

415-00B Information and Entertainment System - General Information - Vehicles  
With: SYNC 3

2019 Ranger

Description and Operation

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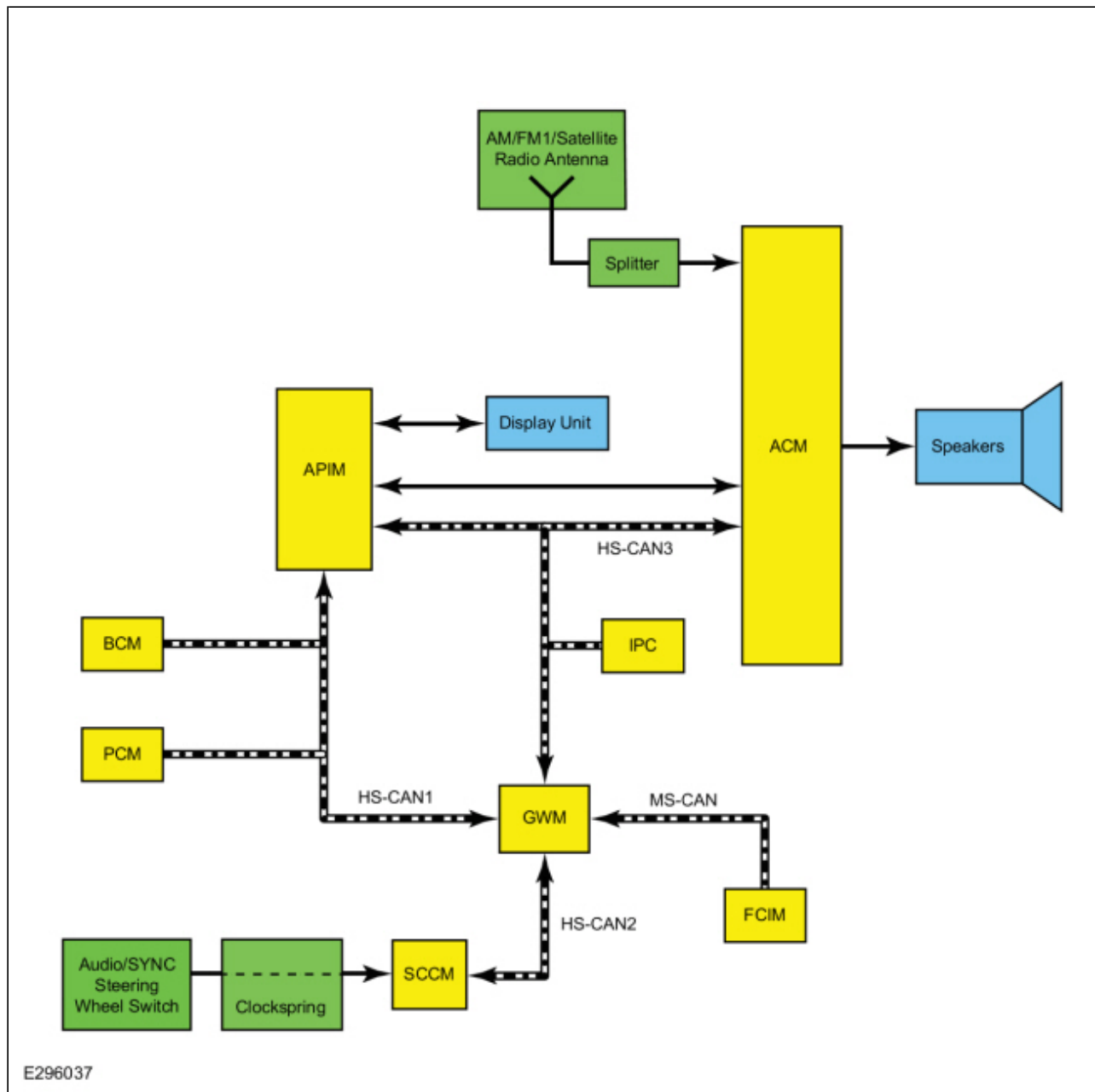
## Information and Entertainment System - System Operation and Component Description

