## ■ ELECTRONIC CONTROL SYSTEM

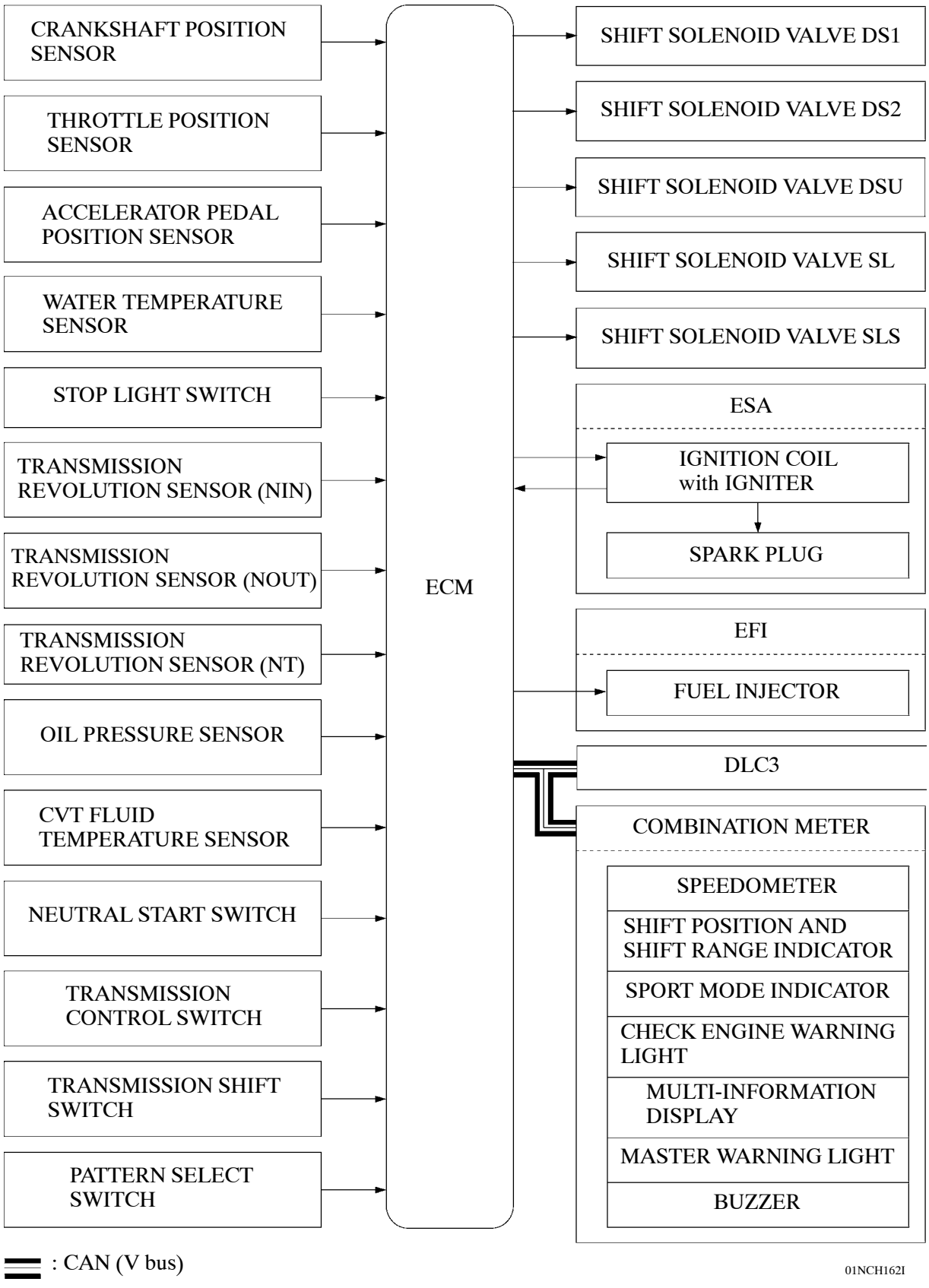
### 1. General

The electronic control system of the K111F CVT consists of the controls listed below:

| Control | | Outline |
|---|---|---|
| Engine – CVT Integrated Control | | Effects coordinate control of the CVT system and engine control system to ensure both smooth and power driving that excels in shift response and excellent fuel economy. |
| Pulley Ratio Control | Automatic Shift Control | Optimally controls the pulley ratio and shifting speed to suit the driver's intentions and driving conditions based on the signals from various sensors and switches. |
| | Acceleration Improvement Control | |
| | 7-speed Sport Sequential Shiftmatic (with Transmission Shift Switch) | |
| Lock-up Control | | The ECM sends current to the solenoid valve DSU based on the throttle position sensor signal and vehicle speed signal, and engages or disengages the lock-up clutch. |
| Shift Control in Uphill/Downhill Traveling | | Controls to restrict the upshift or to provide appropriate engine braking by using the ECM to determine whether the vehicle is traveling uphill or downhill. |
| Fail-safe | | Even if a malfunction is detected in the sensors or solenoids, the ECM effects fail-safe control to prevent the vehicle's driveability from being affected significantly. |
| Diagnosis | | When the ECM detects a malfunction, the ECM makes a diagnosis and memorizes the failed section. |

