



Research & Vehicle Technology
“Infotainment Systems Product Development”

Feature – Audio Settings v2

**APIM Infotainment Subsystem Part Specific
Specification (SPSS)**

Version 1.1

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Version Date: May 23, 2019

FORD CONFIDENTIAL



Revision History

| Date | Version | Notes | |
|-------------------|---|--|-----------------------------------|
| September 6, 2018 | 1.0 | Initial SYNC 4.1 Release | Integrates AHU features into SYNC |
| May 23, 2019 | 1.1 | | |
| | AUDSET-FRD-REQ-310964/B-Audio Settings - Variant 2 (APIM 4.X) | <jmyslin2> changed feature name description to SYNC 4.X | |
| | STR-540122/B-Interface Requirements - APIM v2 | <jmyslin2> added surround sound variant 1 signals | |
| | MD-REQ-276496/B-Audio_Demo_CMND | <jmyslin2> accidental revision bump. No change | |
| | MD-REQ-348781/A-Audio_Demo_CMND - Variant 2 | <jmyslin2> signal for Audio Demo variant 2 | |
| | MD-REQ-348784/A-Audio_Demo_Status - variant 2 | <jmyslin2> New Audio Demo MD for audio demo variant 2 | |
| | AUDSET-CLD-REQ-347441/A-Audio Settings Server - DSP AMP variant 2 | <jmyslin2> New Class Description for DSP AMP variant 2 | |
| | AUDSETv2-CLD-REQ-348194/A-Audio Demo Audio Switch Server - variant 2 | <jmyslin2> New class description for Audio Demo Audio Switch Server | |
| | AUDSETv2-CLD-REQ-349882/A-Audio Demo Client - variant 2 | <jmyslin2> New Class Description Audio Demo Client variant 2 | |
| | AUDSETv2-CLD-REQ-349883/A-Audio Demo Server - variant 2 | <jmyslin2> New Class description for Audio Demo Server variant 2 | |
| | AUDSET-SR-REQ-014882/C-Audio Settings Server module controlling Tonal Settings (TcSE ROIN-40208-3) | <jmyslin2> Updated requirement to include the DSP AMP variant 2 | |
| | AUDSET-SR-REQ-014883/E-Display module looking at the correct Audio Settings Server Module (TcSE ROIN-40209-2) | <jmyslin2> updated to include DSP AMP variant 2 module | |
| | STR-540124/B-Functional Definition | <jmyslin2> added surround sound variant 1 for legacy DSP AMP's | |
| | AUDSET-SR-REQ-014926/C-Audio during an Audio Demonstration event (TcSE ROIN-39733-2) | <jmyslin2> no content change. Just noted that the audio demonstration audio is a media source. | |
| | AUDSET-FUN-REQ-348161/A-Audio Demonstration Mode - variant 2 (with DSP AMP v2) | <jmyslin2> Audio Demonstration when paired with DSP AMP variant 2 | |
| | AUDSET-SR-REQ-348201/A-Audio Demo variant 2 Module Deployment | <jmyslin2> audio demo module deployment | |
| | AUDSETv2-SR-REQ-350948/A-Chimes and Prompts during Audio Demonstration | <jmyslin2> new requirement | |
| | AUDSET-SR-REQ-348162/A-Activation of an Audio Demo event | <jmyslin2> new audio demo requirement when paired with a DSP AMP variant 2 | |
| | AUDSETv2-SR-REQ-350947/A-Audio during an Audio Demonstration event | <jmyslin2> new requirement | |
| | AUDSET-SR-REQ-348207/A-Completion of an Audio Demonstration event | <jmyslin2> New Audio Demo requirement for audio demonstration variant 2 | |
| | AUDSET-SR-REQ-348205/A-Cancelling Audio Demonstration during an audio demonstration event | <jmyslin2> new audio demo variant 2 requirement | |
| | AUDSETv2-TMR-REQ-348206/A-T_AudioDemo_Rsp | <jmyslin2> new timing requirement for DSPv2 for audio demonstration | |
| | AUDSET-SD-REQ-348208/A-Activating Audio Demonstration Mode | <jmyslin2> new sequence diagram audio demonstration variant 2 | |
| | AUDSET-SD-REQ-348209/A-Deactivating Audio Demonstration Mode | <jmyslin2> New sequence diagram audio demonstration variant 2 | |
| | AUDSETv2-FUN-REQ-016388/B-Simulated Surround Sound (DSP Mode Setting) - Variant 2 (TcSE ROIN-290236-1) | <jmyslin2> No content change. Just added variant 2 to the title of the function | |



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1 Architectural Design

1.1 Interface Requirements - APIM v2

Interface Requirements

1.1.1 MD-REQ-276198/A-SetBalance

Message Type: Request

Signal sent by the Audio Setting Client to the Audio Settings Server to set the Balance level.

| Logical Signal Name | Literals | Value | Description |
|---------------------|------------------|-------|--------------------------------------|
| SetBalance | -7 | 0x0 | Set balance all the way to the Left |
| | -6 | 0x1 | |
| | -5 | 0x2 | |
| | -4 | 0x3 | |
| | -3 | 0x4 | |
| | -2 | 0x5 | |
| | -1 | 0x6 | |
| | 0 | 0x7 | Mid-Point |
| | +1 | 0x8 | |
| | +2 | 0x9 | |
| | +3 | 0xA | |
| | +4 | 0xB | |
| | +5 | 0xC | |
| | +6 | 0xD | |
| | +7 | 0xE | Set balance all the way to the Right |
| | Inactive/Invalid | 0xF | |

1.1.2 MD-REQ-276206/B-Balance.St

Message Type: Status

Signal sent by the Audio Setting Server with the current status of the Balance level

| Logical Signal Name | Literals | Value | Description |
|---------------------|----------|-------|----------------------------------|
| Balance.St | -7 | 0x0 | Balance all the way to the Left |
| | -6 | 0x1 | |
| | -5 | 0x2 | |
| | -4 | 0x3 | |
| | -3 | 0x4 | |
| | -2 | 0x5 | |
| | -1 | 0x6 | |
| | 0 | 0x7 | Mid-Point |
| | +1 | 0x8 | |
| | +2 | 0x9 | |
| | +3 | 0xA | |
| | +4 | 0xB | |
| | +5 | 0xC | |
| | +6 | 0xD | |
| | +7 | 0xE | Balance all the way to the Right |



Inactive/Invalid

0xF

1.1.3 MD-REQ-276207/A-SetBass**Message Type:** Request

Signal sent by the Audio Setting Client to the Audio Settings Server to set the Bass level.

| Logical Signal Name | Literals | Value | Description |
|---------------------|------------------|-------|-------------|
| SetBass | -7 | 0x0 | Min Bass |
| | -6 | 0x1 | |
| | -5 | 0x2 | |
| | -4 | 0x3 | |
| | -3 | 0x4 | |
| | -2 | 0x5 | |
| | -1 | 0x6 | |
| | 0 | 0x7 | Mid-Point |
| | +1 | 0x8 | |
| | +2 | 0x9 | |
| | +3 | 0xA | |
| | +4 | 0xB | |
| | +5 | 0xC | |
| | +6 | 0xD | |
| | +7 | 0xE | Max Bass |
| | Inactive/Invalid | 0xF | |

1.1.4 MD-REQ-276208/A-Bass.St**Message Type:** Status

Signal sent by the Audio Setting Server with the current status of the Bass level

| Logical Signal Name | Literals | Value | Description |
|---------------------|------------------|-------|-------------|
| Bass.St | -7 | 0x0 | Min Bass |
| | -6 | 0x1 | |
| | -5 | 0x2 | |
| | -4 | 0x3 | |
| | -3 | 0x4 | |
| | -2 | 0x5 | |
| | -1 | 0x6 | |
| | 0 | 0x7 | Mid-Point |
| | +1 | 0x8 | |
| | +2 | 0x9 | |
| | +3 | 0xA | |
| | +4 | 0xB | |
| | +5 | 0xC | |
| | +6 | 0xD | |
| | +7 | 0xE | Max Bass |
| | Inactive/Invalid | 0xF | |

**1.1.5 MD-REQ-276209/A-SetMidRange****Message Type:** Request

Signal sent by the Audio Setting Client to the Audio Settings Server to set the Mid Range level.

| Logical Signal Name | Literals | Value | Description |
|---------------------|------------------|-------|--------------|
| SetMidRange | -7 | 0x0 | Min MidRange |
| | -6 | 0x1 | |
| | -5 | 0x2 | |
| | -4 | 0x3 | |
| | -3 | 0x4 | |
| | -2 | 0x5 | |
| | -1 | 0x6 | |
| | 0 | 0x7 | Mid-Point |
| | +1 | 0x8 | |
| | +2 | 0x9 | |
| | +3 | 0xA | |
| | +4 | 0xB | |
| | +5 | 0xC | |
| | +6 | 0xD | |
| | +7 | 0xE | Max MidRange |
| | Inactive/Invalid | 0xF | |

1.1.6 MD-REQ-276210/A-MidRange.St**Message Type:** Status

Signal sent by the Audio Setting Server with the current status of the Mid Range level

| Logical Signal Name | Literals | Value | Description |
|---------------------|------------------|-------|--------------|
| MidRange.St | -7 | 0x0 | Min MidRange |
| | -6 | 0x1 | |
| | -5 | 0x2 | |
| | -4 | 0x3 | |
| | -3 | 0x4 | |
| | -2 | 0x5 | |
| | -1 | 0x6 | |
| | 0 | 0x7 | Mid-Point |
| | +1 | 0x8 | |
| | +2 | 0x9 | |
| | +3 | 0xA | |
| | +4 | 0xB | |
| | +5 | 0xC | |
| | +6 | 0xD | |
| | +7 | 0xE | Max MidRange |
| | Inactive/Invalid | 0xF | |

1.1.7 MD-REQ-276448/A-SetTreble**Message Type:** Request



Signal sent by the Audio Setting Client to the Audio Settings Server to set the Treble level.

| Logical Signal Name | Literals | Value | Description |
|---------------------|------------------|-------|-------------|
| SetTreble | -7 | 0x0 | Min Treble |
| | -6 | 0x1 | |
| | -5 | 0x2 | |
| | -4 | 0x3 | |
| | -3 | 0x4 | |
| | -2 | 0x5 | |
| | -1 | 0x6 | |
| | 0 | 0x7 | Mid-Point |
| | +1 | 0x8 | |
| | +2 | 0x9 | |
| | +3 | 0xA | |
| | +4 | 0xB | |
| | +5 | 0xC | |
| | +6 | 0xD | |
| | +7 | 0xE | Max Treble |
| | Inactive/Invalid | 0xF | |

1.1.8 MD-REQ-276453/A-Treble.St

Message Type: Status

Signal sent by the Audio Setting Server with the current status of the Treble level

| Logical Signal Name | Literals | Value | Description |
|---------------------|------------------|-------|-------------|
| Treble.St | -7 | 0x0 | Min Treble |
| | -6 | 0x1 | |
| | -5 | 0x2 | |
| | -4 | 0x3 | |
| | -3 | 0x4 | |
| | -2 | 0x5 | |
| | -1 | 0x6 | |
| | 0 | 0x7 | Mid-Point |
| | +1 | 0x8 | |
| | +2 | 0x9 | |
| | +3 | 0xA | |
| | +4 | 0xB | |
| | +5 | 0xC | |
| | +6 | 0xD | |
| | +7 | 0xE | Max Treble |
| | Inactive/Invalid | 0xF | |

1.1.9 MD-REQ-276451/A-SetFade

Message Type: Request

Signal sent by the Audio Setting Client to the Audio Settings Server to set the Fade level.



| Logical Signal Name | Literals | Value | Description |
|---------------------|------------------|-------|-------------------------------|
| SetFade | -7 | 0x0 | Fade all the way to the Back |
| | -6 | 0x1 | |
| | -5 | 0x2 | |
| | -4 | 0x3 | |
| | -3 | 0x4 | |
| | -2 | 0x5 | |
| | -1 | 0x6 | |
| | 0 | 0x7 | Mid-Point |
| | +1 | 0x8 | |
| | +2 | 0x9 | |
| | +3 | 0xA | |
| | +4 | 0xB | |
| | +5 | 0xC | |
| | +6 | 0xD | |
| | +7 | 0xE | Fade all the way to the Front |
| | Inactive/Invalid | 0xF | |

1.1.10 MD-REQ-276454/A-Fade.St**Message Type:** Status

Signal sent by the Audio Setting Server with the current status of the Fade level

| Logical Signal Name | Literals | Value | Description |
|---------------------|------------------|-------|-------------------------------|
| Fade.St | -7 | 0x0 | Fade all the way to the Back |
| | -6 | 0x1 | |
| | -5 | 0x2 | |
| | -4 | 0x3 | |
| | -3 | 0x4 | |
| | -2 | 0x5 | |
| | -1 | 0x6 | |
| | 0 | 0x7 | Mid-Point |
| | +1 | 0x8 | |
| | +2 | 0x9 | |
| | +3 | 0xA | |
| | +4 | 0xB | |
| | +5 | 0xC | |
| | +6 | 0xD | |
| | +7 | 0xE | Fade all the way to the Front |
| | Inactive/Invalid | 0xF | |

1.1.11 MD-REQ-276456/A-SetSpeed_Comp_Vol**Message Type:** Request

Signal sent by the Audio Setting Client to the Audio Settings Server to set the Speed Compensated Volume level.

| Logical Signal Name | Literals | Value | Description |
|---------------------|----------|-------|-------------|
| SetSpeed_Comp_Vol | OFF | 0x0 | |
| | Level1 | 0x1 | |



| | | | |
|--|----------|-----|--|
| | Level2 | 0x2 | |
| | cont. | | |
| | Level7 | 0x7 | |
| | Inactive | 0xF | |

1.1.12 MD-REQ-276457/A-Speed_Comp_Vol.St**Message Type:** Status

Signal sent by the Audio Setting Server with the current status of the Speed Compensated Volume level

| Logical Signal Name | Literals | Value | Description |
|---------------------|----------|-------|-------------|
| Speed_Comp_Vol.St | OFF | 0x0 | |
| | Level1 | 0x1 | |
| | Level2 | 0x2 | |
| | Level3 | 0x3 | |
| | cont. | | |
| | Level7 | 0x7 | |
| | Inactive | 0xF | |

1.1.13 MD-REQ-276458/B-Vehicle_Speed.St**Message Type:** Status

Signal with the current status of the Vehicle Speed

| Logical Signal Name | Literals | Value | Description |
|---------------------|--|--|-------------|
| Vehicle_Speed.St | See info-CAN database for signal details | See info-CAN database for signal details | |

1.1.14 MD-REQ-276459/A-Vehicle_Speed_QF**Message Type:** Status

Signal with the Vehicle Speed Quality Factor

| Logical Signal Name | Literals | Value | Description |
|---------------------|---------------------------|-------|-------------|
| Vehicle_Speed_QF | Faulty | 0x0 | |
| | No_Data_Exists | 0x1 | |
| | Not_Within_Specifications | 0x2 | |
| | OK | 0x3 | |

1.1.15 MD-REQ-276461/A-SetOccupancy_Mode**Message Type:** Request

Signal sent by the Audio Setting Client to the Audio Settings Server to set the Occupancy Mode.



| Logical Signal Name | Literals | Value | Description |
|---------------------|----------------|---------|---|
| SetOccupancy_Mode | Inactive | 0x0 | |
| | All Seats | 0x1 | |
| | Driver Seat | 0x2 | |
| | Passenger Seat | 0x3 | Used for RH drive vehicles – see IDS (infotainment diagnostic spec) for details |
| | Reserved | 0x4-0x6 | |
| | Front Seats | 0x7 | |
| | Rear Seats | 0x8 | |

1.1.16 MD-REQ-276462/A-Occupancy_Mode.St**Message Type:** Status

Signal sent by the Audio Setting Server with the current status of the Occupancy Mode

| Logical Signal Name | Literals | Value | Description |
|---------------------|--------------|---------|--|
| Occupancy_Mode.St | Inactive | 0x0 | |
| | All Seats | 0x1 | |
| | Driver Seats | 0x2 | |
| | Passenger | 0x3 | Use for RH drive vehicles – See IDS (infotainment diagnostic spec) for details |
| | Reserved | 0x4-0x6 | |
| | Front Seats | 0x7 | |
| | Rear Seats | 0x8 | |

1.1.17 MD-REQ-276463/A-Surround_Sound_Upmix.Rq**Message Type:** Request

Signal sent by the Surround Sound Client to the Surround Sound Server to set the Simulated Surround Sound.

| Logical Signal Name | Literals | Value | Description |
|-------------------------|----------|-------|-------------|
| Surround_Sound_Upmix.Rq | Inactive | 0x0 | |
| | Stereo | 0x1 | |
| | Surround | 0x2 | |

1.1.18 MD-REQ-276464/A-Surround_Sound_Upmix.St**Message Type:** Status

Signal sent by the Surround Sound Server with the current status of the Simulated Surround Sound

| Logical Signal Name | Literals | Value | Description |
|-------------------------|----------|-------|-------------|
| Surround_Sound_Upmix.St | Inactive | 0x0 | |
| | Stereo | 0x1 | |
| | Surround | 0x2 | |

1.1.19 MD-REQ-276465/A-Surround_Sound_Upmix2.Rq**Message Type:** Request



Signal sent by the Surround Sound Client to the Surround Sound Server to command the Surround Sound Server to go into a particular sound mode

| Logical Signal Name | Literals | Value | Description |
|--------------------------|----------|-----------|-------------|
| Surround_Sound_Upmix2.Rq | Inactive | 0x0 | |
| | Stereo | 0x1 | |
| | Surround | 0x2 | |
| | ON_Stage | 0x3 | |
| | Audience | 0x4 | |
| | Reserved | 0x5 – 0x7 | |

1.1.20 MD-REQ-276466/A-Surround_Sound_Upmix2.St

Message Type: Status

Signal sent by the Surround Sound Server with the current status of the what particular sound mode is active

| Logical Signal Name | Literals | Value | Description |
|--------------------------|----------|-----------|-------------|
| Surround_Sound_Upmix2.St | Inactive | 0x0 | |
| | Stereo | 0x1 | |
| | Surround | 0x2 | |
| | ON_Stage | 0x3 | |
| | Audience | 0x4 | |
| | Reserved | 0x5 – 0x7 | |

1.1.21 MD-REQ-276496/B-Audio_Demo_CMND

Message Type: Request

Signal sent by the Audio Demo Client to the Audio Demo Server telling the Audio Demo Server to start or end an Audio Demonstration event.

| Logical Signal Name | Literals | Value | Description |
|---------------------|----------|-------|-------------|
| Audio_Demo_CMND | Inactive | 0x0 | |
| | OFF | 0x1 | |
| | ON | 0x2 | |

1.1.22 MD-REQ-276502/A-Audio_Demo_Status

Message Type: Status

Signal sent by the Audio Demo Server with the current status of the Audio Demonstration

| Logical Signal Name | Literals | Value | Description |
|---------------------|----------------|-------|-------------|
| Audio_Demo_Status | Inactive / OFF | 0x0 | |
| | Active | 0x1 | |

1.1.23 MD-REQ-014871/B-CnvtTopPosUp_St (TcSE ROIN-280563-1)

Message Type: Status

Reports the status of whether the roof is closed or not



| Logical Signal Name | Literals | Value | Description |
|---------------------|----------|-------|-----------------------------------|
| CnvtTopPosUp_St | Not_Up | 0x0 | The convertible top is not closed |
| | Up | 0x1 | The convertible top is closed |

1.1.24 MD-REQ-276211/A-ImmersionLevel_D_Rq**Message Type:** Request

Signal sent by the Immersion Settings Client to request a change to the Immersion Level

| Logical Signal Name | Literals | Value | Description |
|---------------------|----------|-------|-------------|
| ImmersionLevel_D_Rq | Inactive | 0x0 | |
| | Level0 | 0x1 | |
| | Level1 | 0x2 | |
| | Level2 | 0x3 | |
| | Level3 | 0x4 | |
| | cont. | | |
| | Level125 | 0x7E | |
| | Level126 | 0x7F | |
| | Level127 | 0x80 | |

1.1.25 MD-REQ-276212/A-ImmersionLevel_D_St**Message Type:** Status

Signal sent by the Immersion Settings Server with the status of the immersion level

| Logical Signal Name | Literals | Value | Description |
|---------------------|----------|-------|-------------|
| ImmersionLevel_D_St | Inactive | 0x0 | |
| | Level0 | 0x1 | |
| | Level1 | 0x2 | |
| | Level2 | 0x3 | |
| | Level3 | 0x4 | |
| | cont. | | |
| | Level125 | 0x7E | |
| | Level126 | 0x7F | |
| | Level127 | 0x80 | |

1.1.26 MD-REQ-348781/A-Audio_Demo_CMND - Variant 2**Message Type:** Request

Signal sent by the Audio Demo Server to the Audio Demo Audio Switch Server telling the Audio Demo Audio Switch Server to mute or unmute its input audio lines.

| Logical Signal Name | Literals | Value | Description |
|---------------------|----------|-------|-------------|
| Audio_Demo_CMND | Inactive | 0x0 | |
| | OFF | 0x1 | |
| | ON | 0x2 | |



1.1.27 MD-REQ-348784/A-Audio_Demo_Status - variant 2

Message Type: Response

Signal sent by the Audio Demo Audio Switch Server to the Audio Demo Server telling the Audio Demo Server if Acoustic Settings are ready to support Audio Demo audio.

| Logical Signal Name | Literals | Value | Description |
|---------------------|----------------|-------|-------------|
| Audio_Demo_Status | Inactive / OFF | 0x0 | |
| | Active | 0x1 | |

1.2 AUDSET-CLD-REQ-311123/A-Audio Settings Client - APIM v2

The Audio Settings Client is the interface of the Audio Settings function. It acts with other system parts that control the Audio Settings or need data from it.

1.2.1 AUDSET-HMI-REQ-050361/D-Speed Compensated Volume values when HMI has SCV settings OFF, LOW, MED and HIGH (HMI)

The Speed Compensated Volume Client shall request the following Speed Compensated Volume settings when the HMI buttons (OFF, Low, Med, High) are activated by the user: Off = SCV 0, Low = SCV 1, Med = SCV 4, High = SCV 7.

At infotainment start-up (ie HMI_HMIMode_St from OFF to ON) if the Speed Compensated Volume Server SCV values in its status message are not equal to Off = 0, Low = 1, Med = 4, High = 7 then the Speed Compensated Client shall request the following SCV values from the Speed Compensated Volume Server:

- If the Speed Compensated Volume Server status message is set to SCV 2 then the Speed Compensated Client requests SCV = 1 (Low)
- If the Speed Compensated Volume Server status message is set to SCV 3 or 5 then the Speed Compensated Client requests SCV = 4 (Med)
- If the Speed Compensated Volume Server status message is set to SCV 6 then the Speed Compensated Client requests SCV = 7 (High)

If the Speed Compensated Volume Server doesn't respond to the Speed Compensated Volume Client request for Off = 0, Low = 1, Med = 4, High = 7 then the following shall be mapped to the SCV HMI buttons: SCV setting of 1 or 2 is mapped to HMI Low, SCV setting of 3,4,5 is mapped to HMI Medium and SCV setting of 6 or 7 is mapped to HMI High.

Note: The Speed Compensated Volume Client is a subset of the Audio Settings Client and the Speed Compensated Volume Server is a subset of the Audio Settings Server.

1.3 AUDSET-CLD-REQ-311124/A-Audio Settings Server - APIM v2

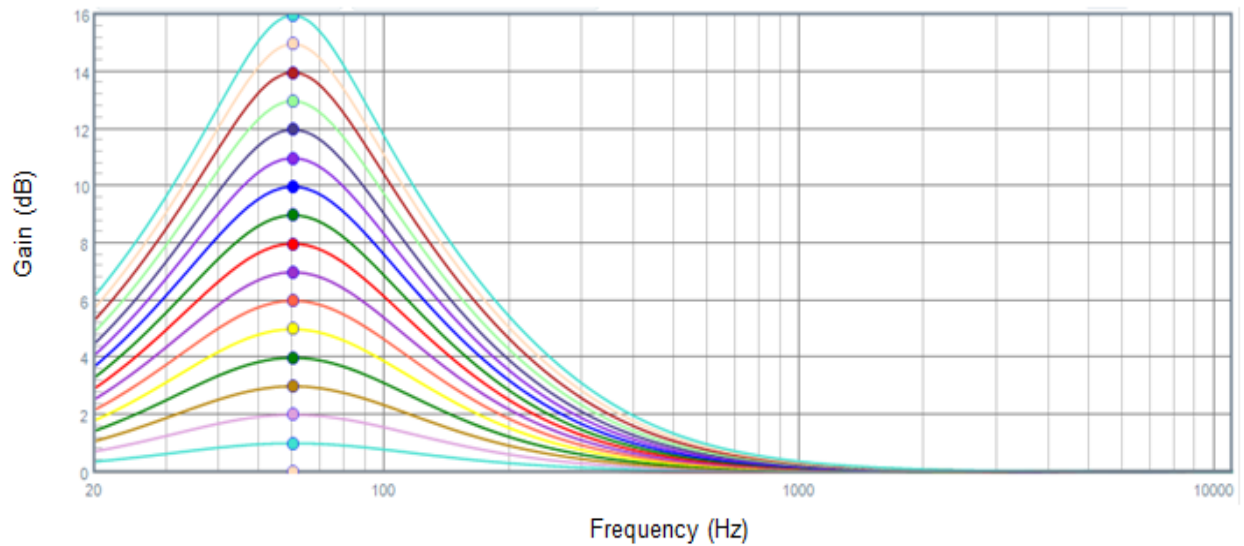
The Audio Settings Server is responsible for control of acoustical properties, such as BTMBF. It shall also manage speed compensated volume, occupancy mode and others.

1.3.1 AUDSET-FUR-REQ-031114/D-Bass Control (TcSE ROIN-112570-5)

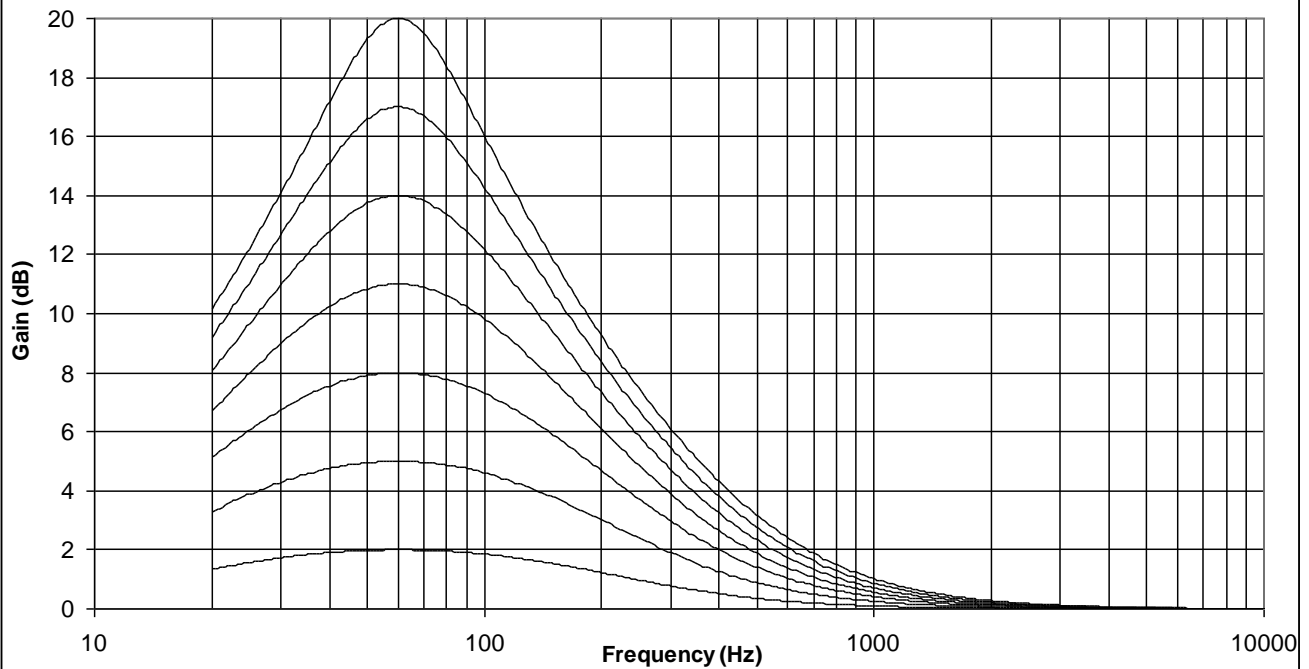
The AHU (or DSP-AMP) shall implement bass control as shown in the figure below:



Bass Control



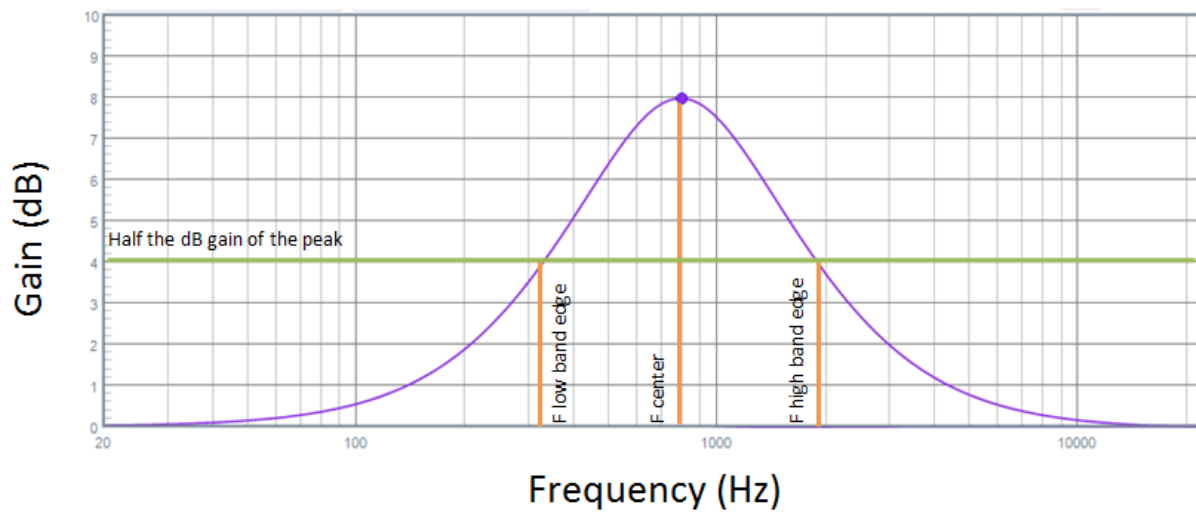
Bass Control



Implement Q values that will result in the curves shown in the figure above. Q is defined as the $F_{\text{center}}/\text{Bandwidth}$ where the Bandwidth is defined as the difference between the band edges at half the dB gain of the peak (see figure below).



