



RX400h

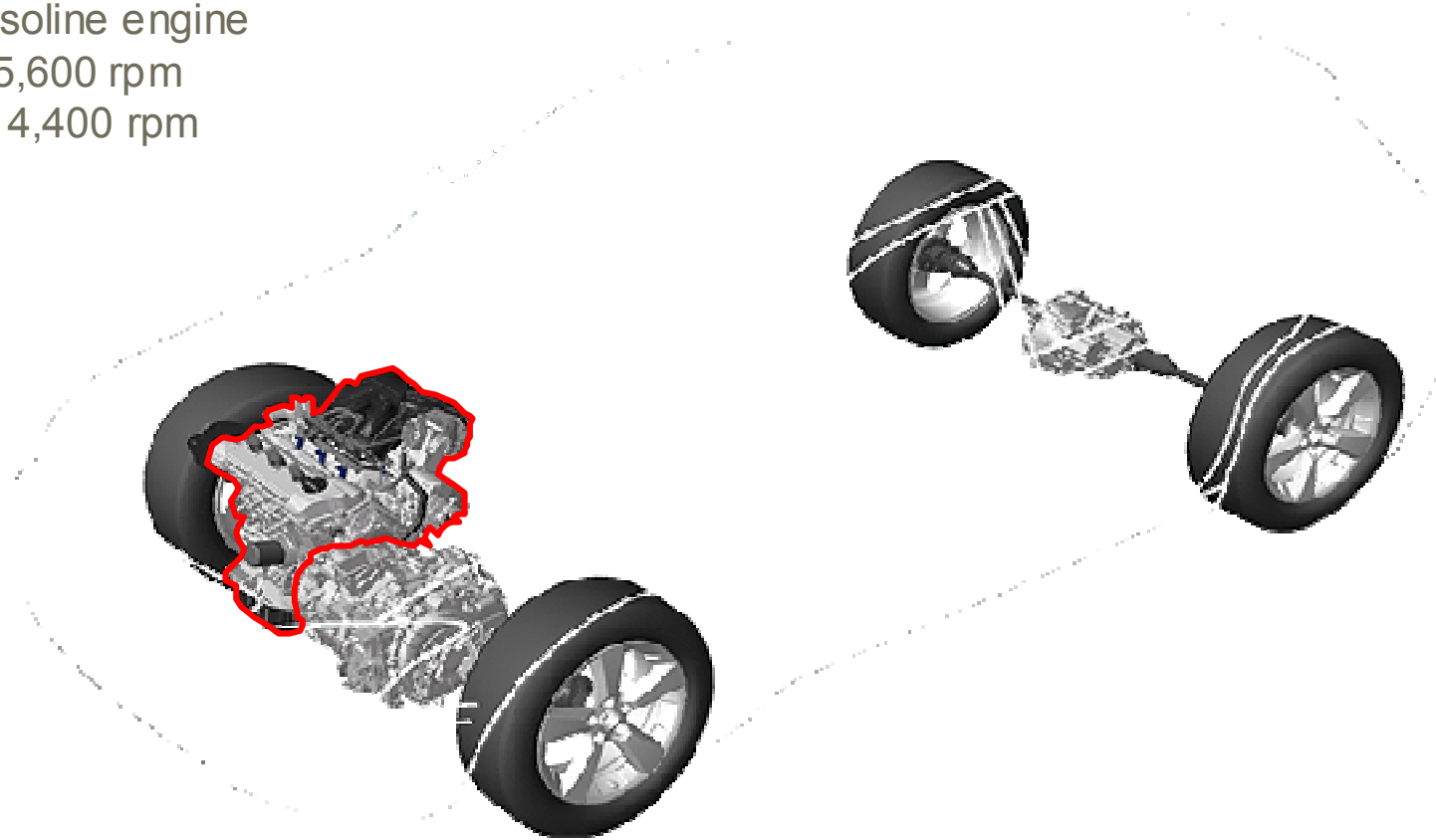


New
Technology

Performance

- Power Train
 - 3MZ-FE engine

3.3-liter, 24-valve, DOHC,
w/VVT-i gasoline engine
155 kW @ 5,600 rpm
288 N·m @ 4,400 rpm



Performance

- Power Train
 - MG1 / MG2

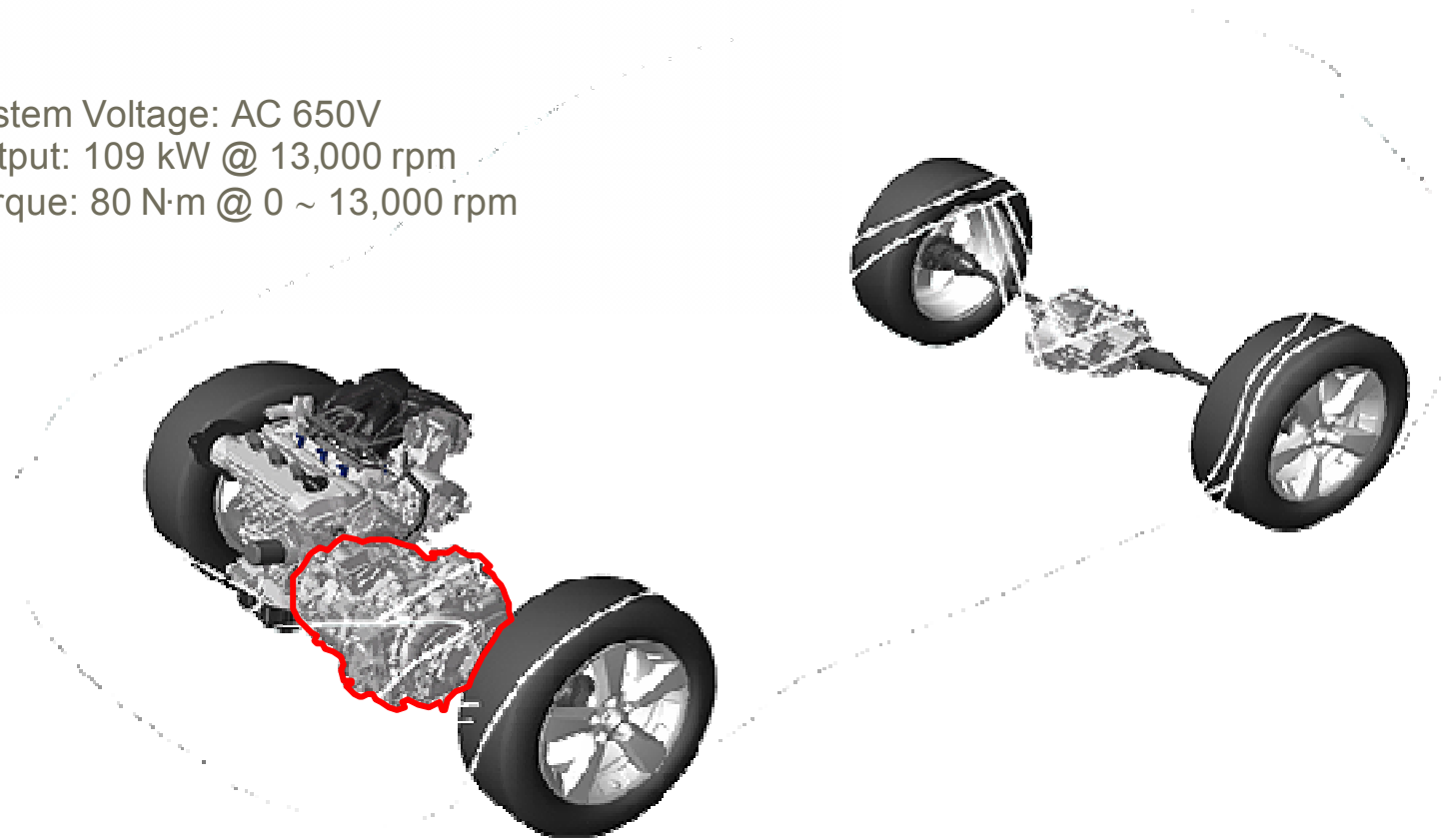
[MG1]

Alternating current permanent magnet synchronous type motor

Max. System Voltage: AC 650V

Max. Output: 109 kW @ 13,000 rpm

Max. Torque: 80 N·m @ 0 ~ 13,000 rpm



Performance

- Power Train
 - MG1 / MG2

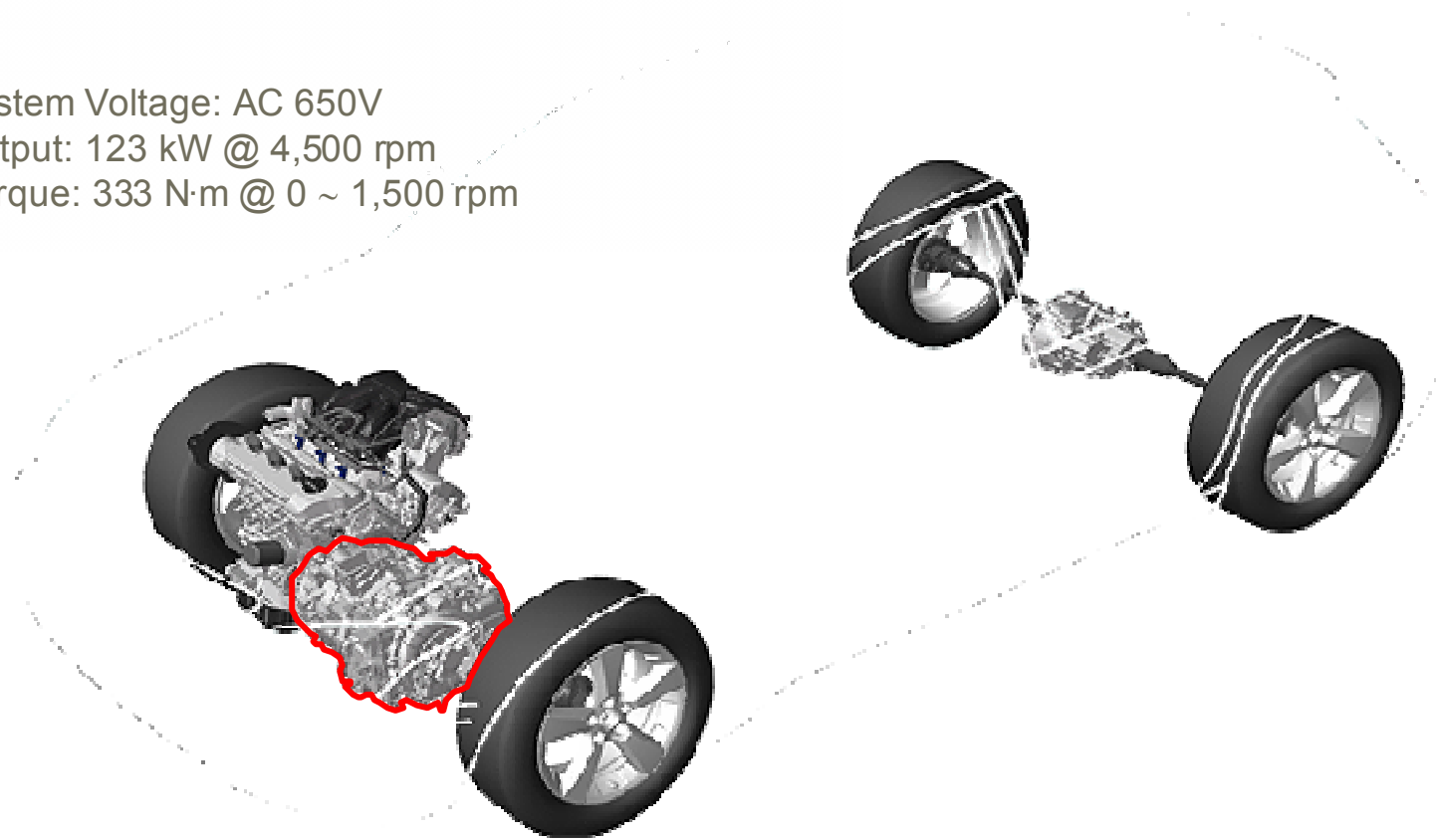
[MG2]

Alternating current permanent magnet synchronous type motor

Max. System Voltage: AC 650V

Max. Output: 123 kW @ 4,500 rpm

Max. Torque: 333 N·m @ 0 ~ 1,500 rpm



Performance

- Power Train
 - MGR (4WD model only)

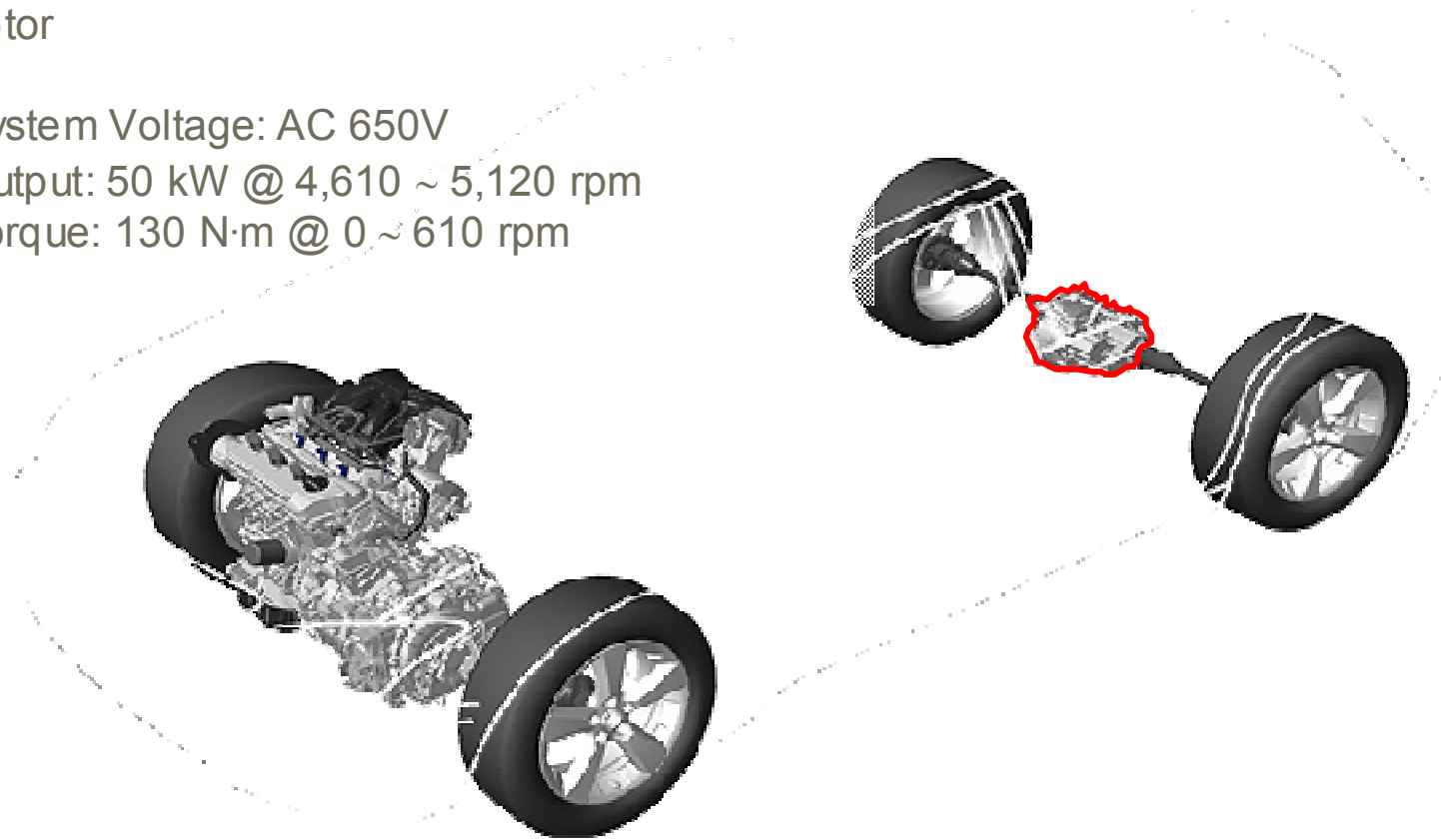
[MGR]

Alternating current permanent magnet synchronous type motor

Max. System Voltage: AC 650V

Max. Output: 50 kW @ 4,610 ~ 5,120 rpm

Max. Torque: 130 N·m @ 0 ~ 610 rpm



Equipment



- THS-II
 - DC 288V high-output HV Battery



Equipment



- THS-II
 - Inverter

MG ECU

*Controls inverter
components*

Inverter

AC ↔ DC

Boost Converter

DC288V ↔ DC650V

DC-DC Converter

DC288V → DC12V



Equipment

- Combination meter
 - Power meter : Indication of total of engine & motor output
 - Multi-information : Indication of cruise information, energy monitor, etc..



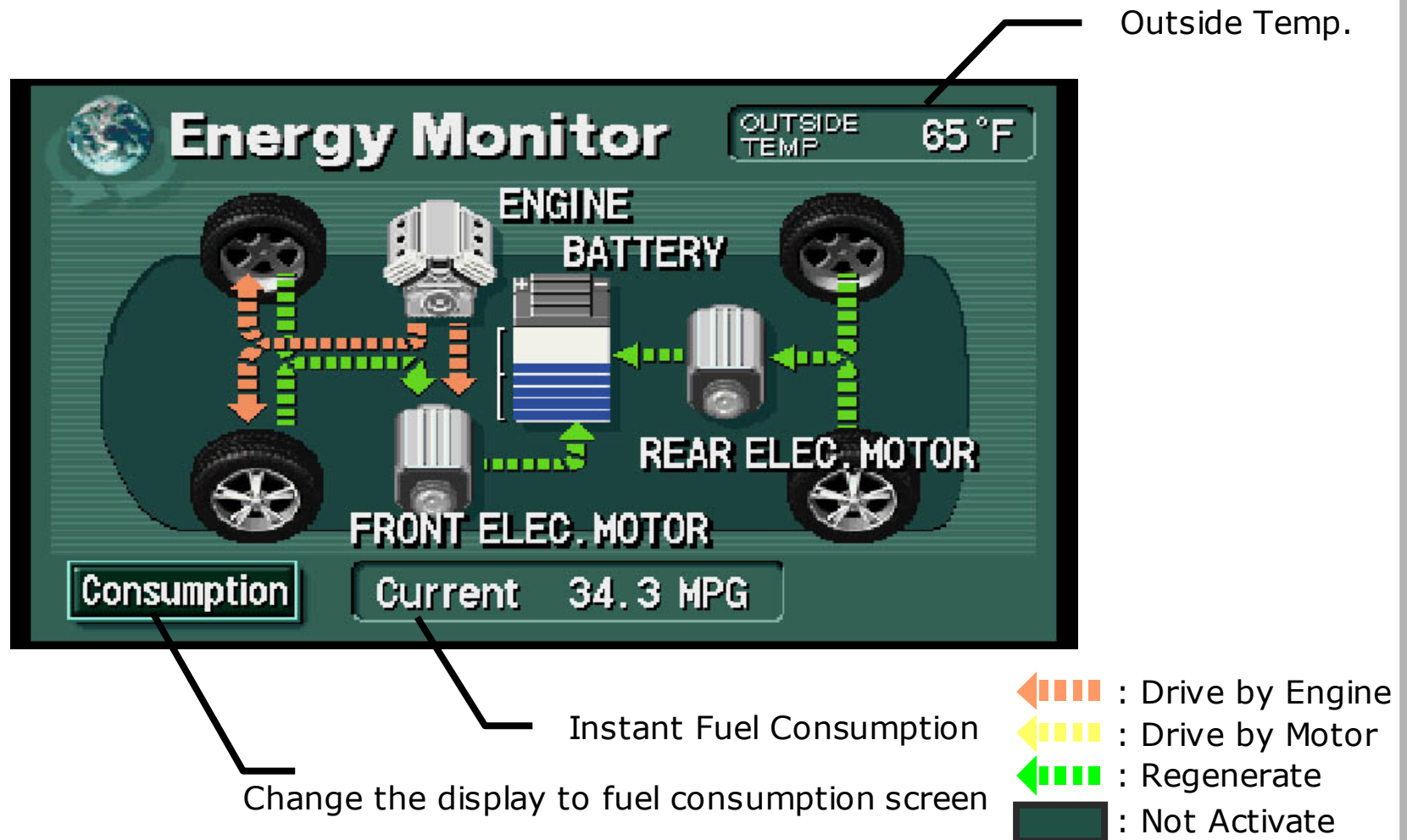
Power Meter

READY Light

Multi-information Display
•Energy monitor, etc.,

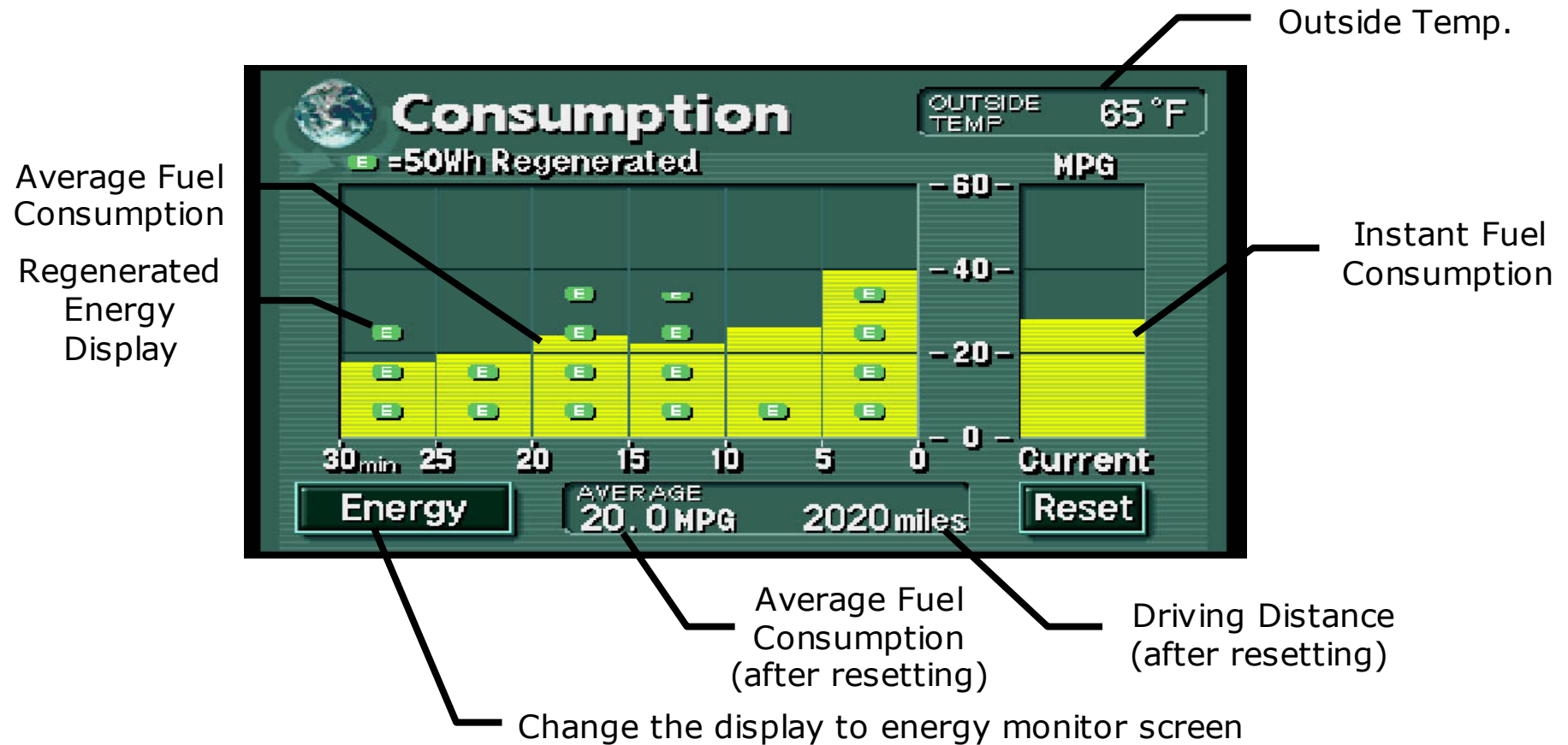
Equipment

- Multi display
 - New functions of multi display : Energy monitor



Equipment

- Multi display
 - New functions of multi display : Fuel consumption



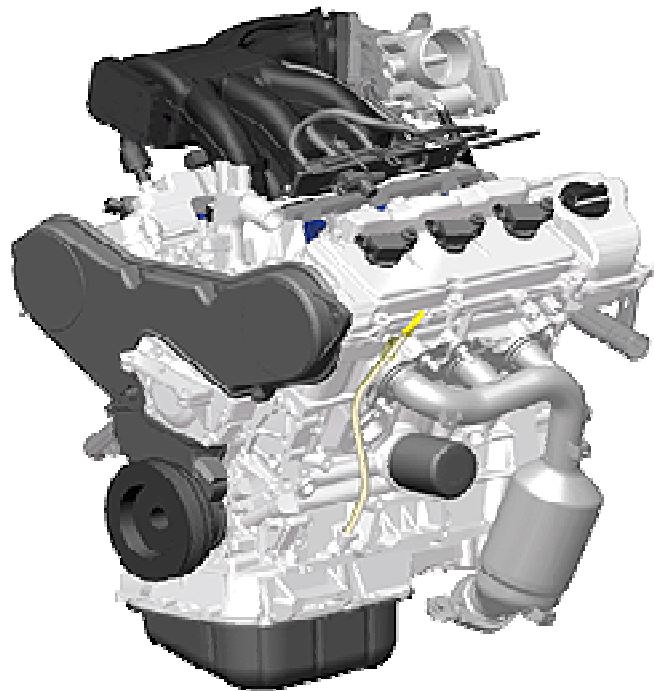
Engine

Engine specifications

Engine properties

Engine specifications

- Outline
 - V6 (60-degree), 3.3-liter, 24-valve, DOHC, w/VVT-i gasoline engine



Basic construction and operation are same as 3MZ-FE on RX330

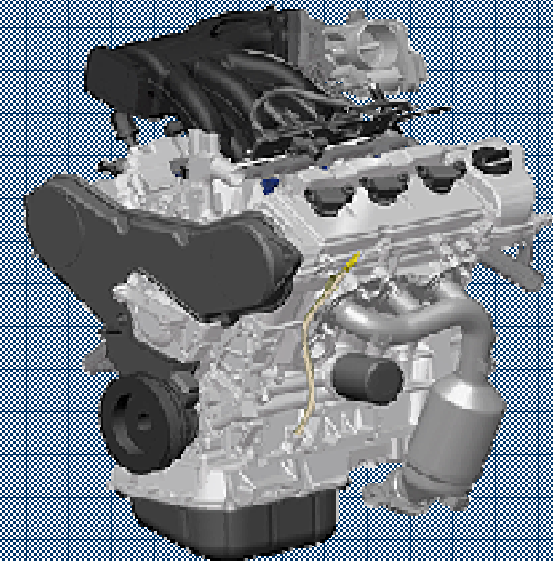
Engine specifications

Item	3MZ-FE (RX400h)	3MZ-FE (RX330)	1MZ-FE (RX300)
Destination	-A, -W	-A	-W
No. of Cylinders and Arrangement	6-Cylinder, V-type	←	←
Valve Mechanism	24-Valve DOHC, Gear/Belt Drive, VVT-i	←	←
Displacement cm ³	3311	←	2995
Bore x stroke mm	92.0 X 83.0	←	87.5 X 83.0
Compression Ratio	10.8	←	10.5
Max. Output	155 kW @ 5,600 rpm 208 HP @5,600 rpm	172 kW @ 5,600 rpm 230 HP @ 5,600 rpm	150 kW @ 5,600 rpm
Max. Torque	288 N·m @ 4,400 rpm	328 N·m @ 3,600 rpm	283 N·m @ 4,500 rpm

Engine specifications

- Major Difference from 1MZ-FE (RX300)

- THS ECU controls the engine
- Cylinder bore diameter is increased
- Same piston for right and left bank
- Intake valve timing is changed (retarded)
- ACIS is discontinued
- Intake air control system is discontinued
- Flat type knock sensor
- Drive belt is discontinued



THS – II

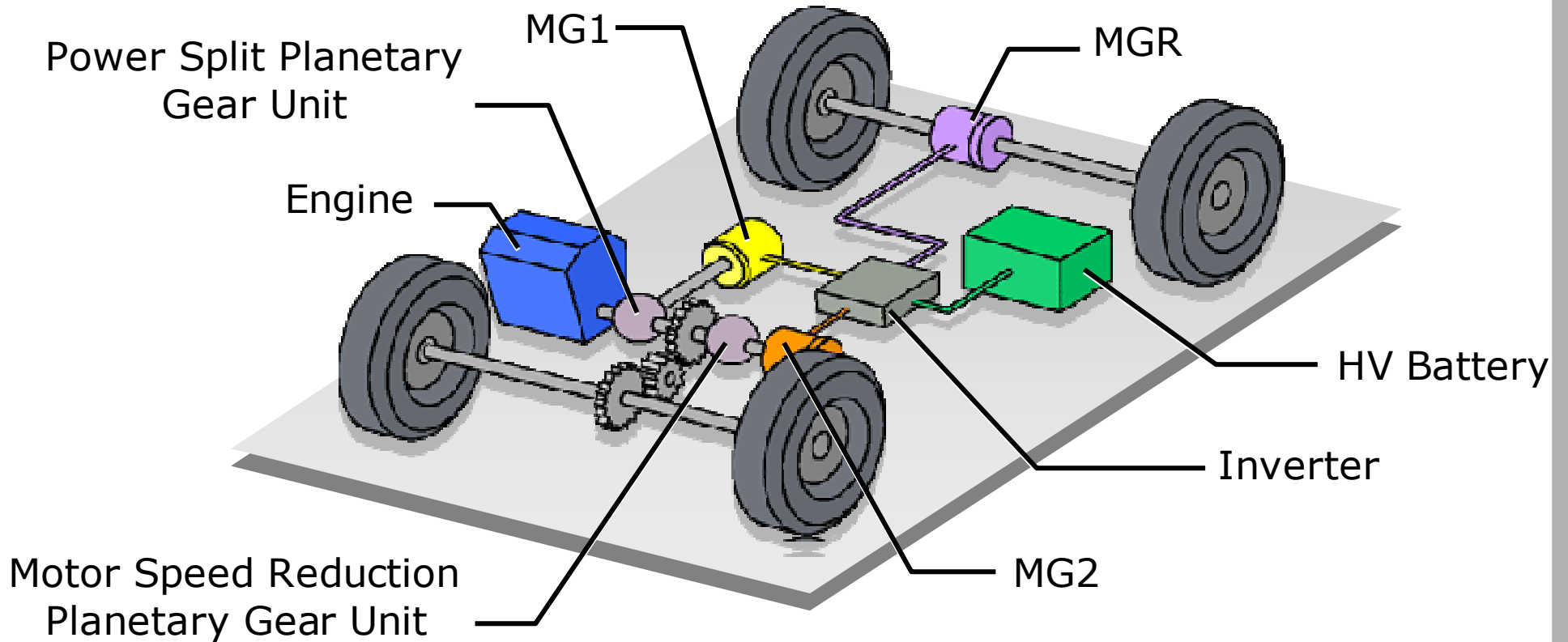
THS-II Overall
THS-II Operation
Motor / Generator
Inverter assembly



