Transmission Electronic Control System

Electronic System Description

The PCM and its input/output network control the following transmission operations:

- Shift timing
- Line pressure (shift feel)
- Torque Converter Clutch (TCC)

The transmission control strategy combined with the engine control provides optimum powertrain operation under all conditions. When determining the best operating strategy for transmission operation, the PCM uses input information from certain engine-related and driver-demand-related sensors and switches.

In addition, the PCM receives input signals from certain transmission-related sensors and switches. The PCM also uses these signals when determining transmission operating strategy.

Using all of these input signals, the PCM can determine when the time and conditions are right for a shift, or when to apply or release the TCC . It will also determine the pressure needed to optimize shift feel. To accomplish this, the PCM uses 3 pressure control solenoids, 1 TCC solenoid and 4 shift solenoids to control transmission operation.

The following provides a brief description of each of the sensors and actuators used to control transmission operation.

PCM

The operation of the transmission is controlled by the PCM. Many input sensors provide information to the PCM. The PCM then controls the actuators which determine transmission operation.

A/C Clutch

An electromagnetic clutch is energized when the clutch cycling pressure switch closes. The switch is located on the suction accumulator/drier. The closing of the switch completes the circuit to the clutch and draws it into engagement with the compressor driveshaft. When the A/C is engaged, operating pressures are adjusted to compensate for additional load on the engine.

Brake Pedal Position (BPP) Switch

The Brake Pedal Position (BPP) switch tells the PCM when the brakes are applied. The TCC disengages when the brakes are applied. The BPP switch closes when the brakes are applied and opens when they are released. The BPP is also used to disengage the Brake Shift Interlock Actuator (BSIA).

Engine Coolant Temperature (ECT) Sensor

The Engine Coolant Temperature (ECT) sensor detects ECT and supplies the information to the PCM. The ECT sensor is used to control TCC operation.

Cylinder Head Temperature (CHT) Sensor

The Cylinder Head Temperature (CHT) sensor is a thermistor device in which resistance changes with the temperature. The electrical resistance of a thermistor decreases as temperature increases, and the resistance increases as the temperature decreases. The varying resistance affects the voltage drop across the sensor terminals and provides electrical signals to the PCM corresponding to temperature.

Electronic Ignition (EI) System

The Electronic Ignition (EI) system consists of a Crankshaft Position (CKP) sensor, a pair of 4-tower ignition coils and the PCM. The ignition control module operates by sending CKP information from the CKP sensor to the ignition control module. The ignition control module generates a profile ignition pickup signal (engine rpm) and sends it to the PCM. The PCM uses the profile ignition pickup signal in the transmission strategy, Wide Open Throttle (WOT) shift control, TCC control and operating pressures.

Intake Air Temperature (IAT) Sensor

The Intake Air Temperature (IAT) sensor provides the Sequential Multi-Port Fuel Injection (SFI) system mixture temperature information. The IAT sensor is used both as a density corrector for airflow calculation and to proportion cold enrichment fuel flow. The IAT sensor is installed in the air cleaner outlet tube. The IAT sensor is also used in determining control pressures.

Mass Air Flow (MAF) Sensor

The Mass Air Flow (MAF) sensor measures the mass of air flowing into the engine. The MAF sensor output signal is used by the PCM to calculate fuel injector pulse width. For transmission strategies, the MAF sensor is used to regulate Electronic Pressure Control (EPC), shift and TCC scheduling.

Transmission Control Switch (TCS)

The Transmission Control Switch (TCS) is a momentary contact switch that allows the driver to cancel operation of 5th (D) gear.

The TCS is located on the end of the transmission selector lever knob.

When the driver initially presses the TCS , a signal is sent to the PCM.

The PCM uses the shift solenoids to disengage/disable 5th gear operation and activate the coast clutch.

At the same time, the PCM illuminates the Transmission Control Indicator Lamp (TCIL) to notify the driver that 5th gear is cancelled.

When the TCS is pressed again, 5th (D) gear operation is enabled, the coast clutch is released and the TCIL is turned OFF.

Whenever the ignition is cycled (vehicle shut off, then started again), the TCS is turned OFF and 5th gear will be enabled, even if the TCS had been on when the ignition was shut off.

Transmission Control Indicator Lamp (TCIL)

The TCIL is located in the Instrument Cluster (IC) and is labeled O/D OFF. The lamp is illuminated in conjunction with the TCS .

