

The rear parking aid camera image is displayed by the touchscreen audio system display when reverse gear is selected. To determine the selector lever position and enable the camera display, the PCM sends the gear position message to the GWM on the HS-CAN1. The GWM then sends the message to the APIM via the HS-CAN3.

The camera is on any time it receives voltage (when the ignition is ON), but a video signal is only generated under certain conditions. When reverse gear is selected, the camera continuously generates a video signal. When any gear except reverse is selected, the camera turns the video signal off when the vehicle speed reaches 10 mph (16 km/h), and turns the video signal on when vehicle speed falls below 5 mph (8 km/h). If the camera is not configured properly, some features may be inoperative. The camera sends the video signal on shielded twisted pair wires to the APIM, which displays the image on the touchscreen audio system display.

The following parking aid camera system features are driver selectable:

- Visual park aid alert “” assists the driver to visually see the object causing the parking aid system to sound.
- Manual zoom “” allows the driver to manually zoom the image.
- Video delay “” allows the driver to see the image behind the vehicle after the vehicle is shifted out of reverse into any gear other than park.

The following camera system features are not driver selectable:

- Fixed guidelines “” assists the driver with aligning the vehicle with an object.
- Active guidelines “” displays the intended path of the vehicle based upon steering wheel input.

The touchscreen audio system display settings menu is used to turn the visual park aid alert and video delay on and off. The visual park aid alert and video delay features are generated within the APIM. Refer to the Owner Literature for more information.

To turn the manual zoom feature on and off, the driver uses an on screen button located on the touchscreen audio system display while in reverse. The driver generated commands originate at the touchscreen audio system display, which is hardwired to the APIM. The APIM sends the driver generated commands over the HS-CAN3 to the GWM. The GWM then sends the commands to the BCM on the HS-CAN1. The BCM sends the zoom command to the rear parking aid camera via the LIN circuit. The zoom is generated by the rear parking aid camera. Refer to the Owner Literature for more information.

The fixed and active guidelines are generated by the rear parking aid camera and are not selectable by the driver.

Non-Touchscreen Audio System Display

NOTE: *The lifgate must be fully closed for correct operation of the rear parking aid camera system.*

The rear parking aid camera image is displayed by the non-touchscreen audio system display when reverse gear is selected. To determine the selector lever position and enable the camera display, the PCM sends the gear position message to the GWM on the HS-CAN1. The GWM then sends the message to the APIM via the HS-CAN3.

The camera is on any time it receives voltage (when the ignition is ON), but a video signal is only generated under certain conditions. When reverse gear is selected, the camera continuously generates a video signal. When any gear except reverse is selected, the camera turns the video signal off when the vehicle speed reaches 10 mph (16 km/h), and turns the video signal on when vehicle speed falls below 5 mph (8 km/h). If the camera is not configured properly, some features may be inoperative. The camera sends the video signal on shielded twisted pair wires to the APIM, which displays the image on the non-touchscreen audio system display.

The following parking aid camera system are driver selectable:

- Visual park aid alert “” assists the driver to visually see the object causing the parking aid system to sound.
- Manual zoom “” allows the driver to manually zoom the image.
- Video delay “” allows the driver to see the image behind the vehicle after the vehicle is shifted out of reverse into any gear other than park.
- Active guidelines “” displays the intended path of the vehicle based upon steering wheel input.

The following camera system features are not driver selectable:

- Fixed guidelines “” assists the driver with aligning the vehicle with an object.

The visual park aid alert and video delay are turned on and off in the non-touchscreen audio system display. The visual park aid alert and video delay features are generated within the APIM. Refer to the Owner Literature for more information.

To turn the visual park aid alert and manual zoom features on and off, the driver generated commands originate from the non-touchscreen audio system display. The display is hardwired to the APIM. The APIM sends the driver generated commands over the HS-CAN3 to the GWM. The GWM then sends the commands to the BCM on the HS-CAN1. The BCM sends the zoom command to the rear parking aid camera via the LIN circuit. The zoom is generated by the rear parking aid camera. Refer to the Owner Literature for more information.

The fixed and active guidelines and the manual zoom are generated by the rear parking aid camera.

