

Handles, Locks, Latches and Entry Systems - System Operation and Component Description

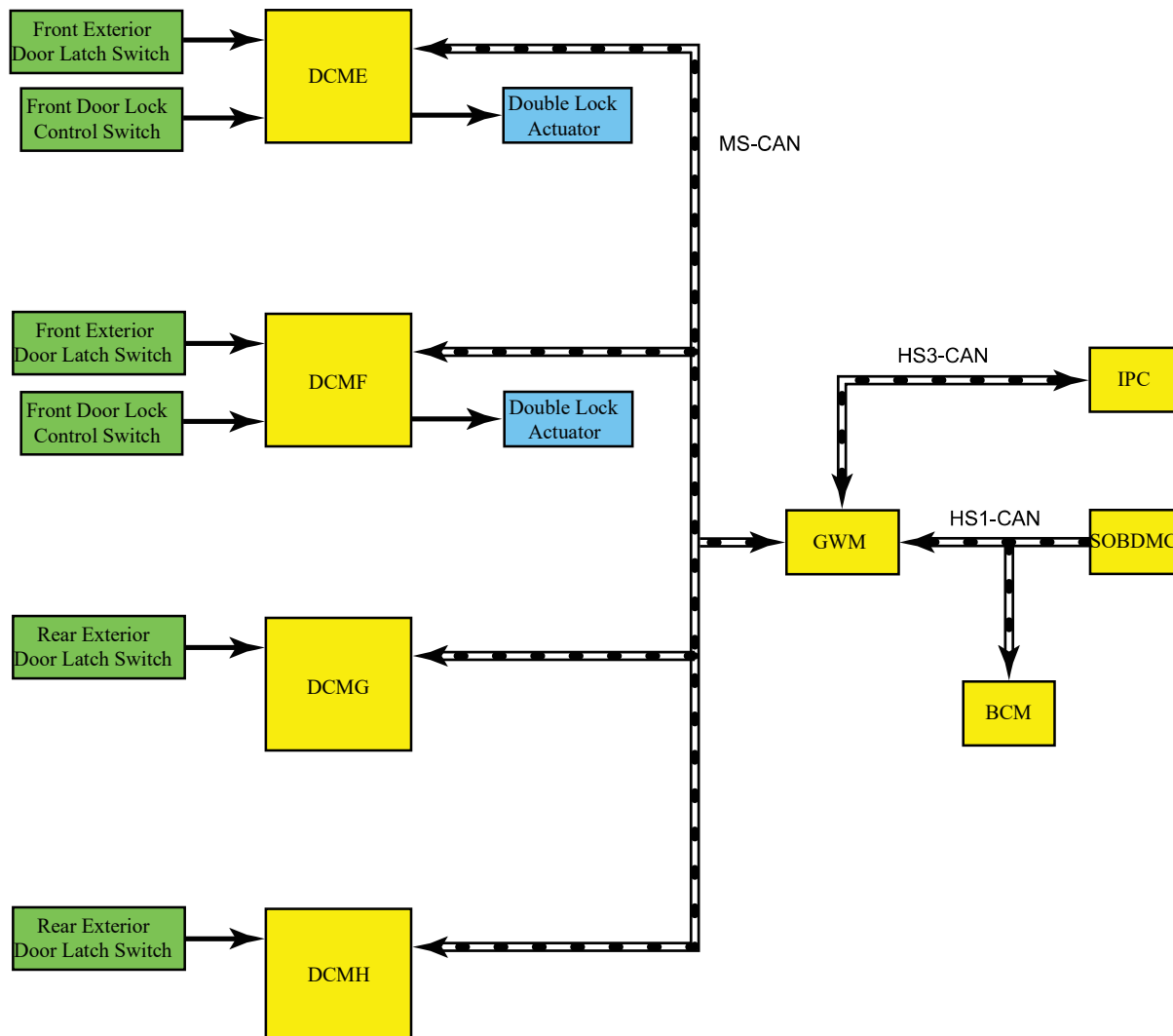
System Operation

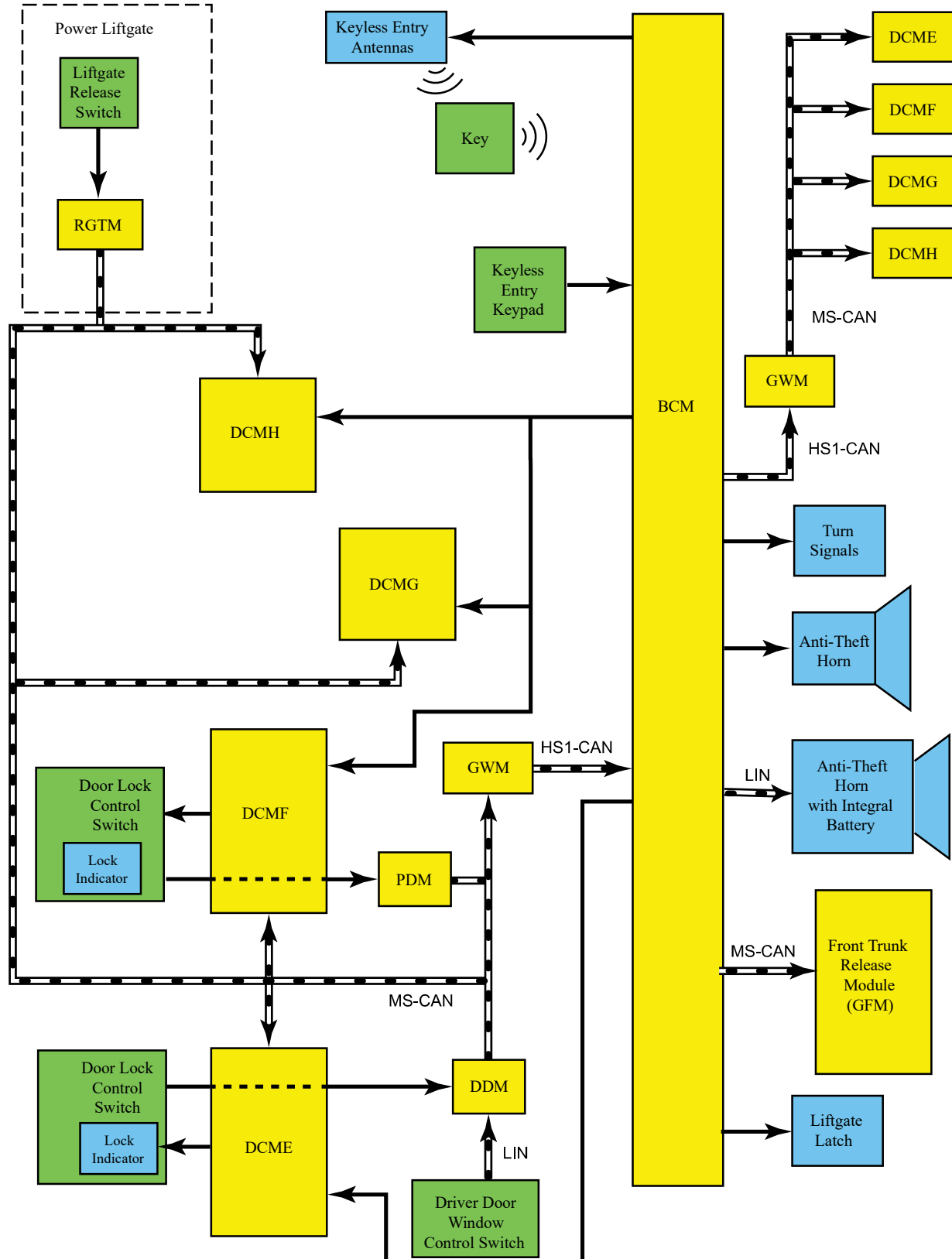
System Diagrams

