

# Electronic Diagnosis of the BW 4405 Transfer Case

**By Mike Weinberg**  
Contributing Editor

One of the most popular transfer cases is the BorgWarner 4405. This electronically shifted transfer case has been used in the Ford Explorer and Mercury Mountaineer since

the 1995 model year. I did an introductory article in this magazine in February 1998 and am now including vital electrical schematics and diagnostic information here.

The 4405 transfer case permits the driver to choose among three 4X4 modes using a rotary switch on the dashboard. Ford also refers to this drivetrain as the A4WD (Automatic Four Wheel Drive)

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**GEM Primary Identification (PID) Reference Chart**

PID	Circuit	Circuit Description	Expected Values
VSS_GEM	679 (GY/BK)	Vehicle Speed Input	000-255 k/hr
CLTCHSW	463 (R/W)	Transmission Clutch Interlock Switch	Engaged, Not Engaged
NTRL SW MTR_CCW	463 (R/W) 339 (GY)	Neutral Safety Switch Input Transmission Transfer LO to Hi Motor Output	NTRL, not NTRL On—, Off—, Off O-G
MTR_CW	513 (BR/PK)	Lo to Hi Shift Relay Coil Status	Off—
4WDCLCH	275 (Y)	4WD Electronic Clutch Output Status	On—, Off—, Off O-G
4WDLOW	784 (LB/BK)	4WD Low Indicator Status	On—, Off—
4WDHIGH	783 (GY)	4WD High Indicator Status	On—, Off—
PLATE__A	771 (P/Y)	Transfer Case Contact Plate Switch A	Open, Closed
PLATE__B	770 (W)	Transfer Case Contact Plate Switch B	Open, Closed
PLATE__C	764 (BREW)	Transfer Case Contact Plate Switch C	Open, Closed
PLATE__D	763(O/W)	Transfer Case Contact Plate Switch D	Open, Closed
BOO_GEM	511 (LG)	Brake On/Off (BOO) Switch Input	On, Off
IGN_GEM	1000 (R/BK), 1002 (BK/PK), 1003 (GY/Y)	Ignition Switch Status	Start, Run, Off, ACC
HALLPWR	774 (LG)	Hall Effect Speed Sensor Power	On—, Off—
4WDCLST	—	FWD Clutch PWM Output Status	On—, Off—
TRA__RSP	772 (LB)	Rear Shaft Speed	0-255 mph
TRA__FSP	236 (BKILG)	Front Shaft Speed	0-225 mph
PLATEPW	762 (Y/W)	Contact Plate Ground Output	On—, Off—
PWR__RLY	239 (W/O)	ABS Active Input	On, Off
NTF		Neutral Tow Function	On, Off
NTF LMP		Neutral Tow Light	On, Off



