2022

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中日电动汽车充电设施技术与标准交流会

China-Japan EV Charging Equipment Technology and Standard Conference

Ultra ChaoJi充电连接组件的研究

Ultra Chaoji Research

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2022.9.21

大功率充电接口发展现状（Current Status of HPC)

全球大功率充电接口种类较多，如下图。日本已率先使用超级接口作为大功率接口。随着重型用电器（如电动重卡等）的需求增长，兆瓦级功率的超大充电接口的需求也日益增长。

The demand of Ultra Chaoji Charger increases with the increasing requirement of high power charging.

	GB/T	New GB/T	CHAdeMO	CCS1	CCS2	Tesla	HPCVC	MCS
								
Max Power	950V x 250A = 237.5 kW	1500V x 600A = 900 kW	1000V x 400A = 400 kW	1000V x 500A = 500 kW	1000V x 500A = 500 kW	410V x 610A = 250 kW	1500V x 2000A = 3 MW??	1500V x 2000A = 3 MW??
Range add /minute charge	1.5 miles	5.8 miles	2.6 miles	3.2 miles	3.2 miles	1.6 miles	19.2 miles	19.2 miles
Communication Protocol	CAN (SAE J1939)	CAN (SAE J1939)	CAN (ISO 11898)	PLC (ISO 15118)	PLC (ISO 15118)	CAN (SAE J2411)	CAN or Ethernet (ISO 15118)	CAN or Ethernet (ISO 15118)
Location Used	China, India	China	Global	US	EU, South Korea, Australia	Global	US?, EU?	CN？ JP?
Related Standards	IEC 61851	IEC 61851	IEC 61851 IEEE 2030.1	IEC 61851 SAE J1772	IEC 61851	none	none	none
Notes	none	Liquid Cooled under development	Liquid Cooled under development	Liquid Cooled	Liquid Cooled	Liquid Cooled	Liquid Cooled	Liquid Cooled

◆ 2018年，CharIN发起了“兆瓦充电系统（MCS）”工作组，以发明基于组合充电系统CCS的整体系统方法。CharIN兆瓦充电系统 (MCS) 工作组CharIN帮助该行业创建一个通用解决方案。CharIN has set up Megawatt Charging System working team to develop a system solution based on combined charging system.

◆ 中国国家电网立项了科研项目-面向交通电气化的兆瓦级超大电流充电接口关键技术研究及其标准数字化应用示范，预计2024年完成系统的示范运行。The State Grid of China has established a scientific research project – Research on key technologies of ultra charging interface for megawatt current charging and its demonstration of standard digital application.

超大功率充电—国网项目（The State Grid Project of Ultra Power Charging）

◆ 中国国家电网有限公司于2022年立项了科技项目“面向交通电气化的兆瓦级超大电流充电接口关键技术研究及其标准数字化应用示范”，开展大功率充电技术研究，预计2024年完成示范应用。

◆ In 2022, State Grid Corporation of China set up a science and technology project " Research on key technologies of ultra charging interface for megawatt current charging and its demonstration of standard digital application " , to carry out research on high-power charging technology, and it is expected to complete the demonstration application in 2024.

车辆最高电压1000V	Vehicle maximum voltage 1000V
充电倍率2C	Charging rate 2C
动力电池容量500kWh	Power battery capacity 500kWh

最高输出电压1000V	Maximum output voltage 1000V
最大输出电流1200A	Maximum output current 1200A
最大输出功率1.2MW	Maximum output power 1.2MW

超大功率充电的研究内容（Research Content of Ultra Power Charging）

技术难点（Technological Difficulty）

满足实际需求的兼容性和拓展性结构，3000A超大电流的功能实现、热管理和失效安全防护难度大，多元应用场景的信息交互、开源架构和数值化实现（It is difficult to implement the 3000A ultra current, thermal management, and failure safety protection ）

