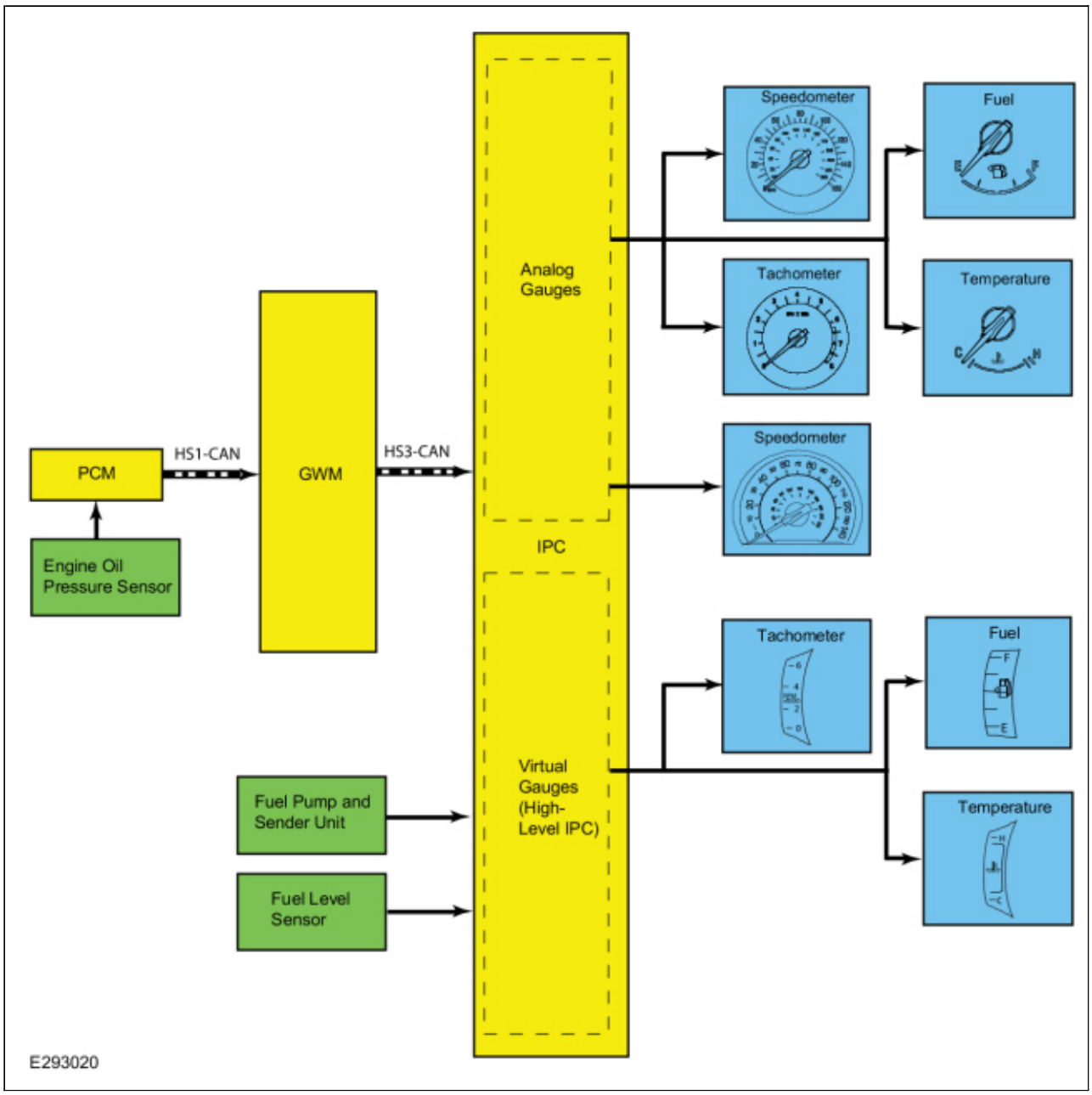
Instrument Panel Cluster (IPC) - System Operation and Component Description