**Diagnostic Trouble code (DTC) Reference chart**

DTC	Circuit	Description	Test Mode
B1342	N/A	ECU is Defective	On-Demand, Continuous
P1483	307 (BK/Y)	Brake Pedal Input Circuit Open or Short to Ground	Continuous
P1485	307 (BK/Y)	Brake Pedal Input Short to Power	On-Demand, Continuous
P1804	210 (LB)	4WD High Indicator Circuit Open or Short to Ground	On-Demand, Continuous
P1806	210 (LB)	4WD High Indicator Short to Power	On-Demand, Continuous
P1808	975 (BR/Y)	4WD Low Indicator Circuit Open or Short to Ground	On-Demand, Continuous
P1810	975 (BR/Y)	4WD Low Indicator Short to Power	On-Demand, Continuous
P1812	780 (DB)	4WD Mode Select Switch Circuit Open	On-Demand, Continuous
P1815	783 (G)	4WD Mode Select Switch Circuit Short to Ground	On-Demand, Continuous
P1820	782 (BR/W)	Transfer Case Lo to Hi Shift Relay Coil Circuit Open or Short to Ground	On-Demand, Continuous
P1822	782 (BR/W)	Transfer Case Lo to Hi Shift Relay Coil Short to Power	Continuous
P1824	779 (BR)	4WD Electric Clutch Relay Circuit Open or Short to Ground	On-Demand, Continuous
P1826	779 (BR)	4WD Electric Clutch Relay Short to Power	Continuous
P1828	781 (O/EB)	Transfer Case Hi to Lo Shift Relay Coil Circuit Open or Short to Ground	On-Demand, Continuous
P1830	781 (O/LB)	Transfer Case Hi to Lo Shift Relay Coil Short to Power	Continuous
P1836	772 (LB)	Transfer Case Front Shaft Speed Sensor Circuit Failure	Continuous
P1837	236 (BK/LG)	Transfer Case Rear Shaft Speed Sensor Circuit Failure	Continuous
P1838	777 (Y) 778 (O)	Transfer Case Shift Motor Circuit Failure	Continuous
P1846	771 (P/Y)	Transfer Case Contact Plate A Circuit Open	Continuous
P1850	770 (W)	Transfer Case Contact Plate B Circuit Open	Continuous
P1854	764 (BR/W)	Transfer Case Contact Plate C Circuit Open	Continuous
P1858	763 (O/W)	Transfer Case Contact Plate D Circuit Open	Continuous
P1863	762 (Y/W)	Transfer Case Contact Plate Power Circuit Open	On-Demand
P1866	N/A	Transfer Case System Concern	Continuous
P1867	N/A	Transfer Case Contact Plate General Circuit Failure	Continuous
P1874	774 (LG)	Automatic Hall Effect Sensor Power Circuit Failure	On-Demand
P1875	774 (LG)	Automatic Hall Effect Sensor Power Circuit Short to Power	On-Demand, Continuous

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System. In the automatic mode, a computer (the GEM, or generic electronic control module) can vary the torque split between the front and rear driveshafts. This allows the operator to drive in 4WD on highways full time without the characteristic wheel and driveline windup associated with other 4WD systems on dry pavement.

