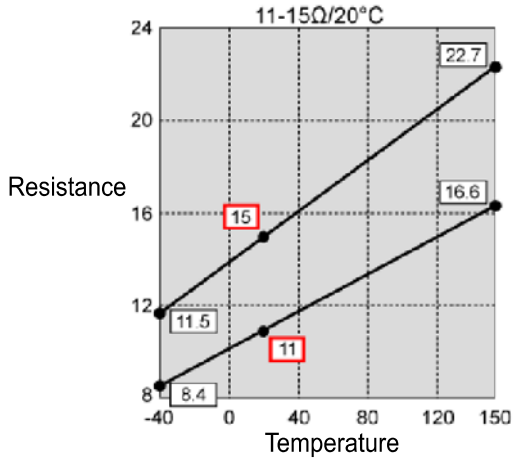
6 SPEED AUTO TRANSAXLE

3690-01

GENERAL INFORMATION

1. SPECIFICATIONS

Items		Specifications	
Classification		G16DF	D16DTF
Max. torque		220 Nm	400 Nm
Oil level		Overflow type	
Manual shift control		Yes	
Stall rpm		2800rpm±150rpm	
Fluid	Type	AW-1	
	Capacity	6.1L	7.0L
	Change interval	Maintenance-free, change-free (However, check and change at every 100,000 km of driving under demanding conditions)	
Gear ratio	1st gear	4.044	4.148
	2nd gear	2.371	2.370
	3rd gear	1.556	1.556
	4th gear	1.159	1.155
	5th gear	0.852	0.859
	6th gear	0.672	0.686
	Reverse	3.193	3.394
	Counter	1.061	0.942
	Differential	3.867	3.533

<table>
<tr><th colspan="3">Items</th><th colspan="5">Specifications</th></tr>
<tr><td colspan="2" rowspan="5">Configuration of disc clutch
*( ) D16DTF</td><td>Specific name</td><td>Flange</td><td>Disc</td><td>Plate</td><td>Band</td></tr>
<tr><td>C1</td><td>1 (2) ea</td><td>5 (7) ea</td><td>5 (6) ea</td><td>-</td></tr>
<tr><td>C2</td><td>1 (1) ea</td><td>4 (4) ea</td><td>4 (4) ea</td><td>-</td></tr>
<tr><td>C3</td><td>1 (1) ea</td><td>3 (4) ea</td><td>3 (4) ea</td><td>-</td></tr>
<tr><td colspan="2" rowspan="2">Configuration of disc brake
*( ) D16DTF</td><td>B1</td><td>-</td><td>-</td><td>-</td><td>1 (1) ea</td></tr>
<tr><td>B2</td><td>2 (2) ea</td><td>5 (6) ea</td><td>4 (5) ea</td><td>-</td></tr>
<tr><td colspan="2">Configuration of one-way clutch</td><td>F1</td><td colspan="4">Roller type</td></tr>
<tr><td colspan="2">Planetary gear unit</td><td colspan="5">2 EA</td></tr>
<tr><td rowspan="2">Solenoid</td><td>Shift solenoid</td><td colspan="5">2 EA (S1 and S2)</td></tr>
<tr><td>Linear solenoid</td><td colspan="5">6 EA (SLC1, SLC2, SLC3, SLB1, SLT and SLU)</td></tr>
<tr><td colspan="2">Shift solenoid
[S1, S2]</td><td colspan="5"> 
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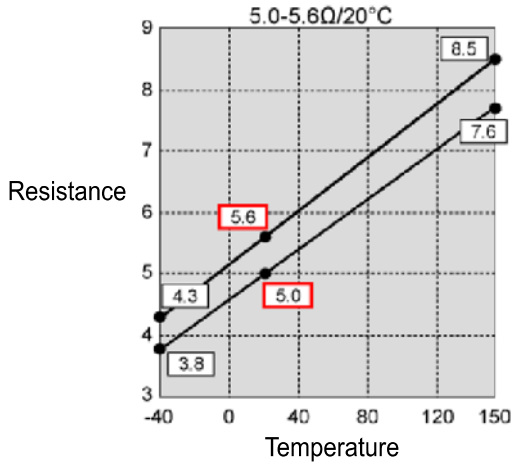
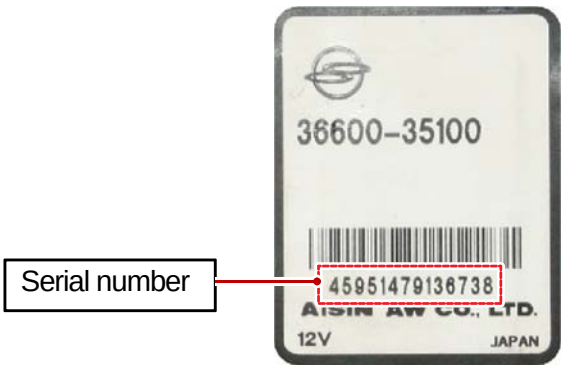
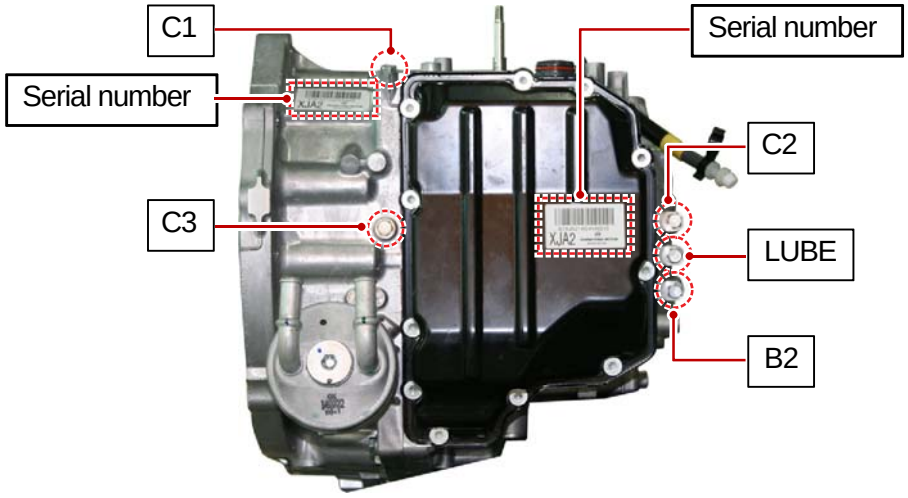
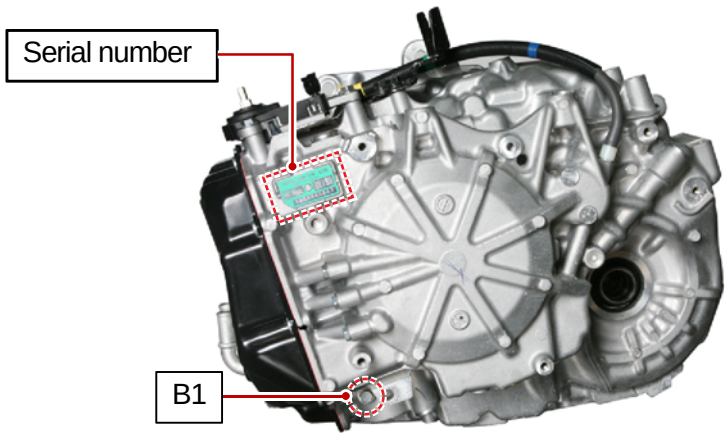
[SLC1, SLC2, SLC3,
SLB1, SLT, SLU</td><td colspan="5"> 
</td></tr>
</table>

Modification basis	
Application basis	
Affected VIN	

Item			Specification
Line pressure	Idle	D	350~520 (kPa)
Input speed sensor Output speed sensor	High		12 mA ~ 16 mA
	Low		4 mA ~ 8 mA
Oil temperature sensor resistance	-40°C		Max. 161 kΩ
	-30°C		36.3 kΩ to 52.1 KΩ
	10°C		5.626 kΩ to 7.303 KΩ
	25°C		3.5 kΩ
	110°C		0.224 kΩ to 0.271 KΩ
	145°C		0.102 kΩ to 0.121 KΩ
	150°C		Min. 0.087 kΩ

A/T serial number	
TCU serial number	
Serial number positions for test plug and A/T	 

Modification basis	
Application basis	
Affected VIN	

2. ESSENTIAL TIGHTENING TORQUES

Item	Tightening torque (Nm)	Size x Number
Oil drain plug	34.0 ~ 60.0	Hexagon 17 mm X 1 ea
Oil overflow tube	5.9 ~ 8.8	T-40 mm X 1 ea
Oil filler plug	23.5 ~ 54.9	T-55mm X 1 ea
A/T side cover	17.0 ~ 20.0 (9.8 ~ 15.7)	T-40 mm X 11 ea
Valve body assembly	8.0 ~ 12.0	10 mm X 3 ea (5 ea)
		10 mm X 5 ea (1 ea)
Suction cover(D16DTF only)	(8.0 ~ 12.0)	(10mm X 2 ea)
Oil temperature sensor	6.0 ~ 8.0	8 mm X 1 ea
Valve body wire clamp (G16DF only)	6.0 ~ 8.0	8 mm X 1 ea
Input speed sensor	3.9 ~ 6.9	10 mm X 1 ea
Oil cooler	33.3 ~ 39.2 (39.2 ~ 45.1)	Hexagon 10 mm X 1 ea
TCU	19.6 ~ 29.4	12 mm X 3 ea
Test plug	5.9 ~ 8.8	12 mm X 6 ea (5 ea)
Torque converter	44 ~ 51	13 mm X 6 ea

* ( ) D16DTF

1) Oil Seal

Item	Specification (oil seal depth)
Manual shaft	- 0.3 to 0.4 mm
Oil pump	- 0.2 ~ 0.2 mm

▶ **Transmission diff. oil seal**

Engine	T/C	Specification (oil seal depth)	
		Housing	Case
G16DF	2WD	3.9 ± 0.5 mm	2.7 ± 0.5 mm
	AWD	6.4 ± 0.5 mm	
D16DTF	2WD	15.3 ± 0.5 mm	3.5 ± 0.5 mm
	AWD	5.5 ± 0.5 mm	

2) Distance Between A/T Housing And Torque Converter

Item	Specification
Distance between A/T housing and torque converter	12.15 mm or longer

