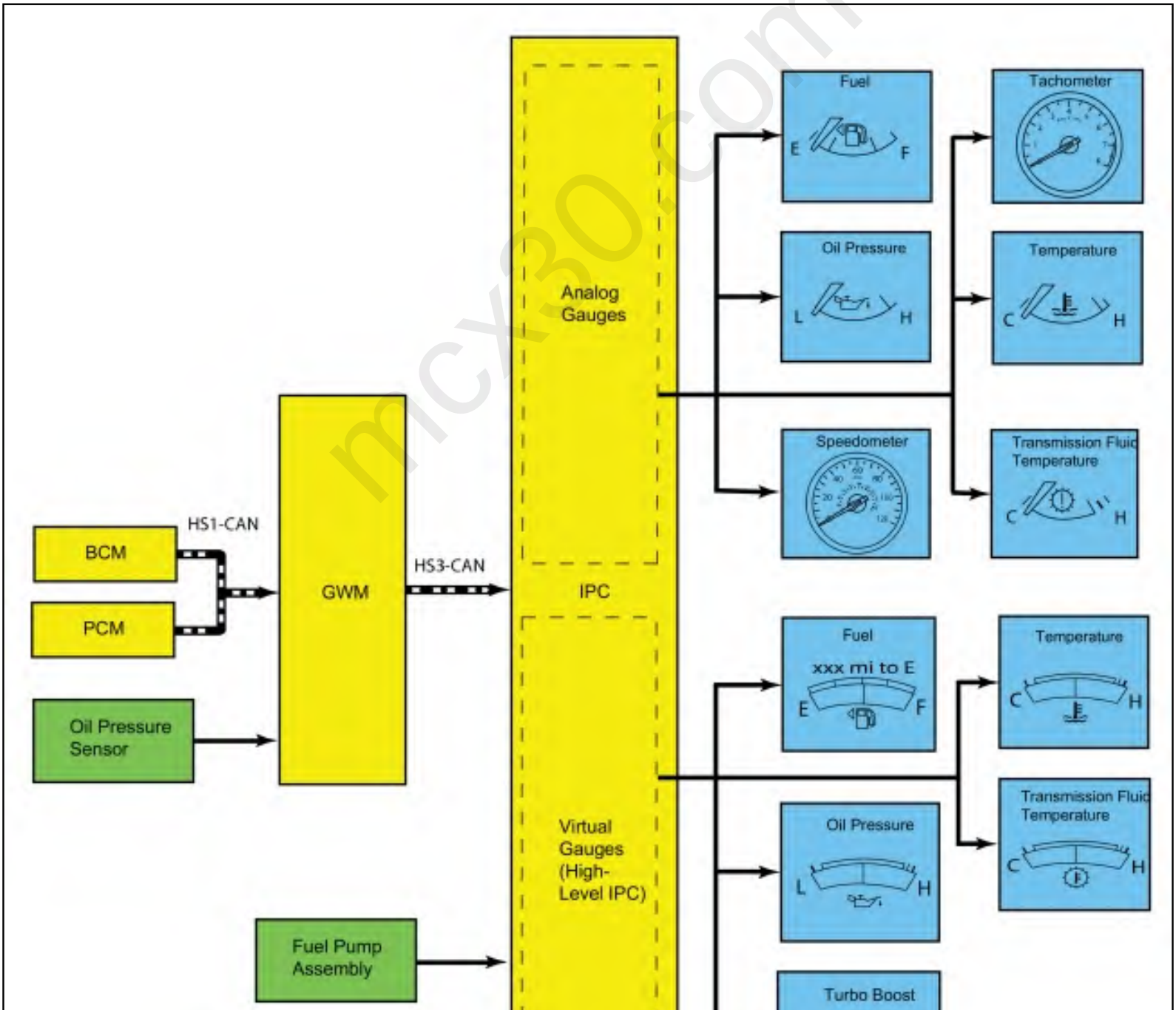
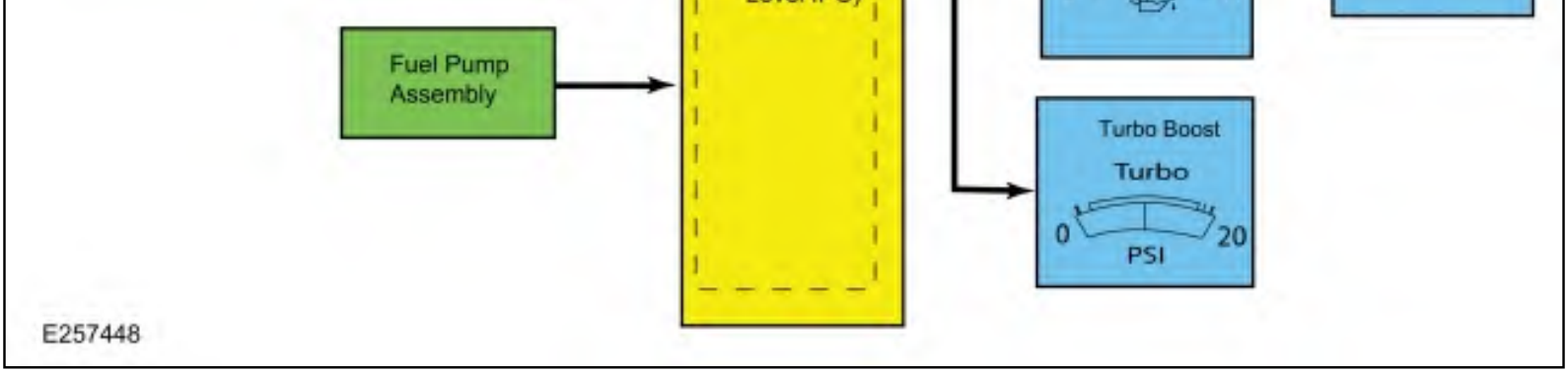
Instrument Panel Cluster (IPC) - System Operation and Component Description

