SOLAX POWER

Zero Injection
C&I Inverter Solution

CONTENT

Background

Nowadays, photovoltaic power generation systems have been used worldwide. There are many advantages of using solar-powered loads to reduce carbon emissions, lower the cost of electricity, or sell electricity to the grid for profit. In a solar system, the inverter can convert DC into AC which firstly supplies the load, and the excess electrical energy will be fed into the grid. Due to the need to maintain grid quality, not all countries or utilities allow inverters to inject power to the grid, creating the need of zero injection control.

1. Solution Introduction

Zero injection solution for **Single on-grid inverter+ Single meter**
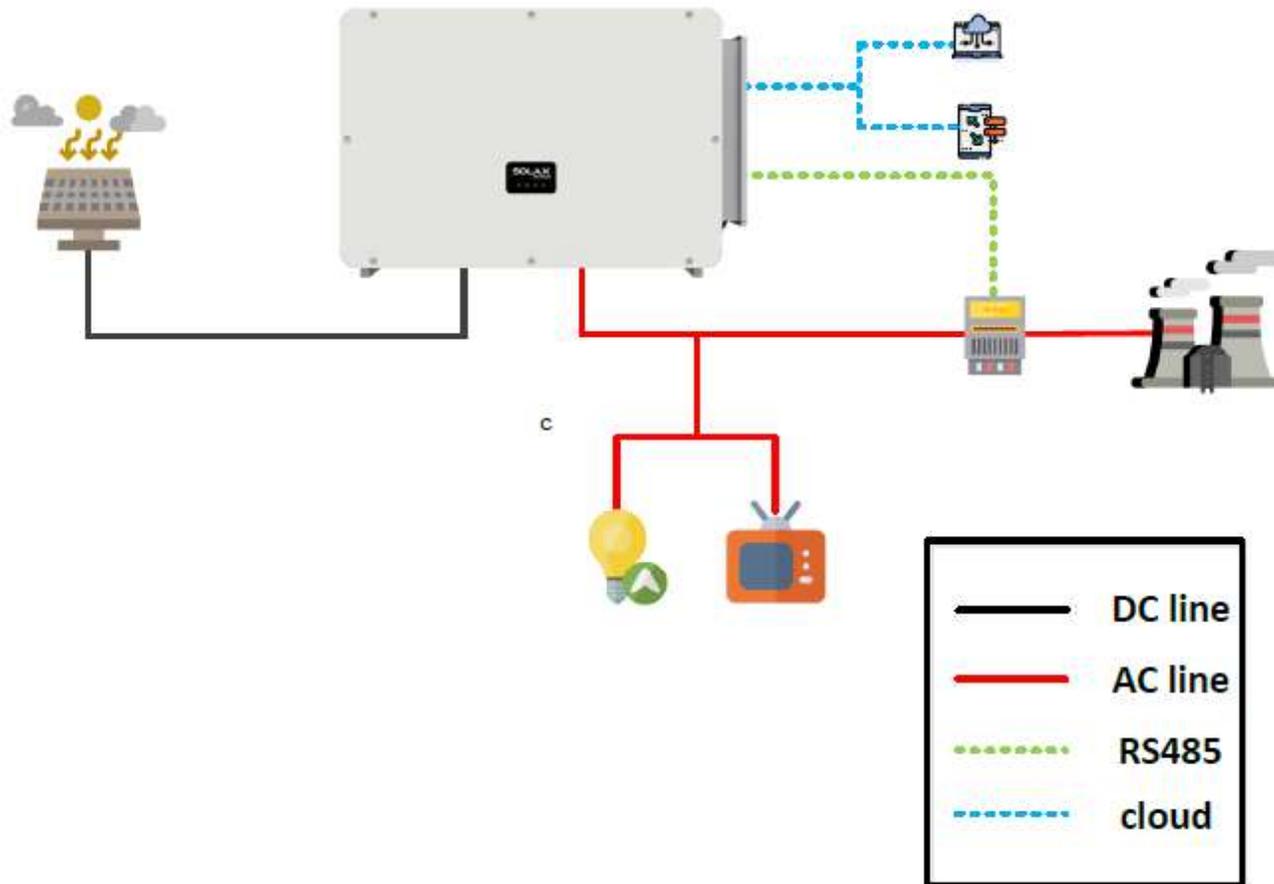
- For single-phase inverters it's optional to choose CT or Meter, but the Meter is the only choice for three-phase inverter.
- For the Meter, X1-MINI/BOOST G4, X3-MIC G2, X3-PRO G2 series can use CHINT Meters or Eastron Meters; but X3-MEGA G2, X3-FORTH can only use the **CHINT Meters**.

——	DC line
——	AC line
······	RS485
- - - -	cloud

Zero injection solution for **Multiple on-grid inverters+Single meter**
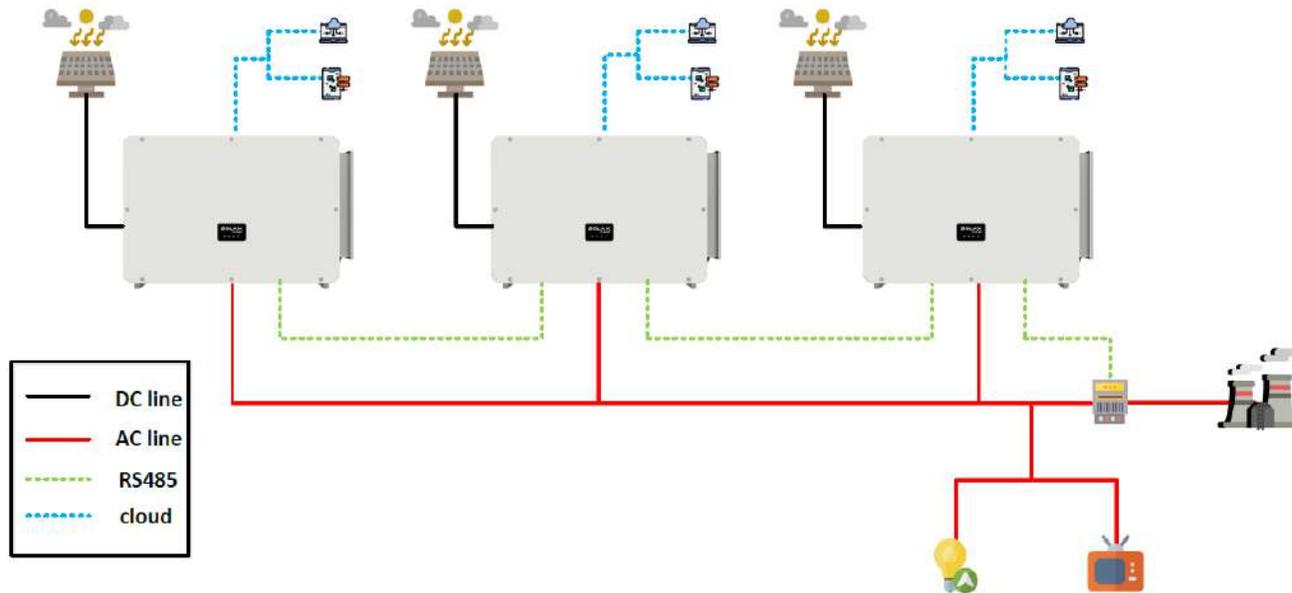
- Currently we have following inverter series which surpport this solution : X1-MINI/BOOST G4, X3-PRO G2, X3-MEGA G2, X3-FORTH; but **X3-MIC G2** doesn't support this solution for now
- This solution allows the connection of up to **10 pcs** X3-MEGA G2 or X3-FORTH; and up to **5 pcs** for X1-MINI/BOOST G4, X3-PRO G2.
- The inverter's model must be the same in this solution but the power range can be different.
- For the Meter, X1-MINI/BOOST G4, X3-PRO G2 series can use CHINT Meters or Eastron Meters ; but X3-MEGA G2, X3-FORTH can only use the **CHINT Meters**.

Zero injection solution for **Multiple on-grid inverters+Datahub+Single meter**
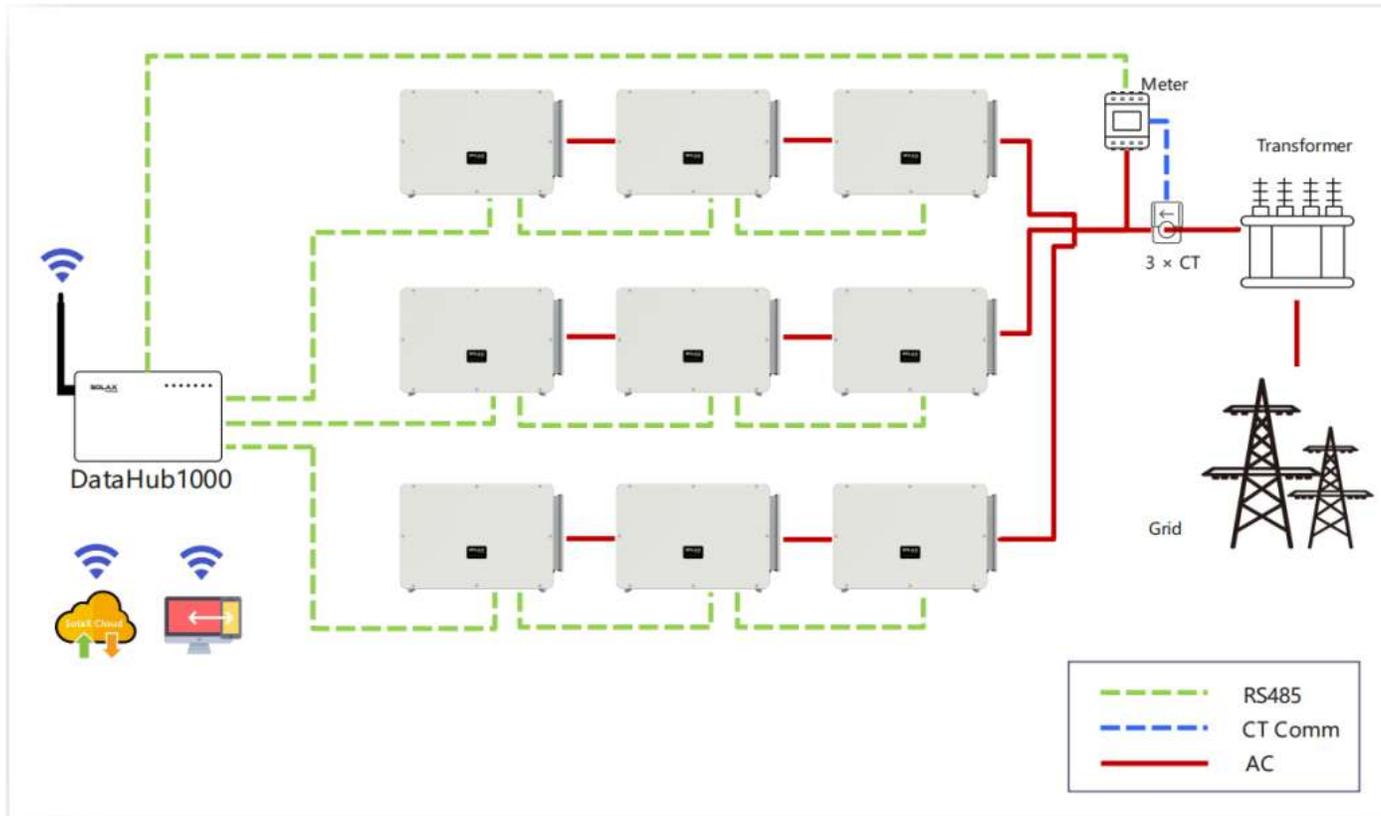
- Currently we have following inverter series which surpport this solution：X1-MINI G4, X1-BOOST G4, X3-MIC G2, X3-PRO G2, X3-MEGA G2, X3-FORTH
- Datahub can connect up to **20 pcs** same series inverters per string, and **60 pcs** in total at the same time.
- Smart control function such as Ripple control, smart schedule etc.
- Datahub only support **CHINT Meters**.

Zero injection solution for **Multiple on-grid inverters+Hybrid inverters+Datahub+Dual meters**
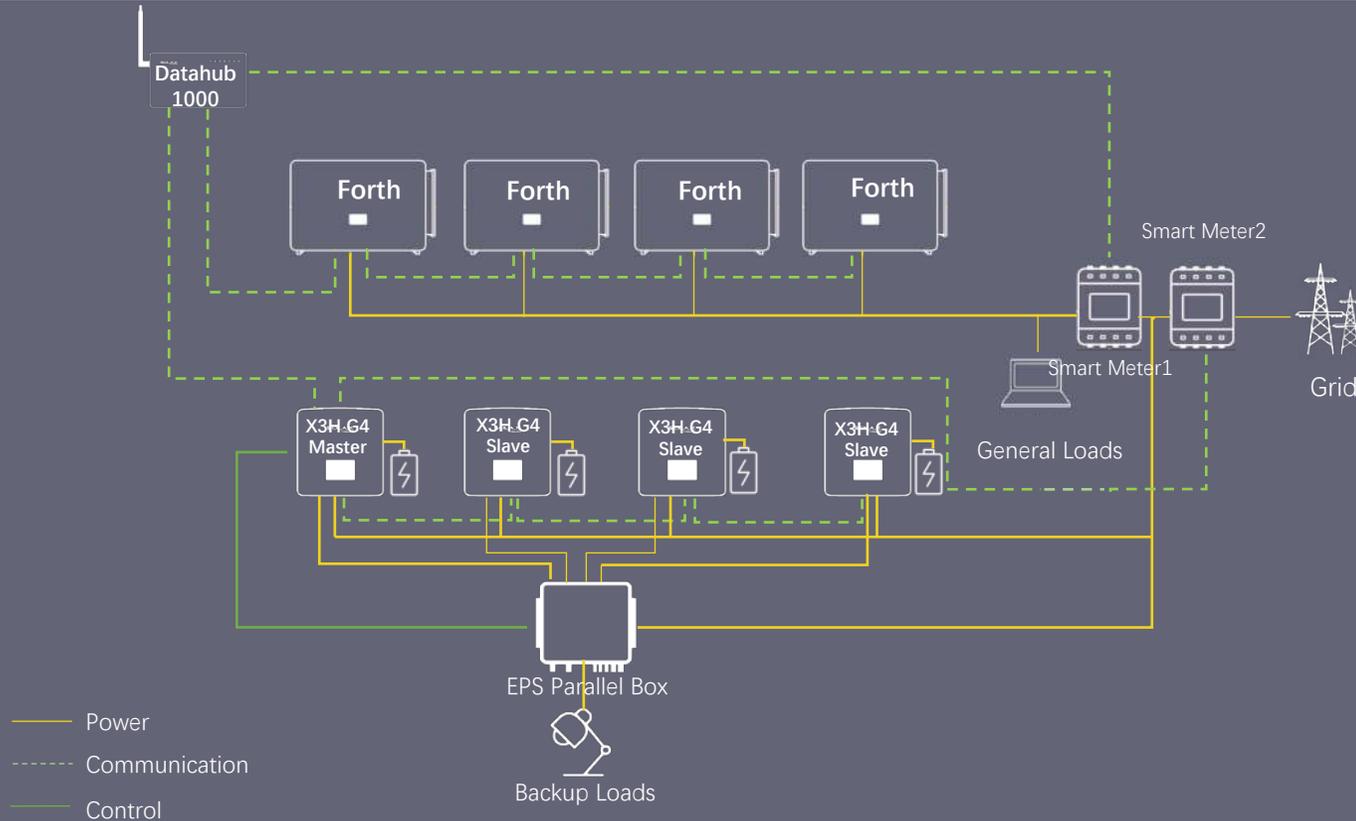
- Support up to **40** on-grid inverters and **10** Hybrid inverters in this system.
- Support export control/ripple control/DRM
- The surplus PV form FTH inverters can charge the batteries.
- The loads will use the energy from FTH in priority to avoid unnecessary discharging
- The FTH inverter in the diagram can also be replaced by X3-PRO G2, X3-MEGA G2
- Datahub only support **CHINT Meters**.

