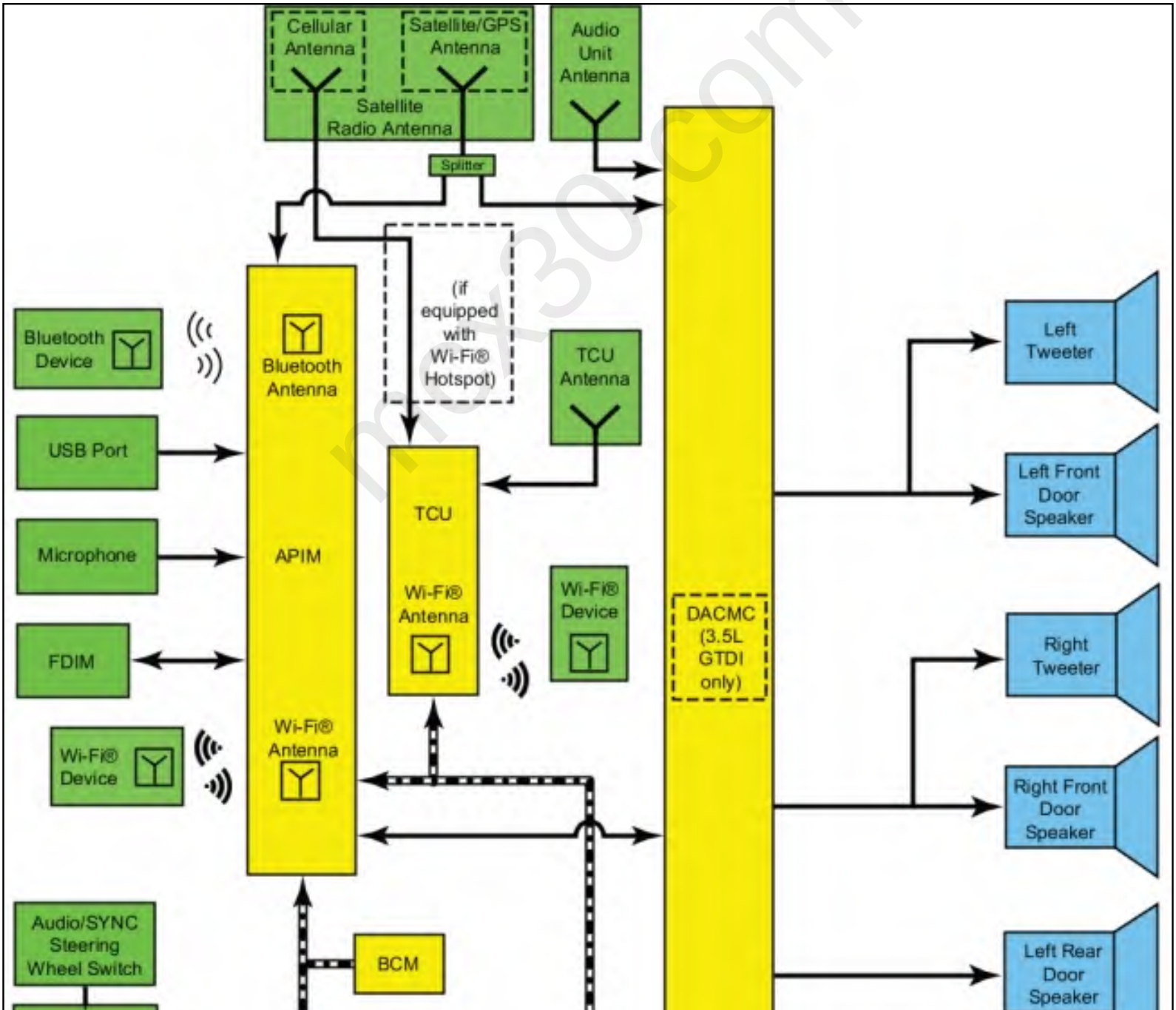
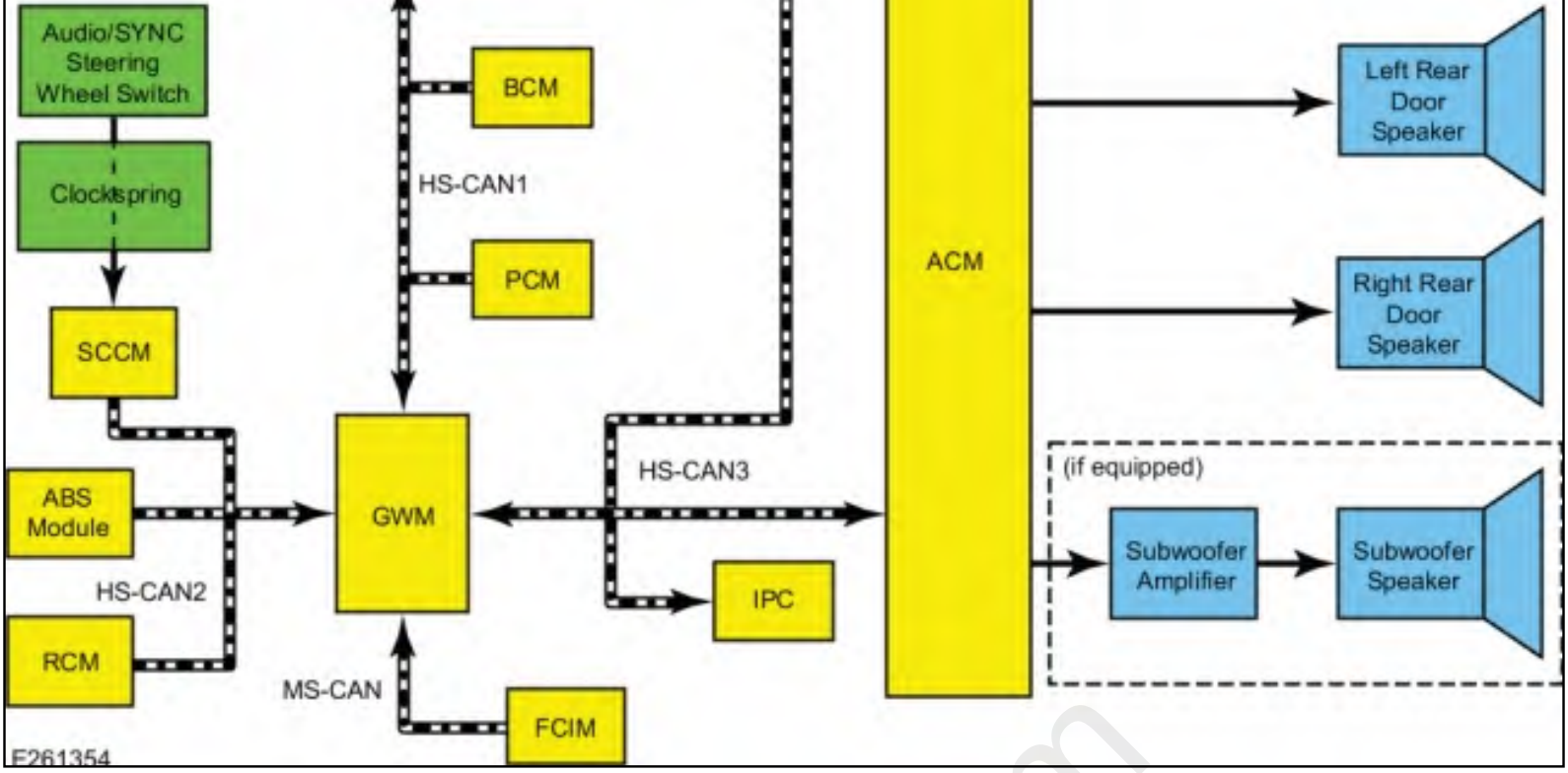
Information and Entertainment System - System Operation and Component Description

