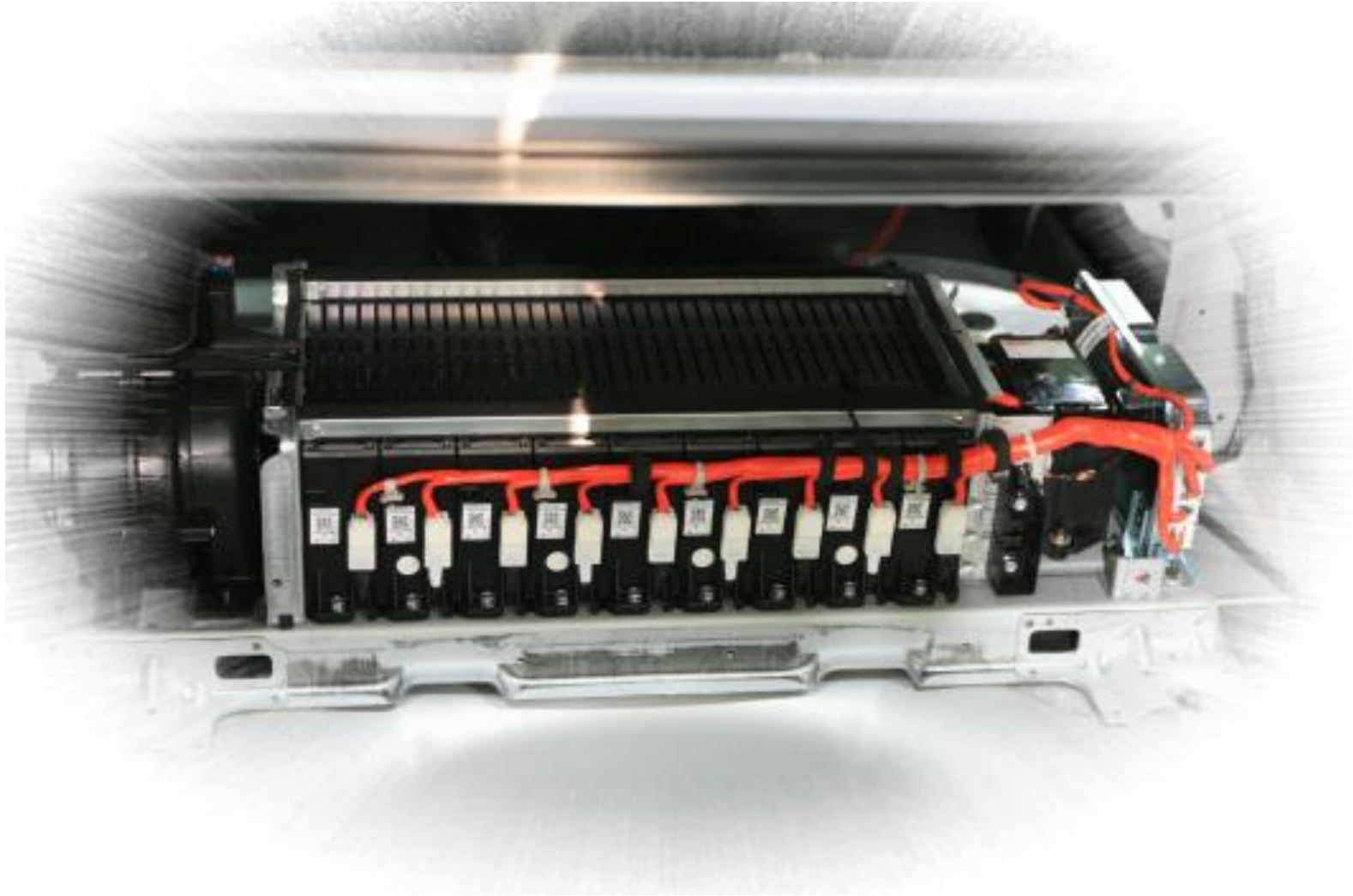
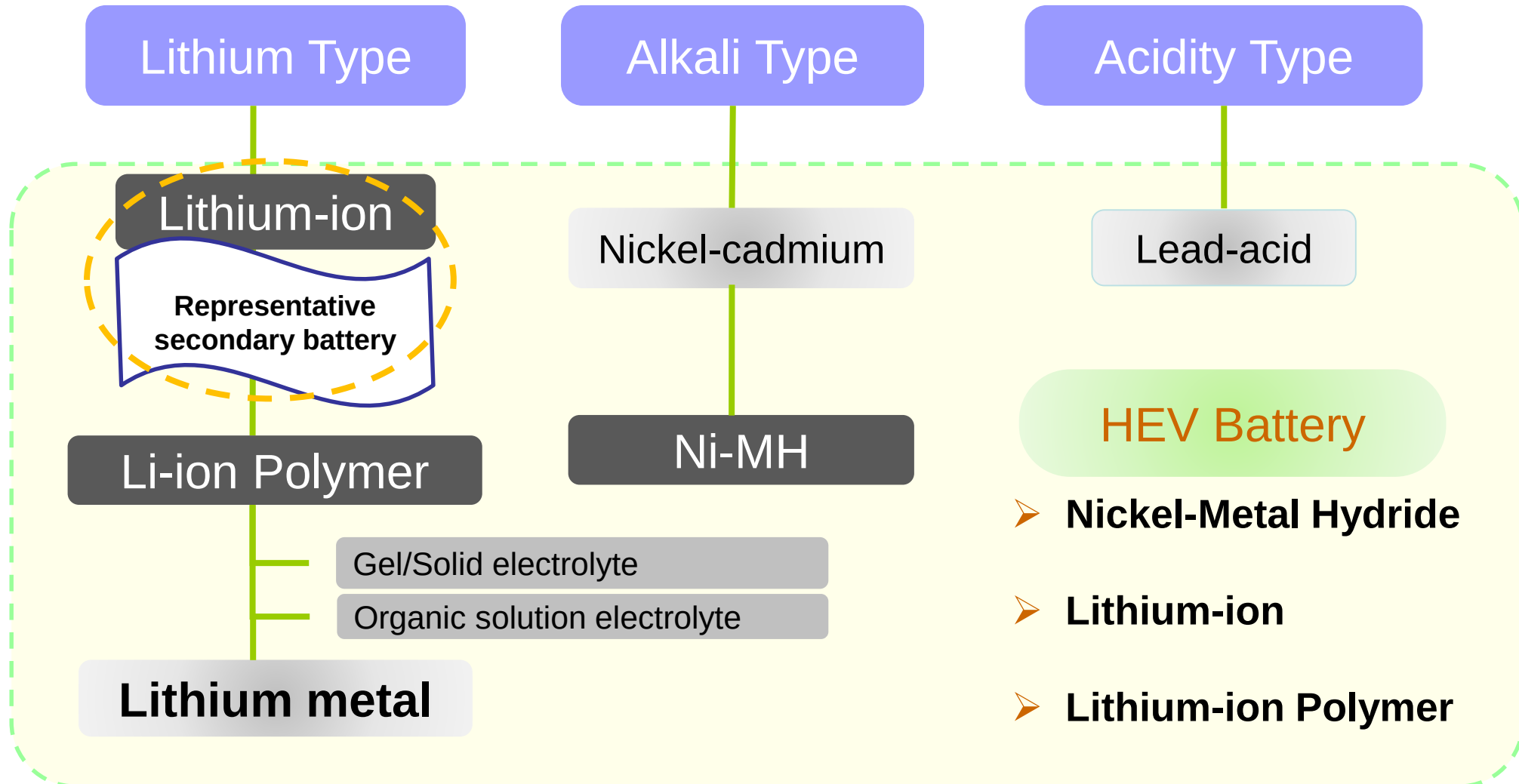


High Voltage Battery System



1. General
2. System Components
3. Battery Management System
4. Diagnosis
5. Cautions

Types of Rechargeable Battery



General

Alkaline Battery

Alkali Type

Nickel-cadmium
(Ni-Cd)

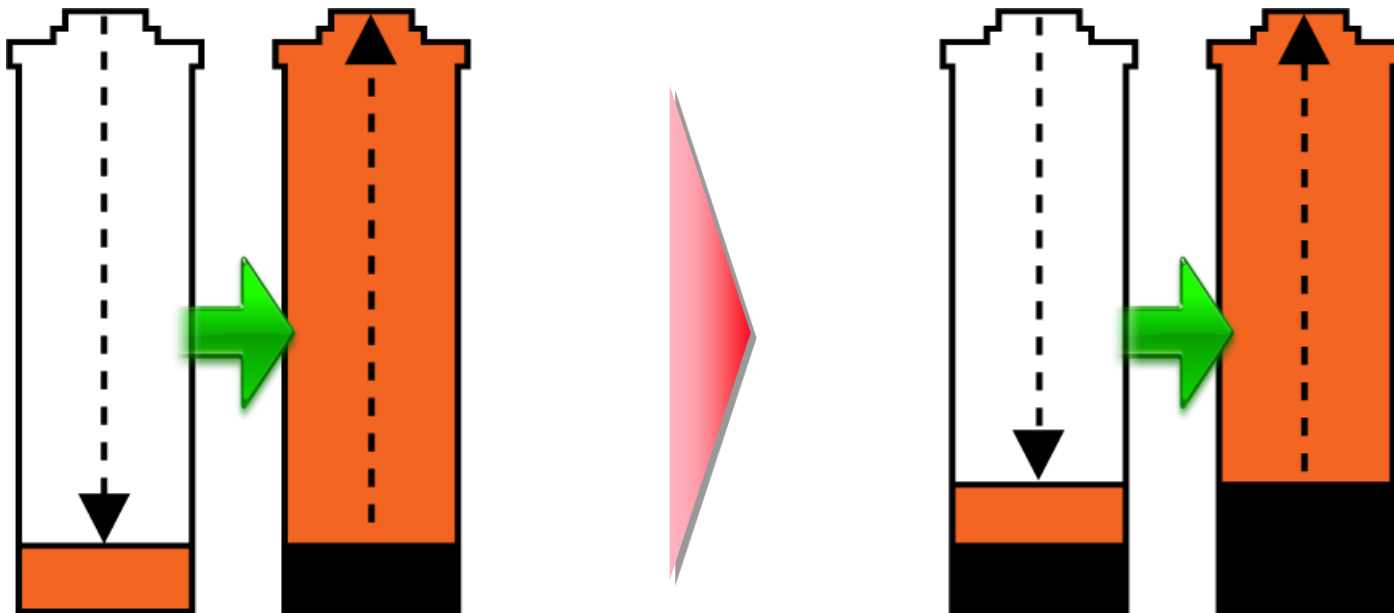
Nickel-Metal Hydride
(Ni-MH)

- Cell voltage : 1.2V
- Self discharge rate: 10~30%
- Memory effect: YES
- Application : Walkman, CD player
- Performance : Ni-MH > Ni-Cd

Ni-MH Capacity: about 1~5 kWh
(Normal battery : about 0.3~1.0 kWh)

What is memory effect

Effect which cause to hold less charge because battery remember the smaller capacity



If 80% discharged and then fully charged,
→ **only 80% capacity can be used**

If 64%(80% of 80%) discharged and then fully charged,
→ **only 64% capacity can be used**

Nickel-Metal Hydride Battery (Ni-MH)

Most of HEV → Using Ni-MH Battery

Prius



Insight



General

Lithium-ion Polymer Battery (LiPB)

Lithium type

Lithium-ion
(Li-ion)

