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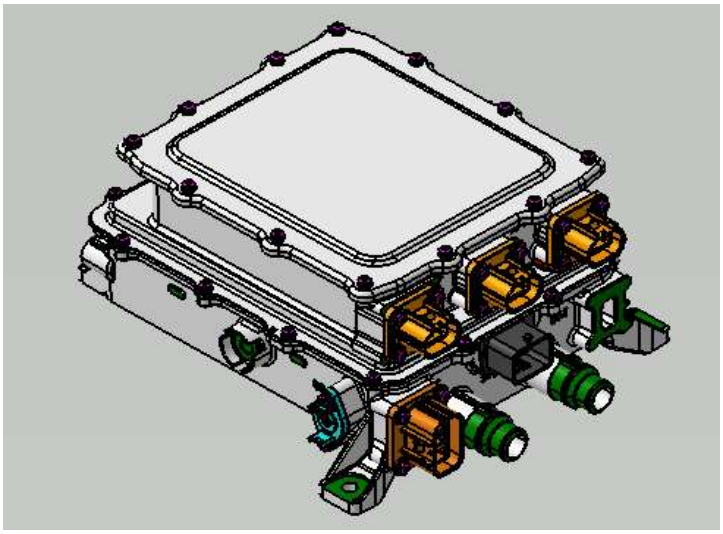
3 in 1 PDU integrated 2.5KWDC/DC converter & 6.6KW Bi-directional OBC Liquid Cooled System

Model No.: AT3PD2K5C6K6B-D14C350-W



Features

1. Output Power: DC/DC Converter: 2.5KW
   OBC: 6.6KW
2. Input Voltage:
   OBC: 90~264VAC DC/DC: 200~500VDC
3. Output Voltage:
   DC/DC: 13.8~14.6VDC
   OBC: 200~500 VDC Rated Voltage: 350Vdc
4. Communication Method: CAN-BUS
5. Cooling Mothed: Liquid Cooled
6. Weight: ≦ 8.5KW
7. Enclosure: Aluminum alloy
8. IP Rating: IP67
9. Software: Digital software design
10. Inverter function: supported

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1. Overview

1.1 Summary

This product is a three-in-one, bidirectional, onboard charging and power distribution assembly developed for new energy vehicles. It features high integration and power density. The onboard charger (OBC) draws energy from a 220V AC power source to charge the vehicle's high-voltage power battery. During the charging process, the power battery management system monitors the charging status in real time. The OBC responds to voltage and current commands from the BMS and provides status feedback for self-diagnosis. Furthermore, this OBC has a reverse discharge function, capable of outputting 220V AC voltage to power devices with different characteristics. The DC/DC converter's primary function is to convert the power battery pack's high-voltage DC power into 13.8V low-voltage DC power to power the vehicle's accessory systems.

