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■ELECTRONIC CONTROL SYSTEM

1. General

The electronic control system of the U340E automatic transaxle consists of the controls listed below.

System	Function
Clutch Pressure Control (See page CH-20)	● Controls the pressure that is applied directly to B_1 brake and C_1 clutch by actuating the solenoid valves (ST, SLT) in accordance with the ECM signals. ● The solenoid valve SLT minutely controls the clutch pressure in accordance with the engine output and driving conditions.
Line Pressure Control (See page CH-21)	Actuates the solenoid valve SLT to control the line pressure in accordance with information from the ECM and the operating conditions of the transaxle.
Shift Control in Uphill/Downhill Traveling (See page CH-22)	Controls to restrict the 4th upshift or to provide appropriate engine braking by using the ECM to determine whether the vehicle is traveling on uphill or downhill.
Shift Timing Control	The ECM sends current to the solenoid valve S1 and/or S2 based on signals from each sensor and shifts the gear.
Flex Lock-up Clutch Control (See page CH-23)	Controls the solenoid valve SLU, 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 ensure fuel economy.
Lock-up Timing Control	The ECM sends current to the solenoid valve SLU based on the signals from each sensor and engages or disengages the lock-up clutch.
Engine Torque Control	Temporarily retards the engine ignition timing to restrict the output torque, thus ensuring the shift feel during up or down shifting.
“N” to “D” Squat Control	When the shift lever is shifted from the “N” to “D” position, the gear is temporarily shifted to the 3rd and then to the 1st to reduce vehicle squat.
Diagnosis (See page CH-24)	When the ECM detects a malfunction, the ECM makes a diagnosis and memorizes the failed section.
Fail-Safe (See page CH-24)	Even if a malfunction is detected in the sensors or solenoids, the ECM effects fail-safe control to prevent the vehicle’s drivability from being affected significantly.

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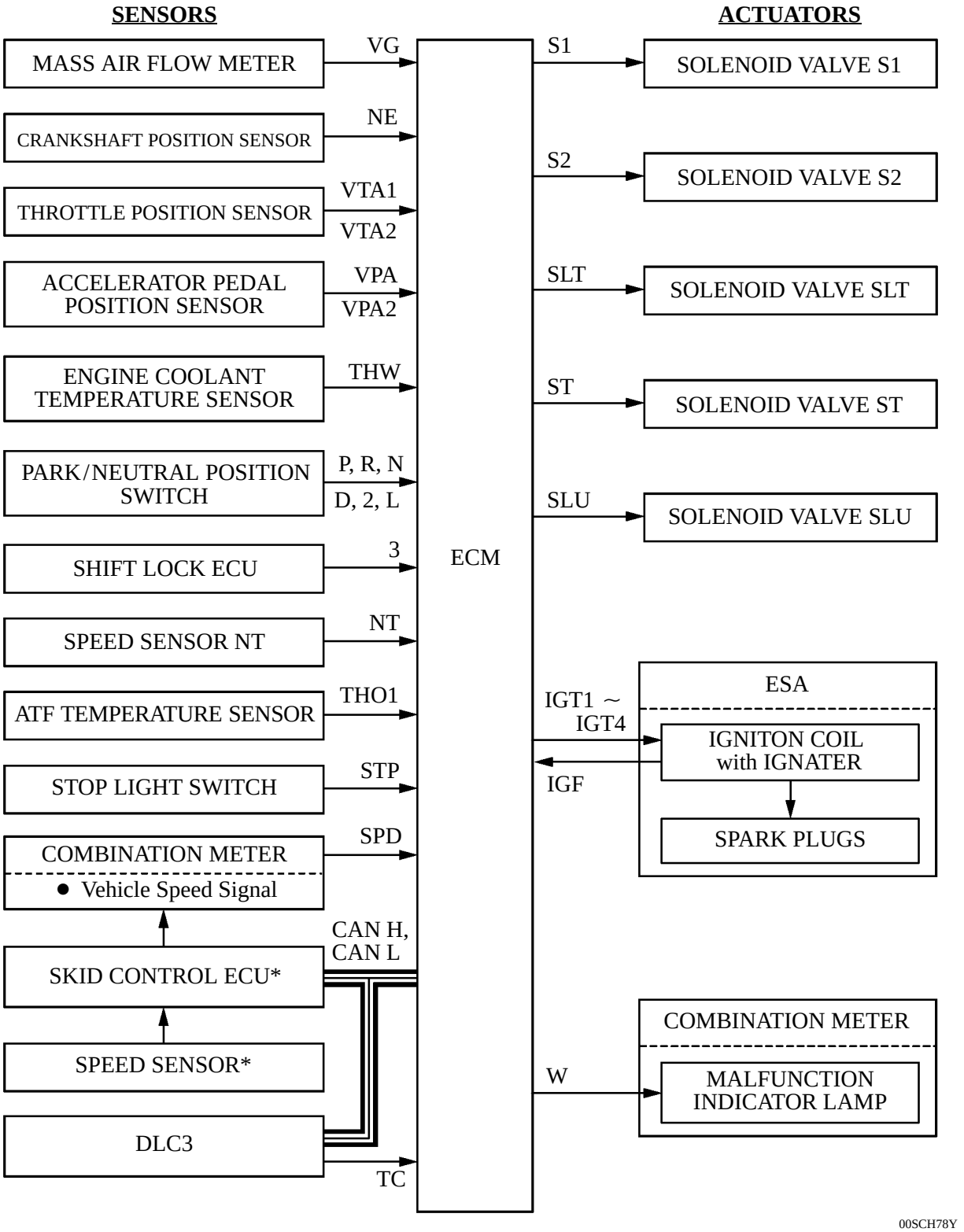
2. Construction

The configuration of the electronic control system in the U340E automatic transaxle is as show in the following chart.



*: Models with ABS System

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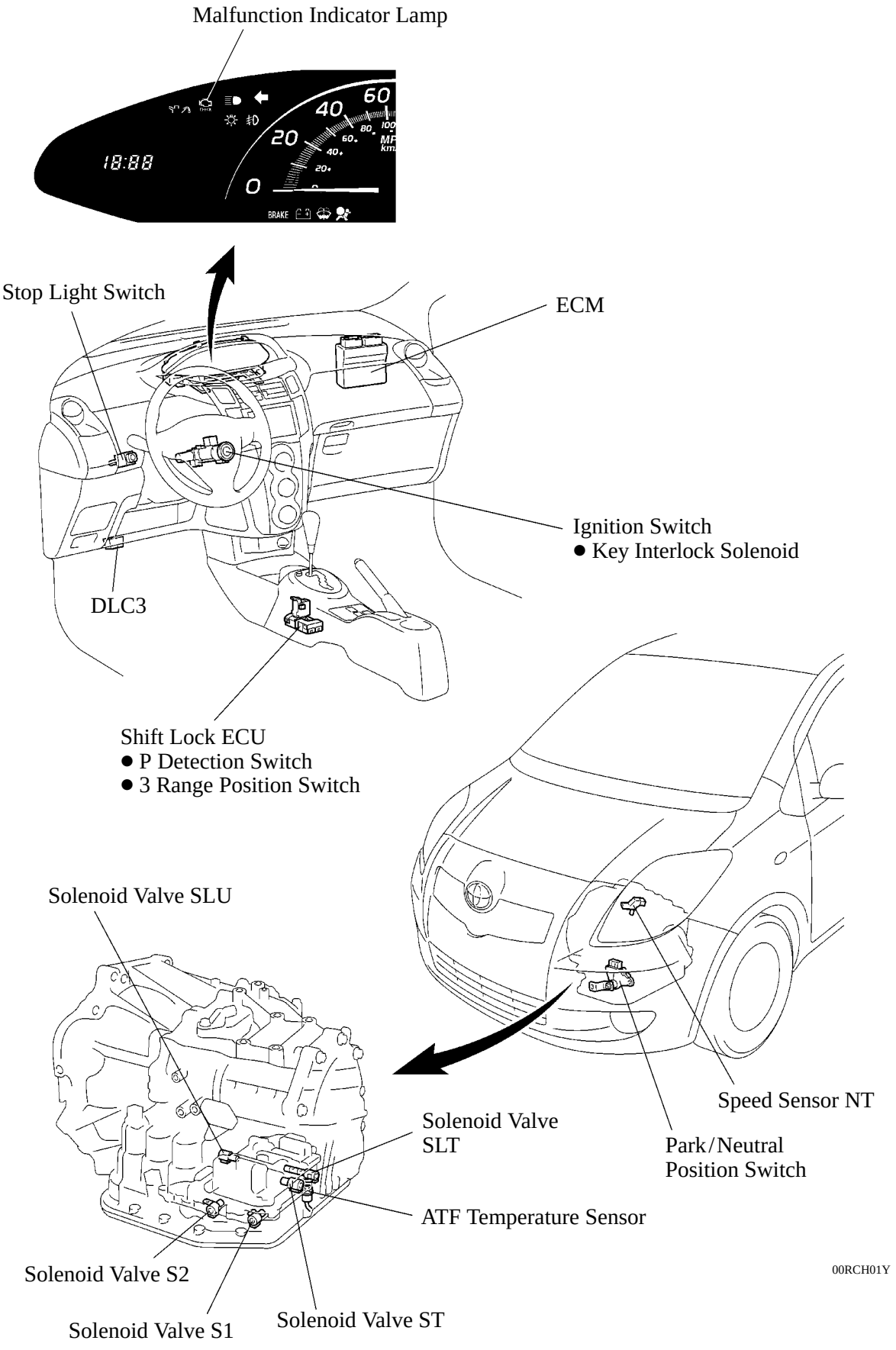
3. Layout of Main Components