Overall

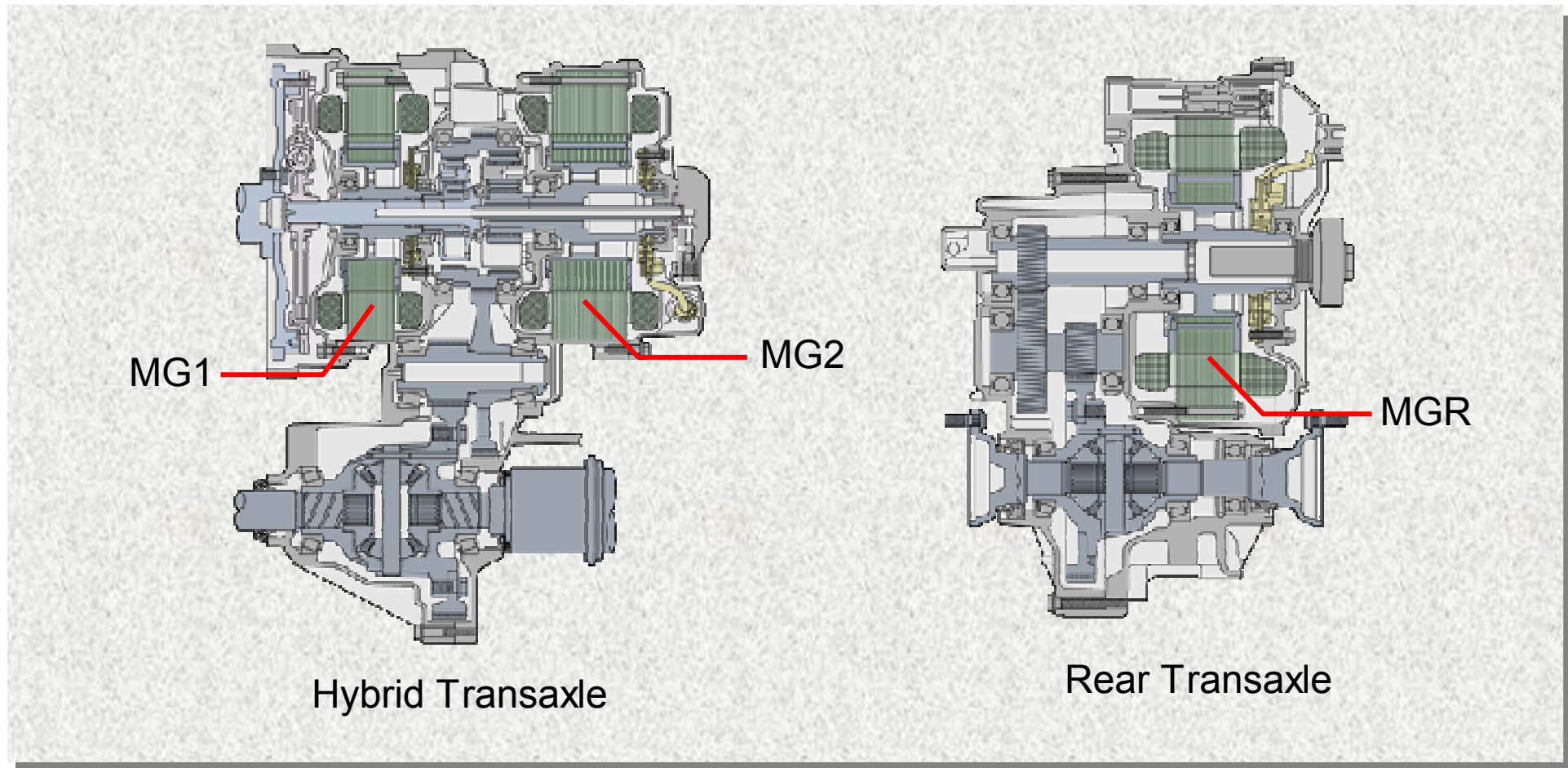


- Basic components of THS-II



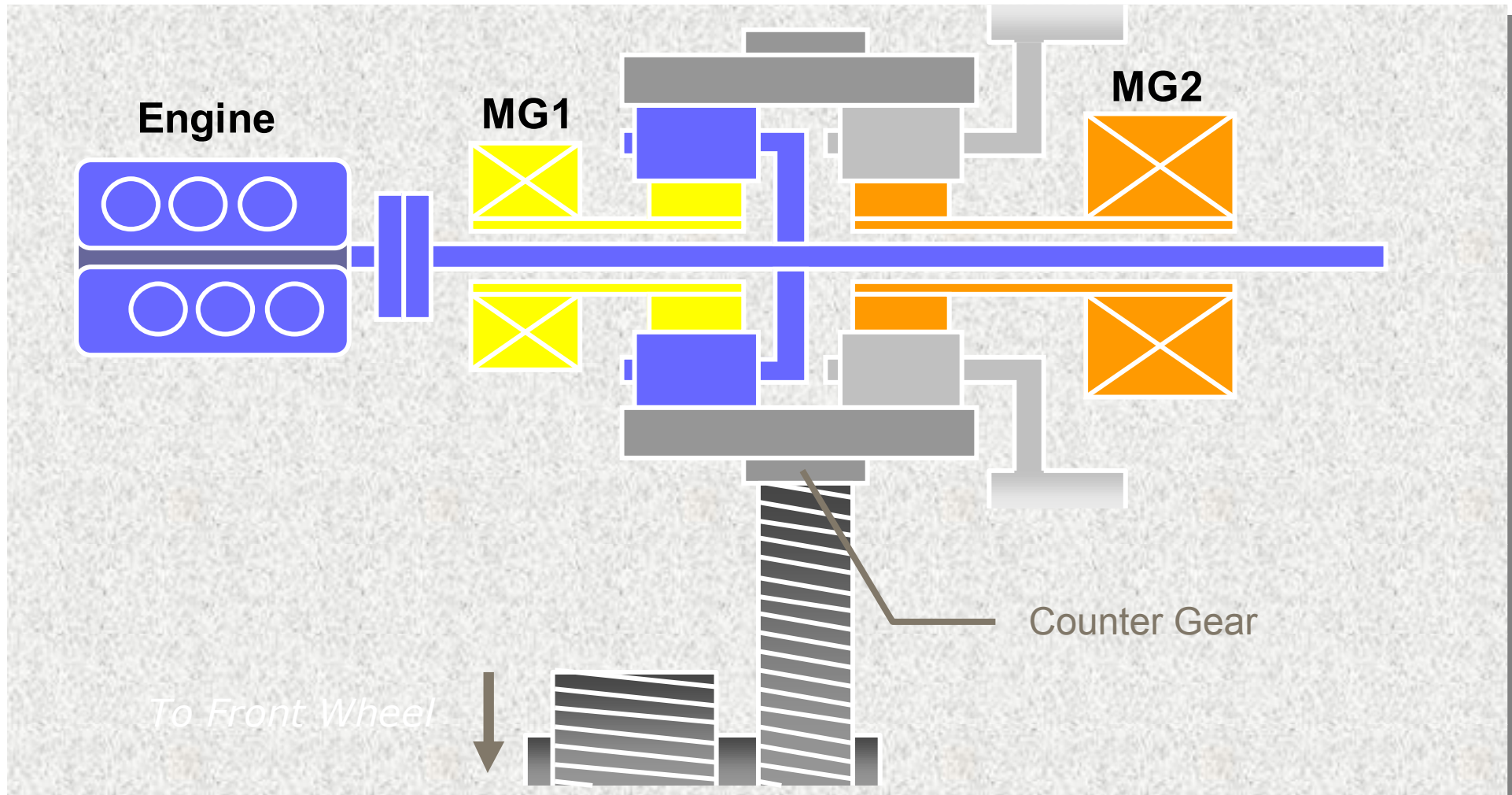
MG (Motor Generator)

- MG1, MG2 and MGR
 - Alternating current permanent magnet synchronous motor



Overall

- Power-dividing mechanism
 - 2 Planetary Gears



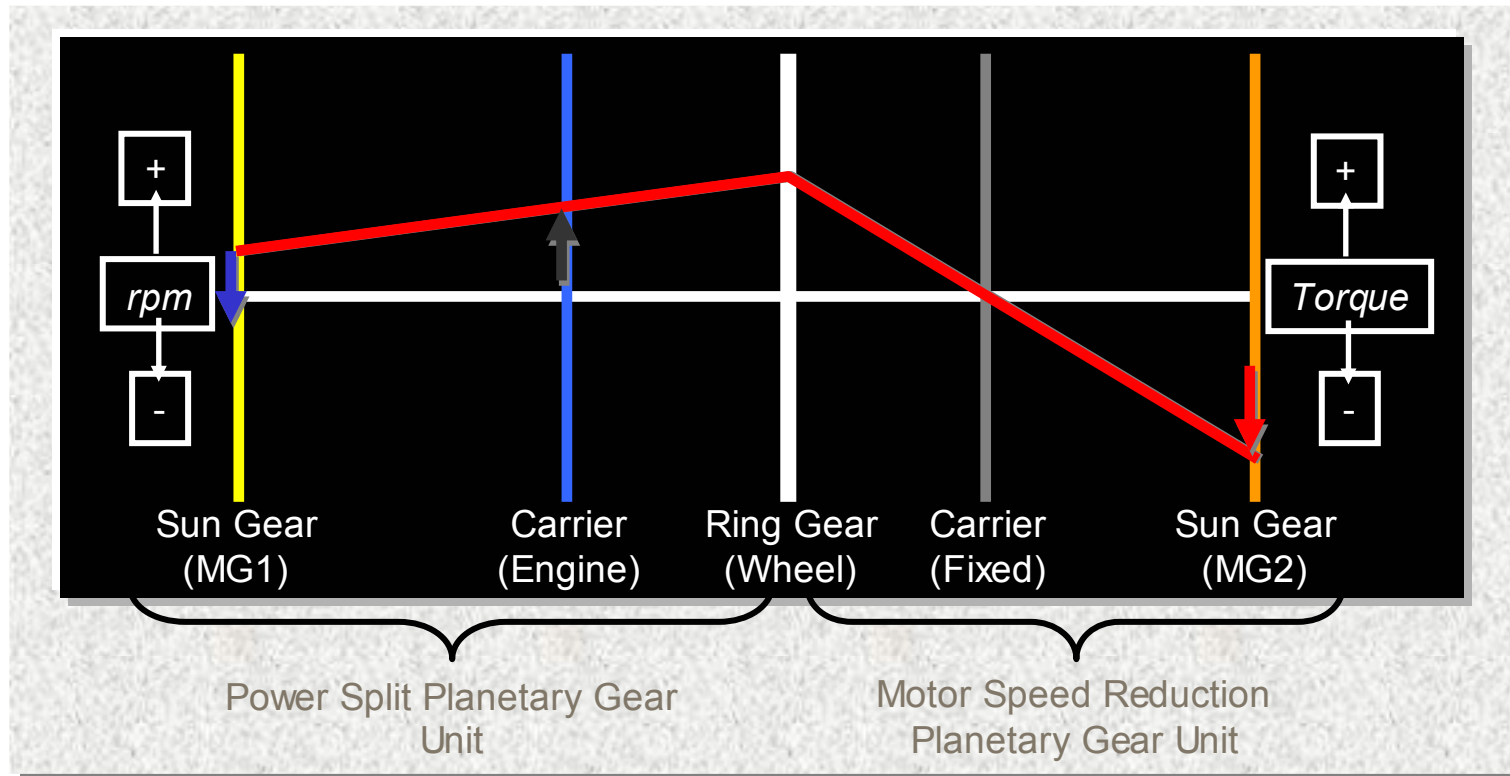
MG (Motor Generator)



- Specifications

Item	MG1	MG2	MGR
Type	Permanent Magnet Motor	←	←
Function	Generator, Engine Starter	Drive Front Wheels, Generator	Drive Rear Wheels, Generator
System Voltage V	Max. AC 650	←	←
Max. Output kW / rpm	109 / 13,000	123 / 4,500	50 / 4,610 ~ 5,120
Max. Torque N·m / rpm	80 / 0 ~ 13,000	335 / 0 ~ 1,500	130 / 0 ~ 610
Cooling System	Water-cooled	←	Air-cooled

Nomographic Chart



- Vertical lines show rpm and direction of rotation
- Spaces between vertical lines show gear ratios
- Arrows show torque direction (Red: Discharge / Blue: Charge)

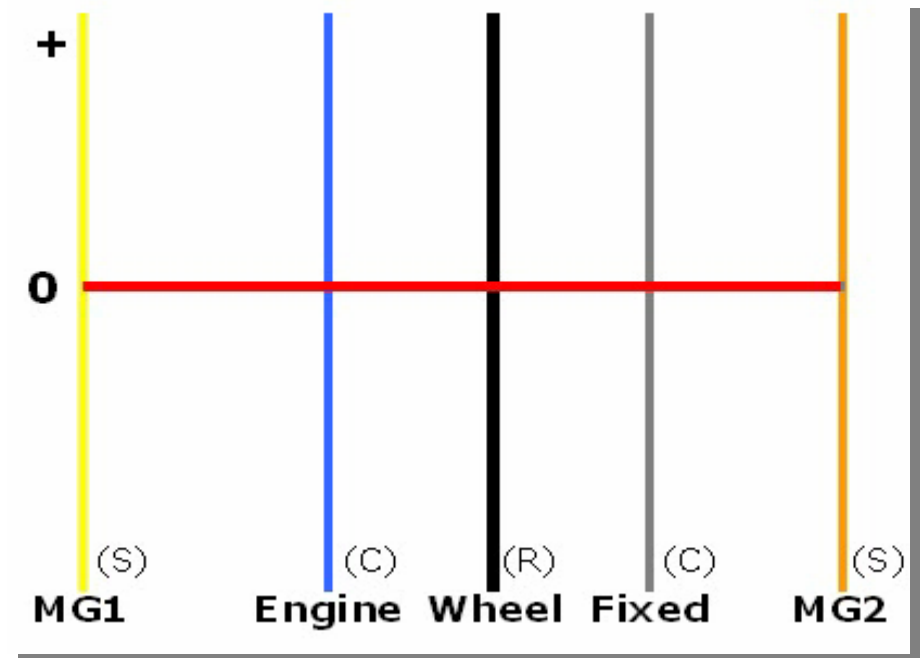
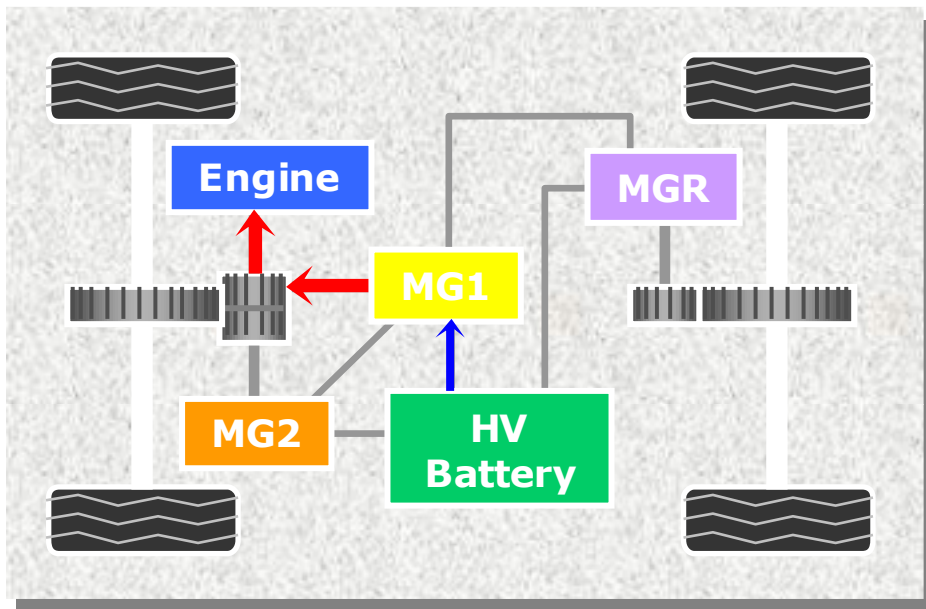
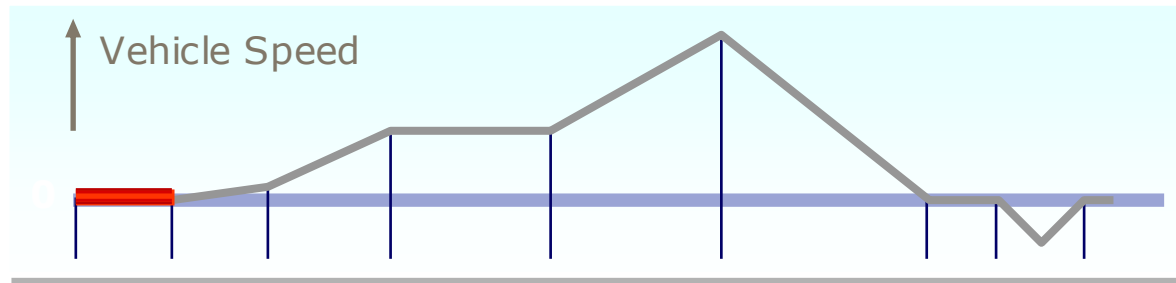
- MG1, MG2 Condition -

		Rotation Direction of MG	
		+	-
Torque	+	Discharge	Charge
	-	Charge	Discharge

THS-II Operation



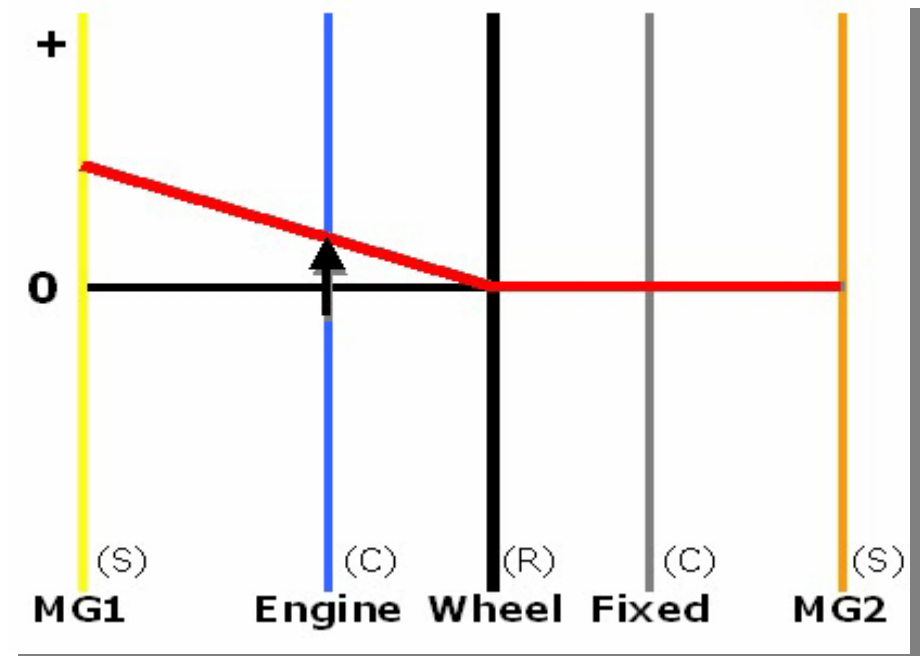
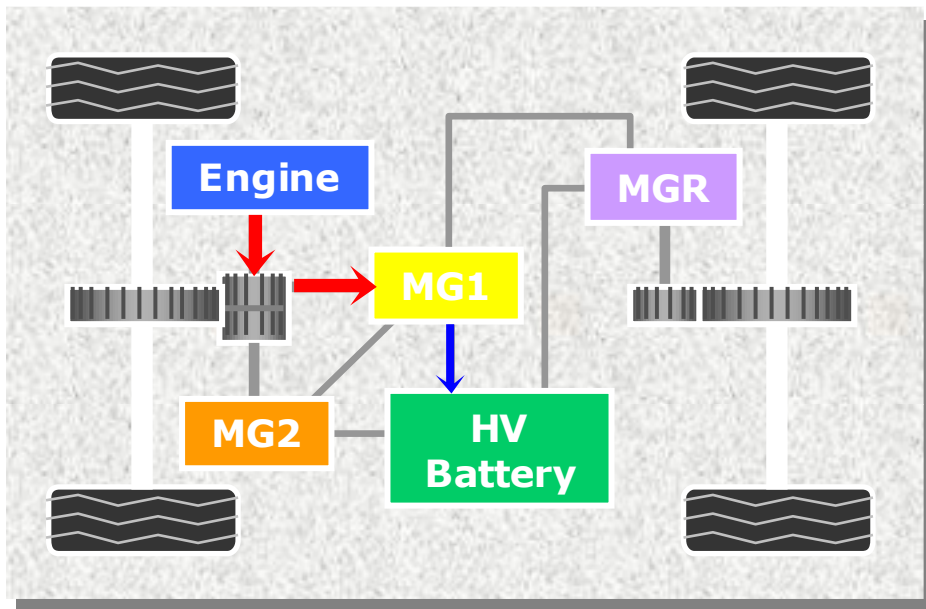
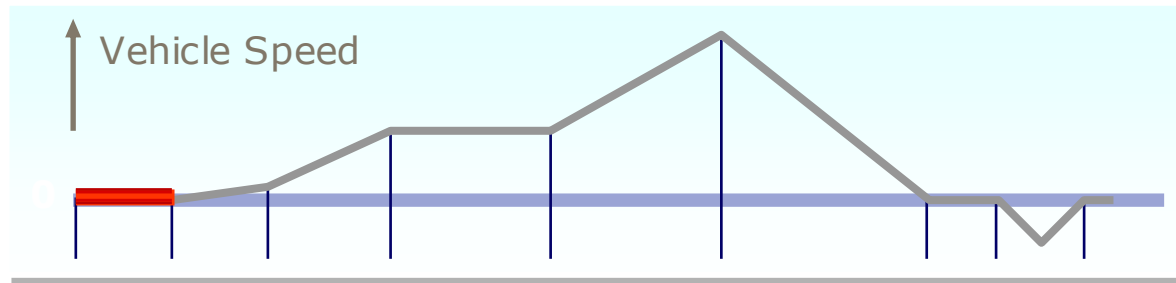
- Engine starting
 - MG1 starts engine



← Refer to chart

THS-II Operation

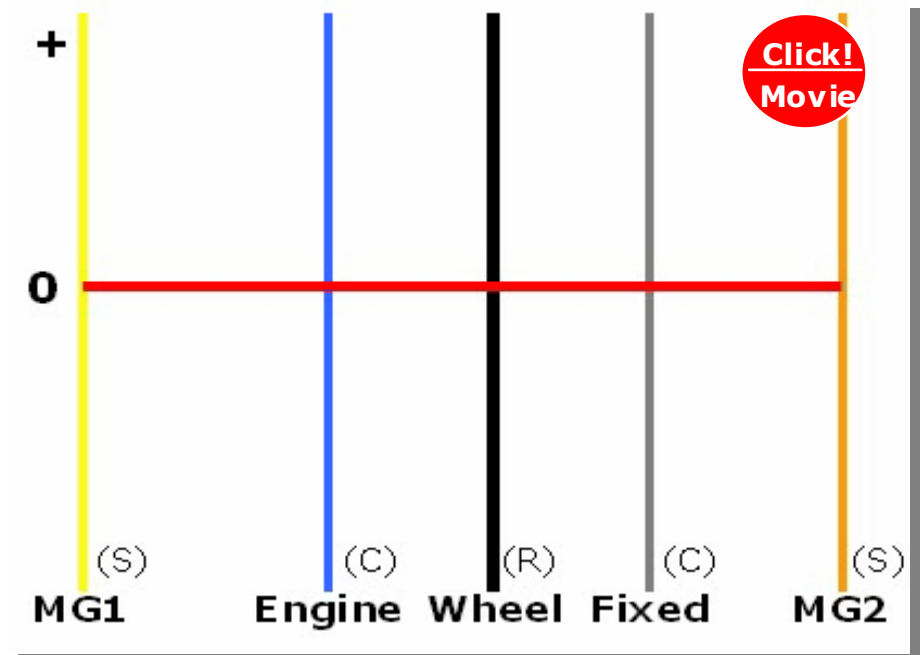
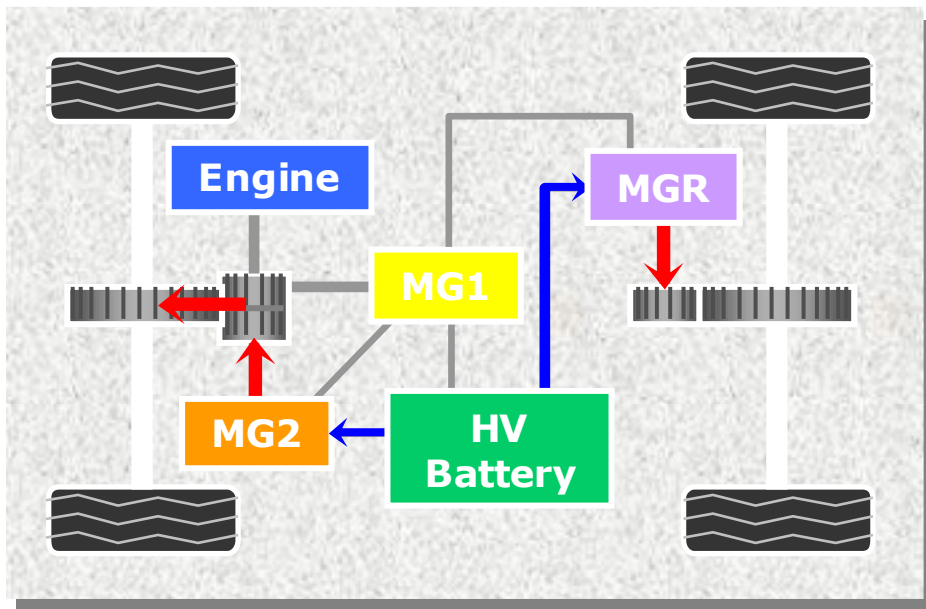
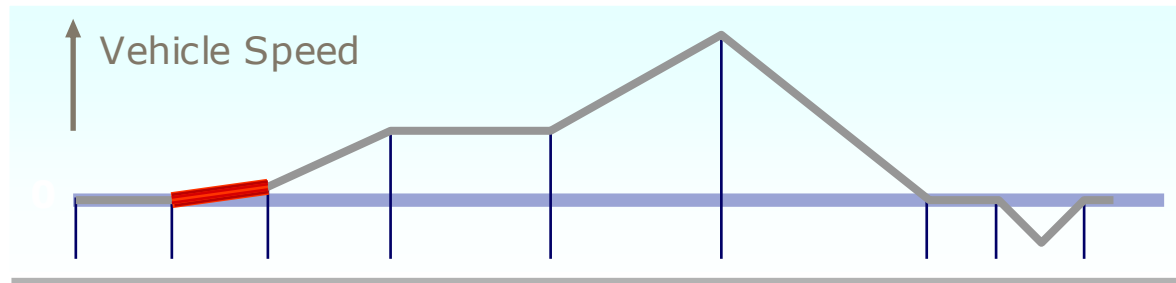
- Idling
 - Engine turns MG1 to charge HV battery



← Refer to chart

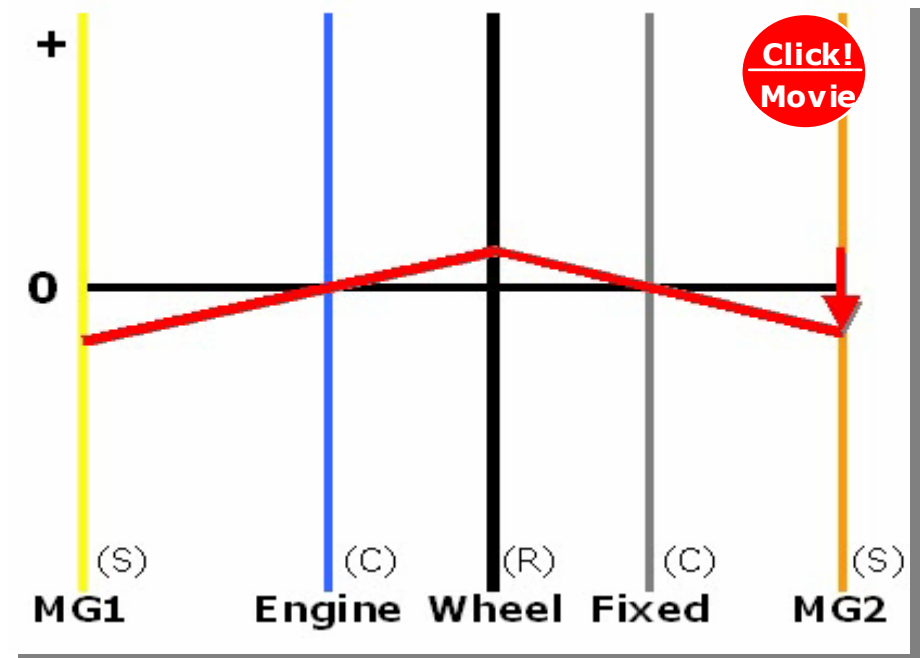
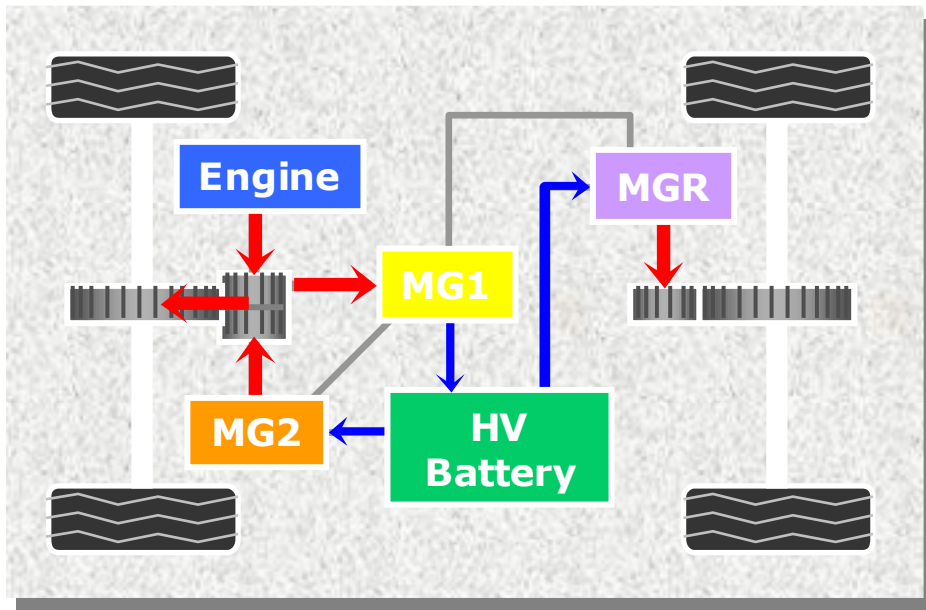
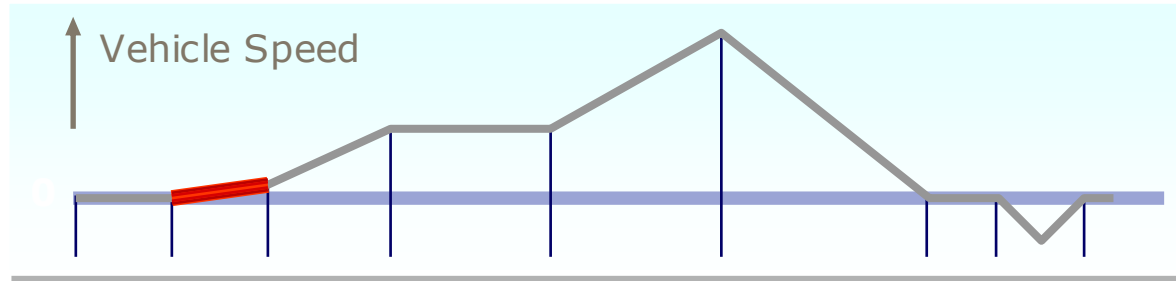
THS-II Operation