NOTE: The Phone as a Key feature can be used to lock/unlock the vehicle. Refer to section 419-01C for information regarding this feature.

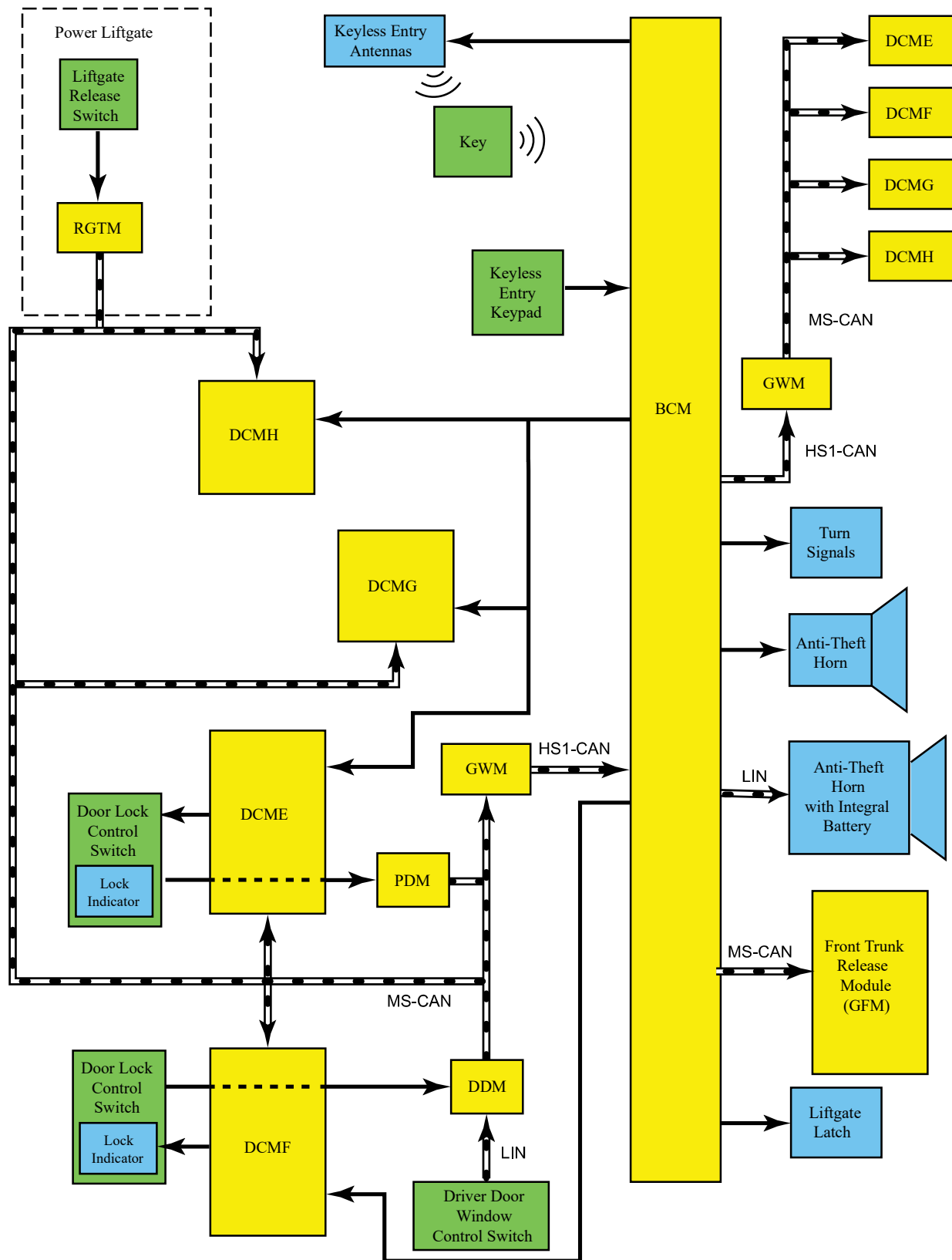
NOTE: Not all vehicles come equipped with all the items listed in the system diagrams.

