



# Intel® Smart Sound Technology Driver

**Bring Up Guide**

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*Revision 2.03*

*January 2025*

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## Revision History

Document Number	Revision Number	Description	Revision Date
613171	1.0	<ul style="list-style-type: none"> <li>Initial release.</li> </ul>	June 2019
	1.1	<ul style="list-style-type: none"> <li>Updated BIOS Configuration for USB/BT audio enable.</li> <li>Updated Audio DSP Features Check for USB/BT audio offload.</li> <li>Added additional statement for device class code.</li> </ul>	August 2019
	1.2	<ul style="list-style-type: none"> <li>Updated <a href="#">Section 1.2</a> on Acronyms and Terminology and reference document.</li> <li>Updated picture of SST architecture.</li> <li>Added description into <a href="#">Section 2.3</a> For Audio Codec Selection and External NHLT settings.</li> <li>Included the BT audio configuration in <a href="#">Chapter 3</a> NHLT and DMIC Blob Integration.</li> <li>Added description of BT and UAOL driver installation into <a href="#">Section 4.1</a>.</li> <li>Added endpoint descriptor check in Device Manager in <a href="#">Section 5.4</a> to <a href="#">Section 5.7</a>.</li> </ul>	November 2019
	1.3	<ul style="list-style-type: none"> <li>Added <a href="#">Section 5.8</a> on Multi-Voice Assistant and <a href="#">Section 2.3</a> on MVA BIOS configuration.</li> <li>Updated <a href="#">Section 5.6</a> on USB Audio offload screenshot.</li> <li>Added RVP default NHLT as sample for NHLT generation.</li> </ul>	March 2020
	1.4	<ul style="list-style-type: none"> <li>Updated <a href="#">Section 1.3</a> with Ref005,006, and 007.</li> <li>Added <a href="#">Section 5.5</a> on BT* Audio offload GPIO pin configuration.</li> <li>Updated <a href="#">Section 5.6</a> USB audio offload.</li> </ul>	May 2020
	1.5	<ul style="list-style-type: none"> <li>Added MVA ext inf certified standalone information in <a href="#">Section 5.8</a>.</li> <li>Added suggestion to install GFX before SST driver for TGL 20H1 system in <a href="#">Section 4.1</a>.</li> <li>Removed "Install SST before GFX" from <a href="#">Chapter 7</a>.</li> </ul>	September 2020
	1.6	<ul style="list-style-type: none"> <li>Updated <a href="#">Section 1.3</a>.</li> <li>Added <a href="#">Chapter 6</a> for -26dBFS MIC sensitivity calibration.</li> </ul>	December 2020
	1.7	<ul style="list-style-type: none"> <li>Updated <a href="#">Section 1.3</a>.</li> <li>Updated <a href="#">Section 5.8</a>.</li> </ul>	February 2021
	1.8	<ul style="list-style-type: none"> <li>Updated <a href="#">Section 2.3</a> for Audio DSP NHLT Endpoints Configuration for ADL.</li> <li>Updated <a href="#">Chapter 3</a> for IADK 2.7.0.</li> </ul>	April 2021
	1.9	<ul style="list-style-type: none"> <li>Updated <a href="#">Section 2.3</a> and <a href="#">Section 3.4</a> for Audio DSP NHLT Endpoints Configuration for ADL.</li> <li>Added ADL_NHLT.zip in attachment.</li> </ul>	May 2021

Document Number	Revision Number	Description	Revision Date
613171	1.91	<ul style="list-style-type: none"> <li>Updated <a href="#">Section 2.3</a> for BT A2DP Offload and UAOL Config in BIOS for ADL</li> <li>Updated <a href="#">Section 5.5</a> on BT A2DP offload</li> </ul>	August 2021
	1.92	<ul style="list-style-type: none"> <li>Updated <a href="#">Section 4.1</a> for driver introduction</li> <li>Updated <a href="#">Section 4.2</a> for ACX SDCA driver installation</li> <li>Updated <a href="#">Section 6.2</a> for SPET 2.0</li> </ul>	July 2022
	1.93	<ul style="list-style-type: none"> <li>Updated <a href="#">Section 2.3</a> for BT audio offload settings change</li> <li>Updated <a href="#">Section 3.2</a> for latest IADK tool version</li> <li>Updated <a href="#">Section 3.3.1</a> for DMIC output format support change for ADL/RPL/MTL</li> <li>Updated <a href="#">Section 3.4</a> for default NHLT binary file for MTL and added MTL_NHLT.zip in attachment.</li> <li>Added <a href="#">Section 4.4</a> for how to integrate ROM EXT driver for MTL</li> </ul>	November 2022
	1.94	<ul style="list-style-type: none"> <li>Updated <a href="#">Section 3.2</a> for latest IADK tool version 3.1.2117.0</li> <li>Removed Section 3.2.1, 3.2.2 and 3.2.3 because Blob generator is implemented in Java and don't need to preinstall python/wxPython/OpenSSL since IADK 3.1.x and onwards.</li> <li>Updated <a href="#">Section 3.3.1</a> for DMIC NHLT bin file generation with IADK version 3.1.2117.0 for MTL</li> </ul>	April 2023
	1.95	<ul style="list-style-type: none"> <li>Updated <a href="#">Section 2.3</a> for MTL BT legacy for embedded CNVi, discrete BT, and BT LE BIOS configuration.</li> <li>Updated <a href="#">Section 2.3</a> for MTL BT NHLT options.</li> </ul>	July 2023
	1.96	<ul style="list-style-type: none"> <li>Update NHLT.zip in the package.</li> </ul>	November 2023
	1.97	<ul style="list-style-type: none"> <li>Update Section 2.3 for LNL BT offload, BT LE support and NHLT options</li> <li>Update Section 3.4 to add LNL platform support and 4 mic, add LNL_NHLT.zip in attachment</li> <li>Update Section 1.1, 1.2, 2.1, 2.3, 3.2, 3.4, 4.2 to add LNL platform</li> <li>Add LE Audio section 5.8</li> </ul>	March 2024
	1.98	<ul style="list-style-type: none"> <li>Add section 4.5 for PSNS enabling</li> <li>Refine section 2.3 SNDW index and add enable SoundWire multilane</li> </ul>	April 2024
	1.99	<ul style="list-style-type: none"> <li>Update section 2.3, delete Cortana and Alexa part</li> <li>Delete section 5.7 Cortana part</li> <li>Add Ref028 Ultrasound guide doc</li> </ul>	August 2024
	2.00	<ul style="list-style-type: none"> <li>Update section 2.3: BT* Audio Offload settings below are only supported with Intel Bluetooth modules.</li> <li>Delete section 3.3.1 step 6 point a: Core Revision: The PCH ID according to target project SoC PCH info.</li> </ul>	September 2024

Document Number	Revision Number	Description	Revision Date
	2.01	<ul style="list-style-type: none"> <li>• Add BT NHLT for DSP drives I2S clock for HFP: NhlTbTfReq38_4MHzDspClockHfp.bin.</li> <li>• For BT drivers I2S clock for HFP, change original NHLT file name from NhlTbTfReq38_4MhzLNL.bin to NhlTbTfReq38_4MHzBtClockHfp.bin</li> </ul>	December 2024
	2.02	<ul style="list-style-type: none"> <li>• Created new folder ARL_NHLT in NHLT folder that includes NhlTbTfReq38_4MHzBtClockHfp .bin and NhlTbTfReq38_4MHzDspClockHfp.bin for BT/DSP driving I2S clock respectively and DMIC bin as well</li> </ul>	January 2025
	2.03	<ul style="list-style-type: none"> <li>• Added new PTL_NHLT folder with BT and DMIC NHLT</li> <li>• Moved section 5.4 point 1 to section 2.3 BT offload settings part</li> <li>• Added a I2S2 table regarding different platform</li> <li>• Added ARL in BT* Audio Offload Legacy Settings for embedded CNVi: (For MTL) and BT* Audio Offload Legacy Settings for Discrete BT: (For MTL) part</li> <li>• Expanded Audio DSP NHLT Endpoints Configurations: (For LNL) to ARL and PTL</li> </ul>	January 2025

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# 1 Introduction

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## 1.1 Purpose and Scope of Document

This document provides installation instructions and general usage guidance for Intel® Smart Sound Technology (Intel® SST) Driver (formerly Audio DSP Driver).

The Intel® Smart Sound Technology Driver supports Lunar Lake (LNL), Meteor Lake (MTL), Raptor Lake (RPL), Alder Lake (ADL), Coffee Lake (CFL), Cannon Lake (CNL), Comet Lake (CML), Ice Lake (ICL), Jasper Lake (JSL), Raptor Lake (RPL), Rocket Lake (RKL), Tiger Lake (TGL) and Whiskey Lake (WHL) platforms with Intel audio DSP integrated on Windows\* 10/11 64-bit Operating Systems.

## 1.2 Acronyms and Terminology

Term	Description
ACPI	Advanced Configuration and Power Interface
ADL	Alder Lake
BIOS	Basic Input/Output System
BKC	Best Known Configuration
BT	Bluetooth*
BT LE	Bluetooth* Low Energy
CFL	Coffee Lake
CML	Comet Lake
CNL	Cannon Lake
CS	Connected-Standby (Instant Go)
CRB	Customer Reference Board
DMIC	Digital Microphone
DSP	Digital Signal Processing
EVAD	External Voice Activity Detection
FW	Firmware
Gfx	Graphics



Term	Description
HDA or HD-Audio	High Definition Audio
I2S	Inter-IC Sound, A data interface
IADK	Intel® Audio Development Kit. (Former name: FDK, Firmware Development Kit)
ICL	Ice Lake
IHV	Independent Hardware Vendor
Intel® OED or OED	Intel® Offload Engine Driver
Intel® SST	Intel® Smart Sound Technology
Intel® WOV	Intel® Wake on Voice. (Former name: LPAL, Low Power Always Listening)
ISV	Independent Software Vendor
JSL	Jasper Lake
LP	Low Power
MCP	Multi-Chip Package
MSFT	Microsoft** Corporation
MTL	Meteor Lake
MVA	Multi-Voice Assistant
NHLT	Non-HD-Audio Link Table
Non-CS	Non-Connected-Standby (Non-Instant Go)
OS	Operating System
PCH	Platform Controller Hub
RKL	Rocket Lake
RPL	Raptor Lake
RVP	Reference Validation Platform
SDW or /SNDW	SoundWire or SoundWire**
SPET	Speech Platform Evaluation Toolset
SUT	System Under Test
TBD	To be determined
TGL	Tiger Lake

Term	Description
UAA	Universal Audio Architecture
UAOL	USB Audio Offload
ULT	Ultra-Thin
VAD	Voice Activity Detection
WHL	Whiskey Lake
LNL	Lunar Lake

## 1.3 Related Documents and References

ID	Document Number	Document Title
Ref001	<a href="#">613651</a>	Intel® Smart Sound Technology Validation and Debug Guide
Ref002	<a href="#">610730</a>	Intel® Wireless Technical Advisory: Bluetooth* Audio Offload
Ref003	<a href="#">642222</a>	Intel® Smart Sound Technology FW Key Usage on Non-Production Driver Sighting Alert
Ref004	<a href="#">microphone-array-geometry-descriptor-format</a>	Microphone Array Geometry Descriptor Format
Ref005	<a href="#">620882</a>	Intel® Smart Sound Technology ISV/IHV Enabling Tutorial User Guide
Ref006	<a href="#">620544</a>	Intel® Smart Sound Technology Multi-Voice Assistant (MVA) Enabling Dashboard
Ref007	<a href="#">571948</a>	Audio, Voice, and Speech System Implementation Design Guide
Ref008	<a href="#">728048</a>	Intel® Speech Platform Evaluation Toolset 2 (SPET2) User Guide
Ref009	<a href="#">598645</a>	Intel® Smart Sound Technology (Intel® SST) Customer Enabling Update Technical Advisory
Ref010	<a href="#">630235</a>	Intel® Smart Sound Technology Acoustic Context Awareness Bring Up Guide
Ref011	<a href="#">632541</a>	Intel® Smart Sound Technology Audio Firmware Signing and Manifesting User Guide
Ref012	<a href="#">634270</a>	Intel® Smart Sound Technical Advisory: USB Audio Offload
Ref013	<a href="#">631659</a>	USB Audio Offload (UAOL) Disable
Ref014	<a href="#">633107</a>	Audio Processing Object (APO) Support on Bluetooth* and USB Offload Endpoints Technical White Paper
Ref015	<a href="#">633975</a>	Intel® Smart Sound Technology – Audio Processing on USB and Bluetooth* Offload Endpoint Guidance

ID	Document Number	Document Title
Ref016	<a href="#">632502</a>	Intel® Wake on Voice (Intel® WoV) – Customer Data Requirement Specification
Ref017	<a href="#">576591</a>	Intel® TGL-LP Platform Controller Hub External Design Specification
Ref018	<a href="#">615985</a>	Intel® TGL-H Platform Controller Hub External Design Specification
Ref019	<a href="#">619362</a>	Intel® ADL-S & RPL-S Platform Controller Hub External Design Specification
Ref020	<a href="#">639169</a>	Alder Lake BIOS NHLT Binary Integration Flow User Guide
Ref021	<a href="#">645276</a>	Intel® GNA Introduction
Ref022	<a href="#">645278</a>	ADL Athena - Intel® GNA Validation and MOS Test
Ref023	<a href="#">638665</a>	Project Athena Audio Process Technical Training Material
Ref024	<a href="#">631623</a>	Athena System Design Specification - Alder Lake Platform
Ref025	<a href="#">730932</a>	Intel® Smart Sound Technology (Intel® SST) Driver Windows* Update Submission Technical Advisory
Ref026	<a href="#">771728</a>	Intel® Wireless Technical Advisory Bluetooth LE Audio for Intel® Platforms with Windows 11*
Ref027	<a href="#">647767</a>	Intel® Smart Sound Technology SoundWire* Enabling User Guide
Ref028	<a href="#">762247</a>	Intel® Smart Sound Technology – Ultrasound DSP Module Integration and Enablement Guide Specification

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## 2 Platform Details

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### 2.1 Audio Subsystem Overview

Intel® Smart Sound Technology (Intel® SST) supports HD-Audio codecs connected to designs based on Lunar Lake (LNL), Meteor Lake (MTL), Raptor Lake (RPL), Alder Lake (ADL), Rocket Lake (RKL), Tiger Lake (TGL), Ice Lake (ICL), Comet Lake (CML), Whiskey Lake (WHL), Coffee Lake (CFL), and Cannon Lake (CNL) Platform. Intel® SST is supported both on Connected Standby and Non-Connected Standby platforms. The Audio DSP in the HD-Audio controller controls both the HD-Audio codec and the audio on the Display Port and HDMI interfaces. This HD-Audio link for the audio codec supports multiple voltages (1.5 V/1.8 V/3.3 V).

Audio DSP in the HD-Audio controller meets the Microsoft\* UAA compliancy. With DSP integrated into the PCH, the offloaded audio goes through multi-layer audio processing inside the DSP with the Intel® SST FW loaded.

**Note:** Be aware of all Intel® SST features available on Standard (non-InstantGo\*) platforms. Intel® WOV saves power while in S0 — but currently cannot wake a system while in S3 on the Standard (non-InstantGo\*) platforms.

