6. Electronic Control System

General

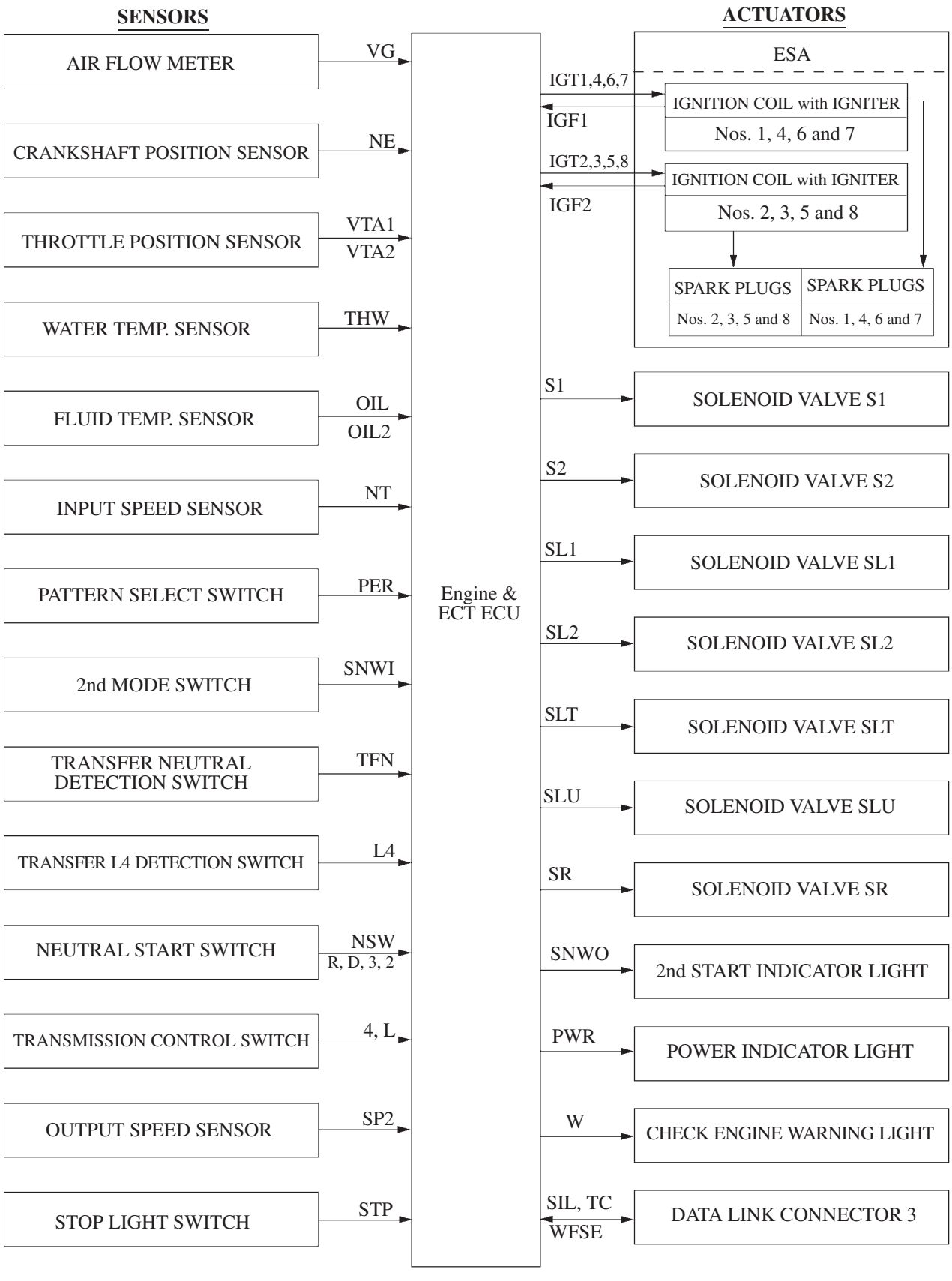
The electronic control system of the A750F automatic transmission consists of the controls listed below.

System	Function	2UZ-FE	1HD-FTE
Clutch Pressure Control (See Page 205)	● 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 engine & ECT ECU 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 206)	Actuates the solenoid valve SLT to control the line pressure in accordance with information from the engine & ECT ECU and the operating conditions of the transmission.	○	○
Engine Torque Control	Retards the engine ignition timing temporarily to improve shift feeling during up or down shifting.	○	—
	Effects engine torque control in accordance with the fuel injection volume to reduce the shift shock	—	○
Shift Timing Control	The engine & ECT ECU sends current to the solenoid valve S1, S2 and/or SR based on signals from each sensor and shifts the gear.	○	○
Flex Lock-up Clutch Control (See Page 207)	Controls the solenoid valve SLU, 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.	○*	—
Lock-up Timing Control	The engine & ECT ECU sends current to the shift solenoid valve SLU based on signals from each sensor and engages or disengages the lockup clutch.	○	○
"N" to "D" Squat Control	When the shift lever is shifted from "N" to "D" position, the gear is temporarily shifted to 2nd and then to 1st to reduce vehicle squat.	○	○
2nd Start System	Enabling the vehicle to take off in the 2nd gear and thus make it easy to take off on snowy, sandy or muddy terrain.	○	○
AI (artificial Intelligence) -SHIFT (See Page 208)	Based on the signals from various sensors, the engine & ECT ECU determines the road conditions and the intention of the driver. Thus, the shift pattern is automatically regulated to an optimal level, thus improving drivability.	○	○
Diagnosis	When the engine & ECT ECU detects a malfunction, the engine & ECT ECU makes a diagnosis and memorizes the failed section.	○	○
	To increase the speed for processing the signals, the 32-bit CPU of the engine & ECT ECU has been adopted.	○	○
Fail-safe	Even if a malfunction is detected in the sensors or solenoids, the engine & ECT ECU effects fail-safe control to prevent the vehicle's drivability from being affected significantly.	○	○

