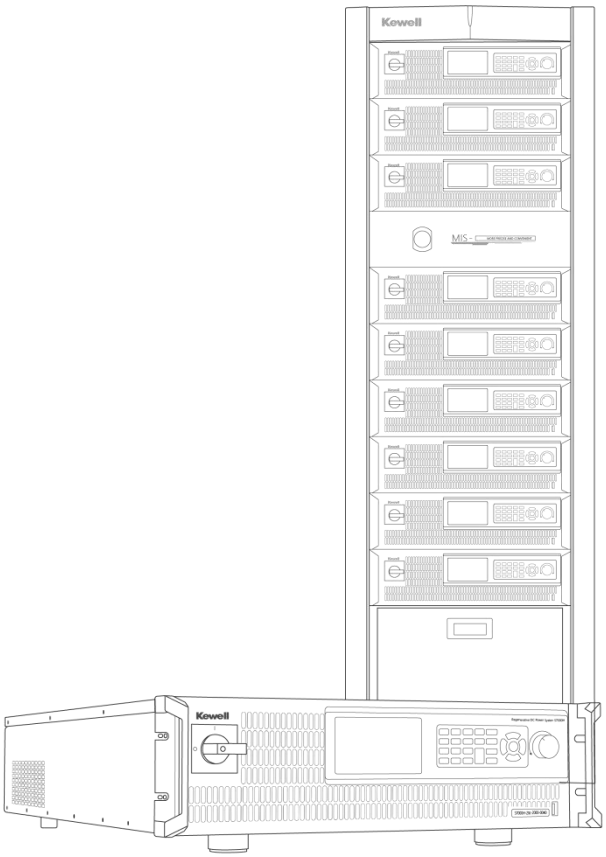
Kewell

Stock Code: 688551



S7000 SERIES

REGENERATIVE PROGRAMMABLE DC POWER SOURCE

Jan. 2023 Version: A/6.1

KEWELL TECHNOLOGY CO,.LTD.

www.Kewelltest.com

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1 Summary

S7000 Series is a high precision DC power source(hereinafter referred to as S7000 supporting energy regenerative feature.

As a DC source, it supports dual quadrant energy flow.

High conversion efficiency and high-power density. 3U-sized enables it to power up to 30kW and output voltage up to 2000V. Support parallel operation of multiple machines. Human-computer interface: Colorful touchscreen and knob. Can be applied in battery testing, battery storage inverter testing, electronic testing of EV etc.

S7000 Series Appearance

2 External Conditions

To ensure that the equipment has suitable ambient conditions, the following items need to be met:

- Installation environment

The equipment protection level is IP20, please find a suitable place, and avoid dusty, dripping and raining.

The installation site needs to consider load bearing and size issues.

- Temperature

The storage temperature is -25℃ ~ +50℃, and the ambient temperature is 0℃ ~ +40℃. Please ensure that the space has good ventilation conditions.

- Humidity

The equipment should be used in a humidity environment of 0~90%RH, 25°C without condensation.

- Altitude

The equipment should be used at an altitude lower than 2000m. For high altitude applications, it may cause overheating protection, which requires derating operation.

- Grid parameters

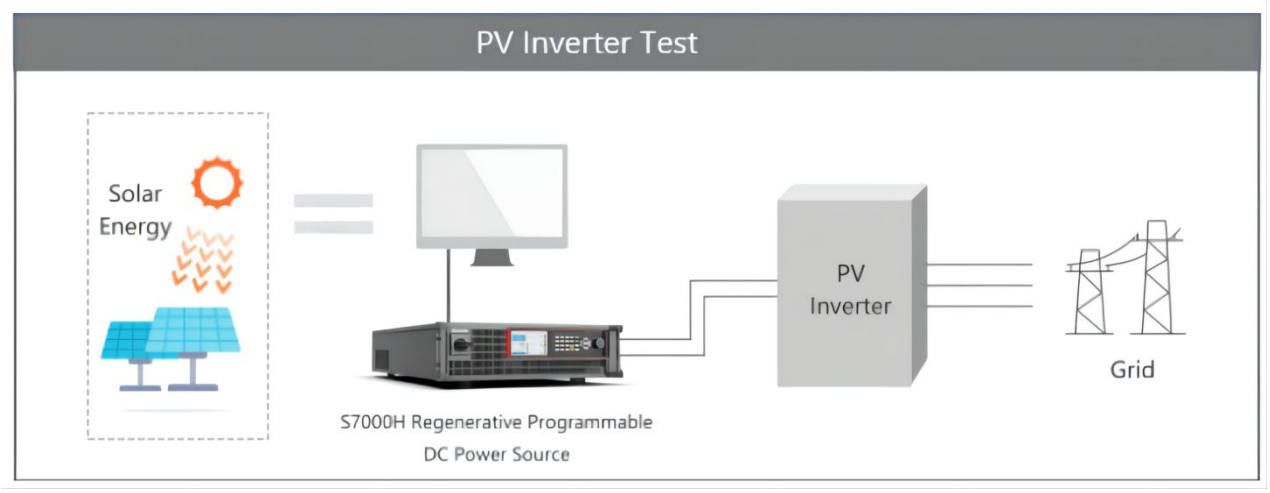
Three-phase four-wire system, rated voltage 342 ~ 528Vac, grid frequency 50±3Hz, grid capacity needs to meet the peak power of test power supply and auxiliary equipment.

