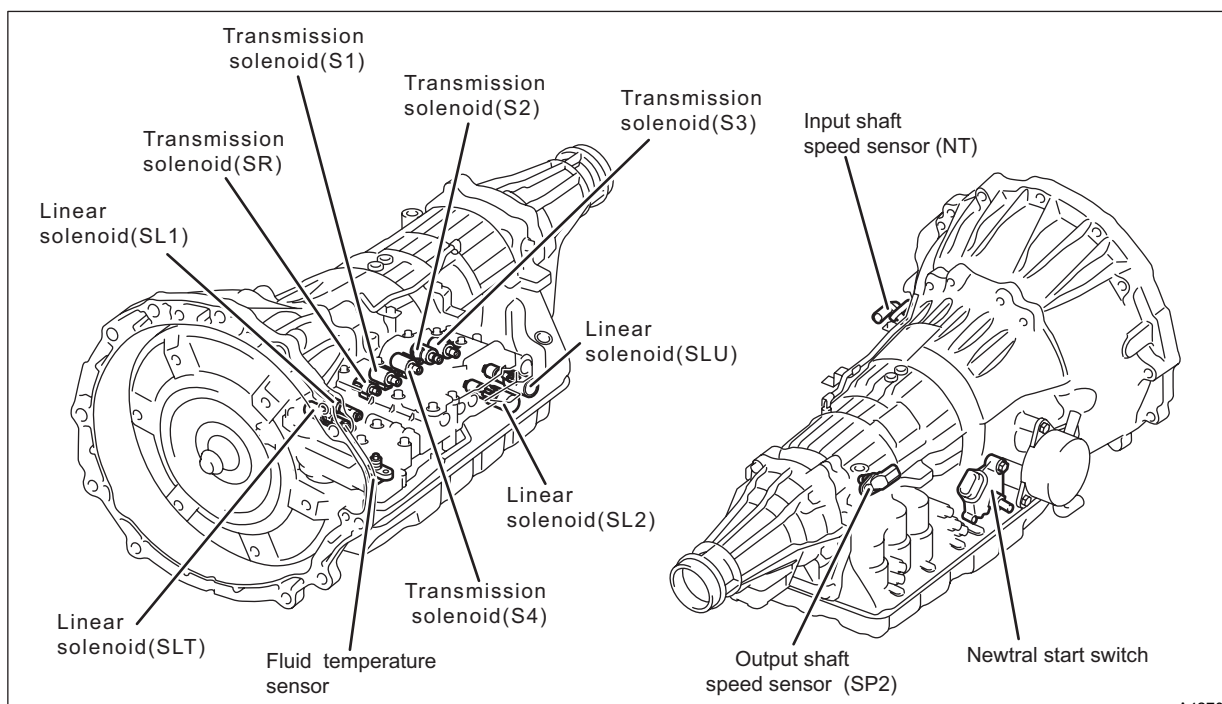
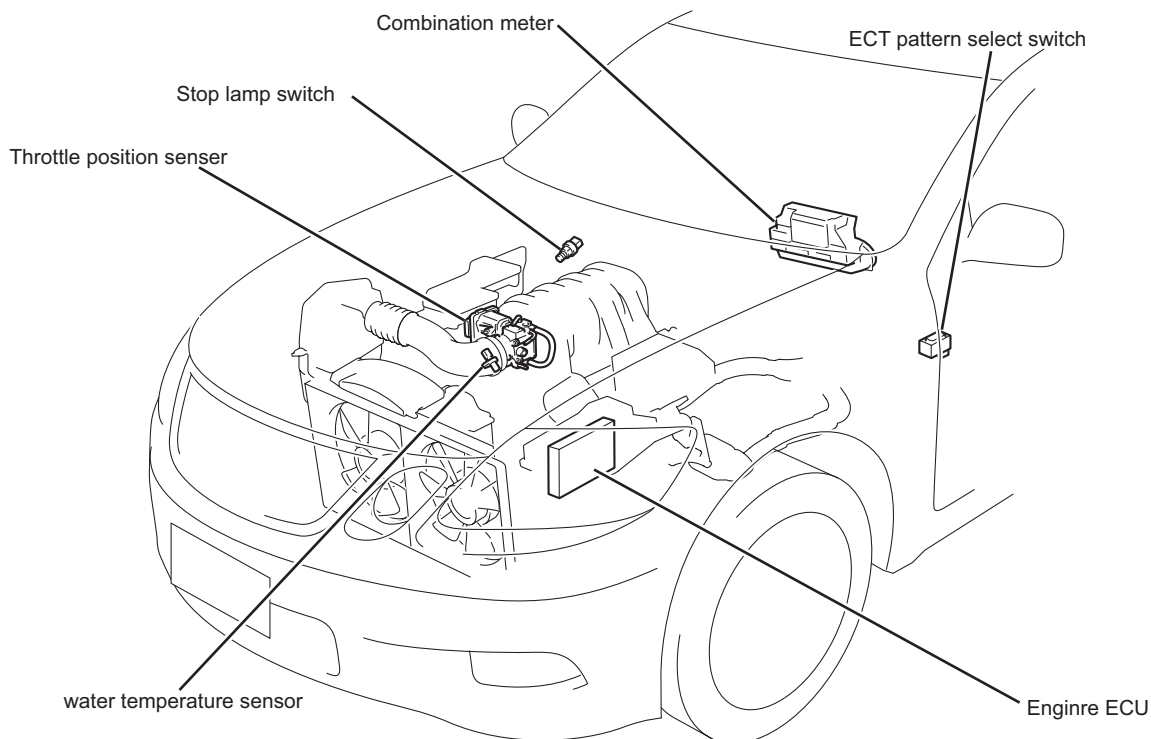
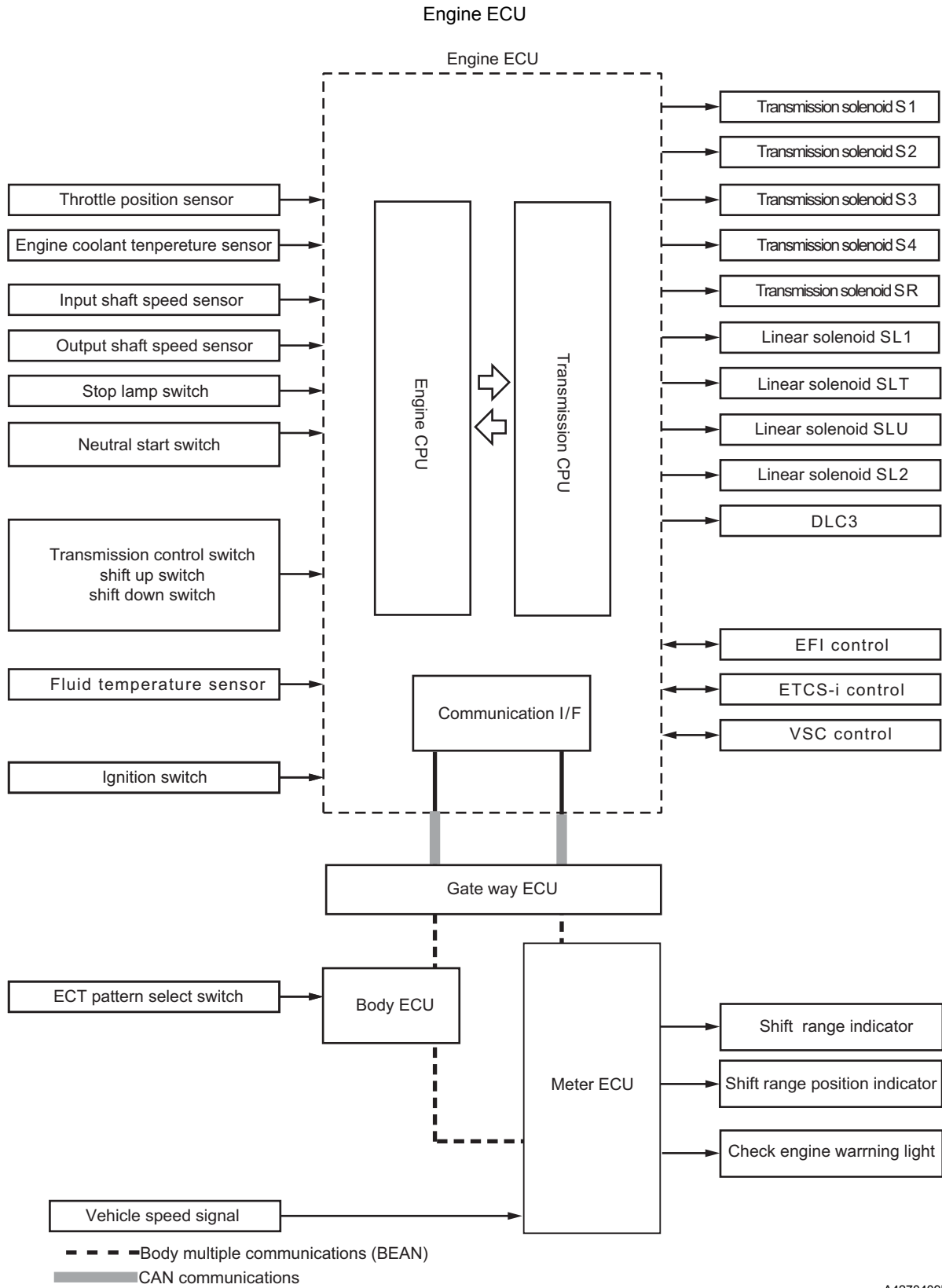