Installation Case

Product	Quantity
X3-PRO-30K-G2	4
X3-Hybrid-15.0-D	2
BMS Parallel Box	2
T58 Slave	6
Datahub	1
DTSU666-CT	2

Product	Quantity
X3-MEGA-50K-G2	2
X3-Hybrid-15.0-D	2
BMS Parallel Box	2
T58 Slave	12
Datahub	1
DTSU666-CT	2

Zero injection

There are two modes of zero injection control methods：total and per phase.

The total mode ensures that the algebraic sum of the grid side feeding and purchasing electricity to be 0 (i.e. the sum of the buying and selling electricity in each channel is 0).

Per phase mode, also known as minimum phase power injection control, it ensures that feedin energy in each phase of grid is zero.Per phase mode can only be used for three-phase four-wire systems.

Total control mode   Per phase control mode

Zero injection

Datahub Feed-in Buffer is divided into 4 levels: disable, low, medium, and high. The thresholds represented by each level are: 1%, 2.5%, 4.5%, 6.5%.

The default redundancy of the C&I inverters is 2% and cannot be modified. It will gradually be optimized to around 0.5% in the future.

The meaning of threshold：

1. Except for "disable", in the other three levels when the load power is stable, it will tend to take power from the grid (total rated power of the on-grid inverters*threshold); When the buffer is "disable" and the load power is stable, the output power of the on-grid inverters will fluctuate between taking 1% electricity from grid and feed in 1% electricity, which cannot guarantee that the feedin electricity is completely zero, but there will be less purchasing electricity from grid.

2. When the load power fluctuation is within the range of (total rated power of the on-grid inverters*threshold), the power output of the on-grid inverters will not directly drop to 0. Otherwise, the power of the on-grid inverter will directly drop to 0, and then slowly increase the power to load power.
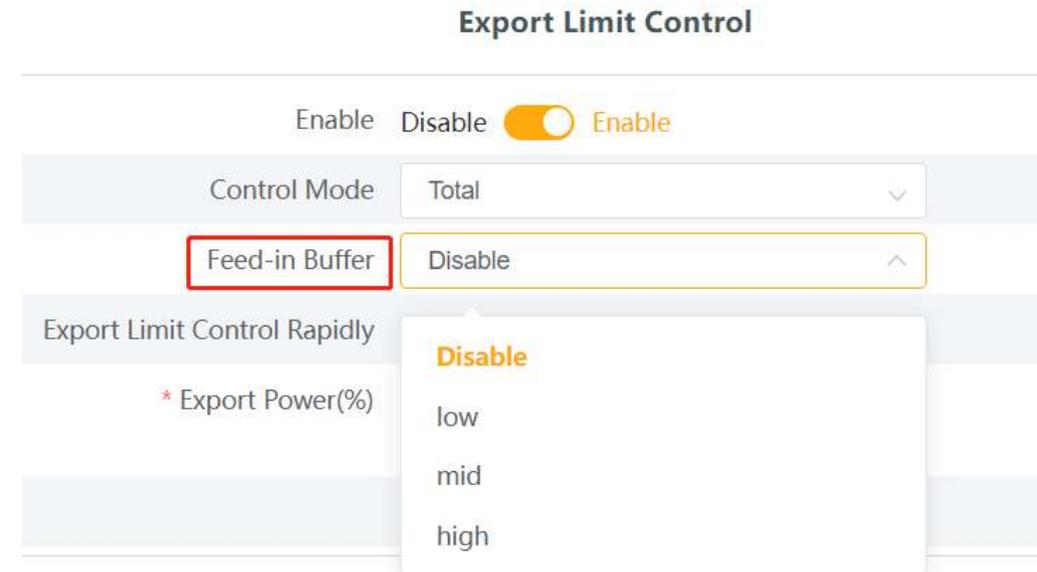
Export Limit Control

Enable Disable Enable

Control Mode Total

Feed-in Buffer Disable

Export Limit Control Rapidly **Disable**

* Export Power(%) low

mid

high

Communication loss/recovery

Due to the fact that Datahub mainly relies on the data of the meter for zero injection control, all inverters should be shut down when the communication with the meter is lost to prevent the inverters from continuing to feed power to grid during this period. Datahub currently supports communication loss shutdown and communication recovery startup functions.

For the communication loss shutdown function, after enabling, the inverter starts timing after receiving a zero injection message. If the next zero injection message is not received after the timeout, the inverter will shut down. Note that if the inverter has been turned off already, even if we change the "enable" status, the inverters will not start. For the communication recovery startup function, after enabling, if the inverter receives a zero injection message and the current device status is OFF, the device will start up and operate normally.

These two functions of communication loss shutdown/recovery startup currently need to be set in Datahub local interface before they can take effect. This will be optimized in the future.

Modbus register address	Write value	Function
6152	0	Disable communication loss shutdown function
	1	Enable communication loss shutdown function
6153	0	Disable communication recovery startup function
	1	Enable communication recovery startup function
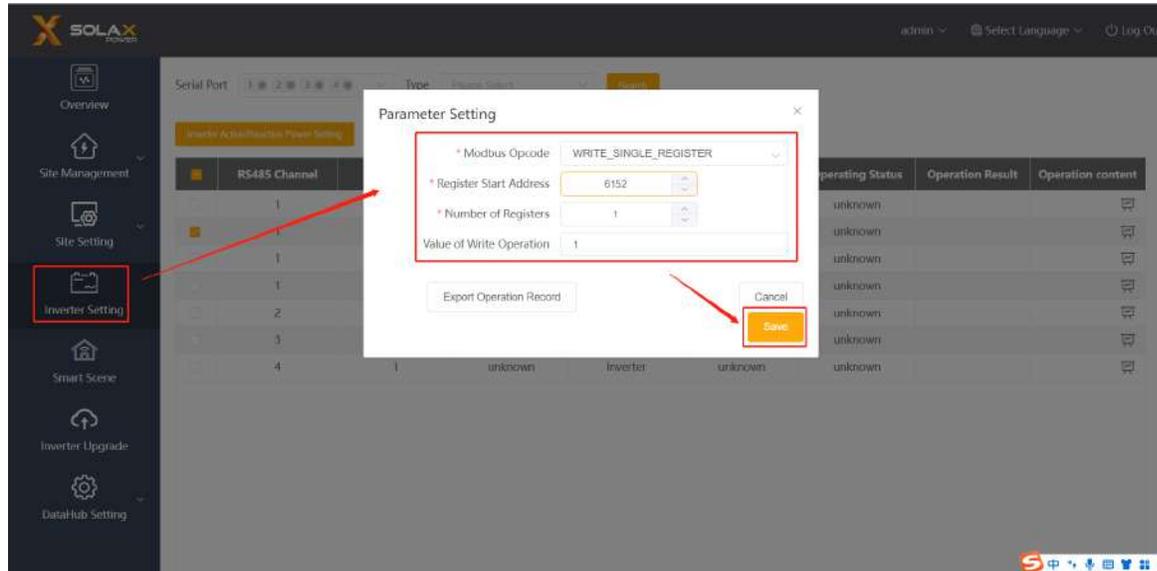
Communication loss shutdown
Select WRITE_SINGLE_REGISTER
Input register address 6152
Input number of registers 1
Input Write Value 1
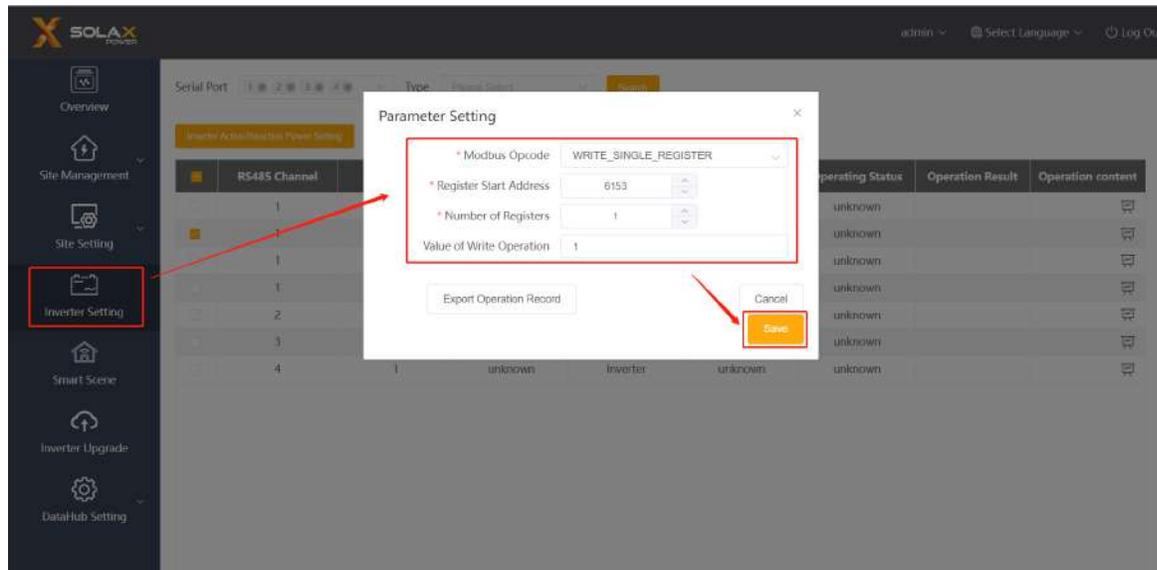
Communication recovery startup
Select WRITE_SINGLE_REGISTER
Input register address 6153
Input number of registers 1
Input Write Value 1

Meter direction

How to determine whether the direction of the meter is correct or not. Datahub relies on the data of the meter to achieve zero injection control, so it is important to ensure that the meter is installed in the correct position and direction. When the on-grid inverter outputs power, the grid power displayed on the DataHub homepage should be positive. If it is a negative value, you can choose either solutions: 1. Turn on the meter reverse function of DataHub. 2. Remove the meter and reinstall it.
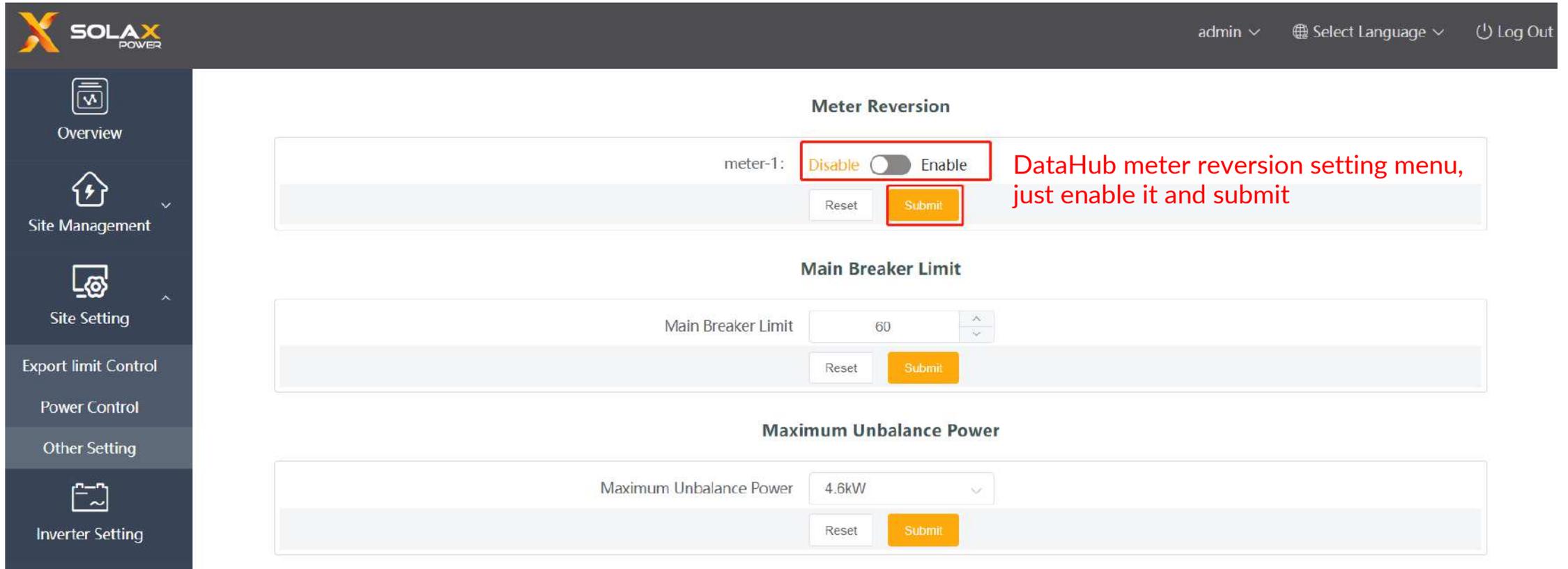
DataHub meter reversion setting menu, just enable it and submit

