

AUTO TRANS DIAGNOSIS - AW50-42LE

1995 Volvo 850

1995 AUTOMATIC TRANSMISSIONS
Volvo AW50-42LE Electronic Controls

850

APPLICATION

TRANSMISSION APPLICATIONS

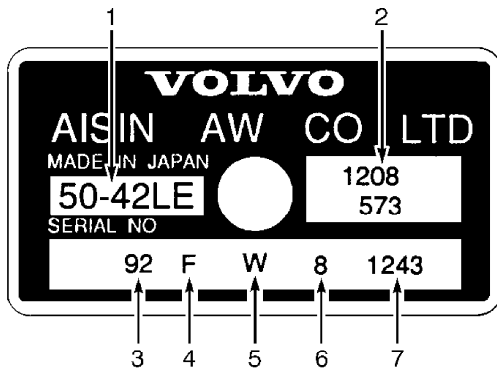
Vehicle Model	Transmission Model
850	AW50-42LE

NOTE: Overhaul information or specifications are not available. In case of internal malfunction, manufacturer recommends replacing transaxle as an assembly.

CAUTION: Vehicle is equipped with a Supplemental Restraint System (SAS). When servicing vehicle, use care to avoid accidental air bag deployment. SRS-related components are located in steering column, center console, instrument panel and lower panel on instrument panel. DO NOT use electrical test equipment on these circuits. If may be necessary to deactivate SRS before servicing components. For 1995 850, see the AIR BAG RESTRAINT SYSTEM article in the ACCESSORIES/SAFETY EQUIP section.

IDENTIFICATION

Transaxle can be identified by identification plate attached to top of transaxle case. See Fig. 1. Identification plate contains transaxle model, year of manufacture and transaxle part number.



- 1. Transaxle Model
- 2. Transaxle Part Number
- 3. Year Of Manufacture
- 4. Month Of Manufacture (June)
- 5. Designates 50-42LE
- 6. Transaxle Manufactured For Volvo
- 7. Manufacturing Number Starting With 0001 Each Month

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Fig. 1: Locating Transaxle Identification Plate Information
Courtesy of Volvo Cars of North America.

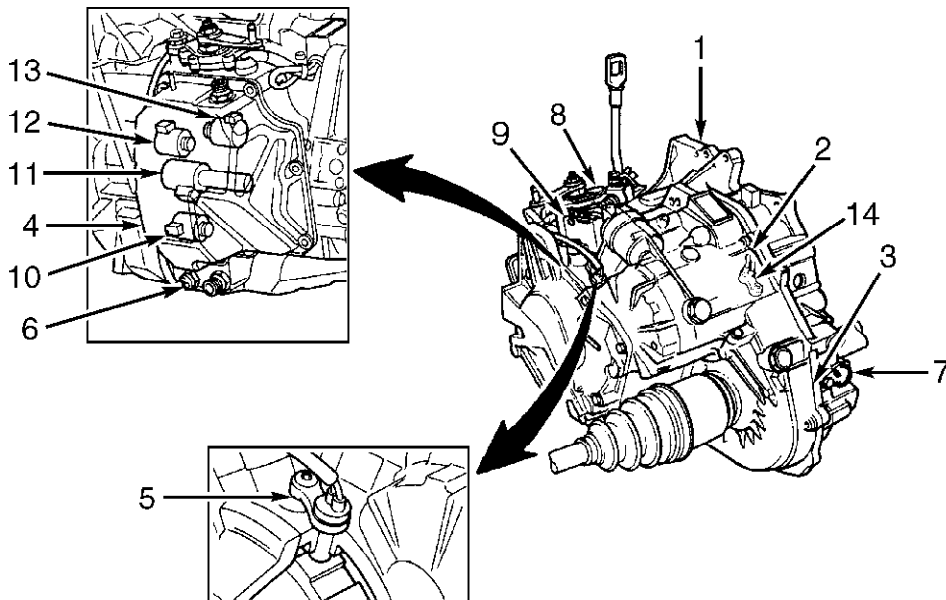
DESCRIPTION

Transaxle is a 4-speed overdrive electronically controlled automatic transaxle. Transaxle consists of lock-up torque converter, oil pump, 3 planetary gear sets, clutch and brake units, accumulator pistons, valve body and 4 electronic valve body solenoids.

Valve body with solenoids and Transaxle Control Module (TCM) are used for controlling transaxle operation. Solenoids are controlled by TCM.

TCM receives input signals from various components to determine transaxle shift points and torque converter lock-up. Components consist of mode selector switch, throttle position sensor, engine speed (RPM) sensor, vehicle speed sensor, gear position sensor, transaxle oil temperature sensor, brake switch and kickdown switch. See Fig. 2.

Transaxle is equipped with a mode selector switch. Switch is used for normal, high performance and winter driving conditions. Transaxle is also equipped with a shift lock and key interlock system. Shift lock system prevents shift lever from being moved from Park position unless brake pedal is applied. In case of malfunction, shift lever can be released by depressing shift lock override button, located near shift lever. Key interlock system prevents ignition switch from being moved from ACC to LOCK position unless shift lever is in Park position.



- | | |
|--------------------------------|---------------------------------|
| 1. Torque Converter Housing | 8. Gear Position Sensor |
| 2. Transaxle Housing | 9. Transaxle 26-Pin Connector |
| 3. Differential Housing | 10. Lock-Up Solenoid |
| 4. Transaxle Oil Pan | 11. Line Pressure Solenoid |
| 5. Engine Speed (RPM) Sensor | 12. No. 1 Shift Solenoid |
| 6. Oil Temperature Sensor | 13. No. 2 Shift Solenoid |
| 7. Vehicle Speed Sensor (1995) | 14. Vehicle Speed Sensor (1996) |

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Fig. 2: Locating Transaxle Components
Courtesy of Volvo Cars of North America.

OPERATION

BRAKE SWITCH

Brake switch is an input device mounted above the brake pedal. When brake pedal is applied, brake switch delivers an input signal to the TCM. TCM uses input signal to control No. 3 solenoid for torque converter lock-up.

ENGINE SPEED (RPM) SENSOR

Electromagnetic RPM sensor, mounted in transaxle housing, is activated by a toothed impulse wheel. Sensor is an input device which delivers an engine RPM signal to the TCM. By comparing engine RPM and vehicle speed, TCM can determine amount of torque converter slippage.

GEAR POSITION SENSOR

NOTE: Gear position sensor may also be referred to as neutral safety switch.

Gear position sensor is an input device mounted on the transaxle manual valve shaft. Sensor delivers an input signal to TCM, indicating transaxle manual valve gear position.

KEY INTERLOCK SYSTEM

With ignition key in ignition switch, place shift lever into "P" position. Ensure ignition key can be installed and removed from ignition switch with ease. If key is difficult to remove, key interlock cable is too short. Adjust cable as necessary. Move shift lever to position other than Park. Ignition key should not be removable from ignition switch. If key can be removed, cable is too long. Adjust cable as necessary.

KICKDOWN SWITCH

Kickdown switch, located at firewall on accelerator cable, sends input signal to TCM when accelerator pedal is fully depressed. TCM uses input signal for controlling transaxle downshifting and torque converter lock-up.

MODE SELECTOR SWITCH

Mode selector switch, located to left of shift lever, has 3 different modes which effect transaxle shift points. Input signal from mode selector switch is sent to TCM. TCM uses input signal for controlling transaxle shifting and torque converter lock-up.

ECON (Economy) mode, is for normal driving and provides early upshifts combined with lock-up as often as possible for top 3 gears. Transaxle line pressure is modulated to provide smooth gear engagement.

In SPORT mode, transaxle shift points are designed to provide the highest possible performance. Under normal acceleration, transaxle shifts occur the same as in ECON mode. During increased acceleration, TCM selects shift and lock-up points for best possible performance.

WINTER mode prevents wheel spin on slippery surfaces. Transaxle starts out in high gear. When WINTER mode is selected, warning light on dash is illuminated. This mode may also be used when driver wants to control gear selection.

OIL TEMPERATURE SENSOR

Oil temperature sensor, located below transaxle oil pan, measures transaxle fluid temperature and delivers an input signal to TCM. TCM uses input signal for controlling transaxle shifting and torque converter lock-up.

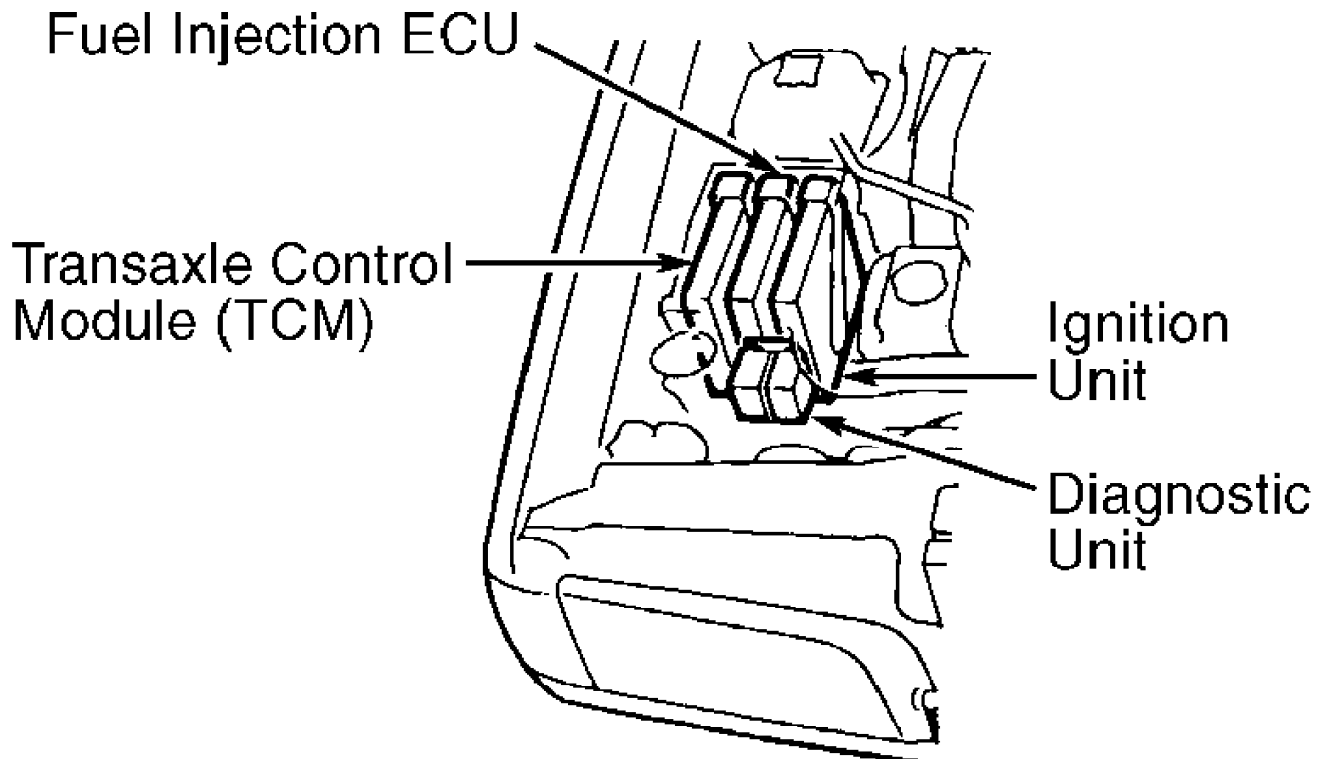
SHIFT LOCK OVERRIDE FUNCTION

Move shift lever to "P" position and turn ignition key to (I) or (II) position. Press override button. Shift lever should move from "P" position. Return shift lever to "P" position and remove ignition key. Press override button. Shift lever should not move from "P" position. Override function should operate only when ignition key is in (I) or (II) position.

TRANSAXLE CONTROL MODULE (TCM)

TCM is located in control module box in engine compartment, between coolant recovery reservoir and washer fluid reservoir. TCM is in position No. 3 in module box. See Fig. 3. TCM determines shift points and torque converter lock-up timing based on input signals received from various components. Components consist of mode selector switch, throttle position sensor, engine speed (RPM) sensor, vehicle speed sensor, gear position sensor, transaxle oil temperature sensor, brake switch and kickdown switch.

TCM contains a self-diagnostic system which stores a Diagnostic Trouble Code (DTC). If a transaxle problem exists, DTC(s) can be retrieved to determine transaxle problem area.



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Fig. 3: Locating Transaxle TCM & Diagnostic Unit
Courtesy of Volvo Cars of North America.

THROTTLE POSITION (TP) SENSOR

Throttle position sensor, mounted on throttle body, determines throttle position and delivers an input signal to TCM. TCM uses input signal for controlling transaxle upshifts and torque converter lock-up.

VALVE BODY SOLENOIDS

Valve body solenoids, mounted on the valve body, are output devices controlled by signals received from the TCM. The No. 1 and No. 2 solenoids are used to control transaxle shifting. No. 3 solenoid is used to control torque converter lock-up. No. 4 solenoid is used to control transaxle line pressure. For solenoid locations, See Fig. 2. For valve body solenoid usage, see VALVE BODY SOLENOID APPLICATION table.

VALVE BODY SOLENOID APPLICATION (1)

Shift Lever Position	No. 1 Solenoid	No. 2 Solenoid
"D" (Drive)		
1st Gear	OFF	ON
2nd Gear	ON	ON
3rd Gear	ON	OFF
4th Gear	OFF	OFF
"3"		
1st	OFF	ON
2nd	ON	ON
3rd	ON	OFF
"L"		
1st	OFF	ON
2nd	ON	ON
"R" (Reverse)	OFF	ON
"N" Or "P"	OFF	ON

(1) - Valve body contains 4 solenoids. No. 1 and No. 2 solenoids are used to control transaxle shifts. No. 3 solenoid is used to control torque converter lock-up. No. 4 solenoid is used to control line pressure.

