# 1 HUD Lane Keeping System – CGEA1.3

## 1.1 Functional Description

The Lane Keeping System for HUD consists of two (2) display functions:

1. Display the Lane Keeping Alert.
2. Display the Lane Keep Aid (LKA) status.

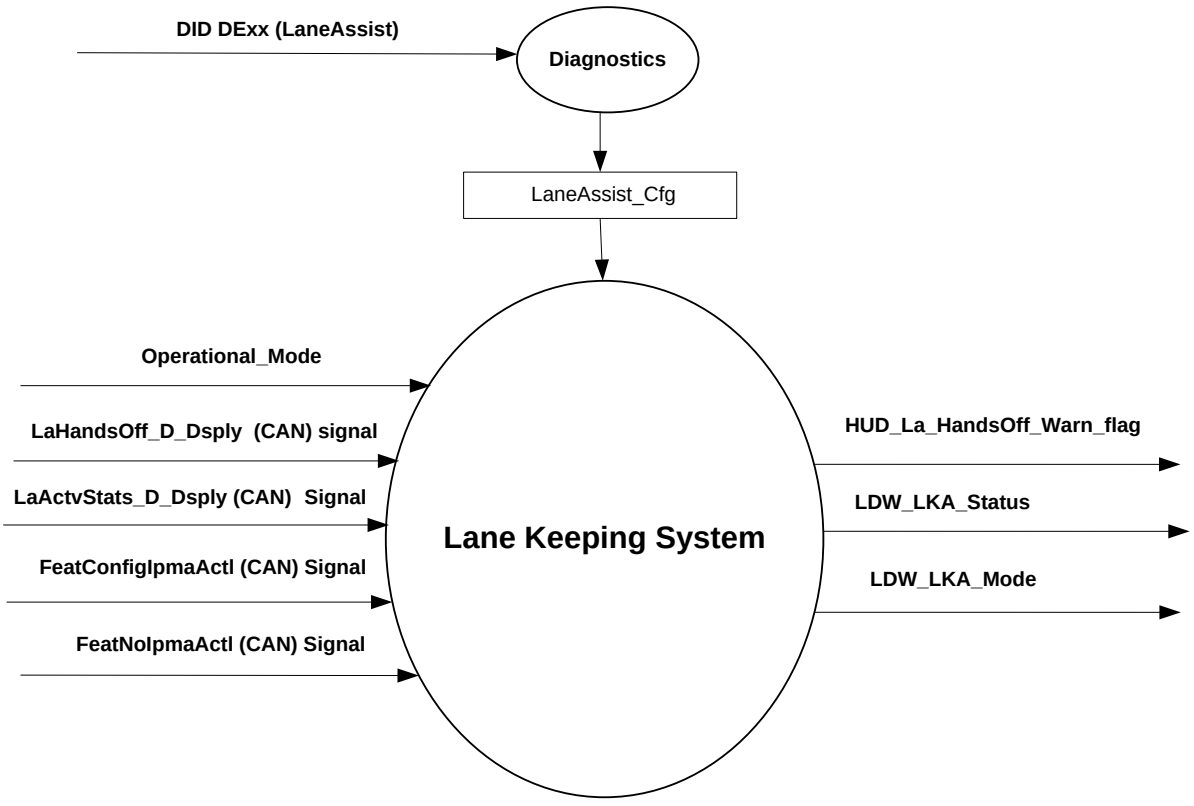
Both display functions have the same logic and use the same CAN bus input from IPMA module, the difference resides in the display graphics that Lane Keep Aid status uses additional arrows along the lane markings (See section 1.3.3.2). The internal flag LDW_LKA_mode is used to distinguish the two display graphics only.

Note that the Lane Departure Warning (LDW) is equivalent to the Lane Keeping Alert. LDW will be used as the abbreviation throughout this specification.
LKA/LDW shall be visible in HUD only if the user turned on the LKS option for HUD. Refer HUD Memory/Recall STSS for the feature configuration.
This specification also includes Hands on Steering wheel warning.

