Research & Vehicle Technology
"Infotainment Systems Product Development"

Feature – Propulsion Sound (Phoenix)

Infotainment Subsystem Part Specific Specification (SPSS)

Version 1.0

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FORD CONFIDENTIAL

Revision History

Date	Version	Notes	
March 9, 2022	**1.0**	**Initial Release**	

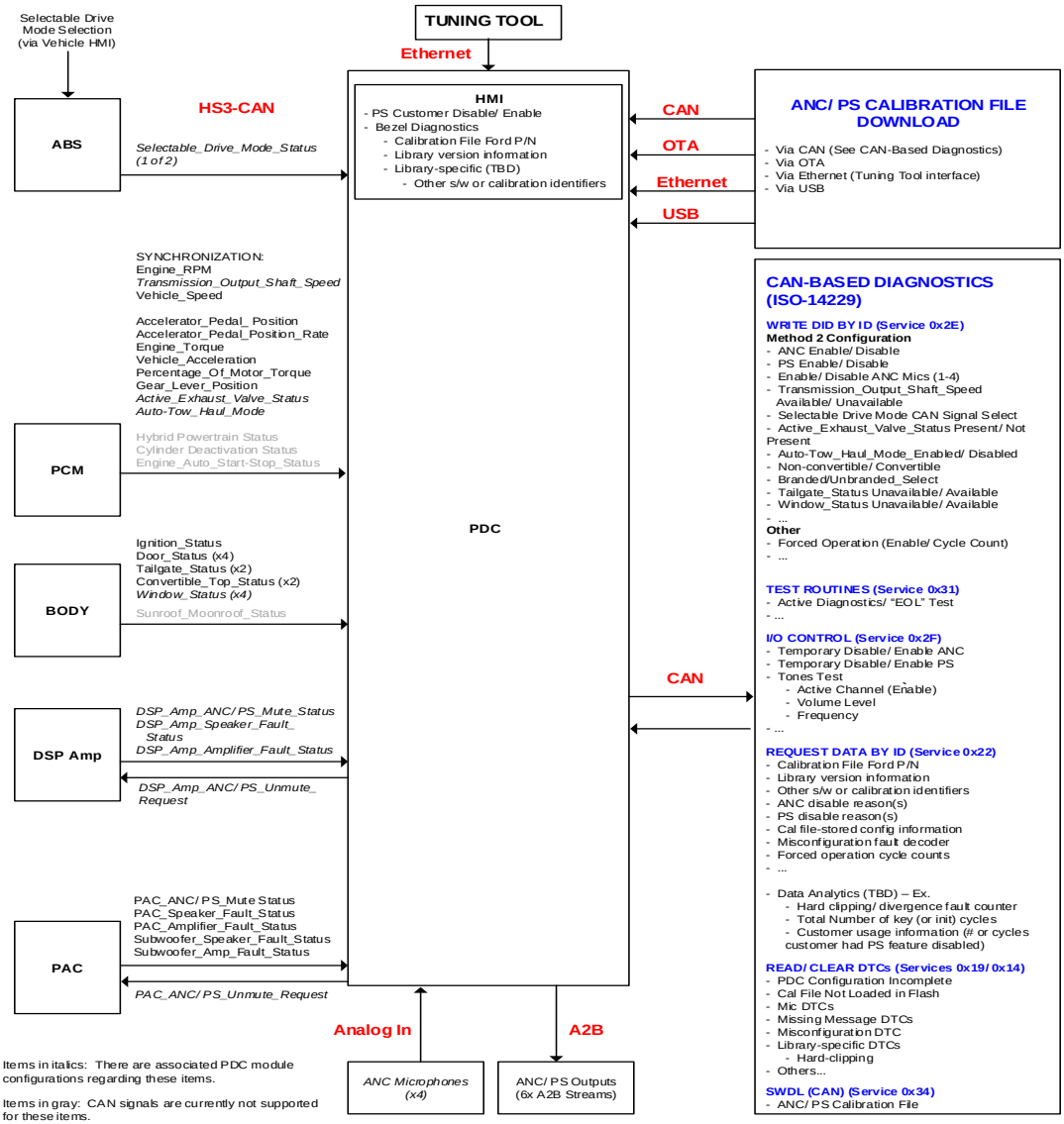
Table of Contents

1 Feature Assumptions

The APIM Phoenix Domain Controller (NVH Service) is expected to host ‘ASD Library’ and shall perform the operations necessary for initialization of the Library, input/ output audio connections to the Library. Muting/Unmuting the NVH audio based upon the PAC, DSP AMP, and Auxiliary Amp channel and amplifier fault statuses will be done by the Library (Not the NVH Service).

2 Logical Block Diagram

The diagram below illustrates the various interfaces to the ANC/PS Audio components that are related to the ANC/PS feature.



3 Architectural Design

3.1 PPS-CLD-REQ-483953/A-NVH Event Server

The 'NVH Event Server' is responsible to notify the change in vehicle status.

3.2 PPS-CLD-REQ-483952/A-NVH Event Client

The 'NVH Event Client' is the master that tells the ANC/PS Audio Components (i.e., ANC/PS Generator, Amplifier and Aux Amplifier Source Server) when to play the sound. It also receives the vehicle status from 'NVH Event Server' and controls the ANC/PS sound based on the status received.

3.3 PPS-CLD-REQ-433484/A-PS Generator

The 'PS Generator' is responsible for generating the propulsion sound signal.

3.4 PPS-CLD-REQ-433485/A-PS Amplifier

The PS Amplifier is responsible for producing the Propulsion Sound audio through the vehicle loudspeakers.

