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About us

Company Introduction

Located in Chengdu Tianfu New District, Sichuan Tengli Hengxin(TLHX) Technology Co., Ltd was established by veteran professionals working in the new energy automobile industry in September 2014. In the context of global pursuit of low carbon transportation today, our company is specialized in the R&D, design and sales of Battery Management System (BMS) product targeting the bright prospect of new energy automobiles.



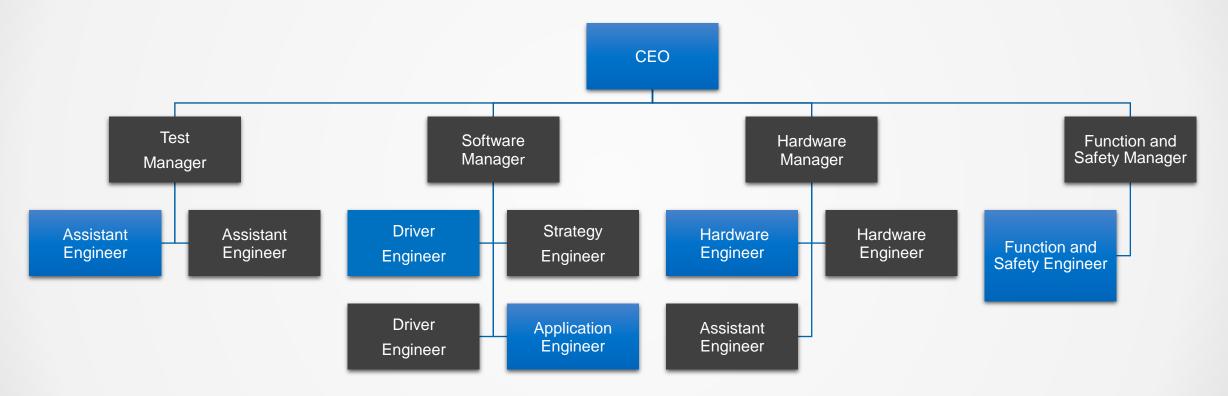


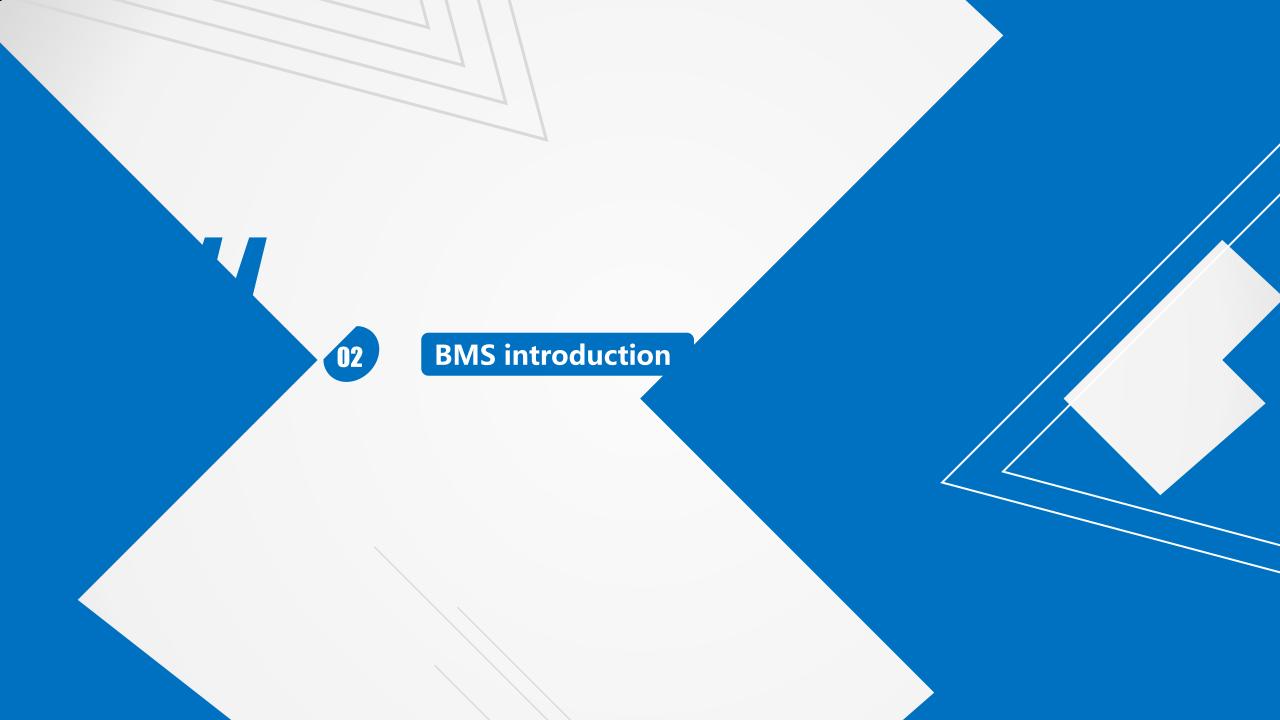
Senior Team used to work for Toyota, CATL, A123, with over 6 years' experience in BMS product development.



