Technical Description of On-Grid Switching Controller (STS/PCC)

1 Device function

Microgrid Controller (STS, By fast switch, High-precision detection, Logic control, External Communications , Four-part group It can automatically complete the on-grid and off-grid switching and grid - connected synchronization functions. Active switching and off-grid time is 0 ms , passive switching Time is 20 ms (typical) , which can be achieved through customization 4 ms Switch within.

Switch application scope

In energy storage systems , Themainfunctionof PCS is to control energy in both directions. , Realize the absorption or release of grid energy , Therefore, PCS is more sensitive to abnormal fluctuations in the power grid (such asundervoltage, Overvoltage, Drop wave, Frequency abnormality, etc.) All have a certain tolerance force. Therefore, for energy storage systems with on-grid and off-grid switching requirements, , usually the judgment of abnormal grid voltage is more tolerant , Only when the power grid is actuallypowered off/short-circuited, the off-grid switch is disconnected toachieve off-grid power suppl , ensuring system stability , Its classic The recommended passive switching time is 10 ms However, for occasions with higher requirements on power supply , then ST is required S Rapidly detect abnormal grid waveform , And can Quick response , to ensure the quality of power supply. However, this application may have an impact on the charging and discharging of energy storage power . Influence , that is, ifthe grid waveform is abnormal, it will switch to the off - grid state , regardless ofwhether it is in the energy storage charging or machine technology, the waveform abnormality cannot be solved. , Because the virtual sync machine Only active and reactive power can be added to the energy and impedance at the frequency level , but cannot compensate for the instantaneous voltage waveform . Therefore, Get the best voltage waveform , Only runs off-grid , Pure power is provided by the inverter.

2 Logic block diagram

1) Passive switching:

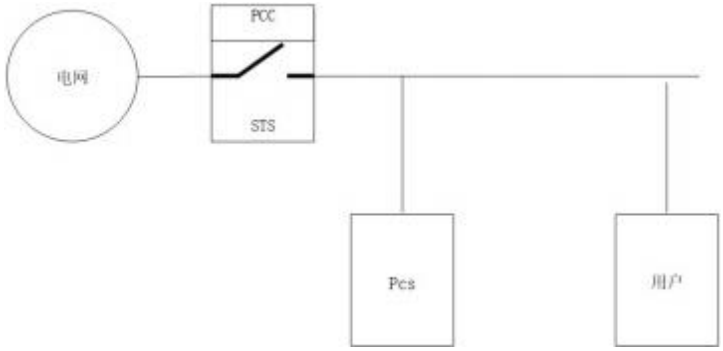
①Typical switching: STS samples network-side information in real time , when the grid voltage drops , control detection half cycle , Determine the poweroutage At this time, the

control fast switch disconnects , and send the off-grid switching command to PCS at the same time The whole process takes 10 ms Within.

② Power supply switch: Depend on STS samples network side information in real time and then sent to the control board , when the grid side power ,When the pressure drops , the control board detects the grid voltagewaveform , determine the waveform abnormality At this time, the controlfast switch disconnects , and issue and Off-grid switching command to PCS ,The whole process takes less than 3 ms . (This function needs to be customized)discharging state For this situation Even with VSG virtual synchronou）

2) Active Switching:

Send off-grid command under monitoring , After receiving the command, PCS switches to off-grid operation , Disconnect the fast switch. The switching time of this process is 0 ms



picture 1 Basic Schematic Diagram

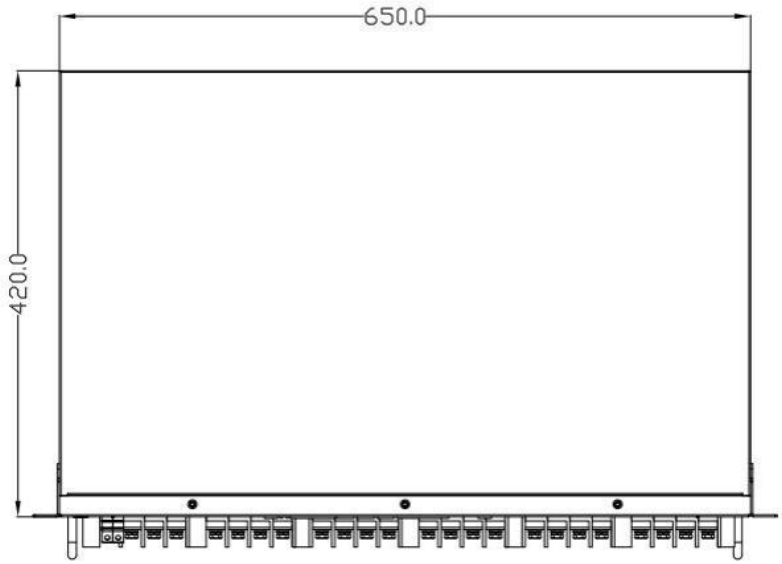
System composition

3) Grid connection at the same time:

