





# 1 HUD\_Memory Save and Recall – CGEA 1.3

## 1.1 Functional Description

There are two (2) types of memory features covered in the specification, “Classic” Memory and Enhanced Memory. These two types of features correspond to the Position Features and Non-Position Features accordingly.

### 1. Position Features

The following features are classified and grouped as the “Classic” Memory features that are physically adjustable, owned and used by the HUD:

- HUD Vertical Position – Adjust the vertical position of the image
- HUD Horizontal Position – Adjust the Horizontal position of the image
- HUD Rotation – Adjust the tilt of the image by rotating the image
- HUD Brightness - Adjust the brightness of the image
- HUD Vertical Size – Adjust the vertical size of the displayed image

### 2. Non-Position Features

The following features are classified and grouped as the Enhanced Memory features that are configurable, possible used and /or configured by other modules (e.g. IPC):

- HUD Image ON/Off
- HUD ADAS On/Off
- HUD Image Density
- CHUD State
- HUD Navigation
- HUD Lane Keeping
- HUD Cruise Control
- HUD Traffic Signs
- HUD Infotainment
- HUD Efficient Drive
- HUD Distance Indication
- HUD Incoming Call
- HUD Local Hazard Information

Both groups of features are user adjustable features.

Some of the features are applicable for CHUD only and some of them are applicable for AHUD only. Please refer to the corresponding vehicle program for details

The Enhanced Memory feature is not deployed for MY17 vehicle programs. The HUD uses this feature for Infrastructure setup only for MY17 (e.g. CAN signals) and as a placeholder in reducing the future work by anticipating that the Enhanced Memory will be introduced soon after MY17. The MY17 HUD will use subset functions of the Enhanced Memory, mainly “SET” and “ENQUERY” features while fully implement the messaging mechanism for communicating with IPC for HUD feature setting and configuration.

The HUD uses “Classic” Memory feature for save and recall HUD settings for both “classic” Memory and Enhanced Memory features for MY17 vehicles. When the “Enhanced Memory” feature is officially deployed and available for MY18 and on, HUD memory save and recall function may follow the “Enhanced Memory” approach. Since the “Enhanced Memory” feature supports and includes “Classic” memory feature, most HUD settings that classified as “Classic” memory such as “HUD vertical position”, “HUD image rotation”, etc. will remain the same.

MY17 HUD Memory Save and Recall function uses 3 door switch buttons option. This allows the driver to store up to 3 sets of HUD settings using the door switch memory “1”, “2”, “3” buttons. It uses 3 CAN signals, PersNoPos\_D\_Actl (note this is for classical – i.e. seat/mirror – memory, and is different than PersNo\_D\_Actl), RecallEvent\_No\_Cnt, and Memory\_Cmd. There is also a vehicle level personalization profile, and an active personalization profile. Therefore the HUD has to store 4 copies for each of these features (3 drivers + vehicle) in EEPROM memory as well as the active profile in battery backed memory.



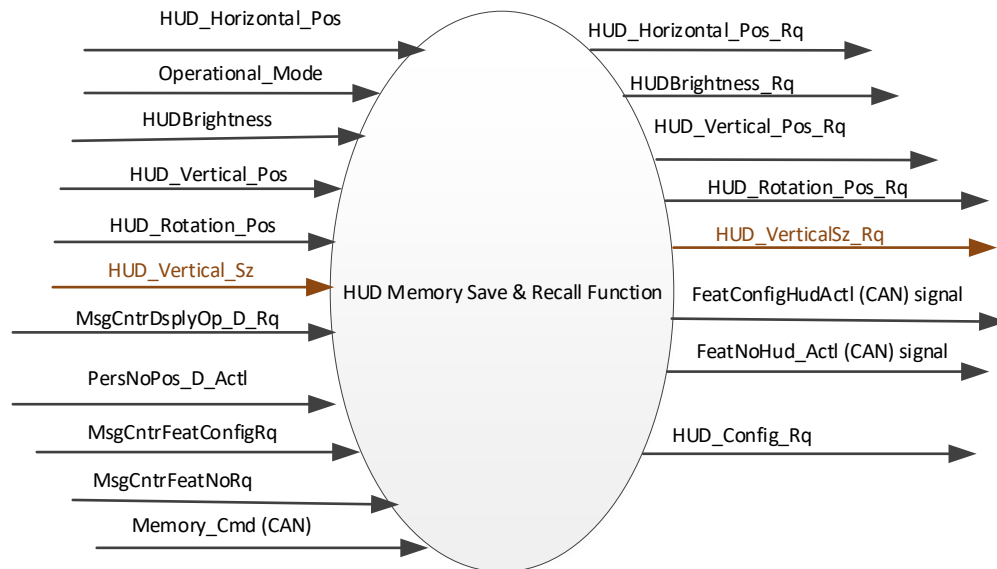
When PersNoPos\_D\_Actl is PERS\_1, PERS\_2, or PERS\_3, the active profile is only stored when the Memory\_Cmd signal indicates Store\_1, Store\_2, or Store\_3. Note that once the BCM associates a FOB with a memory position, or someone presses a memory button, BCM will not send "Vehicle" again in PersNoPos\_D\_Actl until after a battery disconnect.

