## ■ ELECTRONIC CONTROL SYSTEM

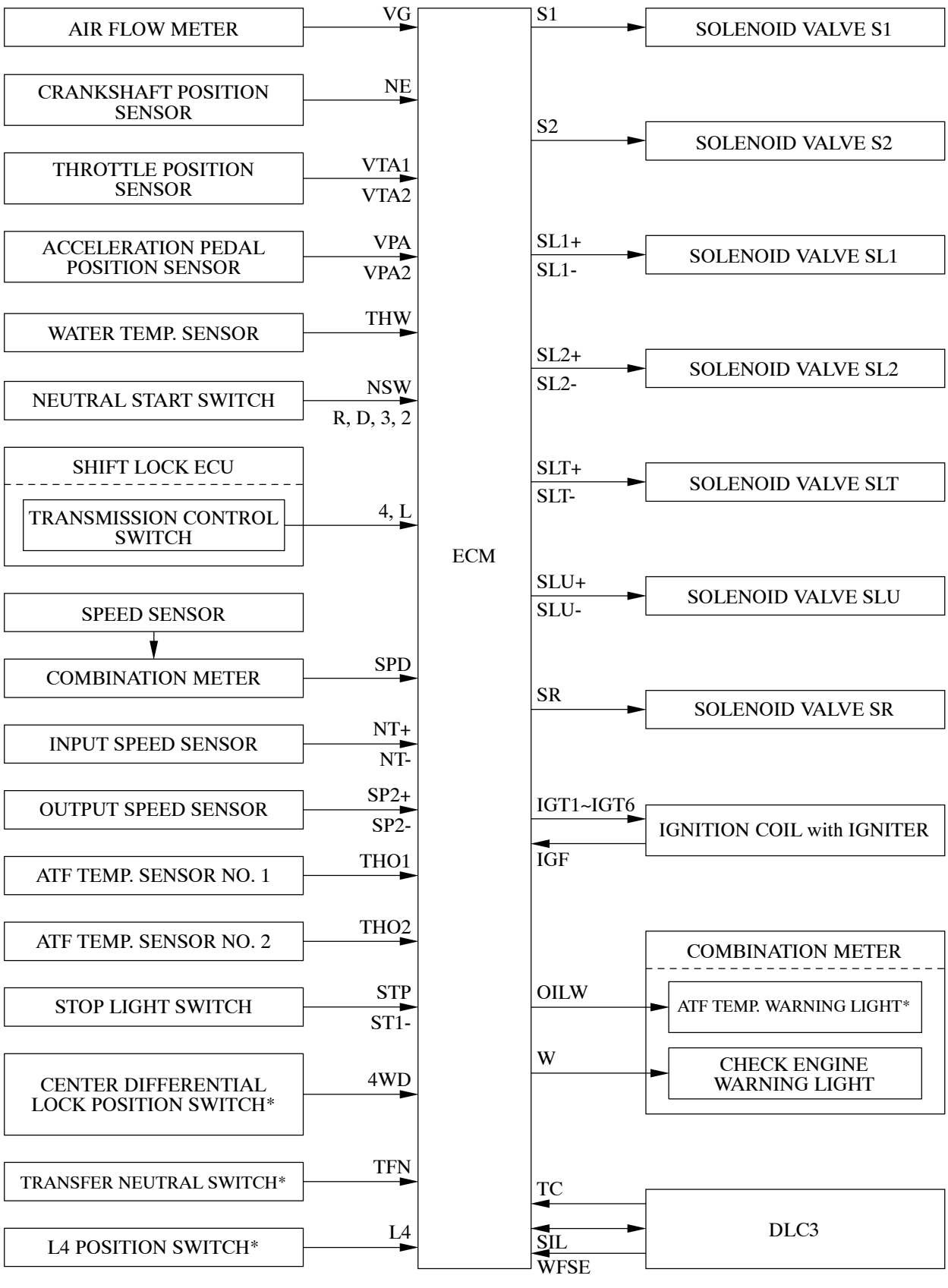
### 1. General

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

| System | Function |
|---|---|
| Clutch Pressure Control | • 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.<br>• The solenoid valves SLT and SL1 minutely control the clutch pressure in accordance with the engine output and driving conditions. |
| Line Pressure Control | 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 ignition timing temporarily to improve shift feeling during up or down shifting. |
| Shift Timing Control | The ECM sends current to the solenoid valves S1, S2 and/or SR based on signals from each sensor and shifts the gear. |
| Lock-up Timing Control | The ECM sends current to the shift solenoid valve SLU 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 2nd and then to 1st to reduce vehicle squat. |
| AI (Artificial Intelligence) -SHIFT Control | Based on the signals from various sensors, the ECM 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 ECM detects a malfunction, it makes a diagnosis and memorizes the failed section. |
| Fail-safe | 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 new Fortuner/Hilux SW4 A750E and A750F is as shown in the following charts.

