

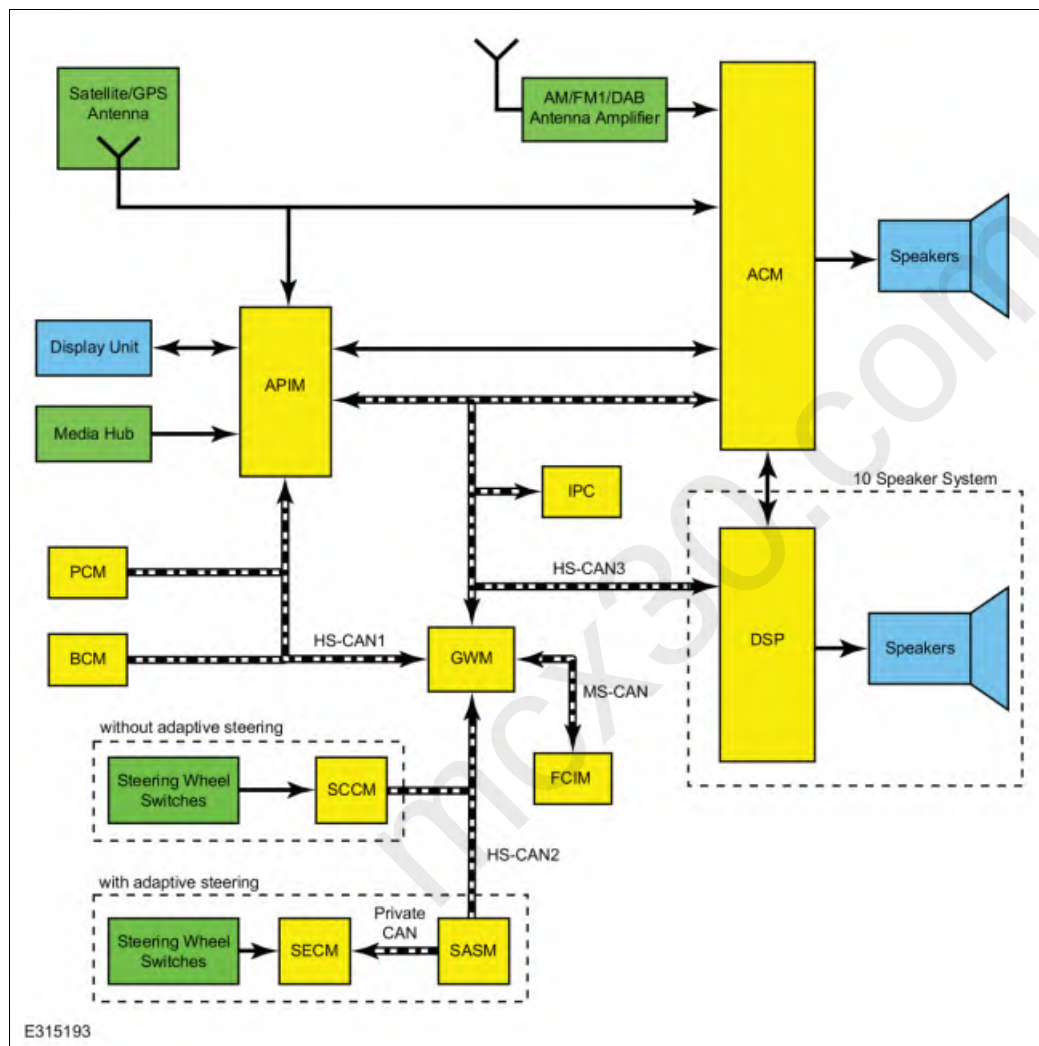
# Information and Entertainment System - System Operation and Component Description

