Trail Turn Assist Feature Specification

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Trail Turn Assist Feature Specification

1. Introduction (774615/B)

1.1 Purpose (774616/A)

The purpose of this document is to communicate the requirements of the Trail Turn Assist feature to all relevant systems for fully functional implementation.

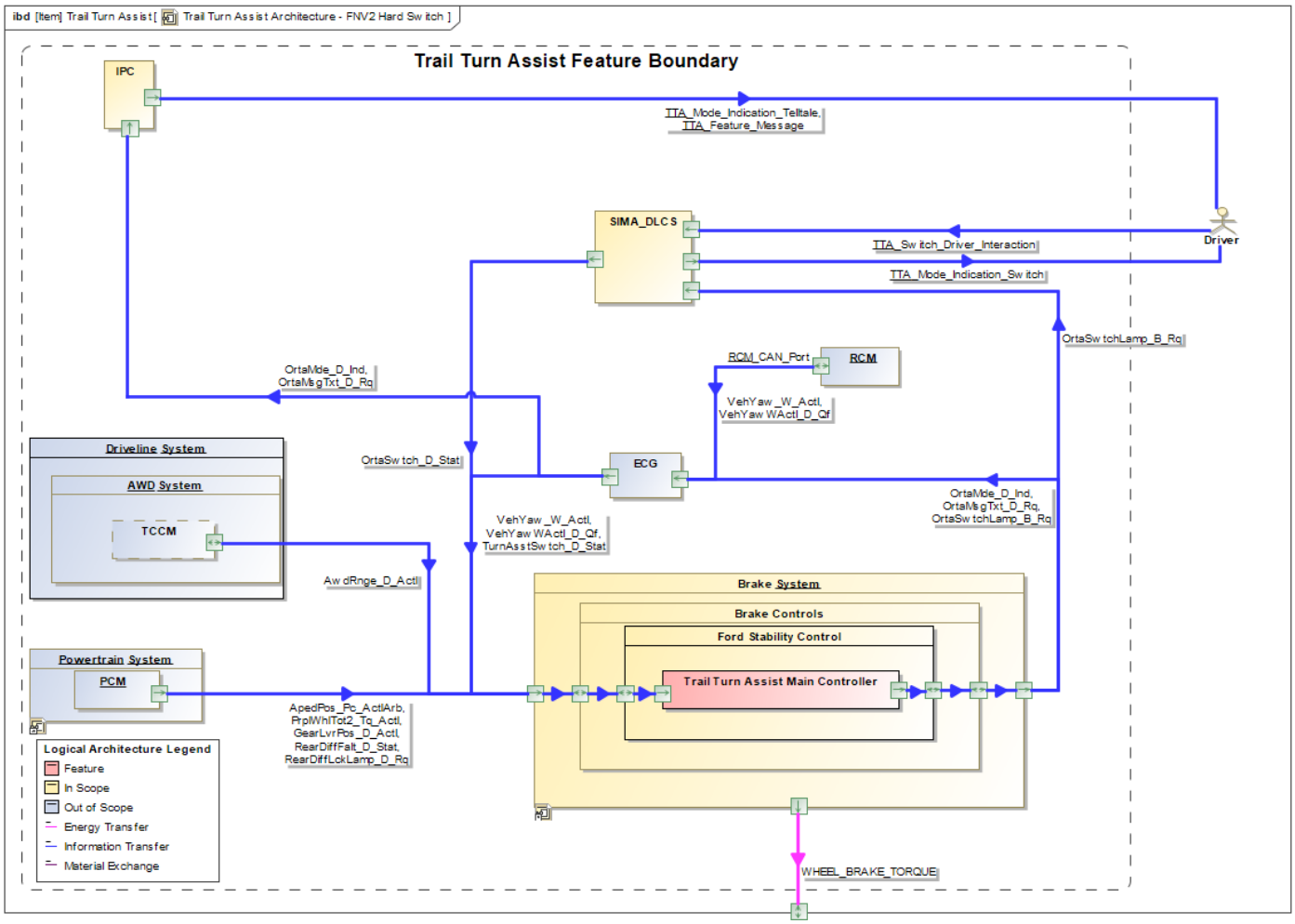
1.2 Scope (774617/A)

The scope of this document is the functional requirements related to the Trail Turn Assist feature.

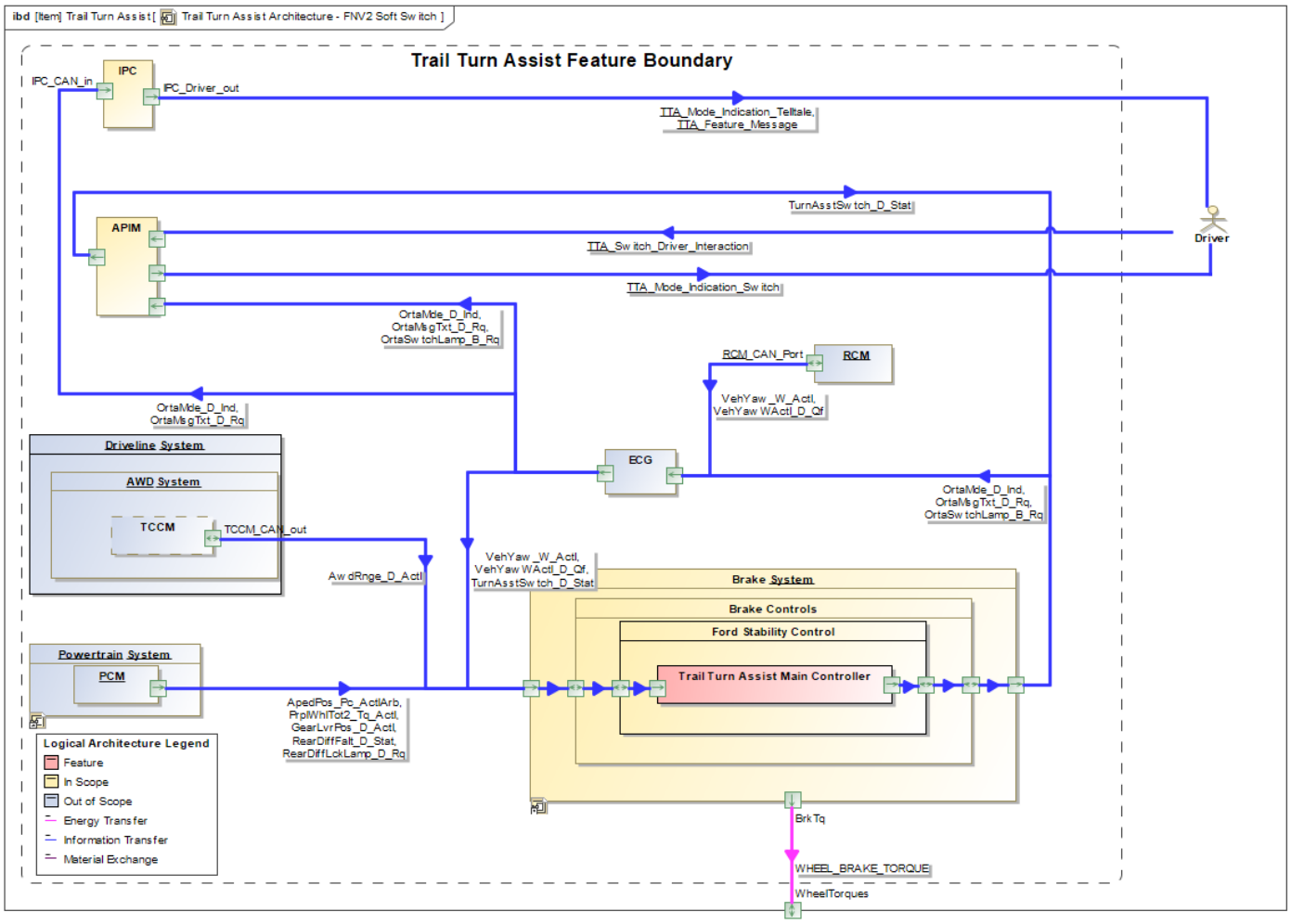
1.3 Definitions & Abbreviations (774618/A)

1.4 Architecture - Boundary Diagrams (774619/B)

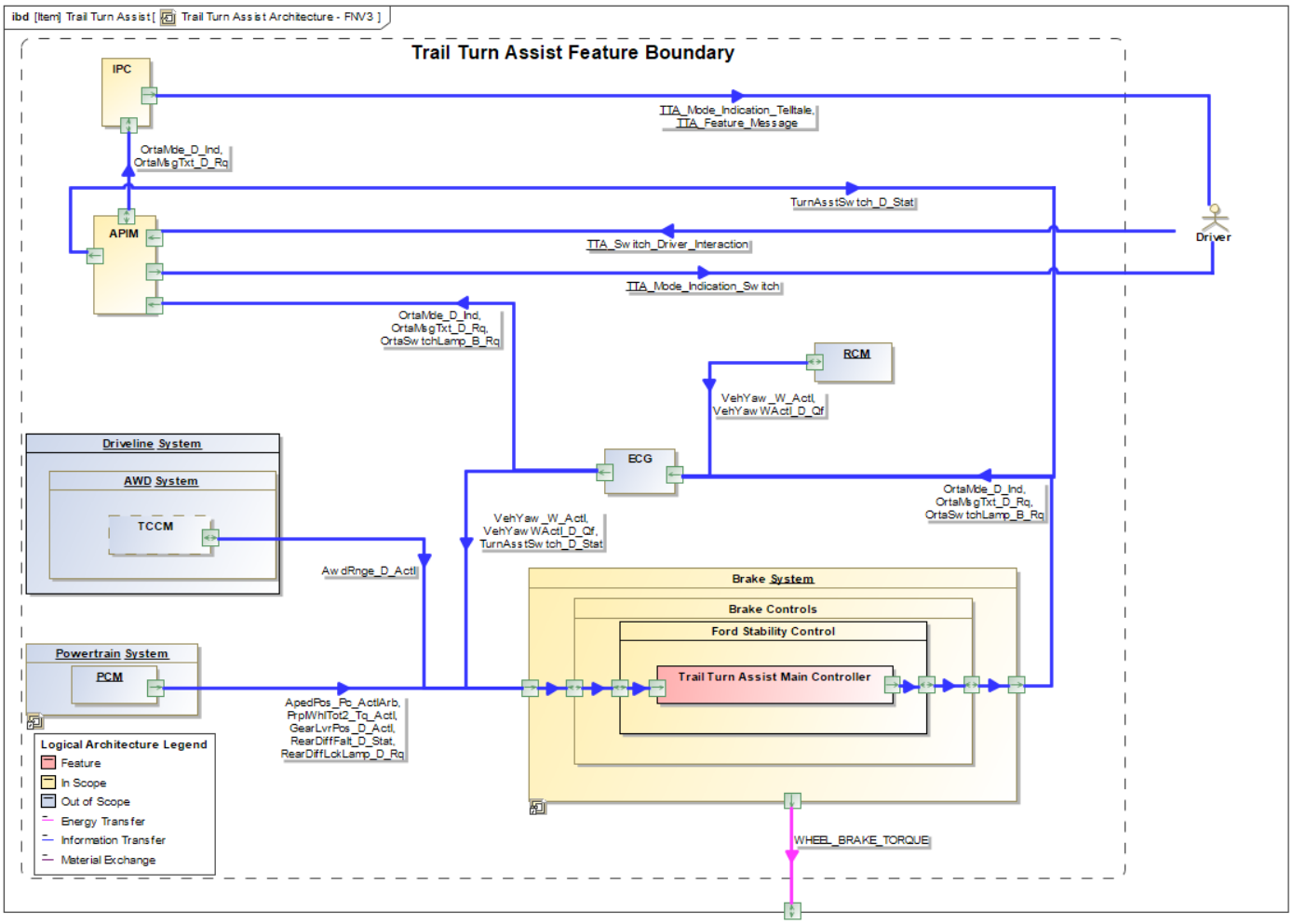
1.4.1 FNV2 with Hard Switch (1051990/A)



1.4.2 FNV2 with Soft Switch (1051992/A)



1.4.3 PHX with Soft Switch (1051991/A)



1.5 References (774621/A)

- Program-specific FSC Interface Logic Description
- Program-specific FSC Interface Matrix
- Program-specific TTA FMA documentation

2. Trail Turn Assist Main Function Specification - ABS

2.1 Trail Turn Assist Attribute Requirements (669362/A)

2.1.1 Trail Turn Assist Vehicle Turn Radius Reduction	(REQ-385763/B)
Requirement Status:	Frozen
Test Requirement:	TST-REQ-385768/A-Vehicle Turn Radius Reduction Test
Applicable to:	
Notes:	
Acceptance Criteria:	TTA_Turn_Radius_Reduction_4H_R >= 10% TTA_Turn_Radius_Reduction_4H_L >= 10% TTA_Turn_Radius_Reduction_4L_R >= 10% TTA_Turn_Radius_Reduction_4L_L >= 10%
Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	Primary feature use case
Purpose:	
Requirement Text: On an off-road surface (grass, gravel, mud, snow, sand, etc.) the Trail Turn Assist feature shall reduce the turning radius of the host vehicle by a minimum of 10% when active.	

