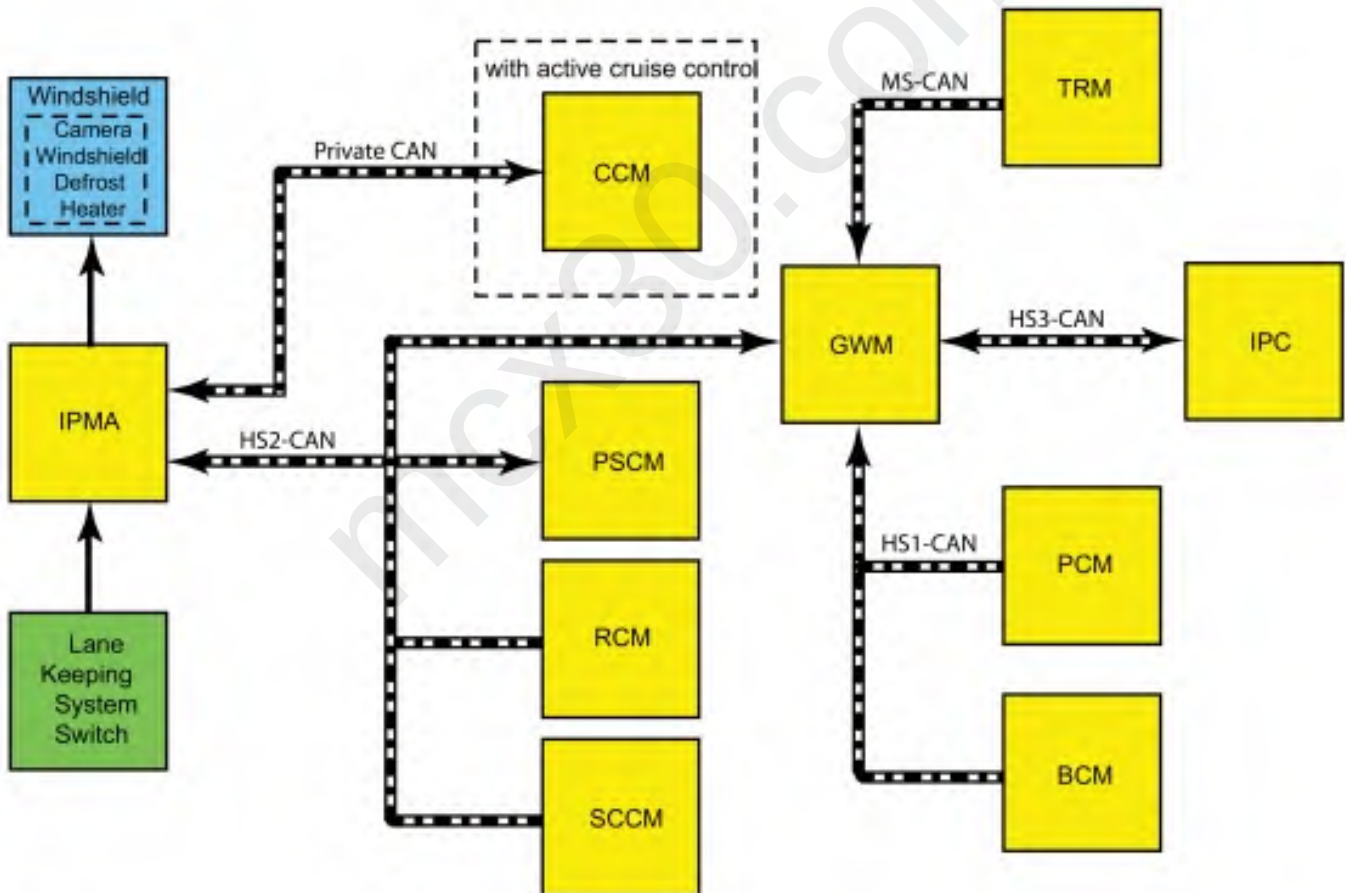


Lane Keeping System - System Operation and Component Description

System Operation

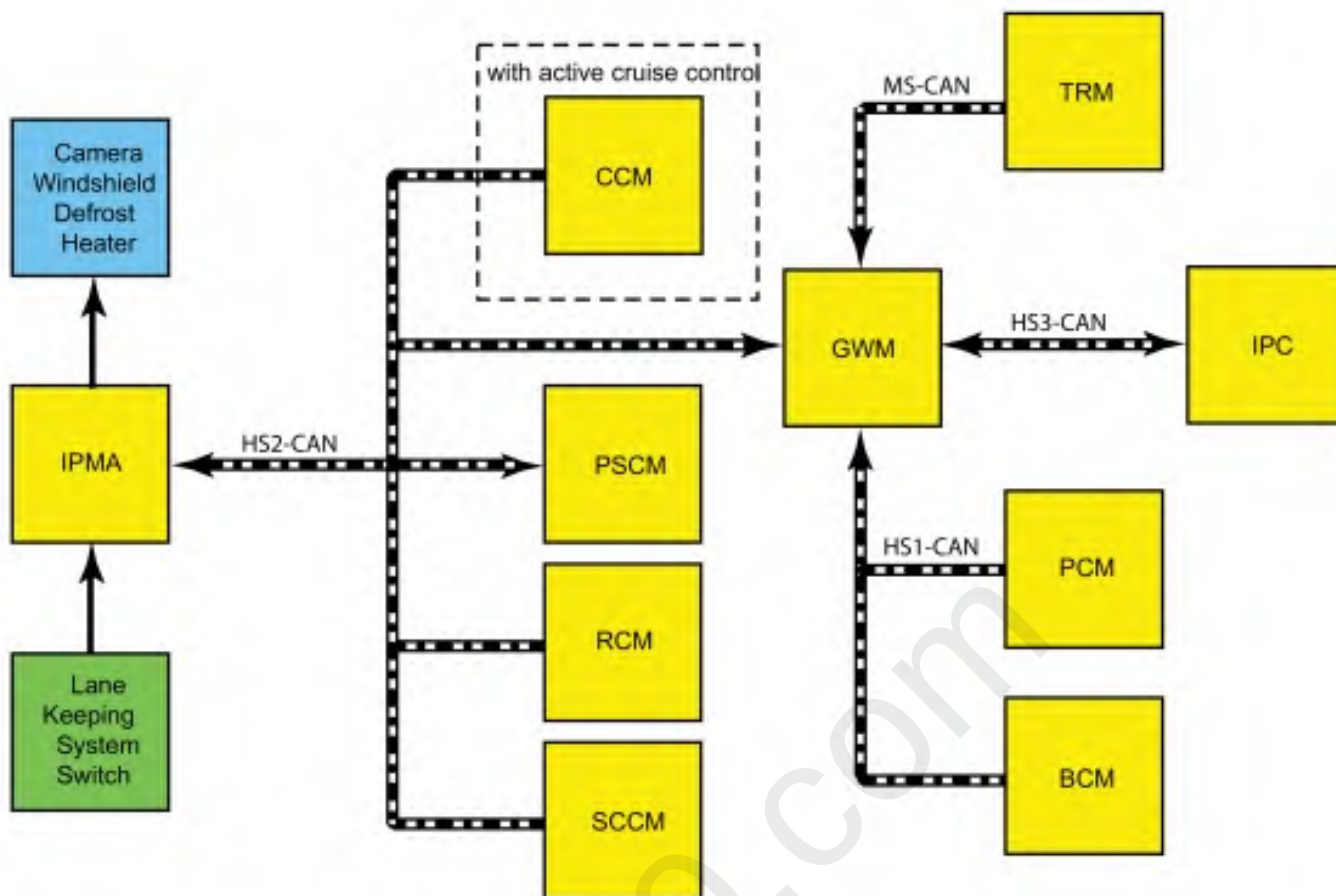
Lane Keeping Alert and Lane Keeping Aid

System Diagram - Except Raptor



E256147

System Diagram - Raptor



E254996

Network Message Chart

Module Network Input Messages - IPMA

Broadcast Message	Originating Module	Message Purpose
Ambient air temperature filtered	PCM	Used to control the camera windshield defrost heater operation. The IPMA may turn the heater on when the ambient temperature is below 41°F (5°C).
Lane keep assist hands off status	PSCM	Used to determine if a driver's hands are on the steering wheel when the lane keeping aid system is active. If a hands off condition is detected, the driver will be alerted via the message center.
Head up display flash rate (Raptor only)	CCM	Disables the lane keeping system in the event of a collision warning.
Ignition key type	BCM	Prevents the lane keeping system from being disabled when a MyKey® is in use.

Ignition status	BCM	Enables and disables the IPMA based on the ignition switch position.
Lane keeping system suppression	PSCM	Disables the lane keeping system in the event of an evasive steering maneuver by the driver.
Personalization mode	IPC	Used to configure the personalized options for the lane keeping system (mode and intensity).
Restraint impact event status	RCM	Disables the lane keeping system when a RCM event occurs.
Turn signal switch status	SCCM	When the turn signal is activated, this message is used to suppress the lane keeping on the side of the vehicle corresponding the turn signal direction.
Trailer lamp connected	TRM	Provides the current trailer connection status to the IPMA.
Vehicle yaw rate	ABS	Disables the lane keeping system in the event that the yaw rate of the vehicle exceeds a predetermined threshold.
Vehicle lateral acceleration	RCM	Disables the lane keeping system in the event that the lateral acceleration of the vehicle exceeds a predetermined threshold.
Vehicle longitudinal acceleration	RCM	Disables the lane keeping system in the event that the longitudinal acceleration of the vehicle exceeds a predetermined threshold.
Vehicle speed	PCM	The lane keeping system is only active when the vehicle speed is above 64 km/h (40 mph).

