Research & Vehicle Technology
"Infotainment Systems Product Development"

Feature – Active Noise Cancellation (Phoenix)

Infotainment Subsystem Part Specific Specification (SPSS)

Version 1.0

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FORD CONFIDENTIAL

Revision History

Date	Version	Notes	
March 8, 2022	1.0	Initial Release	

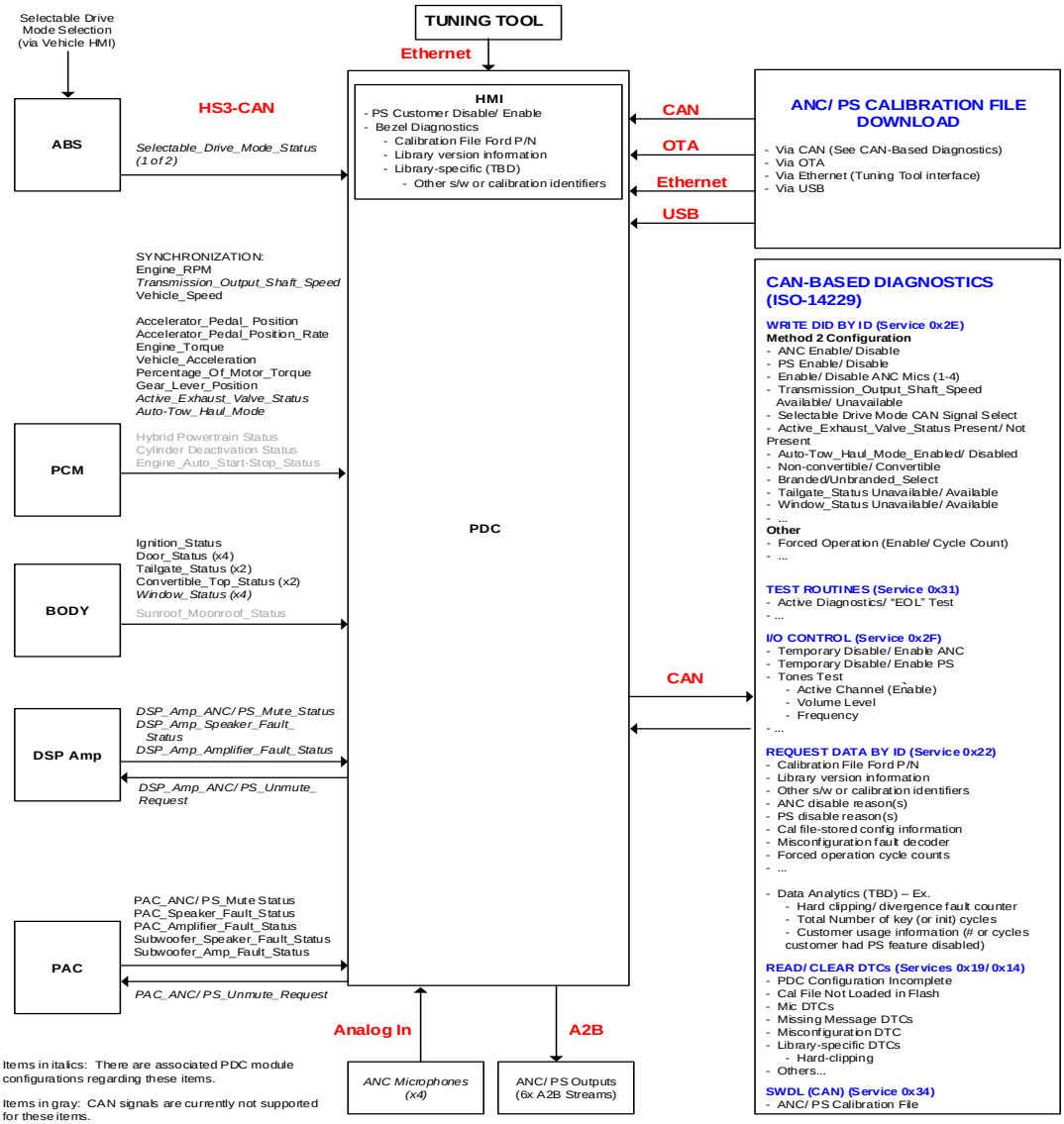
Table of Contents

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 ANC-CLD-REQ-433459/A-ANC Generator

The ANC Generator is responsible for generating the ANC (active noise cancellation) signal.