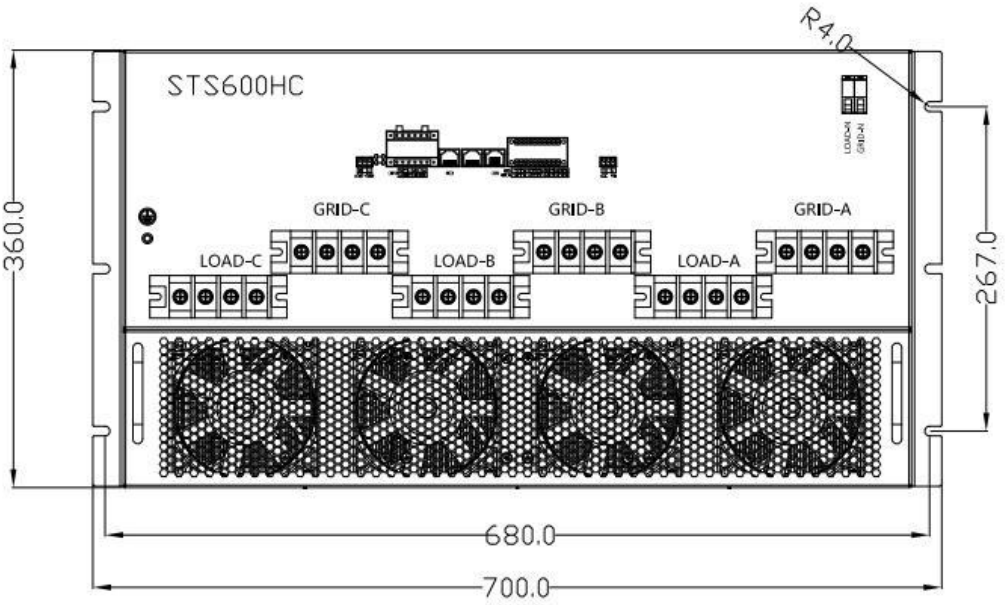
4) Monitor and issue grid connection instructions After receiving the data , STS starts to detect the grid voltage. , At the same time , the PCS output is controlled to change the phase and amplitude value , until it matches the grid , Grid connection successful , This process is seamless switching.

3 Equipment Pictures

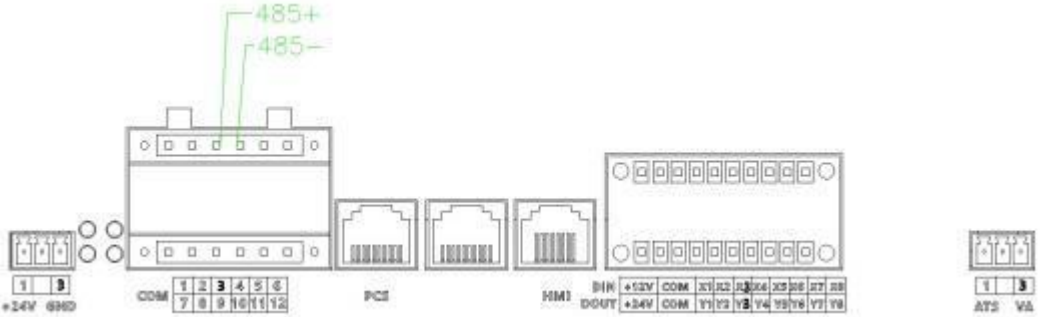
1) Fast switching module (capacity 200/300 KW , 400/600K): Contains power distribution unit and detection unit.



Picture 2 Top view



Picture 3 Front view



STS Wiring and interface definition:

Logo		definition	Remark
GRID-A/GRID-B/GRID-C		Grid side ABC	OT terminal (RNB38-6)
GRID-N		Grid side N line	Sheet terminal (DBV5. 5 - 14)
LOAD-A/LOAD-B/LOAD-C		Load side ABC	OT terminal (RNB38-6)
LOND-N		Load side N Wire	Sheet terminal (DBV5. 5 - 14)
+24V/GND		STS models do not need to connect	Retain functionality , No external power supply. If external power supply is required, please contact after-sales
Signal part			
PCS		Connect the PCS parallel cable	Super 4 Network cable
HMI		Modbus Tcp	Can connect to EMS Or
COM	1	Reserved Port	COM port multiplexing supports RTU mode configuration for EMS connection, with default EMS linkage.
	2	Reserved Port	
	3	COM3_A (RS485+)	
	4	COM3_B (RS485-)	
	5/6/7/8/9/10/11/12	Reserved Port	