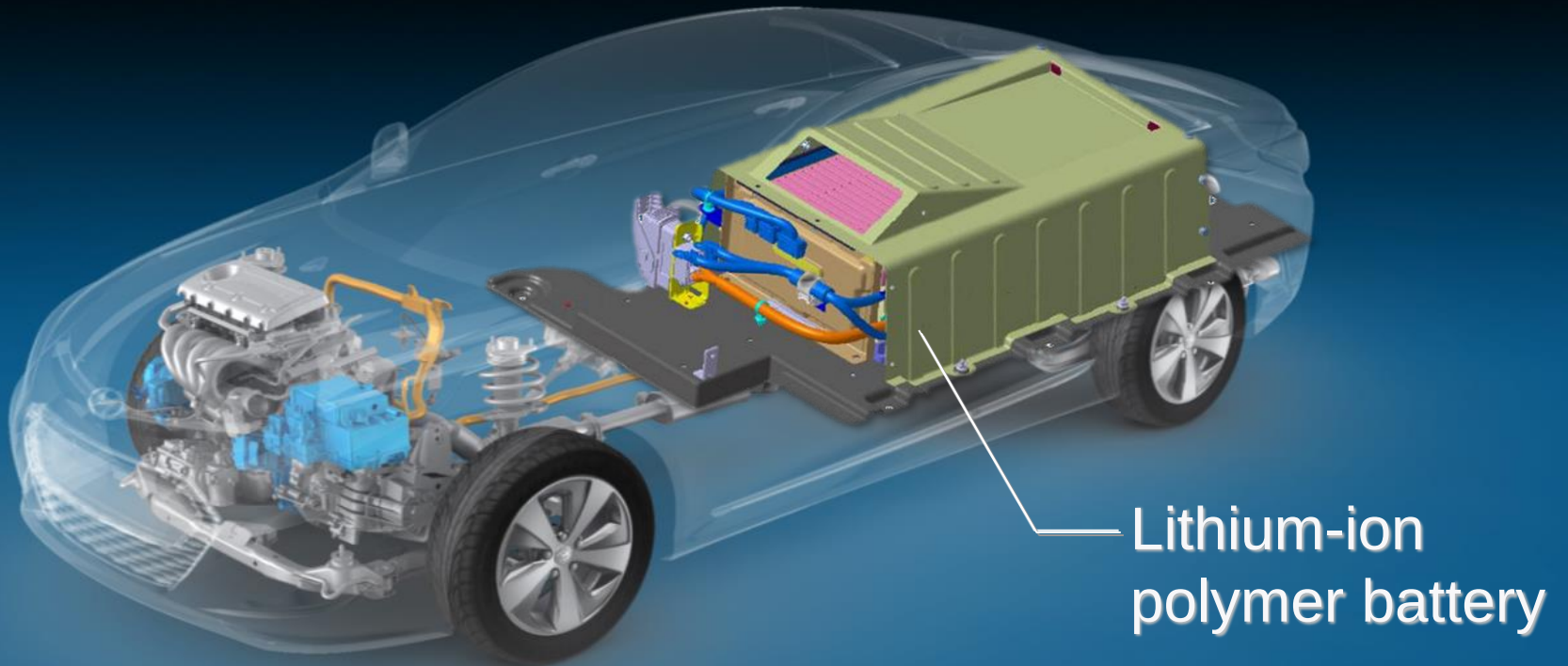
Representative
secondary battery

Lithium-ion Polymer
(LiPB)

- Cell voltage: 3.75V
- Self discharge rate: 5% or less
- Memory effect: NO
- Application: Laptop, Digital camera, Cellular phone, etc
- Performance: High Voltage, High energy density

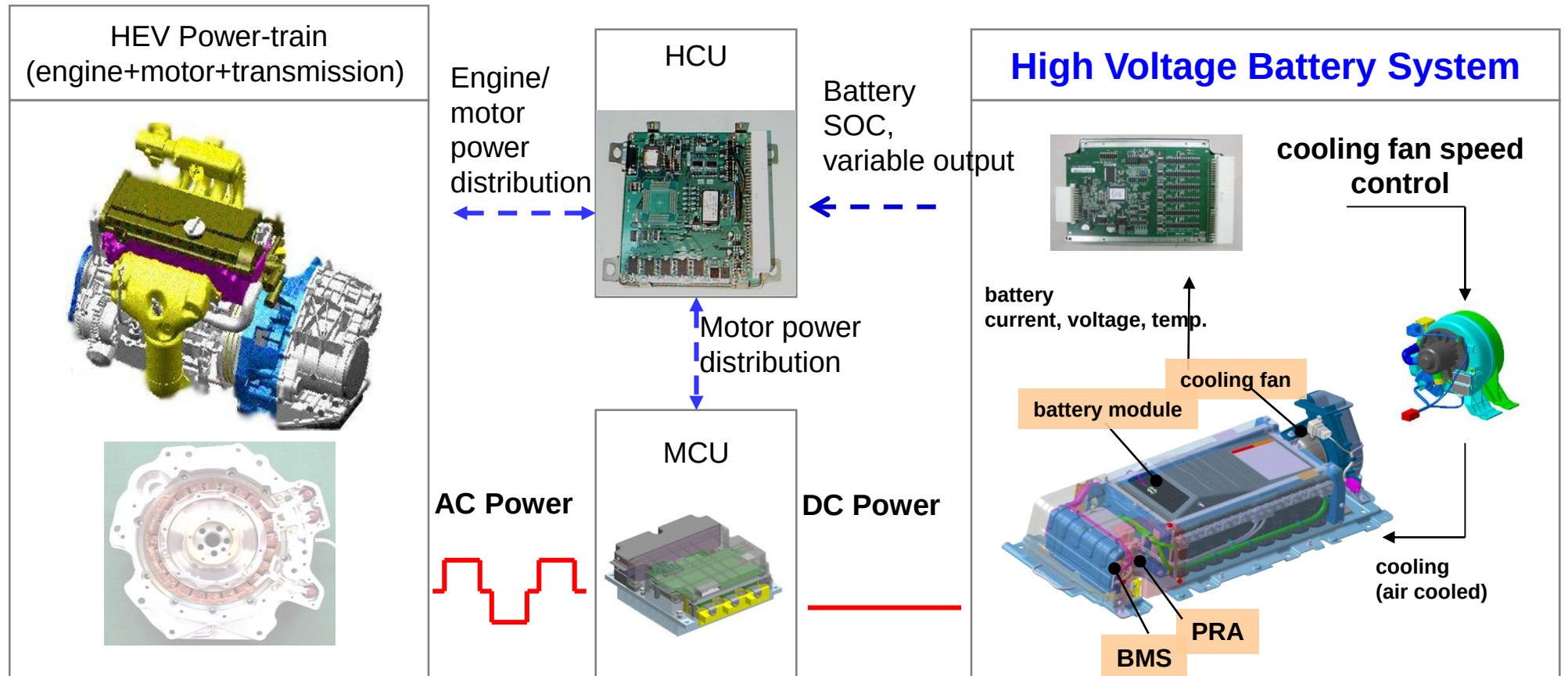
YF Sonata Hybrid High Voltage Battery

YF Sonata Hybrid



World's first lithium-ion polymer battery for HEV

System Layout



Components

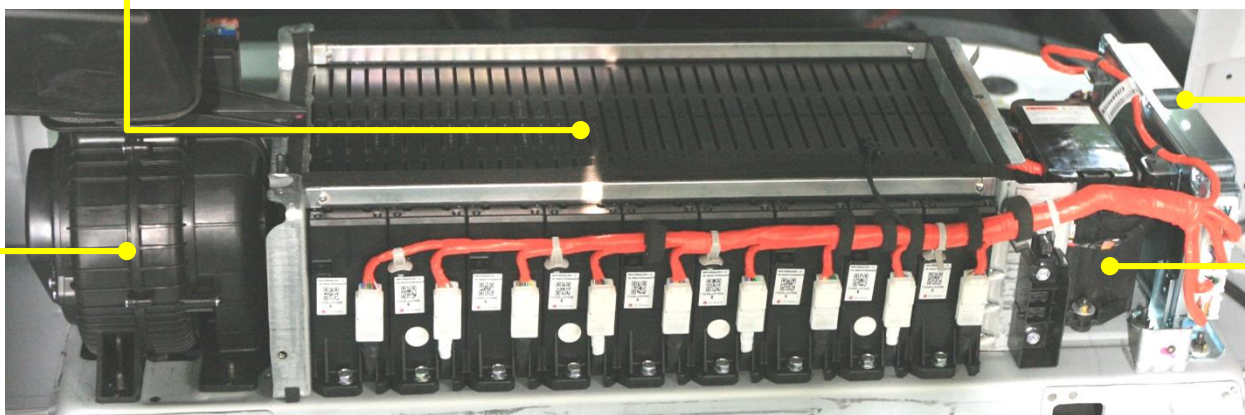
High Voltage Battery System Components

High voltage battery

- Lithium-ion polymer battery
- 270V / 5.3Ah, 72Cells in series
- Enhance safety
 - Prevent overcharging

BMS*

- Voltage, Current, Temperature sensing
- SOC* estimation, Power-cut, Cooling control, Relay control, Cell balancing, Diagnosis



Cooling system

- Maintain proper temperature
 - Equipped with BLDC* cooling fan
 - Increase air flow & Reduce noise

Power Relay Ass'y(PRA)

