





1 HUD Lane Keeping System – FNV2+

1.1 Functional Description

The Lane Keeping System for HUD consists of **three (3)** display functions:

1. Display the Lane Keeping Alert.
2. Display the Lane Keep Aid (LKA) status.
3. **Display the LKS RTT**

Above 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.

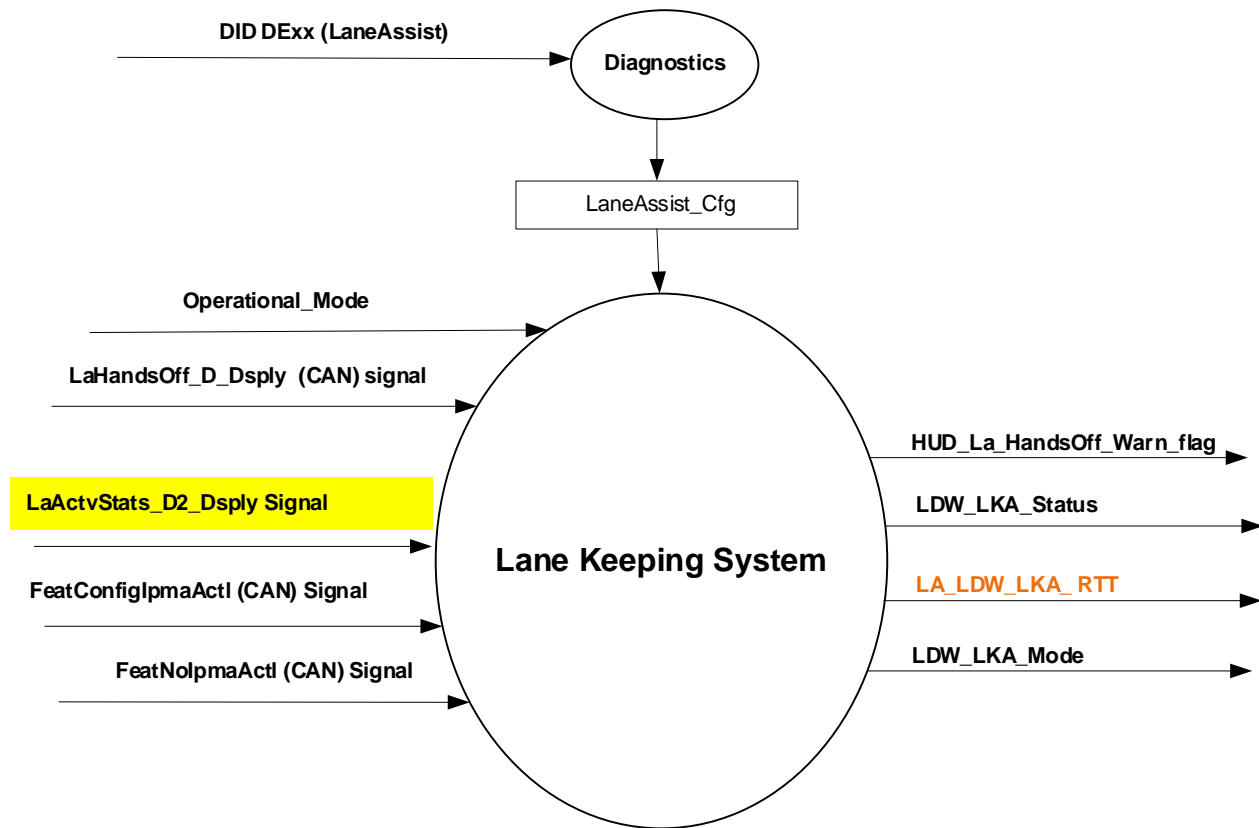
New signal LaActvStats_D2_Dsply replaces old LaActvStats_D_Dsply signal starting from MY23 CX483, MY23 P708 and onward programs which has DAT 204, DAT 221/222 or latest DAT SW. Backward compatibility is not maintained since IPMA will stop supporting the old signal.

MY24 and onwards vehicle program will start showing LKS RTT as well as per HMI/program directions.