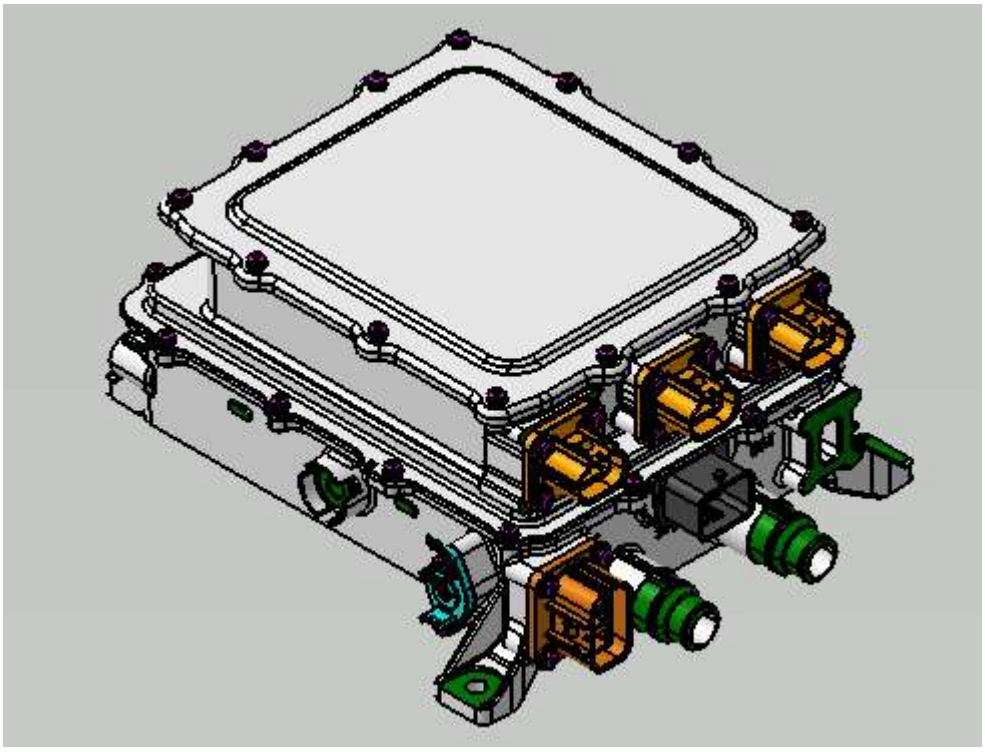

Figure 1 Product digital model

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1.2 Industry Terminology

No.	Terms or abbreviations	illustration
1	BMS	Battery Management System
2	ADS	High-voltage safety system (Auto-Disconnect System)
3	SOC	Battery State of Charge
4	CAN	CAN communication network (Controller Area Network)
5	ECU	Electronic Control Unit
6	EV	Electric Vehicle
7	OBC	On-Board Charger
8	DCDC	DC - DC Converter
9	HV	High Voltage
10	LV	Low Voltage
11	CC	Constant Current
12	CV	Constant Voltage
13	MCU	Motor Control Unit
14	VCU	Vehicle Control Unit
15	CAN	Controller Area Network
16	UDS	Unified Diagnostic Services
17	ASIL	Automotive Safety Integrity Level
18	HVIL	High Voltage Interlock Loop
1 9	PDU	High-voltage power distribution unit

1.3 Introduction to the main functions of the system

1.3.1 OBC Module Function

According to the BMS instruction requirements, the battery is charged with constant current and constant voltage in different states within the adjustable range;

According to the BMS instruction requirements, the pure resistive load is powered with different power requirements within the adjustable range to achieve battery heating;

According to the BMS instruction requirements, AC inverter output is performed within a certain voltage range to supply AC load;

The OBC module diagnosis, self-test and protection functions can be realized according to the CAN information of the whole vehicle and the information of its own monitoring;

1.3.2 DC-DC Converter Function

The DCDC converter receives the control signal from the vehicle controller and converts the high voltage of the power battery into a low voltage 14V output to meet the charging and load requirements of the subsequent on-board battery. At the same time, it can realize feedback on its own status and load status.

1.3.3 PDU Function

Vehicle power distribution system: contains fuses and relays of main circuits;

1.3.4 CAN Communication Function

OBC and DC/DC control the output voltage and output current through the CAN bus, and realize information exchange with BMS and VCU and feedback of working status through CAN communication.

1.3.5 UDS Diagnosis

It can diagnose the functions of OBC and DCDC and report to the vehicle system. It can also flash the program remotely to achieve offline programming, reducing after-sales maintenance costs .

1.3.6 Self-diagnosis and multiple protection functions

With self-diagnosis, input and output over-voltage, under-voltage protection, output short circuit protection, hardware fault protection, whole machine over-temperature protection and recovery functions;

1.3.7 Cooling method:

Liquid Cooling

2 . Reference Standards

The reference standards of this technical requirement include but are not limited to the following standards. Regardless of whether the following standard documents are marked with a date, their latest versions (including all amendments) apply to this technical requirement.

No.	Standard/Document No.	Standard/File Name
1	QC/T 895-2011	Conductive on-board charger for electric vehicles
2	GB/T 18384.1-2015	Safety requirements for electric vehicles Part 1: On-board energy storage devices
3	GB/T 18384.2-2015	Safety requirements for electric vehicles Part 2: Functional safety and fault protection
4	GB/T 18384.3-2015	Safety requirements for electric vehicles Part 3: Protection of personnel against electric shock
5	GB/T 18487.1-2015	Electric vehicle conductive charging system Part 1: General requirements
6	GB/T 2423.1	Environmental testing for electrical and electronic products Part 2: Test methods Experiment A: Low temperature

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7	GB/T 2423.2	Environmental testing for electric and electronic products Part 2: Test methods Experiment B: High temperature
8	GB/T 2423.10	Environmental testing for electric and electronic products Part 2: Test methods Experiment Fc: Vibration (sinusoidal)
9	GB/T 2423.17	Environmental testing for electrical and electronic products Part 2: Test methods Experiment Ka: Salt spray
10	GB/T 2423.22	Environmental testing for electric and electronic products Part 2: Test method Experiment N: Temperature change
11	GB/T 28046.2	Environmental conditions and testing for electrical and electronic equipment in road vehicles - Part 2: Electrical loads
12	GB/T 17619—1998	Limits and measurement methods for electromagnetic radiation immunity of electronic and electrical components in motor vehicles
13	GB/T 4094.2—2005	Markings for electric vehicle controls, indicators and signal devices
14	QC/T 413-2002	Basic technical requirements for automotive electrical equipment
15	IEC 61851-1	Technical Committee on Electric Road Vehicles - General Requirements for Charging Systems
16	GB 14023—2011	Limits and methods of measurement of radio disturbance characteristics of vehicles, ships and internal combustion engines for the protection of off-vehicle receivers
17	GBT 18387—2017	Limits and measurement methods for electromagnetic field emission intensity of electric vehicles, broadband, 9KHZ-30MHZ related requirements
18	EN 62477-1	Power electronic converter systems and equipment: general safety requirements
19	GB/T 4208-2008	Shell protection rating (IP rating)
20	GB/T 17619-1998	Electromagnetic radiation immunity limits and measuring methods for motor vehicle electrical and electronic components
21	GB/T 24347 - 2009	Electric vehicle DCDC converter