2.1.2 Trail Turn Assist Driver Feedback	(REQ-385762/B)
Requirement Status:	
Test Requirement:	TST-REQ-461497/A-TTA - Driver Feedback Test TST-REQ-400898/A-Trail Turn Assist Activation Test TST-REQ-406178/A-Trail Turn Assist Cluster Function Verification Test TST-REQ-385764/A-Trail Turn Assist Unit Testing
Applicable to:	
Notes:	
Acceptance Criteria:	All applicable referenced requirements in the linked test requirement are passing.
Last Change:	
Last modified:	02-Nov-2021 09:38

Rationale:	Driver information
Purpose:	
Requirement Text: The Trail Turn Assist feature shall provide feedback to the Driver regarding the feature's status (off, standby, active, unavailable).	

2.1.3 Trail Turn Assist with Locking Differentials	(REQ-405927/A)
Requirement Status:	Frozen
Test Requirement:	TST-REQ-461517/A-TTA with Locking Differentials Test TST-REQ-405930/A-TTA Differential State Detection Verification
Applicable to:	
Notes:	
Acceptance Criteria:	In applications with an eLRD, when the eLRD is intentionally engaged, Trail Turn Assist shall be in the 'Off' state. When the eLRD has been requested to be disengaged, Trail Turn Assist shall not activate until the rear differential has actually disengaged. In applications with a rear eLSD, Trail Turn Assist shall request the rear differential to disengage and not activate until it has disengaged.
Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	
Purpose:	
Requirement Text: In applications with a locking rear differential (either electronic locking rear differential, eLRD, or rear electronic limited slip differential, eLSD, with locking function), the Trail Turn Assist feature shall not activate while the rear differential is engaged. For vehicles with an eLRD, this shall apply both to scenarios where the rear differential is intended to be engaged as well as to scenarios where the rear differential has been commanded to be disengaged but is unable physically disengage (torque-trap).	

2.2 Interface Requirements (778757/B)

2.2.1 Trail Turn Assist CAN Inputs	(REQ-386678/B)
Requirement Status:	

Test Requirement:	TST-REQ-470319/A-TTA - CAN Inputs Test TST-REQ-394109/A-Program DBC Review
Applicable to:	060901 - Brake Controls
Notes:	
Acceptance Criteria:	All applicable referenced signals are found in the program specific .dbc files and are Rx by ABS
Last Change:	
Last modified:	02-Nov-2021 10:26
Rationale:	Required Inputs
Purpose:	

Requirement Text:

The Trail Turn Assist feature shall use the following CAN inputs (if available in the program specific message list):
ApedPos_Pc_ActlArb
AwdRnge_D_Actl
GearLvrPos_D_Actl
PrplWhlTot2_Tq_Actl
RearDiffFalt_D_Stat
RearDiffLckLamp_D_Rq
VehYaw_W_Actl
VehYawWActl_D_Qf
OrtaSwtch_D_Stat (SIMA hard switch implementations)
TurnAsstSwtch_D_Stat (soft switch implementations)
OrtaSwtch_D_Stat2 (ATCM hard switch implementations)
Ignition_Status
PwPckTq_D_Stat

That is, the ABS module shall be a receiver of the above signals.

2.2.2 Trail Turn Assist FSC Inputs	(REQ-386677/B)
Requirement Status:	
Test Requirement:	TST-REQ-470320/A-TTA - FSC Inputs Test TST-REQ-394110/A-Ford Stability Control r_ram_ex.h Review
Applicable to:	060901 - Brake Controls
Notes:	
Acceptance Criteria:	r_ram_ex.h in the FSC source files includes all referenced signals.
Last Change:	

Last modified:	02-Nov-2021 10:24
Rationale:	Required Inputs
Purpose:	

Requirement Text:

The Trail Turn Assist feature shall use the following FSC inputs (if available in the program specific interface matrix):

ss_RSC_REF_VEL
uc_AWD_MODE_SELECT
uc_GEAR_SHIFTER_POSITION
b_RSC_VEH_STANDSTILL
ss_ACTUAL_AXLE_TORQ
BRAKE_TORQ_GAIN_Nm_p_Bar
ss_STEER_WHL_ANG
uc_REARDIFFLCKLAMP_D_RQ
ss_RAW_WHL_VEL
ss_WHL_BRK_PRESS_EST
ss_RAW_YAW_RATE
uc_ORTASWTCH_D_STAT
b_SWA_SENSOR_INVLID
uc_REAR_ELOCKER_STATUS
b_ANY_WHEEL_SPEED_ERROR
b_YSC_DISABLED
uc_YAW_RATE_SNSR_STATUS
uc_THROTTLE_POSITION
uc_RSC_RQST_ELSD_DISENGAGE (specific to eLSD programs, see also TTA Interface Matrix)
uc_REAR_DIFF_CFG
ss_STEERING_RATIO
b_TTA_CONFIG
uc_IGNITION_STAT
uc_PWR_PCK_TRQ_STAT

2.2.3 Trail Turn Assist HMI Input Interface	(REQ-375928/B)
Requirement Status:	
Test Requirement:	TST-REQ-394108/A-Ford Stability Control Interface Matrix Review TST-REQ-470321/A-TTA - HMI Input Interface Test
Applicable to:	060901 - Brake Controls
Notes:	
Acceptance Criteria:	FSC Interface Matrix contains the referenced signal.
Last Change:	

Last modified:	02-Nov-2021 10:24
Rationale:	Driver control of feature status
Purpose:	

Requirement Text:

Driver requests to enable or disable Trail Turn Assist shall be communicated through the FSC interface signal uc_ORTASWTCH_D_STAT.

See the FSC Interface Matrix for further details on the definition of this signal.

2.2.4 Trail Turn Assist HMI Output Interface	(REQ-375929/B)
Requirement Status:	
Test Requirement:	TST-REQ-470322/A-TTA - HMI Output Interface Test TST-REQ-394108/A-Ford Stability Control Interface Matrix Review
Applicable to:	060901 - Brake Controls
Notes:	
Acceptance Criteria:	FSC Interface Matrix contains the referenced signals.
Last Change:	
Last modified:	02-Nov-2021 10:24
Rationale:	Feature interface for HMI display
Purpose:	

Requirement Text:

The Trail Turn Assist feature shall make HMI requests through the following FSC interface signals:

uc_ORTAMDE_D_IND (controls feature telltale in IPC)
uc_ORTAMSGTXT_D_RQ (controls feature messages in IPC)
uc_ORTASWMDE_B_IND (controls feature status indications in feature switch)

See the FSC Interface Matrix for further details on the definition of these signals.

2.2.5 Trail Turn Assist Pressure Request Interface	(REQ-375930/C)
Requirement Status:	
Test Requirement:	TST-REQ-394112/A-Ford Stability Control Interface Logic Description Review TST-REQ-470323/A-TTA - Pressure Request Interface Test TST-REQ-394108/A-Ford Stability Control Interface Matrix Review
Applicable to:	060901 - Brake Controls

Notes:	
Acceptance Criteria:	See FSC ILD DVM Section 9.3.6-9.3.7 FSC Interface Matrix contains the referenced signal.
Last Change:	
Last modified:	02-Nov-2021 10:26
Rationale:	Define interface over which TTA pressure request is communicated to Brake Actuation
Purpose:	

Requirement Text:

The Trail Turn Assist feature shall communicate its brake pressure request to the Brake Controls supplier over the FSC interface signal ss_FSC_ORTA_WHL_PRESS_RQST[2].

See the FSC Interface Matrix for further details on the definition of this signal and the FSC Interface Logic Description (Sections 9.3.6-9.3.7) for further details on how this signal is to be implemented.

2.2.6 Trail Turn Assist Traction Control Interface	(REQ-375915/B)
Requirement Status:	Frozen
Test Requirement:	TST-REQ-394108/A-Ford Stability Control Interface Matrix Review TST-REQ-394112/A-Ford Stability Control Interface Logic Description Review TST-REQ-470324/A-TTA - Traction Control Interface Test
Applicable to:	060901 - Brake Controls
Notes:	

Acceptance Criteria:	IF ((uc_ORTAMDE_D_IND = ActiveLeft[0x3]) || (uc_ORTAMDE_D_IND = ActiveRight[0x4])
	THEN
	b_INHIBIT_SUPPLIER_TC == True[0x1]
	ELSE
	b_INHIBIT_SUPPLIER_TC == False[0x0]

Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	Feature performance and driveline robustness
Purpose:	

Requirement Text:

Trail Turn Assist shall communicate its request to inhibit Traction Control via the FSC interface signal b_INHIBIT_SUPPLIER_TC.

See the FSC Interface Matrix for further details on the definition of this signal and the FSC Interface Logic Description (Section 9.7) for further details on how this signal is to be implemented.

2.3 Trail Turn Assist Brake Controls Functional Requirements (669367/A)

2.3.1 Enabling Trail Turn Assist	(REQ-325847/E)
Requirement Status:	
Test Requirement:	TST-REQ-400898/A-Trail Turn Assist Activation Test TST-REQ-470325/A-Enabling Trail Turn Assist Test TST-REQ-385764/A-Trail Turn Assist Unit Testing
Applicable to:	060901 - Brake Controls
Notes:	

Acceptance Criteria:	WHILE (Ignition_Status != Run[0x4]);
	IF (Ignition_Status = Run[0x4]);
	THEN
	(OrtaMde_D_Ind = Off[0x0]);
	(OrtaSwLamp_B_Rq = Off[0x0]);
	(OrtaMsgTxt_D_Rq = No_Message[0x0]);
	ENDIF
	
	WHILE [(Ignition_Status == Run[0x4]) && (AwdRnge_D_Actl == High_Range_Locked[0x4])];
	IF (OrtaSwtch_D_Stat = Pressed[0x1]) (where: TUNE_ORTA_SWTCHDBNCE_TIME_MS < TimePressed < 120 sec);
	THEN
	(OrtaMde_D_Ind = StandbyLeft[0x1]) || (OrtaMde_D_Ind = StandbyRight[0x2]) || (OrtaMde_D_Ind = ActiveLeft[0x3]) || (OrtaMde_D_Ind = ActiveRight[0x4]);
	(OrtaSwLamp_B_Rq = On[0x1])
	(OrtaMsgTxt_D_Rq = Message_4[0x4]);
	ENDIF
	
	WHILE [(Ignition_Status == Run[0x4]) && (AwdRnge_D_Actl == Low_Range_Locked[0x0])];
	IF (OrtaSwtch_D_Stat = Pressed[0x1]) (where: TUNE_ORTA_SWTCHDBNCE_TIME_MS < TimePressed < 120 sec);
	THEN
	(OrtaMde_D_Ind = StandbyLeft[0x1]) || (OrtaMde_D_Ind = StandbyRight[0x2]) || (OrtaMde_D_Ind = ActiveLeft[0x3]) || (OrtaMde_D_Ind = ActiveRight[0x4]);
	(OrtaSwLamp_B_Rq = On[0x1])
	(OrtaMsgTxt_D_Rq = Message_4[0x4]);
	ENDIF

Last Change:	

Last modified:	02-Nov-2021 11:36
Rationale:	Trail Turn Assist is a driver-enabled comfort/convenience feature intended for Off-Road use only.
Purpose:	

Requirement Text:

At the start of each key cycle, Trail Turn Assist shall initialize in the Disabled state.

Trail Turn Assist may only be enabled when the vehicle ignition status is Run, and the vehicle is in a locked four-by-four state (4-High or 4-Low). The driver shall enable Trail Turn Assist by actuation of the Trail Turn Assist switch.

Upon being enabled by the Driver, the Trail Turn Assist feature software shall request a message to be displayed to the Driver informing them of the feature state change (via CAN signal OrtaMsgTxt_D_Rq), the Trail Turn Assist telltale to be displayed in the cluster (via CAN signal OrtaMde_D_Ind), and the switch LED (if applicable) to be illuminated (via the CAN signal OrtaSwLamp_B_Rq).