For MY17 HUD, the "person indexing" for both feature level and ECU level will be ignored, they are treated as the same. For example, MsgCntrPosInde and PersonIndexHud\_D\_Actl will be treated as the same.

## 1.2 Interfaces

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

#### Memory Save and Recall Function Context Diagram



### 1.2.2 Inputs

#### 1.2.2.1 IR-REQ-305892/A-INTERNAL:

- Operational\_Mode
- HUDBrightness
- HUD\_Vertical\_Pos
- HUD\_Horizontal\_Pos
- HUD\_Rotation\_Pos
- HUD\_Vertical\_Sz

**1.2.2.2 MUX signals on the CAN Bus****1.2.2.2.1 SIG-REQ-305885/A-Memory\_Cmd Signal**

Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min	Max
Memory_Cmd	4	-	SED	1	0		0 (0x0)	15 (0xF)
		NULL				0 (0x0)		
		STORE_1				1 (0x1)		
		STORE_2				2 (0x2)		
		STORE_3				3 (0x3)		
		STORE_4				4 (0x4)		
		RECALL_1				5(0x5)		
		RECALL_2				6 (0x6)		
		RECALL_3				7 (0x7)		
		RECALL_4				8 (0x8)		
		Not used				9 (0x9)		
		Not used				10 (0xA)		
		Not used				11 (0xB)		
		Not used				12 (0xC)		
		Not used				13 (0xD)		
		Not used				14 (0xE)		
		Not used				15 (0xF)		

Note: The HUD only uses states 0x0 – 0x3.

**1.2.2.2.2 SIG-REQ-305886/A-MsgCntrFeatConfigActl Signal**

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

**1.2.2.2.3 SIG-REQ-305887/A-MsgcntrFeatNoActl Signal**

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

**1.2.2.2.4 SIG-REQ-305888/A-MsgCntrDsplyOp\_D\_Rq Signal**

Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min	Max
MsgCntrDsplyOp_D_Rq	3		SED	1	0		0 (0x0)	7 (0x7)
		Null				0x0		
		Query				0x1		
		Set				0x2		
		Upload				0x3		
		Restore				0x4		
		Copy				0x5		



		Unused_1				0x6		
		Unused_2				0x7		

Note: The HUD only uses states 0x1 and 0x2.

#### 1.2.2.2.5 SIG-REQ-305889/A-PersNoPos\_D\_Actl

Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min	Max
PersNoPos_D_Actl	3		SED	1	0		0 (0x0)	7 (0x7)
		PERS_1				0x0		
		PERS_2				0x1		
		PERS_3				0x2		
		PERS_4				0x3		
		Vehicle				0x4		
		NotDetermined				0x5		
		Unused_2				0x6		
		Unused_3				0x7		

### 1.2.3 Outputs

#### 1.2.3.1 IR-REQ-305893/A-Internal

- HUDBrightness\_Rq
- HUD\_Vertical\_Pos\_Rq
- HUD\_Horizontal\_Pos\_Rq
- HUD\_Rotation\_Pos\_Rq
- HUD\_Config\_Rq
- HUD\_VerticalSz\_Rq