LIN Communication

The BCM and the rear parking aid camera communicate via a LIN circuit which is a dedicated single wire communication network.

The messages sent from the BCM to the camera are:

- Camera configuration data
- Display manual zoom request
- Guideline on/off request
- Trailer connection status (if equipped with trailer tow)
- Steering angle
- Standby enable/disable request

The messages sent from the camera to the BCM are:

- Camera status
- Display zoom status
- Camera part number data
- Guideline status

Visual Park Aid Alert

NOTE: *The on-screen alert transitions may not match changes in the audible parking aid alert tone frequency.*

The visual park aid alert feature displays a visual highlight in the zone where an object has been detected by the rear parking aid system. This feature utilizes the parking aid sensor data from the PAM to generate the visual highlights on the video image. When reverse gear is selected and an object is detected by a rear parking aid sensor, the parking aid sensor data message from the PAM is used by the APIM to generate the alert.

If the visual park aid alert feature is enabled, the feature is still operational even if the rear parking aid system has been disabled by the driver.

Fixed Guidelines

NOTE: *The color-coded lines cannot indicate accurate or consistent distances between the rear of the vehicle and objects shown in the video image. This normal condition is due to variances in vehicle ride height, including, but not limited to, vehicle loading.*

The video camera fixed guidelines feature displays guidelines on top of the video image to assist the driver with alignment of the vehicle. A dashed line on the displayed image represents the center of the vehicle and 3 color-coded lines (red, yellow, green) identify different zones between the rear of the vehicle and objects.

The guidelines are not shown when reverse is not selected (video delay active).

If the vehicle is equipped with a TRM, the fixed guidelines are not shown when a trailer is electrically connected to the vehicle.

Active Guidelines

NOTE: *If the battery has been disconnected or discharged, or a module is disconnected or replaced, the active guidelines may be inoperative until the vehicle is driven on a flat and smooth road at 32 km/h (20 mph) or more, with hands placed loosely on the steering wheel and minimal steering correction for approximately 30 seconds.*

If the guidelines remain inoperative, it may be necessary to disconnect the battery for 5 minutes with the driver's door open, then drive the vehicle for 5 miles in normal city driving before performing the procedure described above.

The active guidelines feature displays dynamic guidelines that correspond to the projected path of vehicle travel, based on the current steering angle. Several modules are involved in generating the steering angle data used to support the active guidelines. The PSCM monitors the steering angle sensor and sends the steering wheel angle sensor data to the ABS module via the HS-CAN2. The ABS module uses this message from the PSCM to generate the steering angle message that is sent to the GWM on the HS-CAN2. The GWM then sends the message to the BCM via the HS-CAN1. The BCM sends the steering angle data to the rear parking aid camera via the LIN circuit. The camera uses this data to generate the active guidelines over the video image.

If the steering wheel is in the straight-ahead position, the active guidelines are not shown.

The guidelines are not shown when reverse is not selected (video delay active).

If the vehicle is equipped with a TRM, the active guidelines are not shown when a trailer is electrically connected to the vehicle.

Manual Zoom

The manual zoom feature is generated by the rear parking aid camera and has one level of zoom. If the manual zoom feature is on and the vehicle is shifted out of reverse gear, the manual zoom feature is disabled and must be re-enabled the next time reverse gear is selected. When the driver turns the zoom on or off at the audio system display, the zoom command is sent through HS-CAN3 to the GWM then over HS-CAN1 to the BCM. The BCM then sends the manual zoom request message to the rear parking aid camera via the LIN circuit. The camera then turns the zoom

