

Transformer Based Off Grid Stackable Solar Inverter Charger with DC&AC Coupling User's Manual

For Model:
MS6048D



Version 1.1 (PN:MS6048202207120)

Manufacturer Information

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Table of Content

1 Important Safety Information	1
1.1 General Safety Precautions.....	1
1.2 Precautions When Working with Batteries.....	2
1.3 Target Group	2
2 Introduction	2
2.1 General Information	2
2.2 Mechanical Design	3
2.3 Features	5
2.4 Electrical Performance	5
2.4.1 DC to AC Invert.....	5
2.4.2 AC & MPPT Charger.....	6
2.4.3 DC&AC Transfer.....	9
2.4.4 Power Saver.....	9
2.4.5 Protections	10
2.4.6 Remote Monitoring	11
2.4.7 LCD & Specification Setup.....	11
2.4.8 Audible Alarm	27
2.4.9 FAN Operation	27
2.4.10 Auto Generator Start Dry Contact	27
2.4.11 Automatic Recovery Operation	27
2.4.12 DC/AC Coupling Operation	28
2.4.13 Power Boost & AC Bypass Current Limit.....	29
2.4.14 Advanced Utility Charging & Bypass Control with Timer.....	30
2.4.15 Lithium Battery Wakeup.....	30
2.4.16 Other Features	30
3 Installation	31
3.1 Location.....	31
3.2 Unpacking and Inspection	31
3.3 Battery Wiring	32
3.4 PV Wiring	35
3.5 AC Wiring.....	35
3.6 Communication with Lithium Batteries	37
3.7 Inverter Parallel Operation	39
3.7.1 Parallel in Split Phase to Expand Power.....	39
3.7.4 LCD Setting For Parallel Operation	42
3.8 Communication with Computer	43
3.9 Grounding	43
4 Maintenance & Troubleshooting	44
5 Warranty	47
Appendix 1 : MS6048D Solar Inverter Spec Sheet.....	47

Please record the Sigineer Power unit's model and serial number in case you need to provide this information in the future. It is much easier to record this information now than try to gather it after the unit has been installed.

Order Number: _____

Model Number: _____ / **Serial Number:** _____

1 Important Safety Information

Save This Manual! Read this manual before installation, it contains important safety, installation and operating instructions. Keep it in a safe place for future reference.

All wiring must follow the National Electric Code, Provincial or other codes in effect at the time of installation, regardless of suggestions in this manual. This off grid solar inverter should be connected to a grounded wiring system. If the system ground is floating, please follow the codes in effect.

MISTAKES TO AVOID

- 1 Don't reverse the PV input polarity.**
- 2 Don't use any third-party accessories, communication cables on the inverter.**
- 3 Don't wire the AC input power to the AC output terminals.**
- 4 Don't install the inverter without AC input surge protection device (SPD)or lightning protection.**
- 5 Don't wire grid power to the inverter AC output, it is an OFF grid inverter.**

1.1 General Safety Precautions

1.1.1 Before installing and using the MS Series Off Grid Solar Inverter Charger, read the manual and cautionary markings on the Inverter/Charger enclosure. Be sure to read all instructions and cautionary markings for any equipment attached to this unit. Installers must be certified technicians or electricians.

1.1.2 This product is designed for indoor/compartment installation. Do not expose the inverter/charger to rain, snow, spray, bilge, or dust. To reduce the risk of hazard, do not cover or obstruct the ventilation openings. Do not install the inverter/charger in a zero-clearance compartment. Overheating may result. Allow at least 30CM (11.81 inches) of clearance around the inverter for air flow. Make sure that the air can circulate freely around the unit. A minimum air flow of 145CFM is required.

1.1.3 To avoid a risk of fire and electronic shock. Make sure that existing wiring is in good electrical condition; and that wire size is not undersized. Do not operate the Inverter with damaged or substandard wiring.

1.1.4 This equipment contains components which can produce arcs or sparks. To prevent fire or explosion do not install in compartments containing batteries or flammable materials or in locations which require ignition protected equipment. This includes any space containing gasoline-powered machinery, fuel tanks, or joints, fittings, or other connection between components of the fuel system. See Warranty for instructions on obtaining service.

1.1.5 Do not dis-assemble the Inverter/Charger. It contains no user serviceable parts. Attempting to service the Inverter/Charger yourself may result in a risk of electrical shock or fire. Internal capacitors remain charged after all power is disconnected.

1.1.6 To reduce the risk of electrical shock, disconnect both AC and DC power from the Inverter/Charger before attempting any maintenance or cleaning. Turning off controls will not reduce this risk

CAUTION: Equipment damage

The output side of the inverter's AC wiring should at no time be connected to public power or a generator. This condition is far worse than a short circuit. If the unit survives this condition, it will shut down until corrections are made.

Installation should ensure that the inverter's AC output is, at no time, connected to its AC input.

WARNING: LIMITATIONS ON USE

SPECIFICALLY, PLEASE NOTE THAT THE INVERTER/CHARGER SHOULD NOT BE USED IN CONNECTION WITH LIFE SUPPORT SYSTEMS OR OTHER MEDICAL EQUIPMENT OR DEVICES.

WE MAKE NO WARRANTY OR REPRESENTATION IN CONNECTION WITH THEIR PRODUCTS FOR SUCH USES. USING THE INVERTER/CHARGER WITH THESE PARTICULAR EQUIPMENTS IS AT YOUR OWN RISK.

1.2 Precautions When Working with Batteries

- 1.2.1 If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters eye, immediately flood eye with running cold water for at least 20 minutes and get medical attention immediately.
- 1.2.2 Never smoke or allow a spark or flame in the vicinity of battery or engine.
- 1.2.3 Do not drop a metal tool on the battery. The resulting spark or short-circuit on the battery or other electrical part may cause an explosion.
- 1.2.4. Remove personal metal items such as rings, bracelets, necklaces, and watches when working with a lead-acid battery. A lead-acid battery produces a short-circuit current high enough to weld a ring or the like to metal, causing a severe burn.
- 1.2.5 To reduce the risk of injury, charge only rechargeable batteries accepted by our inverter such as deep-cycle lead acid, lead antimony, lead calcium gel cell, absorbed mat, NiCad/NiFe or Lithium battery. Other types of batteries may burst, causing personal injury and damage. NEVER charge a frozen battery.
- 1.2.6 Don't install the inverter near batteries, the inverter may heat battery electrolyte and cause corrosive fumes to vent and damage/corrode nearby electronics or metals.

1.3 Target Group

This document is intended for qualified persons and end users. Tasks that do not require any particular qualification can also be performed by end users. Qualified persons must have the following skills:

- Knowledge of how an inverter works and is operated
- Training in how to deal with the dangers and risks associated with installing and using electrical devices and installations
- Training in the installation and commissioning of electrical devices and installations
- Knowledge of the applicable standards and directives
- Knowledge of and compliance with this document and all safety information

2 Introduction

2.1 General Information

Thank you for purchasing the MS6048D Off Grid Solar Inverter/Chargers.

The MS6048D transformer based Off Grid Solar Inverter/Charger is a combination of 4 products:

- 1. Transformer based DC to AC power inverter**
- 2. AC to DC utility battery charger**
- 3. 80A MPPT Solar Charger Controller**
- 4. High Speed DC/AC Transfer Switch(10ms).**

It is a very technically advanced off grid solar inverter on the market.

Its powerful DSP (digital signal processor) makes it very versatile and almost all of its specifications can be

adjusted via its top cover LCD or remote LCD panel, such as AC output voltage, frequency, power priority, low/high battery cutoff, charging profiles & amperage, DC/AC transfer conditions, etc.

Our MPPT charger is able to harness the PV production to charge batteries with a peak efficiency of 97%, it will also work when the inverter is powered off.

The MS6048D model is built with 48V DC input and output pure sine wave split phase output.

You can get 36KW split phase by stacking them up to 6 pcs.

The unit can operate without batteries if there is AC input power.

The timer built in the inverter enables the inverter to use the utility to power loads and battery charging at preset time.

In AC mode, when an error is triggered, the inverter will bypass power and cut off charging instead of power it off. This guarantees the power continuity of the loads.

Its power boost feature allows it to combine AC input and battery to power loads up to 12KW.

It can create an AC coupled system with grid tie inverters by paralleling the AC outputs to the loads.

This allows the users to easily retrofit the on-grid system without removing the grid inverter.

The AGS terminals will allow the inverter to start the generator at preset low voltage and shut it off at preset voltage.

It supports different types of remote monitoring with Remote LCD Panel (Sold separately), Wi-Fi or GPRS module or computer.

The BMS port communicates with lithium battery for optimal operation of batteries.

It also has a programmable “US2” setting which works with lithium batteries without BMS communication with the inverter.

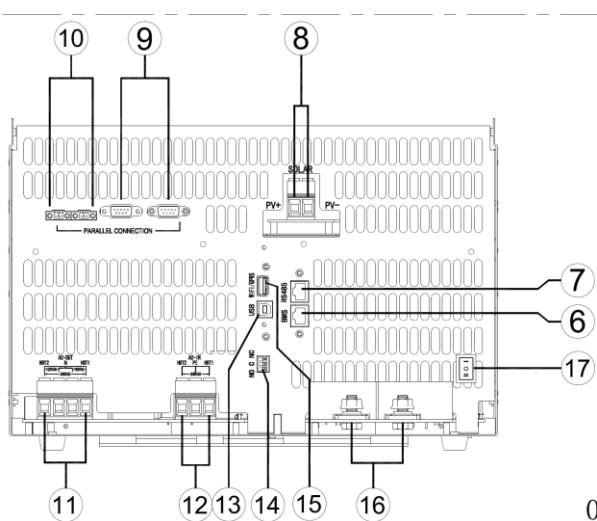
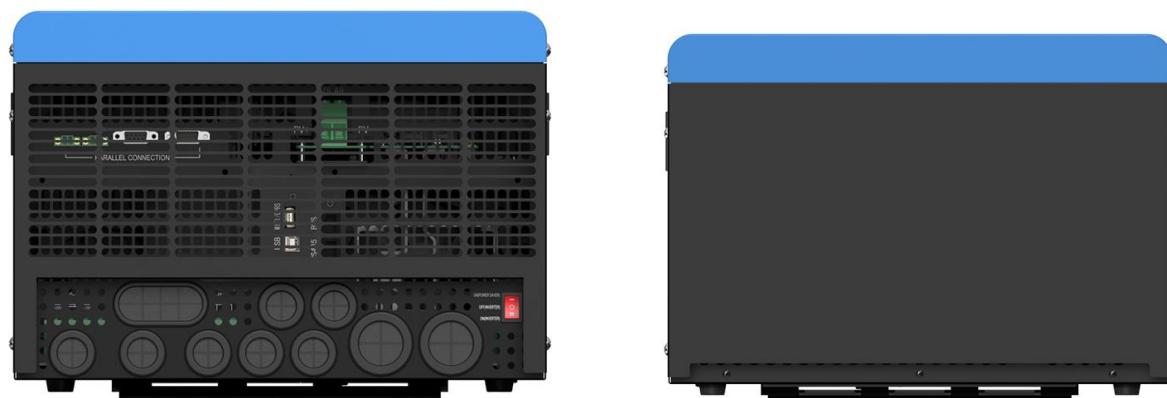
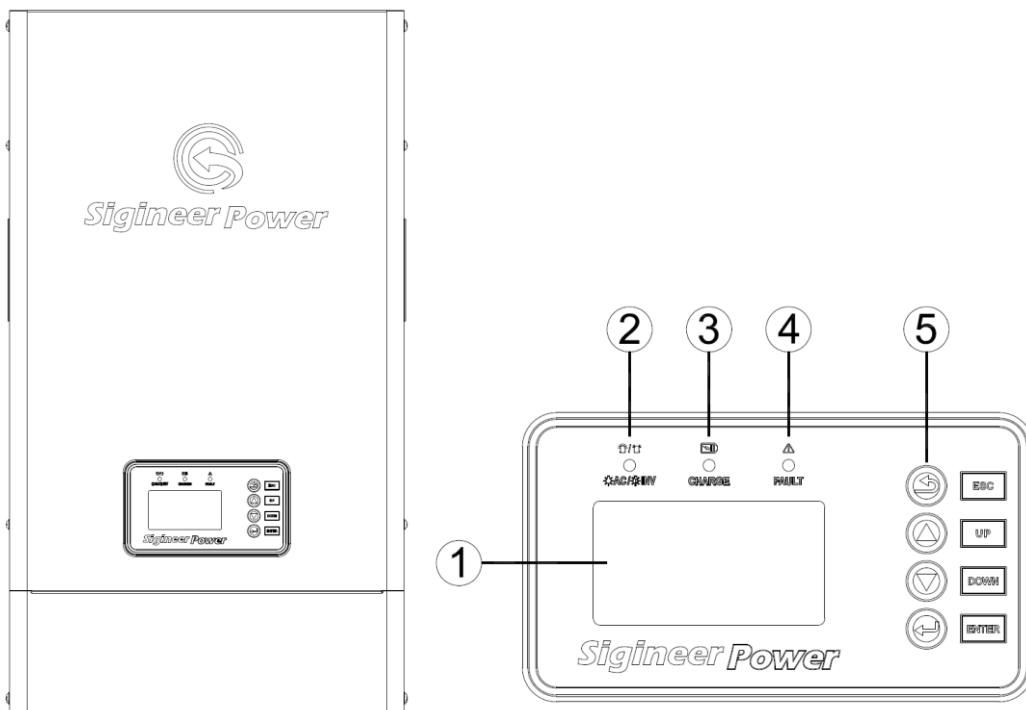
The 200% surge capacity of 5 seconds makes it possible to support demanding inductive loads.

Thus the MS Series Solar Inverter/Charger is suitable for a myriad of applications including renewable energy systems, utility, truck, RV and emergency vehicles etc.

To get the most out of the power inverter, it must be installed, used and maintained properly. Please read the instructions in this manual before installing and operating.

Model Comparison			
Item	Feature	M6048D/M6048UL	MS6048D
1	Idle	90W	30W
2	Peak DC to AC Efficiency	90%	93.50%
3	Peak Utility Charger Efficiency	83%	91.80%
4	Utility Charger Pulse	380%	200%
5	AC Bypass Protection	Breaker	Software 50A
6	Lithium Battery Wakeup with Utility Charger	N/A	YES
7	Batteryless Operation with AC Input	N/A	YES
8	Power Boost	N/A	YES
9	Ac Bypass Current Limit	N/A	YES
10	AC Coupling with Grid Tie Inverter	N/A	YES
11	Parallel Operation	N/A	YES

2.2 Mechanical Design



1.LCD Display	2.Status Indicator	3.Charging Indicator
4.Fault Indicator	5. Function Buttons	6. BMS Communication Port(For RS485/CAN Protocol)

7. RS485 Communication Port (For Expansion)	8. PV Input Terminal	9. Parallel Communication Ports
10. Current Sharing Ports	11 AC Output	12. AC Input Terminal
13. USB Port (connects to computer)	14. AGS Dry Contact	15. Wi-Fi/GPRS Port
16. Battery Terminals	17. ON/OFF Power Switch	

2.3 Features

- * AC Coupling with Grid Tie Inverters
- * Stackable up to 6 pcs
- * Power Boost to Combine AC Input with Battery for Supporting Loads up to 12KW
- * Automatic Solar Charging When the Inverter is Powered Off
- * Batteryless Operation with AC Input
- * Advanced Utility Charging & Bypass Control with Timer
- * AC Mode Bypass in the Event of Errors
- * Peak DC to AC Conversion Efficiency of 93.5%
- * Auto Generator Start
- * Smart remote monitor with WI-FI or GPRS Module
- * Remote LCD Panel with Adjustable Parameters
- * 80A MPPT Solar Charger
- * Maximum THD: 3% at nominal battery voltage
- * Powerful 4-stage power factor corrected battery charger
- * High surge output capability, 200% peak load for 5 seconds
- * Equalization Charging
- * 20ms transfer time from AC to battery for the continuous load operation
- * Thermally controlled variable speed fan for more efficient cooling
- * Extensive protections against various harsh situations
- * Solar Priority or SBU developed for renewable energy systems

2.4 Electrical Performance

2.4.1 DC to AC Invert

Overload Capacity

The MS6048D inverter/charger has different overload capacities, making it ideal to handle demanding loads.