System Operation

System Diagram





Network Message Chart

ACM Network Input Messages

Broadcast Message	Originating Module	Message Purpose
Audio settings	IPC	Used to select the audio system listening source (AM/ FM or satellite).
Battery saver status	BCM	Used to disable the functionality of the ACM due to the load shedding feature.
Chime request	IPC	Used to control the priority, characteristics, volume, and speaker output of the warning chime tones played through the audio system speakers.
Chime source	IPC	Used to set the audio system or IPC as the source for the chime tones.
FCIM button state	FCIM	Used to indicate when a button is pressed on the FCIM.
Ignition status	BCM	Used to indicate the ignition mode.
MyKey Belt-Minder audio mute	IPC	Used to mute speaker output so the Belt-Minder tone can be more easily heard.
Satellite radio request signals (if equipped)	APIM	Used to carry out various satellite radio functions using the FDIM.

SYNC alerts	APIM	Used to control the characteristics, volume, and speaker output of the SYNC notifications [text message, news, sports, weather, satellite radio artist/title favorites (if activated), and traffic alerts].
Vehicle configuration data	BCM	Used to verify vehicle configuration data such as the VIN and system module configuration.
Vehicle speed	PCM	Used for the speed compensated volume function.
Voice recognition audio source request	APIM	Used to select the audio system listening source (AM/ FM, satellite, USB, Bluetooth audio, etc.) from a voice command.

APIM Network Input Messages

Broadcast Message	Originating Module	Message Purpose
911 Assist override status	IPC	Used to enable or disable the “Always on” 911 Assist or emergency assistance MyKey feature as selected through the IPC while using an administrator MyKey.
Airbag deployment status	RCM	Used to monitor airbag deployment status for 911 Assist or emergency assistance.
Date and time	BCM	Used to display the current date and time on the display.
Display language selection	IPC	Used to display information on the FDIM in the selected language.
eCall notification	RCM	Used to notify of a 911 Assist or emergency assist call being initiated due to airbag deployment.
FCIM bezel diagnostic status	FCIM	Used to display the requested bezel diagnostics operations in the infotainment display.
FCIM button state	FCIM	Used to indicate when a button is pressed on the FCIM.
Gear lever position	PCM	Used to verify the gear selector position for bezel diagnostics.
Ignition status	BCM	Used to indicate the ignition mode.

Illumination dimming level	BCM	Used to control the backlight intensity.
MyKey volume limit status	IPC	Used to limit the maximum audio system volume when a MyKey restricted key is in use.
Navigation rolling wheel count and direction	ABS module	Used to provide more accurate vehicle position tracking when the GPS signal is temporarily unavailable.
Steering wheel switch status	SCCM	Used to indicate the button press status of the steering wheel switches.
Vehicle configuration data	BCM	Used to verify vehicle configuration data such as the VIN and system module configuration.
Vehicle speed	PCM	Used for navigation functionality.

DACMC Network Input Messages (vehicles equipped 3.5L GTDI)

Broadcast Message	Originating Module	Message Purpose
Accelerator pedal position	PCM	Used to determine the accelerator pedal position percentage for the ESE system operation.
Accessory delay status	BCM	Used to determine the ESE system operating mode.
Door ajar status	BCM	Used to disable the ESE system when any door is ajar.
Engine status	PCM	Used to enable/disable the ESE system if the engine is running/off.
Hood ajar status	BCM	Used to disable the ESE system when the hood is ajar.
Ignition status	BCM	Used to indicate the ignition mode, required for DACMC operating modes and fault reporting.
Powertrain drive mode status	PCM	Used to indicate the selected drive mode (normal, sport, tow/haul, etc.) for the ESE system operation.
Transmission gear position	PCM	Used to indicate the current transmission gear for the ESE system operation.

FCIM Network Input Messages

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

IPC Network Input Messages

Broadcast Message	Originating Module	Message Purpose
Audio source selection	ACM	Used to display the selected audio source on the IPC.
Display language request	APIM	Used to display information on the IPC in the selected language.

