

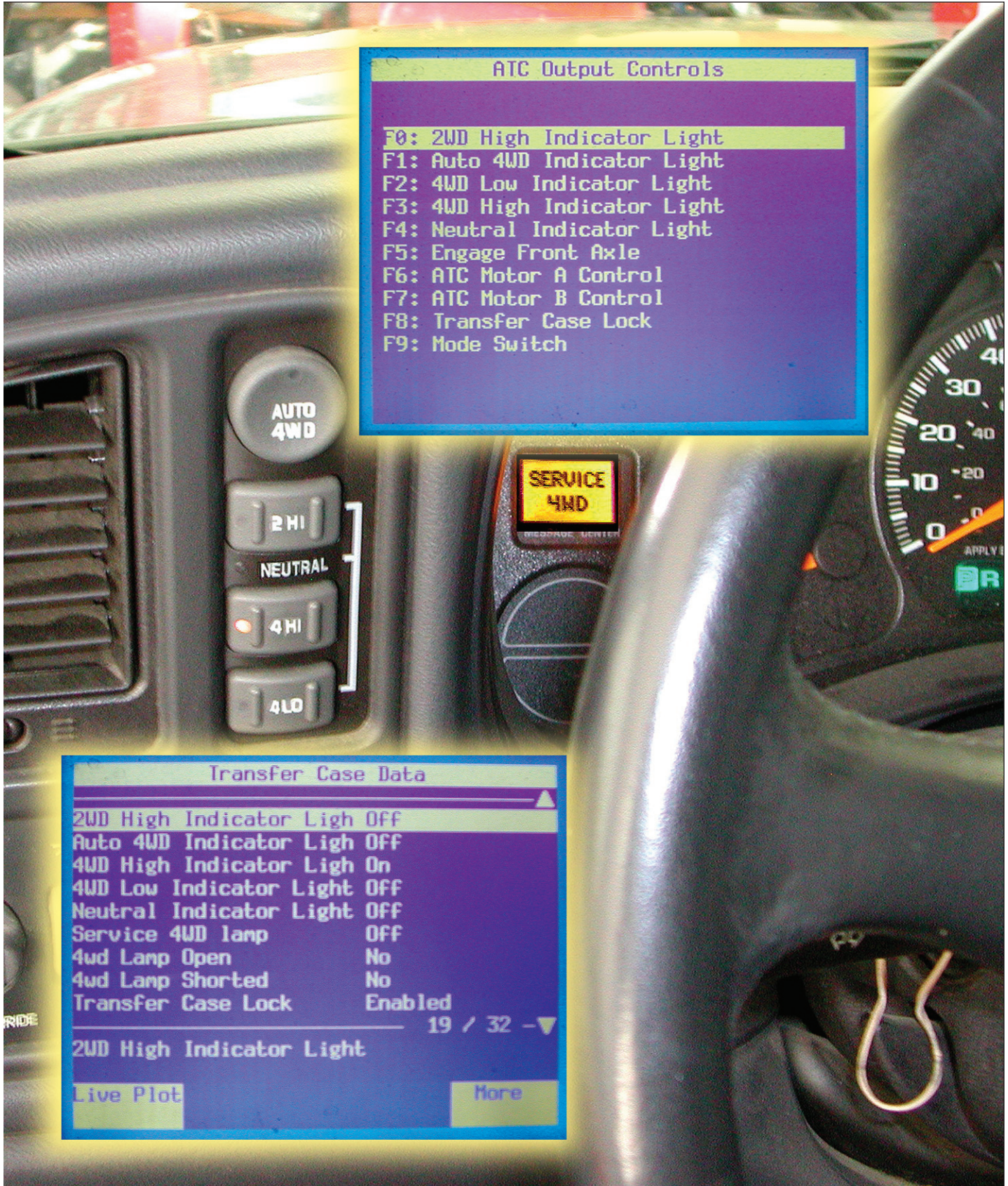
TRANSFER CASE STUDIES: DIAGNOSING GM's 4WD SYSTEM

BY RANDY BERNKLAU

Access to DTCs can simplify any system diagnosis. But as two separate cases on GM's 4WD system reveal, these codes are not always 100% accurate.

GM has used many different four-wheel-drive control systems in its vehicles over the years, ranging from pure mechanical to electronically controlled. Each has its own diagnostic procedures, and the best source for understanding how these systems work will always be your information system.