Located in Tianfu New District High-tech Industry Park.

About us organization chart

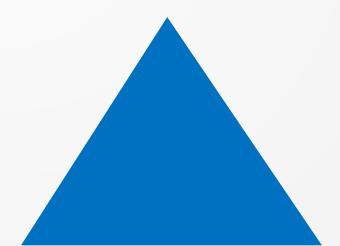




BMS solution



- Development Capability
- Performance and Architecture
- Summary Of Functional Safety Strategy
- BMS Validation



List of Development Tools

Mechanical Design Tools

Stage	Tool Used	Application
Mech.	Solidworks	3D structure design
Design	AutoCAD	2D structure design

Hardware Design Tools

Stage	Tool Used	Application	
HW. Design	Pspice	Circuit simulation	
	Mathcad	Worst case analysis	
	OrCAD Capture CIS	Schematic design	
	Allegro PCB Designer	PCB layout design	

Software Design Tools

Stage	Tool Used	Application
SW Arch	Enterprise Architect	SW arch.design
SW Dev.	Matlab,Simulink	App.SW dev.
SW Unit Test	QAC Polyspace	Static code analysis
	Tessy,MTest	Unit testing
Int.Test	Busmaster	Interface testing, Communication testing
	ZLG	Functional testing
System LNT. Test	ECU Labcar,vTest Studio	System int.testing
Calibration	CANape	ECU calibration

TLHX Product developments process - APQP

			•			
APQP Phases	Phase 0 NBO to Awark/Cell R& D	Phase 1 Plan & Define	Phase 2 Production Design & Development	Phase 3 Process Design & Development	Phase 4 Product & Process Validation	Phase 5 Production
AIAG Phase	N/A	Program Approval	Prototype	Pilot	Launch	Production
TLHX Sample Phase	NBO/Roadmap Phase Biz Acquisition/Cell R&D	A Phase(CV) Concept Design/Test	B Phase(DV) Product Design/Test	C Phase(PV) Process Design /Test	D Phase Pilot Production	Production High Volume SS Production
Sourcing Status	Cost Estimation	Prototype Sourcing	Strategic	Production Sourcing Component	Commodity	Value Engineering
Project K/O to SOP Min 18 mo to SOP Max 36 mo to SOP	3 – 6 months	3 – 6 months	6 – 12 months	6 – 12 months	3 – 6 months	2 – 5 yrs
Lifecycle	N/A	Business Dv'lp/Acqusition	Design	Prototype	Pilot	Production
Key Customer Activities Key Core Activities	nal funding Kid		lidation Reviews Kid	ekoff Reviews prod.	1 PPAP	Ext. PPAP of project "Health"
TLHX Phase Gate Reviews	Quote		lidation Validation Kid	koff Validation prod.	РРАР	Int PPAP Yearly assessment of project "Health" EOF
Gate 0 Key Deliverables -Target cust / application -Product type / size -Parts built / issues -Performance req'mts / compliance matrix -Customer timing + TLHX timing -Customer PO or internal funding -Staffing plan & proposed budget -Gross margin calculations -Project risk assessment -Mfg location / strategy -Capex / tooling req"d -Facilities upgrades / add -Service strategy concept -Lesson learned review -APQP phase report complete	Gate 1 Key Deliverables -Prelim Design / BOM -Parts built / issues -Exceptions / Perf.gaps -Timing / Deliverables -Updated budget -Updated Staffing plan / gaps -Updated Margin Calc -CV Test Results -DV Test plan w / timing -Mfg strategy / capacity -CapEx and facilities status -Key supplier SSOWS -Service strategy plan -Lesson learned review -APQP phase report complete	Gate 2 Key Deliverables -Design review summary -Released BOM -Total parts built / issues -DV test summary / issues -PV test plan w / timing -"OK to Toll" cust.approval -Key suppliers sourced -Resource review / gaps -Budget / Margins / Tooling -Manfg. process plan -CapEx facilities status -Service strategy status -Lesson learned review -APQP phase report complete	Gate 3 Key Deliverables -Design / Process review -Design change summary -Total parts built / issues -Key PV tests complete -Process flow / control -Volume confirmation -All suppliers PPAP"d -Resource review -Mfg execution status -Budget / Margins / Tooling -Capex / tooling req"d -Final service strategy -Service strategy concept -Lesson learned review -APQP phase report complete	Gate 4 Key Deliverables -Process change review -Total parts built / issues -Suppliers PPAP'ed -PPAP accepted by OEM -Confirm capacity plan -Resource review -Budget / Margins / Toolir -Update service strategy -Lesson learned review -APQP phase report complete	Gate 5 Key Deliver -Volume plan vs ac -Field issue pareto -Warranty costs -Prod / process str -Lessons learned -Customer satisfac	Gate 6 Key Deliverables -Why project ended -Warranty summary -Service parts strategy -Project cost summary -Close out project -Lesson learned review

