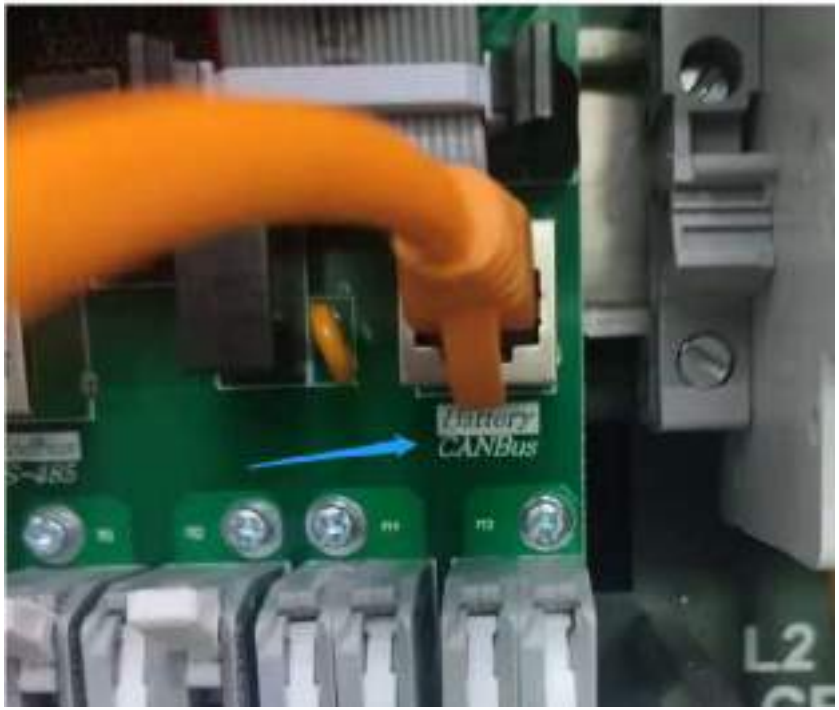
LINIOTECH

Sol-Ark 12KW&15KW Inverter and Liniotech Battery

Sol-Ark-12k-P
Sol-Ark-15k-p

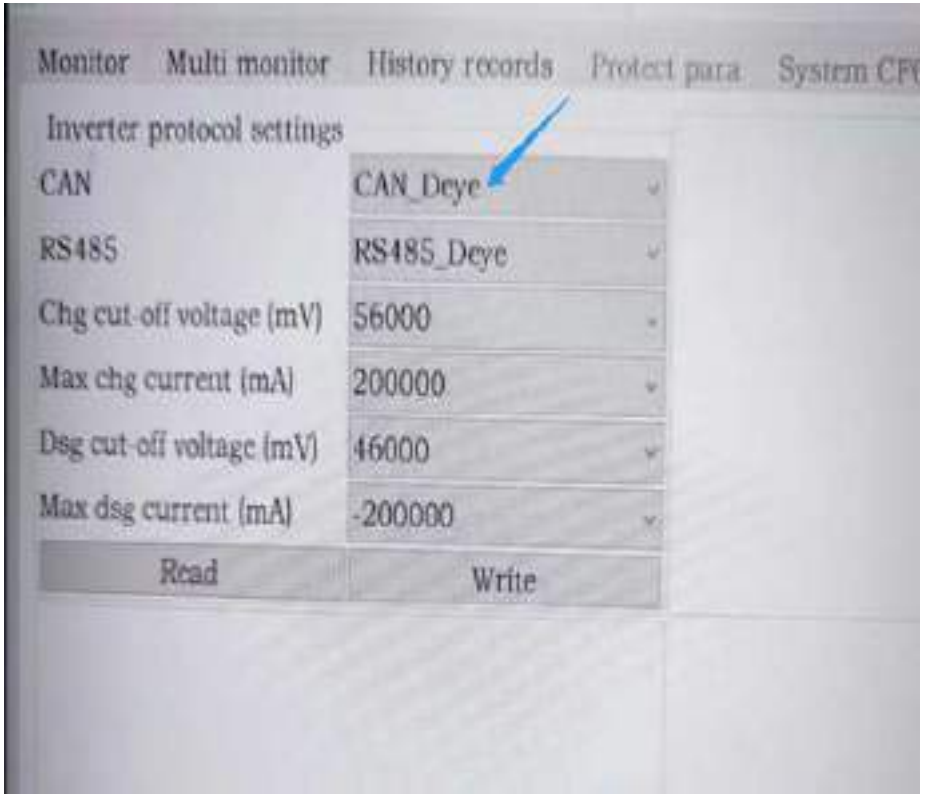
51200 (51.2V200Ah/10KWH)
51280(51.2V280Ah/14.33KWH)



Inverter Battery CANBus Port

Battery CAN Port

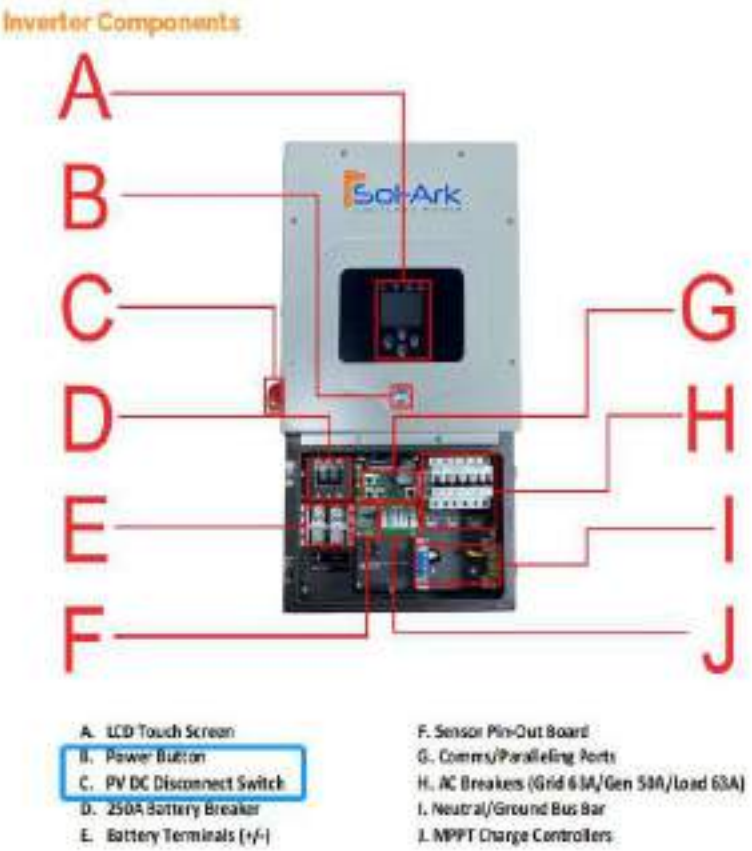
The inverter sets the 00 protocol

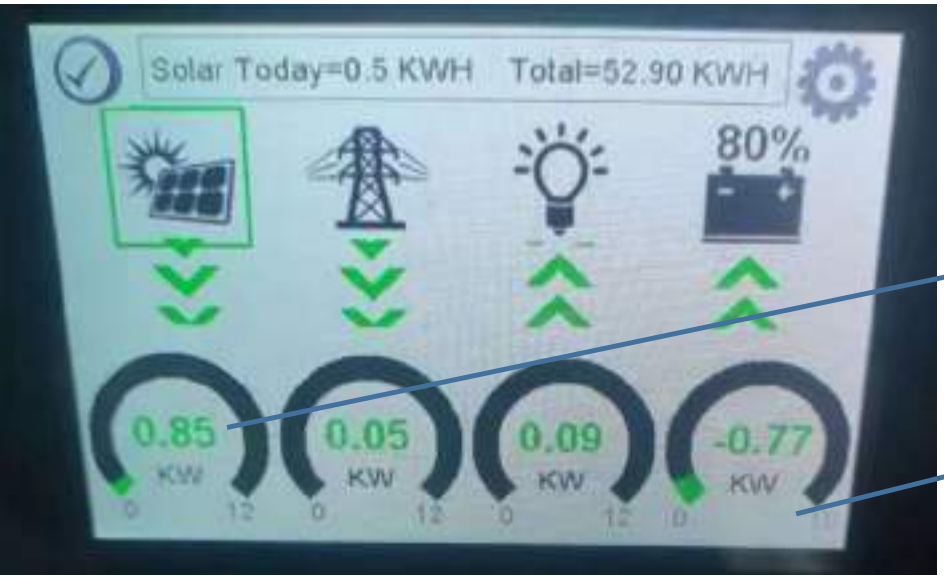


The Battery sets the CAN_Deye protocol
(OLD BMS STYLE NEED TO BE CHOICED BY THE SPECIAL CABLE WITH COMPUTER