2.3.2 Activating Trail Turn Assist	(REQ-326112/E)
Requirement Status:	
Test Requirement:	TST-REQ-400898/A-Trail Turn Assist Activation Test TST-REQ-470326/A-Activating Trail Turn Assist Test
Applicable to:	060901 - Brake Controls
Notes:	Nominal values: TTA_MIN_SWA = 500 degrees; TTA_MAX_VEL = 12 mph / 19 kph; ORTA_SWTCHDBNCE_TIME_MS = 100 msec;
Acceptance Criteria:	WHILE [((OrtaMde_D_Ind == StandbyLeft[0x1]) || (OrtaMde_D_Ind == StandbyRIght[0x2]))]; IF [(StePinComp_An_Est <= -TTA_MIN_SWA) && (Veh_V_ActlBrk <= TTA_MAX_VEL)]; THEN (OrtaMde_D_Ind = ActiveLeft[0x3]) ELIF [(StePinComp_An_Est >= TTA_MIN_SWA) && (Veh_V_ActlBrk <= TTA_MAX_VEL)]; THEN (OrtaMde_D_Ind = ActiveRight[0x4]) ELIF [((StePinComp_An_Est >= TTA_MIN_SWA) || (StePinComp_An_Est <= TTA_MIN_SWA)) && (Veh_V_ActlBrk > TTA_MAX_VEL)] THEN [(OrtaMde_D_Ind = StandbyLeft[0x1] || (OrtaMde_D_Ind = StandbyRight[0x1])]; ENDIF

Last Change:	
Last modified:	02-Nov-2021 11:18
Rationale:	Trail Turn Assist state change criteria
Purpose:	
Requirement Text: Once enabled by the Driver, Trail Turn Assist shall transition from a ‘Standby’ state to an ‘Active’ state when the requisite steering wheel angle (absolute value) is greater than the (calibratable) value TTA_MIN_SWA and the vehicle speed is less than the feature’s maximum allowed velocity, TTA_MAX_VEL, and the feature has confirmed the rear differential to be disengaged (if applicable).	

2.3.3 Enabling Trail Turn Assist within Activation Criteria	(REQ-355229/D)
Requirement Status:	
Test Requirement:	TST-REQ-385764/A-Trail Turn Assist Unit Testing TST-REQ-470327/A-Enabling TTA within Activation Criteria Test
Applicable to:	060901 - Brake Controls
Notes:	Nominal values: TTA_MIN_SWA = 500 degrees; TTA_MAX_VEL = 12 mph / 19 kph; ORTA_SWTCHDBNCE_TIME_MS = 100 msec;
Acceptance Criteria:	WHILE [(OrtaMde_D_Ind == Off[0x0]) && (Veh_V_ActlBrk <= TTA_MAX_VEL)]; IF [(StePinComp_An_Est <= -TTA_MIN_SWA) && (OrtaSwtch_D_Stat = Pressed[0x1]) (where: TUNE_ORTA_SWTCHDBNCE_TIME_MS < TimePressed < 120 sec)]; THEN (OrtaMde_D_Ind = ActiveLeft[0x3]); (OrtaMsgTxt_D_Rq = Message_4[0x4]); (OrtaSwLamp_B_Rq = On[0x1]); ELIF [(StePinComp_An_Est >= TUNE_TTA_MIN_SWA) && (OrtaSwtch_D_Stat = Pressed[0x1]) (where: TUNE_ORTA_SWTCHDBNCE_TIME_MS < TimePressed < 120 sec)]; THEN (OrtaMde_D_Ind = ActiveRight[0x4]); (OrtaMsgTxt_D_Rq = Message_4[0x4]); (OrtaSwLamp_B_Rq = On[0x1]); ENDIF

	WHILE [(OrtaMde_D_Ind == On[0x1]) && (Veh_V_ActlBrk <= TTA_MAX_VEL)]; IF [(StePinComp_An_Est <= -TTA_MIN_SWA) && (OrtaSwtch_D_Stat = Pressed[0x1]) (where: TUNE_ORTA_SWTCHDBNCE_TIME_MS < TimePressed < 120 sec)]; THEN (OrtaMde_D_Ind = Off[0x0]); (OrtaSwLamp_B_Rq = Off[0x0]); (OrtaMsgTxt_D_Rq = No_Message[0x0]); ELIF [(StePinComp_An_Est >= TUNE_TTA_MIN_SWA) && (OrtaSwtch_D_Stat = Pressed[0x1]) (where: TUNE_ORTA_SWTCHDBNCE_TIME_MS < TimePressed < 120 sec)]; THEN (OrtaMde_D_Ind = Off[0x0]); (OrtaSwLamp_B_Rq = Off[0x0]); (OrtaMsgTxt_D_Rq = No_Message[0x0]); ENDIF WIP: Unit Tests to PASSED: Operating_Mode_Soft_Switch TEST 02b or Operating_Mode_Hard_Switch TEST 02b (depending on implementation applicability) Operating_Mode_Soft_Switch TEST 02c or Operating_Mode_Hard_Switch TEST 02c (depending on implementation applicability)
Last Change:	
Last modified:	02-Nov-2021 11:27
Rationale:	Driver may desire Trail Turn Assist assistance after initializing a turn
Purpose:	
Requirement Text: If the Driver enables Trail Turn Assist while all the criteria necessary for activation are valid, Trail Turn Assist shall initialize into the appropriate ‘Active’ state for the direction of the turn	

2.3.4 Attempt to Enable Trail Turn Assist - Incompatible 4x4 State Message Request	(REQ-355021/D)
Requirement Status:	
Test Requirement:	TST-REQ-470328/A-Attempt to Enable TTA - Incompatible 4x4 State Message Request Test TST-REQ-385764/A-Trail Turn Assist Unit Testing TST-REQ-406178/A-Trail Turn Assist Cluster Function Verification Test
Applicable to:	060901 - Brake Controls
Notes:	

Acceptance Criteria:	WHILE [(Ignition_Status == Run[0x4]) && ((AwdRnge_D_Actl != Low_Range_Locked[0x0]) && (AwdRnge_D_Actl != High_Range_Locked[0x4]))];
	IF (OrtaSwtch_D_Stat = Pressed[0x1]) (where:
	TUNE_ORTA_SWTCHDBNCE_TIME_MS < TimePressed < 120 sec);
	THEN
	(OrtaMde_D_Ind = Off[0x0]);
	(OrtaSwLamp_B_Rq = Off[0x0]);
	(OrtaMsgTxt_D_Rq = Message_2[0x2]);
	ENDIF
	
	WIP:
	In Trail Turn Assist Unit Testing:
	Unit Tests to be PASSED:
	Operating_Mode_Soft_Switch TEST 10 or
	Operating_Mode_Hard_Switch TEST 09 (depending on if TTA is implemented with a soft or hard switch)
	
	Operating_Mode_Soft_Switch TEST 11 or
	Operating_Mode_Hard_Switch TEST 08 (depending on if TTA is implemented with a soft or hard switch)

Last Change:	
Last modified:	02-Nov-2021 11:36
Rationale:	Inform driver of changes to other vehicle systems necessary to enable Trail Turn Assist
Purpose:	

Requirement Text:

If the Driver attempts to enable Trail Turn Assist while the vehicle is not in a 4-High or 4-Low four-by-four state, the Trail Turn Assist feature software shall request a message to be displayed in the cluster indicating the four-by-four states in which it can be enabled to be displayed in the cluster. This shall be communicated by the CAN signal OrtaMsgTxt_D_Rq == Message2[0x2].

If the Driver transitions out of 4-High or 4-Low while Trail Turn Assist is enabled, the same message shall be displayed.

The Trail Turn Assist telltale shall not be displayed and the Trail Turn Assist switch LED (if applicable) shall not be illuminated.

2.3.5 Disabling Trail Turn Assist	(REQ-355023/C)
Requirement Status:	Frozen
Test Requirement:	TST-REQ-470329/A-Disabling Trail Turn Assist Test TST-REQ-385764/A-Trail Turn Assist Unit Testing TST-REQ-406291/A-Trail Turn Assist APIM (SYNC) Function Verification Test

Applicable to:	060901 - Brake Controls
Notes:	

Acceptance Criteria:	WHILE (OrtaMde_D_Ind != Off[0x0])
	IF (OrtaSwtch_D_Stat = Pressed[0x1]) (where:
	TUNE_ORTA_SWTCHDBNCE_TIME_MS < TimePressed < 120 sec);
	THEN
	(OrtaMde_D_Ind = Off[0x0]);
	(OrtaSwLamp_B_Rq = Off[0x0]);
	(OrtaMsgTxt_D_Rq = Message_5[0x5]);
	ENDIF

Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	Inform the Driver of a change in feature state
Purpose:	

Requirement Text:

While enabled, the Driver may disable Trail Turn Assist through actuation of the Trail Turn Assist switch. Upon being disabled by the Driver, the Trail Turn Assist feature software shall request a message to be displayed to the Driver informing them of the feature state change (via CAN signal OrtaMsgTxt_D_Rq), the Trail Turn Assist telltale to be removed from the cluster (via CAN signal OrtaMde_D_Ind), and the switch LED (if applicable) to not be illuminated (via the CAN signal OrtaSwLamp_B_Rq).

2.3.6 Disabling of Trail Turn Assist based on Interface Fault Conditions (REQ-355231/D)

Requirement Status:	
Test Requirement:	TST-REQ-385764/A-Trail Turn Assist Unit Testing TST-REQ-470330/A-Disabling of TTA Based on Interface Fault Conditions Test
Applicable to:	060901 - Brake Controls
Notes:	

Acceptance Criteria:	WHILE (OrtaMde_D_Ind != Off[0x0])
	IF(Fault that disables TTA is set [per requirement text])
	THEN
	(OrtaMde_D_Ind = Off[0x0]);
	(OrtaSwLamp_B_Rq = Off[0x0]);
	(OrtaMsgTxt_D_Rq = Message_3[0x3]);
	ENDIF

	WIP: Unit Tests to be PASSED: AWDRnge_D_Actl_FMEM_TEST_01 GearLvrPos_D_Actl_FMEM_TEST_01 PrplWhlTot2_Tq_Actl_FMEM_TEST_01 RearDiff_FMEM_TEST_01 VehYaw_W_Actl_FMEM_TEST_01 TTASwtch_D_Stat_FMEM_TEST_01 Input_Fault_TEST_01 Operating_Mode_TEST_Transition_00_03 Operating_Mode_TEST_Transition_01_03 Operating_Mode_TEST_Transition_04_03
Last Change:	
Last modified:	02-Nov-2021 11:44
Rationale:	FMEM
Purpose:	

Requirement Text:

If the Driver attempts to enable Trail Turn Assist while there is a fault condition preventing the correct operation of the feature, the Trail Turn Assist feature software shall prevent the feature from being enabled and notify the Driver by requesting a cluster message (OrtaMsgTxt_D_Rq = Message_3[0x3]). If a fault condition that prevents correct feature operation occurs while Trail Turn Assist is enabled, it shall transition to the disabled state and notify the driver by requesting a cluster message (OrtaMsgTxt_D_Rq = Message_3[0x3]).

When disabled, the Trail Turn Assist telltale shall not be displayed and the Trail Turn Assist switch LED (if applicable) shall not be illuminated.

Interface Signal Faults that can disable Trail Turn Assist:

- uc_GEAR_SHIFTER_POSITION == Fault[0xF]
- ss_ACTUAL_AXLE_TORQ == Faulty[0xFFFF]
- b_SWA_SENSOR_INVLID == Faulty[0x1]
- uc_REAR_ELOCKER_STATUS == Fault, NonSpecific[0x1]
- uc_REAR_ELOCKER_STATUS == DiffFailedClosed[0x3]
- uc_YAW_RATE_SNSR_STATUS != OK[0x3]
- uc_AWD_MODE_SELECT == Unknown[0x7]
- uc_ORTASWTCH_D_STAT == Faulty[0x3]
- b_YSC_DISABLED == TRUE[0x1]

A TTA fault shall not occur until 200 ms after Ignition_Status = ‘Run’.

