

■ ELECTRONIC CONTROL SYSTEM

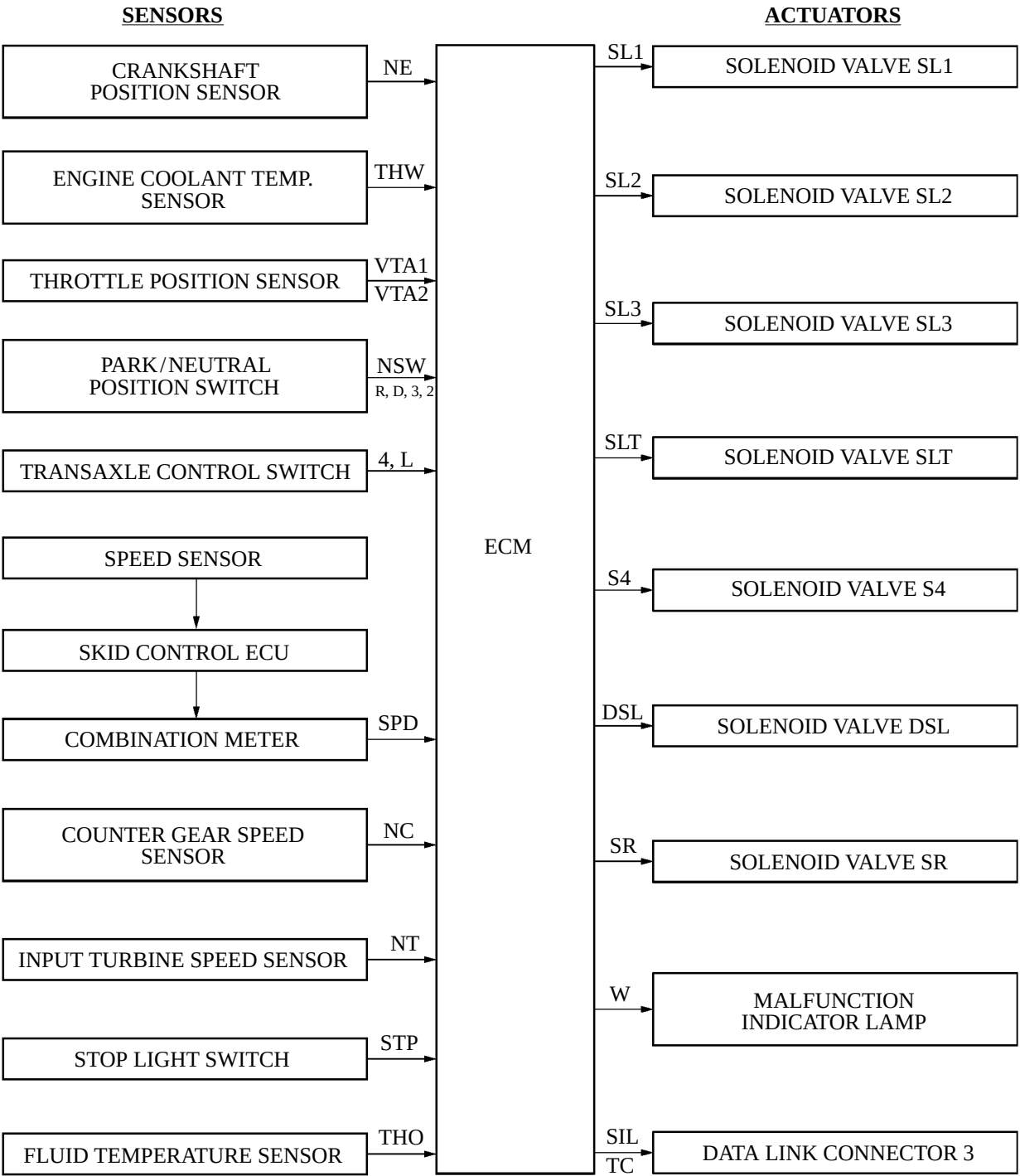
1. General

The electronic control system of the U150E automatic transaxle consists of the control listed below.

