



Voltronic Power

Advancing Power

Axpert MKS-4000/KS-5000 Service manual

Axpert MKS Charger/ Inverter

Service manual

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Table of contents

1.	General information	4
1.1	Getting start.....	4
1.2	Important safety instructions	4
2.	Functional block	6
3.	Working principle of the major functional block	7
3.1	Switch Power Supply	7
3.2	DC TO DC dual converter (Full bridge converter).....	8
3.3	Inverter (Full bridge)	8
3.4	Buck converter.....	9
3.5	MPPT solar charger	9
4.	Functional explanations for each PCB.....	11
4.1	Main board	11
4.2	Cntl board.....	11
4.3	SCC board	11
4.4	COMM board	12
4.5	LED board	12
4.6	MPPT board.....	12
5.	Interface.....	12
5.1	LED Indicator	12
5.2	LCD Display Icons	14
6.	Troubleshooting.....	17
6.1	Fault Reference Code	17
6.2	Warning Indicator	18
6.3	Trouble shooting according to fault indication	18
6.4	Quick start	20
7.	Test Step.....	23
8.	Electrical specification.....	24
Table 1	Line Mode Specifications	24
Table 2	Invert Mode Specifications.....	25
Table 3	Charge Mode Specifications.....	26
Table 4	General Specifications.....	26
Charging Controls.....		26

1. General information

1.1 Getting start

This manual is for Axpert MKS 4KVA-5KVA series, it can help service personal perform the basic maintenance and repair service.

This manual focus on the service, so you should get the basic operation of the Inverter/Charger from the user manual, and make sure you had read and understood user manual before you use this service manual.

The manual include 8 sections, as follows

- General Information, this section show you the general information of the service manual
- Functional Block, this section show you the major functional block of the Inverter/Charger
- Working Principle of the major Functional Block, this section show you the major functional block
- Function explanations for each PCB, this section show you all the PCBs of the Inverter/Charger
- Interface, this section show you the LCD interface, include display and setting
- Trouble shooting, this section will give you the way to find the trouble
- Test step ,this section tell you how to test the Inverter/Charger after you repair the unit
- Electric Specifications, this section show you the basic electric specification of the Inverter/Charger

1.2 Important safety instructions



WARNING: This chapter contains important safety and operating instructions. Read and keep this manual for future reference.

1. Before using the unit, read all instructions and cautionary markings on the unit, the batteries and all appropriate sections of this manual.
2. **CAUTION** --To reduce risk of injury, charge only deep-cycle lead acid type rechargeable batteries. Other types of batteries may burst, causing personal injury and damage.
3. Do not disassemble the unit. Take it to a qualified service center when service or repair is required. Incorrect re-assembly may result in a risk of electric shock or fire.
4. To reduce risk of electric shock, disconnect all wirings before attempting any maintenance or cleaning. Turning off the unit will not reduce this risk.
5. **CAUTION** – Only qualified personnel can install this device with battery.
6. **NEVER** charge a frozen battery.
7. For optimum operation of this inverter/charger, please follow required spec to select appropriate cable size. It's very important to correctly operate this inverter/charger.
8. Be very cautious when working with metal tools on or around batteries. A potential risk exists to drop a tool to spark or short circuit batteries or other electrical parts and could cause an explosion.
9. Please strictly follow installation procedure when you want to disconnect AC or DC terminals.

Please refer to INSTALLATION section of this manual for the details.

10. Fuses (40A, 32VDC *4pcs for 1KVA/2KVA and *6pcs for 3KVA) are provided as over-current protection for the battery supply.
11. GROUNDING INSTRUCTIONS -This inverter/charger should be connected to a permanent grounded wiring system. Be sure to comply with local requirements and regulation to install this inverter.
12. NEVER cause AC output and DC input short circuited. Do NOT connect to the mains when DC input short circuits.
13. **Warning!!** Only qualified service persons are able to service this device. If errors still persist after following troubleshooting table, please send this inverter/charger back to local dealer or service center for maintenance.

2. Functional block

Axpert MKS 4KVA-5KVA series production employ a double conversion topology, comprise following functional blocks, as shown in figure 2.1.

