## ■ELECTRONIC CONTROL SYSTEM

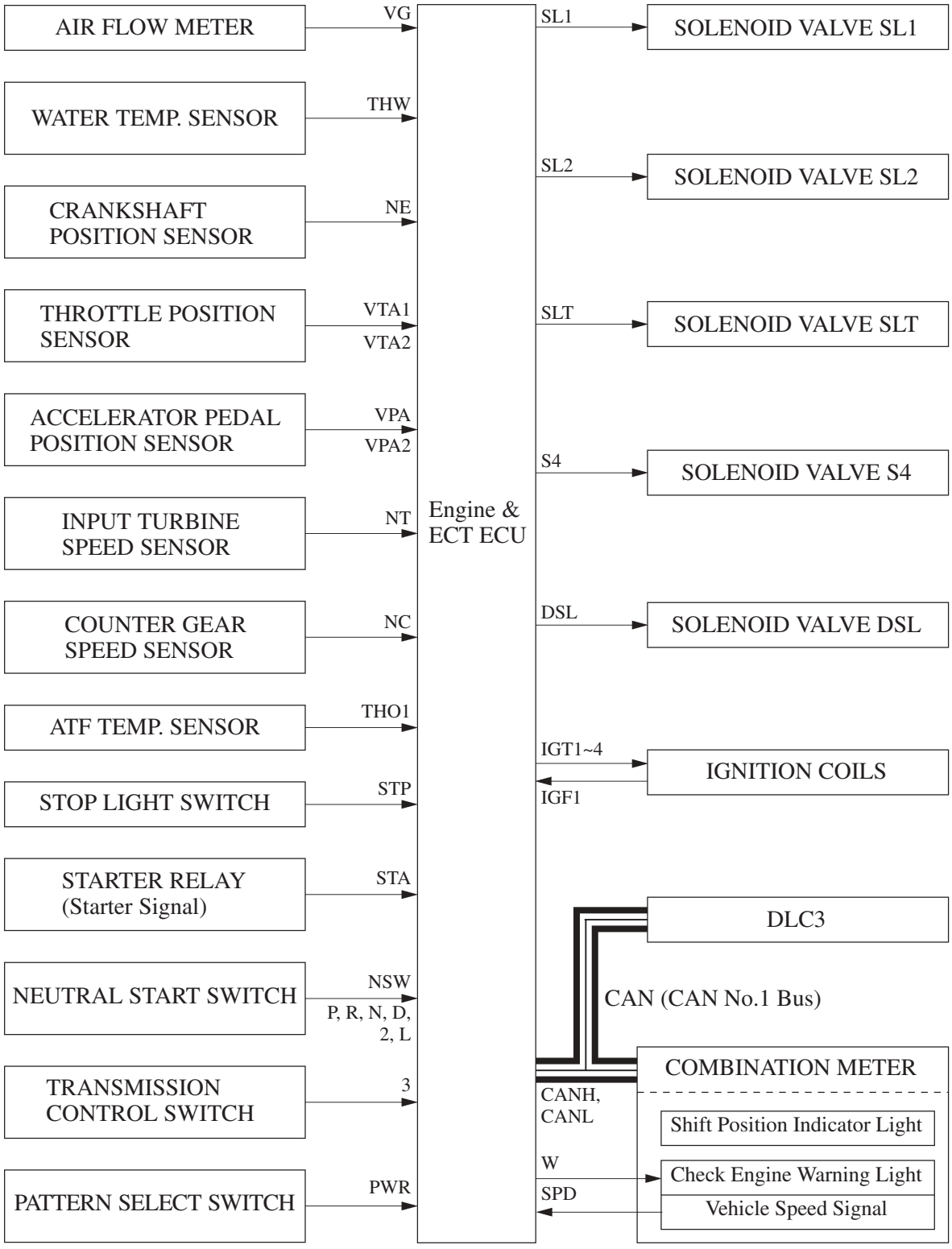
### 1. General

The electronic control system of the U241E automatic transaxle consists of the control listed below.

