■ELECTRONIC CONTROL SYSTEM

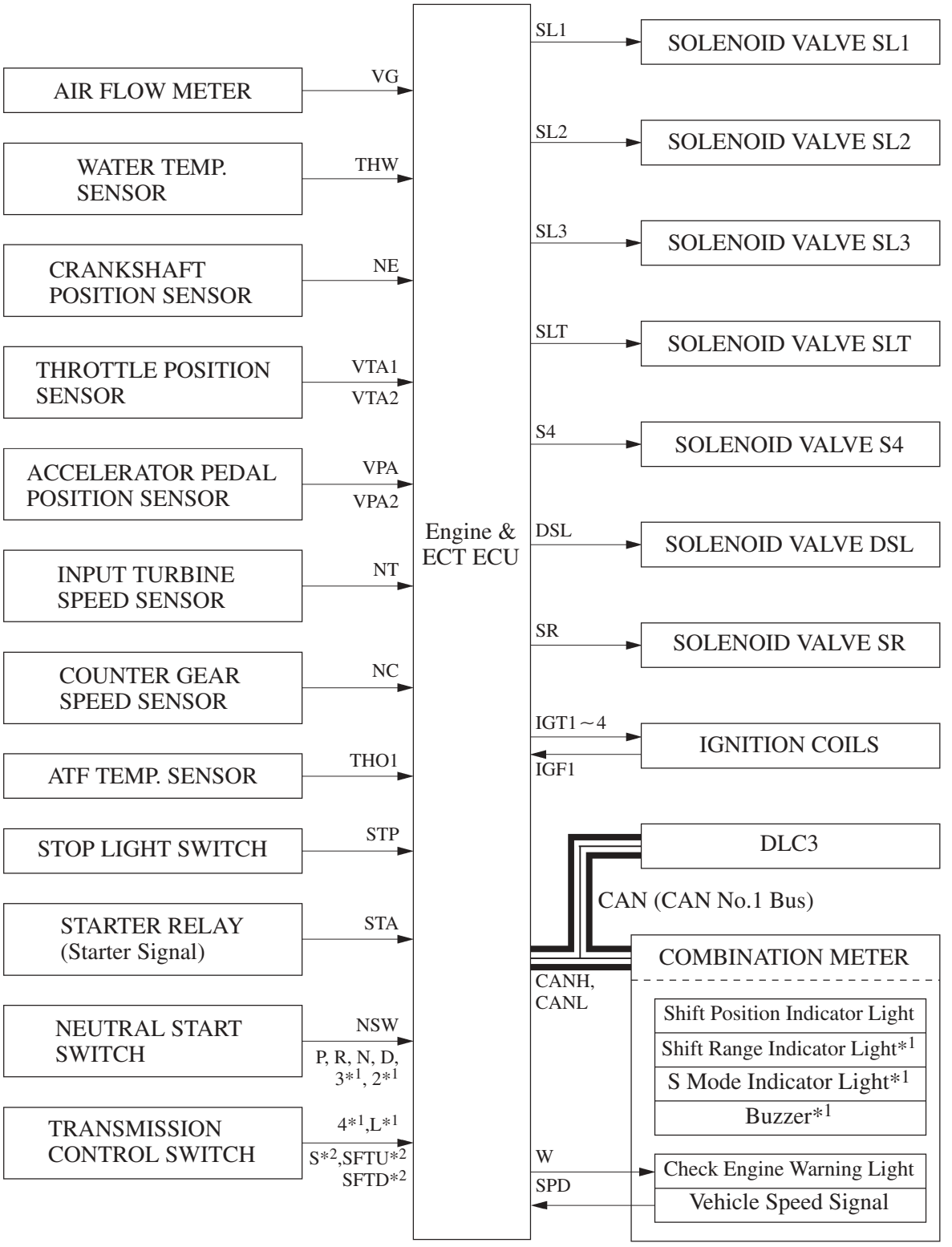
1. General

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

System	Outline
Shift Timing Control	The engine & ECT ECU 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-56)	● 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 engine & ECT ECU 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-57)	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 transaxle.
Shifting Control in Uphill/Downhill Traveling (See page CH-58)	Controls to restrict the 4th or 5th upshift or to provide appropriate engine braking by the engine & ECT ECU to determine whether the vehicle is traveling uphill or downhill.
Lock-up Timing Control	The engine & ECT ECU sends current to the solenoid valves DSL and SL2 based on signals from each sensor and engages or disengages the lock-up clutch.
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.
Multi-mode Automatic Transmission (See page CH-59)	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-61)	When the engine & ECT ECU detects a malfunction, the engine & ECT ECU makes a diagnosis and memorizes the malfunctioning part.
Fail-safe (See page CH-61)	Even if a malfunction is detected in the sensors or solenoids, the engine & 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 U250E automatic transaxle is as shown in the following chart.