RCM Network Input Messages

Broadcast Message	Originating Module	Message Purpose
eCall confirmation	APIM	Used to confirm the configuration of the 911 Assist or emergency assist feature and to confirm the status of the 911 Assist or emergency assist phone call.

TCU Network Input Messages

Broadcast Message	Originating Module	Message Purpose
GPS data	APIM	Used to indicate the vehicle location to the customer via the FordPass mobile application.
Ignition status	BCM	Used to indicate the ignition mode.
Odometer value	IPC	Used to indicate the odometer value to the customer via the FordPass mobile application.

Transport mode	BCM	Used to disable the functionality of the TCU until the vehicle is taken out of transport mode.
Vehicle lock status	BCM	Used to indicate the vehicle lock/unlock mode.
WiFi Settings	APIM	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.*

AM/ FM Radio

The audio unit antenna receives AM/ FM radio waves containing data. The data is sent through the audio unit antenna cable to the ACM. The radio waves are converted into fluctuating AC voltage and sent as analog audio signals to the speakers.

To prevent voltage spikes from producing popping noises through the speakers when the ignition is in the START mode, the ACM receives a voltage signal from the PCM-controlled starting circuit. When the ACM detects the voltage signal from the starting circuit, the audio signal output is muted.

Satellite Radio

The satellite antenna sends data through the satellite radio cable to a splitter (integrated into the cable). The satellite radio data is separated from the GPS data and sent to the satellite radio receiver within the ACM. The metadata is displays on the FDIM and the audio data is converted and sent to the speakers in the same manner as the AM/ FM radio.

Accessory Delay Feature

The accessory delay feature is a BCM-controlled function that allows the audio system to be operated for a preset period of time after the ignition is turned off and a front door has not been opened.

Battery Load Shed Feature

The BCM uses the battery current sensor to monitor the battery state of charge. When conditions exist to cause the battery load shed feature to activate, the BCM deactivates the battery saver relay (internal to the BCM) and a message is sent over the CAN to turn off selected systems. When activated, thhis feature turns off the audio system to save the remaining battery charge. To activate the battery saver relay, start the vehicle.

Chimes

Various vehicle systems send chime requests over the CAN to the IPC. The following are determined as the IPC processes these requests:

- Chime characteristics such as tone, tone length, number of repetitions, and time between tones
- Chime output volume
- Priority of the chime request
- Specific speakers (all, front, or rear) to sound chime

The IPC sends the processed requests over the CAN to the ACM. The ACM outputs the left and right analog chime tones to the appropriate audio system speakers as fluctuating AC voltage.

For specific chime information,
Refer to: Warning Chimes - System Operation and Component Description (413-01 Instrumentation, Message Center and Warning Chimes, Description and Operation).

Speed Compensated Volume Feature

The speed compensated volume feature compensates for wind and road noise by adjusting the audio system volume based on the vehicle speed and the selected setting.

The ACM compensates for wind and road noise by adjusting the audio system volume based on the vehicle speed provided by the PCM over the CAN and the speed compensated volume setting.

ESE (vehicles equipped with 3.5L GTDI)

The ESE system uses a DACMC (integrated into the ACM) and the audio system speakers.

The DACMC determines the engine tone to enhance based upon engine rotation speed data, engine torque data, and accelerator pedal position data from the PCM. The data from the PCM is processed and converted into an analog audio signal, transmitted to the DACMC internal tone generator, and output by the ACM to the front door speakers as fluctuating AC voltage.

Subwoofer Amplifier and Speaker Enclosure (if equipped)

The ACM outputs voltage through the enable circuit to enable the subwoofer amplifier. The ACM also uses this circuit to detect an amplifier overload condition. In the event of an amplifier overload, the subwoofer amplifier modifies the voltage signal from the ACM to increase the voltage on the enable circuit to a higher level than provided by the ACM. When the ACM detects this higher voltage level, it momentarily reduces the audio levels on the audio output channels to the subwoofer amplifier to prevent clipping and subwoofer speaker damage.

