Navigation Based Pilot

Subsystem Technology Specific Specification (STSS)

Version 1.6

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FORD CONFIDENTIAL

Table of Contents

Terms and Definitions

Abbreviation	Description
NBP	Navigation Based Pilot
ALC	Assisted Lane Change
TJA	Traffic Jam Assist

1. Navigation Based Pilot

1.1 Functional Description

This STSS handles the functions associated with the Navigation Based Pilot feature, hereafter called NBP feature or NBP.

When a user is driving a vehicle with ALC, the user will be indicated by a lane change suggestion if it's determined to be helpful. Following a turn signal initiated by driver, the vehicle will perform a lane change.

Based on ALC, NBP will add the ability for vehicle to provide lane change suggestions according Navigation indication.
Currently, NBP scenarios are below:

- Highway Exit
- Y-shaped Road
- Lane End

It would support expanded scenarios in the future. Hence, the NBP indication signal is protected with 6-bit size.

Depending on the vehicle location relative to lane position and the distance to target road section and objects, this feature will:

- Signal to driver for a lane change suggestion
- Signal to driver for taking over steering control
- Signal to driver for a coming auto lane change maneuver if VLC (Vehicle-initiated Lane Change) is active

Starting with MY2024 CX771/CX821, Navigation Based Pilot (NBP) has been introduced to the suite of Highway Assist feature with the support of new introduced IPMB_EPC module. NBP enriches the capability providing lane change suggestion against additional scenarios (means Highway Exit) compared with that supported by ALC.

Navigation Based Pilot correlates the personalization signals from the IPMB, several signals from IPMB_EPC and the Operation Mode to determine when to activate additional appropriate displays.

1.2 Interfaces

1.2.1 Interface Context Diagram (I/O Block Diagram)

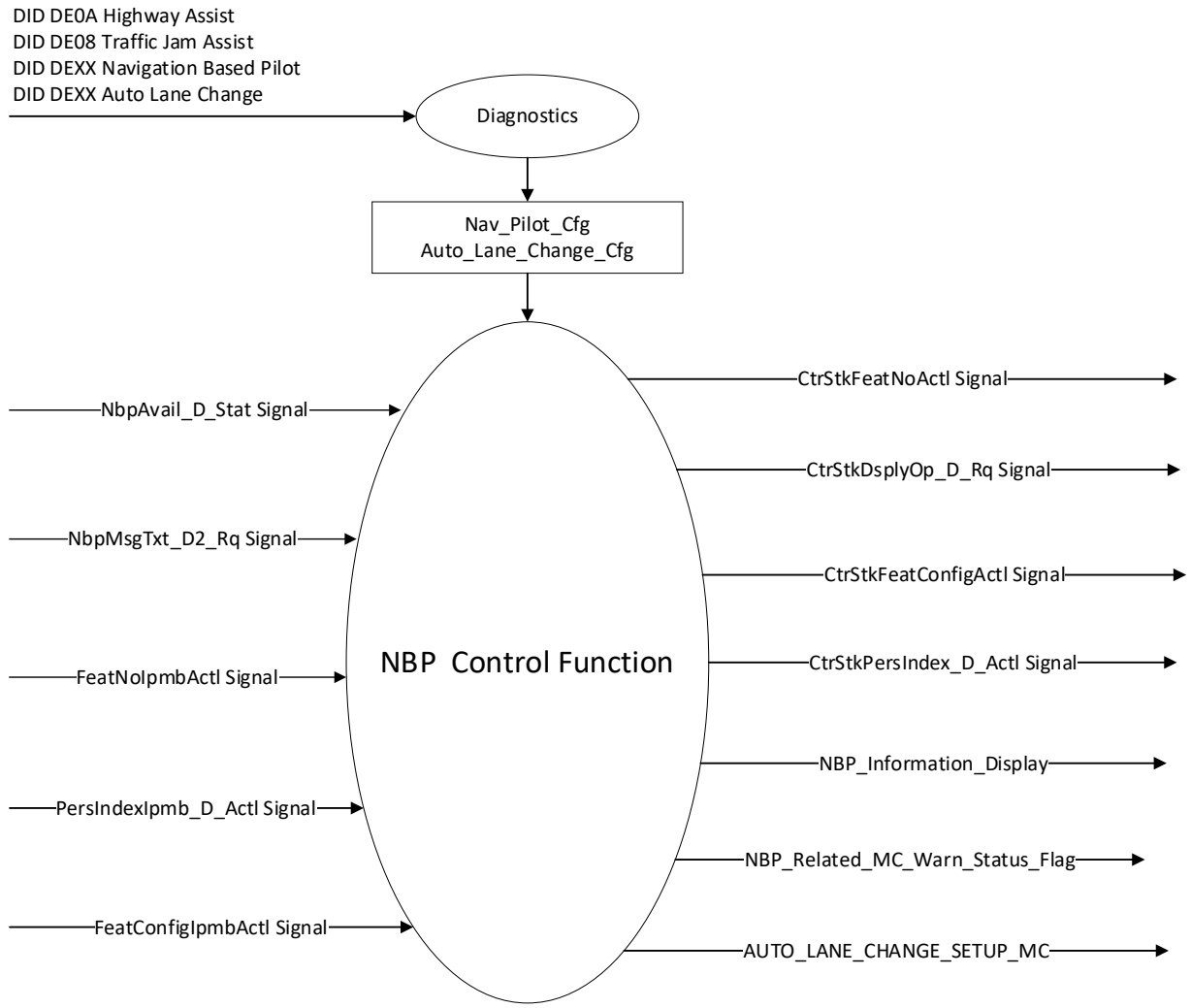


Figure 2.1 NBP Context Diagram

1.2.2 Inputs

1.2.2.1 Internal

- Hwy_Assist_Cfg – Feature Cfg
- Traffic_Jam_Assist_Cfg – Feature Cfg
- Nav_Piolot_Cfg
- Auto_Lane_Change_Cfg

1.2.2.2 MUX signals on the CAN Bus from IPMB (2nd ECU)

1.2.2.2.1 FeatConfigIpmbActl Signal

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

1.2.2.2.2 FeatNoIpmbActl Signal

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

1.2.2.2.3 PersIndexIpmb_D_Actl Signal

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

1.2.2.2.4 NbpAvail_D_Stat Signal

Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min	Max
NbpAvail _D_Stat	3		SED	1	0		0 (0x0)	7 (0x7)
		Off				0x0		
		Standby				0x1		
		AvailableLnChngSuggstnOnly				0x2		
		AvailableDrvLnChng				0x3		
		AvailableVehLnChng				0x4		
		NbpFailure				0x5		
		NotUsed				0x6		
		NotUsed				0x7		

