

## **DTC C0455**

### **Circuit Description**

The steering wheel position sensor (SWPS) provides one analog signal and 3 digital signals. The digital signals, Phase A, Phase B and marker pulse, are direct inputs to the rear wheel steering control module. The analog signal is input to the body control module (BCM) and is sent via a class 2 message to the rear wheel steering control module. Battery voltage is supplied to the sensor from the cruise fuse to operate the digital portion of the sensor.

A 12-volt reference is provided by the rear wheel steering control module to the Phase A, Phase B, and marker pulse circuits of the SWPS. The module monitors each circuit as it is either remains high or is pulled low by the SWPS.

The scan tool displays the Phase A and Phase B data parameters as either HIGH or LOW when the steering wheel is being rotated. Each change from HIGH to LOW, or LOW to HIGH, represents one degree of steering wheel rotation. When observing the Phase A and Phase B data with the scan tool, the parameters will not always display the same value at the same time.

The marker pulse is a digital pulse signal that is displayed as HIGH by the scan tool with the steering wheel angle between +10 degrees and -10 degrees. At greater than 10 degrees steering wheel angle in either direction, the marker pulse data will be displayed as LOW.

The BCM provides the 5-volt reference and low reference for the analog portion of the SWPS. The BCM reads the SWPS analog signal in voltage, which is typically 2.5 volts with the steering wheel on center. The voltage ranges from 0.25 volts at approximately 1 full turn left to 4.75 volts at approximately 1 full turn right. The voltage will then remain at that level for the remainder of steering wheel travel. This voltage can be monitored in BCM data display.

The rear wheel steering control module receives the analog signal via a class 2 message from the BCM. When monitoring the rear wheel steering data, this information is displayed in the Steering Wheel Angle (TBC) Data parameter, and is shown in degrees. The range of the display is +/- 225 degrees, with negative numbers representing steering input to the left, and positive numbers representing input to the right.

### **DTC Descriptor**

This diagnostic procedure supports the following DTC:

DTC C0455 Front Steering Position Sensor Circuit

### **Conditions for running the DTC**

Turn ON the ignition, with engine ON.

### **Conditions for Setting the DTC**

- A condition that sets a BCM DTC C0472 or C0473 is present.
- The marker pulse signal was low at less than +/-10 degrees of steering wheel angle and the steering wheel angle has changed more than 30 degrees.
- The marker pulse signal was high at greater than +/-10 degrees of steering wheel angle and the steering wheel angle has changed more than 30 degrees.
- No change in Phase A or Phase B signals and the steering wheel angle has changed more than 30 degrees.
- The SWPS Phase A, Phase B, or marker pulse circuits have an open, short to ground, or short to battery voltage.

#### Action Taken When the DTC Sets

- The Service 4-Wheel Steer indicator in instrument panel cluster (IPC) will be displayed.
- The code is displayed on the scan tool as DTC C0455.
- The output to the motor is ramped down slowly, at a rate of 2 degrees per second to 0 degrees and held.
- The rear wheels will be returned to the centered position.
- The internal power relay of the rear wheel steering control module is turned OFF, which in turn shuts down the 12-volt reference to the SWPS. This results in all digital signals being displayed as low by the scan tool. Battery voltage and hall sensor reference voltage will also display low voltage. This occurs only when the DTC is current.

#### Conditions for Clearing the DTC

- Conditions for DTC are not currently present.
- The module receives a clear code command from the scan tool.
- The DTC clears after 100 malfunction free ignition cycles.

