

The BorgWarner 44-11 Transfer Case, Chapter 2

Electronic Operation and Diagnosis

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Contributing Editor**

In last month's article we looked at the mechanical operation of the BorgWarner 44-11 automatic all-wheel-drive transfer case, which replaces the BW 44-05 transfer case and is used in the Ford Explorer, Ranger and Mountaineer and Lincoln Aviator models. This month's article is devoted to the electronic functions of this transfer case.

The mechanical end of the transfer case is relatively simple, and the design did not change much; however, the electronic and computer controls are advancing at a rapid pace, and this is the area where most shops have trouble. In the repair manual you will find 29 pages devoted to repairing the transfer case and more than 100 pages covering diagnosis and testing for the electronic control systems. It is absolutely impossible to diagnose or test one of these units electrically without a service manual.

That said, it is also crucial to your success to stop looking at the transmission or transfer case as a unit and begin to visualize it as part of a vehicle composed of interlocking control systems. Once you start to think of the vehicle as a collection of related systems, you open your mind to possibilities that affect the unit you are working on but may have nothing to do with the parts inside the unit. It is important to step back and view the forest and not just the trees.

In the earlier BW 44-05 you have an "active" transfer case that is capable of sending torque to the axle that needs it according to changing conditions. The BW 44-11 is very much the same design with more-sophisticated electronics.

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Figure 1 4WD Control Module Diagnostic Trouble Code (DTC) Index – Electronic Shift

DTC	Description	Source	Action
B1317	Battery Voltage High	4WD control module	Refer to Section 414-00.
B1318	Battery Voltage Low	4WD control module	Refer to Section 414-00.
B1342	ECU is Defective	4WD control module	Clear the DTCs. Repeat the 4WD control module self-test. If DTC B1342 is retrieved, install a new 4WD control module. Refer to four-wheel drive (4WD) control module in this section. Clear the DTCs. Repeat the self-test.
B1359	Ignition Run/Acc Circuit Failure	4WD control module	Go to Pinpoint Test B
B1555	Ignition Run/Start Circuit Failure	4WD control module	Go to Pinpoint Test B.
B1483	Brake Pedal Input Circuit Failure	4WD control module	Go to Pinpoint Test C.
B1485	Brake Pedal Input Short to Battery	4WD control module	Go to Pinpoint Test C.
B2105	Throttle Position Input Out of Range Low	4WD control module	Go to Pinpoint Test A.
B2106	Throttle Position Input Out of Range High	4WD control module	Go to Pinpoint Test A.

(table continues page 26)

Figure 1 4WD Control Module Diagnostic Trouble Code (DTC) Index – Electronic Shift

DTC	Description	Source	Action
C1729	Transfer Case Unable to Transition Between 4WD HIGH and 4WD LOW	4WD control module	Go to Pinpoint Test C.
P1707	Transfer Case Neutral Indicator Hard Fault Present	4WD control module	Go to Pinpoint Test C.
P1804	Transmission 4-Wheel Drive High Indicator Circuit Failure	4WD control module	Go to Pinpoint Test A.
P1806	Transmission 4-Wheel Drive High Indicator Short Circuit to Battery	4WD control module	Go to Pinpoint Test A.
P1808	Transmission 4-Wheel Drive Low Indicator Circuit Failure	4WD control module	Go to Pinpoint Test A.
P1810	Transmission 4-Wheel Drive Low Indicator Short Circuit to Battery	4WD control module	Go to Pinpoint Test A.
P1812	Transmission 4-Wheel Drive Mode Select Circuit Failure	4WD control module	Go to Pinpoint Test A.
P1815	Transmission 4-Wheel Drive Mode Select Short Circuit to Ground	4WD control module	Go to Pinpoint Test A.
P1816	Transmission NEUTRAL Safety Switch Circuit Failure	4WD control module	Go to Pinpoint Test C
P1819	Transmission NEUTRAL Safety Switch Circuit Short to Ground	4WD control module	Go To Pinpoint Test C
P1824	Transmission 4-Wheel Drive Clutch Relay Circuit Failure	4WD control module	Go to Pinpoint Test A.
P1826	Transmission 4-Wheel Drive Low Clutch Relay Short Circuit to Battery	4WD control module	Go to Pinpoint Test A.
P1827	Transmission 4-Wheel Drive Low Clutch Relay Short Circuit to Ground	4WD control module	Go to Pinpoint Test A.
P1836	Transmission Transfer Case Front Shaft Speed Sensor Circuit Failure	4WD control module	Go to Pinpoint Test A.