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-FeatConfiglpmaActl Signal

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

1.2.2.2.2 IR-REQ-300959/A-FeatNolpmaActl Signal

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

1.2.2.2.3 IR-REQ-410938/A-LaActvStats_D2_Dsply Signal



Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min	Max
LaActvStats_D2_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)		
		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)		
		ECE OFF RTI				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/B-Outputs

- LDW_LKA_Status
- LDW_LKA_Mode



- HUD_La_HandsOff_Warn_flag
- LA_LDW_LKA_RTT

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

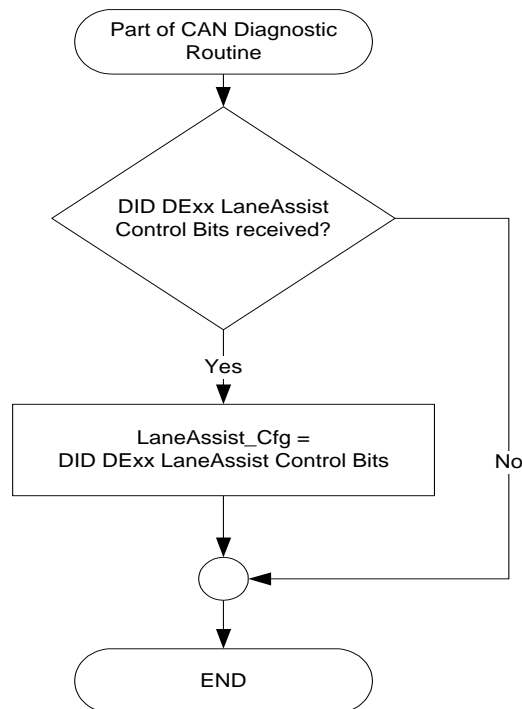
1.3.4 PFM-REQ-300986/A-System Accuracy

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/C-Lane Keeping System (Activation) State







FeatNolpmaActl	FeatConfiglpmaActl Signal	LDW_LKA_Mode	Representative Graphics
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Signal			(Actual graphic may differ)
0x0807 ⁽¹⁾	0x0001 (LDW)	0x0001 (LDW)	
	0x0002 (LKA)	0x0002 (LKA)	
	0x0003 (LDW+LKA)	0x0003 (LDW+LKA)	
	other	inactive	
Missing as per section 1.4.1		inactive	











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

Operational Mode	LaneAssist - Cfg	LDW_LKA_M ODE	LaActvStats_D2 Dsply Signal **	LDW_LKA_Status		HUD display	LA_LDW_LKA_RTT *
				Left Lane	Right Lane		
Sleep/Limited	X	X	X	Inactive	Inactive	Inactive	Inactive
Normal or Crank	LDW (0x1) OR Full_LDW_LKA (0x2)	LDW (0x1) (only if LaneAssist_Cfg = Full_LDW_LKA), else it's a Don't Care (X)	Available Left No Right (0x1)	Available	Not Available		Not Available
			No Left Available Right (0x5)	Not Available	Available		Not Available
			Available Left Available Right (0x6)	Available	Available		Available
			Suppress Left Available Right (0x7)	Not Available	Available		Available
			Warn Left Available Right (0x8)	Warning	Available		Warning
			Available Left Suppress Right (0xB)	Available	Not Available		Available






			Suppress Left Suppress Right (0xC)	Not Available	Not Available		Not Available
			Warn Left Suppress Right (0xD)	Warning	Not Available		Warning
			Available Left Warn Right (0x10)	Available	Warning		Warning
			Suppress Left Warn Right (0x11)	Not Available	Warning		Warning
	Full_LDW_ LKA (0x2) OR LKS_EuroN CAP (0x03)	LKA (0x2) OR LDW+LKA (0x3)	Available Left No Right (0x1)	Available	Not Available		Not Available
			No Left Available Right (0x5)	Not Available	Available		Not Available
			Available Left Available Right (0x6)	Available	Available		Available
			Suppress Left Available Right (0x7)	Not Available	Available		Available



			Intervene Left Available Right (0x9)	Intervention	Available		Intervention
			Available Left Suppress Right (0xB)	Available	Not Available		Available
			Suppress Left Suppress Right (0xC)	Not Available	Not Available		Not Available
			Intervene Left Suppress Right (0xE)	Intervention	Not Available		Intervention
			Available Left Intervene Right (0x15)	Available	Intervention		Intervention
			Suppress Left Intervene Right (0x16)	Not Available	Intervention		Intervention
	Full_LDW_ LKA (0x2) OR LKS_EuroN CAP (0x03)	LDW+LKA (0x3)	Warn Left Available Right (0x8)	Warning	Available		Warning
			Warn Left Suppress Right (0xD)	Warning	Not Available		Warning



			Available Left Warn Right (0x10)	Available	Warning		Warning
			Suppress Left Warn Right (0x11)	Not Available	Warning		Warning
	LDW (0x1) OR Full_LDW_ LKA (0x2) OR LKS_NCAP (0x03)	X	LA OFF (0x1E) OR ECE OFF RTT (0x1D)** OR Missing as per section 1.4.1	Inactive	Inactive		Inactive
	All other cases			Inactive	Inactive		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.