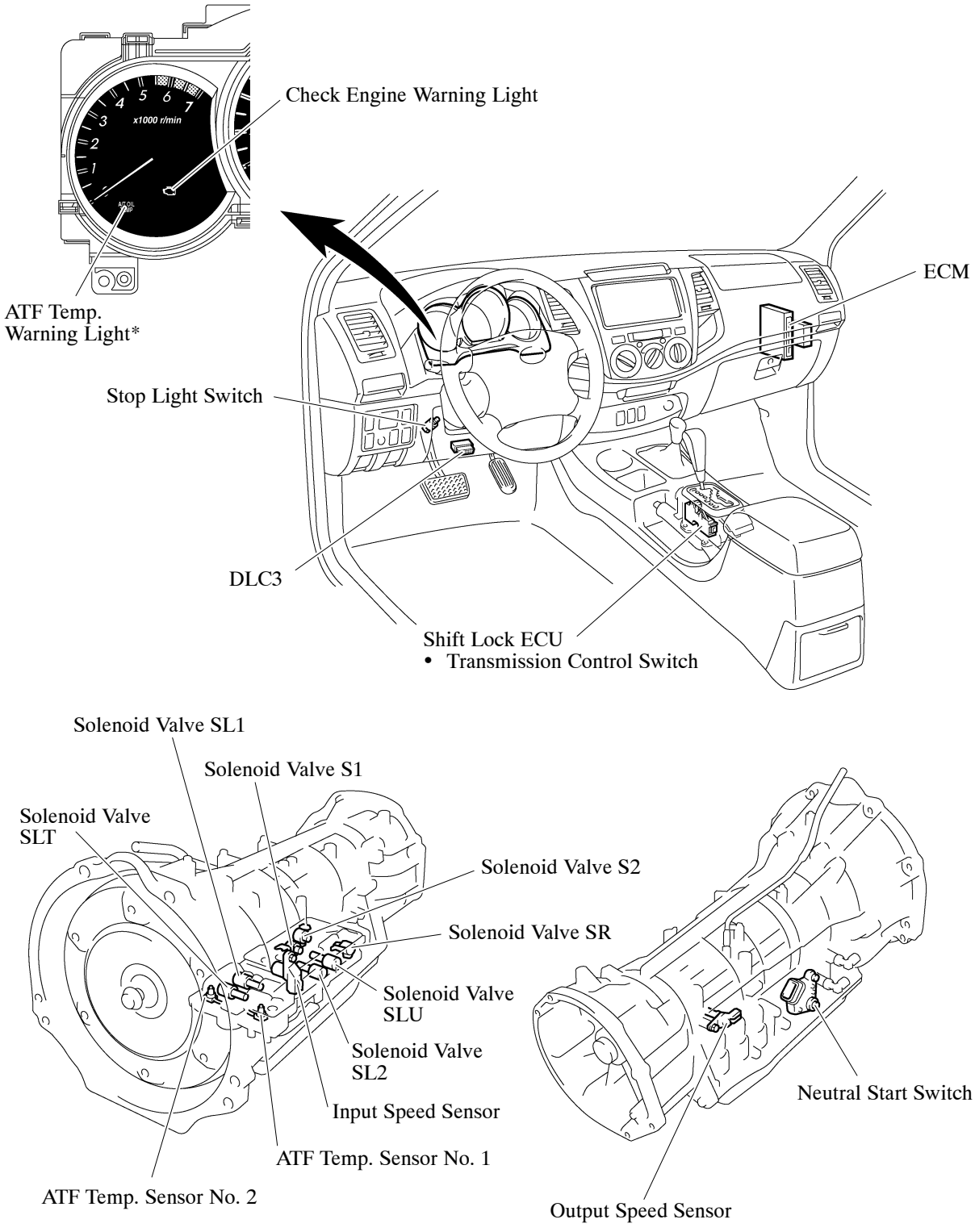



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*: Models with A750F automatic transmission

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## 3. Layout of Main Components

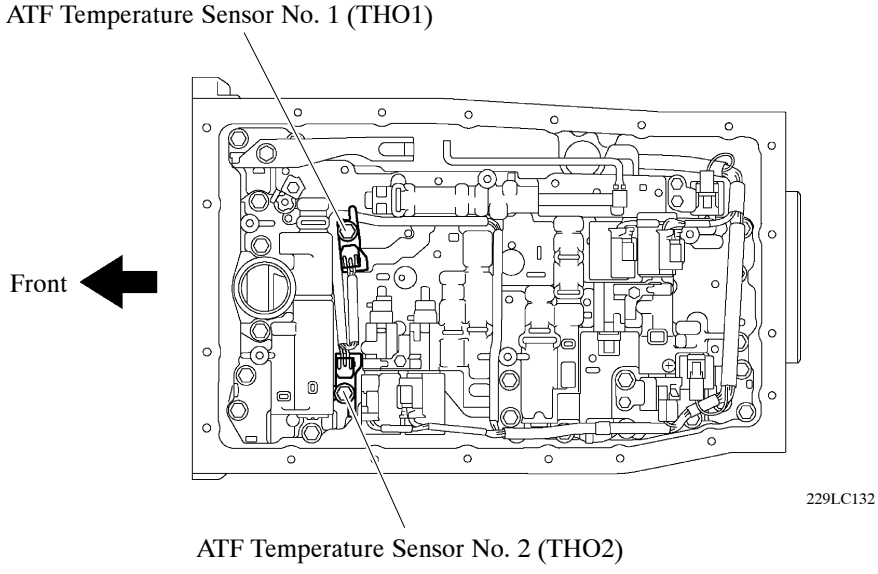



*: Models with A750F automatic transmission

## 4. Construction and Operation of Main Components

### ATF Temperature Sensors No. 1 and No. 2

- ATF temperature sensor No. 1 (THO1) is used for hydraulic pressure control. This sensor is used for revision of clutch and brake pressure to ensure smooth shift quality every time.
- ATF temperature sensor No. 2 (THO2) is used for shifting of the shift timing control of ECT when the ATF temperature is high. However, on the 4WD model, it is also used for the ATF temperature warning light.