### System Operation

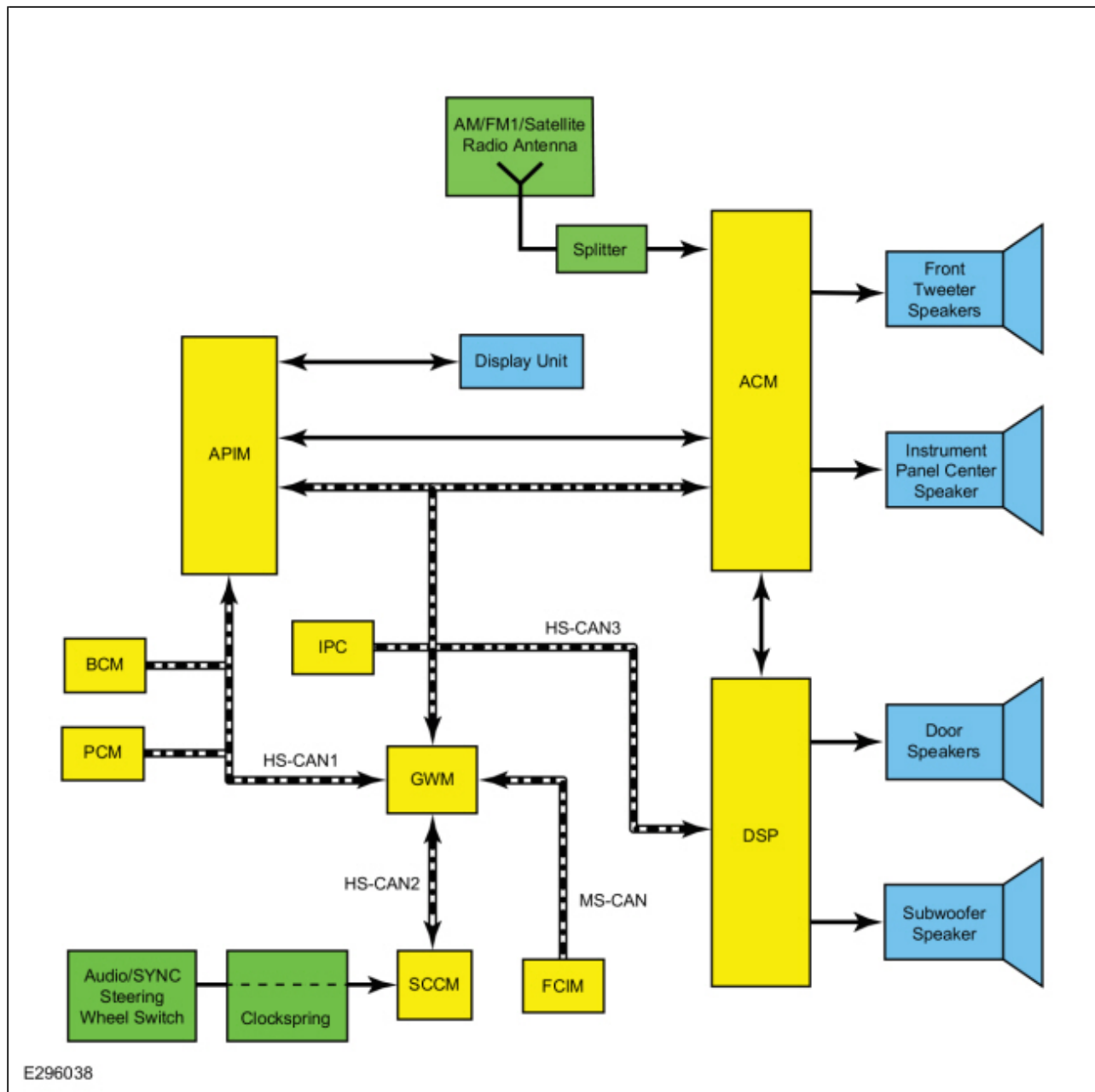
#### System Diagram

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

#### Audio System - 6 Speaker System



**Audio System - 8 Speaker System**



## SYNC System



MyKey Belt-Minder audio mute	<u>IPC</u>	Used to mute speaker output so the Belt-Minder tone can be more easily heard. This message only applies to vehicles with a MyKey enabled and in use. The audio system is muted until the safety belt(s) are buckled.
MyKey volume limit status	<u>IPC</u>	Used to limit the maximum audio system volume when a MyKey restricted key is in use.
Power shed level request	<u>BCM</u>	Used to disable the functionality of the <u>ACM</u> due to the load shedding feature.
Steering wheel switch status	<u>SCCM</u>	Used to indicate the button press status of the steering wheel switches.
SYNC alerts	<u>APIM</u>	Used to control the characteristics, volume, and speaker output of the SYNC notifications [text message, news, sports, weather and artist/title favorites (if activated)].
Transport mode	<u>BCM</u>	Used to disable the functionality of the <u>ACM</u> until taken out of transport mode.
Vehicle configuration data	<u>BCM</u>	Used to verify vehicle configuration data such as the <u>VIN</u> and system module configuration.
Vehicle speed	<u>PCM</u>	Used for the speed compensated volume function.

### **DSP Network Input Messages**

<b>Broadcast Message</b>	<b>Originating Module</b>	<b>Message Purpose</b>
Chime source	<u>IPC</u>	Used to set the audio system or <u>IPC</u> as the source for the chime tones.
Ignition status	<u>BCM</u>	Used to indicate the ignition mode.
Vehicle configuration data	<u>BCM</u>	Used to verify vehicle configuration data such as the <u>VIN</u> and system module configuration.

### **APIM Network Input Messages**

<b>Broadcast Message</b>	<b>Originating Module</b>	<b>Message Purpose</b>
Airbag deployment status	<u>RCM</u>	Used to monitor airbag deployment status for 911 Assist or emergency assistance.
Date and time	<u>BCM</u>	Used to display the current date and time on the display.
Display language selection	<u>IPC</u>	Used to display information on the display in the language as selected by the user.
eCall notification	<u>RCM</u>	Used to notify of a 911 Assist or emergency assist call being initiated due to airbag deployment.
<u>FCIM</u> button state	<u>FCIM</u>	Used to indicate when a button is pressed on the <u>FCIM</u> .
