PYLONTECH

Li-ion (LFP)
Energy Storage System
Force-H1 V2

Operation Manual

This manual introduces Force-H1 V2 from Pylontech.

Force-H1 V2 is a high voltage DC Lithium-Ion Phosphate Battery storage system.

Please read this manual before you install the battery and follow the instruction carefully during the installation process.

Any confusion, please contact the supplier immediately for advice and clarification.

Content

1.0 SAFETY

Force-H1 V2 is a high voltage DC system, operated by skilled/qualified personnel only. Read all safety instructions carefully prior to any work and observe them at all times when working on with the system

Incorrect operation or work may cause:

- injury or death to the operator or a third party;
- damage to the system hardware and other properties belonging to the operator or a third party.

1.1 Skills of Qualified Personnel

Qualified personnel must have the following skills:

- training in the installation and commissioning of the electrical system, as well as the dealing with hazards;
- knowledge of this manual and other related documents;
- knowledge of the local regulations and directives.

1.2 Symbols

	**DANGER** **Lethal voltage!** **Battery strings will produce HIGH DC power and can cause a lethal voltage and an electric shock.** **Only qualified person can perform the wiring of the battery strings.**
	**Warning** **Risk of battery system damage or personal injury.** **Do not pull out the connectors while the system is working!** **De-energize from all multiple power sources and verify that there is no voltage.**
	**Caution** **Risk of battery system failure or life cycle reduces.**
	**Read the product and operation manual before operating the battery system!**
	**Danger! Safety!**
	**Warning electric shock!**
	**Do not place near flammable material**
	**Do not install the system in an outdoor area**

	Do not reverse connection the positive and negative.
	Do not place near open flame.
	Do not place at the children and pet touchable area.
	Recycle label.
	Label for Waste Electrical and Electronic Equipment (WEEE) Directive (2012/19/EU)
	CE Marking
	The certificate label for EMC.
	The certificate label for Safety by TÜV SÜD.
	The certificate label for Safety by TÜV Rheinland.

Danger.
Batteries deliver electric power, resulting in burns or a fire hazard when they are short circuited, or wrongly installed.

Danger. Lethal voltages are present in the battery terminals and cables. Severe injuries or death may occur if touch the cables and terminals.

Warning. Do not open or deform the battery module, otherwise the product will be out of warranty scope.

Warning. Whenever working on the battery, wear suitable personal protective equipment (PPE) such as rubber gloves, rubber boots and goggles.

Warning. For battery installation, the installer shall refer to NFPA70 or similar local installation standard for operation.

Caution.
Improper settings or maintenance can permanently damage the battery.

Caution. Incorrect inverter parameters will lead to a further faulty/damage to battery.

Caution. It is very important and necessary to read the user manual carefully (in the accessories) before installing or using battery. Failure to do so or to follow any of the instructions or warnings in this document can result in electrical shock, serious injury, or death, or can damage battery, potentially rendering it inoperable.

- If the battery is stored for long time, it is required to charge them every six months, and the SOC should be no less than 90%.
- Battery needs to be recharged within 12 hours, after fully discharged.
- Do not install the product in outdoor environment, or an environment out of the operation temperature or humidity range listed in manual.
- Do not expose cable outside.
- Do not connect power terminal reversely.
- All the battery terminals must be disconnected for maintenance.
- Any foreign object is prohibited to insert into any part of battery.
- Do not use cleaning solvents to clean battery.
- Do not expose battery to flammable or harsh chemicals or vapors.
- Do not paint any part of battery, include any internal or external components.
- Do not connect battery with PV solar wiring directly.
- Please contact the supplier within 24 hours if there is something abnormal.
- The warranty claims are excluded for direct or indirect damage due to items above.

1.3 Before Connecting

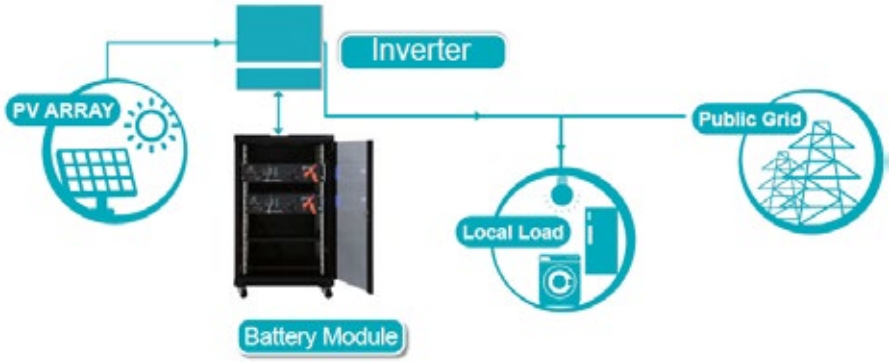
- After unpacking, please check product and packing list first, if product is damaged or lack of parts, please contact with the local retailer.
- Before installation, be sure to cut off the grid power and make sure the battery is in the switched-off mode.
- Wiring must be correct, do not mistake the positive and negative cables, and ensure no short circuit with the external device.
- It is prohibited to connect the battery and AC power directly.
- The BMS is designed for 350V DC, please DO NOT connect battery in series.
- Battery system must be well ground and the resistance must be less than 100mΩ.
- Please ensured the electrical parameters of battery system are compatible to related equipment.
- Keep the battery away from water and fire.

1.4 In using

- If the battery system needs to be moved or repaired, the power must be cut off and the battery is completely shut down.
- It is prohibited to connect the battery with different type of battery.
- It is prohibited to put the batteries working with faulty or incompatible inverter.
- It is prohibited to disassemble the battery (QC tab removed or damaged).
- In case of fire, only dry powder fire extinguisher can be used, liquid fire extinguishers are prohibited.
- Please do not open, repair or disassemble the battery except staffs from Pylontech or authorized by Pylontech. We do not undertake any consequences or related responsibility which because of violation of safety operation or violating of design, production and equipment safety standards.

1.5 Safe handling of lithium batteries guide

1.5.1 Schematic diagram of solution



2.0 SYSTEM INTRODUCE

Force-H1 V2 is a high voltage battery storage system based on lithium iron phosphate battery, which is one of the new energy storage products developed and produced by Pylontech. It can be used to support reliable power for various types of equipment and systems.
Force-H1 V2 enabled multiple strings` parallel operation feature, which provide tremendous flexibility in system design and configuration.
Force-H1 V2 is especially suitable for those application scenes which required high power output, limited installation space, restricted load-bearing and long cycle life.