*: Only for Europe Model

Construction

The configuration of the electronic control system in the 2UZ-FE engine model's A750F is as shown in the following chart.



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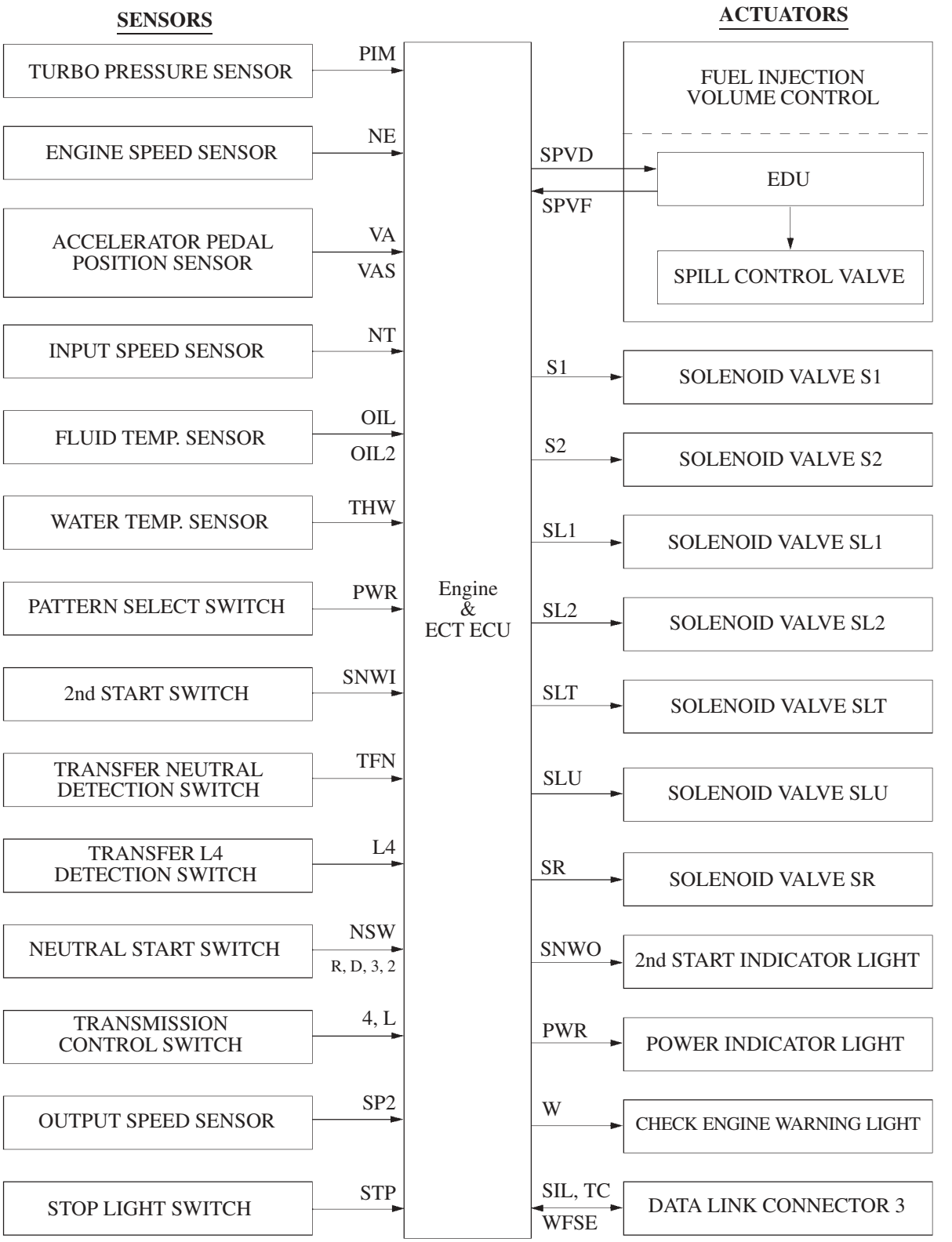
The configuration of the electronic control system in the 1HD-FTE engine model's A750F is as shown in the following chart.