- Relay ON/OFF control
- Battery current check

BLDC: Brushless DC, BMS: Battery Management System, SOC: State of charge

Components

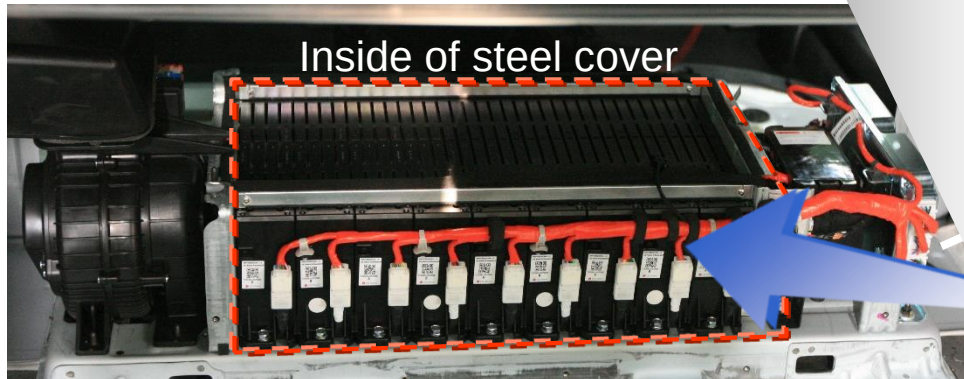
Location of High Voltage Battery



Inside of trunk



Cover opened

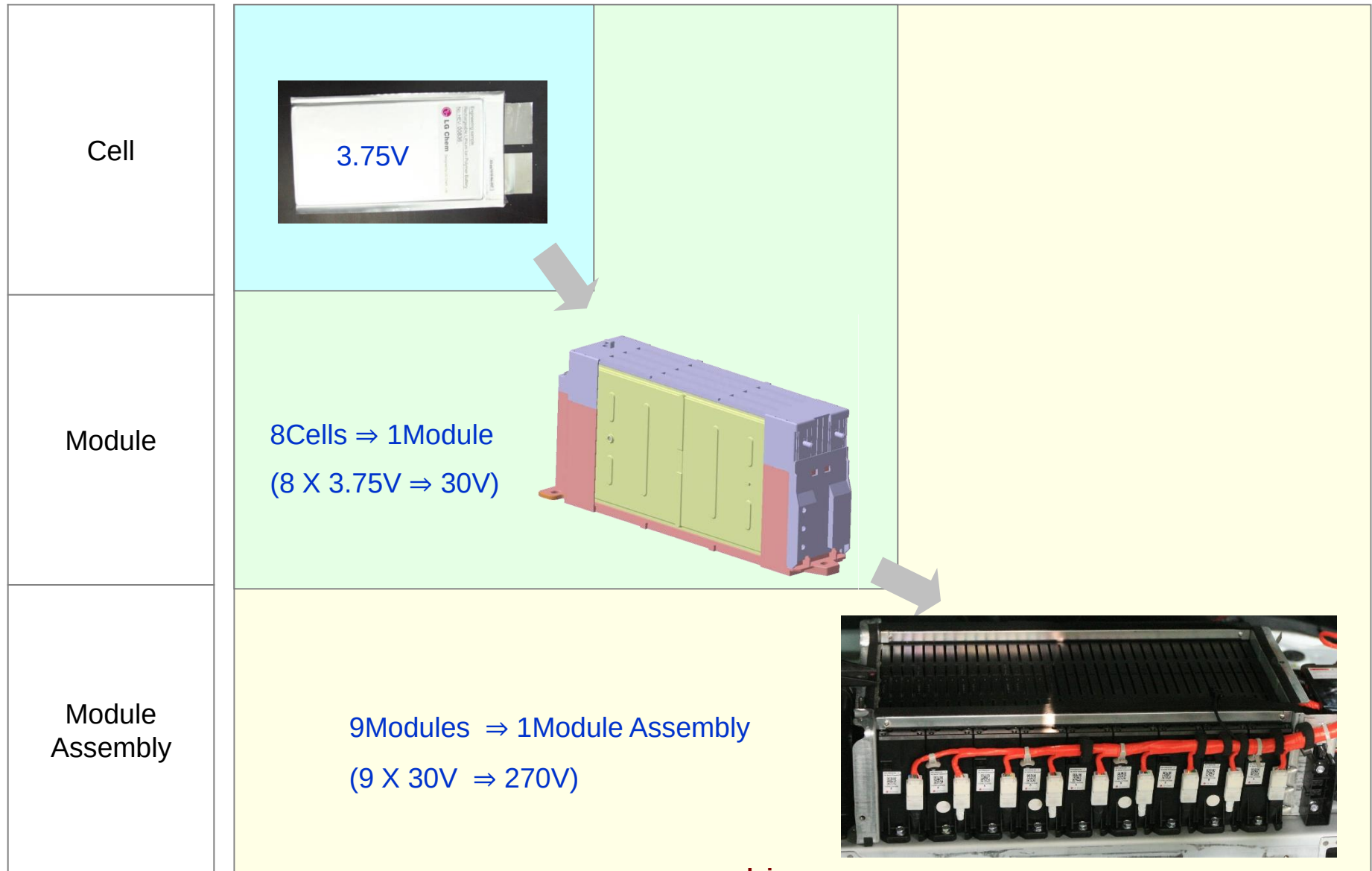


High voltage battery module assembly



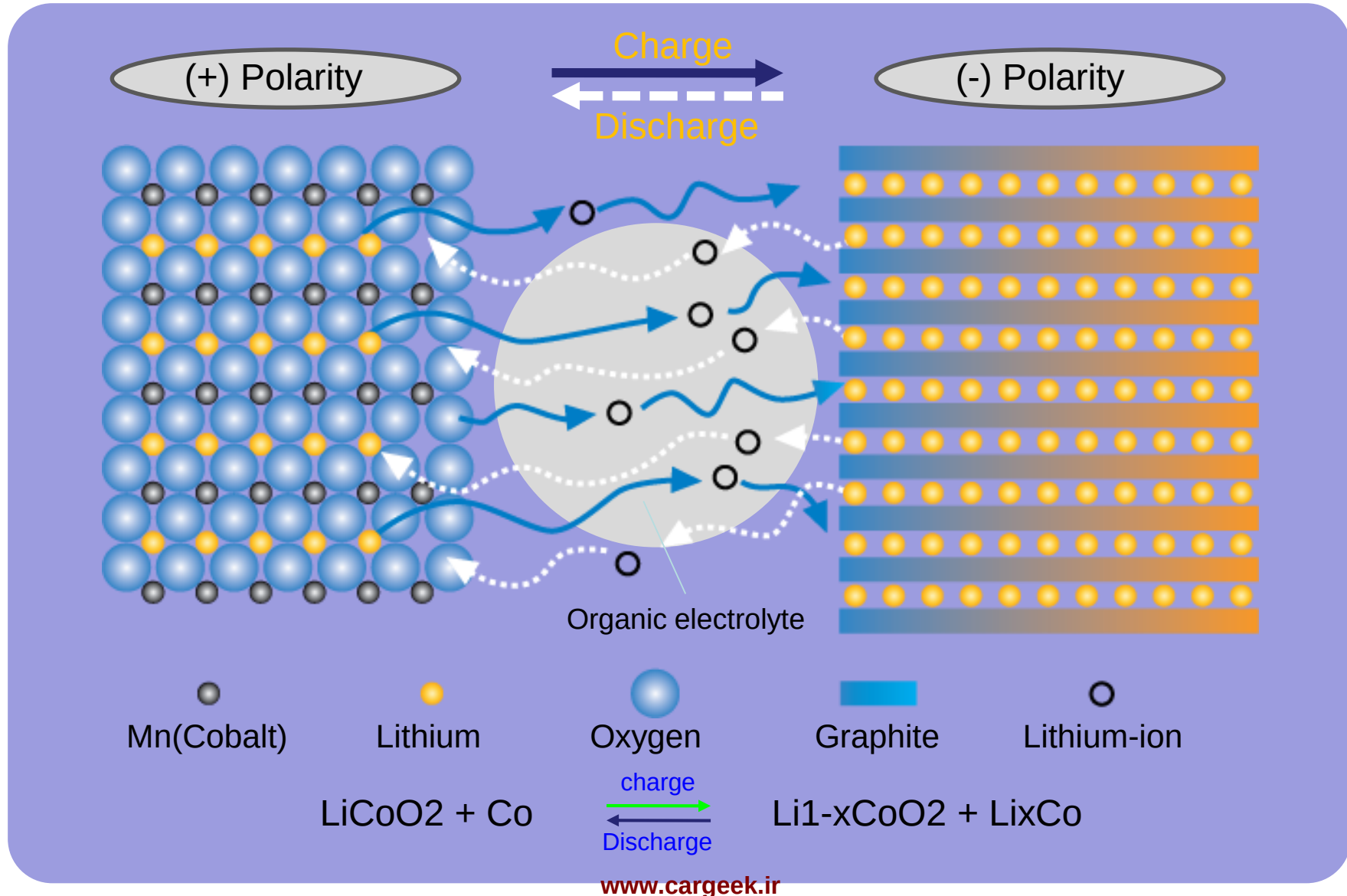
Components

Composition of High Voltage Battery

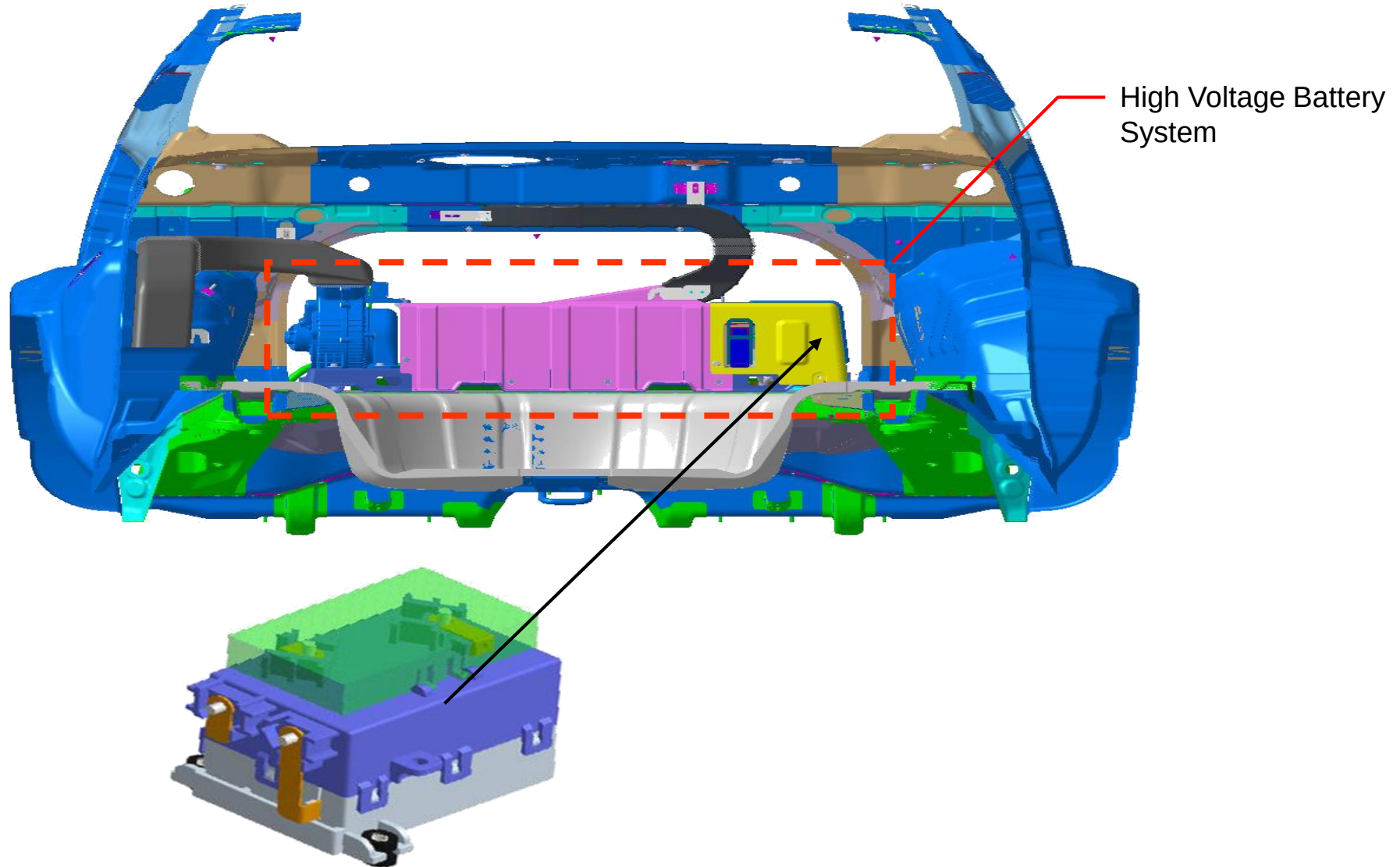


Components

Operation of High Voltage Battery (Li-ion)

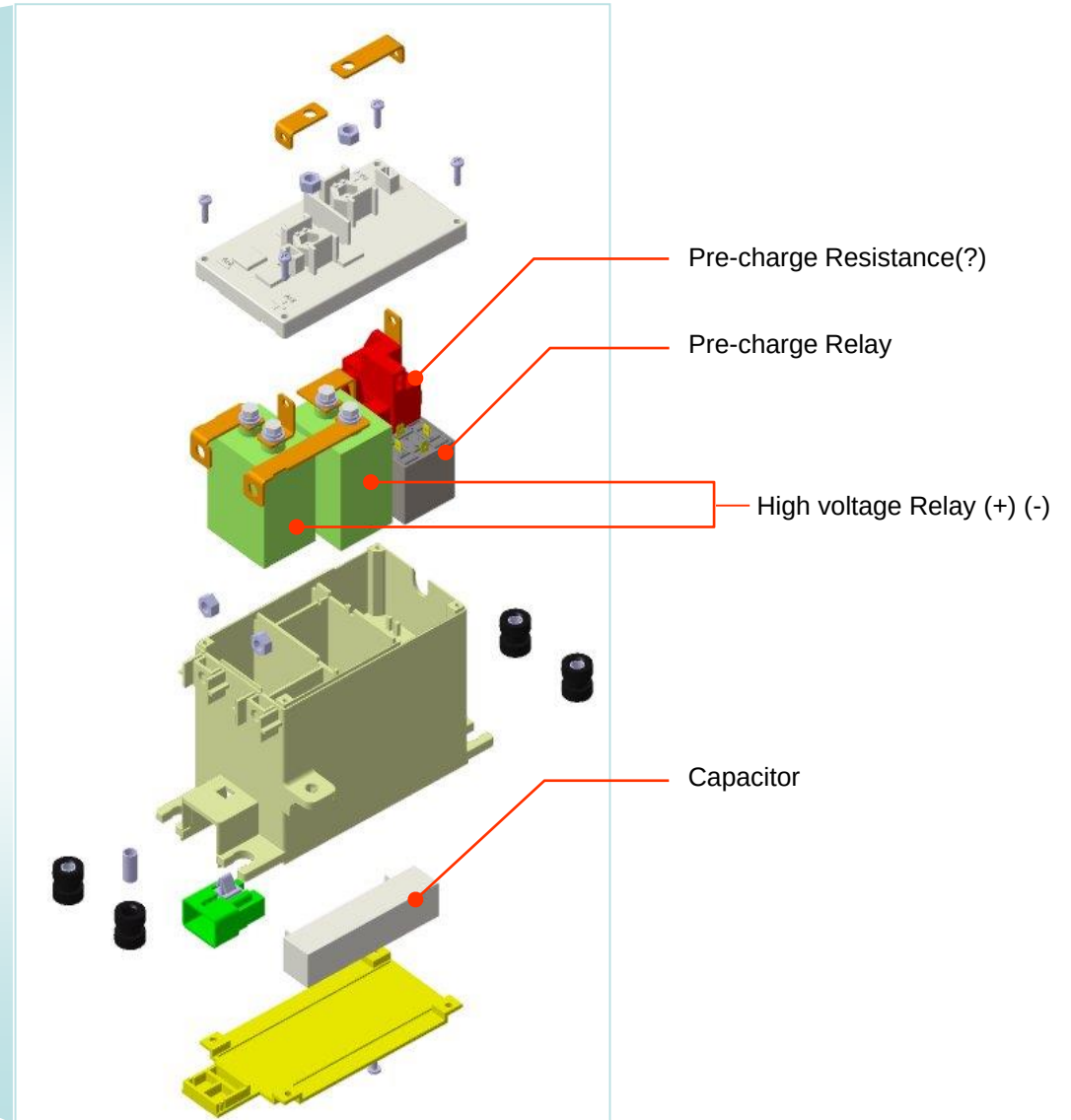
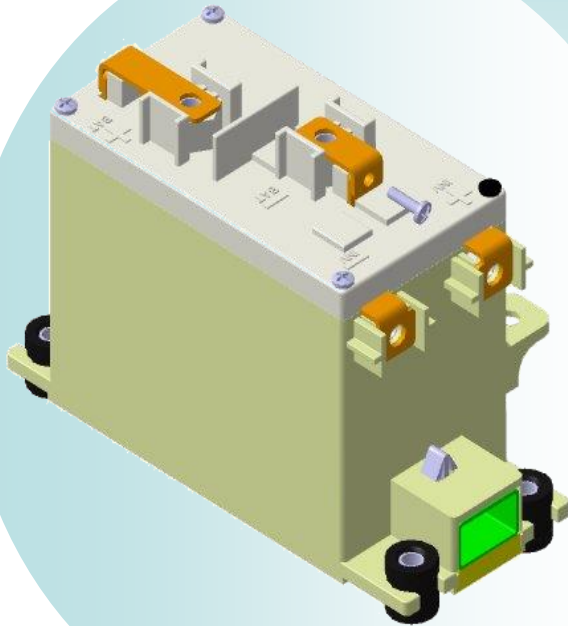