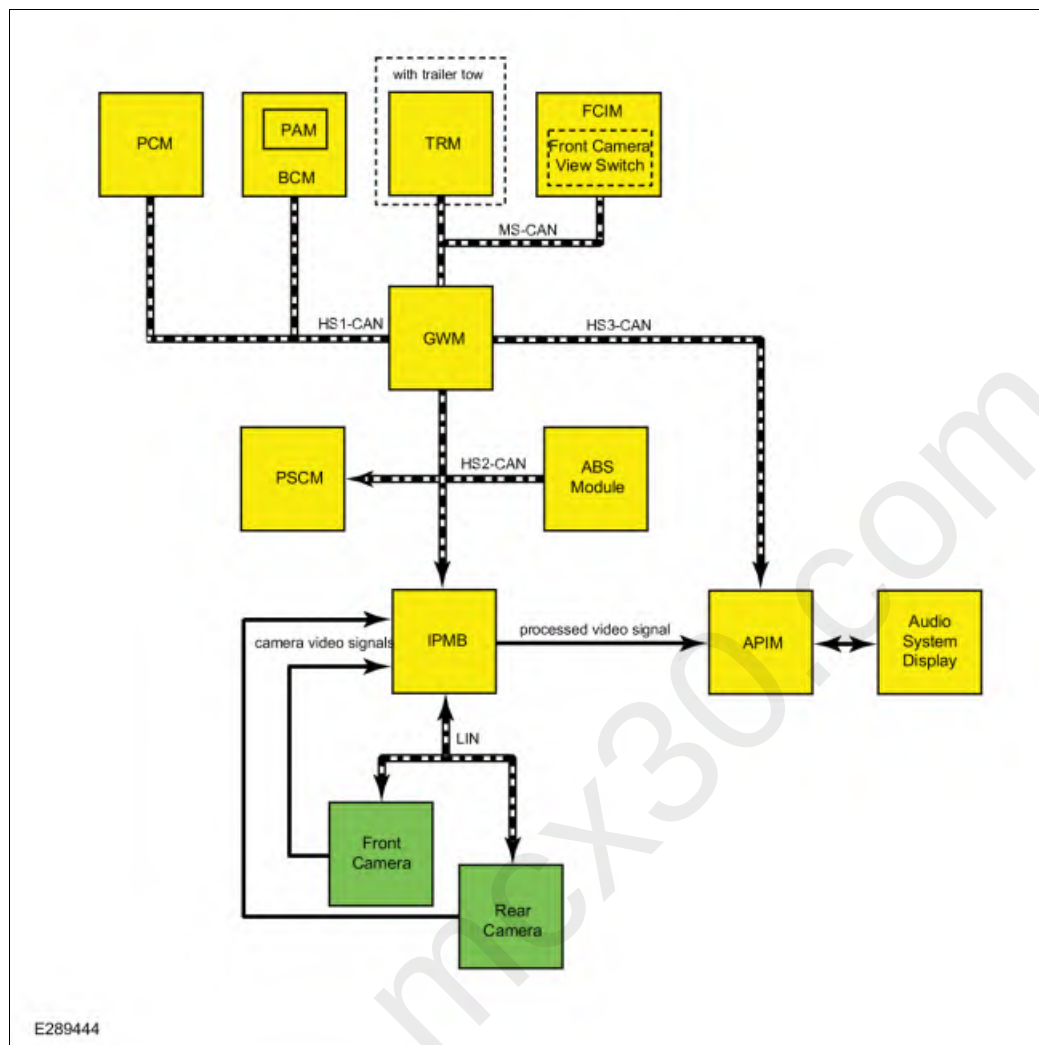
on or off.

Video Delay

When the video delay is turned on, the display keeps the rear video display enabled after the transmission is shifted out of reverse gear, into any gear other than park, until the vehicle speed reaches 8 km/h (5 mph). With the delay off (default), the image displays until the transmission is shifted out of reverse gear.

Front And Rear Parking Aid Camera

System Diagram



Item	Description
1	BCM
2	processed video signal
3	PAM
4	PCM
5	APIM
6	Audio system display
7	Rear camera
8	PSCM
9	IPMB
10	GWM
11	TRM
12	with trailer tow
13	camera video signals

14	FCIM
15	Front camera
16	ABS module
17	Front camera view switch

Network Message Chart

IPMB Network Input Messages

Broadcast Message	Originating Module	Message Purpose
Camera commands	APIM	Used to command the visual park aid alert and zoom level on and off based on driver inputs through the audio system display.
Front camera view switch status	FCIM	Used to switch the front parking aid camera views when any gear other than reverse is selected.
Gear lever position	PCM	Used to switch to the rear camera views when reverse gear is selected.
Parking aid sensor data	PAM	Used to generate the visual highlights in the zone where an object is detected by the parking aid system.
Steering angle	ABS Module	Used to generate the intended vehicle path for the active guideline feature.
Trailer lamp connected	TRM	Disables the guidelines and visual park aid alert when a trailer is electrically connected to the vehicle. (if equipped with trailer tow)
Vehicle speed	PCM	Used to support the front and rear camera standby mode. Turns the camera image output off when vehicle speed is 10 mph (16 km/h) or greater and turns the camera image output on when the vehicle speed is 5 mph (8 km/h) or less.