- 1 For $101\% < \text{Load} < 150\%$, Fault (Power off) after 10 seconds.
- 2 For $150\% < \text{Load} \leq 200\%$, Fault (Power off) after the 5 seconds.

Caution:

After the inverter is switched on, it takes a finite time for it to self diagnose and get ready to deliver full power. Hence, the user should always switch on the load(s) after a few seconds of switching on the inverter to avoid switching on the load before the inverter is powered on. This may prematurely trigger the overload protection. When a load is switched on, it may require a higher initial power surge to start. If multiple loads are being powered, they should be switched on one by one so that the inverter is not overloaded by the higher starting surge.

DC to AC Conversion Efficiency

Load Wattage	600W	1200W	1800W	2400W	3000W	3600W	4200W	4800W	5400W	6000W
45Vdc	92.51%	93.27%	93.54%	93.11%	92.60%	91.50%	90.20%	89.80%	88.50%	86.90%
48Vdc	92.12%	92.81%	92.63%	92.31%	91.84%	90.68%	89.38%	88.38%	87.31%	86.67%
54Vdc	91.98%	92.65%	92.32%	91.61%	90.95%	89.90%	88.81%	87.95%	87.20%	86.41%

2.4.2 AC & MPPT Charger

The MS Series pure sine wave inverter/charger is equipped with an active PFC (Power Factor Corrected) multistage battery charger. The PFC feature is used to control the amount of power used to charge the batteries in order to obtain a power factor as close as possible to 1.

The V Series pure sine wave inverter/charger has a very rapid charge current available, and the max charge current can be adjusted from 10% to 100% in small increments on the LCD of the inverter. This will be helpful if this powerful charger applies charging on a small capacity battery bank.

The max charging current decreases according to the input AC voltage.

There are three main charging stages:

Bulk Charging: This is the initial stage of charging. While Bulk Charging, the charger supplies the battery with controlled constant current. The charger will remain in Bulk charge until the Absorption charge voltage (determined by the Battery Type selection) is achieved.

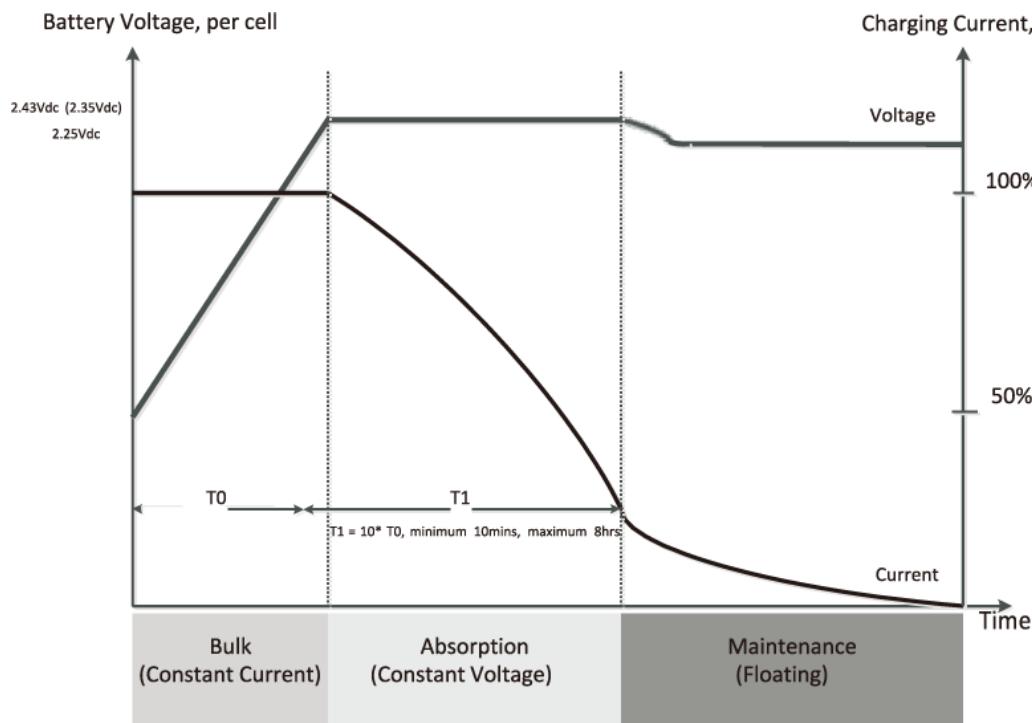
Software timer will measure the time from charger start until the battery charger reaches 0.3V below the boost voltage, then take this time as T0 and $T0 \times 10 = T1$.

Absorb Charging: This is the second charging stage and begins after the absorb voltage has been reached. Absorb Charging provides the batteries with a constant voltage and reduces the DC charging current in order to maintain the absorb voltage setting.

In this period, the inverter will start a T1 timer; the charger will keep the boost voltage in Boost CV mode until the T1 timer has run out. Then drop the voltage down to the float voltage. The timer has a minimum time of 10 minutes and a maximum time of 8 hours. When charging current reduces to below 0.01C, the charger will go to the float charge.

Float Charging: The third charging stage occurs at the end of the Absorb Charging time. While Float charging, the charge voltage is reduced to the float charge voltage (determined by the Battery Type selection*). In this stage, the batteries are kept fully charged and ready if needed by the inverter.

If the battery type is selected as “lithium battery”, our charger will drastically reduce the charging current to zero once float voltage is reached.



The charging capacity will go to peak in around 3 seconds, this may probably cause a generator to drop frequency, making inverter transfer to battery mode.

It is suggested to gradually put charging load on the generator by switching the charging switch from min to max, together with the 15s switch delay, our inverter gives the generator enough time to spin up.



Caution:

To guarantee the best performance of AC charger when the AC input is from a generator, the standby generator should be of at least 150% higher capacity than the inverter.

Warning! Operation with an under-rated generator or generator with unqualified wave form may cause premature failure which is not under warranty.

Battery Equalization

Equalization function is added into the MS Series inverter charge controller. It reverses the buildup of negative chemical effects like stratification, a condition where acid concentration is greater at the bottom of the battery than at the top. Equalization also helps to remove sulfate crystals that might have built up on the plates. If left unchecked, this condition, called sulfation, will reduce the overall capacity of the battery. Therefore, it's recommended to equalize battery periodically.

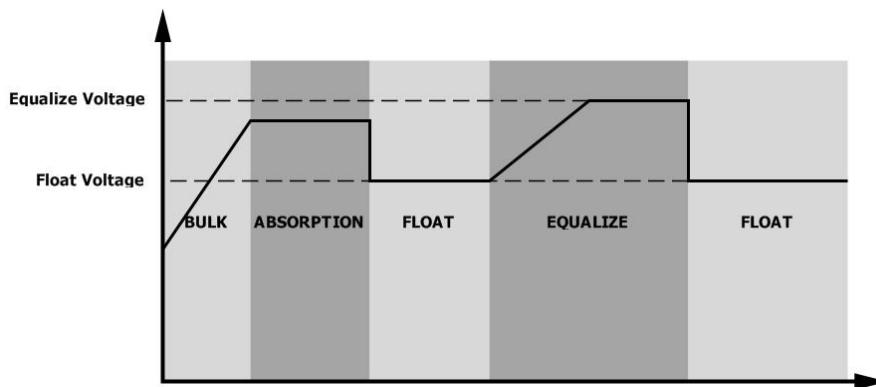
How to Apply Equalization Function

You must enable battery equalization function in monitoring LCD setting program 43 first. Then, you may apply this function in device by either one of following methods:

1. Setting equalization interval in program 47.
2. Active equalization immediately in program 48.

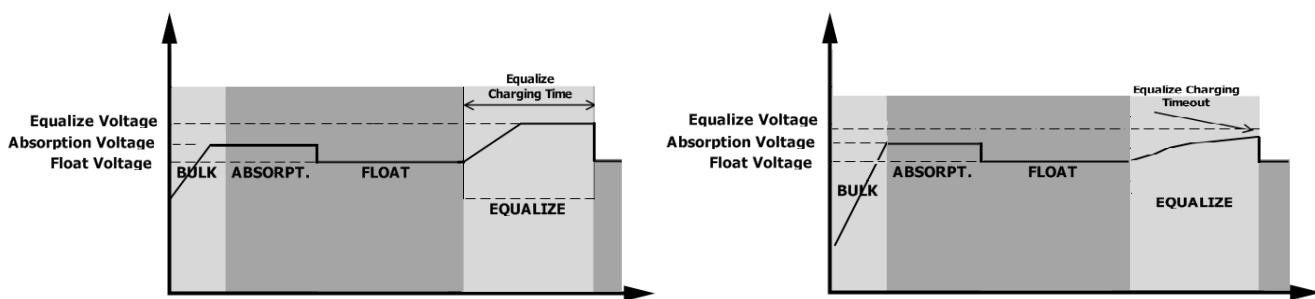
When to Equalize

In float stage, when the setting equalization interval (battery equalization cycle) is arrived, or equalization is active immediately, the controller will start to enter Equalize stage.



Equalize charging time and timeout

In Equalize stage, the controller will supply power to charge battery as much as possible until battery voltage raises to battery equalization voltage. Then, constant-voltage regulation is applied to maintain battery voltage at the battery equalization voltage. The battery will remain in the Equalize stage until setting battery equalized time is arrived.



However, in Equalize stage, when battery equalized time is expired and battery voltage doesn't rise to battery equalization voltage point, the charge controller will extend the battery equalized time until battery voltage achieves battery equalization voltage. If battery voltage is still lower than battery equalization voltage when battery equalized timeout setting is over, the charge controller will stop equalization and return to float stage.

Note: The MS6048D AC charger pulse has been significantly improved, it is less than 200% of the nominal setting.

The MS Series pure sine wave inverter/charger is built with MPPT solar charging modules up to 80A.

Model #	AC Charging Current	MPPT Solar Charger	Max Charging Current
MS6048D	60A	80A	140A

Charger Voltage Range	High Voltage Recovery	
191-265Vac	260Vac	

When AC input is in the range of 155~190VAC, the maximum charge current is 30A.

The MPPT Solar Charger will automatically work when the inverter is powered off.

Even when the power switch is in unit off position, the built-in solar charger will automatically work when PV input voltage and battery voltage is qualified, this is to optimize solar production for battery charging. But the inverter will not convert battery power to AC output.

When the battery is fully charged, the inverter will keep the battery capacity at 100%, and convert the extra PV power directly from DC to AC to power loads.

When the battery is fully charged, the voltage has to drop by 2 volts (or below 95% of SOC when BMS communication is established) to activate the charger.

AC Charger Efficiency at 230Vac

Utility Charger	10A	20A	30A	40A	50A	60A
Efficiency	90.69%	91.16%	91.79%	90.34%	89.46%	88.13%

MPPT Solar Charger Efficiency

MPPT Charger	Battery Voltage (Vdc)	Battery Charge Current(A)	Battery Charge Power(W)	PV Input Voltage(Vdc)	PV Input Current(A)	PV Input Wattage	MPPT Charge Efficiency (%)
80A	54.9	81.0	4447.7	98.0	47.3	4636.0	95.9%
70A	54.6	70.7	3863.8	98.5	40.7	4012.7	96.3%
60A	54.6	60.6	3310.9	98.9	34.7	3430.3	96.5%
50A	54.5	50.5	2749.1	99.1	28.6	2839.5	96.8%
40A	54.3	40.3	2188.8	99.5	22.7	2259.3	96.9%
30A	54.1	30.2	1632.7	99.8	16.9	1684.3	96.9%
20A	53.9	20.1	1080.3	100.1	11.2	1118.8	96.6%
10A	53.7	9.9	533.5	100.4	5.6	562.5	94.8%

2.4.3 DC&AC Transfer

While in the Standby Mode, the AC input of the inverter is continually monitored. Whenever AC power falls out of the trip voltages, the inverter automatically transfers back to the Invert Mode with minimum interruption to your appliances.

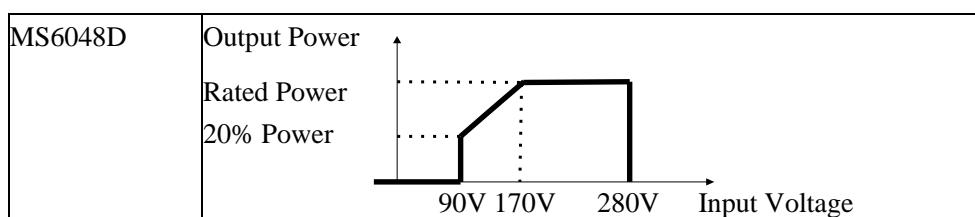
The transfer from AC mode to Inverter mode occurs in approximately 10 milliseconds, with the worst case of 20 milliseconds. And it is the same time from Inverter mode to Standby mode.

Though it is not designed as a computer UPS system, this transfer time is usually fast enough to hold them up as devices like computers can generally tolerate a max power loss of 20ms.

When the inverters are paralleled, the transfer time is <30ms.

Bypass output power derating:

When AC input voltage drops below 170Vac, the output power will be de-rated linearly to as long as 20% at 90Vac.



2.4.4 Power Saver

There are two working statuses for the inverters: “Power On” and “Power Off”.

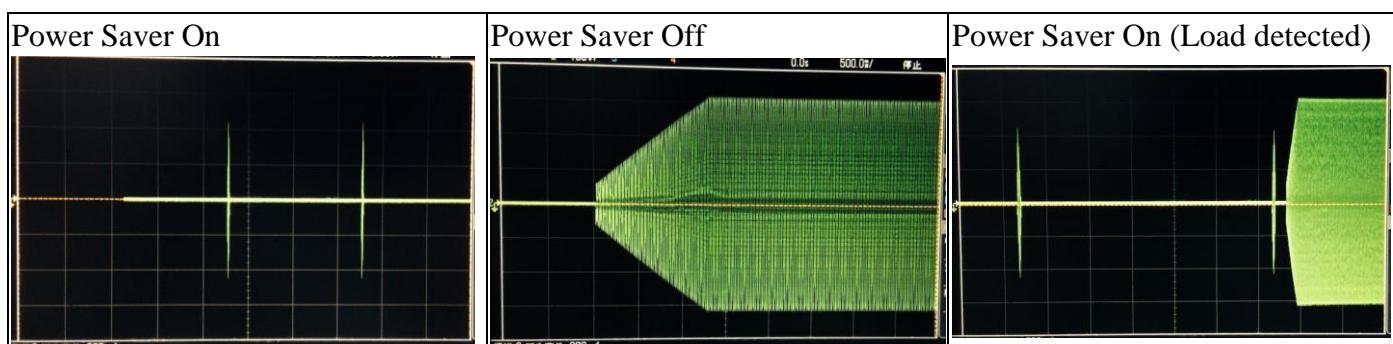
When power switch is in the “Unit Off” position, the inverter is powered off.

