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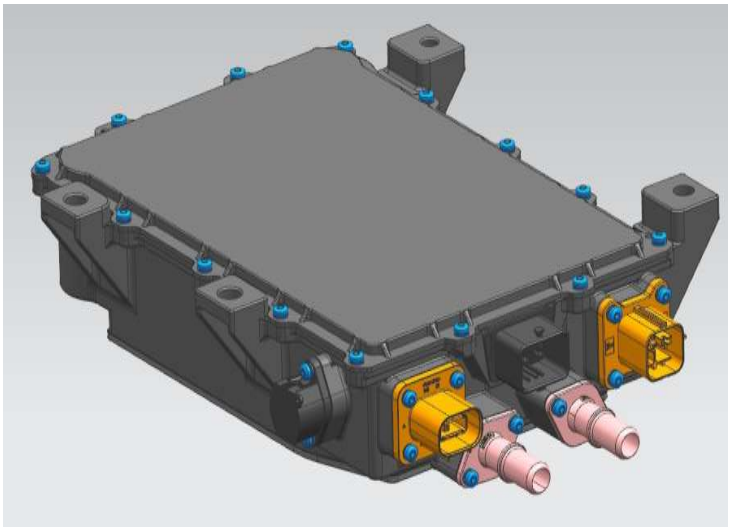
Combo 2 in 1
2.5KW DC/DC Converter + 6.6KW On board charger
Liquid Cooled System
MODEL NO: ATTD2K5C6K6-350S14W



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: without supported

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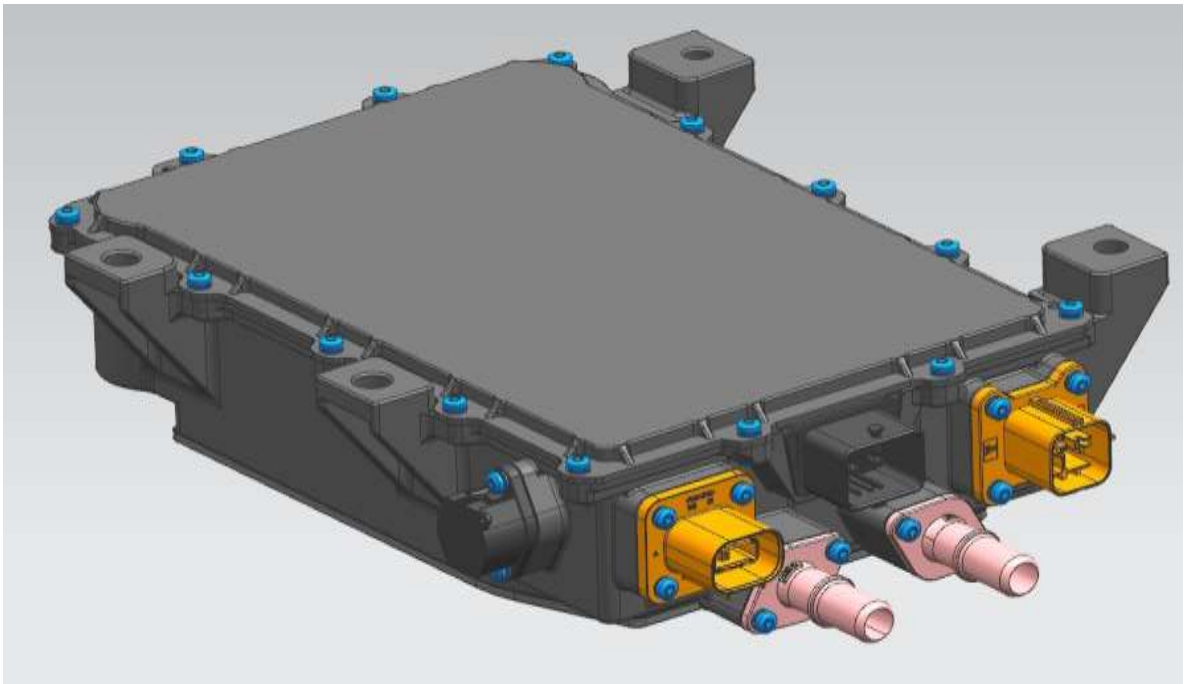
1. Summary

1.1 Abstract

The model of **ATTD2K5C6K6-350S14W** is a two-in-one assembly of on-board charger and DC/DC converter developed for new electric vehicles, and is a single directional charger without V2L feature. It has the characteristics of high integration and high power density. The on-board charger (OBC) obtains energy from 220V AC power supply to charge the high-voltage power battery in the vehicle. During the charging process, the power battery management system monitors the charging status in real time. OBC responds to the voltage and current commands given by BMS, and carries out state feedback to realize self-diagnosis. The main function of DC/DC is to convert the high voltage DC of the power battery pack into 13.8V low voltage DC to supply power to the automobile accessory system.



