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Bi-directional 1.5KW 48V-12V DC/DC Converter Non-Isolated Natural Cooled System

Model No.: ATTD1K5-48B12N

Features

1. Output Power：1.5KW
2. Input Voltage：30~60VDC Rated Voltage: 48VDC
3. Output Voltage：14.5VDC
4. Dimensions(MM)：250 x 219 x 60 (LxWxH)
5. Weight(KG): ≦3
6. Cooling System：Natural Cooling
7. IP Protection Rating: IP67
8. Communication Method：CAN 2.0B 250kbps-500kbps
9. Enclosure: Aluminum alloy made
10. Software: Digital software design

Version: V0 Date: 09/30/2025
File No.: SDC-P73-0

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Contents

1 Summary

1.1 Abstract

This document mainly defines the product specifications and performance parameters of automotive 48V/12V bi-directional DC/DC converter.

1.2 Terminology

Serial Number	Terms or abbreviations	Instructions
1	DC/DC	DC/DC Converter (DC/DC Converter)
2	CAN	CAN Communications Network (Controller Area Network)
3	VCU	Vehicle Control Unit (VCU)
4	ASIL	Automotive Safety Integrity Level
5	Io	DC/DC output current
6	IN	DC/DC current rating
7	BMS	Battery Management System (BMS)

1.3 Application Scope

This document is the product technical description of automotive 48V/12V bidirectional DC/DC converter, which is suitable for 48V/12V dual battery automotive system.

1.4 Introduction to the main functions of the system

1.4.1 DC/DC conversion function

By receiving the control signal of the vehicle controller, the DC/DC converter will realize the bidirectional conversion of the 48V/12V battery, meet the charge and discharge requirements of 48V and 12V battery and the load requirements, and can realize its own state and load state feedback.

1.4.2 CAN communication function

DC/DC controls output voltage and output current through CAN bus, and realizes information interaction with BMS and VCU through CAN communication, as well as feedback of working state.

1.4.3 Self-diagnosis and multiple protection functions

With self-diagnosis, input and output overvoltage, undervoltage protection, short circuit protection, hardware fault protection, overtemperature protection and recovery functions.

2 Product execution standards

2.1 GB/T Standard

The design and production of DC/DC converters must meet the relevant contents of China's mandatory regulations on vehicle requirements and environmental regulations. The relevant national standards are as follows:

Table 1:

Serial number	Standard number	Standard name
1	GB/T 24347-2009	DC/DC converter for electric vehicles
2	GB/T 18488.1-2015	Electric motors and their controllers for electric vehicles - Part 1: Technical requirements

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 for personnel
5	GB/T 18387-2008	Limits and methods of measurement for electromagnetic field emission intensity of electric vehicles
6	GB/T 31498-2015	Post-crash safety requirements for electric vehicles
7	GB 9254-2008	Limits and methods of measurement for radio disturbance of information technology equipment
8	GB/T 18655-2010	Vehicle boat and internal combustion engine radio disturbance characteristics Limits and measurement methods used to protect on-board receivers
9	GB 29743-2013	Motor vehicle engine coolant
10	GB 4208	Enclosure protection Class (IP code)
11	GB/T 28046-2	Environmental conditions and tests for electrical and electronic equipment for road vehicles - Part 2: Electrical loads
12	GB/T 28046-3	Environmental conditions and tests for electrical and electronic equipment for road vehicles - Part 3: Mechanical loads
13	GB/T 28046-4	Environmental conditions and tests for electrical and electronic equipment for road vehicles - Part 4: Climatic loads
14	GB/T 2423.34-2012	Environmental tests-Part 2: Test methods Test Z/AD: Combined temperature/humidity cycle test
15	GB/T 2423.1-2008	Environmental testing for electrical and electronic products - Part 1: Test methods - Test A: Low temperature
16	GB/T 2423.2-2008	Environmental testing for electrical and electronic products -- Part 2: Test methods -- Test B: High temperature
17	GB/T 2423.3-2016	Environmental testing for electrical and electronic products -- Part 2: Test methods Cab: Constant damp heat test
18	GB/T 2423.17-2008	Environmental testing for electrical and electronic products - Part 2: Test methods - Test Ka: salt spray
19	GB/T 30512-2014	Requirements for Banned Substances in motor vehicles
20	QC/T 413	Basic technical conditions for automotive electrical equipment

2.2 ISO / IEC Regulations

The vehicle whose target market includes the foreign market must meet the mandatory regulations and environmental protection regulations of the country and region where the target market is located.

