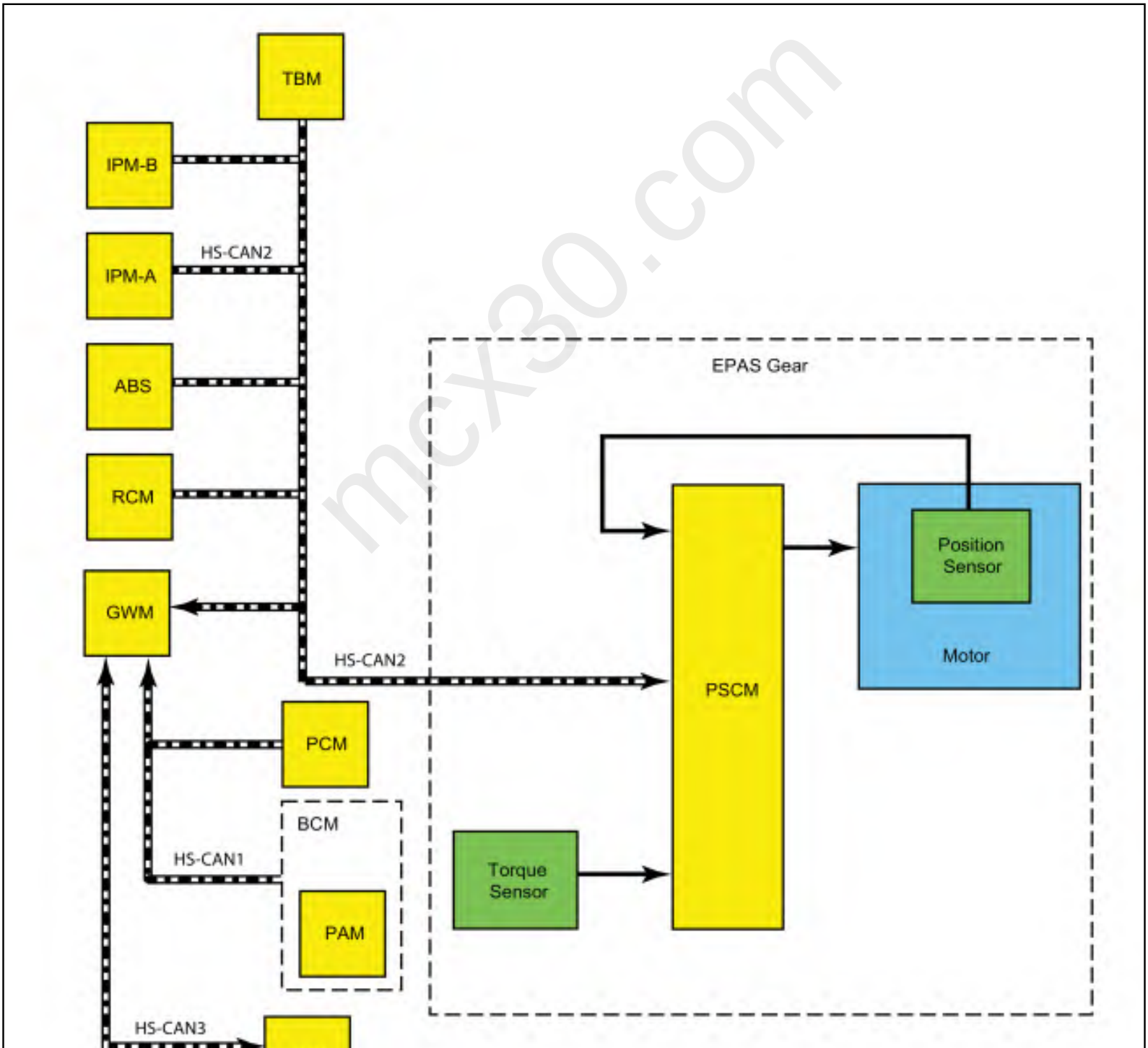
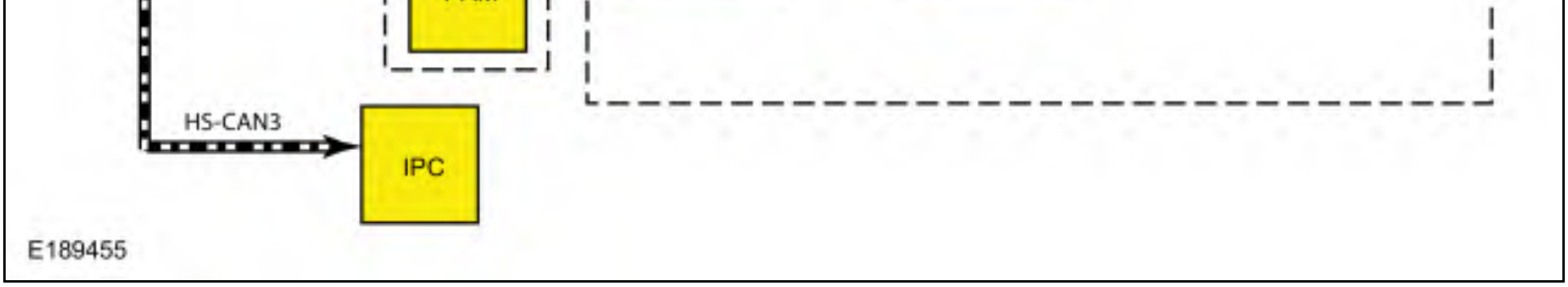
Power Steering - System Operation and Component Description