Figure 1 4WD Control Module Diagnostic Trouble Code (DTC) Index – Electronic Shift

DTC	Description	Source	Action
P1837	Transmission Transfer Case Rear Shaft Speed Sensor Circuit Failure	4WD control module	Go to Pinpoint Test A.
P1849	Transmission Transfer Case Contact Plate A Short Circuit to Ground	4WD control module	Go to Pinpoint Test C.
P1853	Transmission Transfer Case Contact Plate B Short Circuit to Ground	4WD control module	Go to Pinpoint Test C.
P1857	Transmission Transfer Case Contact Plate C Short Circuit to Ground	4WD control module	Go to Pinpoint Test C.
P1861	Transmission Transfer Case Contact Plate D Short Circuit to Ground	4WD control module	Go to Pinpoint Test C.
P1867	Transmission Transfer Case Contact Plate General Circuit Failure	4WD control module	Go to Pinpoint Test C.
P1874	Transmission Automatic Hall Effect Sensor Power Circuit Failure	4WD control module	Go to Pinpoint Test A.
P1875	Transmission Automatic Hall Effect Sensor Power Circuit Short to Battery	4WD control module	Go to Pinpoint Test A.
P1891	Transmission Transfer Case Contact Plate Ground Return Open Circuit	4WD control module	Go to Pinpoint Test C.
U1900	CAN Communication BUS Fault	4WD control module	Refer to Section 418-00.
U1950	USB Communication BUS Fault	4WD control module	Refer to Section 418-00.
U2023	External Node Fault	4WD control module	Refer to Section 418-00.
U2306	Invalid UBP Data From Instrument Cluster (Node 60)	4WD control module	Refer to Section 418-00.
U2226	Invalid UBP Data From PCM (Node 10)	4WD control module	Refer to Section 418-00.
-	For All Other DTCs	4WD control module	Refer to Section 418-00.