Module Network Input Messages - PSCM

Broadcast Message	Originating Module	Message Purpose
Calculated steering angle	IPMA	Provides a reference steering angle for PSCM intervention.
Lane keeping alert request	IPMA	Request to provide haptic feedback (vibration) through the steering wheel to alert the driver of a lane departure.
Lane keeping aid request	IPMA	Request for steering torque when a lane departure is detected and the lane keeping aid is on.
Lane keeping system status	IPMA	Used to provide the lane keeping system status (suppressed, available and active states).

Road curvature	IPMA	Provides road curvature as detected by the camera. Used to calculate required steering torque for lane keeping aid interventions.
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Module Network Input Messages - IPC

Broadcast Message	Originating Module	Message Purpose
Camera status	IPMA	Used to display camera status messages.
Lane keep assist hands off	IPMA	Used to display a hands off warning message and sounds a chime through the audio system.
Lane keeping system switch status	IPMA	Used to display the lane keeping system status (suppressed, available and active states).
Lane keeping system status display	IPMA	Turns the lane keeping aid system display on and off.

Lane Keeping System Operation

The lane keeping system is turned on and off using the lane keeping system switch located on the center console. The lane keeping system switch is directly connected to the IPMA. The last known on/off setting for the lane keeping system is recalled every time the key is turned on. When a MyKey® is in use, the system defaults the lane keeping alert mode to on and cannot be turned off. When the system is on, it is active only when the vehicle speed is above 64 km/h (40 mph) and at least one lane marking can be detected by the camera. The system can be turned off at any time by pressing the lane keeping system switch. If the lane keeping system switch is pressed when a MyKey® is in use, the IPC message center will display a message informing the driver that the system is on.

The system can be temporarily suppressed at any time by the following:

- Rapid braking or acceleration
- Evasive steering maneuver
- Using the turn signal indicator (only for the side the indicator is on)

Lane Keeping Alert

The lane keeping alert generates vibration through the steering wheel when an unintended lane departure is detected by the IPMA. When commanded by the IPMA, the PSCM rapidly oscillates the power steering left to right, simulating the vehicle driving on a rumble strip. The intensity of the steering wheel vibration can be adjusted using the Driver Assist options in the message center. The system also provides a visual alert in the message center when a lane departure is detected.

Lane Keeping Aid

The lane keeping aid provides steering torque to help the driver keep the vehicle in the lane when a lane departure is detected. The IPMA sends the road curvature and calculated steering angle messages to the PSCM. The PSCM uses these messages to calculate and generate the intervention torque.

Hands-Off Warning

When the lane keeping aid is active, the PSCM continuously monitors the torque sensor in the EPAS system to determine if a hand is on the steering wheel and sends the data to the IPMA. If the IPMA detects that the driver's hands are off the wheel for more than a few seconds, the hands-off warning is generated.

The hands-off warning is generated in 2 levels. The first level is a message center warning only and is triggered after 3 seconds of hands-off driving is detected. The second level warning consists of a message center warning and an audio chime and is generated after 6 seconds of hands-off driving.

NOTE: *Due to certain road conditions and the driver's individual grip/touch on the steering wheel, the system may generate a hands-off warning when hand(s) are still on the steering wheel.*

IPMA Camera Windshield Defrost Heater

The camera windshield defrost heater keeps the windshield in front of the IPMA clear of frost and ice. The IPMA uses input from the front camera and the ambient air temperature to turn the camera windshield defrost heater on and off. Voltage and ground is supplied to the heater by the IPMA. The heater may be commanded on if the ambient temperature is below 5°C (41°F).

Except Raptor, the IPMA camera windshield defrost heating element is integral to the windshield and can not be serviced without replacing the windshield. For Raptor, the IPMA camera windshield defrost heating element is a resistive-type heater grid that is adhered to the inside of the windshield directly in front of the IPMA camera. Before replacing the IPMA camera heated windshield element or the IPMA for an IPMA camera heated windshield element concern, verify the integrity of the wiring, connectors and terminals on the jumper harness.