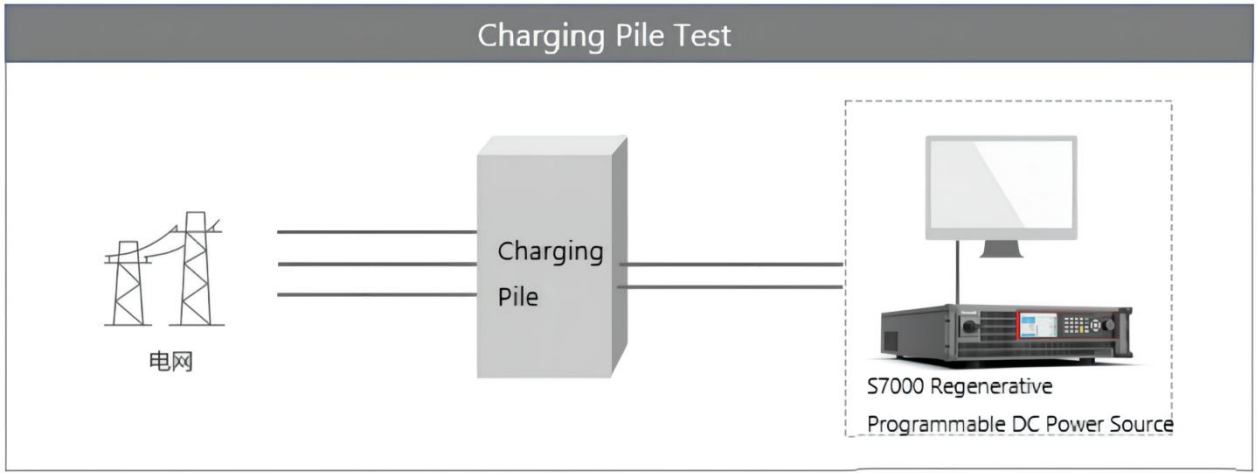
3 Product Features

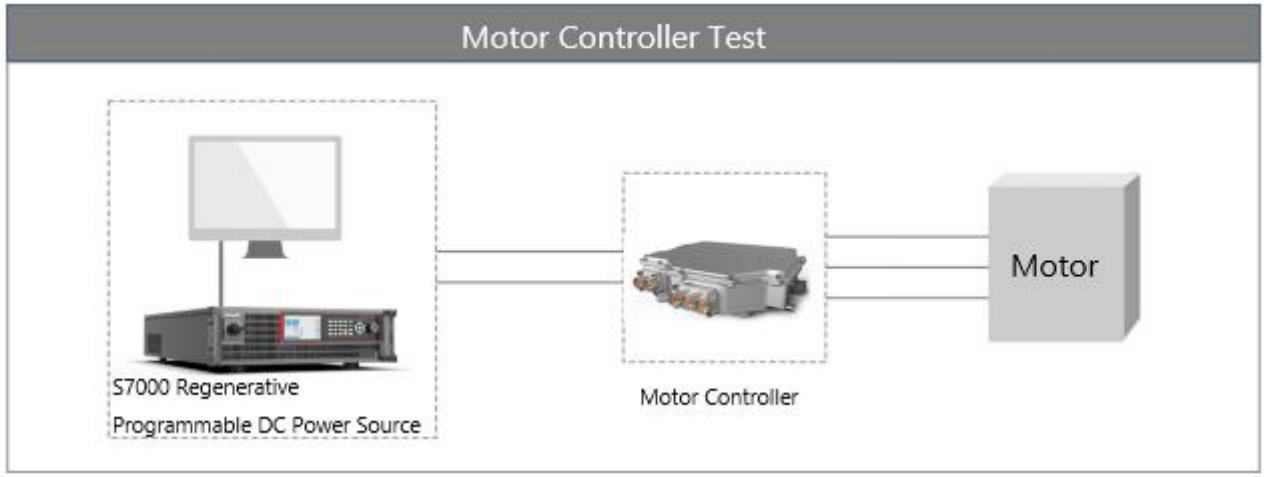
- Seamless bidirectional energy flow
- Output energy is efficiently fed back to the grid, energy saving and environment friendly
- High power density in 3U
- Human-computer interface: Colorful touchscreen and keypad
- Support standard RS485/CAN/LAN/USB communication interface, other interfaces could be modified
- Support AC voltage input world wildly: 342 VAC ~528 VAC
- High precision voltage and current output. Low ripple
- Comprehensive protection including OCP/OVP/OPP/OTP/input protection/ anti-islanding protection/ power fail protection etc.
- Multiple modes, constant voltage, constant current, multiple steps, etc.
- Support CC/CV setting
- Master/slave parallel expansion function
- Support solar panel I-V curve simulation
- Support battery charge and discharge test
- Support battery simulation

4 Typical Application

S7000 is mainly used for PCS test, photovoltaic inverters, energy storage converters, charging pile module test, motor controller test, it is an ideal power source for solar photovoltaic system testing and new energy vehicle testing.







5 Product Specifications

The specifications of the S7000 Regenerative Programmable DC Power Source are as follows:

Model		S7000-15K-0750-0080-G	S7000-30K-0750-0120-G	S7000-15K-1500-0040-G	S7000-21K-2000-0040-G	S7000-30K-2000-0040-G	S7000-30K-2000-0060-G
Rated Values	Voltage	750V	750V	1500V	2000V	2000V	2000V
	Current	80A	120A	40A	40A	40A	60A
	Power	15kW	30kW	15kW	21kW	30kW	30kW
Readback Resolution	Voltage	0.01V		0.1V			
	Current	0.01A					
	Power	1W					
Accuracy	Voltage	≤0.05%F.S.					
	Current	≤0.1% F.S.					
Line Regulation	Voltage	≤0.02%F.S.					
	Current	≤0.02%F.S.					
Load Regulation	Voltage	≤0.05%F.S.					
	Current	≤0.05%F.S.					
Ripple	Voltage Vpp	< 3000mV	< 3000mV	< 3000mV	< 3000mV	< 3000mV	< 3000mV
	Voltage (rms)	< 300mV	< 300mV	< 400mV	< 400mV	< 400mV	< 400mV
	Current (rms)	< 100mA	< 100mA	< 35mA	< 35mA	< 35mA	< 60mA
Slew Rate	Voltage (No load)	0.001V/ms ~ 200V/ms	0.001V/ms ~ 200V/ms	0.001V/ms ~ 200V/ms	0.001V/ms ~ 200V/ms	0.001V/ms ~ 200V/ms	0.001V/ms ~ 200V/ms
	Voltage (Full load)	0.001V/ms ~ 30V/ms		0.001V/ms ~ 90V/ms			
	Current	0.001 ~ 40A/ms	0.001 ~ 60A/ms	0.001 ~ 20A/ms	0.001 ~ 20A/ms	0.001 ~ 20A/ms	0.001 ~ 20A/ms
Dynamic Response Time		< 1ms					
Voltage Fluctuation (with load)*1		15%	15%	15%	10%	10%	15%
AC Input	Voltage	342VAC ~ 528VAC					
	Frequency	47Hz ~ 63Hz					

	Maximum Current	27A	53.8A	27A	37.8A	53.8A	53.8A
	MaximumApparent Power	16kVA	32kVA	16kVA	22.4kVA	32kVA	32kVA
Efficiency		≈95%					
Power Factor		> 0.99					
Protection		OVP、OCP、OPP、OTP、Anti-islanding protection、Reverse polarity protection					
Communication Interface		RS485/LAN/CAN/USB/Others (custom)					
Ambient Temperature		0 ~ 40℃					
Dimensions（mm）		733(D)*445(W)*132.5(H)					
Weight		≈45kg	≈50kg	≈45kg	≈50kg		