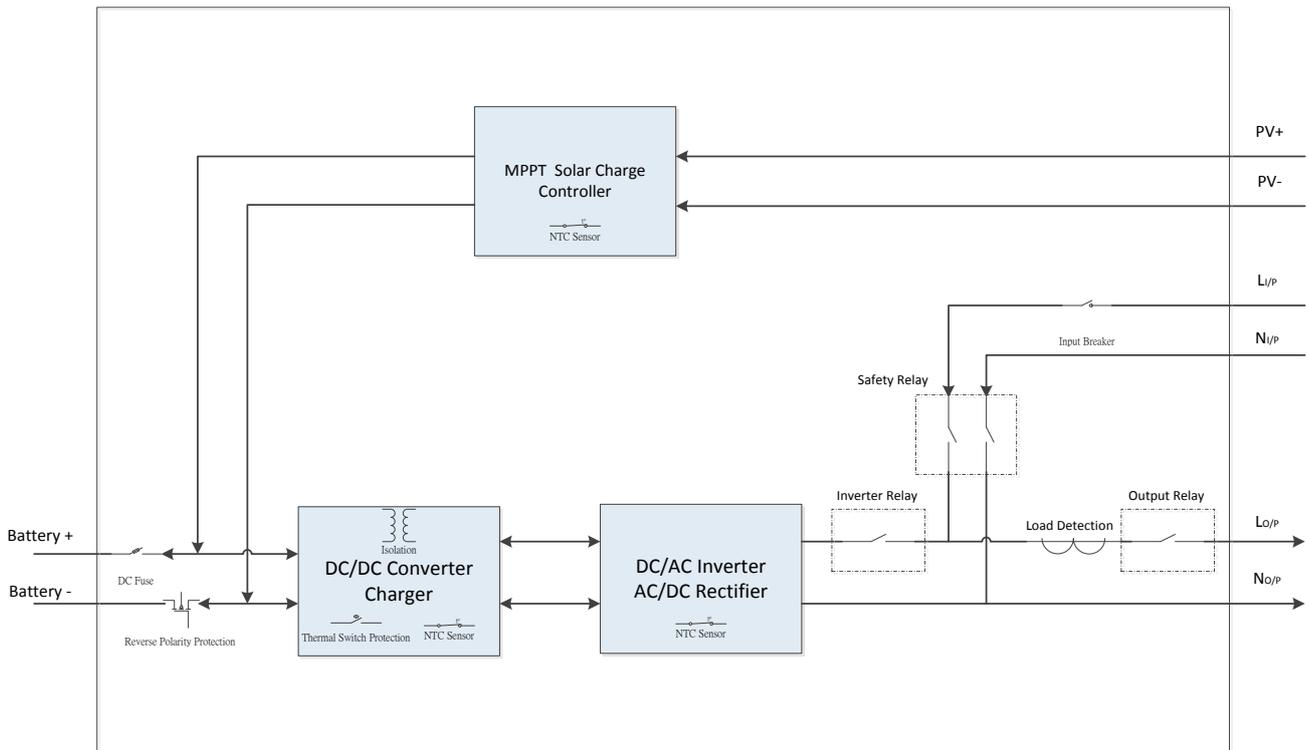


Figure 2.1 function block diagram

3. Working principle of the major functional block

3.1 Switch Power Supply

The switch power supply (SPS) supplies DC power for Inverter/Charger operation. The input voltage of the SPS is the battery or AC Charger output voltage.

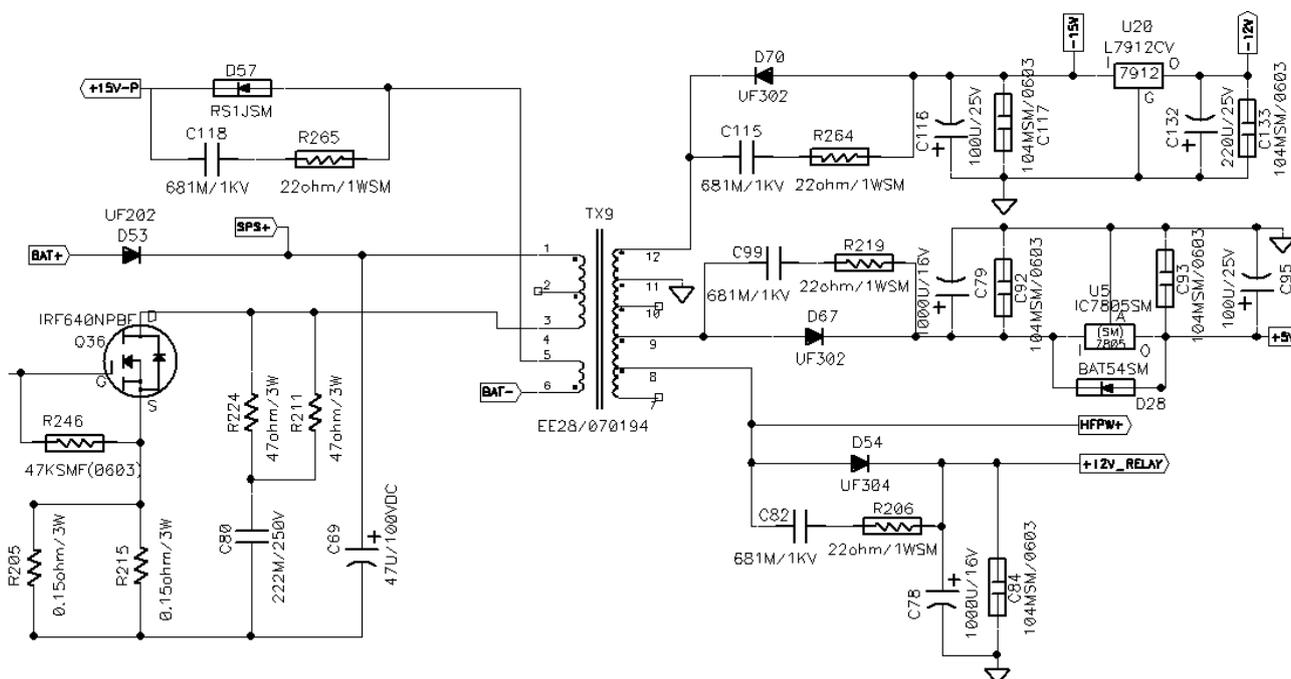


Figure 3.1 basic circuit of power supply

This is the fly-back DC-DC converter, fly-back operation can be easily recognized from the position of the dots on the transformer primary and secondary (these dots show starts of the winds). When Q36 is ON, the dot ends of all winds are negative with respect to their no-dot ends. Output rectifier diodes D54, D57, D67 and D70 are reverse-biased and all the output load currents are supplied from storage filter capacitors C78, C75, C79 and C116. The primary coil of the transformer acts as an inductor and stored energy.