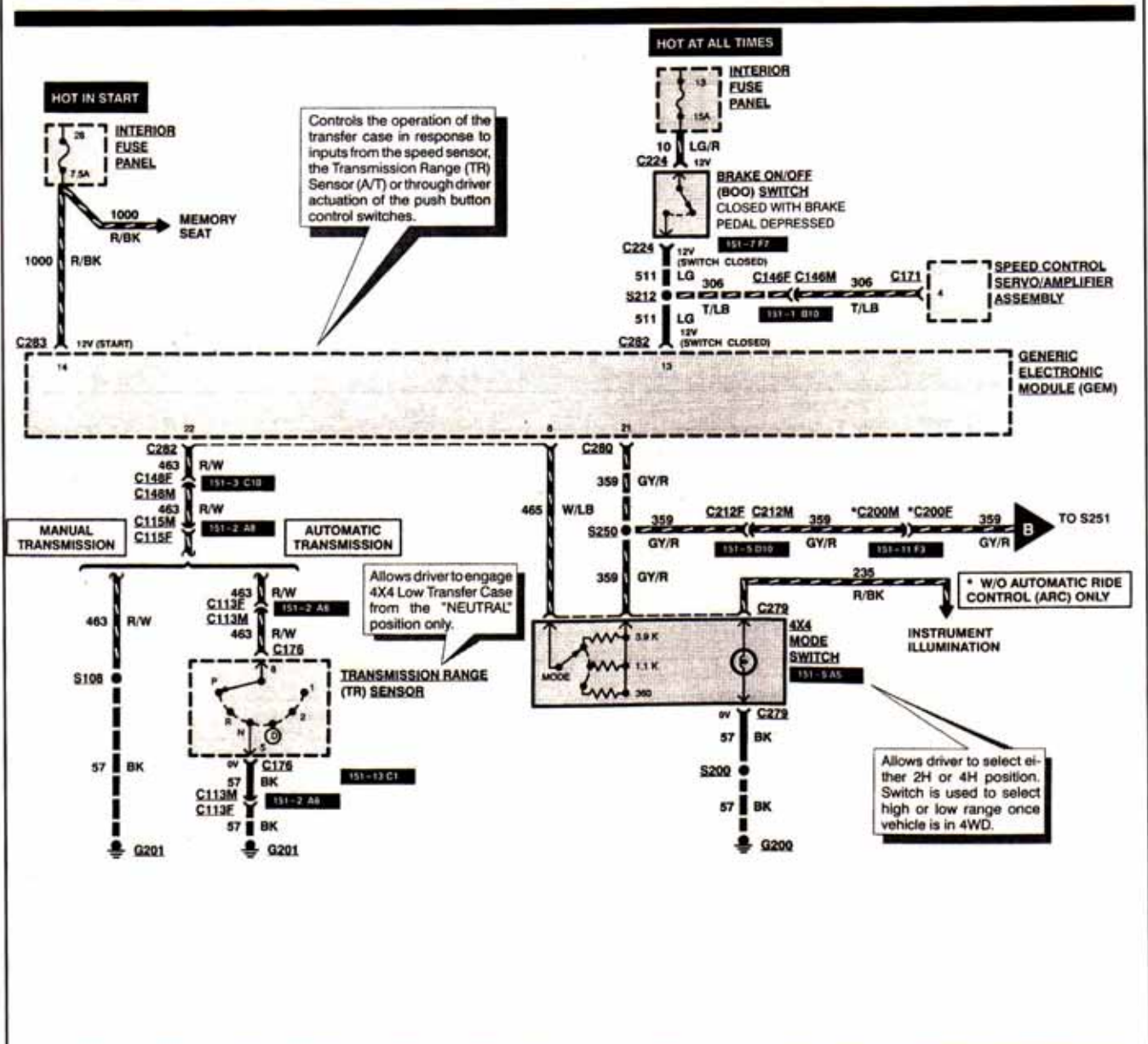
The secret behind the technology

is the computer control of the clutch in the transfer case. The application of the clutch is normally at a minimum duty cycle. When the GEM detects a slip at the rear wheels, it increases duty cycle of the transfer-case clutch to as much as 98% power to the front wheels. When the shaft speeds equalize, the computer operates the clutch again at minimum duty cycle.

The driver can choose the 4X4 High mode, which locks the torque split at 50/50 front to back. This shift can be made "on the fly" at any time, and this mode should be used for driving on snow-covered roads. In order for the driver to use the 4WD Low range, the vehicle speed must be less than 3 mph, the transmission must be in neutral and the brake pedal must be

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depressed. The Low range is to be used only in off-road situations.