| System | Function |
|---|---|
| Shift Timing Control | The engine & ECT ECU sends current to 2 solenoid valves (SL1 and SL2) based on signals from each sensor and shifts the gear. |
| Clutch Pressure Control (See page CH-25) | ● Controls the pressure that is applied directly to $B_1$ brake and $C_2$ clutches by actuating 2 solenoid valves (SL1 and SL2) in accordance with engine & ECT ECU signals.<br>● 2 solenoid valves (SL1 and SL2) minutely control the clutch pressure in accordance with the engine output and driving conditions. |
| Line Pressure Optimal Control (See page CH-26) | 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. |
| Shift Control in Uphill/Downhill Traveling (See page CH-27) | Controls to restrict the 4th upshift or to provide appropriate engine braking by using the engine & ECT ECU to determine whether the vehicle is traveling on uphill or downhill. |
| Lock-up Timing Control | The engine & ECT ECU sends current to the solenoid valve DSL 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 moved from the “N” to “D” position, the gear is temporarily shifted to the 2nd and then to the 1st to reduce vehicle squat. |
| Diagnosis (See page CH-28) | When the engine & ECT ECU detects a malfunction, the engine & ECT ECU makes a diagnosis and memorizes the failed section. |
| Fail-safe (See page CH-28) | 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. |

## 2. Construction

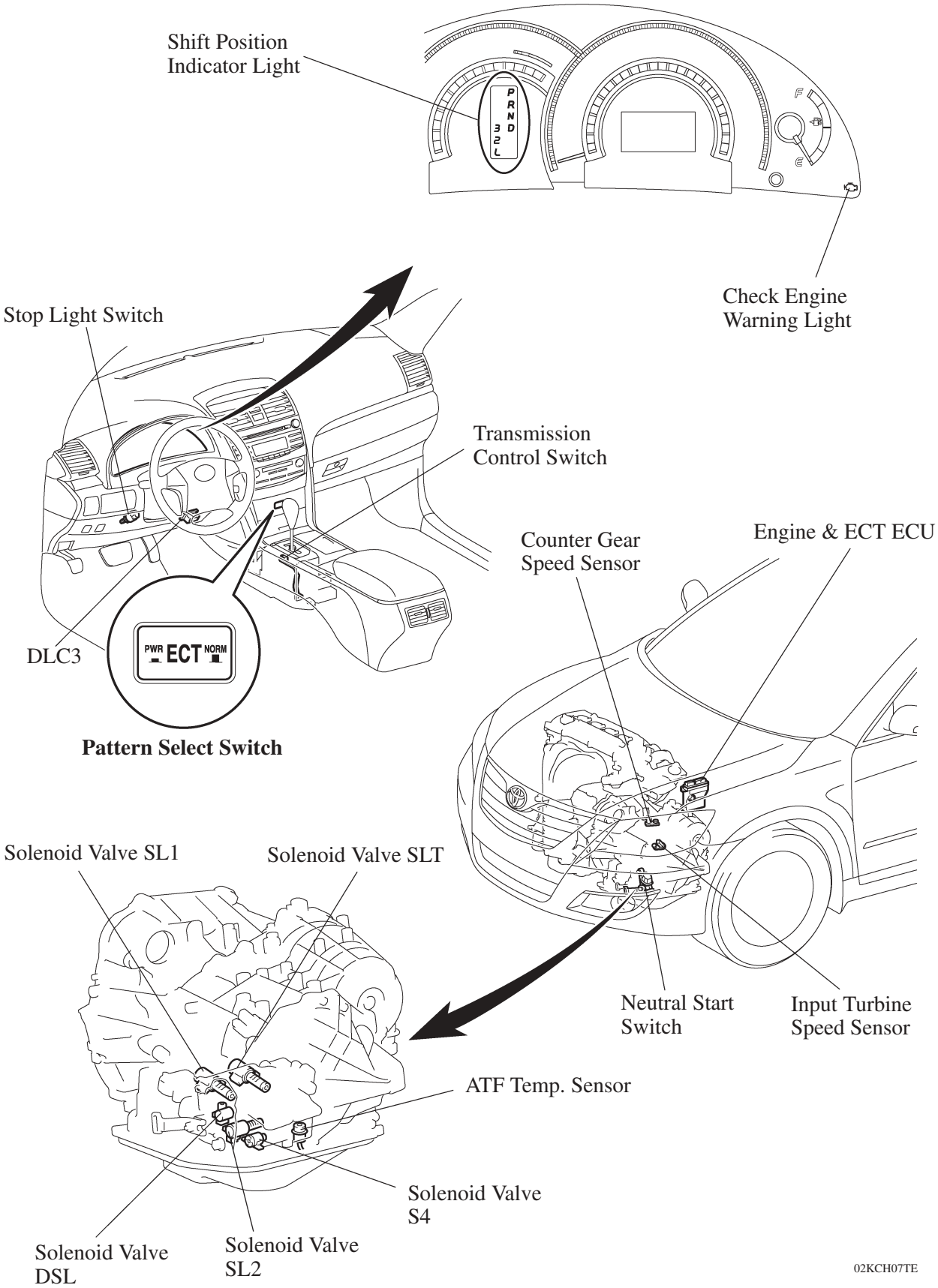
The configuration of the electronic control system in the U241E automatic transaxle is as shown in the following chart.




