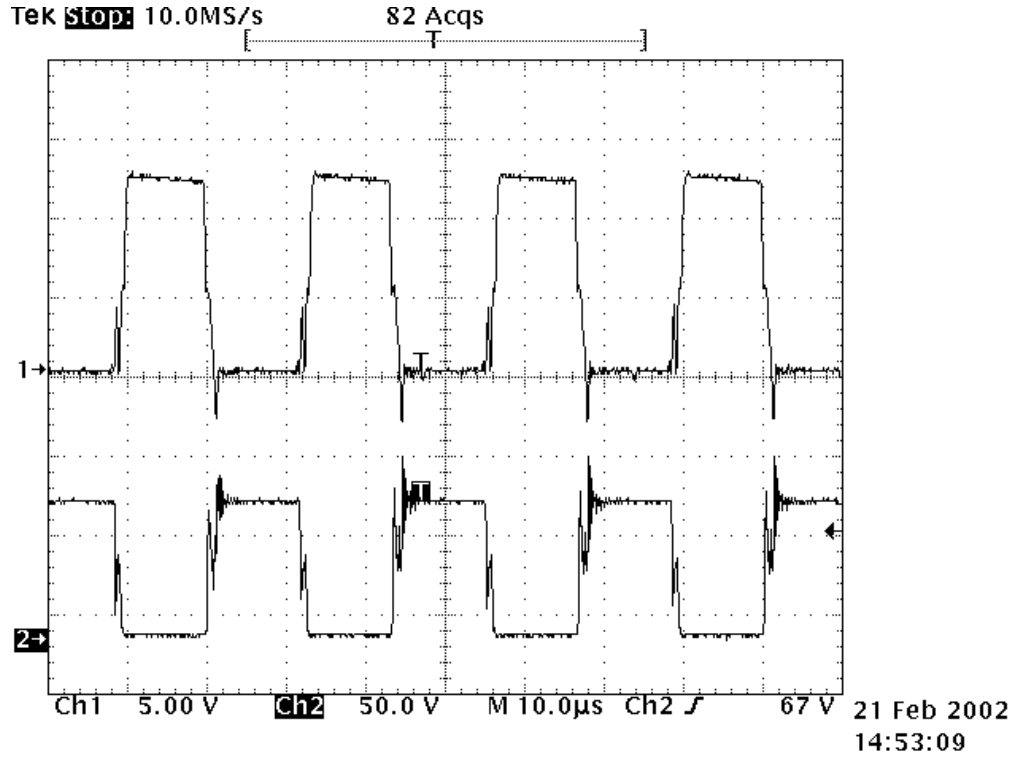
vi.DC-DC CONVERTER SUB-SYSTEM :

The major function of the UPS is to deliver accurate AC power to the loads connected to it whenever the AC line is correct or fails. In this system, the batteries release the stored energy to supply inverter immediately upon AC line fails.

Refer to figure 9, the battery voltage is transformed through a push-pull DC-DC converter to ± 170Vd as DC buses for inverter. When the line fails, the ± 170Vdc DC sources are caught up to supply the power needed by the inverter immediately.



CH1 3525PIN11 CH2 3525PIN14 CH3 3525PIN16 CH4 3525PIN5



CH1 Vgs CH2 Vds

1.MAIN CONTROL PCB ASSEMBLIES (CNTL)

These assemblies are the control center of UPS. It is composed of three major circuits as following.

(1) Regulation & control

(2) Protection

(3) Signaling

i.REGULATION & CONTROL SUB-SYSTEM :

This portion can be seen as brain of the UPS. It provides the control pulses to the switching elements which deliver power to the output. The sub-system also regulates the output to ensure that the UPS is delivering constant AC voltage to the loads.

The inverter signal is sensed directly by resistor division. It is compared with a reference signal from sine wave generator. The difference of these two signals (error signal) alter the pulse widths of PWM signals which control the duty cycles of switching elements to regulate the output voltage within specification.

In order to avoid un-wanted surge current at the transfer of bypass relay, the bypass signal activates the tracking circuit. It matches the inverter voltage with the line voltage by having the amplitude of the reference signal following the variation of line voltage.

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

ii.PROTECTION SUB-SYSTEM :

The UPS provides the following protection circuits :

1. Overload protection

The load detector senses the load current. i.e. the inverter current, and sends the signal by two paths. In battery mode, the UPS will go to failure mode if overload condition happened. The panel will indicate the fault condition.

A.The UPS collects the continuous overload signals through CPU switch the bypass relay. If the output load is 110% of rated load(VA ,or Wattage) the UPS keeps running on inverter running for seconds.

If the output load is higher than 130% of rated load, the UPS transfers to bypass immediately.