Q Definition



$$Q = \frac{F_{center}}{F_{high} - F_{low}}$$

For DSPs that calculate Q using the method above (e.g. Sigma DSPs), use the table below to implement the Bass Control figure:

| F_{center} (Hz) | Q | Gain (dB) @ F_{center} |
|-------------------|-----|--------------------------|
| 60 | 0.5 | 1 dB |
| 60 | 0.5 | 2 dB |
| 60 | 0.5 | 3 dB |
| 60 | 0.5 | 4 dB |
| 60 | 0.5 | 5 dB |
| 60 | 0.5 | 6 dB |
| 60 | 0.5 | 7 dB |
| 60 | 0.5 | 8 dB |
| 60 | 0.5 | 9 dB |
| 60 | 0.5 | 10 dB |
| 60 | 0.5 | 11 dB |
| 60 | 0.5 | 12 dB |
| 60 | 0.5 | 13 dB |
| 60 | 0.5 | 14 dB |
| 60 | 0.5 | 15 dB |
| 60 | 0.5 | 16 dB |

When implementing the table above on Other DSPs (e.g. Dirana DSPs) use an2, however, there is an additional gain factor involved in calculating the Q values. The define Q is defined as the following:

$$Q = \frac{F_{center}}{F_{high} - F_{low}} * A$$

$$\text{where } A = 10^{\frac{\text{Peak Gain}}{40}}$$



Use the following table when implementing on ~~Dirana~~ 2DSPs with the additional gain factor to implement the Bass Control figure:

| <u>F_{center} (Hz)</u> | <u>Q</u> | <u>Gain (dB) @ F_{center}</u> |
|--------------------------------|-------------|---------------------------------------|
| <u>60</u> | <u>0.53</u> | <u>1 dB</u> |
| <u>60</u> | <u>0.56</u> | <u>2 dB</u> |
| <u>60</u> | <u>0.59</u> | <u>3 dB</u> |
| <u>60</u> | <u>0.63</u> | <u>4 dB</u> |
| <u>60</u> | <u>0.67</u> | <u>5 dB</u> |
| <u>60</u> | <u>0.71</u> | <u>6 dB</u> |
| <u>60</u> | <u>0.75</u> | <u>7 dB</u> |
| <u>60</u> | <u>0.79</u> | <u>8 dB</u> |
| <u>60</u> | <u>0.84</u> | <u>9 dB</u> |
| <u>60</u> | <u>0.89</u> | <u>10 dB</u> |
| <u>60</u> | <u>0.94</u> | <u>11 dB</u> |
| <u>60</u> | <u>1.00</u> | <u>12 dB</u> |
| <u>60</u> | <u>1.06</u> | <u>13 dB</u> |
| <u>60</u> | <u>1.12</u> | <u>14 dB</u> |
| <u>60</u> | <u>1.19</u> | <u>15 dB</u> |
| <u>60</u> | <u>1.26</u> | <u>16 dB</u> |

The chart above is used only for center frequency and Q of the loudness/bass tone curve. Refer to FAS-AHU-GREQ-112581-Automatic Loudness Volume/Bass Characteristics in the Global AHU Hardware Spec for boost values at each volume step and bass tone setting.

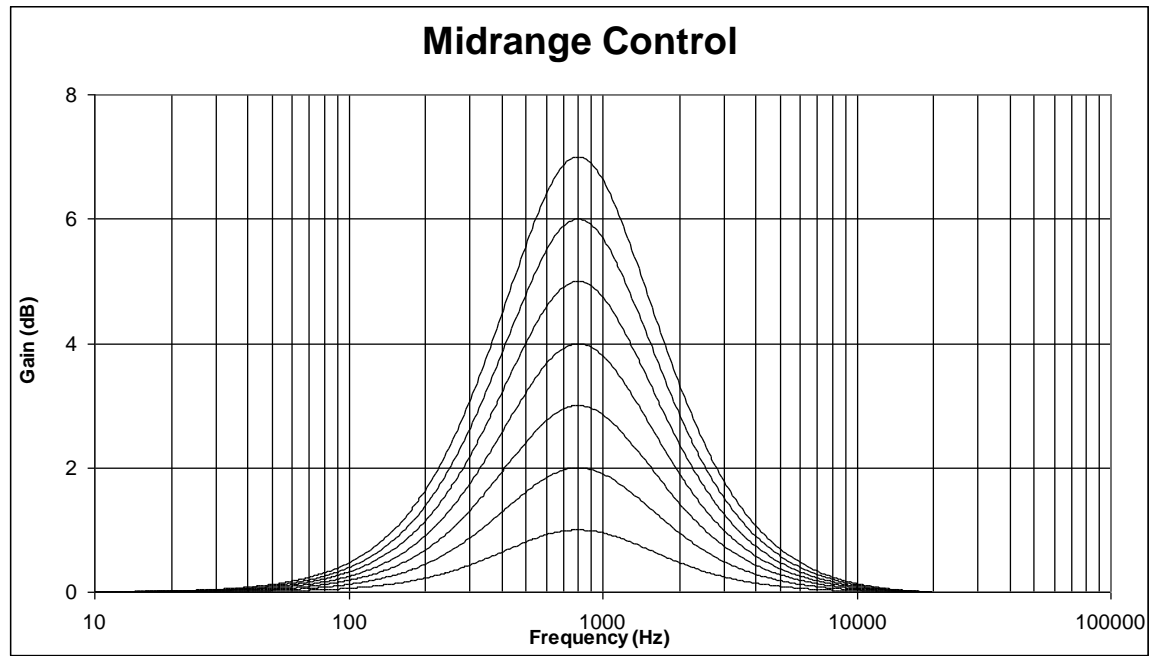
The bass control design target shall be +/- ~~20~~16 dB nominal.
The bass boost gain shall match the curves above, within +/- 1 dB.

The bass setting is not source dependent.

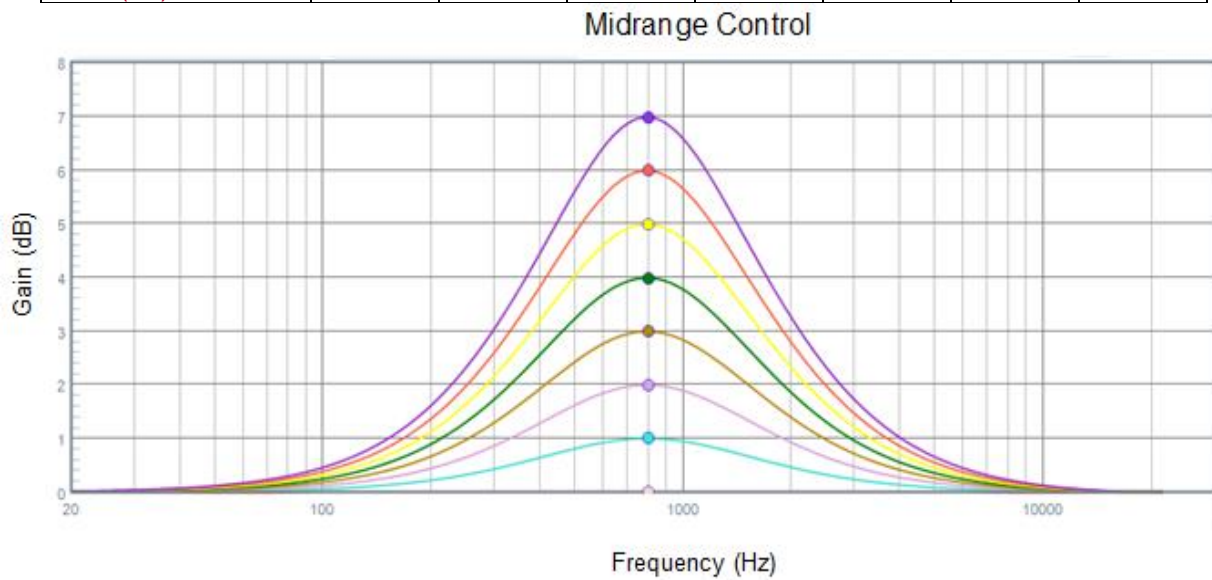
Bass cut characteristics shall mirror the bass boost frequencies.

1.3.2 AUDSET-FUR-REQ-031115/D-Midrange Control (TcSE ROIN-112571-5)

The AHU (or DSP-AMP) shall implement midrange control as shown in the figure below:



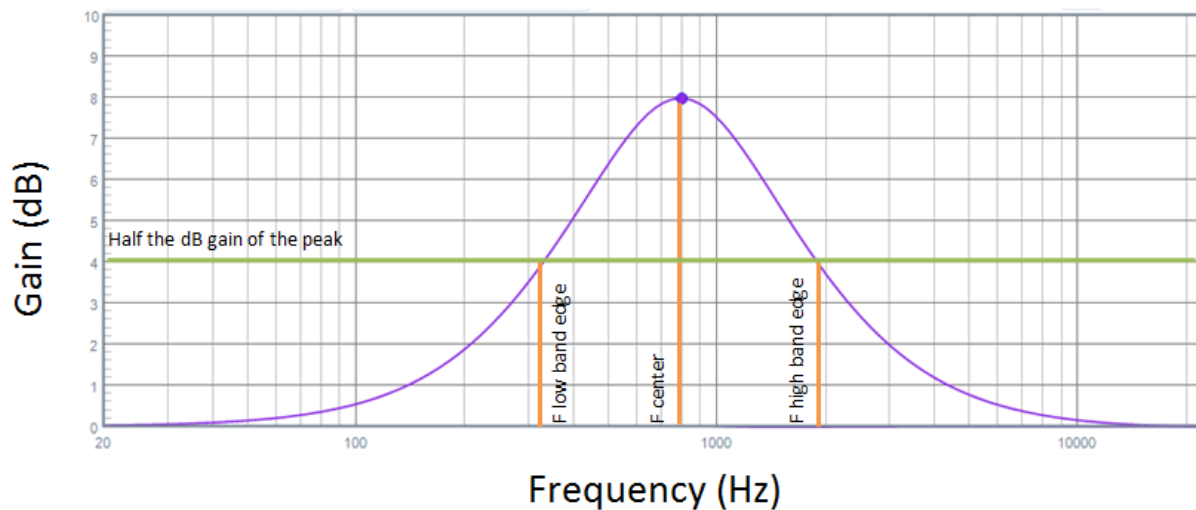
| | | | | | | | |
|-------------------|---------|---------|---------|---------|---------|---------|---------|
| fo (Hz) | 800 | 800 | 800 | 800 | 800 | 800 | 800 |
| Q | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Gain (dB) @ fo | 7-dB | 6-dB | 5-dB | 4-dB | 3-dB | 4.2-dB | 1-dB |
| Gain (dB) @ 1 kHz | 6.61-dB | 5.67-dB | 4.73-dB | 3.79-dB | 2.84-dB | 1.90-dB | 0.95-dB |



Implement Q values that will result in the curves shown in the figure above. Q is defined as the $F_{\text{center}}/\text{Bandwidth}$ where the Bandwidth is defined as the difference between the band edges at half the dB gain of the peak (see figure below).



Q Definition



$$Q = \frac{F_{center}}{F_{high} - F_{low}}$$

For DSPs that calculate Q using the method above (e.g. Sigma DSPs), use the table below to implement the Mid Control figure:

| F_{center} (Hz) | Q | Gain (dB) @ F_{center} |
|-------------------|-----|--------------------------|
| 800 | 0.5 | 1 dB |
| 800 | 0.5 | 2 dB |
| 800 | 0.5 | 3 dB |
| 800 | 0.5 | 4 dB |
| 800 | 0.5 | 5 dB |
| 800 | 0.5 | 6 dB |
| 800 | 0.5 | 7 dB |

When implementing the table above on Other DSPs (thee.g. Dirana DSPs) use $an2$, however, there is an additional gain factor involved in calculating the Q values. They define Q is defined aas the following:

When implementing the table above on the Dirana 2, however, there is an additional gain factor involved in calculating the Q values. Q is defined as the following:

$$Q = \frac{F_{center}}{F_{high} - F_{low}} * A$$

$$\text{where } A = 10^{\frac{\text{Peak Gain}}{40}}$$

Use the following table when implementing on Dirana 2DSPs with the additional gain factor to implement the Mid Control figure:

Use the following table when implementing on Dirana 2:



| <u>F_{center} (Hz)</u> | <u>Q</u> | <u>Gain (dB) @ F_{center}</u> |
|--------------------------------|-------------|---------------------------------------|
| <u>800</u> | <u>0.53</u> | <u>1 dB</u> |
| <u>800</u> | <u>0.56</u> | <u>2 dB</u> |
| <u>800</u> | <u>0.59</u> | <u>3 dB</u> |
| <u>800</u> | <u>0.63</u> | <u>4 dB</u> |
| <u>800</u> | <u>0.67</u> | <u>5 dB</u> |
| <u>800</u> | <u>0.71</u> | <u>6 dB</u> |
| <u>800</u> | <u>0.75</u> | <u>7 dB</u> |

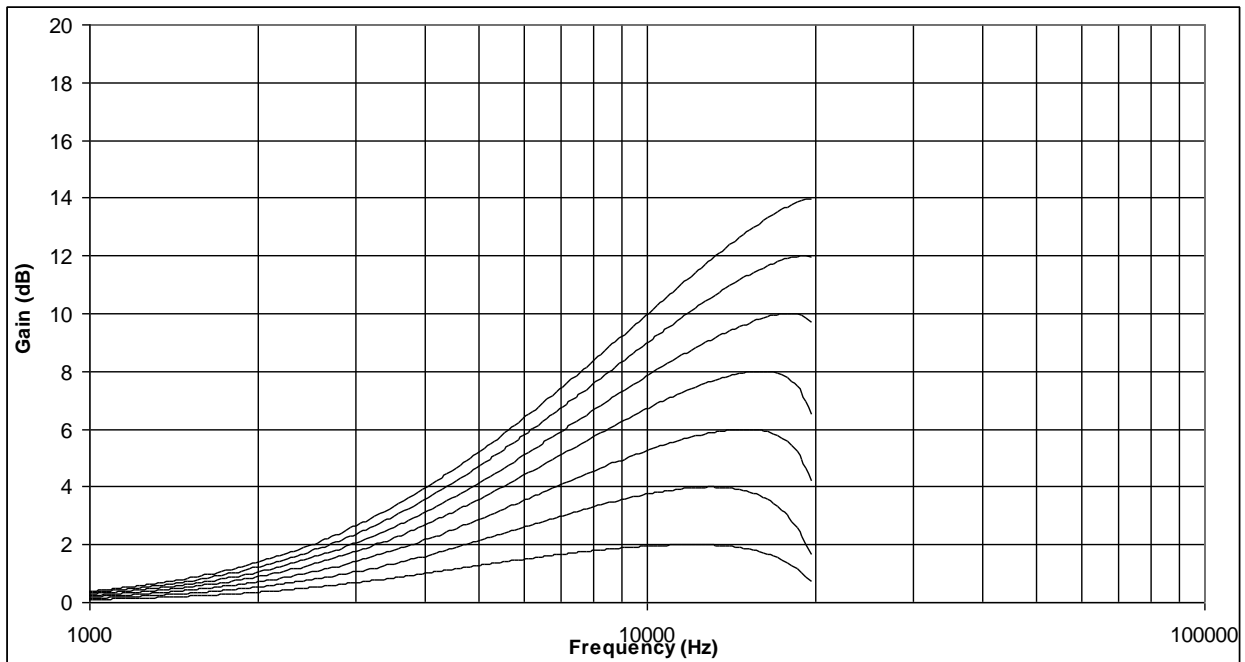
The midrange control design target shall be +/- 7 dB nominal.
The midrange boost gain shall match the curves above, within +/- 1 dB.

The midrange setting is not source dependent.

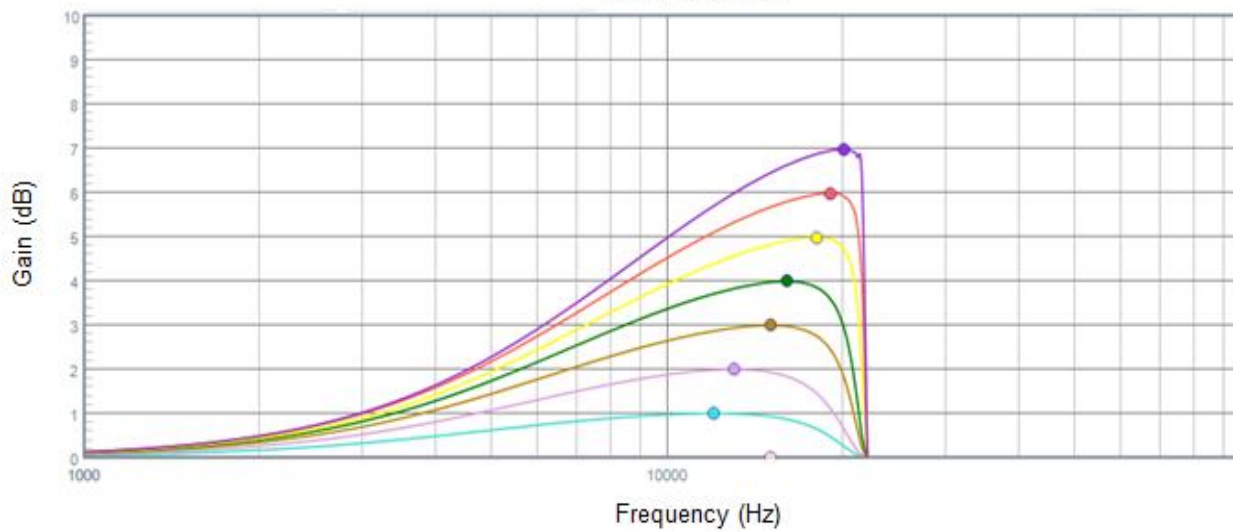
Midrange cut characteristics shall mirror the midrange boost frequencies.

1.3.3 AUDSET-FUR-REQ-031116/D-Treble Control (TcSE ROIN-112573-5)

The AHU (or DSP-AMP) shall implement treble control as shown in the figure below:



Treble Control



19000

18000

16000

15000

0.106

0.135

0.198

0.222

12 dB

10 dB

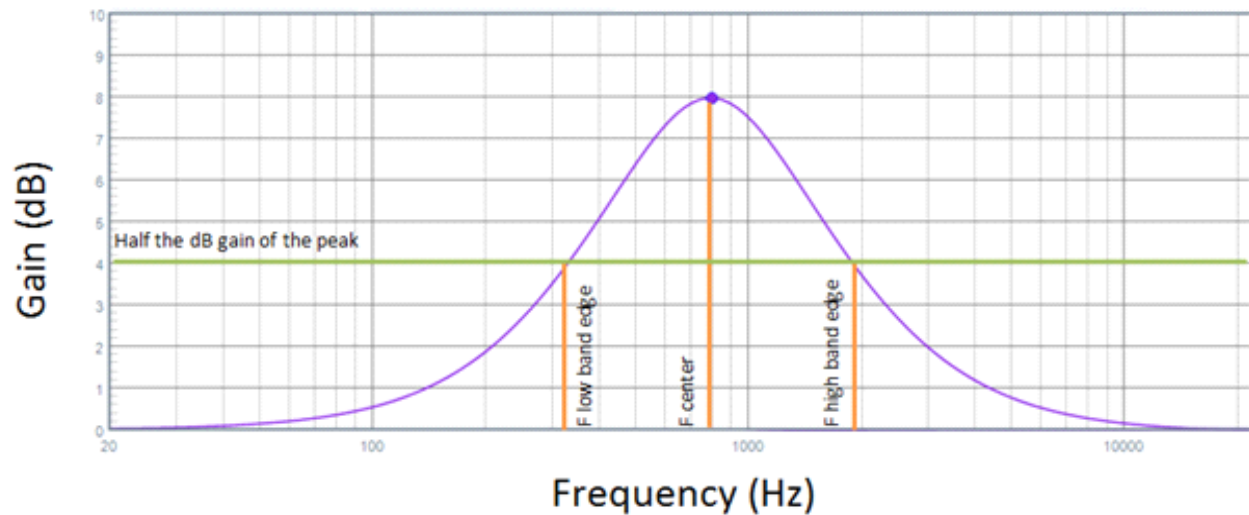
8 dB

6 dB

Implement Q values that will result in the curves shown in the figure above. Q is defined as the $F_{\text{center}}/\text{Bandwidth}$ where the Bandwidth is defined as the difference between the band edges at half the dB gain of the peak (as shown in figure below). For the treble control, with center frequencies above 10kHz, there is warping caused by a brickwall filter at 20kHz. It has been noted that several suppliers have used different Q values in order to achieve the curves in the figure due to differences in calculations and DSP software around 20kHz



Q Definition



$$Q = \frac{F_{center}}{F_{high} - F_{low}}$$

For DSPs that calculate Q using the method above with the warping at 20kHz (e.g. Sigma DSPs), use the table below to implement the Treble Control figure:

| <u>F_{center} (Hz)</u> | <u>Q</u> | <u>Gain (dB) @ F_{center}</u> |
|--------------------------------|-------------|---------------------------------------|
| <u>12000</u> | <u>0.28</u> | <u>1 dB</u> |
| <u>13000</u> | <u>0.28</u> | <u>2 dB</u> |
| <u>15000</u> | <u>0.22</u> | <u>3 dB</u> |
| <u>16000</u> | <u>0.20</u> | <u>4 dB</u> |
| <u>18000</u> | <u>0.14</u> | <u>5 dB</u> |
| <u>19000</u> | <u>0.11</u> | <u>6 dB</u> |
| <u>20000</u> | <u>0.08</u> | <u>7 dB</u> |

~~When implementing the table above on Other DSPs (the e.g. Dirana DSPs) use an2, however, there is an additional gain factor involved in calculating the Q values. They define Q is defined as the following:~~

~~When implementing the table above on the Dirana 2, however, there is an additional gain factor involved in calculating the Q values. Q is defined as the following:~~

$$Q = \frac{F_{center}}{F_{high} - F_{low}} * A$$

$$\text{where } A = 10^{\frac{\text{Peak Gain}}{40}}$$

~~Use the following table when implementing on Dirana 2: Use the following table when implementing on Dirana 2 DSPs with the additional gain factor to implement the Treble Control figure:~~

| <u>F_{center} (Hz)</u> | <u>Q</u> | <u>Gain (dB) @ F_{center}</u> |
|--------------------------------|-------------|---------------------------------------|
| <u>12000</u> | <u>0.56</u> | <u>1 dB</u> |



| | | |
|--------------|-------------|-------------|
| <u>13000</u> | <u>0.61</u> | <u>2 dB</u> |
| <u>15000</u> | <u>0.67</u> | <u>3 dB</u> |
| <u>16000</u> | <u>0.77</u> | <u>4 dB</u> |
| <u>18000</u> | <u>0.88</u> | <u>5 dB</u> |
| <u>19000</u> | <u>1.01</u> | <u>6 dB</u> |
| <u>20000</u> | <u>1.19</u> | <u>7 dB</u> |

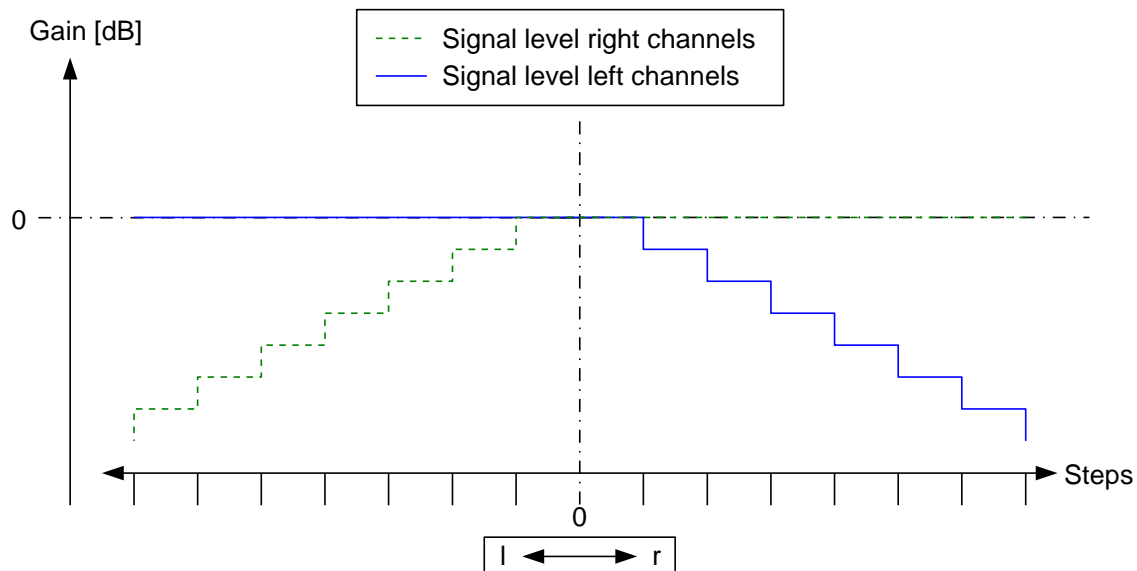
The treble control design target shall be +/- 44 dB nominal at peak frequency.
The treble boost gain shall match the curves above within +/- 1dB.

The treble setting is not source dependent.

Treble cut characteristics shall mirror the treble boost.

1.3.4 AUDSET-FUR-REQ-031117/B-Balance Control (TcSE ROIN-112574-2)

The AHU shall implement balance control as shown in the figure below.



The AHU shall provide left and right gain characteristics as defined in the table below:

| Steps | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|-------------|------|-----|-------------------------|----|----|----|----|---|----|----|----|----|-----|-----|------|
| Value in dB | Mute | -20 | - <u>43</u> <u>1</u> | -8 | -5 | -2 | -1 | 0 | -1 | -2 | -5 | -8 | -11 | -20 | Mute |

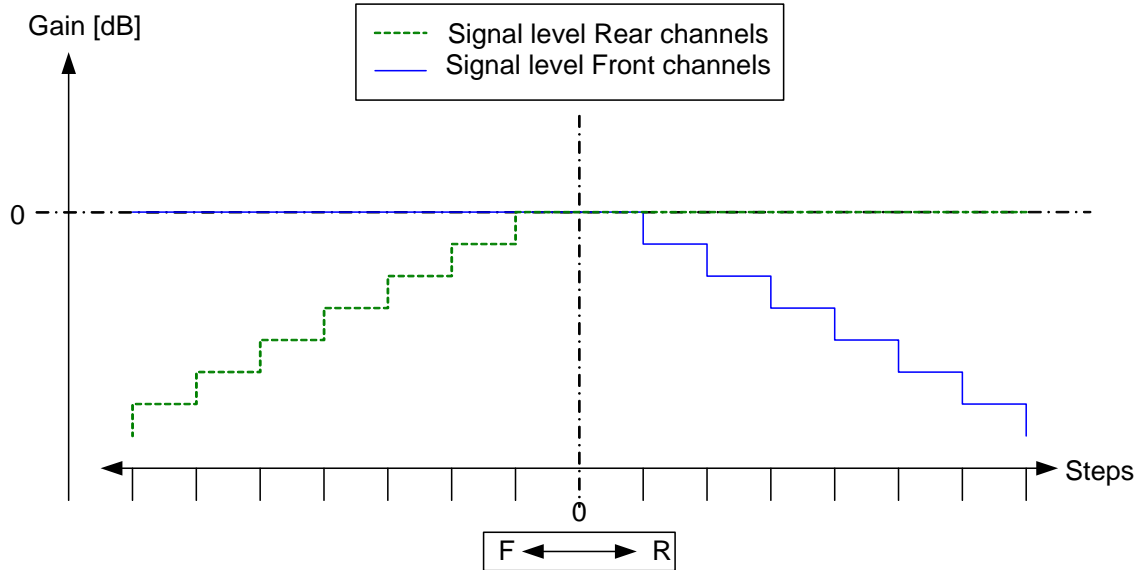
Mute \leq -60dB

The balance control shall match the values above within +/- 1dB.

The balance setting is not source dependent.

1.3.5 AUDSET-FUR-REQ-031118/B-Fade Control (TcSE ROIN-112575-2)

The AHU shall implement fade control as shown in the figure below.



The AHU shall provide front and rear fade gain characteristics as defined in the table below.

| Steps | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|-------------|------|-----|-----|----|----|----|----|---|----|----|----|----|-----|-----|------|
| Value in dB | Mute | -20 | -13 | -8 | -5 | -2 | -1 | 0 | -1 | -2 | -5 | -8 | -11 | -20 | Mute |

Mute \leq -60dB

The fade control shall match the values above within +/- 1dB.