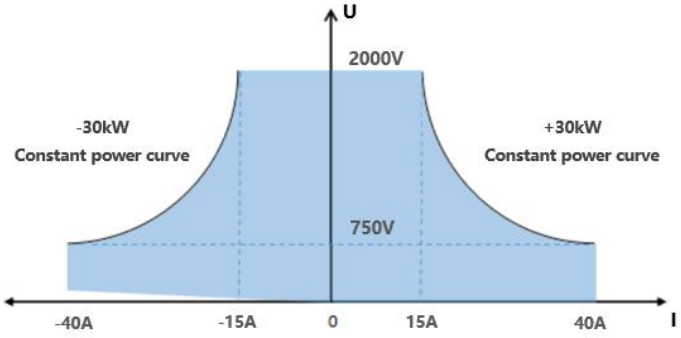
*1: Voltage fluctuation amplitude for 0-50% sudden loading of resistive loads (voltage slope set to Max.)

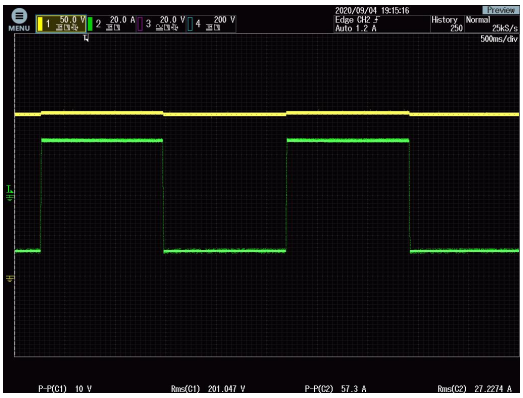
The above specifications are subject to change without notice.

6 Product Introduction

- Bidirectional DC power source

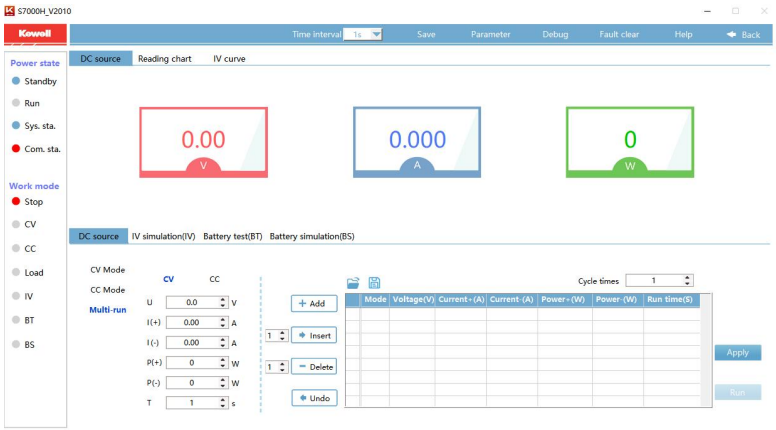
S7000 can effectively avoid voltage and current overshooting, and is widely applied in test of batteries, charging piles, energy storage converters, PCS and other fields.





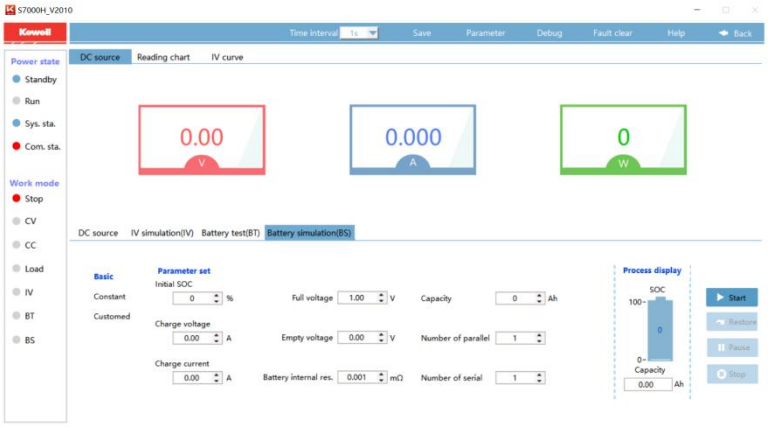
- Multi-step operation:

Up to 999 work steps editable, work steps can be set in cycles.

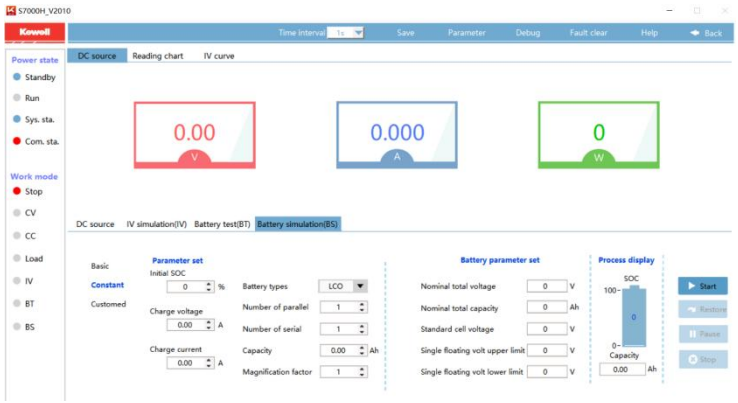


- Battery simulation

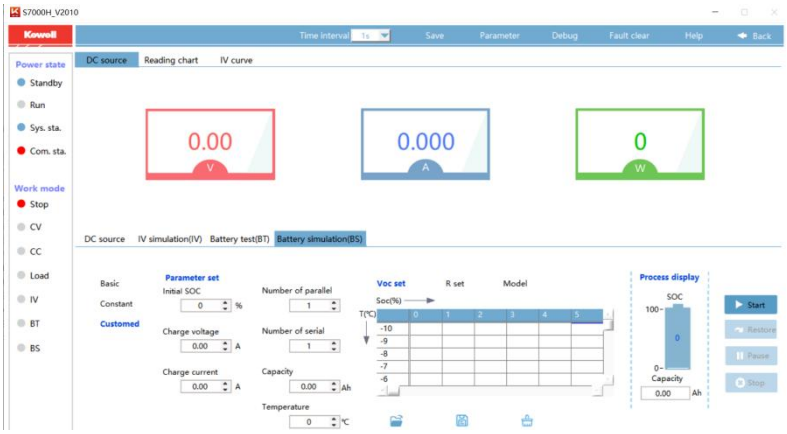
Standard mode: parameter: [Initial Soc], [Discharge Limit], [Charge Limit], [Full Voltage], [Empty Voltage], [Battery Internal Resistance], [Capacity], [Number in Parallel], [Number in string] could be set for testing.