## System Operation

## System Diagram

**NOTE:** The system diagrams may include all component options. Some components may not be equipped on the vehicle.

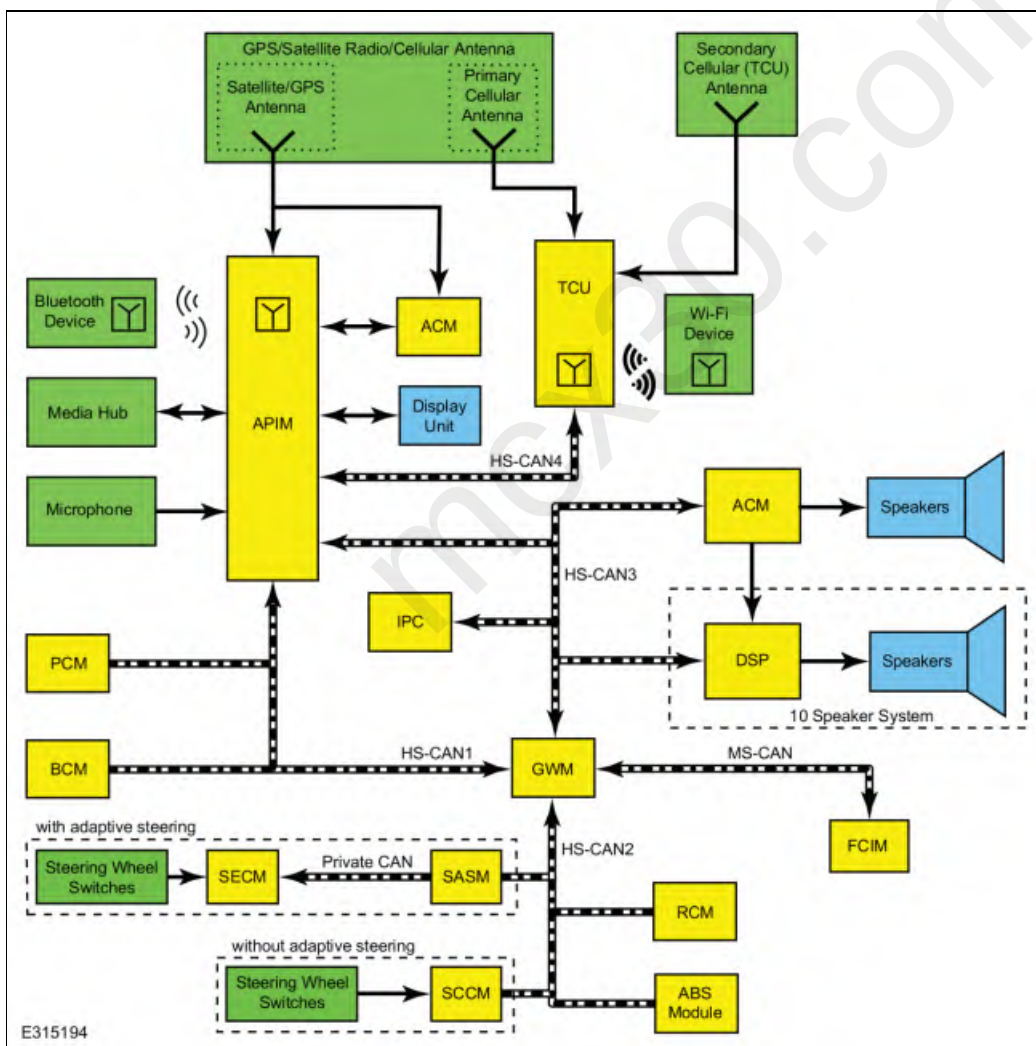
## Audio System



| Item | Description           |
|------|-----------------------|
| 1    | APIM                  |
| 2    | Speakers              |
| 3    | Display Unit          |
| 4    | GWM                   |
| 5    | BCM                   |
| 6    | ACM                   |
| 7    | DSP                   |
| 8    | IPC                   |
| 9    | Satellite/GPS Antenna |

|    |                                |
|----|--------------------------------|
| 10 | AM/ FM1/ DAB Antenna Amplifier |
| 11 | PCM                            |
| 12 | Speakers                       |
| 13 | Media Hub                      |
| 14 | Steering Wheel Switches        |
| 15 | SCCM                           |
| 16 | Steering Wheel Switches        |
| 17 | SECM                           |
| 18 | with adaptive steering         |
| 19 | without adaptive steering      |
| 20 | SASM                           |
| 21 | 10 Speaker System              |
| 22 | FCIM                           |

