Range Shifts

1. The range shifts are the shifts between the HI and the LO ranges.
   - 2HI to 4LO
   - 4HI to 4LO
   - 4LO to 4HI
   - 4LO to 2HI
2. A range shift can only be made with the automatic transmission in neutral or with the manual transmission clutch fully depressed. The shift occurs when the vehicle speed is below three miles per hour.

   Whenever a shift into 4LO is initiated, the 4LO shift select button blinks. The 4LO shift select button will continue to blink until the shift is completed mechanically or until 30 seconds elapses. The 4LO shift select button must be on and not blinking prior to shifting the transmission into gear or releasing the clutch pedal.

If a range shift is initiated when the transmission is engaged or the vehicle speed is above 3 mph, the 4LO shift select button will blink for 30 seconds and no range shift actually occurs, the TCCM will default and position the transfer case into 4HI.

Transfer Case Control Module Description

1. The TCCM performs the following functions:
   - Receives input signals
   - Processes the signal information
   - Develops output signals
   - Sends the output signal in order to control the shifting of the transfer case
2. The TCCM receives input signals from the following sources:
   - The transfer case shift select buttons
   - The NSBU switch on the vehicles with automatic transmissions
   - The clutch position switch on the vehicles with manual transmissions
   - The vehicle sped sensor calibrator module
   - The encoder/motor range and the mode feedback signals
   - The diagnostic enable
   - The front axle mechanical status signal
3. In order to ensure the electronic shift system is operating properly, the transfer case control module (TCCM) continually performs diagnostics checks on itself and other parts of the electronic shift system when the ignition switch is in the run position. The following are different types of system checks that the TCCM continually performs.

"NSBU switch" = "neutral safety back-up" switch

RAM/ROM Check

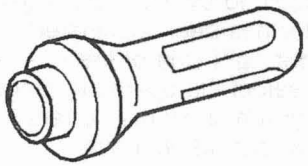
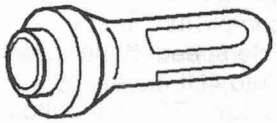
The TCCM compares the current internal operating program with a stored operating program. This comparison allows the TCCM in order to evaluate if the TCCM's RAM and ROM are operating properly. Should the TCCM detect a problem with the internal operating program, a diagnostic trouble code (DTC) of 4 is stored indicating the TCCM memory is damaged. Replace the TCCM. Refer to *Transfer Case Control Module Description*.

Data Memory Retention Check

The TCCM checks the stored diagnostic trouble code memory to see if the memory has changed since the ignition switch was last positioned to OFF. This self test checks in order to see if the RAM standby power supply has been interrupted. If the TCCM detects a RAM standby power supply interruption, (the loss of stored diagnostic trouble code) the TCCM stores a DTC of 1 indicating RAM standby power failure.

This condition occurs when the TCCM is disconnected from the wiring harness or battery power is removed. The DTC of 1 automatically clears from the TCCM after cycling the ignition switch ON and OFF five times.

Special Tools and Equipment

Tool Illustration	Tool No. and Description
 990	J 33831 Front Output Shaft Seal Installer
 991	J 33843 Rear Extension Seal Installer
 3430	J 39200 Digital Multimeter

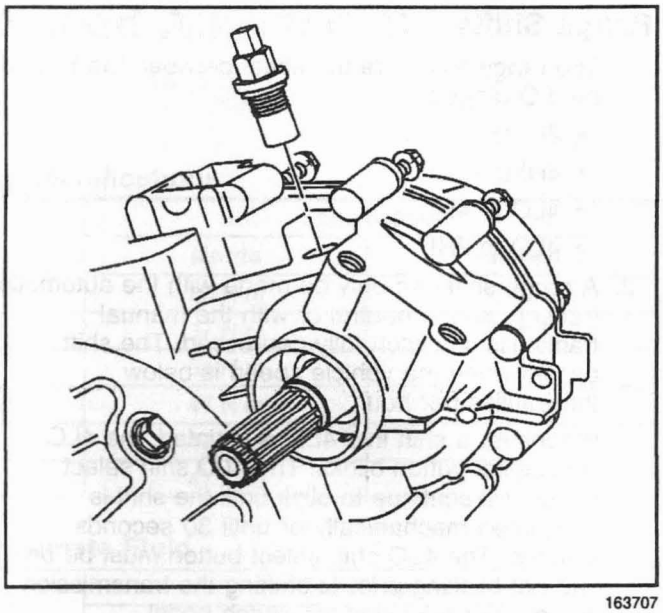
Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the front speed sensor into the transfer case.