3.5 PPS-CLD-REQ-473738/A-PS Aux Amplifier

The 'PS Aux Amplifier' is responsible for producing auxiliary audio amplification for the propulsion sound audio through vehicle loudspeakers.

3.6 Deployment Table

The table below shows how the logical classes may be mapped to physical modules for the 'Propulsion Sound' feature/function. The table below covers the lead program.

At the time the specification was written the below table was the latest. If there are additional modules deployed to the class descriptions or the vehicle architecture changed since the spec was written and released, then the applicable implementation guide class description would cover those modules. If there is a conflict between the implementation guide and the table below the implementation guide takes precedent.

Logical Class	**Physical Module (ECU)**
NVH Event Server	BCM/PCM
NVH Event Client	APIM PDC CCPU
PS Generator	APIM PDC CCPU
PS Amplifier	PAC, DSP AMP (note applies to whatever module receiving the PS audio signal)
PS Aux Amplifier	Sub-Woofer Amplifier
PS Audio Components	NVH Event Client, PS Generator, PS Amplifier, PS Aux Amplifier

Module Present	PS Generator	PS Amplifier	PS Aux Amplifier	Notes
PDC, PAC	APIM PDC	PAC	-	-
PDC, PAC, Sub-Woofer Amp	APIM PDC	PAC	Sub-Woofer Amp	-
PDC, PAC, DSP Amp	APIM PDC	DSP AMP	-	PAC takes the responsibility of Secondary amplification.

3.7 PPS-IIR-REQ-433486/A-NVH Event Client Interface

3.7.1 Logical Signal Mapping

The CAN signals mentioned throughout this document shall refer to the CAN signal's logical name. The logical names shall be mapped to their actual CAN signal names. Please use the table below to perform the mapping. The InfoCAN database file is the master file for the actual CAN signal names. Note: There may be cases where the actual CAN signal name is used in this documentation.

Logical Name	CAN Signal Name
AudioHeadUnit_Channel_St	
AudioAmplifier_Channel_St	
Aux_Amplifier Channel_St	
AudioHeadUnit_Fault_St	InfotainmentAudio_St
AudioAmplifier_Fault_St	InfotainmentAudio_St2
Aux_Amplifier_Fault_St	InfotainmentAudio_St3

Table: Logical name/CAN signal mapping

3.7.2 MD-REQ-473378/A-EngExhMdeQuiet_D2_Stat

Message Type: Status

This method is used to indicate the exhaust status.

Signal name	Literals	Values	Description
EngExhMdeQuiet_D2_Stat	-	-	-
	Null	0x0	
	Stealth	0x1	
	Normal	0x2	
	Sport	0x3	
	Track	0x4	
	NotUsed_1	0x5	
	NotUsed_2	0x6	
	Faulty	0x7	

3.7.3 MD-REQ-473380/A-EngAout_N_Actl

Message Type: Status

This method is used to indicate engine speed in rotations per minute (RPM).

Signal name	Literals	Values	Description
EngAout_N_Actl	-		
	<Range>	0x000 - 0x1FFF	0 to 16382 Resolution: 2 Offset: 0

3.7.4 MD-REQ-473381/A-ApedPos_Pc_ActlArb

Message Type: Status

This method is used to indicate the accelerator pedal position, given in %.

Signal name	Literals	Values	Description
ApedPos_Pc_ActlArb	<Range>	0x000 – 0x3FF	0 to 102.3 Offset: 0 Resolution: 0.1

3.7.5 MD-REQ-473382/A-ApedPosPcActl_D_Qf

Message Type: Quality Factor

This method is used to indicate the quality factor of the accelerator PedalPosition signal

Signal name	Literals	Values	Description
ApedPosPcActl_D_Qf	-	-	-
	Fault	0x00	
	No_Data_Exists	0x01	
	Not_Within_Specifications	0x02	
	OK	0x03	

3.7.6 MD-REQ-473383/A-TrnAin_Tq_Actl

Message Type: Status

This method is used to indicate engine torque, in Nm.

Signal name	Literals	Values	Description
TrnAin_Tq_Actl	-		
	<Range>	0x000 - 0x7FF	-500 to 1547 Offset: -500 Resolution: 1

3.7.7 MD-REQ-473384/A-TrnAinTq_D_Qf

Message Type: Quality Factor

This method is used to indicate the quality factor of the EngineTorque signal.

Signal name	Literals	Values	Description
TrnAinTq_D_Qf	-	-	
	Fault	0x00	
	No_Data_Exists	0x01	
	Not_Wothin_Specifications	0x02	
	OK	0x03	

3.7.8 MD-REQ-473385/A-PwPckTq_D_Stat

Message Type: Status

This method is used to indicate the Power Pack Status.

Signal name	Literals	Values	Description
PwPckTq_D_Stat	-	-	-
	Off Tq Not Available	0x0	
	On Tq Not Available	0x1	
	Strt In Prg No Tq	0x2	
	On Tq Available	0x3	

3.7.9 MD-REQ-473386/A-Eng_D_Stat

Message Type: Status

This method is used to indicate the Engine Status.

Signal name	Literals	Values	Description
Eng_D_Stat	-	-	-
	EngOff	0x0	
	EngOn	0x1	
	EngAutoStopped	0x2	
	NotUsed	0x3	

3.7.10 MD-REQ-473390/A-AutoTowActv_B_Stat

Message Type: Status

Status signal to indicate Auto tow activation status.

Signal Name	Literals	Value	Description
AutoTowActv_B_Stat	No	0x0	
	Yes	0x1	

3.7.11 MD-REQ-483898/A-Veh_V_ActlEng

Message Type: Status

This signal is used to represent the vehicle speed.