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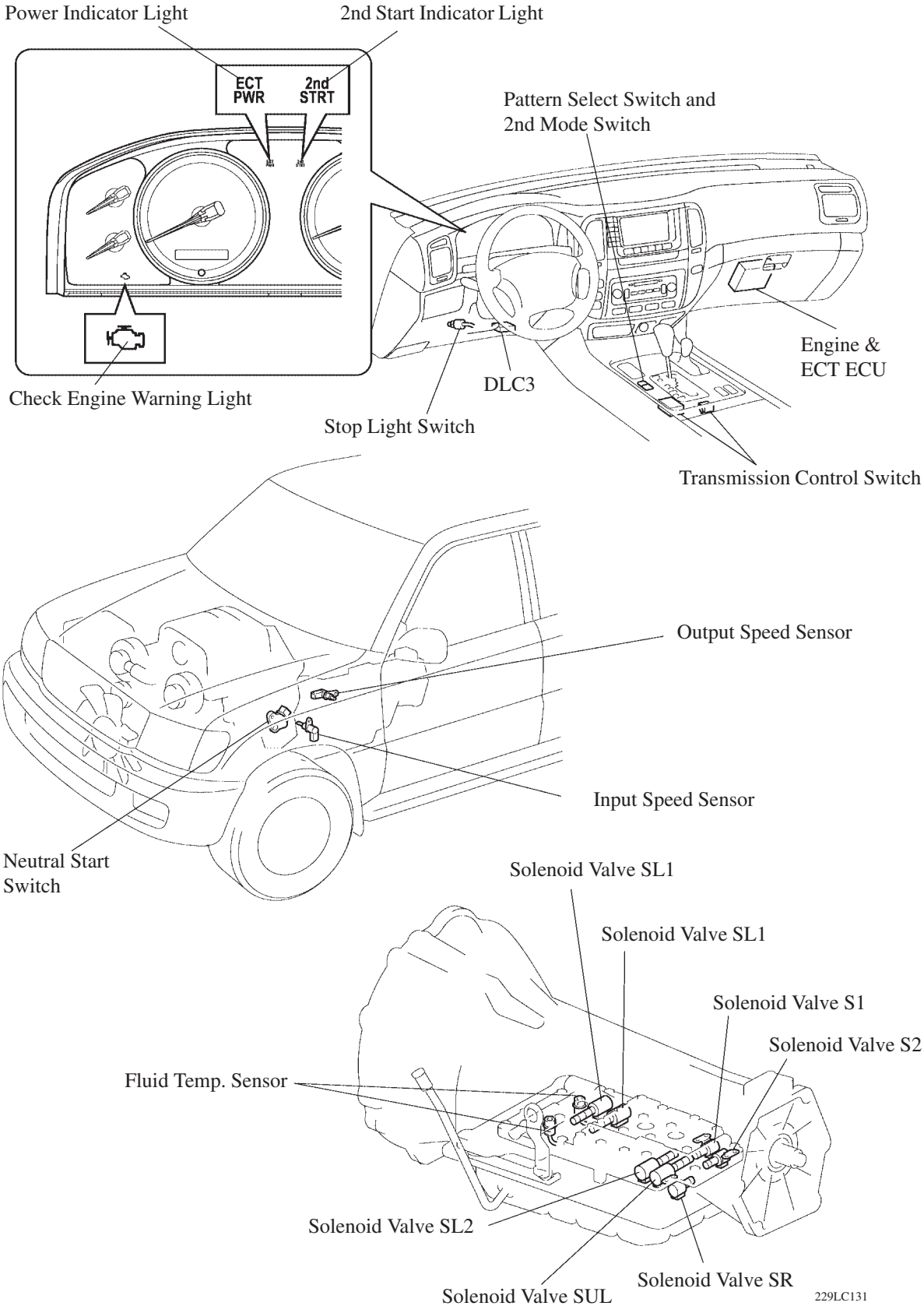
Layout of Component



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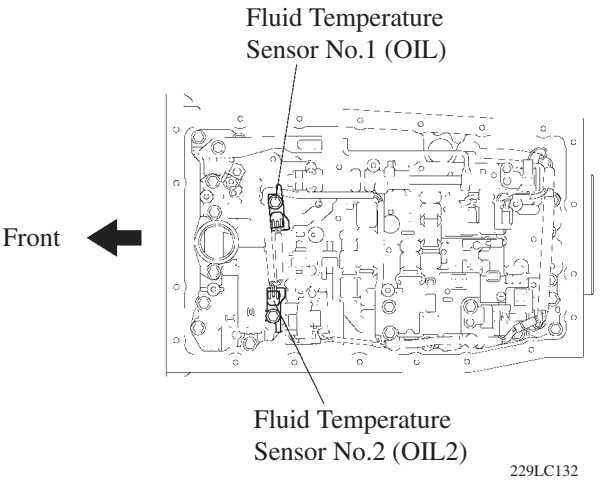
Construction and Operation of Main Component

1) Fluid Temperature Sensor No.1 and No.2

- Fluid temperature sensor No.1 (OIL) is used for hydraulic pressure control. This sensor is used for revision of clutches and brakes pressure to keep smooth shift quality every time.
- Fluid temperature sensor No.2 (OIL2) is used for the switching of the shift timing control of ECT when the fluid temperature is high and ATF temp. warning light control.