   Tighten

   Tighten the front speed sensor to 31 N·m (23 lb ft).
2. Install the electrical connector to the speed sensor.
3. If removed, install the transfer case shields. Refer to *Shield Replacement*.



163707

Description and Operation

Transfer Case Description

Range Shifting

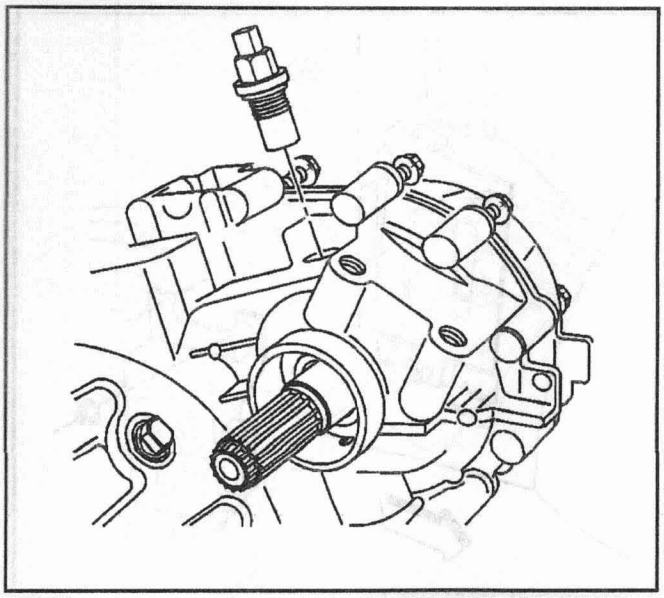
The New Venture Gear NV233 is an electronic shift transfer, with the following three modes of operation, Two–wheel drive high range, Four–wheel drive high range, Four–wheel drive low range. The gear reduction for low range is provided by a planetary gear set. The floor–mounted shifter has been eliminated. A switch, located on the upper right side of the instrument panel, is used to select the operating range. The indicator lamps on the switch show the current mode of operation. When the four–wheel drive has been selected, the four–wheel drive indicator lamp on the switch is designed to turn on when the front axle has engaged.

Mode Shifts

The mode shifts are shifts from 2HI to 4HI and 4HI to 2HI. A mode shift can be accomplished in any gear position and at any vehicle speed. If the system is in 2HI, the driver can shift into 4HI merely by pressing the 4HI shift select button. The 4HI button will blink status whenever a 2HI or 4HI shift is initiated and will continue to blink until the TCCM completes the shift. After the shift into 4HI is accomplished, the 4HI status lamp remains lit to indicate that the system is in 4HI.

There is a difference between when the TCCM sends voltage signals in order to engage a four wheel drive shift and when the vehicle is truly in four wheel drive. The transfer case can be shifted into 4HI *and the front axle may not be engaged.*

The driver can shift from 4HI back to 2HI by pressing the 2HI shift select button. The 2HI shift select button blinks until the shift to 2HI is complete. The 2HI shift select button will remain on once the shift is mechanically complete.



163707

Installation Procedure

Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the front speed sensor into the transfer case.

   Tighten

   Tighten the front speed sensor to 31N·m (23 lb ft).
2. Install the electrical connector to the speed sensor.
3. If removed, install the transfer case shields. Refer to *Shield Replacement.*

Description and Operation

Transfer Case Circuit Description

Transfer Case Shift Control Module

The transfer case shift control module uses the VIN information for calculations that are required for the different calibrations used based on axle ratio, transmission, tire size, and engine. The system does not know which calibration to use without this information.