Power Button

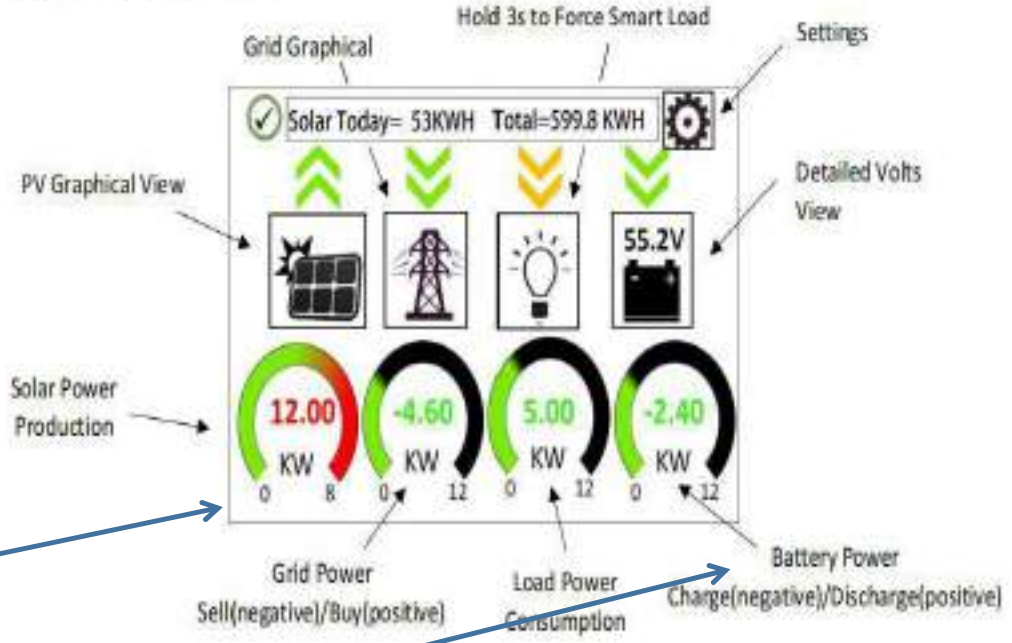
PV Disconnect Switch





Screens

- **Home Screen (Touchscreen)**



PV Graphical View

- Displays power production over time for the PV array
- Use up/down buttons to navigate between days
- Month view, Year view, and Total view

Sol-Ark

Sol-Ark 12K-P Spec Sheet

Solar	Input Power 12000W
Max Allowed PV Power	6500W + 6500W = 13000W
Max PV Power Delivered to Battery & AC Outputs	12000W
Max DC Voltage (Voc)	500V @ 18A, 450V @ 20A
MPPT Voltage Range	150-425V
Starting Voltage	125V
Number of MPPT	2
Max Solar Strings Per MPPT	2
Max DC Current per MPPT (Self Limiting)	20A
Max AC Coupled Input (Micro/String Inverters)	9600W

Connecting Solar Panels

A. Sol-Ark has DUAL MPPTs for two separate PV input pairs

B. MAX PV input = 13kW (± 5%) / system | 6.5kW / MPPT | MAX 500V_{OC} PV | MAX I_{SC} /MPPT 25A (limiting to 20A)

Damage will occur if PV V_{OC} > 550V

C. **Parallel strings per MPPT must be the same Voltage**
   i. PV1 A/B must be the same voltage if using both strings
   ii. Panels on the same MPPT CAN face different directions

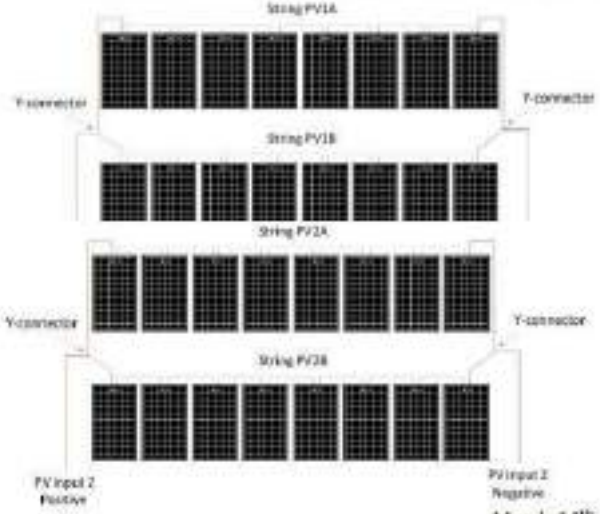
D. Ground the panel MOUNTS/FRAMES to any ground in the Home via 12AWG wire

E. **IF using Y-Connectors: Running two strings in parallel, totaling 20A (self-limiting)**

F. Connect the solar panel strings as indicated by the following diagram:

Each string **can** use separate wires

String minimum is usually 5 panels or 175V



Grid Graphical View

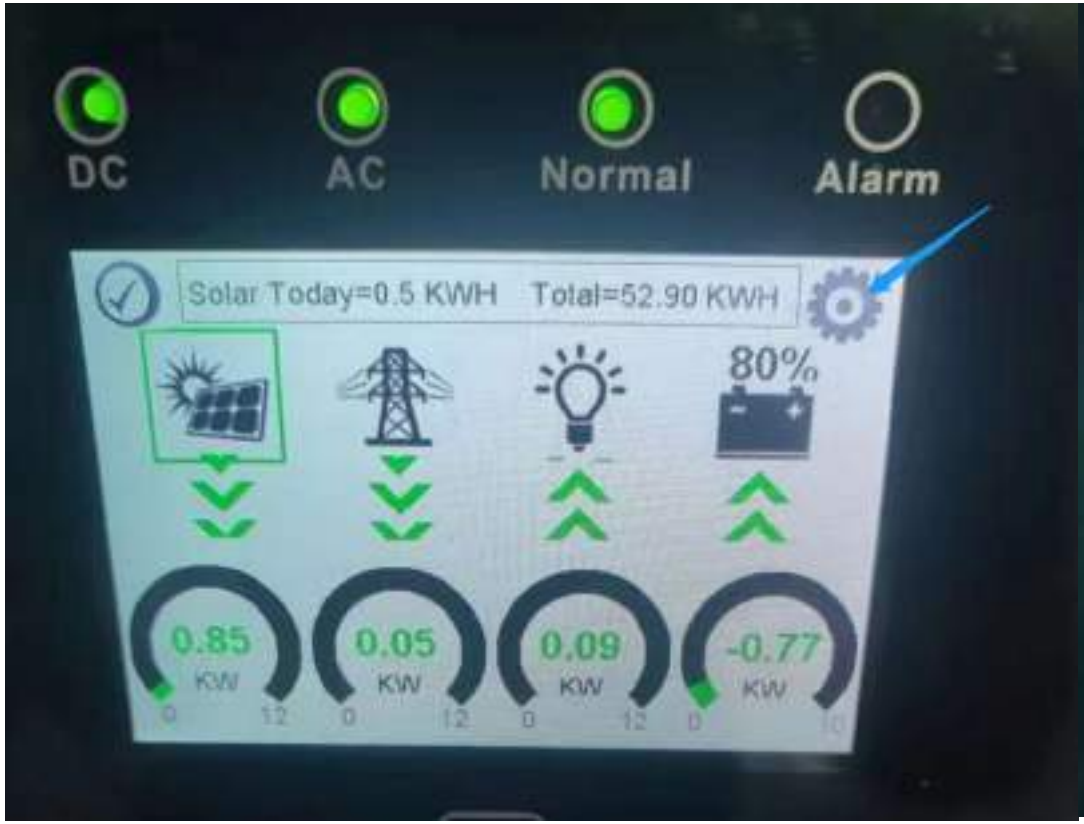
- Displays power drawn from and sold to the grid over time
- Bars above the line indicate power bought from the grid
- Bars below the line indicate power sold back to the grid
- This view can be helpful in determining when the most power is used in the home and for time of use programing