2.3.7 Trail Turn Assist Inhibits Traction Control	(REQ-394113/A)
Requirement Status:	Frozen
Test Requirement:	TST-REQ-385764/A-Trail Turn Assist Unit Testing TST-REQ-470331/A-TTA Inhibits Traction Control Test
Applicable to:	060901 - Brake Controls
Notes:	

Acceptance Criteria:	IF ((uc_ORTAMDE_D_IND = ActiveLeft[0x3]) || (uc_ORTAMDE_D_IND = ActiveRight[0x4])
	THEN
	b_INHIBIT_SUPPLIER_TC == True[0x1]
	ELSE
	b_INHIBIT_SUPPLIER_TC == False[0x0]
	
	Unit Tests to be PASSED:
	Active_State_TEST_Transition_00_01
	Active_State_TEST_Transition_01_02
	Active_State_TEST_Transition_02_00

Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	Feature performance and driveline robustness
Purpose:	
Requirement Text: While active, Trail Turn Assist shall request that Traction Control be inhibited.	

2.3.8 Disabling of Trail Turn Assist based on Brake System Fault Conditions	(REQ-355022/C)
Requirement Status:	
Test Requirement:	TST-REQ-385764/A-Trail Turn Assist Unit Testing TST-REQ-470332/A-Disabling of TTA Based on Brake System Fault Conditions Test
Applicable to:	060901 - Brake Controls
Notes:	

Acceptance Criteria:	WHILE (OrtaMde_D_Ind != Off[0x0])
	IF(Fault that disables TTA is set [per requirement text])
	THEN
	(OrtaMde_D_Ind = Off[0x0]);
	(OrtaSwLamp_B_Rq = Off[0x0]);
	(OrtaMsgTxt_D_Rq = Message_3[0x3]);

	ENDIF WIP Unit tests to be PASSED: Input_Fault_TEST_01 Operating_Mode_TEST_Transition_00_03
Last Change:	
Last modified:	02-Nov-2021 11:53
Rationale:	FMEM, Drivers Information
Purpose:	

Requirement Text:

If the Driver attempts to enable Trail Turn Assist while there is a fault condition preventing the correct operation of the feature, the Trail Turn Assist feature software shall request a message to be displayed in the cluster indicating that it cannot be enabled. This message shall be communicated by OrtaMsgTxt_D_Rq == Message_3[0x3].

The Trail Turn Assist telltale shall not be displayed and the Trail Turn Assist switch LED (if applicable) shall not be illuminated.

2.3.9 Trail Turn Assist Reference Velocity	(REQ-359373/B)
Requirement Status:	Frozen
Test Requirement:	TST-REQ-385764/A-Trail Turn Assist Unit Testing TST-REQ-470333/A-TTA Reference Velocity Test
Applicable to:	060901 - Brake Controls
Notes:	
Acceptance Criteria:	TTA_Reference_Velocity = (ss_RAW_WHL_VEL[FL] + ss_RAW_WHL_VEL[FR])/2 Unit tests to be PASSED: Calculate_TTA_RefVel_TEST_01
Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	
Purpose:	

Requirement Text:

Trail Turn Assist shall use the arithmetic mean of the vehicle's front wheels to estimate the vehicle speed.

2.3.10 Trail Turn Assist Status Output Synchronization	(REQ-359374/C)
Requirement Status:	
Test Requirement:	TST-REQ-470334/A-TTA Status Output Synchronization Test TST-REQ-385764/A-Trail Turn Assist Unit Testing
Applicable to:	060901 - Brake Controls
Notes:	

Acceptance Criteria:	WHILE [(Ignition_Status == Run[0x4]) && (AwdRnge_D_Actl == High_Range_Locked[0x4])];
	IF (OrtaSwtch_D_Stat = Pressed[0x1]) (where: TUNE_ORTA_SWTCHDBNCE_TIME_MS < TimePressed < 120 sec);
	THEN
	(OrtaMde_D_Ind = StandbyLeft[0x1]) || (OrtaMde_D_Ind = StandbyRight[0x2]) || (OrtaMde_D_Ind = ActiveLeft[0x3]) || (OrtaMde_D_Ind = ActiveRight[0x4]);
	(OrtaSwLamp_B_Rq = On[0x1])
	(OrtaMsgTxt_D_Rq = Message_4[0x4]);
	ENDIF
	(OrtaMde_D_Ind, OrtaSwLamp_B_Rq, and OrtaMsgTxt_D_Rq all update at the same time)
	
	WIP
	Unit tests to be PASSED:
	Operating_Mode_TEST_Transition_00_01_00
	Operating_Mode_TEST_Transition_00_04_00

Last Change:	
Last modified:	02-Nov-2021 11:58
Rationale:	Synchronicity of multiple indications
Purpose:	

Requirement Text:

Trail Turn Assist shall set the value of the signal used to communicate the desired state of switch indication (uc_ORTASWMDE_B_IND) based on the signal used to communicate the desired telltale state to the cluster (uc_ORTAMDE_STAT)

2.3.11 Trail Turn Assist Overall Network Latency Timing	(REQ-305929/C)
Requirement Status:	Frozen
Test Requirement:	TST-REQ-470335/A-TTA Overall Network Latency Timing Test TST-REQ-400898/A-Trail Turn Assist Activation Test
Applicable to:	060901 - Brake Controls 011220 - Switch Pack - Instrument Panel

	130101 - Drivers Information Module (Instrument Cluster)
Notes:	

Acceptance Criteria:	WHILE (OrtaSwtch_D_Stat == Pressed[0x1])
	IF (OrtaSwtch_D_Stat = NotPressed[0x0])
	THEN
	[IPC displays message W4268, "Trail Turn Assist; On"]
	[IPC displays Off-Road IOD with TTA graphics]
	[IPC displays ORTA_RTT]
	[Switch LED is illuminated]
	ENDIF
	
	Time(OrtaSwtch_D_Stat = NotPressed[0x0]) - Time(IPC displays[…]) <= 0.120 sec (120 ms)

Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	To ensure in-time Driver indication
Purpose:	
Requirement Text: The overall latency between driver releasing the Trail Turn Assist switch manually and the corresponding system response with the LED in the switch and / or the RTT and / or txt message in the cluster shall not exceed 120ms.	

2.3.12 Trail Turn Assist Overall Synchronization	(REQ-325769/C)
Requirement Status:	Frozen
Test Requirement:	TST-REQ-406178/A-Trail Turn Assist Cluster Function Verification Test TST-REQ-470336/A-TTA Overall Synchronization Test
Applicable to:	060901 - Brake Controls 011220 - Switch Pack - Instrument Panel 130101 - Drivers Information Module (Instrument Cluster)
Notes:	

Acceptance Criteria:	WHILE (OrtaMde_D_Ind == Off[0x0])
	IF (OrtaMde_D_Ind != Off[0x0])
	THEN
	[IPC displays message W4268, "Trail Turn Assist; On"]
	[IPC displays Off-Road IOD with TTA graphics]
	[IPC displays ORTA_RTT]
	[Switch LED is illuminated]
	ENDIF

	Abs(Time(IPC displays ORTA_RTT) - Time(Switch LED is illuminated)) <= 0.050 sec (50 ms).
Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	To ensure in-time Driver indication
Purpose:	
Requirement Text: The latency of the indication between the switch LED and the IPC shall not exceed 50ms	

2.4 Locking Differential Considerations (957350/A)

2.4.1 Trail Turn Assist Hard Switch ECU with Electronic Locking Differential Control	(REQ-331854/E)
Requirement Status:	
Test Requirement:	TST-REQ-355230/B-Trail Turn Assist - ELRD Interaction Verification Method (TTA Hard Switch) TST-REQ-470337/A-TTA Hard Switch ECU with Electronic Locking Differencial Control Test
Applicable to:	011220 - Switch Pack - Instrument Panel
Notes:	

Acceptance Criteria:	WHILE ((RearDiffLckLamp_D_Rq == On[0x1]) || (RearDiffLckLamp_D_Rq == Flashing[0x2] || (RearDiffLckLamp_D_Rq == Blocked[0x3]));
	IF (TTA switch is pressed (OrtaSwtch_D_Stat == Pressed [0x1]) and then released (OrtaSwtch_D_Stat == NotPressed[0x0]));
	// i.e. on falling edge of OrtaSwtch_D_Stat from Pressed [0x1] to NotPressed [0x0]
	THEN
	(RearDiffLck_D_RqDrv ==Off[0x0]);
	ENDIF
	
	WHILE(OrtaSwtchMde_B_Rq == On[0x1]);
	IF (RearDiffLck_D_RqDrv == On[0x1]);
	THEN
	(OrtaSwtch_D_Stat = Pressed[0x1]);
	ENDIF
	
	IF (TTA switch is Faulty (OrtaSwtch_D_Stat == Faulty[0x3]) and then transitions to released (OrtaSwtch_D_Stat == NotPressed[0x0]))
	// i.e. on falling edge of OrtaSwtch_D_Stat from Faulty [0x3] to NotPressed [0x0]

	THEN (RearDiffLck_D_RqDrv == NoRequest[0x2]) ENDIF Note: OrtaSwtch_D_Stat2 replaces OrtaSwtch_D_Stat when applicable. OrtaSwtch_D_Stat is Tx by SIMA_DCLS OrtaSwtch_D_Stat is Tx by ATCM_FFSM
Last Change:	
Last modified:	31-Jan-2022 13:16
Rationale:	The Trail Turn Assist feature is mutually exclusive with an engaged ('locked') rear differential
Purpose:	

Requirement Text:

In implementations in which the Trail Turn Assist Hard Switch ECU also controls the switch for the vehicle's electronic locking rear differential, the switch ECU shall control the signals to enforce the mutual exclusivity of the two features.

That is, if the rear differential has been requested to be engaged prior to the Driver's actuation of the Trail Turn Assist switch, the switch ECU shall transmit the signal representing the Driver's actuation of the rear differential switch (following the requirements for the signal transmission of that switch) to disengage the rear differential (e.g. *RearDiffLck_D_RqDrv == OFF*) on the falling edge of the TTA switch press (i.e. OrtaSwtch_D_Stat, OrtaSwtch_D_Stat2 == Pressed [0x1] to NotPressed [0x0]).

The opposite case shall also be true. That is, if Trail Turn Assist is enabled (*OrtaSwtchLamp_B_Rq == ON*) prior to the Driver's actuation of the front or rear differential switches to engage the rear differential, the switch ECU shall transmit the signals to disable Trail Turn Assist (*OrtaSwtch_D_Stat OR OrtaSwtch_D_Stat2 == PRESSED*, for the duration of the Driver's press of the rear differential switch) along with the signals to engage the rear differential (*RearDiffLck_D_RqDrv == ON*).

If the Trail Turn Assist switch is detected as 'stuck' (OrtaSwtch_D_Stat OR OrtaSwtch_D_Stat2 == Faulty[0x3]) and then transitions to a released state (OrtaSwtch_D_Stat OR OrtaSwtch_D_Stat2 == NotPressed[0x0]), the switch ECU shall NOT transmit the signal requesting the disengagement of the rear differential.

2.4.2 Trail Turn Assist Electronic Locking Rear Differential State Check	(REQ-325855/D)
Requirement Status:	
Test Requirement:	TST-REQ-385764/A-Trail Turn Assist Unit Testing TST-REQ-405930/A-TTA Differential State Detection Verification TST-REQ-325859/B-ORTA_FNCT_DVM_04: Off-Road Turn Assist Check of Rear Differential State TST-REQ-470338/A-TTA Electronic Locking Rear Differential State Check Test

Applicable to:	060901 - Brake Controls
Notes:	TTA_DiffStat signal is ABS-internal only. See TTA Software Specification for details on the determination of the TTA_DIffStat signal.
Acceptance Criteria:	uc_ORTA_REARDIFF_STAT == Unlocked[0x0] only if us_TTA_WhlVel_Flt_RR or us_TTA_WhlVel_Flt_RL >= us_TTA_Pred_oRW_Spd_4_DiffDetect. uc_ORTAMDE_D_IND == ActiveLeft[0x3] or ActiveRight[0x4] only if uc_ORTA_REARDIFF_STAT == Unlocked[0x0];
Last Change:	
Last modified:	20-Sep-2021 09:58
Rationale:	To ensure Trail Turn Assist only applies asymmetric brake torque across the rear axle when the rear differential is actually unlocked.
Purpose:	
Requirement Text: In vehicles with an electronic locking rear differential (ELRD), Trail Turn Assist shall confirm the disengaged (‘unlocked’) state of the rear differential prior to entering an ‘Active’ state by observing a minimum differential in rear wheel speeds. If the differential cannot be confirmed to be disengaged (‘unlocked’), Trail Turn Assist shall not transition to an ‘Active’ state.	