1.2.2.2.5 SIG-REQ-XXXXXX/A- NbpMsgTxt_D2_Rq Signal

Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min	Max
NbpMsgTxt_D2_Rq	6		SED	1	0		0 (0x0)	63 (0x3F)
		NoMessage				0x00		
		HandOver				0x01		
		MissingExitAlert				0x02		
		AlcOn				0x03		
		AlcOff				0x04		
		TurnOffIndicator				0x05		
		SuggstnLeftExitManual				0x06		
		SuggstnRightExitManual				0x07		
		SuggstnLeftLnEndManual				0x08		
		SuggstnRightLnEndManual				0x09		
		SuggstnLeftYShapeManual				0x0A		
		SuggstnRightYShapeManual				0x0B		
		SuggstnLeftSlowVeh				0x0C		
		SuggstnRightSlowVeh				0x0D		
		SuggstnLeftExit				0x0E		
		SuggstnRightExit				0x0F		
		SuggstnLeftMergeIn				0x10		
		SuggstnRightMergeIn				0x11		
		SuggstnLeftUnintndExit				0x12		
		SuggstnRightUnintndExit				0x13		
		SuggstnLeftLnEnd				0x14		
		SuggstnRightLnEnd				0x15		
		SuggstnLeftYShape				0x16		
		SuggstnRightYShape				0x17		
		AutoLnChngLeftSlowVeh				0x18		
		AutoLnChngRightSlowVeh				0x19		
		AutoLnChngLeftOptmzedLn				0x1A		
		AutoLnChngRightOptmzedLn				0x1B		
		AutoLnChngLeftExit				0x1C		
		AutoLnChngRightExit				0x1D		
		AutoLnChngLeftMergeIn				0x1E		
		AutoLnChngRightMergeIn				0x1F		
		AutoLnChngLeftUnintndExit				0x20		
		AutoLnChngRightUnintndExit				0x21		
		AutoLnChngLeftLnEnd				0x22		
		AutoLnChngRightLnEnd				0x23		
		AutoLnChngLeftYShape				0x24		
		AutoLnChngRightYShape				0x25		
		NotUsed				0x26~0x3F		

1.2.3 Outputs

1.2.3.1 Internal

- NBP_Information_Display displays the Navigation Based Pilot information in the ADAS metaphor.
- AUTO_LANE_CHANGE_SETUP_MC, controls the setting menu display output for Auto Lane Change.
- NBP_Related_MC_Warn_Status_Flag, which is used to control the state of the text warning message including those MC_Warn_Status_Flag below:
    1) Navigation_Pilot_Unavailable_MC_Warn_Status_Flag
    2) HandOver_MC_Warn_Status_Flag
    3) MissingExitAlert_MC_Warn_Status_Flag
    4) SuggstnLeftExitManual_MC_Warn_Status_Flag
    5) SuggstnRightExitManual_MC_Warn_Status_Flag
    6) SuggstnLeftLnEndManual_MC_Warn_Status_Flag
    7) SuggstnRightLnEndManual_MC_Warn_Status_Flag
    8) SuggstnLeftYShapeManual_MC_Warn_Status_Flag
    9) SuggstnRightYShapeManual_MC_Warn_Status_Flag
    10) SuggstnLeftSlowVeh_MC_Warn_Status_Flag
    11) SuggstnRightSlowVeh_MC_Warn_Status_Flag
    12) SuggstnLeftExit_MC_Warn_Status_Flag
    13) SuggstnRightExit_MC_Warn_Status_Flag
    14) SuggstnLeftMergeIn_MC_Warn_Status_Flag
    15) SuggstnRightMergeIn_MC_Warn_Status_Flag
    16) SuggstnLeftUnintndExit_MC_Warn_Status_Flag
    17) SuggstnRightUnintndExit_MC_Warn_Status_Flag
    18) SuggstnLeftLnEnd_MC_Warn_Status_Flag
    19) SuggstnRightLnEnd_MC_Warn_Status_Flag
    20) SuggstnLeftYShape_MC_Warn_Status_Flag
    21) SuggstnRightYShape_MC_Warn_Status_Flag
    22) AutoLnChngLeftSlowVeh_MC_Warn_Status_Flag
    23) AutoLnChngRightSlowVeh_MC_Warn_Status_Flag
    24) AutoLnChngLeftOptmzedLn_MC_Warn_Status_Flag
    25) AutoLnChngRightOptmzedLn_MC_Warn_Status_Flag
    26) AutoLnChngLeftExit_MC_Warn_Status_Flag
    27) AutoLnChngRightExit_MC_Warn_Status_Flag
    28) AutoLnChngLeftMergeIn_MC_Warn_Status_Flag
    29) AutoLnChngRightMergeIn_MC_Warn_Status_Flag
    30) AutoLnChngLeftUnintndExit_MC_Warn_Status_Flag
    31) AutoLnChngRightUnintndExit_MC_Warn_Status_Flag
    32) AutoLnChngLeftLnEnd_MC_Warn_Status_Flag
    33) AutoLnChngRightLnEnd_MC_Warn_Status_Flag
    34) AutoLnChngLeftYShape_MC_Warn_Status_Flag
    35) AutoLnChngRightYShape_MC_Warn_Status_Flag

1.2.3.2 MUX signals on the CAN Bus to IPMB (2nd ECU)

1.2.3.2.1 CtrStkFeatNoActl Signal

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

1.2.3.2.2 CtrStkDsplyOp_D_Rq Signal

Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min	Max
CtrStkDsplyOp_D_Rq	3		SED	1	0		0 (0x0)	7 (0x7)
		NULL				0x0		
		QUERY				0x1		
		SET				0x2		
		UPLOAD				0x3		
		RESTORE				0x4		
		COPY				0x5		
		Unused				0x6		
		Unused				0x7		

1.2.3.2.3 CtrStkFeatConfigActl Signal

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

1.2.3.2.4 CtrStkPersIndex_D_Actl Signal

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

1.3 Function/Performance

1.3.1 Operational Modes

Mode	Differentiating Vehicle Conditions
Sleep Mode	NBP Control Function Text Message Disabled
Limited Mode	NBP Control Function Text Message Disabled
Normal Mode	NBP Control Function Text Message Enabled / Disabled
Crank Mode	NBP Control Function Text Message Enabled / Disabled

1.3.2 Voltage Levels

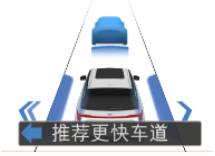
Refer to the Cluster Features table located in the Operational Modes and Voltage Range Strategies.

1.3.3 Human-Machine Interface

1.3.3.1 Visual

1.3.3.1.1 Indicator Graphics / Display Format

Example Graphic (final graphics to be provided by HMI wallpaper)



Message Center Text Warning Message as defined in section 1.3.5.1.10 of this document. Actual wording may vary based on Program Translation table.

And HMI have difference between VLC on and VLC off. Such as blue shading in road when VLC on and no blue shading in road when VLC off. Final difference display will be provided by HMI.

No blue shading in road when VLC off

Blue shading in road when VLC on

Please refer to the program specific menu structure for exact graphics.
Example Menu Structure:

Menu level 0	Menu level 1	Menu level 2	Comments
Driver Assist	Cruise Control	With Lane Centering	Traffic_Jam_Assist_Cfg = 0x1 (Enabled) Hwy_Assist_Cfg = 0x0 (Disabled) Nav_Pilot_Cfg = X (Don't Care) Auto_Lane_Change_Cfg = X (Don't Care)

		With Lane Centering (Blue Cruise) □ With Smart Offerings □ Lane Biasing Assist Lane Change	Hwy_Assist_Cfg = 0x1 (Enabled) Traffic_Jam_Assist_Cfg = X (Don't Care) Nav_Pilot_Cfg = X (Don't Care) Auto_Lane_Change_Cfg = 0x0 (Disabled)
		With Lane Centering (Blue Cruise) □ With Smart Offerings □ Lane Biasing Assist Lane Change • Auto Lane Change	Hwy_Assist_Cfg = 0x1 (Enabled) Traffic_Jam_Assist_Cfg = X (Don't Care) Nav_Pilot_Cfg = X (Don't Care) Auto_Lane_Change_Cfg = 0x1 (Enabled)

Nav_Pilot_Cfg affect Chinese name about With Lane Centering for distinguish different vehicles with different configurations like below.