Figure 2

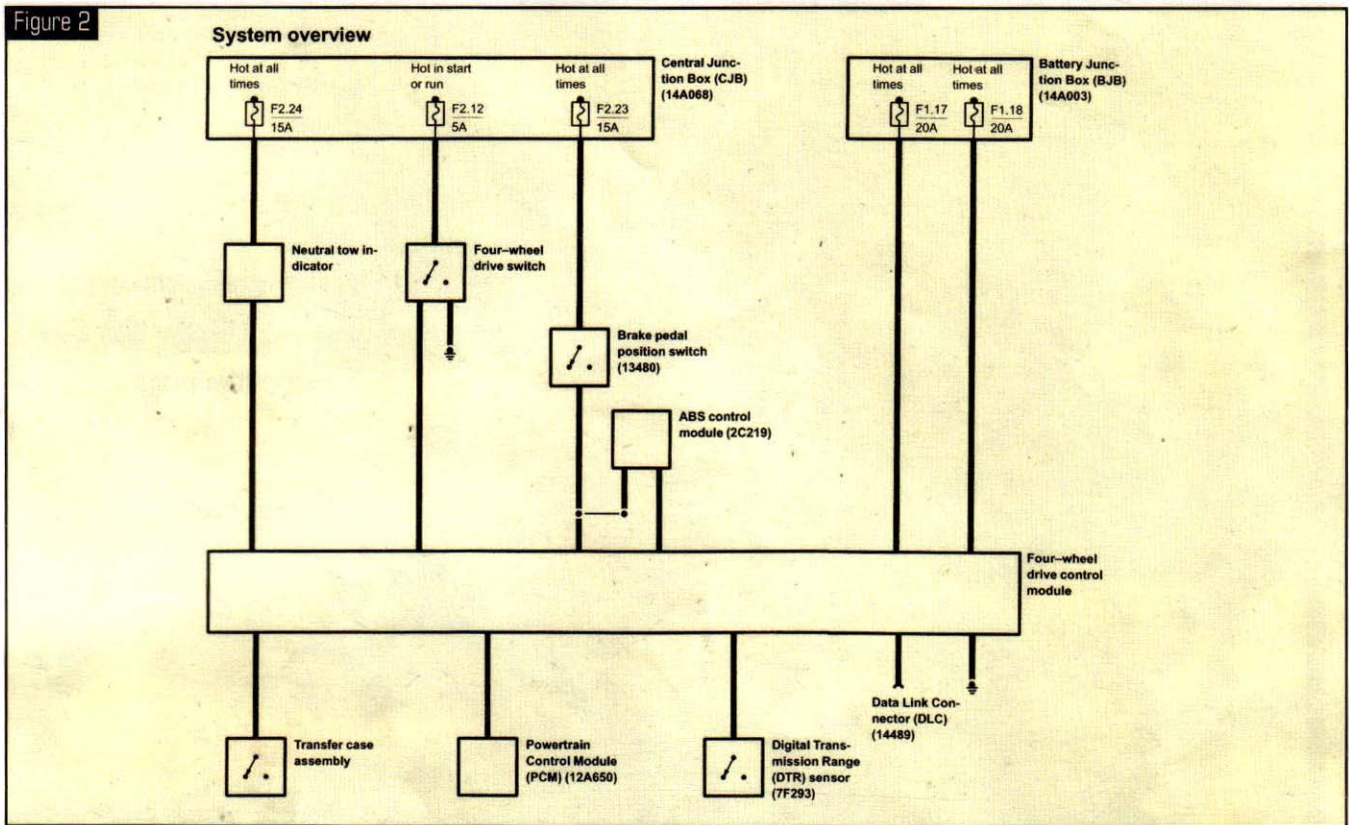
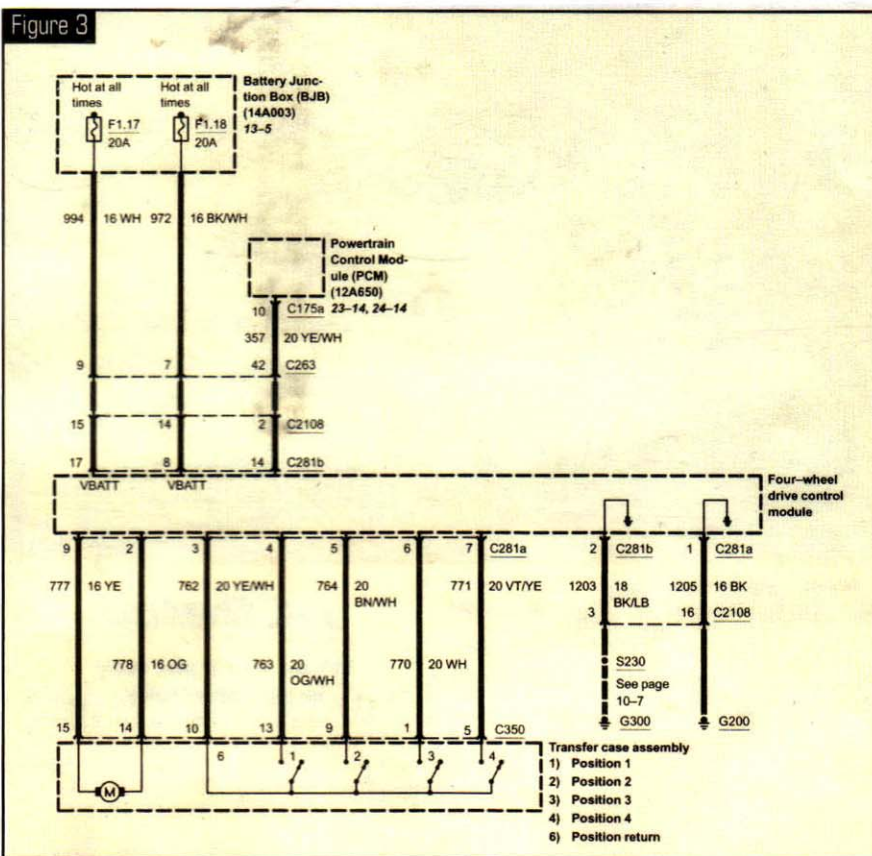