Location of Power Relay Assembly

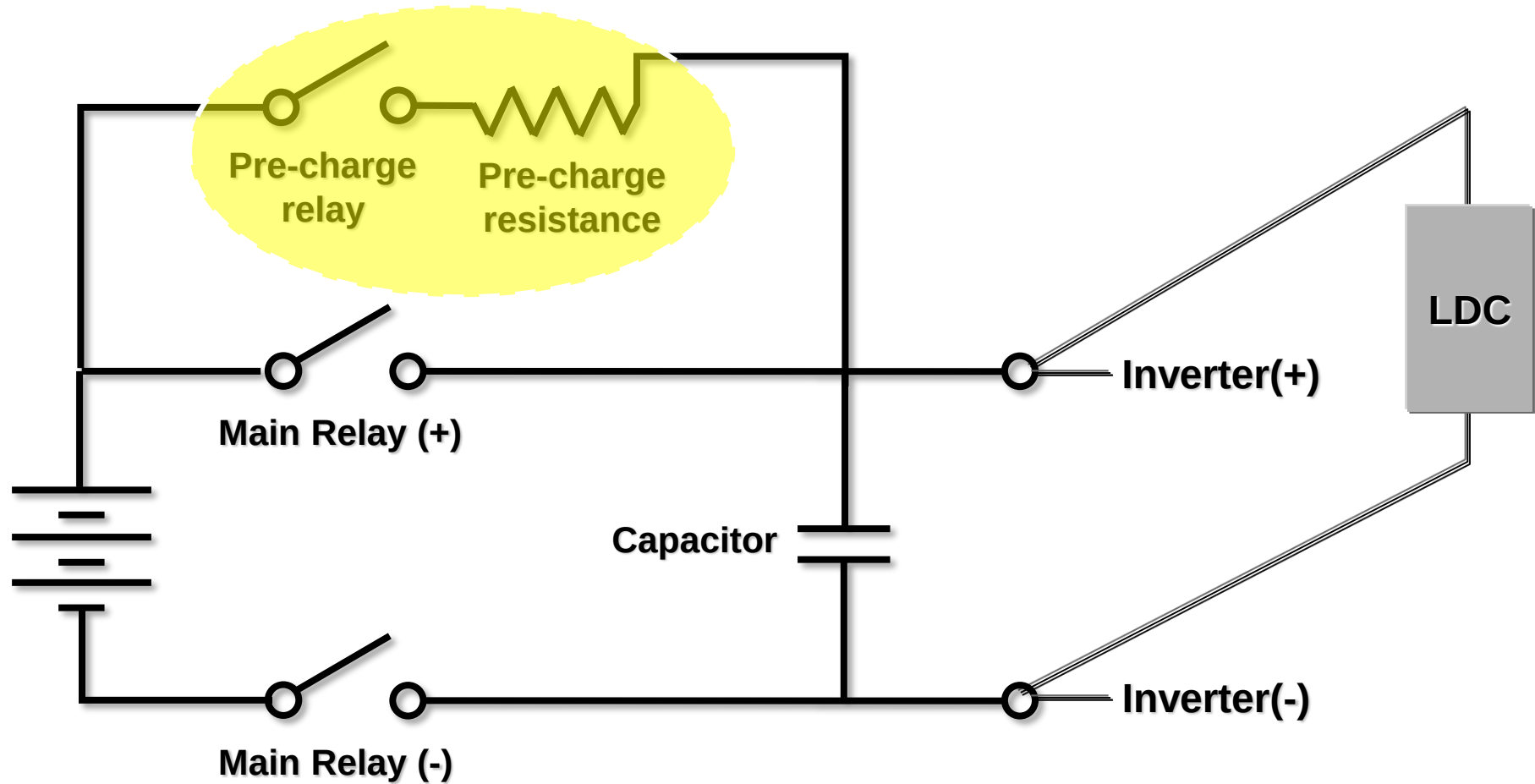


Components

Composition of Power Relay Assembly



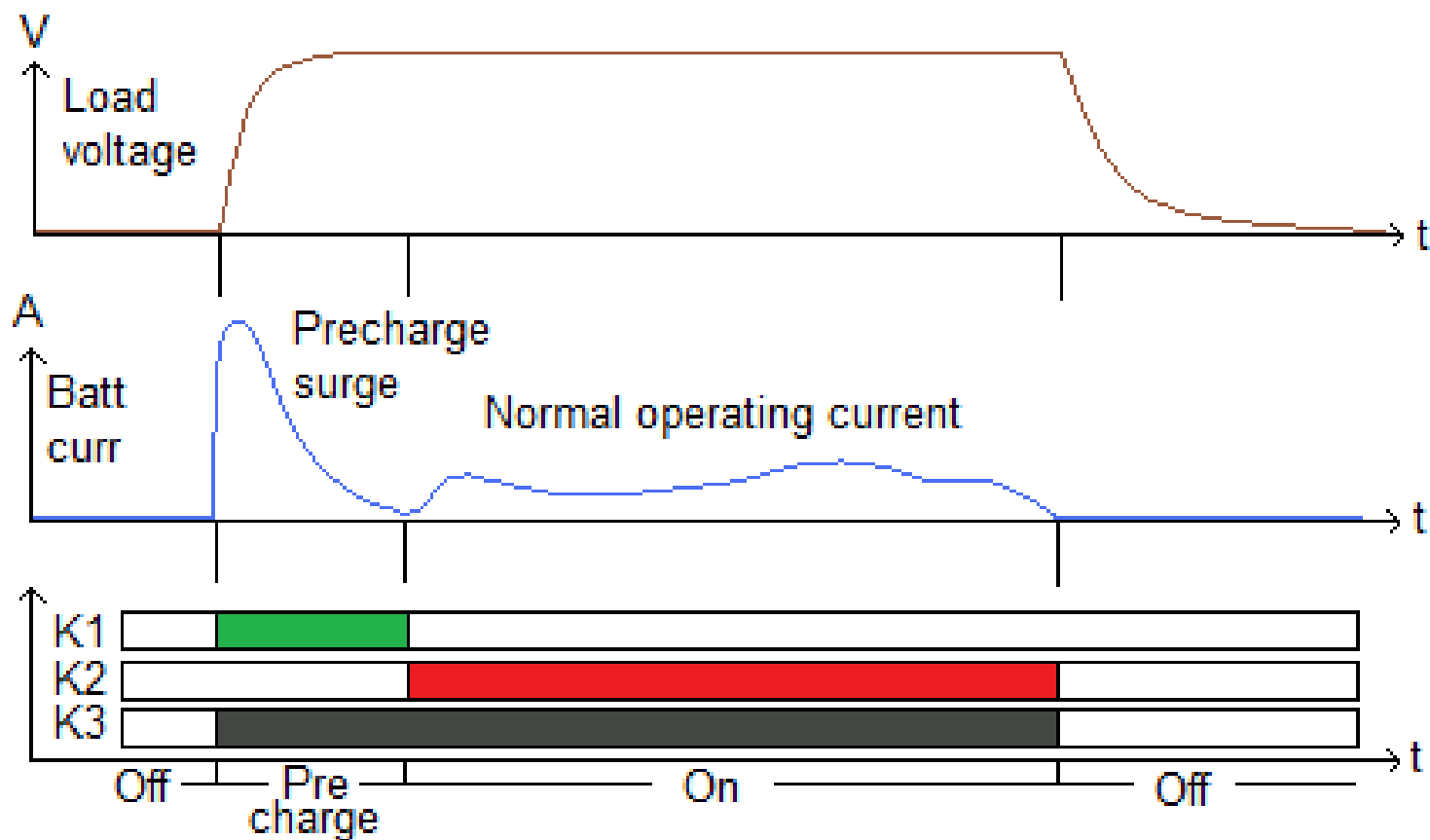
Power Relay Circuit



Equipped with Pre-charge circuit
to protect electrical components

Components

Power Relay Circuit

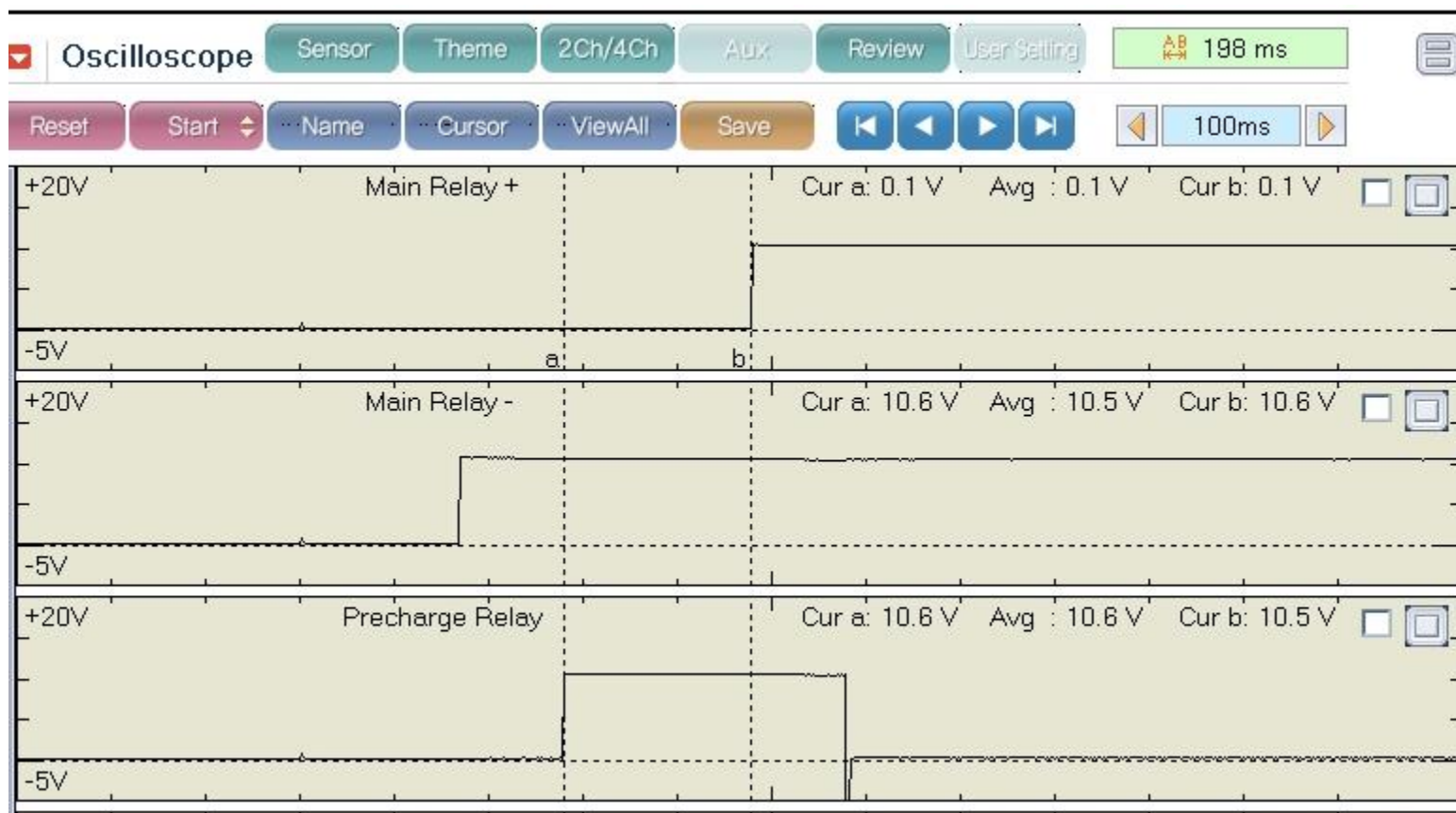


K1 : Pre-charge relay

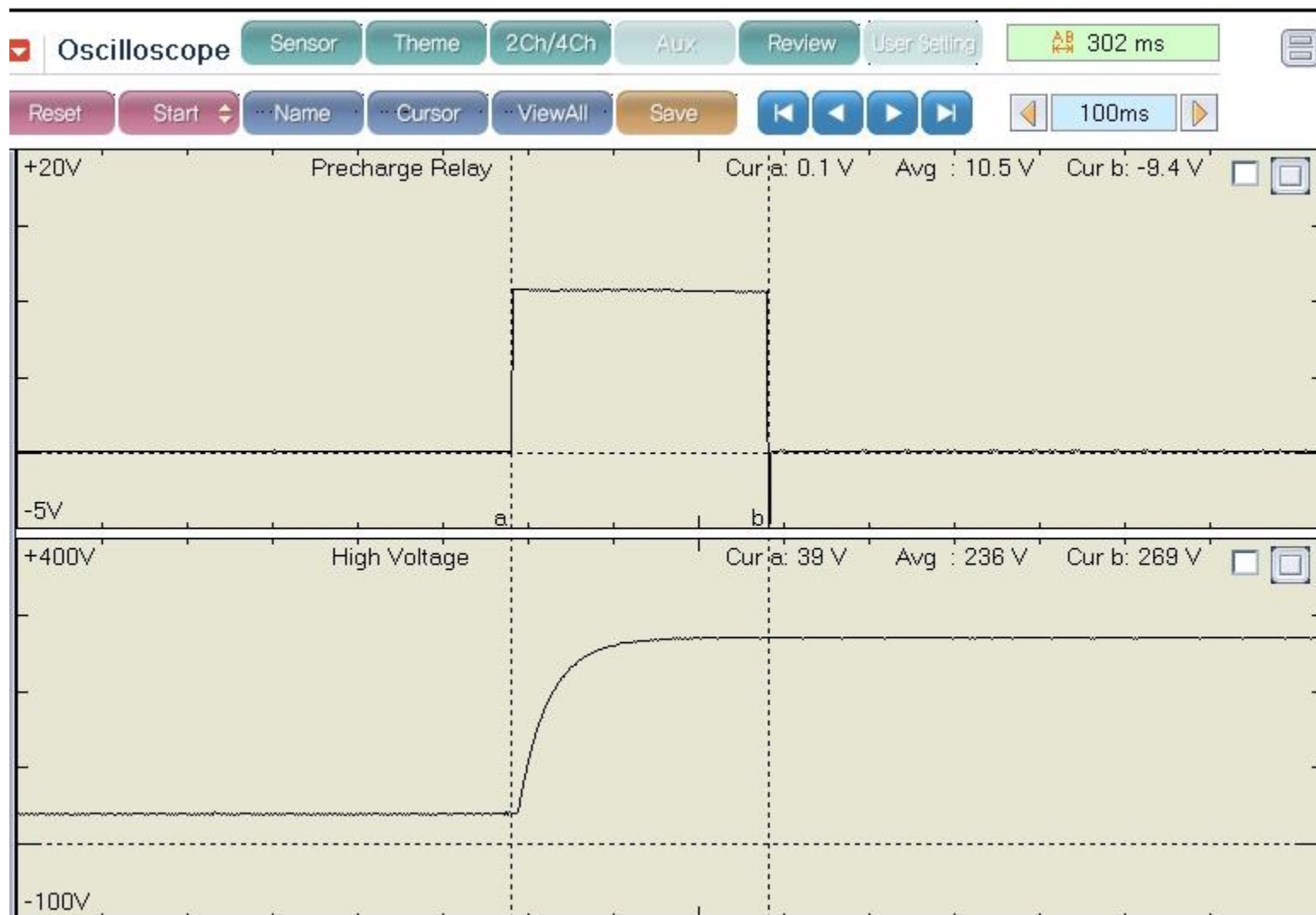
K2 : Main relay (+)

K3 : Main relay(-)

Relay Control

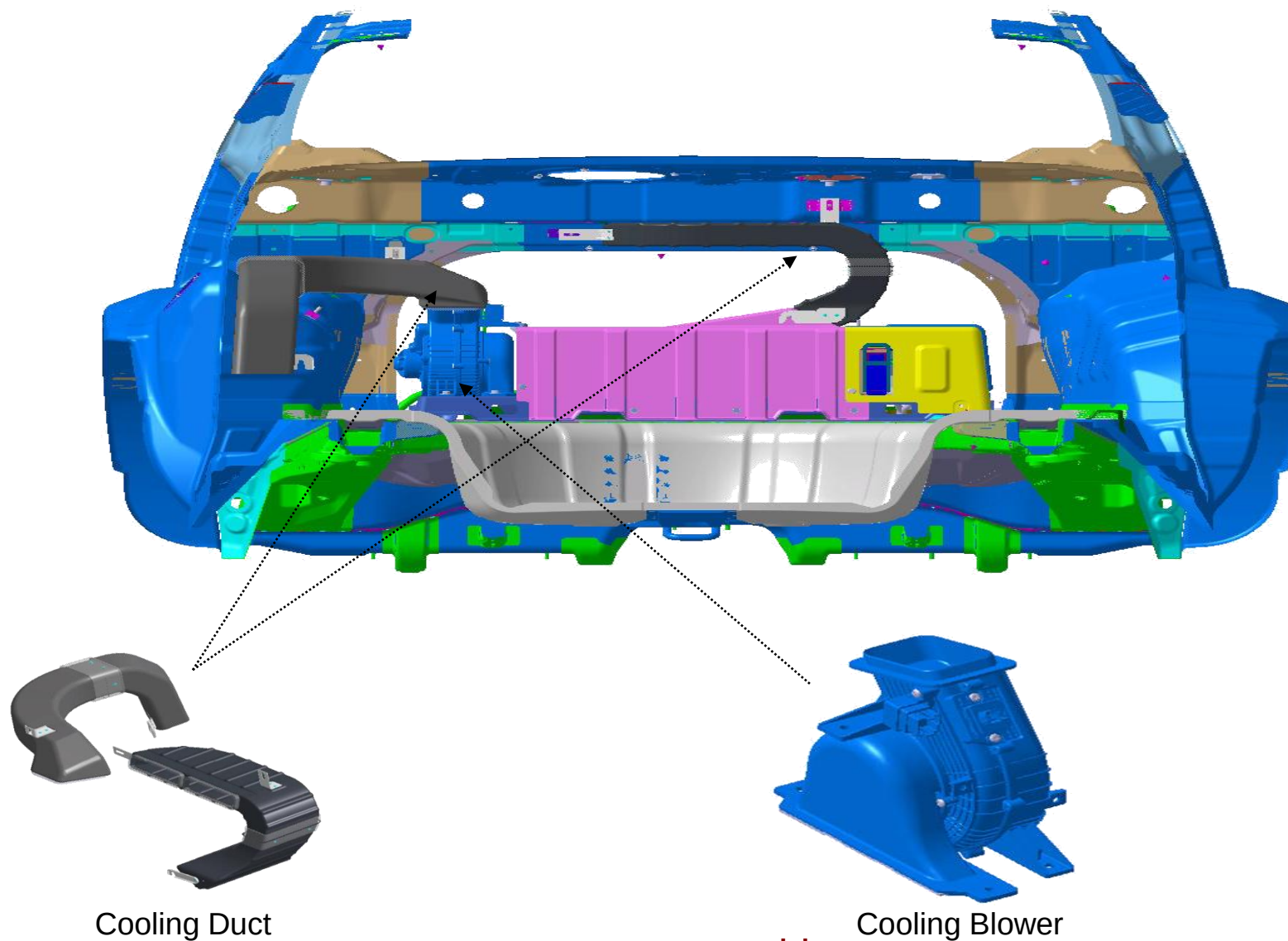


Pre-charge Relay Control



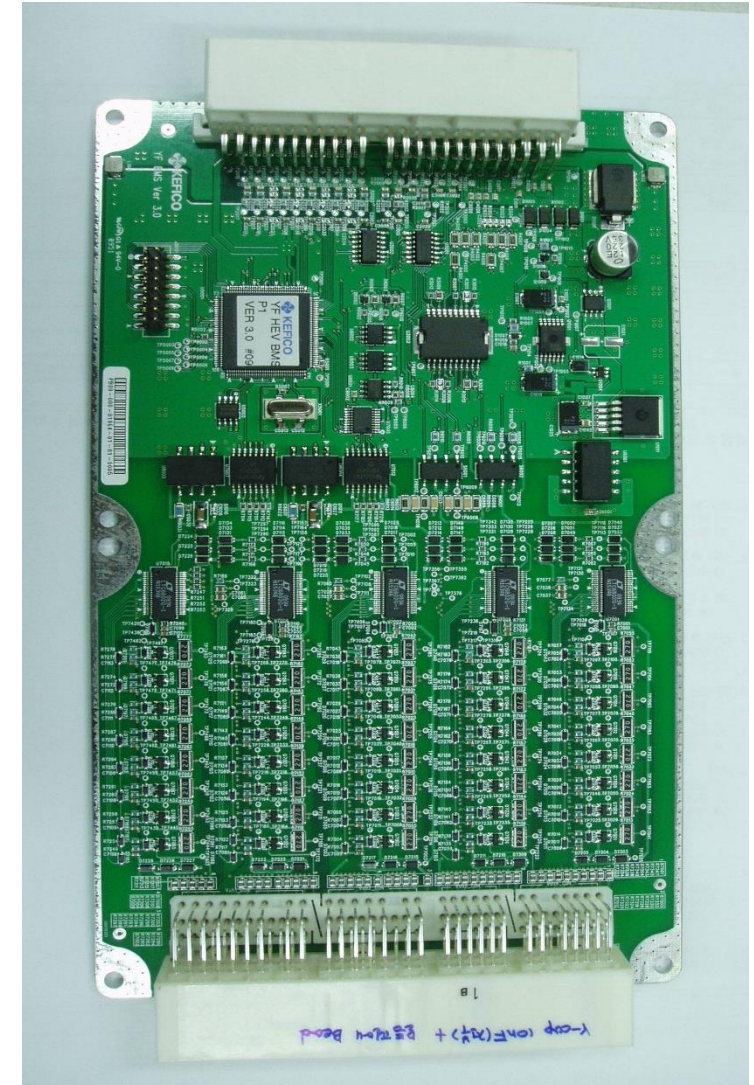