Figure 2-1. Audio System

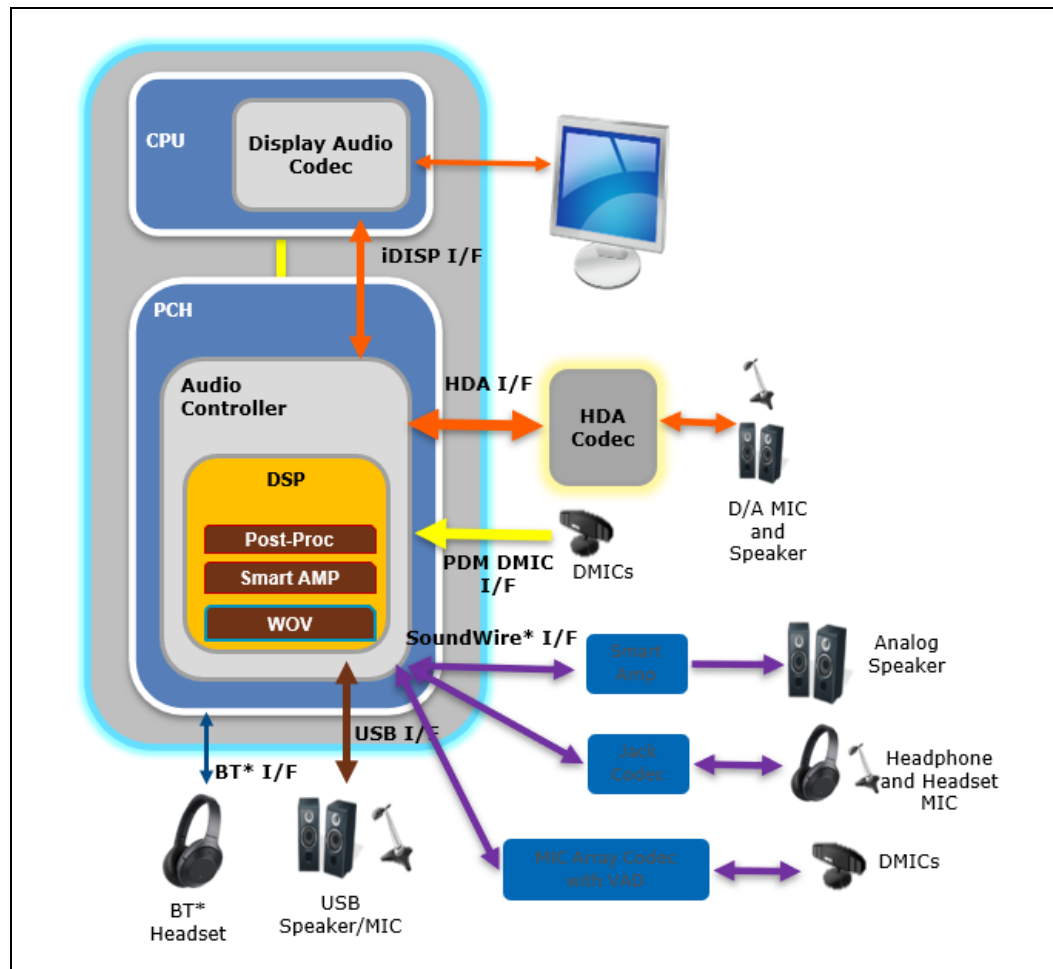


Figure 2-2. SoundWire\*-Based Smart AMP

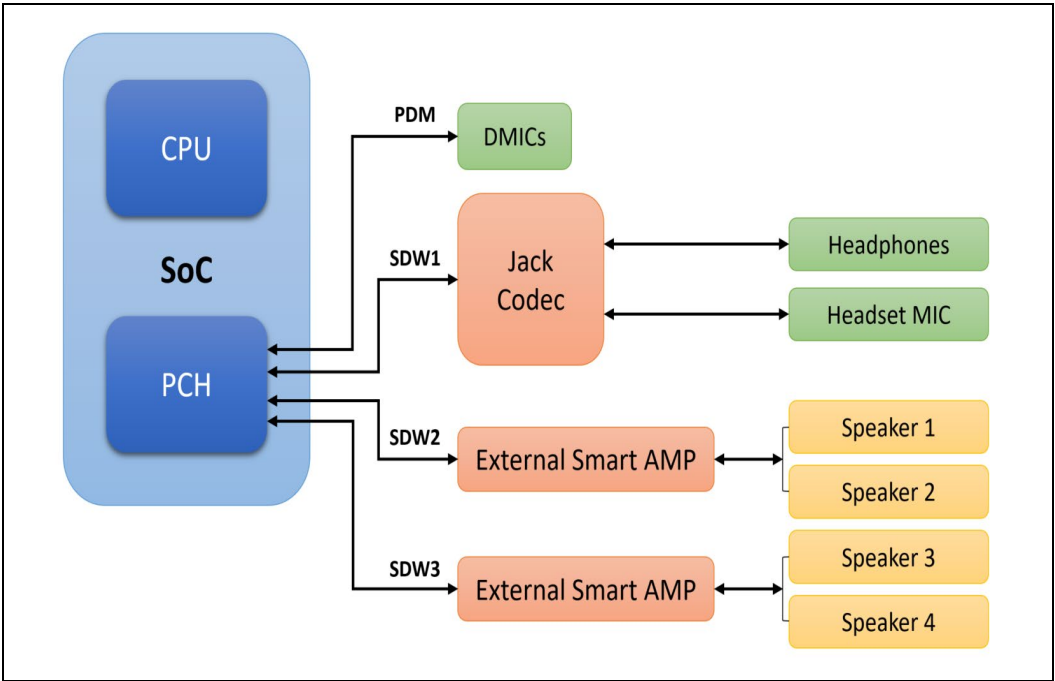
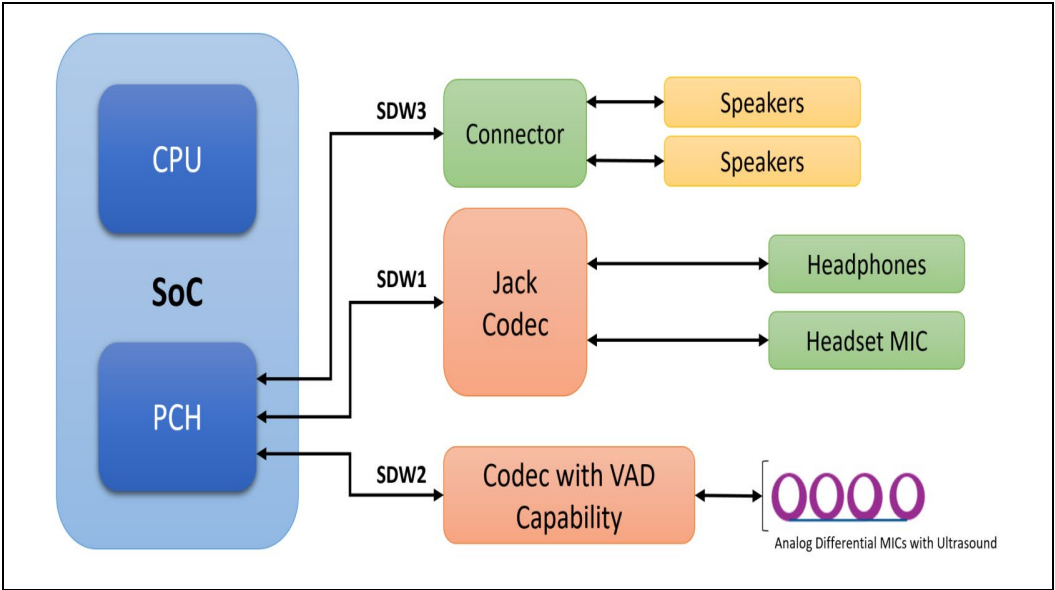


Figure 2-3. Intel® WOV with SoundWire\*-Based External VAD



## 2.2 System Configuration

<b>Platform</b>	Meteor Lake, Raptor Lake, Alder Lake, Cannon Lake, Coffee Lake, Comet Lake, Ice Lake, Jasper Lake, Raptor Lake, Rocket Lake, Tiger Lake, Whiskey Lake
<b>Operating System</b>	Windows* 10 x64 RS5/RS6/20H1/20H2 and Windows* 11 x64
<b>BIOS</b>	Audio DSP enabled, HDA codec enabled, SoundWire* enabled, BT/USB audio enabled

Intel® SST driver should be installed on systems with at least 1 GB of system memory. There should be enough hard disk space in the directory on the system in order to install this software.

**Note:** Contact the respective BIOS AE for BIOS specifications.

## 2.3 Mandatory BIOS Configuration for Intel® SST

Enter BIOS by tapping F2 once the platform starts to boot.

### For SST Enable:

[Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration](#)

HD Audio = <Enabled>  
Audio DSP = <Enabled>

Audio DSP Compliance Mode:

1. If DMIC is connected to PCH, select <Non-UAA (Intel® SST)>
2. If DMIC is connect to codec, select <UAA (HDA Inbox/Intel® SST)>

### For Audio Codec Selection:

[Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration](#)

HDA-Link Codec Select: Selecting "Platform Onboard" means that a single verb table is installed. On the other hand, selecting "External Codec" will use multiple verb tables. Depending on environment, select <Platform OnBoard> or <External Codec Kit>

### For Audio Link Selection:

[Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration](#)

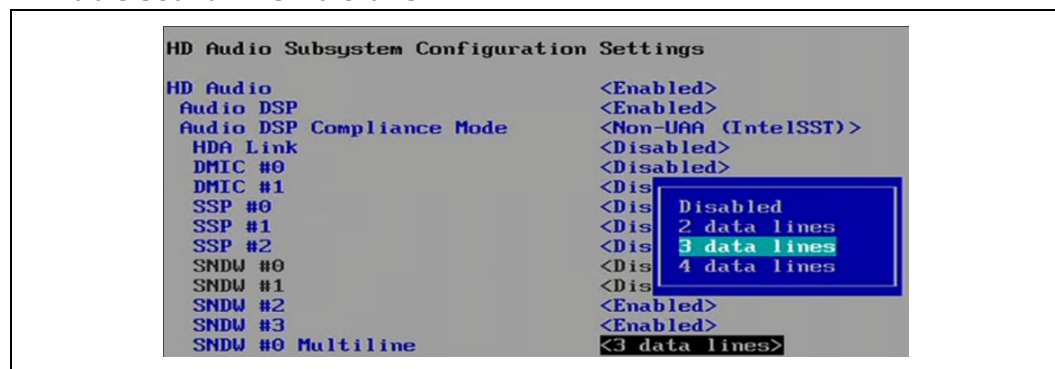
- **If it uses HDA - Audio Link Mode** choose <HD Audio Link>
- **If it uses I2S - Audio Link Mode** choose <I2S>
- **If it uses SoundWire\***
  - For default SoundWire setting - **Audio Link Mode** choose <SoundWire>
  - For different SoundWire setting - **Audio Link Mode** choose <Advanced Link Config> and set:
    - HDA Link [ ]
    - DMIC #0 [X]

- DMIC #1 [X]
- SSP #0 [ ]
- SSP #1 [ ]
- SSP #1 [ ]
- SSP #2 [ ]
- SSP #3 [ ]
- SSP #4 [ ]
- SSP #5 [ ]
- SNDW #0 [X]
- SNDW #1 [X]
- SNDW #2 [ ]
- SNDW #3 [ ]
- [X] – Enabled [ ] – Disabled

**NOTES:**

1. Enable or disable the required audio link from the menu above.
2. Enable the Audio Link in RVP by following the respective rework instructions.

• **Enable SoundWire Multilane**



**NOTES:**

- Up to 4 SoundWire interfaces frame rate synchronized on global periodic events
- Only SNDW[0] can support Multi-lane function for up to 4 data lane per SoundWire interface after MTL Processor
- Support SoundWire Device Class Specification for Audio Controls and Memories
- Up to 12 PCM bidirectional streams per SoundWire interface — Direction is programmable as either input or output stream
- Up to 8 channels per PCM streams
- Interrupt / PME wake capable on DATA pin assertion in low power state

**For Post-Processing Selection:**

[Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration/HD Audio DSP Features Configuration](#)

Audio DSP Pre/Post-Processing Module Support: Select corresponding post-processing effect in options.

If there is Custom Module to add, select Custom Module 'Alpha'/'Beta'/'Gamma' and input corresponding GUID of the IP. Also, corresponding GUID mapping needs to be added in Platform ACPI code.

**Intel® Wake on Voice (Intel® WoV) Support for Personal Assistant (PA):**



Intel® Wake on Voice (WoV) is running from Intel DSP, it could wake system up from Modern Standby (S0ix) or Ready Mode (S0 screen off). When system enters S0, Intel® WoV triggers personal assistant (PA).

Intel® WoV solution provides integrated solution that provides personalization and convenience. Intel® WoV running on DSP supports Microsoft\* Windows\* 10 RS5/RS6/20H1/20H2 and Windows\* 11 custom PA with Hardware Keyword Spotter for keyword detection.

— **Intel® Wake on Voice on DSP Support for 20H1 OS MVA:**

To configure Intel® Wake on Voice support for MVA, the following setup is needed:

[Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration/HD Audio DSP Features Configuration](#)

WoV (BIT 0) = <TRUE>

VAD API Mode (BIT 8) = <Windows 10 Voice Activation>

**Note:** Refer to [Section 5.8](#) for the remaining configuration for MVA.

**NOTES:**

1. For Modern Standby system, BIOS needs to add PEP constraint code to support Audio Controller being in D0:F1 state.

```
Package() {"\\_SB.PCI0.HDAS",0x1, Package() {0, Package() {0xFF,
0, 0x81}}},// 15 -cAVS(HDAudio)
```

2. Post-processing modules can be enabled together with Intel® WoV on most platforms, please refer to Ref009 for more details.
3. More than one post-processing modules can be enabled depending on the resources used by ISV. For Post-processing modules combinations, contact the ISV for more information.

**CS/non-CS Settings:**

[Intel Advanced Menu/ACPI SETTINGS](#)

Low Power S0 Idle Capability

- a. If CS is supported, select <ENABLED>
- b. If CS is not supported, select <DISABLED>

**RTD3 Settings:**

[Intel Advanced Menu/ACPI D3Cold Settings](#)

ACPI D3Cold Support = <Enabled>

**Note:** BT\* Audio Offload settings below are only supported with Intel Bluetooth modules.

**For all CNVi configurations:**

For TGL, contact BIOS member to ensure GPIOs for BT\* Offload (**GPPC\_A\_7** and **GPPC\_A\_10**) are configured as **GPIO mode**.

