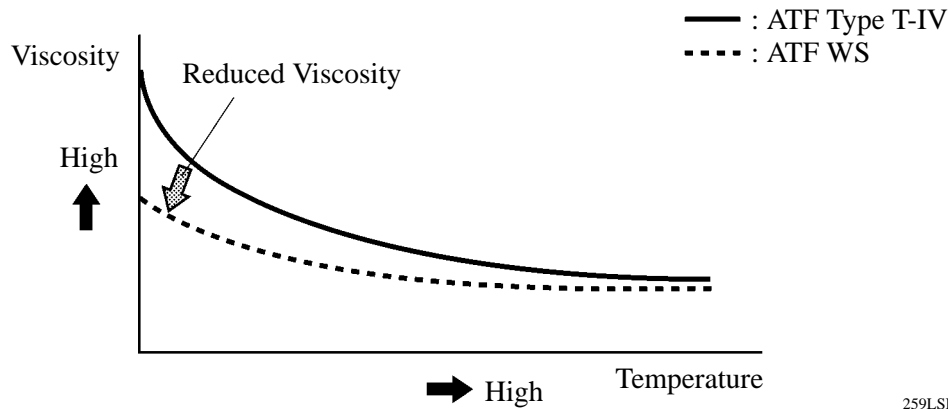


● ATF (AUTOMATIC TRANSMISSION FLUID) WS

- ▶ ATF WS is used to reduce the resistance of the ATF and improve the fuel economy by reducing its viscosity in the practical operating temperature range. At higher fluid temperatures, the viscosity is the same as that of ATF Type T-IV, which ensures the durability of the automatic transaxle.
- ▶ ATF WS and other types of ATF (ATF Type T-IV, D-II.) are not interchangeable.

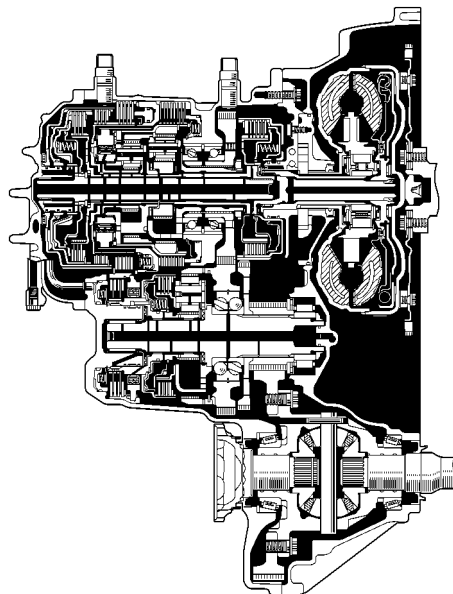


259LSK03

U250E AUTOMATIC TRANSAXLE

DESCRIPTION

U250E automatic transaxle is used on the 2AZ-FE engine models. This automatic transaxle is a compact, lightweight and high-capacity 5-speed Super ECT (Electronically Controlled Transaxle).



025CH01Y

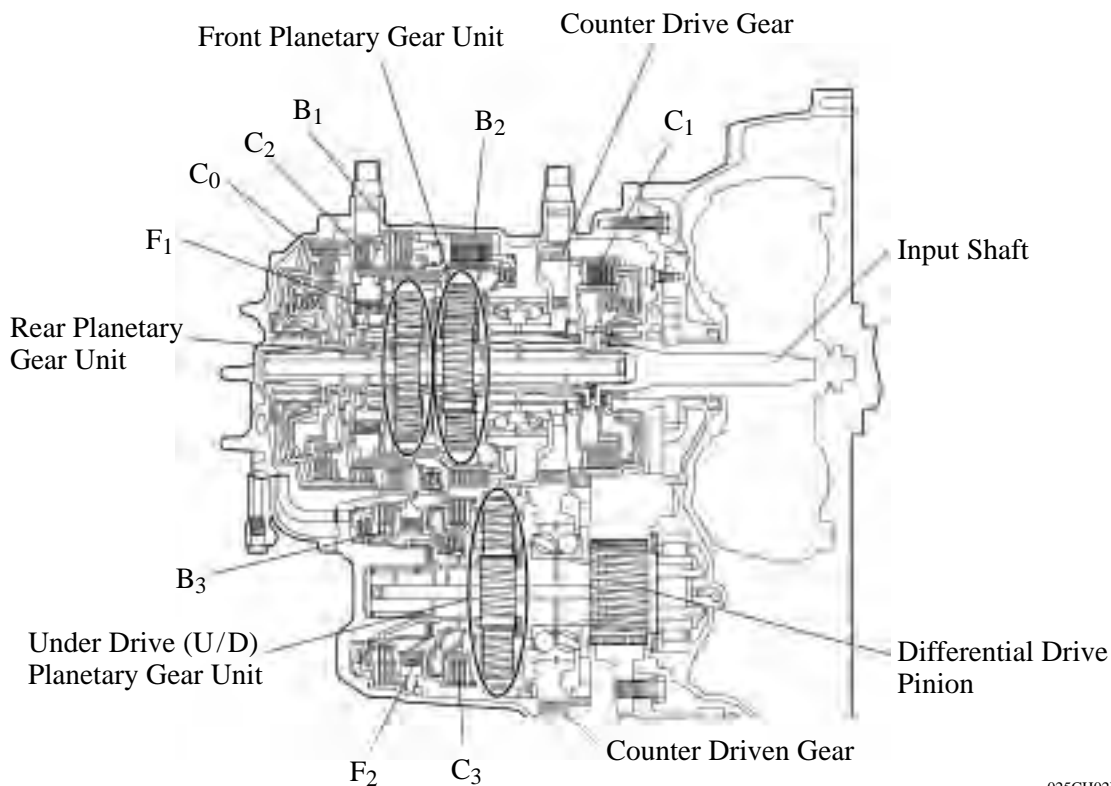
► Specifications ●

Model		'07 Camry	'06 Camry
Engine Type		2AZ-FE	△
Transaxle Type		U250E	△
Gear Ratio*1	1st	3.943	△
	2nd	2.197	△
	3rd	1.413	△
	4th	0.975	△
	5th	0.703	△
	Reverse	3.145	△
Differential Gear Ratio		3.391	△
Fluid Capacity*2 Liters (US qts, Imp. qts)		8.0 (8.5, 7.0)	△
Fluid Type		Toyota Genuine ATF WS	ATF Type T-IV
Weight (Reference)*3 kg (lb)		93 (205)	△

*1: Counter gear ratio included

*2: Differential included

*3: Weight shows the figure with the fluid filled to the maximum level.



025CH02Y

► Specifications ●

C ₁	Forward Clutch	The No. of Discs	5
C ₂	Reverse Clutch		3
C ₃	U/D Direct Clutch		3
C ₀	Direct & O/D Clutch		3
B ₁	2nd & O/D Brake		3
B ₂	1st & Reverse Brake		5
B ₃	U/D Brake		3
F ₁	No.1 One-Way Clutch	The No. of Sprags	22
F ₂	U/D One-Way Clutch		15
Front Planetary Gear Unit	The No. of Sun Gear Teeth		43
	The No. of Pinion Gear Teeth		17
	The No. of Ring Gear Teeth		77
Rear Planetary Gear Unit	The No. of Sun Gear Teeth		31
	The No. of Pinion Gear Teeth		19
	The No. of Ring Gear Teeth		69
U/D Planetary Gear Unit	The No. of Sun Gear Teeth		32
	The No. of Pinion Gear Teeth		26
	The No. of Ring Gear Teeth		83
Counter Gear	The No. of Drive Gear Teeth		50
	The No. of Driven Gear Teeth		51

ELECTRONIC CONTROL SYSTEM

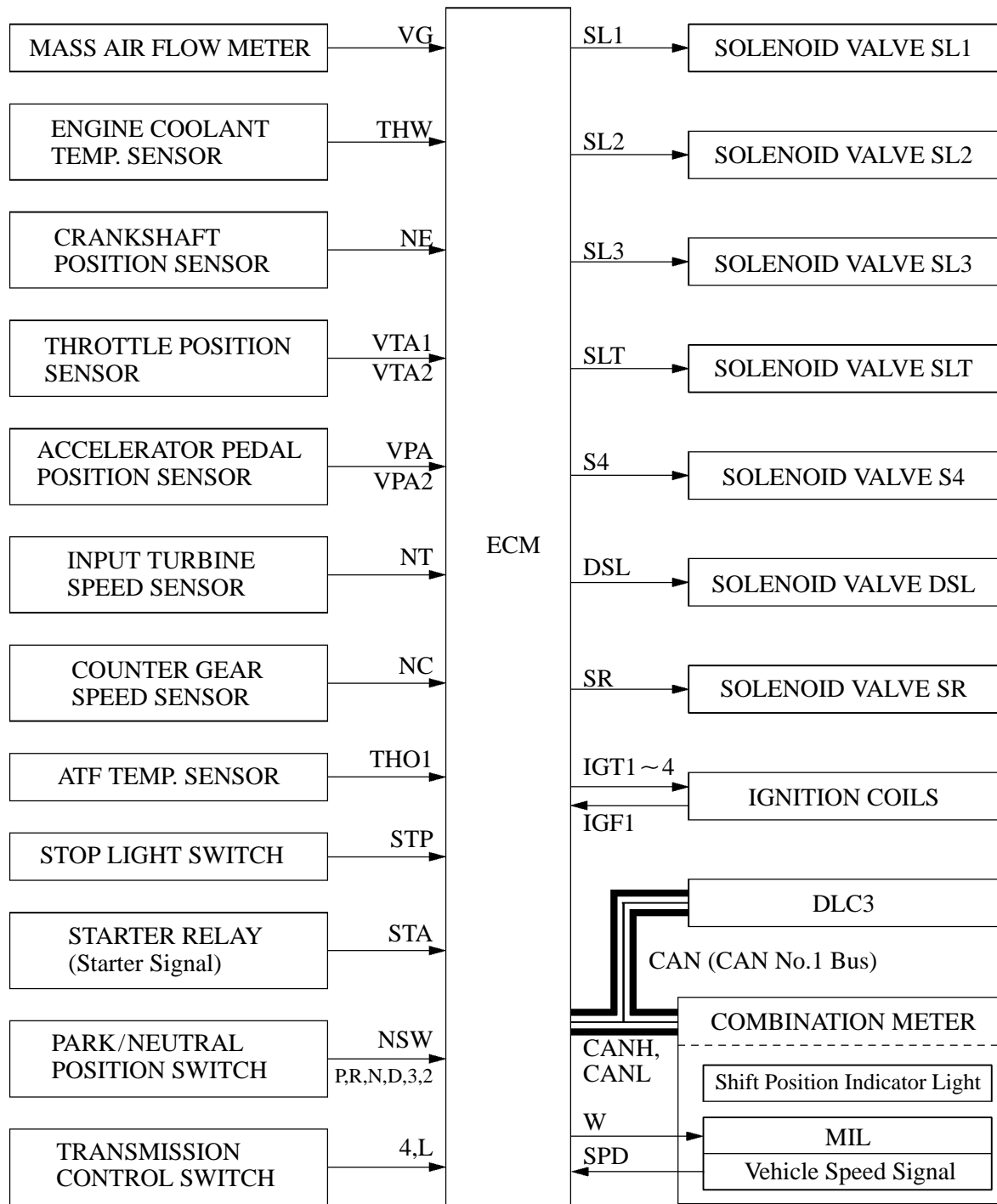
1. General

The electronic control system of the U250E automatic transaxle consists of the control listed below.

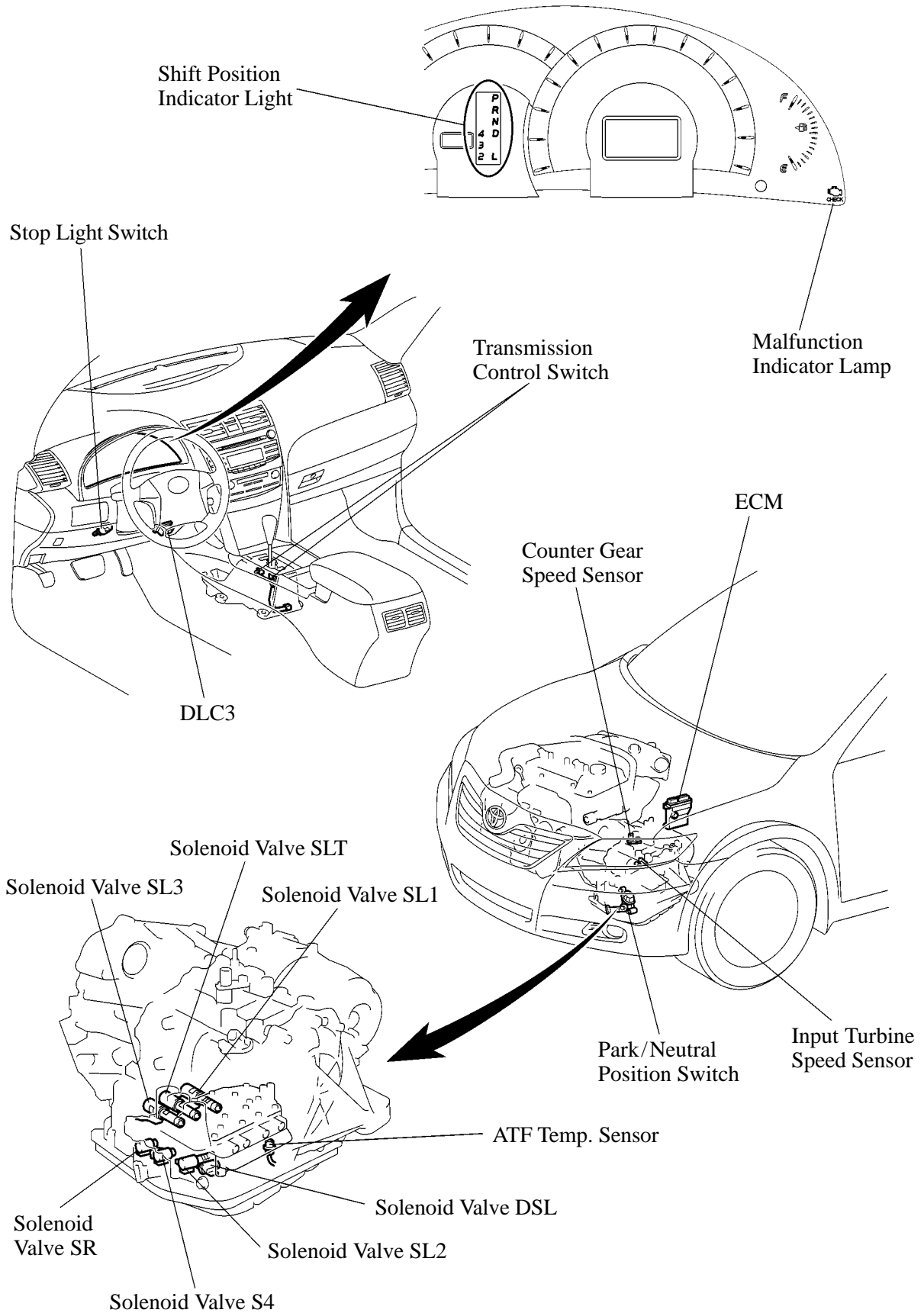
System	Outline
Shift Timing Control	The ECM sends current to 3 solenoid valves (SL1, SL2, and SL3) based on signals from each sensor and shifts the gear.
Clutch Pressure Control (See page CH-28)	Controls the pressure that is applied directly to B ₁ brake, C ₀ and C ₁ clutches by actuating 3 solenoid valves (SL1, SL2, and SL3) in accordance with ECM signals. 3 solenoid valves (SL1, SL2, and SL3) minutely control the clutch pressure in accordance with the engine output and driving conditions.
Line Pressure Optimal Control (See page CH-29)	Actuates the solenoid valve SLT to control the line pressure in accordance with information from the ECM and the operating conditions of the transaxle.
Shifting Control in Uphill/ Downhill Traveling (See page CH-30)	Controls to restrict the 4th or 5th upshift or to provide appropriate engine braking by the ECM to determine whether the vehicle is traveling uphill or downhill.
Lock-up Timing Control	The ECM sends current to the solenoid valves DSL and SL2 based on signals from each sensor and engages or disengages the lock-up clutch.
Flex Lock-up Clutch Control (See page CH-31)	Controls the solenoid valve SL2 and DSL, provides an intermediate mode between the ON/OFF operation of the lock-up clutch, and increase the operating range of the lock-up clutch to improve fuel economy.
Engine Torque Control	Retards the engine ignition timing temporarily to improve shift feeling during up or down shifting.
“N” to “D” Squat Control	When the shift lever is shifted from “N” to “D” position, the gear is temporarily shifted to 3rd and then to 1st to reduce vehicle squat.
Diagnosis (See page CH-32)	When the ECM detects a malfunction, the ECM makes a diagnosis and memorizes the malfunctioning part.
Fail-safe (See page CH-32)	Even if a malfunction is detected in the sensors or solenoids, the ECM activates fail-safe control to prevent the vehicle’s drivability from being significantly affected.

2. Construction

The configuration of the electronic control system in the U250E automatic transaxle is as shown in the following chart.



3. Layout of Main Components

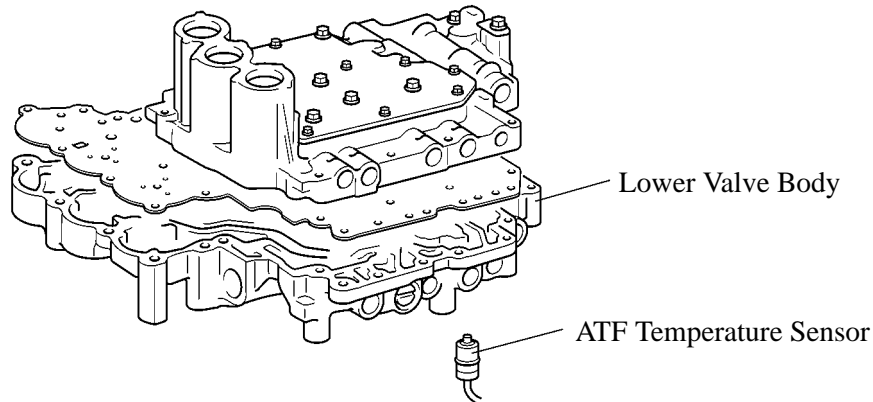


4. Construction and Operation of Main Components

ATF Temperature Sensor

The ATF temperature sensor is installed in the valve body for direct detection of the fluid temperature.

The ATF temperature sensor is used for the revision of clutch and brake pressures to maintain a smooth shift quality every time.



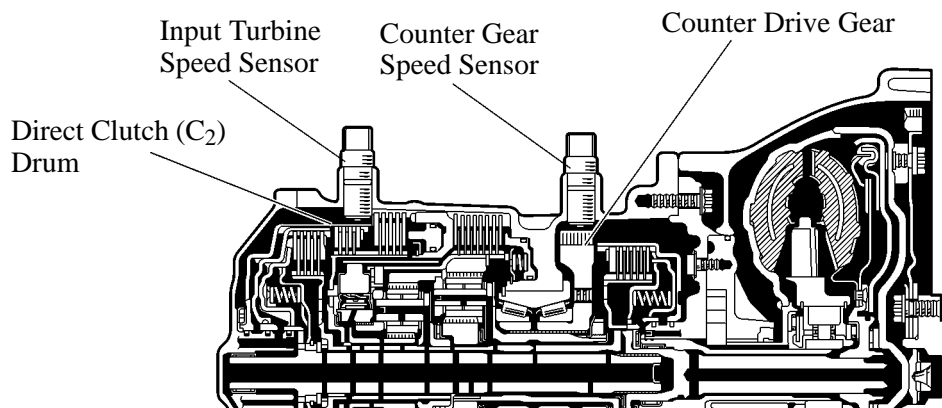
241CH87

Speed Sensors

The U250E automatic transaxle uses an input turbine speed sensor (for the NT signal) and a counter gear speed sensor (for the NC signal). Thus, the ECM can detect the timing of the shifting of the gears and appropriately control the engine torque and hydraulic pressure in response to the various conditions. These speed sensors are the pick-up coil type.

The input turbine speed sensor detects the input speed of the transaxle. The direct clutch (C₂) drum is used as the timing rotor for this sensor.

The counter gear speed sensor detects the speed of the counter gear. The counter drive gear is used as the timing rotor for this sensor.



211CH16

Transmission Control Switch and Park/Neutral Position Switch

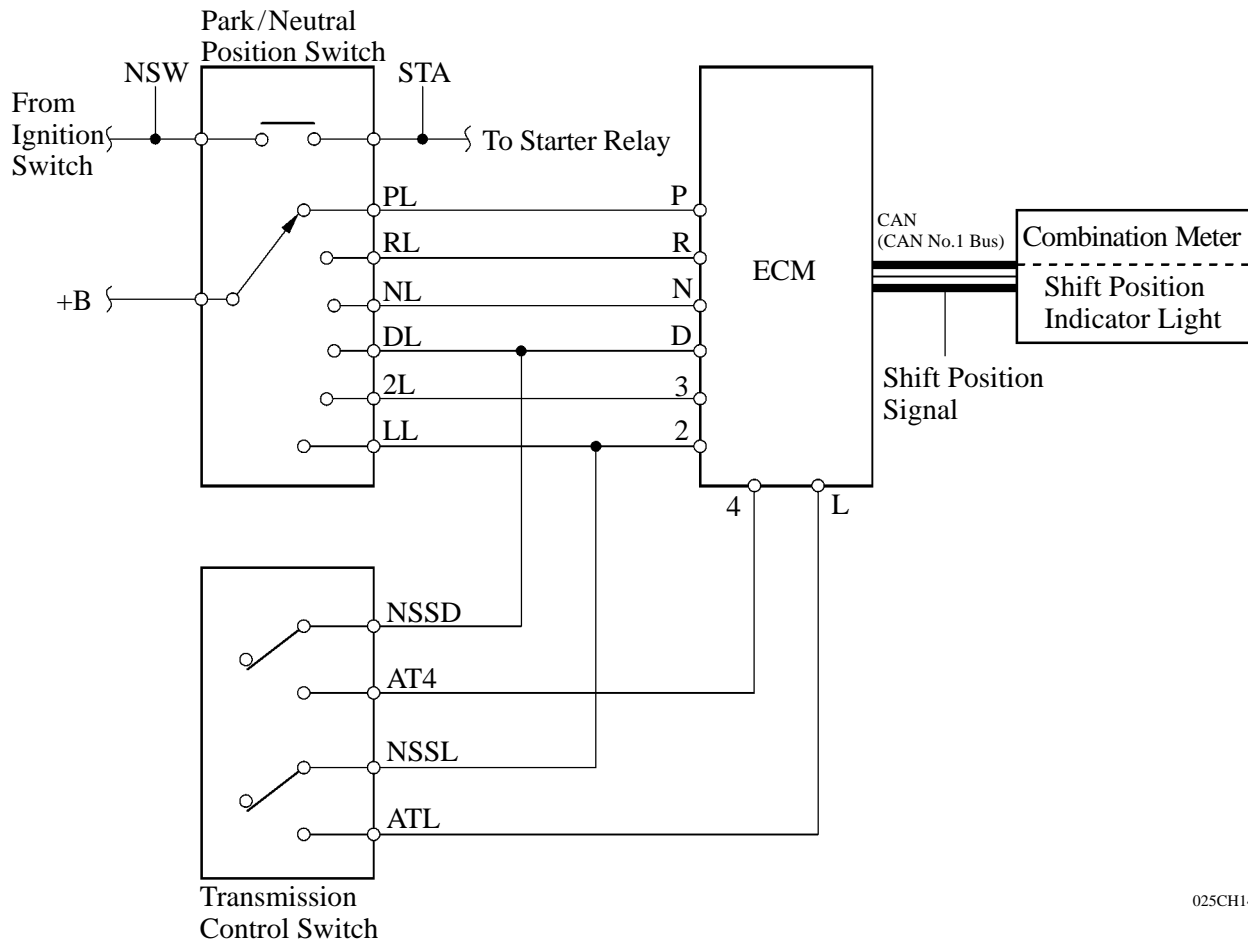
The ECM uses these switches to detect the shift lever position.

The park/neutral position switch sends the P, R, N, D, 3 and 2 position signals to the ECM.

The transmission control switch is installed inside the shift lever assembly. This switch sends the 4 and L position signals to the ECM.

The ECM sends these shift position signals to the combination meter (meter ECU) through CAN communication. The combination meter (meter ECU) controls the shift position indicator light based on these signals.

► Wiring Diagram ●

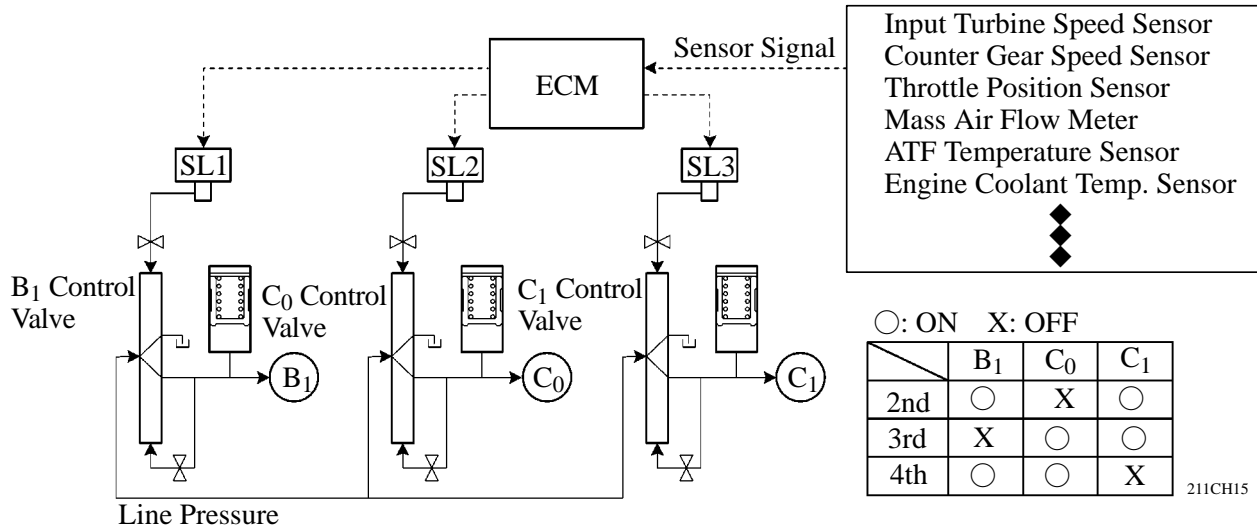


5. Clutch Pressure Control

Clutch to Clutch Pressure Control

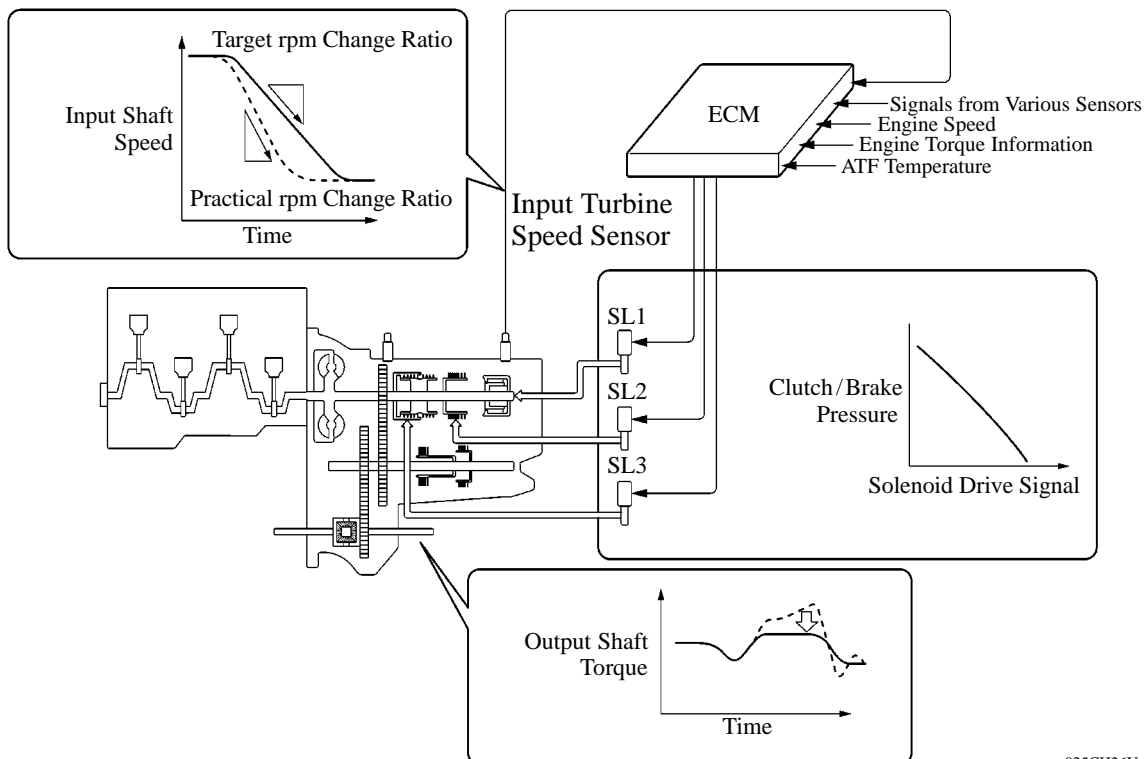
This control is used for shifting from the 2nd to 3rd gear, and from the 3rd to 4th gear.

Solenoid valves actuate SL1, SL2, and SL3 in accordance with the signals from the ECM, and guide this output pressure directly to the control valves B₁, C₀, and C₁ in order to regulate the line pressure that acts on the B₁ brake, C₀ and C₁ clutches. As a result, compact B₁, C₀ and C₁ accumulators without a back pressure chamber have been realized.



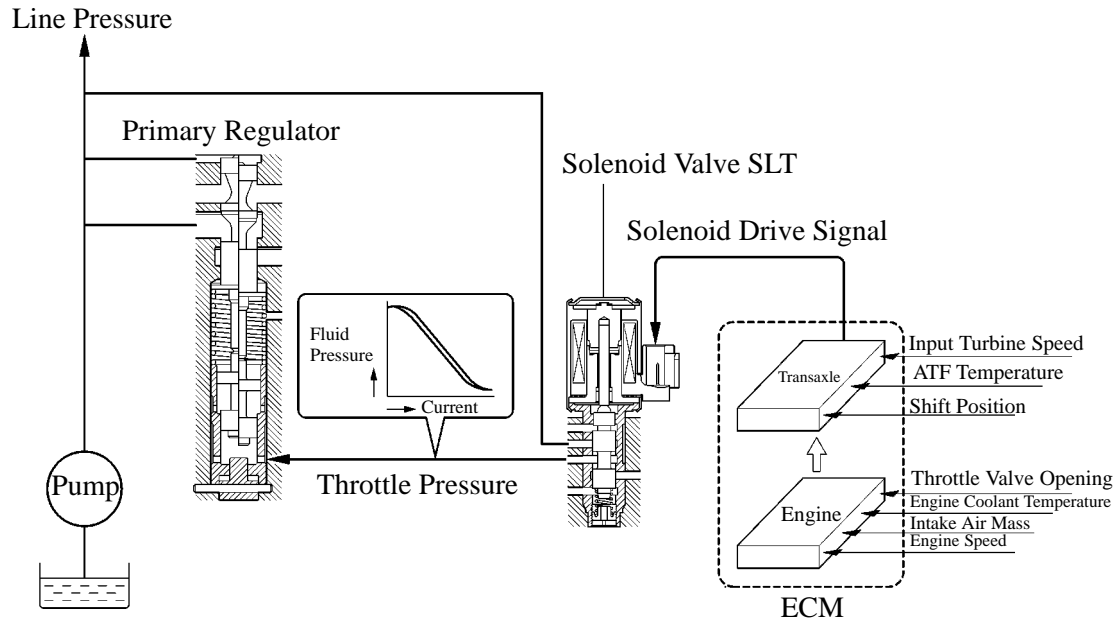
Clutch Pressure Optimal Control

The ECM monitors the signals from various types of sensor such as the input turbine speed sensor, allowing shift solenoid valves SL1, SL2, and SL3 to minutely control the clutch pressure in accordance with engine output and driving conditions. As a result, smooth shift characteristics have been realized.



