

Brief introduction of Cell Contact System (CCS) products

Directory

- 1. Company Profile**
2. CCS Product Introduction
3. Development experience and cases
4. R&D and design capabilities
5. Production delivery capacity
6. Quality assurance

Group company profile



- Diversified, intelligent and international development strategy, the main products are relays/contactors, sensors, and CCS busbars.
- There are three major production bases in China with branches in United States and Germany, and a research institute in Tokyo, Japan. In total, Churod employs more than 1200 people worldwide.
- First-class test platform, the laboratory has passed CNAS certification, providing customers with safe and reliable experimental data.
- Company focuses on scientific and technological innovation and research, accounting for 8% of R&D annually.
- Annual production capacity of relays has reached more than 500 million, and it is in a leading position in the world in the field of new energy.



1200

Employees worldwide



10 +

Service Agencies



4

Factory base

Relays. Contactors (Division 1)



- ◆ Average annual growth of $\geq 26\%$
- ◆ The scale of the relay industry is at the forefront

Sensor (Division 2)



- ◆ Suzhou Sensor Company was established
- ◆ Targeting the fields of automobiles, optical storage, air conditioning, etc

CCS Busbar (Division 3)



- ◆ CCS Division was established
- ◆ Focusing in the fields of automobiles, energy storage, and so on

Company history

■ January 2010
First plant in Dongguan
was put into operation

■ June 2016
Wuhu plant was
put into operation

■ December 2024
Churod Group is
slated to open

2010



2016



2024



■ October 2009
Churod registered
trademark brand

■ June 2014
Second plant in
Dongguan was
put into operation

■ October 2022
Churod Suzhou
sensor factory was
put into operation

2009



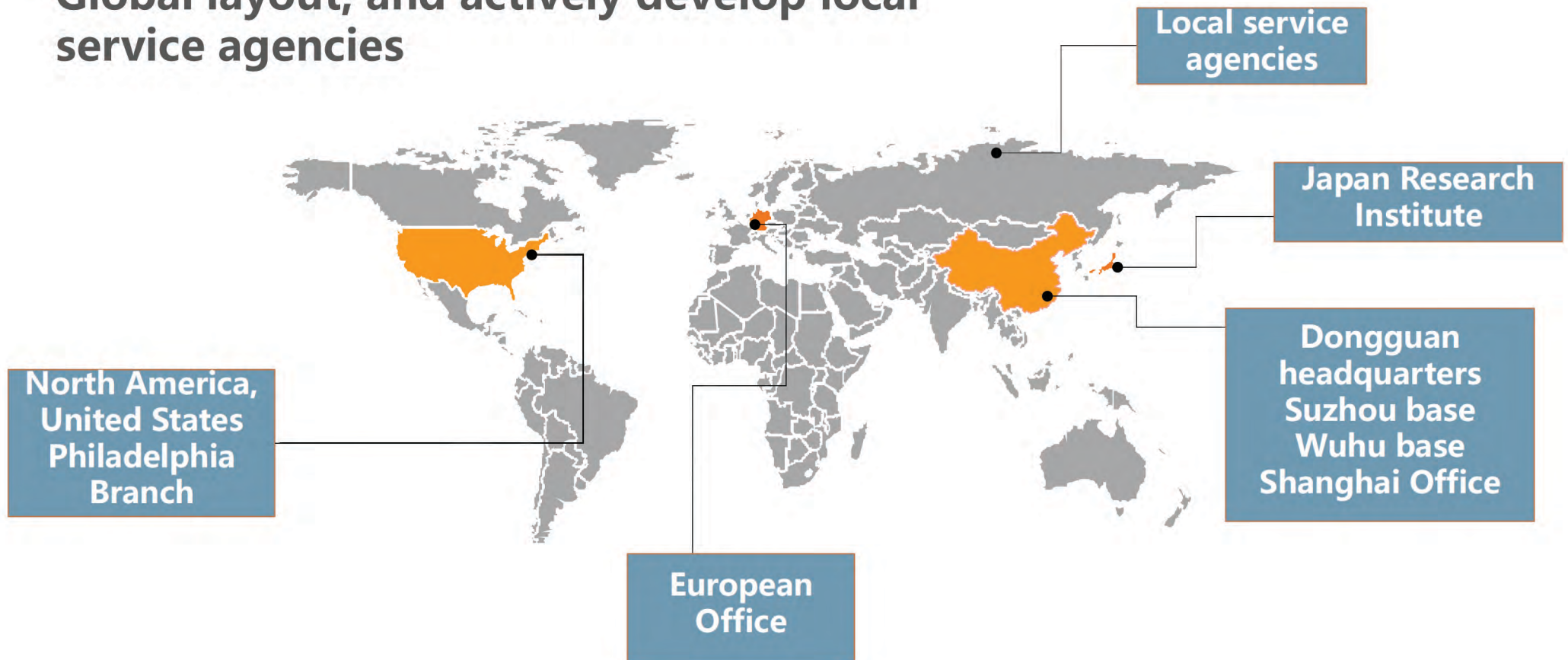
2014



2020



Global layout, and actively develop local service agencies



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- **CCS: Cell connection and voltage and temperature measurement components (Cell contact system)**

■ CCS components

CCS consists of a busbar, which is pressed to an FPC. Blister structural parts, copper, and aluminum bars are integrated into the product via hot riveting and laser welding.

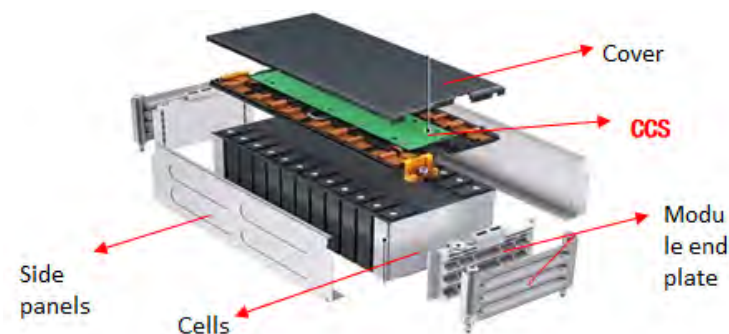
Integrated CCS replaces the structure of the traditional wiring harness. This means it can use automatic assembly and welding, thus improving the accuracy of collected data, space utilization, adding assembly efficiency, and other advantages.