ABS Module Network Input Messages

Broadcast Message	Originating Module	Message Purpose
Steering wheel angle sensor data	PSCM	The ABS module uses the steering angle sensor data to generate the steering angle message that is sent to the IPMB to support the active guideline feature.

APIM Network Input Messages

Broadcast Message	Originating Module	Message Purpose
Camera status	IPMB	Used to enable the video display when the front parking aid camera view switch is pressed and any gear except reverse is selected.
Gear lever position	PCM	Used to enable the video display when reverse gear is selected.
Parking aid sensor data	PAM	Used to generate the visual highlights in the zone where an object is detected by the rear audible parking aid system.

Broadcast Message	Originating Module	Message Purpose
Vehicle speed	PCM	When the video delay feature is turned on, this message is used to turn the rear camera display off after the vehicle speed exceeds a preset threshold.

Image Display

NOTE: *The liftgate must be fully closed for correct operation of the rear parking aid cameras system.*

The front and rear parking aid camera system is capable of generating several different views using the front camera, the rear camera and the IPMB. The IPMB processes the video signals from the 2 cameras and generates the appropriate views that are displayed on the audio system display. The views that are displayed are determined by the transmission gear selector position.

When the ignition is ON and reverse gear is selected, the rear parking aid camera view is shown on the audio system display.

When the ignition is ON and any gear **except** reverse selected, the front parking aid camera views are shown on the audio system display when the front parking aid camera view switch is pressed. The front images are shown until the vehicle speed reaches 10 km/h (6 mph). The front normal view is shown first. Subsequent presses of the front parking aid camera view switch allow the driver to cycle between front normal and front split view.

The front split view provides an extended wide angle image of what is in front of the vehicle.

To enable the front or rear camera displays, the IPMB monitors the gear position and vehicle speed messages. The PCM sends the gear position and vehicle speed messages to the GWM through the HS-CAN1. The GWM then sends the messages to the IPMB via HS-CAN2.

All camera views are generated by the IPMB, using the video signals from the front or rear cameras. The video signals are sent from the cameras to the IPMB through twisted pair, shielded circuits. The IPMB processes the image(s) from the cameras and sends a single image with the desired view to the APIM.

Camera Image Generation

The front and rear parking aid cameras are on any time they receive voltage (when the ignition is ON), but a video signal is only generated under certain conditions. When reverse gear is selected or the front parking aid camera view switch is pressed, the IPMB sends an enable request message to the front and rear cameras to turn the video signal output on. When any gear except reverse is selected, the IPMB sends a disable request message to the cameras to turn the video signal off when the vehicle speed reaches 10 mph (16 km/h), and sends an enable request message to turn the video signal on when vehicle speed falls below 5 mph (8 km/h). If the front or rear camera is not configured properly, some features and views may be inoperative.

LIN Communication

The IPMB communicates with the front and rear cameras via a LIN circuit, which is a dedicated single wire communication network.

The messages sent from the IPMB to the front and rear cameras are:

- Camera view request (front camera only)
- Camera configuration data
- Display manual zoom request (rear camera only)
- Guideline on/off request (rear camera only)
- Trailer connection status (if equipped with trailer tow)
- Steering angle (rear camera only)
- Standby enable/disable request

The messages sent from the front and rear camera to the BCM are:

- Camera status
- Display zoom status (rear camera only)
- Camera part number data
- Guideline status (rear camera only)

Camera Features

The system supports several rear camera features to assist the driver.

The following features are driver selectable:

- Visual park aid alert “” visually alerts the driver to objects causing the parking aid system to sound.

- Manual zoom “allows the driver to manually zoom the image.
- Video delay “allows the driver to see the image behind the vehicle after the vehicle is shifted out of reverse into any gear other than park.
- Active guidelines “displays the intended path of the vehicle based upon steering wheel input.