6. Line Pressure Optimal Control

The line pressure is controlled by using solenoid valve SLT. Through the use of solenoid valve SLT, the line pressure is optimally controlled in accordance with the engine torque information, as well as with the internal operating conditions of the torque converter and the transaxle. Accordingly, the line pressure can be accurately controlled in accordance with the engine output, traveling condition, and the ATF temperature, thus realizing smooth shift characteristics and optimizing the workload of the oil pump.



7. Shifting Control in Uphill/Downhill Traveling

General

This control helps minimize the shifting of gears when the driver operates the accelerator pedal while driving on a winding road with ups and downs, in order to ensure a smooth drive.

Shift Control in Uphill Traveling

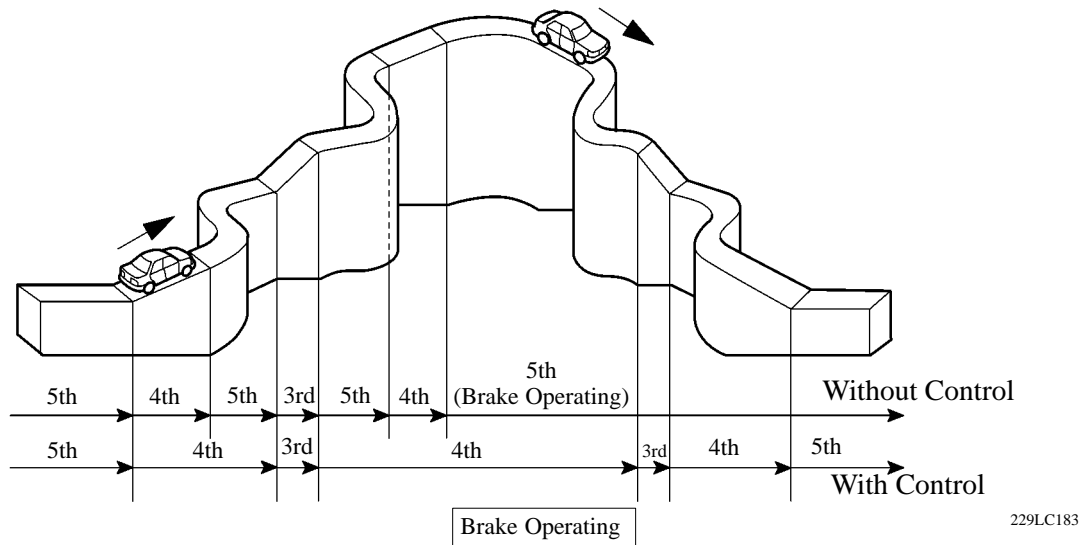
When the ECM determines uphill travel, it prohibits the transaxle from shifting up into 5th after the transaxle has shifted down below 4th.

When the ECM determines uphill travel with a steeper grade, it prohibits the transaxle from shifting up into 4th after the transaxle has shifted down below 3rd.

Shift Control in Downhill Traveling

When the ECM determines downhill travel, it shifts down the transaxle from 5th to 4th in accordance with the brake operation signal that is input when the driver operates the brake pedal.

When the ECM determines downhill travel with a steeper grade, and a brake operation signal is input again, the ECM shifts the transaxle down from 4th to 3rd.



229LC183

Uphill/Downhill Judgment

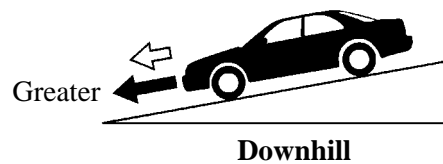
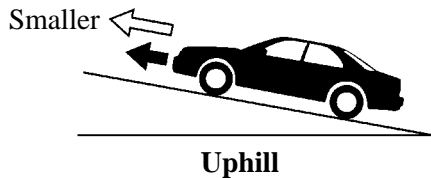
The actual acceleration calculated from the speed sensor signal is compared with the reference acceleration stored in the ECM to judge uphill or downhill traveling.

Actual Acceleration < Reference Acceleration

Actual Acceleration > Reference Acceleration

← Reference acceleration

← Actual acceleration



162CH10

8. Flex Lock-up Clutch Control

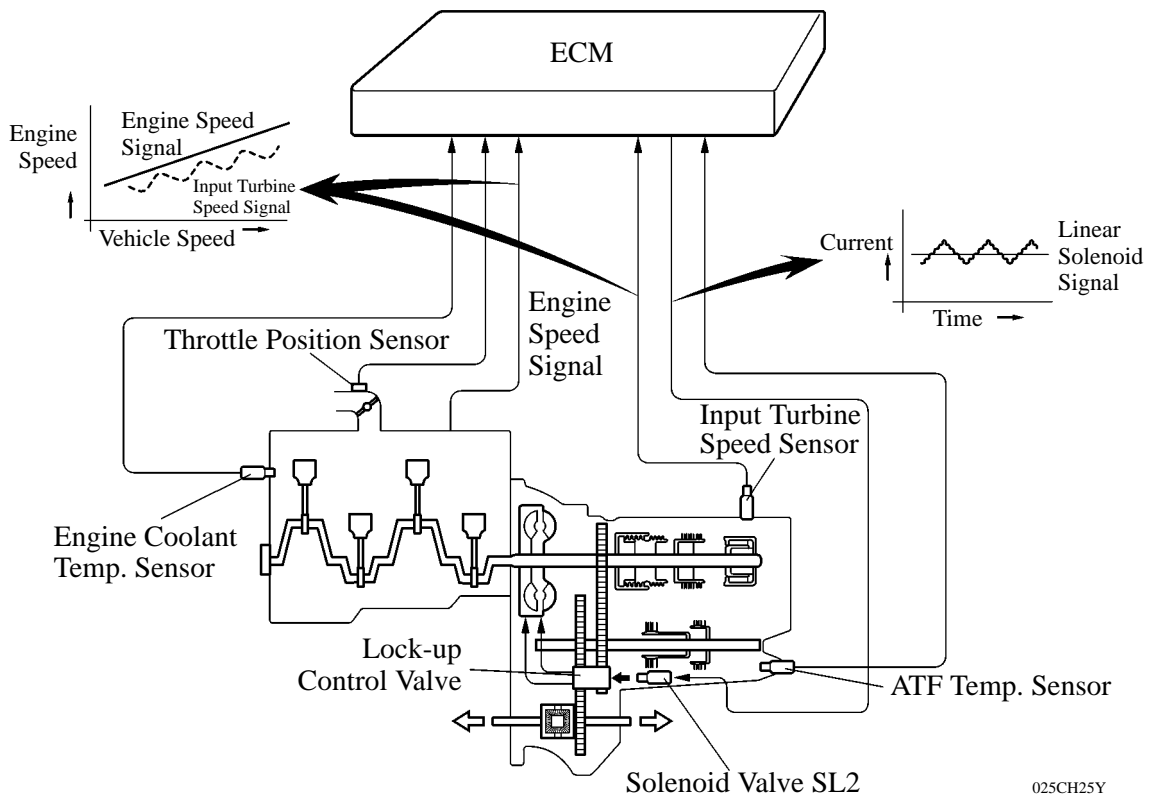
In addition to the conventional lock-up timing control, flex lock-up clutch control is used.

This flex lock-up clutch control regulates solenoid valve SL2 as an intermediate mode between the ON and OFF operations of the lock-up clutch.

The flex lock-up clutch control operates during acceleration, in the 4th and 5th gear in the D range, and during deceleration, in the 4th and 5th gear in the D range, and in the 4th gear in the 4 range.

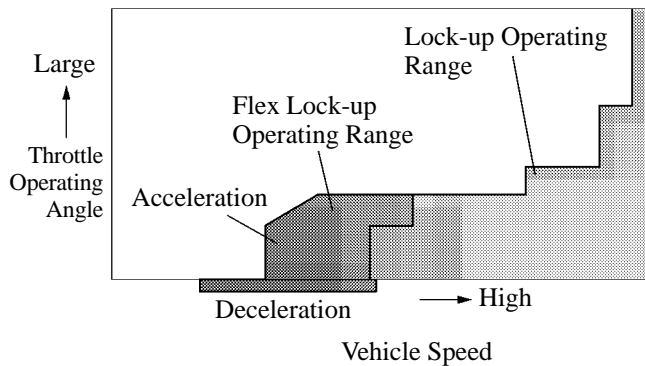
During acceleration, the partition control of the power transmission between the lock-up clutch and torque converter greatly boosts the transmission efficiency in accordance with the driving conditions, improving the fuel economy.

During deceleration, the lock-up clutch is made to operate. Therefore the fuel-cut area is expanded and fuel economy is improved.



025CH25Y

► Flex Lock-up Operation ●



275TU89

Flex Lock-up Timing

Range	Gear	Acceleration Flex Lock-up	Deceleration Flex Lock-up
D	1st	X	X
	2nd	X	X
	3rd	X	X
	4th	○	○
	5th	○	○
4	1st	X	X
	2nd	X	X
	3rd	X	X
	4th	X	○

○: Operates X: Does not operate

9. Diagnosis

When the ECM detects a malfunction, the ECM makes a diagnosis and memorizes the information related to the fault. Furthermore, the MIL (Malfunction Indicator Lamp) in the combination meter illuminates or blinks to inform the driver of the malfunction.

At the same time, the DTC (Diagnosis Trouble Code) are stored in the memory. The DTC can be read by connecting a hand-held tester.

For details, see the 2007 Camry Repair Manual (Pub. No. RM0250U).

Service Tip

The ECM uses the CAN protocol for diagnostic communication. Therefore, a hand-held tester and a dedicated adapter [CAN VIM (Vehicle Interface Module)] are required for accessing diagnostic data. For details, see the 2007 Camry Repair Manual (Pub. No. RM0250U).

10. Fail-safe

This function minimizes the loss of operation when any abnormality occurs in a sensor or solenoid.

► Fail-safe Control List ●

Malfunction Part	Function
Speed Sensor	During a speed sensor malfunction, the vehicle speed is detected through the signals from the counter gear speed sensor to effect normal control.
Counter Gear Speed Sensor	During a counter gear speed sensor malfunction, 5th upshift is prohibited.
ATF Temp. Sensor	During a ATF temperature sensor malfunction, 5th upshift is prohibited.
Solenoid Valve SL1, SL2, SL3, and S4	The current to the failed solenoid valve is cut off and control is effected by operating other solenoid valves with normal operation. Shift control is effected as described in the table in the next page, depending on the failed solenoid. Even if the engine starts under this condition, the gear position remains where it was before.

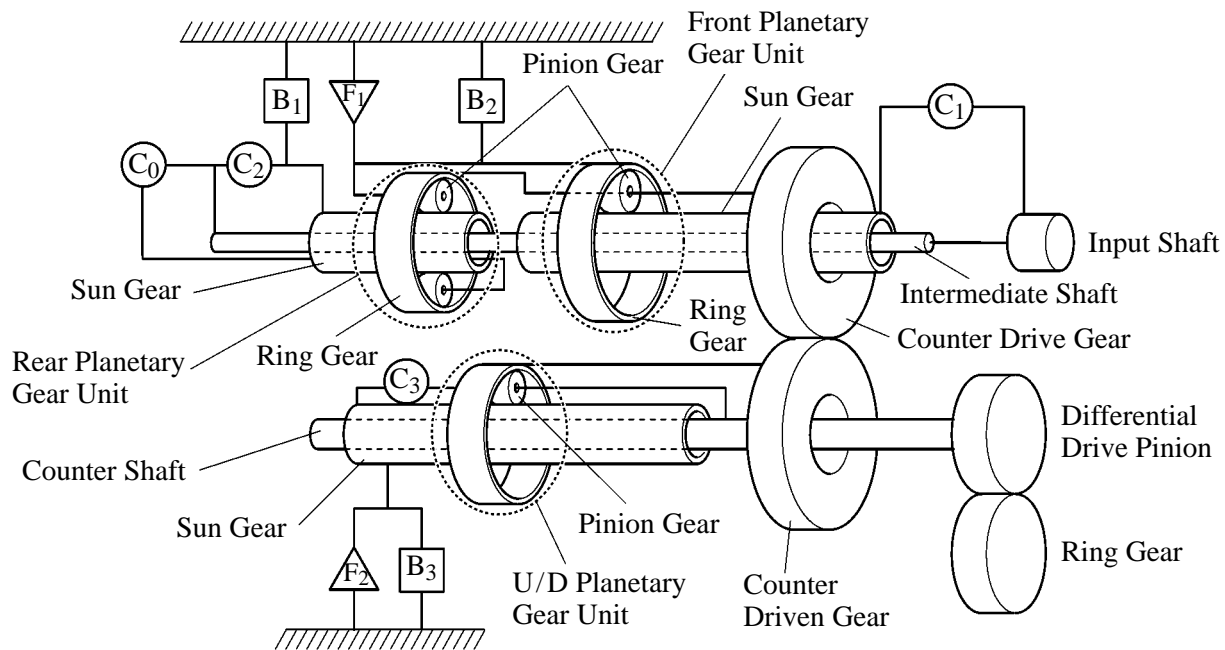
○: ON Δ: According to Flex Lock-up X: OFF

Normal	Solenoid Valve	SL1	○	X	○	X	X
		SL2	○	○	X	Δ	Δ
		SL3	X	X	X	○	○
		S4	X	X	X	X	○
	Gear Position		1st	2nd	3rd	4th	5th
SL1 Malfunction (During driving at 1st or 2nd)	Solenoid Valve	SL1	X				
		SL2	○	○	○	○	○
		SL3	X	X	X	○ Δ X	○ Δ X
		S4	X	X	X	X	○ Δ X
	Gear Position		1st Δ 2nd	2nd	3rd Δ 2nd	4th Δ 2nd	5th Δ 2nd
SL1 Malfunction (During driving at 3rd)	Solenoid Valve	SL1	X				
		SL2	○ Δ Δ	○ Δ Δ	Δ	Δ	Δ
		SL3	X	X	X	○ Δ X	○ Δ X
		S4	X Δ ○	X Δ ○	X Δ ○	X Δ ○	○
	Gear Position		1st Δ 4th	2nd Δ 4th	3rd Δ 4th	4th	5th Δ 4th
SL1 Malfunction (During driving at 4th or 5th)	Solenoid Valve	SL1	X				
		SL2	○ Δ Δ	○ Δ Δ	Δ	Δ	Δ
		SL3	X Δ ○	X Δ ○	X Δ ○	○	○
		S4	X	X	X	X	○
	Gear Position		1st Δ 4th	2nd Δ 4th	3rd Δ 4th	4th	5th
SL2 Malfunction	Solenoid Valve	SL1	○	X Δ ○	○	X Δ ○	X Δ ○
		SL2	X				
		SL3	X	X	X	○ Δ X	○ Δ X
		S4	X Δ ○	X Δ ○	X Δ ○	X Δ ○	○
	Gear Position		1st Δ 4th	2nd Δ 4th	3rd Δ 4th	4th	5th Δ 4th
SL3 Malfunction	Solenoid Valve	SL1	○	X	○	X Δ ○	X Δ ○
		SL2	○	○	X	Δ	Δ
		SL3	X				
		S4	X	X	X	X Δ ○	○
	Gear Position		1st	2nd	3rd	4th	5th Δ 4th
S4 Malfunction	Solenoid Valve	SL1	○	X	○	X	X
		SL2	○	○	X	Δ	Δ
		SL3	X	X	X	○	○
		S4	X				
	Gear Position		1st	2nd	3rd	4th	5th Δ 4th
SL1, SL2, SL3, and S4 Malfunction	Solenoid Valve	SL1	X				
		SL2	X				
		SL3	X				
		S4	X				
	Gear Position		1st Δ 4th	2nd Δ 4th	3rd Δ 4th	4th	5th Δ 4th

● PLANETARY GEAR UNIT

1. Construction

- ▶ The U250E automatic transaxle uses the gear layout in which the front and rear planetary gear units are placed on the input shaft (intermediate shaft), the counter drive and driven gears are placed on the front of the front planetary gear unit, and the U/D planetary gear unit is placed on the counter shaft.
- ▶ A centrifugal fluid pressure canceling mechanism is used in the C₀, C₂, C₃, and C₁ clutches that are applied when shifting from 2nd to 3rd, from 3rd to 4th and from 4th to 5th. For detail, refer to Centrifugal Fluid Pressure Canceling Mechanism on page CH-16.



212CH01

2. Function of Components

Component		Function
C ₁	Forward Clutch	Connects input shaft and front planetary sun gear.
C ₂	Reverse Clutch	Connects input shaft and rear planetary sun gear.
C ₃	U/D Direct Clutch	Connects U/D planetary sun gear and U/D planetary carrier.
C ₀	Direct & O/D Clutch	Connects input shaft and rear planetary carrier.
B ₁	2nd & O/D Brake	Prevents rear planetary sun gear from turning either clockwise or counterclockwise.
B ₂	1st & Reverse Brake	Prevents rear planetary carrier and front planetary ring gear from turning either clockwise or counterclockwise.
B ₃	U/D Brake	Prevents U/D planetary sun gear from turning either clockwise or counterclockwise.
F ₁	No.1 One-Way Clutch	Prevents rear planetary carrier and front planetary ring gear from turning counterclockwise.
F ₂	U/D One-Way Clutch	Prevents U/D planetary sun gear from turning clockwise.
Planetary Gears		These gears change the route through which driving force is transmitted, in accordance with the operation of each clutch and brake, in order to increase or reduce the input and output speeds.

3. Transaxle Power Flow

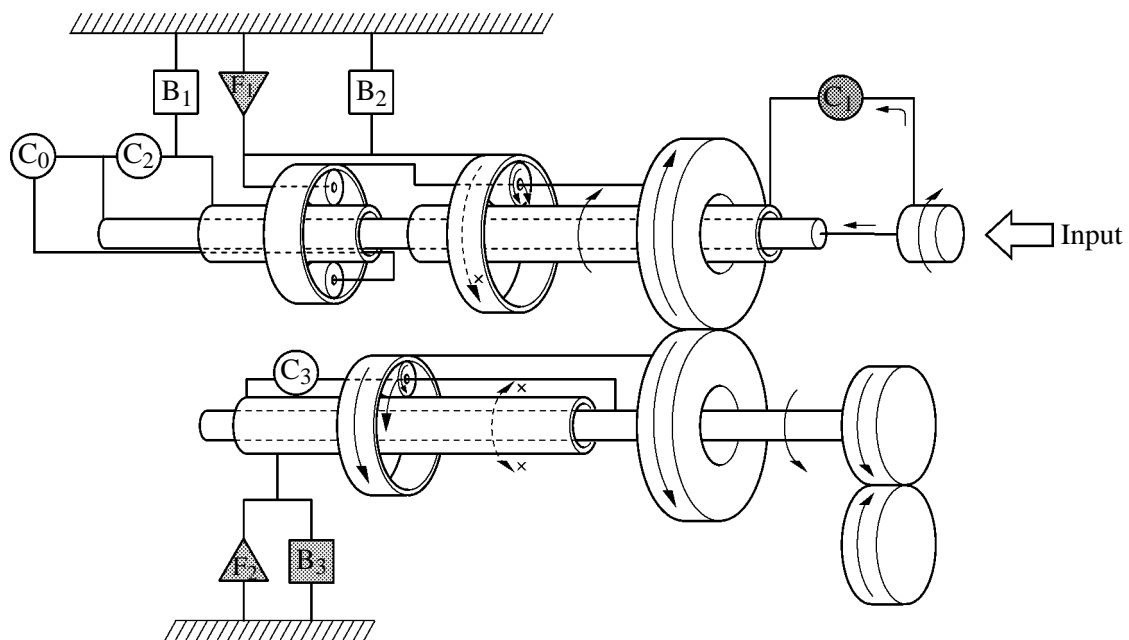
Shift Lever Position	Gear	Solenoid Valve						Clutch				Brake			One-way Clutch	
		S4	SR	DSL	SL1	SL2	SL3	C ₀	C ₁	C ₂	C ₃	B ₁	B ₂	B ₃	F ₁	F ₂
P	Park															
R	Reverse															
N	Neutral															
D	1st															
	2nd															
	3rd															
	4th			△*1◆		△*1◆										
	5th			△◆		△◆										
4	1st															
	2nd															
	3rd															
	4th			△◆*2		△◆*2										
3	1st															
	2nd															
	3rd															
2	1st															
	2nd															
L	1st															

△: ON △: Lock-up ON ◆: Flex lock-up ON

*1: Shift control operates only when 5th is prohibited while traveling uphill/downhill.

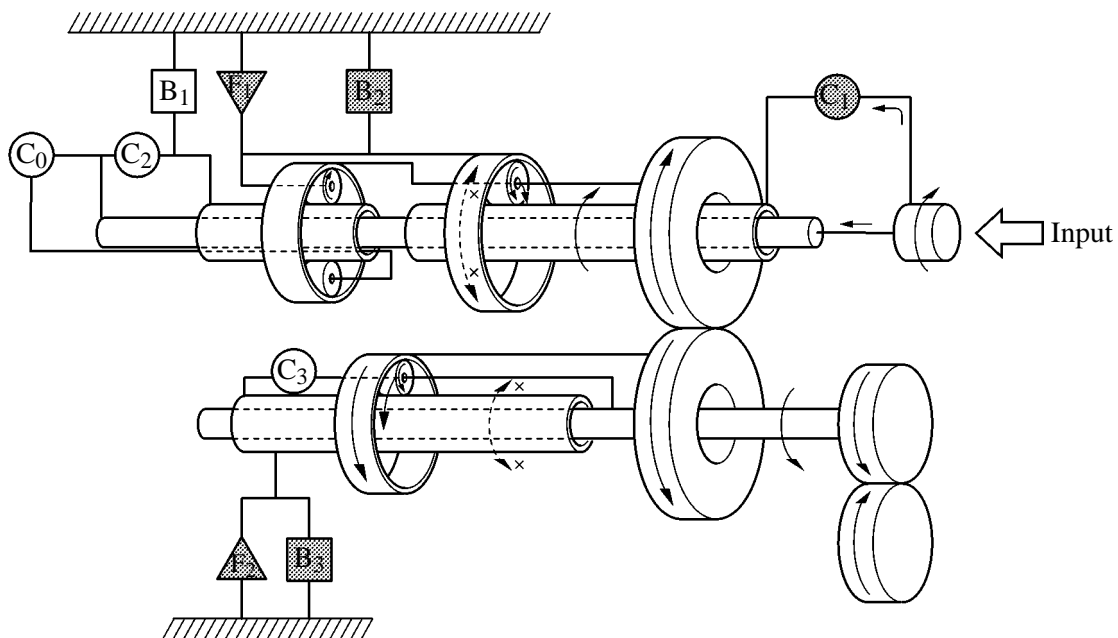
*2: The 4th gear in 4-range flex lock-up is ON only during deceleration.

1st Gear (D, 4, 3 or 2 Position)



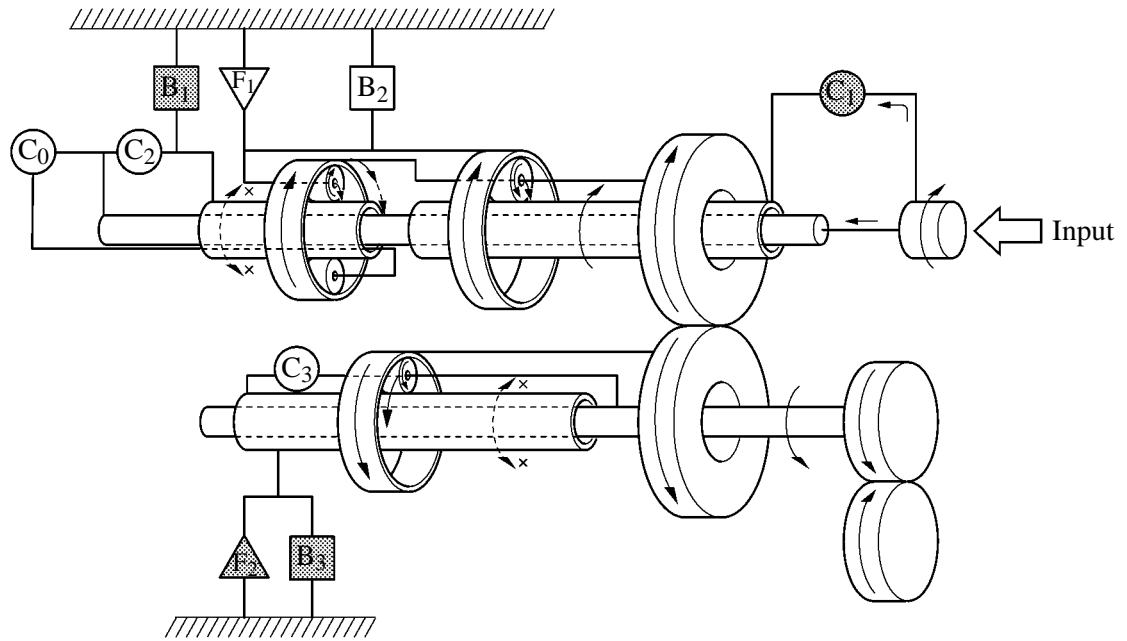
275CA44

1st Gear (L Position)



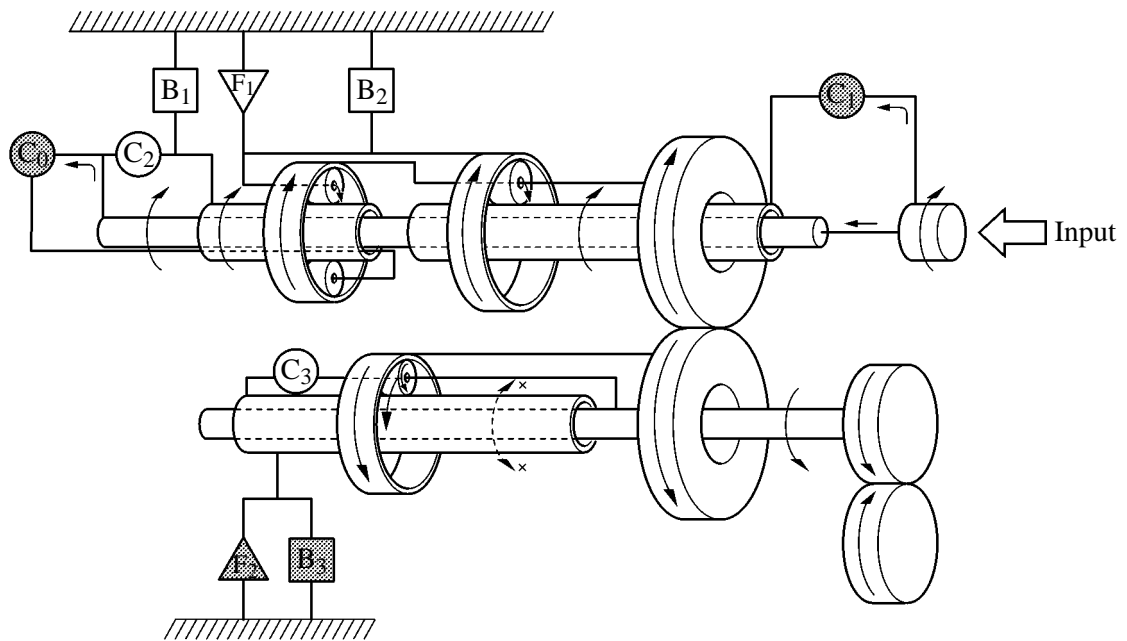
025CH04Y

2nd Gear (D, 4, 3 or 2 Position)



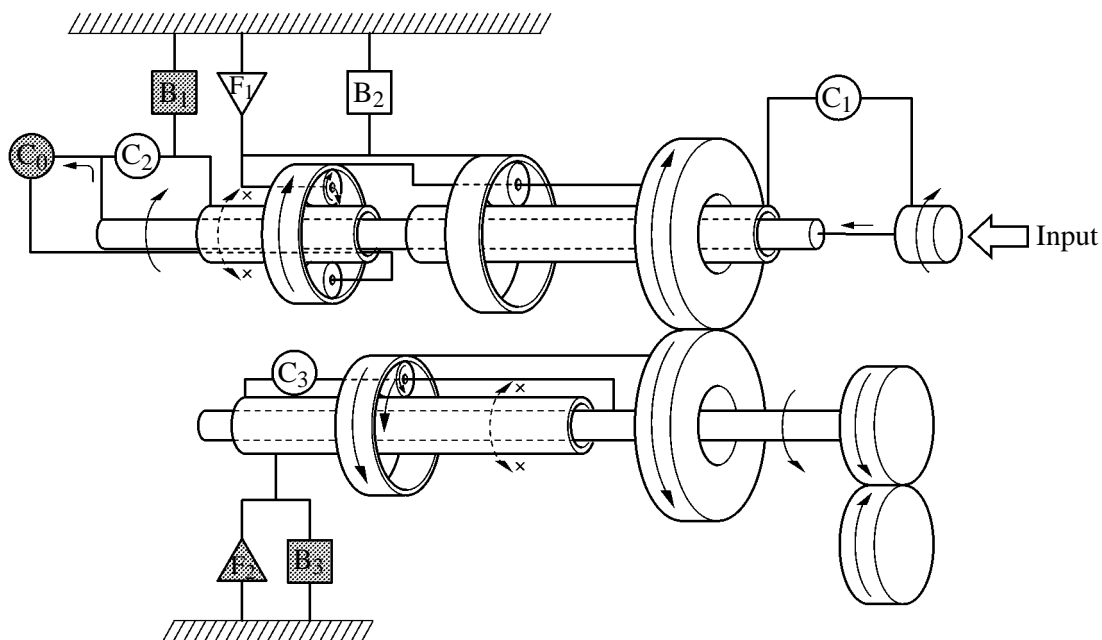
025CH05Y

3rd Gear (D, 4 or 3 Position)



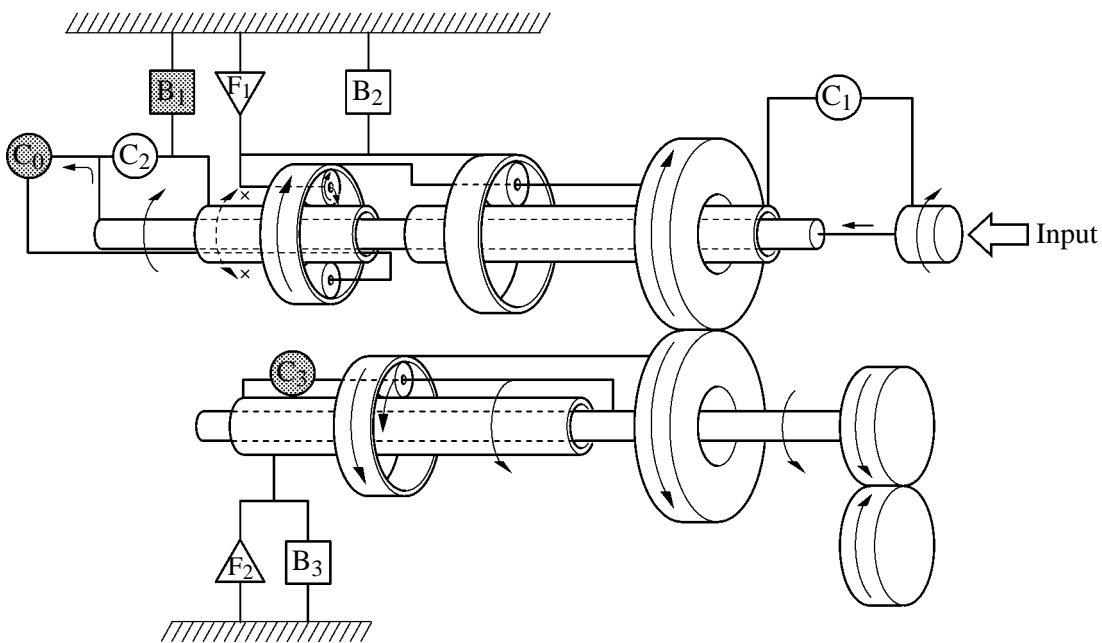
025CH06Y

4th Gear (D or 4 Position)