研究内容Research Content

①研究充电物理接口高效安全的液冷、动力输出集成技术（High efficiency and safety integration）

②研究充电物理接口与 ChaoJi 充电接口对接转移的自适应力柔顺控制技术（Adaptive compliance control technology）

⑤研究基于开源架构的信息交互接口标准数字化实现方法（ Information interaction protocol）

④研究满足多元应用场景的信息交互框架和流程（Information interaction frameworks and processes）

物理接口

互联方案

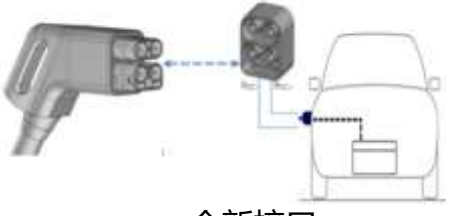
开源协议

信息交互

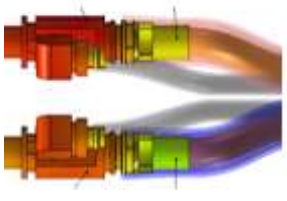
安全保护

课题Subject

③研究充电物理接口温度管理和监控技术（Thermal management）



全新接口
New interface

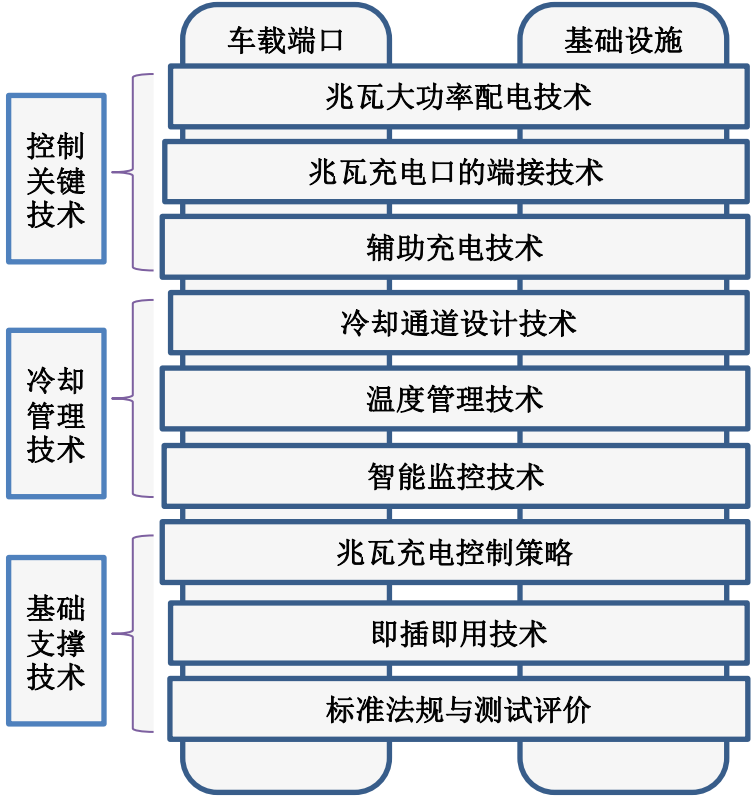


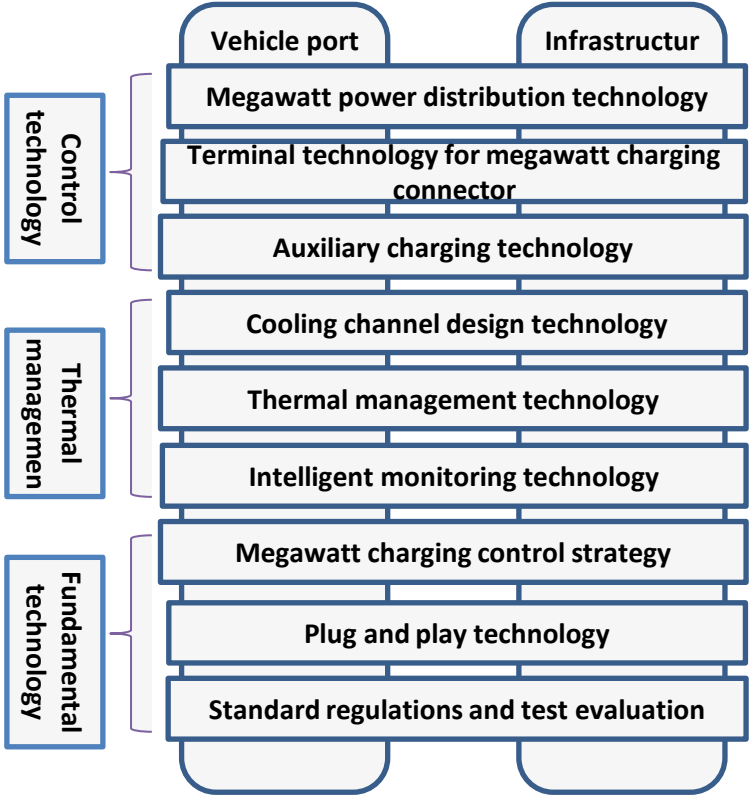
液冷和动力输出集成
Integration

温度测试和监控
Thermal Management

超大功率充电的关键技术（Key Technologies of Ultra Power Charging）

兆瓦级大功率超充结合了机、电、液、热控等多方面新技术，包括从源端到接口的控制、冷却管理技术、基础支撑技术等多领域的关键技术。Megawatt charging combines several new technologies form different fields such as mechanical, electrical, hydraulic, thermal control etc.