Components

Cooling Fan & Duct

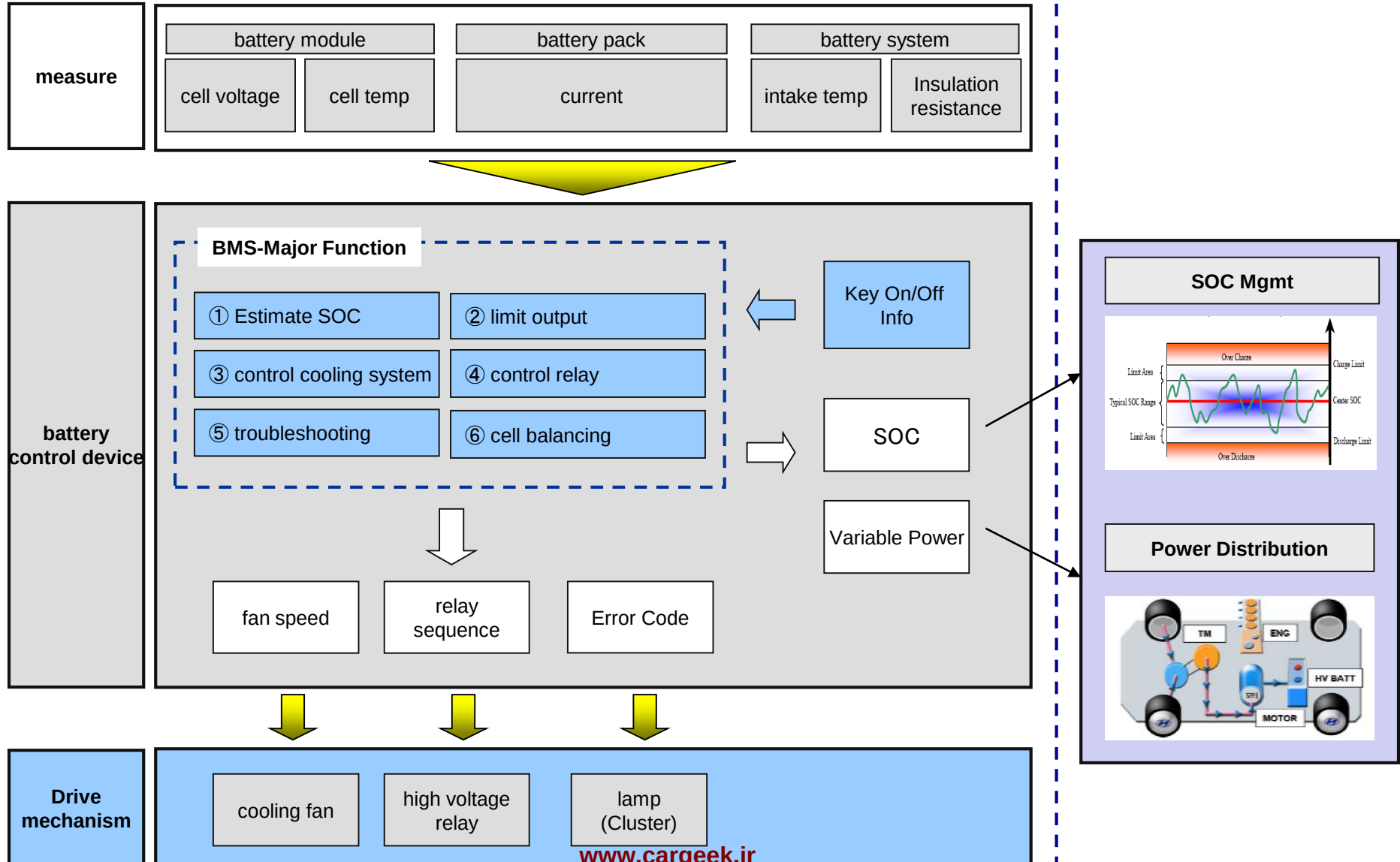


BMS Hardware

Item	Spec	Remark
CPU	16bit	XC167 (Infineon)
Battery Cell Voltage Sensing	72 Cells	Exclusive sensing chip
Cell Balance	150mA@4V	Bucking
Current Sensing	-200 ~ 200A, 10Bit	-
Temp Sensing	11 ch	Battery 5 + External Device 1 + Aux. Battery 1ch
Insulation Resistance Sensing	0.01~1MΩ	-
Cooling Fan Control	FCTL (relay control) FSPEED (PWM output) VF (speed monitoring input)	BLDC Motor
Relay Control	3 ch	Pre / Main (+)/(-)
Interlock	1 ch	Safety plug
CAN Comm.	2 ch	C-CAN / H-CAN