2.4.3 Conditions for Trail Turn Assist eLSD Maximum Locking Torque Request	(REQ-359350/B)
Requirement Status:	Frozen
Test Requirement:	TST-REQ-400898/A-Trail Turn Assist Activation Test TST-REQ-470339/A-Conditions for TTA eLSD Maximum Locking Torque Request Test
Applicable to:	060901 - Brake Controls
Notes:	

Acceptance Criteria:	IF ((TTA_Mode == Active_Left[0x3]) || (TTA_Mode == Active_Right[0x4]));
	THEN
	TTA_eLSD_TqLm_Rq = 0;
	ENDIF

Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	TTA shall only request the rear eLSD to disengage prior to the application of TTA brake torque
Purpose:	
Requirement Text:	

The Trail Turn Assist feature shall only request an eLSD locking torque limit in the 'Active' operating state. See REQ-326112 “Activating Trail Turn Assist” for specific details on Trail Turn Assist activation criteria.

2.4.4 Trail Turn Assist eLSD Interface	(REQ-359351/B)
Requirement Status:	Frozen
Test Requirement:	TST-REQ-400898/A-Trail Turn Assist Activation Test TST-REQ-470340/A-TTA eLSD Interface Test
Applicable to:	060901 - Brake Controls 050702 - Driveline Control Unit
Notes:	

Acceptance Criteria:	IF ((OrtaMde_D_Ind == ActiveLeft[0x3]) || (OrtaMde_D_Ind == ActiveRight[0x3]) && (TTA_eLSD_TqLm_Rq < OtherFeature_eLSD_TqLm_Rq));
	THEN
	(RearDiffLck_Tq2_RqMx = TTA_eLSD_TqLm_Rq);
	(RearDiffLck_Tq_Rq = TTA_eLSD_TqLm_Rq);
	ENDIF

Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	In implementations in which the rear differential is not at risk of 'torque-trap', requests by the feature to open the rear differential when necessary offer an improved user experience.
Purpose:	

Requirement Text:

In Trail Turn Assist implementations with a rear electronic Limited Slip Differential (eLSD), the Trail Turn Assist feature shall request the rear differential to disengage prior to application of TTA brake torque. The request shall be communicated via the RearDiffLck_Tq2_RqMx signal (signal details specified in GSDB).

When TTA is requesting the rear eLSD to disengage, the eLSD shall honor the locking torque limit request value of RearDiffLck_Tq2_RqMx.

2.4.5 Arbitration of Trail Turn Assist Maximum eLSD Locking Torque Request with other External Features eLSD Torque Requests	(REQ-359329/B)
Requirement Status:	Frozen
Test Requirement:	TST-REQ-400898/A-Trail Turn Assist Activation Test

	TST-REQ-470341/A-Arbitration of TTA Maximum eLSD Locking Torque Request with other External Features eLSD Torque Requests Test
Applicable to:	060901 - Brake Controls
Notes:	

Acceptance Criteria:	IF (TTA_eLSD_TqLm_Rq < ESC_eLSD_TqLm_Rq)
	THEN
	FSC_eLSD_TqLm_Rq = TTA_eLSD_TqLm_Rq;
	ELSIF
	FSC_eLSD_TqLm_Rq = ESC_eLSD_TqLm_Rq;
	ENDIF
	
	IF (FSC_eLSD_TqLm_Rq <= BCS_eLSD_TqLm_Rq)
	THEN
	RearDiffLck_Tq_RqMx = FSC_eLSD_TqLm_Rq;
	ELSIF
	RearDiffLck_Tq_RqMx = BCS_eLSD_TqLm_Rq;
	ENDIF
	
	Where:
	TTA_eLSD_TqLm_Rq refers to the Trail Turn Assist feature's eLSD locking torque request;
	ESC_eLSD_TqLm_Rq refers to stability control's eLSD locking torque limit request;
	FSC_eLSD_TqLm_Rq refers to the arbitrated eLSD locking torque limit request from the Ford Stability Control (FSC) eLSD locking torque limit request interface;
	BCS_eLSD_TqLm_Rq refers to the eLSD locking torque limit request from other brake control features (e.g. traction control);

Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	Define system arbitration requirements when multiple features are making the same type of request for maximum eLSD locking torque.
Purpose:	

Requirement Text:

The Trail Turn Assist eLSD Locking Torque Limit request shall be arbitrated within FSC with other FSC features making the same type of request, with the lowest request winning arbitration.

The FSC eLSD Locking Torque Limit request shall be arbitrated by the Brake Controls system, with other Brake Control features making the same type of request, with the lowest request winning arbitration.

The eLSD Locking Torque Limit request from the Brake Control System arbitration shall be output on the CAN signal RearDiffLck_Tq2_RqMx.

2.5 Internal Functional Safety Requirements (747478/A)

2.5.1 Avoid Unintended TTA Inhibition of Stability Control	(REQ-385746/B)
Requirement Status:	Frozen
ASIL Classification:	A
Uplink / SG:	SG-002067/A-Avoid degraded stability due to no braking to at least one wheel when stabilizing torque is required to avoid hazard
Core Requirement:	
Safe State:	
V&V Method:	
V&V Acceptance Criteria:	When the vehicle speed is greater than the threshold velocity <TTAVxThreshold>, stability control shall be fully functional. Unit tests to be PASSED: Vehicle_Velocity_for_Activation_TEST_01 Vehicle_State_for_Activation_TEST_01 Active_Left_TEST_01 Active_Right_TEST_01 Operating_Mode_TEST_Transition 01.00_01.01_01.00 Operating_Mode_TEST_Transition 01.00_01.02_01.00 Active_TEST_01 Active_State_TEST_Transition_00_01 Active_State_TEST_Transition_01_02_00 Active_State_TEST_Transition_01_02_01
Fault Tolerant Time Interval:	300 ms
Last modified:	17-Sep-2021 14:12
Rationale:	
Purpose:	
Requirement Text: Above threshold velocity, <TTAVxThreshold>, Trail Turn Assist shall not inhibit stability control.	

2.5.2 Avoid Unintended TTA Inhibition of Traction Control	(REQ-385747/B)
Requirement Status:	Frozen
ASIL Classification:	A

Uplink / SG:	SG-002067/A-Avoid degraded stability due to no braking to at least one wheel when stabilizing torque is required to avoid hazard
Core Requirement:	
Safe State:	
V&V Method:	
V&V Acceptance Criteria:	When the vehicle speed is greater than the threshold velocity <TTAVxThreshold>, traction control shall be fully functional. Unit tests to be PASSED: Vehicle_Velocity_for_Activation_TEST_01 Vehicle_State_for_Activation_TEST_01 Active_Left_TEST_01 Active_Right_TEST_01 Operating_Mode_TEST_Transition 01.00_01.01_01.00 Operating_Mode_TEST_Transition 01.00_01.02_01.00 Active_TEST_01 Active_State_TEST_Transition_00_01 Active_State_TEST_Transition_01_02_00 Active_State_TEST_Transition_01_02_01
Fault Tolerant Time Interval:	300 ms
Last modified:	17-Sep-2021 14:12
Rationale:	
Purpose:	
Requirement Text: Above threshold velocity, <TTAVxThreshold>, Trail Turn Assist shall not inhibit traction control.	

2.5.3 Transition to TTA-Allowed Normal Operating State	(REQ-375905/B)
Requirement Status:	Frozen
ASIL Classification:	D
Uplink / SG:	FS-REQ-375902/B-Avoid unintended TTA Braking at speeds that could cause a hazardous degradation of vehicle stability
Core Requirement:	
Safe State:	

V&V Method:	
V&V Acceptance Criteria:	When Vx <= TTAVxThreshold the Trail Turn Assist component of the final brake pressure output is equal to Trail Turn Assist braking request for the specified wheel.
Fault Tolerant Time Interval:	N/A
Last modified:	17-Sep-2021 14:12
Rationale:	
Purpose:	Allow feature activation within intended speed range
Requirement Text: If the vehicle's velocity is equal to or below the threshold velocity, <TTAVxThreshold>, and there are no faults affecting the correct determination of the vehicle's velocity, Trail Turn Assist shall function normally within the TTA-Allowed Operating Mode.	

2.6 Internal Technical Safety Requirements (747480/A)

2.6.1 Trail Turn Assist - Traction Control Interface	(REQ-385755/A)
Requirement Status:	Frozen
ASIL Classification:	A
Uplink / SG:	FS-REQ-385747/B-Avoid Unintended TTA Inhibition of Traction Control
Core Requirement:	
Safe State:	
V&V Method:	
V&V Acceptance Criteria:	IF Vx > TTAVxThreshold THEN b_INHIBIT_SUPPLIER_TC = FALSE [0x0] Unit tests to be PASSED: Vehicle_Velocity_for_Activation_TEST_01 Vehicle_State_for_Activation_TEST_01 Active_Left_TEST_01 Active_Right_TEST_01 Operating_Mode_TEST_Transition 01.00_01.01_01.00 Operating_Mode_TEST_Transition 01.00_01.02_01.00 Active_TEST_01

	Active_State_TEST_Transition_00_01 Active_State_TEST_Transition_01_02_00 Active_State_TEST_Transition_01_02_01
Fault Tolerant Time Interval:	300 ms
Last modified:	10-Sep-2021 12:31
Rationale:	
Purpose:	
Requirement Text: If the vehicle velocity, Vx, is greater than <TTAVxThreshold> or if the vehicle velocity cannot be accurately determined, the Trail Turn Assist interface signal used to request traction control be inhibited, b_INHIBIT_SUPPLIER_TC, shall be FALSE (0x0).	

2.6.2 Trail Turn Assist - Stability Control Interface	(REQ-385754/A)
Requirement Status:	Frozen
ASIL Classification:	A
Uplink / SG:	FS-REQ-385746/B-Avoid Unintended TTA Inhibition of Stability Control
Core Requirement:	
Safe State:	
V&V Method:	
V&V Acceptance Criteria:	IF ((Vx > TTAVxThreshold) || (TTA_Mode != Active)) THEN Stability Control is fully functional Unit tests to be PASSED: Vehicle_Velocity_for_Activation_TEST_01 Vehicle_State_for_Activation_TEST_01 Active_Left_TEST_01 Active_Right_TEST_01 Operating_Mode_TEST_Transition 01.00_01.01_01.00 Operating_Mode_TEST_Transition 01.00_01.02_01.00 Active_TEST_01 Active_State_TEST_Transition_00_01 Active_State_TEST_Transition_01_02_00 Active_State_TEST_Transition_01_02_01
Fault Tolerant Time Interval:	300 ms

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Last modified:	10-Sep-2021 12:31
Rationale:	
Purpose:	

Requirement Text:

Trail Turn Assist shall only inhibit stability control if it is active AND if the vehicle velocity is not greater than <TTAVxThreshold>.

3. Trail Turn Assist Brake Controls Supplier Function Specification - ABS

3.1 Trail Turn Assist Brake Controls Supplier Interface Requirements (718798/B)

3.1.1 Trail Turn Assist Pressure Request Interface Supplier Implementation	(REQ-375931/B)
Requirement Status:	Frozen
Test Requirement:	TST-REQ-400898/A-Trail Turn Assist Activation Test TST-REQ-472606/A-TTA Pressure Request Interface Supplier Implementation Test
Applicable to:	060901 - Brake Controls
Notes:	
Acceptance Criteria:	See FSC ILD DVM Section 9.3.6-9.3.7
Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	Define supplier implementation of TTA brake pressure requests
Purpose:	

Requirement Text:

The Brake Controls Supplier shall receive the Trail Turn Assist brake pressure request over the FSC interface signal ss_FSC_ORTA_WHL_PRESS_RQST (see the FSC Interface Matrix for further details on the definition of this signal).

The Brake Controls Supplier shall process this signal based on the requirements of sections 9.3.6 and 9.3.7 of the FSC Interface Logic Description.

3.1.2 Trail Turn Assist HMI Interface Signal CAN mapping	(REQ-375932/C)
Requirement Status:	
Test Requirement:	TST-REQ-400898/A-Trail Turn Assist Activation Test TST-REQ-472607/A-TTA HMI Interface Signal CAN Mapping Test
Applicable to:	060901 - Brake Controls
Notes:	
Acceptance Criteria:	CAN signal states correspond to FSC interface signal states
Last Change:	

Last modified:	10-Nov-2021 07:57
Rationale:	Map FSC interface signals to CAN signals for vehicle network communications
Purpose:	

Requirement Text:

The Brake Controls Supplier shall map the Trail Turn Assist FSC interface HMI signals to their corresponding CAN signals as follows (FSC_Interface_Signal : CAN_Signal):

FSC Inputs:

uc_ORTASWTCH_D_STAT : OrtaSwtch_D_Stat OR TurnAsstSwtch_D_Stat OR OrtaSwtch_D_Stat2 (depending on which is present in the program-specific message list).