When power switch is turned to “Power ON”, the inverter is powered on.

When the inverter is powered on, users can activate “power saver” in the program 04 of the software. The “Power Saver” function is dedicated to conserve battery power when AC power demand is either minimal or not required at all by the loads.

In this mode, the inverter pulses the AC output in every 30 seconds looking for an AC load (i.e., electrical appliance). Whenever an AC load (greater than 100 watts) is turned on, the inverter recognizes the need for power and automatically starts inverting and output goes to full voltage. When there is a small load (less than 100 watts) detected, the inverter automatically goes back into search mode to minimize energy consumption from the battery bank.

In “Power saver” mode, the inverter will draw power mainly in sensing moments, thus the idle consumption is reduced from 60 watts to 30 watts.



Note: The minimum power of a load to take inverter out of sleep mode (Power Saver On) is 100 Watts.

When the inverter is in idle, even there is AC input power, the inverter will discharge the battery as the LCD, relay, fans are powered by DC.

For more detailed technical information, please contact us.

In the “search sense” mode, the LED will blink and the inverter will make a ticking sound. At full output voltage, the inverter will make a steady humming sound. When the inverter is used as an “uninterruptible” power supply the search sense mode function should be defeated.

Exceptions

Some devices, when scanned by the load sensor, cannot be detected. Small fluorescent lights are the most common example. (Try altering the plug polarity by turning the plug over.) Some computers and sophisticated electronics have power supplies that do not present a load until line voltage is available. When this occurs, each unit waits for the other to begin. To drive these loads, either a small companion load must be used to bring the inverter out of its search mode, or the inverter may be programmed to remain operating at full output voltage.

2.4.5 Protections

The MS Series inverter/charger is equipped with extensive protections against various harsh situations/faults.

These protections include:

- AC Input over voltage protection/AC Input low voltage protection
- Low battery alarm/High battery alarm
- Over temperature protection/Over load protection

- Short Circuit protection (1s after fault)
- Battery Polarity Reverse Protection

Users can customize whether the inverter should automatically restart or not after some of these protections.

Warning !

The below mistakes will damage the inverter permanently and must be avoided:

- *Reverse the PV input polarity.
- *Use any third-party accessories, communication cables on the inverter.
- *Wire the AC input power to the AC output terminals.

2.4.6 Remote Monitoring

The MS Series inverter can be remotely monitored and controlled.

It supports 4 different types of remote monitoring

1. Plug in the remote LCD panel to the RS485 port.
2. Connects it to a computer via the USB port and monitor the inverter on the software.
3. Plugs a Wi-Fi or GPRS module into Wi-Fi port, monitor it on a computer or cellphone APP.
4. Connect to the RS485 port, it allows customer to monitor on their own software programmed with the same protocol.



To monitor the inverter on a computer, please download the software (**SG Solar Power Monitor**) from our website in the Support>Software Download section.

The MS Series inverters can be remotely monitored by a Wi-Fi or GPRS module plugged into its USB port.

The Wi-Fi / GPRS module is a plug-and-play monitoring device which allows users to monitor the status of the PV system from a mobile phone APP or from the website anytime anywhere.

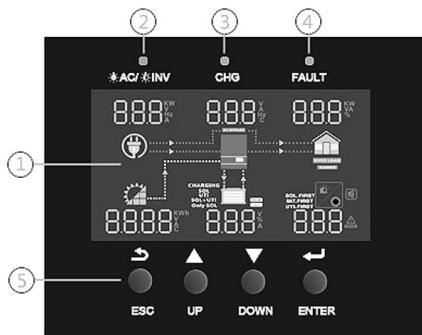
The inverter's AC output power can be powered on and off via APP.

The Sigineer Monitor APP will automatically refresh the data in every 5 minutes. To access real date, please roll down the screen to refresh.

To monitor the inverter via both WiFi and USB port, the RMT-WiFi module can be connected via a short extension cable.

2.4.7 LCD & Specification Setup

Press the On/Off switch to turn on the unit.



The operation and display panel area includes three LED indicators, four function keys and a LCD display. It shows very rich operating info.

1 LCD display 2 Status indicator 3 Charging indicator 4 Fault indicator 5 Function buttons

LED Indicator	Operation Status		
	Green	Solid On	Output is powered by utility in AC mode.
		Flashing	Output is powered by battery or PV in battery mode.
	Green	Solid On	Battery is fully charged.
		Flashing	Battery is being charged.
	Red	Solid On	Fault occurs in the inverter.
		Flashing	Warning condition occurs in the inverter.

Icon	Description
	To exit setting mode
	To go to previous selection
	To go to next selection
	To confirm the selection in setting mode or to enter setting mode

Icon	Description
AC Input Information	
	AC input icon
	Indicate AC input power, AC input voltage, AC input frequency, AC input current
	Indicate AC power loads in bypass
PV Input Information	
	PV input icon
	Indicate PV power, PV voltage, PV current, etc
Output Information	
	Inverter icon

	Indicate output voltage, output current, output frequency, inverter temperature
Load Information	
	Load icon
	Indicate power of load, power percentage of load
	Indicate overload happened
	Indicate short circuit happened
Battery Information	
	Indicate battery level by 0-24%, 25-49%, 50-74% and 75-100% in battery mode and charging status in line mode.
	Indicate battery voltage, battery percentage, battery current
	Indicate SLA battery
	Indicate lithium battery
	Indicate charging source priority: solar first, solar and utility, or only solar
Other Information	
	Indicate output source priority: solar first, utility first, SBU mode or SUB mode
	Indicate warning code or fault code
	Indicate a warning or a fault is happening
	Indicate it's during setting values
	Indicate the alarm is disabled

In AC mode, battery icon will present Battery Charging Status

Status	Battery voltage	LCD Display
Constant Current mode Constant Voltage mode	<48V	4 bars will flash in turns.
	48 ~ 50V	Bottom bar will be on and the other three bars will flash in turns.
	50 ~ 52V	Bottom two bars will be on and the other two bars will flash in turns.
	> 52V	Bottom three bars will be on and the top bar will flash.
Floating mode. Batteries are fully charged.		4 bars will be on.

CC&CV Charge Mode	Battery Voltage @ Load >50%	Battery Voltage @ Load > 20%	Battery Voltage @ Load < 20%	Icon
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<48V	< 41.2V	< 43.6V	<44.8V	
48-50V	41.2-43.2V	43.6-45.6V	44.8-46.8V	
50-52V	43.2-45.2V	45.6-47.6V	46.8-48.8V	
>52V	> 45.2V	> 47.6V	>48.8V	

Load Information				
OVER LOAD	Indicates overload.			
  100% 25%	Indicates the load level by 0-24%, 25-49%, 50-74% and 75-100%.			
	0%~24%	25%~49%	50%~74%	75%~100%
				
Mode Operation Information				
	Indicates unit connects to the mains.			
	Indicates unit connects to the PV panel.			
BYPASS	Indicates load is supplied by utility power.			
	Indicates the utility charger circuit is working.			
	Indicates the DC/AC inverter circuit is working.			
SOL.FIRST BAT.FIRST UTI.FIRST	These three signs indicate the output priority. SOL.FIRST indicates solar first. BAT.FIRST indicates battery first. UTI.FIRST indicates utility first.			
Mute Operation				
	Indicates unit audible alarm is disabled.			

LCD SETTING

The MS6048D inverter LCD allows users to virtually change all of its specs. It will enter setting mode if the ENTER button is held for 3 seconds. Press “UP” or “DOWN” button to select setting programs, and then press “ENTER” button to confirm the selection or ESC button to exit.

Program 01: Power Priority for AC Loads

01 UEI: Utility Priority (Default)

In this mode, the utility will provide power to the AC loads as the first power source.

Solar and battery energy will provide power to the loads only when utility power is not available.

This mode works for applications with cheap utility power or using battery in power outages.

Utility>Solar=Battery

01 SOL: Solar Priority

In this mode, the solar energy provides power to the loads as the first power source.

If solar energy is insufficient, battery energy will be consumed.

Utility power will engage when one of below conditions happens:

1 Solar energy is not available (No PV production).

2 Battery voltage drops to either low-level warning voltage or the setting point in program 12 (DC to AC Transfer Voltage in “SOL Priority”).

Once the solar power is lost, the utility will have higher priority than battery.

In this mode, the inverter will transfer between DC and AC as per the settings of program 12 and 13. Users can set it to utility priority to stop the cycling.

01 SbU: SBU Priority

As indicated by the abbreviation, the power priority comes as solar>battery>utility.

Solar energy provides power as the first priority.

If solar energy is insufficient, battery energy will be consumed.

Utility provides power to the loads only when battery voltage drops to either low-level warning voltage or the setting point in program 12(DC to AC Transfer Voltage in “SBU Priority”).

When solar is gone in SBU mode, the power priority becomes battery>utility, battery priority is higher than utility priority.

In this mode, the inverter will transfer between DC and AC as per the settings of program 12 and 13. Users can set it to utility priority to stop the cycling.

Utility> Battery >Solar

01 SUB Priority (with Power Boost)

When SUB is selected, the inverter is able to boost output power with AC input power by combining the AC input power with the inverted power from battery to support a load over the nominal power.

When the program 42 is set to 30A and the AC voltage set to 240Vac, the inverter AC output is 30A*240V(6000W) + 6000W (Nominal Power) =13.2KW.

For more details, please refer to program 42.

In this SUB mode, solar energy provides power to the loads as the first source.

If solar energy is not sufficient to power the loads, utility will jointly power loads.

If battery voltage drops to value set at Program 90 or lower, utility grid and solar energy will both power loads and charge battery.

Battery provides power to the loads only when solar energy is not sufficient and there is no utility.

Choose SUB, then press ENTER to switch to Program 90, it is battery charging voltage threshold.

(Program 21 < Program 90 < Program 20) Default 52V, 44V~56V Settable.

Program 02: Maximum Charging Current

MS6048D model: default 80A, 10A~140A Settable

(If Li is selected in program 5, this program can't be set up)

The MPPT charger will stop when charging is completed. To activate the charger, the battery voltage must drop at least 2 voltages below the lower value in program 19 and 20.

Program 03: AC Input Voltage Range

03 APL: Appliance Mode

In Appliance Mode, the acceptable AC input voltage range is

MS6048D	154~272VAC±7V.
---------	----------------

03:UPS

In UPS Mode, the acceptable AC input voltage range:

MS6048D	184~272VAC±7V.
---------	----------------

Note: When the inverter is connected to a generator, the generator should be more than twice the inverter nominal power.

Program 05: Battery Type

05: AGN

AGM Battery (Default) : CV :56.4V, Float 54V.

05: FLd

Flood Battery: CV :58.4V, Float 56V.

05: USE

User-Defined

If “User-Defined” is selected, battery charge voltage and low DC cut-off voltage can be set up in program 19, 20 and 21. This setting works for GEL batteries etc.

05: US2

User-Defined 2

This US2 setting is designed for the inverter to work with lithium battery without communication via BMS. As floating charging is not required for lithium batteries, in US2 mode, the program 19&20 will be interlocked and set to the same value whenever one of them is changed.

Compared with USE, the charger in US2 will immediately reduce charging current when the preset voltage in 19 is reached.

NOTE: The US2 will not optimally charge the lithium battery due to the lack of BMS communication. The battery capacity icon bar doesn't reflect the actual battery capacity; it is converted from battery voltage. For more details, please refer to page 13.

When the inverter is in US2, it could not correctly display the accurate SOC of the lithium batteries.

The displayed SOC is converted from battery voltage. The SOC will change only when the battery voltage changes big enough.

Due to the ripple current from the utility charger, when “US2” is set for charging lithium batteries, it is recommended to set the max utility charging current at 30% of the nominal charge current.

05: LI

Lithium

This setting only works when inverter communicates with lithium battery BMS built with the same protocol. The program is set to “LI”, the LCD will show a hidden program of 91 about BMS protocol types.

There are many lithium battery BMS communication protocols, L01, L02 to L99.

For Sigineer Power LFP power walls, the protocol is L01.

When the battery type set as “LI”, the maximum charge current can be modified by the user.

Note: When the communication fails, the inverter will cut off output.

RS485 communication protocol is L01 to L50.

The CAN communication protocol is L51 to L99.

Note: When the battery type set to “LI”, the setting option 12, 13, 21 will change to display SOC percent.

Note: When the battery type set as “LI”, the maximum charge current can't be changed by the user. When the communication fails, the inverter will cut off output.

Program 06: Overload Restart/Bypass

06: dIS

Disabled.

06: ENA

When this feature is enabled, the inverter will attempt to restart 3 times after overloads, if it still fails to start the load after 3 attempts, it will show warning code 07.

06:bYP

When this feature is enabled, the inverter will use AC input power to bypass loads automatically when overload in battery mode.

Program 08: AC Output Voltage

The AC output voltage between H1 and H2 can be set to 208V, 220V, 230V and 240V for MS6048D.

Program 09: AC Output Frequency

The AC Output Frequency can be set to 50Hz or 60Hz.

Program 11: Maximum Utility Charging Current

Model #	Default Value	Resettable Range
MS6048D	30A	0-60A

The solar charger has higher priority than the utility charger, if the max charging current and utility charger is set to the same value, the solar charger will still work.

If setting value in Program 02 is smaller than that in Program 11, the final charging current is set according to Program 02 for utility charger.

Program 12 DC to AC Transfer Voltage

The setting works when program 01 is in “SBU Priority” or “Solar Priority” Mode.

Model #	Default Value	Resettable Range
MS6048D	46V/40%	44V~51.2V/6%-50%

The battery SOC will be displayed when BMS communication is established.

Program 13 AC to DC Transfer Voltage

The setting works when program 01 is in “SBU Priority” or “Solar Priority” Mode.

Model #	Default Value	Resettable Range
MS6048D	54V/80%	48V~58V/51%-100%

The battery SOC will be displayed when BMS communication is established.

Program 14 Charge Power Source Priority

14:CSO

Solar Priority

Solar energy will charge battery as the first priority.

Utility will charge battery only when solar energy is not available (lost).

14:SNU

Solar and Utility (Default)

Solar energy and utility will both charge battery.

14:OSO

Solar Only

Solar energy will be the only charger source no matter utility is available or not.

But when the battery voltage drops below the setting of 21(Low DC Cut-off Voltage) , the utility power will be used to force a charging cycle to avoid battery over discharging.

14:CUT

Utility First.

Utility will charge battery as the the first priority.

Solar energy will charge battery only when utility power is not available.

If this off grid solar inverter is working in DC to AC invert mode, only solar energy can charge the battery.
Solar energy will charge battery if it's available and sufficient.