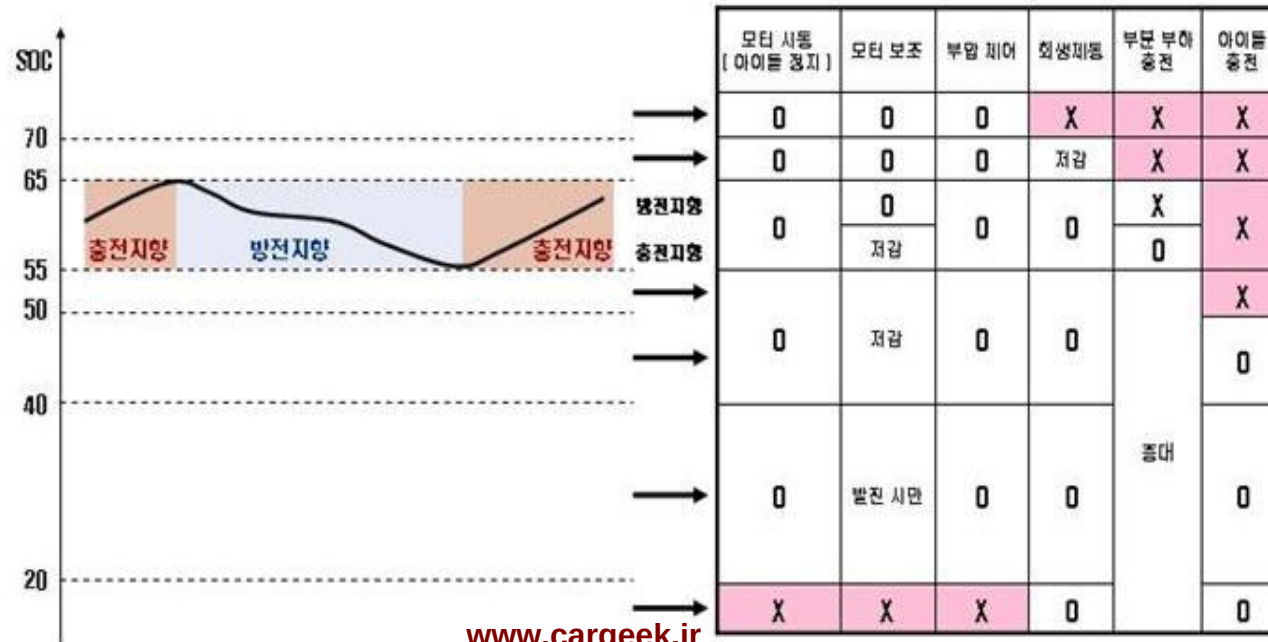
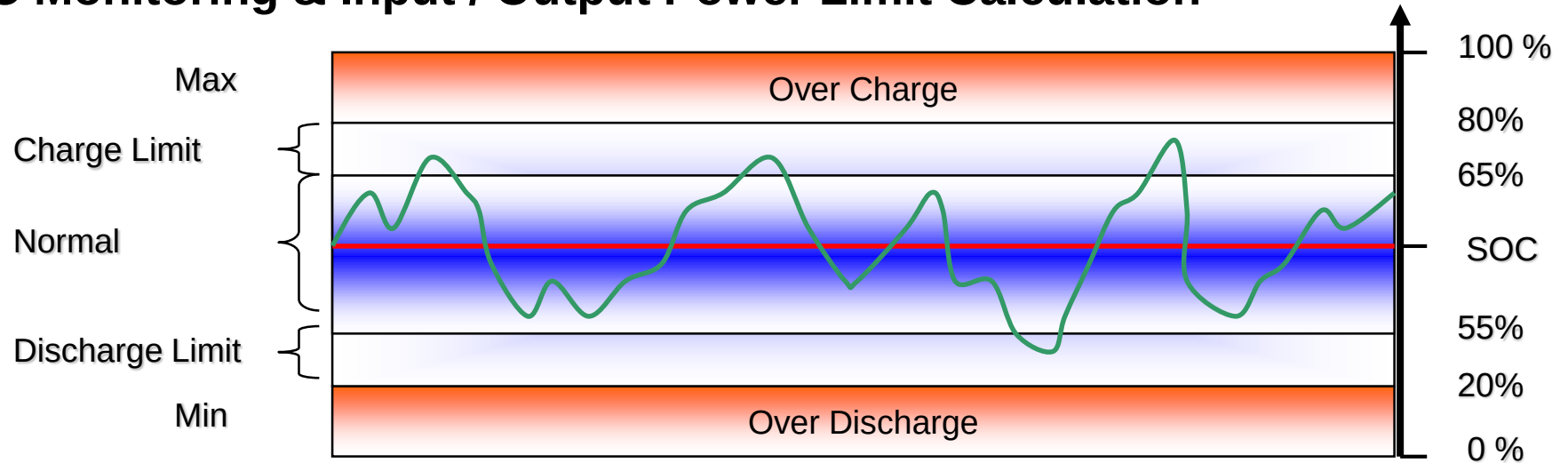
BMS Framework



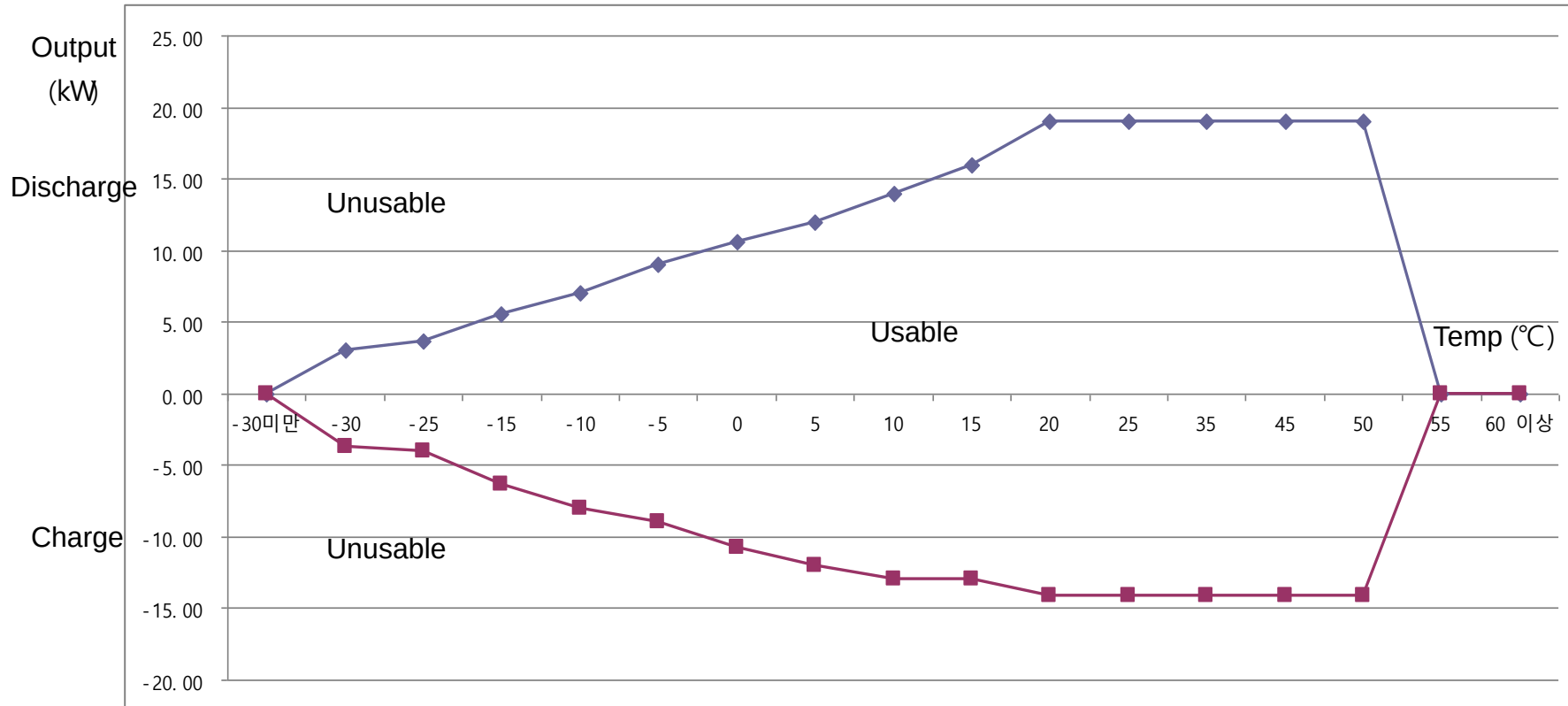
Functions

- SOC monitoring
- Input / Output power limit calculation
- Cell balancing
- Cooling fan control
- High voltage power relay control
- Self diagnosis

SOC Monitoring & Input / Output Power Limit Calculation



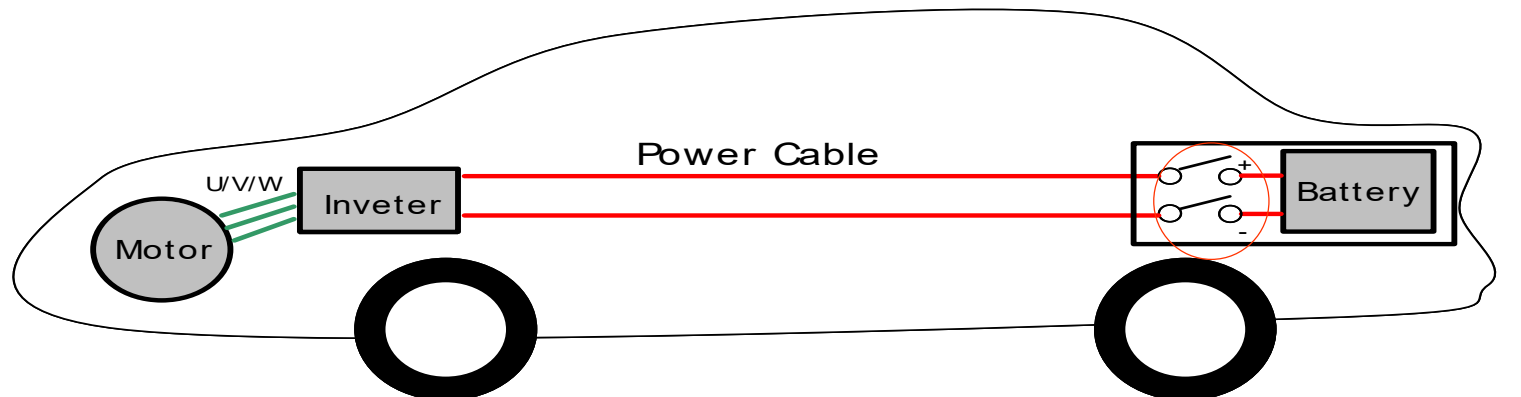
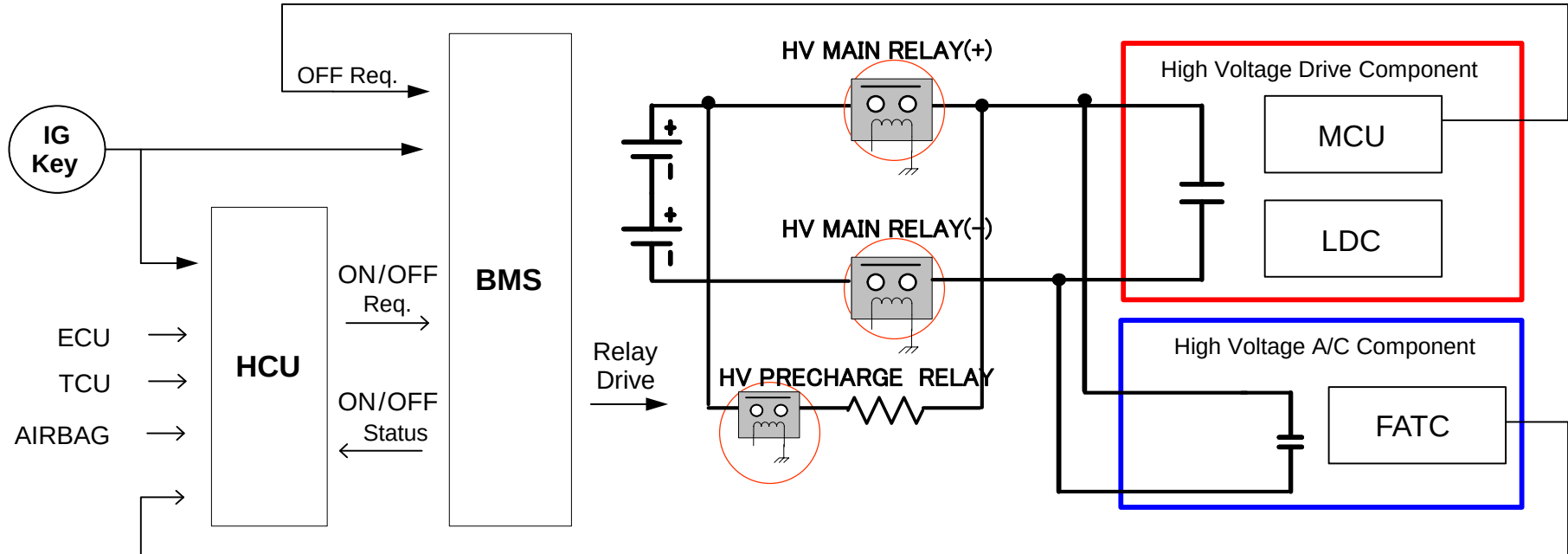
Cooling Fan Control