Signal Name	Literals	Value	Description
VehVActlEng_D_Qf	-	-	Indicates vehicle speed.
	<Range>	0x0 – 0xFFFF	0 to 655.35 kilometers / hour. Unit: kph Resolution:0.01 Offset:0

3.7.12 MD-REQ-483899/A-VehVActlEng_D_Qf

Message Type: Status

This signal is used to represent the Quality factor for vehicle speed.

Signal Name	Literals	Value	Description
VehVActlEng_D_Qf	-	-	Indicates vehicle speed quality factor.
	Fault	0x0	Faulty
	NoData	0x1	NoDataExists
	NotInRange	0x2	NotWithinSpecifications
	OK	0x3	OK

3.7.13 MD-REQ-473391/A-SelDrvMdeHmi04_D_Rq

Message Type: Status

Request signal to select drive mode

Logical Signal Name	Literals	Value	Description
SelDrvMdeHmi04_D_Rq	SelDrvMde01	0x0	
	SelDrvMde02	0x1	
	SelDrvMde03	0x2	
	SelDrvMde04	0x3	
	SelDrvMde05	0x4	
	SelDrvMde06	0x5	
	SelDrvMde07	0x6	
	SelDrvMde08	0x7	
	SelDrvMde09	0x8	
	SelDrvMde10	0x9	
	SelDrvMde11	0xA	
	SelDrvMde12	0xB	
	SelDrvMde13	0xC	
	SelDrvMde14	0xD	
	SelDrvMde15	0xE	
	SelDrvMde16	0xF	
	SelDrvMde17	0x10	
	SelDrvMde18	0x11	
	SelDrvMde19	0x12	
	SelDrvMde20	0x13	
	SelDrvMde21	0x14	
	SelDrvMde22	0x15	
	SelDrvMde23	0x16	
	SelDrvMde24	0x17	
	SelDrvMde25	0x18	
	SelDrvMde26	0x19	

	SelDrvMde27	0x1A	
	SelDrvMde28	0x1B	
	SelDrvMde29	0x1C	
	SelDrvMde30	0x1D	
	SelDrvMde31	0x1E	
	Faulty	0x1F	

3.7.14 MD-REQ-473392/A-ActvDrvMde_D2_Stat

Message Type: Status

Status signal to indicate active drive mode

Logical Signal Name	Literals	Value	Description
ActvDrvMde_D2_Stat	SelDrvMde01	0x0	
	SelDrvMde02	0x1	
	SelDrvMde03	0x2	
	SelDrvMde04	0x3	
	SelDrvMde05	0x4	
	SelDrvMde06	0x5	
	SelDrvMde07	0x6	
	SelDrvMde08	0x7	
	SelDrvMde09	0x8	
	SelDrvMde10	0x9	
	SelDrvMde11	0xA	
	SelDrvMde12	0xB	
	SelDrvMde13	0xC	
	SelDrvMde14	0xD	
	SelDrvMde15	0xE	
	SelDrvMde16	0xF	
	SelDrvMde17	0x10	
	SelDrvMde18	0x11	
	SelDrvMde19	0x12	
	SelDrvMde20	0x13	
	SelDrvMde21	0x14	
	SelDrvMde22	0x15	
	SelDrvMde23	0x16	
	SelDrvMde24	0x17	
	SelDrvMde25	0x18	
	SelDrvMde26	0x19	
	SelDrvMde27	0x1A	
	SelDrvMde28	0x1B	
	SelDrvMde29	0x1C	

	SelDrvMde30	0x1D	
	SelDrvMde31	0x1E	
	Faulty	0x1F	

3.7.15 MD-REQ-273750/A-Ignition_Status

Message Type: Status

Signal sent to the infotainment system indicating the ignition status of the vehicle

Logical Signal Name	Literals	Value	Description
Ignition_Status	Unknown	0x0	
	OFF	0x1	
	Accessory	0x2	
	Run	0x4	
	Start	0x8	
	Invalid	0xF	

3.7.16 MD-REQ-482277/A-TrnRng_D_Rq

Message Type: Status

This signal is used to indicate the actual state of the shift lever or other device (and incorporates transmission state requests from outside functions such as FAPA).

Name	Literals	Value	Description
TrnRng_D_Rq	-	-	
	Park	0x0	
	Reverse	0x1	
	Neutral	0x2	
	Drive	0x3	
	Sport_DriveSport_Mposition	0x4	
	Low	0x5	
	Range1_M1_L1	0x6	
	Range2_M2_L2	0x7	
	Range3_M3_L3	0x8	
	Range4	0x9	
	Range5	0xA	
	Range6	0xB	
	NotUsed_1	0xC	
	NotUsed_2	0xD	
	Unknown_Position	0xE	
	Fault	0xF	

3.7.17 MD-REQ-473394/A-CnvtTopPos_Dn_Stat

Message Type: Status

Status signal to indicate convertible top position.

Signal Name	Literals	Value	Description
CnvtTopPos_Dn_Stat	Not_Down	0x0	
	Down	0x1	

3.7.18 MD-REQ-473395/A-CnvtTopPos_Up_Stat

Message Type: Status

Status signal to indicate convertible top position.

Signal Name	Literals	Value	Description
CnvtTopPos_Up_Stat	Not_Up	0x0	
	Up	0x1	

3.7.19 MD-REQ-479457/A-AudioHeadUnit_Channel_St

Message Type: Status

Signal used to indicate the status of the Audio Head Unit channel(s).

