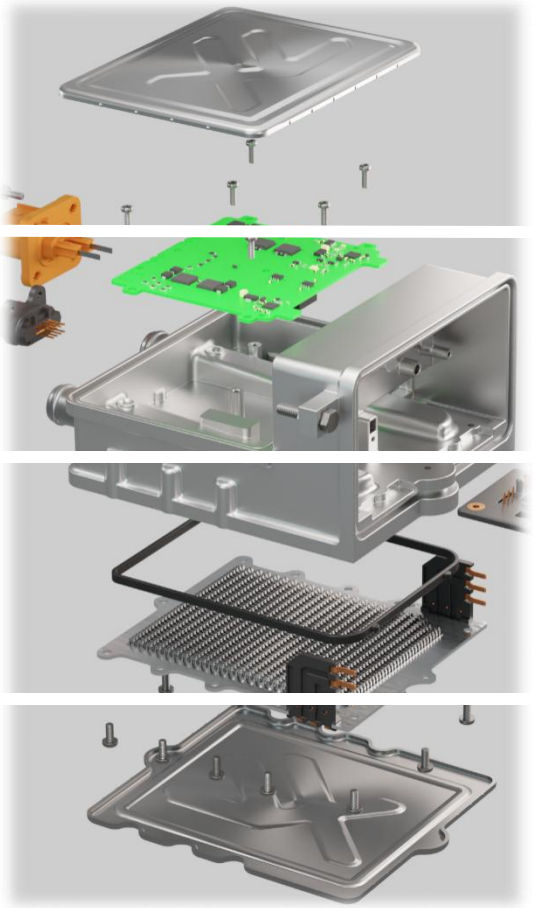
Version：2024v1.4

向隆电控
奋斗 创新 共赢

HIGH VOLTAGE HEATER

Xianglong Electronic Bussiness Unit
Zhejiang Xianglong Manufacturing Co., Ltd
Website: www.cn-sps.com

CATALOGUE



COMPANY PROFILE

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SPS Shareholding Structure

US_VEM

45%

CN_Jialong

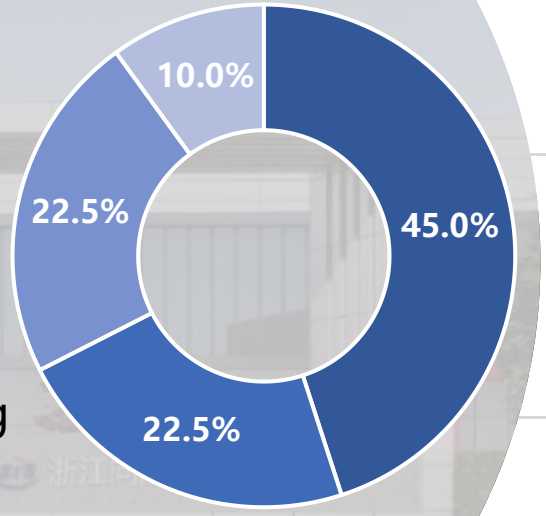
22.5%

CN_Hangzhou Xiebang

22.5%

CN_Employee Shareholding

10%



Mission: Make travel safer and more comfortable with high-quality products and Services.

Vision: To become strategic partners of mainstream auto brands.

Values: Customer-oriented, Employee-rooted, Realistic and innovative, Continuously-improved.

Spirit: Unswerving Responsible Aggressive Sharing.

Enterprise Culture: Diligence, innovation and win-win cooperation.

COMPANY PROFILE

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Drive Shaft Department

- Light Weight
- High Strength
- High Transfer Efficiency
- High NVH Performance

Hub Bearings Department

- Gen Ⅱ Hub Bearing
- Gen Ⅲ Hub Bearing
- Gen Ⅳ Hub Bearing

Electronic Controls Department

- Thermal Management System
- High Voltage Heater
- PTC Heater

Modularisation Department

- Steering Gearbox
- Hub Unit
- Brake Disc
- Steering Column
- Stabilizer Bar

COMPANY PROFILE

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2 R&D Center
- Ningbo
- Germany(CPO)