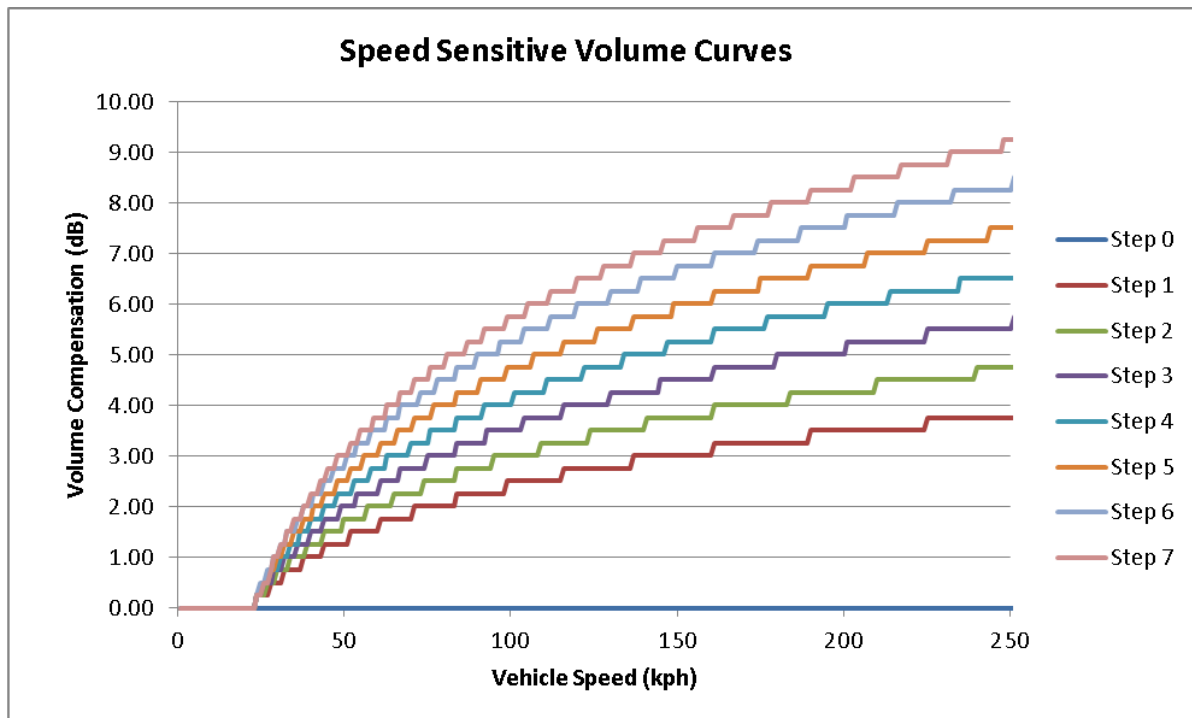
The fade setting is not source dependent.

1.3.6 AUDSET-FUR-REQ-033712/D-Speed Sensitive Volume Control (TcSE ROIN-112582-4)

(Hardware support does not apply to "Fixed Line Level, only HS-CAN message outputs apply)

The AHU/DSP shall provide a Speed Sensitive Volume Control feature. Gain compensation for speed adjusted volume control shall consist of 8 user selectable levels, and operate as follows:

Figure: Speed Sensitive Volume Gain Compensation



The AHU/DSP shall provide speed sensitive volume control characteristics as defined in the table below:

| kph | Step 0 | Step 1 | Step 2 | Step 3 | Step 4 | Step 5 | Step 6 | Step 7 |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 1 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 4 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 7 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 8 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 9 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 11 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 12 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 13 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 14 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 15 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 16 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 17 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 18 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 19 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 20 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 21 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 22 | 0 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| 23 | 0 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.50 | 0.25 |
| 24 | 0 | 0.25 | 0.25 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| 25 | 0 | 0.25 | 0.50 | 0.50 | 0.50 | 0.50 | 0.75 | 0.50 |
| 26 | 0 | 0.50 | 0.50 | 0.50 | 0.75 | 0.75 | 0.75 | 0.75 |
| 27 | 0 | 0.50 | 0.50 | 0.75 | 0.75 | 0.75 | 1.00 | 1.00 |



| | | | | | | | | |
|----|---|------|------|------|------|------|------|------|
| 28 | 0 | 0.50 | 0.75 | 0.75 | 0.75 | 1.00 | 1.00 | 1.00 |
| 29 | 0 | 0.50 | 0.75 | 0.75 | 1.00 | 1.00 | 1.25 | 1.25 |
| 30 | 0 | 0.75 | 0.75 | 1.00 | 1.00 | 1.25 | 1.25 | 1.25 |
| 31 | 0 | 0.75 | 0.75 | 1.00 | 1.00 | 1.25 | 1.50 | 1.50 |
| 32 | 0 | 0.75 | 1.00 | 1.00 | 1.25 | 1.25 | 1.50 | 1.50 |
| 33 | 0 | 0.75 | 1.00 | 1.00 | 1.25 | 1.50 | 1.50 | 1.75 |
| 34 | 0 | 0.75 | 1.00 | 1.25 | 1.25 | 1.50 | 1.75 | 1.75 |
| 35 | 0 | 0.75 | 1.00 | 1.25 | 1.50 | 1.50 | 1.75 | 1.75 |
| 36 | 0 | 1.00 | 1.00 | 1.25 | 1.50 | 1.75 | 2.00 | 2.00 |
| 37 | 0 | 1.00 | 1.25 | 1.25 | 1.50 | 1.75 | 2.00 | 2.00 |
| 38 | 0 | 1.00 | 1.25 | 1.50 | 1.75 | 1.75 | 2.00 | 2.25 |
| 39 | 0 | 1.00 | 1.25 | 1.50 | 1.75 | 2.00 | 2.25 | 2.25 |
| 40 | 0 | 1.00 | 1.25 | 1.50 | 1.75 | 2.00 | 2.25 | 2.25 |
| 41 | 0 | 1.00 | 1.25 | 1.50 | 1.75 | 2.00 | 2.25 | 2.50 |
| 42 | 0 | 1.25 | 1.50 | 1.75 | 2.00 | 2.25 | 2.50 | 2.50 |
| 43 | 0 | 1.25 | 1.50 | 1.75 | 2.00 | 2.25 | 2.50 | 2.75 |
| 44 | 0 | 1.25 | 1.50 | 1.75 | 2.00 | 2.25 | 2.50 | 2.75 |
| 45 | 0 | 1.25 | 1.50 | 1.75 | 2.00 | 2.25 | 2.75 | 2.75 |
| 46 | 0 | 1.25 | 1.50 | 1.75 | 2.25 | 2.50 | 2.75 | 3.00 |
| 47 | 0 | 1.25 | 1.50 | 2.00 | 2.25 | 2.50 | 2.75 | 3.00 |
| 48 | 0 | 1.25 | 1.75 | 2.00 | 2.25 | 2.50 | 2.75 | 3.00 |
| 49 | 0 | 1.25 | 1.75 | 2.00 | 2.25 | 2.50 | 3.00 | 3.00 |
| 50 | 0 | 1.50 | 1.75 | 2.00 | 2.25 | 2.75 | 3.00 | 3.25 |
| 51 | 0 | 1.50 | 1.75 | 2.00 | 2.50 | 2.75 | 3.00 | 3.25 |
| 52 | 0 | 1.50 | 1.75 | 2.25 | 2.50 | 2.75 | 3.25 | 3.25 |
| 53 | 0 | 1.50 | 1.75 | 2.25 | 2.50 | 2.75 | 3.25 | 3.50 |
| 54 | 0 | 1.50 | 1.75 | 2.25 | 2.50 | 3.00 | 3.25 | 3.50 |
| 55 | 0 | 1.50 | 2.00 | 2.25 | 2.50 | 3.00 | 3.25 | 3.50 |
| 56 | 0 | 1.50 | 2.00 | 2.25 | 2.75 | 3.00 | 3.50 | 3.50 |
| 57 | 0 | 1.50 | 2.00 | 2.25 | 2.75 | 3.00 | 3.50 | 3.75 |
| 58 | 0 | 1.50 | 2.00 | 2.25 | 2.75 | 3.00 | 3.50 | 3.75 |
| 59 | 0 | 1.75 | 2.00 | 2.50 | 2.75 | 3.25 | 3.50 | 3.75 |
| 60 | 0 | 1.75 | 2.00 | 2.50 | 2.75 | 3.25 | 3.50 | 3.75 |
| 61 | 0 | 1.75 | 2.00 | 2.50 | 3.00 | 3.25 | 3.75 | 4.00 |
| 62 | 0 | 1.75 | 2.00 | 2.50 | 3.00 | 3.25 | 3.75 | 4.00 |
| 63 | 0 | 1.75 | 2.25 | 2.50 | 3.00 | 3.25 | 3.75 | 4.00 |
| 64 | 0 | 1.75 | 2.25 | 2.50 | 3.00 | 3.50 | 3.75 | 4.00 |
| 65 | 0 | 1.75 | 2.25 | 2.75 | 3.00 | 3.50 | 4.00 | 4.25 |
| 66 | 0 | 1.75 | 2.25 | 2.75 | 3.00 | 3.50 | 4.00 | 4.25 |
| 67 | 0 | 1.75 | 2.25 | 2.75 | 3.00 | 3.50 | 4.00 | 4.25 |
| 68 | 0 | 1.75 | 2.25 | 2.75 | 3.25 | 3.50 | 4.00 | 4.25 |
| 69 | 0 | 2.00 | 2.25 | 2.75 | 3.25 | 3.75 | 4.00 | 4.50 |
| 70 | 0 | 2.00 | 2.25 | 2.75 | 3.25 | 3.75 | 4.00 | 4.50 |
| 71 | 0 | 2.00 | 2.25 | 2.75 | 3.25 | 3.75 | 4.25 | 4.50 |
| 72 | 0 | 2.00 | 2.50 | 2.75 | 3.25 | 3.75 | 4.25 | 4.50 |
| 73 | 0 | 2.00 | 2.50 | 3.00 | 3.25 | 3.75 | 4.25 | 4.50 |
| 74 | 0 | 2.00 | 2.50 | 3.00 | 3.50 | 3.75 | 4.25 | 4.75 |
| 75 | 0 | 2.00 | 2.50 | 3.00 | 3.50 | 4.00 | 4.25 | 4.75 |
| 76 | 0 | 2.00 | 2.50 | 3.00 | 3.50 | 4.00 | 4.50 | 4.75 |
| 77 | 0 | 2.00 | 2.50 | 3.00 | 3.50 | 4.00 | 4.50 | 4.75 |
| 78 | 0 | 2.00 | 2.50 | 3.00 | 3.50 | 4.00 | 4.50 | 4.75 |
| 79 | 0 | 2.00 | 2.50 | 3.00 | 3.50 | 4.00 | 4.50 | 5.00 |
| 80 | 0 | 2.00 | 2.50 | 3.00 | 3.50 | 4.00 | 4.50 | 5.00 |
| 81 | 0 | 2.00 | 2.50 | 3.00 | 3.50 | 4.00 | 4.50 | 5.00 |



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|-----|---|------|------|------|------|------|------|------|
| 82 | 0 | 2.25 | 2.75 | 3.25 | 3.75 | 4.25 | 4.75 | 5.00 |
| 83 | 0 | 2.25 | 2.75 | 3.25 | 3.75 | 4.25 | 4.75 | 5.00 |
| 84 | 0 | 2.25 | 2.75 | 3.25 | 3.75 | 4.25 | 4.75 | 5.00 |
| 85 | 0 | 2.25 | 2.75 | 3.25 | 3.75 | 4.25 | 4.75 | 5.25 |
| 86 | 0 | 2.25 | 2.75 | 3.25 | 3.75 | 4.25 | 4.75 | 5.25 |
| 87 | 0 | 2.25 | 2.75 | 3.25 | 3.75 | 4.25 | 4.75 | 5.25 |
| 88 | 0 | 2.25 | 2.75 | 3.25 | 3.75 | 4.25 | 5.00 | 5.25 |
| 89 | 0 | 2.25 | 2.75 | 3.25 | 3.75 | 4.50 | 5.00 | 5.25 |
| 90 | 0 | 2.25 | 2.75 | 3.25 | 4.00 | 4.50 | 5.00 | 5.50 |
| 91 | 0 | 2.25 | 2.75 | 3.50 | 4.00 | 4.50 | 5.00 | 5.50 |
| 92 | 0 | 2.25 | 2.75 | 3.50 | 4.00 | 4.50 | 5.00 | 5.50 |
| 93 | 0 | 2.25 | 3.00 | 3.50 | 4.00 | 4.50 | 5.00 | 5.50 |
| 94 | 0 | 2.25 | 3.00 | 3.50 | 4.00 | 4.50 | 5.00 | 5.50 |
| 95 | 0 | 2.25 | 3.00 | 3.50 | 4.00 | 4.50 | 5.25 | 5.50 |
| 96 | 0 | 2.25 | 3.00 | 3.50 | 4.00 | 4.50 | 5.25 | 5.50 |
| 97 | 0 | 2.50 | 3.00 | 3.50 | 4.00 | 4.75 | 5.25 | 5.75 |
| 98 | 0 | 2.50 | 3.00 | 3.50 | 4.00 | 4.75 | 5.25 | 5.75 |
| 99 | 0 | 2.50 | 3.00 | 3.50 | 4.25 | 4.75 | 5.25 | 5.75 |
| 100 | 0 | 2.50 | 3.00 | 3.50 | 4.25 | 4.75 | 5.25 | 5.75 |
| 101 | 0 | 2.50 | 3.00 | 3.50 | 4.25 | 4.75 | 5.25 | 5.75 |
| 102 | 0 | 2.50 | 3.00 | 3.75 | 4.25 | 4.75 | 5.50 | 5.75 |
| 103 | 0 | 2.50 | 3.00 | 3.75 | 4.25 | 4.75 | 5.50 | 6.00 |
| 104 | 0 | 2.50 | 3.00 | 3.75 | 4.25 | 4.75 | 5.50 | 6.00 |
| 105 | 0 | 2.50 | 3.00 | 3.75 | 4.25 | 5.00 | 5.50 | 6.00 |
| 106 | 0 | 2.50 | 3.00 | 3.75 | 4.25 | 5.00 | 5.50 | 6.00 |
| 107 | 0 | 2.50 | 3.25 | 3.75 | 4.25 | 5.00 | 5.50 | 6.00 |
| 108 | 0 | 2.50 | 3.25 | 3.75 | 4.25 | 5.00 | 5.50 | 6.00 |
| 109 | 0 | 2.50 | 3.25 | 3.75 | 4.50 | 5.00 | 5.50 | 6.00 |
| 110 | 0 | 2.50 | 3.25 | 3.75 | 4.50 | 5.00 | 5.75 | 6.25 |
| 111 | 0 | 2.50 | 3.25 | 3.75 | 4.50 | 5.00 | 5.75 | 6.25 |
| 112 | 0 | 2.50 | 3.25 | 3.75 | 4.50 | 5.00 | 5.75 | 6.25 |
| 113 | 0 | 2.50 | 3.25 | 3.75 | 4.50 | 5.00 | 5.75 | 6.25 |
| 114 | 0 | 2.75 | 3.25 | 4.00 | 4.50 | 5.25 | 5.75 | 6.25 |
| 115 | 0 | 2.75 | 3.25 | 4.00 | 4.50 | 5.25 | 5.75 | 6.25 |
| 116 | 0 | 2.75 | 3.25 | 4.00 | 4.50 | 5.25 | 5.75 | 6.25 |
| 117 | 0 | 2.75 | 3.25 | 4.00 | 4.50 | 5.25 | 5.75 | 6.25 |
| 118 | 0 | 2.75 | 3.25 | 4.00 | 4.50 | 5.25 | 6.00 | 6.50 |
| 119 | 0 | 2.75 | 3.25 | 4.00 | 4.50 | 5.25 | 6.00 | 6.50 |
| 120 | 0 | 2.75 | 3.25 | 4.00 | 4.75 | 5.25 | 6.00 | 6.50 |
| 121 | 0 | 2.75 | 3.25 | 4.00 | 4.75 | 5.25 | 6.00 | 6.50 |
| 122 | 0 | 2.75 | 3.50 | 4.00 | 4.75 | 5.25 | 6.00 | 6.50 |
| 123 | 0 | 2.75 | 3.50 | 4.00 | 4.75 | 5.25 | 6.00 | 6.50 |
| 124 | 0 | 2.75 | 3.50 | 4.00 | 4.75 | 5.50 | 6.00 | 6.50 |
| 125 | 0 | 2.75 | 3.50 | 4.00 | 4.75 | 5.50 | 6.00 | 6.50 |
| 126 | 0 | 2.75 | 3.50 | 4.00 | 4.75 | 5.50 | 6.00 | 6.75 |
| 127 | 0 | 2.75 | 3.50 | 4.00 | 4.75 | 5.50 | 6.00 | 6.75 |
| 128 | 0 | 2.75 | 3.50 | 4.25 | 4.75 | 5.50 | 6.25 | 6.75 |
| 129 | 0 | 2.75 | 3.50 | 4.25 | 4.75 | 5.50 | 6.25 | 6.75 |
| 130 | 0 | 2.75 | 3.50 | 4.25 | 4.75 | 5.50 | 6.25 | 6.75 |
| 131 | 0 | 2.75 | 3.50 | 4.25 | 4.75 | 5.50 | 6.25 | 6.75 |
| 132 | 0 | 2.75 | 3.50 | 4.25 | 5.00 | 5.50 | 6.25 | 6.75 |
| 133 | 0 | 2.75 | 3.50 | 4.25 | 5.00 | 5.50 | 6.25 | 6.75 |
| 134 | 0 | 2.75 | 3.50 | 4.25 | 5.00 | 5.50 | 6.25 | 6.75 |
| 135 | 0 | 3.00 | 3.50 | 4.25 | 5.00 | 5.75 | 6.25 | 7.00 |



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|-----|---|------|------|------|------|------|------|------|
| 136 | 0 | 3.00 | 3.50 | 4.25 | 5.00 | 5.75 | 6.25 | 7.00 |
| 137 | 0 | 3.00 | 3.50 | 4.25 | 5.00 | 5.75 | 6.50 | 7.00 |
| 138 | 0 | 3.00 | 3.50 | 4.25 | 5.00 | 5.75 | 6.50 | 7.00 |
| 139 | 0 | 3.00 | 3.75 | 4.25 | 5.00 | 5.75 | 6.50 | 7.00 |
| 140 | 0 | 3.00 | 3.75 | 4.25 | 5.00 | 5.75 | 6.50 | 7.00 |
| 141 | 0 | 3.00 | 3.75 | 4.25 | 5.00 | 5.75 | 6.50 | 7.00 |
| 142 | 0 | 3.00 | 3.75 | 4.25 | 5.00 | 5.75 | 6.50 | 7.00 |
| 143 | 0 | 3.00 | 3.75 | 4.50 | 5.00 | 5.75 | 6.50 | 7.00 |
| 144 | 0 | 3.00 | 3.75 | 4.50 | 5.00 | 5.75 | 6.50 | 7.25 |
| 145 | 0 | 3.00 | 3.75 | 4.50 | 5.25 | 5.75 | 6.50 | 7.25 |
| 146 | 0 | 3.00 | 3.75 | 4.50 | 5.25 | 5.75 | 6.50 | 7.25 |
| 147 | 0 | 3.00 | 3.75 | 4.50 | 5.25 | 6.00 | 6.50 | 7.25 |
| 148 | 0 | 3.00 | 3.75 | 4.50 | 5.25 | 6.00 | 6.75 | 7.25 |
| 149 | 0 | 3.00 | 3.75 | 4.50 | 5.25 | 6.00 | 6.75 | 7.25 |
| 150 | 0 | 3.00 | 3.75 | 4.50 | 5.25 | 6.00 | 6.75 | 7.25 |
| 151 | 0 | 3.00 | 3.75 | 4.50 | 5.25 | 6.00 | 6.75 | 7.25 |
| 152 | 0 | 3.00 | 3.75 | 4.50 | 5.25 | 6.00 | 6.75 | 7.25 |
| 153 | 0 | 3.00 | 3.75 | 4.50 | 5.25 | 6.00 | 6.75 | 7.25 |
| 154 | 0 | 3.00 | 3.75 | 4.50 | 5.25 | 6.00 | 6.75 | 7.50 |
| 155 | 0 | 3.00 | 3.75 | 4.50 | 5.25 | 6.00 | 6.75 | 7.50 |
| 156 | 0 | 3.00 | 3.75 | 4.50 | 5.25 | 6.00 | 6.75 | 7.50 |
| 157 | 0 | 3.00 | 3.75 | 4.50 | 5.25 | 6.00 | 6.75 | 7.50 |
| 158 | 0 | 3.00 | 3.75 | 4.50 | 5.25 | 6.00 | 6.75 | 7.50 |
| 159 | 0 | 3.25 | 4.00 | 4.75 | 5.50 | 6.25 | 7.00 | 7.50 |
| 160 | 0 | 3.25 | 4.00 | 4.75 | 5.50 | 6.25 | 7.00 | 7.50 |
| 161 | 0 | 3.25 | 4.00 | 4.75 | 5.50 | 6.25 | 7.00 | 7.50 |
| 162 | 0 | 3.25 | 4.00 | 4.75 | 5.50 | 6.25 | 7.00 | 7.50 |
| 163 | 0 | 3.25 | 4.00 | 4.75 | 5.50 | 6.25 | 7.00 | 7.50 |
| 164 | 0 | 3.25 | 4.00 | 4.75 | 5.50 | 6.25 | 7.00 | 7.50 |
| 165 | 0 | 3.25 | 4.00 | 4.75 | 5.50 | 6.25 | 7.00 | 7.75 |
| 166 | 0 | 3.25 | 4.00 | 4.75 | 5.50 | 6.25 | 7.00 | 7.75 |
| 167 | 0 | 3.25 | 4.00 | 4.75 | 5.50 | 6.25 | 7.00 | 7.75 |
| 168 | 0 | 3.25 | 4.00 | 4.75 | 5.50 | 6.25 | 7.00 | 7.75 |
| 169 | 0 | 3.25 | 4.00 | 4.75 | 5.50 | 6.25 | 7.00 | 7.75 |
| 170 | 0 | 3.25 | 4.00 | 4.75 | 5.50 | 6.25 | 7.00 | 7.75 |
| 171 | 0 | 3.25 | 4.00 | 4.75 | 5.50 | 6.25 | 7.00 | 7.75 |
| 172 | 0 | 3.25 | 4.00 | 4.75 | 5.50 | 6.25 | 7.25 | 7.75 |
| 173 | 0 | 3.25 | 4.00 | 4.75 | 5.50 | 6.50 | 7.25 | 7.75 |
| 174 | 0 | 3.25 | 4.00 | 4.75 | 5.50 | 6.50 | 7.25 | 7.75 |
| 175 | 0 | 3.25 | 4.00 | 4.75 | 5.75 | 6.50 | 7.25 | 7.75 |
| 176 | 0 | 3.25 | 4.00 | 4.75 | 5.75 | 6.50 | 7.25 | 8.00 |
| 177 | 0 | 3.25 | 4.00 | 4.75 | 5.75 | 6.50 | 7.25 | 8.00 |
| 178 | 0 | 3.25 | 4.00 | 5.00 | 5.75 | 6.50 | 7.25 | 8.00 |
| 179 | 0 | 3.25 | 4.00 | 5.00 | 5.75 | 6.50 | 7.25 | 8.00 |
| 180 | 0 | 3.25 | 4.00 | 5.00 | 5.75 | 6.50 | 7.25 | 8.00 |
| 181 | 0 | 3.25 | 4.00 | 5.00 | 5.75 | 6.50 | 7.25 | 8.00 |
| 182 | 0 | 3.25 | 4.25 | 5.00 | 5.75 | 6.50 | 7.25 | 8.00 |
| 183 | 0 | 3.25 | 4.25 | 5.00 | 5.75 | 6.50 | 7.25 | 8.00 |
| 184 | 0 | 3.25 | 4.25 | 5.00 | 5.75 | 6.50 | 7.25 | 8.00 |
| 185 | 0 | 3.25 | 4.25 | 5.00 | 5.75 | 6.50 | 7.50 | 8.00 |
| 186 | 0 | 3.25 | 4.25 | 5.00 | 5.75 | 6.50 | 7.50 | 8.00 |
| 187 | 0 | 3.25 | 4.25 | 5.00 | 5.75 | 6.50 | 7.50 | 8.00 |
| 188 | 0 | 3.50 | 4.25 | 5.00 | 5.75 | 6.75 | 7.50 | 8.25 |
| 189 | 0 | 3.50 | 4.25 | 5.00 | 5.75 | 6.75 | 7.50 | 8.25 |



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|-----|---|------|------|------|------|------|------|------|
| 190 | 0 | 3.50 | 4.25 | 5.00 | 5.75 | 6.75 | 7.50 | 8.25 |
| 191 | 0 | 3.50 | 4.25 | 5.00 | 5.75 | 6.75 | 7.50 | 8.25 |
| 192 | 0 | 3.50 | 4.25 | 5.00 | 5.75 | 6.75 | 7.50 | 8.25 |
| 193 | 0 | 3.50 | 4.25 | 5.00 | 6.00 | 6.75 | 7.50 | 8.25 |
| 194 | 0 | 3.50 | 4.25 | 5.00 | 6.00 | 6.75 | 7.50 | 8.25 |
| 195 | 0 | 3.50 | 4.25 | 5.00 | 6.00 | 6.75 | 7.50 | 8.25 |
| 196 | 0 | 3.50 | 4.25 | 5.00 | 6.00 | 6.75 | 7.50 | 8.25 |
| 197 | 0 | 3.50 | 4.25 | 5.00 | 6.00 | 6.75 | 7.50 | 8.25 |
| 198 | 0 | 3.50 | 4.25 | 5.00 | 6.00 | 6.75 | 7.50 | 8.25 |
| 199 | 0 | 3.50 | 4.25 | 5.25 | 6.00 | 6.75 | 7.75 | 8.25 |
| 200 | 0 | 3.50 | 4.25 | 5.25 | 6.00 | 6.75 | 7.75 | 8.25 |
| 201 | 0 | 3.50 | 4.25 | 5.25 | 6.00 | 6.75 | 7.75 | 8.50 |
| 202 | 0 | 3.50 | 4.25 | 5.25 | 6.00 | 6.75 | 7.75 | 8.50 |
| 203 | 0 | 3.50 | 4.25 | 5.25 | 6.00 | 6.75 | 7.75 | 8.50 |
| 204 | 0 | 3.50 | 4.25 | 5.25 | 6.00 | 6.75 | 7.75 | 8.50 |
| 205 | 0 | 3.50 | 4.25 | 5.25 | 6.00 | 7.00 | 7.75 | 8.50 |
| 206 | 0 | 3.50 | 4.25 | 5.25 | 6.00 | 7.00 | 7.75 | 8.50 |
| 207 | 0 | 3.50 | 4.25 | 5.25 | 6.00 | 7.00 | 7.75 | 8.50 |
| 208 | 0 | 3.50 | 4.50 | 5.25 | 6.00 | 7.00 | 7.75 | 8.50 |
| 209 | 0 | 3.50 | 4.50 | 5.25 | 6.00 | 7.00 | 7.75 | 8.50 |
| 210 | 0 | 3.50 | 4.50 | 5.25 | 6.00 | 7.00 | 7.75 | 8.50 |
| 211 | 0 | 3.50 | 4.50 | 5.25 | 6.00 | 7.00 | 7.75 | 8.50 |
| 212 | 0 | 3.50 | 4.50 | 5.25 | 6.25 | 7.00 | 7.75 | 8.50 |
| 213 | 0 | 3.50 | 4.50 | 5.25 | 6.25 | 7.00 | 7.75 | 8.50 |
| 214 | 0 | 3.50 | 4.50 | 5.25 | 6.25 | 7.00 | 8.00 | 8.50 |
| 215 | 0 | 3.50 | 4.50 | 5.25 | 6.25 | 7.00 | 8.00 | 8.75 |
| 216 | 0 | 3.50 | 4.50 | 5.25 | 6.25 | 7.00 | 8.00 | 8.75 |
| 217 | 0 | 3.50 | 4.50 | 5.25 | 6.25 | 7.00 | 8.00 | 8.75 |
| 218 | 0 | 3.50 | 4.50 | 5.25 | 6.25 | 7.00 | 8.00 | 8.75 |
| 219 | 0 | 3.50 | 4.50 | 5.25 | 6.25 | 7.00 | 8.00 | 8.75 |
| 220 | 0 | 3.50 | 4.50 | 5.25 | 6.25 | 7.00 | 8.00 | 8.75 |
| 221 | 0 | 3.50 | 4.50 | 5.25 | 6.25 | 7.00 | 8.00 | 8.75 |
| 222 | 0 | 3.50 | 4.50 | 5.25 | 6.25 | 7.00 | 8.00 | 8.75 |
| 223 | 0 | 3.75 | 4.50 | 5.50 | 6.25 | 7.25 | 8.00 | 8.75 |
| 224 | 0 | 3.75 | 4.50 | 5.50 | 6.25 | 7.25 | 8.00 | 8.75 |
| 225 | 0 | 3.75 | 4.50 | 5.50 | 6.25 | 7.25 | 8.00 | 8.75 |
| 226 | 0 | 3.75 | 4.50 | 5.50 | 6.25 | 7.25 | 8.00 | 8.75 |
| 227 | 0 | 3.75 | 4.50 | 5.50 | 6.25 | 7.25 | 8.00 | 8.75 |
| 228 | 0 | 3.75 | 4.50 | 5.50 | 6.25 | 7.25 | 8.00 | 8.75 |
| 229 | 0 | 3.75 | 4.50 | 5.50 | 6.25 | 7.25 | 8.00 | 8.75 |
| 230 | 0 | 3.75 | 4.50 | 5.50 | 6.25 | 7.25 | 8.00 | 9.00 |
| 231 | 0 | 3.75 | 4.50 | 5.50 | 6.25 | 7.25 | 8.25 | 9.00 |
| 232 | 0 | 3.75 | 4.50 | 5.50 | 6.25 | 7.25 | 8.25 | 9.00 |
| 233 | 0 | 3.75 | 4.50 | 5.50 | 6.50 | 7.25 | 8.25 | 9.00 |
| 234 | 0 | 3.75 | 4.50 | 5.50 | 6.50 | 7.25 | 8.25 | 9.00 |
| 235 | 0 | 3.75 | 4.50 | 5.50 | 6.50 | 7.25 | 8.25 | 9.00 |
| 236 | 0 | 3.75 | 4.50 | 5.50 | 6.50 | 7.25 | 8.25 | 9.00 |
| 237 | 0 | 3.75 | 4.50 | 5.50 | 6.50 | 7.25 | 8.25 | 9.00 |
| 238 | 0 | 3.75 | 4.75 | 5.50 | 6.50 | 7.25 | 8.25 | 9.00 |
| 239 | 0 | 3.75 | 4.75 | 5.50 | 6.50 | 7.25 | 8.25 | 9.00 |
| 240 | 0 | 3.75 | 4.75 | 5.50 | 6.50 | 7.25 | 8.25 | 9.00 |
| 241 | 0 | 3.75 | 4.75 | 5.50 | 6.50 | 7.25 | 8.25 | 9.00 |
| 242 | 0 | 3.75 | 4.75 | 5.50 | 6.50 | 7.50 | 8.25 | 9.00 |
| 243 | 0 | 3.75 | 4.75 | 5.50 | 6.50 | 7.50 | 8.25 | 9.00 |



| | | | | | | | | |
|-----|---|------|------|------|------|------|------|------|
| 244 | 0 | 3.75 | 4.75 | 5.50 | 6.50 | 7.50 | 8.25 | 9.00 |
| 245 | 0 | 3.75 | 4.75 | 5.50 | 6.50 | 7.50 | 8.25 | 9.00 |
| 246 | 0 | 3.75 | 4.75 | 5.50 | 6.50 | 7.50 | 8.25 | 9.25 |
| 247 | 0 | 3.75 | 4.75 | 5.50 | 6.50 | 7.50 | 8.25 | 9.25 |
| 248 | 0 | 3.75 | 4.75 | 5.50 | 6.50 | 7.50 | 8.25 | 9.25 |
| 249 | 0 | 3.75 | 4.75 | 5.75 | 6.50 | 7.50 | 8.50 | 9.25 |
| 250 | 0 | 3.75 | 4.75 | 5.75 | 6.50 | 7.50 | 8.50 | 9.25 |

- Speed sensitive volume has no effect until vehicle reaches 22 KPH.
- The AHU/DSP shall not increase volume above 250KPH.
- Speed Compensated Volume does not increase the maximum volume of the AHU/DSP, it only causes the maximum volume to be reached at a lower volume step.
- When the Speed Compensated Volume feature is enabled, if there is a loss of speed signal the AHU/DSP shall disable the Speed Compensated Volume feature for the duration of the key cycle. After IGN cycles from OFF back to run, the Speed Compensated Volume feature can be re-enabled if the Speed signal is present.
- Assess the QF of speed signal (Vehicle Speed QF in message 0x202) 1000ms after changing IGN signal from "Start" to "Run". If QF = OK then activate AVC, if QF signal is ≠ OK keep AVC deactivated.
- The availability of this feature (enabled/disabled status) shall be EOL configurable via HS-CAN. Refer to applicable IDS specification for configuration information.
- The speed sensitive volume control modifies all AHU/DSP input sources that are controlled by the Volume control.
- Resultant electrically measured volume levels shall be within +/- 0.75 dB of the calculated values.
- Volume level tolerances shall not be interpreted to allow compensation levels to "overlap" but rather are intended to allow variation in the overall gain lineup. For example, volume step 2 should always be higher than volume step 1 unless the calculations result in a difference of less than 0.25 dB. .

