

CRUISE CONTROL SYSTEM

1995 Volvo 850

1995-96 ACCESSORIES & EQUIPMENT
Volvo Cruise Control Systems

850

NOTE: 1996 850 models are equipped with OBD II diagnostic connector located in center console. Follow instructions included with Volvo Scan Tool (998-8686-3) for diagnosis and testing.

DESCRIPTION & OPERATION

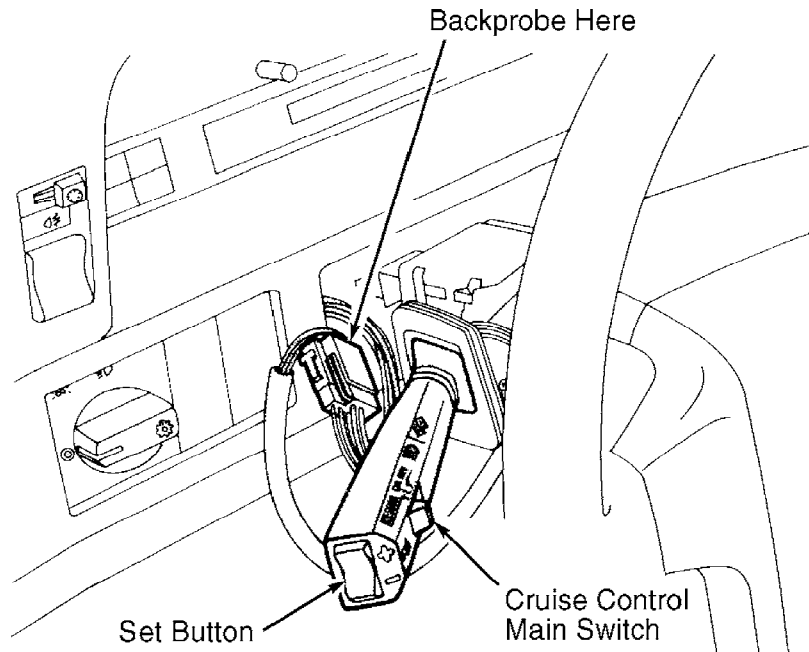
MAIN SWITCH

Cruise control main switch is located at end of turn signal lever. See Fig. 1. Selector switch has 3 positions, OFF, ON and RESUME. SET button is at tip of lever.

BRAKE & CLUTCH VALVES

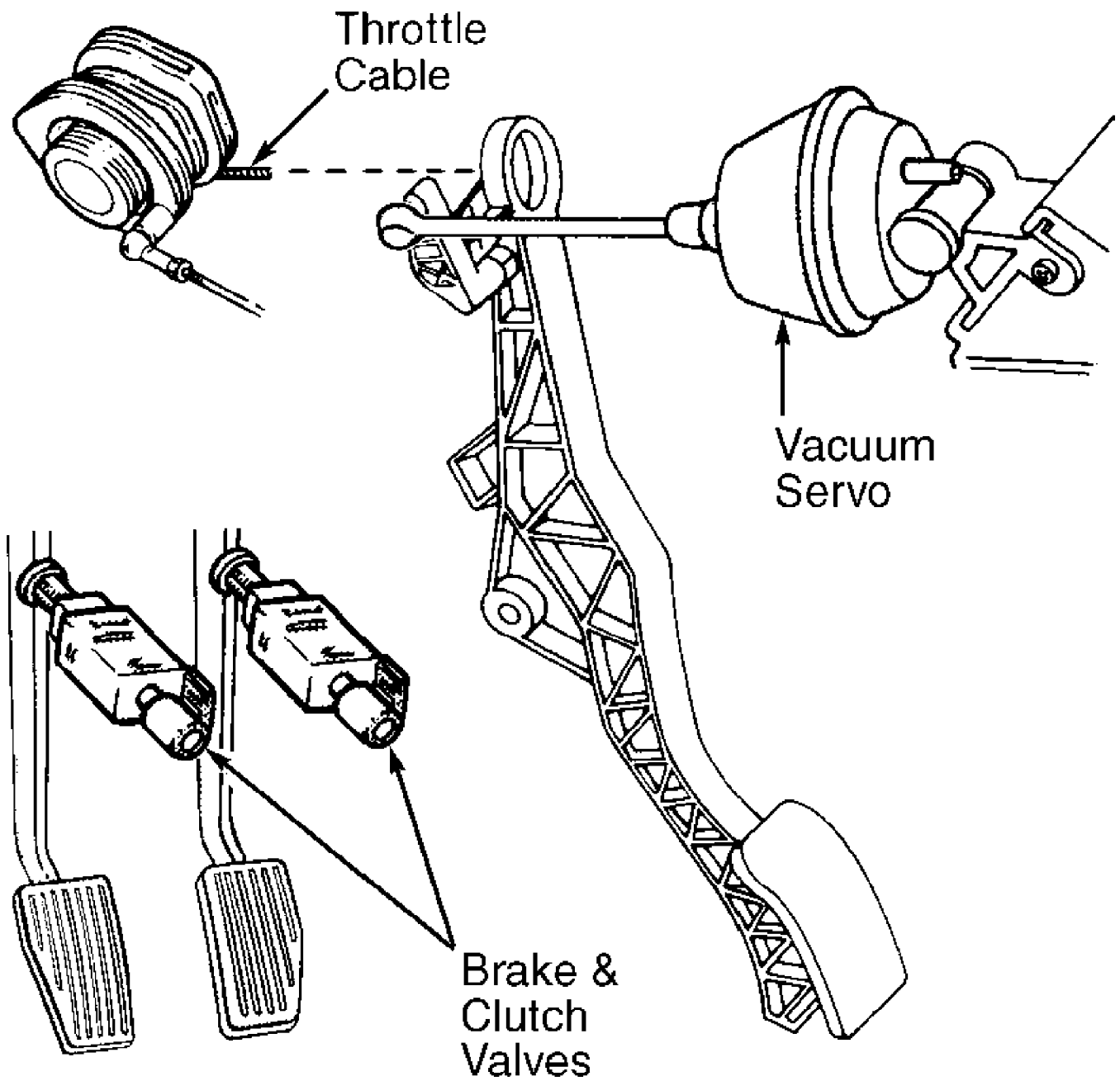
Brake and clutch valves are located on the pedal assembly. See Fig. 2. Valve adjusts using small plastic catches which hook onto plunger, holding it in place.