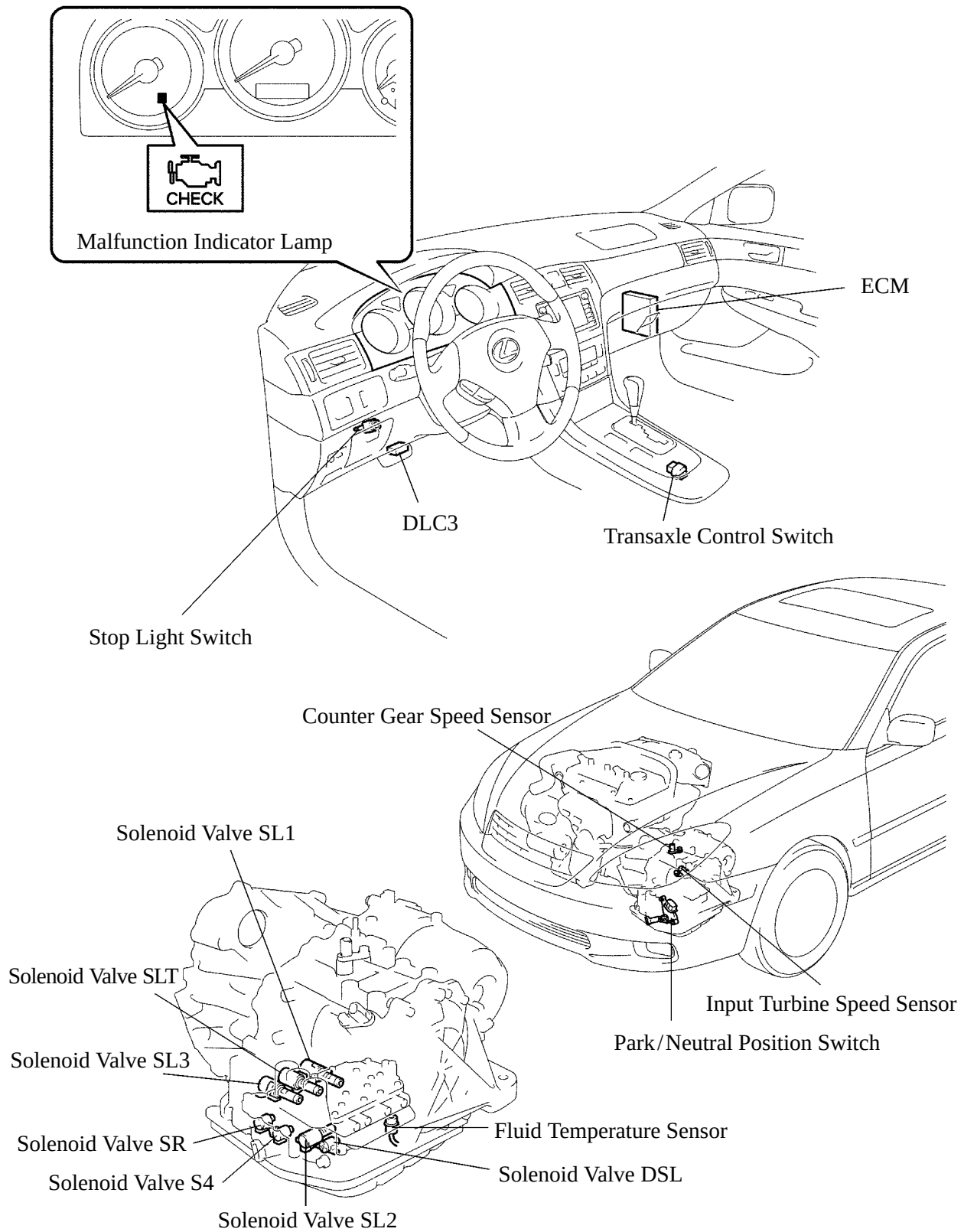
System	Function	U150E	U140E
Clutch Pressure Control (Refer to CH-24)	- Controls the pressure that is applied directly to B₁ brake and C₂ clutch by actuating 2 solenoid valves (SL1, SL2) in accordance with ECM signals. 2 solenoid valves (SL1 and SL2) minutely controls the clutch pressure in accordance with the engine output and driving conditions.	—	○
	- Controls the pressure that is applied directly to B₁ brake, C₀ and C₁ clutches by actuating 3 solenoid valves (SL1, SL2, and SL3) in accordance with ECM signals. 3 solenoid valves (SL1, SL2, and SL3) minutely controls the clutch pressure in accordance with the engine output and driving conditions.	○	—
Line Pressure Optimal Control (Refer to CH-26)	Actuates the solenoid valve SLT to control the line pressure in accordance with information from the ECM and the operating conditions of the transaxle.	○	○
Engine Torque Control	Retards the engine ignition timing temporarily to improve shift feeling during up or down shifting.	○	○
Shift Control in Uphill/Downhill Traveling (Refer to CH-25)	Controls to restrict the 4th upshift or to provide appropriate engine braking by the ECM to determine whether the vehicle is traveling uphill or downhill.	—	○
	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.	○	—
Shift Timing Control	The ECM sends current to the solenoid valve SL1 and/or SL2 based on signals from each sensor and shifts the gear.	—	○
	The ECM sends current to 3 solenoid valves (SL1, SL2, and SL3) based on signals from each sensor and shifts the gear.	○	—
Lock-up Timing Control	The ECM sends current to the solenoid valve DSL based on signals from each sensor and engages or disengages the lock-up clutch.	○	○
“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 (Refer to CH-27)	When the ECM detects a malfunction, the ECM makes a diagnosis and memorizes the failed section.	○	○
	To increase the speed for processing the signals, the 32-bit CPU of the ECM has been adopted.	○	—
Fail-safe (Refer to CH-28)	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.	○	○