When the MyKey feature is active Speed Compensated Volume shall be disabled.

1.4 AUDSET-CLD-REQ-014879/A-Audio Settings Server - DSP AMP (Global) (TcSE ROIN-129220-1)

The Audio Settings Server is responsible for control of acoustical properties, such as BTMBF. It shall also manage speed compensated volume, occupancy mode and others.

1.5 AUDSET-CLD-REQ-347441/A-Audio Settings Server - DSP AMP variant 2

The DSP AMP variant 2 Audio Settings Server is responsible for control of speed compensated volume, balance and fade for tonal settings.

1.6 AUDSET-CLD-REQ-014872/A-Audio Demo Client (TcSE ROIN-202556-1)

The Audio Demo Client is the interface for the Audio Demo function

1.7 AUDSET-CLD-REQ-014873/A-Audio Demo Server (TcSE ROIN-202557-1)

The Audio Demo Server is responsible for control of the Audio Demo function

1.8 AUDSET-CLD-REQ-014876/A-Surround Sound Client (TcSE ROIN-202560-1)

The Surround Sound Client is the interface for the Surround Sound function

1.9 AUDSET-CLD-REQ-014877/A-Surround Sound Server (TcSE ROIN-202561-1)

The Surround Sound Server is responsible for control of the Surround Sound function

**1.10 AUDSET-CLD-REQ-014880/A-Convertible Occupancy Mode Client (TcSE ROIN-280661-1)**

The Convertible Occupancy Mode Client is responsible for reporting the status of whether the convertible roof is open or closed.

1.11 AUDSET-CLD-REQ-014881/A-Convertible Occupancy Mode Server (TcSE ROIN-280666-1)

The Convertible Occupancy Mode Server is responsible for setting the convertible occupancy mode state based on the convertible roof status it receives from the Convertible Occupancy Mode Client.

1.12 AUDSET-CLD-REQ-238552/A-Immersion Setting Client**1.13 AUDSET-CLD-REQ-238553/A-Immersion Setting Server****1.14 AUDSETv2-CLD-REQ-348194/A-Audio Demo Audio Switch Server - variant 2**

The Audio Demo Audio Switch Server is responsible for muting and unmuting the audio demonstration audio inputs and responsible for the speakers to use for audio demonstration.

The Audio Demo Audio Switch Server interfaces over the network with the Audio Demonstration Client.

The Audio Demo Audio Switch Server receives audio signals from the Audio Demo Server.

1.15 AUDSETv2-CLD-REQ-349882/A-Audio Demo Client - variant 2

The Audio Demo Client is the interface for the Audio Demo function

1.16 AUDSETv2-CLD-REQ-349883/A-Audio Demo Server - variant 2

The Audio Demo Server is responsible for control of the Audio Demo function



2 General Requirements

2.1 Tonal Settings Control (BTMBF, Occupancy Mode, EQ Mode, Speed Compensated Volume)

2.1.1 AUDSET-SR-REQ-014882/C-Audio Settings Server module controlling Tonal Settings (TcSE ROIN-40208-3)

The tonal settings adjustment will be sent from the Audio Settings Client to the Audio Settings Server. When the DSP AMP is on the vehicle the DSP AMP shall be the Audio Settings Server for tonal settings.

When the AAM (Audio Amp Module) is on the vehicle then it shall be the Audio Settings Server for the Occupancy Mode function only. The AHU shall be the Audio Settings Server for all other Tonal Settings.

When the DSP AMPv2 (DSP AMP variant 2) is on the vehicle then the DSPv2 shall be the Audio Settings Server for Occupancy Mode, Speed Compensated Volume, Balance and Fade. The AHU/iAHU shall be the Audio Settings Server for all other Tonal Settings (ie Bass, Treble, Mid-Range).

Note: iAHU is for the integrated AHU module (ex display and AHU integrated in one module).

2.1.2 AUDSET-SR-REQ-014883/E-Display module looking at the correct Audio Settings Server Module (TcSE ROIN-40209-2)

When there is both an AHU and DSP AMP on the vehicle then the DSP AMP is the Audio Settings Server for tonal settings. The Audio Settings Client display module(s) shall only look at the tonal settings values (ex. BTMBF, SCV...) from the DSP AMP signals for display information when it is the Audio Settings Server. The AHU shall set its tonal settings to the default values when the DSP AMP is present.

When there is both an AHU and AAM (Audio Amp Module) on the vehicle then the AAM shall be the Audio Settings Server for the Occupancy Mode function only. The Audio Settings Client display module(s) shall only look at the Occupancy Mode signals from the AAM for display information. All other Audio Settings Server display information shall come from the AHU.

When there is both an AHU/iAHU (integrated AHU) and DSP AMPv2 (DSP AMP variant 2) on the vehicle then the DSP AMPv2 shall be the Audio Settings Server for Speed Compensated Volume, Balance, Fade, and Occupancy Mode only. The Audio Settings Client display module(s) shall only look at the Speed Compensated Volume, Occupancy Mode, Balance and Fade signals from the DSP AMPv2 for display information. All other Audio Settings Server display information for Tonal Settings (ie Bass, Treble, Mid-Range) shall come from the AHU/iAHU.

Note: iAHU is for the integrated AHU module (ex display and AHU integrated in one module).

2.1.3 AUDSET-SR-REQ-014884/C-Audio Settings Server saving the Tonal Settings (TcSE ROIN-40210-1)

The Audio Setting Server is responsible for maintaining the last known Tonal Settings state (ex. BTMBF, Occupancy Mode, DSP Program Mode, SCV...) during all times of operation and transition of power modes.

2.1.4 AUDSET-TMR-REQ-014885/D-T_Tonal_Response (TcSE ROIN-40212-1)

| Name | Description | Units | Range | Resolution | Default |
|------------------|--|-------|--------|------------|---------|
| T_Tonal_Response | Maximum time allowed for the 'Audio Setting Server' to respond with the status message update to an 'Audio Setting Client' request for a Tonal Settings value change. Note: use the default value | msec | 0-1000 | 5 | 75 |

2.2 AUDSET-SR-REQ-310962/A-HMI updates from server module status signals

The Audio Setting Client HMI shall use what is in the Audio Setting Server status signal to display the feature status to the HMI unless specifically noted otherwise.

- Note: this is shown in the sequence diagrams also



The Audio Setting Client may request a setting (the HMI may show button pressed) but whether the HMI shows the settings active or not depends on what the Audio Setting Server module signal is set to.

- Ex. The user presses the increase bass button to Bass +6. The HMI may show the increase button HMI button press selected when pressed. The Bass volume level shown in the vehicle though is not shown as Bass +6 unless the Audio Setting Server status signal says Bass +6.



3 Functional Definition

3.1 AUDSET-FUN-REQ-016365/A-Bass, Treble, Midrange, Balance, Fade (TcSE ROIN-290183-1)

3.1.1 Use Cases

3.1.1.1 AUDSET-UC-REQ-016366/B-Increase Bass/MidRange/Treble Setting (TcSE ROIN-290134-1)

| | |
|-----------------------------|---|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment system powered ON |
| Scenario Description | User selects <Increase Bass> via HMI Infotainment System adjusts bass setting. HMI indicates {Bass Setting} as level is being adjusted. |
| Post-conditions | HMI indicates {Bass Setting} (final setting). The Infotainment system will operate with the new bass setting. |
| List of Exception Use Cases | E1 – AUDSET-GUC-290136-1-Increase Bass/MidRange/Treble Setting - Currently set to Max E2 – AUDSET-GUC-290137-1-Increase Bass/MidRange/Treble Setting - User selects and holds via HMI E3 – AUDSET-GUC-290158-1-User selected BTMBF Settings when Audio Source is Phone/Chimes/VR/Beeps/Mixable Prompts (ex Nav Prompts) |
| Notes | For the use case MidRange and Treble setting behave the same as the Bass setting. |
| Interfaces | G-HMI, CBI |

3.1.1.2 AUDSET-UC-REQ-016367/B-Increase Bass/MidRange/Treble Setting - Currently set to Max (TcSE ROIN-290136-1)

Linked Elements

AUDSET-UC-REQ-016366/B-Increase Bass/MidRange/Treble Setting (TcSE ROIN-290134-1)

| | |
|-----------------------------|---|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment System Powered ON Bass at Max Level |
| Scenario Description | User selects <Increase Bass> via HMI. |
| Post-conditions | Bass setting remains unchanged. HMI indicates {Bass Setting}. |
| List of Exception Use Cases | N/A |
| Notes | For the use case MidRange and Treble setting behave the same as the Bass setting. |
| Interfaces | G-HMI; CBI |

3.1.1.3 AUDSET-UC-REQ-016368/B-Increase Bass/MidRange/Treble Setting - User selects and holds <increase Bass/MidRange/Treble> via HMI (TcSE ROIN-290137-1)

Linked Elements

AUDSET-UC-REQ-016366/B-Increase Bass/MidRange/Treble Setting (TcSE ROIN-290134-1)

| | |
|----------------|--------------------------------|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment System Powered ON |



| | |
|------------------------------------|---|
| Scenario Description | User selects and holds <increase Bass> via HMI |
| Post-conditions | Infotainment system adjusts bass setting with increasing by 1 step every T_audio hold. HMI indicates {Bass Settings} as level being adjusted |
| List of Exception Use Cases | N/A |
| Notes | For the use case MidRange and Treble setting behave the same as the Bass setting. |
| Interfaces | G-HMI, CBI |

3.1.1.4 AUDSET-UC-REQ-016369/B-Decrease Bass/MidRange/Treble Setting (TcSE ROIN-290151-1)

| | |
|------------------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment system powered ON |
| Scenario Description | User selects <Decrease Bass> via HMI Infotainment System adjusts bass setting. HMI indicates {Bass Setting} as level is being adjusted. |
| Post-conditions | HMI indicates {Bass Setting} (final setting). The Infotainment system will operate with the new bass setting. |
| List of Exception Use Cases | E1- AUDSET-GUC-290152-1-Decreaes Bass/MidRange/Treble Setting - Currently set to Minimum E2- AUDSET-GUC-290153-1-Decrease Bass/MidRange/Treble Setting - User selects and holds via HMI E3- AUDSET-GUC-290158-1-User selected BTMBF Settings when Audio Source is Phone/Chimes/VR/Beeps/Mixable Prompts (ex Nav Prompts) |
| Notes | For the use case MidRange and Treble setting behave the same as the Bass setting. |
| Interfaces | G-HMI, CBI |

3.1.1.5 AUDSET-UC-REQ-016370/B-Decreaes Bass/MidRange/Treble Setting - Currently set to Minimum (TcSE ROIN-290152-1)

Linked Elements

AUDSET-UC-REQ-016369/B-Decrease Bass/MidRange/Treble Setting (TcSE ROIN-290151-1)

| | |
|------------------------------------|---|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment System Powered ON Bass at Minimum Level |
| Scenario Description | User selects <Decrease Bass> via HMI. |
| Post-conditions | Bass setting remains unchanged. HMI indicates {Bass Setting}. |
| List of Exception Use Cases | N/A |
| Notes | For the use case MidRange and Treble setting behave the same as the Bass setting. |
| Interfaces | G-HMI; CBI |

**3.1.1.6 AUDSET-UC-REQ-016371/B-Decrease Bass/MidRange/Treble Setting - User selects and holds <decrease Bass/MidRange/Treble> via HMI (TcSE ROIN-290153-1)****Linked Elements**

AUDSET-UC-REQ-016369/B-Decrease Bass/MidRange/Treble Setting (TcSE ROIN-290151-1)

| | |
|------------------------------------|---|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment System Powered ON |
| Scenario Description | User selects and holds <decrease Bass> via HMI |
| Post-conditions | Infotainment system adjusts bass setting with decreasing by 1 step every T_audio hold. HMI indicates {Bass Settings} as level being adjusted |
| List of Exception Use Cases | N/A |
| Notes | For the use case MidRange and Treble setting behave the same as the Bass setting. |
| Interfaces | G-HMI, CBI |

3.1.1.7 AUDSET-UC-REQ-016372/B-Change Balance Setting (TcSE ROIN-290154-1)

| | |
|------------------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | The infotainment system is powered ON |
| Scenario Description | User selects <Change Balance Left or Change Balance Right> via HMI. Infotainment System adjusts Balance setting. HMI indicates {Balance Setting} as level is being adjusted. |
| Post-conditions | HMI indicates {Balance Setting} (final setting). The Infotainment system will operate with the new Balance setting. |
| List of Exception Use Cases | E1– AUDSET-GUC-290156-1-Change Balance Setting - Balance currently set to all the way Left or Right E2– AUDSET-GUC-290157-1-Change Balance Setting - User selects and holds via HMI E3– AUDSET-GUC-290158-1-User selected BTMBF Settings when Audio Source is Phone/Chimes/VR/Beeps/Mixable Prompts (ex Nav Prompts) |
| Interfaces | G-HMI, CBI |

3.1.1.8 AUDSET-UC-REQ-016373/B-Change Balance Setting - Balance currently set to all the way Left or Right (TcSE ROIN-290156-1)**Linked Elements**

AUDSET-UC-REQ-016372/B-Change Balance Setting (TcSE ROIN-290154-1)

| | |
|------------------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment System powered ON Balance set all the way to the Left |
| Scenario Description | User selects <Change Balance Left> via HMI. |
| Post-conditions | Balance setting remains unchanged. HMI indicates {Balance Setting}. |
| List of Exception Use Cases | N/A |
| Notes | This use case concept for balance set all the way to the left also applies to balance set all the way to the right |



| | |
|-------------------|------------|
| Interfaces | G-HMI; CBI |
|-------------------|------------|

3.1.1.9 AUDSET-UC-REQ-016374/B-Change Balance Setting - User selects and holds <change Balance Left/Right> via HMI (TcSE ROIN-290157-1)

Linked Elements

AUDSET-UC-REQ-016372/B-Change Balance Setting (TcSE ROIN-290154-1)

| | |
|------------------------------------|---|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment System is powered ON |
| Scenario Description | User selects and holds <change balance> via HMI |
| Post-conditions | Infotainment System adjusts Balance setting with level changing by 1 step every T_audio hold . HMI indicates {Balance Setting} as level is being adjusted. |
| List of Exception Use Cases | N/A |
| Interfaces | G-HMI; CBI |

3.1.1.10 AUDSET-UC-REQ-016375/B-Change Fade Setting (TcSE ROIN-290159-1)

| | |
|------------------------------------|---|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment System is powered ON |
| Scenario Description | User selects <Change Fade Front/Rear> via HMI. Infotainment system adjusts Fade setting. HMI indicates {Fade Setting} as level is being adjusted. |
| Post-conditions | HMI indicates {Fade Setting} (final setting). The infotainment system will operate with the new Fade setting. |
| List of Exception Use Cases | E1– AUDSET-GUC-290160-1-Change Fade Setting - Fade currently set to all the way to Front/Rear E2– AUDSET-GUC-290161-1-Change Fade Setting - User selects and holds via HMI E3– AUDSET-GUC-290158-1-User selected BTMBF Settings when Audio Source is Phone/Chimes/VR/Beeps/Mixable Prompts (ex Nav Prompts) |
| Interfaces | G-HMI; CBI |

3.1.1.11 AUDSET-UC-REQ-016376/B-Change Fade Setting - Fade currently set to all the way to Front/Rear (TcSE ROIN-290160-1)

Linked Elements

AUDSET-UC-REQ-016375/B-Change Fade Setting (TcSE ROIN-290159-1)

| | |
|------------------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment System powered ON Fade is set all the way to the Front |
| Scenario Description | User selects <Change Fade Front> via HMI |
| Post-conditions | Fade setting remains unchanged. HMI indicates {Fade Setting}. |
| List of Exception Use Cases | N/A |



| | |
|------------|--|
| Notes | This use case concept for Fade set all the way to the Front also applies to fade set all the way to the rear |
| Interfaces | G-HMI; CBI |

3.1.1.12 AUDSET-UC-REQ-016377/B-Change Fade Setting - User selects and holds <Change Fade Front/Rear> via HMI (TcSE ROIN-290161-1)

Linked Elements

AUDSET-UC-REQ-016375/B-Change Fade Setting (TcSE ROIN-290159-1)

| | |
|-----------------------------|---|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment System Powered ON |
| Scenario Description | User selects and holds <Change Fade Front/Rear> via HMI |
| Post-conditions | Infotainment System adjusts Fade setting with level increasing by 1 step every T_audio hold . HMI indicates {Fade Setting} as level is being adjusted. |
| List of Exception Use Cases | N/A |
| Interfaces | G-HMI; CBI |

3.1.1.13 AUDSET-UC-REQ-016378/D-User selected BTMBF Settings when Audio Source is Phone/Chimes/VR/Beeps/Mixable Prompts (ex Nav Prompts) (TcSE ROIN-290158-1)

| | |
|----------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment System is powered ON Media Source (ex CD, USB) is the active audio source using the user selected BTMBF setting |
| Scenario Description | A phone call, or infotainment chime, or VR session, or Beep or Mixable Prompts (ex Nav Prompt) becomes active |
| Post-conditions | Phone/Chimes/VR/Beeps/Mixable Prompts are not affected by the user selected BTMBF setting |
| Notes | Also the user cannot adjust BTMBF when the audio is OFF (ie empty audio stack) See SPSS requirement “Volv2-REQ-014817-User Volume Behavior” for additional details supporting the use case above for the AHU and DSP AMP. |
| Interfaces | G-HMI; CBI |

3.1.2 Requirements

3.1.2.1 AUDSET-TMR-REQ-014897/D-T_audio hold (TcSE ROIN-184723-1)

| Name | Description | Units | Range | Resolution | Default |
|--------------|--|-------|----------|------------|---------|
| T_audio hold | Once in a press and hold state this is the time until the Audio Settings Client increases/decreases to the next level for a persistent press and hold operation. Note: reference the HMI specification(s) for time a button is held before the Audio Settings Client considers it in a press and hold state. Note: use default value | msec | 50 - 200 | 1 | 100 |



3.1.3 Sequence Diagrams

3.1.3.1 AUDSET-SD-REQ-014898/A-Adjustment to BTMBF Sequence Diagram (TcSE ROIN-40213-1)

The 'Audio Settings Client' can command the 'Audio Settings Server' to change it's BTMBF status via the SetBTMBF.Rq() signal.

The BTMBF Display status can be updated based on the BTMBF.St() signal from the 'Audio Settings Server'.

Pre-condition

Sound Settings Display is Active

Scenario

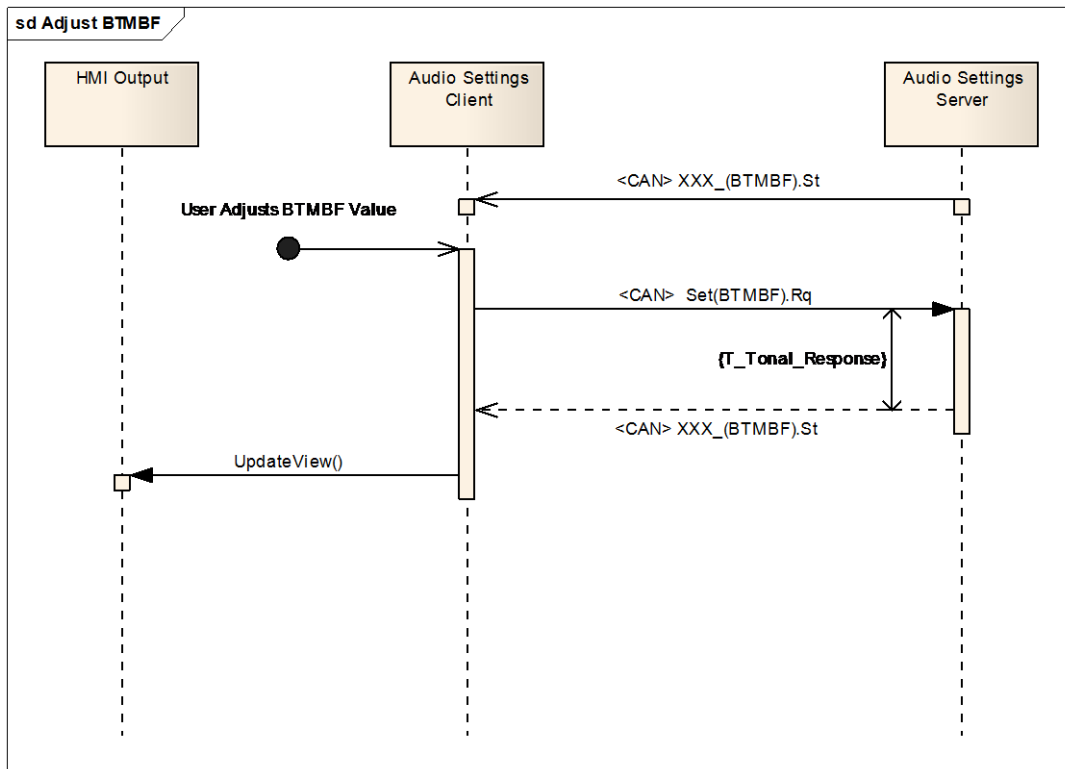
The user adjusts a BTMBF setting

Post-condition

The BTMBF setting is adjusted

The BTMBF setting has changed on the display

Sequence Diagram



3.1.3.2 AUDSET-SD-REQ-088155/B-Increase Bass Sequence Diagram

Pre-Condition

Bass is set to Step 0

Event

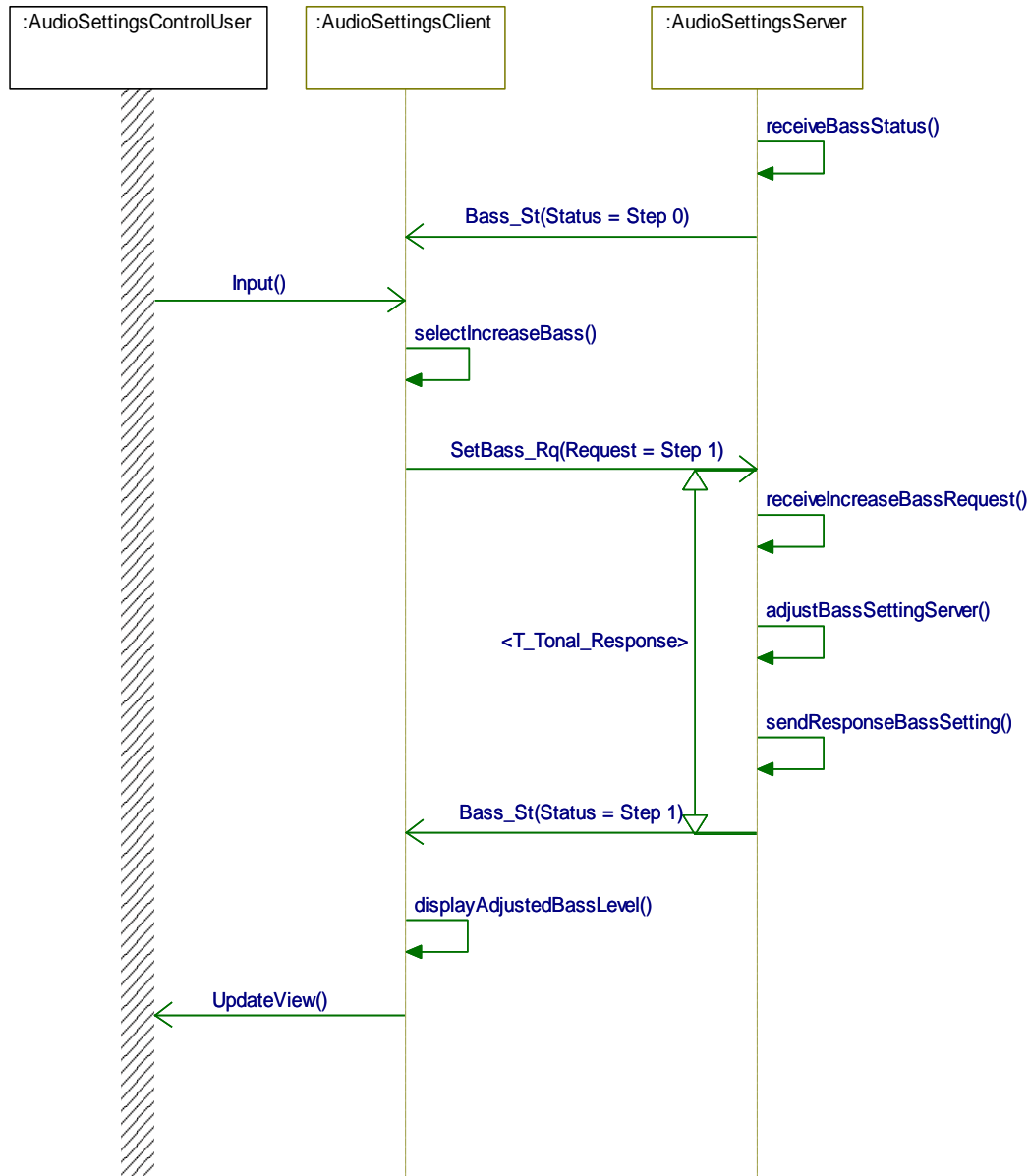
User increases Bass by one Step

Post-Condition

Bass is increased by one step



Sequence Diagram

**3.1.3.3 AUDSET-SD-REQ-088157/C-Press and Hold - Increase Bass Sequence Diagram****Pre-Condition**

Bass is set to Step 1

Event

User press and holds increase Bass

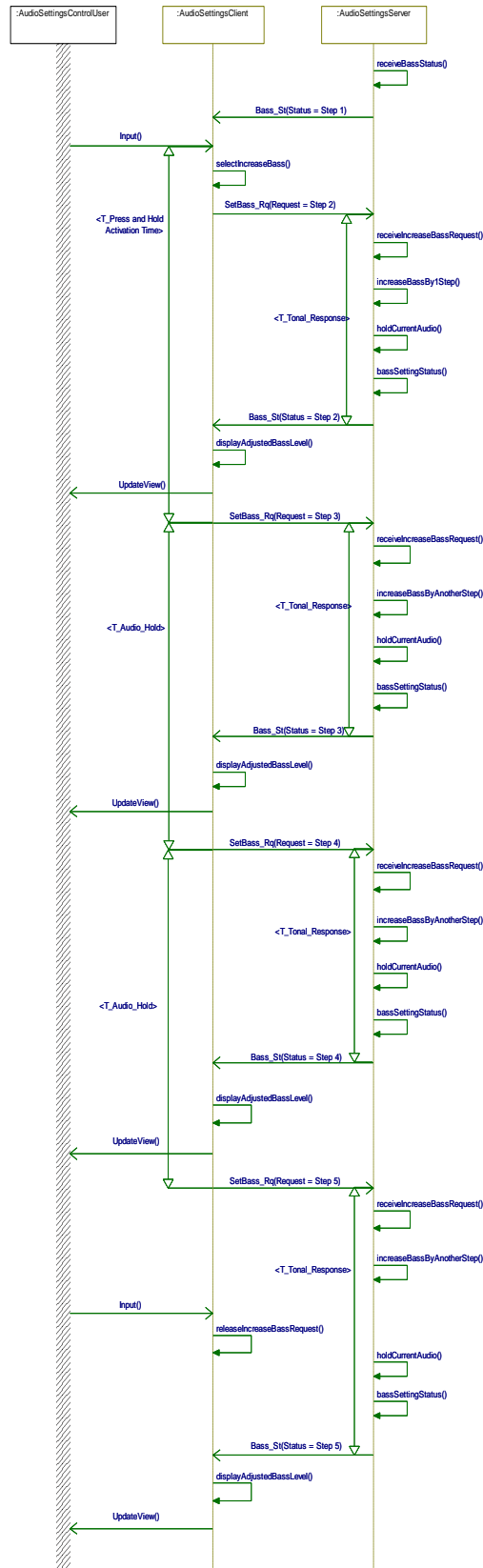
Post-Condition

Bass is increased while being increase Bass is being held

Bass stops increasing when increase Bass button is released



Sequence Diagram





3.2 AUDSET-FUN-REQ-016379/A-Speed Compensated Volume (TcSE ROIN-290192-1)

3.2.1 Use Cases

3.2.1.1 AUDSET-UC-REQ-016380/B-Change Speed Sensitive Volume (SSV) (TcSE ROIN-290162-1)

| | |
|-----------------------------|---|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment System is powered ON |
| Scenario Description | User selects <Increase/Decrease SSV> via HMI. |
| Post-conditions | HMI indicates updated {SSV Setting}. The infotainment system will operate with updated SSV level. HMI display returns to display appropriate for currently selected audio source. |
| List of Exception Use Cases | E1– AUDSET-GUC-290163-1-Change Speed Sensitive Volume (SSV) - SSV currently set to maximum |
| Interfaces | G-HMI; CBI |

3.2.1.2 AUDSET-UC-REQ-016381/B-Change Speed Sensitive Volume (SSV) - SSV currently set to maximum (TcSE ROIN-290163-1)

Linked Elements

AUDSET-UC-REQ-016380/B-Change Speed Sensitive Volume (SSV) (TcSE ROIN-290162-1)

| | |
|-----------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment System is powered ON SSV (speed sensitive volume) set to maximum |
| Scenario Description | User selects <Increase SSV> via HMI |
| Post-conditions | SSV setting remains unchanged |
| List of Exception Use Cases | N/A |
| Interfaces | G-HMI; CBI |

3.2.2 Requirements

3.2.3 Sequence Diagrams

3.2.3.1 AUDSET-SD-REQ-014902/B-Set Speed Compensated Volume Sequence Diagram (TcSE ROIN-40218-2)

The 'Audio Settings Client' can command the 'Audio Settings Server' to change it's Speed Compensated Volume setting via the SetSpeed_Comp_Vol.Rq() signal.