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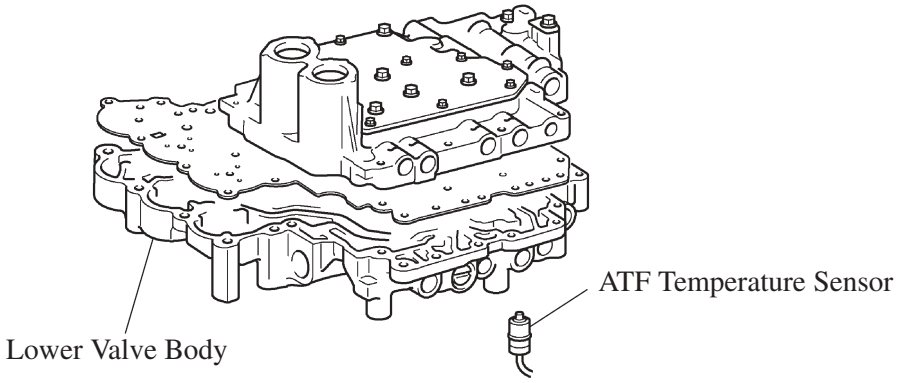
## 3. Layout of Main Components



## 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.

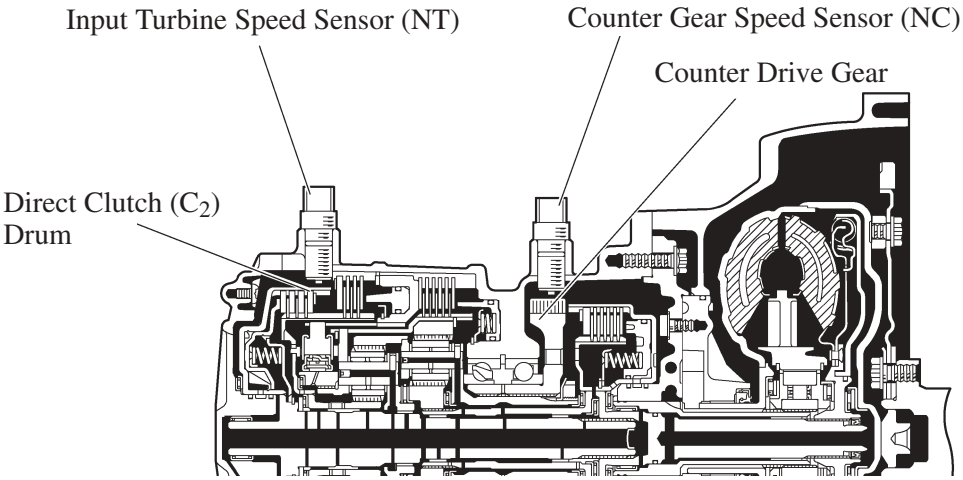



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### Speed Sensors

- The U241E 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.