VEHICLE SPEED SENSOR

Vehicle speed sensor, mounted in transaxle housing, is an input device consisting of speed sensor rotor and speed sensor. Input signal is delivered from speed sensor to TCM with each revolution of axle shaft. TCM uses speed sensor input signal for controlling transaxle operation.

TROUBLE SHOOTING

PRELIMINARY CHECKS

Ensure fluid level is correct. Inspect and adjust throttle cable, kickdown cable and gear position sensor (if necessary). Check idle speed RPM and adjust as necessary.

NOTE: Manufacturer recommends transaxle assembly replacement only. Manufacturer does not provide mechanical trouble shooting information.

TESTING

ROAD TEST

"D" & "3" Position

1) Engine and transaxle must be at normal operating temperature. Shift transaxle into "D" position. Set mode selector switch to ECON position. Test drive vehicle and ensure all upshifts and downshifts occur at specified speeds. Refer to the appropriate SHIFT SPEED SPECIFICATIONS table.

2) Ensure lock-up occurs at appropriate speeds. See LOCK-UP SPEED SPECIFICATIONS table. Lightly depress accelerator. If excessive increase in engine RPM exists, lock-up did not occur.

NOTE: Lock-up does not occur at coolant temperatures below 68°F (20°C). Lock-up in 2nd gear occurs when transaxle oil temperature exceeds 239°F (115°C).

"L" Position

While driving vehicle in "L" position, check for failure to upshift to 2nd gear. Check engine braking effect when accelerator pedal is released.

"R" Position

Shift vehicle into "R" position. Accelerate vehicle and check for transaxle slippage.

"P" Position

Stop vehicle on incline of 5 degrees or steeper. Shift vehicle into "P" position and release parking brake. Ensure parking pawl prevents vehicle from moving.

TIME LAG TEST

1) Engine and transaxle must be at normal operating temperature. Start engine and ensure idle RPM is within specification with A/C off. Apply service and parking brakes. Using stop watch, measure time until engagement shock is felt when shift lever is shifted from "N" to "D" position.

2) Allow one minute intervals between tests. Perform time measurement several times and calculate average time. Time should be less than .7 seconds. Repeat test procedure to test time lag when shift lever is shifted from "N" to "R" position. Time lag should be less than 1.2 seconds. If test time is not as described, check transaxle line pressure. See HYDRAULIC PRESSURE TEST.

SHIFT SPEED SPECIFICATIONS

SHIFT SPEED SPECIFICATIONS (2.3L TURBO) (1)

Application	MPH
Economy Mode	
1st-2nd	25
2nd-3rd	51
3rd-4th	76
4th-3rd	53
3rd-2nd	31
2nd-1st	16
Sport Mode	
1st-2nd	36
2nd-3rd	69
3rd-4th	106
4th-3rd	62

3rd-2nd	47
2nd-1st	26

(1) - With shift lever in "D" position and throttle valve open 60 percent.

SHIFT SPEED SPECIFICATIONS (2.4L NON-TURBO) (1)

Application	MPH
Economy Mode	
1st-2nd	24
2nd-3rd	48
3rd-4th	75
4th-3rd	60
3rd-2nd	36
2nd-1st	15
Sport Mode	
1st-2nd	35
2nd-3rd	68
3rd-4th	101
4th-3rd	86
3rd-2nd	57
2nd-1st	24

(1) - With shift lever in "D" position and throttle valve open 60 percent.

LOCK-UP SPEED SPECIFICATIONS

LOCK-UP SPEED SPECIFICATIONS (2.3L TURBO) (1) (2) (3)

Application	MPH
Economy & Sport Mode	
Lock-Up ON - 4th Gear	129
Lock-Up OFF - 4th Gear	124

(1) - With shift lever in "D" position and throttle valve open 60 percent.

(2) - Lock-up does not occur in 2nd gear until fluid temperature exceeds 239°F (115°C).

(3) - Lock-up occurs in 4th gear only.

LOCK-UP SPEED SPECIFICATIONS (2.4L NON-TURBO) (1) (2)

Application	MPH
Economy Mode	
Lock-Up ON	
2nd Gear	25
3rd Gear	49
4th Gear	73
Lock-Up OFF	
2nd Gear	23
3rd Gear	44
4th Gear	68
Sport Mode	
Lock-Up ON	
2nd Gear	35

3rd Gear	65
4th Gear	96
Lock-Up OFF	
2nd Gear	33
3rd Gear	60
4th Gear	90

- (1) - With shift lever in "D" position and throttle valve open 60 percent.
- (2) - Lock-up does not occur in 2nd gear until fluid temperature exceeds 239°F (115°C).

STALL SPEED TEST

1) Operate engine and transaxle at normal operating temperature. Connect tachometer to vehicle and ensure it is visible to driver. Apply parking brake and block all 4 wheels.

CAUTION: DO NOT maintain stall speed RPM for more than 5 seconds. Transaxle damage may occur.

2) Ensure A/C is off. Start engine, apply brakes and place transaxle in "D" position. Depress accelerator to full throttle and note maximum RPM obtained. Repeat test in "R" position. For stall speed specifications, see STALL SPEED SPECIFICATIONS table.

STALL SPEED SPECIFICATIONS

Engine Application	RPM
2.3L Turbo	2900
2.4L	2650

3) If stall speed RPM recorded is lower or higher than specified, check fluid color and odor. If fluid color and odor is normal, replace torque converter. If fluid is discolored or has a burnt smell, manufacturer recommends replacing transaxle as an assembly.

HYDRAULIC PRESSURE TEST

1) Ensure transaxle is at normal operating temperature. Connect pressure gauge to line pressure test port. See Fig. 4.

2) Connect tachometer to vehicle and ensure it is visible to driver. Block all 4 wheels and fully apply parking brake. Start engine and ensure idle speed is adjusted properly. Idle speed should be 850 RPM.

3) Apply service brake and shift transaxle into "D" position. Check line pressure at idle and record pressure reading. Accelerate engine to stall speed and record line pressure reading.

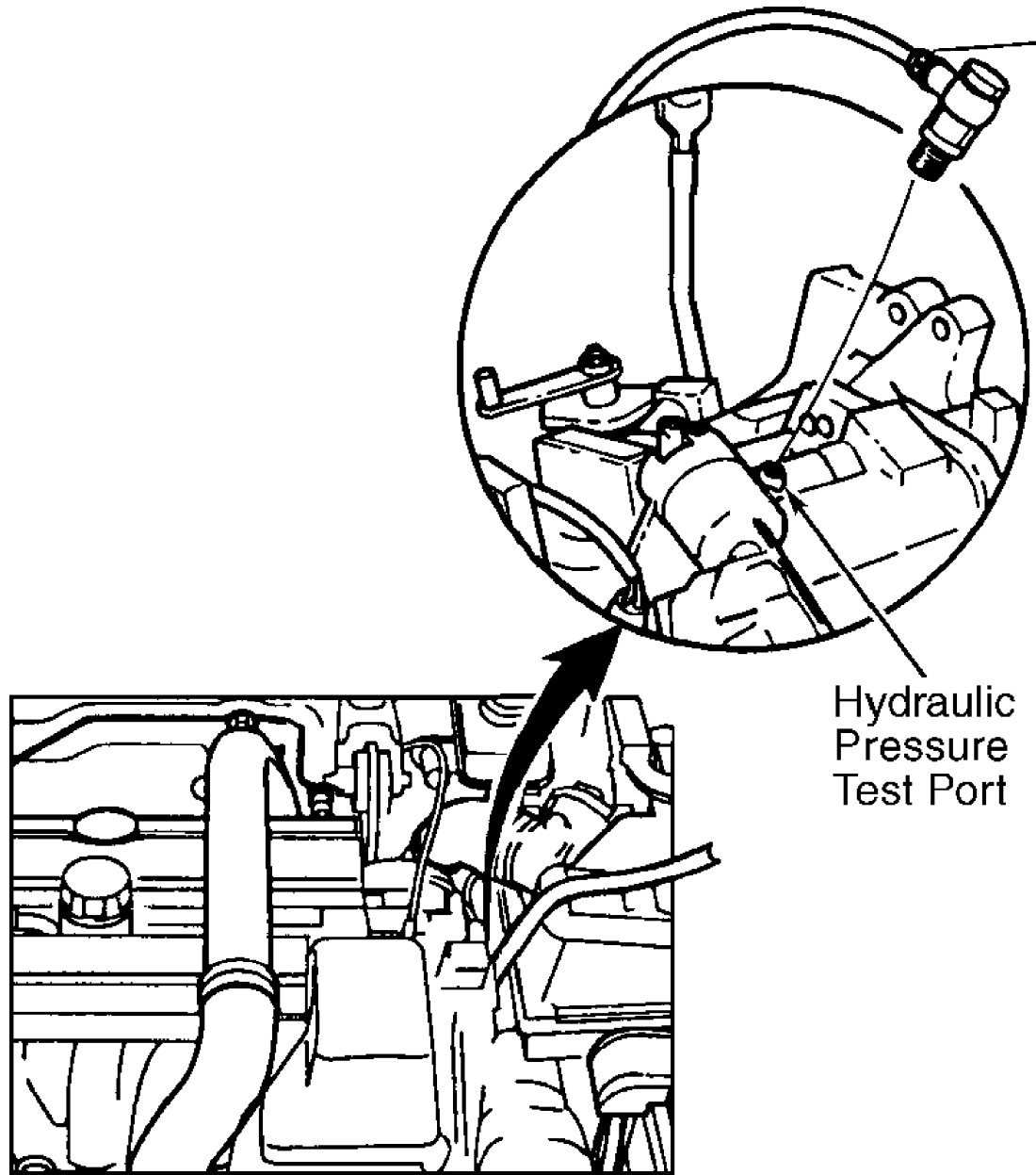
4) Repeat test procedure in "R" position. If line pressures are not as specified, check throttle cable adjustment. Adjust throttle cable as necessary, and repeat test procedure and record pressure readings. Compare all readings to specification. See LINE PRESSURE SPECIFICATIONS table.

LINE PRESSURE SPECIFICATIONS

Engine Speed	"D" Position psi (kg/cm ²)	"R" Position psi (kg/cm ²)
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Idle Speed	57 (4)	85 (6)
Stall Speed	171 (12)	256 (18)

5) If line pressures are not as specified, internal components in transaxle may be malfunctioning. Check for Diagnostic Trouble Codes (DTCs). See SELF-DIAGNOSTIC SYSTEM. If no DTCs are found, manufacturer recommends replacing transaxle as an assembly.



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Fig. 4: Locating Line Pressure Test Port
 Courtesy of Volvo Cars of North America.

AXLE SHAFTS

See appropriate AXLE SHAFTS article in AXLE SHAFTS & TRANSFER CASES section.

THROTTLE & KICKDOWN CABLES

For throttle and kickdown cable adjustments, see appropriate AUTOMATIC TRANSMISSION SERVICING article in TRANSMISSION SERVICING section.

REMOVAL & INSTALLATION

TRANSAXLE

For transaxle removal and installation procedure, see appropriate AUTOMATIC TRANSMISSION REMOVAL article in TRANSMISSION SERVICING section.

ACCUMULATOR PISTONS & SPRINGS

NOTE: Control valve assembly is equipped with 3 accumulator pistons and 6 modulator valves. Assembly has 2 cover plates on opposite sides of assembly.

Removal & Installation

1) Remove control valve assembly. See CONTROL VALVE ASSEMBLY. Place control valve assembly on clean workbench. Remove gear selector valve ("S" shaped) from control valve assembly (transaxle side of assembly). Remove 6 cover plate bolts, cover plate and gasket. Remove 2 accumulator pistons and 3 springs, and 3 modulator valves and springs. Note location and direction of all components during removal. Lay all components on workbench exactly as removed from control valve assembly.

2) Rotate control valve assembly and remove 6 cover plate bolts, cover plate and gasket. Remove one accumulator piston and spring, and 3 modulator valves and springs. Note location and direction of all components during removal. Lay all components on workbench exactly as removed from control valve assembly.

3) Clean all components in solvent. Dry with compressed air. Ensure valve spools are not worn and that valves move easily in their bores. Valve spools may be dressed using extremely fine emery cloth if necessary. Measure accumulator valve spring free length and outside diameter. Replace springs if not within specification. See appropriate ACCUMULATOR SPRING SPECIFICATIONS table.

4) To install, reverse removal procedure. Replace accumulator piston seal rings prior to installation. Lubricate seal rings with ATF. Ensure components are installed in correct direction and location. Tighten cover plate bolts to 62 INCH lbs. (7 N.m).

ACCUMULATOR SPRING SPECIFICATIONS (1995)

Spring Color	Free Length In. (mm)	Outer Diameter In. (mm)
1-Piston Side		
Non-Turbo Engine		
No Color	.96 (24.4)	.28 (7.0)
Violet	1.12 (28.5)	.31 (8.0)
Blue	1.05 (26.6)	.28 (7.0)
Violet	1.89 (48.0)	.48 (12.3)

Turbo Engine			
Yellow	.....	.90 (22.8)	..... .33 (8.3)
Violet	.....	1.12 (28.5)	..... .31 (8.0)
Blue	.....	1.05 (26.6)	..... .28 (7.0)
Violet	.....	1.89 (48.0)	..... .48 (12.3)
2-Piston Side			
Non-Turbo Engine			
No Color	.....	.86 (21.9)	..... .24 (6.0)
White	.....	1.29 (32.8)	..... .28 (7.0)
Yellow	.....	1.21 (30.7)	..... .28 (7.0)
Lt. Green (1)	....	1.38 (35.0)	..... .58 (14.8)
Violet	.....	1.45 (37.0)	..... .44 (11.3)
Green	.....	1.81 (46.0)	..... .60 (15.3)
Turbo Engine			
No Color	.....	.86 (21.9)	..... .24 (6.0)
White	.....	1.29 (32.8)	..... .28 (7.0)
Blue	.....	1.04 (26.6)	..... .28 (7.0)
Lt. Green (1)	....	1.38 (35.0)	..... .58 (14.8)
No Color	.....	1.81 (46.0)	..... .56 (14.2)

(1) - Not applicable to outer spring attached to piston.