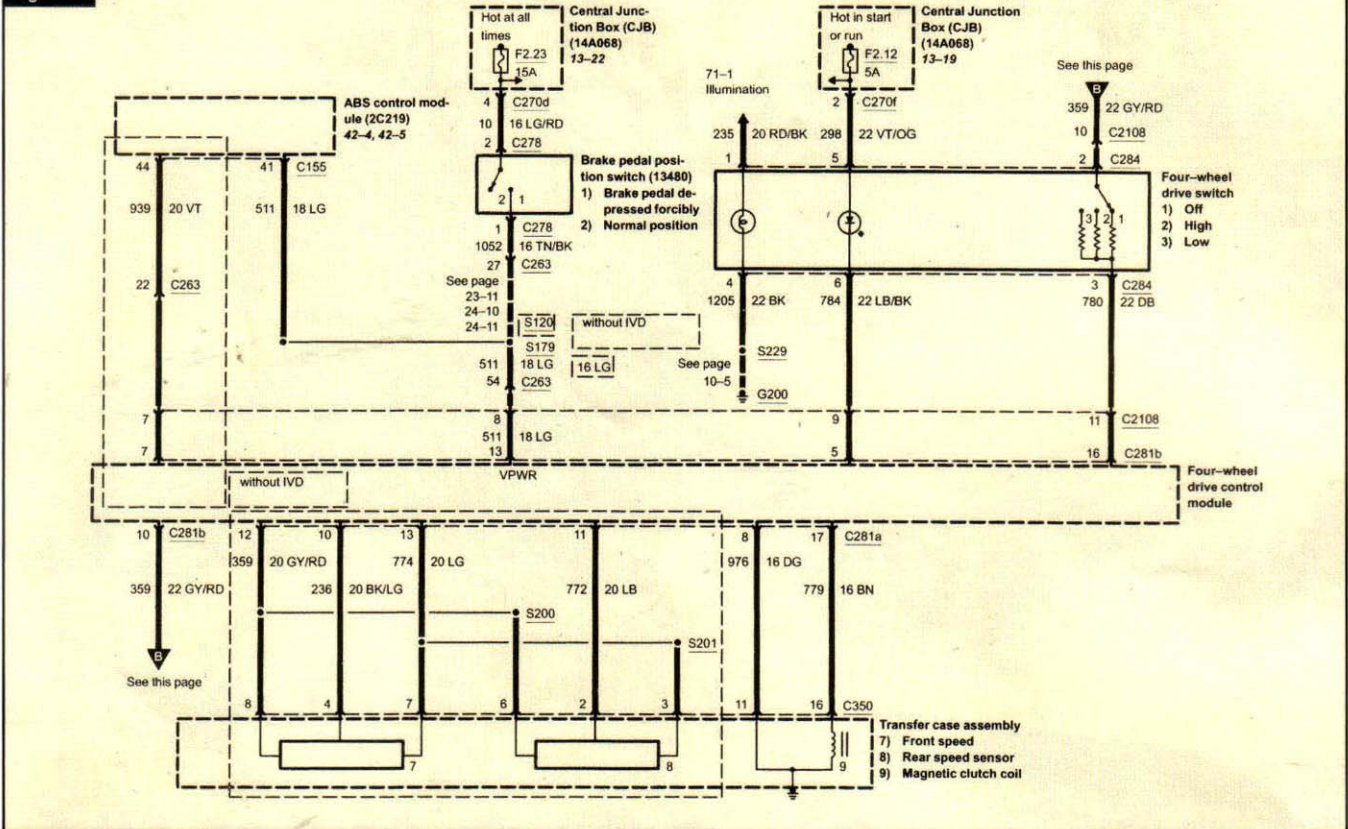
Figure 3



“Why does it have to be more complex?” you ask, figuring that the engineers are changing things just to keep their jobs and make yours tougher. Look at the vehicle systems and you will see a lot of added sophistication. We now have four-wheel antilock-braking systems (ABS), which affect the torque biasing on the transfer-case clutch. There is now a “stability” system, which is a form of traction control that is designed to make the SUV platform with its high center of gravity safer for the average American driver to use. This system will also affect the computer controls that make the transfer case function. To design and perfect this package, the engineers have had to add more computer control, and more computer control creates the need for increasingly complex diagnostic routines and the need to look at circuitry that is not directly connected to

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Figure 4



the transmission and transfer case. The electronic parts that control the transfer case are basically the same as those in the BW 44-05. An electric shift motor mounted on the transfer case engages the various modes of operation. Contained in the motor is a surface-contact plate or "encoder"

that tells the computer which position the motor is in. In the passenger compartment is a mode-select switch (MSS) that enables the driver to select the transfer-case operating modes, which are 4x4 Auto, 4x4 High and 4x4 Low. On the 2003 models, the MSS