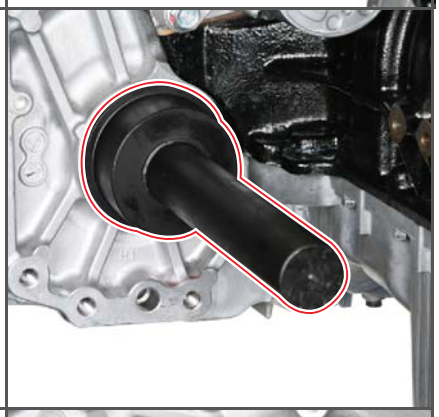
3) Acronyms And Abbreviations

Abbreviations	Description
C1	Clutch1
C2	Clutch2
C3	Clutch3
B1	Brake1
B2	Brake2
F1	One-way clutch
S1	Shift solenoid1
S2	Shift solenoid2
SLC	Shift control solenoid (clutch)
SLB	Shift control solenoid (brake)
SLT	Line pressure control solenoid
SLU	Lock-up control solenoid

3. SPECIAL TOOLS

PN & Name	Special Tool	Use
PN: X9936 0080A **Name:** AISIN 6 A/T housing bottom oil filler adapter **Use:** Oil filler adapter for filling with oil at AISIN 6 A/T housing bottom		
PN: X9936 0090A **Name:** AISIN 6A/T oil seal installer (RH side) **Use:** For fitting G16DF-2WD A/T RH oil seal		
PN: X9936 0100A **Name:** AISIN 6A/T oil seal installer (LH side) **Use:** For fitting G16DF-2WD/AWD A/T LH oil seal		
PN: X9936 0110A **Name:** AISIN 6A/T oil seal installer (oil pump) **Use:** For fitting A/T oil pump oil seal		

PN & Name	Special Tool	Use
PN: X9936 0120A **Name:** AISIN 6 A/T oil seal installer (manual shaft) **Use:** For fitting A/T manual shaft oil seal		
PN: X9936 0130A **Name:** AISIN 6A/T oil seal puller (LH & RH side) **Use:** For removing A/T LH & RH oil seal		
PN: X9936 0140A **Name:** AISIN 6 A/T oil seal puller (oil pump) **Use:** For removing A/T oil pump oil seal		
Name: AWD-A/T deep oil seal installer (RH) (G16DF-AWD A/T only) **Use:** For fitting G16DF-AWD A/T RH oil seal **Selling:** http://www.toolntech.com		

PN & Name	Special Tool	Use
Name: 2WD-A/T deep oil seal installer (RH) (D16DTF-2WD A/T only) **Use:** For fitting D16DTF-2WD A/T RH oil seal **Selling:** http://www.toolntech.com		
Name: AWD-A/T deep oil seal installer (RH) (D16DTF-AWD A/T only) **Use:** For fitting D16DTF-AWD A/T RH oil seal **Selling:** http://www.toolntech.com		
Name: 2WD/AWD-A/T deep oil seal installer (LH) (D16DTF-2WD/AWD A/T only) **Use:** For fitting D16DTF-2WD/AWD A/T LH oil seal **Selling:** http://www.toolntech.com		

4. DIAGNOSIS ITEMS FOR EACH SYMPTOM

	Symptoms / Possible cause	Poor shift/slip			Shift time lag		Engine stall					Poor up/down shift									
		D position	R position	Slip when accelerating	N to D	D to N	N to D	D to N	Slow down	Starting difficulty	Poor acceleration	1st, 2nd poor gear shift	2nd, 3rd poor gear shift	3rd, 4th poor gear shift	4th, 5th poor gear shift	5th, 6th poor gear shift	Poor lock-up	Poor engine brake	Poor kick-down	Poor shift	Poor manual shift
ENGINE	Engine fault			O			O	O	O	O	O	O	O	O	O	O					
	Drive plate vibration																				
	Engine/transmission mounting																				
	Exhaust system resonance																				
CHASSIS	Drive shaft vibration																				
	Tire imbalance																				
	Drive train interference																				
	Faulty suspension system																				
ELECTRICAL DEVICE	Battery voltage low/high									O		O	O	O	O	O	O	O			
	Input speed sensor[NIN]											O	O	O	O	O	O			O	
	Output speed sensor[SP]											O	O	O	O	O	O				
	Oil temperature sensor[OT]											O	O	O	O	O	O				
	Shift solenoid[S1]		O									O	O	O				O			
	Shift solenoid[S2]		O											O				O			
	Shift control solenoid[SLC1]	O													O	O					
	Shift control solenoid[SLC2]										O			O							
	Shift control solenoid[SLC3]		O								O		O	O	O	O					
	Shift control solenoid[SLB1]										O	O	O	O	O	O					
	Line pressure control solenoid[SLT]			O																	
	Lock-up control solenoid[SLU]						O	O	O								O				
	Manual mode switch																				O
	Brake switch																				
	TCU	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
CAN COMM	Accelerator pedal position signal																				
	Engine torque signal																				
	Engine rpm signal																				
	Engine coolant temperature signal																				
	Brake pedal signal																				
	Wheel speed signal																				
	Brake pressure signal																				
RELEVANT PARTS	Shift cable fault	O	O	O	O	O				O											
A/T	Torque converter	O	O	O			O	O	O		O										
	Oil seal	O	O	O	O	O															
	O-ring	O	O	O	O	O															
	FIPG(Sealant)	O	O	O	O	O															
	Oil cooler(A/T cooler)	O	O	O	O	O															
	Valve body	O	O	O	O	O	O	O	O		O	O	O	O	O	O	O	O			
	Transmission internal failure	O	O	O	O	O					O	O	O	O	O	O	O	O			
OIL	Overheated oil	O	O	O	O	O					O	O	O	O	O	O	O				
	Insufficient oil	O	O	O	O	O					O	O	O	O	O	O	O	O			
	Inadequate transmission oil	O	O	O	O	O					O	O	O	O	O	O	O				

Modification basis	
Application basis	
Affected VIN	

Symptoms / Possible cause		Oil leakage									Poor shift						Vacuum/noise				
		Intermittent	Between engine and housing	Between transmission case and housing	Oil pump oil seal	To differential oil seal housing	To differential oil seal case	Manual shift oil seal	O-ring	Oil cooler	N to D	N to R	Up shift	Down shift	Kick-down	Poor acceleration	Idling	Parking	Driving	Up/Down shift	Poor acceleration
ENGINE	Engine fault		O													O	O	O	O	O	O
	Drive plate vibration																				
	Engine/transmission mounting																O	O	O	O	O
	Exhaust system resonance																O	O	O	O	O
CHASSIS	Drive shaft vibration																		O	O	O
	Tire imbalance																		O		O
	Drive train interference																O		O	O	O
	Faulty suspension system																O		O	O	O
ELECTRICAL DEVICE	Battery voltage low/high										O	O	O	O	O						
	Input speed sensor[NIN]																				
	Output speed sensor[SP]																				
	Oil temperature sensor[OT]										O	O	O	O	O						
	Shift solenoid[S1]																				
	Shift solenoid[S2]																				
	Shift control solenoid[SLC1]										O		O	O	O						
	Shift control solenoid[SLC2]												O	O	O						
	Shift control solenoid[SLC3]											O	O	O	O						
	Shift control solenoid[SLB1]										O	O	O	O	O						
	Line pressure control solenoid[SLT]													O							
	Lock-up control solenoid[SLU]																				
	Manual mode switch																				
	Brake switch																				
	TCU										O	O	O	O	O						
CAN COMM	Accelerator pedal position signal																				
	Engine torque signal																				
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	Engine coolant temperature signal																				
	Brake pedal signal																				
	Wheel speed signal																				
	Brake pressure signal																				
RELEVANT PARTS	Shift cable fault																				
A/T	Torque converter		O																		
	Oil seal		O		O	O	O	O													
	O-ring								O	O											
	FIPG(Sealant)			O																	
	Oil cooler(A/T cooler)									O											
	Valve body										O	O	O	O	O						
	Transmission internal failure	O									O	O	O	O	O			O	O	O	O
OIL	Overheated oil										O	O	O	O	O		O	O		O	
	Insufficient oil										O	O	O	O	O						
	Inadequate transmission oil										O	O	O	O	O			O		O	

5. CAUTIONS FOR OPERATION & HANDLING

CAUTION

1) Cautions For Working On Electronic Parts

- Before replacing the electronic parts, turn the ignition off and remove the negative (-) terminal from the battery.
- Release the lock part first, and remove the connector. (prevent wiring from being pulled)
- Make sure that the connector is locked fully until a click is heard.
- Do not subject the electronic parts to impact. If it is dropped or subjected to impact, you must replace it with a new one.

2) Handling Component With Care

- Do not store the A/T under the poor surroundings for a long time. (Long-term storage at high humidity causes the corrosion of the internal parts)
- Before installation, remove the shipping cap. Do not store the components for a long time, with the shipping cap removed.
- Do not put the A/T directly on the floor.

3) Dirt-protecting

- When removing the relevant components from the A/T, remove any dirt, sand and etc. completely.
- Place the components into the plastic bag or similar.
- When performing the work, do not use a cotton gloves or cloth, instead bare hands or plastic gloves should be used.

4) To Protect Components From Damage

- When using the plastic hammer to remove the components, tap lightly it. (Do not use the screwdriver as a leverage.)
- Do not pull the components such as the valve with an excessive force.
- Ensure refit the components without being damaged.

5) Cleaning

- All the components should be thoroughly cleaned, dried with a compressed air and applied the oil only for A/T.
- Do not use an alkaline based cleaner to clean the aluminum and rubber parts.
- Do not use the waxing oil (unleaded gasoline) to clean the rubber part.

6) Cautions For Handling ATF

- Do not discharge the ATF when it is hot. (wait until it has cooled down)
- Wipe off any spilled AFT immediately since the floor is slippery and dangerous.
- Make sure to use the oil only for AW-1.

Modification basis	
Application basis	
Affected VIN	

OVERVIEW AND OPERATING PROCESS

1. SPECIFICATIONS

The auto transaxle used for this vehicle is FF type 6 speed auto transaxle, which performs the lock-up control self-learning control and manual shift control. The TCU is integrated into the non-contact type shift position sensor, fitted to top of the A/T and uses a external oil cooler.