ECT Control

- A transmission control computer that is integrated with the engine control computer is used.
- Based on the signals from each of the sensors, the latest control, such as AI-SHIFT control, is administered to achieve smooth gear shifting.





Component & Function

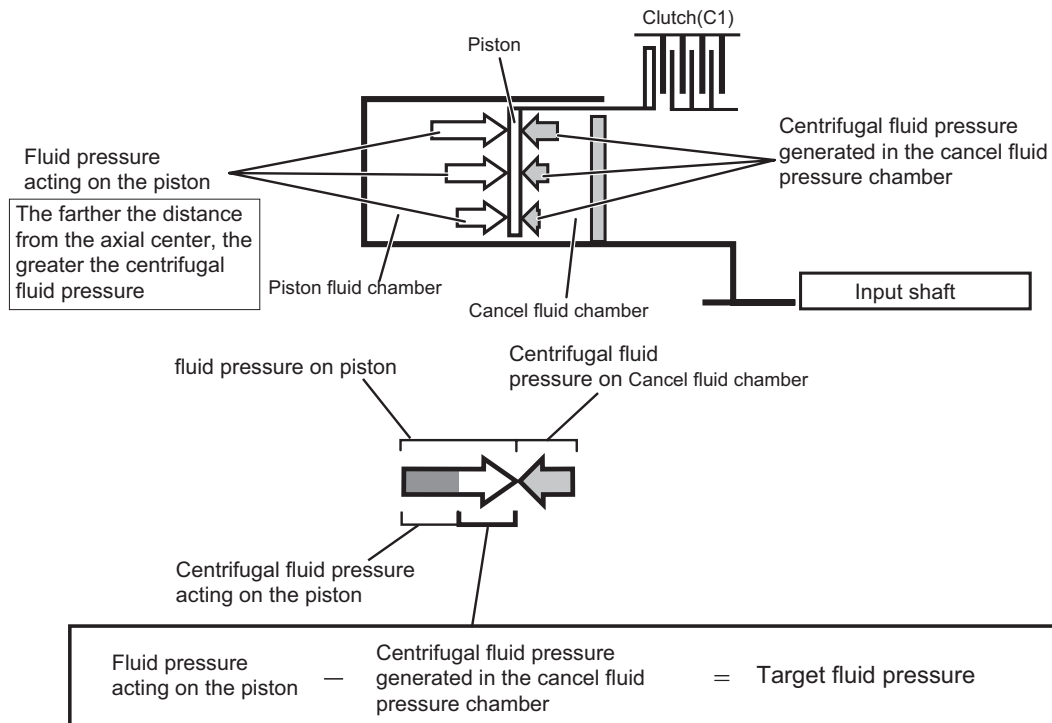
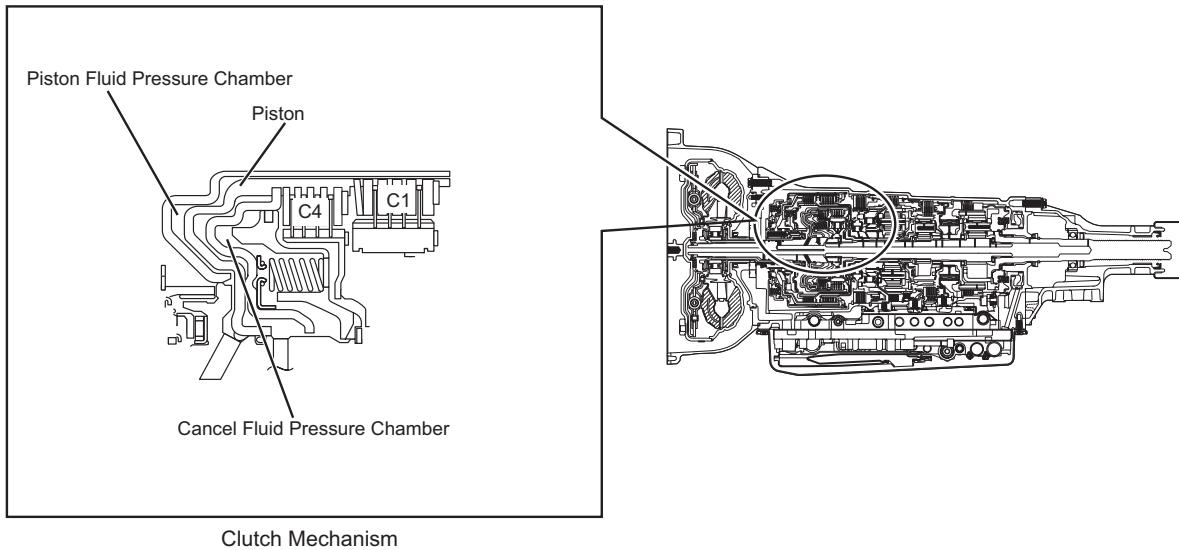
Component	Function
Transmission solenoid S1	Operates when shifting between first and second gears. Switches the oil path of SL1 pressure.
Transmission solenoid S2	Operates when shifting between second and third gears, and fifth and sixth gears.
Transmission solenoid S3	Operates when shifting between third and fourth gears.
Transmission solenoid S4	Operates when shifting between fourth and fifth gears. Switches the oil path of SL1 pressure. Switches the reverse sequence valve.
Transmission solenoid SR	Performs switching between C4 clutch and B1 brake.
Linear solenoid SLT	Performs line hydraulic control and accumulator back pressure control.
Linear solenoid SLU	Performs lock-up control.°
Linear solenoid SL1	Performs clutch hydraulic control and accumulator back pressure control.
Linear solenoid SL2	Performs brake hydraulic control.
Input shaft speed sensor	Detects the rotation speed of the transmission input shaft.
Output shaft speed sensor	Detects the rotation speed of the transmission output shaft.
Oil temperature sensor	Detects the temperature of the oil in the transmission hydraulic control circuit.
Water temperature sensor	Detects the engine water temperature.
Throttle position sensor	Detects the opening of the throttle valve.