D IN	+12V	No need to pick up	Retain functionality , No external power supply. If external power supply is required, please contact after-sale
	XCOM	enter IO Public COM Port	
	X1/X2/X3/X4 /X5/X6/ X7/	7 inputs IO side (X8 Internally used)	The protocol transparently transmits the closed/open status of all input I/Os. For details, refer to the protocol documentation.
DOUT	+24V	No need to pick up	Retain functionality , No external power supply. If external power supply is required, please contact after-sales
	YCOM	Output IO Public COM Port	
	Y1/Y2/Y3/Y4/ Y5/Y6/ Y7/Y8/	8 outputs IO side	The protocol transparently controls the open/close status of all output dry contacts. For implementation details, refer to the protocol documentation.
DOUT_2	ATS	N	Default: Disabled Configurable via software to enable N-PE bonding during islanding, with AC contactor control capability.
	VA	PE	

STS parameter table:

Type designation	STS200HC	STS300HC	STS400HC	STS600HC
Input/Output (AC)				
Rated power	200KVA	300KVA	400KVA	600KVA
Rated voltage	230V/400VAC(-20%/15%)			

Rated grid frequency	**50 Hz/60HZ /(+/-5Hz)**			
Max. power	**220KVA**	**330KVA**	**440KVA**	**600KVA**
Max. current	**330A**	**480A**	**660A**	**900A**
General Data				
Dimensions (W* H * D)	**440*320*420**		**650*360*420**	
Weight	**35KG**		**63KG**	
Degree of protection	**IP5x**			
Operating temperature	**-30 ℃ to 60 ℃**			
humidity range	**0% – 100 %**			
Cooling method	**Temperature controlled forced air cooling**			
Max. operating altitude	**4000 m(>3000mderating)**			
Communication	**RS485*3/ modbusTCP/CAN/4G DI:8 DO:8**			
Switch time (PCC)	**< 10ms**			

4. Function Introduction

4.1 On-grid and off-grid switching function. use 32 Dual-core signal processor , real-time processing , achieving rapid fault detection. Effective value, Instantaneous value, Modulus value, etc. Rapid detection means enable rapid detection of power grid faults. Can achieve as low as 1 ms Fault diagnosis.

Internal integrated transformer, accomplish The current of the PCC on - off point, Meritorious, Real-time monitoring of reactive power , Can realize the grid connection point Reactive power compensation, Power factor correction, Un balance suppression and other functions.

5. For optical storage integrated machine

Internal External EMS Scheduling function:

5.1 Self-generation and self-use : suitable for high electricity prices and access to the Internet FIT Low or no subsidies FIT Subsidized areas.

Store excess solar PV generation in batteries, and discharge the batteries when PV output is insufficient or during nighttime to power the load. This improves the self-consumption rate of the PV system and enhances household energy self-sufficiency, reducing electricity costs.

For example：(1) When PV irradiation is sufficient, the PV output power is 80kW, with 40kW consumed by the load and 40kW charging the energy storage system.

(2) When PV irradiation decreases, the PV output power drops to 30kW. With a load demand of 40kW, the energy storage system discharges 10kW to supplement the power supply.

5.2 Economic Model：

Designed for scenarios with significant peak/off-peak electricity price differentials.

Key features:

Manual schedule setting:

Off-peak hours (low tariff): System charges ESS at maximum power from grid (Requires enabling "Grid Charging" function in [ESS Control])

Peak hours (high tariff): ESS discharges exclusively during predefined intervals

Cost-saving mechanism: Capitalizes on electricity arbitrage opportunities.

5.3 Feed-in Priority Mode

Applicable to grid-tied systems operating under full feed-in tariff schemes.