Picture 1 3D diagram

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1.2 Industry terminology

No.	Terms or abbreviations	Explanation
1	BMS	电池管理系统（Battery Management System）
2	ADS	高压电安全系统（Auto-Disconnect System）
3	SOC	电池荷电状态（State of Charge）
4	CAN	CAN 通讯网络（Controller Area Network ）
5	ECU	电子电控单元（Electronic Control Unit ）
6	EV	纯电动车（Electric Vehicle ）
7	OBC	车载充电机（On Board Charger）
8	DCDC	直流变换器（DC-DC Converter）
9	HV	高压（High Voltage）
10	LV	低压（Low Voltage）
11	CC	恒流（Constant Current）
12	CV	恒压（Constant Voltage）
13	MCU	电机控制器（Motor Control Unit）
14	VCU	整车控制器（Vehicle Control Unit）
15	CAN	Controller Area Network
16	UDS	诊断系统（Unified Diagnostic Services）
17	ASIL	汽车功能安全等级（Automotive Safety Integrity Level）
18	HVIL	高压互锁（High Voltage Interlock Loop）

1.3 Introduction to main functions of the system

1.3.1 OBC module function

Conduct constant current and constant voltage charging of the battery in different states within the adjustable range according to the BMS instruction;

According to BMS instructions, the pure resistive load is supplied with different power requirements within the adjustable range to realize battery heating;

It can realize the diagnosis, self-check and protection functions of the OBC module according to the CAN information of the whole vehicle and the information monitored by itself;

1.3.2 DC-DC Converter Function

The DCDC converter converts the high voltage of the power battery into the low voltage 14V output by receiving the control signal of the vehicle controller to meet the charging demand and load demand of the later stage on-board battery, and can also realize the feedback of its own state and load state.

1.3.3 CAN Communication Function

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

1.3.4 UDS Diagnostics

It can realize the function diagnosis of OBC and DCDC, report to the whole vehicle system, and also realize offline flash through remote flashing program to reduce after-sales maintenance costs;

1.3.5 Self-diagnosis and multiple protection functions

It has self-diagnosis, input and output over-voltage protection, under-voltage protection, output short-circuit protection, hardware fault protection, over-temperature protection and recovery functions;

1.3.6 Cooling Method：

Liquid cooling

2. Reference standards

The reference standards of the technical requirements include but are not limited to the following standards. The latest version of the following standard documents (including all amendments) applies to the technical requirements, regardless of whether they are dated or not.

No.	Standard/Document No.	Standard/document name	Remark
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 device	
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 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 electric and electronic products Part 2: Test methods Test A: Low temperature	
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 Test Fc: Vibration (sinusoidal)	
9	GB/T 2423.17	Environmental testing for electric and electronic products Part 2: Test methods Test Ka: Salt spray	
10	GB/T 2423.22	Environmental testing for electric and electronic products Part 2: Test methods Test N: Temperature change	
11	GB/T 28046.2	Road vehicles - Environmental conditions and tests for electrical and electronic equipment - Part 2: Electrical loads	
12	GB/T 17619—1998	Limits and measurement methods for electromagnetic radiation immunity of electronic and electrical components of motor vehicles	
13	GB/T 4094.2—2005	Marking of controls, indicators and tell-tales for electric vehicles	
14	QC/T 413-2002	Basic technical conditions for automotive electrical equipment	
15	IEC 61851—1	Technical Committee on Electrically propelled road vehicles - General requirements for charging systems	
16	GB 14023—2011	Radio disturbance characteristics of vehicles, ships and internal combustion engines - Limits and methods of	

		measurement for the protection of receivers outside the vehicle	
17	GBT 18387—2017	Limits and measurement methods of 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 environmental conditions for the assembly are shown in the table below:

No.	Term	Technical indicators	Unit	Remark
1	Inlet coolant temperature	-40～65	℃	
2	Storage temperature	-40～95	℃	Power failure
3	Relative humidity	5～95	%RH	No condensation, no frost
4	IP Grade	IP67		
5	Cooling method	Liquid cooling		
6	Vibration level	Complied with QC/T895-2011		
7	Noise level	65	dB	Complied with QC/T895-2011
8	Salt fog grade	Complied with QC/T2423.17-2011		
9	Altitude	4000	m	GB/T16935.1-2008
10	Temperature and humidity resistance	Complied with GB/T 2423.22		

11	drop	Harness as per QC/T417.1-2001 Shell according to GB/T 2423.8-1995		Normal appearance, structure and performance