Table 2:

Serial number	Standard number	Standard name
1	CISPR 25: 2008	Radio disturbance characteristics for the protection of receivers used on board vehicles, boats, and on devices – Limits and methods of measurement
2	ISO 7637-2:2011	Electrical disturbance from conduction and coupling Part 2 -Electrical transient conduction along supply lines only
3	ISO 7637-3:2007	Electrical disturbance from conduction and coupling Part 3-Electrical transient transmission by capacitive and inductive coupling via lines

Serial number	Standard number	Standard name
		other than supply lines
4	ISO 11452-4:2005	Road Vehicles-Component test methods for electrical disturbances by narrow radiated electromagnetic energy-Part 4-Bulk current injection
5	ISO 10605:2008	Test methods for electrical disturbances from electrostatic discharge
6	ISO 16750-2:2012	Road Vehicles-Environmental conditions and testing for electrical and electronic equipment Part 2:Electrical load
7	ISO 16750-3:2012	Road Vehicles-Environmental conditions and testing for electrical and electronic equipment Part 3:Mechanical loads
8	ISO 16750-4:2010	Road vehicles-Environmental conditions and testing for electric and electronic equipment –Part 4:Climatic loads
9	ISO 16750-5:2010	Road vehicles-Environmental conditions and testing for electric and electronic equipment-Part 5:Chemical loads
10	ISO 6469-3:2011	Electrically propelled road vehicles-Safety specifications-Part 3:Protection of persons against electric shock
11	IEC 60068-2-6	Environmental testing-Part 2-6:TestFc:Vibration(Sinusoidal)
12	IEC 60068-2-14	Basic environmental testing procedures Part 2:Tests-Test N Change of temperature
13	IEC 60068-2-27	Environmental testing-Part 2-27:Tests test Ea and guidance: Shock
14	IEC 60068-2-32	Basic environmental testing procedures Part 2: Test-Test Ed Free fall
15	DIN 50018:1997	Sulfur dioxide corrosion testing in a saturated atmosphere
16	ISO 26262	Road vehicles — Functional safety
17	IEC 61508	Functional safety of electrical/electronic/ programmable electronic safety-related systems
18	EN61000-4-2	Electromagnetic compatibility Part4:Testing and measurement techniques
19	LV148	48V-vehicleelectricalsystem

Note: Standards with no release date are executed in accordance with their latest version.

3 DC/DC Converter specifications

3.1 Specifications for Use

Table 3:

item	Content	Remarks
Storage temperature range	-40℃ to 105℃	/
Operating temperature range	-40℃ ~ 85℃	/
Humidity	5% to 95%	Relative humidity

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Cooling method	Natural cooling	/
altitude	Under 2000m, it is normal to use. Above 2000m, the use conditions are given	/
Level of protection	IP67	/
Vibration resistance	Sinusoidal vibration Standard: EN/IEC 60068-2-6 (2009) Method: Frequency: 5~200Hz, sweep rate: 1 frequency doubled into/min; Frequency/displacement: 5~18.6Hz 10mm; Frequency/acceleration: 18.6~50Hz 4.5g, 50~100Hz 4.5g, 100~200Hz 3g, vibration direction and time: vertical direction, horizontal left and right direction and horizontal front and rear direction each 20 hours of work, working mode: Mode A, the load is outside the vibration bench, the high and low voltage wiring harness is connected to DC/DC, and the upper computer records the data. Requirements: After the test, there is no damage to the mechanical structure, deformation and loosening of the fastening part. After the test is completed, the functional parameters are tested at room temperature, and all the test items meet the requirements of the functional parameters.	Vibration conditions: pure electric passenger cars
	Random vibration Standard: ISO 16750-3 (2007) Method: Frequency range: 10~1000Hz, total root-mean-square acceleration: 27.8 m/s^2; Energy spectral density 10 HZ-20 (m/s2)2/Hz, 55Hz-6.5 (m/s2)2/Hz, 180Hz-0.25 (m/s2)2/Hz, 300Hz-0.25 (m/s2)2/Hz, 360Hz-0.14 (m/s2)2/Hz, 1000Hz-0.14 (m/s2)2/Hz, Vibration direction and time: 8 hours in the vertical direction, the horizontal left and right direction and the horizontal front and back direction, working mode: mode A, the load is outside the vibration bench, the high and low voltage wiring harness is connected with DC/DC, the upper computer records the data Requirements: After the test, there is no damage to the mechanical structure, deformation and loosening of the fastening part. After the test is completed, the functional parameters are tested at room temperature, and all the test items meet the requirements of the functional parameters.	
	Mechanical impact Standard: EN/IEC 60068-2-27 (2009) Methods: Pulse width: 11ms; Acceleration: 20g; Test direction and number: Vertical: +Z10 times -Z10 times	

