



# Intel® Smart Sound Technology Driver

**Bring Up Guide**

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***Revision 1.93***

***November 2022***

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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
	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

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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 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*
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
HDA or HD-Audio	High Definition Audio

<b>Term</b>	<b>Description</b>
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	MicrosoftMicrosoft** 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	SoundWireSoundWire**
SPET	Speech Platform Evaluation Toolset
SUT	System Under Test
TBD	To be determined
TGL	Tiger Lake
UAA	Universal Audio Architecture



Term	Description
UAOL	USB Audio Offload
ULT	Ultra-Thin
VAD	Voice Activity Detection
WHL	Whiskey 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
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

ID	Document Number	Document Title
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

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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 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

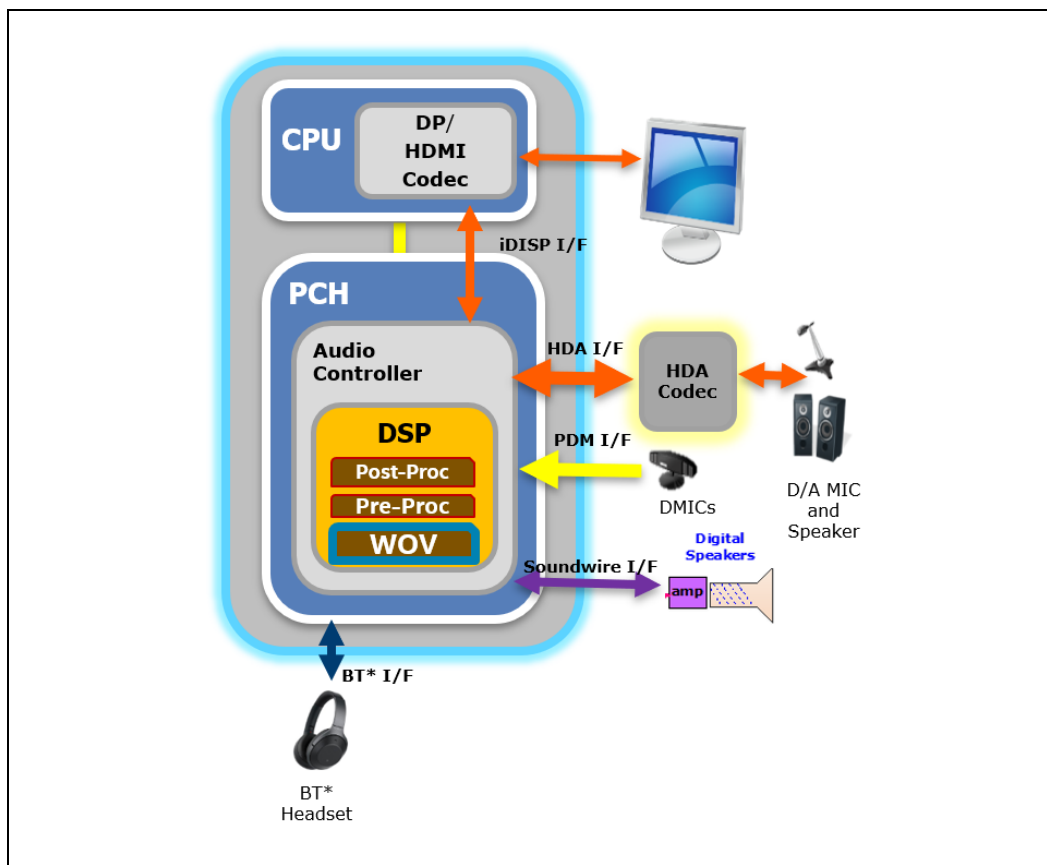


Figure 2-2. SoundWire\*-Based Smart AMP

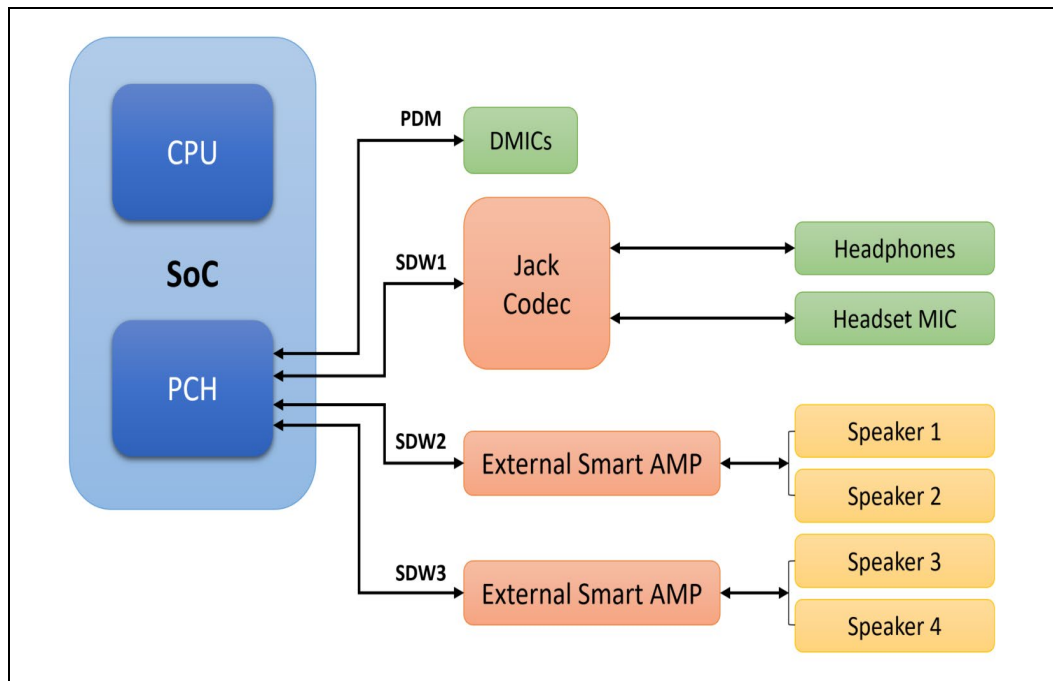
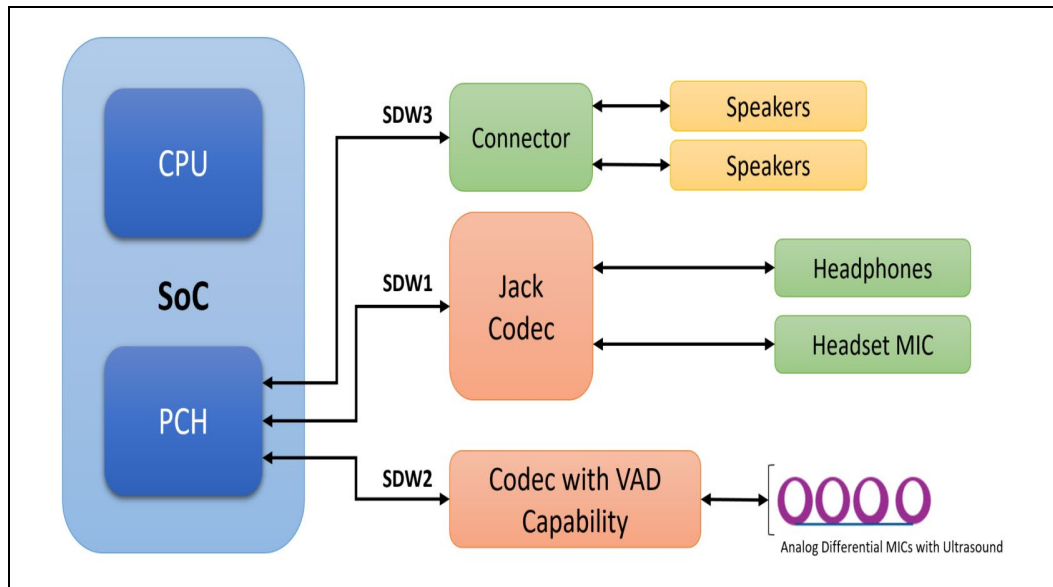


Figure 2-3. Intel® WOV with SoundWire\*-Based External VAD



## 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 #1 [X]
- SNDW #2 [X]
- SNDW #3 [ ]
- SNDW #4 [ ]
- [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.