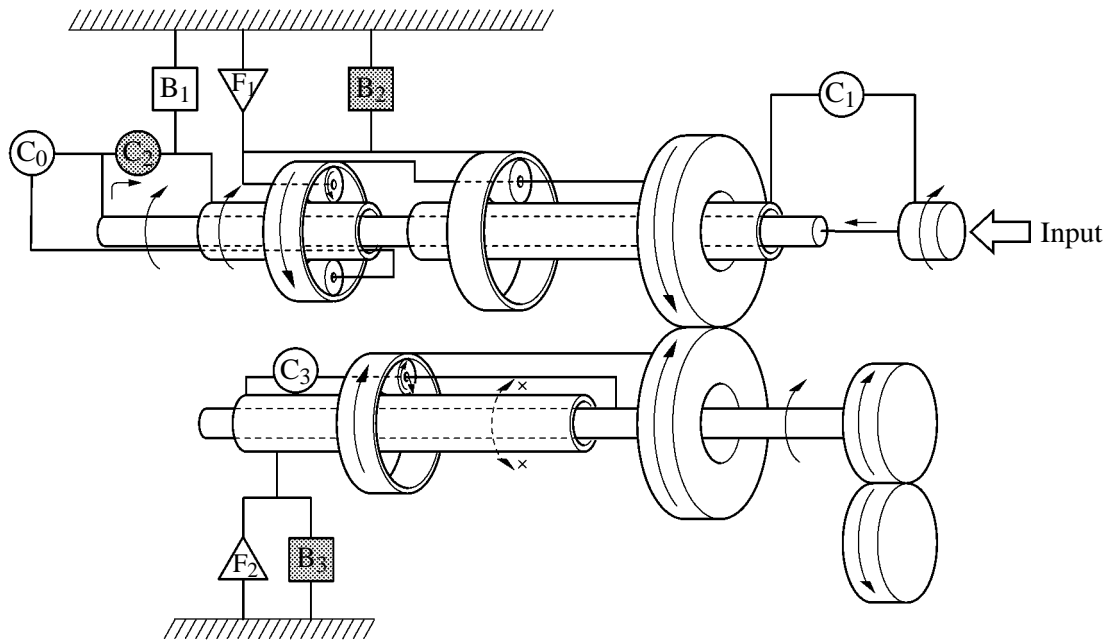
025CH07Y

5th Gear (D Position)



025CH08Y

Reverse Gear (R Position)



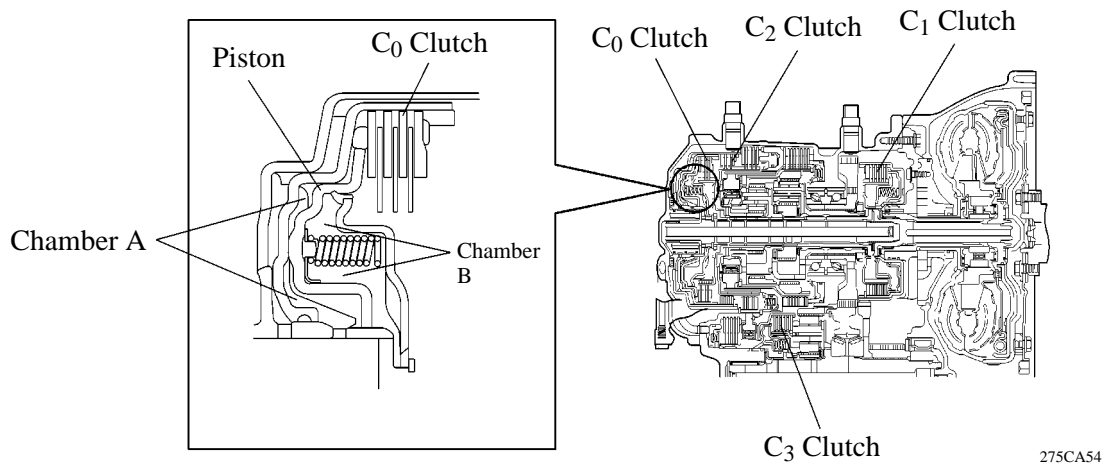
025CH09Y

4. Centrifugal Fluid Pressure Canceling Mechanism

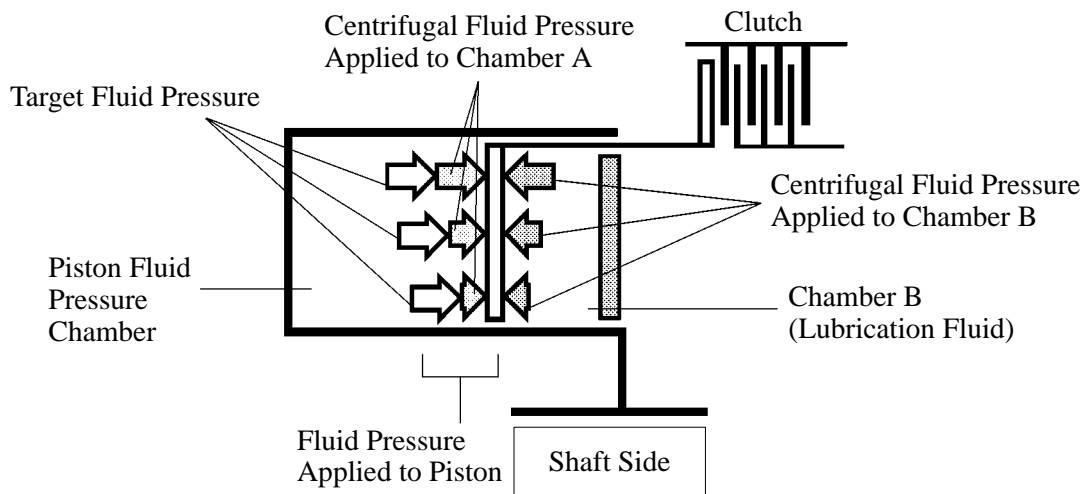
There are two reasons for improving the conventional clutch mechanism:

- ▶ To prevent the generation of pressure by the centrifugal force that is applied to the fluid in piston fluid pressure chamber (hereafter referred to as “chamber A”) when the clutch is released, a check ball is provided to discharge the fluid. Therefore, before the clutch could be subsequently applied, it took time for the fluid to fill the chamber A.
- ▶ During shifting, in addition to the original clutch pressure that is controlled by the valve body, the pressure that acts on the fluid in chamber A also exerts influence, which is dependent upon revolution fluctuations.

To address these two needs for improvement, a canceling fluid pressure chamber (hereafter referred to as “chamber B”) has been provided opposite chamber A.



By utilizing lubrication fluid such as that of the shaft, an equal centrifugal force is applied, thus canceling the centrifugal force that is applied to the piston itself. Accordingly, it is not necessary to discharge the fluid through the use of a check ball, and a highly responsive and smooth shifting characteristic has been achieved.



Fluid pressure applied to piston	-	Centrifugal fluid pressure applied to chamber B	=	Target fluid pressure (original clutch pressure)
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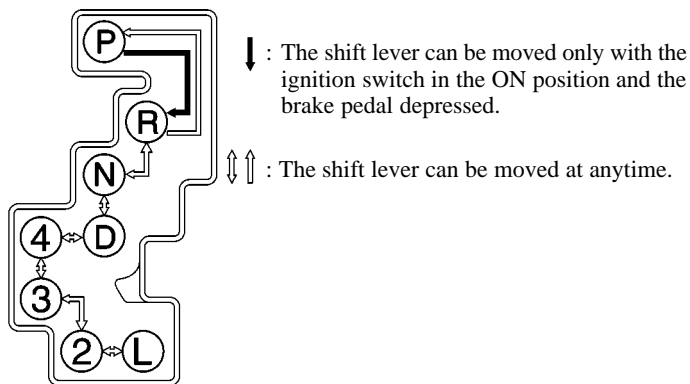
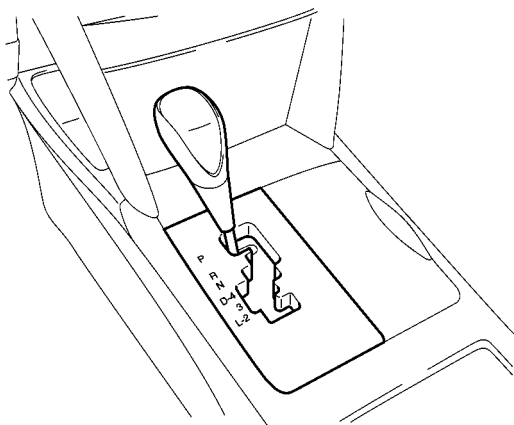
◆ SHIFT CONTROL MECHANISM

1. General

A gate type shift lever is used in conjunction with the 5-speed automatic transaxle. With the gate type lever, the shift lever button and the overdrive switch of the straight type (L gate type) shift lever are discontinued. Similar functions are achieved through a single-shift operation (fore-aft and side-to-side).

The shift control cable with a length adjustment mechanism is used.

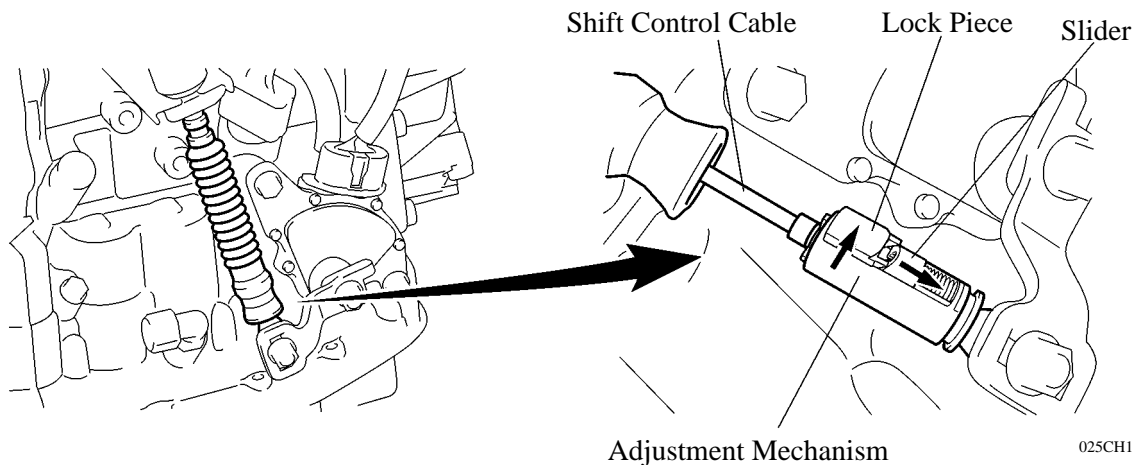
A shift lock system is used.



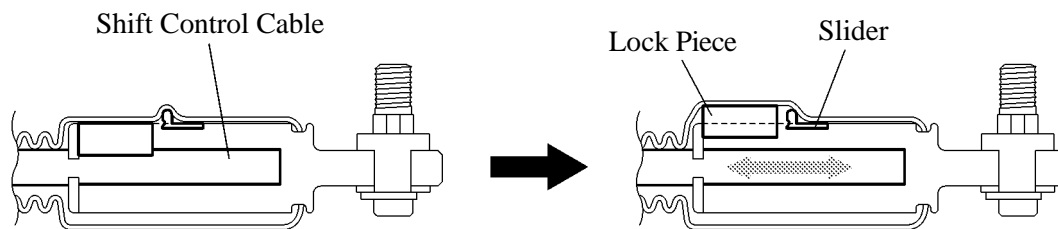
025CH15TE

Service Tip

The shift control cable is fixed by the lock piece of the adjustment mechanism. Adjustment of the shift control cable is possible by releasing the lock piece from the cable. For details, see the 2007 Camry Repair Manual (Pub. No. RM0250U).



025CH16TE



Adjustment Mechanism Cross Section

01YCH48TE

2. Shift Lock System

General

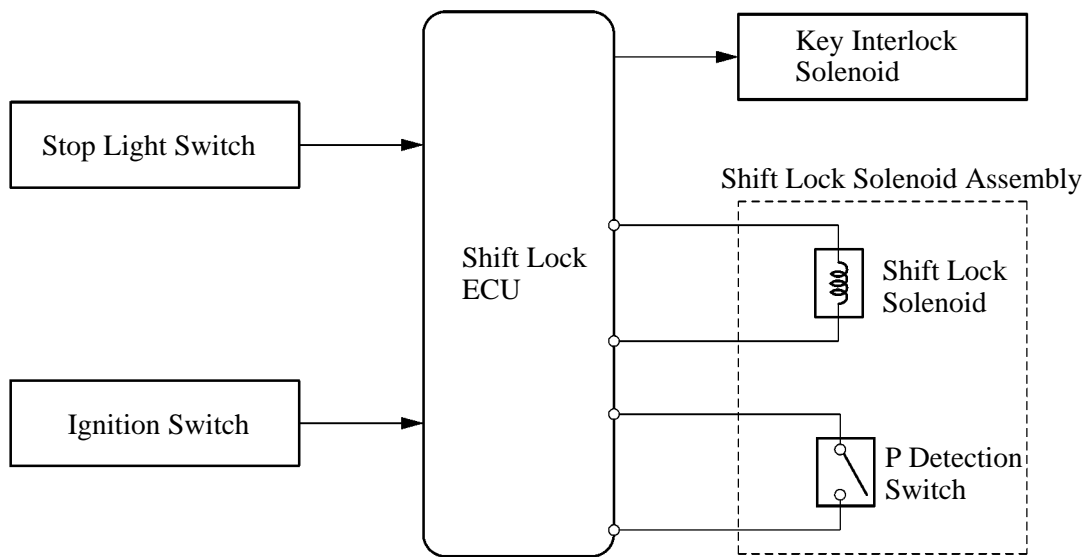
The key interlock device prevents the key from being pulled out after the ignition switch is turned OFF, unless the shift lever is moved to the P position. Thus, the driver is urged to park the vehicle in the P position.

The shift lock mechanism prevents the shift lever from being shifted to any position other than the P position, unless the ignition switch is ON, and the brake pedal is depressed. This mechanism helps to prevent unintentional acceleration.

The shift lock system mainly consists of the shift lock ECU, shift lock solenoid, key interlock solenoid and shift lock override button.

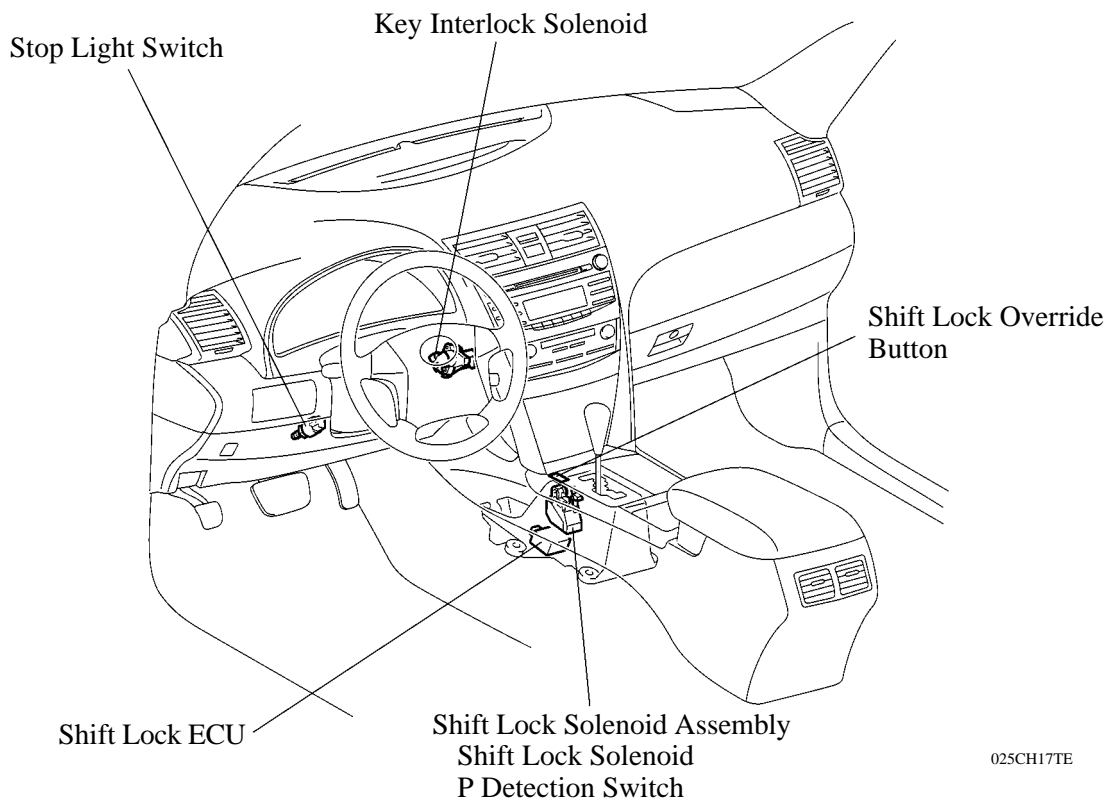
The shift lock solenoid has a built-in P detection switch.

► System Diagram ●



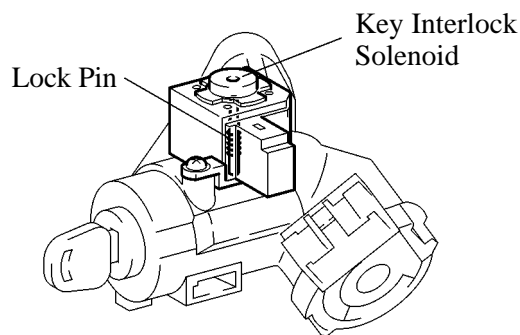
025CH20TE

Layout of Main Components



Key Interlock Solenoid

The activation of the key interlock solenoid that is mounted on the upper column bracket moves the lock pin to restrict the movement of the key cylinder. Therefore, if the shift lever is shifted to any position other than “P”, the ignition key cannot be moved from “ACC” to the “LOCK” position.

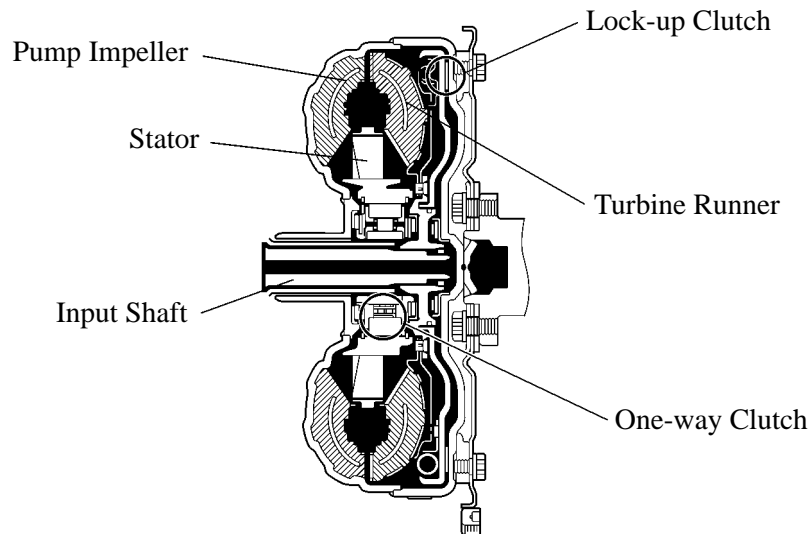


System Operation

The shift lock ECU uses the P detection switch to detect the shift lever position, and receives inputs from the stop light switch and the ignition switch. Upon receiving these signals, the shift lock ECU turns ON the key interlock solenoid and the shift lock solenoid in order to release the key interlock and shift lock. A shift lock override button, which manually overrides the shift lock mechanism, is used.

◆ TORQUE CONVERTER

This torque converter has optimally designed fluid passages and impeller configuration resulting in substantially enhanced transmission efficiency to ensure better starting, acceleration and fuel economy. Furthermore, a hydraulically operated lock-up mechanism, which enables the lock-up (flex lock-up) operation at medium to high vehicle speeds, is used to reduce the slip loss of the torque converter.



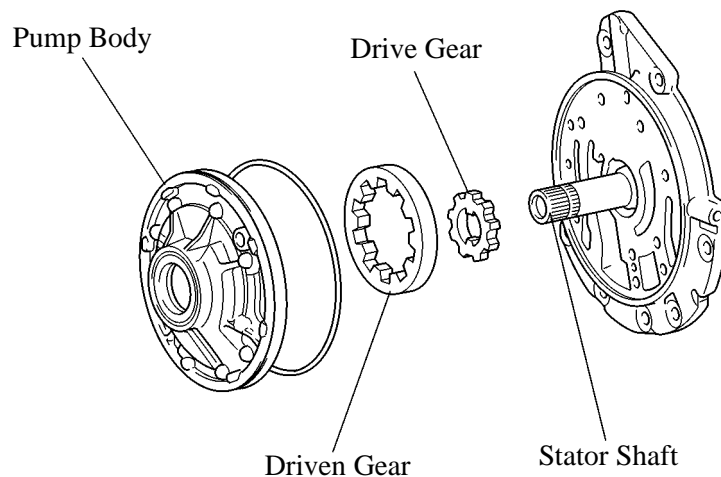
208CH02

► Specifications ●

Torque Converter Type	3-Element, 1-Step, 2-Phase
Stall Torque Ratio	1.8

◆ OIL PUMP

The oil pump is operated by the torque converter. It lubricates the planetary gear units and supplies operating fluid pressure for hydraulic control.



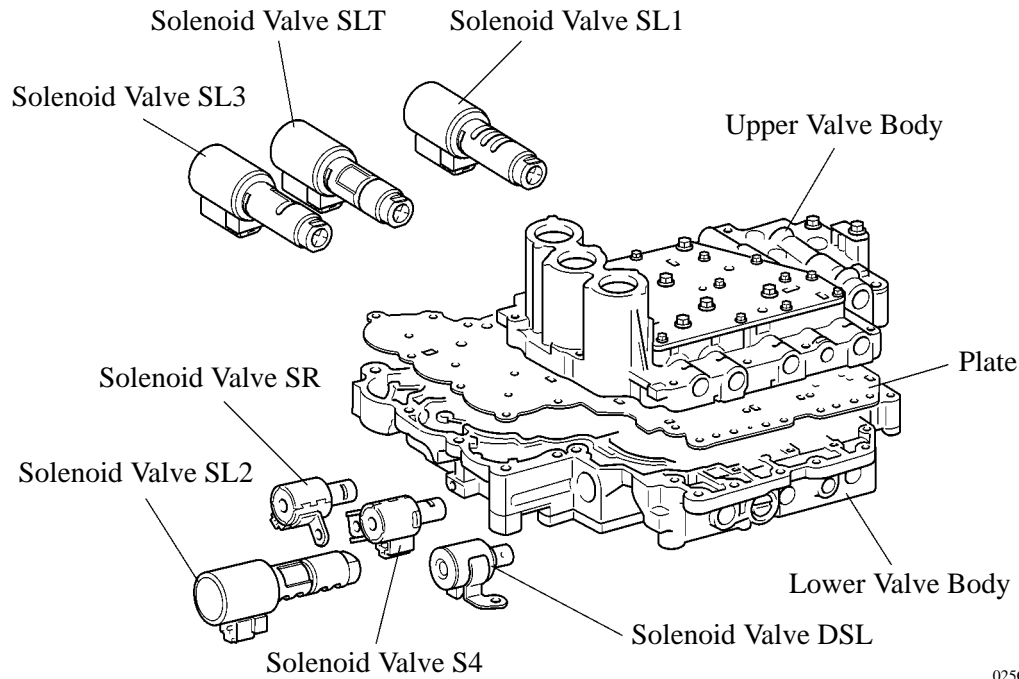
025CH03Y

◆ VALVE BODY UNIT

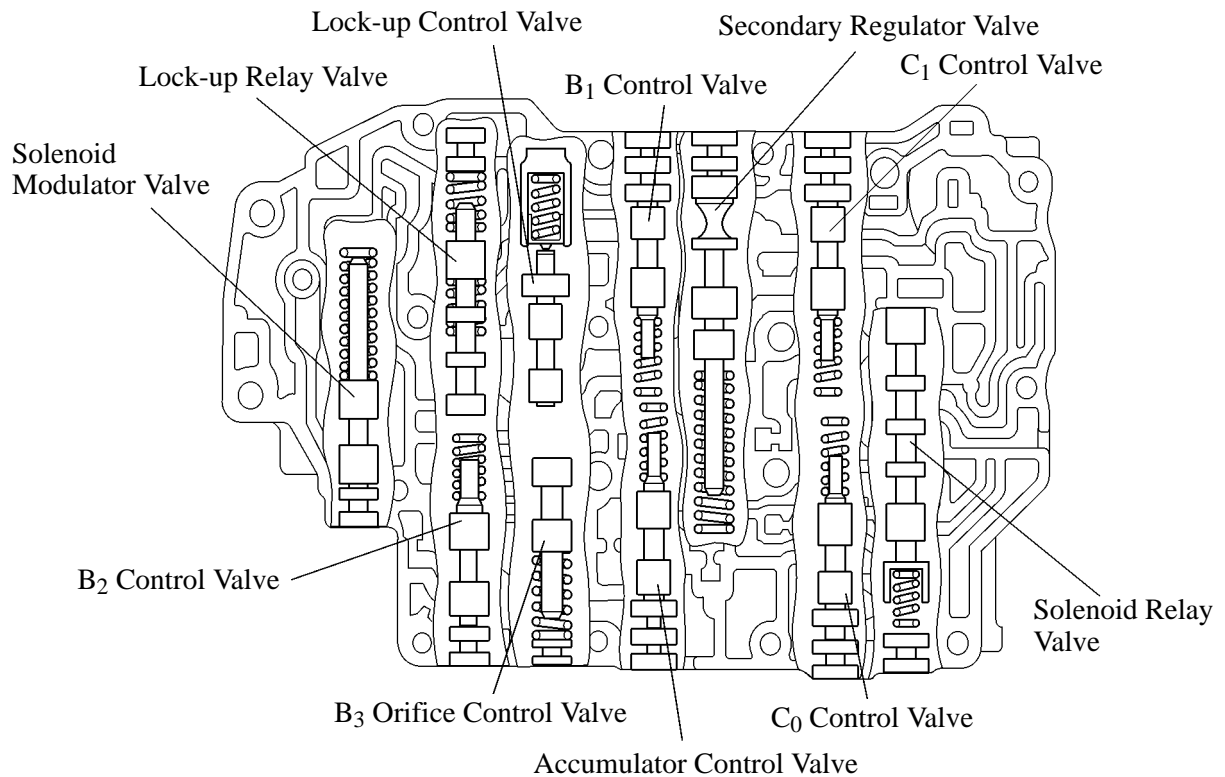
1. General

The valve body consists of the upper and lower valve bodies and 7 solenoid valves (SL1, SL2, SL3, SLT, DSL, S4, SR).

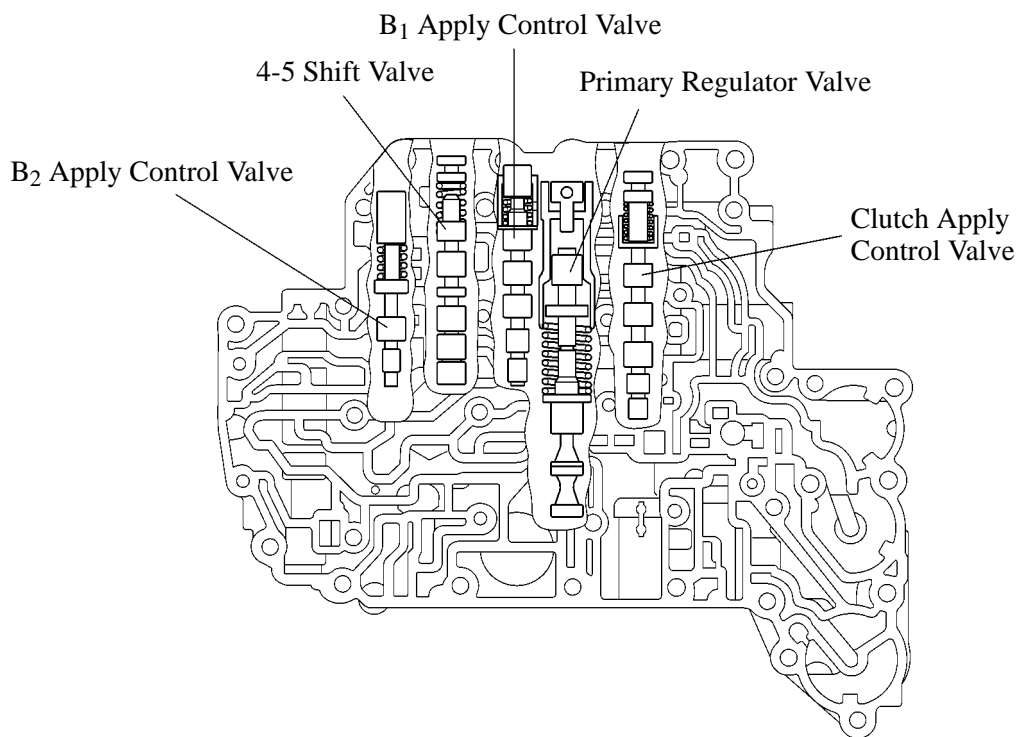
Apply orifice control, which controls the flow volume to the B₃ brake, is used in this unit.



► Upper Valve Body ●



► Lower Valve Body ●



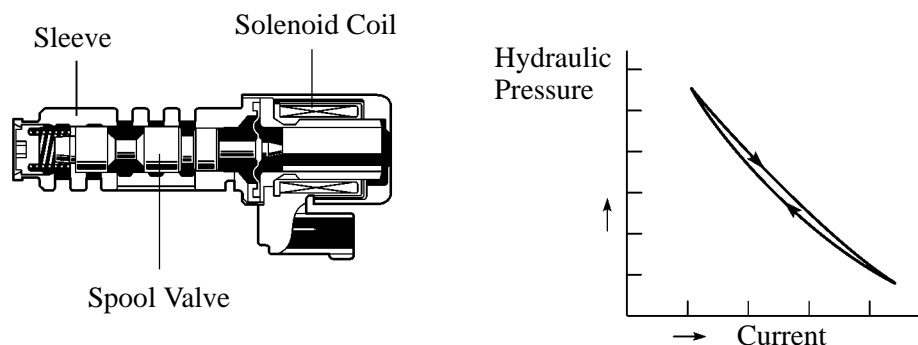
025CH23Y

2. Solenoid Valves

Solenoid Valves SL1, SL2, SL3 and SLT

In order to provide a hydraulic pressure that is proportion to current that flows to the solenoid coil, the solenoid valves SL1, SL2, SL3, and SLT linearly control the line pressure and clutch and brake engagement pressure based on the signals received from the ECM.

The solenoid valves SL1, SL2, SL3, and SLT have the same basic structure.