B.When output loads sink a high surge current , a high inverter current is detected and the inverter switches, i.e. the IGBT's, are turned off pulse by pulse to protect themselves from thermal runaway. The bypass relay stays at inverter output position unless a continuous overload is detected or an abnormal inverter operation occurs.

2. Battery over or under shut down

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

In case of the battery voltage is high voltage, the UPS will discharge the battery capacity by way of DC-DC coverter to ensure the battery life. The panel will indicate the fault condition.

3. Inverter output abnormal protection

The inverter failure signal shuts down the inverter immediately, makes the buzzer a continuous alarm, and lights "FAULT" LED. The panel will indicated the fault condition.

" The failure signal latches itself unless SW off or battery is empty".

4. Over temperature protection

The thermal switch detect the temperature of PSDR heatsink. The thermal switches are electrically connected to the CPU. An opened thermal switch is thought as temperature failure by the UPS. The panel will indicated the fault condition.

5. Bus overvoltage protection

To protect any BUS overvoltage condition especially for the half-bridge load. The panel will indicated the fault condition.

iii.SIGNALING SUB-SYSTEM :

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

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

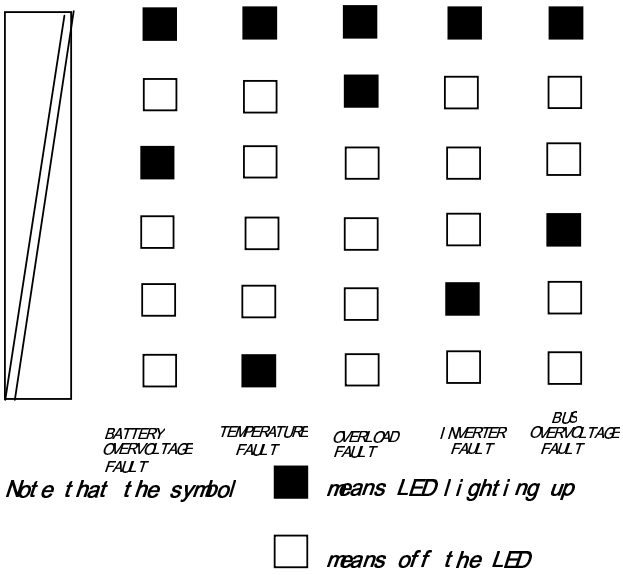
Remote shutdown signal is enabled only when the line fails. The signal is connected to the battery detector. It generates battery-under signal to cut off the bias power supply of the UPS system.

2.FRONT PANEL :

The front panel consists 2 parts: push bottom and display LED set.

The push bottom is used to turn on and off the UPS. LED display indicates the load level (battery mode indicates the battery voltage level) and operation status of the UPS. Line LED indicates AC line is normal.If the line LED flash, it warns the power souce is bad. Bypass LED indicates bypass is active. Inverter LED indicates inverter is working and Fault LED indicates the UPS is in fault condition.

Besides, when the system works abnormally, the fault LED will light up and the buzzer will beep continuously. In this situation, the panel LED will indicate which part inside the UPS is out of order. The representations of fault conditions are listed as following:



IV. ALIGNMENTS

PCB	TEST	TEST POINT	TEST AND ADJUSTMENT SEQUENCE	EXPECTED RESULT
PSDR	DC(+) BUS	R58(+) (GND)	1.Connect DVM (DC) to test points and connect I/P ac power cord, then turn on the switch.	+170VDC±5V
	DC(-) BUS	R53(+) (GND)	1.Connect DVM (DC) to test points and connect I/P ac power cord, then turn on the switch.	-170VDC±5V
CNTL	CURRENT BALANCE	O/P OUTLET	1.Connect test circuit as figure. 2.Connect DVM (DC) to test points and connect I/P AC power cord, then turn on the switch. 3.Disconnect I/P power cord when INV. LED is light and BYPASS LED is off. The buzzer will beep for every 4 seconds. 4Auto-Balance.	±300mV DC

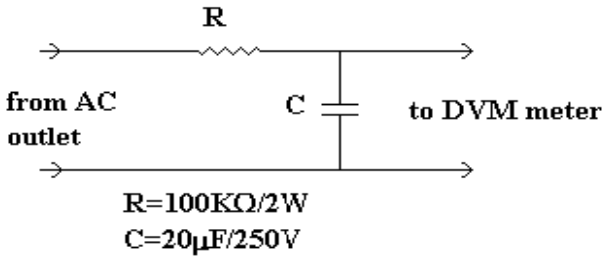


Figure IV-1 : Circuit for test output balance

V. TROUBLE SHOOTING

For the reason of safety, you must unplug the power cord and disconnect the batteries from UPS (unplug theP5 andP6).