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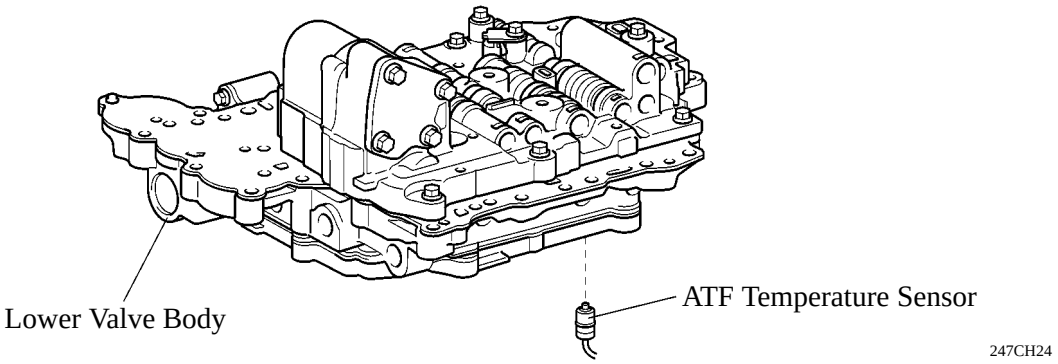
4. Construction and Operation of Main Components

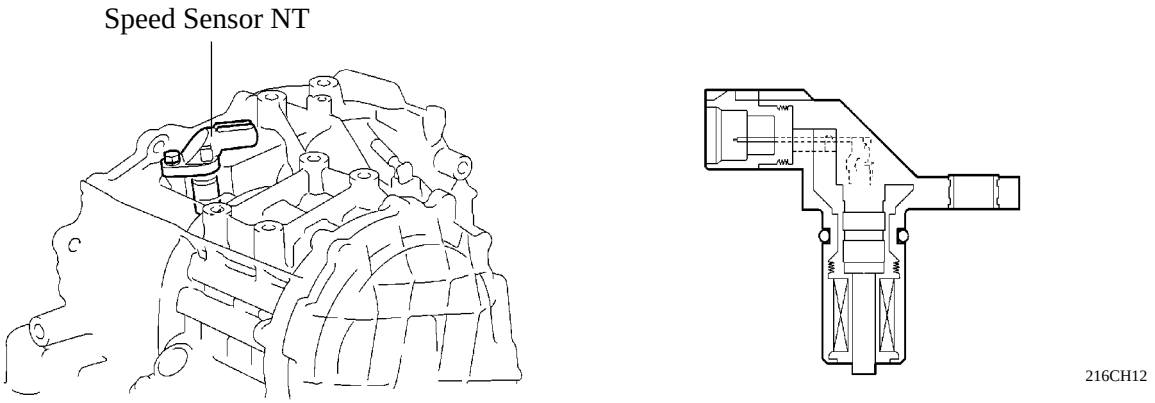
ATF Temperature Sensor

- The ATF temperature sensor is installed in the lower valve body for direct detection of the fluid temperature.
- The ATF temperature sensor is used for correction of clutch and brake pressures to keep smooth shift quality every time.



Speed Sensor NT

The speed sensor NT detects the input speed of the transaxle. The forward clutch (C_1) drum is used as the timing rotor for this sensor.
Thus, the ECM can detect shift timing of the gears and appropriately control the engine torque and hydraulic pressure in response to the various conditions.



Speed Sensor NT

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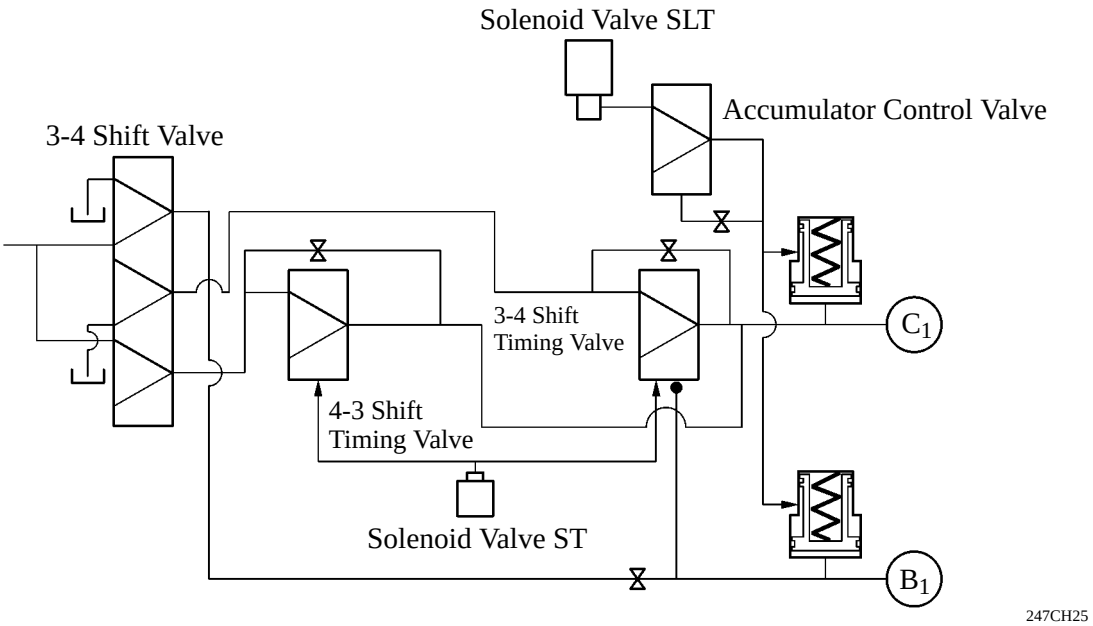
5. Clutch Pressure Control

Clutch to Clutch Pressure Control

This control is used for shifting from the 3rd to 4th gear, and from the 4th to 3rd gear. It actuates solenoid valves ST and SLT in accordance with the signals from the ECM, and guides this output pressure directly to 4-3 shift timing valve and 3-4 shift timing valve in order to regulate the line pressure that acts on the B_1 brake and C_1 clutch.
As a result, compact B_1 and C_1 accumulators without a back pressure chamber have been realized.



