1 Traffic Sign Recognition – HUD – FNV2

1.1 Functional Description

The Traffic Sign Recognition (TSR) feature is a mechanism for determining the currently valid speed limit and currently valid overtaking restrictions of the current vehicle path and displaying that information to the user. TSR relies on data transmitted by the Electronic Horizon (EH) feature, as well as data collected by a forward facing camera. The TSR application determines this environmental information and transmits this information to the cluster and the Head-Up Display for display to the user.

Traffic Sign Recognition Feature has two variants:

Variant Name	Variant Description	HMI Example

SLOIF	**Speed Limit and Overtaking Information Function**
	• Full TSR functionality which includes:
	  ○ Display of up to two traffic signs for two speed limit signs or speed limit and no-passing sign
	  ○ Display of detailed suplementary signs
	  ○ Over speed warning (optical)
		

SLIF	**Speed Limit Information Function** Reduced TSR functionality to support Euro NCAP requirements: • Display of one placeholder for a speed limit sign (including generic suplementary signs) • Optical over speed warning • SLIF is sufficient for Speed Assist Features support (intelligent speed assist (ISA) and intelligent adaptive cruise control (iACC))	

Reference: TSR Feature Overview and cluster “Traffic Sign Recognition Control Function –FNV2_v1.0”

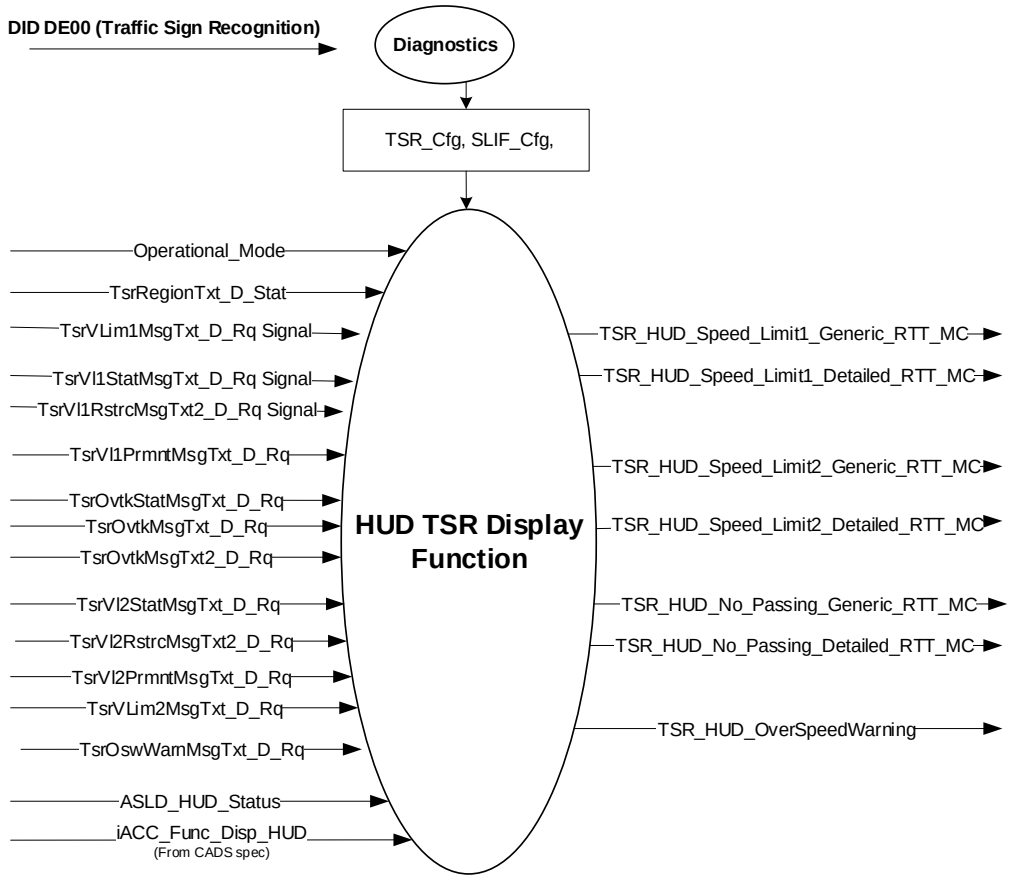
The TSR control function correlates the Personalization signals, several signals from the IPMA module and the Operational Mode to determine when to activate the appropriate displays. The ADAS-ECU is responsible for processing personalization signals from IPC and SYNC; HUD will simply follow the TSR input signals from IPMA. Please refer to HUD_Memory_Save_and_Recall_-CGEA1.3 and Basic Settings Control Function for AHUD or CHUD (CGEA 1.3).

This STSS is applicable on programs that are equipped with DAT2.0 ADAS domain controller. Programs with CADS3.5 IPMA shall continue to implement the “HUD Traffic Sign Recognition– CGEA1.3” STSS. HUD D&R shall align with TSR application feature owner on STSS version.

1.2 Interfaces

1.2.1 Interface Context Diagram (I/O Block Diagram)

TSR Function Context Diagram



1.2.2 Inputs

1.2.2.1 IR-REQ-351306/A-Internal

- Operational_Mode
- TSR_Cfg -Traffic Sign Recognition configuration
- SLIF_Cfg – Speed Limit Information configuration
- ASLD_HUD_Status – Please refer to “the HUD Adjustable Speed Limiter Device (with Optional Intelligent Speed Assistance) Control Function – CGEA1.3” for more information
- IACC_Func_Disp_HUD from CADS Specification

1.2.2.2 MUX messages

1.2.2.2.1 SIG-REQ-351304/A-TsrVl1StatMsgTxt_D_Rq Signal

Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min	Max
TsrVl1StatMsgTxt_D_Rq	2		SED	1	0		0 (0x0)	3 (0x3)
		Null				0x0		
		LimitChanged				0x1		
		LimitReliable				0x2		
		LimitOutdated				0x3		

1.2.2.2.2 SIG-REQ-351307/A-TsrVl1RstrcMsgTxt2_D_Rq Signal

Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min	Max
TsrVl1RstrcMsgTxt2_D_Rq	3		SED	1	0		0 (0x0)	7 (0x7)
		Null				0x0		
		NoSpeedLimitRestriction				0x1		
		NoRecognizable Restriction				0x2		
		RainWet				0x3		
		Snow				0x4		
		Trailer				0x5		
		Time				0x6		
		NotUsed				0x7		

1.2.2.2.3 SIG-REQ-351308/B-TsrVLim1MsgTxt_D_Rq Signal

Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min	Max
TsrVLim1MsgTxt_D_Rq	8		SED	1	0		0 (0x0)	255 (0xFF)
		Null				0 (0x0)		
		Message1				1 (0x1)		
		Message2				2 (0x2)		
		Message3				3 (0x3)		
		Message4				4 (0x4)		
		Message5				5 (0x5)		
		Message6				6 (0x6)		
		Message7				7 (0x7)		
		Message8				8 (0x8)		
		Message9				9 (0x9)		
		Message10				10 (0xA)		
		Message11				11 (0xB)		
		Message12				12 (0xC)		
		Message13				13 (0xD)		
		Message14				14 (0xE)		
		Message15				15 (0xF)		
		Message16				16 (0x10)		
		Message17				17 (0x11)		
		Message18				18 (0x12)		
		Message19				19 (0x13)		
		Message20				20 (0x14)		
		Message21				21 (0x15)		
		Message22				22 (0x16)		
		Message23				23 (0x17)		
		Message24				24 (0x18)		
		Message25				25 (0x19)		
		Message26				26 (0x1A)		
		Message27				27 (0x1B)		
		Message28				28 (0x1C)		

		Message29				29 (0x1D)		
		Message30				30 (0x1E)		
		1F_FA_Message31_250				31 (0x1F)		
		…				…		
		LimitCancelled				251 (0xFB)		
		NotToBeDisplayed				252 (0xFC)		
		NotUsed				253, 254 (0xFD, 0xFE)		
		NoLimit				255 (0xFF)		