■ Pack

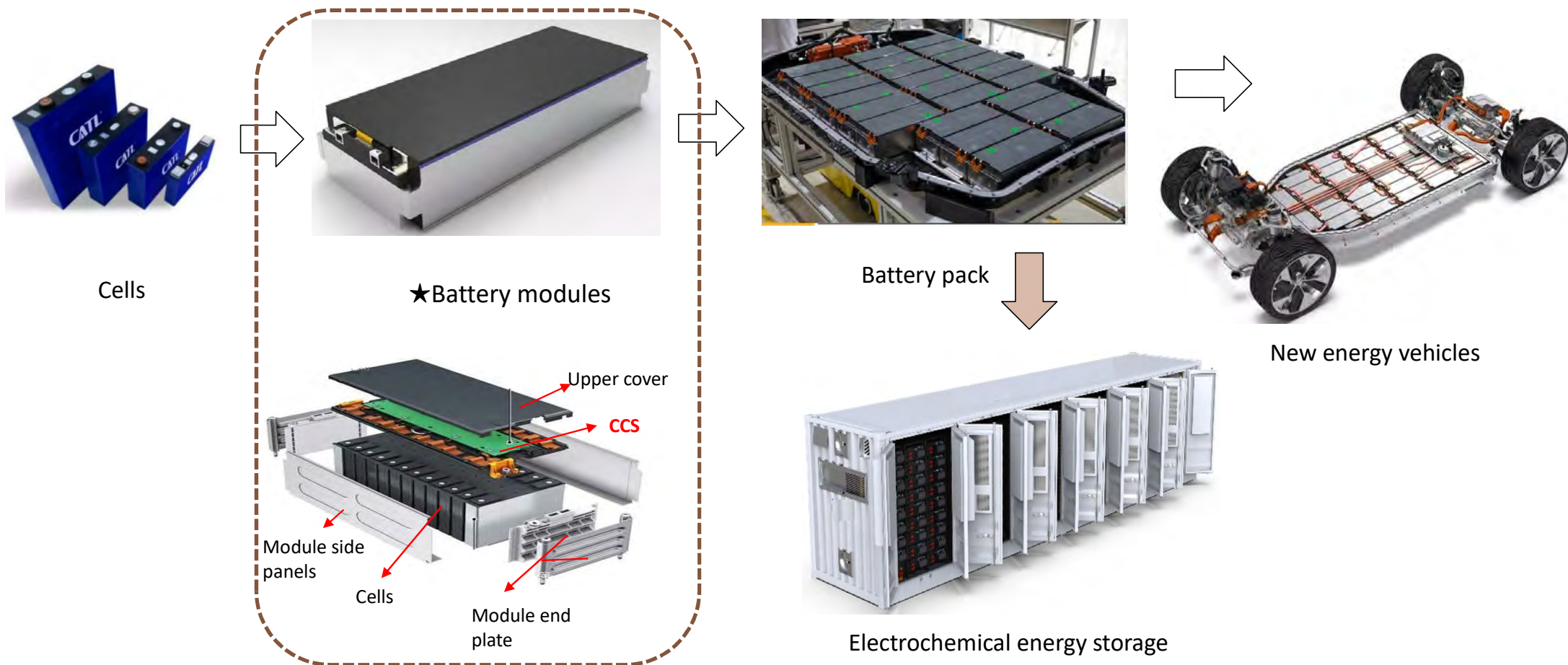


■ Battery modules

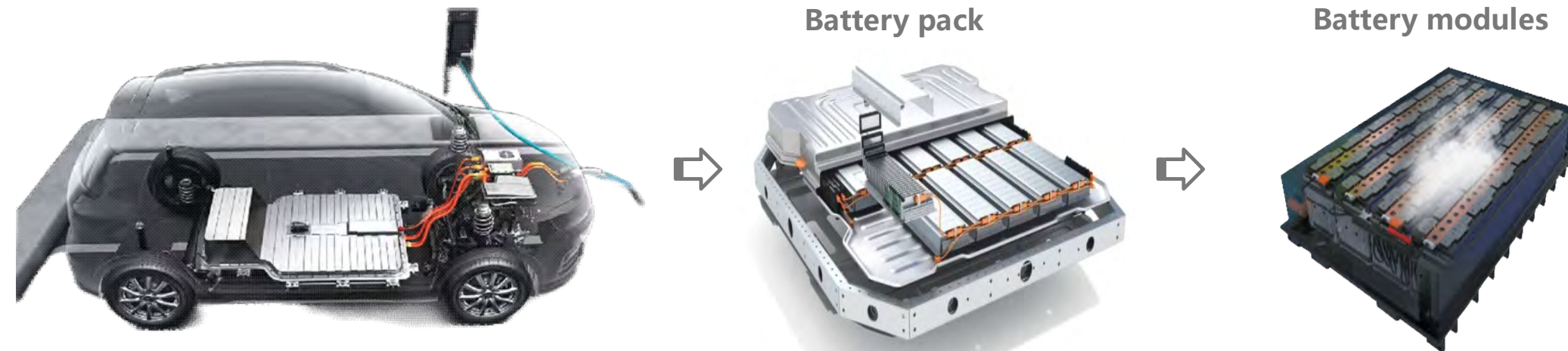


CCS product introduction

➤ CCS products are widely used in the fields of energy storage and new energy vehicles



Application of CCS in power batteries



■ Application of CCS in the field of new energy vehicles:



New energy passenger vehicles



New energy commercial vehicles

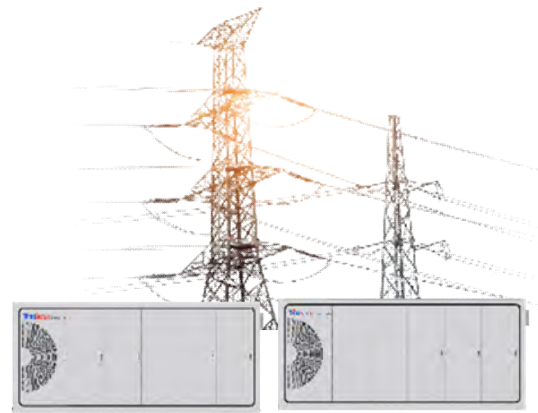


New energy heavy trucks



New energy engineering vehicles

Application of CCS in the field of energy storage



Grid-side energy storage



Energy storage on the power generation side



Residential energy storage



Commercial and industrial energy storage

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Experience in CCS project development