Stop lamp switch	Detects depression and non-depression of the brake pedal.
Neutral start switch	Detects the transmission shift lever position.
ECT pattern selector switch	Selects either SNOW mode* or POWER mode.
Shift lever position indicator (built into the combination meter)	Notifies driver of the current shift lever position by lighting the corresponding lamp.
Shift range position indicator (built into the combination meter)	Notifies the driver by displaying the shift lever position (1st to 6th) in sequential mode.°
PWR indicator(built into the combination meter)	Notifies the driver the ECT pattern selector switch is in POWER mode by lighting the corresponding lamp.
SNOW indicator*(built into the combination meter)	Notifies the driver the ECT pattern selector switch is in SNOW mode by lighting the corresponding lamp(SNOW mode is Europe model only).
Cruise control indicator (built into the combination meter)	Notifies the driver that cruise control is activated by lighting the corresponding lamp.
Engine ECU (integrated with transmission control computer)	Performs overall control of engine transmission and transmission control based on the signals from each of the sensors. Equipped with diagnosis mode and failsafe function for better serviceability when a malfunction has occurred.
DLC3	By connecting a diagnostic tool and operating it, the diagnosis code and computer data can be read out.

❖ REFERENCE ❖

* : SNOW mode is Europe model only

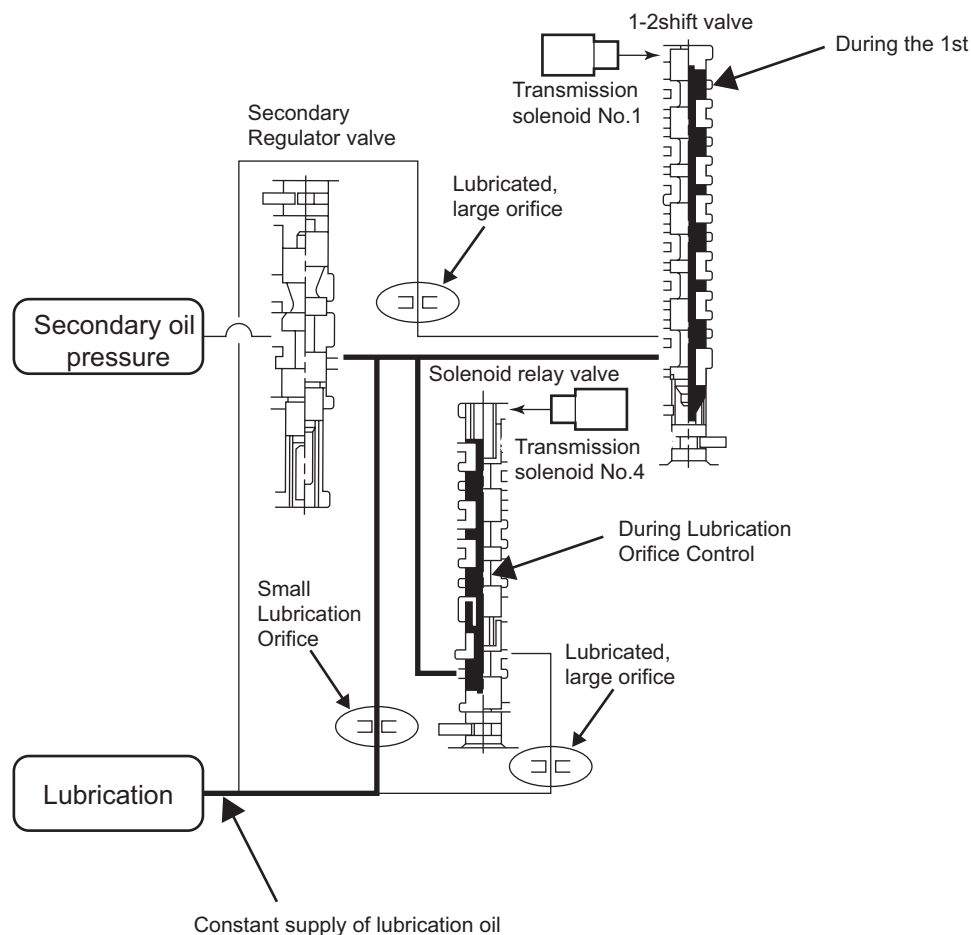
Centrifugal Fluid Pressure Canceling Mechanism