1.2.2.2.4 SIG-REQ-351309/A-TsrVl1PrmntMsgTxt_D_Rq Signal

Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min	Max
TsrVl1PrmntMsgTxt_D_Rq	2		SED	1	0		0 (0x0)	3 (0x3)
		DoNotShowSignPermanent				0x0		
		ShowPermanentlyWithoutSupp				0x1		
		ShowPermanentlyWithSupp				0x2		
		NotUsed				0x3		

1.2.2.2.5 SIG-REQ-351310/A-TsrOvtkStatMsg_Txt_D_Rq Signal

Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min	Max
TsrOvtkStatMsgTxt_D_Rq	2		SED	1	0		0 (0x0)	3 (0x3)
		Null				0x0		
		LimitChanged				0x1		
		LimitReliable				0x2		
		LimitOutdated				0x3		

1.2.2.2.6 SIG-REQ-351311/A-TsrVl2StatMsgTxt_D_Rq Signal

Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min	Max
TsrVl2StatMsgTxt_D_Rq	2		SED	1	0		0 (0x0)	3 (0x3)
		Null				0x0		
		LimitChanged				0x1		
		LimitReliable				0x2		
		LimitOutdated				0x3		

1.2.2.2.7 SIG-REQ-351312/A-TsrVl2RstrcMsgTxt2_D_Rq Signal

Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min	Max
TsrVl2RstrcMsgTxt2_D_Rq	3		SED	1	0		0 (0x0)	7 (0x7)
		Null				0x0		
		NoSpeedLimitRestriction				0x1		
		NoRecognizable Restriction				0x2		
		RainWet				0x3		
		Snow				0x4		
		Trailer				0x5		
		Time				0x6		
		NotUsed				0x7		

1.2.2.2.8 SIG-REQ-351313/A-TsrVl2PrmntMsgTxt_D_Rq Signal

Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min	Max
TsrVl2PrmntMsgTxt_D_Rq	2		SED	1	0		0 (0x0)	3 (0x3)
		DoNotShowSignPermanent				0x0		
		ShowPermanentlyWithoutSupp				0x1		
		ShowPermanentlyWithSupp				0x2		
		NotUsed				0x3		

1.2.2.2.9 SIG-REQ-351314/A-TsrOvtkMsgTxt_D_Rq Signal

Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min	Max
TsrOvtkMsgTxt_D_Rq	3		SED	1	0		0 (0x0)	7 (0x7)
		Null				0x0		
		OvertakingAllowed				0x1		
		LimAllWithoutRestriction				0x2		
		LimAllWithoutQfdRstrc				0x3		
		LimAllCancelled				0x4		
		LimForTrucksWithoutRstrc				0x5		
		LimForTrucksWoQlfdRstrc				0x6		
		LimForTrucksCancelled				0x7		

1.2.2.2.10 SIG-REQ-351315/A-TsrOvtkMsgxt2_D_Rq Signal

Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min	Max
TsrOvtkMsgTxt2_D_Rq	4		SED	1	0		0 (0x0)	7 (0x7)
		OvertakingAllowed				0x0		
		LimAllWithoutRestriction				0x1		
		LimAllWithoutQfdRstrc				0x2		
		LimAllWithRstrcRain				0x3		
		LimAllWithRstrcSnow				0x4		
		LimAllWithRstrcTrailer				0x5		
		LimAllWithRstrcTime				0x6		
		LimAllCancelled				0x7		
		LimForTrucksWithoutRstrc				0x8		
		LimForTrucksWoQlfdRstrc				0x9		
		LimForTrucksCancelled				0xA		
		NotUsed1				0xB		
		NotUsed2				0xC		
		NotUsed3				0xD		
		NotUsed4				0xE		
		NotUsed5				0xF		

1.2.2.2.11 SIG-REQ-351316/B-TsrVLim2MsgTxt_D_Rq Signal

Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min	Max
TsrVLim2MsgTxt_D_Rq	8		SED	1	0		0 (0x0)	255 (0xFF)
		Null				0 (0x0)		
		Message1				1 (0x1)		
		Message2				2 (0x2)		
		Message3				3 (0x3)		
		Message4				4 (0x4)		
		Message5				5 (0x5)		
		Message6				6 (0x6)		
		Message7				7 (0x7)		
		Message8				8 (0x8)		
		Message9				9 (0x9)		
		Message10				10 (0xA)		
		Message11				11 (0xB)		
		Message12				12 (0xC)		
		Message13				13 (0xD)		
		Message14				14 (0xE)		
		Message15				15 (0xF)		

		Message16				16 (0x10)		
		Message17				17 (0x11)		
		Message18				18 (0x12)		
		Message19				19 (0x13)		
		Message20				20 (0x14)		
		Message21				21 (0x15)		
		Message22				22 (0x16)		
		Message23				23 (0x17)		
		Message24				24 (0x18)		
		Message25				25 (0x19)		
		Message26				26 (0x1A)		
		Message27				27 (0x1B)		
		Message28				28 (0x1C)		
		Message29				29 (0x1D)		
		Message30				30 (0x1E)		
		1F_FA_Message31_250				31 (0x1F)		
		…				…		
		LimitCancelled				251 (0xFB)		
		NotToBeDisplayed				252 (0xFC)		
		NotUsed				253, 254 (0xFD, 0xFE)		
		NoLimit				255 (0xFF)		

1.2.2.2.12 SIG-REQ-351317/A-TsrOswWarnMsgTxt_D_Rq Signal

Signal Name	Size (bits)		Detail	Units	Res.	Offset	State Encoded	Min	Max
TsrOswWarnMsgTxt_D_Rq	2			SED	1	0		0 (0x0)	3 (0x3)
			Null				0 (0x0)		
			False				1 (0x1)		
			True				2 (0x2)		
			NotUsed				3 (0x3)		

1.2.2.2.13 SIG-REQ-351318/B-TsrRegionTxt_D_Stat Signal

Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min	Max
TsrRegionTxt_D_Stat	5		SED	1	0		0 (0x0)	31 (0x1F)
		NotDetermined				0 (0x0)		
		Region_01				1 (0x1)		
		Region_02				2 (0x2)		

		Region_03				3 (0x3)		
		Region_04				4 (0x4)		
		Region_05				5 (0x5)		
		Region_06				6 (0x6)		
		Region_07				7 (0x7)		
		Region_08				8 (0x8)		
		Region_09				9 (0x9)		
		Region_10				10 (0xA)		
		Region_11				11 (0xB)		
		Region_12				12 (0xC)		
		Region_13				13 (0xD)		
		Region_14				14 (0xE)		
		Region_15				15 (0xF)		
		Region_16				16 (0x10)		
		Region_17				17 (0x11)		
		Region_18				18 (0x12)		
		Region_19				19 (0x13)		
		Region_20				20 (0x14)		
		Region_21				21 (0x15)		
		Region_22				22 (0x16)		
		NotUsed_1 – NotUsed_08				23 (0x17) – 30 (0x1E)		
		Faulty				31 (0x1F)		

1.2.3 Outputs

1.2.3.1 IR-REQ-351319/B-Internal

- TSR_HUD_Speed_Limit1_Generic_RTT_MC, displays status of generic TSR/SLIF SpeedLimit1.
- TSR_HUD_Speed_Limit1_Detailed_RTT_MC, displays status of TSR/SLIF of detailed Speed Limit1.
- TSR_HUD_Speed_Limit2_Generic_RTT_MC, displays status of TSR/SLIF generic Speed Limit2.
- TSR_HUD_Speed_Limit2_Detailed_RTT_MC, displays status of TSR/SLIF detailed Speed Limit 2.
- TSR_HUD_No_Passing_Generic_RTT_MC, displays supplementary generic TSR
- TSR_HUD_No_Passing_Detailed_RTT_MC, displays supplementary generic TSR
- TSR_HUD_OverSpeedWarning, displays Overspeed Warning

1.3 Function/Performance

1.3.1 F-REQ-351320/A-Operational Modes

Mode	Differentiating Vehicle Conditions
Sleep Mode	TSR Display Messages on HUD Disabled
Limited Mode	TSR Display Messages on HUD Disabled
Normal Mode	TSR Display Messages on HUD Enabled / Disabled
Crank Mode	TSR Display Messages on HUD Enabled / Disabled

1.3.2 Voltage Levels

Refer to the Cluster 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-351321/A-TSR HMI Display

- In SLOIF, up to two traffic signs can be displayed in two locations.
  - The primary speed limit shall be displayed in the first location. (Speed Limit 1)
  - Input signal related to the primary speed limit:
    - TsrVl1PrmntMsgTxt_D_Rq, TsrVl1StatMsgTxt_D_Rq,
    - TsrVl1RstrcMsgTxt2_D_Rq, TsrVLim1MsgTxt_D_Rq
  - The secondary speed limit and the no-passing sign shall be displayed in the second location (Speed Limit 2 / No Passing Info)
  - Input signals related to the secondary speed limit:
    - TsrVl2PrmntMsgTxt_D_Rq, TsrVl2StatMsgTxt_D_Rq,
    - TsrVl2RstrcMsgTxt2_D_Rq, TsrVLim2MsgTxt_D_Rq
  - Input signals related to the No-passing sign:
    - TsrOvtkMsgTxt2_D_Rq, TsrOvtkMsgTxt_D_Rq, TsrOvtkStatMsgTxt_D_Rq
    - In case valid no-passing sign and secondary speed limit information is received, nothing should be displayed.

