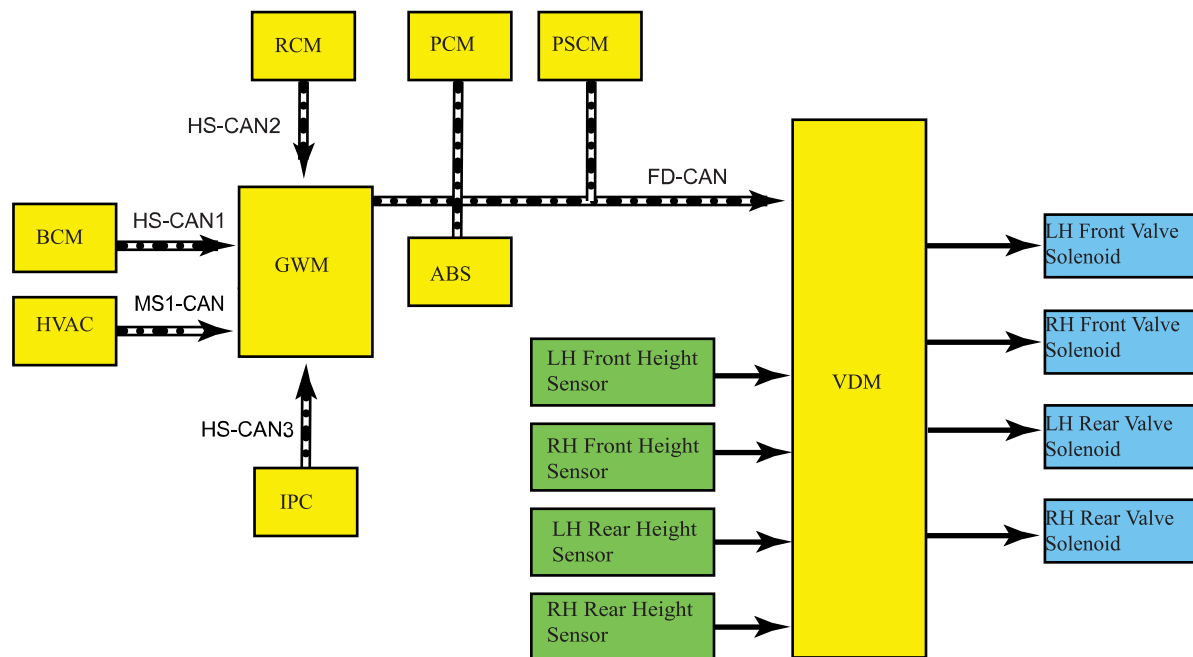


Vehicle Dynamic Suspension - System Operation and Component Description

System Operation

System Diagram



E344999

Network Message Chart

Module Network Input Messages - VDM

Broadcast Message	Originating Module	Message Purpose
<u>ABS</u> active	<u>ABS</u> module	Indicates the current <u>ABS</u> activity, on or off.
Accelerator pedal position	<u>PCM</u>	Indicates the current accelerator pedal position in percentage of travel with 0% at rest and 100% at full throttle.
Ambient air temperature	<u>HVAC</u> module	Indicates the current ambient air temperature in degrees Celsius.
Brake torque request	<u>ABS</u> module	This message indicates the total amount of braking, in newton meters, requested by the driver (via the brake pedal), the adaptive cruise control system or the collision avoidance system. The <u>VDM</u> adjusts the valve solenoids to help stabilize the vehicle during the operation of those systems.
Driven wheel torque request	<u>PCM</u>	Torque at the wheels (sum of all wheels) desired from the propulsion system. This includes the effects of the driver's accelerator pedal input and the effects of the virtual driver functions, cruise control, adaptive cruise control.
Fuel level	<u>IPC</u>	This message is sent to the <u>GWM</u> and then to the <u>VDM</u> . Indicates the fuel level at time of ride height calibration in fractions of the fuel tank. The <u>VDM</u> uses fuel level when calculating suspension settings and uses a default setting when the information is not available.
Gear lever position	<u>PCM</u>	Indicates the current transmission gear status.

