■AUTOMATIC TRANSMISSION CONTROL SYSTEM

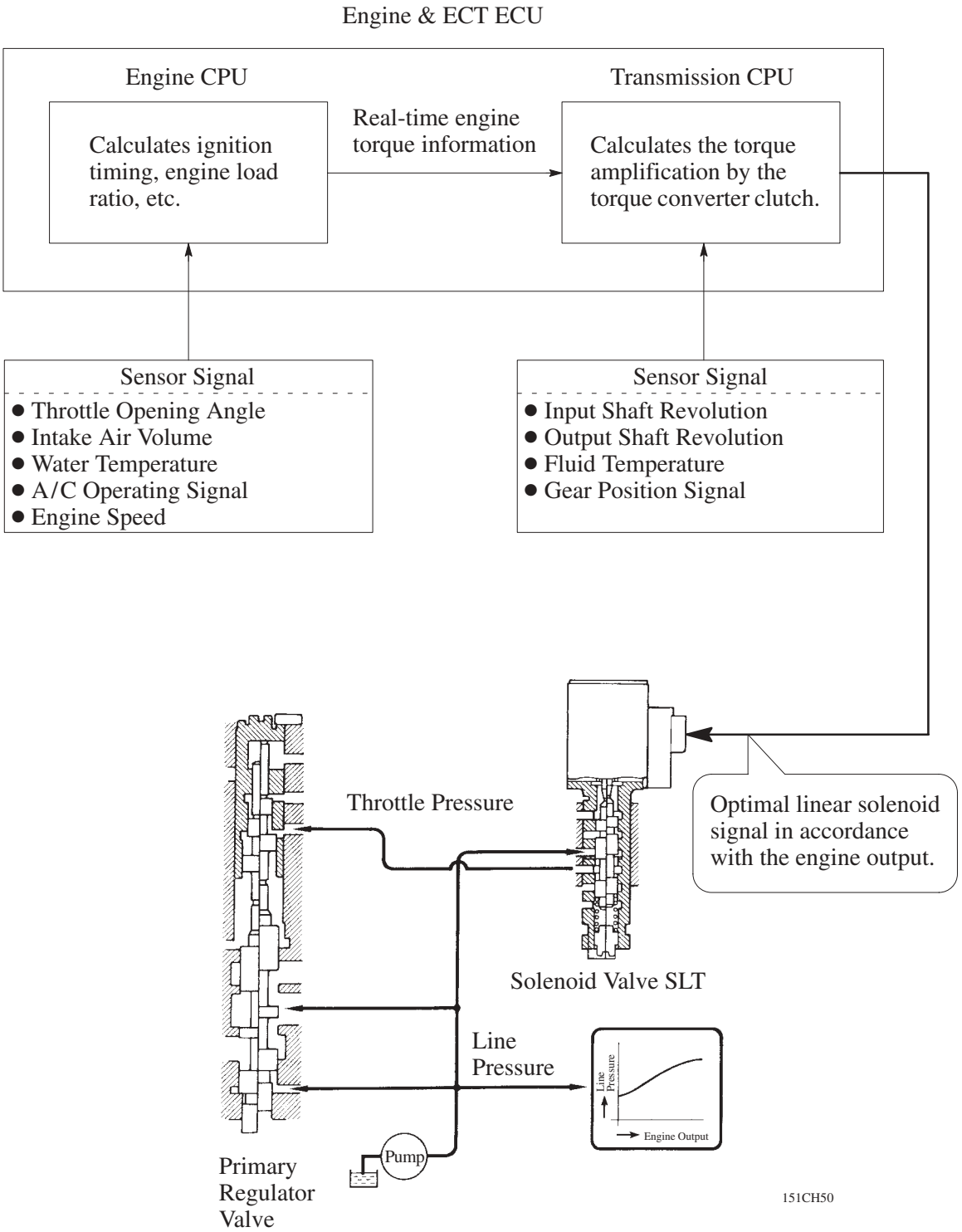
1. General

The automatic transmission control system of the IS300/IS300 SportCross's A650E automatic transmission, GS300's A650E automatic transmission are compared below.