- For operations that require a high level of response while the transmission shifts 2-3, 3-4, 4-5, or 5-6, a centrifugal fluid pressure cancel mechanism is used to engage and disengage the C1, C2, C3, and C4 clutch mechanisms. As a result, a high level of response and smooth shifting characteristics are realized.
- Along with the increase in the speed of the clutch, a centrifugal force acts on the oil in the clutch, which increases the fluid pressure and accelerates the engagement of the clutch. In addition, a shift shock could be created by the rotational difference between the input and output shafts. For this reason, a cancel fluid pressure chamber is provided opposite the piston fluid pressure chamber in the clutch mechanism. The cancel fluid pressure chamber applies an equal amount of centrifugal fluid pressure force to the piston, in the opposite direction. Thus, it cancels out the influences of the centrifugal force.



Apply Orifice Control

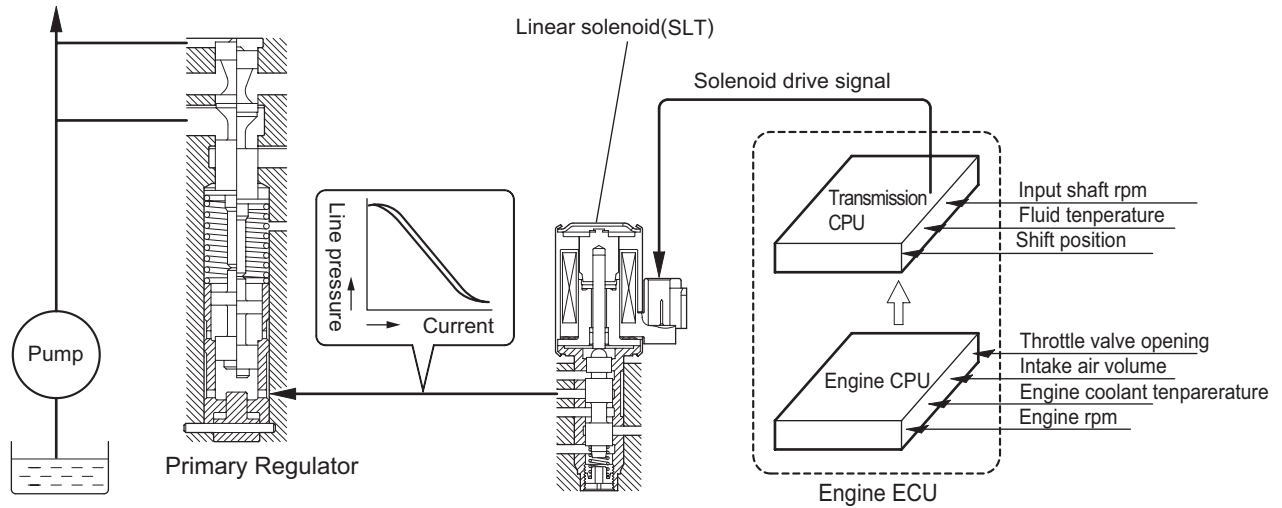
- A lubrication orifice switching control is used in order to counter the suction of air at extremely low temperatures. This control reduces the volume of the lubrication oil when the vehicle is stopped in 1st gear, in a shift position other than reverse.
- When the vehicle is stopped in 1st gear, the transmission uses only the small lubrication orifice. At other times, one of the two lubrication orifices, or both orifices are used for supplying lubrication oil.



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Line Pressure Optimal Control

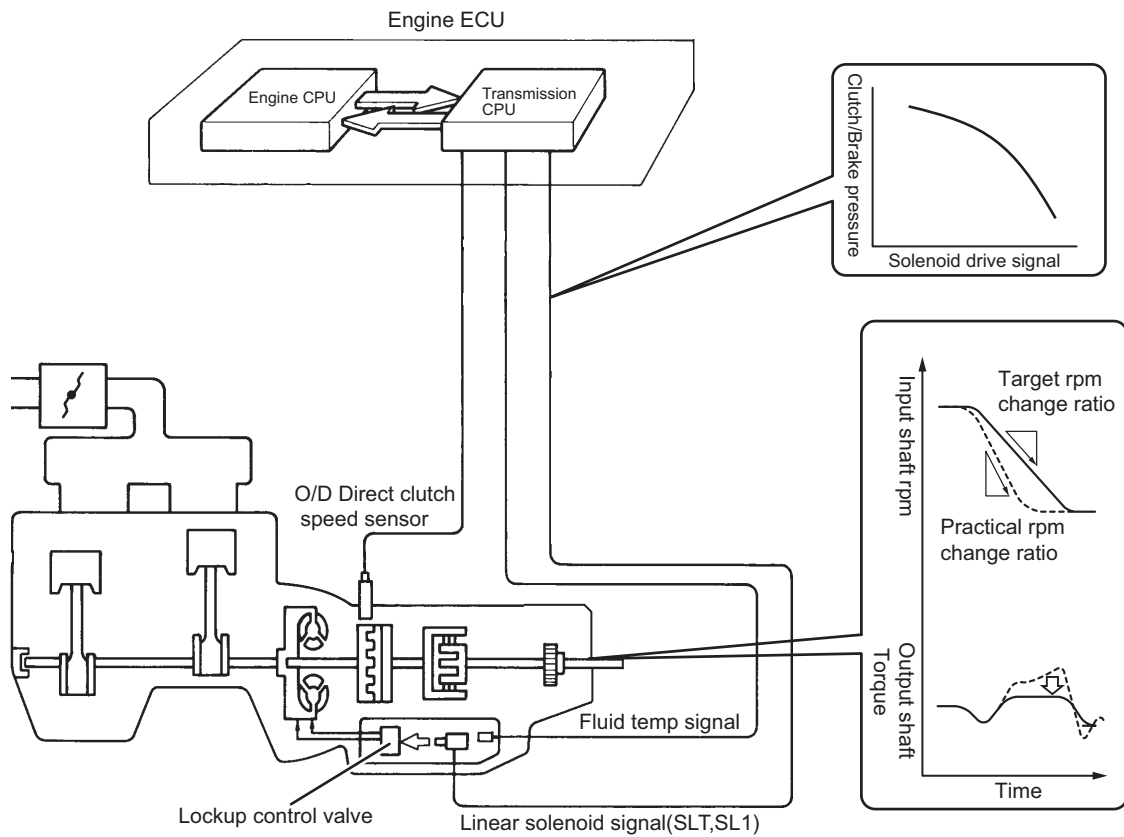
- Controls the line pressure to an optimal value based on real-time engine torque information provided by the engine
- This enables the line pressure to be finely controlled at a high rate of precision in accordance with the engine output and conditions, thus realizing smooth shift characteristics.