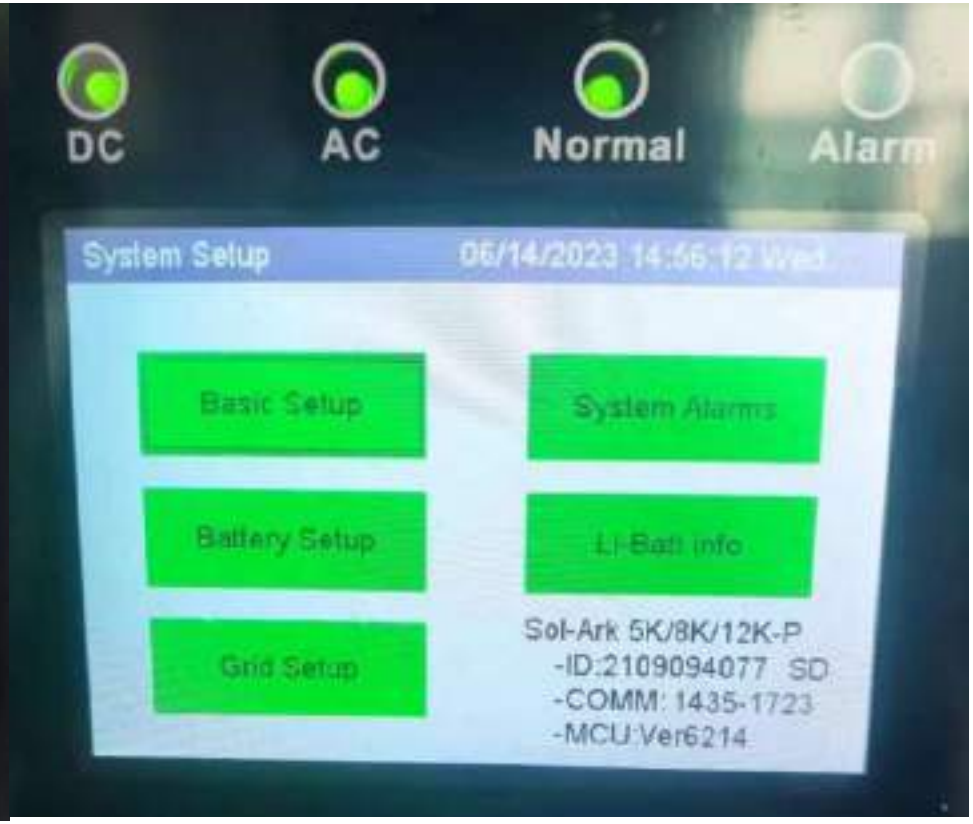

DC
AC
Normal
Alarm
Solar Today=0.5 KWH Total=52.90 KWH
80%
0.85
KW
0.05
KW
0.09
KW
-0.77
KW

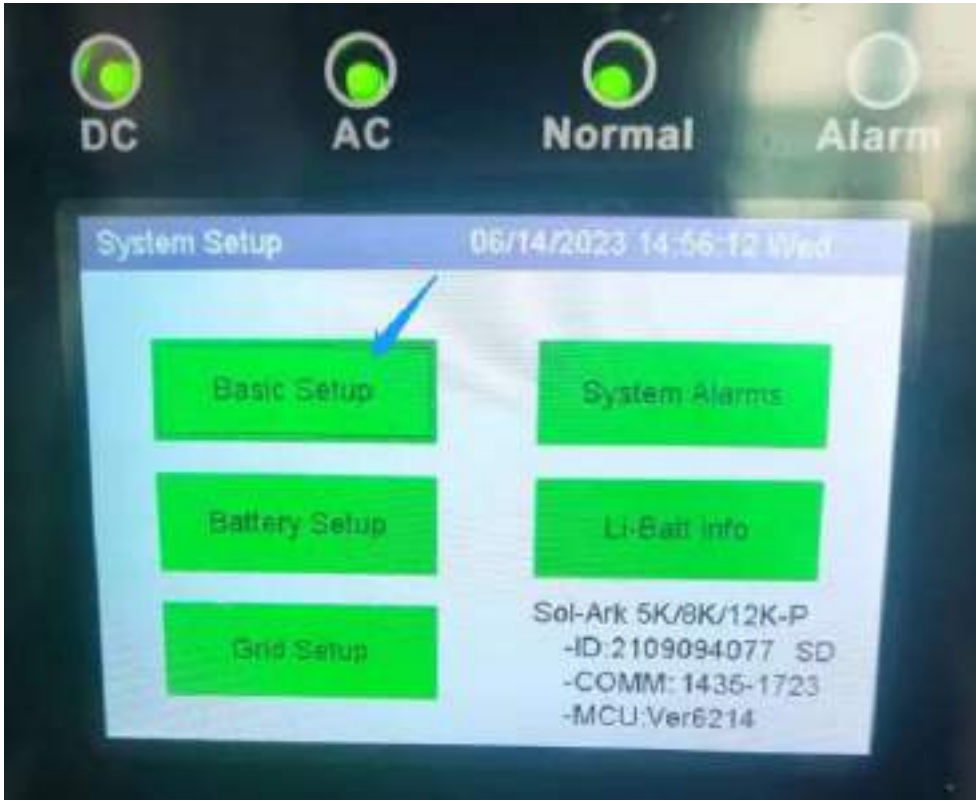
Detailed Volts View

- Top row = Total power for column
- Middle Row = Line 1/PV1 voltage, Amps, and Watts (note: PV Voltage not to exceed 500)
- Bottom Row = Line 2/PV2 voltage, Amps, and Watts (note: PV Voltage not to exceed 500)
- Batt Temperature will show -20°C if temperature sensor is not connected
- Batt SOC % = % batteries are charged
- DC Temp = Temperature of DC conversion electronics
  - Batt → AC
  - PV → Batt
  - AC → Batt
- AC Temp = Temperature of AC conversion electronics
  - Batt → AC
  - PV → AC
- Grid Column
  - If selling to grid, Grid Watts = negative
  - If buying from grid, Grid Watts = positive
  - Note: If these values are reversed, current sensors may have been installed incorrectly (reverse polarity).
  - HM = Power detected by the external current sensors on entire home L1 & L2
  - LD = Power detected using internal sensors on AC grid in/out breaker

Solar	Grid	INV	Load	Batt
0W	0W 50.0Hz	0W 50.0Hz	0W	0W 0%
L1 0V 0.0A 0W	117V HM 0W LD 0W	119V 0.2A 0W	119V 0W	53.53V 1.30A 0.0C
L2 0V 0.0A 0W	117V HM 0W LD 0W	119V 0.2A 0W	119V 0W	DC 50.3C AC 40.3C


DC
AC
Normal
Alarm
Solar Today=0.5 KWH
Total=52.90 KWH
80%
0.85
KW
0.05
KW
0.09
KW
-0.77
KW