3.4 ANC-CLD-REQ-433460/A-ANC Amplifier

The ANC Amplifier is responsible for producing the ANC audio through the vehicle loudspeakers.

3.5 ANC-CLD-REQ-478037/A-ANC Aux Amplifier

The 'ANC Secondary Amplifier' is responsible for producing auxiliary audio amplification for the ANC audio through vehicle loudspeakers.

3.6 Deployment Table

The table below shows how the logical classes may be mapped to physical modules for the ANC 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
ANC Generator	APIM PDC CCPU
ANC Amplifier	PAC, DSP AMP (note applies to whatever module receiving the ANC audio signal)
ANC Aux Amplifier	Sub-Woofer Amplifier
ANC Audio Components	NVH Event Client, ANC Generator, ANC Amplifier, ANC Aux Amplifier

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

3.7 ANC-IIR-REQ-433461/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	
Aux_Amplifier Channel_St	
Audio_Amplifier_Channel_St	
PAC_Amplifier_Fault_St	InfotainmentAudio_St
DSP_Amplifier_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-473388/A-EngAoutNActl_D_QF

Message Type: Quality Factor

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

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

3.7.5 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	

3.7.6 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	

3.7.7 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	

3.7.8 MD-REQ-473387/A-TrnAout_W_ActlUnfilt

Message Type: Status

This method is used to indicate the Transmission Output Shaft Speed given in rad/s.
It is unfiltered or very lightly filtered. Suitable for calculating derivatives.

Signal name	Literals	Values	Description
TrnAout_W_ActlUnfilt	-		
	<Range>	0x0000 - 0x7FFD	0 to 3276.5 Resolution : 0.1 Offset: 0
	NoDataExists	0x7FFE	NoDataExists
	Faulty	0x7FFF	Faulty

3.7.9 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	

3.7.10 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	

3.7.11 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	

3.7.12 MD-REQ-473459/A-DrStatInnrTgate_B_Actl

Message Type: Status

This method is used to indicate the status iof inner tailgate/ liftgate.

Signal name	Literals	Values	Description
DrStatInnrTgate_B_Actl	-	-	-
	Closed	0x0	
	Ajar	0x1	

3.7.13 MD-REQ-473460/A-DrStatDrv_B_Actl

Message Type: Status

This method is used to indicate the status of the driver door.

Signal name	Literals	Values	Description
DrStatDrv_B_Actl	-	-	-
	Closed	0x0	
	Ajar	0x1	

3.7.14 MD-REQ-473461/A-DrStatPsngr_B_Actl

Message Type: Status

This method is used to indicate the status of the passenger door.

Signal name	Literals	Values	Description
DrStatPsngr_B_Actl	-	-	-
	Closed	0x0	
	Ajar	0x1	

3.7.15 MD-REQ-473462/A-DrStatRr_B_Actl

Message Type: Status

This method is used to indicate the status of the rear right door.

Signal name	Literals	Values	Description
DrStatRr_B_Actl	-	-	-
	Closed	0x0	
	Ajar	0x1	

3.7.16 MD-REQ-473463/A-DrStatRl_B_Actl

Message Type: Status

This method is used to indicate the status of the rear left door.

Signal name	Literals	Values	Description
DrStatRl_B_Actl	-	-	-
	Closed	0x0	
	Ajar	0x1	

3.7.17 MD-REQ-473464/A-DriverWindowPosition

Message Type: Status

This method is used to indicate the driver windows status.

Signal name	Literals	Values	Description
DriverWindowPosition	-	-	-
	Undefined_window_position	0x0	
	Fully_closed_position	0x1	
	Between_fully_closed_and_10___op	0x2	
	Between_10___open_and_60___open	0x3	
	Between_60___open_and_fully_open	0x4	
	Fully_open_position"	0x5	

3.7.18 MD-REQ-473465/A-RearDriverWindowPos

Message Type: Status

This method is used to indicate the rear driver windows status.