Note: For CAN all these signals need to be in the same message

Logical Signal Name	Literals	Value	Description
Channel1	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel2	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel3	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel4	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
	Null	0x0	

Channel5	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel6	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel7	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel8	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	

3.7.20 MD-REQ-473397/A-AudioAmplifier_Channel_St

Message Type: Status

Signal used to indicate the status of the channel(s) used by DSP AMP.

Note: For CAN all these signals need to be in the same message.

Logical Signal Name	Literals	Value	Description
Channel1	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel2	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel3	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
	Null	0x0	

Channel4	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel5	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel6	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel7	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel8	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel9	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel10	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel11	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel12	Null	0x0	
	NormalOperation	0x1	

	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel13	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel14	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel15	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel16	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel17	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel18	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel19	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel20	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	

	NotUsed	0x3	
Channel21	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel22	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel23	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel24	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	

3.7.21 MD-REQ-473396/A-Aux_Amplifier Channel_St

Message Type: Status

Signal used to indicate the status of the Aux Amplifier channel(s).

Note: For CAN all these signals need to be in the same message

Logical Signal Name	Literals	Value	Description
Channel1	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel2	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	
Channel3	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	

	NotUsed	0x3	
Channel4	Null	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	

3.7.22 MD-REQ-483908/A-AudioHeadUnit_Fault_St

Message Type: Status

Signal sent by the PAC indicating there is no infotainment audio because of an error condition when the infotainment system is powered ON.

Logical Signal Name	Literals	Value	Description
AudioHeadUnit_Fault_St	Null / Inactive	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	Not Used	0x3	

3.7.23 MD-REQ-483909/A-AudioAmplifier_Fault_St

Message Type: Status

Signal sent by the DSP AMP indicating there is no infotainment audio because of an error condition when the infotainment system is powered ON.

Logical Signal Name	Literals	Value	Description
AudioAmplifier_Fault_St	Null / Inactive	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	Not Used	0x3	

3.7.24 MD-REQ-473402/A-Aux_Amplifier_Fault_St

Message Type: Status

Signal sent by the Aux amplifier to indicate the status when the infotainment system is powered ON (ex. non-channel-specific faults).

Logical Signal Name	Literals	Value	Description
Aux_Amplifier_Fault_St	Null / Inactive	0x0	
	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	Not Used	0x3	

Note: This signal is reported by the PAC, based on diagnostic status information provided by the Aux Amplifier to the PAC via the A2B bus.

3.7.25 MD-REQ-482277/A-TrnRng_D_Rq

Message Type: Status

This signal is used to indicate the actual state of the shift lever or other device (and incorporates transmission state requests from outside functions such as FAPA).

Name	Literals	Value	Description
TrnRng_D_Rq	-	-	
	Park	0x0	
	Reverse	0x1	
	Neutral	0x2	
	Drive	0x3	
	Sport_DriveSport_Mposition	0x4	
	Low	0x5	
	Range1_M1_L1	0x6	
	Range2_M2_L2	0x7	
	Range3_M3_L3	0x8	
	Range4	0x9	
	Range5	0xA	
	Range6	0xB	
	NotUsed_1	0xC	
	NotUsed_2	0xD	
	Unknown_Position	0xE	
	Fault	0xF	

3.7.26 MD-REQ-483968/A-VehSimSnd_Pc_Rq

Message Type: Status

This signal is to request a level of simulated vehicle acceleration/deceleration sound according to driving characteristics, e.g. full, moderate or low vehicle acceleration/deceleration.

Name	Literals	Values	Description
			-
3.8 VehSimSnd_Pc_Rq	<Range>	-102.2 to 102.4	Min: -102.2 Max: 102.4 Resolution: 0.2 Offset: -102.2 Unit : %

4 General Requirements

4.1 PPS-SR-REQ-433479/A-Feature Configuration

The Infotainment system shall have a configurable parameter/DID to allow the Propulsion sound feature to be enabled/disabled.

- When enabled, all the functionality and signals defined in this SPSS shall be supported.
- When disabled, PS functionality shall not be available, and the functionality defined in this SPSS shall not be supported.

Refer to the Infotainment Diagnostic Specification for the details on the configuration.

4.2 PPS-SR-REQ-477739/A-PS Settings Preference

If Enhanced Memory is supported, then the 'NVH Event Client' shall support to persist the current PS settings (i.e., Enabled/Disabled) for each personality profile between power mode changes, bus asleep/awake and between battery resets.

If Enhanced memory is not supported, then the 'NVH Event Client' shall persist the current PS settings for the guest vehicle profile between power mode changes, bus asleep/awake and between battery resets.

Note: Refer 'Enhanced Memory InterfaceClient SPSS' to understand 'NVH Event Client' role in persisting PS settings.

5 Functional Definition

5.1 PPS-FUN-REQ-478849/A-PS Power Mode

5.1.1 Requirements

5.1.1.1 PPS-SR-REQ-478854/A-ANC/PS power mode state definitions

PS Sleep:
PS Sleep State is defined as the state where the CAN bus is asleep and PS functionality is powered down.

PS Standby:
PS Standby State is defined as the state where the CAN bus is active, but PS functionality is not active and is powered down if possible.

- Note this can be a low power state if the PS Amplifier is not powered up for other non-PS features.

PS Functional:
PS Functional State is defined as the state where the CAN bus is active and PS functionality is powered up.

5.1.1.2 PPS-SR-REQ-478856/A-Power-up for PS audio components

PS Audio Components shall transition from PS Standby/Sleep state to PS Functional state within 2.0 seconds of HMIAudioMode=OFF -> ON.

Only when the PS audio components DE bits are configured as enabled then the PS Amplifier, PS Generator shall support the requirements covered in this spec (refer IDS spec for details of DE bits).

