MQ4 New Model Course

M5

Drivetrain System

Learning Objective

After completing the module, the trainee will be able to …

- **Explain drivetrain system components which are applied to MQ4.**
- **Explain major functions & principals of drivetrain systems.**

Chassis System Overview

System	UM (19MY)	MQ4	Changes (in brief)
Transmission	FWD 8-speed A/T	ICE model: FWD 6-speed Gen2 / 8-speed AT, FWD 8-speed wet DCT HEV: FWD 6-speed AT Gen2	First model with wet DCT SBW (dial)
Steering	→	C-MDPS R-MDPS (dual pinion type)	Reduced weight and increased responsiveness
Suspension (front/rear wheels)	→	MacPherson/multi-link	No ECS
Braking (ESC/EPB)	MEB-4 / cable-type EPB (DIH) (Hyundai Mobis)	MEB-5 / caliper-type EPB (Hyundai Mobis) ※ HEV: IEB (Mando)	Improved braking force and stability
Platform	Gen2 (N2)	Gen3 (N3): i-GMP	Improved design and safety/driving performance
AWD	FF type (WIA Magna)	FF type (Hyundai WIA)	Terrain mode is available

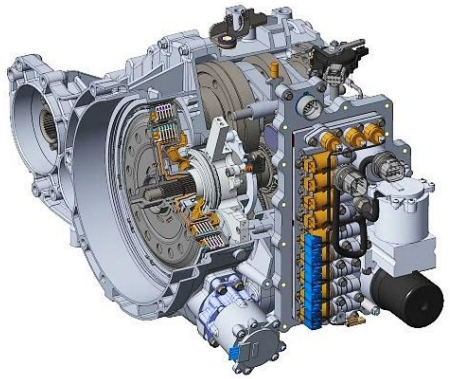
Drivetrain Overview

- **MQ4 System**

※ SBW : Shift By Wire

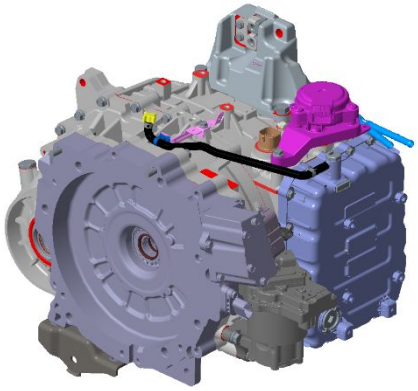
NEW

FWD 8-speed wet DCT



HEV

FWD 6-speed A/T (Gen2)



SBW (dial type)

- First Kia vehicle model with wet DCT (Engine: New R 2.2, Theta Ⅲ 2.5 T-GDI)
- First compact SUV HEV with Gen2 FWD 6-speed A/T (Engine: Gamma Ⅱ 1.6 T-GDI)
- Dial-type SBW (same type as the Gen3 Optima [DL3]) - ICE model: optional / HEV: standard

M5

Drivetrain System

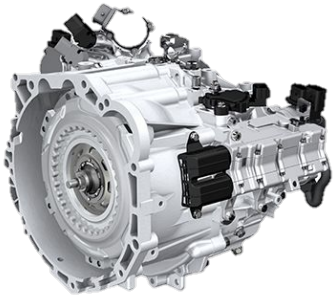
Lesson 1.

8 Speed DCT

Overview

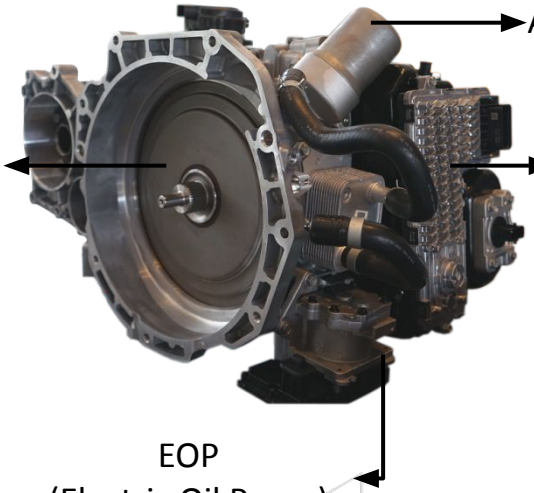
- **Combination of advantages of A/T and dry DCT**

Automated manual transmission (dry DCT)
Double clutch, air-cooled, gear/clutch actuator, Good fuel efficiency, noise, clutch overheat, etc.



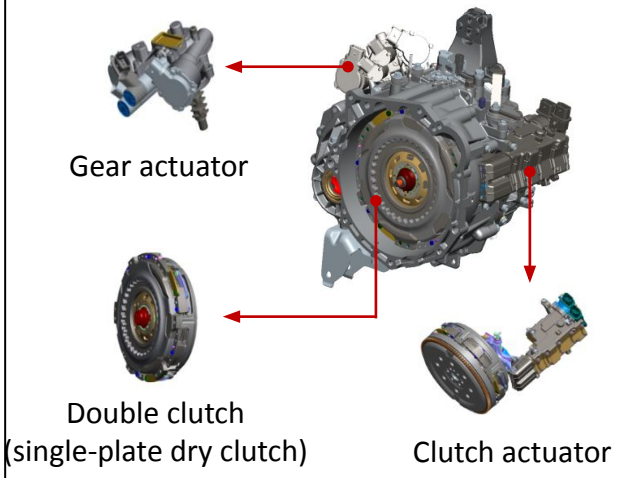
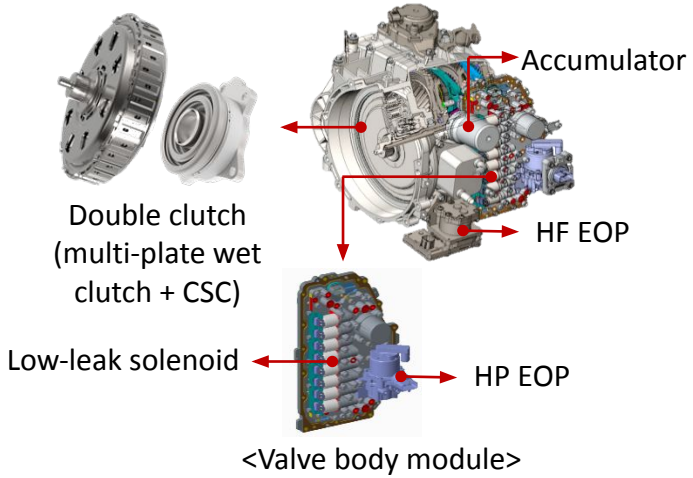
Automatic transmission (A/T)
Valve body, oil-cooled, torque converter, Clutch/brake, planetary gear, multi-range, Easy gear shifting, relatively low fuel efficiency

Automated manual transmission (wet DCT)