The Speed Compensated Volume Display status can be updated based on the Speed_Comp_Volume.St() signal from the 'Audio Settings Server'.

~~If the Vehicle Speed Quality Factor network signal is not set to OK then the "Audio Settings Server" shall treat the vehicle speed as though the vehicle is not moving for the speed compensated volume feature.~~

Pre-condition

Sound Settings Display is Active

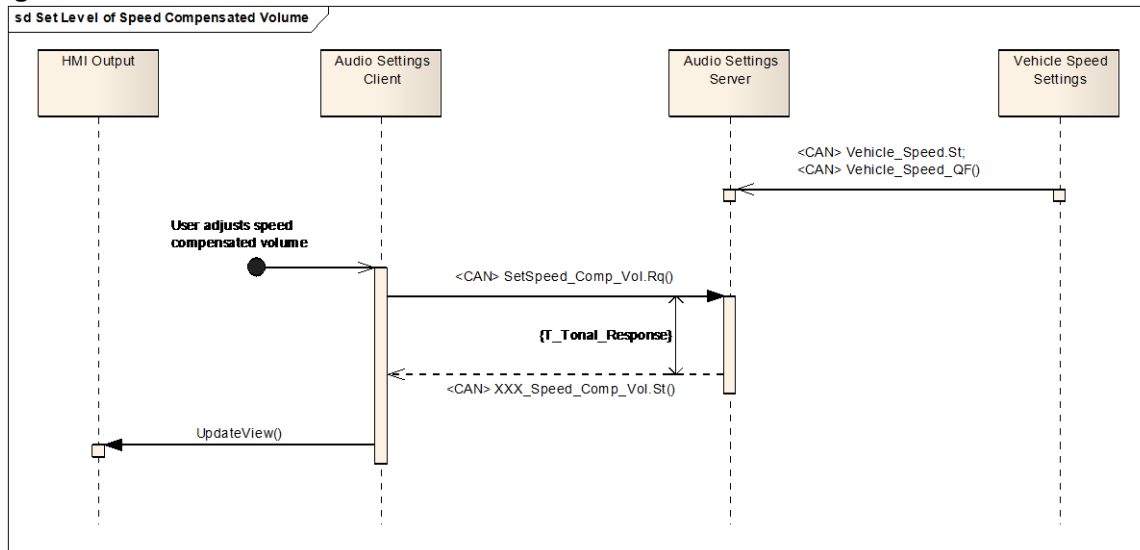
Scenario

The user adjusts the Speed Compensated Volume setting

**Post-condition**

The Speed Compensated Volume setting is adjusted

The Speed Compensated Volume setting has changed on the display

Sequence Diagram**3.2.3.2 AUDSET-SD-REQ-088159/B-Change Speed Compensated Volume from Level 1 to Level 2****Pre-Condition**

Speed Compensated Volume is at Level 1

Event

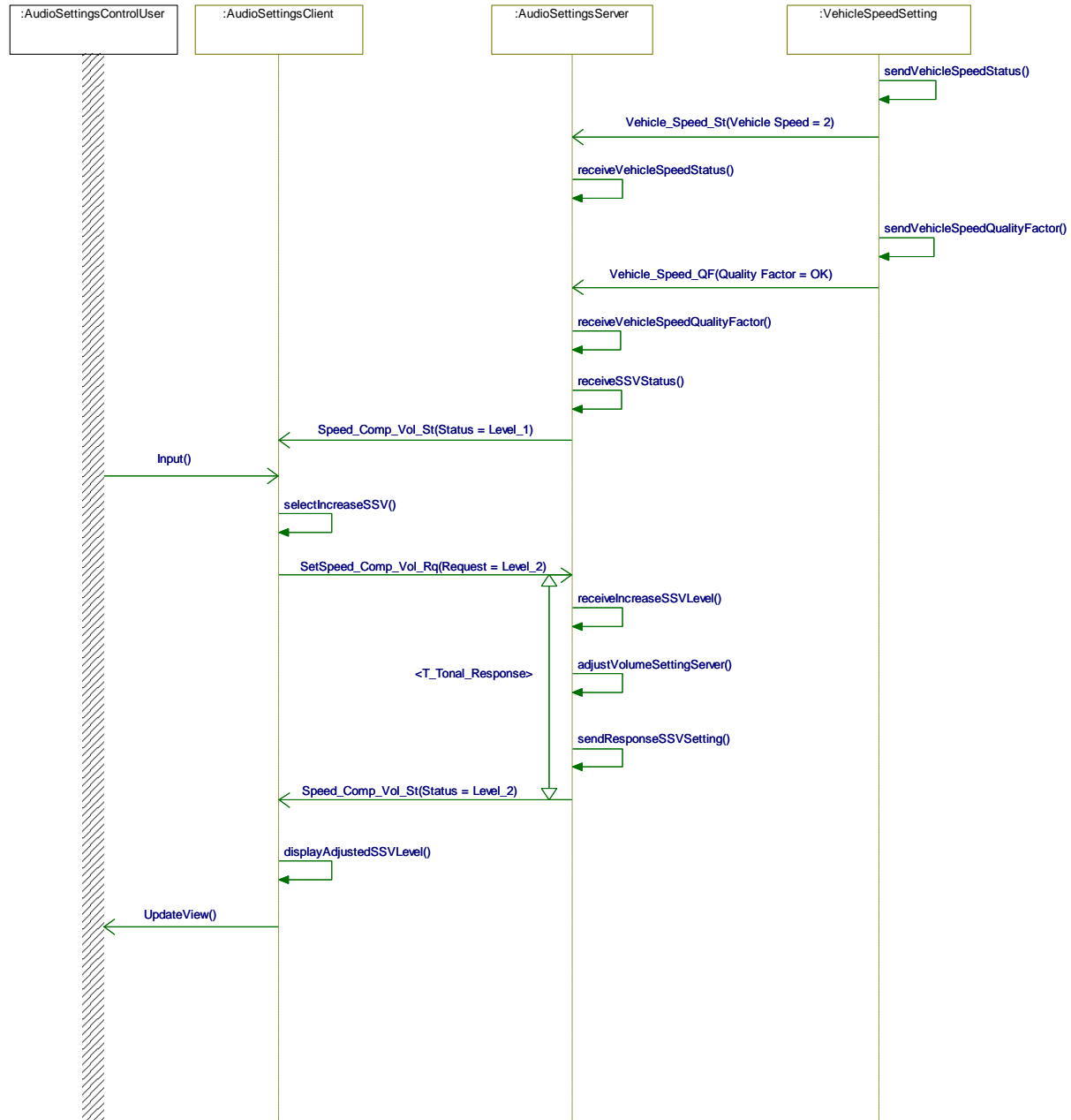
User selects Speed Compensated Volume Level 2

Post-Condition

The infotainment system goes to Speed Compensated Volume Level 2 and the HMI is updated



Sequence Diagram





3.3 AUDSET-FUN-REQ-016382/B-Occupancy Mode (TcSE ROIN-290196-1)

Note: see IDS specification for configuring occupancy mode for RH or LH drive vehicles

For Left Hand Drive vehicles if the user selects the Driver occupancy HMI the Audio Setting Client will send SetOccupancyMode_Rq = Driver. The Audio Setting Server will respond with Occupancy_Mode_St = Driver.

For Right Hand Drive vehicles if the user selects the Driver occupancy HMI the Audio Setting Client will send SetOccupancyMode_Rq = Passenger. The Audio Setting Server will respond with Occupancy_Mode_St = Passenger.

3.3.1 Use Cases

3.3.1.1 AUDSET-UC-REQ-016383/B-Select Occupancy Mode Settings (TcSE ROIN-290164-1)

| | |
|------------------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment System is powered ON |
| Scenario Description | User selects <Occupancy Mode x> via HMI (where "x" represents "Driver Seat", "All Seats", etc setting). |
| Post-conditions | The infotainment system will operate with the new occupancy mode setting. HMI displays selected Occupancy Mode. The selected occupancy mode remains enabled until a new selection is made by the user. |
| List of Exception Use Cases | N/A |
| Interfaces | G-HMI; CBI |

3.3.2 Requirements

3.3.2.1 AUDSET-SR-REQ-016384/D-Auto-Configuring for Occupancy Mode (TcSE ROIN-40734-4)

The AHU (if AAM not present) or AAM shall tell the display module(s) what occupancy modes are supported via the periodic _AutoConfigOcc_XXX CAN signals. The display modules shall store what occupancy modes are supported between ignition cycles.

For example the Audio Settings Client display would only show to the user the selectable occupancy modes that were supported by a particular AHU / AAM (_Auto_ConfigOcc_XXX = Supported) and not show the selectable occupancy modes that were not supported (_Auto_ConfigOcc_XXX = Not Supported).

Note: if display module is EOL configurable for occupancy mode then the display module shall ignore the auto-config signals and use the EOL occupancy mode configuration.

Note2: this requirement is not about the user selecting or storing a particular occupancy mode. This requirement is about what Occupancy Modes are shown to the user as possible occupancy modes that can be selected for a particular vehicle.

The AHU _AutoConfigOcc_XXX CAN signals are not applicable if the display module is integrated with the AHU.

3.3.3 Sequence Diagrams

3.3.3.1 AUDSET-SD-REQ-016385/A-Set Occupancy Mode Sequence Diagram (TcSE ROIN-40224-1)

The 'Audio Settings Client' can command the 'Audio Settings Server' to change it's Occupancy Mode setting via the SetOccupancy_Mode.Rq() signal.



The Occupancy Mode Display status can be updated based on the Occupancy_Mode.St() signal from the 'Audio Settings Server'.

Pre-condition

Sound Settings Display is Active

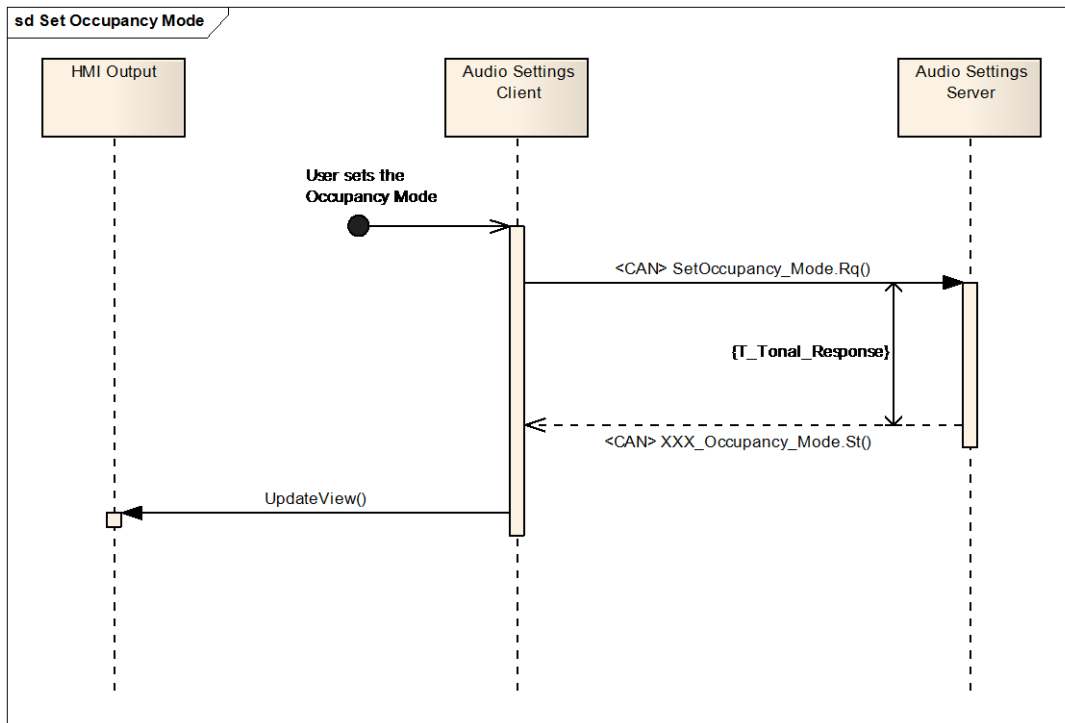
Scenario

The user adjusts the Occupancy Mode settings

Post-condition

The Occupancy Mode setting is adjusted

The Occupancy Mode setting has changed on the display

Sequence Diagram**3.3.3.2 AUDSET-SD-REQ-088158/B-Change Occupance Mode from All Seats to Driver Seats****Pre-Condition**

Occupancy mode is on All Seats

Event

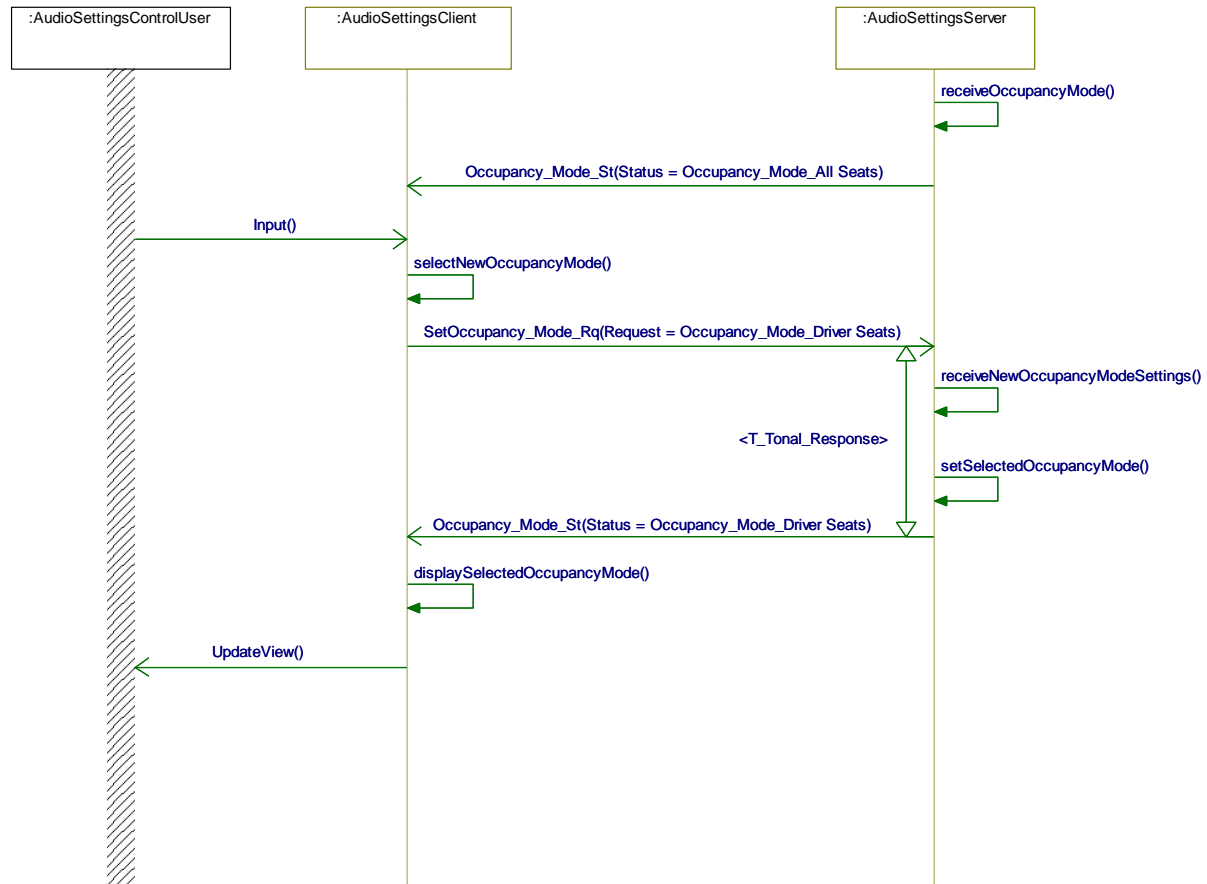
User selects Driver Seat occupancy mode

Post-Condition

Driver Seat occupancy mode is enabled and the HMI is updated



Sequence Diagram





3.4 AUDSET-FUN-REQ-016386/A-Convertible Auto-EQ Occupancy Mode (TcSE ROIN-290228-1)

3.4.1 Use Cases

3.4.1.1 AUDSET-UC-REQ-016387/B-Auto EQ Mode - Convertible Roof Up/Down Occupancy Mode (TcSE ROIN-290181-1)

| | |
|------------------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment System is powered ON |
| Scenario Description | User selects to change the position of the convertible roof to x (where x represents Roof Up (closed) or Roof Down (Open)). |
| Post-conditions | The Infotainment system mutes the audio. The Infotainment System sets the EQ cabin mode to <EQ Cabin Mode x> (where x represents Convertible Roof Up or Roof Down occupancy mode). The Infotainment System unmutes the audio. The user selected Occupancy Mode shall remain unchanged (ex. Driver, All, Rear). HMI is not affected. The EQ cabin mode remains unchanged until the convertible roof up/down position is changed by the user. |
| List of Exception Use Cases | N/A |
| Interfaces | Vehicle System Interface |

3.4.2 Requirements

3.4.2.1 AUDSET-FUR-REQ-014936/B-Activating Convertible Roof Closed Occupancy Mode (TcSE ROIN-280694-1)

IF

1. the Convertible Audio Settings Server receives CnvtTopPos_Up_Stat = Up, AND
2. the current Convertible Occupancy Mode state is set to Roof Open, THEN

If

1. Vehicle Speed is < 5KPH, AND
2. If CnvtTopPos_Up_Stat = Not_Up for at least 3 seconds before switching to CnvtTopPos_Up_Stat = Up

Then

Immediately change to the Convertible Occupancy Mode to Roof Closed. Note: when convertible occupancy mode changes reference IDS for setting DID indicating convertible occupancy mode status.

Else if

1. Vehicle Speed is < 5KPH, AND
2. If CnvtTopPos_Up_Stat = Up for more than 3 seconds (protects for hysteresis)

Then

Immediately change to the Convertible Occupancy Mode to Roof Closed. Note: when convertible occupancy mode changes reference IDS for setting DID indicating convertible occupancy mode status.

Else

Remain in the current convertible occupancy mode state



3.4.2.2 AUDSET-FUR-REQ-014937/B-Activating Convertible Roof Open Occupancy Mode (TcSE ROIN-280695-1)

IF

1. the Convertible Audio Settings Server receives CnvtTopPos_Up_Stat = Not_Up, AND
2. the current Convertible Occupancy Mode state is set to Roof Closed, THEN

If

1. Vehicle Speed is < 5KPH, AND
2. If CnvtTopPos_Up_Stat = Up for at least 3 seconds before switching to CnvtTopPos_Up_Stat = Not_Up

Then

Immediately change to the Convertible Occupancy Mode to Roof Open. Note: when convertible occupancy mode changes reference IDS for setting DID indicating convertible occupancy mode status.

Else if

1. Vehicle Speed is < 5KPH, AND
2. If CnvtTopPos_Up_Stat = Not_Up for more than 3 seconds (protects for hysteresis)

Then

Immediately change to the Convertible Occupancy Mode to Roof Open. Note: when convertible occupancy mode changes reference IDS for setting DID indicating convertible occupancy mode status.

Else

Remain in the current convertible occupancy mode state

3.4.2.3 AUDSET-FUR-REQ-014938/B-Error State for Convertible Roof Open Occupancy Mode (TcSE ROIN-280696-1)

The Convertible Occupancy Mode Server shall remember the Convertible Occupancy Mode Roof Open / Roof Closed state between power mode states. (ex when HMIAudioMode goes from ON -> OFF -> ON, bus sleep and wake-up events...)

Upon loss of Convertible Occupancy Mode setting because of a loss of B+ the Convertible Occupancy Mode Server shall default to Convertible Roof Closed Occupancy state upon a new battery connection event. The Convertible Occupancy Mode server shall remember convertible occupancy mode state during an engine crank event.

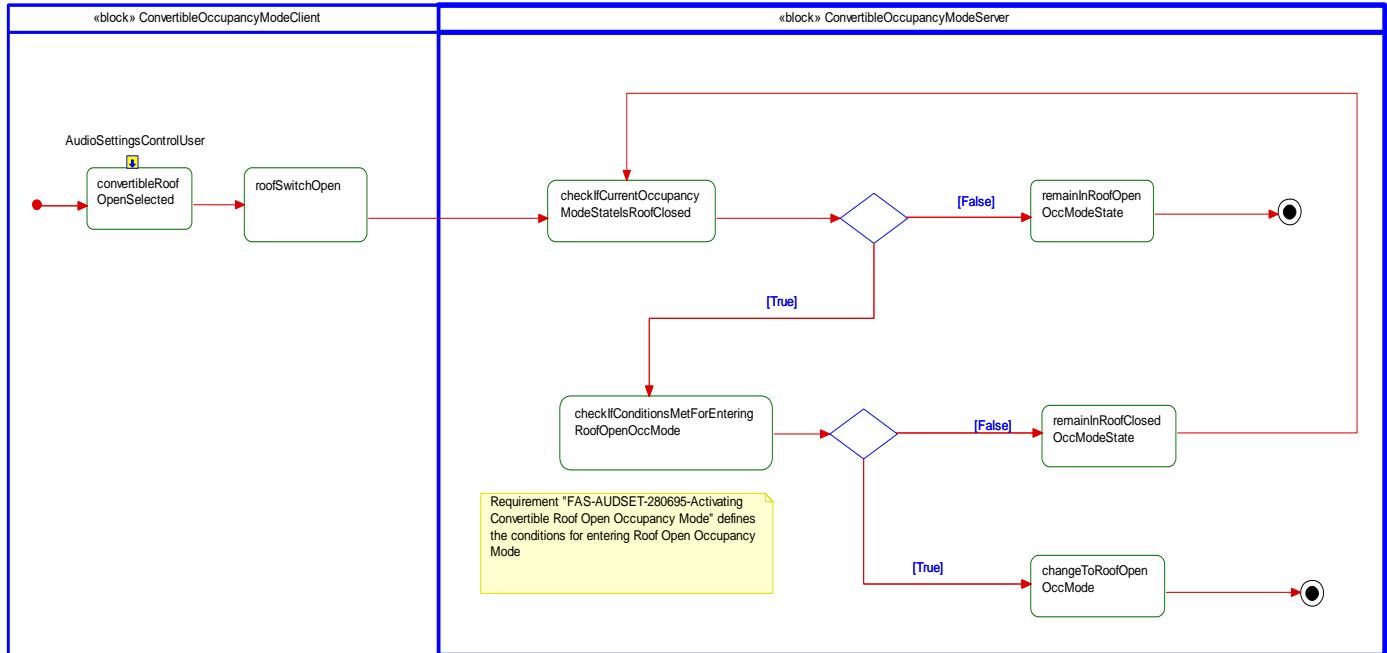
Note: reference IDS for setting DID indicating convertible occupancy mode status.