ATC Output Controls

- F0: 2WD High Indicator Light
- F1: Auto 4WD Indicator Light
- F2: 4WD Low Indicator Light
- F3: 4WD High Indicator Light
- F4: Neutral Indicator Light
- F5: Engage Front Axle
- F6: ATC Motor A Control
- F7: ATC Motor B Control
- F8: Transfer Case Lock
- F9: Mode Switch

Transfer Case Data

2WD High Indicator Ligh	OFF
Auto 4WD Indicator Ligh	OFF
4WD High Indicator Ligh	On
4WD Low Indicator Light	OFF
Neutral Indicator Light	OFF
Service 4WD lamp	OFF
4wd Lamp Open	No
4wd Lamp Shorted	No
Transfer Case Lock	Enabled

19 / 32

2WD High Indicator Light

Live Plot More

Photos & screen capture: Randy Bernklau

TRANSFER CASE STUDIES: DIAGNOSING GM's 4WD SYSTEM

Some later model 4WD systems have scan tool capabilities along with diagnostic trouble codes (DTCs) to help locate and diagnose many of the problems associated with them.

We looked at two GM K 1500 trucks that have the NVG 246 two-speed transfer case. One is a 1999 model, the other a 2000. Both use the same controls and happen to have stored the same DTC. The basic system consists of a transfer case motor and encoder, front differential actuator, transfer case module, speed sensors, switches and park input and output to the PCM. It seems logical to use case studies to show how these systems can be repaired.

The transfer case module data can be accessed with a scan tool such as the Tech 2, which is GM's official scan tool. To get to the proper screens, you must choose the Powertrain selection, then navigate your way to the ATC selections. ATC is the GM acronym for *active transfer case*. As with any module/computer-based diagnostic strategy, it's always a good idea to make checking DTCs one of the first steps in your diagnosis. These two trucks have 19 possible DTCs, including those for input, mo-



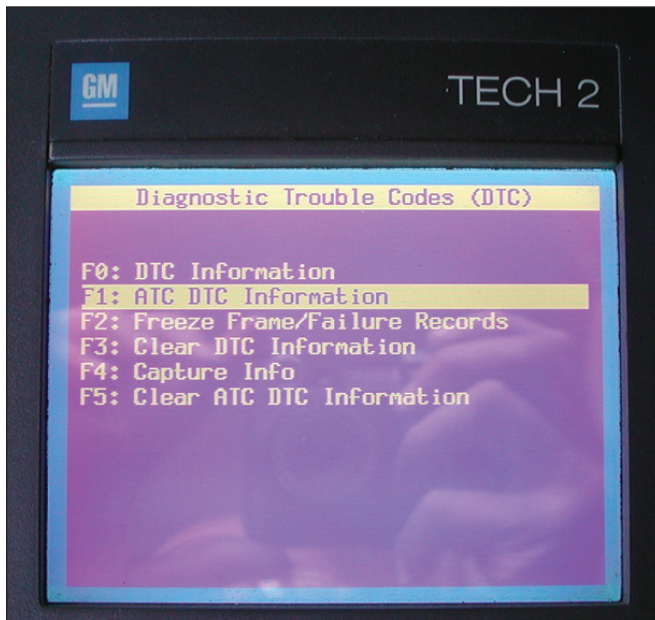
The dash buttons to the right of the air vent identify this system as an NVG 246 automatic two-speed, which means it has DTCs and scan tool capabilities.

tor, encoder and even VIN codes.

Selecting "F1" on the menu got us where we needed to be. Both trucks had one DTC stored: B2725 (active transfer case mode switch malfunc-

tion). A Tech 2 information screen will also let you know whether certain 4WD systems do not allow scan tool access.

The dash-mounted transfer case



Left: ATC information can be found under the Powertrain menu on the Tech 2 scan tool. Other scan tools may allow access to these features as well. **Right:** A scan tool is also required to access DTCs. History and current DTCs are displayed on different menus (History menu shown here). DTCs will stay in memory for 100 key cycles.

TRANSFER CASE STUDIES: DIAGNOSING GM's 4WD SYSTEM

mode control is a set of normally open switches that vary the voltage supplied by the transfer case module when closed. The transfer case module sends 8 volts to the switches, then monitors the return circuit to determine whether any of the switches is depressed. It can determine this because each switch has a different resistor in series with the circuit. Since both trucks have mode switch trouble codes, it seems logical to start there.

On the 2000 GM truck, the complaint was no four-wheel drive, and the 4WD light in the IPC (instrument panel cluster) came on at times. (This warning light, located in the left-side LED indicator, can display various messages, from "Security" to "Low Fuel" and even "4WD/AWD.") Any ATC system malfunction will turn on this light to alert the driver of a problem. A trouble code is also stored at that time.