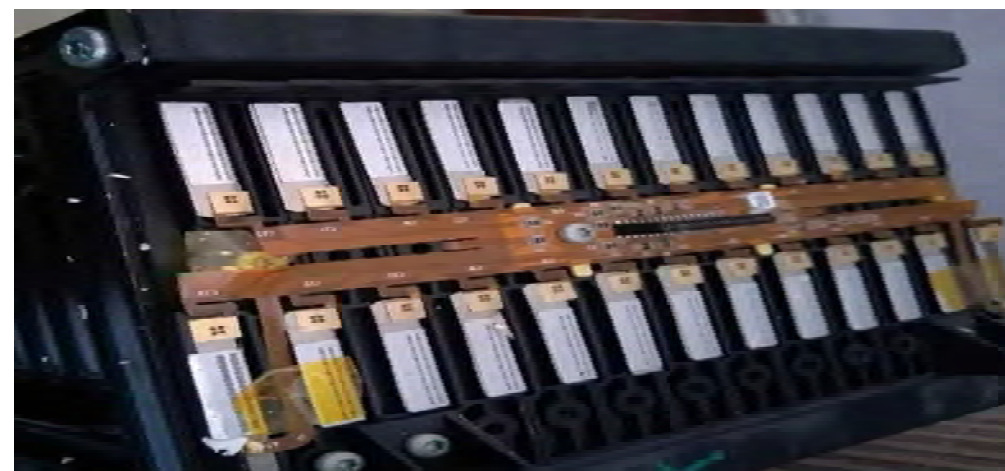
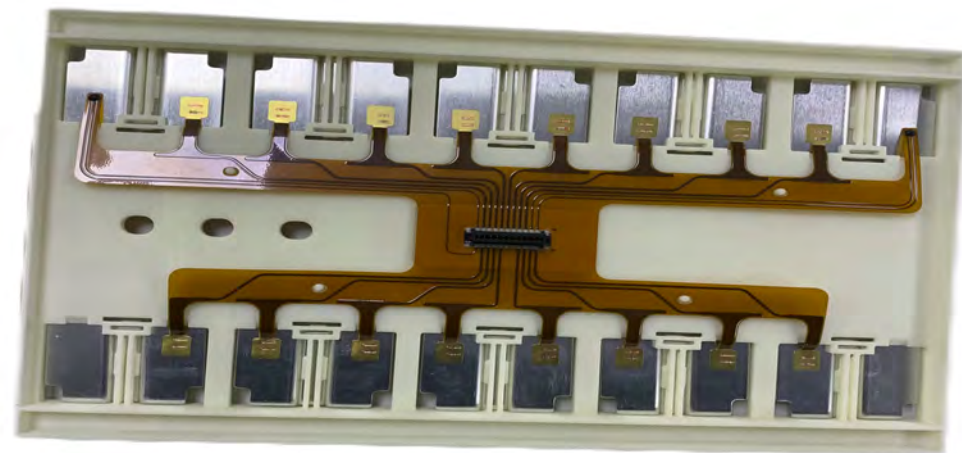
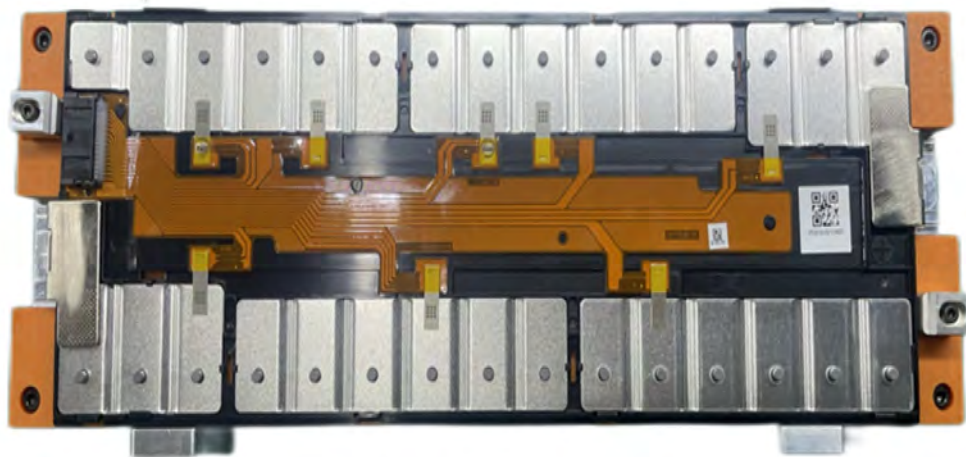
Category	Supporting customers > vehicles/models	CCS scheme
Power battery energy storage	CATL	Injection molding, hot pressing, blister molding
Power battery energy storage	Sunwoda	Hot pressing, blistering
Power battery	Sany Heavy Industry/Engineering Vehicle	Injection molded separators
Power battery energy storage	Leapmotor	Hot pressing, blistering
Power battery energy storage	Geely	Hot pressing
Power battery	Changan/Lynk & Co	Injection molded separators
Power battery	Chery Automobile	Hot pressing
Power battery	Dongfeng Motor Corporation	Hot pressing, blistering
Power battery	Wuling Motors/Cylindrical Battery Project	Blistering, injection molding
Energy storage	CRRC	Blister
Energy storage	Huawei Digital Power	Blister

Existing cooperative customers



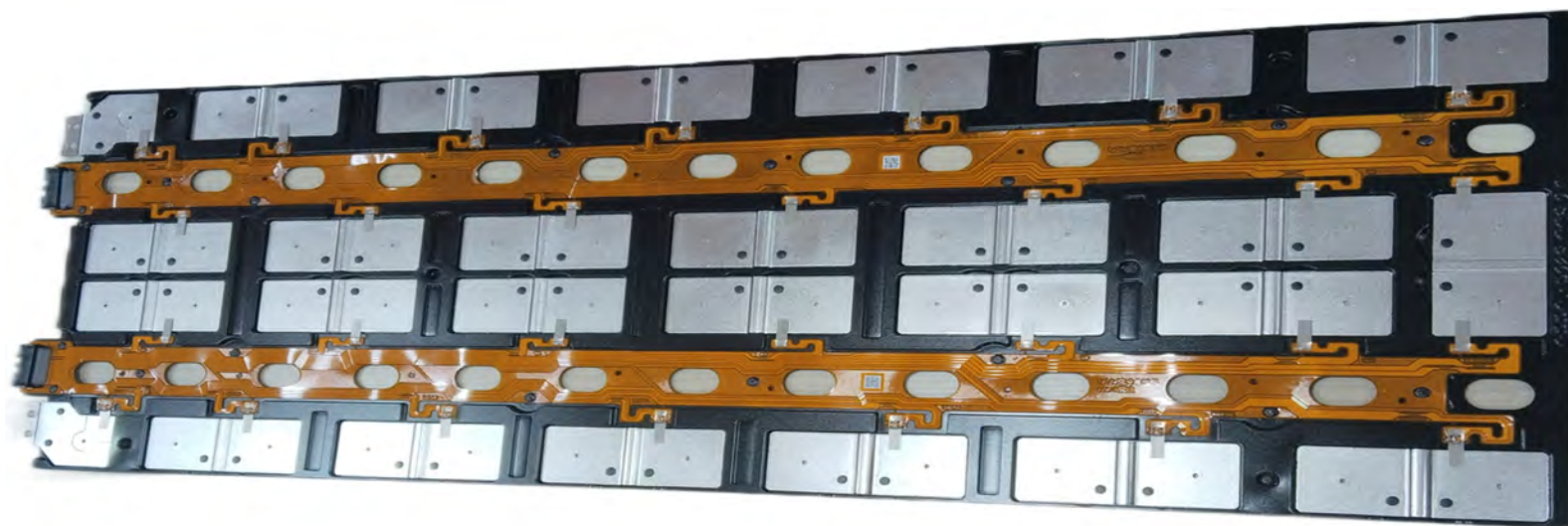
Product case: Module-to-bracket (MTB) solution