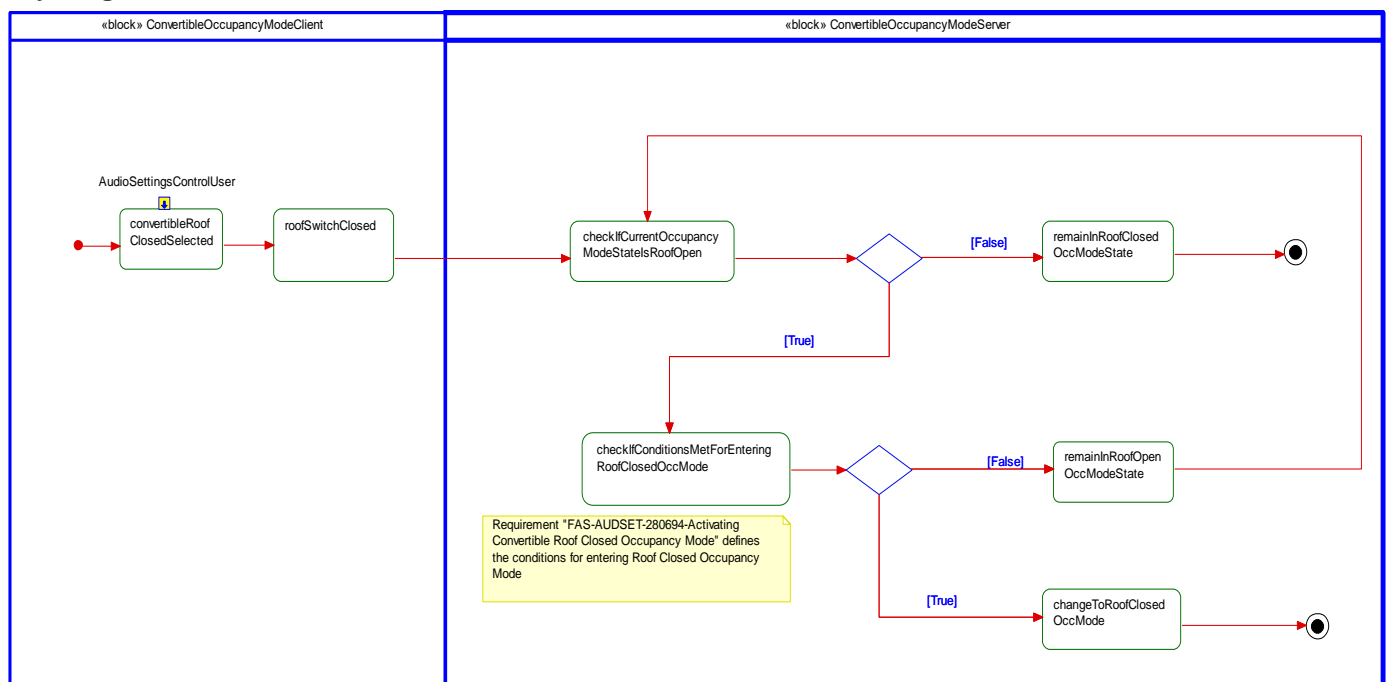
3.4.3 White Box View

3.4.3.1 Activity Diagrams

3.4.3.1.1 AUDSET-ACT-REQ-014939/A-Activating Convertible Roof Open Occupancy Mode (TcSE ROIN-281068-1) Activity Diagram



3.4.3.1.2 AUDSET-ACT-REQ-014940/A-Activating Convertible Roof Closed Occupancy Mode (TcSE ROIN-281071-1) Activity Diagram





3.4.3.2 Sequence Diagrams

3.4.3.2.1 AUDSET-SD-REQ-014941/A-Activating Convertible Roof Open Occupancy Mode (TcSE ROIN-280698-1)

Pre-condition

The Infotainment System is ON

Pre-condition

The Convertible Occupancy Mode Server is in Roof Closed Occupancy Mode

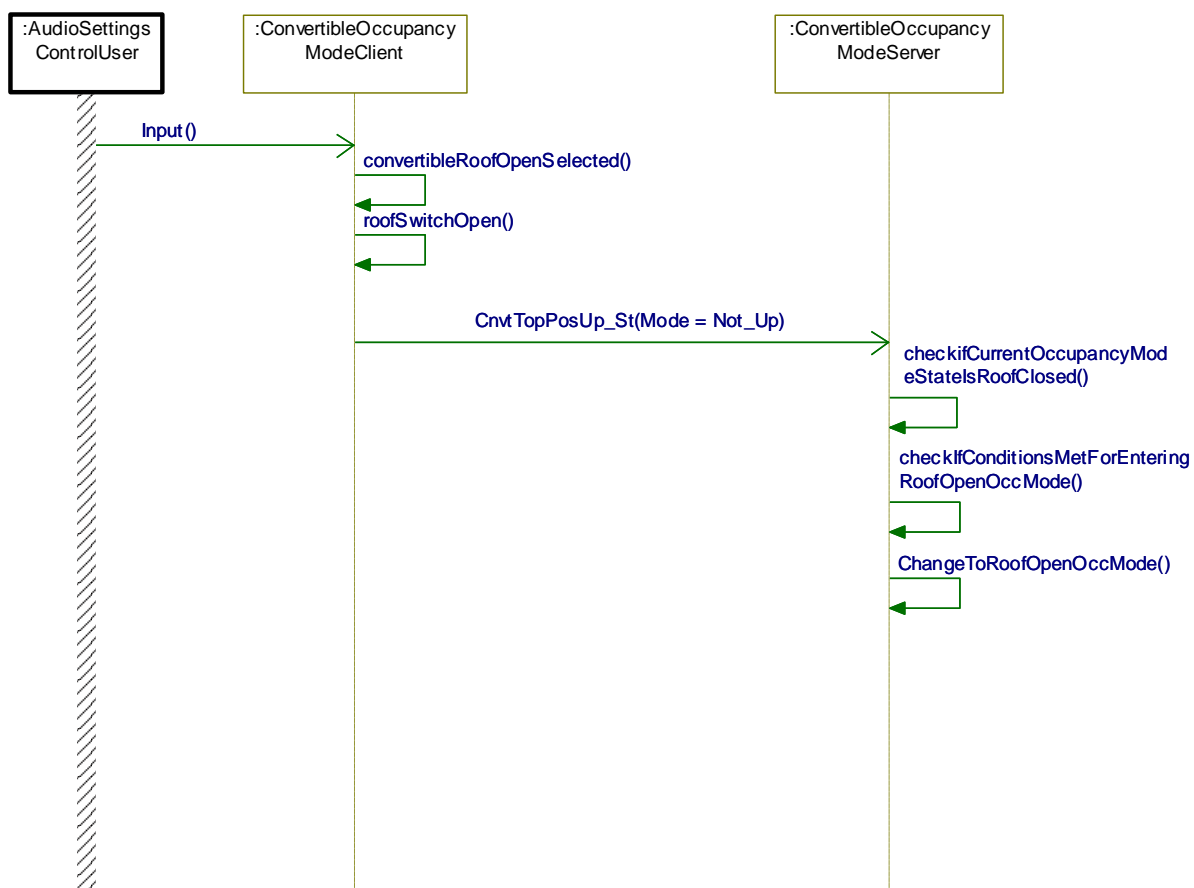
Normal Usage

The user activates a convertible top roof open event

Post-condition

The Convertible Occupancy Mode is in Roof Open Occupancy Mode

Sequence Diagram



3.4.3.2.2 AUDSET-SD-REQ-014942/A-Activating Convertible Roof Closed Occupancy Mode (TcSE ROIN-280706-1)

Pre-condition

The Infotainment System is ON

Pre-condition

The Convertible Occupancy Mode Server is in Roof Open Occupancy Mode

Normal Usage

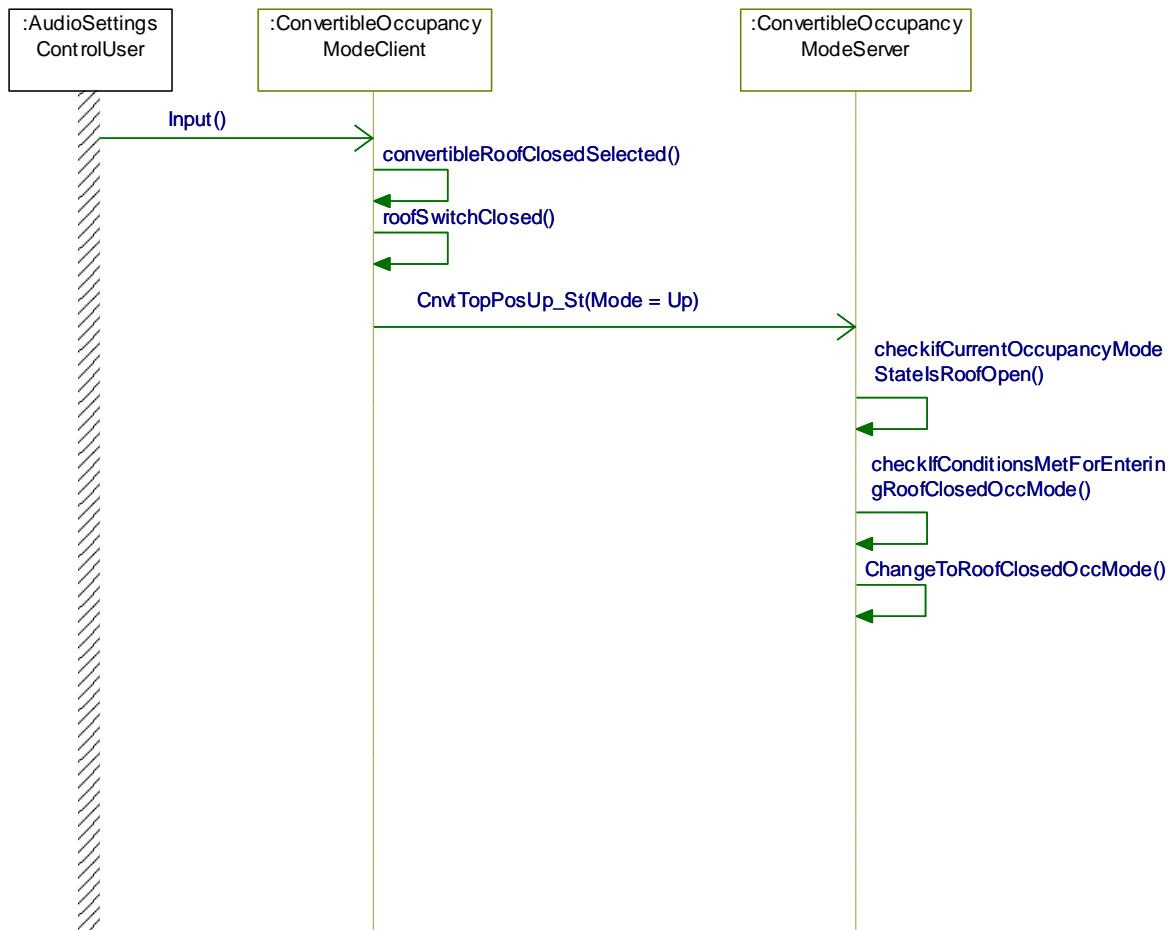
The user activates a convertible top roof closed event

Post-condition

The Convertible Occupancy Mode is in Roof Closed Occupancy Mode



Sequence Diagram





3.5 AUDSET-FUN-REQ-016390/A-Audio Demonstration Mode (TcSE ROIN-290208-1)

The user may have the ability to initiate an Audio Demonstration of a particular sound system which will play the stored audio.

3.5.1 Use Cases

3.5.1.1 AUDSET-UC-REQ-016391/D-Audio Demo Mode - Enable (TcSE ROIN-290166-1)

| | |
|-----------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment system is powered ON Audio Demo is OFF <u>A Media source is active</u> |
| Scenario Description | User selects <Audio Demo ON> via HMI. |
| Post-conditions | The Infotainment System plays Audio Demo audible elements at reference audio settings. HMI displays {audio demo} visual elements (e.g. splash screen, video clip, etc.). User may adjust <volume> during the Audio Demo via HMI. The audio demo will play until completion or cancellation by the user. Audio system will return to previous audio source and settings when Audio Demo is complete |
| List of Exception Use Cases | N/A |
| Interfaces | G-HMI; CBI |

3.5.1.2 AUDSET-UC-REQ-016392/B-Audio Demo Mode - Cancel (TcSE ROIN-290180-1)

| | |
|-----------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment System is powered ON Audio Demo is ON |
| Scenario Description | User selects <Audio Demo OFF> or <button press ≠ volume> via HMI. |
| Post-conditions | Audio demo is cancelled. Infotainment system will return to previous audio source and settings. |
| List of Exception Use Cases | N/A |
| Interfaces | G-HMI; CBI; SWC |

3.5.2 Requirements

3.5.2.1 AUDSET-SR-REQ-014922/B-Chimes and Prompts during Audio Demonstration (TcSE ROIN-39723-1)

During an Audio Demonstration event the vehicle chimes / prompts shall still be functional and be able to be mixed in with the Audio Demonstration audio.

3.5.2.2 AUDSET-SR-REQ-014923/B-Audio Demonstration during dual play (TcSE ROIN-39724-1)

If an Audio Demonstration event is selected during Dual Play then all the vehicle speakers will be used for the Audio Demonstration. The RSE (Rear Seat Entertainment) Audio Source will continue to play through the headphones except that none of the rear speakers will be muted. After the Audio Demonstration is complete the rear speakers will be muted again for the RSE Audio Source.



3.5.2.3 AUDSET-SR-REQ-014924/C-Audio Demo Client activation of an Audio Demo event (TcSE ROIN-39725-1)

The Audio Demo Client shall activate an Audio Demonstration event by Tx the 'Audio_Demo_CMND = ON' request to the Audio Demo Server.

3.5.2.4 AUDSET-SR-REQ-014925/B-Audio Demo Server response to Audio_Demo_CMND = ON from the Audio Demo Client (TcSE ROIN-39726-1)

The Audio Demo Server shall respond to 'Audio_Demo_CMND = ON' from the Audio Demo Client within Taudio_DSP_rsp with the signal 'Audio_Demo_Status = Active'. Before responding back with 'Audio_Demo_Status = Active' the Audio Demo Server shall mute the FSE (Front Seat Entertainment) audio into the Audio Demo Server (if there is an active source), unmute the rear speakers (if muted in dual play), and then Tx 'Audio_Demo_Status = Active' when the Audio Demo Server starts playing the audio demonstration.

3.5.2.5 AUDSET-SR-REQ-014926/C-Audio during an Audio Demonstration event (TcSE ROIN-39733-2)

The Media Audio will not be heard during an Audio Demonstration event but the Audio Demo Server will only send out audio for the Audio Demonstration unless noted otherwise. The Audio Demonstration audio is a Media audio source.

Audio Demonstration shall not prevent chimes from being played.

3.5.2.6 AUDSET-SR-REQ-014927/C-Audio Demo Server response when an Audio Demonstration event is complete (TcSE ROIN-39734-1)

When the Audio Demonstration completes the Audio Demo Server shall mute the rear speakers (if in dual play), unmute the active audio source into the Audio Demo Server and Tx the signal 'Audio_Demo_Status = Inactive/OFF' to the Audio Demo Client.

3.5.2.7 AUDSET-SR-REQ-014928/B-Audio Demo Client ending an Audio Demonstration event (TcSE ROIN-39735-1)

If the Audio Demonstration is interrupted and ended by the Audio Demo Client for any reason such as a source change, power mode change, or a button press (except volume button) before the audio Demonstration is complete then the Audio Demo Client shall use the signal 'Audio_Demo_CMND = OFF' to end the audio demonstration. When ending the audio demonstration because of a source change the Audio Demo Client shall not send the DSP AMP the signal 'Audio_Demo_CMND = OFF' until the source change is complete (this is so don't momentarily hear the previous FSE Audio Source).

After the Audio Demo Server receives the 'Audio_Demo_CMND = OFF' it shall then exit Audio Demonstration mode and return to the FSE Audio Source as indicated in the ResourceUpdate status message.

3.5.2.8 AUDSET-TMR-REQ-014929/B-Taudio_DSP_rsp (TcSE ROIN-39731-1)

| Name | Description | Units | Range | Resolution | Default |
|----------------|--|-------|--------|------------|---------|
| Taudio_DSP_rsp | Maximum time allowed from when the DSP AMP receives the 'Audio_Demo_CMND = ON' command, mute/unmute as required and responds with the "Audio_Demo_Status = Active" when the DSP AMP is about to begin playing the audio. | msec | 0-1000 | 10 | 125 |

3.5.3 Sequence Diagrams

3.5.3.1 AUDSET-SD-REQ-014930/A-Audio Demo Event Sequence Diagram (TcSE ROIN-39727-1)

Pre-condition

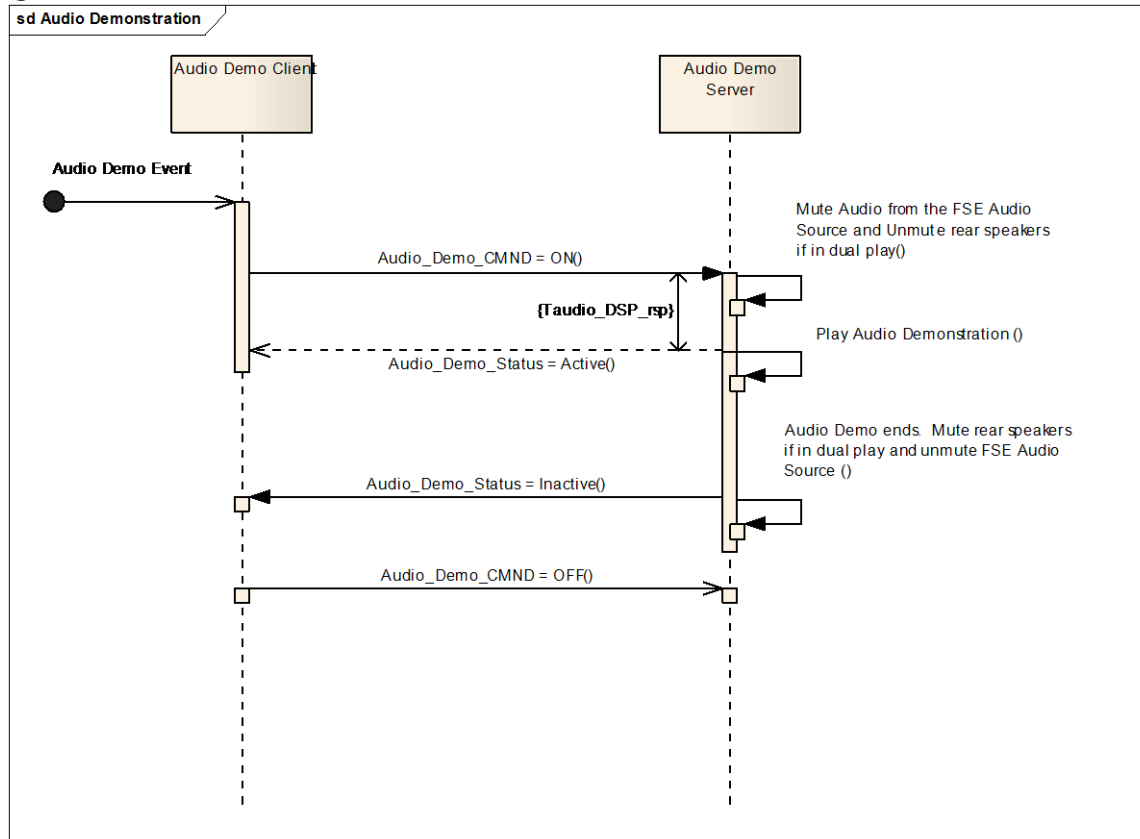
Audio Demonstration is not active

Post-condition

Audio Demonstration is Inactive and the Audio Demo Server can play audio from an active audio source



Sequence Diagram





3.6 AUDSET-FUN-REQ-348161/A-Audio Demonstration Mode - variant 2 (with DSP AMP v2)

3.6.1 AUDSETv2-CLD-REQ-349882/A-Audio Demo Client - variant 2

The Audio Demo Client is the interface for the Audio Demo function

3.6.2 AUDSETv2-CLD-REQ-349883/A-Audio Demo Server - variant 2

The Audio Demo Server is responsible for control of the Audio Demo function

3.6.3 AUDSETv2-CLD-REQ-348194/A-Audio Demo Audio Switch Server - variant 2

The Audio Demo Audio Switch Server is responsible for muting and unmuting the audio demonstration audio inputs and responsible for the speakers to use for audio demonstration.

The Audio Demo Audio Switch Server interfaces over the network with the Audio Demonstration Client.

The Audio Demo Audio Switch Server receives audio signals from the Audio Demo Server.

3.6.4 Use Cases

3.6.4.1 AUDSET-UC-REQ-016391/D-Audio Demo Mode - Enable (TcSE ROIN-290166-1)

| | |
|-----------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment system is powered ON Audio Demo is OFF <i>A Media source is active</i> |
| Scenario Description | User selects <Audio Demo ON> via HMI. |
| Post-conditions | The Infotainment System plays Audio Demo audible elements at reference audio settings. HMI displays {audio demo} visual elements (e.g. splash screen, video clip, etc.). User may adjust <volume> during the Audio Demo via HMI. The audio demo will play until completion or cancellation by the user. Audio system will return to previous audio source and settings when Audio Demo is complete |
| List of Exception Use Cases | N/A |
| Interfaces | G-HMI; CBI |

3.6.4.2 AUDSET-UC-REQ-016392/B-Audio Demo Mode - Cancel (TcSE ROIN-290180-1)

| | |
|-----------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment System is powered ON Audio Demo is ON |
| Scenario Description | User selects <Audio Demo OFF> or <button press ≠ volume> via HMI. |
| Post-conditions | Audio demo is cancelled. Infotainment system will return to previous audio source and settings. |
| List of Exception Use Cases | N/A |
| Interfaces | G-HMI; CBI; SWC |



3.6.5 Requirements

3.6.5.1 AUDSET-SR-REQ-348201/A-Audio Demo variant 2 Module Deployment

The deployment below is for audio demonstration mode with DSP AMP variant 2.

The DSPv2 module is the Audio Demonstration Audio Switch Server.

- The Audio Demonstration Audio Switch Server mutes and unmutes its audio demonstration audio inputs.
- The Audio Demonstration Audio Switch Server controls the directionality of the audio demo audio through the speakers.
- The audio Demonstration Audio Switch Server controls any surround acoustic settings that reside in the DSP AMP variant 2 and shall set them as needed to optimize the sound quality of the audio demo
- All other audio demonstration functions are contained in the Audio Demonstration Client and Server.

For APIM in this variant the Audio Demonstration Client and Audio Demonstration Server are both integrated in the APIM module. This includes generating the audio demonstration audio.

This network signals from the original audio demonstration function shall be re-used in the manner described in this variant 2 function.

3.6.5.2 AUDSETv2-SR-REQ-350948/A-Chimes and Prompts during Audio Demonstration

During an Audio Demonstration event the vehicle chimes / prompts shall still be functional and be able to be mixed in with the Audio Demonstration audio.

3.6.5.3 AUDSET-SR-REQ-348162/A-Activation of an Audio Demo event

The Audio Demo Server shall initiate an Audio Demonstration event to the Audio Demo Audio Switch Server by transmitting Audio_Demo_CMND = ON.

When the Audio Demo Audio Switch Server receives Audio_Demo_CMND = ON, then the Audio Demo Audio Switch Server shall mute, adjust any acoustical settings and unmute for Audio Demonstration before responding with Audio_Demo_Status = Active. The Audio Demo Audio Switch Server shall respond to Audio_Demo_CMND = ON (ie unmuted) within T_AudioDemo_Rsp of receiving Audio_Demo_CMND = ON.

When the Audio Demo Server receives Audio_Demo_Status = Active then the Audio Demo Server shall generate the Audio demonstration audio.

See sequence diagrams for detailed example

See applicable specs whether certain Media audio sources should be paused or not during an audio demonstration event.

Note:

Audio_Demo_Status = Active means the Audio Demo Audio Switch Server is unmuted for an audio demonstration event.

Audio_Demo_Status = Inactive/OFF means the Audio Demo Audio Switch Server is not ready for audio for an audio demonstration event. When Audio_Demo_Status = Inactive/OFF then Media audio could be muted or Media audio acoustics could be set for other media sources (ex sound immersion, surround sound etc).

3.6.5.4 AUDSETv2-SR-REQ-350947/A-Audio during an Audio Demonstration event

The Media Audio will not be heard during an Audio Demonstration event but the Audio Demo Server will only send out audio for the Audio Demonstration unless noted otherwise. The Audio Demonstration audio is a Media audio source.

Audio Demonstration shall not prevent chimes from being played.

**3.6.5.5 AUDSET-SR-REQ-348207/A-Completion of an Audio Demonstration event**

Whenever an Audio Demonstration event is not occurring the Audio Demonstration Server will send Audio_Demo_CMND = inactive/OFF.

When the Audio Demo Audio Switch Server receives Audio_Demo_CMND = OFF, then the Audio Demo Audio Switch Server shall mute and adjust for any media acoustical settings and unmute Media audio (ex Sound immersion, Surround Sound, etc if applicable) before responding with Audio_Demo_Status = Inactive. The Audio Demo Audio Switch Server shall respond to Audio_Demo_CMND = OFF within T_AudioDemo_Rsp of receiving Audio_Demo_CMND = OFF.

3.6.5.6 AUDSET-SR-REQ-348205/A-Cancelling Audio Demonstration during an audio demonstration event

The Audio Demo Server is responsible for ending an Audio Demo event.

Some reasons for cancelling an Audio Demo event (but not limited to these) are a source change, power mode change (ie HMIAudioMode from ON to OFF), user selects audio demo off or there is an infotainment button press (except volume button).

3.6.5.7 AUDSETv2-TMR-REQ-348206/A-T_AudioDemo_Rsp

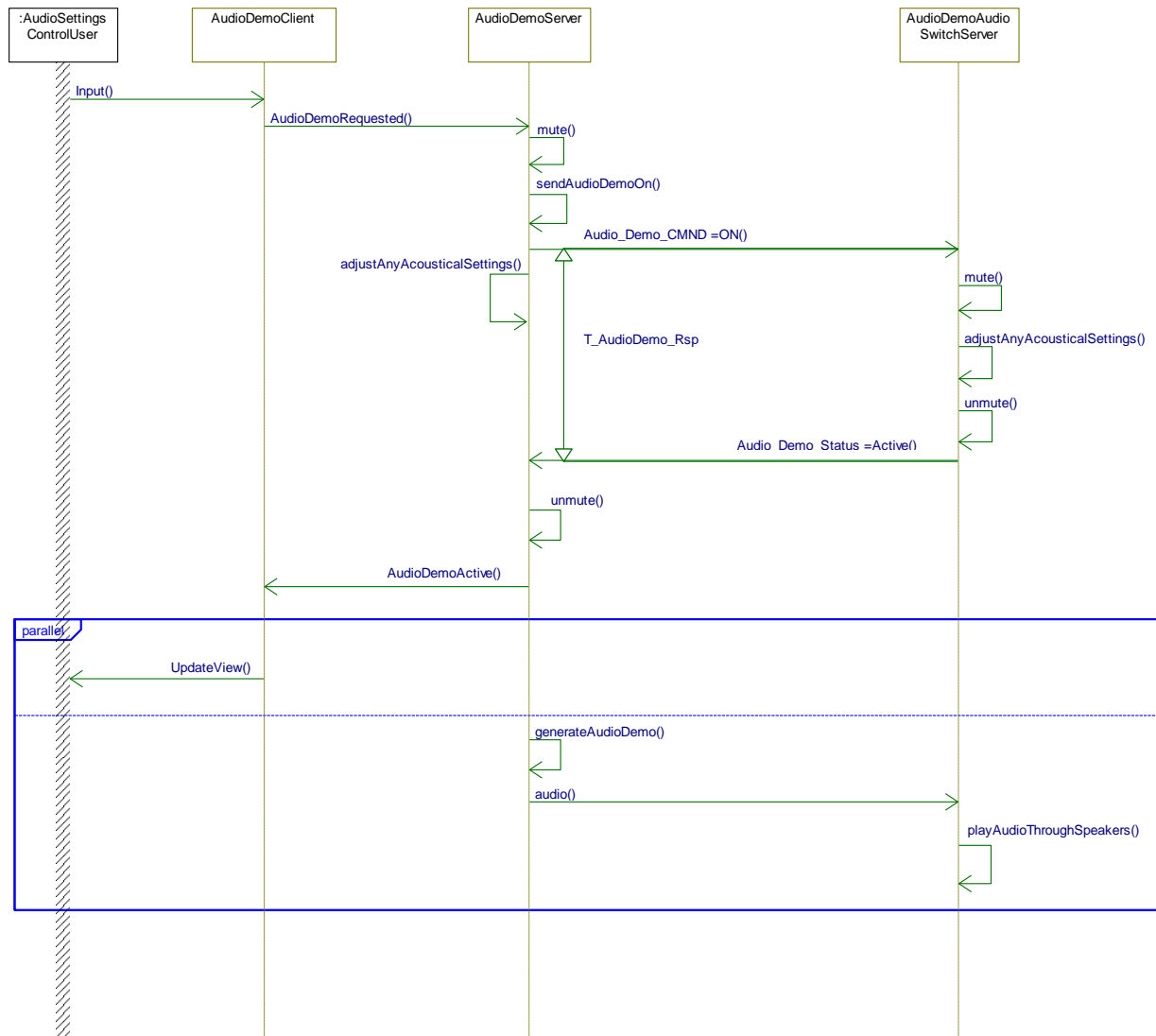
| Name | Description | Units | Range | Resolution | Default |
|-----------------|---|-------|-------|------------|---------|
| T_AudioDemo_Rsp | Maximum time allowed from when the Audio Demo Audio Switch Server receives the Audio_Demo_CMND command (Mute or Unmute) until the Audio_Demo_Status signal is updated with the response. Note: use the default value | msec | | | 300 |

3.6.6 Sequence Diagrams**3.6.6.1 AUDSET-SD-REQ-348208/A-Activating Audio Demonstration Mode**

Pre-Condition:

Audio Demonstration is not active

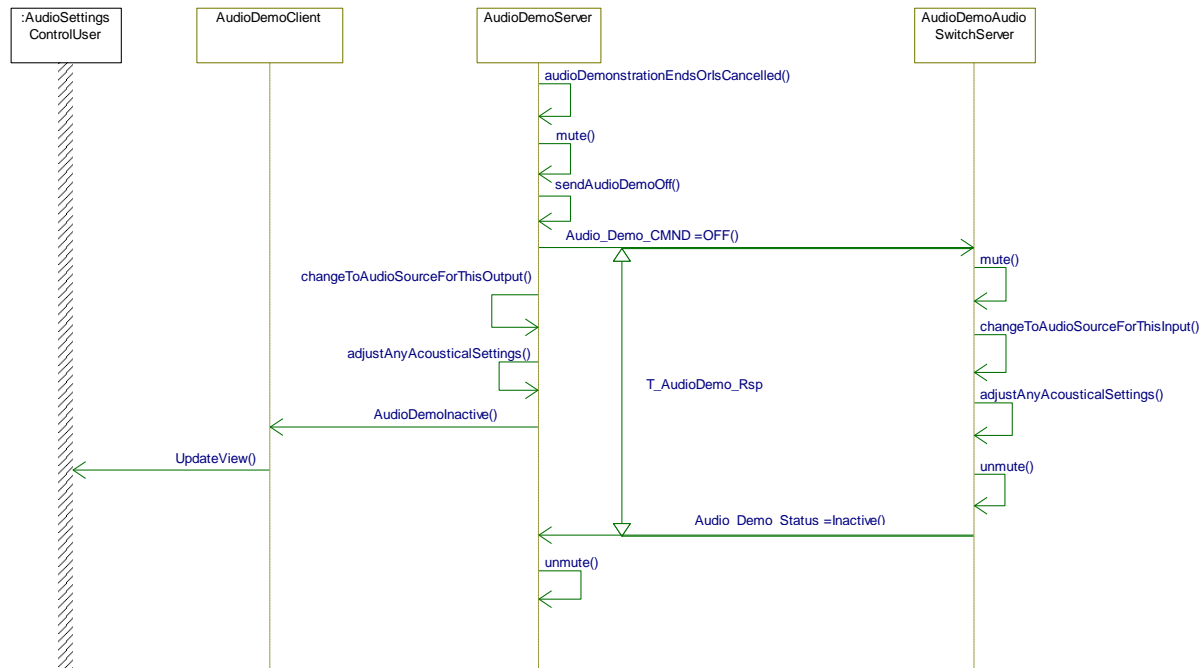
A media source is active



3.6.6.2 AUDSET-SD-REQ-348209/A-Deactivating Audio Demonstration Mode

Pre-Condition:

Audio Demonstration is Active





3.7 AUDSET-FUN-REQ-016393/A-Simulated Surround Sound (DSP Mode Setting) (TcSE ROIN-292781-1)

The Surround Sound Server may have the ability to 'Upmix' an audio stereo signal to a simulated surround sound when commanded by the Surround Sound Client.

3.7.1 Use Cases

3.7.1.1 AUDSET-UC-REQ-016394/B-Select DSP Mode Settings (ex Stereo, Surround) (TcSE ROIN-292780-1)

| | |
|------------------------------------|---|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment System is powered ON |
| Scenario Description | User selects <DSP Mode x> via HMI (where "x" represents Stereo, Surround). |
| Post-conditions | <p>The Infotainment System sets the DSP mode to the selected setting. The infotainment system will operate with the new DSP mode setting.</p> <p>HMI indicates {DSP Mode x Selected} (where "x" represents Stereo, Surround).</p> <p>The selected DSP mode remains enabled until a new selection is made by the user.</p> |
| List of Exception Use Cases | N/A |
| Interfaces | G-HMI; CBI |

3.7.2 Requirements

3.7.2.1 AUDSET-SR-REQ-014908/B-Surround Sound Client signal usage (TcSE ROIN-39721-3)

The Surround Sound Client shall Tx the 'Surround_Sound_Upmix = Surround' signal to the Surround Sound Server to request the Surround Sound Server to enter simulated surround sound mode.

The Surround Sound Client shall Tx the 'Surround_Sound_Upmix = Stereo' signal to the Surround Sound Server to request the Surround Sound Server to enter Stereo mode.