## 1.2 Interfaces

### 1.2.1 Interface Context Diagram (I/O Block Diagram)

**Lane Keeping System Context Diagram**



### 1.2.2 Inputs

*1.2.2.1 IR-REQ-300976/A-INTERNAL:*

- Operational_Mode

#### *1.2.2.2 MUX message*

1.2.2.2.1 IR-REQ-300958/A-FeatConfigIpmaActl Signal

| Signal Name | Size (bits) | Detail | Units | Res. | Offset | State Encoded | Min | Max |
|---|---|---|---|---|---|---|---|---|
| FeatConfigIpmaActl | 16 | - | Undefined | 1 | 0 | | 0 (0x0) | 65535 (0xFFFF) |

1.2.2.2.2 IR-REQ-300959/A-FeatNoIpmaActl Signal

| Signal Name | Size (bits) | Detail | Units | Res. | Offset | State Encoded | Min | Max |
|---|---|---|---|---|---|---|---|---|
| FeatNoIpmaActl | 16 | - | Number | 1 | 0 | | 0 (0x0) | 65535 (0xFFFF) |

1.2.2.2.3 IR-REQ-300960/A-LaActvStats_D_Dsply Signal

| Signal Name | Size (bits) | Detail | Units | Res. | Offset | State Encoded | Min | Max |
|---|---|---|---|---|---|---|---|---|
| LaActvStats_D_Dsply | 5 | | | 1 | 0 | | 0 (0x0) | 31 (0x1F) |
| | | No Left No Right | | | | 0 (0x0) | | |
| | | Available Left No Right | | | | 1 (0x1) | | |
| | | Suppress Left No Right | | | | 2 (0x2) | | |
| | | Warn Left No Right | | | | 3 (0x3) | | |
| | | Intervene Left No Right | | | | 4 (0x4) | | |
| | | No Left Available Right | | | | 5 (0x5) | | |
| | | Available Left Available Right | | | | 6 (0x6) | | |
| | | Suppress Left Available Right | | | | 7 (0x7) | | |
| | | Warn Left Available Right | | | | 8 (0x8) | | |
| | | Intervene Left Available Right | | | | 9 (0x9) | | |
| | | No Left Suppress Right | | | | 10 (0xA) | | |
| | | Available Left Suppress Right | | | | 11 (0xB) | | |
| | | Suppress Left Suppress Right | | | | 12 (0xC) | | |
| | | Warn Left Suppress Right | | | | 13 (0xD) | | |
| | | Intervene Left Suppress Right | | | | 14 (0xE) | | |
| | | No Left Warn Right | | | | 15 (0xF) | | |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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Available Left Warn Right | | | | 16 (0x10) | | |
| | | Suppress Left Warn Right | | | | 17 (0x11) | | |
| | | Warn Left Warn Right | | | | 18 (0x12) | | |
| | | Intervene Left Warn Right | | | | 19 (0x13) | | |
| | | No Left Intervene Right | | | | 20 (0x14) | | |
| | | Available Left Intervene Right | | | | 21 (0x15) | | |
| | | Suppress Left Intervene Right | | | | 22 (0x16) | | |
| | | Warn Left Intervene Right | | | | 23 (0x17) | | |
| | | Intervene Left Intervene Right | | | | 24 (0x18) | | |
| | | Not Used | | | | 25 (0x19) | | |
| | | Not Used | | | | 26 (0x1A) | | |
| | | Not Used | | | | 27 (0x1B) | | |
| | | Not Used | | | | 28 (0x1C) | | |
| | | Not Used | | | | 29 (0x1D) | | |
| | | LA OFF | | | | 30 (0x1E) | | |
| | | Not Used | | | | 31 (0x1F) | | |

1.2.2.2.4 IR-REQ-300961/A-LaHandsOff_D_Dsply Signal

| Signal Name | Size (bits) | Detail | Units | Res. | Offset | State Encoded | Min. | Max. |
|---|---|---|---|---|---|---|---|---|
| LaHandsOff_D_Dsply | 2 | | | 1 | 0 | | 0 (0x0) | 3 (0x3) |
| | | Hands On | | | | 0x0 | | |
| | | Level 1 | | | | 0x1 | | |
| | | Level 2 | | | | 0x2 | | |
| | | Suppressed | | | | 0x3 | | |