Fig. 2.1 - Force-H1 V2

2.1 Single group system parameter

Product Type	Force-H1 V2					
Cell Technology	Li-ion (LFP)					
Battery Module Quantity	2	3	4	5	6	7
Nominal voltage [V]	96	144	192	240	288	336
Nominal capacity [kWh / Ah]	7.10 / 74	10.65 / 74	14.20 / 74	17.76 / 74	21.31 / 74	24.86 / 74
Nominal current [A]	37					
Dimension 680x380xH [mm]	530	700	870	1040	1210	1380
Weight [kg]	86	122	158	194	230	266
Min/Max charge voltage [V]	87 / 108	130,5 / 162	174 / 216	217,5 / 270	261 / 324	305 / 378
Charge / discharge test current [A] (1)	14,8					
Max charge / discharge current [A]	40 @15s					
Short circuit rating [A]	<4000					
Battery module model	FH48074					
Module nominal voltage [V]	48					
Module nominal capacity [kWh / Ah]	3.552 / 74					
Depth of Discharge [%]	95					
Module available capacity [kWh / Ah]	3.374 / 70.3					
Efficiency [%]	96					
Controller Name	FC0500-40S-V2					
Communication	CANBUS / Modbus RTU					
Operation Temperature [°C]	0~50					
Storage Temperature [°C]	-20 ~ 60					
Humidity [RH %]	5 ~ 95					
Altitude [m]	<2000					
Protection Class	IP55					
Operation Life [years]	15+					
Transfer Certificate	UN38.3					
Product Certificate	VDE-AR-E 2510-50, IEC62619, IEC63056, IEC62040-1, 2014/53/EU(RED), UL1973					
Controller dimensions WxHxD [mm]	600 x 150 x 380					
Battery module dimensions WxHxD [mm]	600 x 170 x 380					
Battery bottom base dimensions WxHxD [mm]	600 x 40 x 380					

(1) Current value used to determine the capacity of the battery during test.

2.2 Multi-groups system parameter (Max. 6 groups per system)

For multi-groups operation, please make sure the battery type in the whole system is the same, please make sure the battery amount of each group is the same.

Product Type	**Force-H1 V2 in multi-groups**				
Battery System group amount (pcs)	2	3	4	5	6
Battery System Voltage [Vdc] (2)	96, 144, 192, 240, 288, 336				
Capacity [Ah]	148	222	296	370	444
Battery System test operation current [A] (3)	29.6	44.4	59.2	74	88.8
Battery System nml. operation current [A]	74 (4)	111 (4)	148 (5)	185 (5)	222 (5)
Battery System max operation current [A]	84 (4)	126 (4)	168 (5)	210 (5)	252 (5)
P-Combiner-HV-3/6 nml. operation current	50		100		
P-Combiner-HV-3/6 max operation current	80		160		

(2) The Battery System Voltage is varying depends on battery amount in serial per group.

(3) Current value used to determine the capacity of the battery during test.

(4) The installer is responsible for creating the DC distribution panel for to parallelize the battery groups to be connected to the inverter. Up to 3 parallel battery groups, it is recommended to consider as design values a current of 50A continuous, 80A peak for 15" and a voltage of 600V DC.

(5) The installer is responsible for creating the DC distribution panel for to parallelize the battery groups to be connected to the inverter. From 4 to 6 parallel battery groups, it is recommended to consider as design values a current of 100A continuous, 160A peak for 15" and a voltage of 600V DC.

2.3 Battery Module

Fig. 2.2 - Battery Module FH48074

Model	**FH48074**
Cell Technology	Li-ion (LFP)
Nominal capacity [kWh/Ah]	3.552/74
Dimension WxHxD [mm]	600x170x380
Weight [kg]	36
Battery Cell Voltage [V]	3.2
Battery Cell Capacity [Wh/Ah]	118.4/37
Battery Module Serial Cell Quantity [pcs]	30 (15)
Operation Temperature [°C]	0~50
Storage Temperature [°C]	-20~60
Operation Life [Years]	15+
Operation Cycle Life	5000
Transfer Certificate	UN38.3

Tab. 2.1 - Battery Technical data

2.4 Control Module

Fig. 2.3 - Control Module FC0500-40S-V2 (internal power supply)

Fig. 2.4 - Control Module FC0500-40S-V2 Display Panel
1) System status, 2) System SOC (Each LED indicate 25% SOC), 3) LED button, 4) Battery Module Status

System Indicator (1) and SOC Indicator (2)

System status (1)	Battery status (2)	Condition	NOTE
Blue, Flashing	All flashing	Self-checking	
Orange, Slow flashing	Off	Self-checking failure	Battery Module Status off. See trouble shooting steps in section 4.2
Blue, fast flashing	Off	Black start success	
Orange, Fast flashing	Off	Black start failure	See trouble shooting steps in section 4.2
Orange, solid	Indicate SOC, blue, solid	Communication Lost or BMS error	See trouble shooting steps in section 4.2
Blue, slow flashing	Indicate SOC, blue, solid	Idle	
Blue, solid	Indicate SOC, blue, solid	Charge	
Blue, solid	All flashing, horse race lamp	Floating charge	
Blue, flashing	Indicate SOC, blue, solid	Discharge	
Blue, flashing	Off	System sleep	Battery module status off

Remark:
Slow flashing: 2,0s ON / 1,0s OFF
Flashing 0,5s ON / 0,5s OFF
Fast flashing: 0,1s ON / 0,1s OFF

LED Button (3)

Short Press	Display the LED panel for 20sec.
Long Press 1 (between 5 to 10 seconds)	When status LED fast flashes blue, loss the button, then it is 115200 baud rate of RS485.
	When status LED fast flashes orange, loss the button, then it is 9600 baud rate of RS485. If a special protocol (except Pylontech Protocol), is selected follow 'Long Press 2', then the baud rate changing described here is ineffective.
Long Press 2 (more than 10 seconds)	Communication Protocol Selection, for details please check with Energy service team

Battery Module Status (4)

Blue solid	Normal
Orange solid	Individual module alarm or protection. See trouble shooting steps in section 4.2

2.4.1 Control Module Cable Panel

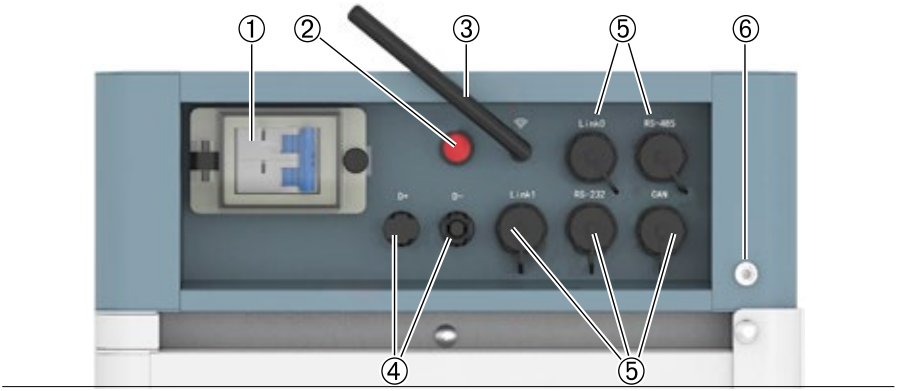


Fig. 2.5 - Control Module FC0500-40S-V2
1) Power switch, 2) Start button, 3) WiFi, 4) Power terminal, 5) Communication terminal, 6) Grounding point

- **Power Switch (1).**
  ON: main breaker ON, able to turn on battery system by start button.
  OFF: system turn off completely, no power output.

Caution. When the breaker is tripped off because of over current or short circuit, must wait more than 30' then can turn on it again, otherwise may cause the breaker damage.

- **Start function (2)**
  Press more than 5sec until the buzzer rings, to turn on controller.

