■ELECTRONIC CONTROL SYSTEM

1. General

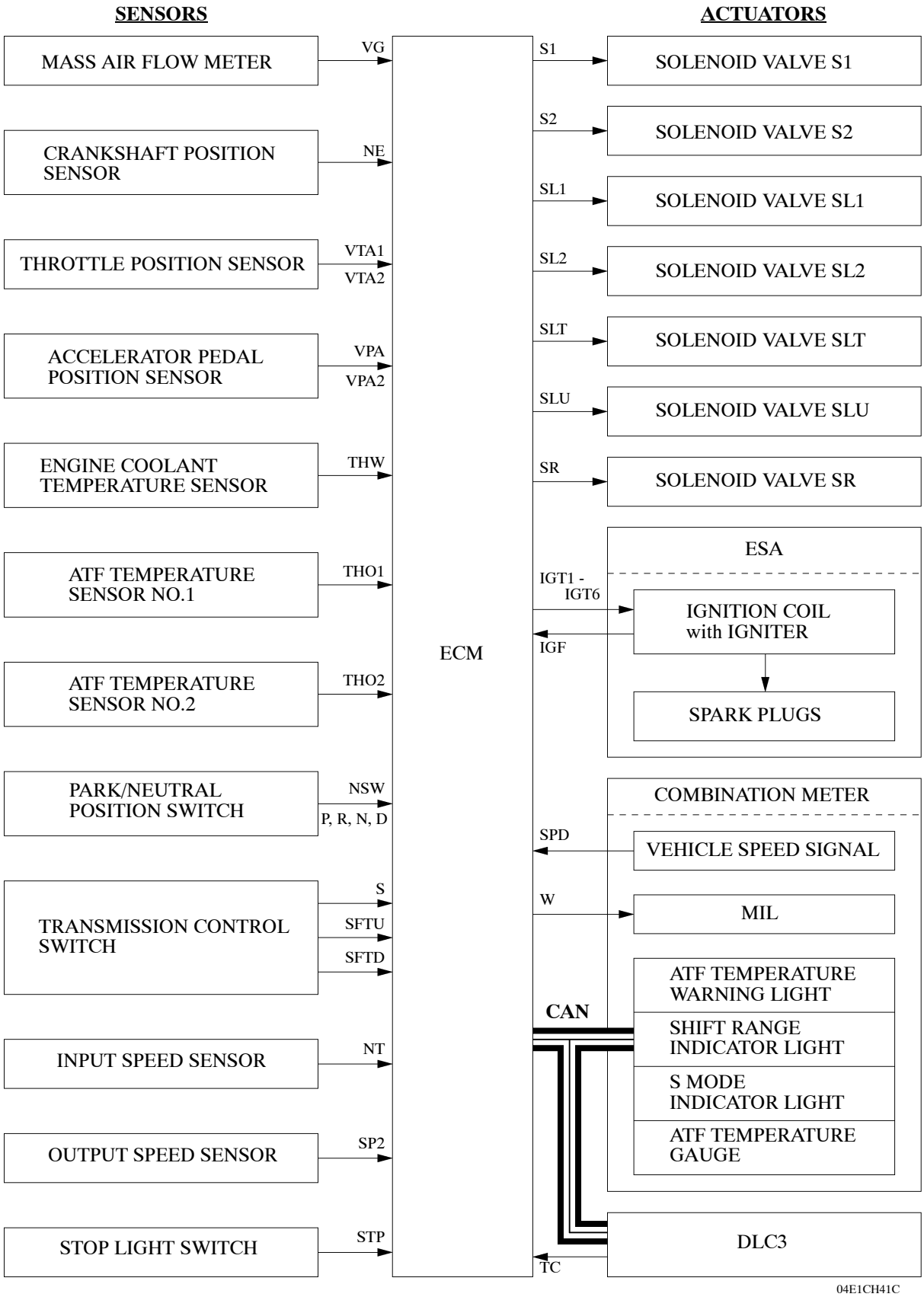
The electronic control system of the A750E and A750F automatic transmissions consists of the control functions listed below.

System	Function
Shift Timing Control	The ECM sends current to solenoid valves S1, S2 and/or SR based on signals from various sensors in order to shift the gears.
Clutch Pressure Control (See Page CH-29)	• Controls the pressure that is applied directly to B_1 brake and C_1 clutch by actuating the linear solenoid valves SL1 and SL2 in accordance with the ECM signals. • The solenoid valve SLT and SL1 minutely controls the clutch pressure in accordance with the engine output and driving conditions.
Line Pressure Optimal Control (See Page CH-30)	Actuates the solenoid valve SLT to control the line pressure in accordance with information from the ECM and the operating conditions of the transmission.
Engine Torque Control	Retards the engine ignition timing temporarily to improve shift feeling while up-shifts or downshifts occur.
Lock-up Timing Control	The ECM sends current to the solenoid valve SLU based on signals from various sensors and engages or disengages the lock-up clutch.
Flex Lock-up Clutch Control (See Page CH-31)	Controls the solenoid valve SLU, provides an intermediate mode for when the lock-up clutch is between ON and OFF, increasing the operating range of the lock-up clutch to improve fuel economy.
“N” to “D” Squat Control	When the shift lever is shifted from “N” to “D” position, 2nd gear is temporarily engaged before 1st to reduce vehicle squat.
AI (Artificial Intelligence) -SHIFT Control (See Page CH-32)	Based on the signals from various sensors, the ECM determines the road conditions and the intention of the driver. Thus, an appropriate shift pattern is automatically determined, thus improving drivability.
Multi-Mode Automatic Transmission (See page CH-34)	The ECM appropriately controls the automatic transmission in accordance with the range position selected while the shift lever is in the S mode position.
Diagnosis (See Page CH-37)	When the ECM detects a malfunction, the ECM records the malfunction and memorizes the information that relates to the fault.
Fail-safe (See Page CH-37)	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.

2. Construction

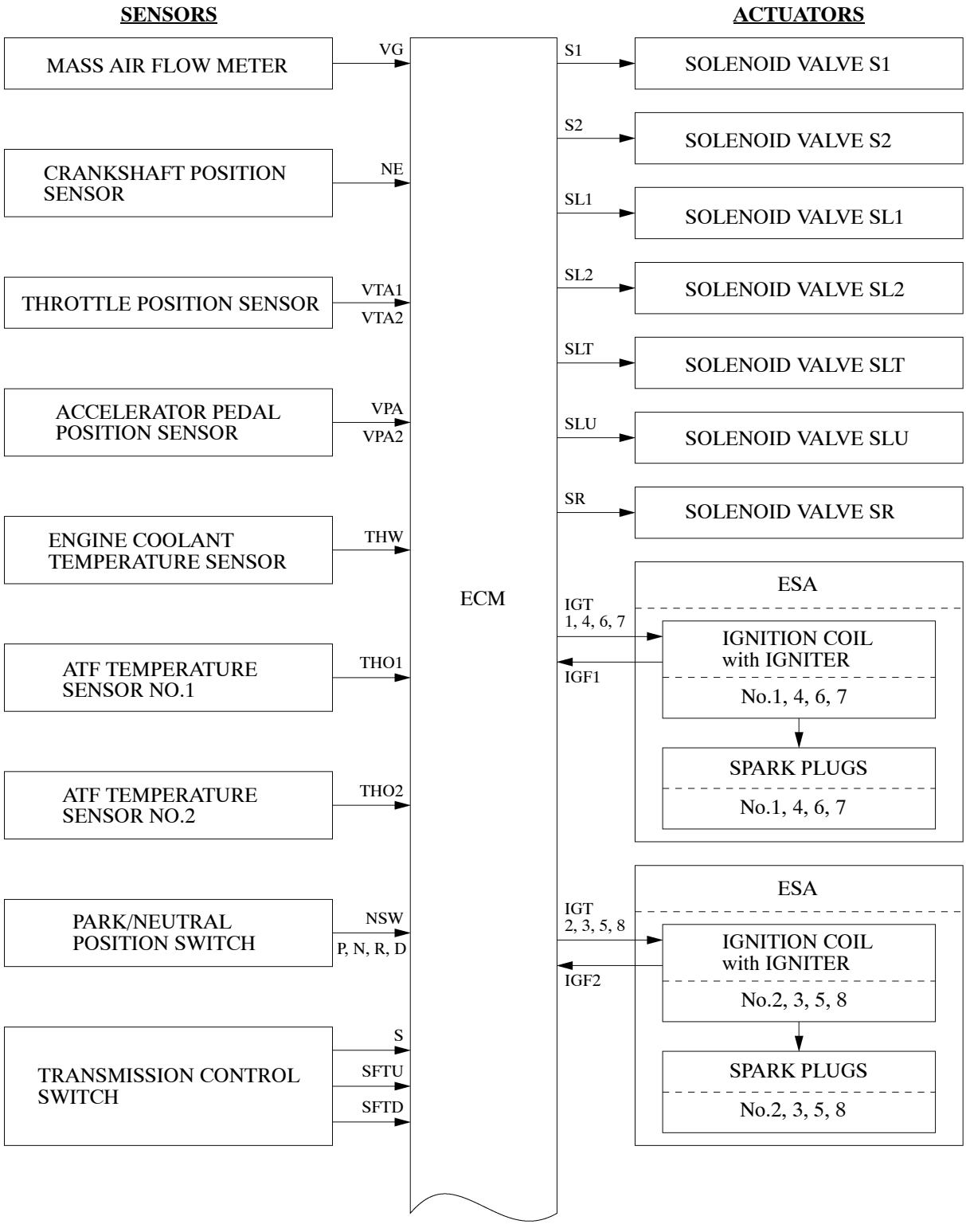
The configurations of the electronic control system for the A750E and A750F automatic transmissions are as shown in the following charts.