The subwoofer amplifier receives audio signals from the ACM in the form of fluctuating AC voltage. The subwoofer amplifier processes and amplifies these inputs and sends analog audio signals to the subwoofer speaker as fluctuating AC voltage.

Steering Wheel Audio Controls

The right steering wheel switch contains series of resistors. Each steering wheel switch function corresponds with a specific resistance value within the switch.

The SCCM sends a 5 volt reference voltage to the right steering wheel switch. When a switch is pressed, the voltage is routed through the corresponding resistor, through the return circuit, and then to ground through the SCCM. The SCCM monitors the resultant voltage drop to determine which switch was pressed. The voltage drop varies depending upon the resistance of the specific switch pressed.

The right steering wheel switch inputs are sent as network messages from the SCCM to the ACM to control SYNC functions.

SYNC System

NOTE: *For additional informaion related to operating a specifc SYNC system feature, refer to the Owner Literature.*

The SYNC system uses Bluetooth, the USB, the FDIM, the GPS, the microphone and the CAN message APIM inputs to control the entertainment system, a phone, the climate control system and navigation system (if equipped).

Once the update download and installation is complete, an ignition cycle must occur before the update becomes active.

Audio Inputs

The APIM receives stereo and mono inputs. Stereo inputs include audio from the USB ports, connected Bluetooth-enabled media device and outside device during a phone call. The mono input includes signals from the SYNC microphone.

Audio Outputs

The APIM sends stereo and mono audio signals to the ACM as fluctuating AC voltage. Stereo outputs include audio from the USB ports, connected Bluetooth-enabled media device, ringback tone, outside device during a phone call, voice or tone prompts initiated from the voice steering wheel switch, and instructions or information spoken by the SYNC® system when initiated from the voice steering wheel switch. Mono outputs include audio from the TTS feature, incoming call ringtone, instructions, navigation route guidance voice or tone prompts (if equipped with navigation) or information spoken by the SYNC system when initiated.

Steering Wheel SYNC Controls

The right steering wheel switch contains series of resistors. Each steering wheel switch function corresponds with a specific resistance value within the switch.

The SCCM sends a 5 volt reference voltage to the right steering wheel switch. When a switch is pressed, the voltage is routed through the corresponding resistor, through the return circuit, and then to ground through the SCCM. The SCCM monitors the resultant voltage drop to determine which switch was pressed. The voltage drop varies depending upon the resistance of the specific switch pressed.

The right steering wheel switch inputs are sent as network messages from the SCCM to the APIM to control SYNC functions.

Bluetooth Mode

Bluetooth is a secure, short-range radio frequency that allows devices to communicate wirelessly through radio waves. The operating range of a Bluetooth signal is application specific, but has a minimum range of 10 meters (33 feet).

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

Any Bluetooth-enabled device used with the SYNC system must first be paired with the APIM before it can become operational. Pairing a Bluetooth-enabled device is accomplished through the "Add Device" selection of the phone menu. When pairing a device, the SYNC system generates a unique PIN that must be entered on the Bluetooth-enabled device in order for the pairing process to be successful. There are also some device-specific actions that must take place.

Multiple Bluetooth-enabled phones and Bluetooth-enabled media devices can be paired to the APIM at the same time. The APIM supports an active connection with one Bluetooth-enabled phone and one Bluetooth-enabled media device at a time. If an additional device of either type is paired and made active, the APIM ends any active connection with an already-paired device, and establishes an active connection with the new device.

It is important to understand that while most Bluetooth-enabled devices can pair with the SYNC system, not all Bluetooth-enabled devices have the same level of available features when interacting with the SYNC system. To determine if a Bluetooth-enabled device or feature is supported, review the device compatibility list. Refer to the appropriate Ford website to view a list of compatible devices and features.

USB Mode

When a portable media device, such as an iPod® with its available cable or portable mass storage such as a USB flash drive, is connected to the vehicle audio system through a USB port, audio from the device can be played through the vehicle speakers. Functions such as volume, seek, fast forward, pause, etc. can be controlled with the vehicle audio controls.

