Module Configuration - System Operation and Component Description

System Operation

Overview

Over the Air (OTA) Programming

Over-the-Air updates allow for vehicle system software to be updated wirelessly over Wi-Fi (both private and or public Wi-Fi connection) and or the vehicle cellular network. Over-the-Air updates occur on a rolling basis. By default, the vehicle starts the update process as soon as new software becomes available, notifications of software update availability are displayed on the vehicle display screen.

The Over-the-Air Updates are available for vehicles that are factory equipped with GWM, TCU and APIM with Ethernet communication network connections.

Some OTA updates can complete in the background, more complex updates can take up to 45 minutes to complete and the vehicle will be disabled during the update process. These more complex updates must be scheduled by the customer, to complete at a time convenient for them. If an OTA update becomes available that is required to be scheduled, the customer is notified through the vehicle display screen, remotely through the FordPass app and via e-mail where available.

During scheduled updates the vehicle will not function. The vehicle is inhibited by design when the OTA software update is being installed to the receiving module(s). Scheduled updates may take up to 45 minutes to complete.

Certain conditions must be met for a scheduled update installation to complete. If these conditions are not met, the update is cancelled. Cancelled updates can be rescheduled for a time when the conditions can be met.
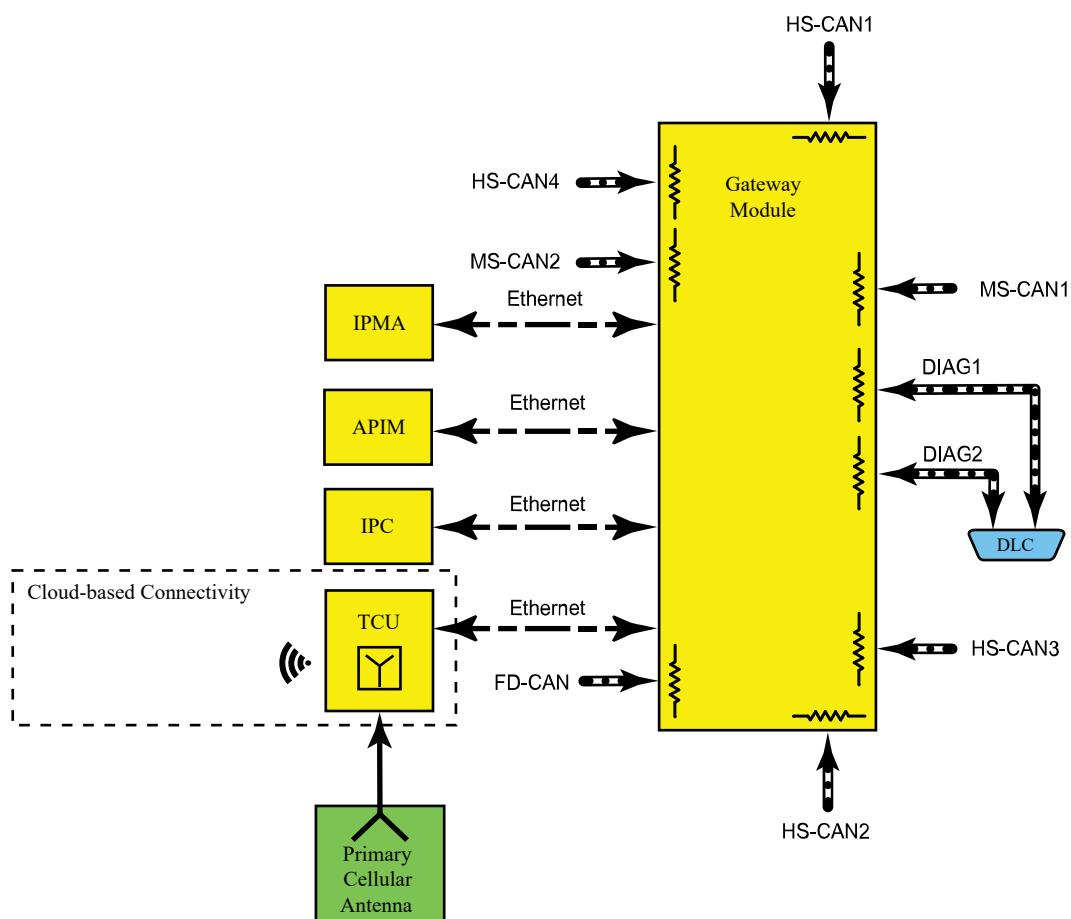
The vehicle display screen displays a 2 minute countdown prior to the scheduled update start time, to give the customer the opportunity to cancel the update if necessary. Once the update has started it can not be canceled.