Overview

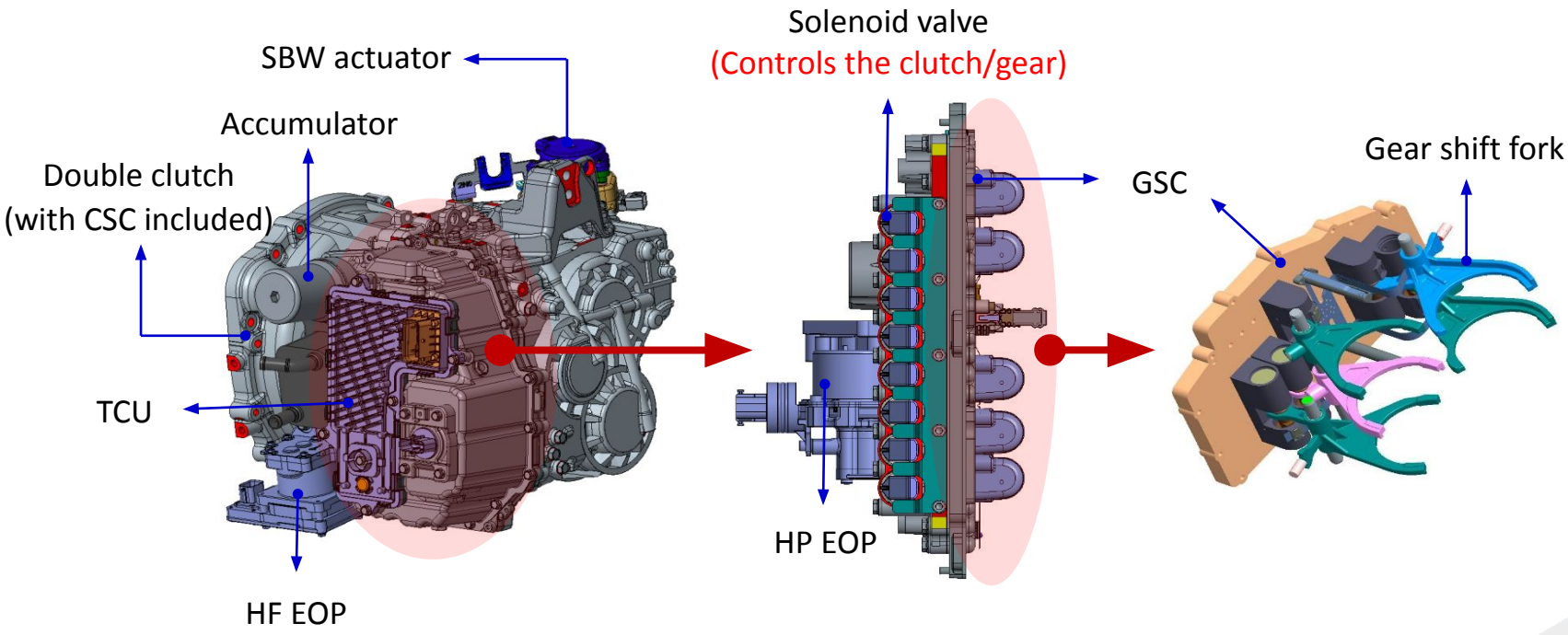
▪ Dry-type DCT vs Wet-type DCT

Category		7-Speed dry-type DCT	FWD 8-speed wet-type DCT (MQ4)
Main constituent systems			 <Valve body module>
Characteristics	Dual clutch	Single-plate dry clutch	Multi-plate wet clutch + CSC
	Clutch control	Electric motor driven	Valve body control (HP EOP + accumulator + solenoid)
	Gear shifting	Mechanical actuator control	
	Gear lubrication	Lubrication through gear churning	Forced lubrication (Activation of HF EOP)
	Clutch cooling	Air-cooled type	Oil-cooled type (Activation of HF EOP)
	TCU	Separate or integrated type (Gen2)	Attached directly to the transmission

System Configuration

- **Main components**

※ GSC : Gear Shift Cylinder

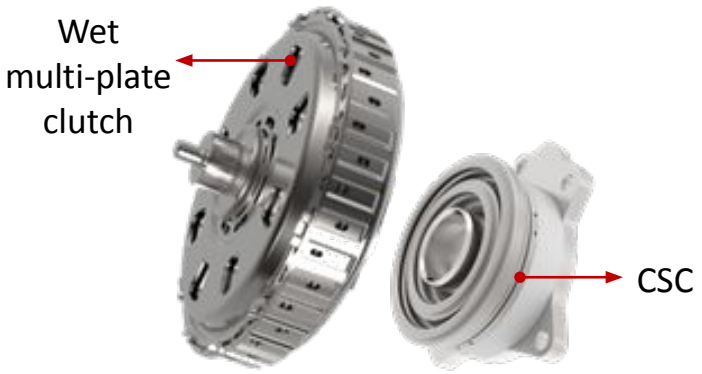


Components

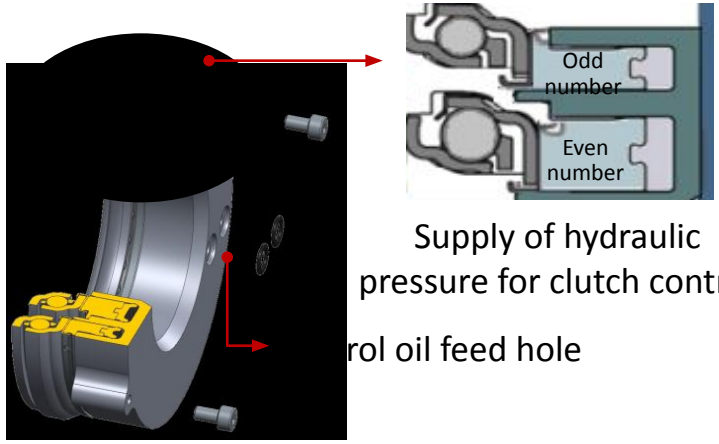
- **Wet double clutch**
  - Multi-plate control through CSC control by hydraulic pressure

※ CSC : Concentric Slave Cylinder

Wet double clutch assembly



Double CSC



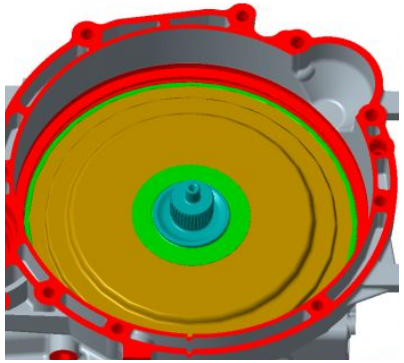
- The oil used for clutch control and the oil used for lubrication/cooling enter through completely different passages
  - Oil used for control: Only enters the CSC to control the clutch
  - Oil used for lubrication/cooling: Enters the clutch through the passage between the input shaft and CSC and becomes cooled before being discharged
- Sequence of operation: Hydraulic pressure is applied to the CSC and the pistons are activated → The apply ring is activated → The clutch is engaged (Torque is delivered)

Components

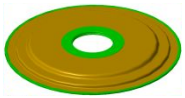
- **Precautions when replacing the clutch assembly**
  - Removal/attachment by following the steps below

※ Applicable when partial repair of the clutch is required

① Remove the snap ring and sealing cover
(Be careful to ensure that the housing is not damaged)



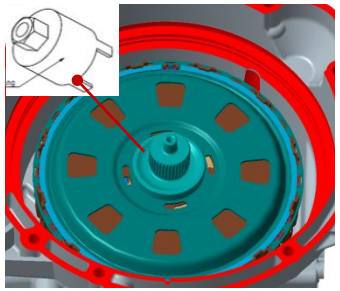
Snap ring



Sealing cover
(Use a magnetic jig)

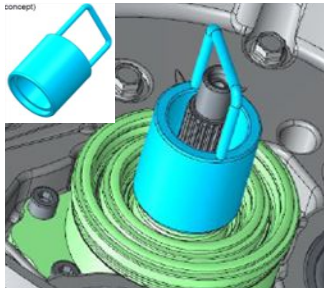
② Remove the clutch and CSC (using a dedicated jig)

Clutch



① Attach the jig (four holes)
② Turn the clutch counterclockwise 8 times to remove it
* Tightening torque – 30 Nm±5

CSC

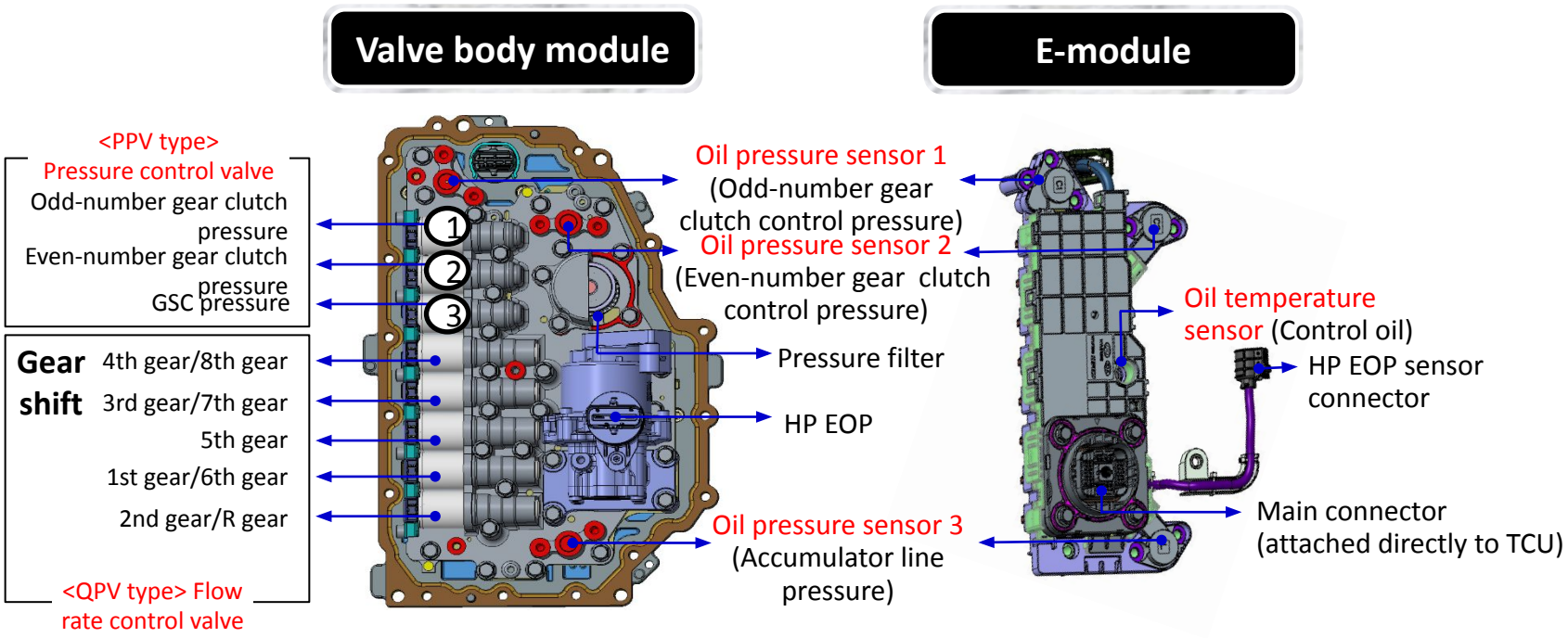


① Remove the bolts (at four points)
② Attach the jig and remove the CSC

- When replacing the double clutch pack, the CSC should also be replaced together.
  (View the serial numbers engraved on the two devices to make sure they are a matching pair)
- When handling (transporting/attaching/removing) the CSC, only hold the housing
  - If you handle the CSC by holding the bearing, the piston may become removed
- After replacement, perform manual learning by KDS and driving learning
  - Air bleeding and touch point learning