1.3.3.1.2 TSR HMI Display Note:

The IPMA (control module) will avoid conflicts between the secondary speed limit information and no-passing sign display by transmitting the appropriate states over the input signals. The HUD shall simply display the information based on these inputs.

1.3.3.1.3 HMI-REQ-351322/A-Indicator Graphics / Display Format

Please refer to the specific program for exact graphics.
Sample graphics provided below for HUD Display

Only one speed limit info

Speed limit Info – Aging

Overspeed warning (Red Digital Speedo)

Supplementary information Identified – Generic Image

Displaying the above graphics is possible only if Traffic Signs Display in HUD is enabled.
Refer “AHUD Basic Settings Control Function - CGEA1.3_xxx.doc” or “CHUD Basic Settings Control Function - CGEA1.3_xxx.doc” and HUD – Memory Save and Recall STSS CGEA1.3_xxx to enable or disable the feature.
Refer to Traffic Sign Recognition Control Function -FNV2 for IPC Settings related RTT Display and Speed Warning settings. The same values are used for limited display in HUD.

1.3.3.1.4 Indicator Color Coordinates

Reference section COLOR & ILLUMINATION REQUIREMENTS (GRAPHICS)

1.3.3.2 Audio

HUD will not initiate any TSR related chimes. IPC takes care of sounding the chime based on overspeed warning.

1.3.3.3 Switch Control Logic

Consumer access to the Traffic Sign Recognition 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.

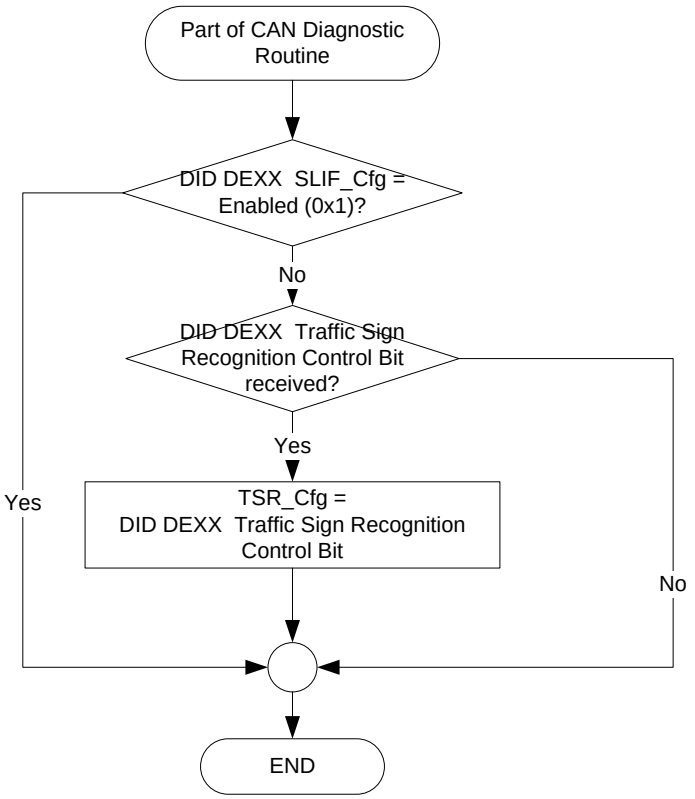
1.3.4 PFM-REQ-351323/A-System Accuracy

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 Subsystem Algorithm Flowchart / State Diagram

1.3.5.1.1 F-REQ-351324/A-Traffic Sign Recognition Diagnostic Configuration Flowchart



1.3.5.1.2 F-REQ-351325/A-Traffic Signs – Enable/ Disable Display in HUD

HUD_Config_Rq[x], x for TSR (1)	TSR_HUD_Display
0x0000 (OFF)	0x00
0x0001 (ON)	0x01

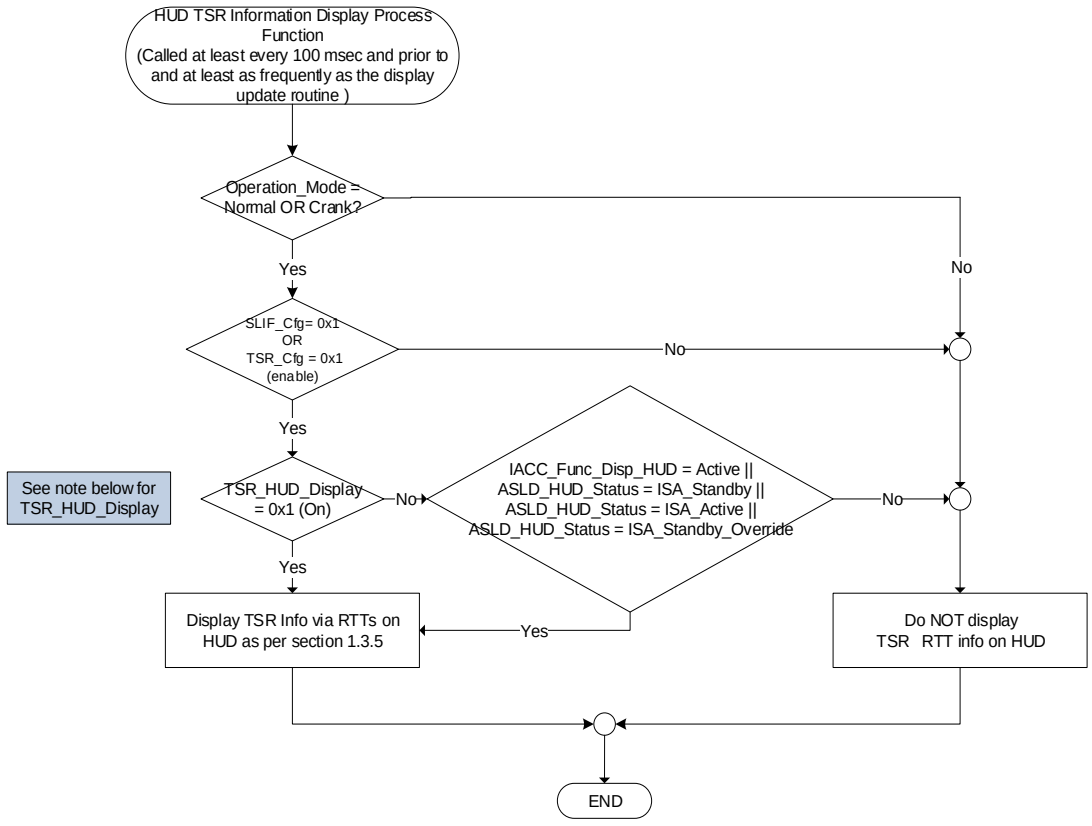
(1) As set in HUD Memory Save and Recall STSS
(2) TSR_Cfg and SLIF_Cfg will be mutually exclusive. The same output value can be used while implementing SLIF (SLIF_Cfg = Enabled) instead of TSR.