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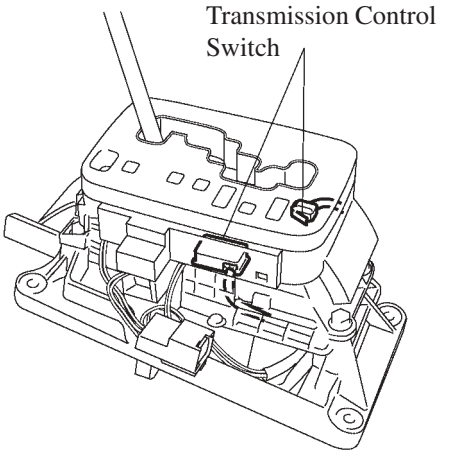
2) Transmission Control Switch

The transmission control switch is installed inside shift lever assembly to detect the shift lever position ("4th" or "D" and "2nd" or "L") and to inform engine & ECT ECU the shift position indicator light in the combination meter.



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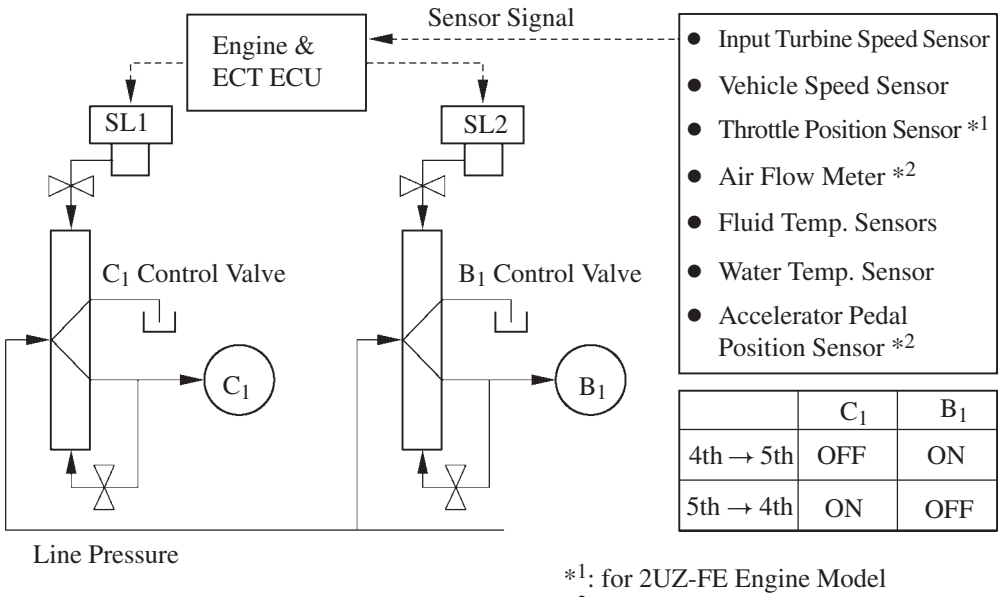
3) Output Speed Sensor and Input Speed Sensor

- A rotor is provided on the output shaft of the transmission, and the output speed sensor on the right side of the transmission case detects the speed and outputs it to the engine & ECT ECU.
- The input speed sensor detects the input speed of the transmission. The direct clutch drum is used as the timing rotor for this sensor.

Clutch Pressure Control

1) Clutch to Clutch Pressure Control

This control has been adopted for shifting from the 4th to 5th gear and from the 5th to 4th gear.
Actuates solenoid valves SL1 and SL2 in accordance with the signals from the Engine & ECT ECU, and guides this output pressure directly to the control valves B_1 and C_1 in order to regulate the line pressure that acts on the B_1 brake and C_1 clutches.
As a result, high response and excellent shift characteristics have been realized.



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

*1: for 2UZ-FE Engine Model
*2: for 1HD-FE Engine Model

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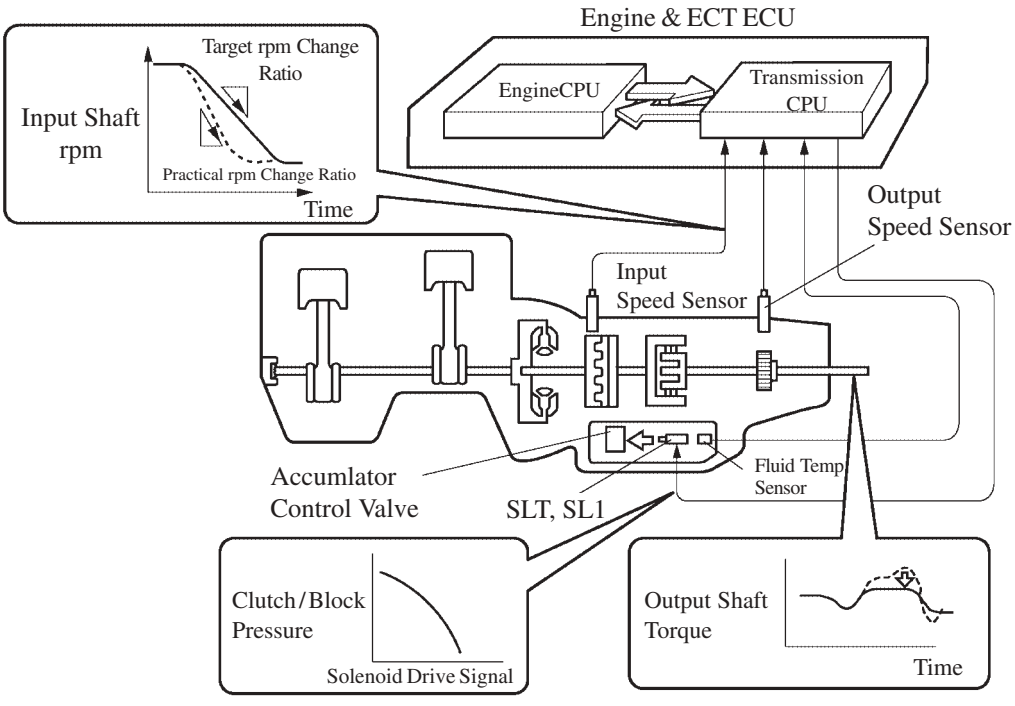
2) Clutch Pressure Optimal Control

The Engine & ECT ECU monitors the signals from various types of sensor such as the input turbine 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 have been realized.