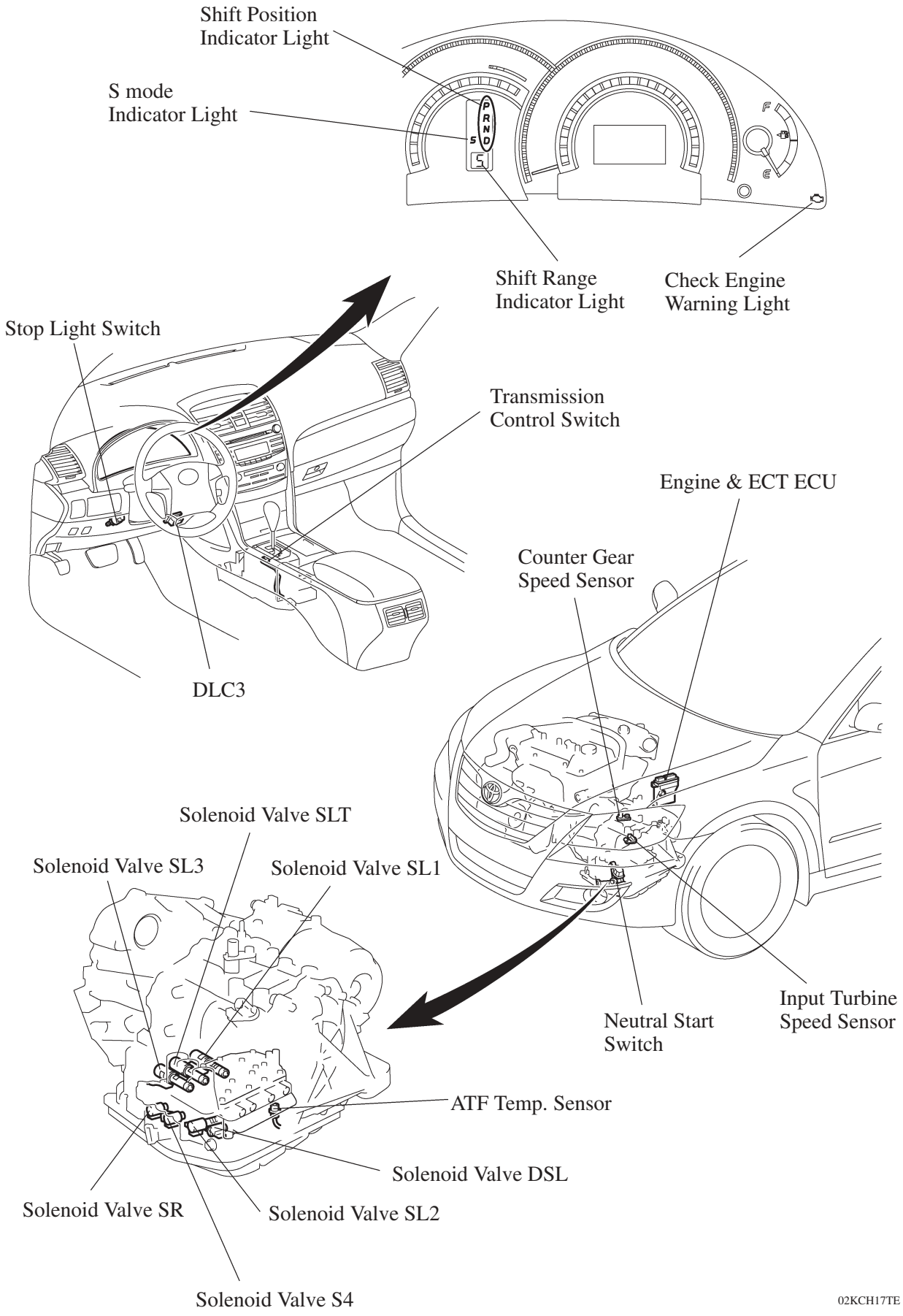


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*1: Models without Multi-mode Automatic Transmission
*2: Models with Multi-mode Automatic Transmission

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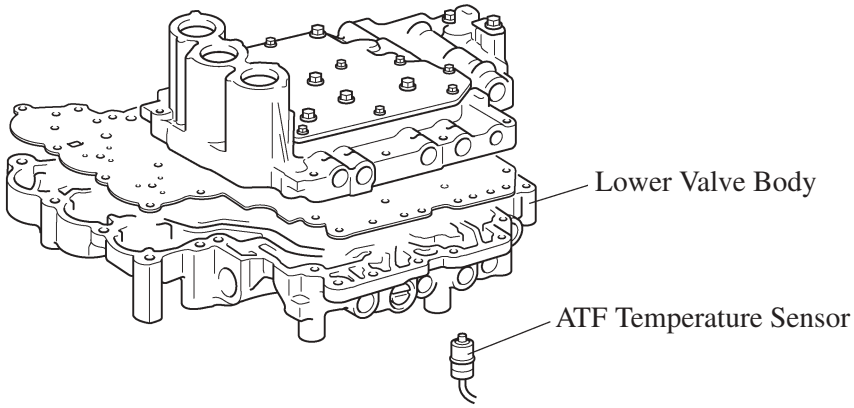
3. Layout of Main Components