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Clutch Pressure Optimal Control

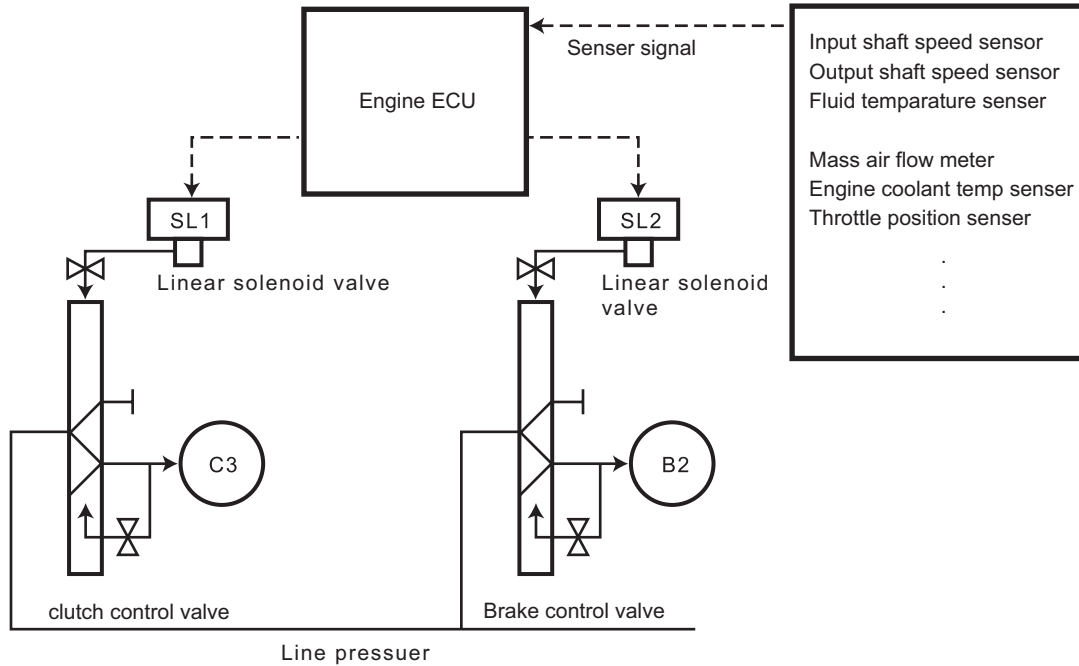
- Based on the signals from the input shaft speed and other sensors, clutch hydraulics are finely controlled by the linear solenoid valves (SLT and SL1) in line with engine output and driving conditions to achieve even smoother gear shifting.



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Clutch to Clutch Pressure Control

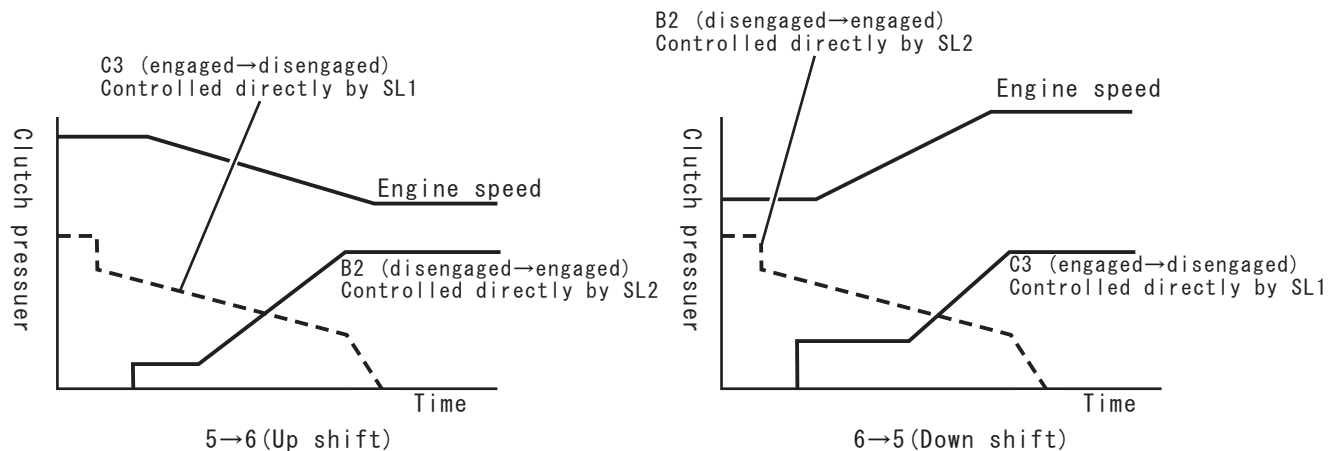
- Clutch-to-clutch shift control is used for controlling the shifting between the 5th and 6th gears. This has enabled the transmission to discontinue the use of a one-way clutch for shifting between 5th and 6th gears, and realize a compact and lightweight construction.
- The engine and transmission ECUs output signals to control the output fluid pressures of the linear solenoid valves SL1 and SL2. These pressures control the control valves in order to directly control the fluid pressures of the C3 clutch and the B2 brake.



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- Up-Downshift: Based on data such as the input and output shaft speeds and engine torque, the ECU controls the clutch to be disengaged and the clutch to be engaged at an optimal fluid pressure and timing. Thus, superior shift characteristics have been realized under all possible driving conditions.