Base Part Number: 10849

System Operation

System Diagram - Gauges

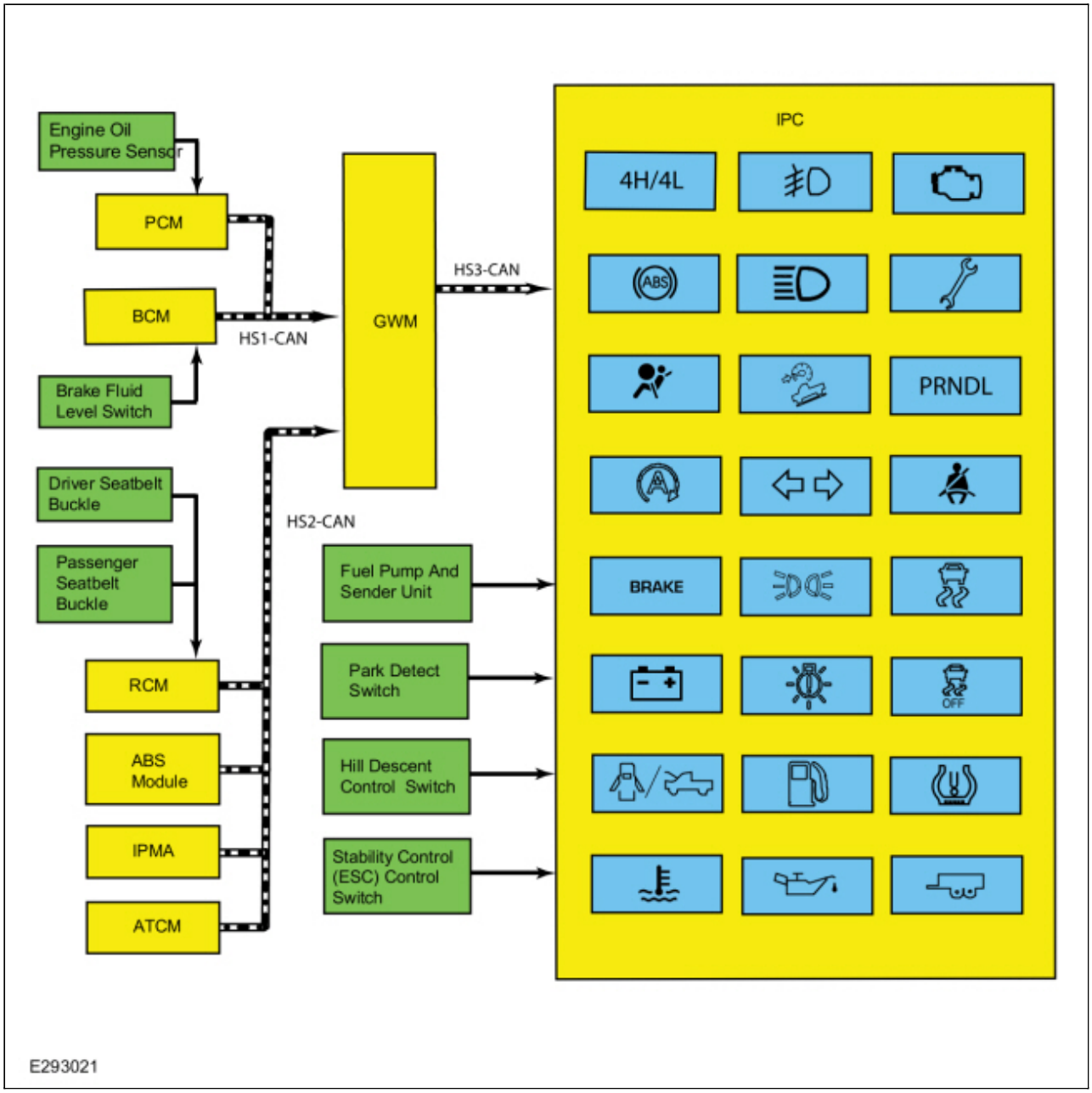


Network Message Chart - Gauges

Module Network Input Messages - IPC

Broadcast Message	Originating Module	Message Purpose
Engine coolant temperature data	PCM	Input used for the analog and virtual temperature gauge indication.
Engine overheat indication request	PCM	Input used to send the analog and virtual temperature gauge pointer to full hot.
Engine rpm data	PCM	Input used for analog and virtual tachometer indication.
Ignition status	BCM	Ignition RUN, START and accessory states required for the IPC operating modes and fault reporting.
Vehicle speed	PCM	Vehicle speed data used for the speedometer indication.

System Diagram - Indicators



Network Message Chart - Indicators

Module Network Input Messages - IPC

Broadcast Message	Originating Module	Message Purpose
AWD mode request	ATCM	Input used to control the 4WD high (4H) and 4WD low (4L) indicators.
ABS warning indicator request	ABS module	Input used to control the ABS warning indicator.
Airbag warning indicator request	RCM	Input used to control the airbag warning indicator.

Battery low state of charge	BCM	Input used to control the charging system warning indicator.
Body service required request	BCM	Input used to control the powertrain malfunction (wrench) warning indicator.
Brake warning indicator request	BCM	Brake fluid level input used to control the brake warning indicator.
Brake (red) warning indicator request	ABS module	ABS input used to control the brake warning indicator.
Driver door ajar status	BCM	Input used to control the door ajar indicator.
Driver seatbelt buckle status	RCM	Input used to control the seatbelt warning indicator.
Engine coolant temperature data	PCM	Input used to control the engine over-temperature warning indicator.
Engine oil pressure warning indicator request	PCM	Input used to control the engine oil pressure warning indicator.
Engine overheat indication request	PCM	Input used to control the engine over-temperature warning indicator.
Engine rpm data	PCM	Input used to control the low engine oil pressure warning indicator.
Engine service required request	PCM	Input used to control the powertrain malfunction (wrench) warning indicator.
Front fog lamp indicator request	BCM	Input used to control the front fog lamp indicator.
Headlamp low beam out	BCM	Input used to control the LED low beam headlamp malfunction indicator.
High beam status	BCM	Input used to control the high beam indicator.
Hill descent control indicator request	ABS module	Input used to control the hill descent control indicator.
Hood ajar status	BCM	Input used to control the door ajar indicator.
Ignition status	BCM	Ignition RUN, START and accessory states required for the IPC operating modes and fault reporting.
Left rear door ajar status	BCM	Input used to control the door ajar indicator.
Left turn lamp on request	BCM	Input used to control the LH turn indicator.
MIL request	PCM	Input used to control the MIL.
Passenger door ajar status	BCM	Input used to control the door ajar indicator.
Parking brake (red) indicator request	ABS module	Input from the ABS for the parking brake input used to control the brake warning indicator.
Parklamp status	BCM	Input used to control the lights on indicator.
Passenger seatbelt buckle status	RCM	Input used to control the seatbelt warning indicator.
Powertrain drive mode status	PCM	Input used to control the tow haul indicator.
Right rear door ajar status	BCM	Input used to control the door ajar indicator.
Right turn lamp on request	BCM	Input used to control the RH turn indicator request.
Stability-traction control	ABS module	Input used to control the stability/traction control (sliding car