2. Construction

The configuration of the electronic control system in the U150E automatic transaxle is as shown in the following chart.



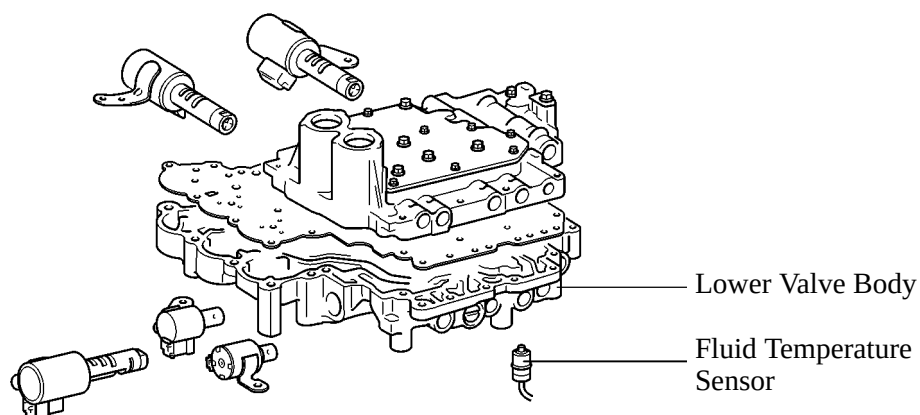
3. Layout of Component



4. Construction and Operation of Main Component

Fluid Temperature Sensor

A fluid temperature sensor is installed in the valve body for direct detection of the fluid temperature. Fluid temperature sensor is used for revision of clutches and brakes pressure to keep smooth shift quality every time.