▶ 1GR-FE × A750E ◀



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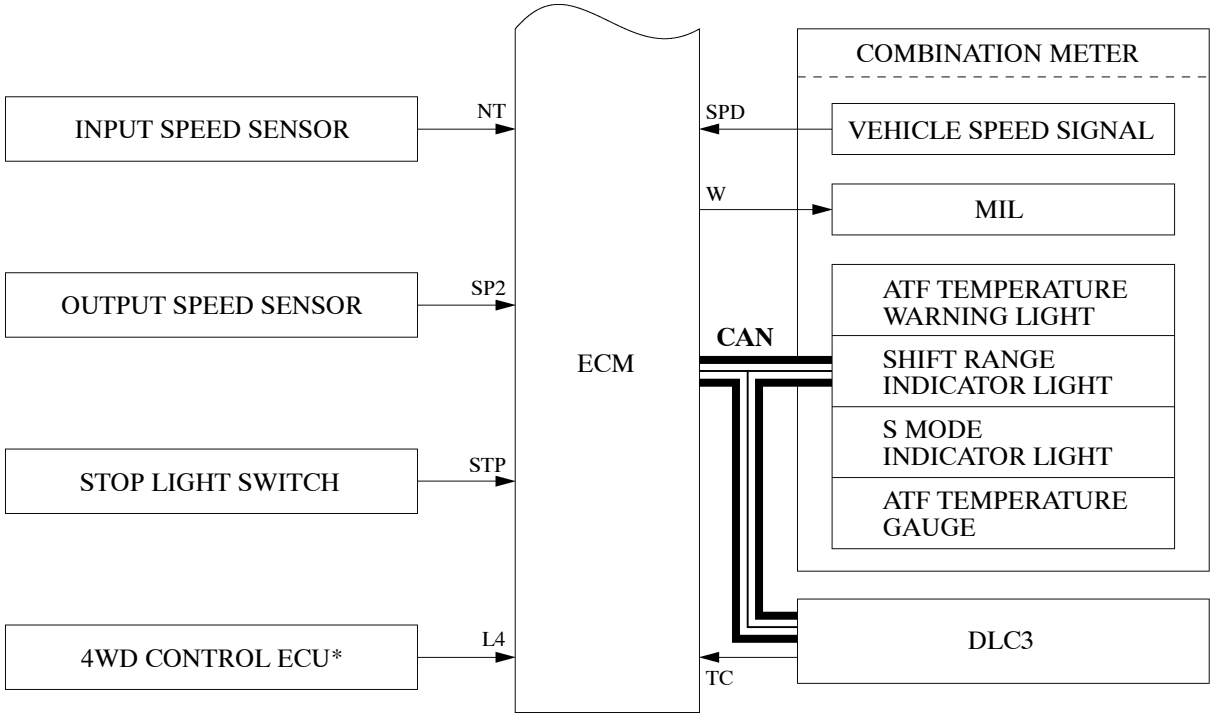
▶ 2UZ-FE × A750E, A750F ◀



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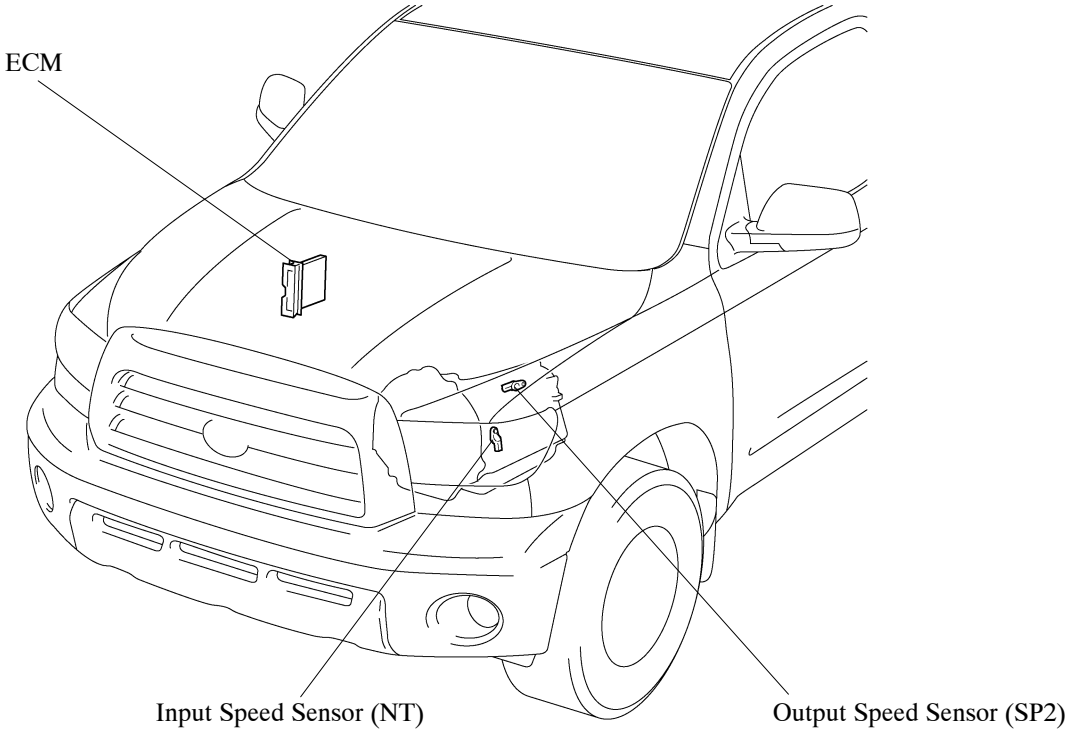
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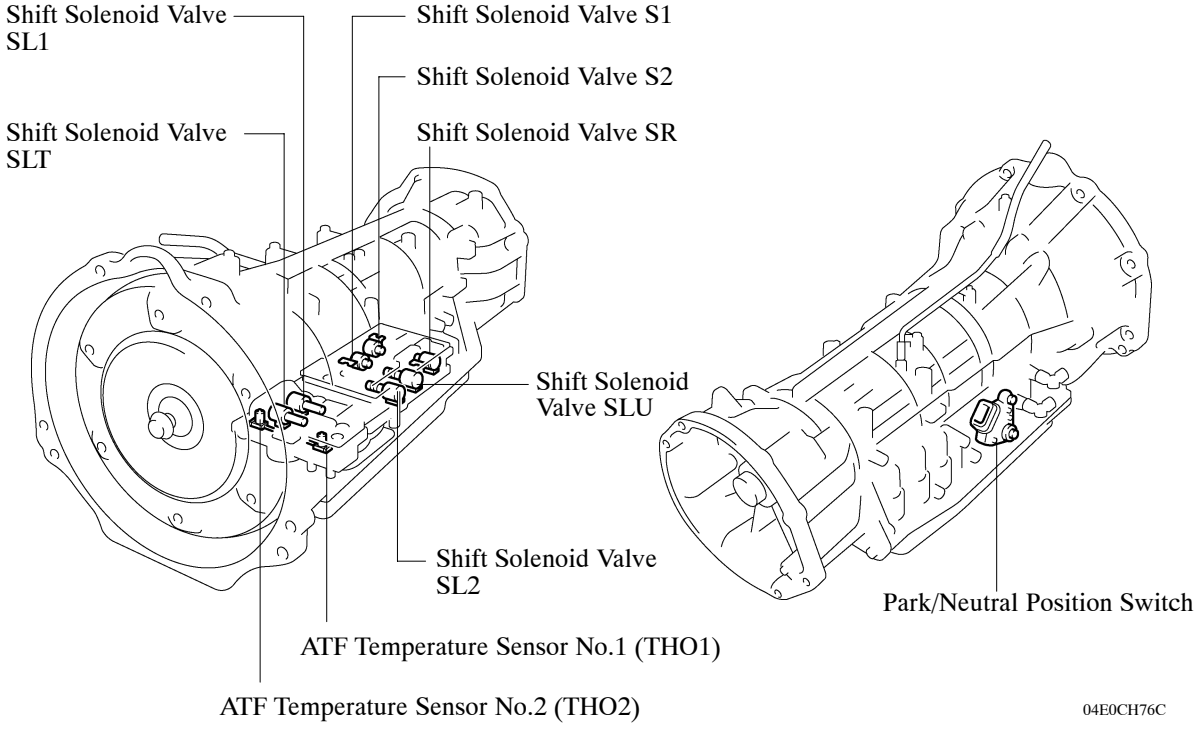