FSC Outputs:

uc_ORTAMDE_D_IND : OrtaMde_D_Ind

uc_ORTAMSGTXT_D_RQ : OrtaMsgTxt_D_Rq

uc_ORTASWMDE_B_IND : OrtaSwtchLamp_B_Rq

3.1.3 Trail Turn Assist ABS Latency Timing	(REQ-305930/C)
Requirement Status:	Frozen
Test Requirement:	TST-REQ-400898/A-Trail Turn Assist Activation Test TST-REQ-472601/A-TTA ABS Latency Timing Test
Applicable to:	060901 - Brake Controls
Notes:	
Acceptance Criteria:	WHILE [(Ignition_Status == Run[0x4]) && (AwdRnge_D_Actl == High_Range_Locked[0x4])]; IF (OrtaSwtch_D_Stat = Pressed[0x1]) (where: TUNE_ORTA_SWTCHDBNCE_TIME_MS < TimePressed < 120 sec); THEN (OrtaMde_D_Ind = StandbyLeft[0x1]) || (OrtaMde_D_Ind = StandbyRight[0x2]) || (OrtaMde_D_Ind = ActiveLeft[0x3]) || (OrtaMde_D_Ind = ActiveRight[0x4]); (OrtaSwLamp_B_Rq = On[0x1]) (OrtaMsgTxt_D_Rq = Message_4[0x4]);

	ENDIF Time(OrtaSwtch_D_Stat = NotPressed[0x0]) - Time(OrtaMde_D_Ind != Off[0x0]) <= 0.020 sec(20 ms) Time(OrtaSwtch_D_Stat = NotPressed[0x0]) - Time(OrtaSwLamp_B_Rq != Off[0x0]) <= 0.020 sec(20 ms) Time(OrtaSwtch_D_Stat = NotPressed[0x0]) - Time(OrtaMsgTxt_D_Rq != NoMessage[0x0]) <= 0.020 sec(20 ms)
Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	To ensure in-time Driver indication
Purpose:	
Requirement Text: The ABS shall not exceed the internal latency of 20 ms to respond on CAN signal status changes with corresponding Trail Turn Assist status change and driver indication related signals on CAN.	

3.1.4 Trail Turn Assist ABS Synchronization	(REQ-325770/C)
Requirement Status:	Frozen
Test Requirement:	TST-REQ-400898/A-Trail Turn Assist Activation Test TST-REQ-472602/A-TTA ABS Synchronization Test
Applicable to:	060901 - Brake Controls
Notes:	

Acceptance Criteria:	WHILE (OrtaMde_D_Ind == Off[0x0])
	IF (OrtaMde_D_Ind != Off[0x0])
	THEN
	(OrtaMsgTxt_D_Rq != No_Message[0x0])
	(OrtaSwLamp_B_Rq = On[0x1])
	[With change occurring within same CAN loop]
	ENDIF

Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	To ensure synchronized driver indication
Purpose:	
Requirement Text: The ABS shall transmit all Trail Turn Assist related signals (status and driver indication) within the same transmitting loop.	

3.2 Trail Turn Assist Brake Controls Supplier Functional Requirements (718797/A)

3.2.1 Traction Control Inhibited While Trail Turn Assist is Active	(REQ-375914/B)
Requirement Status:	Frozen
Test Requirement:	TST-REQ-400898/A-Trail Turn Assist Activation Test TST-REQ-472608/A-Traction Control Inhibited While TTA is Active Test
Applicable to:	060901 - Brake Controls
Notes:	It may be acceptable for the Brake Controls supplier to use method of ramping Traction Control in/out that is different from what is described in the FSC Interface Logic Description, pending approval from the Trail Turn Assist Feature Owner.

Acceptance Criteria:	IF (b_INHIBIT_SUPPLIER_TC == True[0x1])
	THEN
	b_VHCL_IN_ETCS_CNTRL = False[0x0];
	b_WHL_IN_BTCS_CNTRL_FL = False[0x0];
	b_WHL_IN_BTCS_CNTRL_FRL = False[0x0];
	b_WHL_IN_BTCS_CNTRL_RL = False[0x0];
	b_WHL_IN_BTCS_CNTRL_RR = False[0x0];

Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	Feature performance and driveline robustness
Purpose:	
Requirement Text: While Trail Turn Assist is requesting Traction Control to be inhibited (b_INHIBIT_SUPPLIER_TC = True[0x1]), Traction Control shall follow the requirements of the FSC Interface Logic Description, Section 9.7.	

3.3 Supplier-Allocated Functional Safety Requirements (747477/A)

3.3.1 Avoid unintended TTA Braking at speeds that could cause a hazardous degradation of vehicle stability	(REQ-375902/B)
Requirement Status:	Frozen
ASIL Classification:	D
Uplink / SG:	SG-001847/A-Avoid degraded stability due to unintended braking
Core Requirement:	
Safe State:	

V&V Method:	System test
V&V Acceptance Criteria:	When the vehicle speed is greater than the threshold velocity <TTAVxThreshold>, the brake pressure at each wheel from an Trail Turn Assist braking request is equal to 0 bar.
Fault Tolerant Time Interval:	300 ms
Last modified:	10-Sep-2021 12:31
Rationale:	
Purpose:	Avoid violation of SG-001847
Requirement Text: Above threshold velocity, <TTAVxThreshold>, Trail Turn Assist shall be in the TTA-Inhibited safe state. This threshold shall be chosen such that any unintended braking does not lead to a hazardous degradation of vehicle stability.	

3.3.2 Transition to TTA-Inhibited Safe State	(REQ-375906/B)
Requirement Status:	Frozen
ASIL Classification:	D
Uplink / SG:	FS-REQ-375902/B-Avoid unintended TTA Braking at speeds that could cause a hazardous degradation of vehicle stability
Core Requirement:	
Safe State:	
V&V Method:	
V&V Acceptance Criteria:	When Vx cannot be accurately determined, the Trail Turn Assist component of the final brake pressure output is equal to 0 bar.
Fault Tolerant Time Interval:	300 ms
Last modified:	17-Sep-2021 14:12
Rationale:	
Purpose:	Prevent violation of SG-001847 due to faults
Requirement Text: If the vehicle's velocity cannot be accurately determined, Trail Turn Assist shall transition to the TTA-Inhibited Safe State in which no TTA braking is allowed.	

3.3.3 Detection of Faults Related to Vehicle Velocity Determination	(REQ-375904/B)
Requirement Status:	Frozen
ASIL Classification:	D
Uplink / SG:	FS-REQ-375902/B-Avoid unintended TTA Braking at speeds that could cause a hazardous degradation of vehicle stability
Core Requirement:	
Safe State:	
V&V Method:	
V&V Acceptance Criteria:	Faults on sensors used to determine vehicle velocity are detected.
Fault Tolerant Time Interval:	300 ms
Last modified:	17-Sep-2021 14:12
Rationale:	
Purpose:	Prevent violation of SG-001847 due to faults
Requirement Text: Any fault that reduces the vehicle's estimated velocity by a margin large enough to violate the safety goal shall be detected.	

3.4 Supplier-Allocated Technical Safety Requirements (747482/A)

3.4.1 Trail Turn Assist Safety Barrier	(REQ-375910/B)
Requirement Status:	Frozen
ASIL Classification:	D
Uplink / SG:	FS-REQ-375902/B-Avoid unintended TTA Braking at speeds that could cause a hazardous degradation of vehicle stability
Core Requirement:	
Safe State:	
V&V Method:	

V&V Acceptance Criteria:	Trail Turn Assist braking requests are disabled when true vehicle speed is above the corresponding speed threshold, even when other feature-specific criteria for activation are met.
Fault Tolerant Time Interval:	300 ms
Last modified:	10-Sep-2021 12:31
Rationale:	
Purpose:	Prevent violation of SG-001847
Requirement Text: A software safety barrier shall prevent Trail Turn Assist braking requests from being realized if the vehicle velocity, Vx, is greater than <TTAVxThreshold> or if the vehicle velocity cannot be accurately determined, as described in REQ-375909 “Vehicle Velocity Accuracy for Trail Turn Assist Safety Barrier”.	

3.4.2 Vehicle Velocity Accuracy for Trail Turn Assist Safety Barrier	(REQ-375909/B)
Requirement Status:	Frozen
ASIL Classification:	D
Uplink / SG:	FS-REQ-375902/B-Avoid unintended TTA Braking at speeds that could cause a hazardous degradation of vehicle stability TS-REQ-375910/B-Trail Turn Assist Safety Barrier
Core Requirement:	
Safe State:	
V&V Method:	Software test
V&V Acceptance Criteria:	Excluding the scenarios described in the requirements text, Vx_SB >= min(Actual Vehicle Speed - 5 kph, (90% * Actual Vehicle Speed))
Fault Tolerant Time Interval:	300 ms
Last modified:	17-Sep-2021 14:12
Rationale:	
Purpose:	Determine vehicle velocity to prevent violation of SG-001847
Requirement Text: The vehicle reference velocity used for the Trail Turn Assist software safety barrier shall not under-report the vehicle speed by more than:	

Vx_SB_MAX_ERROR = max(5 kph, (10% Actual Vehicle Speed))*

Excluding the following conditions:

- At least two wheel speeds are below vehicle speed by more than *Vx_SB_MAX_ERROR*
- Reverse driving

Note: if tires are fitted to the vehicle that exceed the OEM tire radius by more than 2%, then *Vx_SB_MAX_ERROR* is increased by *((Tire Radius / OEM Tire Radius) - 2%) * Actual Vehicle Speed*

3.4.3 TTA Safety Barrier Threshold Speed	(REQ-385756/A)
Requirement Status:	Frozen
ASIL Classification:	D
Uplink / SG:	FS-REQ-375902/B-Avoid unintended TTA Braking at speeds that could cause a hazardous degradation of vehicle stability
Core Requirement:	
Safe State:	
V&V Method:	
V&V Acceptance Criteria:	IF (Vx_SB > 12 mph/19.3 kph) THEN Wheel_BrkPress_From_TTA = 0 bar
Fault Tolerant Time Interval:	300 ms
Last modified:	10-Sep-2021 12:31
Rationale:	
Purpose:	
Requirement Text: The threshold speed, Vx_SB, above which Trail Turn Assist braking is inhibited, <TTAVxThreshold> shall be 12 mph (19.3 kph).	

4. Trail Turn Assist Switch Function Specification - (SIMA_DLCS or ATCM_FFSM or APIM)

4.1 Trail Turn Assist Switch Implementation Requirements (683266/B)

4.1.1 Trail Turn Assist Switch Status	(REQ-325781/E)
Requirement Status:	
Test Requirement:	TST-REQ-472743/A-TTA Switch Status Test TST-REQ-400897/A-Trail Turn Assist HMI Test
Applicable to:	011220 - Switch Pack - Instrument Panel 150102 - Center Stack Display
Notes:	

Acceptance Criteria:	IF [Driver Presses Trail Turn Assist Switch]
	THEN
	(OrtaSwtch_D_Stat = Pressed[0x1])
	ELSE
	(OrtaSwtch_D_Stat = NotPressed[0x0])
	ENDIF
	
	Note: OrtaSwtch_D_Stat may be substituted with OrtaSwtch_D_Stat2 or TurnAsstSwtch_D_Stat as applicable.

Last Change:	
Last modified:	18-Nov-2021 11:25
Rationale:	Define switch status indication from switch ECU to ABS
Purpose:	

Requirement Text:

If the driver presses the Trail Turn Assist switch, the switch ECU shall transmit the applicable CAN signal (***OrtaSwtch_D_Stat, OrtaSwtch_D_Stat2, or TurnAsstSwtch_D_Stat)*** as Pressed (0x1) as long as the driver presses the switch.

If the driver does not press the Trail Turn Assist switch, the switch ECU shall transmit the applicable CAN signal (***OrtaSwtch_D_Stat, OrtaSwtch_D_Stat2, or TurnAsstSwtch_D_Stat)*** as NotPressed (0x0) as long as the driver is not pressing the switch.

Note/For Reference:
OrtaSwtch_D_Stat Tx by SIMA_DCLS
OrtaSwtch_D_Stat2 Tx by ATCM_FFSM

TurnAsstSwtch_D_Stat Tx by APIM

4.1.2 Trail Turn Assist Switch Status LED	(REQ-325782/F)
Requirement Status:	
Test Requirement:	TST-REQ-472744/A-TTA Switch Status LED Test TST-REQ-400897/A-Trail Turn Assist HMI Test
Applicable to:	011220 - Switch Pack - Instrument Panel 150102 - Center Stack Display
Notes:	

Acceptance Criteria:	IF (OrtraSwtchLamp_B_Rq == On[0x1])
	THEN
	[Trail Turn Assist Switch LED is illuminated]
	ELSE
	[Trail Turn Assist Switch LED is not illuminated]
	ENDIF
	
	Note: Applicable only to hard switches with an LED.