### SYNCA,ç System



| Item | Description  |
|------|--------------|
| 1    | APIM         |
| 2    | Display Unit |
| 3    | Media Hub    |
| 4    | Microphone   |

|    |                                      |
|----|--------------------------------------|
| 5  | ABS Module                           |
| 6  | RCM                                  |
| 7  | GWM                                  |
| 8  | BCM                                  |
| 9  | PCM                                  |
| 10 | IPC                                  |
| 11 | ACM                                  |
| 12 | Bluetooth Device                     |
| 13 | Speakers                             |
| 14 | GPS/Satellite Radio/Cellular Antenna |
| 15 | Primary Cellular Antenna             |
| 16 | Satellite/GPS Antenna                |
| 17 | DSP                                  |
| 18 | ACM                                  |
| 19 | Speakers                             |
| 20 | TCU                                  |
| 21 | Secondary Cellular (TCU) Antenna     |
| 22 | Wi-Fi Device                         |
| 23 | Steering Wheel Switches              |
| 24 | SCCM                                 |
| 25 | Steering Wheel Switches              |
| 26 | SECM                                 |
| 27 | with adaptive steering               |
| 28 | without adaptive steering            |
| 29 | SASM                                 |
| 30 | FCIM                                 |
| 31 | 10 Speaker System                    |

## Network Message Chart

### ACM Network Input Messages

| Broadcast Message            | Originating Module | Message Purpose                                                                                   |
|------------------------------|--------------------|---------------------------------------------------------------------------------------------------|
| Battery saver status         | BCM                | Disables the functionality of the ACM due to the load shedding feature.                           |
| Chime controls               | IPC                | Controls the characteristics of the warning chime tones played through the audio system speakers. |
| Chime source                 | IPC                | Sets the audio system or IPC as the source for the chime tones.                                   |
| FCIM button state            | FCIM               | Indicates the button pressed on the FCIM.                                                         |
| Ignition status              | BCM                | Indicates the ignition mode.                                                                      |
| MyKey Belt-Minder audio mute | IPC                | Mutes speaker output so the Belt-Minder tone can be more easily heard.                            |
| MyKey volume limit status    | IPC                | Limits the maximum audio system volume when a MyKey restricted key is in use.                     |
| Steering wheel switch status | SCCM/ SECM         | Indicates the button press status of the steering wheel switches.                                 |
| SYNC alerts                  | APIM               | Controls the characteristics of the SYNC notifications.                                           |
| Vehicle configuration data   | BCM                | Verifies vehicle configuration data such as the VIN and system module configuration.              |
| Vehicle speed                | PCM                | Used for the speed compensated volume function.                                                   |

## APIM Network Input Messages

| Broadcast Message                 | Originating Module | Message Purpose                                                                                  |
|-----------------------------------|--------------------|--------------------------------------------------------------------------------------------------|
| 911 Assist override status        | IPC                | Enables or disables the Always on 911 Assist or emergency assistance MyKey feature.              |
| Airbag deployment status          | RCM                | Monitors airbag deployment status for 911 Assist or emergency assistance.                        |
| Date and time                     | BCM                | Displays the current date and time on the display unit.                                          |
| Display language selection        | IPC                | Displays information on the display unit in the language as selected by the user.                |
| Call notification                 | RCM                | Notifies of a 911 Assist or emergency assist call being initiated due to airbag deployment.      |
| FCIM button state                 | FCIM               | Indicates the button pressed on the FCIM                                                         |
| Ignition status                   | BCM                | Indicates the ignition mode.                                                                     |
| Illumination dimming level        | BCM                | Controls the backlight intensity.                                                                |
| MyKey volume limit status         | IPC                | Limits the maximum audio system volume when a MyKey restricted key is in use.                    |
| Rolling wheel count and direction | ABS module         | Provides more accurate vehicle position tracking when the GPS signal is temporarily unavailable. |
| Steering wheel switch status      | SCCM/ SECM         | Indicates the button press status of the steering wheel switches.                                |
| Vehicle configuration data        | BCM                | Verifies vehicle configuration data such as the VIN and system module configuration.             |
| Vehicle speed                     | PCM                | Used for navigation functionality.                                                               |

## DSP Network Input Messages

| Broadcast Message            | Originating Module | Message Purpose                                                                                   |
|------------------------------|--------------------|---------------------------------------------------------------------------------------------------|
| Chime controls               | IPC                | Controls the characteristics of the warning chime tones played through the audio system speakers. |
| Chime source                 | IPC                | Sets the audio system or IPC as the source for the chime tones.                                   |
| Ignition status              | BCM                | Indicates the ignition mode.                                                                      |
| MyKey Belt-Minder audio mute | IPC                | Mutes speaker output so the Belt-Minder tone can be more easily heard.                            |
| MyKey volume limit status    | IPC                | Limits the maximum audio system volume when a MyKey restricted key is in use.                     |
| Vehicle configuration data   | BCM                | Verifies vehicle configuration data such as the VIN and system module configuration.              |
| Vehicle speed                | PCM                | Used for the speed compensated volume feature.                                                    |