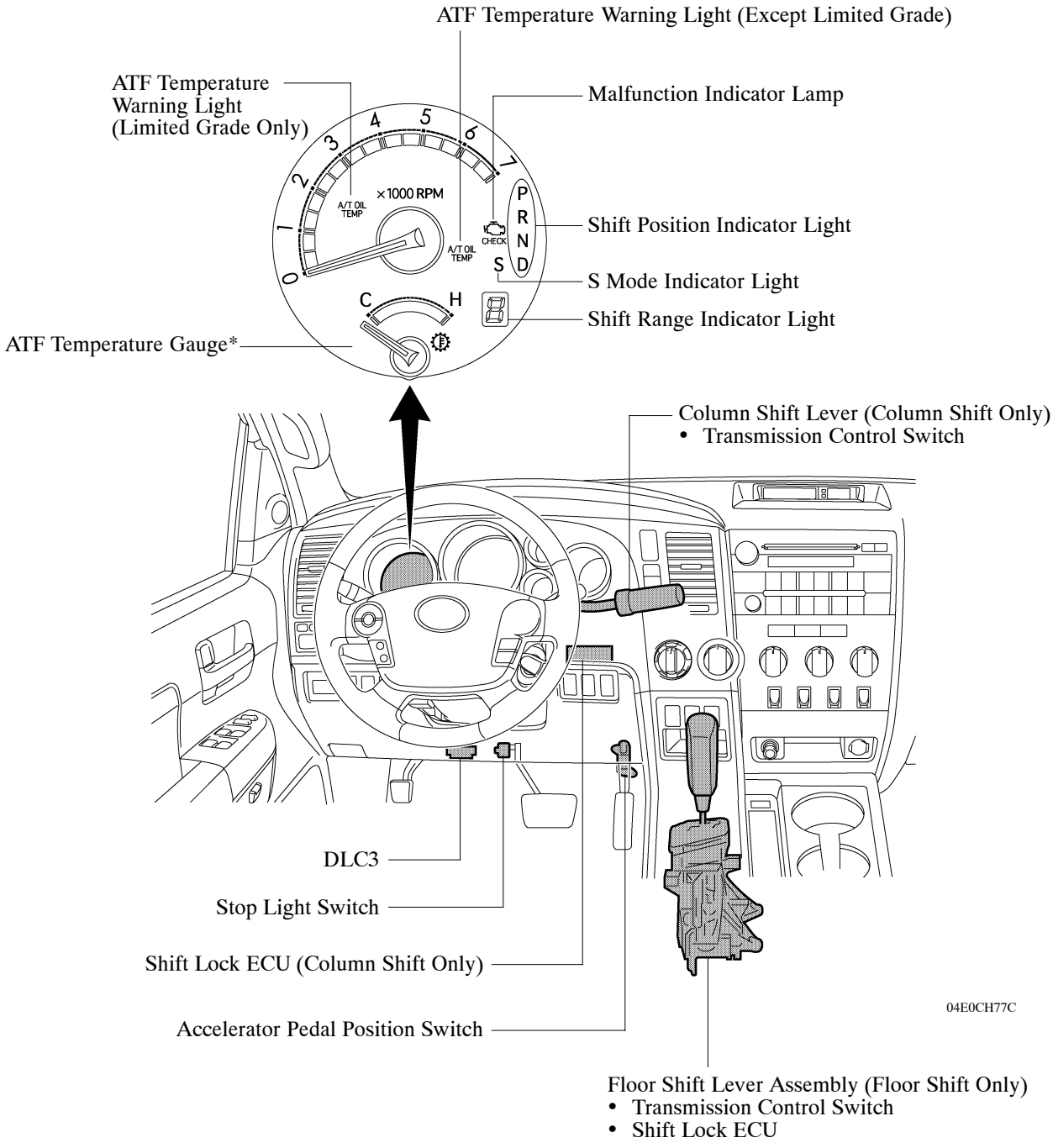
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*: Only for 4WD Models

3. Layout of Main Components





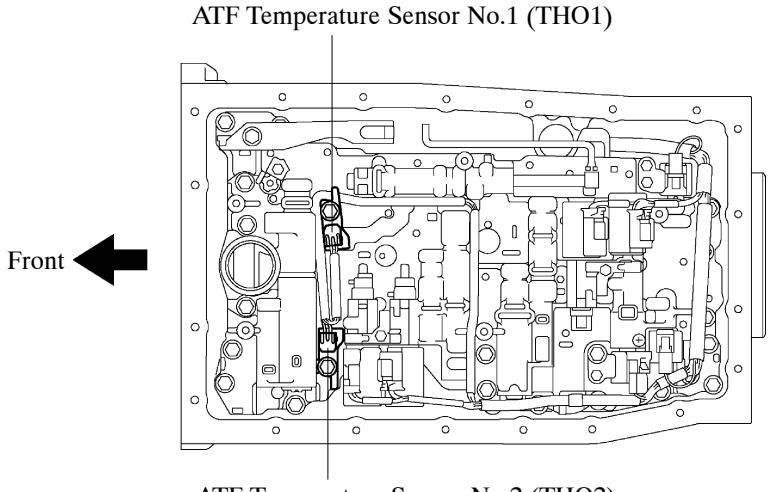


*: The ATF temperature gauge is used on models with 2UZ-FE engines only. For details, see page BE-31.