Details of the over the air (OTA) update release status can be can be viewed on the PTS Connected Vehicle tab.

System Diagram

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

Over the Air (OTA) Updates

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Network Message Chart

Over the Air Network Input Messages

Broadcast Message	Originating Module	Message Purpose
OTA physical data	GWM	Module update data packet received OTA, to be delivered to the receiving module.
OTA data push function	GWM	Update distribution data message to the receiving module, function

Over the Air (OTA) Updates

NOTE: *Refer to the Owner Literature for additional details of the over the air update process.*

Over The Air (OTA) module updates are released from the Ford cloud and received by the vehicle GWM over the vehicle cellular and WiFi connection. The TCU WiFi and cellular connection is used to connect the vehicle to the Ford data cloud and pass the data to the GWM over its Ethernet network connection. The download of OTA updates from the cloud to the GWM occurs seamlessly in the background. Once the download from the cloud to the GWM has completed, the GWM manages the software update installation to the receiving module(s). The module updates are communicated between the GWM and the receiving modules over the Ethernet network, for Ethernet connected modules and the controller area networks (CAN), for all other modules, dependent on the update protocols.

For vehicles capable of receiving over the air updates there are 2 general types of update; Scheduled updates and Non Scheduled updates. If it is determined the update installation to the module requires the vehicle to be disabled for the installation process to complete, an installation update icon will appear on the vehicle display screen to inform the user to schedule a convenient time for the update to take place.

Vehicle status and operational preconditions must be met for all over the air (OTA) update software installations to complete, scheduled or unscheduled. Battery state of charge is an important factor that is considered before an update is started. The GWM is aware of the length of time required to update a given module and compares this against the battery state of charge. If it determines that the battery state of charge is not high enough to support the update, the update is cancelled. Other preconditions that must be met before an OTA update is installed. The PTS software update dashboard displays the preconditions applicable to your vehicle. The preconditions can include but are not limited to, the following:

- Electronic Steering Column Lock (ESCL) is engaged
- Steering tension torque, no torque is applied to the steering wheel
- A diagnostic self-test is not active
- No Charging faults are reported
- Ignition status, Ignition Off
- Ignition status, Accessory functionality Off
- The battery voltage is within the required range
- The vehicle is stopped
- PRNDL in park
- Parking brake is applied
- Charging is not in Progress (hybrid or EV high voltage battery charging/LIII)
- The hazard indicators are off
- The alarm is not sounding
- The engine is not running
- All doors and liftgate are closed
- The parking lights are off
- Limp home mode is not active
- Illuminated exit is not active
- The brake pedal is not being pressed
- The battery voltage is within the required range
- The windows are closed and not operating
- eCall is not active
- Remote start is not active
- Vehicle theft (SVS) is not active
- Remote park assist is not active
- Neutral tow is not active
- 4x4 high/Low is not active
- A DTC requiring vehicle service, is not present in the module targeted for the update.

The vehicle must be off for a minimum of 5 minutes before the GWM will attempt the target module update, scheduled or unscheduled. The GWM confirms the 5 minute off condition is met, all other preconditions are met and the battery status can support the update process before initiating the module update(s).

Note: The GWM considers the battery life while the module programming action is active and the vehicle is off, to be a maximum of 40 minutes. With the deterioration of the state of charge increasing after the 5 minute period with the vehicle off before starting any update, the maximum download time allowable is approximately 10 minutes.

Scheduled Updates

NOTE: *During scheduled updates the vehicle is disabled and does not function. Scheduled updates may take up to 45 minutes to complete.*

When software updates are available that must be scheduled, because the update requires the vehicle to be disabled (unusable) for a period of up to 45 minutes, a schedule installation update pop appears on the vehicle display screen. Using the vehicle display screen the customer can schedule a time when the vehicle will not be in use, for the installation of the update to take place. 2 minutes before the update is scheduled to start the vehicle display screen displays a

countdown to the scheduled start time. During these 2 minutes the update can be canceled. Once the update has begun, the update can not be cancelled. When the update is in progress the vehicle display screen displays a progress bar. Upon completion, details of the competed update can be viewed on the vehicle display screen.

If the vehicle is in use or any of the preconditions are not met, at the scheduled update time the update will be canceled. If the installation of the update is canceled by the user or because preconditions were not met at the scheduled time, the user is able to reschedule the update for a time when the preconditions can be met.