When pedal is up (valve actuated), spring is compressed, switch is on and vacuum valve is closed. When pedal is down (valve deactivated), spring pushes plunger back. Electric contact is broken and vacuum valve opens to allow atmospheric pressure into the system.



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Fig. 1: Identifying Cruise Control Main Switch & Connector
Courtesy of Volvo Cars of North America.



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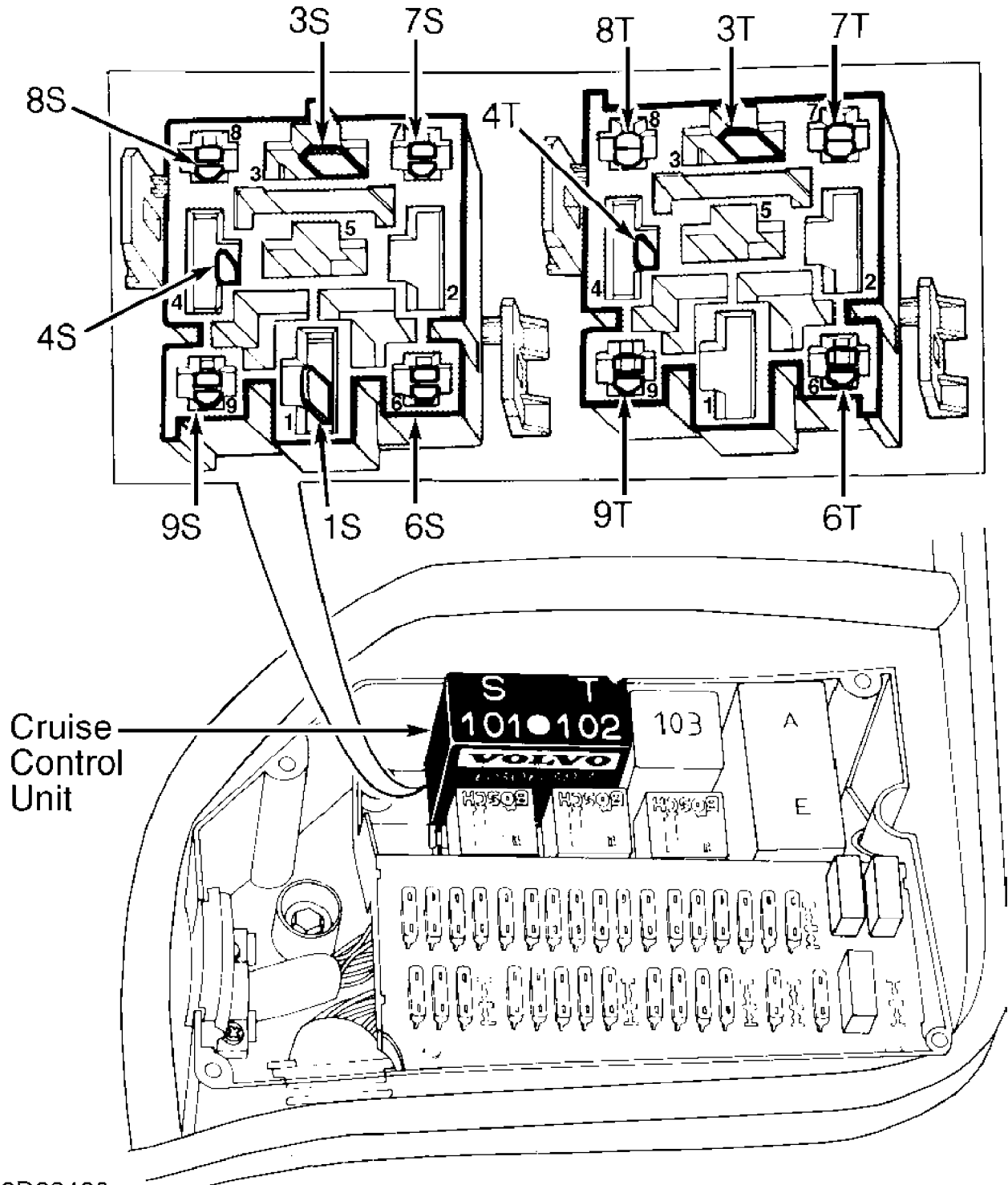
Fig. 2: Locating Brake & Clutch Valves & Servo
 Courtesy of Volvo Cars of North America.