	Around horizontal: +Y10 times -Y10 times Before and after horizontal: +X10 times -X10 times load outside the shaking table, high and low voltage harness and DC/DC connection mode: DC/DC not powered on Requirements: After the test, there is no damage to the mechanical structure, deformation and loosening of the fastening part. After the test is completed, the functional parameters are tested at room temperature, and all the test items meet the requirements of the functional parameters.	
	Drop test Standard: EN/IEC 60068-2-32 (2009) Method: Drop direction: 6 faces, 8 corners Height: 500mm with packing scheme Requirements: After the test DC/DC appearance and plug-in according to the appearance inspection requirements, after the test is completed, the functional parameters are tested at room temperature, and all the test items meet the functional parameters requirements.	
EMC	RE, CISPR 25, level 2; CE, CISPR 25, level 2; RI, ISO11452-2, in the frequency range of 80M ~ 2000MHz, the injection intensity is 75V/m; BCI, ISO11452-4, in the frequency range of 1MHz ~ 400MHz, the injection intensity is 75mA; ESD, ISO10605-2008, +/-8kV, 330Ω/150pF, direct discharge test and indirect discharge test (see DVP for specific test requirements) DC/DC power line transient immunity meets ISO7637-2 test requirements (test pulse and function level see DVP); The transient coupling immunity of DC/DC signal line meets the test requirements of IS07637-3.	/
Noise	DC/DC converters operate with no more than 70dB of noise	/
Grounded	The ground resistance should not be greater than 0.1Ω The ground point should be clearly marked	/
Reliability	Eight years / 120,000km (calculated according to the service life of the capacitor)	/

3.2 Electrical Specifications

3.2.1 48V to 12V DC/DC Electrical Specifications and features

Table 4:48V to 12V DC/DC input characteristics

item	Minimum value	Typical value	Maximum value	Remarks
Rated input voltage range (V)	30	48	60	
Input current (A)		58		36V input, 1.5kW output
Standby current (mA)		300		Test on 14V battery power

(The current consumed when the ignition switch is ON)				

Table 5:48V to 12V DC/DC input protection

Items	Protection Points	Content	Remarks
Input overvoltage	Overvoltage value: 61 ~ 65V Recovery value: >60V	Protection threshold 61 to 65V Recovery value: >60V	When the DC/DC input voltage is greater than the overvoltage protection value, the output should be turned off and the alarm should be alerted. After the fault is removed, it should have an automatic recovery function.
Input undervoltage	Undervoltage value: 20 ~ 24V Recovery value: <24V	Protection threshold 20 to 24V, Recovery value: <24V	When the DC/DC input voltage is less than the undervoltage protection value, the output should be turned off and the alarm should be prompted. After the fault is removed, the automatic recovery function should be provided.
Short circuit protection	Power off; The fault is removed and can be self-recovered		

Table 6:48V to 12V DC/DC output characteristics

Items	Rated	Error	Content	Remarks
Output voltage	14.5 V		Adjustable range: 9-16V	The charging process is carried out according to the voltage and current instruction of VCU
Output voltage accuracy	/	Plus or minus 2% or less	/	/
Output voltage ripple	240mV	/	/	/
Output voltage monitoring accuracy	/	+ / - 0.2 V	/	/
Output current	110A	/	Adjustable range: 2-110A	The charging process is carried out according to the voltage and current instruction of VCU
Output current monitoring accuracy	/	± 1A	/	/