Base Part Number: Base Part Number: 10849

System Operation

System Diagram - Gauges



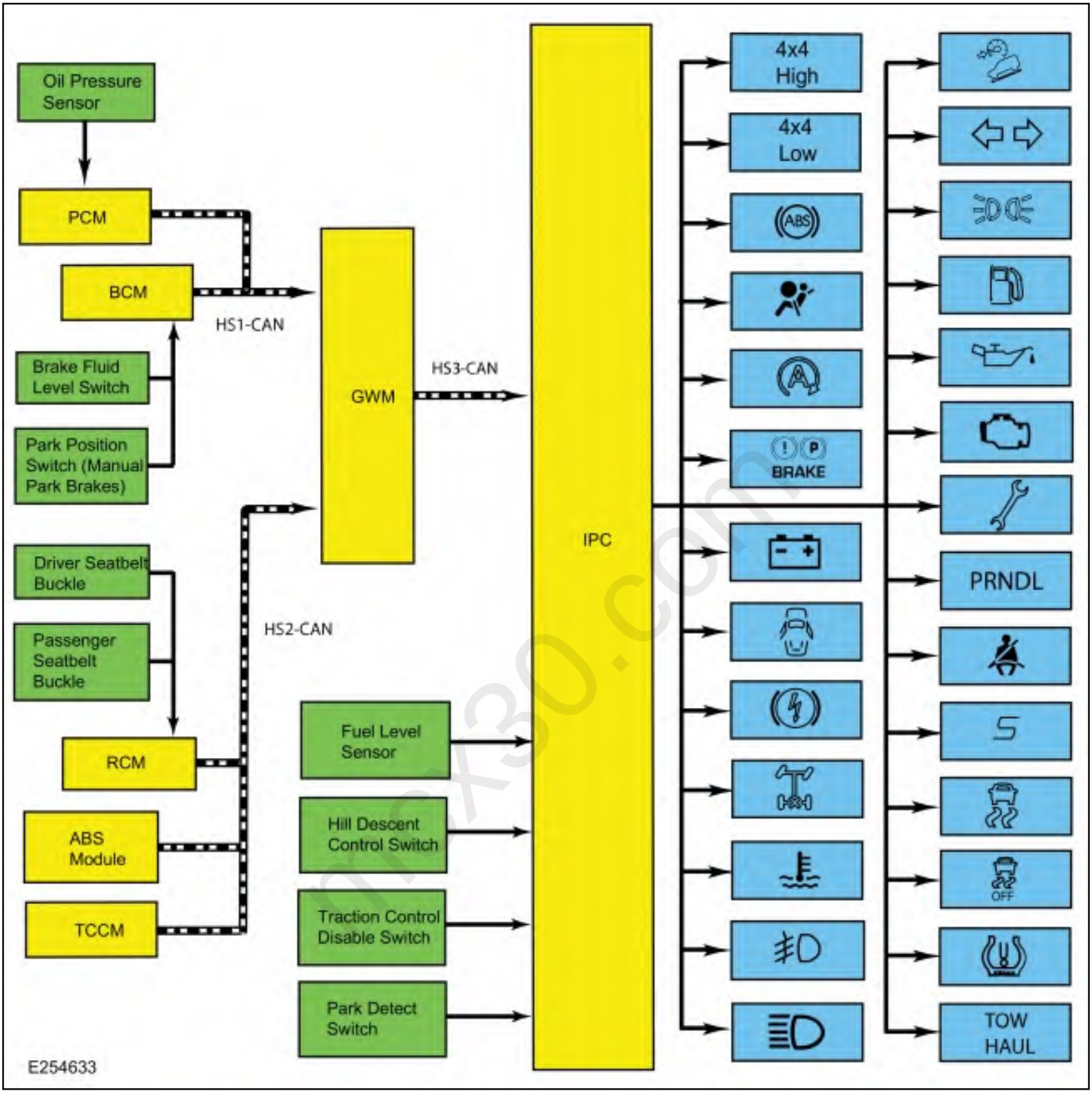


Network Message Chart - Gauges

Module Network Input Messages - IPC

Broadcast Message	Originating Module	Message Purpose
Engine coolant temperature data	PCM	Input used to control the temperature gauge and the virtual temperature gauge.
Engine off status	PCM	Input provides the length of time the engine is off used to calculate the rate of change for the transmission temperature gauge.
Engine overheat indication request	PCM	Input used to send the temperature gauge to full hot.
Engine rpm data	PCM	• Input used to control the tachometer indication. • Input used to calculate the rate of change for the transmission temperature gauge.
Ignition status	BCM	Ignition RUN, START and accessory states required for the IPC operating modes and fault reporting.
Oil pressure warning indicator request	PCM	Input used to control the engine oil pressure gauge and the virtual engine oil pressure gauge.
Transmission fluid temperature data	PCM	Input used to control the transmission temperature gauge and the virtual transmission temperature gauge.
Turbo boost data	PCM	Input used to control the virtual turbo boost gauge.
Vehicle speed	PCM	Vehicle speed data used for the virtual AWD gauge display and speedometer indication.