Abnormal energy diagram

The measuring type of a meter can be sum metering or per phase metering.If on the power diagram it appears as $P_{AC} + P_{Grid} = P_{Load}$, and the grid power is mostly negative throughout the day.However, the energy diagram shows there is a large amount of power feeding into the grid every day, which may be due to the fact that the zero injection control of the inverter is total mode, but on the meter it is per phase metering. If the user prefer to have no feedin energy on the energy diagram, they can replace the meter with a sum metering one, or set the inverter to per phase zero injection.
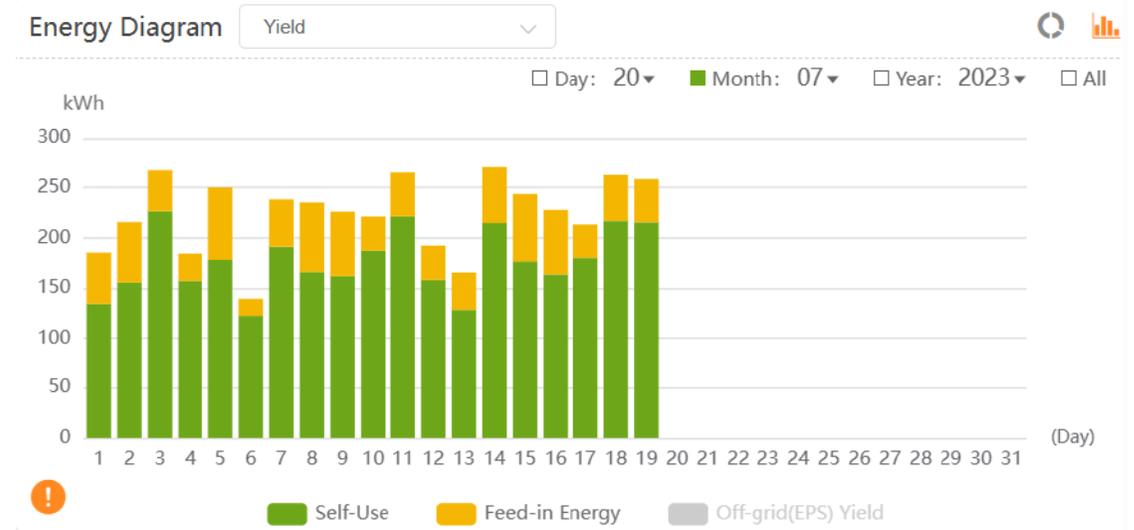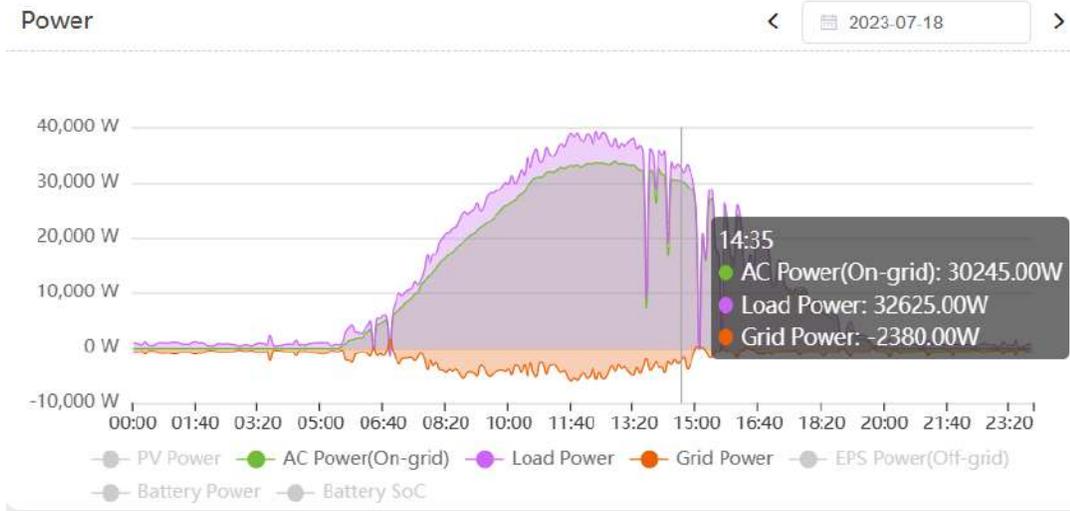
Others

The DataHub supports full on-grid inverter solutions in a version of V008.00 or higher; supports on-grid+energy storage solutions of V009.04 or higher, as well as "Disable" option for feedin buffer. When using the zero injection solution, both the inverter side ARM and DSP need to be updated to the latest versions (ForthV018.01, MegaV009.09 and higher)

In the scheme of multiple on-grid inverters + single meter zero injection solution, the version of X3-MEGA G2 must be at V009.09 or above, and the version of X3-FORTH must be at V18.00 or above.

After enabling zero injection, DataHub no longer collects inverter 's data in real-time, but collects it every 5 minutes (the collection of meter data is still real-time). Therefore, it is normal if the "real-time power" on the homepage does not match the actual value, only needs to pay attention to whether the grid power is correct. And due to the above reasons, when Datahub sends a zero injection command to the inverter, the inverter's state may temporarily be offline, there is no need to worry about it. We will optimize the Datahub 5 minutes data collection interval afterwards.

Diagram of communication ports for different on-grid inverter models compatible with Datahub
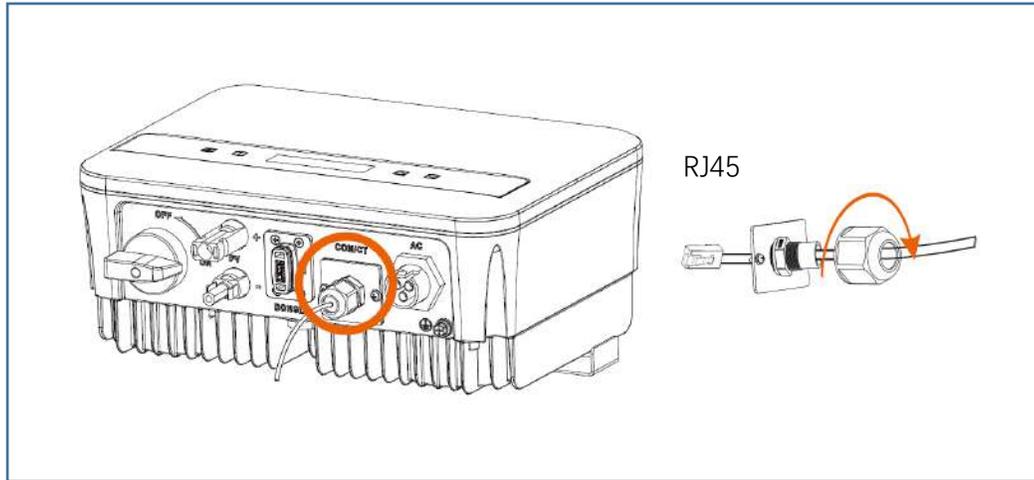
X1-MINI/X1-BOOST G4
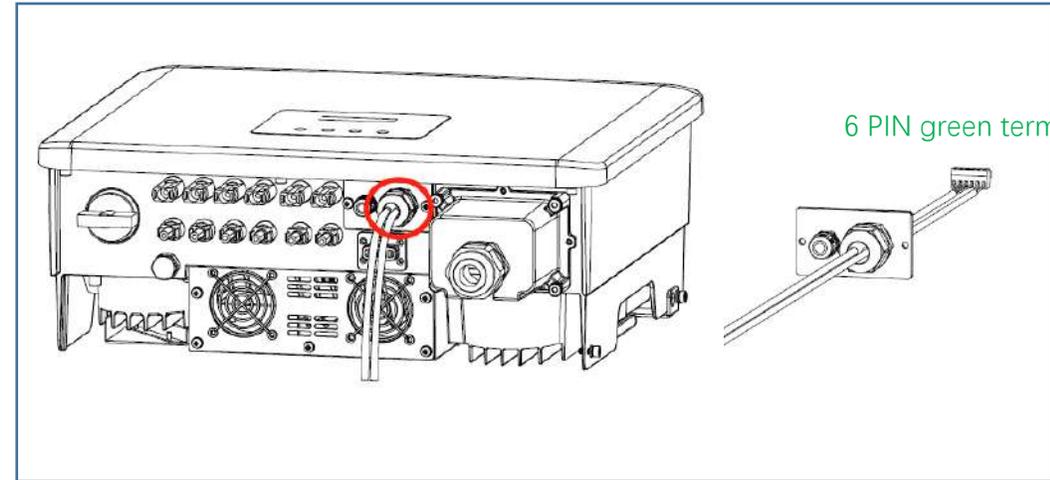
X3-PRO G2
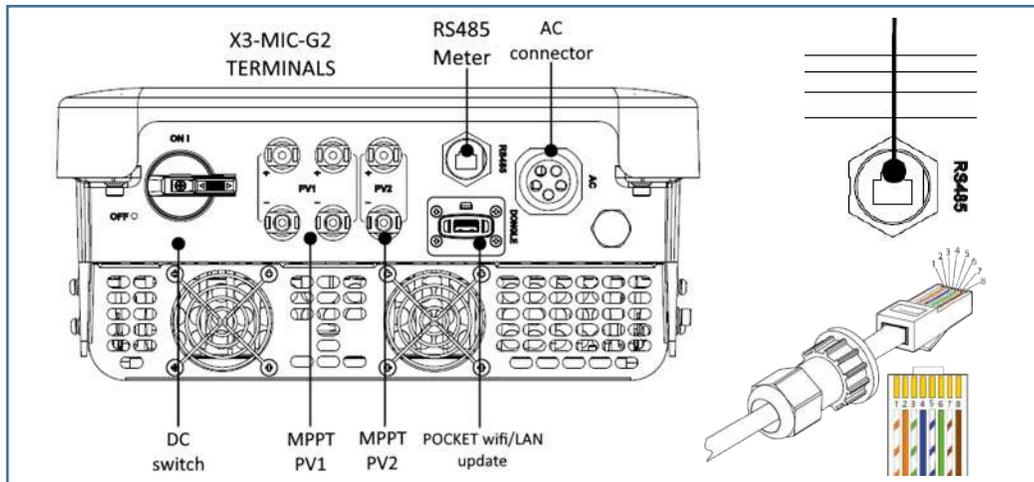
X3-MIC G2
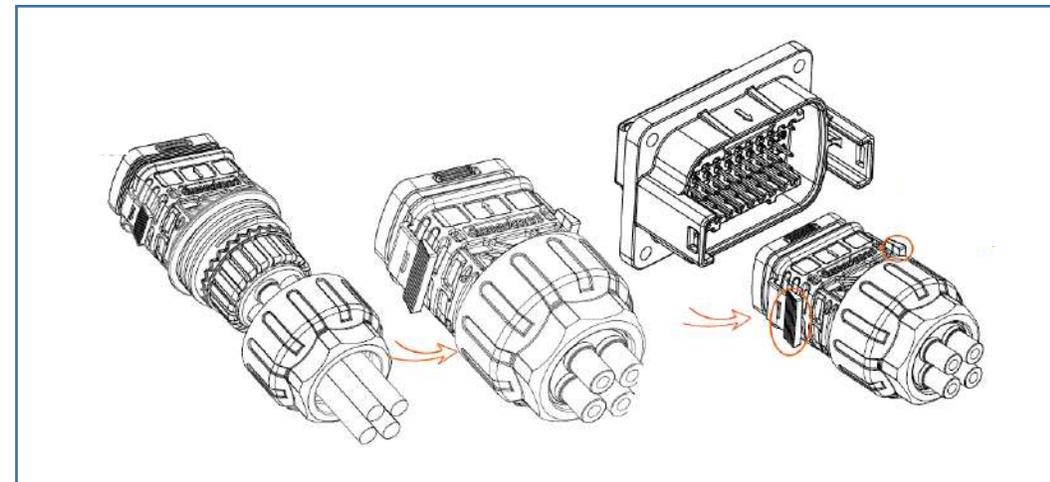
X3-MEGA G2/X3-FTH

X3-FORTH/X3-MEGA-G2
Communication Port
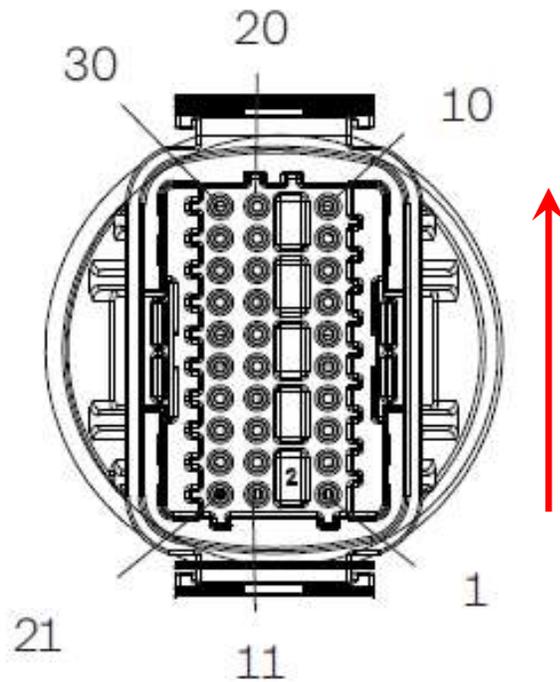
Port	PIN	Definition	Remark
RS485-1	1	RS485A IN+	Inverter RS485 networking or connect the data collector
	2	RS485B IN-	
	3	RS485 IN-GND	
	4	RS485A OUT+	
	5	RS485B OUT-	
	6	RS485 OUT-GND	
RS485-2	7	RS485A meter	Connect the RS485 meter or other devices
	8	RS485B meter	
	9	V+5V	
	10	COM_GND	
DRM	11	DRM1/5	Reserved for DRM
	12	DRM2/6	
	13	DRM3/7	
	14	DRM4/8	
	15	RG/0	
	16	CL/0	
DI	21	Digital IN+	Input digital signal
	22	Digital IN	
DO	29	Digital OUT+	Output digital signal
	30	Digital OUT	