Armed with the complaint and DTC B2725, I was ready to continue my diagnosis. I simply pressed the buttons while watching the scan data. As I pressed various buttons, the scan data would not indicate the proper input. Pressing "4HI" or "4LO" would not always result in the data stream reflecting that condition. Also,

TP Angle	0 %	Encoder Gear Position	4WD High
Front Propshaft Speed	0 RPM	Mode Switch Selected	Off
Rear Propshaft Speed	0 RPM	2WD High Indicator Light	Off
ATC Slip Speed	0 RPM	Auto 4WD Indicator Light	Off
Total Slippage	0 RPM	4WD High Indicator Light	On
Rear Slippage	0 RPM	4WD Low Indicator Light	Off
Slip Adapt Mode	Disabled	Neutral Indicator Light	Off
Slip Adapt PWM	0 % DC	Service 4WD lamp	On
Last Adapt Highest PWM	9 % DC	4wd Lamp Open	No
Throttle Anticipation Mode	Disabled	4wd Lamp Shorted	No
Ignition 3	13.9 Volts	Transfer Case Lock	Enabled
Encoder Circuit P	Off	Front Axle Switch	Locked
Encoder Circuit A	Off	Front Axle Requested	Yes
Encoder Circuit B	Off	Park Switch	Closed
Encoder Circuit C	On	Software ID	212
Commanded Mode Indicator		GM Part Number	15749703

Access to datastream information for GM's NVG 246 system makes most problems simple to locate and diagnose, as our case studies demonstrate. These systems also allow bidirectional control for many outputs.

the LEDs on the switch would randomly go on and off.

The easiest way to confirm this problem is to tap on the button and watch the scan data along with the switch LEDs. When we did this, it caused all kinds of random lights and data readings. At one point, it even turned on the 4WD warning indicator. It was obvious the switch had a mind of its own and needed replacement.

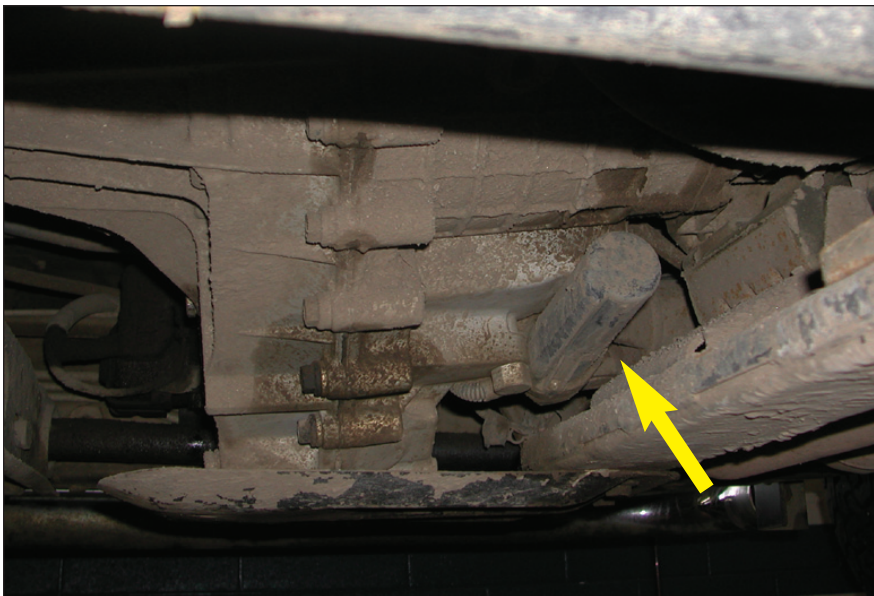
It's always nice to have such an easy diagnosis, but should we assume that all B2725 DTCs indicate the need for a switch replacement? After all, General Motors TSB No. 02-04-

21-004 indicates a known problem with this switch assembly.

Before we look at the other truck, it might be useful to see what GM's ESI website (www.acdelcotds.com) information says about B2725, to get a better understanding of the system's design characteristics. The following description comes from document ID No. 375434:

"The transfer case shift control module constantly monitors this signal voltage to determine the condition of the mode switch circuit. If no buttons are pressed, and the transfer case shift control module detects a voltage level outside the possible range (approx. 0.5-1.0 volts) for longer than 5 minutes, the transfer case shift control module will set this DTC if a button is held down or sticks for a period longer than 5 minutes. When each of the switches is depressed they will complete a circuit through their own specific resistor. The transfer case shift control module continuously monitors the switch input to determine whether the 4HI, AUTO 4WD, 2HI, and 4LO button selections are made by the driver."