CONTROL VALVE ASSEMBLY

Removal & Installation

1) Raise and support vehicle. Remove transaxle oil pipe and drain fluid. Undo clip securing oil temperature sensor harness. Remove oil pan Torx screws and remove oil pan. Disconnect 4 valve body solenoid wire connectors, noting wire color and locations. Remove 9 control valve assembly bolts, noting length and location of bolts for installation reference. Remove control valve assembly.

2) To install, reverse removal procedure. Ensure bolts are installed in correct locations. Tighten bolts to 89 INCH lbs. (10 N.m). Install .12" (3 mm) thick bead of sealing compound on oil pan and install pan. Tighten oil pan Torx screws to 18 ft. lbs. (25 N.m).

GEAR POSITION SENSOR

NOTE: Gear position sensor may also be referred to as neutral safety switch.

Removal & Installation

1) Ensure transaxle is in "N" position and parking brake is applied. Remove battery, battery tray and air intake hose. Remove air cleaner assembly. Disconnect transaxle cable from shift rod arm. Remove shift rod arm from sensor. Note position of notch on sensor for installation reference.

2) Remove nut, washer and seal from sensor. Loosen dipstick bracket. Remove 2 bolts securing sensor to transaxle. Remove sensor from control shaft. To install, reverse removal procedure. Ensure notch on sensor is located in exact position as prior to removal. Tighten 2 sensor bolts to 18 ft. lbs (25 N.m).

SELF-DIAGNOSTIC SYSTEM

DIAGNOSTIC PROCEDURE

When performing vehicle diagnosis:

- * Ensure transaxle fluid level is correct and fluid is neither contaminated nor aerated.

- * Ensure throttle and kickdown cables are properly adjusted. See appropriate AUTOMATIC TRANSMISSION SERVICING article in TRANSMISSION SERVICING section.
- * Ensure battery is fully charged.
- * Perform visual inspection, ensuring all electrical connections at transaxle, TCM, throttle position sensor, gear position sensor, speed sensors and brake switch are clean and properly installed.
- * Repair diagnostic trouble codes in order displayed.

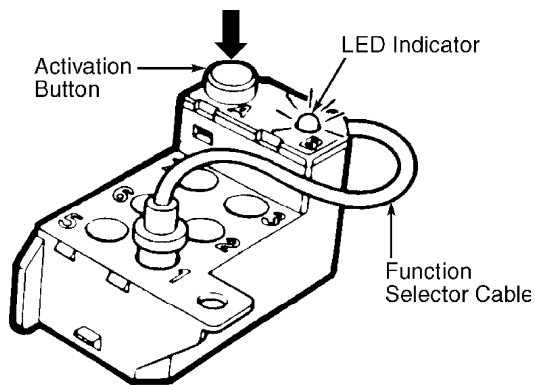
NOTE: Volvo diagnostic unit (1995 vehicles) or scan tool (1995 and 1996 vehicles) can be used in 6 different system test functions using manufacturer's instructions to activate system components and perform several tests on transaxle. See SYSTEM TEST FUNCTIONS.

SELF-DIAGNOSTICS

Signals from various sensors are monitored continuously by TCM. If certain signals are lost or become faulty, TCM will cut off electrical signal to transaxle components to protect transaxle. TCM adopts fixed substitute values (limp-home mode) to enable vehicle to be driven when certain failures occur. Warning indicator light will illuminate. Transaxle will not shift gears due to lack of electrical signal. Transaxle will operate in 4th gear in "D", and in 3rd gear in "L" position. Manual shifting is possible into all other shift lever positions. When starting off in limp-home mode, shift lever should be in "L" position to minimize transaxle wear. Faults are recorded in TCM memory in the form of Diagnostic Trouble Codes (DTCs).

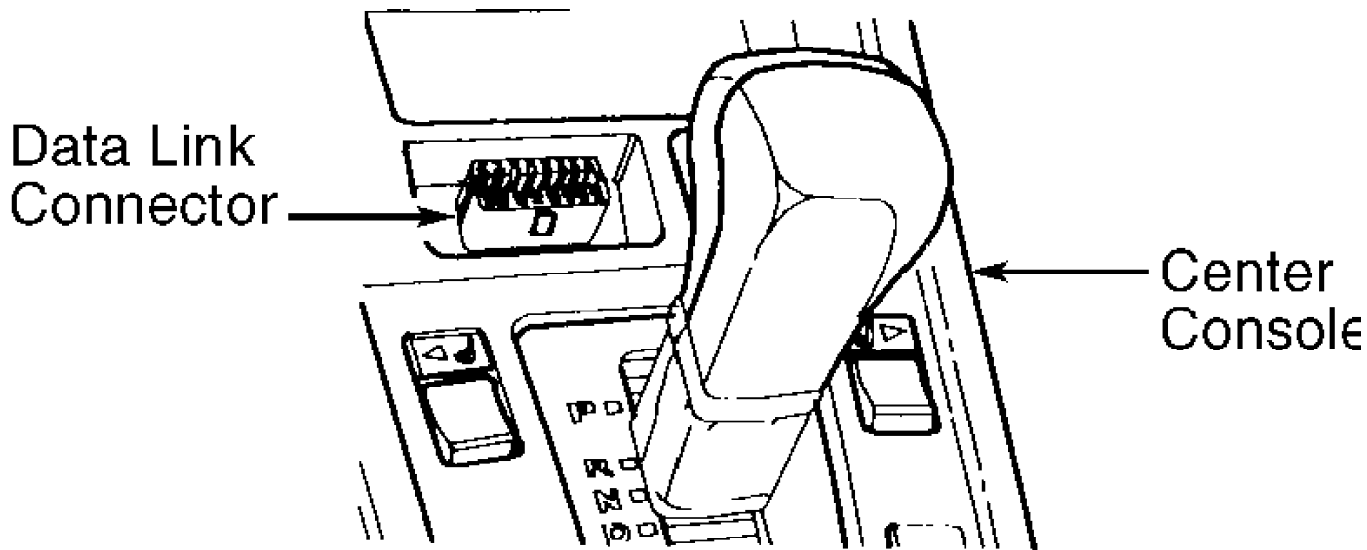
On 1995 vehicles, DTCs can be displayed using LED on Volvo diagnostic unit in engine compartment, using Volvo Diagnostic Key Scan Tool connected to Volvo Data Link Connector (DLC) in engine compartment, using Volvo System Tester Scan Tool connected to Volvo Data Link Connector (DLC) in engine compartment, or using an aftermarket scan tool connected to On-Board Diagnostics II (OBD-II) Data Link Connector (DLC). OBD-II DLC is located in center console in front of gear shift lever. Using OBD-II DLC and scan tool will only output OBD-II DTCs, and not entire range of DTCs. See Figs. 5 and 6.

On 1995 vehicles, on-board Volvo diagnostic unit for retrieving codes is located in right front of engine compartment. See Fig. 3. Diagnostic unit is equipped with an LED indicator, activation button and function select cable. See Fig. 5.



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Fig. 5: Identifying Diagnostic Unit Components (1995 Vehicles)
 Courtesy of Volvo Cars of North America.

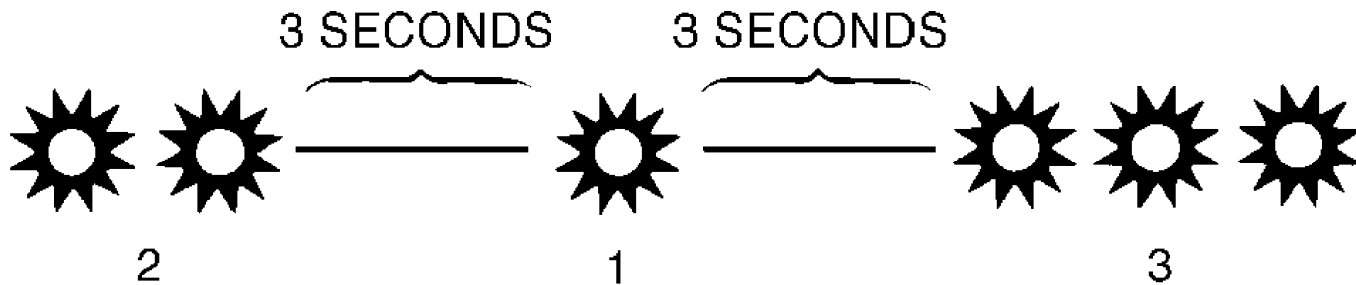


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Fig. 6: Locating Data Link Connector (DLC)
 Courtesy of Volvo Cars of North America.

Diagnostic unit output socket No. 1 is used to retrieve TCM diagnostic codes. Once function selector cable has been inserted in correct socket, depressing button 1-6 times selects from 1 to 6 control (system test) functions. Depress button and keep depressed for more than one second (but not more than 3 seconds). DTCs stored in memory are read by observing diagnostic unit LED flashes. Observe LED and count number of flashes to determine DTC. If LED does not flash, see DIAGNOSTIC UNIT LED DOES NOT FLASH.

All codes contain 3 digits (example: 2-1-3). Since all codes have 3 digits, each code requires 3 series of flashes. A 3-second interval separates each series of flashes. See Fig. 7. For DTC definition, see appropriate DIAGNOSTIC TROUBLE CODE DEFINITION table under TROUBLE CODE DEFINITION.



91E16646

Fig. 7: Counting Red LED Code Flashes For Code 213
 Courtesy of Volvo Cars of North America.

DIAGNOSTIC SYSTEM FAULTS

Diagnostic Unit LED Does Not Flash

1) Disconnect diagnostic unit. Turn ignition on. Check for voltage at diagnostic connector terminal No. 4. If voltage is not present, check fuse and wiring. If voltage is present, turn ignition off.

2) Connect an ohmmeter between diagnostic connector terminal No. 8 and ground. Ohmmeter should indicate approximately zero ohms. If

reading is not approximately zero ohms, check wiring. If wiring is okay, replace diagnostic unit.

Diagnostic Unit LED Flashes But TCM Does Not Respond

Turn ignition on. Check for voltage at diagnostic connector terminal No. 2 and ground. Approximately 5 volts should be present. Check for voltage at diagnostic connector terminal No. 6 and ground. Approximately 5 volts should be present. If voltage is not as specified, check wiring and repair as necessary.

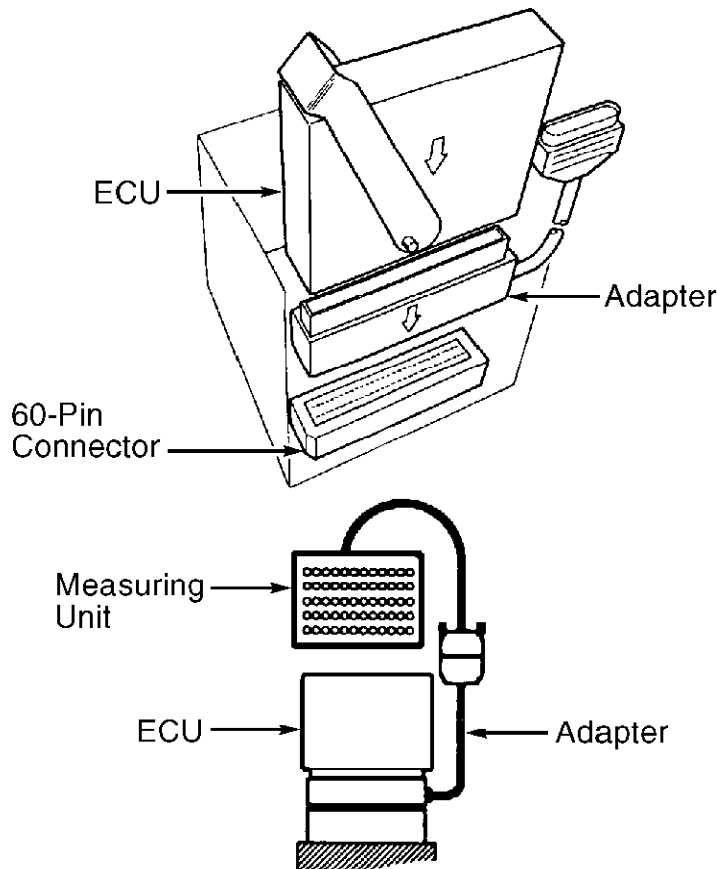
MEASURING UNIT

Connecting Measuring Unit (9813190) & Adapter (9813195)

1) Measuring unit is used to measure system voltage while engine is running. Measuring unit also is used to check individual circuit resistance without influence from other systems.

2) Disconnect negative battery cable. Remove TCM cover located in right front engine compartment. See Fig. 3. Remove TCM. Press adapter into TCM base. Position adapter lead at front of TCM and thread through slot next to TCM.

3) Press TCM, with adapter connected, into connector in bottom of TCM box. Connect measuring unit to adapter 60-pin connector. See Fig. 8.



93F79165

Fig. 8: Installing Measuring Unit & Adapter
Courtesy of Volvo Cars of North America.

CLEARING CODES

1995 Vehicles

1) On 1995 vehicles, codes can be cleared only after all DTCs have been displayed and first DTC has been repeated at least once. To clear DTC, turn ignition on. Press test button on diagnostic unit and hold for more than 5 seconds. Wait for LED response.