Menu level 0	Menu level 1	Menu level 2	Comments
Driver Assist	Cruise Control	With Lane Centering (Chinese name: ActiveGlide 智能辅助驾驶) □ With Smart Offerings □ Lane Biasing Assist Lane Change	Hwy_Assist_Cfg = 0x1 (Enabled) Traffic_Jam_Assist_Cfg = X (Don't Care) Nav_Pilot_Cfg = 0x0 (Disabled) Auto_Lane_Change_Cfg = X (Don't Care)
		With Lane Centering (Chinese name: ActiveGlide 领航辅助驾驶) □ With Smart Offerings □ Lane Biasing Assist Lane Change	Hwy_Assist_Cfg = 0x1 (Enabled) Traffic_Jam_Assist_Cfg = X (Don't Care) Nav_Pilot_Cfg = 0x1 (Enabled) Auto_Lane_Change_Cfg = X (Don't Care)

Menu display logic in above list:

1. About the menu of Lane Biasing and Assist Lane Change (Pre-condition: Hwy_Assist_Cfg = 0x1 (Enabled))

Menu display of Lane Biasing and Assisted Lane Change depends on the customer selection of Blue Cruise (Ford Brand)/Active Glide (Lincoln Brand) feature. There are two presentations. The final use of which will refer to HMI design. One case is that LB and ALC shall appear when Blue Cruise is selected on, while disappear when Blue Cruise is selected off. The other case is that LB and ALC show active and can be checked or unchecked when Blue Cruise is selected on, while LB and ALC show gray and cannot be checked or unchecked when Blue Cruise is selected off.

2. About the menu of Auto Lane Change (Pre-condition: Hwy_Assist_Cfg = 0x1 (Enabled) and Auto_Lane_Change_Cfg =0x1(Enabled))

Menu display of Auto Lane Change depends on the customer selection of ALC feature. Auto Lane Change shall appear when ALC is selected on, while disappear when ALC is selected off.

3. IVI/SYNC+ should query Auto Lane Change menu every time after bootup and get response and display last remembered settings (follow HA menu strategy). Last remembered settings are saved on IPMB.

1.3.3.1.2 Indicator Color Coordinates

Refer to program specific HMI requirements for styling direction.

1.3.3.1.3 Indicator Characteristics

As per program specific HMI theme.

1.3.3.2 Switch Control Logic

Consumer access to NBP Module Configuration shall be as specified in the message center basic functionality display as specified in Message Center X Display_Y Button Interface Section, where X and Y are appropriate values in this document.

1.3.4 System Accuracy

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

1.3.5 Operation: Performance and Functional

1.3.5.1 Subsystem Algorithm Flowchart / State Diagram

1.3.5.1.1 Highway Assist with Navigation Pilot Diagnostic Configuration Flowchart

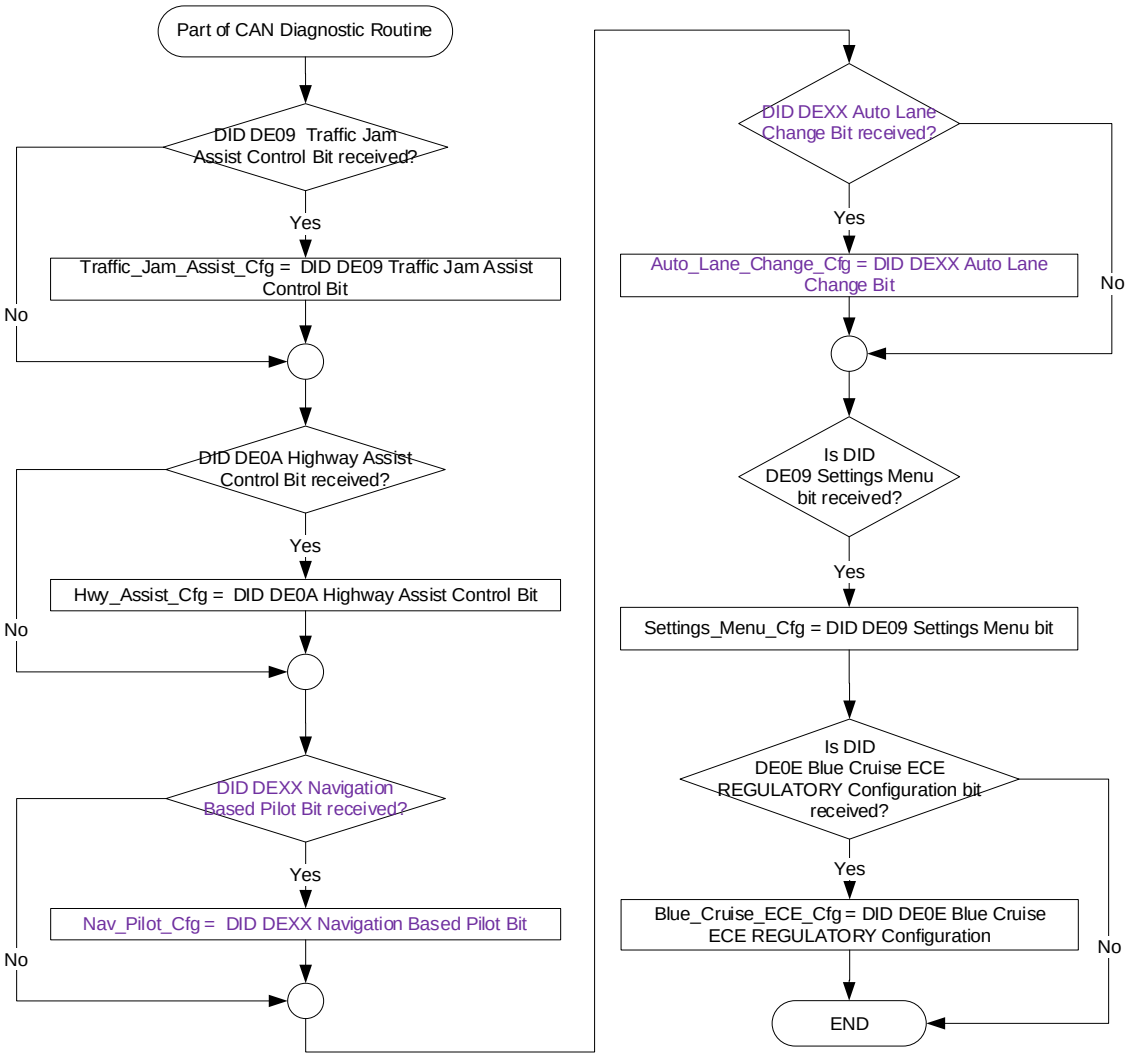


Figure 3.1 Diagnostic Configuration Flowchart

Figure3.1 is based on F-REQ-343087/A-Highway Assist and Lane Centering Diagnostic Configuration Flowchart in < Highway Assist with Lane Centering Control Function and Warnings – FNV2.docm>. The purple content is added for NBP.