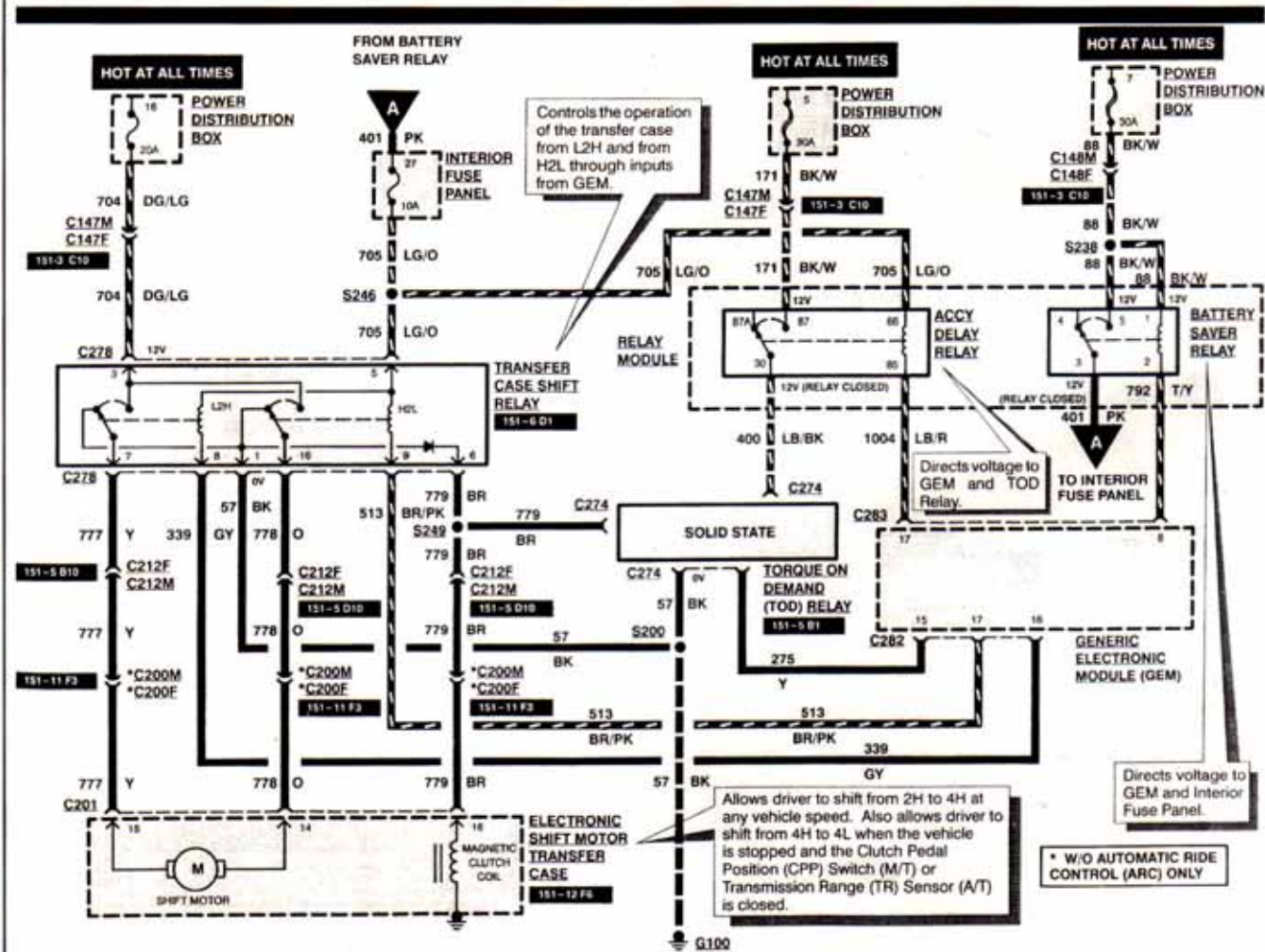
To perform these functions, the GEM receives information from the following inputs: 4WD mode switch, transmission-range sensor, vehicle-speed sensor, front and rear driveshaft-speed sensors, and the contact-plate 4-position sensor inside the transfer-case electric shift motor. The GEM commands

the transfer-case clutch through a solid-state clutch relay using a pulse-width-modulated signal that is grounded when the relay is active and has battery voltage when off. The GEM also communicates with the driver through an A4WD indicator light that indicates the position of the transfer case, and this indicator is grounded when active.