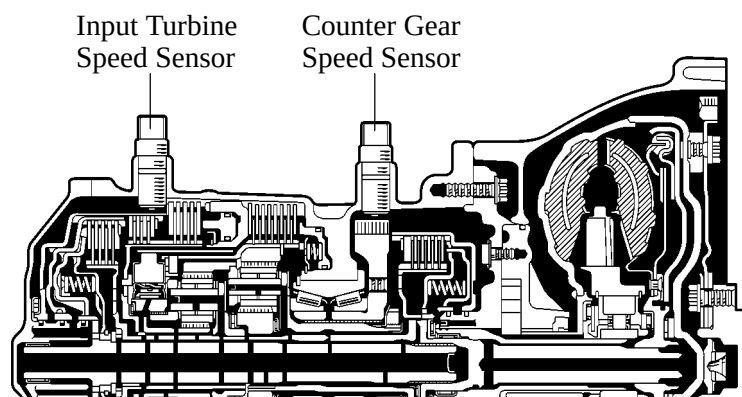


181CH11

Speed Sensors

The U150E automatic transaxle has adopted 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.

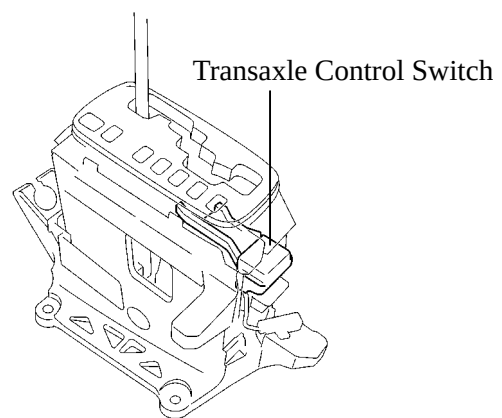
- The input turbine speed sensor detects the input speed of the transaxle. The direct clutch (C₂) drum is used as the timing rotor for this sensor.
- The counter gear speed sensor detects the speed of the counter gear. The counter drive gear is used as the timing rotor for this sensor.



211CH16

Transaxle Control Switch

The transaxle control switch is installed inside shift lever assembly to detect the shift lever position (“4th” or “D” and “2nd” or “L”) and to inform ECM the shift position indicator light in the combination meter.