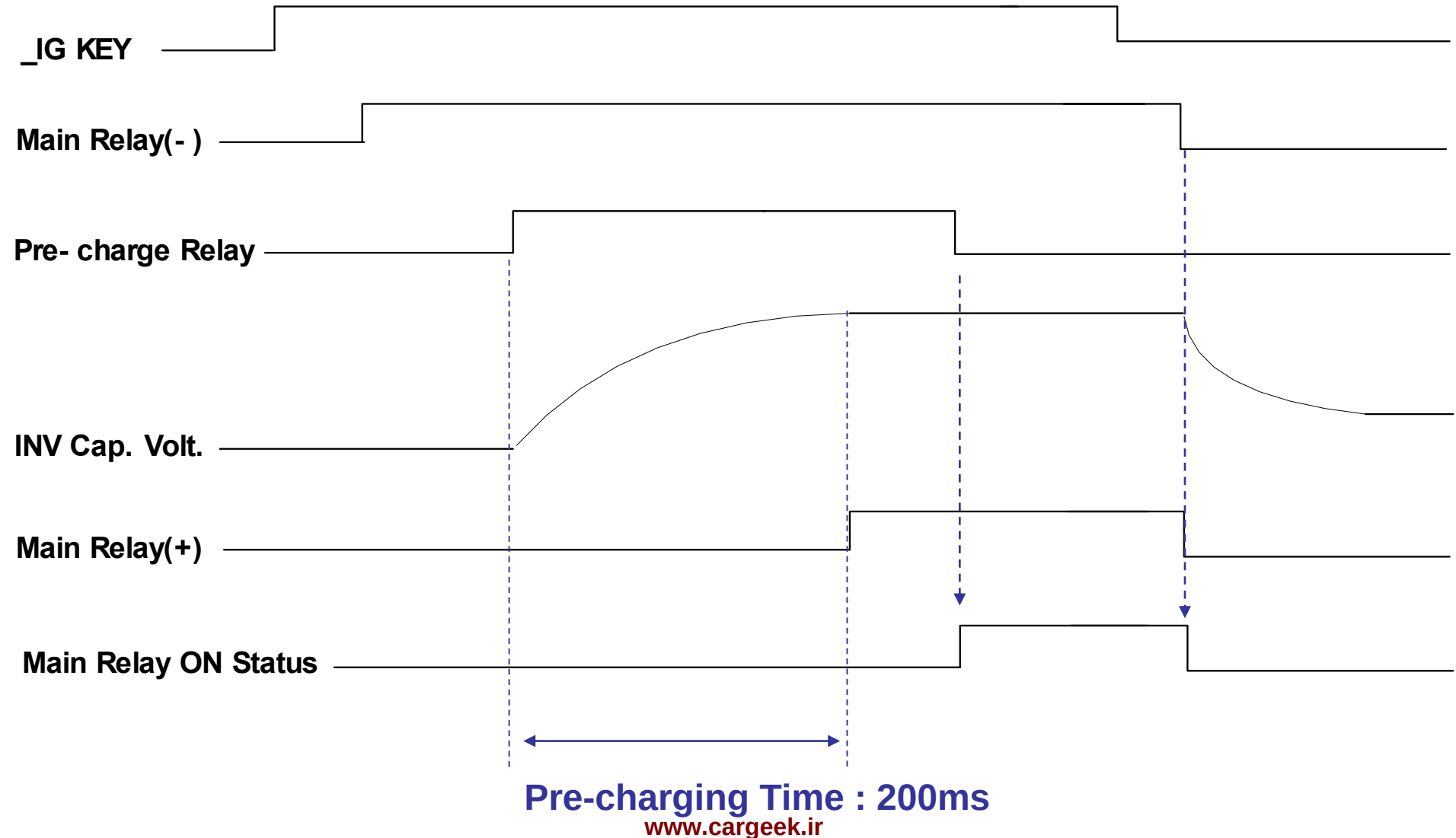
Min. Storage Temp.	Min. Charge/Discharge Temp.	Warning	Operating Temp.	Max. Charge/Discharge Temp.	Warning	Max. Storage Temp.
-40°	-30°		- 29° ~ 49°	50°	55°	65°