4. Construction and Operation of Main Components

ATF Temperature Sensor

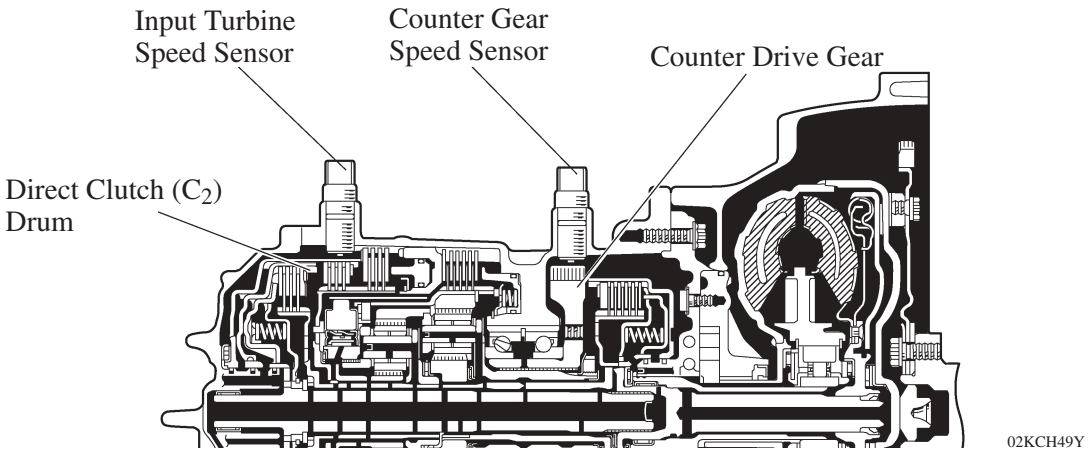
- The ATF temperature sensor is installed in the valve body for direct detection of the fluid temperature.
- The ATF temperature sensor is used for the revision of clutch and brake pressures to maintain a smooth shift quality every time.



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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 engine & 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 pick-up coil type.
- The input turbine speed sensor detects the input speed of the transaxle. The direct clutch (C_2) 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.



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Transmission Control Switch and Neutral Start Switch