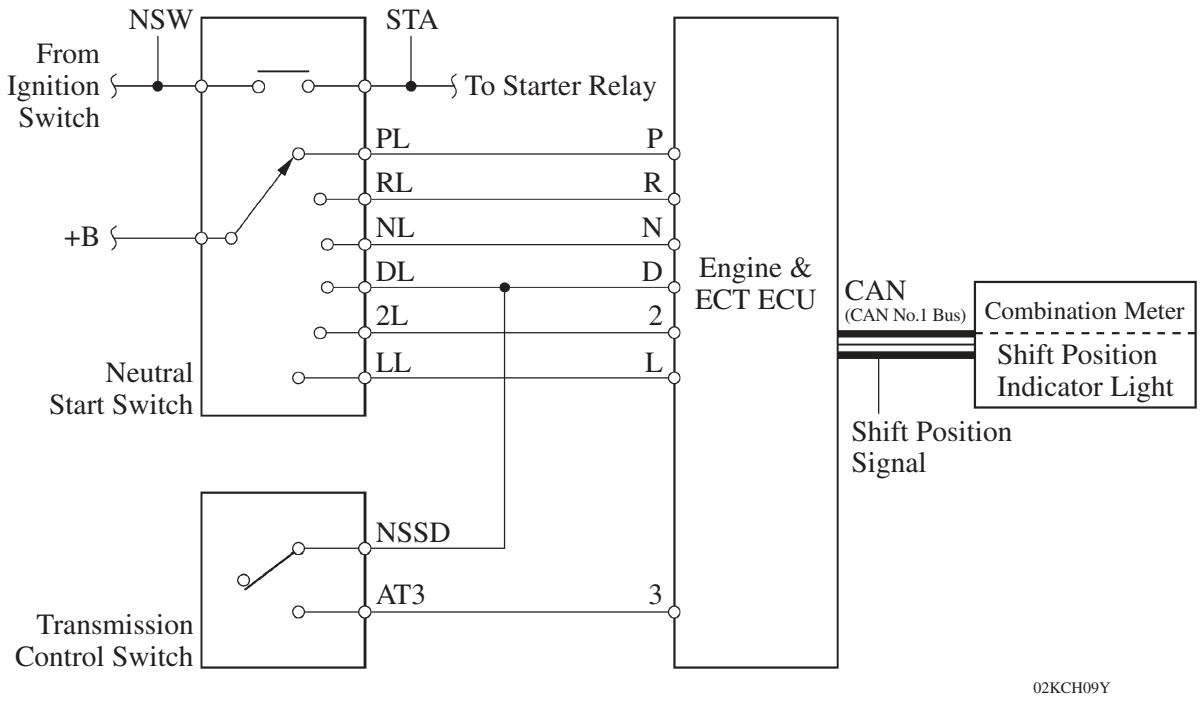

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### Transmission Control Switch and Neutral Start Switch

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

- The neutral start switch sends the P, R, N, D, 2 and L position signals to the engine & ECT ECU.
- The transmission control switch is installed inside the shift lever assembly. This switch sends the 3 position signals to the engine & ECT ECU.
- 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.