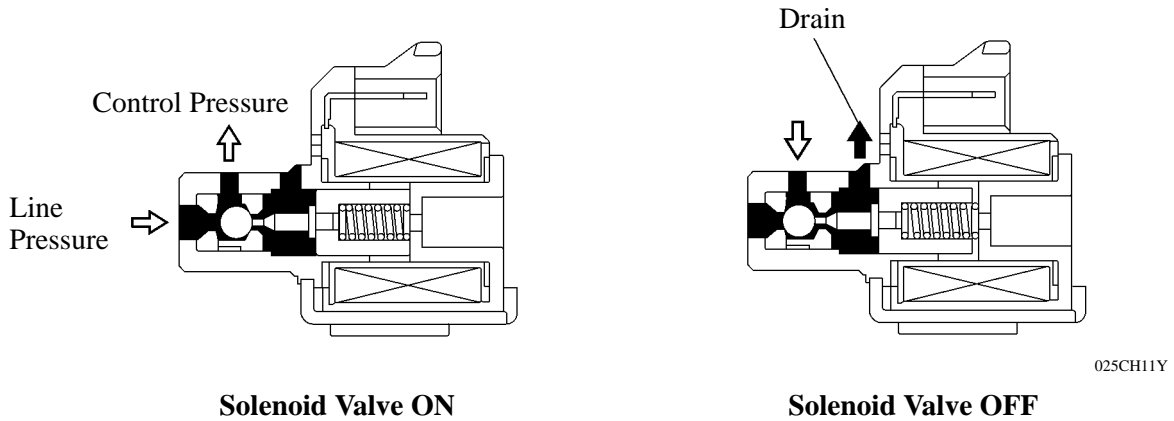
275CA51

► Function of Solenoid Valves ●

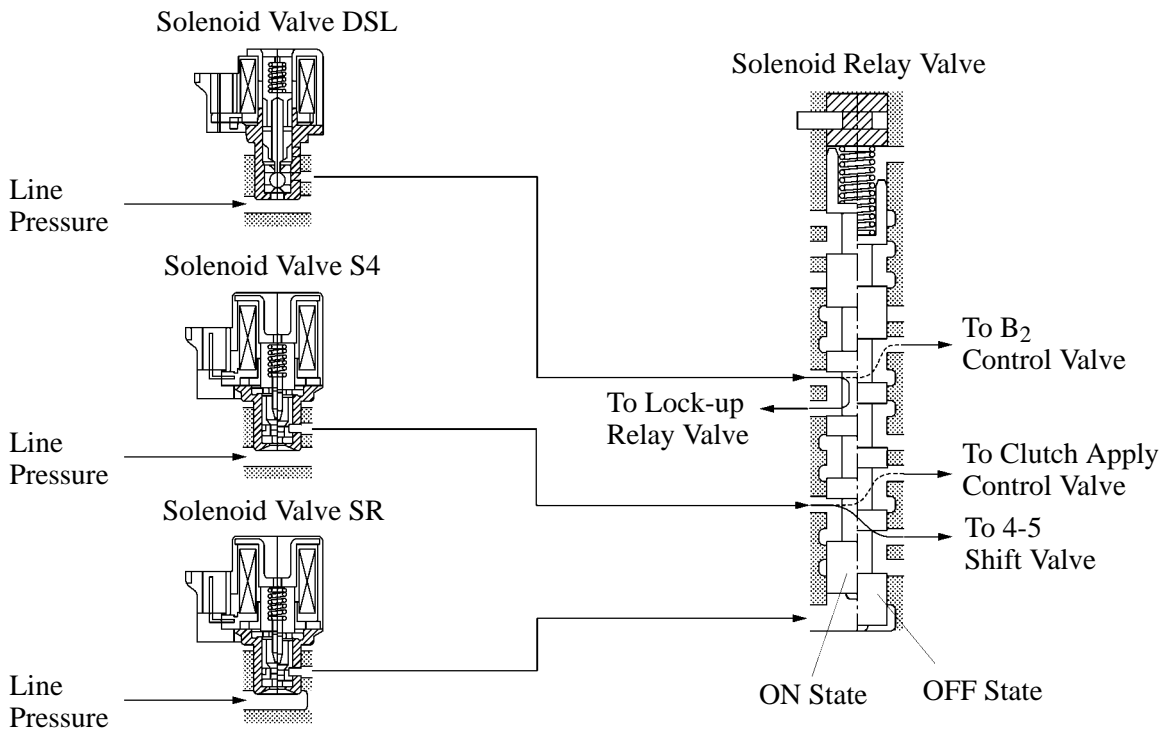
Solenoid Valve	Function
SL1	B ₁ brake pressure control
SL2	C ₀ clutch pressure control Lock-up clutch pressure control
SL3	C ₁ clutch pressure control
SLT	Line pressure control Secondary pressure control

Solenoid Valve SR, S4 and DSL

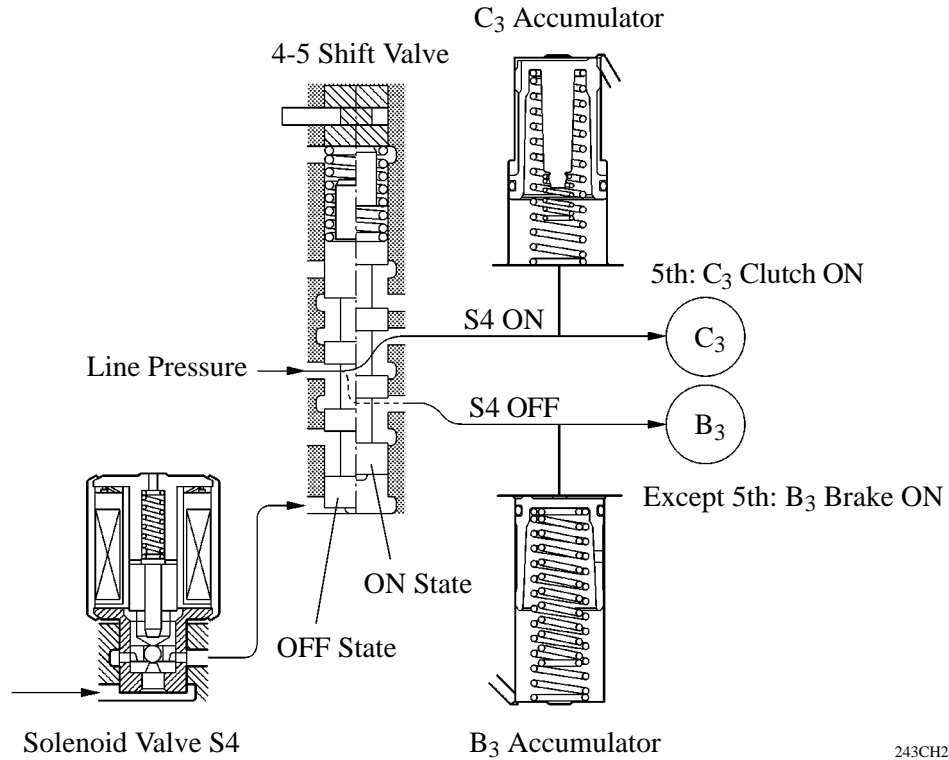
The solenoid valves SR, S4, and DSL use a three-way solenoid valve.



The solenoid valve SR controls the solenoid relay valve. Accordingly, the fluid passages from the solenoid valve DSL and S4 have been changed.

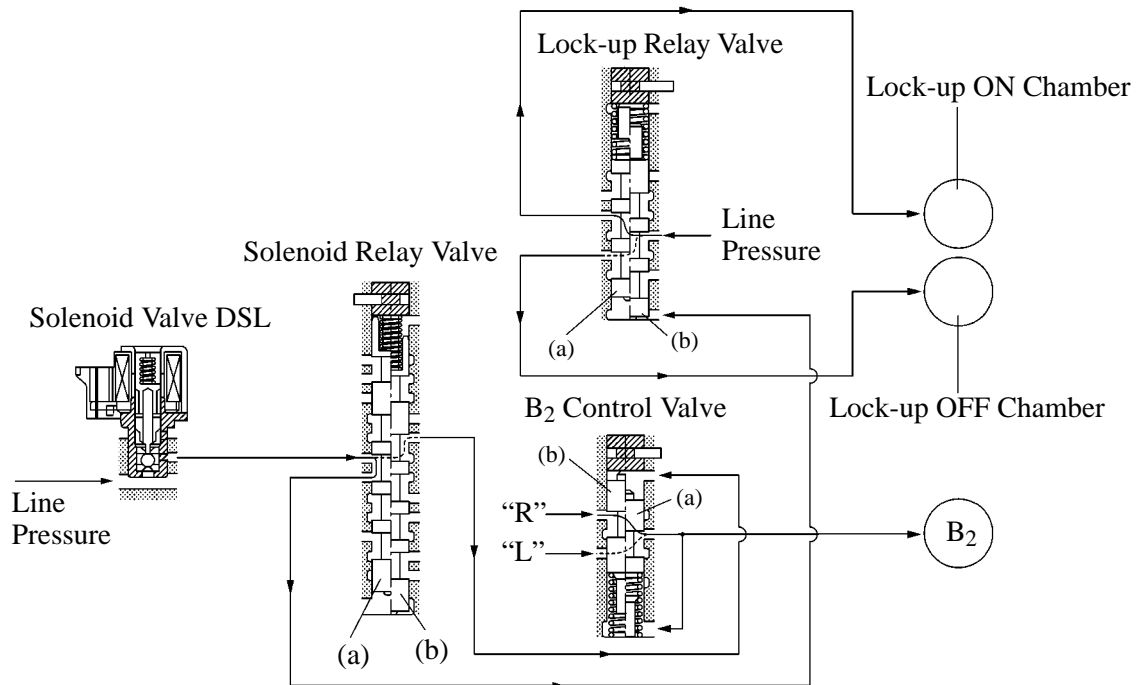


The solenoid valve S4, when set to ON, controls the 4-5 shift valve to establish the 5th by changing over the fluid pressure applied to B₃ brake and C₃ clutch.



243CH20

The solenoid valve DSL controls the B₂ control valve via the solenoid relay valve when the transaxle is shifted in the R or L position. During lock-up, the lock-up relay valve is controlled via the solenoid relay valve.

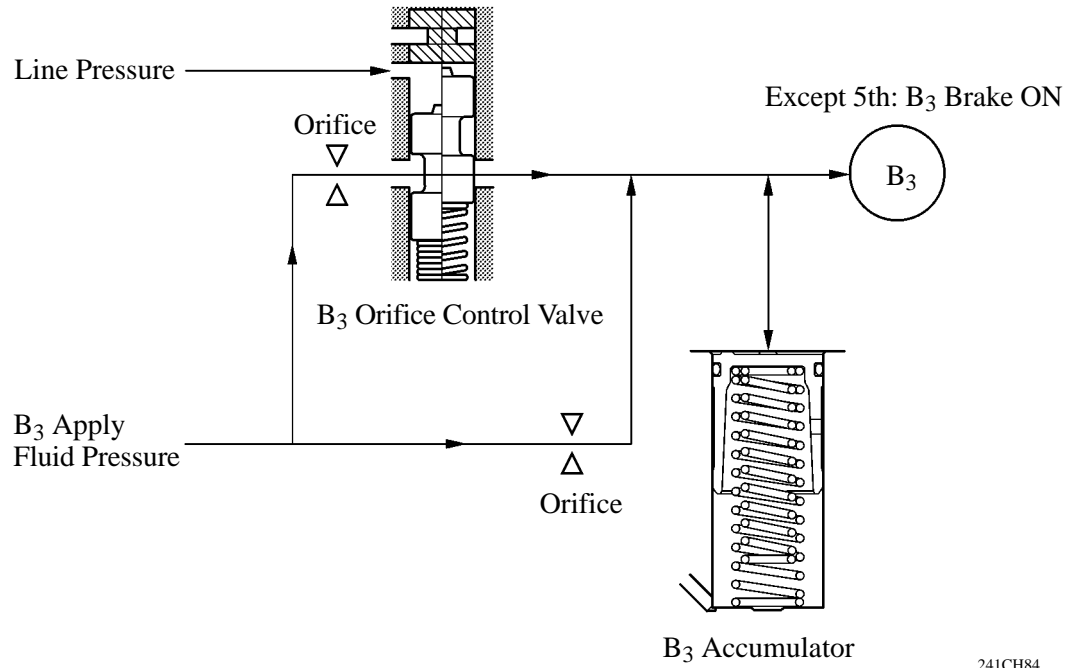


(a): ON State
(b): OFF State

241CH83

3. Apply Orifice Control

This control is effected by the B₃ orifice control valve. The B₃ orifice control valve has been provided for the B₃ brake, which is applied when shifting from 5th to 4th. The B₃ orifice control valve is controlled by the amount of the line pressure in accordance with shifting conditions, and the flow volume of the fluid that is supplied to the B₃ brake is controlled by varying the size of the orifice in the control valve.

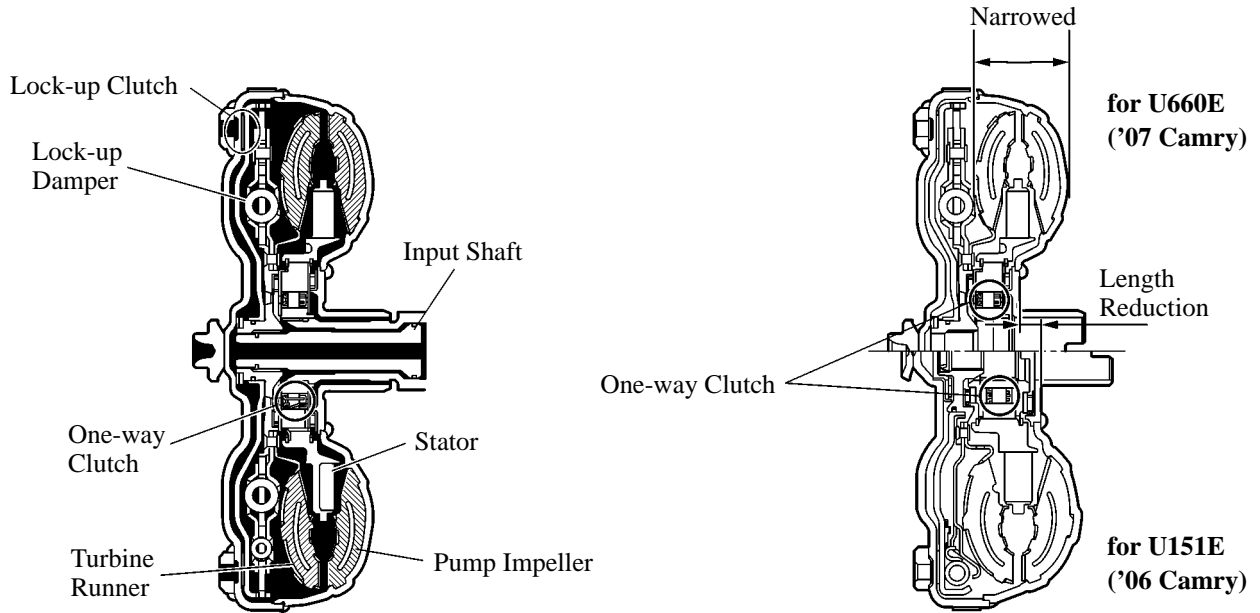


◆ TORQUE CONVERTER

A compact, lightweight and high-capacity torque converter is used.

In order to make the torque converter more compact and shorten its total length, the pump impeller and turbine runner portions have been made narrower, and the structure of the one-way clutch has been simplified.

This torque converter has optimally designed fluid passages and impeller configuration resulting in substantially enhanced transmission efficiency to ensure better starting, acceleration and fuel economy. Furthermore, a hydraulically operated lock-up mechanism, which enables the lock-up (flex lock-up) operation at low to high vehicle speeds, is used to reduce the slip loss of the torque converter.



01YCH05Y

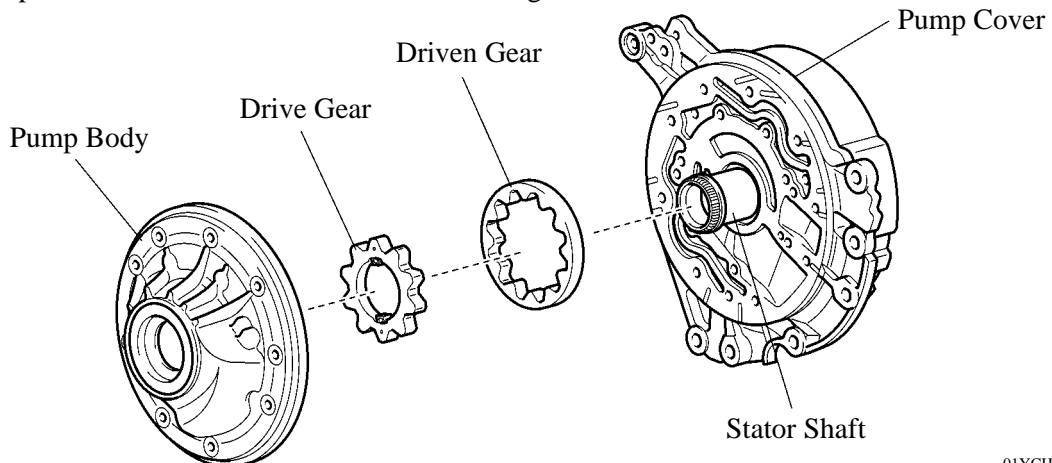
► Specifications ●

Model	'07 Camry	'06 Camry
Transaxle Type	U660E	U151E
Torque Converter Type	3-Element, 1-Step, 2-Phase	Δ
Stall Torque Ratio	1.80	1.75

◆ OIL PUMP

The oil pump is operated by the torque converter. It lubricates the planetary gear units and supplies operating fluid pressure for hydraulic control.

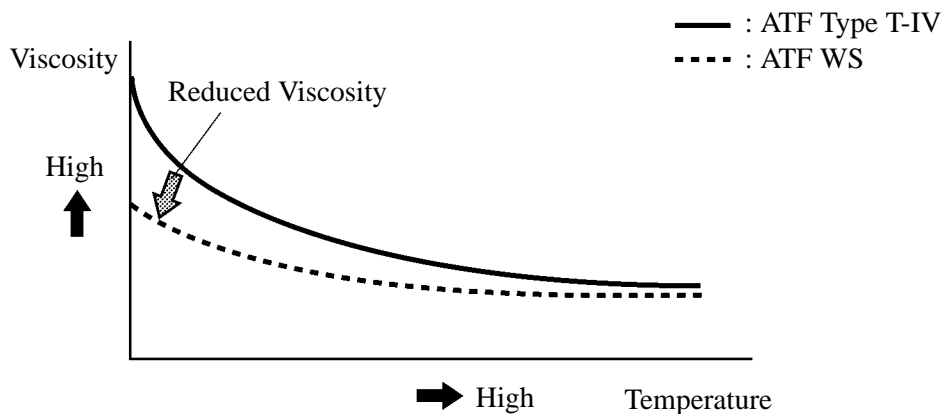
The pump cover is made of aluminum to reduce weight.



01YCH36TE

● ATF (AUTOMATIC TRANSMISSION FLUID) WS

- ▶ ATF WS is used to reduce the resistance of the ATF and improve the fuel economy by reducing its viscosity in the practical operating temperature range. At higher fluid temperatures, the viscosity is the same as that of ATF Type T-IV, which ensures the durability of the automatic transaxle.
- ▶ ATF WS and other types of ATF (ATF Type T-IV, D-II.) are not interchangeable.

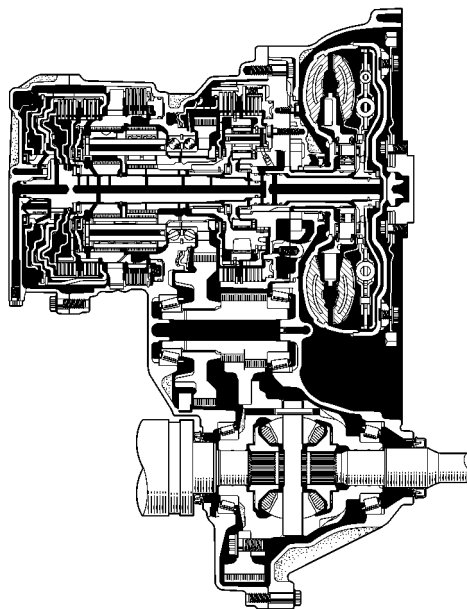


259LSK03

U660E AUTOMATIC TRANSAXLE

DESCRIPTION

A newly developed U660E automatic transaxle is used on the 2GR-FE engine models. This automatic transaxle is a compact, lightweight and high-capacity 6-speed Super ECT (Electronically Controlled Transaxle).



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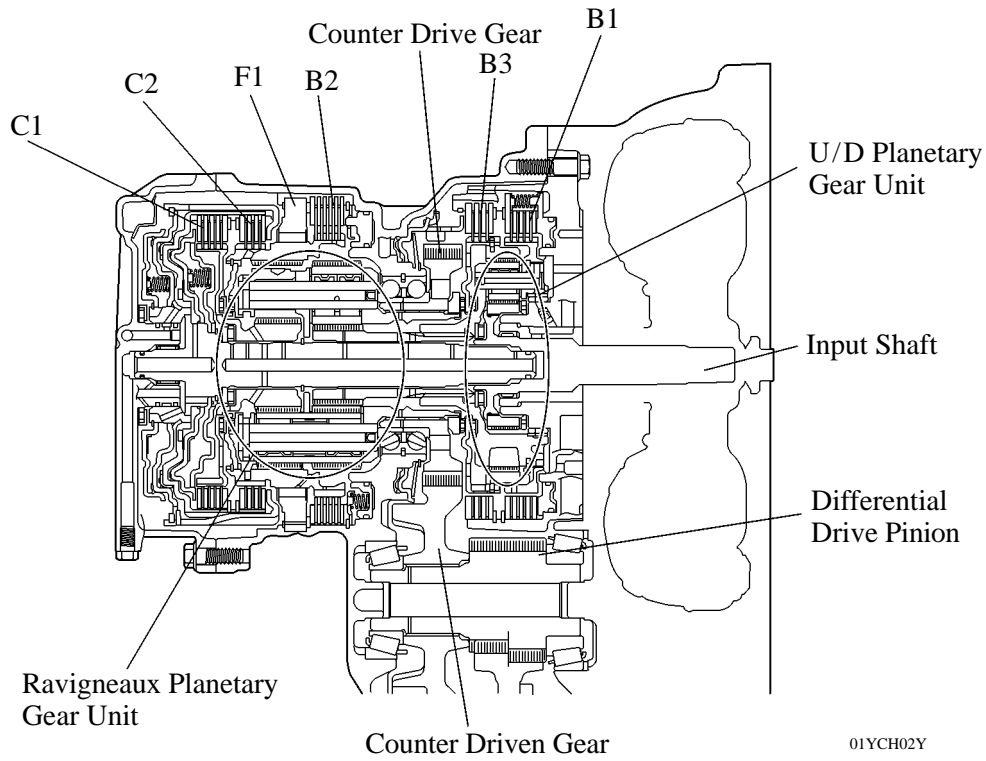
► Specifications ●

Model		'07 Camry	'06 Camry
Transaxle Type		U660E	U151E
Gear Ratio	1st	3.300	4.235* ¹
	2nd	1.900	2.360* ¹
	3rd	1.420	1.517* ¹
	4th	1.000	1.047* ¹
	5th	0.713	0.756* ¹
	6th	0.608	—
	Reverse	4.148	3.378* ¹
Differential Gear Ratio		3.685* ¹	3.291
Fluid Capacity* ²	Liters (US qts, Imp. qts)	6.57 (6.94, 5.78)	8.9 (9.4, 7.8)
Fluid Type		Toyota Genuine ATF WS	ATF Type T-IV
Weight (Reference)* ³	kg (lb)	94.4 (208.1)	101 (222.2)

*¹: Counter gear ratio included

*²: Differential included

*³: Weight shows the figure with the fluid filled to the maximum level.



01YCH02Y

► Specifications ●

C1	No.1 Clutch		4
C2	No.2 Clutch		3
B1	No.1 Brake	The No. of Discs	4
B2	No.2 Brake		5
B3	No.3 Brake		3
F1	No.1 One-Way Clutch	The No. of Sprags	20
Ravigneaux Planetary Gear Unit		The No. of Front Sun Gear Teeth	30
		The No. of Rear Sun Gear Teeth	27
		The No. of Long Pinion Gear Teeth	20
		The No. of Short Pinion Gear Teeth	22
		The No. of Ring Gear Teeth	69
U/D Planetary Gear Unit		The No. of Sun Gear Teeth	66
		The No. of Pinion Gear Teeth	21
		The No. of Ring Gear Teeth	110
Counter Gear		The No. of Drive Gear Teeth	44
		The No. of Driven Gear Teeth	47

◆ ELECTRONIC CONTROL SYSTEM

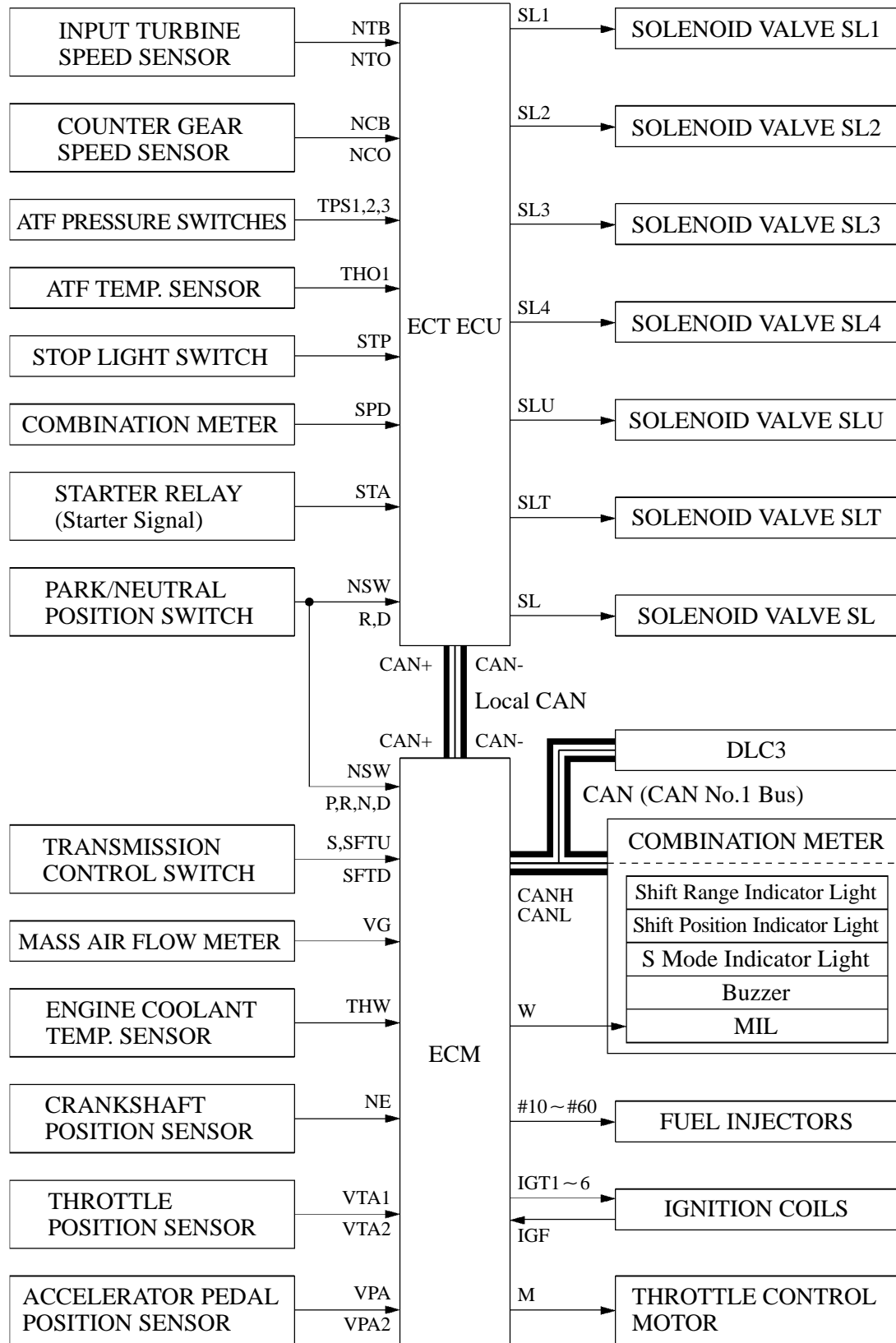
1. General

The electronic control system of the U660E automatic transaxle consists of the control listed below.

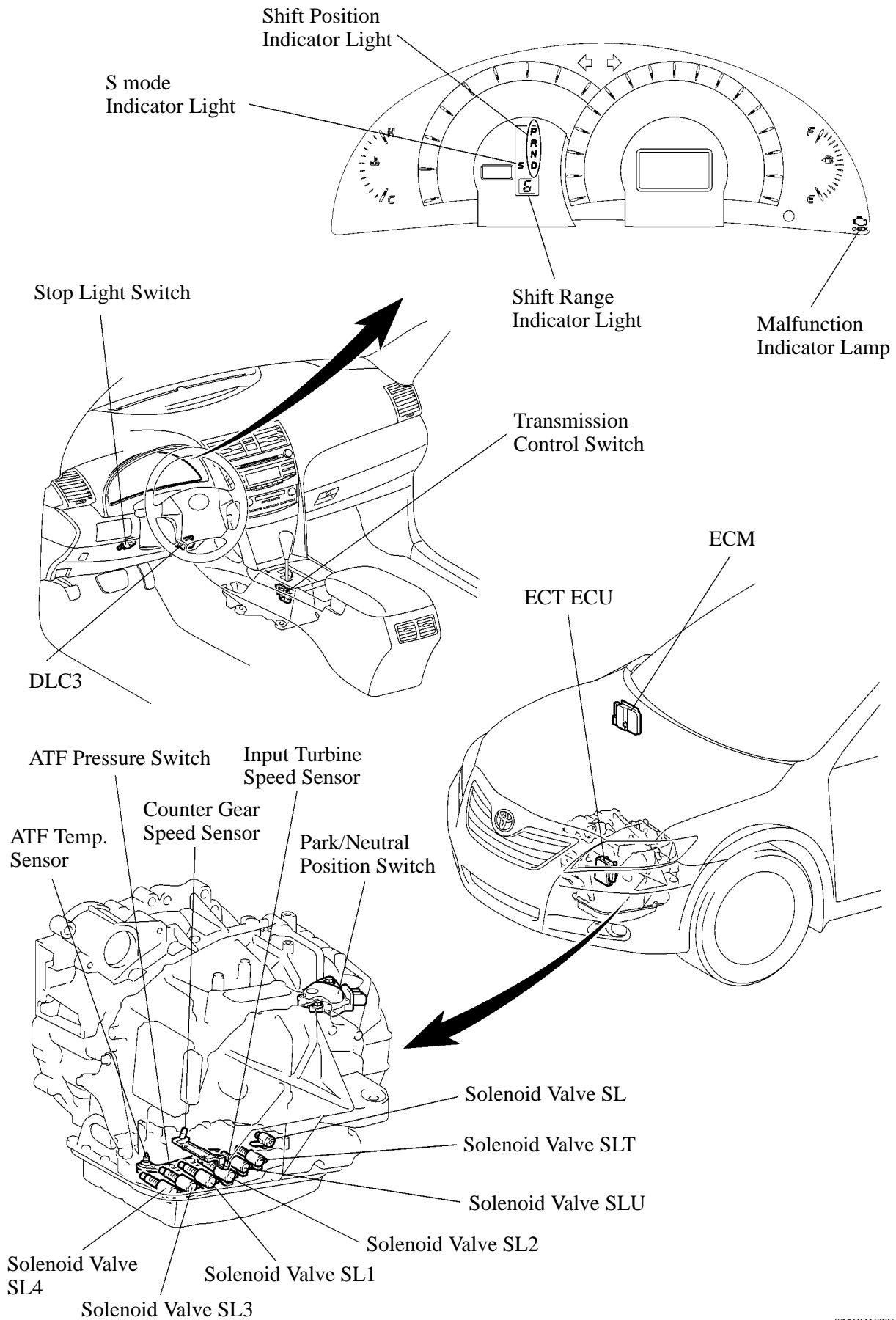
System	Outline
Shift Timing Control	The ECT ECU supplies current to 6 solenoid valves (SL1, SL2, SL3, SL4, SL and/or SLU) based on signals from each sensor to shift the gear.
Clutch to Clutch Pressure Control (See page CH-65)	Controls the pressure that is applied directly to the C1, C2 clutches and B1, B3 brakes by actuating the shift solenoid valves (SL1, SL2, SL3 and SL4) in accordance with ECT ECU signals.
Line Pressure Optimal Control (See page CH-66)	Actuates solenoid valve SLT to control the line pressure in accordance with information from the ECT ECU and the operating conditions of the transaxle.
Powertrain Cooperative Control (See page CH-67)	Controls both the shift control and engine output control in an integrated way, achieving excellent shift characteristics and drivability.
Lock-up Timing Control (See page CH-68)	The ECT ECU supplies current to shift solenoid valves SL and SLU based on signals from each sensor and engages or disengages the lock-up clutch.
Flex Lock-up Clutch Control (See page CH-69)	Controls solenoid valves SLU and SL, provides an intermediate mode between the ON/OFF operation of the lock-up clutch, and increases the operating range of the lock-up clutch to improve fuel economy.
Coast Downshift Control (See page CH-70)	The ECT ECU performs downshift control so that fuel cut control can continue for as long as possible during deceleration.
AI (Artificial Intelligence) -SHIFT (See page CH-71)	Based on the signals from various sensors, the ECT ECU determines the road condition and the intention of the driver. Thus, the shift pattern is automatically regulated to an optimal level, improving drivability.
Multi-Mode Automatic Transmission (See page CH-73)	The ECT ECU appropriately controls the automatic transaxle in accordance with the range position selected while the shift lever is in the S mode position.
Diagnosis (See page CH-75)	When the ECT ECU detects a malfunction, the ECT ECU makes a diagnosis and memorizes the malfunctioning part.
Fail-safe (See page CH-75)	Even if a malfunction is detected in the sensors or solenoids, the ECT ECU activates fail-safe control to prevent the vehicle's drivability from being significantly affected.