X3-FORTH/X3-MEGA-G2 Parallel Connection without Datahub
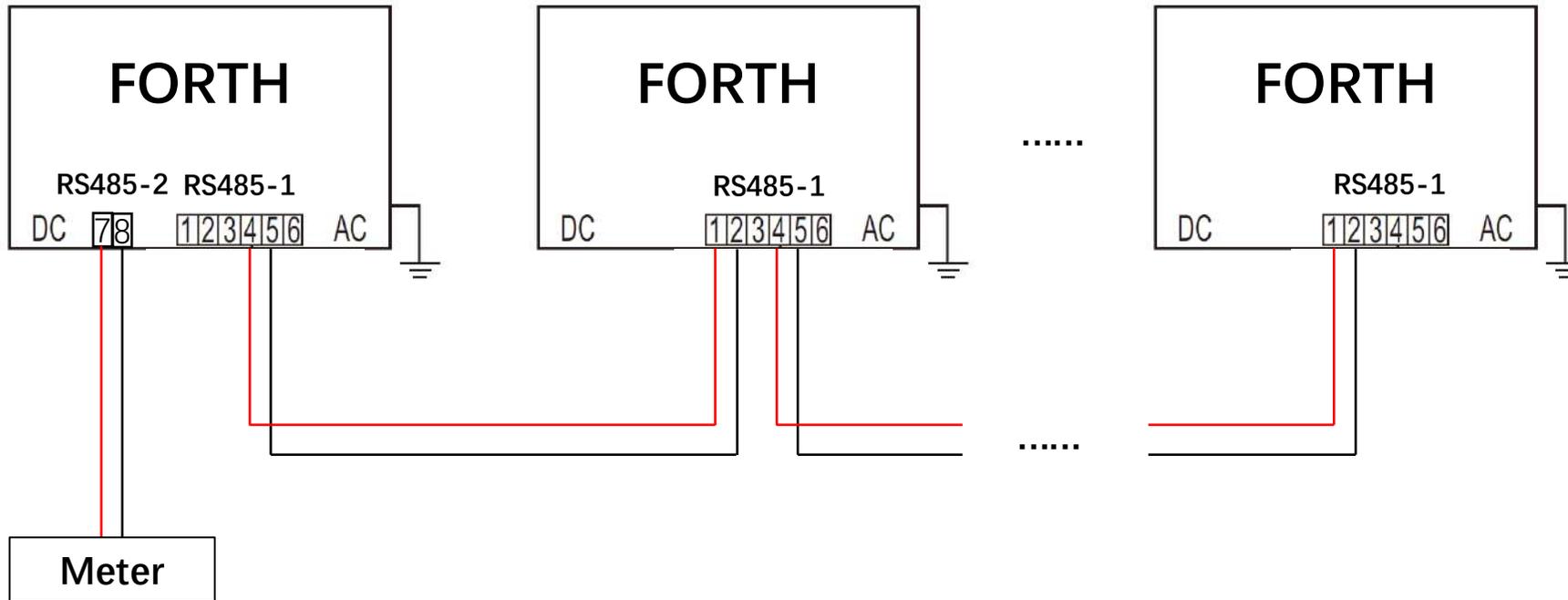
1. PIN 4,5 of the master inverter comm port RS485-1 are connected to PIN 1,2 of the first slave inverter RS485-1, PIN 4,5 is connected to PIN 1,2 of the next slave, and so on.
2. PIN 7,8 of the master inverter comm port RS485-2 is connected to the meter.

X3-FORTH/X3-MEGA-G2 Parallel Connection with Datahub
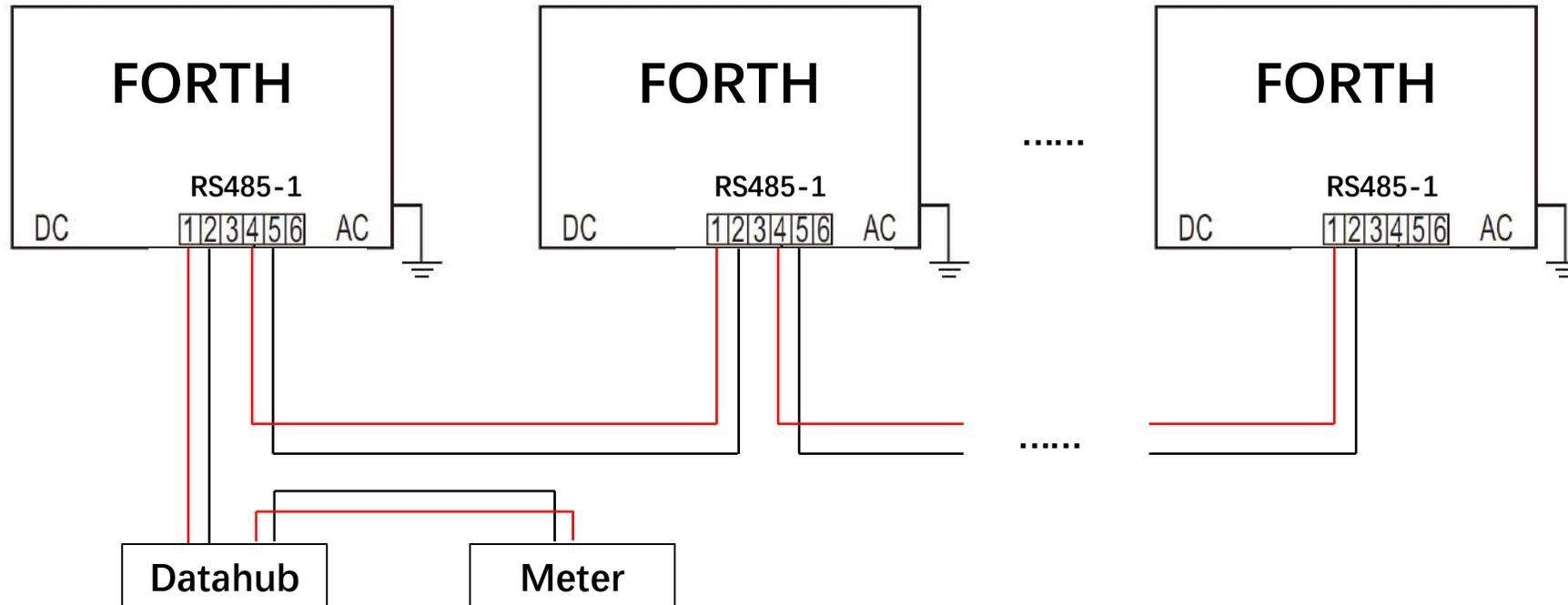
1. Connect PIN 4,5 of the comm port RS485-1 of the first inverter(the one directly connected to the Datahub) to PIN 1,2 of the comm port RS485-1 of the second inverter, PIN 4,5 to PIN 1,2 of the next inverter, and repeat this process.
2. PIN 1,2 of the first inverter comm port RS485-1 connects to one RS485 port on the Datahub.
3. Connect the meter to one RS485 port on the Datahub.

X3-PRO G2 Communication Port
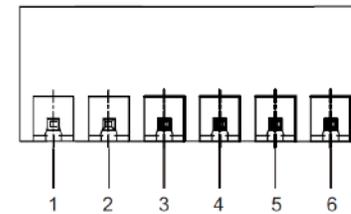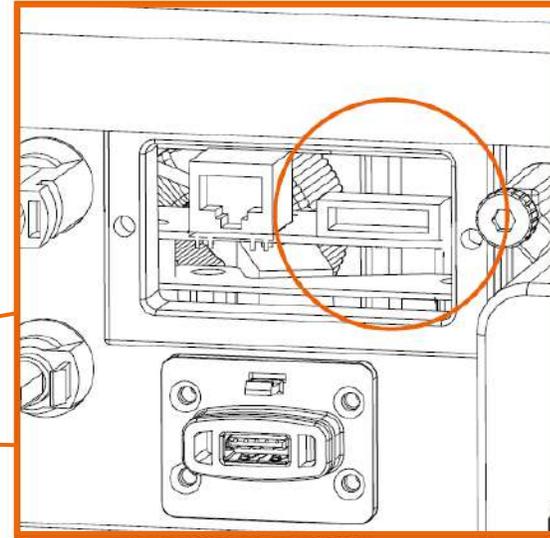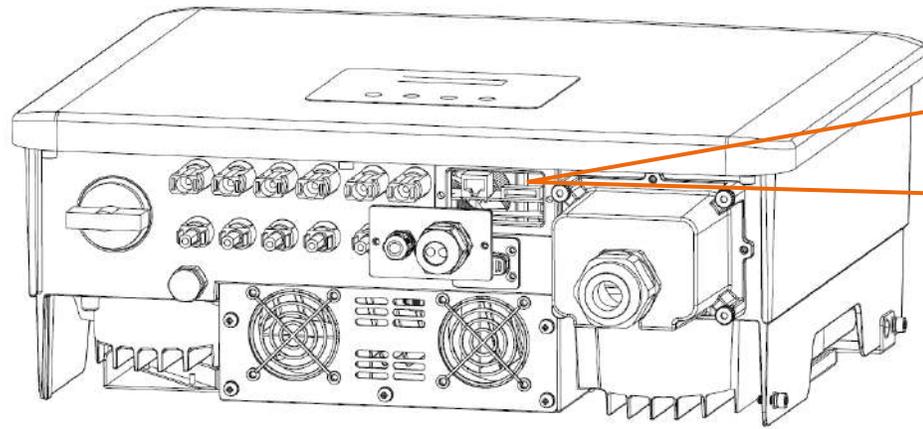
Pin	1	2	3	4	5	6
Definition	485A	485B	485A	485B	meter A	meter B

X3-PRO G2 Parallel Connection without Datahub
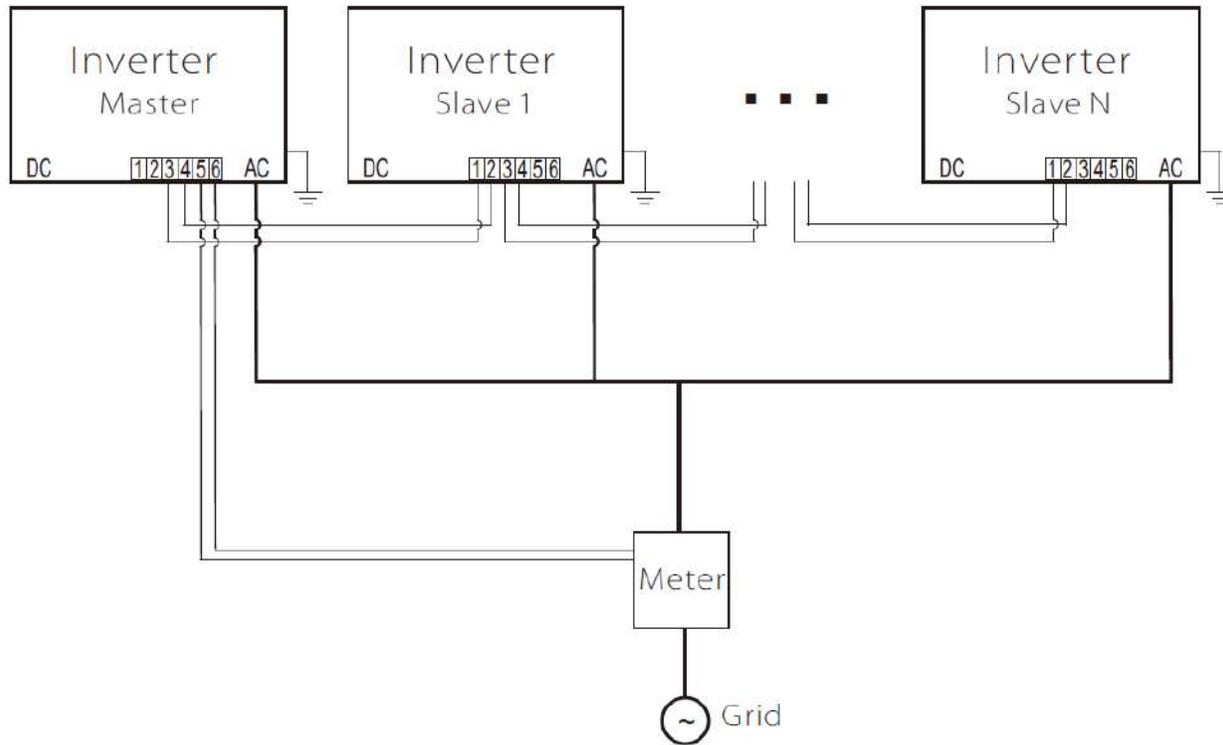
1. PIN 3,4 of the Master inverter RS485 port are connected to PIN 1,2 of the first slave RS485 port, PIN 3,4 is connected to PIN 1,2 of the next slave, and so on.
2. PIN 5 and 6 of the RS485 port of the Master are connected to the meter.