211CH47

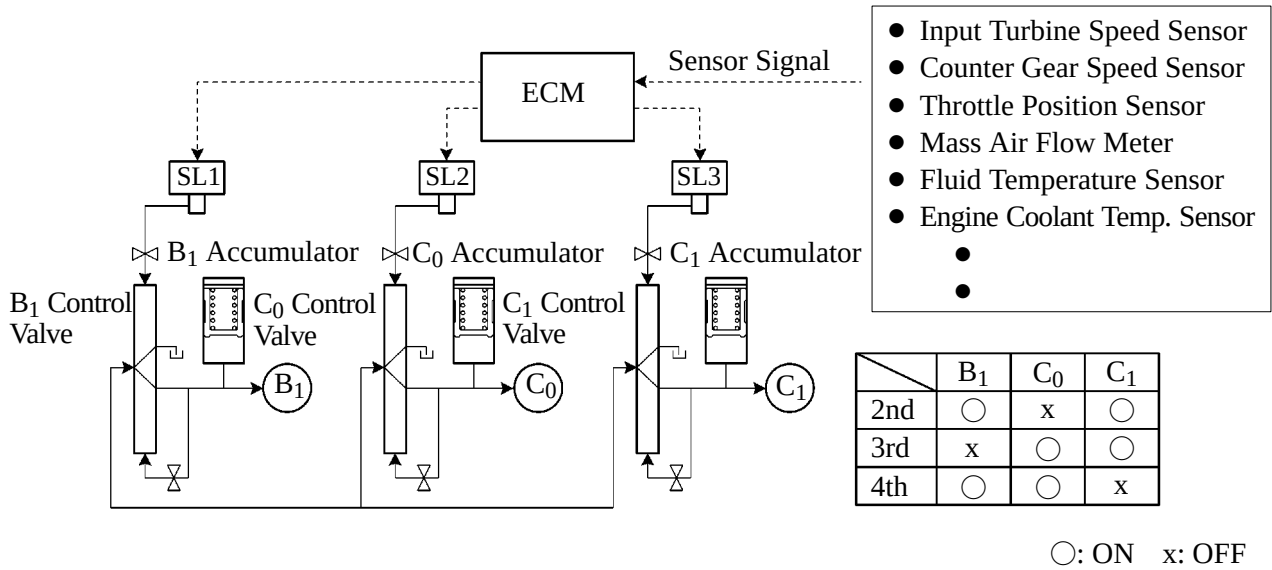
5. Clutch Pressure Control

Clutch to Clutch Pressure Control

This control has been adopted for shifting from the 1st to 2nd gear, from the 2nd to 3rd gear, and from the 3rd to 4th gear.

Actuates solenoid valves SL1, SL2, and SL3 in accordance with the signals from the ECM, and guides 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.

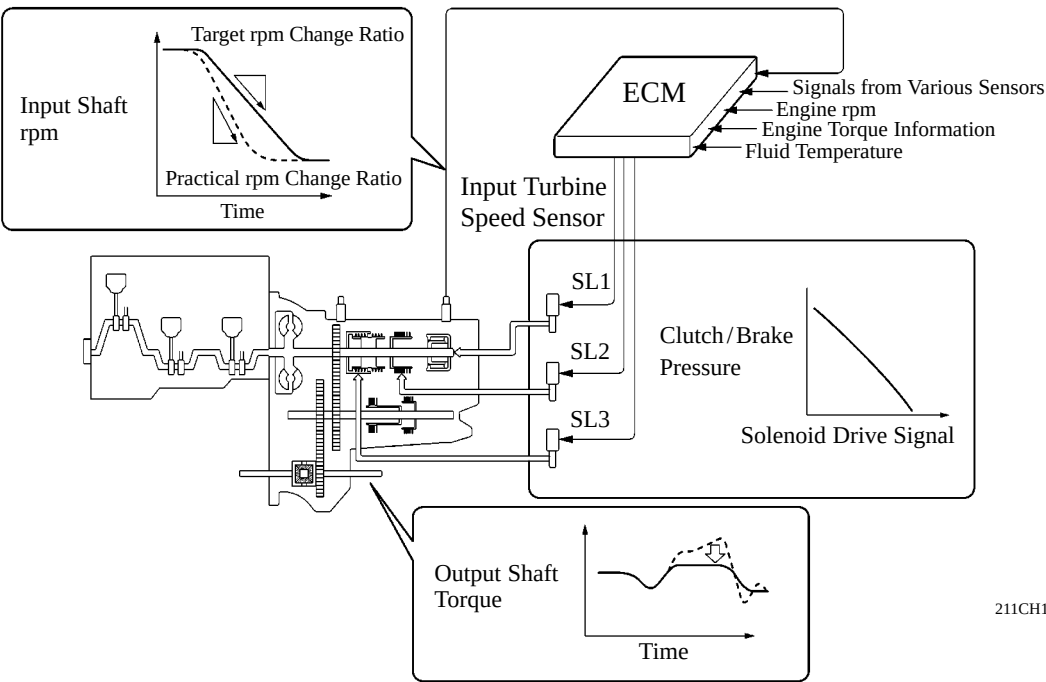


211CH15

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.