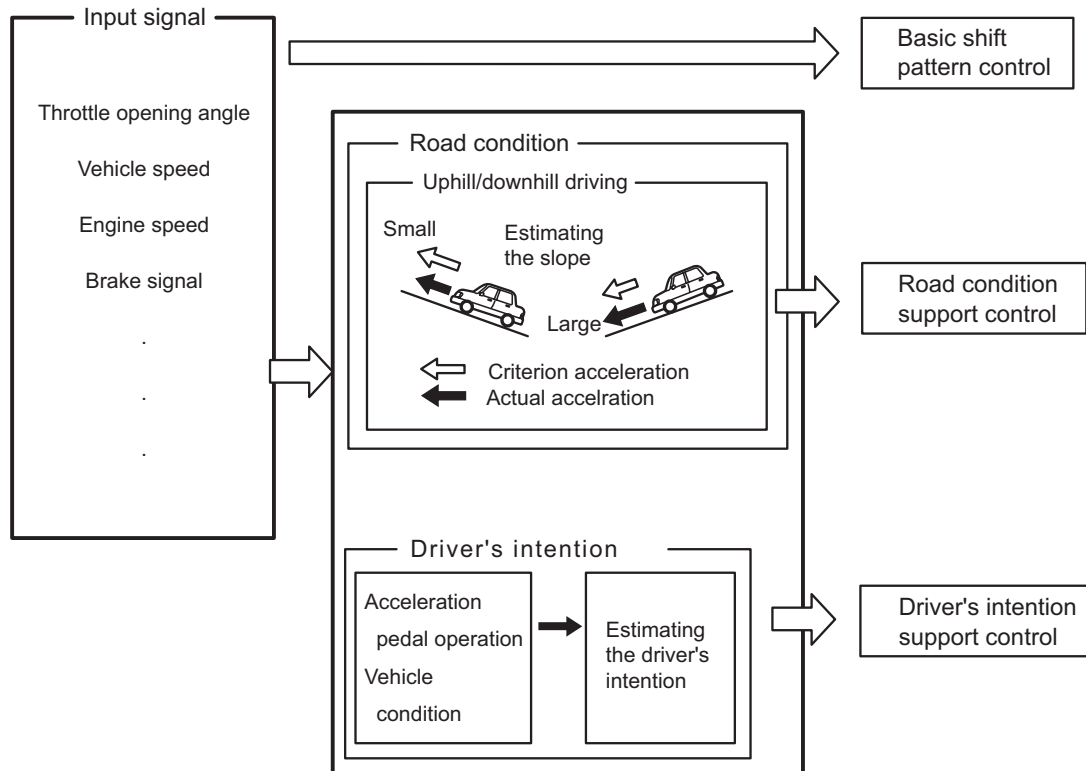
Up shift and down shift



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AI-Shift Control

- The shifting of the gears in the automatic transmission is determined by a shift pattern consisting of vehicle speeds and the engine throttle position as parameters. To switch between the shift lines, the driver operates a switch to change a shift pattern, such as NORMAL, POWER, or SNOW. (SNOW mode is Europe model only)
- In addition to the aforementioned selection of shift patterns through the operation of the switch, the AI-Shift control automatically changes the shift patterns to suit the "road condition" or "driver's intention". As a result, a comfortable driving experience is realized at high levels.
- The AI-Shift control is effected only with the shift lever in the D position, based on accelerator and brake operation data. The AI-Shift control will be canceled when the driver selects the S (sequential) mode.



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Driver's Intention Support Control

- Estimates the driver's intention based on the accelerator operation and vehicle condition to switch to a shift pattern that is well-suited to each driver, without the need to operate the shift pattern select switch.

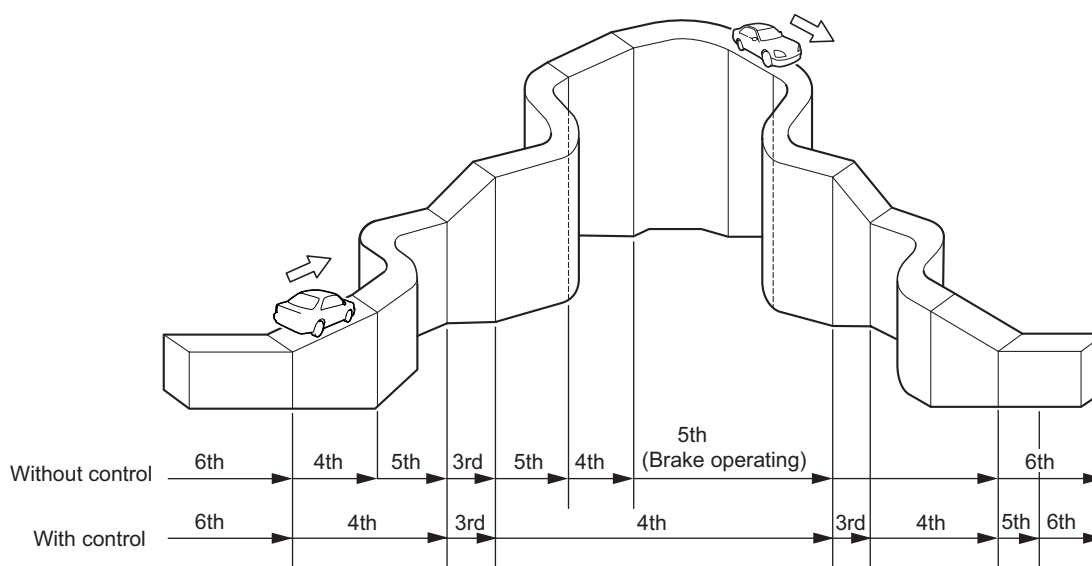
Sport Driving Support Control (AI-SHIFT)

- A type of AI-Shift that excels in acceleration response and thus is suitable for sporty driving, it is used when the POWER pattern is selected.