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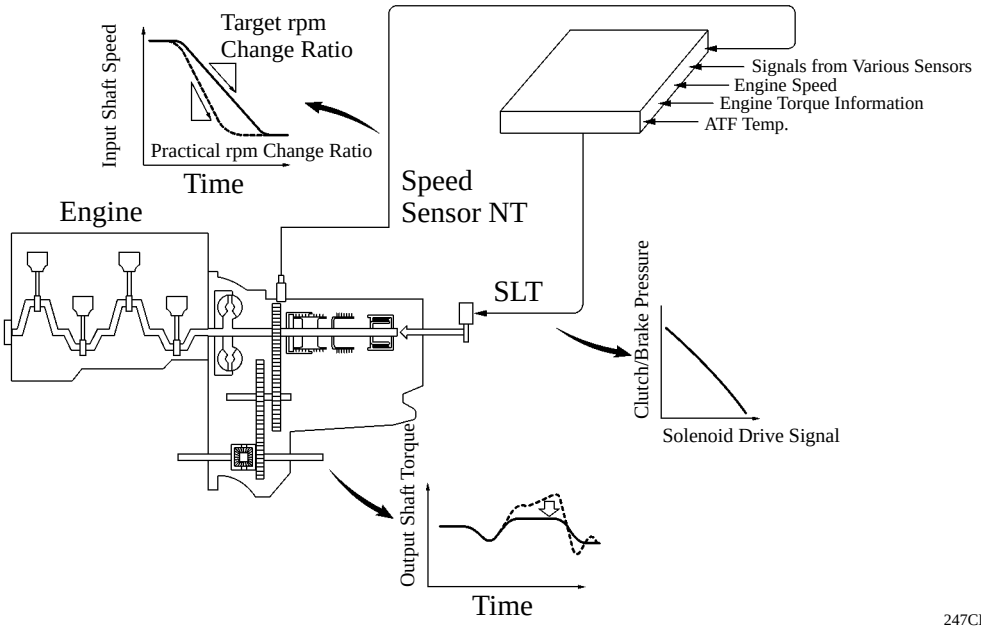
Clutch Pressure Optimal Control

The ECM monitors the signals from various types of sensors such as the speed sensor NT, allowing solenoid valve SLT to minutely control the clutch pressure in accordance with engine output and driving conditions. As a result, smooth shift characteristics have been realized.



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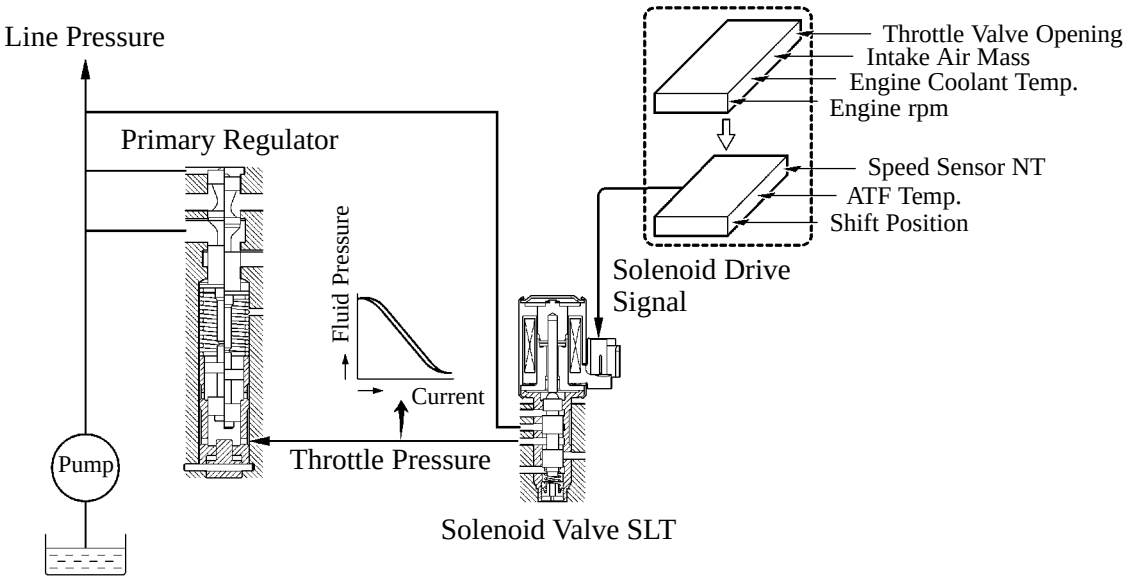
6. Line Pressure Control

Through the use of the 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 controlled minutely in accordance with the engine output, traveling condition, and the ATF temperature, thus realizing smooth shift characteristics and optimizing the workload in the oil pump.



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7. Shift Control in Uphill/Downhill Traveling

General

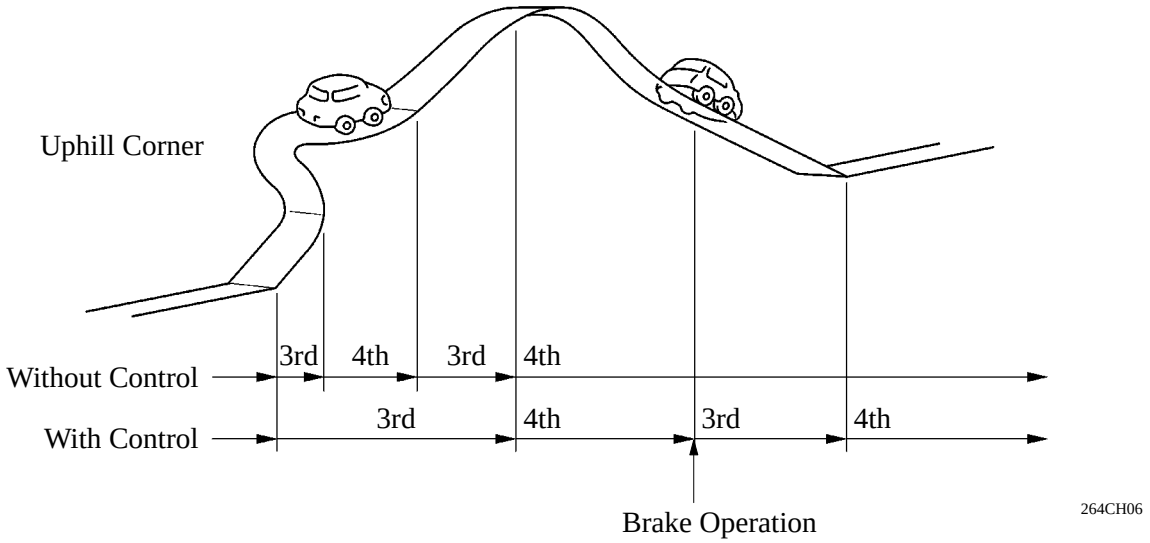
This control helps minimize the gear shifting when the driver operates the accelerator pedal while driving on a winding uphill or downhill road in order to ensure a smooth drive.

Shift Control in Uphill Traveling

When the ECM detects uphill travel, it prohibits upshifting to the 4th after downshifting to the 3rd.

Shift Control in Downhill Traveling

If a signal indicating that the driver has operated the brake pedal is input while the ECM detects downhill travel, it downshifts from the 4th to 3rd.