When playing media files stored on a mass storage device such as a USB flash drive, the SYNC system only plays supported file types that do not have DRM protection, and are contained on a properly formatted device. For more information, refer to “Supported Media Players, Formats and Metadata Information” in the Owner Literature.

In addition to audio information (track length, track number, etc.), metadata (information such as artist, album title, song title, and genre) may also be sent to the APIM from a device connected to the USB ports. The APIM uses the metadata to create indexes that can be used to sort for particular music based on the set preferences. Not all USB devices can send metadata to the APIM. When a new media device is connected to the SYNC system, the APIM automatically indexes the information. This may take several minutes depending on the amount of data on the device and is considered normal operation. When a device that was previously connected to the SYNC system is reconnected, the APIM updates the index rather than creating a new one. This reduces the time needed to index the device.

USB Hub

The USB hub is powered by the APIM. The APIM outputs approximately 5 volts on the USB cable to power the USB cable data communication circuits.

The USB hubs can be used to power and/or charge a device if the device supports this feature and does not have a power consumption requirement of more than approximately 5 volts and 2.5 amps (about 13 watts).

The USB hub is used to communicate data between the two USB ports to the APIM using a single USB cable.

Voice Recognition

When the steering wheel voice button is pressed, the SCCM sends a message to the APIM over the CAN indicating a request to initiate the voice recognition feature.

When voice commands are spoken, the monitored sounds are converted into analog signals by the microphone and sent to the APIM as fluctuating AC voltage. The software within the APIM is used to interpret them.

The monitored sounds are converted into analog signals by the microphone and sent to the APIM as fluctuating AC voltage.

911 Assist or Emergency Assistance

The 911 Assist or emergency assistance feature is used to call for help in the event the airbags are deployed. This only operates when a cellular phone has been successfully paired and actively communicating with the audio system.

Compass

The GPS antenna (integrated into the satellite radio antenna) is used to acquire the compass heading that displays in the instrument cluster message center display.

The compass heading is sent through the GPS coaxial cable to the APIM. The APIM uses this data in addition to wheel speed and wheel rotation direction CAN 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 FDIM. In the event the GPS fix or signal is temporarily lost, the APIM continues to use the CAN messages from the ABS module as well as information from the internal gyroscope and accelerometer to provide vehicle tracking.

Navigation (if equipped)

The navigation system guides the driver to a pre-entered destination.

The navigation displays on the FDIM.

Map data is stored in the APIM. The GPS antenna (integral to the satellite radio antenna) receives GPS data and sends it through the satellite radio/ GPS coaxial cable to a splitter. The splitter separates the GPS and satellite radio data and sends it to the APIM. The APIM uses this data in addition to CAN messages from the ABS module to

calculate route information and provide accurate navigation tracking.

The APIM processes the data and transmits it though the LVDS cable to display on the FDIM.

In the event the GPS fix or signal is temporarily lost, the APIM continues to use the CAN messages from the ABS module as well as information from an internal gyroscope and accelerometer to provide accurate vehicle tracking.

The voice recognition system allows the driver to interface with the system without using the FDIM. A microphone located in the overhead console provides a direct input to the APIM.

SIRIUS™ Travel Link™

The satellite radio antenna receives digital signals containing Travel Link™ data. The time intervals for each Travel Link category to update the data vary depending on the category. These signals are routed to the satellite radio receiver (integral to the ACM) from the splitter described in the operation of the navigation system. 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, and the 5-day weather forecast) require the use of GPS data for accuracy. The APIM processes the data from the ACM (together with GPS data obtained from the GPS cable for date-dependent features that require the use of GPS data for accuracy) and sends it to display on the FDIM.

SYNC Connect (if equipped)

The SYNC Connect system uses the TCU to connect and transmits/receives data to/from the cellular network. When requested, the TCU communicates with other vehicle modules to obtain information or to carry out commands, depending on the request.