System Operation

System Diagram





Network Message Chart

PSCM Network Input Messages

Broadcast Message	Originating Module	Message Purpose
ABS active	ABS	Used to confirm the operational state of the ABS.
Ignition status	BCM	This message is first sent to the GWM and then to the PSCM. Used to confirm the ignition status of the vehicle.
Power pack status	PCM	This message is first sent to the GWM and then to the PSCM. Used to confirm the status of the operating mode; off - torque not available, on - torque not available, start in progress - torque not available or on - torque available.
Power system status	BCM	This message is first sent to the GWM and then to the PSCM. Used to confirm the status of the vehicle battery and charging system.
Stability control brake active	ABS	Used to confirm the operational state of the stability control system.
Steering wheel angle	ABS	Used to verify the validity of the steering angle sensor.
Traction control brake active	ABS	Used to confirm the operational state of the traction control system.
Vehicle configuration information	BCM	This message is first sent to the GWM and then to the PSCM. Used to compare the PSCM configuration against the vehicles specific configuration (central car configuration).
Vehicle lateral acceleration	ABS	Used by the PSCM for steering assist calculations.
Vehicle lateral acceleration	RCM	Used by the PSCM for steering assist calculations.
Vehicle longitudinal acceleration	ABS	Used by the PSCM for steering assist calculations.

Vehicle speed data	ABS	Used to determine the level of assist supplied to the steering gear and to validate the steering wheel component angle by comparing the rotational speeds of each wheel. The difference in the speed of each wheel is used to derive a steering angle for comparison against the EPAS motor position sensor.
Vehicle yaw rate	ABS	Used by the PSCM for steering assist calculations.

EPAS System

The PSCM controls the functions of the EPAS system and communicates with other modules over the HS-CAN2 and through the GWM.

To activate, the EPAS system requires battery voltage at the hot at all times PSCM input, battery voltage at the PSCM ignition-run input, the PSCM must communicate with other modules over the HS-CAN2 and the PSCM must receive the power pack status message from the PCM.

The main input for calculating the level of EPAS assist is the steering torque sensor signal (internal to the PSCM). Vehicle speed is also taken into consideration in order to achieve the vehicle speed dependent steering assist characteristic.

The EPAS gear uses a reversible motor to apply the steering assist by moving the rack inside the steering gear. The motor is connected to the rack of the steering gear by a toothed belt and pulley-bearing assembly.

The PSCM continually monitors and adjusts steering efforts based on the steering torque sensor signal, motor position and HS-CAN2 inputs to enhance the feel of the steering system. As vehicle speed increases, the amount of assist decreases to improve and enhance road feel at the steering wheel. As vehicle speed decreases, the amount of assist increases to ease vehicle maneuvering. Compensation is made to reduce the effect of pull or drift experienced when driving on roads with a high degree of camber. Compensation is also made for the impact of wheel imbalance on steering feel, up to a predetermined threshold.

The steering torque sensor senses the torque at the steering wheel. It is integrated into the PSCM and works by measuring the relative rotation between an input and output shaft which are connected by a torsion bar. The steering torque sensor sends out 2 PWM signals which allows a channel to channel cross-check and an accurate correction of the neutral point.