BMS solution

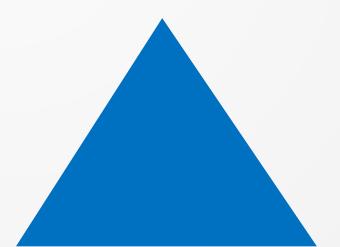
Development Capability



Performance and Architecture

Summary Of Functional Safety Strategy

BMS Validation



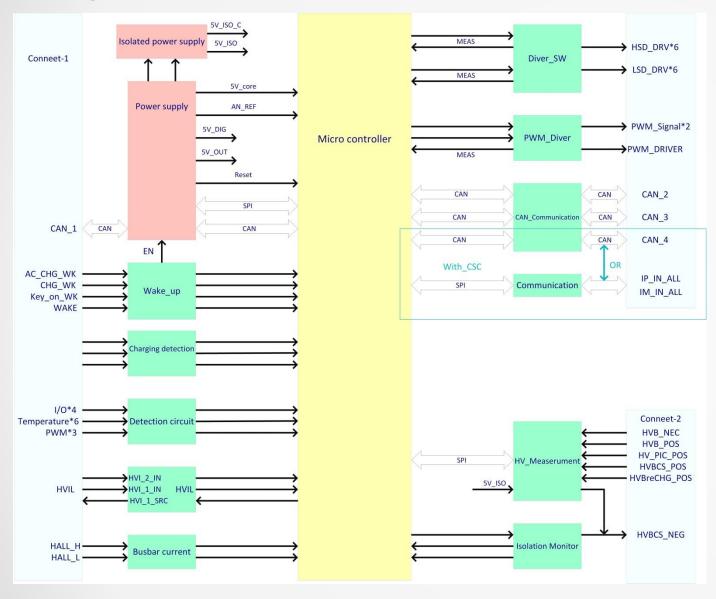
Performance Indices

Item	Parameter	Value	Comment
	Range	0V~5V	
Cell Voltage	Resolution	1mV	
	Accuracy	±5mV	-20℃~+65℃
	Range	-40℃~+125℃	
	Resolution	1℃	
Cell Temperature		±2℃	-40℃~-20℃
	Accuracy	±1.5℃	-20℃~+65℃
		±5°C	+65℃~+125℃
	Range	-500A~+500A	
Main Current Sensor	Resolution	0.05A	
wain Current Sensor	Acquirect	±0.5%	I<-20A, I>20A
	Accuracy	0.15A	-20A< I<20A
	Range	-350A~+350A	
Sacardam, Current Sanaar	Resolution	0.5A	
Secondary Current Sensor	Accuracy	±2%	I<-50A, I>50A
		1A	-50A< I<50A
	Range	0V~500V	
High Voltage	Resolution	0.1V	
	Accuracy	±0.5%	-20℃~+65℃
	Range	0Ω~5ΜΩ	
	Resolution	1ΚΩ	
Isolation Resistance	A	±15K	20kΩ ~ 100kΩ
	Accuracy	±15%	100kΩ ~ 5MΩ
	Check Time	≤8s	Default value
Balance Current	Passsive	50mA	
	Range	0%~100%	
SOC Estimation	Resolution	0.10%	
	Accuracy	≤5%	