System Diagram - Indicators



Network Message Chart - Indicators

Module Network Input Messages - IPC

Broadcast Message	Originating Module	Message Purpose

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.
4x4 high status	TCCM	Input used to control the 4x4 high indicator.
4x4 low status	TCCM	Input used to control the 4x4 low indicator.
4WD service required	TCCM	4WD input used to control the powertrain malfunction (wrench) indicator
Battery low state of charge	BCM	Input used to control the charging system warning indicator.
Body service required	BCM	Input used to control the powertrain malfunction (wrench) indicator
Brake (red) warning indicator request	ABS module	Input for ABS faults used to control the brake warning indicator.
Driver door ajar status	BCM	Input used to control the driver door ajar warning indicator.
Driver seatbelt buckle status	RCM	Input used to control the seatbelt warning indicator.
Electronic park brake (red) indicator request	ABS module	Parking brake input used to control the brake warning indicator when equipped with electronic parking brakes.
Electronic park brake (yellow) indicator request	ABS module	Input used to control the electronic park brake indicator.
Engine coolant temperature data	PCM	Input used to control the engine over-temperature 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 engine oil pressure indicator.
Engine service required	PCM	Input used to control the powertrain malfunction (wrench) indicator
Front fog lamp indicator request	BCM	Input used to control the fog lamp indicator.
Headlamp high/low status	BCM	Input used to control the high beam indicator.
Hill descent mode	ABS module	Input used to control the hill descent 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 left rear door ajar warning indicator.
Left turn lamp on request	BCM	Input used to control the LH turn indicator.
MIL request	PCM	Input used to control the MIL.
Oil pressure warning indicator request	PCM	Input used to control the low engine oil pressure warning indicator.
Parking brake warning indicator request	BCM	Input used to control the parking brake indicator when equipped with manual parking brakes.
Parklamp status	BCM	Input used to control the lights on indicator.
Passenger door ajar status	BCM	Input used to control the passenger door ajar warning indicator.
Power shed level request	BCM	Input used to turn off the PRNDL when vehicle power shed function is requesting battery conservation.
Powertrain drive mode status	PCM	Input used to control the sport and tow haul indicators.
Rear differential lock indicator request	TCCM	Input used to control the ELD indicator.
Red brake warning indicator request	BCM	Input for the brake fluid level status used to control the brake warning indicator.
Right rear door ajar status	BCM	Input used to control the right rear ajar warning indicator.
Right turn lamp on request	BCM	Input used to control the RH turn indicator.
Stability-traction control indicator request	ABS module	Input used to control the stability/traction control (sliding car icon) indicator.
Stability-traction control disabled indicator request	ABS module	Input used to control the stability/traction control disabled (sliding car OFF icon) indicator.
Stop-start mode indicator	PCM	Input used to control the auto stop/start indicator.
Tire pressure warning indicator	BCM	Input used to control the TPMS indicator.
Transmission gear display	PCM	Input used to control the select shift segment of the PRNDL indication.
Transmission service required	PCM	Input used to control the powertrain malfunction (wrench) indicator

Transmission gear display mode	PCM	Input used to display or flash the PRNDL indication.
Transport mode	BCM	Input used to control the PRNDL 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 PRNDL 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 assembly
- Park detect switch (part of the floor shifter assembly)

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 (418-00 Module Communications Network) .

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 network overview information,

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

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.

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; SPEED LIMITED TO XXX KM/H (XX MPH). The MyKey® top speed selections are; 105, 113, 121 or 129 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 (105, 113, 121 or 129 km/h [65, 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, 113, 121 or 129 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 (72, 89, 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.

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 PRNDL, backlighting of the message center display, displaying a message center splash screen, gauge and LED prove out and finally normal IPC operation.

Dealer Test Mode

To enter the IPC engineering test mode or dealer test mode, begin with the ignition OFF. Press and hold the LH steering wheel switch OK button. Place the ignition ON and continue to hold the button for 5-8 seconds until the display indicates Engineering Test Mode. 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

NOTE: *It is important to view each of the cluster options in the Overview to identify which IPC uses a specific analog gauge.*

Refer to: Instrument Panel Cluster (IPC) (413-01 Instrumentation, Message Center and Warning Chimes) .

Engine Oil Pressure

The IPC uses the engine oil pressure warning indicator request network message to control the engine oil pressure gauge. The engine oil pressure sensor is hardwired to the PCM. The PCM sends the oil pressure warning indicator request message to the GWM over the HS-CAN1. The GWM sends the oil pressure warning indicator request message to the IPC over the HS-CAN3.

Engine Temperature

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 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.

Fuel

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

Anti-Slosh Mode

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).

Key OFF Fueling Mode

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.

Key ON Fueling Mode

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.

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

Recovery 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. The PCM uses tire size stored in the vehicle configuration file along with wheel speed inputs to generate a vehicle speed signal.

The IPC provides a tolerance that allows the speed indication to display between 3% below and 7% above the actual vehicle speed. This means that with an actual vehicle speed of 97 km/h (60 mph), the speedometer can indicate between 94-103 km/h (58-64 mph). Incorrect tire size or tire size configuration could 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.

Transmission Temperature

The IPC uses a base transmission temperature message then filters the transmission fluid temperature signal based on engine rpm and the length of time the engine has remained in the off state to provide a more accurate gauge indication.

The IPC receives the transmission fluid temperature data, the engine rpm data and the engine off status messages from the GWM over the HS-CAN3. The GWM receives the transmission fluid temperature data, the engine rpm data and the engine off status messages from the PCM over the HS-CAN1.