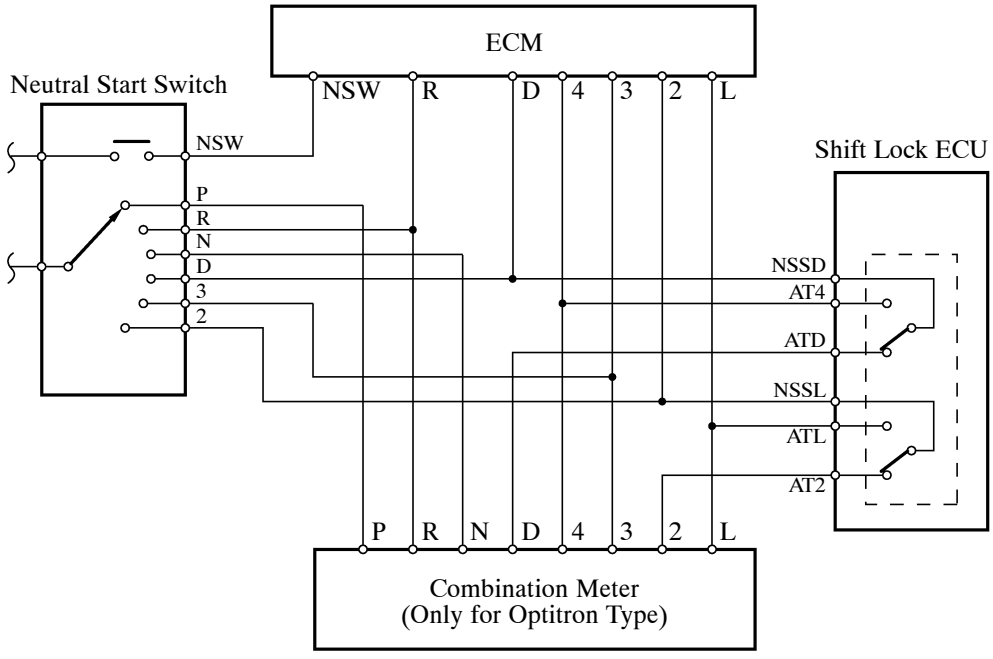


### Transmission Control Switch and Neutral Start Switch

The ECM uses these switches to detect the shift position.

- The neutral start switch sends the R, D, 3, 2, and NSW position signals to the ECM. It also sends signals for the shift position indicator light (P, R, N, and 3) in the combination meter (only for Optitron type).
- The transmission control switch is located in the shift lock ECU. This switch sends the 4th and L signals to the ECM. It also sends signals for the shift position indicator light (D, 4, 2 and L) in the combination meter (only for Optitron type).

**▶ Wiring Diagram ◀**

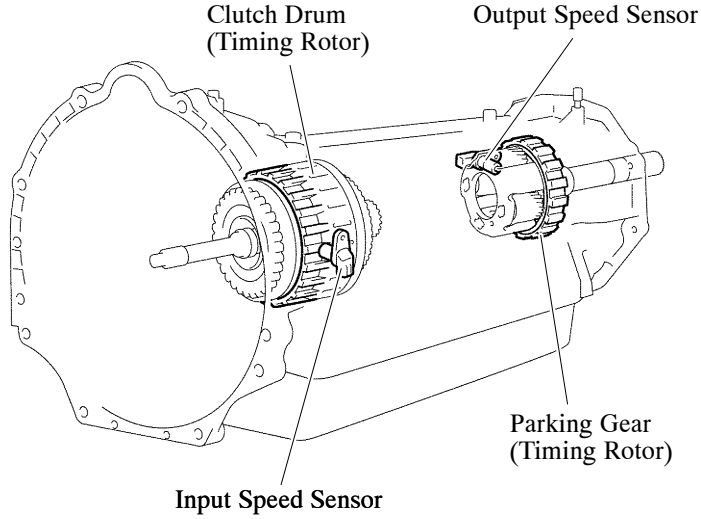



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### Input Speed Sensor and Output Speed Sensor

The A750E and A750F automatic transmissions use an input speed sensor (for the NT signal) and output speed sensor (for the 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 the 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.