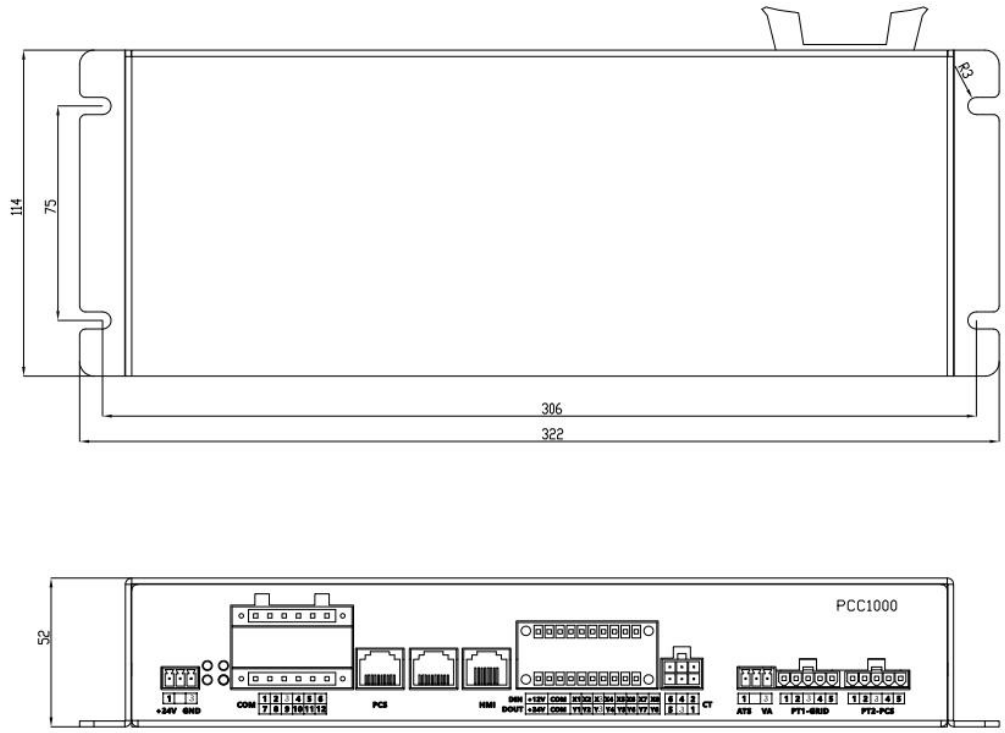
PV Maxmum Feed-in Mode.During daytime operation, when PV generation exceeds the inverter's maximum output capacity, the excess energy is stored by charging the batteries. When PV generation is lower than the inverter's maximum output capacity, the batteries discharge to ensure the inverter maintains maximum power output to the grid.

6. Simplified Grid-Off-Grid Transfer Device (Contactor + PCC)

The use of contactors, electric actuators, and other devices as the switching elements for the connection points to the power grid. This meets the needs of applications where the switching time for grid connection and disconnection is not critical. The switching frequency is relatively low.

The switching time is mainly determined by the time the executing device takes to disconnect. For the contactor selection, a model with a fast disconnecting time is recommended, such as the AX series. The wiring diagram can be found in Appendix Three.

6.1, Introduction to PCC



6.2 Wiring and Interface Definitions

Identifier		Definition	Remarks
+24V/GND		Requires external 24Vdc power supply	~20W
PCS		Connect PCS parallel cable	Cat-5e or higher network cable
HMI		ModbusTcp protocol	Can connect to EMS or debugging software
COM	1	Reserved Port	
	2	Reserved Port	
	3	COM3_A	COM port multiplexing supports RTU mode configuration for EMS connection, with default EMS linkage.
	4	COM3_B	
	5/6/7/8/9/10/11/12	Reserved Port	
	+12V	No connection required	Reserved function (no external power supply). Contact after-sales service

			if external power is needed
DIN	**XCOM**	**Input IO Common COM Port**	
	X8	**KM Normally Closed Feedback Contact**	**Contactor KM Normally Closed Contact**
	X1/X2/X3/X4/X5/X6/ X7	**7-channel input port**	**The protocol transparently transmits the on/off status of each input IO. For specific details, please refer to the protocol documentation.**
DOUT	**+24V**	**No connection required**	**Reserved function (no external power supply). Contact after-sales service if external power is needed**
	YCOM	**Output IO Common COM terminal**	
	Y1/Y2/Y3/Y4/Y5/Y6/ Y7/Y8/	**8-channel output IO terminal**	**The protocol transparently transmits control over the closure/opening of each output dry contact. For specific details, please refer to the protocol documentation.**
CT	**1**	**Phase A CTA_H**	**Maximum 1mA input**
	2	**Phase A CTA_L**	
	3	**Phase B CTB_H**	
	4	**Phase B CTB_L**	
	5	**Phase C CTCH**	
	6	**Phase C CTCL**	
ATS	**1**	**KM Control Coil**	**The KM control coil is powered by the A-phase on the grid side, and the normally closed feedback contact is connected to X8.**
	2		
VA	**3**	**Take the L line from the A phase on the grid side**	
PT1-Grid	**1**	**Grid Phase A**	**Pay attention to the sampling line sequence.**
	2	**NC (Not Connected)**	
	3	**Grid Phase B**	
	4	**Grid side _N**	
	5	**Grid Phase C**	