Program 15 Alarm On/Off Control

Program 16 Backlight On/Off Control

When off is set, the LCD will go dim after 60 seconds left unattended.

Program 17 Beeps once between AC and DC Transfer

Program 18 Overload Bypass

When enabled, the unit will transfer to line mode if overload occurs in battery mode.

Program 19 C.V. Charging Voltage

Model #	Default Value	Resettable Range
MS6048D	56.4V	48V~58.4V

If user-defined setting (USE/US2) is selected in program 5, this program can be set up.

When the battery is charged to CV setting, the voltage must drop by 2 volts to activate the charger.

Program 20 Float Charging Voltage

Model #	Default Value	Resettable Range
MS6048D	54V	48V~58.4V

If user-defined setting (USE/US2) is selected in program 5, this program can be set up

Program 21 Low Battery Cut-Off Voltage

Model #	Default Value	Resettable Range
MS6048D	42V/20%	40V~48V/5%~49%

The battery SOC will be displayed when BMS communication is established.

After User-defined (USE/US2) setting is selected in program 5, this program can be set up

Low DC cut-off voltage will be fixed to setting value regardless of load percentage.

When low DC Cut-Off voltage is reached:

1. If battery is the only power source, inverter will shut down.
2. If PV energy and battery power are available, inverter will charge battery without AC output.
3. If PV energy, battery power and utility are all available, inverter will transfer to line mode and provide output power to loads and charge the battery at the same time.

When low battery voltage protection occurs and qualified PV or AC power inputs, the inverter will automatically charge and invert DC to AC when the battery voltage reach 54V Or 10% more SOC than low battery cut off in Lithium mode).

To make it work, the power switch must remain in the original “ON” position.

When the Program 12: DC to AC Transfer Voltage value is already set, the Program 21: Low Battery Cut-Off Voltage value must be lower than that. When the two values conflicts, the value in program 21 will automatically revert back.

Program 22 RS485 Communication Address

Default 001,001-255 Settable.

It is for communication with external solar charger.

Program 23 AC Output Mode

23:SIG

Single Unit Operation.

When unit operates separately and is not in parallel operation.

23:PAL

Parallel in Single Phase

When the units are used in parallel with split phase, please select “PAL” in program 23.

The parallel setting is only available when the inverters are connected to batteries.

Program 27 Battery Equalization

If “Flooded” or “User-Defined” is selected in program 05, this program can be set up. The Equalization is banned for AGM batteries.

Program 28 Battery Equalization Voltage

Model #	Default Value	Resettable Range
MS6048D	58.4V	48-60V

This setting should be higher than that of program 19.

Program 29 Battery Equalized Time

Default 60min, 5min~900min Settable

Program 30 Battery Equalized Timeout

Default 120min, 5min~900min Settable

Program 31 Equalization Interval

Default 30days, 1 day~90 days Settable

Program 32 Instant Equalization Activation

If equalization function is enabled in program 27, this program can be set up. If “Enable” is selected in this program, it’s to activate battery equalization instantly and LCD main page will shows “Eq”. If “Disable” is selected, it will cancel equalization function until next activated equalization time arrives based on program 31 setting. At this time, “Eq” will not be shown in LCD main page

Program 36 Lithium BMS Protocol

For Sigineer Power LFP power walls, the protocol is L01.

Please refer to “05: LI” for details.

Program 36 Real time setting---Year

Default 2000, range 2000~2099

Program 37 Real time setting---Month

Default 01, range 01~12

Program 38 Real time setting---Date

Default 01, range 01~31

Program 39 Real time setting---Hour

Default 00, range 00~23

Program 40 Real time setting---Minute

Default 00, range 00~59

Program 42 Max AC Input Current in Power Boost

Default 30A, adjustable from 5A to 30A.

This program controls the max AC input current in power boost mode.

When in power boost, the inverter will combine the AC input power with the inverted power from battery to support a load over the nominal power.

When the program 42 is set to 30A and the AC voltage set to 240Vac, the inverter AC output is 30A*240V(6000W) + 6000W (Nominal Power)=13.2KW.

Previously, the older Sigineer inverters doesn’t have AC input current control, it will pull as much AC power as it is needed for the loads and utility charger, resulting in an overload at the AC input power source with limited wattage.

Now with the AC bypass current limit, customers can safely power the inverter system with a smaller power source.

Program 49 Utility Charging Time

Allow utility to charge the battery all day run.

0000(default)

The timer allows utility to charge the battery at preset time.

Use 4 digits to represent the time period, the upper two digits represent the time when utility start to charge the battery, setting range from 00 to 23, and the lower two digits represent the time when utility end to charge the battery, setting range from 00 to 23.

(eg: 2320 represents the time allows utility to charge the battery is from 23:00 to the next day 20:59, and the utility charging is prohibited outside of this period)

Program 50 AC Output Time

Allow inverter to power the load all day run.

0000(default)

The timer allows inverter to power the load at preset time.

Use 4 digits to represent the time period, the upper two digits represent the time when inverter start to power the load, setting range from 00 to 23, and the lower two digits represent the time when inverter end to power the load, setting range from 00 to 23.

(eg: 2320 represents the time allows inverter to power the load is from 23:00 to the next day 20:59, and the inverter AC output power is prohibited outside of this period)

Note:

Some of the program settings are interlocked with other settings, for example:

1 When the program 05 is set to AGM、FLD, the program 19, 20 and 21 will be locked to factory default value.

2 When program 05 is set to LI, the program 02 max charging current setting will be locked.

Program #	Description	ICON
01 Power Priority for AC Loads	Utility Priority	OPPF UTI 00 1
01 Power Priority for AC Loads	Solar Priority	OPPF SOL 00 1
01 Power Priority for AC Loads	SBU Priority	OPPF SBU 00 1
01 Power Priority for AC Loads	SUB Priority	OPPF SUB 00 1 SUB 520 90
02 Maximum Charging Current	Max PV+Utility Charging Current	CHG 60 002
03 AC Input Voltage Range	Appliance Mode (Default)	AC ^u APL 003
03 AC Input Voltage Range	UPS Mode	AC ^u UPS 003
05 Battery Type	AGM Battery (Default)	BATT AGM 005
05 Battery Type	Flood Battery	BATT FLd 005
05 Battery Type	User-Defined	BATT USE 005
05 Battery Type	User-Defined 2	BATT US2 005
05 Battery Type	Lithium	BATT LI 005
06 Overload Restart/Bypass	Restart Disable (Default)	LdRS dis 006
06 Overload Restart/Bypass	Restart Enable	LdRS enr 006

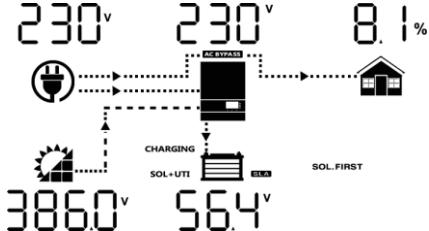
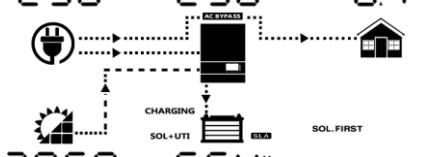
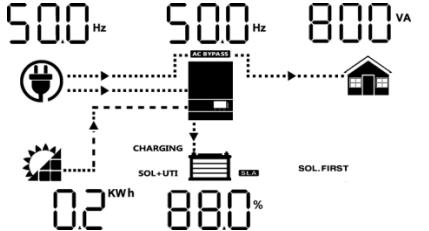
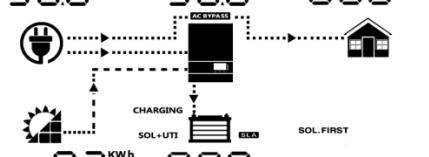
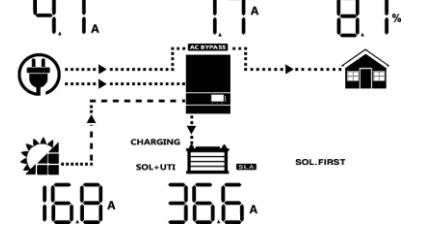
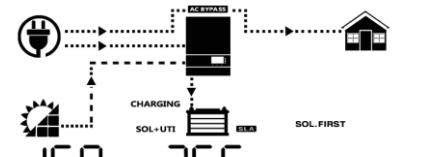
06 Overload Restart/Bypass	Overload Bypass	LdFS bYP 006	*
08 AC Output Voltage	230V (Default)	OUTv 230 008	*
09 AC Output Frequency	50Hz (Default)	OUTF 50 009	*
11 Maximum Utility Charging Current	10A to Max(default 30A)	ACI 30^ 011	*
12 DC to AC Transfer Voltage	Default 46.0V, 44.0V~51.2V resettable,	b2AC 46.0^ 012	*
12 DC to AC Transfer Voltage	Lithium mode: default 40%, 6%~50% resettable	b2AC 50% 012	*
13 AC to DC Transfer Voltage	Default 54.0V, 48.0V~58.0V resettable,	AC2b 54.0^ 013	*
13 AC to DC Transfer Voltage	Li mode: default 80%, 51%~100% resettable	AC2b 95% 013	*
14 Charger Power Source Priority	Solar Priority	CG.PT CSO 014	<small>SOL</small>
14 Charger Power Source Priority	Solar and Utility (Default)	CG.PT SNU 014	<small>SOL+UTI</small>
14 Charger Power Source Priority	Solar Only	CG.PT 050 014	<small>Only SOL</small>
14 Charger Power Source Priority	Utility Priority	CG.PT UTE 014	<small>UTI</small>
15 Alarm On/Off Control	Audible Alarm on (default)	bUZZ ON 015	*
15 Alarm On/Off Control	Audible Alarm off(Mute)	bUZZ OFF 015	*
16 Backlight On/Off Control	Backlight on (default)	LCdb ON 016	*
16 Backlight On/Off Control	Backlight off	LEdb OFF 016	*
17 Beeps once between AC and DC Transfer	Alarm on (default)	ALARM ON 017	*
17 Beeps once between AC and DC Transfer	Alarm off	ALARM OFF 017	*
19 C.V. Charging Voltage	default 56.4V, 48.0V~58.4V Settable	Cv 56.4^ 019	*
20 Float Charging Voltage	default 56.4V, 48.0V~58.4V Settable	FLEv 54.0^ 020	*
21 Low Battery Cut-Off Voltage	Without BMS communication, Default 42.0V, 40.0V~48.0V Settable	CUEv 42.0^ 021	*
21 Low Battery Cut-Off Voltage	With BMS communication Default 20%, 5%~49%	CUEv 20% 021	*

	Settable	
22 RS485 Communication Address	Default 001. 001-255 Settable. For external solar charger expansion.	Addr 1 028°
23 AC Output Mode	Single Unit Operation	PULL SIG 023°
23 AC Output Mode	Parallel in Single Phase	PULL PRL 023°
27 Battery Equalization	Disabled (Default)	EQUA dIS 027°
27 Battery Equalization	Enable	EQUA ENA 021°
28 Battery Equalization Voltage	Default 58.4V, 48.0V~60V Settable (the value should be higher than Program 19 setting)	EQUU 584° 028
29 Battery Equalization Time	Setting range is from 5min to 900min. Increment of each click is 1min.	E9t 060 029°
30 Battery Equalization Timeout	Setting range is from 5min to 900min. Increment of each click is 1 min.	E9t0 120 030°
31 Equalization Interval	Setting range is from 1 to 90 days. Increment of each click is 1 day.	E9I t 001 031°
32 Instant Equalization Activation	Disabled (Default)	E9RE dIS 032°
32 Instant Equalization Activation	Enable	E9RE ENA 032°
36 Real time setting---Year	Default 2000, range 2000~2099	2021 036°
37 Real time setting---Month	Default 01, range 01~12	00 11 037°
38 Real time setting---Date	Default 01, range 01~31	DAY 10 038°
39 Real time setting---Hour	Default 00, range 00~23	HOUR 14 039°
40 Real time setting---Minute	Default 00, range 00~59	MIN 52 040°
42 Max AC Input Current in Power Boost	Default 20A, adjustable 5-25A	bPI 20. 42°
49 Utility Charging Time		CHG ETU 0000 049°

50 AC Output Time		0UP 81.1 0000 050°
90 Battery Charger Activation	Choose SUB, then press ENTER to switch to Program 90, which is set voltage point to charge battery Default 52V, 46V~58V Settable (Program 21 < Program 90 < Program 20)	SUB 52.0° 90*

LCD Display Setting

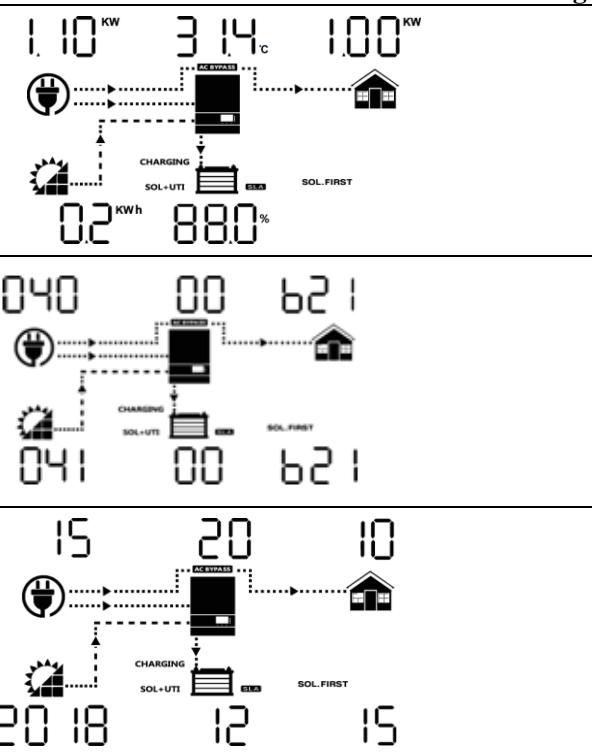
The LCD display information will be switched in turns by pressing “UP” or “DOWN” key. The selectable information is switched in below order: input voltage, input frequency, PV voltage, MPPT charging current, MPPT charging power, battery voltage, output voltage, output frequency, load percentage, load in VA, load in Watt, DC discharging current, main CPU Version and second MCU Version.

Setting Information	LCD display
① AC Input voltage ② Output voltage ③ Load percentage ④ PV input voltage ⑤ Battery voltage ⑥ Warning or Fault code (Default Display Screen)	 230V 230V 8.1% 
① AC Input frequency ② Output frequency ③ Load power in VA ④ PV energy sum in KWH ⑤ Battery percentage ⑥ Warning or Fault code	 500 Hz 500 Hz 800 VA 
① AC Input current ② Output current ③ Load percentage ④ PV input current ⑤ Battery charging current ⑥ Warning or Fault code	 4.7 A 17 A 8.1% 

- ① AC input power in Watts
- ② Inverter temperature
- ③ Load power in Watts
- ④ PV energy sum in KWH
- ⑤ Battery percentage
- ⑥ Warning or Fault code

Firmware Version of Inverter PCB and MPPT PCB
 (CPU1: 040-00-b21; CPU2:041-00-b21)

Time
 (15:20:10, December 15, 2018)



The LCD will display different inverter status when the up or down button is pressed.