Fixed battery type mode: Lithium manganese oxide, lithium cobalt oxide, lithium iron carbonate, nickel-metal hydride batteries, ternary lithium, lithium titanate and other battery types under standard single cell voltage could be selected for simulation.



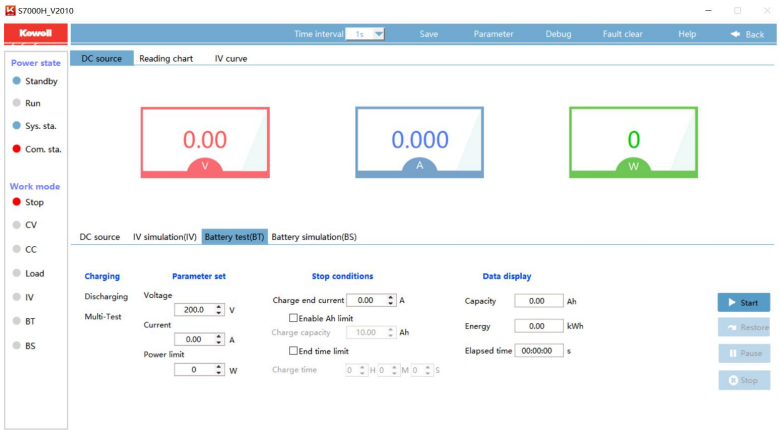
Custom battery type: At a given temperature and SoC, fill in the open circuit voltage and internal resistance in the form, or load the Excel file written in advance, then set other parameters to start running.



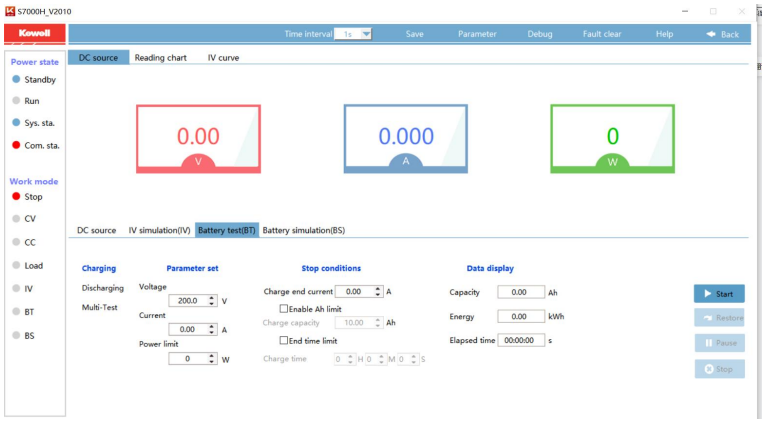
- Battery Pack Charge-discharge Function

Static charging mode: parameters such as charging voltage, charging current and charging power can be set,

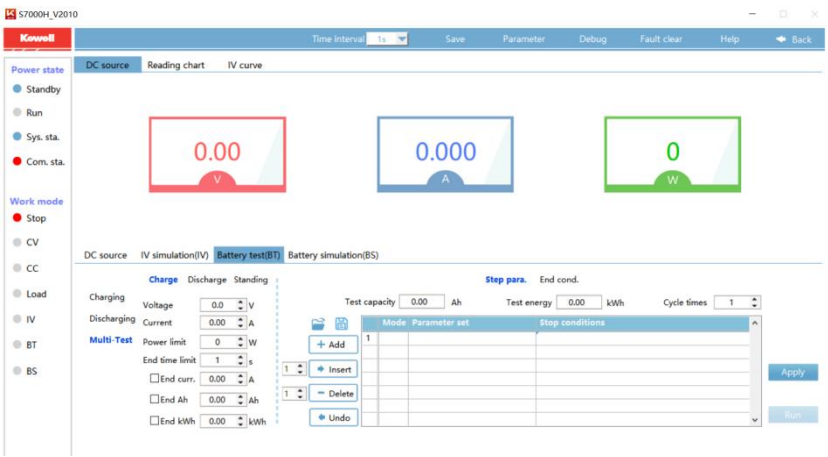
while the charging cut-off conditions including end-of-charge current, capacity and time can be set.



Static discharging mode： parameters such as discharge current and discharge power can be set, as well as discharge cut-off conditions including end-of-discharge voltage, capacity and time.



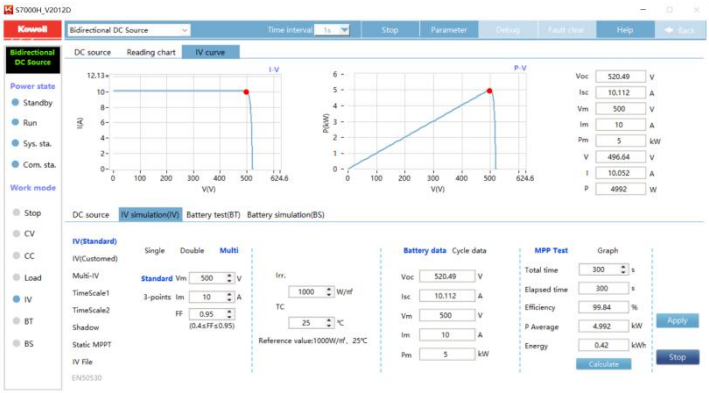
The battery test mode: allows to set parameters such as static charging and discharging mode and resting time to simulate several operating conditions.



- IV simulation

Photovoltaic array simulation

Three modes: single-point, double-point and multi-point setting

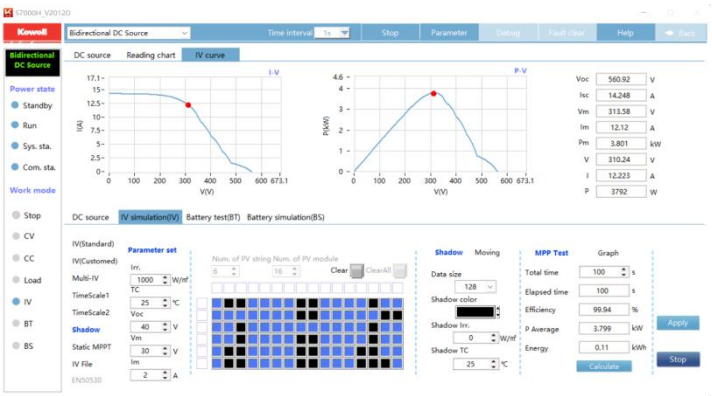


- Multi-step IV mode

Up to 100 IV curves can be set up, with the option to import IV curve files to run.