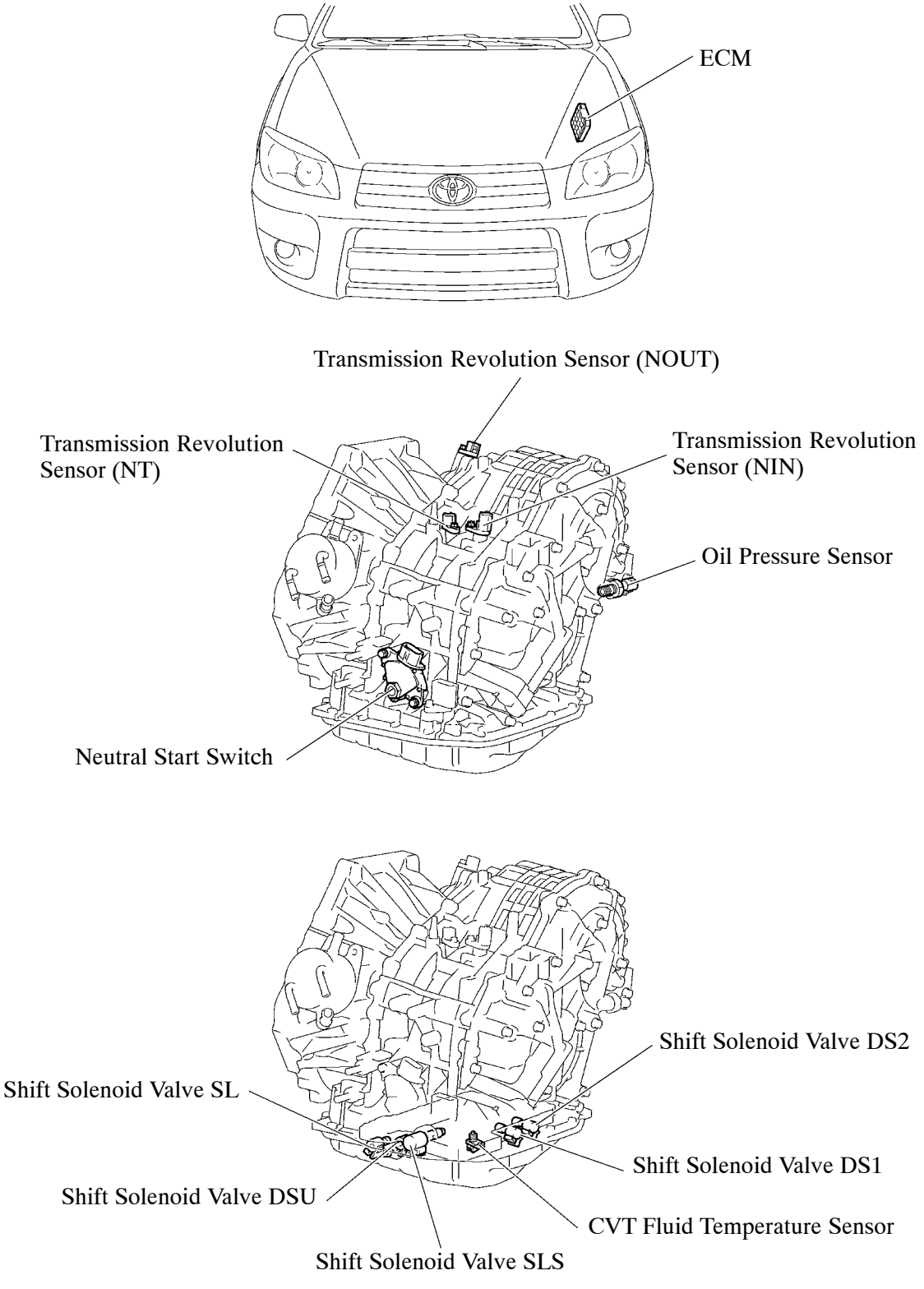
## 2. Construction

The configuration of the electronic control system in the K111F CVT is as shown in the following chart:

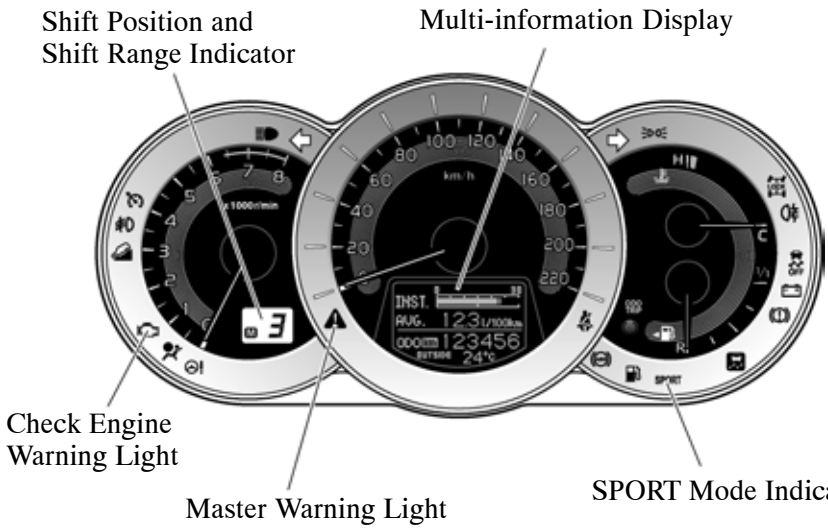


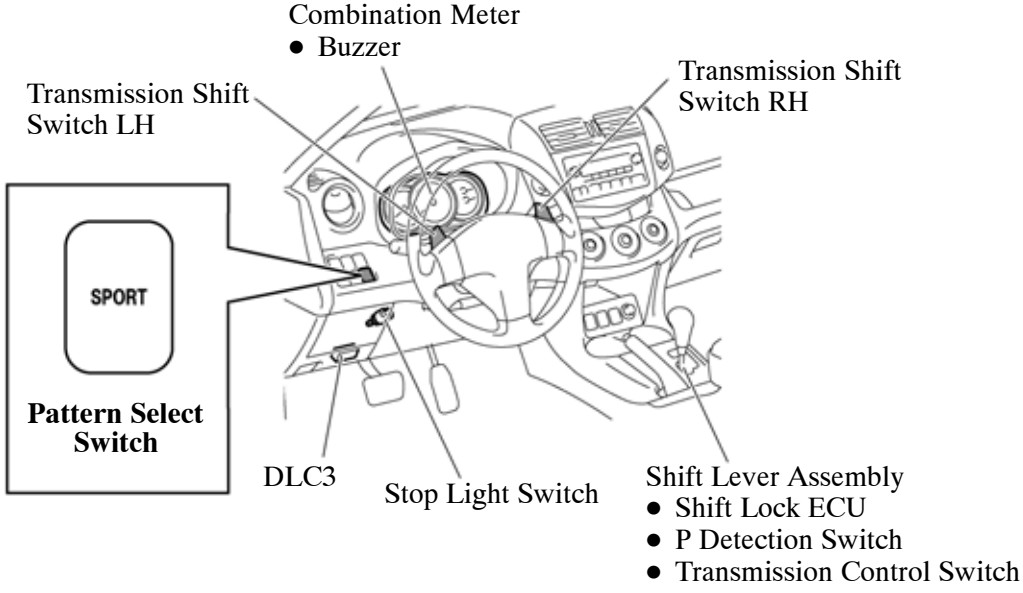

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## 3. Layout of Main Components




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Shift Position and
Shift Range Indicator
Multi-information Display
Check Engine
Warning Light
Master Warning Light
SPORT Mode Indicator

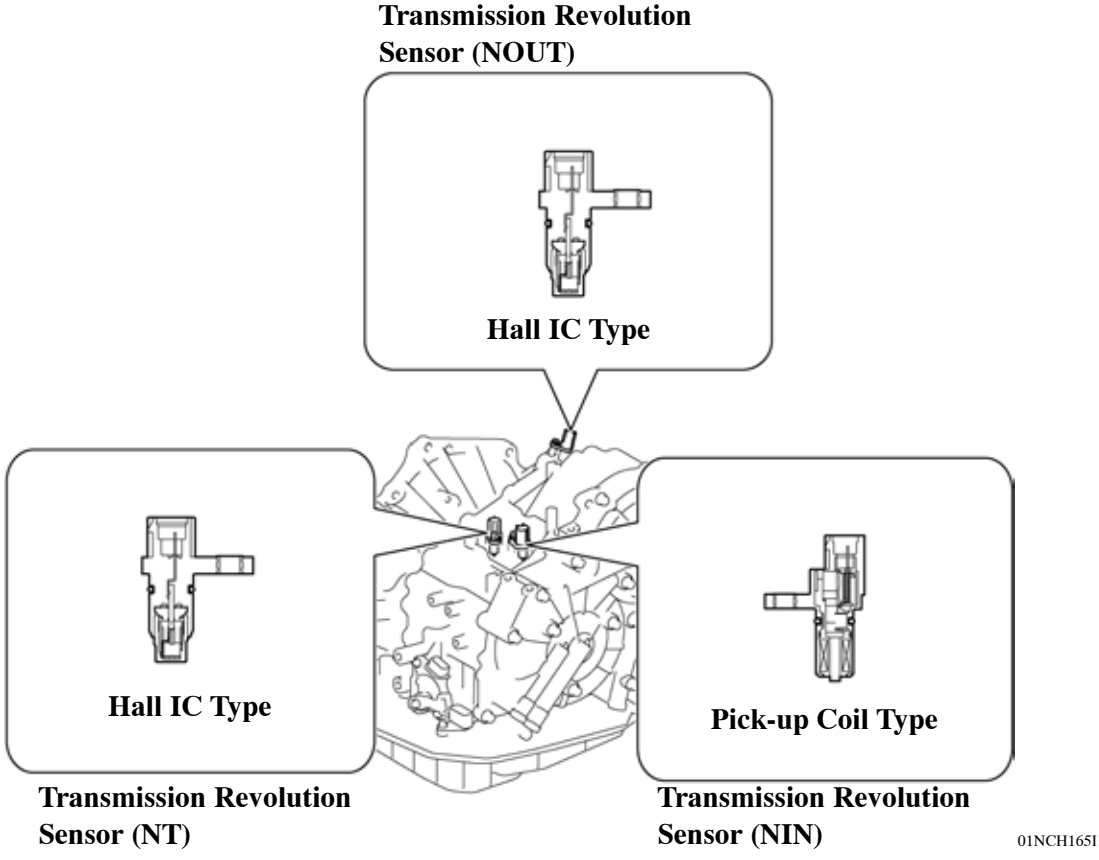

Combination Meter
● Buzzer
Transmission Shift
Switch LH
Transmission Shift
Switch RH
SPORT
Pattern Select
Switch
DLC3
Stop Light Switch
Shift Lever Assembly
● Shift Lock ECU
● P Detection Switch
● Transmission Control Switch

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## 4. Construction and Operation of Main Components

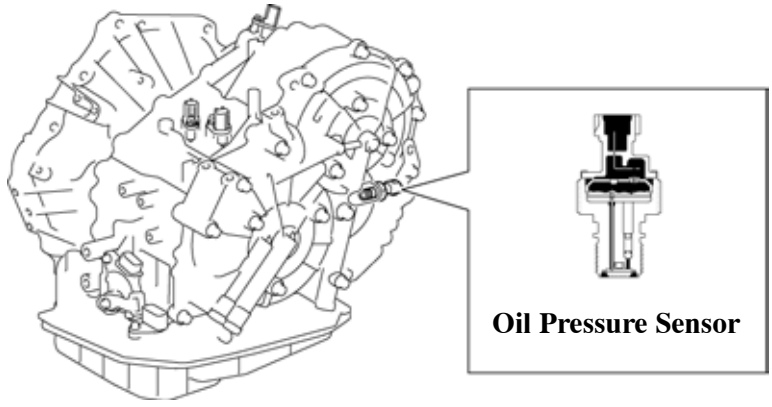
### Transmission Revolution Sensors

- A pick-up coil type sensor is used for transmission revolution sensor (NIN).
- The transmission revolution sensor (NIN) detects the input shaft speed and participates in pulley ratio control.
- A Hall IC type sensor is used for transmission revolution sensor (NOUT) and transmission revolution sensor (NT).
- The transmission revolution sensor (NOUT) detects the output shaft speed and participates in pulley ratio control.
- The transmission revolution sensor (NT) detects the forward clutch turbine speed and participates in lock-up clutch pressure control and forward clutch pressure control.