2) Press button again and hold for more than 5 seconds. LED should go out when button is released. Ensure codes have been cleared by pressing button once. If LED displays code 111, codes have been cleared.

TCM LOCATION

TCM is located in right front of engine compartment, between coolant recovery reservoir and washer fluid reservoir. See Fig. 3.

SYSTEM TEST FUNCTIONS

CAUTION: Never disconnect or connect TCM connector with ignition switch in ON position.

Follow tool manufacturer's instructions if retrieving codes with Volvo Diagnostic Key Scan Tool, Volvo System Tester Scan Tool or generic scan tool. Volvo Diagnostic Key Scan Tool and Volvo System Tester Scan Tool must be connected to Volvo DLC located in engine compartment. Generic scan tool must be connected to DLC located in console in front of gear shift lever. See Fig. 6.

Volvo Self-Diagnostic System

System is capable of self-diagnostic functions through the use of diagnostic unit in engine compartment, or manufacturer's scan tool. Access to diagnostic system is provided by socket No. 1 on diagnostic unit with ignition on. See Fig. 5. System has 6 test modes. Test mode No. 1 is used to display and clear codes. Test mode No. 2 is used to verify operation of system components. Test mode No. 3 operates components in a certain order.

Test mode No. 4 activates individual components to verify component operation when a specific code is input into diagnostic unit. Test mode No. 5 reads data values of various sensors. Values are for vehicle speed, throttle position, engine RPM and transaxle oil temperature. Test mode No. 6 is used to enter data to reset adaptive values for throttle signal and shift speed adjustment function. Shift speed must be reset when transaxle has been replaced.

NOTE: Manufacturer recommends use of scan tool when test modes No. 5 and 6 are performed. Follow manufacturer's instructions when performing these modes.

CAUTION: After displaying DTCs, ignition must be switched off BEFORE engine is started.

Test Mode No. 1 (Displaying Codes)

1) To display DTCs, open diagnostic unit cover (located in right corner of engine compartment) and connect test lead to socket No. 1. Turn ignition on. Enter test mode No. 1 by pressing test button once for 1-3 seconds.

2) Observe LED, and count number of flashes in 3 digit series comprising a DTC. Because series are displayed at 3-second intervals, codes can be easily distinguished.

3) If a DTC is displayed, refer to appropriate DIAGNOSTIC TROUBLE CODES DEFINITION table under TROUBLE CODE DEFINITION. Depress button again, and check for additional codes. Depress button a third time if necessary. If first code repeats, no other codes are present.

Test Mode No. 1 (Clearing Codes)

1) Codes can be cleared only after all DTCs have been displayed and first DTC has been repeated at least once. To clear DTCs, turn ignition on. Press button on diagnostic unit and hold for more than 5 seconds. Wait for LED response.

2) Press button again and hold for more than 5 seconds. LED should go out when button is released. Ensure codes have been cleared by pressing button once. If LED flashes code 1-1-1, codes have been cleared.

Test Mode No. 2 (Verifying Operation Of System Components)

1) Sensors and switches are activated by diagnostic unit. When TCM receives a signal, a response code is displayed for each input signal. This function checks component operation, wiring and connections in each circuit. If response code is displayed, component and circuit are okay. If response code is not displayed, TCM has not received a signal. Check appropriate component or circuit and repair as necessary.

2) This test mode is activated by briefly pressing test button on diagnostic unit 2 times, causing LED to rapidly flash. TCM will flash a code indicating receipt of a signal from components.

3) Activate sensors or switches by operating appropriate component as described in RESPONSE CODE IDENTIFICATION table. Diagnostic unit LED should display appropriate response code.

NOTE: For optimum results, components should be activated in order given in RESPONSE CODE IDENTIFICATION table. Components may be tested individually if necessary.

RESPONSE CODE IDENTIFICATION

Component & Position	Circuit Tested	Response (1) Code
Gear Position Sensor		
"R" To "P"	Park	242
"P" To "R"	Reverse	144
"R" To "N"	Neutral	241
"N" To "D"	Drive	214
"D" To "3"	3rd Gear	224
"3" To "L"	Low Gear	234
Any Position	(2) Position Sensor	243
Mode Selector Switch		
Economy	Economy Mode	244
Sport	Sport Mode	314
Winter	Winter Mode	324
Brake Pedal Depressed	Brake Switch	334
Acc. Pedal At WOT	Kickdown Switch	341

(1) - If response code is displayed, component and circuit tested are okay.

(2) - If response code 2-4-3 is present, gear position sensor is faulty.

Test Mode No. 3 (Operating Components In Specified Order)

1) Output signals are checked at various actuators to determine component operation. Testing is performed in a cycle in which each component is activated 6 times with a short delay between each activation. A longer delay occurs prior to testing next component. The entire cycle is repeated 3 times, then test is exited automatically.

2) Test must be performed with shift lever in "P" or "N"

position, and vehicle must be stopped. Test cannot be performed while driving vehicle. Output signals can be monitored by watching or listening to appropriate component to be activated. Engine RPM will increase during drive compensation activation and decrease during torque limiting activation. If any signal fails to activate a component, check wire circuit and repair as possible.

3) This test mode is activated by briefly pressing test button on diagnostic unit button 3 times. LED will flash each time component is activated. Components will be activated in the following order:

- * No. 1 Shift Solenoid.
- * No. 2 Shift Solenoid.
- * Torque Converter Lock-Up Solenoid.
- * Line Pressure Solenoid.
- * Warning Indicator Light In Instrument Panel Flashes.
- * Fault Indication Signal (OBD-II) Malfunction Indicator Light.
- * Torque Limiting Signal (TCT).
- * Drive Compensation For Idling.
- * Torque Limiting Signal TC2 When Engine Idling.
- * Torque Limiting Signal TC1 When Engine Idling.

NOTE: Engine idle speed will change during drive compensation, TC1 and TC2 activation.

Test Mode No. 4 (Activating Individual Components)

1) Test mode No. 4 activates individual components to verify operation when a specific code is input into diagnostic unit. Components are activated 6 times in sequence. Shift lever must be in "P" or "N" position and vehicle must be stopped. Rate of code transmission between TCM and diagnostic unit can be changed to 2 or 10 times the basic rate. Doubled rate can be used for reading codes from diagnostic unit LED. Highest rate is selected automatically when Volvo scan tool is used.

2) To activate test mode No. 4, push diagnostic unit button 4 times. Enter code for chosen component. See COMPONENT ACTIVATION CODES table. One digit is entered each time diagnostic unit LED is lit. Diagnostic unit LED flashes when chosen component is activated. After testing components, system automatically exits test mode No. 4.

COMPONENT ACTIVATION CODES

Component	Code
No. 1 Shift Solenoid	342
No. 2 Shift Solenoid	343
Lock-Up Solenoid	344
Line Pressure Solenoid	411
Warning Indicator Light	412
Drive Compensation (1)	414
Torque Limiting TC2 (1)	422
Torque Limiting TC1 (1)	423
Basic Code Transmission Rate	311
2 Times Basic Code Transmission Rate	312
10 Times Basic Code Transmission Rate	313

(1) - Engine idle speed will change during activation.

TROUBLE CODE DEFINITION

DIAGNOSTIC TROUBLE CODE DEFINITION DTC/OBD-II

DTC/OBD-II DTC	Warning Light On (1)	Fault/Repair
112/P0750	Yes	Short To Voltage In No. 1 Shift Solenoid Circuit
113/P0755	Yes	TCM Fault
114	No	Mode Selector Switch Circuit Malfunction
121/P0750	Yes	Short To Ground In No. 1 Shift Solenoid Circuit
122/P0750	Yes	Open In No. 1 Shift Solenoid Circuit
123/P0745	Yes	Short To Voltage In Line Pressure Solenoid (STH) Circuit
124	No	Short To Ground In Mode Selector Switch Circuit
131	Yes	Open Or Short To Ground In Line Pressure Solenoid (STH) Circuit
132/P0745	Yes	TCM Fault
134	No	Incorrect Load Signal
141	No	Short Circuit In Oil Temperature Sensor Circuit
142	No	Open In Oil Temperature Sensor Circuit
143	No	Short To Ground In Kickdown Switch Circuit
211/P0750	Yes	TCM Fault
212/P0755	Yes	Short To Voltage In No. 2 Shift Solenoid Circuit
213/P0120	Yes	Throttle Position Sensor Signal Too High
221/P0755	Yes	Short To Ground In No. 2 Shift Solenoid Circuit
222/P0755	Yes	Open In No. 2 Shift Solenoid Circuit
223/P0120	Yes	Throttle Position Sensor Signal Too Low
231	Yes	Erratic Throttle Position Sensor Signal
232/P0500	Yes	Speedometer Signal Missing Or Vehicle Speed Signal Missing
233	Yes	Speedometer Signal Incorrect
235	(2) Yes	High Oil Temperature
245	Yes	Open Or Short In Torque Limiting Circuit
311/P0715	Yes	RPM Signal Missing Or Transmission Speed Sensor Signal Missing
312	Yes	RPM Signal Incorrect
313/P0705	Yes	Gear Position Sensor Signal Incorrect
321/P0731, 322/P0732, 323/P0733 & 324/P0734	Yes	Incorrect Gear Ratio
322/P0730 (3)	Yes	Gear Ratio Information Incorrect
323 (3)	Yes	Lock-Up Slips Or Is Not Engaged
331	No	Short To Voltage In Lock-Up Solenoid Circuit
332	No	Open In Lock-Up Solenoid Circuit
333	No	Short To Ground In Lock-Up Solenoid Circuit
341	Yes	Lock-Up Function Slips Or Disengages
411	No	Control Module EEPROM Memory Fault

421 No Battery Voltage Too Low

- (1) - Warning light is located in instrument panel. When a fault occurs, DTC is recorded and warning light comes on. If fault is intermittent, warning light will go out, but DTC will remain.
 - (2) - Only for as long as oil temperature remains high.
 - (3) - If DTC is present, mechanical malfunction has occurred. Manufacturer recommends replacing transaxle assembly.
-

CIRCUIT & COMPONENT TESTING

BRAKE SWITCH

1) Ensure ignition is off. Remove sound insulator to gain access to brake switch, located at top of brake lever. Connect a voltmeter between brake switch terminal No. 1 (Red wire) and a good known ground. Battery voltage should be present. If battery voltage is not present, check for open circuit between terminal No. 1 and brake switch fuse.

2) Disconnect brake switch connector. Connect an ohmmeter between brake switch terminals No. 1 (Red wire) and 2 (Yellow wire). With brake pedal released, resistance should be infinite. With brake pedal depressed, resistance should be zero ohms. If resistance is not as specified, replace brake switch.

KICKDOWN SWITCH

Ensure ignition switch is off. Disconnect kickdown switch connector from switch. Using a DVOM, measure resistance between switch terminals when accelerator pedal is in WOT position. Resistance should be zero ohms. While slowly releasing accelerator pedal continue to measure resistance. Resistance should be infinite in all other pedal positions. If kickdown switch does not test as described, replace switch.

MODE SELECTOR SWITCH

1) Ensure ignition switch is off. Disconnect mode selector switch from center bracket. Disconnect switch connector from switch. Using a DVOM, measure resistance between switch terminals No. 2 (Green/Orange wire) and 5 (Light Blue wire) when switch is in SPORT mode. Resistance should be infinite. When mode selector switch is moved to any other position, zero ohms should exist.

2) Measure resistance between switch terminals No. 3 (Brown/Gray wire) and 5 (Light Blue wire) when switch is in ECON mode. Resistance should be infinite. When mode selector switch is moved to any other position, zero ohms should exist. If resistance is not as specified, replace mode selector switch.

OIL TEMPERATURE SENSOR

1) Ensure ignition switch is off. Connect measuring unit to TCM. See Fig. 8. Using a DVOM, measure resistance between measuring unit terminals No. 14 and 15. If resistance is as specified in OIL TEMPERATURE SENSOR RESISTANCE table, sensor and wiring are okay. If resistance is not as specified, go to next step.

2) Disconnect transaxle 26-pin connector. See Fig. 2. Connect DVOM leads to 26-pin connector terminals No. 12 and 13. See Fig. 9. Measure resistance between 26-pin connector terminals (oil temperature sensor terminals) as transaxle fluid temperature gradually increases.

See OIL TEMPERATURE SENSOR RESISTANCE table. If resistance is not as specified, replace oil temperature sensor.

OIL TEMPERATURE SENSOR RESISTANCE

Temperature °F (°C)	Resistance (Ohms)
32 (0)	2000
68 (20)	900
104 (40)	400
176 (80)	125
212 (100)	75
302 (150)	27

RPM SENSOR

1) Ensure ignition switch is off. Connect measuring unit to TCM. See Fig. 8. Using a DVOM, measure resistance between measuring unit terminals No. 1 and 2. Resistance should be 300-600 ohms. If resistance is as specified, sensor and wiring are okay. If resistance is not as specified, go to next step.

2) Measure resistance between transaxle 26-pin connector terminals No. 16 and 17. See Fig. 9. Resistance should be 300-600 ohms. If resistance is as specified, sensor is okay. If resistance is not as specified, replace sensor.

THROTTLE POSITION SENSOR (TPS)

1) Ensure ignition switch is off. Connect measuring unit to TCM. See Fig. 8. Turn ignition switch on. Using a DVOM, measure voltage between measuring unit terminals No. 20 and 50. Voltage should be .2 volt with throttle closed and up to 4.8 volts with wide open throttle (WOT). If voltage is as specified, sensor is okay. If voltage is not as specified, replace sensor.