Note:

**In above matrix table LaActvStats_D2_Dsply signal is replaced with old LaActvStats_D_Dsply signal and relevant new state "ECE OFF RTT (0x1D)" is added for MY23 CX483, MY23 P708 and onward programs.

*If any HUD program doesn't have LKS RTT then ignore "LA_LDW_LKA_RTT" for that program.





For LKS lines and RTT colors and graphics always follow the program specific HMI.

All Suppress/ Not Applicable/Standby states shows Grey lines and LKS RTT as per program HMI directions.

In Legacy programs LKS "Active/Available" states always show Green lines and LKS RTT but From MY24 and onward programs LKS "Active/Available" will show White lines and LKS RTT as per program HMI direction.



1.3.5.1.4 F-REQ-444537/A-Lane Assist RTT State Mapping

RTT State" LA_LDW_LKA_RTT" (from F-REQ- 300969)	Example LKS RTT Color	Example LKS RTT Graphic
Not Available	(Grey)*	
Available	(White)*	
Intervention	(Amber)*	
Warning	(Red)*	
Inactive	None	None

Notes-

If HUD program doesn't have LKS RTT then above table would not be applicable.

*For all the RTT color follow the program specific HMI

**For all the RTT Graphics follow the program specific HMI

1.3.5.1.5 F-REQ-300972/B-State Matrix for HUD_La_HandsOff_Warn_flag

LaneAssist_Cfg	Operational _Mode	LaHandsOff_D_Dsply Signal	HUD_La_HandsOff_Warn_flag
LDW (0x1) OR Full_LDW_LK A (0x2) OR LKS_EuroNC AP (0x03)	Normal or Crank	Level 1 (0x1)	Active
		Level 2 (0x2)	Active
		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/D-Memory Storage**

Parameter Name	Description	Value at Battery Connect	Value at Wake-up
LaActvStats_D2_Dsply Signal	Input signal sent from IPMA to indicate the Lane Keeping System status for MY23 CX483, MY23 P708 and onwards HUD programs.	0x0	0x0
FeatNolpmaActl Signal	Input signal sent from IPMA to indicate Feature Number.	(0x0000)	Do Not Init
FeatConfiglpmaActl 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
LA_LDW_LKA_RTT	Internal flag used to display Lane Keeping System RTT.	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
LKS-Metaphor_Cfg	Indicator for metaphor variant 1 or variant 2.	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

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.
If LaneAssist_Cfg = Disabled, the HUD shall never log a missing message DTC for this feature.

1.4.2 SIG-REQ-395406/B-Missing Signal Strategy

If LaneAssist_Cfg != Disabled and any of the Signals FeatConfigIpmaActl, FeatNolpmaActl and LaActvStats_D2_Dsply are missing for 5 seconds then Lane departure warning/Lane keeping assist graphics including RTT are not shown on HUD.

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/B-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 = Disabled	0x0	



Block Num	Block Description	Size (bits)	Type	Byte(s)	Bits	State: Description	Default	Comments/ Information
						0x1 = LDW		
						0x2 = Full_LDW_LKA		
						0x3 = LKS_EuroNCAP		
\$xx	Option Content (B&A)	*	1	*	1	LKS-Metaphor:Cfg	0x0	
						0x0 = Variant1		
						0x1 = Variant2		