indicator request		icon) indicator.
Stop-start standby indicator request	PCM	Input used to control the auto stop-start indicator.
Tire pressure warning indicator	BCM	Input used to control the TPMS indicator.
Traction control off indicator request	ABS module	Input used to control the stability/traction control disabled (sliding car OFF icon) indicator.
Transmission gear display	PCM	Input used to control the PRNDS display.
Transmission gear display mode	PCM	Input used to control the PRNDS display.
Transmission service required	PCM	Input used to control the powertrain malfunction (wrench) warning indicator.
Transport mode	BCM	Input used to control the PRNDS state upon vehicle entry and at key off to conserve battery voltage when in transport mode.
Vehicle speed	PCM	Input used to confirm a park detect input concern for PRNDS indication.

Hardwired Inputs

The IPC requires hardwired inputs from components that are not on the CAN. These components are required for specific IPC functions.

The hardwired inputs are provided by the following components:

- CAN
- Fuel pump and sender unit
- Hill descent control switch
- Park detect switch (part of the gearshift lever)
- Low washer fluid switch
- Stability control (ESC) disable switch

Networked Input Messages and Default States

NOTE: *Whenever a network message is suspected as missing and confirmed by a missing message DTC (U-code), it is important to look for other symptoms that can also be present in the IPC and throughout the vehicle. Once a DTC sets in the IPC, it is helpful to review the complete message list to determine which other modules also rely on the same message and run the self-test for those modules. If the message is missing from other modules, the same or similar lost communication DTC can also be set in those modules. Confirmation of missing messages common to multiple modules can indicate the originating module is the source of the concern or the communication network may be faulted.*

For a list of all the network messages,
Refer to: Communications Network - System Operation and Component Description (418-00 Module Communications Network, Description and Operation).

The IPC uses input messages from other modules to control the gauges, informational indicators, warning indicators and message center message displays over the communication networks. The IPC receives all networked data over the HS-CAN3.

The vehicle uses 4 communication networks to transmit the data used by the IPC.

- HS-CAN1
- HS-CAN2
- HS-CAN3
- MS-CAN

For overview information,
Refer to: Communications Network - Overview (418-00 Module Communications Network, Description and Operation).

For system operation information,
Refer to: Communications Network - System Operation and Component Description (418-00 Module Communications Network, Description and Operation).

All messaged inputs to the IPC from other networks are received from the GWM over the HS-CAN3. The GWM, as the name implies, acts as a gateway to convert messages from one of the other 3 networks to the HS-CAN3, which is recognized by the IPC.

Network messages can drop out or be missing for a variety of reasons, such as high network traffic on the bus. The IPC incorporates a defined strategy for handling missing network messages based on time. The required time for a network message to be missing differs between the various gauges, indicators and message center displays. The strategy is basically the same for all indication outputs (gauges, indicators or chimes), but differs in the length of time required for the network message to be missing. If a required network message is missing or invalid for less than the programmed length of time, the gauge, indicator or message center display that requires the network message remains at the last commanded state based upon the last network message received. If the messaged input is missing for longer than the programmed length of time, the IPC output (gauge, indicator etc.) reacts according to a pre-defined default action.

For example, if the stability-traction control indicator request network message is missing for less than 5 seconds, and the stability-traction control indicator (sliding car icon) was on, the indicator remains in the on state until the next network message is received. If the network message remains missing or invalid for more than 5 seconds, the IPC sets a U-code DTC and the IPC output becomes a default action for the indicator or gauge. The indicator may default on/off or the gauge may default to the rest position.

Each indicator or gauge utilizes a different default strategy depending on the nature of the indication. Refer to the diagnostic overview descriptions located before each pinpoint test for further descriptions of the default action specific to each indicator or gauge. If the missing messaged input to the IPC returns at any time, the normal function of the gauge, indicator or message center display resumes.

It is very important to understand:

- where the input originates.
- all the information necessary in order for a feature to operate.
- which module(s) receive(s) the input or command message.
- which module controls the output of the feature.
- whether the module that receives the input controls the output of the feature, or whether it outputs a message over the communication network to another module.

Startup-Shutdown

The IPC provides a startup/shutdown sequence also known as a welcome/goodbye strategy. The IPC initiates and follows a progressive strategy providing increasing IPC functionality from IPC wake up to ready to drive status. This sequence begins at RKE unlock or driver door open through the ignition RUN state. During this period, the IPC provides increasing functionality from backlighting or illuminating gauge rings, gauge pointers, illuminating the PRNDS, backlighting of the message center display, displaying a message center splash screen, gauge and LED prove out, gauge sweep and finally normal IPC operation.