Components

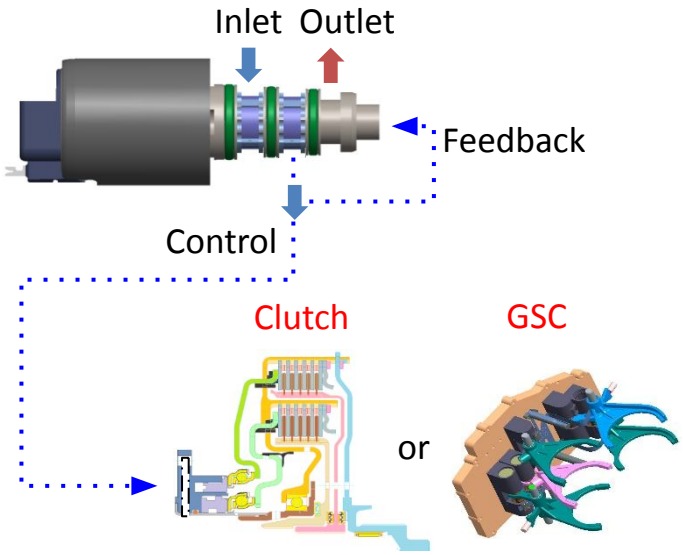
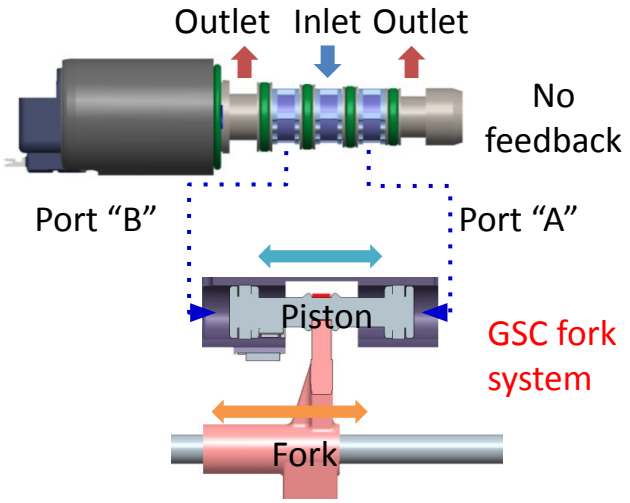
Hydraulic System and E-Module



- Components: Oil pressure sensor (x3), oil temperature sensor (x1), solenoid valve (x8), pressure filter, and HP EOP
- The line pressure sensor detects a pressure drop in the accumulator so as to variably drive the HP EOP (Oil pressure is maintained at a constant level)
- The low-leak solenoid valve reduces oil consumption
- The pressure filter prevents foreign matter from entering the solenoid valve

Components

▪ Differences between PPV-type and QPV-type solenoid valves

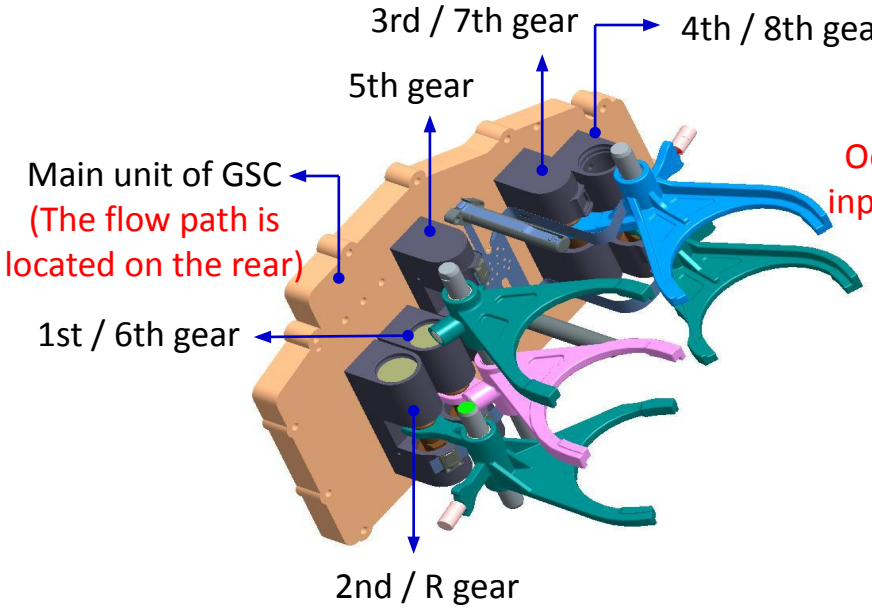
Category	Oil pressure control valve (PPV) Pressure Proportional Valve	Flow rate control valve (QPV) Flowrate(Q) Proportional Valve
Purpose	Control of clutch pressure and GSC pressure	Control of gear shifting (Moving of shift fork)
Operating principle		
Quantity	3EA	5EA

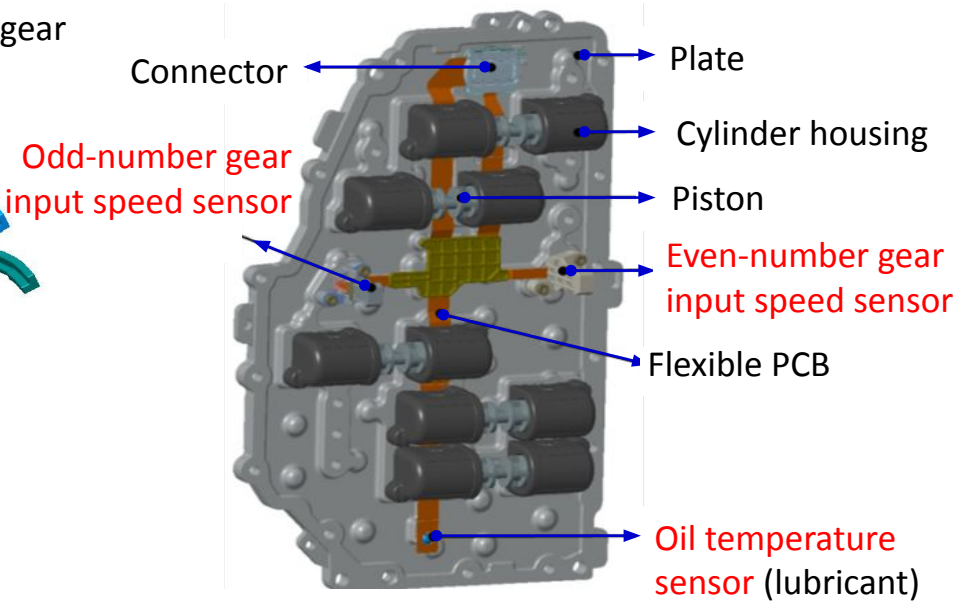
※ Normal resistance during inspection of a solenoid valve: 4.6±0.25 Ω (under room temperature of 20℃ conditions)