1.3.5.1.2 Highway Assist and Lane Centering and Auto Lane Change Menu Display Determination Matrix

Hwy_Assist_Cfg	Traffic_Jam_Assist_Cfg	Auto_Lane_Change_Cfg	"With Lane Centering" Displayed in menu?	"With Smart Offering" Displayed in menu?	"With Auto Lane Change" Displayed in menu?
Enabled (0x1)	Enabled (0x1)	Enabled (0x1)	Yes	Yes	Yes
Enabled (0x1)	Enabled (0x1)	Disabled (0x0)	Yes	Yes	No
Enabled (x1)	Disabled (0x0)	Enabled (0x1)	Yes	Yes	Yes
Enabled (0x1)	Disabled (0x0)	Disabled (0x0)	Yes	Yes	No
Disabled (0x0)	Enabled (0x1)	Enabled (0x1)	Yes	No	No
Disabled (0x0)	Enabled (0x1)	Disabled (0x0)	Yes	No	No
Disabled (0x0)	Disabled (0x0)	Enabled (0x1)	No	No	No
Disabled (0x0)	Disabled (0x0)	Disabled (0x0)	No	No	No

1.3.5.1.3 Highway Assist with Navigation Pilot input request Flowchart

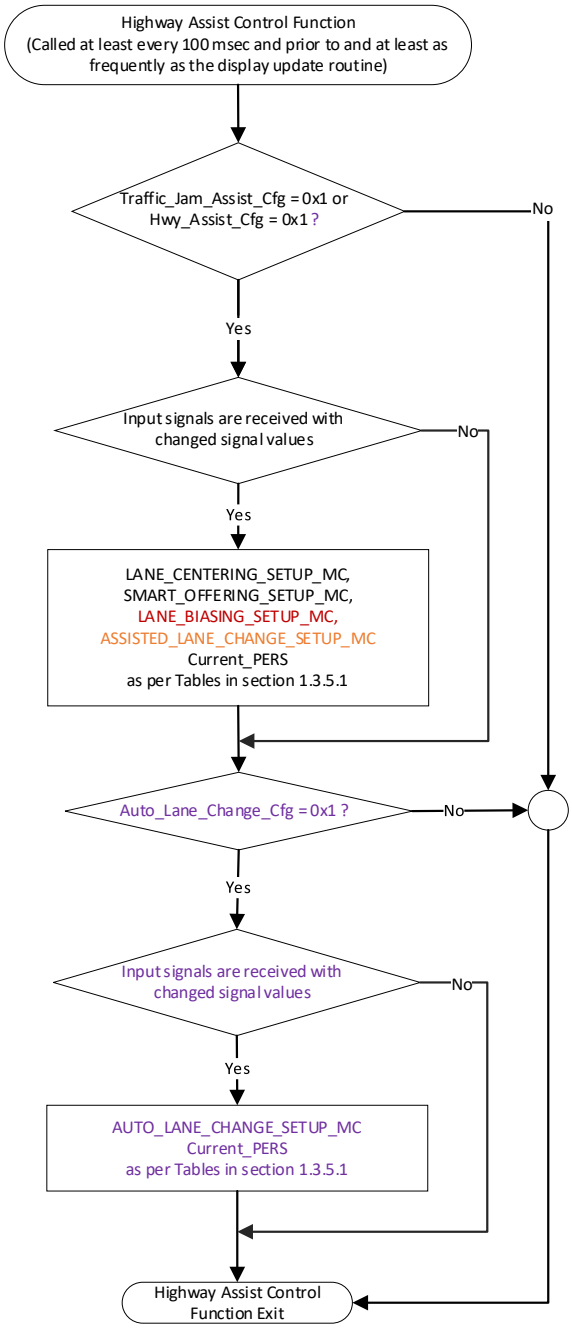


Figure 3.2 Input Request Flowchart

Figure3.2 is based on F-REQ-343089/D-Highway Assist and Lane Centering input request Flowcharts in < Highway Assist with Lane Centering Control Function and Warnings – FNV2.docm>. The purple content is added or modified for NBP.

Input signals are received in a message from IPMB (2nd ECU), including FeatNoIpmbActl Signal, FeatConfigIpmbActl Signal, PersIndexIpmb_D_Actl Signal that is described in IO inputs.

1.3.5.1.4 Highway Assist with Navigation Pilot output SET request Flowchart

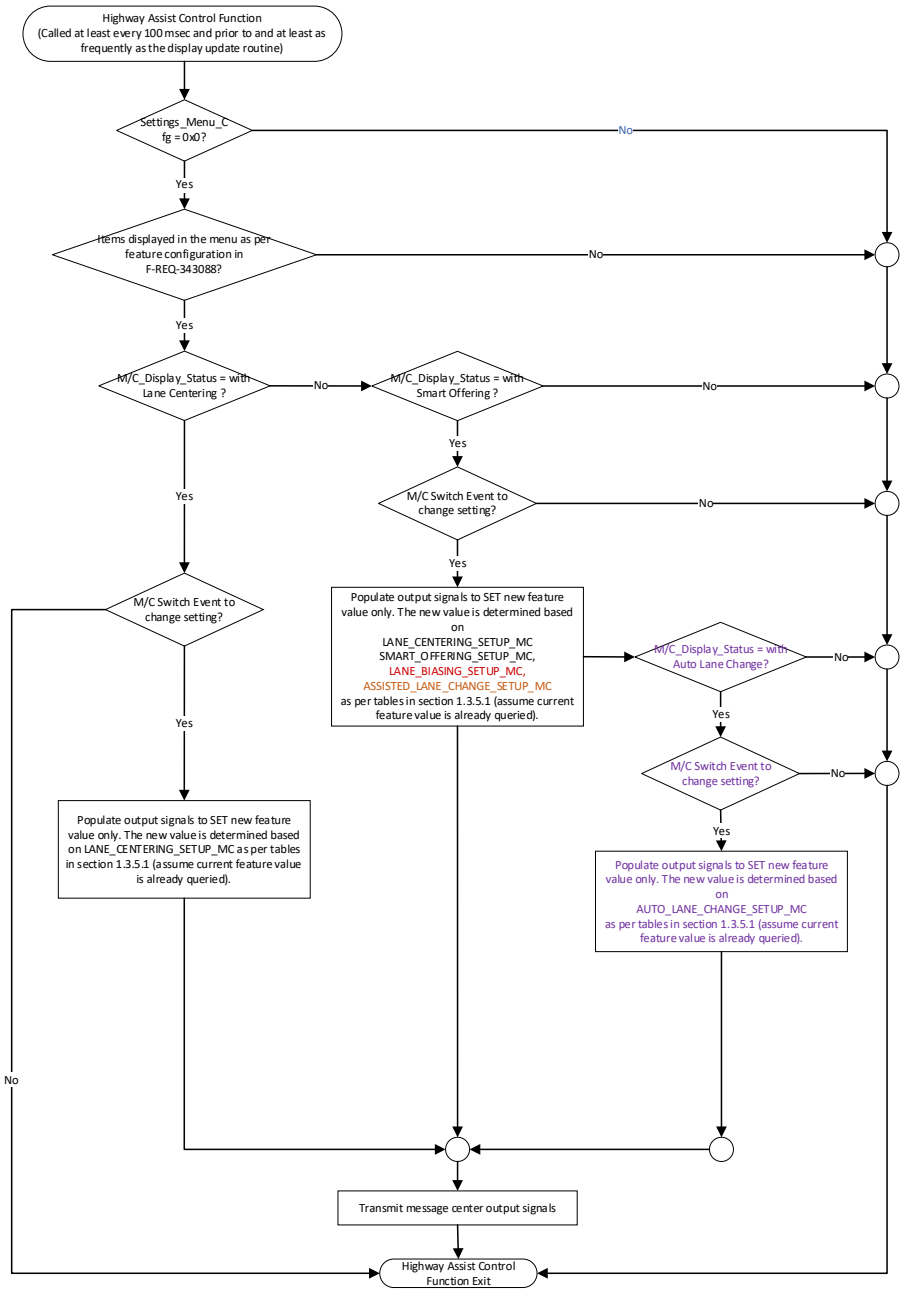


Figure 3.3 Output SET Request Flowchart

Figure3.3 is based on F-REQ-343090/D-Highway Assist and Lane Centering Output SET request Flowchart in < Highway Assist with Lane Centering Control Function and Warnings – FNV2.docm>. The purple content is added for NBP.