关键技术之接口界面设计（Key Technology – Interface Design）

ChaoJi 界面
ChaoJi interface

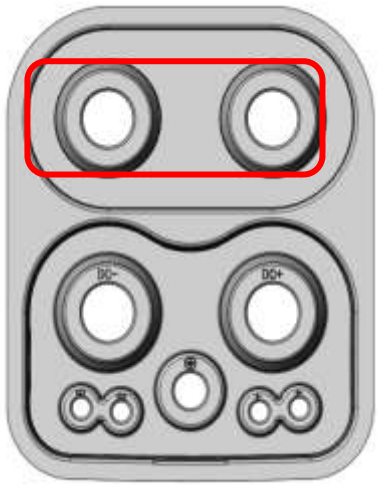
附加功率端子在底部
Additional power terminals on bottom

附加功率端子在顶部
Additional power terminals on top

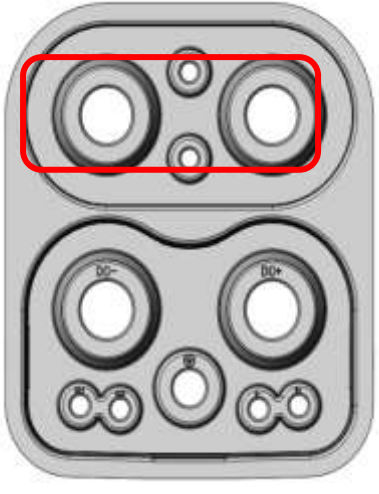
- Ultra ChaoJi充电接品通过增加一对功率端子，额定电流提升至1200A~3000A，额定电压1500V Max；
- By adding a pair of power terminals for the Ultra ChaoJi interface, the rated current is increased to 1200A~3000A, and the rated voltage is 1500V Max;
- Ultra ChaoJi车辆插座兼容ChaoJi插头，提升Ultra ChaoJi车辆的补电便利性；
- Ultra ChaoJi vehicle inlet is compatible with ChaoJi connector to improve the convenience of Ultra ChaoJi vehicle charging;
- 附加功率端子如何布置，放上面或放下面？
- How are the additional power terminals arranged, top or bottom?
- 附加功率端子直径和ChaoJi接口的功率端子是否需保持一致，设计成10mm或是更大？
- Should the diameter of the additional power terminal be the same as the power terminal of the ChaoJi interface,? Designed to be 10mm or bigger?

附加功率端子设计 – 位置 (Additional Power terminals design - position)

附加功率端子在顶部
Additional power terminals on top

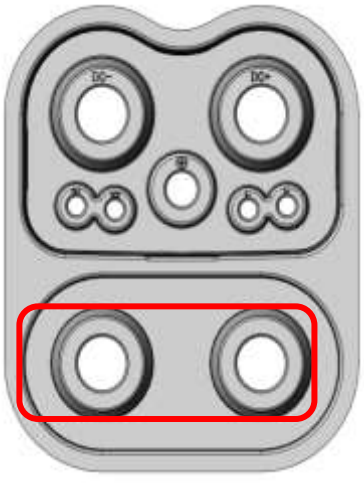


No auxiliary power

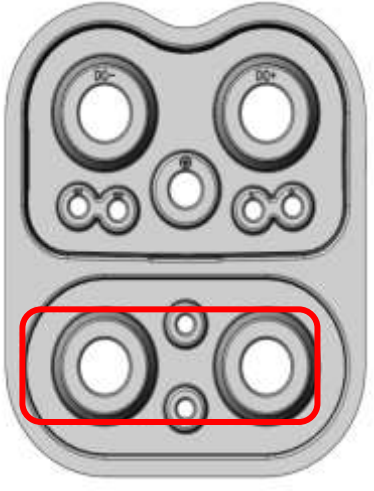


With auxiliary power

附加功率端子在底部
Additional power terminals on bottom.