4 Production Plant
- Jiangbei District,Ningbo
- Cixi City,Ningbo
- Haining City,Jiaxing
- Rayong,Thailand

2 Planning Plant
- Mexico
- Poland

1000+ The Number of Employees

- Drive shaft
- Thermal Management
- Modularity
- Hub Bearing

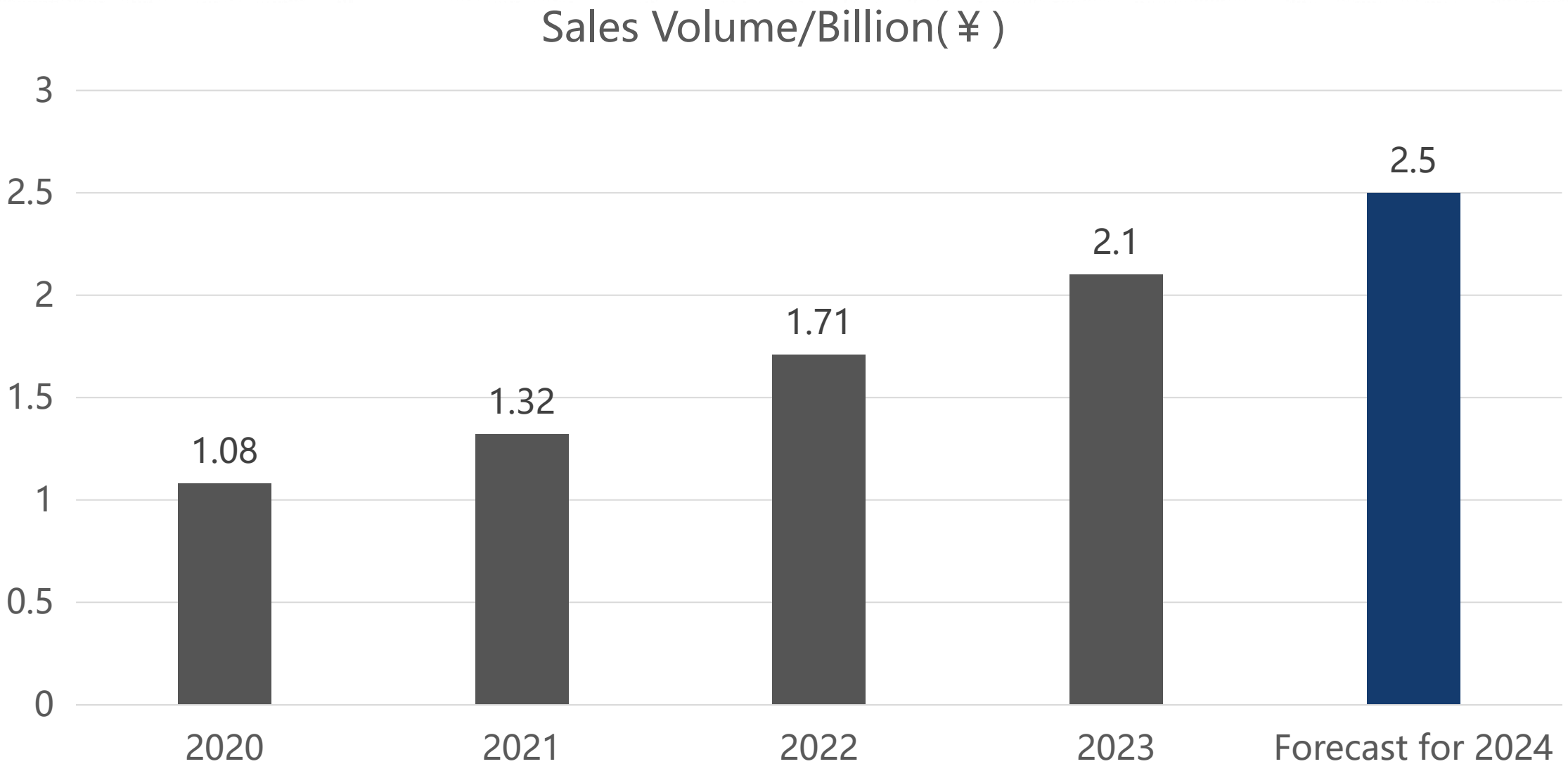
Jiangbei Plant

Cixi Plant

Haining Plant

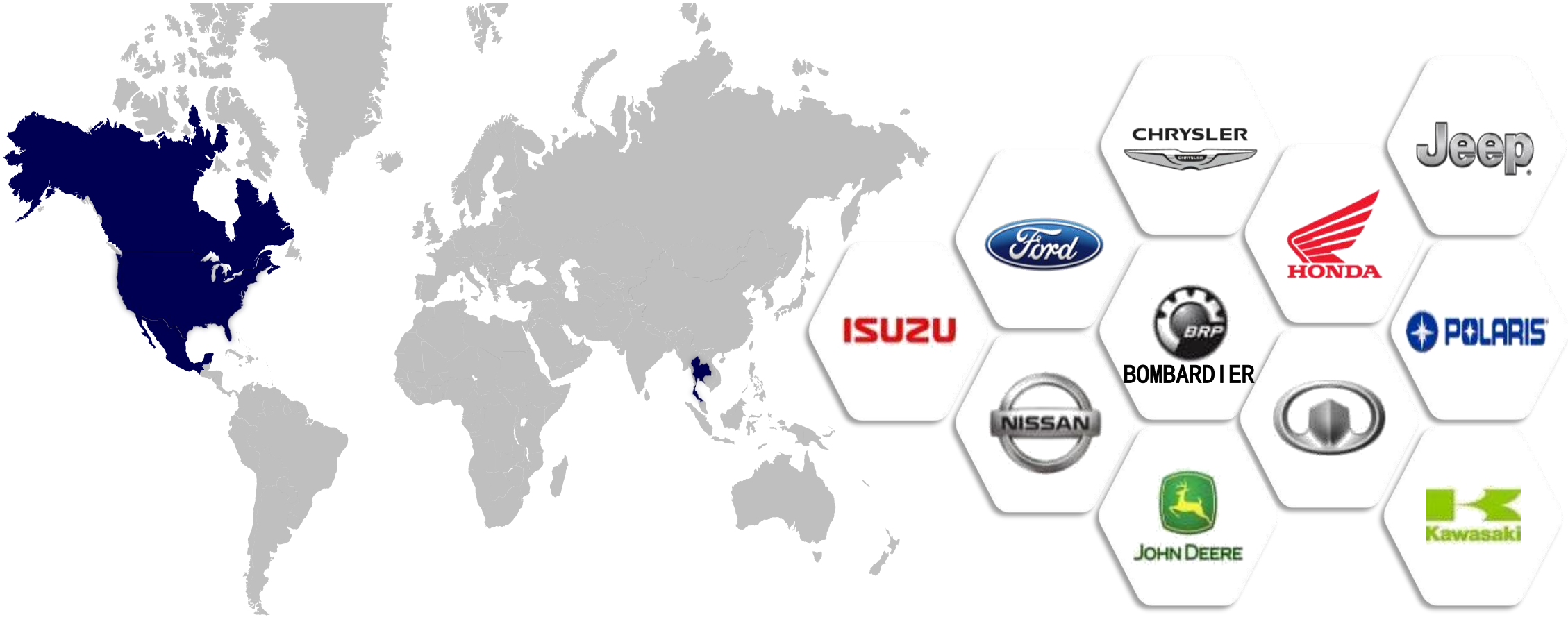
Rayong Plant

SALES IN RECENT YEARS



OUR CLIENTS

- Global Markets



OUR CLIENTS

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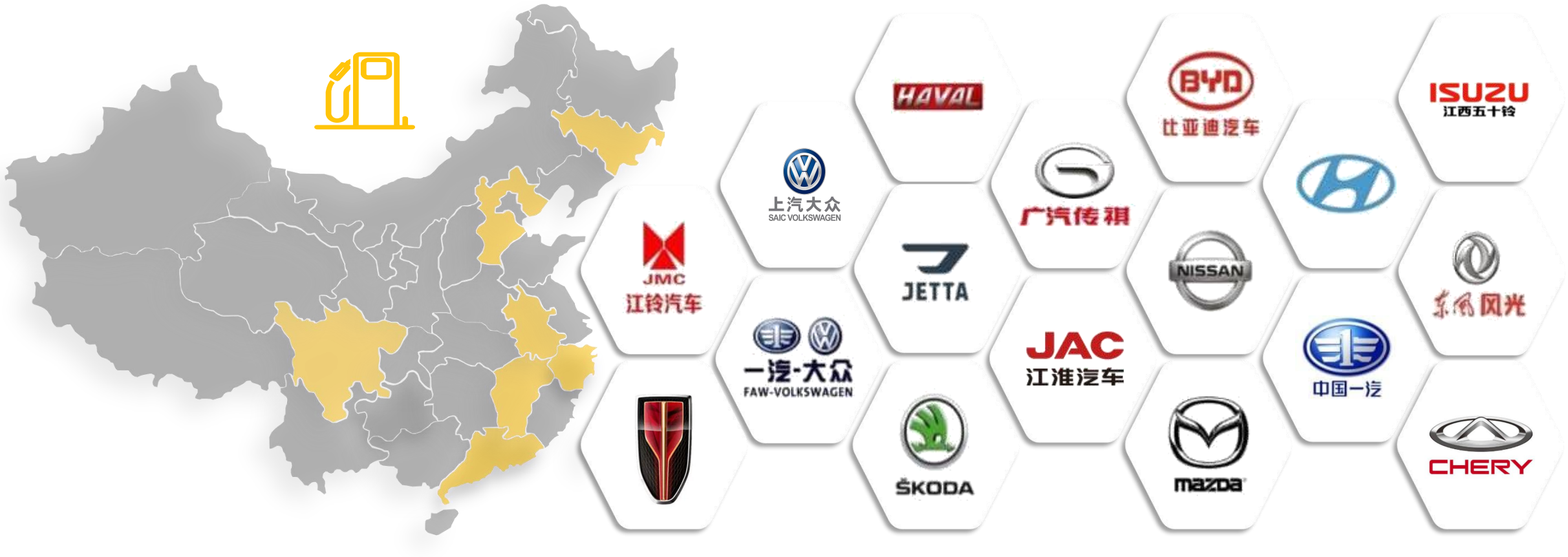
- CN Market-ICE Vehicle