5.1.1.3 PPS-SR-REQ-478858/A-Power down for PS audio components

PS Audio Components shall transition from Functional to Sleep/Standby when the 'HMIAudioMode = ON -> OFF/Load Shed'.

5.2 PPS-FUN-REQ-433476/A-Propulsion Sound Audio - Operation

5.2.1 Requirements

5.2.1.1 PPS-SR-REQ-433480/A-PS Audio Enable/Disable

PS Audio Components shall support to play propulsion audio on the infotainment speakers only when Propulsion audio is enabled through infotainment system screen. The PS Generator shall support to generate the PS audio within 'T_PS_Enable_time' when the propulsion audio is enabled.

PS Audio Components shall support to stop the propulsion audio on the infotainment speakers only when Propulsion audio is disabled through infotainment system screen.
PS Audio components shall support to gracefully mute the PS audio generation within 'T_PS_Disable_time' so that no audio blips or pop is heard.

5.2.1.2 PPS-TMR-REQ-481117/A-T_PS_Disable_time

Name	Description	Units	Range	Resolution	Default
T_PS_Disable_time	Maximum time the PS Generator shall take to stop generating the PS audio and mute the channel. Note: Maximum time defined as the default value	msec	0-1000		100

5.2.1.3 PPS-TMR-REQ-481097/A-T_PS_Enable_time

Name	Description	Units	Range	Resolution	Default
T_PS_Enable_time	Maximum time the PS Generator shall take to unmute the audio channel and to start PS audio generation. Note: Maximum time defined as the default value	msec	0-1000		100

5.2.1.4 PPS-SR-REQ-479458/A-Error Handling when any of the Audio Head Unit channel(s) are faulted

When the PAC detects 1 or more of its audio channel(s) are faulted then the Audio Head Unit shall set the corresponding signal in the 'AudioHeadUnit_Channel_St.Channel [n] = ErrorState_NoAudio'. When the 'NVH Event Client' receives 'ErrorState_NoAudio' that means the corresponding audio channel on the 'Audio Head Unit' is faulted. The 'NVH Event Client' shall take necessary fault handling as needed

In the same ignition cycle, if the PAC audio channel recovers from error then the corresponding 'AudioHeadUnit_Channel_St.Channel [n]' signal shall change to NormalOperation.

Note: For a given vehicle configuration when there are unused audio channels with the PAC, the corresponding 'AudioHeadUnit_Channel_St.Channel [n]' shall remain 'Null'.
'n' represents the possible channels it can support.

5.2.1.5 PPS-SR-REQ-473860/A-Error Handling when any of the Amplifier audio channel(s) are faulted

When the 'ANC/PS Amplifier' detects 1 or more of its audio channel(s) are faulted then the 'ANC/PS Amplifier' shall set the corresponding signal in the 'AudioAmplifier_Channel_St.Channel [n] = ErrorState_NoAudio'. When the 'NVH Event Client' receives 'ErrorState_NoAudio' that means the corresponding audio channel on the 'ANC/PS Amplifier' is faulted. The 'NVH Event Client' shall take necessary fault handling as needed

In the same ignition cycle, if the 'ANC/PS Amplifier' audio channel recovers from error then the corresponding ''AudioAmplifier_Channel_St.Channel [n]' signal shall change to NormalOperation.

Note: For a given vehicle configuration when there are unused audio channels in the 'ANC/PS Amplifier', the corresponding 'AudioAmplifier Channel_St.Channel [n]' shall remain 'Null'. 'n' represents the possible channels the 'ANC/PS Amplifier' can support.

5.2.1.6 PPS-SR-REQ-473877/A-Error Handling when Aux Amplifier audio channel(s) are faulted

When the 'ANC/PS Aux Amplifier' detects 1 or more of its audio channel(s) is faulted then it shall set the corresponding signal in the 'Aux_Amplifier_Channel_St.Channel [n] = ErrorState_NoAudio'. When the 'NVH Event Client' receives 'ErrorState_NoAudio' that means the corresponding audio channel on the 'ANC/PS Amplifier' is faulted. The 'NVH Event Client' shall take necessary fault handling as needed

In the same ignition cycle, if the 'ANC/PS Aux Amplifier' audio channel recovers from error then the corresponding ''Aux_Amplifier_Channel_St.Channel [n]' signal shall change to NormalOperation.

Note1: This signal is reported by the PAC, based on diagnostic status information provided by the Aux Amplifier to the PAC via the A2B bus.
Note2: For a given vehicle configuration when there are unused audio channels in the 'ANC/PS Aux Amplifier', then the respective 'Aux_Amplifier_Channel_St.Channel [n]' signals shall remain 'Null'.
Note3: 'n' represents the possible channels the 'ANC/PS Aux Amplifier'.

5.2.1.7 PPS-SR-REQ-483910/A-Error Handling when Audio Head Unit is in Error State and cannot produce audio

The 'NVH Event Client' shall take appropriate fault handling when it receives AudioHeadUnit_Fault_St = ErrorState_NoAudio.

When the 'NVH Event Client' receives AudioHeadUnit_Fault_St = ErrorState_NoAudio that means the PAC cannot produce audio through the vehicle speakers (ex. "Overvoltage Protection Active") and fault handling should be taken by the 'NVH Event Client ' as needed (ex HMI updates if needed). If the PAC recovers and can produce audio through speakers, then the signal AudioHeadUnit_Fault_St shall change to NormalOperation.

5.2.1.8 PPS-SR-REQ-483911/A-Error Handling when Audio Amplifier is in Error State and cannot produce audio

The 'NVH Event Client' shall take appropriate fault handling when it receives AudioAmplifier_Fault_St = ErrorState_NoAudio.