Door Latch Release and Double Lock Actuator (if equipped)



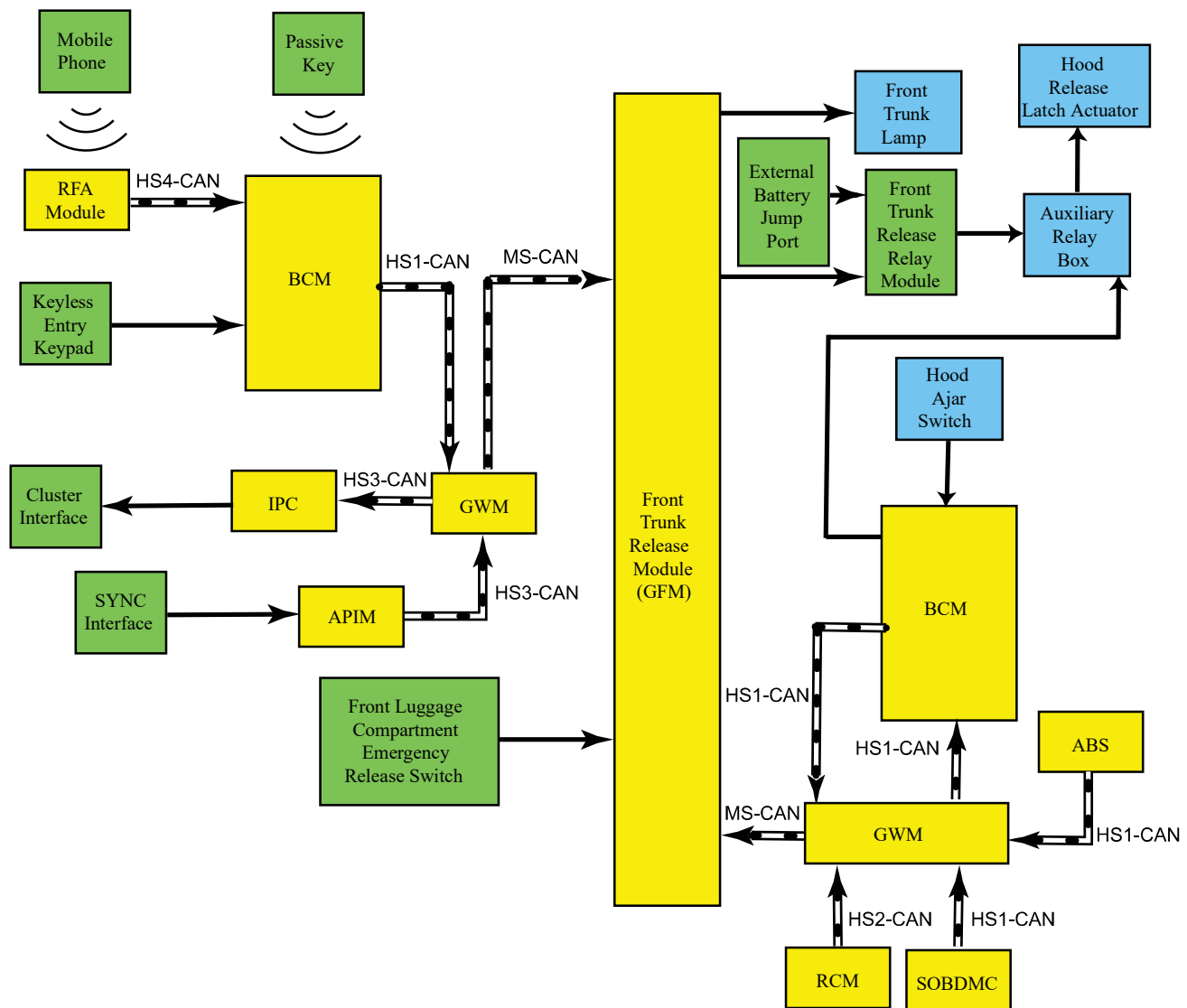
Door Lock/Unlock LHD

E347598

Door Lock/Unlock RHD

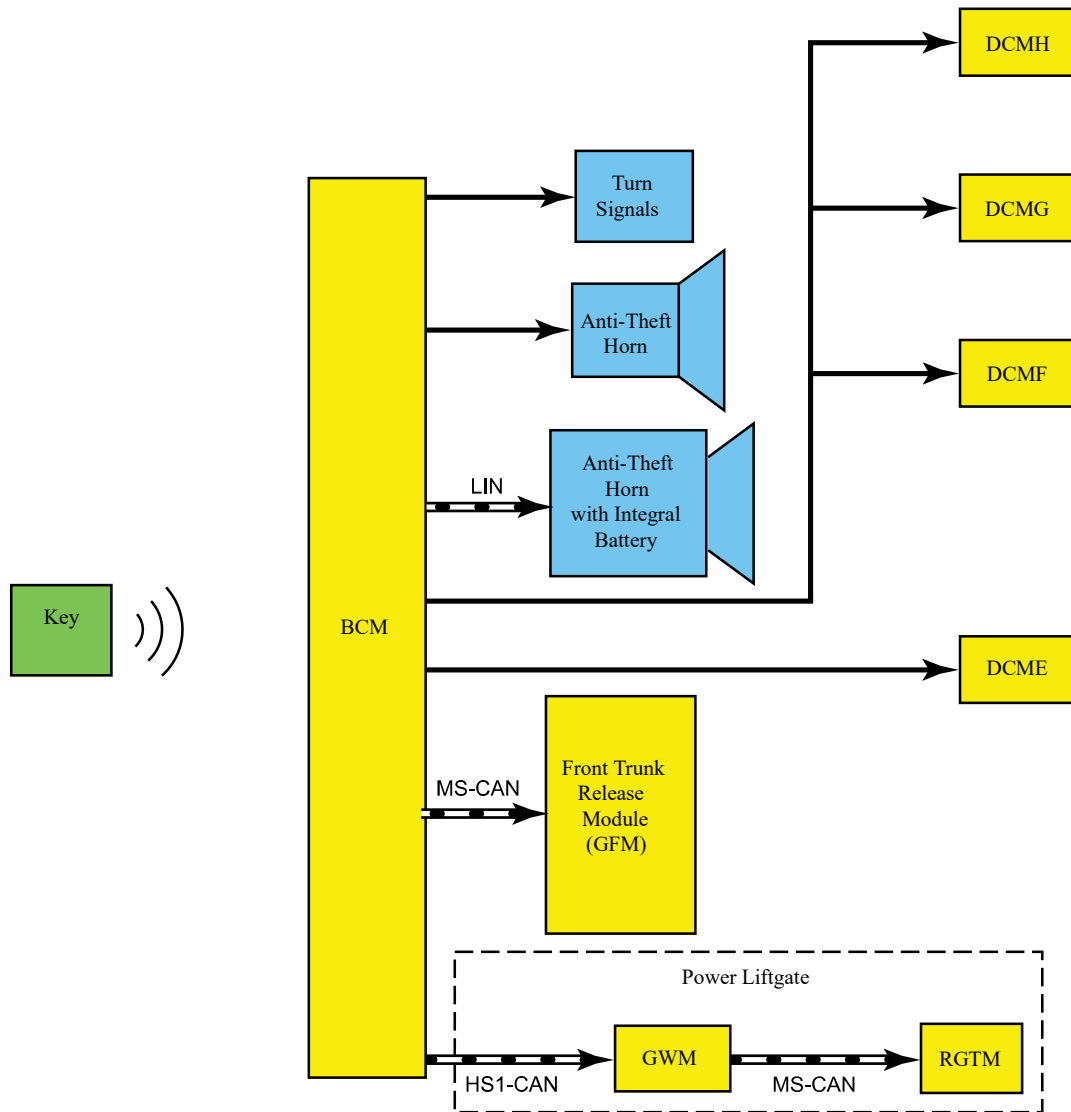
E347601

Front Trunk Luggage Compartment



E347603

RKE And Phone as a Key



E347606

Network Message Chart

BCM Network Input Messages

Broadcast Message	Originating Module	Message Purpose
Door lock switch status	<u>DDM</u> / <u>PDM</u>	Provides the <u>BCM</u> with lock/unlock requests based on the input from the front door lock control switch.
Vehicle speed	<u>SOBDMC</u>	Provides the <u>BCM</u> with the vehicle speed. The <u>BCM</u> uses this message to determine when to activate some features, such as the autolock feature.