Components

▪ GSC

※ GSC : Gear Shift Cylinder

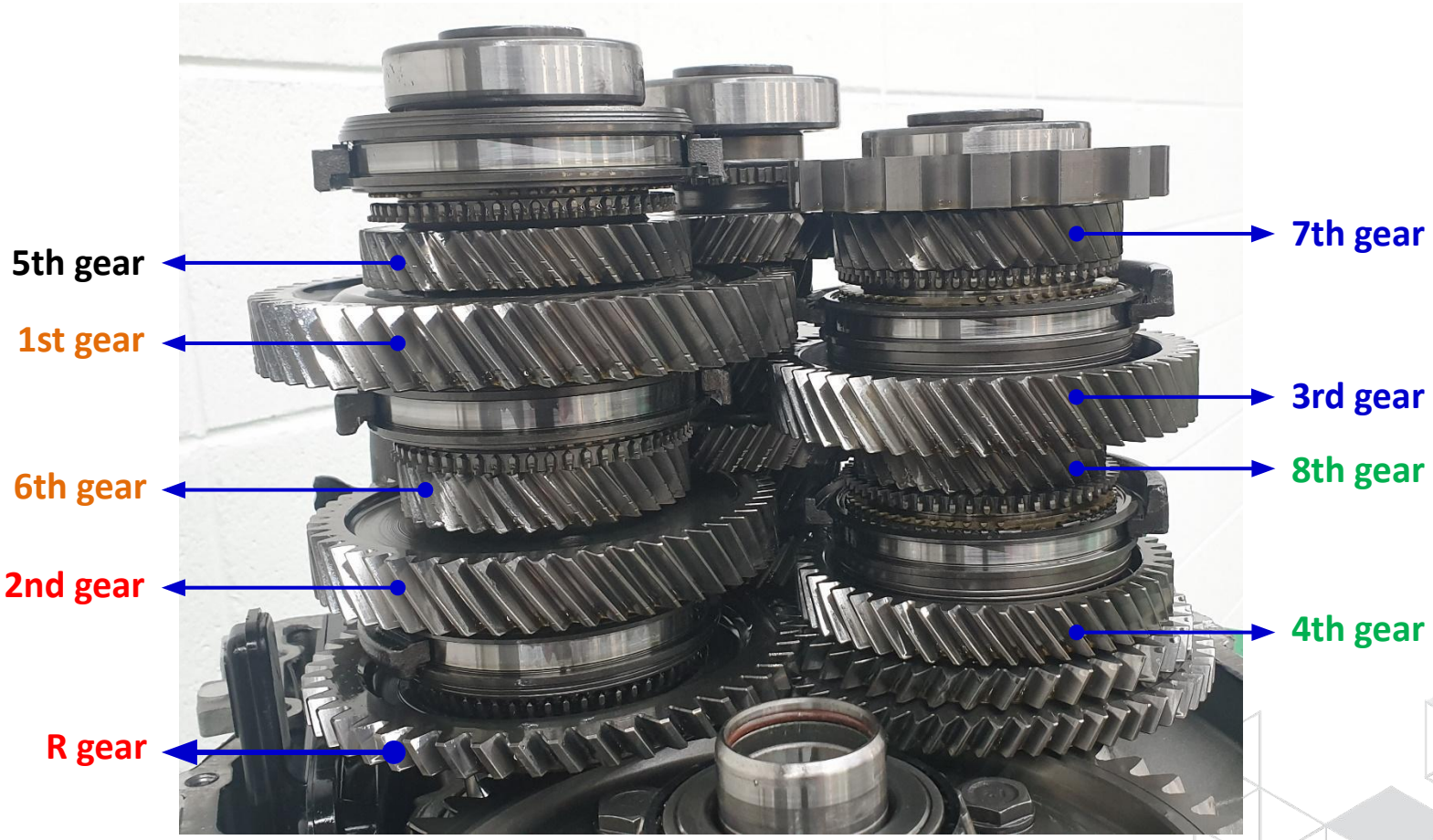




- Gear shifting through control of (five) QPV-type solenoid valves
- Position sensor for each cylinder (The piston position value can be checked from the current data)
- Check that the piston is in the neutral position prior to assembly, and perform alignment when required (See Fig. 2 below.)
  - The piston automatically switches to the neutral position when the engine is turned off under normal conditions

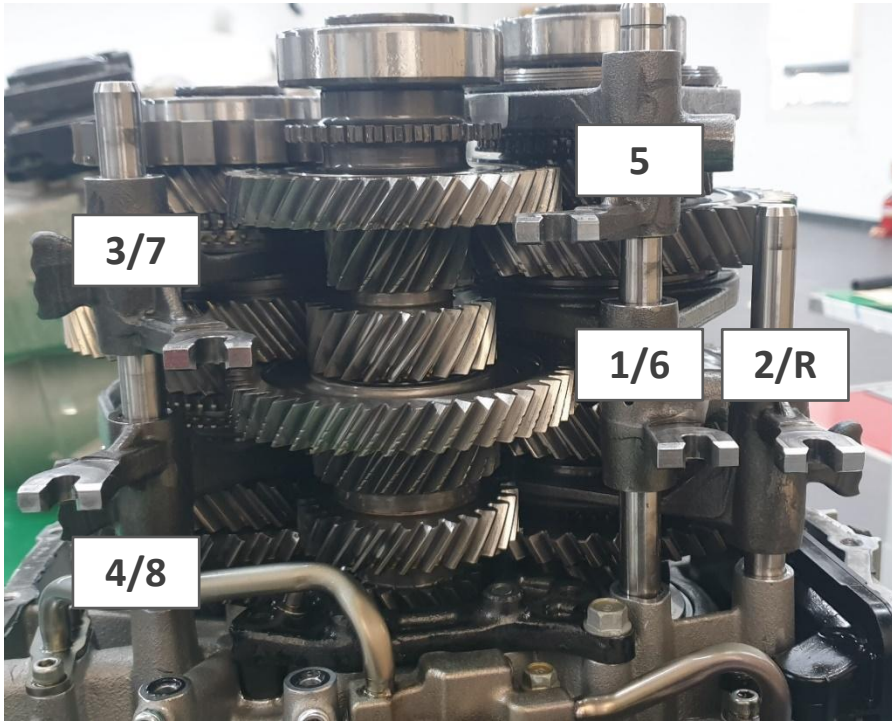
Components

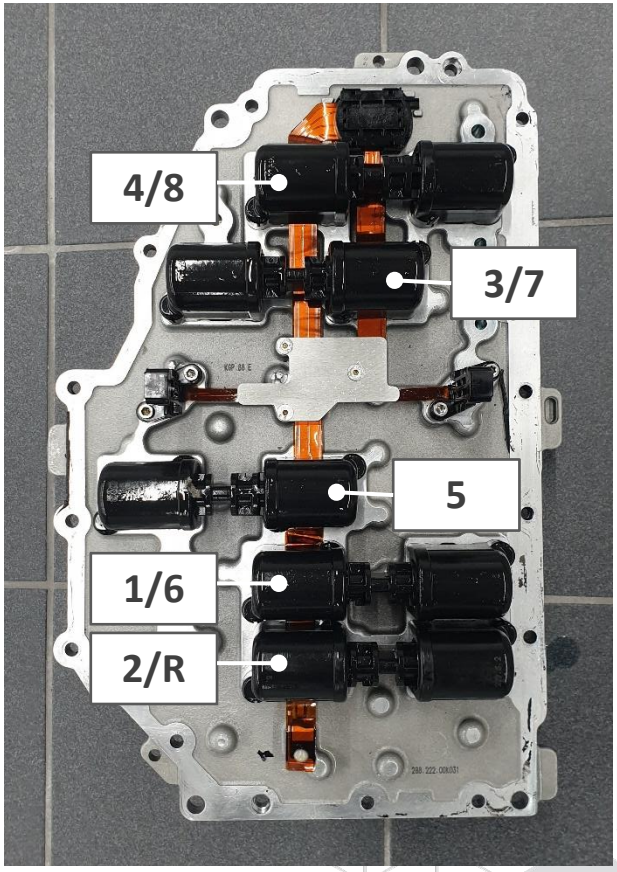
- **Gear set**



Components

- **Gear set**





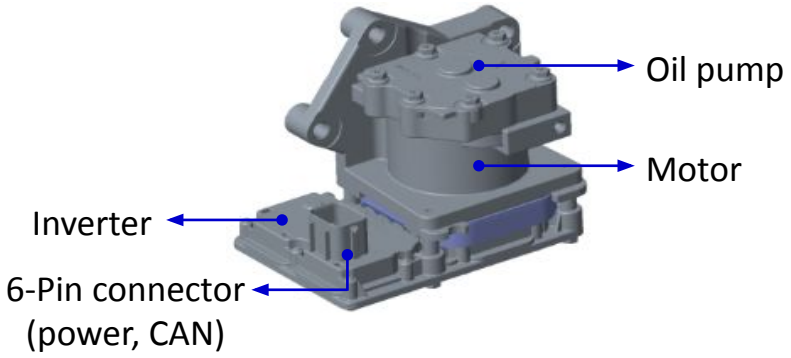
Components

※ EOP: Electric Oil Pump

- **EOP (x2)**
  - EOP operates to supply necessary oil pressure and amount of oil, irrespective of the engine rpm

HF EOP

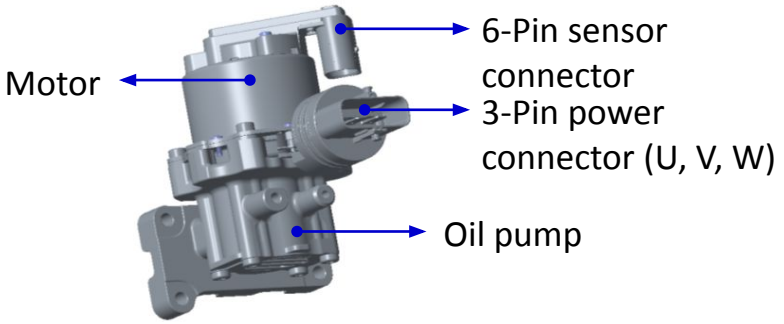
Supplies oil used to cool the clutch and lubricate/cool the gear