Output signals are sent in a message to IPMB (2nd ECU), including CtrStkDsplyOp_D_Rq Signal, CtrStkFeatNoActl Signal, CtrStkFeatConfigActl Signal and CtrStkPersIndex_D_Actl Signal that is described in Setup Request Messages.

1.3.5.1.5 Auto Lane Change Setup State Assignment

FeatNoIpmbActl Signal	FeatConfigIpmbActl Signal	PersIndexIpmb_D_Actl Signal	AUTO_LANE_CHANGE_ SETUP_MC	Current_PERS [3]
0x0882 [1]	0x0000 (Off)	0x0 – 0x4	0x00	0x0 – 0x4
	0x0001 (On)	0x0 – 0x4	0x01	0x0 – 0x4
	Other [2]		Error (0x2)	Last Known
Missing per Section 1.4.1 [2]				

1.3.5.1.6 Auto Lane Change Setup Request Messages based upon AUTO_LANE_CHANGE_SETUP_MC

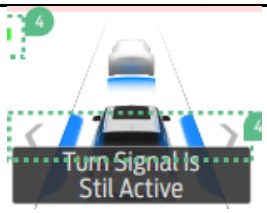
AUTO_ LANE_CHANGE_ SETUP_MC	Display Menu	M/C Switch Selection Event	CtrStkDsplyOp_D_ Rq Signal	CtrStkFeatNoActl Signal	CtrStkFeatConfigActl Signal	CtrStkPersIndex_D _Actl Signal
0x00 or 0x02	☐ (Off)	Up/Down + OK (Select On)	SET (0x2)	0x0882	0x0001 (If On is selected)	Current_PERS
0x01	☑ (On)	Up/Down + OK (Select Off)	SET (0x2)	0x0882	0x0000 (If Off is selected)	Current_PERS

1.3.5.1.7 State Matrix Update for Assisted Lane Change Information with NBP

Assisted Lane Change Information will be shown whenever Navigation Based Pilot is not available (either because Navigation Based Pilot is configured off or even if equipped but not activated due to driver deselection or without Navigation route).

Operational_Mode	Feature Config	NbpAvail_D_Stat Signal	Blue_Cruise_ECE_ Cfg	TjaLc_D_Stat Signal	TjaLcWarn_D_Rq Signal	TjaLcMsgTxt_D_Rq	ALC_Information_ Display (Example Graphics)		Chime Status Flag
Normal or Crank	Traffic_Jam_Assist_Cfg = 0x1 (Enabled) OR Hwy_Assist_Cfg = 0x1 (Enabled) AND Nav_Pilot_Cfg = X (Don't Care) AND Auto_Lane_Change_Cfg = X (Don't Care)	0x0 (Off) Or 0x1 (Standby) Or 0x5 (Nbp Failure) Or Missing	X (Don't Care)	0x1 (Standby)	X (Don't Care)	X (Don't Care)	Active	 ((under speed threshold or no lanes detected) chevrons have less contrast and line thickness)	None
				0x2 (AvailableLeft)				 (Grey chevron on the left only)	None
				0x3 (AvailableRight)				 (Gray chevron on the right only)	None
				0x4 (AvailableLeftRight)				 (Grey Chevron on both sides, example graphic of HA in limited mode)	None
				0x5 (PreparingLeft)				 (Blue Chevron on the Left, none Right, example graphic of HA in extended mode)	None

				0x6 (PreparingRight)				 (Blue Chevron on the Right, none Left)	None
				0x7 (LcActiveLeft)				 (part of animation Indicating a lane change to the left, final static image is displayed as long as signal is active)	None
				0x8 (LcActiveRight)				 part of animation Indicating a lane change to the right, final static image is displayed as long as signal is active)	None
			0x1 (Enabled)	X (Don't Care)	0x1 (DriverCancel)	X (Don't Care)	Active	Canceled by Driver* (GML ID: A13)	TJA_Low_Priority_ Chime_Status_Flag
			X (Don't Care)		0x2 (SystemCancel)			Not Available (GML ID: A21)	
					0x3 (CancelNoLane)			Not Available No Lane Seen* (GML ID: A15)	
					0x4 (CancelLaneBusy)			Not Available Lane Busy* (GML ID: A14)	
					0x5 (CancelSpeedTooLow)			Not Available Low Speed* (GML ID: A16)	

Normal or Crank	Traffic_Jam_Assist_Cfg = 0x1 (Enabled) OR Hwy_Assist_Cfg = 0x1 (Enabled) AND Nav_Pilot_Cfg = X (Don’ t Care) AND Auto_Lane_Change_Cfg = X	0x0 (Off) Or 0x1 (Standby) Or 0x5 (Nbp Failure) Or Missing	X (Don’t Care)	X (Don’t Care)	X (Don’t Care)	0x1 (LcSuggestionLeft)	Active	 (above text or “Lane Change Possible, Use Left Turn Signal to make lane change” based on application HMI)	None
						0x2 (LcSuggestionRight)		 (above text or “Lane Change Possible, Use Left Turn Signal to make lane change” based on application HMI Example graphic of HA in Extended mode)	None
						0x5 (TurnOffIndicator)		 (Text: Turn Signal is Still Active)	None
All Other Cases							Inactive	(No indication)	None

The ADAS controller will arbitrate and populate the 3 input signals above, cluster simply displays information based on signal states received.
Note *: The generic “Cancelation (GML ID: A1)” notification shall be displayed only if application display does not have space to display reason text.
For Assisted Lane Change, “Not Available” (GML ID: A21) notification shall be displayed only if an application display does not have space to display reason text.
Note: The Lane_Centering_Assist_Canceled_MC_Warn_Status_Flag shall have higher priority over any and all ALC cancelation messages.

Blue_Cruise_ECE_Cfg – Determines if certain notifications need to be displayed on the cluster per ECE regulations. Required to be enabled on ECE regions.

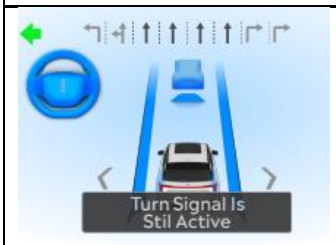
Above State Matrix for Assisted Lane Change Information is based on F-REQ-438184/B-State Matrix for Assisted Lane Change Information in < Highway Assist with Lane Centering Control Function and Warnings – FNV2.docm>. The purple content is added for NBP.

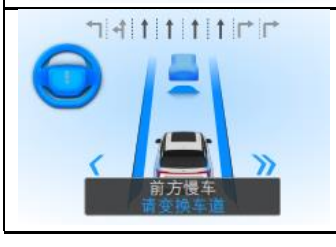
1.3.5.1.8 State Matrix for Navigation Based Pilot Information

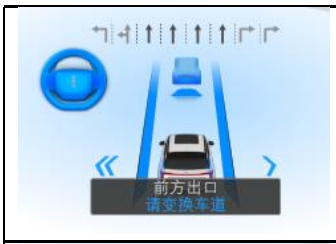
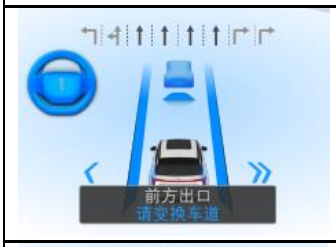
Navigation Based Pilot Information will only be shown when the feature is active.