X3-PRO G2 Parallel Connection with Datahub
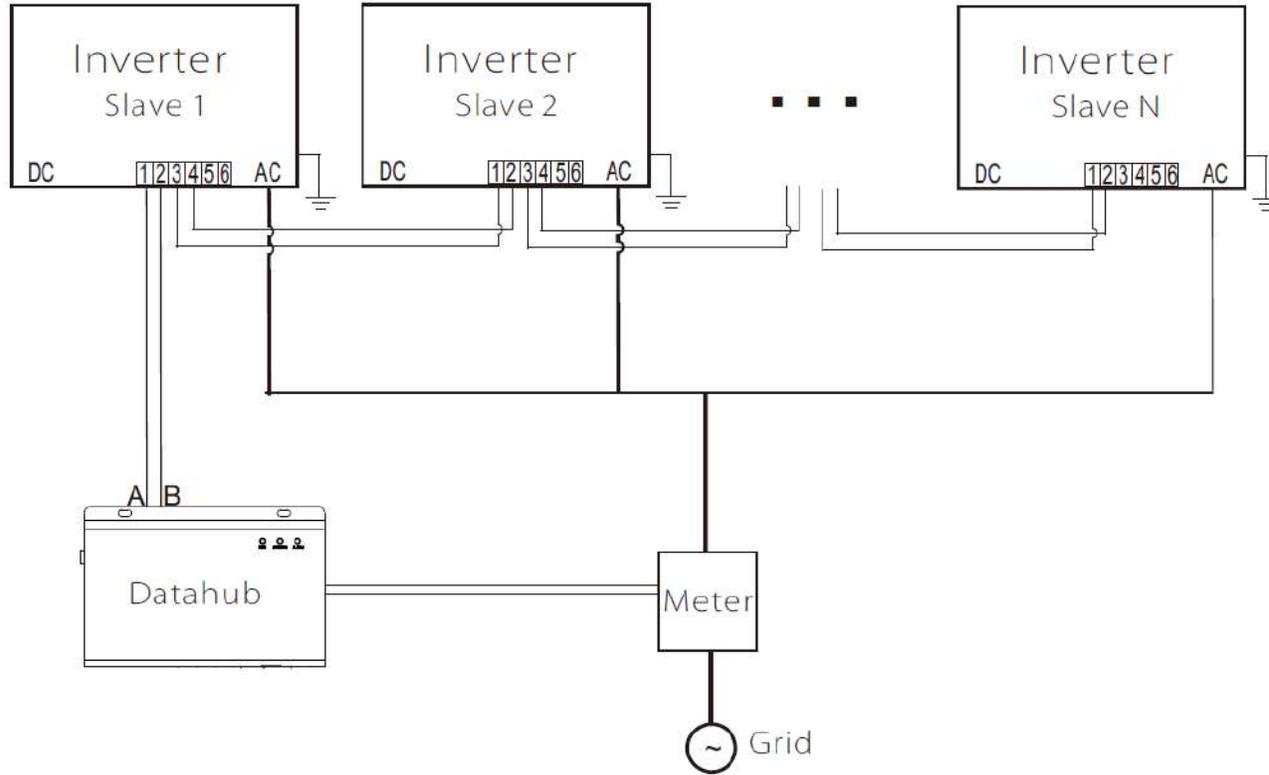
1. PIN 3,4 of the RS485 port of the first inverter (the one directly connected to the Datahub) is connected to PIN 1,2 of the RS485 port of the second inverter, and PIN 3,4 is connected to PIN 1,2 of the next slave, and so on.
2. The PIN 1,2 of the first inverter RS485 port is connected to one RS485 port on the Datahub.
3. Connect the meter to one RS485 port on the Datahub.

X3-MIC G2 Communication Port

PIN	1	2	3	4	5	6	7	8
Definition	X	X	X	485_A	485_B	X	X	X

X3-MIC G2 Parallel Connection with Datahub
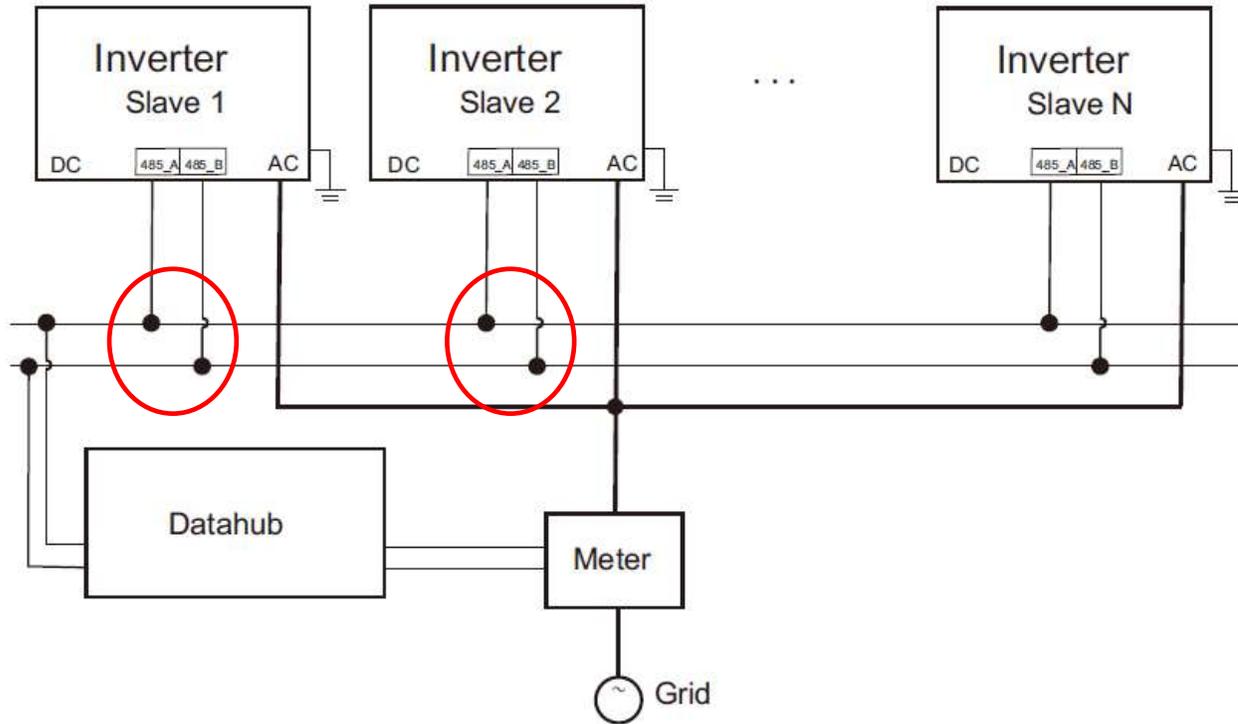
1. PIN 4,5 of the RS485 port of the first inverter(the one directly connected to the Datahub) is connected to PIN 4,5 of the RS485 port of the second inverter. At the same time, split a set of PIN 4,5 and connect to PIN 4,5 of the RS485 port of the next inverter, and so on.
2. PIN 4,5 of the RS485 port of the first inverter is connected to one RS485 port on the Datahub.
3. Connect the meter to one RS485 port on the Datahub.
4. RJ45 spliters are required to separate the RS485 signals.

X3-FORTH/X3-MEGA-G2+X3-Hybrid G4+Datahub Parallel Connection

Connection on X3-FORTH/X3-MEGA-G2 is the same as introduced in **X3-FORTH/X3-MEGA-G2 parallel connection with Datahub**

X3-FORTH/X3-MEGA-G2+X3-Hybrid G4+Datahub Parallel Connection

X3-Hybrid G4 Connection port
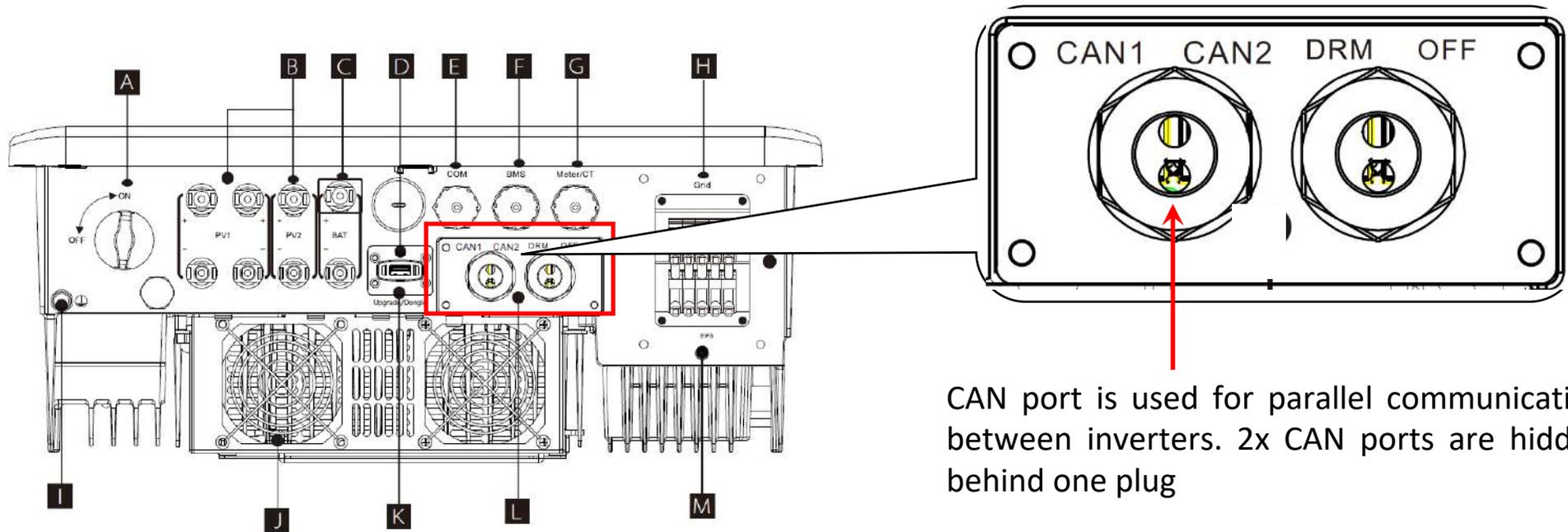
CAN port is used for parallel communication between inverters. 2x CAN ports are hidden behind one plug

CAN PIN Definition
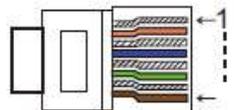
1	2	3	4	5	6	7	8
485A	485B	VCC	CANH	CANL	GND	SYN1	SYN2

NOTE: All the PINs will be used for parallel connection

X3-FORTH/X3-MEGA-G2+X3-Hybrid G4+Datahub Parallel Connection

Hybrid COM port PIN definition

	1	2	3	4	5	6	7	8
	Drycontact_A(in)	Drycontact_B(in)	+13V	485A	485B	GND	Drycontact_A(out)	Drycontact_B(out)
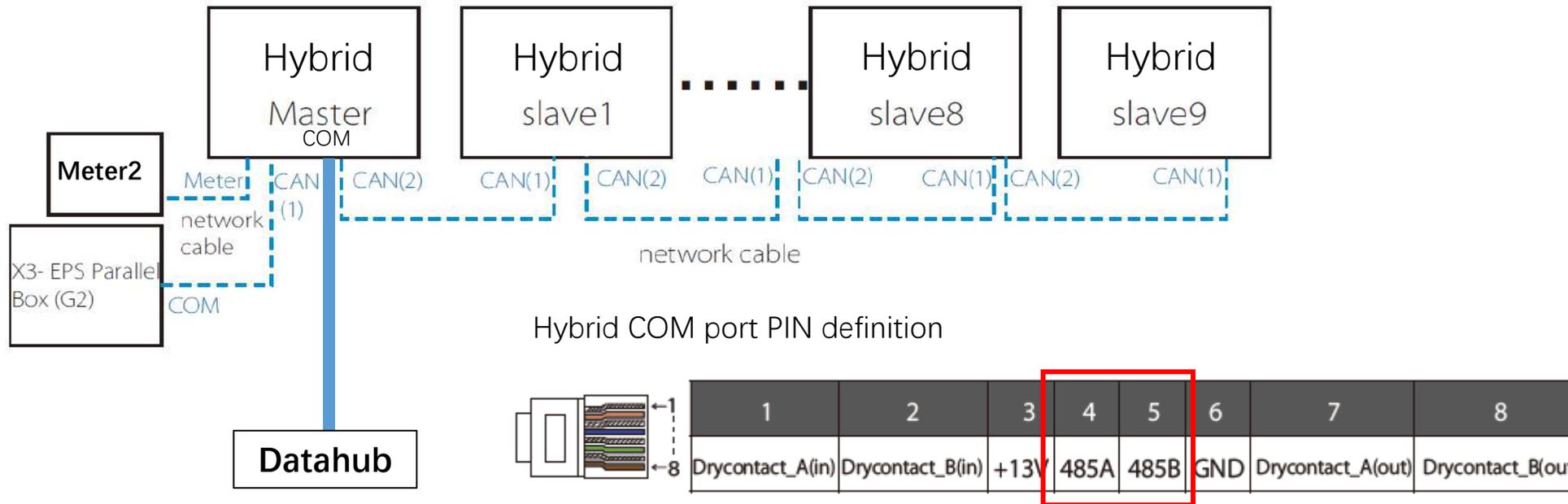
1. The CAN2 port of the Hybrid master is connected to the CAN1 port of the first slave, and the CAN2 port of the slave is connected to the CAN1 port of the next slave, and so on.
2. Connect the CAN 1 port of the Hybrid master to the EPS Parallel Box (if there is EPS load).
3. Connect meter 2 (address 1) to the Meter/CT port of the Hybrid master.
4. Connect the PIN4,5 of the COM port of Hybrid master to one RS485 port on the Datahub.