For ADL/RPL, ODM should not expose I2S2 externally

Signal Name	GPIO	GPIO Community	Power Well	Voltage Tolerance	Native Function 1	Native Dir 1	Native Function 2	Native Dir 2
GPP_R4 / HDA_RST# / I2S2_SCLK / DMIC_CLK_A0	GPP_R4	5	VCCPRIM_1P8 or VCCPRIM_3P3	1.8 V or 3.3 V	HDA_RST#	out	I2S2_SCLK	inout
GPP_R5 / HDA_SDI1 / I2S2_SFRM / DMIC_DATA0	GPP_R5	5	VCCPRIM_1P8 or VCCPRIM_3P3	1.8 V or 3.3 V	HDA_SDI1	inout	I2S2_SFRM	inout
GPP_R6 / I2S2_TXD / DMIC_CLK_A1	GPP_R6	5	VCCPRIM_1P8 or VCCPRIM_3P3	1.8 V or 3.3 V			I2S2_TXD	out
GPP_R7 / I2S2_RXD / DMIC_DATA1	GPP_R7	5	VCCPRIM_1P8 or VCCPRIM_3P3	1.8 V or 3.3 V			I2S2_RXD	in

Recommend following ADL/RPL RVP Design as below:

Intel		
Primary Well Group R (Per-Family 1.8 V or 3.3 V) GPIO Community 5		
GPP_R0	GPP_R0 / HDA_BCLK / I2S0_SCLK / DMIC_CLK_B0 / HDAPROC_BCLK	Native F1
GPP_R1	GPP_R1 / HDA_SYNC / I2S0_SFRM / DMIC_CLK_B1	Native F1
GPP_R2	GPP_R2 / HDA_SDO / I2S0_TXD / HDAPROC_SDO	Native F1
GPP_R3	GPP_R3 / HDA_SDI0 / I2S0_RXD / HDAPROC_SDI	Native F1
GPP_R4	GPP_R4 / HDA_RST# / I2S2_SCLK / DMIC_CLK_A0	Native F1
GPP_R5	GPP_R5 / HDA_SDI1 / I2S2_SFRM / DMIC_DATA0	GP-In
GPP_R6	GPP_R6 / I2S2_TXD / DMIC_CLK_A1	GP-In
GPP_R7	GPP_R7 / I2S2_RXD / DMIC_DATA1	GP-In

For MTL, ARL-U/H, ARL\_S/HX, LNL, PTL, ODM should not expose I2S2 externally either, please follow ADL/RPL RVP Design above:

	I2S_SCLK	I2S_SFRM	I2S2_TXD	I2S2_RXD
ADL/RPL	GPP_R4(I2S2)	GPP_R5(I2S2)	GPP_R6(I2S2)	GPP_R7(I2S2)
MTL/ARL-U/H	GPP_D14(I2S2)	GPP_D15(I2S2)	GPP_D16(I2S2)	GPP_D17(I2S2)
ARL-S/HX	GPP_R00(I2S0)	GPP_R01(I2S0)	GPP_R02(I2S0)	GPP_R03(I2S0)
LNL	N/A	N/A	N/A	N/A
PTL	GPP_S04(I2S2)	GPP_S05(I2S2)	GPP_S06(I2S2)	GPP_S07(I2S2)

#### **BT\* Audio Offload Legacy Settings: (For ICL, CML v2, TGL, ADL, RPL):**

[Intel Advanced Menu/Connectivity Configuration/CNVi Configuration/Audio Offload](#)

BT\* audio offload mode support = <Enabled>

[Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration/HD Audio DSP Features Configuration/Audio DSP NHLT Endpoints Configuration/Bluetooth\\*](#) (For ICL, CML v2, TGL only)

BT\* audio offload mode support = <Enabled>

[Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration/HD Audio DSP Features Configuration/Audio DSP Feature Support](#)

Bluetooth\* Sideband [X]

BT\* Intel HFP [X]

BT\* Intel A2DP [X] (For TGL-R, ADL , RPL and MTL only)

BT\* Intel Low Energy [X]

**BT\* Audio Offload Legacy Settings for embedded CNVi: (For MTL, ARL):**

[Intel Advanced Menu/Connectivity Configuration/CNVi Configuration/Audio Offload](#)

BT\* audio offload mode support = <Enabled>

[Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration/HD Audio DSP Features Configuration/Audio DSP Feature Support](#)

Bluetooth\* Sideband [X]

BT\* Intel HFP [X]

BT\* Intel A2DP [X]

Discrete BT HCI Audio Offload Support [Disabled]

Discrete BT HCI Audio Offload Link [ ] (Leave it gray out)

**BT\* Audio Offload Legacy Settings for Discrete BT: (For MTL, ARL):**

[Intel Advanced Menu/Connectivity Configuration/CNVi Configuration/Audio Offload](#)

BT\* audio offload mode support = <Enabled>

[Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration](#)

SSP#2 [X]

[Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration/HD Audio DSP Features Configuration/Audio DSP Feature Support](#)

Bluetooth\* Sideband [X]

BT\* Intel HFP [X]

BT\* Intel A2DP [X]

Discrete BT HCI Audio Offload Support [X]

Discrete BT HCI Audio Offload Link [SSP #2]

**Note:** If customer HW doesn't follow default configuration, please refer to Ref002 for available configuration. Also contact BT team for more detail.

**BT\* Audio Offload Legacy Settings for BT LE Audio: (For MTL, LNL):**

[Intel Advanced Menu/Connectivity Configuration/CNVi Configuration/Audio Offload](#)

BT\* audio offload mode support = <Enabled>

[Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration/HD Audio DSP Features Configuration/Audio DSP Feature Support](#)

Bluetooth\* Sideband [X]

BT\* Intel HFP [X]

BT\* Intel Low Energy [X]

**Note:** Enabling A2DP Audio Offload is not required for LE Audio to function. However, enabling HFP Audio Offload is mandatory for LE Audio.

**BT\* Audio Offload Legacy Settings for embedded CNVi: (For LNL):**

[Intel Advanced Menu/Connectivity Configuration/CNVi Configuration/Audio Offload](#)

BT\* audio offload mode support = <Enabled>

[Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration/HD Audio DSP Features Configuration/Audio DSP Feature Support](#)

Bluetooth\* Sideband [X]

BT\* Intel HFP [X]

BT\* Intel A2DP [X]

**USB Audio Offload Settings: (For ADL, RPL and MTL only):**

[Intel Advanced Menu/PCH-IO Configuration/USB Configuration](#)

USB Audio Offload [X]

**External NHLT Settings: (For ICL, CML v2 and TGL only):**

[Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration/HD Audio DSP Features Configuration/Audio DSP NHLT Endpoints Configuration/NHLT External Table](#)

This is an optional setting that depends on which NHLT settings you would use for CML v2/ICL/TGL platforms:

1. Load the customized NHLT which is imported to BIOS by customer, enable < NHLT External Table>
2. Load default DMIC blob integrated in RVP, disable < NHLT External Table>

**Audio DSP NHLT Endpoints Configurations: (For ADL, RPL):**

[Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration/HD Audio DSP Features Configuration/Audio DSP NHLT Endpoints Configuration](#)

From ADL, it accepts audio endpoint configurations in separate NHLT bin files depending on the NHLT settings enabled in BIOS option. Select the required features for your project:

DMIC Mono 38.4MHz	<Disabled>
DMIC Stereo 38.4MHz	<Disabled>
DMIC Quad 38.4MHz	<Disabled>
Bluetooth 38.4MHz	<Disabled>

#### **Audio DSP NHLT Endpoints Configurations: (For MTL):**

[Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration/HD Audio DSP Features Configuration/Audio DSP NHLT Endpoints Configuration](#)

Select the required features for your project to load separate NHLT bin files depending on the NHLT settings enabled in BIOS option:

Clock Source	<Platform POR>
DMIC Mono	<Disabled>
DMIC Stereo	<Disabled>
DMIC Quad	<Disabled>
Bluetooth SSP2	<Disabled>

#### **Audio DSP NHLT Endpoints Configurations: (For LNL, ARL, PTL):**

[Intel Advanced Menu/PCH-IO Configuration/HD Audio Configuration/HD Audio DSP Features Configuration/Audio DSP NHLT Endpoints Configuration](#)

Select the required features for your project to load separate NHLT bin files depending on the NHLT settings enabled in BIOS option:

DMIC Stereo	<Disabled>
DMIC Quad	<Enabled>

By enabling the features in BIOS, it will load the corresponding NHLT configuration in BIOS code. For BIOS code integration user guidance, please refer to Ref020 for more details.

## **2.4 Action Required After Flashing BIOS/Change BIOS Settings**

After flashing the new BIOS or changing ACPI table settings it is important to perform the following sequence:

1. Boot to Windows\* OS.
2. Perform system reboot.

3. After reboot, perform system shutdown.

The above sequence is important to ensure that Windows\* OS reloads and uses the ACPI tables provided by a new BIOS.

S4 (hibernation) is a normal shutdown state for Windows\* OS. While walking from S4 state Windows\* reloads the ACPI tables from disk (hibernation file).

If BIOS is changed, ACPI tables generated by the previous BIOS version are still stored in the hibernation file on a disk. Windows\* restart ensures usage of ACPI tables generated by the current BIOS. A subsequent shutdown stores these new ACPI tables in hibernation file.



## 3 NHLT and DMIC Blob Integration

---

### 3.1 Introduction

NHLT (Non-HD-Audio Link Table) is defined as an ACPI Data consisting of the standard ACPI Header and information about non-HD Audio endpoints supported by the system. NHLT Generator in IADK provides graphical configurator of endpoints and generates NHLT binary file.

Refer to Platform controller hub external design specification – Ref017\Ref018\Ref019 for DMIC connection, clock, voltage requirements. Contact Intel Audio CE if the DMIC HW connection in customer design is different from RVP.

To integrate the generated NHLT/DMIC blob file into BIOS, refer to BIOS guidance in Ref020 for NHLT integration.

**Note:** The USB audio offload feature is supported from TGL by default, so it does not require configuration in NHLT.

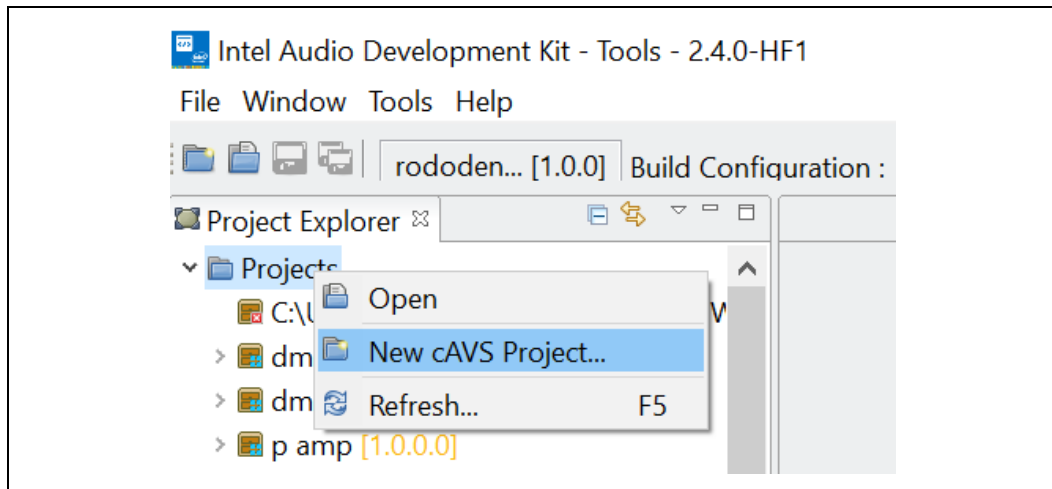
### 3.2 How to get IADK tool

Please get the latest IADK from: [VIP:kitid=1001873](https://www.intel.com/content/www/us/en/developer/tools/oneapi/iadk.html). If you have no access, Contact Intel Audio CE. Latest IADK version is IADK 3.1.2117.0 which supports ACE platform(MTL, LNL) and cAVS platforms(N-2: TGL, ADL, RPL).

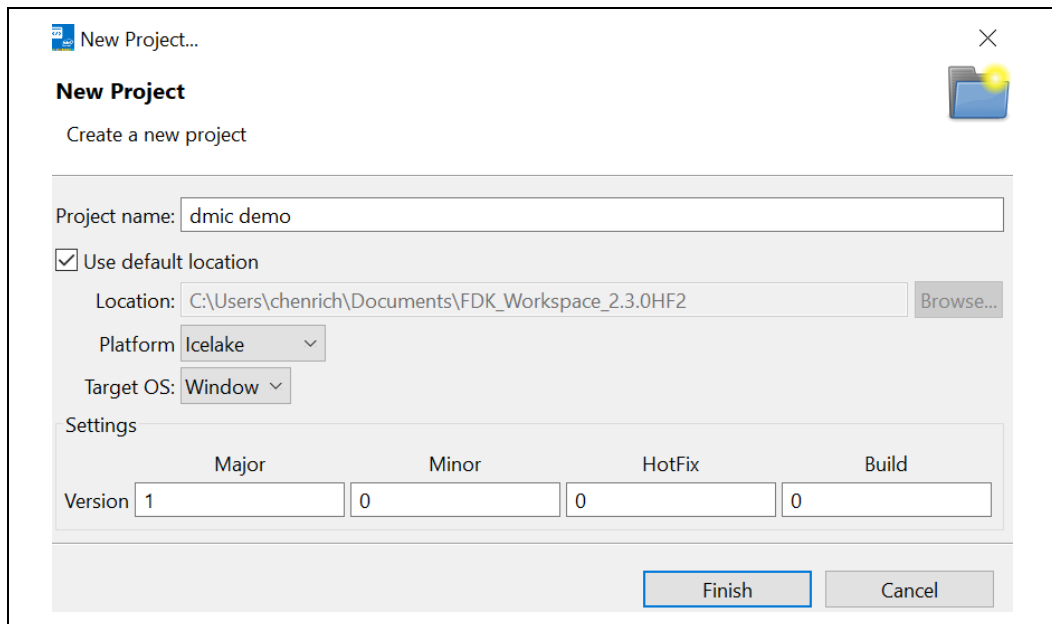
### 3.3 Generating nhlt.bin for DMIC

#### 3.3.1 IADK Usage Step by Step

1. Install **IADK**. NHLT generation is supported after IADK 2.5 MR1. Versions equal or higher would support the same functions.
2. Right click **Project** and select **New Cavs Project**.

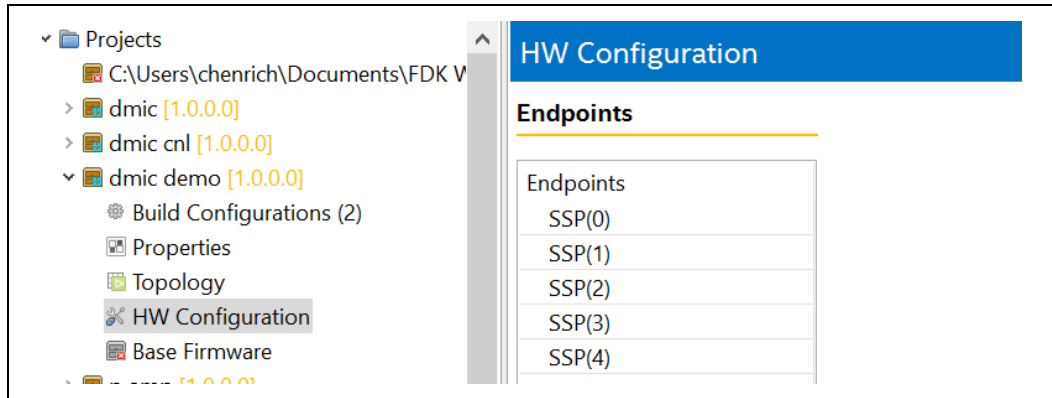


3. Fill the fields:
  - a. **Project Name** and **Version**.
  - b. Choose correct **Platform**.
  - c. Select **Target OS** according to target project platform.