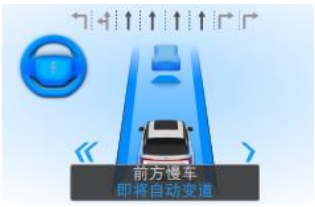
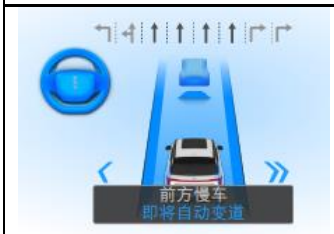
Operational_Mode	Feature Config	NbpAvail_D_Stat Signal	Blue_Cruise_ECE_Cfg	TjaLc_D_Stat Signal	TjaLcWarn_D_Rq Signal	NbpMsgTxt_D2_Rq	NBP_Information_Display (Example Graphics)		Chime Status Flag
Normal or Crank	Traffic_Jam_Assist_Cfg = 0x1 (Enabled) OR Hwy_Assist_Cfg = 0x1 (Enabled) AND Nav_Pilot_Cfg = X (Don't Care) AND Auto_Lane_Change_Cfg = X (Don't Care)	0x2 (AvailableLnChngSuggstnOnly) Or 0x3 (Available DrvLnChng) Or 0x4 (Avaialble VehLnChng)	X (Don't Care)	0x1 (Standby)	X (Don't Care)	X (Don't Care)	Active	 ((under speed threshold or no lanes detected) chevrons have less contrast and line thickness)	None
				0x2 (AvailableLeft)				 (Grey chevron on the left only)	None
				0x3 (AvailableRight)				 (Gray chevron on the right only)	None
				0x4 (AvailableLeftRight)				 (Grey Chevron on both sides, example graphic of HA in limited mode)	None

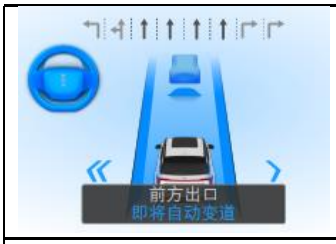
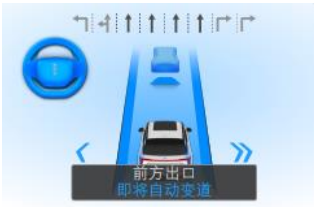
				0x5 (PreparingLeft)				 (Blue Chevron on the Left, none Right, example graphic of HA in extended mode)	None
				0x6 (PreparingRight)				 (Blue Chevron on the Right, none Left)	None
				0x7 (LcActiveLeft)				 (part of animation Indicating a lane change to the left, final static image is displayed as long as signal is active)	None
				0x8 (LcActiveRight)		X (Don't Care)		 part of animation Indicating a lane change to the right, final static image is displayed as long as signal is active)	None
			0x1 (Enabled)	X (Don't Care)	0x1 (DriverCancel)		Active	Canceled by Driver* (GML ID: A13)	TJA_Low_Priority_Chime_Status_Flag
			X (Don't Care)		0x2 (SystemCancel)			Not Available (GML ID: A21)	

					0x3 (CancelNoLane)			Not Available No Lane Seen* (GML ID: A15)	
					0x4 (CancelLaneBusy)			Not Available Lane Busy* (GML ID: A14)	
					0x5 (CancelSpeedTooLow)			Not Available Low Speed* (GML ID: A16)	
Normal or Crank	Hwy_Assist_Cfg = 0x1 (Enabled) OR Traffic_Jam_Assist_Cfg = X (Don't Care) AND Nav_Pilot_Cfg = 0x1 (Enabled) AND Auto_Lane_Change_Cfg = X (Don't Care)	0x2 (AvailableLnChngSuggstnOnly) Or 0x3 (Available DrvLnChng) Or 0x4 (Avaialble VehLnChng)	X (Don't Care)	X (Don't Care)	X (Don't Care)	0x01 (HandOver)	Active		None
						0x02 (MissingExitAlert)			TJA_Low_Priority_Chime_Status_Flag
						0x05 (TurnOffIndicator)			None
						0x06 (SuggstnLeftExitManual)			None

						0x07 (SuggstnRightExitManual)		None
						0x08 (SuggstnLeftLnEndManual)		None
						0x09 (SuggstnRightLnEndManual)		None
						0x0A (SuggstnLeftYShapeManual)		None
						0x0B (SuggstnRightYShapeManual)		None
						0x0C (SuggstnLeftSlowVeh)		None
						0x0D (SuggstnRightSlowVeh)		None

						0x0E (SuggstnLeft Exit)		None
						0x0F (SuggstnRight Exit)		None
						0x10 (SuggstnLeft MergeIn)		None
						0x11 (SuggstnRight MergeIn)		None
						0x12 (SuggstnLeft UnintndExit)		None
						0x13 (SuggstnRight UnintndExit)		None
						0x14 (SuggstnLeft LnEnd)		None

						0x15 (SuggstnRightLnEnd)		None
						0x16 (SuggstnLeftYShape)		None
						0x17 (SuggstnRightYShape)		None
	Hwy_Assist_Cfg = 0x1 (Enabled) OR Traffic_Jam_Assist_Cfg = X (Don't Care) AND Nav_Pilot_Cfg = 0x1 (Enabled) AND Auto_Lane_Change_Cfg = 0x1 (Enabled)					0x18 (AutoLnChngLeftSlowVeh)		TJA_Low_Priority_Chime_Status_Flag
						0x19 (AutoLnChngRightSlowVeh)		TJA_Low_Priority_Chime_Status_Flag
						0x1A (AutoLnChngLeftOptmzedLn)		TJA_Low_Priority_Chime_Status_Flag
						0x1B (AutoLnChngRightOptmzedLn)		TJA_Low_Priority_Chime_Status_Flag

						0x1C (AutoLnChng LeftExit)		TJA_Low_Priority_Chime_Status_Flag
						0x1D (AutoLnChng RightExit)		TJA_Low_Priority_Chime_Status_Flag
						0x1E (AutoLnChng LeftMergeIn)		TJA_Low_Priority_Chime_Status_Flag
						0x1F (AutoLnChng RightMergeIn)		TJA_Low_Priority_Chime_Status_Flag
						0x20 (AutoLnChng LeftUnintndE xit)		TJA_Low_Priority_Chime_Status_Flag
						0x21 (AutoLnChng RightUnintnd Exit)		TJA_Low_Priority_Chime_Status_Flag
						0x22 (AutoLnChng LeftLnEnd)		TJA_Low_Priority_Chime_Status_Flag

						0x23 (AutoLnChng RightLnEnd)			TJA_Low_Priority_ Chime_Status_Flag
						0x24 (AutoLnChng LeftYShape)			TJA_Low_Priority_ Chime_Status_Flag
						0x25 (AutoLnChng RightYShape)			TJA_Low_Priority_ Chime_Status_Flag
All Other Cases							Inactive	(No indication)	None

The ADAS controller will arbitrate and populate the 3 input signals above, cluster simply displays information based on signal states received.
Note *: The generic “Cancelation (GML ID: A1)” notification shall be displayed only if application display does not have space to display reason text.
For Assisted Lane Change, “Not Available” (GML ID: A21) notification shall be displayed only if an application display does not have space to display reason text.
Note: The Lane_Centering_Assist_Canceled_MC_Warn_Status_Flag shall have higher priority over any and all ALC cancelation messages.

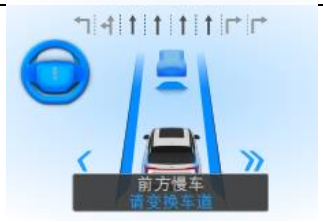
Blue_Cruise_ECE_Cfg – Determines if certain notifications need to be displayed on the cluster per ECE regulations. Required to be enabled on ECE regions.

