

2004 STEERING**Variable Effort Steering - SRX****SCHEMATIC AND ROUTING DIAGRAMS****STEERING CONTROLS SCHEMATIC ICONS****Steering Controls Schematic Icons**

Icon	Icon Definition
	IMPORTANT: Twisted-pair wires provide an effective shield that helps protect sensitive electronic components from electrical interference. If the wires were covered with shielding, install new shielding. In order to prevent electrical interference from degrading the performance of the connected components, you must maintain the proper specification when making any repairs to the twisted-pair wires shown : • The wires must be twisted a minimum of 9 turns per 31 cm (12 in) as measured anywhere along the length of the wires • The outside diameter of the twisted wires must not exceed 6.0 mm (0.25 in).

STEERING CONTROLS SCHEMATICS

2004 Cadillac SRX

2004 STEERING Variable Effort Steering - SRX

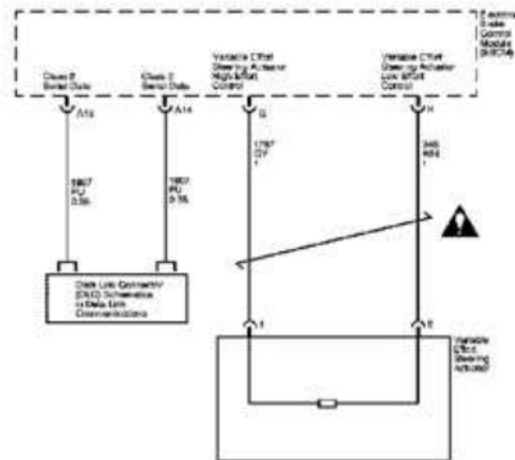


Fig. 1: Steering Controls Schematics
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