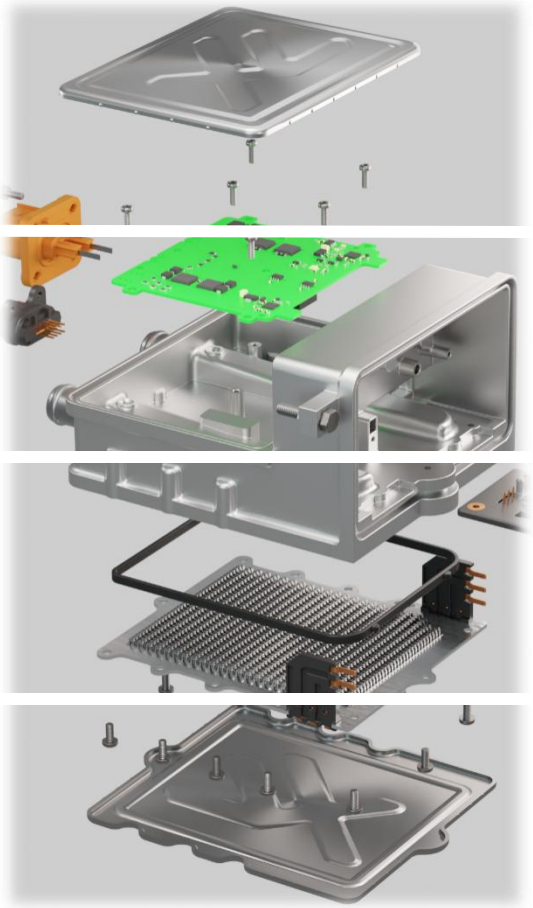
OUR CLIENTS

- CN Market-EV/PHEV

More partners on the way ……

CATALOGUE

向隆电控
奋斗 创新 共赢



R&D TEAM

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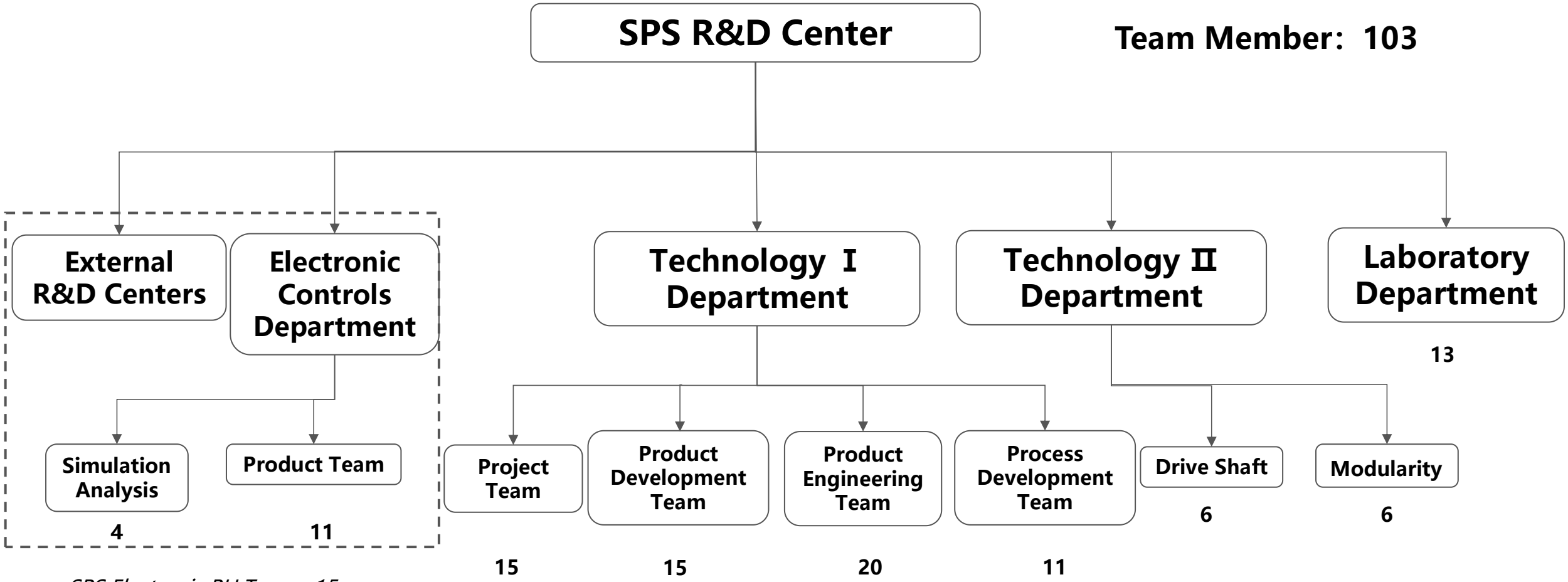
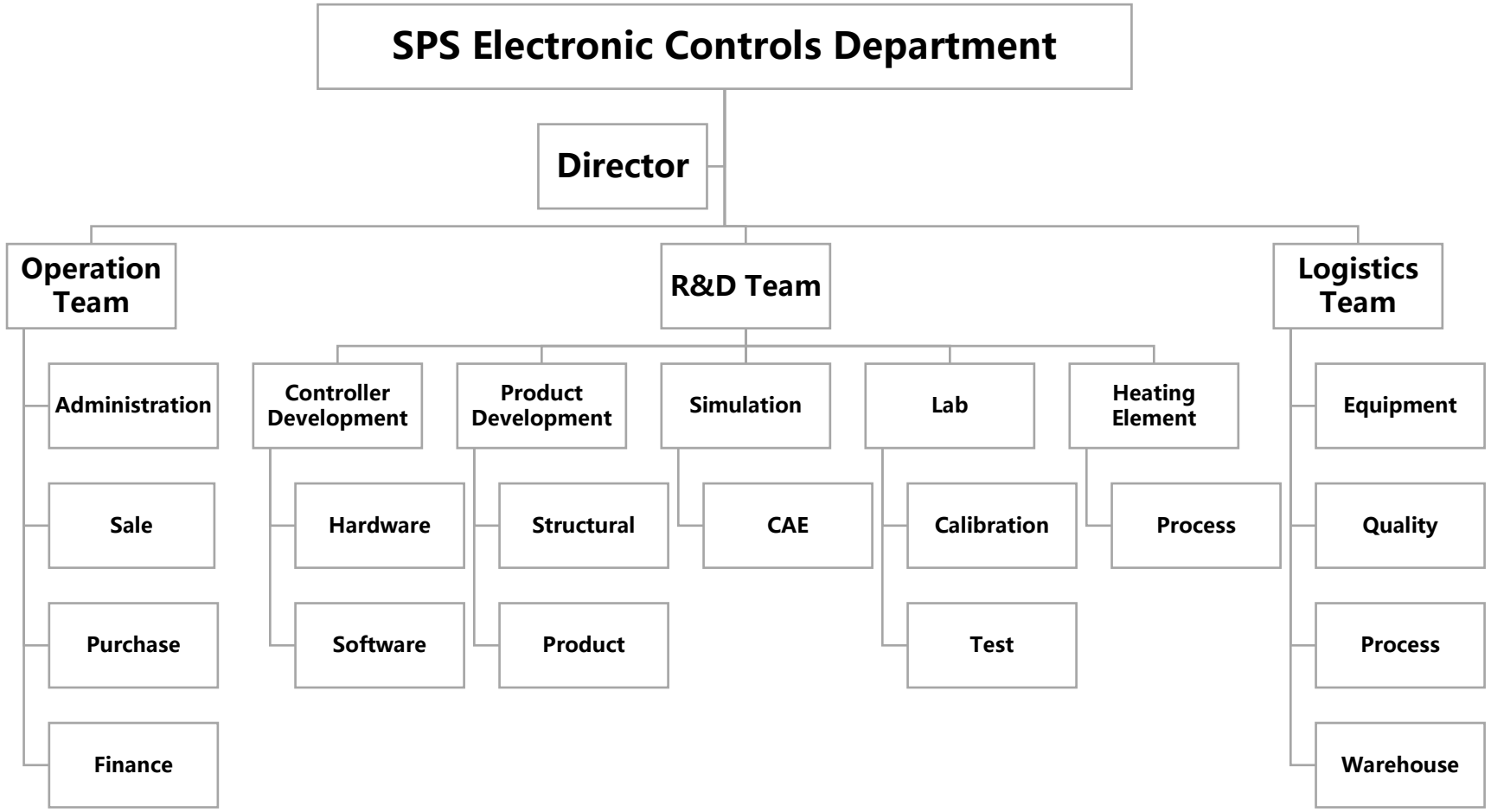
Pre-research Development Optimization



ELECTRONIC CONTROLS DEPARTMENT



Expert Introduce：

Experience	Time	Worked for
Electronic Controls	>20 years	OEM and leading auto parts company
Structure	>10 years	First-tier automotive research institute and a foreign-funded heater company
Calibration	>10 years	Domestic first-tier automobile research institute
Quality	>10 years	Leading auto parts company

SPS HIGH VOLTAGE HEATER SERIES

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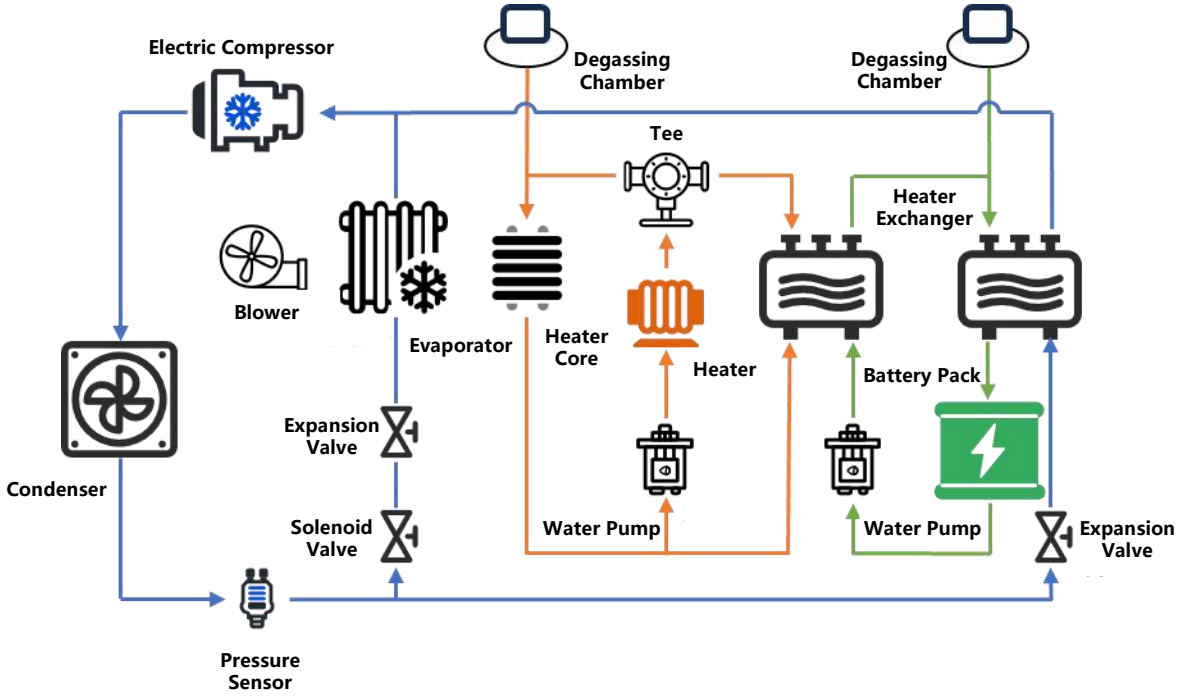
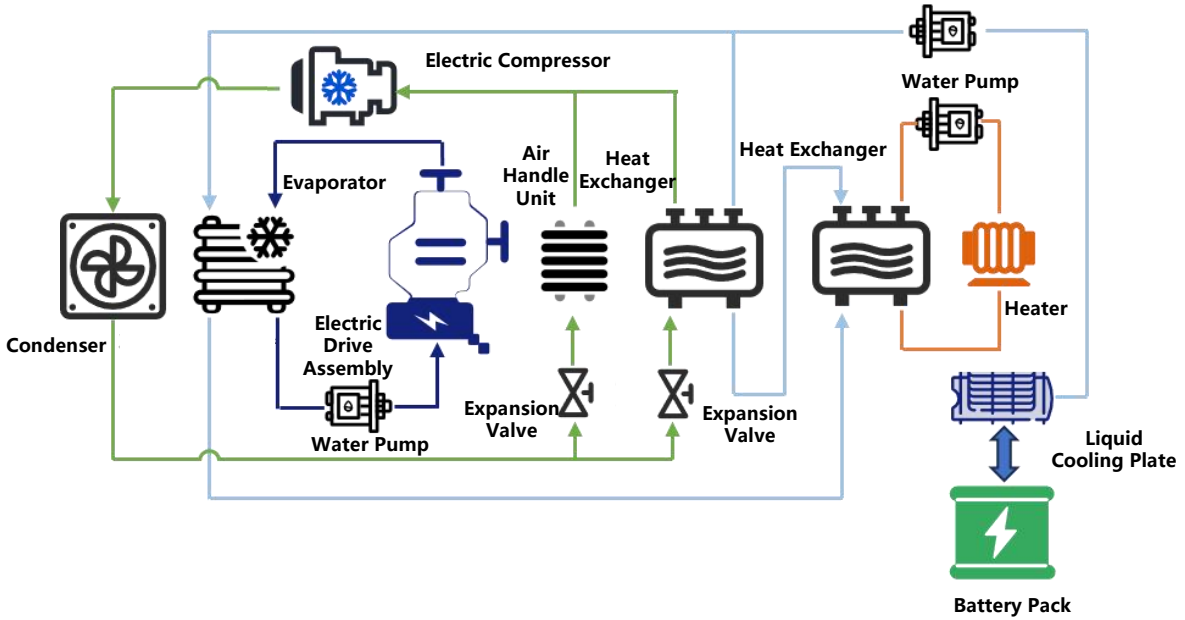
- Application Scenarios for Both Series