- Shadow condition (Multimodal shadow curve) function

S7000 can simulate the IV curve (Multimodal shadow curve) under the shade of the solar panel. The user can set the irradiance, temperature, array type and shadow movement direction of different components.



Shadow condition simulation

- Time scaling

S7000 can simulate the typical output changes of solar panels in a given time to shorten the test time. The characteristic mode, array type, irradiance change and temperature parameters can be set.

Time scaling

- Static MPPT test

Single or multi-step configuration mode can be set to test static MPPT performance.

Static MPPT test

- Dynamic MPPT test

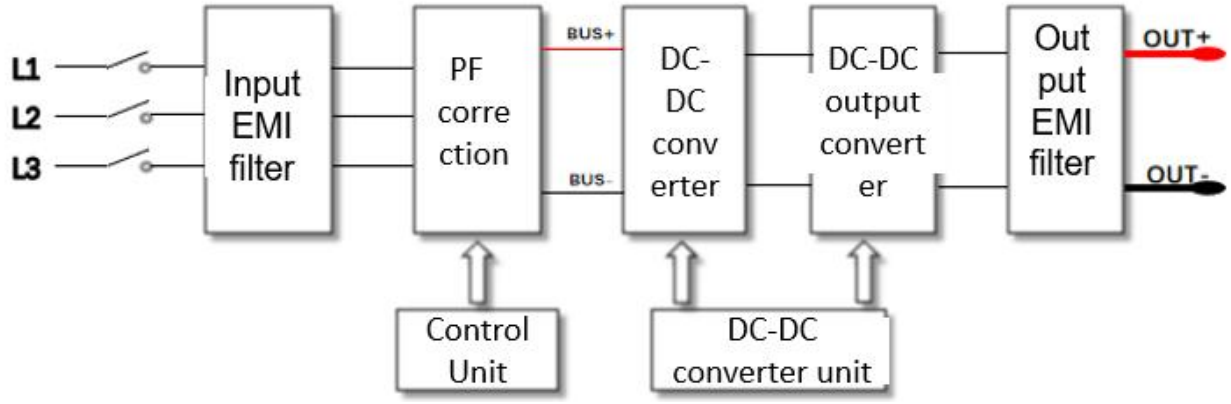
The built-in dynamic test environment according to EN 50530, with three power bands "1%-10%", "10%-50%" and "30%-100%", enables detailed testing of the dynamic tracking performance of the PV inverter.

Dynamic MPPT test

7 Product Design

7.1 Main Electrical Units

The system topology is divided into four stages. From left to right, are input EMI filter unit, power correction unit, DC-DC converter unit and output EMI filter unit.



7.1.1 Input EMI Filter Unit

The input EMI filter circuit includes anti-inrush devices, differential mode, common mode filters, etc. In the event of lightning strikes or other high-voltage inrush, varistors and transient voltage suppressors can protect the converter from it. The differential mode filter and common mode filter can effectively suppress the high-frequency noise generated inside the module, prevent the interference from the input side from affecting the operation of the unit.

7.1.2 Power Factor Correction Unit

The three-phase power factor calibration unit is based on the dq control model, which realizes bi-directional energy flow by changing the phase of the inverter side, and the power factor >0.99 under full power. By harmonic compensation processing, it could achieve THD <5% under full range (380VAC or 480VAC input).

7.1.3 DC-DC Converter Unit

This unit improves the power density, reduces the output leakage voltage and output ripple. Make it is possible to switch, upgrade, and expand different modes.

Output EMI Filter Unit

The multi-level LC parallel structure and the multi-level EMC filter circuit are configured on the output EMI filter board, which can achieve voltage ripple less than 0.2% F.S. and current ripple less than 50mA (RMS).

7.2 Software Introduction

The power source has multiple operation modes like: local operation, remote operation and integrated control (via communication protocol).

7.2.1 Local Operation

The power source is equipped with LCD screen. The operation modes include DC power source, battery simulation, battery pack charge-discharge, IV simulation etc.

7.2.2 Remote Operation

The power source is equipped with an Ethernet interface and the software adopts the Modbus TCPIP communication protocol. Seamless connection to software based on the standard Modbus communication protocol.

The power source is equipped with RS-485/USB interface and the software adopts the Modbus RTU communication protocol. Seamless connection to software based on the standard Modbus communication protocol.

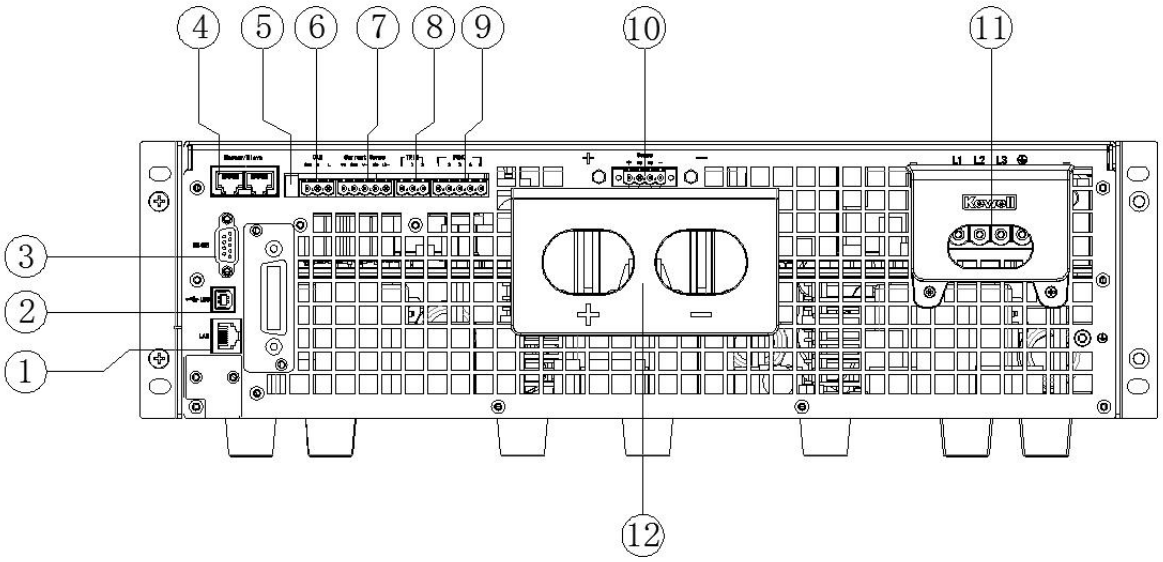
The Controller Area Network (CAN) is a serial communication protocol bus for real-time applications that uses twisted pair cables to transmit signals and is one of the most widely used fieldbuses in the world. The standard CAN communication interface allows the user to configure the functional parameters of the power source for remote control.