Check the components listed below to confirm which block is out of order and follow the procedures listed on the following pages to repair them.

CAUTION: **DO NOT** supply UPS with the mains unless you are sure that you have replaced all defective components.

1. OVERVIEW :

Circuit Block	Components to be checked	Fail condition
FUSE	F1,F2,F3	short or open
U.P.F. Correction	D13, D18,REC1,Q14	short or open
Push-Pull Booster	Q4,Q6 Q10,Q11	D-S short or open
	D11,D12, D23, D24	short or open
Inverter	Q12,Q13	D-S short or open
Charger	Q8	D-S short or open
	D5, D6	short or open
DC Power Supply	Q620	D-S short or open

2. U.P.F. CORRECTION:

Step	Checked components	*Instrument function	Reference Value	Failed condition
1	F3	Ω	short	open
2	Q14 (D,S)	DIODE	0.46	short or open
3	D13, D18	DIODE	0.44	short or open
4	R52	Ω	47	open or value change
5	REC1(+, ~),(~ ,-)	DIODE	0.46	short or open
6	C51, C52,C73,C68	Ω visual	open	short deformed

3. PUSH-PULL DC-DC CONVERTER:

Step	Checked components	*Instrument function	Reference Value	Failed condition
1	F1,F2	Ω	short	open
2	Q4,Q6,Q10,Q11 (D,S)	DIODE	0.47	short or open
3	R7, R11, R77, R73	Ω	10	open
4	D11,D12, D23, D24	DIODE	0.41	short or open

* The instrument is D.M. (digital multimeter).

4.DC/AC INVERTER:

Step	Checked components	*Instrument function	Reference Value	Failed condition
1	F1,F2,F3	Ω	short	open
2	Q12,Q13 (D,S)	DIODE	0.47	short or open
3	R56, R50	Ω	10 Ω	open

5.DC POWER SUPPLY :

Step	Checked components	*Instrument function	Reference Value	Failed condition
1	Q620	DIODE	0.47	short or open
2	R18	Ω	47	open
3	R23,R23A	Ω	0.75	open
4	U601 (3845) PIN 5-6 5-7 5-8 6-8	Ω	>1M >1M 3.5k >1M	too low

6.AC/DC CHARGER :

Step	Checked components	*Instrument function	Reference Value	Failed condition
1	Q8	DIODE	0.49	short or open
2	R42	Ω	47	open
3	R45,R45A	Ω	<0.75Ω	open
4	U501 (3845) PIN 5-6 5-7 5-8 6-8	Ω	45k >1M 3.5k 53.5k	too low
5	D5, D6, D14, D48	DIODE	0.57	short or open
6	C29, C12	Ω visual	open	short deformed

After you have replaced all defect components on power stage (PSDR) , connect with control board. Supply DC voltage48VDC/3Amp (limited current) with DC power supply via P5+ and P6-. Turn on the switch on panel, you will see "current limit" on the DC power supply for about 2 seconds (If not, there are some defective components you have not found).

When everything seems good, turn off the switch on panel and remove DC power supply. Plug in the power cord and supply UPS with the mains. Test the output of charger (P5+,P6-). Is it 54.9VDC.The fan will also active. If there is no problem in charger, connect the batteries via P5, P6.

Finally, turn on the switch on panel again and follow the procedure listed in part III (Alignment) to adjust the DC offset, and measure voltage on DC bus, output voltage.

CAUTION: **DO NOT** supply UPS with the mains unless you are sure that you have replaced all defective components