3. Environmental requirements

The operating environment conditions of this assembly are as follows:

No.	Project	Technical indicators	Unit	Remark
1	Operating temperature	- 40 to 85	℃	Internal power reduction when the temperature exceeds 85°C
2	Storage temperature	-40～105	℃	The power supply is not turned on
3	relative humidity	5 to 95	%RH	No condensation, no frost
4	Protection level	IP67		
5	Cooling method	Liquid Cooling		
6	Vibration level	Meet QC/T895-2011		
7	Noise level	65	dB	Meet QC/T895-2011
8	Salt spray level	Meets QC/T2423.17-2011		
9	Altitude	4000	m	GB/T16935.1-2008

1 0	Temperature and humidity resistance	Meets GB/T 2423.22		
1 1	fall	Wiring harness according to QC/T417.1-2001 The shell is in accordance with GB/T 2423.8-1995		Appearance, structure and performance are normal

4. Technical Specifications

4.1.OBC electrical performance requirements

Project		Mini	Typical	Max	Unit	Condition
OBC electrical characteristics (AC /DC)						
1. Input characteristics						
Rated input voltage		-	220	-	V a c	
Input voltage range		90	-	264	Vac	Normal operating voltage range
Maximum input current		-	-	32	A	Input voltage changes, input current does not exceed 32 A
AC input voltage frequency		45	50	65	Hz	Rated 50 Hz
Power Factor (PF)		0.98 0.94	-	-	-	@50% to 100% load > 0.98 @15% to 50% load > 0.94
2. Output characteristics						
high voltage Output	Rated output voltage	350			Vdc	When the input is 110Vac, the output power will be automatically reduced. Output can run at full power when input is 220Vac
	Output voltage range	200		460	Vdc	
	Output current range		22		A	
	Output rated power		6.6		KW	
	Output ripple and noise		± 5		%Vo	
	Startup ramp-up time		4		S	After the OBC receives the BMS charging request, the output voltage rises from 10% to 90%.
	Output fall time		3 00		mxD	The time it takes for the output current to drop to 0A after the OBC receives the BMS shutdown command.
	Output constant voltage accuracy			1	%	Maximum not more than ±1%
	Output steady current accuracy			5	%	Maximum does not exceed ±0.5A

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	Static current loss			0.5	mA	Sleep mode without gun plugged in, consumes KL30 constant current
	Overall efficiency	93	-		%	Output voltage below 300V , efficiency ≥9.3 % Output voltage above 300V , efficiency ≥9.4 %
3. Protection characteristics						
Input overvoltage protection		2 65	2 73	2 75	Vac	Turn off the output,
Input overvoltage recovery		2 5 0	2 59	2 6 0	Vac	Hysteresis ≥5Vac
Input undervoltage protection		80		90	Vac	Turn off output
Input undervoltage recovery		9 0		95	Vac	Hysteresis ≥5Vac
Input overcurrent protection				32	A	The input maintains the input current no more than 32 A and automatically adjusts the output power.
High voltage output	Output overvoltage protection	475	482	485	Vdc	Turn off high voltage output and restore after troubleshooting
	Output undervoltage protection	190	195	200	Vdc	Turn off high voltage output, which can be restored after troubleshooting (battery voltage and output voltage must be synchronized)
	Output overcurrent protection			21	A	
	Output short-circuit protection	Yes			-	Before entering the charging process, if the output short circuit is detected, charging will not start. If the output short circuit occurs during charging, the high voltage output will be immediately turned off.
	Output reverse polarity protection	Yes			-	The output is reversed, and the high voltage output does not start. After the fault is eliminated, normal operation is restored.
Communication fault protection		Yes			-	If the charger does not receive BMS instructions for 5 consecutive seconds, or a communication

						failure occurs during the charger operation, the charger will shut down the output.
Over-temperature protection	OBC_MCU	95		100	℃	OBC _ MCU temperature derating range is 95~100℃. PFC MOS tube temperature derating range is 120~124℃. Compare the difference between MCU temperature and MOS tube temperature and the starting derating value, and the one with the larger difference will be derated; MOS tube shuts down at 125℃.
	PFC_ M OS	120		124		