Virtual Gauges (High-Level IPC Only)

NOTE: *It is important to view each of the cluster options in the Overview to identify which IPC uses a specific virtual gauge.*

Refer to: Instrument Panel Cluster (IPC) (413-01 Instrumentation, Message Center and Warning Chimes) .

Engine Oil Pressure

The IPC uses the engine oil pressure warning indicator request network message to control the engine oil pressure gauge. The engine oil pressure sensor is hardwired to the PCM. The PCM sends the oil pressure warning indicator request message to the GWM over the HS-CAN1. The GWM sends the oil pressure warning indicator request message to the IPC over the HS-CAN3.

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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.

Fuel

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

Anti-Slosh Mode

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).

Key OFF Fueling Mode

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.

Key ON Fueling Mode

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.

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

Recovery 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.

Transmission Temperature

The IPC receives the transmission fluid temperature message from the GWM over the HS-CAN3. The GWM receives the transmission fluid temperature message from the PCM over the HS-CAN1. The PCM filters the transmission fluid temperature signal to remove fluctuations that could affect the stability of the transmission temperature gauge indication.

Turbo Boost

The turbo boost gauge is a configurable gauge that ranges between 0-20 PSI (0-140 kPa) and can be configured on through the message center controls. The IPC receives the turbo boost data message from the GWM over the HS-CAN3. The GWM receives the turbo boost data message from the PCM over the HS-CAN1.

Indicators

NOTE: *It is important to view each of the cluster options in the Overview to identify which IPC uses specific fixed location indicators.*

Refer to: Instrument Panel Cluster (IPC) (413-01 Instrumentation, Message Center and Warning Chimes) .

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. Upon initiation of the prove-out, the gauges sweep from one stop to the other then return to the normal indication state based on the input received. The IPC also 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
4x4 Low	Informational	3 seconds
4x4 High	Informational	3 seconds
Airbag	Warning	6 seconds
ABS	Warning	3 seconds
Auto stop/start	Informational	None
Brake	Warning	3 seconds
Charging	Warning	Engine start up
Door ajar	Warning	None
Electronic park brake	Informational	3 seconds
ELD	Informational	None
Engine over-temperature	Warning	3 seconds
Fog lamp	Informational	None
High beam	Informational	None
Hill descent control	Informational	None
Lights on	Informational	None
Low fuel	Informational	3 seconds
Low engine oil pressure	Warning	3 seconds
MIL	Informational	Engine start up
Powertrain malfunction (wrench)	Informational	3 seconds

Seatbelt	Informational	65 seconds if the seatbelt is unbuckled, turns off when the seatbelt is buckled
Sport mode	Informational	None
Stability-traction control (sliding car icon)	Warning	3 seconds
Stability-traction control disabled (sliding car OFF icon)	Informational	3 seconds
TPMS	Warning	3 seconds
Tow haul	Informational	None
Turn-hazard	Informational	None

4x4 Low And 4x4 High Indicators (Low-Level IPC Only)

The IPC receives the 4x4 high status and 4x4 low status messages from the GWM over the HS-CAN3. The GWM receives the 4x4 high status and 4x4 low status messages from the TCCM over the HS-CAN2.

ABS/Brake/Stability-Traction Control System Indication

The brake/stability-traction control system indication is controlled in many instances 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 (Sliding Car Icon) Status	Stability-Traction Control Disabled Indicator (Sliding Car OFF Icon) Status
Normal operation	Off	Off	Off	Off
Parking brake applied	Off	On	Off	Off
Wheel speed sensor faults	On	Off	On	Off
Pump motor electrical fault	On	On	On	Off
Invalid or missing PCM data	Off	Off	On	On
Steering wheel angle sensor fault	Off	Off	Flashing	On