Performance Indices

Item	Preformance Preformance		Comment	
	16 bit Dual core processor system			
	Min. 256 KB Flash and m			
	Processor frequen			
MCU	Floating Point Unit (FPU) & Memo	NXP MC9S12XET256		
	3x CAN H			
	CAN interfaces with at least 2 m	ailboxes per each CAN		
	High Temp Endurance	1000h	105°C	
	Thermal Shock	632 Cycle	-40°C to 105°C	
	Quiescent Current	≤80uA		
HW	Operation Current	250mA	Not include relay driver current	
	Operation Temp	-40°C to 105°C		
	Under Voltage	4.5V~9V	Class B	
	Operation Voltage	9V~18V	Class A	
	Over Voltage	18V~24V	Class B	
	CE	Class 4	CISPR 25	
	7637-2	Class 3	CISPR 25	
EMC	RE	Class 5	CISPR 25	
	BCI	200mA	ISO 11452	
	7637-3	100V/m	CISPR 25	

BMU Hardware Architecture



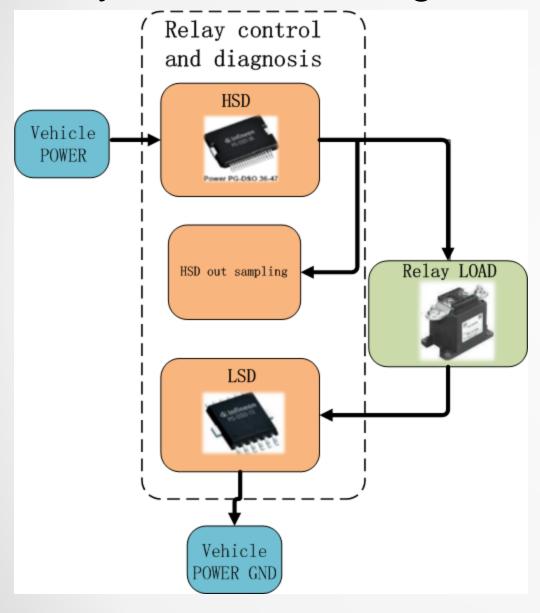
System Key Features:

- CAN FD, CAN Interface
- Primary OBD ECU
- Galvanic Isolation between HV and LV
- KL30C for contactor supply

Main Features:

- Contactor control and diagnosis and fuse check
- Precharge control and diagnosis
- Redundant Current measurement and monitoring
- Voltage measurement and monitoring
- Leakage detection / isolation resistance monitoring
- Ground strap monitoring
- High Voltage Interlock (HVIL)
- Temperature monitoring
- Coolant temperature control (Inlet/Outlet/Valve)
- Crash detection
- CMCe control incl, balancing and E2E CAN comm
- Safe state based on OC/OV/UV/OT
- SOC, SOH, Power Prediction (through VW BMC)
- Flashbootloader / Online Remote Update
- DTC handling
- Fault Event Manager

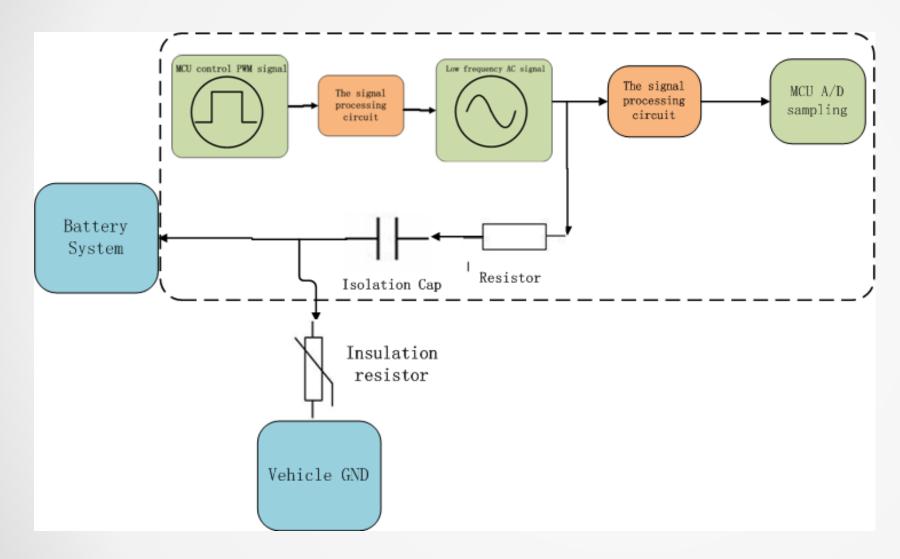
Relay control and diagnosis – An example