Signal name	Literals	Values	Description
RearDriverWindowPos	-	-	-
	Undefined_window_position	0x0	
	Fully_closed_position	0x1	
	Between_fully_closed_and_10___op	0x2	
	Between_10___open_and_60___open	0x3	
	Between_60___open_and_fully_open	0x4	
	Fully_open_position"	0x5	

3.7.19 MD-REQ-473466/A-PassWindowPosition

Message Type: Status

This method is used to indicate the passenger windows status.

Signal name	Literals	Values	Description
PassWindowPosition	-	-	-
	Undefined_window_position	0x0	
	Fully_closed_position	0x1	
	Between_fully_closed_and_10___op	0x2	
	Between_10___open_and_60___open	0x3	
	Between_60___open_and_fully_open	0x4	
	Fully_open_position"	0x5	

3.7.20 MD-REQ-473467/A-RearPassWindowPos

Message Type: Status

This method is used to indicate the rear passenger windows status.

Signal name	Literals	Values	Description
RearPassWindowPos	-	-	-
	Undefined_window_position	0x0	
	Fully_closed_position	0x1	
	Between_fully_closed_and_10___op	0x2	
	Between_10___open_and_60___open	0x3	
	Between_60___open_and_fully_open	0x4	
	Fully_open_position"	0x5	

3.7.21 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	

3.7.22 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	

3.7.23 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	
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	
	Null	0x0	

Channel8	NormalOperation	0x1	
	ErrorState_NoAudio	0x2	
	NotUsed	0x3	

3.7.24 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	
Channel4	Null	0x0	
	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	
	Null	0x0	

Channel7	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	

3.7.25 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	

3.7.26 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	

3.7.27 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	

3.7.28 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.

4 General Requirements

4.1 ANC-SR-REQ-481697/A-Feature Configuration

The Infotainment system shall have a configurable parameter/DID to enabled/disable the ANC feature

- When enabled, all the functionality and signals defined in this SPSS shall be supported.
- When disabled, ANC 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.

5 Functional Definition

5.1 ANC-FUN-REQ-477777/A-ANC Power Mode

5.1.1 Requirements

5.1.1.1 Deployment Table

The table below shows how the logical classes may be mapped to physical modules for the ANC 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)
ANC Generator	APIM Phoenix Domain Controller
ANC Amplifier	AHU/PAC, DSP AMP (note applies to whatever module receiving the ANC signal)
ANC Aux Amplifier	Sub-Woofer Amplifier
ANC Audio Components	ANC Generator, ANC Amplifier, ANC Aux Amplifier

5.1.1.2 ANC-SR-REQ-477778/A-ANC/PS power mode state definitions

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

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

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

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

5.1.1.3 ANC-SR-REQ-477779/A-Power-up for ANC audio components

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

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

5.1.1.4 ANC-SR-REQ-477780/A-Power down for ANC audio components

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

5.2 ANC-FUN-REQ-433451/A-ANC Audio Operation

5.2.1 Requirements

5.2.1.1 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.

5.2.1.2 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.

5.2.1.3 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'.

5.2.1.4 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.

5.2.1.5 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'.

5.2.1.6 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'.

5.2.1.7 ANC-SR-REQ-484619/A-Error Handling when speaker fault is reported

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

5.2.1.8 ANC-TMR-REQ-484617/A-T_ANC_Disable_time

Name	Description	Units	Range	Resolution	Default
T_ANC_Disable_time	Maximum time the ANC Generator shall take to stop generating ANC audio and to mute the audio channel. Note: Maximum time defined as the default value	msec	0-1000	5	100

5.2.1.9 ANC-SR-REQ-484406/A-Loss of Communication

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

5.2.2 Use Cases

5.2.2.1 ANC-UC-REQ-481737/A-Activating ANC

Actors	Vehicle Occupant
Pre-conditions	Infotainment system is ON Vehicle Engine is OFF
Scenario Description	Vehicle Engine is turned ON
Post-conditions	ANC is enabled in the vehicle.
Exception Use Cases	1. Amplifier/Aux Amplifier Fault is detected. 2. Channel Faults detected in the Amplifier/Aux Amplifier. 3. ANC Feature is disabled through DE bit configuration.
Notes	ANC is just referring to sound interior to vehicle