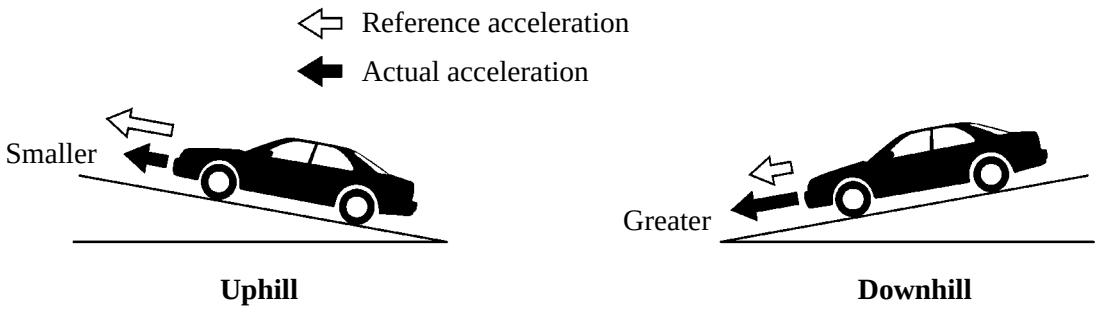


1) Uphill/Downhill Judgment

The actual acceleration calculated from the speed sensor signal is compared with the reference acceleration (based on level road travel) stored in the ECM to determine uphill or downhill travel.

Actual Acceleration < Reference Acceleration

Actual Acceleration > Reference Acceleration



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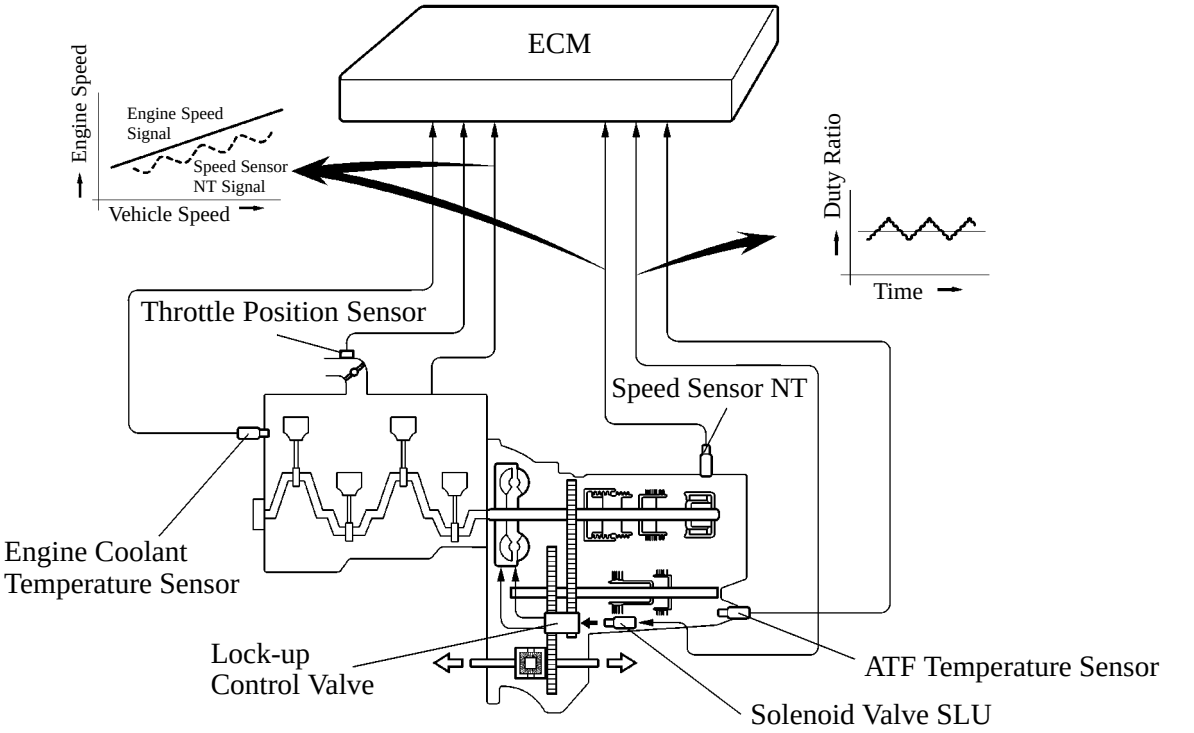
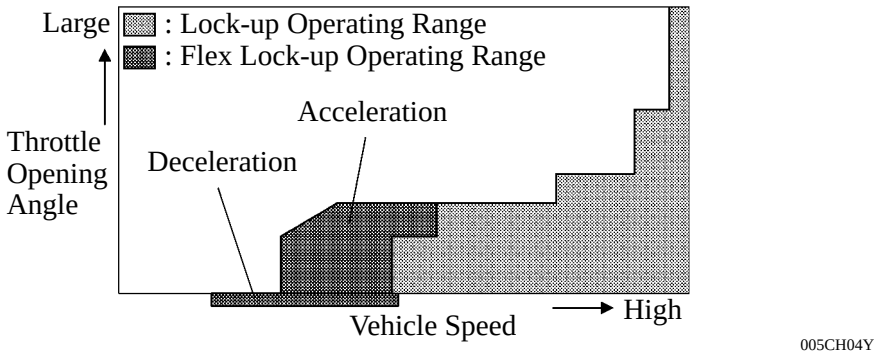
8. Flex Lock-up Clutch Control

In addition to the conventional lock-up timing control, flex lock-up clutch control is used.
This flex lock-up clutch control regulates the solenoid valve SLU as an intermediate mode between the ON/OFF operation of the lock-up clutch.
The flex lock-up clutch control operates during acceleration, in the 3rd and 4th gears in the D range, and during deceleration, in the 3rd and 4th gears in the D range, and in the 3rd gear in the 3 range.





Flex Lock-up Operating Range

▶ Flex Lock-up Operation Gears in D and 3 Range ◀

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

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9. Diagnosis

- When the ECM detects a malfunction, the ECM makes a diagnosis and memorizes the failed section. Furthermore, the MIL (Malfunction Indicator Lamp) in the combination meter illuminates or blinks to inform the driver.
- At the same time, the DTCs (Diagnosis Trouble Codes) are stored in the memory. The DTCs can be read by connecting the hand-held tester. For details, see the '06 Yaris Repair Manual (Pub. No. RM00R0U).

10. Fail-Safe

This function minimizes the loss of operability when any abnormality occurs in each sensor or solenoid.

▶ Fail-Safe Control List ◀

Malfunction Part	Function
Vehicle Speed Signal	During a vehicle speed signal malfunction, the 4th upshift is prohibited.
Speed Sensor NT	During a speed sensor NT signal malfunction, the 4th upshift is prohibited.
ATF Temperature Sensor	During a ATF temperature sensor malfunction, the 4th upshift is prohibited.
Solenoid Valve SLT or SLU	During a solenoid valves SLT or SLU malfunction, the 4th upshift is prohibited.
Engine Coolant Temperature Sensor, Knock Sensor, or Throttle Position Sensor	During a water temperature sensor, knock sensor, or throttle position sensor malfunction, the 4th upshift is prohibited.
Solenoid Valve S1 or S2	During a malfunction in the solenoid valve S1 or S2, the current to the faulty solenoid valve is cut off and control is effected by operating the normal solenoid valves. Shift control is effected as described in the table below, depending on the failed solenoid valve.