		Operation	Control Shift Gear
TA Control	Sudden Open Control	When the driver operates the accelerator quickly, this control downshifts rapidly to improve acceleration response.	4th to 6th
	Sudden Close Control	When the driver releases (turns OFF) the accelerator quickly, this control makes it easy for the transmission to hold the gear, which improves engine braking force and re-acceleration response.	2nd to 5th
Sudden Deceleration Downshift Control		When the driver decelerates the vehicle suddenly, this control downshifts rapidly, which improves engine braking force and re-acceleration response.	4th to 6th

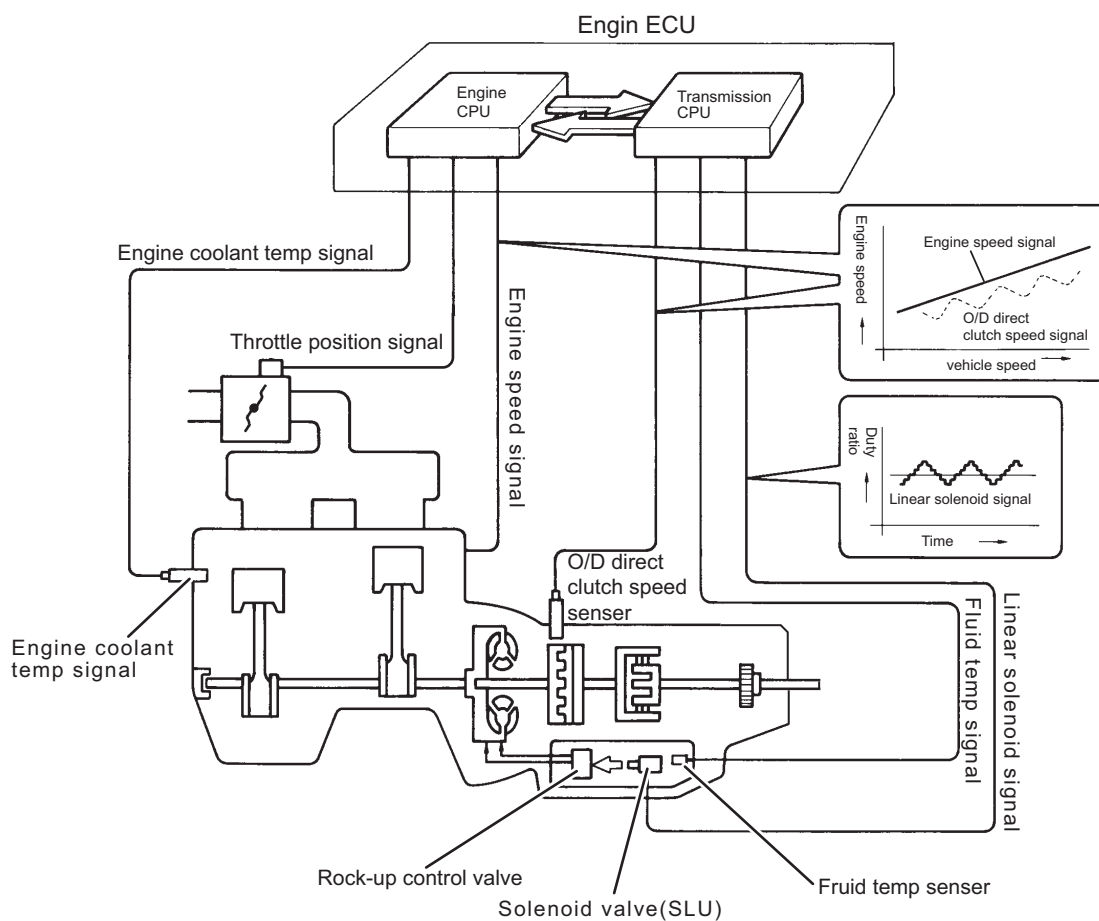
Shifting Control in Uphill / Downhill Traveling

- In the conventional automatic transmission, if the vehicle is accelerated or decelerated while driving uphill, depending on the circumstances, the transmission shifted up or down frequently. While driving downhill, because the transmission is upshifted when the throttle valve is almost completely closed, the transmission upshifted quickly even at low driving speeds, occasionally creating a condition in which it was difficult to apply the engine brake.
- In the road condition support control, the uphill or downhill driving conditions are assessed through the throttle opening angle, vehicle speed, etc. to achieve an optimal and constant driving force by restraining the transmission from upshifting while driving uphill (ascent of approximately 5% or more). The transmission automatically downshifts with brake signal ON so that an optimal engine brake can be achieved while driving downhill (ascent of approximately 6% or more).



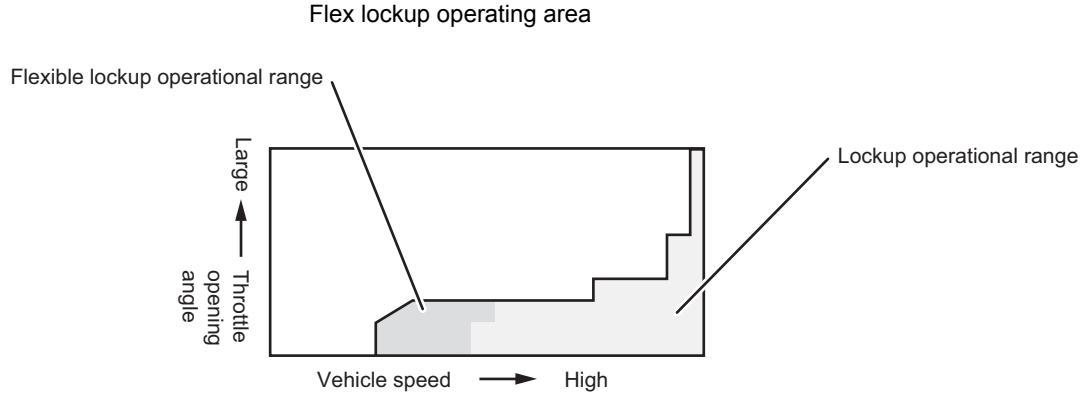
Flex Lockup Clutch Control

- Flex lockup control is used on the models equipped with the 3GR-FSE and 3GR-FE engine.
- Through the use of a leading-edge $H\infty$ (H infinity) control logic, it has become possible to continuously provide the lockup clutch with a subtle slippage in a stable manner. As a result, it has become possible to apply a lockup in a wide range of operations, thus realizing superior fuel economy characteristics.
- The flex lockup operation ranges from 6th to 3rd.



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- In the low- to medium-speed range, this control applies a very small specified amount of slippage rotation to the lockup clutch, thus ensuring the transmission efficiency of the torque converter and realizing superior fuel economy characteristics.
- When the accelerator is OFF, this control subtly slips the lockup clutch in the same manner as when the accelerator is ON, thus enabling the engine to expand its fuel cut range.