### Oil Pressure Sensor

The oil pressure sensor detects the hydraulic pressure applied to the secondary pulley and participates in belt clamping pressure control, which optimally controls the clamping pressure of the steel belt necessary for transmitting torque.

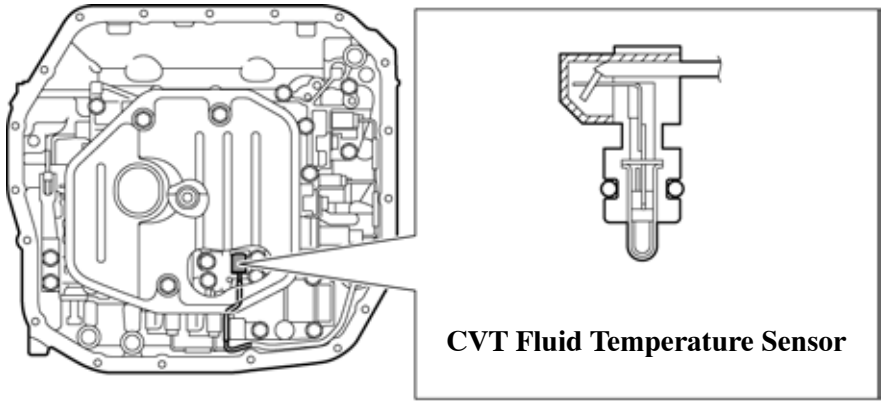



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### CVT Fluid Temperature Sensor

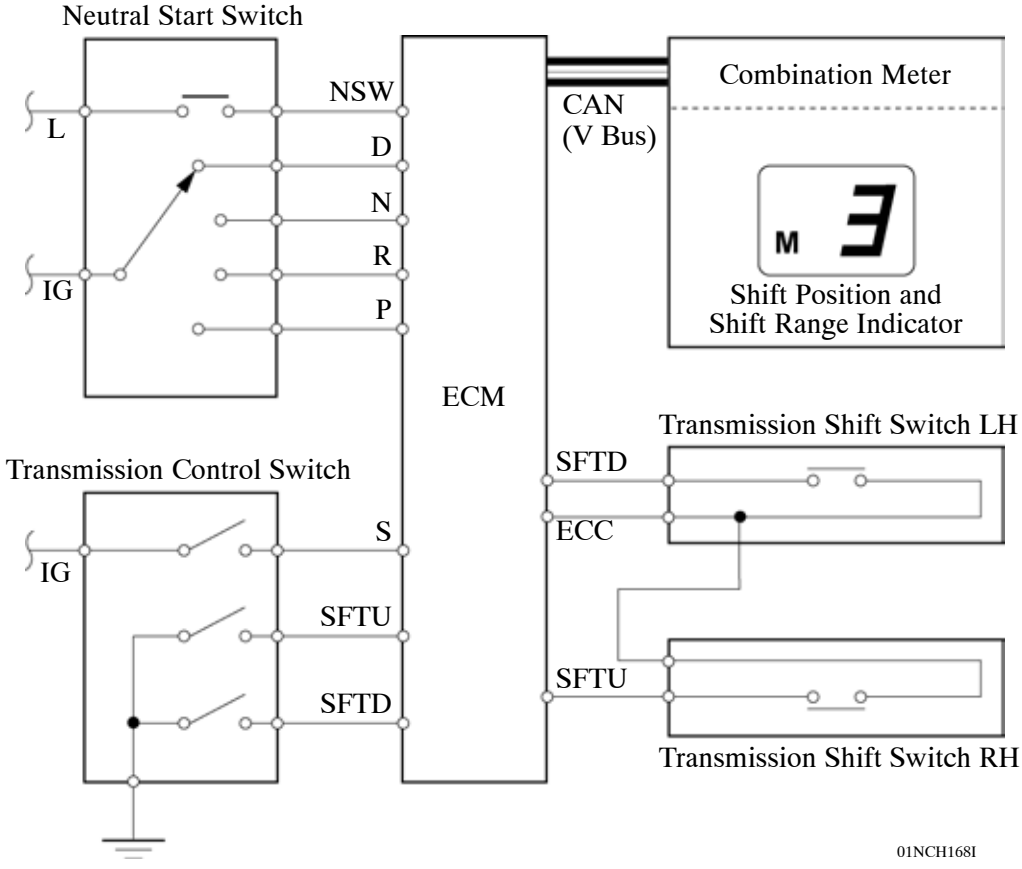
- The CVT fluid temperature sensor is installed in the valve body unit.
- The CVT fluid temperature sensor detects the fluid temperature, effects pulley ratio control in accordance with the fluid temperature, and participates in lock-up clutch pressure control, forward clutch pressure control, and belt clamping pressure control.