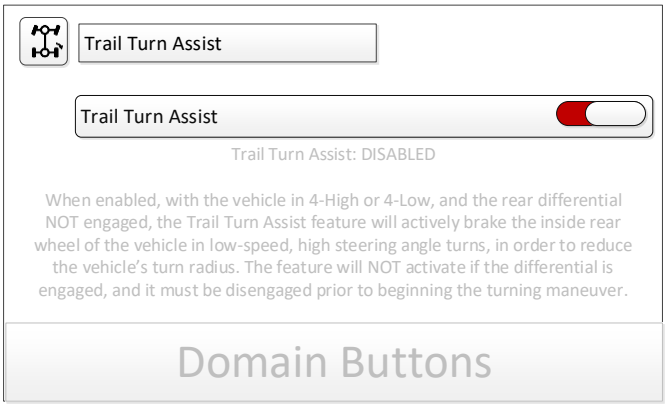
Last Change:	
Last modified:	18-Nov-2021 11:25
Rationale:	Define switch status LED behavior
Purpose:	

Requirement Text:

For hard switch implementations, the switch ECU shall control the Trail Turn Assist switch status LED (if supported) according to CAN signal ***OrtaSwtchLamp_B_Rq.***
If ***OrtaSwtchLamp_B_Rq*** equals Off (0x0) the switch status LED shall be turned OFF.
If ***OrtaSwtchLamp_B_Rq*** equals On (0x1) the switch status LED shall be turned ON.

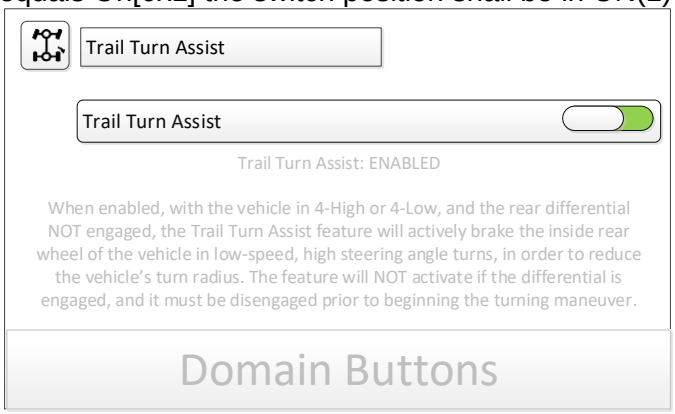
For soft switch implementations, the soft switch ECU shall show the Trail Turn Assist switch position in the display according to CAN signal ***OrtaSwtchLamp_B_Rq.***

If ***OrtaSwtchLamp_B_Rq*** equals OFF[0x0] the switch position shall be in OFF(0) position.



TTA_Soft_Switch_Position = OFF

If ***OrtaSwtchLamp_B_Rq*** equals On[0x1] the switch position shall be in ON(1) position.



TTA_Soft_Switch_Position = ON

4.1.3 Trail Turn Assist Switch Failure Modes and Indication	(REQ-325783/E)
Requirement Status:	
Test Requirement:	TST-REQ-472745/A-TTA Switch Failure Modes and Indication Test TST-REQ-400897/A-Trail Turn Assist HMI Test
Applicable to:	011220 - Switch Pack - Instrument Panel 150102 - Center Stack Display
Notes:	Soft Switch applications may have shorter than 120 second timeouts. This may also vary within a program based on hardware. The responsible soft switch ECU engineer shall communicate the timeout(s) to the TTA feature owner directly or through the ABS D&R engineer.
Acceptance Criteria:	IF [Driver Presses Trail Turn Assist Switch for greater than 120 sec] THEN (OrtaSwtch_D_Stat = Faulty[0x3])

	ENDIF
	
	IF [Switch ECU detects switch/LED fault]
	THEN
	(OrtaSwtch_D_Stat = Faulty[0x3])
	ENDIF
	
	IF (OrtaSwtchLamp_B_Rq == MISSING) (for greater than 5 sec)
	THEN
	(OrtaSwtch_D_Stat = Faulty[0x3])
	ENDIF
	
	Note: OrtaSwtch_D_Stat may be substituted with OrtaSwtch_D_Stat2 or TurnAsstSwtch_D_Stat as applicable.

Last Change:	
Last modified:	31-Jan-2022 13:16
Rationale:	Define switch failure modes and their indication
Purpose:	

Requirement Text:

If the Trail Turn Assist switch is pressed or stuck in the pressed position for longer than 120 seconds, then the switch ECU shall set a DTC corresponding to the failure and transmit the applicable CAN signal (***OrtaSwtch_D_Stat, OrtaSwtch_D_Stat2, or TurnAssistSwtch_D_Stat)*** as FAULTY(0x3).

Anytime the switch ECU detects a fault with the Trail Turn Assist switch, it shall set a DTC corresponding to the failure and transmit the applicable CAN signal (***OrtaSwtch_D_Stat, OrtaSwtch_D_Stat2, TurnAsstSwtch_D_Stat)*** as FAULTY(0x3).

The following paragraph is not applicable if the switch does not have an LED:
Anytime the switch ECU detects a fault with the switch LED or CAN signal ***OrtaSwtchLamp_B_Rq*** is missing for 5 consecutive seconds, it shall set a DTC corresponding to the failure and transmit the applicable CAN signal (***OrtaSwtch_D_Stat, OrtaSwtch_D_Stat2, TrailTurnAssist_D_Stat)*** as FAULTY(0x3). It shall also turn the status indicator LED/switch position off.

Note: This REQ (REQ-325783) takes priority over REQ-325781 when conditions correct.

4.1.4 Trail Turn Assist Switch ECU Latency Timing	(REQ-325774/D)
Requirement Status:	
Test Requirement:	TST-REQ-472746/A-TTA Switch ECU Latency Timing Test TST-REQ-406291/A-Trail Turn Assist APIM (SYNC) Function Verification Test

Applicable to:	011220 - Switch Pack - Instrument Panel 150102 - Center Stack Display
Notes:	

Acceptance Criteria:	IF [Driver Presses TTA Switch]
	THEN
	(OrtraSwtch_D_Stat = Pressed[0x1]) [within 0.070 sec, 70 ms]
	ENDIF
	
	WHILE (OrtaSwLamp_B_Rq == Off[0x0])
	IF (OrtaSwLamp_B_Rq = On[0x1])
	THEN
	[TTA Switch LED is illuminated within 0.010 sec (10 ms) (if equipped)]
	ENDIF
	
	Note: OrtaSwtch_D_Stat may be substituted with OrtaSwtch_D_Stat2 or TurnAsstSwtch_D_Stat as applicable.

Last Change:	
Last modified:	18-Nov-2021 11:25
Rationale:	To ensure in-time reactions to Driver inputs
Purpose:	
Requirement Text: The switch ECU internal latency of detecting the switch being pressed shall not exceed 60ms. The switch ECU latency of transmitting the switch status change on CAN (OrtaSwtch_D_Stat OR TurnAsstSwtch_D_Stat OR OrtaSwtch_D_Stat2) shall not exceed 10ms. The switch ECU latency of receiving switch indication status change on CAN (OrtaSwtchLamp_B_Rq) and switching the displayed indication shall not exceed 10ms.	

4.2 Trail Turn Assist Switch in SIMA_DLCS Module Requirements (669731/B)

4.2.1 OrtaSwtch_D_Stat Debounce for SIMA_DLCS Implementations	(REQ-354114/C)
Requirement Status:	Frozen
Test Requirement:	TST-REQ-385764/A-Trail Turn Assist Unit Testing TST-REQ-472747/A-OrtaSwtch_D_Stat Debounce for SIMA_DLCS Implementations Test
Applicable to:	060901 - Brake Controls

Notes:	In the U725 application, the delay time for transition of OrtaSwtchLamp_B_Rq signal (TUNE_ORTA_SWTCHLMP_DLYTIME_MS) shall be 50ms

Acceptance Criteria:	WHILE (OrtaSwtch_D_Stat == Pressed[0x1])
	IF (OrtaSwtch_D_Stat == NotPressed[0x0])
	AFTER(TUNE_ORTA_SWTCHLMP_DLYTIME_MS)
	(OrtaSwtchLamp_B_Rq == On[0x1])
	ENDIF

Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	Prevent overlapping switch LED indications of feature activations during transitions
Purpose:	
Requirement Text: When the Trail Turn Assist hard switch is implemented in the SIMA_DLCS switch module with the Electronic Locking Rear Differential switch, when the TTA switch status (OrtaSwtch_D_Stat) transitions from 'Pressed'[0x1] to 'NotPressed'[0x0] (indicating the Driver has requested activation of the Trail Turn Assist feature), the Trail Turn Assist feature software shall delay the transition of the switch LED signal (OrtaSwtchLamp_B_Rq) from Off[0x0] to On[0x1] for a calibratable amount of time.	

4.3 Trail Turn Assist & ELRD Hard Switches Share Module Requirements (669350/C)

4.3.1 Trail Turn Assist Hard Switch ECU with Electronic Locking Differential Control	(REQ-331854/E)
Requirement Status:	
Test Requirement:	TST-REQ-355230/B-Trail Turn Assist - ELRD Interaction Verification Method (TTA Hard Switch) TST-REQ-470337/A-TTA Hard Switch ECU with Electronic Locking Differencial Control Test
Applicable to:	011220 - Switch Pack - Instrument Panel
Notes:	

Acceptance Criteria:	WHILE ((RearDiffLckLamp_D_Rq == On[0x1]) || (RearDiffLckLamp_D_Rq == Flashing[0x2] || (RearDiffLckLamp_D_Rq == Blocked[0x3]));
	IF (TTA switch is pressed (OrtaSwtch_D_Stat == Pressed [0x1]) and then released (OrtaSwtch_D_Stat == NotPressed[0x0]));
	// i.e. on falling edge of OrtaSwtch_D_Stat from Pressed [0x1] to NotPressed [0x0]
	THEN
	(RearDiffLck_D_RqDrv ==Off[0x0]);
	ENDIF
	
	WHILE(OrtaSwtchMde_B_Rq == On[0x1]);

	IF (RearDiffLck_D_RqDrv == On[0x1]);
	THEN
	(OrtaSwtch_D_Stat = Pressed[0x1]);
	ENDIF
	
	IF (TTA switch is Faulty (OrtaSwtch_D_Stat == Faulty[0x3]) and then transitions to released (OrtaSwtch_D_Stat == NotPressed[0x0]))
	// i.e. on falling edge of OrtaSwtch_D_Stat from Faulty [0x3] to NotPressed [0x0]
	THEN
	(RearDiffLck_D_RqDrv == NoRequest[0x2])
	ENDIF
	
	Note: OrtaSwtch_D_Stat2 replaces OrtaSwtch_D_Stat when applicable.
	OrtaSwtch_D_Stat is Tx by SIMA_DCLS
	OrtaSwtch_D_Stat is Tx by ATCM_FFSM

Last Change:	
Last modified:	31-Jan-2022 13:16
Rationale:	The Trail Turn Assist feature is mutually exclusive with an engaged ('locked') rear differential
Purpose:	

Requirement Text:

In implementations in which the Trail Turn Assist Hard Switch ECU also controls the switch for the vehicle's electronic locking rear differential, the switch ECU shall control the signals to enforce the mutual exclusivity of the two features.

That is, if the rear differential has been requested to be engaged prior to the Driver's actuation of the Trail Turn Assist switch, the switch ECU shall transmit the signal representing the Driver's actuation of the rear differential switch (following the requirements for the signal transmission of that switch) to disengage the rear differential (e.g. *RearDiffLck_D_RqDrv == OFF*) on the falling edge of the TTA switch press (i.e. OrtaSwtch_D_Stat, OrtaSwtch_D_Stat2 == Pressed [0x1] to NotPressed [0x0]).

The opposite case shall also be true. That is, if Trail Turn Assist is enabled (*OrtaSwtchLamp_B_Rq == ON*) prior to the Driver's actuation of the front or rear differential switches to engage the rear differential, the switch ECU shall transmit the signals to disable Trail Turn Assist (*OrtaSwtch_D_Stat OR OrtaSwtch_D_Stat2 == PRESSED*, for the duration of the Driver's press of the rear differential switch) along with the signals to engage the rear differential (*RearDiffLck_D_RqDrv == ON*).

