

Flash! Transfer Cases Go Electronic!

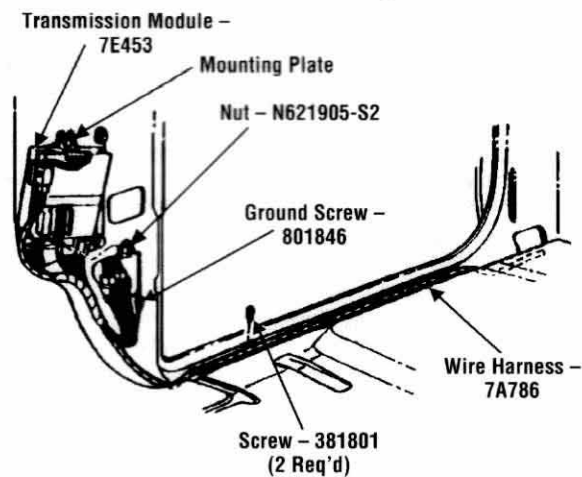
Electricity arrived in our industry with a vengeance, in case you hadn't noticed. Transmissions are now computer controlled and tied into the engine-management system. It is only natural that transfer cases would learn to obey Ohm's law. The Borg-Warner transfer cases were the first to be electronically shifted and New Process has followed suit. The next progress was to integrate the transfer case into more advanced electronics with its own electronic control module (ECM).



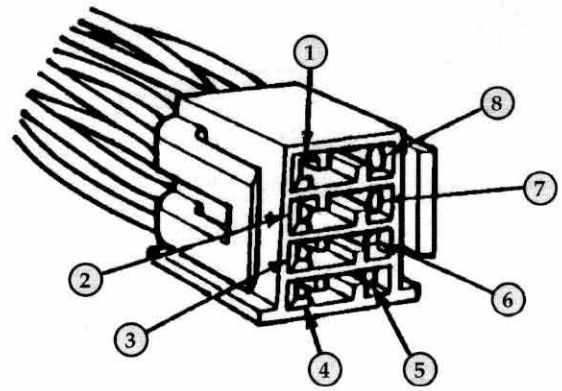
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Contributing Editor

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To check the integrity of these circuits, disconnect the harnesses from the Electronic Control Module and perform the following checks:



ECM Checks



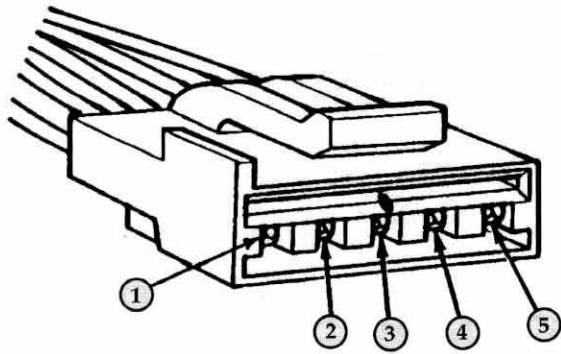
Eight-Wire Pigtail Harness Connector (E25B-14489-GB)

Position	Circuit Number	Color Code	Function
1	OPEN		
2	57	Blk	Ground
	57A	Blk	Ground
3	396	Blk/Org	Logic Ground
4	778	Org	Transfer Case Motor Control (Clockwise) 2H-4H-4L
5	777	Yel	Transfer Case Motor Control (Counterclockwise) 4L-4H-2H
6	779	Brn	Electromagnetic Clutch (Feed)
7	296	Wht/Ppl	Ignition Run and Accessory Feed (Fused)
8	517	Blk/Wht	Battery Feed (Circuit Breaker)

1. Connect a voltmeter between terminal 8 and ground. The voltmeter should indicate battery voltage at all times.
2. Connect a voltmeter between terminal 7 and ground. Then turn the ignition switch to the "RUN" position. The voltmeter then should indicate battery voltage.

Caution: When the use of an ohmmeter is specified, always remember that an ohmmeter NEVER should be connected into a "live" or powered circuit. If the ohmmeter is subjected to a powered circuit, severe damage will be done to the instrument. The vehicle's battery should be disconnected before performing checks on any circuit with an ohmmeter to prevent any accidental damage to the instrument.