No auxiliary power

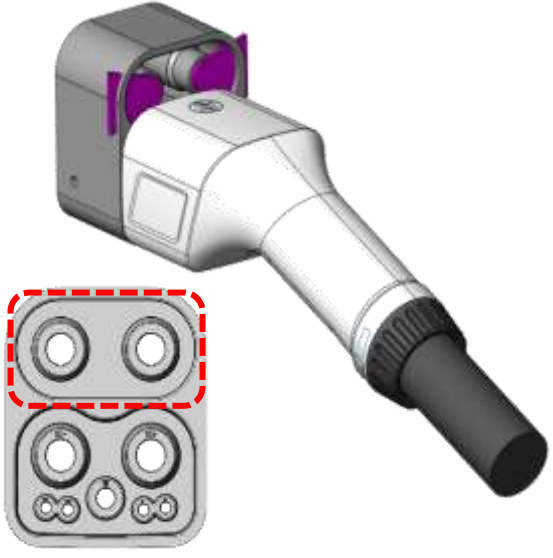


With auxiliary power

如果在Ultra ChaoJi上考虑增加辅助电源的话，但是ChaoJi界面上是没有辅助电源的，这样会导致ChaoJi与Ultra ChaoJi之间无法兼容
If need adding auxiliary power on Ultra ChaoJi, but there is no auxiliary power on the ChaoJi interface, which will lead to incompatibility between ChaoJi and Ultra ChaoJi.
注：增加的辅助电源是满足电动飞机的辅助充电需求（Note：Auxiliary power is designed for electric aircraft use）

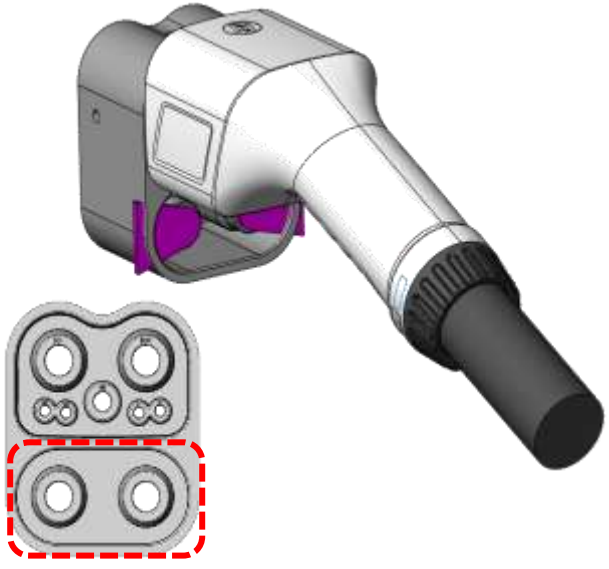
附加功率端子设计 – 位置 (Additional Power terminals design - position)

附加功率端子在顶部
Additional power terminals on top



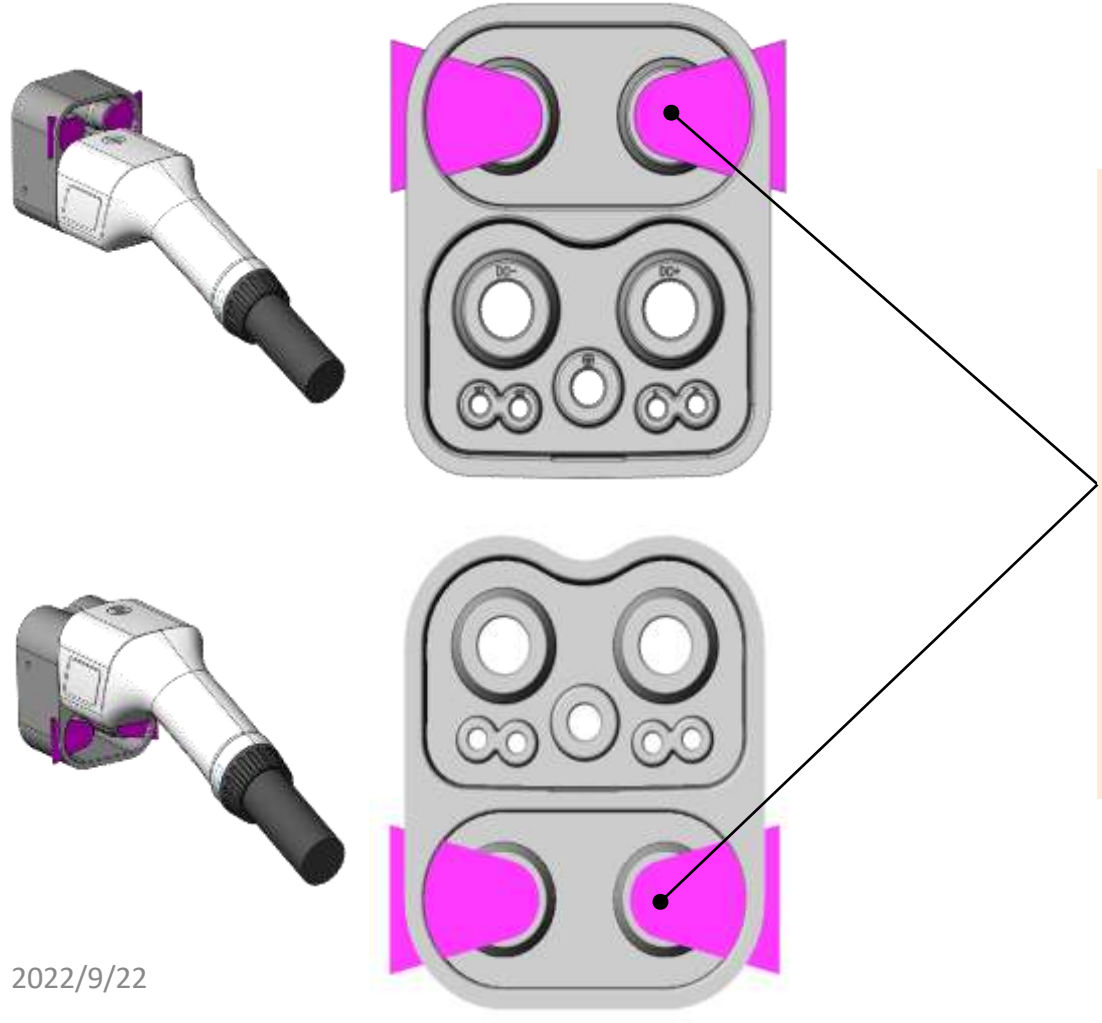
附加功率端子在界面顶部，在雨雪天气时使用ChaoJi充电插头充电时，如果防护结构不好的话，可能会在附加功率端子处增加电气绝缘故障的风险
The additional power terminal is at the top of the interface. When charging with the ChaoJi charging connector in rainy and snowy weather, if the protective structure is not good, it may increase the risk of insulation failure at the additional power terminal