#### 1.2.3.2 MUX message on the CAN Bus

##### 1.2.3.2.1 SIG-REQ-305890/A-FeatConfigHudActl Signal

Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min	Max
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FeatConfigHudActl	16	-	Undefined	1	0		0 (0x0)	65535 (0xFFFF)
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#### 1.2.3.2.2 SIG-REQ-305891/A-FeatNoHudActl Signal

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

### 1.3 Function/Performance

#### 1.3.1 F-REQ-305894/A-Operational Modes

Mode	Differentiating Vehicle Conditions
Sleep Mode	Disabled
Limiting Mode	Enabled / Disabled
Normal Mode	Enabled / Disabled
Crank Mode	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

None

##### 1.3.3.1.1 Indicator Graphics / Display Format

None

##### 1.3.3.1.2 Indicator Characteristics

None

##### 1.3.3.2 Audio

None



### 1.3.3.3 Switch Control Logic

None

### 1.3.4 PFM-REQ-305906/A-System Accuracy

Within a 100msec of receiving a message that results in a change of state the HUD will update 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 Classic Memory

##### 1.3.5.1.1.1 F-REQ-305908/A-Current Classic Memory Personality & Profile Recall

When the user wants to recall the active settings from a profile, the BCM shall generate the signal Memory\_Cmd with a value of "RECALL\_1", "RECALL\_2", or "RECALL\_3" to inform the HUD. Once receiving this signal, the HUD shall recall all the parameters from EEPROM.

##### 1.3.5.1.1.2 F-REQ-305895/A-Determination of Memory\_Cmd\_Index

Memory_Cmd signal*	Memory_Cmd_Index
RECALL_1 (0x5)	0x0
RECALL_2 (0x6)	0x1
RECALL_3 (0x7)	0x2

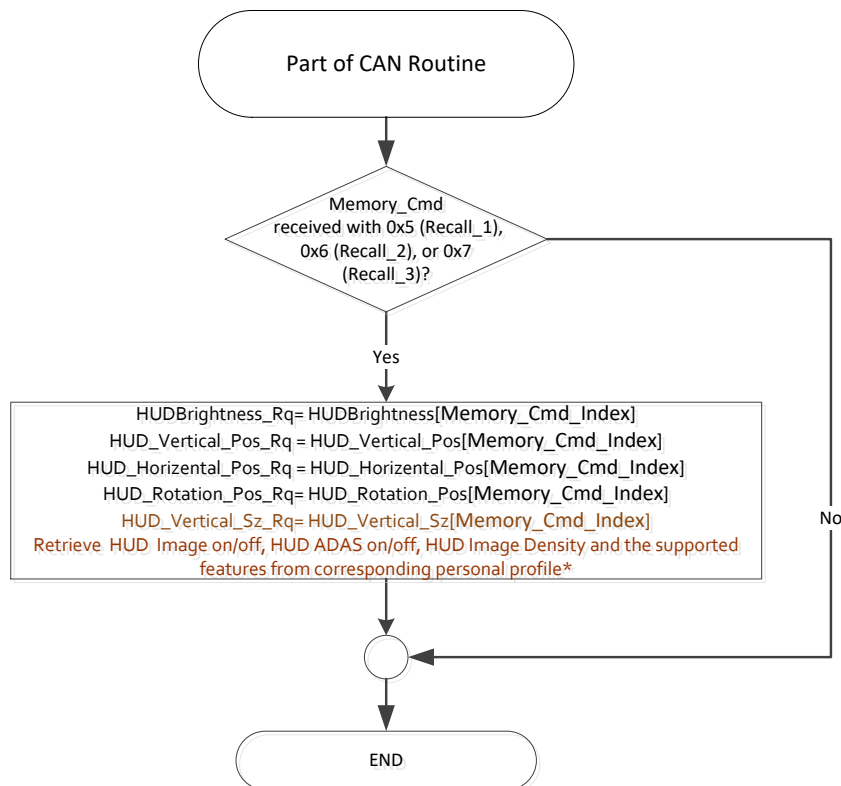
\*NOTE: There is no missing message strategy for Memory\_Cmd signal. Also, there are 3 memory door switch buttons. Memory\_Cmd\_Index is used simply to keep the indexes the same between Memory\_Cmd and PersNoPos\_D\_Actl.

