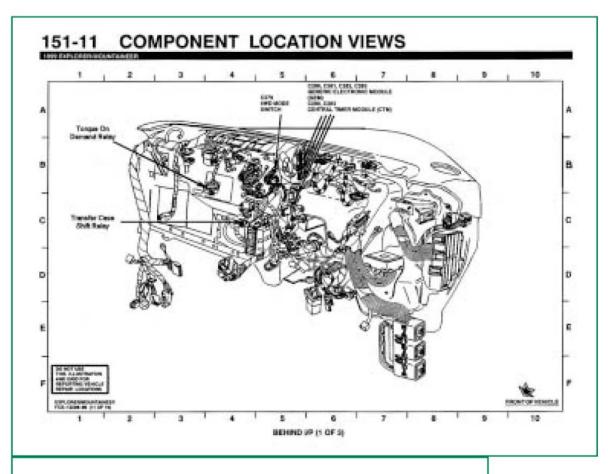
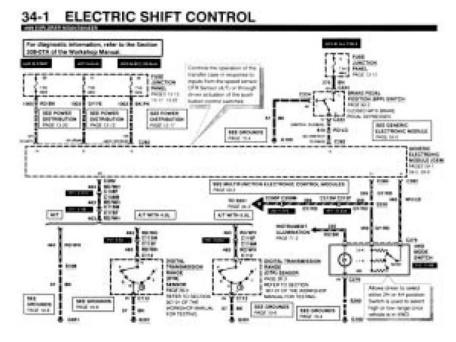
Diagnosing the Borg by Mike Weinberg, President, Rockland Standard Gear Inc. Warner 4405 Transfer Case





y devoting this issue to diagnostics, GEARS Magazine has focused on the most critical issue faced by our industry on a daily basis. Diagnostic technique can best be compared to light. Without a proper understanding of the theory of operations of the units you are working on and a planned approach to diagnosis of the mechanical and electronic components of the operation system, you will be perpetually working in darkness, feeling your way as if you were blind. Proper diagnosis before a unit is removed and disassembled will illuminate the problem area and make it possible to complete the repair quickly and profitably. Just as you need to buy lamps for your home and shop, you need to buy,

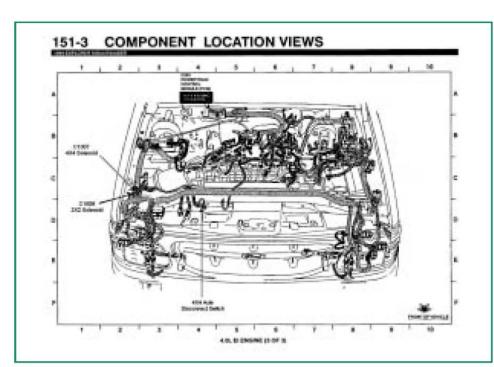
Diagnosing the Borg Warner 4405 Transfer Case

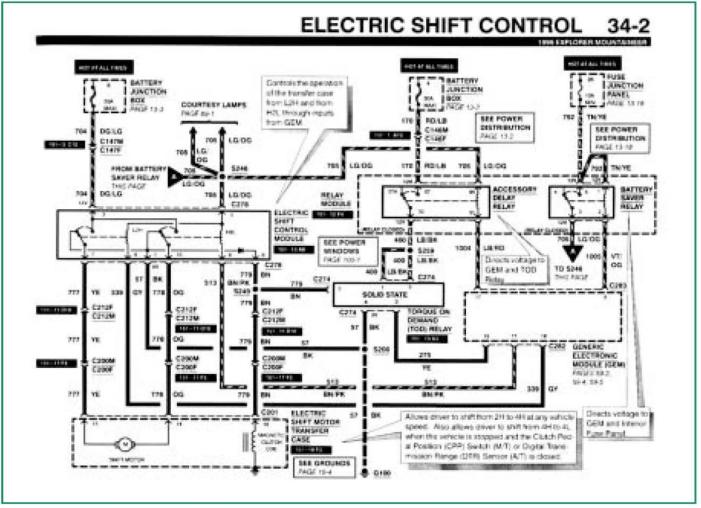
borrow, or steal the various manuals pertaining to the mechanical and electronic components of the unit you are working on.