1.3.5.1.9 State Matrix for NBP Warning

Operational_Mode	**Feature Config**	**NbpAvail_D_Stat Signal**	**Navigation_Pilot_Unavailable_MC_ Warn_Status_Flag**
Normal or Crank	Hwy_Assist_Cfg = Enabled (0x1) OR Traffic_Jam_Assist_Cfg = X (Don’t Care) AND Nav_Pilot_Cfg = Enabled (0x1) AND Auto_Lane_Change_Cfg = X (Don’t Care)	NbpFailure(0x5)	Active
All Other Cases			Inactive

1.3.5.1.10 MC Status Flag to MC Warning Message

MC Warn Status Flag	Reference Text or Graphic (see GML for exact wording)	MC Warning ID	Chime Status Flag
Navigation_Pilot_Unavailable_MC_Warn_Status_Flag			None
HandOver_MC_Warn_Status_Flag			None
MissingExitAlert_MC_Warn_Status_Flag			TJA_Low_Priority_Chime_Status_Flag
SuggstnLeftExitManual_MC_Warn_Status_Flag			None
SuggstnRightExitManual_MC_Warn_Status_Flag			None
SuggstnLeftLnEndManual_MC_Warn_Status_Flag			None
SuggstnRightLnEndManual_MC_Warn_Status_Flag			None

SuggstnLeftYShapeManual_MC_Warn_Status_Flag			None
SuggstnRightYShapeManual_MC_Warn_Status_Flag			None
SuggstnLeftSlowVeh_MC_Warn_Status_Flag			None
SuggstnRightSlowVeh_MC_Warn_Status_Flag			None
SuggstnLeftExit_MC_Warn_Status_Flag			None
SuggstnRightExit_MC_Warn_Status_Flag			None
SuggstnLeftMergeIn_MC_Warn_Status_Flag			None

SuggstnRightMergeIn_MC_Warn_Status_Flag			None
SuggstnLeftUnintndExit_MC_Warn_Status_Flag			None
SuggstnRightUnintndExit_MC_Warn_Status_Flag			None
SuggstnLeftLnEnd_MC_Warn_Status_Flag			None
SuggstnRightLnEnd_MC_Warn_Status_Flag			None
SuggstnLeftYShape_MC_Warn_Status_Flag			None
SuggstnRightYShape_MC_Warn_Status_Flag			None

AutoLnChngLeftSlowVeh_MC_Warn_Status_Flag			TJA_Low_Priority_Chime_Status_Flag
AutoLnChngRightSlowVeh_MC_Warn_Status_Flag			TJA_Low_Priority_Chime_Status_Flag
AutoLnChngLeftOptmzedLn_MC_Warn_Status_Flag			TJA_Low_Priority_Chime_Status_Flag
AutoLnChngRightOptmzedLn_MC_Warn_Status_Flag			TJA_Low_Priority_Chime_Status_Flag
AutoLnChngLeftExit_MC_Warn_Status_Flag			TJA_Low_Priority_Chime_Status_Flag
AutoLnChngRightExit_MC_Warn_Status_Flag			TJA_Low_Priority_Chime_Status_Flag
AutoLnChngLeftMergeIn_MC_Warn_Status_Flag			TJA_Low_Priority_Chime_Status_Flag

AutoLnChngRightMergeIn_MC_Warn_Status_Flag			TJA_Low_Priority_Chime_Status_Flag
AutoLnChngLeftUnintndExit_MC_Warn_Status_Flag			TJA_Low_Priority_Chime_Status_Flag
AutoLnChngRightUnintndExit_MC_Warn_Status_Flag			TJA_Low_Priority_Chime_Status_Flag
AutoLnChngLeftLnEnd_MC_Warn_Status_Flag			TJA_Low_Priority_Chime_Status_Flag
AutoLnChngRightLnEnd_MC_Warn_Status_Flag			TJA_Low_Priority_Chime_Status_Flag
AutoLnChngLeftYShape_MC_Warn_Status_Flag			TJA_Low_Priority_Chime_Status_Flag
AutoLnChngRightYShape_MC_Warn_Status_Flag			TJA_Low_Priority_Chime_Status_Flag

1.3.5.2 Operation Description (supports algorithm flow chart)

NBP settings are at IVI instead of cluster.

1.3.5.3 Personalization Feature Number Definition

None

1.3.5.4 Function Safety Classification (EMC)

Class B

1.3.5.6 Reconfigurable Telltale

None

1.3.5.5 Memory Storage

1.3.5.5.1 Memory Storage Parameters

Parameter Name	Description	Value at Battery Connect	Value at Wake-up
Nav_Piolot_Cfg	Configures cluster to display items in the Settings menu (Set to “cluster” at cluster supplier manufacturer plant.	Use Stored Value	Use Stored Value
Auto_Lane_Change_Cfg	Configures cluster to display items in the Settings menu (Set to “cluster” at cluster supplier manufacturer plant.	Use Stored Value	Use Stored Value
FeatConfigIpmbActl signal	Input signal sent from IPMB to indicate current value of the feature setting for the feature that is being set or queried.	(0x0000)	Do Not Init
FeatNoIpmbActl	Input signal sent from IPMB to indicate Feature Number.	(0x0000)	Do Not Init
PersIndexIpmb_D_Actl	Input signal from IPMB to indicate which personality profile is being reported.	Vehicle (0x4)	Do Not Init
Nbp_D_Stat	Input signal from IPMB to display current status of NBP system.	0x0	0x0
NbpMsgTxt_D2_Rq	Input signal from IPMB to display lane change assist notifications to the user.	0x0	0x0
NBP_Information_Display	Output signal to displays the Navigation Based Pilot information in the ADAS metaphor.	Inactive	Inactive
Navigation_Pilot_Unavailable_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
HandOver_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
MissingExitAlert_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
SuggstnLeftExitManual_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
SuggstnRightExitManual_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
SuggstnLeftLnEndManual_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive

Parameter Name	Description	Value at Battery Connect	Value at Wake-up
SuggstnRightLnEndManual_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
SuggstnLeftYShapeManual_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
SuggstnRightYShapeManual_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
SuggstnLeftSlowVeh_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
SuggstnRightSlowVeh_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
SuggstnLeftExit_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
SuggstnRightExit_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
SuggstnLeftMergeIn_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
SuggstnRightMergeIn_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
SuggstnLeftUnintndExit_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
SuggstnRightUnintndExit_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
SuggstnLeftLnEnd_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
SuggstnRightLnEnd_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
SuggstnLeftYShape_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
SuggstnRightYShape_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
AutoLnChngLeftSlowVeh_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
AutoLnChngRightSlowVeh_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
AutoLnChngLeftOptmzedLn_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
AutoLnChngRightOptmzedLn_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
AutoLnChngLeftExit_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
AutoLnChngRightExit_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
AutoLnChngLeftMergeIn_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
AutoLnChngRightMergeIn_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
AutoLnChngLeftUnintndExit_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
AutoLnChngRightUnintndExit_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
AutoLnChngLeftLnEnd_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive

Parameter Name	Description	Value at Battery Connect	Value at Wake-up
AutoLnChngRightLnEnd_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
AutoLnChngLeftYShape_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
AutoLnChngRightYShape_MC_Warn_Status_Flag	Output signal to control the state of the text warning message.	Inactive	Inactive
AUTO_LANE_CHANGE_SETUP_MC	Output signal to control the setting menu display output for Auto Lane Change.	Inactive	Inactive

1.3.5.6 Prove Out

None

1.3.5.7 Message Center Msg

Refer to 1.3.3.5.14 MC Status Flag to MC Warning Message.