- Vehicle start-off
 - Driving with MG2 & MGR



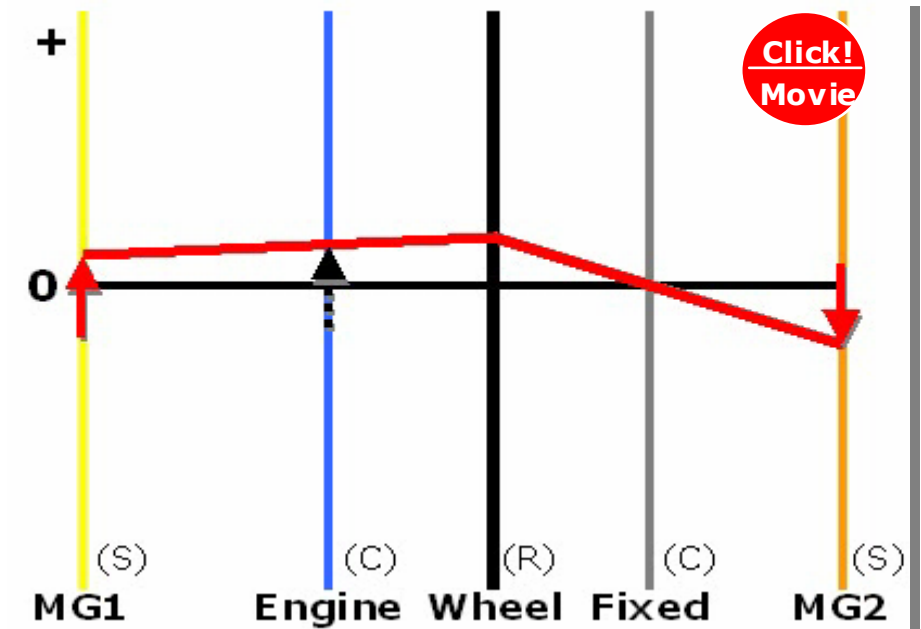
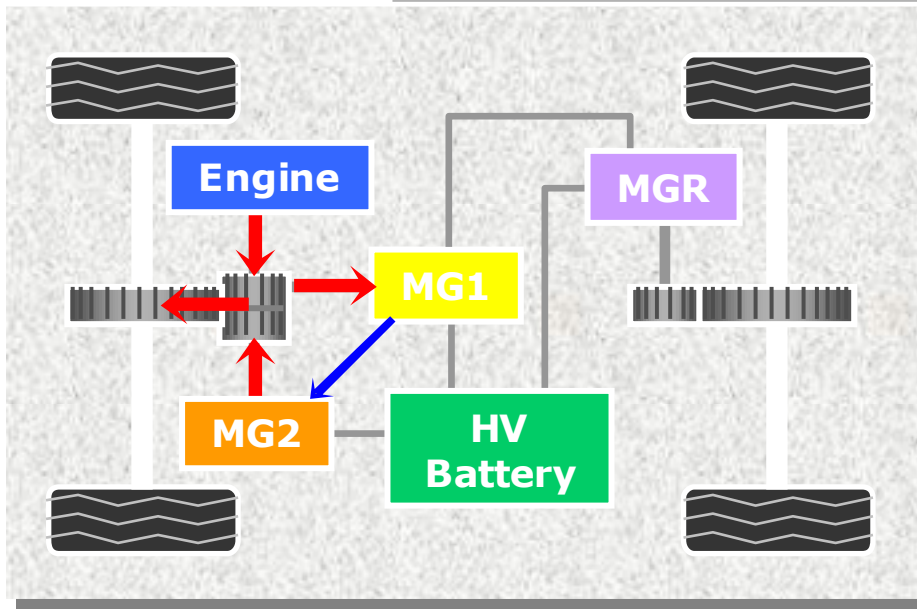
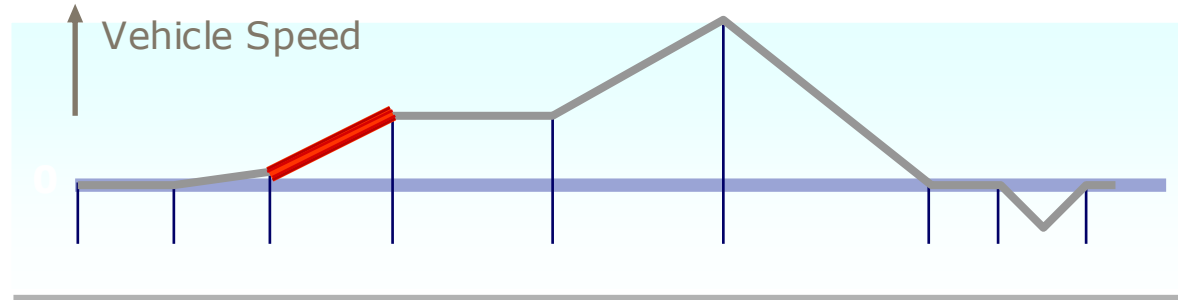
THS-II Operation

- Vehicle start-off with engine
 - MG1 starts engine for increase of drive torque
 - Engine turns MG1 to charge HV battery



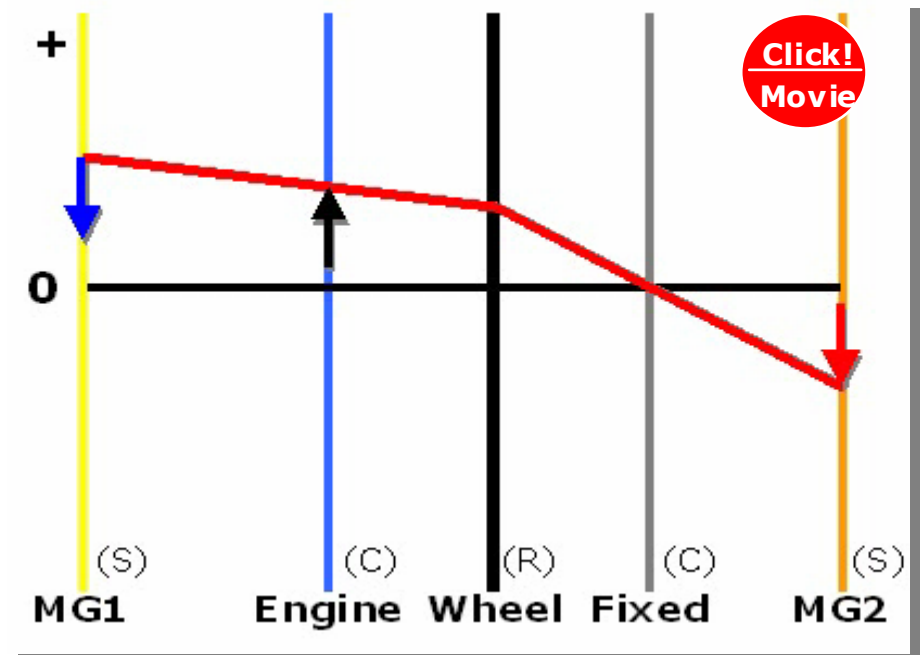
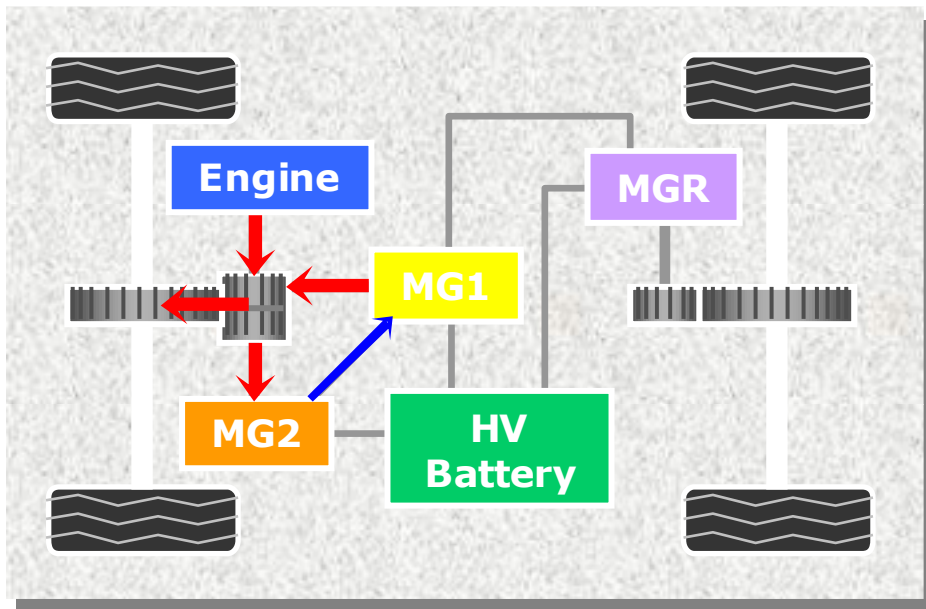
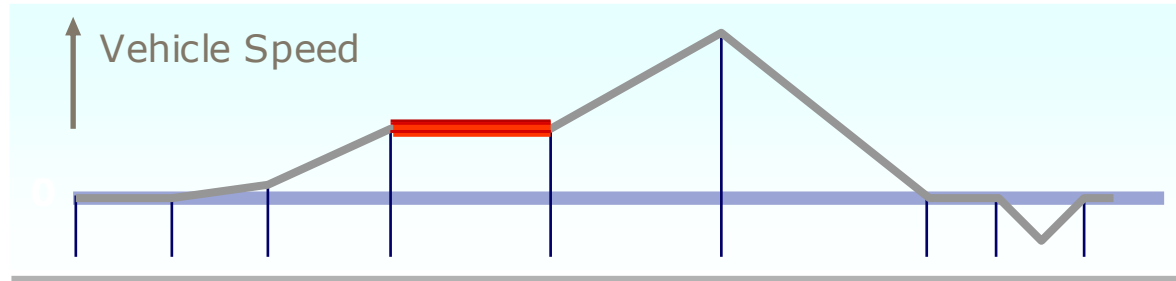
THS-II Operation

- During slight acceleration with engine
 - Engine drives wheel and MG1
 - Generated electricity is supplied to MG2



THS-II Operation

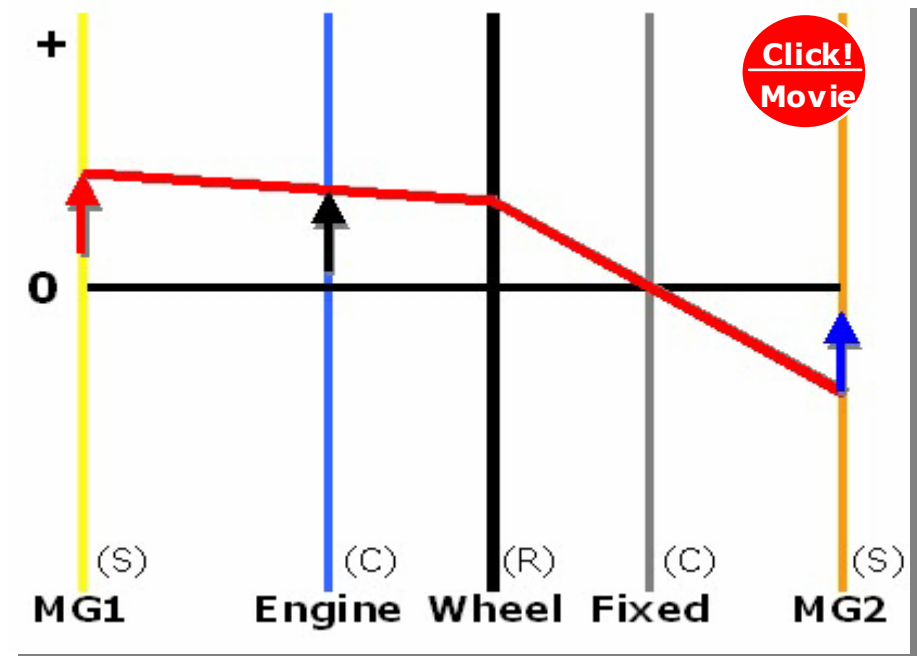
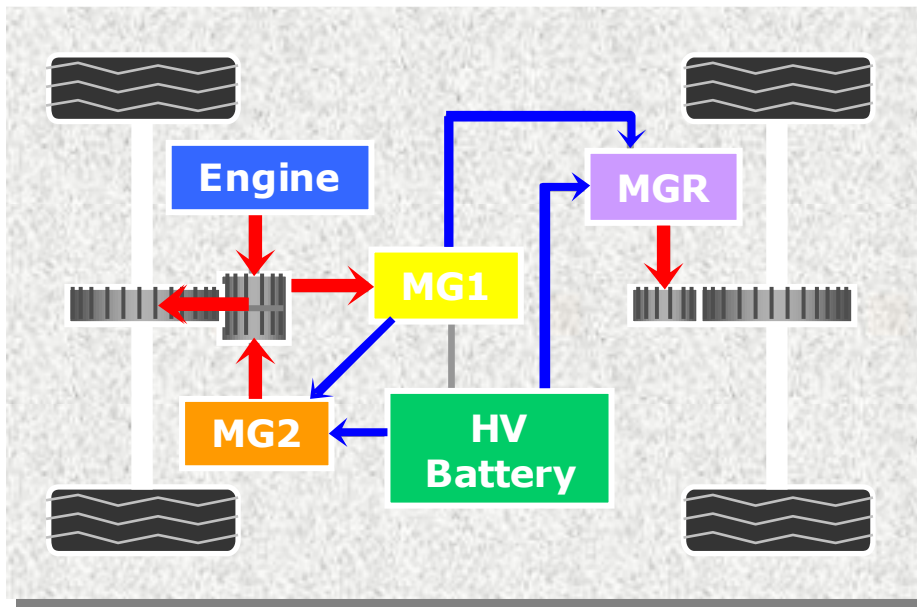
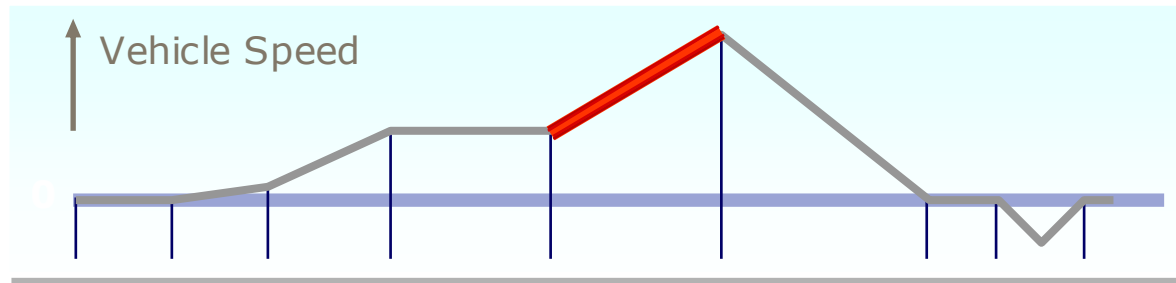
- During low load & constant-speed cruising
 - Engine drives wheel and MG2
 - MG1 is turned to keep an optimum gear ratio



THS-II Operation



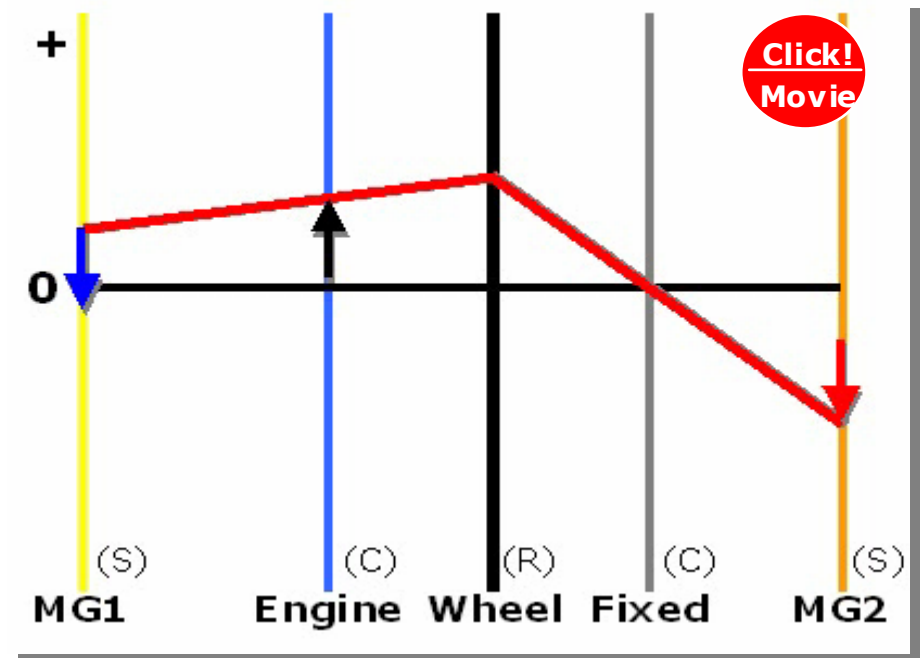
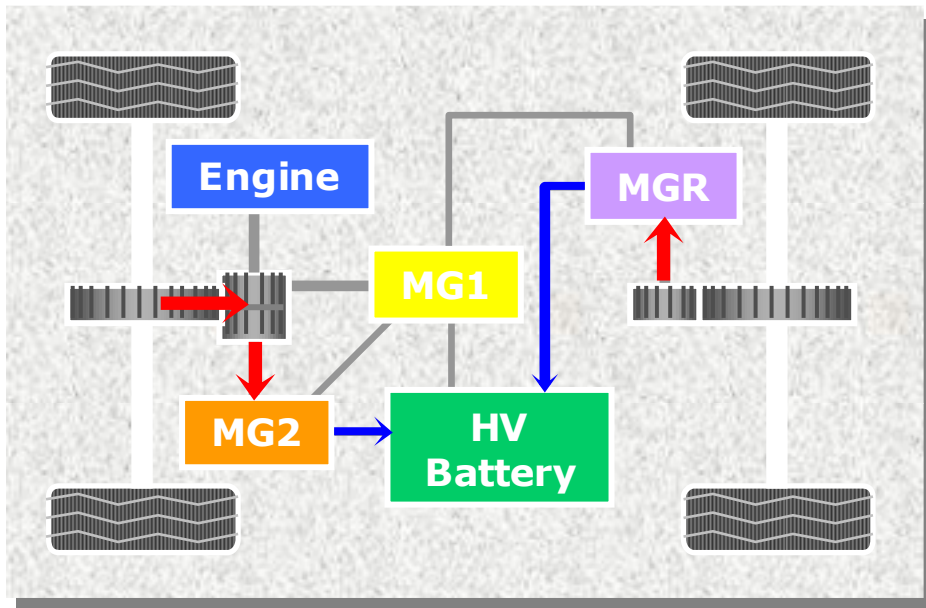
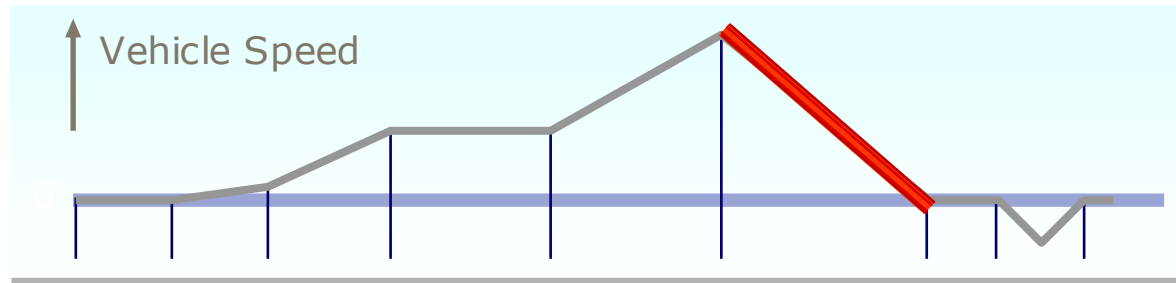
- During full throttle acceleration
 - HV battery supplies electricity to MG2 and MGR



THS-II Operation

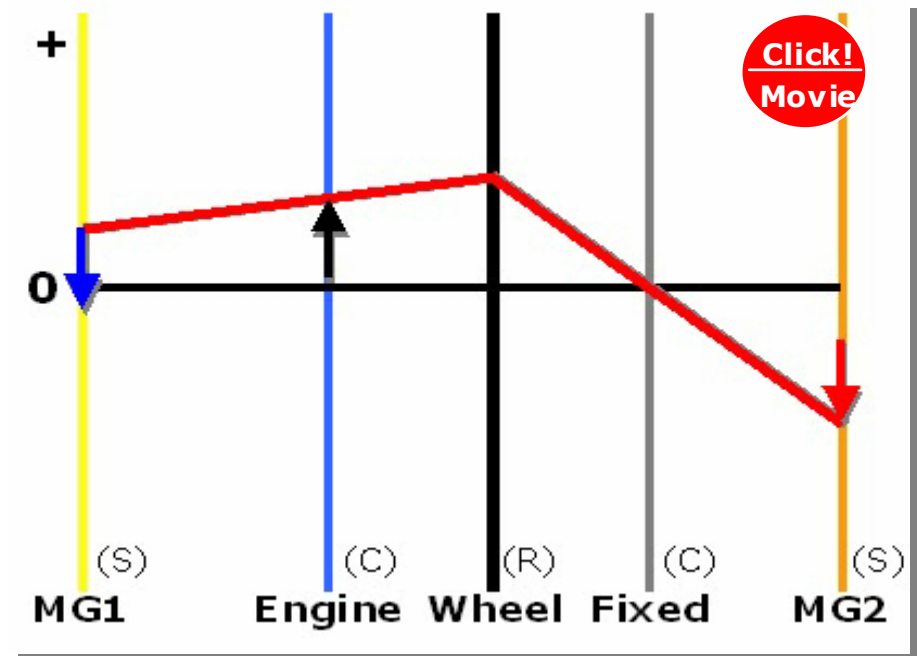
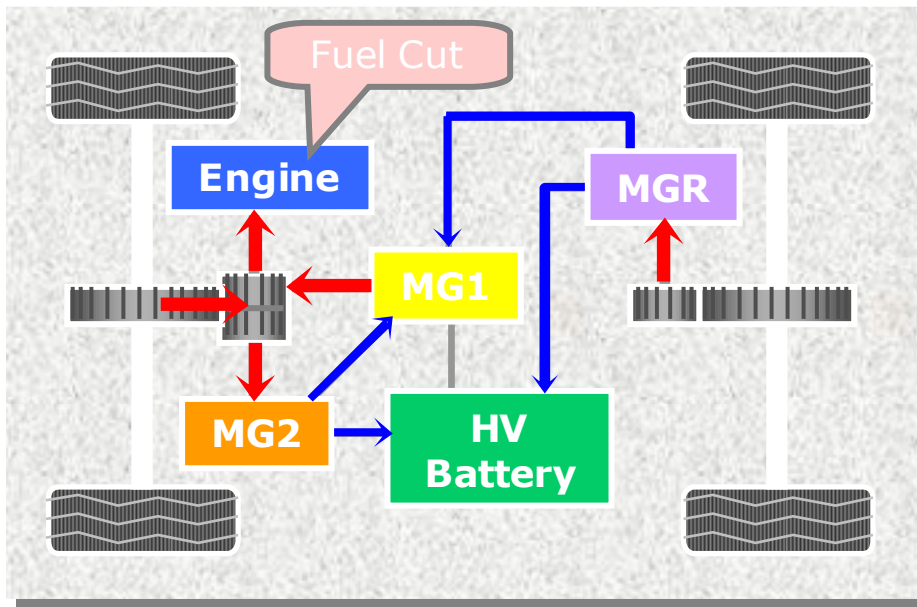
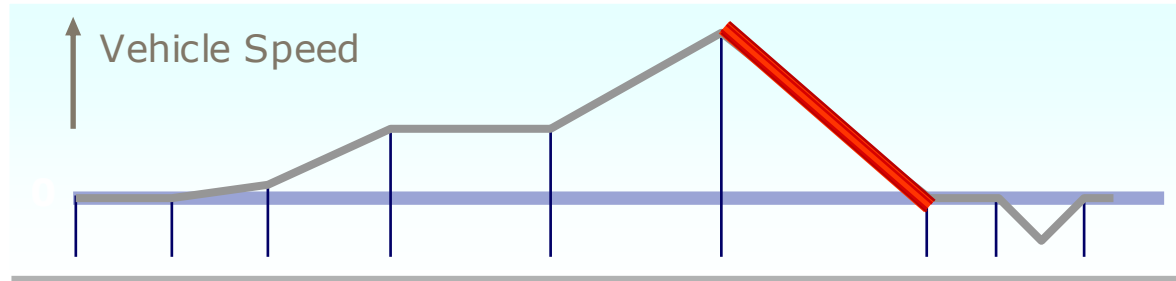


- Deceleration in D range
 - MG2 & MGR charge HV battery



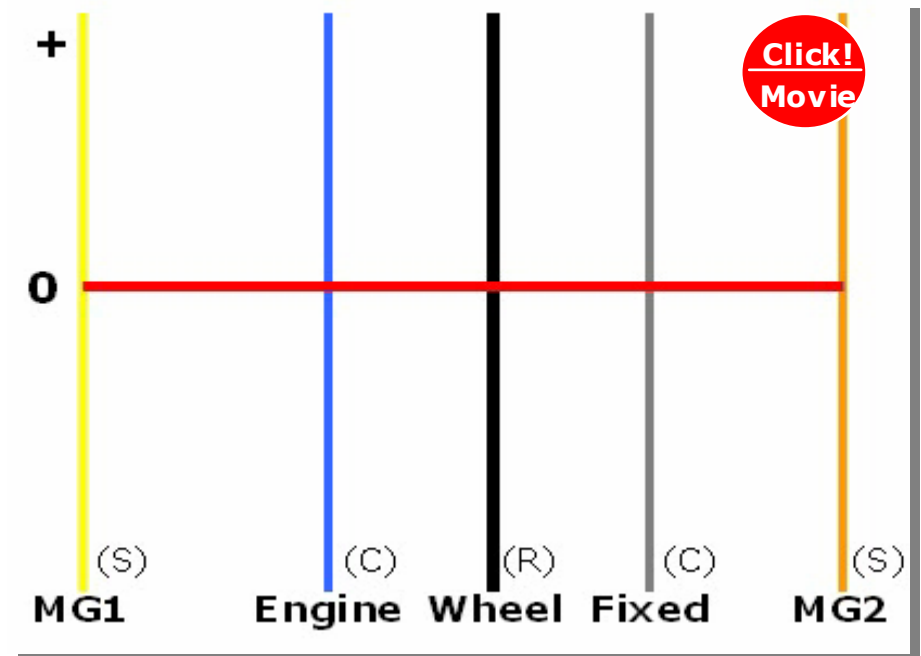
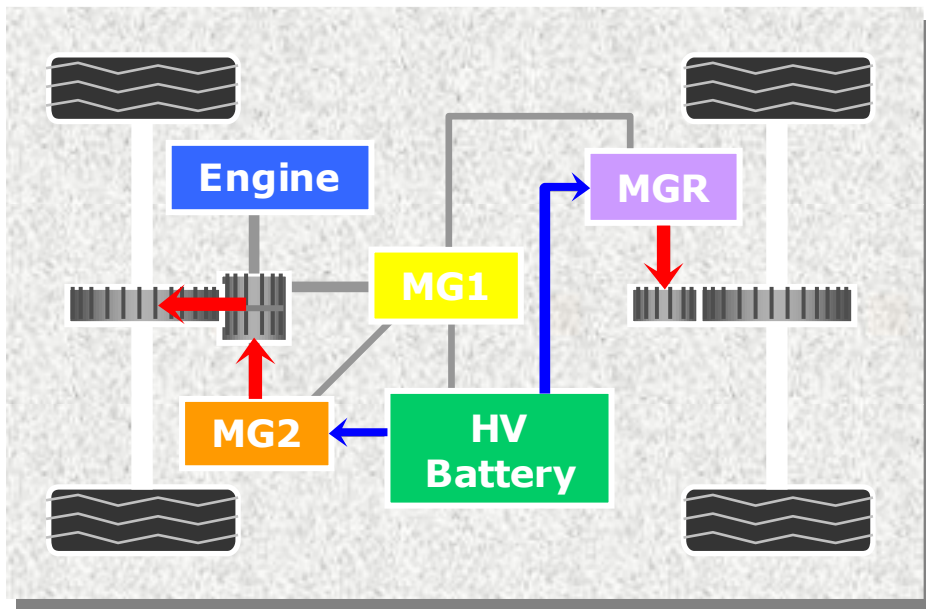
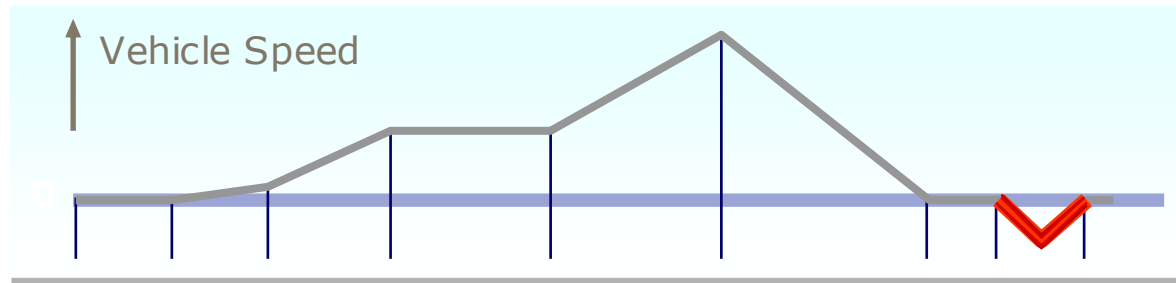
THS-II Operation

- Deceleration in B range
 - MG1 drives the engine
 - The motive force of MG1 is used for engine brake



THS-II Operation

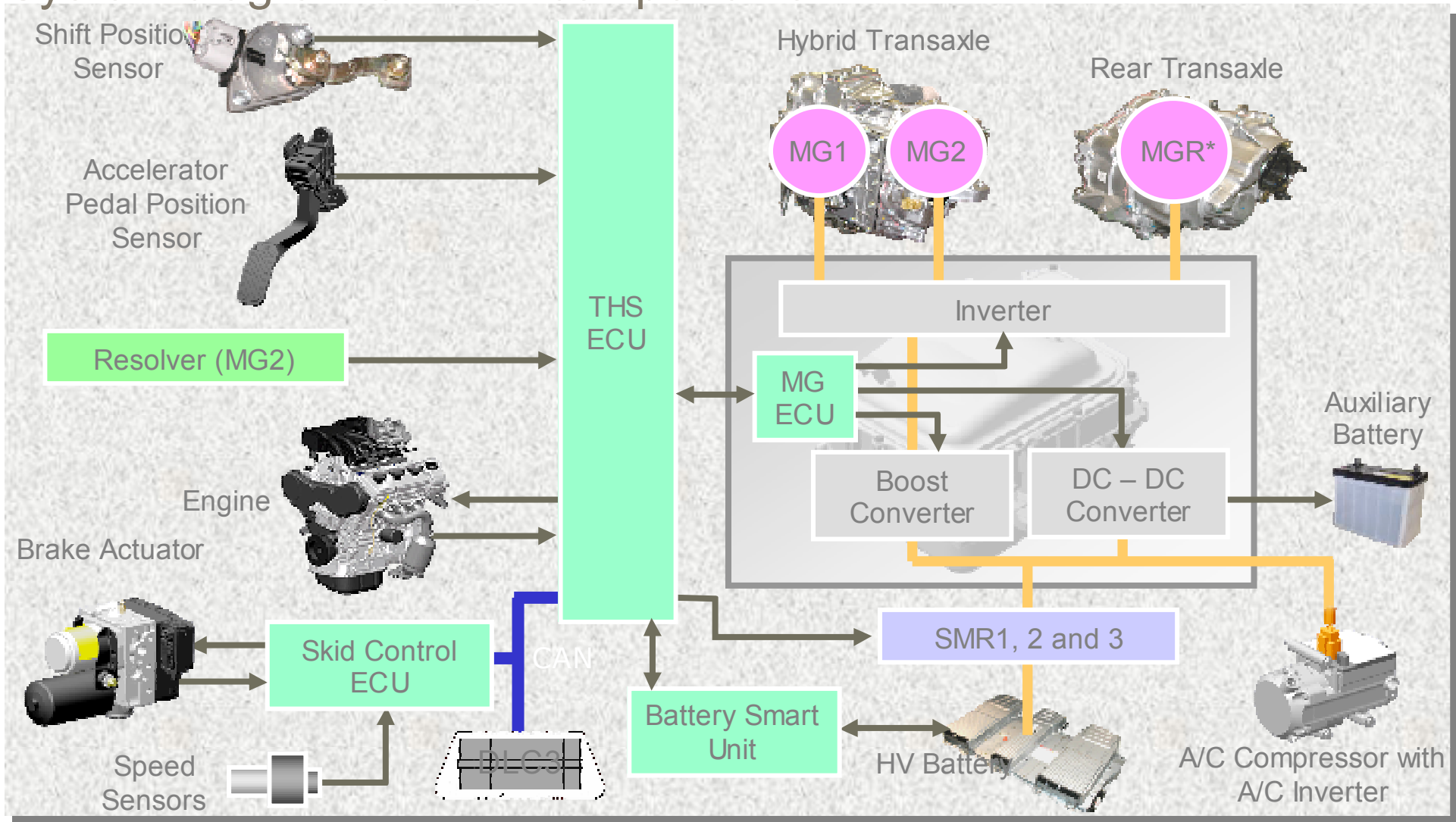
- Driving in reverse
 - MG2 & MGR are reversing