CONTROL UNIT

Control unit is located in underhood fuse and relay center. See Fig. 3. Control unit receives signals from sensor and switches. Main function of control unit is to decide if system can be controlled based on values and status of input signals, and to regulate system for optimal function.

Control unit also performs diagnostic functions. This enables the unit to communicate with the technician via the underhood

diagnostic hookup.



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Fig. 3: Locating Control Unit & Terminal Identification
Courtesy of Volvo Cars of North America.

VACUUM PUMP & REGULATOR

Vacuum pump and regulator are contained in one unit, located in left front corner of engine compartment. When cruise control system is operating, a 12-volt electric motor pumps vacuum when accelerator is depressed, sucking air out of tube which leads to vacuum servo. Air is pumped out through right coupling. Each coupling is equipped with a check valve to prevent air from entering tube via lower part of pump housing.

Another tube provides constant atmospheric pressure to upper pump housing. Regulator releases air to vacuum system when accelerator is released.

VACUUM SERVO

Vacuum servo is located next to accelerator pedal and consists of a housing and bellows. See Fig. 2. Bellows is pulled toward housing when pressure decreases inside bellows, thereby pulling on wire connecting throttle linkage and bellows.

ADJUSTMENTS

BRAKE & CLUTCH VALVES

Valves are self-adjusting. If manual adjustment is desired, depress pedal until pedal arm does not make contact with valve. Pull out plunger as far as possible and pull pedal up slowly. Plastic catches in valve will hold piston in correct position.

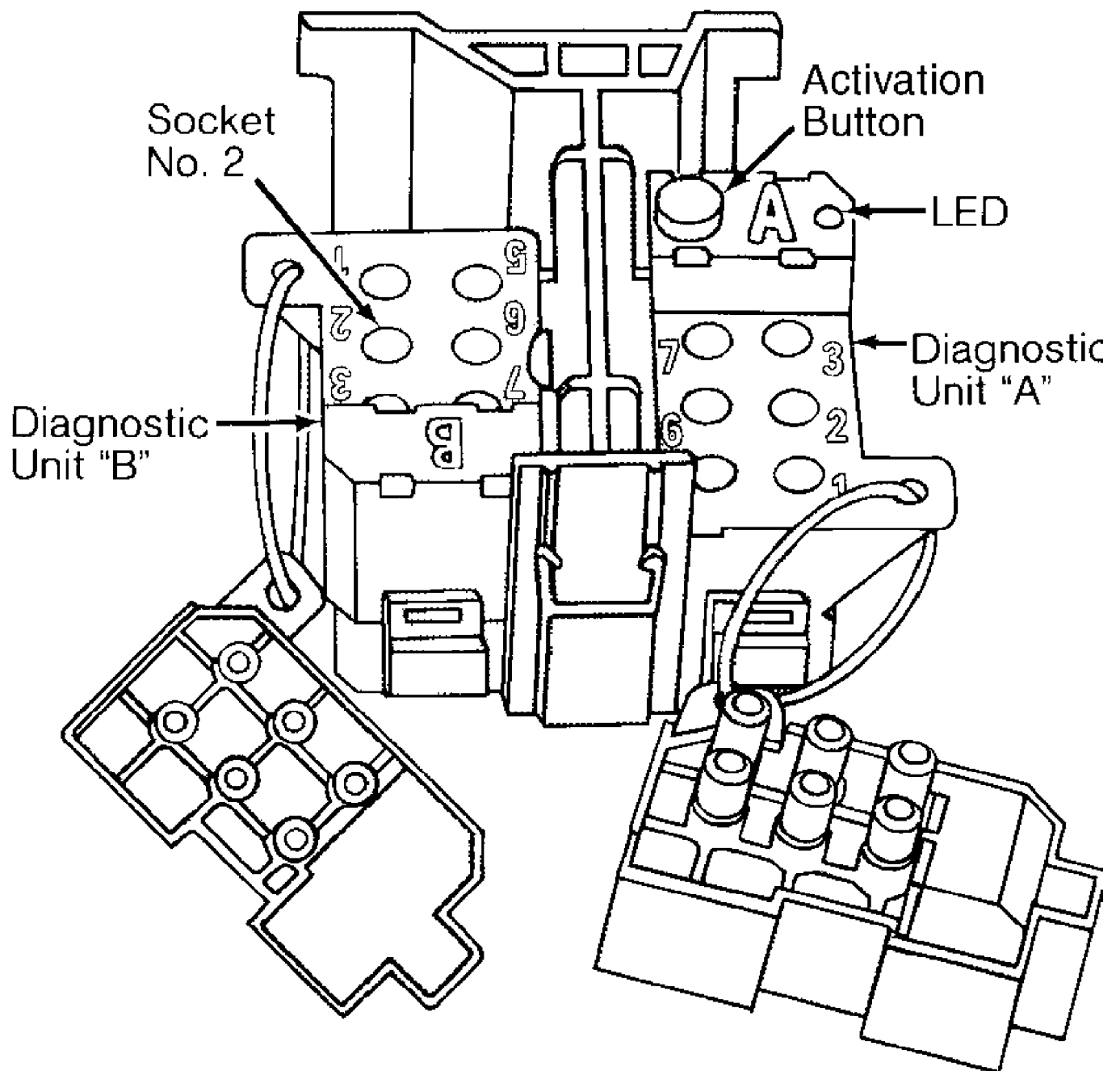
VACUUM SERVO THROTTLE CABLE

Ensure throttle cable is taut at idle. Cable must not affect position of throttle. See Fig. 2.