  Multi-groups start up sequence: please start up the last string(from communication structure, the last slave) of battery system first, one by one to the first string which shall be start up lastly. Details as below table:

Communication Structure	Start-up Sequence
Slave string 5	1th Start up (if has)
Slave string 4	2th Start up (if has)
Slave string 3	3th Start up (if has)
Slave string 2	4th Start up (if has)
Slave string 1	5th Start up
Master string	Last Start up

  Black Start function: when system turn on, and relay is OFF, press more than 10", and relay will turn on for 10' without communication (depends on conditions).

  Multi-groups Black Start: Only need perform black start operation on MASTER string, it will close circuit for one of the strings within the system for 10mins. The slave string black start function is being solely controlled by master string.

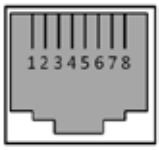
- **WIFI (3)**

Manufacturer	Pylon Technologies Co., Ltd.
Address	Plant 8, No.505 Kunkai Road, JinXi Town, 215324 Kunshan City, Jiangsu Province, PEOPLE'S REPUBLIC OF CHINA
Importer	Energy S.p.A.
Address	Piazza Manifattura 1, 38068 Rovereto (TN) - Italy
Wireless maximum output power	20dBm
Operating frequency	2412-2472 MHz
Antenna gain	Max 3dBi
Modulation system	DBPSK / DQPSK / CCK (DSSS) - BPSK / QPSK / 16QAM / 64QAM (OFDM)
Modulating Repetition	1 Mbps / 2 Mbps / 5,5 Mbps / 11 Mbps (DSSS) 6 Mbps / 9 Mbps / 12 Mbps / 18 Mbps / 24 Mbps / 36 Mbps / 48 Mbps / 54 Mbps (OFDM) MCS0~MCS7 (802,1 1n 20MHz)
Channel spacing	5 MHz
Type of antenna	2,4G IPEX-SMA

- **Power Terminal (4)**
  Connect power cables of battery system with Inverter
- **Communication Terminal (5) - RS485 / CAN / RS232**
  RS485 Communication Terminal: (RJ45 port) follow MODBUS 485 protocol, for communication between battery system and inverter.
  CAN Communication Terminal: (RJ45 port) follow CAN protocol, for communication between battery system and inverter.
  RS232 Communication Terminal: (RJ45 port) for manufacturer or professional engineer to debug or service. The Pin1&2(12Vdc+/-) is dedicated for Sunny Boy Storage Enable Line design.
  Link0/Link1 Communication Terminal: (RJ45 port) for multi-groups operation using only, connecting from first BMS Link 1 to second BMS Link 0, then from second BMS Link 1 to third BMS link 0 (if has), all the way to the last BMS Link 0. The BMS with Link Port 0 EMPTY is defined as the Master string, which further communication with the inverter or upper controller.
  For multi-groups operation, please firstly make sure the communication cable between multiple BMSs are properly connected between Link 1 and Link 0, before the start up.

No.	CAN	RS485	RS232
1	---	---	12V DC IN+ (*)
2	GND	---	12V DC IN- (*)
3	---	---	TX
4	CANH	---	---
5	CANL	---	---
6	---		RX
7	---	RS485A	---
8	---	RS485B	GND

Tab. 2.2 - RJ45 PIN
The Pin1&2 (12Vdc IN + / 12Vdc IN -)
is dedicated for SMA Enable Line design.



RJ45 Port

RJ45 Plug

2.5 System Diagram

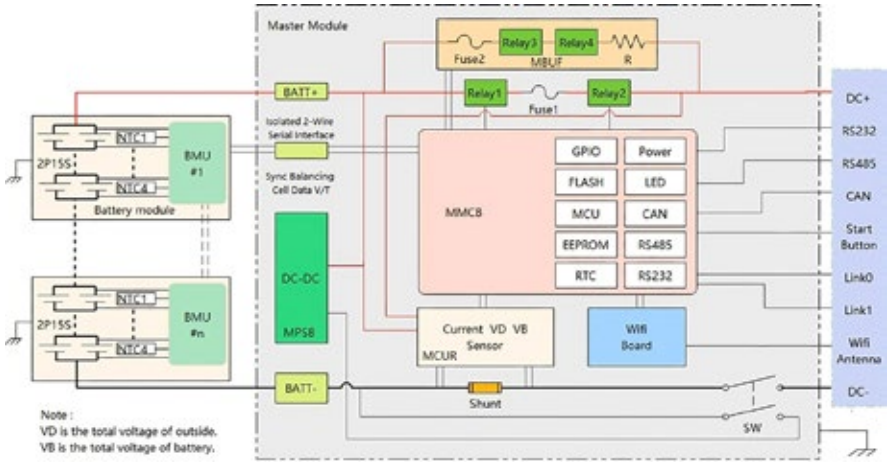


Fig. 2.6 - System Diagram.
VD is the total voltage of outside, VB is the total voltage of battery.

3.0 INSTALLATION

3.1 Tools

			
Wire Cutter	Crimping Modular Plier	Cable Ties	Screw Driver
			
Electric Screw Driver	Adjustable Wrench	Isolating nut drivers	Multimeter

Tab. 3.1 - Tools needed to install battery pack

Danger. Use properly insulated tools to prevent accidental electric shock or short circuits.
If insulated tools are not available, cover the entire exposed metal surfaces of the available tools, except their tips, with electrical tape.

3.2 Safety Gear

It is recommended to wear the following safety gear when dealing with the battery pack.

		
Insulating gloves	Safety goggles	Safety shoes

3.3 System Working Environments Checking

3.3.1 Cleaning

Warning! The battery system has high voltage connectors. The clean condition will cause the isolation characteristic of the system.
Before installation and system working, the dust and iron scurf must be clean to ensure the environments cleaning. And the environment must have certain anti-dust ability.

The system after long term running must check if the humidity and dust cover or not. If heavy dust cover with high humidity on the system, stop the system running and make clean especially the ventilation channels.

Warning! The power cables and plugs still have high voltage DC power from serial connected battery modules (battery module can't be turned off), be careful to handle the Power Plugs.

3.3.2 Temperature

Caution. Force-H1 V2 system working temperature range 0° - 50°C; Optimum temperature: 18°C - 28°C.
There are no mandatory ventilation requirements for the battery module, but please avoid installation in confined areas. Avoid high salinity, humidity or high temperature conditions.

Caution. The installation areas shall avoid of direct sunlight.
Out of the working temperature range may cause the battery reduces the cycle of life even trigger the battery system over / low temperature alarm or protection.
The room should be equipped with cooling/heating system. If the environment is lower than 0°C, the heating system at first must be turned on.

3.3.3 Fire-extinguisher System

Warning. The room must be equipped with fire-extinguisher system for lithium-ion battery. The fire system needs to be regularly checked to be in normal condition. Refer to the using and maintenance requirements of local fire equipment relevant.

3.3.4 Grounding System

Warning. Before the battery installation be sure the grounding point of the basement is stable and reliable. If the battery system is installed in an independent equipment cabin (e.g. container), make sure the grounding of the cabin is stable and reliable. The resistance of the grounding system must be ≤100 mΩ**.**

3.3.5 Safety area

Keep free area around the system to allow access to each battery and routine maintenance.
The distance from air outlet of inverter is more than 0.5 meters.