- Operates one time for 2 to 5 seconds (200 rpm) when IG is turned on
- Operates variably at all times (200–3200 rpm) when the vehicle is on
- Exchanges heat with the coolant via the oil cooler before supplying oil

HP EOP

Supplies oil used to maintain a certain level of pressure in the accumulator (gear shifting control)

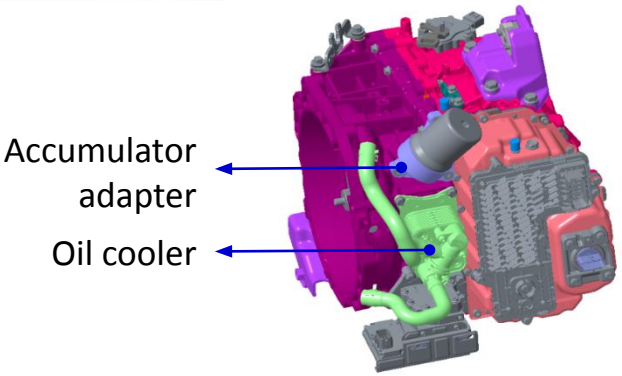


- The inverter is embedded in the TCU
- Operating range: 1000–3000 rpm
- Level of pressure maintained in accumulator: Above 45 bars (The value differs depending on the temperature)

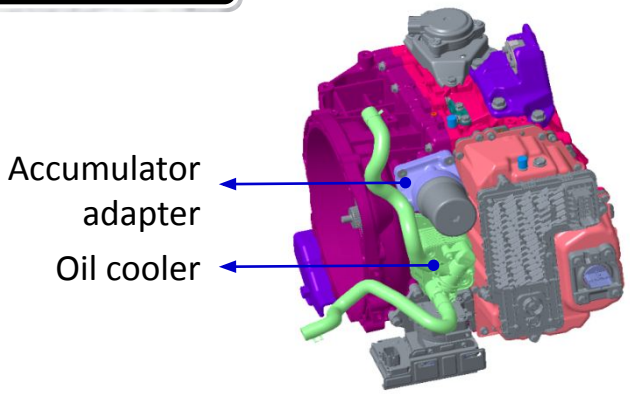
Components

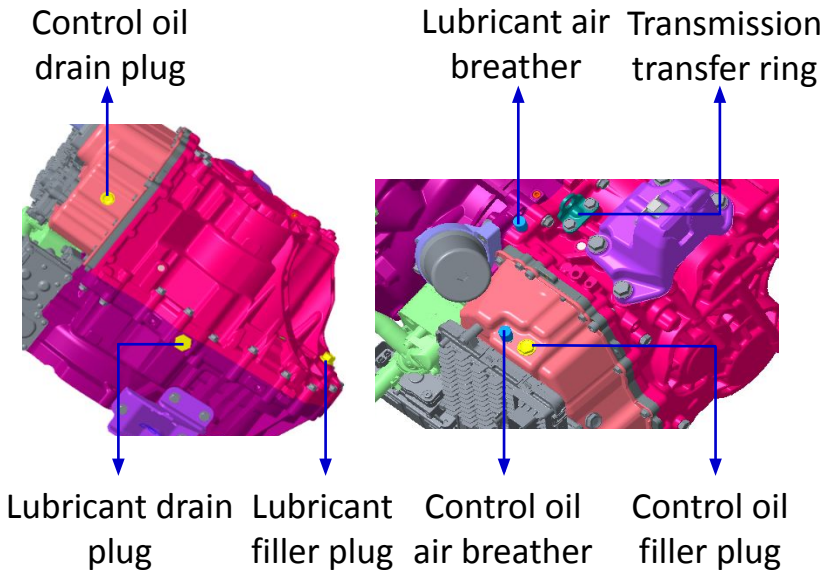
- **Transmission case**
  - Transmission components differ depending on the engine type and vehicle type

New R 2.2



Theta Ⅲ 2.5T





- Standard oil quantity (under room temperature of 25℃ conditions)
  - Lubricant / cooling oil (yellow): 3300–3400 cc
  - Control oil (blue): 2450–2500 cc

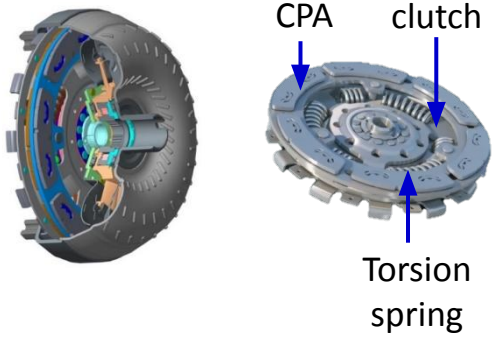
Components

※ CPA : Centrifugal Pendulum Absorbers

- **CPA**
  - Reduces engine vibrations and booming

Automatic transmission

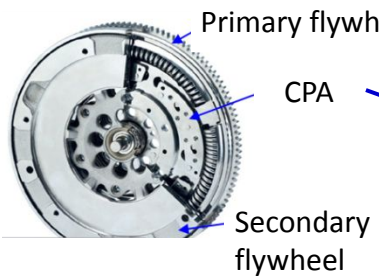
CPA is installed on the torque converter damper clutch



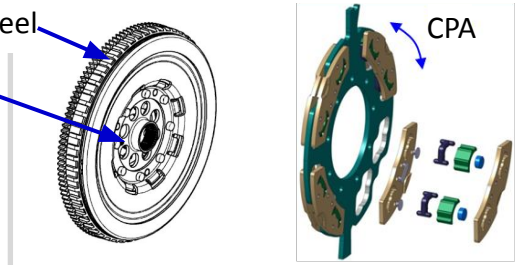
※ Applied in the Stinger (CK)

Manual transmission and DCT

CPA is installed on the DMF (Dual Mass Flywheel) or external damper



Manual transmission (DMF)



DCT (external damper)

Applied in the MQ4

※ DMF and external damper have a similar structure to each other (The name differs depending on the transmission type)

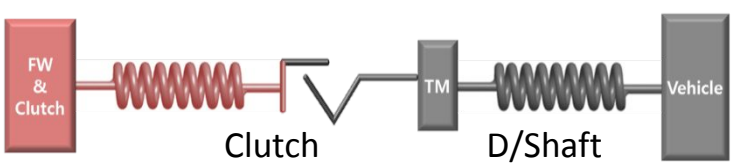
- The CPA, which uses the opposite phase to the engine's vibration, offsets vibrations using the left/right movements of the pendulum

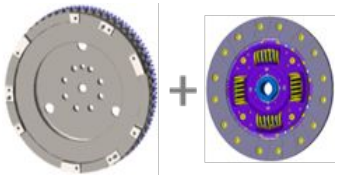
Components

※ SMF : Single Mass Flywheel

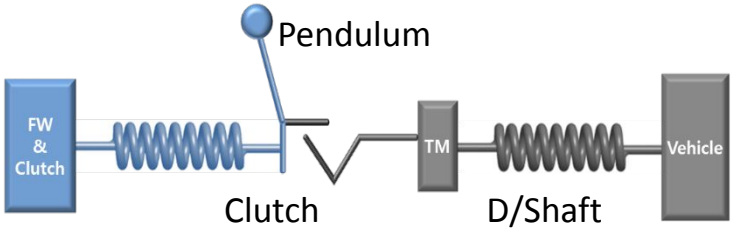
- **CPA**
  - Classification depending on the installation location of the damper and CPA (in manual transmissions)