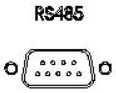
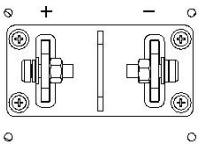
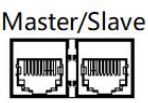
The power source supports the standard CAN 2.0 communication protocol using the extended frame type (CAN data frames using 29 bit identifiers). The data communication format is Intel format (that is, the low byte comes first and the high byte comes second). The protocol is divided into two main types of data forms: status information uploaded by the communication board at regular intervals and parameters set by remote control via the upper computer.

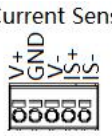
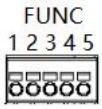
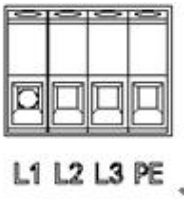
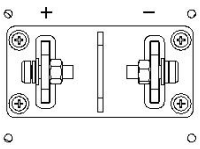
The operating system's upper computer software is suitable for running on platforms such as Microsoft Windows, including Windows 7, Windows 10, etc.

7.3 Interface Introduction

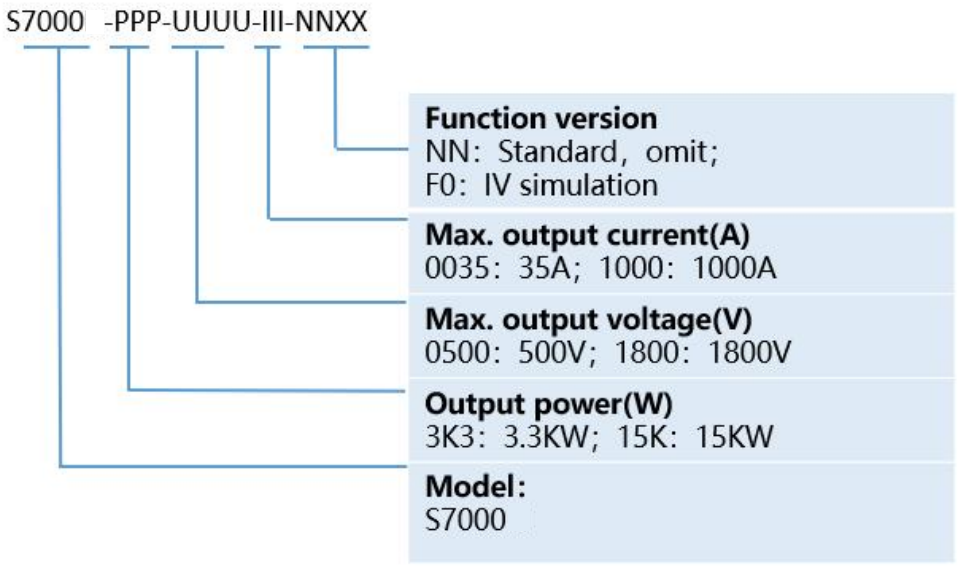
S7000 Regenerative Programmable DC Power Source as Follows:



No.	Interface Figure	Description
1		CAN communication
2		LAN communication
3		RS485 communication
4		DC output
5		DIP switch
6		Parallel network

7		Total current sampling (Not open yet)
8		synchronizing signal (Not open yet)
9		External multi-function interface
10		Voltage drop compensation
11		AC input
12		DC output

8 Parallel Solutions



S7000 naming rule

Model	Voltage U	Current A	Power kW	Dimension
S7000-18K-0100-0600-G	100	600	18	3U
S7000-15K-750-0080-G	750	80	15	3U
S7000-30K-750-0120-G	750	120	30	3U
S7000-15K-1500-0040-G	1500	40	15	3U
S7000-21K-2000-0040-G	2000	40	21	3U
S7000-30K-2000-0040-G	2000	40	30	3U
S7000-30K-2000-0060-G	2000	60	30	3U

S7000 series stand-alone model

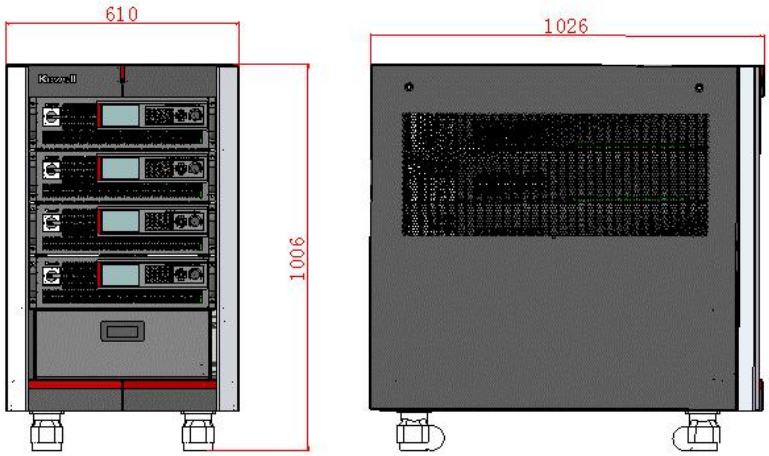
Model	Specification	Application
Cabinet	HK-15U Cabinet	for 2-4 parallel
Cabinet	HK-29U Cabinet	for 5-8 parallel
Cabinet	HK-42U Cabinet	for 9-10 parallel

