TRANSMISSION CONTROL STRATEGIES

The TCM uses a number of driver-selected and automatic adaptive strategies (modes) to control transmission operation. Based on gear selection, driver demand, driving conditions and vehicle status, the following strategies may be used.

Driver Selected Modes

Normal Mode

Normal is automatically selected by the TCM on power-up. In this mode, all automatic and adaptive modes are active. Normal mode remains engaged unless Sport mode is selected or Cruise Control is engaged. Normal mode is resumed when Cruise Control is disengaged. Various adaptive strategies can override Normal mode.

Sport Mode

Sport mode is selected with the Mode Switch on the J-gate. The Sport mode strategy allows upshifts to occur at higher engine speeds and downshifts at lower pedal angles. Sport mode remains engaged until Normal mode is selected or Cruise Control is engaged. If Cruise Control is engaged while Sport mode is selected, Sport mode is resumed when Cruise Control is disengaged. Various adaptive strategies can override Sport mode.

NOTE: In Sport mode, 6th gear will be inhibited when the vehicle is driven aggressively (N/A engines > 20% throttle opening; SC engines > 35%). Furthermore, consistent aggressive driving may prompt the adoption of a shift strategy in which 6th gear is unavailable. This is not a fault.

Cruise Control

When Cruise Control is activated, the TCM receives a CAN message from the ECM. The TCM adopts a shift and torque converter clutch locking strategy that minimizes upshifts and downshifts.

"Fast Off"

If the throttle pedal is released rapidly following hard acceleration, one or more upshifts are inhibited to improve subsequent response. This may be perceived by the customer as hanging on to gears. This feature has been included to reduce gear hunting and improve response; it is not a fault.

Adaptive Shift Strategy (ASIS)

The ZF 6HP26 transmission control system employs the newly developed Adaptive Shift Strategy (ASIS).

The TCM is in constant communication with other vehicle systems, and receives data regarding vehicle status, operating and driving conditions, and driver demand. Signals received by the TCM from other systems include:

- Engine speed and torque
- Engine oil temperature
- Accelerator pedal position
- Wheel speed
- Longitudinal and lateral acceleration

Comprehensive evaluation of these signals permits refined adaptive control of the transmission system. The TCM can respond to spontaneous driver action, sudden topographical changes or extremes of temperature, and immediately transmit the optimized shift strategy to the hydraulic unit. In this way, the control system can quickly adapt to innumerable variations of driving style and conditions.

ASIS includes the following adaptive modes:

Hot Mode

If transmission temperatures exceed critical thresholds, the TCM adopts a Hot mode shift strategy designed to reduce heat generated within the transmission. The Hot mode strategy allows torque converter lock-up and forces upshift at lower vehicle speeds. Hot mode is cancelled when transmission temperature falls back into normal range.

NOTE: With Hot mode implemented, the driver may experience unexpected upshifts when driving at high vehicle speeds and loads.

Traction Control Mode

On slippery road surfaces, it is possible that a driven wheel will spin (that its rotational speed will accelerate out of proportion with vehicle speed and acceleration). When the TCM senses such a “traction event” (based on a CAN message from the ABS module), it will upshift to a higher gear to reduce wheel slip; the higher gear is held until traction is regained.

Hill and Trailer Towing Mode

When the TCM senses reduced vehicle acceleration at a given throttle angle (due to the increased effort of ascending a hill or towing a trailer) it will adopt a shift strategy that will hold lower gears for a longer period, thus increasing acceleration and reducing the number of shifts. This strategy may also be used at high altitudes, where engine torque is reduced by the effects of reduced ambient pressure and, hence, reduced maximum air flow.

Safety Features

The safety functions are designed to safeguard against operation by the driver that could damage the transmission. The system:

- Prevents reverse gear from being engaged at high forward speeds (above 3 mph)
- Prevents manual downshifting at excessive engine speeds

Shift Energy Management

By reducing engine torque during synchronization without interrupting the tractive drive, the control system reduces the energy that is dissipated in the friction elements of the transmission during upshifts. This has the benefit of:

- Increasing the transmission service life by shortening the slipping time
- Improving the shift comfort by reducing the step change in torque caused by the gearshift
- Transferring reduced engine power up to the maximum allowed by the mechanical in-gear strength of the transmission