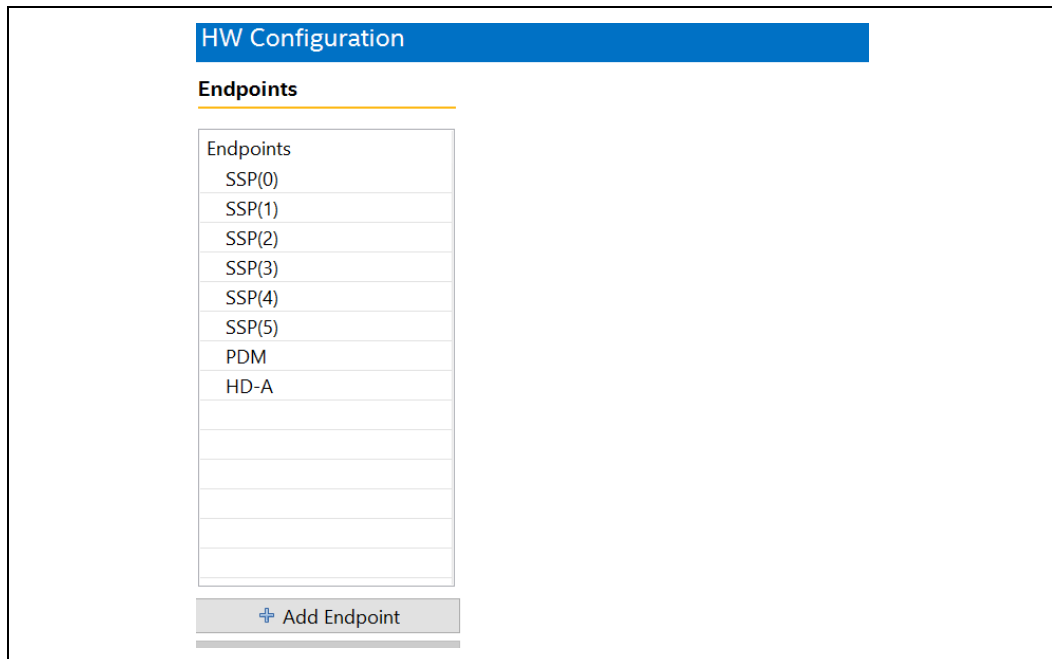


4. Select **Project created** and double click **HW Configuration**.





5. Click **Add Endpoint** to create new endpoint.
  - a. Choose the preferred link type.
  - b. To create configuration for DMIC connecting to PCH, choose Endpoint as **PDM**.
  - c. Click **Add Endpoint**.



6. Configure the following information according to the target project configurations:
  - a. **Number of channels:** The number of MIC channel on the target project.

**Note:** If there are three microphones attached, two on PDM0 and one on PDM1, then you must choose 4 channels in **Number of channels** configuration. Paired DMIC connection is recommended, IADK uses PDM0 for 2 DMIC by default.

**Hardware Configuration**

**Endpoint Configuration**

Endpoints: SSP(0), SSP(1), SSP(2), SSP(3), SSP(4), SSP(5), PDM, New Endpoint 0, HD-A, SoundWire

Link type: PDM

Name: New Endpoint 0

Topology Name: new\_endpoint\_0

Virtual Bus Id: 0

Device Type: PDM

Direction: Capture

Virtual Slot: 1

Subsystem Id (Hex): 1

Revision Id (Hex): 1

Core Revision: MTL

Hw Id: INTELAUDIO\CTLR\_DEV\_7E28&LINK

Config Type: ☒ Microphone array

**Format Configurations**

☐ Advanced format configuration

If I/O clock value is not correct then new project should be created with a suitable platform.

**IO Clock: 38.4MHz**

Decimators with shared filters create both 48kHz and 16kHz microphone sampling rates simultaneously. Default blobs are recreated from previous platforms and may require to be redone.

Number of channels: ☐ 1 channel ☒ 2 channels ☐ 4 channels

Output format: ☒ 48kHz/24 bit (Raw), 16kHz/24bit (Voice)

**Microphone Array Configuration**

Number of microphones: 2

Mic Type: SUBCARDIOID

Mic Panel: FRONT

Speaker Position Distance [mm]: 0

Horizontal Offset [mm]: 0

## 7. Microphone array and geometry configuration.

- a. **Config Type:** choose if **Microphone array** is in use on the target project. **Microphone array** checkbox activates the following array type configuration.
  - i. **Array Type:** choose if the Microphone array placement matches one of the pre-defined geometry configurations or choose **Vendor defined** to customize your own.
  - ii. **Number of microphones:** Choose the microphone number on **MIC array**.
  - iii. **Horizontal Offset(mm):** Put the distance offset of microphone components.

**Note:** If microphone placement is horizontal linear then put the distance offset of microphone component to the center of the device as plus-minus millimeter values.

For further details to define Microphone Array Geometry Descriptor Format, refer to Ref004.

**Endpoints**

Revision Id (Hex): 1

Core Revision: MTL

Hw Id: INTELAUDIO\CTLR\_DEV\_7E28&LINK

Config Type: ☒ Microphone array

Array Type: Vendor defined

**Microphone Array Configuration**

Number of microphones: 2

Mic Type: SUBCARDIOID

Mic Panel: FRONT

Speaker Position Distance [mm]: 0

Horizontal Offset [mm]: -39

Vertical Offset [mm]: 0

Frequency Low Band (Hz): 100

Frequency High Band (Hz): 20000

Direction Angle [-180deg, 180deg]: 0

Elevation Angle [-180deg, 180deg]: 0

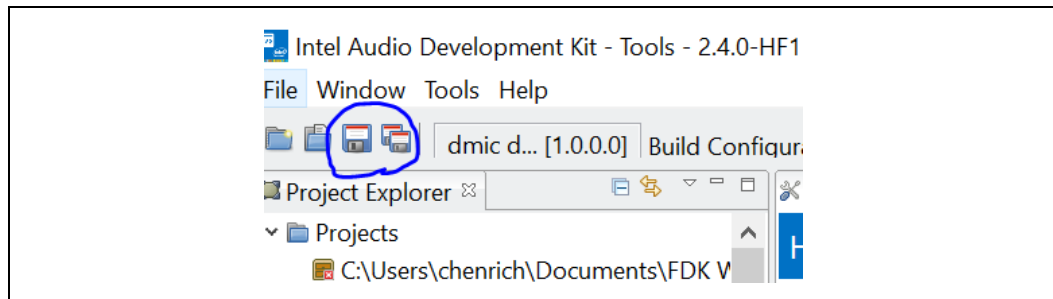
Work Vertical Angle Begin [-180deg, 180deg]: -60

Work Vertical Angle End [-180deg, 180deg]: 60

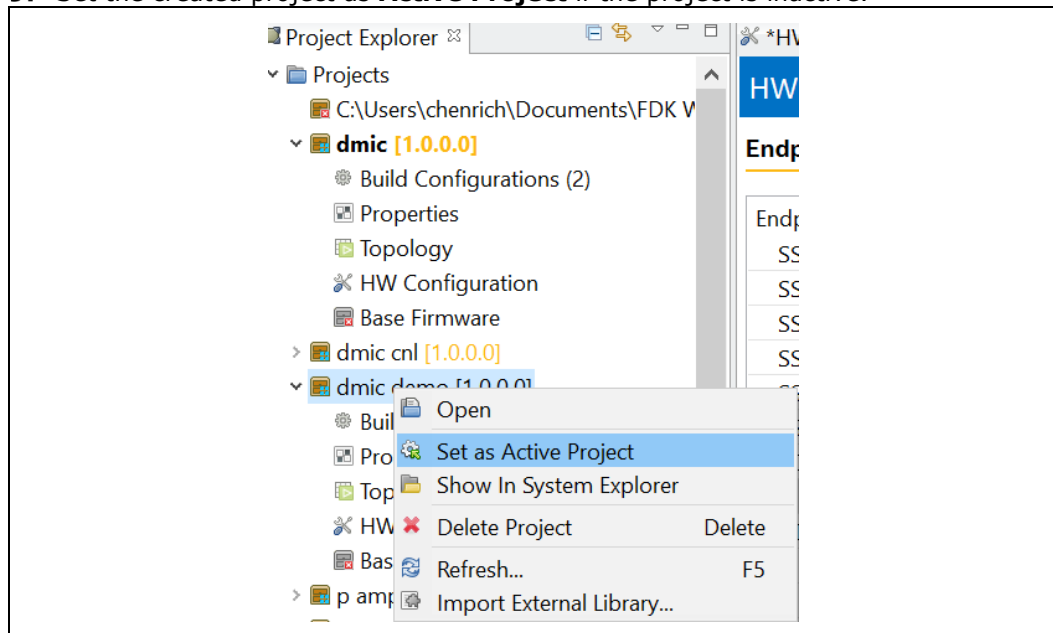
Work Horizontal Angle Begin [-180deg, 180deg]: -50

Work Horizontal Angle End [-180deg, 180deg]: 50

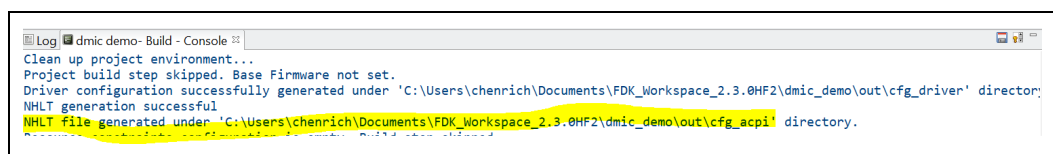
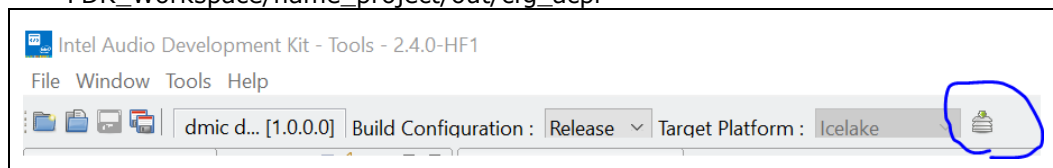
8. Click **Save** to retain settings in the hwconfiguration.xml file in the following location: FDK\_Workspace/name\_project/metadata.

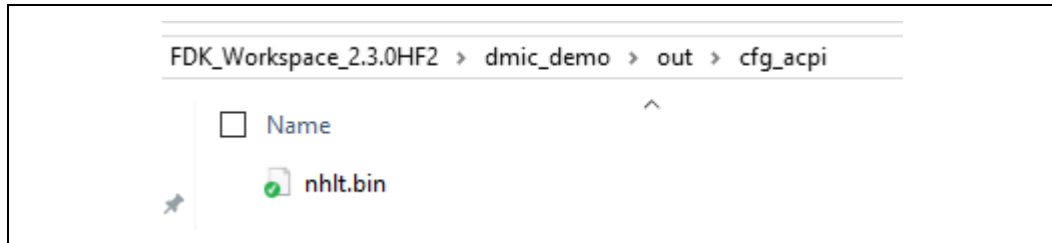


9. Set the created project as **Active Project** if the project is inactive.



10. Build the project to generate nhlt.bin file. The nhlt.bin file will be in the path "FDK\_Workspace/name\_project/out/cfg\_acpi"





### 3.3.2 Verifying nhlt.bin

After generating the nhlt.bin file, verify the bin file to target device, and check DMIC CLK on the device.

1. Copy nhlt.bin file to device, path:  
C:\windows\system32\cAVS\nhlt\_FILE\_NAME.bin
2. Add registry key to override the value.  
**[HKEY\_LOCAL\_MACHINE\SYSTEM\CurrentControlSet\Services\IntcOED\Parameters]**
3. "NhltOverridePath"="\SystemRoot\System32\cAVS\nhlt\_FILE\_NAME.bin"  
Reboot system
4. Measure DMIC CLK and check signal.

If the microphone is working as expected, then the nhlt.bin file is ready for BIOS integration. Need to integrate the generated NHLT/DMIC blob file into BIOS, refer to BIOS guidance in Ref020 for BIOS integration. Contact the BIOS CE if any assistance is required.

## 3.4 Generating nhlt.bin for BT\* Offload

**Note:** For ICL, CML v2 and TGL only

The default BT\* audio settings are integrated into Intel RVP BIOS, and it should be suitable for most of BT\* headset device in our experience. Add your customized PDM (DMIC configuration) into the default nhlt.bin file from RVP.

The default NHLT from RVP is available in the following Bring Up Guide files:

- CML v2
- ICL
- TGL

**Note:** For ADL, RPL MTL and LNL only

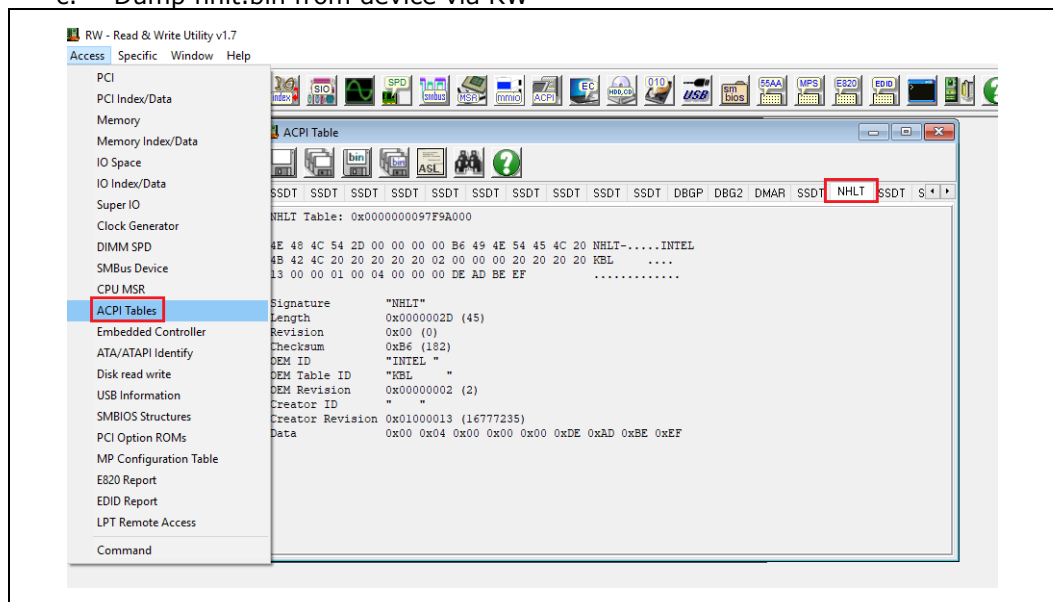
Starting from ADL, the BIOS code architecture accepts BT\* offload audio setting and DMIC configuration in separate NHLT bin files depending on the NHLT settings enabled in BIOS option. There's no need to combine BT offload and DMIC configuration in single NHLT file. Follow the step of Audio DSP NHLT Endpoints Configurations: (For ADL and RPL) in [Section 2.3](#).