MyKey®

The MyKey® feature allows the customer to program a restricted driving mode that is tied to one or more keys known as a MyKey® key. The following features are provided by the IPC when a MyKey® key is being used:

- At the beginning of vehicle start up, as part of the welcome strategy, the message center greets the MyKey® driver with MYKEY ACTIVE DRIVE SAFELY displayed in the message center. If the MyKey® speed limiter feature is turned on, the message center also displays the MyKey® administrator selected top speed setting message. The MyKey® top speed selections are; 105, 110, 120 or 130 km/h (65, 70, 75, or 80 mph) or to the administrator desired setpoint.
- The IPC provides a periodic Belt-Minder® warning chime until the driver and passenger seatbelts are buckled. When the Belt-Minder® is issued, the ACM is muted and the message center displays BUCKLE UP TO UNMUTE AUDIO.
- If the MyKey® speed limiter feature is turned on and the vehicle speed approaches the selected top speed (100, 110, 120 or 130 km/h [60, 70, 75, or 80 mph]), the message center displays NEAR VEHICLE TOP SPEED along with a chime.
- If the MyKey® speed limiter feature is turned on and the vehicle speed reaches the selected top speed (105, 110, 120 or 130 km/h [65, 70, 75, or 80 mph]), the message center displays TOP SPEED MYKEY SETTING along with a chime.
- If the speed warning is selected at one of the preset values (75, 90, 105 km/h [45, 55, 65 mph]) and the vehicle approaches the preset speed, the message center displays CHECK SPEED DRIVE SAFELY along with a chime.
- At approximately 1/8 tank of remaining fuel, the IPC illuminates the low fuel message center indicator and the message center displays FUEL LEVEL LOW along with a chime.
- Traction control, Emergency Assist feature and the Do Not Disturb feature can be set to always on or user selectable in the MyKey® menu.
- If the traction control always on feature is turned on and the MyKey® driver attempts to disable the traction control, the message center displays ADVANCETRAC ON MYKEY SETTING.
- MyKey® miles driven by the MyKey® user can be found in the information display.
- The number of MyKey® programmed and administrator keys can be found in the MyKey® menu.
- The parking aid, Blind Spot Monitoring System/Cross Traffic Alert (BLIS®/CTA), lane departure alert and collision avoidance warning menus are disabled in the message center to force these features always on.

When an administrator key is in use, the IPC provides:

- a menu in the message center guiding the user to create a MyKey®. When the maximum MyKey® limit is reached, the MyKey® creation menu is no longer available.
- a menu in the message center with options for setting 6 MyKey® features:
  - MyKey® speed limiter.
  - MyKey® pre-selected speed warning.
  - MyKey® radio volume limiter.
  - traction control always on or user selectable.
  - emergency assist feature always on or user selectable.
  - do not disturb feature always on or user selectable.
- a menu in the message center with the option to clear all MyKey® programmed keys at once.
- MyKey® mileage driven by the MyKey® user can be found in system check function of the message center.
- the number of MyKey® programmed keys and administrator keys can be found in the system check function of the message center.

For information on the MyKey® features, refer to the Owner's Literature.

Configuration

The IPC contains items that are configurable. Most of the configurable items (configurable parameters) are customer preference items, which can be set with a diagnostic scan tool. The remaining configurable items can only be set through the vehicle configuration parameters.
Refer to: Module Programming (418-01 Module Configuration, General Procedures).

Prove-Out

The IPC carries out a display prove-out to verify the gauges function and all module controlled warning indicator lamps and monitored systems are functioning correctly within the IPC. The IPC provides a timed prove-out of some indicators while other indicators illuminate upon engine start up or have no prove-out. When the ignition is cycled on, the indicators illuminate to prove-out according to the following table.

Indicator	Indicator Type	Prove-Out Duration
4WD indication	Informational	3 seconds
Airbag	Warning	6 seconds
ABS	Warning	3 seconds
Brake	Informational	3 seconds
Engine oil pressure	Warning	3 seconds
Engine over-temperature	Warning	3 seconds
Low fuel	Warning	3 seconds
MIL	Informational	Engine start up
Powertrain malfunction (wrench)	Warning	3 seconds
Seatbelt	Informational	6 seconds if the seatbelt is unbuckled, turns off when the seatbelt is buckled
Stability – traction control ESC	Warning	3 seconds
Stability – traction control OFFESC OFF	Informational	3 seconds
TPMS	Warning	3 seconds

Dealer Test Mode

To enter the IPC engineering test mode or dealer test mode, begin with the ignition OFF. Press and hold the RH steering wheel switch OK button. Place the ignition ON and continue to hold the button for 5-8 seconds until the display indicates Test or Gauge Sweep. Press the up or down arrow buttons to navigate through each of the display windows. To exit the IPC dealer test mode, press and hold the OK button for 5-8 seconds or place the ignition in OFF. Each down arrow button press advances the viewing window to the next set of items.

Analog Gauges

Fuel Gauge

The IPC sends a reference voltage to the fuel level sender(s). As the fuel level changes, a float actuates the variable resistor fuel level sender, raising or lowering the fuel level signal voltage. The IPC monitors the changes in voltage from both senders and commands the fuel gauge with a corresponding movement of the pointer.

After a fuel fill up, the time for the fuel gauge to move from empty (E) to full (F) ranges from 2 seconds to 55 minutes depending on which operating mode the fuel gauge is in.