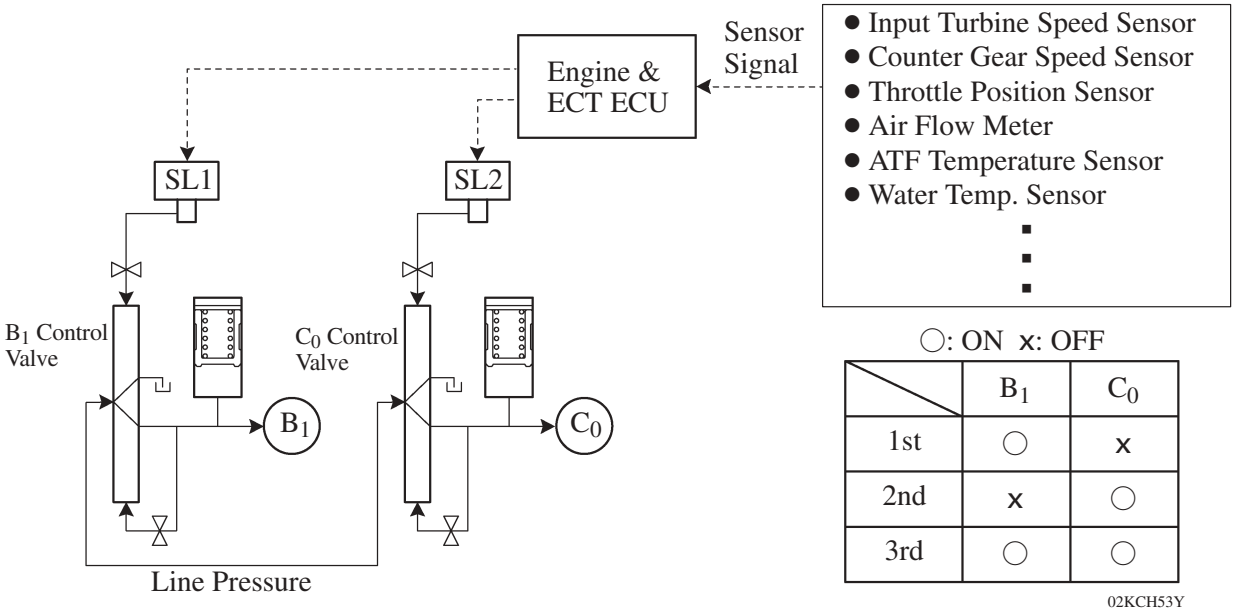
**▶ Wiring Diagram ◀**



## 5. Clutch Pressure Control

### Clutch to Clutch Pressure Control

- A clutch to clutch pressure control is used for shifting from the 1st to 2nd gear, and from the 2nd to 3rd gear.
- Solenoid valves SL1 and SL2 are actuated in accordance with the signals from the engine & ECT ECU, and this output pressure is guided directly to the control valves $B_1$ and $C_2$ in order to regulate the line pressure that acts on the $B_1$ brake and $C_2$ clutch. As a result, high response and excellent shift characteristics have been achieved.