S7000 parallel specifications

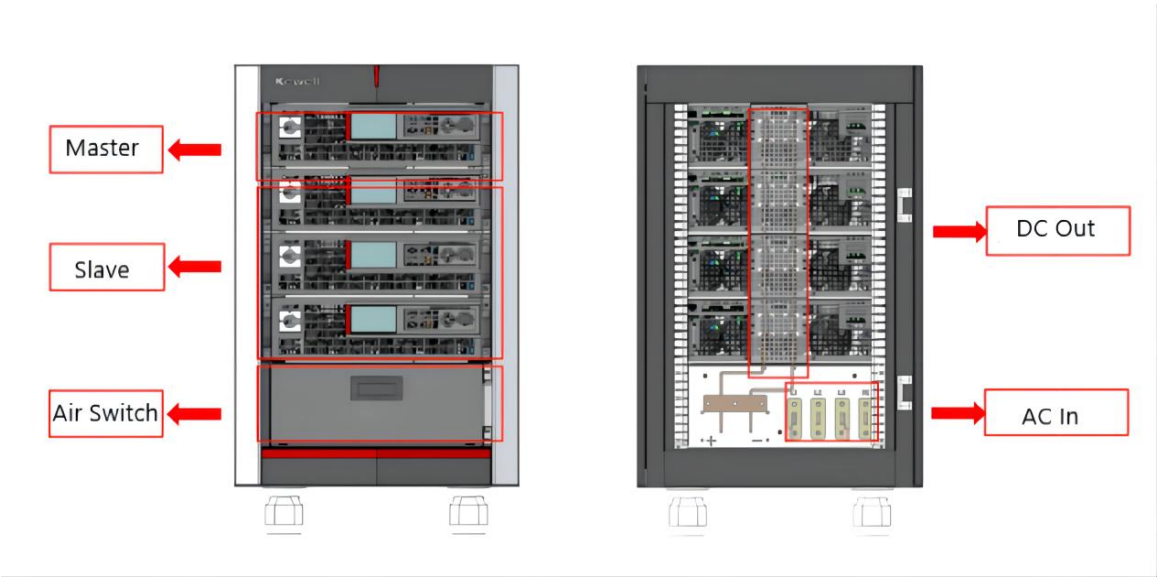
- Four devices in parallel

This solution consists of four S7000-30K and one HK-15U cabinet, total power 120kW and current up to 240A.

Component	Model	Quantity	Note
Regenerative DC Power Source	S7000-30K-2000-0040-G	4	Voltage: 2000V Current: 60A Power: 30kW
Cabinet	HK-15U Cabinet	1	for 2-4 parallel



4 devices in parallel cabinet size
610mm*1006mm*1026mm (WHD)
Weight: 130kg

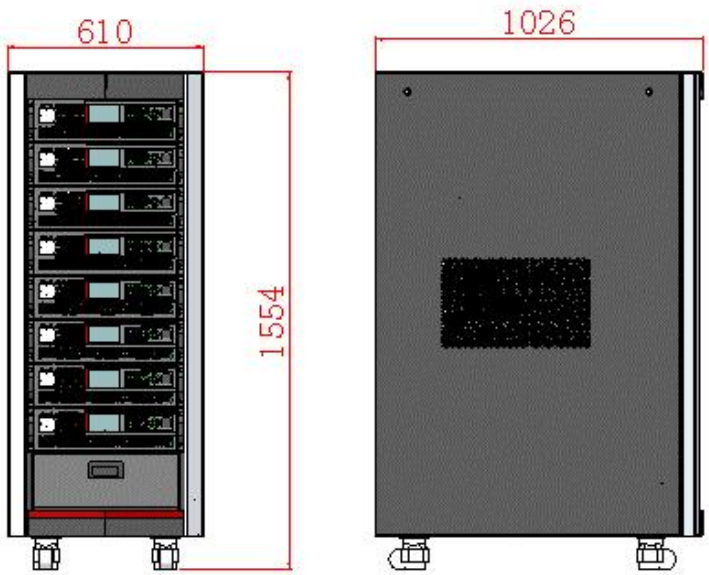


15U Cabinet (front & rear)

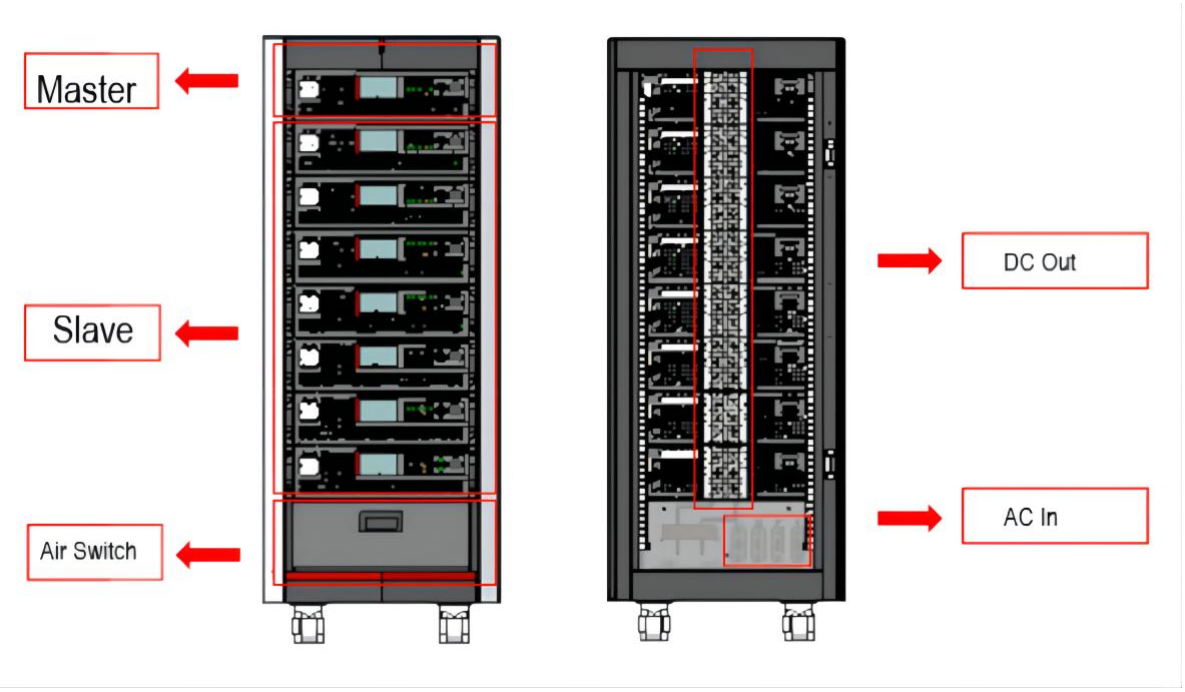
- Eight devices in parallel

This solution consists of eight S7000-30K and one HK-29U cabinet, total power 240kW and current up to 480A.