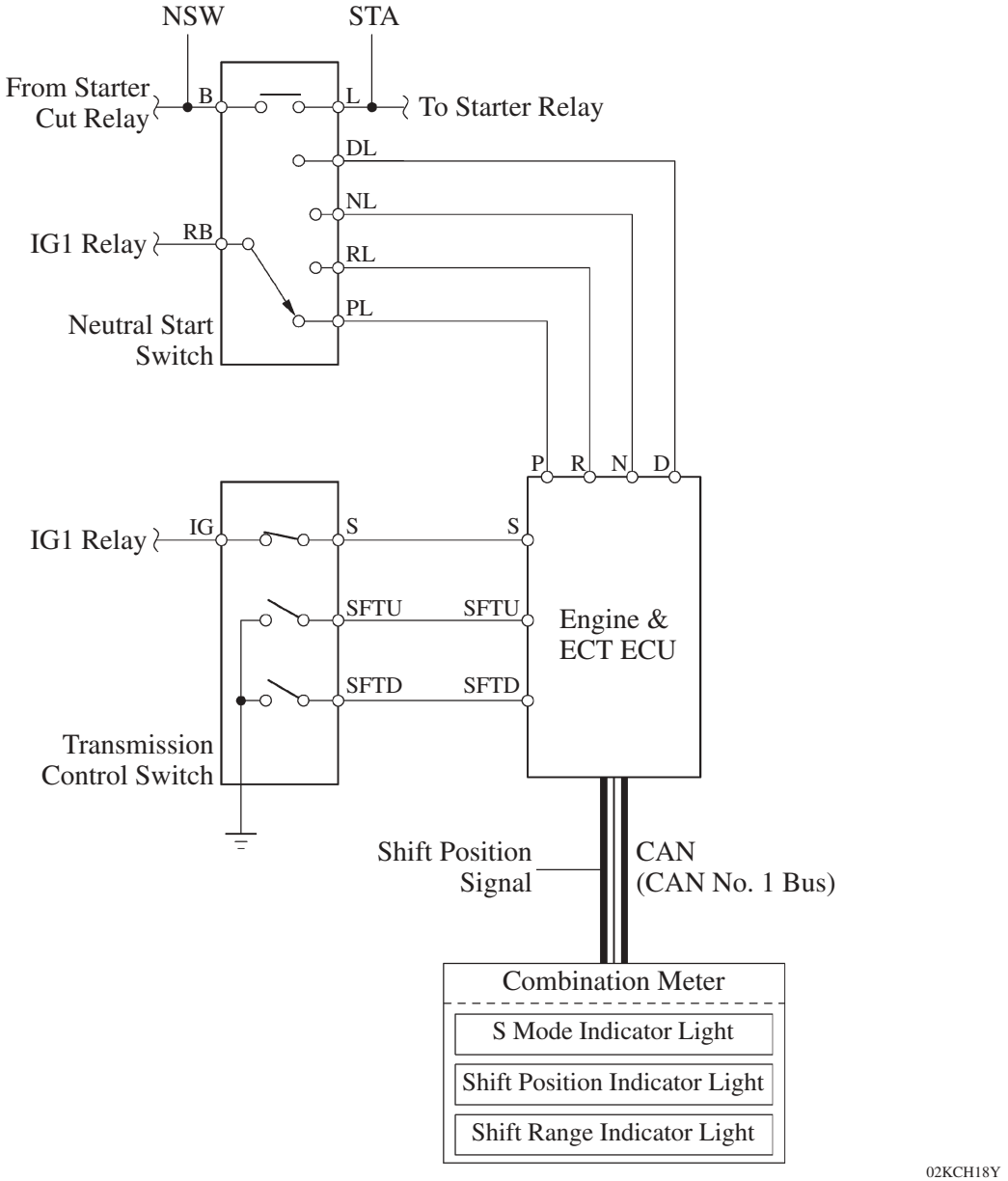
1) General

The engine & ECT ECU uses these switches to detect the shift lever position.

- On models with multi-mode automatic transmission, the engine & ECT ECU detects the shift lever positions P, R, N and D using the neutral start switch, and detects S mode shift lever positions (S, SFTU and SFTD) using the transmission control switch provided in the shift lever.
- On models without multi-mode automatic transmission mode, the engine & ECT ECU detects shift lever positions P, R, N, D, 3 and 2 using the neutral start switch, and detects shift lever positions 4 and L using the transmission control switch provided in the shift lever.
- The engine & ECT ECU 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.