211CH17

6. Shifting Control in Uphill/Downhill Traveling

General

This control minimizes 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

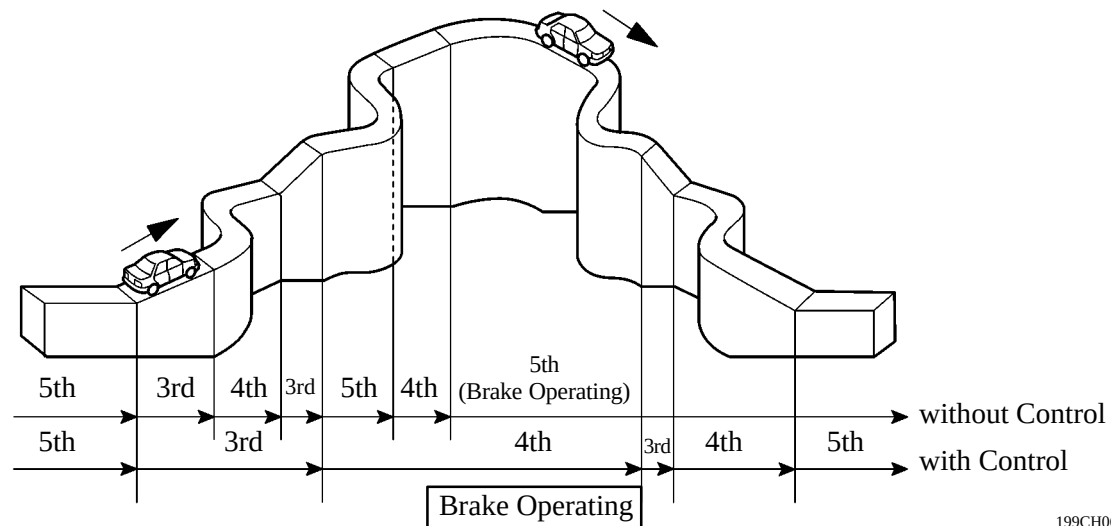
When the ECM determines uphill travel before the transaxle attempts to shift up into 5th or after it has shifted down into 4th, it prohibits the transaxle from shifting up into 5th.

When the ECM determines uphill travel with a steeper grade, it automatically shifts down into 3rd and thus prevents the transaxle from shifting up into 4th.

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.



199CH06

Uphill/Downhill Judgment

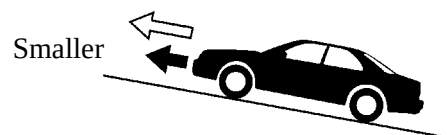
The actual acceleration calculated from the speed sensor signal is compared with the reference acceleration stored in the ECM to judge uphill or downhill traveling.