1.3.5.1.3 F-REQ-351326/A-Intelligent Speed Assistance (ISA) with TSR/SLIF

When IACC_Func_Disp_HUD = Active OR ASLD_HUD_Status = ISA_Standby (0x3) or ISA_Active (0x4) or ISA_Standby_Override (0x5), the TSR/SLIF
information is displayed in the HUD, regardless of the status of TSR_HUD_Display . However, the TSR/SLIF over speed indication shall be inactive in the HUD. TSR/SLIF over speed indication can still be active when the over speed indication request is received from CAN signal, TsrOswWarnMsgTxt_D_Rq from IPMA.
ISA will not react to one speed limit with supplementary sign.

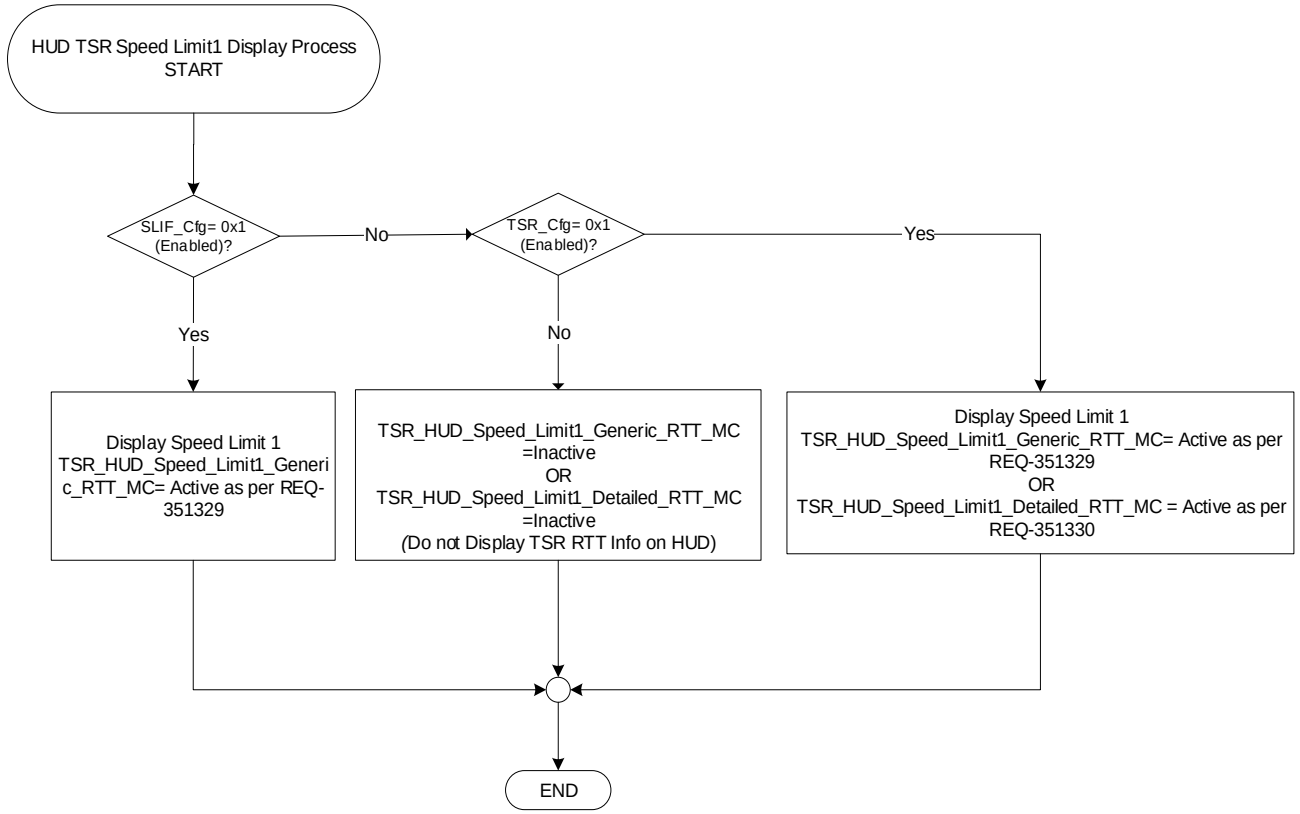
1.3.5.1.4 F-REQ-351327/B-TSR Information Display Process

TSR Information Display Process Flowchart



TSR_HUD_Diplay Note: TSR_HUD_Display corresponds to the cluster or SYNC HUD TSR menu input.
Program specific HMI will decide if TSR_HUD_Display shall be used.
If program specific HMI directs NOT use TSR_HUD_Display, HUD should always take the "Yes" value.
Check with program D&R for direction.

1.3.5.1.5 F-REQ-351328/A-TSR Speed Limit 1 Information Display Pre-Conditions



Note: Program HMI team will decide if Generic or Detailed Speed Limit 1 information should be displayed.

1.3.5.1.6 F-REQ-351329/A-State Matrix for TSR_HUD_Speed_Limit1_Generic_RTT_MC

Operational_Mode	TsrVl1StatMsg Txt_D_Rq Signal	TsrVl1PrmntMsgTxt_D_Rq Signal	TsrVLim1MsgTxt_D_ Rq Signal	TSR_HUD_Speed_Limit1_Generic_RTT_MC	
				TsrRegionTxt_D_Stat	
				<>Region_03	Region_03
Normal or Crank	LimitChanged (0x1)	ShowPermanentlyWithoutSupp (0x1)	<> (0x00, 0xFB, 0xFC, 0xFD, 0xFE, 0xFF)		
		ShowPermanentlyWithSupp (0x2)			
	LimitReliable (0x2)	ShowPermanentlyWithoutSupp (0x1)			
		ShowPermanentlyWithSupp (0x2)			
	LimitOutdated (0x3)	ShowPermanentlyWithoutSupp (0x1)			
		ShowPermanentlyWithSupp (0x2)			

	LimitChanged (0x1)	X	LimitCancelled (0xFB)		
	LimitReliable (0x2) || LimitOutdated (0x3)		LimitCancelled (0xFB)		
	X	X	NoLimit (0xFF)		
	X	X	NotToBeDisplayed (0xFC)		
All other cases					

- The graphics shown above are for example purposes only. Please refer to program specific display menu and/or graphics library for accurate graphics.
- The value in the circle of the RTT shall be replaced by the value received in the TsrVLim1MsgTxt_D_Rq input signal.
- RTT locations determined by product specific HMI logic.
- Region 3 (United States, Canada) HMI applies for SLIF only, for this reason it is not applicable for detailed display of speed limit 1(TSR_HUD_Speed_Limit1_Detailed_RTT_MC).

1.3.5.1.7 F-REQ-351330/B-State Matrix for TSR_HUD_Speed_Limit1_Detailed_RTT_MC

Operational_Mode	TsrVl1StatMsg Txt_D_Rq Signal	TsrVl1RstrcMsgTxt2_D_Rq Signal	TsrVLim1MsgTxt_D_Rq Signal	TSR_HUD_Speed_Limit1_Detailed_RTT_MC
Normal or Crank	LimitChanged (0x1)	NoSpeedLimitRestriction (0x1)	<> (0x00, 0xFB, 0xFC, 0xFD, 0xFE, 0xFF)	
		NoRecognizableRestrctn (0x2)		
		RainWet (0x3)		
		Snow (0x4)		
		Trailer (0x5)		
		Time (0x6)		
	LimitReliable (0x2)	NoSpeedLimitRestriction (0x1)		
		NoRecognizableRestrctn (0x2)		

