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Model No: ATD1K5-4812-A	Version: V0
Nominal Energy:	Date released: 13-May-2021

Specification

1.5KW DC/DC Converter
Model No.: ATD1K5-4812-A

Bidirection DC/DC Converter 48V/12V

Non- isolation

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Revision History

Version	Remarks	Preparation	Audit	Approval	Date
V01	Draft				2021.05. 13

Contents

1 Overview

1.1 Abstract

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

1.2 Terminology

Serial No.	Abbreviation	Description
1	DC/DC	DC/DC Converter
2	CAN	Controller Area Network
3	VCU	Vehicle Control Unit
4	ASIL	Automotive Safety Integrity Level
5	Io	DC/DC Output Current
6	IN	DC/DC Nominal Current
7	BMS	Battery Management System

1.3 Application

This document is the technical description for automotive 48V/ 12V DC/DC converter， be suitable with 48V/ 12V battery system.

1.4 Major Function Introduction

1.4.1 DC/DC Converter Function

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

1.4.2 CAN Communication Function

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

1.4.3 Self-diagnosis and Multi-protection Functions

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

2 Product Reference Standards

2.1 China Standards

Table 1：

No.	Standard	Description	Remark
1	GB/T 24347-2009	電動汽車 DC/DC 變換器	/
2	GB/T 18488. 1-2015	電動汽車用電機及其控制器第 1 部分:技術條件	/
3	GB/T 18384.2-2015	電動汽車安全要求第 2 部分: 功能安全和故障防護	/
4	GB/T 18384.3-2015	電動汽車安全要求第 3 部分:人员防觸電防護	/
5	GB/T 18387-2008	電動車輛的電磁場發射强度的限值和測量方法	/
6	GB/T 31498-2015	電動汽車碰撞後安全要求	/
7	GB 9254-2008	信息技術設備的無線電騷擾限值和測量方法	/
8	GB/T 18655-2010	車輛船和內燃機無線電騷擾特性用於保護車載接收機的限值和測量方法	/
9	GB 29743-2013	機動車發動機冷卻液	/
10	GB 4208	外殼防護等級(IP 代碼)	/
11	GB/T 28046-2	道路車輛電器及電子設備的環境條件和試驗第 2 部分： 電氣負荷	/
12	GB/T 28046-3	道路車輛電器及電子設備的環境條件和試驗第 3 部分：機械載荷	/
13	GB/T 28046-4	道路車輛電器及電子設備的環境條件和試驗第 4 部分：氣候載荷	/
14	GB/T 2423.34-2012	環境試驗第 2 部分:試驗方法試驗 Z/AD:溫度/濕度組合循環試驗	/
15	GB/T 2423. 1-2008	電工電子產品環境試驗第 1 部分:試驗方法試驗 A:低温	/
16	GB/T 2423.2-2008	電工電子產品環境試驗第 2 部分:試驗方法試驗 B:高温	/
17	GB/T 2423.3-2016	電工電子產品環境試驗第 2 部分:試驗方法 Cab:恆定濕熱試驗	/
18	GB/T 2423. 17-2008	電工電子產品環境試驗第 2 部分: 試驗方法試驗 Ka:鹽霧	/
19	GB/T 30512-2014	汽車禁用物質要求	/
20	QC/T 413	汽車電氣設備基本技術條件	/

2.2 Foreign Standards

Table 2：

No.	Standard	Description	Remark
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 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	4 8 V- vehicleelectricalsystem	/