When Q36 is OFF, the stored energy in the primary coil is delivered to secondary filter capacitors C78, C75, C79 and C116.

As shown in figure 3.1, this circuit may generate several output voltage, such as +12V, -12V, +15V, +5V, HFPW+.

3.2 DC TO DC dual converter (Full bridge converter)

The full bridge topology is a transformer isolated forward-mode regulator. Unlike the Fly-back transformer, the push-pull transformer does not store any energy and output current is drawn when either power switches (S1-S4 or S2-S3) is conducting. P1 is the battery, P2 is the BUS

This is dual converter, it means that battery can feed power to BUS and also BUS can charge the battery. And it is an open loop control: the transformer N1:N2 is 1:8, when the battery voltage is transformed through the converter to more than the BUS voltage, the battery discharge power to the BUS, or the BUS can charge the battery.

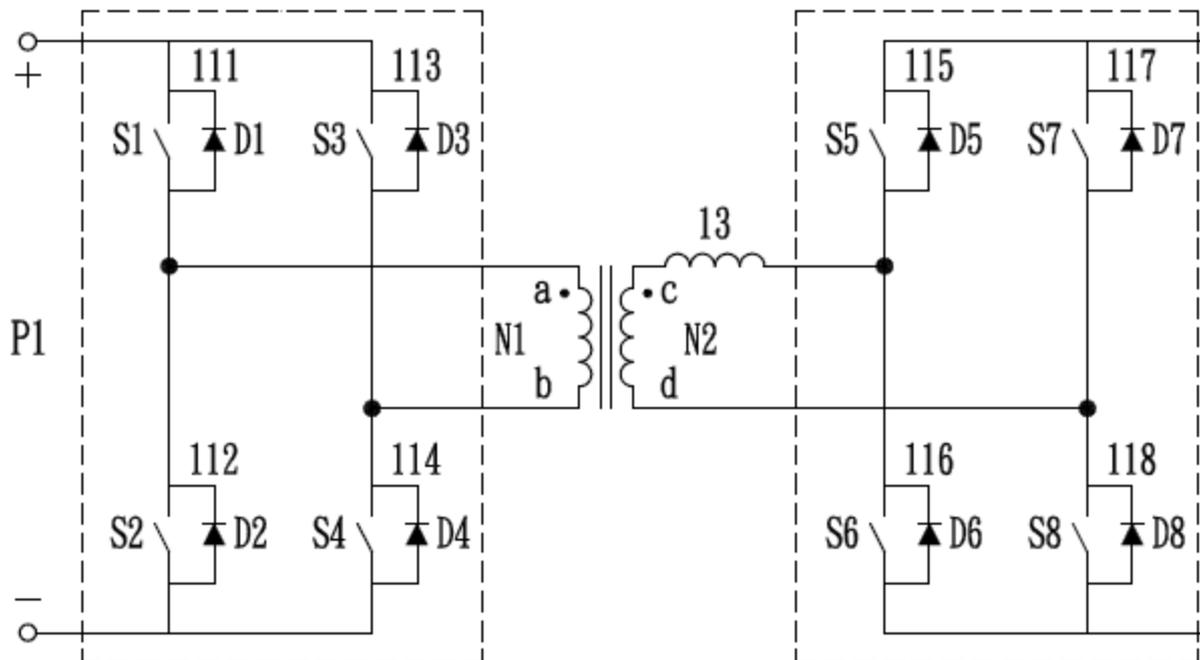


Figure 3.2 DC TO DC dual converter

3.3 Inverter (Full bridge)

The Inverter circuit (Figure 3.3) and PWM control are can both active under battery mode and line mode. In line mode, the inverter can convert power from grid to BUS for charging. The Inverter circuit of Axpert series is based on a full-bridge circuitry and its output is driven by photo-couplers. The photo-couplers are capable to drive high energy and high speed power of MOSFET and IGBT with independent high and low referenced output channels.

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.

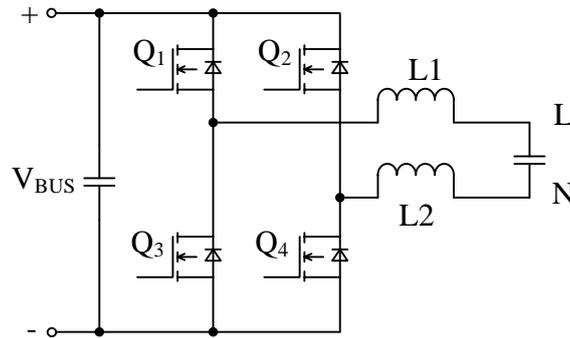


Figure 3.3 Full-bridge topology

3.4 Buck converter

The Buck circuit (Figure 3.3) is active only when the line charging the battery. When the battery is discharging, S12 is ON, and S10 is OFF, D10 is reversed cut off, L15 is used as a filter inductor.