4. Construction and Operation of Main Components

ATF Temperature Sensor No.1 and No.2

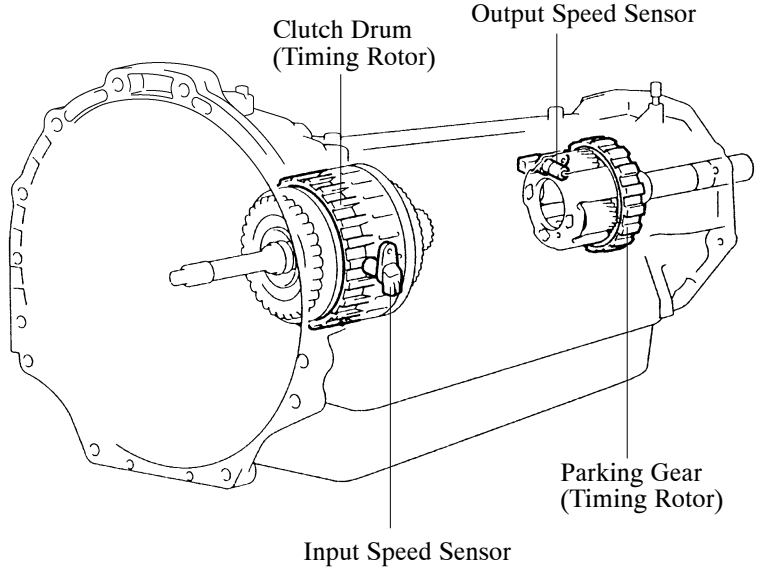
- ATF temperature sensor No.1 (THO1) is used for hydraulic pressure control. This sensor is used for revision of the pressure that is used to apply clutches and brakes in the transmission. This helps to ensure smooth shift quality.
- ATF temperature sensor No.2 (THO2) is used as a basis for modifying the ECT shift timing control when the ATF temperature is high. It is also used for the ATF temperature warning light.



Input Speed Sensor and Output Speed Sensor

The A750E and A750F automatic transmissions use an input speed sensor (for NT signal) and output speed sensor (for SP2 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 various conditions.
These speed sensors are the pick-up coil type.

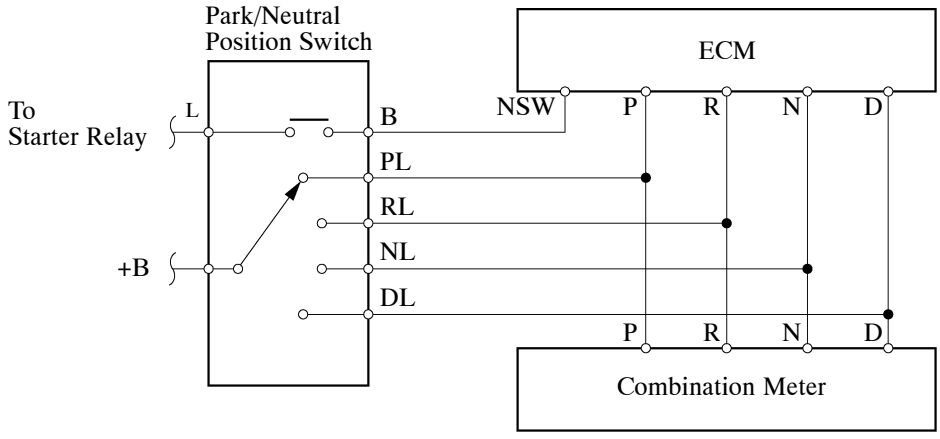
- The input speed sensor detects the input speed of the transmission. The clutch drum is used as the timing rotor for this sensor.
- The output speed sensor detects the speed of the output shaft. The parking gear on the rear planetary gear is used as the timing rotor for this sensor.



Park/Neutral Position Switch

The park/neutral position switch sends the P, R, N, D and NSW position signals to the ECM. It also sends signals for the shift position indicator light (P, R, N, and D).

▶ Wiring Diagram ◀

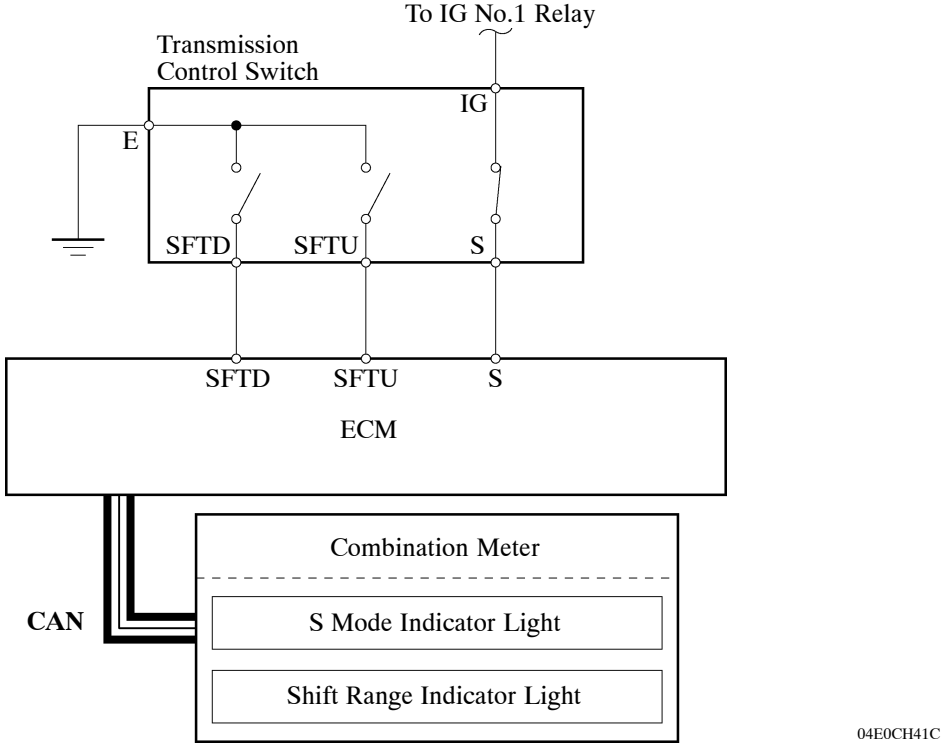


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Transmission Control Switch

- The transmission control switch is installed inside the shift lever assembly to detect the shift lever position and to inform the ECM. The ECM turns on the shift position indicator light and S mode indicator light.
- The transmission control switch detects whether the shift lever is in the D position or in the S mode position, and detects the operating conditions of the shift lever ("+" position or "-" position) if the S mode is selected, and sends signals to the ECM. At this time, the ECM turns on the shift range indicator light for the selected range.

▶ Wiring Diagram ◀

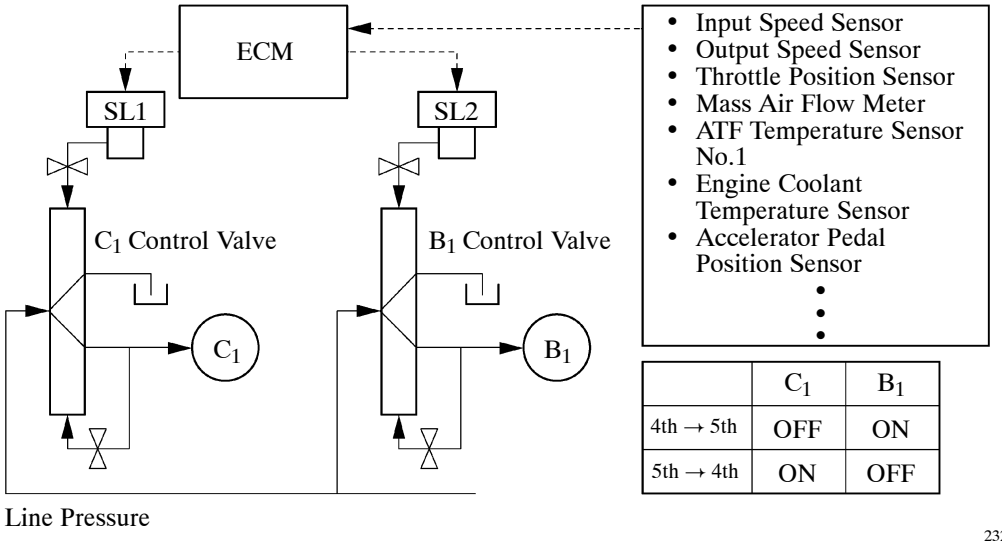


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5. Clutch Pressure Control

Clutch to Clutch Pressure Control

This control is used for shifting from 4th to 5th gear and from 5th to 4th gear.
The ECM actuates solenoid valves SL1 and SL2 in accordance with various signals. The output from these solenoid valves acts directly on control valves B_1 and C_1 in order to regulate the line pressure that acts on the B_1 brake and C_1 clutch.
As a result, high response and excellent shift characteristics have been realized.