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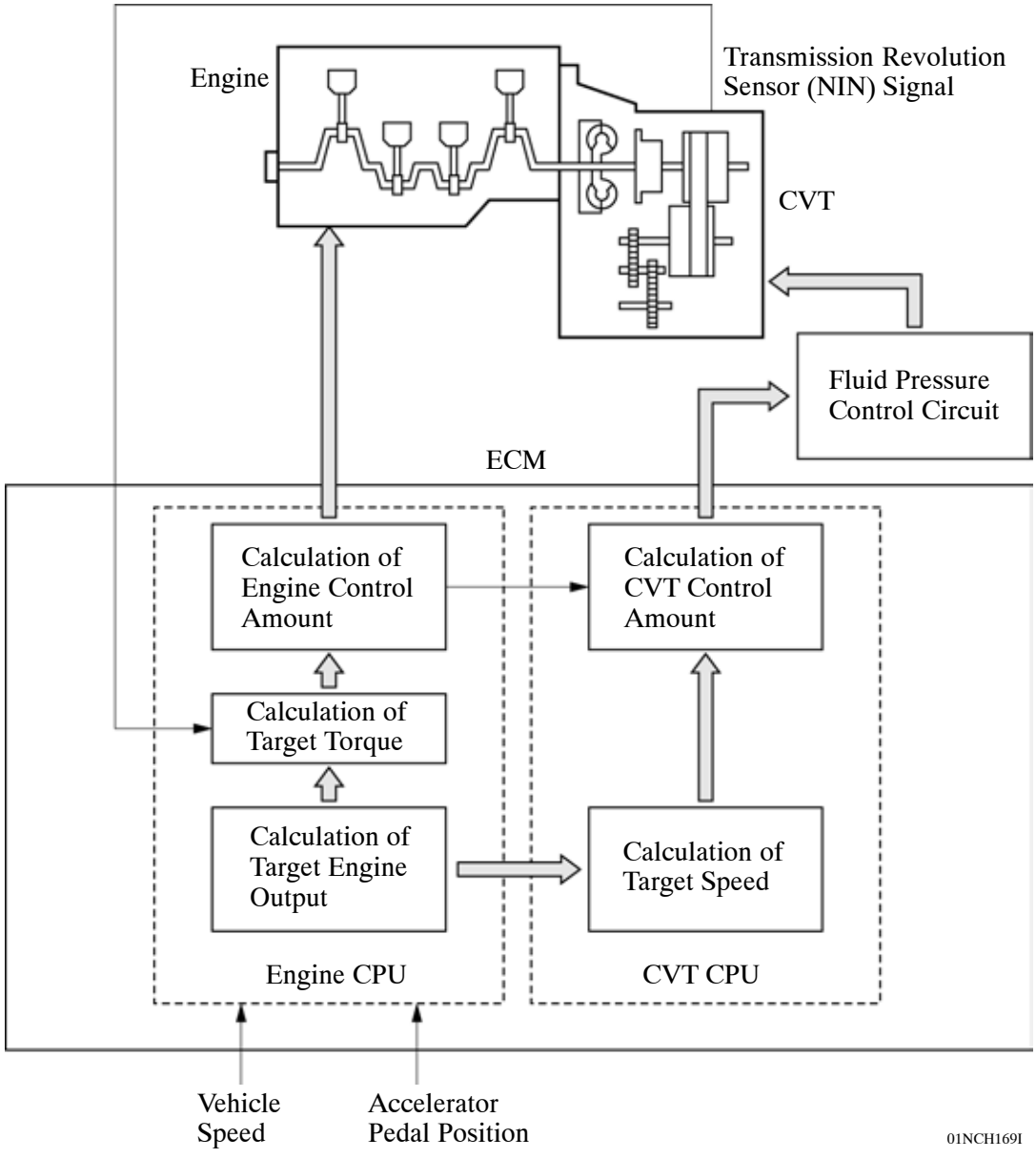
### Neutral Start Switch, Transmission Control Switch and Transmission Shift Switch

- The neutral start switch sends the P, R, N, D and NSW signals to the ECM.
- The transmission control switch detects whether the shift lever is in M (S signal), and detects the operating conditions of the shift lever ("+" or "–"), and sends the SFTU and SFTD signals to the ECM.
- The transmission shift switch RH (for up-shift) sends the SFTU signal to the ECM.
- The transmission shift switch LH (for down-shift) sends the SFTD signal to the ECM.



## 5. Engine - CVT Integrated Control

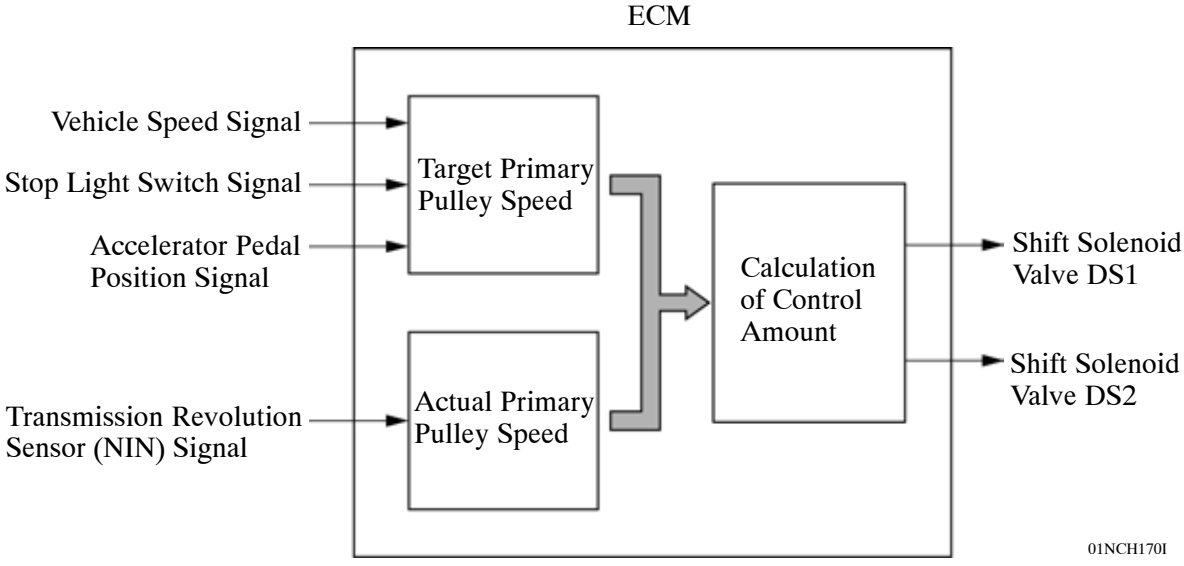
To effect fine-tuned control in accordance with driving conditions, various signals are exchanged between the engine control system and the CVT system. As a result, both smooth and powerful driving that excels in shift response and excellent fuel economy has been achieved.