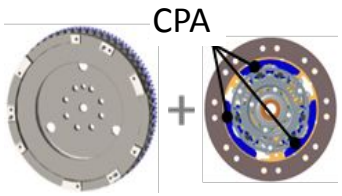
SMF + damper clutch



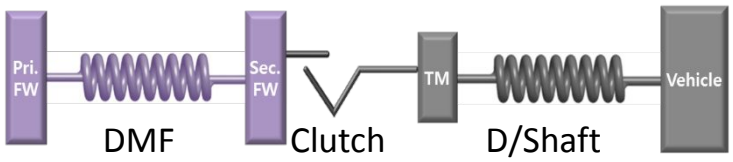


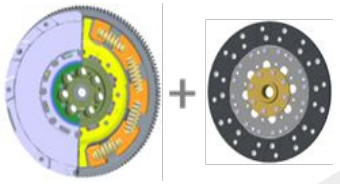
SMF + CPA clutch



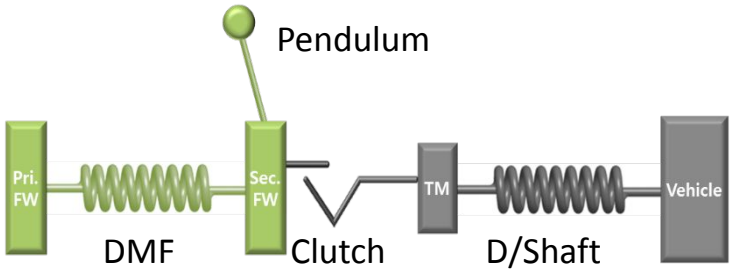


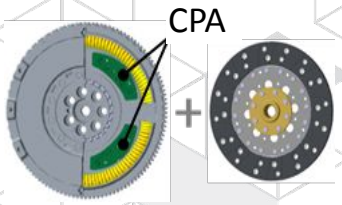
DMF + rigid clutch





CPA DMF + rigid clutch





Components

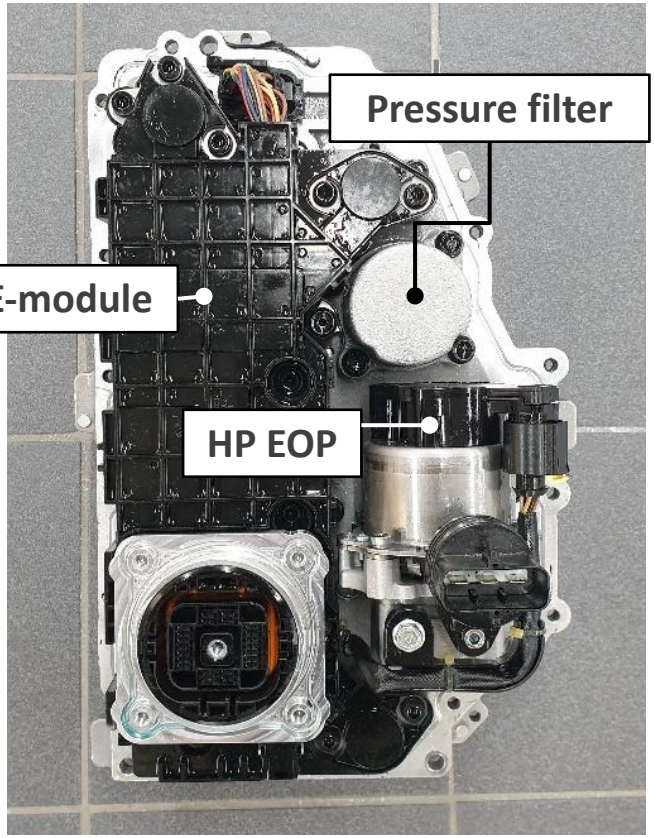
- **Images**

Multi-plate wet clutch pack

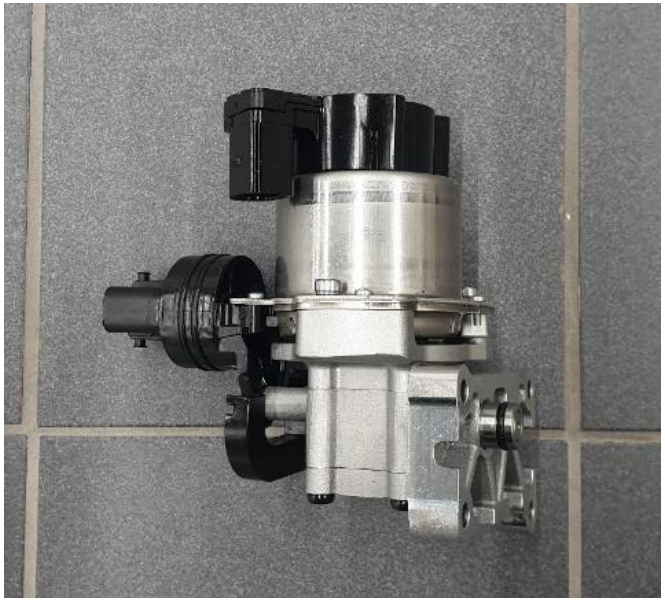
CSC

Components

- **Images**



Valve body

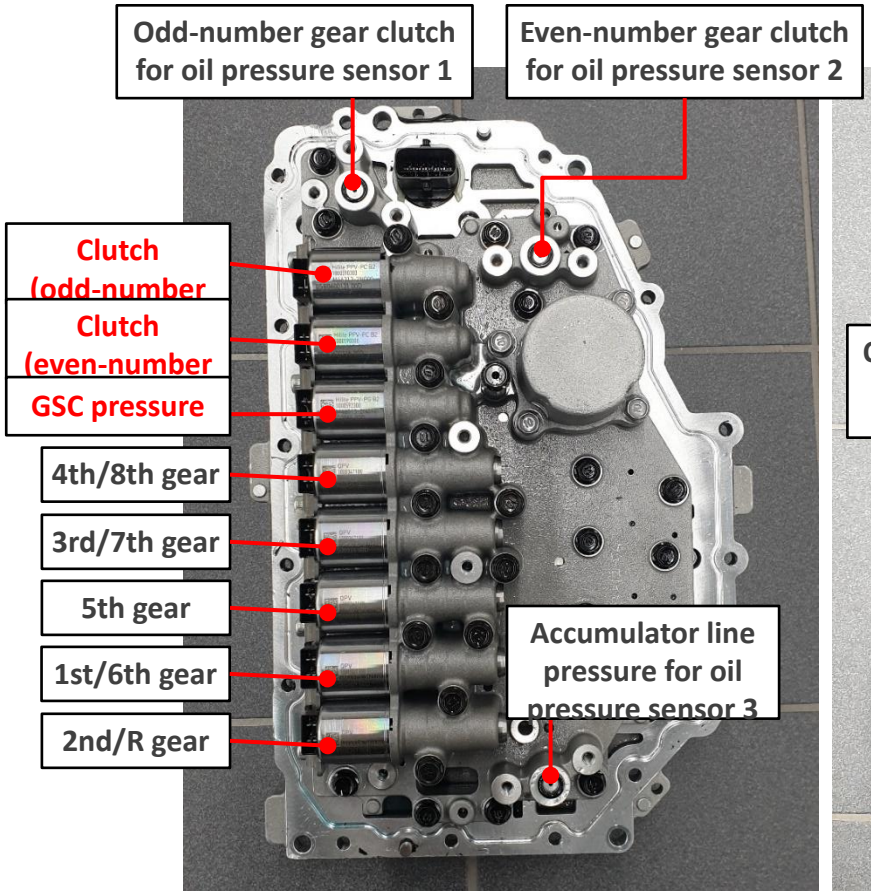


HP EOP

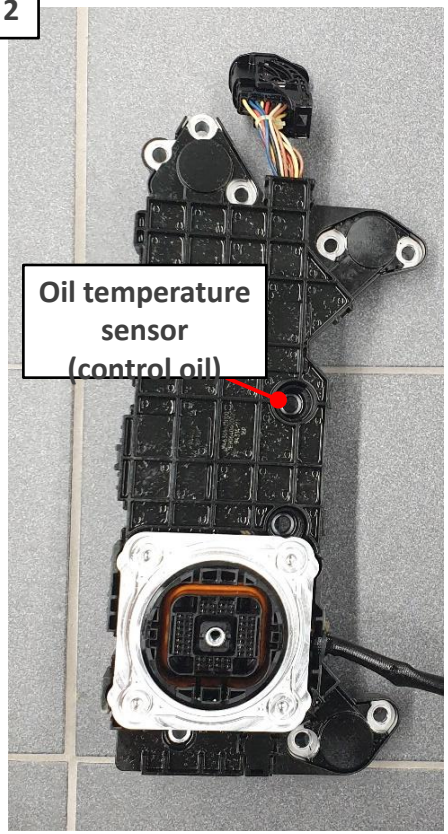
Accumulator

Components

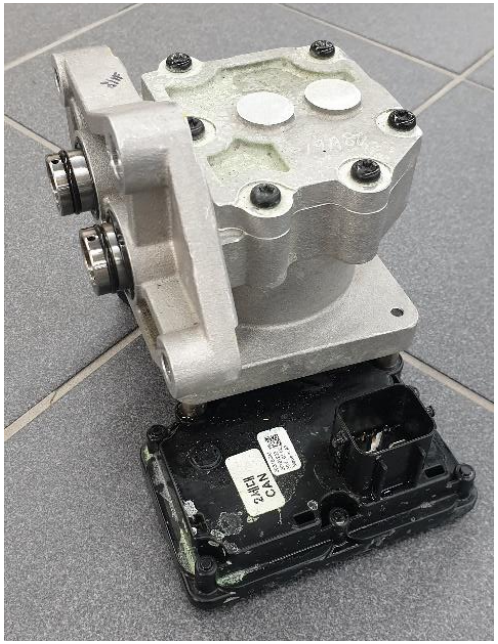
- **Images**



Valve body



E-module



HF EOP

Diagnosis

- **Over-temperature/overheat warning**

  Method 1) Overheat warning is activated in stages depending on the clutch temperature

  (The possibility of activation is low) → Modeling temperature value (No sensor, no measurement)

Category	Activation condition	Deactivation condition	Functional limitation	Auditory warning	Warning message (on cluster)
Stage 1	Over 250℃	Under 140℃	-	-	-
Stage 2	Over 300℃		-	-	-
Stage 3	Over 350℃		Launch slip is reduced HF EOP is activated at maximum rpm	-	-
Stage 4	Over 380℃		Single clutch control (Odd or even number)	-	-
Stage 5	Even and odd-numbered clutches Stage 4 is active	Even and odd-numbered clutches Under 140℃	Engine torque is limited to cause the vehicle to stop (Clutch is opened after vehicle stops)	Repeat	 10 Sec. after activation   4 Sec. after deactivation