4.1.1 OBC output efficiency and temperature derating curve

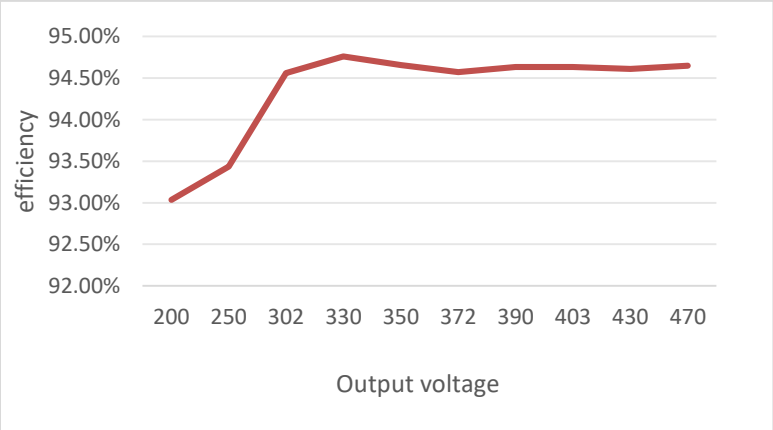

Figure 2 OBC efficiency curve

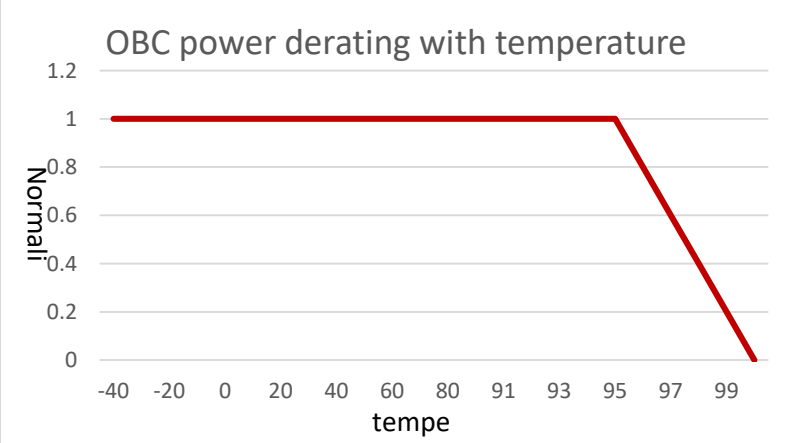

Figure 3 OBC temperature derating curve

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project		Minimum	typical	maximum	unit	condition
OBC electrical characteristics (DC/AC)						
1. Input characteristics						
Rated input voltage		-	350	-	Vdc	D C
Input voltage range		240	-	50 0	Vdc	D C
2. Output characteristics						
	Output voltage range	209	220	231	Vac	220 VAC ± 5 %
	Output waveform	Sine Wave				
	AC output voltage frequency	49	50	5 1	Hz	5 0 ±1 Hz
	Rated output power	-	3.3	-	kW	
	efficiency	9 2	-	-	%	
	Output current range	0	-	15	A	
3. Protection characteristics						
Output overvoltage protection		-	400V	-		The protection point setting voltage is the peak voltage
Output overvoltage recovery		-	380V	-		
Output overcurrent protection		-	22A	-		
Overload capacity		-	125%			The current shall work continuously and reliably for not less than 1 minute at 110% of the rated load; and shall work continuously and reliably for not less than 10 seconds at 125% of the rated load.

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4.2.DC electrical performance requirements

Project		Mini	Typical	Max	Unit	Condition
DC/DC electrical performance						
1. Input characteristics						
Input voltage range		200	-	460	Vdc	
2. Output characteristics						
Output voltage range		9	14	16	Vdc	
Rated output current		-	178	-	A	
Peak output current		-	214	-	A	
Output power		-	2500	-	W	
Peak Power		-	-	3000	W	3 kW@6 min
DC efficiency		90	-	-	%	Rated input, load> 30% weighted efficiency, peak efficiency
3. Protection characteristics						
Input overvoltage protection point		475	482	485	Vdc	Turn off the output,
Input overvoltage recovery point		465	470	475	Vdc	Hysteresis ≥5VDC
Input undervoltage protection point		19 0	195	200	Vdc	Turn off output
Input undervoltage recovery point		200	208	210	Vdc	Hysteresis ≥5VDC
Output over-voltage protection point			1 6		Vdc	
Output under-voltage protection point			9		Vdc	
Over-temperature protection	MCU	1 00		1 09	℃	The MCU temperature derating range is 100~109. The MOS tube temperature derating range is 115~124. Compare the difference between the MCU temperature and the MOS tube temperature and the starting derating value. The derating value is determined by the larger
	MOS	1 20		1 24	℃	

						difference. The MOS tube shuts down at 125℃.
Output overcurrent protection		> 214			A	Software output is adjustable, this value is the hardware current limit value
Communication fault protection		Yes			-	If the charger does not receive BMS instructions for 5 consecutive seconds, or a communication failure occurs during operation, the charger will shut down the output.