System	Function	IS300/IS300 SportCross	GS300
Shift Timing Control	The optimum shift pattern is selected from 2 shift patterns in the engine & ECT ECU by the pattern select switch. The engine & ECT ECU sends current to the solenoid valve No.1, No.2, No.3 and/or No.4 based on signals from each sensor and shifts the gear.	○	○
Lock-up Timing Control	The optimum lock-up pattern is selected from 2 lock-up patterns in the engine & ECT ECU by the pattern select switch. The engine & ECT ECU sends current to the solenoid valve SLU based on signals from each sensor and engages or disengages the lock-up clutch.	○	○
Line Pressure Optimal Control (See page 69)	Based on the throttle opening angle and various signals, the engine & ECT ECU sends a signal to solenoid valve SLT to generate line pressure according to the engine output and to effect a smooth gear shift change.	○	○
Clutch Pressure Control (See page 70)	To achieve smooth shifting, the solenoid valve SLN controls the accumulator back pressure in order to finely regulate the hydraulic pressure that is applied to the clutch.	○	○
	Uses the solenoid valve SLU to directly control the hydraulic pressure that is applied to the clutch.	○	○
Engine Torque Control	Retards the engine ignition timing temporarily to improve shift feeling during up or down shifting.	○	○
High Response Shift Control (See page 72)	Through the cooperative control with the ETCS-i (Electronic Throttle Control System-intelligent), and the electronic control of supply and discharge speed of the clutch and brake hydraulic pressure, excellent response has been realized.	○	○
AI (Artificial Intelligence) -SHIFT (See page 74)	Based on the signals from various sensors, the engine & ECT ECU determines the road conditions and the intention of the driver. Thus, the shift pattern is automatically regulated to an optimal level, thus improving driveability.	○	○
E-Shift (See page 77)	Provided that the shift lever is engaged in the M position, the driver can shift the ranges by operating the transmission shift switches that are located on the steering wheel.	○	○
Fail-Safe (See page 75)	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.	○	○
Diagnosis (See page 76)	When the engine & ECT ECU detects a malfunction, the engine and ECT ECU diagnoses and memorizes the faild section.	○	○

2. Line Pressure Optimal Control

The line pressure controlled by using a solenoid valve SLT.
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.