## 6. Pulley Ratio Control

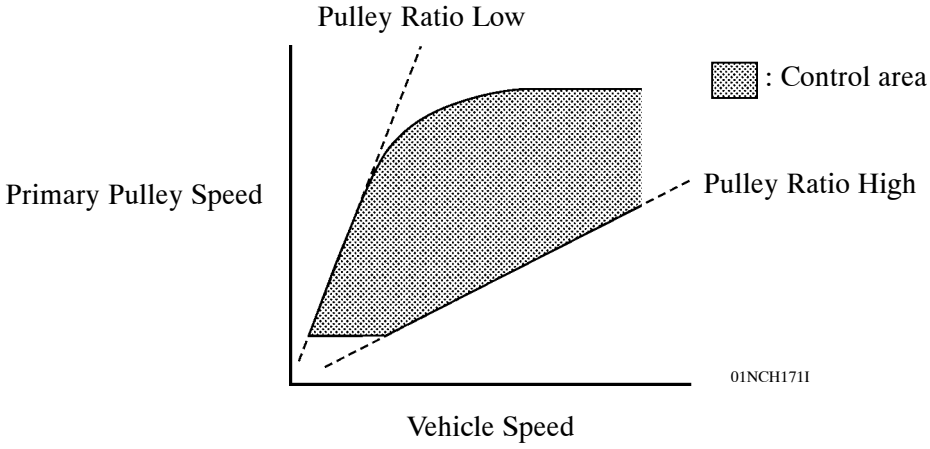
### Automatic Shift Control

- The ECM calculates the target primary pulley speed in accordance with the accelerator pedal position signal, vehicle speed signal, and stop light switch signal, in order to attain an optimal pulley ratio and shifting speed. To allow the actual primary pulley speed [acquired from the transmission revolution sensor (NIN)] to match the target primary pulley speed, the ECM actuates solenoid valves DS1 and DS2 in order to control the inflow and outflow volume of line pressure to and from the primary pulley. As a result, optimal shift ratio and speed have been achieved.

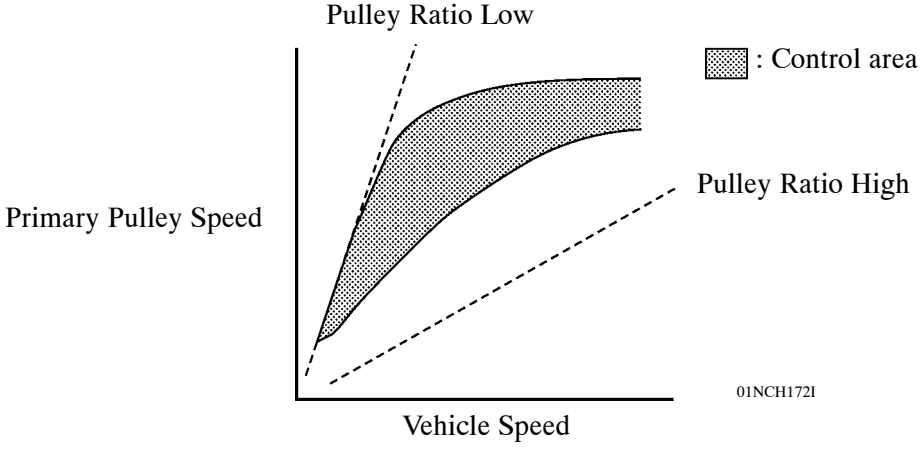


- When the shift lever is in D, the system effects engine integrated control to maximize fuel economy characteristics and driving performance.
- The SPORT mode limits the shift range for the acceleration side and maintains the primary pulley speed at high speeds. This produces a moderate engine braking force and achieves an excellent shift response.