Ignition status	<u>BCM</u>	Used to indicate the ignition mode.
Illumination dimming level	<u>BCM</u>	Used to control the backlight intensity.

MyKey volume limit status	<u>IPC</u>	Used to limit the maximum audio system volume when a MyKey restricted key is in use.
Navigation rolling wheel count and direction	<u>ABS</u> module	Used to provide more accurate vehicle position tracking when the <u>GPS</u> signal is temporarily unavailable.
Steering wheel switch status	<u>SCCM</u>	Used to indicate the button press status of the steering wheel switches.
Transport mode	<u>BCM</u>	Used to disable the functionality of the <u>APIM</u> until taken out of transport mode.
Vehicle configuration data	<u>BCM</u>	Used to verify vehicle configuration data such as the <u>VIN</u> and system module configuration.
Vehicle speed	<u>PCM</u>	Used for navigation functionality.

### **FCIM Network Input Messages**

<b>Broadcast Message</b>	<b>Originating Module</b>	<b>Message Purpose</b>
Illumination dimming level	<u>BCM</u>	Used to control the backlight intensity.
Ignition status	<u>BCM</u>	Used to indicate the ignition mode.
Power shed level mode	<u>IPC</u>	Used to disable the functionality of the <u>FCIM</u> due to the load shedding feature.
Vehicle configuration data	<u>BCM</u>	Used to verify vehicle configuration data such as the <u>VIN</u> and system module configuration.

### **TCU Network Input Messages**

<b>Broadcast Message</b>	<b>Originating Module</b>	<b>Message Purpose</b>
Door ajar status	<u>BCM</u>	Used to indicate a door ajar condition.
GPS data	<u>APIM</u>	Used to indicate the vehicle location via the FordPass mobile application.
Ignition status	<u>BCM</u>	Used to indicate the ignition mode.
Odometer value	<u>IPC</u>	Used to indicate the odometer value via the FordPass mobile application.
Transport mode	<u>BCM</u>	Used to disable the functionality of the <u>TCU</u> until the vehicle is taken out of transport mode.
Vehicle lock status	<u>BCM</u>	Used to indicate the vehicle lock/unlock mode.
Wi-Fi request	<u>APIM</u>	Used to control 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 (radio waves and audio signals for example), conditions and amplifies them, 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 BCM ignition status message is used 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 receives vehicle speed information, used to adjust audio volume with different vehicle speeds, from the PCM over the CAN.