- **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 the corresponding GUID of the IP. Also, corresponding GUID mapping needs to be added in the Platform ACPI code.

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

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

The Intel® WOV solution provides an integrated solution, with personalization and convenience. Intel® WOV running on DSP supports Microsoft\*, Windows\* 10 RS5/RS6/20H1/20H2, Windows\* 11 Cortana\*, and Amazon\* Alexa\* as Hardware Keyword Spotter for keyword detection. Intel® WOV supports two PAs simultaneously running on the system configuration. PA selection could be Microsoft\*, Windows\* 10 RS5/RS6/20H1/20H2, Windows\* 11 Cortana\*, Amazon\* Alexa\*, or any new PA integrated with Intel® WOV.

- **Intel® WOV on DSP Support for 20H1 OS MVA:**

To configure Intel® WOV 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 a PEP constraint code to support the 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 with Intel® WOV on most platforms. Refer to [Ref009](#) for more details.
3. More than one post-processing module can be enabled, depending on the resources used by ISV. Contact the ISV for more information on post-processing module combinations.

- **CS/Non-CS Settings:**

[Intel® Advanced Menu/ACPI SETTINGS](#)

Low Power S0 Idle Capability:

1. If CS is supported, select <**ENABLED**>
2. If CS is not supported, select <**DISABLED**>

- **RTD3 Settings:**

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

ACPI D3Cold Support = <**Enabled**>

- **Bluetooth\* Audio Offload Settings: (For ICL, CML v2, TGL, ADL, RPL and MTL):**

[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)

- **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 are used for CML v2/ICL/TGL platforms:



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

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

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

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

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

By enabling this features in BIOS, it will load the corresponding NHLT configuration in the BIOS code. Refer to [Ref020](#) for more details on BIOS code integration user guidance.

## 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 waking from the S4 state, Windows\* reloads the ACPI tables from the disk (hibernation file).

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



## 3 NHLT and DMIC Blob Integration

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### 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 Pre-Installed Libraries

Get the latest IADK version from: [VIP:kitid=1001873](#). If you have no access, contact your Intel® Audio CE. The latest IADK version is IADK 3.0.0 MR1, which supports Meteor Lake and later platforms only, and IADK 2.8.0, which supports RPL, ADL, TGL, EHL, ICL, CML, LKF, and CNL platforms.

Python, wxPython, OpenSSL are prerequisite libraries for NHLT generator. Refer to “How to create NHLT binary file.pdf” in the IADK package to install the proper version of Python and wxPython.

#### 3.2.1 Python

The recommended Python version is 3.8.6 for IADK 2.7.0 MR3-HF1. If the user has installed the incorrect version of Python, such as v2.7, uninstall it. Download the correct version of Python 3.8.6 from: <https://www.python.org/downloads/release/python-386/>.

The %PATH% environment should be set to include the Python directory.

#### 3.2.2 wxPython

To install wxPython in Python libraries, use: “pip install -U wxPython” in the command-line console:

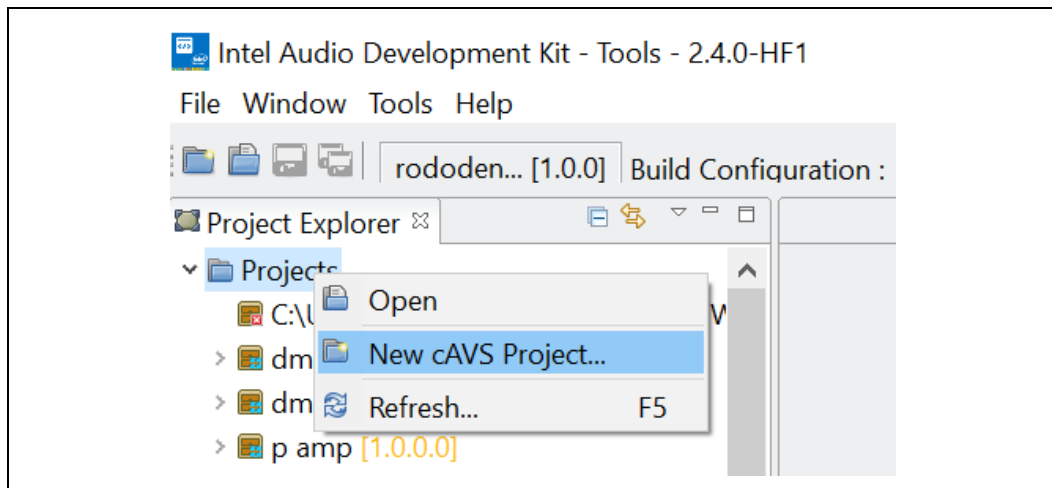
```
C:\Python38\Scripts>pip install -U wxPython
```

Check your home or company network if you meet with a network connection error.