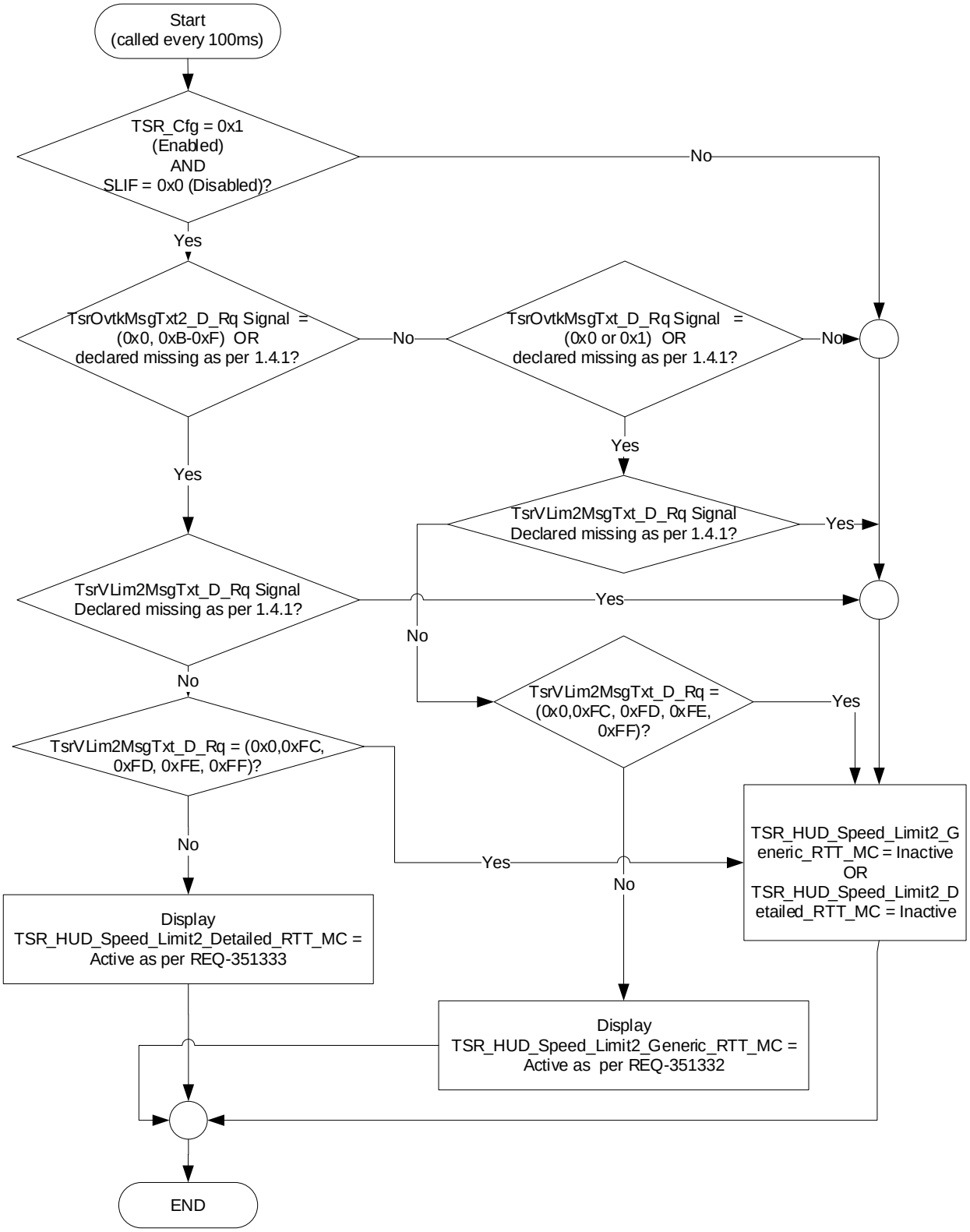
		RainWet (0x3)		
		Snow (0x4)		
		Trailer (0x5)		
		Time (0x6)		
	LimitOutdated (0x3)	NoSpeedLimitRestriction (0x1)		
		NoRecognizableRestrctn (0x2)		
		RainWet (0x3)		
		Snow (0x4)		
		Trailer (0x5)		
		Time (0x6)		
	LimitChanged (0x1)	X	LimitCancelled (0xFB)	
	LimitReliable (0x2) || LimitOutdated (0x3)		LimitCancelled (0xFB)	
	X	X	NoLimit (0xFF)	
	X	X	NotToBeDisplayed (0xFC)	
All Other Cases				

Notes:

- The graphics shown above are for example purposes only. Please refer to program specific display menu and/or graphics library for accurate graphics.
- The value in the circle of the RTT shall be replaced by the value received in the TsrVLim1MsgTxt_D_Rq input signal.
- RTT locations determined by product specific HMI logic.
- It is assumed that the information for No Passing and/or Speed Limit 2 has not been received in these example graphics.

- If SLIF_CFG = 0x1(enabled), the State Matrix table shall not be executed
- North American HMI is not applicable for SLOIF

1.3.5.1.8 F-REQ-351331/B-TSR pre-conditions to activate TSR Speed Limit 2 Information

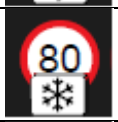
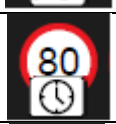


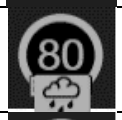
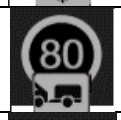
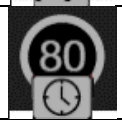
Note:
Program specific HMI will decide if Detailed or Generic Speed Limit 2 information should be displayed

1.3.5.1.9 F-REQ-351332/A-State Matrix for TSR_HUD_Speed_Limit2_Generic_RTT_MC

Operational_Mode	TsrVLim2MsgTxt_D_Rq Signal	TsrVl2StatMsgTxt_D_Rq Signal	TsrVl2PrmntMsgTxt_D_Rq Signal	TSR_HUD_Speed_Limit2_ Generic_MC
Normal or Crank	<> (0x00, 0xFB, 0xFC, 0xFD, 0xFE, 0xFF)	LimitChanged (0x1)	ShowPermanentlyWithoutSupp (0x1)	
			ShowPermanentlyWithSupp (0x2)	
		LimitReliable (0x2)	ShowPermanentlyWithoutSupp (0x1)	
			ShowPermanentlyWithSupp (0x2)	
		LimitOutdated (0x3)	ShowPermanentlyWithoutSupp (0x1)	
			ShowPermanentlyWithSupp (0x2)	
	LimitCancelled (0xFB)	LimitChanged (0x1)	X	
	LimitCancelled (0xFB)	LimitReliable (0x2) || LimitOutdated (0x3)	X	
All other cases				

1.3.5.1.10 F-REQ-351333/B-State Matrix for TSR_HUD_Speed_Limit2_Detailed_RTT _MC

Operational_Mode	TsrVl2StatMsg Txt_D_Rq Signal	TsrVl2RstrcMsgTxt2_D_Rq Signal	TsrVLim2MsgTxt_D_Rq Signal	TSR_HUD_Speed_Limit2_D etailed_RTT_MC
Normal or Crank	LimitChanged (0x1)	NoSpeedLimitRestriction (0x1)	<> (0x00, 0xFB, 0xFC, 0xFD, 0xFE, 0xFF)	
		NoRecognizableRestrctn (0x2)		
		RainWet (0x3)		
		Snow (0x4)		
		Trailer (0x5)		
		Time (0x6)		
	LimitReliable (0x2)	NoSpeedLimitRestriction (0x1)		
		NoRecognizableRestrctn (0x2)		