➤ CCS size: length 350~800mm x width 200mm



Product case: Cell-to-pack (CTP) solution

- CCS size: length 800~1500mm x width 300mm

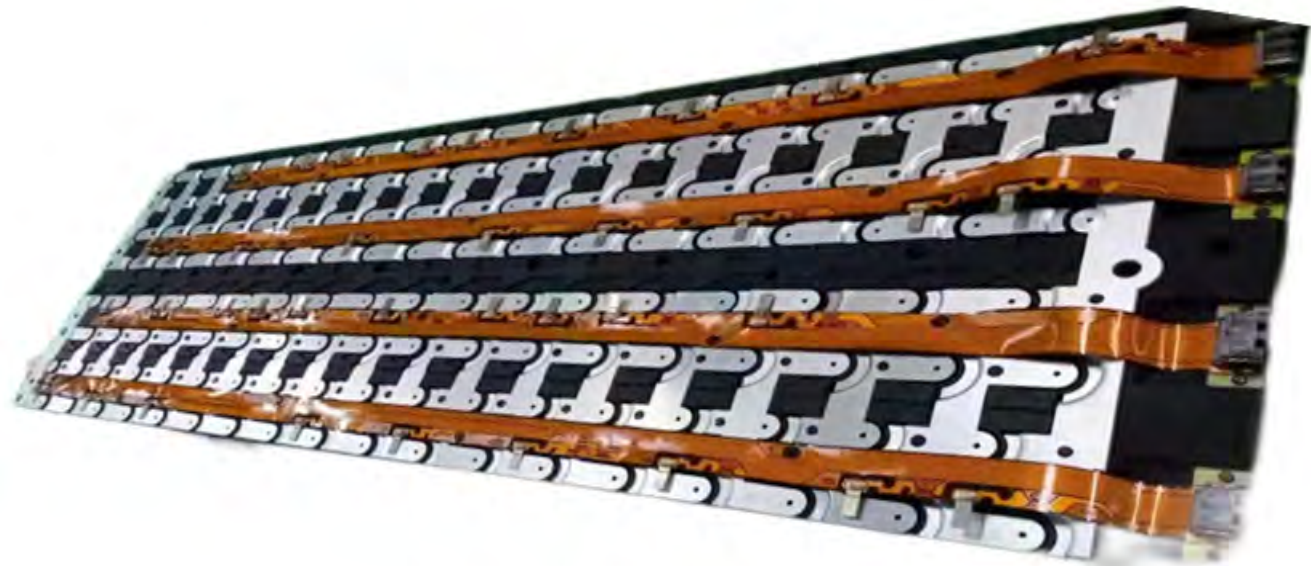


Product case: Cell-to-chassis (CTC) solution

- CCS size: length 120~2000mm x width 500~700mm



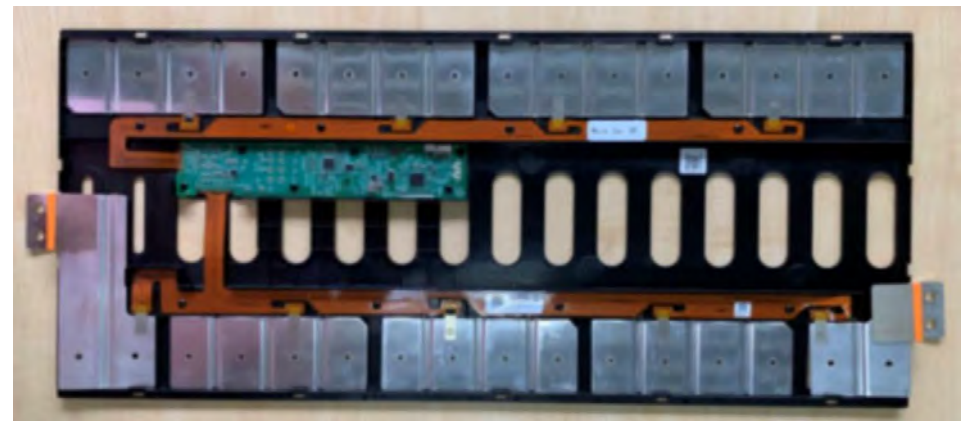
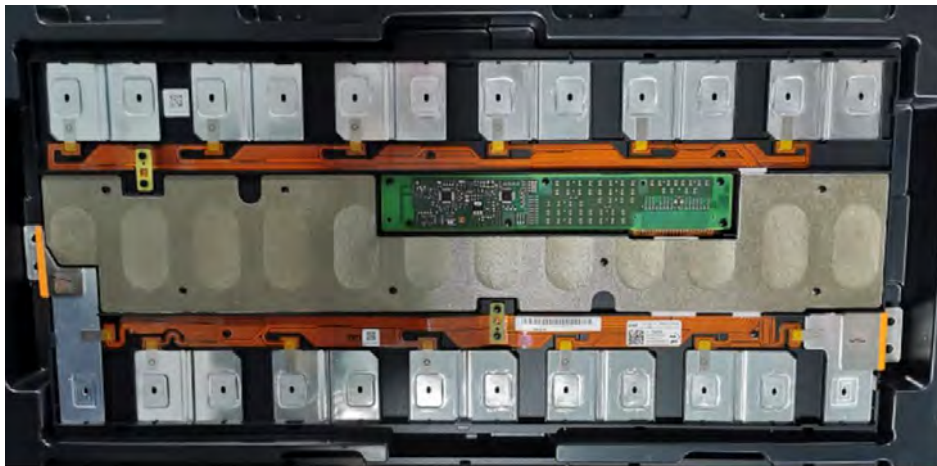
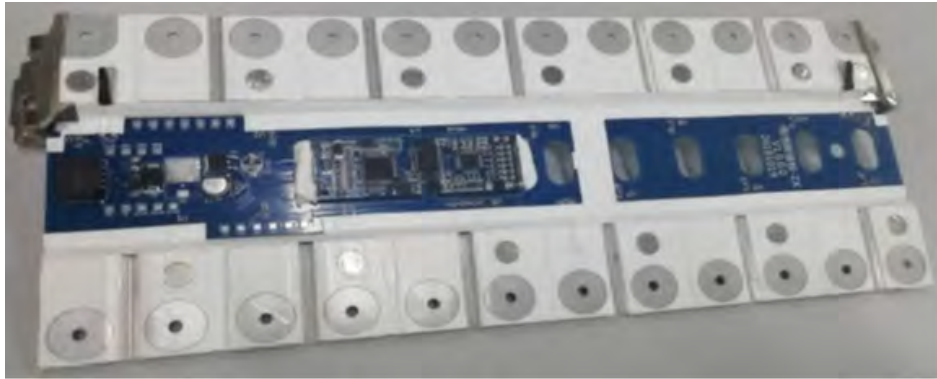
Product case: Cylindrical battery solution



Product case: Blade battery solution



Product case: BMU integration



Product case: Energy storage



Product case: Energy storage



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➤ Large-size and high levels of integration are the overall development trends



355*151.4*108mm



390*151.4*108mm



590*225*108mm

Cell To Pack &
Blade Battery



1200*300*108mm

Cell to Chassis
Integrated Technology



1800*300*108mm

Battery modules are constantly evolving toward larger sizes and higher integration with continuous improvement of space utilization.

Technology Trends:

- Applicable to the large size scheme of ketep and gram
- Integrated solution, space and efficiency optimization
- Low-energy, low-cost process



1. Traditional harness solutions

Assembly efficiency is low, and the consistency is difficult to guarantee.



2. PCB scheme

Increased assembly efficiency and improved sampling consistency.



3. FPC solution

Overcurrent protection is added to address the risk of sampling failure due to cell thermal expansion.



4. Long-size integrated process

Further improved assembly efficiency; reduced product thickness and weight; size has increased from 1.2 meters to 2 meters.



