



Experts in Power Conversion

User Manual



Energy Storage System

AB-ESS2000

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1. Safety Instructions and Storage/ Battery Care

1.1 Safety Instructions

SAVE THESE INSTRUCTIONS.

This manual contains important instructions that should be followed during installation and maintenance of the ESS and batteries.

1. Do not open the case as there are no serviceable parts inside. Opening the case will void your warranty and introduces the risk of electric shock.
2. Do not try to repair the unit yourself. Doing so will void your warranty. Contact your local supplier for repairs.
3. If liquids are spilt onto the ESS or foreign objects dropped into the unit the ESS could be damaged, users could be subject to electric shock, and the warranty will become null and void.
4. Do not install the ESS in an environment with sparks, smoke, or hazardous gas.
5. This ESS is equipped with an EMI filter. To prevent potential leakage current hazards ensure that the AC mains supply is securely grounded. Because of small leakage currents generated by the EMI filter in the ESS it is necessary to double check that the ground wire of the ESS is properly grounded before connecting the ESS to the AC mains
6. This ESS is designed to be installed and commissioned in a sheltered, controlled environment as follows:
 - Ensure that the ESS is installed within the proper environmental range. (0-40°C and 0-90% non-condensing humidity). High ambient temperature reduces battery life.
 - Do not install the ESS in direct sunlight. Your warranty may be void if the batteries fail
 - Do not install the ESS in an inflammable or otherwise hazardous environment.
 - Avoid vibration and areas subject to physical impact.
 - Avoid any area with sparks.
 - Dusty, corrosive, and salty environments can damage any ESS.
 - Install the ESS indoors as it is not designed for installation outdoors.
7. To prevent overheating of the ESS keep all ventilation openings free from obstruction, and do not place anything on top of the ESS. Keep the ESS rear panel 20 cm away from the wall or other obstructions.
8. Install the ESS in a ventilated area, ideally exchanging 5 m³ of air per hour, because the chemical reaction during battery charging causes trace gas

production. If the batteries suffer breakage electrical arcing could occur in the ESS interior.

9. If the product emits a strange noise or smell please immediately stop using the product and contact your dealer for maintenance.
10. Always switch off the ESS and disconnect the batteries when relocating the ESS. Be aware that, even when disconnected, charged batteries present a possible electric shock hazard.
11. The ESS should be recharged every 2-3 months if unused. If this is not done then the warranty will be null and void. When installed and being used the batteries will be automatically recharged and kept in top condition.
12. Make sure that the AC utility outlet is correctly grounded.
13. Ensure that the input voltage of the ESS matches the utility supply voltage. Use a certified input power cable with the correct plugs and sockets for the system voltage.
14. To ensure safety in all applications where a ESS is hard wired to the electrical supply, ensure that the system is installed by a qualified electrical contractor.
15. The ESS has its own internal energy source (battery). Should the battery be switched on when no AC power is available there could be voltage at the output terminals.
16. Make sure that the AC utility outlet is correctly grounded
17. Install the ESS away from objects that give off excessive heat and areas that are excessively wet.
18. The battery will discharge naturally if the system is unused for a long time
19. This ESS supports electronic equipment in office, telecommunication, process-control, medical, and security applications. Non-authorized technicians are not allowed to install the ESS in the following areas.
 - a. Medical equipment directly related to human life
 - b. Elevators, subway systems, or any other equipment related to human safety.
 - c. Public systems or critical computer systems.
20. The ESS offers a CVCF (Constant Voltage Constant Frequency) setting function.
 - a. For correct setting and wiring please contact with your local utility agent.
 - b. Do not set it yourself or your warranty will be void.
21. This ESS has been designed and constructed to protect your assets from the wide range of power aberrations experienced on utility power lines today. It is your insurance for a reliable, clean and stable voltage supply. It is worth taking care to install the system correctly and to have it maintained correctly by your local dealer.

22. Do not try to replacement of the battery yourself. Doing so will void your warranty. Contact your local supplier for repairs.
23. The ESS is intended for installation in a controlled environment.
24. Install the ESS so that it is not likely to be contacted by people.
25. The maximum ambient operating temperature is 40°C or equivalent.
26. Units are considered acceptable for use in a maximum ambient 40°C
27. CAUTION - RISK OF EXPLOSION IF BATTERY IS REPLACED BY AN INCORRECT TYPE. DISPOSE OF USED BATTERIES ACCORDING TO THE INSTRUCTIONS.
28. CAUTION - Do not dispose of batteries in a fire. The batteries may explode.
29. CAUTION – Do not open or mutilate batteries. Released electrolyte is harmful to the skin and eyes. It may be toxic.
30. CAUTION– A battery can present a risk of electrical shock and high short circuit current. The following precautions should be observed when working on batteries:
 - 1) Remove watches, rings, or other metal objects.
 - 2) Use tools with insulated handles.
 - 3) Wear rubber gloves and boots.
 - 4) Do not lay tools or metal parts on top of batteries.
 - 5) Disconnect charging source prior to connecting or disconnecting battery terminals.
 - 6) Determine if battery is inadvertently grounded. If inadvertently grounded, remove source from ground. Contact with any part of a grounded battery can result in electrical shock. The likelihood of such shock can be reduced if such grounds are removed during installation and maintenance (applicable to equipment and remote battery supplies not having a grounded supply circuit).
31. External battery cabinet installation instructions, please refer to " Battery Bank Installation User's MANUAL "

1.2 Storage / Battery Care

If the ESS is unused for an extended period of time it must be stored in a moderate climate. The batteries should be charged for 12 hours every three months by connecting the ESS to the utility supply and switching on the input breaker located on the ESS rear panel. Repeat this procedure every two months if the storage ambient temperature is above 25°C.



2. Product Introduction

2.1 General Characteristics

1. True on-line technology continuously supplies your critical device with stable, regulated, transient-free, pure-sine-wave AC power.
2. High-efficiency PWM sine-wave topology yields excellent overall performance.
3. The high crest factor of the inverter handles all high in-rush current loads without the need to upgrade the power rating.
4. User-friendly plug-and-play design allows hassle-free installation.
5. Built-in maintenance-free, sealed batteries minimize the need for after-sales service.
6. To protect the unit from overloading, the ESS will automatically switch to bypass mode in 30 seconds if loading is at 105% of rated capacity. It will automatically switch back to inverter mode once the overload condition ceases.
7. Should the output become short-circuited the ESS puts the system in stand-by mode, provides visible and audible alarms, and cuts the output supply automatically until the short circuit situation is resolved manually.

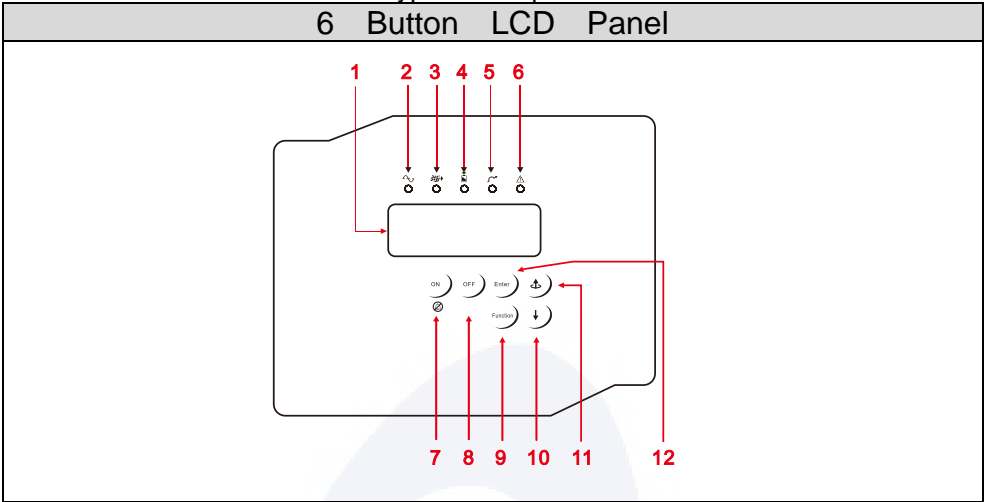
2.2 Special Features

1. Our High Frequency Transformer-less technology and tower-convertible enclosure enables the ESS to be integrated into even the most difficult environments with space constraints.
2. This ESS is equipped with fully digital control logic for greater functionality and enhanced power protection. Digital signal processing (DSP) also provides the ESS with powerful communication capability, which simplifies remote control and monitoring.
3. Our wide input voltage tolerance of 55-150 V allows under-voltage or over-voltage correction without unnecessary battery drain and helps extend battery life.
4. Our DC-start function ensures the start-up of the ESS even during power outages.
5. Our smart battery management system extends the batteries' life span.
6. Our Active Power Factor Correction control function constantly maintains the ESS input power factor at > 0.98 for superb energy efficiency.
7. Our Selectable Bypass input voltage tolerance (sensitivity low/high) prevents under- or over-voltage being supplied to the loads in Bypass mode. The selectable voltage ranges are (i) Bypass Sensitivity Low: many selectable output voltages $\pm 15\%$ and (ii) Bypass Sensitivity High: many selectable output voltages $\pm 10\%$. For example, if the output voltage setting is 100 V the Bypass Sensitivity Low range is 100 V $\pm 15\%$, i.e., 85-115 VAC.
8. The ESS provides numerous configurable output voltages to match various system voltages.
9. The ESS is designed to comply with various stringent international standards for electromagnetic interference compatibility (EMC).