附加功率端子在底部
Additional power terminals on bottom.



附加功率端子在界面底部，在雨雪天气使用ChaoJi充电插头充电时，ChaoJi枪头的主体可以对底部附加功率端子遮盖保护的功能。
The additional power terminal is at the bottom of the interface. When using the ChaoJi charging connector to charge in rainy and snowy weather, the body of the ChaoJi connector can protect the bottom from the snow and rain with the additional power terminal.

附加功率端子设计 – IP防护（Additional Power terminals design – IP degree）



两种布置都需考虑附加功率端子的防护要求： IPXXD需考虑做成自动防护结构

- 当使用ChaoJi充电枪对车辆进行充电时，附加功率端子同时也带电，须对附加的功率端子口部设计防护结构以达到IPXXD的等级
- 而当使用Ultra ChaoJi充电插头插合时，防护盖应能自动张开使端子能够正常进行耦合接触。

Both design need to consideration the protection requirements of the additional power terminals for IPXXD

- If making an automatic protection structure.

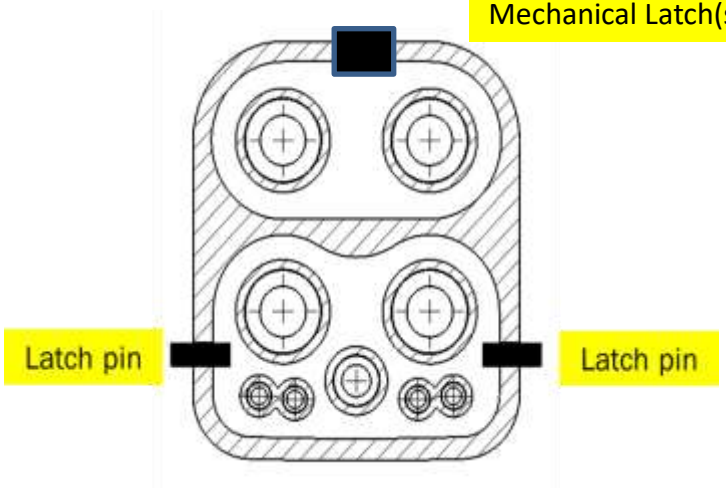
When using the ChaoJi charging connector ,the additional power terminals may be exposing and live , and a protective structure must be designed for the ports of the additional power terminals to reach the IPXXD level

- When the Ultra ChaoJi charging connector is used, the protective cover should be able to open automatically so that the Ultra ChaoJi coupler can be mated.