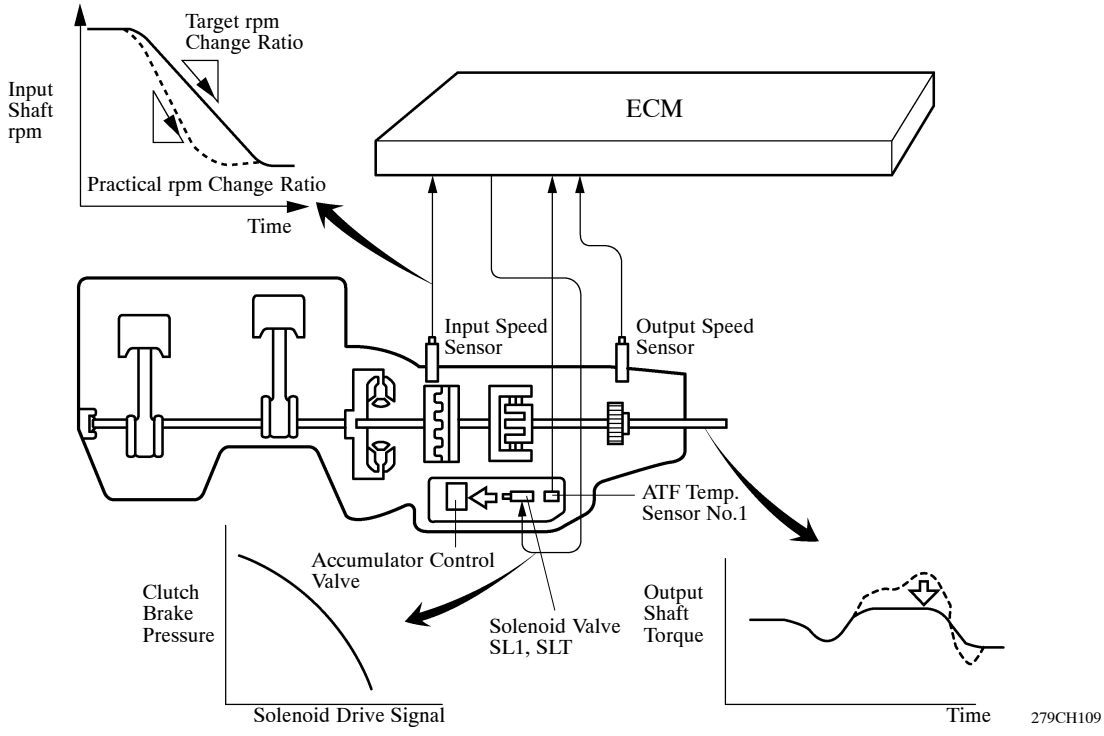


	C_1	B_1
4th → 5th	OFF	ON
5th → 4th	ON	OFF

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Clutch Pressure Optimal Control

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

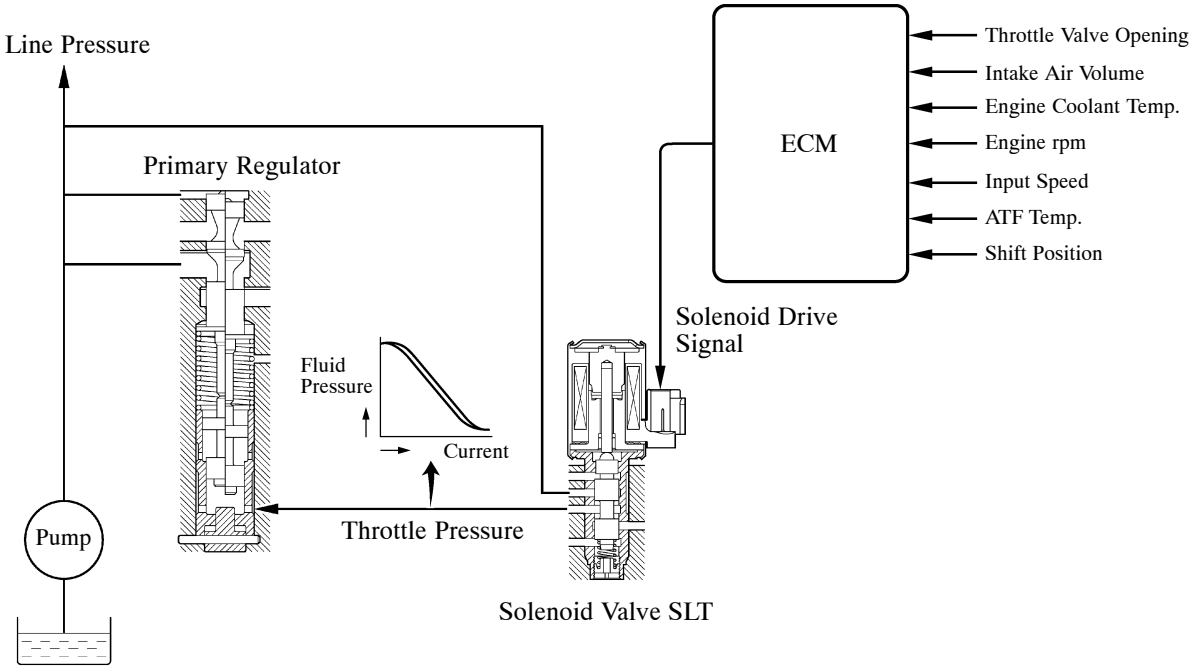


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6. Line Pressure Optimal Control

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 transmission.

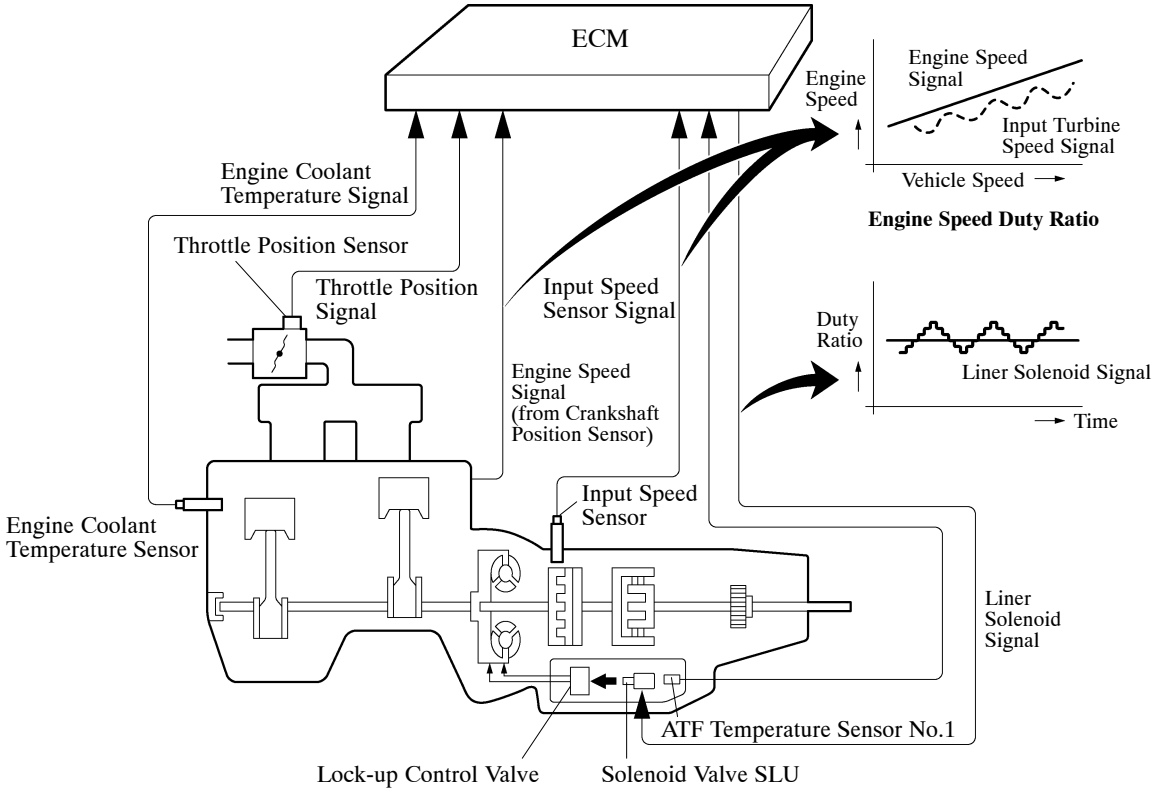
Accordingly, the line pressure can be controlled minutely in accordance with the engine output, traveling condition, and ATF temperature, thus realizing smooth shift characteristics and optimizing the workload of the oil pump (reducing unnecessary parasitic losses).