System diagram



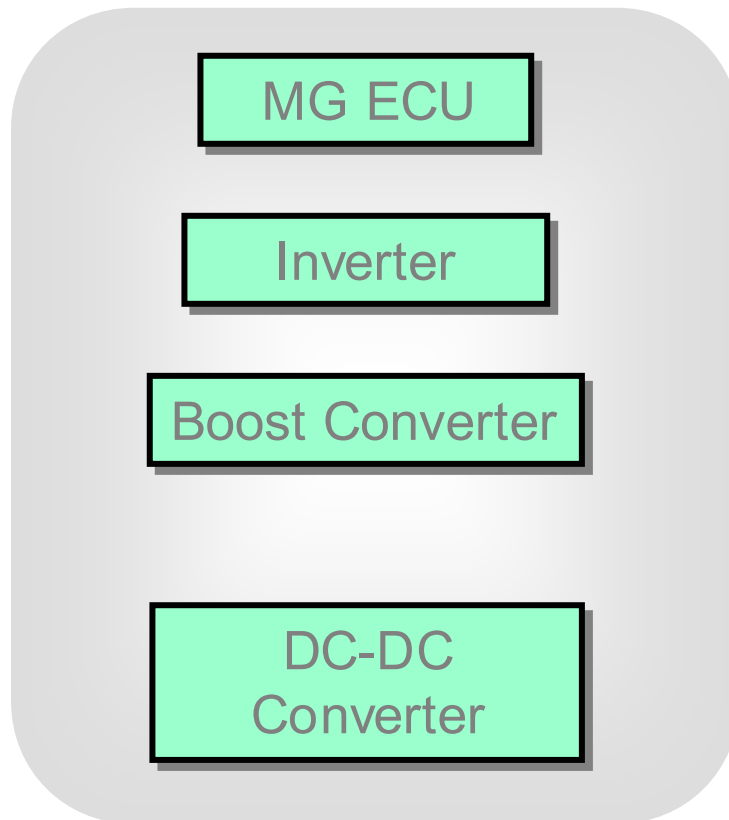
- System diagram of main components



Inverter assembly



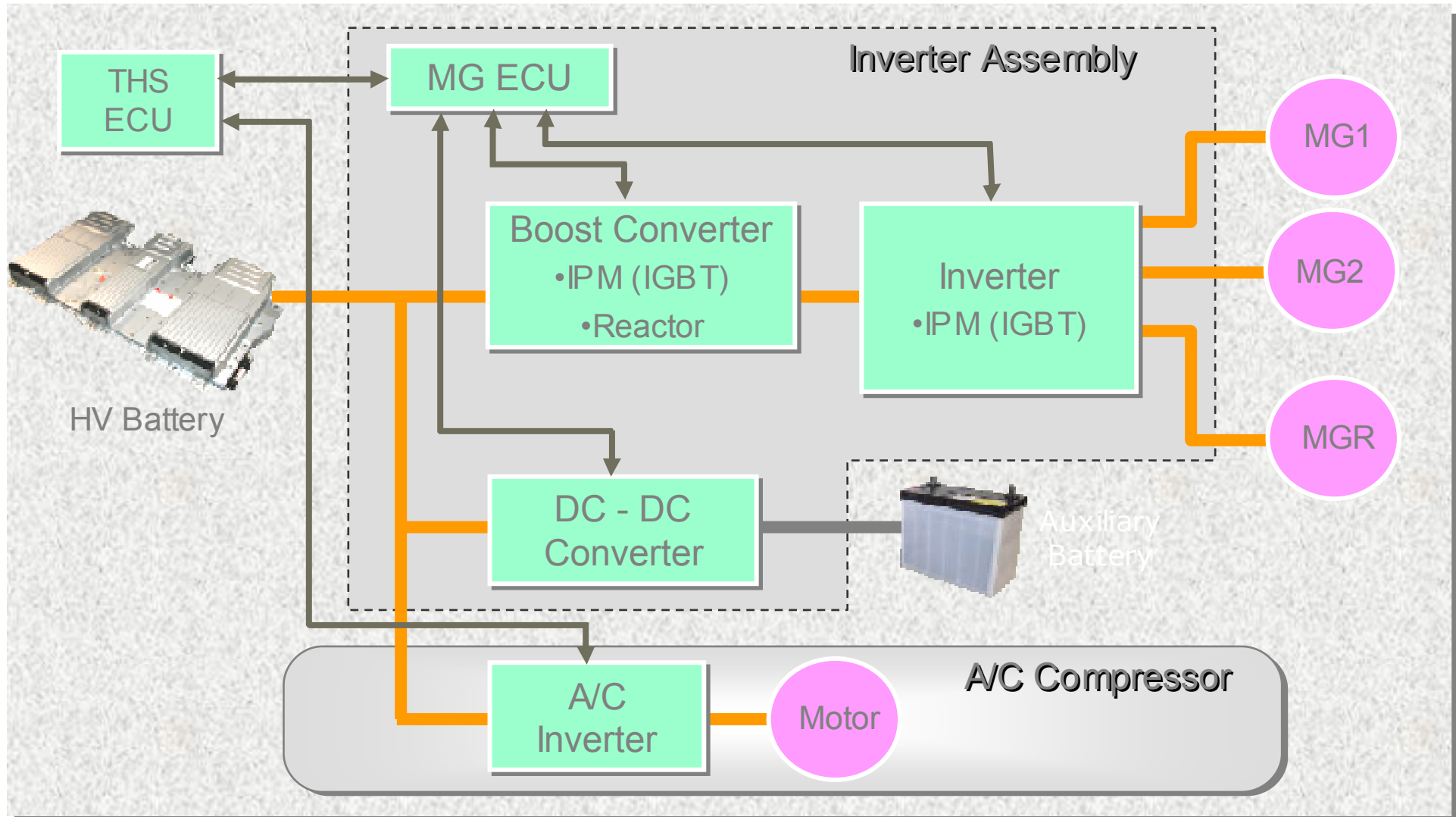
- General
 - 4 components



Inverter assembly

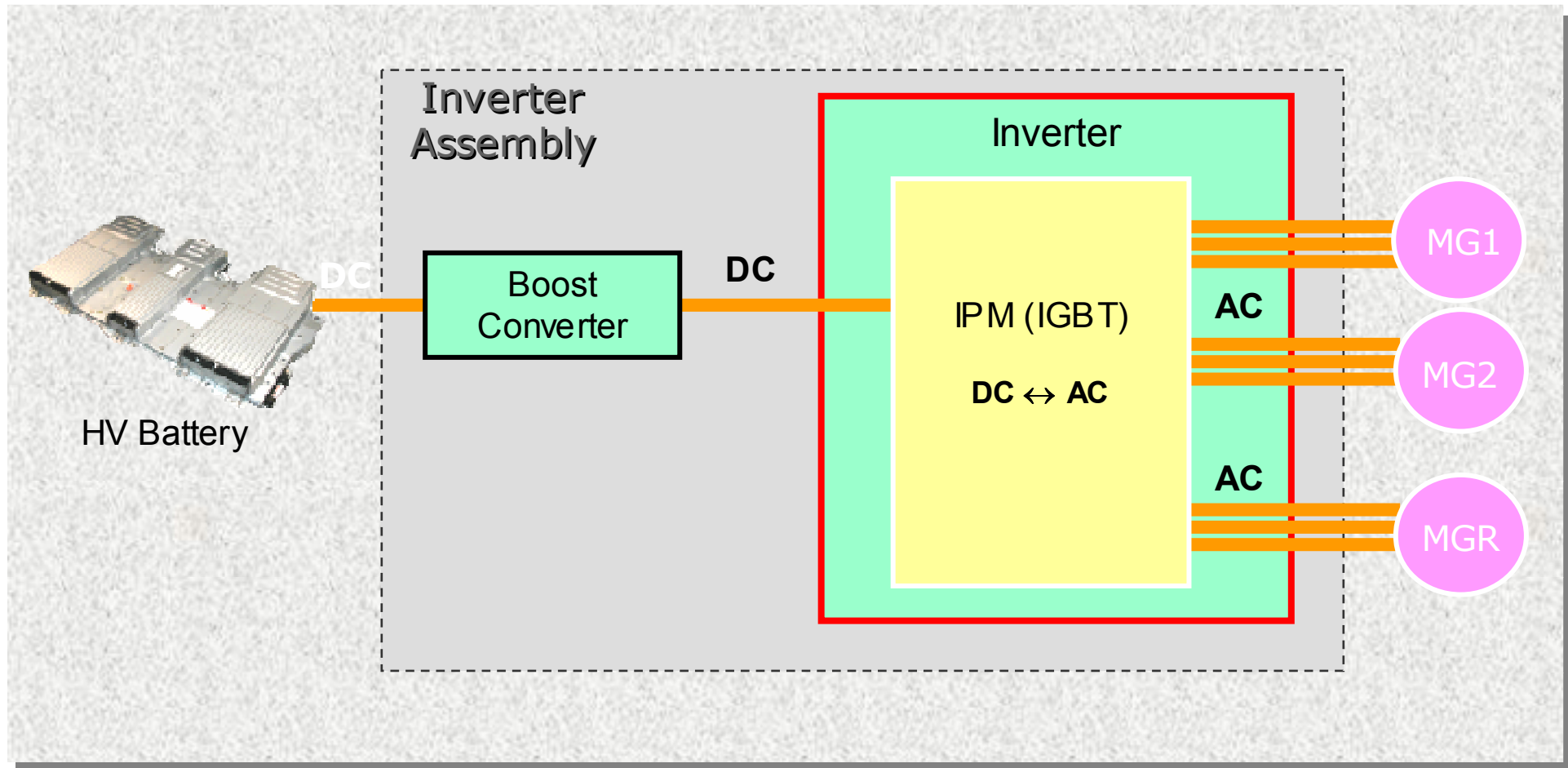
Inverter assembly

- System diagram



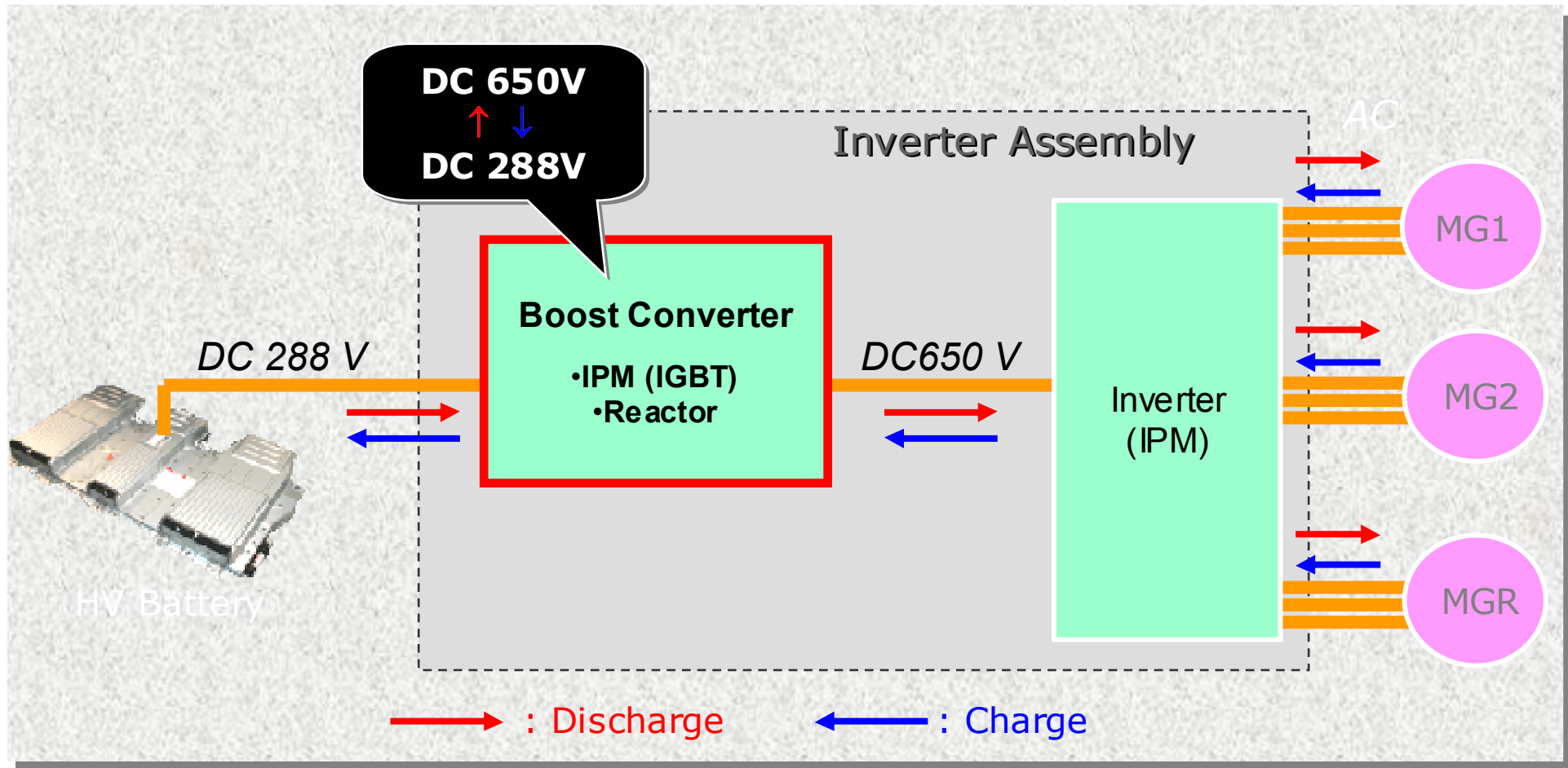
Inverter assembly

- Inverter
 - Converts DC \leftrightarrow AC



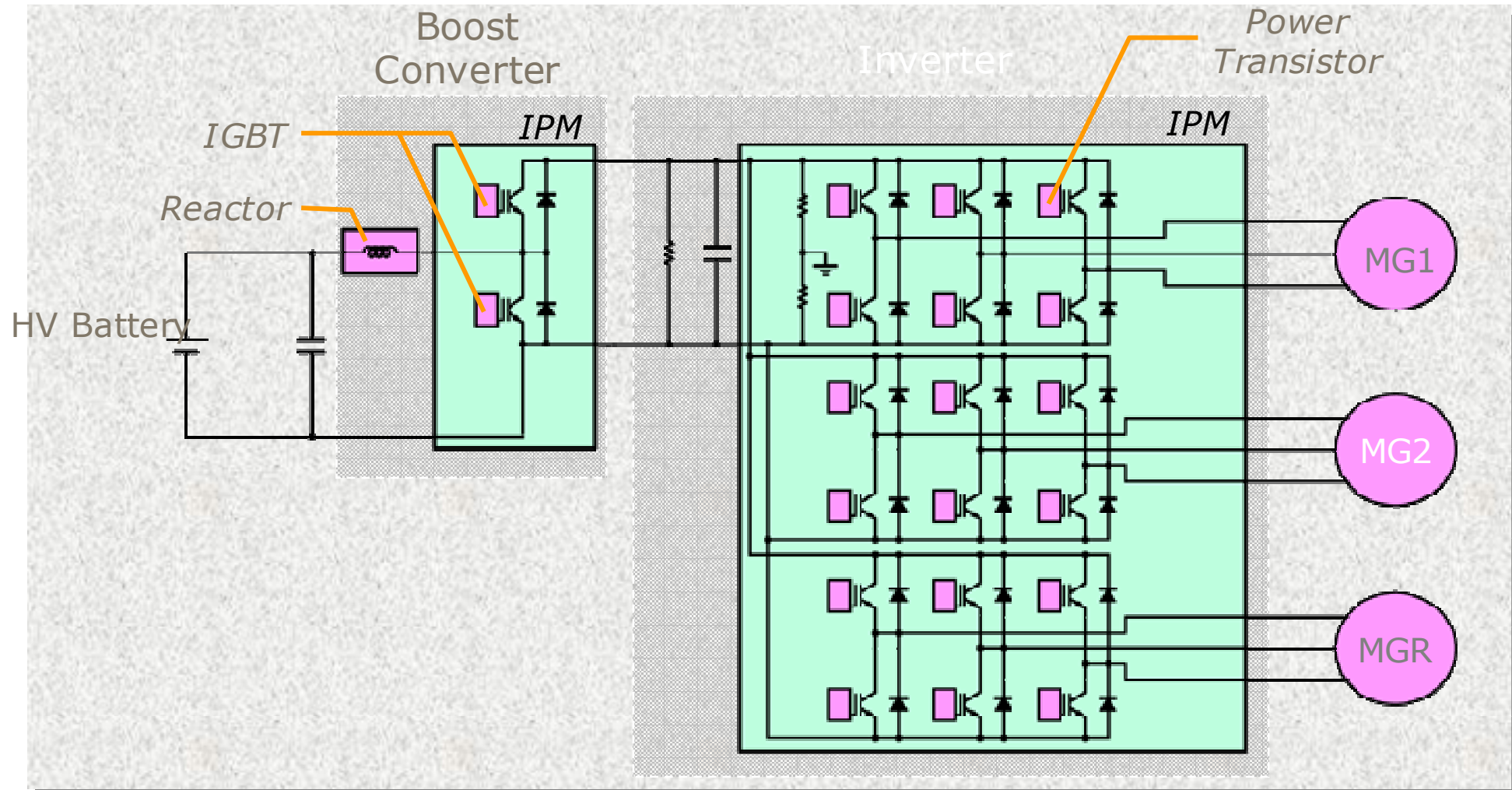
Inverter assembly

- Boost converter (Variable-voltage system)
 - converts DC 288V ↔ DC 650V



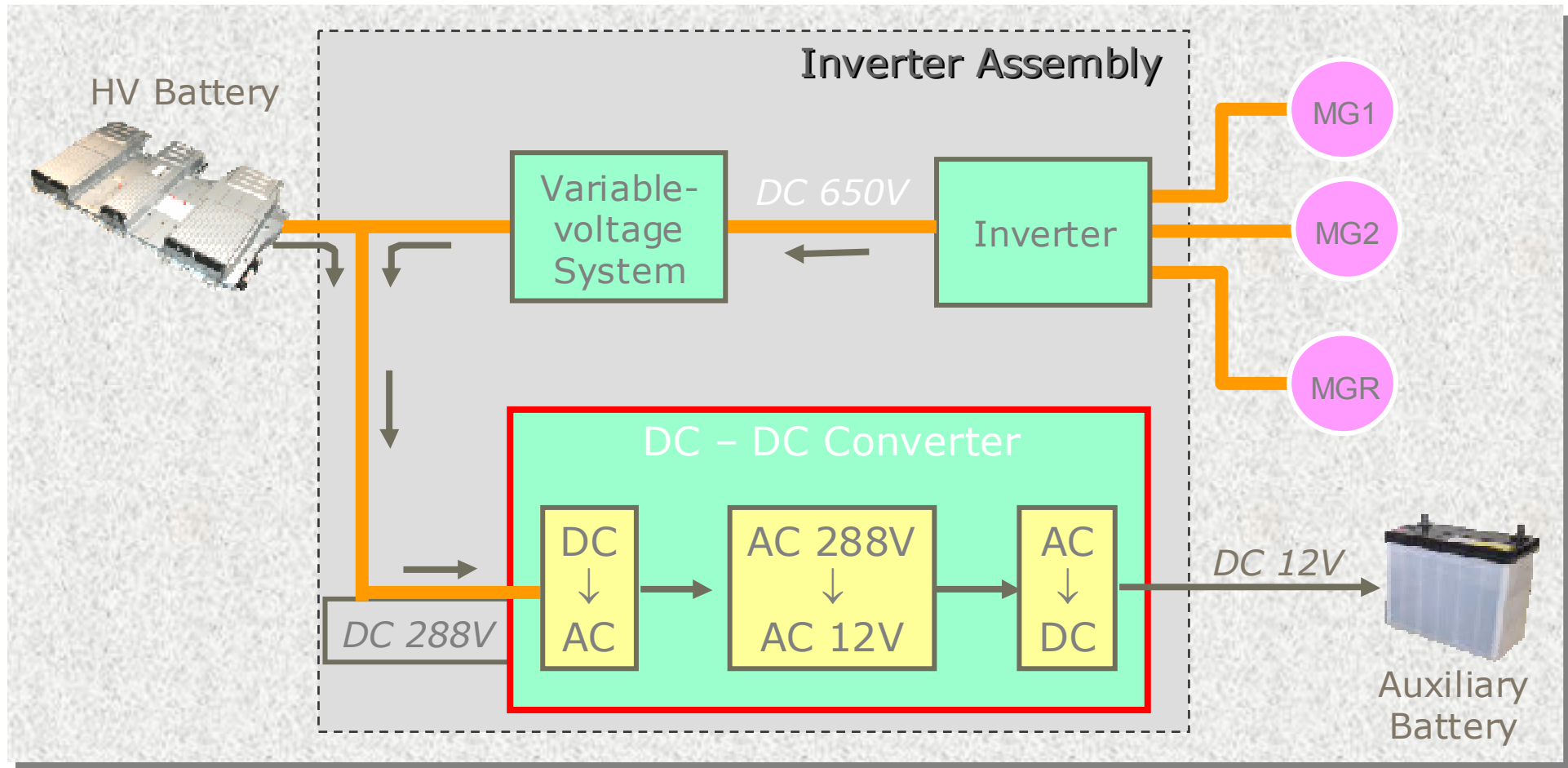
Inverter assembly

- Boost converter (Variable-voltage system)
 - System diagram



Inverter assembly

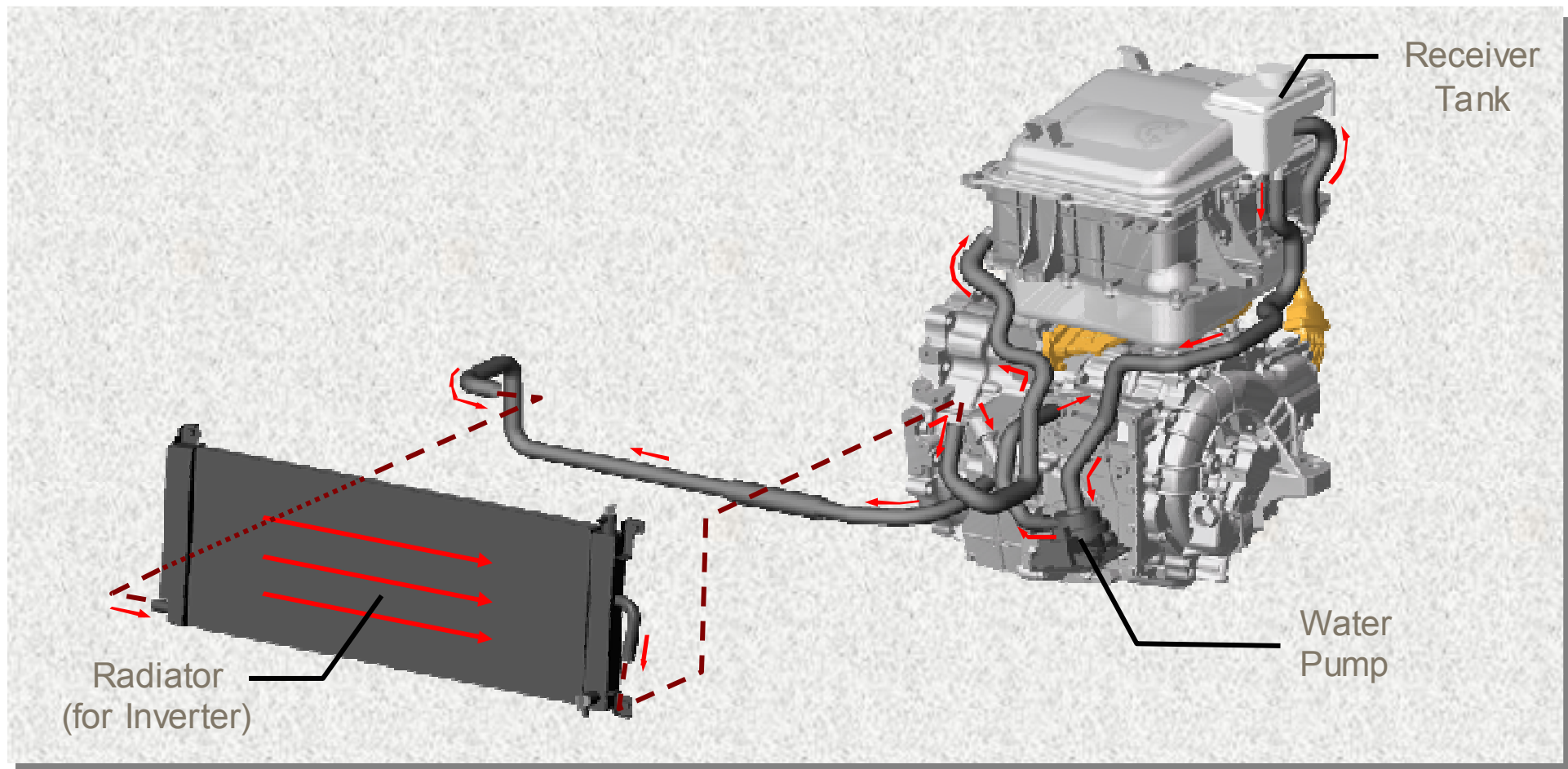
- DC – DC converter
 - Converts DC 288V → DC 12V



Inverter assembly



- Cooling
 - Separate cooling system from engine



HV battery



- General
 - Power supply



HV Battery



For MG1, MG2 and MGR etc.



Auxiliary Battery



*For headlight, audio, all ECUs, etc.
(when the READY OFF)*

HV battery

- General
 - Located under the rear seat



HV Battery Assembly

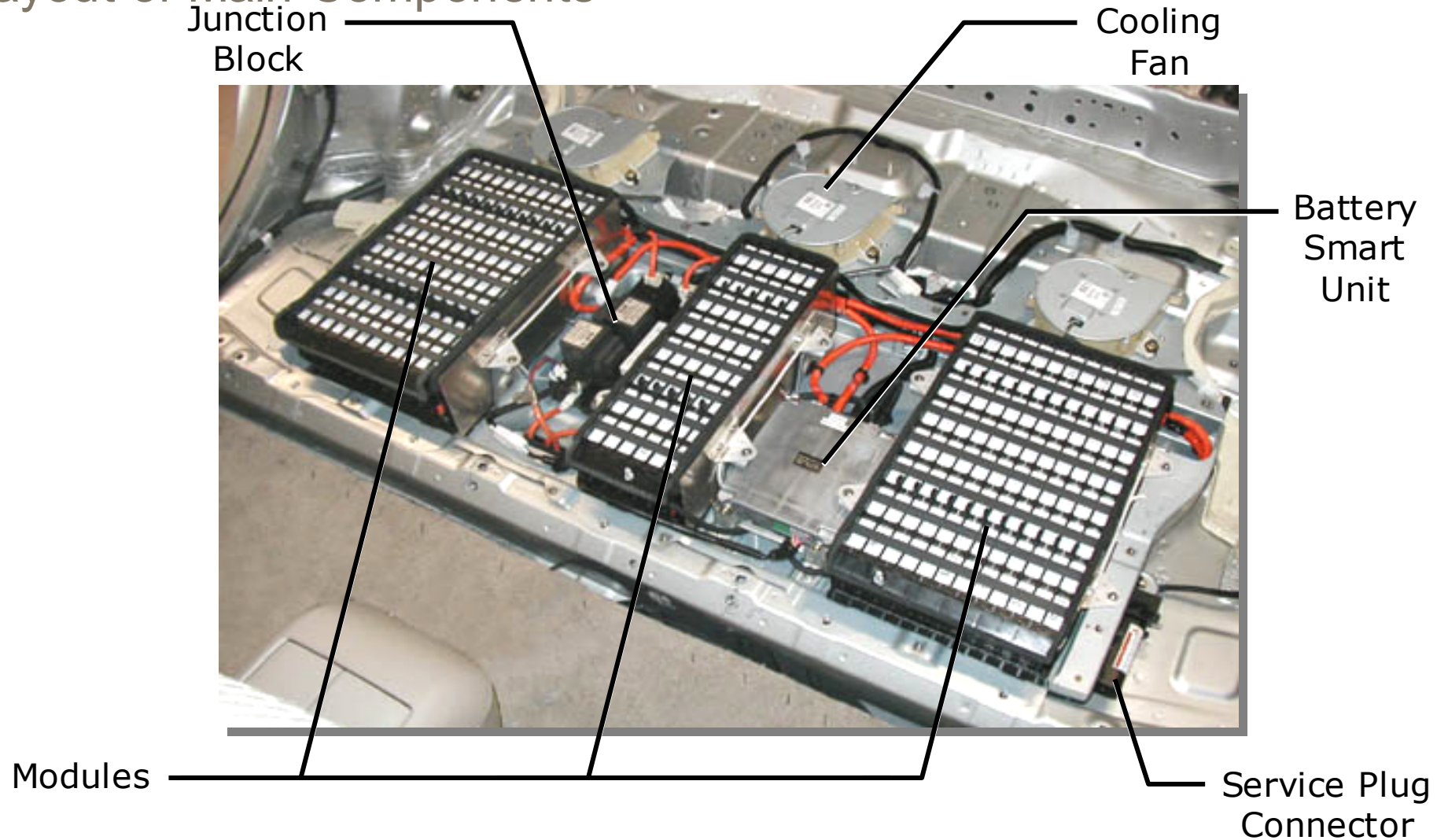
Rear Seat

Service Plug



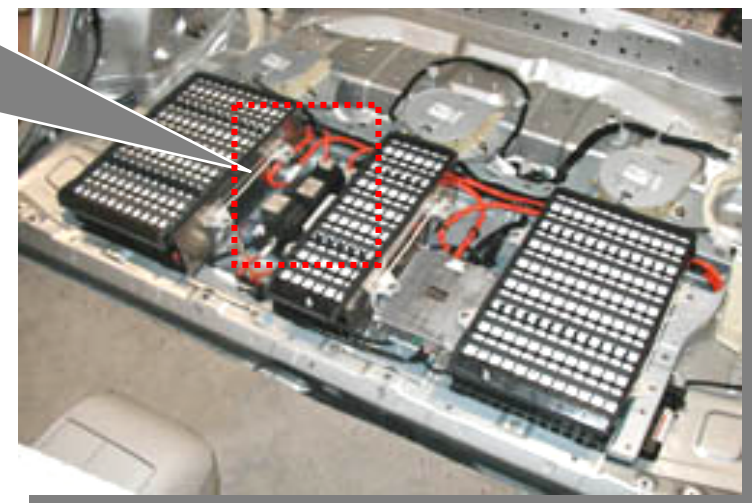
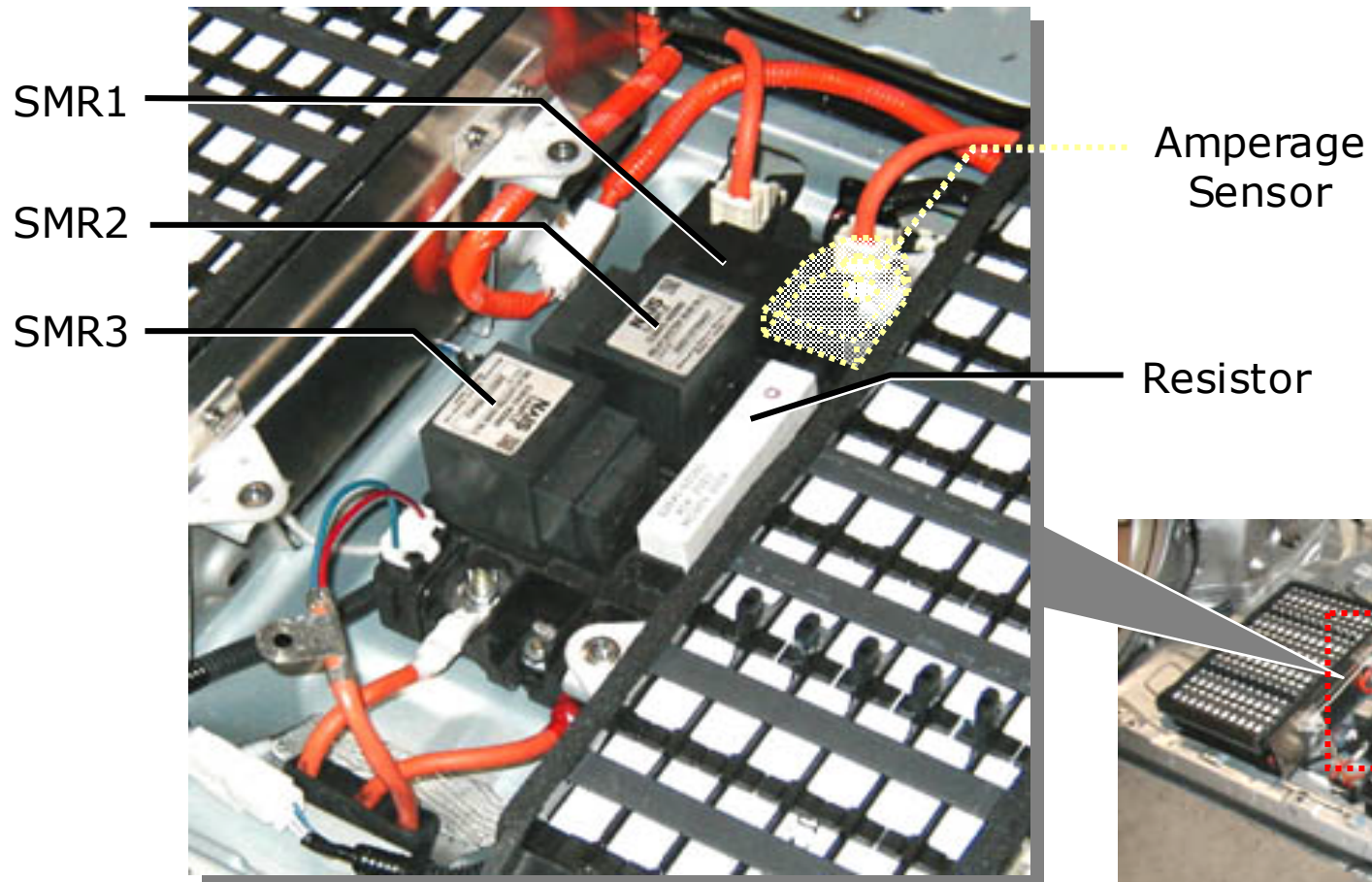
HV battery