4.2.1 DC-DC output efficiency and temperature derating curve

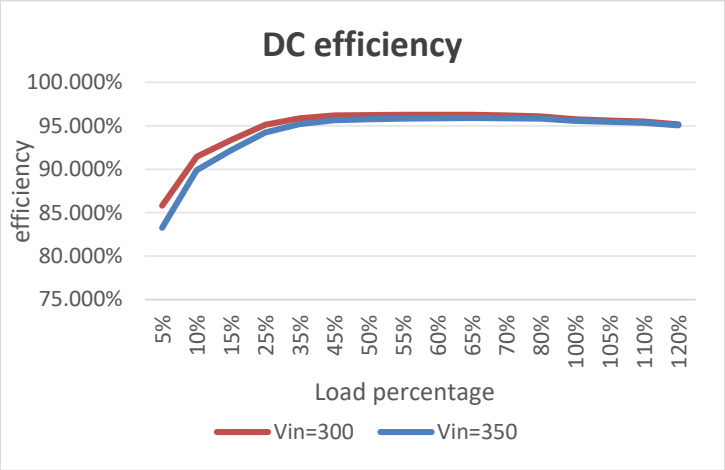


Figure 4 DC efficiency curve

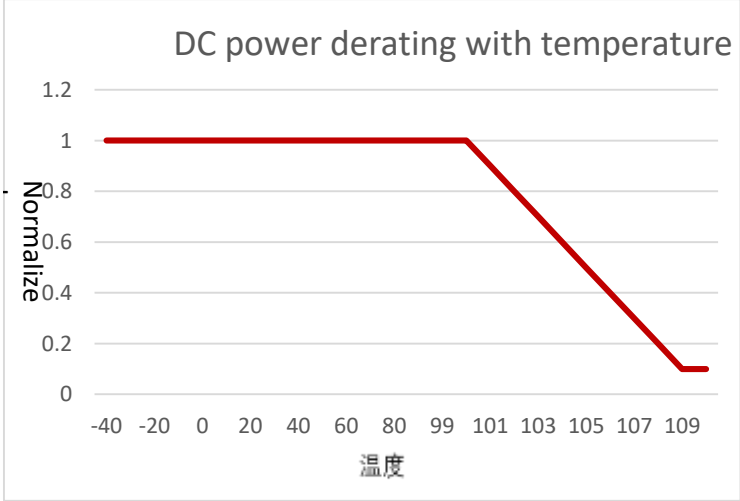


Figure 5 DC temperature derating curve

4.3. Low voltage electrical performance requirements

Signal interface						
K L30	Thermistor	C C/CP	Communicat ion method	Electronic lock	Baud rate	High voltage interlock
12V	1 0K	support	CAN	support	500Kbps	HVIL+/ HVIL-

4.4. Safety performance and other

Safety features				
project		**Technical indicators**	**unit**	**Remark**
Dielectric strength	Input to housing	2000 VAC, 3s, leakage current ≤ 20mA		No breakdown or arcing
	Output to housing	2000 VAC, 3s, leakage current ≤ 12mA		No breakdown or arcing
	Input to Output	2000 VAC, 3s, leakage current ≤ 28mA		No breakdown or arcing
Insulation resistance	DC high voltage-DC low voltage (shell ground)	Resistance ≥ 100 MΩ, test voltage 500 VDC		No breakdown or arcing
Ground resistance	Ground wire to shell - DC low voltage (shell ground)	≤0.1	Ω	The resistance between the ground point and the radiator is less than 100 milliohms, and the test current is 25A AC
Creepage clearance		≥4mm		Meet the requirements of Table 3 of GB/T18488.1-2001
Electrical clearance		≥3mm		Meet the requirements of Table 3 of GB/T 18488.1-2001
MTBF		150000H	h	Ambient temperature 25℃

4.5 Electromagnetic compatibility

Test items	Reference Standards	Performance indicators	Criteria	Remark
1. EMI test				
Conducted disturbances (CE)	GB/T 18487.3-2001			Only for OBC test
Radiated disturbance (RE)	GB/T18487.3-2001			
Conductive Electromagnetic Sensor (CE)	GB/T 18655-2010	Level 3		Only for DCDC test
Fallout (RE)	GB/T 18655-2010	Level 3		