3.4 Handling and placement

Caution. BESS has high voltage connectors and must be operated by qualified and authorized personnel only. It must be installed in a restricted access area.

Warning. Single battery module is 36 kg. If without handling tools must have more than 2 man to handling with it.
The base is light, single person can handle with it.

- The base's weight capacity should support the weight of whole battery system.
- Force-H1 V2 system bust be installed on fixed ground.

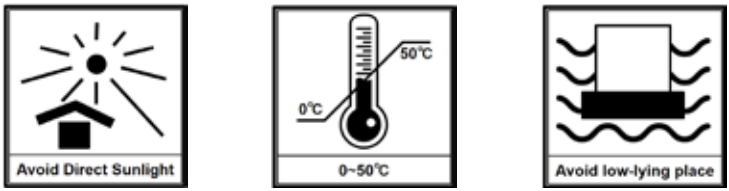


Fig. 3.1 - Avoid direct sunlight and low-lying place

3.5 Packing list

DESCRIPTION	Q.TY
FC0500-40S-V2 Battery Controller	1
Force-H1 V2 basement (600x380x40 mm)	1
EPE foam	3
3m black external communication cable (RJ45 – M19)	2
3m DC+ red external power cable (10AWG)	1
3m DC- black external power cable (10AWG)	1
1m yellow-green grounding cable (10AWG)	1
M4 screws for fixing brackets	20
M8 bolts for fixing basement	4
571.5mm bracket For up to 3 battery modules installation	2
701.5mm bracket for fix ≤ 4 battery modules In combine use with 571.5mm bracket for up to 7 modules installation; see below installation picture;	2
Product Manual	1
Warranty card	1

DESCRIPTION	Q.TY
FH48074 battery module	1
EPE foam	2

No additional kits needed for Force-H1 V2 installation.

3.6 Mounting and installation of the base

The base must be fixed installed on the basement with 4pcs M8×80 foundation bolts.

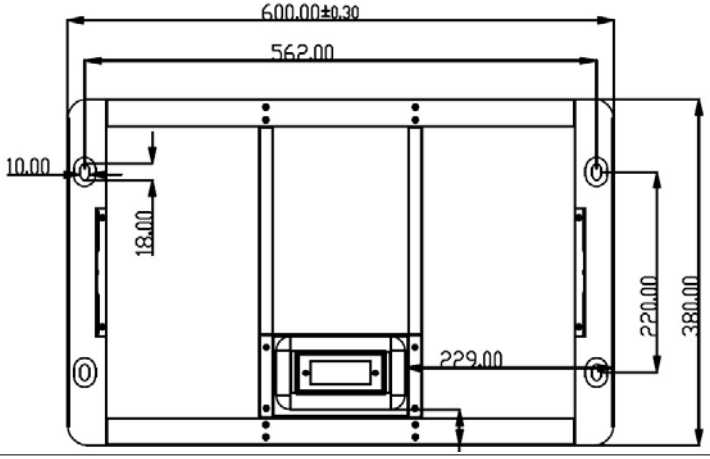


Fig. 3.2 - Battery rack basement holes bitmap (unit in mm)

3.7 Battery Modules and Control Module

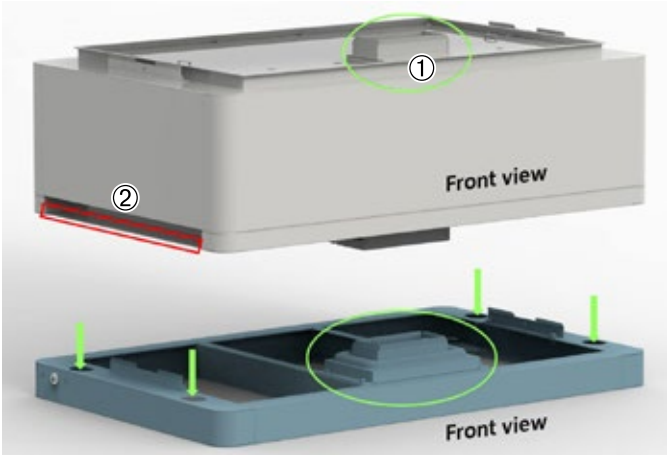


Fig. 3.3 - Battery Modules and base pile up

Caution. Handle above the red marked edgings (2) of the both side of these battery modules and control module (BMS).

If hands under this red marked side (2), hands will get hurt.

Danger. When battery is connected together with the base the internal socket (1) still have high voltage DC power from serial connected battery modules (battery module can't be turned off).

3.8 Installation of the metal bracket for the system

In control module's package has 2pcs short (A) and 2pcs long (B) metal brackets. Fix these metal brackets at the both back side corners.

Fig. 3.4 - Green arrow show screw position

3.9 Locking of the control Module's fix screw of left and right side

Fig. 3.5 - Control Module's fix screw (1) and (2)

3.10 Cables connection

Danger. The battery system is high voltage DC system. Must make sure the grounding is fixed and reliable.

Danger. All the plugs and sockets of the power cables must be not reverse connection. Otherwise it will cause personal injury.

Danger. No short circuit or reserved connection of the battery system's positive and negative port.

Caution. Wrong communication cables connection will cause the battery system failure.

Danger. To perform maintenance it is necessary to install switch or breaker between each string of batteries and inverters, for both the positive and negative connections.

3.10.1 Grounding

Fig. 3.6 - The Force-H1 V2 modules' grounding cable on the grounding point, above the right side of top metal bracket screw (1) or beside the both side of screw (2).

3.10.2 Cables

Caution. Grounding cable (Fig. 3.9) must ≥10AWG. The cable shall be copper with yellow-green color.

Caution. Power cable uses water-proofed connectors.
To disconnect, a special tool is required. Do not pull out directly

Caution. Communication cable uses RJ45 connector and water-proofed cover (M19-RJ45) matched with controller connection port.