Introduced in 1995, the Borg

Warner 4405 transfer case is used in the Ford Explorer and Mercury Mountaineer. Due to the popularity of these vehicles you can rest assured that you will work on plenty of these units. We will discuss here the mechanical and electronic diagnostics that you must understand in order to avoid some of the problems found with this unit.

Ford calls the operational system for the 4405-transfer case the A4WD system. This stands for Automatic Four Wheel Drive System. Computer controlled through the GEM (Generic Electronic Control Module) the 4405 transfer case in the automatic mode can vary the torque split between the front and rear drive shafts. enables the vehicle to be driven on dry pavement at highway speeds while remaining in full time fourwheel drive. The clutch pack in the transfer case is applied normally at a minimum duty cycle with most of the torque transferred to the rear wheels. As the GEM detects a difference in wheel speed between the front and rear axles, it increases the duty cycle of the transfer case clutch pack to send up to 98% of available torque to the front wheels. When the prop shaft speeds even out, the computer

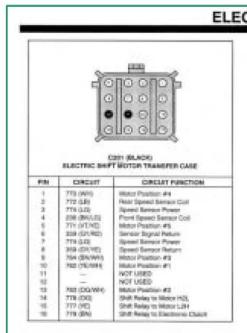


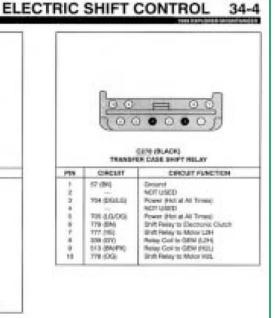


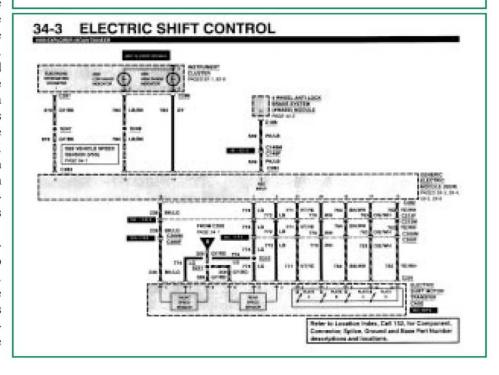
returns the clutch pack to minimum duty cycle. The driver may choose two other modes of operation by using a dash mounted rotary switch. The 4X4 High mode locks the transfer case with a torque split of 50/50 front and rear axle and is used for driving in snowy or slippery conditions. This shift can be 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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Diagnosing the Borg Warner 4405 Transfer Case

Diagnostic Trouble Code (DTC) Reference Chart

Diagnostic Trouble (Greeks (TOT) (II)	Participant Chart

DTC	Circuit	Description	Total Mode
B1342	30.4	BCU is Defective	Cu-Demand, Continuous
D1463	307 (BS/T)	Brake Petal Input Circuit Open or Short to	Continuous Continuous
6.1497	307(886-1)	Ground	Commission
PS483	307 (896/Y)	Brake Pedal lague Short to Power	On-Demand, Continuous
PURBE	210 (LB)	#WD High Indicator Circuit Open or Short to Ground	Ou-Demand, Continuous
P1886 .	210 (LB)	4WD High Indicator Short to Power	On-Demand, Continuous
Proster	905 (886/4)	4WD Low Indicator Circuit Open or Short or Ground	Ou-Demand, Continuous
Pittio	975 (BB/Y)	4WD Low Indicator Short to Perver	On-Demand, Continuous
Pokit	780 (DB) 882 (DB)	AWD Made Select Swech Circuit Open	On-Demand, Continues
Print	763 (G)	4WD Mode Select Switch Classic Short to Oraced	Ou-Demand, Continuous
P1820	782 (BR/W)	Transfer Case LO to H1 Stell Relay Cell Circuit Open or Short of Ground	On-Demund, Continuous
P1622	782 (BB//W)	Transfer Case LO to H1 friell Relay Coll Short to Power	Commission
PIROS	779 (880)	4WD Steets: Cloub Relay Cloud Open or Short to Ground	On Deminal, Continuous
PHES	779 (BR)	#WD Bleatric Chests Relay Short to Prever	Cominaces
P1838	78130ER)	Transfer Case HI to LO Sigh Relay Coll Circuit Open or Short to Ground	On-Demand, Continuos
P1830	781 (O.C.R)	Transfer Case HI to LO Shift Raley Cold Short to Power	Continues
P1836	772 (3.8)	Transfer Case From Shall: Speed Section Circuit Philips	Continuos
91107	236 (BK/LG)	Transfer Case Rear Stuft Speed Sensor Closel Fallers	Combnesse
PIER	771 (T) 778 (O)	Transfer Case Shift Motor Circuit Fallum	Combnavas
P1845	TROWY)	Transfer Case CONTACT PLATE "A" Circuit Open	Continuous
P1880	779 (W)	Transfer Case CONTACT/PLATE "B" Clean Copen	Continuous
F1894	764 (885W)	Transfer Case CONTACT PLATE "C" Classif Open	Comtinuous
P1608	TREGORNI	Transfer Case CONTACT PLATE "D" Circuit Open	Centrovas
PIME	161(EW)	Transfer Case CONTRACT PLATE Power Circuit Open	On Demand
P1866	NA.	Transfer Case System Concern	Coedineous
Piter	MA,	Tracefor Case Contact Plate General Circuit Failure	Continuous
P1874	T14 (3.00	Astroptic Hall Effect Sense Pewer Cleans Talken	On Demand
PIRT	714 (LG)	Automatic Hall Effect Sensor Person Circuit Short to Firwer	On Demand, Continues