- Layout of Main Components



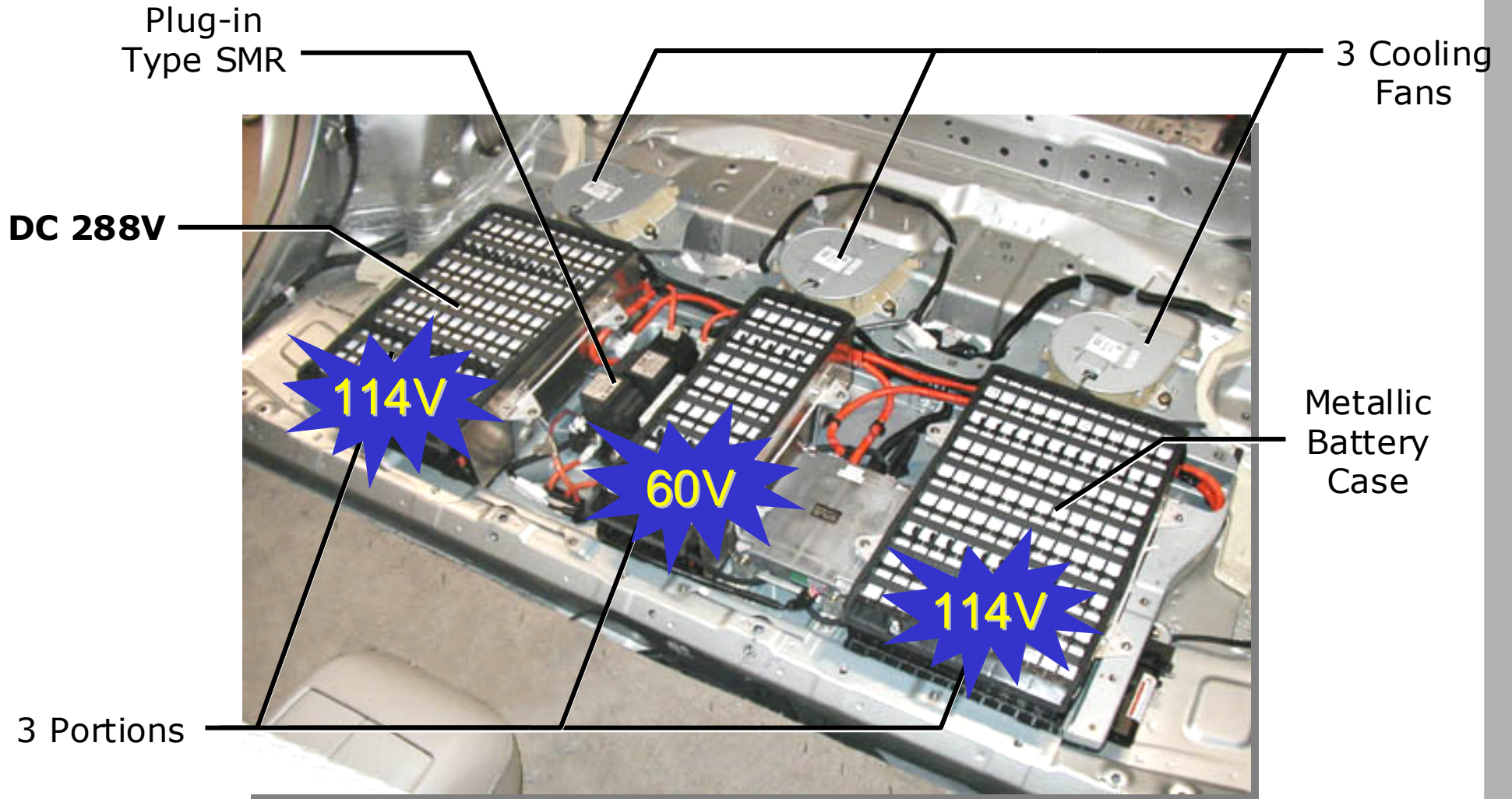
HV battery

- Layout of Main Components
 - Junction block



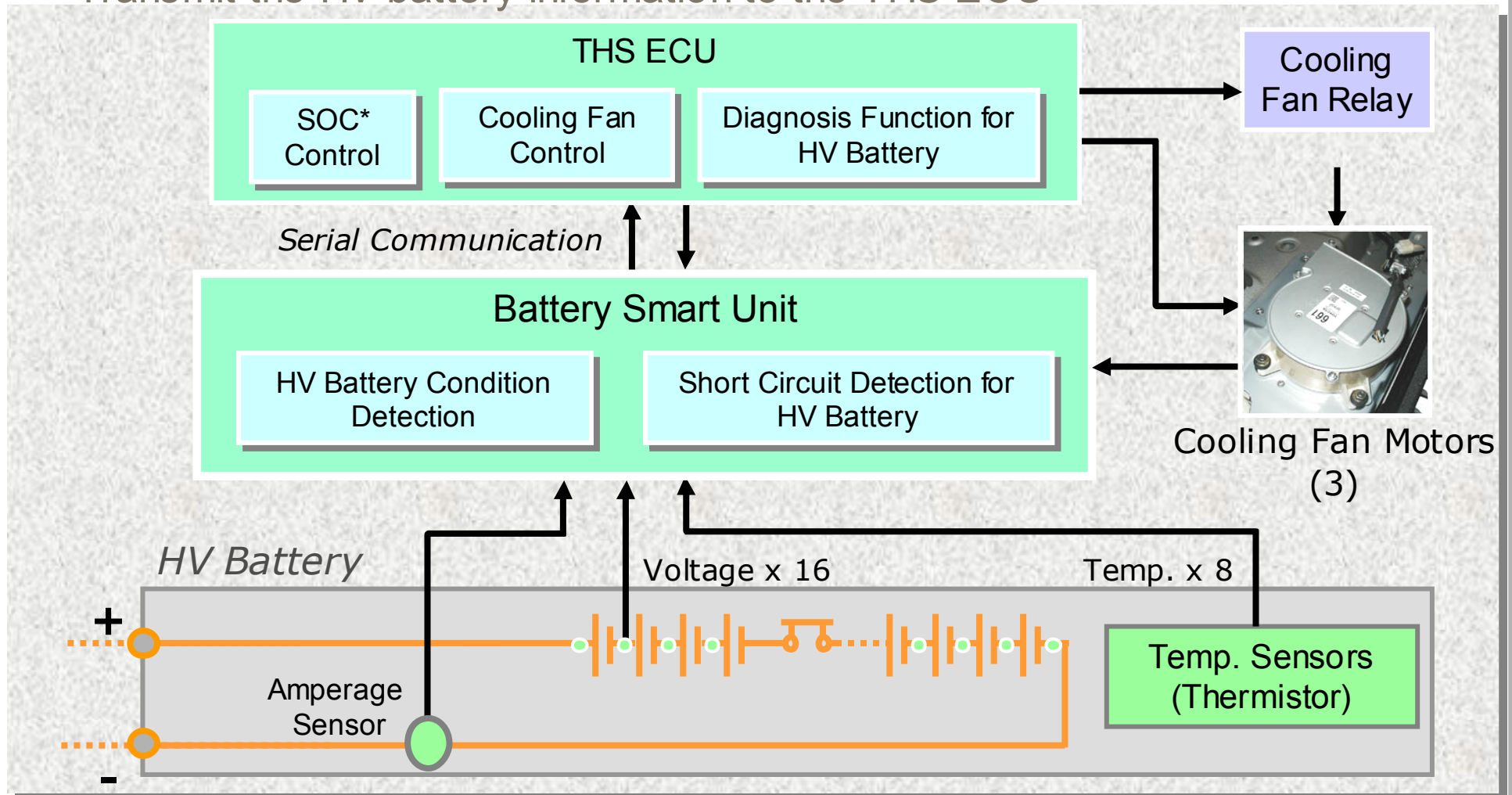
HV battery

- Features



HV battery

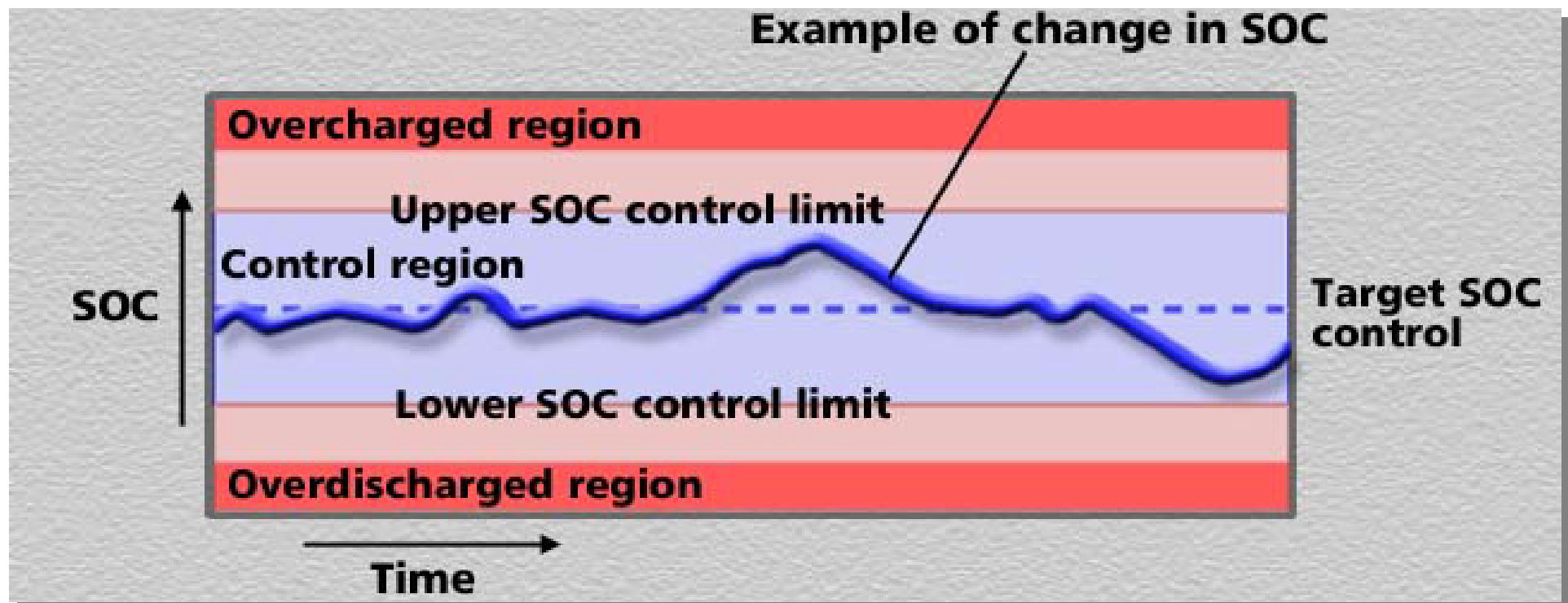
- Battery smart unit
 - Transmit the HV battery information to the THS ECU



*: State of Charge

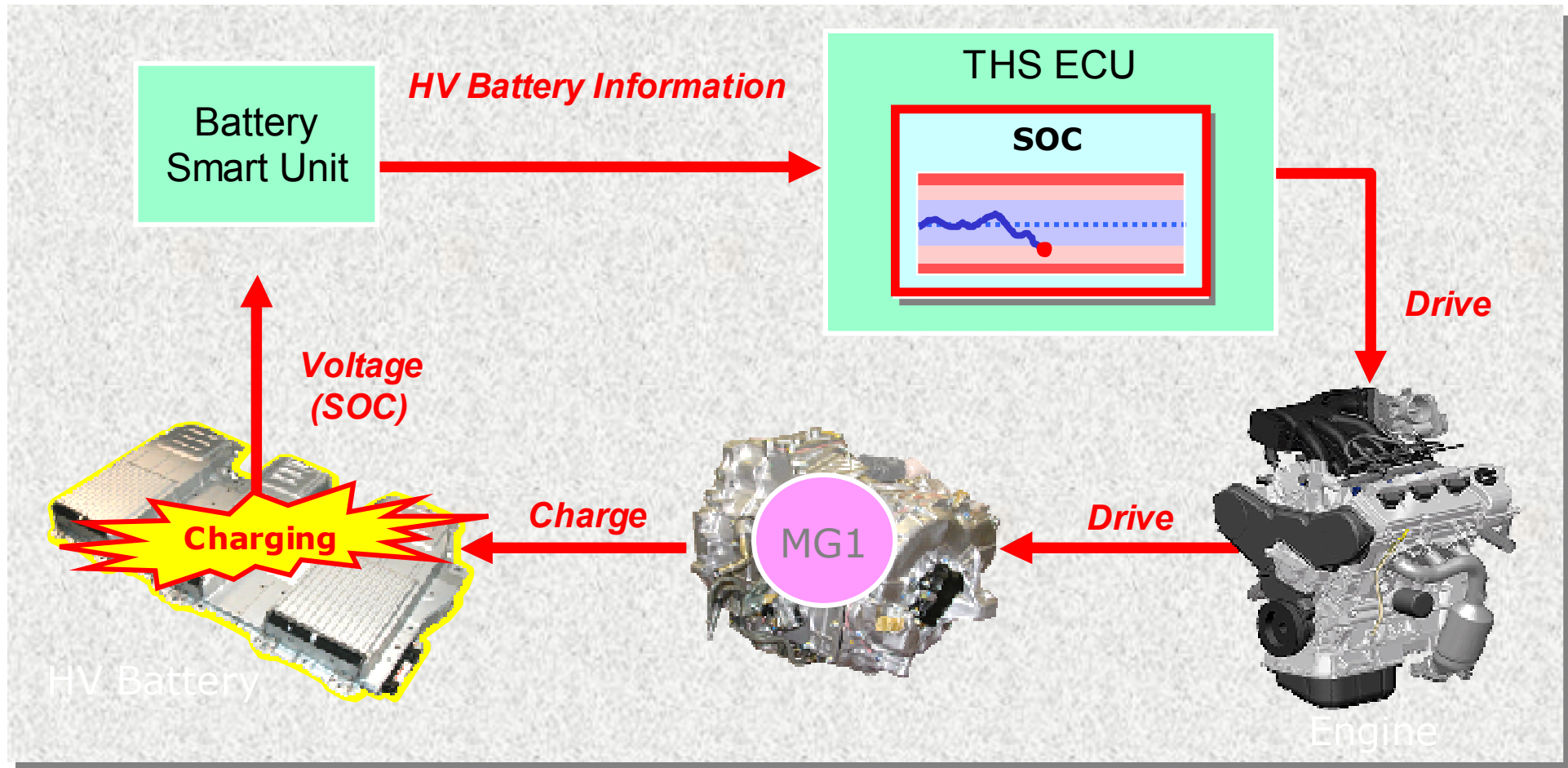
HV battery

- SOC control
 - The SOC is maintained at target SOC



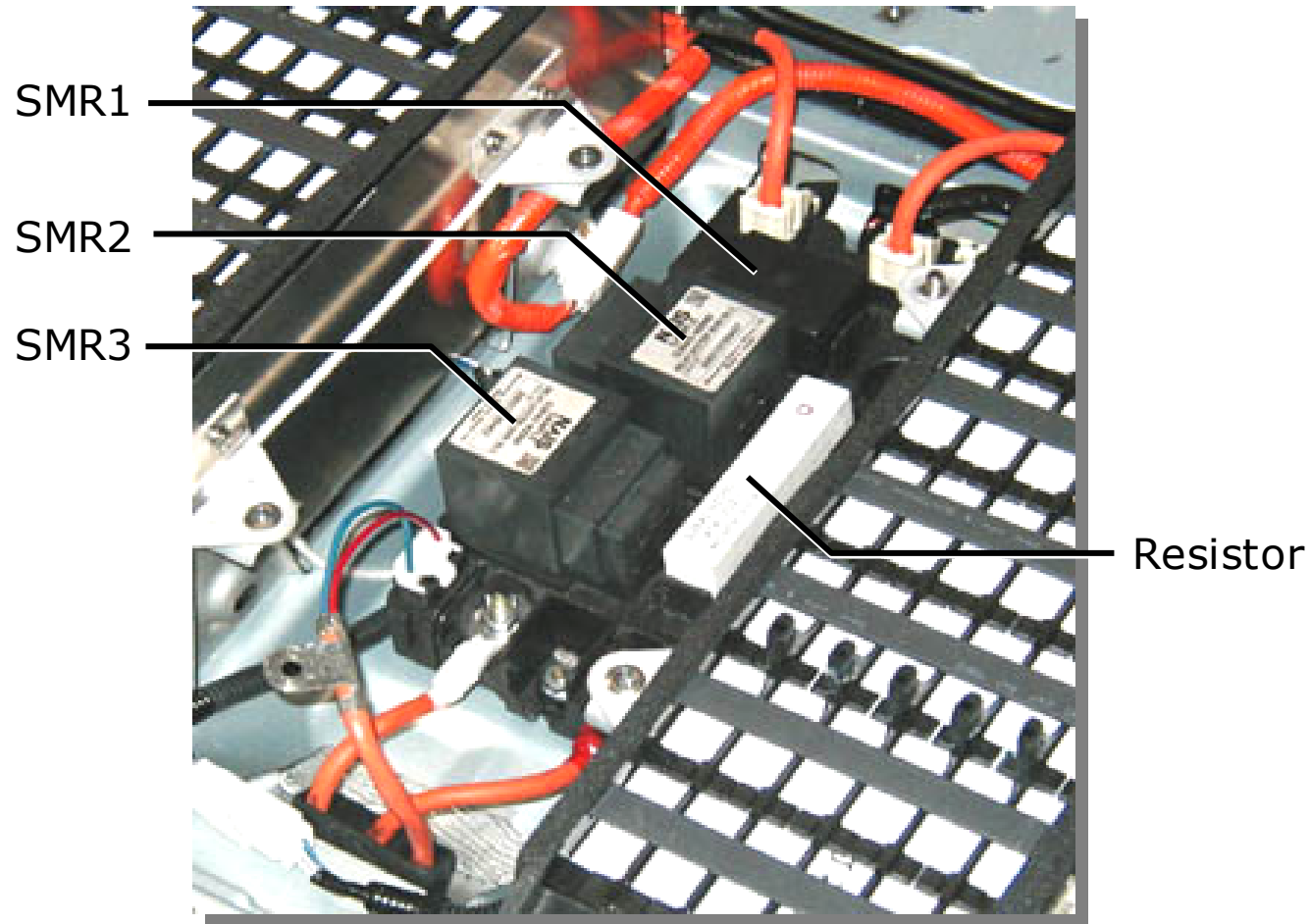
HV battery

- SOC control
 - THS ECU controls the SOC



HV battery

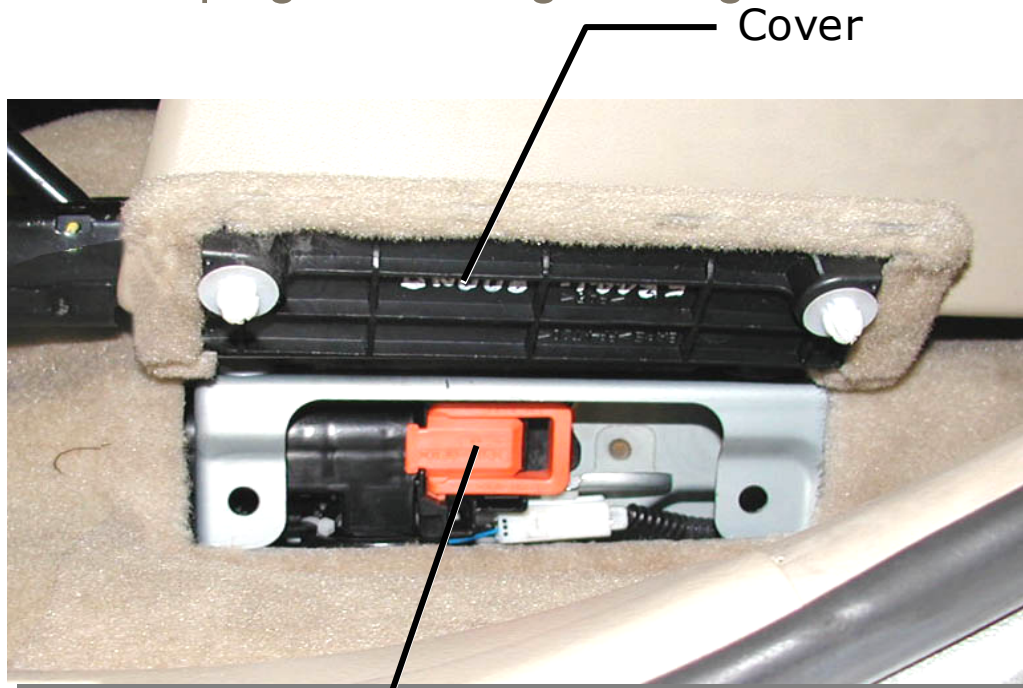
- SMR (System Main Relay)
 - Turns ON / OFF high voltage circuit



HV battery



- Service plug
 - Service plug cut the high voltage circuit



Service Plug

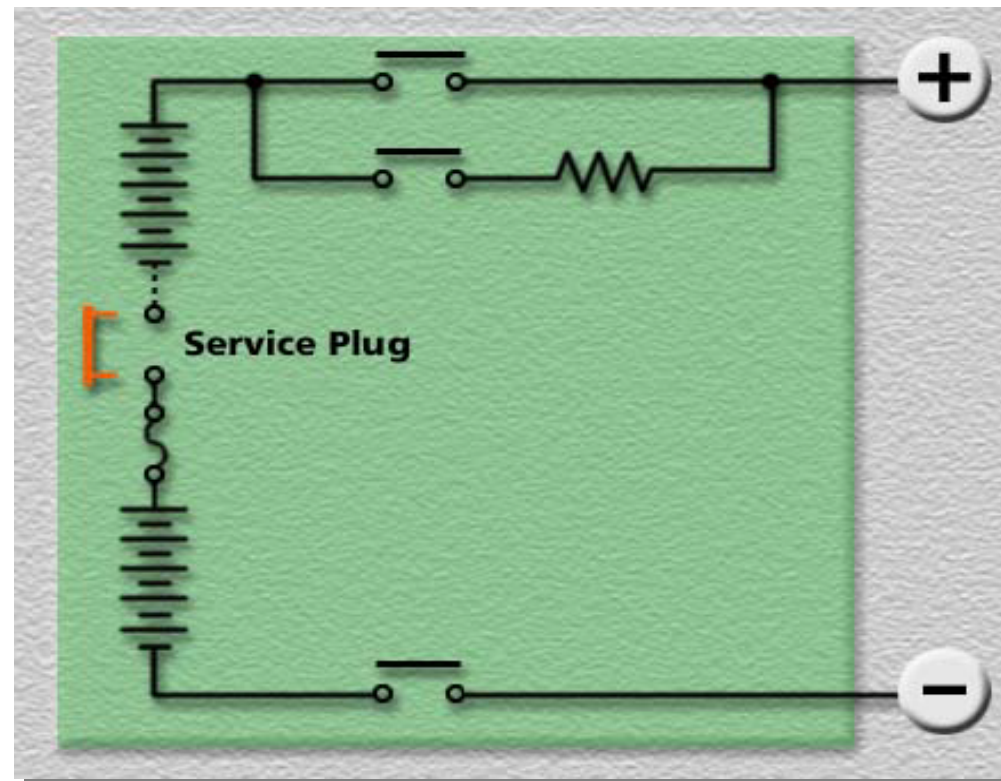
Cover



Rear Seat

HV battery

- Service plug
 - Power is shut off at HV battery midpoint

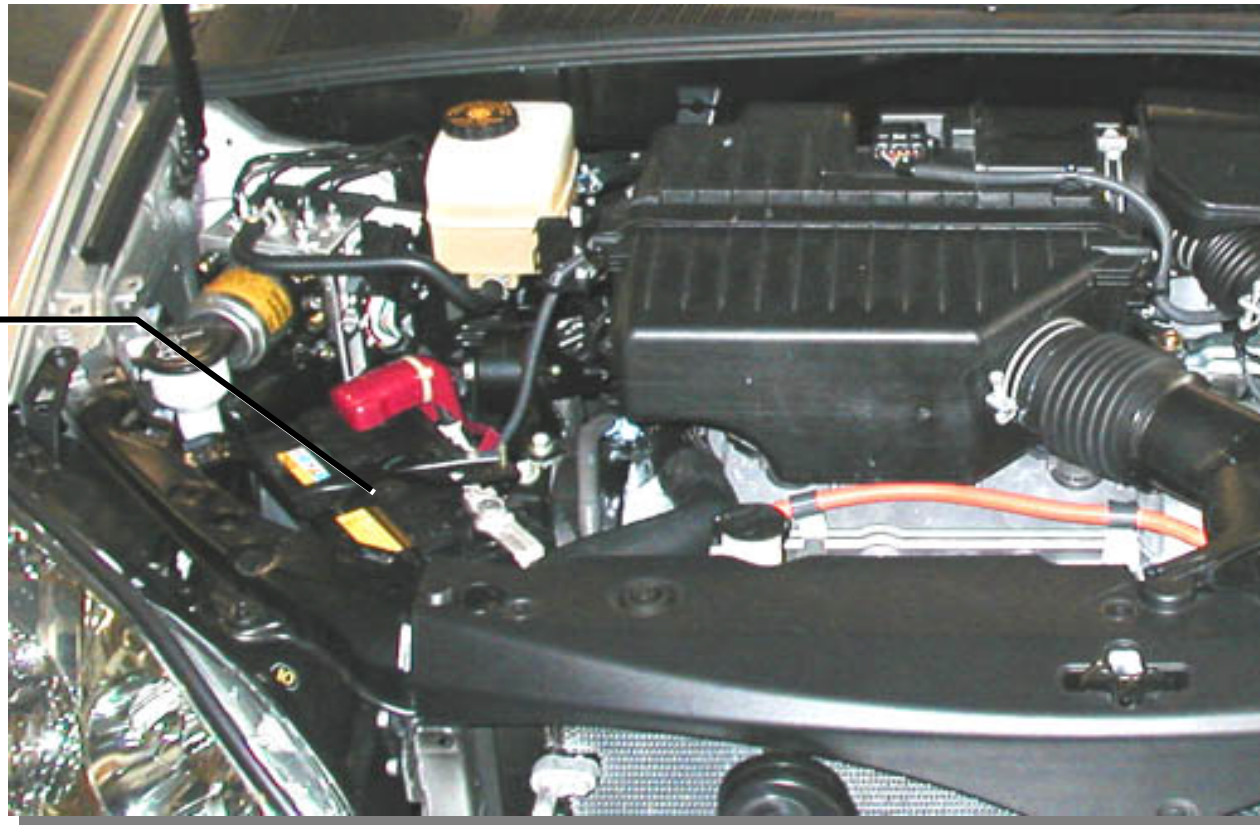


Auxiliary battery



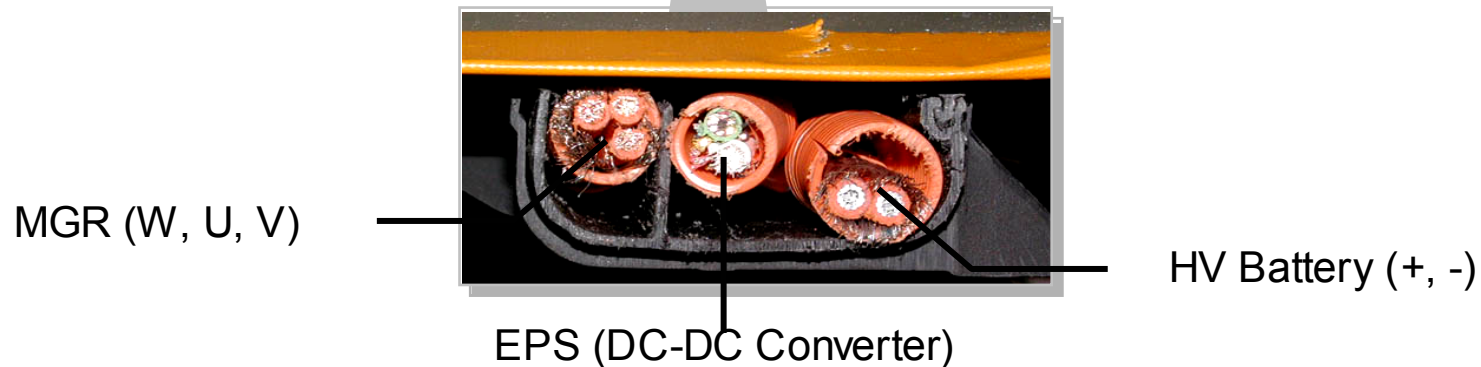
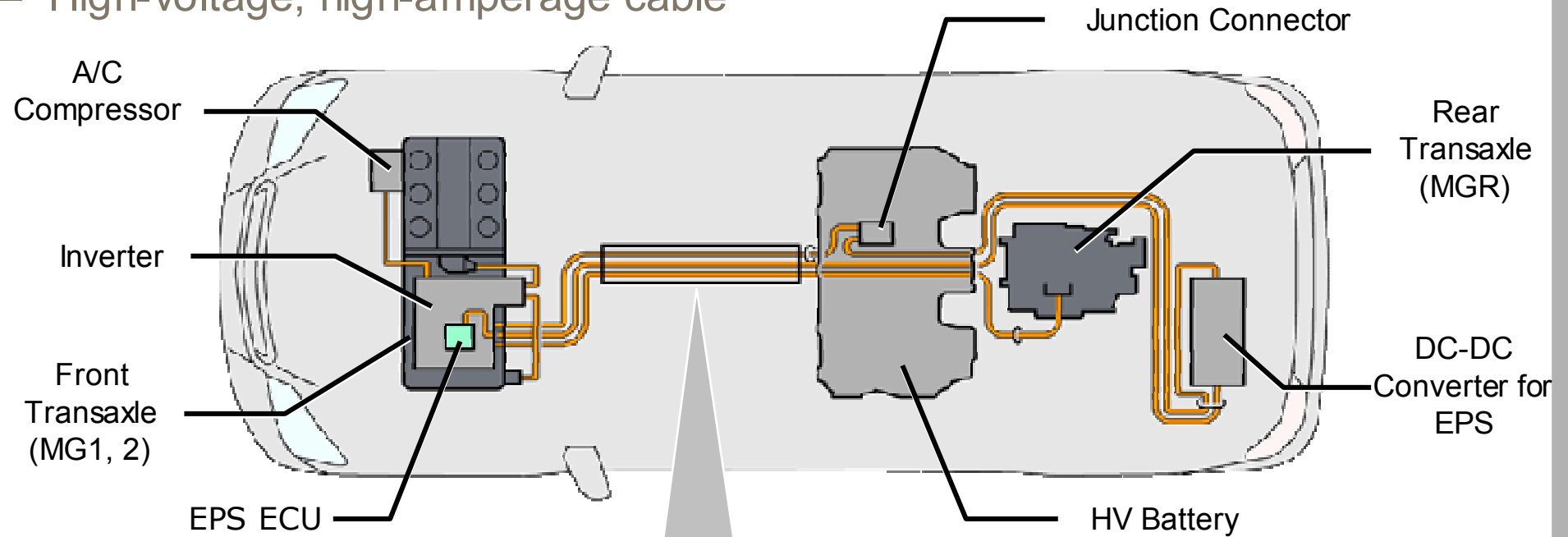
- Auxiliary battery
 - Supplies 12V power