3. Connect an ohmmeter Rotunda Number 007-000001 between terminal 6 and ground. The ohmmeter should indicate a "low" resistance value (less than 10 ohms).
4. Connect an ohmmeter between terminals 4 and 5 of the wiring harness connector. The ohmmeter should indicate a "low" resistance value (less than 10 ohms).
5. Connect an ohmmeter between terminal 3 and ground. The ohmmeter should indicate 0 ohms.
6. Connect an ohmmeter between terminal 2 and ground. The ohmmeter should indicate 0 ohms.



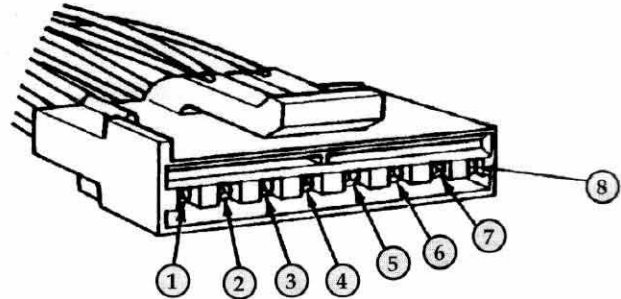
Five-Wire Harness Connector

Position	Circuit Number	Color Code	Function
1	465	Wht/Lt Blu	Switch Feed
2	780	Dk Blu	4x4 Switch
3	781	Org/Lt Blu	Low Range Switch
4	782	Brn/Wht	Low Range Light
5	783	Gry	4x4 Light

1. Connect an ohmmeter between terminals 1 and 2. Then depress the 4x4 (2H-4H) switch in the Overhead Roof Console. The ohmmeter should indicate a very "low" resistance value (less than 50 ohms) while the switch is being depressed.
2. Connect an ohmmeter between terminals 1 and 3. Then depress the "Low Range" switch to the right of the steering column. The ohmmeter should indicate a very "low" resistance value (less than 50 ohms) while the switch is being depressed.
3. Connect a test lead between terminal 4 and ground. Turn the ignition switch to the "RUN" position and observe the Overhead Roof Console. The lamp in the Overhead Roof Console Low Range Bar should illuminate.
4. Connect a test lead between terminal number five and ground. Turn the ignition switch to the "RUN" position and observe the Overhead Roof Console. The lamp in the Overhead Roof Console 4x4 Bar should illuminate.

Eight-Wire Harness Connector (E4EB-14489-SA)

Position	Circuit Number	Color Code	Function
1	32	Red/Lt Blu	Manual Transmission Clutch Interlock Switch
	463	Red/Wht	Automatic Transmission Neutral Safety Switch
2	774	Lt Grn	Speed Sensor (Feed)
3	772	Lt Blu	Speed Sensor Return
4	771	Violet	Wire #5. Contact Plate Position Sensor in Transfer Case
5	770	Wht	Wire #4. Contact Plate Position Sensor in Transfer Case
6	764	Brn/Wht	Wire #3. Contact Plate Position Sensor in Transfer Case
7	763	Org/Wht	Wire #2. Contact Plate Position Sensor in Transfer Case
8	762	Yel/Wht	Wire #1. Contact Plate Position Sensor in Transfer Case

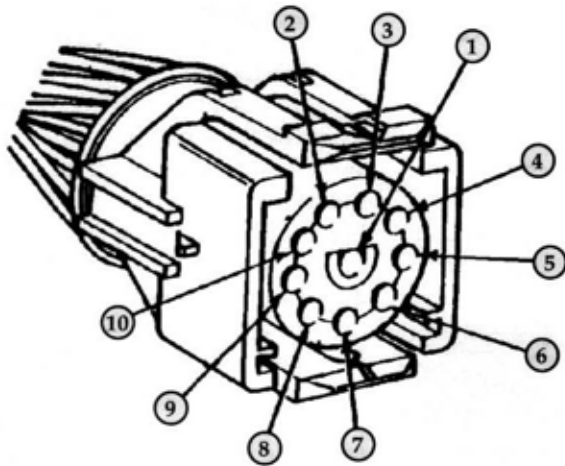


Ohmmeter Readings For Shift Motor Position Sensor

Ohmmeter Connection	Transfer Case Gear Position		
	2 High	4 High	4 Low
Meter Reading From Terminal #8 to #4	Short	Open	Short
Meter Reading From Terminal #8 to #5	Open	Open	Short
Meter Reading From Terminal #8 to #6	Short	Short	Open
Meter Reading From Terminal #8 to #7	Open	Short	Open

Note: Short is a "low" resistance reading on the ohmmeter (zero ohms). Open is a "high" resistance reading on the ohmmeter (infinity).

