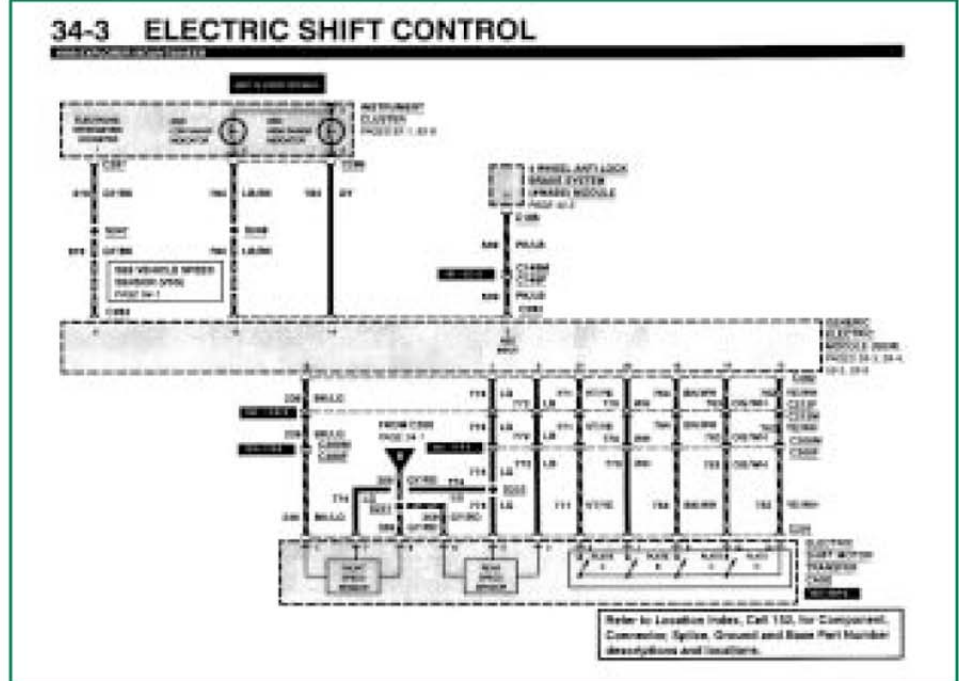
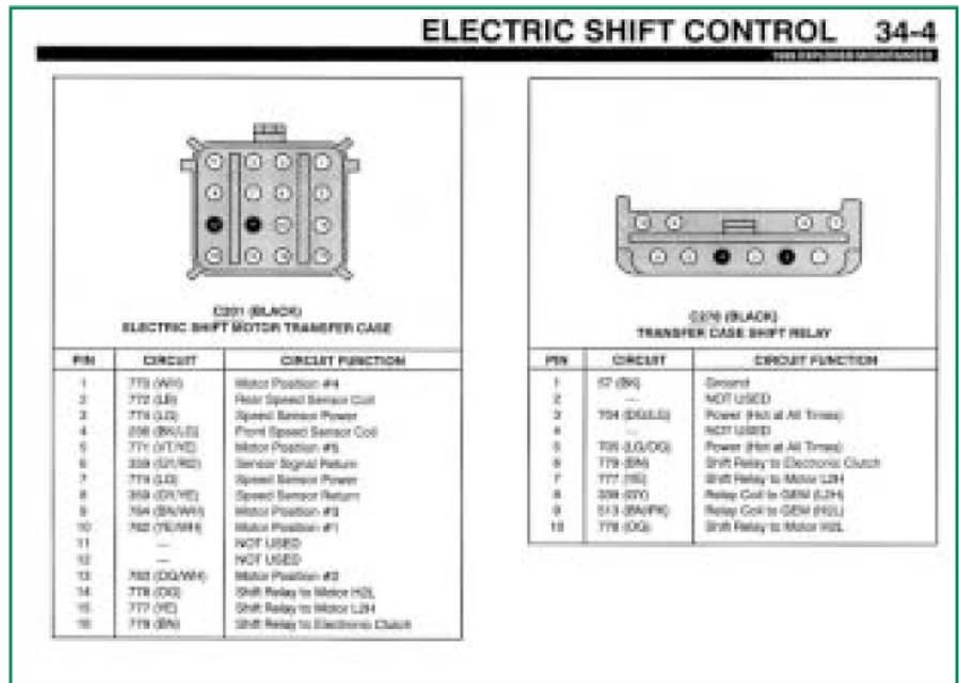


returns the clutch pack to minimum duty cycle. The driver may choose two other modes of operation by using a dash mounted rotary switch. The 4X4 High mode locks the transfer case with a torque split of 50/50 front and rear axle and is used for driving in snowy or slippery conditions. This shift can be made at any time "on the fly". The third operating mode is 4WD Low range, which should only be used for off road low speed conditions. To achieve a shift into the low range, the brake pedal must be depressed, the transmission must be in neutral, and vehicle speed must be under 3 miles per hour.