#### Diagnostic Aids

- **IMPORTANT: When the DTC is current, the internal power relay of the rear wheel steering control module is turned OFF, which in turn shuts down the 12-volt reference to the SWPS. This results in all digital signals being displayed as low by the scan tool. Battery voltage and hall sensor reference voltage will also display low voltage. Cycling the ignition will cause the DTC to become a history code. When the DTC is a history code, the power relay is ON with ignition ON, and the 12-volt reference is supplied to the SWPS. During diagnosis, any steps that require monitoring data must be performed when the code is not current. Monitoring data while the DTC is current will result in inaccurate data being displayed, and misdiagnosis will result.**

The following conditions are possible causes:

- A class 2 communication problem with the TBC
- The steering wheel was rotated with the steering gear disconnected.
- A malfunctioning steering wheel position sensor is present.
- A steering wheel position sensor circuit is open.
- A steering wheel position sensor circuit was shorted.

Perform an inspection of the wiring and of the connectors. Failure to carefully inspect the wiring and the connectors may result in misdiagnosis. Misdiagnosis causes part replacement with reappearance of the malfunction.

### Steering Wheel Position Sensor - Digital Signal

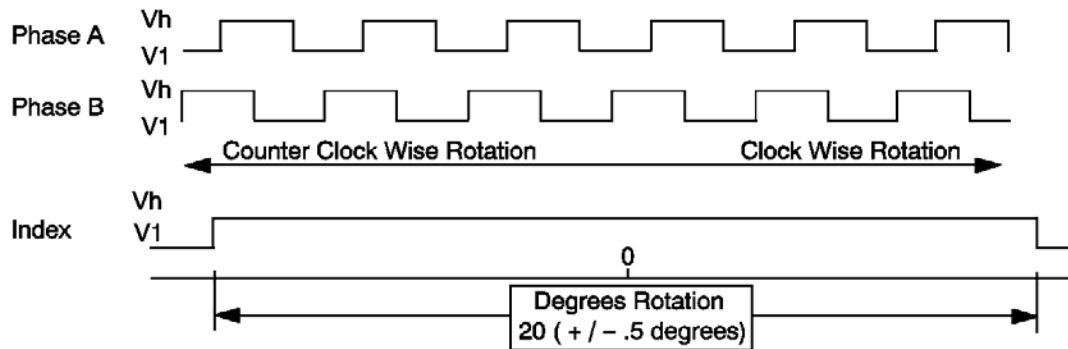
- 3 outputs used (Phase A, Phase B, Index Pulse)
- Phase A & Phase B