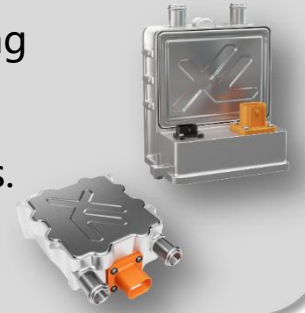


Cabin air conditioning, battery temperature controlled parallel thermal management system

- This serial is responsible for the main fuction of both battery pack heating and cabin heating for EV and PHEV Vehicles.
- Thermal Power:7~10KW

Thermal management system for cabin air conditioning, battery cooling, and motor waste heat recovery

- This serial is only responsible for heating the battery packs or some extreme environments for EV and PHEV Vehicles.
- Thermal Power:3~5KW



向隆高压加热器参数

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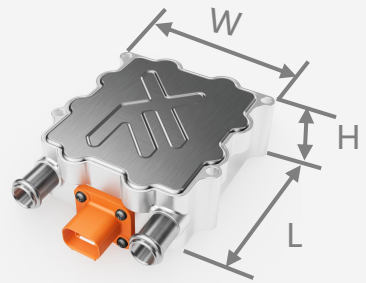
Technical Specifications	Product Parameters
Rated Power	3KW/5KW/7KW
Operating Voltage	200 ~850 V
Low Voltage Operating Range	9~16 V
Electro-thermal Efficiency	> 95%
Communication Protocol	Lin / PWM
Control Accuracy	Power：±2.5% (Request Vs Actual Measurement) Temperature：±3℃ (Steady State 5 min)
Dielectric Strength	3000 VDC
Insulation Resistance	> 50MΩ @1000 VDC
High Voltage Interlock	Yes
Working Medium	50%(Water) + 50%(Ethylene Glycol)
Pressure Drop	< 5KPa (10L/min;60℃)
Medium Operating Temperature	-40~80℃
Flame Retardant Rating	V0
Protection	IP6K9K/IP67
Weight	3KW:<1Kg（without controller）；<1.2Kg(without controller) 5KW：<1.8Kg 7KW：<2.2Kg

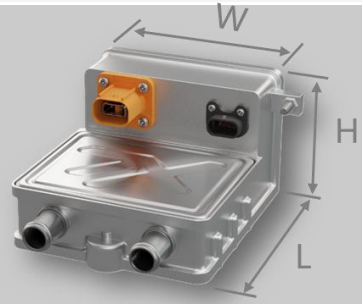
Product Series



3KW Serial

- Using with integrated thermal management systems for auxiliary heat;
- Optional internal controller;

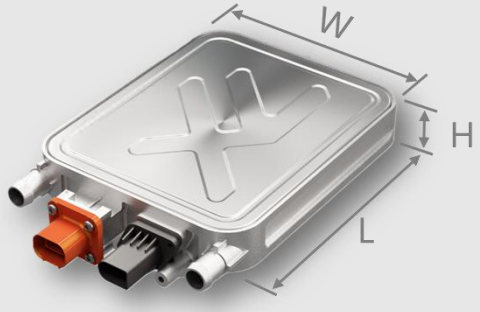
Length(*)	Width	Height
130mm	134mm	67mm



5KW Serial

- Can replace the current mass-produced water heating PTC products

Length(*)	Width	Height
166mm	149mm	99mm



7~10KW Serial

- Can replace the current mass-produced water heating PTC or heating rod products

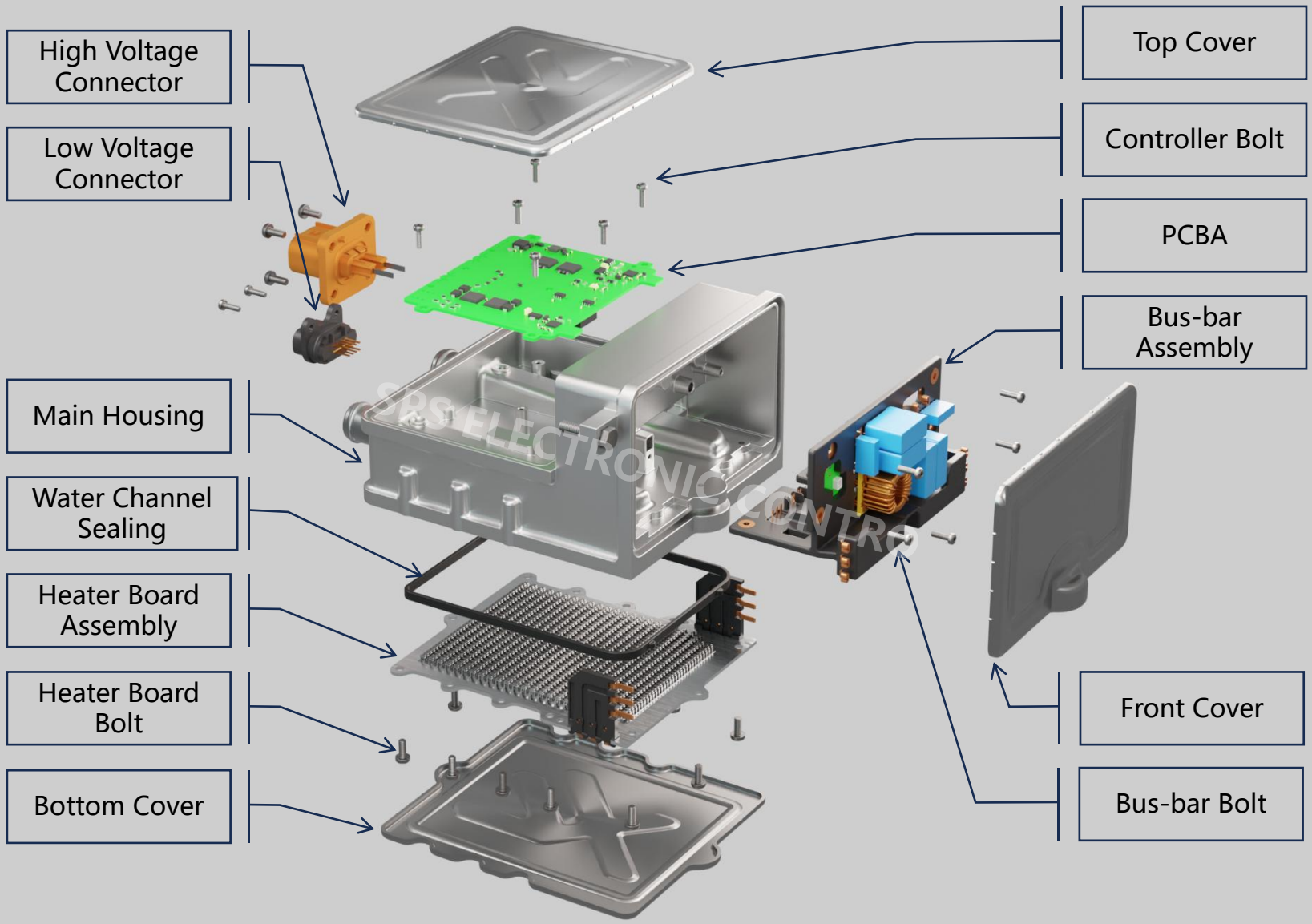
Length(*)	Width	Height
225mm	185mm	54mm

New product development cycle outside the series: 6~10 Months（Bench DV Completed）

➢ *Length excludes water-channel and connectors*

SPS HIGH VOLTAGE HEATER STRUCTURE

Product Exploded Diagram



Technical Characteristics

1.Volume and weight , compared to mass-produced PTC heaters in the same power class:

- 20% reduction in volume,
- 20% reduction in weight;

2.Thick Film Heater Technology:

- Effectively circumvent PTC related patent barriers
  Patent Number: 202420286173.3
- Rapid heating, no delay in starting time;
- Power is not graded and can be finely adjusted;
- Power control or water temperature control optional;

3.Internal Connection:

Category	Connection
PTC Heater	Flying Wire Plug-in
SPS Heater	Welding(Except for high-voltage interlock)

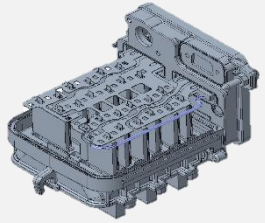
The reliability of SPS heater is effectively improved.