5. BMU integration solution

Integrated BMU slave control module reduces the cost of the module and ensures reliability.

Evaluation and comparison of industry solutions



Project	Injection molding solutions	Hot-pressed film protocol	Blister scheme More competitive advantage; Churod main promotion plan	Harness schemes
Appearance	Simple structure and integrated design	Simple structure and integrated design	Simple structure, integrated design	Structure is very complex
Integrated scenarios	Injection molded board	PET board	PC board	Injection molded board
Stacking	Injection molding board + bar + FPC	PET board + bar + FPC	PC board + bar + FPC	Injection molding board + bar + wiring harness
Product weight	Decrease of about 5%	Decrease of about 8%	Decrease of about 6%	Reference
Product thickness	5-10mm	3-5mm	5-8mm	5-10mm
Product length	Approx. 1200mm	Approx. 1200mm	Greater than 2000mm	Approx. 1200mm
Reliability	<ul style="list-style-type: none"> ① FPC has a flat and tight structure, which effectively avoids the risk of short circuit due to friction with the upper cover. ② Fuse protection + expansion stress relief; ③ Etching molding process to meet the ultra-low internal resistance control. 			<ul style="list-style-type: none"> ① Wiring harness is difficult to fix, and it is easy to shake and collide with the upper cover ② There are many plugging points, large internal resistance, poor consistency, and it is difficult to realize the fuse protection scheme.

Process technology capabilities



NO.	Type	FPCA	CCS
1	Product solutions	Single-layer or double-layer boards	Integrated solutions
2	Conductor material	Calendered copper	T2 Copper, 1060Al
3	Conductor thickness	1oz / 2oz	1.2mm, 1.5mm, 2.0mm
4	Maximum size	2000mm * 430mm	2000mm * 700mm
5	Plate thickness tolerance	10% plate thickness	10% plate thickness
6	Nickel sheet welding strength	Nickel flake and copper bonding: shear force >80N; peel force >20N	Bonding force between nickel sheet and aluminum bar: shear force >300N; peeling force >60N
7	Salt spray resistance	5% NaCl solution for 96 hours, the appearance and performance were not affected	5% NaCl solution for 96 hours, the appearance and performance were not affected
8	Connector push-pull force	≥100N	/
9	Upper and lower surface withstand voltage	2700VDC/60s, leakage current ≤1mA	3500VDC/60s, leakage current ≤1mA
10	Insulation resistance	1000VDC, 500MΩ	1000VDC, 500MΩ
11	Loop resistance	Internal resistance of a single circuit < 1 Ω	/
	Overcurrent		Conventional 100~300A, specific design

Integrated fuse protection design

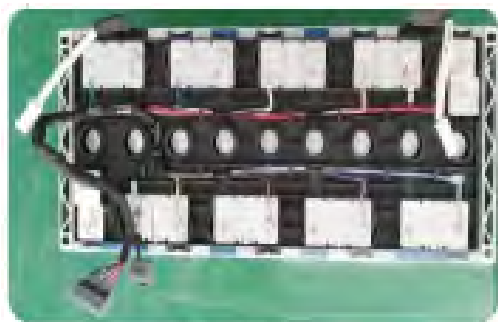
FPC is used to collect signals and control and manage each unit of the new energy battery management module. The fuse circuit design scheme is adopted on the substrate to achieve fusing in 1~2s during overload conditions, thus improving safety and protection performance.

$$S=[t, T, w]$$

Fusing protection for etching processes



S — Fusing state
 t — temperature
 T — Time
 w — Line width



Wire scheme



PCB scheme



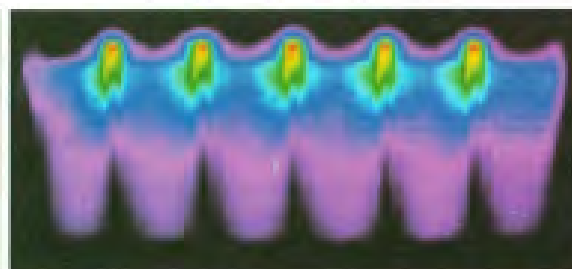
FPC scheme

Design simulation capabilities

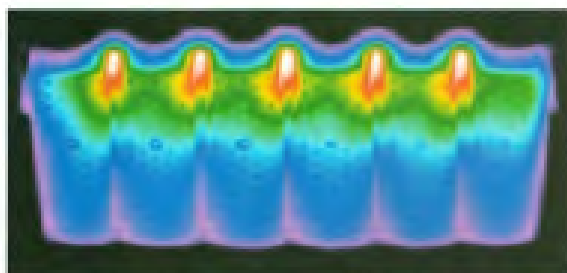
Multi-physics simulation technology is used to model and design the electrical, mechanical, thermal, and other physical parameters of the new energy battery management module. This process also establishes an accurate database and product model of related materials, guides the design and production, improves efficiency, and ensures product quality.



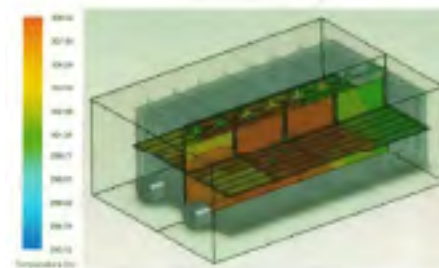
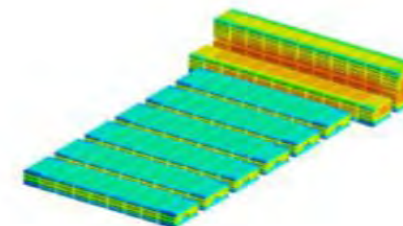
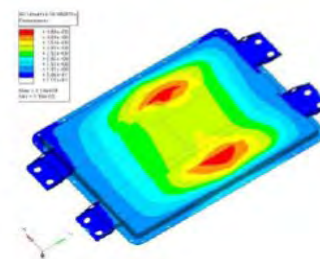
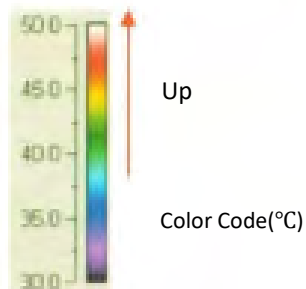
Discharge 2 minute