附加功率端子设计 – 锁合（Additional Power terminals design – lock ）

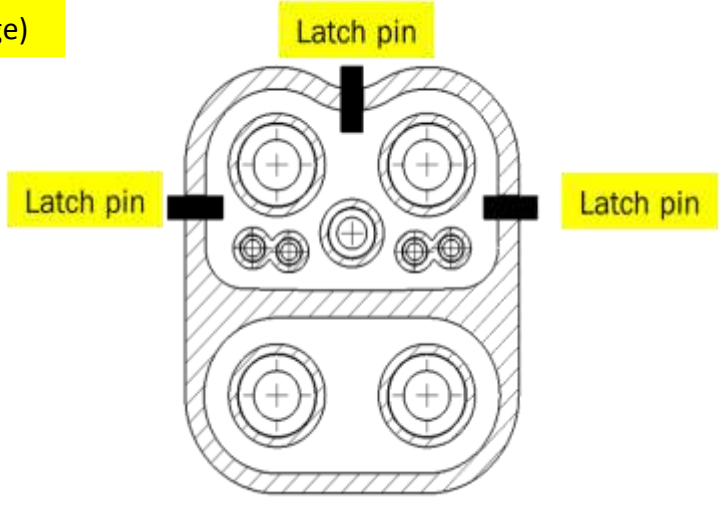
附加功率端子在顶部
Additional power terminals on top

Mechanical Latch(see next page)



考虑兼容ChaoJi插头，电锁安装方向只能选择左、右两侧,且锁止位置在底部
Considering the compatibility with ChaoJi connector, the installation direction of the locking device just can selected on the left and right sides, and the locking position is at the bottom of the interface.

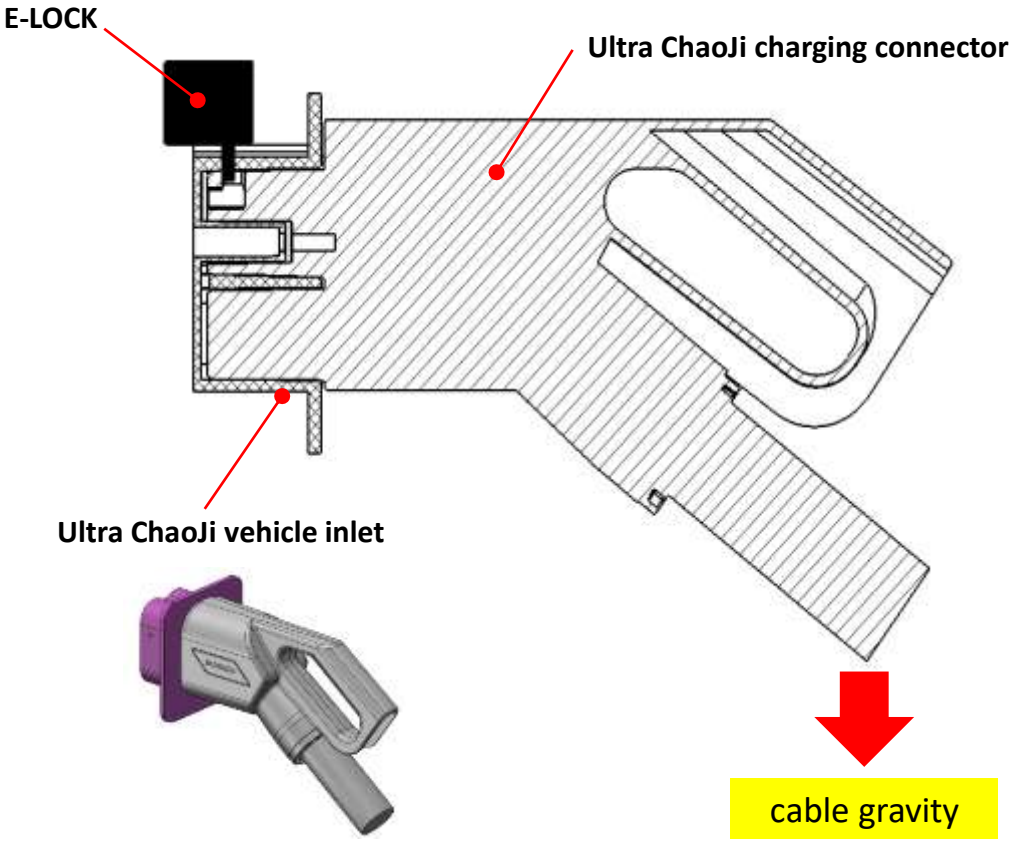
附加功率端子在底部
Additional power terminals on bottom.