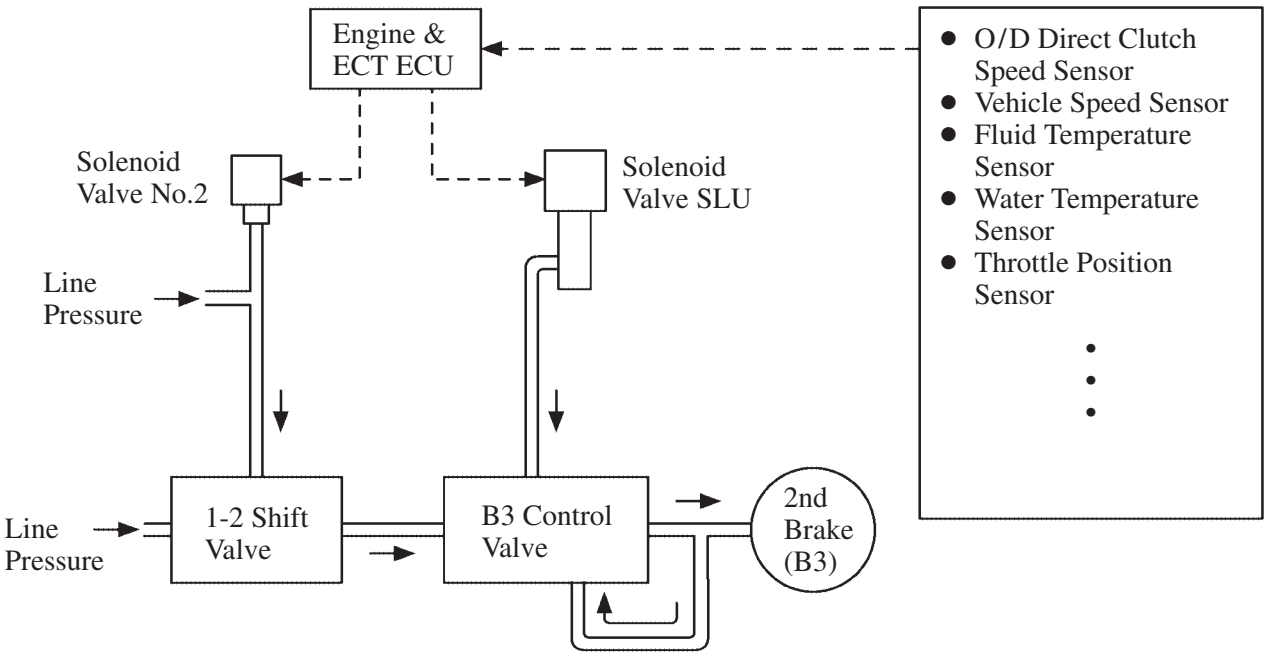
3. Clutch Pressure Control

General

Due to the development of the direct clutch pressure control and the clutch-to-clutch shift control, a 5-speed configuration has been achieved without increasing the accumulator and the one-way clutch.
As a result, a compact and lightweight automatic transmission has been realized.

Direct Clutch Pressure Control System

A direct clutch pressure control system has been adopted for shifting from the 1st to 2nd gear. In contrast to the clutch pressure control system of a conventional automatic transmission that uses an accumulator to execute clutch pressure control, this system controls the solenoid valve SLU to regulate the 2nd brake (B3) hydraulic pressure for the 2nd gear, via the B3 control valve, without using an accumulator.
This realizes highly precise hydraulic control that cannot be achieved with a clutch pressure control system that uses an accumulator.



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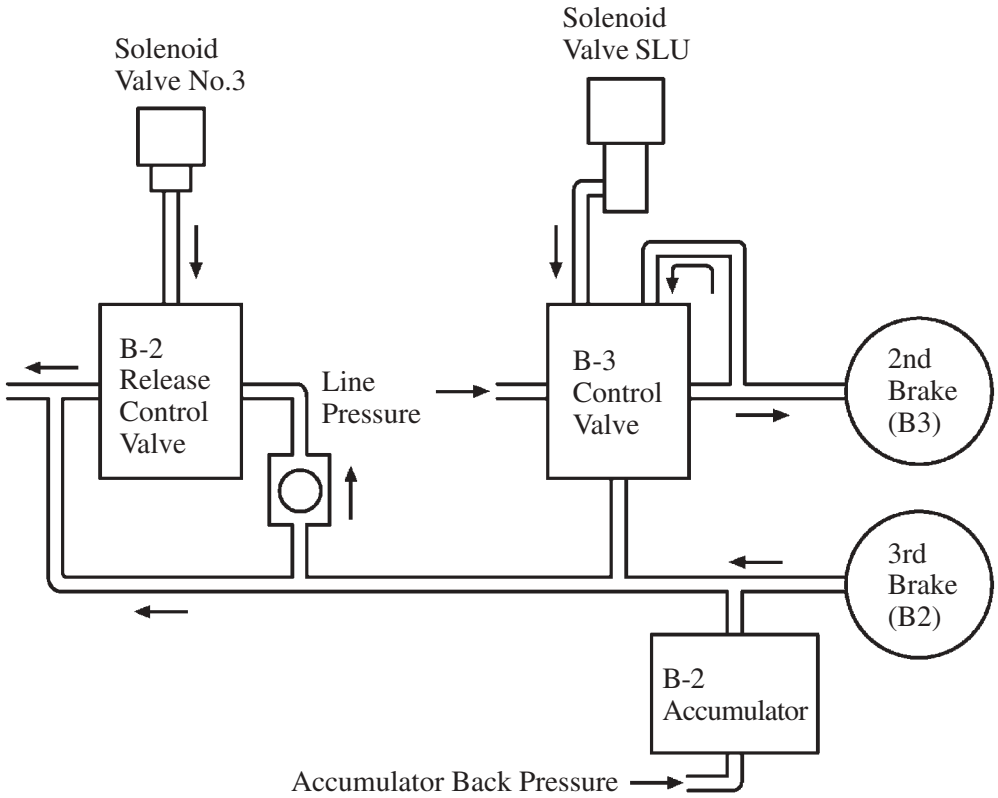
Clutch to Clutch Shift Control