VI. APPENDIX I : SCHEMATICS

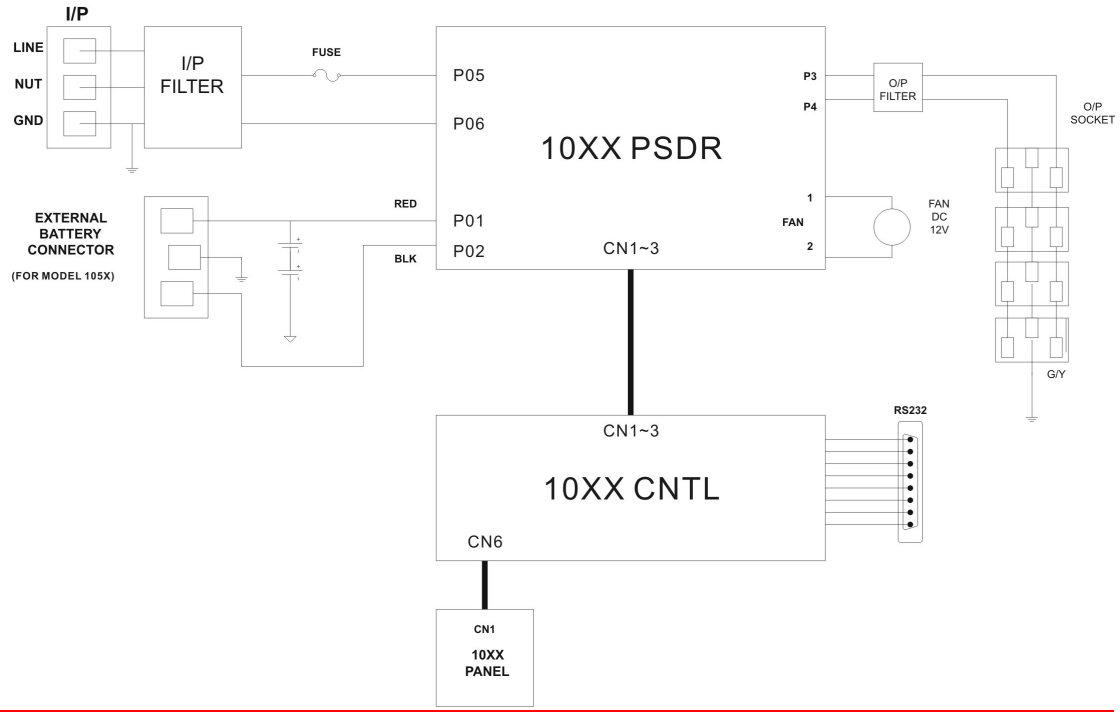
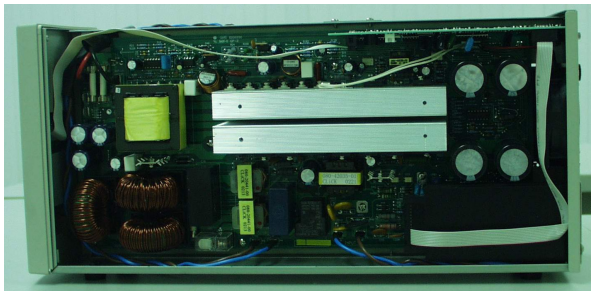