The Surround Sound Client will know the status of the DSP Setting Mode (ex. Surround, Stereo) using the surround sound status signal "DSP_Sur_Sound_Upmix.St".

3.7.2.2 AUDSET-SR-REQ-014909/B-Surround Sound Server signal usage (TcSE ROIN-39722-2)

The Surround Sound Server shall provide the status of the DSP Mode Setting that is being used via the DSP_Sur_Sound_Upmix.St signal.

The Surround Sound Server shall provide simulated surround audio when 'Surround_Sound_Upmix = Surround' unless noted otherwise

The Surround Sound Server shall provide stereo audio when 'Surround_Sound_Upmix = Stereo'

3.7.3 Sequence Diagrams

3.7.3.1 AUDSET-SD-REQ-014910/A-DSP Mode Sequence Diagram (TcSE ROIN-286581-1)

Pre-condition

The Infotainment System is ON

**Pre-condition**

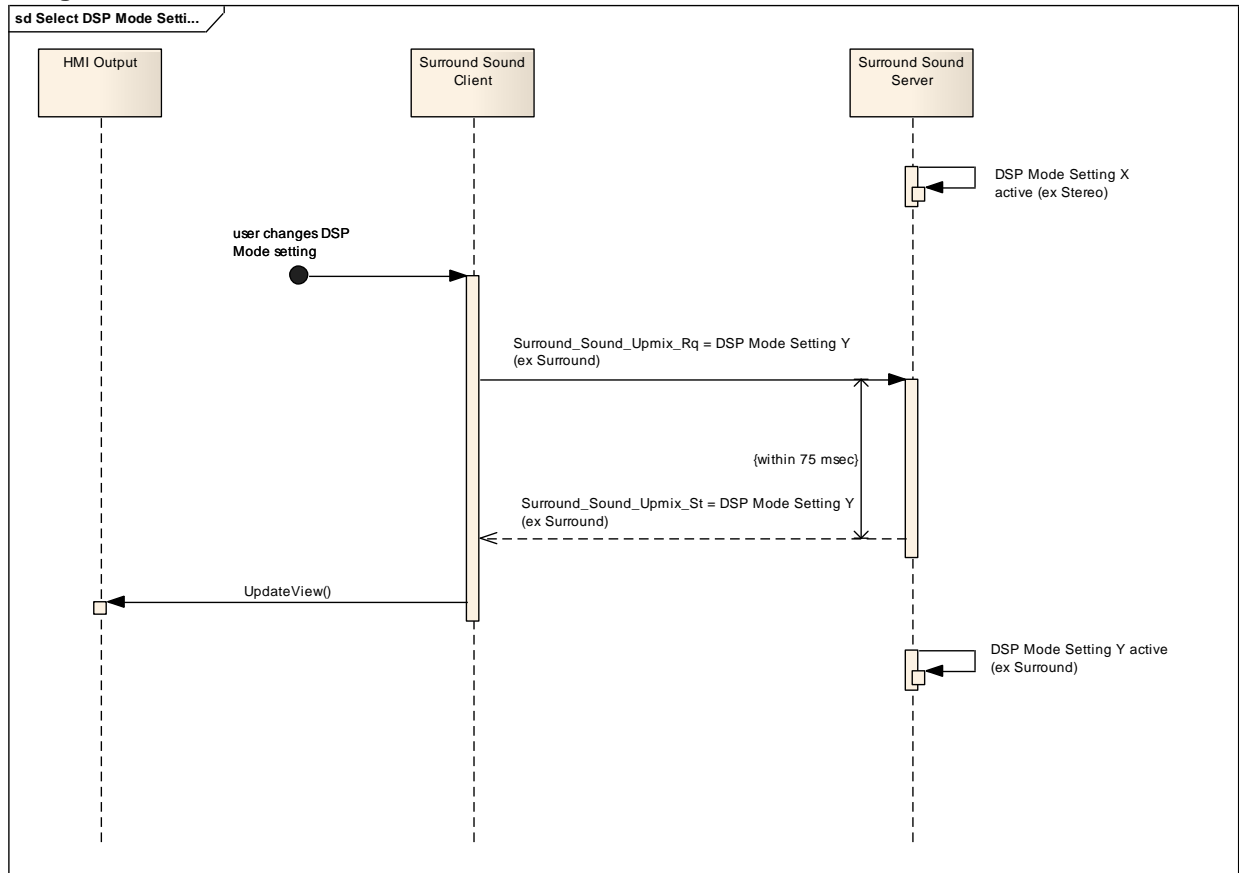
The Surround Sound Server is in DSP Mode Setting X

Normal Usage

The user activates DSP Mode Setting Y

Post-condition

The DSP Mode Setting Y is active

Sequence Diagram



3.8 AUDSETv2-FUN-REQ-016388/B-Simulated Surround Sound (DSP Mode Setting) - Variant 2 (TcSE ROIN-290236-1)

3.8.1 Use Cases

3.8.1.1 *AUDSET-UC-REQ-016389/B-Select DSP Mode Settings (ex Stereo, Surround, OnStage, Audience...) (TcSE ROIN-290165-1)*

| | |
|------------------------------------|---|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment System is powered ON |
| Scenario Description | User selects <DSP Mode x> via HMI (where "x" represents Stereo, Surround, OnStage, or Audience...). |
| Post-conditions | <p>The Infotainment System sets the DSP mode to the selected setting. The infotainment system will operate with the new DSP mode setting.</p> <p>HMI indicates {DSP Mode x Selected} (where "x" represents Stereo, Surround, Onstage, Audience...).</p> <p>The selected DSP mode remains enabled until a new selection is made by the user.</p> |
| List of Exception Use Cases | N/A |
| Note | Some setups may only support Stereo and Surround while others may support different settings such as OnStage or Audience. For display module reference configuration set-up for what should be displayed as DSP Mode options to the user. |
| Interfaces | G-HMI; CBI |

3.8.2 Requirements

3.8.2.1 *AUDSETv2-REQ-014913/B-Surround Sound Client signal usage (TcSE ROIN-286960-1)*

The Surround Sound Client shall request a DSP Setting Mode setting by sending the Surround_Sound_Upmix2_Rq signal to the Surround Sound Server.

The Surround Sound Client will know the status of the DSP Setting Mode (ex. Stereo, Surround, OnStage, Audience...) using the surround sound status signal "Surround_Sound_Upmix2_St" from the Surround Sound Server.

3.8.2.2 *AUDSETv2-REQ-014914/B-Surround Sound Server signal usage (TcSE ROIN-286961-1)*

The Surround Sound Server shall provide the status of the DSP Mode Setting that is being used via the Surround_Sound_Upmix2_St signal.

3.8.2.3 *AUDSETv2-REQ-014915/B-Surround Sound Server DSP Mode Setting between PowerMode changes (TcSE ROIN-287105-1)*

The Surround Sound Server shall remember the DSP Mode Settings between power mode states. (ex when HMIAudioMode goes from ON -> OFF -> ON, bus sleep and wake-up events...).

Upon loss of DSP Mode setting because of a loss of B+ the Surround Sound Server shall default to its default state upon a new battery connection event. The Surround Sound Server shall remember DSP Mode Setting during an engine crank event.



3.8.2.4 *AUDSETv2-REQ-014916/B-Surround Sound Server receives invalid request (TcSE ROIN-287106-1)*

If the Surround Sound Server receives a Surround_Sound_Upmix2_Rq for a DSP Mode setting it does not support then the Surround Sound Server shall ignore the request and respond with its current DSP Mode setting.

3.8.2.5 *AUDSETv2-REQ-014917/B-Revel Branded Specific DSP Mode Setting (TcSE ROIN-287107-1)*

The Revel specific Surround Sound Server shall support the following:

1. OFF (ie Surround_Sound_Upmix2_St = Stereo)
2. Audience
3. On Stage

The Revel Specific default setting is 0x2 Audience (the default setting as described in requirement - [FAS-AUDSETv2-GREQ-287105-1-Surround Sound Server DSP Mode Setting between PowerMode changes](#)).

3.8.3 Sequence Diagrams

3.8.3.1 *AUDSETv2-SD-REQ-014918/A-DSP Mode Sequence Diagram (TcSE ROIN-286752-1)*

Pre-condition

The Infotainment System is ON

Pre-condition

The Surround Sound Server is in DSP Mode Setting X

Normal Usage

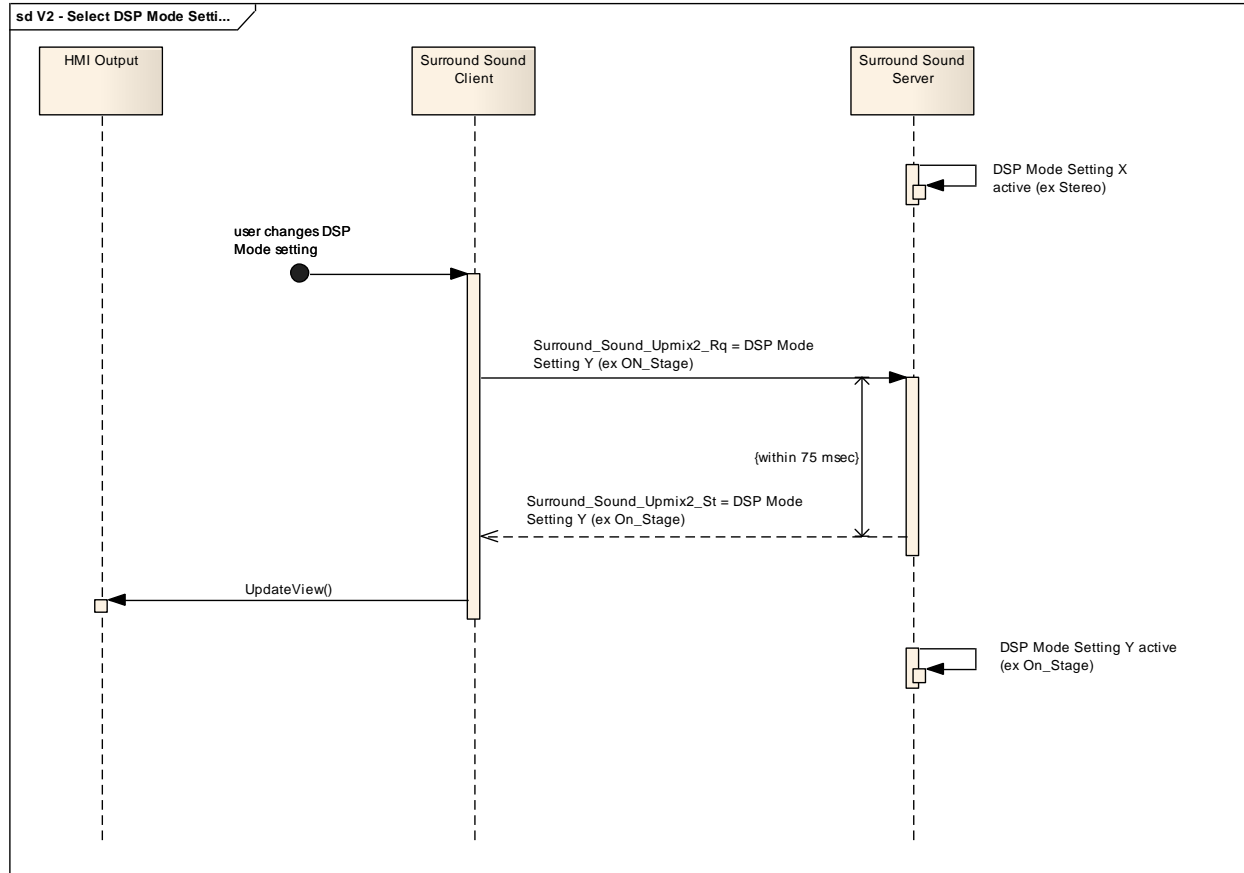
The user activates DSP Mode Setting Y

Post-condition

The DSP Mode Setting Y is active



Sequence Diagram

**3.8.3.2 AUDSET-SD-REQ-088161/B-Change from Stereo to ON_Stage DSP Mode****Pre-Condition**

DSP Mode is set to Stereo

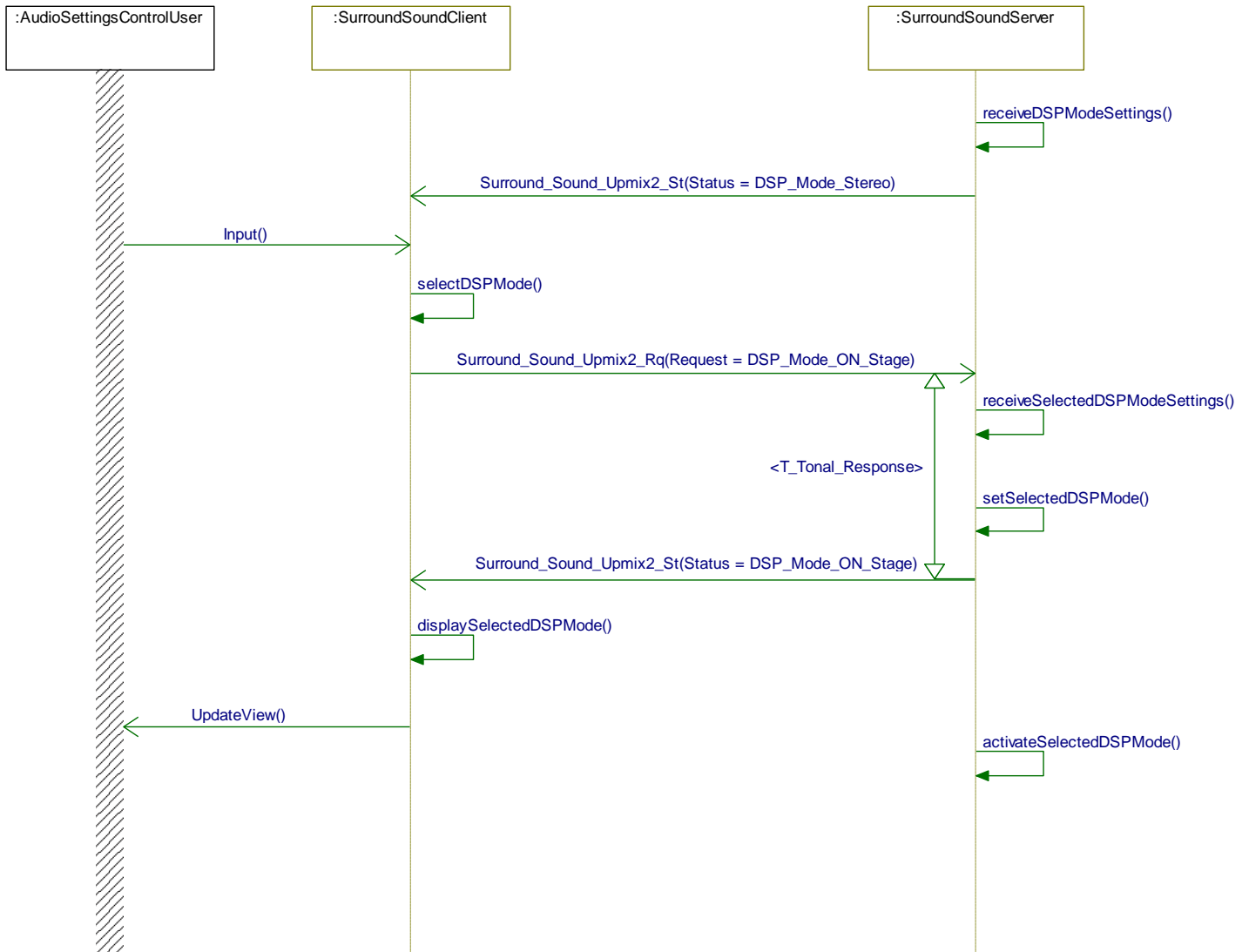
Event

User selects ON_Stage DSP Mode

Post-Condition

The infotainment system goes to DSP Mode ON_Stage and HMI is updated

Sequence Diagram





3.9 AUDSET-FUN-REQ-238444/A-Sound Immersion

3.9.1 Use Cases

3.9.1.1 AUDSET-UC-REQ-238445/B-Change from Stereo immersion level to the default OnStage immersion level by selecting the OnStage DSP Mode HMI setting

| | |
|-----------------------------|---|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment System is Powered ON. Media Source is active DSP Mode is set to Stereo Immersion level is set to minimum (i.e. immersion level = 0) |
| Scenario Description | The user selects DSP Mode "Onstage" from the HMI |
| Post-conditions | The infotainment system sets the DSP Mode to Onstage The infotainment system sets the Audio Immersion level to the default setting for Onstage The HMI for Immersion Level is set to the default setting for Onstage The HMI for DSP mode is set to "Onstage" The selected DSP mode and Immersion level remains saved until a new selection is made by the user. |
| Notes | Same general strategy going from Onstage to Stereo. Immersion Setting 0 = Stereo Immersion Setting 64 = Audience default setting Immersion Setting 127 = Onstage default setting Note: The HMI should be updated quickly enough to give the user the experience of the immersion setting change occurring in real-time. This is only applicable to Media sources and does not apply to other audio sources (such as VR, Phone, Mixable Prompts and TA) |
| Interfaces | G-HMI, CBI |

3.9.1.2 AUDSET-UC-REQ-238446/B-Change from an Audience immersion level to Stereo immersion level by selecting the Stereo DSP Mode HMI setting

| | |
|-----------------------|---|
| Actors | Vehicle Occupant |
| Pre-conditions | Infotainment System is Powered ON. Media Source is active DSP Mode is set to Audience |



| | |
|-----------------------------|---|
| | Immersion level is set to a level in the Audience immersion range (i.e. immersion level between 1 – 64) |
| Scenario Description | The user selects DSP Mode “Stereo” from the HMI |
| Post-conditions | <p>The infotainment system sets the DSP Mode to Stereo</p> <p>The infotainment system sets the Audio Immersion level to minimum (i.e. immersion level = 0)</p> <p>The HMI for Immersion Level is set to the default setting for Stereo</p> <p>The HMI for DSP mode is set to “Stereo”</p> <p>The selected DSP mode and Immersion level remains saved until a new selection is made by the user.</p> |
| Notes | <p>Same general strategy going from Stereo to Audience.</p> <p>Immersion Setting 0 = Stereo Immersion Setting 64 = Audience default setting Immersion Setting 127 = Onstage default setting</p> <p>Note: The HMI should be updated quickly enough to give the user the experience of the immersion setting change occurring in real-time.</p> <p>This is only applicable to Media sources and does not apply to other audio sources (such as VR, Phone, Mixable Prompts and TA)</p> |
| Interfaces | G-HMI, CBI |

3.9.1.3 AUDSET-UC-REQ-238447/B-Change an Onstage immersion level to the default Audience immersion level by selecting the Audience DSP Mode HMI setting

| | |
|-----------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | <p>Infotainment System is Powered ON.</p> <p>Media Source is active</p> <p>DSP Mode is set to Onstage</p> <p>Immersion level is set to an Onstage Level in the range support for Onstage (i.e. immersion level between 65 - 127)</p> |
| Scenario Description | The user selects DSP Mode “Audience” from the HMI |
| Post-conditions | <p>The infotainment system sets the DSP Mode to Audience</p> <p>The infotainment system sets the Audio Immersion level to the default setting for Audience (i.e. immersion level = 64)</p> <p>The HMI for Immersion Level is set to the default setting for Audience</p> |



| | |
|-------------------|--|
| | <p>The HMI for DSP mode is set to “Audience”</p> <p>The selected DSP mode and Immersion level remains saved until a new selection is made by the user.</p> |
| Notes | <p>Same general strategy going from Audience to Onstage.</p> <p>Immersion Setting 0 = Stereo Immersion Setting 64 = Audience default setting Immersion Setting 127 = Onstage default setting</p> <p>Note: The HMI should be updated quickly enough to give the user the experience of the immersion setting change occurring in real-time.</p> <p>This is only applicable to Media sources and does not apply to other audio sources (such as VR, Phone, Mixable Prompts and TA)</p> |
| Interfaces | G-HMI, CBI |

3.9.1.4 AUDSET-UC-REQ-238448/B-Change from Stereo immersion level to an Onstage Immersion level by dragging the wiper to the OnStage region

| | |
|-----------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | <p>Infotainment System is Powered ON.</p> <p>Media Source is active</p> <p>DSP Mode is set to Stereo</p> <p>Immersion level is set to minimum (i.e. immersion level = 0)</p> |
| Scenario Description | The user holds the HMI immersion wiper and drags it to the intended Onstage Immersion level setting in the Onstage region of the HMI |
| Post-conditions | <p>As the HMI immersion wiper is dragged from the Immersion level minimum position to the intended Onstage immersion level the HMI and Audio are continuously updated real time as the wiper is moved.</p> <ul style="list-style-type: none">As the HMI wiper passes the immersion level on HMI from Stereo to the Audience region the HMI is updated to show the DSP Mode set to “Audience”As the HMI immersion wiper passes the immersion level on the HMI from the Audience region to the beginning of the Onstage immersion level region the HMI is updated to show the DSP Mode set “Onstage” <p>The user stops dragging and releases the HMI immersion wiper in the Onstage region and the immersion level Medio audio remains at the selected Onstage immersion level.</p> <p>The selected DSP mode and Immersion level remains saved until a new selection is made by the user.</p> |
| Notes | <p>Same general strategy going from Onstage to Stereo</p> <p>Immersion Setting 0 = Stereo Immersion Setting 64 = Audience default setting</p> |



| | |
|-------------------|--|
| | <p>Immersion Setting 127 = Onstage default setting</p> <p>Note: Refer to HMI whether immersion wipers or some other method is used for controlling the immersion level. Wipers are just used as an example in this use case.</p> <p>Note: The HMI should be updated quickly enough to give the user the experience of the immersion setting change occurring in real-time.</p> <p>This is only applicable to Media sources and does not apply to other audio sources (such as VR, Phone, Mixable Prompts and TA)</p> |
| Interfaces | G-HMI, CBI |

3.9.1.5 AUDSET-UC-REQ-238449/B-Change from an Audience immersion level to the Stereo Immersion level by dragging the wiper to the Stereo region

| | |
|-----------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | <p>Infotainment System is Powered ON.</p> <p>Media Source is active</p> <p>DSP Mode is set to Audience</p> <p>Immersion level is set to a level in the Audience immersion range (i.e. immersion level between 1 – 64)</p> |
| Scenario Description | The user holds an HMI immersion wiper and drags it to the intended Stereo immersion level setting of the HMI |
| Post-conditions | <p>As the HMI immersion wiper is dragged from the Audience immersion level setting to the intended Stereo immersion level, the HMI and media audio are continuously updated real-time as the wiper is moved.</p> <ul style="list-style-type: none">As the HMI immersion wiper passes the immersion level on the HMI from the Audience region to the Stereo setting, the HMI is updated to show the DSP Mode is set to “Stereo” <p>The user stops dragging and releases the wiper on the Stereo setting and the immersion level media audio remains at the selected Stereo immersion level.</p> <p>The selected DSP mode and Immersion level remains saved until a new selection is made by the user.</p> |
| Notes | <p>Same general strategy going from Stereo to Audience</p> <p>Immersion Setting 0 = Stereo Immersion Setting 64 = Audience default setting Immersion Setting 127 = Onstage default setting</p> <p>Note: Refer to HMI whether wipers or some other method is used for controlling the immersion level. Wipers are just used as an example in this use case.</p> <p>Note: The HMI should be updated quickly enough to give the user the experience of the immersion setting change occurring in real-time.</p> |



| | |
|-------------------|--|
| | This is only applicable to Media sources and does not apply to other audio sources (such as VR, Phone, Mixable Prompts and TA) |
| Interfaces | G-HMI, CBI |

3.9.1.6 AUDSET-UC-REQ-238450/B-Change from an Onstage immersion level to an Audience immersion level by dragging the wiper to the Audience region

| | |
|-----------------------------|---|
| Actors | Vehicle Occupant |
| Pre-conditions | <p>Infotainment System is Powered ON.</p> <p>Media source is active</p> <p>DSP Mode is set to "Onstage"</p> <p>Immersion level is set to a level in the Onstage immersion range (i.e. immersion level between 65 - 127)</p> |
| Scenario Description | The user holds an HMI immersion wiper and drags it to the intended immersion level setting in the Audience region of the HMI |
| Post-conditions | <p>As the HMI immersion wiper is dragged from the Onstage immersion level setting to the intended Audience immersion level, the HMI and media audio are continuously updated real-time as the HMI immersion wiper is moved.</p> <ul style="list-style-type: none">As the HMI immersion wiper passes the immersion level on the HMI from the Onstage region to the Audience region, the HMI is updated to show the DSP Mode is set to "Audience". <p>The user stops dragging and releases the HMI immersion wiper on the desired immersion setting in the Audience HMI region, and the immersion level media audio remains at the selected Audience immersion level.</p> <p>The selected DSP mode and Immersion level remains saved until a new selection is made by the user.</p> |
| Notes | <p>Same general strategy going from Audience to Onstage</p> <p>Immersion Setting 0 = Stereo Immersion Setting 64 = Audience default setting Immersion Setting 127 = Onstage default setting</p> <p>Note: Refer to HMI whether wipers or some other method is used for controlling the immersion level. Wipers are just used as an example in this use case.</p> <p>Note: The HMI should be updated quickly enough to give the user the experience of the immersion setting change occurring in real-time.</p> <p>This is only applicable to Media sources and does not apply to other audio sources (such as VR, Phone, Mixable Prompts and TA)</p> |
| Interfaces | G-HMI, CBI |

**3.9.1.7 AUDSET-UC-REQ-238451/B-Change from Stereo immersion level to an Onstage immersion level by pressing & releasing in the OnStage region**

| | |
|-----------------------------|--|
| Actors | Vehicle Occupant |
| Pre-conditions | <p>Infotainment System is Powered ON.</p> <p>Media Source is active</p> <p>DSP Mode is set to "Stereo"</p> <p>Immersion level is set to minimum (i.e. immersion level = 0)</p> |
| Scenario Description | The user changes the immersion level setting by pressing and releasing a point in the Onstage immersion level region of the HMI immersion wheel. |
| Post-conditions | <p>As the user presses and releases a location in the Onstage region of the HMI immersion wheel and the HMI and media audio is updated to the new Onstage immersion level setting.</p> <p>The HMI is updated to show the HMI immersion wipers at the location of the press and release and the DSP mode is updated to the "Onstage" setting.</p> <p>The selected DSP mode and Immersion level remains saved until a new selection is made by the user.</p> |
| Notes | <p>Same general strategy changing from any immersion setting to a new immersion setting in any region with a press and release HMI action.</p> <p>Immersion Setting 0 = Stereo Immersion Setting 64 = Audience default setting Immersion Setting 127 = Onstage default setting</p> <p>Note: Refer to HMI whether wipers or some other method is used for controlling the immersion level. Wipers are just used as an example in this use case.</p> <p>Note: The HMI should be updated quickly enough to give the user the experience of the immersion setting change occurring in real-time.</p> <p>This is only applicable to Media sources and does not apply to other audio sources (such as VR, Phone, Mixable Prompts and TA)</p> |
| Interfaces | G-HMI, CBI |



3.9.2 Requirements

3.9.2.1 AUDSET-SR-REQ-238562/B-DSP Mode signals supporting Sound Immersion

For the Immersion Settings Server (ex DSP AMP) supporting both immersion levels and DSP Modes (ex OnStage, Audience) for the DSP Mode signals use the same CAN signals and strategy for communication as defined in Audio Settings SPSS function: "AUDSETv2-FUN-REQ-016388-Simulated Surround Sound (DSP Mode Setting)".

3.9.2.2 AUDSET-SR-REQ-238551/B-Immersion Level settings

The DSP Mode for the immersion level default settings shall be defined as:

- Immersion Setting 0 = Stereo (ie ImmersionLevel_D_St = Level 0)
- Immersion Setting 64 = Audience default setting (ie ImmersionLevel_D_St = Level 64)
- Immersion Setting 127 = Onstage default setting (ie ImmersionLevel_D_St = Level 127)

The DSP Mode range of immersion level settings shall be defined as:

- Stereo setting (immersion level 0)
- Audience Region (immersion settings 1 - 64)
- OnStage Region (immersion settings 65 – 127)

3.9.2.3 AUDSET-SR-REQ-238565/D-Immersion Setting Client - Immersion Level Rq and St signal usage

The Immersion Setting Client shall request an immersion level setting by sending the ImmersionLevel_D_Rq signal to the Immersion Setting Server.

The Immersion Setting Client will know the status of the Audio Immersion Level using the immersion level status signal "ImmersionLevel_D_St" from the Surround Sound Server. The ImmersionLevel_D_St shall be used for updating HMI (ex when release wiper the final HMI location of the wiper would depend on the ImmersionLevel_D_St status signal).

On the HMI if the user updates the Immersion Level quickly covering many immersion levels in a short period of time then the quickest Immersion Setting Client shall send the ImmersionLevel_D_Rq is 20 msec +/-10%.

- An example of updating the Immersion Level quickly could be the user quickly dragging the immersion Wiper HMI from one immersion level across many immersion levels until the wiper is released on another immersion level.
 - For example the immersion level was level 2 and then the HMI immersion wiper is dragged across 20 immersion levels in 100 msec then only 5 ImmersionLevel_D_Rq would be sent out 20 msec +/- 10% apart. This could be something like:

Pre-Condition:

The Immersion Level is at Level 2 (ie ImmersionLevel_D_St = Level2)

Event:

The HMI immersion wiper is quickly dragged and

1. 20 msec after first started dragging "ImmersionLevel_D_Rq = Level5" →
2. 20 msec later "ImmersionLevel_D_Rq = Level9" →
3. 20 msec later "ImmersionLevel_D_Rq = Level13" →
4. 20 msec later "ImmersionLevel_D_Rq = Level15" →
5. 20 msec later "ImmersionLevel_D_Rq = Level22" when the user releases the HMI wiper

Post-Condition:

When the Wiper is released final resting place of the HMI wiper would depend on what the last ImmersionLevel_D_St is set to. It should be set to ImmersionLevel_D_St = Level22 within 75 msec of the last ImmersionLevel_D_Rq request.