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Flex lockup operation table

Range	1st	2nd	3rd	4th	5th	6th
D,S-6	×	×	○	○	<○>	<○>
S-5	×	×	○	○	<○>	
S-4	×	×	○	○		

❖REFERENCE❖

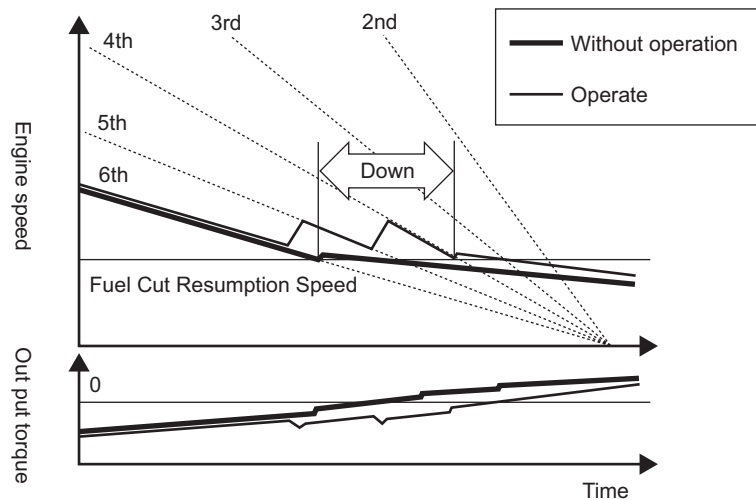
○:Operation

×:non-operation

<>:deceleration flex lockup operation

Downshift Control At Deceleration

- Deceleration downshift control, which maintains the fuel cut control at the maximum possible limit to realize fuel economy, is used on the models equipped with the 3GR-FSE and 3GR-FE engine.
- While in 6th gear, the deceleration downshift control downshifts from 6th to 5th, and 5th to 4th, before fuel delivery is resumed from the fuel cut state. By maintaining the fuel cut state in this manner, this control realizes fuel economy.



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Gear Shift and Lockup Control

- This control effects shift point control (including AI-Shift control) and lockup control (including flex lockup control) in accordance with the shift position, vehicle speed, and throttle position.

Shift Positions, Gears, and Lockup Patterns

Shift position	Gear change pattern
D,6	1st←→2nd←→3rd*1←→4th*1←→5th*2←→6th*2
5	1st←→2nd←→3rd*1←→4th*1←→5th*2
4	1st←→2nd←→3rd*1←→4th*2
3	1st←→2nd←→3rd
2	1st←→2nd
1	1st

❖ REFERENCE ❖

*1Flex lockup operation (on 3rd, flex lockup operation during acceleration only)

*2Lockup or flex lockup operation

Gear, Lockup, and AI-Shift Control Operating Conditions(A960E)

		4th	5th	6th	Lock-up	AI-SHIFT
Shift position		4,5,6,D	5,6,D	6,D	4,5,6,D	D
Engine coolant temperature	40°C maximum	45km/h minimum	51km/h minimum	55km/h minimum	×	55km/h minimum
	40°C minimum	○	51km/h minimum	55km/h minimum	×	55km/h minimum
	55°C minimum	○	○	55km/h minimum	×	55km/h minimum
	60°C minimum	○	○	○	○	○

❖ REFERENCE ❖

* : No operation restriction to shift from 1st to 3rd

Diagnosis

- If this function detects a failure in the speed sensor or any of the solenoids, it alerts the driver by illuminating the check engine warning light in the combination meter assembly.
- The troubleshooting of the entire vehicle is made possible through the use of a diagnostic tool. For details, refer to the repair manual. (This vehicle supports the intelligent Tester II diagnostic tool .)

Fail Safe

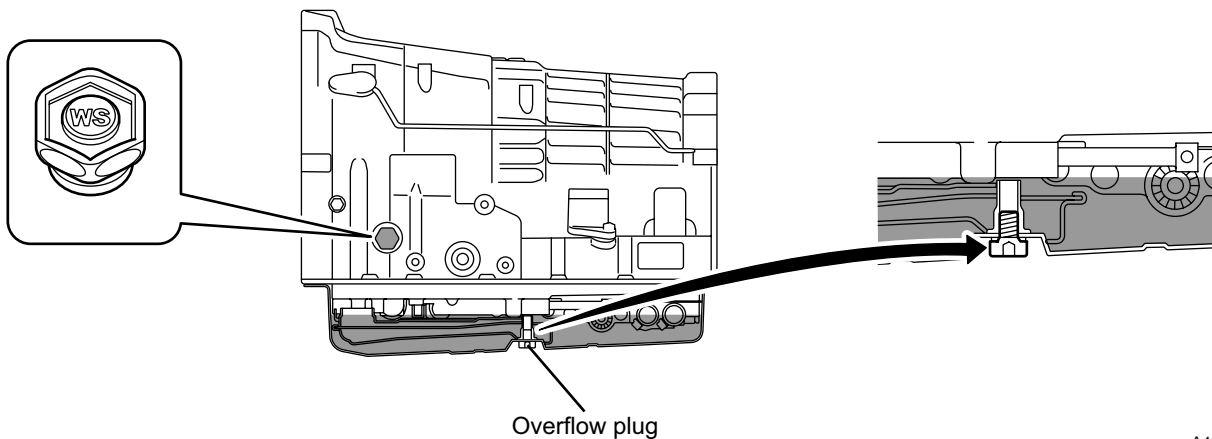
- This function prevents a failure in any of the sensors or solenoids from drastically affecting drivability. For details, refer to the repair manual.

List of Failsafe Functions

Failure Location	Function
Output Shaft Speed Sensor (SP2)	If the output shaft speed sensor (SP2) malfunctions, the system uses the NT signals of the input shaft speed sensor to effect shift control.
Transmission Solenoid	The system stops the current to the malfunctioning solenoid and turns the normal solenoids ON or OFF to effect shift control. If all solenoids fail, the system will shift gears through a mechanical fluid pressure circuit.
Fluid Temperature Sensor	The system prohibits shifting into 5th or 6th, and prohibits flex lockup control.
Linear Solenoid (SLU)	The system stops the control current to the solenoid to interrupt lockup control.
Linear Solenoid (SLT)	The system stops the control current to the solenoid. It effects shift control in the normal manner.

Oil Level Detection Mechanism

- The transmission has discontinued the use of the automatic transmission oil filler tube and the level gauge. Instead, it uses a oil level detection mechanism called an "overflow system".
- The manufacturer of the automatic transmission guarantees the proper oil level. This prevents the transmission from being contaminated with the wrong type of oil, or being overfilled or underfilled. Thus, a maintenance-free transmission has been realized.
- During a repair or replacement, the oil level can be adjusted mechanically through the overflow system. Thus, the control accuracy of the oil level has been improved. For detailed oil replenishment and adjustment procedures, refer to the repair manual.



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