SYSTEM TESTS

NOTE: Diagnostic unit for retrieving codes is located in right front section of engine compartment. Diagnostic unit is equipped with an LED indicator, activation button and function select cable. See Fig. 4.

All fault codes contain 3 digits (example 3-1-1). Since codes have 3 digits, each code requires 3 series of flashes. A 3-second interval separates series of flashes. Ensure all testing and diagnosis is performed in the following order.



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Fig. 4: Locating Diagnostic Unit
 Courtesy of Volvo Cars of North America.

CONNECTING DIAGNOSTIC SYSTEM

Remove covers on diagnostic units. Connect selector cable to socket No. 2 on diagnostic unit "B". See Fig. 4.

TRANSFER RATE TEST MODE

- 1) In this test mode, transfer rate (speed of information)

between control unit and diagnostic hookup can be changed. This is useful if system is read with a display instrument (scan tool). See TRANSFER RATE TEST CODES table. This step is not necessary if normal rate is desired, as this rate is loaded with each ignition start.

2) To enter transfer rate test mode, press activation button 4 times, holding button down about one second each time. When LED lights up, enter selected code. See TRANSFER RATE TEST CODES table. Enter one digit each time LED lights up. Hold button down about one second each time it is pressed. If code is entered correctly, LED will flash code at new rate.

TRANSFER RATE TEST CODES TABLE

Code	Function
3-1-1	Normal Rate
3-1-2	(1) Double Rate
3-1-3	10-Times Normal Rate (Display Instrument)

(1) - Recommended for experienced user of diagnostic system only.

CHECKING DIAGNOSTIC WIRE

1) Turn ignition on. Connect a voltmeter between diagnostic unit "B" socket No. 2 and ground. See Fig. 4. If voltage is about 10 volts, diagnostic wire is okay. Go to COMPONENT TEST MODE. If voltage is not about 10 volts, go to next step and check ground and voltage to control unit in addition to wire from socket No. 2 in diagnostic unit "B" to terminal 4S in control unit. See Fig. 3.

2) Remove cover from underhood relay and fuse unit. Remove cruise control unit. Connect an ohmmeter between socket No. 2 on diagnostic unit "B" and control unit terminal 4S. See Fig. 3. Ohmmeter should show about zero ohms. Connect ohmmeter between ground and control unit terminal 3S. Ohmmeter should show about zero ohms.

3) Turn ignition on. Connect a voltmeter between ground and control unit terminal 1S. Battery voltage should be present. If any measurement is not to specification, check fuse No. 28 and all wiring. If all measurements are okay, retest using a known-good control unit.

COMPONENT TEST MODE

Introduction

1) This test mode is used to check the components that comprise cruise control system. By activating components one by one, and by giving control unit a response code if control unit has received a signal from component, sensor as well as wiring and connections can be checked. See COMPONENT TEST MODE CODES table.

2) If correct response code is not obtained, go to appropriate testing for that particular response code. If correct response codes are obtained, go to VACUUM SYSTEM CHECK.

COMPONENT TEST MODE CODES TABLE

Code	Activated Component
1-1-3	Selector ON/OFF
With Selector In ON Position	
1-1-3	Brake Or Clutch Valve
1-2-3	Selector RESUME
1-3-1	Selector SET+
2-1-3	Selector SET-

2-2-3 Shift A/T From "N" To "D"
 With Selector In OFF Position
 1-3-2 Depress Brake Pedal
 3-1-1 Several Signals

Selector Switch Test (Response Code 1-1-3)

1) Response Code 1-1-3 is obtained when selector is switched from OFF to ON, ON to OFF, or if brake or clutch pedal is depressed while selector is set to ON. If code cannot be obtained in any position, voltage is either constantly high (12 volts) or low (zero volts). If Codes 1-3-1, 1-2-3, or 2-1-3 are also present, there is voltage to selector switch. Go to BRAKE & CLUTCH PEDAL CHECK (RESPONSE CODE 1-1-3). If Codes 1-3-1, 1-2-3, or 2-1-3 are not present, go to next step and check voltage supply to selector switch.

2) Check cruise control fuse No. 28 and replace as necessary. If fuse is okay, remove upper and lower steering column covers. Check voltage to cruise control selector switch by turning ignition on. Connect voltmeter (backprobe) between selector connector terminal No. 2 (Blue/Yellow wire) and ground. See Fig. 1. If battery voltage is not present, check selector wiring. If battery voltage is present, go to next step.

3) Connect voltmeter (backprobe) between selector connector terminal No. 1 (Gray/White wire) and ground. Put switch in ON position. If battery voltage is not present, replace selector switch. If battery voltage is present, selector switch is okay.

Brake & Clutch Pedal Check (Response Code 1-1-3)

1) Check voltage to cruise control selector switch. See SELECTOR SWITCH TEST (RESPONSE CODE 1-1-3). If test verifies cruise control switch is okay, check voltage at brake and clutch pedal power circuits. Ensure voltage is entering but not exiting switch. Adjust switch as necessary. See BRAKE & CLUTCH VALVES under ADJUSTMENTS. If switches are okay, go to next step.

2) Remove cruise control unit from underhood fuse and relay center. See Fig. 3. Turn ignition on. Connect voltmeter between ground and control unit terminal 9T. Battery voltage should be present. If battery voltage is not present, check voltage circuit to brake and clutch pedal valves.