When the 'NVH Event Client' receives AudioAmplifier_Fault_St = ErrorState_NoAudio that means the DSP amplifier cannot produce audio through the vehicle speakers (ex. "Overvoltage Protection Active") and fault handling should be taken by the 'NVH Event Client' as needed (ex HMI updates if needed). If the DSP amplifier recovers and can produce audio through speakers, then the signal AudioAmplifier_Fault_St shall change to NormalOperation.

Note: For a given vehicle configuration when the 'PS Amplifier' is not in the vehicle network, then the InfotainmentAudio.St2 shall remain 'Null'.

5.2.1.9 PPS-SR-REQ-473718/A-Error Handling when Aux Amplifier is in Error State and cannot produce audio

The 'NVH Event Client' shall take appropriate fault handling when it receives Aux_Amplifier_Fault_St = ErrorState_NoAudio.

When the 'NVH Event Client' receives Aux_Amplifier_Fault_St = ErrorState_NoAudio that means the 'ANC/PS Aux Amplifier' cannot produce audio through the vehicle speakers (ex. "Overvoltage Protection Active") and fault handling should be taken by the 'NVH Event Client' as needed (ex HMI updates if need). If the 'ANC/PS Aux Amplifier' recovers and can produce Propulsion sound audio through speakers, then the signal Aux_Amplifier_Fault_St shall change to NormalOperation.

Note1: This signal is reported by the PAC, based on diagnostic status information provided by the Aux Amplifier to the PAC via the A2B bus.
Note2: For a given vehicle configuration when the 'ANC/PS Aux Amplifier' is not in the vehicle network, then the Aux_Amplifier_Fault_St shall remain 'Null'.

5.2.1.10 PPS-SR-REQ-477741/A-Error Handling when speaker fault is reported

Whenever a system fault is detected with the ANC/PS Audio Components (i.e., AudioHeadUnit_Fault_St/AudioAmplifier_Fault_St/Aux_Amplifier_Fault_St') and the system is not able to play ANC/PS audio through vehicle speakers, then the active ANC/PS audio shall be stopped within T_PS_Disable_time (TBD) ms, and the ANC/PS audio generation shall remain disabled for the same ignition cycle.

5.2.1.11 PPS-SR-REQ-477740/A-Loss of Communication

When the NVH Event Client loses communication with PS Audio Components for more than 5 seconds, then the NVH Event Client shall stop all its operation (i.e., PS Audio) if any and shall remain disabled for the same ignition cycle.

5.2.2 Use Cases

5.2.2.1 PPS-UC-REQ-481077/A-User Enables Propulsion Sound Setting

Actors	Vehicle front seat Occupant
Pre-conditions	Infotainment system is ON Propulsion Sound is Disabled (user HMI)
Scenario Description	User change propulsion sound setting to enabled
Post-conditions	Propulsion sound is enabled Propulsion sound HMI is shown set to enabled.
Exception Use Cases	1. Amplifier/Aux Amplifier Fault is detected. 2. Channel Faults detected in the Amplifier/Aux Amplifier. 3. PS Feature is disabled through DE bit configuration.
Notes	Propulsion sound is just referring to propulsion sound interior to vehicle

5.2.2.2 PPS-UC-REQ-481078/A-User Disables Propulsion Sound Setting

Actors	Vehicle front seat occupant

Pre-conditions	Infotainment System is ON Propulsion Sound is Enabled (user HMI)
Scenario Description	User changes propulsion sound setting to disabled
Post-conditions	Propulsion sound is disabled Propulsion sound HMI is shown set to disabled
Exception Use Cases	1. Amplifier/Aux Amplifier Fault is detected. 2. Channel Faults detected in the Amplifier/Aux Amplifier. 3. PS Feature is disabled through DE bit configuration.
Notes	Propulsion sound is just referring to propulsion sound interior to vehicle

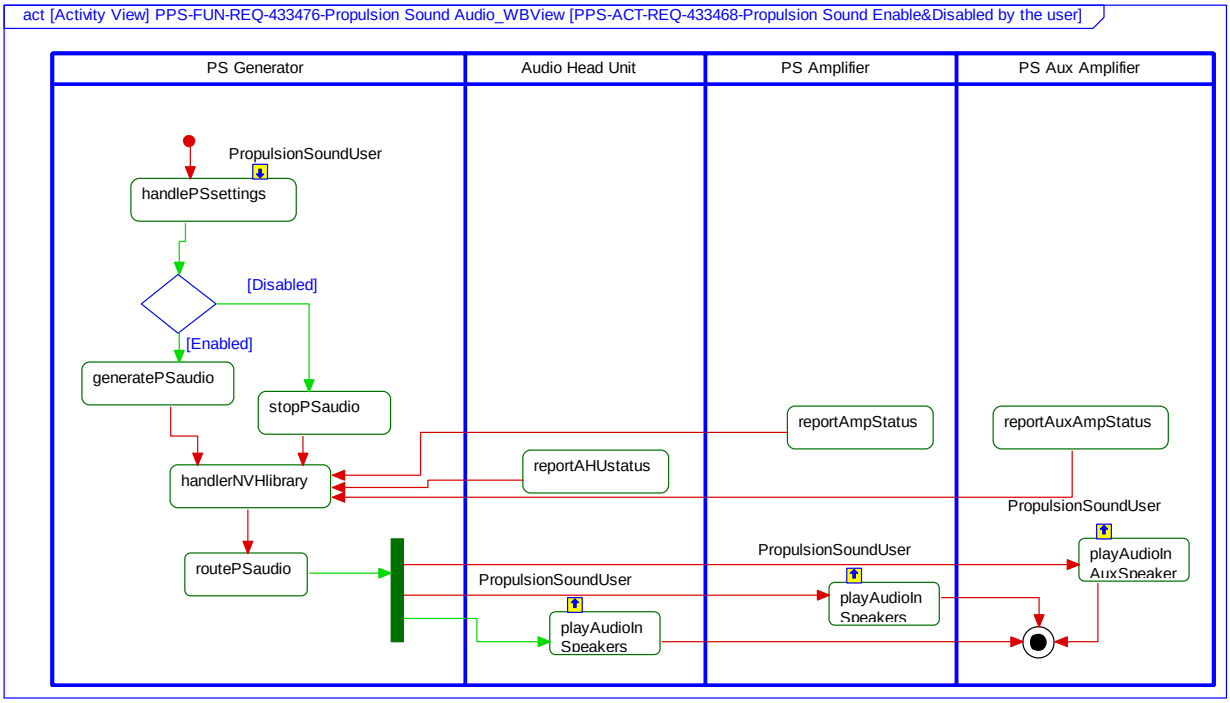
5.2.2.3 PPS-UC-REQ-433481/A-Amplifier Fault status is received while playing PS Audio