2. Construction

The configuration of the electronic control system in the U660E automatic transaxle is as shown in the following chart.



3. Layout of Main Components



4. Construction and Operation of Main Components

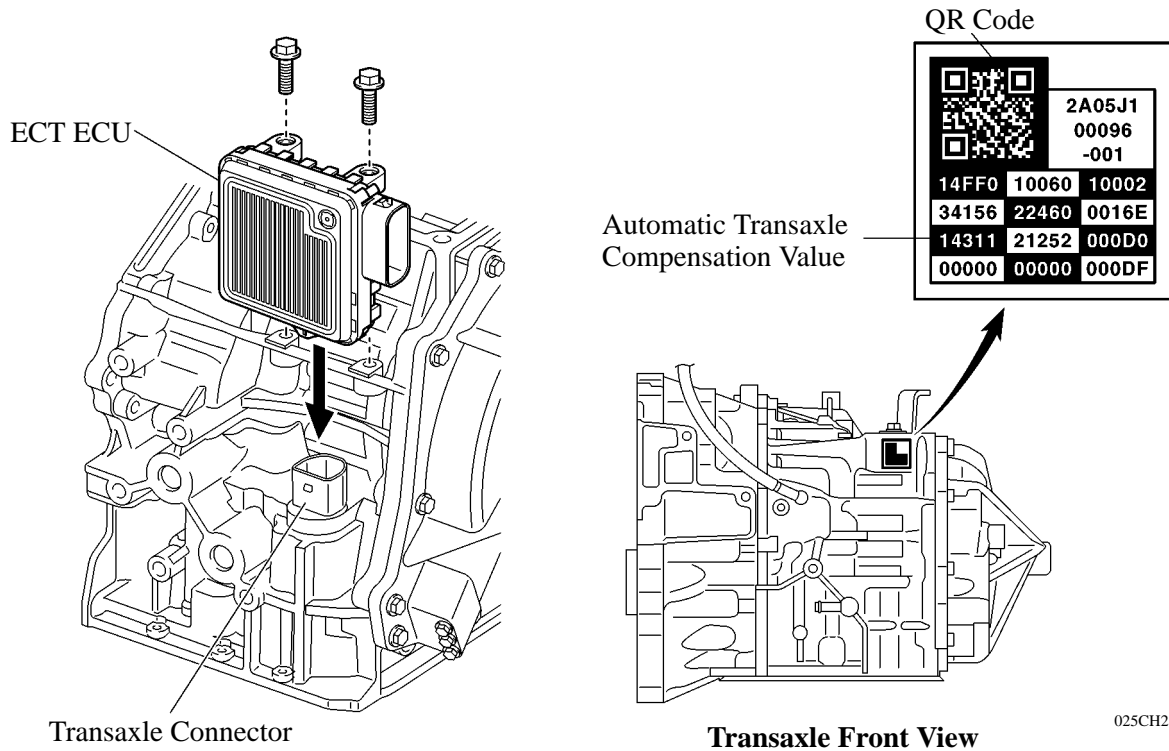
ECT ECU

The ECT ECU has been isolated from the ECM and directly fitted to the transaxle. Thus, the wiring harness has been shortened allowing the weight to be reduced. All the solenoid valves and sensors used for automatic transaxle control are directly connected to the ECT ECU through the connector located in front of the automatic transaxle.

The ECT ECU maintains communication with the ECM through the CAN (Controller Area Network). Thus, engine control is effected in coordination with ECT control.

A label, on which the automatic transaxle compensation values and QR (Quick Response) code are printed, is attached on the top of the automatic transaxle. The label contains encoded automatic transaxle property information. When the automatic transaxle is replaced, allow the ECT ECU to learn the automatic transaxle property information by inputting the automatic transaxle compensation values into the ECT ECU using a hand-held tester. In this way, the shift control performance immediately after replacement of the automatic transaxle is improved. For details, see the 2007 Camry Repair Manual (Pub. No. RM0250U).

The QR code, which requires a special scan tool, is used at the vehicle assembly plant.



025CH28TE

— REFERENCE —

What are QR (Quick Response) Codes?

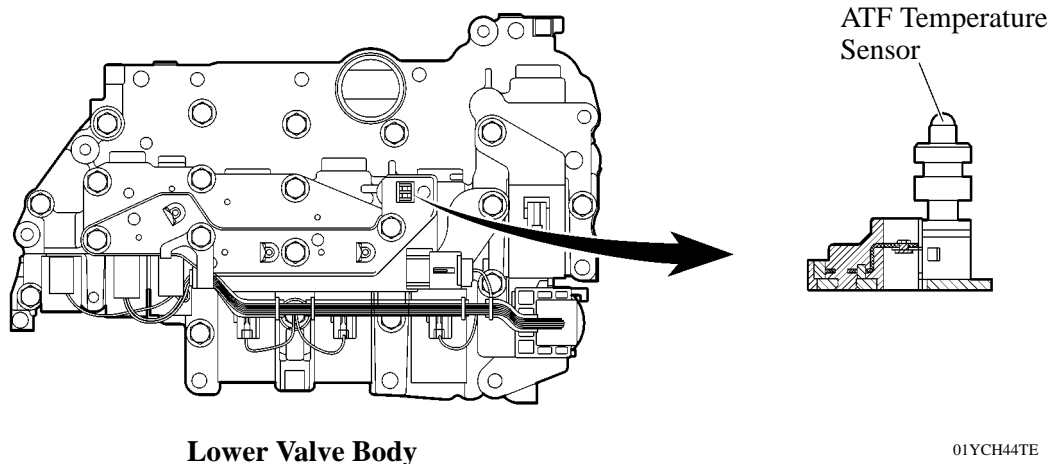
QR code, a matrix symbology consisting of an array of nominally square cells, allows omni-directional, high-speed reading of large amounts of data.

QR codes encode many types of data such as numeric, alphanumeric, kanji, kana and binary codes. A maximum of 7,089 characters (numeric) can be encoded.

QR codes (2D code) contain information in the vertical and horizontal directions, whereas bar codes only contain data in one direction. QR codes (2D code) hold considerably greater volumes of information than bar codes.

ATF Temperature Sensor

The ATF temperature sensor is installed in the valve body for direct detection of the fluid temperature. The ATF temperature sensor is used for the revision of clutch and brake pressures to maintain a smooth shift quality every time.

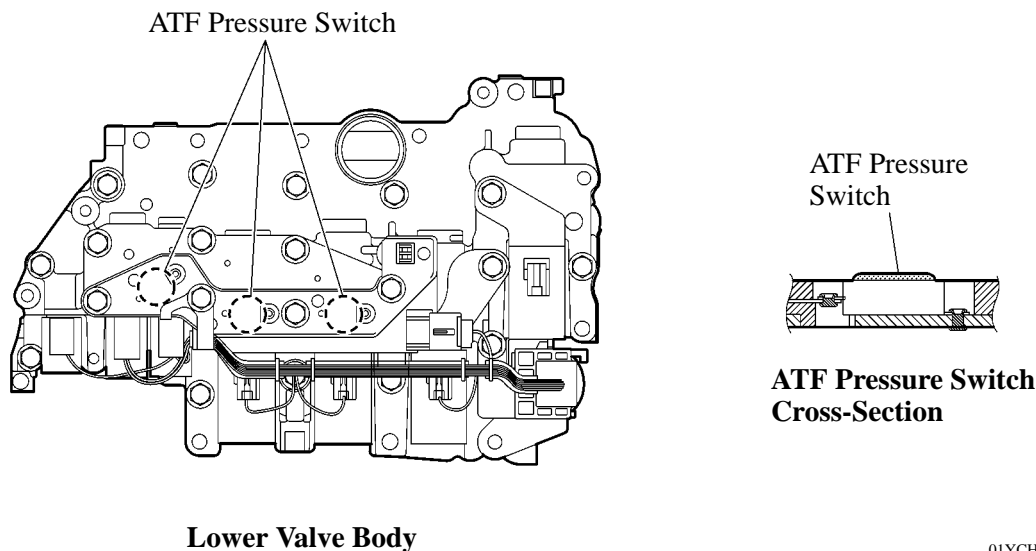


ATF Pressure Switch

The ATF pressure switches are located in the output fluid passages of SL1, SL2 and SLU, and turn ON/OFF in accordance with the solenoid valve output fluid pressure.

The ECT ECU detects malfunctions in solenoid valves SLU and SL used in lock-up control in accordance with the ON/OFF signals from ATF pressure switch 3 located in the SLU output fluid passage.

When any of SL1 to SL4 malfunctions, the ECT ECU determines the appropriate fail-safe operation to be actuated in accordance with the ON/OFF signals from ATF pressure switches 1 and 2 located in the SL1 and SL2 output fluid passages.



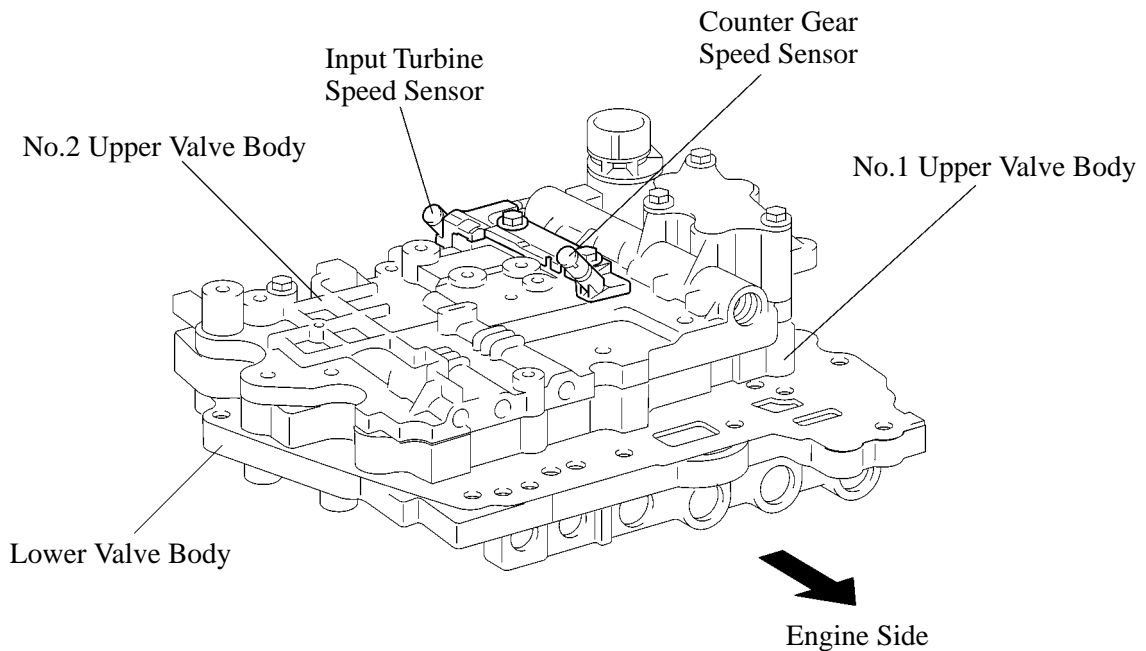
Speed Sensors

The U660E automatic transaxle uses an input turbine speed sensor (for the NT signal) and a counter gear speed sensor (for the NC signal). Thus, the ECT ECU can detect the timing of the shifting of the gears and appropriately control the engine torque and hydraulic pressure in response to the various conditions. These speed sensors are the Hall type.

The input turbine speed sensor detects the input speed of the transaxle. The No.2 clutch piston is used as the timing rotor for this sensor.

The counter gear speed sensor detects the speed of the counter gear. The counter drive gear is used as the timing rotor for this sensor.

The Hall type speed sensor consists of a magnet and Hall IC. The Hall IC converts the changes in the magnetic flux density that occur through the rotation of the timing rotor into electric signal, and outputs the signal to the ECT ECU.



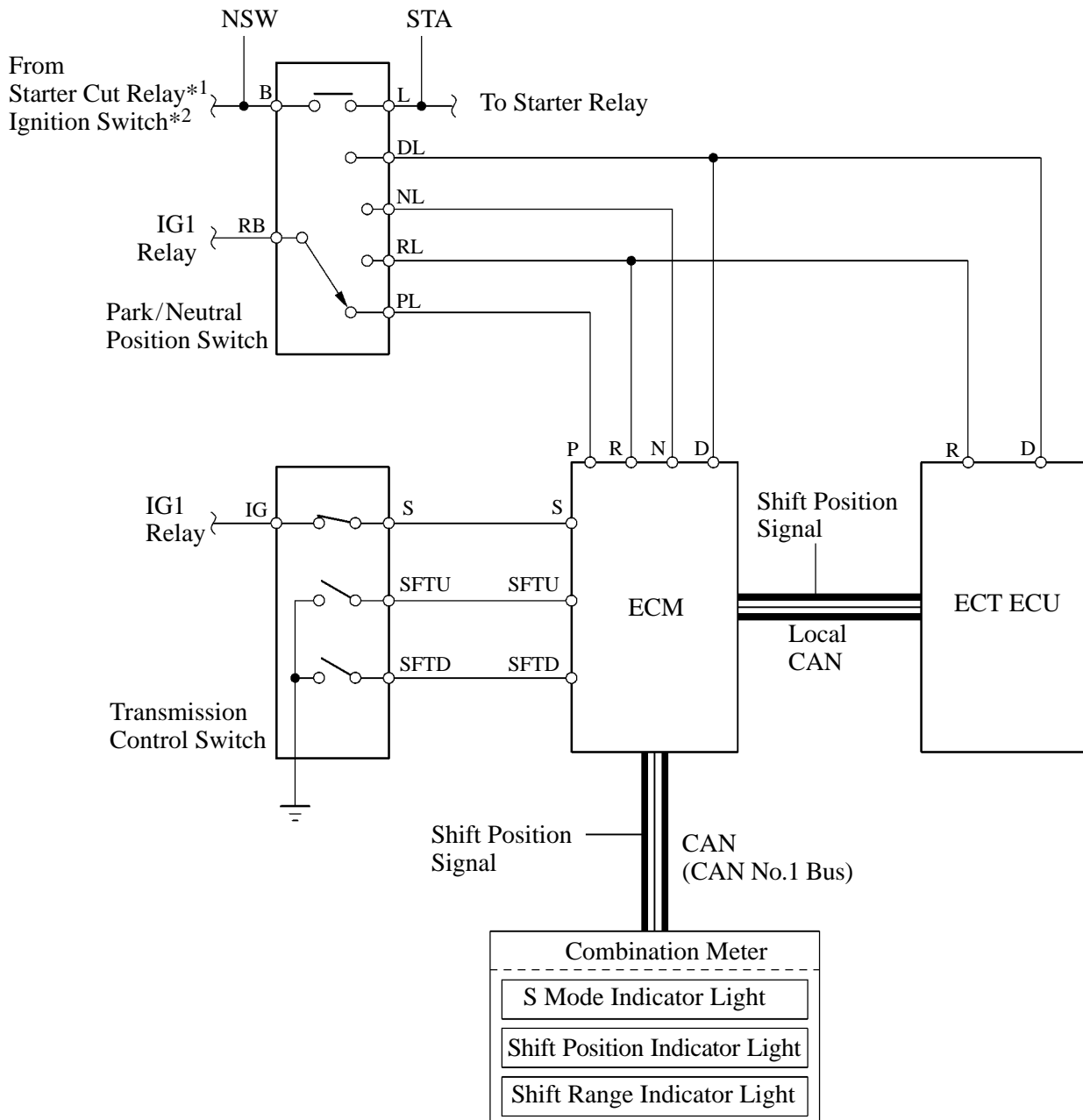
Transmission Control Switch and Park/Neutral Position Switch

The ECT ECU and ECM use these switches to detect the shift lever position.

The park/neutral position switch sends the P, R, N and D position signals to both the ECM and ECT ECU. The ECM transmits signals to the combination meter for the shift position indicator light (P, R, N and D) in response to the signal it receives from the switch.

The transmission control switch is installed inside the shift lever assembly. Switch terminal S is used to detect whether the shift lever is in the D position or S mode position, and terminals SFTU and SFTD are used to detect the operating conditions of the shift lever (front [+ position] or rear [- position]) if S mode is selected. By transmitting signals to the ECM, the transmission control switch turns on both the shift range indicator light and S mode indicator light when the shift lever is moved to the S mode position, and indicates the selected range position through shift range indicator light.

► Wiring Diagram ●

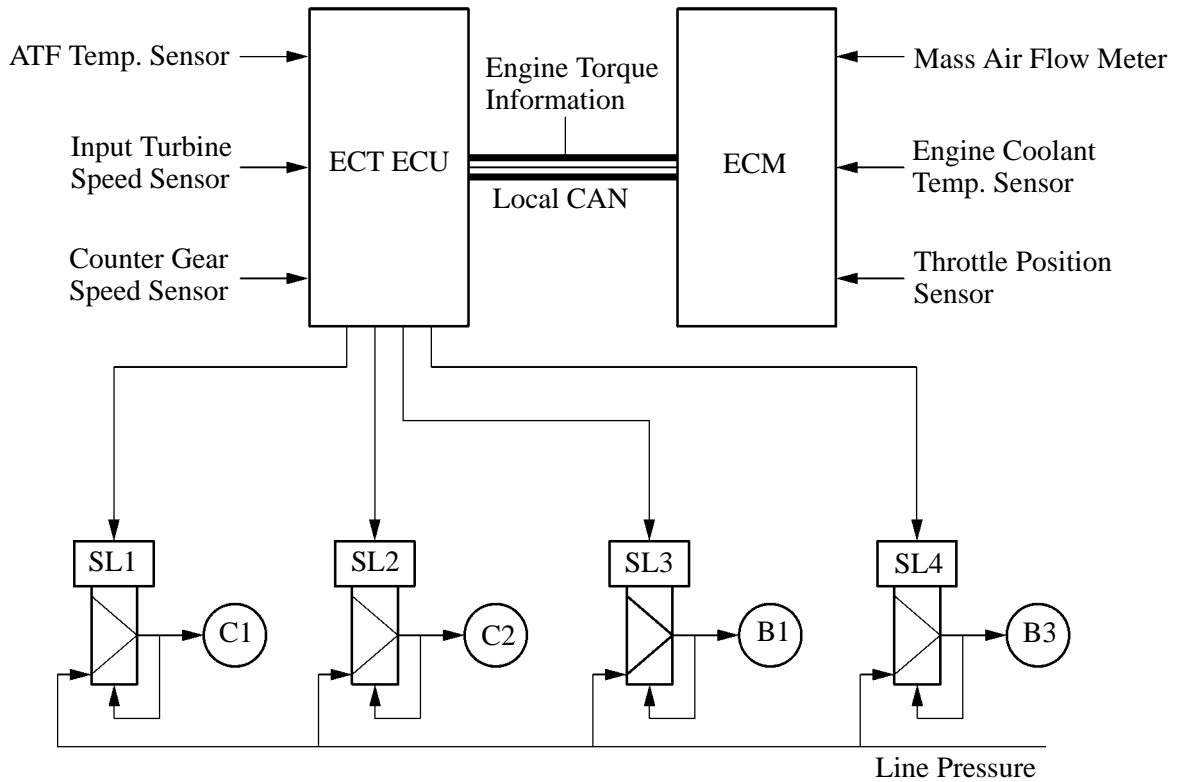


*1: Models with smart key system
 *2: Models without smart key system

5. Clutch to Clutch Pressure Control

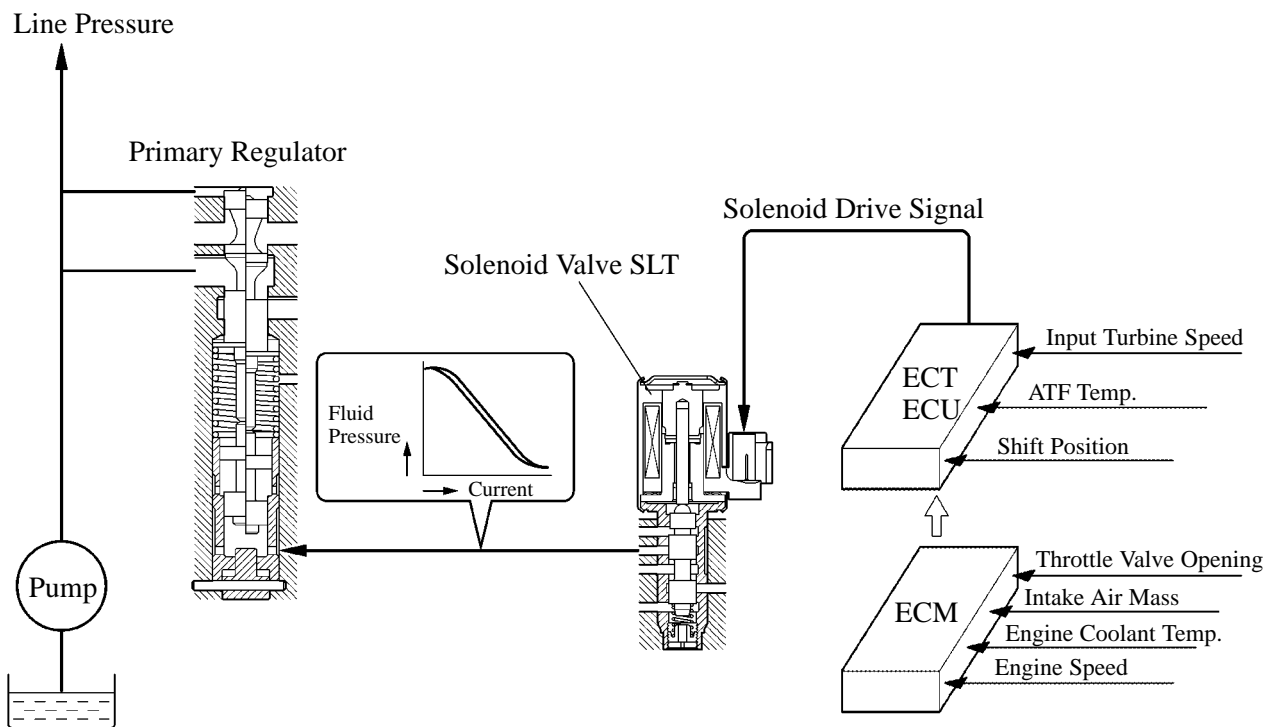
Clutch to clutch pressure control is used for shift control. As a result, shift control in the 2nd gear or above is possible without using the one-way clutch, and the automatic transaxle has been made lightweight and compact.

Using the fluid pressure circuit, which enables the clutches and brakes (C1, C2, B1 and B3) to be controlled independently, and the high flow SL1, SL2, SL3 and SL4 linear solenoid valves, which directly control the line pressure, the ECT ECU controls each clutch and brake accordingly with the optimum fluid pressures and timings in accordance with the information transmitted by the sensors, and then shifts the gears. As a result, highly responsive and excellent shift characteristics have been realized.



6. Line Pressure Optimal Control

The line pressure is controlled by using solenoid valve SLT. Through the use of solenoid valve SLT, the line pressure is optimally controlled in accordance with the engine torque information, as well as with the internal operating conditions of the torque converter and the transaxle. Accordingly, the line pressure can be accurately controlled in accordance with the engine output, traveling condition, and the ATF temperature, thus realizing smooth shift characteristics and optimizing the workload of the oil pump.



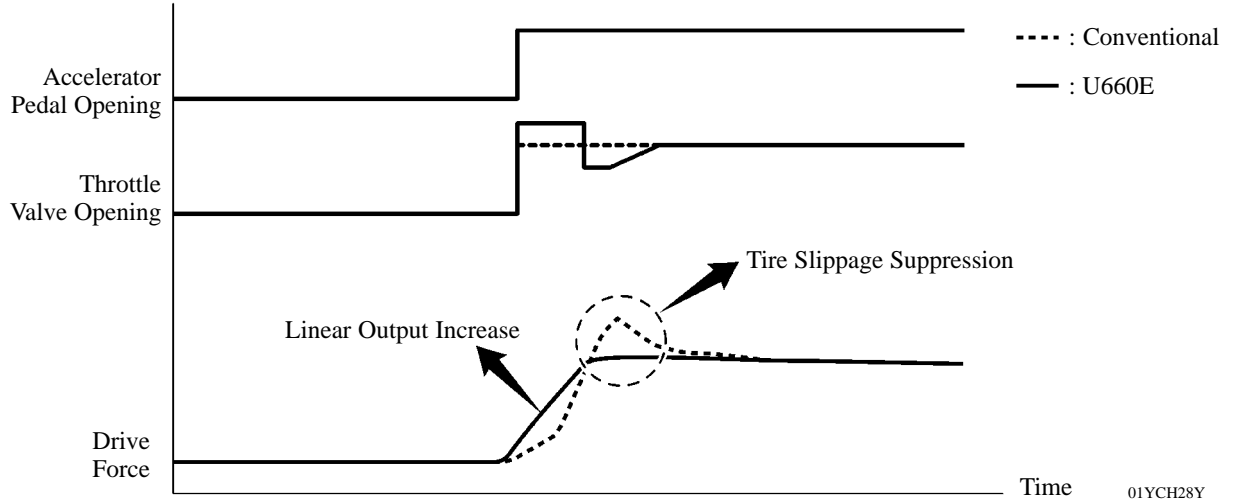
01YCH27Y

*: This diagram illustrates the fundamentals of Line Pressure Control. The valve shapes differ from the actual ones.

7. Powertrain Cooperative Control

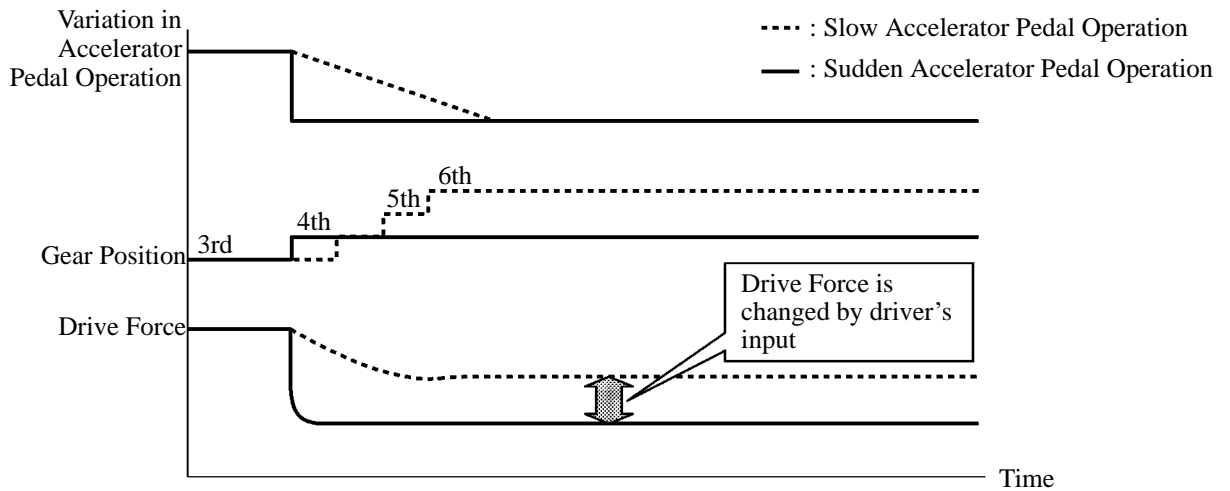
Throttle Control at Launch

By controlling the engine output in cooperative control with ETCS-i (Electronic Throttle Control System-intelligent) when the vehicle is launched, excellent launch performance (improved response and suppression of tire slippage) is ensured.



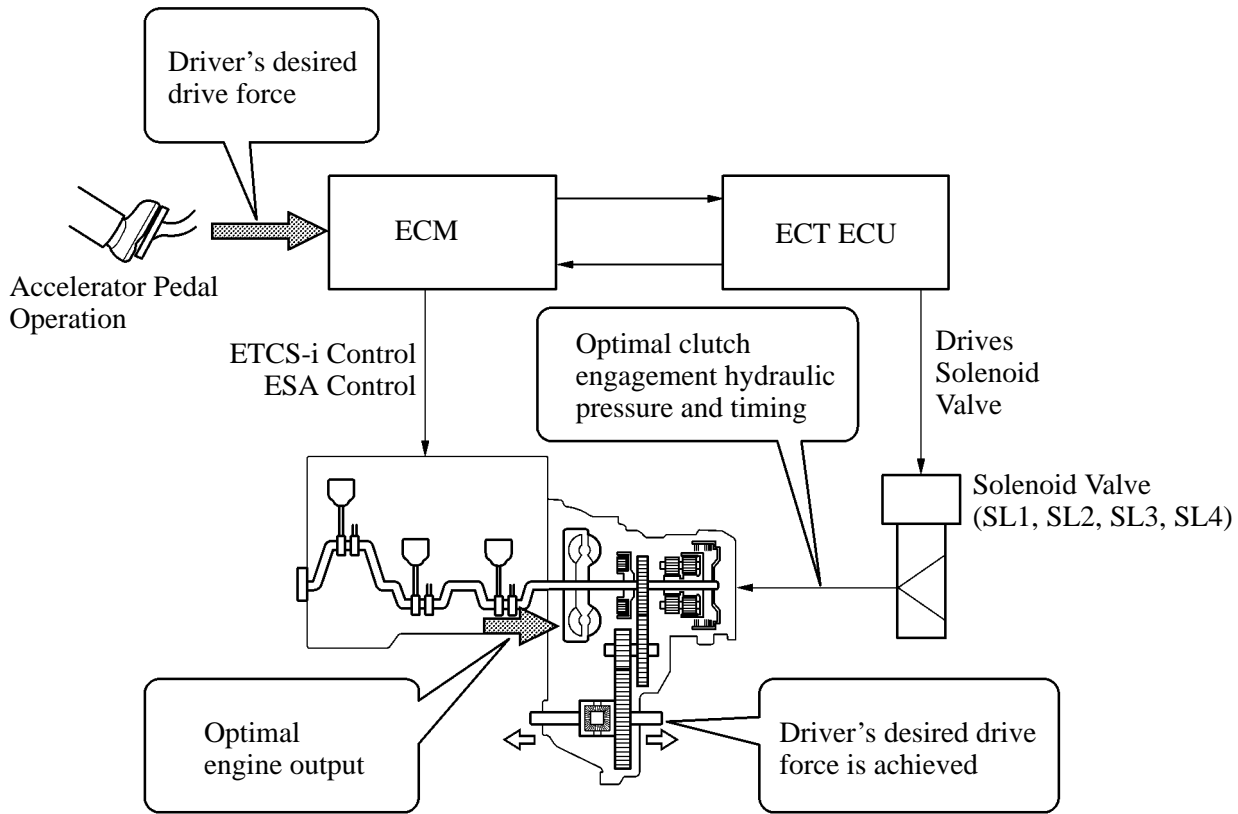
Deceleration Force Control

The ECT ECU determines the gear position when the accelerator pedal is OFF (released completely) in accordance with the operation of the accelerator pedal (released suddenly or slowly) during deceleration. In this way, preventing unnecessary upshifts and downshifts when the accelerator pedal is OFF and ensuring smooth acceleration when the vehicle needs to accelerate again.



Transient Shifting Control

Through cooperative control with ETCS-i (Electronic Throttle Control System-intelligent) and ESA (Electronic Spark Advance), and electronic control of the engagement and release speed of the clutch and brake hydraulic pressures, excellent response and shift shock reduction have been achieved.

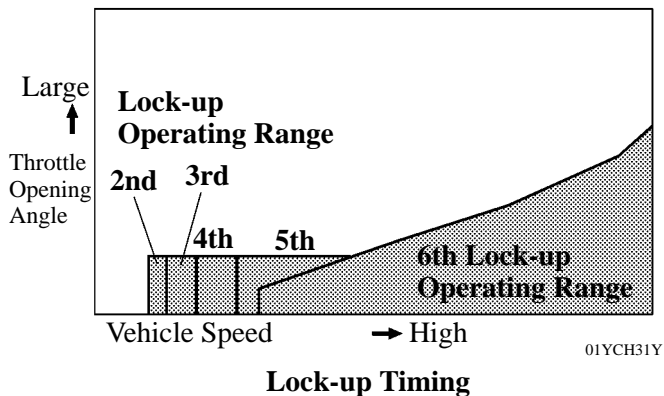


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8. Lock-up Timing Control

The ECT ECU operates the lock-up timing control in order to improve the fuel consumption while in the 2nd gear or above with the shift lever in the D, S6, S5, S4 range.