The following features are not driver selectable:

- Fixed guidelines “displays guidelines to assist the driver with aligning the vehicle with an object.

The system supports visual park aid alert on the rear and front normal camera views. The visual park aid alert feature is displayed as a vehicle icon in the upper part of the display. This icon is generated by the APIM.

To turn the manual zoom on and off, the driver generated commands originate at the audio system display, which is hardwired to the APIM. The commands are sent by the APIM to the IPMB via the HS-CAN3 then to the GWM over the HS-CAN2. The IPMB then sends the zoom command to the rear camera via the LIN circuit. The image is then zoomed in or out by the rear camera.

The video delay feature is controlled within the APIM.

The fixed and active guidelines are generated by the rear parking aid camera based on the IPMB commands.

Visual Park Aid Alert

NOTE: *The on-screen alert transitions may not match changes in the audible parking aid alert tone frequency.*

The visual park aid alert feature displays a visual highlight in the zone where an object has been detected by the parking aid system. The visual park aid alert feature is displayed as a vehicle icon in the upper part of the display. This icon is generated by the APIM. The feature utilizes the parking aid sensor data from the PAM to generate the visual highlights on the video image.

When an object is detected by the front or rear parking aid sensor, the parking aid sensor data message from the PAM is used by the APIM to generate the alert.

If the visual park aid alert feature is enabled, the feature is still operational even if the rear parking aid system has been disabled by the driver.

Fixed Guidelines

NOTE: *The color-coded lines cannot indicate accurate or consistent distances between the rear of the vehicle and objects shown in the video image. This normal condition is due to variances in vehicle ride height, including, but not limited to, vehicle loading.*

Fixed guidelines are only displayed on the rear camera image.

The video camera fixed guidelines feature displays guidelines on top of the rear video image to assist the driver with alignment of the vehicle. A dashed line on the displayed image represents the center of the vehicle and 3 color-coded lines (red, yellow, green) identify different zones between the rear of the vehicle and objects.

Fixed guidelines are not shown when the liftgate is open.

If the vehicle is equipped with a TRM, the fixed guidelines are not shown when a trailer is electrically connected to the vehicle.

Active Guidelines

NOTE: *If the battery has been disconnected or discharged, or a module is disconnected or replaced, the active guidelines may be inoperative until the vehicle is driven on a flat and smooth road at 32 km/h (20 mph) or more, with hands placed loosely on the steering wheel and minimal steering correction for approximately 30 seconds.*

If the guidelines remain inoperative, it may be necessary to disconnect the battery for 5 minutes with the driver's door open, then drive the vehicle for 5 miles in normal city driving before performing the procedure described above.

Active guidelines are only displayed on the rear camera image.

The active guidelines feature displays dynamic guidelines that correspond to the projected path of vehicle travel, based on the current steering angle. Several modules are involved in generating the steering angle data used to support the active guidelines. The PSCM monitors the steering angle sensor and sends the steering wheel angle sensor data to the ABS module via the HS-CAN2. The ABS module uses this message from the PSCM to generate the steering angle message that is sent to the IPMB through the HS-CAN2. The IPMB sends the steering angle data to the rear parking aid camera via the LIN circuit. The camera uses this data to generate the active guidelines over the video image.

When the steering wheel is in the straight-ahead position, the active guidelines are not shown.

Active guidelines are not shown when the liftgate is open.

If the vehicle is equipped with a TRM, the active guidelines are not shown when a trailer is electrically connected to the vehicle.

Manual Zoom

The manual zoom is only supported by the rear camera.

The manual zoom feature has one level of zoom. If the manual zoom feature is on and the vehicle is shifted out of reverse gear, the manual zoom feature is disabled. The manual zoom feature must be re-enabled the next time reverse gear is selected. When the driver turns the zoom on or off at the audio system display, the command is sent from the APIM via the HS-CAN3 to the GWM. The GWM then sends the message to the IPMB through the HS-CAN2. The IPMB sends the manual zoom request message to the rear parking aid camera via the LIN circuit. The camera then turns the zoom on or off.

Video Delay

When the video delay is turned on, the APIM keeps the rear view display enabled after the transmission is shifted out of reverse gear, into any gear other than park, until the vehicle speed reaches 8 km/h (5 mph). With the delay off (default), the image displays until the transmission is shifted out of reverse gear.

