

# DESCRIPTION AND OPERATION

## REAR WHEEL STEERING DESCRIPTION AND OPERATION

Quadrasteer™ is a 4-wheel steering system that dramatically enhances low speed maneuverability, high speed stability, and towing capability. The system is an electrically powered rear wheel steering system comprised of the following components:

- A steerable, solid rear axle
- A heavy duty wiring harness and fuse
- A programmable control module
- A power relay in the control module
- A rack and pinion style steering actuator mounted on the rear differential cover
- An electric motor assembly on top of the rear steering actuator
- Three hall effect switches in the motor assembly
- A shorting relay in the motor assembly
- A rear wheel position sensor located under a cover on the bottom of the actuator, below the motor assembly
- A steering wheel position sensor located at the base of the steering column
- A mode select switch on the dash

The rear wheel steering control module has these inputs:

- Battery voltage
- Switched battery voltage
- Class 2 serial data
- Steering wheel position sensor analog signal, via class 2 message from the body control module (BCM)
- Steering wheel position sensor phase A
- Steering wheel position sensor phase B
- Steering wheel position sensor marker pulse
- Rear wheel position sensor position 1
- Rear wheel position sensor position 2
- Rear wheel steering motor hall sensor hall A
- Rear wheel steering motor hall sensor hall B
- Rear wheel steering motor hall sensor hall C
- Vehicle speed signal from the instrument panel cluster (IPC)
- Rear wheel steering mode switch signal

The rear wheel steering control module has these outputs:

- Rear wheel steering module class 2 serial data
- Rear wheel steering motor phase A control
- Rear wheel steering motor phase B control
- Rear wheel steering motor phase C control
- Rear wheel steering motor shorting relay voltage
- Rear wheel steering mode select switch supply voltage
- 2-wheel steer mode indicator control
- 4-wheel steer mode indicator control
- 4-wheel steer tow mode indicator control
- Rear wheel position sensor 5-volt reference
- Rear wheel steering motor hall sensor 12-volt reference
- Steering wheel position sensor phase A, phase B, and marker pulse 12-volt reference

Separate connectors to the rear wheel steering control module are provided for the following 4 capacities:

- Vehicle battery power
- The vehicle class 2, steering wheel position, mode select switch, speed sensor signals
- The motor phase power leads
- The motor hall sensors, shorting relay, and rear wheel position sensor signals

**IMPORTANT:**

- **Beginning with the 2003 model year, the rear wheel steering control module supports flash programming.**
- **Beginning with the 2004 model year, the combination yaw rate/lateral accelerometer sensor has been removed.**

The system operates in 3 principal modes, as follows:

### **2-Wheel Steer Mode:**

Normal steering operation-The rear wheels held in a centered position and rear wheel steering is disabled while in this mode.

### **4-Wheel Steer Mode:**

The 4-wheel steering mode provides 3 principal phases of steering: negative phase, neutral phase, and positive phase. Negative phase occurs at low speeds and the rear wheels turn opposite of the front wheels. In the neutral phase, the rear wheels are centered and do not turn. Positive phase occurs at higher speeds and the rear wheels turn in the same direction as the front wheels.

NOTE : There is a cross-over speed. This is the speed at which the control module transitions from negative phase steering to positive phase steering. In 4-wheel steer mode, this transition occurs when the vehicle obtains a speed of 65 km/h (40 mph).

### **4-Wheel Steer Tow Mode**

The 4-wheel steer tow mode provides more positive phase steering than the normal 4-wheel steering at high speed. During low speed driving, the 4-wheel steer tow mode provides similar negative phase steering as it does in the normal 4-wheel steering mode.

The cross over speed in the 4-wheel steer tow mode occurs at 40 km/h (25 mph).

## Rear-Wheel-Steering-Control-Module

The rear wheel steering control module controls all functions of the rear wheel steering system. The module has a dedicated power feed line from an under hood fuse holder, via a 125-amp mega fuse. The module is located in the rear of the vehicle on the underbody. The module uses the inputs listed above to determine when and how far to turn the rear wheels. The module uses the hall switches in the motor assembly, a shorting relay, and a motor control relay to monitor and control the direction and speed of the motor. The module also controls the duty cycle of the phase leads to the motor. The motor control relay is part of the rear wheel steering control module and is not serviceable. The module uses both a class 2 and a discrete vehicle speed signal. The 2 vehicle speed signals are used for comparison purposes. The system will not function without a discrete vehicle speed sensor signal. The module uses digital inputs from the steering wheel position sensor to determine steering wheel position and rate of change. The body control module (BCM) sends a class 2 message for the analog portion of the signal from the steering wheel position sensor. The rear wheel position sensor signals provide the module with rear wheel position data. The module will send out a class 2 message to the instrument panel cluster (IPC) to turn ON and OFF the Service 4 Wheel Steering message. The rear wheel steering control module also controls the ground circuits for the mode indicator lamps in the mode select switch.