Auxiliary
Battery



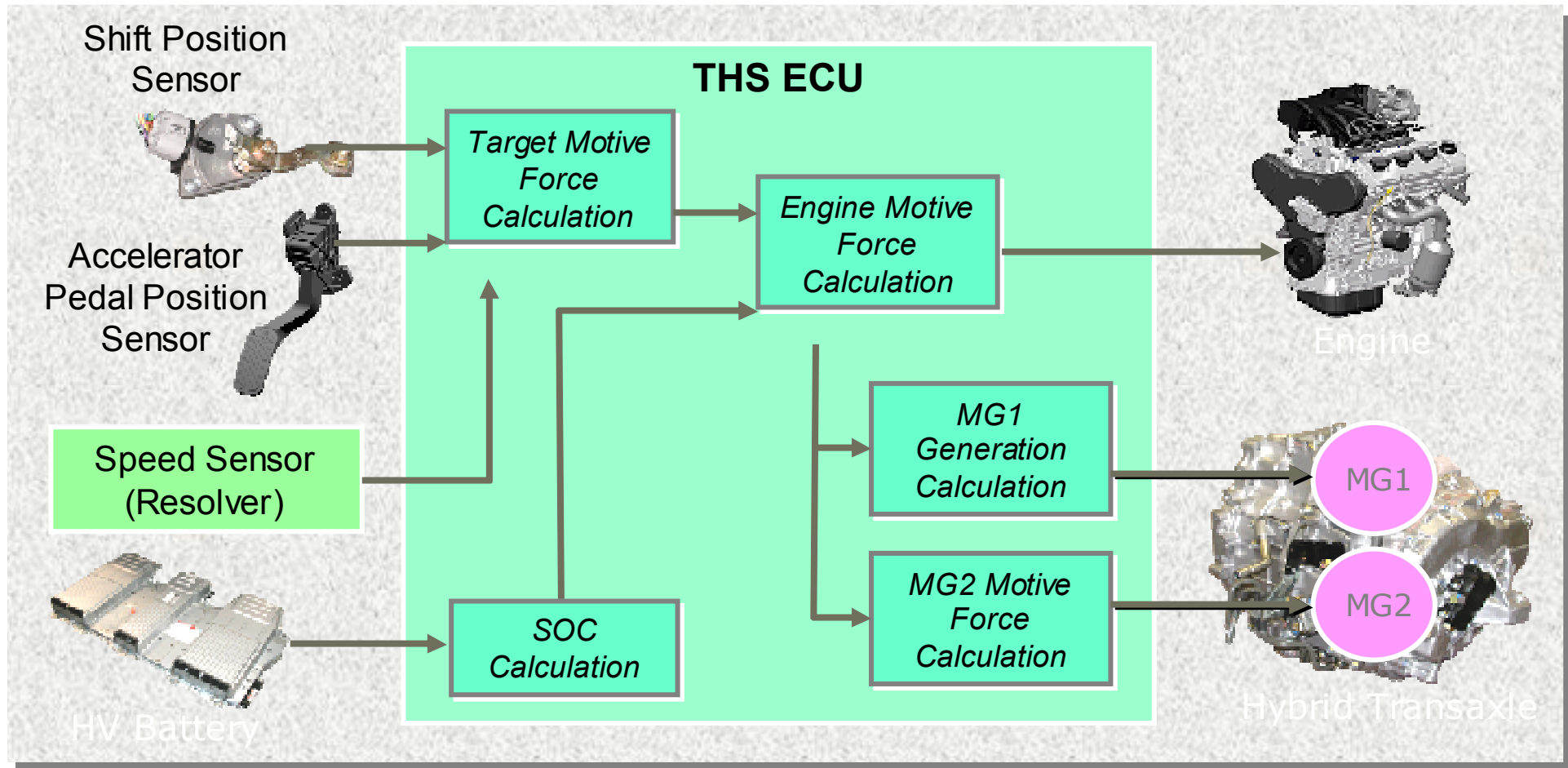
Power cable

- Power cable
 - High-voltage, high-amperage cable



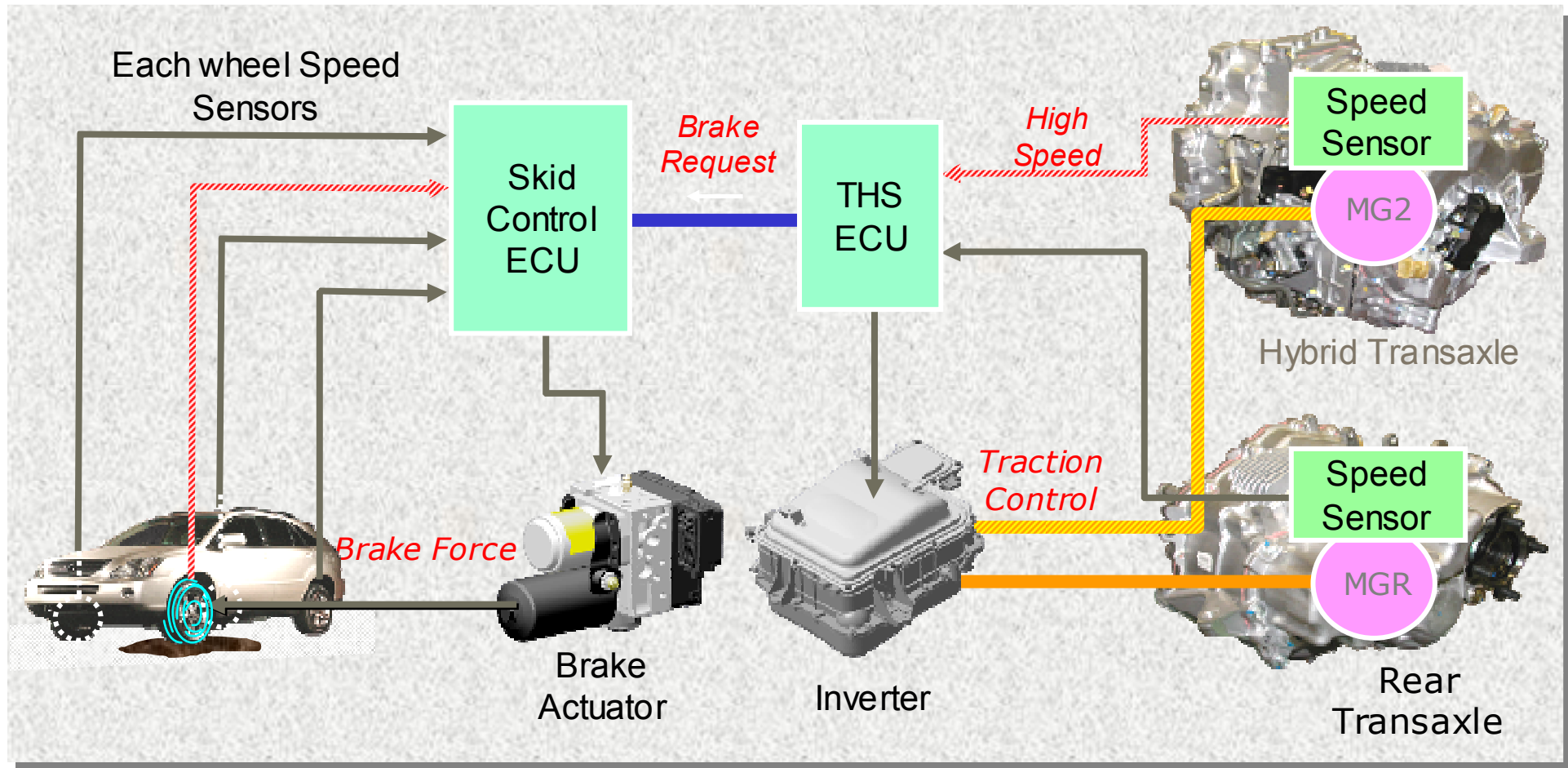
THS-II control system

- Motive force calculation
 - Target motive force - Engine motive force = MG2 motive force



THS-II control system

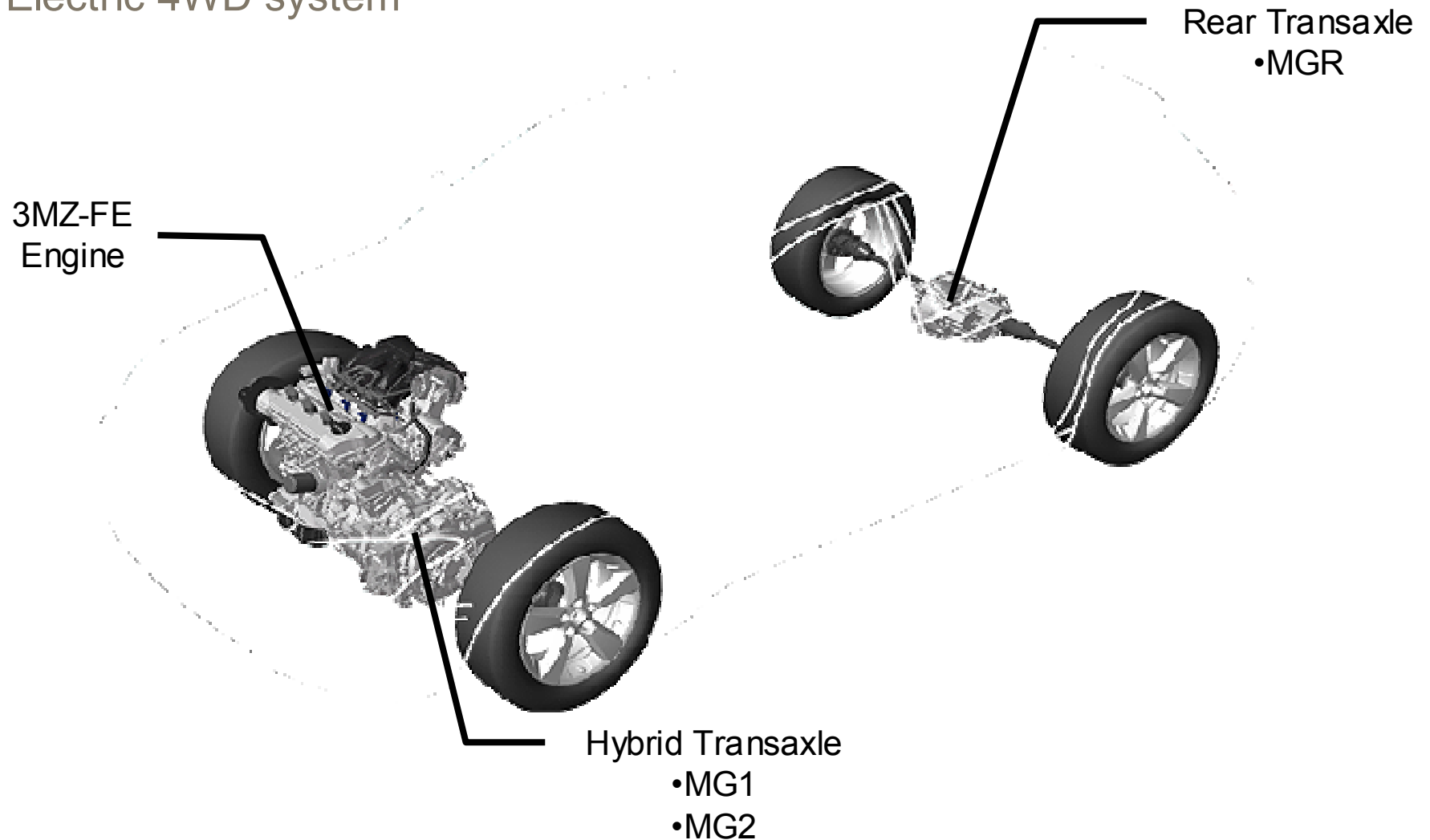
- Motor traction control



THS-II control system

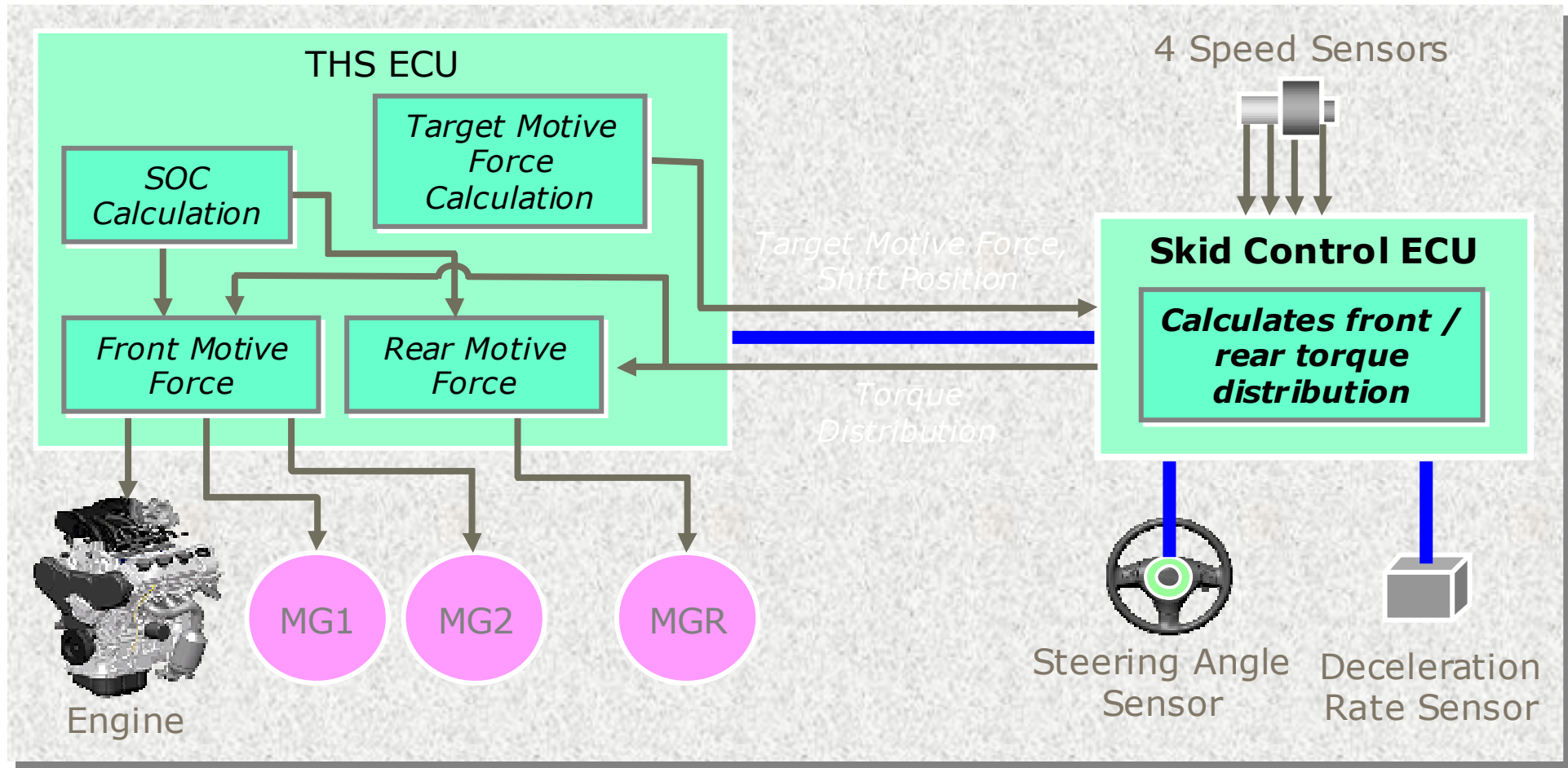


- 4WD system
 - Electric 4WD system



THS-II Control System

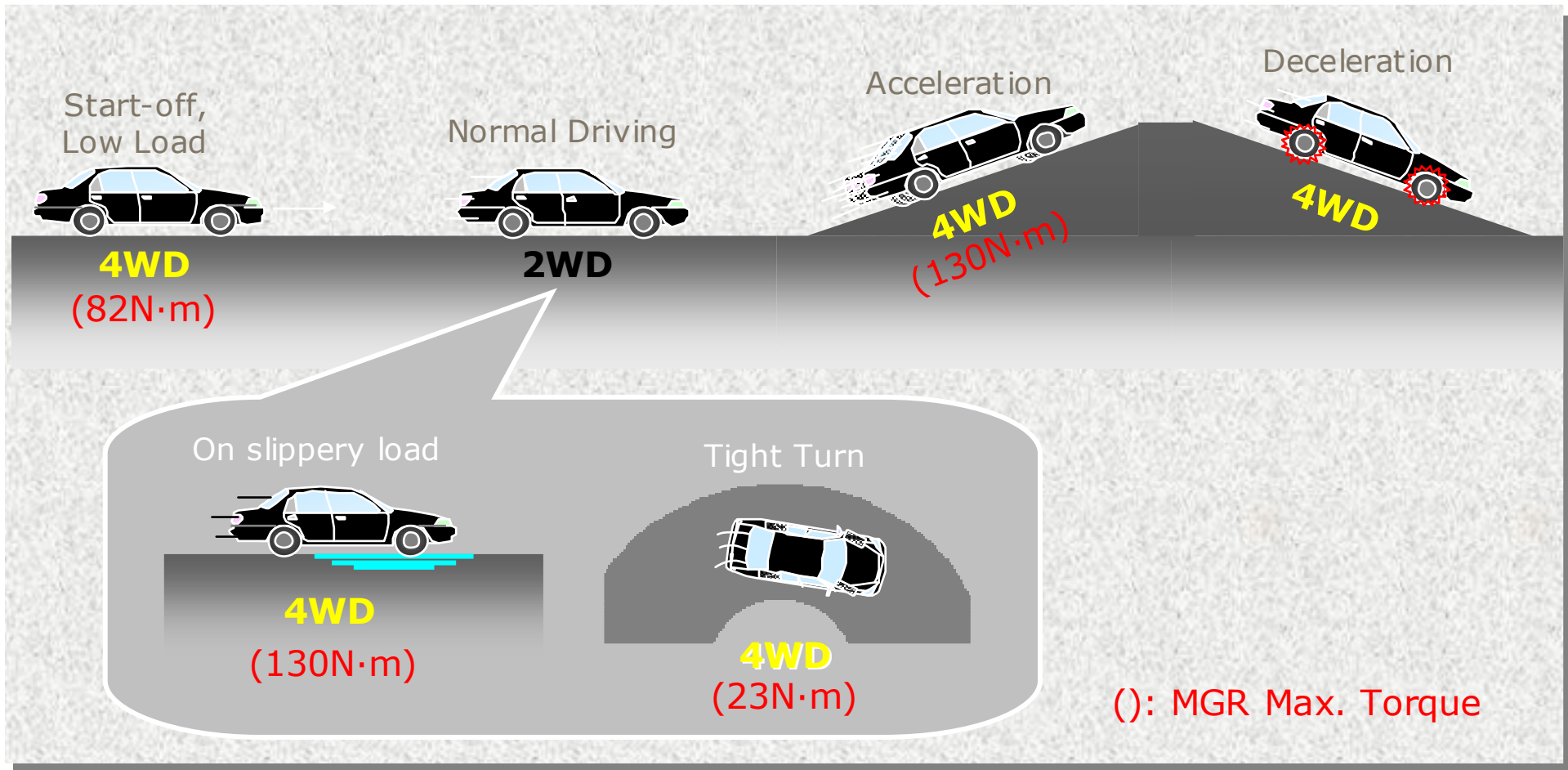
- 4WD system
 - Skid control ECU calculates the front / rear wheel torque distribution



THS-II control system



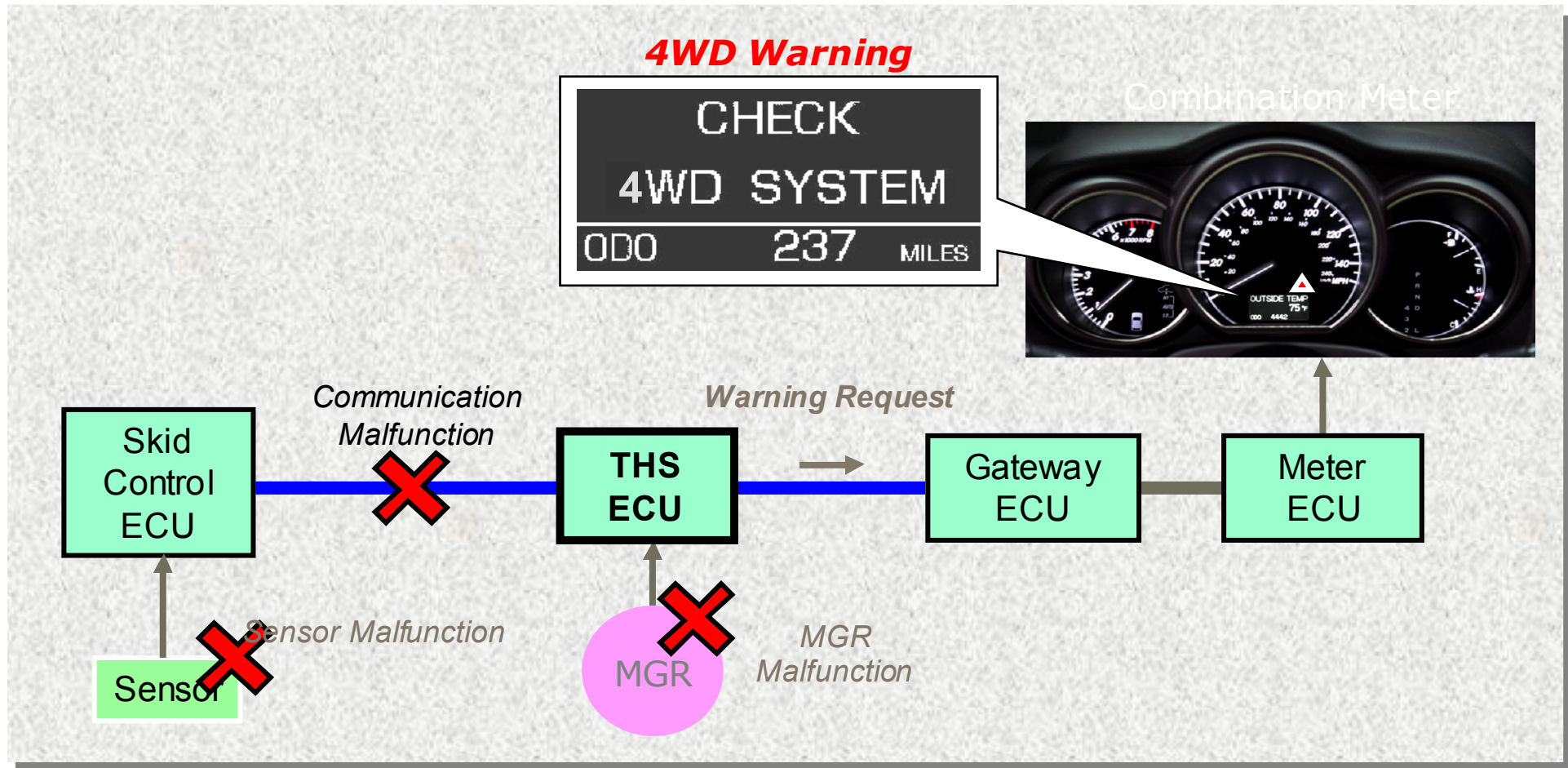
- 4WD system
 - 2WD / 4WD Operation



THS-II control system



- 4WD system
 - 4WD warning on multi information display



Chassis

Hybrid Transaxle
Rear Transaxle
Steering
Brake Control system

Chassis

P310 Hybrid Transaxle



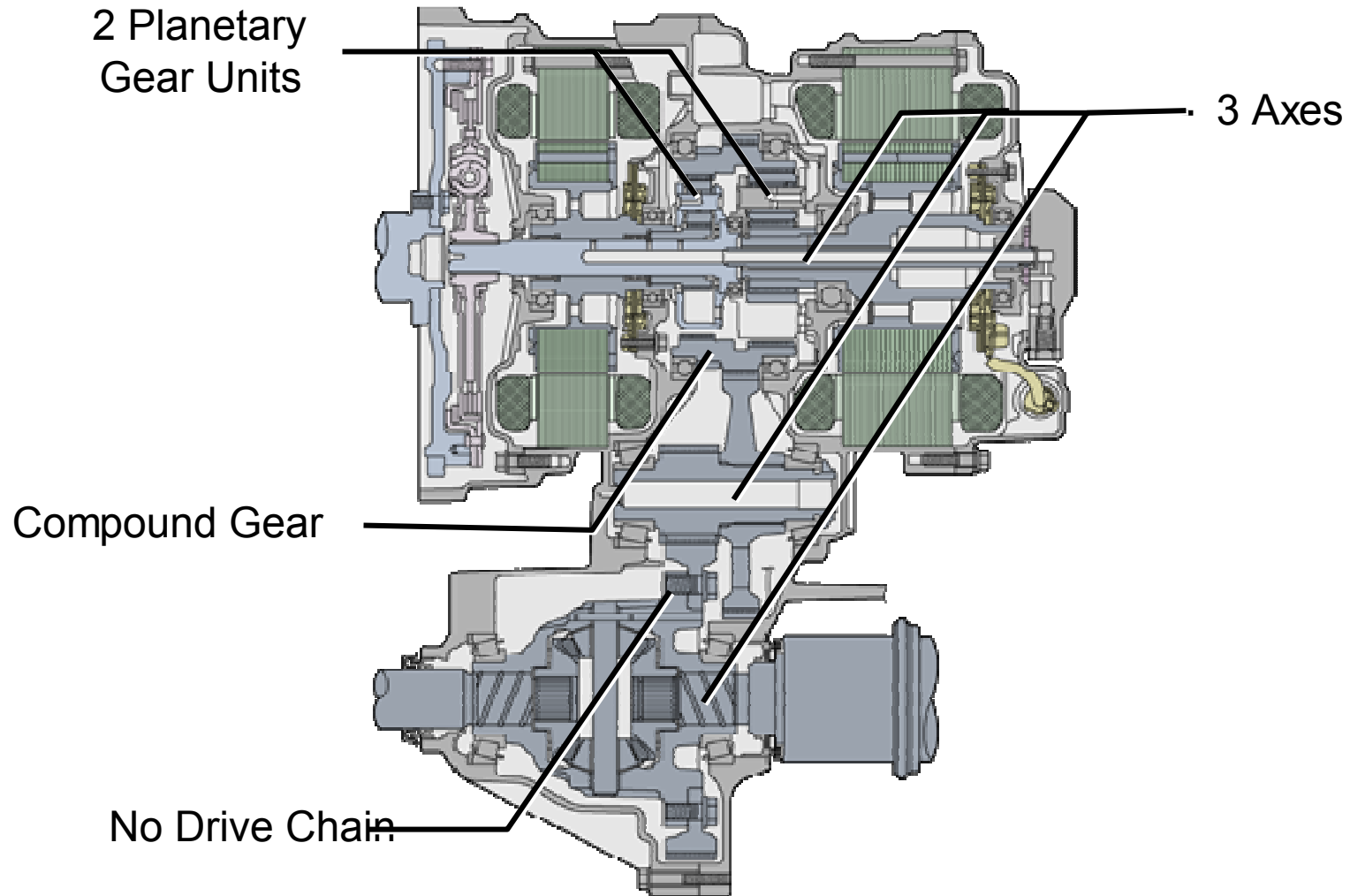
- General
 - A new “P310” hybrid transaxle