Main Features:

- LSD and HSD control.
- Short circuit protection.
- · Overload protection.
- Current limitation.
- Thermal shutdown.
- Overvoltage protection.

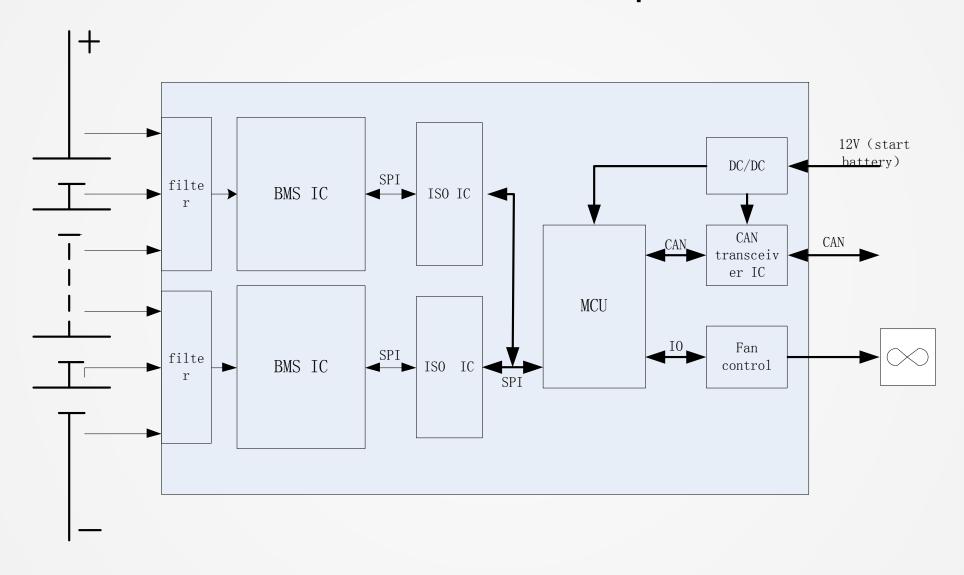
Insulation Monitoring – An example



Main Features:

- Based on low frequency signal.
- Check time < 8s.

CSC Hardware Architecture – An example

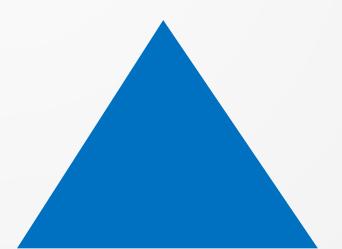


BMS solution

- Development Capability
- Performance And Architecture



- Summary Of Functional Safety Strategy
- BMS Validation



Summary Of Functional Safety Strategy

Manage cell over-temperature risk

- BMS monitors and reacts to high cell stack temperatures
 - Open relay under high temperature conditions.
 - Redundant temperature sensors included in design.
- BMS monitors and reacts to extreme current events.
 - Design components to withstand short overcurrent events that do not present a component or cell failure risk.
 - Open relay during hard short circuit conditions that may present a component or cell failure risk.
 - Include in-pack fusing element: Prevent compromising cells in hard short events that exceed the relay's capacity to clear.

Manage cell overvoltage risk

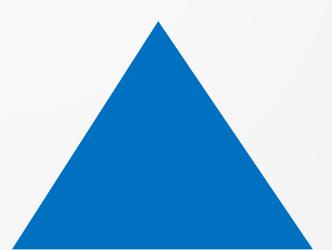
- BMS monitors and reacts to high voltage at a cell level.
 - Open relay under high voltage condition.
 - Redundant overvoltage monitor circuit can open relay independent of SW.