Output power	1.5 kW	/	/	Rated power P
Peak power and duration	1.8kW (132A)	/	$1.2_{N在}$P6 minutes	Peak output power: 1.2_{N}P Duration: within 6min
Load adjustment rate	/	Plus or minus 1% or less	/	/
Source adjustment rate	/	Plus or minus 1% or less	/	/
Dormant current	200 mu A or less	/	/	/
Output response time	≤200ms	/	Input power-on, from receiving to VCU enable command to output voltage stable build time	Time when the output voltage rises to stabilize
Overshoot	/	Plus or minus 5% or less	/	Switch on/off
Dynamic recovery time	≤5ms	/	Dynamic recovery time: ≤5ms	Load dynamic range: 30% ~ 80% ~ 30%
Dynamic load effect	/	Plus or minus 5% or less	Dynamic load effect: ≤5%	Dynamic load range: 30% ~ 80% ~ 30%
Shield layer and housing resistance	100 m or less Ω	/		The housing of the DC/DC must be equipotential connected with the body iron, and the contact resistance with the body iron of the housing should be less than 0.1Ω
Efficiency	95% or higher	/		Rated input, rated output

Table 7:48V to 12V DC/DC output protection

item	Protection Points	Content	Remarks
Output overvoltage	Overvoltage value: 17V ~ 18V Recovery value: >16V	Protection threshold 17 to 18V Recovery value: >16V	When the DC/DC output voltage is greater than the overvoltage protection value, the output should be turned off and the alarm should be alerted. After the fault is removed, it should have an automatic recovery function.

Output undervoltage	Undervoltage value: 6V ~ 9V Recovery value: <10V	Protection threshold 6V to 9V Recovery value: <10V	When the DC/DC output voltage is less than the undervoltage protection value, the output should be turned off and the alarm should be alerted. After the fault is removed, it should have an automatic recovery function.
Overtemperature protection	With overtemperature protection function, allowing the ambient temperature of 60℃~85℃ to reduce power operation, greater than 95℃ overtemperature protection, when the temperature is reduced to the safe temperature (for example, the temperature of the detection temperature point inside the DC/DC is less than 90℃) automatically resume charging.		
Output overcurrent	Overcurrent protection: 120A~180A, off, can be recovered after the fault is removed		
Short-circuit protection	DC/DC before starting, when the output is short circuited, it should not start after power-on, and alarm prompt; In the process of work, when the output short-circuit, the output should be turned off, and the alarm prompt. After troubleshooting, DC/DC should be able to work normally.		
Reverse connection protection	When the DC/DC output is reversed negative, it should not be started after power-on. After troubleshooting, the DC/DC should be able to work normally.		

3.2.2 12V to 48V DC/DC Electrical Specifications (reverse function)

Table 8:12V to 48V DC/DC input characteristics

Items	Minimum value	Typical value	Maximum value	Remarks
Input voltage range (V)	9	14.5	16	Normal battery voltage range
Input current (A)		90		Input voltage is 9V, maximum load
Standby current (mA) (The current consumed when the ignition switch is ON)		300		Test on 14V power supply
Rated input power (W)		500	750	Rated input, rated output

Table 9:12V to 48V DC/DC output characteristics (reverse function)

Items	Rated	Error	Content	Remarks
Output voltage	48V	/	Adjustable range: 36~52V	The charging process is carried out according to the voltage and current instruction of VCU

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Output voltage accuracy	/	Plus or minus 2% or less	/	/
Output voltage ripple	480mV	/	/	/
Output voltage monitoring accuracy	/	±2V	/	/
Output current	10A	/	Adjustable range: 1 to 10A	The charging process is carried out according to the voltage and current instruction of VCU
Output current monitoring accuracy	/	Plus or minus 0.5 A	/	/
Output power	0.5 kW	/	/	/
Load adjustment rate	/	Plus or minus 1% or less	/	/
Source adjustment rate	/	Plus or minus 1% or less	/	/
Dormant current	200 mu A or less	/	/	/
Output response time	≤200ms	/	/	Output voltage rises to stable
Output overshoot	/	Plus or minus 5% or less	/	Switch on/off
Output response time	≤200ms	/	/	Input power on, from receiving to VCU enable command to output voltage stable build
Dynamic recovery time	≤5ms	/	Dynamic recovery time: ≤5ms	Load dynamic range: 30% ~ 80% ~ 30%
Dynamic load effect	/	Plus or minus 5% or less	Dynamic load effect: ≤5%	Dynamic load range: 30% ~ 80% ~ 30%
Efficiency	93% or higher	/	/	Rated input, full load output