The GEM gets inputs from the 4WD Mode Switch, Vehicle Speed Sensor, Front and Rear Drive Shaft Speed Sensors, Transmission Range Sensor, the brake switch, and the Contact Plate 4 position Sensor inside the transfer case electric shift motor. The transfer case clutch is activated through the GEM sending a pulse width modulated signal through a solid-state clutch relay. This signal is grounded when the clutch is active and shows battery voltage when off. The driver receives information through the A4WD indicator, which shows the mode, engaged in the transfer case. When active, this circuit is grounded.

The GEM is capable of self-diagnosis and will set trouble codes to begin the diagnostic process. Remember that components outside of the system can create parameters that will set codes and there are certain external checks that must be



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Diagnostic Trouble Code (DTC) Reference Chart

Diagnostic Trouble Code (DTC) Reference Chart			
DTC	Circuit	Description	Test Mode
P1342	56A	ECU in Defective	On-Demand, Continuous
P1483	307 (BR/Y)	Brake Pedal Input Circuit Open or Short to Ground	Continuous
P1483	307 (BR/Y)	Brake Pedal Input Short to Power	On-Demand, Continuous
P1684	219 (LB)	4WD High Indicator Circuit Open or Short to Ground	On-Demand, Continuous
P1685	219 (LB)	4WD High Indicator Short to Power	On-Demand, Continuous
P1686	925 (BR/Y)	4WD Low Indicator Circuit Open or Short to Ground	On-Demand, Continuous
P1687	925 (BR/Y)	4WD Low Indicator Short to Power	On-Demand, Continuous
P1683	780 (DR) 882 (DB)	4WD Mode Select Switch Circuit Open	On-Demand, Continuous
P1683	780 (DR)	4WD Mode Select Switch Circuit Short to Ground	On-Demand, Continuous
P1620	782 (BR/W)	Transfer Case LD to HI Shift Relay Coil Circuit Open or Short to Ground	On-Demand, Continuous
P1621	782 (BR/W)	Transfer Case LD to HI Shift Relay Coil Short to Power	Continuous
P1624	779 (BR)	4WD Electric Clutch Relay Circuit Open or Short to Ground	On-Demand, Continuous
P1625	779 (BR)	4WD Electric Clutch Relay Short to Power	Continuous
P1626	781 (DLR)	Transfer Case HI to LD Shift Relay Coil Circuit Open or Short to Ground	On-Demand, Continuous
P1626	781 (DLR)	Transfer Case HI to LD Shift Relay Coil Short to Power	Continuous
P1636	772 (LR)	Transfer Case Front Shaft Speed Sensor Circuit Failure	Continuous
P1637	236 (BR/LG)	Transfer Case Rear Shaft Speed Sensor Circuit Failure	Continuous
P1638	771 (F) 778 (D)	Transfer Case Shaft Motor Circuit Failure	Continuous
P1645	771 (F/Y)	Transfer Case CONTACT PLATE "A" Circuit Open	Continuous
P1650	770 (W)	Transfer Case CONTACT PLATE "B" Circuit Open	Continuous
P1654	764 (BR/W)	Transfer Case CONTACT PLATE "C" Circuit Open	Continuous
P1655	763 (D/W)	Transfer Case CONTACT PLATE "D" Circuit Open	Continuous
P1683	782 (Y/W)	Transfer Case CONTACT PLATE Power Circuit Open	On-Demand
P1686	NA	Transfer Case System Concern	Continuous
P1687	NA	Transfer Case Contact Plate General Circuit Failure	Continuous
P1874	714 (LG)	Automatic Hall Effect Sensor Power Circuit Failure	On-Demand
P1875	714 (LG)	Automatic Hall Effect Sensor Power Circuit Short to Power	On-Demand, Continuous

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DIAGNOSIS AND TESTING (Continued)

Diagnostic Trouble Code (DTC) Reference Chart			
DTC	Circuit	Description	Test Mode
P1650	770 (W)	Transfer Case CONTACT PLATE "B" Circuit Open	Continuous
P1654	764 (BR/W)	Transfer Case CONTACT PLATE "C" Circuit Open	Continuous
P1655	763 (D/W)	Transfer Case CONTACT PLATE "D" Circuit Open	Continuous
P1683	782 (Y/W)	Transfer Case CONTACT PLATE Power Circuit Open	On-Demand
P1686	NA	Transfer Case System Concern	Continuous
P1687	NA	Transfer Case Contact Plate General Circuit Failure	Continuous
P1874	714 (LG)	Automatic Hall Effect Sensor Power Circuit Failure	On-Demand
P1875	714 (LG)	Automatic Hall Effect Sensor Power Circuit Short to Power	On-Demand, Continuous

