Ford's TorqShift Transmission
by Lance Wiggins

Ford's new TorqShift transmission has everybody on the streets talking: The 6-speed transmission and 6.0L diesel perform flawlessly (Figure 1). As for the power? Huge improvement! The shift strategy really helped this unit and adding the extra gears keeps the power in the band. Some of this unit's features are:

- Direct Electronic Shift Control: That's right techs, no valves! The valve body only has one valve... the manual valve. Of course, the eight solenoids and five switches keep the lonely manual valve company (Figures 2a, 2b).
- Optional Power Takeoff: Just like its older brother, the 4R100, this unit also has the option of a PTO.

Internally, this unit is quit charming (Figures 3, 4, & 5). Featuring some of the engineering characteristics of the 5R55N, the TorqShift uses 6 multiple-disc friction clutches; 2 mechanical diode one-way clutches; and 3 planetary gear sets.

Upshifts are controlled by the Powertrain Control Module (PCM). The PCM receives inputs from various engine or vehicle sensors and driver demands, from which it controls shift scheduling, shift feel, and torque converter clutch (TCC) operation.

Under certain conditions the transmission will downshift automatically, without having to move the transmission range selector lever. There are 4 categories of automatic downshifts:

1. Coastdown
2. Torque Demand
3. Forced or Kickdown Shifts
4. Grade Braking

The torque demand downshift occurs automatically during part-throttle acceleration, when the demand for torque is greater than the engine can provide at the current gear ratio.

A forced downshift into a lower gear is possible below calibrated speeds. Specifications for downshift speeds are subject to variations in engine and transmission calibration requirements

Problems with the engine sensors must be diagnosed and repaired before proceeding with any transmission diagnosis.
Turning the Tow/Haul switch on makes the transmission's upshifts and downshifts firmer. The reason? To prevent clutches from failing under heavy loads. With the switch turned on, the PCM commands higher line pressure, which holds the clutches a little tighter. And the PCM alters the clutch apply timing by modifying the shift strategy.

During tow/haul operation, automatically scheduled downshifts may occur to increase the level of engine braking, particularly on downgrades.

Transmission shift scheduling relies on:
- Accelerator pedal position
- Engine RPM and acceleration
- Vehicle speed and acceleration
- Engine torque
- Converter state as defined by engine RPM
- Turbine RPM
- Transmission range sensor position
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- Brake status
- Speed control status
- Tow/haul switch status
- Transmission fluid temperature
- Engine coolant temperature
- PTO engaged signal
- 4x4L status

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

- VFS (shift feel)
- Shift timing
- Line pressure (engagement feel)
- Torque converter clutch operation

The transmission control is separate from the engine control strategy in the PCM, although some of the input signals are shared. When determining the best operating strategy for the transmission, the PCM uses input information from certain engine-related and driver demand-related sensors and switches.

The PCM uses these components to determine engine torque information for the transmission control strategies:

- Crankshaft Position (CKP) Sensor
- Camshaft Position (CMP) Sensor
- Barometric Pressure (BARO) Sensor
- Mass Air Flow (MAF) Sensor
- Manifold Absolute Pressure (MAP) Sensor
- Engine Oil Temperature (EOT) Sensor
- Air Conditioning Pressure (ACP) Switch
- Exhaust Gas Recirculation (EGR) Sensor
- Injection Pressure Regulator (IPR)
- Manifold Air Temperature (MAT) Sensor

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Using these input signals, the PCM can determine when the time and conditions are right for a shift, or when to apply or release the torque converter clutch. It will also determine the best line pressure needed to optimize shift feel, while keeping the clutches from slipping.

As you can see, the truck world is changing rapidly. Within the next few years this style of truck transmission will be the norm. Chevrolet, GMC, Ford... all heavy-duty and passenger trucks will be on the best fuel mileage top ten list soon enough, and the torque ratios will be through the roof. Until the next Techside… throw it in drive and just go, baby!