This system is able to self-diagnose and set trouble codes to help you in problem solving. It is critical for you to realize that problems which show up as fault codes in the GEM may be due to external problems. *Every time you work on one of these vehicles, you must first measure all tire pressures and tire diameters to ensure that they are equal.*

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A difference of 0.060 inch in tread wear or a difference of a few pounds per square inch in air pressure will set codes and have you wasting time. Just as you would never try to diagnose electronic complaints without first verifying correct battery voltage, never work on one of these vehicles without making sure all the tire pressures are the same and

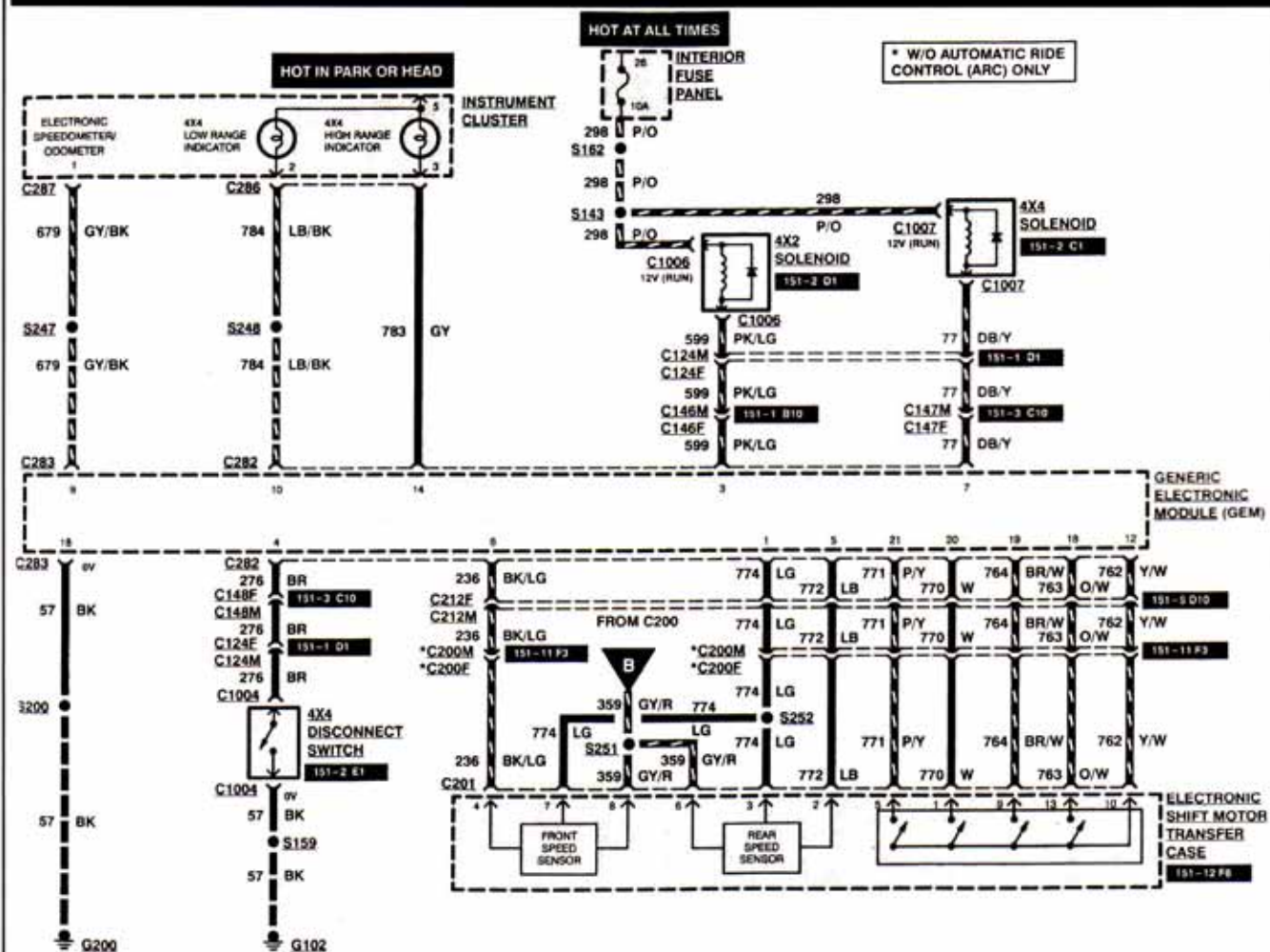
using a stagger gauge to make sure that all tire diameters are the same.