▶ Lock-up control

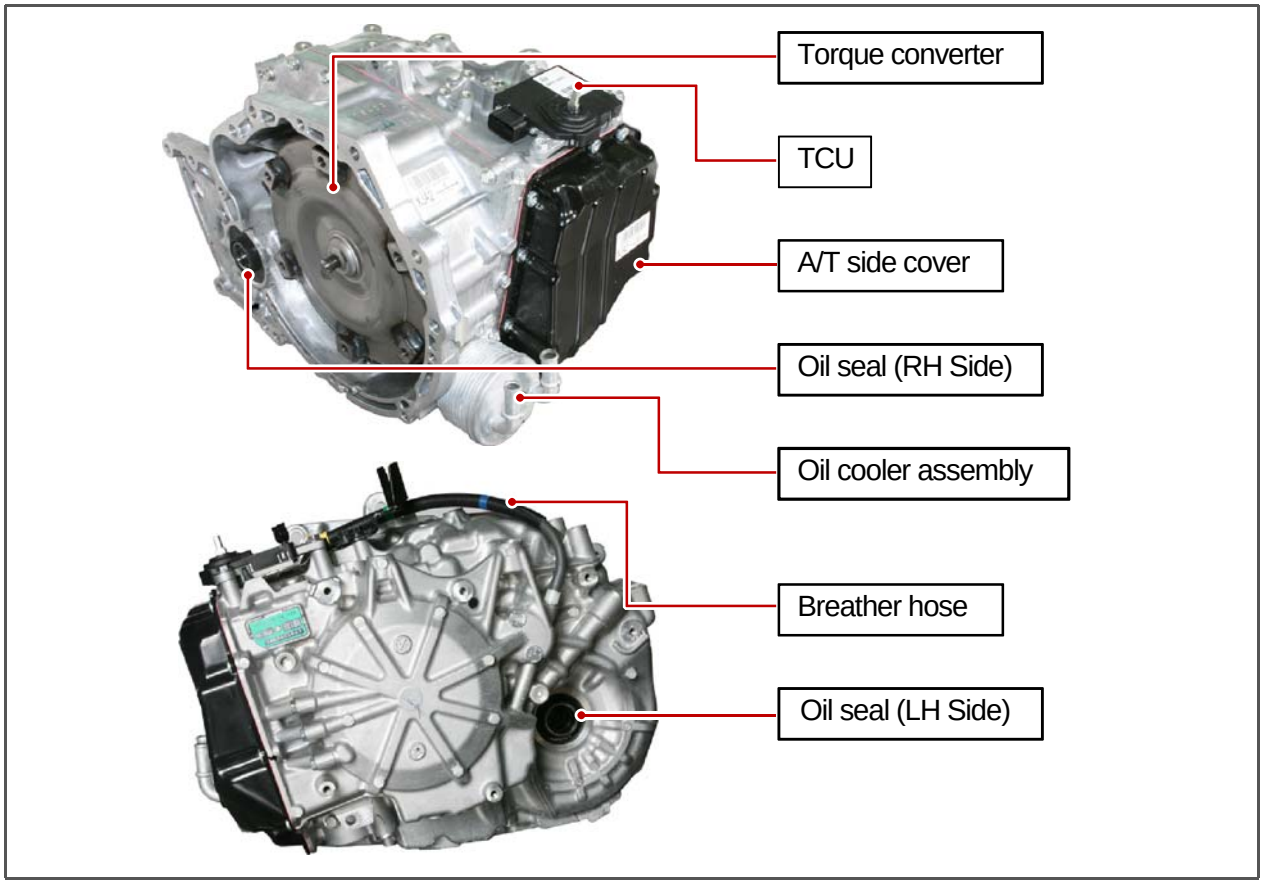
The output rpm signal, engine ECU (engine rpm and throttle opening) signals and vehicle speed are used for smooth lock-up control.

▶ Self-learning control

The TCU performs the shift control learning and stationary-vehicle control learning to provide the smooth clutch engagement during gear shift and the smooth and delicate shift during driving.

▶ Manual shift control

The driver can choose the desired gear by moving the shift lever from "D" range to manual shift position and operating the tip switch + (up shift) or - (down shift) and feel the sportiness as in the manual transmission.



2. TCU CONTROL FUNCTION

1) Automatic Gear Change Control

The automatic gear change control turns S1 and S2 on or off and operates the SLC1, SLC2, SLC3 and SLB1 linearly according to the vehicle speed, throttle opening, information on brake signal, based on the each gear pattern.

▶ **Gear & solenoid operation**

O: On (current on) / - : OFF (current off)

Item	Linear solenoid				Shift solenoid	
Gear	SLC1 (N.C)	SLC2 (N.O)	SLC3 (N.O)	SLB1 (N.C)	S1 (N.O)	S2 (N.C)
P, N	-	O	O	-	O	-
R	-	O	-	-	O	-
1st	O	O	O	-	O	-
1st engine brake	O	-	O	-	-	O
2nd	O	O	O	O	O	-
3rd	O	O	-	-	O	-
4th	O	-	O	-	O	-
5th	-	-	-	-	O	-
6th	-	-	O	O	O	-

N.O: Normal Open
N.C: Normal Close

2) Manual Shift Control

Moving the shift lever from "D" position to manual shift position and changing to + (up shift) or - (down shift) allows the driver to choose the required gear and feel the sportiness as in the manual transmission. However, the TCU performs the lock-up control by up-shifting automatically and by down-shifting during deceleration, in order to prevent the excessive rpm increase.

Modification basis	
Application basis	
Affected VIN	

3) Neutral Control (N control)

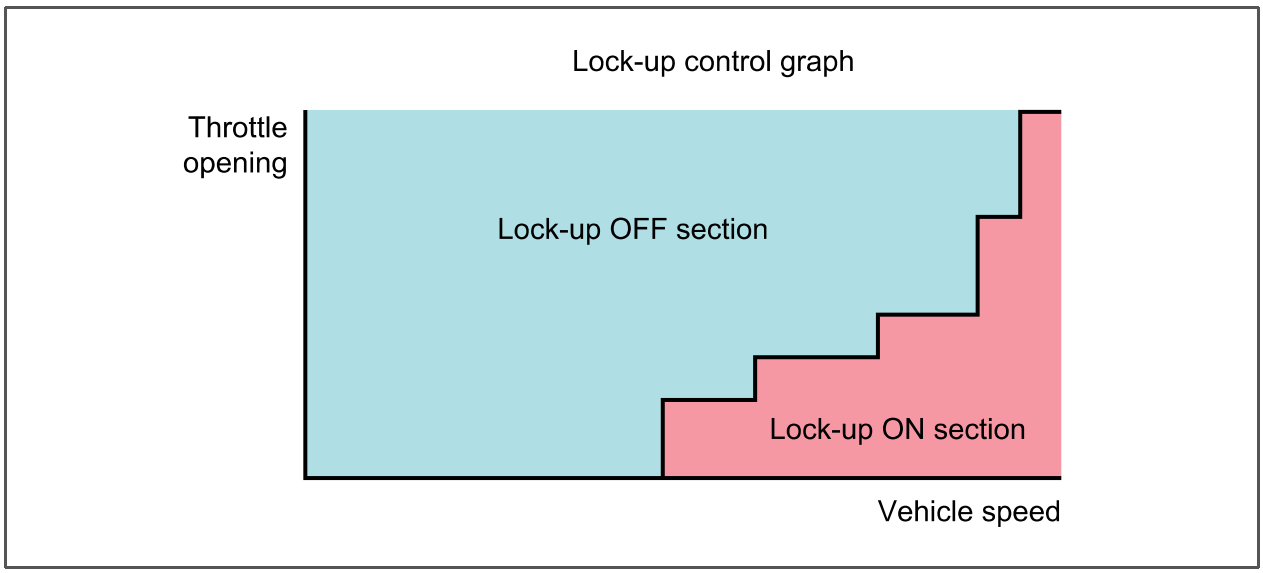
If the vehicle stands to still with the selector lever in D, the transmission enters neutral by releasing the clutch. This helps to reduce the engine load, improve fuel economy and reduce the vibration during idling by reducing the drag loss of the torque converter.

NOTE

- During neutral control, the C1 clutch is controlled by the linear solenoid independently.
- During neutral control on an uphill climb, the creep force is not generated and the B1 brake is applied in order to prevent the vehicle from being pushed back and for safe vehicle start.
- The neutral control system operates when the engine is warmed up.
- The neutral control does not operate on a steep slope.

4) Lock-up Control

The smooth lock-up control is carried out through the linear control by the lock-up control solenoid [SLU], based on the signals from engine ECU (engine rpm and throttle opening) and vehicle speed signals



Control	Description
Lock-up control	The control is carried out by lock-up control solenoid [SLU]. It turns on or off the lock-up control solenoid valve [SLU] linearly. The lock-up clutch in the torque converter is operated and pump impeller is connected to the turbine runner. This connects the engine to the auto transaxle. The engine output is connected directly to the auto transaxle, reducing the loss of output and improving the fuel economy.

5) Stationary-Vehicle Control

When the shift lever is moved from "N" to "D" or "R" position after the engine is started, the shift control solenoids (SLC1, SLC2 and SLC3) delivers the oil pressure required by the C1 and C3 clutches and properly predefined oil pressure for smooth engagement to the clutch.

NOTE

The shift time lag occurs since the first piston stoke resistance increases at cold engine. In this case, the control is not performed to reduce the time lag. The impactless and smooth engagement is achieved by controlling the oil pressure according to the piston stoke.

6) Reverse Control

When the shift lever is moved from "D" to "R" position and the auto transmission is shifted to reverse during driving, the vehicle is extremely hazardous and the wheels become stuck. Therefore, the TCU prevents the transmission from shifting to reverse during driving.

NOTE

If the vehicle drives at higher speed of 11 km/h, the automatic transmission will not shift to reverse when the shift lever is moved "D" to "R" position. When this control is activated, the C3 clutch is released without operation of the shift control solenoid (SLC3) to prevent the automatic transmission from shifting to reverse. The reverse control has a higher priority than the shift control from "D" to "R" position.

7) Self-Diagnosis Function

The TCU monitors the status of communication on the electronic components including each sensor and ECU. In the event of malfunction, the TCU activates the warning lamp to warn the driver this and stores the fault as a diagnostic trouble code (DTC).

On-board diagnosis	If any fault occurs in the A/T, the TCU activates the warning lamp to inform the driver of this.
Off-board diagnosis	The TCU stores a DTC. The DTC and TCU data can be reviewed by connecting the diagnostic device.

8) Fail-Safe Function

If any fault occurs at the A/T system, the fail-safe function will be activated and the TCU outputs the control signal in order to get the vehicle to the nearest service center. If the shift solenoid is malfunctioning, the TCU will no longer output the control signal If this happens, the gear change will be controlled by the hydraulic circuit and the gear shifted from "R" position to reverse or from "D" position to 3rd.