The IPC uses 4 different operating modes to calculate the fuel level:

- Anti-slosh (default mode).
- Key OFF fueling.
- Key ON fueling.
- Recovery.

The default fuel gauge mode is called the anti-slosh mode. To prevent fuel gauge changes from fuel slosh (gauge instability due to changes in fuel sensor readings caused by fuel moving around in the tank), the fuel gauge takes approximately 40 minutes to go from empty (E) to full (F).

The key OFF fueling mode (2 seconds to read empty [E] to full [F]) requires 3 conditions to be met:

- The ignition must be in the OFF mode when refueling the vehicle.
- At least 6% of the vehicle's fuel capacity must be added to the fuel tank.
- The IPC must receive a valid ignition ON fuel sensor reading within one second of the ignition being put into the RUN mode. The key ON sample readings are considered valid if the fuel sensor reading is between 10 ohms ± 2 ohms and 180 ohms ± 4 ohms.

If these conditions are not met, the fuel gauge stays in the anti-slosh mode, which results in a slow to read full (F) event.

The key ON fueling mode (approximately 60 seconds to read empty [E] to full [F]) requires the following conditions be met:

- The transmission is in PARK (P) or NEUTRAL (N).
- The ignition is in the RUN mode.
- At least 6% of the vehicle's fuel capacity must be added to the fuel tank.

In key ON fueling mode, a 30-second timer activates after the transmission is put into the PARK (P) or NEUTRAL (N) position. When the 30-second time has elapsed and at least 9% of the vehicle's fuel capacity has been added, the fuel gauge response time is 60 seconds to read from empty (E) to full (F). When the transmission is shifted out of PARK (P) or NEUTRAL (N), the fuel gauge strategy reverts to the anti-slosh mode. The key ON fueling mode prevents slow to read full events from happening if the customer refuels the vehicle with the ignition in the RUN mode.

Recovery mode is incorporated into the IPC strategy to recover from a missing fuel level input after a refueling event. Missing fuel level inputs result from intermittent opens in the fuel sensor or its circuits. Recovery mode (empty [E] to full [F] approximately 17 minutes) is initiated when the following 2 conditions are met:

- The IPC is in the anti-slosh (default) mode.
- The actual fuel level in the tank is 5% different from what is being displayed by the fuel gauge.

Speedometer

The IPC receives the vehicle speed data from the GWM over the HS-CAN3. The GWM receives the vehicle speed message from the PCM over the HS-CAN1. The PCM receives the wheel speed data from the ABS module. The PCM uses tire size stored in the vehicle configuration file along with wheel speed inputs to generate a vehicle speed signal.

Tachometer

The IPC receives the engine RPM data message from the GWM over the HS-CAN3. The GWM receives the engine RPM data message from the PCM over the HS-CAN1.

Temperature Gauge

The IPC uses 2 messages to control the temperature gauge. The first is the engine coolant temperature data, which provides the current engine temperature input to the PCM. The second message is the engine overheat indication request, which is sent by the PCM to the IPC when an overheating condition exists. When the IPC receives the engine overheat indication request message, the IPC sends the temperature gauge to full hot and turns on the over-temperature warning indicator.

The IPC receives all the temperature gauge inputs from the GWM over the HS-CAN3. The GWM receives the engine coolant temperature data and the engine overheat indication request messages from the PCM over the HS-CAN1.

Virtual Gauges

Fuel Gauge

The IPC sends a reference voltage to the fuel level sender(s). As the fuel level changes, a float actuates the variable resistor fuel level sender, raising or lowering the fuel level signal voltage. The IPC monitors the changes in voltage from both senders and commands the fuel gauge with a corresponding movement of the pointer.

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- The ignition must be in the OFF mode when refueling the vehicle.
- At least 6% of the vehicle's fuel capacity must be added to the fuel tank.
- The IPC must receive a valid ignition ON fuel sensor reading within one second of the ignition being put into the RUN mode. The key ON sample readings are considered valid if the fuel sensor reading is between 10 ohms ± 2 ohms and 180 ohms ± 4 ohms (gas engine).

If these conditions are not met, the fuel gauge stays in the anti-slosh mode, which results in a slow to read full (F) event.

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- The transmission is in PARK (P) or NEUTRAL (N).
- The ignition is in the RUN mode.

- At least 6% of the vehicle's fuel capacity must be added to the fuel tank.

In key ON fueling mode, a 30-second timer activates after the transmission is put into the PARK (P) or NEUTRAL (N) position. When the 30-second time has elapsed and at least 9% of the vehicle's fuel capacity has been added, the fuel gauge response time is 60 seconds to read from empty (E) to full (F). When the transmission is shifted out of PARK (P) or NEUTRAL (N), the fuel gauge strategy reverts to the anti-slosh mode. The key ON fueling mode prevents slow to read full events from happening if the customer refuels the vehicle with the ignition in the RUN mode.

Recovery mode is incorporated into the IPC strategy to recover from a missing fuel level input after a refueling event. Missing fuel level inputs result from intermittent opens in the fuel sensor or its circuits. Recovery mode (empty [E] to full [F] approximately 17 minutes) is initiated when the following 2 conditions are met:

- The IPC is in the anti-slosh (default) mode.
- The actual fuel level in the tank is 5% different from what is being displayed by the fuel gauge.