### AM/ FM 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 HD Radio capability, the radio automatically detects and outputs the improved sound quality and multiple programs of HD broadcasts.

### Satellite Radio

If equipped with satellite radio capability, 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 hard-wired inputs from the SYNC system. These include USB or Bluetooth connected music sources, phone call audio, and more. Refer to the SYNC System information in Description and Operation, System Operation.

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 Bluetooth-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 - 6 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.

### **ACM Signal/Speaker Output - 8 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 include stereo channels to the front tweeters and a center channel to the instrument panel center speaker.

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 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.

### **Remote Audio Controls**

The audio system 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 resultant 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.

### **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 inputs or panel switches
- Steering wheel switches
- Voice microphone input
- GPS data
- Satellite radio wired input from the ACM

### **SYNC Outputs**

- CAN messages
  - Audio system commands from the display unit
  - HVAC system commands from the display unit
- Wired outputs between the APIM and the ACM
  - Stereo audio (Bluetooth/USB streaming and phone call audio) (two pairs of circuits)



- Monaural audio (voice responses and navigation guidance) (single pair of circuits)
- Satellite radio/travel link/GPS information (two pairs of circuits)
- Commands to a USB or Bluetooth device
  - Outgoing call commands
  - TTS information for a phone
  - USB device file selection for playback

## Remote SYNC Controls

The audio system 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 resultant 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.

## 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 cables to the APIM are shielded to prevent interference from electromagnetic sources. The APIM provides 5 volt power for USB single ports.

## 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 audio unit 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 display on the touchscreen. In the event the GPS fix or signal is temporarily lost, the APIM continues to use the vehicle tracking 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 through the LVDS cable to display on the touchscreen display.

## **SIRIUS™ Travel Link™**

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.

## **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 audio unit 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 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 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 TCU antenna.

# **Component Description**

## **Audio Unit Antenna**

The audio unit antenna contains the AM/ FM1 antenna, the GPS/satellite radio antenna and the cellular antenna.

## **AM/FM1 Antenna**

The AM/ FM1 antenna receives AM/ FM radio waves and sends them to the ACM via the AM/ FM1 antenna coaxial cable (also called the audio unit antenna 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 APIM ( GPS data) and through a splitter to the ACM (satellite radio data).

## **Cellular Antenna**

If equipped, the audio unit 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.

### **TCU Antenna**

The TCU antenna is used to boost reception for incoming and outgoing cellular network data. It is a compact, cellular phone type, planar inverted-F antenna.

### **Voice Microphone**

The voice microphone is connected to the APIM.

### **Steering Wheel Switches**

The audio/SYNC system 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.

### **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 transmits the steering wheel switch inputs over the network to the APIM and ACM, to control audio and SYNC system functions.

The SCCM requires PMI when it is replaced.

### **Media Hub**

#### **Vehicles Equipped With Non-Touchscreen Display**

The media hub contains a single USB port and is powered by the APIM. The port consists of two circuit connections for the 5 volt power, plus two more circuits for digital serial data.

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

#### **Vehicles Equipped With Touchscreen Display**

The media hub contains two illuminated USB ports and is powered by the APIM. The media hub has an internal 5 volt power source for the USB ports. Each port consists of two circuit connections for the 5 volt power, plus two more circuits for digital serial data.

Data is sent from the two media hub USB ports to the APIM through a single USB cable. The media hub switch manages the data from the two sources.

### **LVDS Cable**

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

### **Display Unit**

The display unit is also 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 bezel

test requests, display switch status, and display Diagnostic Trouble Codes (DTCs) over the CAN. The APIM provides the display unit with power and ground through the LVDS cable. The display unit does not communicate over the CAN.

### **FCIM**

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

### **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.

### **TCU**

The TCU connects the vehicle to a cellular network. It contains a non-serviceable internal SIM card. The TCU is assigned to the VIN of the vehicle and does not work in another vehicle.

The TCU requires PMI when it is replaced.

### **APIM**

The APIM consists of two internal modules: the CIP and the VIP. The modules are not replaceable individually, but can be programmed independently 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 queries 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, which must be transmitted by the owner personal computer back to Ford.