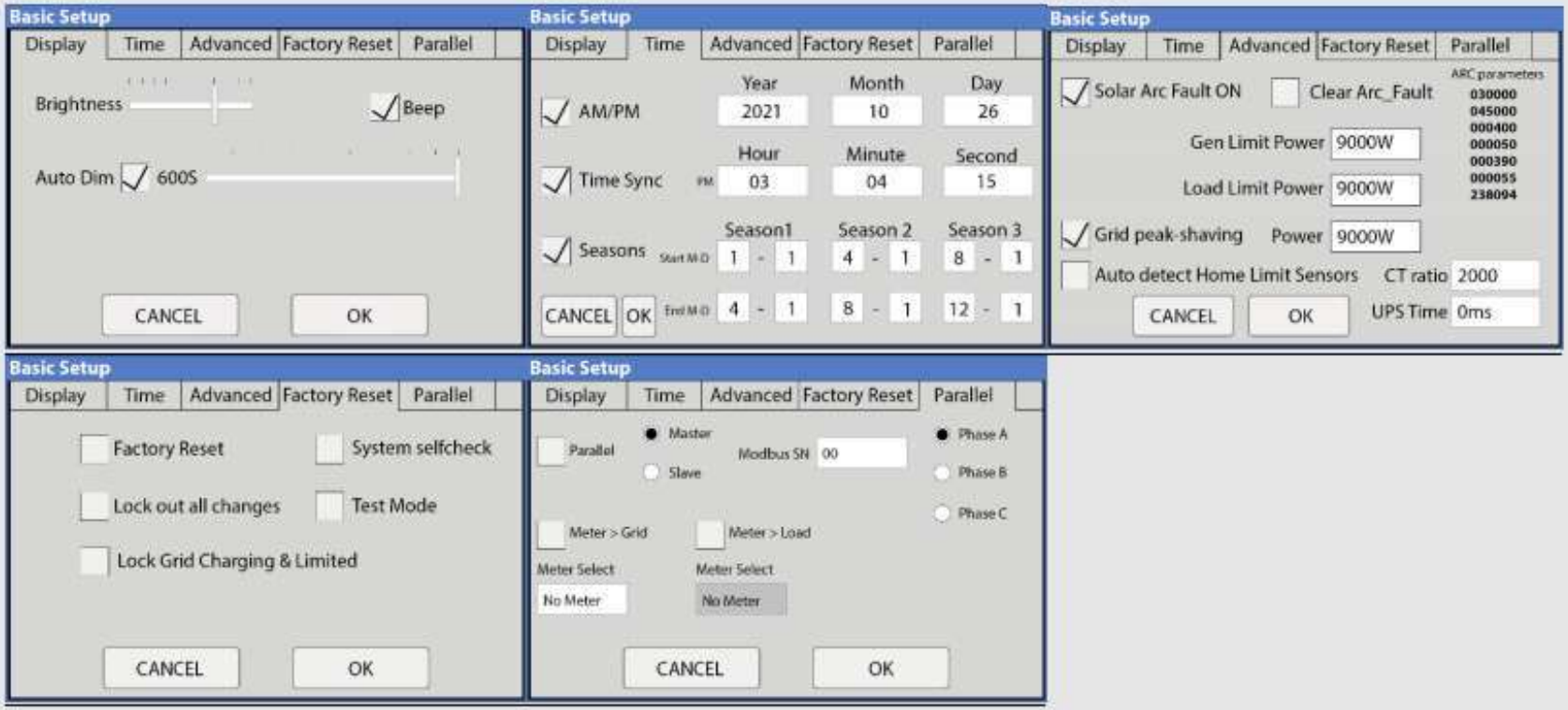

DC
AC
Normal
Alarm
System Setup
Basic Setup
System Alarms
Battery Setup
Li-Batt info
Grid Setup
Sol-Ark 5K/8K/12K-P
-ID:2109094077 SD
-COMM: 1435-1723
-MCU:Ver6214



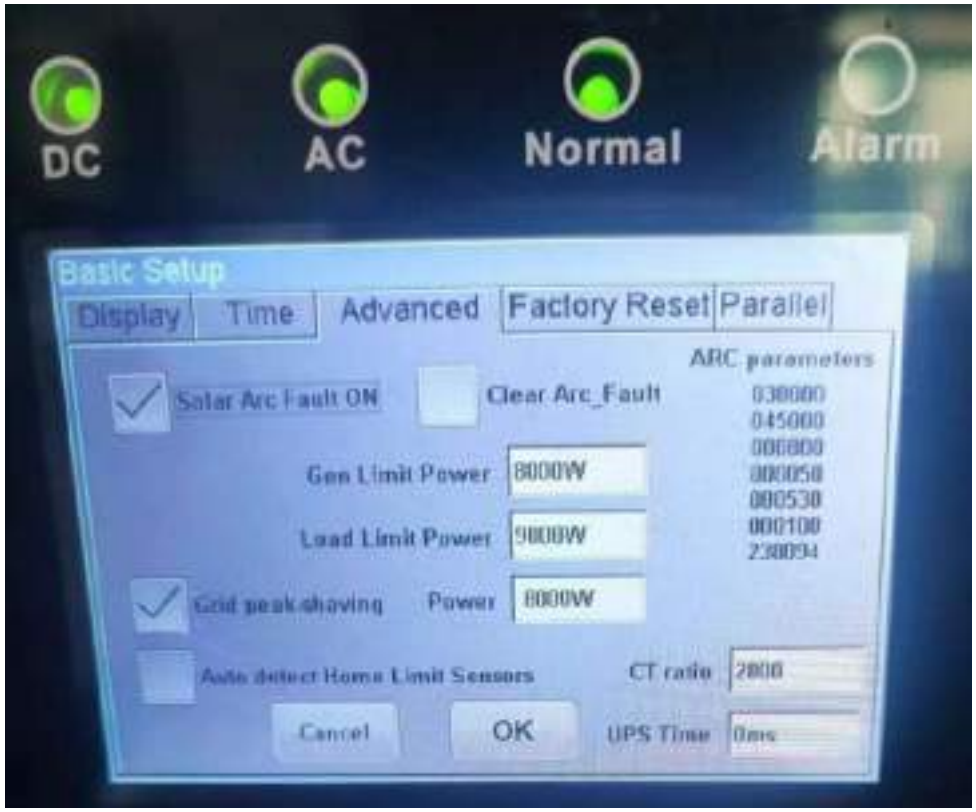
Basic Setup

- Display
  - Brightness adjustment
  - Auto dim (must be enabled for LCD screen to be covered by warranty)

Basic Setup


Basic Setup
Display
Time
Advanced
Factory Reset
Parallel
Brightness
Beep
Auto Dim
600S
CANCEL
OK
Year
Month
Day
AM/PM
2021
10
26
Hour
Minute
Second
Time Sync
PM
03
04
15
Season1
Season 2
Season 3
Seasons
Start M-D
1 - 1
4 - 1
8 - 1
End M-D
4 - 1
8 - 1
12 - 1
Solar Arc Fault ON
Clear Arc_Fault
ARC parameters
030000
045000
000400
000050
000390
000055
238094
Gen Limit Power
9000W
Load Limit Power
9000W
Grid peak-shaving
Power
9000W
Auto detect Home Limit Sensors
CT ratio
2000
UPS Time
0ms
Factory Reset
System selfcheck
Lock out all changes
Test Mode
Lock Grid Charging & Limited
Parallel
Master
Slave
Modbus SN
00
Phase A
Phase B
Phase C
Meter > Grid
Meter > Load
Meter Select
No Meter

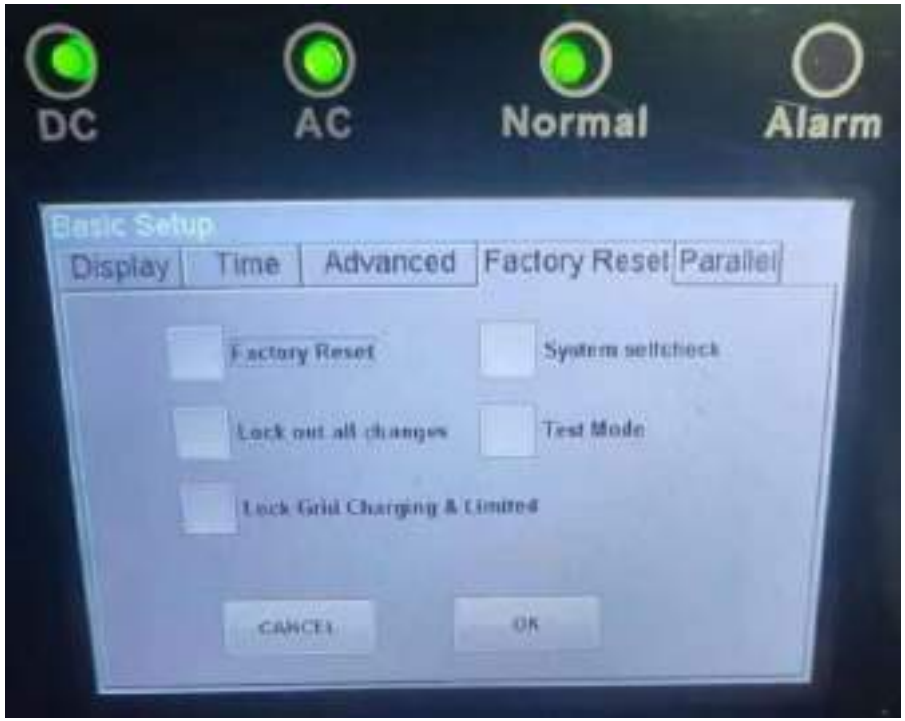

DC
AC
Normal
Alarm
Basic Setup
Display
Time
Advanced
Factory Reset
Parallel
Year
Month
Day
AM/PM
2023
06
14
Hour
Minute
Second
Time Sync
PM
03
32
11
Season1
Season2
Season3
Seasons
Start M-D
1 - 1
4 - 1
8 - 1
Cancel
OK
End M-D
4 - 1
8 - 1
12 - 1



- Alarms & Safety
  - Arc fault detects if a poor connection in the PV wires
- Grid Peak Shaving
  - Set the threshold that the Sol-Ark will begin contributing Power to keep the power drawn from the grid below the threshold.
- Gen Peak Shaving
  - Set the threshold at which the Sol-Ark will contribute to the generator to prevent large loads overloading the generator.