► Lock-up Operation ●



01YCH31Y

Gear	Position or Range		
	D or S6	S5	S4
1st	X	X	X
2nd			
3rd			
4th			
5th			—
6th		—	—

: Operates X: Does not operate —: Not applicable

9. Flex Lock-up Clutch Control

In addition to the conventional lock-up timing control, flex lock-up clutch control is used.

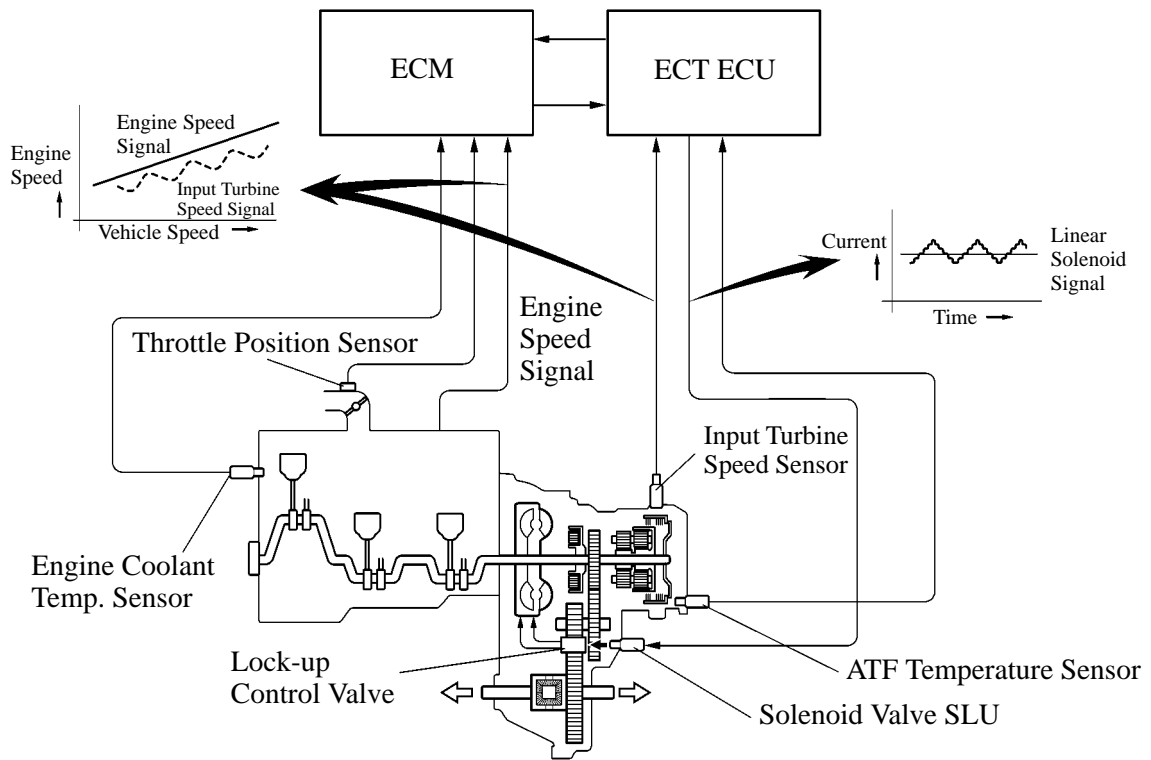
This flex lock-up clutch control regulates solenoid valve SLU as an intermediate mode between the ON and OFF operations of the lock-up clutch.

During acceleration, flex lock-up clutch control operates when the gear position is the 2nd or higher and the shift lever is in the D, S6, S5 or S4 range position. During deceleration, it operates when the gear position is the 4th or higher and the shift lever is in the D, S6, S5 or S4 range position.

During acceleration, the partition control of the power transmission between the lock-up clutch and torque converter greatly boosts the transmission efficiency in accordance with the driving conditions, improving the fuel economy.

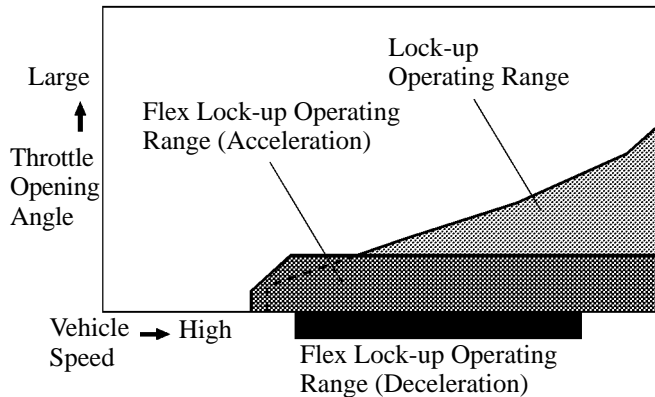
During deceleration, the lock-up clutch is made to operate. Therefore the fuel-cut area is expanded and fuel economy is improved.

By allowing flex lock-up clutch control to continue operating during gearshift, the smooth torque transmission has been obtained. As a result, the fuel economy and drivability have been improved.



01YCH32Y

► Flex Lock-up Operation ●



Flex Lock-Up Timing in 6th Gear

Gear	Position or Range		
	D, S6	S5	S4
1st	X	X	X
2nd			
3rd			
4th	*	*	*
5th	*	*	—
6th	*	—	—

: Operates X: Does not operate —: Not applicable

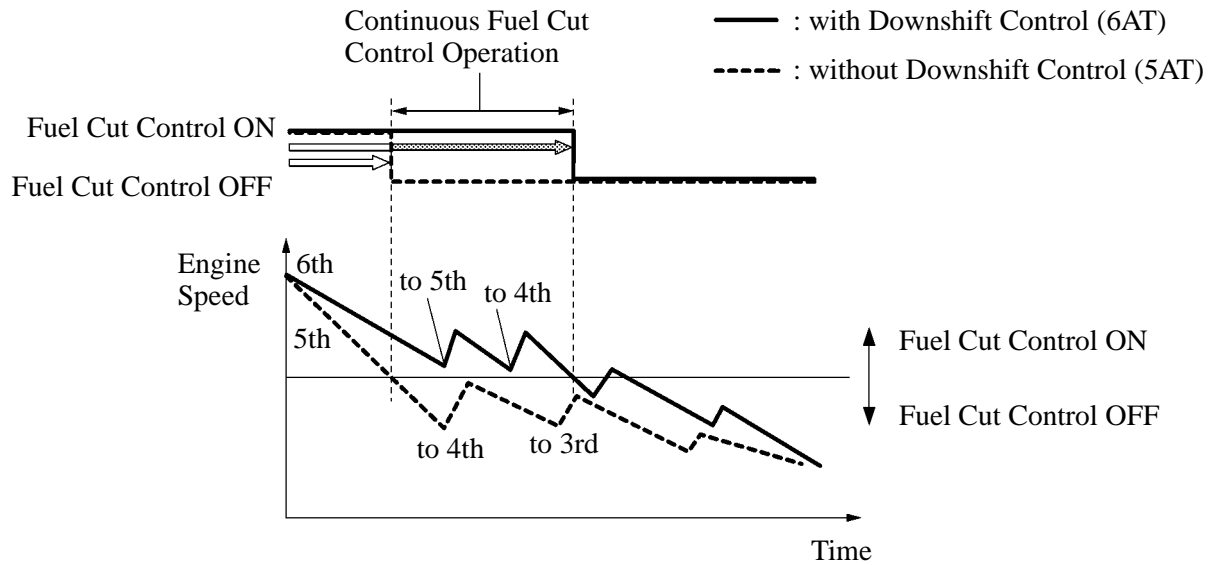
*: Flex Lock-up Clutch Control also operates when the vehicle is decelerated.

01YCH33Y

10. Coast Downshift Control

The ECT ECU performs downshift control to restrain the engine speed from decreasing, and keeps fuel cut control operating for as long as possible. In this way, the fuel economy is improved.

In this control, the transaxle downshifts from 6th to 5th and then 5th to 4th before fuel cut control ends when the vehicle is decelerated in the 6th gear, so that fuel cut control continues operating.

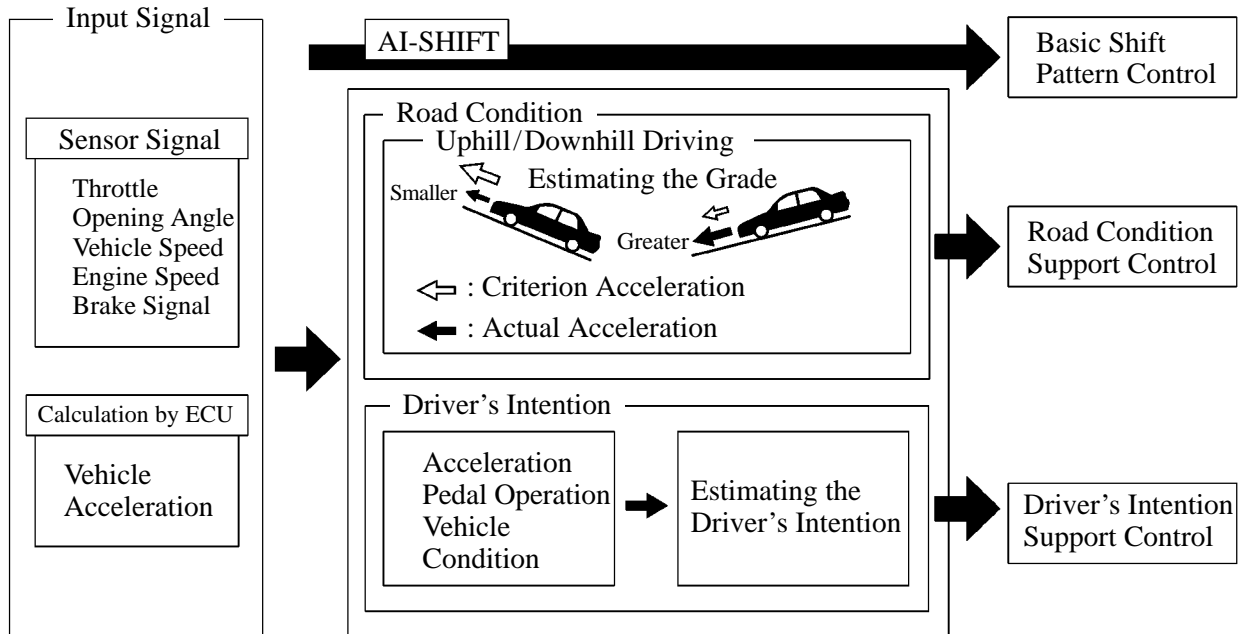


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11. AI (Artificial Intelligence)-Shift Control

General

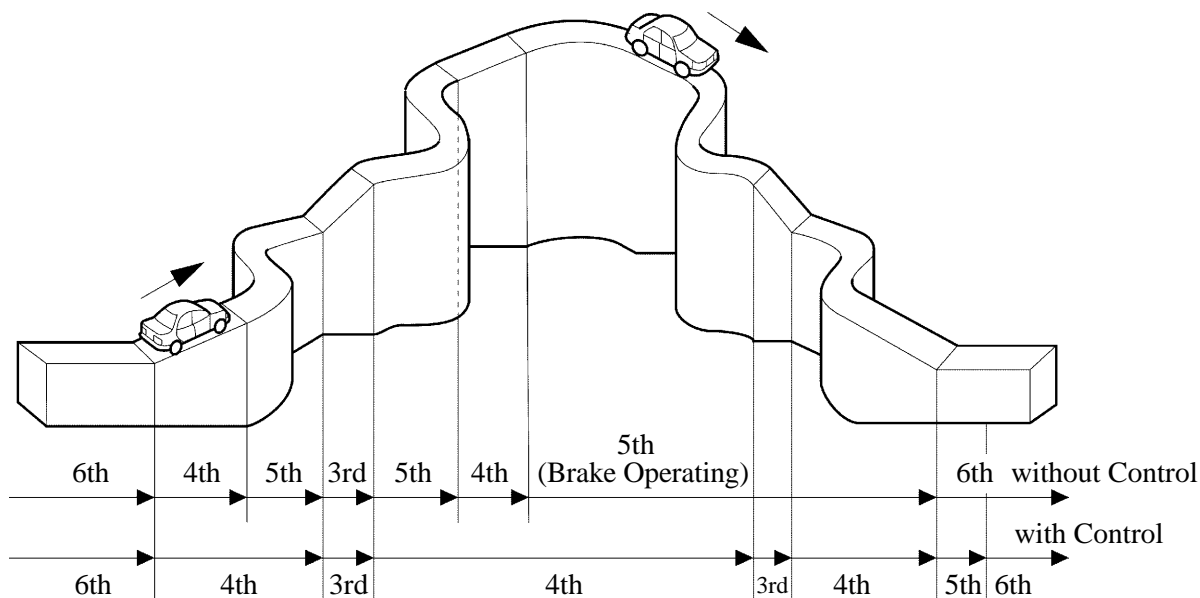
AI-SHIFT control enables the ECT ECU to estimate the road conditions and the driver's intention in order to automatically control the shift pattern in the optimal manner. As a result, a comfortable ride has been achieved.



Road Condition Support Control

Under road condition support control, ECT ECU determines the throttle valve opening angle and the vehicle speed whether the vehicle is being driven uphill or downhill.

To achieve the optimal drive force while driving uphill, this control prevents the transaxle from up shifting to the 5th or 6th gear. To achieve the optimal engine brake effect while driving downhill, this control automatically downshifts the transaxle to the 5th or 4th or 3rd gear.



040SC13C

Driver's Intention Support Control

Estimates the driver's intention based on the accelerator operation and vehicle condition to switch to a shift pattern that is well-suited to each driver, without the need to operate the shift pattern select switch used in the conventional models.

12. Multi-Mode Automatic Transmission

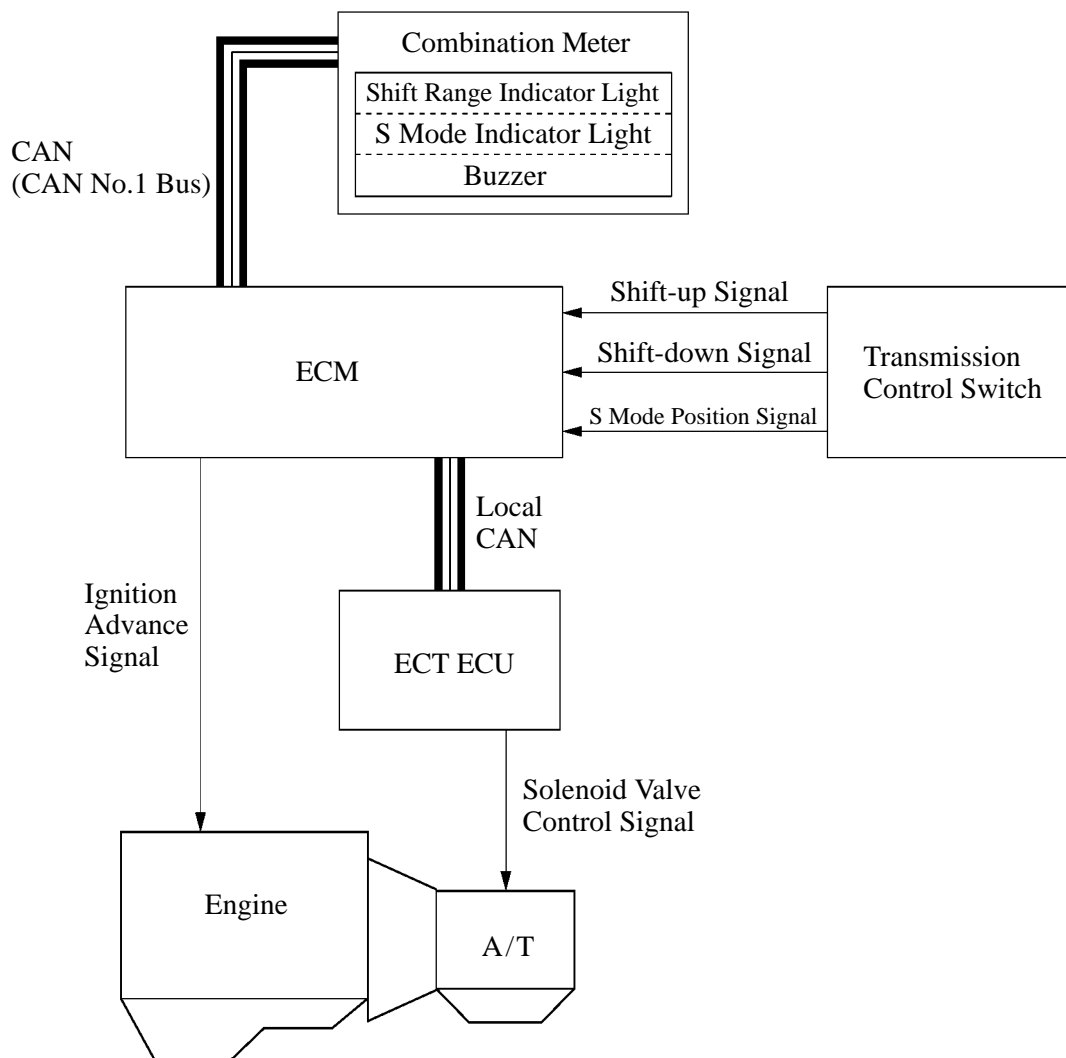
General

By moving the shift lever to the front (“+” position) or to the rear (“-” position), the driver can select the desired shift range position. Thus, the driver is able to shift gears with a manual-like feel.

This Multi-mode automatic transmission is designed to allow the driver to switch the gear ranges; not for manually selecting single gears.

An S mode indicator light, which illuminates when the S mode position is selected and a shift range indicator light, which indicates the range position, have been provided in the combination meter.

When the vehicle is being driven at a prescribed speed or higher, any attempt to shift down the range by through the operation of the shift lever will not be executed, in order to protect the mechanism of the automatic transaxle. In this case, the ECM sounds the buzzer in the combination meter twice to alert the driver.

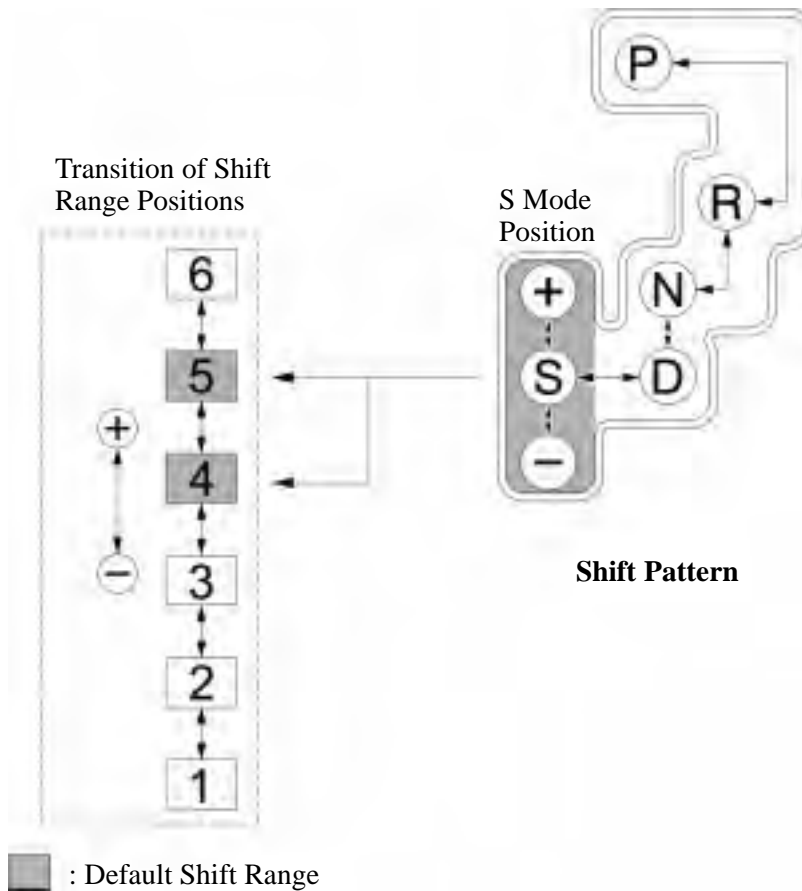


Operation

The driver selects the S mode position by engaging the shift lever. At this time, the shift range position selects the 4th or 5th range according to the vehicle speed. (During AI-Shift control, the shift range that has the currently controlled gear position as the maximum usable gear position is displayed.) Then, the shift range positions change one at a time, as the driver moves the shift lever to the front (“+” position) or to the rear (“-” position).

Under this control, the ECT ECU effects optimal shift control within the usable gear range that the driver has selected. As with an ordinary automatic transmission, it shifts to the 1st gear when the vehicle is stopped.

When the shift lever is in the S mode position, the S mode indicator light in the combination meter illuminates. The shift range indicator light indicates the state of the shift range position that the driver has selected.



030SC29C

► Usable Gear Chart ●

Shift Range Indicator Light Indication	Shift Range	Usable Gear
6	6	6th ↔ 5th ↔ 4th ↔ 3rd ↔ 2nd ↔ 1st
5	5	5th ↔ 4th ↔ 3rd ↔ 2nd ↔ 1st
4	4	4th ↔ 3rd ↔ 2nd ↔ 1st
3	3	3rd ↔ 2nd ↔ 1st
2	2	2nd ↔ 1st
1	1	1st

13. Diagnosis

When the ECT ECU detects a malfunction, the ECT ECU makes a diagnosis and memorizes the information related to the fault. Furthermore, the MIL (Malfunction Indicator Lamp) in the combination meter illuminates or blinks to inform the driver of the malfunction.

At the same time, the DTC (Diagnosis Trouble Code) are stored in the memory. The DTC stored in the ECT ECU are output to a hand-held tester connected to the DLC3 via the ECM.

For details, see the 2007 Camry Repair Manual (Pub. No. RM0250U).

Service Tip

The ECM uses the CAN protocol for diagnostic communication. Therefore, a hand-held tester and a dedicated adapter [CAN VIM (Vehicle Interface Module)] are required for accessing diagnostic data. For details, see the 2007 Camry Repair Manual (Pub. No. RM0250U).

14. Fail-safe

This function minimizes the loss of operation when any abnormality occurs in a sensor or solenoid.

► Fail-safe Control List ●

Malfunction Part	Function
Input Turbine Speed Sensor	Shifting to only either the 1st or 3rd gears is allowed.
Counter Gear Speed Sensor	The counter gear speed is detected through the signals from the skid control ECU (speed sensor signals). Shifting between the 1st to 4th gears is allowed.
ATF Temp. Sensor	Shifting between the 1st to 4th gears is allowed.
ECT ECU Power Supply (Voltage is Low)	When the vehicle is being driven in 6th gear, the transaxle is fixed in 6th gear. When being driven in any of the 1st to 5th gears, the transaxle is fixed in 5th gear.
CAN Communication	Shifting to only either the 1st or 3rd gears is allowed.
Knock Sensor	Shifting between the 1st to 4th gears is allowed.
Solenoid Valve SL1, SL2, SL3 and SL4	The current to the failed solenoid valve is cut off and operating the other solenoid valves with normal operation performs shift control. (Shift controls in fail-safe mode are described in the table on the next page. For details, refer to Fail-Safe Control List)

► Solenoid Valve Operation when Normal ●

Gear Position		1st	2nd	3rd	4th	5th	6th
Solenoid Valve	SL1					X	X
	SL2	X	X	X			
	SL3	X		X	X	X	
	SL4	X	X		X		X

► Fail-safe Control List ●

Gear Position in Normal Operation		1st	2nd	3rd	4th	5th	6th
SL1	OFF Malfunction (without Fail-safe Control)	1st Δ N	2nd Δ N	3rd Δ N	4th Δ N	5th	6th
	ON Malfunction (without Fail-safe Control)* ¹	1st	2nd	3rd	4th	5th Δ 4th	6th Δ 4th
	Fail-safe Control during OFF Malfunction	Fixed in 3rd or 5th* ²					
	Fail-safe Control during OFF Malfunction (ATF Pressure Switches 1 or 2 Malfunctions)	Fixed in 3rd or 5th* ²					
SL2	OFF Malfunction (without Fail-safe Control)	1st	2nd	3rd	4th Δ 1st	5th Δ N	6th Δ N
	ON Malfunction (without Fail-safe Control)* ¹	1st Δ 4th	2nd Δ 4th	3rd Δ 4th	4th	5th	6th
	Fail-safe Control during OFF Malfunction	1st	2nd	3rd	3rd* ³	3rd* ³	3rd* ³
	Fail-safe Control during OFF Malfunction (ATF Pressure Switches 1 or 2 Malfunctions)	Fixed in 2nd or 3rd* ³					
SL3	OFF Malfunction (without Fail-safe Control)	1st	2nd Δ 1st	3rd	4th	5th	6th Δ N
	ON Malfunction (without Fail-safe Control)* ¹	1st Δ 2nd	2nd	3rd	4th	5th	6th
	Fail-safe Control during OFF Malfunction	1st	3rd	3rd	4th	5th	5th* ³
	Fail-safe Control during OFF Malfunction (ATF Pressure Switches 1 or 2 Malfunctions)	Fixed in 3rd* ³					
SL4	OFF Malfunction (without Fail-safe Control)	1st	2nd	3rd Δ 1st	4th	5th Δ N	6th
	ON Malfunction (without Fail-safe Control)* ¹	3rd	3rd	3rd	4th	5th	5th
	Fail-safe Control during OFF Malfunction	1st* ⁴	2nd* ⁴	4th* ⁴	4th* ⁴	6th	6th
	Fail-safe Control during OFF Malfunction (ATF Pressure Switches 1 or 2 Malfunctions)	Fixed in 2nd* ³					

*¹: Fail-safe control is not actuated when the ON malfunction occurs.

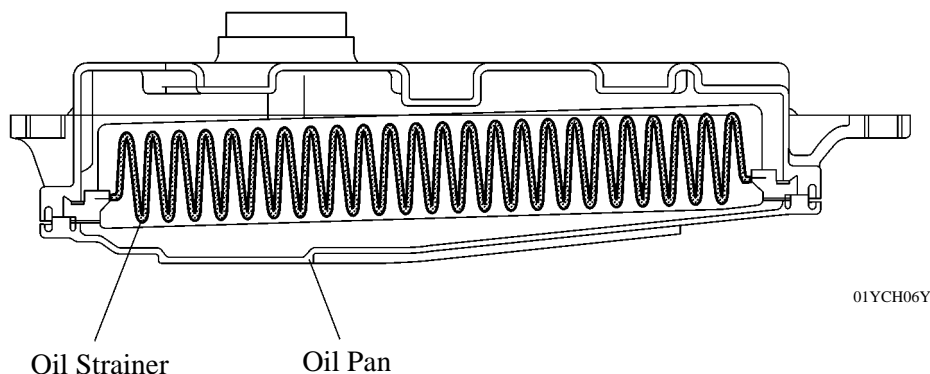
*²: If malfunctions already exist in any of the P, R or N range positions and a malfunction is detected when the gear is shifted to the 1st gear, the gear position is fixed in the 5th gear. After that, if any of the P, R or N range positions is selected, the gear is fixed in the 3rd gear position.

*³: The gear is fixed in the neutral position until the vehicle speed reaches a certain speed that enables the transaxle to be shifted.

*⁴: Shifting to the 5th and 6th gears is prohibited.

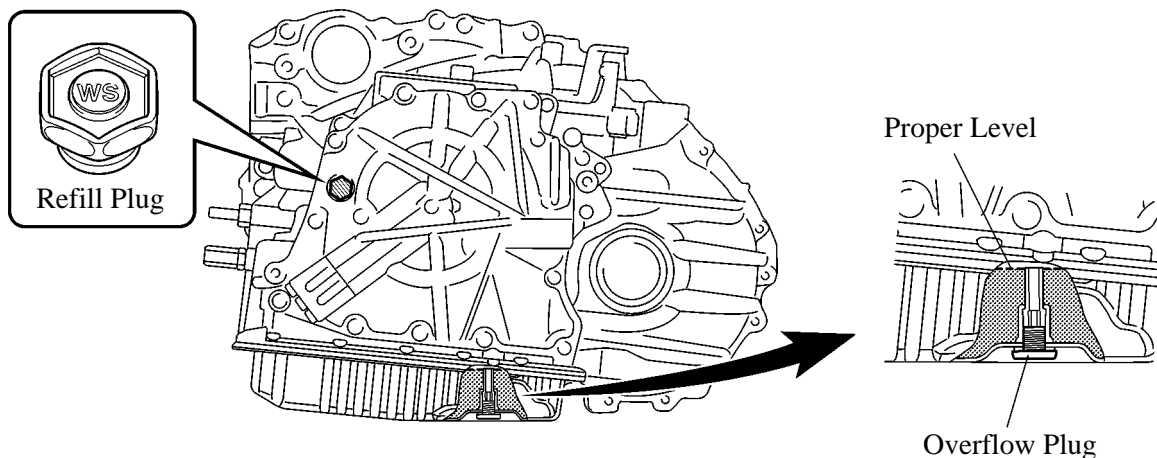
● OIL STRAINER

A felt type oil strainer is used because it is lightweight, provides excellent filtering ability, is more reliable and free from maintenance.



● ATF FILLING PROCEDURES

- ▶ The ATF filling procedure is changed in order to improve the accuracy of the ATF level when the transaxle is being repaired or replaced. As a result, the oil filler tube and the oil level gauge used for a conventional automatic transaxle are discontinued, eliminating the need to inspect the fluid level as a part of routine maintenance.
- ▶ This filling procedure employs a refill plug, overflow plug, ATF temperature sensor, and shift indicator light "D". After the transaxle is refilled with ATF, remove the overflow plug and drain the extra ATF at the proper ATF temperature. Thus, the appropriate ATF level can be obtained. For details about the ATF filling procedure, refer to the Service Tip on the next page.



Service Tip

ATF Filling procedure using SST (09843-18040)

When a large amount of ATF needs to be filled (i.e. after removal and installation of oil pan or torque converter), perform the procedure from step 1.

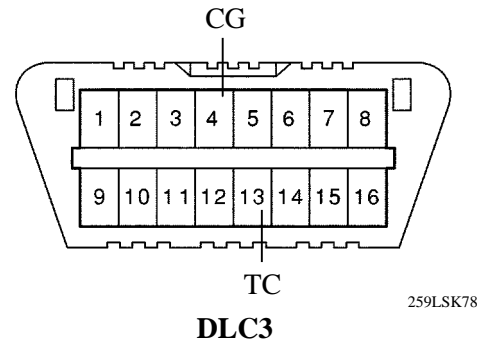
When a small amount of ATF is required (i.e. removal and installation of oil cooler tube, repair of a minor oil leak), perform the procedure from step 7.

- 1) Raise the vehicle while keeping it level.
- 2) Remove the refill plug and overflow plug.
- 3) Fill the transaxle with WS type ATF through the refill plug hole until it overflows from the overflow plug hole.
 ► ATF WS must be used to fill the transaxle.
- 4) Reinstall the overflow plug.
- 5) Add the specified amount of ATF (specified amount is determined by the procedure that was performed) and reinstall the refill plug.

Example:

Procedure	Liters (US qts, Imp.qts)
Removal and installation of transaxle oil pan (including oil drainage)	2.9 (3.1, 2.6)
Removal and installation of transaxle valve body	3.3 (3.5, 2.9)
Replacement of torque converter	4.9 (5.2, 4.3)

- 6) Lower the vehicle
- 7) Use the SST (09843-18040) to make shorts between the TC and CG terminals of the DLC3 connector:
- 8) Start the engine and allow it to idle.
 ► A/C switch must be turned off.
- 9) Move the shift lever from the P position to the S mode position and slowly selects each gear S1 - S6. Then move the shift lever back to the P position.
- 10) Move the shift lever to the D position, and then quickly move it back and forth between N and D (at least once every 1.5 seconds) for at least 6 seconds. This will activate oil temperature detection mode.



Standard: The shift position indicator light “D” remains illuminated for 2 seconds and then goes off.

- 11) Return the shift lever to the P position and disconnect the TC terminal.
- 12) Idle the engine to raise the ATF temperature.
- 13) Immediately after the shift position indicator “D” light turns on, lift the vehicle up.
 ► The shift position indicator light “D” will indicate the ATF temperature according to the following table.