Broadcast Message	Originating Module	Message Purpose
Gross train weight estimate	<u>PCM</u>	Rough estimate of the combined mass of a road vehicle, the passengers and cargo in the tow vehicle, plus the mass of the trailer and cargo in the trailer.
Ignition status	<u>BCM</u>	This message is sent to the <u>GWM</u> and then to the <u>VDM</u> . Indicates the current ignition status; off, accessory, run, start, invalid or unknown.
Life cycle mode	<u>BCM</u>	This message is sent to the <u>GWM</u> and then to the <u>VDM</u> . Indicates the current vehicle life cycle; normal, factory, not used or transport.
Odometer master value	<u>IPC</u>	This message is sent to the <u>GWM</u> and then to the <u>VDM</u> . Indicates the current odometer value in kilometers and whether the data is fresh or unchanged.
Power pack status	<u>PCM</u>	Indicates the current status of the engine and powertrain; Off - torque not available, On - torque not available, start in progress - torque not available or On - torque available.
Selectable Drive Modes mode request	<u>ABS</u>	Indicates the current SDM mode.
Stability control event in progress	<u>ABS</u> module	Indicates a stability control system (traction control or <u>ESC</u>) is currently active.
Stability control indicator request	<u>ABS</u> module	Indicates the current stability control warning indicator status; on, off, slow flash or fast flash.
Stability control	<u>ABS</u> module	Indicates if <u>ESC</u> is available, yes or no, and active, yes or no.
Start stop status	<u>PCM</u>	Indicates the current start/stop status of the engine.
Steering angle data	<u>PSCM</u>	Indicates the current steering wheel angle relative to the straight ahead position.
Traction control	<u>ABS</u> module	Indicates the current traction control state, active or inactive and if it is active, yes or no.
Vehicle configuration data	<u>BCM</u>	This message is sent to the <u>GWM</u> and then to the <u>VDM</u> . Indicates the current vehicle configuration and optional equipment.
Vehicle lateral acceleration	<u>ABS</u> module	Indicates the current lateral acceleration of the vehicle in meters per second squared as measured by the sensors in the <u>RCM</u> and relayed by the <u>ABS</u> module.
Vehicle lateral acceleration	<u>RCM</u>	Indicates the current lateral acceleration of the vehicle in meters per second squared as measured by the sensors in the <u>RCM</u> .
Vehicle longitudinal acceleration	<u>ABS</u> module	Indicates the current longitudinal acceleration of the vehicle in meters per second squared as measured by the sensors in the <u>RCM</u> and relayed by the <u>ABS</u> module.
Vehicle longitudinal acceleration	<u>RCM</u>	Indicates the current longitudinal acceleration of the vehicle in meters per second squared as measured by the sensors in the <u>RCM</u> .
Vehicle roll rate	<u>ABS</u> module	Indicates the current roll rate of the vehicle in radians per second squared as measured by the sensors in the <u>RCM</u> and relayed by the <u>ABS</u> module.
Vehicle roll rate	<u>RCM</u>	Indicates the current roll rate of the vehicle in radians per second squared as measured by the sensors in the <u>RCM</u> .
Vehicle speed	<u>PCM</u>	Indicates the current vehicle speed in kilometers per hour.
Vehicle yaw stability index	<u>ABS</u> module	Indicates the current stability (oversteer or understeer) of the vehicle.
Vehicle yaw rate	<u>ABS</u> module	Indicates the current yaw rate of the vehicle in radians per second squared as measured by the sensors in the <u>RCM</u> .