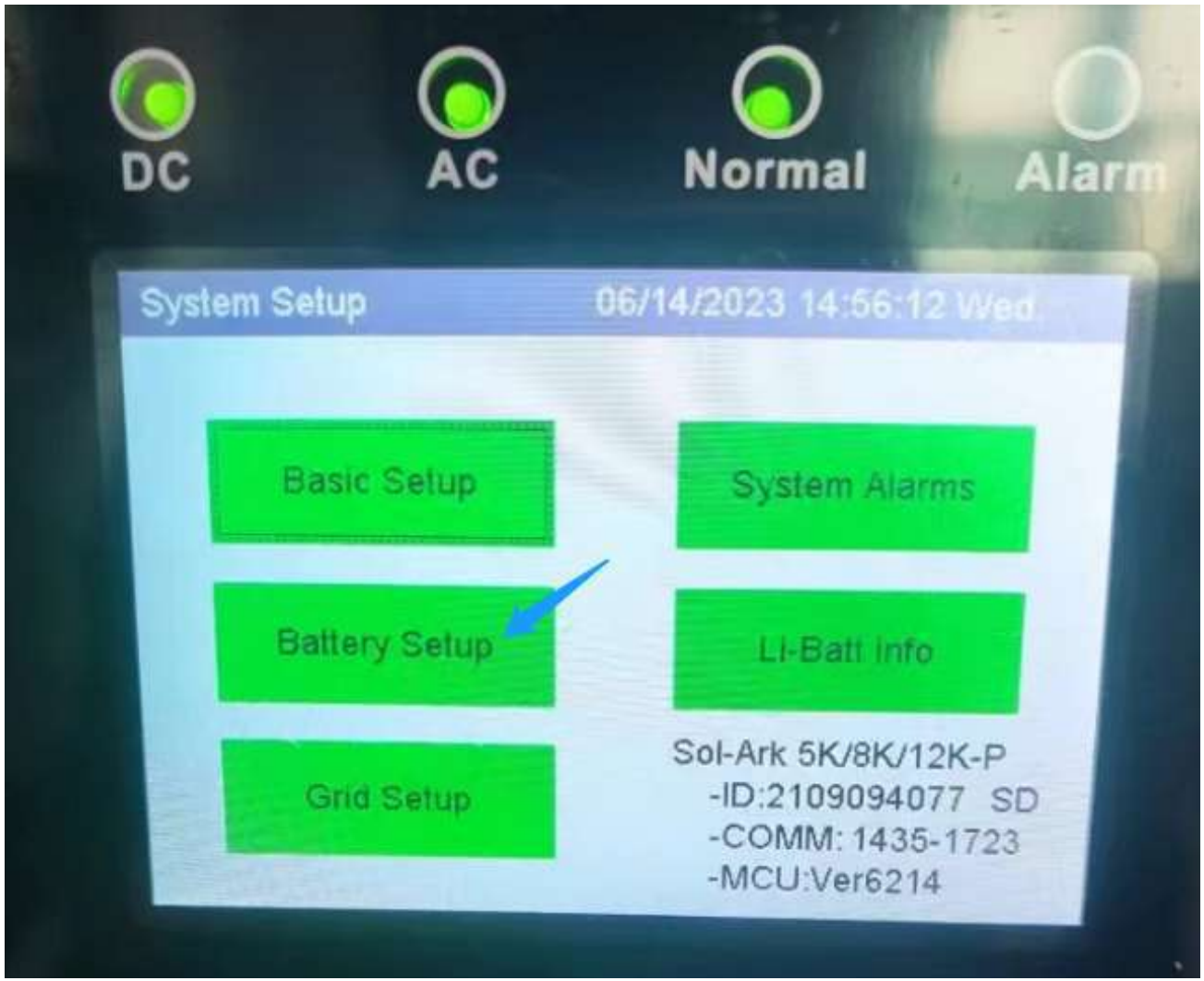
Grid Peak Shaving Mode (For Gen Connected to Grid Breaker)

A. Prevents the Sol-Ark from overloading generators
B. Must place the CT sensors so that they measure L1 and L2 of the generator's output, pointing arrows on the CTs towards the generator
C. Sol-Ark contributes power above the "Power" value threshold to prevent overloading the generator
D. This mode will auto-adjust the Grid Charge Amperage to avoid overloads



Parallel (when using multiple systems, Multi-system app note)

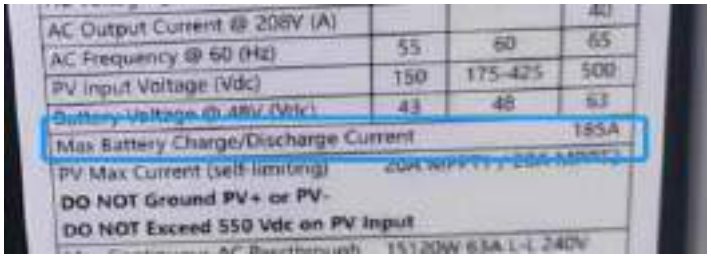
- Select parallel mode when using multiple systems
- Set the Master/Slave status of each system
  - Only one system can be set to "Master"
- Set the MOBDUS address of each system
- When using multiple system in 120/208V mode select which phase each system is responsible for (A,B,C)


DC
AC
Normal
Alarm
System Setup
06/14/2023 14:56:12 Wed
Basic Setup
System Alarms
Battery Setup
LI-Batt Info
Grid Setup
Sol-Ark 5K/8K/12K-P
-ID:2109094077 SD
-COMM: 1435-1723
-MCU:Ver6214

Battery Setup

Batt Setup

- Batt
  - Batt Capacity: enter the size of the battery bank connected to the system
  - Max A charge: set the max charge rate for the batteries (This also sets PV → Battery charge rate)
  - Suggest 20%-30% of battery capacity for lead acid
  - Max A discharge: set max discharge for battery bank (In off-grid mode, the battery bank will discharge 120% of this value for 10 seconds before the inverter shuts down to prevent battery damage)



AC Output Current @ 208V (A)			40
AC Frequency @ 60 (Hz)	55	60	65
PV Input Voltage (Vdc)	150	175-425	500
Battery Voltage @ 48V (Vdc)	43	48	63
Max Battery Charge/Discharge Current			185A
PV Max Current (self-limiting)			
DO NOT Ground PV+ or PV-			
DO NOT Exceed 550 Vdc on PV Input			

- TEMPCO: Temperature coefficient used in conjunction with the batt temp sensor to adjust optimal voltages for lead acid batteries
- Use Batt V charged: displays battery charge in terms of voltage
- Use Batt % charged: Battery voltage can be misleading for determining the % Charged. So, we use algorithms measuring power in and out to measure a true value for % Charged. It compensates for aging batteries also.

Charge

- Float V: Set value appropriate for the batteries connected to the system using chart (Page 35)
- Absorption: Set value appropriate for the batteries connected to the system using chart (Page 35)
  - Absorption will stop at 1% of the capacity of the battery bank and drop to float
  - Ex: 400Ah battery would be 4A
- Equalization: Set value appropriate for the batteries connected to the system using chart (Page 35)
- Days: period between equalization cycles
- Hours: period taken to equalize batteries
  - Note if Hours = 0 system will not equalize the batteries
- Gen Charge: uses the gen input of the system to charge battery bank from an attached generator.

  - Start V: voltage at which system will AutoStart a connected generator to charge the battery bank
  - Start percentage: Percent S.O.C at which system will AutoStart a connected generator to charge the battery bank
  - A: charge rate from the attached generator in Amps
    - Note: size this value appropriately for your given generator size

Grid Charge

- Start V: voltage at which system will charge the battery bank from the grid. If grid is on, batteries will stay at float voltage.
- Start percentage: Percent S.O.C at which system will AutoStart a connected generator to charge the battery bank
- A: charge rate from the grid in Amps

Gen Start V or % (Grid Start if Gen on Grid Breaker)

Value batts need to reach BEFORE automatically starting a generator connected to the GEN breaker to charge the battery bank.