Offset pulse width modulator (PWM) wave forms created when turning the wheel

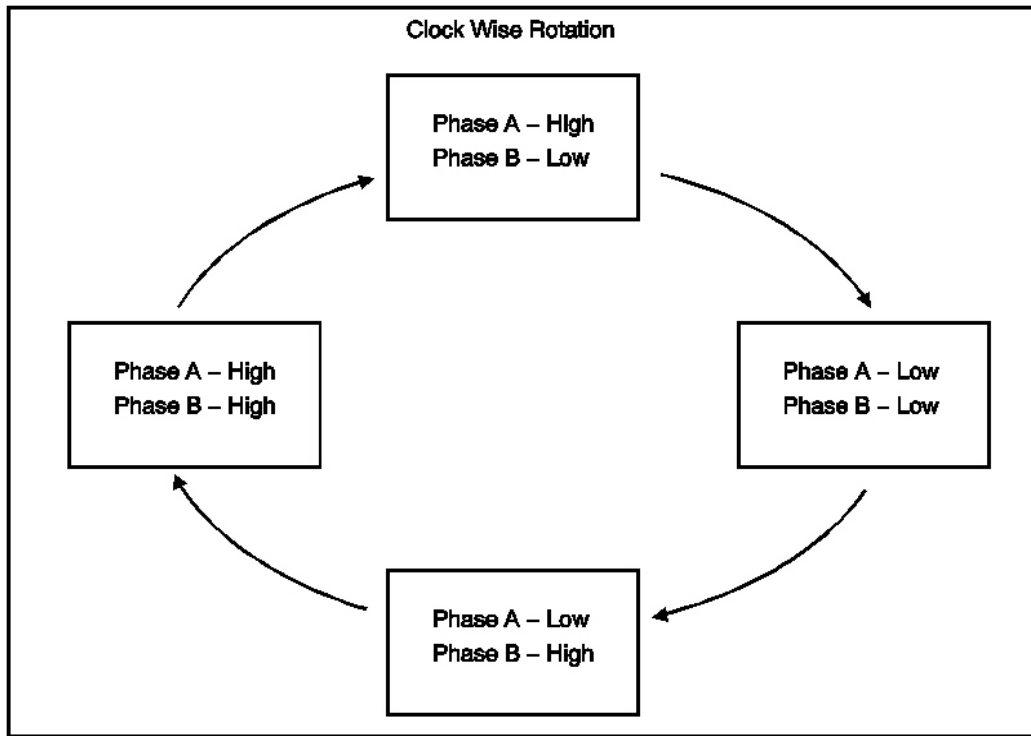
- Index pulse

Signal is present only when steering wheel is within 10 degrees either side of center.

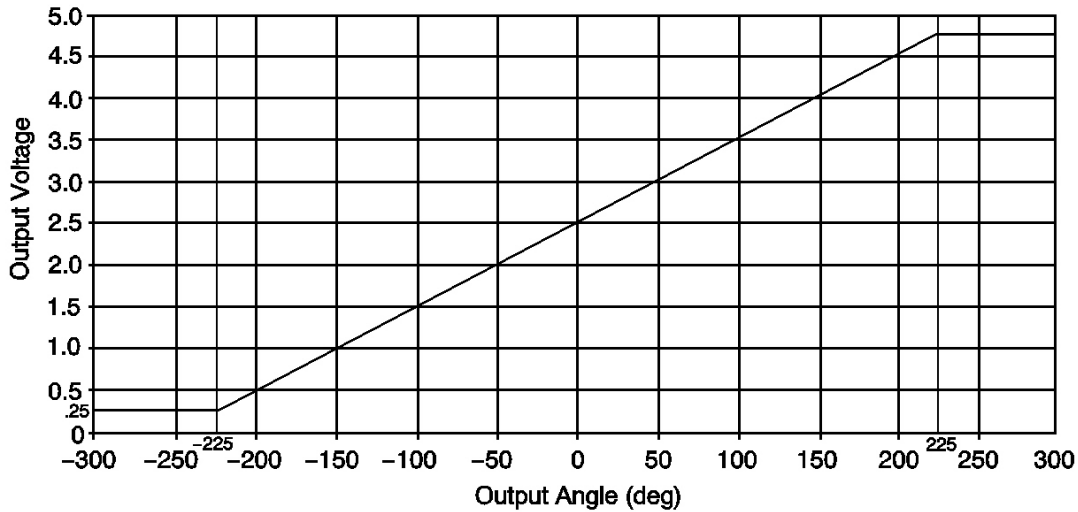
Output is used to determine Direction of Rotation and Rate of Rotation



**Fig. 11: Steering Wheel Position Sensor - Digital Signal**  
Courtesy of GENERAL MOTORS CORP.



**Fig. 12: Steering Wheel Position Sensor - A and B Phase**  
 Courtesy of GENERAL MOTORS CORP.



**Fig. 13: Steering Wheel Position Sensor - Analog Signal**  
 Courtesy of GENERAL MOTORS CORP.

## Test Description

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

**3:** This step will help determine if the fault is in the analog or the digital portion of the SWPS.

**4:** This step determines if the condition is currently present.

**6:** This step will help determine if a short to voltage exists in any of the digital circuits. A short to voltage in any of these circuits will cause all parameters to remain high.

**14:** This step checks for proper voltage to the phase A and Phase B circuits at the sensor and for proper operation of the sensor.

**15:** This step checks for proper voltage to the marker pulse circuit of the sensor and for proper operation of the sensor.

**17:** This step checks for proper operation of the sensor circuits by testing the sensors ability to switch a voltage signal between high and low.