Broadcast Message	Originating Module	Message Purpose
Vehicle vertical acceleration	<u>ABS</u> module	Indicates the current vertical acceleration of the vehicle in meters per second squared as measured by the sensors in the <u>RCM</u> and relayed by the <u>ABS</u> module.
Vehicle vertical acceleration	<u>RCM</u>	Indicates the current vertical acceleration of the vehicle in meters per second squared as measured by the sensors in the <u>RCM</u> and relayed by the <u>ABS</u> module.
Vehicle yaw rate	<u>RCM</u>	Indicates the current yaw rate of the vehicle in radians per second squared as measured by the sensors in the <u>RCM</u> .

Vehicle Dynamic Suspension

The VDM is connected to the FD-CAN to communicate with other modules. The VDM also gathers suspension height information from the height sensors. With the information received, the VDM monitors the heave, roll, pitch, cornering, braking and acceleration of the vehicle. Based on this information the VDM calculates the best action for each valve solenoid.

Once the valve solenoid is energized, the damping increases with the PWM duty cycle. At maximum current the damping is less than when minimum current is applied. The damper and valve solenoid have been designed so failure leads to a firm ride. The fail-safe level of damping is at a level equivalent to what is produced at the minimum current.

When the VDM is initialized (ignition ON), the module carries out a preliminary electrical check of the height sensors, height sensor circuits, valve solenoids and valve solenoid circuits. It also checks for battery voltage above or below acceptable thresholds. Any malfunction detected in the above hardware of the system causes the VDM to set a DTC and send a message over the CAN to the IPC . The IPC responds by displaying a message in the message center and the VDM will deactivate the dynamic suspension system resulting in a firm suspension feel.

Component Description

Selectable Drive Modes (SDM)

The driver can select system modes using the (SDM) rotary dial. F-150 Raptor customers can also set the suspension mode independent of the drive mode via the suspension button on the steering wheel. When a mode is selected, the VDM regulates the PWM signal to the valve solenoids to keep the suspension "feel" realtional to the selected mode.

Height Sensor

The height sensor sends a variable amount of voltage back to the VDM based on suspension height. 2021 model year F150 with Continous Control Damping (CCD) suspension have an integrated height sensor and damper assembly on the rear of the vehicle. In this case, the height sensor is built into the dust boot of the rear dampers and is commonly known as a "linear sensor". The sensor has 3 circuits, one circuit is for the 5 volt sensor supply, one circuit is for sensor ground and one circuit is for the sensor output.

Valve Solenoid

The VDM uses a PWM output to control the valve solenoid. The solenoid opens or closes the valve depending on the amount of current supplied by the VDM . **For the base F-150** the higher the current, the more the valve is closed, resulting in a higher level of damping. **For the Raptor** the higher the current, the more the valve is opened, resulting in a lower level of damping.

Vehicle Dynamics Control Module (VDM)

The VDM monitors all sensor inputs and all HS-CAN messages that relate to the vehicle dynamic suspension and then directly controls the valve solenoids. The VDM sends an individual electrical current to each valve solenoid to control the amount of damping required.

The VDM requires calibration when any of the following components is installed new, disassembled, disconnected or removed.

- VDM
- Suspension height sensor
- Front upper control arm
- Front coil over shock assembly
- Rear upper control arm (Raptor)
- Rear leaf spring (Base F-150)
- Rear shock (Base F-150)

The calibration procedure is carried out using the diagnostic scan tool and required for the system to learn the zero-position of the vehicle.

Before performing the calibration procedure:

- Be sure the vehicle is on a level surface.
- The vehicle must not be moving.
- No occupants in the vehicle.
- Make sure the suspension is in a neutral position if it was recently lowered. To neutralize the suspension, drive the vehicle a short distance, such as around a parking lot.

For the Raptor only (Activate the **Engineering Test** mode for dynamic suspension which will power the shocks and allow the vehicle to settle by following the procedure below:

- Put the vehicle into Neutral
- Turn the vehicle ON with engine OFF
- Depress the gas pedal fully 3 times within 10 seconds, letting it fully return between each depression
- If the above sequence is correctly executed, a small **ET** for **Engineering Test** will display in the bottom right of the cluster and the shocks will power on (truck may also drop slightly).