Scheduled updates are required for downloads to modules where the module data is erased before the new data can be uploaded (Erase and replace method). These updates need to be scheduled as the vehicle is disabled (INHIBITED) for up to 45 minutes while the update takes place. When software updates are available, the vehicle is informed and the download begins in the background. Once the download has completed, a schedule installation update icon will appear for the user to schedule a time for the installation to take place. Once scheduled, the user is informed the installation is taking place and the vehicle is disabled while the update installation takes place. On the next use of the vehicle, details of the update can be viewed on the vehicle display screen.

Installation at the Scheduled Time

Note: An internet network connection is not required during the installation of the update to the target module.

- The vehicle checks the ignition status, the ignition must be off
- The vehicle display screen will display a 2 minute countdown timer with the option to cancel the update
- The user is given the opportunity to reschedule the update
    - If the user chooses to cancel the update, it will postpone until the next scheduled time.
    - Once the update starts the use must wait until the update is complete.
- The vehicle checks that all preconditions are met.
    - If any preconditions are not met the installation process is postponed until the next scheduled time.
    - If all preconditions are met the installation process starts and the vehicle is disabled for the time it takes for the installation to complete (up to 45 minutes).
- The update begins, the user will see the update progress displayed on the vehicle display screen and is informed the vehicle is disabled while the update installation takes place. The vehicle may be disabled for up to 45 minutes. On the next use of the vehicle, details of the update installation carried out can be viewed on the vehicle touchscreen.

Non Scheduled Updates

Some updates are not required to be scheduled, These updates will install in the background when all preconditions are met, without the requirement to disable (INHIBIT) the vehicle for a period of time. These are commonly updates to modules that do not require the module data to be erased before the update can be installed (ABA swap configuration).

The user has the choice to select whether to allow the updates to happen automatically or whether to manually choose when the updates take place.

Update Now

The update now function enables the vehicle owner to activate an update as soon as an update has been downloaded to the vehicle, rather than waiting for the scheduled update time. The option is designed to give more flexibility for users with schedules that do not fit a scheduled weekly update timing.

The update now button can be selected on the vehicle display screen when an update is available through the following:

- Settings Menu, System Updates
- The OTA schedule update notification
- The OTA 24hr update reminder notification

When the update now button is selected, a pop up screen displays showing a countdown stating the update will start in "x" minutes, the vehicle is not usable during the update and instructing the occupants to exit and secure the vehicle before the update starts. An option to cancel an update is also displayed.

NOTE: *The occupants of the vehicle must have exited and secured the vehicle within the stated time period for the update to start.*

System Settings

Vehicle connectivity must be enabled for over the air updates to be applied to the vehicle.

The customer has the option to turn Automatic Updates on or off, to switch notifications on or off, and set or change update schedules. Manual updates can be initiated by selecting the update icon on the vehicle display screen.

Notifications

The primary point for notification of OTA software updates to the customer is the vehicle display screen. The customer also has the option to receive notifications through the FordPass app or the Ford customer website. If the customer's e-mail is available, the customer can choose to receive OTA related notification via e-mail.

Update available: Notifies the user system software updates are available.

Schedule reminder: Once an update is scheduled the user is informed through the vehicle display screen 24 hours prior to the scheduled time that the installation is going to take place and is given the option to reschedule. If the user has chosen to use the Ford mobile app, they will receive the same notification 12 hours prior to the scheduled installation time.

Download From the Cloud to the Vehicle

All module software update files are downloaded from the Ford data cloud by the GWM to the GWM through the vehicle WiFi or cellular connection, expect for APIM SYNC software files, which are passed through the GWM to the APIM. Updates to the APIM module are driven by the GWM.

Internet Network Connection

The vehicle has 2 sources of connection to the Ford data cloud, vehicle WiFi and vehicle cellular data. The vehicle is required to have a minimum of 3 bars signal at the location where the vehicle is parked over night, to make sure OTA updates are completed without delays.

OTA Update Subtypes

There are a number of OTA update sub types as described below.

- Simple: These are update releases that generally affect a single module.
- Coordinated: These are update releases that may affect a number of modules and requires each module to be at a specific version.
- Non Coordinated: update may include multiple modules in each update, however does not require all modules to be at a specific software version.

Cancellation of Ongoing OTA Updates

The customer does not have the direct ability to cancel an OTA system software update. There are a few reasons why an update may be canceled.

- Ford Motor Company can cancel the update at any time before the installation of the update is complete.
- If the automatic updates setting has been toggled to OFF, with the vehicle connectivity selection still enabled, the update will expire after a period of time if a manual update icon is not available from the vehicle display screen determined based on currently installed software.
- A master reset can cancel an ongoing update.