1. Connect an ohmmeter between terminal 1 and ground. On a vehicle equipped with a manual transmission, depress the clutch pedal and observe the ohmmeter. The ohmmeter should indicate a "low" resistance (less than 50 ohms) while the clutch pedal is being depressed. If the vehicle is equipped with an automatic transmission, shift the transmission into the "Neutral" position and observe the ohmmeter. The ohmmeter should indicate a "low" resistance (less than 50 ohms) while the transmission selector lever is in the "Neutral" position.
2. Connect an ohmmeter between terminals 2 and 3. The ohmmeter should indicate a "low" resistance reading (200-350 ohms). This will check the continuity of the speed sensor that is located in the transfer case. The speed sensor picks up the rotating speed of the output shaft from two notches that are cut in opposite sides of the outer ring of the clutch housing assembly.
3. Connect an ohmmeter between terminal 8 and terminals 4, 5, 6 and 7, respectively. Refer to Chart 4 for the appropriate ohmmeter readings in each transfer-case position.



A listing of the transfer-case feed harness circuits and their functions follows:

1. The electromagnetic clutch-feed circuit provides a power signal to the clutch coil, from the control module when shifting from 2W to 4W drive.
2. Clockwise rotation of the electric shift motor circuit provides power to drive the shift motor through the 2H-4H-4L sequence. If a position is selected that would require a shift through an intermediate position, the module will respond as if each intermediate position was selected, even if the 4L position was commanded from 2H. It then will fulfill all of the requirements for shifting into or out of each intermediate position.
3. Counterclockwise rotation of the electric shift motor circuit provides power to drive the shift motor through the 4L-4H-2H sequence. Actuation of the Low Range Switch, while in 4L, will cause a shift to 4H. Actuation of the "Four-by-Four" 2W-4W switch, after a shift to 4H from 4L, then will cause a shift to 2H.
4. The speed sensor coil feed circuit provides a constant signal from the electronic control module to the speed sensor located in the transfer case.
5. The speed sensor coil return circuit provides a varying signal (while the vehicle is in motion) from the speed sensor to the electronic control module. This signal indicates the vehicle speed to the microprocessor so that it can control the application of the "Low Range" gear selection in the transfer case.

Electronic Transfer Case Harness (E4DB-14489-AA)

Position	Circuit Number	Color Code	Function
1	779	Brn	Electromagnetic Clutch (Feed)
2	778	Org	Transfer Case Motor Control (Clockwise) 2H-4H-4L
3	777	Yel	Transfer Case Motor Control (Counterclockwise) 4L-4H-2H
4	774	Lt Grn	Speed Sensor (Feed)
5	772	Lt Blu	Speed Sensor (Return)
6	771	Violet	Wire #5. Shift Position Sensor in Transfer Case (Output to Module)
7	770	Wht	Wire #4. Shift Position Sensor in Transfer Case (Output to Module)
8	764	Brn/Wht	Wire #3. Shift Position Sensor in Transfer Case (Output to Module)
9	763	Org/Wht	Wire #2. Shift Position Sensor in Transfer Case (Output to Module)
10	762	Yel/Wht	Wire #1. Shift Position Sensor in Transfer Case (Input from Module)

6. The shift position sensor feed circuit provides a power signal from the Electronic Control Module to the shift position sensor to energize the sensor.
7. Shift position sensor return circuits provide the output information signals from the transfer case to the electronic control module. This information gives the control module the correct position of the shaft that turns the helical cam in the transfer case.

The nitty gritty is if you don't know how it works, it will be worth your life to diagnose and repair.

The example we will use is the BW 1356 electronic shift transfer case used on the full-size Bronco with automatic transmission. This transfer case has an electric motor which, through a screw type drive, works a cam that moves the internal shift forks to achieve the 4WD and low-range modes. Inside the transfer case is an electromagnetic clutch much like that on an air-conditioning compressor. When you shift from 2WD to 4WD, this clutch is engaged to spin up the moving

parts instantly and synchronize the shift. When the shift is complete, the clutch disengages. A speed sensor inside the transfer case signals the ECM to regulate the engagement of low range within the proper road speed. External electronics consist of a two-rocker switch in the passenger compartment, the ECM, a speed sensor, the electric shift motor which has an integral shift position sensor that lets the ECM know which position the transfer case is in.

When the driver selects 4WD and presses that

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