2) Using a DVOM, measure voltage between measuring unit terminal No. 20 and a good known ground. Voltage should be less than .7 volt. If voltage is as specified, TCM is properly grounded. If voltage is not as specified, check for poor ground connection.

TORQUE LIMITING SIGNAL VOLTAGE

1) Ensure ignition is off. Connect measuring unit to TCM. See Fig. 8. Turn ignition on. Check torque limiting signals using test mode No. 4. Using a DVOM, measure voltage at measuring unit terminals No. 20 and 32 (TC1), terminals No. 20 and 33 (TC2) and between terminals No. 20 and 34 (acknowledged signal). Voltage should vary between zero and 5 volts at each pair of terminals.

2) If TC1 and/or TC2 voltage is not as specified, fault is in TCM. If TC1 voltage is correct, but TC2 voltage is not, fault is in wiring to TCM. If all voltage measurements are correct, but fault is still present, replace TCM.

VEHICLE SPEED SENSOR (VSS)

1) To check speed signal, connect measuring unit to TCM. See Fig. 8. Raise and support front wheels of vehicle. Set shift lever to " N " position. Turn ignition on.

2) Connect voltmeter between measuring unit terminals No. 20 and 48. Battery voltage should be present. Block one front wheel and spin other wheel rapidly. Voltage should be 4-7 volts. If voltage is

consistently high or low, check wiring for an open or short circuit. If no fault is found, replace TCM.

3) To check speed signal wiring to instrument panel, connect measuring unit to instrument panel 30-pin connector. Ensure ignition is off. Using a DVOM, measure resistance between measuring unit terminal No. 6 and TCM connector "B" terminal No. 18. See Fig. 10.

4) Resistance should be zero ohms. If resistance is not as specified, check wiring circuit and repair as necessary. If resistance is as specified, check for incorrect installation of wiring which may cause interference, such as ignition wiring, mobile phone, etc.

VALVE BODY SOLENOIDS

1) Remove transaxle oil pan. Disconnect solenoid wire connector(s). For solenoid wire color identification, see SOLENOID WIRE COLOR IDENTIFICATION table. Using a DVOM, measure resistance between appropriate solenoid terminal and ground. Resistance should be 10-15 ohms for No. 1, No. 2 and torque converter lock-up solenoids. If resistance is not as specified, replace solenoid.

2) Using DVOM, measure resistance between line pressure solenoid terminals. Resistance should be 2-6 ohms. If resistance is not as specified, replace solenoid.

SOLENOID WIRE COLOR IDENTIFICATION

Solenoid	Wire Color
No. 1	White
No. 2	Black
Line Pressure	Blue & Brown
Torque Converter Lock-Up	Red

VALVE BODY SOLENOID CIRCUITS

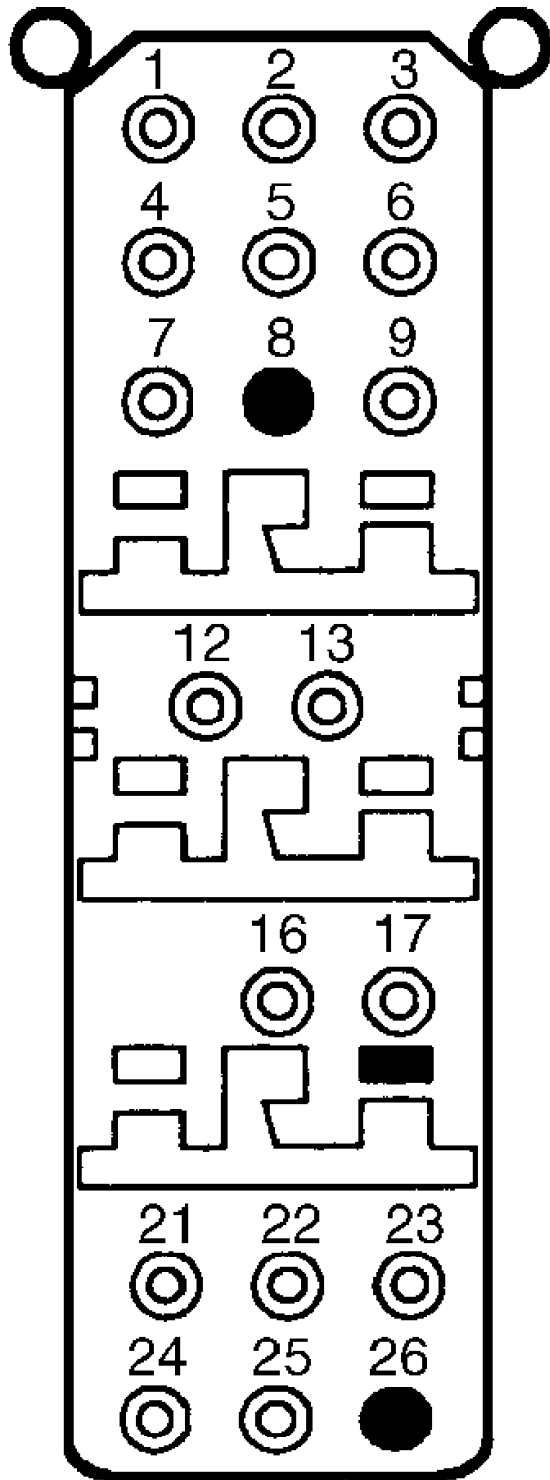
Using a DVOM, measure resistance between appropriate solenoid wire connector and appropriate terminal at transaxle 26-pin connector. Resistance should be zero ohms for each solenoid wire. For transaxle connector terminal locations, See Fig. 9. For transaxle connector terminal identification, see TRANSAXLE CONNECTOR TERMINAL IDENTIFICATION table. If resistance is not as specified, repair appropriate circuit as necessary.

TRANSAXLE CONNECTOR TERMINAL IDENTIFICATION

Terminal No. (1) (2)	Component
1-9	Gear Position Sensor
12 & 13	Oil Temperature Sensor
16 & 17	RPM Sensor
21	No. 1 Shift Solenoid
22	No. 2 Shift Solenoid
23	Lock-Up Solenoid
24 & 25	Line Pressure Solenoid

(1) - For terminal locations, See Fig. 9.

(2) - Terminals No. 8 and 26 are blank.



95F21001

Fig. 9: Identifying Transaxle Connector Terminals
 Courtesy of Volvo Cars of North America.

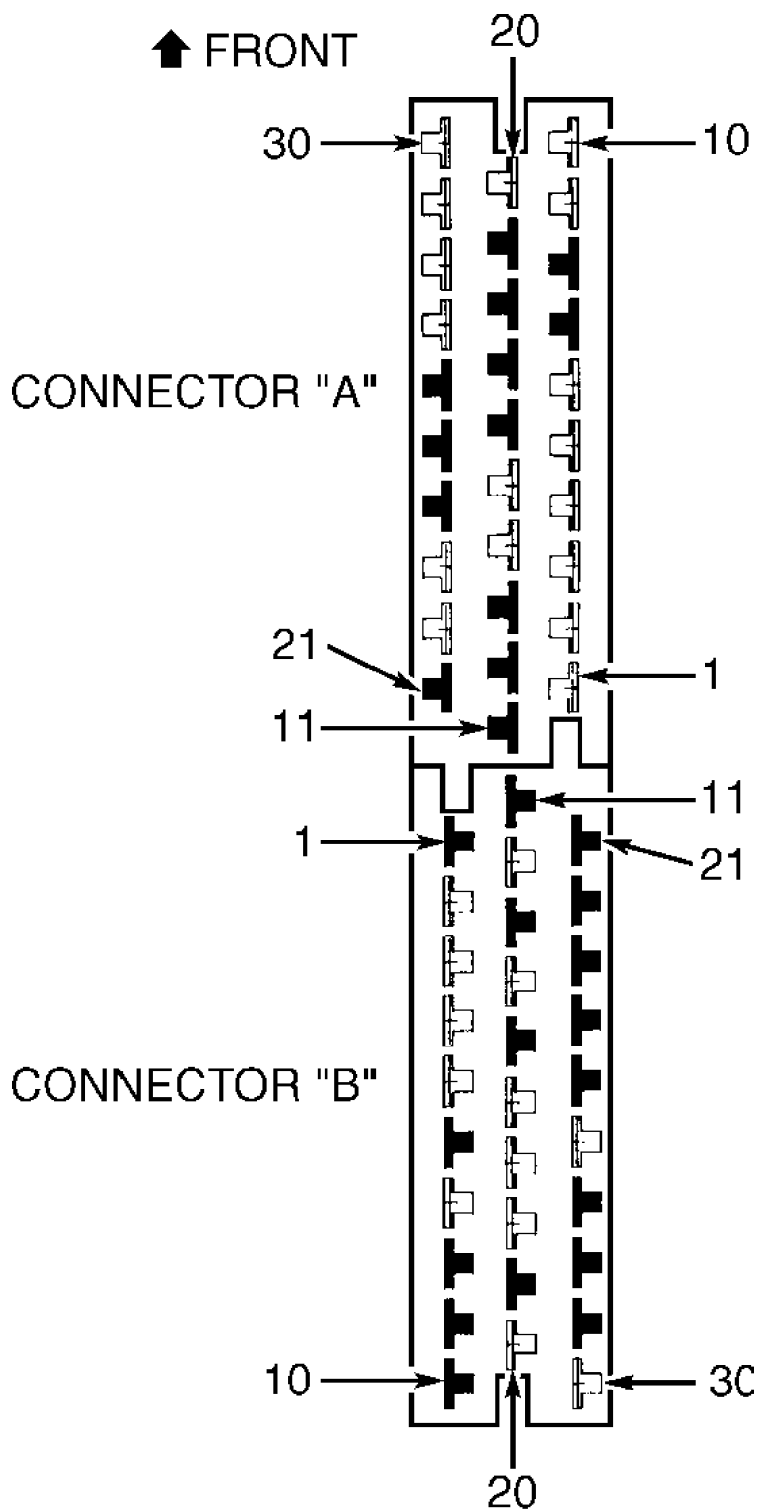
TCM WIRING CIRCUITS

If component and/or circuit fault is diagnosed, check appropriate circuit between component and TCM connector terminal(s) and repair as necessary. If component and circuits are okay, replace TCM. For TCM connector terminal locations, See Fig. 10. For TCM connector terminal identification, see TCM CONNECTOR TERMINAL IDENTIFICATION table.

TCM CONNECTOR TERMINAL IDENTIFICATION

Terminal No.	(1)	(2)	Component
Connector "A"			
1		RPM/Speed Sensor
2		RPM/Speed Sensor Ground
3		Gear Position Sensor
4		Gear Position Sensor
5		Gear Position Sensor
6		Gear Position Sensor
9		Lock-Up Solenoid
10		Battery Power
14		Oil Temperature Sensor
15		Oil Temperature Sensor Ground
20		Signal Ground
22		Line Pressure Solenoid
23		Line Pressure Solenoid Ground
27		No. 1 Shift Solenoid
28		No. 2 Shift Solenoid
29		Power Ground
30		Battery Voltage Via Ignition Switch
Connector "B"			
2		Torque Limiting
3		Torque Limiting
4		Torque Limiting Acknowledge Signal
5		Diagnostic Output
7		Warning Indicator Light
12		Engine Load
14		Gear Position Sensor
16		Mode Selector Switch
17		Mode Selector Switch
18		Speedometer
20		Throttle Position Sensor
26		Brake Switch
30		Kickdown Switch

(1) - For terminal locations, See Fig. 10.
(2) - Terminals not listed are blank.



95G21002

Fig. 10: Identifying TCM Connector Terminals
 Courtesy of Volvo Cars of North America.

DTC 112/P0750: SHORT TO VOLTAGE IN NO. 1 SHIFT SOL CIRCUIT

1) Turn ignition on. Set gearshift lever to "P" position. Check solenoid function by using test mode No. 4 or Volvo scan tool. See TEST MODE NO. 4.

2) If solenoid operates, check wiring for an intermittent short circuit in Green/White wire. If solenoid does not operate, check Green/White wire for a short circuit. If wiring is okay, replace solenoid.

DTC 113/P0755: TCM FAULT

1) Turn ignition off. Turn off all equipment in the vehicle that uses battery power. Disconnect TCM. Connect measuring unit to TCM connector. Leave TCM disconnected. Connect ohmmeter between measuring unit terminal No. 20 and ground, and between measuring unit terminal No. 29 and ground. If ohmmeter reads zero ohms, go to next step. If ohmmeter does not read zero ohms, check grounds for an open circuit.

2) Reconnect TCM. Turn ignition on. Turn on as many power consuming items as possible. Connect voltmeter between measuring unit terminals No. 20 and 29. If voltmeter reads less than .6 volts, go to next step. If voltmeter does not read less than .6 volts, check grounds for an open circuit.

3) Ensure ignition is off. Connect measuring unit to TCM connector. Ensure TCM is connected. Connect an additional measuring unit to ECM connector. Ensure ECM is connected. Turn ignition on. Turn on as many power consuming items as possible. Connect voltmeter between TCM measuring unit terminal No. 20 and ECM measuring unit terminal No. 20 (non-turbo) or No. 42 (turbo). If voltmeter reads less than 10 volts, go to next step. If voltmeter does not read less than 10 volts, check ground points for an open circuit or poor terminal contact. Repair as necessary.

4) Ensure ignition is on. Connect voltmeter between TCM measuring unit terminals No. 29 and 30. If voltmeter reads about battery voltage, go to next step. If voltmeter does not read about battery voltage, check for an open circuit in Blue/Red wire between TCM terminal A30 and fuse No. 11-1. Repair as necessary.

5) Ensure ignition is on. Connect voltmeter between TCM measuring unit terminals No. 10 and 20. If voltmeter reads about battery voltage, go to next step. If voltmeter does not read about battery voltage, check for an open circuit in wiring between battery positive terminal and TCM terminal A30 (Blue/Red wire). Repair as necessary.