The control module allows the vehicle rear wheels to turn a maximum of 12 degrees left or right. When the vehicle is operated in reverse, the maximum rear wheel steering angle is 5 degrees left or right. When the vehicle is sitting still in the test mode the system will move a maximum of 5 degrees left or right.

**IMPORTANT: The rear wheel steering control module may shut down if the system is operated under very extreme conditions and becomes overheated. The Service 4 Wheel Steering message will not be displayed. Once the temperature decreases back to operating range, the rear wheel steering system will resume normal operation upon the next ignition cycle.**

## Rear Wheel Steering Mode Switch

The mode switch located in the instrument panel allows the driver the option of selecting 2-wheel steering, 4-wheel steering, or 4-wheel steering tow modes of operation. The mode switch has indicators that show which mode the rear wheel steering system is in. When all indicators are lit the rear wheel steering control module has lost its memory settings and the scan tool must be used to re-calibrate the rear wheel steering control module. During a mode change, the indicator for the selected mode will flash until the mode change is complete. The rear wheel steering control module will wait for the steering wheel to pass the center position before entering the selected mode. The indicators on the mode switch are LEDs, the switch is also back lit.

## Rear Wheel Steering Motor Assembly

The rear wheel steering motor assembly is a 3 phase, 6 pole, brushless DC motor. The motor assembly is located on the top of the rear steering actuator, and transmits its power through a planetary gear set inside the actuator. There are 3 hall switches inside the assembly: hall A, hall B, and hall C. The rear wheel steering control modules uses the hall switch inputs to monitor the position, speed and direction of the motor. There is a motor phase shorting relay located inside the motor assembly. The hall switches and shorting relay are part of the motor assembly and cannot be serviced separately. The motor leads are not to be repaired or spliced in any fashion. If there is damage to the motor wiring, the motor assembly must be replaced, as any damage to the wiring could permit water intrusion into the actuator. The motor assembly can be serviced separately from the actuator.

## Steering Wheel Position Sensor

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 one full turn left to 4.75 volts at approximately one 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.

The sensor may also be utilized by other optional systems.

## **Rear Wheel Position Sensor**

The rear wheel position sensor has 2 signal circuits: position 1 and position 2. Position 1 is a linear measurement of voltage per degree. The voltage range for position 1 is from 0.25-4.75 volts, and the angular measurement range is from -620 degrees to +620 degrees. At 0.25 volts the steering wheel has been rotated -600 degrees past center. At 4.75 volts the steering wheel has been rotated +600 degrees past center. Position 2 circuit is a linear measurement of voltage per degree. The voltage for position 2 increases or decreases from 0.25-4.75 volts every 180 degrees. When the steering wheel is 0 degrees center, position 1 and position 2 output signals measure 2.5 volts respectively.

## **Steerable Rear Axle**

The steerable rear axle has a rack and pinon style actuator mounted to the differential cover, specially designed axle shafts, and movable hub and bearing assemblies mounted by upper and lower ball joints. The actuator housing is part of the differential cover. In the event of a system malfunction, the actuator returns the rear wheels to the center position through internal springs. The actuator has specially designed inner and outer tie rods ends. There are inner tie rod boots to prevent contaminants from entering the actuator. Long term exposure to moisture due to a damaged boot or components can result in an internal malfunction or damage. The actuator has the rear wheel steering motor assembly attached to the upper housing. There are shields and a skid plate on the rear axle to protect the actuator. There are no internal adjustments to the actuator. It is mandatory to perform a four wheel alignment if any hard parts, such as tie rods, ball joints or wheel bearings are serviced. The axle shafts are a heavy duty design with a specially designed CV joint and boot at the wheel end of the axle to provide up to 15 degrees of movement. The axle assembly is a heavier duty version of the standard rear axle used on a non rear wheel steer truck.

You must consult the owners manual and the trailer towing guide for specific towing capacities.