2) Wiring Diagram

▶ Models with Multi-mode Automatic Transmission ◀

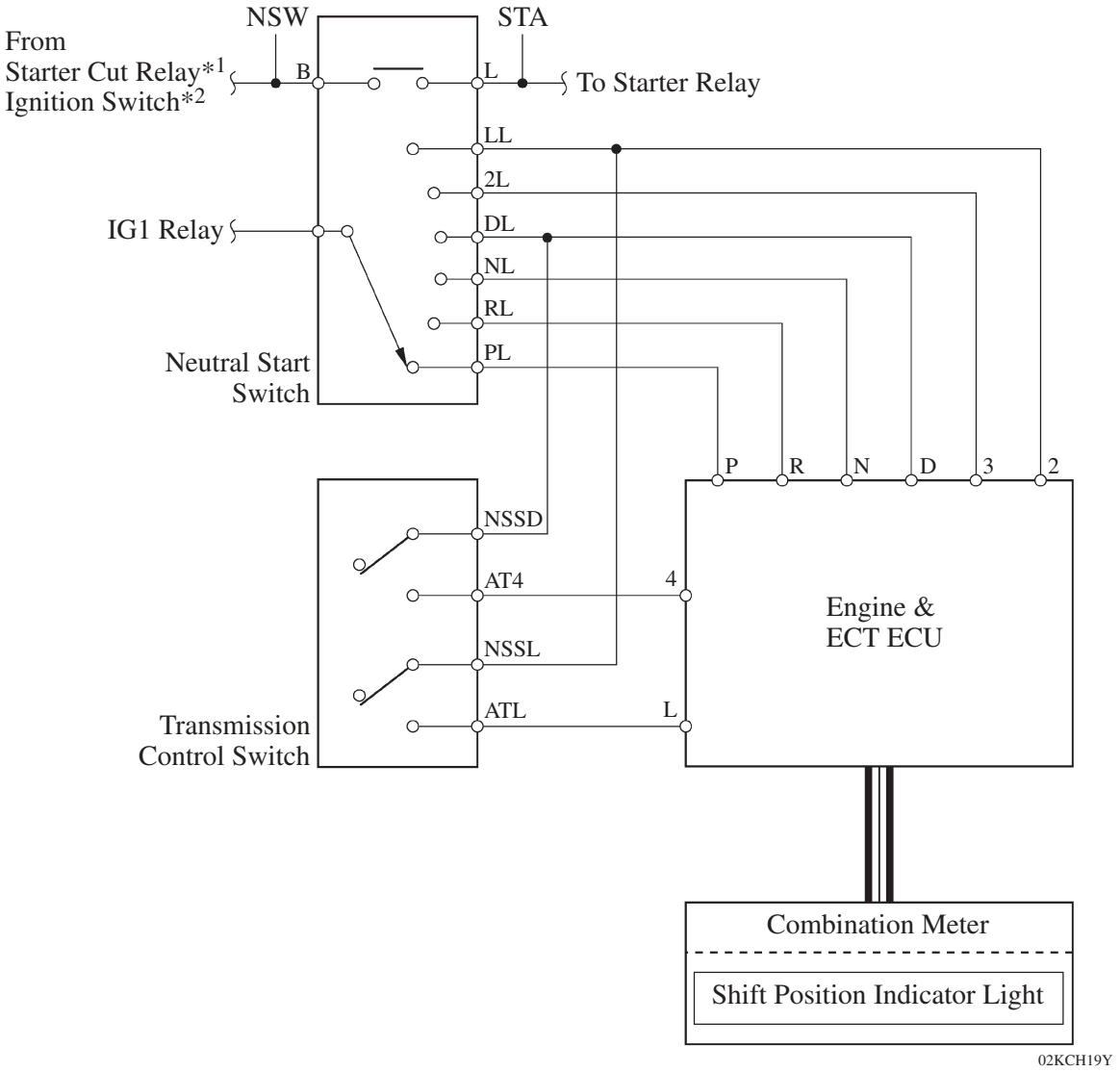


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*1: Models with smart entry and start system

*2: Models without smart entry and start system

▶ Models without Multi-mode Automatic Transmission ◀



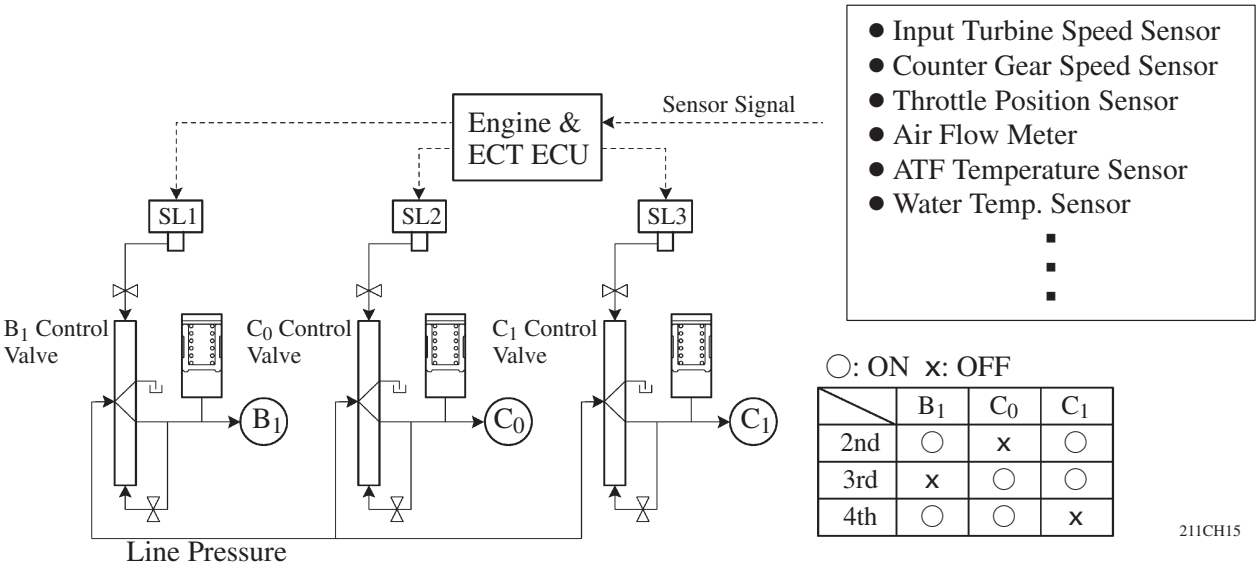
*1: Models with smart entry and start system
*2: Models without smart entry and start system