## DTC C0455

Step	Action	Values	Yes	No
<b>Schematic Reference: <u>Rear Wheel Steering Schematics</u></b> <b>Connector End View Reference: <u>Rear Wheel Steering Connector End Views</u></b>				
1	Did you perform the Diagnostic System Check - Vehicle?	-	Go to <b>Step 2</b>	Go to <b><u>Diagnostic System Check - Vehicle</u></b> in Vehicle DTC Information
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. With the scan tool, monitor the DTC information in the Rear Wheel Steering Control module.  Does the information indicate the DTC C0455 is current?	-	Go to <b>Step 3</b>	Go to <b>Step 4</b>
3	With the scan tool, monitor the DTC information in the body control module (BCM). Does the information indicate a DTC C0472 or C0473 is present?	-	Go to <b><u>DTC C0472 or C0473</u></b>	Go to <b>Step 4</b>
4	1. Center the steering wheel. 2. Turn OFF the ignition. 3. Wait 10 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Rotate the steering wheel 90 degrees left and right. 6. Monitor the DTC information in the rear wheel steering control module.  Does the DTC C0455 become current?	-	Go to <b>Step 5</b>	Go to Diagnostic Aids

5	<p><b>IMPORTANT:</b> Rotating the steering wheel in excess of 30 degrees from center in either direction will result in DTC C0455 becoming current. This will result in inaccurate data being displayed and will cause misdiagnosis. If this occurs, you must repeat steps 1 through 4 of the following procedure before monitoring the data parameters.</p> <ol style="list-style-type: none"> <li>1. Center the steering wheel.</li> <li>2. Turn OFF the ignition.</li> <li>3. Wait 10 seconds.</li> <li>4. Turn ON the ignition, with the engine OFF.</li> <li>5. Observe the steering wheel angle in the rear wheel steering data list.</li> <li>6. Move the steering wheel slowly back and forth over center.</li> </ol> <p>Does the steering wheel angle value change?</p>	-	Go to <b>Step 13</b>	Go to <b>Step 6</b>
6	<p><b>IMPORTANT:</b> If DTC C0455 becomes current during this step, you must repeat steps 1 through 4 of Step 5 before monitoring the data parameters.</p> <p>Using the scan tool, monitor the Phase A, Phase B, and Marker Pulse Data parameters. Do all parameters remain HIGH at all times with steering input?</p>	-	Go to <b>Step 8</b>	Go to <b>Step 7</b>
7	<p><b>IMPORTANT:</b> If DTC C0455 becomes current during this step, you must repeat steps 1 through 4 of Step 5 before monitoring the data parameters.</p> <p>Using the scan tool, monitor the Phase A and Phase B Data parameters. Does the Phase A or Phase B parameter remain HIGH at all times with steering input?</p>	-	Go to <b>Step 11</b>	Go to <b>Step 12</b>
8	<p>Test the battery positive voltage circuit of the steering wheel position sensor (SWPS) for an open or short to ground. Refer to <b>Circuit Testing</b> and <b>Wiring Repairs</b> in Wiring Systems. Did you find and correct the condition?</p>	-	Go to <b>Step 22</b>	Go to <b>Step 9</b>
9	<p>Test the ground circuit of the SWPS for an open or high resistance. Refer to <b>Circuit Testing</b> and <b>Wiring Repairs</b> in Wiring Systems. Did you find and correct the condition?</p>	-	Go to <b>Step 22</b>	Go to <b>Step 10</b>