Shift position	Gear position
"R"	Reverse
"D"	3rd gear

9) "N" Position Learning

If the automatic transmission or TCU has been replaced, you should initialize the learned value and perform the "N" position learning.

NOTE

Refer to [INITIALIZING/LEARNING PROCESS] for detailed information.

10) Initializing Learning

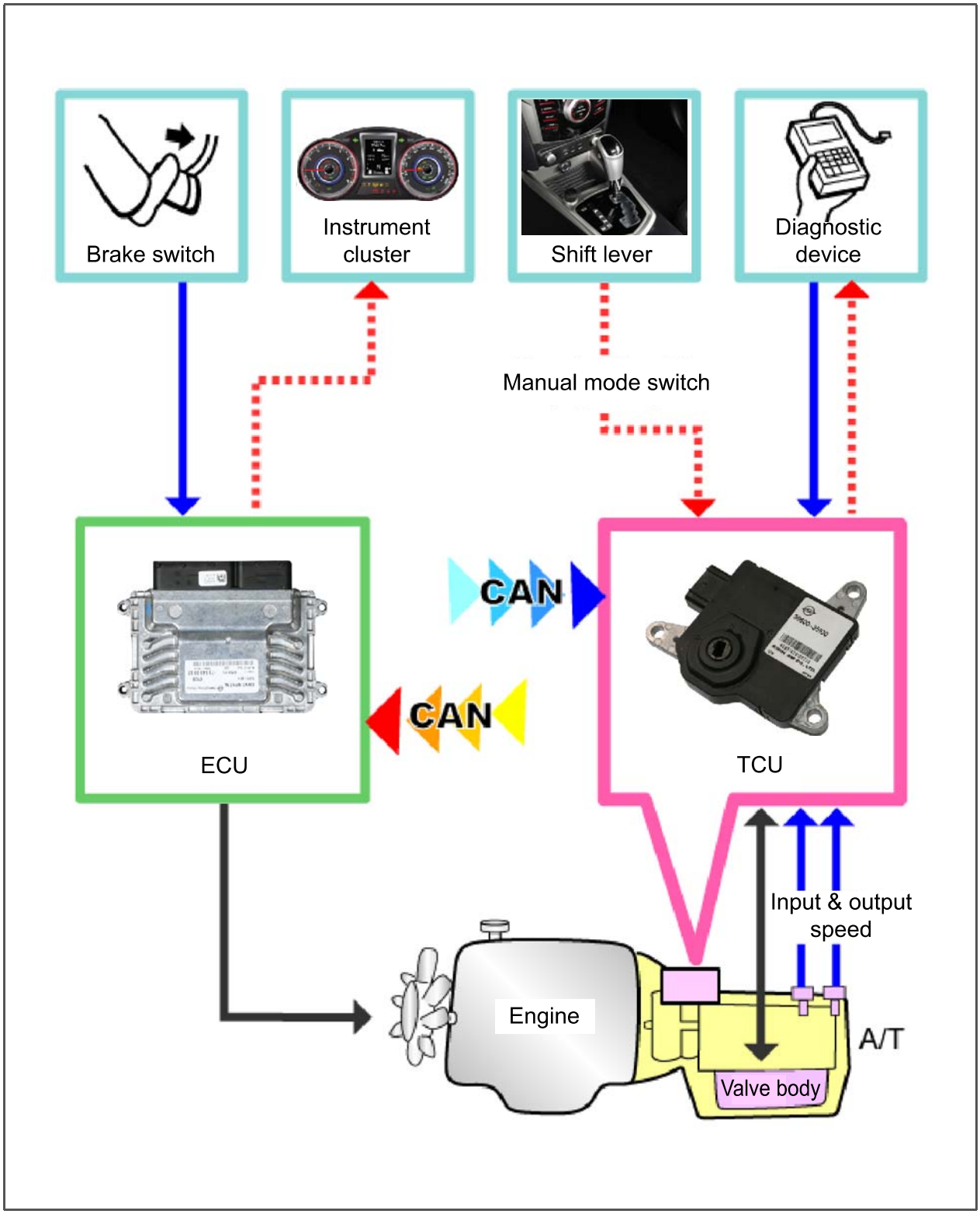
If the automatic transmission, TCU or ECU has been replaced or reprogrammed, you should initialize the TCU learned value and perform the initializing learning.

NOTE

Refer to [INITIALIZING/LEARNING PROCESS] for detailed information.

3. OPERATING COMPONENTS

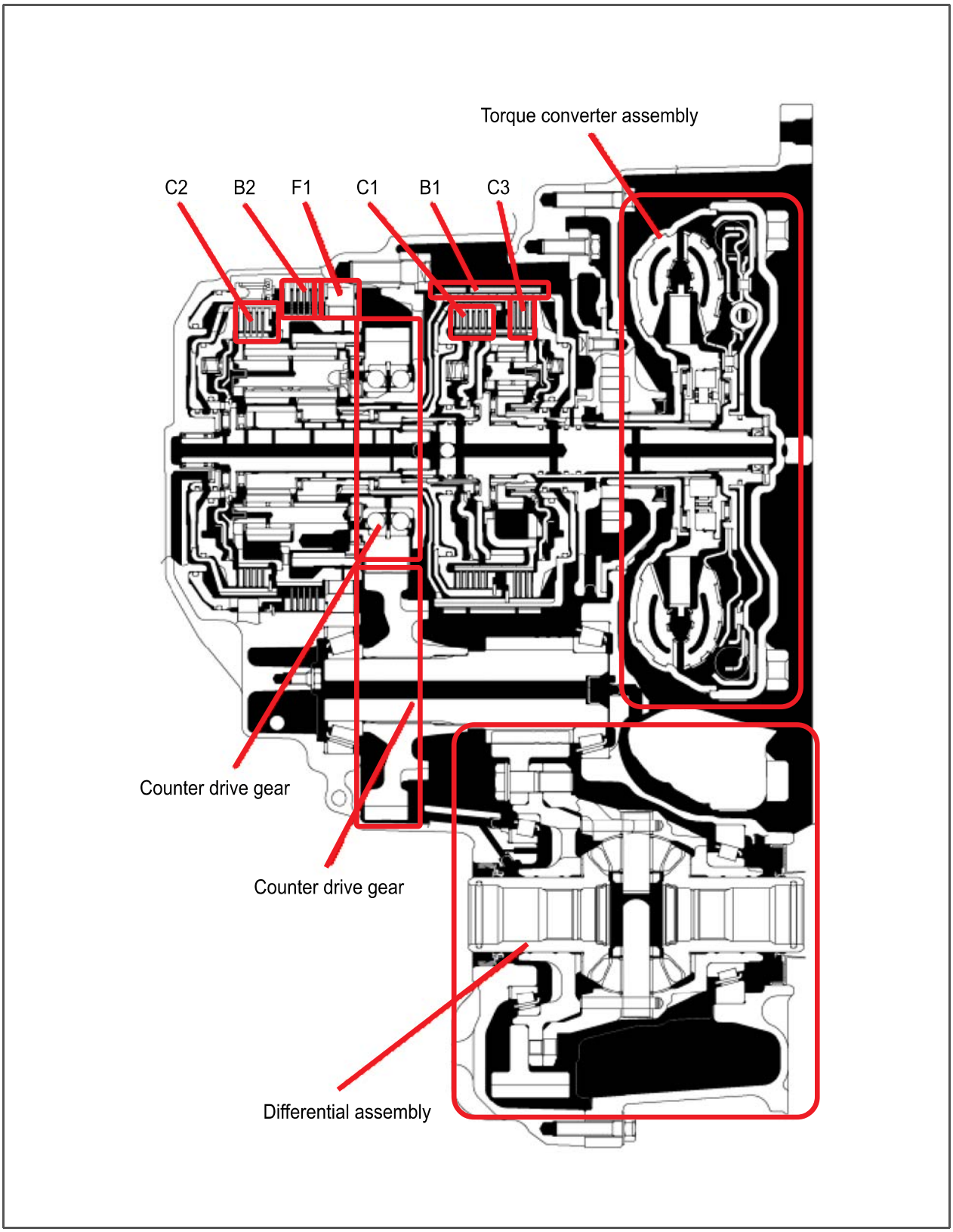
It is consisted of various sensors that retrieve the information required to determine the shift, the ECU that provides those values, the shift lever that inputs the driver's command to the TCU, the TCU that finally sends a shift command through the hydraulic control and etc.



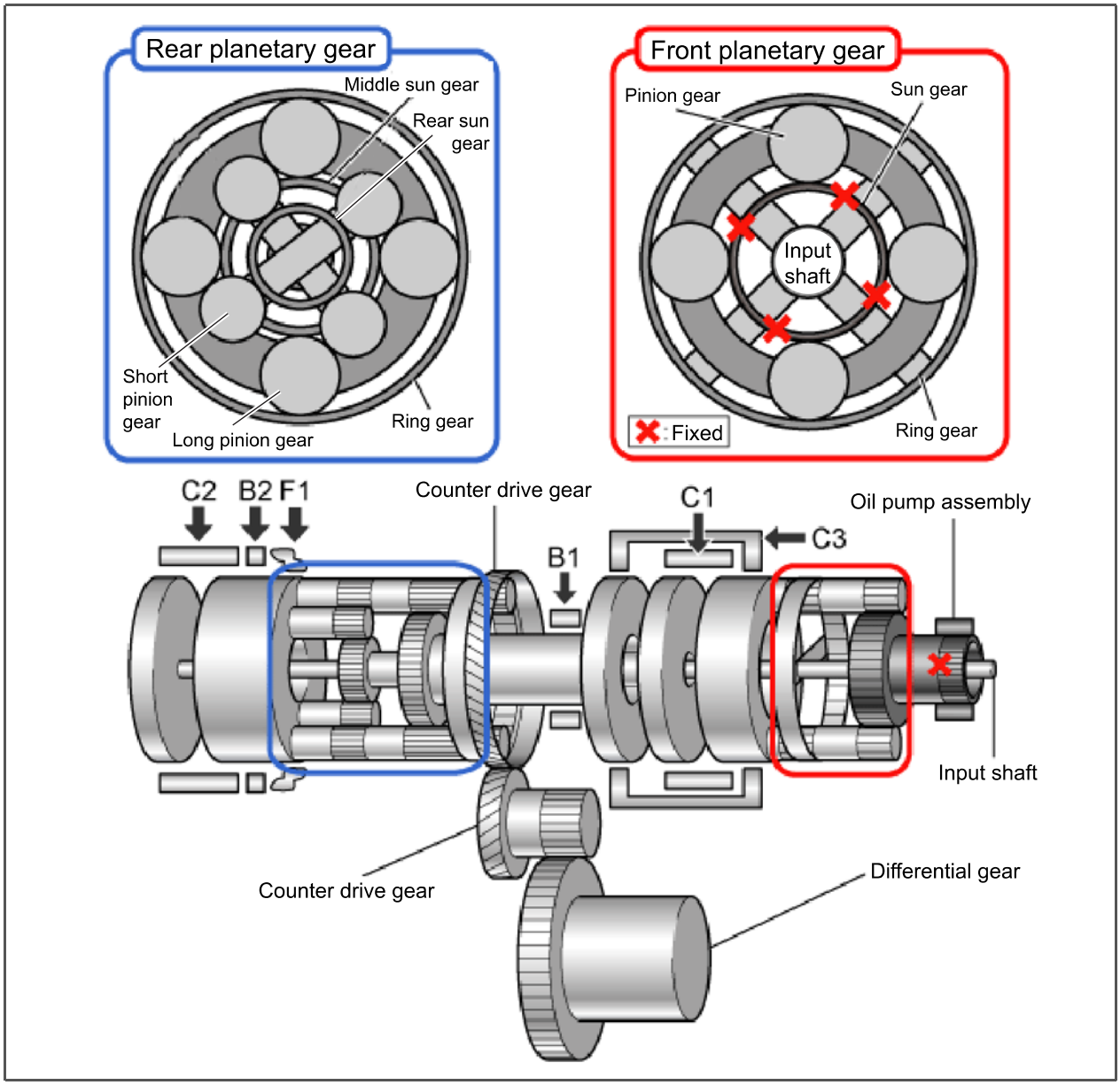
Modification basis	
Application basis	
Affected VIN	