When all solenoid valves are normal			When solenoid valve S1 is abnormal			When solenoid valve S2 is abnormal			When solenoid valves S1 and S2 are abnormal		
Solenoid valve		Gear	Solenoid valve		Gear	Solenoid valve		Gear	Solenoid valve		Gear
S1	S2		S1	S2		S1	S2		S1	S2	
ON	ON	1st	x	ON ↓ OFF	3rd	ON	x	2nd	x	x	3rd
ON	OFF	2nd	x	OFF	3rd	ON	x	2nd	x	x	3rd
OFF	OFF	3rd	x	OFF	3rd	OFF	x	3rd	x	x	3rd
OFF	ON	4th	x	ON	4th	OFF	x	3rd	x	x	3rd

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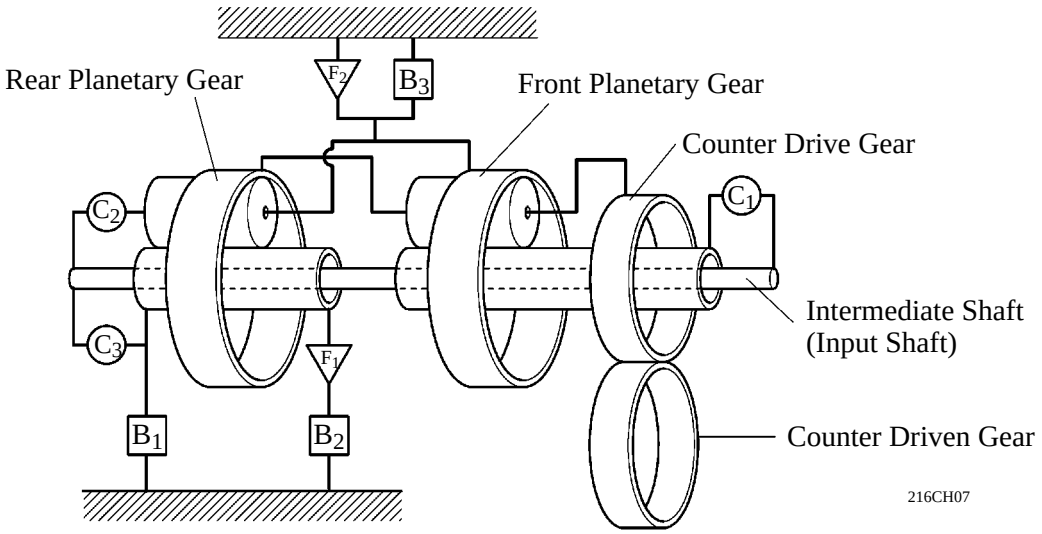
■PLANETARY GEAR UNIT

1. Construction

- A CR-CR type planetary gear is used in the planetary gear unit, which is located on the input shaft. This planetary gear is a type of the planetary gear unit that joins the front and rear planetary carriers to the front and rear ring gears. As a result, the unit has been made significantly simple and compact.
- A centrifugal fluid pressure canceling mechanism is used in the C_1 clutch, which is applied when shifting from the 3rd to 4th.



2. Function of Component

Component		Function
C_1	Forward Clutch	Connects input shaft and front planetary sun gear.
C_2	Direct Clutch	Connects intermediate shaft and rear planetary carrier.
C_3	Reverse Clutch	Connects intermediate shaft and rear planetary sun gear.
B_1	OD & 2nd Brake	Lock the rear planetary sun gear.
B_2	2nd Brake	Prevent rear planetary sun gear from turning counterclockwise.
B_3	1st & Reverse Brake	Lock the front planetary ring gear and rear planetary carrier.
F_1	No. 1 One-Way Clutch	Prevents rear planetary sun gear from turning counterclockwise.
F_2	No. 2 One-Way Clutch	Prevents front planetary ring gear and rear planetary carrier 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 speed.

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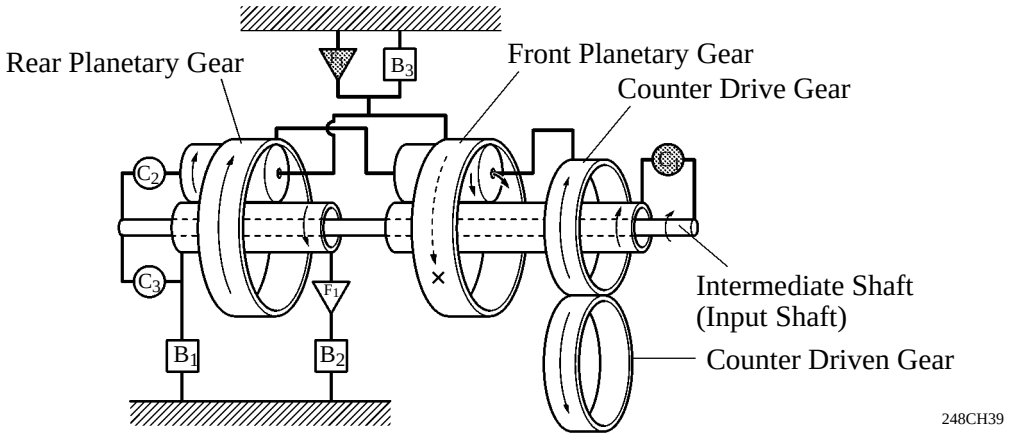
3. Transaxle Power Flow

Shift Lever Position	Gear	Solenoid Valve		Clutch			Brake			One-Way Clutch	
		S1	S2	C_1	C_2	C_3	B_1	B_2	B_3	F_1	F_2
P	Park	ON	ON								
R	Reverse	ON	ON			○			○		
N	Neutral	ON	ON								
D	1st	ON	ON	○							○
	2nd	ON	OFF	○				○		○	
	3rd	OFF	OFF	○	○			○			
	4th	OFF	ON		○		○	○			
3	1st	ON	ON	○							○
	2nd	ON	OFF	○				○		○	
	3rd	OFF	OFF	○	○			○			
2	1st	ON	ON	○							○
	2nd	ON	OFF	○			○	○		○	
L	1st	ON	ON	○					○		○

○: Operation

1st Gear (D, 3 or 2 Position)



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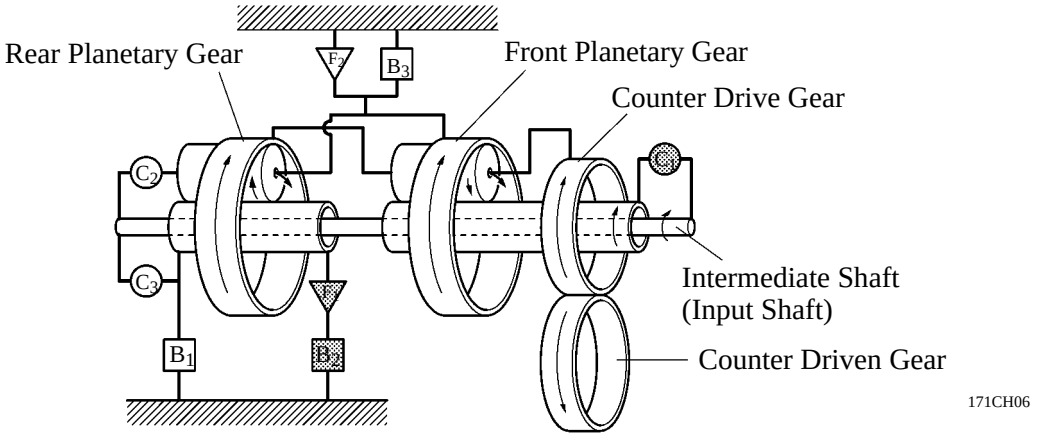
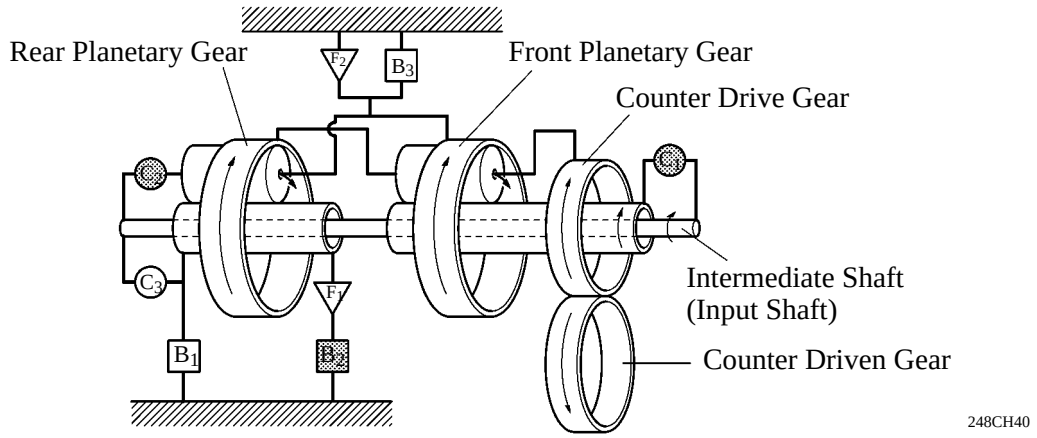
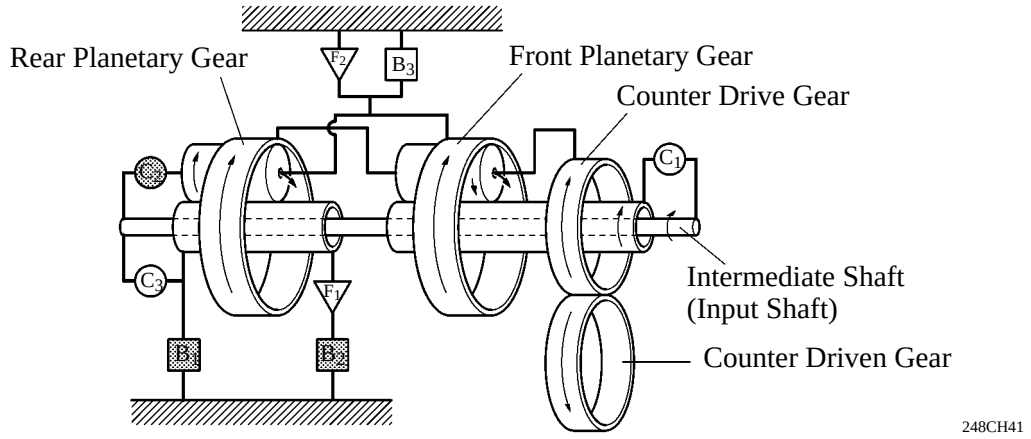
2nd Gear (D or 3 Position)