6) Ensure ignition is off. Disconnect measuring unit. Reconnect TCM. Turn ignition on. Clear DTCs. Test drive vehicle at a speed greater than 15 MPH. If DTC resets, replace TCM.

DTC 114: MODE SELECTOR SWITCH CIRCUIT MALFUNCTION

1) Ensure ignition is off. Using a screwdriver, carefully pry off selector switch from console. Check wires at back of switch for poor terminal contact. Repair as necessary. If terminal contact is okay, check Black ground wire for good terminal contact. Repair as necessary. If Black ground wire is okay, go to next step.

2) Turn ignition on. Connect voltmeter between selector switch Brown/Green and Black wires. If about 11 volts are present, go to step 4). If zero voltage is present, go to next step. If battery voltage is present, check Brown/Green wire for a short circuit to voltage.

3) Check TCM connector for poor terminal contact. Repair as necessary. If TCM connector is okay, check for an open circuit in Brown/Green wire.

4) Connect voltmeter between selector switch Green/Orange and Black wires. If about 11 volts are present, go to step 6). If zero voltage is present, go to next step. If battery voltage is present, check Green/Orange wire for a short circuit to voltage.

5) Check TCM connector for poor terminal contact. Repair as necessary. If TCM connector is okay, check for an open circuit in Green/Orange wire.

6) Turn ignition off. Switch selector to position "S". Connect ohmmeter between Brown/Green and Black wires. Switch selector to position "E". Connect ohmmeter between Green/Orange and Black wires. If ohmmeter does not read zero ohms in both cases, replace driving mode selector module. If ohmmeter reads zero ohms, DTC was set because of poor terminal contact in mode selector connector.

DTC 121/P0750: SHORT TO GROUND IN NO. 1 SHIFT SOL CIRCUIT

1) Turn ignition on. Set gearshift lever to "P" position. Check solenoid function by using test mode No. 4 or Volvo scan tool. See TEST MODE NO. 4. If solenoid operates, check Green/White wire for an intermittent short circuit. If solenoid does not operate, go to next step.

2) Turn ignition off. Remove air cleaner housing to access transaxle connector. Disconnect transaxle connector. Connect ohmmeter between transaxle connector terminal No. 21 (Green/White wire) and ground. If ohmmeter does not read 10-15 ohms, go to next step. If ohmmeter reads 10-15 ohms, check for short circuit to ground in Green/White wire.

3) Access and disconnect shift solenoid No. 1. Connect ohmmeter between pin on solenoid and ground. If ohmmeter reads about 10-15 ohms, check for short circuit to ground in Green/White wire. If ohmmeter does not read about 10-15 ohms, replace solenoid.

DTC 122/P0750: OPEN IN NO. 1 SHIFT SOLENOID CIRCUIT

1) Turn ignition on. Set gearshift lever to "P" position. Check solenoid function by using test mode No. 4 or Volvo scan tool. See TEST MODE NO. 4. If solenoid operates, check Green/White wire for an intermittent short circuit. If solenoid does not operate, go to next step.

2) Turn ignition off. Connect measuring unit to TCM. Connect ohmmeter between measuring unit terminals No. 20 and 27. If ohmmeter reads about 10-15 ohms, repair poor terminal contact at TCM connector. If ohmmeter does not read about 10-15 ohms, go to next step.

3) Remove air cleaner housing to access transaxle connector. Disconnect transaxle connector. Connect ohmmeter between transaxle connector terminal No. 21 (Green/White wire) and measuring unit terminal No. 27. If ohmmeter reads about zero ohms, go to next step. If ohmmeter does not read about zero ohms, check for open circuit in Green/White wire.

4) Disconnect transaxle connector. Connect ohmmeter between transaxle connector terminal No. 21 (Green/White wire) and ground. If ohmmeter reads 10-15 ohms, repair poor terminal contact at TCM connector. If ohmmeter does not read 10-15 ohms, go to next step.

5) Access and disconnect shift solenoid No. 1. Connect ohmmeter between pin on solenoid and ground. If ohmmeter reads about 10-15 ohms, check for short circuit to ground in Green/White wire. If ohmmeter does not read about 10-15 ohms, replace solenoid.

DTC 123/P0745: SHORT TO VOLTAGE IN LINE PRESSURE SOLENOID (STH) CIRCUIT

1) Turn ignition on. Set gearshift lever to "P" position. Check solenoid function by using test mode No. 4 or Volvo scan tool.

See TEST MODE NO. 4. If solenoid operates, check Violet/White or Violet wire for an intermittent short circuit. If solenoid does not operate, go to next step.

2) Turn ignition off. Connect measuring unit to TCM. Connect ohmmeter between measuring unit terminals No. 22 and 23. If ohmmeter reads 2-6 ohms, repair short to voltage in control signal wiring. If control signal wiring is okay, replace TCM. If ohmmeter does not read 2-6 ohms, go to next step.

3) Remove air cleaner housing to access transaxle connector. Disconnect transaxle connector. Connect ohmmeter between transaxle connector terminals No. 24 (Violet wire) and No. 25 (Violet/White wire). If ohmmeter reads about 2-6 ohms, check for short circuit in Violet and Violet/White wiring. If ohmmeter does not read about 2-6 ohms, go to next step.

4) Access and disconnect solenoid STH. Connect ohmmeter between pins on solenoid connector. If ohmmeter reads about 2-6 ohms, check Violet and Violet/White wiring between solenoid STH and transaxle connector terminals No. 24 and 25 for a short circuit. If ohmmeter does not read about 2-6 ohms, replace TCM.

DTC 124: SHORT TO GROUND IN MODE SELECTOR SWITCH CIRCUIT

1) Turn ignition off. Carefully pry driving mode selector switch from center console. Ensure controls for selector operate smoothly and do not stick. Ensure "W" button does not stick in depressed position and operates smoothly without catching. Shake driving mode selector to see if there are loose parts in the switch. Replace as necessary. If driving mode selector is okay, go to next step.

2) Disconnect driving mode selector connector. Put switch in mode "E". Connect ohmmeter between selector terminal Brown/Green and Black wires. Put switch in mode "S". Connect ohmmeter between Green/Orange and Black wires. Ensure "W" button is up. Connect ohmmeter between Green/Orange and Brown/Green wires. If ohmmeter reads infinite resistance for all tests, go to next step. If ohmmeter does not read infinite resistance for all tests, replace driving mode selector module.

3) Disconnect TCM. Connect ohmmeter between TCM side of selector terminal Brown/Green and Black wires. If ohmmeter reads infinite resistance, check for short circuit to ground in Green/Orange wire. If ohmmeter does not read infinite resistance, check for short circuit to ground in Brown/Green wire.

DTC 131: OPEN OR SHORT TO GROUND IN LINE PRESSURE SOLENOID (STH) CIRCUIT

1) Check for open or short circuit to ground in control signal wiring or signal wiring. See DTC 113: TCM FAULT. If wiring is okay, check solenoid voltage supply. Repair as necessary. If voltage supply is okay, go to next step.

2) Ensure ignition is off. Open control system and access solenoid. Disconnect solenoid. Connect ohmmeter between terminals in solenoid connector. If ohmmeter reads 2-6 ohms, check Violet/White and Violet wires for an open circuit. If ohmmeter does not read 2-6 ohms, replace TCM.

DTC 132/P0745: TCM FAULT

Check TCM connector for poor terminal contact. Repair as necessary. Check for open circuit in TCM voltage supply or grounds. See DTC 113: TCM FAULT. Repair as necessary. If TCM connector and voltage/ground circuits are okay, replace TCM.

DTC 134: INCORRECT LOAD SIGNAL

1) Load signal from ECM provides information to TCM on torque being delivered by engine. If TCM does not register an incoming load signal when RPM sensor on transmission gives a signal that input shaft RPM is greater than about 600 RPM, DTC 134 will set.

2) If DTC 134 is set, check for poor terminal contact in connectors between TCM and ECM. Also check for an open, short circuit to voltage, or short circuit to ground in signal wiring between ECM and TCM. If all circuits are okay, connect scan tool to DLC. Ensure engine is warm, transmission is in neutral, and A/C is off. Select SCROLLING VALUES. Load signal should be about 35. If load signal is okay, replace TCM. If load signal is not okay, replace ECM.

DTC 141: SHORT CIRCUIT IN OIL TEMPERATURE SENSOR CIRCUIT

1) Check for short circuit to ground in oil temperature sensor signal wiring. Repair as necessary. If wiring is okay, go to next step.

2) Ensure ignition is off. Disconnect transaxle connector. Connect ohmmeter between transaxle connector terminals No. 12 (Blue/Green wire) and No. 13 (Blue/Black wire). See OIL TEMPERATURE SENSOR RESISTANCE table. If resistance is to specification, check Blue/Green wire for a short circuit to ground. If resistance is not to specification, replace oil temperature sensor.

OIL TEMPERATURE SENSOR RESISTANCE

°F (°C)	Ohms
0 (0)	1700-2300
68 (20)	765-1035
104 (40)	340-460
176 (80)	107-143
212 (100)	64-86
302 (150)	23-31

DTC 142: OPEN IN OIL TEMPERATURE SENSOR CIRCUIT

1) Check for open or short circuit to ground or voltage in oil temperature sensor signal wiring. Repair as necessary. If wiring is okay, go to next step.

2) Ensure ignition is off. Remove air cleaner housing to access transaxle connector. Disconnect transaxle connector. Connect ohmmeter between transaxle connector terminal No. 13 (Blue/Black wire) and ground. If ohmmeter reads about zero ohms, go to step 4). If ohmmeter does not read about zero ohms, go to next step.

3) Check TCM connector for poor terminal contact. Repair as necessary. Connect ohmmeter between transaxle connector terminal No. 13 and ground. If ohmmeter reads about zero ohms, DTC was set because of poor terminal contact. If ohmmeter does not read about zero ohms, check Blue/Black wire for an open circuit.

4) Turn ignition on. Connect voltmeter between transaxle connector terminal No. 12 (Blue/Green wire) and ground. If voltmeter reads about 5 volts, check oil temperature sensor resistance. See DTC 141: SHORT CIRCUIT IN OIL TEMPERATURE SENSOR CIRCUIT. If voltmeter reads less than 5 volts, go to next step. If voltmeter reads greater than 5 volts, check Blue/Green wire for a short circuit to voltage. If wire is okay, check oil temperature sensor resistance. See DTC 141: SHORT CIRCUIT IN OIL TEMPERATURE SENSOR CIRCUIT.

5) Turn ignition off. Check TCM connector for poor terminal contact. Repair as necessary. Connect voltmeter between transaxle

connector terminal No. 12 (Blue/Green wire) and ground. If voltmeter reads about 5 volts, DTC set because of poor contact in TCM connector. If voltmeter does not read about 5 volts, check Blue/Green wire for an open circuit.

DTC 143: SHORT TO GROUND IN KICKDOWN SWITCH CIRCUIT

1) Check for short circuit to ground in signal wiring between TCM and ECM. Connect measuring unit to TCM and another measuring unit to ECM. Turn ignition on. Connect voltmeter between TCM measuring unit terminal No. 20 and ECM measuring unit terminal No. 20 (non-turbo) or No. 42 (turbo).

2) If voltage is less than .10 volt, check kickdown switch. Replace as necessary. If voltage is greater than .10 volt, check grounds and wiring for poor terminal contact. Repair as necessary.

DTC 211/P0750: TCM FAULT

Check voltage drop over signal ground and power ground. See DTC 113: TCM FAULT. If voltage drop and power ground are okay, check voltage supply to TCM. If voltage supply to TCM is okay, replace TCM.

DTC 212/P0755: SHORT TO VOLTAGE IN NO. 2 SHIFT SOL CIRCUIT

Turn ignition on. Check solenoid using diagnostic test mode No. 4 or scan tool. See TEST MODE NO. 4. If solenoid operates, fault is intermittent. Check for loose wiring. If solenoid does not operate, check Brown/White wire for a short circuit to voltage.

DTC 213/P0120: THROTTLE POSITION SENSOR SIGNAL TOO HIGH

Check throttle position sensor signal. See appropriate K - SENSOR RANGE CHARTS article in ENGINE PERFORMANCE. Repair as necessary. If sensor signal is okay, check voltage drop over signal ground and power ground. See DTC 113: TCM FAULT. Repair as necessary.

DTC 221/P0755: SHORT TO GROUND IN NO. 2 SHIFT SOL CIRCUIT

1) Turn ignition on. Set gearshift lever to "P" position. Check solenoid function by using test mode No. 4 or Volvo scan tool. See TEST MODE NO. 4. If solenoid operates, check wiring for an intermittent short circuit. If solenoid does not operate, go to next step.

2) Turn ignition off. Remove air cleaner housing to access transaxle connector. Disconnect transaxle connector. Connect ohmmeter between transaxle connector terminal No. 22 (Violet wire) and ground. If ohmmeter does not read 10-15 ohms, go to next step. If ohmmeter reads 10-15 ohms, check for short circuit to ground in Violet wire.

3) Access and disconnect shift solenoid No. 2. Connect ohmmeter between pin on solenoid and ground. If ohmmeter reads about 10-15 ohms, check for short circuit to ground in Violet wire. If ohmmeter does not read about 10-15 ohms, replace solenoid.

DTC 222/P0755: OPEN IN NO. 2 SHIFT SOLENOID CIRCUIT

1) Turn ignition on. Set gearshift lever to "P" position. Check solenoid function by using test mode No. 4 or Volvo scan tool. See TEST MODE NO. 4. If solenoid operates, check wiring for an intermittent short circuit. If solenoid does not operate, go to next step.