4. Technical Specifications

4.1. OBC Electrical Performance Requirements

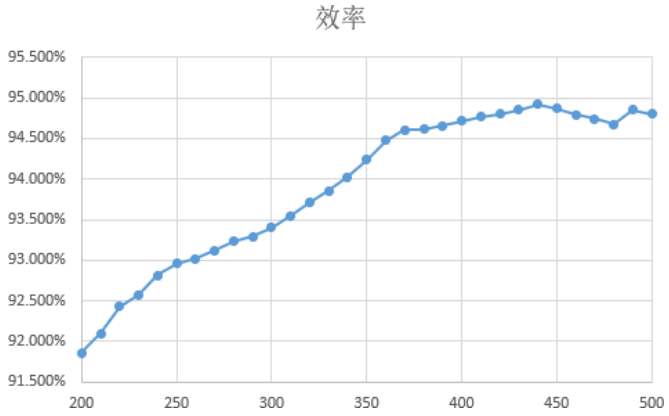
Item		Min	Typical	Max	Unit	Condition
OBC electrical characteristics（AC/DC）						
1、Input Characteristic						
Rated input voltage		-	220	-	Vac	
Input voltage range		90	-	264	Vac	Normal operating voltage range
Maximum input current		-	-	32	A	The input voltage changes and the input current does not exceed 32A
AC input voltage frequency		47	50	60	Hz	Rated 50 Hz
Power factor (PF)		0.98 0.94	-	-	-	@>0.98 at 50%~100% load @>0.94 at 15%~50% load
2、Output Characteristic						
High voltage output	Rated output voltage	350			Vdc	When 110Vac is input, the output will automatically reduce power for operation. When 220Vac is input, output can operate at full power
	Output voltage range	200		500	Vdc	
	Output current range		20		A	
	Output rated power		6.6		KW	
	Output ripple and noise		±5		%Vo	
	Startup rise time		4		S	After the OBC receives the BMS charging request, the output voltage rises from 10% to 90%
	Output drop time		300		mS	The time when the output current decreases to 0A after the OBC receives the BMS shutdown

						command	
	Output constant voltage accuracy			1	%	Maximum not more than ± 1%	
	Output current stabilization accuracy			3	%	Maximum not more than ± 0.5A	
	Static loss current			1	mA	Sleep without inserting coupler, consume KL30 constant current	
	Overall efficiency	93	-		%	Output voltage below 300V, efficiency ≥ 93% Output voltage above 300V, efficiency ≥ 94.5%	
3、Protection characteristics							
Input Overvoltage Protection		260	264	270	Vac	Turn off output，	
Input overvoltage recovery		250	259	260	Vac	Return difference ≥ 5Vac	
Input undervoltage protection		80		90	Vac	Turn off output	
Input undervoltage recovery		90		95	Vac	Return difference ≥ 5Vac	
Input overcurrent protection				32	A	Input maintenance input current is not more than 32A, and output power is automatically adjusted.	
	Output overvoltage protection		510		Vdc	Turn off the high voltage output, which can be recovered after troubleshooting	

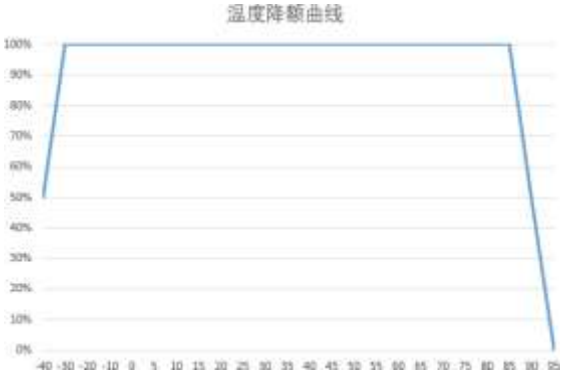
High voltage output	Output undervoltage protection		195		Vdc	Turn off the high voltage output, which can be recovered after troubleshooting (The battery voltage and output voltage shall be synchronized)	
	Output overcurrent protection			22	A		
	Output short circuit protection	Yes			-	Before entering the charging process, when the output short circuit is detected, the charging will not be started. In case of short circuit in the output during charging, turn off the high-voltage output immediately.	
	Output reverse connection protection	Yes			-	The output is inversely connected and the high voltage output does not start. After troubleshooting, the normal operation is resumed.	
Communication failure protection		Yes			-	When the charger does not receive the BMS command for 5 consecutive seconds, or the	

					charger has communication failure during operation, the charger will close the output.	
Over temperature protection		85		℃	Detect the internal temperature of the OBC. When the internal temperature of the CPU is detected to be higher than 85 degrees, the power will be reduced, but when the temperature continues to rise to 90 degrees, the OBC will be shut down.	
		90				