IPC Network Input Messages

Broadcast Message	Originating Module	Message Purpose
Door latch fault	<u>DCME</u> / <u>DCMF</u> / <u>DCMG</u> / <u>DCMH</u>	Provides the <u>IPC</u> with the request to display a fault message in the message center.

DCME / DCMF / DCMG / DCMH Network Input Messages

Broadcast Message	Originating Module	Message Purpose
Vehicle lock status	<u>BCM</u>	Provides the door latch control modules with the vehicle lock/unlock status. The door latch control modules use this message to determine when to allow the electronic latch to release without the request of passive key information.
Vehicle speed	<u>SOBDMC</u>	Provides the door latch control modules with the vehicle speed. The door latch control modules use this message to determine when to allow the electronic latch to release when the vehicle is in motion.
Window lockout status	<u>BCM</u>	Provides the door latch control modules with the vehicle lock/unlock status. The door latch control modules use this message to determine when to allow the electronic latch to release without the request of passive key information.

RGTM Network Input Messages

Broadcast Message	Originating Module	Message Purpose
Vehicle lock status	<u>BCM</u>	Provides the <u>RGTM</u> with the lock/unlock status. The <u>RGTM</u> uses this message to determine when to allow the power liftgate to open when a power liftgate switch is pressed.

Front Trunk Release Module (GFM) Network Input Messages

Broadcast Message	Originating Module	Message Purpose
Vehicle lock status	<u>BCM</u>	Provides the Front Trunk Release Module (<u>GFM</u>) with the lock/unlock status. The Front Trunk Release Module (<u>GFM</u>) uses this message to determine when to allow the power front trunk open when a power front trunk switch is pressed.

Electronic Door Unlatch and Double Lock Actuators (if equipped)

The doors are electronically unlatched, and if equipped, with double lock actuators the locks lock completely from the inside. The double lock actuator incorporates switches for both latch mechanism position indication and lock mechanism position indication in a single assembly. Each door latch communicates on the MS-CAN and is identified by the scan tool as follows:

- Left front door - DCME

- Right front door - DCMF
- Left rear door - DCMG
- Right rear door - DCMH

Door Unlatch

The doors can be unlatched when the door latch control modules are in the unlock mode. The BCM sends vehicle lock status messages over the network as well as providing wired voltage signals (one for lock and one for unlock) to each door latch control module.

Each door latch control module sends multiple voltage signals to the exterior door latch release switches. When a front or rear exterior door latch switch is activated, the voltage signals change, indicating a request to unlatch the door. When the door latch control module detects the request to unlatch the door, it activates an internal solenoid to release the door latch.

When either front or rear exterior door latch switch is disconnected, a DTC sets in the respective door latch control module. When a door latch control module detects a fault from any of the inputs or outputs to the door latch, it sends a message to the IPC to display a door latch fault message.

Each door latch control module has an internal power backup, allowing the door latch release to function for approximately 20 activations or 72 hours after, a power loss (such as a disconnected or depleted battery).

The door lock actuators are commanded by the door latch modules to open the front doors.

The two front door lock control switches, located in the interior of the vehicle, sends a signal to the door latch modules that will open both front and rear doors. If the front door lock control switches are equipped with the memory function, refer to the Owners Literature for setting those features.

The door latch control modules provide voltage and ground to the door latch release motor. When activated, the door latch release motor partially opens the door. On the front door the door handle, (located just below the front exterior door latch switch), is then used to fully open the door. On the rear doors the door pad, (located just inside the rear door), is then used to fully open the door. The electric operation is tied into a PATS to prevent unauthorized operation. The exterior door latch switch lamp illuminates the button upon approaching the vehicle.

Double Lock Actuators (if equipped)

The door latch control module provides voltage to the double lock actuator motor. When activated, the double lock actuator disables the interior manual operation of the door control switch to lock the vehicle. The electric operation is tied into an PATS to prevent unauthorized operation.

Electronic Door Locks

Each door latch is a door latch control module that communicates on the network. The door latches use actuators to lock/unlock the doors. They rely on inputs from the BCM to determine if the door should be in lock or unlock mode. Locking and unlocking the doors is handled electronically.

A lock and unlock signal is provided to each door latch control module. The BCM provides voltage to the door lock circuits to actuate a solenoid when present. When a lock or unlock request is carried out by the BCM, it provides voltage to the lock and unlock circuits to each door latch control module as appropriate. When a door latch control module detects the voltage and ground combination, the door latch control module interprets that as a signal to electronically lock or unlock the door.