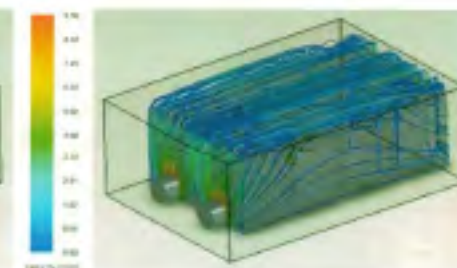
Discharge 2.5 minute



Discharge 3 minute



a) Temperature field



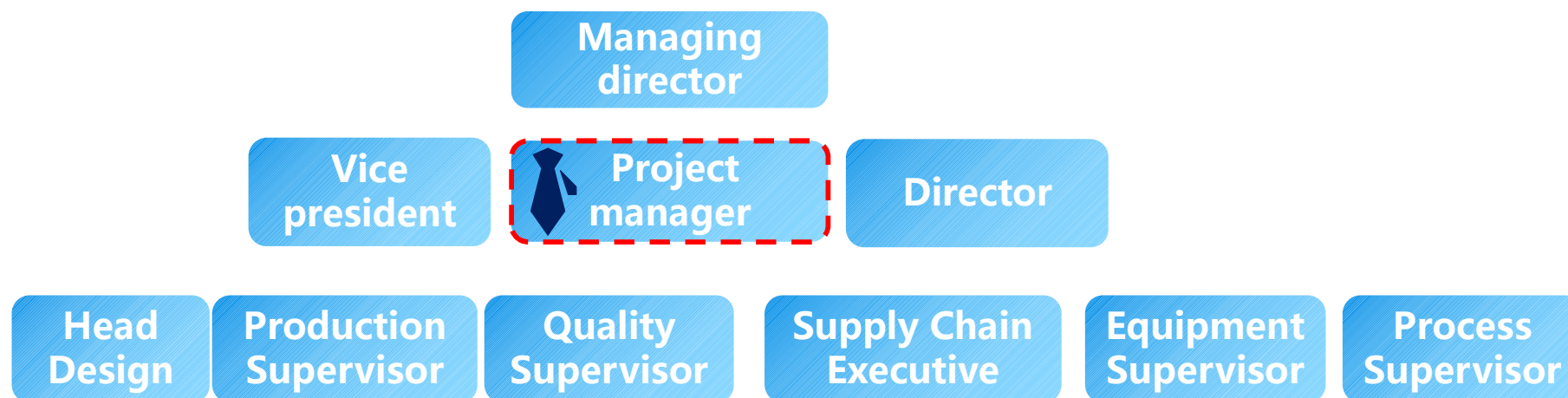
b) Velocity trace

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Project-based product development

- In a project-based manner, special product development management and promotion are carried out.



Product development cycle

Type	FPC and other material production (Days)		Tooling/tooling preparation (Days)		Production and processing (Days)		CCS total man-hours		Notes
	standard	urgent	standard	urgent	standard	urgent	standard	urgent	
Prototypes are produced for the first time	15	10	13	8	10	5	25	15	
First production of hard molds	20	15	20	15	15	10	35	25	

Capacity planning



No.	Type	Status		Second half of 2024		2025		2025	
		Number of threads	Capacity (pcs/month)	Cumulative number of lines	Capacity (pcs/month)	Cumulative number of lines	Capacity (pcs/month)	Cumulative number of lines	Capacity (pcs/month)
1	FPCA	2 lines	120K	3 lines	200K	6 lines	320K	11 lines	600K
2	CCS	3 lines	120K	5 lines	200K	8 lines	320K	15 lines	600K

Expansion capacity

No.	Production process	Equipment Name	Equipment production cycle (days)	Note
1	FPCA	SMT+reflow line	20	
2	Dispensing	Automatic dispensing machine	25	
3	Hot riveting	Hot riveting machine	30	
4	Laser welding	Laser welding machine	30	IPG lasers were chosen
5	Electrical testing	ICT testing machine, insulation withstand voltage testing machine	25	
6	Automatically detect	SPI, X-ray, AOI	30	
7	Packaging and other accessories	Packaging machines, etc	20	











- **Production equipment and automatic lines are independently developed by Churod. Our team can introduce new equipment in about 40 days, and can respond quickly to the need to expansion of production capacity.**

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System certification



System Certificate	System management	Churod
ISO9001 	Quality control 	✓
IATF16949 	Auto 	✓
ISO45001 	Health & Safety 	✓
ISO14001 	Environmental protection 	✓
ISO27001 	Confidentiality information 	✓
QC080000 	Hazardous waste management 	✓
	VDA 6.3 over process audit 	✓



Critical feature control – FPCA



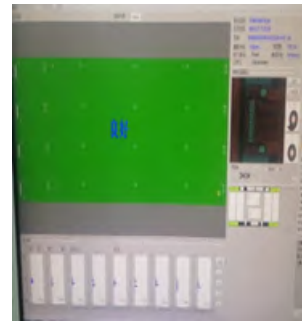
Stencil opening control

Control scheme: patented steel design, with a stepped scheme to increase the thickness of the steel mesh and increase the amount of tin, to improve the risk of false welding



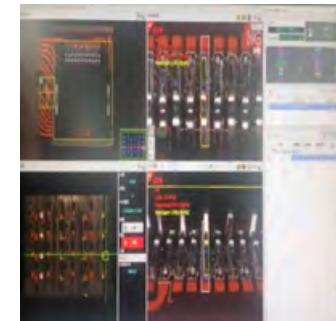
Printing automatic cleaning

Control scheme: high precision longboard printing; Separate scraper head; CCD automatically identifies alignment; Spray type automatic cleaning; Fully automatic and high-precision plate thickness adjustment



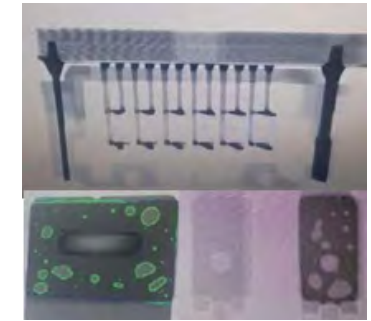
SPI automatic solder paste detection

Control scheme: automatic solder paste detection through printing inspection equipment, intercept printing defects; Main detection defects: missing prints, more tin, less tin, even tin, offset, poor shape



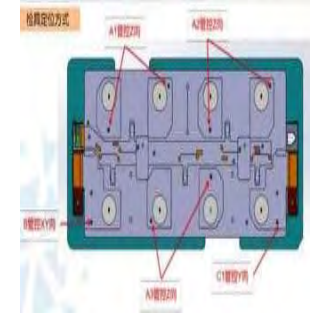
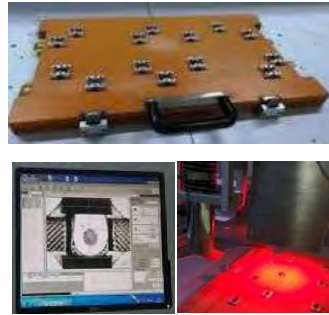
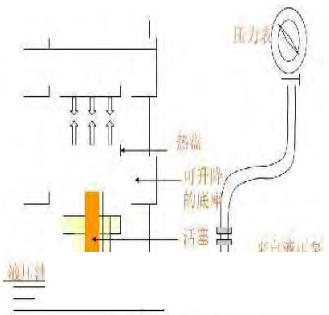
3D AOI

Measurement items: missing parts, offset, rotation, three-dimensional polarity, reverse parts, warping, side standing, monument, poor welding, etc
Solder joint inspection items: solder tipping, solder quantity percentage, more tin, less tin, bridging, hole plugging, solder climbing, pad contamination, etc



X-RAY

Control scheme: X-ray penetration is generated by high voltage impact on the target to detect the quality of electronic components, the internal structure of semiconductor packaging products, and the quality of SMT solder joints



Hot pressing

Process parameters DOE; Producer permission settings: Hot pressing time, temperature, pressure, real-time monitoring, MES system accurate traceability