##### 1.3.5.1.1.3 F-REQ-305896/A-Profile Recall

Profile recall is for the "classic" and "enhanced" memory features for MY 17 HUD. HUD Image on/off, HUD ADAS on/off and HUD Image Density shall be recalled from the storage of the corresponding index. HUD shall transmit **FeatNoHudActl** and **FeatConfigHudActl** CAN signals with the all HUD owned Feature Numbers and corresponding config values, whenever a profile is recalled.



#### 1.3.5.1.1.4 F-REQ-305897/A-Figure 2. Memory Recall Diagram



\* Features supported by the corresponding vehicle program have to be retrieved. For example, ADAS On/Off and Image Density are not applicable for CHUD, but CHUD can have Navigation, Distance Indication etc. Refer to the actual vehicle program for the features supported

#### 1.3.5.1.1.5 Storing a Profile

##### 1.3.5.1.1.5.1 F-REQ-305909/A-Storing Active Settings

When the user wants to store the active settings to a profile, the BCM shall generate the signal Memory\_Cmd with a value of "Store\_1", "Store\_2", or "Store\_3" to inform the HUD. Once receiving this signal, the HUD shall store all the parameters to EEPROM.

##### 1.3.5.1.1.5.2 F-REQ-305898/A-Determination of Memory\_Cmd\_Index

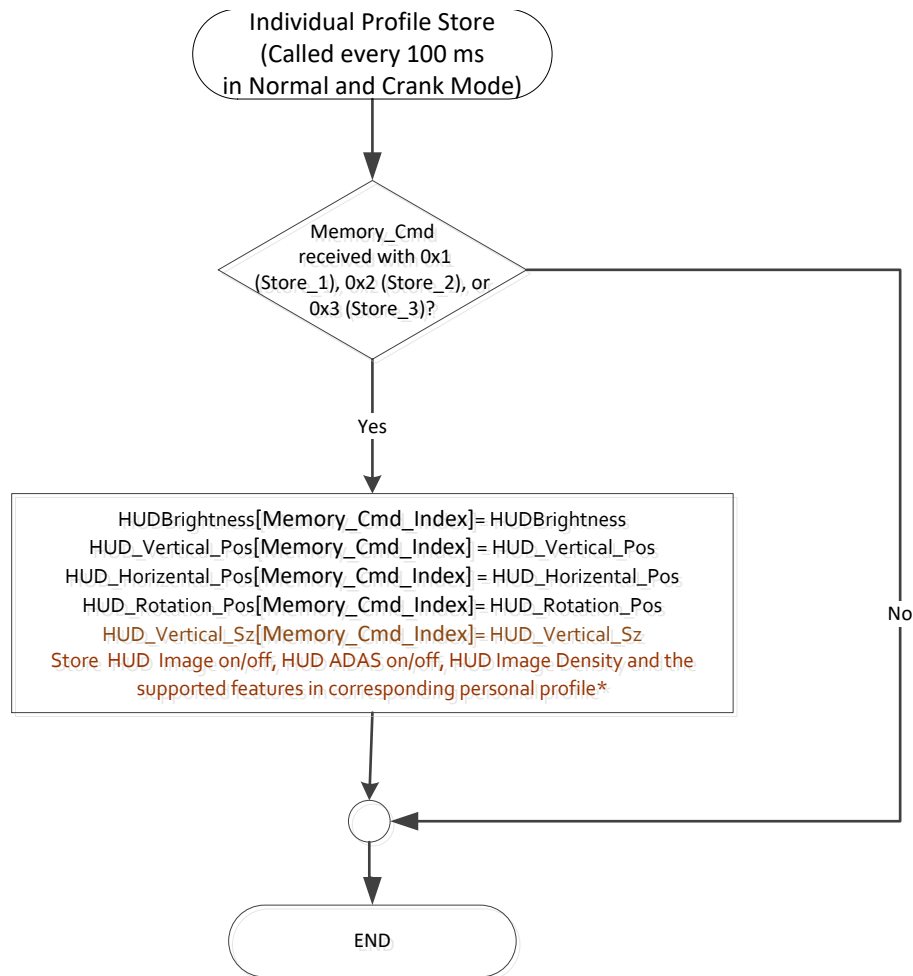
Memory_Cmd signal*	Memory_Cmd_Index
STORE_1 (0x1)	0x0
STORE_2 (0x2)	0x1
STORE_3 (0x3)	0x2

\*NOTE: There is no missing message strategy for Memory\_Cmd signal. Also, there are 3 memory door switch buttons. Memory\_Cmd\_Index is used simply to keep the indexes the same between Memory\_Cmd and PersNoPos\_D\_Actl.