Ford has done a super job of publishing the diagnostic codes, wiring diagrams and pinpoint tests that will enable you to sort out these problems. We are printing the codes and some of the wiring diagrams to help you locate components, but you will need the service manual and the electrical-

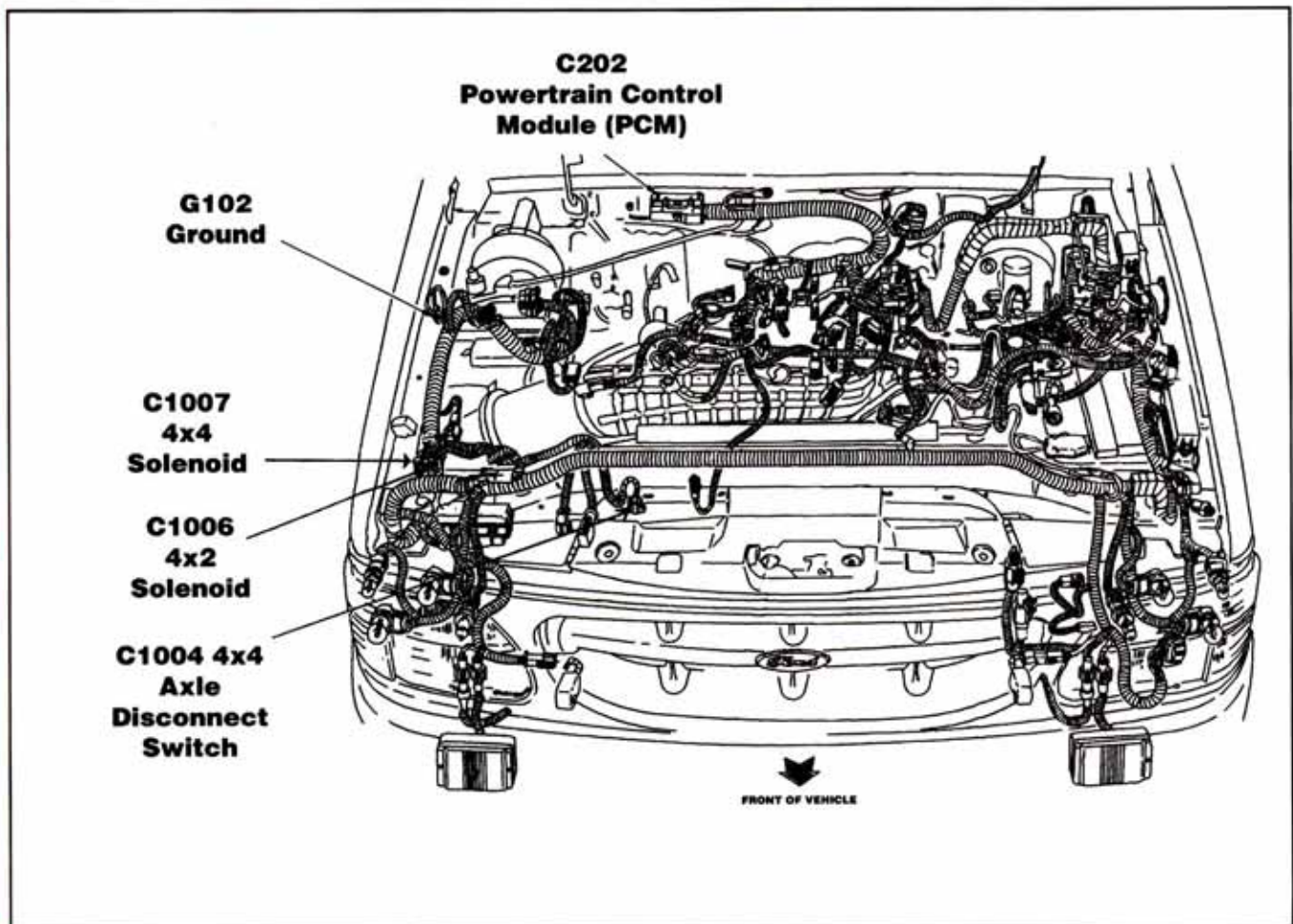