3. ESS Functional Descriptions

3.1 Front Panel Display

3.1.1 ESS 2000< Wall mount Type > LCD panel

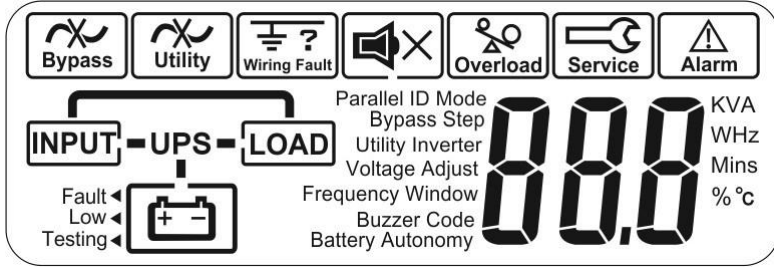









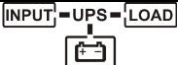


Item	Sign	Description
①		LCD Display
②		Green LED steadily lights up to indicate that the Utility input voltage is within the window (90Vac~145Vac); the LED flashes flickeringly to indicate that the Utility input voltage is within the acceptable window (60Vac~90Vac).
③		Green LED lights up to indicate solar charger input information, ex voltage, current, power
④		Green LED lights up to indicate solar charger output information, ex voltage, current, power
⑤		Amber LED lights up to indicate the Bypass Input is normal.
⑥		ESS Fault LED
⑦		ESS On/Alarm Silence
⑧		ESS OFF Switch

⑨		Special functions log in/out
⑩		Go to next page
⑪		Go to previous page or change the setting of the ESS.
⑫		To re-confirm the change of ESS Setting

© Manual Bypass : Press "⑦ON-KEY" and "⑪Up-KEY" key simultaneously for approx. 3 seconds to transfer from "Inverter to Bypass" (the bypass led continuously "blink" and the buzzer will beep intermediately or "Bypass to Inverter", when the ESS is on Line Mode and the Bypass Voltage Window is Normal.

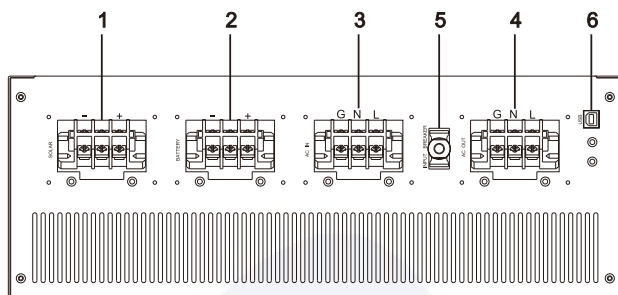
3.1.2 LCD displayer description



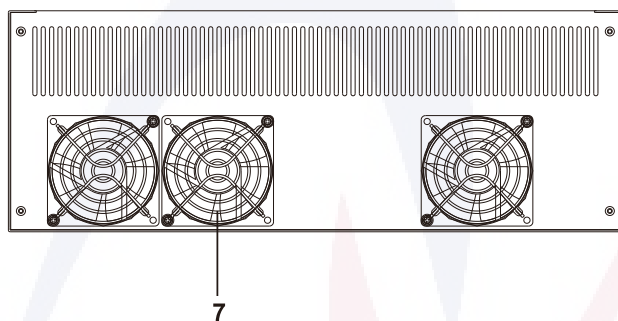
Item	Sign	Description
1		Bypass Input Abnormal, ESS fails to transfer to bypass, Bypass Abnormal at ECO mode
2		Utility Input Abnormal
3		Site Wiring Fault
4		Buzzer Silent
5		ESS Overloading
6		ESS Working in specified mode*
7		ESS Fault or Abnormal Warning
8		ESS Flow Chart
9		3-Digit Measurement Display
10		Indicates the item to be measured
11	Fault ◀	Battery Abnormal
12	Low ◀	Battery Low
13	Testing ◀	Testing

3.2 Rear Panel

ESS 2000 120V



2K



1. Solar connector
2. Battery connector
3. AC input connector
4. AC output connector
5. Input Breaker
6. USB port
7. Fan

3.3 Communication Port Explanation

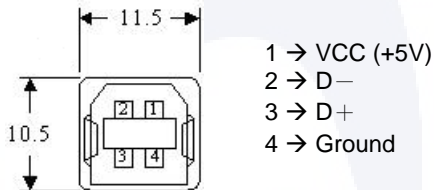
The ESS is equipped with a true USB communication port as standard to provide communication with bundled ESS monitoring software for remote monitoring of the ESS status using a PC.

The software bundled with the ESS is compatible with many operating systems, including Windows 98 / Me / NT / 2000 / 2003 / XP / Vista / 2008 / 7 / 8 , Novell, NetWare, Unix, Linux 2.6.x, Mac OS X v10.5 Leopard, Mac OS X v10.6 Snow Leopard please contact your local dealer for suitable software.

3.3.1 USB

The USB communication protocol definition is as below.

1. Complies with USB version 1.0, 1.5 Mbps.
2. Complies with USB HID version 1.0.
3. Pin Assignments:



4. Installation

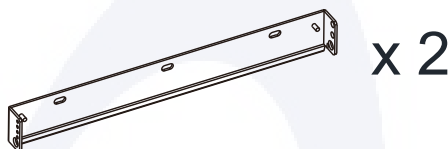
Please first read the safety instructions carefully before the ESS inverter installation.

4.1 Unpacking

Although the manufacturer has designed robust packaging for the product, still the damages may occur during the shipment. When you received your ESS inverters, please check them carefully. If there is any damage, please notify your local distributor. (Packaging materials can be recycled and reused.)

Take out the ESS inverter from the carton and check the package content. Standard accessories include:

- ✓An accessory pack.
- ✓A data disc
- ✓A wall mount kit set (include a backrest and a backplane position paper).

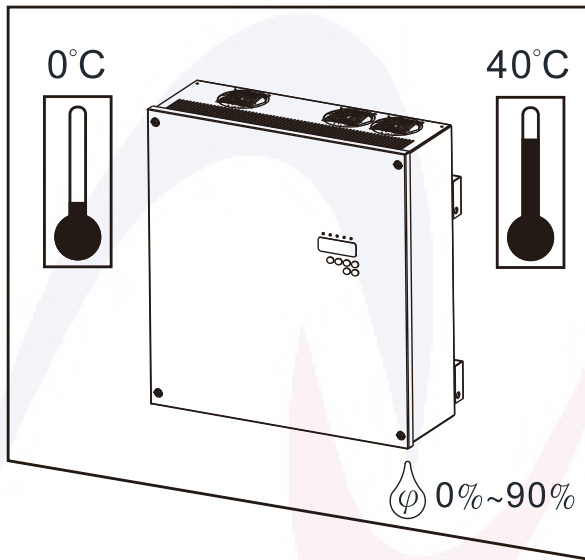


4.2 Installation site requirements

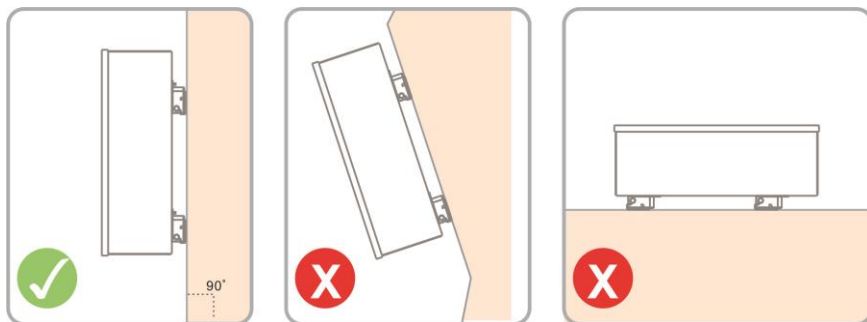
When selecting an installation location and method, be sure to take the weight of the ESS inverter into account.