Brake fluid level low	Off	On	Off	Off
RCM RAM fault	Off	Off	Flashing	Off
Stability control EEPROM fault	Off	Off	Flashing	Off
RCM sensor cluster lateral acceleration sensor failure	Off	Off	Flashing	Off
RCM sensor cluster longitudinal acceleration sensor failure	Off	Off	Flashing	Off
RCM sensor cluster yaw rate/ lateral acceleration sensor failure	Off	Off	Flashing	Off
RCM sensor cluster roll rate sensor signal failure	Off	Off	Flashing	Off
Brake switch failure - pressure sensor offset learned (stability control only applications)	Off	Off	Flashing	Off
Brake pedal switch failure - signal stuck high	Off	Off	N/A	Off
Low brake booster vacuum below threshold	Off	On	Flashing	Off
Stability control event duration too long	On	Off	On	Off
ABS control event duration too long	On	On	On	Off
Traction control system/ESC mode switch stuck on	Off	Off	Flashing	Off
Brake booster vacuum sensor signal invalid	Off	On	Flashing	Off
Traction control isolation valves over-temperature	Off	Off	Flashing	Off
Brake system evacuate and fill process not complete.	Flashing	On	On	On
Valve relay general failure	On	On	On	Off
Valve relay supply circuit short to ground	On	On	On	Off
Wheel speed sensor incorrectly installed	On	Off	On	Off

Wheel speed sensor signal wheel rotation direction plausibility failure	Off	Off	Flashing	Off
ABS control event plausibility failure	On	Off	On	Off
Pressure sensor failure	On	On	N/A	Off
CAN bus off failure	Off	Off	On	Off
Lost communication with the PCM	Off	Off	On	Off
Valves general electronic failure	On	On	On	Off
Configuration not complete	Flashing	On	On	On
Calibration file not downloaded or flashed	On	Off	On	On
Configuration incompatible or not correct	On	On	On	On
Collision mitigation by braking event control request incorrect	Off	Off	Flashing	Off
Collision mitigation by braking deceleration plausibility failure	Off	Off	Flashing	Off
ACC deceleration plausibility failure	Off	Off	Flashing	Off
End of line configuration EEPROM failure	On	Off	On	On
RAM failure	On	On	On	On
EEPROM failure	On	On	On	On
Control module microcontroller failure	On	Off	On	On
Control module initialization failure	Off	Off	On	On
General electronic failure	On	On	On	On
Control module temperature over allowable limit	On	On	On	On

Vehicle Identification Number (VIN) HS-CAN2 data mismatch compared with the end of line configuration	On	Off	On	On
Control module voltage under limit	On	On	On	On

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.

Airbag Warning Indicator

The IPC receives the airbag warning indicator status from the GWM over the HS-CAN3. The GWM receives the airbag indicator status 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 mode indicator message from the GWM over the HS-CAN3. The GWM receives the stop-start mode 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 the following 3 messaged inputs to control the brake warning

indicator.

Network Message	Condition
Brake (red) warning indicator request	Indicates a brake system concern from the ABS.
Red brake warning indicator request	Indicates a low brake fluid level concern.
Parking brake warning indicator request (manual parking brake)	Indicates the parking brake is applied.
Electronic park brake (red) indicator request (electronic parking brake)	Indicates the parking brake is applied.

The IPC receives all network messages required to operate the brake warning indicator 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 red brake warning indicator request and the parking brake warning indicator request (manual parking brake only) from the BCM over the HS-CAN1.

The GWM receives the electronic park brake (red) indicator request (electric parking brake only) from the ABS module over the HS-CAN2.

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

Charging System Warning Indicator

The charging system warning indicator is controlled by the IPC based upon the battery low state of charge message received from the GWM over the HS-CAN3. The GWM receives the battery low state of charge message from the BCM over the HS-CAN1. When a fault is detected in the charging system, the BCM sends the IPC the battery low state of charge message to illuminate the charging system warning indicator.

Door Ajar Warning Indicator

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

Electronic Park Brake Indicator (If Equipped)

The electronic park brake indicator indicates a fault in the electronic park brake system. The IPC receives the electronic park brake (yellow) indicator request from the GWM over the HS-CAN3. The GWM receives the electronic park brake (yellow) indicator request from the ABS module over the HS-CAN2.

ELD Indicator

The ELD indicator informs the driver the locking differential is engaged. The IPC receives the rear differential lock indicator request message from the GWM over the HS-CAN3. The GWM receives the rear differential lock indicator request message from the TCCM over the HS-CAN2.

Engine 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 over-temperature message from the PCM over the HS-CAN1.