To ensure the reliability of clutch-to-clutch control, the 2nd brake (B3) hydraulic presssure for the 2nd gear is regulated in link with the 3rd brake (B2) hydraulic pressure for the 3rd gear.
Also, optimal shift characteristics have been achieved through optimal hydraulic pressure settings and switchover timing in which the clutch rpm and input torque estimate values have been utilized.



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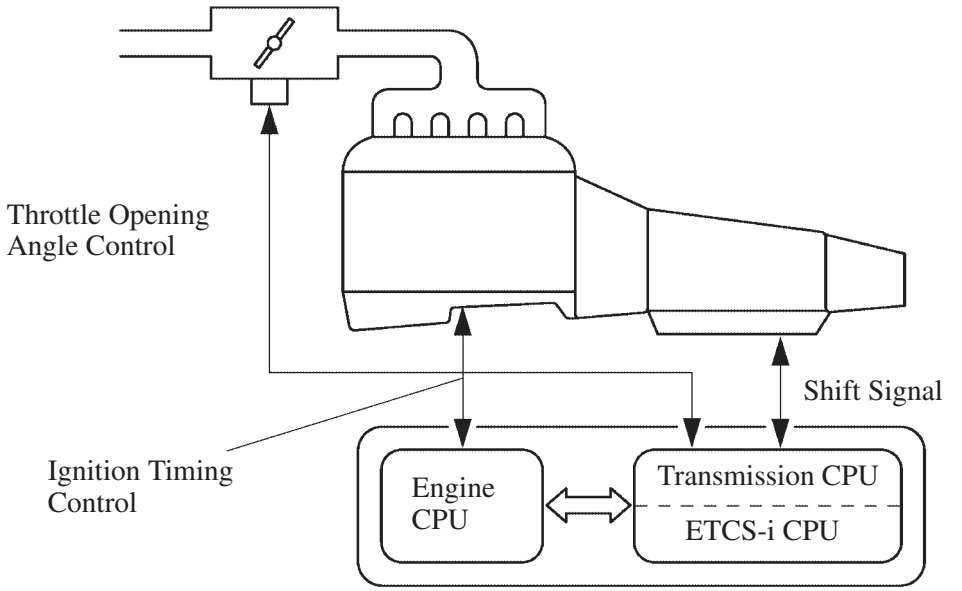
4. High Response Shift Control

General

A high-response clutch hydraulic pressure control, which executes high-response engine torque-up control during shifting and optimizes the supply and discharge speed of the clutch hydraulic pressure through electronic control, has been adopted. As a result, both the reduction of shift shock and the improvement of shift response have been realized at high levels.

High Response Engine Torque Up Control

Performs cooperative control that retards the engine ignition timing at the same when time the throttle valve is opened when the shift lever is downshifted manually. This realizes high-response engine torque control. As a result, a considerable reduction in shift time has been achieved.