3rd Gear (D or 3 Position)



4th Gear (D Position)



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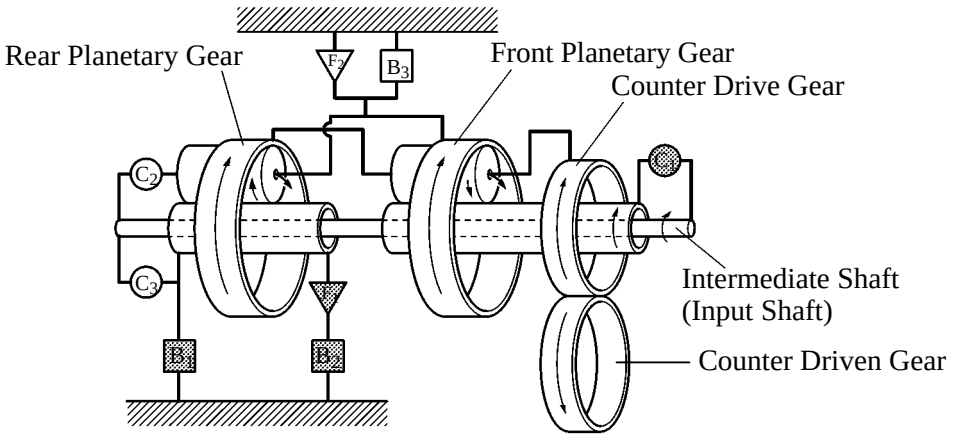
2nd Gear (2 Position)



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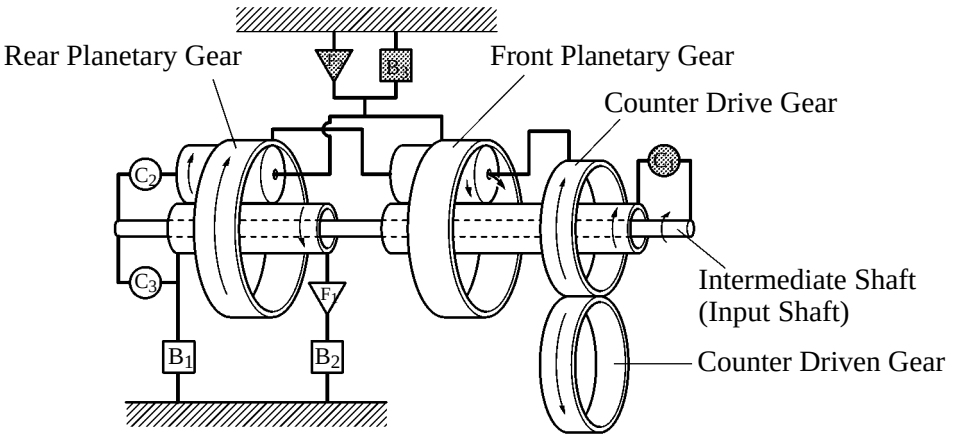
1st Gear (L Position)



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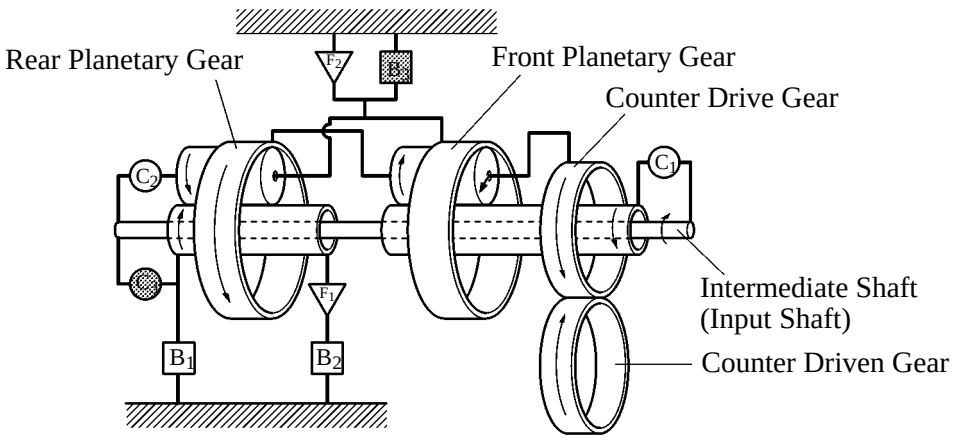
Reverse Gear (R Position)



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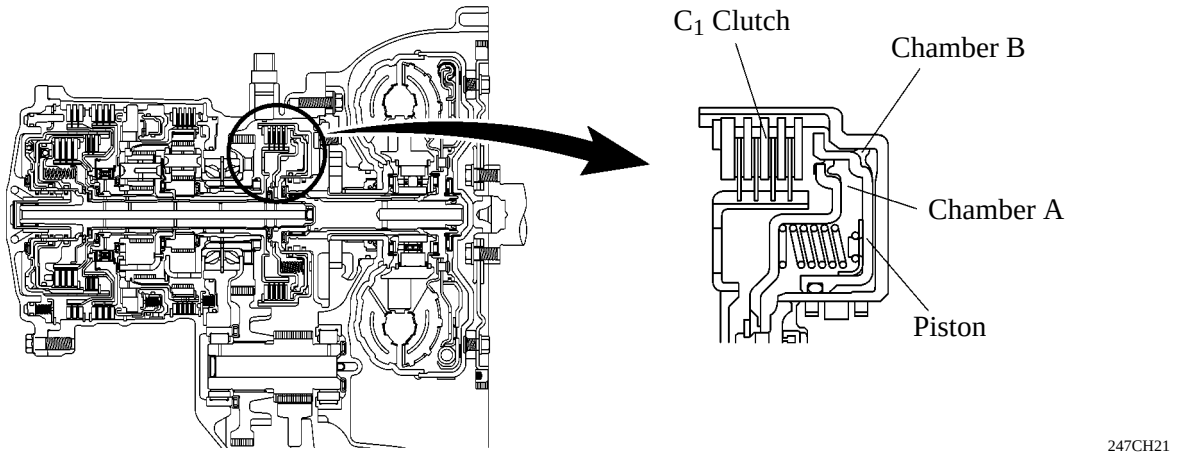
4. Centrifugal Fluid Pressure Canceling Mechanism