An appropriate installation location will optimize system performance, reduce the chances of malfunctions, and extend the product lifetime. Please follow the guidelines below for an appropriate location:

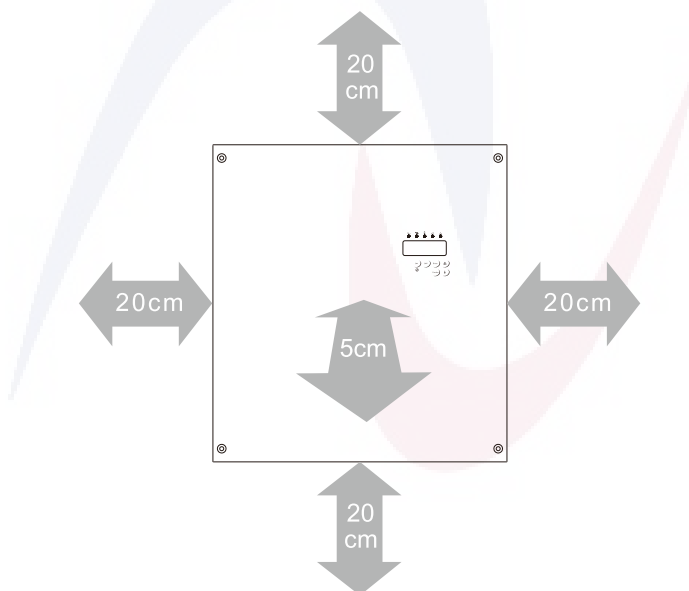
ESS inverters are designed for indoor use, with protection class IP20, and can be installed indoors and in wet environments. Power generation capacity of the ESS inverters varies due to ambient temperature, humidity, and installation location. Recommend locations shall out of direct sunlight, with ambient temperatures between 0°C and +40°C, are recommended.



The ESS inverter should be hung perpendicularly against the wall. Please make sure that the wall mounting location does not cause the ESS inverter to tilt forward or backward during installation.

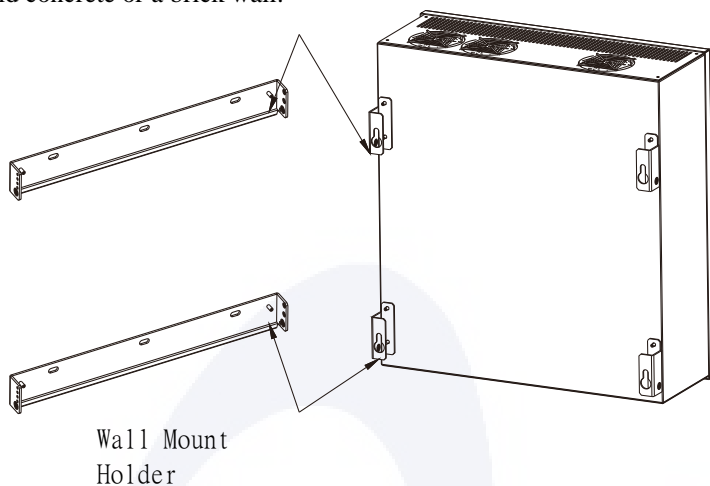


When choosing an installation site, ensure that there is enough space for the ESS inverter to dissipate the heat generated during operation. Please see the diagram below for recommended heat dissipation space.



4.3 Wall Mounting

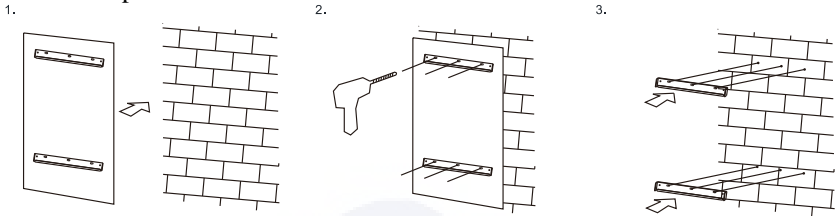
It is recommended to use the enclosed backplane to mount the ESS inverter on the wall. When selecting an installation location, be sure to consider whether it can withstand the weight of ESS inverter. It is recommended to install the unit vertically on a solid concrete or a brick wall.



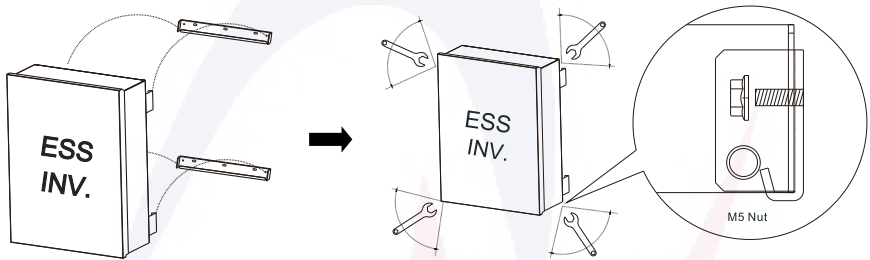
4.3.1 Installation steps for wall mounting

Method I: Use the backplane to fix the unit.

Step 1: Put the backplane position paper on the intended spot of the wall. Drill holes based on the diameter of the backplane to fix holes. Finally, fix the backplane on the wall.

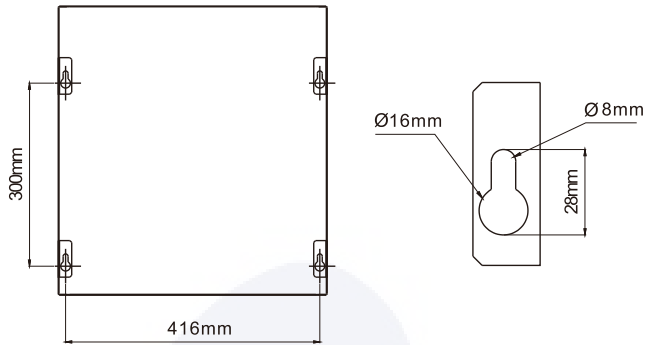


Step 2: Hang the ESS inverter on the backplane. Make sure that it holds the inverter unit firm and securely.

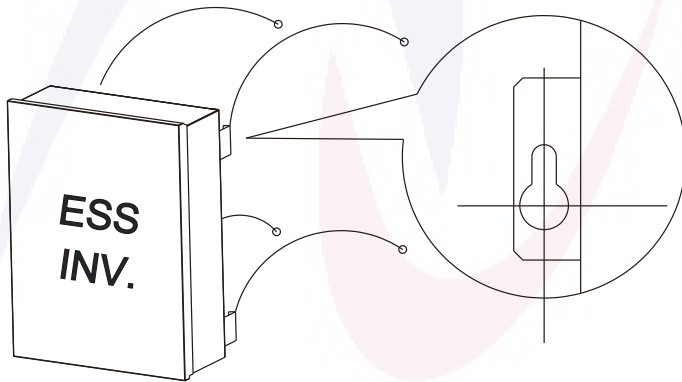


Method II: Use screws to fix the unit.

Step 1: As shown in the figure below, drill holes on the wall at the marked distances and fasten the screws to the drilled holes.



Step 2: Mount the ESS inverter on the wall. Make sure the unit is installed securely and not slanted.



4.4 Electrical Installation



Caution! Risk of electric shock!

- Make sure an AC circuit breaker has been installed between the ESS inverter and utility power.
Note: The U_e : 120Vac / I_e : 20A breaker is recommended.
- Make sure that a DC circuit breaker has been installed between the ESS inverter and the solar panel array.
Note: The U_e : 150Vdc / I_e : 35A breaker is recommended.
- The AC circuit breaker and DC circuit breaker must be disconnected during installation process.
- During installation, make sure that both the AC and DC powers which go through the AC and DC circuit breakers are turned off.

The wiring of the ESS inverter is shown in Figure 1. Detailed installation steps for AC input, output, solar panel input and battery input are explained in the following sections.

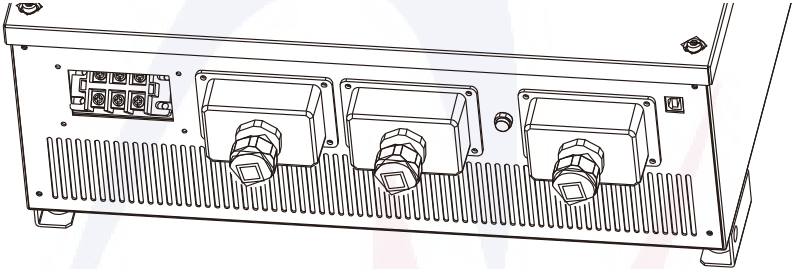


Figure 1

4.5 Installation Steps for AC Input



An AC circuit breaker between the ESS inverter and utility power should be installed before wiring the unit to utility power.