## 1.3.5.1.1.5.3 F-REQ-305899/A-Memory Store Diagram



\* Features supported by the corresponding vehicle program have to be stored. For example, ADAS On/Off and Image Density are not applicable for CHUD, but CHUD can have Navigation, Distance Indication etc. Refer to the actual vehicle program for the features supported

## 1.3.5.1.2 Enhanced Memory

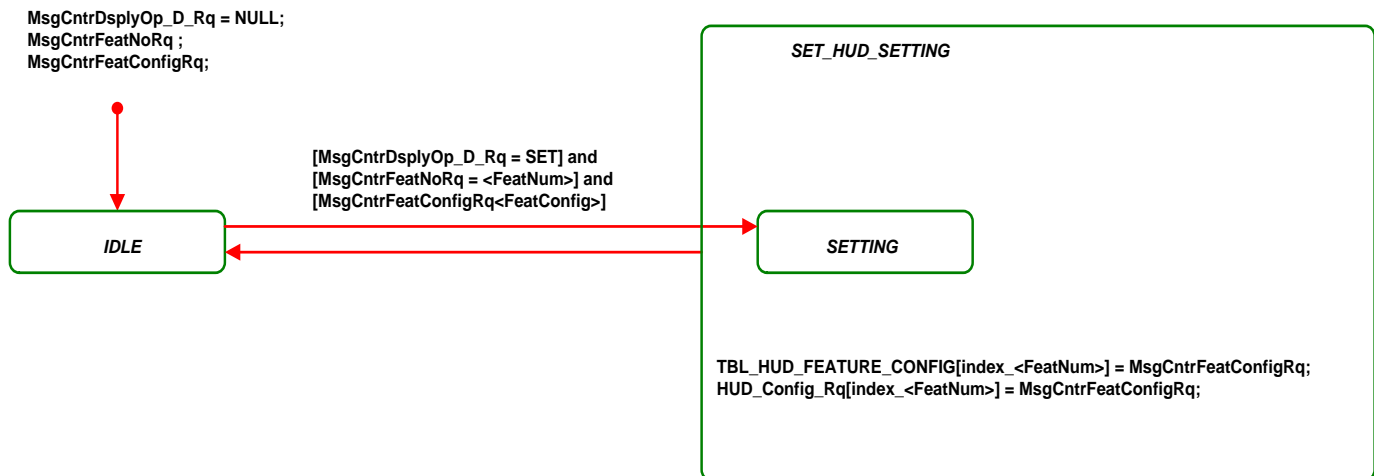
## 1.3.5.1.2.1 F-REQ-305910/A-Enhanced Memory Setup

The Enhanced Memory uses the following mechanism to communicate with other ECUs (in this case, only IPC) and to store and recall configurations. Note that since MY17 HUD is not using Enhanced Memory per its designed feature/function, there is no personality management for those features although they are classified as the Enhanced Memory.