The door latch control modules send voltage signals to their respective front door lock control switch and the front or rear exterior door latch switch. When a front door lock control switch is pressed or a passive signal from a passive key is received by the front or rear front or rear exterior door latch switch, the voltage signal is routed to ground, indicating a request to lock/unlock the doors.

The BCM sends voltage signals to the rear door latch control modules. When a rear door latch control module detects a lock or unlock request, it grounds the respective voltage signal from the BCM to lock or unlock the doors.

When the BCM receives a valid lock or unlock request, it provides a voltage signal to the door latch control modules to either lock or unlock the door.

Each door latch control module also monitors the lock and unlock request signals from the corresponding front door

lock control switch and front or rear exterior door latch switch.

Based on input from the front or rear exterior door latch switch, the keyless entry keypad, the passive entry system and the RKE transmitter, the BCM sends a message to the front door lock control modules to request to lock or unlock all the doors.

The door latch control modules also provide an unlock override feature in the event of a severe crash event. Depending on the severity of the crash event, the RCM provides a network message and wired voltage signal to the door latch control modules. Approximately 10 seconds after the door latch control modules detect this input from the RCM, they enter a crash unlock mode to allow the doors to unlatch from the interior door handle or front or rear exterior door latch switch. The crash unlock mode is exited by cycling the ignition on and off twice.

Autolock

The autolock feature locks all of the doors after all of the following have occurred:

- All the doors are closed.
- The ignition is on.
- The vehicle is shifted into any gear to put the vehicle in motion.
- The vehicle attains a speed greater than 20 km/h (12.4 mph).

The autolock feature can be enabled/disabled if the setting is available in the message center settings. If the setting is not available in the message center settings, this feature cannot be disabled.

Auto-Unlock

NOTE: *The doors do not auto-unlock if the vehicle has been electronically locked before the driver door is unlocked.*

The auto-unlock feature unlocks all of the doors when all of the following conditions have been met:

- All the doors are closed and locked.
- The ignition was on.
- The vehicle was shifted out of park and a speed greater than 20 km/h (12.4 mph) was achieved.
- The vehicle has come to a stop.
- The ignition transitions to accessory or off and, within 10 minutes, the driver door is opened.

The auto-unlock feature can be enabled/disabled through the message center.

Walk Away Lock

Walk away lock is a locking feature that locks the vehicle when you walk away from the vehicle with the passive key or authorized phone programmed with Phone as a Key.

For additional information, See Owner's Literature.

Switch Inhibit Feature

The switch inhibit feature prevents unauthorized access to the vehicle from the front door lock control switches. The BCM disables the function of both front door lock control switches 20 seconds after the vehicle is electronically locked. If any of these switches are activated while they are inhibited, a chime sounds and a message is displayed in the message center to indicate the switches are inhibited. The BCM enables the function of these switches when the vehicle is electronically unlocked.

The BCM also sends a switch inhibit message to the door latch control modules and the RGTM (if equipped) over the network.

This feature can be configured on/off through the message center.

Liftgate Latch Release

The liftgate latch can be released when the vehicle is in PARK by:

- electronically unlocking the doors and then pressing the exterior liftgate release switch.
- pressing the liftgate button on a valid programmed passive key and then pressing the exterior liftgate release

switch within 45 seconds

The BCM sends a voltage signal to the liftgate release switch. When the liftgate release button is pressed, the voltage signal is routed to ground, indicating a request to release the liftgate latch. The BCM momentarily provides voltage to the liftgate latch to actuate the release motor.

Power Liftgate

For power liftgate information,

Refer to: [Body Closures - System Operation and Component Description](#) (501-03 Body Closures, Description and Operation).

Front Trunk Luggage Compartment

NOTE: *People should Never climb inside the front trunk luggage compartment. Never shut the front trunk luggage compartment when a person inside.*

The front trunk release module (GFM) provides power to the electronic latch release actuator for the front trunk luggage compartment. The actuator consists of a single motor unit capable of performing two consecutive release operations. The first operation releases the primary latch, and the second operation releases the secondary latch. When vehicle speed is less than 2 mph (3 km/h), both release pulses will be delivered by the module to release primary and secondary latch positions. When vehicle speed is greater than or equal to 2 mph (3 km/h), the module will only deliver the power signal to release the primary latch. Latch positions will be manually reset when the user applies downward force to the hood of the front trunk to place it back into closed position.

The actuator consists of a single motor unit performing two consecutive release operations. The first operation releases the primary latch, and the second operation releases the secondary latch. When vehicle speed is less than 2 mph (3 km/h), both release pulses will be delivered by the module to release primary and secondary latch positions. When vehicle speed is greater than or equal to 2 mph (3 km/h), the module will only deliver the power signal to release the primary latch. Latch positions will be manually reset when the user applies downward force to the hood of the front trunk to place it back into closed position.