Vehicles not equipped with Wi-Fi® hotspot

- The TCU communicates to the cellular network using the TCU antenna. The TCU antenna transmits/ receives data to/from the TCU via a coaxial cable.

Vehicles equipped with Wi-Fi® hotspot

- The primary means of communication between the TCU and the cellular network, uses the satellite radio antenna. The satellite radio antenna contains a splitter to transmit/receive data to/from the TCU via a coaxial cable.
- The secondary means of communication between the TCU and the cellular network uses the TCU antenna. The TCU antenna transmits/receives data to/from the TCU via a coaxial cable.

The data transmitted via the cellular network to a server or device is used by the software host or the mobile application.

The data received from the cellular network is processed by the TCU.

Vehicle Wi-Fi® Hotspot (if equipped)

The TCU contains an internal Wi-Fi® hotspot chip.

The TCU communicates to the cellular network by 2 means. The primary means is through a coaxial cable connected to the satellite antenna. The secondary means is through a coaxial cable to the TCU antenna.

Component Description

Audio Unit Antenna

The audio unit antenna is a fixed-mast antenna mounted to the fender. It receives AM/ FM radio waves and sends them to the ACM via the antenna coaxial cable. The antenna mast is used to amplify the AM/ FM radio waves to improve reception.

Satellite Radio Antenna

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

If equipped with the vehicle Wi-Fi® hotspot feature, the satellite radio antenna contains a cellullar antenna for separate cellular network data to the TCU.

TCU Antenna

The TCU antenna is used is used to boost reception for incoming and outgoing cellular network data.

Subwoofer Amplifier and Speaker Enclosure

The subwoofer speaker and subwoofer enclosure are replaced as an assembly. The subwoofer amplifier can be replaced separately.

The subwoofer amplifier does not require PMI when replaced.

Microphone

The microphone is powered and monitored by the APIM.

Steering Wheel Switches

The right steering wheel switch contains a series of resistors. Each steering wheel switch function corresponds with a specific resistance value within the switch.

USB Hub

The USB hub contains two illuminated USB ports.

The USB hub is powered by circuits from the APIM.

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

LVDS Cable

The four circuit shielded LVDS cable provides power and ground from the APIM to the FDIM. It is also the means by which data is transmitted between the APIM and the FDIM.

FDIM

The FDIM does not communicate on the CAN. The APIM acts as the proxy for all FDIM inputs and outputs requiring CAN communication. Communication between the FDIM and the APIM is accomplished via the LVDS cable. The FDIM power and ground are also provided by the APIM through this cable.

FCIM

The FCIM requires PMI when it is replaced.

ACM

Tha satellite radio reciever is integral to the ACM.

The ACM contains the CD player.

For vehicles equipped with the 3.5L GTDI engine, the ACM contains the DACMC. The DACMC is a digital signal processor that consists of an internal analog/digital converter and tone generator.

The ACM and, if equipped, the DACMC require separate PMI procedures when the ACM is replaced.

TCU

The TCU contains a non-serviceable internal SIM card to connect to a cellular network to send and receive data. The TCU is associated with the VIN of the vehicle and is not compatible from one vehicle to another.

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 interfaces with all of the customer inputs to the APIM. It contains an analog-to-digital-to-analog

converter, as well as the Bluetooth/Wi-Fi® chipset. Any application upgrades that are available to the consumer are loaded directly to the CIP through a USB port.

The VIP provides an interface between the CIP and the vehicle inputs. The main functions are controlling the APIM power management and translating inbound and outbound CAN signals. Additionally, the VIP queries the modules on the network to retrieve any Diagnostic Trouble Codes (DTCs) when a vehicle health report is requested.

APIM Programming

The APIM requires specific programming procedures for correct operation when it is replaced, when upgrades are available and requested and requested, or when directed by a TSB, a FSA, a SSM or an Electronic Field Communication (EFC) to resolve SYNC performance concerns.
Refer to: SYNC Module [APIM] Programming (415-00C Information and Entertainment System - General Information - Vehicles With: Touchscreen Display, General Procedures).

BCM

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