4.System Protection:

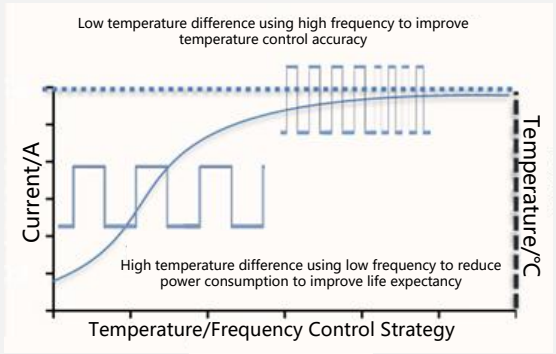
- Temperature sensors in the heating board, controller (board temperature and power components) and inlet/outlet provide effective monitoring and protection.

SPS ADVANTAGES OF HIGH VOLTAGE HEATER

Control Accuracy

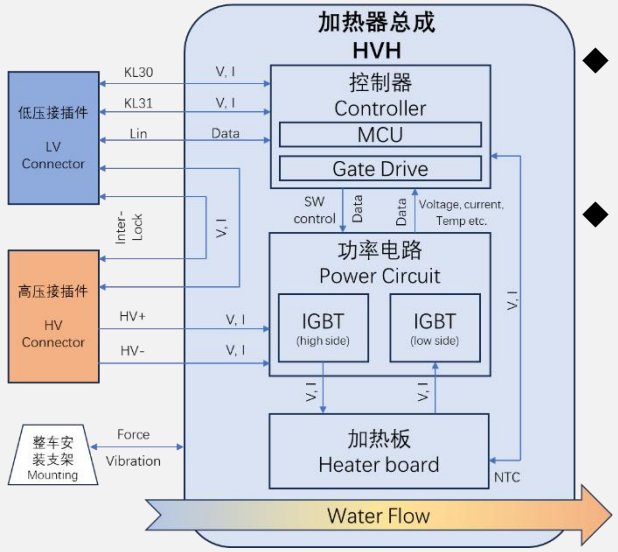


Stage	Heating Request
Stage 0: all heater legs off	0 – 16 %
Stage 1: heater leg 1 on	17 – 32 %
Stage 2: heater leg 2 on	33 – 49 %
Stage 3: heater leg 1 & 2 on	50 - 66 %
Stage 4: heater leg 1 & 3 on	67 – 82 %
Stage 5: heater leg 2 & 3 on	83 – 99 %
Stage 6: all heater legs on	100 %
Stage 0: all off	> 100%



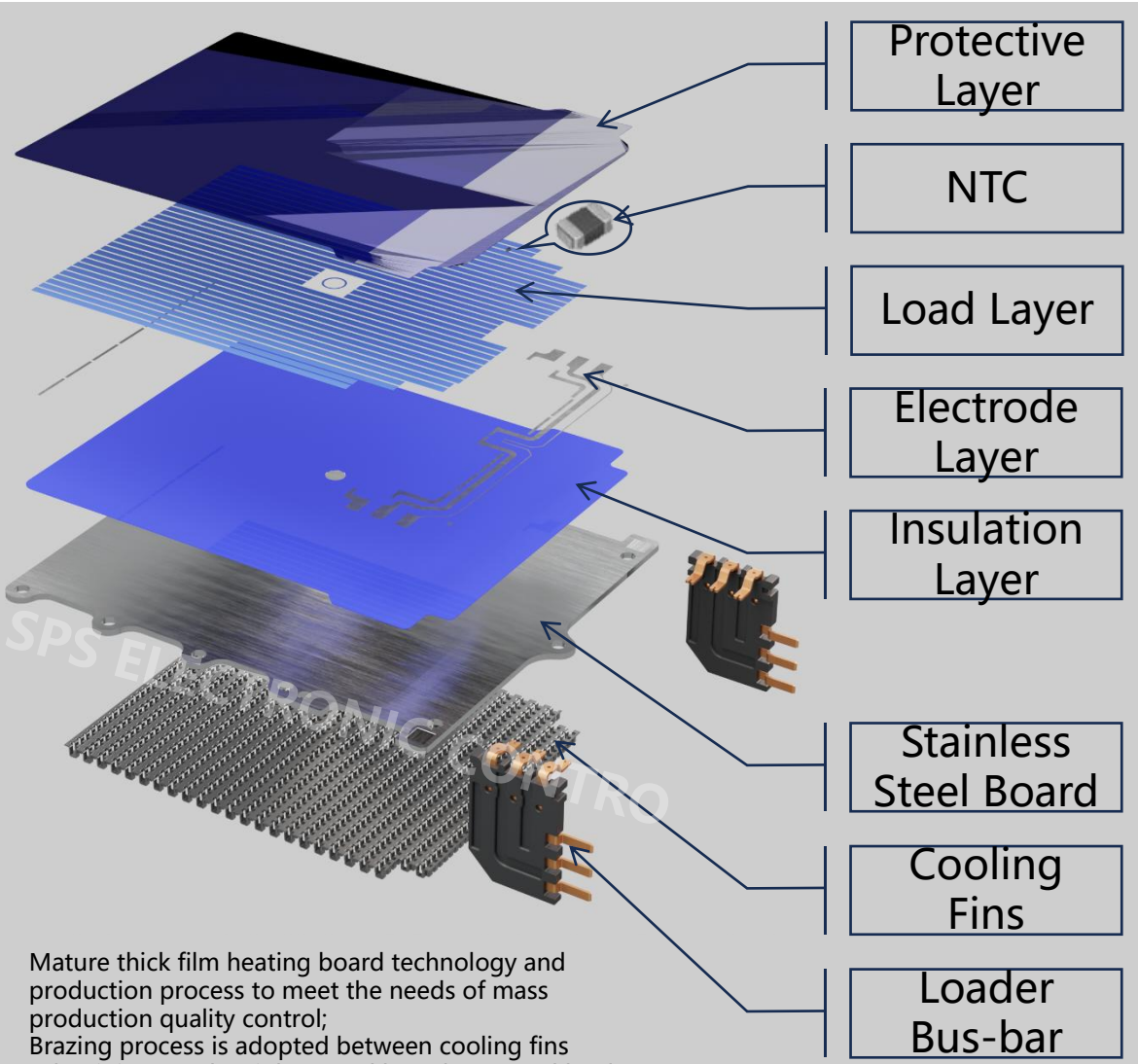
- Traditional PTC heater are gear-controlled, and thick film allows for 1% to 100% power control;
- Different test frequencyare used for high and low temperature differences to maximise control accuracy and efficiency.

Control Security



- All heat generating devices are arranged with NTC to monitor the temperature in real time;
- Power Circuit(IGBT) are located on the high and low sides of the heating board; redundant disconnect mechanisms are provided to ensure that they are shut down in time to avoid thermal overload.

Thick Film Assembly



- Mature thick film heating board technology and production process to meet the needs of mass production quality control;
- Brazing process is adopted between cooling fins (Aluminium) and stainless steel board; NTC and load leads adopt reflow soldering process, automatic welding and online AOI inspection.