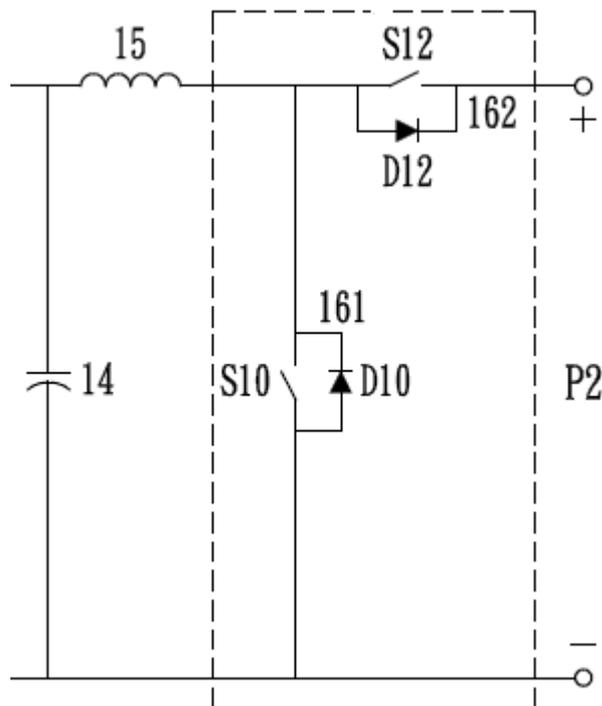


Figure 3.4 Buck topology

3.5 MPPT solar charger

It employed an interleave buck converter, comprise following functional blocks, as shown in figure as below.

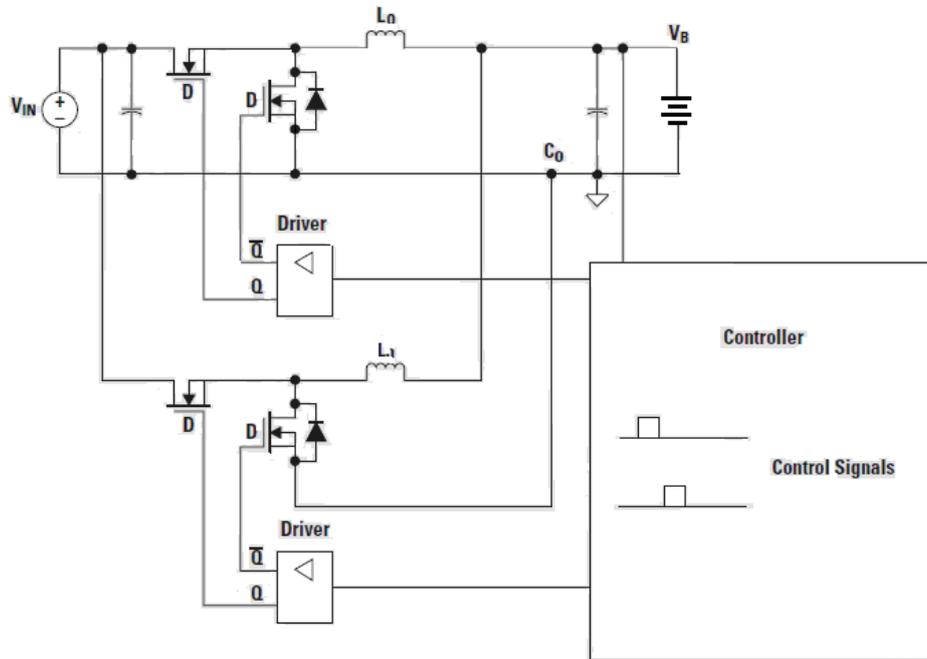


Figure 3.5 MPPT topology

4. Functional explanations for each PCB

Item	Series name	PCB name	PCB serial number	Quantity	Remark
1	KS4000	Main	71-500264-XXG	1	
2		SCC	71-500244-XXG	1	
3		COMM	71-500245-XXG	1	
4		LED	71-500238-XXG	1	
5		CNTL	71-500251-XXG	1	
6		MPPT	71-500362-XXG	1	
1	KS5000	Main	71-500352-XXG	1	
2		SCC	71-500244-XXG	1	
3		COMM	71-500245-XXG	1	
4		LED	71-500238-XXG	1	
5		CNTL	71-500XXX-XXG	1	
6		MPPT	71-500362-XXG	1	

Note: "XX" in the serial number is the version of the PCB.

4.1 Main board

The main board consists of SPS, DC-DC converter, inverter. Many semiconductors and easy-failure components on the board, so it should be play more attention when the system is abnormal.

4.2 Cntl board

The cntl board consists of AD sample, MCU control and communication module. It control the other module work orderly.

4.3 SCC board

The solar current control (SCC) board based on a PW control mode .When the solar source is presented, battery charged from solar source; MAX charge current is 50A if solar panel with enough energy.

4.4 COMM board

This inverter/charger is equipped with a communication port to communicate with a PC with corresponding software. Please use supplied communication cable to connect to communication port of this inverter and RS-232 port of the PC.