Meter Selection
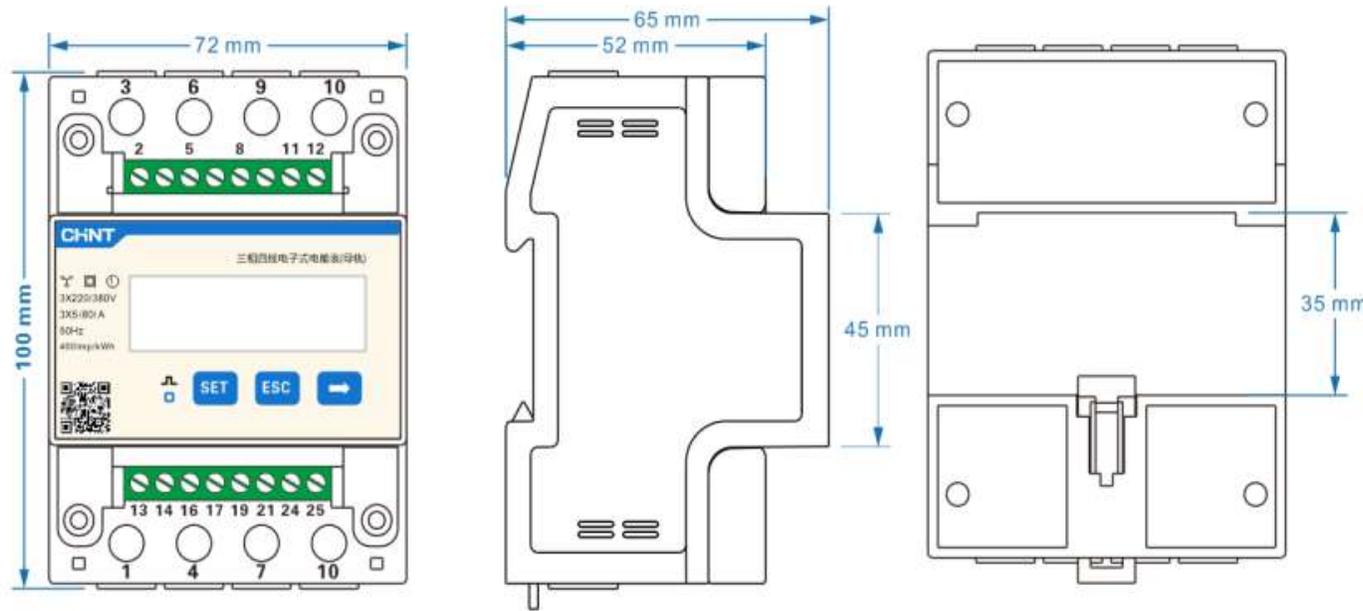
DTSU666-CT

1. The meter should be CHINT DTSU666-CT, and the Eastron meter series currently does not support C&I inverters and Datahub.
2. Normally it will use a meter with CT, because the system using Datahub normally has a large power capacity and AC current, and a direct connection meter cannot withstand such a large current.
3. If the range of CT is not sufficient, DTSU666-CT can be used with a third-party CT, as long as the CT transformation ratio is appropriate.

CT selection of meters

In general, CT can ensure the rated accuracy within a certain power range, such as when the circuit current is within 20% to 120% of rated current, the CT can ensure level 0.5 accuracy. The transformation ratio of a current transformer refers to the ratio of the primary side current to the secondary side current. According to the CT model parameters, the corresponding current transformation ratio is set on the DTSU666-CT screen. The definition of the current ratio of the CHINT DTSU666-CT is shown in the following figure:

Parameter	Value range	Description
Ct	1~9999	Current ratio, used for setting the input loop current ratio: When the current is connected to the line via the transformer, Ct=the rated current of the primary loop / the rated current of the secondary circuit; When the current is directly connected to the line, Ct shall be set as 1.

Taking the ESCT-B816 1500A/5A CT as an example, the secondary current is 5A, and the effective accuracy range is 1500 * 20%~1500 * 120%, which is 300A~1800A, with a ratio of 1500/5=300.

CT selection of meters

If the CT provided by SolaX cannot meet the current value, a third-party CT on the market can be chosen. The common current ratios of CT are shown in the table below:

Ratio(A)	Class 0.5	Meter Ratio Set
1500A/5A	7.5A	300
2000A/5A	10A	400
3000A/5A	15A	600
4000A/5A	20A	800
5000A/5A	25A	1000
6000A/5A	30A	1200

1500A/5A: ratio of primary side current to secondary side current.

Class 0.5: The accuracy level of the transformer is 0.5, and the higher the level, the lower the accuracy.

CT selection of meters

When using third-party CT, please note do not use Rogowski Coil. The Rogowski coil is divided into two parts: the coil and the integrator. The coil converts the primary current signal into a voltage signal, and the integrator converts the voltage signal into a secondary current signal and sends it to the meter. Rogowski coil is mainly used for high-frequency and high current measurement, and its compatibility with our CHINT meter has not been tested. It also involves twice current transformations and the ratio calculation is complex, so it is not recommended for customers to use this kind of CT.

Meter connection

The cable connection of meter consists of three parts: electrical connection, CT connection, and RS485 communication connection. When connecting CT on the meter, it is important to note that the current direction of the CT sensor should be pointing **from the grid to the inverter**.
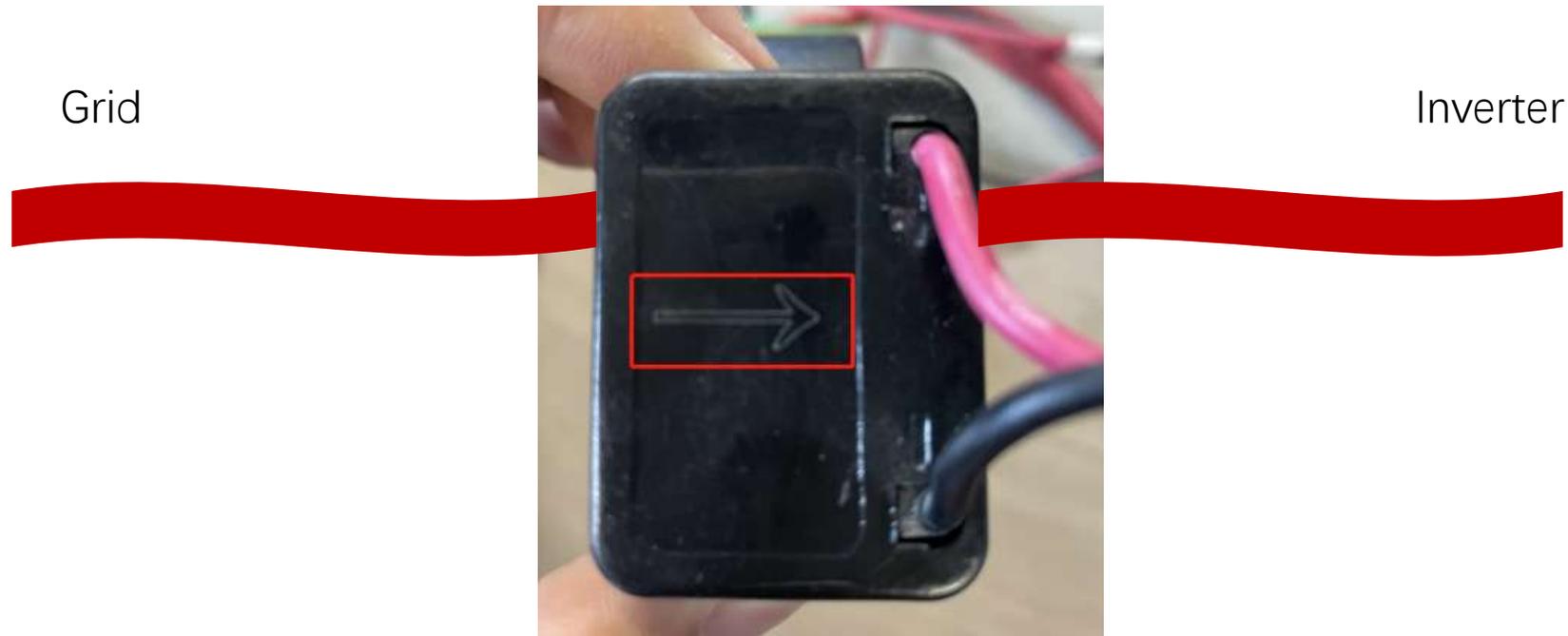
Grid   Inverter

Meter connection

There 2 electrical connection diagrams of DTSU666-CT three-phase meter: three-phase four-wire and three-phase three-wire.
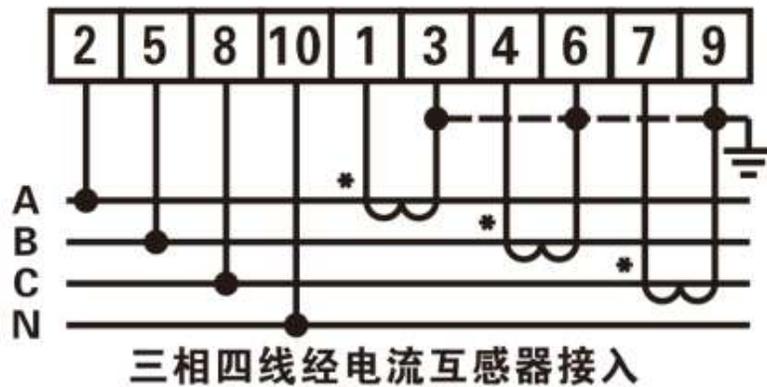
三相四线经电流互感器接入

Supported inverter series
X3-Hybrid G4
X3-MIC G2
X3-PRO G2
X3-MEGA G2
X3-FORTH
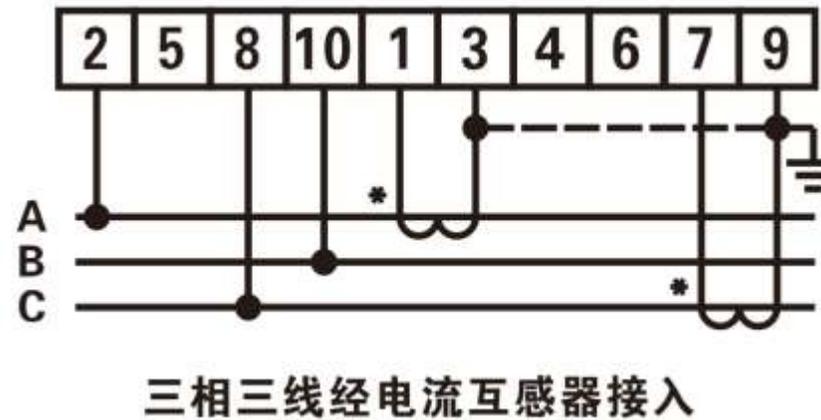
三相三线经电流互感器接入

Supported inverter series
X3-PRO G2
X3-MEGA G2
X3-FORTH

Meter connection

The RS485 communication ports of the CHINT DTSU666-CT is 24,25, which needs to be connected to the corresponding communication interface on the inverter or Datahub. The details are shown in the following figure.
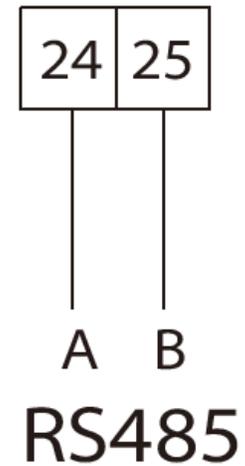
Datahub connection

There are 4 RS485 channels on Datahub, please do not mix different devices (such as meters or inverters) to the same RS485 channel.
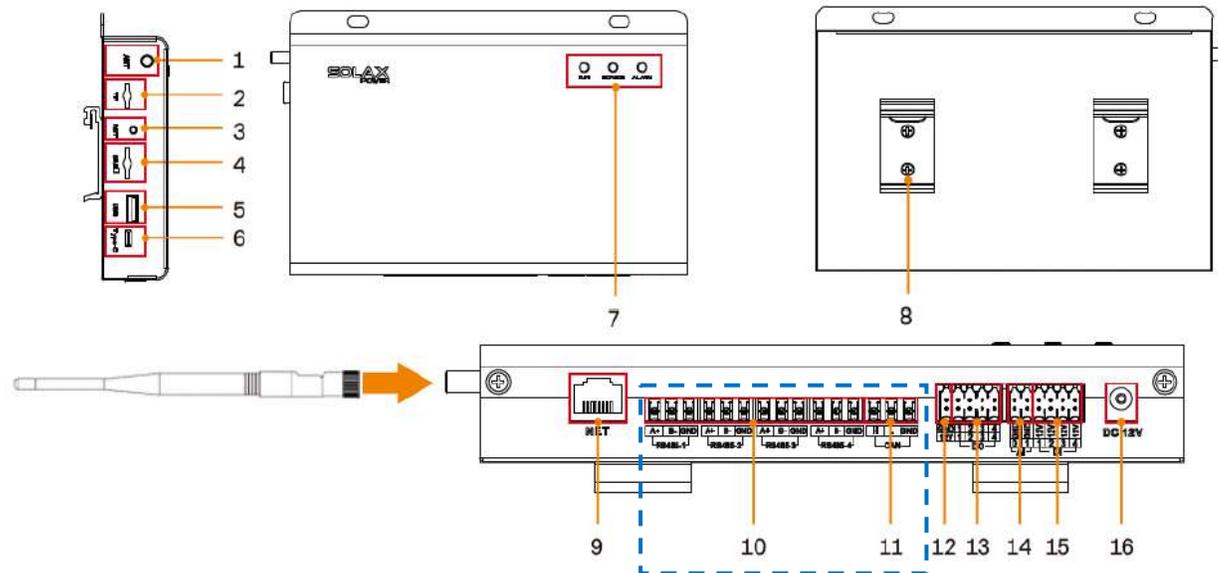
(1) Antenna jack
(3) RST button (RST)
(5) USB socket (USB)
(7) LED indicator (RUN,SERVER,ALARM)
(9) NET socket (NET)
(11) CAN socket (CAN)
(13) DO socket (DO)
(15) DI socket (DI)

(2) TF card socket (TF)
(4) SIM card socket (SIM)
(6) TYPE-C socket
(8) Rail clip
(10) RS485 socket (RS485)
(12) 12V power output (12V/GND)
(14) AI socket (AI)
(16) 12V power input (DC12V)

Datahub connection

Connect the two RS485 wires of the inverter or meter to the green terminal that comes with Datahub, and then plug it into one of the RS485 ports of Datahub.