*1.2.2.3 IR-REQ-300974/A-Outputs*

- LDW_LKA_Status
- LDW_LKA_Mode
- HUD_La_HandsOff_Warn_flag

## 1.3 Function/Performance

### 1.3.1 F-REQ-300985/A-Operational Modes

| Mode | Differentiating Vehicle Conditions |
|---|---|
| Sleep Mode | Lane Keeping System Disabled |
| Limited Mode | Lane Keeping System Disabled |
| Normal Mode | Lane Keeping System Enabled / Disabled |
| Crank Mode | Lane Keeping System Enabled / Disabled |

### 1.3.2 Voltage Levels

Refer to the HUD Features table located in the Operational Modes and Voltage Range Strategies Section in this SPSS.

### 1.3.3 Human-Machine Interface

#### *1.3.3.1 Visual*

1.3.3.1.1 HMI-REQ-300962/A-Indicator Graphics / Display Format

**Example Graphics:**


The graphics for Lane Keeping Alert are the Lane Markings, and the graphics for Lane Keeping Aid are the Lane Markings with additional Arrows, which are shown in the same color as its associated Lane Marking.

#### 1.3.3.1.2 Indicator Color Coordinates

Reference section COLOR & ILLUMINATION REQUIREMENTS (GRAPHICS)

#### *1.3.3.2 Audio*

None

#### *1.3.3.3 Switch Control Logic*

None

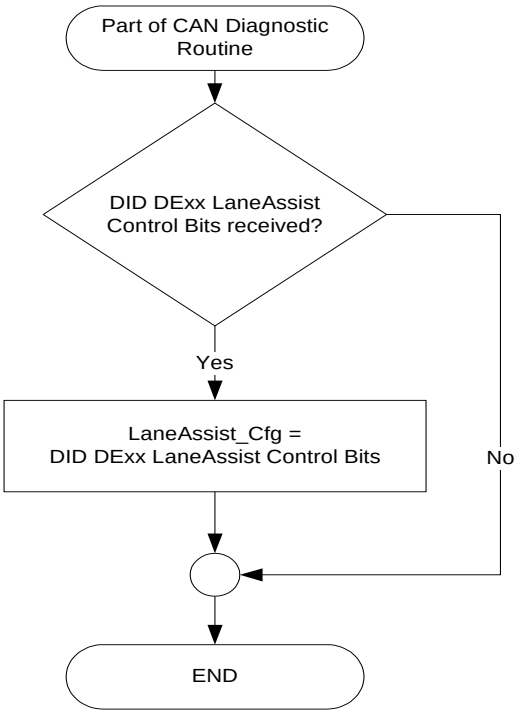
1.3.4 PFM-REQ-300986/A-System Accuracy

Within a 100msec of receiving a message that results in a change of state the HUD will update the display to the proper status.

### 1.3.5 Operation: Performance and Functional

#### *1.3.5.1 Operation Description (supports algorithm flowchart /state diagram)*

##### 1.3.5.1.1 F-REQ-300965/A-Lane Assist Diagnostic Configuration Flowchart




*** = Unused data received for 5 seconds continuously, use last known data otherwise. The graphics shown above are for example purposes only. Please refer to your program specific data directory for accurate graphics.**

##### 1.3.5.1.2 F-REQ-301297/A-Lane Keeping System (Activation) State

| FeatNoIpmaActl Signal | FeatConfigIpmaActl Signal | LDW_LKA_Mode | Representative Graphics (Actual graphic may differ) |
|---|---|---|---|
| 0x0807 (1) | 0x0001 (LDW) | 0x0001 (LDW) |   |