1.3.6 Electronic Horizon (EH) Message Handling

Electronic Horizon messages include ElecHorizon_Data1 (0x22E) and ElecHorizon_Data2 (0x22F) and they are originated from ADAS map which resides in In-Vehicle Infotainment System.
With an alternative solution utilizing HD map for EH message creation, as it's stored outside of the IVI system, IVI has no responsibility broadcasting EH messages anymore. Neither does the ADAS map exist. Additionally, since HD map is highly linked with NBP feature, it makes sense to determine IVI EH messages broadcast based on NBP configuration.

- When Nav_Pilot_Cfg = 0x1 (Enabled), IVI should inhibit the broadcast of EH messages and disable any faults caused by ADAS map loss.
- When Nav_Pilot_Cfg = 0x0 (Disabled), IVI should broadcast EH messages based on ADAS map outputs.

Note: please align with corresponding team who handles the ADAS map and EH message implementation.*

1.4 Error Handling

1.4.1 Missing Message Strategy

Missing message DTC (TBD) shall be logged if signals NbpAvail_D_Stat or NbpMsgTxt_D_Rq is not received for continuous 5s.
If Nav_Pilot_Cfg = Disabled (0x0), the cluster shall never log a missing message DTC for NbpAvail_D_Stat and NbpMsgTxt_D_Rq signals for this feature.

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 DID Dexx

Block Num	Block Description	Byte	Start Bit	Size (bits)	State: Description	“0”	“1”	Default	Comments/ Information
PACKETED BLOCKS									
$08	Option Content (B&A)	4	5	1	Navigation Based Pilot	Disabled	Enabled	Disabled	This parameter allows the NBP related menu items and all information pertaining to the feature to be displayed in the vehicle. Disabled means NBP feature is not present in the vehicle.
$08	Option Content (B&A)	4	4	1	Auto Lane Change	Disabled	Enabled	Disabled	This parameter allows the Auto Lane Change settings menu and all pertaining information to be displayed in the cluster, as well as information. Disabled means Auto Lane Change (that is submenu of NBP) is not present in the vehicle.
	*Byte and bit location to be identified in Part II Specification for this cluster								

1.5.3.2 Supported Diagnostic Trouble Codes (DTCs)

DTC	Description
C23B	Lost Communication with IPMB (Image Processing Module “B”)

1.6 Reference Specification

< Highway Assist with Lane Centering Control Function and Warnings – FNV2.docm>

1.7 Revision History

Version	Name	Change Description	Date
1.0	Zhang Wayne Zheng Dong	Initial release	October 31/2022
1.1	Zheng Dong	8. According < Highway Assist with Lane Centering Control Function and Warnings – FNV2_v3.4_[VDOC075263_N]>, renaming assisted lane change "cancelation" notifications from "Canceled" to "Not Available". And add Blue_Cruise_ECE_Cfg condition in the chapter of State Matrix Update for Assisted Lane Change Information with NBP and State Matrix for Navigation Based Pilot Information. And add Blue_Cruise_ECE_Cfg condition in Diagnostic Configuration Flowchart. 2. Update DTC ID in 1.5.3.2 chapter 3. Update Highway Assist with Navigation Pilot input request Flowchart 4. Update Feature Config in State Matrix for Navigation Based Pilot Information	November 15/2022
1.2	Zheng Dong	1. Add output signals of MsgCntrDsplyOp_D_Rq, MsgCntrFeatNoRq, MsgCntrFeatConfigRq, MsgCntrPersIndex_D_Rq in I/O Block Diagram and description in outputs. 2. Add Hwy_Assist_Cfg and Traffic_Jam_Assist_Cfg in I/O Block Diagram. 3. Update for Menu display logic description. 4. Remove function ID such as F-REQ-XXXXXX/A. 5. Update Input Request Flowchart and Output SET Request Flowchart. 6. Delete the chapter of 1.3.5.5.2 Time Constants.	November 28/2022
1.3	Zhang Wayne Zheng Dong	1. Add 1.3.6 chapter for Electronic Horizon (EH) Message Handling. If this change implementation does not belong to NBP teams, please inform relevant responsible owner.	December 02/2022
1.4	Zhang Wayne Zheng Dong	Update relative change for Setting menu change and NbpMsgTxt_D2_Rq replacing NbpMsgTxt_D_Rq. 1. update "1.1 Functional Description" 2. Add NbpMsgTxt_D2_Rq replacing NbpMsgTxt_D_Rq and remove NAVIGATION_PILOT_SETUP_MC and NAV_PILOT_AUDIO_SETUP_MC in I/O Block Diagram and descriptions in outputs. 3. Update Example Menu Structure and Menu display logic description in "1.3.3.1.1 Indicator Graphics / Display Format" 4. Remove 1.3.3.2 Audio-待修改 5. Update "1.3.5.1.2 Highway Assist and Lane Centering and Auto Lane Change Menu Display Determination Matrix"	January 03/2023

		6. Update “1.3.5.1.3 Highway Assist with Navigation Pilot input request Flowchart” 7. Update “1.3.5.1.4 Highway Assist with Navigation Pilot output SET request Flowchart” 8. Remove “1.3.5.1.5 Navigation Based Pilot Setup State Assignment” 9. Remove “1.3.5.1.6 Navigation Based Pilot Setup Request Messages based upon NAVIGATION_PILOT_SETUP_M” 10. Remove “1.3.5.1.7 Navigation Pilot Audio Setup State Assignment” 11. Remove “1.3.5.1.8 Navigation Pilot Audio Setup Request Messages based upon NAV_PILOT_AUDIO_SETUP_MC” 12. Update “1.3.5.1.8 State Matrix for Navigation Based Pilot Information” 13. Update “1.3.5.1.10 MC Status Flag to MC Warning Message” 14. Update “1.3.5.5.1 Memory Storage Parameters” 15. Update block number for DID in 1.5.3.1 chapter	
1.5	Zhang Wayne Zheng Dong	1. Add description about HMI difference display between VLC on and VLC off in “1.3.3.1.1 Indicator Graphics / Display Format” 2. “CtrStkFeatNoActl, CtrStkDsplyOp_D_Rq, CtrStkFeatConfigActl, CtrStkPersIndex_D_Actl” replace “MsgCntrFeatNoRq, MsgCntrDsplyOp_D_Rq, MsgCntrFeatConfigRq, MsgCntrPersIndex_D_Rq” in whole document 3. Update “1.3.5.1.3 Highway Assist with Navigation Pilot input request Flowchart” 4. Change NAVIGATION_PILOT_SETUP_MC to AUTO_LANE_CHANGE_SETUP_MC in “1.3.5.1.5 Auto Lane Change Setup State Assignment” 5. Change ASSISTED_LANE_CHANGE_SETUP_MC to AUTO_LANE_CHANGE_SETUP_MC in “1.3.5.1.6 Auto Lane Change Setup Request Messages based upon AUTO_LANE_CHANGE_SETUP_MC” 6. Update State Matrix for NBP Warning in “1.3.5.1.9 State Matrix for NBP Warning” for just keeping NBP Warning relative conditions and result 7. Update NBP_Information_Display in “1.3.5.1.8 State Matrix for Navigation Based Pilot Information” and “1.3.5.1.10 MC Status Flag to MC Warning Message” 8. Update Feature Config in “1.3.5.1.8 State Matrix for Navigation Based Pilot Information”	January 16/2023
1.6	Zhang Wayne Zheng Dong	1. Update Chime Status Flag for Auto Lane Change display in “1.3.5.1.8 State Matrix for Navigation Based Pilot Information” and “1.3.5.1.10 MC Status Flag to MC Warning Message”	February 08/2023