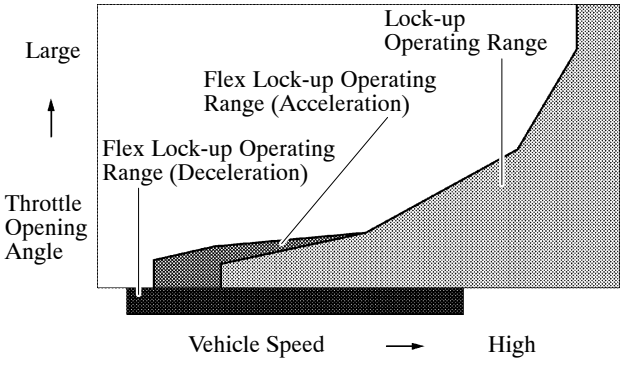
7. Flex Lock-up Clutch Control

In the low-to-mid-speed range, this flex lock-up clutch control regulates the solenoid valve SLU to provide an intermediate mode between the ON/OFF operation of the lock-up clutch in order to improve the energy transmitting efficiency in this range.
As a result, the operating range of the lock-up clutch has been increased and fuel economy has been improved.
The flex lock-up clutch control operates in the 3rd, 4th and 5th gears in the D position and S5 range, 4th gears in the S4 range.

- Even when the vehicle is decelerating (the accelerator pedal is released), the flex lock-up clutch control operates. Therefore, fuel-cut area of the engine has been expanded and fuel-economy has been improved.



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▶ Flex Lock-up Operation Gears in Each Range ◀

Range	Gear	Acceleration Flex Lock-up	Deceleration Flex Lock-up
D, S5	1st	×	×
	2nd	×	×
	3rd	○	×
	4th	○	○
	5th	○	○
S4	1st	×	×
	2nd	×	×
	3rd	×	×
	4th	×	○

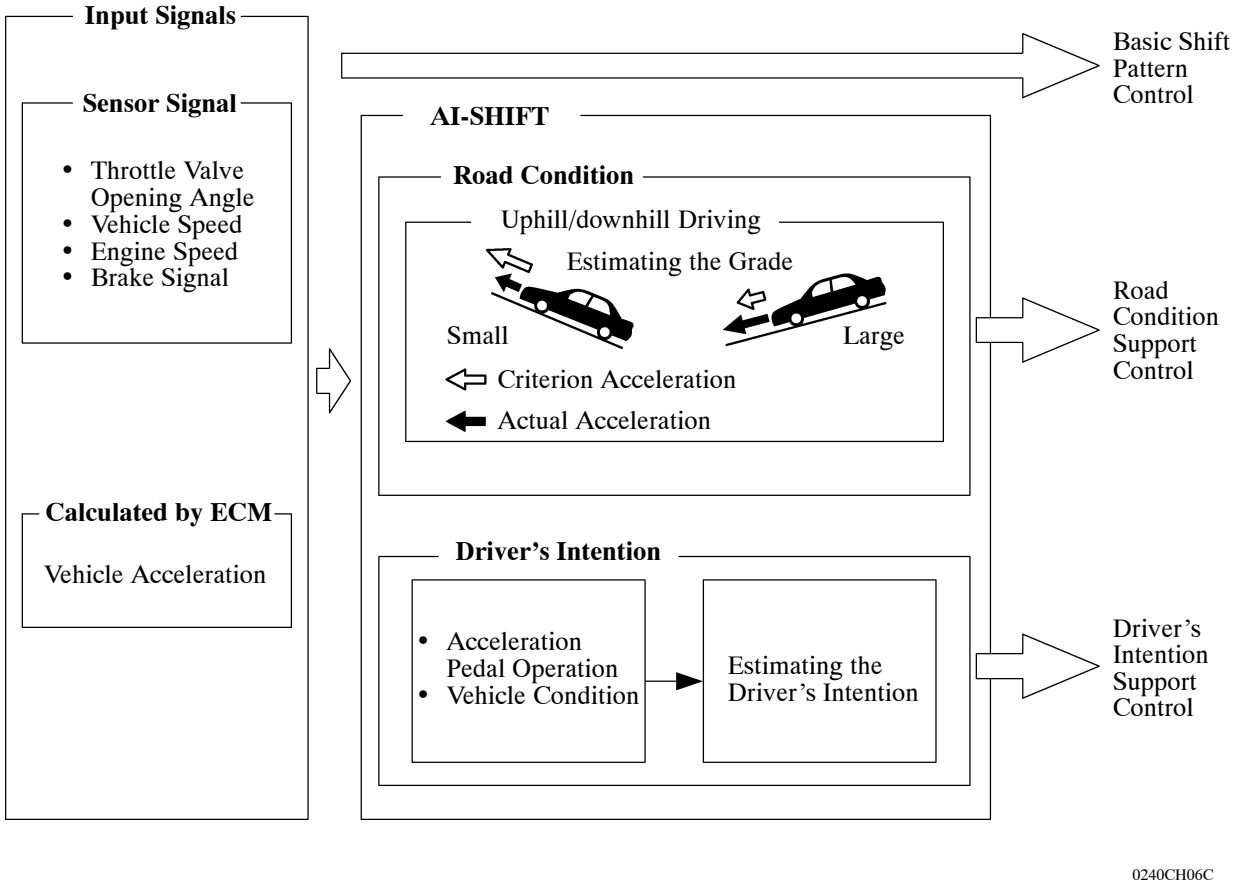
× = Off ○ = Operates

8. AI (Artificial Intelligence) - SHIFT Control

General

The AI-SHIFT control includes a road condition support control and a driver's intention support control. The AI-SHIFT control determines optimal transmission control based on input signals and automatically changes the shift pattern. As a result, a high caliber of transmission operation is achieved.

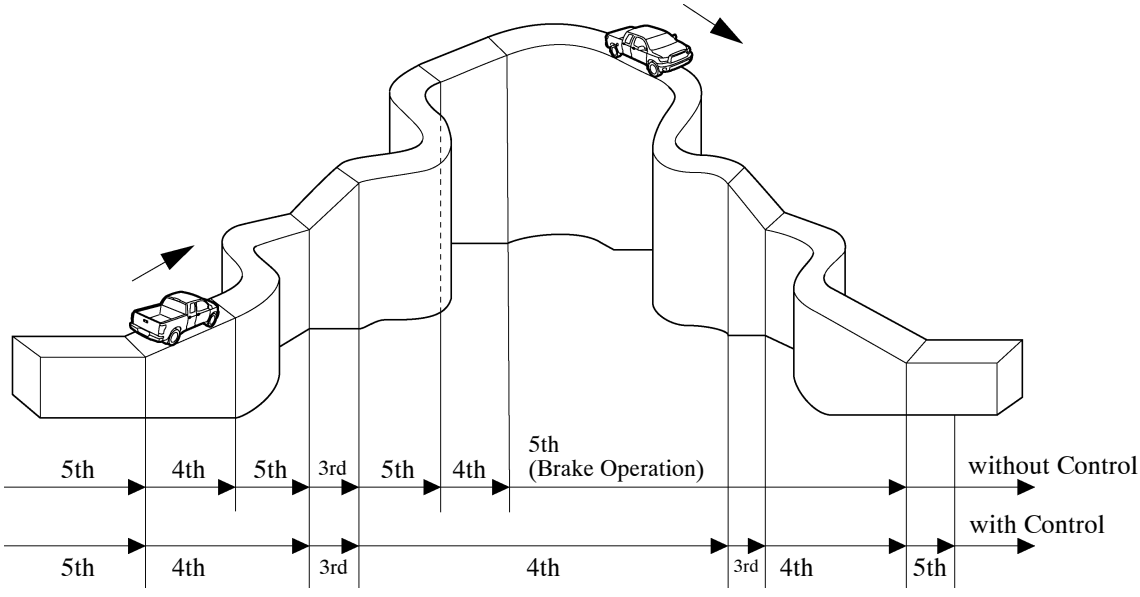
- AI-SHIFT control is effect only with the shift lever in the D position, based on the accelerator and brake operation data. AI-SHIFT control will be canceled when the driver selects the S mode.