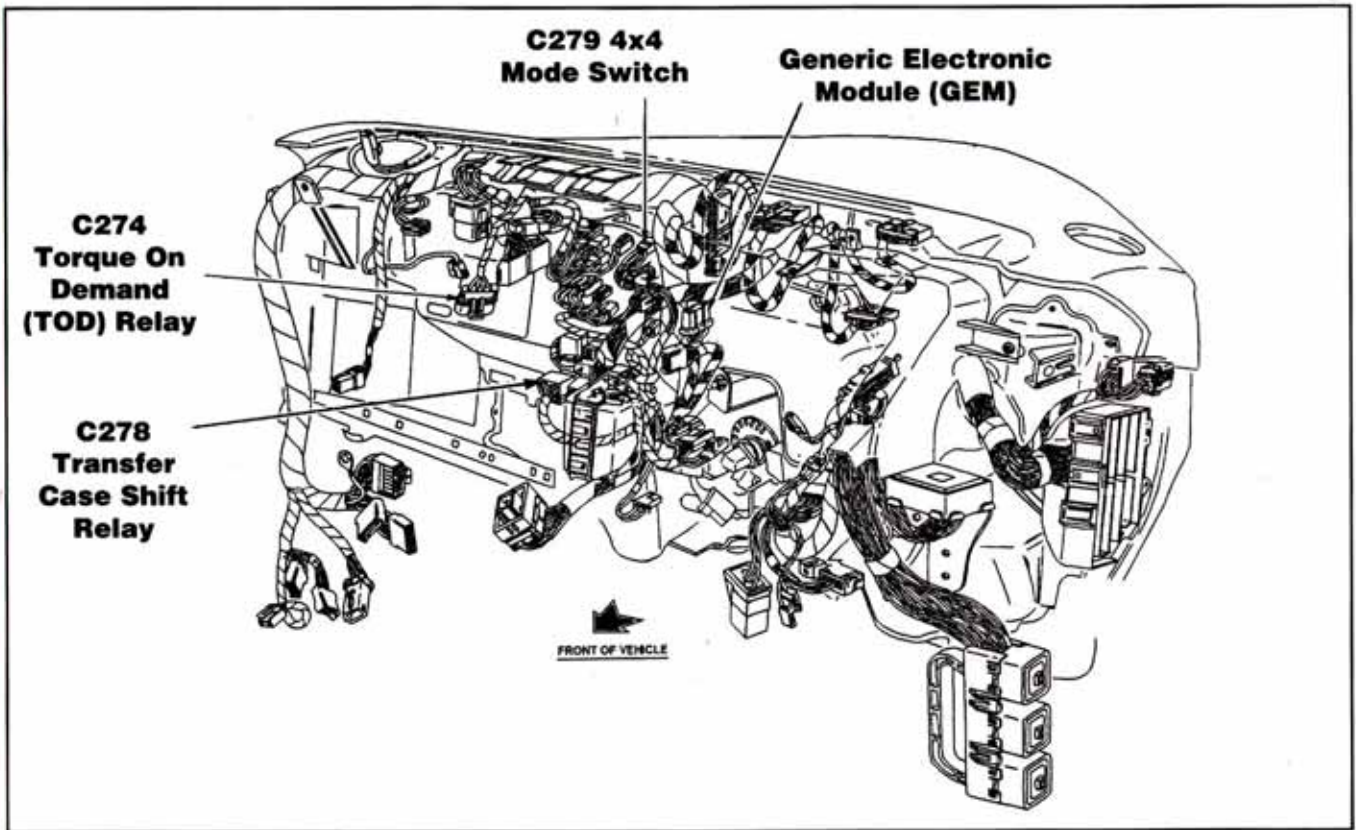
and-vacuum troubleshooting manual. There are 134 pinpoint tests in the service manual, and we do not have the space to print all of them. You will not solve these problems without the detailed information on circuit numbers and wire colors found here. It is easy to see how much the technology has changed when the