4. OPERATING PROCESS

1) Component Parts



2) Configuration and Designation of Planetary Gear



Designation		Operation
Clutch	C1	Connects front planetary gear carrier to rear planetary gear sun gear
	C2	Connects input shaft to rear planetary gear carrier
	C3	Connects front planetary gear carrier to rear planetary gear middle sun gear
Brake	B1	Fix rear planetary gear middle sun gear
	B2	Fix rear planetary gear carrier
One-way clutch	F1	Prevents rear planetary gear carrier from rotating anti-clockwise

Modification basis	
Application basis	
Affected VIN	

3) Operation Element Chart

Gear position		Solenoid valve						Clutch			Brake		One-way clutch
		SLC1 (N.C)	SLC2 (N.O)	SLC3 (N.O)	SLB1 (N.C)	S1 (N.O)	S2 (N.C)	C1	C2	C3	B1	B2	F1
"P"		-	O	O	-	O	-	-	-	-	-	-	-
Reverse	V ≤ 11km/h	-	O	-	-	O	-	-	-	O	-	O	-
	V > 11km/h	-	O	O	-	O	O	-	-	-	-	-	-
"N"		-	O	O	-	O	-	-	-	-	-	-	-
1st		O	O	O	-	O	-	O	-	-	-	-	O
1st engine brake		O	-	O	-	-	O	O	-	-	-	O	O
2nd		O	O	O	O	O	-	O	-	-	O	-	-
3rd		O	O	-	-	O	-	O	-	O	-	-	-
4th		O	-	O	-	O	-	O	O	-	-	-	-
5th		-	-	-	-	O	-	-	O	O	-	-	-
6th		-	-	O	O	O	-	-	O	-	O	-	-

NOTE

The lock-up applies to from 2nd gear to 6th gear.

NOTE

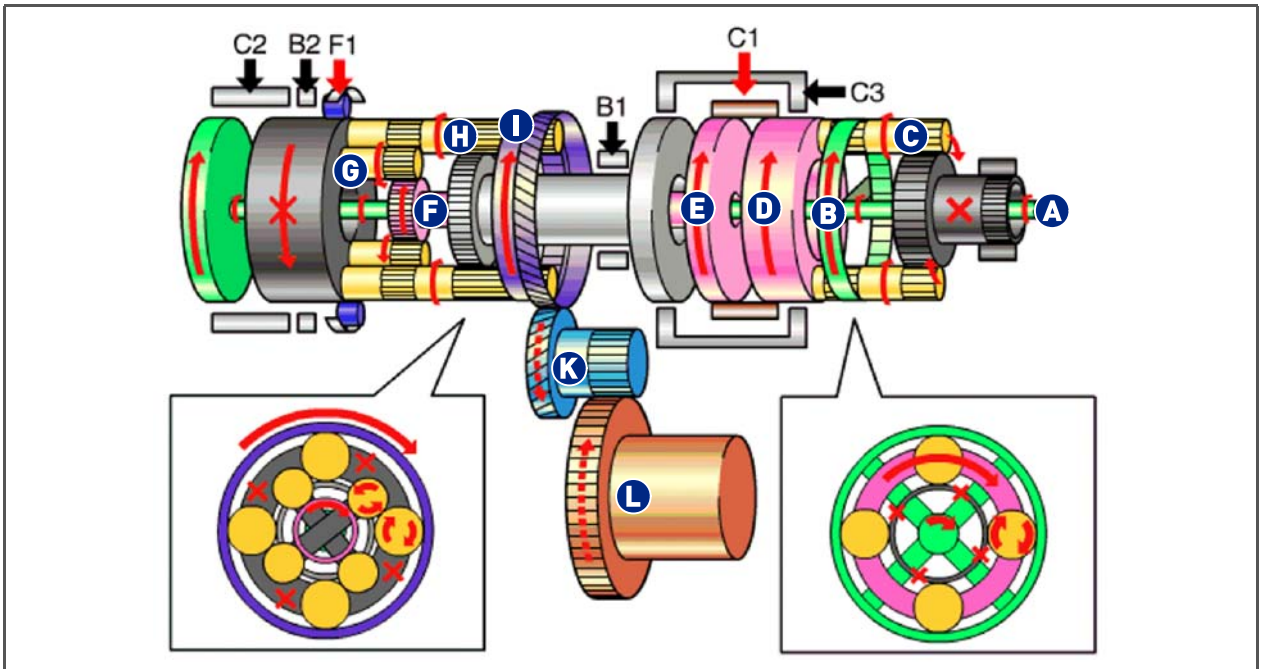
The B2 brake is operated only by the shift lever and the SLB2 solenoid does not exist.

5. POWER TRANSFER PROCESS

▶ 1st gear power transfer

A. Input shaft rotates clockwise (same revolutions as turbine runner in torque converter)
B. Front ring gear rotates clockwise (same revolutions as input shaft)
C. Front pinion gear rotates clockwise
D. Front sun gear is fixed and front planetary gear carrier rotates clockwise
E. C1 clutch engaged (front planetary gear carrier and rear sun gear are connected together and rotate clockwise)
F. Rear sun gear rotates clockwise
G. Rear short pinion gear rotates anti-clockwise
(Rear planetary gear carrier locks anti-clockwise by one-way clutch F1)
H. Rear long pinion gear rotates clockwise
I. Rear ring gear rotates clockwise by rear long pinion gear
K. Counter drive gear rotates anti-clockwise
L. Differential gear rotates clockwise

Gear position	Solenoid valve						Clutch			Brake		One-way clutch
	SLC1 (N.C)	SLC2 (N.O)	SLC3 (N.O)	SLB1 (N.C)	S1 (N.O)	S2 (N.C)	C1	C2	C3	B1	B2	F1
1st	O	O	O	-	O	-	O	-	-	-	-	O



-	Input	Fixed	Output
Front planetary gear	Ring gear	Sun gear	Carrier
Rear planetary gear	Rear sun gear	Carrier	Ring gear

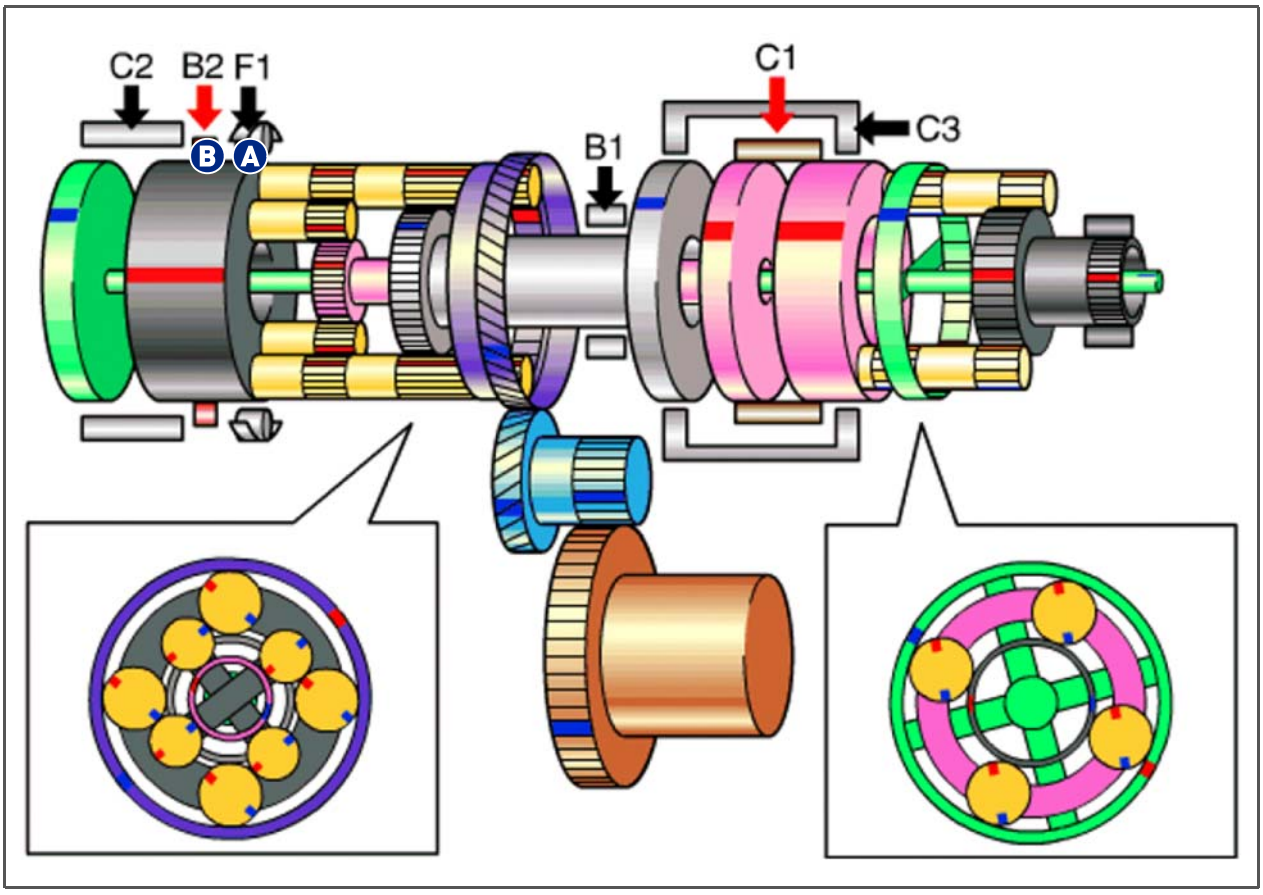
Modification basis	
Application basis	
Affected VIN	