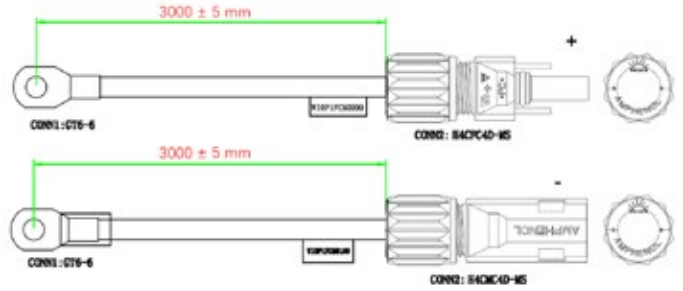


Fig. 3.7 - Power cable

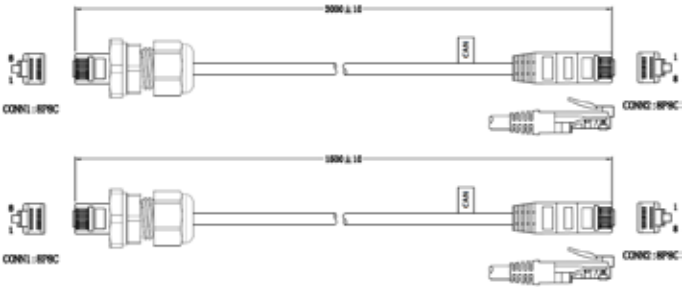


Fig. 3.8 - Communication cable

Fig. 3.9 - Grounding cable

3.11 Multi-groups battery wiring diagram

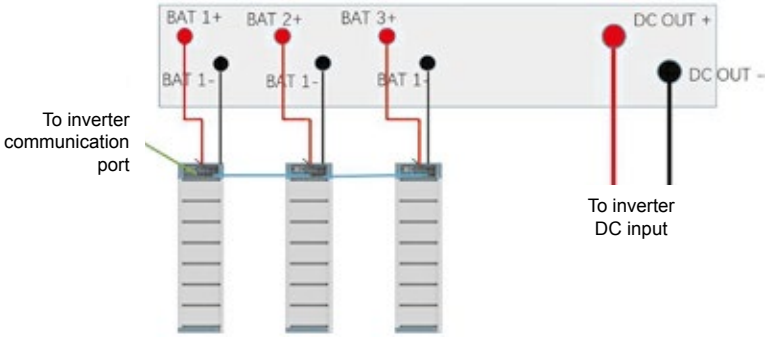


Fig. 3.10 - Three string system wiring diagram

- It`s suggested to use P-Combiner-HV-3 for upto 3 strings, max. 50Amps synchronized continuous operation.
- It`s not allowed to use the P-Combiner-HV-6 or similar concept of multi-groups connection method in case the multiple groups` of battery are operation independently.
- Make sure to have the D+ & D- plug into the combiner box properly.

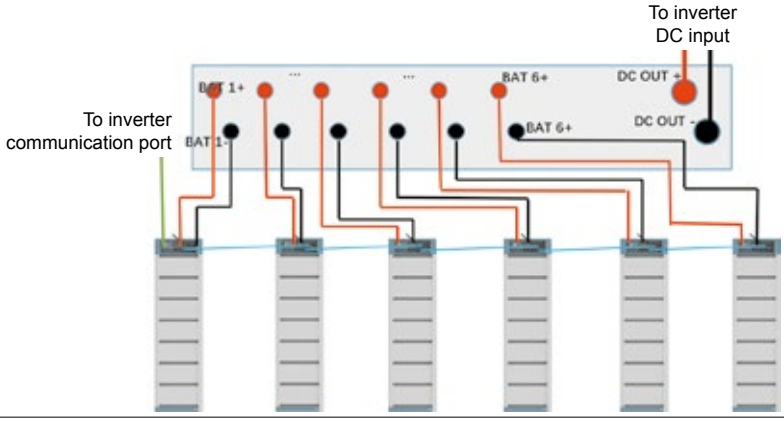


Fig. 3.11 - Six string system wiring diagram

- It`s suggested to use P-Combiner-HV-6 for upto 6 strings, max. 100Amps synchronized continuous operation.
- *It`s not allowed to use the P-Combiner-HV-6 or similar concept of multi-groups connection method in case the multiple groups` of battery are operation independently.
- Make sure to have the D+ & D- plug into the combiner box properly.

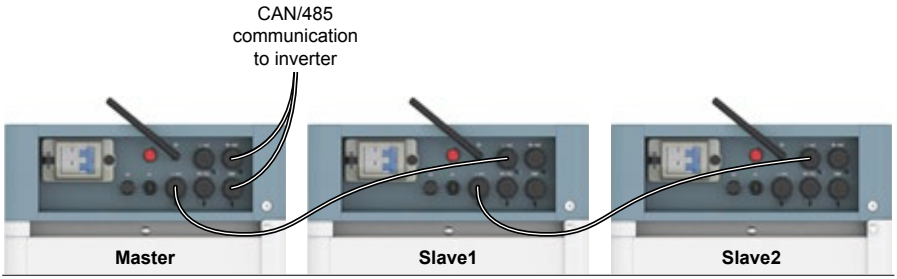


Fig. 3.12 - Wiring diagram of master/slave communication cable

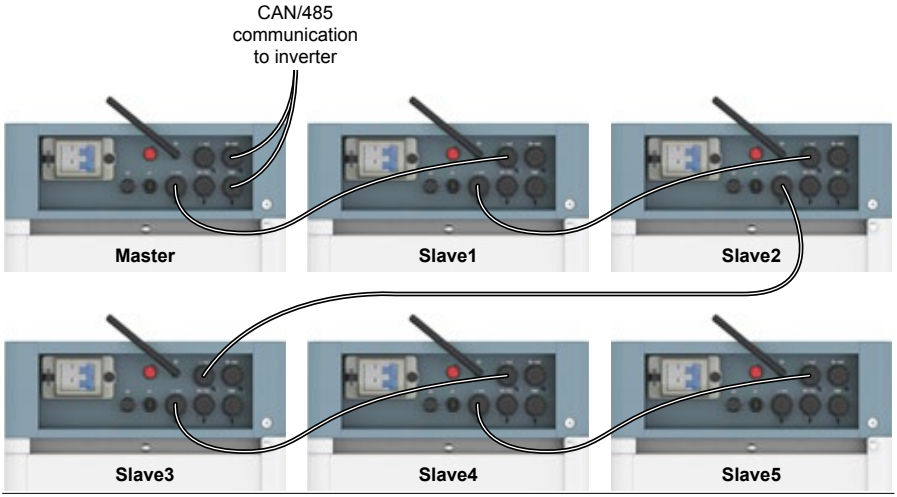


Fig. 3.13 - Wiring diagram of master/slave communication cable

The communication for master/slave string connection shall use a 8pin pin-pin RJ45 cable, connecting from first BMS Link 1 to second BMS Link 0, then from second BMS Link 1 to third BMS link 0 (if has), all the way to the last BMS Link 0. The BMS with Link Port 0 EMPTY is defined as the Master string, which further communication with the inverter or upper controller.

The slave strings` CAN/RS485 Port is ineffective in this case.

3.12 System turns on

Warning. Double check all the power cables and communication cables. Make sure the voltage of the inverter/PCS is same level with the battery system before connection. Check all the power switch are OFF.

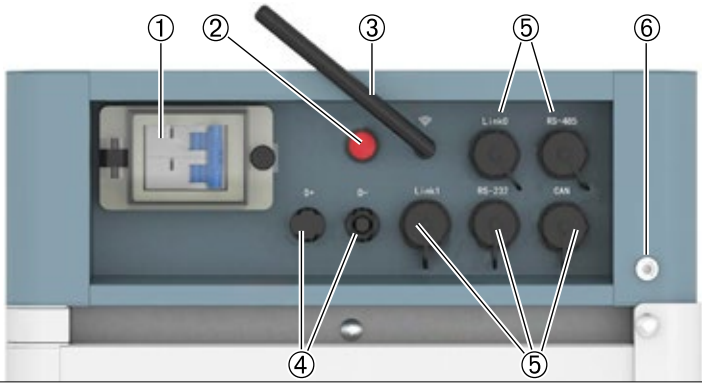


Fig. 3.14 - Control Module FC0500-40S-V2
1) Power switch, 2) Start button, 3) WiFi, 4) Power terminal, 5) Communication terminal, 6) Grounding point

3.12.1 Single group system turns on step

System turns on step:

1. Check all cables are connected correctly. Check grounding is connected.
2. If necessary, turn on the switch at inverter`s battery side or between inverter and battery. If possible, turn on AC or PV power source to wake up inverter.
3. Open protect cover of Power switch. And turn on power switch.
4. Press start button (2, Fig. 3.14) for at least 5 seconds or until buzzer rings. Battery takes 10-30s for self-checking.