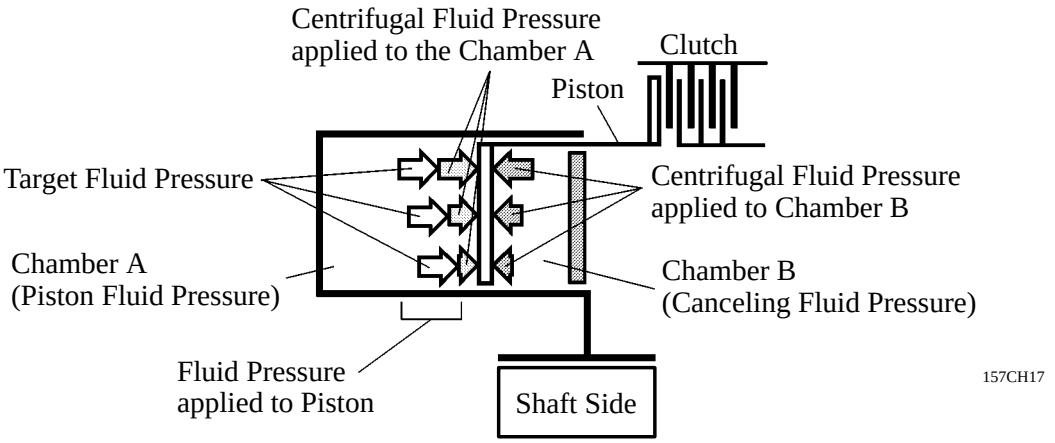
There are two reasons for improving the conventional clutch mechanism:

- To prevent the generation of pressure by the centrifugal force that 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 can 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 the 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 the lubrication fluid such as that of the shaft, the same amount of 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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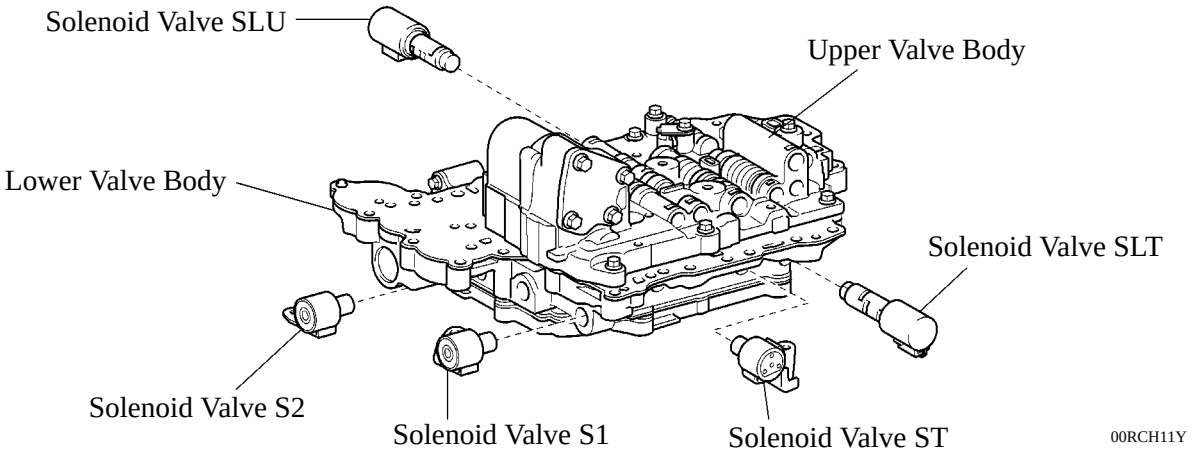
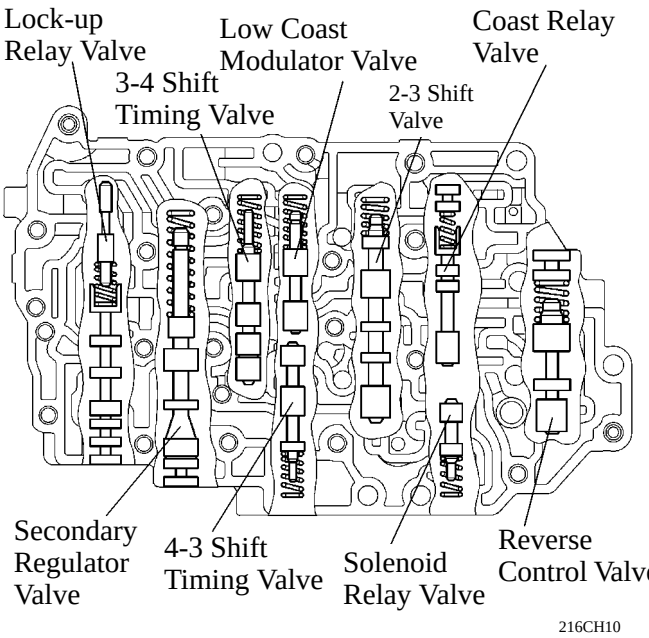
■VALVE BODY UNIT

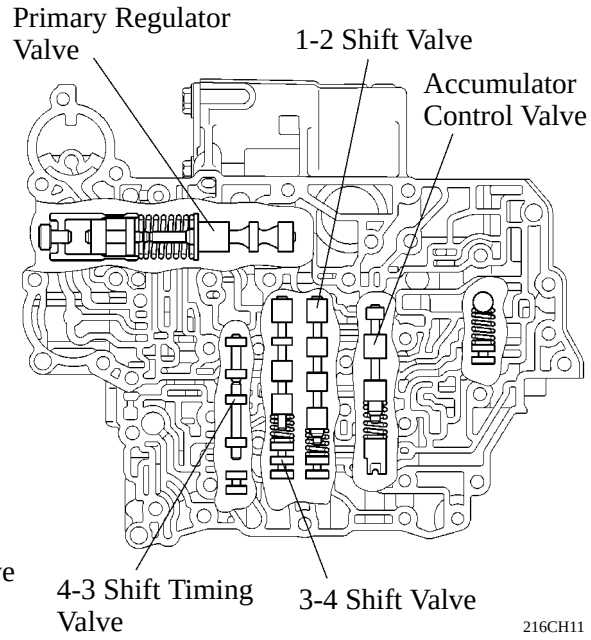
The valve body consists of the upper and lower valve bodies and 5 solenoid valves.
The 5 solenoid valves are installed in the lower valve body for serviceability.



▶ Upper Valve Body ◀



▶ Lower Valve Body ◀



▶ Function of Solenoid Valve ◀

Solenoid Valve	Action	Function
S1	For 2-3 shift valve control	Shifts gears by switching the 2-3 shift valve and controlling the C_2 clutch.
S2	For 1-2 and 3-4 shift valve control	Shifts gears by switching the 1-2 and 3-4 shift valves and controlling 2 clutches (C_1 and C_2) and 2 brakes (B_1 and B_2).
ST	For clutch to clutch pressure control	Switches 3-4 and 4-3 shift valves.
SLU	For clutch engagement pressure control	Controls the lock-up clutch.
SLT	For line pressure control	Controls the line pressure, secondary pressure, and accumulator back pressure.

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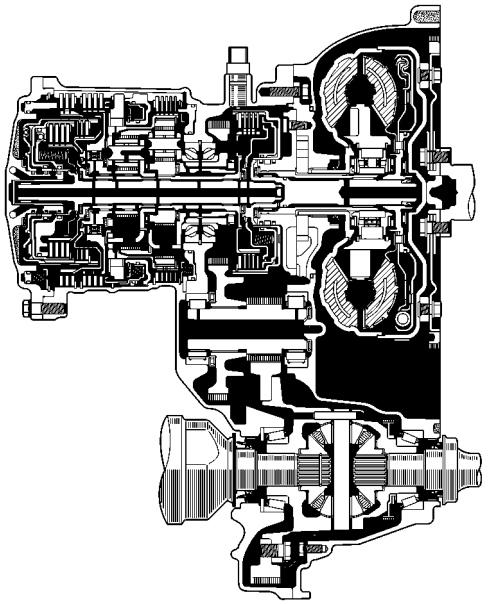
U340E AUTOMATIC TRANSAXLE

■DESCRIPTION

'06 Yaris 1NZ-FE engine model with automatic transaxle uses the U340E automatic transaxle.
This automatic transaxle is a compact and high-capacity 4-speed Super ECT (Electronic Controlled Transaxle).