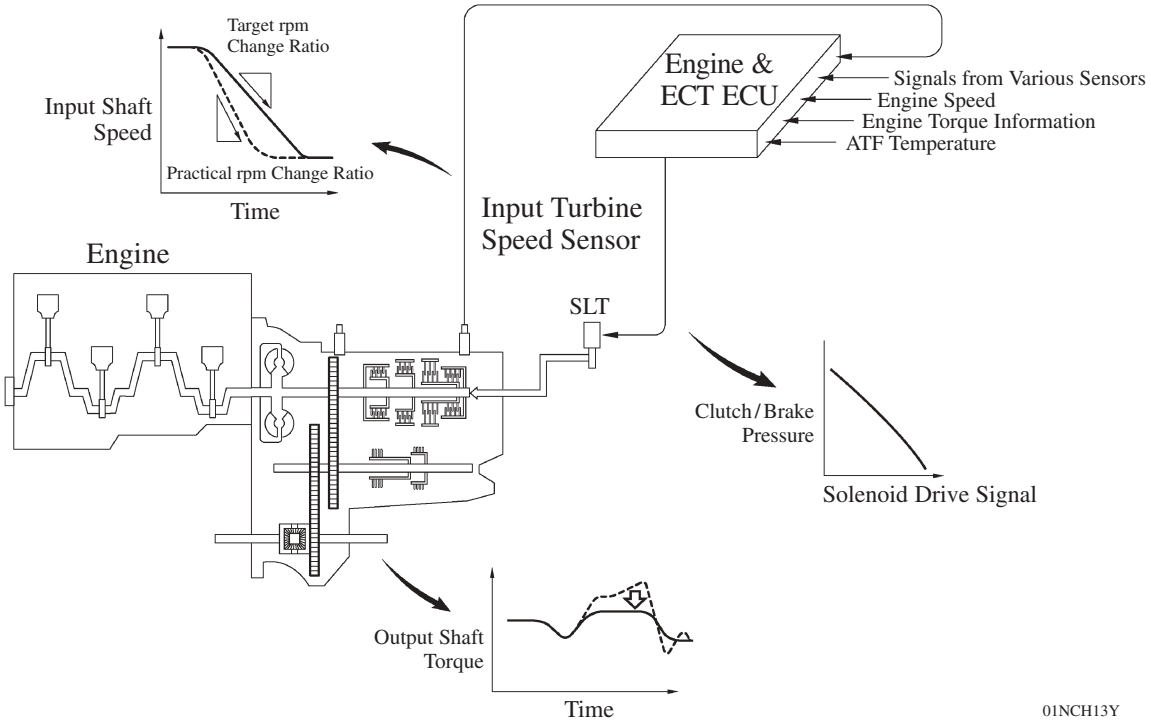

○: ON x: OFF

| | $B_1$ | $C_0$ |
|---|---|---|
| 1st | ○ | x |
| 2nd | x | ○ |
| 3rd | ○ | ○ |

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### Clutch Pressure Optimal Control

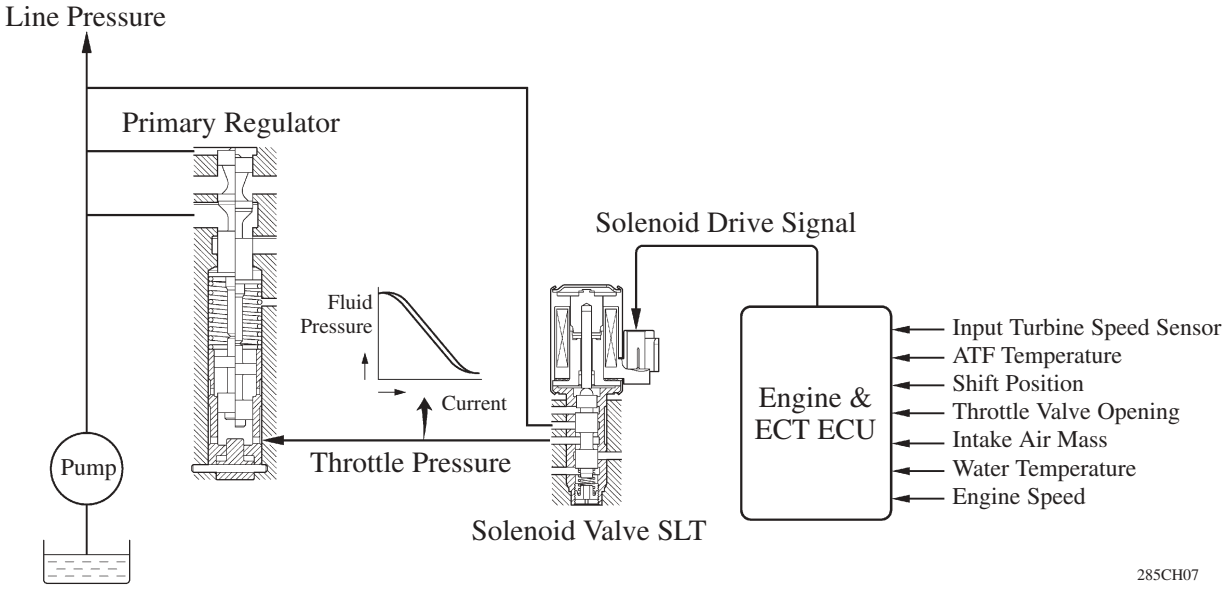
The solenoid valve SLT is used for optimal control of clutch pressure. The engine & ECT ECU monitors the signals from various types of sensors such as the input turbine speed sensor, allowing solenoid valve SLT to minutely control the clutch pressure in accordance with engine output and driving conditions. As a result, smooth shift characteristics have been realized.