ATF Temp.	Lower than Optimal Temp.	Optimal Temp.	Higher than Optimal Temp.
Shift Position Indicator Light “D”	OFF	ON	Blinking

(Continued)

14) Remove the overflow plug and adjust the oil quantity.

▶ If the ATF overflows, go to step 17, and if the ATF does not overflow, go to step 15.

15) Remove the refill plug.

16) Add ATF through the refill plug hole until it flows out from the overflow plug hole.

17) When the ATF flow slows to a trickle, install the overflow plug and a new gasket.

18) Reinstall the refill plug (if the refill plug was removed).

19) Lower the vehicle.

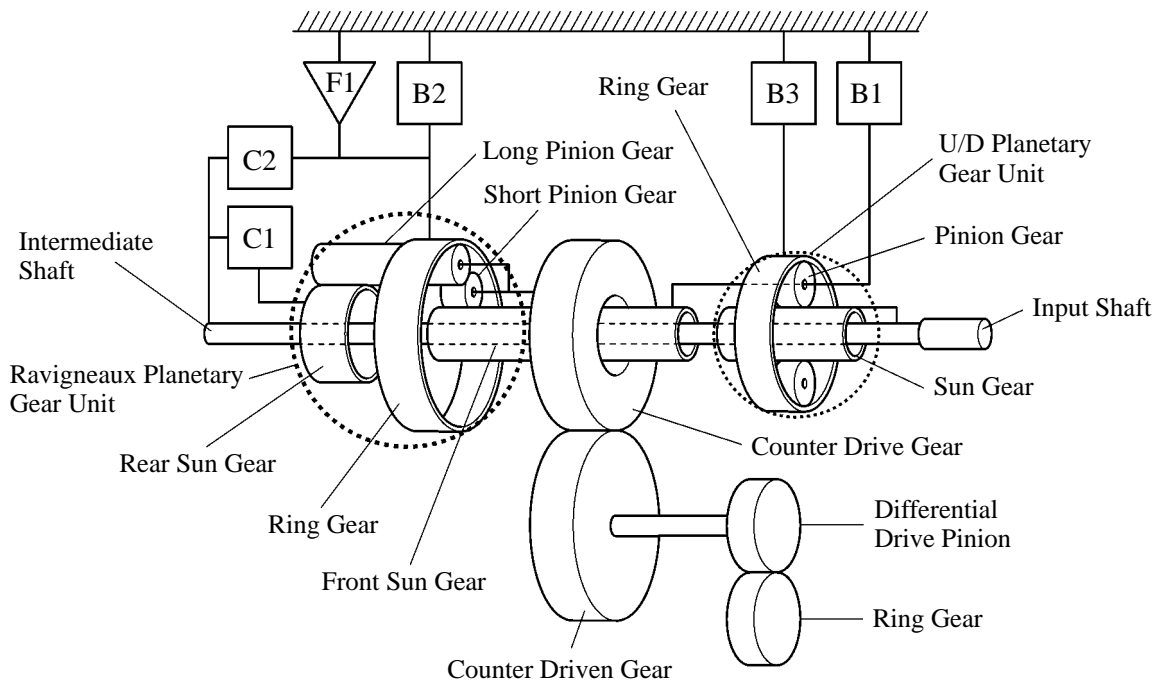
20) Turn the ignition switch (engine switch) OFF to stop the engine.

For details about the ATF Filling procedures, see the 2007 Camry Repair Manual (Pub. No. RM0250U).

PLANETARY GEAR UNIT

1. Construction

- ▶ The 6-speed configuration has been achieved by using 2 planetary gear units, creating a 6-speed automatic transaxle.
- ▶ A Ravigneaux type planetary gear unit is used as the rear gear unit. The gear unit consists of pairs of sun gears (front and rear) and planetary pinion gears (long and short) with different diameters within a single planetary gear.
- ▶ The centrifugal fluid pressure canceling mechanism is used in the C1 and C2 clutches that are applied when shifting between the 1st to 6th gears. Refer to CH-51 for details.
- ▶ The shapes of the grooves in the clutches and brake linings have been optimized in order to reduce drag during clutch and brake operation.



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2. Function of Components

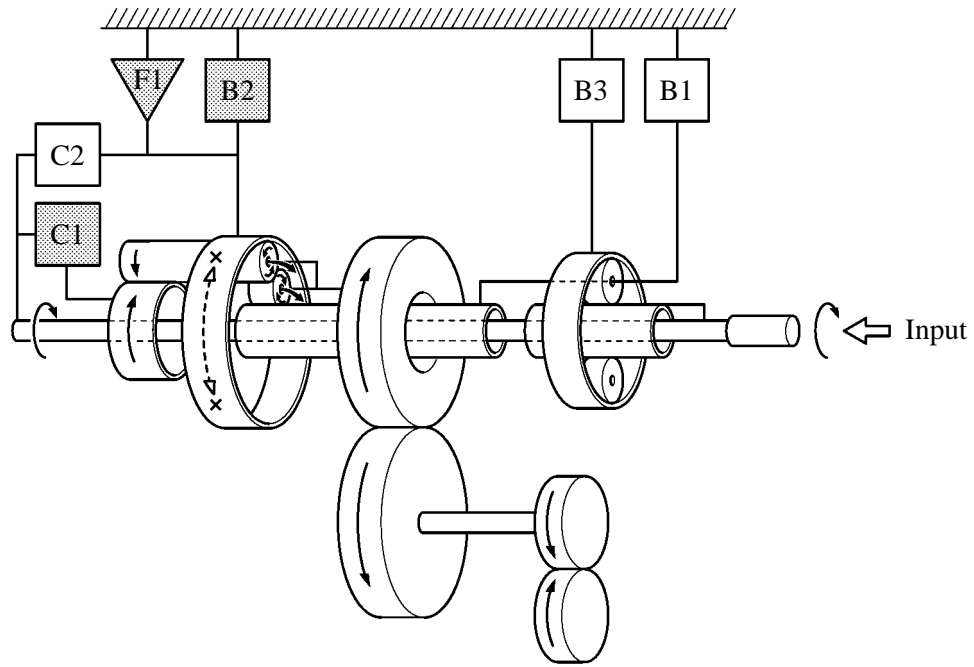
Component		Function
C1	No.1 Clutch	Connects intermediate shaft and Ravigneaux planetary rear sun gear.
C2	No.2 Clutch	Connects intermediate shaft and Ravigneaux planetary ring gear.
B1	No.1 Brake	Prevents Ravigneaux planetary front sun gear and U/D planetary carrier from turning either clockwise or counterclockwise.
B2	No.2 Brake	Prevents Ravigneaux planetary ring gear from turning either clockwise or counterclockwise.
B3	No.3 Brake	Prevents U/D planetary ring gear from turning either clockwise or counterclockwise.
F1	No.1 One-Way Clutch	Prevents Ravigneaux planetary ring gear from turning counterclockwise.
Planetary Gears		These gears change the route through which driving force is transmitted, in accordance with the operation of each clutch and brake, in order to increase or reduce the input and output speeds.

3. Transaxle Power Flow

Shift Lever Position	Gear	Solenoid Valve						Clutch		Brake			One-way Clutch
		SL	SL1	SL2	SL3	SL4	SLU	C1	C2	B1	B2	B3	F1
P	Park		◆										
R	Reverse	●				◆					◆	◆	
N	Neutral		◆										
D, S6	1st		◆					◆					◆
	2nd	◆	◆		◆		△	◆		◆			
	3rd	◆	◆			◆	△	◆				◆	
	4th	◆	◆	◆			△	◆	◆				
	5th	◆		◆		◆	△		◆			◆	
	6th	◆		◆	◆		△		◆	◆			
S5	1st		◆					◆					◆
	2nd	◆	◆		◆		△	◆		◆			
	3rd	◆	◆			◆	△	◆				◆	
	4th	◆	◆	◆			△	◆	◆				
	5th	◆		◆		◆	△		◆			◆	
S4	1st		◆					◆					◆
	2nd	◆	◆		◆		△	◆		◆			
	3rd	◆	◆			◆	△	◆				◆	
	4th	◆	◆	◆			△	◆	◆				
S3	1st		◆					◆					◆
	2nd		◆		◆			◆		◆			
	3rd		◆			◆		◆				◆	
S2	1st		◆					◆					◆
	2nd		◆		◆			◆		◆			
S1	1st		◆				◆	◆			◆		◆

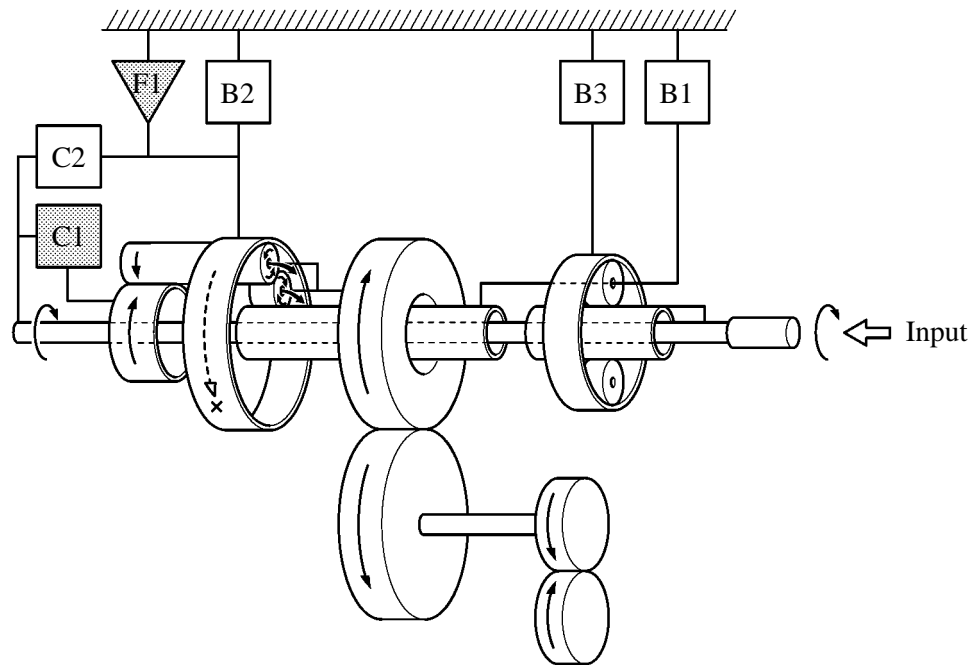
◆: ON △: In accordance with flex lock-up ►: ON while engaging, OFF after engaged

1st Gear (S Mode 1 Range)



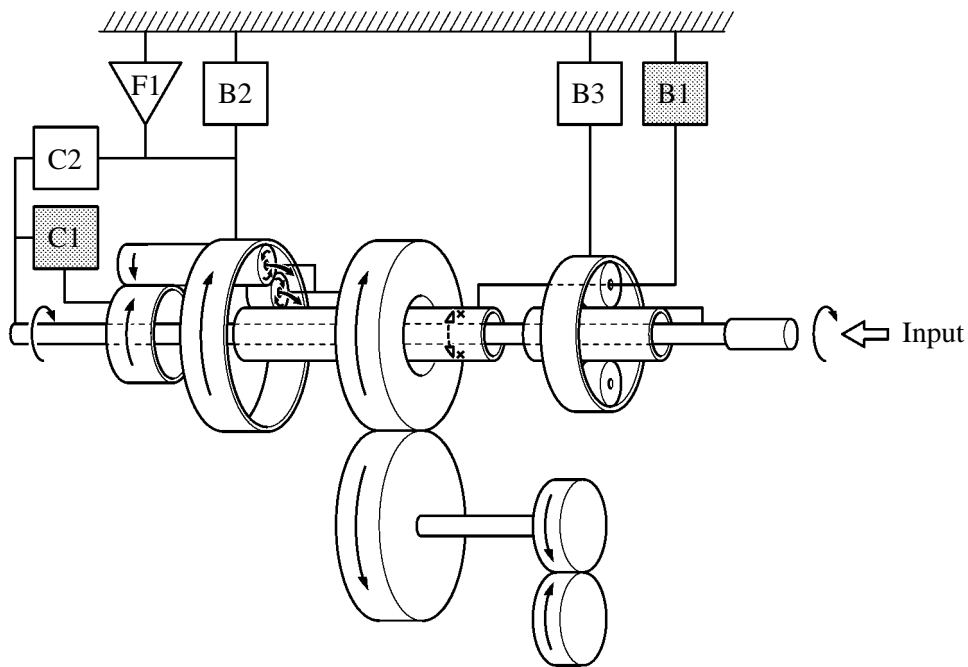
01YCH08Y

1st Gear (D Position or S Mode)



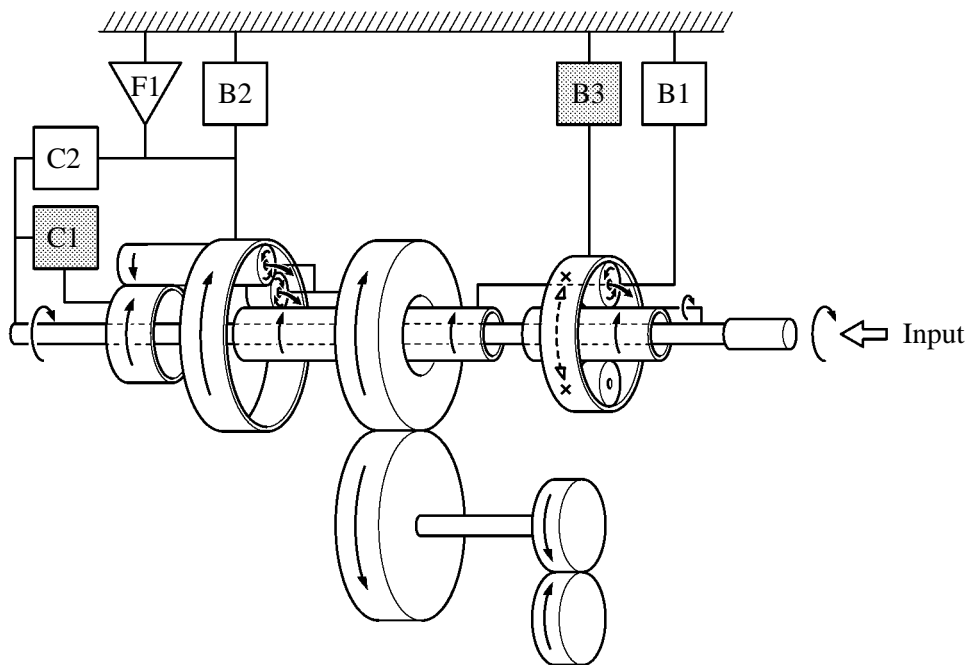
01YCH09Y

2nd Gear (D Position or S Mode)



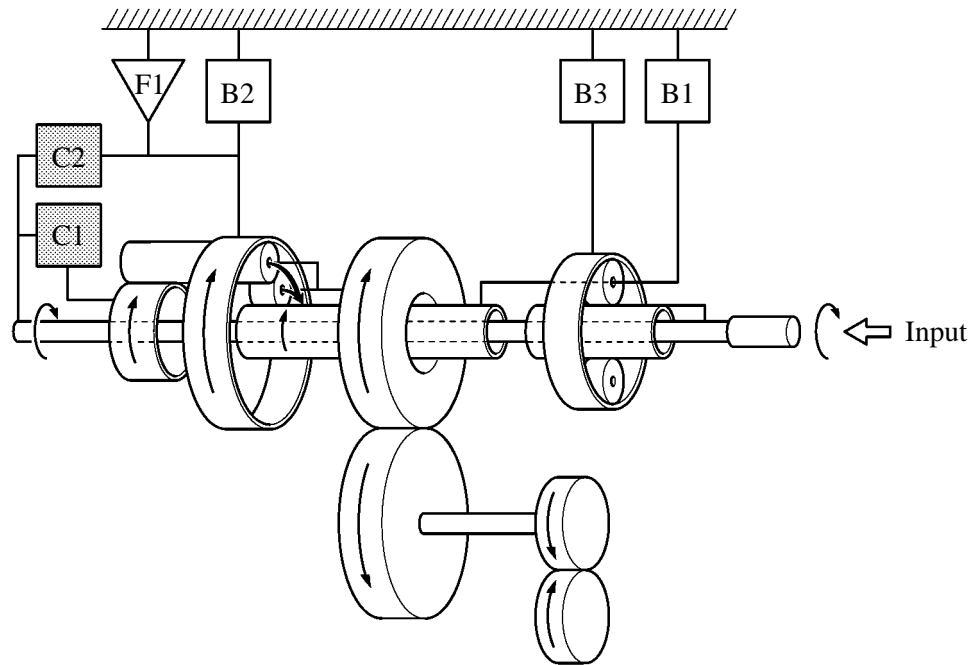
01YCH10Y

3rd Gear (D Position or S Mode)



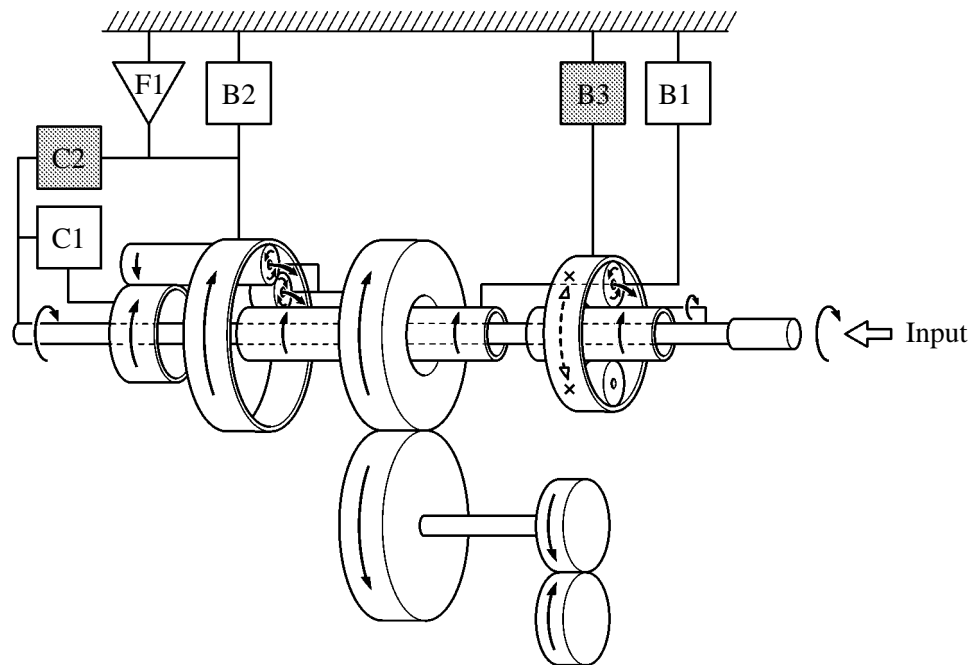
01YCH11Y

4th Gear (D Position or S Mode)



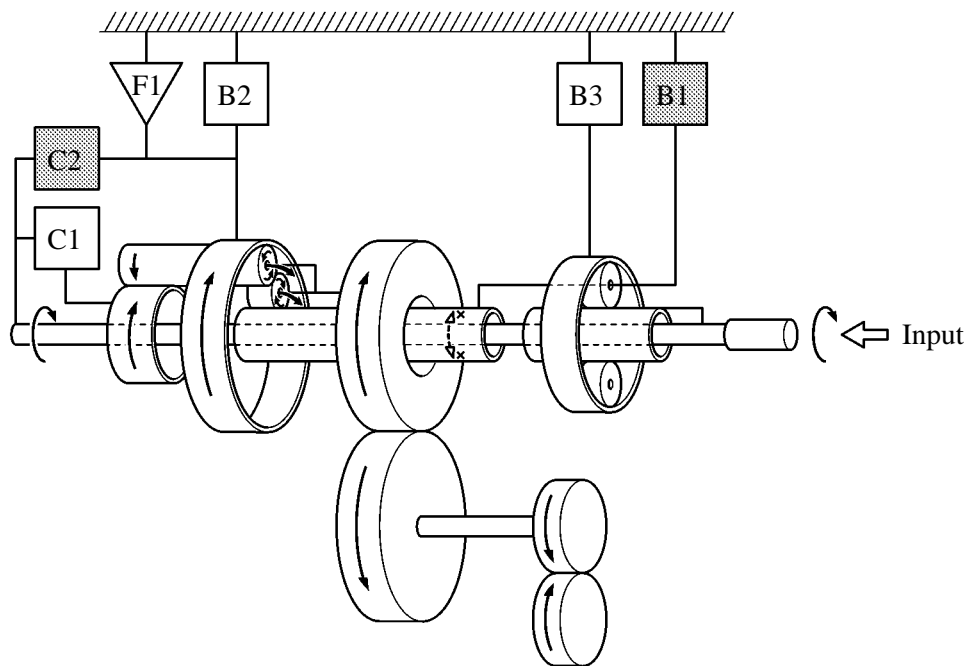
01YCH12Y

5th Gear (D Position or S Mode)



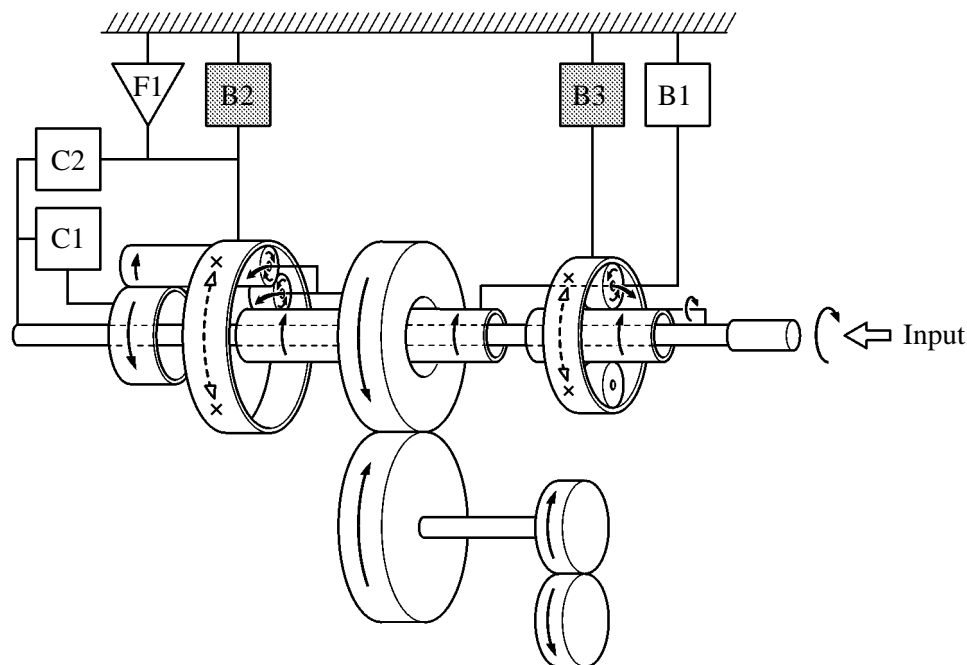
01YCH13Y

6th Gear (D Position or S Mode)



01YCH14Y

Reverse Gear (R Range Position)



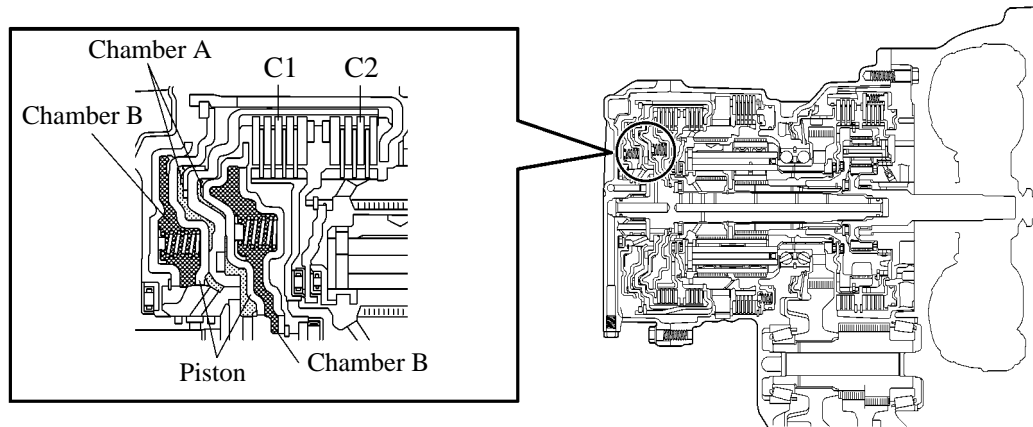
01YCH15Y

4. Centrifugal Fluid Pressure Canceling Mechanism

There are two reasons for improving the conventional clutch mechanism:

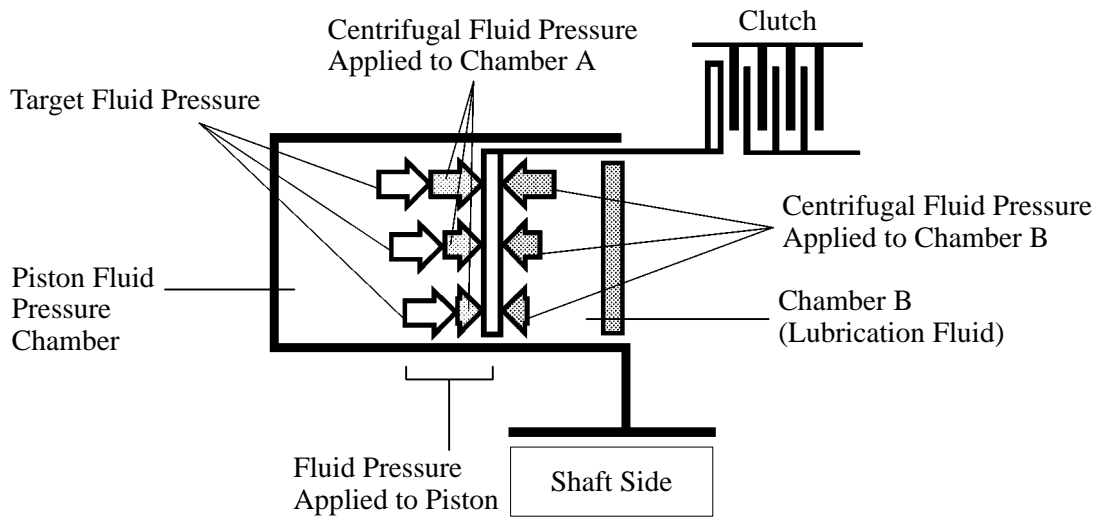
- ▶ To prevent the generation of pressure by the centrifugal force that is applied to the fluid in piston fluid pressure chamber (hereafter referred to as “chamber A”) when the clutch is released, a check ball is provided to discharge the fluid. Therefore, before the clutch could be subsequently applied, it took time for the fluid to fill the chamber A.
- ▶ During shifting, in addition to the original clutch pressure that is controlled by the valve body, the pressure that acts on the fluid in chamber A also exerts influence, which is dependent upon revolution fluctuations.

To address these two needs for improvement, a canceling fluid pressure chamber (hereafter referred to as “chamber B”) has been provided opposite chamber A.



025CH27Y

By utilizing lubrication fluid such as that of the shaft, an equal centrifugal force is applied, thus canceling the centrifugal force that is applied to the piston itself. Accordingly, it is not necessary to discharge the fluid through the use of a check ball, and a highly responsive and smooth shifting characteristic has been achieved.

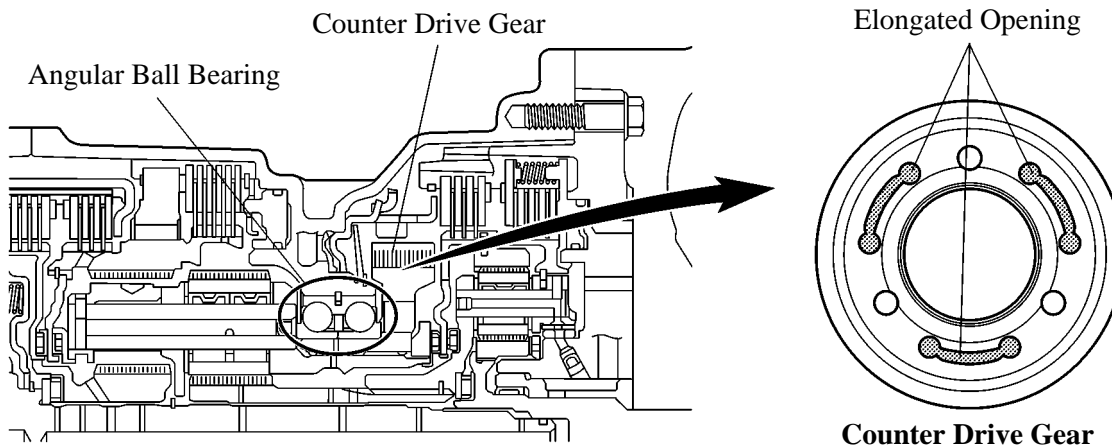


157CH17

Fluid pressure applied to piston	-	Centrifugal fluid pressure applied to chamber B	=	Target fluid pressure (original clutch pressure)
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5. Counter Drive Gear

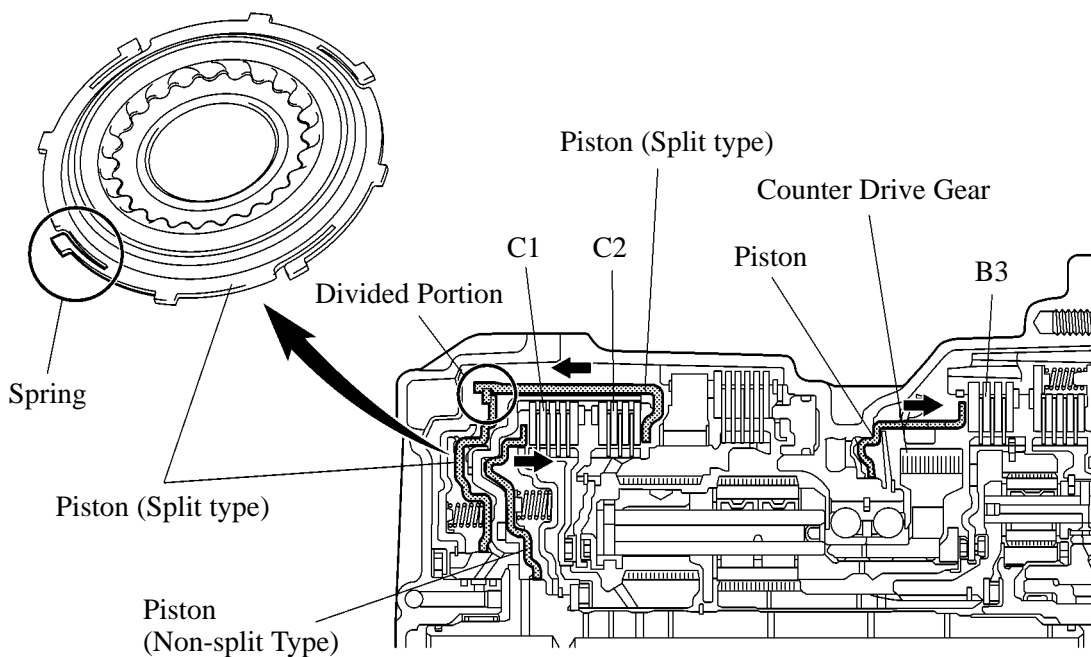
- ▶ Angular ball bearings are used to support the counter drive gear and the Ravigneaux planetary gear unit, reducing the rolling resistance and noise.
- ▶ By providing three elongated openings in the counter drive gear, the vibration conduction characteristic of the gear has been optimized. As a result, both gear noise and weight reductions have been achieved.



01YCH17Y

6. Clutch and Brake Pistons

- ▶ Two types of pistons are used; a non-split piston that acts in the push direction for the No.1 clutch (C1) operation, and a split piston that acts in the pull direction for the No.2 clutch (C2) operation. These two types of pistons contribute to making the entire clutch structure compact.
- ▶ When the split piston operates, clutch drag occurs due to rattling caused by the divided portion of the piston. However, by fitting springs on the piston circumference, such rattling is restrained and the occurrence of clutch drag is minimized.
- ▶ By setting the piston for the No.3 brake (B3) operation around the counter drive gear, the brake structure has been made more compact.