#### 1.3.5.1.2.2 F-REQ-305900/C-SET REQUEST

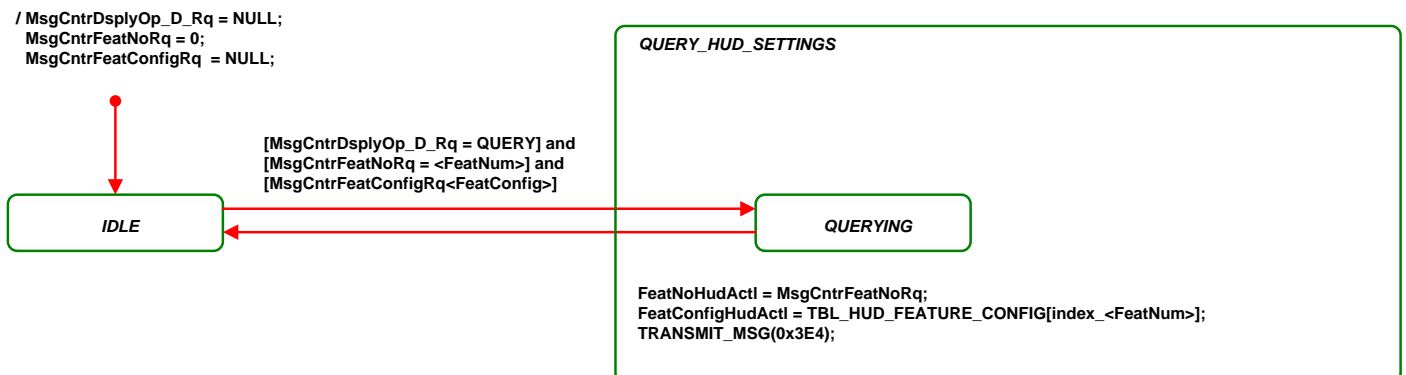
The IPC sets signal MsgCntrDsplyOp\_D\_Rq to "SET" when the user selects to change the HUD setting and subsequently the setting will be automatically saved to the memory. Upon receiving the SET request, the HUD shall set the configuration and store it immediately.



**\*\*Whenever HUD receives a SET command with applicable Feature Number, HUD shall store the non-positional settings to the memory location corresponding to the PersNoPos\_D\_Actl. Note autosave applies to 0x0(PERS\_1), 0x1(PERS\_2), 0x2(PERS\_3)**

#### 1.3.5.1.2.3 F-REQ-305901/B-QUERY REQUEST

The IPC sets signal MsgCntrDsplyOp\_D\_Rq to "QUERY" when the user push the "HUD" button on the steering wheel. The IPC shall query each feature number, and the HUD shall report back the configuration value of the feature identified in CtrStkFeatNoActl for the current profile.



#### 1.3.5.1.2.4 F-REQ-305902/A-Display Fault handling

- If HUD enters a fault state that is incapable of displaying information (for example: High or extreme temperatures, DMD Failure, LED Failure, Memory Failure etc) the following action shall be taken by HUD:
  - Retain the current user setting for HUD Image – On/ Off in RAM variable HUDImgOnOffUserSetState



- HUD shall transmit CAN signals FeatNoHudActl = 0xC01 and FeatConfigHudActl = Off (0x00) on entering the fault state
- HUD shall always respond to a SET/QUERY request for 0xC01 (MsgCntrDsplyOp\_D\_Rq = "SET" or "QUERY" ) with FeatNoHudActl = 0xC01 and FeatConfigHudActl = Off( 0x00), while in the fault state
- Any Memory Save action during this fault state should store HUD Image – On/ Off state with HUDImgOnOffUserSetState
- Memory recall during fault state shall update HUDImgOnOffUserSetState with the HUD Image – On/ Off recalled value. But shall transmit CAN signals FeatNoHudActl = 0xC01 and FeatConfigHudActl = Off (0x00)
- Upon Exit from fault state during the same ignition cycle
  - HUD shall transmit CAN signals FeatNoHudActl = 0xC01 and FeatConfigHudActl = HUDImgOnOffUserSetState
- After an ignition cycle, the variable states are to be recalculated based on Fault conditions

#### 1.3.5.1.2.5 F-REQ-305903/B-HUD Personalization Feature List (excerpt from A42 Personalization Technical Specification)

Feature Name	Feature Num	Cfg Num	Cfg Value
HUD Image on/off	0xC01	0x0	Off
		0x1	On
HUD ADAS on/off	0xC02	0x0	Cruise Control & Lane Keep OFF
		0x1	Cruise Control & Lane Keep ON
		0x2	Cruise Control ONLY
HUD Image Density	0xC03	0x0	Low
		0x1	High
CHUD State	0x0C10	0x00	Off
		0x01	On
HUD Navigation	0x0C11	0x00	Off
		0x01	On
HUD Lane Keeping	0x0C12	0x00	Off
		0x01	On
HUD Cruise Control	0x0C13	0x00	Off
		0x01	On
HUD Traffic Signs	0x0C14	0x00	Off
		0x01	On
HUD Infotainment	0x0C15	0x00	Off
		0x01	On
HUD Efficient Drive	0x0C16	0x00	Off
		0x01	On
HUD Distance Indication	0x0C17	0x00	Off
		0x01	On
HUD Incoming Call	0x0C18	0x00	Off
		0x01	On
	0x0C19	0x00	Off