4.1.1 OBC output efficiency and temperature derating curve



Pic2 OBC Efficiency curve



Pic3 OBC Temperature derating curve

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4.2.DC Electrical performance requirements

Item	Min	Typical	Max	Unit	Condition
DC/DC Electrical performance					
1、Input Characteristic					
Input voltage range	200	-	500	Vdc	
2、Output Characteristic					
Output voltage range	13.8	14	14.6	Vdc	
Rated output current	-	178	-	A	
Peak output current	-	214	-	A	
Output power	-	2500	-	W	
Peak power	-	-	3000	W	3kW@6min
DC efficiency	93	-	-	%	Rated input weighted efficiency
3、Protection characteristics					
Input overvoltage protection point	500		505	Vdc	Turn off output，
Input overvoltage recovery point	495		500	Vdc	Return difference ≥ 5VDC
Input undervoltage protection point	235		240	Vdc	Turn off output
Input undervoltage recovery point	240		245	Vdc	Return difference ≥ 5VDC
Output overvoltage protection point		16		Vdc	
Output undervoltage protection point		9		Vdc	
		100		℃	The internal CPU of the DC detects the internal temperature of the DC, reduces the power and derates the output under this condition.

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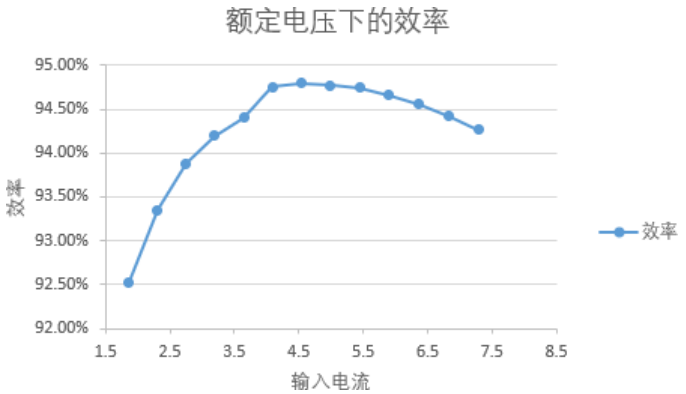
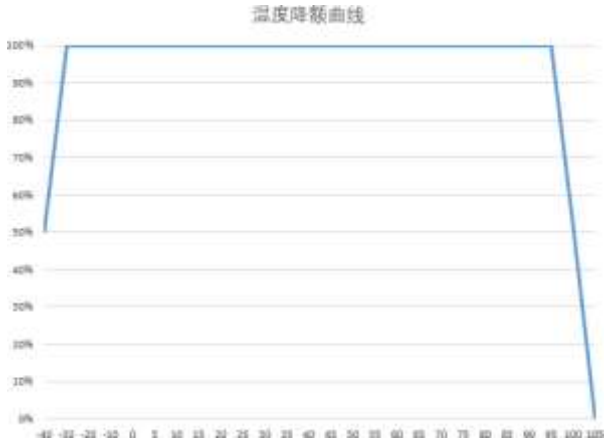
Over temperature protection		105		℃	The internal CPU of the DC detects the internal temperature of the DC, and reduces the power output when the temperature reaches 100 ℃, but the DC shuts down the output when the temperature continues to reach 105 ℃.
Output overcurrent protection	>214			A	The software output is adjustable, which is the hardware current limit value.
Communication failure protection	Yes			-	When the charger does not receive BMS command for 5s continuously, or communication failure occurs during operation, the charger will close the output.

4.2.1 DC-DC Output efficiency curve



Pic4 DC efficiency curve



Pic5 DC temperature derating curve

4.3. Low-voltage electrical performance requirements

Signal interface						
KL30	Thermistor	CC/CP	Communicat ion mode	Electronic lock	Baud rate	HVIL
12V	10K	support	CAN	support	500Kbps	HVIL+/HVIL-

4.4. Safety performance and others

Safety regulation characteristics				
Item		**Technical indicators**	**Unit**	**Remark**
Dielectric strength	Input to housing	2800VDC、3s、Leakage current≤10mA		No breakdown and flashover
	Output to housing	2800VDC、3s、Leakage current≤10mA		No breakdown and flashover

	Input to output	2800VDC、3s、Leakage current≤10mA		No breakdown and flashover
insulation resistance	DC high voltage - DC low voltage (housing ground)	resistance≥100MΩ，Test voltage 500VDC		No breakdown and flashover
Grounding resistance	Ground wire to housing - DC low voltage (housing ground)	≤0.1	Ω	The resistance between the grounding point and the radiator is less than 100 milliohm, and the test current is 25A AC.
Creepage clearance		≥4mm		Meet the requirements of Table 3 of GB/T18488.1-2001 standard
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**	**criterion**	**Reamrk**
Conducted disturbance （CE）	GB/T 18487.3-2001			For OBC testing only
Radiation disturbance (RE)	GB/T18487.3-2001			