▶ 1st engine brake power transfer

When the engine brake is operated, the drive power is transmitted from the tires.
The rear planetary gear carrier is fixed as follows:

A. F1 (one-way clutch): offsets anti-clockwise rotation power
B. B2 (brake): Operates (fix rear planetary gear carrier)

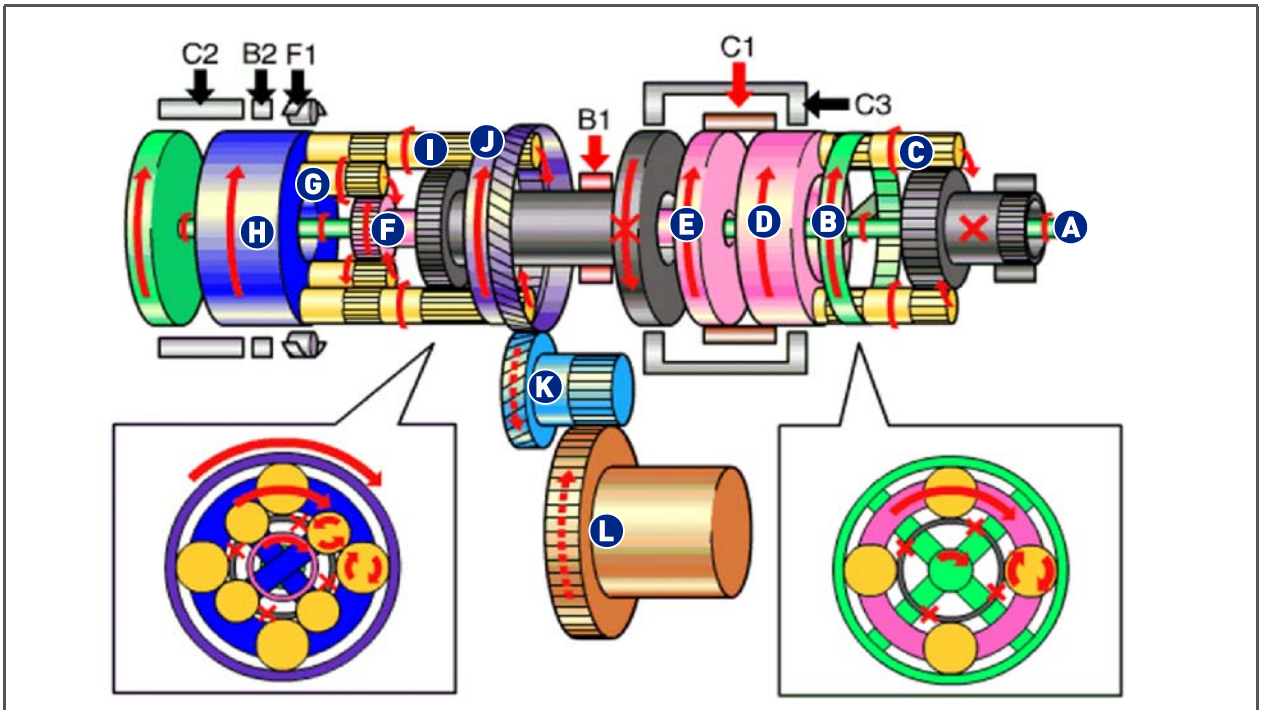
Gear position	Solenoid valve						Clutch			Brake		One-way clutch
	SLC1 (N.C)	SLC2 (N.O)	SLC3 (N.O)	SLB1 (N.C)	S1 (N.O)	S2 (N.C)	C1	C2	C3	B1	B2	F1
1st engine brake	O	-	O	-	-	O	O	-	-	-	O	O



▶ 2nd gear power transfer

A. Input shaft rotates clockwise
B. Front ring gear rotates clockwise
C. Front pinion gear rotates clockwise
D. Front sun gear is fixed and front planetary gear carrier rotates clockwise
E. C1 clutch engaged (front planetary gear carrier and rear sun gear are connected together and rotate clockwise)
F. Rear sun gear rotates clockwise
G. Rear short pinion gear rotates anti-clockwise
H. Middle sun gear is fixed by B1 brake and rear planetary gear carrier rotates clockwise
I. Rear long pinion gear rotates clockwise
J. Rear ring gear rotates clockwise by rear long pinion gear
K. Counter drive gear rotates anti-clockwise
L. Differential gear rotates clockwise

Gear position	Solenoid valve						Clutch			Brake		One-way clutch
	SLC1 (N.C)	SLC2 (N.O)	SLC3 (N.O)	SLB1 (N.C)	S1 (N.O)	S2 (N.C)	C1	C2	C3	B1	B2	F1
2nd	O	O	O	O	O	-	O	-	-	O	-	-



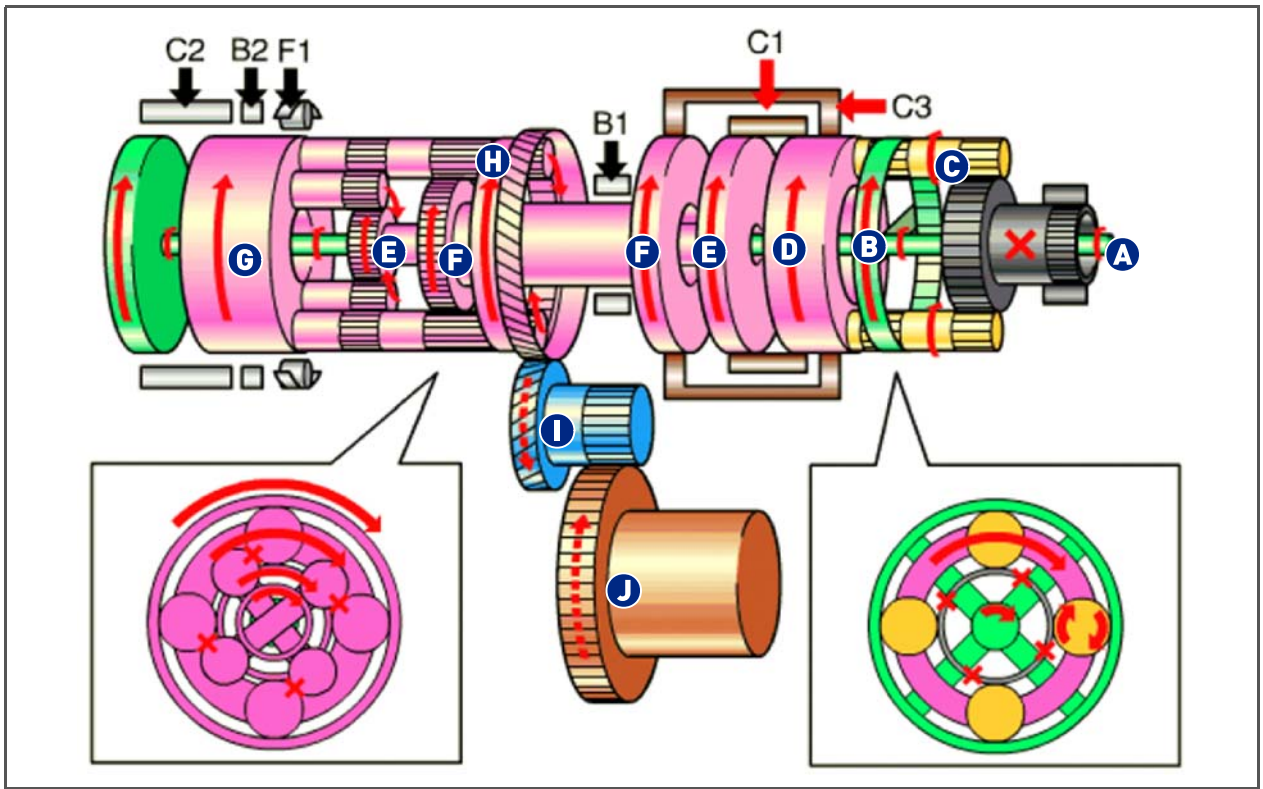
-	Input	Fixed	Output
Front planetary gear	Ring gear	Sun gear	Carrier
Rear planetary gear	Rear sun gear	Middle sun gear	Ring gear

Modification basis	
Application basis	
Affected VIN	

▶ 3rd gear power transfer

A. Input shaft rotates clockwise
B. Front ring gear rotates clockwise
C. Front pinion gear rotates clockwise
D. Front sun gear is fixed and front planetary gear carrier rotates clockwise
E. C1 clutch engaged (front planetary gear carrier and rear sun gear are connected together)
F. C3 clutch engaged (front planetary gear carrier and rear middle sun gear are connected together)
Rear short pinion and long pinion gears are fixed to body of revolution (rear sun gear and rear middle
G. sun gear) and rear planetary gear carrier rotates clockwise
Rear ring gear rotates clockwise by rear long pinion gear
H. Counter drive gear rotates anti-clockwise
I. Differential gear rotates clockwise
J.