10	Test the Phase A, Phase B, and marker pulse circuits for a short to voltage. Refer to <b><u>Circuit Testing</u></b> and <b><u>Wiring Repairs</u></b> in Wiring Systems. Did you find and correct the condition?	-	Go to <b>Step 22</b>	Go to <b>Step 14</b>
11	Test the Phase A or Phase B circuit for an open circuit. Refer to <b><u>Circuit Testing</u></b> and <b><u>Wiring Repairs</u></b> in Wiring Systems. Did you find and correct a condition?	-	Go to <b>Step 22</b>	Go to <b>Step 14</b>
12	Test the Phase A or Phase B circuit for a short to ground. Refer to <b><u>Circuit Testing</u></b> and <b><u>Wiring Repairs</u></b> in Wiring Systems. Did you find and correct the condition?	-	Go to <b>Step 22</b>	Go to <b>Step 14</b>
13	Test the marker pulse circuit for an open or short to ground. Refer to <b><u>Circuit Testing</u></b> and <b><u>Wiring Repairs</u></b> in Wiring Systems. Did you find and correct the condition?	-	Go to <b>Step 22</b>	Go to <b>Step 15</b>
14	<b>IMPORTANT:</b> If DTC C0455 becomes current during this step, you must repeat steps 1 through 4 of Step 5 before performing the following test.  With the ignition ON, use a DVOM to measure the voltage of the Phase A and Phase B circuits by back probing the circuits at the SWPS while slowly rotating the steering wheel back and forth over center. Does the voltage switch in the range specified?	0.080-0.180 V to 10.5-12.0 V	Go to <b>Step 19</b>	Go to <b>Step 16</b>
15	<b>IMPORTANT:</b> If DTC C0455 becomes current during this step, you must repeat steps 1 through 4 of Step 5 before performing the following test.  With the ignition ON, use a DVOM to measure the voltage of the marker pulse circuit by back probing the circuit at the SWPS while rotating the steering wheel from center to more than 10 degrees but less than 30 degrees. Does the voltage change from high on center to low at greater than 10 degrees rotation?	10.5-12.0 V to 0.080-0.180 V	Go to <b>Step 19</b>	Go to <b>Step 16</b>
16	Does the voltage of a circuit tested in a previous step remain high at all times?	-	Go to <b>Step 18</b>	Go to <b>Step 17</b>

17	<ol style="list-style-type: none"> <li>1. Connect a DVOM positive lead to battery voltage.</li> <li>2. Connect the DVOM negative lead to the circuit that remained low in the preceding step by back probing the circuit at the SWPS.</li> <li>3. Move the steering wheel slowly back and forth over center.</li> </ol> <p>Does the voltage switch between high and low?</p>	-	Go to <b>Step 19</b>	Go to <b>Step 18</b>
18	<p>Inspect for poor connections at the SWPS. Refer to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> and <b><u>Connector Repairs</u></b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	-	Go to <b>Step 22</b>	Go to <b>Step 20</b>
19	<p>Inspect for poor connections at the rear wheel steering control module. Refer to <b><u>Testing for Intermittent Conditions and Poor Connections</u></b> and <b><u>Connector Repairs</u></b> in Wiring Systems.</p> <p>Did you find and correct the condition?</p>	-	Go to <b>Step 22</b>	Go to <b>Step 21</b>
20	<p><b>IMPORTANT:</b></p> <p><b>Perform the learn alignment procedure. Refer to <u>Measuring Wheel Alignment (w/Rear Wheel Steering)</u> or <u>Measuring Wheel Alignment (w/o Rear Wheel Steering)</u> in Wheel Alignment.</b></p> <p>Replace the SWPS. Refer to <b><u>Steering Wheel Position Sensor or Steering Shaft Lower Bearing Replacement</u></b> in Steering Wheel and Column. Did you complete the replacement?</p>	-	Go to <b>Step 22</b>	-
21	<p>Replace the rear wheel steering control module. Refer to <b><u>Control Module References</u></b> in Computer/Integrating Systems for replacement, setup, and programming.</p> <p>Did you complete the replacement?</p>	-	Go to <b>Step 22</b>	-
22	<ol style="list-style-type: none"> <li>1. Use the scan tool to clear DTCs.</li> <li>2. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text.</li> </ol> <p>Does the DTC reset?</p>	-	Go to <b>Step 2</b>	System OK