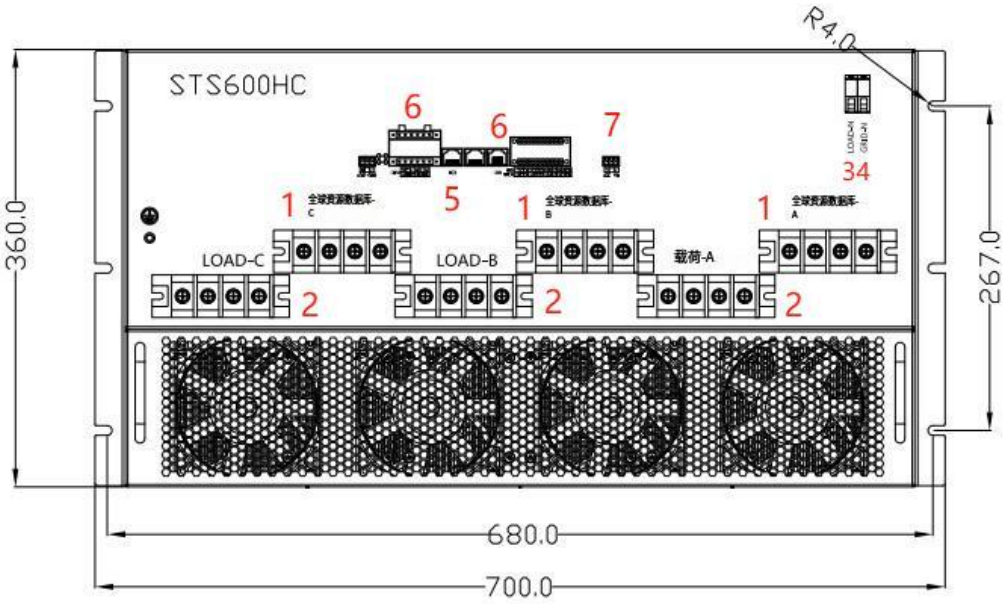
PT2-PCS	**1**	**PCS Output Phase A**	**Pay attention to the sampling line sequence.**
	2	**NC (Not Connected**	
	3	**PCS Output Phase B**	
	4	**PCS output N**	
	5	**PCS Output Phase C**	

7. Communication Protoco

PCC/STS and EMS of Modbus Communication Protocol

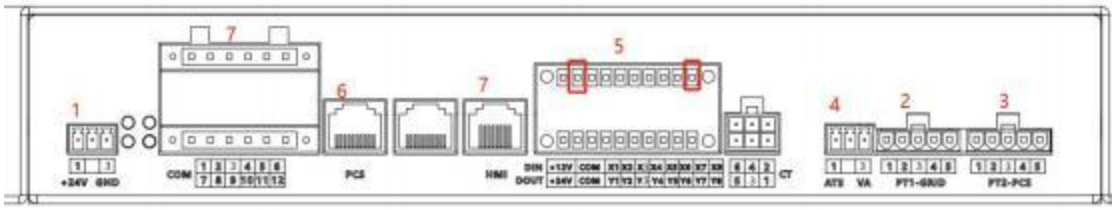
SinoSoar
PCC及STS 通信协

Appendix 1, STS Module Wiring Introduction



1. ABC three-phase power line on the grid side
2. PCS side ABC Three-phase power line
3. PCS side N Line (auxiliary source and sampling power, non-accessible power)
4. Grid side N Line (auxiliary source and sampling power, No power available)
5. PCS parallel communication line
6. Connect EMS (Modbus Rtu or ModbusTcp Optional)
7. Control the near end after leaving the network N and PE grounding KM (Grid demand in some areas , Optional feature)
Note: LOAD _N and GRID _N For sampling, grid and load power connection. TN The N line ofthe power supply system grid needs to be directly connected to load

Appendix 2, KM (Contactor) Recommended AX series



1. Connect to +24v, pin 1 +24, pin 3 GN D.
2. Connect to grid voltage sampling; Pin 1 is connected to VA , pin 3 is connected to VB , pin 4 is connected to VN , and pin 5 is connected to VC .
3. Connect to PCS side voltage sampling; Pin 1 connects to VA , 3 pins connected to VB , 4 Pin 1 is connected to VN , and pin 5 is connected to VC .
4. Contactor KM Control line VA is taken from phase A on the grid side , ATS contactor control coil L.
5. The contactor normally closed feedback contact is connected to X8, XCOM .
6. Connect PCS parallel communication port.
7. Connect to EMS (or select Modbus Tcp or Modbus Rtu).