STEERING CONTROLS COMPONENT VIEWS

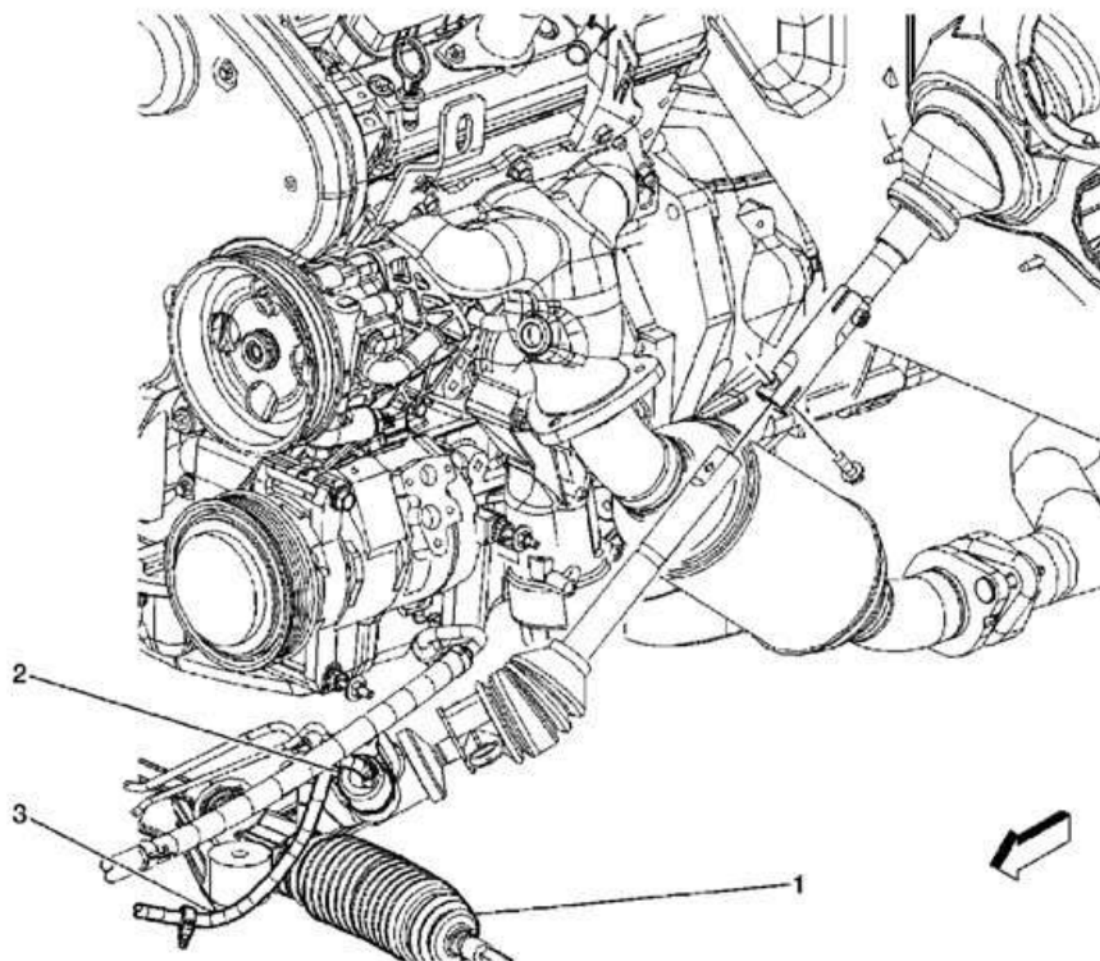


Fig. 2: Lower Left Side Of Engine Compartment Component View
 Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 2

Callout	Component Name
1	Power Steering Rack
2	Variable Effort Steering Actuator
3	Engine Harness

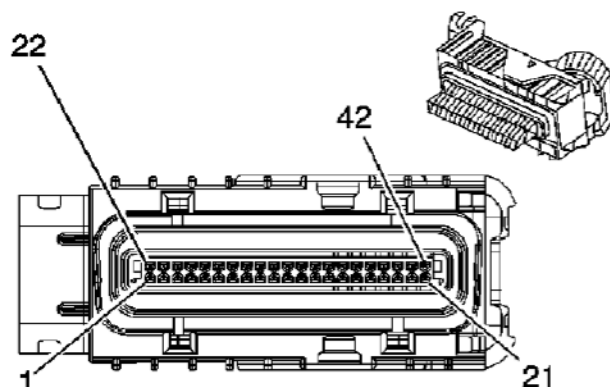
STEERING CONTROLS CONNECTOR END VIEWS

Variable Effort Steering Actuator Terminal Identification

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2004 Cadillac SRX

2004 STEERING Variable Effort Steering - SRX



Connector Part Information		• E3550 • 2-Way F (BK)	
Pin	Wire Color	Circuit No.	Function
1	GY	1787	Variable Effort Steering Actuator High Effort Control
2	WH	345	Variable Effort Steering Actuator Low Effort Control

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC STARTING POINT - VARIABLE EFFORT STEERING

Begin the system diagnosis with the **Diagnostic System Check - Variable Effort Steering**. The Diagnostic System Check will provide the following information:

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the serial data circuit
- The identification of any stored diagnostic trouble codes (DTCs) and their status

The use of the Diagnostic System Check will identify the correct procedure for diagnosing the system and where the procedure is located.

DIAGNOSTIC SYSTEM CHECK - VARIABLE EFFORT STEERING

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: The lack of communication may be caused by a partial or a total malfunction of the circuit containing the class 2 serial data. The specified procedure will determine the

2004 Cadillac SRX

2004 STEERING Variable Effort Steering - SRX

particular condition.

3: Tests for other electronic brake control module (EBCM) controlled subsystem malfunctions that may use the same inputs as the variable effort steering (VES) system.

4: The presence of DTCs which begin with "U" indicate some other module is not communicating. The specified procedure will collect all the available information before tests are performed.

5: Tests if the malfunction lies specifically in the VES system.

Diagnostic System Check - Variable Effort Steering

Step	Action	Yes	No
Schematic Reference: <u>Steering Controls Schematics</u>			
1	Install a scan tool. Does the scan tool turn ON?	Go to Step 2	Go to Scan Tool Does Not Power Up in Data Link Communications
2	1. Turn ON the ignition, with the engine OFF. 2. Attempt to establish communication with the EBCM. Does the scan tool communicate with the EBCM?	Go to Step 3	Go to Scan Tool Does Not Communicate with Class 2 Device in Data Link Communications
3	Select the ABS Diagnostic Trouble Codes function on the scan tool. Does the scan tool display any DRP/ABS/TCS or VSES DTCs?	Go to Diagnostic System Check - ABS in Antilock Brake System	Go to Step 4
4	Does the scan tool display any DTCs which begin with a "U"?	Go to Diagnostic Trouble Code (DTC) List in Data Link Communications	Go to Step 5
5	Does the scan tool display "DTC C0450?"	Go to Diagnostic Trouble Code (DTC) List	System OK

SCAN TOOL OUTPUT CONTROLS**Scan Tool Output Controls**

Scan Tool Output Control	Additional Menu Selections	Description
		The Electronic Brake Control Module (EBCM)

2004 Cadillac SRX

2004 STEERING Variable Effort Steering - SRX

Scan Tool Input Control	Additional Menu Selections	Description
		can be commanded using the scan tool to perform a self-test varying steering effort from more firm, to less firm, to more firm, then back to normal.