Engine & ECT ECU

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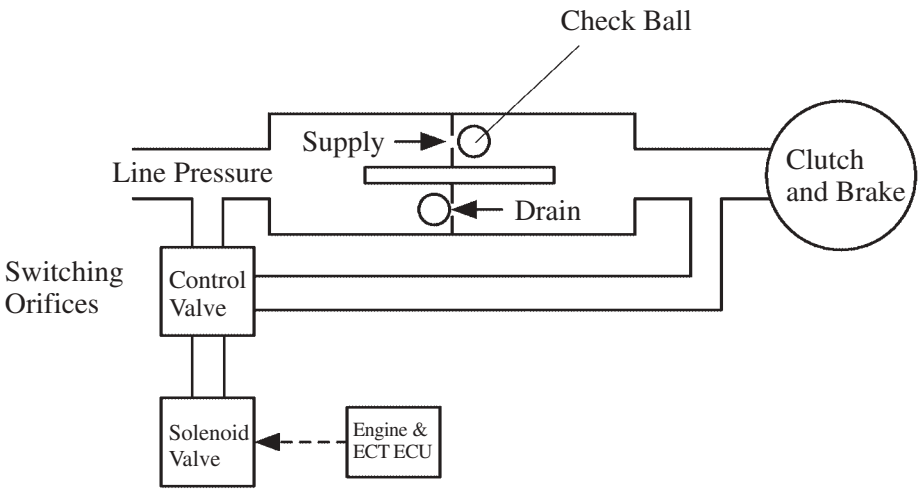
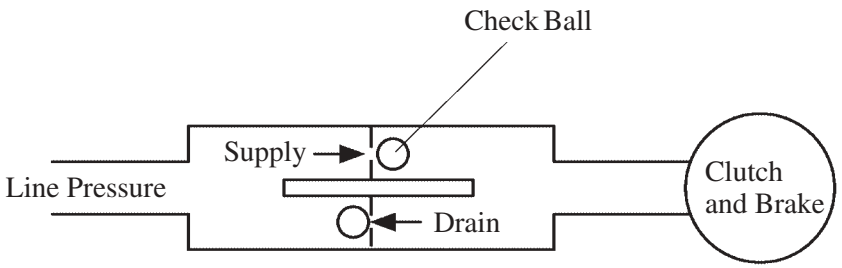
High Response Clutch Hydraulic Pressure

A conventional automatic transmission ordinarily had one circuit each for supplying and discharging the hydraulic pressure to the clutch and brake.
However, in the A650E automatic transmission, a mechanism has been added to control the solenoid valves No.3 and No.4 to activate the control valve, which switches the supply and discharge speeds of the clutch and brake pressure.
As a result, the hydraulic pressure can be supplied or discharged slowly, when the redduction of shift shock is more important, or supplied quickly, when response is more important. Thus, a shift feeling that is constantly favorable has been realized.



A650E Automatic Transmission



Conventional Automatic Transmission

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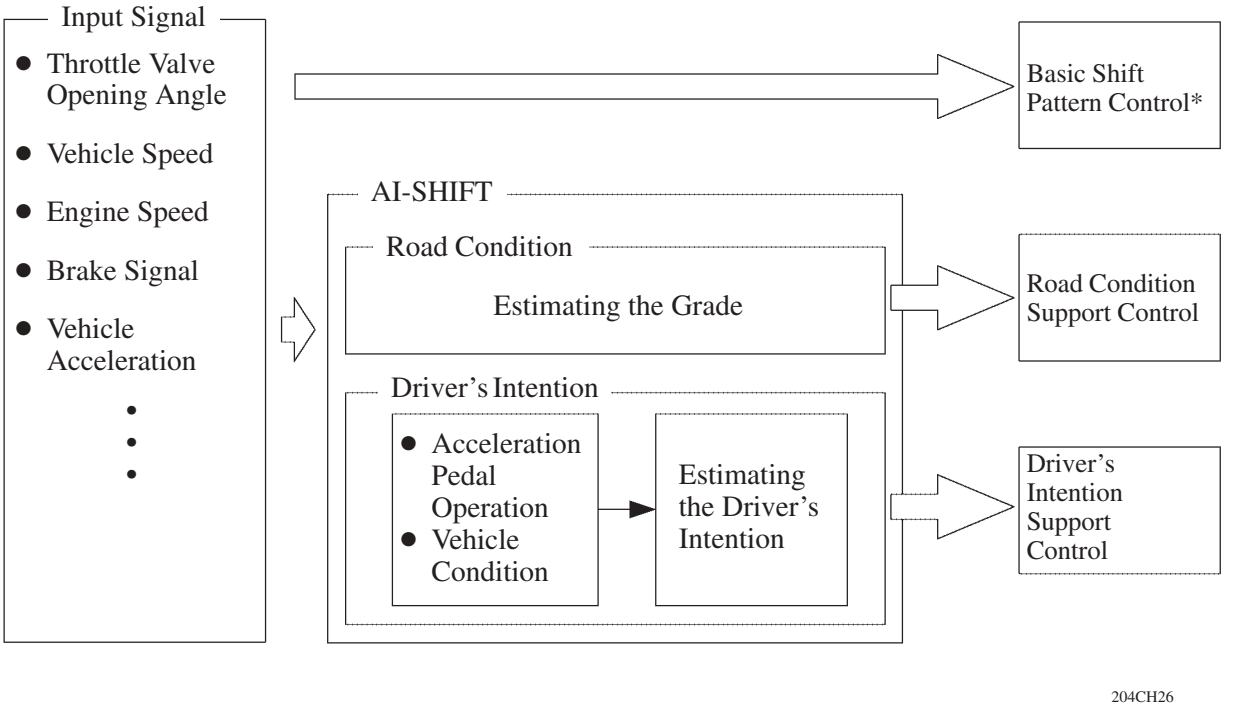
5. AI (Artificial Intelligence)-SHIFT Control