Component Description

Rear Camera

The rear parking aid camera is located on the liftgate. On vehicles equipped with the front and rear parking aid camera system, the rear camera communicates with the IPMB through a LIN circuit. On vehicles equipped with the rear only parking aid camera system, the rear camera communicates with the BCM through a LIN circuit. The camera must be configured using a diagnostic scan tool after replacement in order for all features to operate properly.

Front Camera

The front parking aid camera is located on the front grille, below the center emblem. The camera communicates with the IPMB through a LIN circuit. The camera must be configured using a diagnostic scan tool after replacement in order for all features to operate properly.

Front Camera View Switch

The front parking aid camera view switch is a momentary contact switch that is integral to the FCIM. The front camera views are shown on the audio system display when the front parking aid camera view switch is pressed.

Front Camera Washer

The front parking aid camera washer is located on the front grille, below the center emblem. Washer solvent is directed to the front camera lens when the washer pump is active.

For additional information on the front camera washer, Refer to: Wipers and Washers - System Operation and Component Description (501-16 Wipers and Washers, Description and Operation).

BCM (vehicles equipped with rear only parking aid camera)

The BCM serves as a gateway between the rear parking aid camera and other modules on the HS-CAN1. It communicates with the rear camera via the LIN and stores Diagnostic Trouble Codes (DTCs) for the camera and the LIN in the event of a concern.

IPMB (vehicles equipped with front and rear parking aid camera)

For vehicles equipped with the front and rear parking aid camera system, all camera views are produced by the IPMB. The processed video signals are sent from the IPMB to the APIM on shielded, twisted pair circuits.

The IPMB receives the video signals from the front and rear parking aid cameras through shielded, twisted pair circuits and determines which image(s) are sent to the APIM to be displayed on the audio system display.

In addition to generating the camera views, the IPMB serves as a gateway between the front and rear parking aid cameras and other modules on the HS-CAN2. It communicates with the front and rear cameras via the LIN and stores Diagnostic Trouble Codes (DTCs) for the cameras and the LIN in the event of a concern.

Diagnosis and Testing

Parking Aid

DTC Chart(s)

DTC Chart: BCM

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices.
REFER to: Diagnostic Methods (100-00 General Information, Description and Operation).

DTC	Description	Action
B115E:01	Camera Module: General Electrical Failure	GO to Pinpoint Test A
B115E:02	Camera Module: General Signal Failure	GO to Pinpoint Test A
B115E:08	Camera Module: Bus Signal/Message Failure	GO to Pinpoint Test A
B115E:49	Camera Module: Internal Electronic Failure	• Sets in continuous memory and on-demand in the BCM when an internal fault in the rear parking aid camera is detected. ▪ CLEAR the Diagnostic Trouble Codes (DTCs) and REPEAT the BCM self-test. ▪ If DTC B115E:49 returns, INSTALL a new rear parking aid camera. REFER to: Rear Parking Aid Camera (413-13B Parking Aid - Vehicles With: Parking Aid Camera, Removal and Installation).
B115E:55	Camera Module: Not Configured	• Sets in continuous memory and on-demand in the BCM when the rear parking aid camera is not configured. ▪ PERFORM the rear parking aid camera configuration using a diagnostic scan tool under Electrical>Service Functions>LIN New Module Initialization.
B115E:9A	Camera Module: Component or System Operating Conditions	• Sets as an on-demand DTC in the BCM when the prerequisite conditions are not met for the on-demand self test. ▪ INSPECT the liftgate to make sure it is fully closed and DIAGNOSE any other Diagnostic Trouble Codes (DTCs) present in the BCM. REFER to: Body Control Module (BCM) (419-10 Multifunction Electronic Modules, Diagnosis and Testing).
All other Diagnostic Trouble Codes (DTCs)	-	REFER to: Body Control Module (BCM) (419-10 Multifunction Electronic Modules, Diagnosis and Testing).

DTC Chart: IPMB

Diagnostics in this manual assume a certain skill level and knowledge of Ford-specific diagnostic practices.
REFER to: Diagnostic Methods (100-00 General Information, Description and Operation).