## TCU Network Input Messages

| Broadcast Message     | Originating Module | Message Purpose                                                                         |
|-----------------------|--------------------|-----------------------------------------------------------------------------------------|
| GPS data              | APIM               | Indicates the vehicle location via the FordPass mobile application.                     |
| Ignition status       | BCM                | Indicates the ignition mode.                                                            |
| Odometer master value | IPC                | Indicates the odometer value via the FordPass mobile application.                       |
| Transport mode        | BCM                | Disables the functionality of the TCU until the vehicle is taken out of transport mode. |

| Broadcast Message   | Originating Module | Message Purpose                                                          |
|---------------------|--------------------|--------------------------------------------------------------------------|
| Vehicle lock status | BCM                | Indicates the vehicle lock/unlock mode.                                  |
| Wi-Fi request       | APIM               | Controls various Wi-Fi features, such as password and add/remove device. |

## Audio System

**NOTE:** Refer to the Owner Literature for additional details of the audio system.

### ACM Operation

The ACM receives and sends network messages over the CAN. A diagnostic scan tool can retrieve Diagnostic Trouble Codes (DTCs), PID data and carry out other diagnostic functions for the ACM via the vehicle DLC.

The ACM is powered at all times and uses the ignition status message to control the on/off mode. The accessory delay feature is controlled by an ignition status message from the BCM.

The ACM takes various inputs such as radio waves and audio signals, conditions, amplifies and converts them to an analog audio signal. This signal can be amplified internally and sent directly to the speakers, or transmitted to a separate amplifier and speaker system.

The ACM uses the BCM ignition status message to temporarily mute audio output during engine cranking. This prevents the normal voltage spikes during engine cranking from producing popping noises in the audio system.

The ACM (or the DSP if equipped with 10 speakers) receives vehicle speed information from the PCM over the CAN to adapt the volume based on the different vehicle speeds.

### AM/ FM/ DAB Radio

When the AM/ FM mode is selected, the radio amplifies radio waves sent from the antenna. It then selects the requested frequency, converts and amplifies the content. These fluctuating audio signals are output as AC output voltage to power the speakers or as an input to a separate amplifier.

If equipped with High Definition (HD) radio capability, the radio automatically detects and plays back the improved sound quality and multiple programs of HD broadcasts. HD-equipped radios use the existing standard AM/ FM antenna for signal reception. If a concern only exists for the HD radio feature, refer to the troubleshooting guide within the Owner Literature.

If equipped with DAB capability, the radio can provide improved sound quality and multiple programs of digital broadcasts.

DAB-equipped radios are not available in North America.

### Satellite Radio (if equipped)

Satellite signals collected by the satellite radio antenna can be selected and played back over the audio system. The satellite antenna sends satellite radio and GPS data through the satellite radio cable to a splitter (integrated into the cable). The satellite radio signals are separated by the splitter and sent to the satellite radio receiver within the ACM.

### SYNC Input

The ACM receives stereo and monaural audio wired inputs from the SYNC system. These include USB or Bluetooth connected music sources, phone call audio, and more.

When the USB input mode is selected, the radio converts the digital media playback to analog audio signals. It amplifies and sends this output to the speakers.

If a compatible phone is paired with the SYNC system, phone call audio may be heard on the vehicle speakers and the spoken response is transmitted to outgoing phone call audio.

### ACM Speaker Output - 4, 6, 5 and 7 Speaker System

The ACM is configured to directly power vehicle speakers. An amplifier in the final stage of the ACM sends an analog AC signal to drive the speakers. Output includes stereo channels. The ACM powers all of the vehicle speakers.

A speaker circuit short to ground or power can be detected by the ACM. The ACM may disable speakers to prevent damage to the internal amplifier. A DTC sets to identify which speaker circuits are causing the concern. This may cause all audio to be inoperative.

### ACM Signal/Speaker Output - 10 Speaker System

The ACM is configured to directly power some of the vehicle speakers. An amplifier in the final stage of the ACM sends an analog AC signal to drive the speakers. Output includes stereo channels to the front A-pillar tweeter speakers.