Actual Acceleration < Reference Acceleration

Actual Acceleration > Reference Acceleration

⇐ Reference acceleration

⇐ Actual acceleration



Uphill



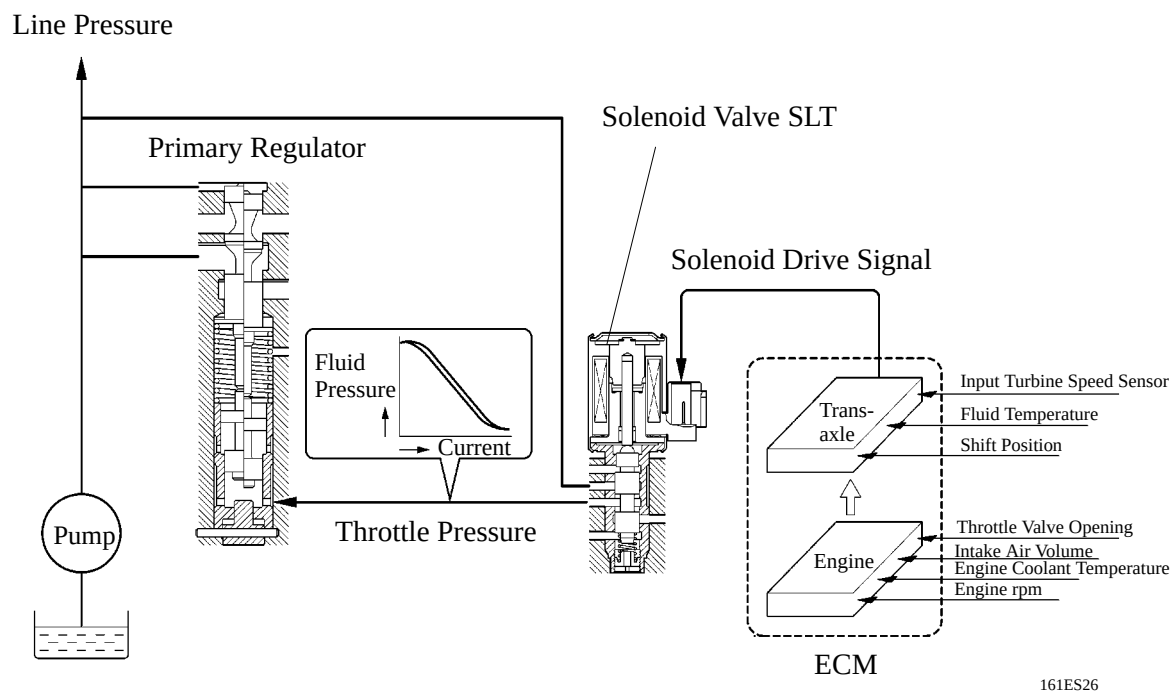
Downhill

162CH10

7. Line Pressure Optimal Control

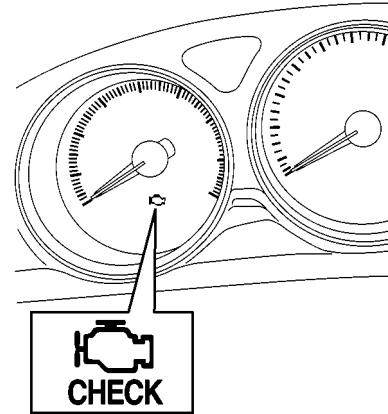
Through the use of the solenoid valve SLT, the line pressure is optimally controlled in accordance with the engine torque information, as well as with the internal operating conditions of the torque converter and the transaxle.

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.



8. Diagnosis

- When the ECM detected 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 memory. The DTCs can be read by connecting a hand-held tester.



211CH21

–Changes (from U140E)–

The DTCs (Diagnosis Trouble Codes) listed below have been added.

DTC No.	Detection Item
P0711	Transmission Fluid Temp. Sensor Malfunction (Fluid Temp. Sensor)
P0760	Shift Solenoid C Malfunction (Solenoid Valve SL3)
P0763	Shift Solenoid C Electrical Malfunction (Solenoid Valve SL3)
P1815	Solenoid Valve SR Malfunction
P1818	Solenoid Valve SR Electrical Malfunction

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.

9. 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
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.
Fluid Temp. Sensor	During a fluid temp. sensor malfunction, 5th upshift is prohibited.
Counter Gear Speed Sensor	During a counter gear speed 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 the other solenoid valves with normal operation. Shift control is effected as described in the table below, depending on the failed solenoid. Even if starting the engine under this condition, the gear position remains where it was before.

○: ON Δ: Lock-up ON x: OFF

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

(Continued)

SL2 Malfunction	Solenoid Valve	SL1	○	x → ○	○	x → ○	x → ○
		SL2	x				
		SL3	x	x	x	○ → x	○ → x
		S4	x → ○	x → ○	x → ○	x → ○	○
	Gear Position		1st → 4th	2nd → 4th	3rd → 4th	4th	5th → 4th
SL3 Malfunction	Solenoid Valve	SL1	○	x	○	x → ○	x → ○
		SL2	○	○	△	△	△
		SL3	x				
		SL4	x	x	x	x → ○	○
	Gear Position		1st	2nd	3rd	4th	5th → 4th
S4 Malfunction	Solenoid Valve	SL1	○	x	○	x	x
		SL2	○	○	△	△	△
		SL3	x	x	x	○	○
		S4	x				
	Gear Position		1st	2nd	3rd	4th	5th → 4th
SL1, SL2, SL3, and S4 Malfunction	Solenoid Valve	SL1	x				
		SL2	x				
		SL3	x				
		S4	x				
	Gear Position		1st → 4th	2nd → 4th	3rd → 4th	4th	5th → 4th