2) Turn ignition off. Connect measuring unit to TCM. Connect ohmmeter between measuring unit terminals No. 20 and 28. If ohmmeter

reads about 10-15 ohms, repair poor terminal contact at TCM connector. If ohmmeter does not read about 10-15 ohms, go to next step.

3) Remove air cleaner housing to access transaxle connector. Disconnect transaxle connector. Connect ohmmeter between transaxle connector terminal No. 22 (Violet wire) and measuring unit terminal No. 28. If ohmmeter reads about zero ohms, go to next step. If ohmmeter does not read about zero ohms, check for open circuit in Violet wire.

4) Disconnect transaxle connector. Connect ohmmeter between transaxle connector terminal No. 22 (Violet wire) and ground. If ohmmeter reads 10-15 ohms, repair poor terminal contact at TCM connector. If ohmmeter does not read 10-15 ohms, go to next step.

5) Access and disconnect shift solenoid No. 2. Connect ohmmeter between solenoid terminal and ground. If ohmmeter reads about 10-15 ohms, check for short circuit to ground in Violet wire. If ohmmeter does not read about 10-15 ohms, replace solenoid.

DTC 223/P0120: THROTTLE POSITION SENSOR SIGNAL TOO LOW

1) Throttle Position (TP) sensor signal is normally .5-4.2 volts. Opening throttle increases signal voltage. If TPS voltages are not to specification, check voltage drop over signal ground and power ground. See DTC 113: TCM FAULT. Repair as necessary. If voltage drop and power ground are okay, go to next step.

2) Ensure ignition is off. Disconnect TCM and ECM modules. Connect ohmmeter between TCM measuring unit terminal No. 20 and ECM measuring unit terminal No. 50 (non-turbo) or No. 20 (turbo). If ohmmeter reads about zero ohms, go to next step. If ohmmeter does not read about zero ohms, check Green/Brown wire between TCM and ECM for an open circuit.

3) Connect ohmmeter between TCM measuring unit terminals No. 50 and 20. If ohmmeter reads infinite resistance, go to next step. If ohmmeter does not read infinite resistance, check Green/Brown wire between TCM and ECM for a short circuit to ground.

4) Ensure ignition is off. Connect measuring unit to TCM. Connect ECM control modules. Turn ignition on. Measure voltage between measuring unit terminals No. 50 and 20. Press accelerator pedal. If voltmeter reads about .5 volt for closed throttle, and about 4.2 volts for wide open throttle, DTC was set due to poor terminal contact at ECM connector or ground. If voltmeter does not read about .5 volt for closed throttle, and about 4.2 volts for wide open throttle, check TP sensor. See appropriate K - SENSOR RANGE CHARTS article in ENGINE PERFORMANCE.

DTC 231: ERRATIC THROTTLE POSITION SENSOR SIGNAL

1) Throttle Position (TP) sensor signal is normally .5-4.2 volts. Opening throttle increases signal voltage. If TPS voltages are not to specification, check voltage drop over signal ground and power ground. See DTC 113: TCM FAULT. Repair as necessary. If voltage drop and power ground are okay, go to next step.

2) Turn ignition off. Ensure TP sensor wiring and Brown/Green wire between TCM and ECM are not located near sources of interference, such as electric motors, spark plug wires, and mobile telephone wires. Repair as necessary.

DTC 232/P0500: SPEEDOMETER SIGNAL MISSING

1) Speedometer provides vehicle speed information to TCM. TCM uses signal to determine whether transmission changes gear at correct speeds. If DTC 232 is set, use scan tool and compare vehicle speed with speedometer. If reading is correct, go to step 3). If reading is incorrect, check for speedometer malfunction. See appropriate

INSTRUMENT PANELS article in ACCESSORIES & EQUIPMENT. If speedometer is okay, check for an open circuit or short to voltage or ground in signal wiring. Repair as necessary. If wiring is okay, go to next step.

2) Ensure ignition is off. Connect measuring unit to TCM. Shift transmission to "N" position. Raise and support front of vehicle. Turn ignition on. Measure voltage between measuring unit terminals No. 20 and 48. Block one front wheel and spin other wheel rapidly. If voltmeter reads 4-7 volts, DTC was set because of poor terminal contact at TCM or speedometer connector. If voltmeter does not read 4-7 volts, replace speedometer.

3) Ensure ignition is off. Check that Vehicle Speed Sensor (VSS) is securely fastened to transmission. Ensure there is no dirt between sensor and mating surfaces. Repair as necessary. If VSS is okay, ensure all grounds are clean and tight. Repair as necessary.

DTC 233: SPEEDOMETER SIGNAL INCORRECT

If TCM registers an unusually large variation in speed signal from speedometer, DTC will set. Check for loose contact in wiring or splices, damaged insulation, or poor terminal contact. Repair as necessary.

DTC 235: HIGH OIL TEMPERATURE

1) Check for other DTCs. If DTC 141 is stored, perform testing for that DTC first. See DTC 141: SHORT CIRCUIT IN OIL TEMPERATURE SENSOR CIRCUIT. If DTC 141 is not stored, go to next step.

2) Remove air cleaner housing to access transaxle connector. Disconnect transaxle connector. Connect ohmmeter between transaxle connector terminal No. 12 (Blue/Green wire) and measuring unit terminal No. 28. If ohmmeter reads infinite resistance, go to next step. If ohmmeter does not read infinite resistance, check Blue/Green wire for a short circuit to ground.

3) Ensure ignition is off. Disconnect transaxle connector. Connect ohmmeter between transaxle connector terminals No. 12 (Blue/Green wire) and No. 13 (Blue/Black wire). See OIL TEMPERATURE SENSOR RESISTANCE table. If resistance is to specification, check Blue/Green wire for a short circuit to ground. If resistance is not to specification, replace oil temperature sensor.

DTC 245: OPEN OR SHORT IN TORQUE LIMITING CIRCUIT

1) Engine torque is reduced to allow smoother shifting in some gear changes. Torque limiting process is controlled by signals sent from TCM to ECM. A receipt confirmation signal is sent from ECM to TCM. Signal indicates that torque limiting is taking place. If TCM fails to register a receipt signal after request for torque limiting, DTC 245 is set.

2) Ensure ignition is off. Disconnect TCM. Connect measuring unit to TCM connector. Disconnect ECM. Connect ohmmeter between measuring unit terminal No. 20 and No. 32, 33, and 34. If ohmmeter reads infinite resistance, go to next step. If ohmmeter does not read infinite resistance, check wiring between TCM connector terminal B2 (Yellow/Red wire), B3 (Yellow/Violet wire), or B4 (Violet wire) and respective ECM connector terminal B2, B3, and B4.

3) Ensure ignition is off. Disconnect TCM. Connect measuring unit to ECM connector. Leave ECM disconnected. Connect ohmmeter between TCM measuring unit and ECM measuring unit. See TCM/ECM MEASURING UNIT RESISTANCE CHECK table. If ohmmeter reads about zero ohms, go to next step. If ohmmeter does not read about zero ohms, check for open circuit in Yellow/Red, Yellow/Violet, or Violet wire. Repair as necessary.

TCM/ECM MEASURING UNIT RESISTANCE CHECK

TCM Terminal No.	ECM Terminal No.
32	2
33	3
34	4

4) Ensure ignition is off. Reconnect TCM and ECM. Turn ignition on. Connect voltmeter between TCM measuring unit terminals No. 20 and 32. If voltmeter reads about 5 volts (non-turbo) or about 11 volts (turbo), go to next step. If voltmeter does not read about 5 volts (non-turbo) or about 11 volts (turbo), check for short to voltage in Yellow/Red wire.

5) Ensure ignition is on. Connect voltmeter between TCM measuring unit terminals No. 20 and 33. If voltmeter reads about 5 volts (non-turbo) or about 11 volts (turbo), go to next step. If voltmeter does not read about 5 volts (non-turbo) or about 11 volts (turbo), check for short to voltage in Yellow/Violet wire.

6) Ensure ignition is on. Connect voltmeter between TCM measuring unit terminals No. 20 and 34. If voltage is to specification, go to next step. If voltage is not to specification, check for short to voltage in Violet wire. See TCM VOLTAGE CIRCUIT CHECK table.

TCM VOLTAGE CIRCUIT CHECK

ECM Type	Voltage
Non-Turbo	5
Turbo	10

7) Ensure ignition is on. Connect voltmeter between TCM measuring unit terminals No. 20 and 32. Voltmeter should read about 5 volts (non-turbo) or about 10-11 volts (turbo). Check torque limiting (TC1) operation using scan tool or test mode No. 4. See TEST MODE NO. 4. If voltage drops rapidly to about zero volts when signal is activated, go to next step. If voltage does not drop, replace TCM.

8) Ensure ignition is on. Connect voltmeter between TCM measuring unit terminals No. 20 and 33. Voltmeter should read about 5 volts (non-turbo) or about 10-11 volts (turbo). Check torque limiting (TC2) operation using scan tool or test mode No. 4. See TEST MODE NO. 4. If voltage drops rapidly, go to next step. If voltage does not drop, replace TCM.

9) Ensure ignition is on. Connect voltmeter between TCM measuring unit terminals No. 20 and 34. See TCM VOLTAGE CIRCUIT CHECK table. Check TCM acknowledge signal and activate torque limiting (TC1/TC2) using scan tool or test mode No. 4. See TEST MODE NO. 4. If voltage drops, fault is intermittent. Check for poor terminal contact or open circuits in wiring. If voltage does not drop, replace ECM.

DTC 311/P0715: RPM SIGNAL MISSING

1) Ensure ignition is off. Connect measuring unit to TCM. Measure resistance between measuring unit terminals No. 1 and 2. If resistance is 300-600 ohms, sensor and wiring are okay. If resistance is not 300-600 ohms, go to next step.

2) Measure resistance between transmission 26-pin connector terminals No. 16 (Yellow/White wire) and No. 17 (Yellow/Brown wire). If resistance is 300-600 ohms, sensor is okay. Check wiring. If

resistance is not 300–600 ohms, check wiring. If wiring is okay, replace sensor.

DTC 312: RPM SIGNAL INCORRECT

1) Check for additional DTCs. If DTC 311 is present, see DTC 311: RPM SIGNAL MISSING. If DTC 311 is not present, go to next step.

2) Ensure RPM sensor is correctly positioned. Check transmission and TCM connectors for poor terminal contact. Repair as necessary. Check Yellow/Brown and Yellow/White wires between RPM sensor and TCM. Repair as necessary. If all components are okay, ensure RPM sensor wiring is not located close to sources of interference, such as electric motors or spark plugs.

DTC 313/P0705: GEAR POSITION SENSOR SIGNAL INCORRECT

1) If DTC 313 is set, check gear shift position sensor adjustment. Ensure gear shift is set to position "N". Remove battery, battery shelf, and air intake manifold. Remove transmission cable from rod arm. Remove selector lever. Install gear position Alignment Tool (999 5475) on control shaft. If shaft is set correctly to position "N", indentation on alignment tool should align with mark on gear position sensor. If indentation aligns with mark on gear position sensor, go to step 3). If indentation does not align with mark, go to next step.

2) Remove dipstick pipe bracket and gear position sensor screws. Rotate gear position sensor so mark on switch aligns with indentation on tool. Tighten sensor screws to 37 ft. lbs. (25 N.m). To complete installation, reverse removal procedure.

3) Ensure ignition is off. Connect ohmmeter between gear shift position sensor case and transmission housing. If ohmmeter reads about zero ohms, go to next step. If ohmmeter does not read about zero ohms, check gear shift position sensor ground. Repair as necessary.

4) Ensure ignition is off. Check battery voltage at battery and note reading. Connect measuring unit to TCM. Turn ignition on. Check gear position sensor voltage specification by connecting voltmeter between measuring unit terminal No. 20 and gear position sensor terminal. See GEAR POSITION SENSOR VOLTAGE SPECIFICATIONS table. If voltages are to specification, DTC was set because of poor terminal contact in TCM connector. Repair as necessary. If voltmeter reads a steady zero volts for some or all terminals, regardless of selector position, go to step 7). If voltmeter reads a steady 12 volts for some or all terminals, regardless of selector position, check for short circuit to voltage in wiring for terminal with incorrect reading between gear position sensor and TCM, then go to step 8).

5) Ensure ignition is off. Check transaxle connector for poor terminal contact. Repair as necessary. Turn ignition on. Connect voltmeter between measuring unit terminal No. 20 and gear position sensor terminal. See GEAR POSITION SENSOR VOLTAGE SPECIFICATIONS table. If voltage readings are okay, DTC was set because of poor terminal contact. If voltage readings are not okay, go to next step.

6) Ensure ignition is off. Disconnect transaxle connector. Connect ohmmeter between transaxle connector terminal and measuring unit terminal. See TRANSAXLE CONNECTOR/MEASURING UNIT TERMINAL RESISTANCE table. If ohmmeter reads about zero ohms for all readings, replace gear position sensor. If ohmmeter does not read about zero ohms for all readings, check for open circuit in wiring between transaxle connector and TCM. Repair as necessary.

TRANSAXLE CONNECTOR/MEASURING UNIT TERMINAL RESISTANCE

Transaxle Connector Terminal

Measuring Unit Terminal

1 (White wire)	3
2 (Yellow wire)	4
3 (Green wire)	5
4 (Blue wire)	6

7) Ensure ignition is off. Disconnect transmission and TCM connectors. Connect ohmmeter between measuring unit terminal No. 20 and gear position sensor connector terminals No. 3 (Green wire), No. 4 (Blue wire), No. 5 (Blue wire), and No. 6 (Green/Red wire). If ohmmeter reads infinite resistance, replace gear position sensor. If ohmmeter does not read infinite resistance, check for short circuit to ground in wire between transaxle connector and TCM.