Speedometer

The IPC provides a tolerance that allows the speed indication to display between actual vehicle speed and 10% above vehicle speed. This means that with an actual vehicle speed of 100 km/h (54 mph), the speedometer can indicate between 100 and 110. Incorrect axle ratio, tire size or tire size configuration can potentially affect the speedometer accuracy.

Tachometer

The IPC receives the engine RPM data message from the GWM over the HS-CAN3. The GWM receives the engine RPM data message from the PCM over the HS-CAN1.

Temperature Gauge

The IPC uses 2 messages to control the temperature gauge. The first is the engine coolant temperature data, which provides the current engine temperature input to the PCM. The second message is the engine overheat indication request, which is sent by the PCM to the IPC when an overheating condition exists. When the IPC receives the engine overheat indication request message, the IPC sends the temperature gauge to full hot and turns on the over-temperature warning indicator.

The IPC receives all the temperature gauge inputs from the GWM over the HS-CAN3. The GWM receives the engine coolant temperature data and the engine overheat indication request messages from the PCM over the HS-CAN1.

Indicators

4x4 Indicators

The IPC provides 4WD Low and 4WD High indicators to indicate transmission status, including shift in progress information. It uses 4WD status display message to set the indicators. The IPC receives all the required messages from the GWM over the HS-CAN3 . The GWM receives the AWD mode request from ATCM over the HS-CAN2.

ABS Warning Indicator

The IPC receives the ABS warning indicator request message from the GWM over the HS-CAN3. The GWM receives the ABS warning indicator request message from the ABS module over the HS-CAN2. If a fault condition exists in the ABS, the ABS module sends the ABS warning indicator request message to either flash or illuminate the ABS warning indicator.

Refer to ABS/Brake/Stability-Traction Control System Indication description for information on the conditions when the ABS warning indicator is turned on.

ABS/Brake/Stability-Traction Control System Indication

The brake/stability-traction control system indication is controlled almost entirely by the ABS module. The ABS module can illuminate multiple indicators for various fault conditions. The following table provides a summary of the basic fault conditions and the indicators that are illuminated for each condition.

NOTE: *Refer to the Normal Operation and Fault Condition description before each brake/stability-traction control system indicator Pinpoint Test (PPT) for the IPC default action for network/missing message conditions.*

Event/Fault Condition	ABS Warning Indicator Status	Brake Warning Indicator Status	Stability-Traction Control Indicator Status	Stability-Traction Control Disabled Indicator Status
Parking brake applied	Off	• Flashing while applying • On when applied	Off	Off
Low brake fluid level or brake fluid level input concern	Off	On	Off	Off
Stability-traction control event	Off	Off	Flashing	Off
Stability-traction control disabled by driver	Off	Off	Off	On
Single wheel speed sensor faults	On	On	On	On
2 wheel speed sensor faults on the same axle or 3 wheel speed sensor faults	On	Flashing or on	On	On
HCU valve fault	On	On	On	On
ABS module fault	On	Flashing or on	On	On
HCU pressure sensor fault (master cylinder pressure input)	Off	On	On	On
ABS battery voltage faults	On	Flashing or on	On	On
ABS pump motor fault	On	On	On	On
ABS low brake booster vacuum or vacuum sensor fault	Off	On	Off	Off
Steering wheel angle sensor center not found fault	Off	On	On	On
ABS to CAN total failure	• Off (4x2) • On (4x4)	Off	On	On

Thermal shutdown to brake over-temperature condition	Off	Off	Off	Off
Parking brake switch fault	Off	Flashing	Off	Off
Configuration mismatch	Off	Off	Off	Off
VIN mismatch	On	On	On	On
ACC and ABS both active	Off	Off	Flashing	Off

Airbag Warning Indicator

The IPC receives the airbag warning indicator request from the GWM over the HS-CAN3. The GWM receives the airbag indicator request from the RCM over the HS-CAN2. If a SRS concern is detected, the RCM sets a DTC and the IPC illuminates the airbag warning indicator.

Auto Stop-Start Indicator

The auto stop-start indicator informs the driver of the following states:

Indicator State	System Status
Solid green	The auto stop-start feature has temporarily turned off the engine.
Solid amber	A stop-start system concern exists.
Flash in either green or amber	A system state as determined by the PCM.

The IPC receives the stop-start standby indicator message from the GWM over the HS-CAN3. The GWM receives the stop-start standby indicator message from the PCM over the HS-CAN1.

Brake Warning Indicator

The brake warning indicator informs the driver the brake fluid level is low, there is a failure in the base brake system or the park brake is applied. The IPC uses messaged inputs to control the brake warning indicator.

- Brake (red) warning indicator request
- Brake warning indicator request

The IPC receives the brake (red) warning indicator request and the brake warning indicator request messages from the GWM over the HS-CAN3.

The GWM receives the brake (red) warning indicator request from the ABS module over the HS-CAN2.

The GWM receives the brake warning indicator request from the BCM over the HS-CAN1.

Refer to ABS/Brake/Stability-Traction Control System Indication description for information on the conditions when the brake warning indicator is turned on.