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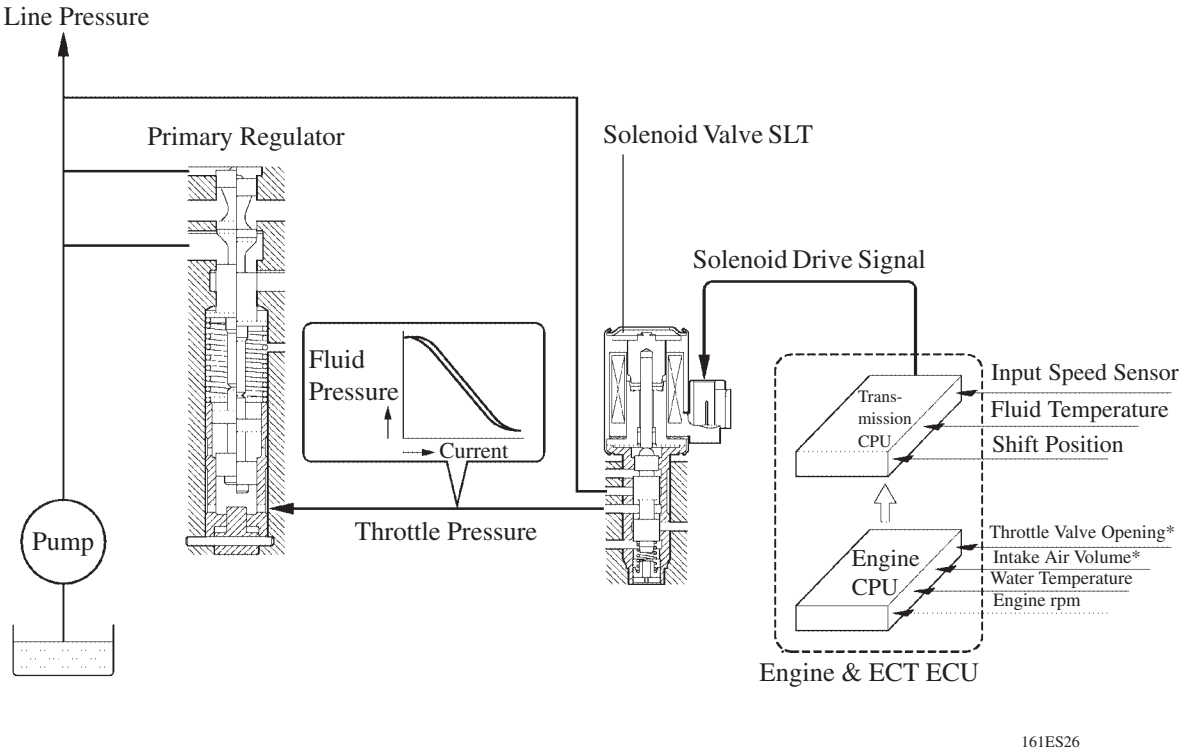
Line Pressure Optimal Control

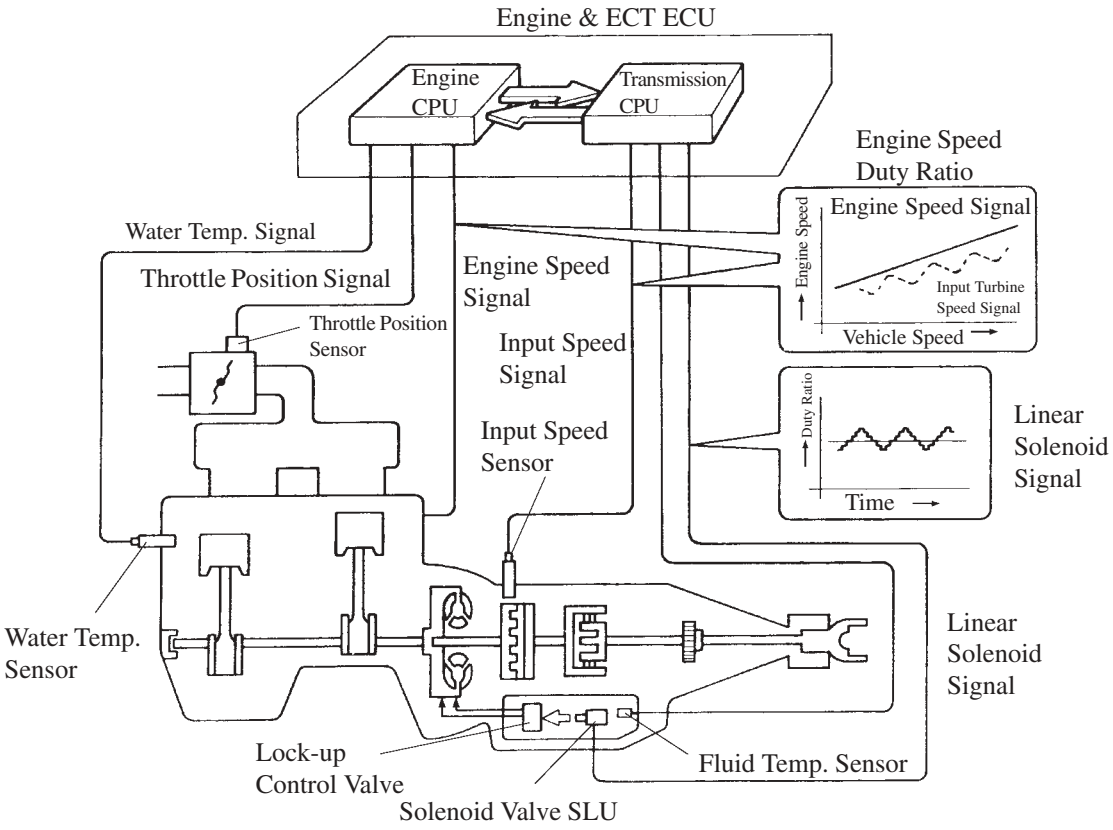
Through the use of the solenoid valve SLT, the line pressure is optimally controlled in accordance with the engine toque information, as well as with the internal operating conditions of the toque converter and the transmission.
Accordingly, the line pressure can be controlled minutely in accordance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