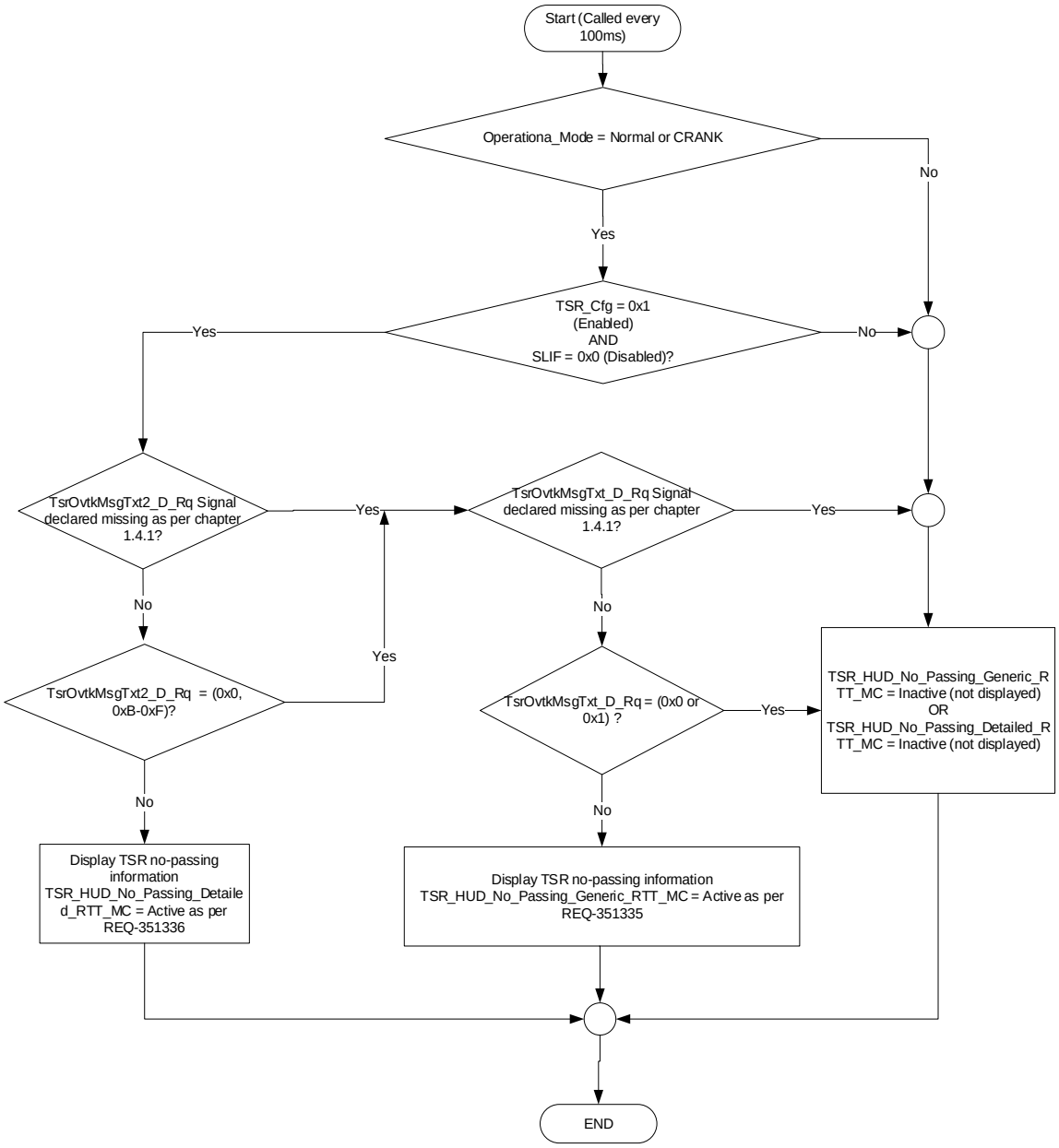
		RainWet (0x3)		
		Snow (0x4)		
		Trailer (0x5)		
		Time (0x6)		
	LimitOutdated (0x3)	NoSpeedLimitRestriction (0x1)		
		NoRecognizableRestrctn (0x2)		
		RainWet (0x3)		
		Snow (0x4)		
		Trailer (0x5)		
		Time (0x6)		
	LimitChanged (0x1)	X	LimitCancelled (0xFB)	
	LimitReliable (0x2) OR LimitOutdated (0x3)	X	LimitCancelled (0xFB)	
All other cases				

Notes:

- The graphics shown above are for example purposes only. Please refer to program specific display menu and/or graphics library for accurate graphics.
- The value in the circles shall be replaced by the value received in the TsrVLim2MsgTxt_D_Rq input signals.

- If SLIF_CFG = 0x1(enabled), this table shall not be executed

1.3.5.1.11 F-REQ-351334/D-TSR No-Passing Restriction Display Preconditions



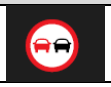
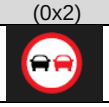
Note:
Program specific HMI will decide if Generic or Detailed No-Passing Sign information should be displayed.
If the No_Passing_Detailed (TsrOvtkMsgTxt2_D_Rq) wants to show any icon (rain, snow, trailer, time etc) then this should be prioritized over No_Passing_Generic (TsrOvtkMsgTxt_D_Rq).

1.3.5.1.12 F-REQ-351335/A-State Matrix and for ACTIVE TSR_HUD_No_Passing_Generic_RTT_MC

TSR_HUD_No_Passing_Generic_RTT_MC

TsrOvtkStatMsgTxt_D_Rq Signal	TsrOvtkMsgTxt_D_Rq Signal	TsrRegionTxt_D_Stat			
		X	Region_02 (0x2)	Region_04 (0x4)	Region_05 (0x5)
LimitChanged (0x1)	LimAllWithoutRestriction (0x2)				
	LimAllWithoutQlfdRstrc (0x3)				
	LimAllCancelled (0x4)				
	LimForTrucksWithoutRstrc (0x5)				
	LimForTrucksWoQlfdRstrc (0x6)				
	LimForTrucksCancelled (0x7)				
LimitReliable (0x2)	LimAllWithoutRestriction (0x2)				
	LimAllWithoutQlfdRstrc (0x3)				
	LimAllCancelled (0x4)				
	LimForTrucksWithoutRstrc (0x5)				
	LimForTrucksWoQlfdRstrc (0x6)				
	LimForTrucksCancelled (0x7)				
LimitOutdated (0x3)	LimAllWithoutRestriction (0x2)				
	LimAllWithoutQlfdRstrc (0x3)				
	LimAllCancelled (0x4)				
	LimForTrucksWithoutRstrc (0x5)				
	LimForTrucksWoQlfdRstrc (0x6)				
	LimForTrucksCancelled (0x7)				
All other cases					

1.3.5.1.13 F-REQ-351336/B-State Matrix and for ACTIVE TSR_HUD_No_Passing_Detailed_RTT_MC

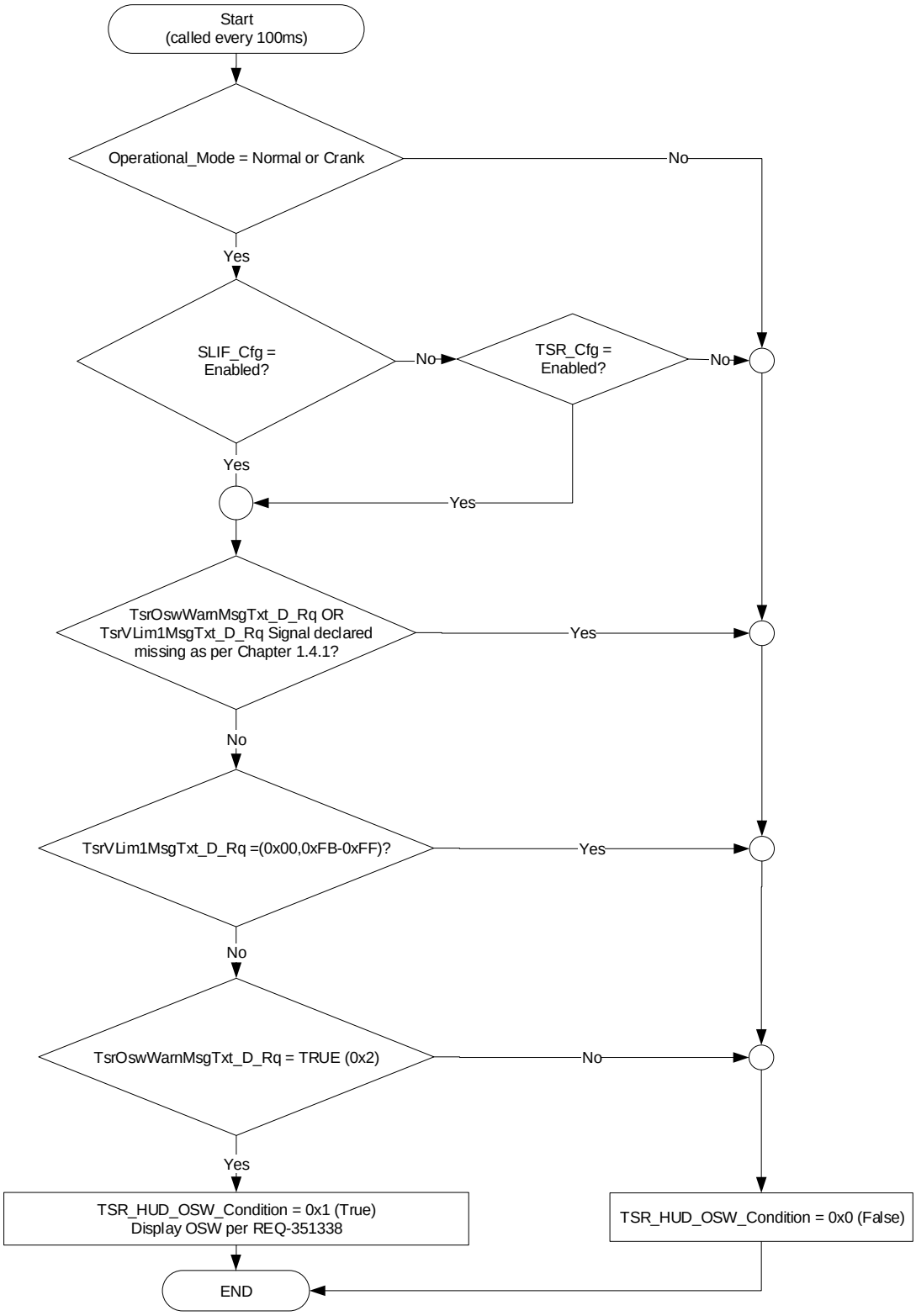
TsrOvtkStatMsgTxt_D_Rq Signal	TsrOvtkMsgTxt2_D_Rq Signal	TSR_HUD_No_Passing_Detailed_RTT_MC TsrRegionTxt_D_Stat X	Region_02 (0x2)	Region_04 (0x4)	Region_05 (0x5)
LimitChanged (0x1)	LimAllWithoutRestriction (0x1)				
	LimAllWithoutQlfdRstrc (0x2)				
	LimAllWithRstrcRain (0x3)				
	LimAllWithRstrcSnow (0x4)				
	LimAllWithRstrcTrailer (0x5)				
	LimAllWithRstrcTime (0x6)				
	LimAllCancelled (0x7)				
	LimForTrucksWithoutRstrc (0x8)				
	LimForTrucksWoQlfdRstrc (0x9)				
	LimForTrucksCancelled (0xA)				
LimitReliable (0x2)	LimAllWithoutRestriction (0x1)				
	LimAllWithoutQlfdRstrc (0x2)				
	LimAllWithRstrcRain (0x3)				
	LimAllWithRstrcSnow (0x4)				
	LimAllWithRstrcTrailer (0x5)				
	LimAllWithRstrcTime (0x6)				
	LimAllCancelled (0x7)				
	LimForTrucksWithoutRstrc (0x8)				