Figure 1 : System schematic diagram



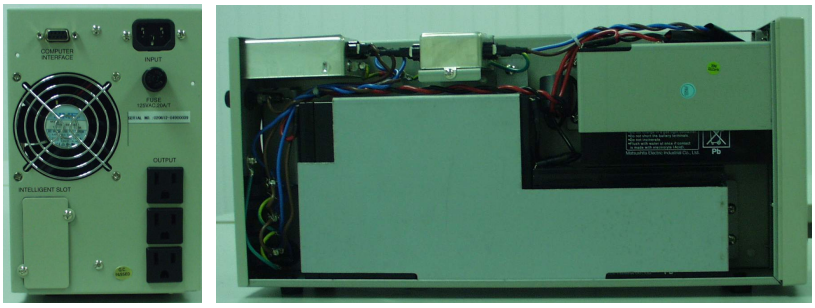


Figure 2 : Sub-assembly location

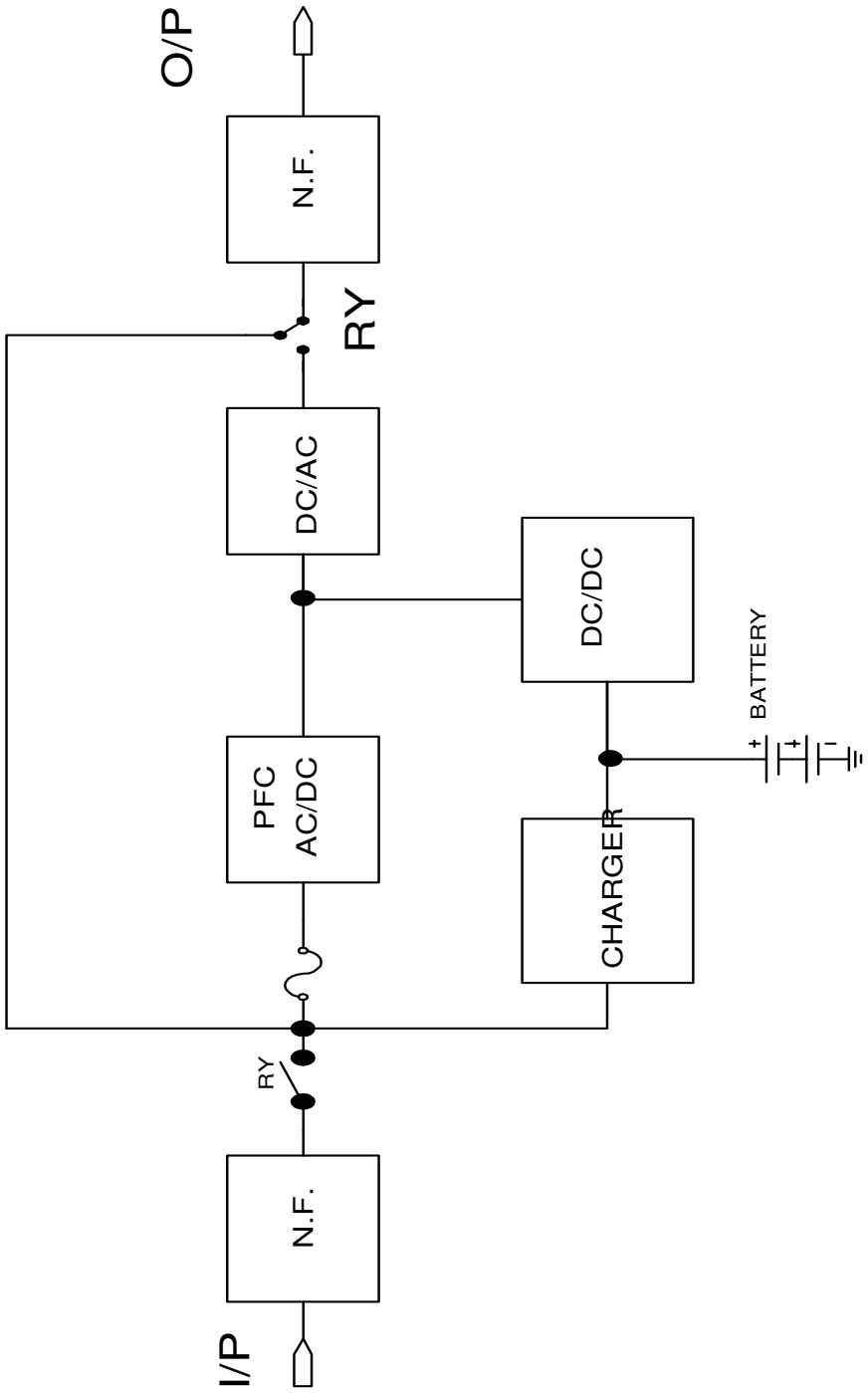


Figure 3 : block diagram

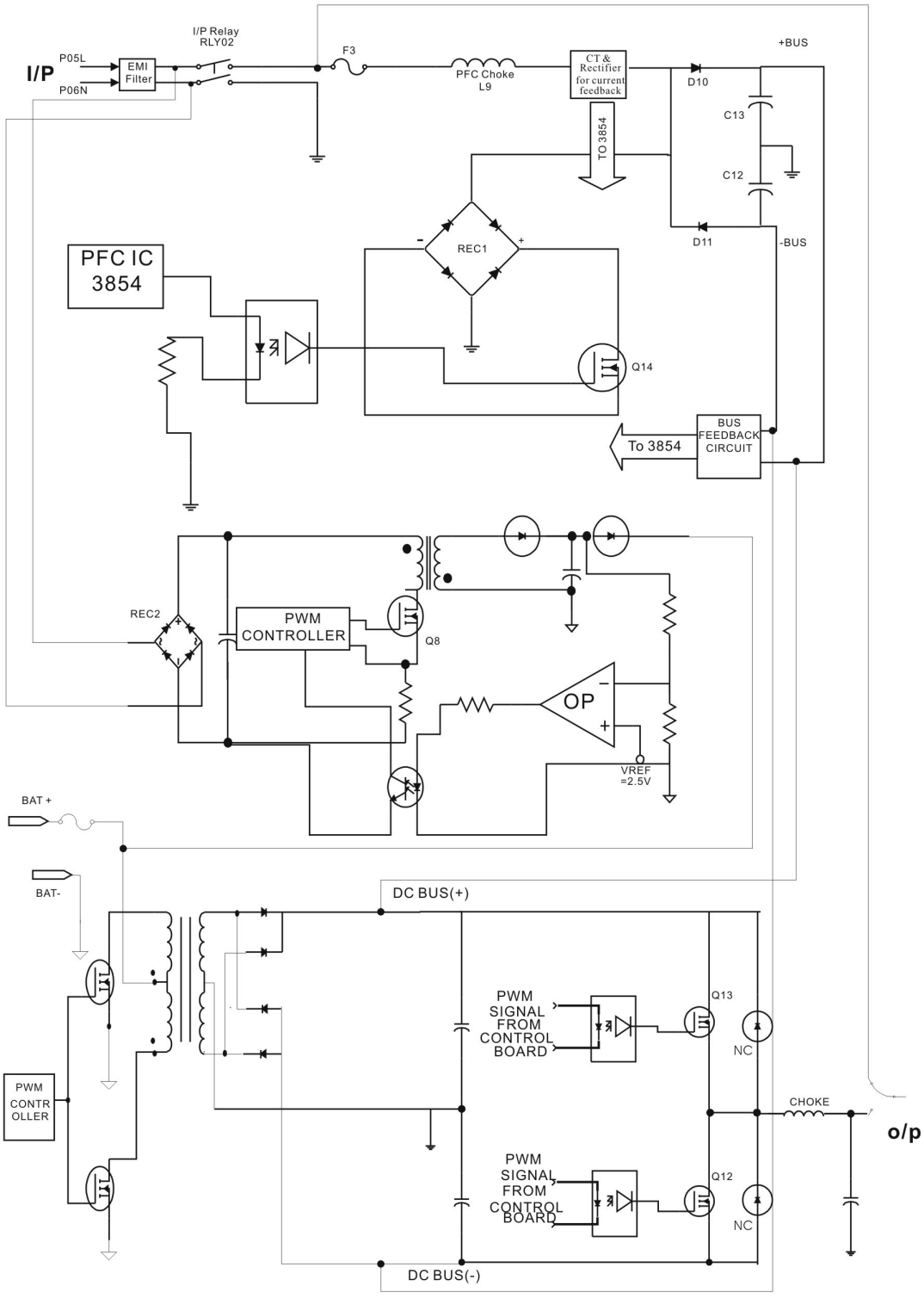


Figure 4 : PSDR functional diagram

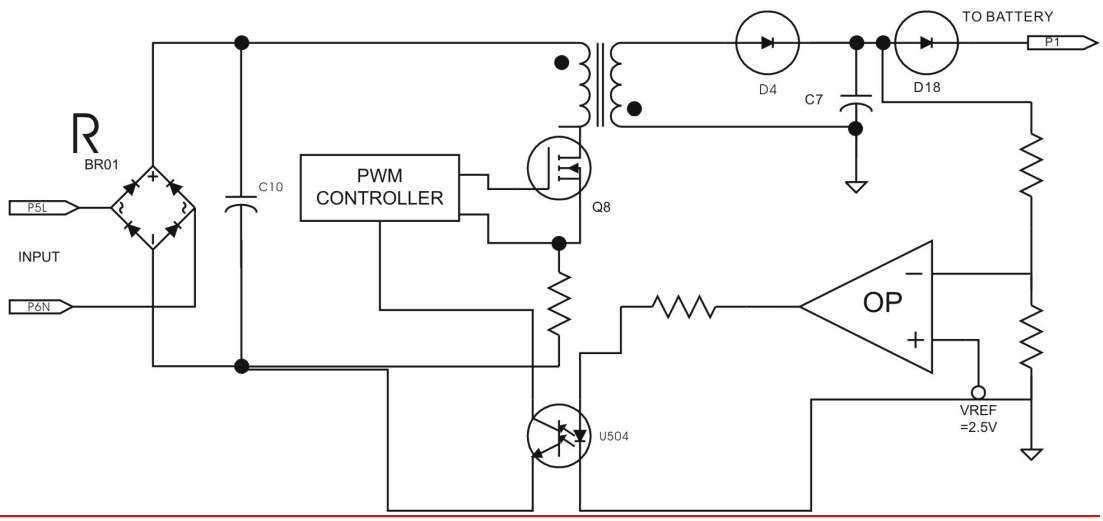