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5. Clutch Pressure Control

Clutch to Clutch Pressure Control

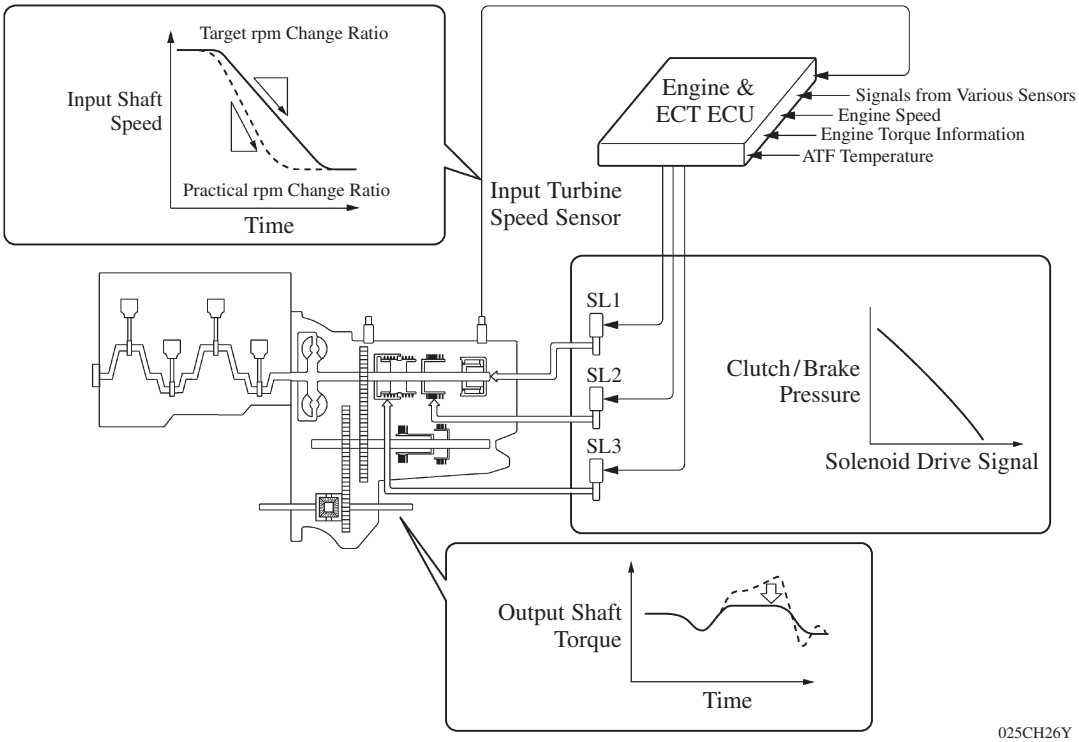
- This control is used for shifting from the 2nd to 3rd gear, and from the 3rd to 4th gear.
- Solenoid valves actuate SL1, SL2, and SL3 in accordance with the signals from the engine & ECT ECU, and guide this output pressure directly to the control valves B_1, C_0, and C_1 in order to regulate the line pressure that acts on the B_1 brake, C_0 and C_1 clutches. As a result, compact B_1, C_0 and C_1 accumulators without a back pressure chamber have been realized.



	B_1	C_0	C_1
2nd	○	x	○
3rd	x	○	○
4th	○	○	x

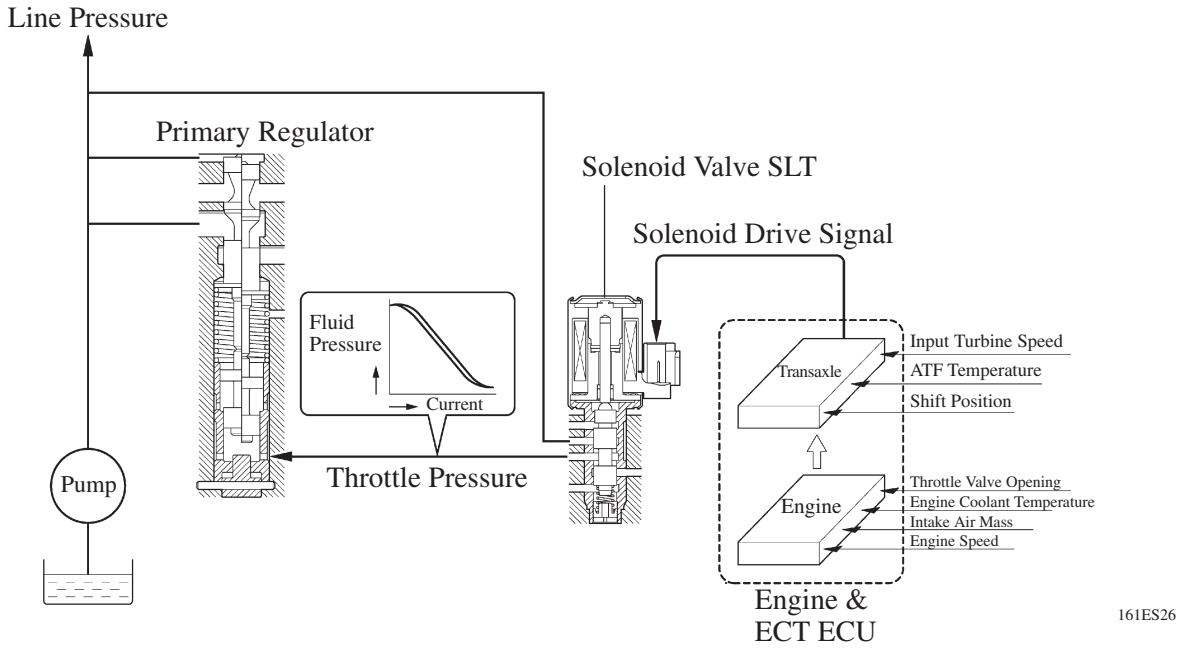
Clutch Pressure Optimal Control

The engine & ECT ECU monitors the signals from various types of sensor such as the input turbine speed sensor, allowing shift solenoid valves 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