4.5 LED board

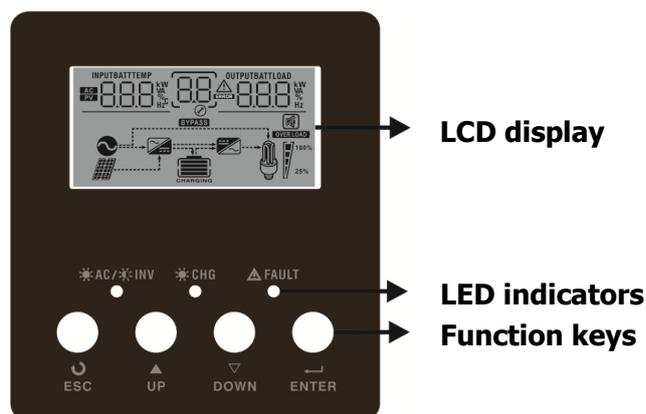
The LED display panel includes three indicators and four functional keys.

4.6 MPPT board

The MPPT board consists of SPS, BUCK converter, MCU control. It integrated the MOSFET driver board and SPS driver board on it. Many semiconductors and easy-failure components on the board, so it should be play more attention when the system is abnormal.

5. Interface

The operation and display panel, shown in below chart, is on the front panel of the inverter. It includes three indicators, four function keys and a LCD display, indicating the operating status and input/output power information.



5.1 LED Indicator

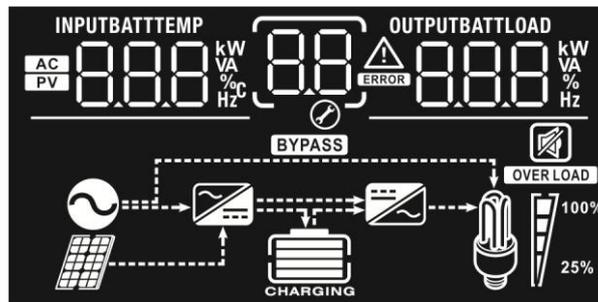
LED Indicator	Messages
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☀️ AC / ☀️ INV	Green	Solid On	Output is available in bypass mode
		Flashing	Output is powered by battery in inverter mode
☀️ CHG	Green	Solid On	Battery is fully charged
		Flashing	Battery is charging.
⚠️ FAULT	Red	Solid On	Fault mode
		Flashing	Warning mode

Function Keys

Function Key	Description
ESC	Exit setting mode
UP	To previous selection
DOWN	To next selection
ENTER	To confirm the selection in setting mode or enter setting mode

5.2 LCD Display Icons



Icon	Function description
Input Source Information	
AC	Indicates the AC input.
PV	Indicates the PV input
INPUTBATT 888 kW VA %C Hz	Indicate input voltage, input frequency, PV voltage, battery voltage and charger current.
Configuration Program and Fault Information	
88 ⌚	Indicates the setting programs.
	Indicates the warning and fault codes. Warning:  flashing with warning code.
	Fault:  lighting with fault code
Output Information	

OUTPUTBATTLOAD 	Indicate output voltage, output frequency, load percent, load in VA and load in Watt.
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Battery Information



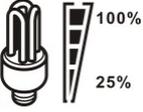
Indicates battery level by 0-24%, 25-49%, 50-74% and 75-100% in battery mode and charging status in line mode.

In AC mode, it will present battery charging status.

Status	Battery voltage	LCD Display
Constant Current mode / Constant Voltage mode	<2V/cell	4 bars will flash in turns.
	2 ~ 2.083V/cell	Bottom bar will be on and the other three bars will flash in turns.
	2.083 ~ 2.167V/cell	Bottom two bars will be on and the other two bars will flash in turns.
	> 2.167 V/cell	Bottom three bars will be on and the top bar will flash.
Floating mode. Batteries are fully charged.		4 bars will be on.

In battery mode, it will present battery capacity.

Load Percentage	Battery Voltage	LCD Display
Load >50%	< 1.717V/cell	
	1.717V/cell ~ 1.8V/cell	
	1.8 ~ 1.883V/cell	
	> 1.883 V/cell	
50%> Load > 20%	< 1.817V/cell	
	1.817V/cell ~ 1.9V/cell	
	1.9 ~ 1.983V/cell	
	> 1.983	
Load < 20%	< 1.867V/cell	
	1.867V/cell ~ 1.95V/cell	
	1.95 ~ 2.033V/cell	
	> 2.033	

Load Information				
	Indicates overload.			
	Indicates the load level by 0-24%, 25-50%, 50-74% and 75-100%.			
	0%~25%	25%~50%	50%~75%	75%~100%
				
Mode Operation Information				
	Indicates unit connects to the mains.			
	Indicates unit connects to the PV panel.			
	Indicates load is supplied by utility power.			
	Indicates the utility charger circuit is working.			
	Indicates the DC/AC inverter circuit is working.			
Mute Operation				
	Indicates unit alarm is disabled.			

6. Troubleshooting

This section describes how to find the trouble when the system is abnormal. We suggest you can follow the service procedure:

- a. Check the system status by LED and LCD display, the sounds of buzzer.
- b. Observe the failure board, static checking.
- c. Replace the failure components.
- d. Static checking.
- e. Power up checking.
- f. Test after repair.

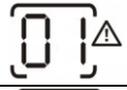
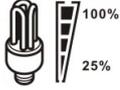
Following section will help service person to solve most of problem.