The ACM outputs audio data over an Automobile Audio Bus (A2B) cable to the DSP. The DSP powers the remaining vehicle speakers. Output includes stereo, center and subwoofer channels.

A speaker circuit short to ground or power can be detected by the ACM and the DSP. The ACM and the DSP may disable speakers to prevent damage to the internal amplifier. A DTC sets to identify which speaker circuits are causing the concern. This may cause all audio to be inoperative.

### **Remote Audio Controls - Vehicles Not Equipped With Adaptive Steering**

The steering wheel switches contain a series of resistors. Each steering wheel audio function switch has a specific resistance value. The SCCM and switch assembly are connected in a voltage divider circuit. The voltage drop over an internal SCCM resistor is changed by the different audio switch function resistances. The SCCM monitors the voltage drop across its internal resistor to determine which steering wheel switch is pressed. The SCCM transmits the steering wheel switch inputs over the CAN to the ACM, to control audio functions.

### **Remote Audio Controls - Vehicles With Adaptive Steering**

The steering wheel switches contain a series of resistors. Each steering wheel audio function switch has a specific resistance value. The SECM and switch assembly are connected in a voltage divider circuit. The voltage drop over an internal SECM resistor is changed by the different audio switch function resistances. The SECM monitors the voltage drop across its internal resistor to determine which steering wheel switch is pressed. The SECM transmits the steering wheel switch inputs over a private CAN to the SASM which relays the message over the HS-CAN to the ACM, to control audio functions.

### **SYNC System**

**NOTE:** Refer to the Owner Literature for additional details of the SYNC system.

The APIM contains the SYNC software. The SYNC system connects various inputs over Bluetooth or USB connections to the car audio system. The SYNC system allows driver control of a phone, media device, and vehicle systems (navigation and climate control for example).

The APIM is powered at all times and uses the BCM ignition status message to control the on/off mode. The accessory delay feature is controlled by an ignition status message from the BCM.

### **SYNC Inputs**

- USB - media players or flash drives
- Bluetooth - phones or media players
- Display unit and FCIM or panel switches
- Steering wheel switches
- Voice microphone input
- GPS data
- Serial data link wired input from the ACM

### **SYNC Outputs**

- Display unit (touchscreen or non-touchscreen) CAN messages
  - Audio system commands from the touchscreen equipped vehicles
  - HVAC commands from touchscreen-equipped vehicles
- Wired outputs to the ACM
  - Stereo (2 channel) audio
  - Monaural voice responses, including navigation guidance (if equipped)
  - Monaural phone call audio and phone ringtone
- Commands to a USB or Bluetooth device
  - Outgoing call commands
  - Text-to-speech information for a phone
  - USB device file selection for playback

### **Remote SYNC Controls - Vehicles Not Equipped With Adaptive Steering**

The steering wheel switches contain a series of resistors. Each steering wheel audio function switch has a specific resistance value. The SCCM and switch assembly are connected in a voltage divider circuit. The voltage drop over an internal SCCM resistor is changed by the different audio switch function resistances. The SCCM monitors the voltage drop across its internal resistor to determine which steering wheel switch is pressed. The SCCM transmits the steering wheel switch inputs over the CAN to the APIM to control SYNC functions.

### **Remote Audio Controls - Vehicles With Adaptive Steering**

The steering wheel switches contain a series of resistors. Each steering wheel SYNC function switch has a specific resistance value. The SECM and switch assembly are connected in a voltage divider circuit. The voltage drop over an internal SECM resistor is changed by the different SYNC

switch function resistances. The SECM monitors the voltage drop across its internal resistor to determine which steering wheel switch is pressed. The SECM transmits the steering wheel switch inputs over a private CAN to the SASM which relays the message over the HS-CAN to the ACM, to control SYNC functions.

### **Bluetooth Mode**

The APIM supports multiple Bluetooth profiles, allowing the SYNC system to interact with both Bluetooth-enabled phones and Bluetooth-enabled media devices.

### **USB Mode**

The APIM receives serial data input from connected USB devices. The USB cable(s) to the APIM are shielded to prevent interference from electromagnetic sources. The APIM provides power for the USB port in the media hub.

### **Voice Commands**

When the steering wheel voice button is pressed, a CAN message is sent to the APIM, initiating the voice command feature.