- Step 1: Make sure that the utility AC voltage and frequency meet the specifications of the ESS inverter.
- Step 2: Make sure the circuit breaker which connected to the utility power is opened before installed the ESS inverter's AC input. The AC circuit breaker should be closed only after completed the electrical installation of the ESS inverter.
- Step 3: As shown in Figure 2, remove the cover of AC input. Follow the steps in Figure 3 to set the AC input wiring by using the recommended wire diameter. You can follow the instructions in Figure 4 to adopt different wiring methods for the desired input voltage.

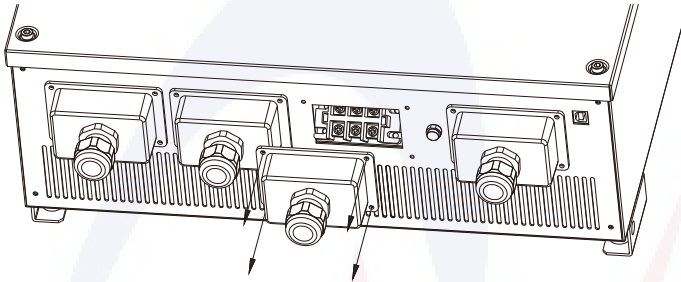


Figure 2

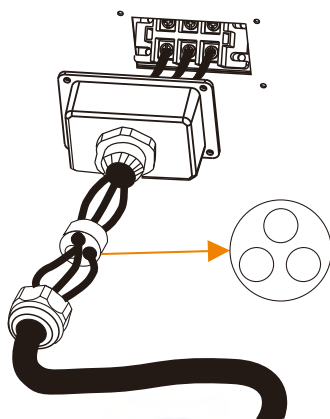


Figure 3

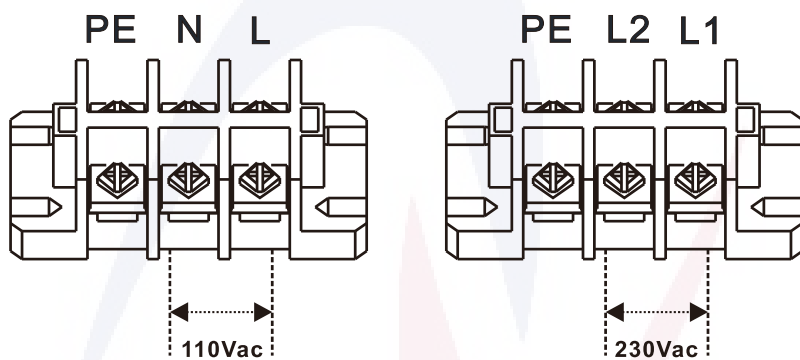


Figure 4

Step 4: Fasten the AC input water-proof cover securely, as shown in Figure 5.

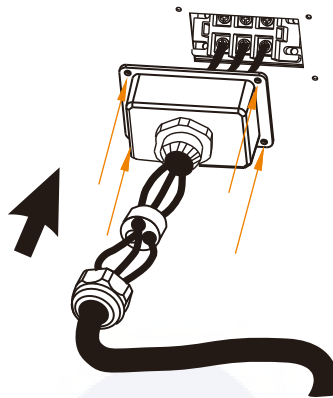


Figure 5

■To prevent electric shock hazard, make sure the ground of the ESS inverter is connected to the ground properly before any operation.

■Recommended wire diameter for AC input

Model	Diameter Φ (mm)	Area (mm ²)	AWG no.
ESS2000	>2.05	>3.5	>12

4.6 Installation Steps for AC Output



An AC circuit breaker between the ESS inverter and load should be installed before wiring the unit to load.

- Step 1: Make sure that the ESS inverter output voltage and frequency meet the specifications of the ESS inverter.
- Step 2: Make sure the circuit breaker which connected to the load is opened before installed the ESS inverter's AC output. The AC circuit breaker should be closed only after completed the electrical installation of the ESS inverter.
- Step 3: As shown in Figure 2, remove the cover of AC output. Follow the steps in Figure 3 to set the AC output wiring by using the recommended wire diameter. You can follow the instructions in Figure 4 to adopt different wiring methods for the desired output voltage.

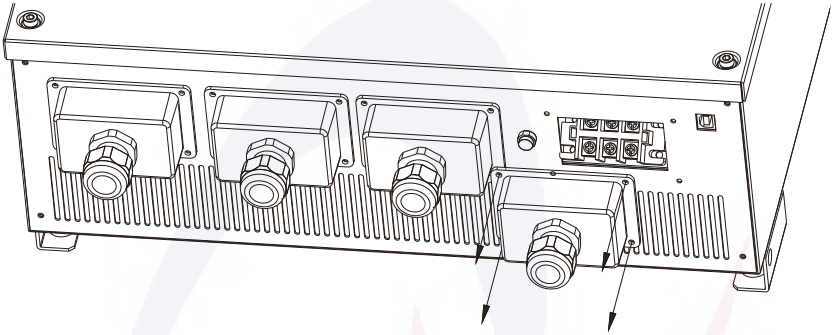


Figure 2

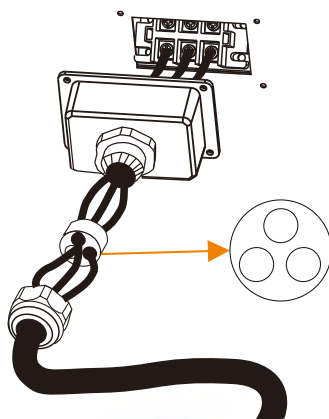


Figure 3

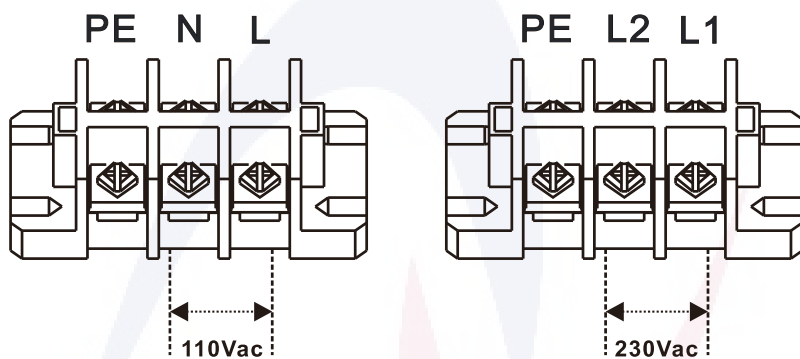


Figure 4

Step 4: Fasten the AC output water-proof cover securely, as shown in Figure 5.

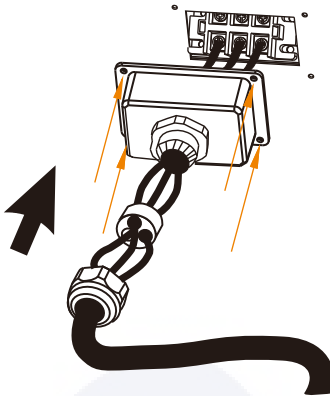


Figure 5

■To prevent electric shock hazard, make sure the ground of the ESS inverter is connected to the ground properly before any operation.

■Recommended wire diameter for AC output

Model	Diameter Φ (mm)	Area (mm ²)	AWG no.
ESS2000	>2.05	>3.5	>12

4.7 Solar Panel Input Wiring

The ESS inverter is equipped with specific quick installation terminals for solar panel modules, as shown in Figure 6.

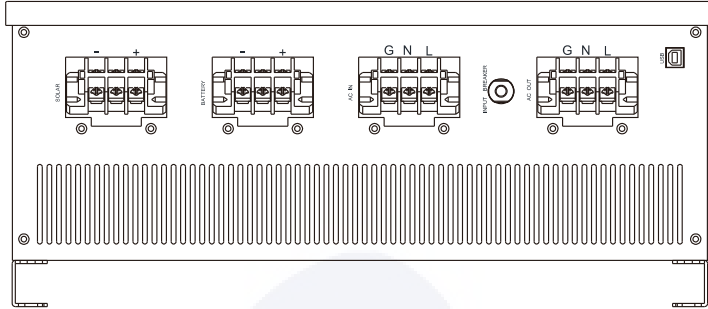


Figure 6

4.7.1 Precautions of Solar Panel Array Configuration

The number and connection of the solar panel modules have to meet the ESS inverter specifications and the following three requirements:

- 1 To prevent damage to the ESS inverter, make sure that the maximum open-circuit voltage (Voc) never exceeds 150Vdc in each solar panel array string. Voltage exceeding 150Vdc will cause permanent damage to the ESS inverters.
- 2 Maximum short circuit current (Isc) for each solar panel array string should not exceed the maximum input current which specified on ESS inverter.
- 3 The maximum power voltage for the solar panel array should remain within the maximum power tracking range under any kind conditions.

