

Toyota's VGRS System

Lexus LX470 August 2002 – 2007

Toyota Land Cruiser 100 Series Sahara 2005 – 2007



Lexus LX470 vehicles produced from August 2002 onwards and Land Cruiser 100 Series Sahara models produced from May 2005 are fitted with a Variable Gear Ratio Steering (VGRS) system which has unique service procedures relating to wheel alignment, battery terminal re-connection and other service repairs. This article is provided by Toyota and explains basic system function, operation and also provides details on very important service procedures.

VGRS System Function

In the conventional steering system, the gear ratio is set primarily for the high-speed driving mode to prevent the vehicle from making over-sensitive movements in response to the driver's steering input. For this reason, it requires a large driver's steering input while driving at low speeds.

In the VGRS system, the steering gear ratio alters to suit the driving conditions. The VGRS ECU operates the VGRS actuator in order to constantly achieve the most optimal gear ratio in accordance with the driving conditions of the vehicle. This ensures a high level of manoeuvrability and stability between the low- and high-speed driving ranges.

In the extremely low-speed range, which occurs when the driver is attempting to park the vehicle, this system changes the steering gear into the smallest gear ratio in order to reduce the driver's steering input. Additionally, at low- to mid-speed range, the driver's steering input is also somewhat reduced, thereby improving the 'agility' of the vehicle. See Diagram 1.

In the high-speed range, the steering gear ratio is set to the maximum level to prevent the vehicle from making over-sensitive movements in response to the driver's steering input (ensuring a more stable vehicle response). See Diagram 2.

How It Works

When the driver turns the steering wheel, turning force is transmitted to the steering rack via the VGRS actuator (located between the steering main shaft and the steering rack).

In basic terms, during normal operation the steering wheel is not 'mechanically connected' to the front wheels. Steering force applied at the steering wheel is transmitted to the steering rack through an electric motor within the VGRS actuator.

The VGRS ECU determines the VGRS actuator ratio (based on signals received from sensors) via operation of the actuator motor and reduction gear mechanism. See Diagram 3.

The reduction gear mechanism within the VGRS actuator is a 'strain wave' type reduction gear. See Diagram 4. The reduction gear operates at a 50:1 ratio.

When the ignition switch is turned off, or when a system abnormality occurs, a lock mechanism stops the motor. Whilst this lock mechanism is engaged, the steering wheel turning force is directly transmitted to the steering gear box (as per a conventional steering system). See Diagram 5.