The PSCM is self-monitoring and is capable of setting and storing Diagnostic Trouble Codes (DTCs). Depending on the DTC set, the PSCM may enter a failure mode. In addition, the PSCM may send a request to the IPC to display a message in the message center, alerting the driver of a potential EPAS concern. The warning message is sent over the HS-CAN2 to the GWM which relays the message to the IPC over the HS-CAN3.

Failure Modes

When a DTC is present in the PSCM, the EPAS enters 1 of 2 modes of operation.

Reduced Steering Assist Mode - The EPAS enters a reduced steering assist mode to protect the internal components of the EPAS when a non-critical safety concern is detected by the PSCM, concerns such as low battery voltage, high battery voltage or over-temperature are considered non-critical safety concerns. This reduced steering assist mode gives the steering operation a heavier than normal feel.

Manual Steering Mode - The EPAS enters a manual steering mode (no electrical steering assistance is provided) when a concern considered to be a critical safety concern is detected. In manual steering mode, the vehicle has mechanical steering only which gives the steering operation a heavy feel.

Pull Drift Compensation (PDC)

EPAS equipped vehicles have a Pull Drift Compensation (PDC) feature to assist drivers in compensating for variation in road and driving conditions. The feature adjusts power assist offset by reducing the steering wheel effort (input torque) required to keep the vehicle traveling straight. The Pull Drift Compensation (PDC) feature is automatically enabled at vehicle speeds above 40 km/h (25 mph) with sensors indicating the vehicle is traveling straight. Pull Drift Compensation (PDC) is designed to compensate for variations in road crown, the system detects input torque to the wheel by the driver to slowly ramp in a steering assist offset to neutralize, in most situations and within limits, steering efforts for the duration of time those driving conditions exist. Full compensation requires up to 45 seconds. Changing lanes on a multilane road and the expected change in road crown would trigger a change in torque input and a compensation adjustment, and is a normal operation of the Pull Drift Compensation (PDC) feature. The feature updates automatically and continuously, however, since it is based on input torque, the feature only works with hands on the steering wheel while driving in a straight line. The system does not compensate when turning or during slight curves on highways. The system does not compensate if driver input torque, steering wheel angle or vehicle yaw rate is too large. For the system to compensate, the driver must have both hands on the steering wheel.

Active Park Assist

The active park assist system is controlled by the PAM (integrated into the BCM) and, when activated, can detect a parking space and steer the vehicle into the space by sending commands to the EPAS gear (the driver still controls the throttle, brakes and transmission). The active park assist system is comprised of several systems and modules working together to aid in parallel parking maneuvers. The presence of certain Diagnostic Trouble Codes (DTCs) in any of those modules or systems may keep the active park assist system from being enabled or may disable the system if currently being used.
Refer to: Parking Aid - System Operation and Component Description (413-13C Parking Aid - Vehicles With: Active Park Assist, Description and Operation).

Lane Keeping System (LKS)

NOTE: *If equipped, the Lane Keeping System (LKS) can interfere with accurate EPAS diagnostics. Disable the Lane Keeping System (LKS) before test driving the vehicle to diagnose EPAS concerns. For information on disabling the Lane Keeping System (LKS), refer to the Owner's Literature.*

The Lane Keeping System (LKS) utilizes the camera located in the IPMA to detect and track the road lane markings. The Lane Keeping System (LKS) has 2 functions, lane keeping alert and lane keeping aid. The lane keeping alert detects unintentional drifting toward the outside of the lane and alerts the driver through steering wheel vibrations and a visual alert in the IPC message center. The lane keeping aid assists the driver by

automatically providing steering torque to help the driver keep the vehicle in the lane.
Refer to: Lane Keeping System - System Operation and Component Description (419-07 Lane Keeping System, Description and Operation).

Component Description

EPAS Steering Gear

The EPAS gear is an assembly consisting of a PSCM, a motor, and a steering torque sensor, all of which are serviced as an assembly. The inner and outer tie rods and the steering gear bellows boots are available separately for service.

- The steering torque sensor is mounted near the input shaft of the EPAS gear and is used by the PSCM to determine how much force is being used to turn the steering wheel.
- The EPAS gear has one inner tie rod located at each end of the gear assembly.
- The EPAS gear has one outer tie rod located at each end of the gear assembly.
- The EPAS gear has one bellows boot located at each side of the EPAS gear assembly. Each boot is held in place with 2 boot clamps.

PSCM

The PSCM is the ECU for the EPAS system. The module monitors all sensor inputs and HS-CAN2 messages relating to the EPAS system and directly controls the output of the EPAS motor.