Gear position	Solenoid valve						Clutch			Brake		One-way clutch
	SLC1 (N.C)	SLC2 (N.O)	SLC3 (N.O)	SLB1 (N.C)	S1 (N.O)	S2 (N.C)	C1	C2	C3	B1	B2	F1
3rd	O	O	-	-	O	-	O	-	O	-	-	-



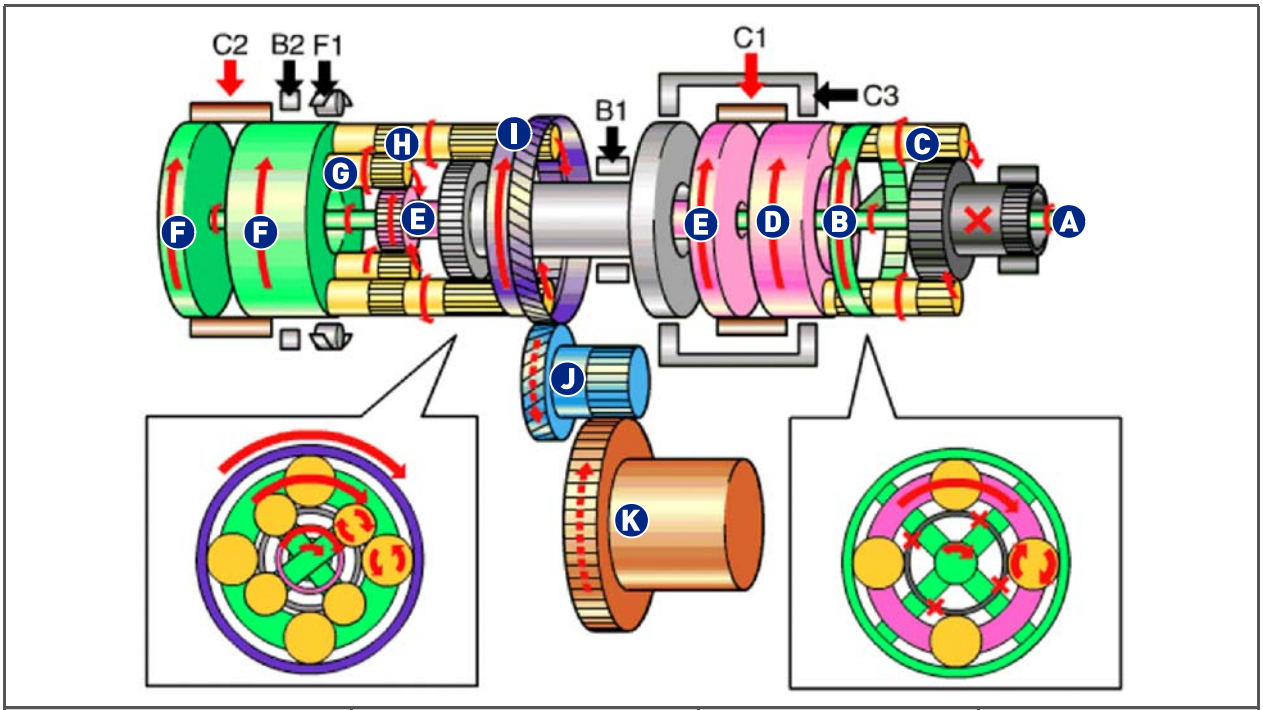
-	Input	Fixed	Output
Front planetary gear	Ring gear	Sun gear	Carrier
Rear planetary gear	Rear sun gear, middle sun gear	-	Ring gear

Modification basis	
Application basis	
Affected VIN	

▶ 4th gear power transfer

A. Input shaft rotates clockwise
B. Front ring gear rotates clockwise
C. Front pinion gear rotates clockwise
D. Front sun gear is fixed and front planetary gear carrier rotates clockwise
E. C1 clutch engaged (front planetary gear carrier and rear sun gear are connected together and rotate clockwise)
F. C2 clutch engaged (rear planetary gear carrier rotates clockwise (same revolutions as input shaft))
Rear short pinion gear rotates clockwise by rear sun gear
G. Rear long pinion gear rotates anti-clockwise
H. Rear ring gear rotates clockwise and its rotation speed is lower than rear planetary gear carrier due
I. to rear long pinion gear.
Counter drive gear rotates anti-clockwise
J. Differential gear rotates clockwise
K.

Gear position	Solenoid valve						Clutch			Brake		One-way clutch
	SLC1 (N.C)	SLC2 (N.O)	SLC3 (N.O)	SLB1 (N.C)	S1 (N.O)	S2 (N.C)	C1	C2	C3	B1	B2	F1
4th	O	-	O	-	O	-	O	O	-	-	-	-



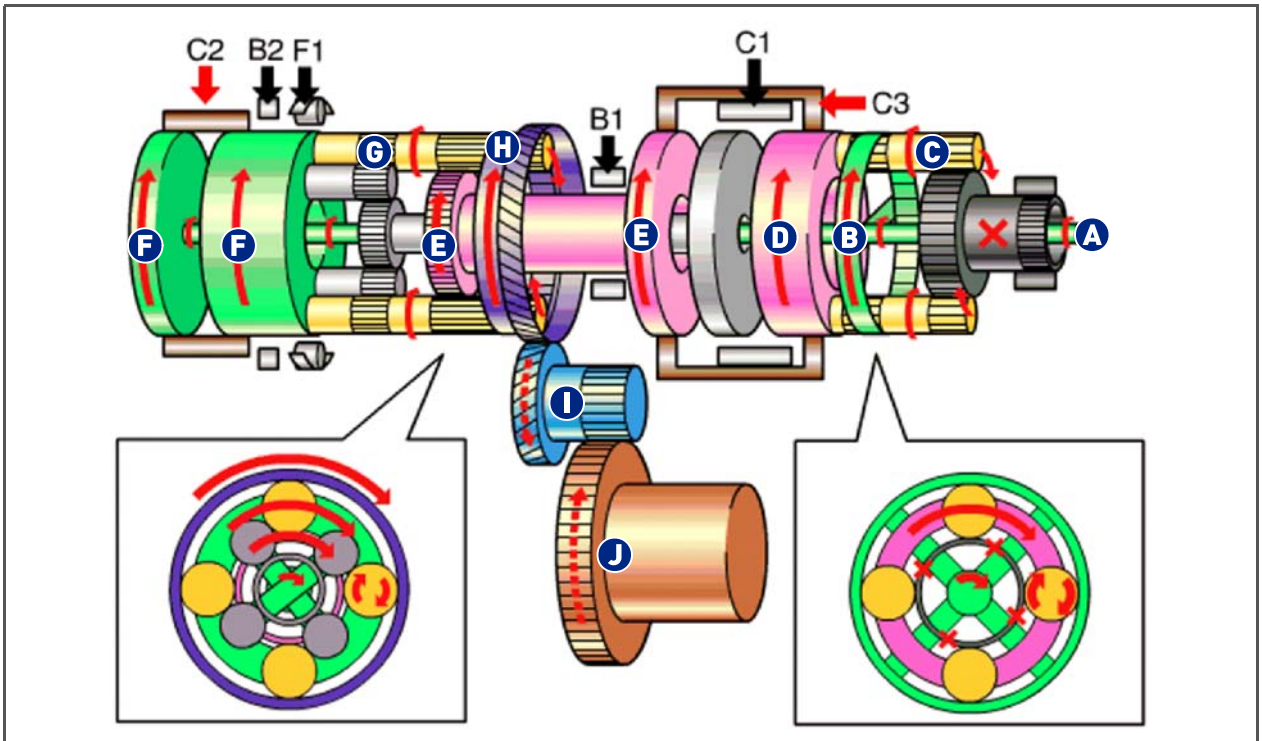
-	Input	Fixed	Output
Front planetary gear	Ring gear	Sun gear	Carrier
Rear planetary gear	Rear sun gear, carrier	-	Ring gear

Modification basis	
Application basis	
Affected VIN	

▶ 5th gear power transfer

A. Input shaft rotates clockwise
B. Front ring gear rotates clockwise
C. Front pinion gear rotates clockwise
D. Front sun gear is fixed and front planetary gear carrier rotates clockwise
E. C3 clutch engaged (front planetary gear carrier and rear middle sun gear are connected together and rotate clockwise)
F. C2 clutch engaged (rear planetary gear carrier rotates clockwise (same revolutions as input shaft))
Rear long pinion gear rotates clockwise
G. Rear ring gear rotates clockwise and its rotation speed is higher than rear planetary gear carrier due
H. to rear long pinion gear.
Counter drive gear rotates anti-clockwise
I. Differential gear rotates clockwise
J.

Gear position	Solenoid valve						Clutch			Brake		One-way clutch
	SLC1 (N.C)	SLC2 (N.O)	SLC3 (N.O)	SLB1 (N.C)	S1 (N.O)	S2 (N.C)	C1	C2	C3	B1	B2	F1
5th	-	-	-	-	O	-	-	O	O	-	-	-

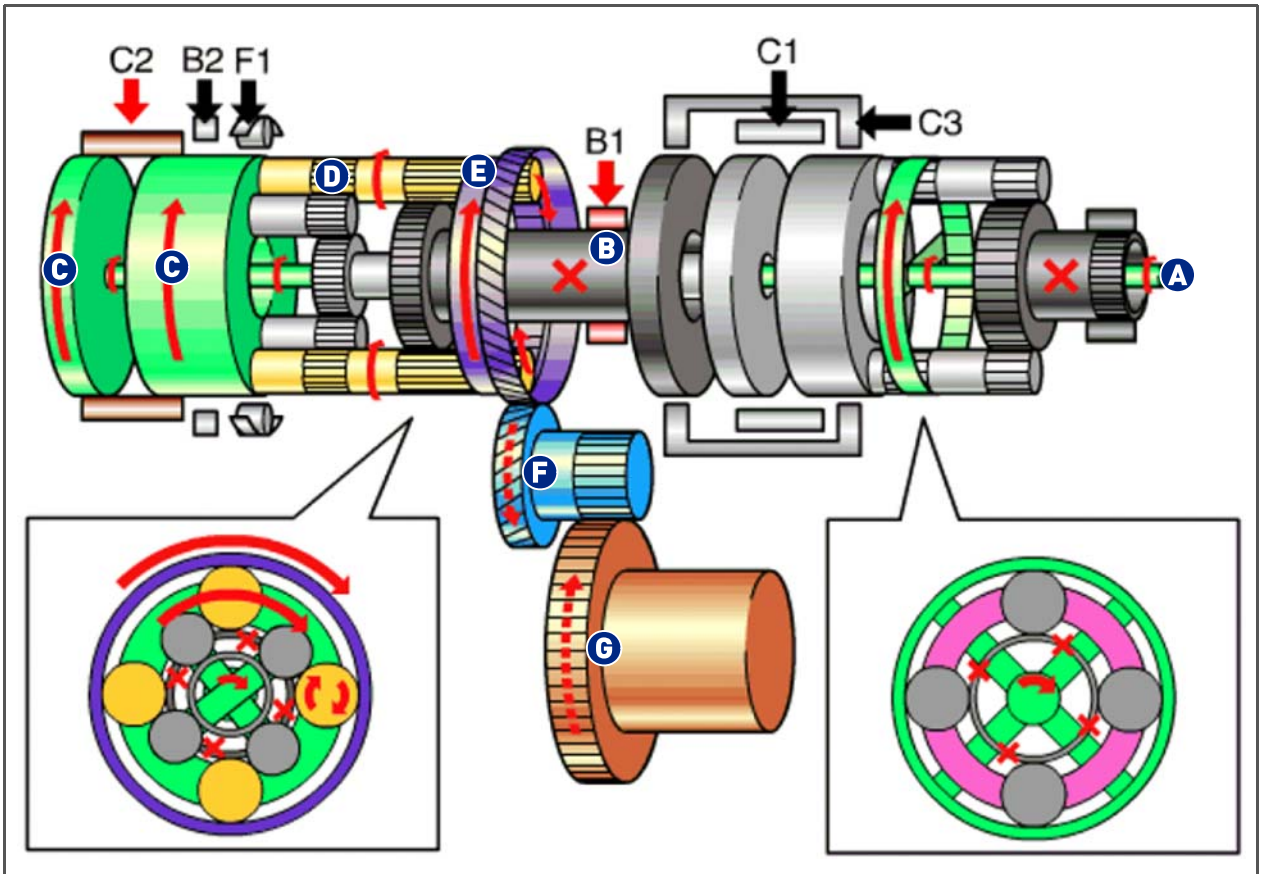


-	Input	Fixed	Output
Front planetary gear	Ring gear	Sun gear	Carrier
Rear planetary gear	Carrier, middle sun gear	-	Ring gear