4.8 Installation steps for solar panel input



An independent DC circuit breaker shall be installed between the inverter and the solar array before the PV inverter is connected to the solar panel array.

- Follow the steps below for connecting of the solar panel array to the ESS inverter:
 - Step 1: Ensure the correct polarity of the solar panel array, and the voltage never exceeds the PV inverter's maximum input voltage (150Vdc).
 - Step 2: Connect the solar panel array's positive polarity to the ESS inverter's positive terminal.
 - Step 3: Connect the solar panel array's negative polarity to the ESS inverter's negative terminal.
 - Step 4: For a multi-string solar panel array, repeat Steps 1 to Steps 3.
 - Step 5: Cover up other unused terminals on the ESS inverter with the protective lids to avoid potential electric shock.
- Recommended wire diameter for solar panel input

Model	Diameter Φ (mm)	Area (mm ²)	AWG no.
ESS2000	≥ 2.59	≥ 5.5	≥ 10

■ Solar Panel Array Wiring Methods

1. Two or Three strings that each of them in same numbers of solar panel array as shown in Figure 7.

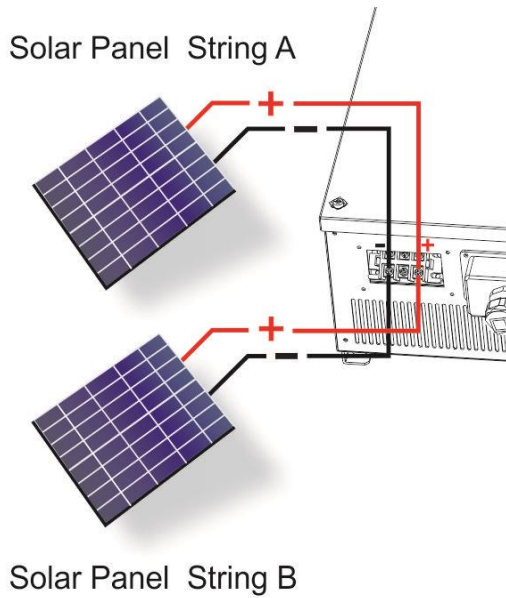


Figure 7

4.9 Battery Cabinet Installation

Step 1:

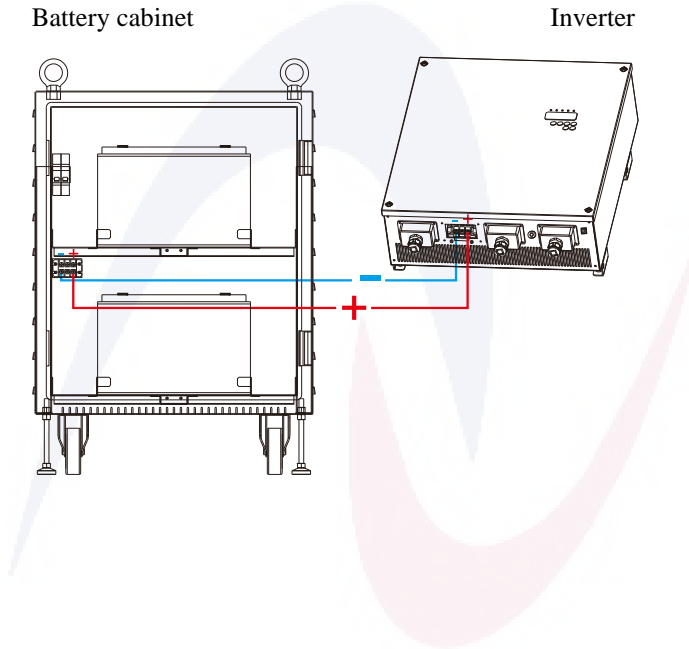
Please do not place the battery into the battery cabinet before installing the battery cabinet cables, and confirm that the DC breaker on the ESS inverter is at the OFF status.

Step 2:

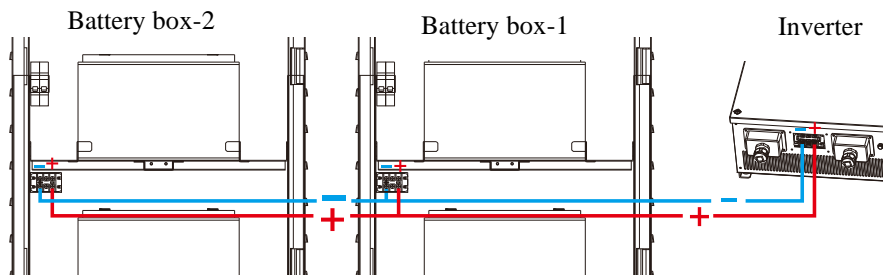
Install the wiring between the battery cabinet and the ESS inverter. Each battery cabinet is equipped with two sets of positive/negative terminals and communication terminal.

Please refer to the explanations in the following figure below according to the number (1 or 2) of battery cabinets users selected.

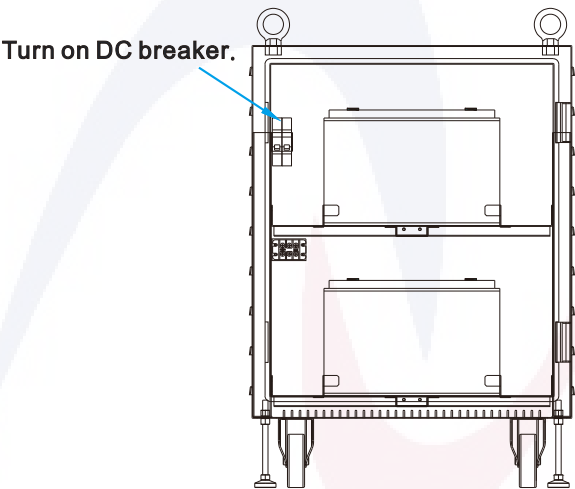
✓ Equipped with one battery cabinet (standard configuration)



✓ Equipped with two battery cabinets



Step 3:
Cover the top cover of the battery cabinet and turn on the DC breaker on the inverter to complete all battery cabinet installation.



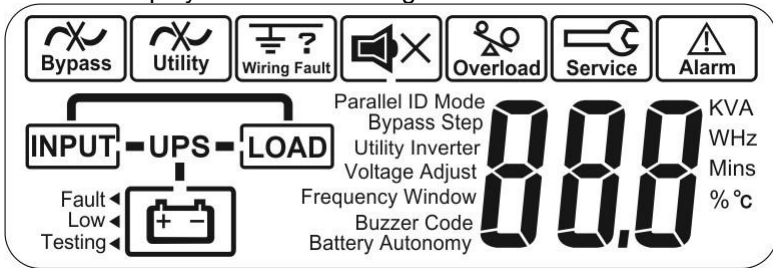
Model	Diameter Φ (mm)	Area (mm ²)	AWG no.
ESS2000	>2.05	>3.5	>12



5. Operation

5.1 LCD Panel

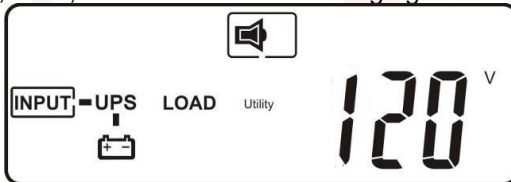
5.1.1 Line mode start up

1. Please ensure the outlet of power source is proper grounded.
2. Ensure the voltage rating of power source is matched with ESS spec.
3. Plug in ESS to the AC source
4. ESS will start initializing after AC input power is available 5 seconds.
LED/LCD indicator will be all lit and dim once and fan will start spinning.
Full LCD display looks as below figure:

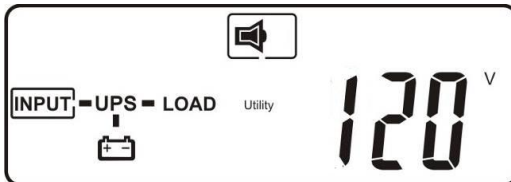


5. Press ESS  button and hold until twice beep heard, ESS begins starting procedures for 5 seconds. LCD display will show as below figure-A and then figure-B sequentially. LEDs  will light up to indicate that the Utility and the Bypass are normal. And then "~", "U1", "U2" LED remain lit during figure-B LCD display.