2. EMS test ★				
surge	GB/T18487.3-2001 GB/T 17626.5-2008	Input differential mode 1KV 1.2/50us Input common mode 2KV 1.2/50us	B	Only for OBC test
EFT	GB/T18487.3-2001GB/T 17626.4-2008	2KV/5KHz/1min	B	
ESD	GB/T18487.3-2001 GB/T 17626.1-1998	Contact 4KV/Air 8KV	B	
CS		10LIVE3 0.15-80MHz	A	
RS	GB/T 18487.3-2001 GB/T 17626.3-2006	3V/m 80-1000MHz	A	
		10V/m 80-1000MHz	B	
DIP	GB/T 18487.3-2001	Drop to 70% U(T), time 10ms; Fall to 50% U(T), time 100ms; Fall to 95% U(T), time 5000ms;	B	
Voltage fluctuations and flicker		Voltage fluctuation and flicker limits for Class A products		
Current harmonic emissions	GB/T 18487.3-2001	Harmonic current limits for Class A products		
Electrostatic Disturbance (ESD)	GB/T 19951-2005	Contact discharge of the whole machine (power on): ±6KV Air discharge: ±8KV	B	
		Whole machine (not powered on) Contact discharge: ±6KV Air discharge: ±15KV	C	
Radiated electromagnetic field immunity free field method (RS)	GB/T 17619-1998		A	
Radiated electromagnetic field immunity Bulk current injection (BCI)	GB/T 17619-1998		A	
Immunity to electrical transient conducted disturbances along power lines (CS)	GB/T 21437.2-2008 (ISO 7637-2)	level 4	Pulse1, Pulse2b is D, Pulse 2a, Pulse 3a/3b is A	

Electrical fast transient (EFT) immunity	GB / T 17626.4-2008 (IEC 61000-4-4)	±4KV, 5KHz/100KHz	B	

Criteria definition:
A: The test process indicators are within the specification range.
B: After the test is completed, they can be automatically restored to the specification range.
C: After the test is completed, they can be manually restored to the specification range.

4.6 CAN Network System

4.6.1 With CAN wake - up function, meeting UDS diagnosis and offline program burning
4.6.2 CAN network compatibility

The CAN circuit is as follows:

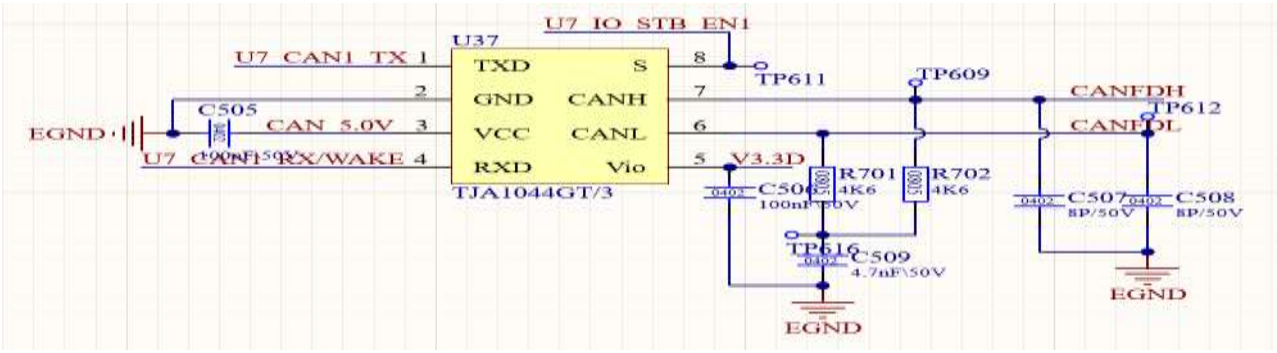
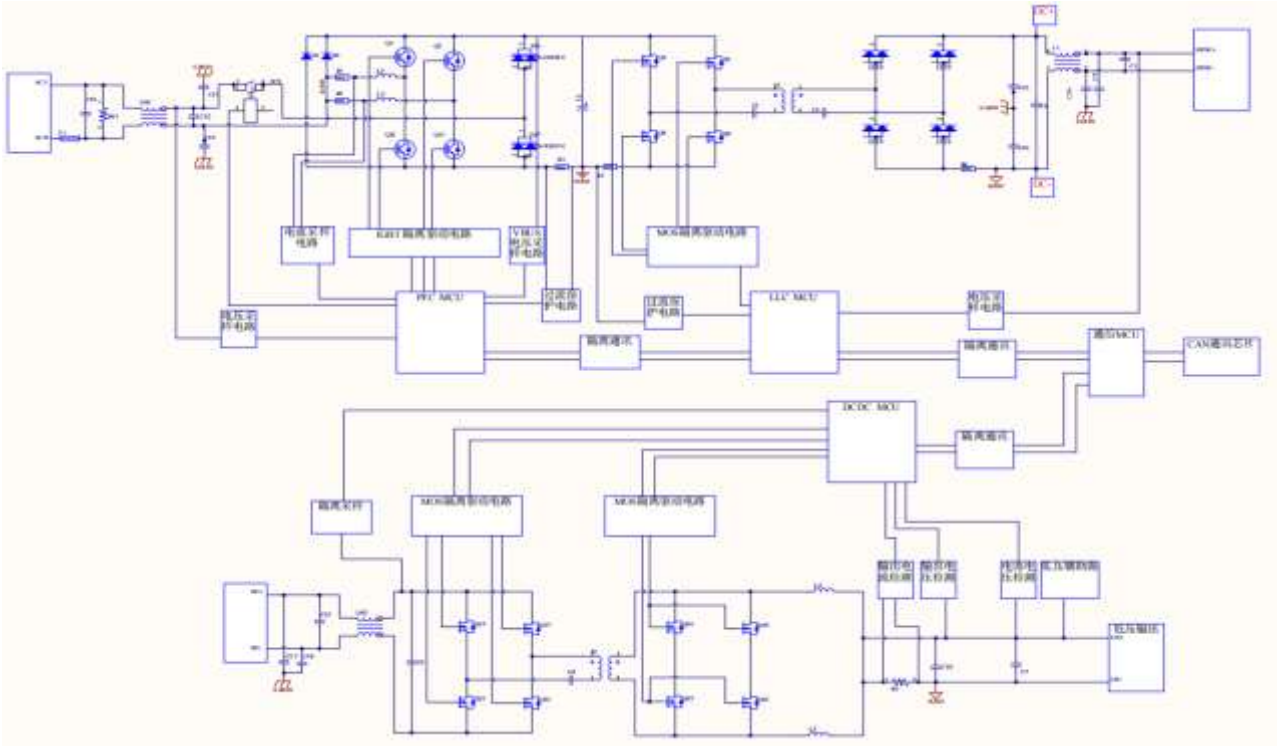