▶ 6th gear power transfer

A. Input shaft rotates clockwise
B. Rear middle sun gear fixed as B1 brake operates
C. C2 clutch engaged (rear planetary gear carrier rotates clockwise (same revolutions as input shaft))
Rear short pinion gear is fixed due to fixed rear middle sun gear and rear long pinion gear rotates
D. clockwise
Rear ring gear rotates clockwise
E. Counter drive gear rotates anti-clockwise
F. Differential gear rotates clockwise
G.

Gear position	Solenoid valve						Clutch			Brake		One-way clutch
	SLC1 (N.C)	SLC2 (N.O)	SLC3 (N.O)	SLB1 (N.C)	S1 (N.O)	S2 (N.C)	C1	C2	C3	B1	B2	F1
6단	-	-	O	O	O	-	-	O	-	O	-	-



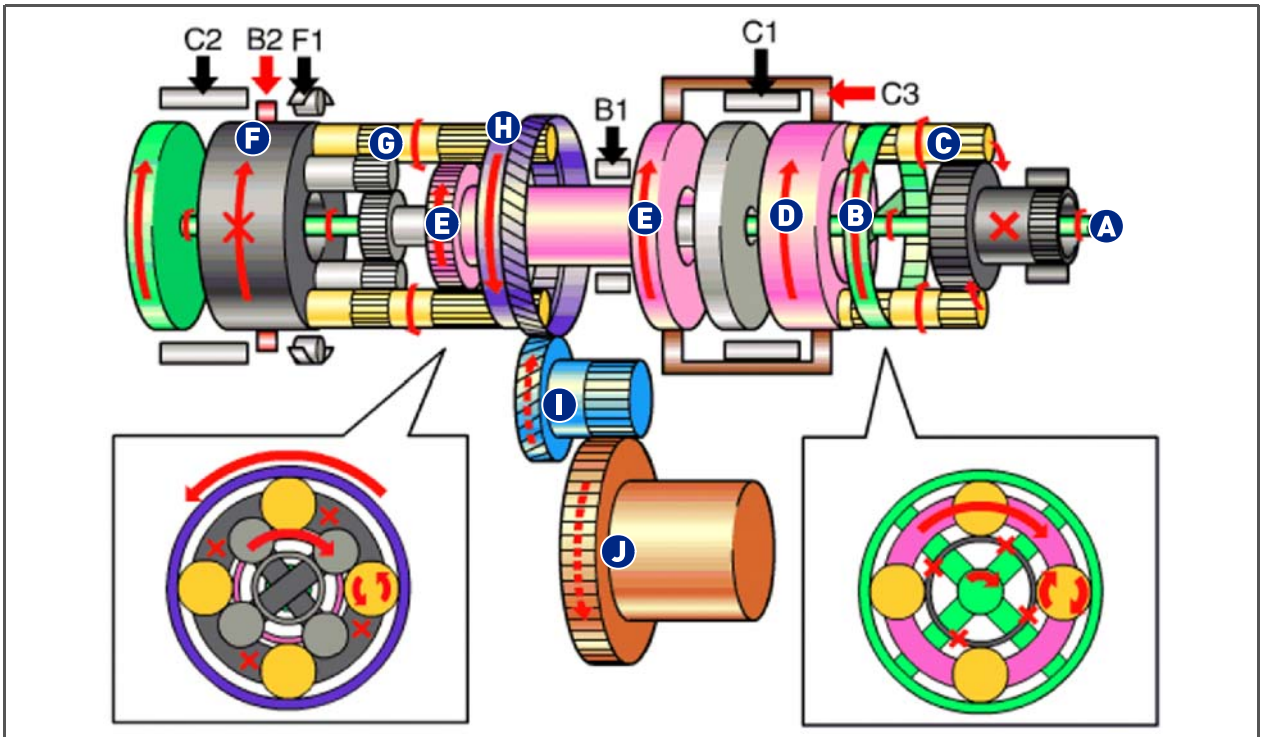
-	Input	Fixed	Output
Front planetary gear	-	-	-
Rear planetary gear	Carrier	Middle sun gear	Ring gear

Modification basis	
Application basis	
Affected VIN	

▶ Reverse power transfer

A. Input shaft rotates clockwise
B. Front ring gear rotates clockwise
C. Front pinion gear rotates clockwise
D. Front sun gear is fixed and front planetary gear carrier rotates clockwise
E. C3 clutch engaged (front planetary gear carrier and rear middle sun gear are connected together and rotate clockwise)
F. Rear planetary gear carrier is fixed as B2 brake operates
G. Rear long pinion gear rotates anti-clockwise due to fixed rear planetary gear carrier
H. Rear ring gear rotates anti-clockwise
I. Counter drive gear rotates clockwise
J. Differential gear rotates anti-clockwise

Gear position		Solenoid valve						Clutch			Brake		One-way clutch
		SLC1 (N.C)	SLC2 (N.O)	SLC3 (N.O)	SLB1 (N.C)	S1 (N.O)	S2 (N.C)	C1	C2	C3	B1	B2	F1
Reverse	V ≤ 11km/h	-	O	-	-	O	-	-	-	O	-	O	-
	V > 11km/h	-	O	O	-	O	O	-	-	-	-	-	-



-	Input	Fixed	Output
Front planetary gear	Ring gear	Sun gear	Carrier
Rear planetary gear	Middle sun gear	Carrier	Ring gear

6. EMERGENCY MODE

If the A/T has a failure while driving, the self-learning control, lock-up control and gear change adaptation control will be deactivated. The TCU stores the DTC if it can diagnose which fault has occurred and sometimes the system enters the emergency mode.

▶ Emergency mode 1

If the linear solenoids (SLC1, SLC2, SLC3 and SLB1) are open or short circuit to B+ or ground, the gear will be stuck at 3rd gear.

▶ Emergency mode 2

If there is a gear ratio error (1st ~ 6th), an abnormal gear change due to the linear solenoids (SLC1, SLC2, SLC3 and SLB1) maximum pressure, or no signal from the output rotation sensor, the gear will be stuck at 5th gear.

▶ Emergency mode 3

If the S1, linear solenoid (SLT) is open or short circuit to B+ or ground, the input rotation sensor has a electrical problem or sends no signal, in the event of high supply voltage to the battery, CAN communication error or CAN bus off, the gear will be stuck at 3rd gear.

▶ Emergency mode 4

If the lever position sensor has a electrical problem, the gear will be stuck at 3rd gear.

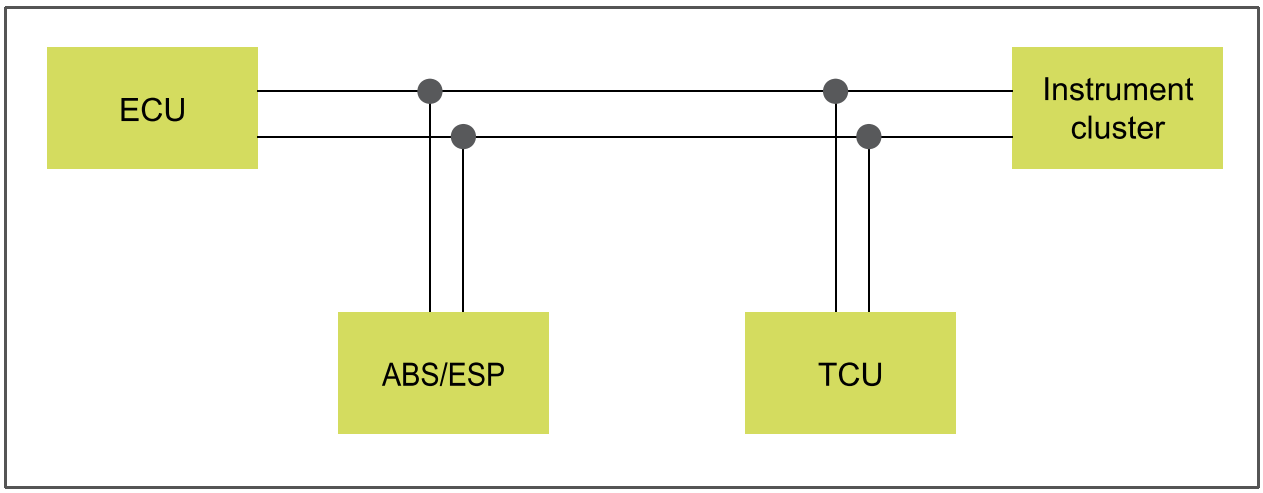
▶ Emergency mode 5

In the event of low supply voltage to the battery, the gear will be stuck at 3rd gear for 1st to 3rd and at 5th gear for 4th to 6th.

Modification basis	
Application basis	
Affected VIN	

7. CONFIGURATION OF CAN RELATED TO TCU

▶ **CAN network communication**



The TCU transmits the following signals via the CAN bus.
- Selector lever position
- Selected gear condition
- Manual mode activation
- Drive mode state
- Output torque
- ATF temperature
- Torque converter lockup clutch status
- Request for reduced engine torque
- Request for increased engine torque