Conducted disturbance （CE）	GB/T 18655-2010	Level 3		For DCDC test only
Radiation disturbance (RE)	GB/T 18655-2010	Level 3		
Surge	GB/T18487.3-2001 GB/T 17626.5-2008	Input differential mode 1KV 1.2/50us Input common mode 2KV 1.2/50us		For OBC testing only
EFT	GB/T18487.3-2001 GB/T 17626.4-2008	2KV/5KHz/1min		
ESD	GB/T18487.3-2001 GB/T 17626.1-1998	Contact 4KV/air 8KV		
CS		10LIVE3 0.15-80MHz		

RS	GB/T 18487.3-2001 GB/T 17626.3-2006	3V/m 80-1000MHz		
		10V/m 80-1000MHz		
DIP	GB/T 18487.3-2001	Drop to 70 %U(T)， time 10ms； Drop to 50 %U(T)， time 100ms； Drop to 95 %U(T)， time 5000ms；	B	
Voltage fluctuation and flicker		Voltage fluctuation and flicker limit of Class A products		
Current harmonic emission	GB/T 18487.3-2001	Harmonic current limit of Class A products		
Electrostatic immunity (ESD)	GB/T 19951-2005	Contact discharge of complete machine (power on): ± 6KV Air discharge: ± 8KV	B	
		Contact discharge of the whole machine (not powered on): ± 6KV Air discharge: ± 15KV	C	
Radiated electromagnetic field immunity free field method (RS)	GB/T 17619-1998		A	
Radiated electromagnetic field immunity Large current injection (BCI)	GB/T 17619-1998		A	
Electrical transient conducted interference immunity along the power line （CS）	GB/T 21437.2-2008 (ISO 7637-2)	level 4	Pulse1,Pulse2b 为 D,Puls2a，Pulse 3a/3b 为 A	

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

Criteria definition:

A: Test process indicators are within the specification range

B: It can automatically recover to the specification after the test

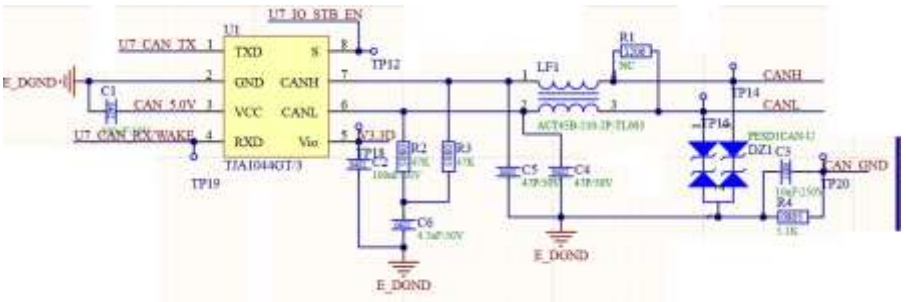
C: After the test, it can be restored to the specification range manually

4.6 CAN network system

4.6.1 With CAN wake-up function, meet UDS diagnosis and offline flashing program

4.6.2 CAN network compatibility

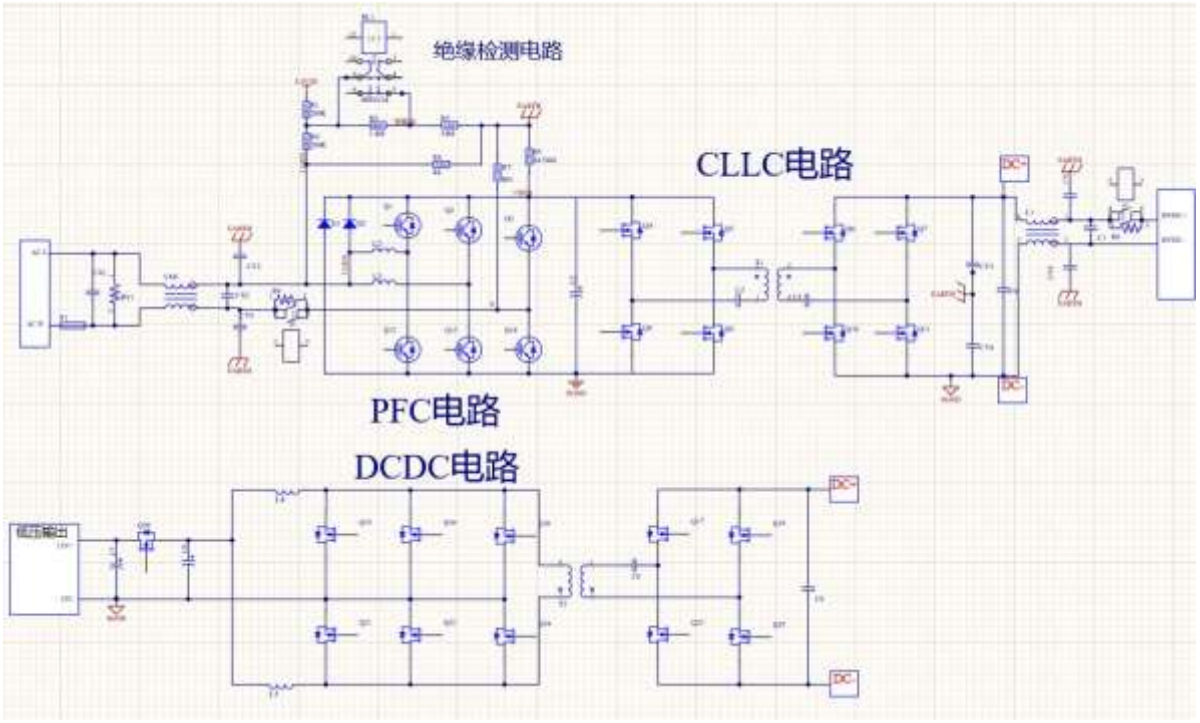
No terminal resistance is added to the CAN terminal. The recommended CAN circuit is as follows:



Pic6 Schematic diagram of CAN network

4.7 Principle block diagram

Principle block diagram of OBC main circuit



5. Interface requirements

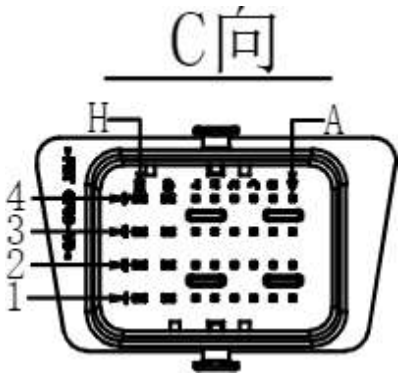
5.1 General interface requirements

Power distribution assembly, vehicle and battery pack mainly include low-voltage interface and high-voltage interface. The model and position of the interface connector shall be defined according to the vehicle layout.

5.2 Low-voltage connector information of on-board charger

5.2.1 Visual angle 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 connector	0643340100	Molex		Molex	



Pic6 View direction of low-voltage signal connector

5.2.2 The pin definition of assembly low voltage signal connector is shown in the following table

Brand	No.	Pin	Name	Function	Remark
Molex	1	1A	OBC_EN		
	2	1H	KL30	Normal input+	
	3	2A	Output wake-up		12V 0.5A
	4	2B	L_TEMP+	Thermistor 1-1	
	5	2C	DC_EN		
	6	2D	L_TEMP-	Thermistor 1-2	
	7	2E	N_TEMP+	Thermistor 2-1	
	8	2F	N_TEMP-	Thermistor 2-2	
	9	3A	CC		
	10	3B	CP		
	11	3H	Electronic lock	Power supply +	
	12	4A	CAN_H		
	13	4B	CAN_L		
	14	4C	HVIL+	HVIL	
	15	4D	HVIL-	HVIL	
	16	4E	Electronic lock	Electronic lock feedback +	

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	17	4F	Electronic lock	Electronic lock feedback -	
	18	4G	GND		
	19	4H	Electronic lock	Power supply -	
	20	Others	NC		

Connector Name	Part Side Connector		Mating Connector (wiring harness)		Remark
	P/N	Supplier	P/N	Supplier	
DC output positive interface		国威通		/	Install bolts M8 * 16.

					Torque 10-11N.m
DC output negative interface					Housing connection

5.3 High voltage connector assembly interface definition

Table 5.3.1 High-voltage DC section interface

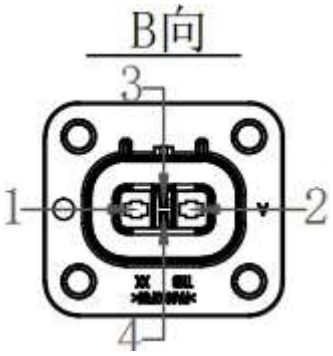
Connector Name	Battery		Connector Model	socket	TP028E-2H1A04(THB)
Pin	Wire diameter	Wire	Definition		
1	4mm2	Red	Positive		
2	4 mm2	Black	Negative		
3	22AWG	Interlock signal	HVIL+		
4	22AWG	Interlock signal	HVIL-		

Table 5.3.2 High-voltage AC section interface

Connector Name	OBC Input		Connector Model	socket	EVH2-N4ZJ-A (中航光电)
				plug	
Pin	Wire diameter	Wire	Definition		
A	6mm2	Blue	N		
B	6mm2	Yellow green	PE		