If the Trail Turn Assist switch is detected as 'stuck' (OrtaSwtch_D_Stat OR OrtaSwtch_D_Stat2 == Faulty[0x3]) and then transitions to a released state (OrtaSwtch_D_Stat OR OrtaSwtch_D_Stat2 == NotPressed[0x0]), the switch ECU shall NOT transmit the signal requesting the disengagement of the rear differential.

5. Trail Turn Assist Driver's Information Function - Cluster (IPC or APIM [FNV3])

5.1 Trail Turn Assist Driver's Information Reference Documents (764091/A)

VDOC075749 – 628226_A_001_Warning and RTT – Off Road Turn Assist – CGEA1.3_v1.0

5.2 Trail Turn Assist HMI Function Requirements (761496/B)

5.2.1 Trail Turn Assist Cluster-APIM Interactions (FNV3)	(REQ-388436/A)
Requirement Status:	Frozen
Test Requirement:	TST-REQ-406178/A-Trail Turn Assist Cluster Function Verification Test TST-REQ-472736/A-TTA Cluster - APIM Interactions (FNV3+) Test
Applicable to:	
Notes:	
Acceptance Criteria:	See: REQ-325779 "Trail Turn Assist Telltale Display" REQ-325816 "Trail Turn Assist Information-on-Demand Indication Display" REQ-355026 "Trail Turn Assist Cluster Message Display".
Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	Clarification for FNV3 electrical architecture implementations
Purpose:	

Requirement Text:

For vehicles implementing the FNV3 electrical architecture, in which the Cluster display is controlled by the APIM module, the APIM module shall receive the Trail Turn Assist HMI output CAN signals (OrtaMde_D_Ind, OrtaMsgTxt_D_Rq, OrtaSwtchLamp_B_Rq).

The APIM module shall convey the intended information communicated by these signals through the Cluster display as defined by REQ-325779 "Trail Turn Assist Telltale Display", REQ-325816 "Trail Turn Assist Information-on-Demand Indication Display" and REQ-355026 "Trail Turn Assist Cluster Message Display".

5.2.2 Trail Turn Assist Cluster Message Display	(REQ-355026/B)
Requirement Status:	Frozen
Test Requirement:	TST-REQ-472737/A-TTA Cluster Message Display Test TST-REQ-406178/A-Trail Turn Assist Cluster Function Verification Test

Applicable to:	130101 - Drivers Information Module (Instrument Cluster)
Notes:	

Acceptance Criteria:	IF (OrtaMsgTxt_D_Rq == NoMessage[0x0])
	THEN
	IPC displays [NO TTA MESSAGE];
	ELIF (OrtaMsgTxt_D_Rq == Message_2[0x2])
	THEN
	IPC displays message W4266, "Trail Turn Assist; Available; in 4L or 4H";
	ELIF (OrtaMsgTxt_D_Rq == Message_3[0x3])
	THEN
	IPC displays message W4267, "Trail Turn Assist; Not Available; See Manual";
	ELIF (OrtaMsgTxt_D_Rq == Message_4[0x4])
	THEN
	IPC displays message W4268, "Trail Turn Assist; On";
	ELIF (OrtaMsgTxt_D_Rq == Message_5[0x5])
	THEN
	IPC displays message W4269, "Trail Turn Assist; Off";
	ELSE
	IPC displays [NO TTA MESSAGE]
	ENDIF

Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	
Purpose:	

Requirement Text:

The Instrument Panel Cluster (IPC) shall display the Trail Turn Assist feature messages communicated by the signal OrtaMsgTxt_D_Rq, based on the specifics of the IPC Program Message List.

5.2.3 Trail Turn Assist Telltale Display	(REQ-325779/C)
Requirement Status:	Frozen
Test Requirement:	TST-REQ-472738/A-TTA Telltale Display Test TST-REQ-406178/A-Trail Turn Assist Cluster Function Verification Test
Applicable to:	130101 - Driver Information Module (Instrument Cluster)
Notes:	
Acceptance Criteria:	IF (OrtaMde_D_Ind == Off[0x0]); THEN IPC displays ORTA_RTT [NONE]

	ELIF (OrtaMde_D_Ind == StandbyLeft[0x1]) THEN IPC displays ORTA_RTT "StandbyLeft" ELIF (OrtaMde_D_Ind == StandbyRight[0x2]) THEN IPC displays ORTA_RTT "StandbyRight" ELIF (OrtaMde_D_Ind == ActiveLeft[0x3]) THEN IPC displays ORTA_RTT "ActiveLeft" ELIF (OrtaMde_D_Ind == ActiveRight[0x4]) THEN IPC displays ORTA_RTT "ActiveRight" ENDIF
Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	Define the mapping from CAN signal OrtaMde_D_Ind to the Off-Road Turn Assist Telltale
Purpose:	

Requirement Text:

The IPC shall display the Trail Turn Assist telltale as communicated by the CAN signal OrtaMde_D_Ind, according to Table 2, below.

OrtaMde_D_Ind	Displayed Symbol
Off (0x0)	[NONE]
StandbyLeft (0x1)	
StandbyRight (0x2)	
ActiveLeft (0x3)	
ActiveRight (0x4)	

Table 1: Mapping of CAN signal OrtaMde_D_Ind to Off-Road Turn Assist telltale states

5.2.4 Trail Turn Assist Off-Road Information-on-Demand Indication Display	(REQ-325816/C)
Requirement Status:	Frozen

Test Requirement:	TST-REQ-406178/A-Trail Turn Assist Cluster Function Verification Test TST-REQ-472739/A-TTA Off-Road Information-on-Demand Indication Display Test
Applicable to:	130101 - Drivers Information Module (Instrument Cluster)
Notes:	

Acceptance Criteria:	IF (OrtaMde_D_Ind == Off[0x0]);
	THEN
	IPC displays Off-Road IOD [No Trail Turn Assist Graphics];
	ELIF [(OrtaMde_D_Ind == StandbyLeft[0x1]) || (OrtaMde_D_Ind == StanbyRight[0x2])];
	THEN
	IPC displays Off-Road IOD [Grey arrow above both rear wheels]
	ELIF (OrtaMde_D_Ind == ActiveLeft[0x3])
	THEN
	IPC displays Off-Road IOD [Green arrow above left rear wheel]
	ELIF (OrtaMde_D_Ind == ActiveRight[0x4])
	THEN
	IPC displays Off-Road IOD [Green arrow above right rear wheel]
	ENDIF

Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	Additional indications to Driver of feature status
Purpose:	

Requirement Text:

The IPC shall display the Trail Turn Assist indications in the Off-Road Information-on-Demand screen based on the following mapping of the CAN signal OrtaMde_D_Ind

OrtaMde_D_Ind	Displayed Symbol
Off (0x0)	[NONE]
StandbyLeft (0x1)	[Grey arrow above both rear wheels]
StandbyRight (0x2)	[Grey arrow above both rear wheels]
ActiveLeft (0x3)	[Green arrow above left rear wheel]
ActiveRight (0x4)	[Green arrow above right rear wheel]

Example of these indications are below:

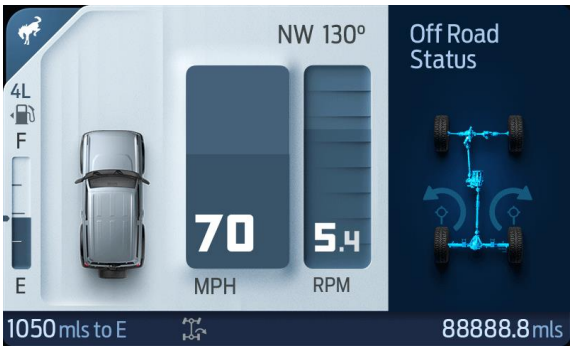


Figure 1:Example Off-Road IOD graphics of Trail Turn Assist in 'Standby' state

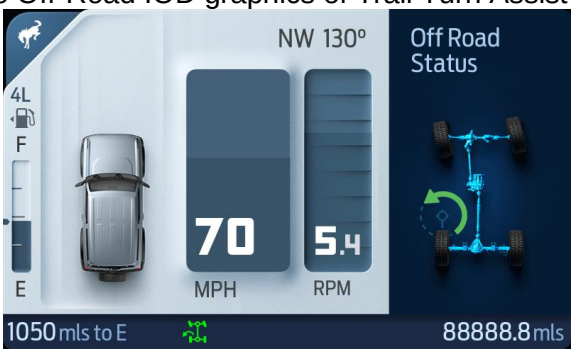


Figure 2: Example Off-Road IOD graphics of Trail Turn Assist in 'Active_Left' state

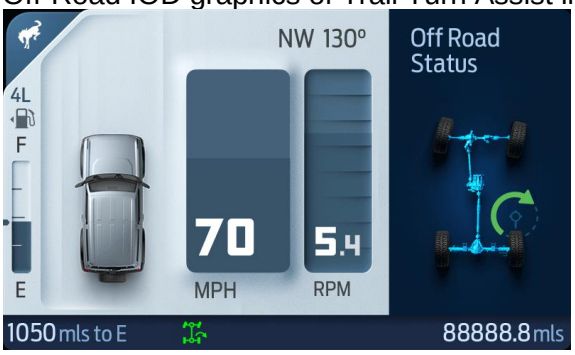


Figure 3: : Example Off-Road IOD graphics of Trail Turn Assist in 'Active_Right' state

5.2.5 Trail Turn Assist IPC Latency Timing	(REQ-325772/C)
Requirement Status:	Frozen
Test Requirement:	TST-REQ-472740/A-TTA IPC Latency Timing Test TST-REQ-406178/A-Trail Turn Assist Cluster Function Verification Test
Applicable to:	130101 - Drivers Information Module (Instrument Cluster)
Notes:	
Acceptance Criteria:	

	Time([IPC Changes ORTA_RTT Display]) - Time(OrtaMde_D_Ind(STATE_CHANGE)) <= 0.050 sec (50 ms) Time([IPC Changes OR IOD Display]) - Time(OrtaMde_D_Ind(STATE_CHANGE)) <= 0.050 sec (50 ms) Time([IPC Changes Message Display]) - Time(OrtaMsgTxt_D_Rq(STATE_CHANGE)) <= 0.050 sec (50 ms)
Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	To ensure in-time Driver indication
Purpose:	
Requirement Text: The IPC latency for enabling the driver indication (RTT and / or Off-Road Plan View Indication and / or message) based on CAN status change of associated signals shall not exceed 50ms.	

5.2.6 Trail Turn Assist IPC Synchronization	(REQ-325773/C)
Requirement Status:	Frozen
Test Requirement:	TST-REQ-406178/A-Trail Turn Assist Cluster Function Verification Test TST-REQ-472741/A-TTA IPC Synchronization Test
Applicable to:	130101 - Drivers Information Module (Instrument Cluster)
Notes:	
Acceptance Criteria:	Abs(Time([IPC Changes Message Display]) - Time([IPC Changes ORTA_RTT Display])) <= 0.005 sec (5 ms) Abs(Time([IPC Changes Message Display]) - Time([IPC Changes OR IOD Display])) <= 0.005 sec (5 ms) Abs(Time([IPC Changes ORTA_RTT Display]) - Time([IPC Changes OR IOD Display])) <= 0.005 sec (5 ms)
Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	To ensure synchronized driver indications

Purpose:	
Requirement Text: The synchronization of driver indications (RTT, message and Off-Road Plan View Indication) shall not exceed 5 ms.	

6. Trail Turn Assist Network Communications Function Specification - ECG

6.1 Trail Turn Assist Network Communication Function Requirements (761370/B)

6.1.1 Trail Turn Assist GWM / ECG Latency Timing	(REQ-305931/C)
Requirement Status:	Frozen
Test Requirement:	TST-REQ-406291/A-Trail Turn Assist APIM (SYNC) Function Verification Test TST-REQ-472748/A-TTA - GWM / ECG Latency Timing Test TST-REQ-406178/A-Trail Turn Assist Cluster Function Verification Test
Applicable to:	000601 - Vehicle Communication Network Subsystems
Notes:	
Acceptance Criteria:	Upon change in signal state of {OrtaMde_D_Ind_FD1, OrtaMsgTxt_D_Rq_FD1}, {OrtaMde_D_Ind_HS3, OrtaMsgTxt_D_Rq_HS3} changes within 5 ms
Last Change:	
Last modified:	10-Sep-2021 12:31
Rationale:	To ensure in-time driver indication
Purpose:	
Requirement Text: The GWM or ECG latency for broadcasting CAN signals shall not exceed 5 ms.	