GEM Primary Identification (PID) Reference Chart

GEM Primary Identification (PID) Reference Chart			
PID	Circuit	Circuit Description	Expected Values
VSS_GEM	479 (D/Y/BR)	Vehicle Speed Input	000-255 kph
CLUTCH_SW	460 (R/W)	Transmission Clutch Interlock Switch	INCLND, NOT ENGAGED
NTRL_SW	460 (R/W)	Neutral Safety Switch Input	NTRL, not NTRL
INTR_OCW	339 (D/Y)	Transmission Transfer LD to HI Motor Output	ON, OFF, OFF D-G
MTR_OCW	315 (BR/YG)	LD to HI Shift Relay Coil Status	OFF, ON
4WDCLCH	275 (Y)	4WD Electronic Clutch Output Status	ON, OFF, OFF D-G
4WDLDFW	784 (L/BR)	4WD Low Indicator Status	ON, OFF
4WDHDFW	783 (D/Y)	4WD High Indicator Status	ON, OFF
PLATE_A	771 (F/Y)	Transfer Case Contact Plate Switch A	OPEN, CLOSED
PLATE_B	770 (W)	Transfer Case Contact Plate Switch B	OPEN, CLOSED
PLATE_C	764 (BR/W)	Transfer Case Contact Plate Switch C	OPEN, CLOSED
PLATE_D	763 (D/W)	Transfer Case Contact Plate Switch D	OPEN, CLOSED
RCO_IDRM	311 (L/D)	Range Control (RCO) Switch Input	ON, OFF
IGN_GEM	1000 (R/BR) 1800 (BR/PK) 1800 (D/Y)	Ignition Switch Status	START, RUN, OFF, ACC
HALLFR	714 (LG)	Hall Effect Speed Sensor Power	ON, OFF
FWTCHST	---	FWT Clutch PWM Output Status	ON, OFF
TBA_RSP	772 (LR)	Rear Shaft Speed	0-255 mph
TBA_FSP	236 (BR/LG)	Front Shaft Speed	0-255 mph
PLATEPW	362 (Y/W)	Contact Plate Ground Output	ON, OFF

(Continued)

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made prior to any further diagnosis. Tire pressure and size will have a great effect on the inputs from the drive shaft speed sensors to the GEM. A few pounds difference in tire pressure or tread wear between the tires can set a code. This means that you would be well advised to equalize all tire pressures and measure all tire diameters with a stagger gauge every time as the first step to diagnosis.

This unit is prone to certain mechanical problems that are beyond the scope of most shops to repair. The most common mechanical failure is a complaint of a loss of drive accompanied by a ratcheting noise coming from the transfer case during coast or deceleration or when in reverse. Careful questioning of the driver will reveal that this condition was preceded by an occasional thump from the transfer case at a constant road speed of 40-60 MPH. When you disassemble the transfer case

you will find that the range hub and range fork will be damaged, but replacing these items will not solve the problem. The range hub is helical cut gearing and will stay in mesh under load, but will move out on coast due to the thrust loads generated by the helical design. Adding power will cause the gear to return to the correct position. The bottom of the teeth get chewed up and the constant pressure on the fork causes it to burn up. The real cause of the problem is an offset in the centerline distance, putting the shift rail at an angle, which allows the range fork to move out of position. The cases are magnesium and we do considerable machine work to correct this problem, which is beyond the equipment found in the average shop. If you see units with this damage, you will usually see oblong holes in the cases where the shift rail rides. It is cheaper and more efficient to buy a unit that has this

problem corrected than to tackle it yourself.

On the electrical side, all the information is available through the Ford Service Manual. They have done a great job of publishing the schematics and pinpoint test to aid you in your problem solving. I have included the trouble codes and basic schematics here to enable you to locate all the components involved. Ford has 134 pinpoint tests to track down the electrical glitches. Buy or borrow the Ford service manual and the electrical schematics manual, which will provide the details on circuits and wire colors without which you will be lost. Transfer cases have become as sophisticated as the transmissions and a scanner, ohmmeter, service manual is the only way to be ahead of the curve. In the new millennium the diagnostic book is five times as thick as the unit repair manual.