The default NHLT from RVP is available in Bring Up Guide file xxx\_NHLT.zip:

- 2 DMIC with 38.4MHz CLK: NhlConf1DmicX2.bin
- 4 DMIC with 38.4MHz CLK: NhlConf2DmicX4\_38\_4.bin
- BT with 38.4MHz CLK: BT\_NHLT.bin

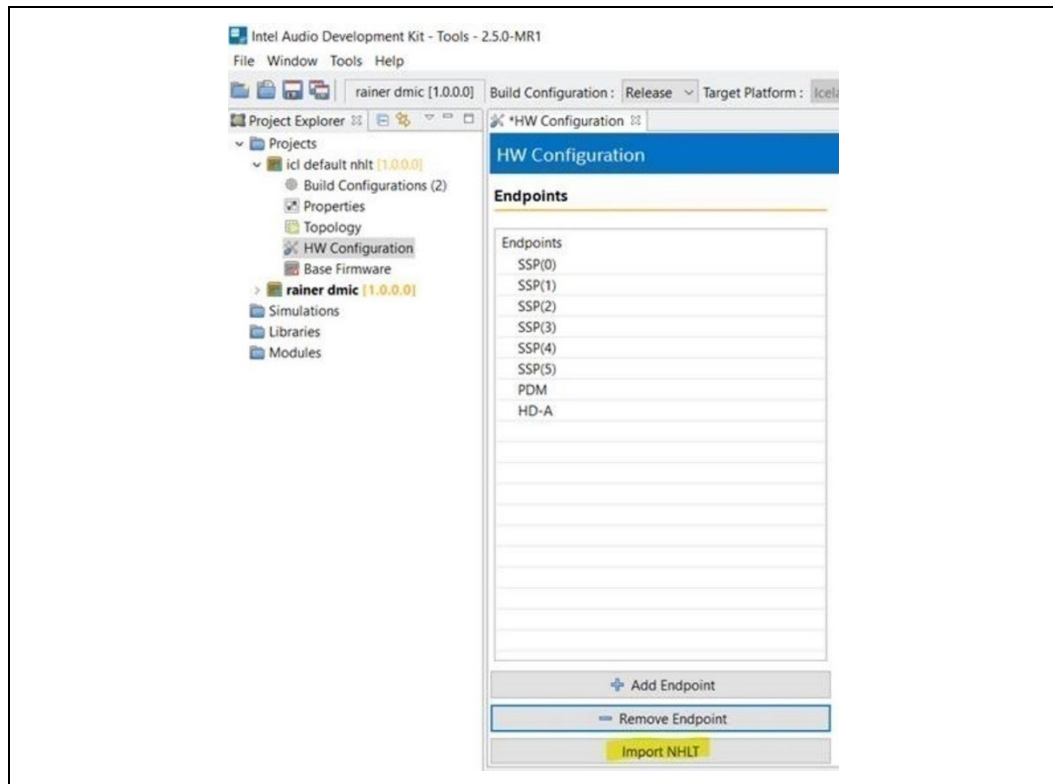
### 3.4.1 IADK Usage Procedure

1. Retrieve the default nhl.t.bin file.  
The method to retrieve the default nhl.t.bin:
  - a. Use internal **NHLT**
  - b. **Boot** into OS
  - c. Dump nhl.t.bin from device via RW

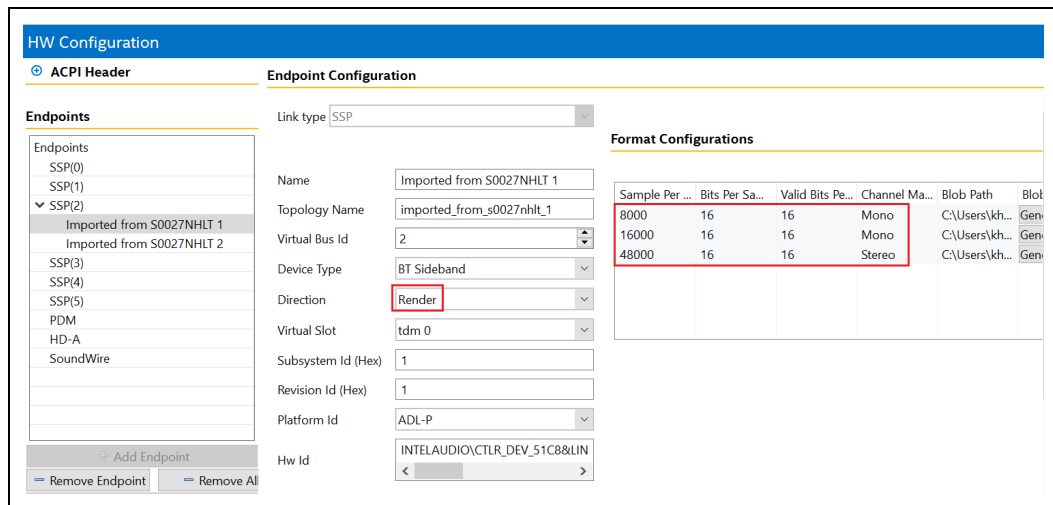


**Note:** Configuration may change on different platforms.

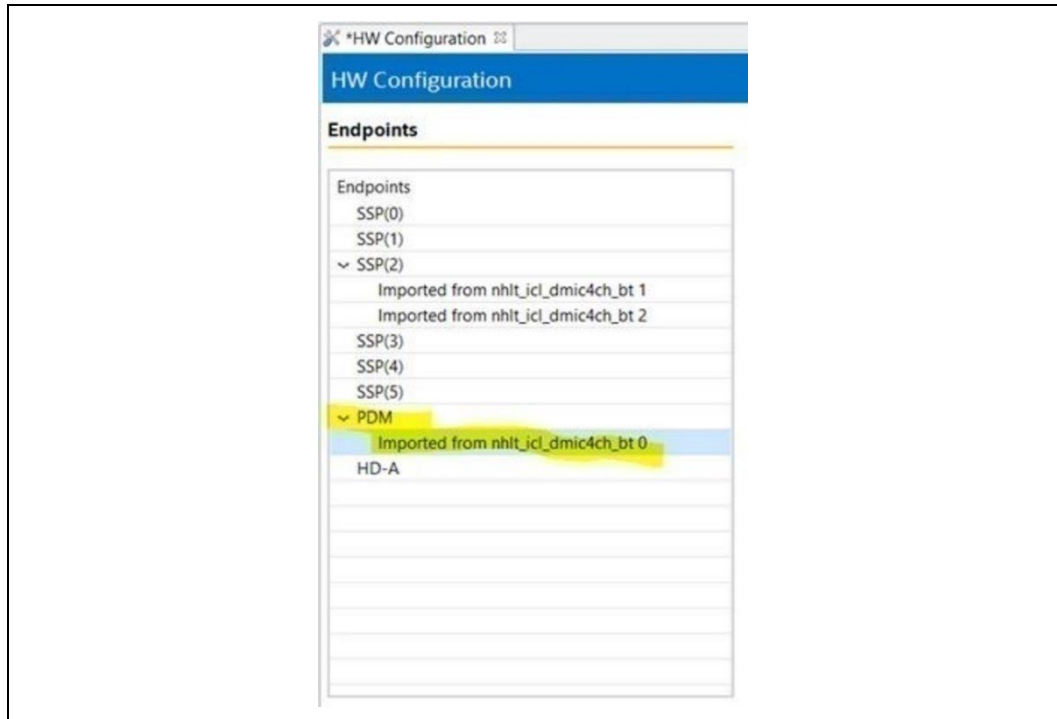
2. Integrate DMIC configuration into default nhl.t.bin
  - a. Create a **New project** in IADK.
  - b. Import the retrieved nhl.t.bin from the previous step.



- c. BT\* configuration is for both render and capture and are included after nhlt.bin imported.



- d. For PDM (DMIC configuration), refer to steps in [Section 3.3.1](#) to fit the DMIC design.



- e. Follow the steps mentioned in [Section 3.3.2](#) to verify BT\* offload function and integrate into BIOS.

§§

## 4 Driver/Application Installation

Ensure BIOS settings are configured before Intel® SST Driver installation.

The following procedure to install the Intel® SST Driver is required.

### 4.1 Folder and Main File Introduction

An official Intel® SST Driver release usually includes the following files:

Folder/File	Comments
Apps	<b>Sample applications</b>
MvaApplications.zip	A sample application to validate Intel® WoV for MVA
Drivers	<b>Basic driver</b>
IntcAudioBus.inf	ISST audio bus driver installation file.
IntcOED.inf	ISST OED driver and IntelAudioService installation file.
DetectionVerificationDrv.inf	Detection Verification driver installation file for Intel® WoV.
IntcDMic.inf	ISST DMIC driver installation file, for DMIC to PCH only.
IntcUSB.inf	USB audio offload (UAOL) driver installation file.
IntcBTAu.inf	Bluetooth* audio offload driver installation file.
IntcSdwBus.inf	Soundwire* bus driver installation file.
IntcSDW.inf	Soundwire* driver installation file.
IntcSST.inf	I2S driver installation file, for I2S Codec only.
DVL	<b>Driver Verification Log (DVL) for certifying customized extension INFs</b>
IntcDMic.DVL.XML	DVL of ISST DMIC driver.
IntcOED.DVL.XML	DVL of ISST OED driver.
IntcUSB.DVL.XML	DVL of UAOL driver.
IntelMvaExtensionInf	<b>Extension driver to support Intel® WoV for MVA</b>
IntelMvaExtension.inf	Customizable extension driver installation file, to support Intel® WoV for MVA.
TemplateInf	<b>Sample or debugging INFs</b>
IntcBTAu_ResourceConstraints.inf	Sample extension inf to apply resource constrains for BT audio.
IntcOED_EnableMclkAlwaysOn.inf	Extension inf to keep MCLK always on when FW is alive.



IntcOED_I2SAlwaysRunningMode.inf	Sample extension inf to set i2s to always running mode (clock driven by DSP).
IntcOED_OemLibPath.inf	Sample extension inf to declare and install third-party FW files for OED driver.
IntcOED_RenderHeadroom.inf	Sample extension inf to enable and set render headroom of DSP modules.
IntcOED_RTD3Disable.inf	Sample extension inf to disable RTD3 for OED driver.
IntcSdwBus_EnableACXAggregation.inf	Sample extension inf to enable ACX aggregation for SDW.
IntcSdwBus_EnableEVAD.inf	Sample extension inf to enable EVAD for SDW.

**NOTES:**

1. Do not install any files in the folder of TemplateInf unless you know exactly what they are for.

## 4.2 Driver Installation

Use the “Have Disk...” method to install the following drivers.

Browse to the unzipped Platform Milestone release folder location (for example, Intel®\_Smart\_Sound\_Technology\_<Platform>\_<Milestone>\_Release\_vx.xx.xx.xxx\)) and perform the following step:

1. Install BUS driver (IntcAudioBus.inf) from the subfolder Drivers over “High-Definition Audio Controller” or “Multimedia Audio Controller” in the Device Manager.
  - a. Name of the device before installing driver: High-Definition Audio Controller or Multimedia Audio Controller.
  - b. Name of the device after installing the driver: Intel® Smart Sound Technology (Intel® SST) Audio Controller or Intel® Smart Sound Technology BUS.
2. Install OED driver (IntcOED.inf) from the subfolder Drivers over “Intel High-Definition DSP” in the Device Manager.
  - a. Name of the device before installing driver: Intel High-Definition DSP.
  - b. Name of the device after installing the driver: Intel® Smart Sound Technology (Intel® SST) OED.

Optional step only if DMIC is connected to PCH

3. Install DMIC driver (IntcDMic.inf) from the subfolder Drivers over “Digital microphone device” in the Device Manager
  - a. Name of the device before installing driver: Digital microphone device.
  - b. Name of the device after installing the driver: Intel® Smart Sound Technology for Digital Microphones.

Optional step only for Bluetooth\* audio offload enabling (For ICL, CML v2, TGL, ADL, RPL, MTL and LNL only)

4. Install Bluetooth\* Audio driver (IntcBtAu.inf) from the subfolder Drivers over “BT Sideband device” in Device Manager.

- a. Name of the device before installing driver: BT Sideband device.
- b. Name of the device after installing the driver: Intel® Smart Sound Technology for Bluetooth\* Audio.

Optional step only for USB audio offload enabling (for TGL, ADL, RPL and MTL only)

5. Install UAOL driver (IntcUSB.inf) from the subfolder Drivers over "USB device" in Device Manager.
  - a. Name of the device before installing driver: USB device.
  - b. Name of the device after installing the driver: Intel® Smart Sound Technology for USB Audio.

Optional step only for Intel® WoV enabling

6. Install Intel® WoV driver (DetectionVerificationDrv.inf) from the subfolder Drivers over "Detection Verification" in Device Manager.
  - a. Name of the device before installing driver: Detection Verification.
  - b. Name of the device after installing the driver: Intel® Smart Sound Technology Detection Verification.

Optional step only for Portclass SDCA design if SDW interface enabled instead of HD audio:

7. Install Intel® SDW bus driver (IntcSdwBus.inf) from the subfolder Drivers over "SoundWire Bus" in the Device Manager.
  - a. Name of the device before installing driver: SoundWire Bus.
  - b. Name of the device after installing driver: Intel® Smart Sound Technology MIPI SoundWire\* Controller.
8. Install Intel® SDW driver (IntcSDW.inf) from the subfolder Drivers over "SoundWire device" in the Device Manager.
  - a. Name of the device before installing driver: SoundWire\* device.
  - b. Name of the device after installing driver: Intel® Smart Sound Technology for MIPI SoundWire\* Audio.

Optional step only for ACX SDCA design if SDW interface enabled instead of HD audio:

9. Remove Intel® SDW driver (IntcSDW.inf) from the subfolder Drivers.
10. Install Intel® SDW bus driver (IntcSdwBus.inf) from the subfolder Drivers over "SoundWire Bus" in the Device Manager.
  - a. Name of the device before installing driver: SoundWire Bus.
  - b. Name of the device after installing driver: Intel® Smart Sound Technology MIPI SoundWire\* Controller.

#### **NOTES:**

1. For QS samples, install ProductionFW driver. For ES samples, install the NonProductionFW driver. Otherwise, Yellow Band will be seen on OED device.
2. Install the appropriate Intel® SST driver based on the platform that the drivers are being installed on (for example, ICL Intel® SST drivers in ICL platforms).
3. For TGL system installed with 20H1 OS, install GFX driver before SST driver because GFX will enable SGPC (Shared Graphics Power Component). Otherwise, there will be non-SGPC HDA hidden device in the Device Manager.
4. From TGL and ADL 10.29.00.6590, Intel® SST adopts the COPYINF mechanism, so the other drivers will be automatically installed when the BUS driver is installed.

- For ACX SDCA design, if Intel® SDW driver (IntcSDW.inf) and ACX Streaming driver are installed at the same time, the speaker will not work. Please make sure IntcSDW.inf is not installed on ACX SDCA design. Removing IntcSDW.inf from system can solve speaker issue. Please remember to remove Intel® SDW driver (IntcSDW.inf) from driver package before installing ISST. For WU submission with ACX SDCA design, ODM/OEM has to remove "IntcSDW.inf" from driver package and submit DUA.

## 4.3 Checking Driver Version

To check the Intel® SST Driver version:

- Open the **Device Manager**.
- Click **Sound, Video, and Game controllers'** arrow to open the list of audio/sound devices.
- Double click the device named as **Intel® Smart Sound Technology**.
- Select **Driver** tab and verify that the **Intel® SST** driver version is correct
- Double click **HW Audio Codec** device
- Select **Driver** tab and verify that the Codec driver version is correct

## 4.4 ROM EXT Driver Integration

From MTL, new ROM EXT driver will be used for authenticating DSP FW and it will be released separately.

Here is how to integrate ROM EXT driver to CSME image.

- When building CSME image via CSME mFIT tool, search for "ace"
- Select "ACE Sub-Partition", and locate the ROM EXT binary for ACE Binary File.
- Then follow general method to build CSME image. ROM Ext will be integrated inside.



## 4.5 PSNS Enable

Platform Self Noise Silencer (PSNS) is supported from LNL.

### 4.5.1 Prerequisites

It is recommended to start with a fresh Windows 11 installation, as any non-production, old, stale, unknown or engineering versions of previous audio drivers, APOs or other 3rd party components may affect final result, even if those components were removed / uninstalled. This is due to the fact that Windows has ambiguous policy regarding deinstallation cleanup and there still might be some interfering residue in registry or driver storage after removal.

Steps to perform:

- Intel PCH DMICs must be properly configured and exposed in BIOS as a 2 or 4 channels microphone array. You can verify under Windows capture endpoint properties, that microphone endpoint is exposed as 2 or 4 channels microphone array.
- Start with a clean Windows 11 installation on a supported Intel platform.
- When switching SST/PSNS build versions, perform uninstallation steps described in chapter 2.3 below to make sure there are no old stale Intel PSNS instances.
- The package supports <Intel SST Digital Microphone Array> endpoint with a recommended sensitivity setting of -26dBFS. If that is not the case for your platform, PSNS may NOT work properly. If unsure, verify platform microphone performance using SPET before installing PSNS. Set proper sensitivity in IADK if necessary, according to regular SPET procedure.

### 4.5.2 Installing

Intel PSNS package consists of two template extension INFs bundled into main Intel SST driver build. Extension INFs enable PSNS on platform's integrated PCH DMICs. For SNDW, you need to customize the INF files by updating their HWIDs.