5.2.2.2 ANC-UC-REQ-481738/A-Deactivating ANC

Actors	Vehicle Occupant
Pre-conditions	Infotainment system is ON Vehicle Engine is ON
Scenario Description	Vehicle Engine is turned OFF
Post-conditions	ANC is disabled in the vehicle.
Exception Use Cases	
Notes	ANC is just referring to sound interior to vehicle

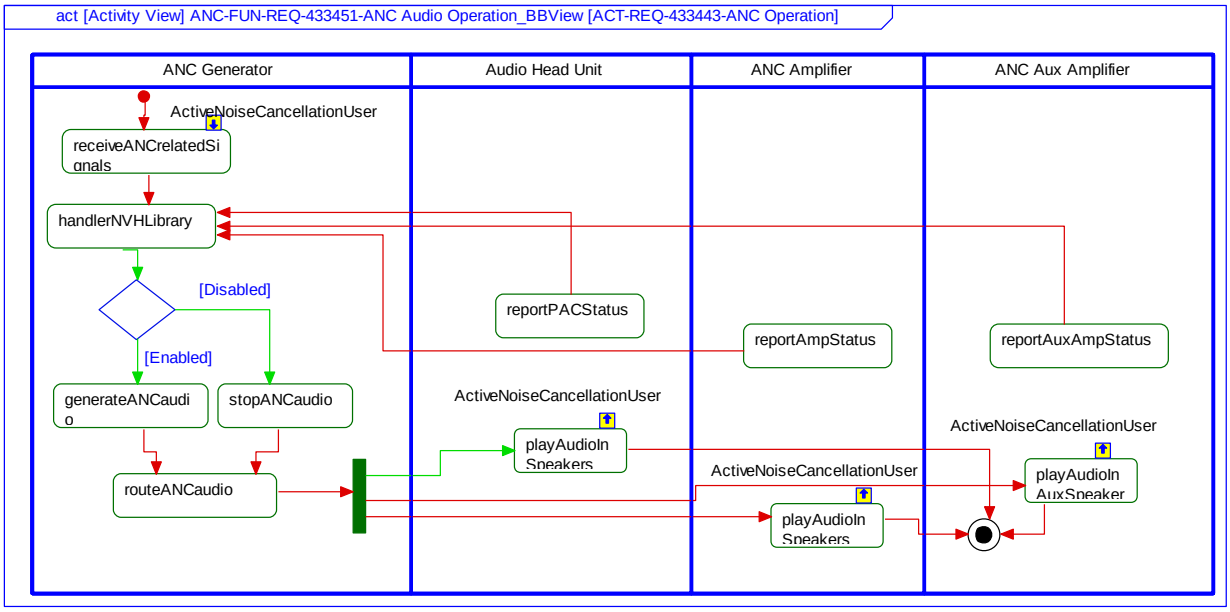
5.2.2.3 ANC-UC-REQ-481739/A-Amplifier Fault status is received while playing ANC Audio

Actors	Vehicle Occupant
Pre-conditions	Infotainment system is ON ANC is Enabled, and the ANC audio is played through vehicle speakers
Scenario Description	Amplifier faulted status signal is received.
Post-conditions	Infotainment system shall stop generating the ANC audio. Only when no faults are detected from the amplifier the infotainment system shall start generating the ANC Audio.
Exception Use Cases	
Notes	ANC is just referring to sound interior to vehicle