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	<ul style="list-style-type: none">Added Diagnostic Cfg functionUpdated TBD graphic in table 1.2	8/15/2014
2.0	A. Mathai	<ul style="list-style-type: none">New HMI for LKSAdd Hands off warning	11/18/2015
2.1	A. Salameh	<ul style="list-style-type: none">Initial VSEM RM Release	3/12/2018
2.2	R. Kieneke F. Mueller	<ul style="list-style-type: none">LKS metaphor and minor clarifications. EOL parameter EuroNCAP alignment	04/06/2018
2.3	F. Sethi	Added requirement "SIG-REQ-395406/A-Missing Signal Strategy" while adding; If LaneAssist_Cfg != Disabled and any of the Signals FeatConfigIpmaActl, FeatNolpmaActl and LaActvStats_D_Dsply are missing for 5 seconds then Lane departure warning/Lane keeping assist graphics are not shown on HUD. This STSS is applicable for CGEA1.3 and greater architectures.	7/24/2020
2.4	F. Sethi	As part of new UN-ECE requirements, the HUD is to display LKS Off visual notification to the user in case of a fault or if the system is turned off. Hence, a new LKS Off RTT is introduced in this version. A new CAN signal has also been introduced, which going forward replaces the old signal. This update needs to be coordinated with IPMA to ensure both modules support the new CAN signal. LaActvStats_D2_Dsply signal replaces LaActvStats_D_Dsply signal on all new programs starting from MY23 CX483, MY23 P708 and onward programs, which has DAT 204, DAT 221/222 or latest DAT SW. Backward compatibility is not maintained since IPMA will stop supporting the old signal as well. All updates are highlighted in YELLOW :	4/13/2021



		<ul style="list-style-type: none">Updated requirement "515100/B-Functional Description" while adding Description "New signal LaActvStats_D2_Dsply replaces old LaActvStats_D_Dsply signal starting from MY23 CX483, MY23 P708 and onward programs which has DAT 204, DAT 221/222 or latest DAT SW. Backward compatibility is not maintained since IPMA will stop supporting the old signal."Updated requirement "515102/B-Interface Context Diagram (I/O Block Diagram)" while replacing "LaActvStats_D_Dsply" with "LaActvStats_D2_Dsply Signal".Deleted requirement "IR-REQ-300960/B-LaActvStats_D_Dsply Signal"Added new Signal "IR-REQ-410938/A-LaActvStats_D2_Dsply Signal"Updated requirement "F-REQ-300969/C-Lane Assist HUD Information State with Example graphics" with new signal "LaActvStats_D2_Dsply" and deleted old signal "LaActvStats_D_Dsply" and added new state.Updated requirement "NVM-REQ-300978/C-Memory Storage" with new signal "LaActvStats_D2_Dsply" and deleted old signal "LaActvStats_D_Dsply".	
2.5	F. Sethi	<p>HUD will also start displaying LKS RTT on MY24 and onwards vehicle programs. New output state "LA_LDW_LKA_RTT" is added in STSS and following requirements are updated in Orange:</p> <p>Updated requirement "515100/C-Functional Description" while adding "MY24 and onwards vehicle program will start showing LKS RTT as well as per HMI/program directions". Added "Display the LKS RTT as 3rd display function.</p> <p>Updated requirement "515102/C-Interface Context Diagram (I/O Block Diagram)" while adding new output state "LA_LDW_LKA_RTT" in Block Diagram.</p> <p>Updated requirement "IR-REQ-300974/B-Outputs", while adding new output state "LA_LDW_LKA_RTT".</p> <p>Updated requirement "F-REQ-300969/D-Lane Assist HUD Information State with Example graphics" while adding new "LA_LDW_LKA_RTT" output column for LKS RTT. Added below notes: "If any HUD program doesn't have LKS RTT then ignore "LA_LDW_LKA_RTT" for that program. For LKS lines and RTT colors and graphics always follow the program specific HMI. All Suppress/ Not Applicable/Standby states shows Grey lines and LKS RTT as per program HMI directions. In Legacy programs LKS "Active/Available" states always show Green lines and LKS RTT but From MY24 and onward programs LKS "Active/Available" will show White lines and LKS RTT as per program HMI direction. "</p> <p>Added new requirement "F-REQ-444537/A-Lane Assist RTT State Mapping".</p> <p>Updated requirement "NVM-REQ-300978/D-Memory Storage", while adding new "LA_LDW_LKA_RTT" parameter.</p> <p>Updated requirement "F-REQ-300969/D-Lane Assist HUD Information State with Example graphics", while splitting output column "LDW_LKA_Status" into 2 separate columns for Left lane and Right Lane</p>	9/28/2021



		Updated requirement "SIG-REQ-395406/B-Missing Signal Strategy" while replacing signal "LaActvStats_D_Dsply" with "LaActvStats_D2_Dsply" Signal. Also added "RTT" for not showing on HUD.	
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