Install the drivers in the following order:

- OED driver extension INF:  
*IntcOED\_PlatformSelfNoiseSilencerCore.inf*
- DMIC codec driver extension INF:  
*IntcDmic\_EnablePlatformSelfNoiseSilencer.inf*

The installation is conducted by right-clicking on each extension INF file and selecting 'Install' option. Wait for the installation to complete and click 'OK' on a confirmation dialog (note that some Windows versions do a silent installation without final confirmation). It is recommended to restart OS after installation, even if not explicitly asked for that.

You can confirm proper PSNS module installation by verifying that a PSNS module block is linked in capture pipeline under IADK



## 5 Basic Audio DSP Features Check

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### 5.1 Playback on System Pin

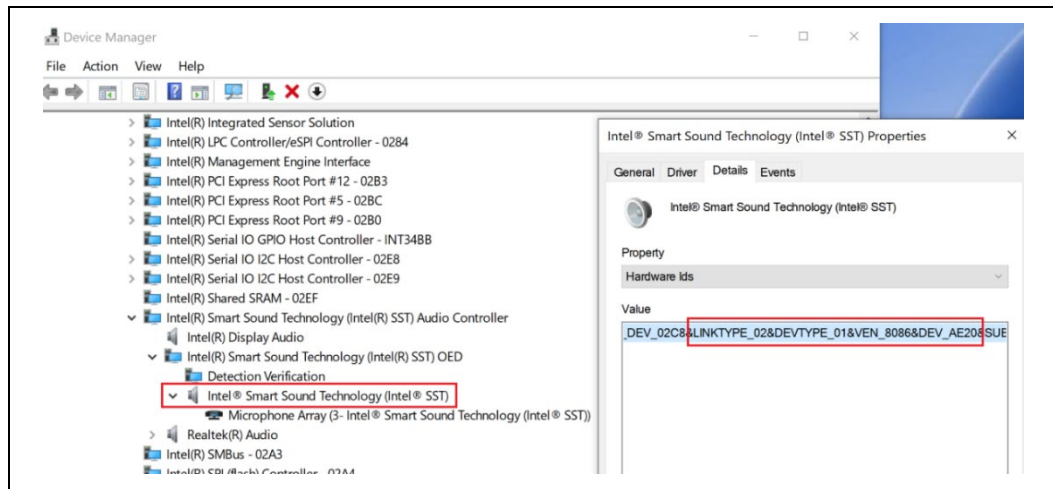
1. Prepare .wav sound file (for example 24bit, 48khz, stereo)
2. Open Windows\* Media Player
3. Select and play the .wav sound file
4. Check if the sound is audible
5. Try **different sound file extensions (.mp3, .aac)**.

### 5.2 Playback on Offload Pin

1. Prepare .wav sound file (for example 24bit, 48khz, stereo)
2. Open Windows\* **Groove Music**.
3. Select and play the .wav sound file
4. Check if the sound is hearable
5. Try **different sound file extensions (.mp3, .aac)**.

### 5.3 Recording Volume on DMIC to PCH

1. Open Windows\* **Voice Recorder**.
2. Click **Record** button and start to record.
3. Open **Recording** page in **Sound** from the speaker icon in right-down corner.
4. Try to adjust the volume bar to check recording volume.
5. Check if recording volume take effect as expectation or not.
6. Check the description of HWID in properties page of Device Manager as well. The full string of DMIC PDM endpoint descriptor is as shown below,
  - a. **LINKTYPE\_02&DEVTYPE\_00&DEV\_AE20 || LINKTYPE\_02&DEVTYPE\_01&DEV\_AE20** (DEVTYPE\_00 is required in the latest BIOS RC code, but DEVTYPE\_01 is required due to old BIOS RC code compatibility)



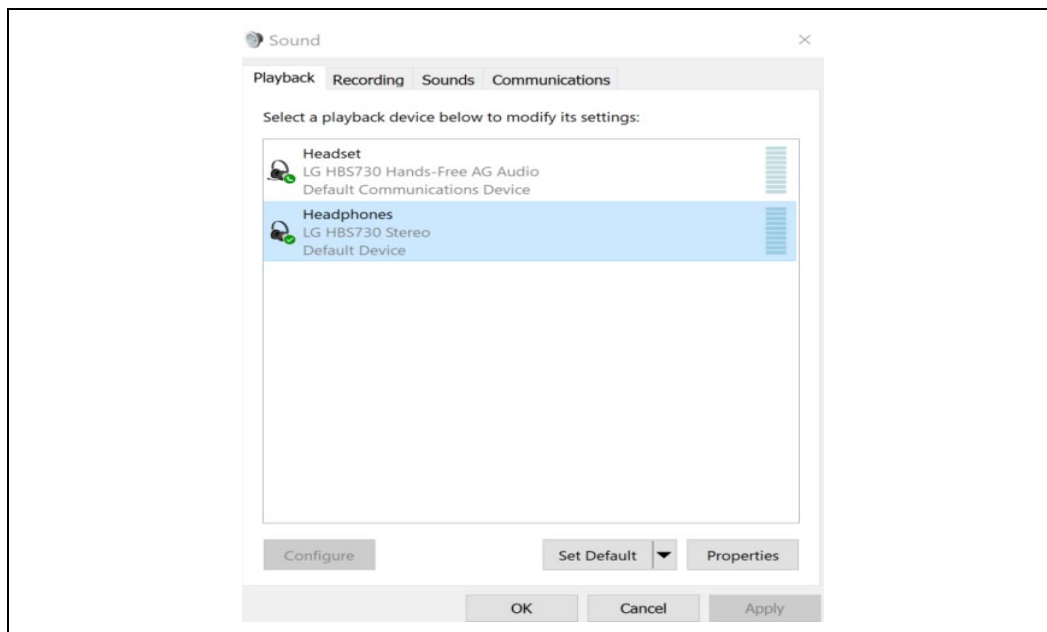
**NOTE:** Since Intel DMIC driver does not provide analog AGC when DMIC is connected to PCH, you will require 3<sup>rd</sup> party SW APO to support SW gain control for volume adjustment.

## 5.4 Bluetooth\* Audio on Offload Pin

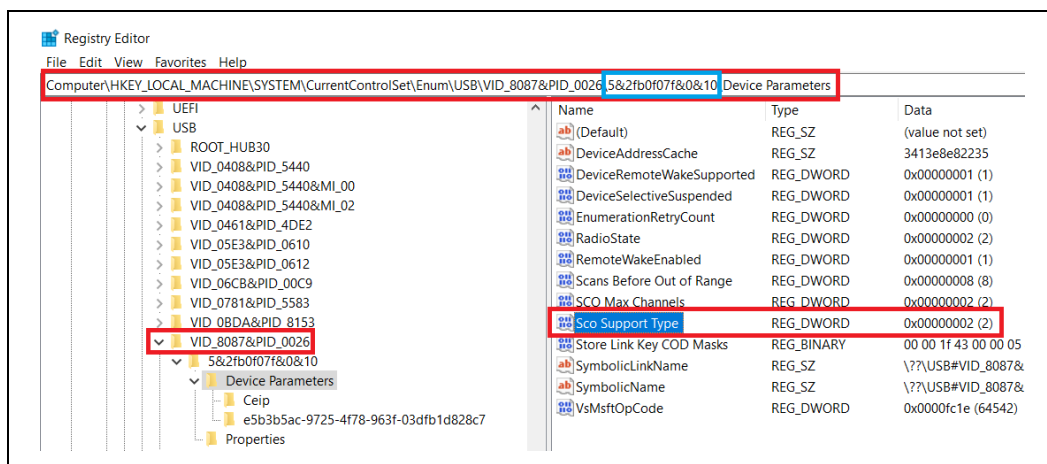
- ADL/RPL + Intel® Wi-Fi 6E AX211: Support Bluetooth HFP and A2DP audio offload. Bluetooth A2DP audio offload can support SBC and AAC codec.
- TGL-R + Intel® Wi-Fi 6 AX201: Support Bluetooth HFP and A2DP audio offload. Bluetooth A2DP audio offload can support SBC codec.
- TGL-U/H + Intel® Wi-Fi 6 AX201: Support Bluetooth HFP audio offload.

**Note:** Refer to Ref002 – “Bluetooth\* Audio Offload Technical Advisory” for more details.

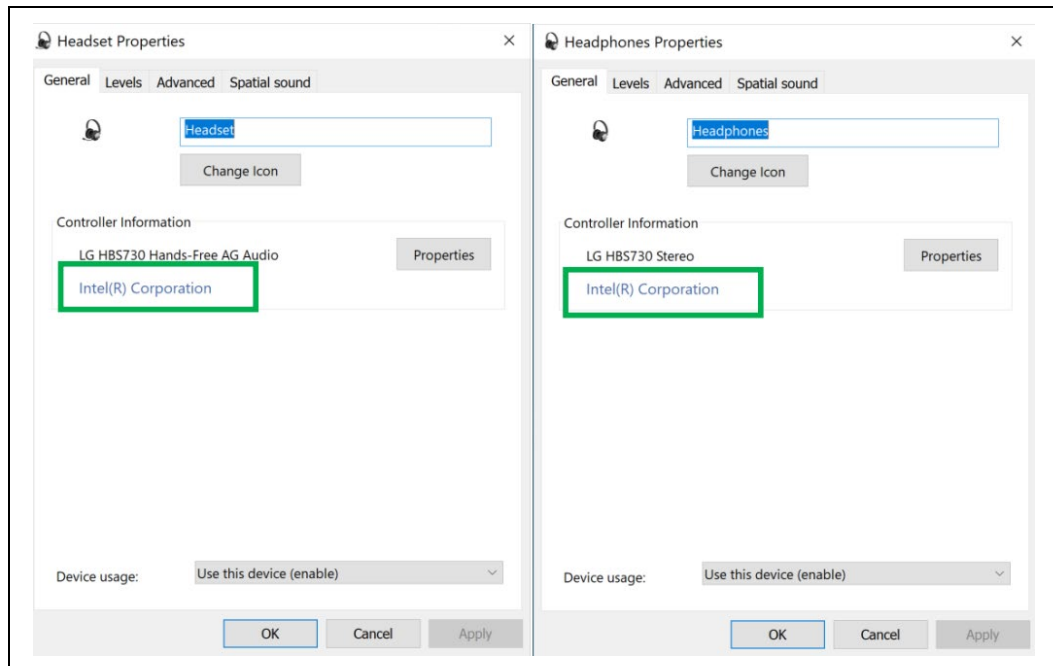
1. Follow [Section 2.3](#) to configure BT\* Audio offload in BIOS.
2. For audio device setup:
  - a. Pair with Bluetooth\* Headset.
  - b. Go to **Playback** tab in **Sound**.
  - c. Verify that the Bluetooth “Headset (Hands-Free)” and Bluetooth “Headphones (Stereo)” is available.



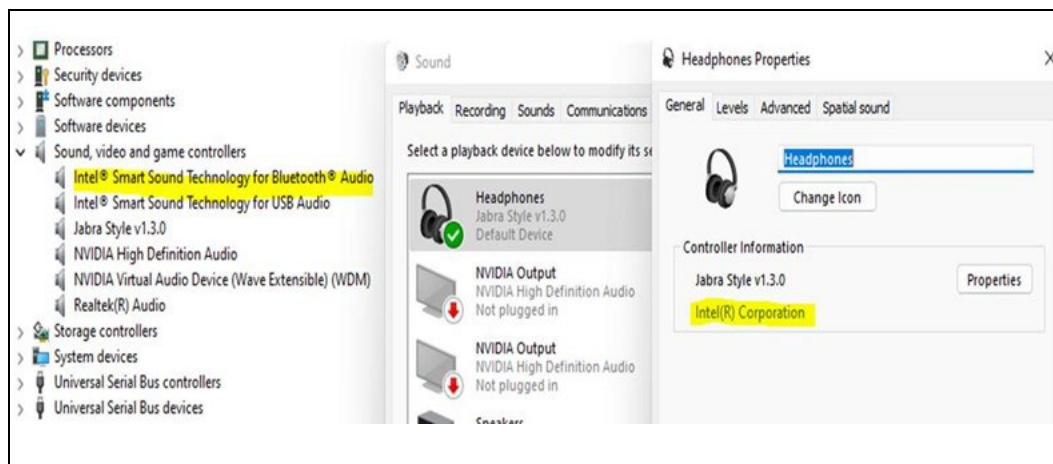
3. BT\* driver will query the BIOS and write into the registry with the appropriate audio offload support value, applies to both HFP and A2DP:
  - a. [HKEY\_LOCAL\_MACHINE\SYSTEM\CurrentControlSet\Enum\USB\VID\_<VID>&PID\_<PID>\<DEV\_ID>\Device Parameters]
    - i. If BT\* Audio Offload is to be disable, "Sco Support Type" <0x0>
    - ii. If BT\* Audio Offload is to be enable, "Sco Support Type" <0x2>



4. Check the **Controller information** from **Sound > Playback > Headset/Headphones Properties**, and check if "**Intel® Corporation**" instead of "Microsoft" if it is running on the offload pin.



6. Since the BT\* Audio link is not standard HD audio, there are necessary configurations in NHLT as described in [Section 3.4](#). An extra Intel® SST child device would be under Intel OED if right NHLT integrated into BIOS as shown in figure below.
7. Check the description of HWID in properties page of Device Manger as well. The full string of BT\* Endpoint Descriptor is as below,
  - a. **LINKTYPE\_03&DEVTYPE\_00&DEV\_AE30**



8. If there is Bluetooth - UsbScoDataTransportLayer WHQL failure for BT offload enabled system, contact Intel Bluetooth and Audio CE for details.



## 5.5 USB Audio Offload

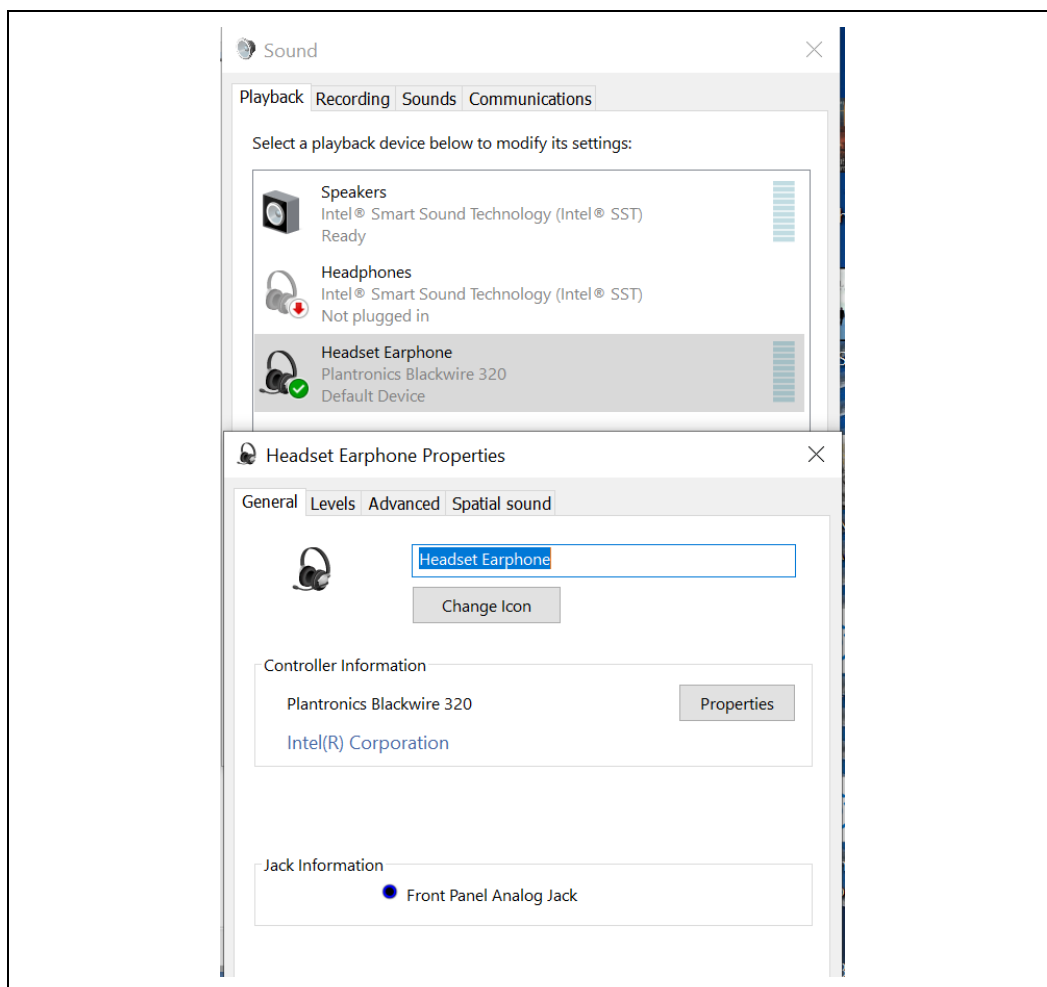
**Note:** Refer to Ref012 – “USB Audio Offload Technical Advisory” for more details.