Actors	Vehicle front seat Occupant
Pre-conditions	Infotainment system is ON Propulsion Sound is Enabled, and the PS audio is played through vehicle speakers
Scenario Description	Amplifier faulted status signal is received.
Post-conditions	Infotainment system shall stop generating the propulsion audio. Only when no faults are detected from the amplifier the infotainment system shall start generating the PS Audio. PS audio will remain disabled and the user shall not be able to Enable PS Audio (via User HMI)
Exception Use Cases	
Notes	Propulsion sound is just referring to propulsion sound interior to vehicle

5.2.3 White Box View

5.2.3.1 Activity Diagrams

5.2.3.1.1 PPS-ACT-REQ-433468/A-Propulsion Sound Enable & Disabled by the user



5.2.3.2 Sequence Diagrams

5.2.3.2.1 PPS-SD-REQ-481538/A-Propulsion Sound Enable & Disabled by the user

Pre-condition

1. Infotainment system is ON

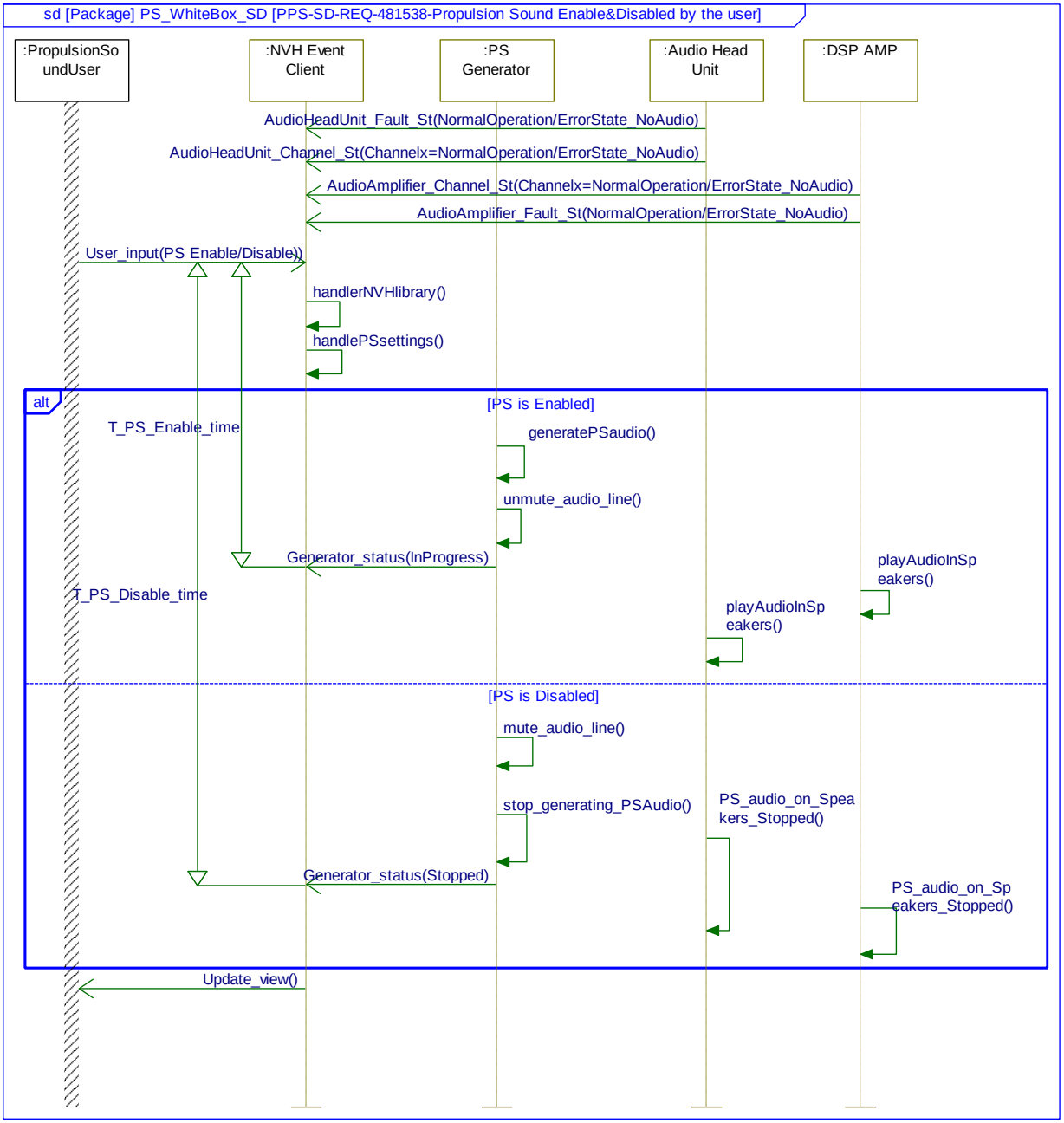
Scenario

1. Vehicle user Enables Propulsion Sound Generation from the Infotainment Screen.

Post-condition

1. Propulsion Sound audio shall be generated and played on the vehicle speakers.