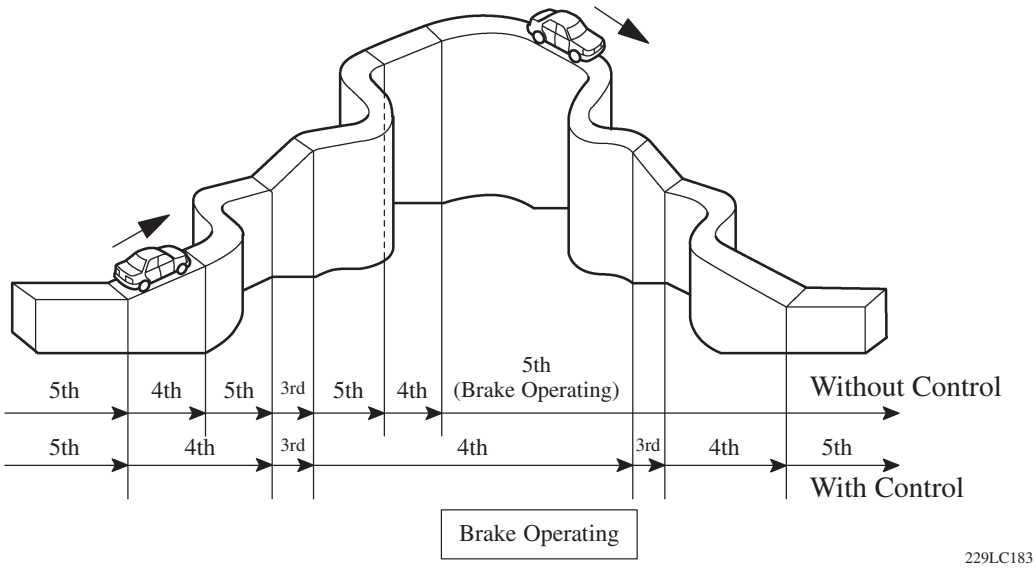
This control helps minimize the shifting of gears when the driver operates the accelerator pedal while driving on a winding road with ups and downs, in order to ensure a smooth drive.

Shift Control in Uphill Traveling

- When the engine & ECT ECU determines uphill travel, it prohibits the transaxle from shifting up into 5th after the transaxle has shifted down below 4th.
- When the engine & ECT ECU 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 engine & ECT ECU 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 engine & ECT ECU determines downhill travel with a steeper grade, and a brake operation signal is input again, the engine & ECT ECU shifts the transaxle down from 4th to 3rd.