| | | | |
|---|---|---|---|
| | 0x0002 (LKA) | 0x0002 (LKA) |  |
| | 0x0003 (LDW+LKA) | 0x0003 (LDW+LKA) |  |

### 1.3.5.1.3 F-REQ-300969/A-Lane Assist HUD Information State with Example graphics

| **Operational_ Mode** | **LaneAssist_ Cfg** | **LDW_LKA_MODE** | **LaActvStats_D_Dsply Signal** | **LDW_LKA_Status** | **HUD display** |
|---|---|---|---|---|---|
| Sleep/Limited | X | X | X | Inactive | **Inactive** |
| Normal or Crank | LDW (0x1)<br><br>OR<br><br>Full_LDW_LKA (0x2) | LDW (0x1)<br><br>(only if LaneAssist_Cfg = Full_LDW_LKA), else it's a Don't Care (X) | Available Left No Right (0x1) | Available Left No Right (0x1) |  |
| | | | No Left Available Right (0x5) | No Left Available Right (0x5) |  |
| | | | Available Left Available Right (0x6) | Available Left Available Right (0x6) |  |
| | | | Suppress Left Available Right (0x7) | Suppress Left Available Right (0x7) |  |

| | | | | | |
|---|---|---|---|---|---|
| | | | Warn Left Available Right (0x8) | Warn Left Available Right (0x8) |  |
| | | | Available Left Suppress Right (0xB) | Available Left Suppress Right (0xB) |  |
| | | | Suppress Left Suppress Right (0xC) | Suppress Left Suppress Right (0xC) |  |
| | | | Warn Left Suppress Right (0xD) | Warn Left Suppress Right (0xD) |  |
| | | | Available Left Warn Right (0x10) | Available Left Warn Right (0x10) |  |
| | | | Suppress Left Warn Right (0x11) | Suppress Left Warn Right (0x11) |  |
| | Full_LDW_LKA (0x2) | LKA (0x2) OR LDW+LKA (0x3) | Available Left No Right (0x1) | Available Left No Right (0x1) |  |
| | | | No Left Available Right (0x5) | No Left Available Right (0x5) |  |

| | | | | | |
|---|---|---|---|---|---|
| | | | Available Left Available Right (0x6) | Available Left Available Right (0x6) |  |
| | | | Suppress Left Available Right (0x7) | Suppress Left Available Right (0x7) |  |
| | | | Intervene Left Available Right (0x9) | Intervene Left Available Right (0x9) |  |
| | | | Available Left Suppress Right (0xB) | Available Left Suppress Right (0xB) |  |
| | | | Suppress Left Suppress Right (0xC) | Suppress Left Suppress Right (0xC) |  |
| | | | Intervene Left Suppress Right (0xE) | Intervene Left Suppress Right (0xE) |  |
| | | | Available Left Intervene Right (0x15) | Available Left Intervene Right (0x15) |  |
| | | | Suppress Left Intervene Right (0x16) | Suppress Left Intervene Right (0x16) |  |

| | | | | | |
|---|---|---|---|---|---|
| | Full_LDW_LKA (0x2) | LDW+LKA (0x3) | Warn Left Available Right (0x8) | Warn Left Available Right (0x8) |  |
| | | | Warn Left Suppress Right (0xD) | Warn Left Suppress Right (0xD) |  |
| | | | Available Left Warn Right (0x10) | Available Left Warn Right (0x10) |  |
| | | | Suppress Left Warn Right (0x11) | Suppress Left Warn Right (0x11) |  |
| | Full_LDW_LKA (0x2) | X | LA OFF (0x1E) OR Missing as per section 1.4.1 | Inactive |  |
| | All other cases | | | Inactive |  |



**For 2017 programs and beyond with On-Demand Graphics and a permanent RTT in the Cluster Display, a Hands-Off Warning Message shall be displayed synchronously to the cluster, only if LKS option is turned on for HUD. Refer HUD Memory/Recall STSS for the feature configuration.**

#### 1.3.5.1.4 F-REQ-300972/A-State Matrix for HUD_La_HandsOff_Warn_flag

| LaneAssist_Cfg | Operational_Mode | LaHandsOff_D_Dsply Signal | HUD_La_HandsOff_Warn_flag |
|---|---|---|---|
| LDW (0x1) OR | Normal or Crank | Level 1 (0x1) | Active |
| | | Level 2 (0x2) | Active |

| | | | |
|---|---|---|---|
| Full_LDW_LKA (0x2) | | Missing as per 1.4.1 | Inactive |
| All Other Cases | | | Inactive |