General

In addition to the switching of the shift pattern through the pattern select switch, the AI-SHIFT control enables the engine & ECT ECU to estimate the road conditions and the driver's intention in order to automatically switch the optimal shift pattern. As a result, comfortable ride has been realized at high levels.



*: Shift control that is determined by the PWR or SNOW mode that is selected by the pattern select switch, or by the normal mode.

Road Condition Support Control

Under road condition support control, the engine & ECT ECU determines the road condition where the vehicle is being driven through the throttle valve opening angle and the vehicle speed.

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.

6. Fail Safe Function

- This function minimizes the loss of operability when any abnormality occurs in each sensor or solenoid. Controls effected as follows.

Malfunction Parts	Function
Speed Sensor (SP2)	During a speed sensor (SP2) malfunction, shift control is effected through the O/D direct clutch speed sensor (NC0) signal or the crankshaft position sensor (NE) signal.
Solenoid Valve No.1, No.2, No.3 and No.4	During a malfunction in solenoid valve No.1, No.2, No.3, or No.4, the current to the faulty solenoid valve is stopped, and shifting is effected by controlling the ON/OFF condition of the remaining normal solenoids. If all the solenoid valves are malfunctioning, the gear position will be based on the state of the hydraulic circuit at that time.
Fluid Temperature Sensor	Normally, the 1st to 2nd upshift is prohibited if the fluid temperature is below the specified value, and gears are shifted as follows: 1st → 3rd → 4th → 5th. The fluid temperature sensor determines that the fluid temperature is higher than the specified value according to the driven distance and time.
Solenoid Valve SLN	During a solenoid valve SLN malfunction, the current to the solenoid valve is stopped. Because this stops clutch pressure control, the shift shock is increased. However, shifting is effected through normal clutch pressure control.
Solenoid Valve SLU	During a solenoid valve SLU malfunction, the current to the solenoid valve is stopped. Because this stops lock-up control and flex lock-up control, the shift shock increases and fuel economy decreases.
Solenoid Valve SLT	During a solenoid valve SLT malfunction, the current to the solenoid valve is stopped. Because this stops line pressure optimal control, the shift shock increases. However, shifting is effected through normal clutch pressure control.

- During a malfunction in the solenoid valve No.1, No.2 or No.3, the current to the faulty solenoid valve is cut off and control is effected by operating the normal solenoid valves. Shift control is effected as described in the table below, depending on the faulty solenoid.
  During a malfunction in solenoid valve No.4, shifting is prohibited to the 5th gears.