Note:

See the actual HMI for how immersion level can be increased by the user. The example given in the Sound Immersion function is using the immersion HMI wiper as shown below. Another method other than wipers may be used on the actual HMI but the same concept and logic would apply in the SPSS.



The picture below is not an actual representation of HMI. See Sound Immersion HMI specifications for actual representation of the HMI.

Immersion Wheel Wiper



3.9.2.4 AUDSET-SR-REQ-238566/E-Immersion Setting Server - Immersion level Rq and St signal usage

The Immersion Setting Server shall provide the status of the Immersion Audio Level setting via the ImmersionLevel_D_St signal.

When the Immersion Setting Server receives a valid ImmersionLevel_D_Rq request from the Immersion Setting Client, then the Immersion Setting Server shall update the ImmersionLevel_D_St signal to that immersion level within T_Tonal_Response.

When the Immersion Setting Server receives a valid DSP Mode request (ex Surround_Sound_Upmix2_Rq = OnStage) from the Immersion Setting Client resulting in a DSP Mode setting change (ex Audience → OnStage), then the Immersion Setting Server shall set the immersion level to the default immersion level for the DSP Mode.

When the Immersion Setting Server changes its ImmersionLevel_D_St to a value that results in a new DSP Mode setting, or a DSP Mode setting changes to a new setting resulting in a new immersion level, then both the DSP Mode signal "Surround_Sound_Upmix2_St" and the immersion level signal "ImmersionLevel_D_St" shall be updated on the network bus within T_Update_Response of each other.

Rapid change to the Immersion Level:

For multiple quick immersion level updates the Immersion Setting Server shall not put consecutive event based ImmersionLevel_D_St updates on the network bus quicker than 20 msec +/- 10% a part.

- ex user drags immersion level HMI wiper quickly across HMI screen so multiple quick ImmersionLevel_D_Rq requests are received by the Immersion Setting Server resulting in quick Immersion Level updates

3.9.2.5 AUDSET-TMR-REQ-239290/B-T_Update_Response

| Name | Description | Units | Range | Resolution | Default |
|-------------------|---|-------|--------|------------|---------|
| T_Update_Response | Maximum timed allowed for the Immersion Setting Server to respond with the updated Immersion Level status signal once an updated DSP Mode signal is put on the network bus, OR Maximum timed allowed for the Immersion Setting Server to respond with the updated DSP Mode status signal once an updated Immersion level status signal is put on the network bus (ie if the immersion level update changed the DSP Mode – ex Stereo to OnStage) Note: use the default value | msec | 0-1000 | 5 | 50 |

3.9.2.6 AUDSET-SR-REQ-238567/B-Immersion Setting Server saving Immersion Levels between PowerMode changes

The Immersion Setting Server shall remember the Immersion Level Settings between power mode states. (ex when HMIAudioMode goes from ON -> OFF -> ON, bus sleep and wake-up events...).

Upon loss of Immersion Level setting because of a loss of B+ (if remembers through B+ this doesn't apply) the Immersion Level Server shall default to its default state upon a new battery connection event.



The Immersion Setting Server shall remember Immersion Level Setting during an engine cold crank event.

3.9.2.7 AUDSET-SR-REQ-238568/A-Immersion Level Server receives invalid request

If the Immersion Setting Server receives a ImmersionLevel_D_Rq for a DSP Mode setting it does not support then the Immersion Setting Server shall ignore the request and respond with its current Immersion Level setting.

3.9.2.8 AUDSET-SR-REQ-238570/B-Applicable Audio Sources supporting Immersion Levels

Only the Media Audio Sources in the ResourceUpdate.St message shall support Sound immersion levels.

The VR, Phone, Prompt and TA audio sources shall not support Sound immersion levels.

See the Volume Settings column in audio management requirement "AUMGNT-SR-REQ-014570-Audio Request – Allowable Combination" which defines whether the source is Media, TA, Phone, Prompt or VR.



3.9.3 Sequence Diagrams

3.9.3.1 SD-REQ-242071/A-Change from Stereo immersion level to the default OnStage immersion level by selecting the OnStage DSP Mode HMI Setting

Pre-Condition:

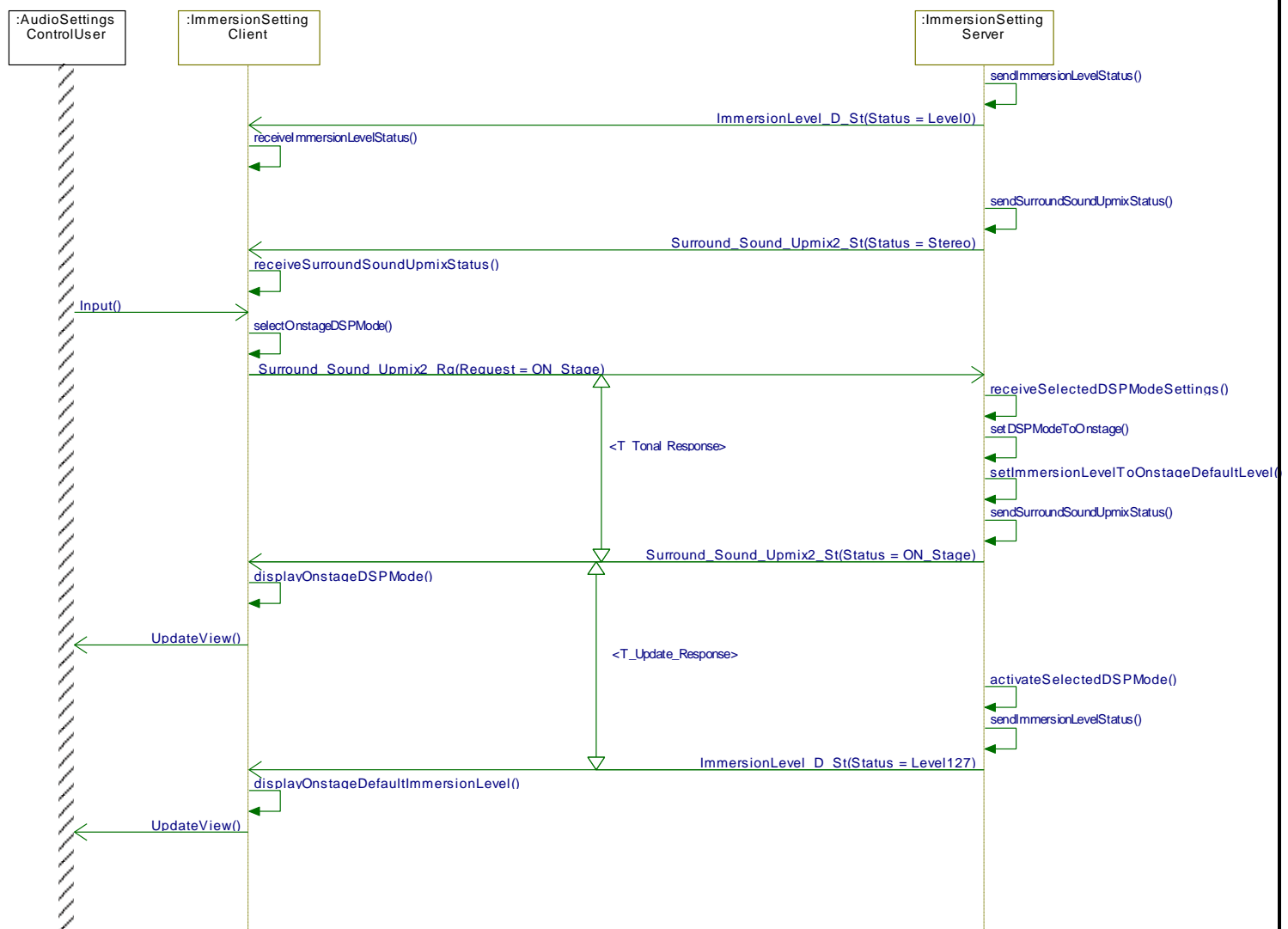
Immersion Level is at Level 0
DSP Mode is set to Stereo
Infotainment System is Powered ON
Media Source is Active

Event:

The user selects DSP Mode “OnStage” from the HMI

Post-Condition:

The HMI for DSP mode is set to “OnStage”
The HMI for Immersion Level is set to 127 (default setting)
The Immersion Level Audio is set to 127 (default setting)





3.9.3.2 SD-REQ-242072/A-Change from an Audience immersion level to Stereo immersion level by selecting the Stereo DSP Mode HMI setting

Pre-Condition:

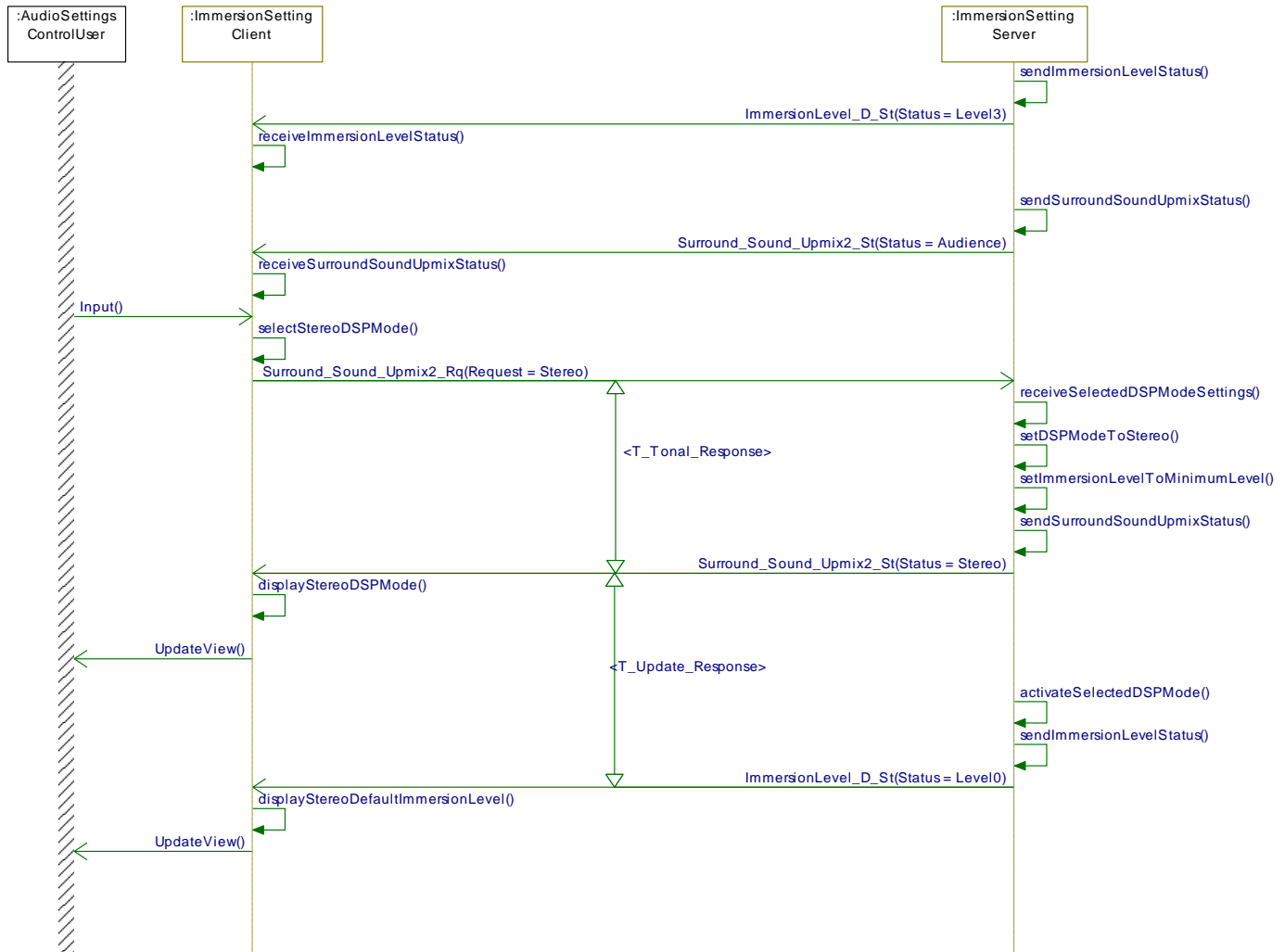
Immersion Level is Level 3
DSP Mode is Audience
Infotainment System is Powered ON
Media Source is Active

Event:

The user selects DSP Mode "Stereo" from the HMI

Post-Condition:

The HMI for DSP Mode is set to Stereo
The HMI for Immersion Level is set to minimum (level 0)
The Immersion Level is set to minimum (level 0)





3.9.3.3 SD-REQ-242076/A-Change an Onstage immersion level to the default Audience immersion level by selecting the Audience DSP Mode HMI setting

Pre-Condition:

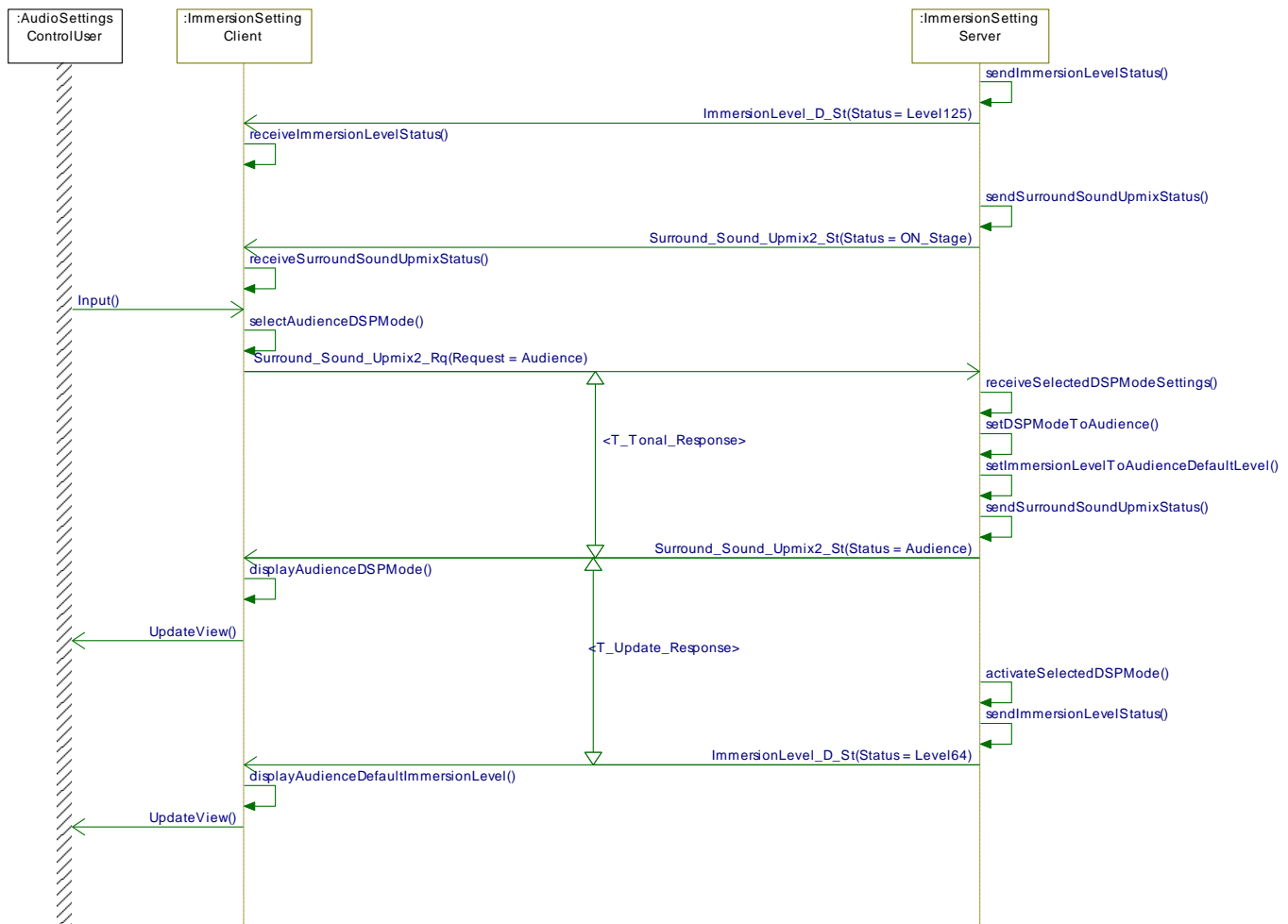
Immersion level is at level 125
DSP Mode is OnStage
Infotainment System is powered ON
Media Source is active

Event:

The user selects DSP mode "Audience" from the HMI

Post-Condition:

The infotainment system and HMI have DSP Mode set to Audience
The immersion level HMI is set to level 64 (audience default level)
The immersion level audio is set to level 64 (audience default level)



**3.9.3.4 SD-REQ-242078/B-Change from Stereo immersion level to an Onstage Immersion level by dragging the wiper to the OnStage region**Pre-Condition:

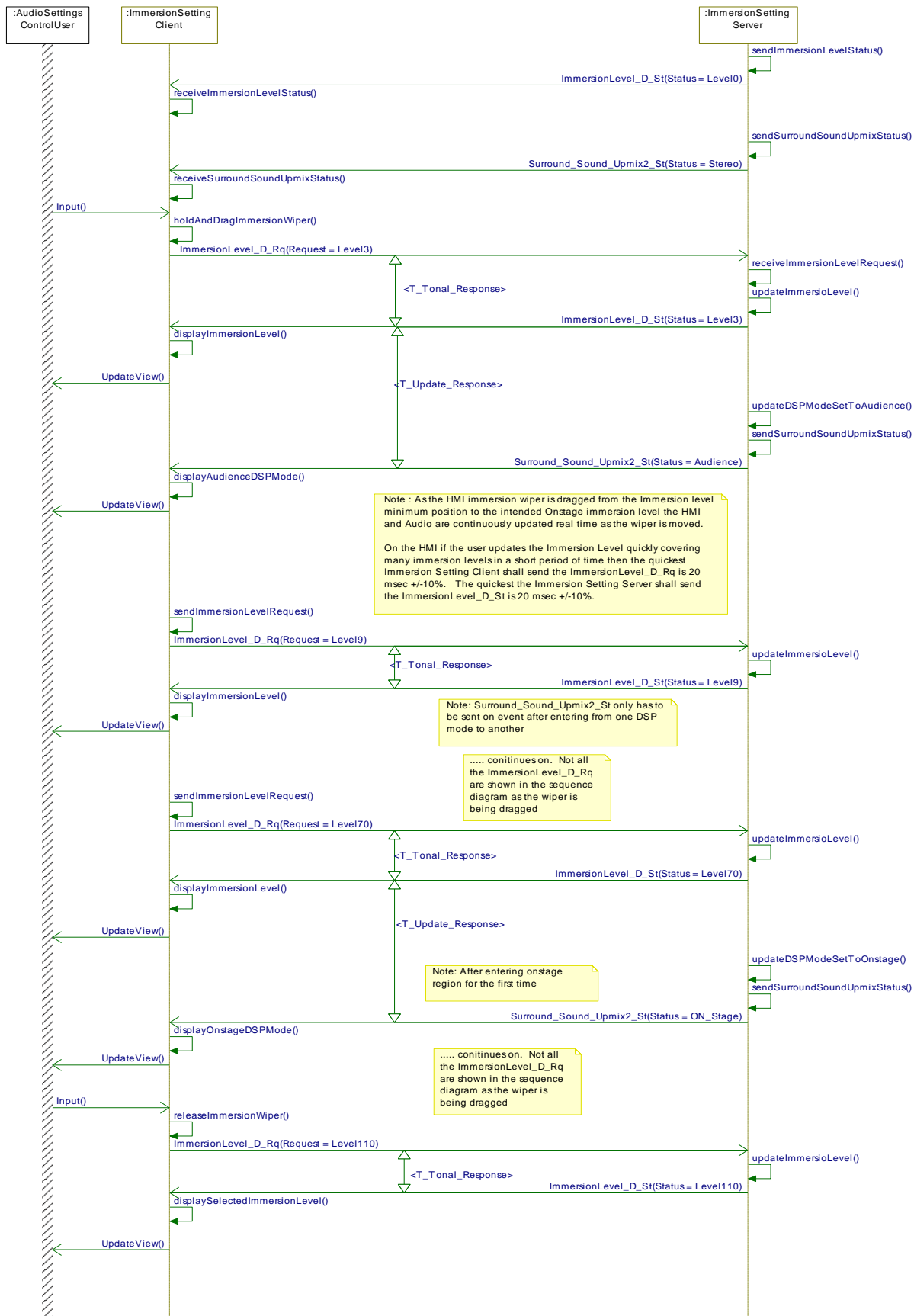
Immersion Level is at Level 0
DSP mode is set to Stereo
Infotainment System is powered ON

Event:

The user holds the HMI immersion wiper and drags it to the intended OnStage immersion level setting in the OnStage region of the HMI (in this example drags and releases at level 110)

Post-Condition:

The Immersion Level audio is at level 110
The HMI shows DSP Mode set to OnStage
The HMI shows immersion level 110 (ex HMI immersion wipers resting at immersion level 110)





3.9.3.5 SD-REQ-242088/B-Change from Stereo immersion level to an Onstage immersion level by pressing & releasing in the OnStage immersion level region

Pre-Condition:

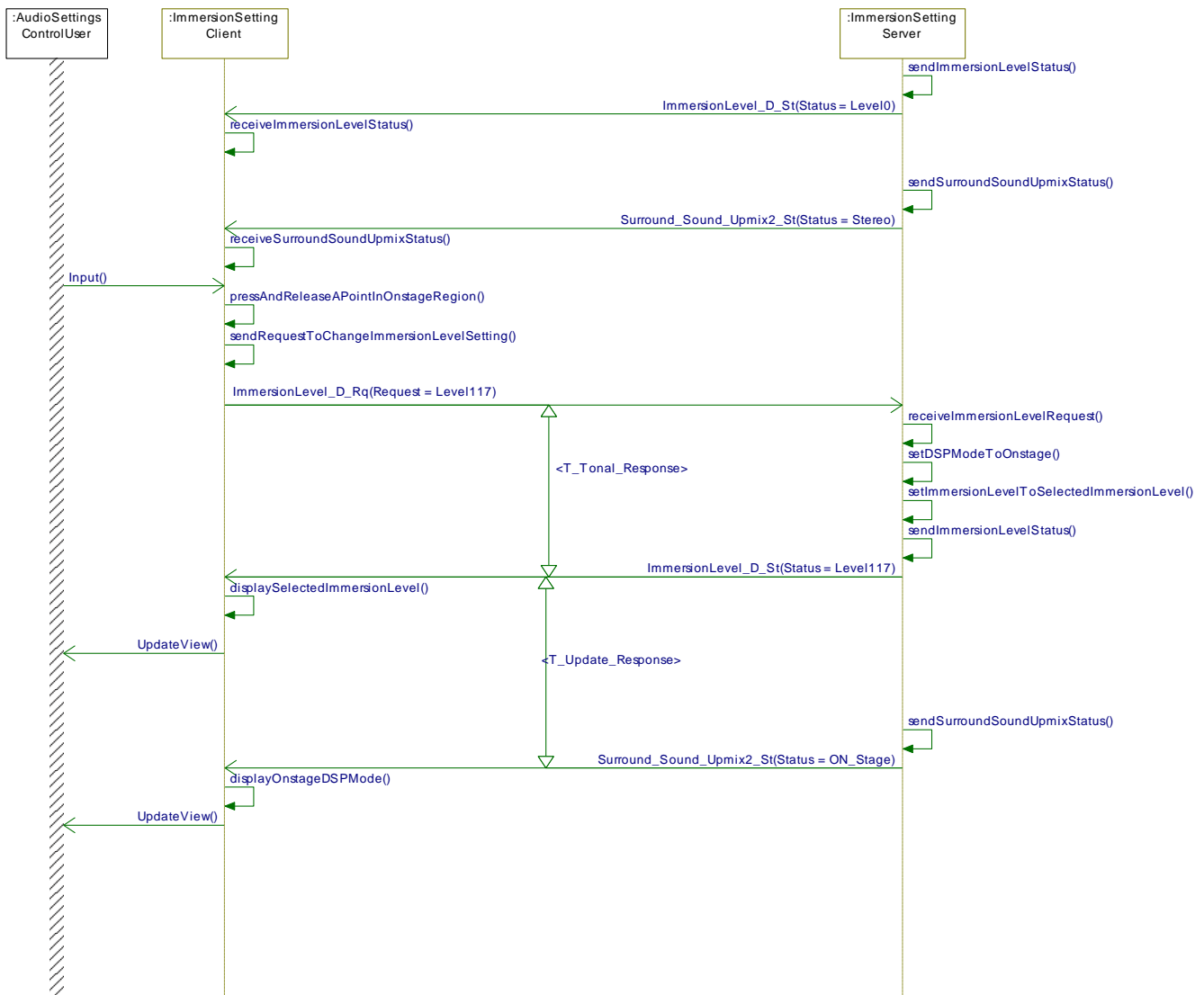
Immersion Level is at the minimum (level 0)
DSP mode is set to Stereo
Infotainment System is powered ON
Media Source is Active

Event:

The user changes the immersion level setting by pressing and releasing a point in the OnStage immersion level region (in this example 117) of the HMI immersion wheel.

Post-Condition:

The Immersion Level Audio is set to Immersion Level 117
The HMI shows DSP Mode is set to OnStage
The HMI shows the immersion level at 117 (ex HMI immersion wipers resting at immersion level 117)





3.9.3.6 SD-REQ-239291/B-Change from Stereo immersion level to an Audience immersion level by pressing and releasing in the Audience region

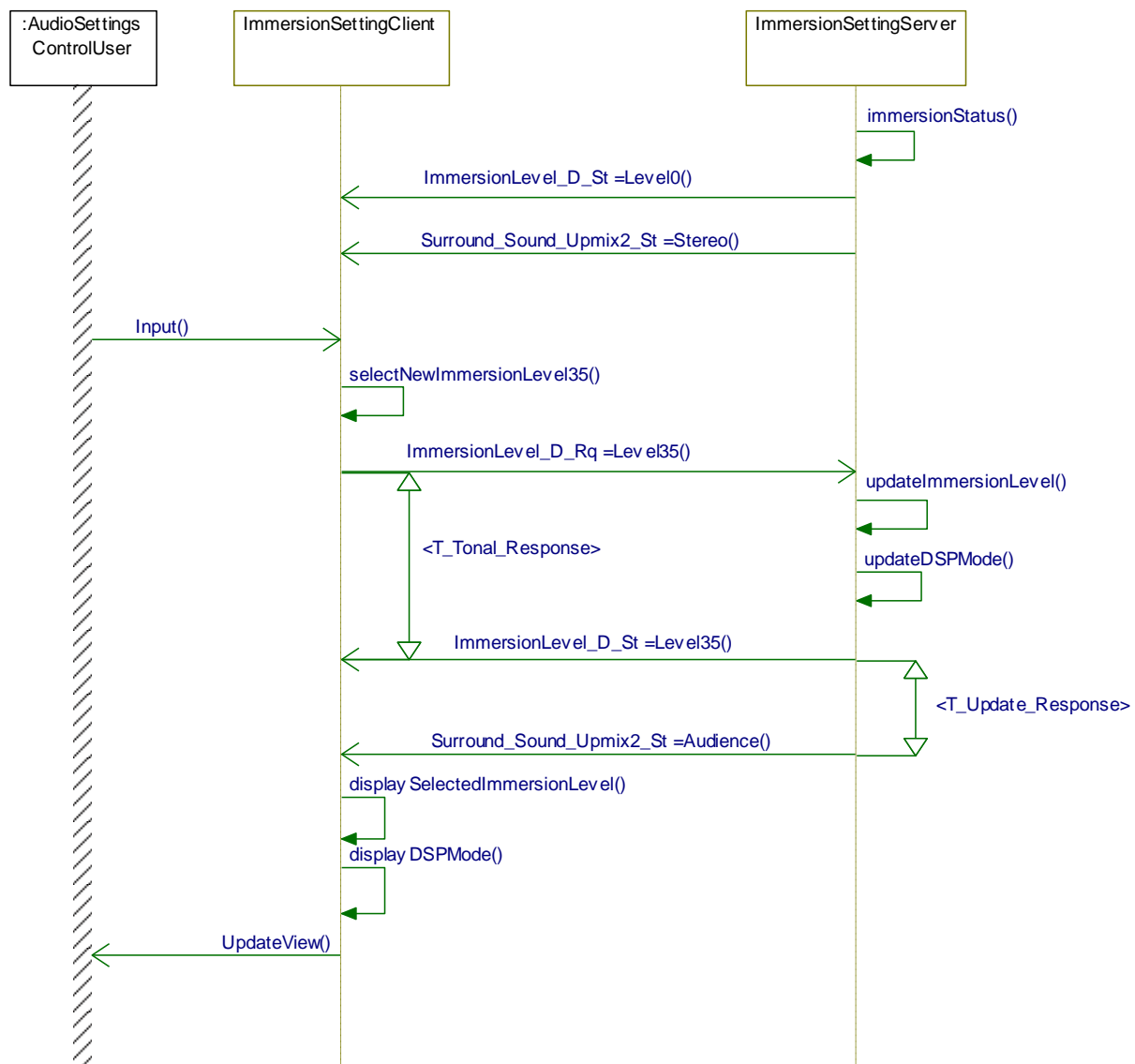
Pre-Condition:

Immersion Level is at level 0
DSP Mode is at Stereo
Infotainment System is Powered ON
Media Source is Active

Event:
The user presses and releases a touch point in the audience region of the HMI to change to the Immersion level 35

Post-Condition:

The Immersion Level Audio is set to Immersion level 35
The HMI shows DSP Mode is set to Audience
The HMI shows at immersion level 35 (ex. HMI immersion wipers resting at immersion level 35)





4 Appendix: Reference Documents

| Reference # | Document Title |
|-------------|------------------|
| 1 | SYNC HMI spec(s) |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| 11 | |
| 12 | |
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