Road Condition Support Control

Under road condition support control, the ECM identifies throttle valve opening angle and the vehicle speed to determine whether the vehicle is being driven uphill or downhill.

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



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Driver's Intention Support Control

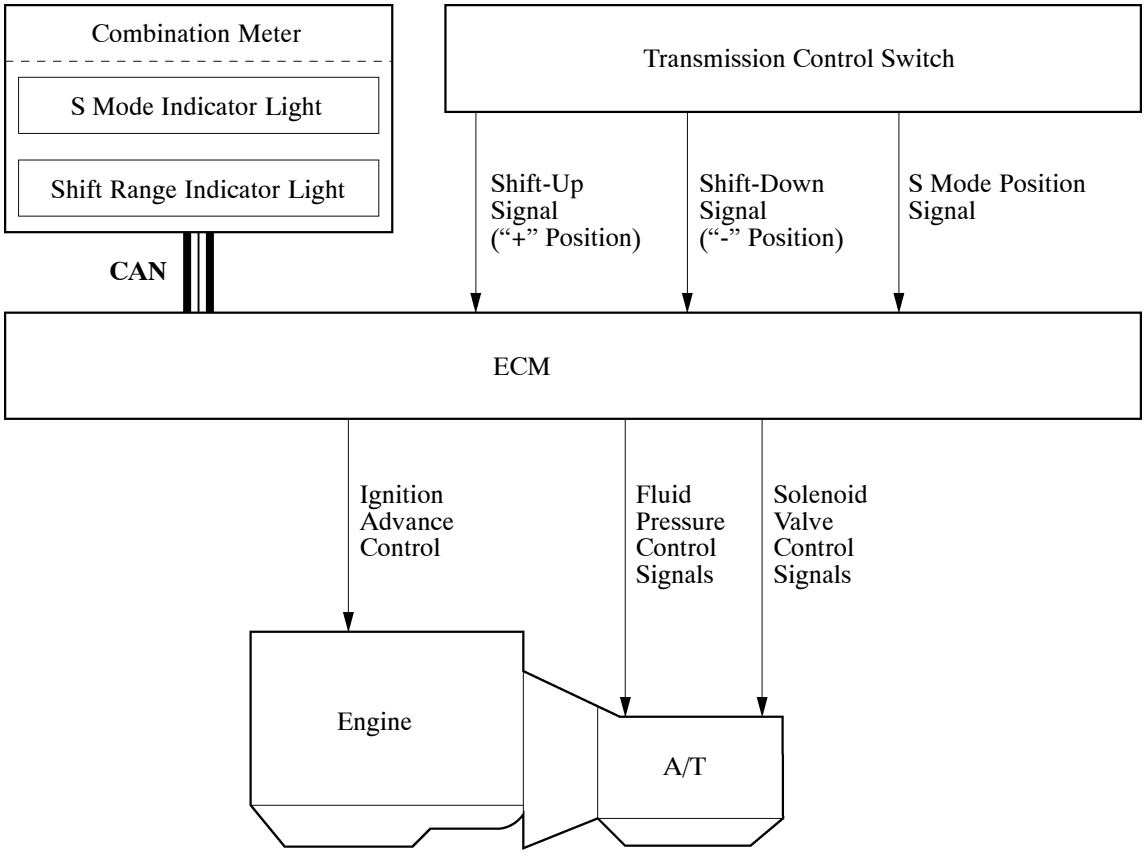
This control estimates the driver's intention based on the accelerator operation and vehicle condition and selects a shift pattern that is well-suited to each driver.

9. Multi-mode Automatic Transmission

General

A multi-mode automatic transmission is designed to allow the driver to switch the gear ranges (a multi-mode transmission is not for manually selecting single gears). After shifting the shift lever to the S mode position and moving the shift lever to the "+" position or to the "-" position, the driver can select the desired shift range. Thus, the driver is able to shift gears with a manual-like feel.

▶ System Diagram ◀

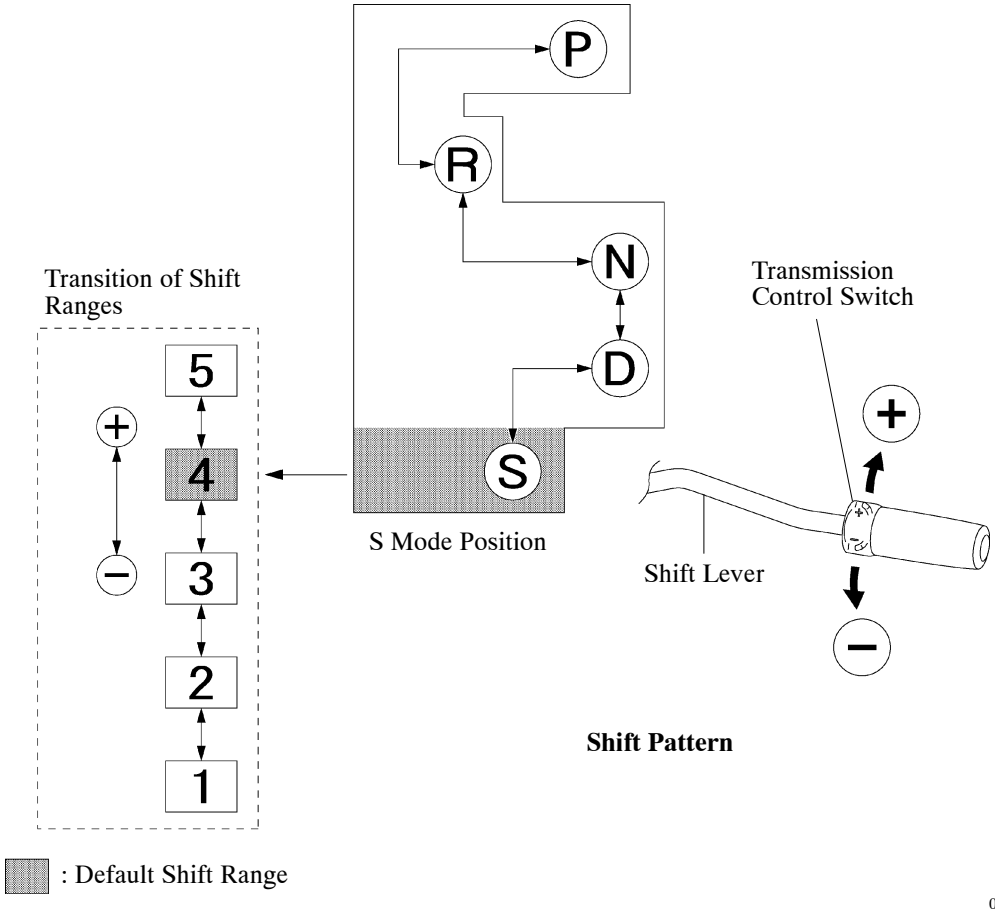


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Operation

4) Column Shift Lever

- The driver selects the S mode position by engaging the shift lever. At this time, the shift range position selects the 4th range. (During AI-Shift control, the shift range that has the currently controlled gear position as the maximum usable gear position will be displayed.) Then, the shift range positions change one at a time, as the driver moves the transmission control switch to the up ("+" position) or to the down ("-" position).
- Under this control, the ECM 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.
- Holding the transmission control switch in the "+" position with the shift lever in the S mode position will change the shift range to the 5th range regardless of range position (1st to 4th).
- 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.