**▶ Shift Lever in D ◀**

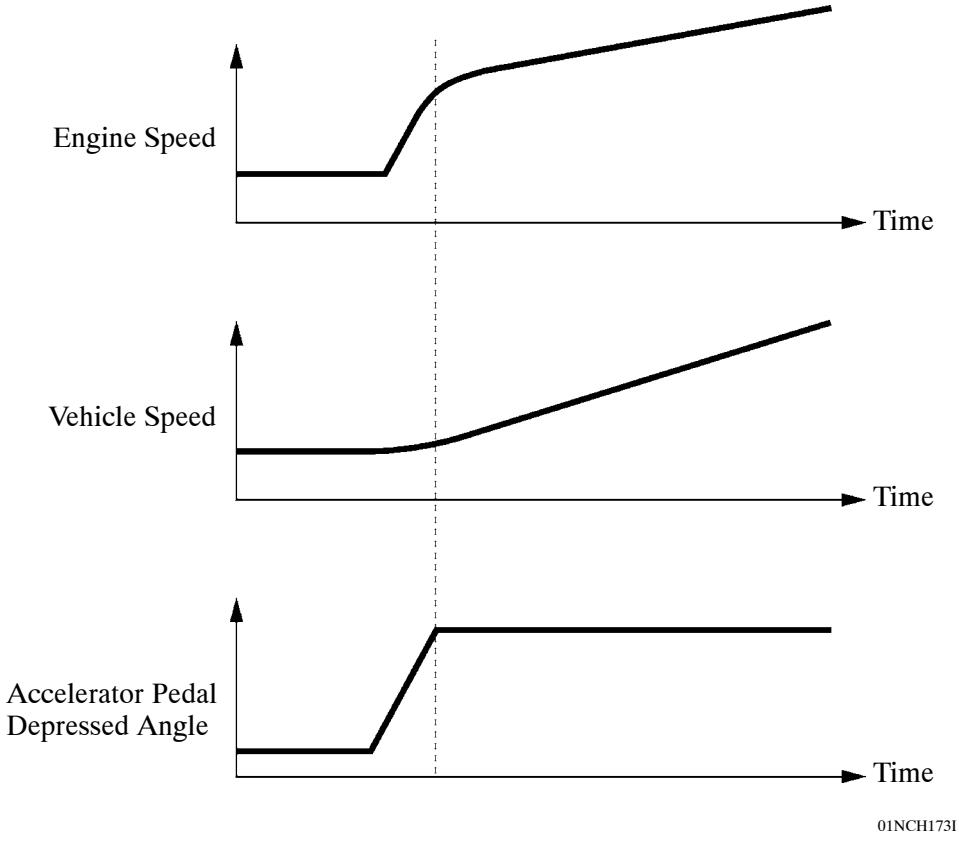



**▶ SPORT Mode ◀**



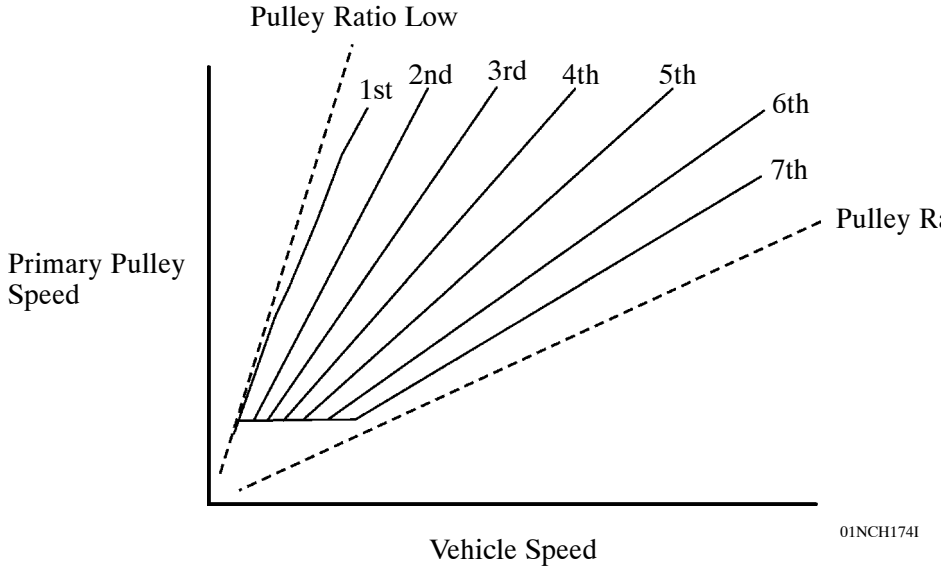
### Acceleration Improvement Control

The system determines the driver's acceleration request based on the vehicle speed and the changes in the accelerator pedal position. When the system determines this request, it will change the shift characteristic into one in which the engine speed and vehicle speed increase linearly. This improves the acceleration feeling.



### 7-speed Sport Sequential Shiftmatic

- When the shift lever is in M, by moving the shift lever or transmission shift switch to "+" or "–", the driver can select the desired shift range. The shift characteristic is as shown below.
- The system will upshift automatically when the vehicle reaches the set speed during acceleration.






- When the shift lever is in M, this system automatically upshifts or downshifts under the following conditions:

| Condition | System Control |
|---|---|
| Engine is under-revving | 1 step downshift |
| Engine is over-revving | 1 step upshift |

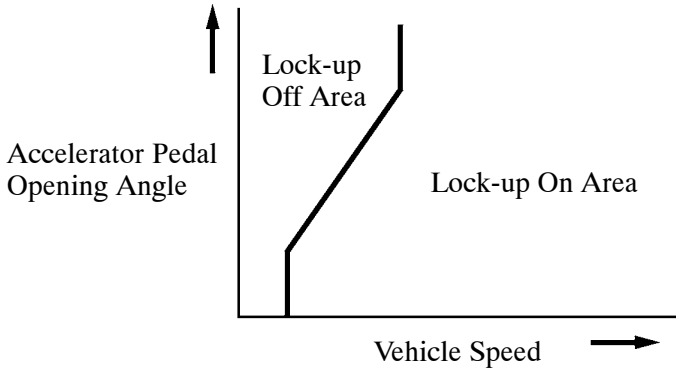
- When the shift lever is in D, the driver can momentarily select a desired shift range by operating the transmission shift switch. It will revert to automatic shift control under the following conditions:

| Condition | System Control |
|---|---|
| The driver continues to push the transmission shift switch in the "+" direction longer than a predetermined length of time. | Reverts to automatic shift control |
| The driver depresses the accelerator pedal longer than a predetermined length of time while the CVT remains in the same shift range. | Reverts to automatic shift control |
| The vehicle has stopped. | Reverts to automatic shift control |
| The driver has moved the shift lever to M. | Transfers to manual shifting |

- The ECM will restrict the changing of the shift range if it detects a malfunction in the system.
- If the vehicle speed and engine speed exceeds or goes below a preset level in response to the driver's downshift operation request, changing the shift range will be prohibited. In this case, the buzzer in the combination meter will sound to alert the driver.