Front Fog Lamp Indicator

The fog lamp indicator informs the driver that the fog lamps are turned on. The IPC receives the front fog lamp indicator request from the GWM over the HS-CAN3. The GWM receives the front fog lamp indicator request from the BCM module over the HS-CAN1.

High Beam Indicator

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

Hill Descent Control Indicator

The hill descent control indicator informs the driver the hill descent function is turned on and may be in ready mode, active control mode or over-temperature mode. The IPC receives the hill descent mode message from the GWM over the HS-CAN3. The GWM receives the hill descent mode message from the ABS module over the 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 right turn lamp on request, the left turn lamp on request or both messages to the GWM over the HS-CAN1. The GWM sends the right turn lamp on request, the left turn lamp on request or both messages to the IPC over the HS-CAN3. Upon receipt of the applicable turn signal on/off data, the IPC flashes the turn signal indicator on and off.

Lights On Indicator

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

on indicator.

Low Fuel Indicator

The IPC provides the low fuel indicator to indicate the fuel level is low at several preset stages before the driver runs out of fuel. The IPC uses the calculated DTE to control the low fuel indicator. When the fuel level reaches approximately 120 km (75 miles) (MyKey® users only) and 80 km (50 miles), 40 km (25 miles), 20 km (10 miles) and 0 km (0 miles) for MyKey® and administrator key users, the IPC turns on the low fuel indicator.

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 warning indicator. When the engine rpm is above 400 rpm, the IPC turns on the low engine oil pressure warning indicator whenever a low engine oil pressure condition exists.

The engine oil pressure sensor is hardwired to the PCM. The PCM provides the oil pressure warning indicator request and the engine rpm data to the GWM over the HS-CAN1. The GWM provides the oil pressure warning indicator request and engine rpm data to the IPC over the HS-CAN3.

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) Indicator

The IPC provides a powertrain malfunction (wrench) message center indicator to indicate transmission, Electronic Throttle Control (ETC), 4WD, and BCM concerns.

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

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

The GWM receives the 4WD service required message from the TCCM over the HS-CAN2.

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

PRNDL Indicator

The IPC uses the following messages to control the PRNDL:

- Power shed level request
- Transmission gear display
- Transmission gear display mode
- Transport mode

- Vehicle speed

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

The GWM receives the transmission gear display, transmission shift mode display and vehicle speed messages from the PCM over the HS-CAN1. The GWM receives the transport mode and power shed level request messages from the BCM over the HS-CAN1.

When the vehicle is in transport mode, the PRNDL 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 park detect input controls the display of the "P". 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 buckle status through the driver 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.

Sport Mode And Tow Haul Indicator

The sport mode and tow haul indicators informs the driver the transmission is operating in either sport mode or tow haul mode based on the driver requested input. 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.

Stability-Traction Control Indicator (Sliding Car Icon)

The stability-traction control indicator informs the driver the stability-traction control system is active by flashing the indicator or that a fault condition exists by illuminating the indicator steady.

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.

Stability-Traction Control Disabled Indicator (Sliding Car OFF Icon)

When the driver enables or disables the stability-traction control system, the ABS module sends the stability-traction control disabled indicator request message to the GWM over the HS-CAN2. The GWM sends the stability-traction control disabled 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.

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.

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 when the tow haul system has been engaged and is actively providing tow haul control for the vehicle. When the system is actively providing tow haul control, the PCM sends the powertrain drive mode status message to the GWM over the HS-CAN1. The IPC receives the powertrain drive mode status message from the GWM over the HS-CAN3.

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 and 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 float drops, allowing the switch to close, pulling the reference voltage low. When the brake fluid level is high, the float lifts, opening the switch contacts, sending the reference voltage high on the signal circuit to the BCM.

The brake fluid level switch uses an internal resistor in parallel. This enables the BCM to differentiate between a disconnected brake fluid level switch connector and a full level condition.

Fuel Level Sender

The fuel level sender is mounted to the fuel pump assembly 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 resistance ranges from 180 ohms ± 4 ohms at empty (E) to 10 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.

Both the fuel pump assembly 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 Programmable Module Installation (PMI) when the IPC is replaced.

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 Hall-effect sensors. The seatbelt buckle sensors are serviced as one component with the seatbelt buckle.