If inverter is turned on by AC or PV source, then most inverter can setup communication with BMS automatically, in this case, the BMS will close relay and system is ready for work.

If inverter needs battery power to turn on, then check the LED of battery.
The status shall be orange solid and the SOC shall be blue solid.

In this case, press the Start button (2, Fig. 3.14) for at least 10s, till the Status lighting Blue and fast flashing, then battery will black start to support inverter and after inverter turned on and set up communication, then BMS is ready for work.

If the battery has been configured to a different communication protocol (see “2.4 Control Module” at page 14), please make sure to select the correct protocol and restart BMS to enable the communication with inverter.

Caution. When the breaker is tripped off because of over current or short circuit, must wait after 10min to turn on it again, otherwise may cause the breaker damage.

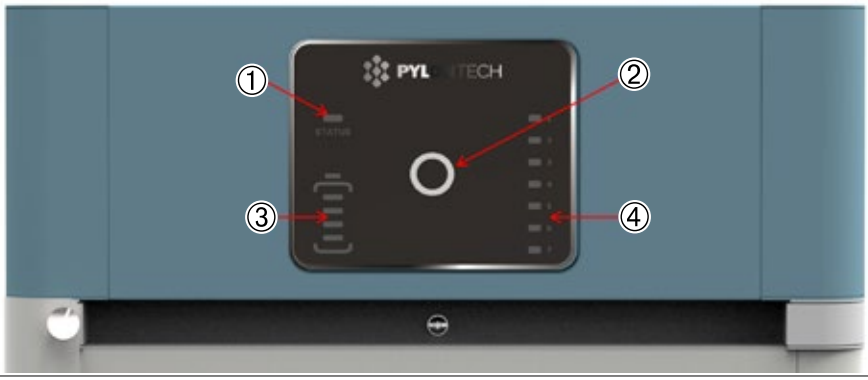


Fig. 3.15 - Control Module FC0500-40S-V2 Display Panel
1) System status, 2) LED button, 3) System SOC (Each LED indicate 25% SOC), 4) Battery Module Status

Warning. If has failure during the self-check, must debug the failure then can start next step.

If the “STATUS” lamp shows orange from beginning, it means there has some failure in the battery string, the Power Relays in BMS will open, must debug at first. The LED lamp will be off in 20sec without any operation

Caution. During first time power on, the system will require to do fully charge progress for SOC calibration purpose.

Caution. it is suggested to fully charge the whole Battery Energy Storage System (BESS) first after installation or after long time storage without charging. Depending on the soc level, there will be a regularly (3 month) fully charge requesting during continuous operation as well, it will be handled automatically by the communication between BESS and external device.

3.12.2 Multi-groups system turns on

1. Check all cables are connected correctly. Especially the Link 1 / Link 0 between master and slave strings. Check grounding is connected.
2. If necessary, turn on the switch at inverter`s battery side or between inverter and battery. If possible, turn on AC or PV power source to wake up inverter.
3. Open protect cover of Power switch. And turn on power switch of all the strings.
4. From the last string, press start button for at least 5 seconds or until buzzer rings for start-up. Then further turn on each string one by one follow below table, the start-up interval between each strings shall less than 30sec.:

Communication Structure	Start-up Sequence
Slave string 5	1th Start up (if has)
Slave string 4	2th Start up (if has)
Slave string 3	3th Start up (if has)
Slave string 2	4th Start up (if has)
Slave string 1	5th Start up
Master string	Last Start up

5. Battery system takes 30sec for self-checking, after all strings start-up.

If inverter is turned on by AC or PV source, then most inverter can setup communication with BMS automatically, in this case, the BMS will close relay and system is ready for work.

If inverter needs battery power to turn on, then check the LED of battery shall be: Status: Orange, solid SOC: blue, solid

In this case, press the Start button for at least 10s, till the Status lighting Blue and fast flashing, then battery will black start to support inverter and after inverter turned on and set up communication, then BMS is ready for work.

Caution. When the breaker is tripped off because of over current or short circuit, must wait after 10min to turn on it again, otherwise may cause the breaker damage.

Warning. If has failure during the self-check, must debug the failure then can start next step.

If the “STATUS” lamp shows orange from beginning, it means there has some failure in the battery string, the Power Relays in BMS will open, must debug at first. The LED lamp will be off in 20sec without any operation

Caution. During first time power on, the system will require to do fully charge progress for SOC calibration purpose.

Caution. It is suggested to fully charge the whole Battery Energy Storage System (BESS) first after installation or after long time storage without charging. Depending on the soc level, there will be a regularly (3 month) fully charge requesting during continuous operation as well, it will be handled automatically by the communication between BESS and external device.

3.13 System turns off

When failure or before service, must turn the battery storage system off:

1. Turn off inverter or power supply on DC side.
2. Turn off the switch between PCS and battery system.
3. Turn off the “Power Switch” of the BMS.

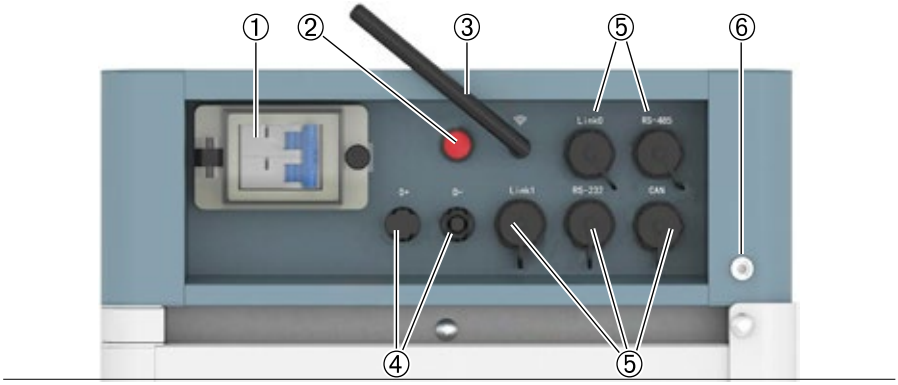


Fig. 3.16 - Control Module FC0500-40S-V2
1) Power switch, 2) Start button, 3) WiFi, 4) Power terminal, 5) Communication terminal, 6) Grounding point

Caution. Contact support for module replacement. Before replace the battery module for service, must charge/discharge the existing battery module voltage similar to the replacement. Otherwise the system need long time to do the balance for this replaced battery module.

Note. **After installation, DO NOT forget to register online for full warranty:** www.pylontech.com.cn/service/support

4.0 MAINTENANCE

4.1 System Debug

This system debug is for BESS system (Battery Energy Storage System). BESS system can't do the debug itself. It must operation with configured inverter, UPS, PCS and EMS system together.