P310 Hybrid Transaxle



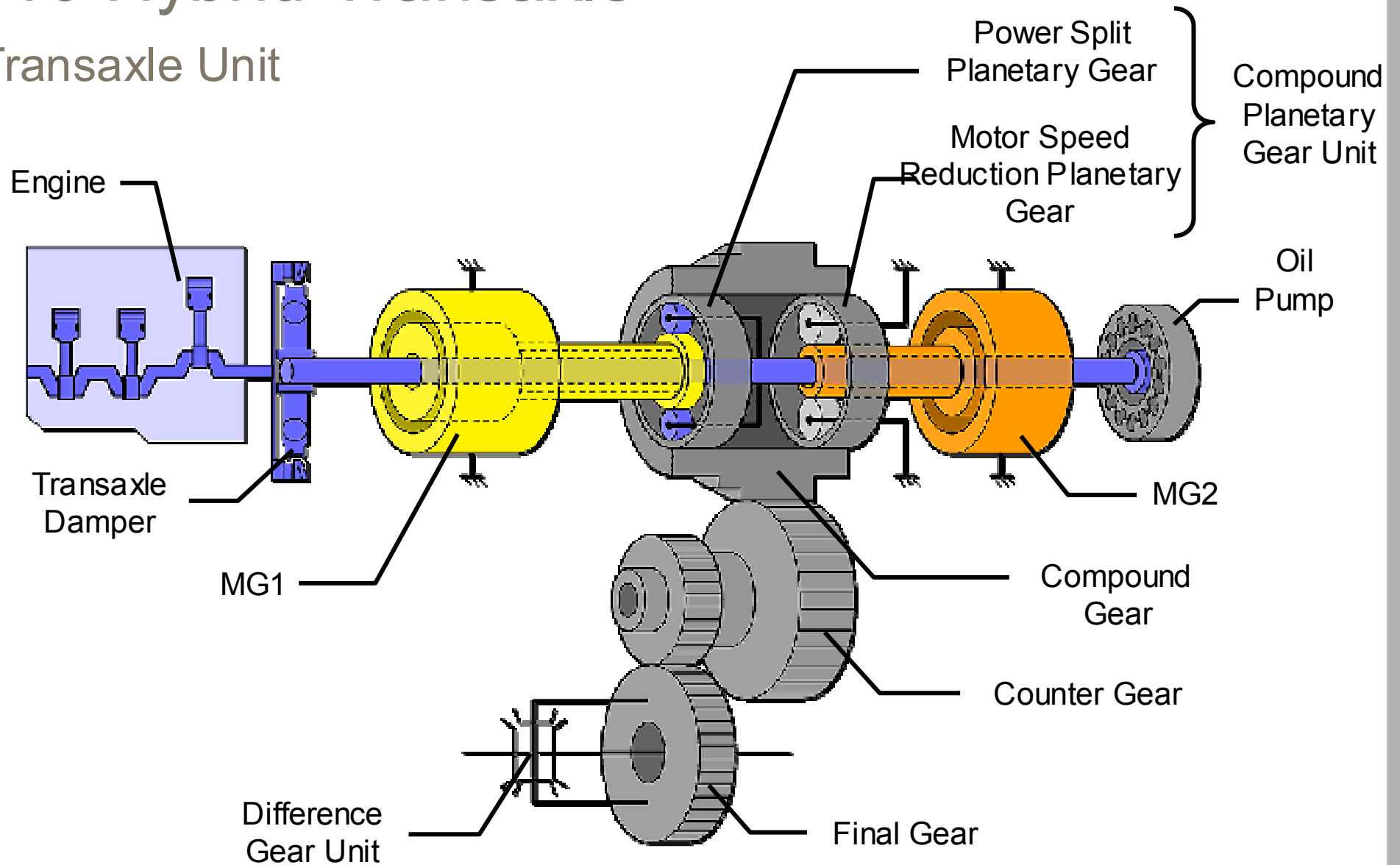
- Features



P310 Hybrid Transaxle



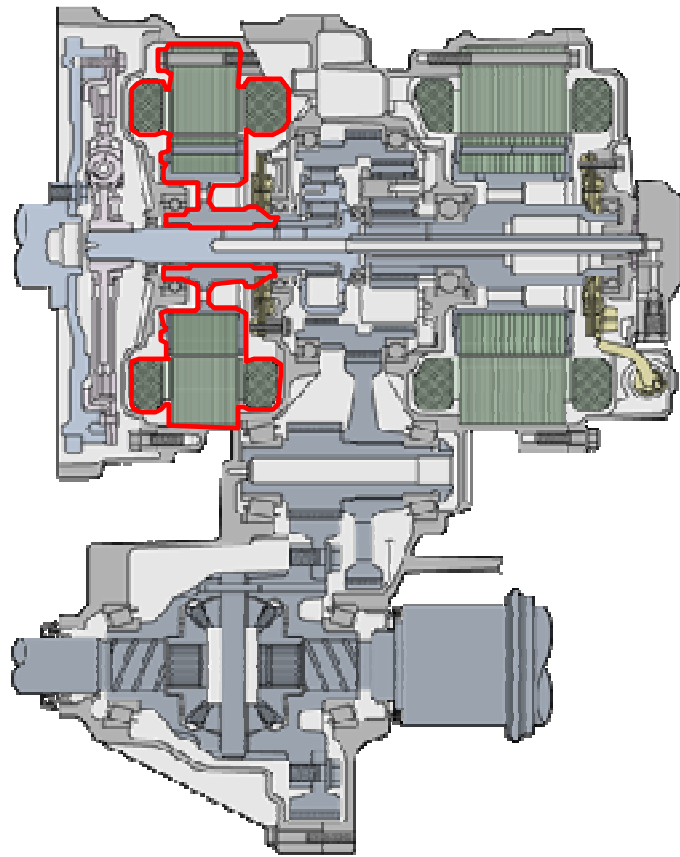
- Transaxle Unit



P310 Hybrid Transaxle



- MG1
 - Operates as generator and starter motor

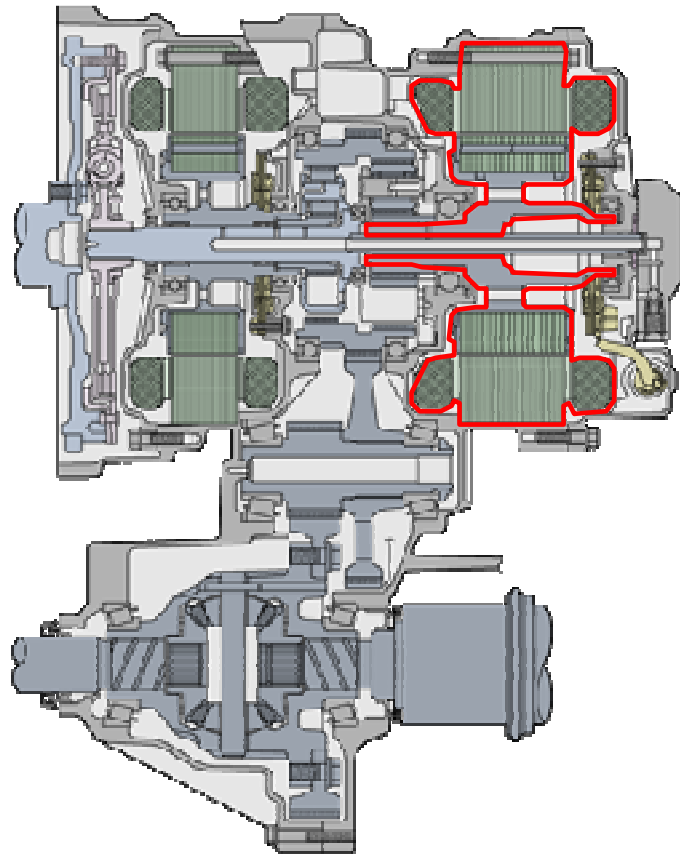


Item	MG1
Type	Permanent Magnet Motor
Function	Generator, Engine Starter
System Voltage V	Max. AC 650
Max. Output kW / rpm	109 / 13,000
Max. Torque N·m / rpm	80 / 0 ~ 13,000
Max. rpm	13,000
Cooling System	Water-cooled

P310 Hybrid Transaxle



- MG2
 - Drives front wheels
 - Operates as generator when braking



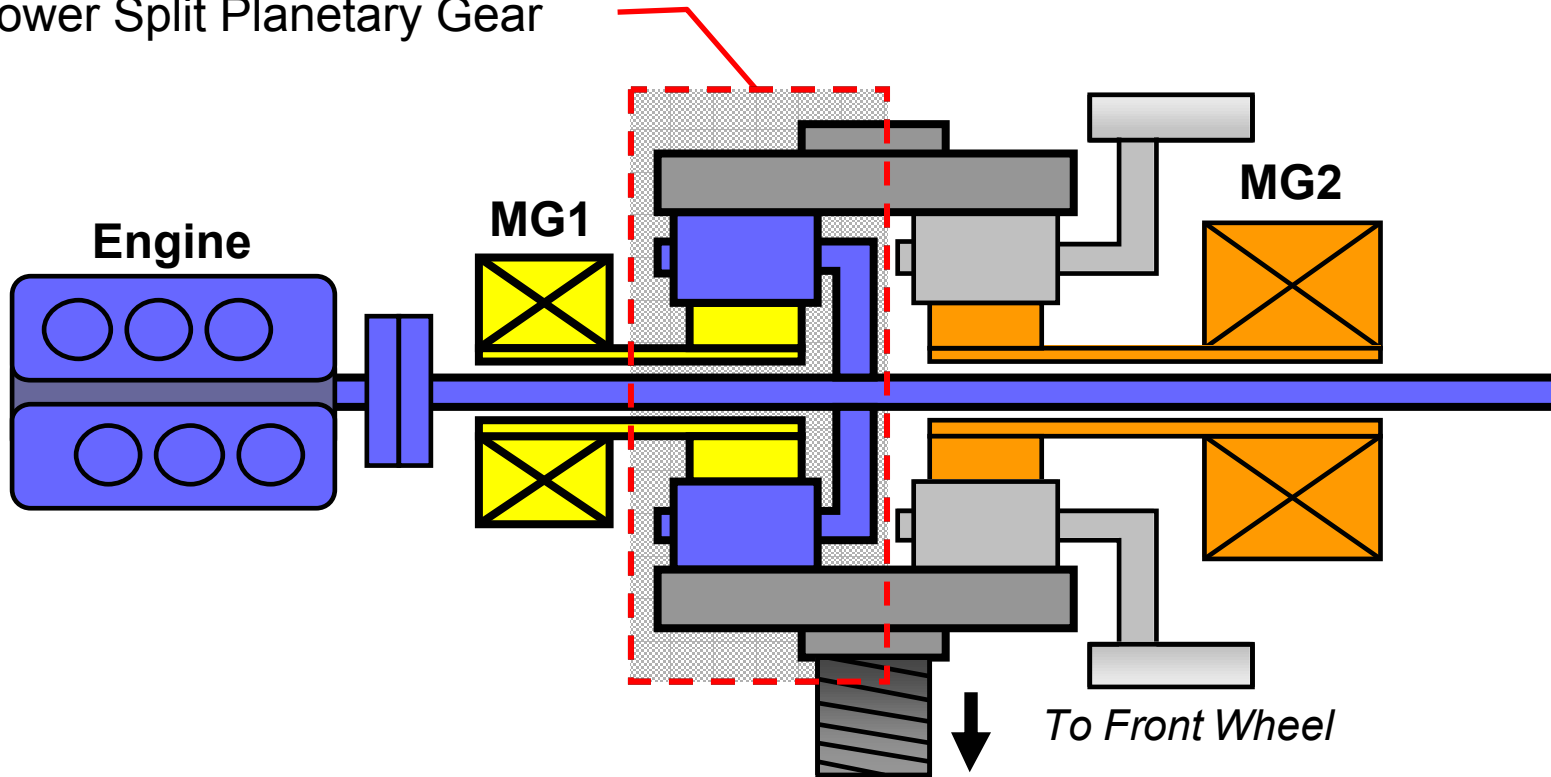
Item	MG2
Type	Permanent Magnet Motor
Function	Drive Front Wheels, Generator
System Voltage	Max. AC 650
Max. Output	123 / 4,500
Max. Torque	335 / 0 ~ 1,500
Max. rpm	12,400
Cooling System	Water-cooled

P310 Hybrid Transaxle



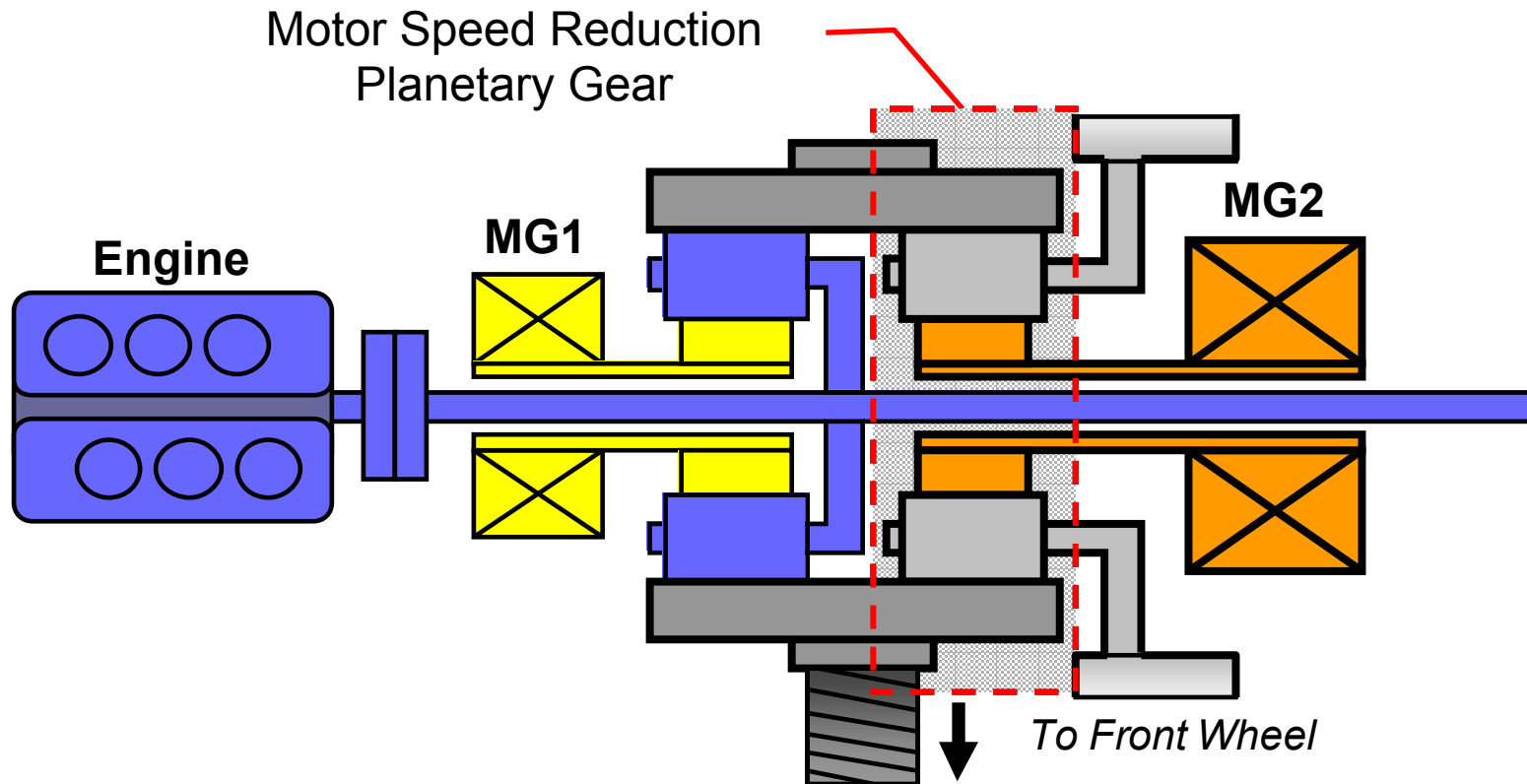
- Power split planetary gear
 - Sun gear = MG1
 - Planetary carrier = Engine
 - Ring gear = Wheel

Power Split Planetary Gear



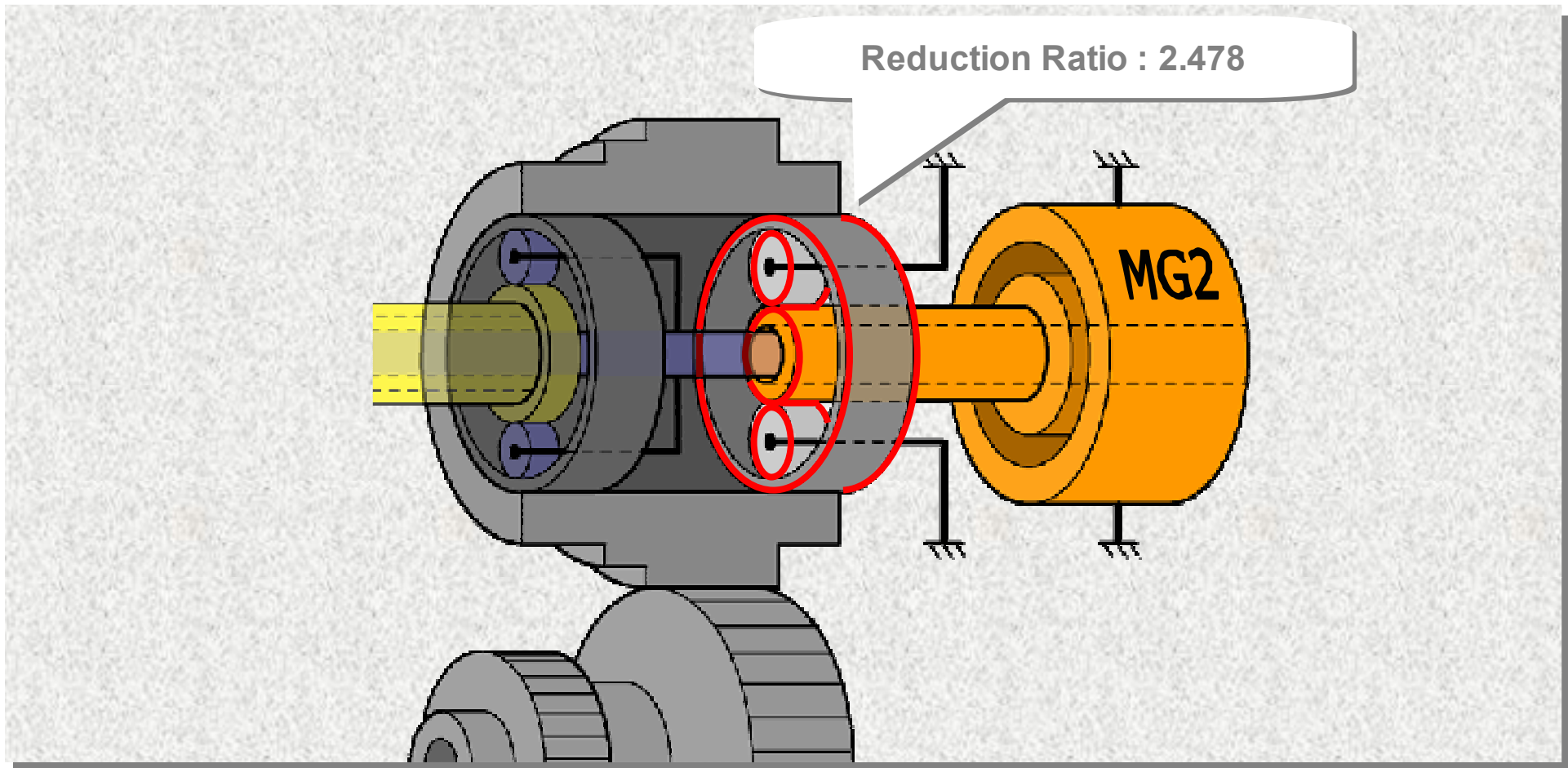
P310 Hybrid Transaxle

- Motor speed reduction planetary gear
 - Sun gear = MG2
 - Planetary carrier = Fixed
 - Ring gear = Wheel



P310 Hybrid Transaxle

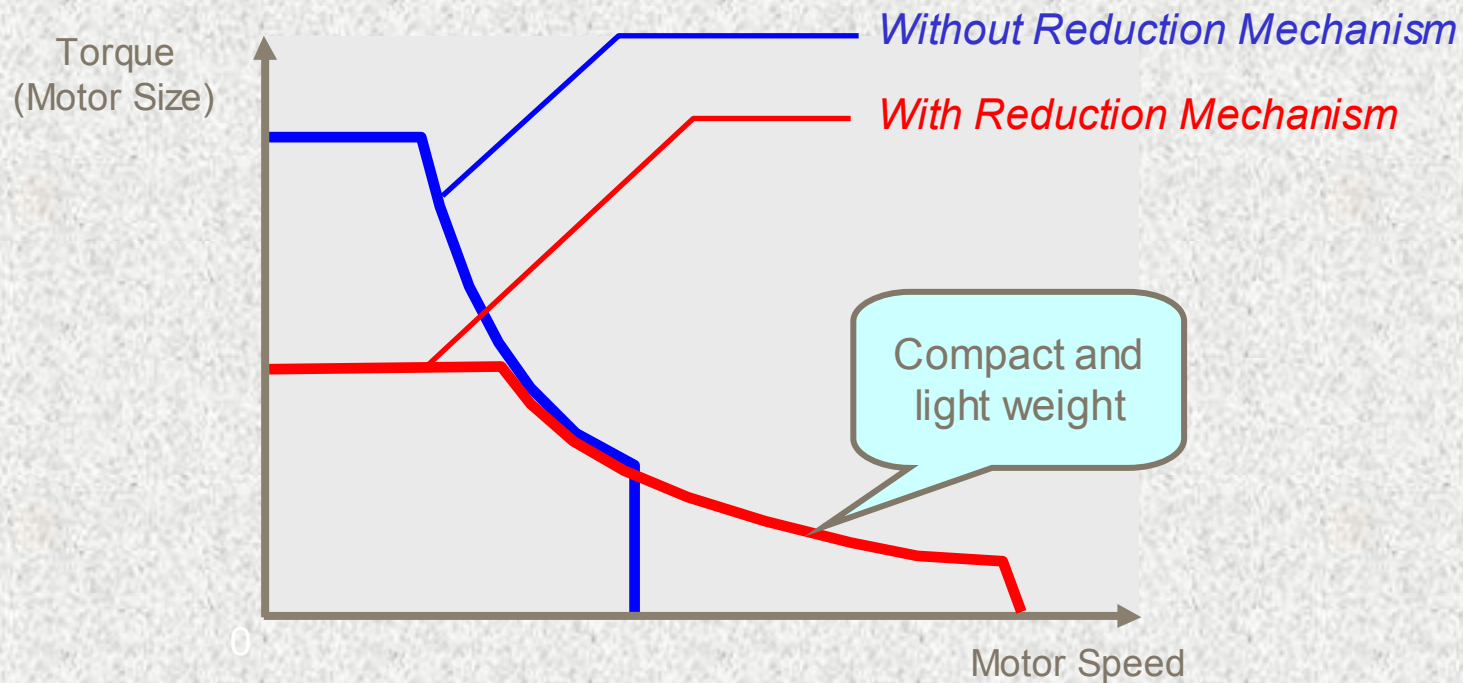
- Motor speed reduction planetary gear
 - Reduction of MG2 speed & increase of torque



Reference (P310 Hybrid Transaxle)



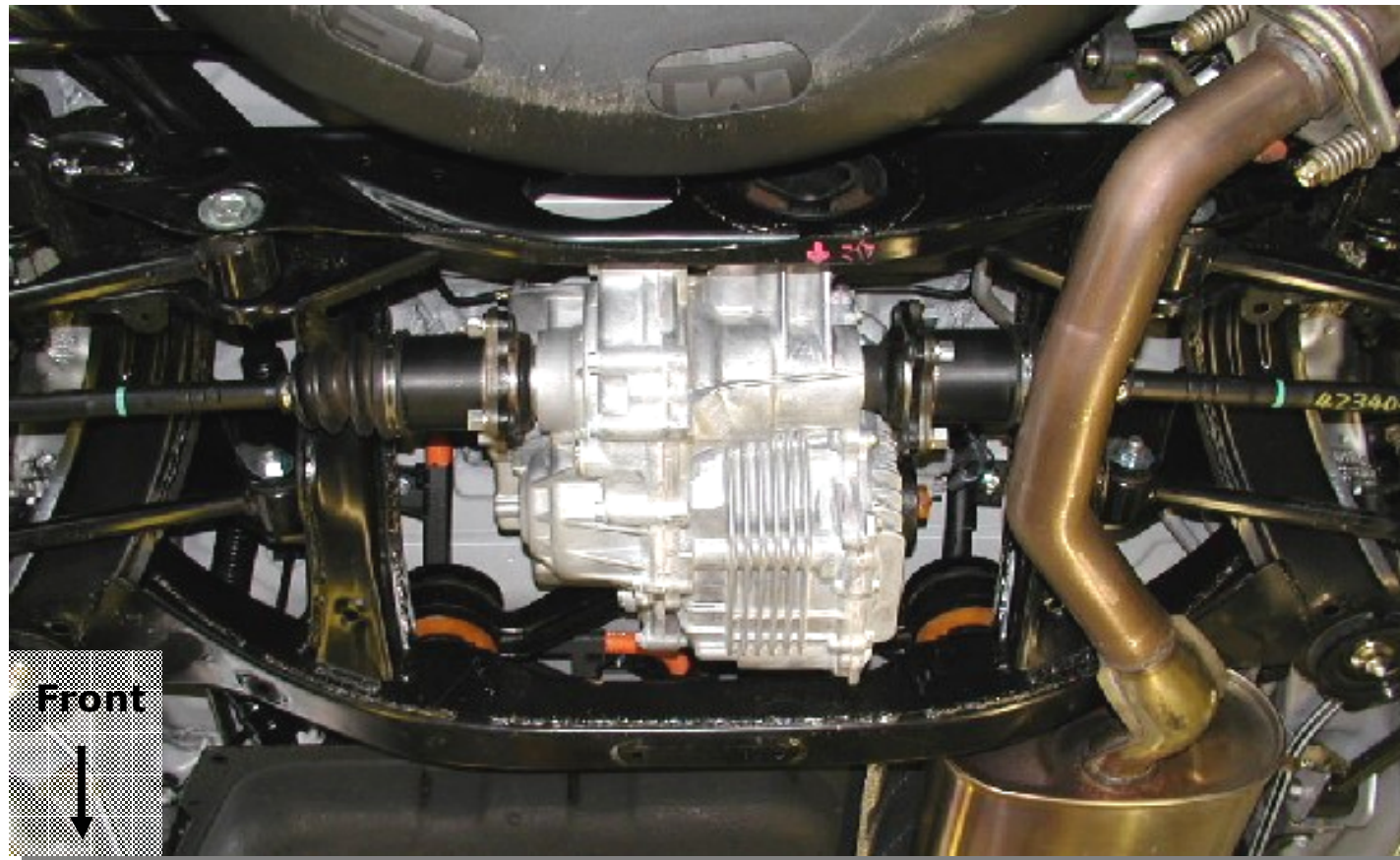
Motor speed reduction planetary gear



Necessary Performance for MG2

Q211 Rear Transaxle

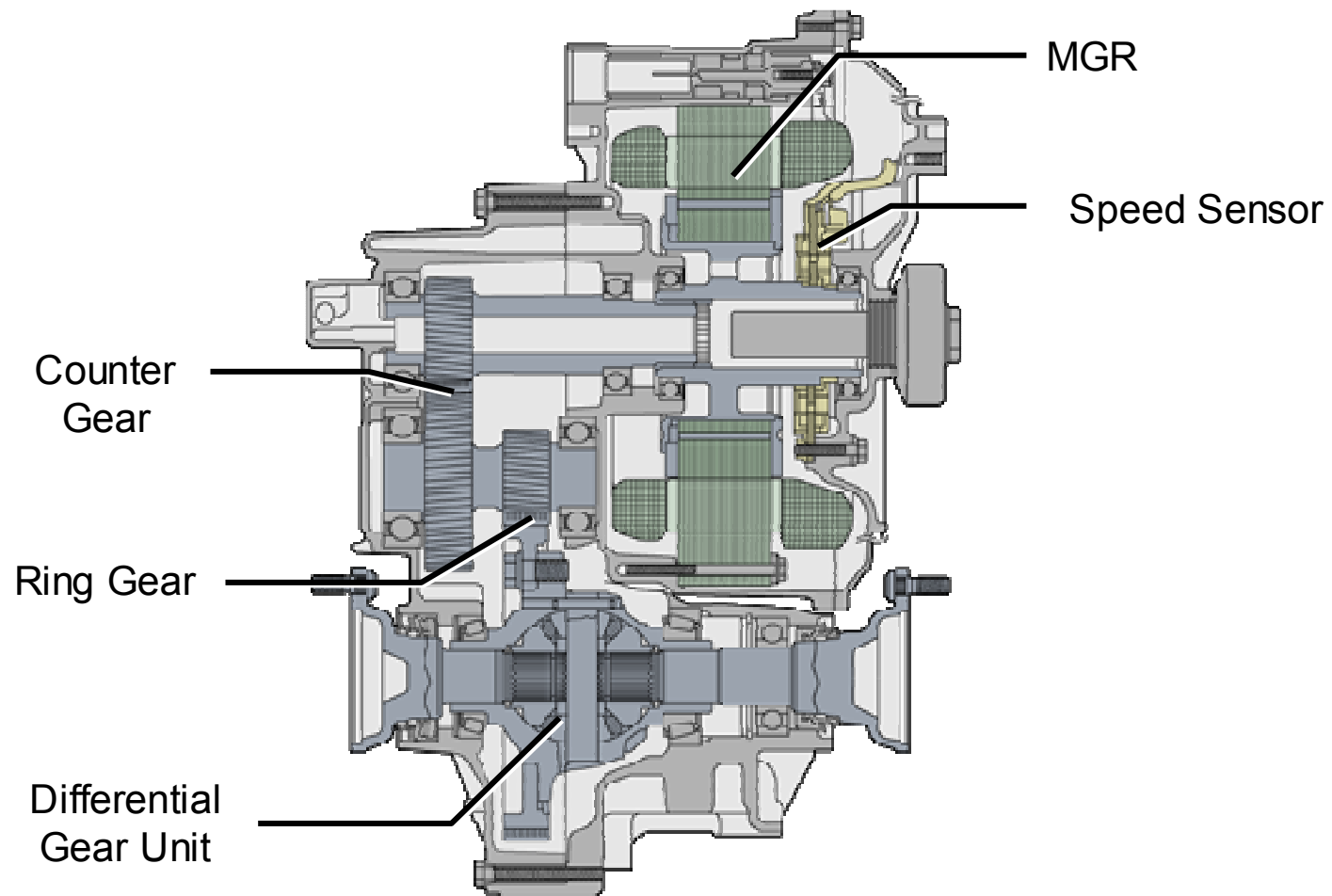
- General
 - Rear transaxle



Q211 Rear Transaxle



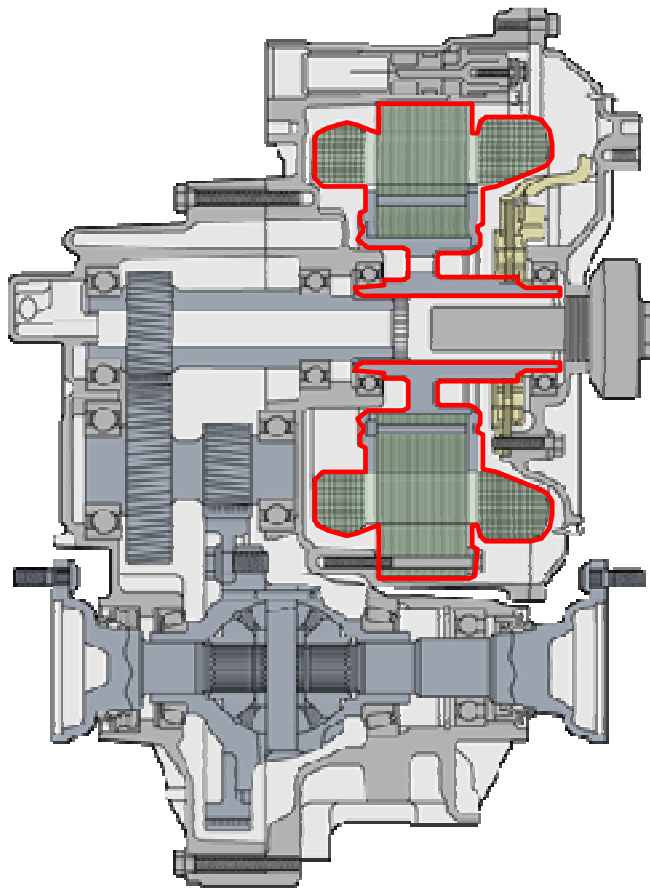
- Construction



Q211 Rear Transaxle



- MGR



Item	MGR
Type	Permanent Magnet Motor
Function	Drive Rear Wheels, Generator
System Voltage	Max. AC 650
Max. Output	50 / 4,610 ~ 5,120
Max. Torque	130 / 0 ~ 610
Max. rpm	10,750
Cooling System	Air-cooled