5.2.3 White Box View

5.2.3.1 Activity Diagrams

5.2.3.1.1 ANC-ACT-REQ-433443/A-ANC Operation



5.2.3.2 Sequence Diagrams

5.2.3.2.1 ANC-SD-REQ-482057/A-ANC Operation

Pre-condition

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

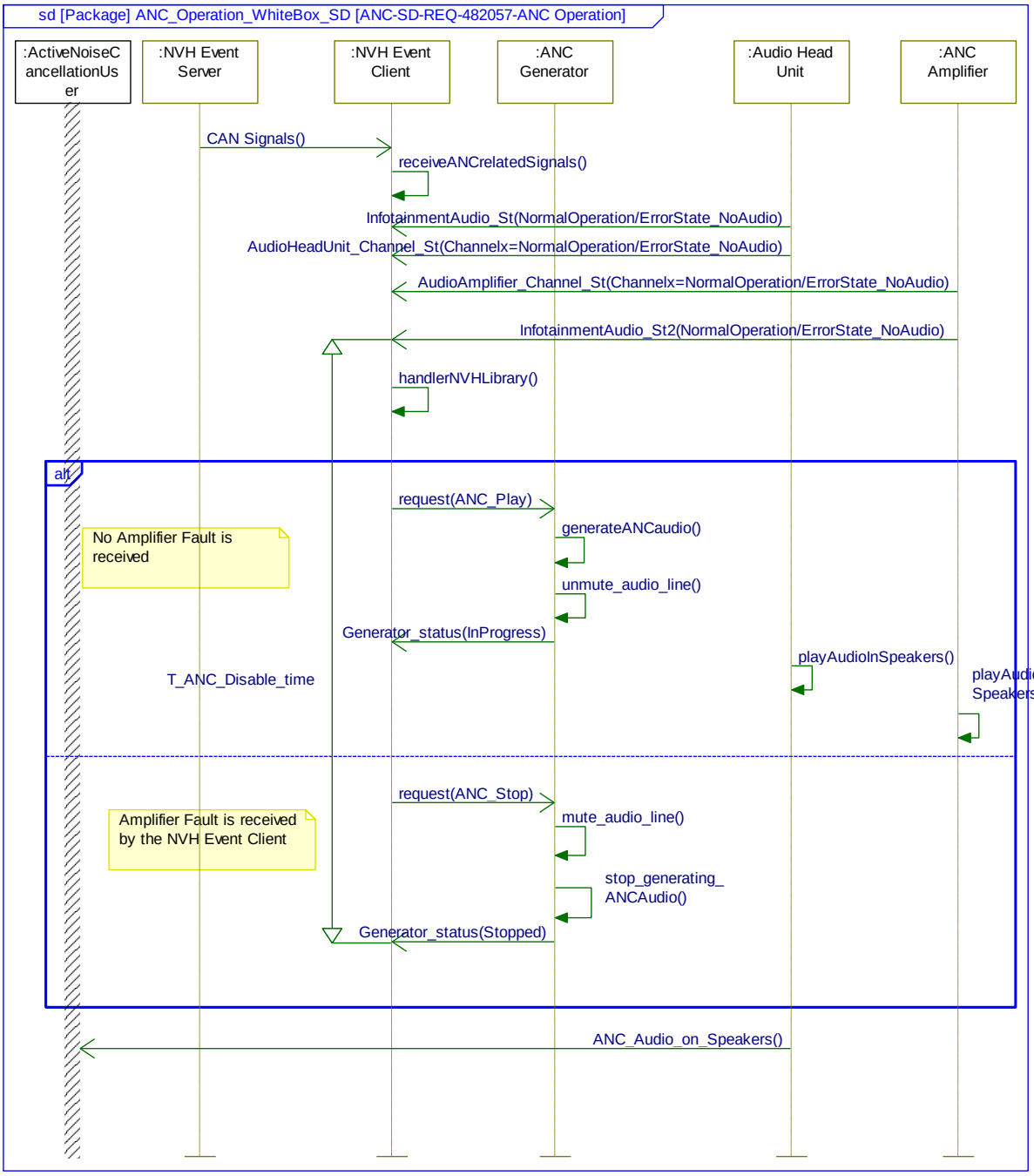
Scenario

1. Amplifier Fault status is received

Post-condition

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

Sequence Diagram



5.3 ANC-FUN-REQ-481698/A-Mute and Unmute Handling

5.3.1 Requirements

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

5.3.1.1 ANC-REQ-481699/A-ANC audio Muting/Unmuting

ANC Generator shall make use of 'A2BBroadcastState' to Mute/Unmute the ANC 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	
4	
5	
6	
7	
8	
9	
10	
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