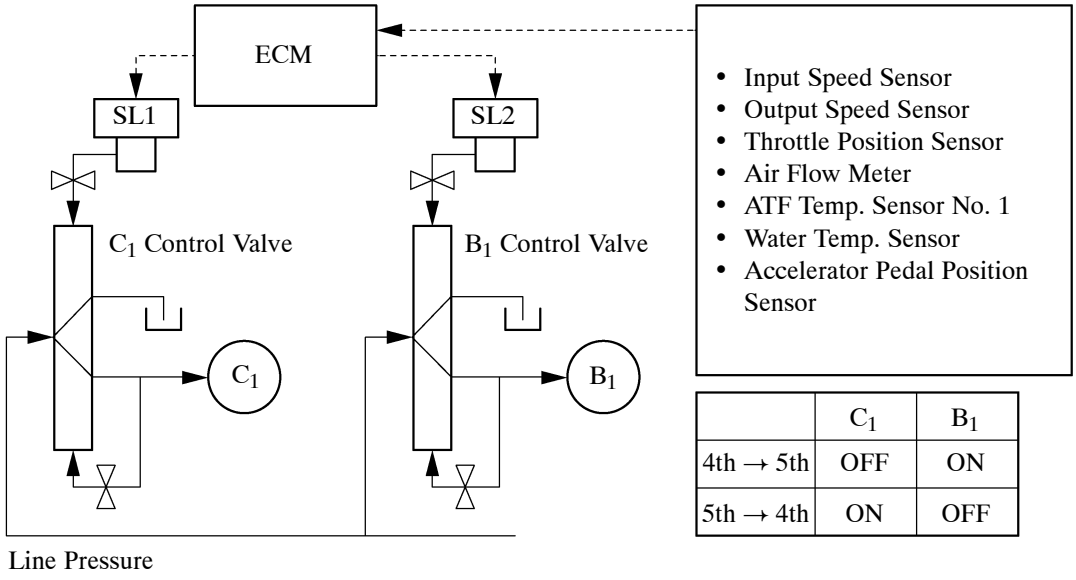



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## 5. Clutch Pressure Control

### Clutch to Clutch Pressure Control

This control is used for shifting from the 4th to 5th gear and from the 5th to 4th gear.
It actuates solenoid valves SL1 and SL2 in accordance with the signals from the ECM, 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 $C_1$ clutch.
As a result, high response and excellent shift characteristics have been achieved.