HUD Local Hazard  
Information

0x01

On

Note: ADAS is defined as the grouping of ACC and LKS features

### 1.3.5.2 FS-REQ-305907/A-Function Safety Classification (EMC)

Class B

### 1.3.5.3 NVM-REQ-305905/B-Memory Storage

Parameter Name	Description	Value at Battery Connect	Value at Module Wake-up
Operational_Mode	4 state indicator for HUD operational mode	Limited	Limited or Normal or Crank
Memory_Cmd	CAN signal from BCM, used to control classic memory features.	0x0	Do Not Init
HUD_Config_Rq[x]	This internal variable array is used to adjust the HUD setting corresponding to TBL_HUD_FEATURE_CONFIG[x] x is the number of features configured for the program. (Can vary from 0 -10 for now)	Read from TBL_HUD_FEATURE_CONFIG[x]	Do Not Init
HUDBrightness_Rq	This internal variable is stored in Battery Backed RAM, and used when recall event occurs, and used by setting module to adjust the setting	0x6 (Default)	Use Stored Value
HUDBrightness	This signal is the actual HUD Image Brightness level from the HUD brightness module to be saved.	0x6 (Default)	Use Stored Value
HUDBrightness[ ]	This is an array of the 3 values of HUDBrightness stored in EEPROM with indexes of 0x0(PERS_1), 0x1(PERS_2), 0x2(PERS_3)	Use Stored Value	Use Stored Value
HUD_Vertical_Pos_Rq	This internal variable is stored in Battery Backed RAM, and used when recall event occurs, and used by setting module to adjust the setting	0x6 (Default)	Use Stored Value
HUD_Vertical_Pos	This signal is the actual vertical position from the setting module to be saved.	0x6 (Default)	Use Stored Value
HUD_Vertical_Pos[ ]	This is an array of the 3 values of HUD_Vertical_Pos stored in EEPROM with indexes of 0x0(PERS_1), 0x1(PERS_2), 0x2(PERS_3)	Use Stored Value	Use Stored Value
HUD_Horizontal_Pos_Rq	This internal variable is stored in Battery Backed RAM, and used when recall event occurs, and used by setting module to adjust the setting	0x6 (Default)	Use Stored Value



HUD_Horizontal_Pos	This signal is the actual Horizontal position from the setting module to be saved.	0x6 (Default)	Use Stored Value
HUD_Horizontal_Pos[ ]	This is an array of the 3 values of HUD_Horizontal_Pos stored in EEPROM with indexes of 0x0(PERS_1), 0x1(PERS_2), 0x2(PERS_3)	Use Stored Value	Use Stored Value
HUD_Rotation_Pos_Rq	This internal variable is stored in Battery Backed RAM, and used when recall event occurs, and used by setting module to adjust the setting	0x6 (Default)	Use Stored Value
HUD_Rotation_Pos	This signal is the actual rotation position from the setting module to be saved.	0x6 (Default)	Use Stored Value
HUD_Rotation_Pos[ ]	This is an array of the 3 values of HUD_Rotation_Pos stored in EEPROM with indexes of 0x0(PERS_1), 0x1(PERS_2), 0x2(PERS_3)	Use Stored Value	Use Stored Value
HUD_Vertical_Sz	This signal is the actual Vertical Size from the setting module to be saved.	0x2 (Default)	Use Stored Value
HUD_Vertical_Sz [ ]	This is an array of the 3 values of HUD_Vertical_Sz stored in EEPROM with indexes of 0x0(PERS_1), 0x1(PERS_2), 0x2(PERS_3)	Use Stored Value	Use Stored Value
TBL_HUD_FEATURE_CONFIG[x]	Suggested storage of HUD features. This array has 3 entries corresponding to the HUD features (0xC01- 0xC03, 0xC10-0xC19). The defaults for each of the HUD features are stored in EEPROM per the DExx configuration. x is the maximum number of features supported for the program. ( Can vary from 0 – 10 for now )	Stored in EEPROM per DExx configuration.	Do Not Init
HUDImgOnOffUserSetState	This internal variable used when HUD turns off due to a malfunction or faulty state	0x0 (Off)	Do Not Init

#### 1.3.5.4 Reconfigurable Telltale

Not Applicable

#### 1.3.5.5 Prove Out

Not applicable

### 1.4 Error Handling

#### 1.4.1 Missing Message Strategy

The signals will be declared missing as per the Diagnostics section of this SPSS.