Hot riveting

Quality requirements: the product has no obvious scratches, the riveting is tight, the peeling force of the hot riveting head is $\geq 50N$, and the surface of the aluminum bar exceeds the $\leq 1.5mm$ after hot riveting

Laser welding

Fixture tooling, nickel sheet pressing design; Automatic CCD alignment; Automatic focal length compensation; Automatic fume & welding foreign matter collection

Electrical testing

On-off 100% tested; Insulation resistance 100% tested; Withstand voltage 100% test; NTC resistance 100% tested

AOI automatic visual inspection

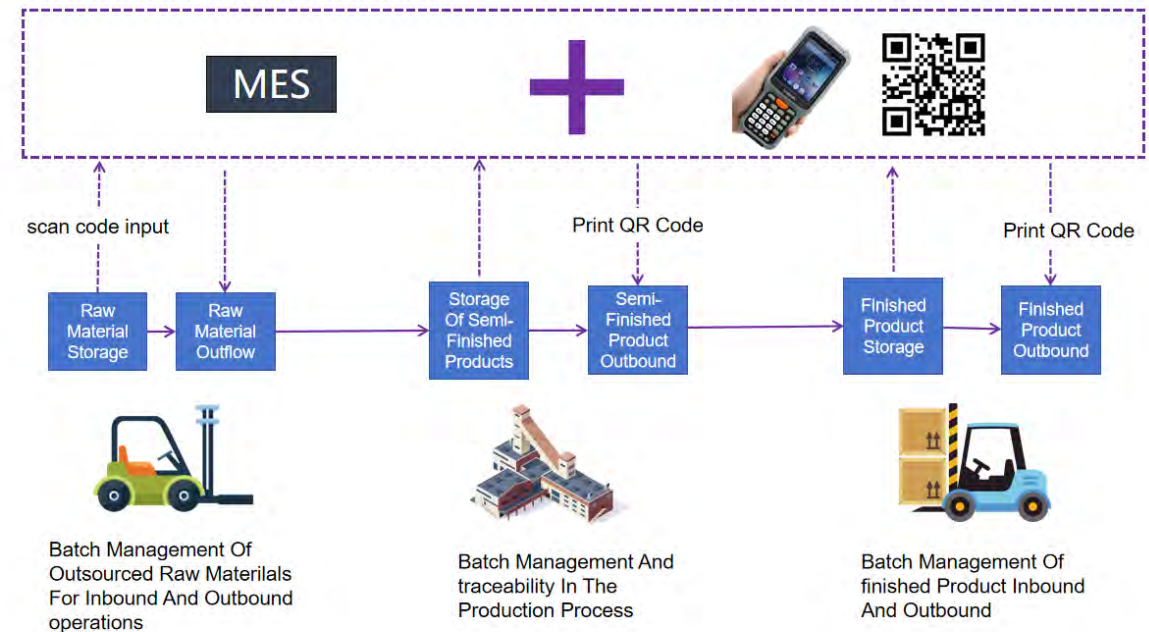
Automatic appearance inspection, identify the appearance of nickel sheet solder joints, and identify whether the connector PIN pin is skewed, broken, foreign matter, etc

Finished product size gauge

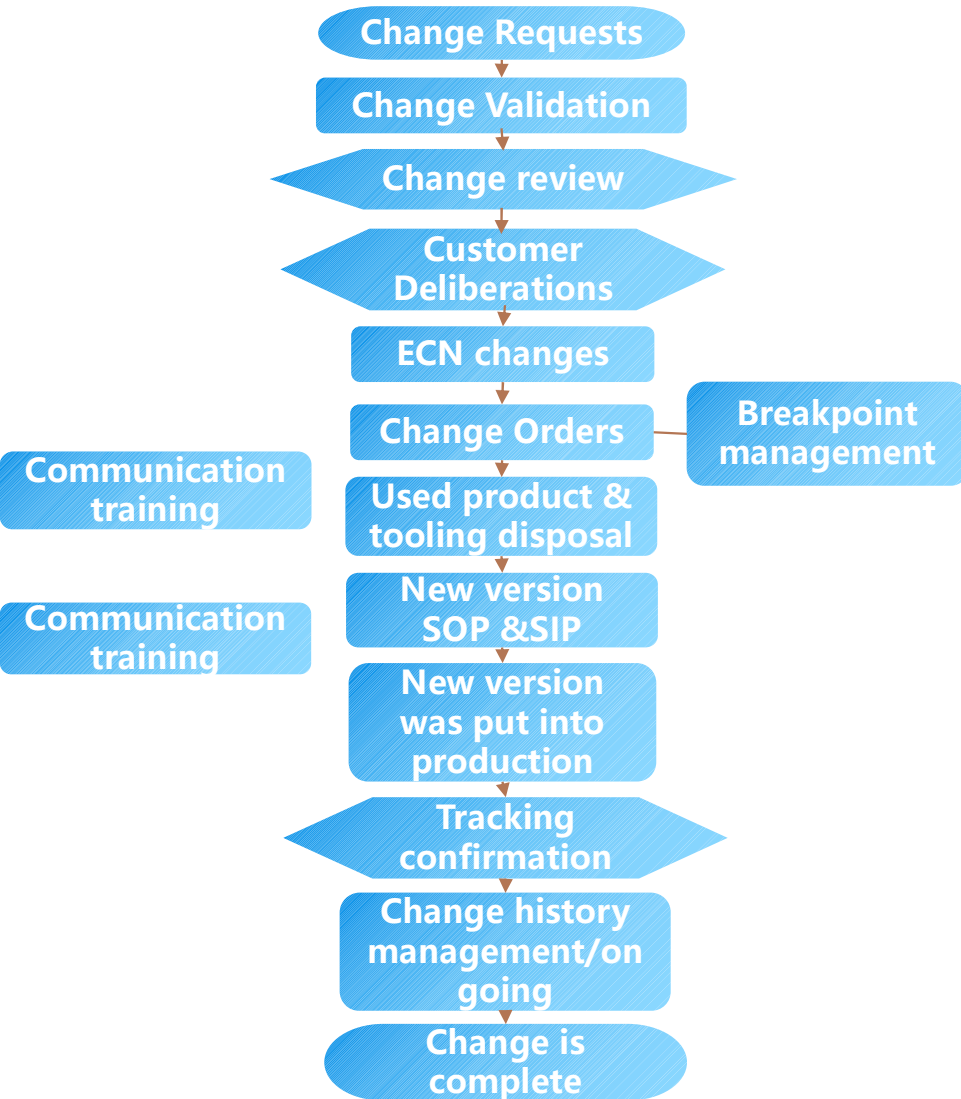
Manufacture of gauges; Perform 100 inspections of size & gauges

Systematic traceability management:

- ✓ FPC, aluminum bar and other materials traceability
- ✓ Tooling and mold traceability
- ✓ Equipment and equipment parameters can be traced
- ✓ Operator traceability
- ✓ Foolproof leakage process and wrong process
- ✓ Batch traceability, single PCS traceability



Systematic change management



Performance testing:

- Withstand voltage
- Insulation resistance
- Product current carrying and temperature rise
- Fuse blowing
- Pull-out force
- Peel force
- Vibration
- Drop



Environmental testing:

- Constant heat and temperature
- Salt spray
- Thermal shock
- Low temperature
- High temperature
- Spectral analysis system
- ROHS



- Laboratory has been accredited by CNAS

CCS reliability test

No.	Pilot project		Test methods or standards	Acceptance indicators	Verify results
1	Dimensional conformity	Full-size report	Use vernier calipers to detect the required size of the drawing; the size of the same position is detected 3 times, and the average value is calculated	Dimensions and tolerances meet the requirements of the drawings	Pass
2		On-off test	In accordance with GB/T 4677-2002 6.2.2 circuit connectivity testing, the electrical performance tester is used to detect all lines (including NTC circuits)	Line is 100% conductive (including NTC circuit), and there is no open circuit, short circuit or wrong circuit in any adjacent circuit. (NTC loop is confirmed by resistance.)	Pass
3	Electrical properties	NTC resistance test	Standard resistance is used to test the NTC resistance value for benchmarking, and the temperature value is converted according to the standard resistance for calibration measurement	Nick resistance test, Entek resistance in accordance with the pull-ter table	Pass
4		Loop resistance test	Test the resistance of each loop	Test the resistance of the loop, and the internal resistance of a single loop meets the requirements of the drawing	Pass
5		Insulation test	Insulation test between arbitrary busbars, 1000V DC, 60s	Insulation resistance \geq 500M Ω	Pass
6		Hipot test	1. PET film & bar pressure test: 2700VDC, 60s; 2. Connector position withstand voltage test: 1600VDC, 60s	1. PET film & bar withstand voltage: leakage current \leq 0.1mA; 2. Withstand voltage of connector position: leakage current <1mA	Pass
7		Fuse current-carrying test	Overload current is loaded through the terminals and pads, and the circuit breaking time is recorded.	1. Fuse breaking characteristics meet the fusing within 5A and 3s; Record the circuit breaker time 2. No fire in CCS, no molten droplets	Pass

No.	Pilot project	Test methods or standards	Acceptance indicators	Verify results
8	Welding strength of nickel sheet and FPC	Fix the FPC, pull the other end of the nickel sheet, the speed of the tensile machine is 50mm/min, until the nickel sheet is broken or the solder mark falls off, and the maximum value of the curve of the tensile machine at the highest point of the tensile force is read.	Shear force ≥ 300 N (180°), peel force ≥ 40 N (90°)	Pass
9	Nickel sheet and aluminum bar welding strength	Fix the Busbar, pull the other end of the nickel sheet, the speed of the tensile machine is 50mm/min, until the nickel sheet is broken or the welding mark falls off, and the maximum value of the curve of the tensile machine at the highest point of the tensile force is read	Shear force ≥ 300 N (180°), peel force ≥ 40 N (90°)	Pass
10	Welding strength of aluminum and copper bar (Output is extremely pure aluminum, not applicable)	Fix the copper bar, pull the other end of the aluminum bar, the speed of the tensile machine is 50mm/min, until the aluminum bar is broken or the welding mark falls off, and the maximum value of the curve of the tensile machine at the highest point of the tensile force is read.	Shear force ≥ 1500 N (180°), and the welding residue after peeling and failure $\geq 1/3$	Pass
11	Structural strength Component thrust	Fix the FPC and stiffener board, apply force according to the direction of connector insertion and in the opposite direction at a rate of 50mm/min	After welding, the NTC should be able to: withstand the push-off force of 10N and the shear force of 5N; maintain 10s \pm 1s without abnormality; and the NTC welding position and resistance value should be without abnormality. The connector thrust meets the requirements of the connector specification	Pass
12	Peel strength of FPC PI film/reinforcing plate	Reference standard: IPC-TM650 2.4.9 Test conditions: speed 50mm/min, test distance: 50mm	Protective film, substrate, adhesive according to the material specification, reinforcing plate peel strength ≥ 0.7 Kgf/cm; The adhesive should meet -40~85°C without cracking, and the adhesive stability should be consistent	Pass
13	Hot-pressed film with each interface Shear strength and peel strength	GB/T 2792-2014	Shear strength ≥ 5 MPa Peel strength ≥ 1.0 N/mm	Pass
14	Hot rivet column with aluminum Peel strength	Fix the isolation plate, use the tooling to pull the aluminum bar (the speed of the tensile machine is 10mm/min) until the aluminum bar falls off from the isolation plate, and read the maximum value of the curve of the tensile machine at the highest point of the tensile force	Peel strength ≥ 50 N	Pass

CCS reliability test

No.	Pilot project		Test methods or standards	Acceptance indicators	Verify results
15	Reliability	NTC Leak Test	1) Thermal shock: 500 cycles temperature shock (-40°C for 30min, conversion time ≤ 30s, 125°C for 30min, this is 1 cycle) 2) Immersion test: submerge the FPC in 25°C water for 500h, connect 5V direct current, and detect the NTC resistance at 120h, 240h, 360h, and 500h respectively.	After the test, 1-6 tests are carried out to meet the requirements of appearance, on-off, loop resistance, NTC resistance and insulation resistance;	Pass
16		Cryogenic storage	Temperature -40°C, 1000h, periodic confirmation every 200h	After the test, 1-6 tests are carried out to meet the requirements of appearance, on-off, loop resistance, NTC resistance and insulation resistance;	Pass
17		High temperature storage	Temperature is 125°C for 1000h, and periodic confirmation is carried out every 200h	After the test, 1-6 tests are carried out to meet the requirements of appearance, on-off, loop resistance, NTC resistance and insulation resistance;	Pass
18		High temperature and humidity	85°C, RH85%,1000h, Periodic confirmation is performed every 200 hours	After the test, 1-6 tests are carried out to meet the requirements of appearance, on-off, loop resistance, NTC resistance and insulation resistance;	Pass
20		Salt spray test	Neutral salt spray 96H	After the test, 1-6 tests are carried out to meet the requirements of appearance, on-off, loop resistance, NTC resistance and insulation resistance;	Pass
21		Vibration test	Test was carried out in accordance with GB/T 2423.56. There are two kinds of tests: random vibration and sinusoidal vibration.	1. There are no cracks, deformations, desoldering, virtual soldering or other phenomena on the components on the FPC board; There are no wrinkles, tears, loosening, etc. 2. The connector weld is not allowed to have defects such as short circuit or open circuit. The thermistor and FPC circuits are not allowed to have short circuits and other phenomena, and the resistance value is normal. 3. The pull-off force and peeling force of FPC nickel sheet meet the requirements of the drawing.	Pass
22		Material layer testing	Restricted substances are prohibited	Q/JLY J7110808B-2016 Q/JLY J7110845B-2016①	Meet Q/JL J160001-2020(1) "Requirements for Prohibited and Restricted Substances in Auto Parts and Materials"
23	RoHS		Product is divided into a single material and a homogeneous material and tested to detect whether the ten hazardous substances including lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBB), polybrominated diphenyl ethers (PBDE), DEHP, DBP, BBP and DIBP meet the requirements of the RoHS directive	Meets the RoHS limit requirements for ten hazardous substances	Pass
24	Flame retardant properties		UL 94	V-0	Pass

*Thank you for your
interest in Churod
CCS!*