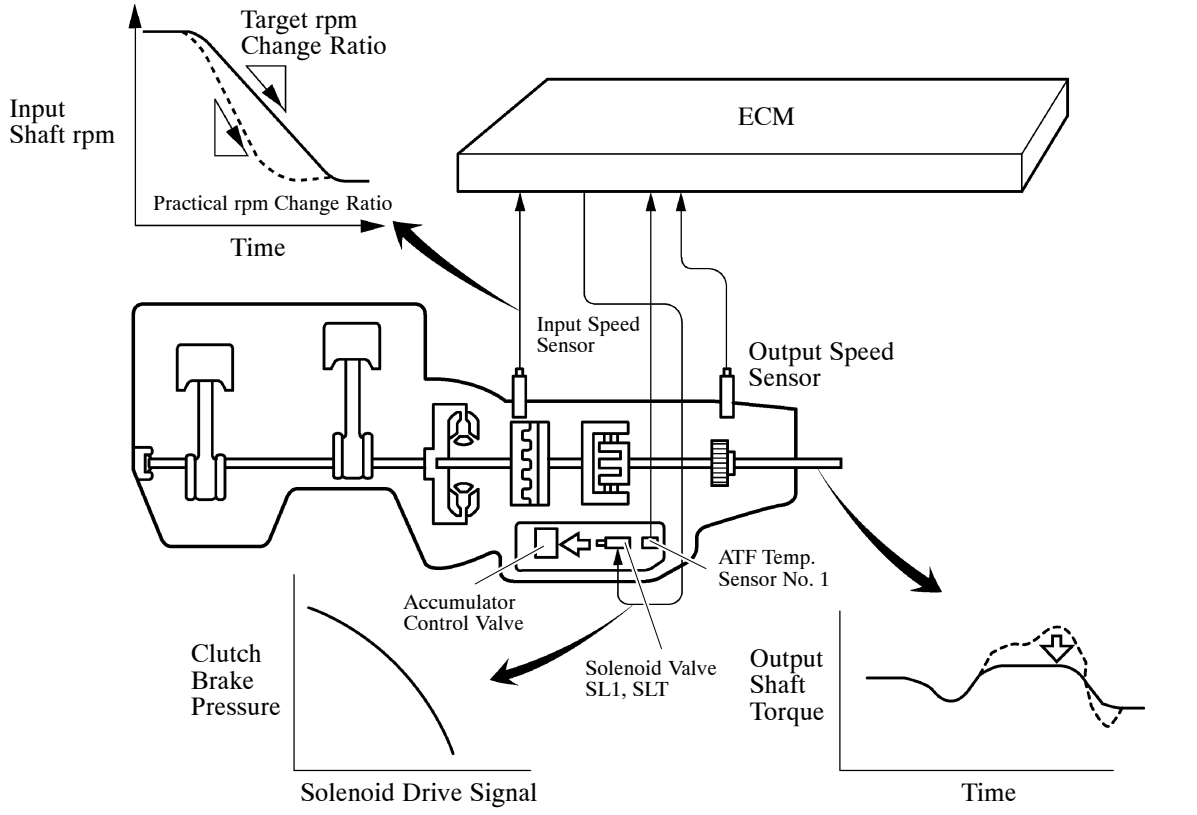



| | $C_1$ | $B_1$ |
|---|---|---|
| 4th → 5th | OFF | ON |
| 5th → 4th | ON | OFF |

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### Clutch Pressure Optimal Control

The ECM monitors the signals from various types of sensor such as