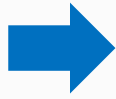




TLHX



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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.



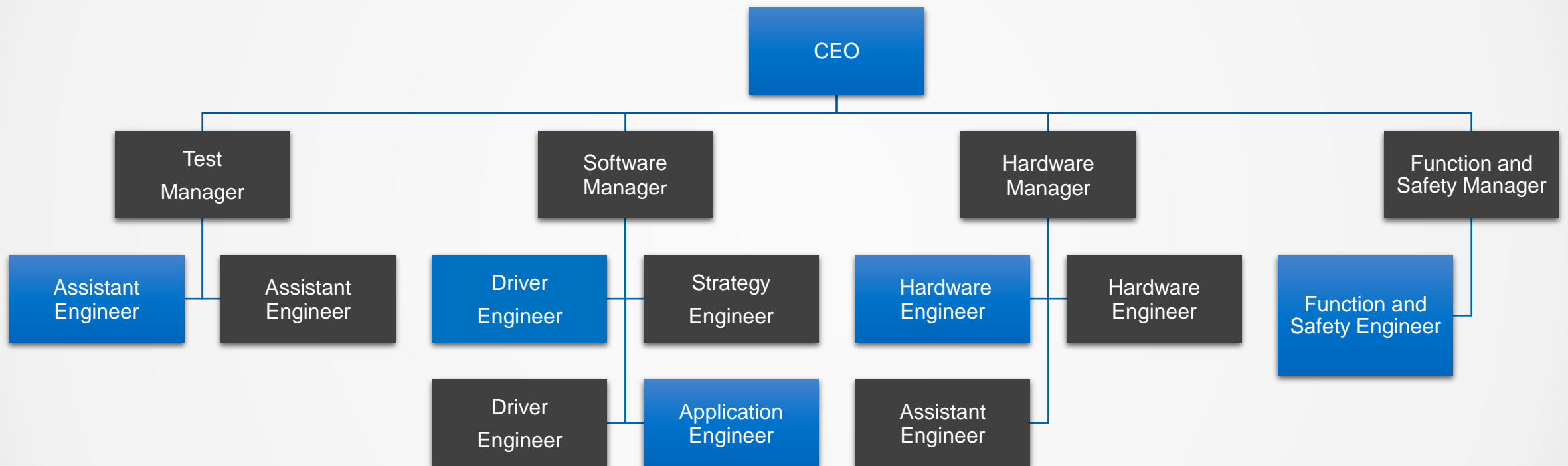
Senior Team used to work for Toyota,CATL, A123, with over 6 years' experience in BMS product development.



Located in Tianfu New District High-tech Industry Park.

About us

organization chart





02

BMS introduction

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. Design	Solidworks	3D structure design
	AutoCAD	2D structure design