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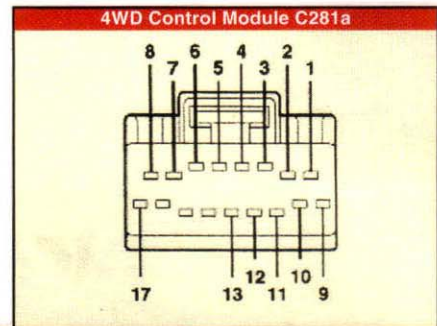


Figure 5

4WD Control Module C281a

Pin #(s)	Circuit Designation/Description	Normal Condition/Measurement
1	CKT 1205 (BK) Ground circuit for transfer-case shift motor.	5 ohms or less to chassis ground.
2	CKT 778 (OG) Transfer-case shift-motor control circuit between 4WD control module and transfer-case shift motor.	10,000 ohms or greater to chassis ground with 4WD control module and transfer-case shift motor disconnected. 5 ohms or less between 4WD control module and transfer-case shift motor.
3	CKT 762 (YE/WH) Transfer-case shift-motor position signal return between transfer case contact encoder plate and 4WD control module.	10,000 ohms or greater to chassis ground with 4WD control module and transfer-case shift motor disconnected. 5 ohms or less between 4WD control module and transfer-case shift motor.
4	CKT 763 (OG/WH) Transfer-case shift-motor position contact plate encoder signal position four.	10,000 ohms or greater to chassis ground with 4WD control module and transfer-case shift motor disconnected. 5 ohms or less between 4WD control module and transfer-case shift motor.
5	CKT 764 (BNIWH) Transfer-case shift-motor position contact plate encoder signal position three.	10,000 ohms or greater to chassis ground with 4WD control module and transfer-case shift motor disconnected. 5 ohms or less between 4WD control module and transfer-case shift motor.

Figure 5 **4WD Control Module C281a**

Pin #(s)	Circuit Designation/Description	Normal Condition/Measurement
6	CKT 770 (WH) Transfer-case shift-motor position contact plate encoder signal position two.	10,000 ohms or greater to chassis ground with 4WD control module and transfer-case shift motor disconnected. 5 ohms or less between 4WD control module and transfer-case shift motor.
7	CKT 771 (VT/YE) Transfer-case shift-motor position contact plate encoder signal position one.	10,000 ohms or greater to chassis ground with 4WD control module and transfer-case shift motor disconnected. 5 ohms or less between 4WD control module and transfer-case shift motor.
8	CKT 976 (OG) Transfer-case-clutch field-coil signal return.	10,000 ohms or greater to chassis ground with 4WD control module and transfer case disconnected. 5 ohms or less between 4WD control module and transfer case.
9	CKT 777 (YE) Transfer-case shift-motor control circuit between 4WD control module and transfer-case shift motor.	10,000 ohms or greater to chassis ground with 4WD control module and transfer-case shift motor disconnected. 5 ohms or less between 4WD control module and transfer-case shift motor.
10	CKT 236 (BK/LG) Non-stability assist only. Front output-shaft speed-sensor signal.	10,000 ohms or greater to chassis ground with 4WD control module and transfer case disconnected. 5 ohms or less between 4WD control module and transfer case.
11	CKT 772 (LB) Non-stability assist only. Rear output-shaft speed-sensor signal.	10,000 ohms or greater to chassis ground with 4WD control module and transfer case disconnected. 5 ohms or less between 4WD control module and transfer case.
12	CKT 359 (GY/RO) Non-stability assist only. Output shaft speed sensors ground circuit.	10,000 ohms or greater to chassis ground with 4WD control module and transfer case disconnected. 5 ohms or less between 4WD control module and transfer case.
13	CKT 774 (LG) Non-stability assist only. Output-shaft speed sensors power circuit.	10,000 ohms or greater to chassis ground with 4WD control module and transfer case disconnected. 5 ohms or less between 4WD control module and transfer case.
17	CKT 779 (BN) Transfer-case-clutch power circuit.	10,000 ohms or greater to chassis ground with 4WD control module and transfer case disconnected. 5 ohms or less between 4WD control module and transfer case.

will light up only when the unit is in 4x4 Low. A brake-pedal-position (BPP) sensor informs the 4WD control module whether the brakes are being used.