3 DC/DC Converter Parameters

3.1 Application Specification

Table 3：

Item	Condition	Remark
Storage Temperature	-40℃~105℃	/
Operating Temperature	-40℃~60℃	/
Humidity	5%~95%	Relative humidity
Cooling Way	Nature cooling	/
Altitude	Normal operation under 2000m,given the usage conditions above 2000m	/
IP Level	IP67	/
Vibration Resistance	Sinusoidal Vibration Standard：EN/IEC 60068-2-6 （2009） Method：frequency：5~200Hz，frequency sweep rate：double frequency/min；Frequency /displacement ： 5~ 18.6Hz 10mm ； Frequency/accelerate ： 18.6~50Hz 4.5g ， 50~ 100Hz 4.5g ， 100~200Hz 3g ， Vibration direction and time： vertical 、 horizontal left and right, horizontal front and back each with 20 hours, operation mode：mode A，the load is outside the vibrating bench，the high voltage and low voltage wiring harness is connected to DC/ DC, upper computer records the data. Requirement: After the test, the mechanical structure has no damage, deformation and loosening for the fastening part. After the test, the functional parameters were tested at room temperature, and all the test items met the requirements of the functional parameters.	Vibration condition: electric vehicle
	Random Vibration Standard：ISO 16750-3 （2007） Method：frequency range：10~ 1000Hz，Total root mean square acceleration：27.8 m/s2；Energy spectral density 10Hz-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 ： vertical, horizontal left and right, horizontal front and back direction each with 8 hours, operation mode: mode A, the load is outside the vibrating bench ， the high voltage and low voltage wiring harness is connected to DC/DC, upper computer records the data. Requirement: After the test, the mechanical structure has no damage, deformation and loosening for the fastening part. After the test, the	

	functional parameters were tested at room temperature, and all the test items met the requirements of the functional parameters.	
	Mechanical Shock Standard：EN/IEC 60068-2-27 （2009） Method：pulse width：11ms；acceleration：20g；test direction and times： Vertical ： +Z10 times -Z10 times Horizontal left and right：+Y10 times -Y10 times Horizontal front and back：+X10 times -X10 times, load is outside the vibration bench ， connection mode between high voltage and low voltage wiring harness and DC/DC：DC/DC with no power Requirement: After the test, the mechanical structure has no damage, deformation and loosening for the fastening part. After the test, the functional parameters were tested at room temperature, and all the test items met the requirements of the functional parameters.	
	Drop Test Standard：EN/IEC 60068-2-32 （2009） Method：drop direction：6 sides ， 8 angles Height：500mm with packaging Requirement：After the test, the appearance of DC/DC and the plug-in shall be inspected according to the appearance requirements. After the test, the functional parameters shall be tested at room temperature, and all the test items shall meet the functional parameters requirements.	
EMC	RE ， CISPR 25, level 2； CE ， CISPR 25, level 2； RI ， ISO11452-2 ， in the frequency of 80M~2000MHz ， injection intensity is 75V/m； BCI，ISO11452-4，in the frequency of 1MHz~400MHz，injection intensity is 75mA； ESD ， ISO10605-2008 ， +/-8kV, 330Ω/ 150pF ， direct discharge test and indirect discharge test DC/DC power line transient immunity shall meet DC/DC signal wire transient coupling immunity meet IS07637-3 test requirement.	/
Noisy	Not more than 70dB	/
Ground	Grounding resistance is no more than 0. 1Ω Grounding position with obvious mark	/
Reliability	8years/ 120,000.00kms (calculated according to the service life of the capacitor)	/

3.2 Electrical Specification

3.2.1 48V to 12V

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

Item	Minimum Value	Typical Value	Maximum Value	Remark
Nominal Input Voltage Range	36V	48V	60V	Normal battery voltage ranges from 36 V to 60V Functional limit voltage range: 24~36V, 61~65V
Input Current		54A		36V input, 1.8kW output
Standby current (mA) Current consumption when under trigger on condition		300		Test under 14V battery power supply

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

Item	Protection Value	Remark
Input over voltage	Over voltage protection value: 61-65V Recovery value: ＞60V	When DC/DC input voltage is more than the over-voltage protection value, it will shut off the output and give an alert. It will automatic recovery after trouble shooting
Input under voltage	Under voltage protection value: 20-24V Recovery value:＜24V	When DC/DC input voltage is lower than the under-voltage protection value, it will shut off the output and give an alert. It will automatic recovery after trouble shooting
Short circuit	It will shut off when short circuit, then automatic recovery when trouble shooting	