A






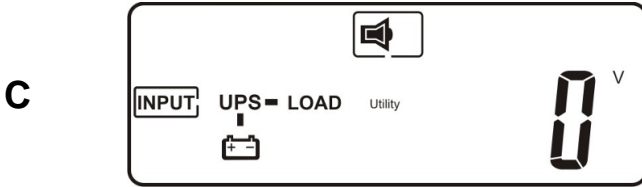
B



When you see figure-B means the starting up procedure is finished. Please ensure ESS recharge in line mode for at least 4 hours for fully recharged before


the first backup test if it's a new installed unit.


6. Back up test – Unplug inlet power cord or switch off power source to simulate power failure condition. Green LED indicator  will be dimmed and Amber LED "" , " will be light. Intermittent audible alarm will be heard and LCD display shows as below figure-C:





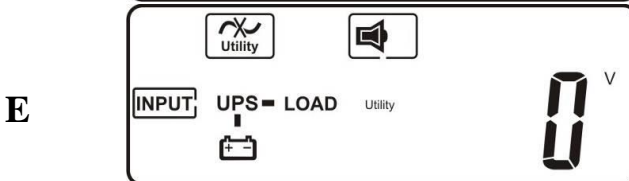
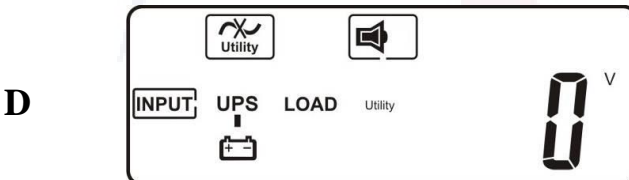
5.1.2 Cold Start (DC start)

1. Ensure the internal battery is available or external battery set well

connected to ESS. Press and hold  key for 3 seconds until twice


beeps heard, release button and press  for 3 seconds until twice beeps heard again to confirm cold start procedure. If the 2nd button confirmation not be finished within 10 seconds after 1st twice beeps, ESS will not cold start and shut off after 10 seconds.

2. 5 seconds after cold starting, amber LED "" , " will be light, intermittent audible alarm will be heard and LCD will show sequentially as below figure-D and figure-E

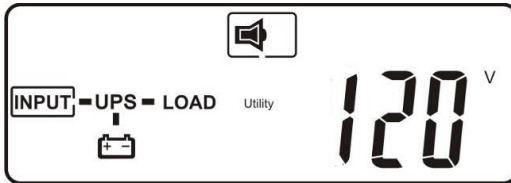


5.1.3 Operation of measurements display

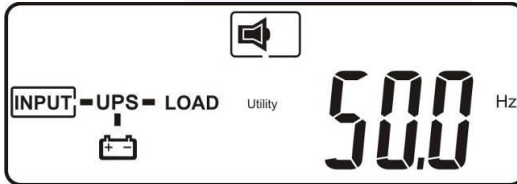
5.1.3.1 ESS measurements can be checked after ESS started by pressing

select key . The display sequence are as below figure-F (AC input voltage)→figure-G (AC input frequency)→figure-H (ESS output voltage)→figure-I (ESS output frequency)→figure-J (ESS loading percentage)→figure-K (ESS output current)→figure-L (Battery voltage) →figure-M (ESS inner temperature) and back to figure-F.

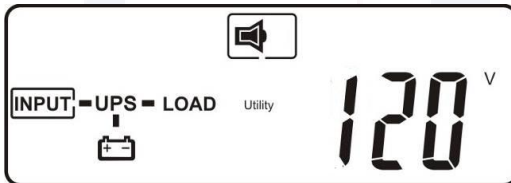
F



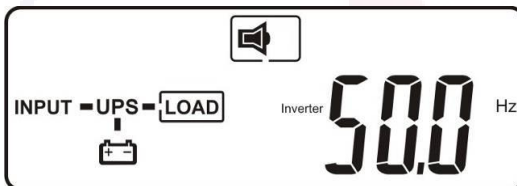
G



H



I



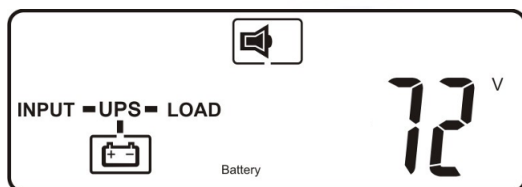
J



K



L

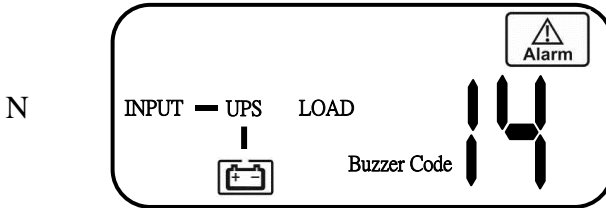


M




5.1.4 ESS Locked up


ESS may lock itself up while there was critical abnormal or failure condition happened. User may see LCD display as below figure-N.

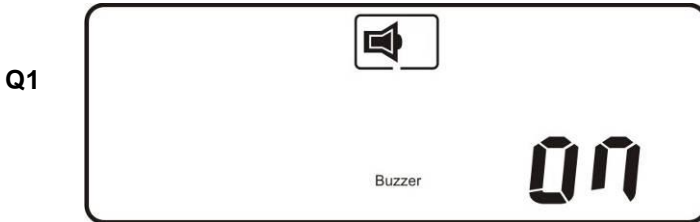


The procedures to release ESS from locked up status are as below:

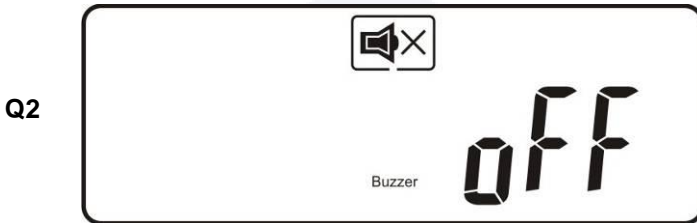
- (a) Check and record the error code.
- (b) Check user's manual to understand possible cause, solve the problem or call service provider.
- (c) Press OFF key  and hold for 5 seconds until twice beep heard.
- (d) Unplug AC input power cord or turn off power source switch.
- (e) After ESS completely shut off, ESS is unlocked.

5.1.5 ESS Default Data and Special Function Execution


After the ESS completely starts up, press the  key to change the LCD display to figure Q1.



buzzer "On"



buzzer "Off"

5.1.5.1 Press the  key to scroll through the ESS settings. The LCD will display in sequence figure Q1 (buzzer) → figure R1 (Self-test) → figure S1 (Bypass Voltage Windows) → figure T (Output Frequency Synchronization Window) → figure U (Inverter Output Voltage) → figure V1 (ESS Operation Mode) → figure W (Output Voltage Micro Tune Value) → figure X (ESS Id) → figure Y (Parallel function status).

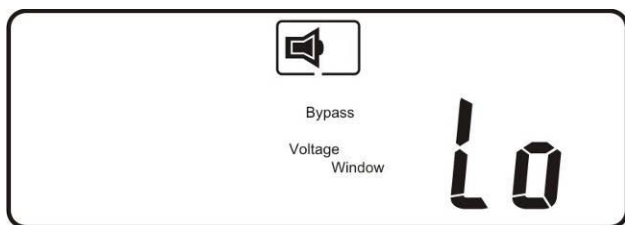


Self-test is not "On".



Self-test is "On".

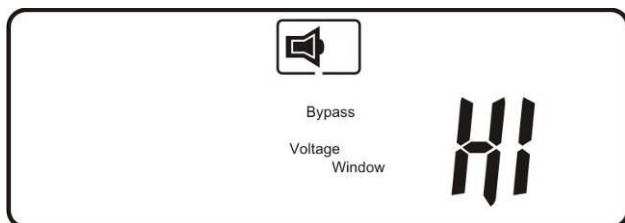
S1



Bypass

Voltage is adjusted to wide range.

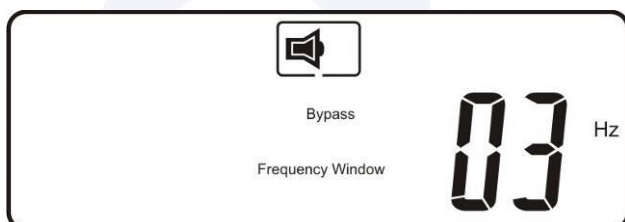
S2



Bypass

Voltage is adjusted to narrow range.