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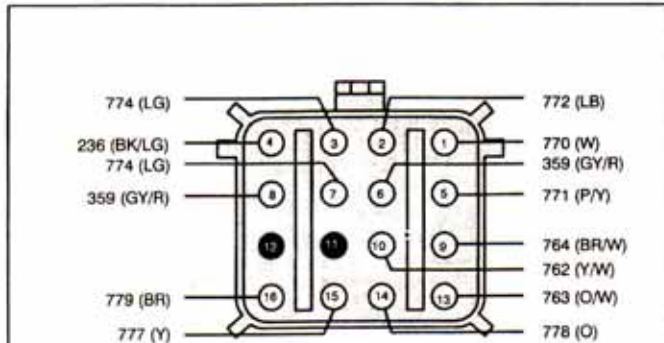
## Electric Shift Control





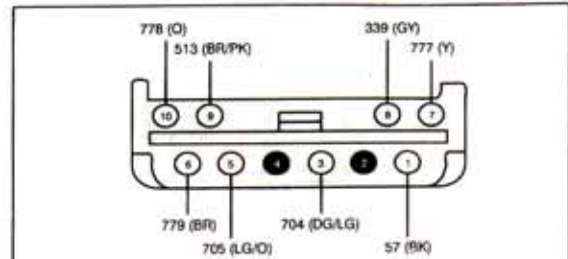


## Electric Shift Control



**C201 (BLACK)  
ELECTRIC SHIFT MOTOR TRANSFER CASE**

PIN	CIRCUIT	CIRCUIT FUNCTION
1	770 (W)	Motor Position #4
2	772 (LB)	Rear Speed Sensor Coil
3	774 (LG)	Speed Sensor Return
4	236 (BK/LG)	Front Speed Sensor Coil
5	771 (P/Y)	Motor Position #5
6	359 (GY/R)	Sensor Signal Return
7	774 (LG)	Speed Sensor Return
8	359 (GY/R)	Speed Sensor Return
9	764 (BR/W)	Motor Position #3
10	762 (Y/W)	Motor Position #1
11	—	NOT USED
12	—	NOT USED
13	763 (O/W)	Motor Position #2
14	778 (O)	Shift Relay to Motor H2L
15	777 (Y)	Shift Relay to Motor L2H
16	779 (BR)	Shift Relay to Electronic Clutch



**C278 (BLACK)  
TRANSFER CASE SHIFT RELAY**

PIN	CIRCUIT	CIRCUIT FUNCTION
1	57 (BK)	Ground
2	—	NOT USED
3	704 (DG/LG)	Power (Hot at All Times)
4	—	NOT USED
5	705 (LG/O)	Power (Hot at All Times)
6	779 (BR)	Shift Relay to Electronic Clutch
7	777 (Y)	Shift Relay to Motor L2H
8	339 (GY)	Relay Coil to GEM (L2H)
9	513 (BR/PK)	Relay Coil to GEM (H2L)
10	778 (O)	Shift Relay to Motor H2L

### CELL 34 CONNECTOR REFERENCE LIST

CONNECTOR	SECTION—PAGE
C171	31—3
C176	93—2
C280	59—7
C282	59—8
C283	59—7
C286	62—9
C287	62—9

number of pages devoted to diagnosis is four times the number covering teardown and reassembly of the unit.

It is a brave new world out there, and the way to be successful in this market is to be equipped with a good scan tool, a modern

ohmmeter, service manuals and a supply of new tires. **ID**

*Illustrations Courtesy of Ford Motor Co.*

### THE BOTTOM LINE:

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