The front trunk release module GFM is activated by the BCM to open the front trunk when signal from any of the following inputs are used: the APIM, Phone as a Key, keyless entry keypad, RKE transmitter. The front trunk emergency release switch communicates hood open requests directly to the front trunk release module GFM. The external battery jump port can provide external 12-volt power, through front trunk release relay module, to the hood release latch actuator when the 12-volt battery State-of-Charge (SOC) is less than the allowable threshold.

The front trunk release module GFM provides the BCM with the release status.

Keyless Entry Keypad

The keyless entry keypad is integrated into the door driver upper moulding. The BCM receives data from the keyless entry keypad. When a keypad button is touched, the button press data is sent to the BCM. When a valid code is received, the BCM sends a lock or unlock command to the door latch control module(s).

RKE

The RKE feature is controlled by the BCM. When a button is pressed, the Transmitter Identification Code (TIC) and RKE command is received by the BCM. If the BCM detects a valid programmed key, it carries out the command by sending a lock/unlock command to the door latch control modules or sending a message to the RGTM to power open/close the liftgate, or activating the horn or turn signals as required.

The RKE transmitters have a normal operating range of 30 m (98 ft) in an open air, no obstruction environment.

The RKE transmitters and the BCM also utilize a rolling code to prevent the code from being captured by a code grabber. The system advances the counter in the RKE transmitter and the BCM every time a RKE transmitter button is pressed.

The RKE is part of vehicle load shed strategy. For additional information

Refer to: [Battery Load Shed](#) (414-01 Battery, Mounting and Cables, Description and Operation).

Passive Entry

NOTE: The passive entry and the RKE system share operation of several components including the passive keys, and the BCM . If there is a concern with either of these components, the passive entry and the RKE system can both be affected.

Doors

With a programmed passive key within 1 m (3.28 ft) outside a door, touch the lock sensor at the bottom of the front door window moulding or activate the front or rear exterior door latch switch. The doors lock or unlock and unlatch depending upon which input the BCM receives.

The driver front door passive entry feature either unlocks the driver door (if 2-stage unlock is enabled) or all four doors (if 2-stage unlock is disabled). The passive entry feature always locks all four doors when the lock sensor is touched for a half second.

The remaining doors passive entry feature always locks or unlocks all four doors.

Liftgate

With a programmed passive key within 1 m (3.28 ft) outside the liftgate, press the liftgate button on the rear of the vehicle to open the liftgate.

The passive entry (Intelligent Access) feature is part of vehicle load shed strategy. For additional information Refer to: [Battery Load Shed](#) (414-01 Battery, Mounting and Cables, Description and Operation).

Door Passive Entry

Door Unlock and Unlatch

When the doors latch control modules are in lock mode and the request to unlatch the door is detected from the front or rear exterior door latch switch, the door lock control module sends a passive entry unlock request through a circuit monitored by the BCM .

When the BCM detects a passive entry unlock request, it activates the keyless entry door antennas. The keyless entry door antenna sends out a low frequency signal to the passive key. The low frequency signal activates the passive key and the passive key sends a high frequency signal to the BCM . The BCM interprets the high frequency signal from the passive key. If the BCM detects a valid programmed passive key, the BCM either commands the driver door to unlock or all the doors to unlock. The respective door latch control module then releases the door latch.

The passive entry unlock feature does not activate if the doors are in unlock mode.

Door Lock

The passive entry door lock touch sensors (located at the bottom of each door upper mouldings) are provided voltage by the BCM at all times. The sensor and the integrated lock LED are monitored and controlled by the respective front door latch control module. When the front door latch control module detects the lock sensor is touched, the door lock control module sends a passive entry lock request through a circuit monitored by the BCM .

When the BCM detects a passive entry lock request, it activates the keyless entry door antennas. The keyless entry door antenna sends out a low frequency signal to the passive key. The low frequency signal activates the passive key and the passive key sends a high frequency signal to the BCM . If the BCM detects a valid programmed passive key, the BCM commands all the doors to lock.

The passive entry lock feature does not activate if the doors are in lock mode.

The passive entry door lock touch sensors are integrated into the door upper mouldings.

Liftgate Passive Entry

When the BCM is in lock mode and the liftgate button is pressed or the liftgate hands free request is detected, it activates the rear keyless entry antenna inside the liftgate. The rear keyless antenna sends out a low frequency signal to the passive key. The low frequency signal activates the passive key and the passive key sends a high frequency signal to the BCM . The BCM interprets the high frequency signal from the passive key. If the BCM detects a valid programmed passive key, the BCM sends a request to the RGTM to open the power liftgate.

With a programmed passive key within 1 m (3.28 ft) outside the liftgate, press the exterior liftgate release button on the

rear of the vehicle to release the liftgate latch (manual liftgate) or power open the liftgate (power liftgate).

Remote Start (Phone as a Key only)

The factory-installed remote start allows the vehicle to be remotely started from outside the vehicle. There is a 2- way communication between the mobile device and the vehicle to provide the remote start status of the vehicle.

The vehicle should remotely start and the LED on the mobile device should be lit solid green.