## 7. Lock-up Control

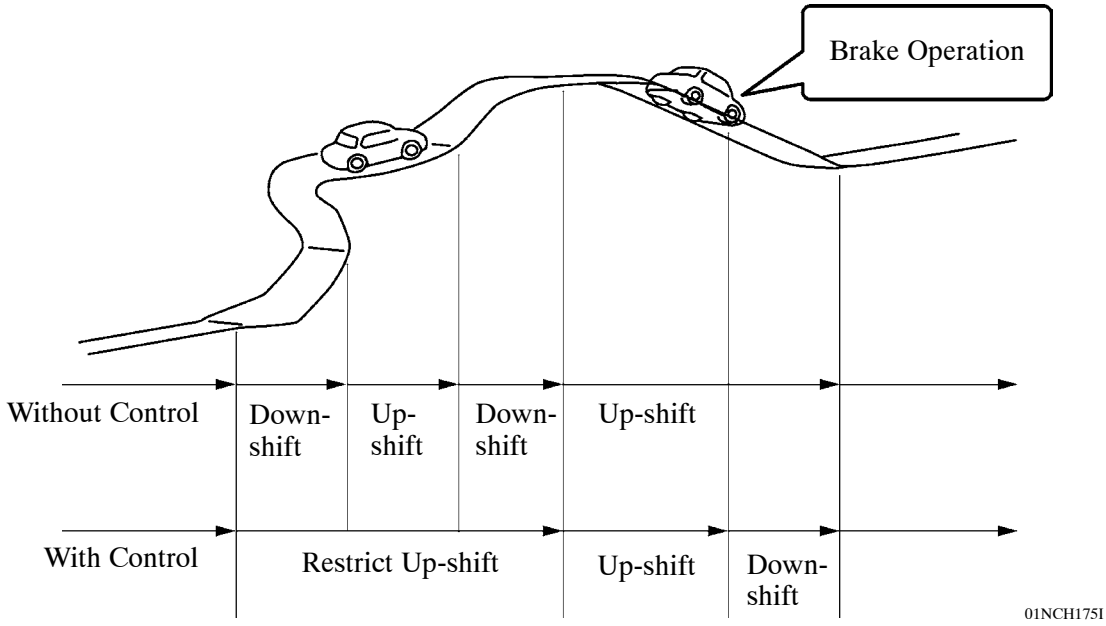
Lock-up is performed based on the evaluation of the accelerator pedal opening and vehicle speed. The lock-up area is widely enlarged to allow the lock-up to be operated while the vehicle is running at a slower speed. In addition, the lock-up area is enlarged towards the low vehicle speed range to widen the fuel cut area. This improves fuel economy.




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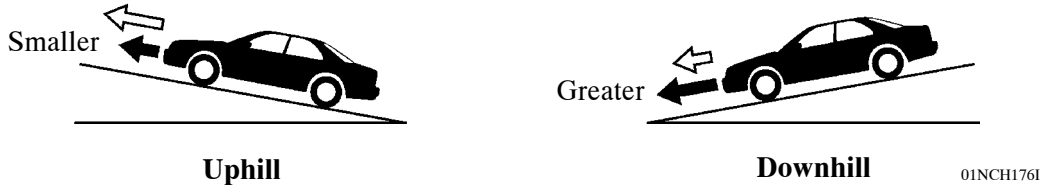
## 8. Shift Control in Uphill/Downhill Traveling

- The ECM determines that the vehicle is driving uphill or downhill based on the accelerator pedal position sensor signal and the vehicle speed signal. During uphill driving, it limits upshift to achieve smooth driving. During downhill driving, it downshifts upon detecting a brake pedal operation, in order to provide a moderate engine brake.




- The actual acceleration calculated from the speed sensor signal is compared with the reference acceleration (based on level road travel) stored in the ECM to determine uphill or downhill travel.

⇦ : Reference acceleration ⬅ : Actual acceleration




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## 9. Fail-safe

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

**▶ Fail-safe Control List ◀**

| Malfunction Part | Function |
|---|---|
| Transmission Revolution Sensor (NIN) | Calculates the input speed from the transmission revolution sensor (NT) signal and effects normal control. |
| Transmission Revolution Sensor (NOUT) | Calculates the output speed from the vehicle speed signal and effects normal control. |
| Transmission Revolution Sensor (NT) | Calculates the turbine speed from the transmission revolution sensor (NIN) signal and effects normal control. |
| Shift Solenoid Valve DS1 | During a solenoid valve DS1 malfunction, the current to the solenoid valve stops, causing the pulley ratio to lean towards deceleration than normal. |
| Shift Solenoid Valve DS2 | During a solenoid valve DS2 malfunction, the current to the solenoid valve stops, causing the pulley ratio to lean towards acceleration than normal. |
| Shift Solenoid Valve SL | ● During a solenoid valve SL malfunction, the current to the solenoid valve is stopped.<br>● The lock-up clutch is released.<br>● The forward clutch and reverse brake pressure control by SLS is stop. |
| Shift Solenoid Valve DSU | ● During a solenoid valve DSU malfunction, the current to the solenoid valve is stopped.<br>● The lock-up clutch is released. |
| Shift Solenoid Valve SLS | ● During a solenoid valve SLS malfunction, the current to the solenoid valve stops, resulting in a maximum belt clamping pressure.<br>● The pulley ratio becomes fixed.<br>● The forward clutch and reverse brake pressure control by SLS is stop. |
| CVT Fluid Temperature Sensor | During a fluid temperature sensor malfunction, the ECM fixes the fluid temperature and effects normal control. |

## 10. Diagnosis

- When the ECM detects a malfunction, the ECM 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 Diagnostic Trouble Codes (DTCs) are stored in memory. The DTCs can be read by connecting an intelligent tester II. For details, refer to the TOYOTA RAV4 Repair Manual.