the input speed sensor, allowing 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 achieved.

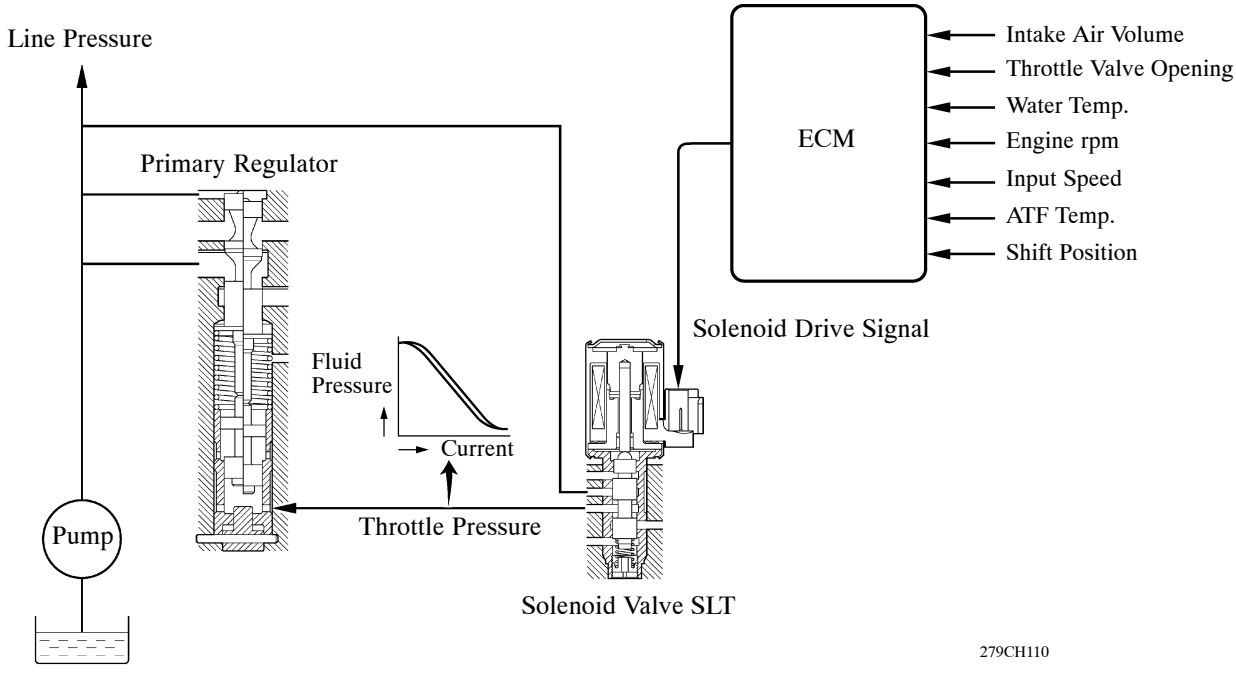



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## 6. Line Pressure Optimal Control

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.