6.1 Fault Reference Code

Fault Code	Fault Event	Icon on
01	Fan is locked	
02	Over temperature	
03	Battery voltage is too high	
04	Battery voltage is too low	
05	Output short circuited or Over temperature	
06	Output voltage is abnormal	
07	Over load time out	
08	Bus voltage is too high	
09	Bus soft start failed	
11	Main relay failed	
51	Over current inverter	
52	Bus soft start failed	
53	Inverter soft start failed	
54	Self-test failed	

55	Over DC voltage on output of inverter	
56	Battery connection is open	
57	Current sensor failed	

6.2 Warning Indicator

Warning Code	Warning Event	Audible Alarm	Icon flashing
01	Fan is locked	Beep three times every second	
03	Battery is over charged	Beep once every 1second	
04	Low battery	Beep once every 1 second	
07	Overload	Beep once every 0.5 second	 
10	Power limitation	Beep twice every 3 seconds	

6.3 Trouble shooting according to fault indication

Problem	LCD/LED/Buzzer	Explanation / Possible cause	What to do
Unit shuts down automatically during startup process.	LCD/LEDs and buzzer will be active for 3 seconds and then complete off.	The battery voltage is too low (<1.91V/Cell)	1. Re-charge battery. 2. Replace battery.
No response after power on.	No indication.	1. The battery voltage is far too low. (<1.4V/Cell) 2. Battery polarity is connected reversed.	1. Check if batteries and the wiring are connected well. 2. Re-charge battery. 3. Replace battery.
Mains exist but the unit works in battery mode.	Input voltage is displayed as 0 on the LCD and green LED is flashing.	Input protector is tripped	Check if AC breaker is tripped and AC wiring is connected well.
	Green LED is flashing.	Insufficient quality of AC power (Shore or Generator)	1. Check if AC wires are too thin and/or too long. 2. Check if generator (if applied) is working well, or check if input voltage range

			setting is correct (UPS→Appliance)
	Green LED is flashing.	Set Solar power as the priority of output source	Change output source priority to Utility first.

When the unit is turned on, internal relay is switched on and off repeatedly.	LCD display and LEDs are flashing.	Battery is disconnected.	Check if battery wires are connected well.
Buzzer beeps continuously and red LED is on.	Fault code 07.	Overload error. The inverter is loaded with more than 110% load and time is up	Reduce the connected load by switching off some equipment.
	Fault code 05.	Output short circuited.	Check if wiring is connected well and remove abnormal load.
		Temperature of internal converter component is over 120°C.	Check whether the air flow of the unit is blocked or whether the ambient temperature is too high.
	Fault code 02.	Internal Inverter component over 100°C	
	Fault code 03.	Battery is over charged.	Return to repair center.
		The battery voltage is too high.	Check if spec and quantity of batteries are meet requirements.
	Fault code 01.	Fan fault	Replace the fan.
	Fault code 06.	Output abnormal (Inverter voltage below than 190Vac or is higher than 260Vac)	1. Reduce the connected load. 2. Return to repair center
	Fault code 08.	Internal components may be failed.	1. Restart the inverter again. 2. If the problem still exists, please return to repair center.
	Fault code 09.		
	Fault code 11		
	Fault code 51		
	Fault code 52		
	Fault code 53		
Fault code 54			
Fault code 55			
Fault code 56	Battery is disconnected.	Check if battery wires are connected well.	
Fault code 57	Internal components may be failed.	1. Restart the inverter again. 2. If the problem still exists, please return to repair center.	

6.4 Quick start

Before any detail check of the system, please check the components listed as follow table.

NOTE: It is important to check the capacitor's voltage on the board lower than the safety voltage before any check action.

Functional block	Checked components		Instruction function	Reference value	Failed status
DC-DC Converter	Fuse	F1/F2/F3/F4/F5	Resistance	0.14 ohm	short or open
	MOSFET(IRFB3307)	Q13/Q18/Q23/Q19	Resistance	>490k DS	short or open
		Q11/Q17/Q20/Q24		271k GD	short or open
		Q38/Q21/Q22/Q12		11.74k GS	short or open
		Q40/Q26/Q25/Q14			
	Diode(30DQ60BG)	D13	Resistance	>24K	short or open
	Driver NPN /PNP	Q51/Q52/Q54/Q56	Resistance	11.9K PIN1-2	short or open
		Q50/Q53/Q55/Q57		11.9K PIN1-3	short or open
	BUCK MOS	Q32/Q31	Resistance	>280K DS	short or open
				39K GD	short or open
				17K GS	short or open
	Driver IC	UC3525	Resistance	>400K PIN14-PIN13/12 PIN12-PIN13/11	short or open
	IGBT(IRGP4063)	Q27/Q28/Q29/Q30	Resistance	>340K CE	short or open
				184K GC	short or open
				22.5 ohm GE	short or open
Resistance	R52/R62/R81/R64 R41/R59/R70/R76 R80/R78/R75/R42 R93/R92/R87/R533 R91/R96/R102/R101	Resistance	22 ohm	short or open	
	R55/R60/R79/R63 R45/R58/R68/R69 R77/R73/R74/R46 R86/R85/R88/R56 R95/R89/R100/R101	Resistance	47K	short or open	
	R1/R4/R47/R20 R51/R49/R61/R54	Resistance	10 ohm	short or open	
	R17/R44/R50/R57	Resistance	200 ohm	short or open	