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DIAGNOSIS AND TESTING (Continued) Observatio Trouble Code STICL Returnos Guart

auc .	Circuit	Description	TestMode	
P1.850	270 (W)	Transfer Case CONTACT PLATE "B" Closuit Open	Continuous	
P1834	764 (BB/W)	TreasPer Case CONTACT PLATE "C" Cancil Open	Continued	
F183B	161 (O/W)	Transfer Case CONTACT PLATE "D" Closel Open	Continues	
P1863	162(Y/W)	Transfer Case CONTACT PLATE Power Count Open	On-Demand	
P1866	INA.	Transfer Case System/Concerns	Continues	
P1667	26A	Truster Case Contact Mais General Circuit: Failus	Continuous	
PIRTH	794 (LG)	Automatis Hall Effect Sensor Power Circuit Co-Demand Follow		
PLINS	714 (LG)	Automatic Half-Effect Sensor Pewer Climais On-Deceard, Comp Shart to Piewer		

GEM Primary Identification (PID) Reference Chart

GEM Primary Identification (PID) Reference Chart

MD	Circuit	Circuit Description	Expected Values
VSS_CEM	479 (Q50 B.K)	Vehicle Speed Signal	000-255 later
CLECKIN	463 (80°PV)	Transmissaon Closel: Interfacia Switch	ENGACED, NOT ENGACED
NTRL_SW	463 (R/W)	Neutral Safety Switch Input	NUMBER OF STREET
MTR_CCW	109 (01)	Transmission Transfer L.O to HI Motor Disput	ON, OFF, OFF-0-G
MTR_CV	313 (BR/PSC)	LO to HI Shift Relay Call Bratus	CF9-
AVDCLCH.	175(0)	4WD Electronic Clutch Output Status	ON
4NOLOW	784 (LB/860)	4WD Low Indicator States	GN-, GPF-
WINDHIGH	180 (GY)	#WD High Indicator Status	GN,GFP
FLATELA	TIL (BYY)	Transfer Case Comunt Plans Switch A.	OPRIN, CLOSED
PLATEL B	T70(W)	Transfer Case Connect Place Switch S.	OPEN, CLOSED
PLATE_C	764(398/9)	Transfer Case Corner Plan Switch C	OPEN, CLOSED
M_ATE_D	363 (0/9)	Transfer Case Cornet Plan Switch D	GPES, CLOSED
BOO_DBM	301 (E.G)	Broke CwCXT(BOC) Switch Input	OM, OFF
ICH_CEM	1000 (8/600). 1800 (86/98). 1800 (378/Y)	Igation Switch States	STANT. SUN. OFF. ACC
SPELLAR	774-(LG)	Half Effect Speed Sensor Power	ON-, OFF-
EWIXILIST.	400	PWD Claub PWM Dopol Status	ON-1, OFF
TRA_RSF	772 (1.80	Rese Shaft Speed	0-250 mgh
TRA_FSP	206-(BEE/LG)	Frant Shaft Speed	6-325 mph
PLATERY	362 (3/74)	Contact Plate Ground Output	QN-,QFF-

1997 Explorer, Mountaineer, 7/1999

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.