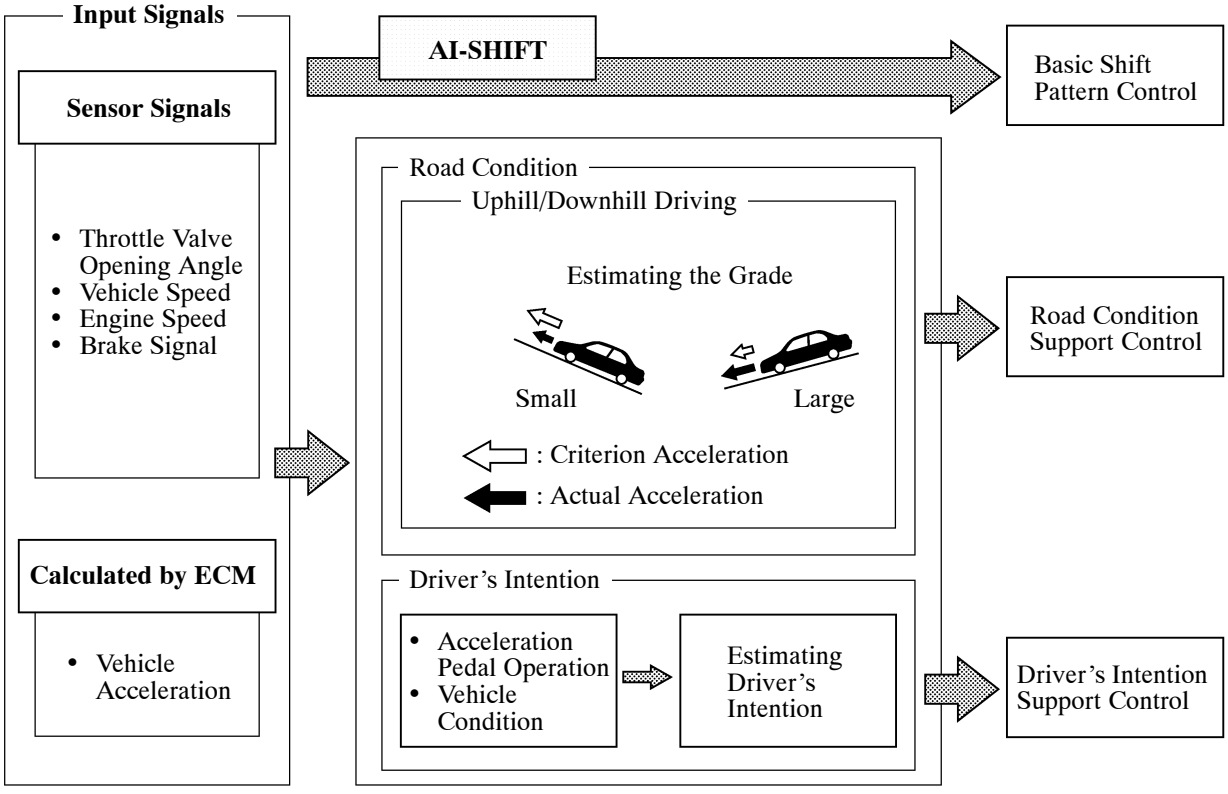
Accordingly, the line pressure can be controlled minutely in accordance with the engine output, traveling condition, and the ATF temperature, thus achieving smooth shift characteristics and optimizing the workload in the oil pump.



## 7. AI (Artificial Intelligence)-SHIFT Control

### General

In addition to the switching of the shift pattern through the pattern select switch, the AI-SHIFT control enables the ECM to estimate the road conditions and the driver's intention in order to automatically switch to the optimal shift pattern. As a result, a comfortable ride has been achieved.