	LimForTrucksWoQlfdRstrc (0x9)				
	LimForTrucksCancelled (0xA)				
LimitOutdated (0x3)	LimAllWithoutRestriction (0x1)				
	LimAllWithoutQlfdRstrc (0x2)				
	LimAllWithRstrcRain (0x3)				
	LimAllWithRstrcSnow (0x4)				
	LimAllWithRstrcTrailer (0x5)				
	LimAllWithRstrcTime (0x6)				
	LimAllCancelled (0x7)				
	LimForTrucksWithoutRstrc (0x8)				
	LimForTrucksWoQlfdRstrc (0x9)				
	LimForTrucksCancelled (0xA)				
All other cases					

Notes:

- The graphics shown above are for example purposes only. Please refer to program specific display menu and/or graphics library for accurate graphics.
- Please refer to the program specific graphics library for RTT placement and positions.
- If SLIF_CFG = 0x1(enabled), this State Matrix table shall not be executed
- No-Passing HMI is only relevant for SLOIF
- If the No_Passing_Detailed (TsrOvtkMsgTxt2_D_Rq) wants to show any icon (rain, snow, trailer, time) then this should be prioritized over No_Passing_Generic (TsrOvtkMsgTxt_D_Rq).

1.3.5.1.14 F-REQ-351337/A-Overspeed Display Determination Process



1.3.5.1.15 F-REQ-351338/A-State Matrix for TSR/SLIF Overspeed Information

TSR_HUD_OSW_Condition	TsrRegionTxt_D_Stat	TSR_HUD_OverSpeedWarning
True (0x1)	All other regions	Red Speedometer 
True (0x1)	Region_03 (0x3)	Highlighted State 
False (0x0)	X	Inactive

Notes:

- The graphics shown above are for example purposes only. Please refer to programs HMI Wallpaper.
- No Flashing in HUD Drivers View. Flashing is only observed in IPC. Digital Speedo Indication goes to Red Color
- Refer Sample HMI Graphics as mentioned in Section 1.3.3
- Red Digital Speedo will be triggered by IPMA for changed and reliable signs without supplementary signs. IPMA hosts this logic and will take care that no flashing for supplementary signs or outdated signs is triggered

1.3.5.2 Operation Description (supports algorithm flowchart /state diagram)

1.3.5.2.1 F-REQ-351339/A-TSR Display Location

- For TSR SOIF variant, there are two dedicated indication location for displaying Speed Limit 1, Speed Limit 2 or No-Passing RTT. IPMA should not request to display Speed Limit 2 and No_passing RTT at the same time.
- For TSR SLIF variant, there is only one dedicated indication location for displaying Speed Limit 1 information.
- The front camera (IPMA) module controls all of the processing and arbitration of the TSR speed limit information
- For the display settings in the HUD there are also interactions with the instrument cluster (IPC).
- If TSR and Nav Repeater(HUD Speed Limit Function) are both active at the same time, the HUD should only use information from TSR since TSR is the fusion of map and Camera Data

1.3.5.2.2 F-REQ-351340/A-ASLD Status

- ISA will not react to one speed limit with supplementary sign
- When ASLD_HUD_Status = ISA_Standby (0x3) or ISA_Active (0x4) or When ASLD_HUD_Status = ISA_Standby (0x3) or ISA_Active (0x4) or ISA_Standby_Override (0x5), the TSR information is displayed in the HUD, regardless of the status of TSR_HUD_Display. However, the TSR/SLIF over speed indication shall be inactive in the HUD. TSR/SLIF over speed indication can still be active when the over speed indication request is received from CAN signal, TsrOswWarnMsgTxt_D_Rq from IPMA.

1.3.5.2.3 F-REQ-351341/A-SLIF/TSR feature

- SLIF and TSR features are mutually exclusive. One is enabled while other is disabled.

1.3.5.2.4 F-REQ-351342/A-TSR Over speed warning

- If user activates over speed warning Indication in IPC or SYNC, HUD does show over speed warning. Digital Speedo will be shown in RED in non-North America. In North America, the Speed Limit Sign will be shown in the highlighted state. IPMA is responsible check if OSW feature is on or off in IPC and SYNC menu. HUD will just follow the inputs from IPMA.
- IPMA will always transmit the higher value on speed limit1, therefore only this limit is used for indicating over speed conditions, IPMA is responsible for this logic.

1.3.5.2.5 F-REQ-351387/A-TSR Generic vs Detailed Indications

The TSR generic indications and the detailed indications are mutually exclusive. The indications are displayed based on the cluster display type, which is determined by the HMI team.