Selector SET+ Check (Response Code 1-3-1)

1) Check voltage to cruise control selector switch. See Fig. 1. See SELECTOR SWITCH TEST (RESPONSE CODE 1-1-3). If test verifies cruise control switch is okay, connect voltmeter (backprobe) between cruise control selector switch connector terminal No. 5 (Red/Black wire) and ground. Turn ignition on. Press SET+ button. If battery voltage is present, go to next step. If battery voltage is not present, replace selector switch.

2) Remove cruise control unit from underhood fuse and relay center. See Fig. 3. Connect voltmeter between ground and cruise control unit base terminal 4T. Turn ignition on. Set cruise control selector switch to ON position. Press SET+ button. If voltmeter indicates battery voltage, replace cruise control selector switch. If voltmeter does not indicate battery voltage, check wiring between selector switch connector terminal No. 5 (Red/Black wire) and cruise control unit terminal 4T.

Selector SET- Check (Response Code 2-1-3)

1) Check voltage to cruise control selector switch. See Fig. 1. See SELECTOR SWITCH TEST (RESPONSE CODE 1-1-3). If test verifies cruise control switch is okay, connect voltmeter (backprobe) between cruise control selector switch connector terminal No. 4 (White/Black wire) and ground. Turn ignition on. Press SET- button. If

battery voltage is present, go to next step. If battery voltage is not present, replace selector switch.

2) Remove cruise control unit from under-hood fuse and relay center. See Fig. 3. Connect voltmeter between ground and cruise control unit base terminal 8T. Turn ignition on. Set cruise control selector switch to ON position. Press SET- button. If voltmeter indicates battery voltage, replace cruise control selector switch. If voltmeter does not indicate battery voltage, check wiring between selector switch connector terminal No. 4 and cruise control unit terminal 8T.

Selector RESUME Check (Response Code 1-2-3)

1) Check voltage to cruise control selector switch.

See Fig. 1. See SELECTOR SWITCH TEST (RESPONSE CODE 1-1-3). If test verifies cruise control switch is okay, connect (backprobe) voltmeter between cruise control selector switch connector terminal No. 3 (Blue wire) and ground. Turn ignition on. Press RESUME button. If battery voltage is present, go to next step. If battery voltage is not present, replace selector switch.

2) Remove cruise control unit from under-hood fuse and relay center. See Fig. 3. Connect voltmeter between ground and cruise control unit base terminal 6T. Turn ignition on. Set cruise control selector switch to ON position. Press RESUME button. If voltmeter indicates battery voltage, replace cruise control selector switch. If voltmeter does not indicate battery voltage, check wiring between selector switch connector terminal No. 3 (Blue wire) and cruise control unit terminal 6T.

Neutral Start Switch Circuit Disengagement (Response Code 2-2-3)

1) Turn ignition off. Remove cruise control unit from under-hood fuse and relay center. See Fig. 3. Connect ohmmeter between ground and cruise control unit base terminal 3T. With transmission shift lever in Park or Neutral, ohmmeter should indicate zero ohms resistance. With transmission shift lever in any other position, ohmmeter should indicate infinite resistance.

2) If resistances are to specification, replace cruise control module. If resistances are not to specification, check wiring between cruise control unit terminal 3T and starter, including neutral start switch.

Brakelight Switch Check (Response Code 1-3-2)

1) Step on brake pedal. If brakelight illuminates, check wiring between cruise control unit connector terminal 6S and brakelight switch. See Fig. 3. If brakelight does not illuminate, go to next step.

2) Remove driver-side knee protector. Connect voltmeter between brakelight switch Red wire and ground. If battery voltage is present, go to next step. If battery voltage is not present, check Red wire between brake light switch and fuse holder.

3) Connect voltmeter between brakelight switch Yellow wire and ground. Step on brake pedal. If battery voltage is present, wiring is okay. If battery voltage is not present, ensure voltage supply is present at brakelight switch. If voltage supply is present, replace brake light switch.

Too Many Simultaneous Input Signals (Response Code 3-1-1)

1) This code is set when control unit receives more than one input signal within 8 milliseconds. This is usually the result of a malfunction in a contact or switch, or if wiring has shorted.

2) Activate switches to determine which circuit might have caused Code 3-1-1 to set. If Code 3-1-1 sets again, check wiring and switches in relation to which trouble code should have appeared.