Debug Step	Content
Prepare of debug	Turn on the BESS system, refer to chapter "3.12 System turns on" at page 30. Before turn on the whole BESS system turn on the load is not allowed! Remark: Except the BESS, if other equipment have its own system turn on step, must follow the operation manual.
Working together with inverter	1) Check the communication cable connection and make sure the cable order on battery and inverter side are matched. All undefined pin are suggested to be empty. 2) Check the baud rate of inverter. The default of battery CAN is 500kbps, MODBUS 485 is 9600bps. If necessary, change the baud rate of RS485. 3) Check the terminal resistance CAN 120 Ω, 485 120 Ω 4) If necessary, check the setting on inverter or control box has right parameter and brand of battery. And check the information of BESS shown on inverter is correct.

4.2 Trouble Shooting

Danger. The Force-H1 V2 is a high voltage DC system, operated by qualified and authorized person only.

Danger. Before check the failure, must check all the cables connection and the BESS system can turn on normally or not.

Check the environment first.

Problem	Possible Reason	Solution
No power output, no led on.	Press start button too short.	To turn on, at least 5s To black start, at least 10s.
	The button battery in controller is missing or failure. The power supply in controller is failure.	Change the controller module.
	The battery voltage is too low.	Make sure at least 2 battery modules.
	The connector of base is failure.	The base is not connected or change the base.
After turned on, status LED slow flashing orange. Others off.	Self-checking failure. DC side has a voltage, but voltage difference with the battery system is higher than 20V.	Make sure no DC voltage or set correct DC voltage before press start button. Then follow turn on process.
	BMS internal failure.	Use debug tool to further analysis or change the controller module.
Status LED fast flashing orange, others off.	The time interval after last time black start is too short.	Wait more than 5 minutes and try black start again.
	The battery system under error condition such as: temperature or current protection or other error, thus do not response black start.	Make sure no other protection factor. Or use debug tool to further analysis.

Tab. 4.1 - Trouble Shooting

Problem	Possible Reason	Solution
Buzzer rings continue	Relay adhesion or failure.	Completely disconnect battery system with any DC source then make a restart. If problem remain, then swap the controller.
Status LED solid orange. Battery module LED blue solid.	Communication lost with inverter	Check the communication cable PIN and wiring whether is correctly.
	Over current protection.	Check DC side. And wait until BMS release protection.
	Controller failure.	Use debug tool to further analysis or change the controller module. Or use debug tool.
Status LED solid orange. Battery module exists LED in orange solid	Over/ under temperature protection.	Check environment temperature. And wait BMS release.
	Over voltage protection.	Check DC charge voltage setting or wait BMS release.
	Under voltage protection.	Use black start function, and then charge the system.
	Battery module BMS failure	Use debug tool to further analysis or change the battery module.
All LED blue but no output.	Fuse fusing	Change the controller module
Other failure	Cell failure or electrical board failure. Or failure need debug tool for further debug.	Can't find out failure point or can't check. Please contact with distributor or Pylontech.

Tab. 4.2 - Trouble Shooting

Note: once a certain failure detected following the trouble shooting steps, shut down the battery string first before replacement to avoid further over discharge to the system due to the self-consumption.

4.3 Replacement of main component

Danger. The Force-H1 V2 is a high voltage DC system, operated by qualified and authorized person only.

Danger. Before replace the main component must shut off the maintenance battery string's power. Must confirm the **D+** and **D-** terminal are without power. The turn off progress refer to chapter "3.13 System turns off" at page 33.

4.3.1 Replacement of Battery Module

- Charge existing module to full (SOC 100%). Make sure new battery module is 100% as well.
- Turn off the whole battery string's power. Must confirm the **D+** and **D-** terminal are without power. The turn off progress refer to chapter "3.13 System turns off" at page 33.

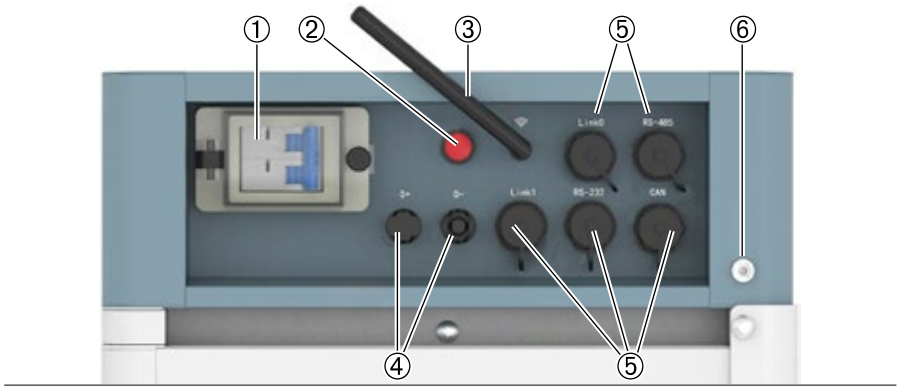


Fig. 4.1 - Control Module FC0500-40S-V2
1) Power switch, 2) Start button, 3) WiFi, 4) Power terminal, 5) Communication terminal, 6) Grounding point

- Dismantle **D+** and **D-** Power Cable, Communication Cable and Grounding Cable.
- Dismantle the control Module's fix screw of left and right side. And dismantle the fix metal brackets.
- Move the control module and each battery module one by one.

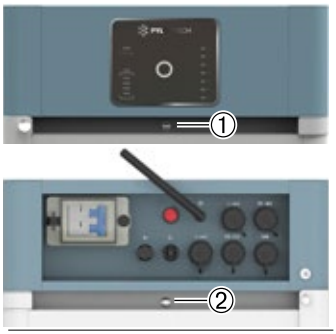


Fig. 4.2 - Control Module's fix screw (1) and (2)

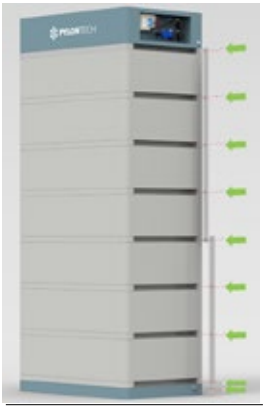


Fig. 4.3 - Green arrow show screw position

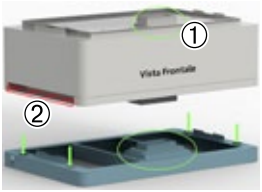


Fig. 4.4 - Battery Modules and Control Module (BMS) pile up

Caution. Handle above the red marked edgings (2) of the both side of these battery modules and control module (BMS).
If hands under this red marked side (2), hands will get hurt.

Danger. When battery is connected together with the base the internal socket (1) still have high voltage DC power from serial connected battery modules (battery module can't be turned off).

Warning. Single battery module is 36kg. If without handling tools must more than 2 men to handling with it.

Warning. Contact support for module replacement. Before installing the new battery and returning to using the system, it is necessary to charge/discharge the module to the same voltage as the other modules present in the system. This operation is necessary to prevent the BMS from remaining engaged in balancing the battery module for a long time.