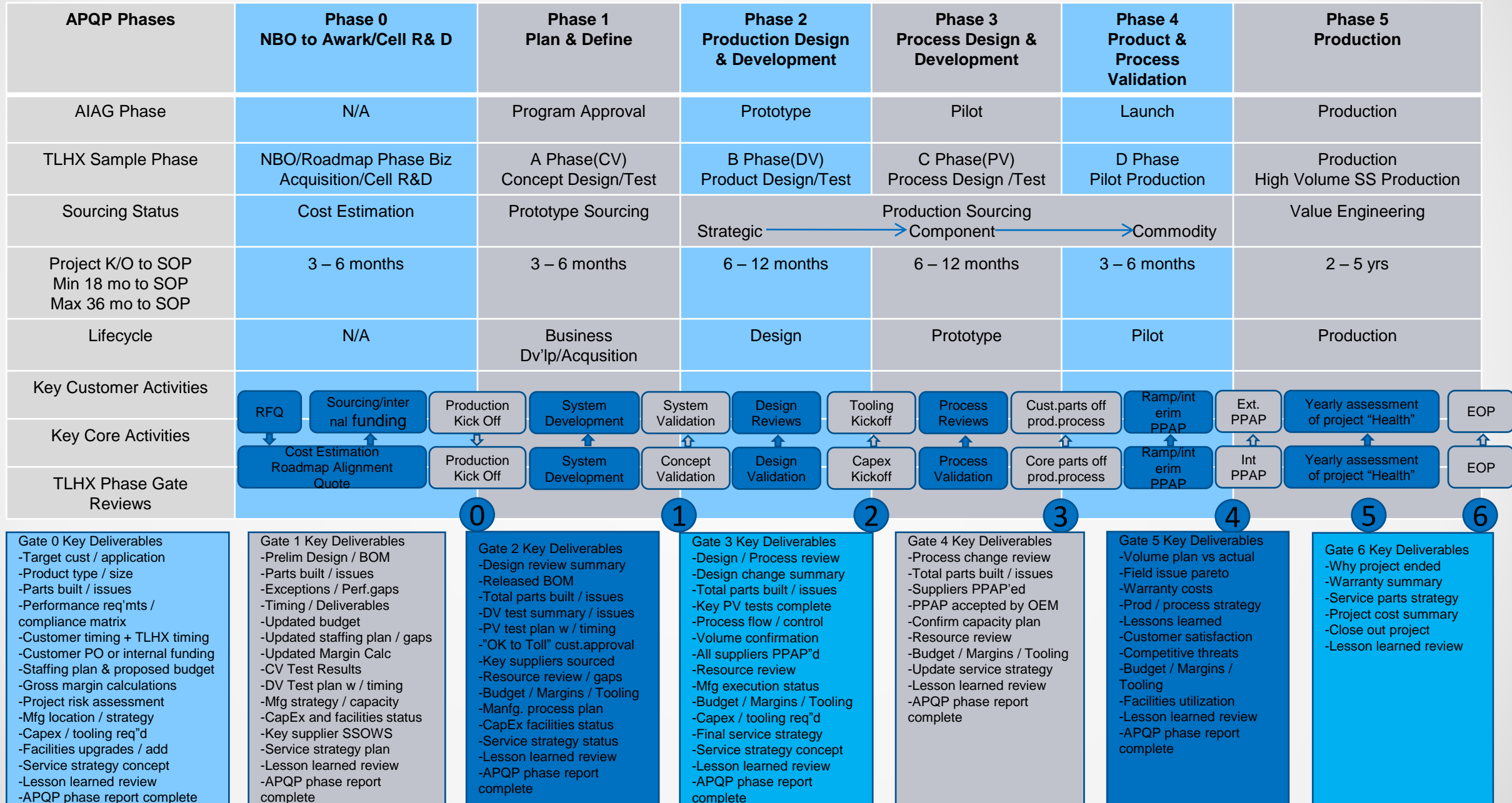
Hardware Design Tools

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



BMS solution

- Development Capability



- Performance and Architecture

- Summary Of Functional Safety Strategy

- BMS Validation

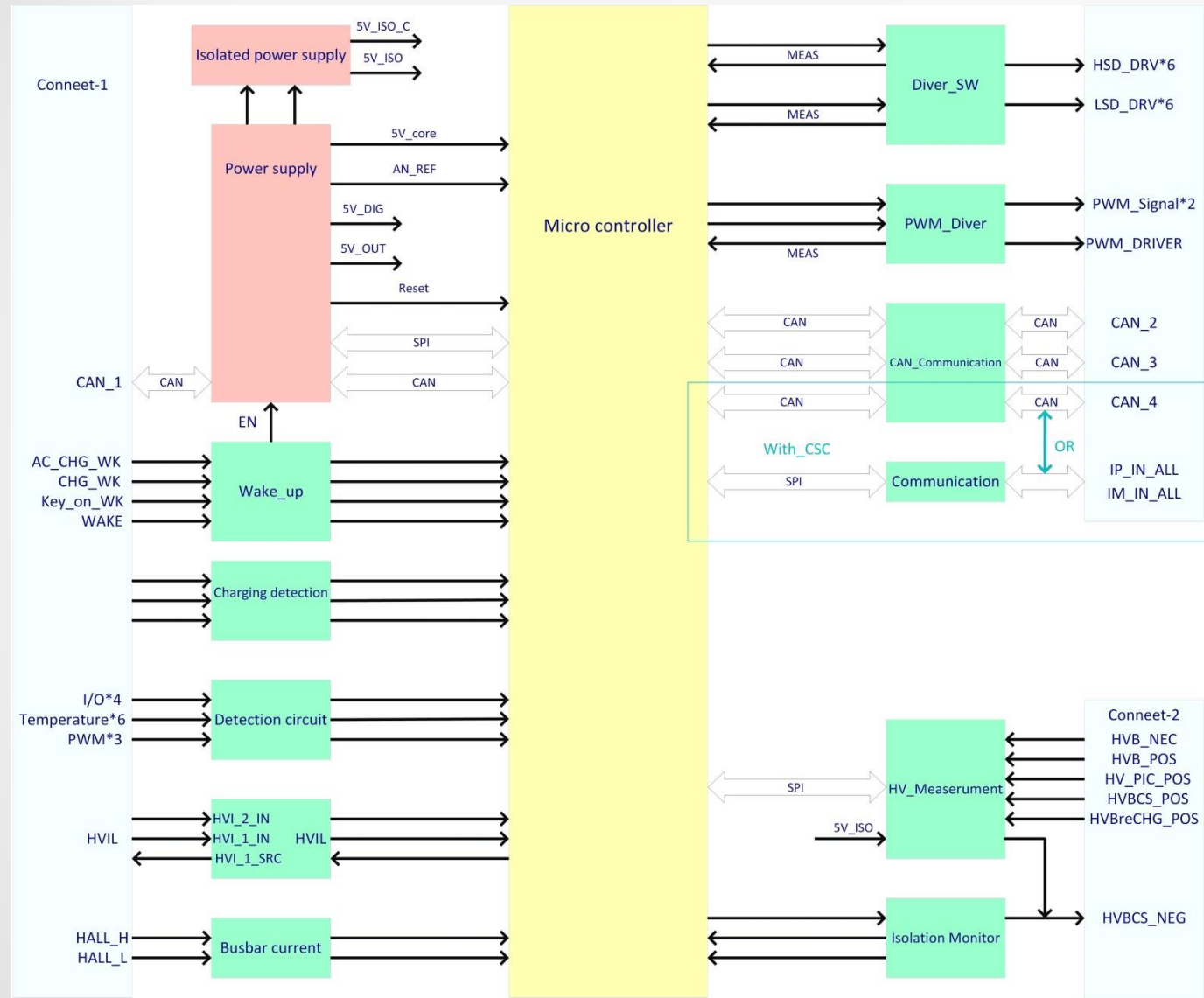
Performance Indices

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

Performance Indices

Item	Preformance		Comment
MCU	16 bit Dual core processor system		NXP MC9S12XET256
	Min. 256 KB Flash and min. 16 kB SRAM		
	Processor frequency 50MHz		
	Floating Point Unit (FPU) & Memory Protection Unit (MPU)		
	3x CAN HS		
	CAN interfaces with at least 2 mailboxes per each CAN		
HW	High Temp Endurance	1000h	105°C
	Thermal Shock	632 Cycle	-40°C to 105°C
	Quiescent Current	≤80uA	
	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
EMC	CE	Class 4	CISPR 25
	7637-2	Class 3	CISPR 25
	RE	Class 5	CISPR 25
	BCI	200mA	ISO 11452
	7637-3	100V/m	CISPR 25