VACUUM SYSTEM CHECK

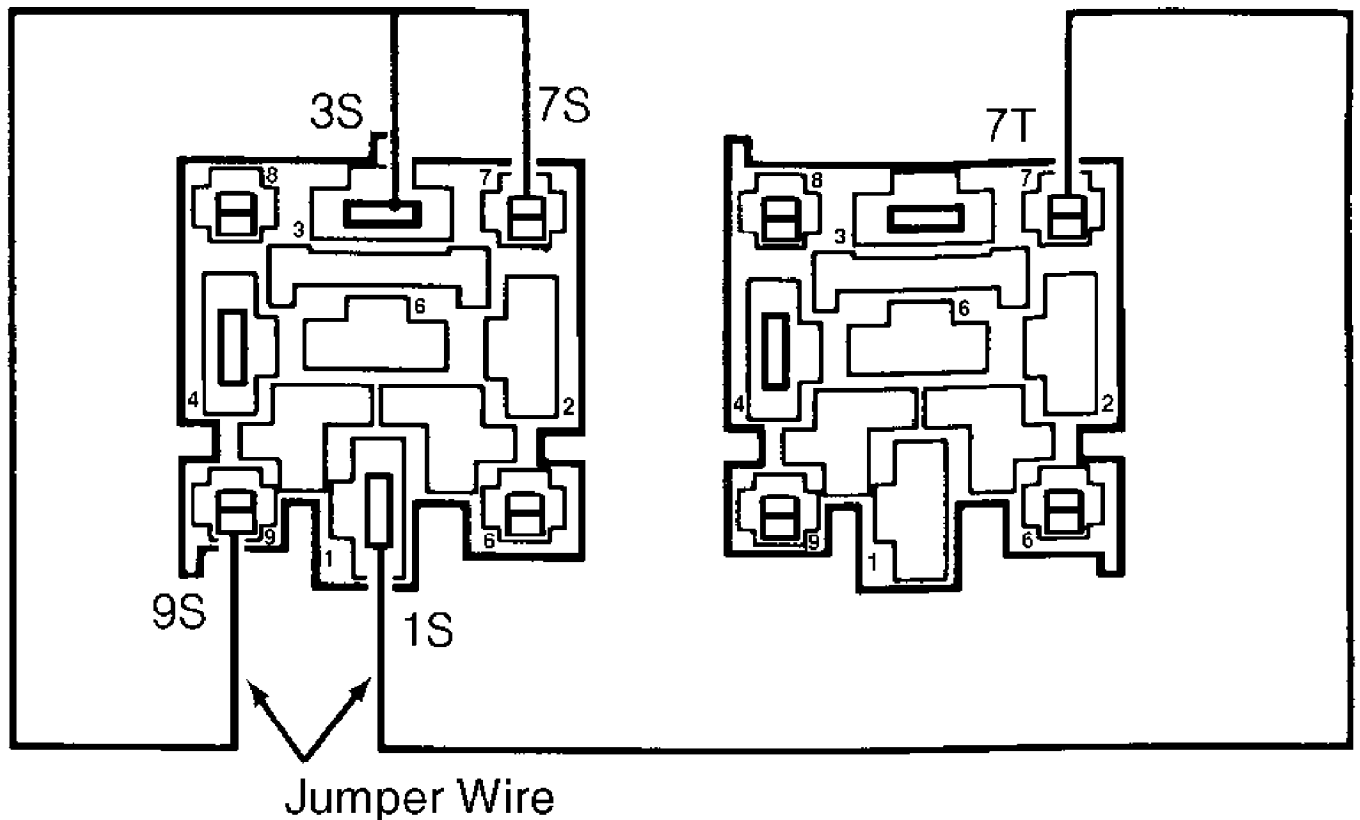
NOTE: To properly test vacuum system, it is necessary to operate vacuum motor and regulator with jumper wires from control unit base. Use care when connecting wires as an incorrect connection can destroy components.

Jumper Wire

Manufacture 2 jumper wires. One should be a single wire with one normal blade terminal at one end and a thin blade terminal at the other end. One blade terminal should be thin. Other jumper wire should be a double wire joined at one end with a normal blade terminal, while other ends should have thin blade terminals.

Starting Vacuum Pump & Regulator

1) Ensure ignition is off. Remove cruise control unit from under-hood relay/fuse block. See Fig. 3. Connect single jumper wire between cruise control unit base terminals 1S and 7T. Connect one end of other wire to terminal 3S. See Fig. 5. Turn ignition on.



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Fig. 5: Connecting Jumper Wires To Control Unit Base Terminals
Courtesy of Volvo Cars of North America.

2) Connect other end of wire connected to terminal 3S to terminal 9S. Vacuum regulator should click. Connect other wire end to terminal 7S. Vacuum motor should start while vacuum servo contracts so control cylinder is pulled up. Remove wire from terminal 7S when vacuum servo is fully contacted, stopping vacuum motor. If system does not operate as described, go to step 4). If system operates as described, go to next step.

3) Let vacuum servo remain contracted for at least 30 seconds to ensure there is no leakage in vacuum system. See Fig. 2. To release vacuum servo, remove wire from terminal 9S. Turn ignition off. If system operates as described, go to step 7). If system does not operate as described, go to next step.

4) Remove all jumper wires from control unit base. Connect voltmeter between cruise control unit base terminals 3S and 1S. If battery voltage is not present, check wiring to cruise control unit. If battery voltage is present, go to next step.

5) Ensure ignition is off. Connect ohmmeter between control unit base terminals 7T and 7S. Ohmmeter should indicate about 17 ohms (internal resistance of vacuum motor). Connect ohmmeter between control unit base terminals 7T and 9S. Ohmmeter should indicate about 100 ohms (internal resistance of regulator). If resistances are not to specification, take measurements at individual components (vacuum motor and regulator) to determine whether fault is in component or wiring. If all measurements are to specification but vacuum system still leaks, go to next step.

6) Start vacuum pump and regulator as outlined in steps 1) and 2). Stop pump so vacuum leaks can be heard. If any valves are leaking and require adjustment, see BRAKE & CLUTCH VALVES under ADJUSTMENTS.

7) If system operated as described in step 3), start vacuum pump and regulator as outlined in steps 1) and 2). Stop vacuum pump when vacuum servo is fully contracted, but keep regulator connected. Press brake pedal to release vacuum servo. If vacuum servo does not release, loosen vacuum hose connection to release servo. Replace valve.

8) Start vacuum pump again and contract vacuum servo. Press clutch pedal to release vacuum servo. If servo does not release, replace valve.