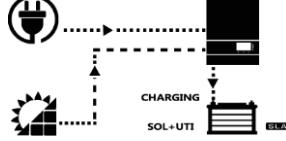
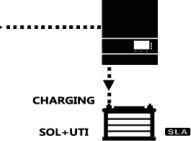
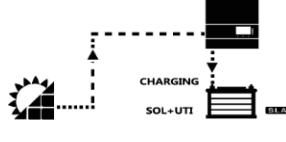
The last page of LCD shows the software version of the inverter PCB. There are 8 digits.

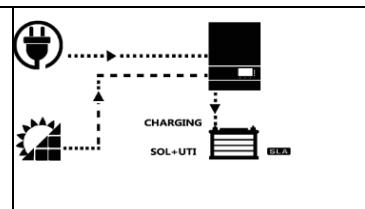
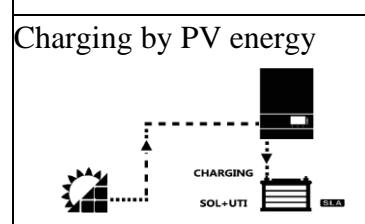
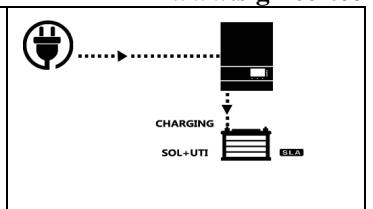
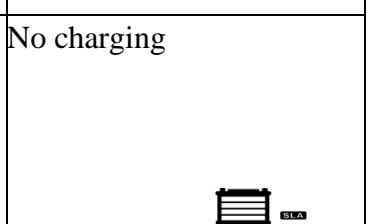
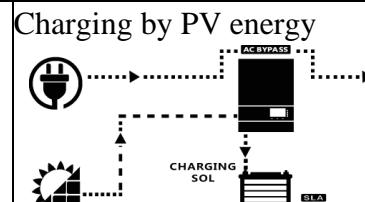
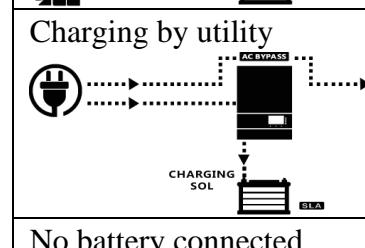
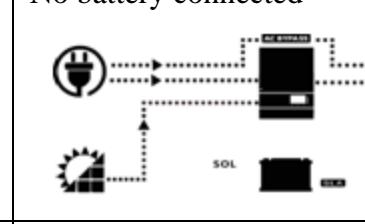
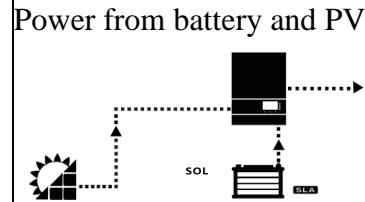
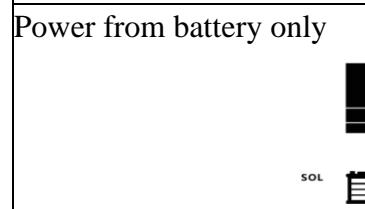
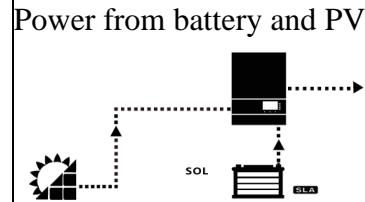
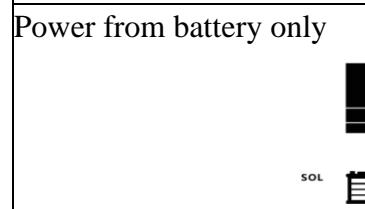
If the MPPT PCB is not activated, it will display 000-00-000.

When the LCD is switched to a new page, the LCD will return to the default home screen in 5 minutes without operation.

When the LCD enters the setting page, the LCD will return to the default home screen in 2 minutes without operation.

Operating Mode Description

Operation mode	Description	LCD display	
Standby mode / Power saving mode Note: *Standby mode: The inverter is not turned on yet but at this time, the inverter can charge battery without AC output. *Power saving mode: If enabled, the output of inverter will be off when connected load is two low or not detected.	No output is supplied by the unit but it still can charge batteries.	<p>Charging by utility and PV energy.</p> 	<p>Charging by utility</p> 
		<p>Charging by PV energy</p> 	<p>No charging</p> 
Fault mode Note: *Fault mode: Errors are caused by inside circuit error or external reasons such as	PV energy and utility can charge batteries.	<p>Charging by utility and PV energy</p>	<p>Charging by utility</p>

over temperature, output short circuited and so on.		 Charging by PV energy 	 No charging 
Line Mode	The unit will provide output power from the mains. It can also charge the battery at line mode.	 Charging by PV energy   Charging by utility  No battery connected 	
Battery Mode	The unit will provide output power from battery and PV power.	 Power from battery and PV energy  Power from battery only 	

The inverter is built with automatic PV and utility power wakeup feature.

When the power switch is in power off, and qualified PV input, the PV charger will be activated, and the rest part of the inverter will remain powered off.

In this mode, the utility power can only illuminate the LCD, it can't charge batteries.

When the inverter shuts off due to low battery voltage, and the switch is kept on “on” position, the inverter will use qualified utility power or PV power to charge batteries and wake up at “cold start voltage” to discharge the battery to provide AC output.

If the inverter is set in SOL or SUB, the automatic wake up feature will charge battery close to “Utility to Battery switch” voltage, and then cut off utility charger, switch to DC to AC model.

2.4.8 Audible Alarm

The inverter also gives audible alarms when the following situations occur.

Warning	Buzzer beeps 0.5s every second.
Error	Long Beep. Beeps 0.5s every 1s for 10s, shut off, then long beep for 60 seconds.

2.4.9 FAN Operation

For MS Series model, there are two DC fans.

The DC fans will just the fan speed in a linear proportion according to load and charger wattage.

It will slow down after 1 minute when the triggering condition disappears.

Allow at least 30CM of clearance around the inverter for air flow. Make sure that the air can circulate freely around the unit.

Fan noise level <60db at a distance of 1 meter.

2.4.10 Auto Generator Start Dry Contact

The solar inverter is built with a very versatile 3-pin dry contact rated at 3A/250VAC on the rear panel.



The internal relays of the dry contact will give out either “close” or “open” signals.

These signals can be used to indicate the low battery voltage alarm or control a generator.

The NC & C pins are constantly close, they will open when battery voltage reaches low alarm or the setting in Program 12 (DC to AC Transfer).

The NO & C pins are constantly open, they will close when battery voltage reaches low alarm or the setting in Program 12 (DC to AC Transfer) to start the generator. Once the generator is started and battery voltage increases with charging, the dry contact pins will open at the setting of Program 13 (AC to DC Transfer) to avoid overcharging.

Unit Status	Operation		NC & C	NO & C	
Power Off	Inverter off (No AC output)		Close	Open	
Power On	Inverter in AC Bypass Mode		Close	Open	
	Inverter in DC to AC Mode	Program 01 set to Utility Priority	Battery Level < Low Battery Alarm	Open	Close
			Battery Level > Program 13 (AC to DC Transfer)	Close	Open
		Program 01 set to SBU or Solar Priority	Battery Level < Program 12 (DC to AC Transfer)	Open	Close
			Battery Level > Program 13 (AC to DC Transfer)	Close	Open

For low battery alarm, when battery setting is not in “LI” mode, it is 2 volts higher than Low DC Cut-off Voltage for 48Vdc model and 1 volt higher than Low DC Cut-off Voltage for 24Vdc model.

When the battery setting is in “LI” mode, low battery alarm is 5% higher than Low DC Cut-off Soc.

2.4.11 Automatic Recovery Operation

For the MS6048D, it is designed with automatic recovery from:

- **Overloads shutoff**
- **Over temperature shutoff**
- **Low battery voltage cutoff.**

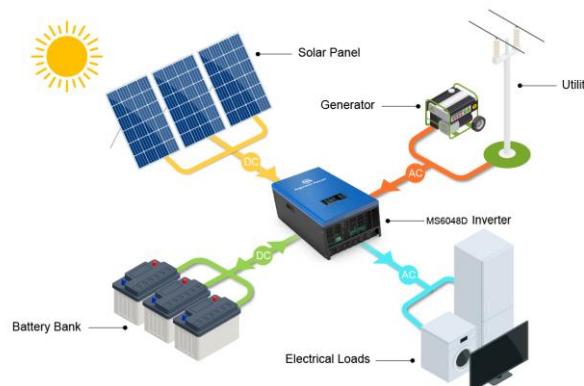
Pls to “Program 06 Automatic Overload Restart ” “Program 07: Automatic OverTemp Restart ” and “Program 21 Low DC Cut-Off Voltage” for more details.

2.4.12 DC/AC Coupling Operation

The MS6048D inverter can operate in both DC coupled and AC coupled systems.

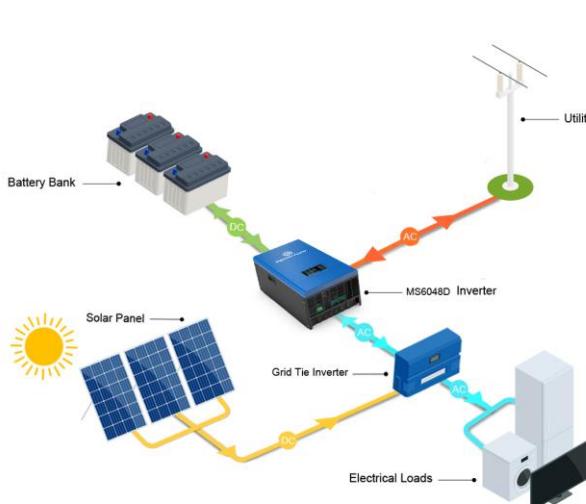
DC COULYING

In DC coupled system, the PV panel is wired to the PV input terminals. The inverter works as a traditional DC to AC solar inverter.

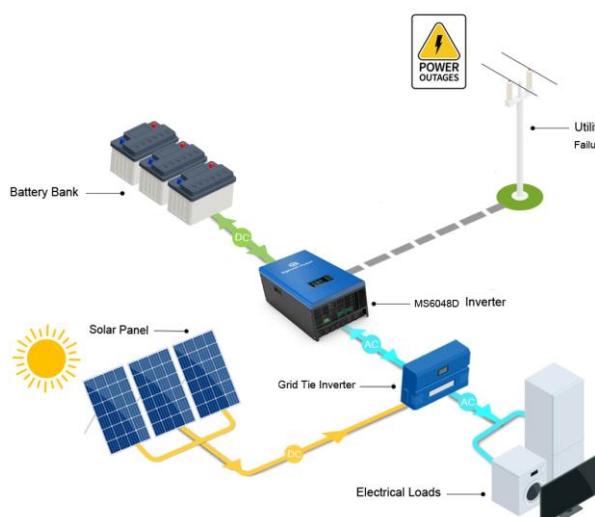


DC Coupled System

AC COULYING



AC Coupled System with Utility



AC Coupled System without Utility

The ac coupled systems have a higher energy efficiency in comparison to DC coupled systems in that PV

power is converted directly from DC to AC by grid tie inverters instead of DC to AC.

When it works with grid tie inverters to form an AC coupling off grid system, the grid tie inverter AC output is wired to the MS6048D AC output terminal block.

The MS6048D can combine its AC output power with grid tie inverter AC power to power loads.

There are four work modes

1: When grid tie inverter doesn't work (at night or due to anti-islanding protection in power outages), the MS6048D will output AC power for the whole system.

2: When the grid tie inverter produces less power than the load wattage, the MS6048D will produce AC from DC to fill in the power gap.

3: If the grid tie inverter produces more power than the load wattage, the excessive power will be first used for battery charging.

When the charging current is below the preset amperage and/or charging voltage is below float charging voltage, the MS6048D outputs a nominal of 60Hz power.

When the charging current reaches the preset amperage and/or charging voltage reaches the float charging voltage, the MS6048D will increase the output frequency in small increments until it reaches 63Hz.

When the MS6048D reaches 63Hz, it will cause most grid tie inverters to alarm and shut off, the MS6048D inverter will solely power the loads.

4 If the MS6048D is connected to the grid, when the battery is fully charged, the MS6048D will allow grid tie inverter to backfeed the AC power via its AC input terminal block to the grid.

The MS6048D is not an on-grid inverter, this transfer is done by an internal relay which bypass the AC output power to the AC input.

Note: If the grid tie inverter doesn't reduce output power as per increased frequency, it will only shut off abruptly at 63Hz, causing instability of the system.

The maximum acceptable power of grid tie inverter on MS6048D AC output terminal is 6000W.

2.4.13 Power Boost & AC Bypass Current Limit

The inverter is able to boost output power with AC input power by combining the AC input power with the inverted power from battery to support a load over its nominal power.

When the power boost capacity is set to 30A and the AC voltage set to 240Vac, the inverter AC output is 30A*240V(6000W) + 6000W (Nominal Power) =13.2KW.

To activate the power boost feature, the inverter setting should be configured as below.

Step		
1	Set program 1 to SUB.	
2	Go into sub-program 90, set the power boost voltage it is adjustable from 44-56V. When the battery voltage is below it, the DC to AC won't work.	
3	Set Program 14 to SNU	
4	Set Program 42 to BPI, adjust the max AC input bypass current, it is adjustable from 5-30A. Refer to program 42 for more details.	

If battery voltage drops to the value set at Program 90, the inverter will only bypass AC input power to the loads.

Previously, the older Sigineer inverters doesn't have AC input current control, it will pull as much AC power as it is needed for the loads and utility charger, resulting in an overload at the AC input power source with limited wattage.

Now with the AC bypass current limit, customers can safely power the inverter system with a smaller power source.

Overload protection:

When load current>max AC input current +max inverter mode current, inverter will show 07 overload error code after 10 seconds.

When battery voltage drops to the setting value in program 90, the inverter will stop discharging batteries in SUB mode, but only use AC input current to power load.

Inverter will show 07 overload error code if load current is larger than max AC input current setting in program 42.

2.4.14 Advanced Utility Charging & Bypass Control with Timer

The M6048D inverters are designed with a timer to control its AC output power and AC charger at preset time frame.

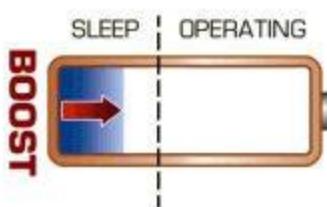
This will enable the inverter to use utility power at off peak hours to save the electricity bills.

2.4.15 Lithium Battery Wakeup

Lithium-ion battery will enter sleep mode when it is over discharged. When the protection circuit is triggered, the voltage could drop to 0Vdc.

Such batteries are assumed to be useless for most inverters which require a minimal DC voltage to be powered on.

It makes it possible for a charger to charge ordinarily.



The MS6048D inverters will use solar or AC input power to wake up overdischarged lithium battery by a boost circuitry.

When they detect a 0V battery, the charger will output a small current of 48Vdc voltage to awaken the lithium batteries.

Once the lithium battery voltage is charged back to normal (over 48Vdc), the charger will proceed with the charging settings of program 19 and 20.