01YCH18Y

◆ SHIFT CONTROL MECHANISM

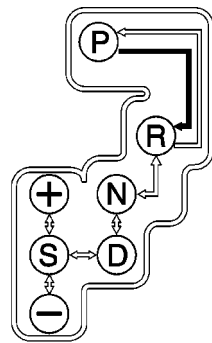
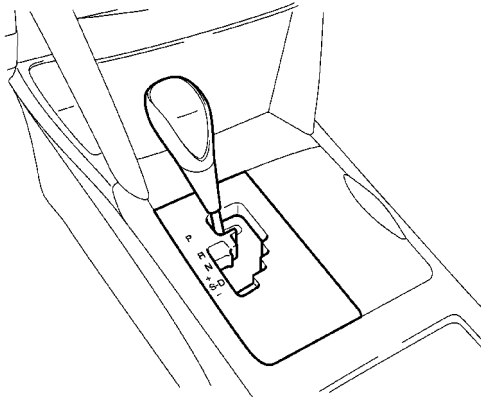
1. General

A gate type shift lever is used in conjunction with the 6-speed automatic transaxle. With the gate type lever, the shift lever button and the overdrive switch of the straight type shift lever are discontinued. Similar functions are achieved through a single-shift operation (fore-aft and side-to-side).

The shift control cable with a length adjustment mechanism is used.

Shift pattern is provided with the S mode position on the side of the D position.

A shift lock system is used.



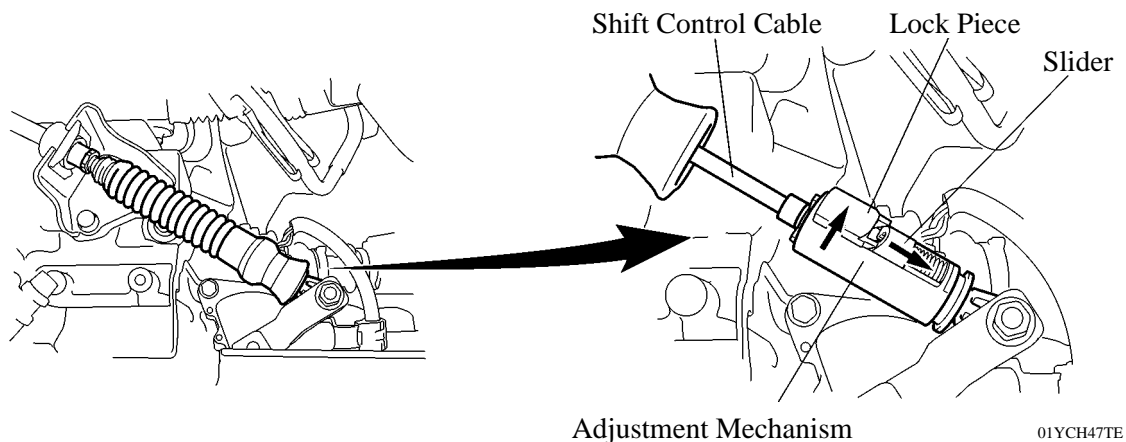
↓ : The shift lever can be moved only with the power source IG-ON and the brake pedal depressed.

↕ : The shift lever can be moved at anytime.

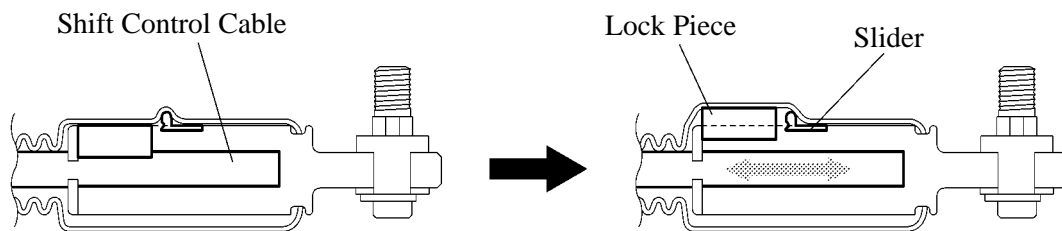
025CH18TE

Service Tip

The shift control cable is fixed by the lock piece of the adjustment mechanism. Adjustment of the shift control cable is possible by releasing the lock piece from the cable. For details, see the 2007 Camry Repair Manual (Pub. No. RM0250U).



01YCH47TE



Adjustment Mechanism Cross Section

01YCH48TE

2. Shift Lock System

General

The shift lock system function setting is as follows:

Function	Without Smart Key System	With Smart Key System
Key Interlock		—
Shift Lock		

The key interlock device prevents the key from being pulled out after the ignition switch is turned OFF, unless the shift lever is moved to the P position. Thus, the driver is urged to park the vehicle in the P position.

The shift lock mechanism prevents the shift lever from being shifted to any position other than the P position, unless the ignition switch is ON (unless the IG-ON mode is selected)*¹, and the brake pedal is depressed. This mechanism helps to prevent unintentional acceleration.

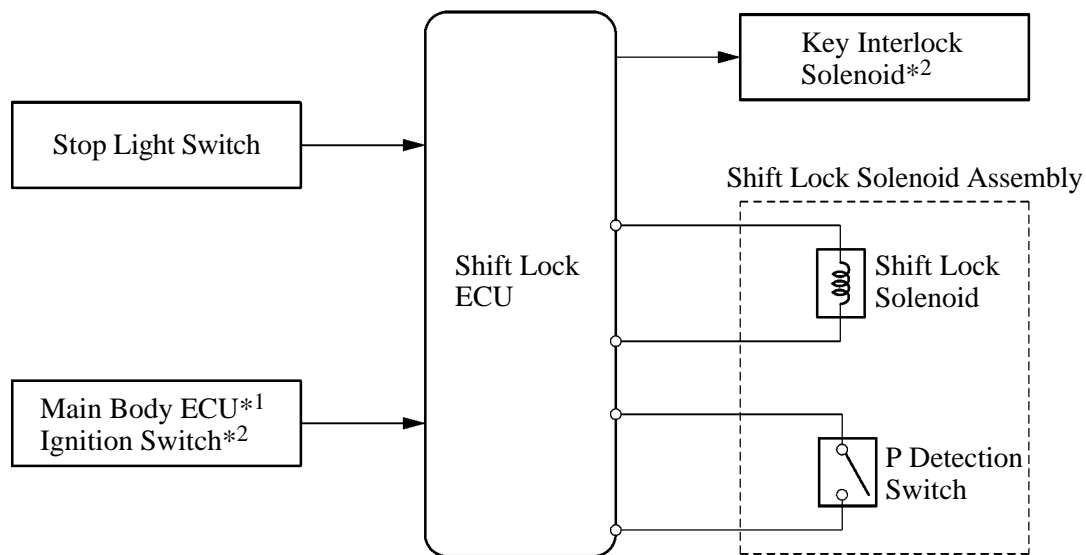
The shift lock system mainly consists of the shift lock ECU, shift lock solenoid, key interlock solenoid*² and shift lock override button.

The shift lock solenoid has a built-in P detection switch.

*1: Models with smart key system

*2: Except models with smart key system

► System Diagram ●

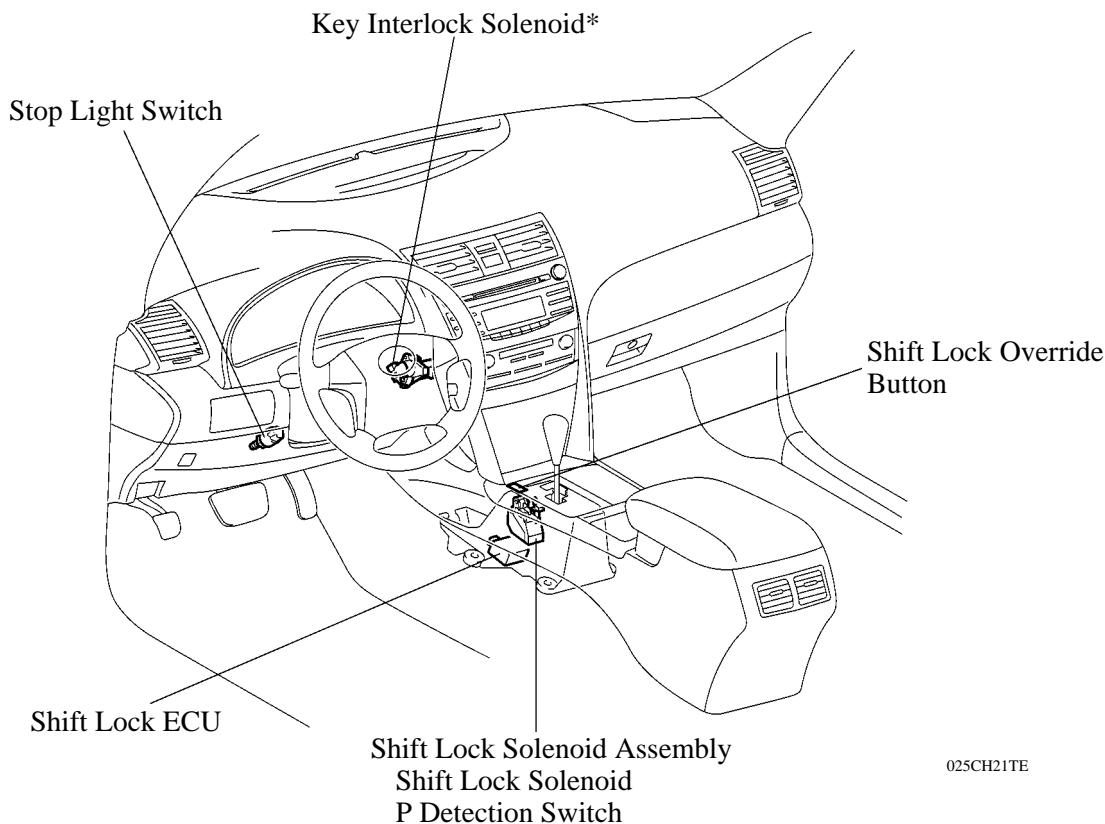


025CH20TE

*1: Models with smart key system

*2: Except models with smart key system

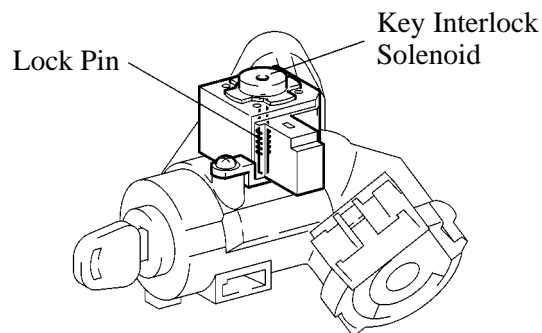
Layout of Main Components



*: Except models with smart key system

Key Interlock Solenoid

The activation of the key interlock solenoid that is mounted on the upper column bracket moves the lock pin to restrict the movement of the key cylinder. Therefore, if the shift lever is shifted to any position other than “P”, the ignition key cannot be moved from “ACC” to the “LOCK” position.



System Operation

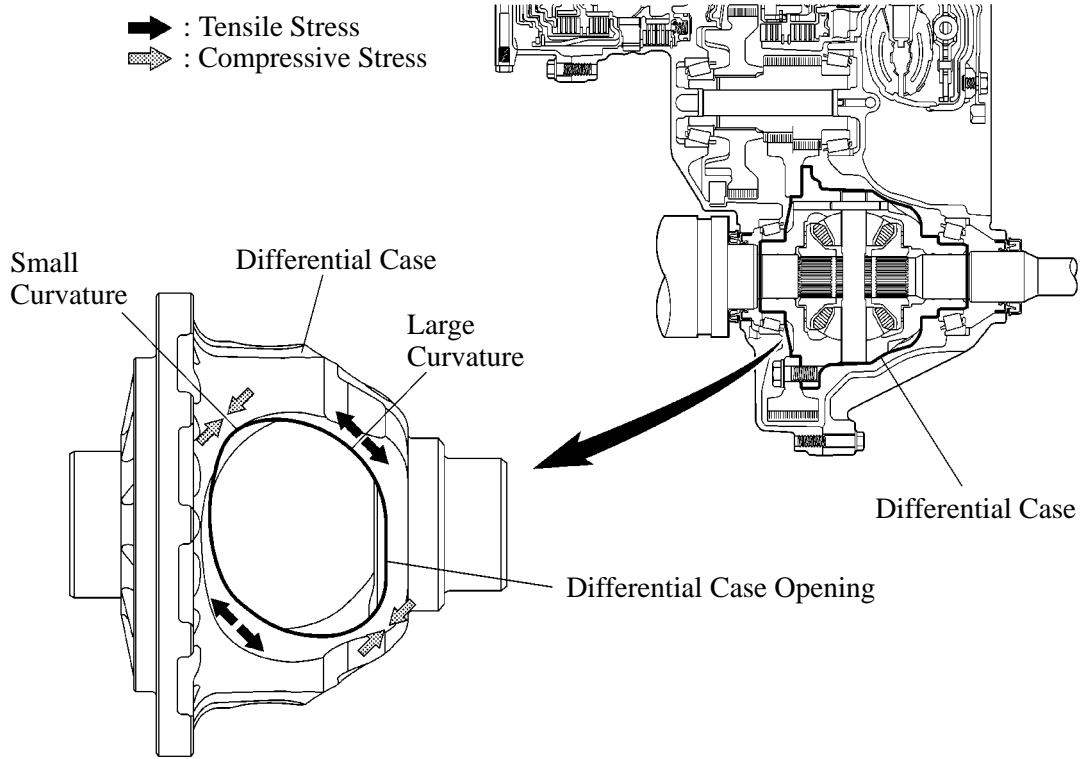
Models with smart key system: The shift lock ECU uses the P detection switch to detect the shift lever position, and receives inputs from the stop light switch and the main body ECU. Upon receiving these signals, the shift lock ECU turns ON the shift lock solenoid in order to release the shift lock.

Models without smart key system: The shift lock ECU uses the P detection switch to detect the shift lever position, and receives inputs from the stop light switch and the ignition switch. Upon receiving these signals, the shift lock ECU turns ON the key interlock solenoid and the shift lock solenoid in order to release the key interlock and shift lock.

A shift lock override button, which manually overrides the shift lock mechanism, is used.

► **DIFFERENTIAL CASE**

The curvature of the differential case opening, where tensile stress is concentrated during driving, is enlarged, in order to moderate the stress concentration and enhance the differential gear tolerant torque. As a result, use of the lightweight 2-pinion differential gears is possible.



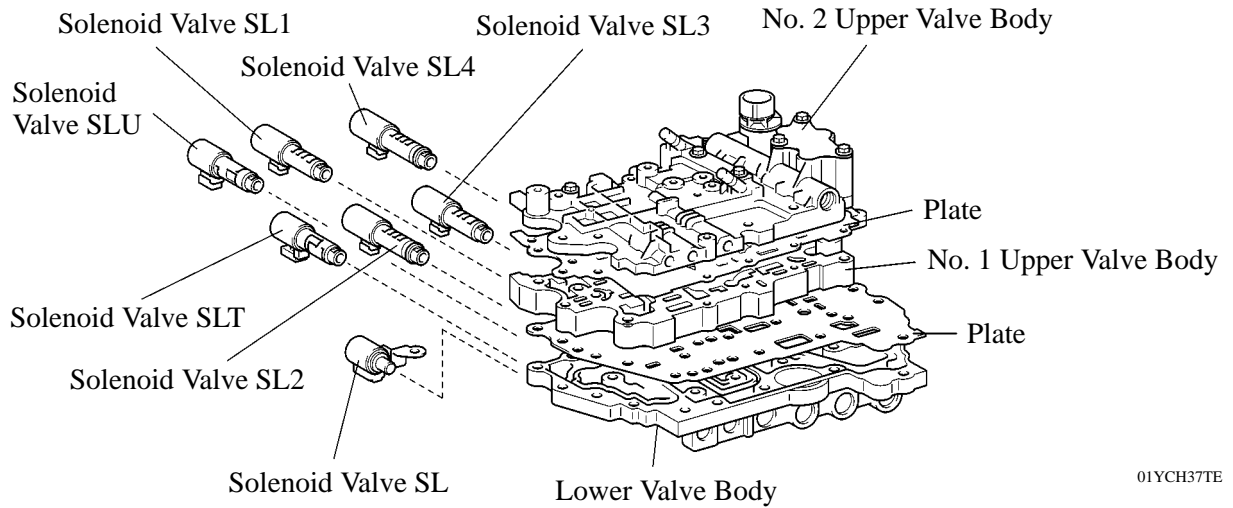
Stresses Applied to Differential Case Opening during Driving

01YCH04Y

◆ VALVE BODY UNIT

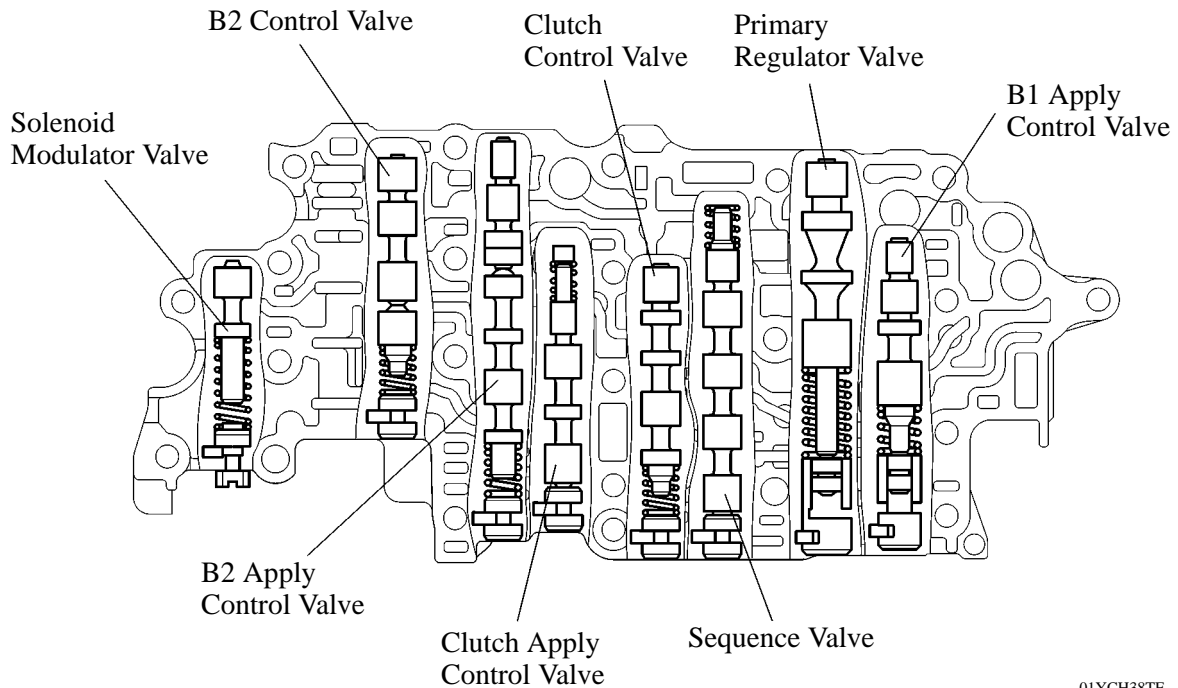
1. General

The valve body unit consists of the No.1 upper, No.2 upper and lower valve bodies and 7 solenoid valves (SL1, SL2, SL3, SL4, SLU, SLT, SL).



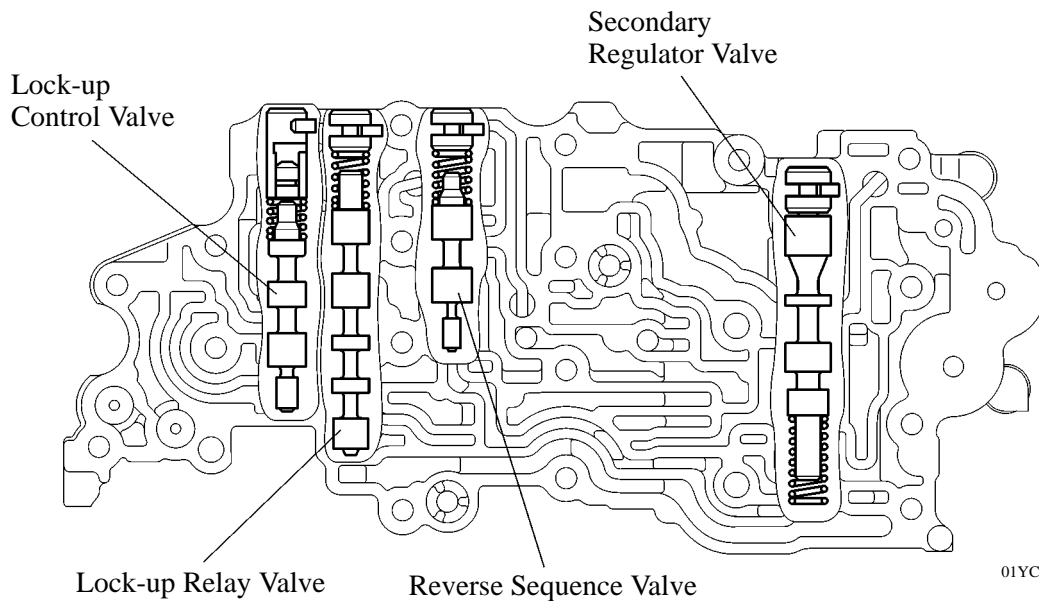
01YCH37TE

► No.1 Upper Valve Body ●

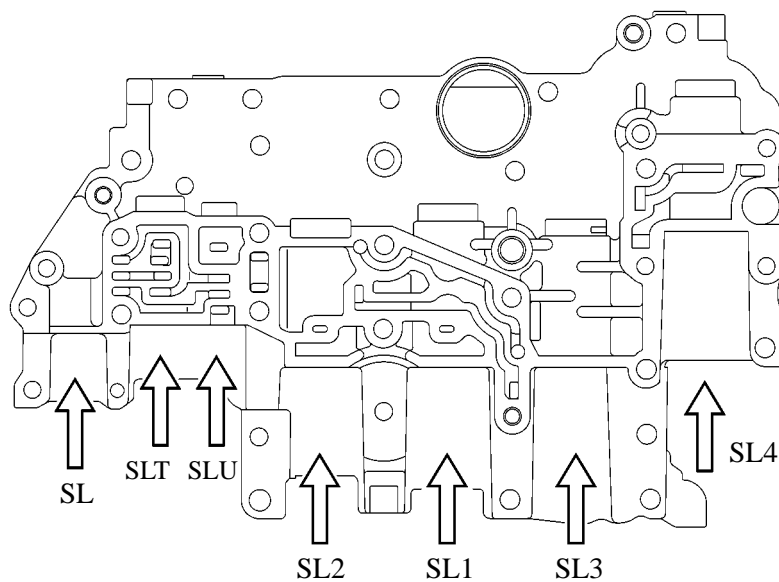


01YCH38TE

► No.2 Upper Valve Body ●



► Lower Valve Body ●

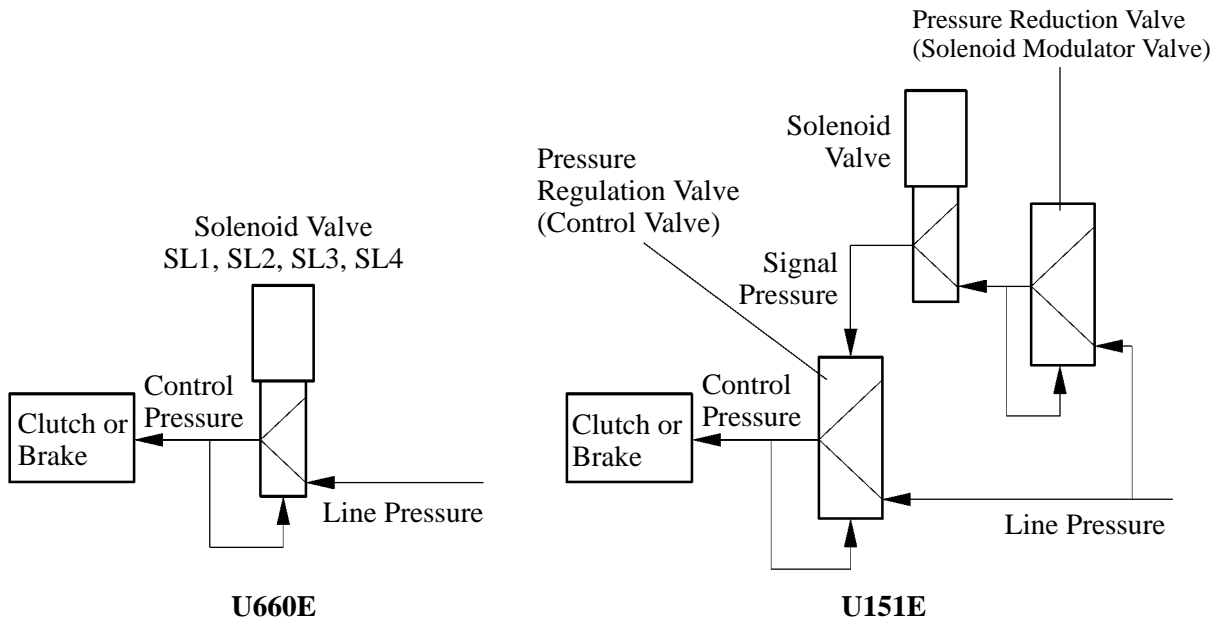


2. Solenoid Valves

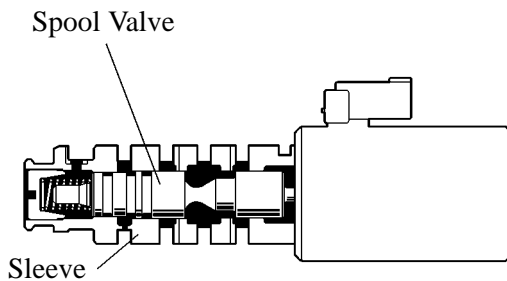
Solenoid Valves SL1, SL2, SL3, SL4, SLU and SLT

In order to provide a hydraulic pressure that is proportional to the current that flows to the solenoid coil, solenoid valves SL1, SL2, SL3, SL4, SLU and SLT linearly control the line pressure and clutch and brake engagement pressure based on the signals from the ECT ECU.

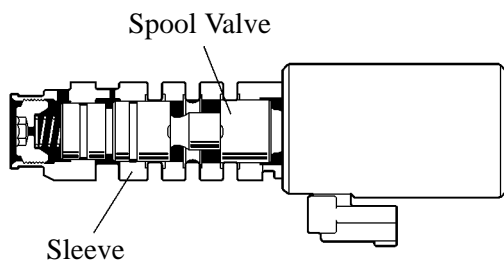
Solenoid valves SL1, SL2, SL3 and SL4 are large flow linear solenoid valves that can supply more pressure than conventional ones. These solenoid valves control engagement elements by directly regulating the line pressure without using the pressure regulation valve (control valve) or the pressure reduction valve (solenoid modulator valve). Thus, the number of valves and the length of the valve body fluid passage have been reduced, the shifting response has been increased and the shift shock has been minimized.



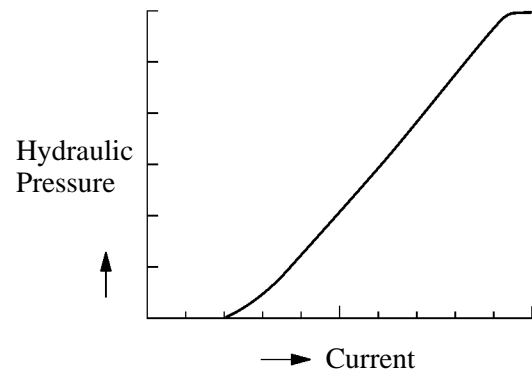
01YCH41TE



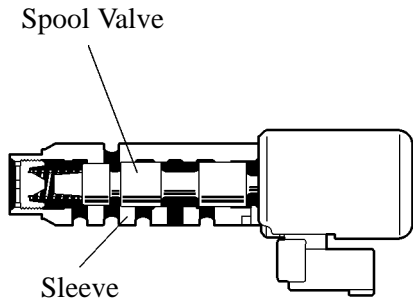
Solenoid Valve SL2 and SL4



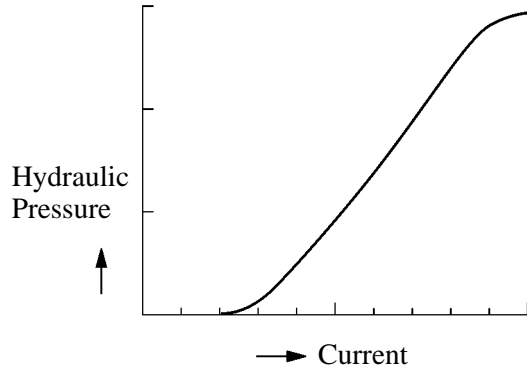
Solenoid Valve SL1 and SL3



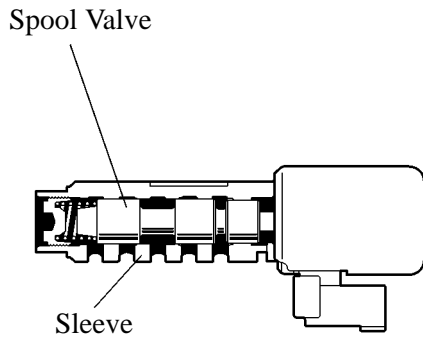
01YCH19Y



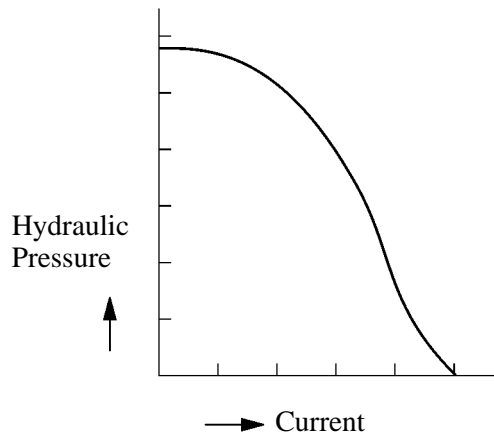
Solenoid Valve SLU



01YCH20Y



Solenoid Valve SLT



01YCH21Y

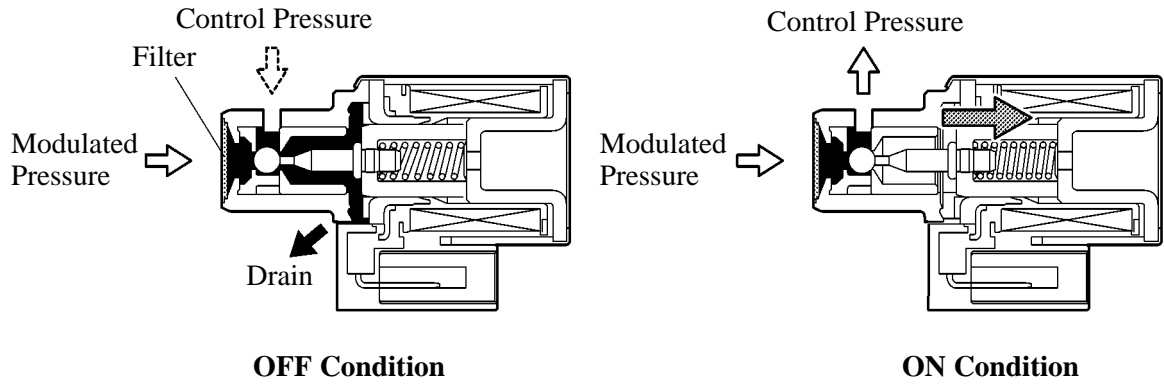
► **Function of Solenoid Valves ●**

Solenoid Valve	Function
SL1	C1 clutch pressure control
SL2	C2 clutch pressure control
SL3	B1 brake pressure control
SL4	B3 brake pressure control
SLU	Lock-up clutch pressure control B2 brake pressure control
SLT	Line pressure control

Solenoid Valve SL

Solenoid valve SL uses a three-way solenoid valve.

A filter is provided at the tip of the solenoid valve to further improve operational reliability.



01YCH22Y

► **Function of Solenoid Valve ●**

Solenoid Valve	Type	Function
SL	3-way	Switches the lock-up relay valve. Switches the B2 apply control valve and the reverse sequence valve.