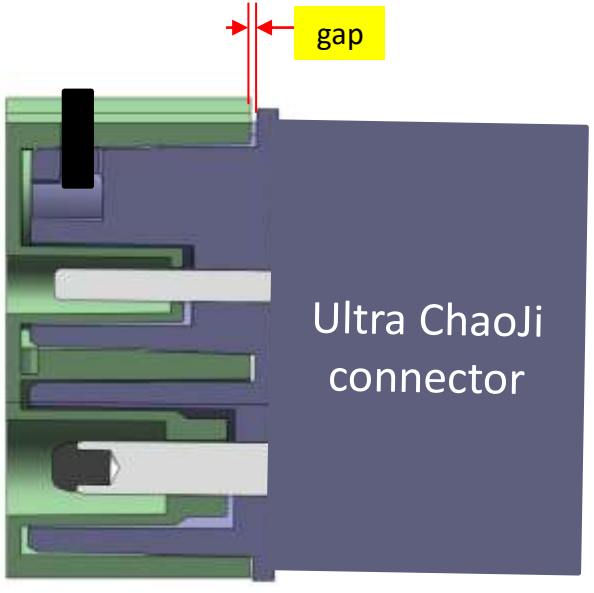
兼容ChaoJi插头的同时，电锁安装方向仍和ChaoJi一样可以三个方向安装电锁（左、右、上）,且锁止位置在顶部
While compatible with ChaoJi plugs, the installation direction of the electric lock is still the same as that of ChaoJi. You can choose to install the electric lock in three directions: left, right and up. And the locking position is at the top of the interface.

附加功率端子设计 – 锁合（Additional Power terminals design – lock ）

附加功率端子在底部
Additional power terminals on bottom.



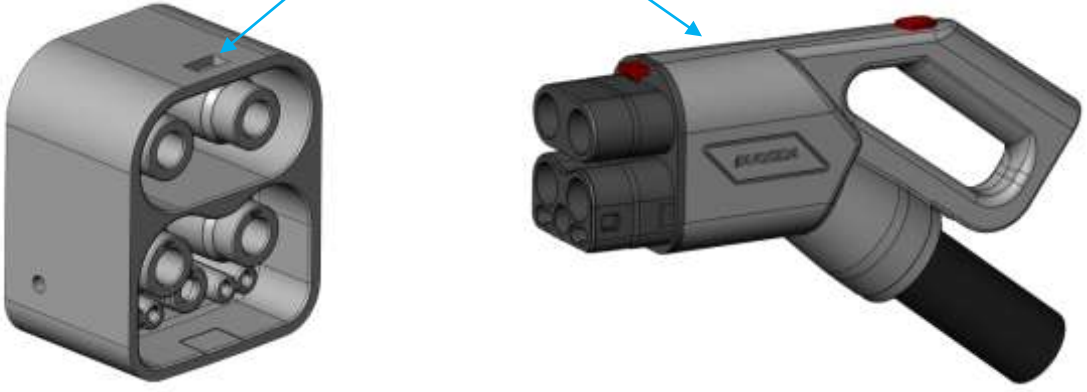
附加功率端子如果在Ultra ChaoJi界面下端，可以通过上方的电锁来控制因线缆重量导至界面上端耦合时产生的间隙问题。
If the additional power terminal is on the bottom of the Ultra ChaoJi interface, the E-lock on the top can improve the gap problem that may be caused by the gravity of the cable.



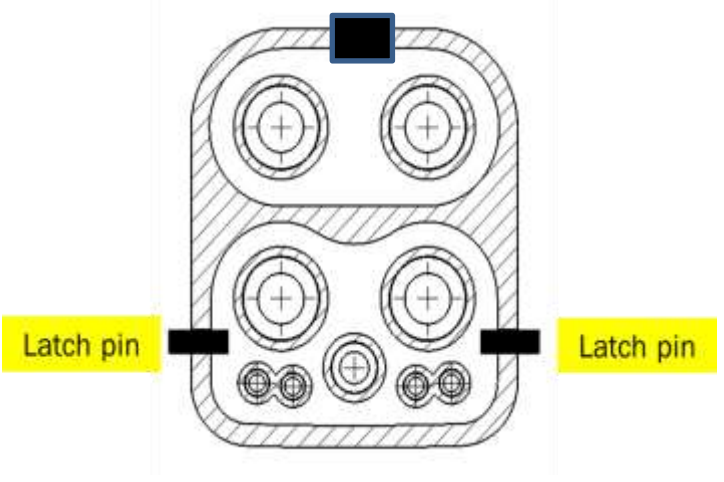
附加功率端子设计 – 锁合（Additional Power terminals design – lock ）