The vehicle does not remote start if any of the following conditions are present:

- The phone as a key feature is not enabled.
- The hood is not closed.
- The vehicle is not in PARK.
- A powertrain system DTC is present, illuminating the service engine soon indicator.
- The ignition is on.
- The alarm system is triggered.
- The vehicle battery voltage is low.

For additional information regarding the remote start system, refer to the Owner's Literature.

Approach Detection

When the approach detection feature is active, the BCM uses the PATS antennas to detect a valid programmed passive key or phone when approaching within 1m (3.28ft) from the front or rear of the vehicle. When the BCM detects a valid programmed device, the illuminated entry feature activates.

For additional information for the illuminated approach detection entry and exit feature.

Refer to: [Interior Lighting - System Operation and Component Description](#) (417-02 Interior Lighting, Description and Operation).

For additional information for the PATS features.

Refer to: [Passive Anti-Theft System \(PATS\) - System Operation and Component Description](#) (419-01B Passive Anti-Theft System (PATS), Description and Operation).

Component Description

Front Door Lock Control Switches

The DDM and PDM provide voltage signals through the corresponding front door latch control module to the front door lock control switch for the lock and unlock requests. When a lock or unlock button is pressed, the corresponding input circuit is routed to ground, indicating a request to lock or unlock the doors.

The BCM provides voltage signals through the rear door latch control modules to the corresponding rear door lock actuator for the lock and unlock requests. When a switch is pressed to lock or unlock, the corresponding input circuit is routed to ground, indicating a request to lock or unlock the doors.

Door Lock Indicators

Each door lock indicator is integrated into a front door lock control switch. They are controlled by the respective door latch control module.

Exterior Door Latch Switch

The front or rear exterior door latch switch is integrated into the door upper mouldings. It is constantly monitored by the door latch control module. If the door latch control module detects a fault, a DTC sets and a message displays in the message center when the ignition is turned on to indicate a fault.

Liftgate Release Switch

The liftgate release switch is a momentary contact switch that supplies a ground signal to the BCM and , if equipped, the RGTM . When the liftgate release switch is pressed, the signal is routed to ground indicating a request to the BCM and the RGTM to release the liftgate latch or power open the liftgate.

Liftgate Latch (manual liftgate)

The liftgate latch contains the release actuator and the ajar switch. The BCM provides voltage to the actuator to unlatch the liftgate from the striker.

Keyless Entry Keypad

The keyless entry keypads are touch-sensitive capacitive sensors integrated into the driver door upper moulding. When a finger touches the keypad, it changes the capacitance of the sensor in the area of the finger touch. The keypad determines which area is touched and communicates the number/button touched to the BCM . The keypad only works when touched with a finger. The keyless entry keypad may not work when gloves are worn. The gloves act as an insulator and do not allow the finger to change the sensor capacitance.

The keyless entry keypad touch sensor is integrated into the front door upper window mouldings and cannot be replaced separately.

Passive Key

The passive key incorporates both the PATS and RKE transmitter functions in a single device.

During key programming procedures, the PATS and RKE transmitter identification of a passive key are both programmed. A maximum of 4 passive keys can be programmed.

In the event the passive key battery fails:

- the passive key must be placed in the backup starting location to start the vehicle.

Keyless Entry Door Antennas

The keyless entry door antennas are activated by the BCM . When activated, they transmit a low frequency signal to activate a passive key.

Keyless Entry Rear Antenna

The keyless entry rear antenna is activated by the BCM . When activated, it transmits a low frequency signal to activate a passive key.

Door Latch Control Module

The door latch control modules are sealed units and contain the door latch release actuator, the door ajar switch, a door latch cinch motor (if equipped), sensors to monitor the latch position and a module that communicates on the network to control the door latch functions. The door latches can be lubricated, if needed.

The door latch control modules require PMI when replaced.

Double Lock Actuator (if equipped)

The double lock actuator is controlled by the door latch control module. It is mounted to the door latch control module and cannot be serviced separately.

DDM or PDM

The DDM and the PDM monitor the front door lock control switches and control the operation of the power windows and the power mirrors. They communicate with each other and the BCM over the CAN .

The DDM and PDM require PMI when replaced.

Front Trunk Release Module (GFM)

The front trunk release module GFM provides power to the electronic latch release actuator.

The front trunk release module GFM requires PMI when replaced.

Front Trunk Release Relay Module

The front trunk release relay modules provides secondary power and signal to the hood latch release cable actuator.

The front trunk release relay module is also the pass-through for the exterior jump post in the event no switch will open the hood.

Hood Latch Release Cable Actuator

The hood latch release cable actuator is provided power through an auxiliary relay box from the BJB , ground signal from the BCM and power actuation from the front trunk release relay to actuate the hood latch.

BCM

The BCM controls the power door lock system. It is responsible for locking/unlocking the doors. The BCM receives inputs for the front door lock control switches, passive keys and RKE commands over the CAN .

The BCM requires PMI when replaced. Additionally, carry out the parameter reset procedure and program at least 2 keys.

© Copyright 2023, Ford Motor Company.