*: for 2UZ-FE Engine Model

Flex Lock-up Clutch Control (Only for 2UZ-FE Engine Model)

In addition to the conventional lock-up timing control, a flex lock-up clutch control is used.
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 4th and 5th gears in the D range and 4th gear in the 4 range.



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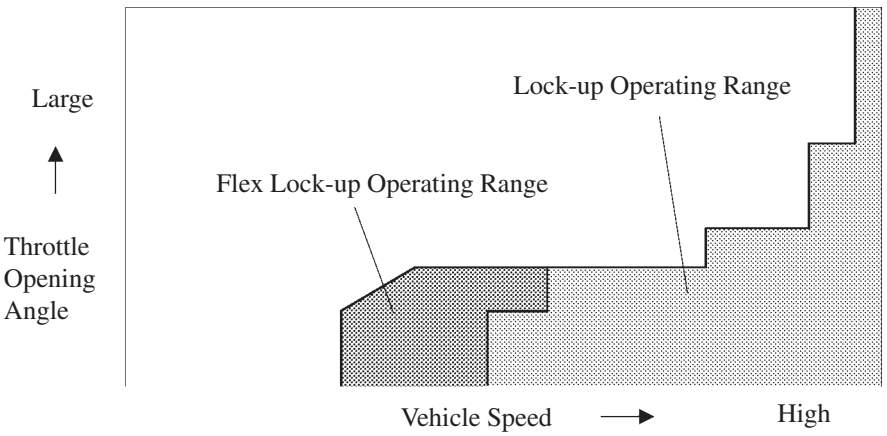

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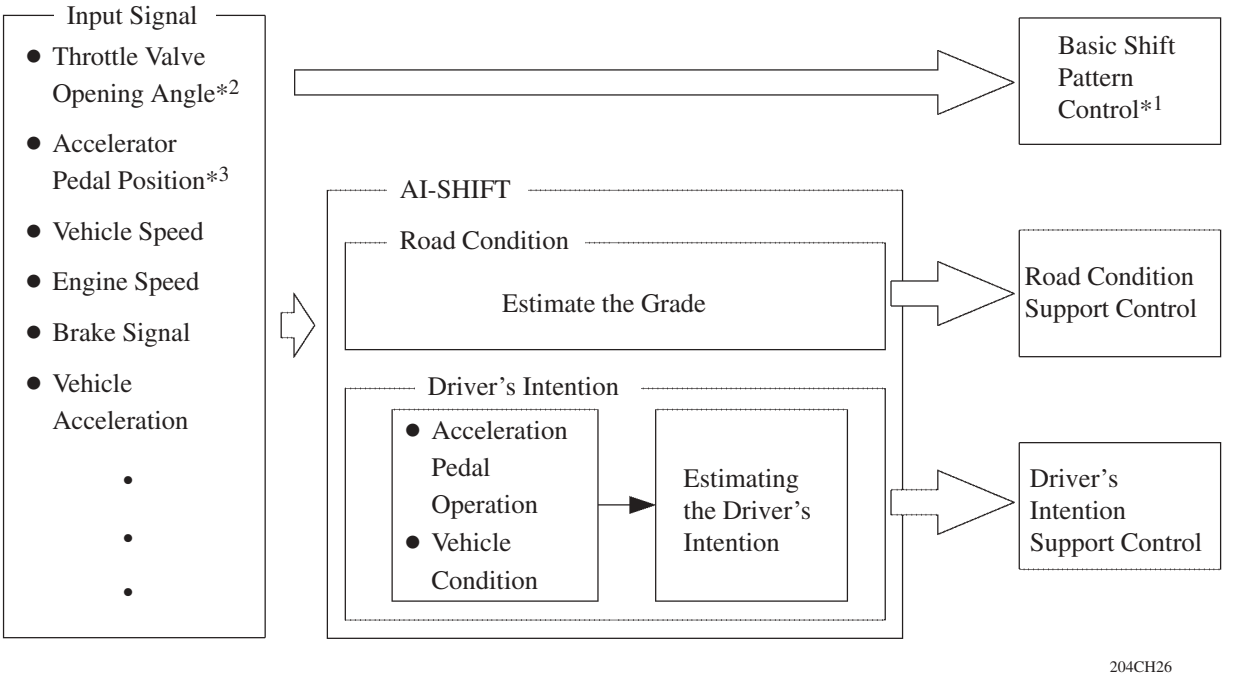
AI (Artificial Intelligence)-SHIFT Control