SPS HIGH VOLTAGE HEATER CONTROLLER SCHEMATIC

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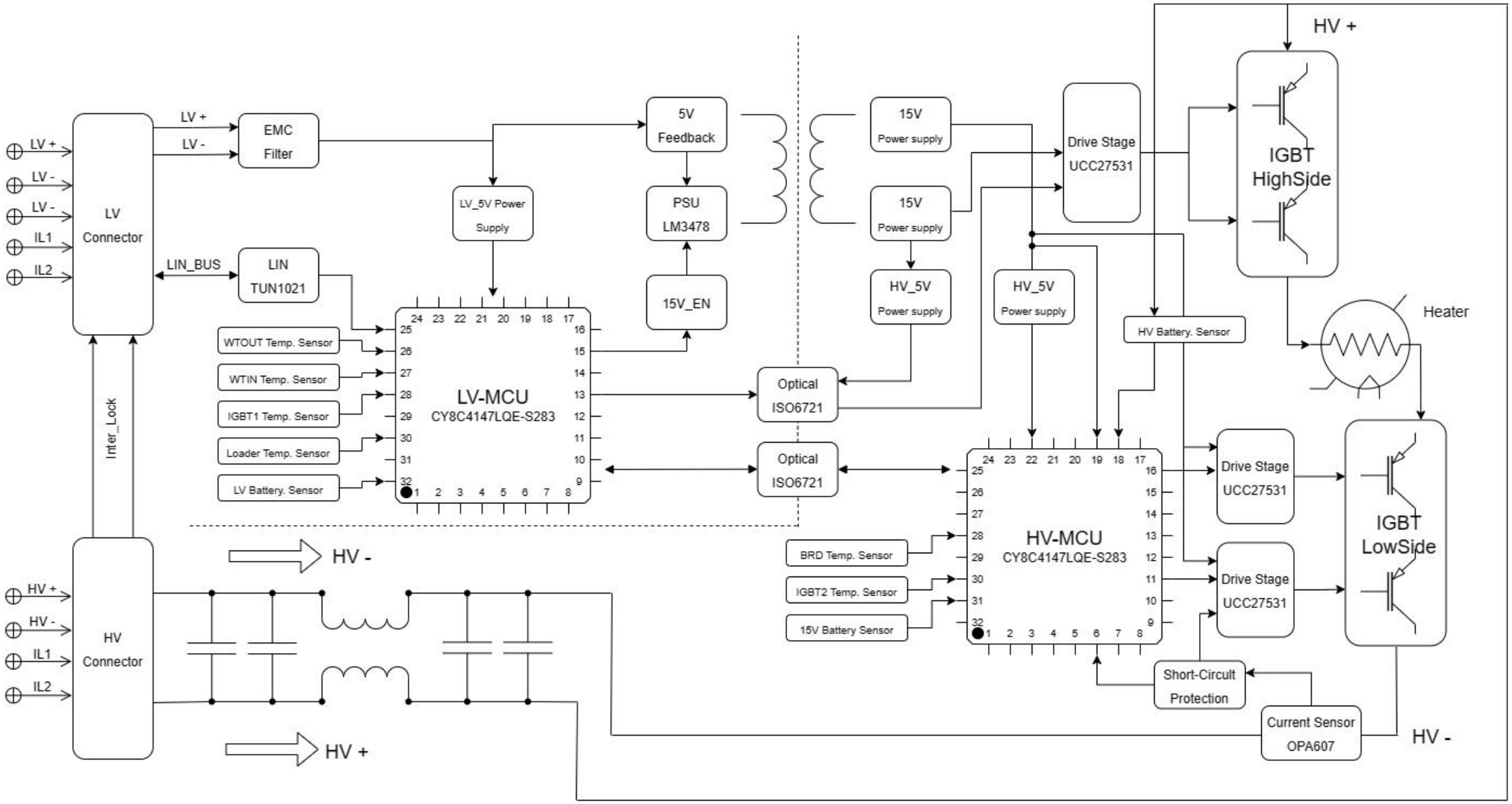

SPS SIMULATION ANALYSIS OF HIGH VOLTAGE HEATER-5KW

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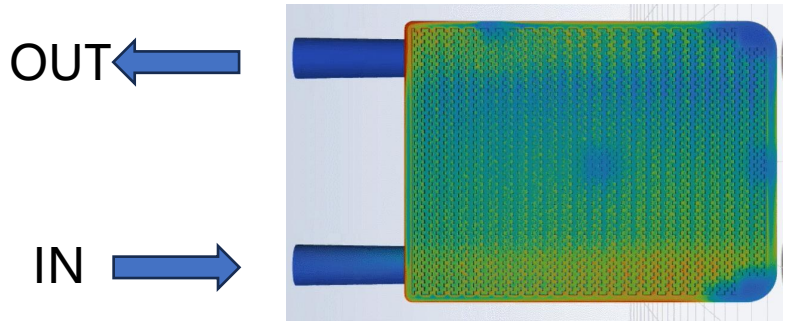
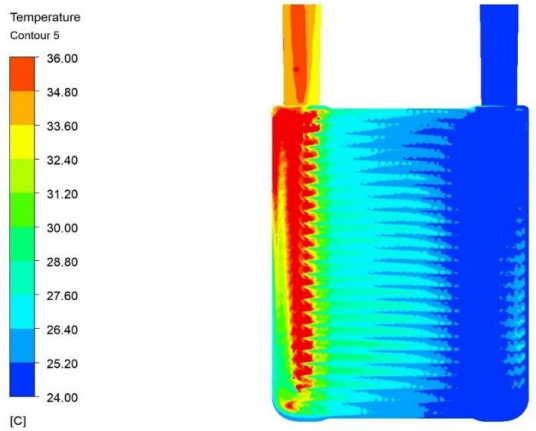
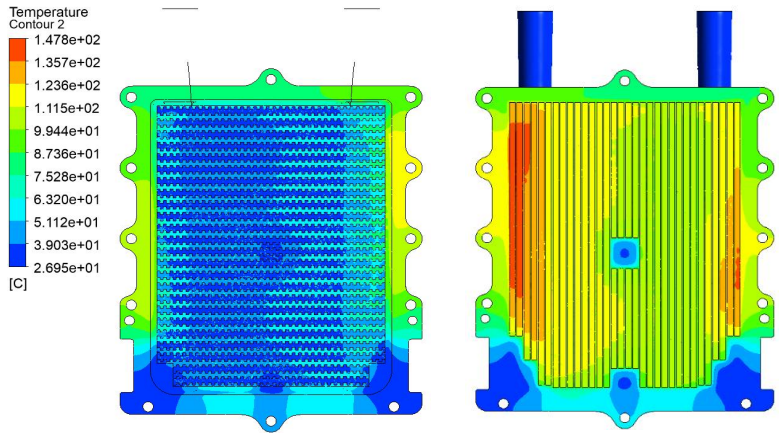
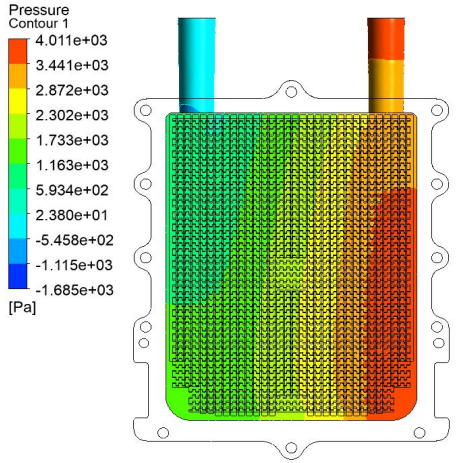
Condition	Media	50% Glycol Aqueous Solution，T=25℃
	Fluid	Flow Rate 10L/min，Relative Pressure 0 pa（*）
	Heater Power	5KW，Base Board Thermal Conductivity 16.27，Fin Thermal Conductivity 202.4(W/M·K)



Medium Temperature	Heater Temperature	Medium Pressure
		
◆ Inlet Temperature：25℃； ◆ Outlet Temperature：34.3℃（Max）；	◆ Optimised by simulation for more uniform temperature distribution； ◆ Maximum backside temperature of 147℃ with no risk of over-heating；	◆ Flow resistance~4 KPa；

(*) ： Relative pressure is the difference between the current ambient pressure and the standard atmospheric pressure, where 0 means that the ambient pressure is the standard atmospheric pressure (101Kpa).