SCAN TOOL DATA LIST**Scan Tool Data List**

Scan Tool Parameter	Data List	Units Displayed	Typical Data Value
Ignition ON/ engine ON/ no vehicle speed present.			
ABS Reference Speed	VES Data	mph	0
LF Wheel Speed	VES Data	mph	0
LR Wheel Speed	VES Data	mph	0
RF Wheel Speed	VES Data	mph	0
RR Wheel Speed	VES Data	mph	0
Ignition Voltage	VES Data	Volts	13.25
Switched System Battery Voltage	VES Data	Volts	13.25
VES Failed	VES Data	Yes/No	No
VES Indicator Message	VES Data	On/Off	Off
VES Commanded Current	VES Data	amps	0.90 or 1.00
VES Feedback Current	VES Data	amps	0.90 or 1.00

SCAN TOOL DATA DEFINITIONS**ABS Reference Speed**

The scan tool displays 0-255 km/h (0-159 mph). The average speed of all four wheel speed sensors.

Ignition Voltage

The scan tool displays 0-17 volts. The amount of ignition voltage available at the Electronic Brake Control Module (EBCM).

LF Wheel Speed

The scan tool displays 0-255 km/h (0-159 mph). The actual speed of the left front wheel.

LR Wheel Speed

The scan tool displays 0-255 km/h (0-159 mph). The actual speed of the left rear wheel.

RF Wheel Speed

The scan tool displays 0-255 km/h (0-159 mph). The actual speed of the right front wheel.

RR Wheel Speed

The scan tool displays 0-255 km/h (0-159 mph). The actual speed of the right rear wheel.

Switched System Battery Voltage

The scan tool displays 0-17 volts. The amount of voltage available to the VES actuator when the ABS relay is activated.

VES Commanded Current

The scan tool displays 0-1 amp. The amount of current the EBCM is commanding to the VES actuator.

VES Failed

The scan tool displays Yes or No. Yes indicates a malfunction has been detected within the VES system. No indicates the VES system is operating to specification.

VES Feedback Current

The scan tool displays 0-1 amp. The amount of current returning to the EBCM from the VES actuator.

VES Indicator/Message

The scan tool displays On or Off. Indicates the status of the VES system DIC warning message.

DIAGNOSTIC TROUBLE CODE (DTC) LIST**Diagnostic Trouble Code (DTC) List**

DTC	Diagnostic Procedure	Module(s)
C0450	<u>DTC C0450</u>	EBCM

DTC C0450**Circuit Description**

The electronic brake control module (EBCM) commands current from 0-1 amp to the VES

actuator, depending on vehicle speed. At low speeds, 1 amp of current is commanded to the actuator and the actuator valve is fully closed. As speed increases, less current is commanded to the actuator and the valve opens, allowing pressure to bleed off through a power steering fluid orifice. The EBCM monitors and compares the Commanded and Feedback Current parameters to detect malfunctions in the VES system.

Conditions for Running the DTC

- Ignition voltage between 10.5-17.0 volts
- Off state test - Initial ignition ON, no engine RPM or vehicle speed present.
- On state test - If off state test passes, engine RPM and vehicle speed present.

Conditions for Setting the DTC

An open, short to ground or short to voltage in the VES actuator or the circuits to the actuator.

Action Taken When the DTC Sets

- A DTC C0450 is stored in memory.
- The DIC displays the SERVICE STEERING SYSTEM warning message.
- The VES system is disabled for the remainder of the ignition cycle.

Conditions for Clearing the DTC

- A current DTC will clear when the malfunction is no longer present.
- A history DTC will clear after 100 consecutive ignition cycles with the malfunction no longer present.
- Using a scan tool.

Diagnostic Aids

The vehicle may need to be driven to view full VES Commanded and Feedback Data parameters

Test Description

The numbers below refer to the step numbers on the diagnostic table.

- 2: Tests if the Commanded and Feedback Current parameters are within specification in their active state.
- 3: Perform the VES test located under Special Functions. This test may indicate if the VES actuator is mechanically bound.
- 4: Tests if the resistance of the VES actuator is within specification.
- 7: Tests the control circuit of the VES actuator for a short to ground.

2004 Cadillac SRX

2004 STEERING Variable Effort Steering - SRX

13: Perform the setup procedure after EBCM replacement.