Component	Model	Quantity	Note
Regenerative DC Power Source	S7000-30K-2000-0060-G	8	Voltage: 2000V Current: 60A Power: 30KW
Cabinet	HK-29U Cabinet	1	for 5-8 parallel



8 devices in parallel cabinet size
610mm*1554mm*1026mm(WHD)
Weight：220kg

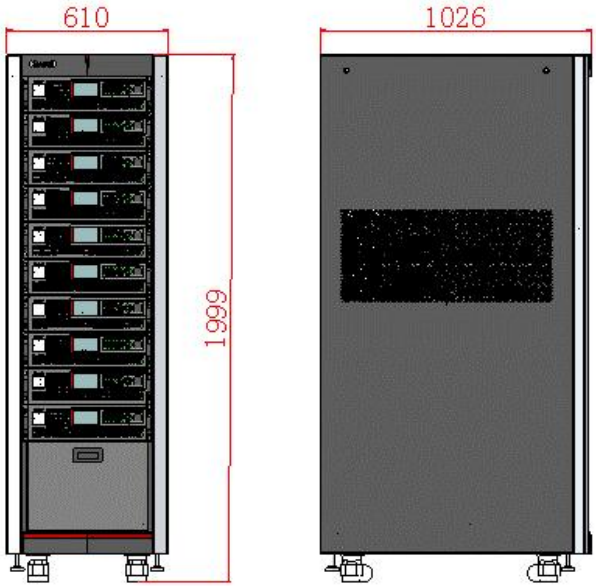


29U Cabinet (front & rear)

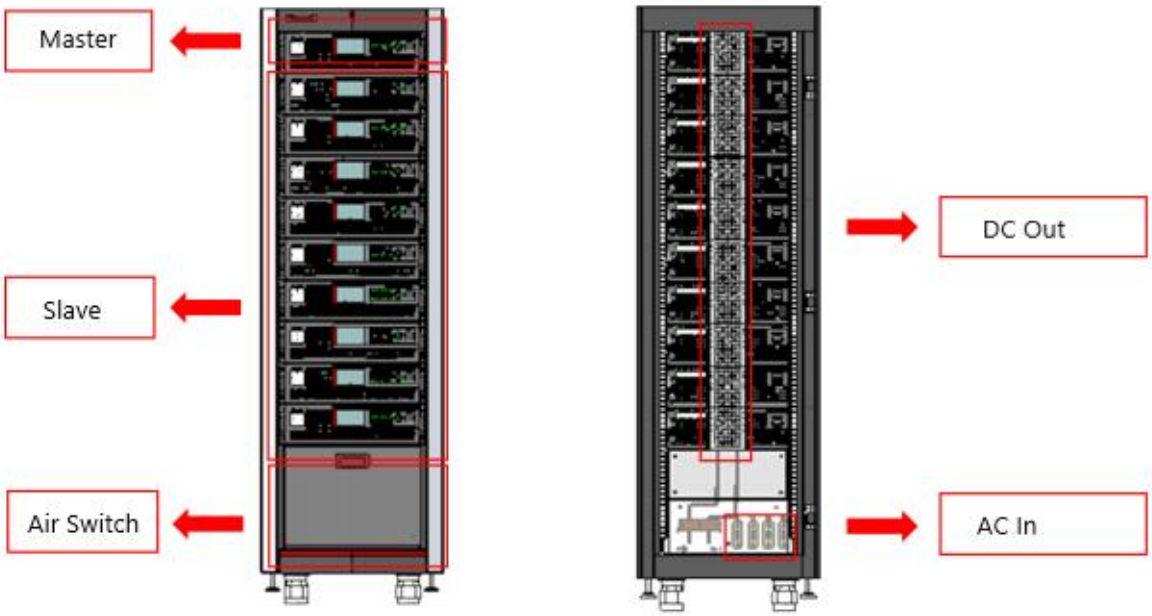
- Ten devices in parallel

This solution consists of ten S7000-30K and one HK-42U cabinet, total power 300kW and current up to 600A.

Component	Model	Quantity	Note
Regenerative DC Power Source	S7000-30K-2000-0060-G	10	Voltage: 2000V Current: 60A Power: 30KW
Cabinet	HK-42U Cabinet	1	for 9-10 parallel



10 devices in parallel cabinet size
610mm*1999mm*1026mm (WHD)
Weight: 280kg



42U Cabinet (front & rear)

9 Reference Standards

No.	Standard/Document Number	Standard / File name
1	GB 50055-2011	Code for Design of Electric Distribution of General-purpose Utilization Equipment
2	GB 50054-2011	Code for Design of Low Voltage Electrical Installations
3	GB/T 4798	Environmental Conditions Existing in the Application of Electric and Electronic Products-Storage
4	GB/T 3859.1-2013	Semiconductor Convertors Specification of Basic Requirements
5	GB/T 3859.2-2013	Semiconductor Convertors Application Guide
6	GB/T 3859.3-2013	Semiconductor Convertors Transformers and Reactors
7	NB/T 32004-2018	Technical Specifications of PV Grid-connected Inverter
8	GB/T 24343-2009	Electrical Equipment of Industrial Machines Insulation Resistance Test Specifications
9	GB 4208-2008	Degrees of Protection Provided by Enclosure
10	GB/T 20850-2014	Safety of Machinery- Guidelines for the Understanding and Use of Safety of Machinery Standards
11	BSEN 62477-1-2012+A11-2014	Safety Requirements for Power Electronic Convertor Systems and Equipment
12	EN ISO 13849-1-2015	Safety of Machinery - Safety-related Parts of Control Systems - Part 1: General Principles for Design
13	EN IEC 61000-6-2:2019	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments
14	EN IEC 61000-6-4-2019	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
15	IEC/EN 62477-1:2012	Safety requirements for power electronic converter systems and equipment –Part 1: General
16	EN ISO 13849-1:2015	Safety of machinery Safety-related parts of control systems Part 1 : General principles for design
17	IEC 61000-2-4:2002	Electromagnetic compatibility (EMC) –Part 2-4: Environment – Compatibility levels in industrial plants for low-frequency conducted disturbances
18	EN 61800-3:2004+A1:2012	Adjustable speed electrical power drive systems — Part 3: EMC requirements and specific test methods
19	IEC/EN 61010-1:2020	Safety requirements for electrical equipment for measurement, control, and laboratory use Part 1: General requirements
20	EN 62040-1:2008+A1:2013	Uninterruptible power systems (UPS) Part 1: General and safety requirements for UPS
21	IEC 61000-6-3:2011	Electromagnetic Compatibility (EMC) - Part 6-3: Generic Standards - Emission Standard for Industrial Environments
22	IEC 61010-2:2010	Safety Requirements for Electrical Equipment for Measurement, Control, and

		Laboratory Use- Part 2: General Requirements
23	IEC 60204-1-2016	Safety of Machinery- Electrical Equipment of Machines- Part 1: General Requirements