1.3.5.3 FS-REQ-351343/A-Function Safety Classification (EMC)

Class B

1.3.5.4 NVM-REQ-351344/A-Memory Storage

Parameter Name	Description	Value at Battery Connect	Value at Wake-up
TSR_HUD_Speed_Limit1_Generic_RTT_MC	Outputs displayed in the HUD	Inactive	Inactive
TSR_HUD_Speed_Limit1_Detailed_RTT_MC		Inactive	Inactive
TSR_HUD_Speed_Limit2_Generic_RTT_MC		Inactive	Inactive
TSR_HUD_Speed_Limit2_Detailed_RTT_MC		Inactive	Inactive
TSR_HUD_No_Passing_Generic_RTT_MC		Inactive	Inactive
TSR_HUD_No_Passing_Detailed_RTT_MC		Inactive	Inactive
TSR_Cfg	State indicator for feature presence controlled via CAN at EOL at VO plant. Set to disable at HUD Supplier Manufacturing Plant	Use Stored Value	Use Stored Value
SLIF_Cfg	State indicator for feature presence controlled via CAN at EOL at VO plant. Set to disable at HUD supplier Manufacturing Plant	Use Stored Value	Use Stored Value
Operational_Mode	4 state indicator for cluster operational mode	Limited	Limited, Normal or Crank
TsrOvtkStatMsgTxt_D_Rq Signal	Input signals sent from IPMA to process No passing information.	0x0	0x0
TsrOvtkMsgTxt_D_Rq Signal		0x1	0x1
TsrOvtkTypeMsgTxt_D_Rq Signal		0x0	0x0
TsrOvtkMsgTxt2_D_Rq Signal		0x0	0x0
TsrRegionTxt_D_Stat Signal	Input signal sent from IPMA that determines the graphics that need to be displayed for a specific region	0x1	0x1
TsrVLim1MsgTxt_D_Rq Signal	Input signals sent from IPMA to process information for Speed Limit 1 displays	0xFF	0xFF
TsrVl1StatMsgTxt_D_Rq Signal		0x0	0x0
TsrVl1RstrcMsgTxt2_D_Rq Signal		0x0	0x0
TsrVl1TypeMsgTxt_D_Rq Signal		0x0	0x0
TsrVl1PrmntMsgTxt_D_Rq Signal		0x0	0x0
TsrVLim2MsgTxt_D_Rq Signal	Input signals sent from IPMA to process information for Speed Limit 2 displays	0xFF	0xFF
TsrVl2StatMsgTxt_D_Rq Signal		0x0	0x0
TsrVl2RstrcMsgTxt2_D_Rq Signal		0x0	0x0
TsrVl2TypeMsgTxt_D_Rq Signal		0x0	0x0
TsrVl2PrmntMsgTxt_D_Rq Signal		0x0	0x0
TsrVlUnitMsgTxt_D_Rq Signal	Input signal sent from IPMA to factor in the units when setting overspeed offset.	0x1 (kph)	Use Stored Value
TsrOswWarnMsgTxt_D_Rq Signal	Signal from IPMA to trigger the OSW indication when Digital speedo is disabled	(0x1) FALSE	(0x1) FALSE

Parameter Name	Description	Value at Battery Connect	Value at Wake-up
IACC_Func_Disp_HUD	Output from the CADS reference spec used as an input to the TSR function related to IACC.	Note 2	Note 2
ASLD_HUD_Status	Output from the HUD Adjustable Speed Limiter Device spec as input to the TSR function	Note 3	Note 3

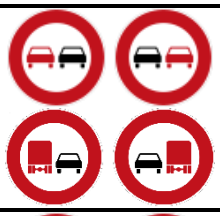
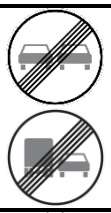
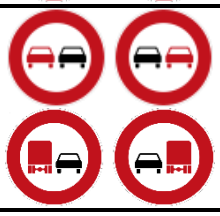
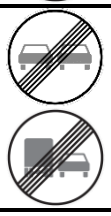
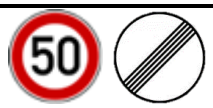
* Refer to Message Center X Display_Y Button Interface Section, where X and Y are appropriate values in this document.
Note2: Please refer to the CGEA13 PCA Cluster Interface Specification - ver 027 – 20180802 (or newer versions) & ACC Cluster Interface Specification - ver28 - 20190208
Note 3: Please refer to the HUD Adjustable Speed Limiter Device (with Optional Intelligent Speed Assistance) Control Function for information

1.3.5.5 Prove Out

Not applicable

1.3.5.6 F-REQ-351345/A-Reconfigurable Telltale

State Matrix for TSR indication graphics based on Region

TsrRegionTxt_D_Stat	Country	Example of Traffic Sign Indications		
		Speed Limit Signs	No Passing Active	No Passing Canceled
Region_01 (0x1)	All Other regions (not captured below)			
Region_02 (0x2)	UK, Northern Ireland			
Region_03 (0x3)	United States, Canada		Not Applicable	Not Applicable
Region_04 (0x4)	China			Not Applicable
Region_05 (0x5)	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Falkland Islands, French Guiana, Guyana, Paraguay, Peru, Surinam, Uruguay, Venezuela			Not Applicable
0x0, 0x6-0x1E	Not Available (Feature not active)			

1.3.5.7 Message Center Msg

none

1.4 Error Handling

1.4.1 Missing Message Strategy

1.4.1.1 SR-REQ-351346/A-Missing Message Strategy

If TSR_Cfg = Disabled (0x0) and SLIF_Cfg = Disabled (0x0), the HUD shall never log a missing message DTC for this feature.

If a signal is declared as missing, the display shall be done as “All other cases” in the tables. The last status shall not be kept.

1.4.1.2 Missing Message Reference

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

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

1.5.3 Part II Performance

1.5.3.1 DTC-REQ-351347/A-Supported Diagnostic Trouble Codes (DTCs)

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

1.5.3.2 DCR-REQ-351348/A-Supported Configuration DIDs

DID DExx

Block Num	Block Description	Size (bits)	Type	Byte(s)	Bits	State: Description	"0"	"1"	Default	Comments/ Information
PACKETED BLOCKS										
$xx	Option Content (B&A)	*	1	*	1	Traffic Sign Recognition	Disabled	Enabled	0x00	
$xx	Option Content (B&A)	*	1	*	1	SLIF	Disabled	Enabled	0x00	

Block Num	Block Description	Size (bits)	Type	Byte(s)	Bits	State: Description	"0"	"1"	Default	Comments/ Information
*Byte and bit location to be identified in Part II Specification for this cluster										

1.6 Reference Specification

- Traffic Sign Recognition Control Function – FNV2
- HUD_Memory_Save_and_Recall_-CGEA1.3_v1.3
- AHUD Basic Settings Control Function – CGEA 1.3
- CHUD Basic Settings Control Function - CGEA 1.3
- HUD_Speedometer Gauge Digital – CGEA1.3
- Speedometer Gauge Digital - CGEA1.3
- HUD_Speedometer_Gauge_Digital_-_CGEA1.3 for information
- CGEA13 PCA Cluster Interface Specification - ver 027 – 20180802 (or newer versions) and ACC Cluster Interface Specification - ver28 - 20190208

1.7 Revision History

SPSS Module Revision History

Revision Level	Name	Change Description	Date
V1.0	Itzamaray Lopez-Lazaro	Initial release. This STSS is based out of TSR Control Function FNV2 for IPC.	4/30/2019
V1.1	Itzamaray Lopez-Lazaro	Very minor modification. Merged all column for “all other cases” in F- REQ- 351330 F – REQ-351333 Corrected Typo in F-REQ-331940 and F-REQ-351327 Corrected Signal name in IR-REQ-351319 (from General to Detailed)	7/18/2019
V1.2	F. Sethi	Corrected Signal Name “TsrRegionStat_D_Stat” to “TsrRegionTxt_D_Stat” in **SIG-REQ-351318/A**	6/30/2020
V1.3	F. Sethi	Updated SIG-REQ-TsrVLim1MsgTxt_D_Rq Signal, while updating State Enclosed from 250 (0x1F) to 31 (0x1F). Also updated Detail “Message0” to “Message10” for State Enclosed 10 (0xA). Updated SIG-REQ-TsrVLim2MsgTxt_D_Rq Signal, while updating State Enclosed from 250 (0x1F) to 31 (0x1F). Also updated Detail “Message0” to “Message10” for State Enclosed 10 (0xA).	1/25/2021
V1.4	F. Sethi	Updated Requirement “F-REQ-351334/C-TSR No-Passing Restriction Display Preconditions” & “F-REQ-351336/B-State Matrix and for ACTIVE TSR_HUD_No_Passing_Detailed_RTT_MC” while adding following note, “If the No_Passing_Detailed (TsrOvtkMsgTxt2_D_Rq) wants to show any icon (rain, snow, trailer, time) then this should be prioritized over No_Passing_Generic (TsrOvtkMsgTxt_D_Rq).”	2/22/2021
V1.5	F. Sethi	Updated Flow Charts in below requirements to clarify the flow with respect to Generic and Detailed RTT: • F-REQ-351331/B-TSR pre-conditions to activate TSR Speed Limit 2 Information • F-REQ-351334/D-TSR No-Passing Restriction Display Preconditions	8/23/3021