The direct battery supply line (CKT 1640) provides the power to the module and motor circuitry.

Transfer Case Encoder Motor

The transfer case encoder motor consists of a permanent magnet (PM) DC motor and gear reduction assembly. It is located on the left hand side (drivers side) of the transfer case. When activated it turns the sector shaft of the transfer case (clockwise or counter clockwise) to shift the transfer case. The encoder motor is controlled with a pulse width modulated (PWM) circuit within the transfer case shift control module. This circuit consists of a driver on both the Motor A and Motor B circuits. The encoder motor is bi-directional to allow the motor to shift the transfer case from 2HI or 4HI to NEUTRAL and 4LO positions.

Transfer Case Encoder

The encoder is mounted to the transfer case encoder motor assembly and is replaced as an assembly. The encoder converts the sector shaft position (representing a mode or range) into electrical signals inputs to the automatic transfer case control module. The module can detect what position the transfer case is in by monitoring the 4 encoder channels (P, A, B, and C). These inputs translates into AUTO, 2H, 4H, NEUTRAL, and 4L or in transition between gears.

Transfer Case Motor Lock

The transfer case motor lock is used to provide a 2H, 4H, and 4L lock-up feature. When the lock circuit is energized, the transfer case encoder motor is allowed to turn. When the transfer case is placed 2H, 4H, or 4L the motor lock circuit has no power provided to it and the lock is applied. This assures that the transfer case remains in the current gear position. When AUTO is selected the motor lock remains applied until an adaptive mode (torque is applied to the front propshaft) is required. During an adaptive mode the motor lock circuit is energized and the motor lock is released, enabling the encoder motor to turn and apply torque to the front propshaft.

Transfer Case Speed Sensors

There are three speed sensors on the automatic transfer case (ATC), two on the rear output shaft and one on the front output shaft. Each speed sensor is a permanent magnet (PM) generator. The PM generator produces a pulsing AC voltage. The AC voltage level and number of pulses increases as speed increases.

Vehicle Speed Sensor

One of the two on the rear output shaft is the vehicle speed sensor (VSS) input to the/powertrain control module (PCM). The PCM sends this information to the transfer case shift control module via the Class 2 Serial Data bus.

Rear Propshaft Speed Sensor

The automatic transfer case control module converts the pulsating AC voltage from the rear transfer case speed sensor to a rear propshaft speed in RPM to be used for calculations. The rear propshaft speed can be displayed with a scan tool.

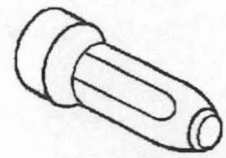
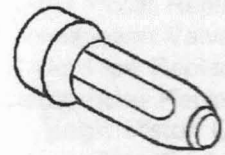
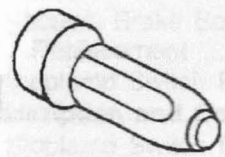
Front Propshaft Speed Sensor

The transfer case shift control module converts the pulsating AC voltage from the front transfer case speed sensor to front propshaft speed in RPM to be used for calculations, and to monitor the difference between the front and rear sensor speed. It is also used in the AUTO (Adapt) mode of operation to determine the amount of slip and the percent of torque to apply to the front axle. The front propshaft speed can be displayed with a scan tool.

SERVICE indicator (4WD/AWD) Lamp

The SERVICE indicator (4WD/AWD) lamp is an integral part of the cluster and cannot be serviced separately. This lamp is used to inform the driver of the vehicle of malfunctions within the automatic transfer case (ATC) system. The SERVICE indicator (4WD/AWD) lamp is controlled by the transfer case shift control module via CKT 1567.

Special Tools and Equipment

Illustration	Tool Number/Description
 404850	J 35870 Rear Output Shaft Seal Installer (For start of production front output shaft seal.)
 404818	J 43484 Front Output Shaft Seal Installer (For midyear 1999 and after front output shaft seal.)
 404841	J 29162 Rear Output Shaft Seal Installer