Charge Warning Indicator

The IPC provides a charging system indicator along with message displays indicating the status of the

charging system. When a fault is present in the charging system, the BCM sends the battery low state of charge message to display message center warning messages and the charging system indicator. The IPC receives the battery low state of charge message from the GWM over the HS-CAN3. The GWM receives the battery low state of charge message from the BCM over the HS-CAN1.

Door-Hood Ajar Indicator

The IPC provides a door ajar or hood ajar indicator along with message displays to indicate the status of the doors and hood. The BCM monitors each of the ajar inputs (driver, passenger, left rear, right rear and hood) and sends a door ajar status or hood ajar status message to the GWM over the HS-CAN1. The IPC receives the driver door ajar status or hood ajar status messages from the GWM over the HS-CAN3 to display the door ajar indicator or hood ajar indicator and corresponding warning message.

Engine Over-Temperature Warning Indicator

The IPC provides an indicator to alert the driver the engine is over temperature. The IPC receives the engine overheat indication request and the engine coolant temperature data from the GWM over the HS-CAN3. The GWM receives the engine overheat indication request and the engine coolant temperature data message from the PCM over the HS-CAN1.

Fog Lamp Indicator - Front

The IPC provides a front fog lamp indicator request to indicate when the front fog lamps are on. The IPC receives the front fog lamp indicator request message from the GWM over the HS-CAN3. The GWM receives the front fog lamp indicator request message from BCM over HS-CAN1.

High Beam Indicator

The high beam indicator informs the driver that the high beams are on. The IPC receives the high beam status message from the GWM over the HS-CAN3. The GWM receives the high beam status message from the BCM module over the HS-CAN1.

Hill Descent Control

The IPC provides a hill descent control indicator to indicate when the HDC is in ready mode, active control mode, or in an over- temperature mode with the system cooling. The IPC receives the hill descent control indicator request message from the GWM over the HS-CAN3. The GWM receives the hill descent control indicator request message from ABS module over HS-CAN2.

LH/ RH Turn Signal/Hazard Indicator

When the multifunction switch is in the LH or RH turn position or if the hazard switch is on, the BCM sends the left turn lamp on request or the right turn lamp on request to the GWM over the HS-CAN1. The GWM sends the left turn lamp on request or the right turn lamp on request to the IPC over the HS-CAN3. Upon receipt of the applicable turn signal on/off message, the IPC flashes the turn signal indicator on and off.

Lights On Indicator

When the parking lamps are turned on, the BCM sends the park lamp status message to the GWM over the HS-CAN1. The IPC receives the park lamp status message from the GWM over the HS-CAN3 to illuminate the lights on indicator.

LED Low Beam Malfunction Indicator

The LED low beam malfunction indicator illuminates when the LED bulb in the headlamp is not functioning correctly. The IPC receives the headlamp low beam out message from the GWM over the HS-CAN3. The

GWM receives the headlamp low beam message from the BCM over the HS-CAN1.

Low Engine Oil Pressure Warning Indicator

The IPC uses the engine oil pressure warning indicator request and engine RPM data to control the low engine oil pressure indicator. The engine oil pressure sensor is hardwired to the PCM. The PCM provides the engine oil pressure warning indicator status request and the engine RPM data to the GWM over the HS-CAN1. The GWM provides the engine oil pressure warning indicator status request and engine RPM data to the IPC over the HS-CAN3. The IPC requires engine RPM above 400 RPM before the message center displays the low engine oil pressure warning.

MIL

The IPC receives the MIL request from the GWM over the HS-CAN3. The GWM receives the MIL request from the PCM over the HS-CAN1.

Powertrain Malfunction (Wrench) Warning Indicator

The IPC provides a powertrain malfunction (wrench) warning indicator to indicate:

- a BCM concern.
- a gearshift concern.
- a powertrain concern (Electronic Throttle Control [ETC]).
- a transmission concern.

The IPC receives all applicable messages from the GWM over the HS-CAN3.

The GWM receives the body service required message from the BCM over the HS-CAN1.

The GWM receives the engine service required and the transmission service required messages from the PCM over the HS-CAN1.

PRNDS Indicator

The IPC uses the following messages to control the PRNDS:

- Battery shed level request
- Ignition status
- Transmission gear display
- Transmission gear display mode
- Transport mode
- Vehicle speed

The IPC receives all messaged inputs from the GWM over the HS-CAN3.

The GWM receives the transmission gear display, transmission gear display mode and vehicle speed messages from the PCM over the HS-CAN1.

The GWM receives the ignition status, transport mode and battery shed level request messages from the BCM over the HS-CAN1.

When the vehicle is in transport mode or during battery load shed operation, the PRNDS is not displayed upon entry or exit from the vehicle to prevent battery drain during longer periods of time when the vehicle is not in

use, such as those experienced during vehicle transport.

The IPC also uses a park position detect switch (part of the selector lever) input to signal the IPC the shift lever is fully seated in the PARK (P) position. The IPC compares the park position detect switch input with the transmission gear display message sent from the PCM.

Seatbelt Warning Indicator

The RCM monitors the driver seatbelt position through the seatbelt buckle switch. The RCM provides the driver seatbelt buckle status message to the GWM over the HS-CAN2. The GWM provides the driver seatbelt buckle status message to the IPC over the HS-CAN3 to either turn on or turn off the seatbelt warning indicator.