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

Item	Nomination	Deviation	Content	Remark
Output Voltage	14.3V		Adjustable range: 9- 16V	Charging process follow the voltage and current command from VCU
Output Voltage Accuracy	/	≤±2%	/	
Output Voltage Ripple	240mV	/	/	
Output Voltage Monitoring Accuracy	/	±0.2V	/	
Output Current	110A	/	Adjustable range: 2- 110A	Charging process follow the voltage and current command from VCU

Output Current Monitoring Accuracy	/	± 1A	/	
Output Power	1.5KW			Rated Power P_N
Peak Power and Duration	1.8KW(132A)	/	Lasting with 6 minutes	Peak output power: 1.2PN Duration: within 6min
Load Regulation	/	≤±1%	/	
Line Regulation	/	≤±1%	/	
Output Response Time	≤200ms	/	/	After trigger ON, the stabilization establish time for output voltage from receiving command from VCU
Over Shoot	/	±5%	/	
Efficiency	94%			In the condition of nominal input and nominal output

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

Item	Protection Value	Remark
Output over voltage	Over voltage protection value: 17- 18V Recovery value: ＞16V	When DC/DC input voltage is more than the over- voltage protection value, it will shut off the output and give an alert. It will automatic recovery after trouble shooting
Output under voltage	Under voltage protection value: 6-9V Recovery value:＜10V	When DC/DC output voltage is lower than the under- voltage protection value, it will shut off the output and give an alert. It will automatic recovery after trouble shooting
Over Temperature Protection	With over temperature protection function, DC/DC can run with decreased power in the ambient temperature of 60℃~85℃ ， over temperature protection when surpass 95℃ ， automatically recovery when temperature decrease to 90℃.	
Output Over Current Protection	Current protection:120A-180A, Shut off, recovery when failures removed	
Short Circuit Protection	Before DC/DC start, when short circuit occur, DC/DC shall not be started after power on, and alarm prompt In the working, when short circuit occur, shut off the output and alarm prompt. DC/DC shall work normal after failures removed.	
Polarity Reverse Protection	When the positive and negative terminals of DC/DC output are connected in reverse, DC/DC shall not start after power on. DC/DC shall normal work after failures removed.	

3.2.2 24V to 48V DCDC Electrical specification characteristics (reverse function)

Table 7：12V to 48V DC/DC Input characteristics

Item	Minimum Value	Typical Value	Maximum Value	Remark
Input Voltage Range (V)	9	14.3	16	Normal battery voltage range
Input Current(A)		80		Input voltage is 9V, maximum load
Standby current(mA) (Current consumed when the ignition switch is ON)		300		Test under 14V power supply
Rated Input Power （W）		500	750	Rated input, rated output

Table 8： 12V to 48V DC/DCOutput characteristics (reverse function)

Item	Rated	Deviation	Content	Remark
Output Voltage	48V	/	Adjustable range：36~52V	The charging process is carried out according to the voltage and current instruction of VCU
output voltage accuracy	/	≤±2%	/	/
Output Voltage Ripple	480mV	/	/	/
Output voltage monitoring accuracy	/	±2V	/	/
Output Current	10A	/	Adjustable range：1~10A	The charging process is carried out according to the voltage and current instruction of VCU
Output current monitoring accuracy	/	±0.5A	/	/
Output Power	0.5kW	/	/	/
Load Regulation	/	≤±1%	/	/
Line Regulation	/	≤±1%	/	/
Dormant current	≤200μA	/	/	/
Output response time	≤200ms	/	/	The output voltage rises to stable
OUTPUT OVERSHOOT TEST	/	≤±5%	/	Startup & Shutdown
Output response	≤200ms	/	/	Power on the input from receiving the VCU enable

time				command until the output voltage is stable
Dynamic recovery time	≤5ms	/	Dynamic recovery time：≤5ms	Load dynamic range：30%~80%~30%
Dynamic loading effect	/	≤±5%	Dynamic loading effect：≤5%	Load dynamic range：30%~80%~30%
Efficiency	≥92%	/	/	Rated input, full load output