USB audio offload is supported only on **UAC 1.0 devices**, and not on UAC 2.0 or other devices. Customers can use USB View tool from Microsoft\* WDK to determine the type of USB device (UAC 1.0 or UAC 2.0) connected to the system.

For TGL, USB Audio is offloaded to DSP by default, refer to Ref013 for UAOL enable/disable in BIOS. From ADL, follow [Section 2.3](#) to enable/disable UAOL. Additionally, BIOS must set **HCCPARAMS2.GSPC** on 1 (When GSPC is 0, then MSFT inbox driver will not expose interface to OED and IntcUSB will not be enumerated).

Refer to items below to check UAOL enable successfully or not.

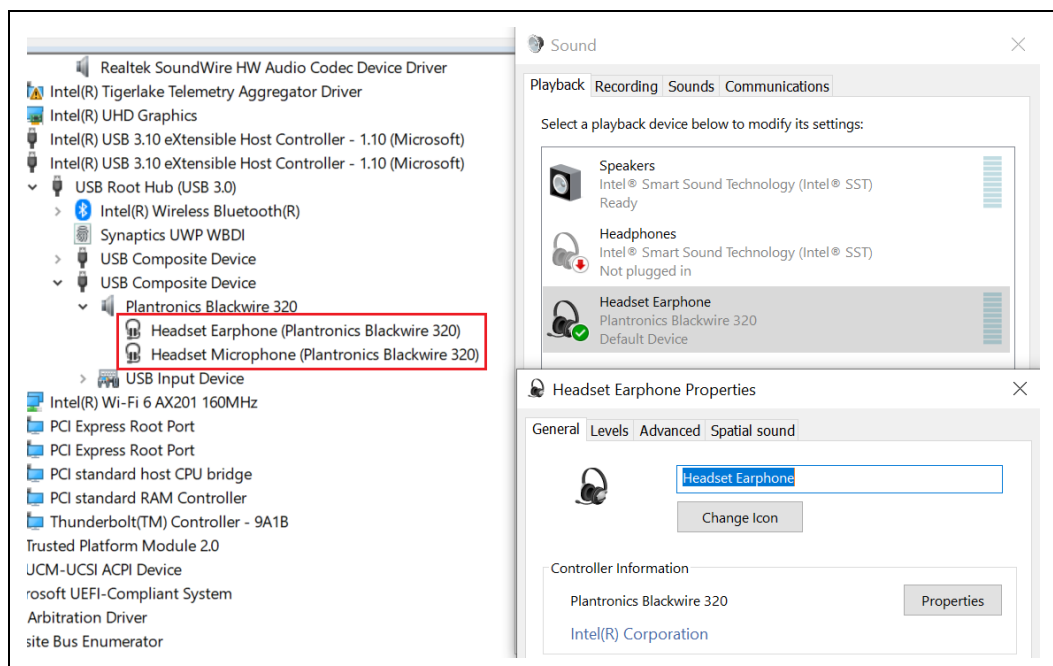
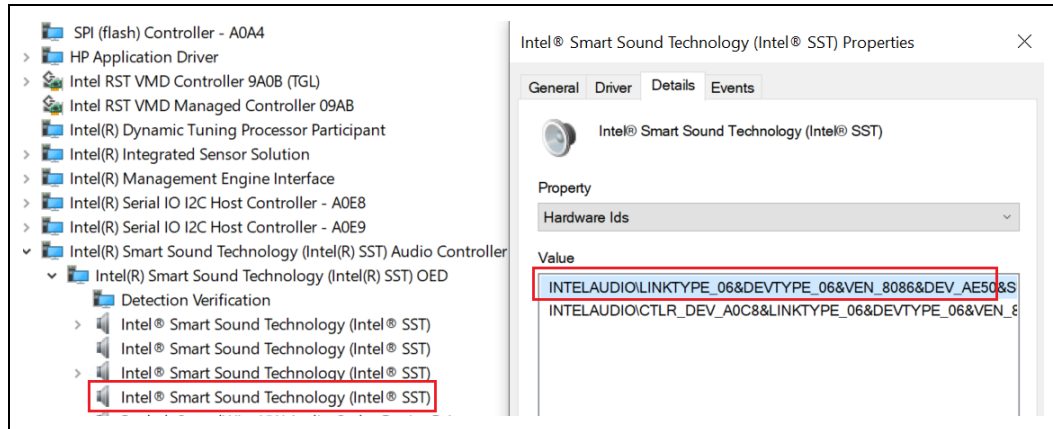
1. After the driver of UAOL installed, check the **Controller information** from **Sound > Playback > Headset Properties**, and check **Intel® Corporation** if it is running on USB audio offload pin.



2. Check if the USB headset device is as child device of Intel® SST OED.

**Note:** USB headset endpoints will still appear under xHCI in the device manager. Check the description of HWID in properties page of the Device Manager as well. The full string of USB Audio device descriptor is as shown below,

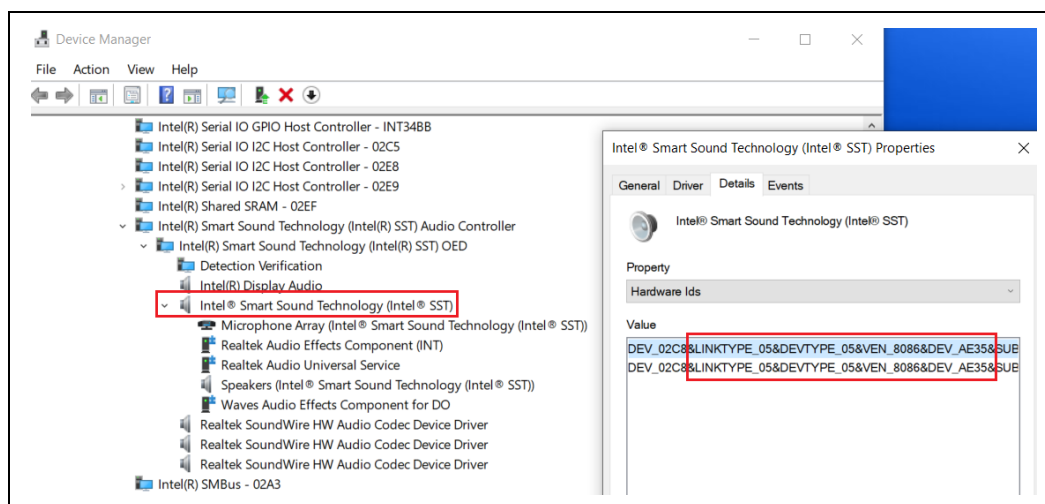
**a. LINKTYPE\_06&DEVTYPE\_06&DEV\_AE50**



## 5.6 SoundWire\* Audio Device

In SDW design, there is one SDW audio device as a child device under Intel OED after driver of IntcSDW is installed. Check the description of HWID in properties page of Device Manager as well. The full string of SDW endpoint descriptor is as below,

**1. LINKTYPE\_05&DEVTYPE\_05&DEV\_AE35**



## 5.7 Intel® WoV with Multi-Voice Assistant

**Note:** Refer to Ref006 – “MVA enabling guidance” for more details. MVA extension inf and Intel® SST driver binaries are separate links in Microsoft partner web site and needs to be resold separately. MVA extension version matches the DetectionVerificationDrv.

For Multi-Voice Assistant enabling, configurations in BIOS, MVAExtension.Inf and Windows\* settings are required.

- ## 1. BIOS

Follow [Section 2.3](#) to configure BIOS, Set **VAD API Mode** as **Windows\* 10 Voice Activation**

Intel Advanced Menu → PCH-IO Configuration → HD Audio Configuration → HD Audio DSP Features Configuration

- WoV (BIT 0) = [TRUE]
- VAD API Mode (BIT 8) = [Windows 10 Voice Activation]

- ## 2. MVA Extension Inf

Define configuration of VAs for a given design in **IntelMvaExtension.inf**

```
; Default placed in VALocaleMap registry key. By default, Alexa and Cortana supported in all locales
[IntelMva.EnableMva Default]
HKR,VALocaleMap,VAEventIDs,0x00010000,%HeyCortanaEventGuid%,%AlexaEventGuid%
```

```
; OEM DLL will read VALocaleMap to determine what VAs to support based on current system locale.
; China Chinese (Simplified) (0804) only supports Cortana and Xiaowei
; VAEventIDs value will be place in locale language id subkey: VALocaleMap\0804.
[IntelMva.EnableMva_zh-CN]
HKR,VALocaleMap\zh-CN,VAEventIDs,0x00010000,%HeyCortanaEventGuid%,%XiaoweiEventGuid%
```

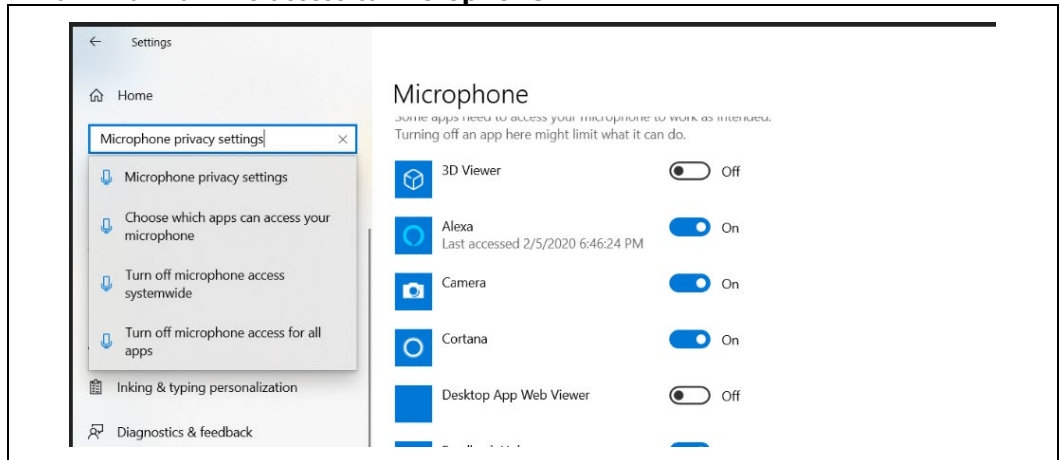
Check the MVA extension installation and version by command with Administrator right "**dism /Online /Get-Drivers /Format:table |findstr mva**".

```
PS D:\> dism /Online /Get-Drivers /Format:table |findstr mva
pem17.inf | intelmvaextension.inf | ? | Extension | Intel(R) Corporation | 2020/12/3 | 1.0.1785.0
```

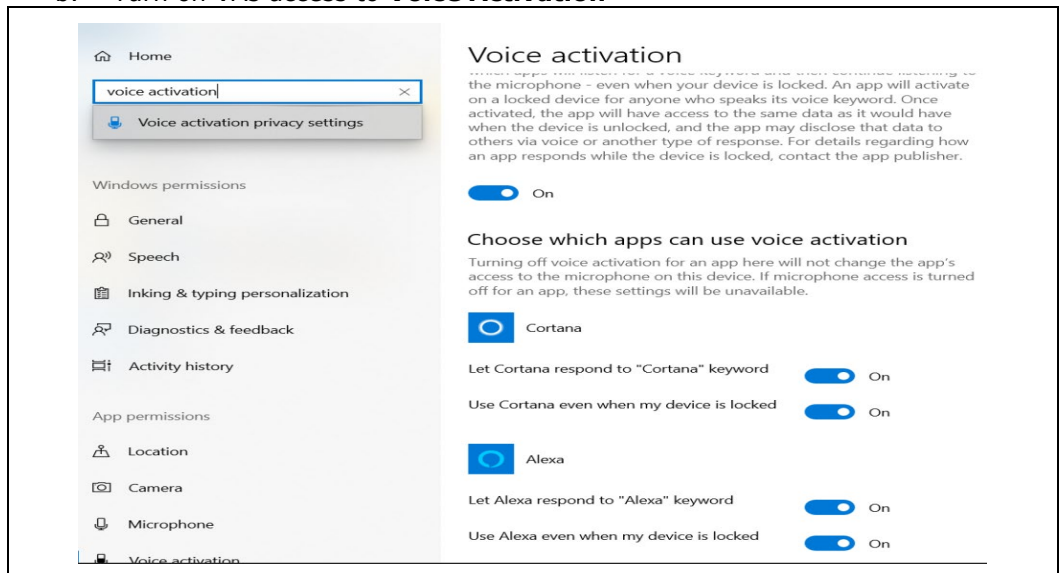
### 3. Windows\* Settings:

Turn on VAs access right to **Microphone** and **Voice Activation**, Enable capture audio enhancements.

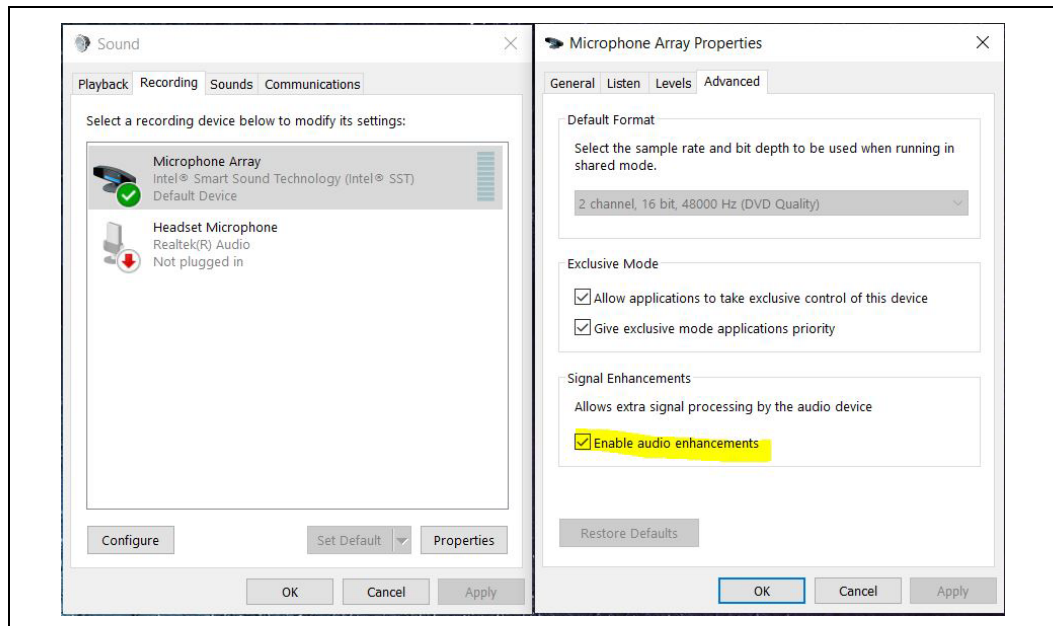
#### a. Turn on VAs access to **Microphone**



#### b. Turn on VAs access to **Voice Activation**



#### c. Select **Sound Control Panel > Recording > Microphone Array > Properties > Advanced**, and check **Enable audio enhancements** checkbox.