### *1.3.5.2 Function Safety Classification (EMC)*

Class B

### *1.3.5.3 NVM-REQ-300978/A-Memory Storage*

| Parameter Name | Description | Value at Battery Connect | Value at Wake-up |
|---|---|---|---|
| LaActvStats_D_Dsply Signal | Input signal sent from Ipma to indicate the Lane Keeping System status. | 0x0 | 0x0 |
| FeatNoIpmaActl Signal | Input signal sent from Ipma to indicate Feature Number. | (0x0000) | Do Not Init |
| FeatConfigIpmaActl Signal | Input signal sent from Ipma to indicate current value of the feature setting for the feature that is being set or queried. | (0x0000) | Do Not Init |
| LaHandsOff_D_Dsply signal | CAN Signal sent from the IPMA | 0x0 (Hands On) | 0x0 (Hands On) |
| LDW_LKA_Status | Internal flag used to display Lane Keeping System status. | Inactive | Do Not Init |
| LDW_LKA_Mode | Internal flag used to distinguish if display is LDW, LKA or both. | (0x0001) | Do Not Init |
| HUD_La_HandsOff_Warn_flag | Internal flag to trigger Hands Off warning in HUD | Inactive | Inactive |
| LaneAssist_Cfg | State indicator for feature presence controlled via CAN at EOL at VO plant. Set to disabled at Cluster Supplier Manufacturing Plant | Use Stored Value | Use Stored Value |
| Operational_Mode | 4 state indicator for HUD operational mode | Limited | Limited, Normal or Crank |

### *1.3.5.4 Reconfigurable Telltale*

None

#### *1.3.5.5 Prove Out*

Not applicable

#### *1.3.5.6 Message Center Msg*

No Warnings

## 1.4 Error Handling

### 1.4.1 Missing Message Strategy

None
.

## 1.5 Diagnostics

### 1.5.1 Self Test

None

### 1.5.2 Engineering Test Mode

Reference section “Dealer / Engineering Test Mode (ETM)”

### 1.5.3 Part II Performance

#### *1.5.3.1 DTC-REQ-300980/A-Supported Diagnostic Trouble Codes (DTCs)*

| DTC | Description |
|---|---|
| C23A00 | Lost Communication with IPMA (Image Processing Module “A”) |

#### *1.5.3.2 DCR-REQ-300982/A-DID DExx:*

| Block Num | Block Description | Byte(s) | Bits | State: Description | "0" | "1" | Default | Comments/Information |
|---|---|---|---|---|---|---|---|---|
| PACKETED BLOCKS | | | | | | | | |
| | | | | | | | | |
| $xx | Option Content (B&A) | * | * | LaneAssist_Cfg | Disabled | Enabled | Disabled | Disabled means the feature is not presented in the vehicle |
| *Byte and bit location to be identified in Part II Specification for this HUD | | | | | | | | |

For 2017 programs and beyond with On-Demand Graphics and a permanent RTT in the Cluster Display

#### *1.5.3.3 DCR-REQ-300984/A-DID DExx*

| Block Num | Block Description | Size (bits) | Type | Byte(s) | Bits | State: Description | Default | Comments/ Information |
|---|---|---|---|---|---|---|---|---|
| PACKETED BLOCKS | | | | | | | | |
| | | | | | | | | |
| $xx | Option Content (B&A) | * | 1 | * | 2 | LaneAssist_Cfg | 0x0 | |
| | | | | | | 0x0 = Disabled | | |
| | | | | | | 0x1 = LDW | | |
| | | | | | | 0x2 = Full_LDW_LKA | | |
| | | | | | | 0x3 = Not Used | | |

## 1.6 Reference Specification

HUD_Memory_Save_and_Recall_-CGEA1.3_v1.3
Warning - Lane Assist System - CGEA1.3_v3.0

## 1.7 Revision History

# SPSS Module Revision History

| Revision Level | Name | Change Description | Date |
|---|---|---|---|
| 1.0 | M. Ye | Initial release. | 7/15/2014 |
| 1.1 | M. Ye | • Added Diagnostic Cfg function<br>• Updated TBD graphic in table 1.2 | 8/15/2014 |
| 2.0 | A. Mathai | • New HMI for LKS<br>• Add Hands off warning | 11/18/2015 |
| 2.1 | A. Salameh | • Initial VSEM RM Release | 3/12/2018 |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