1) General

In addition to the switching of the shift pattern through the pattern select switch, the AI-SHIFT control enables the engine & ECT ECU to estimate the road conditions and the driver's intention in order to automatically switch the optimal shift pattern. As a result, comfortable ride has been realized at high levels.



*1: Shift control that is determined by the PWR or 2nd mode that is selected by the pattern select switch, or by the normal mode.

*2: for 2UZ-FE Engine Model

*3: for 1HD-FTE Engine Model

2) Road Condition Support Control

Under road condition support control, the engine & ECT ECU determines the road condition where the vehicle is being driven through the throttle valve opening angle and the vehicle speed.

3) 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.

Diagnosis

- When the Engine & ECT ECU detects a malfunction, the Engine & ECT ECU makes a diagnosis and memorizes the failed section. Furthermore, the check engine warning light in the combination meter illuminates or blinks to inform the driver.
- At the same time, the DTC (Diagnosis Trouble Codes) are stored in memory. The DTCs can be read by the SST (09843-18040) between the Tc and CG terminals DLC3 and observing the blinking of the check engine warning light, or by connecting a hand-held tester.

Service Tip

The length of time to clear the DTC by the battery terminal disconnection has been changed from the previous 10 seconds to 1 minute.

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
Output Speed Sensor (SP2)	During an output speed sensor malfunction, shift control is effected through the input speed sensor signal.
Fluid Temp. Sensor No.1	During a fluid temperature sensor No.1 malfunction, 5th upshift and flex lock-up clutch control are prohibited.
Solenoid Valve S1, S2 and SR	The current to the failed solenoid valve is cut off and control is effected by operating the other solenoid valves with normal operation. Shift control is effected depending on the failed solenoid as described in the table on the next page.
Solenoid Valve SL1 and SL2	During a solenoid valve SL1 or SL2 malfunction, 5th upshift is 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, the 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 increases. However, shifting is effected through normal clutch pressure control.

Position	Normal						Shift Solenoid Valve S1 Malfunction					
	Shift Solenoid					Gear	Shift Solenoid					Gear
	S1	S2	SR	SL1	SL2		S1	S2	SR	SL1	SL2	
D	ON	OFF	OFF	OFF	ON	1st	x	OFF → ON	OFF	OFF	ON	4th → 3rd
	ON	ON	OFF	OFF	ON	2nd	x	ON	OFF	OFF	ON	3rd
	OFF	ON	OFF	OFF	ON	3rd	x	ON	OFF	OFF	ON	3rd
	OFF	OFF	OFF	OFF	ON	4th	x	OFF	OFF	OFF	ON	4th
	OFF	OFF	ON	ON	OFF	5th	x	OFF	ON	ON	OFF	5th
4	ON	OFF	OFF	OFF	ON	1st	x	OFF → ON	OFF	OFF	ON	4th → 3rd
	ON	ON	OFF	OFF	ON	2nd	x	ON	OFF	OFF	ON	3rd
	OFF	ON	OFF	OFF	ON	3rd	x	ON	OFF	OFF	ON	3rd
	OFF	OFF	OFF	OFF	ON	4th	x	OFF	OFF	OFF	ON	4th
3	ON	OFF	OFF	OFF	ON	1st	x	OFF → ON	OFF	OFF	ON → OFF	3rd → 3rd (E/B)
	ON	ON	OFF	OFF	ON	2nd	x	ON	OFF	OFF	ON → OFF	3rd → 3rd (E/B)
	OFF	ON	OFF	OFF	OFF	3rd (E/B)	x	ON	OFF	OFF	OFF	3rd (E/B)
2	ON	OFF	OFF	OFF	ON	1st	x	OFF	OFF	OFF	ON	1st
	ON	ON	ON	OFF	OFF	2nd (E/B)	x	ON	ON	OFF	OFF	3rd (E/B)
L	ON	OFF	OFF	OFF	OFF	1st (E/B)	x	OFF	OFF	OFF	OFF	1st (E/B)