⚠ Sol-Ark will NOT charge batteries from a generator until the batteries reach this value.

Gen Start A (Grid Start if Gen on Grid Breaker)

This is how many amps (DC) you can pull specifically from the Generator to charge the batts. To ensure you do not overload a small Generator, you will want to adjust the GEN or GRID Start A value. ***Multiply value by # of Sol-Arks for actual current value into batteries.***

Suppose PV production = 0W | Disabled TOU | Enabled Grid/Gen Charge: the batteries will be charged to "full" using the Grid or a Generator (if available) until the battery bank accepts only 5% of its rated capacity in Amperes. This value correlates to roughly 98-99% full for most batteries and is the generator's default "OFF" signal. If producing PV, the system will use PV to charge the batteries to 100% full instead.

Discharge

- Shutdown V: battery voltage at which the inverter will shut down (batt symbol on home screen will turn red)
- Low Batt: Low battery voltage (batt symbol on home screen will turn yellow)
- Restart: battery voltage at which AC output will resume
- Batt Resistance: used in % SOC batt calculations
- Batt Charge Efficiency: used in % SOC batt calculations
- Batt Empty V: sets reserve capacity and improve % SOC calculations. It is not Batt_I adjusted.
    - (Recommendations: 45V for AGMs, 48V for Lithium Iron Phosphate)

Smart Load (Gen Load)

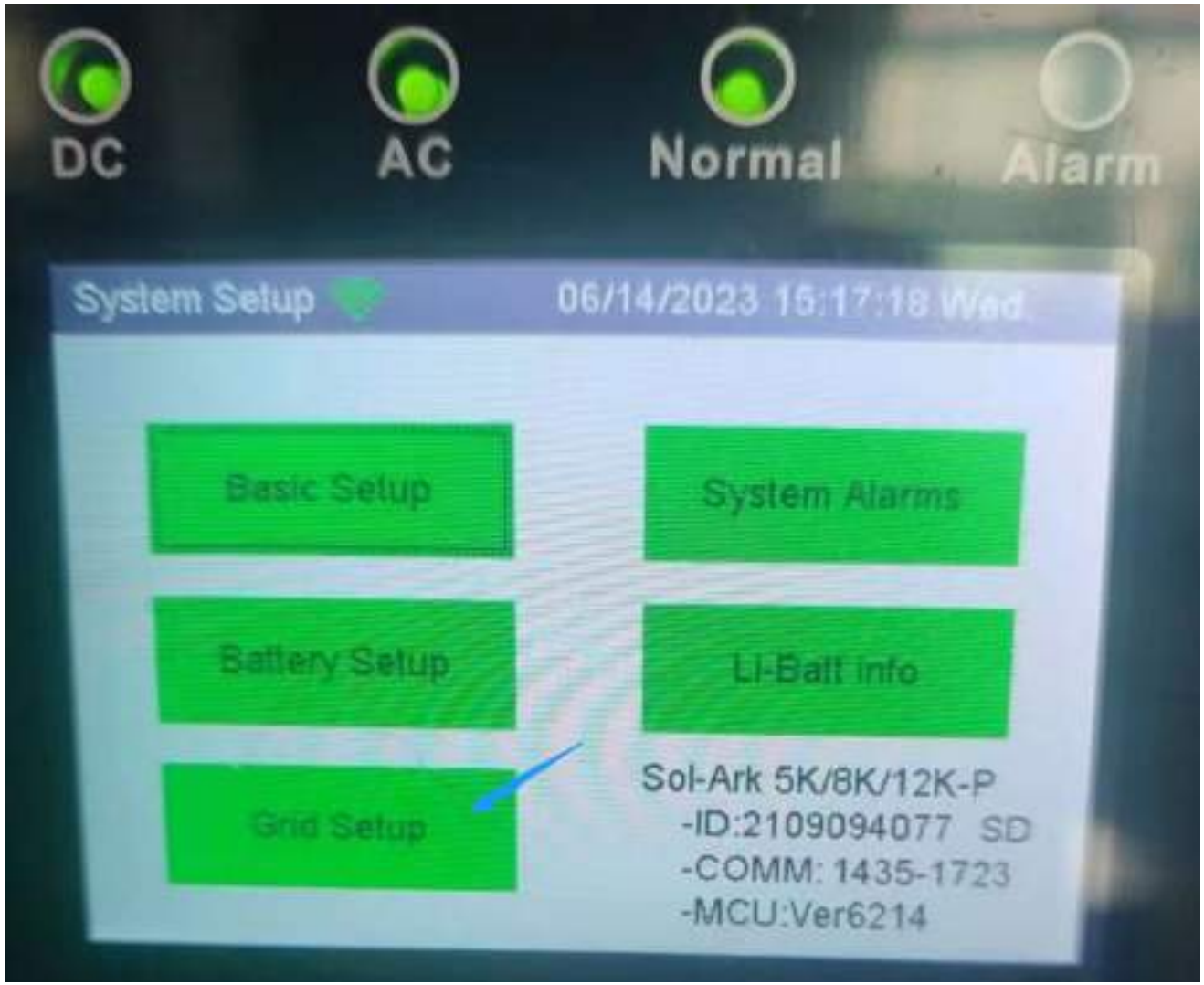
- This mode utilizes the Gen input connection as an output which only receives power when the battery is above a user programmable threshold.
- The Gen input breaker in the user area of the system becomes an output to high power loads such as a water heater, irrigation pump, ac unit, pool pump.
- Smart Load OFF Batt
  - Battery voltage at which the Gen load will stop being powered
- Smart Load ON Batt
  - Battery voltage at which the gen load will start being powered
- Note: If using Gen load for a water heater, it is recommended that only one leg (120V) be connected to the bottom element. This significantly reduces the power consumption of the water heater while retaining core functionality (it will heat water, only slower).
- Note: Gen Load is limited to 40A at 240V (Do not exceed!)

- Solar Watts is for on grid.
  - System waits to turn on smart load until enough PV power is produced (when on grid).

- **AC Coupling Settings (For Micro Inverter Input)**
  - To use the Gen input breaker as a micro inverter AC coupled input, check the "For Micro inverter Input" box (this feature will also work with "Grid-Tied" inverters)
    - Maximum combined input to Sol-Ark (AC+DC)
      - Best: 3kWAC + 11kWDC (8KW sell)
      - Good: 2kWAC + 12kWDC (9KW sell)
      - OK: 4kWAC + 7kWDC
      - Poor: 5kWAC + 6kWDC
      - Poor: 6kWAC + 5kWDC

  - To use the LOAD breaker for AC coupling grid tied inverter(s)
    - You must select "For Micro Inverter Input"
    - The Gen Breaker is not used (even though the GEN breaker is not physically being used for this mode, AC coupling on the LOAD breaker prevents the use of the GEN breaker)
    - Wire as show in the preceding example diagram labeled "Load side AC coupling example"
    - Note: some load side AC coupling installs will require a line side tap instead of the 50A breaker shown in the example diagram
    - Maximum combined input to Sol-Ark (AC+DC)
      - Max AC + DC: 9kWAC (Load side) + 2kWDC
      - Max DC + AC: 12kWDC + 2kWAC
  - Note: when AC coupling "For Micro Inverter Input must be selected"
    - The meaning of Smart Load OFF Batt and Smart Load ON Batt change in this mode
      - Smart Load OFF Batt: The SOC at which the AC coupled inverter(s) are shut down when in off-grid mode
        - 90% recommended
      - Smart Load ON Batt: The SOC at which the AC coupled inverter(s) are turned on when in off-grid mode
        - 60%-80% recommended
      - When on grid the AC coupled inverter will always be on and the power it produces will be sold back to the grid. **Limited To Home mode will not function with AC coupled PV arrays.**


DC
AC
Normal
Alarm
Batt Setup
Batt
Charge
Discharge
Smart Load
WindTurbine
DC1 for WindTurbine
DC2 for WindTurbine
V1 98V 0.0A
V2 110V 1.5A
V3 130V 3.0A
V4 150V 4.5A
V5 170V 6.0A
V6 190V 7.5A
V7 210V 9.0A
V8 230V 10.5A
V9 250V 12.0A
V10 270V 13.5A
V11 290V 15.0A
V12 310V 16.5A
OK
Cancel


DC
AC
Normal
Alarm
System Setup
06/14/2023 15:17:18 Wed
Basic Setup
System Alarms
Battery Setup
LI-Batt Info
Grid Setup
Sol-Ark 5K/8K/12K-P
-ID:2109094077 SD
-COMM: 1435-1723
-MCU:Ver6214