→ Optimal Temp: Average of 30°

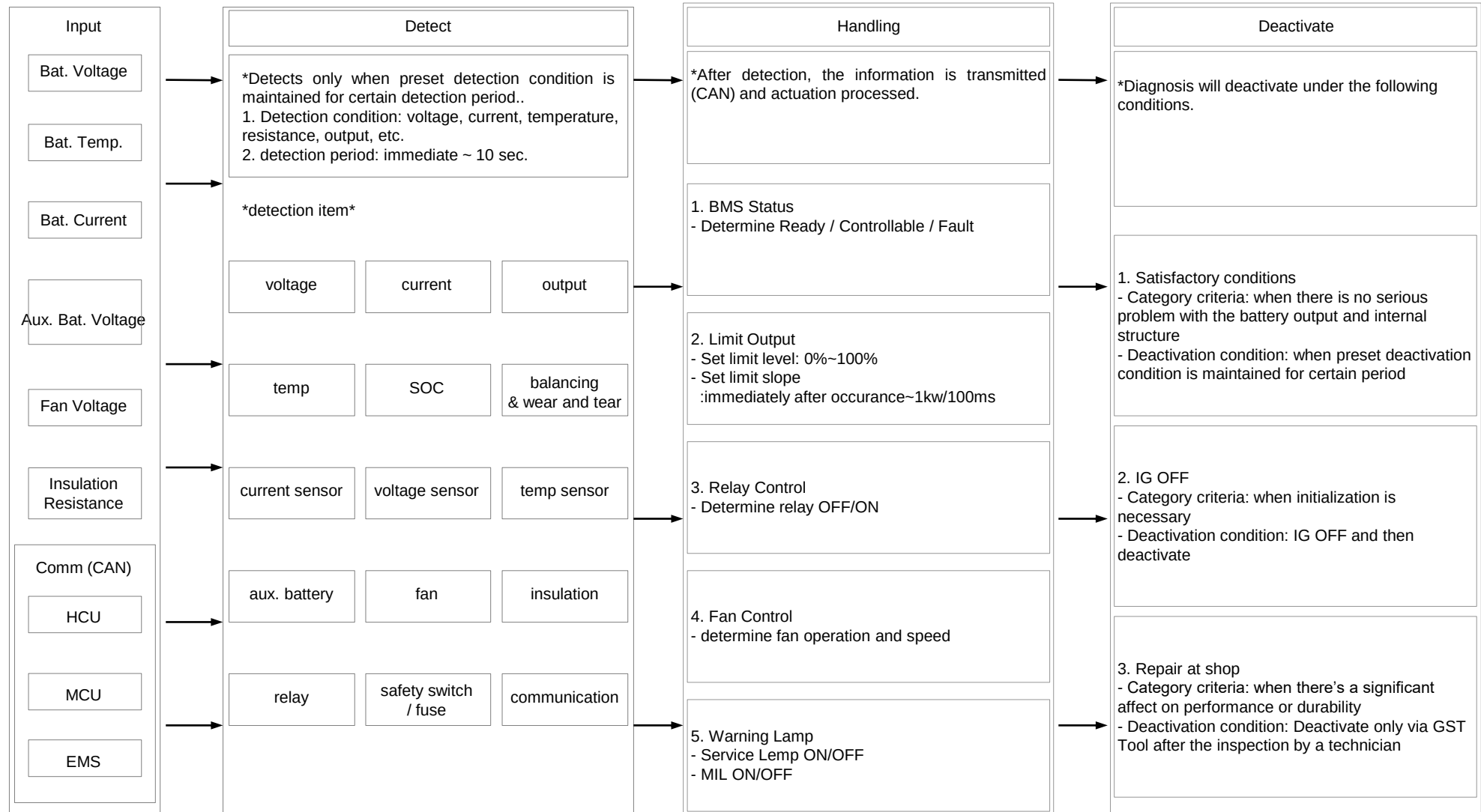
High Voltage Power Relay Control



High Voltage Power Relay Control



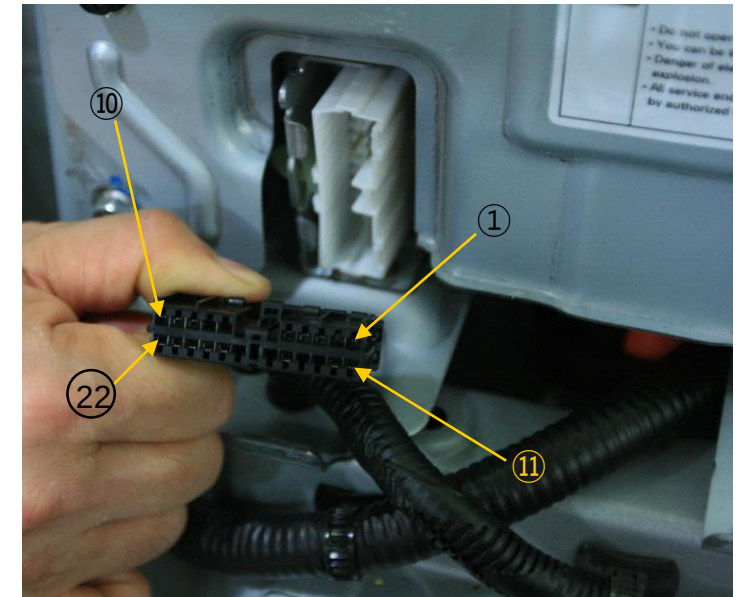
Self Diagnosis



Connector check

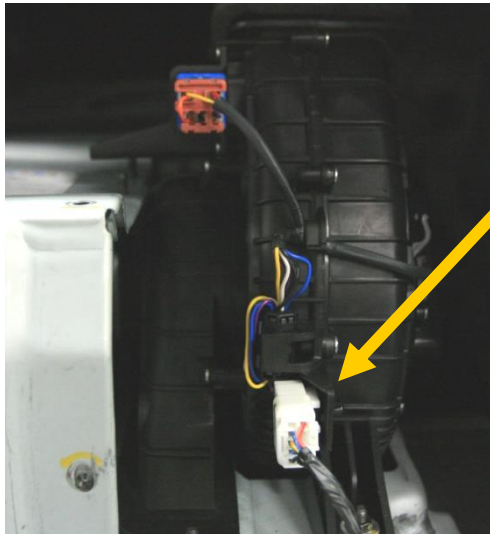


BMS External Connector

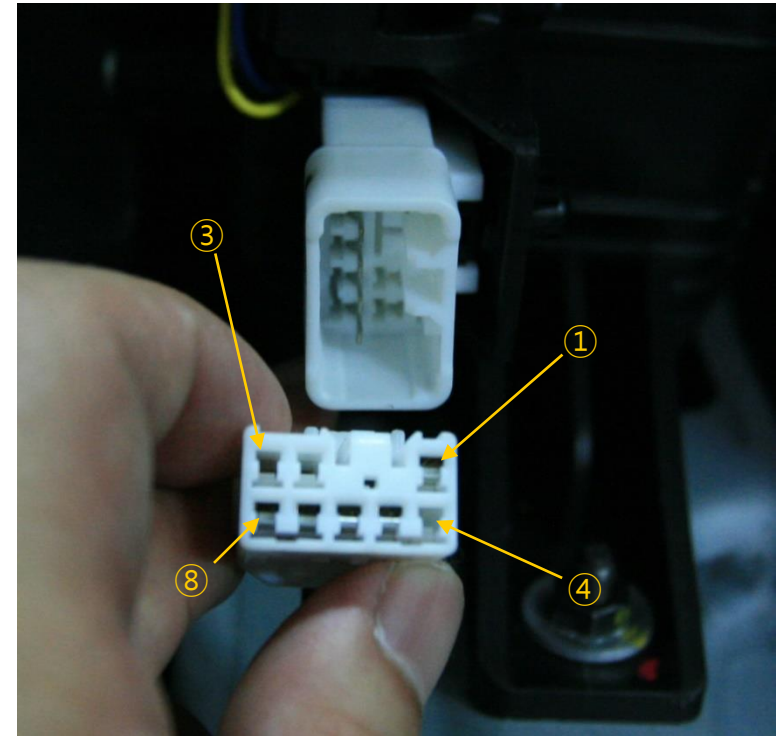


Diagnosis

Connector check



Cooling Fan External Connector



Current Data 1

Internet Off VIN YF HEV / 2011 / G 2.4 MPI System BMS / BMS Search Prt Sc ECU

Current Data

Selective Display Full List Graph Items List Reset Min.Max. Record Stop Grouping

Sensor Name	Value	Unit
☐ State of Charge of Battery(BMS)	45.5	%
☐ Available Charge Power	26000	W
☐ Available Discharge Power	32440	W
☐ BMS Main Relay ON Status	YES	-
☐ BMS Controllable State	YES	-
☐ BMS Warning	NO	-
☐ BMS Fault	NO	-
☐ BMS Weld Flag	NO	-
☐ BMS Overcharge Protection Flag	NO	-
☐ BMS Main Relay ON Retry Flag	NO	-
☐ Battery DC Current	0.0	A
☐ Battery DC Voltage	267.6	V
☐ Battery Max Temperature	30	'C
☐ Battery Min Temperature	29	'C
☐ Battery Module 1 Temperature	30	'C
☐ Battery Module 2 Temperature	30	'C
☐ Battery Module 3 Temperature	30	'C
☐ Battery Module 4 Temperature	30	'C
☐ Battery Module 5 Temperature	29	'C
☐ Auxiliary Battery Temperature	2	'C
☐ Ambient Temperature	29	'C

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Current Data 2

Internet Off

VIN

YF HEV / 2011 / G 2.4 MPI

System

BMS / BMS

Search

Prt Sc

Current Data

Selective Display

Full List

Graph

Items List

Reset Min.Max.

Record

Stop

Grouping

Sensor Name	Value	Unit
☐ Max Cell Voltage	3.72	V
☐ Max Cell Voltage No.	33	-
☐ Min Cell Voltage	3.68	V
☐ Min Cell Voltage No.	60	-
☐ FAN Status	0	-
☐ FAN Control Duty	0	%
☐ Auxiliary Battery Voltage	10.9	V
☐ Accumulative Charge Current	129.7	Ah
☐ Accumulative Discharge Current	128.8	Ah
☐ Accumulative Charge Power	32.0	kWh
☐ Accumulative Discharge Power	29.9	kWh
☐ Accumulative Operating Time	83417	Sec
☐ MCU Ready	YES	-
☐ MCU Main Relay Off Request	NO	-
☐ MCU Controllable	NO	-
☐ GCU Ready	YES	-
☐ GCU Main Relay Off Request	NO	-
☐ GCU Controllable	NO	-
☐ HCU Ready	YES	-
☐ HCU Engine Start Signal	NO	-
☐ Inverter Capacitor Voltage	268	V

Current Data 3

Internet Off VIN YF HEV / 2011 / G 2.4 MPI System BMS / BMS Search Prt Sc

Current Data

Selective Display Full List Graph Items List Reset Min.Max. Record Stop Grouping

Sensor Name	Value	Unit
☐ Motor Speed	0	RPM
☐ HSG Speed	0	RPM
☐ Isolation Resistance	2949	kOhm
☐ Battery Cell Voltage 1	3.70	V
☐ Battery Cell Voltage 2	3.70	V
☐ Battery Cell Voltage 3	3.70	V
☐ Battery Cell Voltage 4	3.70	V
☐ Battery Cell Voltage 5	3.70	V
☐ Battery Cell Voltage 6	3.70	V
☐ Battery Cell Voltage 7	3.70	V
☐ Battery Cell Voltage 8	3.70	V
☐ Battery Cell Voltage 9	3.72	V
☐ Battery Cell Voltage 10	3.72	V
☐ Battery Cell Voltage 11	3.70	V
☐		
☐		
☐		
☐ Battery Cell Voltage 69	3.72	V
☐ Battery Cell Voltage 70	3.72	V
☐ Battery Cell Voltage 71	3.72	V
☐ Battery Cell Voltage 72	3.72	V

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Actuation Test

Internet Off

VIN

YF HEV / 2011 / G 2.4 MPI

System

BMS / BMS

Search

Prt Sc

Current Data

Selective Display

Full List

Graph

Items List

Reset Min.Max.

Record

Stop

Grouping

Sensor Name	Value	Unit	
☒ FAN Status	7	-	
☒ FAN Control Duty	70	%	
☐ Battery Max Temperature	30	'C	
☐ Battery Min Temperature	29	'C	
☐ Battery Module 1 Temperature	30	'C	
☐ Battery Module 2 Temperature	30	'C	
☐ Battery Module 3 Temperature	30	'C	
☐ Battery Module 4 Temperature	30	'C	

Actuation Test

Test Items

FAN 1st	
FAN 2nd	
FAN 3rd	
FAN 4th	
FAN 5th	
FAN 6th	
FAN 7th	
FAN 8th	
FAN 9th	

Duration

Until Stop Button

Conditions

IG. ON

Result

Success

Start

Stop

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Cautions while servicing on high voltage circuit

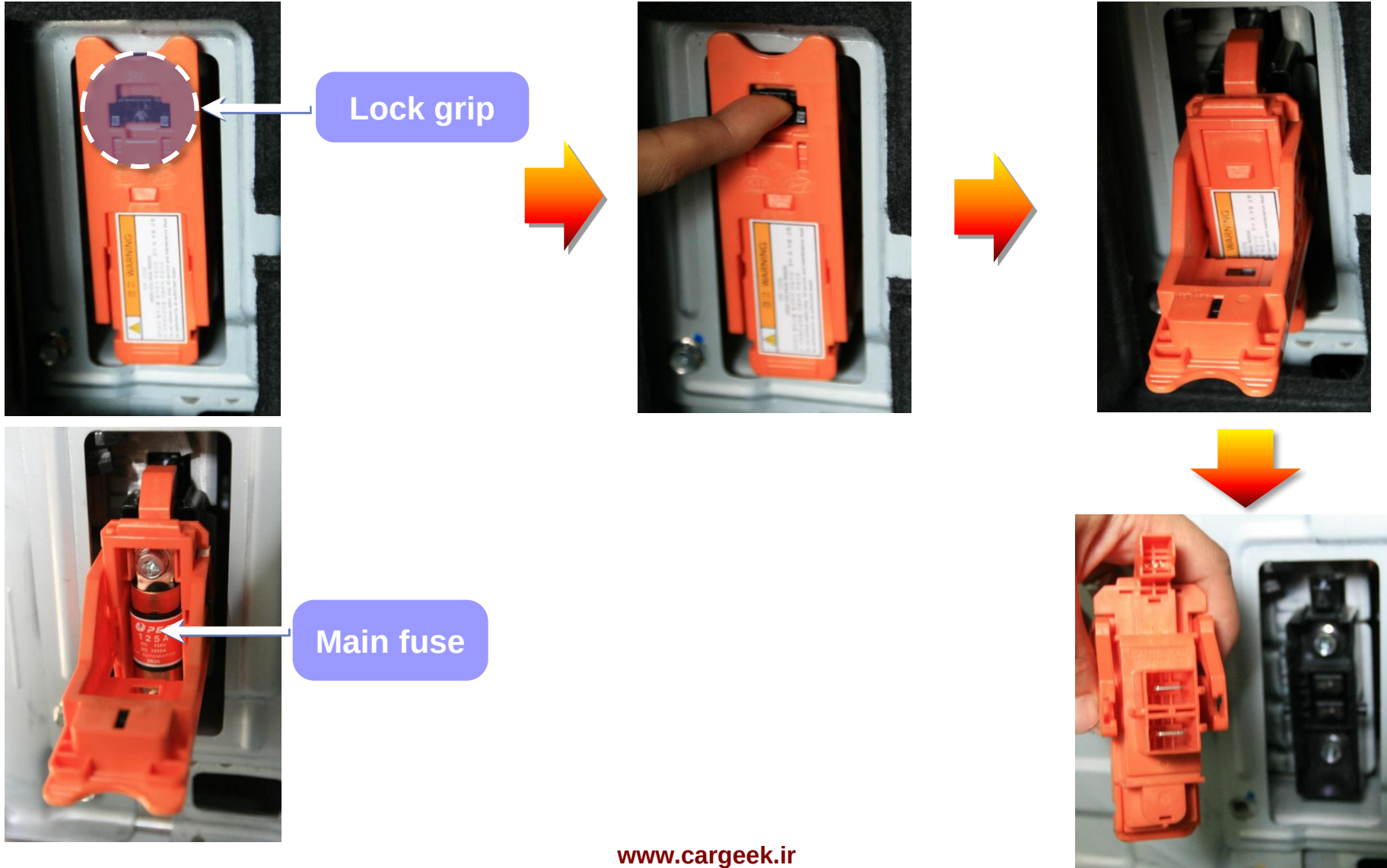


Safety Plug

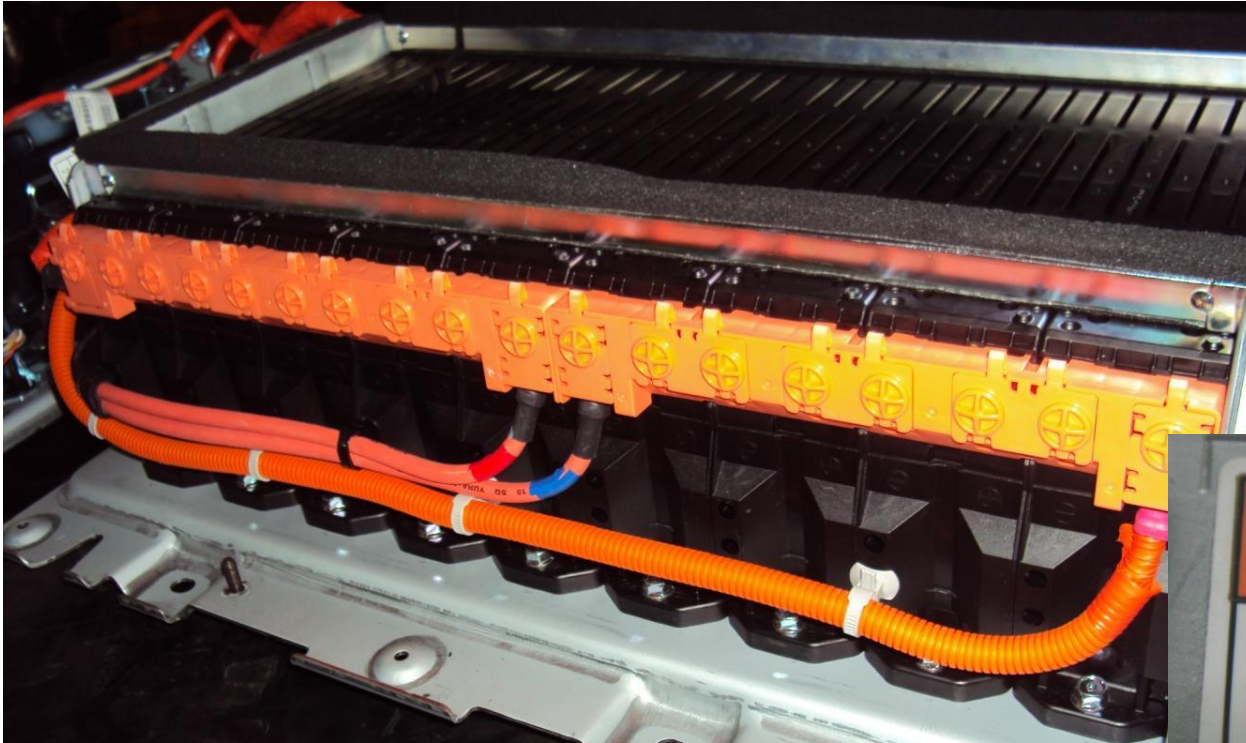
Technician must disconnect safety plug !

Cautions

How to release safety plug



Cautions for high voltage



Orange color means high voltage cable or components

High Voltage Warning



High voltage checking point



Connector	Pin No	Level
PRA (INV + /-)	1	IG OFF : 0V IG ON : 270V (198V~309V)
	2	

- ✓ When servicing high voltage system, checking voltage must be lower than 10V.
- ✓ Must be cautious when checking high voltage.