Figure 5 : Charger circuit

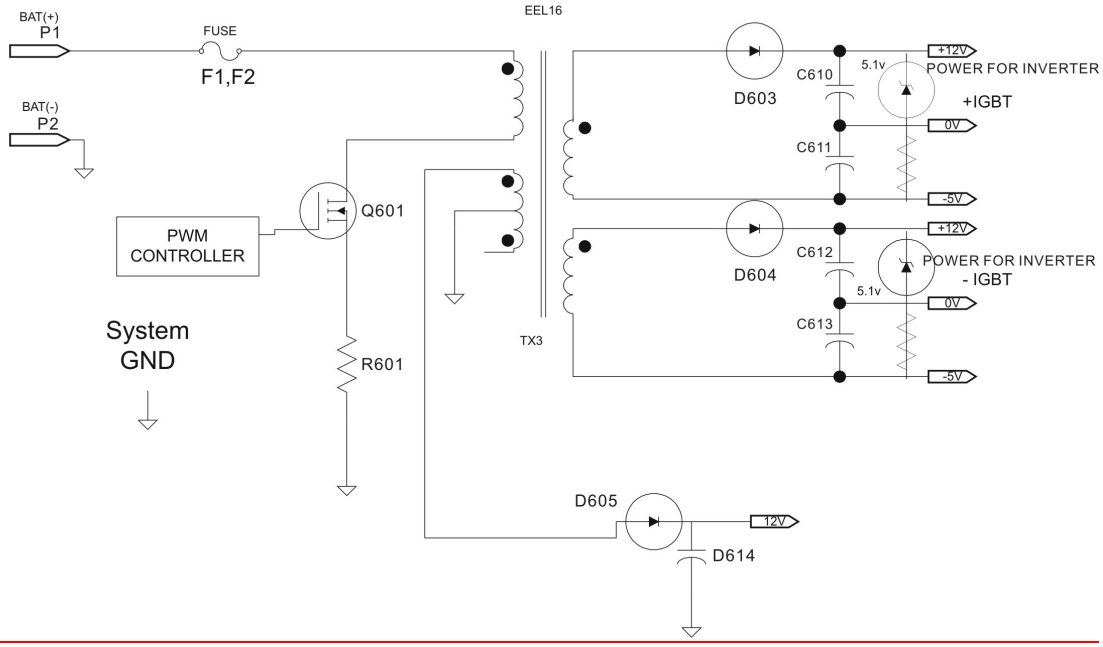


Figure 6 : DC power supply circuit

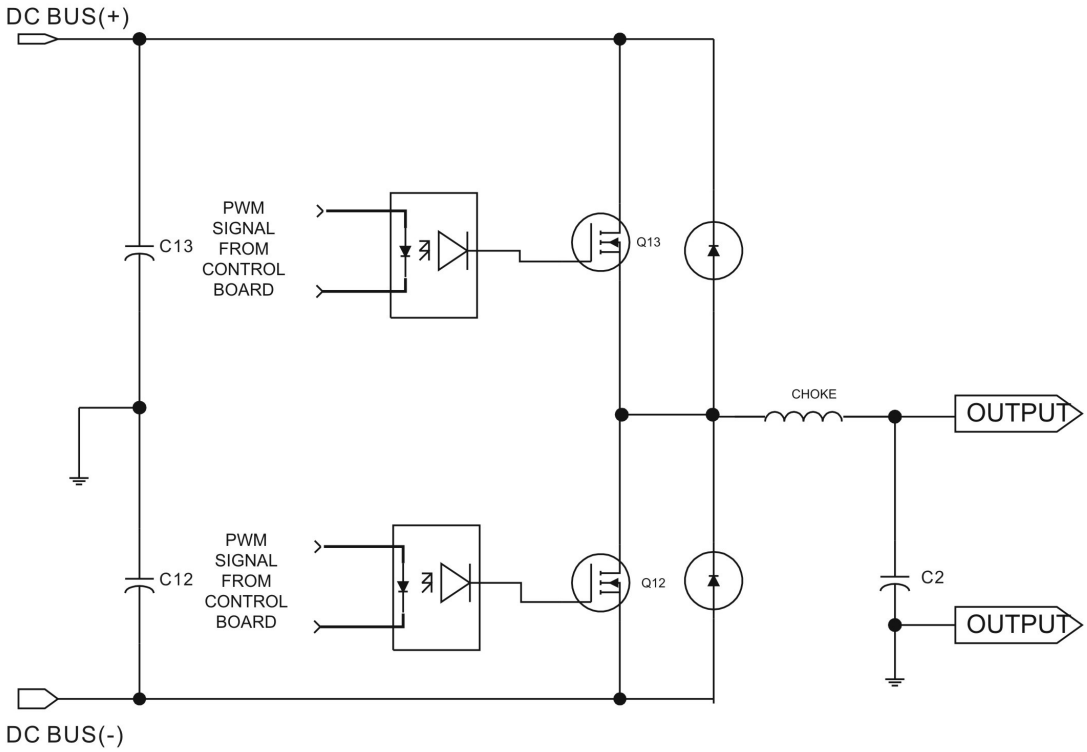


Figure 7 : Inverter circuit

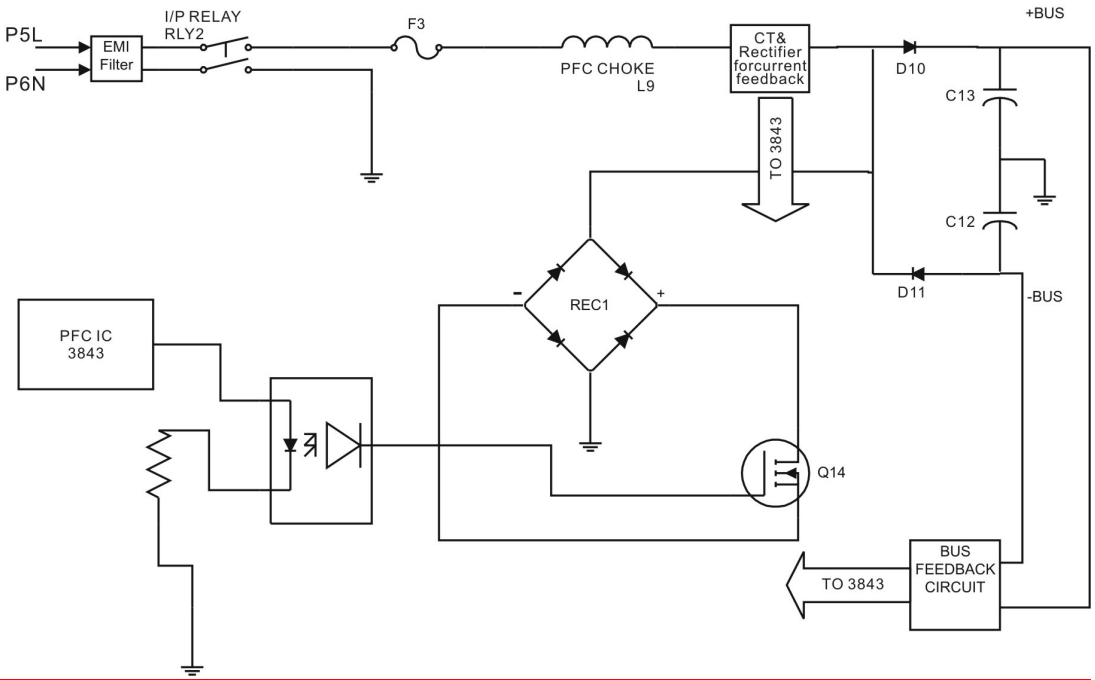


Figure 8 : Input power factor correction circuit