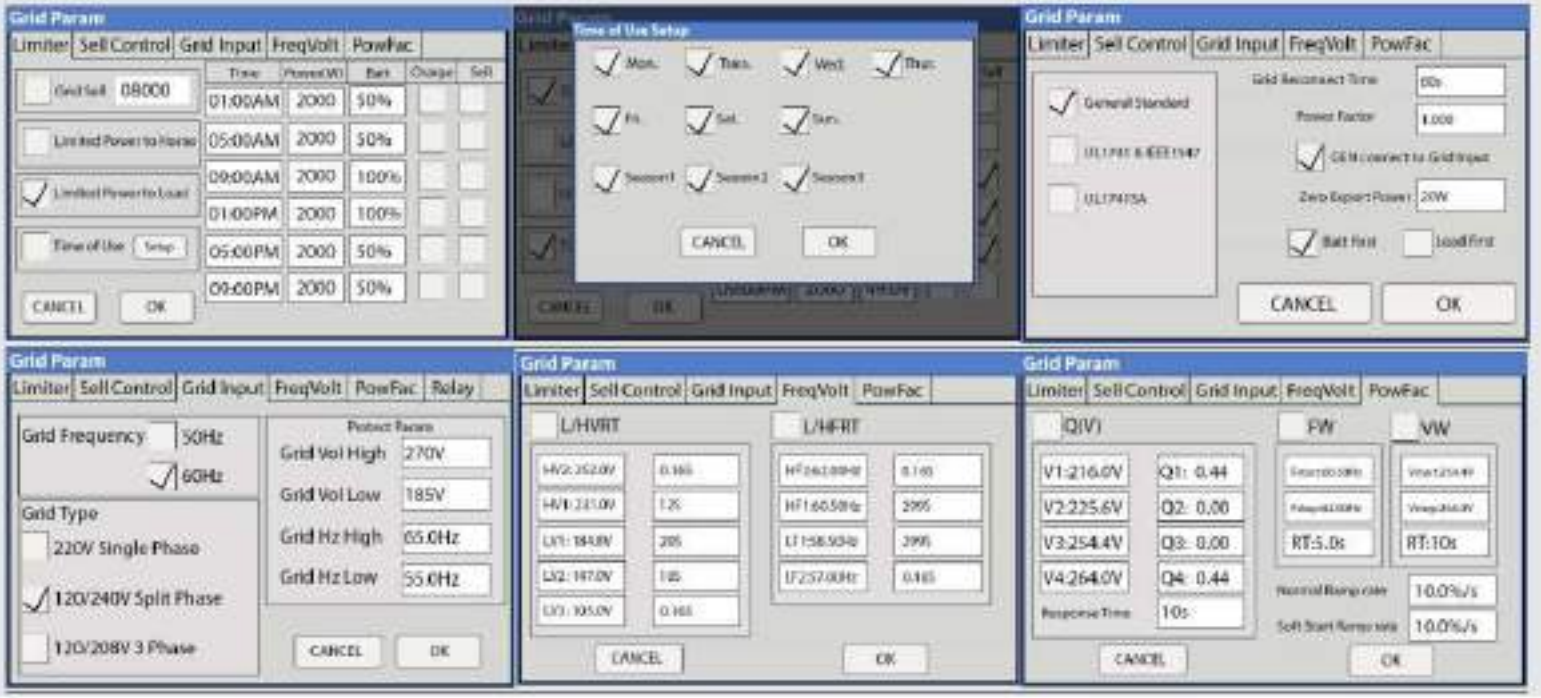
Selecting your Power Mode:

Sol-Ark 12K will simultaneously use various power sources available to meet loads demand. The following power modes allow the user to determine the power sources available to Sol-Ark 12K.

- Limited Load / Self Consumption
  - Sol-Ark will only power loads connected to it. It will not produce more power than the connected loads require. This mode will neither sell back to the home nor grid.
- Limited To Home (zeroing home meter)
  - Pushes power to your whole home without selling back any excess to the grid (no net metering agreement required)
  - This mode requires the use of the limiter sensors
    1. Main Menu → System Settings → Grid Setup → Limiter → Limited to Home
  - Power source priority is same as Grid Sell Back
- Grid Sell Back
  - This Mode allows Sol-Ark 12K to sell back any excess power produced by the solar panels to the grid.
    1. Main Menu → System Settings → Grid Setup → Limiter → Grid Sell
  - Power source priority is as follows:
    1. Solar Panels
    2. Grid
    3. Generator
    4. Batteries (until programable % discharge is reached)
- Time Of Use (using batteries during peak power times)
  - Only available when using Limited To Home mode (Limiter sensors required) and/or Grid Sell Back (Limiter sensors not required) modes
  - Use your batteries to reduce power consumption from the grid during a user programable peak pricing window of time.

- **Grid Setup**
  - Limiter
    - Grid Sell: maximum watts sold to grid
    - Limited To Home: Limits power produced by the system to match the demand of the home
    - Limited To Load: Limits power produced by the system to match the demand of connected loads
    - Time Of Use:
      - Time: When the system will sell batt/PV power to the grid or home
      - Power(W): Max watts to be sold from the battery only at each time
      - Batt: The battery voltage or % at which the system will limit selling to the grid or home from the battery. The system will drain the battery until that percent/voltage is reached.
      - Grid Charge: Enables grid charging during a selected period up to the voltage or percentage specified on the line. PV will always charge to 100%.
      - Gen Charge: Enables a generator to be called during this time period, if not checked generator will not be called for even if the start voltage/% is reached. If the generator is running and then the next time slot is reached and does not have gen charge checked, the generator will be turned off. Otherwise the generator will only be turned off once the charging amperage accepted by the battery bank reaches 5% of its rated capacity in amps. For example, if you had a 100Ah battery the generator would be turned off once the battery only accepted 5 amps of charging current.
      - For Examples: See Pages 38-39
    - Note: This mode requires Grid sell / limited to home be enabled.
    - Note: If you need the batteries to never charge from the grid, uncheck the "Grid Charge" box under the charge tab of the battery menu (see page 30).

Grid Setup


Grid Param
Limiter
Sell Control
Grid Input
Freq/Volt
Pow/Fac
Time
Power(W)
Batt
Charge
Sell
01:00AM 2000 50%
05:00AM 2000 50%
09:00AM 2000 100%
01:00PM 2000 100%
05:00PM 2000 50%
09:00PM 2000 50%
CANCEL
OK
Time of Use Setup
Mon.
Tues.
Wed.
Thur.
Fri.
Sat.
Sun.
Season1
Season2
Season3
CANCEL
OK
Grid Param
Limiter
Sell Control
Grid Input
Freq/Volt
Pow/Fac
General Standard
UL1741 & IEEE1547
UL1741SA
Grid Reconnect Time
Power Factor
Grid Input
Zero Export Power
Batt first
Load first
CANCEL
OK
Grid Param
Limiter
Sell Control
Grid Input
Freq/Volt
Pow/Fac
Relay
Grid Frequency
50Hz
60Hz
Grid Type
220V Single Phase
120/240V Split Phase
120/208V 3 Phase
Protect Param
Grid Vol High 270V
Grid Vol Low 185V
Grid Hz High 65.0Hz
Grid Hz Low 55.0Hz
CANCEL
OK
Grid Param
Limiter
Sell Control
Grid Input
Freq/Volt
Pow/Fac
L/HVRT
L/HFRT
CANCEL
OK
Grid Param
Limiter
Sell Control
Grid Input
Freq/Volt
Pow/Fac
Q(V)
V1:216.0V
V2:225.6V
V3:254.4V
V4:264.0V
Q1: 0.44
Q2: 0.00
Q3: 0.00
Q4: 0.44
Response Time
10s
P/W
RT:5.0s
V/W
RT:10s
10.0%/s
10.0%/s
CANCEL
OK

Sell Control

- General Standard: uses Protect Parameters in table
- UL 1741 & IEEE1547: Enables sell compliant functionality
- UL1741SA: Enables wider Freq, Voltage, and Power Factor
- GEN connect to Grid Input: Must be set if Generator is connected to AC Grid breaker