When voice commands are spoken, the monitored sounds are converted into analog signals by the microphone and sent to the APIM. The APIM software interprets them and outputs a command.

### **Compass**

The GPS antenna (integral to the satellite radio antenna) is used to acquire the compass heading.

The compass data is sent through the GPS cable to the APIM. The APIM uses this data in addition to wheel speed and wheel rotation direction messages from the ABS module to calculate and provide accurate vehicle tracking. The APIM processes the data and transmits it through the LVDS cable to the display unit. In the event the GPS fix or signal is temporarily lost, the APIM continues to use CAN messages from the ABS module to maintain compass accuracy.

### **Navigation (if equipped)**

The APIM receives GPS data from the satellite and the GPS antenna via a coaxial cable. The GPS data is used for the compass heading, vehicle location (in the event of airbag deployment) and navigation guidance. The APIM uses the GPS data along with ABS module wheel speed and rotation direction to provide accurate navigation tracking. In situations where the GPS signal is temporarily lost, the APIM continues to use the ABS module and vehicle acceleration data to continue vehicle tracking.

The navigation map data is stored in the APIM. It can be updated using a USB flash drive. The APIM processes the data and transmits it to the display unit through the LVDS cable.

### **SIRIUS® Travel Link® (if equipped)**

The SIRIUS® Travel Link® is a subscription-based service available on vehicles equipped with navigation. The satellite radio antenna receives digital signals containing Travel Link® data. These signals are routed to the satellite radio receiver (integral to the ACM) from a splitter that is part of the GPS antenna coaxial cable. The satellite receiver decrypts the data and the ACM sends it through wired circuits to the APIM.

Certain date-dependent features (such as sports schedules and scores, movie times, or the 5-day weather forecast) require the use of GPS data for accuracy. The APIM processes the data from the ACM and sends it to display on the touchscreen. The time intervals for each Travel Link category to update the data vary, depending on the category.

### **Digital Radio Data Link (if equipped)**

The digital radio data link is a subscription-free based service available on vehicles equipped with navigation. The DAB radio antenna receives digital signals containing digital radio data. These signals are routed to the radio receiver (integral to the ACM) from audio unit antenna coaxial cable. The digital radio receiver decrypts the data and the ACM sends it through wired circuits to the APIM.

Certain date-dependent features (such as sports schedules and scores, movie times, or the 5-day weather forecast) require the use of GPS data for accuracy. The APIM processes the data from the ACM and sends it to display on the touchscreen. The time intervals for each category to update the data varies, depending on the category.

Digital Radio Data Link is not available in North America.

### **SYNC Connect (if equipped)**

The SYNC Connect system uses the TCU to communicate via the cellular network with a device running the SYNC Connect application. The TCU communicates with other vehicle modules over the CAN to obtain information or to carry out application commands, depending on the request.

The primary means of communication between the TCU and the cellular network uses a cellular antenna integrated into the GPS/satellite radio antenna. A separate coaxial cable connects the cellular portion of the antenna to the TCU. The secondary means of communication between the

TCU and the cellular network is the secondary cellular (TCU) antenna. The TCU antenna connects to the TCU via a coaxial cable.

SYNC Connect data is transmitted via the cellular network to a server or cellular device with the SYNC Connect application installed. The data received via the cellular network from the device application is processed by the TCU, which can make vehicle system commands via the CAN.

### **Vehicle Wi-Fi Hotspot (if equipped)**

The TCU provides the vehicle Wi-Fi access point.

The TCU communicates to the cellular network by two means. The primary connection is through the cable to the cellular antenna incorporated into the GPS/Satellite antenna. The secondary means is through the cable to the secondary cellular (TCU) antenna.

### **Component Description**

#### **AM/ FM1/ DAB Antenna**

The AM/ FM1/ DAB antenna (also called the audio unit antenna) is an aerial antenna, mounted to the right side of the cowl. It receives AM/ FM/ DAB radio waves and sends them through the audio unit antenna amplifier to the ACM via the audio unit antenna coaxial cable (also called the AM/ FM1/ DAB antenna coaxial cable).

#### **DAB Antenna Amplifier**

The DAB antenna amplifier amplifies digital FM radio signals to improve reception. The amplified signal is sent through a coaxial cable to the ACM. The amplifier is powered by the ACM through the coaxial cable.