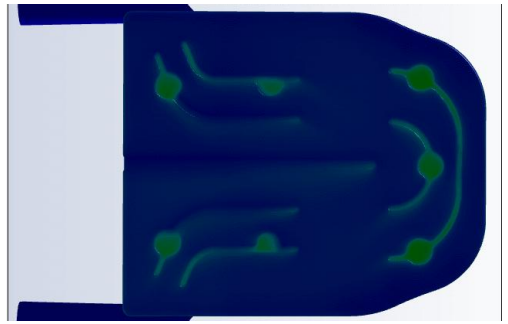
SPS SIMULATION ANALYSIS OF HIGH VOLTAGE HEATER-3KW

向隆电控 奋斗 创新 共赢

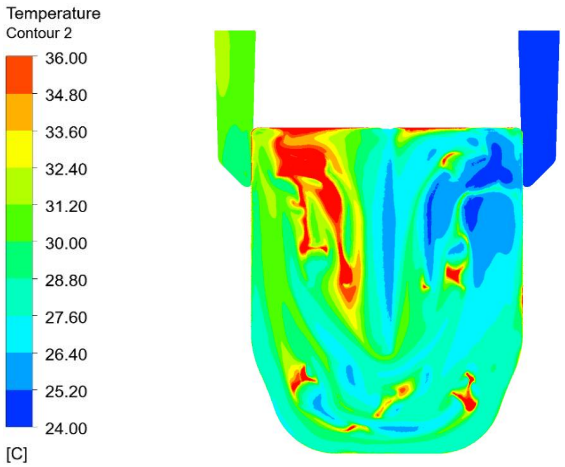
Condition	Media	50% Glycol Aqueous Solution，T=25℃
	Fluid	Flow Rate 10L/min，Relative Pressure 0 pa（*）
	Heater Power	3.3KW，Base Board Thermal Conductivity 23.9(W/M·K)

OUT

IN

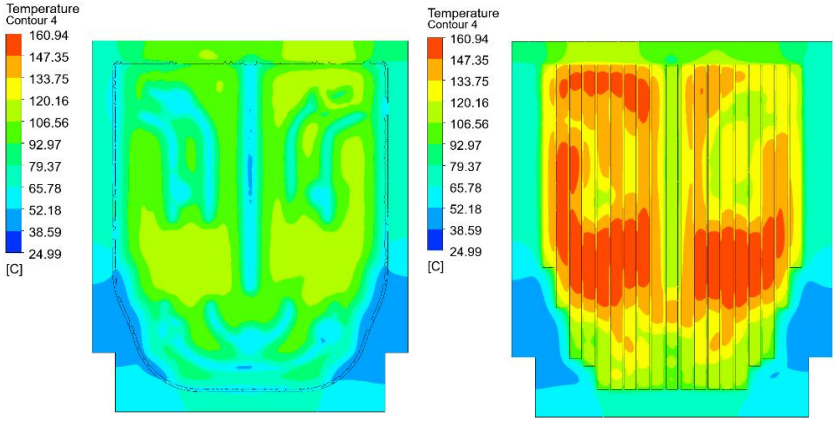


Medium Temperature



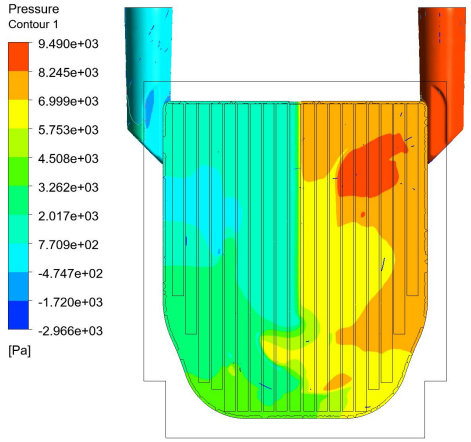
- Inlet Temperature：25℃；
- Outlet Temperature：30.86℃（Max）；

Heater Temperature



- Optimised by simulation for more uniform temperature distribution；
- Maximum backside temperature of 160℃ with no risk of over-heating；

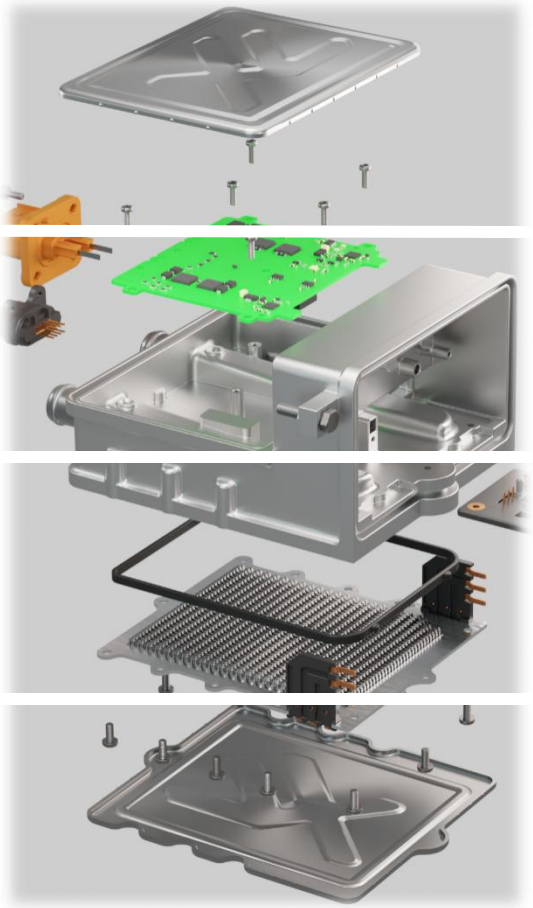
Medium Pressure



- Flow resistance~9 KPa；

(*)：Relative pressure is the difference between the current ambient pressure and the standard atmospheric pressure, where 0 means that the ambient pressure is the standard atmospheric pressure (101Kpa).

CATALOGUE



TEST CAPACITY

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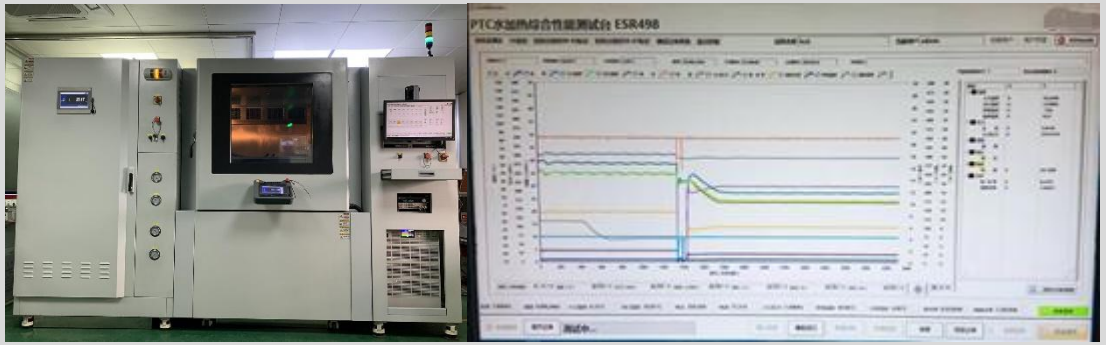
- Test Resources （Some test by the third-party Lab）

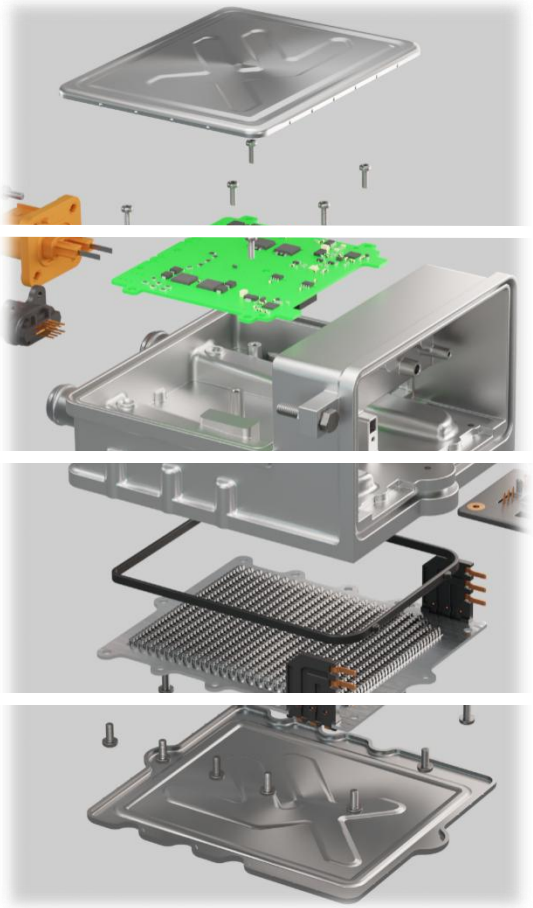
NO.	Test Name	Laboratory
1	Heating Characteristics Test	Internal Laboratory
2	Functional Test 1 point	
3	Functional Test 3 point	
4	Flow Resistance Test	
5	Fluid Corrosion Test	
6	Test without Coolant Test	
7	Storage Temperature Test	
8	Temperature Range Test	
9	Low Temperature Test	
10	Temperature/Humidity Cyclic Test	
11	Endurance Test	
12	High Temperature Durability Test	
13	Power Endurance Test	
14	Powered Temperature Cycle Test	
15	Enhanced Endurance Test	
16	Temperature Shock Test	Third-party Laboratory
17	Random Vibration Test	
18	Mechanical Shock Test	
19	Ice Water Shock Test	
20	Vacuum & Fill Test	
21	Resistance to Static Pressure	
22	Burst Pressure Test	
23	Pressure Cycled Test	