Grid Input

- Grid Frequency: Select the frequency of the grid connected to the system
- Grid Type:
  - 220V Single Phase (Call us before using)
  - 120/240 Split Phase (North America)
  - 120/208V 3 Phase
  - Note: If 120/208V, the L1 and L2 are phase specific. So, you may have to swap Grid L1 L2 for 208V applications.
  - Note: Inverter power cycle is required each time the input/output voltage is changed
- Protect Parameters (when
  - Settings when the system will connect/disconnect from grid
  - This is not used when UL 1741 & IEEE1547 is enabled
  - You may need to widen the frequency range when using a generator (55-65 Hz)

FreqVolt (UL 1741SA must enabled in "Soll Control" tab)

- **Puerto Rico Grid Compliance Settings:**

- **Kauai Grid Compliance Settings:**

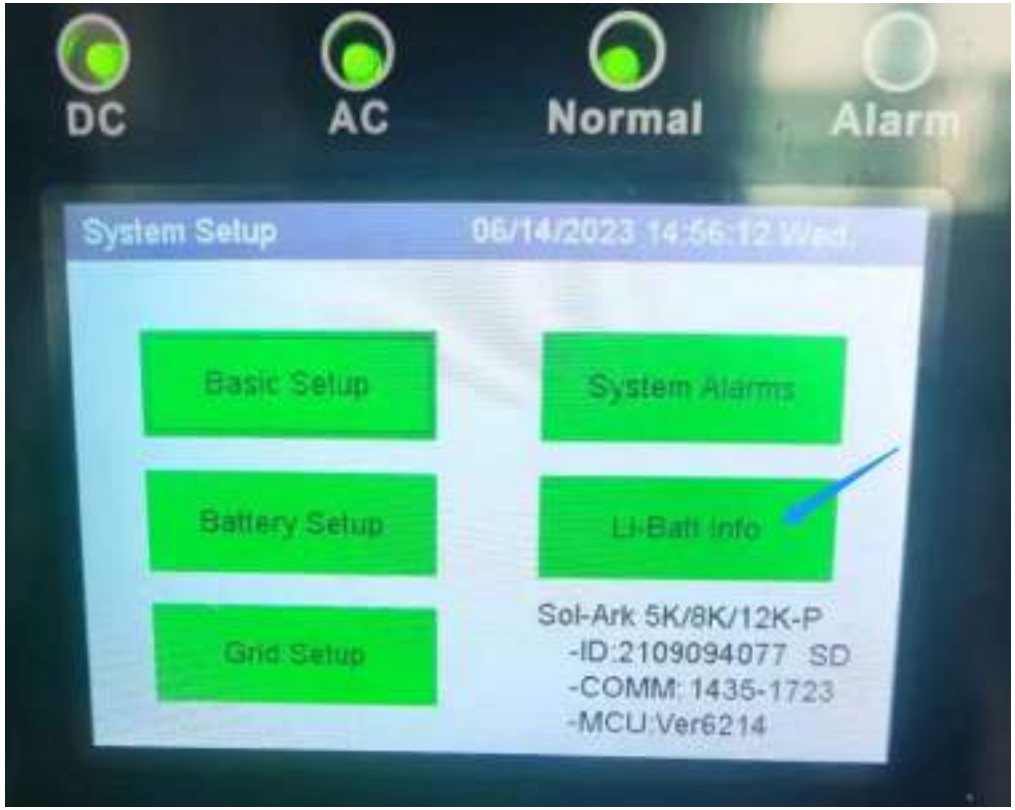
- **HECO Grid Compliance Settings for O'ahu, Maui, Hawai'i:**

PowFac

- Power Factor is programmable from 0.8 – 1.0.

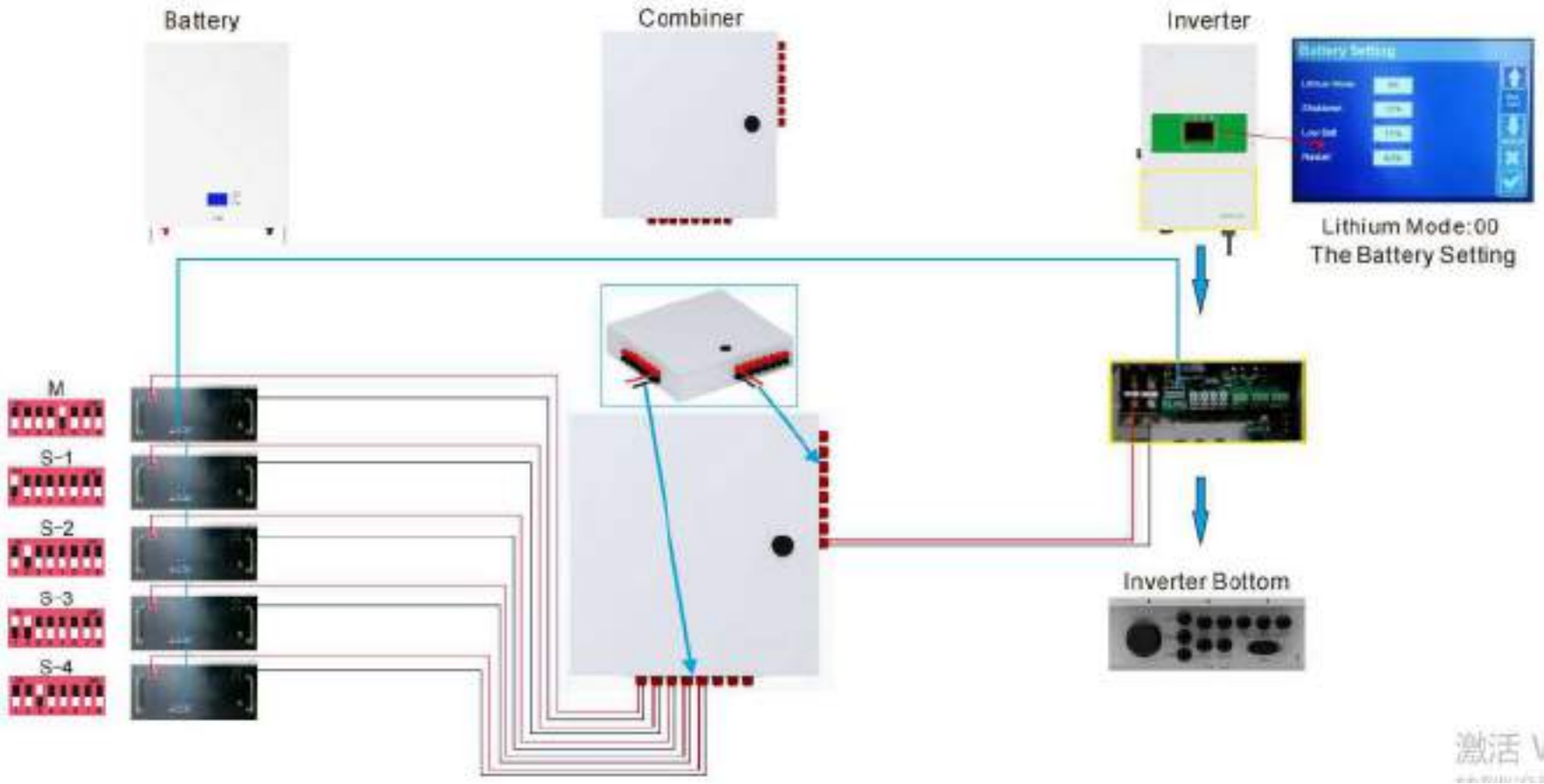

DC
AC
Normal
Alarm
System Setup
06/14/2023 14:56:12 Wed
Basic Setup
System Alarms
Battery Setup
LI-Batt Info
Grid Setup
Sol-Ark 5K/8K/12K-P
-ID:2109094077 SD
-COMM: 1435-1723
-MCU:Ver6214


DC
AC
Normal
Alarm
System Alarms
06/14/2023 15:22:23 Wed
Alarms Code
Occurred
F58 BMS_Communication_Fault 2023-06-14 11:46
F58 BMS_Communication_Fault 2023-06-14 11:19
F58 BMS_Communication_Fault 2023-06-14 11:04
F56 DC_VoltLow_Fault 2023-06-14 10:58
F56 DC_VoltLow_Fault 2023-06-13 18:30
F56 DC_VoltLow_Fault 2023-06-07 18:13
F58 BMS_Communication_Fault 2023-06-07 18:03
F56 BMS_Communication_Fault 2023-06-07 17:53



It can be seen from this that battery and inverter communication is successful.

Batteries parallel



Batteries ADD