RS485 A   RS485 B

8-10mm

φ 2.5mm

0.4-0.5N·m
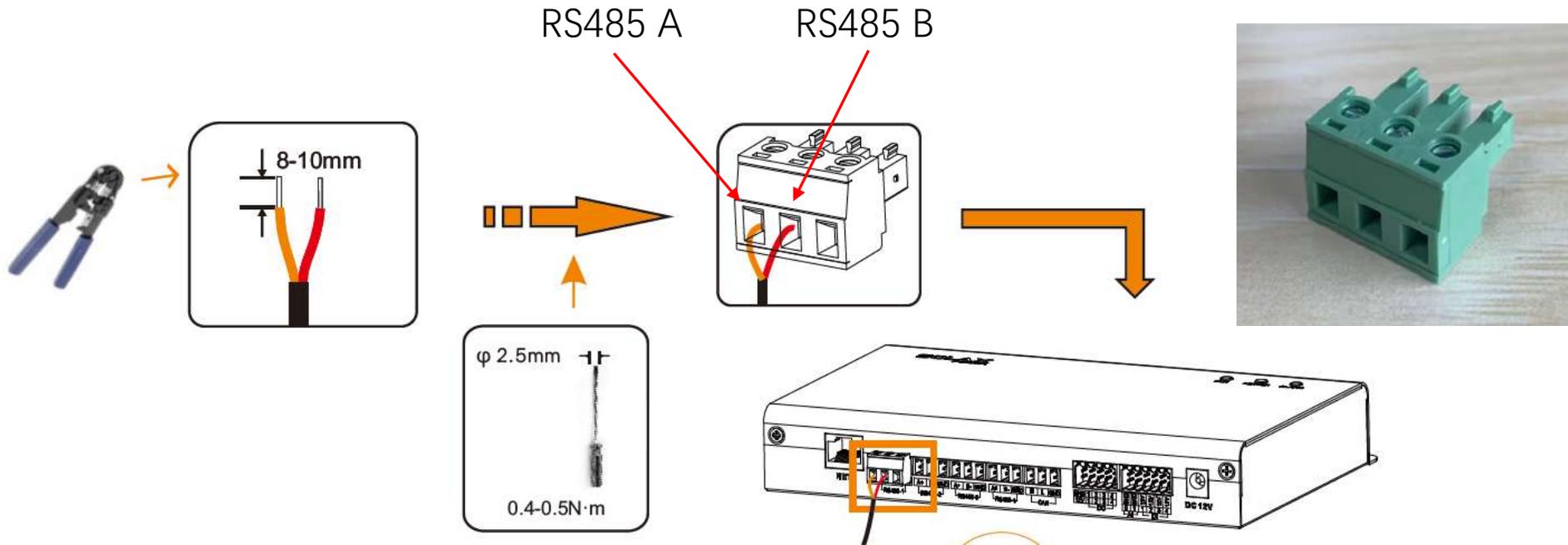
Meter Setting

Normally, the address and baud rate of the meter do not need to be set, just keep as the default. If it is not correct, you can also set it according to the steps below.
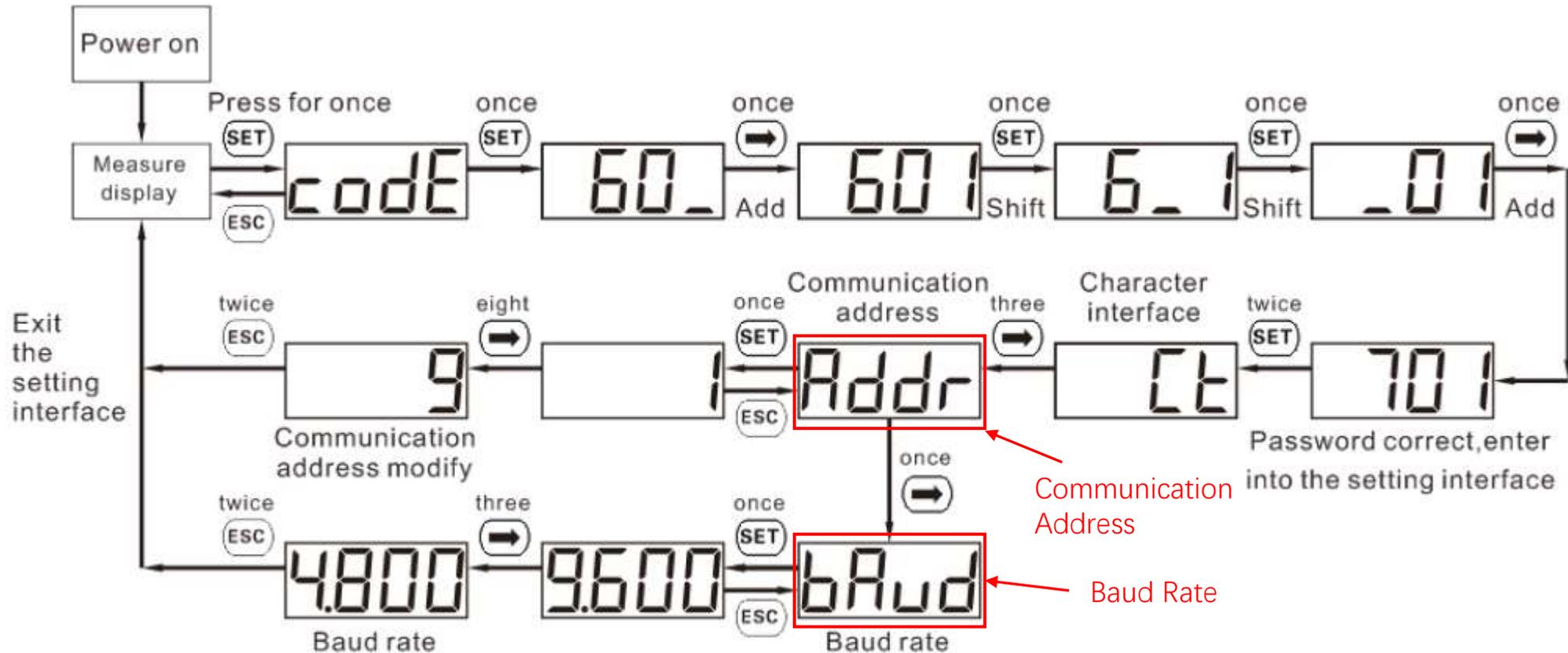
Meter Setting

Grid form normally has no need to set.

After entering the password 701, press the right arrow in the function selection interface until the nEt menu appears in the below image, and then press the SET key to enter, and select three-phase three-wire or three-phase four-wire according to the actual situation.
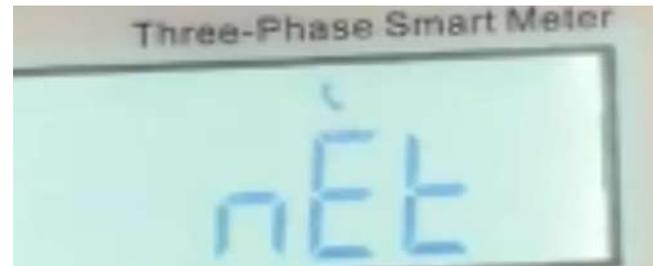
n.34: three-phase four-wire
n.33: three-phase three-wire

Meter Setting
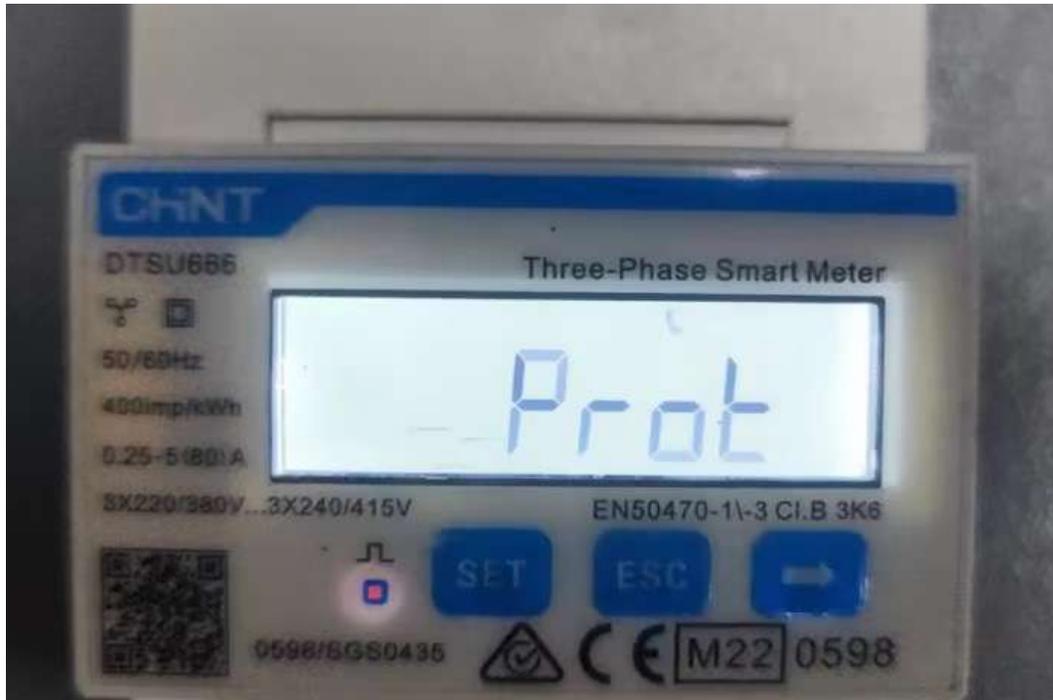
Protocol setting, which in most cases does not need to be set, but it is still recommended to have a check.

After entering the password 701, press the right arrow in the function selection interface until the Prot menu in the left image appears, then press the SET key to enter, select the protocol as n.1, choose other protocols may cause the inverter Meter Fault.

Inverter Setting

There are 2 setting methods of the inverter :

A. LCD screen on the machine

B. WiFi module local mode

Path A requires the inverter equipped with LCD screen

Path B requires the inverter equipped with WiFi module (the inverter does not need to be connected to the WiFi module in Datahub solution)

For ease of explanation, the following inverter settings are explained by using the interface of the WIFI module local mode, and the actual interface and paths of method A and B are consistent.

A. LCD screen on the machine
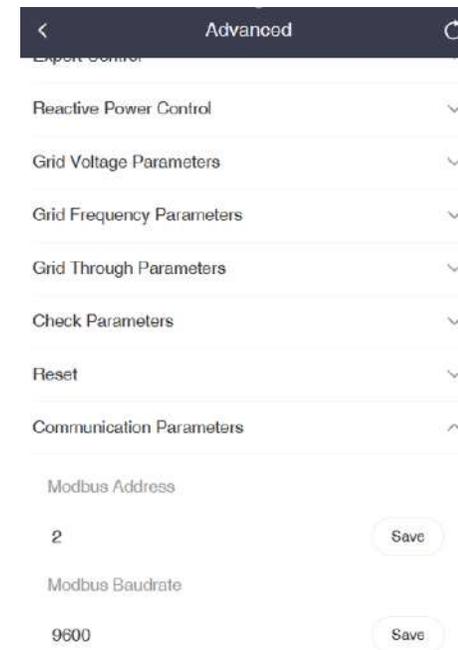
B. WiFi module local mode

On-grid inverter Setting
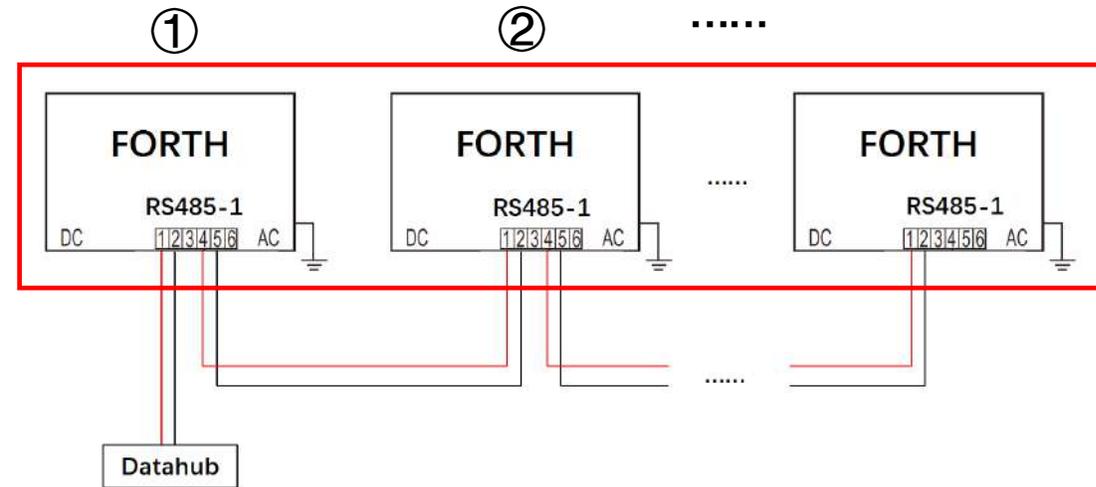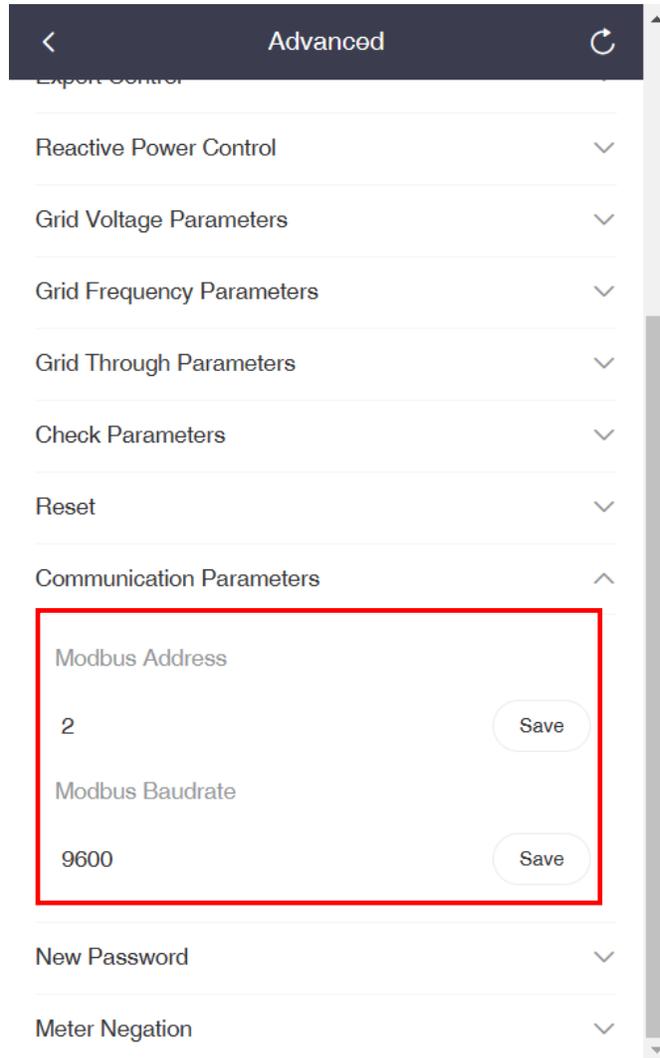
Setting>Advanced(password 2014)>Communication Parameters

All on-grid inverters' Modbus Address and Baud rate need to be set, the baud rate needs to be set as default 9600, the rule for Modbus address is that the address of the inverter directly connects to the datahub set to 1, and the address for inverters in that string sets in an ascending order 2,3,4……

NOTE: There is no master/slave settings for on-grid inverters.