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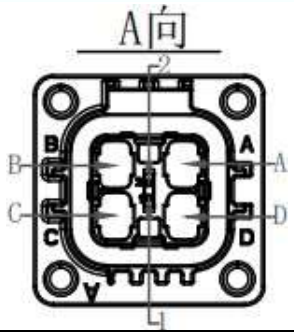
C	6mm2	brown	L	
1	Black 22AWG	Interlock signal	HVIL+	
2	Black 22AWG	Interlock signal	HVIL-	

6. Software requirements

CAN communication

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

7. Mechanical parameters

7.1 Installation size and specification
See the last page: engineering drawings

7.2 Appearance

The surface of the parts shall be smooth and free from defects such as peeling, rust, cracks, spots, burrs, deformation and concave-convex phenomenon that can be touched by hands. The connectors are complete, the parts are fastened and reliable, and there are no defects and damages such as rust, burr and crack. The connector sheath and pins shall be intact and undamaged, and all parts shall be connected firmly.

7.3 Weight

No.	Part name	Part code	Weight（kg）	Remark
1	Charging module assembly		≤8.5	

8. Nameplate, packaging, transportation and storage

8.1. Nameplate bar code (nameplate label should have traceability)

The basic parameters of the nameplate include: model, rated power, etc.

The following format is for reference:

Pic7 High voltage label

Nameplate

Pic 8 Nameplate

8.2. Packaging and packaging diagram

The packing box is marked with product name, model, manufacturer's identification, inspection certificate of the manufacturer's quality department, manufacturing date, etc; There is a list of accessories in the packing box:

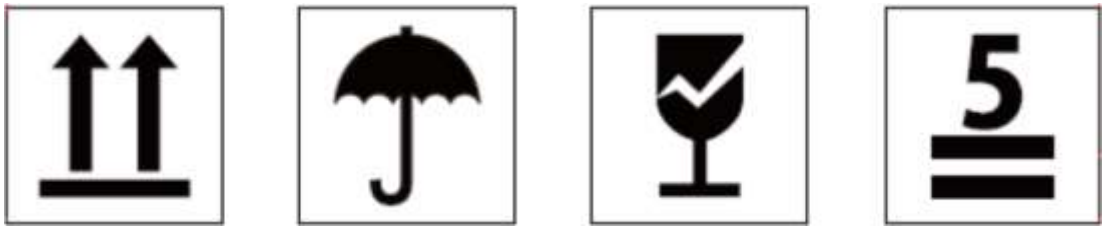
No.	Nam e	Quantity	Unit	Remark
1	Charging and distribution system assembly	1	set	

2	Test report	1	pc	

8.3.Transportation

When transporting products, there should be a solid packaging box, and the outside of the box should comply with the relevant national standards and should be marked with "Handle with Care", "Moisture Proof", and other signs. The packing box containing the product is allowed to be transported by various means of transportation. Direct rain and snow attack and mechanical impact shall be avoided during transportation.

Pic 9 Transportation marks



8.4.Storage

The products shall be stored in the packaging box when not in use. The ambient temperature of the warehouse shall be - 10-40 ℃ and the relative humidity shall not be greater than 80%. There shall be no harmful gases, flammable and explosive products and corrosive chemicals in the warehouse, and there shall be no strong mechanical vibration, impact and strong magnetic field. The packaging box shall be padded at least 20 cm from the ground, and at least 50 cm from the wall, heat source, window or air inlet, The storage period under the specified conditions is generally 2 years, and the inspection shall be conducted again after more than 2 years.

The product should be stored in a ventilated and dry place. At the same time, it is necessary to avoid high temperature sources, fire sources and chemicals. Store neatly and avoid throwing and smashing.

9. Security Guide

Warning: remind the user that the operation is dangerous

* It is forbidden to disassemble and refit the on-board charger for repair or commissioning without authorization.
* Do not place the parts in the rain.

* Before installation, please confirm that the housing is intact. If it is damaged, please replace it immediately or contact after-sales service
* All plugs and sockets shall be firmly connected. If they are damaged or loose, please replace them immediately.
* t is forbidden to plug and unplug the connector with power on the product, otherwise personal injury may be caused.
* It is forbidden to open the product housing during the power-on operation of the product, otherwise personal injury may be caused.
* It is strictly prohibited to touch the high-voltage live parts of the product with bare hands. Please wear insulating gloves, insulating shoes, and insulating clothing during testing and maintenance. Live maintenance and testing are strictly prohibited.