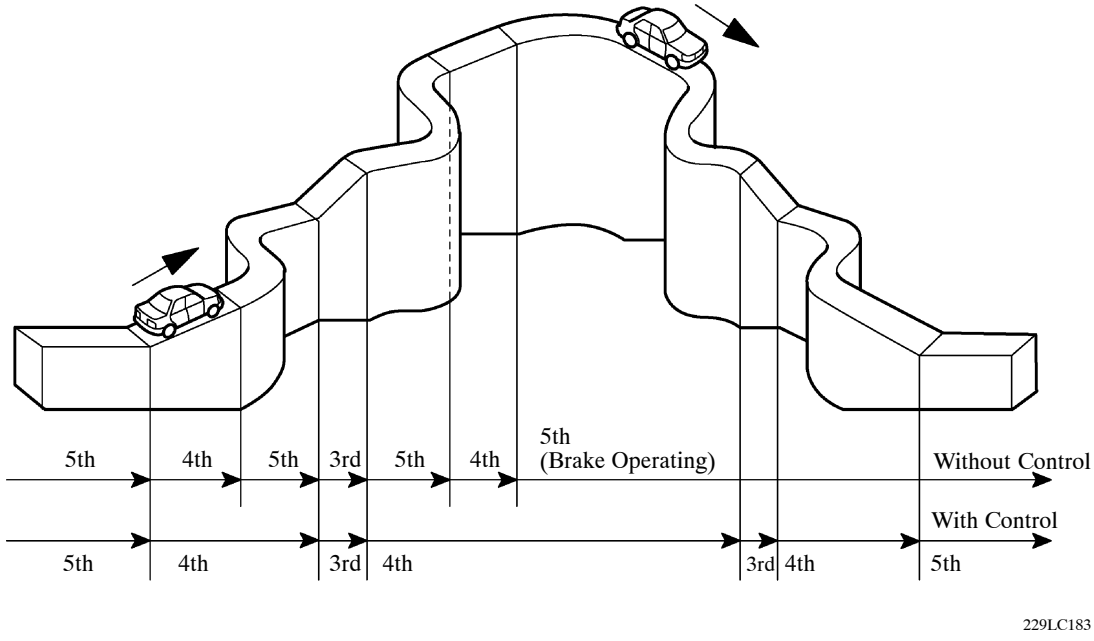



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### Road Condition Support Control

Under road condition support control, the ECM identifies throttle valve opening angle, accelerator pedal operating angle and the vehicle speed whether the vehicle is being driven uphill or downhill.
To achieve an optimal drive force while driving uphill, this control prevents the transmission from upshifting to the 4th or 5th gear. To achieve an optimal engine brake effect while driving downhill, this control automatically downshifts the transmission to the 4th or 3rd gear.




### Driver's Intention Support Control

Under driver's intention support control, the driver's intention is estimated based on the accelerator operation and vehicle condition to switch to a shift pattern that is well-suited to each driver.

## 8. Diagnosis

- When the ECM detects a malfunction, it 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 DTCs (Diagnosis Trouble Codes) are stored in memory. The DTCs can be read by connecting an intelligent tester II to DLC3.

For details, refer to the Fortuner/Hilux SW4 Repair Manual.

## 9. Fail-safe

This function minimizes the loss of operability when any abnormality occurs in any sensor or solenoid.

**▶ Fail-safe Control List ◀**

| Malfunction Part | Function |
|---|---|
| Input Speed Sensor (NT) | During an input speed sensor malfunction, shift control is effected through the output speed sensor signal (SP2).<br>During an input speed sensor malfunction, shift control is effected through the input speed sensor signal (SPD). |
| Output Speed Sensor (SP2) | During an output speed sensor malfunction, shift control is effected through the input speed sensor signal (NT).<br>During an output speed sensor malfunction, shift control is effected through the input speed sensor signal (SPD). |
| ATF Temp. Sensor No. 1 | During an ATF temp. sensor No. 1 malfunction, up-shifts to 5th and lock-up clutch control are prohibited.<br>During an ATF temp. sensor No. 1 malfunction, the system effects control by fixing the ATF temperature at 80°C (176°F). |
| Solenoid Valves<br>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.<br>Shift control is effected depending on the failed solenoid as described in the table on the next page. |
| Solenoid Valves<br>SL1 and SL2 | During a solenoid valve SL1 or SL2 malfunction, up-shifts to 5th and lock-up clutch control are prohibited. |
| Solenoid Valve SLU | During a solenoid valve SLU malfunction, the current to the solenoid valve is stopped. This stops lock-up control, thus decreasing fuel economy. |
| Solenoid Valve SLT | During a solenoid valve SLT malfunction, the current to the solenoid valve is stopped. This stops line pressure optimal control, thus increasing shift-shock. However, shifting is effected through normal clutch pressure control. |

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

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

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

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

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