Table 10:12V to 48V DC/DC input protection (reverse function)

Items	Protection Points	Content	Remarks
Input overvoltage	Overvoltage value: 18 ~ 20V Recovery value: >16V	Protection threshold 18 to 20V Recovery value: >16V	When the DC/DC input voltage is greater than the overvoltage protection value, the output should be turned off and the alarm should be alerted. After the fault is removed, it should have an automatic recovery function.
Input undervoltage	Undervoltage value: 6V ~ 9V Recovery value: >10V	Protection threshold 6 to 9V Recovery value: >10V	When the DC/DC input voltage is less than the undervoltage protection value, the output should be turned off and the alarm should be alerted. After the fault is removed, it should have an automatic recovery function.
Short circuit protection	Power off; The fault is removed and can be self-recovered		

Table 11:12V to 48V DC/DC output protection

Items	Protection Points	Content	Remarks
Output overvoltage	Overvoltage: 54 ~ 58V Recovery value: <54V	Protection threshold 54 ~ 58V, Recovery value: <54V	When the DC/DC output voltage is greater than the overvoltage protection value, the output should be turned off and the alarm should be alerted. After the fault is removed, it should have an automatic recovery function.
Output undervoltage	Undervoltage value: 20 ~ 24V Recovery value: >26V	Protection threshold 20V ~ 24V, Recovery value: >26V	When the DC/DC output voltage is less than the undervoltage protection value, the output should be turned off and the alarm should be alerted. After the fault is removed, it should have an automatic recovery function.
Overtemperature protection	With overtemperature protection function, allowing the ambient temperature of 60℃~85℃ to reduce power operation, greater than 95℃ overtemperature protection, when the temperature is reduced to the safe temperature (for example, the temperature of the detection temperature point inside the DC/DC is less than 90℃) automatically resume charging.		
Output overcurrent	15A~18A, off, can be restored after the fault is removed		
Short circuit protection	DC/DC before starting, output short circuit, after power should not start, and alarm prompt; In the process of work, when the output short-circuit, the output should be turned off, and the alarm prompt. After troubleshooting, DC/DC should be able		

	to work normally
Battery reverse connection protection	When the output is reverse connected to the negative pole, it should not start after energizing. After troubleshooting, the DC/DC should work normally

3.3 Control Logic

1, low voltage KL30 long power supply (9-16V-DC/DC CAN work normally, 6-16V to ensure normal CAN communication);

2, key signal KL15 high level (6-16V), KL30 through the DC/DC internal switch to the auxiliary power supply;

3, DC/DC_Enable mode: CAN;

4, DC/DC Disable shutdown control:

a, through CAN communication

b, DC/DC detects that the hardware wake-up signal jumps from a high level to a low level, and detects that the low level lasts for 1S

3.4 CAN network system

With CAN wake-up function, using the standard CAN2.0B communication protocol.

3.5 DC/DC system functional requirements

Support CANBUSOFF function and UDS refresh. CAN Enables the function.

4. Interface requirements

4.1 Electrical Ports

Table 13: Terminal definitions

Terminals	Definition	Remarks
PIN1	KL30	12V auxiliary power, connected to 12V battery
PIN2	empty	empty
PIN3	A_CAN_H	CAN high
PIN4	A_CAN_L	CAN low
PIN5	empty	empty
PIN6	KL15	Key signal, hardware wake up, 12V high active, high duration greater than 100ms
PIN7	empty	empty
PIN8	GND	KL30, KL15 loop ground
PIN9	empty	empty
PIN10	empty	empty

4.2 Software Interface

Table 14: Application of CAN signals

Items	Function Usage	Protocol protocol
CAN	Communication	250kbps-500kbps