The TCIL will flash if a fault has been detected in a monitored sensor or solenoid used for transmission operation.

Throttle Position (TP) Sensor

The Throttle Position (TP) sensor is a potentiometer mounted on the throttle body. The TP sensor detects the position of the throttle plate and sends this information to the PCM. The TP sensor is used for shift scheduling, EPC and TCC control.

Transmission Range (TR) Sensor

The Transmission Range (TR) sensor is located on the outside of the transmission at the manual lever. The TR sensor completes the start circuit in PARK, NEUTRAL and the back-up lamp circuit in REVERSE. The TR sensor also opens and closes a set of 4 switches that are monitored by the PCM to determine the position of the manual lever (P, R, N, D, 3, 2, 1).

Turbine Shaft Speed (TSS) Sensor

The Turbine Shaft Speed (TSS) sensor is a magnetic pickup that sends the PCM the torque converter turbine speed information.

The TSS sensor is mounted externally on the transmission case.

The PCM uses TSS information to help determine appropriate operating pressures and TCC operation.

Output Shaft Speed (OSS) Sensor

The Output Shaft Speed (OSS) sensor is a magnetic pickup, located at the park gear. The OSS sends a signal to the PCM to indicate transmission output shaft speed. The OSS sensor is mounted externally on the transmission case. The OSS is used for TCC operation, shift scheduling and EPC .

Intermediate Shaft Speed Sensor

The intermediate shaft speed sensor is a magnetic pickup that sends planetary sun gear speed information to the PCM. The sensor is mounted externally on the center of the transmission case.

The PCM uses the sensor information to aid in determining pressure requirements.

Pressure Control Solenoids

The pressure control solenoids are a Variable Force Solenoid (VFS). The VFS solenoid is an electrohydraulic actuator combining a solenoid and a regulating valve.

The line pressure tap is used to verify output pressure from Pressure Control Solenoid A (PCA) or Pressure Control Solenoid B (PCB) by turning either one off while verifying the output from the other solenoid. The second pressure tap is used to verify the output from the Pressure Control Solenoid C (PCC) solenoid.

There are 3 pressure control solenoids located in the main control valve body used to control line pressure, band and clutch application pressure within the transmission.

The PCM varies the current to the pressure control solenoids.

The PCM has an adaptive learn strategy to electronically control the transmission which will automatically adjust the shift feel. When the battery is disconnected or a new battery is installed, certain transmission operating parameters can be lost. The PCM must relearn these parameters. During this learning process, you may experience slightly firm shifts, delayed or early shifts. This operation is considered normal and will not affect the function of the transmission. Normal operation will return once these parameters are stored by the PCM.

Torque Converter Clutch (TCC) Solenoid

The Torque Converter Clutch (TCC) solenoid is a pulse-width modulating-type solenoid that is used to control the apply and release of the TCC .

Shift Solenoids

Four ON/OFF shift solenoids allow the PCM to control shift scheduling.

- The solenoids are 3-way, normally closed style.
- The shift solenoids Shift Solenoid A (SSA), Shift Solenoid B (SSB), Shift Solenoid C (SSC) and Shift Solenoid D (SSD) provide gear selection of 1st through 5th and reverse gears by directing pressure control solenoid pressures to the appropriate elements.

Coast braking and manual gears are also controlled by the shift solenoids.

Transmission Fluid Temperature (TFT) Sensor

- The Transmission Fluid Temperature (TFT) sensor is a thermistor-type sensor that varies a reference voltage signal. The resistance in the TFT varies with temperature. The PCM monitors the voltage signal across the TFT and uses this information to determine the TFT .
- The TFT is located on the solenoid body.
- The PCM uses the TFT signal to help determine shift scheduling, TCC operation and pressure control requirements.

The TFT sends a voltage signal to the PCM. The voltage signal varies with TFT . The PCM uses this signal to determine whether a cold start shift schedule is necessary. The shift schedule is compensated when the TFT is cold. The PCM also inhibits TCC operation at low TFT and determines pressure control solenoid operations.

Accelerator Pedal Position (APP) Sensor

The Accelerator Pedal Position (APP) sensor is mounted on the accelerator pedal. The APP detects the position of the accelerator pedal and inputs this information as a voltage signal to the PCM. The PCM uses the APP sensor information to aid in determining shift scheduling, EPC and TCC operation.