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## 6. Line Pressure 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.



## 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.

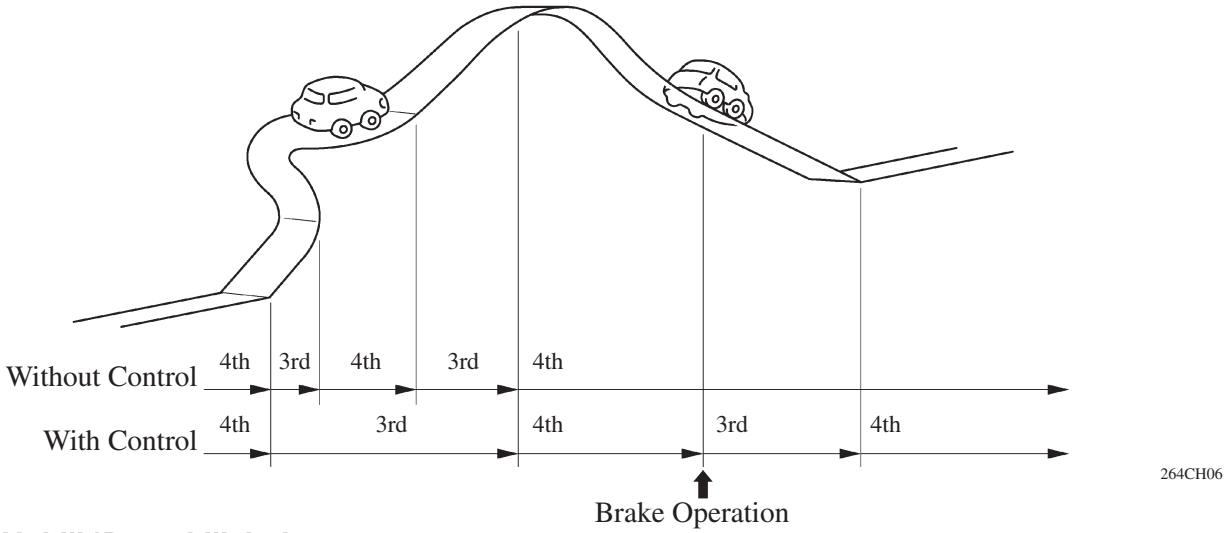
### Shift Control in Uphill Traveling

When the engine & ECT ECU determines uphill travel, it prohibits the transaxle from shifting up into 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 4th to 3rd in accordance with the brake operation signal that is input when the driver operates the brake pedal.



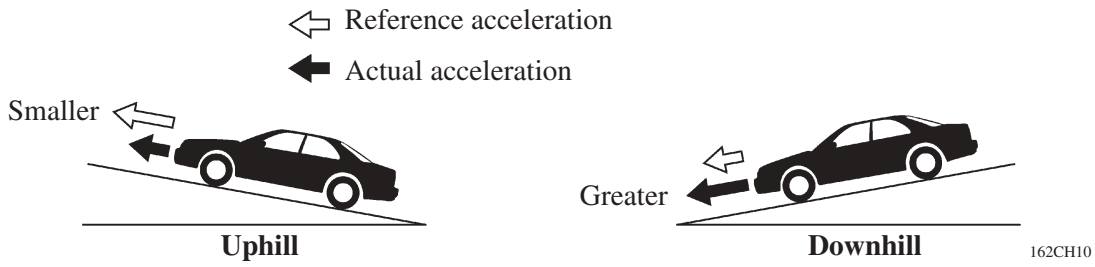



### Uphill / Downhill Judgment

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. 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.