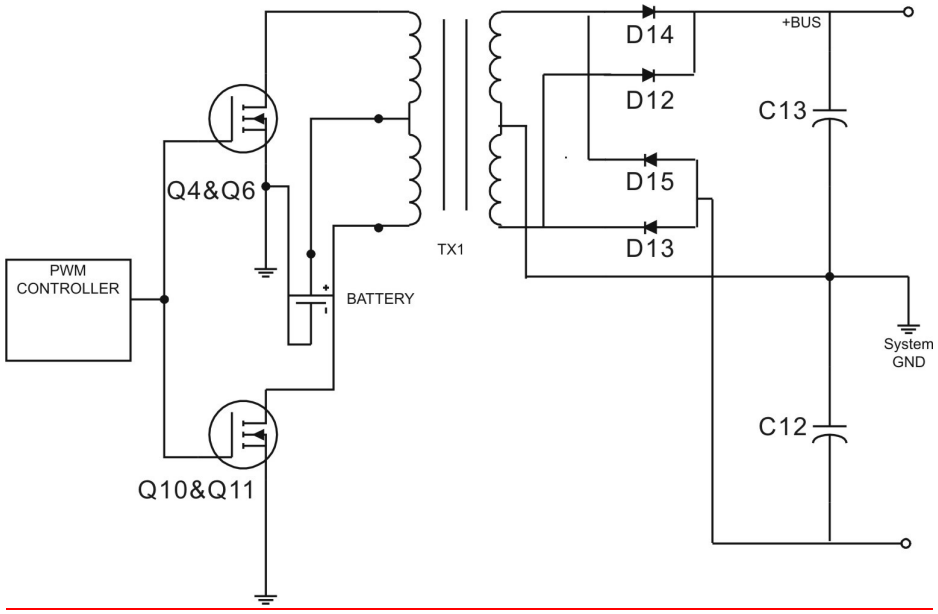


Figure 9 : DC -DC circuit

I.APPENDIX II : COMMUNICATION

i.1. RS232

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

PIN TYPE .....: female

BAUD RATE ..... : 2400 bps

DATA LENGTH ..... : 8 bits

STOP BIT ..... : 1 bit

PARITY ..... : NONE

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

PIN #	Description	I/O type
1,4,6,7,8,9	not connecteed	
3	UPS RS232 receiver Rx from computer.	input
2	UPS RS232 transmitter to computer	output
5	GND	
9	Wake Up	Input

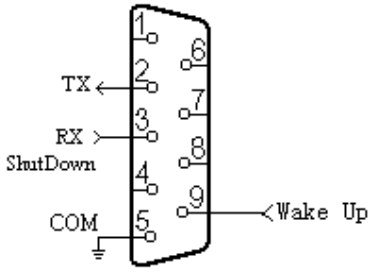


Figure VI-1 : RS232 connection