On the transmission (automatic) is a digital transmission-range

(TR) sensor that tells the power-train control module (PCM) which range the transmission is in. Manual-transmission models have a clutch switch that tells the computer when the clutch is de-

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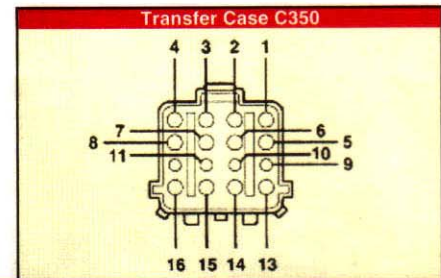


Figure 6 **Transfer Case C350**

Pin #(s)	Circuit Designation/Description	Normal Condition/Measurement
1	CKT 770 (WH) Transfer-case shift-motor-position contact plate encoder signal position two.	10,000 ohms or greater to chassis ground with 4WD control module and transfer-case shift motor disconnected. 5 ohms or less between 4WD control module and transfer-case shift motor.
2	CKT 772 (LB) Non-stability assist only. Rear output-shaft speed-sensor signal.	10,000 ohms or greater to chassis ground with 4WD control module and transfer case disconnected. 5 ohms or less between 4WD control module and transfer case.
3	CKT 774 (LG) Non-stability assist only. Rear output-shaft speed-sensor power circuit.	10,000 ohms or greater to chassis ground with 4WD control module and transfer case disconnected. 5 ohms or less between 4WD control module and transfer case.
4	CKT 236 (BK/LG) Non-stability assist only. Front output-shaft speed-sensor signal.	10,000 ohms or greater to chassis ground with 4WD control module and transfer case disconnected. 5 ohms or less between 4WD control module and transfer case.

Figure 6 Transfer Case C350		
Pin #(s)	Circuit Designation/Description	Normal Condition/Measurement
5	CKT 771 (VT/YE) Transfer-case shift-motor-position contact plate encoder signal position one.	10,000 ohms or greater to chassis ground with 4WD control module and transfer-case shift motor disconnected. 5 ohms or less between 4WD control module and transfer case shift motor.
6	CKT 359 (GY/RD) Non-stability assist only. Rear output-shaft speed-sensor ground circuit.	10,000 ohms or greater to chassis ground with 4WD control module and transfer case disconnected. 5 ohms or less between 4WD control module and transfer case.
7	CKT 774 (LG) Non-stability assist only. Front output-shaft speed-sensor power circuit.	10,000 ohms or greater to chassis ground with 4WD control module and transfer case disconnected. 5 ohms or less between 4WD control module and transfer case.
8	CKT 359 (GY/RD) Non-stability assist only. Front output-shaft speed-sensor ground circuit.	10,000 ohms or greater to chassis ground with 4WD control module and transfer case disconnected. 5 ohms or less between 4WD control module and transfer case.
9	CKT 764 (BN/WH) Transfer-case shift-motor-position contact plate encoder signal position three.	10,000 ohms or greater to chassis ground with 4WD control module and transfer-case shift motor disconnected. 5 ohms or less between 4WD control module and transfer-case shift motor.
10	CKT 762 (YE/WH) Transfer-case shift-motor position signal return between transfer-case contact encoder plate and 4WD control module.	10,000 ohms or greater to chassis ground with 4WD control module and transfer-case shift motor disconnected. 5 ohms or less between 4WD control module and transfer-case shift motor.
11	CKT 976 (OG) Transfer-case-clutch field-coil signal return.	10,000 ohms or greater to chassis ground with 4WD control module and transfer case disconnected. 5 ohms or less between 4WD control module and transfer case.
13	CKT 763 (OG/WH) Transfer-case shift-motor position contact plate encoder signal position four.	10,000 ohms or greater to chassis ground with 4WD control module and transfer-case shift motor disconnected. 5 ohms or less between 4WD control module and transfer-case shift motor.
14	CKT 778 (OG) Transfer-case shift motor control circuit between 4WD control module and transfer-case shift motor.	10,000 ohms or greater to chassis ground with 4WD control module and transfer-case shift motor disconnected. 5 ohms or less between 4WD control module and transfer case shift motor.
15	CKT 777 (YE) Transfer-case shift-motor control circuit between 4WD control module and transfer-case shift motor.	10,000 ohms or greater to chassis ground with 4WD control module and transfer case shift motor disconnected. 5 ohms or less between 4WD control module and transfer-case shift motor.
16	CKT 779 (BN) Transfer-case-clutch power circuit.	10,000 ohms or greater to chassis ground with 4WD control module and transfer case disconnected. 5 ohms or less between 4WD control module and transfer case.

pressed. The throttle-position sensor informs the PCM what the throttle opening is. The PCM will change the throttle-position signal into a pulse-width-modulated (PWM) signal and transmits that signal to the 4WD control module, which uses that signal to control

and modulate the transfer-case clutch-apply cycle.