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▶ Specification ◀

Transaxle Type		U340E
Engine Type		1NZ-FE
Gear Ratio	1st	2.847
	2nd	1.552
	3rd	1.000
	4th	0.700
	Reverse	2.343
Differential Gear Ratio*1		4.237
Fluid Capacity*2 Liters (US qts, Imp.qts)		6.4 (6.78, 5.63)
Fluid Type		Toyota Genuine ATF WS
Weight (Reference)*3 kg (lb)		68.5 (150.7)

*1: Counter Gear Ratio Included.
*2: Differential Included.
*3: Weight shows the figure with the fluid fully filled.

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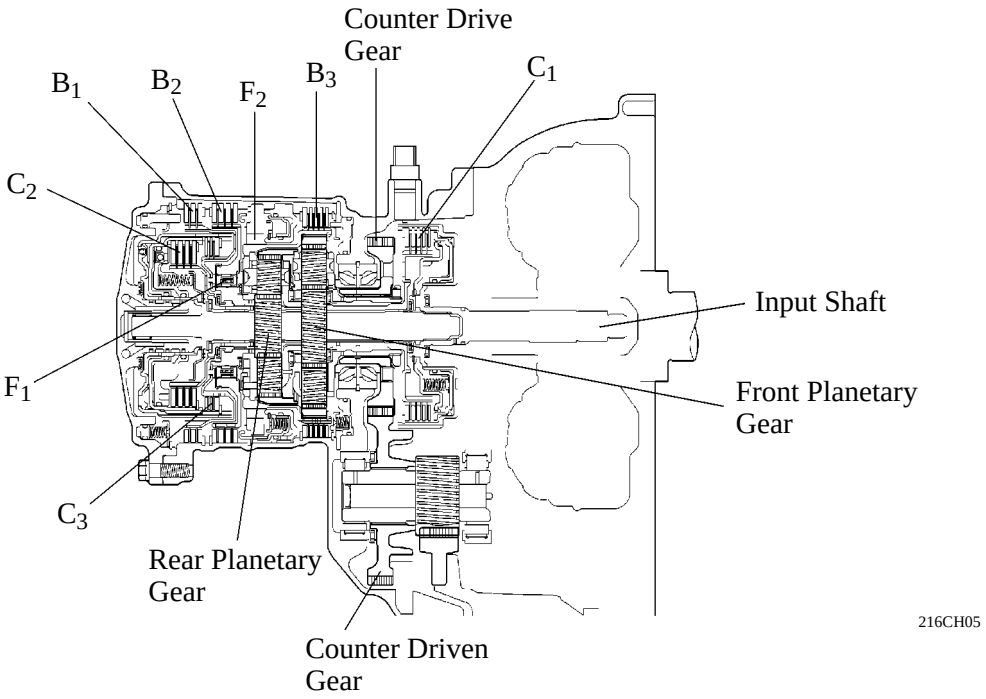

▶ Specification ◀

C_1	Forward Clutch	The No. of Discs	4
C_2	Direct Clutch		3
C_3	Reverse Clutch		2
B_1	OD & 2nd Brake		2
B_2	2nd Brake		3
B_3	1st & Reverse Brake		4
F_1	No. 1 One-Way Clutch	The No. of Sprags	16
F_2	No. 2 One-Way Clutch	The No. of Rollers	15
Front Planetary Gear		The No. of Sun Gear Teeth	46
		The No. of Pinion Gear Teeth	21
		The No. of Ring Gear Teeth	85
Rear Planetary Gear		The No. of Sun Gear Teeth	32
		The No. of Pinion Gear Teeth	21
		The No. of Ring Gear Teeth	75
Counter Gear		The No. of Drive Gear Teeth	52
		The No. of Driven Gear Teeth	53

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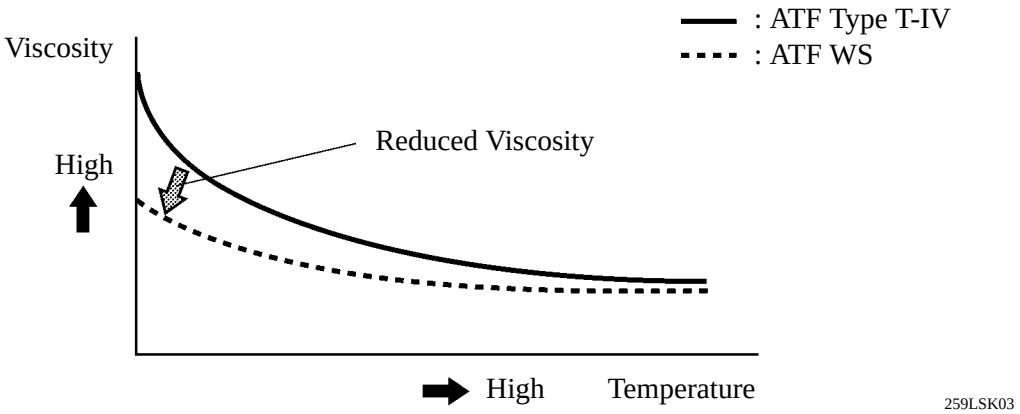
■ATF (AUTOMATIC TRANSMISSION FLUID) WS

- The ATF WS is used to reduce the resistance of the ATF and ensure fuel economy by reducing its viscosity in the practical operation range. At the high-temperature end, its viscosity is the same as that of the ATF Type T-IV, which ensures the durability of the automatic transaxle.
- There is no interchangeability between the ATF WS and other types of ATFs (ATF Type T-IV, D-II).



Service Tip

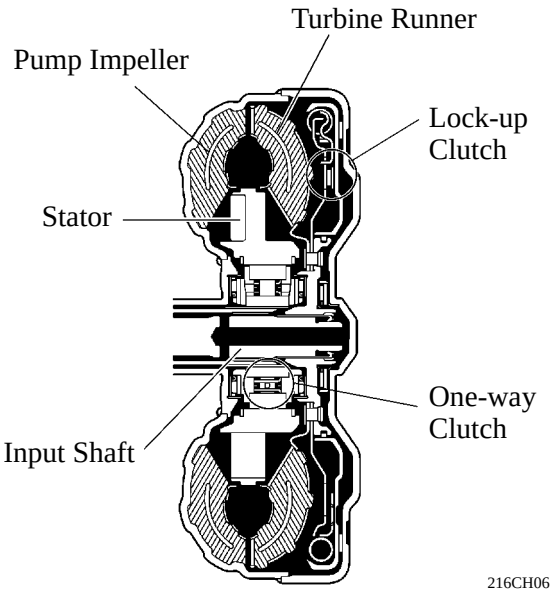
- The color of the ATF level gauge used in the ATF WS has been changed to black. (Orange was used in the ATF Type T-IV on the previous model.)
- If a vehicle with a transaxle filled with ATF WS is replenished with another type of ATF, the vehicle might not start off at extremely low temperatures.

■TORQUE CONVERTER

- This torque converter has optimally designed fluid passages and impeller configuration resulting in substantially enhanced transmission efficiency to ensure good starting, acceleration and fuel economy.
- Furthermore, a hydraulically operated lock-up mechanism which cuts power transmission losses due to slippage at medium and high speeds is used.

▶ Specification ◀

Torque Converter Type	3-Element, 1-Step, 2-Phase (With Lock-up Mechanism)
Stall Torque Ratio	2.0



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■OIL PUMP

The oil pump is combined with torque converter, lubricates the planetary gear units and supplies operating pressure to the hydraulic control.