- Pile up the new battery module. And pile up the battery modules and control module up again.
- Install back the control Module's fix screw of left and right side. And Install back the fix metal brackets.
- Install back Grounding Cable, Communication Cable and the **D+** and **D-** Power Cable.
- Turn on this battery string. Refer to chapter "3.12 System turns on" at page 30.

4.3.2 Replacement of Control Module (BMS)

- Turn off the whole battery string's power.
  Must confirm the **D+** and **D-** terminal are without power. The turn off progress refer to chapter "3.13 System turns off" at page 33.

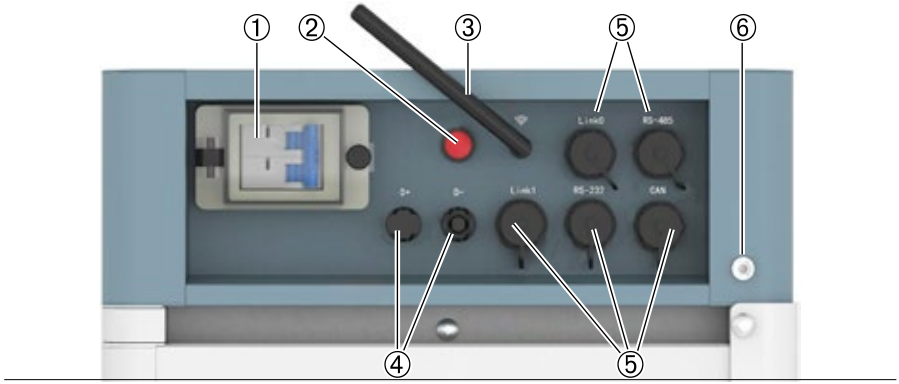


Fig. 4.5 - Control Module FC0500-40S-V2
1) Power switch, 2) Start button, 3) WiFi, 4) Power terminal, 5) Communication terminal, 6) Grounding point

- Dismantle **D+** and **D-** Power Cable, Communication Cable and Grounding Cable.
- Dismantle the control Module's fix screw of left and right side. And dismantle the fix metal brackets.
- Remove the control module.

Danger. When battery is connected together with the base the internal socket still have high voltage DC power from serial connected battery modules (battery module can't be turned off).

- Pile up the new control module.
- Install back the control Module's fix screw of left and right side. And Install back the fix metal brackets.
- Install back Grounding Cable, Communication Cable and the **D+** and **D-** Power Cable.
- Turn on this battery string. Refer to chapter "3.12 System turns on" at page 30.

4.4 Battery Maintenance

Danger. The maintenance of battery must be done by qualified and authorized personnel only.
Some maintenance items must turn off at first.

4.4.1 Voltage Inspection:

[**Periodical Maintenance**] Check the voltage of battery system through the monitor system. Check the system whether exist abnormal voltage or not. For example: Single cell's voltage is abnormal high or low.

4.4.2 SOC Inspection

[**Periodical Maintenance**] Check the SOC of battery system through the monitor system. Check the battery string whether exist abnormal SOC or not.

4.4.3 Cables Inspection

[**Periodical Maintenance**] Visual inspect all the cables of battery system. Check the cables has broken, aging, getting loose or not.

4.4.4 Balancing

[**Periodical Maintenance**] The battery strings will become unbalance if long time not be full charged. Solution: every 3 months should do the balancing maintenance (charge to full), normally it will be done automatically by the communication between system and external device.

4.4.5 Output Relay Inspection

[**Periodical Maintenance**] Under low load condition (low current), control the output relay OFF and ON to hear the relay has click voice, that's mean this relay can off and on normally.

4.4.6 History Inspection

[**Periodical Maintenance**] Analysis the history record to check has accident (alarm and protection) or not, and analysis its reason.

4.4.7 Shutdown and Maintenance

[**Periodical Maintenance**]
Some system function must be maintenance during the EMS restart, it is recommended to maintenance the system every six months.

4.4.8 Recycle

NOTE. Damaged batteries may leak electrolyte or produce flammable gas.
In case a damaged battery needs recycling, it shall follow the local recycling regulation (e.g., Regulation (EC) Nº 1013/2006 among European Union) to process, and using the best available techniques to achieve a relevant recycling efficiency.

5.0 REMARKS

5.1 Storage recommendation

For long-term storage (more than 3 months), the battery cells should be stored in dry (relative humidity <65%), clean and well ventilated, temperature range of -20°C~60°C, no corrosive gas environment.

Before storage the battery should be charged to 50~55% SoC;

It is recommended to active the chemical (discharge and charge) of the battery every 3 months, and the longest discharge and charge interval shall not exceed 6 months.

Caution. If not follow the above instructions for long term store the battery, the cycle life will have relative heavily reduction.

5.2 Capacity expansion

A new battery module can be added onto an existing system at any time. Please make sure the existing system is being fully charged before add on a new module. In a serial connection system, the new module, even has a higher SOH, will follow the system worst SOH condition module to perform.

6.0 SHIPMENT

Battery module will pre-charged to 100% SOC or according to customer requirement before shipment. The remaining capacity of battery cell, after shipment and before charge, is determined by the storage time and condition.

- The battery modules meet the UN38.3 certificate standard.
- In particular, special rules for the carriage of goods on the road and the current dangerous goods law, specifically ADR (European Convention on the International Carriage of Dangerous Goods by Road), as amended, must be observed.

Contact the supplier for more information.

Please note that the product and this manual are subject to change without notice.

INSTALLATION AND SYSTEM TURN ON PROGRESS LIST

	ITEM	REMARK
☐	The environment is meeting all technical requirements. Cleaning, Temperature, Fire-extinguisher System, Grounding System, Clearance	Chapter 3.3 at page 20
☐	Selection of installation sites.	Chapter 3.3.4 at page 20
☐	Battery base is installed follow the technical requirements.	Chapter 3.6 at page 23
☐	Battery modules installation.	Chapter 3.7 at page 24
☐	Battery system are fixed.	Chapter 3.7 at page 24
☐	Control Module (BMS) and Battery Module are installed well.	Chapters 3.7 at page 24, 3.9 at page 25
☐	Connect **D+** and **D-** between BMS to the inverter/ PCS or confluence cabinet.	Chapter 3.10 at page 26
☐	Connect the grounding cable.	Chapter 3.10.1 at page 26
☐	Double check every power cables, communication cables, grounding cable installed well.	Chapter 3.10.2 at page 27
☐	Switch the external power or inverter/PCS on, ensure all the power equipment can work normally.	Chapter 3.12 at page 30
☐	The first installation should do full charging progress automatically. If the status LED of BMS turns to blue, it means this battery string is operation.	Chapter 3.12 at page 30

SYSTEM TURN OFF PROGRESS LIST

	ITEM	REMARK
☐	Soft-off the inverter through inverter's control panel.	Chapter 3.13 at page 33
☐	Turn off the switch between inverter and this battery string (Force-H1 V2), or turn off the power switch of inverter, to make sure no current through this battery string.	Chapter 3.13 at page 33
☐	Turn off the "Power Switch" of the BMS.	Chapter 3.13 at page 33

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