Sequence Diagram



5.2.3.2.2 PPS-SD-REQ-481537/A-Propulsion Sound Muted & Unmuted based on Amp fault status

Pre-condition

1. Infotainment system in ON.
2. PS audio is generated and played in the Vehicle speakers

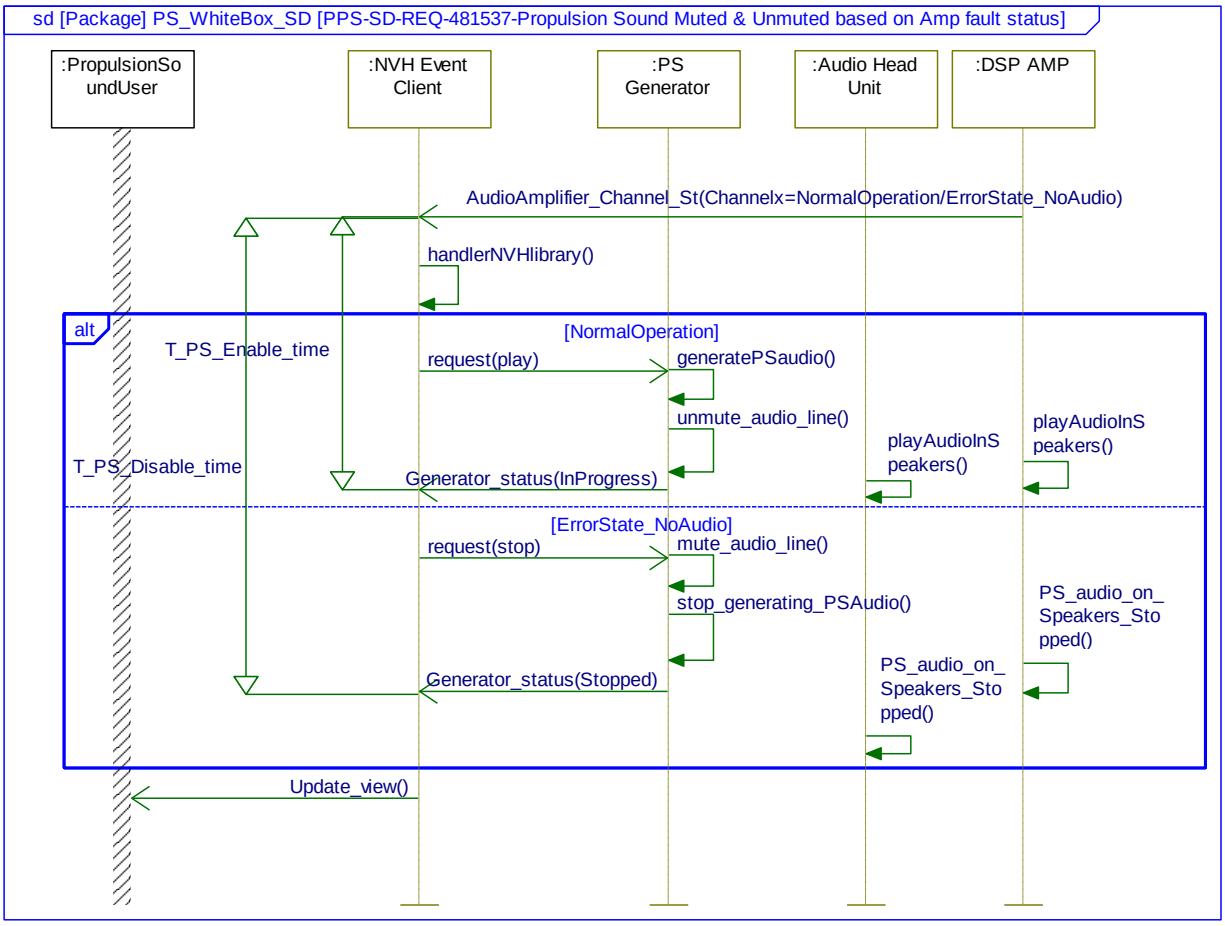
Scenario

1. Amplifier Fault status is received

Post-condition

1. Infotainment System shall stop generating the PS audio on the vehicle speakers.

Sequence Diagram



5.3 PPS-FUN-REQ-477737/A-Mute and Unmute Handling

5.3.1 Requirements

For certain vehicle events the PS audio shall be Muted/Unmuted by the NVH Service (ex. Door/Lift gate status, Window open/close, Amplifier, Aux Amplifier fault status).

5.3.1.1 PPS-REQ-477738/A-PS audio Muting/Unmuting

PS Generator shall make use of ‘A2BBroadcastState’ to Mute/Unmute the PS audio.

Note: Refer A2B SPSS for more details on ‘A2BBroadcastState’.

6 Appendix: Reference Documents

Reference #	Document Title
1	Phoenix ANC-PS FS
2	A2B SPSS
3	Enhanced Memory InterfaceClient SPSS
4	Infotainment Diagnostics Spec
5	
6	
7	
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