BMU Hardware Architecture



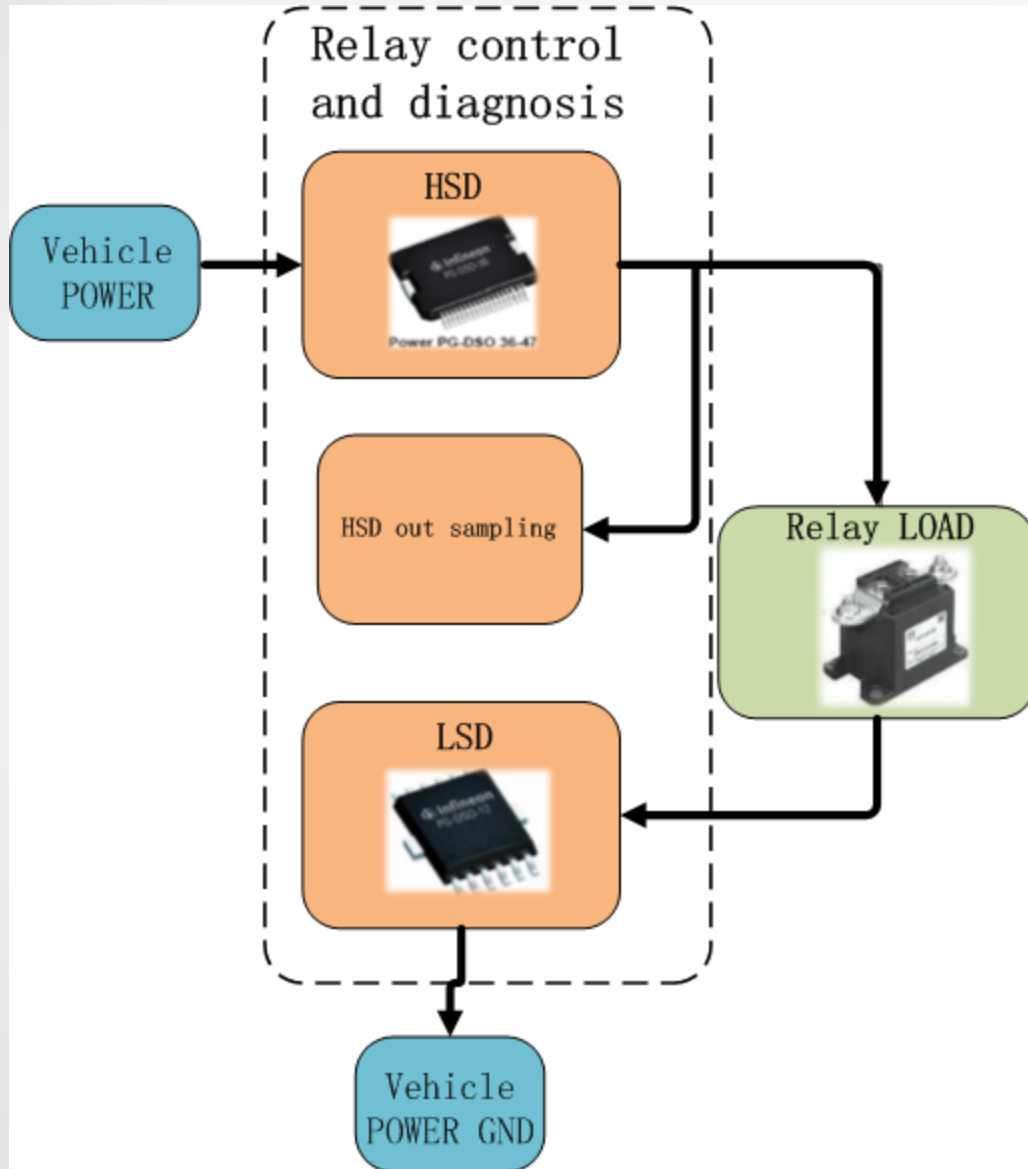
System Key Features:

- 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

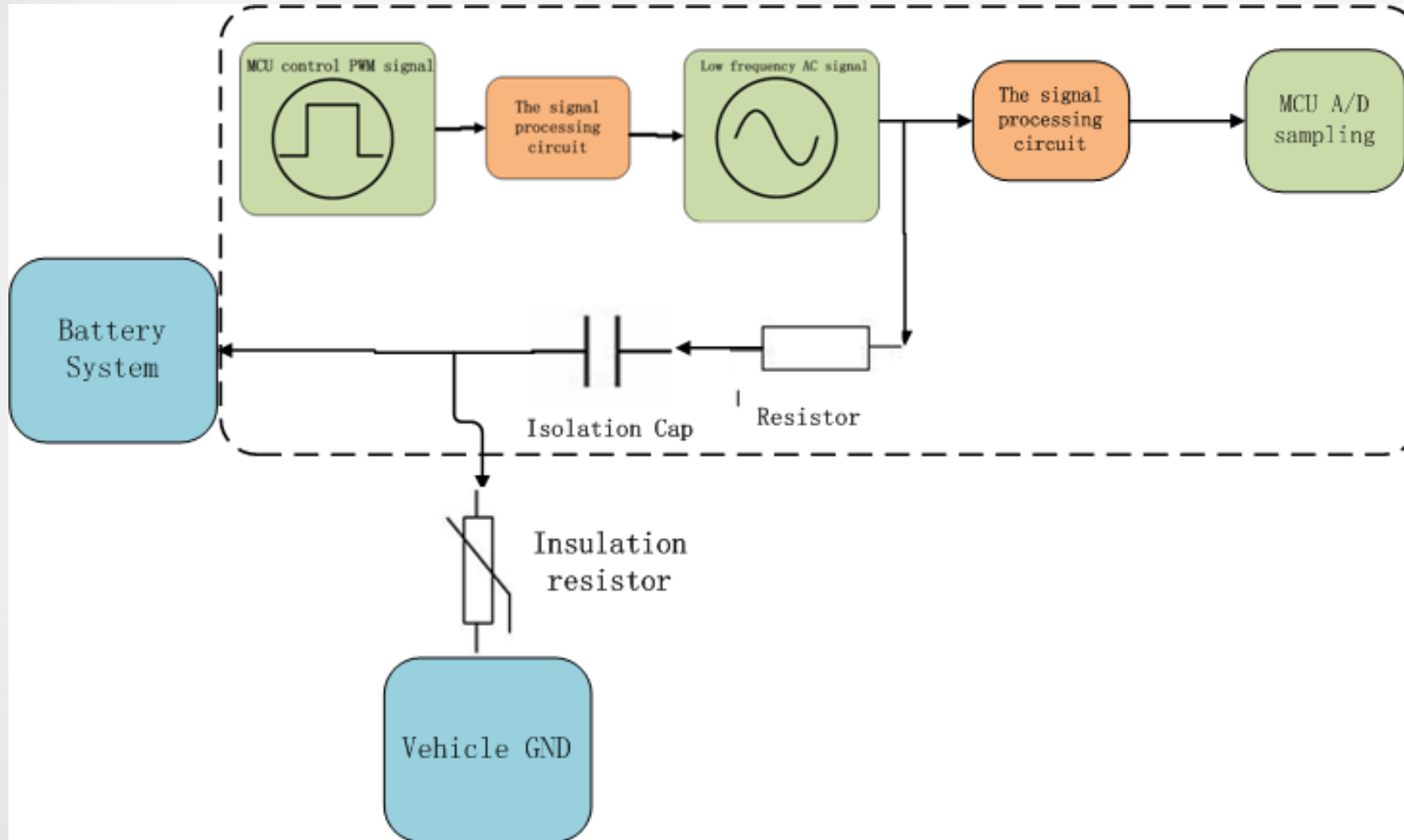
Relay control and diagnosis – An example



Main Features:

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

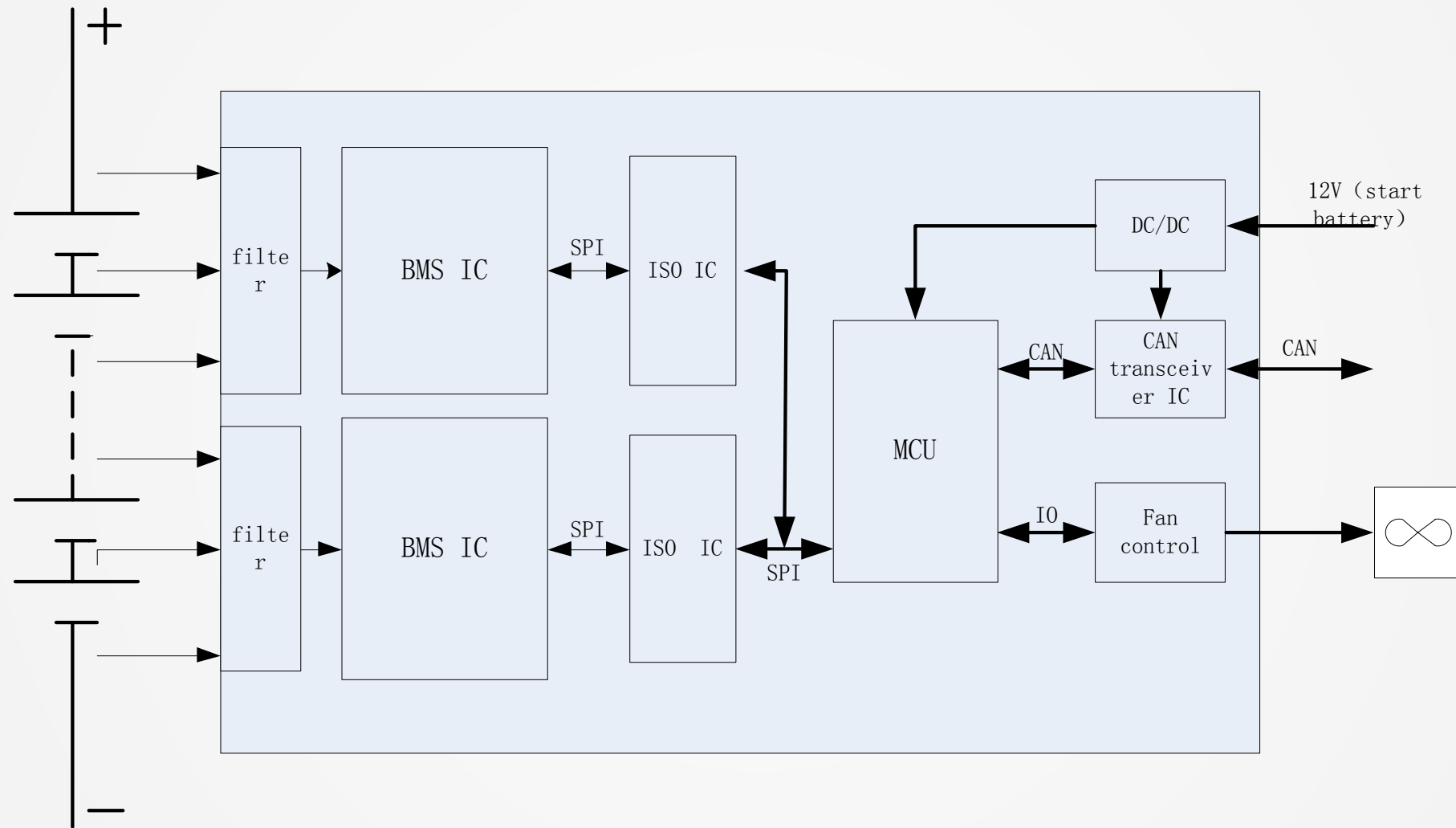
Insulation Monitoring – An example



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

- Development Capability
- Performance And Architecture
- Summary Of Functional Safety Strategy



- 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 methods of measurement	pass
Radio-frequency emission		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 vehicles-component test methods for electrical disturbances from narrowband radiated electromagnetic energy PART 2-Absorber-lined shielded enclosure	pass
Voltage transient emission test	ISO7637-2:Road vehicles -- Electrical disturbances from conduction and coupling -- Part 2: Electrical transient conduction along supply lines only	pass
Test pulse generator for immunity testing		pass
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 standard		Test Result
Direct current supply voltage	ISO16750-2 : Road vehicles- Environmental conditions and testing for electrical and electronic equipment--Part2 Electrical loads.	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		4.6.3.2	pass
Reversed voltage		4.7.2.3	pass
Over voltage		4.3.1	pass
Momentary drop in supply voltage		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		Test Result
High-temperature tests	ISO16750-4 : Road vehicles-Environmental conditions and testing for electrical and electronic equipment—Part4 Climatic loads	5.1.2	pass
Low-temperature tests		5.1.1	pass
Temperature step test		5.2.2	pass
Humid heat,cyclic		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 conditions and testing for electrical and electronic equipment—Part3 Mechanical loads	4.1.2	pass
Mechanical shock		4.2.2	pass
Free fall		4.3.2	pass

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Contact Us



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Thank you