8) Ensure ignition is off. Connect TCM and transaxle connectors. Turn ignition on. Connect voltmeter between measuring unit terminal No. 20 and gear position sensor terminal. See GEAR POSITION SENSOR VOLTAGE SPECIFICATIONS table. If voltage readings are okay, gear position sensor is okay. If voltage readings are not okay, replace gear position sensor.

GEAR POSITION SENSOR VOLTAGE SPECIFICATIONS (1)

Gearshift Position & Measuring Unit Terminal	Specification
"P"	
A3	0-0.5 Volt
A4	Approx. 1 Volt Below Battery Voltage
A5	Approx. 1 Volt Below Battery Voltage
A6	0-0.5 Volt
"R"	
A3	0-0.5 Volt
A4	0-0.5 Volt
A5	Approx. 1 Volt Below Battery Voltage
A6	Approx. 1 Volt Below Battery Voltage
"N"	
A3	Approx. 1 Volt Below Battery Voltage
A4	0-0.5 Volt
A5	Approx. 1 Volt Below Battery Voltage
A6	0-0.5 Volt
"D"	
A3	Approx. 1 Volt Below Battery Voltage
A4	0-0.5 Volt
A5	0-0.5 Volt
A6	Approx. 1 Volt Below Battery Voltage
3	
A3	0-0.5 Volt
A4	0-0.5 Volt
A5	0-0.5 Volt
A6	0-0.5 Volt
"L"	
A3	0-0.5 Volt
A4	Approx. 1 Volt Below Battery Voltage
A5	0-0.5 Volt
A6	Approx. 1 Volt Below Battery Voltage

(1) - Measured between measuring unit terminal A20 and terminal in table.

DTC 322/P0730: GEAR RATIO INFORMATION INCORRECT

1) Check transmission oil level. If oil level is low, top off

as necessary and check for leaks. Repair as necessary. If oil level is okay, turn ignition on and check DTCs. Test drive vehicle while observing automatic transmission warning light. If light begins to flash note any unusual symptoms in transmission operation or function. If transmission does not show any mechanical fault or malfunction, go to next step. If transmission has a mechanical malfunction and DTC 322 is not reset, repair or replace transmission as necessary.

2) Turn ignition off. Connect measuring unit to TCM. Raise and support front of vehicle. Turn A/C off. Idle engine. Set gear selector to position "D" so front wheels begin to rotate. Increase and keep engine speed at 2000 RPM. Set DVOM to Hz scale, then connect DVOM between measuring unit terminals No. 1 and 2. If DVOM gives a stable Hz reading when engine speed is constant and transmission is not shifting, go to step 5). If Hz frequency reading shows wide fluctuations, go to next step.

3) Ensure ignition is off. Disconnect TCM. Connect ohmmeter between measuring unit terminals No. 1 and 2. If ohmmeter does not read 300-600 ohms, go to next step. If ohmmeter reads 300-600 ohms, ensure RPM sensor wiring is not located near sources of interference such as electric motors or spark plugs.

4) Disconnect transaxle connector. Check TCM connector for poor terminal contact. Repair as necessary. Reconnect transaxle connector. Connect ohmmeter between measuring unit terminals No. 1 and 2. If ohmmeter reads about 300-600 ohms, DTC was set because of poor contact in transaxle connector. If ohmmeter does not read about 300-600 ohms, replace RPM sensor.

5) Connect DVOM between measuring unit terminals No. 20 and 48. Shift transmission to "D" so front wheels begin to rotate. Increase engine speed to 1800-2000 RPM. If DVOM displays a stable Hz reading when engine speed is constant, go to step 8). If DVOM does not display a stable Hz reading when engine speed is constant, go to next step.

6) Replace VSS. Connect DVOM between measuring unit terminals No. 20 and 48. Shift transmission to "D" so front wheels begin to rotate. Increase engine speed to 1800-2000 RPM. If DVOM displays a stable Hz reading when engine speed is constant, system is okay. If DVOM does not display a stable Hz reading when engine speed is constant, go to next step.

7) Ensure ignition is off. Ensure wiring between VSS and instrument cluster is not located near sources of interference such as electric motors or spark plugs. If wiring is okay, replace instrument cluster. See appropriate INSTRUMENT PANELS article in ACCESSORIES & EQUIPMENT.

8) Ensure ignition is off. Disconnect TCM. Connect ohmmeter between measuring unit terminals No. 20 and 27 (solenoid S1), then between measuring unit terminals No. 20 and 28 (solenoid S2). If ohmmeter reads 10-15 ohms, go to next step. If ohmmeter does not read 10-15 ohms, check transaxle connector for poor terminal contact. Repair as necessary.

9) Ensure ignition is off. Reconnect TCM. Turn ignition on. Set gearshift selector to "D" position. Connect voltmeter between measuring unit terminals No. 5 and 20. If voltmeter reads 0-.5 volt, twist gear position sensor lever/shaft up, down, and to side. If voltage reading remains constant, system is okay. If voltage reading does not remain constant, go to next step.

10) Turn ignition off. Check gear position sensor adjustment. Repair as necessary. See DTC 313: GEAR POSITION SENSOR SIGNAL INCORRECT. If adjustment is okay, replace gear position sensor.

DTC 323: LOCK-UP SLIPS OR IS NOT ENGAGED

1) Turn ignition on. Clear DTCs. Test drive vehicle. If transmission does not show any malfunction, go to next step. If

transmission has a mechanical malfunction and DTC 323 is not reset, diagnose mechanical malfunction. If transmission has a mechanical malfunction and DTC 323 is reset, replace transmission.

2) Ensure ignition is on. Connect measuring unit to TCM connector. Connect ohmmeter between measuring unit terminals No. 9 and 20. If ohmmeter reads 10-15 ohms, transmission is probably okay. However, if problem persists, replace transmission. If ohmmeter does not read 10-15 ohms, check TCM connector for poor terminal contact. Repair as necessary.

DTC 331: SHORT TO VOLTAGE IN LOCK-UP SOLENOID CIRCUIT

Turn ignition on. Set gearshift lever to "P" position. Check solenoid function by using test mode No. 4 or Volvo scan tool. See TEST MODE NO. 4. If solenoid operates, check wiring for an intermittent short circuit. If solenoid does not operate, check for a short circuit to voltage in wiring between lock-up solenoid and TCM connector terminal A9. Repair as necessary.

DTC 332: OPEN IN LOCK-UP SOLENOID CIRCUIT

1) Turn ignition on. Set gearshift lever to "P" position. Check solenoid function by using test mode No. 4 or Volvo scan tool. See TEST MODE NO. 4. If solenoid operates, check wiring for an intermittent short circuit. If solenoid does not operate, go to next step.

2) Ensure ignition is off. Connect measuring unit to TCM connector. Connect ohmmeter between measuring unit terminals No. 9 and 20. If ohmmeter reads 10-15 ohms, DTC was caused by poor terminal contact in TCM connector. Repair as necessary. If ohmmeter does not read 10-15 ohms, go to next step.

3) Ensure ignition is off. Remove air cleaner housing to access transaxle connector. Connect ohmmeter between transaxle connector terminal No. 23 and measuring unit terminal No. 9. If ohmmeter reads about zero ohms, go to next step. If ohmmeter does not read about zero ohms, check for an open circuit in Brown/Black wire between transaxle connector terminal No. 23 and TCM terminal A9.

4) Ensure ignition is off and transaxle connector is disconnected. Connect ohmmeter between transaxle connector terminal No. 23 and transmission housing. If ohmmeter does not read 10-15 ohms, go to next step. If ohmmeter reads 10-15 ohms, DTC set because of poor terminal contact at transaxle connector. Repair as necessary.

5) Ensure ignition is off. Open control system and disconnect lock-up solenoid. Connect ohmmeter between lock-up solenoid terminal and transmission housing. If ohmmeter reads 10-15 ohms, check for an open circuit in Brown/Black wire between lock-up solenoid and transaxle connector terminal No. 23. If ohmmeter does not read 10-15 ohms, replace lock-up solenoid.

DTC 333: SHORT TO GROUND IN LOCK-UP SOLENOID CIRCUIT

1) Turn ignition on. Set gearshift lever to "P" position. Check solenoid function by using test mode No. 4 or Volvo scan tool. See TEST MODE NO. 4. If solenoid operates, check wiring for an intermittent short circuit. If solenoid does not operate, go to next step.

2) Ensure ignition is off. Remove air cleaner housing to access transaxle connector. Disconnect transaxle connector. Connect ohmmeter between transaxle connector terminal No. 23 (Brown/Black wire) and transmission housing. If ohmmeter does not read 10-15 ohms, go to next step. If ohmmeter reads 10-15 ohms, check for a short circuit to ground in Brown/Black wire between transaxle connector terminal No. 23 and TCM connector terminal A9.

3) Ensure ignition is off. Open control system and disconnect lock-up solenoid. Connect ohmmeter between lock-up solenoid terminal and transmission housing. If ohmmeter reads 10-15 ohms, check for an open circuit in Brown/Black wire between lock-up solenoid and transaxle connector terminal No. 23. If ohmmeter does not read 10-15 ohms, replace lock-up solenoid.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application		Ft. Lbs. (N.m)
Control Arm-To-Ball Joint Nut (New)	(1)	13 (18)
Drive Shaft Nut	(2)	89 (120)
Engine-To-Transmission Bolt		37 (50)
Frame Bolt	(1)	77 (105)
Frame Bracket Bolt		37 (50)
Flexplate-To-Torque Converter Bolt		22 (30)
Rear Transmission/Engine Mount		37 (50)
Roll Bar Bearing Cap Bolt		37 (50)
Steering Gear Nut (New)		37 (50)
Torque Rod-To-Transmission Bolt	(3)	13 (18)

(1) - Tighten an additional 120 degrees.

(2) - Tighten an additional 60 degrees.

(3) - Tighten an additional 90 degrees.

WIRING DIAGRAM

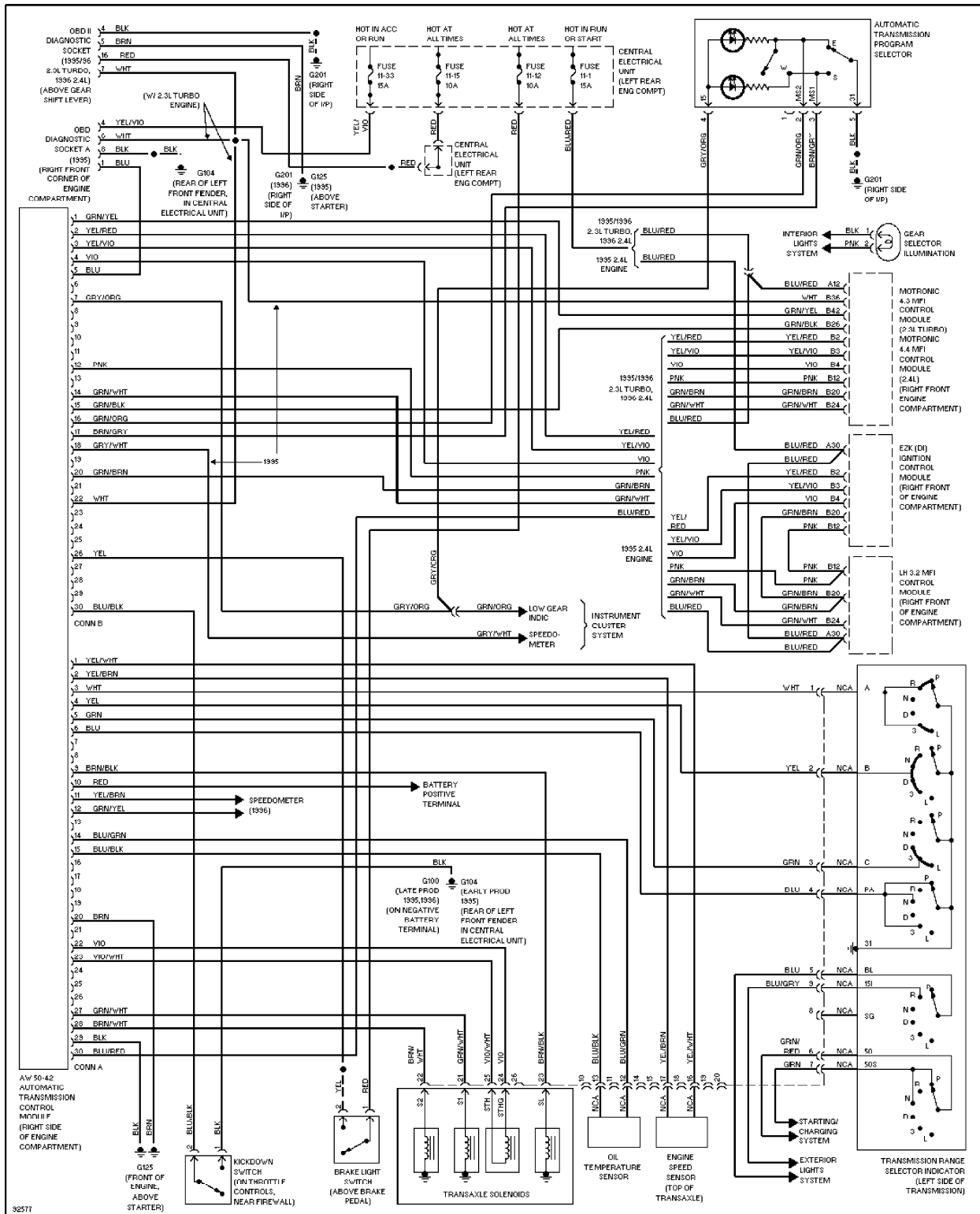


Fig. 11: Volvo 850 Transaxle Wiring Diagram (AW50-42LE)