Performance Test Bench



Endurance Test Bench

CATALOGUE



PRODUCTION CAPACITY

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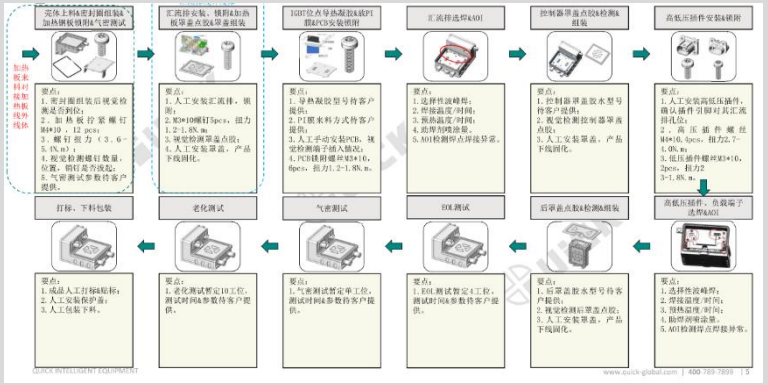
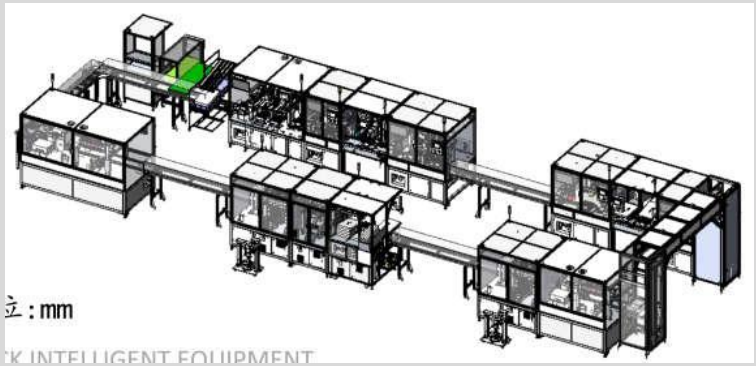
- Class 100,000 clean room (Phase I) 2500 m^2, a total of 3 production lines, heater planning capacity of 500,000 pcs/year;
  - 100% safety protection; using AGV unmanned handling solution; using QCD lean production system operation management.

	Process Flow Diagram	Production Line Programme	Delivery Time	Remark
One Semi-automatic Line			2024.06.31	CT:120s MES Trace
Two Automatic Lines			2024.12.31 (delivery time of the first production line)	CT:60s MES Trace

CATALOGUE

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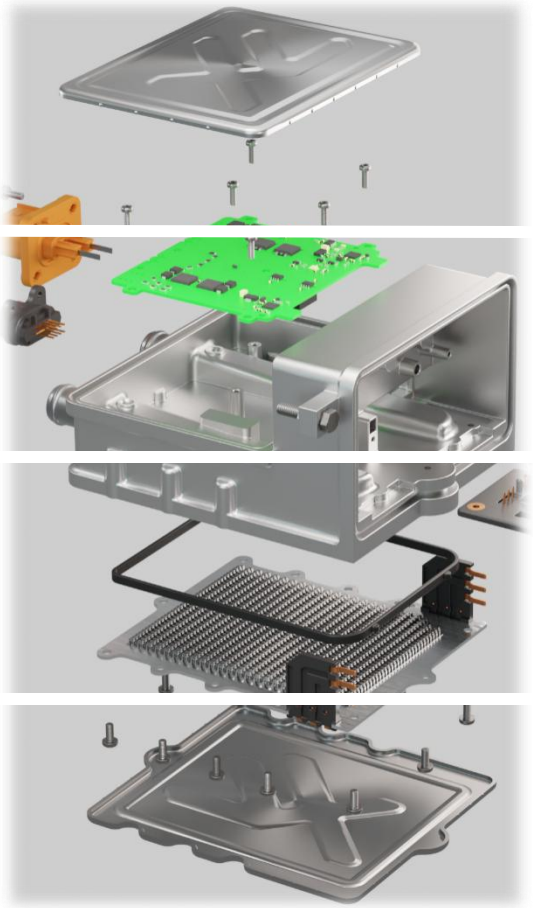

SPS THICK FILM HEATER LIGHTWEIGHT ADVANTAGE

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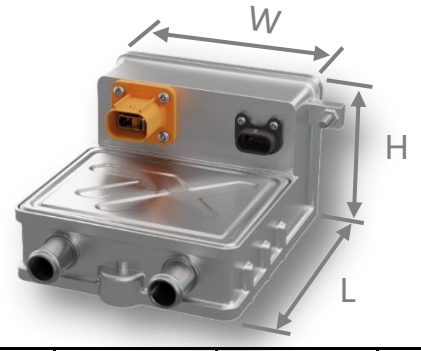
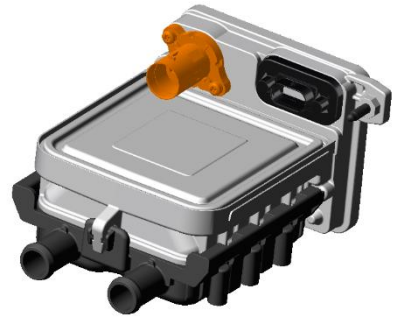
SPS 5kw Thick Film Heater



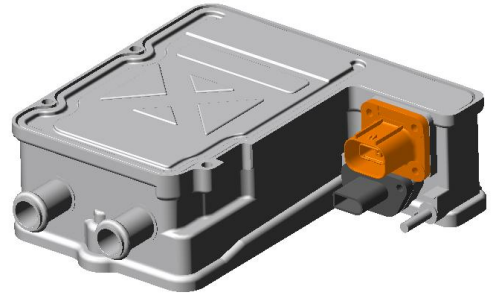
Length	Width	Height	Weight
192mm	149mm	102mm	1690g

Competitor 5kw PTC Heater



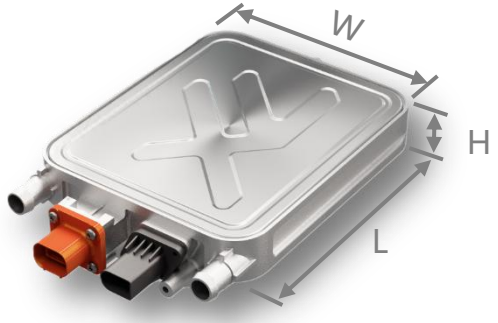
Length	Width	Height	Weight
197mm	145mm	107mm	2048g

Competitor 5kw Thick Film Heater



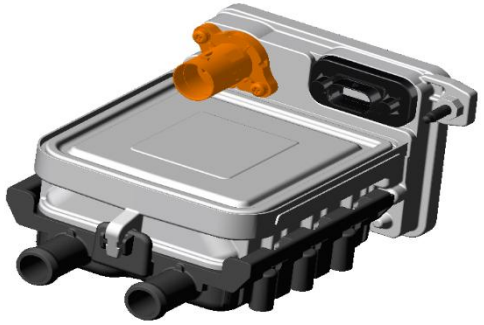
Length	Width	Height	Weight
214mm	204mm	73mm	1817g

SPS 7kw Thick Film Heater



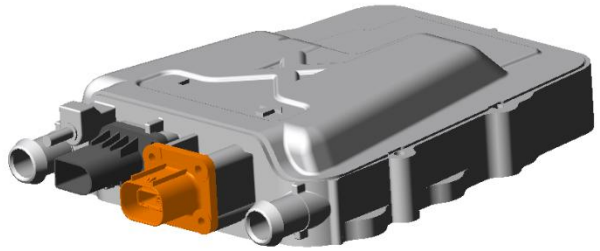
Length	Width	Height	Weight
254mm	185mm	59mm	2050g

Competitor 7kw PTC Heater



Length	Width	Height	Weight
204mm	164mm	112mm	2709g

Competitor 7kw Thin Film Heater



Length	Width	Height	Weight
265mm	196mm	55mm	2000g

SPS THICK FILM HEATER PERFORMANCE ADVANTAGES

向隆电控 奋斗 创新 共赢

- Medium Ratio： 60% Ethylene Glycol+40% Water
  - Density(ρ): 1083.87kg/m³； Specific Heat Capacity(C): 3106 J/(kg/K)
- Medium temperature：25℃
- Environmental Temperature：23℃

DUT	Voltage U(V)	Current I(A)	Electric Power P_1 (W)	Flow Q (L/min)	Inlet Temperature T_1 (℃)	Outlet Temperature T_2 (℃)	Difference in Temperature ΔTa (℃)	Thermal Power P_2 (J/s=W)	Heat Exchange Efficiency η (%)
XL Thick Film#1	290.12	17.49	5074.33	9.6	24.9	34.0	9.1	4901.62	96.60%
	289.72	18.879	5338.23	9.6	24.9	34.5	9.6	5170.94	96.87%
XL Thick Film#2	289.79	17.922	5068.97	9.5	25.0	34.2	9.2	4903.87	96.74%
	289.78	18.54	5305.32	9.6	25.0	34.5	9.5	5117.08	96.45%
PTC#1	289.82	17.819	5164.41	9.6	25.4	34.6	9.2	4955.49	95.95%
PTC#2	289.7	17.622	5105.1	9.6	25.1	34.0	8.9	4793.90	93.89%

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Thanks!

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