Mounted on the transfer case are the output-shaft-speed (OSS) sensors, which transmit the speeds of the two driveshafts to the 4WD control module. The computer then uses the difference

between the two shaft speeds to regulate the duty cycle of the transfer-case clutch pack. One difference in the BW 44-11 electronic system is that vehicles equipped with stability assist have the speed sensors mounted on the transfer

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case but the sensors are not used. With stability assist, the wheel-speed sensors send the signal to the stability control module, which then transmits the signal to the 4WD control module to vary

Also included are the various wiring diagrams and circuit descriptions (see figures 2-9) for the circuitry involved. Although diagnosis has become more complex, the diagnostic programs have im-

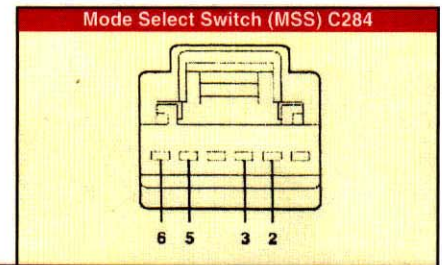


Figure 7

Mode Select Switch (MSS) C284		
Pin #(s)	Circuit Designation/Description	Normal Condition/Measurement
2	CKT 359 (GY/RD) Mode-select signal return to 4WD control module.	10,000 ohms or greater to chassis ground with 4WD control module and MSS disconnected. 5 ohms or less between 4WD control module and MSS.
3	CKT 780 (DB) Mode-select power-supply circuit from 4WD control	10000 ohms or greater to chassis ground with 4WD control module and MSS disconnected. 5 ohms or less between 4WD control module and MSS.
5	CKT 298 (VT/OG) Power-supply circuit to transfer-case-mode indicator lamp (LED).	10 volts or greater to chassis ground. 10,000 ohms or greater to chassis ground with MSS disconnected.
6	CKT 784 (LB/BK) Transfer-case-mode indicator lamp (LED) ground circuit.	10,000 ohms or greater to chassis ground with 4WD control module and MSS disconnected. 5 ohms or less between 4WD control module and MSS.

Figure 8

Transmission Range (TR) Sensor C167		
Pin #(s)	Circuit Designation/Description	Normal Condition/Measurement
8	CKT 463 (RD/WH) Transmission-in-Neutral signal to 4WD control module.	10,000 ohms or greater to chassis ground. 5 ohms or less between TR sensor and 4WD control module.

Transmission Range (TR) Sensor C167

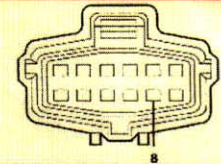
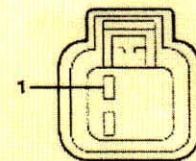


Figure 9

Brake On/Off (BOO) Switch C278		
Pin #(s)	Circuit Designation/Description	Normal Condition/Measurement
1	CKT 1052 (TN/BK) Brake on/off signal to ABS and 4WD control module.	10,000 ohms or greater to chassis ground with 4WD control module and BOO switch disconnected. 5 ohms or less between 4WD control module and BOO switch.

Brake On/Off (BOO) Switch C278



the clutch duty cycle. The vehicle speed sensor now receives its signal from the ABS, and that signal is sent to the 4WD control module to let it know the vehicle road speed.

As you can see, with all this information being provided to the 4WD control module from different interlocking systems, there is much more involved in diagnosis than just the transfer case. There are four types of DTCs that will show up on a scan tool: B, C, P and U codes. The chart in Figure 1 is a code index for your use.

proved dramatically, with the appropriate scan tool being able to activate the circuits to measure performance as well as download DTCs and other information. To be sure of what is creating the customer complaint, a thorough examination of the vehicle will be necessary, starting with tire size and pressures and including a proper electronic scanning routine.

There are no more shortcuts to success. Without the proper manuals and diagnostic tools, there will be very few vehicles you can repair quickly and correctly. **TD**

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