Now we move on to the 1999 model K 1500 truck. The customer complained of no 4WD operation. He did not mention any warning lights, but it seemed like a good idea to check DTCs anyway. As mentioned earlier, this one had the same DTC B2725 stored. A quick check of the switches did not indicate any problem with the inputs from the switch to the module while monitoring scan data. However,



The encoder motor (arrow) is mounted on the front of the transfer case and is used to lock it into 4WD. The scan tool data will show motor position via the encoder circuit PIDs. There's no need to scrape the mud off the undercarriage.

TRANSFER CASE STUDIES: DIAGNOSING GM's 4WD SYSTEM

the front wheels would not engage when the 4WD button was selected. A problem was obviously occurring, but the DTC did not seem to match the system malfunction.

I could hear the encoder motor at the transfer case working, which confirmed my scan data and helped me find a diagnostic direction. Since it seemed like the problem was in the


front axle area, I decided to check the front axle motor actuator next. Using a voltmeter, I determined 0 voltage was present on terminal C, (circuit 241, brown wire). I chose this wire based on the wiring diagram, which showed fuse 24 in the IP fuse box feeding voltage to the front axle motor. Going this far without first checking the fuse could turn out to be pretty embarrassing if the

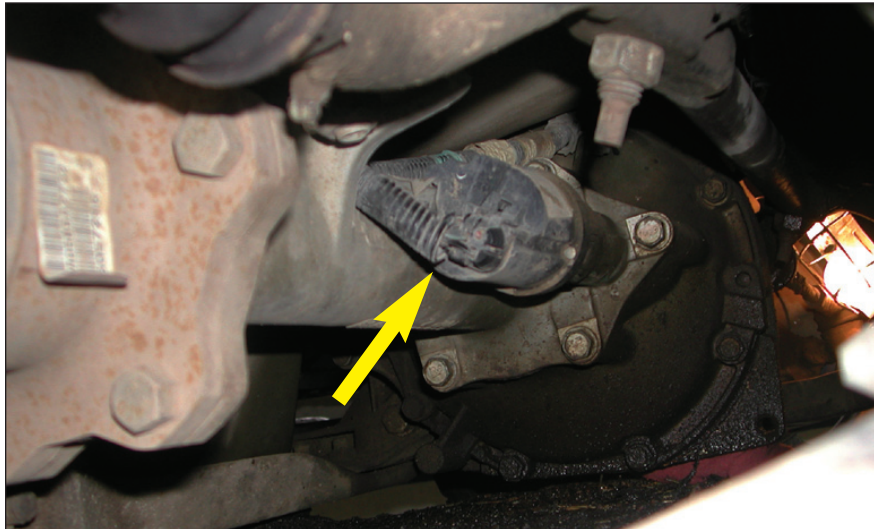
problem was simply a blown fuse. However, I knew the fuse also powered the transfer case control module. Since I was getting scan data and encoder motor operation, the fuse had to be good.

The only culprit left was the wiring harness between the fuse and front axle motor. It's always best to start checking for wiring problems by inspecting the harness in areas where it's most likely to be damaged by moving engine components, rotating parts or road objects striking the underside of the vehicle. I located the problem within minutes. The wiring harness near the right front axle where it enters the differential housing was damaged. At least two wires were broken, including the brown wire, which can be seen in the photo lower left. A harness repair was in order.

I had found the problem, but still could not explain why the system had stored code B2527. Was there another, intermittent problem just waiting for me to turn my back? I decided to look closer at the description for B2527 and found something interesting. "...the transfer case shift control module will set this DTC if a button is held down or sticks for a period longer than 5 minutes."

It seemed very possible that a driver might hold down a 4WD button for five minutes if he got stuck and the 4WD system wasn't working. To test my theory, I held the button down for several minutes to create the 4WD warning light visible in the photo on page 33. The system also set a code B2527. Maybe, just maybe, the DTC was actually set by the driver due to the broken wire to the front axle. I may never know for sure.

It's easy to fall into the habit of replacing common problematic components without verifying that they actually are defective. As this second case study of GM's relatively simple truck 4WD control system proves, this approach can get you into trouble. It always pays to test and verify before replacing a component. 



GM's 4WD system also uses a motor (arrow) on the front of the housing to engage/disengage the front drive axles. The harness connector is out in the open, so circuit testing can be done at this location with relative ease.



The wiring on this vehicle was damaged but did not actually set a DTC. The code that was stored may or may not have been set by driver operation.

Visit www.motor.com to download a free copy of this article.