Hybrid inverter Setting---Master

Find the master Hybrid inverter in the (the one connected to meter or datahub).

Path: Setting>Advanced(password:2014)>Parallel Setting

In parallel setting, set this inverter to be "Master", and then enable "resistance switch" as the picture shows.

NOTE: After selecting the inverter connected with Meter or Datahub to be Master, all the rest inverters will become Slaves automatically.

Hybrid inverter Setting---Master

Path: Setting>Advanced(password:2014)>Export Control

In "Export Control", set User Value as 0W, and click save as the picture shows.

NOTE: No need to set export control for slave inverters.

Hybrid inverter Setting---Master

Path: Setting>Advanced(password:2014)>Meter/CT Setting

On the master inverter, go to meter/CT settings, select the measuring device type as Meter, and set meter address as 1(default)

NOTE: No need to set **Meter/CT** for slave inverters.

Hybrid inverter Setting---Master

Path: Setting>Advanced(password:2014)>Modbus

On the master inverter, go to Modbus settings, set ComFunSelect as Datahub, keep the baud rate as default 19200, and set the Modbus address to be 1.

4. Setting and Commissioning

Hybrid inverter Setting---Slave
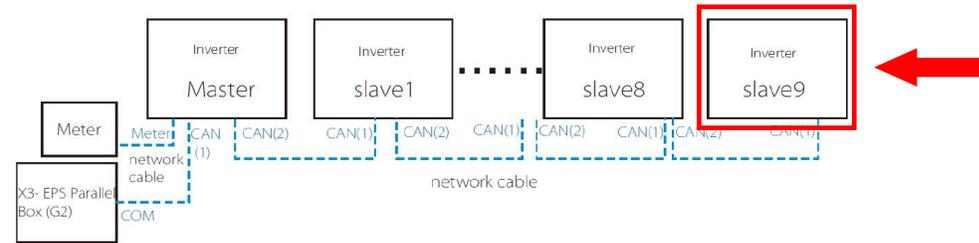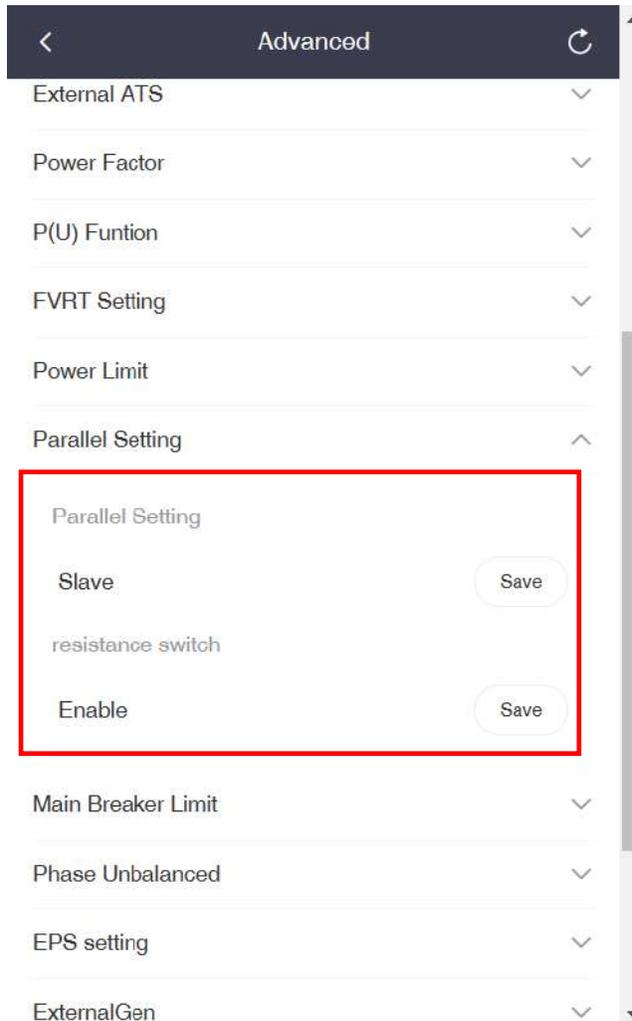
Find the last slave inverter, as the right side inverter in the picture

Path: Setting>Advanced(password:2014)>Parallel Setting

In parallel setting, enable "resistance switch" as the picture shows.

Hybrid inverter Setting---Slave
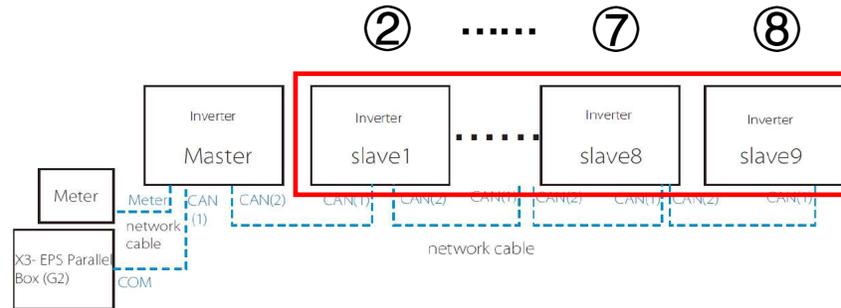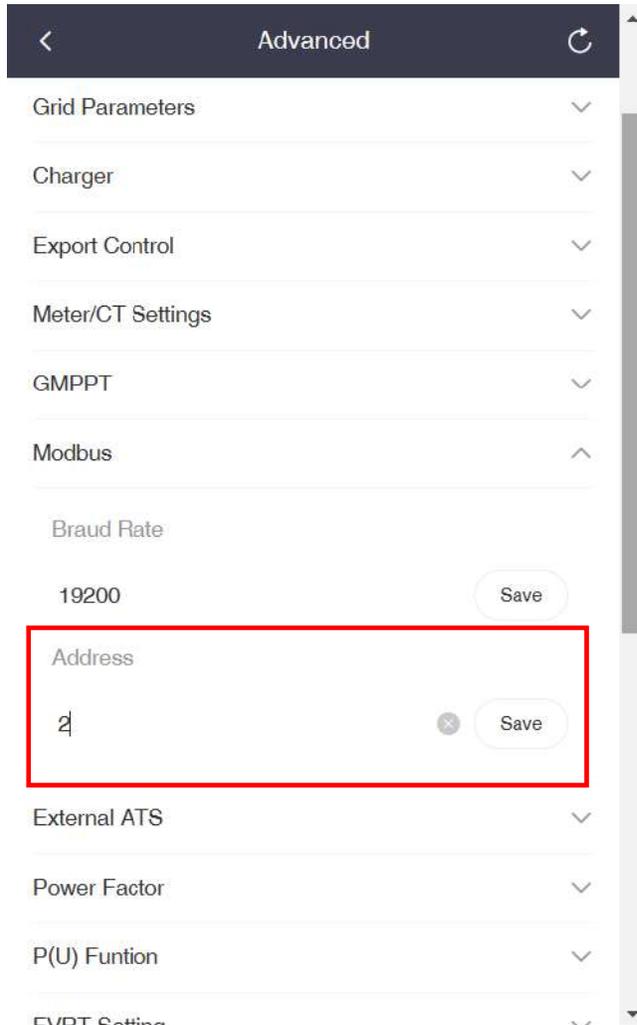
Path: Setting>Advanced(password:2014)>Modbus

For all slave inverters, Modbus address needs to be set. The slave directly connected to the master should be set to 2, the rest slaves set in an ascending order 3,4,5······

4. Setting and Commissioning

Datahub Setting

There are 3 ways to login and connect Datahub: LAN, WiFi and Hotspot.

LAN: Connect Datahub to the router through a network cable, connect the computer to the same router, and access the Datahub IP to enter the login interface.

WiFi: After logging in with the hotspot, in System Setting > Network Setting , connect the WiFi, restart datahub, and access the Datahub IP to enter the login interface after connecting the computer to the same WiFi.

Hotspot: Connect the computer to the Datahub hotspot, and access the computer to 192.168.10.10 to enter the login interface. (Hotspot mode cannot be connected to the Internet, cannot be connected to the cloud platform to upload data, so it is not recommended. It is better to switch from hotspot login to WiFi login.)

Datahub Setting—Serial Port Setting

Select the baud rate of the corresponding channel according to the actual device connected to Datahub: On-grid inverter-9600; Hybrid inverter-19200; Meter-9600. Leave the Verification Method and the Stop Bit as default.

Datahub Setting—Add Device

Login to the datahub, go to Site Management > Add Device(Need to turn off the Export Limit Control before adding devices), select the Device Type, set the Initial Address and the Number of Devices, the addresses are continuous, for example, the Initial Address is 3, the Number of Devices is 4, the address taken by the device is 3, 4, 5, 6, and the address taken cannot be used again.

Click the Save button, Datahub will search for the devices.

Datahub Setting—Add Device

It will take about 30s for Datahub to complete the search, when it is completed, the serial number and device type of each channel will be displayed, if it is displayed as unknown, please check the RS485 connection and add it again.

Datahub Setting—Export Limit Control
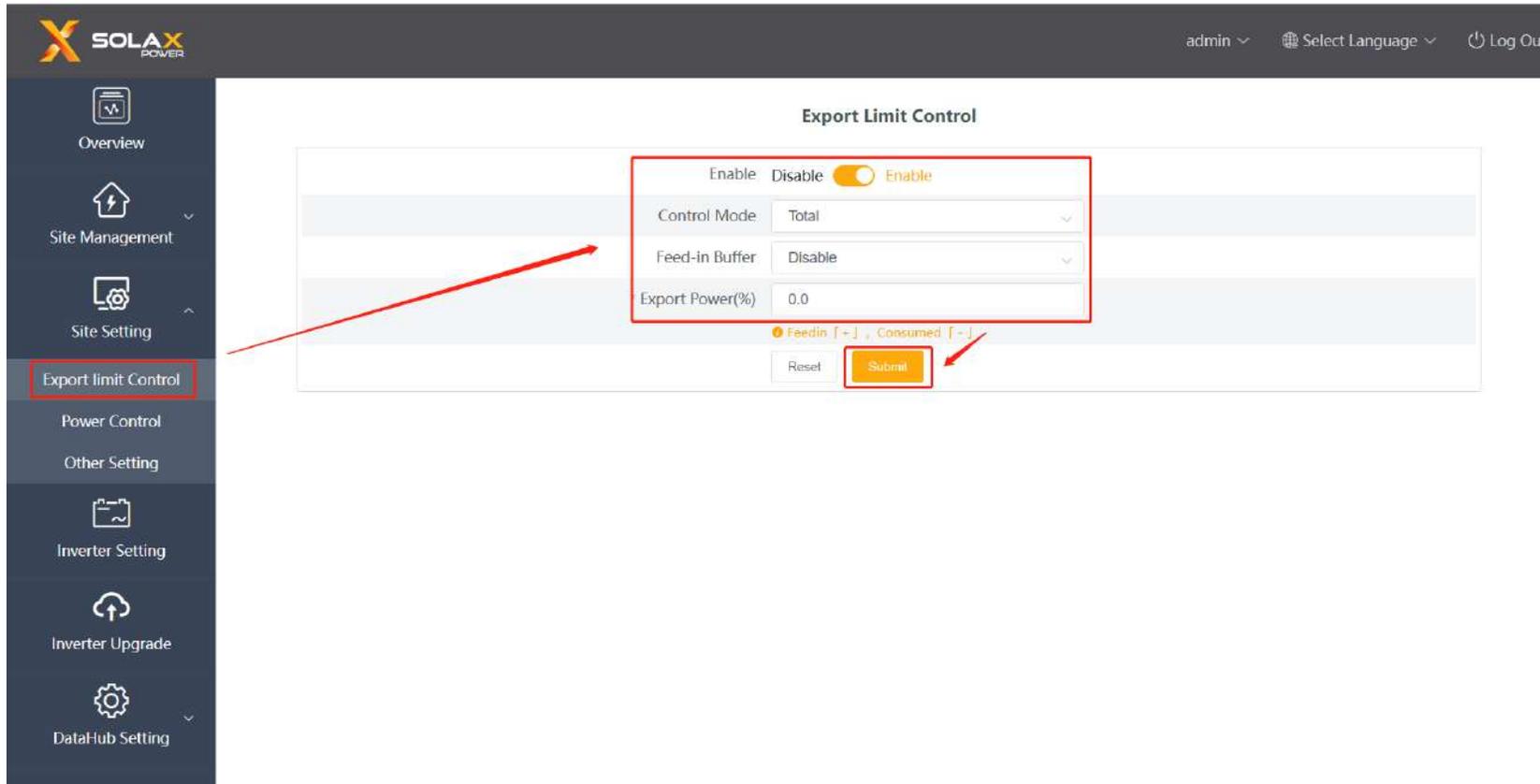
Go to Site Setting > Export Limit Control, enable the function, select the Control Mode(total/per phase), Feed-in Buffer(disable/low/mid/high), then select the Export Power allowed, 0.0% in this case is for 0 export control.

THANK YOU

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