TEST FUNCTION NO. 1

Self Diagnostics

Codes stored in Test Function No. 1 should be read after a road test because cruise control self diagnostics does not store codes. Codes are erased when ignition is turned off. Road test must exceed 22 MPH, otherwise Code 1-2-2 will always be stored, indicating speed has not reached minimum speed.

NOTE: If engine is turned off after road test, Code 1-2-2 will be stored. Road test must be repeated.

Beginning Test Function No. 1

Press activation button once for about one second. Read and note code. Check if more than one code is stored by pressing activation button once more for about one second. Read and note all codes until first code is repeated. See SELF DIAGNOSTIC CODES table.

SELF DIAGNOSTIC CODES TABLE

Code	Fault
1-1-1	No Fault
1-1-2	Abnormal Speed Signal
1-2-2	Speed Below Minimum/No Signal
2-1-1	Voltage Speed/Control Unit Malfunction
2-1-2	Vacuum Pump or Regulator Circuit Malfunction

Code 1-1-2 & Code 1-2-2

1) Code 1-1-2 is stored if a safety feature has been tripped,

or an abnormal speed signal. Code is stored only if control unit has had a normal signal at some time during road test and not for stationary interruptions. Code 1-2-2 is stored when ignition is turned on. It remains until vehicle speed is greater than 22 MPH for at least 15 seconds. If code remains after a road test at speeds greater than 22 MPH, control unit is not getting a speed signal.

2) If speedometer is not operating correctly, fault is not with control unit. If speedometer does operate correctly, there is a proper input signal to instrument cluster. Go to next step and check if code for 12-pulse output signal is registered with instrument cluster, fuel and ignition systems.

3) Enter diagnostic test mode No. 1 for instrument cluster by placing selector cable in socket No. 7 of diagnostic unit "A". Check for codes. Check for fuel system codes by placing selector cable in socket No. 2 of diagnostic unit "A". Check for ignition system codes by placing selector cable in socket No. 6 of diagnostic unit "A".

4) If Code 1-3-1 for instrument cluster, Code 3-1-1 for fuel system, and Code 3-1-1 for ignition system are set, connection between instrument cluster and cruise control, fuel system, and ignition system is shorted to ground or voltage. Remove cruise control unit from underhood relay/fuse block.

5) Raise and support front of vehicle. Turn ignition on. Connect voltmeter between cruise control unit base terminal 8S and ground. Turn front wheels. If voltmeter fluctuates between 0 and 12 volts, replace control module. If voltmeter constantly indicates high (12 volts) or low (zero volts), check wiring between cruise control unit and instrument cluster.

Code 2-1-1

Code 2-1-1 is set if malfunction is detected in control unit. See Fig. 3. Replace control unit and retest system.

Code 2-1-2

Code 2-1-2 is stored if there is short circuit to ground or voltage in circuit to vacuum pump and regulator. Fault may also be in control unit. If a Code 2-1-2 fault code is present, test vacuum system before a road test. See VACUUM SYSTEM CHECK. If trouble code remains, replace control unit. See Fig. 3.

TEST FUNCTION NO. 2

Codes stored in Test Function No. 2 indicate most recent reason for cruise control disengagement. This test function can be used when cruise control disengages without driver input. Code remains in memory until ignition is turned off, or until cruise control is disconnected. These codes are not necessarily fault codes, since a code is also stored after normal disengagement. See DISENGAGEMENT CODES table.

DISENGAGEMENT CODES TABLE

Code	Disengagement Cause
1-1-4	Safety Disengagement
1-4-1	Neutral Start Switch Circuit Disengagement
4-1-1	Brake/Clutch Selector Disengagement
1-2-4	Brakelight Circuit Disengagement
2-1-4	Voltage Feed Not Connected/Disengagement

Beginning Test Function No. 2

Press diagnostic button 5 times, holding activation button down about one second each time. See Fig. 4. When LED lights up, enter

1-1-1 (one press each time LED lights). Hold activation button down about one second each time. Read response code.

Code 1-1-4 (Safety Disengagement)

Code 1-1-4 is set in event of a safety disengagement. Safety disengagement does not necessarily mean something is wrong with system. Cruise control system disengages automatically during abnormal conditions such as wheel spin, climbing a steep hill, etc. If this code is set without a normal safety disengagement, check speed signal circuit. See CODE 1-1-2 & Code 1-2-2 under TEST FUNCTION NO. 1.

Code 1-4-1 (Neutral Start Switch Circuit Disengagement)

Code 1-4-1 is set if cruise control is disengaged when transmission shift lever is set in Park or Neutral. If this code is set without shift lever in one of these positions, control unit terminal 3T was grounded at moment of disengagement. See NEUTRAL START SWITCH CIRCUIT DISENGAGEMENT (RESPONSE CODE 2-2-3) under COMPONENT TEST MODE.

Code 4-1-1 (Brake Selector Disengagement)

Code 4-1-1 is set if cruise control is disengaged by sliding selector to OFF position or depressing brake or clutch pedal. Otherwise, control unit terminal 9T did not have battery voltage at moment of disengagement. This may be caused by play in selector, loose wires and connectors, or incorrectly adjusted brake or clutch valve. See BRAKE & CLUTCH PEDAL CHECK (RESPONSE CODE 1-1-3) under COMPONENT TEST MODE.