DTC C0450

Step	Action	Values	Yes	No
Schematic Reference: Steering Controls Schematics Connector End View Reference: Steering Controls Connector End Views				
1	Did you perform the Variable Effort Steering Diagnostic System Check?	-	Go to Step 2	Go to <u>Diagnostic System Check - Variable Effort Steering</u>
2	1. Install a scan tool. 2. Start the engine. 3. With a scan tool, observe the VES Commanded Current and VES Feedback Current Data parameters in the VES data list for the EBCM. Does the scan tool display the VES Commanded and Feedback Current Data parameters are within 0.03 amps of each other and within specified range?	0.90 to 1.00 amps	Go to Step 3	Go to Step 4
3	Using the scan tool, select F1 VES Test. Does the scan tool indicate, Test Passed?	-	Go to <u>Testing for Intermittent Conditions and Poor Connections</u> in Wiring Systems	Go to Step 4
4	1. Turn OFF the ignition. 2. Disconnect the VES actuator harness connector. 3. Measure the resistance of the VES actuator. Does the resistance measure within	5.0ohm to 10.0ohm		Go to Step

2004 Cadillac SRX

2004 STEERING Variable Effort Steering - SRX

	specified range?		Go to Step 12	
3	Test the VES actuator and actuator harness for a short to ground. Refer to Testing for Short to Ground and to Wiring Repairs in Wiring Systems. Was a short to ground located?	-	Go to Step 6	Go to Step 12
5	Test the control circuit of the VES actuator for a short to ground. Refer to Testing for Short to Ground and to Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 15	Go to Step 8
6	Visually inspect the actuator harness for any cut, chaffed or damaged wires. Did you find and correct the condition?	-	Go to Step 15	Go to Step 14
7	Test the control circuit of the VES actuator for an open or short to voltage. Refer to Circuit Testing and to Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 15	Go to Step 9
8	Test the return circuit of the VES actuator for a short to ground. Refer to Testing for Short to Ground and to Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 15	Go to Step 10
9	Test the return circuit of the VES actuator for an open or a short to voltage. Refer to Circuit Testing and to Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 15	Go to Step 11
10	Inspect for poor connections at the harness connector of the EBCM. Refer to Testing for Intermittent Conditions and Poor Connections and to Connector Repairs in Wiring Systems. Did you find and correct the	-	Go to Step 15	Go to Step 11
11				Go to Step

2004 Cadillac SRX

2004 STEERING Variable Effort Steering - SRX

	Test the return circuit of the VES actuator for an open or short to voltage.		Go to Step 15	Go to Step 11
12	harness connector of the VES actuator. Refer to Testing for Intermittent Conditions and Poor Connections and to Connector Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to Step 15	Go to Step 14
13	IMPORTANT: Always perform the setup procedure for the EBCM. 1. Replace the EBCM. Refer to Electronic Brake Control Module Replacement in Antilock Brake System. 2. Perform the setup procedure for the EBCM. Did you complete the replacement?	-	Go to Step 15	-
14	Replace the VES actuator. Refer to Power Steering Gear Replacement in Power Steering System. Did you complete the replacement?	-	Go to Step 15	-
15	1. Use the scan tool in order to clear the DTCs. 2. Operate the vehicle within the Conditions for Running the DTC. Does the DTC reset?	-	Go to Step 2	System OK

DESCRIPTION AND OPERATION

VARIABLE EFFORT STEERING SYSTEM DESCRIPTION AND OPERATION

The Variable Effort Steering (VES) System varies the amount of effort to steer the vehicle as wheel speed changes or lateral acceleration occurs. The electronic brake control module (EBCM) controls an actuator located in the steering rack and pinion. The actuator consists of an electromagnetic coil and a normally open pintle valve. The valve regulates an orifice that bleeds inlet pressure through a return passage to regulate the amount of pressure available for steering assist. The EBCM commands current from 0-1 amp to the VES actuator which varies

2004 Cadillac SRX

2004 STEERING Variable Effort Steering - SRX

the amount of effort required to steer the vehicle. At low speeds, 1 amp of current is commanded to the VES actuator and the pintle valve is fully closed which provides maximum pressure and maximum steering assist for easy turning and parking maneuvers. As speed increases, current is decreased and the pintle valve opens the orifice, decreasing available pressure providing firmer steering (road feel) and directional stability. The VES system uses the steering wheel position sensor input to calculate lateral acceleration during abrupt driving maneuvers. The system also uses the antilock brake system (ABS) wheel speed sensor inputs to determine vehicle speed. The EBCM is constantly monitoring these inputs to achieve the desired current to the VES actuator. The EBCM has the ability to detect malfunctions in the VES actuator or the circuits to the actuator. Any malfunctions detected will cause the VES outputs to be disabled, and the actuator will return to an open state. The EBCM will command the driver information center (DIC) to display the SERVICE STEERING SYSTEM warning message via a class 2 serial data circuit.