Position	Shift Solenoid Valve S2 Malfunction						Shift Solenoid Valve SR Malfunction					
	Shift Solenoid					Gear	Shift Solenoid					Gear
	S1	S2	SR	SL1	SL2		S1	S2	SR	SL1	SL2	
D	ON	x	OFF	OFF	ON	1st	ON	OFF	x	OFF	ON	1st
	ON→ OFF	x	OFF	OFF	ON	1st → 4th	ON	ON	x	OFF	ON	2nd
	OFF	x	OFF	OFF	ON	4th	OFF	ON	x	OFF	ON	3rd
	OFF	x	OFF	OFF	ON	4th	OFF	OFF	x	OFF	ON	4th
	OFF	x	ON	ON	OFF	5th	OFF	OFF	x	ON	OFF	4th
4	ON	x	OFF	OFF	ON	1st	ON	OFF	x	OFF	ON	1st
	ON → OFF	x	OFF	OFF	ON	1st → 4th	ON	ON	x	OFF	ON	2nd
	OFF	x	OFF	OFF	ON	4th	OFF	ON	x	OFF	ON	3rd
	OFF	x	OFF	OFF	ON	4th	OFF	OFF	x	OFF	ON	4th
3	ON	x	OFF	OFF	ON	1st	ON	OFF	x	OFF	ON	1st
	ON → OFF	x	OFF	OFF	ON → OFF	1st → 3rd (E/B)	ON	ON	x	OFF	ON	2nd
	OFF	x	OFF	OFF	OFF	3rd (E/B)	OFF	ON	x	OFF	OFF → ON	3rd (E/B) → 3rd
2	ON	x	OFF	OFF	ON	1st	ON	OFF	x	OFF	ON	1st
	ON → OFF	x	ON	OFF	OFF → ON	2nd (E/B) → 4th	ON	ON	x	OFF	OFF	2nd
L	ON	x	OFF	OFF	OFF	1st (E/B)	ON	OFF	x	OFF	OFF	1st (E/B)

E/B: Engine Brake

Position	Shift Solenoid Valve S1 and S2 Malfunction						Shift Solenoid Valve S1 and SR Malfunction					
	Shift Solenoid					Gear	Shift Solenoid					Gear
	S1	S2	SR	SL1	SL2		S1	S2	SR	SL1	SL2	
D	x	x	OFF	OFF	ON	4th	x	OFF → ON	x	OFF	ON	4th → 3rd
	x	x	OFF	OFF	ON	4th	x	ON	x	OFF	ON	3rd
	x	x	OFF	OFF	ON	4th	x	ON	x	OFF	ON	3rd
	x	x	OFF	OFF	ON	4th	x	OFF	x	OFF	ON	4th
	x	x	ON	ON	OFF	5th	x	OFF	x	ON→ OFF	OFF → ON	4th
4	x	x	OFF	OFF	ON	4th	x	OFF → ON	x	OFF	ON	4th → 3rd
	x	x	OFF	OFF	ON	4th	x	ON	x	OFF	ON	3rd
	x	x	OFF	OFF	ON	4th	x	ON	x	OFF	ON	3rd
	x	x	OFF	OFF	ON	4th	x	OFF	x	OFF	ON	4th
3	x	x	OFF	OFF	ON → OFF	3rd → 3rd (E/B)	x	OFF → ON	x	OFF	ON	3rd
	x	x	OFF	OFF	ON → OFF	3rd → 3rd (E/B)	x	ON	x	OFF	ON	3rd
	x	x	OFF	OFF	OFF	3rd (E/B)	x	ON	x	OFF	OFF → ON	3rd (E/B) → 3rd
2	x	x	OFF	OFF	ON	1st	x	OFF	x	OFF	ON	1st
	x	x	ON	OFF	OFF → ON	4th	x	ON	x	OFF	OFF	2nd
L	x	x	OFF	OFF	OFF	1st (E/B)	x	OFF	x	OFF	OFF	1st (E/B)

Position	Shift Solenoid Valve S2 and SR Malfunctio						Shift Solenoid Valve S1, S2 and SR Malfunction					
	Shift Solenoid					Gear	Shift Solenoid					Gear
	S1	S2	SR	SL1	SL2		S1	S2	SR	SL1	SL2	
D	ON	x	x	OFF	ON	1st	x	x	x	OFF	ON	4th
	ON → OFF	x	x	OFF	ON	1st → 4th	x	x	x	OFF	ON	4th
	OFF	x	x	OFF	ON	4th	x	x	x	OFF	ON	4th
	OFF	x	x	OFF	ON	4th	x	x	x	OFF	ON	4th
	OFF	x	x	ON → OFF	OFF → ON	4th	x	x	x	ON → OFF	OFF → ON	4th
4	ON	x	x	OFF	ON	1st	x	x	x	OFF	ON	4th
	ON → OFF	x	x	OFF	ON	1st → 4th	x	x	x	OFF	ON	4th
	OFF	x	x	OFF	ON	4th	x	x	x	OFF	ON	4th
	OFF	x	x	OFF	ON	4th	x	x	x	OFF	ON	4th
3	ON	x	x	OFF	ON	1st	x	x	x	OFF	ON	3rd
	ON → OFF	x	x	OFF	ON	1st → 3rd	x	x	x	OFF	ON	3rd
	OFF	x	x	OFF	OFF → ON	3rd (E/B) → 3rd	x	x	x	OFF	OFF → ON	3rd (E/B) → 3rd
2	ON	x	x	OFF	ON	1st	x	x	x	OFF	ON	1st
	ON	x	x	OFF	OFF → ON	1st (E/B) → 1st	x	x	x	OFF	OFF → ON	1st (E/B) → 1st
L	ON	x	x	OFF	OFF	1st (E/B)	x	x	x	OFF	OFF	1st (E/B)

E/B: Engine Brake

6