Code 1-2-4 (Brakelight Circuit Disengagement)

Code 1-2-4 is set if cruise control is disengaged by depressing brake pedal and closing brakelight switch. Otherwise, control unit terminal 6S was not connected to ground through brakelight bulbs at moment of disengagement. Check for loose wires or connectors and an incorrectly adjusted brakelight switch. See BRAKELIGHT SWITCH CHECK (RESPONSE CODE 1-3-2) under COMPONENT TEST MODE.

Code 2-1-4 (Voltage Feed Not Connected/Disengagement)

1) Code 2-1-4 is set when ignition is turned on and remains stored until cruise control is engaged using SET one time and disengaged once. Reason for disengagement is then stored instead of Code 2-1-4.

2) If Code 2-1-4 is set after disengagement during a test drive, without engine having been turned off, voltage to control unit has fallen below minimum level.

REMOVAL & INSTALLATION

BRAKE & CLUTCH VALVE

Removal & Installation

Brake valve is located at brake pedal. Remove clip, vacuum hoses and connectors from valve. Use care not to damage rubber seals. To install, reverse removal procedure. Adjust valve. See BRAKE & CLUTCH VALVES under ADJUSTMENTS.

CRUISE CONTROL SWITCH

Removal & Installation

Turn ignition off. Remove upper and lower steering column covers. Pull off selector connector and remove 2 screws holding selector in place. To install, reverse removal procedure.

BRAKELIGHT SWITCH

Removal & Installation

Remove brakelight fuse. Remove brakelight switch connector.
 Remove brakelight switch. To install, reverse removal procedure.

WIRING DIAGRAM

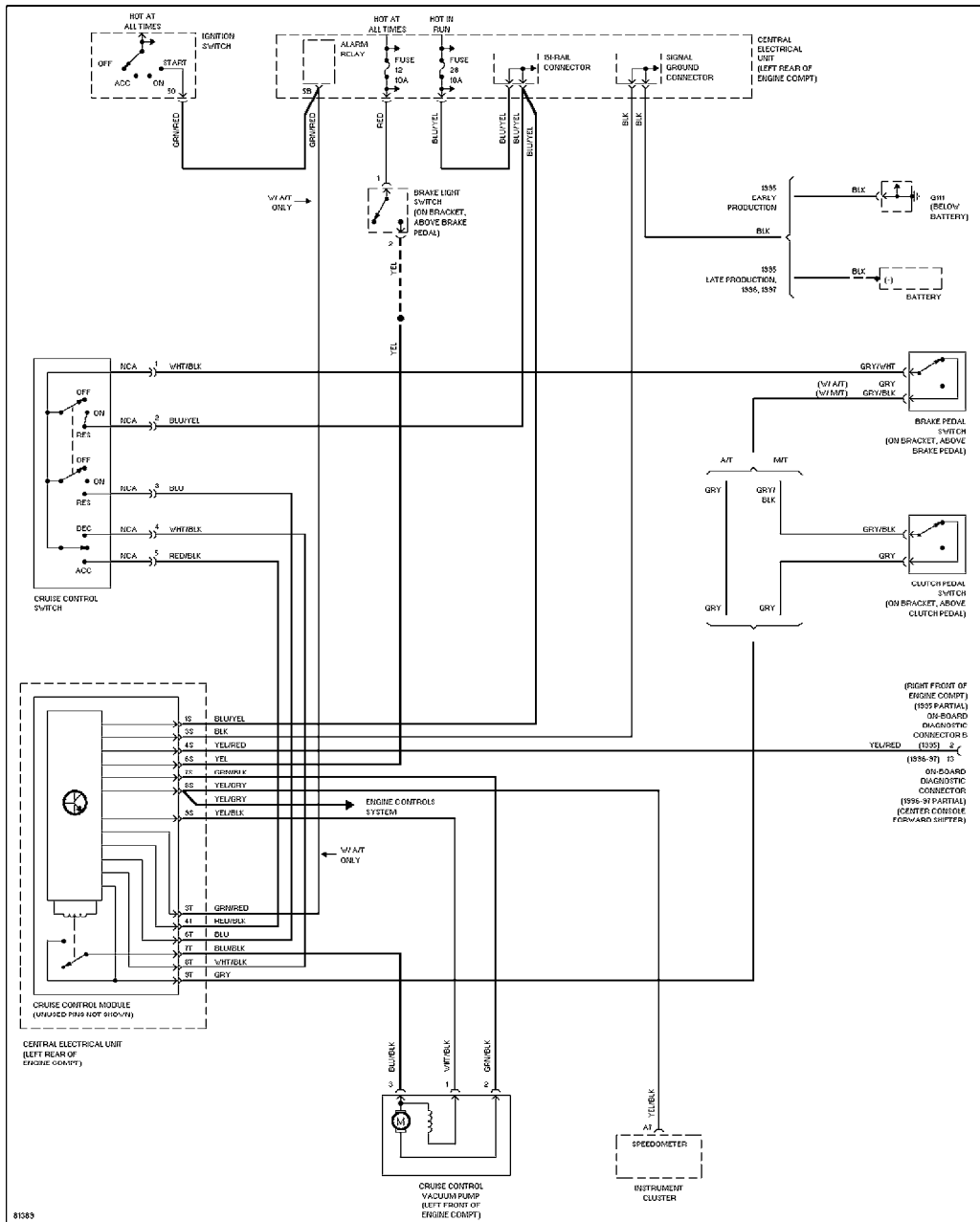


Fig. 6: Cruise Control System Wiring Diagram (1995-96)