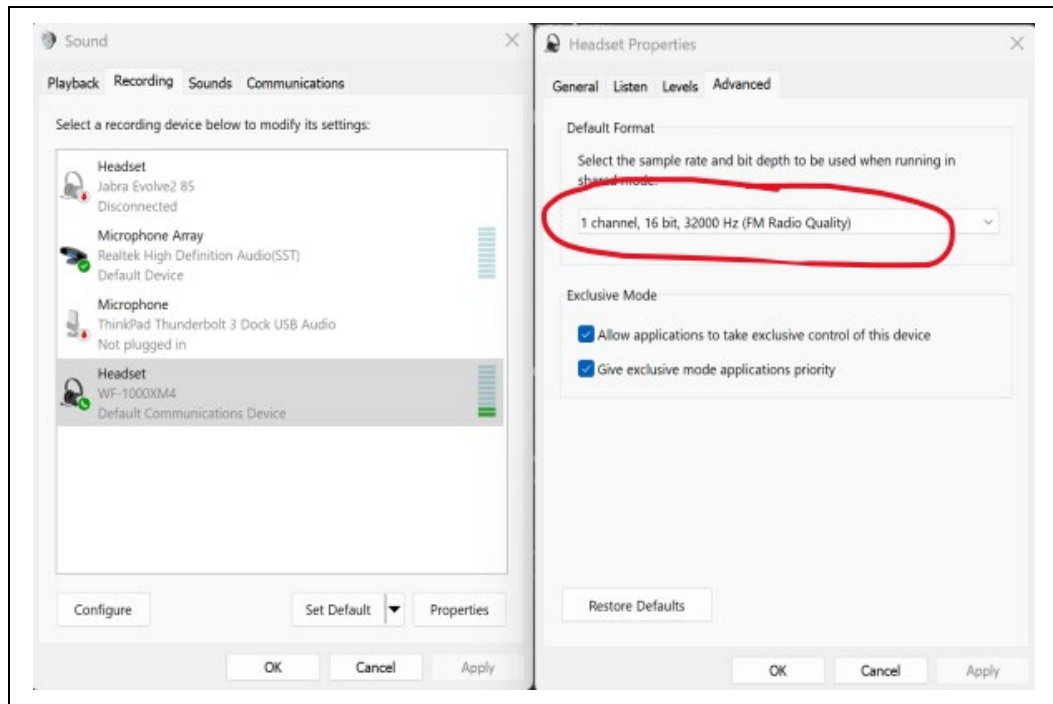
## 5.8 LE Audio

Go to System > **Sound Settings**

In the Advanced section, select **More sound settings**

Select the connected Bluetooth® headset in the Recording tab, then right-click and select Properties

In the Advanced tab, the sample rate should be 16-bit, 32000 Hz for an LE Audio connection



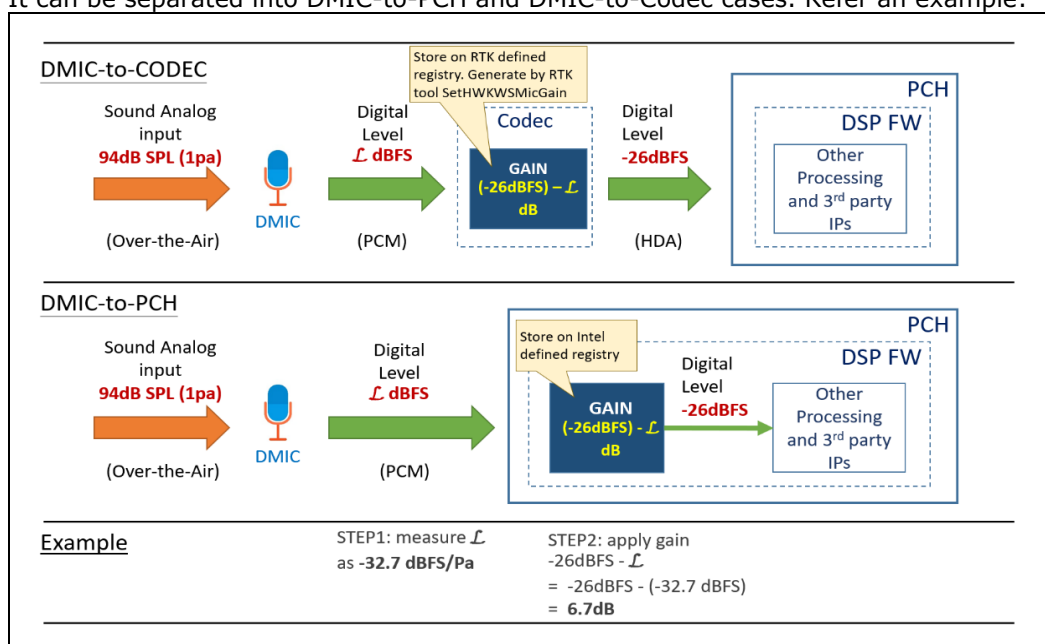
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## 6 -26dBFS MIC Sensitivity Calibration

### 6.1 -26dBFS Introduction

The -26dBFS/Pa calibration process is to let the system have -26dBFS/Pa input sensitivity. To achieve it, we need to add a proper gain on DSP (for DMIC-to-PCH) or codec (for DMIC-to-Codec) designs.

It can be separated into DMIC-to-PCH and DMIC-to-Codec cases. Refer an example:



### 6.2 SPET and MIC Sensitivity Calibration Tool

Intel SPET Tool and Documents: (contact Intel Audio CE to enable access and get latest SPET download link)

- SPET v2.0  
<https://www.intel.com/content/www/us/en/secure/design/confidential/software-kits/kit-details.html?kitId=728908>
- Intel® Speech Platform Evaluation Toolset 2 (SPET2) User Guide  
<https://cdrdv2.intel.com/v1/dl/getContent/728048>

**Note:** SPET 2.0 covers all of platforms. SPET 1.0 covers the platform before ADL (including ADL). Please get the SPET 1.0.2582.0 and test guide from the DRC if necessary (Content ID: 1000547)

## 6.3 MIC Sensitivity Calibration Process

1. Follow Intel® Speech Platform Evaluation Toolset Test Guide to setup your lab, or run by PAL lab.
2. Perform Microphone Path Evaluation according to instructions in the test guide.
3. Localize all tests related to sensitivity. If all the tests passed – no further action is required. If any of these tests is failed – then sensitivity calibration is required.

Metric Name	Test Status	Metric Name	Test Status
DUT Clock Drift	PASS	DUT Clock Drift	PASS
Frequency Response - Channel1	PASS	Frequency Response - Channel1	FAIL
Noise Floor - Channel1	PASS	Noise Floor - Channel1	PASS
SDNR - Channel1	PASS	SDNR - Channel1	PASS
Aliasing - Channel1	PASS	Aliasing - Channel1	PASS
Sensitivity (wideband) - Channel1	PASS	Sensitivity (wideband) - Channel1	FAIL
Frequency Response - Channel2	PASS	Frequency Response - Channel2	FAIL
Noise Floor - Channel2	PASS	Noise Floor - Channel2	PASS
SDNR - Channel2	PASS	SDNR - Channel2	PASS
Aliasing - Channel2	PASS	Aliasing - Channel2	PASS
Sensitivity (wideband) - Channel2	PASS	Sensitivity (wideband) - Channel2	FAIL
Microphones Frequency Response Matching	PASS	Microphones Frequency Response Matching	PASS
Sensitivity (wideband) - all channels average	PASS	Sensitivity (wideband) - all channels average	FAIL

Example A (left): All sensitivity tests passed – no action required.  
Example B (right): Sensitivity tests failed – sensitivity calibration is required.

## 6.4 Calibrate MIC Sensitivity for DMIC-to-PCH Design

1. Get the suggested gain from the SPET Microphone Evaluation report (inside “Channel Comparison” section).

Metric Name	Measured value	Unit	Baseline Requirement	Target Requirement
Greatest difference in channel sensitivity	0.1	dB	<=2	<=1

Metric Name	Unit	Value	Target Value
Sensitivity (wideband) - all channels average	dBfs/Pa	-30.5	-26

Recommended gain for all channels is +4.5 dB

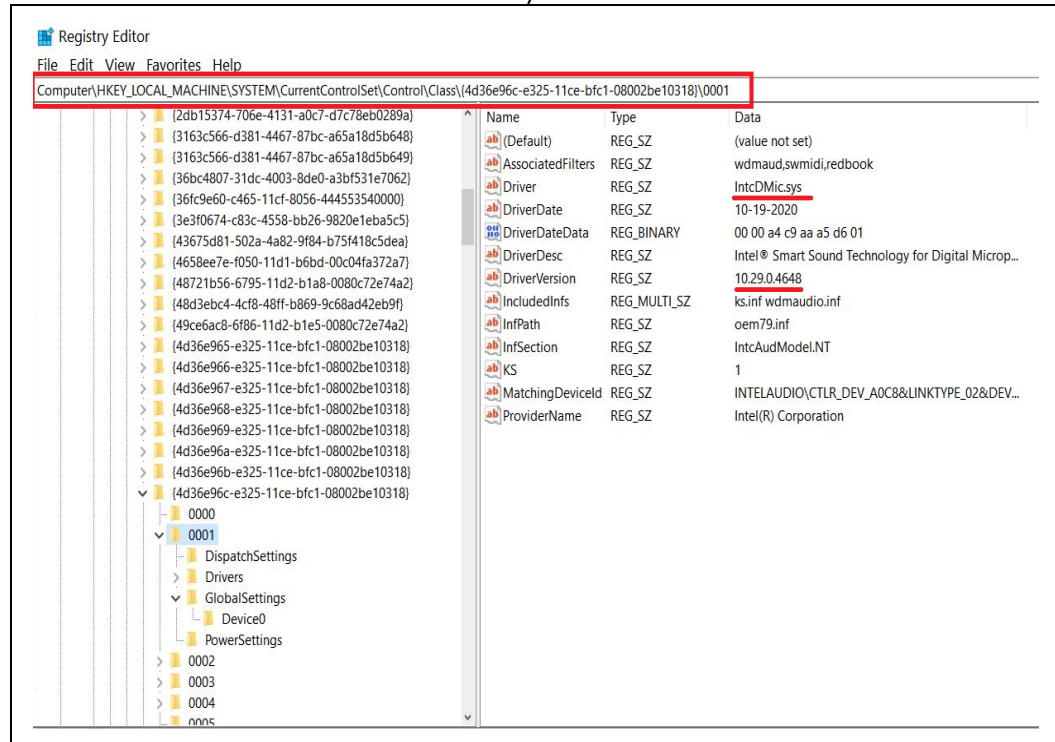
Metric Name	Test Status
Sensitivity (wideband) - all channels average	FAIL

2. Set the gain to DMIC in registry table

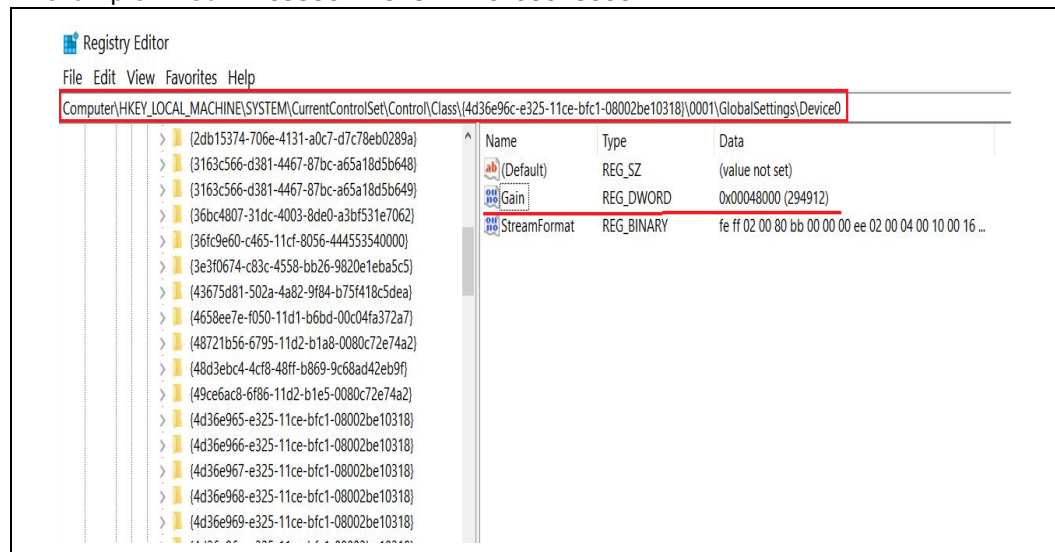
[HKEY\_LOCAL\_MACHINE\SYSTEM\CurrentControlSet\Control\Class\{4d36e96c-e325-11ce-bfc1-08002be10318}\<instance>\GlobalSettings\Device0]



### 3. Make sure the <instance> is IntcDMic.sys



### 4. Set the Gain with DWORD type to registry. To get value multiply suggested gain in dB by 65536 and convert to hexadecimal notation. In example: 4.5dB x 65536 = 294912 = 0x00048000



- Re-test SPET and make sure MIC sensitivity setting take effect
- Integrate the registry setting in audio installation package at production stage

## **6.5 Calibrate Gain for DMIC-to-Codec Design**

Please contact Codec vendor to get the gain adjust tool or method.

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## 7 Intel® SST Driver from Inbox Driver on Audio DSP Disabled System

The newest proposal between Microsoft\* and Intel assures and enables customers to keep UAA compliant hardware IDs while still supporting the Intel® SST driver stack.

Systems that use the HD-A interface are recognized to be UAA compliant. Refer below for the proposals:

- **Microsoft\* Inbox HD-A Bus Driver**
  - Match on PCI\CC\_0403
  - Child PnP IDs are "HDAUDIO\..."
- **Intel HD-A Bus Driver**
  - Match on PCI\VEN\_8086&DEV\_1324&CC\_040301
  - Match on PCI\VEN\_8086&DEV\_1234&CC\_040100
  - Child PnP IDs are "INTELAUDIO\..."

As such:

Class	Subclass	Programming Interface	Drivers Supported
04	03	00	Microsoft* Bus Driver <sup>1</sup> (Windows* 7+)
04	03	80	Microsoft* Bus Driver <sup>1</sup> (Windows* 7+) Intel® SST Bus Driver (Windows* 8+)
04	01	00	Intel® SST Bus Driver (Windows* 8+)

**Note:** <sup>1</sup> Platform configuration must be UAA compliant (example, DMIC must attach to codec, I2S) for Microsoft\* bus driver support.

- **Row1 with class code 040300:** Legacy systems that support the Microsoft\* Inbox Bus driver that is UAA compliant. This value is required to be used on the non-SST systems with DMIC attached to the HD-A Codec.
- **Row2 with class code 040380:** This value is required to be used on SST enabled systems with DMIC attached to HD-A Codec.
- **Row3 with class code 040100:** This is for systems where the DMIC is attached to the PCH via the PDM interface thus deeming it to be a non UAA compliant system.

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