Module Over the Air Programming Capability Chart

Module Name	Over the Air Update Programing Capable (Yes/N0)	Module Update Method
ABS module	Yes	ABA swap
ACCM	Yes	ABA swap
ACM	No	N/A
APIM	Yes	ABA swap
ATCM	Yes	Erase and Replace
BCM	Yes	Erase and Replace
BCMC [BJB]	Yes	Erase and Replace

Module Name	Over the Air Update Programing Capable (Yes/N0)	Module Update Method
BECM	Yes	Erase and Replace
CCM	Yes	ABA swap
CMR_DSMC (Driver status monitor camera)	Yes	ABA swap
DCACA	Yes	Erase and Replace
DCDC	Yes	Erase and Replace
DDM	Yes	Erase and Replace
DSM/ RBM	Yes	Erase and Replace
DSP	No	Erase and Replace
GSM	No	N/A
GWM	Yes	ABA swap
HCM	Yes	Erase and Replace
HVAC module	Yes	ABA swap
IPC	Yes	ABA swap
IPMA - ADAS	Yes	ABA swap
Lithium-Ion Storage Battery (LISB)	No	Erase and Replace
OCS module	No	N/A
PACM	Yes	Erase and Replace
PCM	Yes	ABA swap
PCM (Diesel)	No	N/A
PDM	Yes	Erase and Replace
PSCM	Yes	Erase and Replace
RCM	Yes	Erase and Replace
RGTM	No	Erase and Replace
RTM	Yes	Erase and Replace
SASM	No	N/A
SCCM	Yes	Erase and Replace
SCMG	Yes	Erase and Replace
SCMH	Yes	Erase and Replace
SECM	No	N/A
SOBDMC	Yes	ABA swap
SODCMC	Yes	ABA swap
SODCMD	Yes	ABA swap
SODL	Yes	ABA swap
SODR	Yes	ABA swap
TCCM	No	N/A
TCM	No	N/A
TCU	Yes	ABA swap
TRM/ TBM	Yes	Erase and Replace
WACM	No	N/A

OTA & Connected Vehicle Dashboard

PTS has a Connected Vehicle tab that allows access to details of the Over the Air (OTA) update status of the vehicle. The dashboard contains a calendar with a 60 day history of the Over the air update activity on the vehicle and a Currently In Process dashboard. The calendar contains but is not limited to the information listed below.

- The update ID
- The data and time each update was attempted
- The module(s) receiving the update
- If any DTCs were cleared after the update
- The connectivity methods allowed for each update
- Release notes for each of the updates
- A list of software updates or attempts
- It an errors occurred with the update
- The number of retries that were attempted if an update failed to download to a module
- The software level currently installed in the ECU
- The software that was in the module prior to the update

The Currently In Process dashboard contains but is not limited to the information listed below.

- The update ID
- The data the update was released from the cloud
- The ID of the TSB, FSA or SSM if the update is related to one of these actions
- The module(s) receiving the update
- The connectivity methods allowed for each update
- The download status from the cloud to the GWM
- The type of update being installed (bug fix, security, new feature, etc)
- The status of the download to the GWM or the installation from the GWM to the module.
- If the vehicle needs to be inhibited during installation
- Module software part number
- Release notes for each of the updates

Updating Modules Using The Diagnostic Scan Tool

Modules with an Ethernet network connection can be updated through the diagnostic scan tool, using the USB flash method. A 32 GB USB drive formatted to exFAT can be used to transfer software to the Ethernet connected modules. Connect the appropriate exFAT format USB drive to the diagnostic scan tool and follow the on screen prompts to complete the software download.

Component Description

Telematic Control Module

The TCU receives the software update data from the Ford data cloud and passes it through the Ethernet network to the gateway module for distribution to the receiving module(s).

The TCU requires PMI when replaced.

Gateway Module

The GWM serves as the programming manager for over the air software updates completed for target modules. Depending on the modules involved the gateway module may store the update or just relay the update to the target module. The gateway module acts as a router or hub for the Ethernet networks and is also connected to the vehicle CAN. Software updates can be deployed from the GWM to target modules using either CAN or Ethernet networks.

The GWM requires PMI when replaced.

Erase and Replace Modules

Many modules on the vehicle need to be erased before new data can be installed. The software installation process can take up to 40 minutes to complete. Updates to these modules need to be scheduled and specific vehicle conditions must be met for the update to be initiated.

ABA Swap Configuration Modules

For modules that have an ABA swap configuration the update is applied to the B portion of the module while the vehicle continues to reference the data in the A portion. The module will reference the new data once a key cycle has completed.