2.4.16 Other Features

Conformal Coating

The entire line of MS Series inverters have been processed with a conformal coating on the PCB, making it water, rust, and dust resistant.

While these units are designed to withstand corrosion from the salty air, they are not splash proof.

3 Installation

3.1 Location

Follow all the local regulations to install the inverter.

Please install the equipment in a location of Dry, Clean, Cool with good ventilation.

Working temperature: -20°C to 50°C (-4°F to 122°F)

Storage temperature: -40°C to 60°C (-40°F to 140°F)

Relative Humidity: 5% to 95%, non-condensing

Cooling: Forced air

Warning! Operation in a condensing environment will invalid warranty.

3.2 Unpacking and Inspection

Before installation, please inspect the unit. Be sure that nothing inside the package is damaged. You should have received the following items in the package:

*The inverter x 1

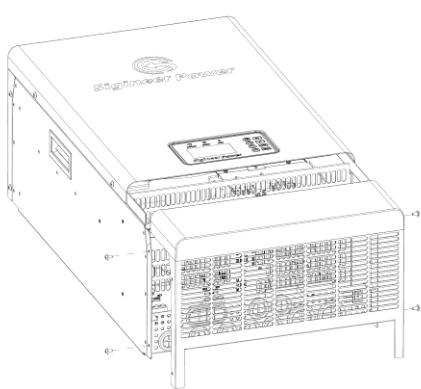
*User manual x 1

*Communication cable x 1

*Parallel communication cable x 1

*Screws x 3

*Mounting board x 1



Mounting the Unit

Before connecting all wiring, please take off bottom cover by removing two screws as shown below.

Consider the following points before selecting where to install:

Do not mount the inverter on flammable construction materials.

Mount on a solid surface

Install this inverter at eye level in order to allow the LCD display to be read at all times.

The ambient temperature should be between 0°C and 55°C to ensure optimal operation.

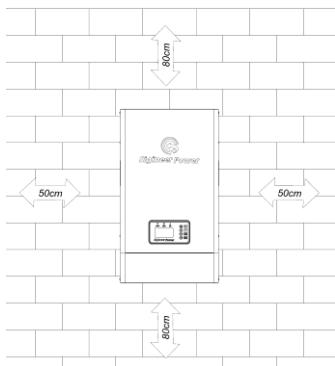
The recommended installation position is to be adhered to the wall vertically.

Be sure to keep other objects and surfaces as shown in the right diagram to guarantee sufficient heat dissipation and to have enough space for removing wires.

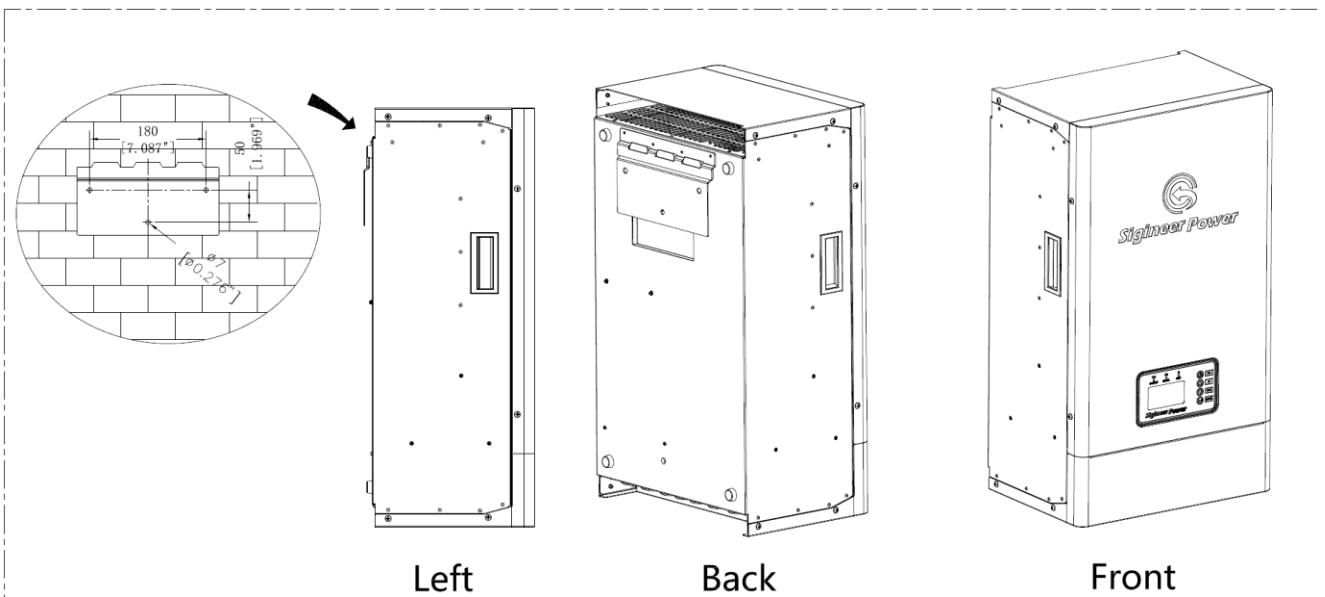
SUITABLE FOR MOUNTING ON CONCRETE OR OTHER NON-COMBUSTIBLE SURFACE.

If it is mounted to a wood or metal surface, please take precaution on the electrical safety and fire prevention.

Install the unit by screwing the six sets of screws.



Install the unit by screwing three screws. It's recommended to use M4 or M5 screws.



Note: For proper air circulation to dissipate heat, allow a clearance of approx. 20cm to the side and approx. 50 cm above and below the unit. Be sure to install each unit in the same level.

Screw three screws to install the unit. It is recommended to use attachment screw ST6.3X40 outside hexagon self-tapping stainless steel screws and Plastic expansion tube

3.3 Battery Wiring

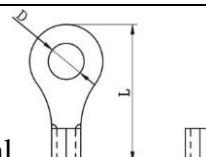
Before connecting all wiring, please take off the DC and AC terminal cover by removing their screws.

The DC terminal bolt size is M6 and the diameter of the DC cable holes on the box is 18mm.

It is suggested the battery bank be kept as close as possible to the inverter. The following table is a suggested wiring option for DC cable with length from 1 meter to 5 meters.

CAUTION: For safety operation and regulation compliance, it's requested to install a separate DC over-current protector or disconnect device between battery and inverter. It may not be requested to have a disconnect device in some applications, however, it's still requested to have over-current protection installed. Please refer to typical amperage in below table as required fuse or breaker size.

Recommended battery cable and terminal size:

Model#	Maximum Amperage	Battery capacity	Wire Size	 Ring Terminal		Torque value	
				Cable mm ²	Dimensions		
MS6048D	200A	200AH	1 x 2AWG	35	6.4	39.2	2-3Nm

Recommended breaker specification of battery for each inverter:

Model	1 unit
MS6048D	200A/60VDC

*If you want to use only one breaker at the battery side for the whole system, the rating of the breaker should be X times current of 1 unit. "X" indicates the number of inverters connected in parallel.

Recommended breaker specification of AC input with single phase:

Model	2 units	3 units	4 units	5 units	6 units
MS6048D	120A/230VAC	180A/230VAC	240A/230VAC	300A/230VAC	360A/230VAC

Note1: Also, you can use 50A breaker for only 1 unit, and each inverter has a breaker at its AC input.

Note2: Regarding three phase system, you can use 4 poles breaker, the rating is up to the current of the phase which has the maximum units. Or you can follow the suggestion of note 1.

Recommended battery capacity

Inverter Parallel Quantity	2	3	4	5	6
MS6048D	500AH	750AH	1000AH	1250AH	1500AH

WARNING! Be sure that all inverters will share the same battery bank. Otherwise, the inverters will transfer to fault mode.

Please follow the above minimum wire size requirement.

One cable is always best, but if there is a problem obtaining for example 100mm²cable, use 2*50mm²or 3*35mm² instead, as long as the square area adds up. Performance of any product can be improved by thicker cable and shorter runs, so if in doubt round up and keep the length as short as possible.

Battery cables must have crimped (or preferably, soldered and crimped) copper compression lugs unless aluminum mechanical lugs are used. Soldered connections alone are not acceptable. High quality, UL-listed battery cables are available .These cables are color-coded with pressure crimped, sealed ring terminals.

Battery terminal must be clean to reduce the resistance between the DC terminal and cable connection. A buildup of dirt or oxidation may eventually lead to the cable terminal overheating during periods of high current draw. Use a stiff wire brush and remove all dirt and corrosion from the battery terminals and cables.

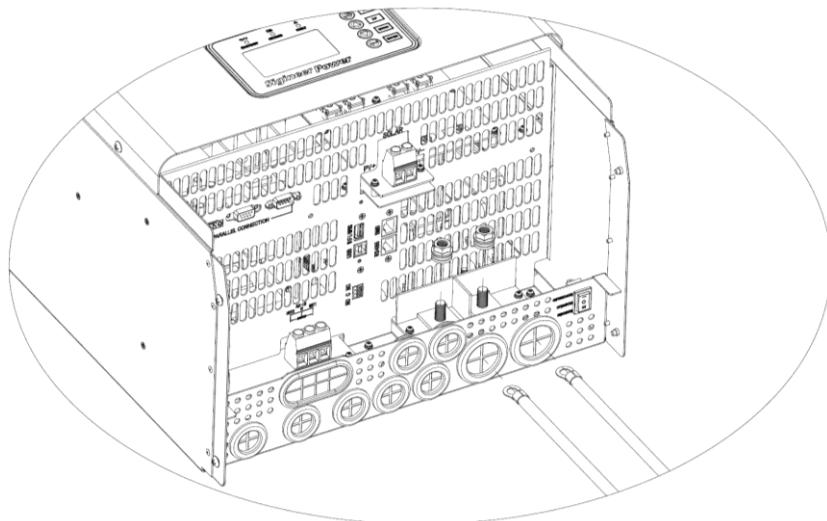
Note: for lead acid battery, the recommended charge current is 0.2C(C=battery capacity)

Please follow below steps to implement battery connection:

Assemble battery ring terminal based on recommended battery cable and terminal size.

Connect all battery packs as units requires. It is suggested to connect at least 250AH capacity battery for 6KW inverter.

Insert the ring terminal of battery cable flatly into battery connector of inverter and make sure the bolts are tightened with torque of 2-3 Nm. Make sure polarity at both the battery and the inverter/charge is correctly connected and ring terminals are tightly screwed to the battery terminals.



WARNING: Shock Hazard

Installation must be performed with care due to high battery voltage in series.



CAUTION!! Do not place anything between the flat part of the inverter terminal and the ring terminal. Otherwise, overheating may occur.



CAUTION!! Do not apply anti-oxidant substance on the terminals before terminals are connected tightly.

CAUTION!! Before making the final DC connection or closing DC breaker/disconnector, be sure positive (+) must be connected to positive (+) and negative (-) must be connected to negative (-).

Reducing RF interference

To reduce the effect of radiated interference, twist the DC cables. To further reduce RF interference, shield the cables with sheathing /copper foil / braiding.

Taping battery cables together to reduce inductance

Do not keep the battery cables far apart. In case it is not convenient to twist the cables, keep them taped together to reduce their inductance. Reduced inductance of the battery cables helps to reduce induced voltages. This reduces ripple in the battery cables and improves performance and efficiency.

CAUTION: For safety operation and regulation compliance, it's requested to install a separate DC over-current protector or disconnect device between battery and inverter. It may not be requested to have a disconnect device in some applications, however, it's still requested to have over-current protection installed. Please refer to typical amperage in below table as required fuse or breaker size.

 WARNING	Over torqueing may cause the bolt to break.
	Equipment Damage The inverter is not reverse polarity protected. Reversing the battery polarity on the DC input connections will cause permanent damage to the inverter which is not covered under

	warranty. Always check polarity before making connections to the inverter.
	The inverter contains capacitors that may produce a spark when first connected to battery.
	Do not mount in a confined a battery or gas compartment.
	Ensure the inverter is off before disconnecting the battery cables, and that AC power is disconnected from the inverter input.

3.4 PV Wiring

CAUTION: Before connecting to PV modules, please install separately a DC circuit breaker between the inverter and PV modules.

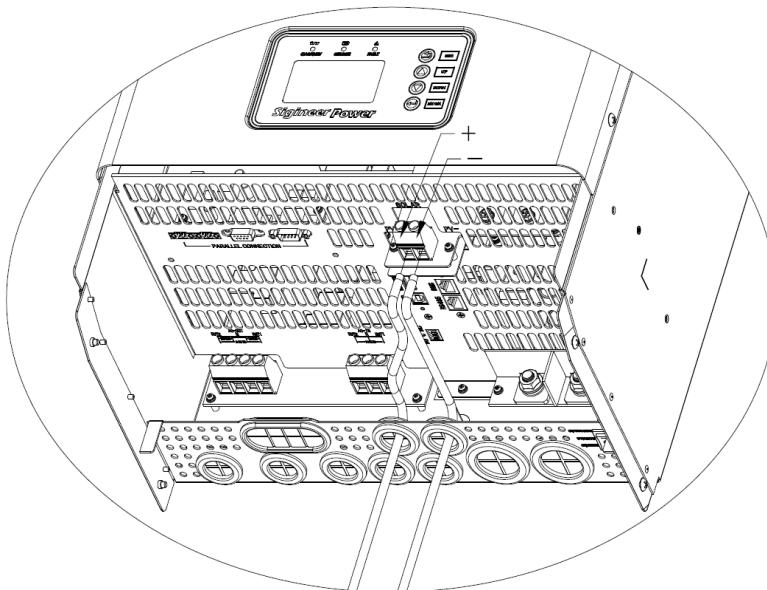
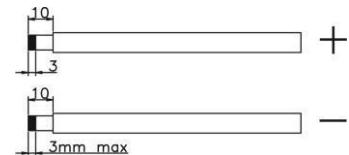
The PV terminal pins can accept cable size up to 8AWG, and the torque for the screws is 1.2-1.6Nm.

Max. PV Array Open Circuit Voltage is 250Vdc, pls make sure Open circuit Voltage (Voc) of PV modules does not exceed 250V.

INVERTER MODEL	MS6048D
Max. PV Array Open Circuit Voltage	250VDC
PV Array MPPT Voltage Range	60-250Vdc
Start-up Voltage	150Vdc

Please follow below steps to implement PV module connection:

1. Remove insulation sleeve 10 mm for positive and negative conductors.
2. Check correct polarity of connection cable from PV modules and PV input connectors. Then, connect positive pole (+) of connection cable to positive pole (+) of PV input connector. Connect negative pole (-) of connection cable to negative pole (-) of PV input connector.
3. Make sure the wires are securely connected.



Don't reverse the PV input polarity or damage will occur.

3.5 AC Wiring

CAUTION!! Before connecting to AC input power source, please install a separate AC breaker between inverter and AC input power source. This will ensure the inverter can be securely disconnected during maintenance and fully protected from over current of AC input. The recommended spec of AC breaker is 60A for 6KW.

CAUTION!! There are two terminal blocks with “IN” and “OUT” markings. Please do NOT mis-connect input and output connectors.

WARNING! All wiring must be performed by qualified personnel.

WARNING! It's very important for system safety and efficient operation to use appropriate cable for AC input connection. To reduce risk of injury, please use the proper recommended cable size as below.