Stability-Traction Control Indicator (Sliding Car Icon) ESC

The stability-traction control indicator (sliding car icon) informs the driver of the current status of the stability and traction control systems. The stability-traction control indicator illuminates when a fault condition exists or when an active traction control or stability control event is occuring. The IPC receives the stability-traction control indicator request message from the GWM over the HS-CAN3. The GWM receives the stability-traction control indicator request message from the ABS over the HS-CAN2.

Refer to ABS/Brake/Stability-Traction Control System Indication description for information on the conditions when the stability-traction control indicator (sliding car icon) is turned on.

Traction Control Disabled Indicator (Sliding Car OFF Icon) ESC OFF

The stability-traction control is configured on/off from the console mounted switch. When the driver enables or disables the stability-traction control system, the ABS module sends the traction control off indicator request message to the GWM over the HS-CAN2. The GWM sends the traction control off indicator request message to the IPC over the HS-CAN3 to illuminate or turn off the stability-traction control disabled indicator (sliding car OFF icon) based upon the system state.

Refer to ABS/Brake/Stability-Traction Control System Indication description for information on the conditions when the stability-traction control disabled indicator (sliding car OFF icon) is turned on.

When a MyKey® administrator has set the AdvanceTrac® feature to always on and a MyKey® programmed key is in use, the stability-traction control system cannot be disabled. The menu selection in the message center used to disable the stability-traction control system does not display when a MyKey® is in use, but remains active for the MyKey® administrator to select the AdvanceTrac® always on feature off. The stability-traction control indicator still functions normally to indicate a stability-traction control system fault and a stability-traction control active event.

TPMS Warning Indicator

The IPC receives the tire pressure warning indicator message from the GWM over the HS-CAN3. The GWM receives the tire pressure warning indicator message from the BCM over the HS-CAN1.

If the BCM determines the tire pressure has exceeded the low tire pressure limits, the tire pressure warning indicator request message is sent to the IPC to illuminate the TPMS warning indicator.

If a TPMS monitor or sensor fault condition exists, the BCM sends the tire pressure warning indicator request message to the IPC to flash the TPMS warning indicator. The IPC flashes the TPMS warning indicator for 75 seconds then turns the indicator on solid.

Tow Haul Indicator

The tow haul indicator illuminates to indicate the tow haul feature has been switched on. The IPC receives the

powertrain drive mode status message from the GWM over the HS-CAN3. The GWM receives the powertrain drive mode status message from the PCM over the HS-CAN1.

Component Description

Brake Fluid Level Switch

The brake fluid level switch is mounted in the master cylinder reservoir and is hardwired to the BCM through a signal circuit. The brake fluid level switch is grounded through a separate body ground circuit. The BCM provides a reference voltage to the brake fluid level switch. When the brake fluid level is low the switch closes, pulling the reference voltage low. When the brake fluid level is high, the switch opens, sending the reference voltage high on the signal circuit to the BCM.

Fuel Level Sender

The fuel level sender is mounted to the fuel pump and sender unit or the fuel level sensor. The fuel level sender is a dual sweep potentiometer style resistor connected to a float mechanism. The dual sweep design provides a second resistance measurement that reduces the intermittent loss of data due to corrosion between the resistor wires and the sweep arm. As the fuel level changes, the float rises or falls with the fuel level moving the sweep arm across the resistor wires. This movement either increases or decreases the resistance through the unit. The fuel level sensor for gasoline engines resistance ranges from 180 ohms +/- 4 ohms at empty (E) and 10 ohms +/- 2 ohms at full (F). The fuel level sensor for Flex fuel (E100) resistance ranges from 500 ohms ± 4 ohms at empty (E) to 50 ohms ± 2 ohms at full (F). When the fuel level is low, the fuel level sensor resistance is high. When the fuel level is high, the fuel level sensor resistance is low. The fuel level sensor is hardwired to the IPC through separate signal and return circuits.

Both the fuel pump and sender unit and fuel level sensor are hardwired to the IPC through separate signal and return circuits. The fuel level return circuits are grounded internally in the IPC. The IPC provides a reference voltage on the fuel level signal circuit. As the fuel level changes, the change in resistance raises or lowers the fuel level signal voltage depending on the resistance of the fuel level sender.

IPC

The IPC provides the driver with a system status and alerts the driver when certain conditions exist in the vehicle. The IPC receives the ignition status from the BCM through the GWM over the HS-CAN3.

The IPC requires PMI when the IPC is replaced. The IPC lens and mask assembly are replaceable as an assembly.

Engine Oil Pressure Sensor

The engine oil pressure sensor is hardwired to the PCM through voltage reference (VREF), signal and return circuits. The PCM provides the sensor voltage supply on the VREF circuit and monitors the change in voltage through the signal and return circuits as the engine oil pressure changes.

Park Position Detect Switch

The park position detect switch is hardwired to the IPC through a single signal circuit and is grounded by a separate circuit through the selector lever. The IPC provides a reference voltage to the park position detect switch. When the selector lever is in PARK (P), the park position detect switch closes to ground, pulling the reference voltage low. When the selector lever is moved out of PARK (P), the park position detect switch opens to ground, sending the reference voltage high to the IPC.

Seatbelt Buckle Sensor

The seatbelt buckles contain integrated sensors that are Hall-effect switches. The seatbelt buckle sensors are

serviced as one component with the seatbelt buckle.