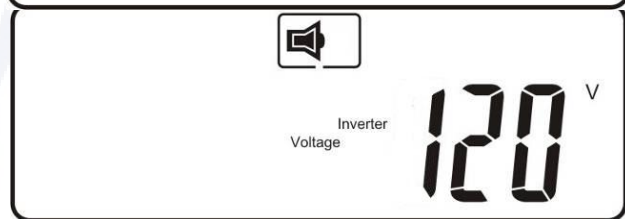
T



Frequency

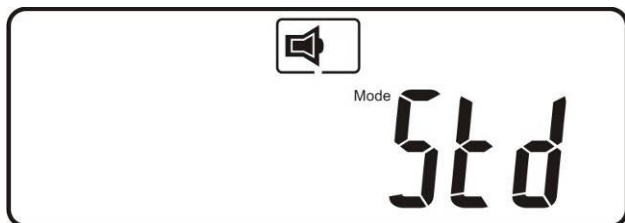
Window is +/-3 Hz.

U



inverter output voltage

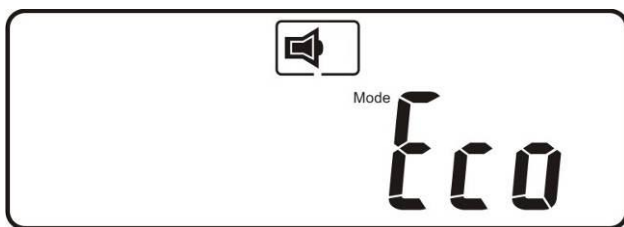
V1



The ESS is operating in “normal mode”.



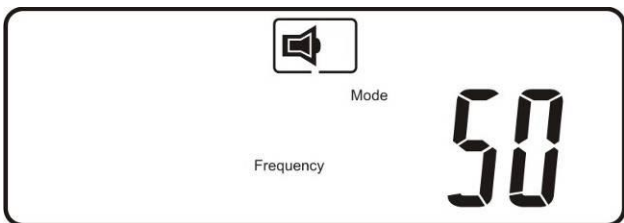
V2



The ESS is

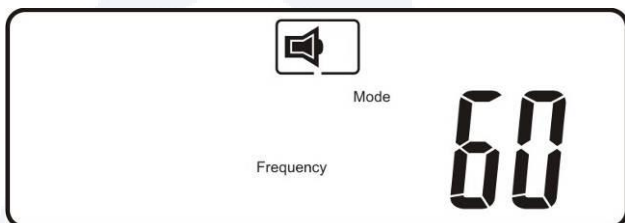
operating in "Eco mode".

V3



The ESS is operating in "CVCF 50 Hz mode".

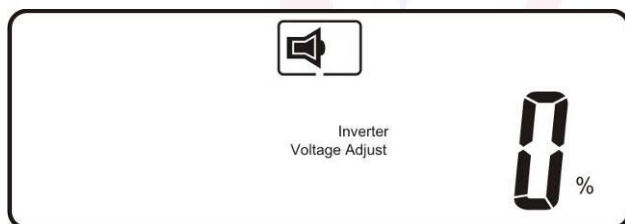
V4




The ESS

is operating in "CVCF 60 Hz mode".

W







Output Voltage Adjustment (-3%, -2%, -1%, 0%, +1%, +2%, +3%)

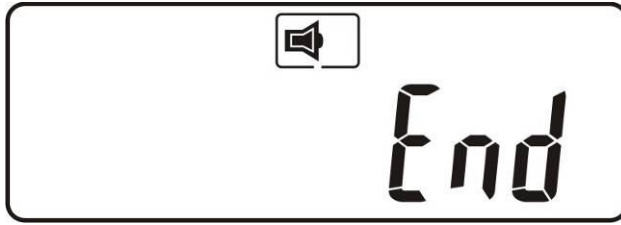
5.1.5.2 Press the scroll up  key to execute special functions. The functions include buzzer ON (as in figure Q1), buzzer OFF (as in figure Q2, Alarm silence for ESS Warning), and self-test OFF (as in figure R1) or self-test ON (as in figure R2). The ESS will execute the battery test for ten seconds.

5.2 ESS Default Settings and their alternatives



- 5.2.1 Make sure the ESS is not "On". Press the On  and scroll down  keys simultaneously for approximately three seconds. The buzzer will sound twice, and the LCD will display figure Q1, indicating that the ESS is in setting mode.
- 5.2.2 To scroll through the options refer to section 5.1.5.1.
- 5.2.3 Except for Buzzer (figures Q1 and Q2) and Self-test (figures R1 and R2) all of the other default settings may be changed by pressing the scroll up  key.
- 5.2.4 Figures S1 and S2 indicate the bypass input acceptable window. It follows the inverter output voltage. Please refer specification for the detail.
- 5.2.5 Figure T indicates the bypass frequency window of the Inverter Output. The acceptable setting values are ± 3 Hz and ± 1 Hz.
- 5.2.6 Figure U indicates the acceptable Inverter Output Voltage. Possible values are 100, 110, 115, 120, or 127 VAC.
- 5.2.7 Figures V1, V2, V3 and V4 indicate the operation modes of the ESS. Possible values are Online, Eco (Economical) mode, fixed 50 Hz Output, and fixed 60 Hz Output.
- 5.2.8 Figure W indicates the adjustment of the Inverter Output, which may be set to 0%, +1%, -1%, +2%, -2%, +3%, or -3%.
- 5.2.9 After changing settings you must scroll to the "End" screen (figure X) and then press the enter  key to save all of your changes.

X





* Press the Enter key to save changes.

5.2.10 Turn Off the Utility Input breaker.


5.2.11 Your setting changes are now complete.

5.2.12 Turn ESS off


- (1) Line mode(AC input available) : Press Off key  and hold until twice beeps heard, ESS output will shut off. ESS will stay in standby mode, fan(s) keep spinning and battery will be remained recharging if AC input still available after output is off, otherwise it will be shutdown completely.
- (2) Backup mode (AC input not available): Press Off key  and hold until twice beeps heard, ESS output will shut off. 10 seconds later, fan stop spinning and ESS shutdown completely.

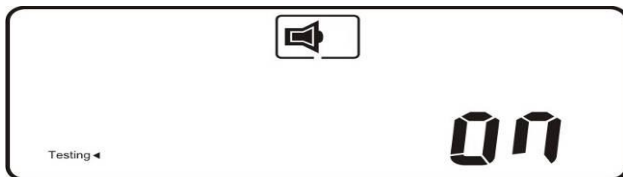
5.2.13 Self-Test (Line mode only)

The purpose of self-test function is to ensure the backup capability of battery set, and it can only be applied when ESS is working under line mode (AC input available) and battery set was proper recharged.

Press  →  key to change the LCD display to below figure.



And press  key to start Self-test as below figure



If ESS transfer to backup mode for 10sec and transfer back to line mode operation without any code or alarm, means the battery set is healthy, otherwise ESS may give code to indicate the cause of failure.

5.3 Beep Codes

The following table contains common ESS statuses with their beep codes.

ESS Status	Beep Code
ESS faulty, Inverter shut down. All functions inhibited.	Long Continuous Beep
Control keypad error	Long Continuous Beep
ESS faulty, loads continue to be supplied via Inverter or Bypass.	Single beep every two seconds
In battery mode	Single beep once per second
Battery low	Quick and short successive beeps
Confirm RS-232 port receiving	two quick and short beeps
Service mode okay	one quick and short beep

6. ESS System Block Diagram

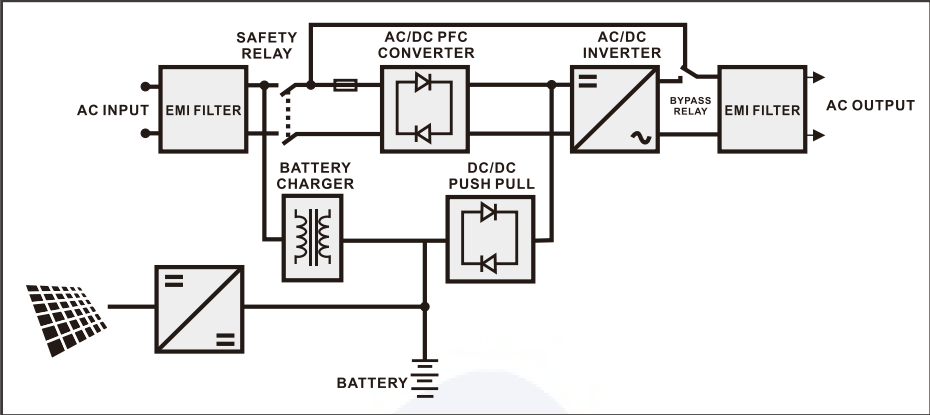











Figure 4.1

Figure 4.1 illustrates the True On-Line Double Conversion architecture of the ESS system. The major modules consist of:

- 1) An AC-to-DC power converter (rectifier) with PFC control circuit
- 2) A DC-to-AC high frequency inverter
- 3) An intelligent battery charger
- 4) A bank of stationary, maintenance-free batteries
- 5) A DC-to-DC push/pull converter control circuit
- 6) A static bypass loop
- 7) Input and output EMI filters

The table below provides a summary of the ESS operating modes under various utility AC power source and battery conditions.