Suggested cable requirement for AC wires

Model	Gauge	Torque Value
MS6048D	8 AWG	1.2~ 1.6Nm

Please follow below steps to implement AC input/output connection:

*Before making AC input/output connection, be sure to open DC protector or disconnector first.

*Remove insulation sleeve 10mm for six conductors. And shorten phase L and neutral conductor N 3 mm.

*Insert AC input wires according to polarities indicated on terminal block and tighten the terminal screws.

Be sure to connect PE protective conductor  first.

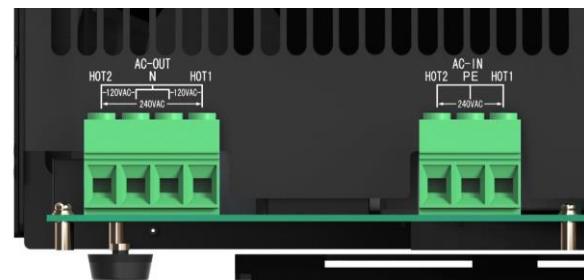
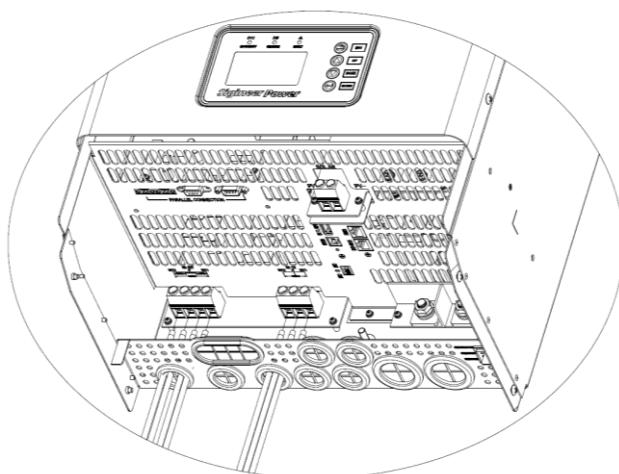
ACINPUT

PE	HOT2	HOT1
Ground (Yellow-Green)	LINE (brown or black)	LINE (brown or black)

Be sure that AC power source is disconnected before attempting to hardwire it to the unit.

*Then, insert AC output wires according to polarities indicated on terminal block and tighten terminal

screws. Be sure to connect PE protective conductor  first.



AC OUPUT

N	HOT2	HOT1
Neutral (Blue)	LINE (brown or black)	LINE (brown or black)

*Make sure the wires are securely connected.

CAUTION: Important

Be sure to connect AC wires with correct polarity. The AC Input doesn't require any neutral input. Don't connect the AC input neutral to the inverter.

CAUTION: Appliances such as air conditioner are required at least 2~3 minutes to restart because it's required to have enough time to balance refrigerant gas inside of circuits. If a power shortage occurs and recovers in a short time, it will cause damage to your connected appliances. To prevent this kind of damage, please check with manufacturer of air conditioner that if it's equipped with time-delay function before installation. Otherwise, this off grid solar inverter will trigger overload fault and cut off output to protect your appliance but sometimes it still causes internal damage to the air conditioner.

Note: Max. AC input current is 50A. If AC input current sustains over 50A, AC charge current will drop down to zero, then the system will cut off output in 10 seconds.

Note:

As the two split phase hot lines is 180 degrees out of phase with each other, the MS6048D inverter is only able to output full 6KW power at 240Vac.

Users can only get 50% nominal power from each one of the 120Vac hot lines of the split phase inverter.

The biggest 120V single load the inverter can drive is 50%(3KW) of its nominal 6KW power.

The two 120Vac can't be paralleled to output 6KW 120Vac.

When AC output is loaded, the LCD will show the load percentage base on the sum of loads from both phases.

Preventing Paralleling of the AC Output

The AC output of the unit should never be connected to the utility power / generator.

Such a connection may result in parallel operation of the different power sources and AC power from the utility / generator will be fed back into the unit which will instantly damage the inverter and may also pose a fire and safety hazard.

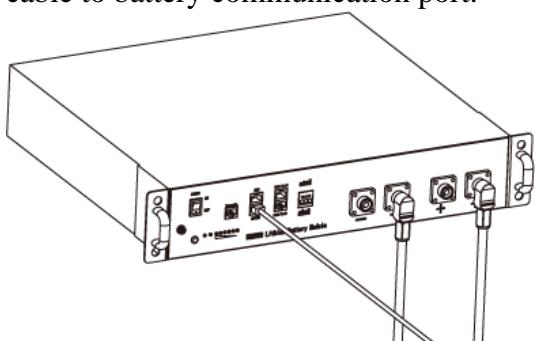
3.6 Communication with Lithium Batteries

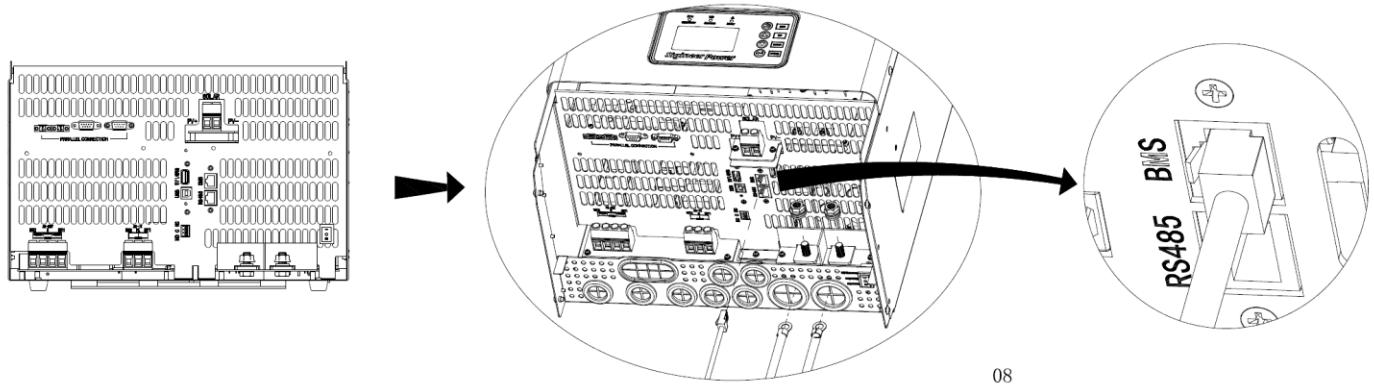
The BMS port allows the MS Series inverters to communicate with lithium batteries BMS with the same protocol. Our MS Series inverters support a growing number of lithium batteries from the big brands.

To get more details of our BMS protocol and the compatible lithium battery models, pls email us at info@sigineer.com.

Please follow below steps to implement lithium battery connection:

Connect one end of RJ45 of battery to BMS communication port of inverter. Connect the other end of RJ45 cable to battery communication port.





08

Lithium Battery Connection (optional)

If choose lithium battery for the inverter, you are allowed to use the lithium battery which has been configured. There're two connectors on the lithium battery, RJ45 port of BMS and power cable.

Please follow below steps to implement lithium battery connection:

Assemble battery ring terminal based on recommended battery cable and terminal size (same as Lead acid, see section Lead-acid Battery connection for details).

Insert the ring terminal of battery cable flatly into battery connector of inverter and make sure the bolts are tightened with torque of 2-3Nm. Make sure polarity at both the battery and the inverter/charge is correctly connected and ring terminals are tightly screwed to the battery terminals.

Connect the end of RJ45 of battery to BMS communication port of inverter.

The other end of RJ45 insert to battery communication port.

Note: if you choose lithium battery, make sure to connect the BMS communication cable between the battery and the inverter. You need to choose battery type as “lithium battery”

Lithium battery communication and setting

In order to communicate with battery BMS, you should set the battery type to “LI” in Program 5. Then the LCD will switch to Program 91, which is to set the protocol type. There are several RS485 protocols in the inverter which can match some customized battery, please consult us first before you choosing the battery model.

1 Connect the end of RJ45 of battery to BMS communication port of inverter

Make sure the lithium battery BMS port connects to the inverter is Pin to Pin, the inverter BMS port and RS485 port pin assignment shown as below:

	PCB Type	CAN PROTOCOL	
Pinout	BMS port	RS485 port	
87654321	Pin#1	RS485B	RS485B
	Pin#2	RS485A	RS485A
	Pin#3	--	--
	Pin#4	CANH	--
	Pin#5	CANL	--
	Pin#6	--	--
	Pin#7	--	--
	Pin#8	--	--

LCD setting For Lithium Batteries

To make the inverter communicate with the battery BMS, the battery type should be set to “LI” in Program 05.

Please refer to “05: LI” for details.

Note:

When multiple inverters are paralleled with multiple lithium batteries, please follow the below setup.

1 Out of the lithium batteries, set one unit as the master and the rest as slave as per the lithium DIP/ADS switches.

2 Connect the master battery to the inverter which shows “Host”.

If the user connects the master battery to one of the rest the slave inverters in the group, the inverter can automatically work as the master unit, but the communication speed will be slower.

3.7 Inverter Parallel Operation

The MS6048D inverters can be stacked up to 6 pcs to expand output power in 120/240Vac split phase.

When they are stacked, all the inverters will share the loads evenly. Each will be ready output full power even the load is under nominal power, none of them will go into power saver mode.

This is designed to handle sudden loads fluctuations.

In parallel kit, you will find the following items in the package:



Parallel communication cable

Note:

When there is more than one inverter paralleled in one phase, if the slave unit shut off, the rest inverters in the system will continue operate.

If the master unit shuts off, all the rest inverters will shut off.

WARNING:

For parallel operation, each inverter should connect to separate PV arrays for optimal performance. They should never be connected to the same solar array, or damage will occur.

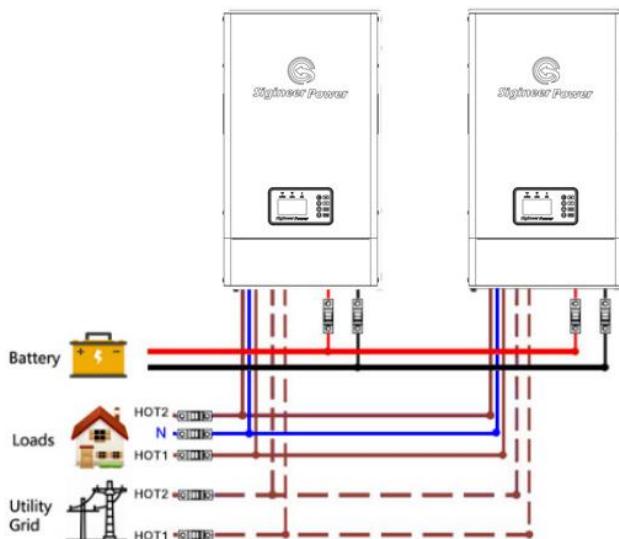
Note: For proper air circulation to dissipate heat, allow a clearance of approx. 20cm to the side and approx. 80 cm above and below the unit. Be sure to install each unit in the same level.

NOTE: When the AC input power is from generators, only a MAX of 3 units can be paralleled.

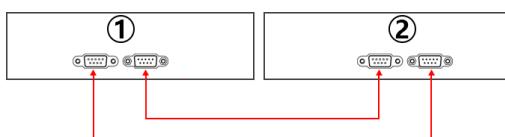
3.7.1 Parallel in Split Phase to Expand Power

Two inverters in parallel:

Power Wire Connection

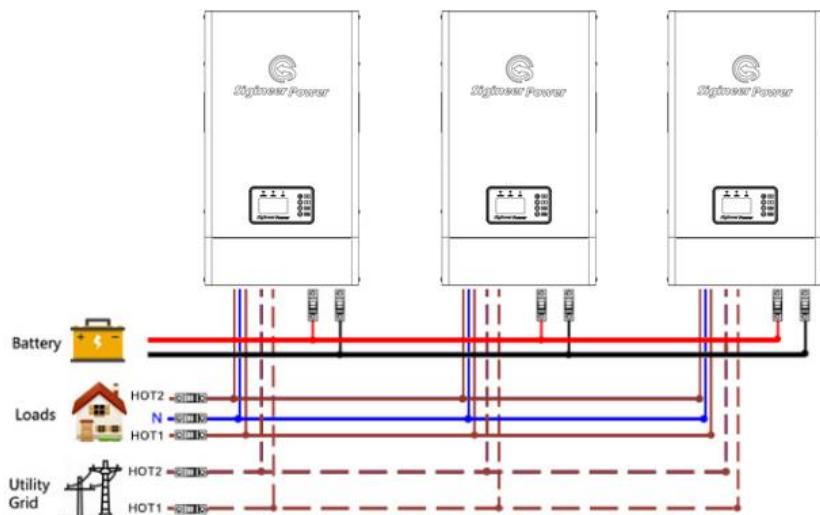


Communication Wire Connection

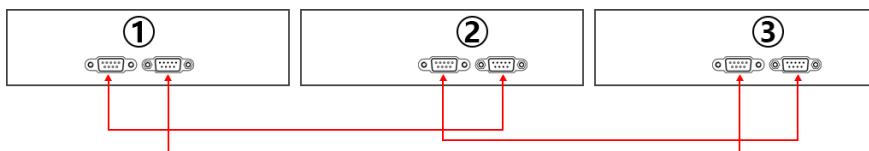


Three inverters in parallel:

Power Wire Connection



Communication Wire Connection

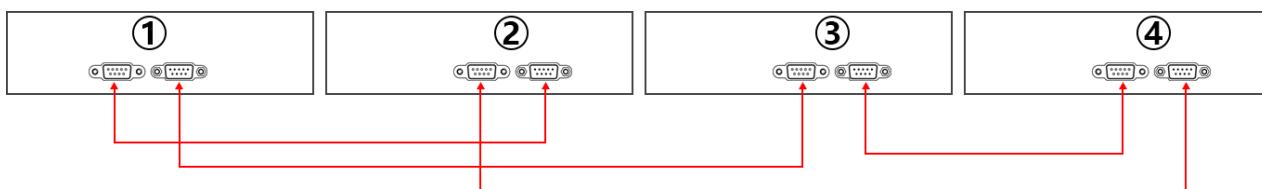


Four inverters in parallel:

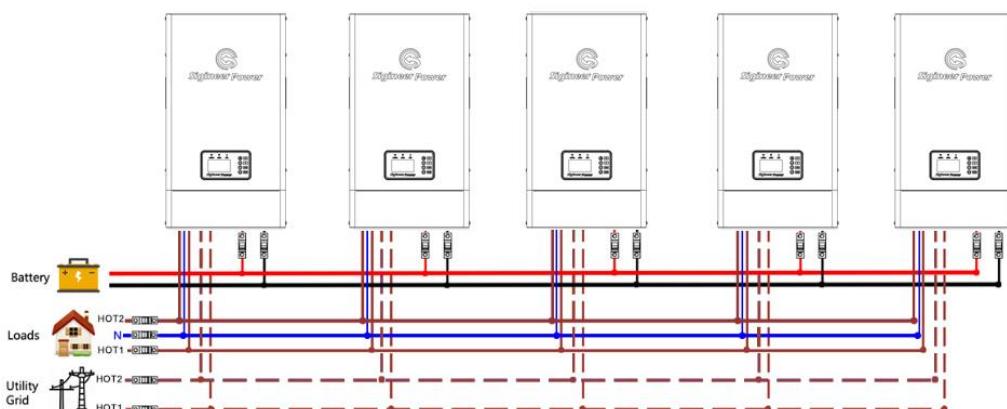
Power Wire Connection



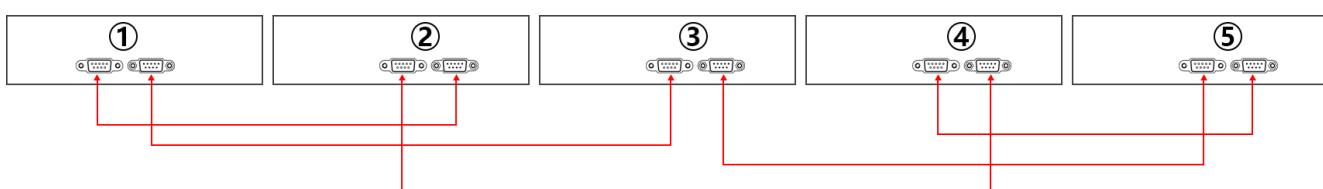
Communication Wire Connection



Five inverters in parallel:
Power Wire Connection



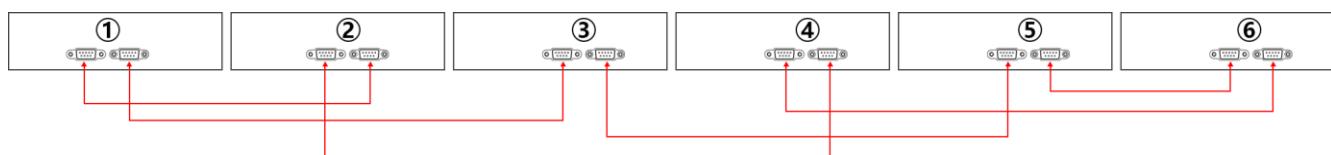
Communication Wire Connection



Six inverters in parallel:
Power Wire Connection



Communication Wire Connection



3.7.4 LCD Setting For Parallel Operation

Setting Program: Please refer to program 23

Commissioning

Parallel in single phase

Step 1: Check the following requirements before commissioning:

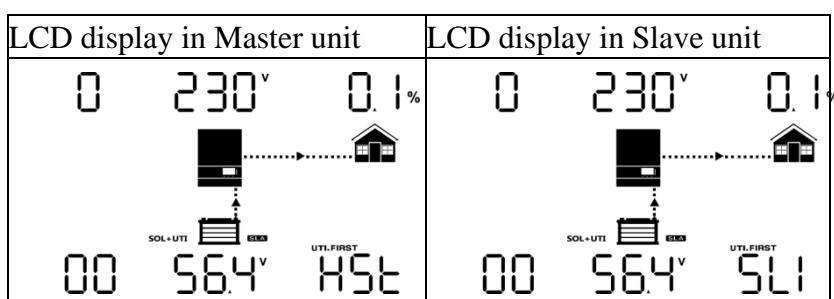
Correct wire connection

Ensure all breakers in Line wires of load side are open and each Neutral wires of each unit are connected together.

Step 2: Turn on each unit and set “PAL” in LCD setting program 23 of each unit. And then shut down all units.

Note: It's necessary to turn off switch when setting LCD program. Otherwise, the setting can not be programmed.

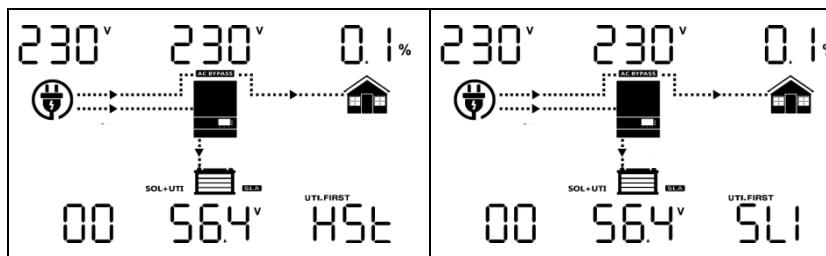
Step 3: Turn on each unit.



Note: Master and slave units are randomly defined.

Step 4: Switch on all AC breakers of Line wires in AC input. It's better to have all inverters connect to utility at the same time. If not, it will display warning 15.

LCD display in Master unit	LCD display in Slave unit
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Step 5: If there is no more fault alarm, the parallel system is completely installed.

Step 6: Please switch on all breakers of Line wires in load side. This system will start to provide power to the load.

3.8 Communication with Computer

The inverter can be monitored on the computer.

Please use the communication cable to connect to inverter and PC. Install the “SG Solar Power Monitor” on a computer and follow on-screen instruction to install the monitoring software. For the detailed software operation, please check user manual of software.

3.9 Grounding

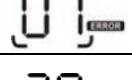
Connect an AWG 8 gauge or greater copper wire between the grounding terminal on the inverter and the earth grounding system or the vehicle chassis.

4 Maintenance & Troubleshooting

This troubleshooting guide contains information about how to troubleshoot possible error conditions while using the MS6048D Solar Power Inverter/Chargers.

The following chart is designed to help you quickly pinpoint the most common inverter failures.

Indicator and Buzzer

Fault Code	Fault Event	Icon on
02	Over temperature	
03	Higher Battery Voltage	
04	Low Battery Voltage	
05	Output short circuit	
06	Higher AC Output Voltage	
07	Overload time out	
20	BMS Communication Error	20-
51	Over current or surge	
56	MOSFET Overcurrent	
60	Negative power fault	
80	CAN fault	
81	Host loss	

Warning Indicator

Warning Code	Warning Event	Audible Alarm	Icon flashing
01	Fan Abnormal	Beep once every second	
02	MPPT Over temperature	Beep once every second	
04	Low battery	Beep once every second	
07	Overload	Beep once every second	

13	Solar charger stops due to high PV voltage	Beep once every second	13 △
14	Solar charger stops due to overload	Beep once every second	14 △
15	Parallel input utility grid different	Beep once every second	15 △
16	Parallel input phase error	Beep once every second	16 △
17	Parallel output phase loss	Beep once every second	17 △
19	Battery Disconnect	No beep	19 △
51	PV Over current or surge	Beep once every second	51 △
58	AC output low voltage	Beep once every second	58 △
63	Sampling error of battery voltage detecting is over 0.5V	Beep once every second	63 △

Note: To restart the inverter, all power sources need to be disconnected. After the LCD screen light is off, only use the battery to boot.

Troubleshooting

Problem	LCD/LED/Buzzer	Explanation / Possible cause	Action
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.
Buzzer beeps continuously and red LED is on. (Fault code)	Warning code 01	Fan Warning	1. Check whether all fans are working properly. 2. Replace the fan.
Buzzer beeps once every second, and red LED is flashing. (Warning code)	Fault code 02	Internal temperature of component is over 90°C.	Check if the air flow of the unit is blocked or the ambient temperature is too high.
	Fault code 03	Battery is over-charged. The battery voltage is too high.	Return to repair center. Check if spec and quantity of batteries are meet requirements.
	Fault code 04	The battery voltage is too low.	Measure battery voltage in DC input. Check battery SOC in LCD when use Li battery Recharge the battery.

	Fault code 05	Output short circuited.	Check if wiring is connected well and remove abnormal load.
	Fault code 06/58	Output abnormal (Inverter voltage below than 180Vac or is higher than 290Vac)	Reduce the connected load. Return to repair center
	Fault code 07	Overload error. The inverter is overload 101% and time is up.	Reduce the connected load by switching off some equipment.
	Warning code 15	The input status is different in parallel system.	Check if AC input wires of all inverters are connected well.
	Warning code 16	Input phase is not correct.	Change the input phase S and T wiring.
	Warning code 17	The output phase not correct in parallel.	Make sure the parallel setting are the same system(single or parallel; 3P1,3P2,3P3). Make sure all phases inverters are power on.
	Warning code 19	No battery alarm	Check that the battery is connected to the machine
Buzzer beeps continuously and red LED is on. (Fault code)	Fault code 20	BMS communication failed	1. Check the BMS communication wire to see if it's well connected 2. Check the transceiver signal
	Fault code 51	Over current or surge	Restart the unit, if the error happens again, please return to repair center.
	Fault code 56	MOS overcurrent	Restart the unit, if the error happens again, please return to repair center.
	Fault code 60	Negative power fault	Check whether the AC output connected to the grid input. Check whether Program 8 settings are the same for all parallel inverters Check whether all neutral wires of all parallel units are connected together. 5.If problem still exists, contact repair center.
	Fault code 80	CAN fault	Check whether the parallel communication cables are connected well. Check whether Program 23 settings are right for the parallel system.
	Fault code 81	Host loss	If problem still exists, contact repair center

Note: To restart the inverter, all power sources need to be disconnected. After the LCD screen light is off, only use the battery to restart the inverter.

5 Warranty

We warrant this product against defects in materials and workmanship for a period of one year from the date of purchase and will repair or replace any defective V Series Inverter when directly returned, postage prepaid, to manufacturer. This warranty will be considered void if the unit has suffered any obvious physical damage or alteration either internally or externally and does not cover damage arising from improper use such as plugging the unit into an unsuitable power sources, attempting to operate products with excessive power consumption requirements, reverse polarity, or use in unsuitable climates.

WARRANTY DOES NOT INCLUDE LABOR, TRAVEL CHARGES, OR ANY OTHER COSTS INCURRED FOR REPAIR, REMOVAL, INSTALLATION, SERVICING, DIAGNOSING OR HANDLING OF EITHER DEFECTIVE PARTS OR REPLACEMENT PARTS. THE WARRANTOR ASSUMES NO LIABILITY FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND.

LOSS OR DAMAGE: Loss or damage in transit is the responsibility of the carrier. Any claim should be filed with the delivering transport company. Invoice, Bill of Lading and Delivery receipt with damage noted therein must accompany any claims for freight damage. Claims for shortage and lost shipments must be made in writing to the shipper within 3 days of the receipt of shipment. Claims not reported within this time frame will not be honored.

This warranty does not apply to and we will not be responsible for any defect in or damage to:

- a) the product if it has been misused, neglected, improperly installed, physically damaged or altered, either internally or externally, or damaged from improper use or use in an unsuitable environment; violations of the warnings in the manual will invalidate the warranty.
- b) the product if it has been subjected to fire, water, generalized corrosion, biological infestations, or input voltage that creates operating conditions beyond the maximum or minimum limits listed in the product specifications including high input voltage from generators and lightning strikes;
- c) the product if repairs have been done to it other than by us or its authorized service centers;

Appendix 1 : MS6048D Solar Inverter Spec Sheet

	MODEL #	MS6048D
AC Mode	Nominal AC Output Power	6000VA/6000W
	AC Input Waveform	Sinusoidal (Utility or Generator)
	Max AC Input Voltage	272Vac
	Low AC Voltage Trip	184Vac±7V (UPS); 154Vac±7V (Appliances)
	Low AC Voltage Return	194Vac±7V (UPS); 164Vac±7V (Appliances)
	High AC Voltage Trip	272Vac±7V
	High AC Voltage Return	262Vac±7V
	Nominal AC Input Frequency	50Hz / 60Hz (Auto Detection)
	Low Frequency Trip	45±1Hz
	Low Frequency Return	47±1Hz
	High Frequency Trip	65±1Hz
	High Frequency Return	63±1Hz
	Efficiency (Line Mode)	>95% (Under full Linear Loads)
	Transfer Time	10 ms(Typical) ; 20 ms Max; <30ms Parallel

	AC Input Breaker	50A MAX
Inverter Mode	Battery Voltage	48 VDC
	Output Waveform	Pure Sine Wave
	AC Voltage Regulation (Batt. Mode)	120/240 VAC ± 5%
	Surge AC Output Power	18000W
	Output Frequency	50Hz/60Hz(default)
	Output Current	25A
	DC To AC Efficiency (Peak)	94%
	Overload Protection	10s@101%~150% load; 5s@≥150% load
	Cold Start Battery Voltage* (Without PV or AC)	Low DC Cut-Off Voltage +2Vdc /Li Mode(Low DC Cut-off SOC +10%)
	Minimal Battery Voltage To Activate AC Charger(Without PV)	40.8Vdc
	Low DC Warning Voltage (Lead-Acid Mode)	44.0Vdc @ load < 20%
		42.8Vdc @ 20% ≤ load < 50%
		40.4Vdc @ load ≥ 50%
	Low DC Warning Return Voltage(Lead-Acid Mode)	46.0Vdc @ load < 20%
		44.8Vdc @ 20% ≤ load < 50%
		42.4Vdc @ load ≥ 50%
	Low DC Cut-off Voltage (Lead-Acid Mode)	42.0Vdc @ load < 20%
		40.8Vdc @ 20% ≤ load < 50%
		38.4Vdc @ load ≥ 50%
	Low DC Cut-off Voltage (Li Mode)	42.0Vdc
	Low DC Warning SOC (Li Mode)	Low DC Cut-off SOC +5%
	Low DC Warning Return SOC (Li Mode)	Low DC Cut-off SOC +15%
	Low DC Cut-off SOC (Li Mode)	Default 20%, 5%~50% settable
Charge Mode	High DC Recovery Voltage	58Vdc
	High DC Cut-off Voltage	AGM:60V, FLD:62V, USE or Li Mode: C.V. Voltage + 4.0V
	Idle Power	<35W
	CV & Float Charge voltage	48.0V~58.4V Settable
	AC charge voltage range	@191V-265V,100% Charging
		@155V-190V,Max charging current 30A
		@>265V,charger deactivated, recovers at 260V
	Maximum PV Array Power	4500W
	Max PV Input Current	22A
	MPPT Efficiency	97.5 0% max.
	PV Open Circuit Voltage	250Vdc
	PV Charger Start-up Voltage	45V
	MPPT Range @ Operating Voltage	60-245VDC
	Overcharge Protection	60Vdc
	Maximum Solar Charge Current	80 A
	Maximum AC Charge Current	60 A
	Maximum Charge Current(PV+AC)	140 A
	Battery Voltage Accuracy	+/-0.3%

	PV Voltage Accuracy	+/-2V
General Specifications	Inverter Dimension LxWxH	650*365*247mm/25.6*14.4*9.7"
	Pack Dimension LxWxH	780*530*450mm/30.7*20.9*17.7"
	Net Weight	38.5KG/84.7lbs
	Gross Weight	55KG/121lbs
	Humidity	5% to 95% Relative Humidity (Non-condensing)
	Operating Temperature	-20°C to 50°C(-4°F to 122°F)
	Storage Temperature	-40°C to 60°C(-40°F to 140°F)
	Altitude	<2000m

*Cold start voltage is the minimal battery voltage for the inverter to power on without PV or AC input.

※Errors and omissions reserved. Specifications in this manual are subject to change without prior notice.

SAVE THIS MANUAL!
READ THIS MANUAL BEFORE INSTALLATION, IT
CONTAINS IMPORTANT SAFETY, INSTALLATION AND
OPERATING INSTRUCTIONS. KEEP IT IN A SAFE PLACE
FOR FUTURE REFERENCE.

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