BMS solution

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BMS Validation



Software Test Capability

- Unit Test
 - Unit Test with defined Coverage from ASIL-C (Statement, Branch coverage, MCDC Coverage)
 - Defined Unit Test Test Case Review and Test Findings Review.
- Manual Test (For functional check and integration check purpose)
- Software Integration Test (PIL or SIL)
 - Different Integration Test strategy regarding following modules.
 - Between Simulink modules.
 - Between Application and Third party library.
 - Between Application and Basic Software.
 - Processor in the Loop or Software in the Loop.
- Software Test
 - Functional Test with 100 percent requirement coverage.
 - PIL and SysIL level Test
 - CANoe, Teststudio based Test Framework and Test automation. (for regression Test)

Hardware Validation

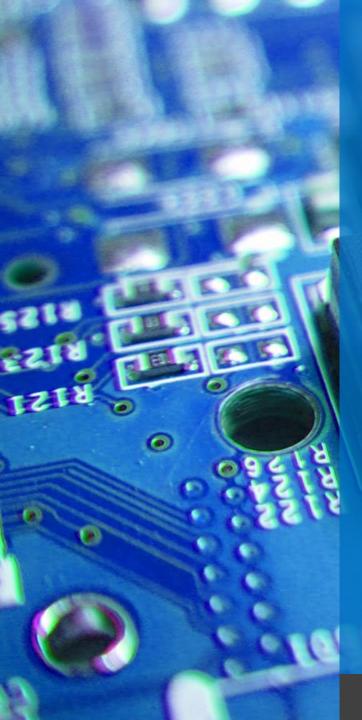
EMC test				
Test item	Reference standard	Test Result		
RF transmit emission of power line	CISPR25:2008 Radio disturbance characteristics for the protection of receivers used on board vehicles, boats, and on devices-Limits and	pass		
Radio-frequency emission	methods of measurement	pass		
Bulk Current Injection (BCI) Test	ISO 11452-4-2005:Road vehicles - Component test methods for electrical disturbances by narrowband radiated electromagnetic energy - Part 4 - Bulk current injection (BCI)	pass		
Radiation interference immunity	ISO11452-2-2004:Road vehicls-component test methods for electrical disturbances from harrowbard radiatiod electromagnetic energy PART 2-Absorber-lined shielded enclosure	pass		
Voltage transient emission test	ISO7637 2: Pood vohicles Electrical disturbances from conduction and	pass		
Test pulse generator for immunity testing	ISO7637-2:Road vehicles Electrical disturbances from conduction and coupling Part 2: Electrical transient conduction along supply lines only			
Electrical transient conduction along I/O lines	ISO7637-3: 2007:Road vehicles Electrical disturbances from conduction and coupling Part 3: Electrical transient transmission by capacitive and inductive coupling via lines other than supply lines	pass		
ESD test	ISO 10605-2008 Test methods for electrical disturbances from electrostatic discharge	pass		

Hardware Validation

Electrical performance test					
Test item Reference s			Test Result		
Direct current supply voltage		4.2.2	pass		
Withstand voltage		4.11.2	pass		
Insulation resistance		4.12.2	pass		
Superimposed alternating voltage		4.4.2	pass		
Starting profile	ISO16750-2 : Road vehicles-	4.6.3.2	pass		
Reversed voltage	Environmental conditions and	4.7.2.3	pass		
Over voltage		4.3.1	pass		
Momentary drop in supply voltage	electronic equipmentPart2 Electrical loads.	4.6.1	pass		
Reset behaviour at voltage drop		4.6.2	pass		
Ground reference and supply offset		4.8	pass		
Open circuit tests		4.9	pass		
Short circuit protection		4.10.2	pass		

Hardware Validation

Climatic loads test					
Test item Reference standard					
High-temperature tests		5.1.2	pass		
Low-temperature tests	ISO16750-4: Road vehicles-Environmental	5.1.1	pass		
Temperature step test	conditions and testing for electrical and	5.2.2	pass		
Humid boot ovolio	electronic equipment—Part4 Climatic loads	5.6.2	pass		
Damp heat, steady-state test		5.7.2	pass		
Temperature cycling test		5.3.1.2	pass		
Mechanical loads test					
Test item	Reference standard		Test Result		
Random vibration	ISO16750-3: Road vehicles-Environmental	4.1.2	pass		
	conditions and testing for electrical and	4.2.2	pass		
Free fall	electronic equipment—Part3 Mechanical loads	4.3.2	pass		



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