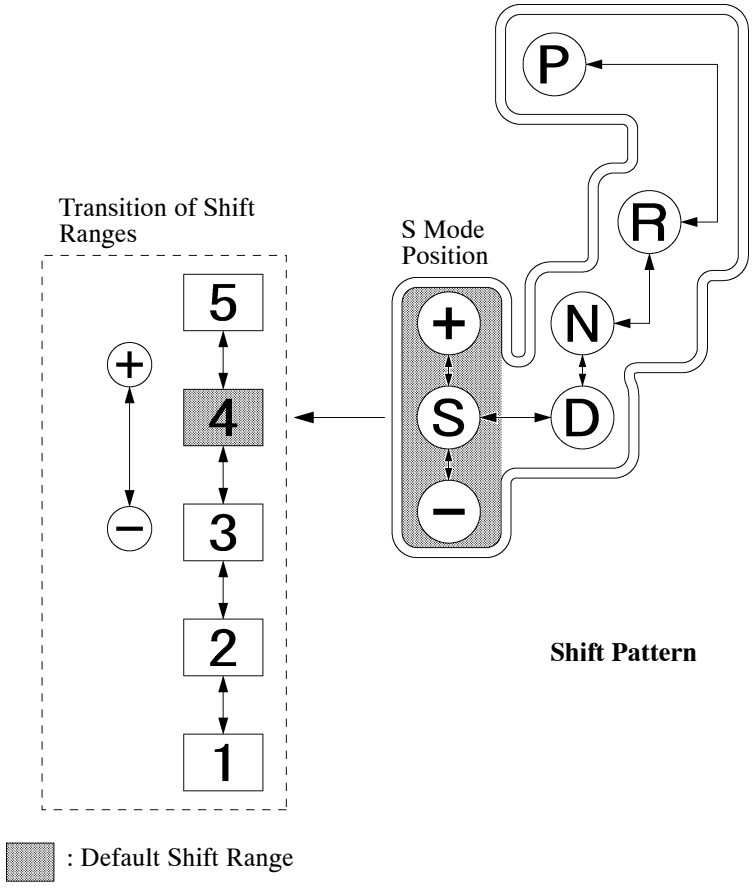


▶ Usable Gear Chart ◀

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

5) Floor Shift Lever

- The driver selects the S mode position by engaging the shift lever. At this time, the shift range position selects the 4th range. (During AI-Shift control, the shift range that has the currently controlled gear position as the maximum usable gear position will be 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 ECM 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.
- Holding the transmission control switch in the "+" position with the shift lever in the S mode position will change the shift range to the 5th range regardless of range position (1st to 4th).
- 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.



▶ Usable Gear Chart ◀

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3rd	3	3rd ↔ 2nd ↔ 1st
2nd	2	2nd ↔ 1st
1st	1	1st

10. Diagnosis

- When the ECM detects a malfunction, the ECM records the malfunction 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.
- The ECM will also store the DTCs (Diagnostic Trouble Codes) of the malfunctions. The DTCs can be accessed using the hand-held tester or Techstream*.
- For details, see the 2007 TOYOTA TUNDRA Repair Manual (Pub. No. RM04E2U).

Service Tip

- The ECM uses the CAN protocol for diagnostic communication. Therefore, a hand-held tester or Techstream* and a dedicated adapter [CAN VIM (Vehicle Interface Module)] are required for accessing diagnostic data.
- To clear DTCs that are stored in the ECM, use a hand-held tester or Techstream*, disconnect the battery terminal or remove the EFI fuse for 1 minute or longer.

For details, see the 2007 TOYOTA TUNDRA Repair Manual (Pub. No. RM04E2U).

*: Techstream is the name for the diagnostic tester in North America, but other countries will continue to use the hand-held tester.

11. Fail-safe

The fail-safe function minimizes the loss of operability when any abnormality occurs in a sensor or solenoid.

▶ Fail-safe Control List ◀

Malfunction Part	Function
Input Speed Sensor (NT)	During an input speed sensor malfunction, shift control is effected based on the output speed sensor signal (SP2). During an input speed sensor malfunction, up-shifts to 5th, AI-SHIFT and flex lock-up clutch control are prohibited.
Output Speed Sensor (SP2)	During an output speed sensor malfunction, shift control is effected based on the input speed sensor signal (NT). During an output speed sensor malfunction, up-shifts to 5th, AI-SHIFT and flex lock-up clutch control are prohibited.
ATF Temperature Sensor No.1 (THO1)	During an ATF temperature sensor No.1 malfunction, up-shifts to 5th and flex lock-up clutch control are prohibited.
Solenoid Valve S1, S2, and SR	When a solenoid valve listed at left malfunctions, current to the failed solenoid valve is cut off. Shift control is changed to a fail-safe mode to shift gears using the normal solenoid valves to allow continued driving. Refer to the table on the next page for operation example.
Solenoid Valve SL1 and SL2	During a solenoid valve SL1 or SL2 malfunction, up-shifts to 5th and flex lock-up clutch control are prohibited.
Solenoid Valve SLU	During a solenoid valve SLU malfunction, the current to the solenoid valve is stopped. Because this stops lock-up control and flex lock-up control, fuel economy decreases.
Solenoid Valve SLT	During a solenoid valve SLT malfunction, the current to the solenoid valve is stopped. Because this stops line pressure optimal control, the shift shock will increase. However, shifting is effected based on normal clutch pressure control.

Position	**Normal**					
	Shift Solenoid Valve					Gear
	S1	S2	SR	SL1	SL2	
D, S5	ON	OFF	OFF	OFF	ON	1st
	ON	ON	OFF	OFF	ON	2nd
	OFF	ON	OFF	OFF	ON	3rd
	OFF	OFF	OFF	OFF	ON	4th
	OFF	OFF	ON	ON	OFF	5th
S4	ON	OFF	OFF	OFF	ON	1st
	ON	ON	OFF	OFF	ON	2nd
	OFF	ON	OFF	OFF	ON	3rd
	OFF	OFF	OFF	OFF	ON	4th
S3	ON	OFF	OFF	OFF	ON	1st
	ON	ON	OFF	OFF	ON	2nd
	OFF	ON	OFF	OFF	OFF	3rd (E/B)
S2	ON	OFF	OFF	OFF	ON	1st
	ON	ON	ON	OFF	OFF	2nd (E/B)
S1	ON	OFF	OFF	OFF	OFF	1st (E/B)

▶ Example ◀

Position	**Shift Solenoid Valve S1 Malfunction**					
	Shift Solenoid Valve					Gear
	S1	S2	SR	SL1	SL2	
D, S5	×	OFF → ON	OFF	OFF	ON	4th → 3rd
	×	ON	OFF	OFF	ON	3rd
	×	ON	OFF	OFF	ON	3rd
	×	OFF	OFF	OFF	ON	4th
	×	OFF	ON	ON	OFF	5th
S4	×	OFF → ON	OFF	OFF	ON	4th → 3rd
	×	ON	OFF	OFF	ON	3rd
	×	ON	OFF	OFF	ON	3rd
	×	OFF	OFF	OFF	ON	4th
S3	×	OFF → ON	OFF	OFF	ON → OFF	3rd → 3rd (E/B)
	×	ON	OFF	OFF	ON → OFF	3rd → 3rd (E/B)
	×	ON	OFF	OFF	OFF	3rd (E/B)
S2	×	OFF	OFF	OFF	ON	1st
	×	ON	ON	OFF	OFF	3rd (E/B)
S1	×	OFF	OFF	OFF	OFF	1st (E/B)

E/B: Engine Brake