附加功率端子在顶部
Additional power terminals on top

Mechanical Latch structure



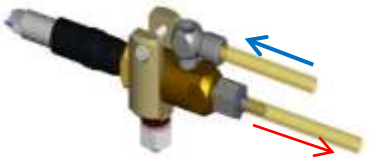
附加功率端子如果在Ultra ChaoJi界面上端，可以考虑增加机械锁钩来改善因线缆重量导至界面上端耦合时产生的间隙问题。
If the additional power terminal is on the top of the Ultra ChaoJi interface, consider adding a mechanical latch structure to improve the gap problem that may be caused by the gravity of the cable.
此外，机械锁可以起到辅助锁合的作用
BTW， the mechanical lock can play the role of auxiliary locking

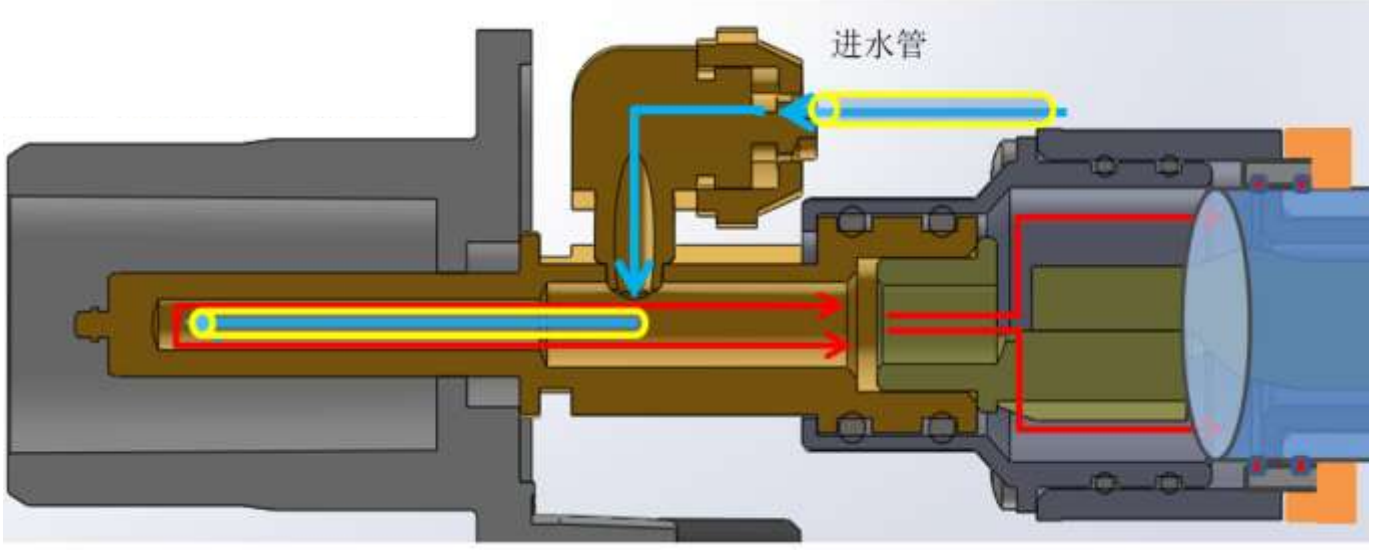


关键技术之冷却通道设计（Key Technology – Cooling Design）

康尼的冷却方案采取了成熟的HPC接口的方案：四进四出，冷却液通过进水管直接到达端子部位，再通过电缆通道流回，冷却效率高。同时改进了冷却电缆的设计，通过螺旋式冷却通道，加大热交换的面积，更好的散热。

KangNi adopts 4 in 4 out cooling scheme. Coolant liquid can reach terminal position which increases cooling efficiency. Spiral cooling channel design increases heat radiating area.





- 功率针直径10mm, 可满足IPXXB的防护要求（Power terminal diameter is 10 mm，meets IPXXB requirement）
- 插针内部有冷却通道，冷却液可到达接触部位，有效带走热量（Coolant liquid can reach terminal position）
- 四进四出，冷却液直接到达端子部位，再通过电缆通道回水（4 in 4 out）
- 压接部位浸在冷却液中，热量可有效带走（The crimped parts are immersed in coolant）
- 功率单股线为95mm2, 采用水包铜的螺旋式冷却通道电缆（Signal power cable is 95mm²， copper-clad spiral cooling channel cable ）

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