DTCs states and history will be determined as per the Diagnostics section of this SPSS.



#### 1.4.2 Invalid Message Strategy

None

### 1.5 Diagnostics

#### 1.5.1 Self Test

None

#### 1.5.2 Engineering Test Mode

None

#### 1.5.3 Part II Performance

##### Supported Diagnostic Trouble Codes (DTCs)

DTC	Description
None	

### 1.6 Reference Specification

FS-DS7T-14C708-AE



## 1.7 Revision History

## SPSS Module Revision History

Revision Level	Name	Change Description	Date
1.11	ilopezla	Added <b>HUD Local Hazard</b> Information in the following sections: <ol style="list-style-type: none"><li>1. Functional Description – Non-Position Features</li><li>2. Section 1.3.5.1.2.5</li></ol> Updated TLB_HUD_FEATURE_CONFIG[x] range from 0xC10-0xC17 to 0xC10-0xC19. This to include HUD Incoming Call (0xC18) and HUD Local Hazard (0xC19) Features.	9/26/2018
1.10	A. Salameh	<ul style="list-style-type: none"><li>Initial VSEM RM release</li></ul>	4/5/2018
1.9	A. Salameh	<ul style="list-style-type: none"><li>Added PersNoPos_D_Actl to the Context Diagram, added table 1.4 PersNoPos_D_Actl, added Local Hazard Information to section 1.1 Non positional features</li></ul>	3/27/2018
1.8	A.Salameh	<ul style="list-style-type: none"><li>Modification made in Enhanced Memory Section in <b>red</b></li></ul>	6/8/2017
1.7	R. Chalandi	<ul style="list-style-type: none"><li>Modifications related to issue on 'HUD turning off due to Thermal Management system but IPC still sensing as HUD ON'.</li><li>Changes in <b>Yellow</b></li></ul>	8/12/2016
1.6	R. Chalandi	<ul style="list-style-type: none"><li>As per request from Felix Mueller and Daniel Kleinhoelting, Feature Num/Cfg Num required for cHUD configuration menu to disable/enable various features in HUD.</li><li>Modifications to support Image Vertical Size adjustment in CHUD</li><li>Table 1.7 updated as per feature numbers in Personalization Feature List_xxx_HUD.xls and Vertical Size info</li><li>Updated Figure 2 and 3 for description on supported features</li><li>Corrected Typos</li><li><b>Changes in Brown</b></li></ul>	1/28/2016
1.5	A. Mathai	<ul style="list-style-type: none"><li>Store and Recall flow chart executed part of CAN routine rather than periodic in RUN/CRANK. Brightness default also made 6.</li></ul>	1/5/2016
1.4	A. Mathai	<ul style="list-style-type: none"><li>Added requirement to transmit FeatNoHudActl and FeatConfigHudActl signals on Recall.</li><li>HUD to use Memory_Cmd to perform recall, instead of RecallEvent_No_Cnt and PersNoPos_D_Actl to prevent recall when vehicle in motion</li><li>Changed the default values in memory section and removed Vehicle from array</li></ul>	10/27/2015
1.3	M. Ye	Deleted the section 1.2.5.1.1.3 to avoid overwritten other personality settings when key Fob is not associated or BCM reset (where PersNoPos_D_Actl Vehicle is always sent):  Section 1.2.5.1.1.3 Storing to Memory When PersNoPos_D_Actl is Vehicle	8/10/2015
1.2	M. Ye	<ul style="list-style-type: none"><li>Updated feature "HUD ADAS on/off" ( 0xC02) to 3 states to allow "Cruise Control ONLY" per HMI requirement update</li></ul>	2/12/2015
1.1	M. Ye	<ul style="list-style-type: none"><li>Added new horizontal adjustment feature</li><li>Moved non-position features to Enhanced Memory and added all associated logics</li></ul>	8/15/2014
1.0	M. Ye	Initial Release	5/15/2014