※ The clutch is cooled fast due to the lubricant

(The clutch temperature converges to the oil temperature within several seconds)

Diagnosis

- **Over-temperature/overheat warning**

  Method 2) Overheat warning is provided in stages depending on the lubricant temp. (The possibility of activation is relatively high)

  ~~Oil temperature sensor reading~~

Category	Activation condition	Deactivation condition	Functional limitation	Auditory warning	Warning message (on cluster)
Stage 1	Over 100℃	Under 90℃	HF EOP rpm increases	-	-
Stage 2	Over 110℃	Under 100℃		-	-
Stage 3	Over 120℃	Under 110℃	Launch slip is reduced HF EOP is activated at maximum rpm Cooling fan operates when the vehicle is stopped	-	-
Stage 4	Over 130℃	Under 120℃		3 Times	
Stage 5	Over 140℃	Under 110℃	Four-stage control + Engine torque is limited to cause the vehicle to stop (Clutch is opened after the vehicle stops)	Repeat	 10 Sec. after activation   4 Sec. after deactivation

Diagnosis

- **TCU DTC (OBD1) – 1** *OBD1(Electrical fault) / OBD2(Mechanical fault)

See the slide note!!

Diagnosis

- **TCU DTC (OBD1) - 2**

See the slide note!!

Diagnosis

- **TCU DTC (OBD1) - 3**

See the slide note!!

Diagnosis

- **TCU DTC (OBD2)**

See the slide note!!

M5

Drivetrain System

Lesson 2.

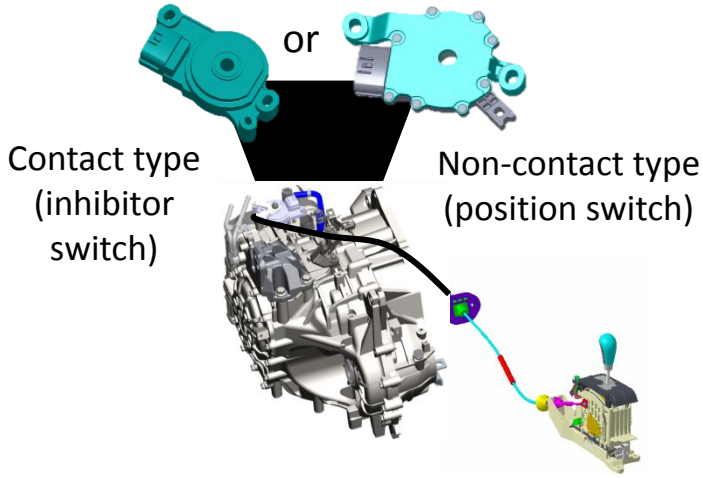
SBW

Overview

- **Types and characteristics of shifters**

SBC type (Shift By Cable)

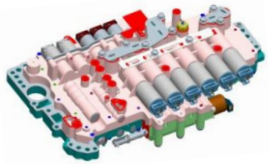
Gear shifting through cable (lever ↔ switch)

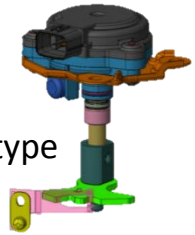


SBW type (Shift By Wire)

Gear shifting through CAN communication (E-Shifter ↔ TCU)

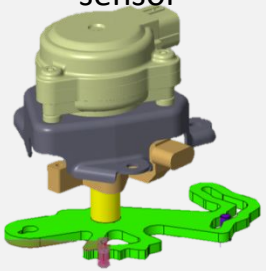
Hydraulic type





Applied in the MQ4!

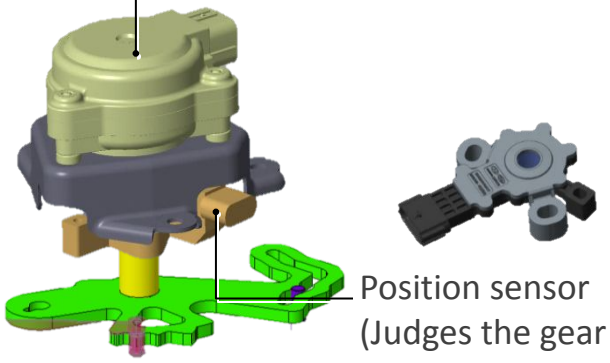
Electric type + position sensor



- Shifters are classified largely as the SBC type and SBW type, depending on the operating principle.

Components

- **Implementation of SBW system achieved without changing the structure of the cable-type shifter**



※ Position sensor data

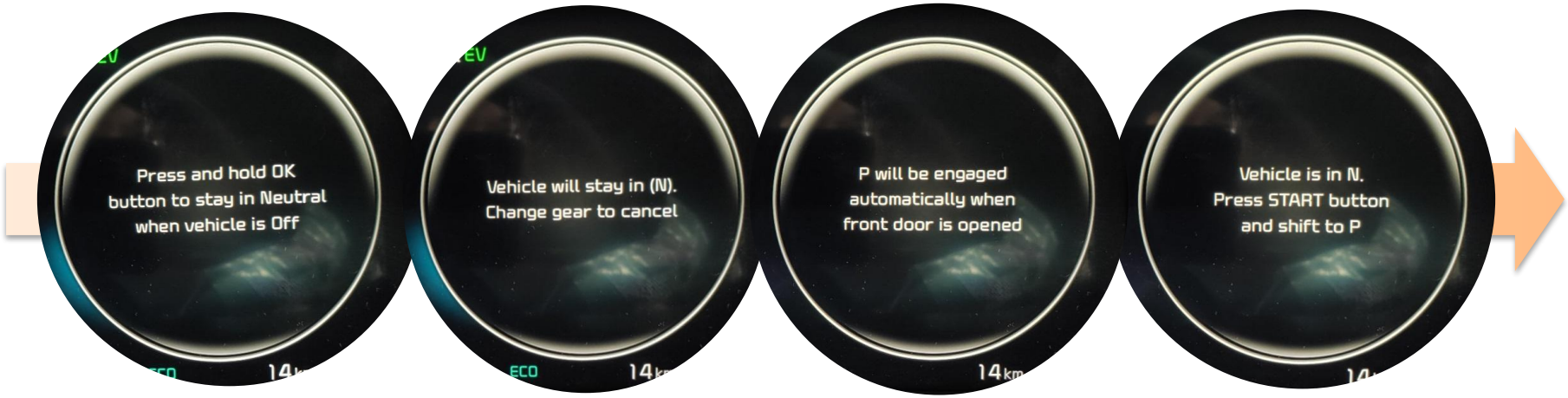
Position of pos. sensor 1	37.6	%
Position of pos. sensor 2	62.4	%
Target gear range	N	-
Current gear range	N	-

Category	P	R	N	D
S1	83.7%	54.5%	37.6%	20.4%
S2	16.3%	45.5%	62.4%	79.6%

- SBW actuator: Operates the three-phase motor and judges the gear range through the internal sensors (relative value)
- Position sensor: Judges the gear range based on the dual PWM signal values (absolute value) (It performs the same functions as the SBC-type inhibitor switch)
- The dial type is used (Same as the Gen3 Optima)

Control

- **Neutral Staying Mode**
  - Keeps the power in “ACC” position and gear in “N” position while automatic washing of the vehicle is in progress



Sequence for ‘Neutral Staying Mode’

① ENG ON

② Shift to ‘N’

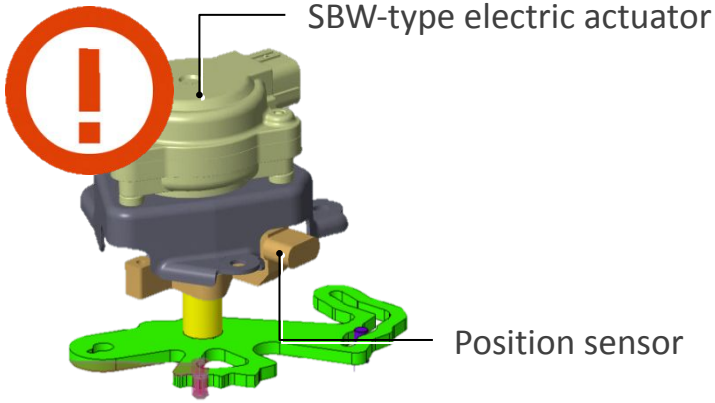
③ Release Brake pedal

④ Hold ‘OK’

⑤ IG OFF & ACC ON

Diagnosis

- **Failsafe**
  - Allows the vehicle to continue to run even when there is a failure in the SBW actuator or position sensor



- If a system failure occurs, the current gear range is maintained (D or R)
- How can the driver recognize the failure and stop the vehicle?