Utility Condition	ESS Operating Mode	LEDs
Normal	Working power starts after approximately 5 seconds, LEDs on the panel will blink and fans will start. Press the ON button  for 1-5 seconds. The ESS starts up normally.	 ,  ,  and Load LEDs remain lit
Abnormal (under or over voltage or absent)	Rectifier and charger stop operating. Battery discharges via DC-DC boost circuit and supplies Inverter. Loads continue to receive supply from Inverter. Alarm buzzer beeps. ESS now in battery mode.	 LED off,  LED illuminated
Utility abnormal or absent, or battery voltage low	Rectifier and charger stop operating. Battery discharges via DC-DC boost circuit and supplies Inverter. Alarm buzzer beeps quickly, indicating battery power low and Inverter may stop	 LED off,  and  LEDs illuminated





	supplying soon.	
--	-----------------	--



7. Maintenance Guide

7.1 Troubleshooting


If the ESS malfunctions during operation please check that all lines are connected properly and that the utility specifications are correct. Then check the table below for solutions. Should the problem persist please contact your local dealer for assistance.

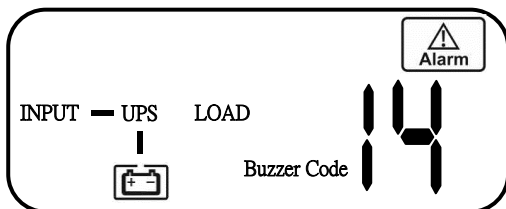
Situation	Check Items	Solution
Fault  LED Read the error code (see next page) displayed by the combination of LEDs, and verify the fault as follows.	1. Er05,Er39 	1. Check for proper battery connection. Measure battery voltage to ensure that batteries are charged and healthy. Recharge batteries for 8 hours if necessary. Simulate utility outage to verify that ESS is able to provide DC backup. Otherwise consult your local dealer right away.
	2. Overload 	2. Disconnect some non-critical loads from the ESS output until the overload ceases. Check if there is any short circuit between cables due to broken cable insulation. Replace the cables if necessary.
	3. Er11 (ESS Over Temperature)	3. Remove any objects obstructing the ventilation louvers. Verify that the cooling fans are working properly. Contact your local dealer to replace the fans if necessary.
	4. Site wiring/Ground fault 	4. Check if the "L" and "N" phases of the utility AC source have been wrongly wired or if the Ground-Neutral voltage exceeds the limits.
	5. Er14 (Fans out of order)	5. Verify that the ventilating fans are functioning properly. Do not attempt to replace the fans yourself. Contact your local dealer for replacement.
	6. Other error codes	6. Consult your local dealer for assistance.

ESS fails to provide battery backup or its backup time is shorter than its intended performance.		If the backup time remains unsatisfactory after 8 hours of charging please contact your local dealer for battery replacement.
ESS is normal, but there is no output to the load.	Check that all power cords are properly connected.	If the problem persists consult your local dealer for technical assistance.
The ESS switches into battery mode and then back into utility mode when a connected device is turned on, or the ESS switches back and forth between battery and utility modes.	1. A power strip is connected to the ESS. See if there is any damage to the utility wall receptacle or if the cord plug is faulty.	1. Do not use the power strip. 2. Replace the wall receptacle/cord plug.
Strange noise or smell		Immediately shut down the whole system. Disconnect the power from the ESS and call for service.
ESS is unable to provide backup power.		Check that the battery connectors are fully engaged. Allow the batteries to recharge if they are weak. If the problem persists after recharging replace the batteries. If the problem still persists consult your local dealer for technical assistance.

Error Codes

Checking error cord on LCD panel :

If ESS is in abnormal condition , common alarm sign  will light up and come with audible alarm. The LCD screen will shows information of alternate normal and error code. You can follow section 6.1 and 6.2 up for troubleshooting.



7.2 Error Codes and Their Meanings

Code	Meaning
Er05	Battery weak or faulty
Er06	Output short-circuited
Er07	EPO mode
Er11	ESS over-temperature
Er12	Inverter overload
Er14	Fan errors
Er39	When ESS start process, Utility Voltage less than 90V and Battery no connection.
Er28	Bypass overload

7.3 Maintenance

1. Clean the dust from the ventilation openings and intakes on the rear panel.
2. Turn off the ESS and wipe the casing with a damp cloth. Be careful to avoid getting water in the ESS.
3. Periodically unplug the power cord of the ESS from the wall receptacle to test the condition of the batteries. Be sure you have saved your data in any open computer applications before you proceed with this battery test.

8. Specifications

MODEL	ITEM	ESS-2K
CAPACITY	VA	2000 VA
	W	1600W
PV	Rated Voltage	40~120Vdc
	MPPT Range	60~120Vdc
	Max. Input Current	35A
	Max. PV Array Open Circuit Voltage	150Vdc
	PV Array Polarity Error Protection	Yes
	Connection	O type terminal block
Battery	Number of batteries	4
	Rated Battery Voltage	48 VDC
	Charge Current (Max.)	6.2A
	Floating Mode Charging Voltage	54.6Vdc±1%
	DC leakage current	≤ 30 μA with no AC applied and the unit in the off position
	Connection	O type terminal block
AC Input	Voltage Rating	55/75/90-150 VAC (Based on load percentage 0-25% / 0-75% / 0-100%)
	Frequency Rating	45-65 Hz
	Phase	Single phase with ground
	Power Factor	≥ 0.99 (with full linear load)
	Generator Input	Supported
	Connection	O type terminal block
AC Output	Voltage	120 V, adjustable to 100/110/115/120/127
	Voltage Regulation	within ±1% until low-battery warning
	Frequency (Synchronized Range)	3 Hz or 1 Hz (selectable)
	Frequency (PV Mode)	50/60 Hz ±0.2% unless synchronized to line
	Current Crest Ratio	3:1
	Harmonic Distortion	< 3% at full linear load < 7% at full non-linear load
	Output Waveform	Pure sine wave

	Connection		O type terminal block
	Overload Capacity (tolerance $\pm 1\%$)	Line mode	$< 105\%$ continuous $106-120\%$ for 30 seconds transfer to bypass $121-150\%$ for 10 seconds transfer to bypass $> 150\%$ Immediately transfer to bypass. Buzzer continuously alarms.
		PV mode	$< 105\%$ continuous $106-120\%$ for 30 seconds shuts down $121-150\%$ for 10 seconds shuts down $> 150\%$ Immediately shuts down. Buzzer continuously alarms.
		Bypass mode	$< 105\%$ continuous $106-120\%$ for 250 seconds shuts down $121-130\%$ for 125 seconds shuts down $131-135\%$ for 50 seconds shuts down $136-145\%$ for 20 seconds shuts down $146-148\%$ for 5 seconds shuts down $149-157\%$ for 2 seconds shuts down $158-176\%$ for 1 seconds shuts down $177-187\%$ for 0.32 seconds shuts down $> 188\%$ for 0.16 seconds shuts down. Buzzer continuously alarms.

Efficiency	PV mode	87%
	Line mode	91%
	ECO mode	97%
Transfer time	DC to AC	0 ms
	Bypass to Inverter	4 ms (Typical)
DC start		Yes
Self Diagnostics		Upon Power-on, Front Panel Setting & Software Control, 24 hours routine check
Front Panel	LED (Standard) LCD (Optional)	Normal, Battery, Bypass, Self-Test, Battery Weak & Bad, Site Wiring Fault , Fault, Overload, and Load/Battery Leve
	Button	ON(Silence) / OFF / Enter / Function / UP / Down
Audible Alarm	Low Battery	Sounds once every 0.2 seconds
	Overload	Sounds once every 3 seconds
	Normal alarm	Sounds once every 3 seconds
	Fault	Continuous tone
Protection	Short Circuit	Bypass mode : Fuse Normal Mode : Electronic Circuit PV Mode : Electronic Circuit

	Battery	ABDM
	Over Temperature	Normal Mode :Transfer to Bypass Mode PV Mode : ESS shuts down immediately.
Physical	Dimensions(D x W x H in mm)	480 x 445 x 155
	Weight	11Kg
Environmental	Operating Temperature	0-40℃
	Noise Level	≤50dB
	Relative Humidity	0-90% (without condensation)
Interface	Standard	USB
	Compatible Platforms	Microsoft Windows series, Linux, Mac, etc.
Standards and Certifications	Safety	UL1778 V4 (cTUVus)
	EMC	FCC Part 15 Class A
	Markings	FCC , cTUVus