## 9. 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, 4th upshift is prohibited. |
| ATF Temp. Sensor | During a ATF temperature sensor malfunction, 4h upshift is prohibited. |
| Solenoid Valve<br>SL1, SL2 and S4 | The current to the failed solenoid valve is cut off and control is effected by operating other solenoid valves with normal operation.<br>Shift control is effected as described in the table in the next page, depending on the failed solenoid.<br>Even if the engine starts under this condition, the gear position remains where it was before. |

**▶ When all solenoid valves are normal ◀**

| Solenoid Valve | | | Gear |
|---|---|---|---|
| SL1 | SL2 | S4 | |
| ON | ON | OFF | 1st |
| OFF | ON | OFF | 2nd |
| OFF | OFF | OFF | 3rd |
| OFF | OFF | ON | 4th |

**▶ When solenoid valve SL1 is abnormal ◀**

| Traveling in 1st or 2nd | | | Gear |
|---|---|---|---|
| Solenoid Valve | | | |
| SL1 | SL2 | S4 | |
| x* | ON | OFF | 2nd |
| x* | ON | OFF | 2nd |
| x* | OFF → ON | OFF → ON | 3rd |
| x* | OFF → ON | ON | 3rd |

| Traveling 3rd or 4th | | | Gear |
|---|---|---|---|
| Solenoid Valve | | | |
| SL1 | SL2 | S4 | |
| x | ON → OFF | OFF | 3rd |
| x | ON → OFF | OFF | 3rd |
| x | OFF | OFF | 3rd |
| x | OFF | ON | 4th |

*: The 2nd brake ($B_1$) is constantly operating.

**▶ When solenoid valve SL2 is abnormal ◀**

| Solenoid Valve | | | Gear |
|---|---|---|---|
| SL1 | SL2 | S4 | |
| ON → OFF | x | OFF | 3rd |
| OFF | x | OFF | 3rd |
| OFF | x | OFF | 3rd |
| OFF | x | ON | 4th |

**▶ When solenoid valve S4 is abnormal ◀**

| Solenoid Valve | | | Gear |
|---|---|---|---|
| SL1 | SL2 | S4 | |
| ON | ON | x | 1st |
| OFF | ON | x | 2nd |
| OFF | OFF | x | 3rd |
| OFF | OFF | x | 3rd |

**▶ When solenoid valves SL1 and SL2 are abnormal ◀**

| Solenoid Valve | | | Gear |
|---|---|---|---|
| SL1 | SL2 | S4 | |
| x | x | OFF | 3rd |
| x | x | OFF | 3rd |
| x | x | OFF | 3rd |
| x | x | ON | 4th |

**▶ When solenoid valves SL1 and S4 are abnormal ◀**

| Traveling in 1st or 2nd | | | Gear |
|---|---|---|---|
| Solenoid Valve | | | |
| SL1 | SL2 | S4 | |
| x | ON | x | 2nd |
| x | ON | x | 2nd |
| x | OFF → ON | x | 2rd |
| x | OFF → ON | x | 2rd |

| Traveling in 3rd or 4th | | | Gear |
|---|---|---|---|
| Solenoid Valve | | | |
| SL1 | SL2 | S4 | |
| x | ON → OFF | x | 3rd |
| x | ON → OFF | x | 3rd |
| x | OFF | x | 3rd |
| x | OFF | x | 3th |

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**▶ When solenoid valves SL2 and S4 are abnormal ◀**

| Solenoid Valve | | | Gear |
|---|---|---|---|
| SL1 | SL2 | S4 | |
| ON → OFF | x | x | 3rd |
| OFF | x | x | 3rd |
| OFF | x | x | 3rd |
| OFF | x | x | 3rd |

**▶ When solenoid valves SL1, SL2 and S4 are abnormal ◀**

| Solenoid Valve | | | Gear |
|---|---|---|---|
| SL1 | SL2 | S4 | |
| x | x | x | 3rd |
| x | x | x | 3rd |
| x | x | x | 3rd |
| x | x | x | 3rd |