System Display

When the lane keeping system is turned on, an overhead graphic of a vehicle and lane markings is displayed in the IPC. If the lane keeping aid mode is selected when the system is on, arrow markings pointing toward the lane lines are also displayed. When the system is off, the lane marking graphics are not displayed. Additional graphics appear in the display if the adaptive cruise control is enabled. While the system is on, the color of the lane markings change to indicate the system status.

Gray: Indicates the system is temporarily unable to provide lane keeping aid or alert activation on the indicated side(s). This may be caused by:

- The vehicle speed is under the activation limit
- High sunload on the IPMA camera lens
- Too close to lane markings
- Lane markings are too narrow or wide
- Road has no or poor lane markings in the camera field-of-view

- Following vehicle in front too closely
- IPMA camera blocked
- Windshield dirty or damaged
- Standing water on road
- Environmental conditions (significant sun angles, shadows, snow, heavy rain or fog)
- Turn signal is active
- Vehicle is in a dynamic maneuver
- Tight curves on the road

Green: Indicates the system is available or ready to provide a lane keeping aid or alert activation on the indicated side(s).

Yellow: Indicates the system is providing or has just provided a lane keeping aid activation.

Red: Indicates the system is providing or has just provided a lane keeping alert activation.

Message Center Settings

The system has 2 optional setting menus available through the Driver Assist menu in the message center. The last-known selection for each setting is stored by the IPMA and does not need to be set again after the key is cycled.

The **Mode** setting allows the driver to select which of the system features will be enabled and turned on when the button is pressed. The 3 options in this menu are:

- Lane Keeping Alert only - provides a steering wheel vibration when an unintended lane departure is detected.
- Lane Keeping Aid only - provides steering input toward the center of the lane when an unintended lane departure is detected.
- Lane Keeping Alert and Lane Keeping Aid - provides both a warning and steering input towards the center of the lane.

The **Intensity** setting allows the driver to select the intensity of the steering wheel vibration used in lane keeping alert mode. This setting does not impact the lane keeping aid mode. The 3 options in this menu are:

- Low
- Normal
- High

NOTE: *The steering wheel performs a test vibration after the intensity setting is changed through the Driver Assist menu in the message center.*

Camera Alignment

Camera alignment is required for the lane keeping alert and lane keeping aid to function correctly. The procedure is initiated using the diagnostic scan tool and requires about 10 minutes of driving above 64 km/h (40 mph) on a flat, straight road with highly visible lane markings to complete.

NOTE: *The alignment completion is indicated on the diagnostic scan tool. If the alignment is unsuccessful, check the IPMA (Except Raptor) or the interior mirror (Raptor) for proper installation.*

NOTE: *The FRONT CAMERA MALFUNCTION - SERVICE REQUIRED message in the IPC disappears when the system is aligned.*

The IPMA camera alignment procedure should be performed when any of the following occur:

- Windshield replacement
- Change in tire size
- Suspension repair or alignment
- Front air bag deployment
- Interior mirror replacement (Raptor only)

Component Description

IPMA (Except Raptor)

The IPMA is located on the windshield, above the interior rear view mirror. The IPMA communicates on the HS-CAN2 and on vehicles equipped with the adaptive cruise control and collision warning system, the IPMA shares information with the CCM on dedicated CAN circuits to assist the driver in avoiding a collision. The IPMA contains a forward-looking camera that is used to detect the position of the vehicle within the lane.

The IPMA requires PMI and camera alignment when replaced. For additional information on the collision warning system,

Refer to: Collision Warning and Collision Avoidance System (419-03 Collision Warning and Collision Avoidance System) .

IPMA (Raptor)

The IPMA is integral to the interior rear view mirror. The IPMA communicates on the HS-CAN2. The IPMA contains a forward-looking camera that is used to detect the position of the vehicle within the lane.

The IPMA requires PMI and camera alignment when replaced.

IPMA Camera Heated Windshield Element (Except Raptor)

The IPMA camera heated windshield element is a resistive-type heater grid that is integrated into the windshield and located directly in front of the IPMA camera. The IPMA camera heated windshield element cannot be replaced separately from the windshield. Before replacing the windshield or the IPMA for an IPMA camera heated windshield element concern, verify the integrity of the wiring, connectors and terminals.

Camera Windshield Defrost Heater (Raptor)

The camera windshield defrost heater is a resistive-type heater grid that is adhered to the inside of the windshield

directly in front of the IPMA camera.

The camera windshield defrost heater uses a jumper harness between the component and the vehicle harness. Before replacing the camera windshield defrost heater or IPMA for a camera windshield defrost heater concern, verify the integrity of the wiring, connectors and terminals on the jumper harness.

Lane Keeping System Switch

The lane keeping system switch is a normally open momentary contact switch that, when pressed, grounds the lane keeping system switch input circuit from the IPMA.

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