Table 9：12V to 48V DC/DC Input protection (reverse function)

Item	Protection Value	Content	Remark
Input Overvoltage Protection	Overvoltage Value：18～20V Recovery Value：>16V	Protection threshold:18～20V Recovery Value：>16V	When the DC/DC input voltage is greater than the overvoltage protection value, shut down the output and give an alarm. After the fault is removed, it should have the automatic recovery function.
Input Under voltage protect	Under voltage value：6V～9V Recovery Value：>10V	Protection threshold: 6～9V Recovery Value：>10V	When the DC/DC input voltage is less than the undervoltage protection value, shut down the output and give an alarm. After the fault is removed, it should have the automatic recovery function.
Short circuit protection	Turn off the machine; The fault is removed and can be recovered by itself		

Table 10：12V to 48V DC/DC Output protection

Item	Protection Value	Content	Remark
Output overvoltage protect	Overvoltage Value：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, shut down the output and give an alarm. After the fault is removed, it should have the automatic recovery function.
Output under voltage protect	under voltage 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, shut down the output and give an alarm. After the fault is removed, it should have the automatic recovery function.
Over-temperature protection	The overtemperature protection function allows the power to be reduced when the ambient temperature ranges from 60 ° C to 85 ° C. When the ambient temperature is greater than 95 ° C, the system automatically restarts charging when the temperature reaches the safe temperature (for example, if the temperature at the DC/DC detection point is less than 90 ° C).		
OUTPUT OVERCURRENT	15A~18A，power off, and can be recovered after the fault is rectified		
Short circuit protection	DC/DC before starting, output short circuit, after power-on should not start, and alarm prompt;In the process of work, output short circuit, should be closed output, and alarm prompt. After the fault is rectified, the DC/DC should work properly		
Battery reverse Protection	When the output terminal is reversed, it should not be started after power-on. After the fault is rectified, the DC/DC should work properly		

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3.3 Control Logic

1、Low voltage KL30 small battery power supply（9- 16V-DC/DC can normal work, 6- 16V to make sure the CAN communication normal）；

2、Give key signal KL15 high voltage（6- 16V）, KL30 supply power supply to the auxiliary powers by DC/DC internal switch

3、DC/DC_Enable: CAN；

4、DC/DC Disable: shut off control

a、through CAN communication

b、The DC/DC detects that the hardware wake-up signal jumps from high level to low level, and it detects that the low level lasts for 5 seconds before sleeping.KL15 jumps from low to high wake-up.

3.4 CAN network system

With CAN wake-up function, to meet the specific frame wake-up requirements.

Adopt Standard CAN2.0B communication protocol

3.5 DC/DC functional requirement

Support CANBUSOFF, CAN enable function。

4. Interface Requirement

4.1 Interface Port (T.D.B.)

Table 9 ： Pins Definition

Pin	Definition	Remark
PIN1	KL30	12V auxiliary power supply, connected to 12V battery
PIN2	/	/
PIN3	A_CAN_H	CAN H
PIN4	A_CAN_L	CAN L
PIN5	/	/
PIN6	KL15	Key signal, hardware wake up, 12V high level is effective, high level duration is greater than 100ms
PIN7	/	/
PIN8	GND	KL30、KL15 circuit ground
PIN9	/	/
PIN10	/	/

4.2 Software Interface

Table 10： Applied CAN signal

Item	Role	Protocol
CAN	Communication	CAN2.0B baud rate 500KB/s

5 Mechanical and Appearance requirement

5.1 Measurement and Weight （Connectors are included）

Table 10：

Item	Spec	Deviation
Height	60mm	<±1 mm
Width	219mm	<±1 mm
Length	250mm	<±1 mm
Weight	< 3.0kg	For your reference

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5.2 Appearance