Position	Normal				Shift Solenoid No.1 Malfunction				Shift Solenoid No.2 Malfunction				Shift Solenoid No.3 Malfunction			
	Shift Solenoid			Gear	Shift Solenoid			Gear	Shift Solenoid			Gear	Shift Solenoid			Gear
	No.1	No.2	No.3		No.1	No.2	No.3		No.1	No.2	No.3		No.1	No.2	No.3	
D	ON	OFF	OFF	1	X	OFF → ON	OFF	5 → 3	ON	X	OFF	1	ON	OFF	X	1
	OFF	ON	OFF	3	X	ON	OFF	3	OFF	X	OFF → ON	5 → 4	OFF	ON	X	3
	OFF	OFF	ON	4	X	OFF	ON	4	OFF	X	ON	4	OFF	OFF	X	5
	OFF	OFF	OFF	5	X	OFF	OFF	5	OFF	X	OFF	5	OFF	OFF	X	5
4	ON	OFF	OFF	1	X	OFF → ON	OFF	5 → 3	ON	X	OFF	1	ON	OFF	X	1
	OFF	ON	OFF	3	X	ON	OFF	3	OFF	X	OFF → ON	5 → 4	OFF	ON	X	3
	OFF	OFF	ON	4	X	OFF	ON	4	OFF	X	ON	4	OFF	OFF	X	5
3	ON	OFF	OFF	1	X	OFF → ON	OFF → ON	4 → 3	ON	X	OFF	1	ON	OFF	X	1
	OFF	ON	ON	3	X	ON	N	3	OFF	X	ON	4	OFF	ON	X	3
	OFF	OFF	ON	4	X	OFF	ON	4	OFF	X	ON	4	OFF	OFF	X	4
2	ON	OFF	ON	1	X	OFF	ON	3	ON	X	ON	1	ON	OFF	X	1
	OFF	ON	ON	3	X	ON	ON	3	OFF	X	ON	3	OFF	ON	X	3
L	ON	OFF	OFF	1	X	OFF	OFF	3	ON	X	OFF	1	ON	OFF	X	1

Position	Shift Solenoid No.1 and No.2 Malfunction				Shift Solenoid No.1 and No.3 Malfunction				Shift Solenoid No.2 and No.3 Malfunction				Shift Solenoid No.1, No. 2 and No.3 Malfunction			
	Shift Solenoid			Gear	Shift Solenoid			Gear	Shift Solenoid			Gear	Shift Solenoid			Gear
	No.1	No.2	No.3		No.1	No.2	No.3		No.1	No.2	No.3		No.1	No.2	No.3	
D	X	X	OFF → ON	5 → 4	X	OFF → ON	X	5 → 3	ON	X	X	1	X	X	X	5
	X	X	OFF → ON	5 → 4	X	ON	X	3	OFF	X	X	5	X	X	X	5
	X	X	ON	4	X	OFF	X	5	OFF	X	X	5	X	X	X	5
	X	X	OFF	5	X	OFF	X	5	OFF	X	X	5	X	X	X	5
4	X	X	OFF → ON	5 → 4	X	OFF → ON	X	5 → 3	ON	X	X	1	X	X	X	5
	X	X	OFF → ON	5 → 4	X	ON	X	3	OFF	X	X	5	X	X	X	5
	X	X	ON	4	X	OFF	X	5	OFF	X	X	5	X	X	X	5
3	X	X	OFF	4	X	OFF → ON	X	4 → 3	ON	X	X	1	X	X	X	4
	X	X	ON	4	X	ON	X	3	OFF	X	X	4	X	X	X	4
	X	X	ON	4	X	OFF	X	4	OFF	X	X	4	X	X	X	4
2	X	X	OFF	3	X	OFF	X	3	ON	X	X	1	X	X	X	3
	X	X	ON	3	X	ON	X	3	OFF	X	X	3	X	X	X	3
L	X	X	OFF	3	X	OFF	X	3	ON	X	X	1	X	X	X	3

7. Diagnosis

If the engine and ECT ECU detects a malfunction in the system, it alerts the driver by illuminating the PWR indicator light and storing the DTCs (Diagnostic Trouble Codes) in memory.
The DTCs that are stored in engine and ECT ECU's memory can be accessed by connecting a hand-held tester to DLC3. Furthermore, this tester can be used to perform active tests or to display the data list. For details, refer to the LEXUS IS300/200 Repair Manual Supplement (Pub. No. RM870E).