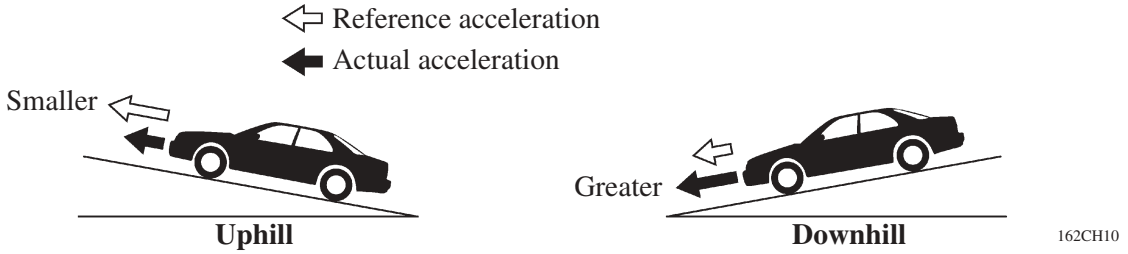


Uphill / Downhill Judgment

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

Actual Acceleration < Reference Acceleration

Actual Acceleration > Reference Acceleration

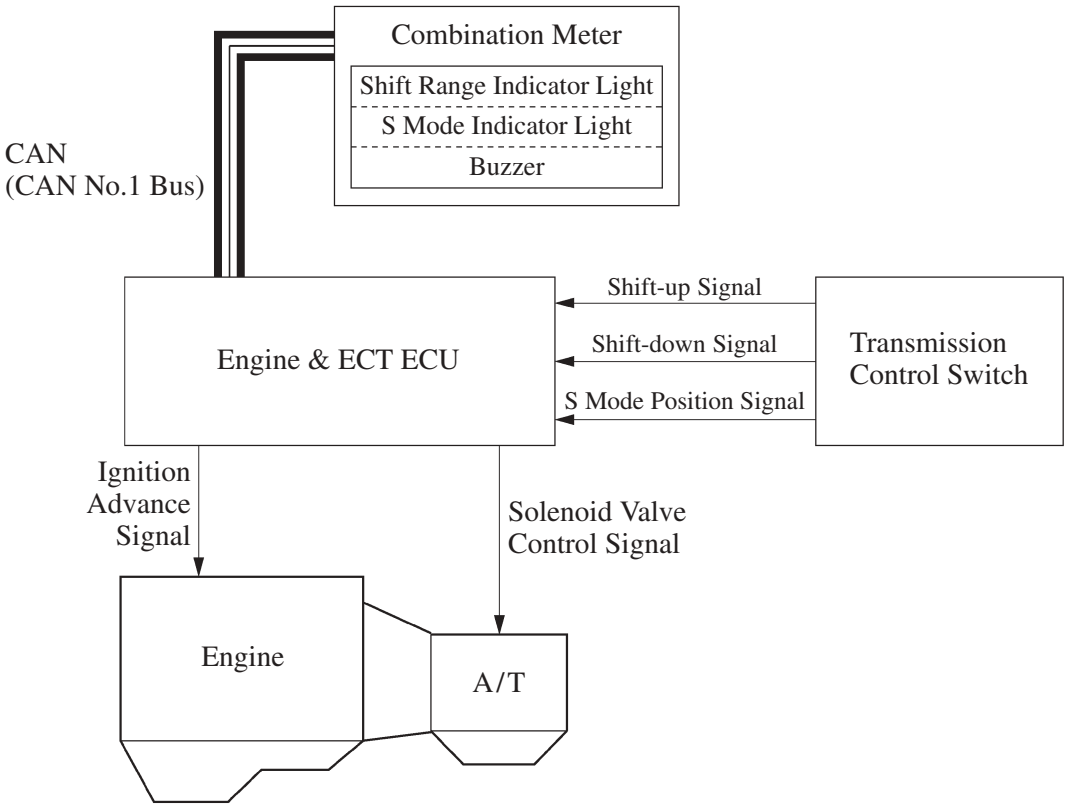


8. Multi-mode Automatic Transmission

General

The multi-mode automatic transmission is provided on all models other than those for Australia and G.C.C. Countries. This transmission system enables the driver to select a desired shift range position by moving the shift lever to the front (+ position) or to the rear (– position), thus, the driver can shift gears with a manual-like feel.

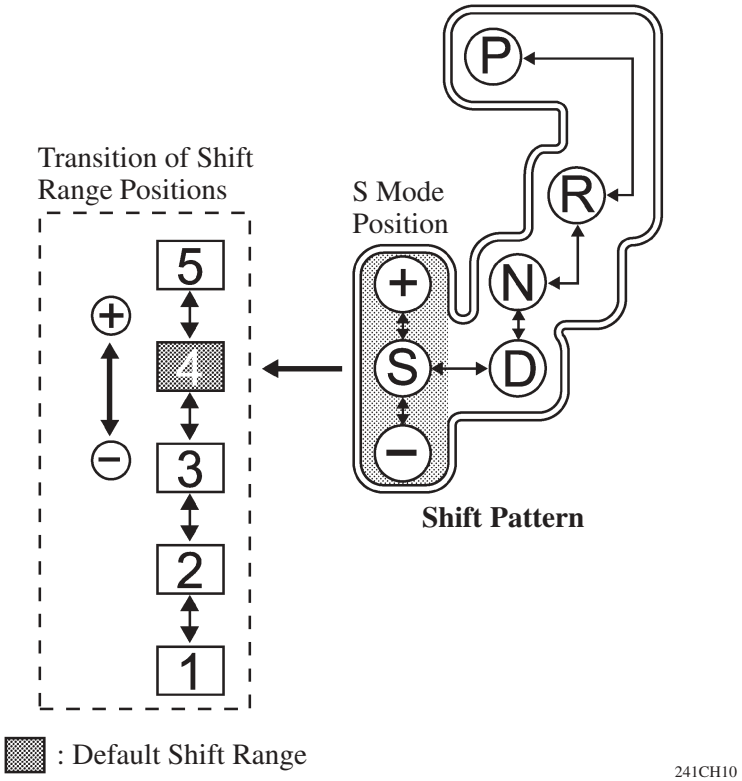
- This multi-mode automatic transmission is designed to allow the driver to switch the gear ranges; not for manually selecting single gears.
- A S mode indicator light, which illuminates when the S mode position is selected and a shift range indicator light, which indicates the range position, have been provided in the combination meter.
- When the vehicle is being driven at a prescribed speed or higher, any attempt to shift down the range 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 engine & ECT ECU sounds the buzzer in the combination meter twice to alert the driver.



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Operation

- The driver selects the S mode position by engaging the shift lever. At this time, the shift range position selects the 4 range. 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 engine & 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.



▶ Usable Gear Chart ◀

Shift Range Indicator Light Indication	Shift Range	Usable Gear
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

9. Diagnosis

- When the engine & ECT ECU detects a malfunction, the engine & ECT ECU makes a diagnosis and memorizes the information related to the fault. Furthermore, the check engine warning light 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 an intelligent tester II.
- For details, see the Camry Repair Manual.

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 x: OFF

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