Figure 6 CAN network schematic diagram

4.7 Assembly principle block diagram



5. Interface requirements

5.1 General interface requirements

The power distribution assembly, vehicle and battery pack mainly include low voltage interface and high voltage interface. The model and position of the interface connector on the part are defined according to the vehicle layout.

5.2 On-board Charger Low Voltage Connector Information

5.2.1 Viewing direction of low voltage signal connector (component end):

Connector Name	Part Side Connector		Mating Connector (wiring harness)		Remark
	P/N	Supplier	P/N	Supplier	
Low voltage signal plug-in	0643340100	Molex		Molex	

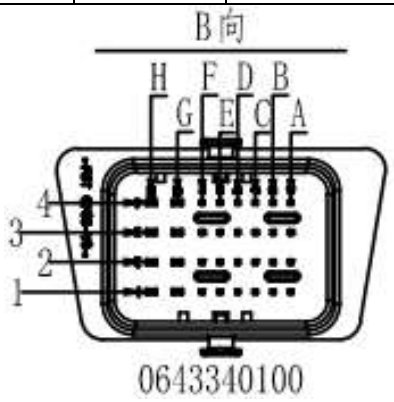


Figure 7 View direction of low voltage signal connector

5.2.2 The pin definitions of the low voltage signal plug-in assembly are shown in the following table.

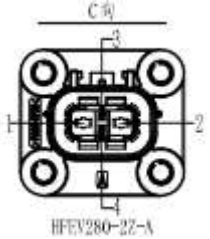
brand	No.	Signal bit number	name	Function	Remark
	1	1G	Relay power supply positive	PTC	
	2	1H	KL30	Normal power input positive	
	3	2 B	L_TEMP+	Thermistor 1 -1	
	4	2C	Hardwire wakeup (ACC)	6-16 v	
	5	2D	L_TEMP-	Thermistor 1 -2	
	6	2E	N_TEMP+	Thermistor 2-1	
	7	2 F	N_TEMP-	Thermistor 2-2	
	8	2G	Relay power supply negative 2	PTC2	
	9	3 A	C C		
	10	3 B	C P		

	11	3G	Relay power supply negative 1	PTC1	
	12	3 H	Electronic lock	Power positive	
	13	4 A	C AN_H		
	14	4 B	C AN_L		
	15	4 C	H VIL+	High voltage interlock	
	16	4D	H VIL-	High voltage interlock	
	17	4 E	Electronic lock	Electronic lock feedback- (K/E)	
	18	4F	Electronic lock	Electronic lock feedback +(C)	
	19	4G	G		
	20	4 H	Electronic lock	Negative power supply	
	twenty one	the remaining	N C		

Connector name	Component end plug-in		Matching end plug-in (harness end)		Remark
	Part Number	supplier	Part Number	supplier	
DC output positive terminal	GH33-F200-1NNB-T01	/		/	Install bolts M8*14. Torque 9-11 N.m
DC output negative terminal					housing connection

5.3 High-voltage connector assembly interface definition

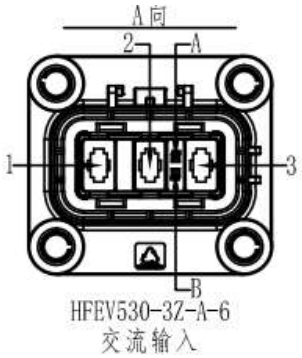
Table 5.3.1 High voltage DC segment interface