Chassis

Shift Lever

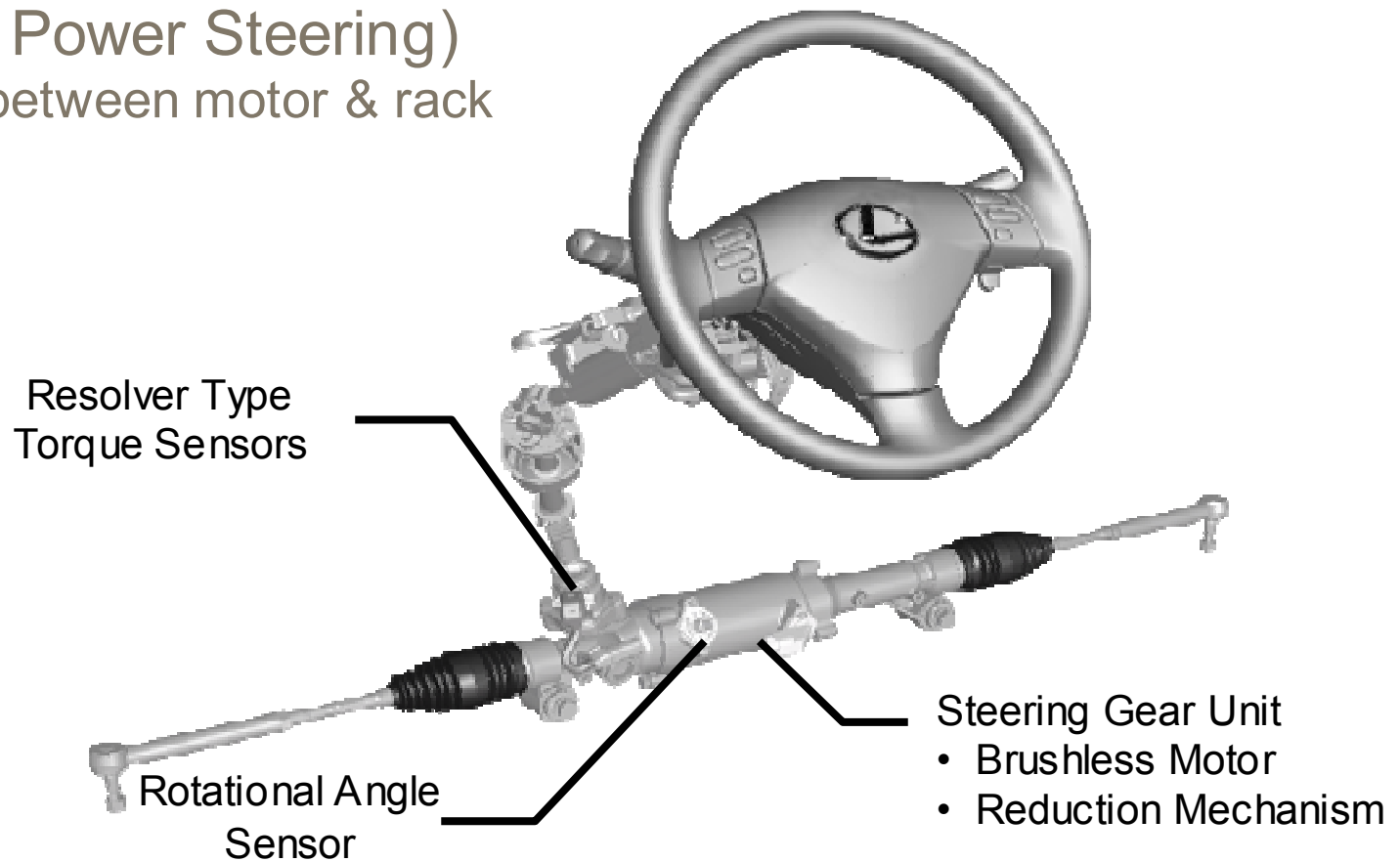
- Shift pattern



Steering



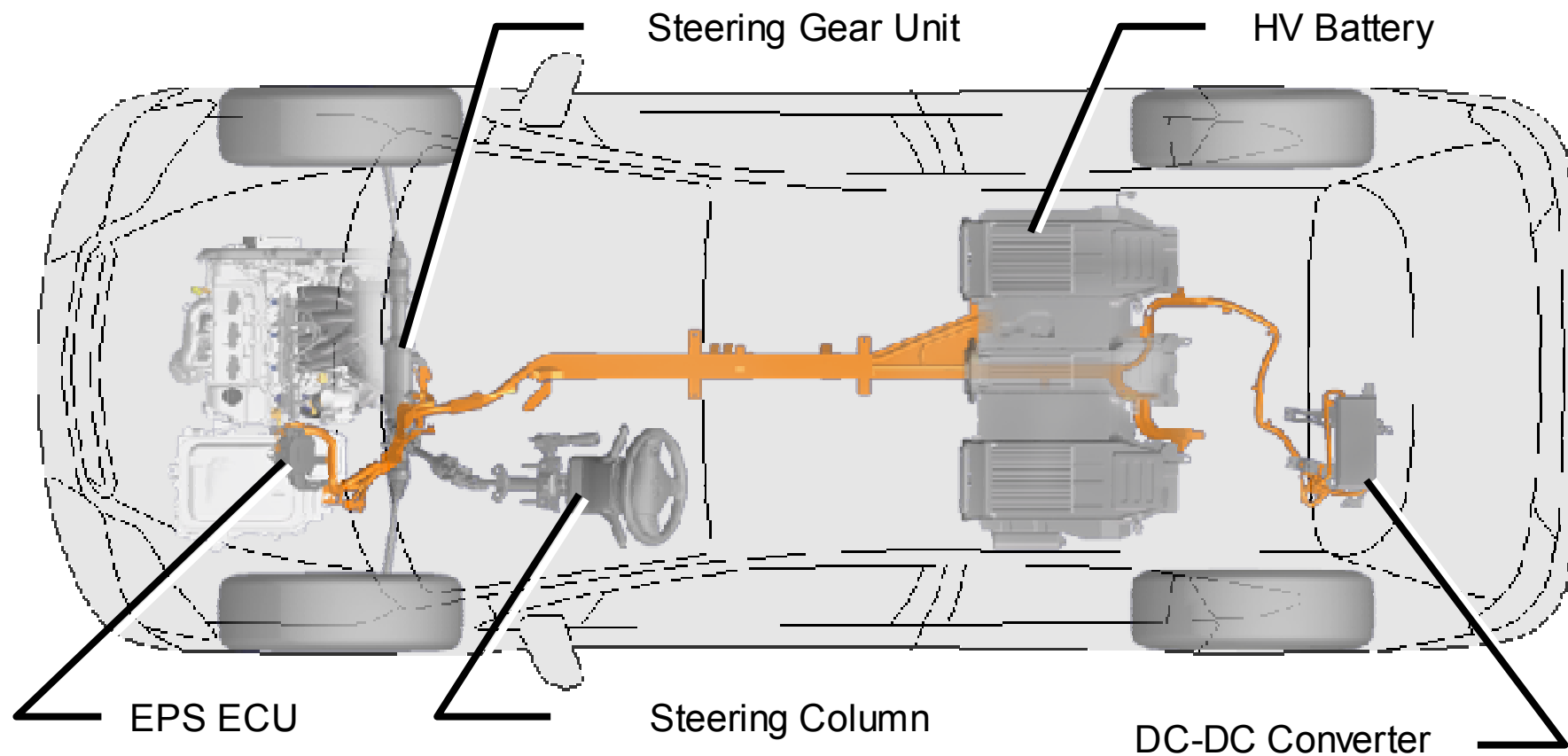
- EPS (Electric Power Steering)
 - Direct drive between motor & rack



Type	Vehicle Speed Sensing Type
Gear Ratio (Overall)	15.6 : 1
No. of Turns Lock to Lock	2.90
Rack Stroke [mm]	145.0

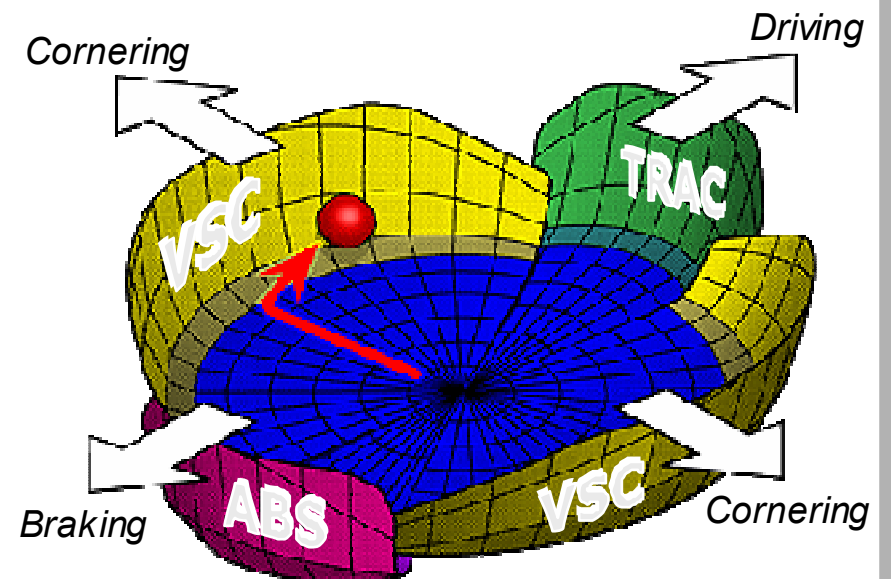
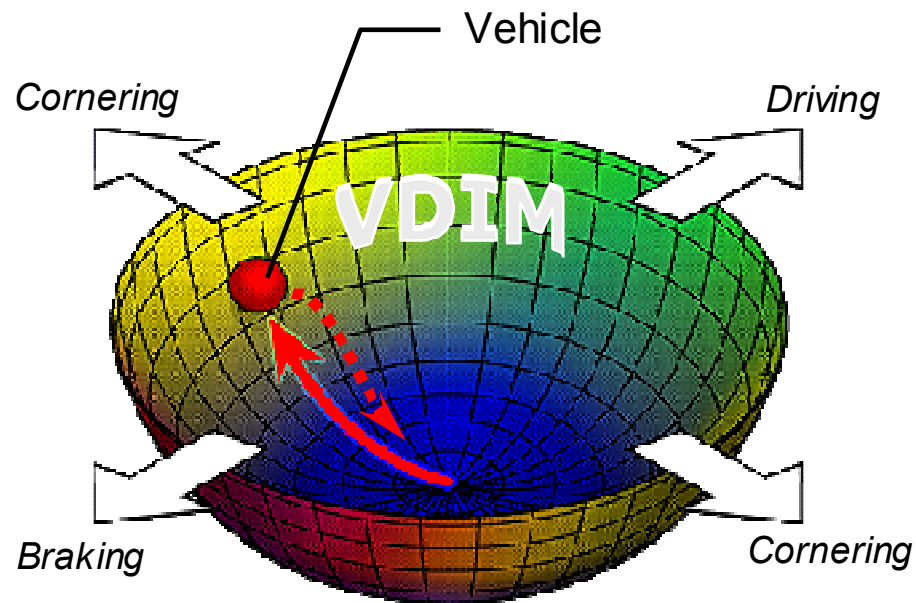
Steering

- Layout of main components



Brake control system

- VDIM (Vehicle Dynamics Integrated Management)
 - Conceptual diagram of control management



VDIM

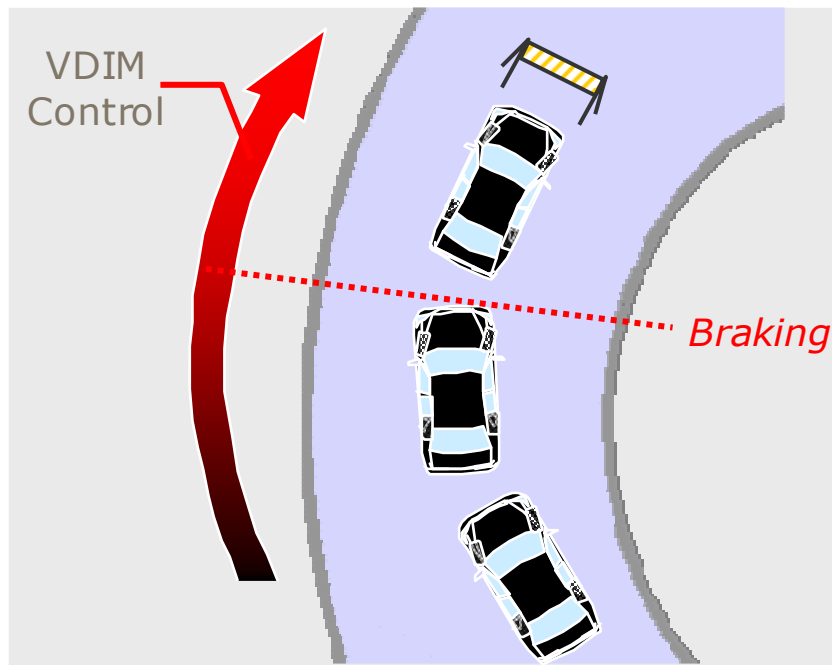


Smooth Vehicle Control

Conventional

Reference (Brake control system)

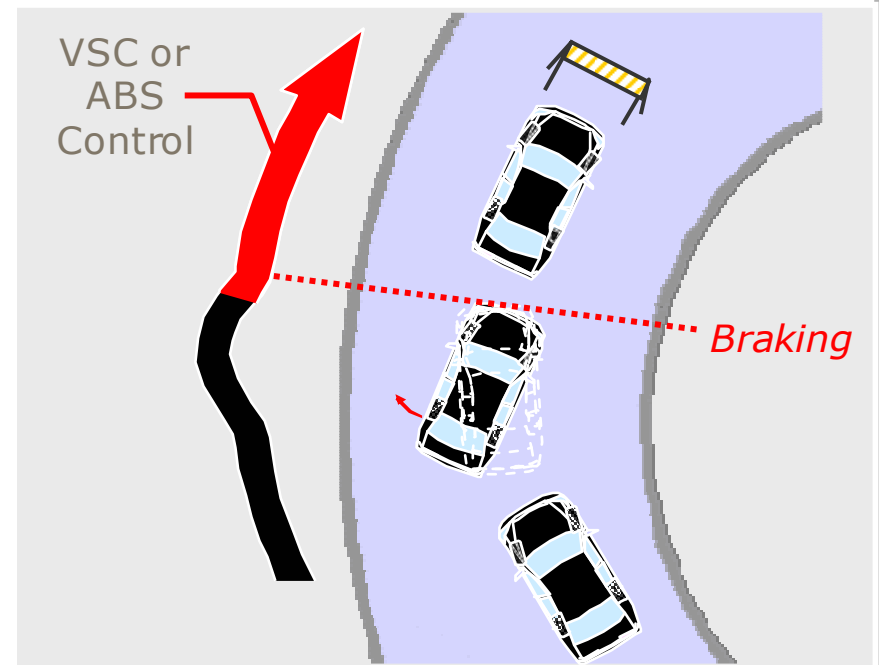
- VDIM (Vehicle Dynamics Integrated Management)
 - Example



VDIM



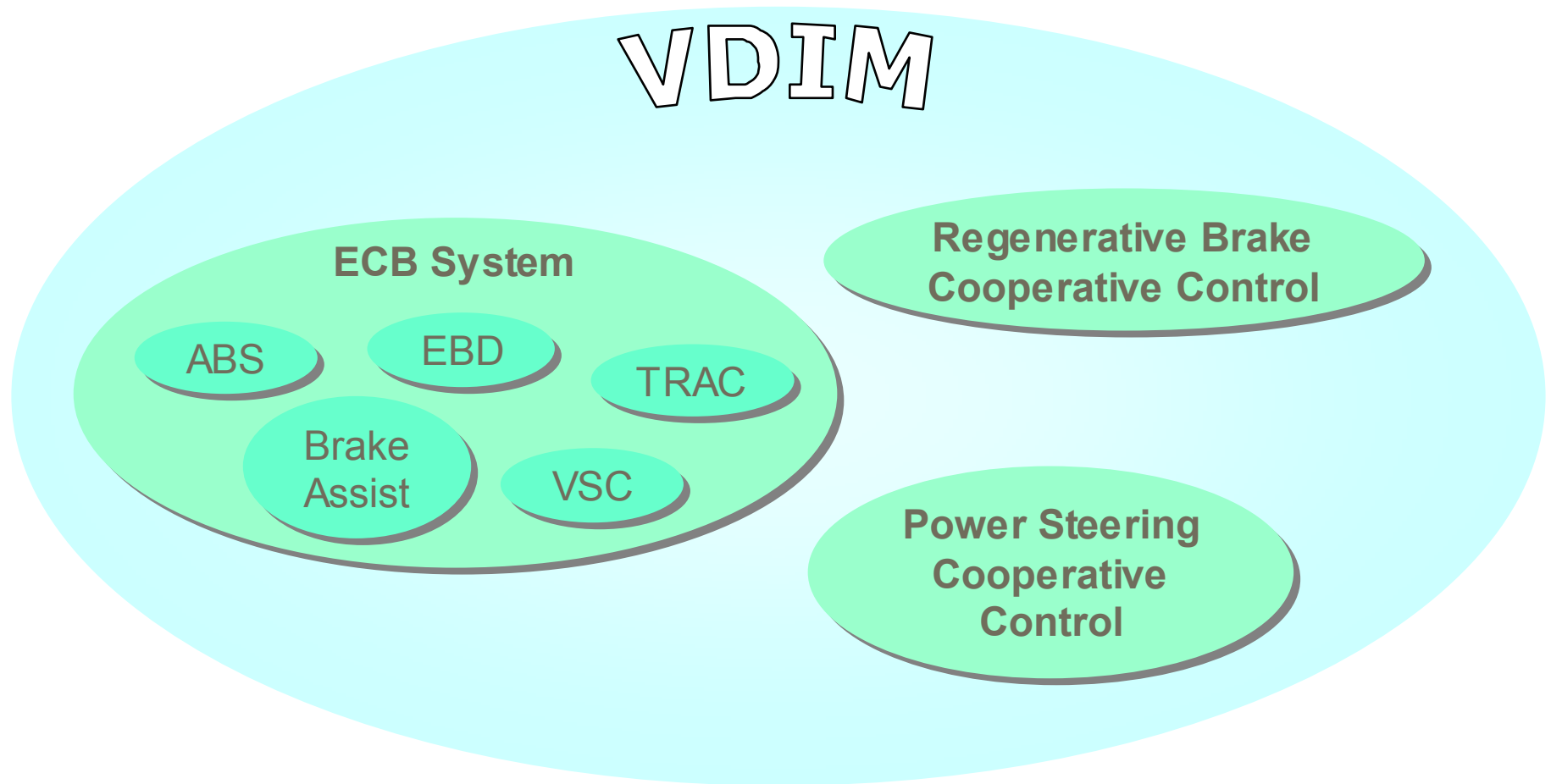
Smooth Vehicle Control



Conventional

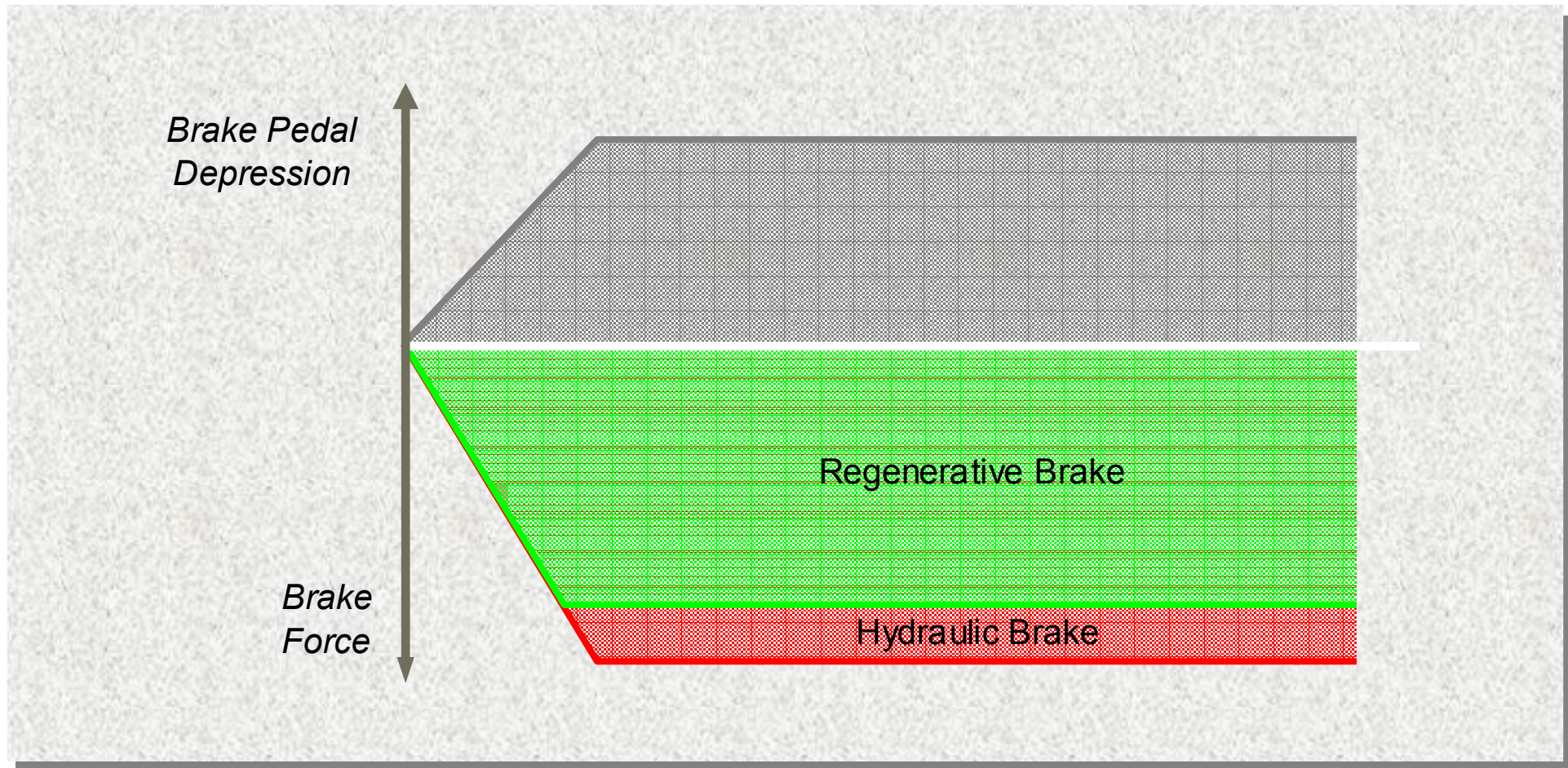
Brake control system

- VDIM (Vehicle Dynamics Integrated Management)
 - Functions



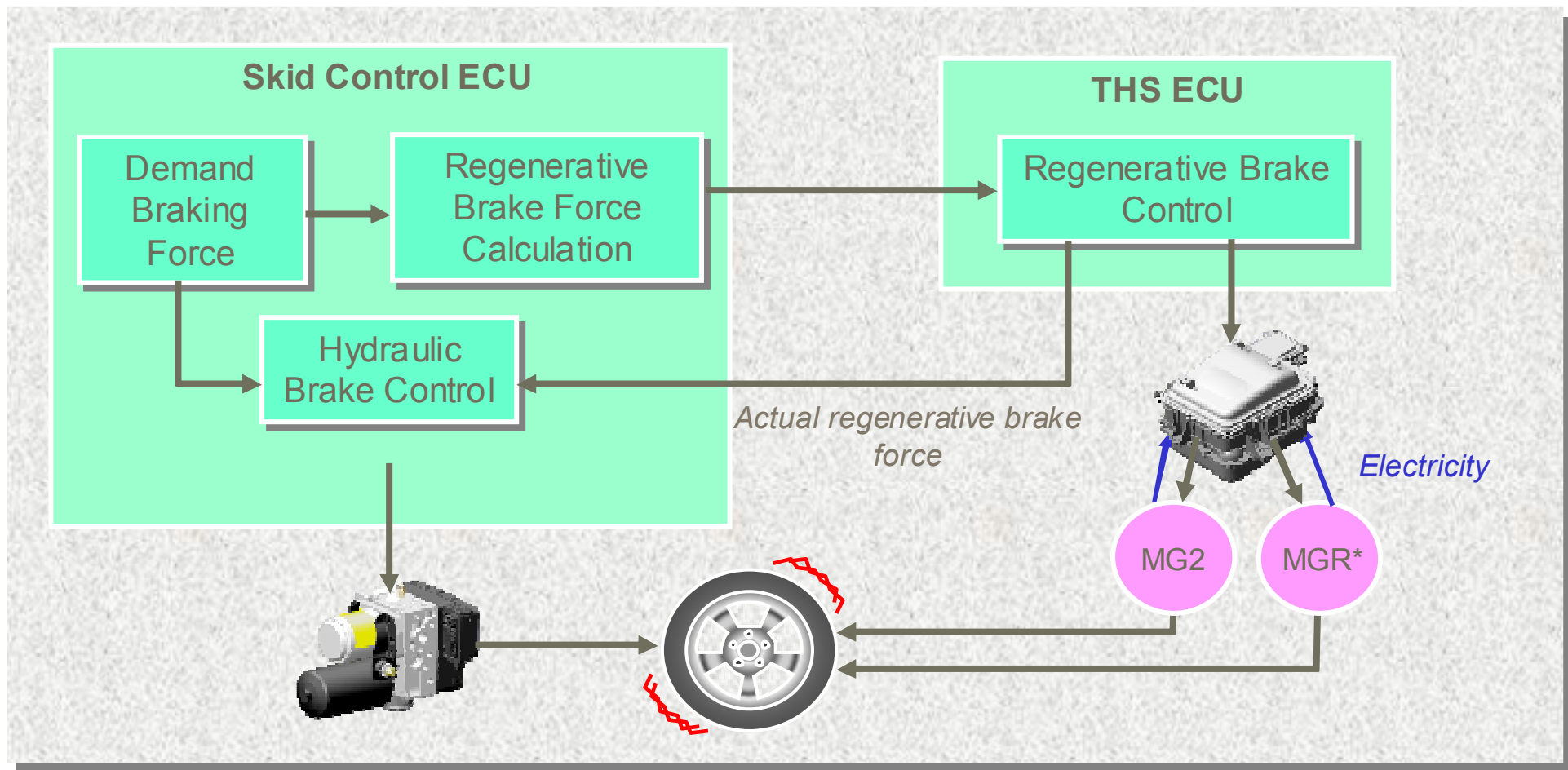
Brake control system

- Regenerative brake cooperative control



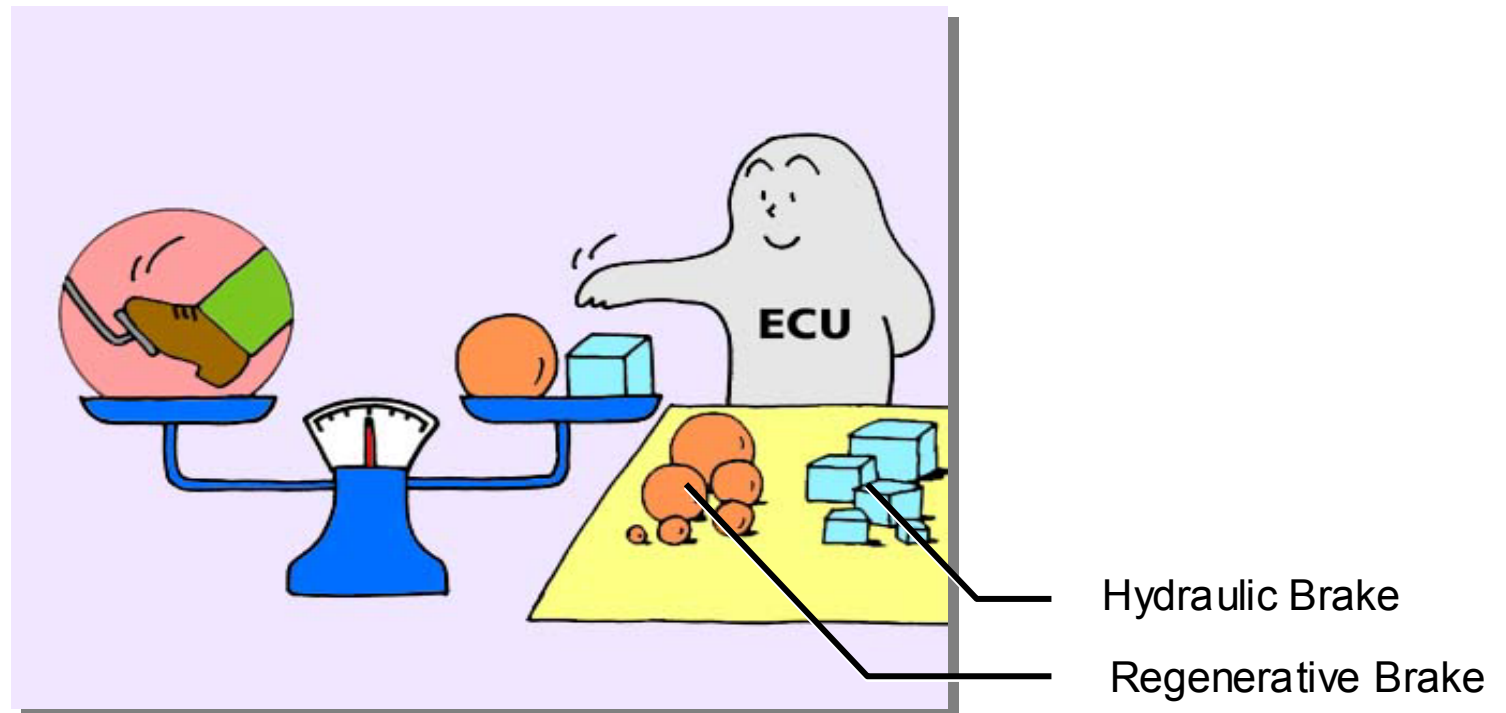
Brake control system

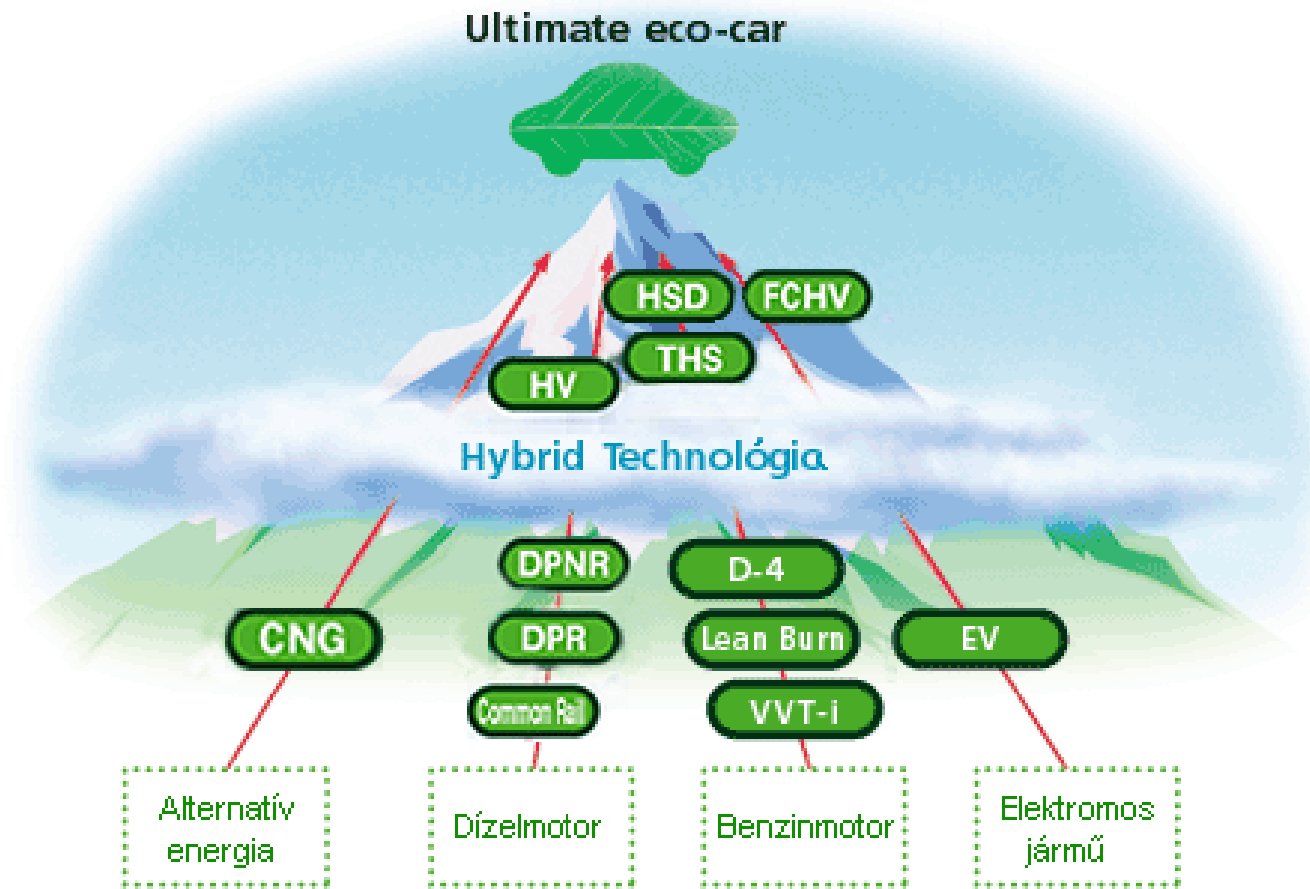
- Regenerative brake cooperative control
 - Operation



Brake control system

- ECB system
 - Total brake force (hydraulic®enerative) matches the required braking power







LEXUS