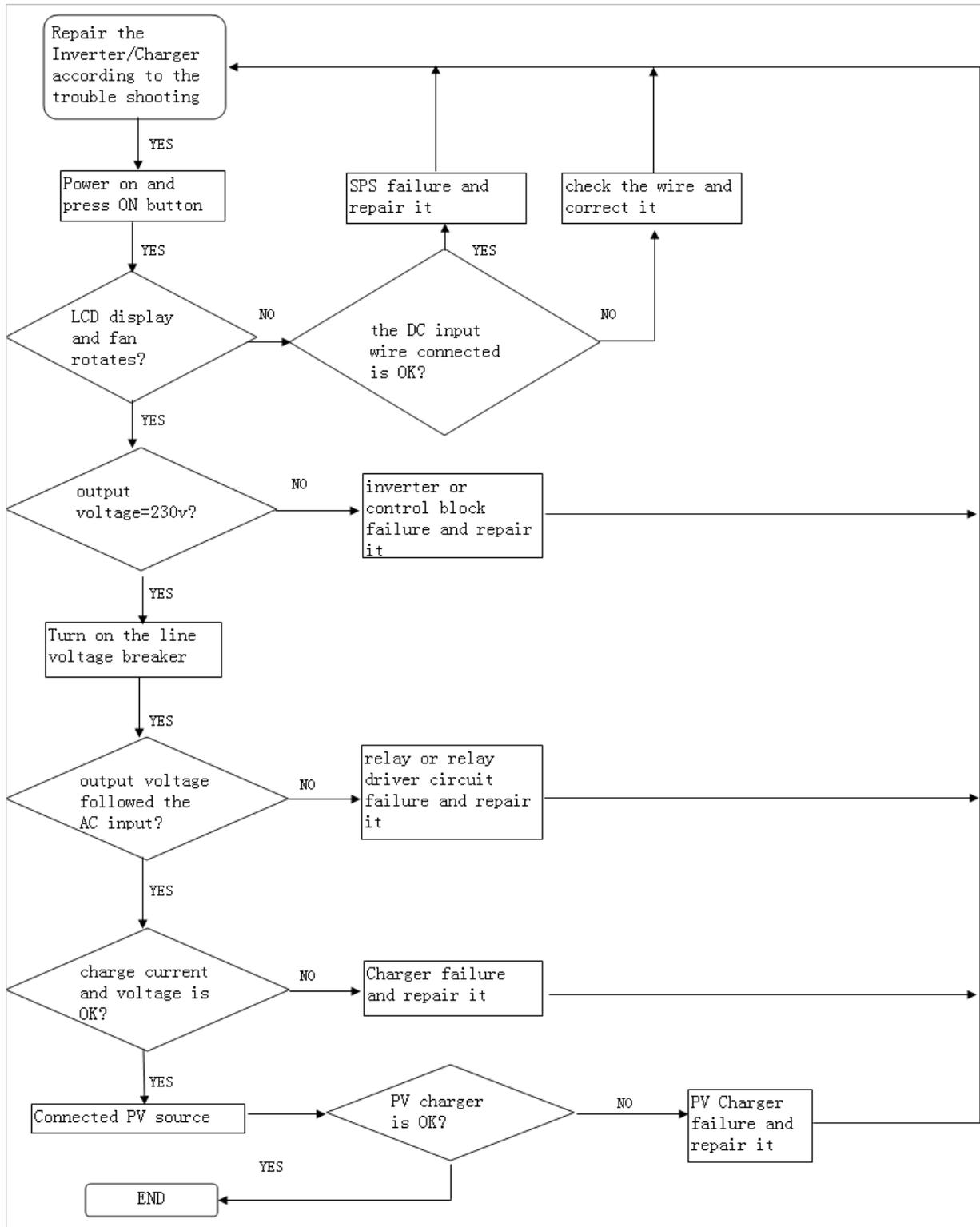
DC-AC Inverter	IGBT(IRGP4066)	QA1/QC1/QD2/QB2	Resistance	>180K CE	short or open
				250K GC	short or open
				23K GE	short or open
	Resistance	R48/R137/R144/R140 R139/R150/R145/R152	Resistance	47 ohm	short or open
Diode	D5/D16/D6/D12	Resistance	94 ohm	short or open	
Photo-coupler	U1/U2/U4/43	Resistance	64K PIN 8-7 >1M PIN 5-6	short or open	
S.P.S	Control IC	UC3845	Resistance	46.5K PIN5-PIN7	short or open
	Diode	D53,D70,D67,D54	Resistance	>4K	short or open
	MOSFET(IRF640NPBF)	Q36	Resistance	>400K DS	short or open
				0.7M GD	
>400K GS					
Resistance	R205/R215	Resistance	0.15 ohm	short or open	
MPPT	MOSFET(IRFB3421PBF)	Q3---Q7	Resistance	>230K DS	short or open
				0.7M GD	short or open
				440K GS	short or open
	Op Amp	U1 PIN8-PIN4	Resistance	>30K	short or open
	Transistor	Q23	Resistance	>85K PIN1-2	short or open
				>0.4M PIN2-3	short or open
				>0.4M PIN1-3	short or open
	Transistor	Q24	Resistance	10K PIN1-2	short or open
				>280K PIN2-3	short or open
>280K PIN1-3				short or open	

MPPT charger board please followed the issue as below:

Functional block	Checked point	Instruction function	Reference value	Failed status	
16-600656-XXG Main board	MOSFET(IRFB4321)	Q2/Q4/Q6/Q7/Q8/ Q10/Q11/Q12/Q13/ Q14	Resistance	10k~300k DS	Short or open
				10k~300k GD	
				4.99k GS	
	Diode(V30200C)	D3/D7	Resistance	1~100k PN	
	MOSFET(IRF640NPBF)	Q16	Resistance	>1M DS	
>1M GD					
SOL+ to SOL-	BAR2 to BAR6	Resistance	>100K		
BAT+ to BAT-	BAR7 to BAR3	Resistance	>100K		
16-500285-XXG Driver board for the MOSFET on	Resistor(75ohm)	R19/R25/R29 R40/R46	Resistance	75ohm	
	Resistor(10ohm)	R20/R26/R30	Resistance	75ohm	

left side of the main board		R41/R47			
	IC(IR2011S)	U5	Resistance	800K PIN3-PIN8	
16-500225-XXG Driver board for the MOSFET on right side of the main board	Resistor(75ohm)	R7/R11/R15 R19/R23	Resistance	75ohm	
	Resistor(10ohm)	R8/R12/R16 R20/R24	Resistance	75ohm	
	IC(IR2011S)	U2	Resistance	800K PIN3-PIN8	

7. Test Step



8. Electrical specification

Table 1 Line Mode Specifications

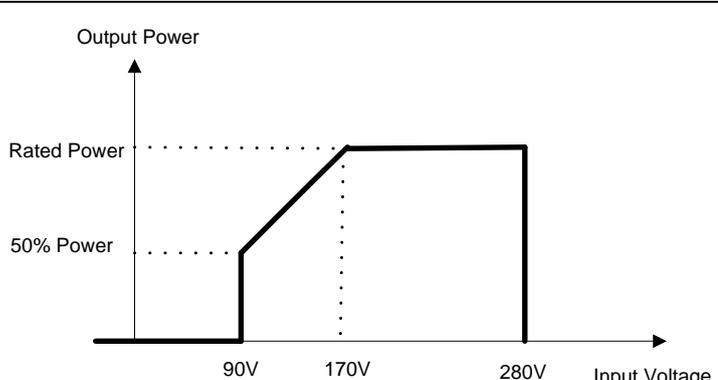
INVERTER MODEL	4KVA	5KVA
Input Voltage Waveform	Sinusoidal (utility or generator)	
Nominal Input Voltage	230Vac	
Low Loss Voltage	170Vac±7V (UPS); 90Vac±7V (Appliances)	
Low Loss Return Voltage	180Vac±7V (UPS); 100Vac±7V (Appliances)	
High Loss Voltage	280Vac±7V	
High Loss Return Voltage	270Vac±7V	
Max AC Input Voltage	300Vac	
Nominal Input Frequency	50Hz / 60Hz (Auto detection)	
Low Loss Frequency	40±1Hz	
Low Loss Return Frequency	42±1Hz	
High Loss Frequency	65±1Hz	
High Loss Return Frequency	63±1Hz	
Output Short Circuit Protection	Circuit Breaker	
Efficiency (Line Mode)	>95% (Rated R load, battery full charged)	
Transfer Time	10ms typical (UPS); 20ms typical (Appliances)	
Power Limitation		

Table 2 Invert Mode Specifications

INVERTER MODEL	4KVA	5KVA
Rated Output Power	4KVA/3.2KW	5KVA/4KW
Output Voltage Waveform	Pure Sine Wave	
Output Voltage Regulation	230Vac±5%	
Output Frequency	50Hz	
Peak Efficiency	90%	
Overload Protection	5s@≥150% load; 10s@110%~150% load	
Surge Capacity	2* rated power for 5 seconds	
Nominal DC Input Voltage	48Vdc	
Cold Start Voltage	46.0Vdc	
Low DC Warning Voltage @ load < 20% @ 20% ≤ load < 50% @ load ≥ 50%	44.0Vdc 42.8Vdc 40.4Vdc	
Low DC Warning Return Voltage @ load < 20% @ 20% ≤ load < 50% @ load ≥ 50%	46.0Vdc 44.8Vdc 42.4Vdc	
Low DC Cut-off Voltage @ load < 20% @ 20% ≤ load < 50% @ load ≥ 50%	42.0Vdc 40.8Vdc 38.4Vdc	
High DC Recovery Voltage	58Vdc	
High DC Cut-off Voltage	60Vdc	
No Load Power Consumption	<50W	
Saving Mode Power Consumption	<15W	

Table 3 Charge Mode Specifications

INVERTER MODEL	4/5KVA
Charging Algorithm	3-Step
Utility Charging Mode	
Charging Current (UPS)	20/30Amp
Charging Floating Voltage	54Vdc
Solar Charging Mode	
Charging Current (MPPT)	60Amp
System DC Voltage	48Vdc
Max. PV Array Open Circuit Voltage	145Vdc
Standby Power Consumption	2W
DC Voltage Accuracy	+/-0.3%

Table 4 General Specifications

INVERTER MODEL	4KVA/5KVA
Safety Certification	CE
Operating Temperature Range	0°C to 55°C
Storage temperature	-15°C~ 60°C
Dimension (D*W*H), mm	468 * 295 * 120
Net Weight, kg	10

Charging Controls

Voltage Setting	Battery Type	Boost CC, CV	Float
			48
	Flooded	58.4	54
	AGM / Gel	56.4	54