Connectors name	Battery		Connector Model	socket	HFEV280-2Z-A (Sichuan Huafeng)
				plug	HFEV280-2T-A-4 (Sichuan Huafeng)
Terminal number	Wire diameter	Line Type	Function Definition		
1	4 mm ^{2}	High-voltage cables	positive electrode		
2	4 mm ^{2}	High-voltage cables	negative electrode		
3	22AWG	Interlock	HVIL+		

		signal		
4	22AWG	Interlock signal	HVIL-	

Table 5.3.2 High-voltage AC section interface

Connector name	OBC input		Connector Model	socket	HFEV530-3Z-A-6 (Sichuan Huafeng)
				plug	HFEV530-3T-A-6 (Sichuan Huafeng)
Terminal number	Wire diameter	Line Type	Function Definition		
1	6 mm ^{2}	High-voltage cables	N		
2	6 mm ^{2}	High-voltage cables	E		
3	6 mm ^{2}	High-voltage cables	L		
A	Black 2 2AWG	Interlock signal	HVIL+		
B	Black 2 2AWG	Interlock signal	HVIL-		



6. Software requirements

CAN communication

No.	Items	Technical indicators	Notes
1	Baud rate	500 Kbit/s	/
2	CAN bus communication protocol	Comply with CAN2.0B specification	/
3	Terminal resistor	No terminating resistor	/

7. Mechanical parameters

7.1 Installation dimensions and specifications

See the last page for details: Engineering drawing

7.2 Appearance

The surface of the parts should be smooth, without any defects such as peeling, rust, cracks, spots, burrs, deformation, or bumps that can be touched by hand. The connectors should be complete, and the parts should be securely fastened without any defects or damage such as rust, burrs, and cracks. The connector sheath and pins should be intact and undamaged, and all parts should be tightly connected.

7.3 Weight

No.	Parts Name	Parts code	weight (kg)	Remark
1	Charging module assembly		≤ 11	

8. Nameplate , packaging, transportation, storage

8.1. Nameplate barcode (nameplate label should be traceable)

The following format is for reference:

Figure 9 High voltage label

8.2. Packaging and packaging diagram

The packaging box contains the product name, model, manufacturer's logo, the manufacturer's quality department's inspection certificate, manufacturing date, etc.; the packaging box also contains a list of accessories:

No.	Name	Quantity	Unit	Remark
1	Charging and distribution system assembly	1	PCS	
2	Test Report	1	page	

8.3. Transportation

Products must be transported in secure packaging that complies with relevant national standards and bears markings such as "Handle with Care" and "Moisture-Proof." The packaging can be transported using any means of transportation. During transportation, the product must be protected from direct exposure to rain, snow, and mechanical impact.

8.4. Storage

When the product is not in use, it should be stored in the packaging box. The warehouse environment temperature should be -10-40℃ and the relative humidity should not exceed 80%. No harmful gases, flammable, explosive products and corrosive chemicals are allowed in the warehouse. There should be no strong mechanical vibration, impact and strong magnetic field. The packaging box should be at least 20cm above the ground and at least 50cm away from the wall, heat source, window or air inlet. The storage period under these specified conditions is generally 2 years. Re-inspection should be carried out after more than 2 years.

The product should be stored in a well-ventilated, dry place. It should also be kept away from sources of high temperature, fire, and chemicals. Store neatly and avoid being

thrown or smashed.

9. Safety Guidelines

Warning: remind users that the operation is dangerous
* It is strictly forbidden to disassemble and modify the on-board charger for repair or debugging without
authorization
* Do not place the parts in the rain
* Please make sure the shell is intact before installation. If it is damaged, please replace it immediately or contact
after-sales service
* All plugs and sockets should be connected tightly. If they are damaged or loose, please replace them immediately
* It is strictly forbidden to plug or unplug the connector while the product is powered on, otherwise it may cause personal injury
* It is strictly forbidden to open the product shell when the product is powered on, otherwise it may cause personal injury.
* It is strictly forbidden to touch the high-voltage live parts of the product with bare hands. Please wear insulating gloves, insulating shoes,
Insulating clothing, maintenance and testing under power is strictly prohibited
* When replacing fuses and contactors, it is strictly forbidden to use rough operations to avoid damaging the product and causing safety hazards
* Use a three-core cable with a grounding wire for AC power supply, and install the grounding wire correctly.
* If there is any abnormal sound or smell during the operation of the charger, please unplug the power plug.
* When the battery is charging normally, please stay away from fire and flammable and explosive items
* Do not charge a damaged or nonchargeable battery.
Note: Remind the user that the following operations are important operations of this product
* Do not block the air inlet and outlet of the charger to prevent overheating
* Please make sure the output cable is not too long to avoid the impact of line voltage drop on charging
* Disconnect the power cord and charging plug when moving the charger
* The battery voltage must match the nominal voltage of the charger
* Avoid collision , voltage , pulling , twisting or shaking the charging cable
* The product should be placed in a safe, ventilated, dust-free and rain-free environment
* Please package and store it if not in use for a long time