* During the replacement of fuses and contactors, barbaric operation is strictly prohibited to avoid damaging the product and causing potential safety hazards.
* For AC power supply, select a three-core cable with a ground wire and install the ground wire correctly.
* If the charger has abnormal sound or smell during operation, please unplug the power plug.
* Please keep away from ignition sources and flammable and explosive substances when the battery is charged normally.
* Do not charge damaged or non-rechargeable batteries.

Note: Remind the user that the following operations are important for this product.

* Do not block the water inlet and outlet of the charger to prevent overheating.

* Please ensure that the output cable is not too long to avoid the impact of line

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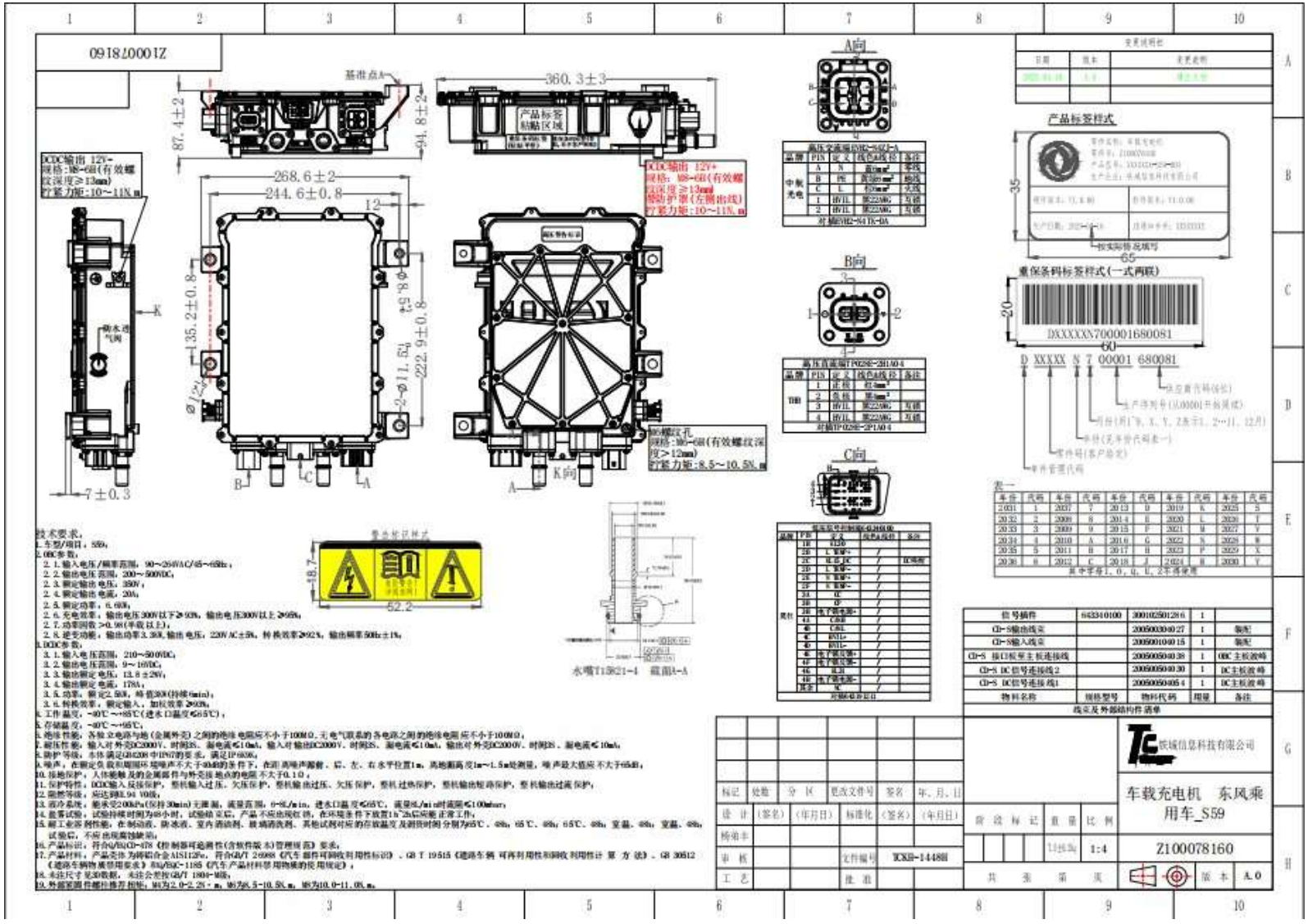
voltage drop on charging.

* Please disconnect the power cord and charging plug when moving the charger.
* The battery voltage must match the nominal voltage of the charger.
* Avoid collision, pressure, pulling, twisting or shaking the charging cable.
* The product should be placed in a safe, ventilated, dust-free and rain-free environment.
* Please pack and store if not used for a long time.



Engineering Drawing