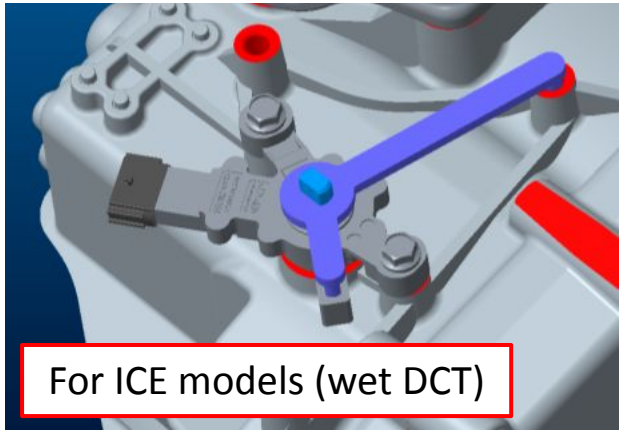
  ① Keep the brake on (It is not possible to engage the P position)

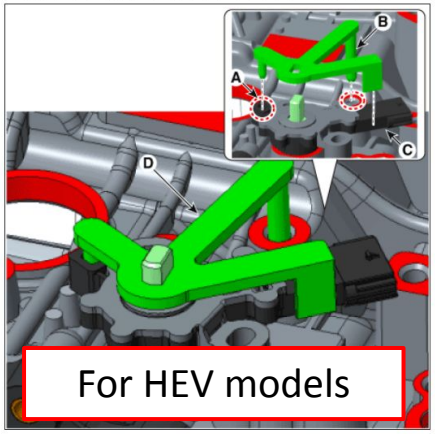
  ② Shift to N-range (The TCU determines the driver's input and cancels the delivery of drive force)

  - Note that the cluster displays a fixed gear range if a failure is present

Diagnosis

- **N-range setting**
  - Gear range alignment requires an “N-range setting jig.”





- The SBW actuator or position sensor can be replaced separately
- When replacing the position sensor, you should use a separate jig to set the N-range
  - ICE models: Use a separate jig (Production is in progress now)
  - HEV models: Use 09459-4G100 which is the jig specific to the large size (It cannot be used interchangeably with 4G200 which is specific to the medium size)
  - N-range setting is not required if the SBW actuator is only replaced

M5

Drivetrain System

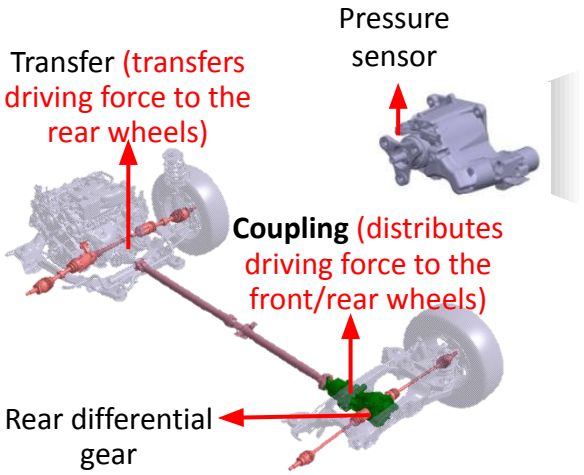
Lesson 3.

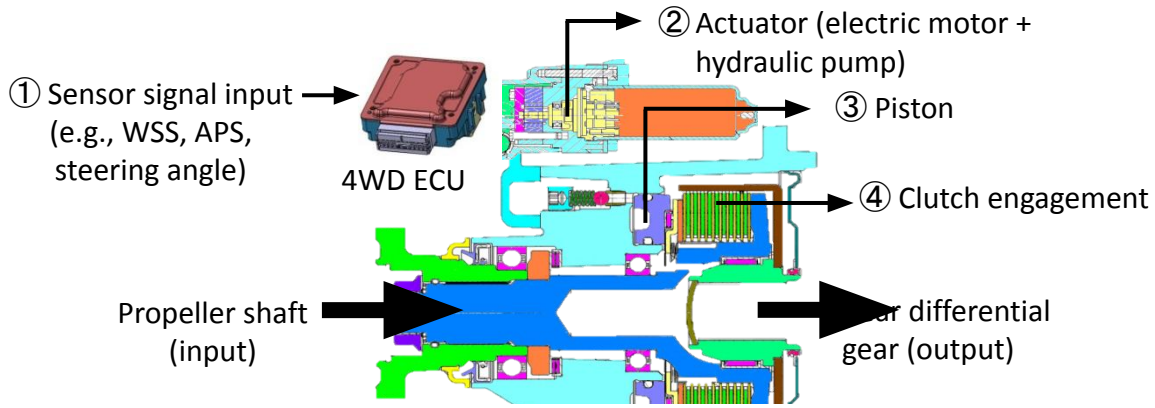
AWD

Overview

▪ FWD-type (FF) AWD system

※ The operating principle is the same as the conventional UM

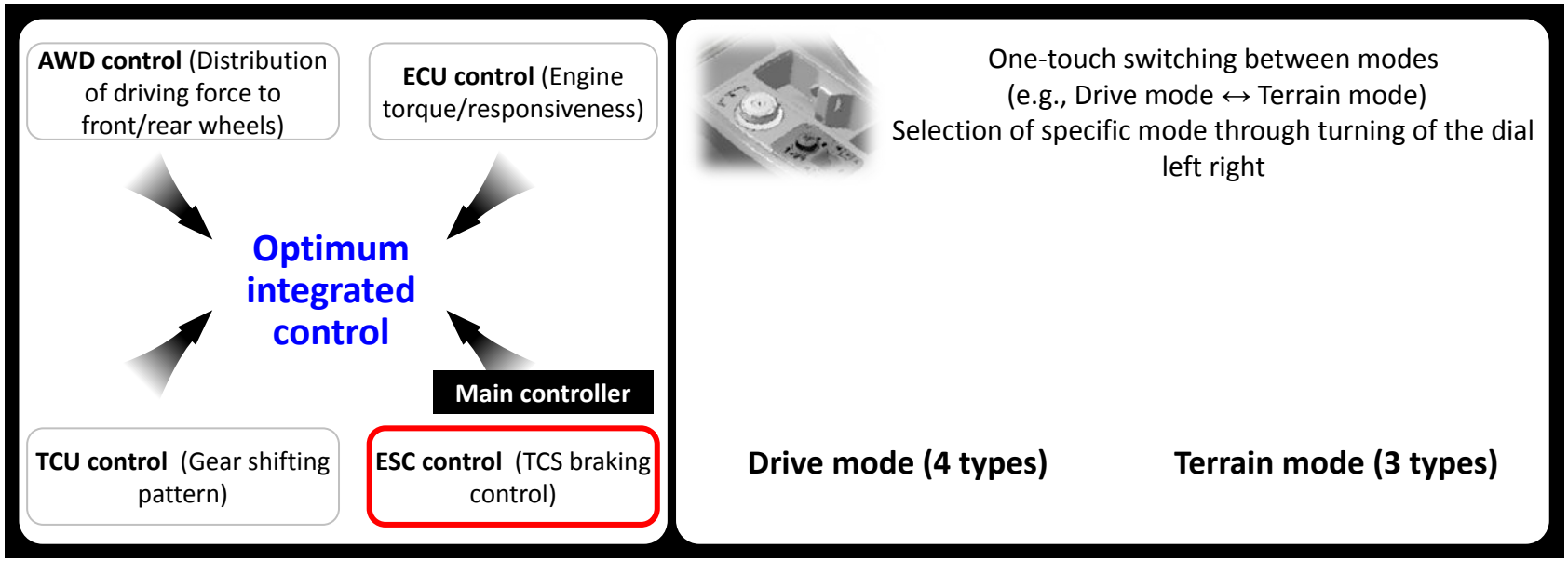




- Varies the drive force, transmitted to the rear wheels, by precisely controlling the clutch engaging force through adjustment of hydraulic pressure generated when the motor is driven
- Equipped with a separate pressure sensor which detects the hydraulic pressure generated
- Features a terrain mode and has no “4WD LOCK” (fixes the front/rear-wheel driving force ratio at 50:50) switch (except the USA)
- The HEV model also has the AWD system (first in Kia)

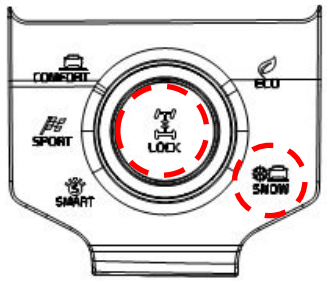
Control

- **Terrain mode**
  - Improves the driving performance through optimum integrated control to suit the road surface (e.g., snow, mud, sand) characteristic



- Integrated control of the engine, transmission, ESC, and AWD to suit the road surface characteristic
- Activation/deactivation of terrain mode by ESC
- Available in some AWD vehicle models only:

  - Sorento (MQ4), Telluride (ON)



<MQ4 model sold in USA>
LOCK and SNOW modes are available