#### **GPS/Satellite Radio Antenna**

The GPS/satellite radio antenna contains a GPS antenna circuit board that receives radio waves containing GPS and satellite radio data. The data is sent through the coaxial cable to the ACM (satellite radio data) and through a splitter to the APIM (GPS data).

#### **Cellular Antenna**

If equipped, the GPS/satellite radio antenna contains a cellular antenna circuit board that receives radio waves containing cellular data. The data is sent through the cellular antenna coaxial cable to the TCU.

#### **Secondary Cellular (TCU) Antenna**

The secondary cellular (TCU) antenna boosts reception for incoming and outgoing cellular network data. It is a compact, cellular phone type antenna.

#### **Voice Microphone**

The voice microphone is connected to the ACM (vehicles not equipped with SYNC) or the APIM (vehicles equipped with SYNC) and is located in the overhead console or mounted to the headliner.

#### **Steering Wheel Switches**

The steering wheel switches contain a series of resistors. Each steering wheel audio function switch has a specific resistance value. The SCCM (or SECM if equipped with adaptive steering) and switch assemblies are connected in a voltage divider circuit.

#### **SCCM**

The voltage drop over an internal SCCM resistor is changed by the different audio switch function resistances. The SCCM monitors the voltage drop across its internal resistor to determine which steering wheel switch is pressed.

The SCCM requires PMI when it is replaced.

#### **SECM**

The voltage drop over an internal SECM resistor is changed by the different audio switch function resistances. The SECM monitors the voltage drop across its internal resistor to determine which steering wheel switch is pressed.

The SECM requires PMI when it is replaced.

#### **USB Port - Vehicles Equipped With A Non-Touchscreen Display Unit**

A single slot USB port is powered by the APIM. The port consists of connections for the 5 volt power and for digital serial data transfer between a USB device and the APIM.

Data is sent from the USB device to the APIM through a USB cable.

## **USB Ports - Vehicles Equipped With A Touchscreen Display Unit**

A double slot USB port is integrated into the media hub and has a separate power and ground provided by the APIM. The media hub has an internal 5 volt power source for the USB ports. Each port consists of connections for the 5 volt power and for digital serial data.

Data is sent from the USB ports to the APIM through a USB cable.

## **LVDS Cable**

The four-circuit shielded LVDS cable provides power and ground from the APIM to the display unit. Data is transmitted between the APIM and the display unit via the LVDS cable.

## **Display Unit**

The display unit may also be known as the non-touchscreen display (FCDIM) or the touchscreen display (FDIM).

The APIM and the display unit exchange information via the LVDS cable. The APIM can communicate display unit-related Diagnostic Trouble Codes (DTCs) over the CAN. The APIM provides the display unit with power and ground through the LVDS cable. The display unit itself does not communicate over the CAN.

## **ACM**

The ACM requires PMI when it is replaced.

## **DSP**

The DSP is a power amplifier for the vehicle speakers. The audio input signal comes from the ACM via the Automobile Audio Bus (A2B) cable. It may drive all speakers on a vehicle or share the speaker output with the ACM.

The DSP requires PMI when it is replaced.

## **FCIM**

The control or switch functions of the FCIM are primarily climate control related. The FCIM requires PMI when it is replaced.

## **TCU**

The TCU connects the vehicle to a cellular network. It contains a non-serviceable internal SIM card.

The TCU requires PMI when it is replaced.

## **APIM**

The APIM consists of two internal modules: the CIP and the VIP. The modules are integrated into the APIM but can be programmed individually if required.

The CIP connects to user devices via Bluetooth, USB or Wi-Fi.

The VIP provides vehicle information for the CIP and other SYNC Apps or functions. In addition, the VIP obtains information from the modules on the network for Diagnostic Trouble Codes (DTCs) when a vehicle health report is requested.

## **APIM Programming**

The APIM CIP or VIP software can be updated. When directed by Ford service, the VIP programming is done via the CAN using a diagnostic scan tool.

The CIP programming may be done using the diagnostic scan tool, Wi-Fi or the SYNC USB connection.

The CIP may also be programmed by registered owners using the Ford owner website. Updates are written to a USB drive and taken to the vehicle USB for programming. After the update completes, the APIM CIP writes the new software level and VIN to the USB flash drive. The vehicle owner must transmit this information back to Ford via the internet.

## **BCM**

The BCM contains the clock software and sends the date/time data information to other modules via the CAN.

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