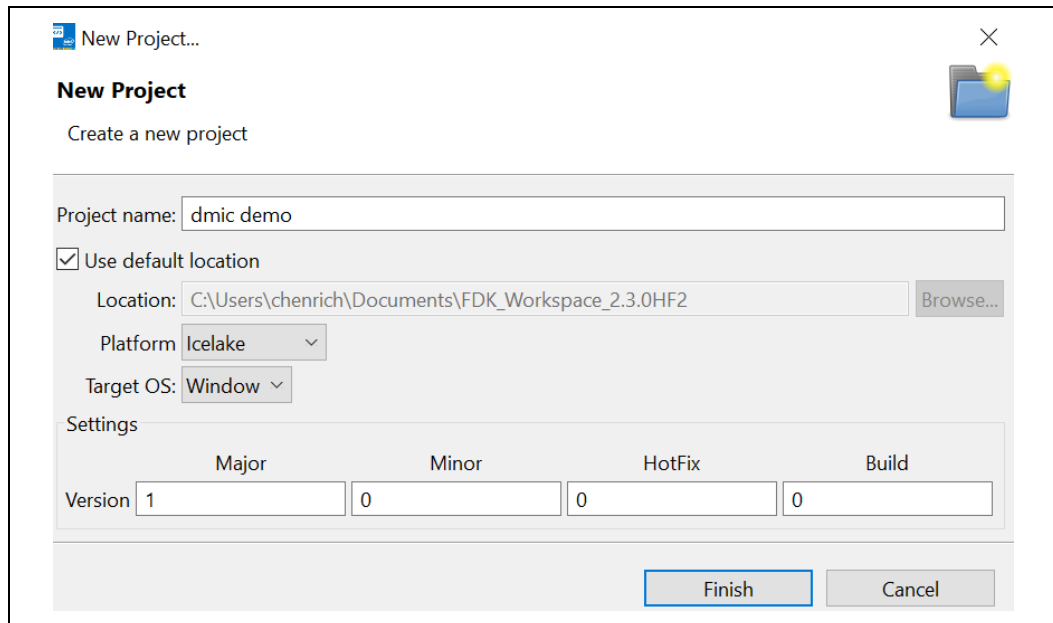
## 3.3 Generating nhlt.bin for DMIC

### 3.3.1 IADK Usage Step by Step

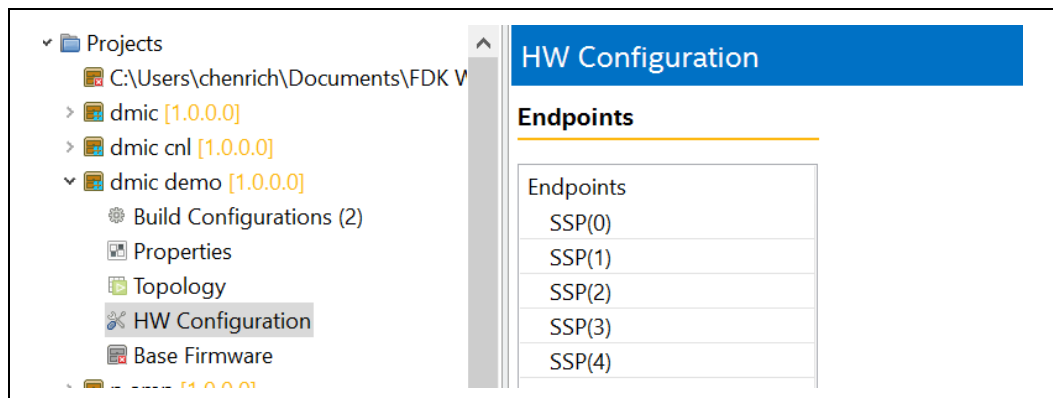
1. Install **IADK**. NHLT generation is supported after IADK 2.5 MR1. Versions equal or higher would support the same functions.
2. Right click **Project** and select **New cAVS Project**.



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



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



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

HW Configuration

Endpoints

Endpoints
SSP(0)
SSP(1)
SSP(2)
SSP(3)
SSP(4)
SSP(5)
PDM
HD-A

+ Add Endpoint

HW Configuration

EndpointsEndpoint Configuration

Endpoints	Link type
SSP(0)	<div> <div>▼</div> <div>HD-A</div> <div>PDM</div> <div>SSP</div> <div>SoundWire</div> </div>
SSP(1)	
SSP(2)	
SSP(3)	
SSP(4)	

6. Configure the following information according to the target project configurations:
  - a. **Platform ID:** The PCH ID according to target project SoC PCH info.
  - b. **I/O Clock:** The PCH XTAL output clock.  
Refer to platform PDG or PCH EDS to get PCH XTAL clock.  
Confirm with the account platform CE and HW CE if unclear about the previous two configurations.
  - c. **Number of channels:** The number of MIC channels 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 the **Number of channels** configuration. A paired DMIC connection is recommended; IADK uses PDM0 for 2 DMIC by default.

**HW Configuration**

**Endpoints**

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

**Endpoint Configuration**

Link type: PDM

Name: New Endpoint 0

Topology Name: new\_endpoint\_0

Virtual Bus Id: 0

Device Type: PDM

Direction: Capture

Virtual Slot:

Subsystem Id (Hex): 1

Revision Id (Hex): 1

Platform Id: ICL-LP

Hw Id: INTELAUDIO/CTLR\_DEV\_34C8&LINK

Config Type: ☒ Microphone array

**Format Configurations**

☐ Advanced format configuration

Please choose adequate I/O clock.

IO Clock: ☐ 24.0 MHz ☒ 38.4 MHz

Decimators with shared filters create both 48kHz and 16kHz microphone sampling rates simultaneously.

Number of channels: ☒ 2 channels ☐ 4 channels

Frequency response optimized: ☐ For 16kHz input, 0dB gain (Intel RVP). ☒ For 48kHz input, 0dB gain.

**Microphone Array Configuration**

Number of microphones: 2

Mic Type: SUBCARDIOID

Mic Panel: FRONT

Speaker Position Distance [mm]: 0

Horizontal Offset [mm]: 39

- For ADL/RPL platform, IADK 2.8 can be used to configure the DMIC output format to support a 24-bit depth.

The default NHLT binary file `adl_rpl_32_24bit_only_nhlt.bin`, which set the DMIC output format to 24-bit depth, has been included in the release package as well.

**Hardware Configuration**

**ACPI Header**

**Endpoint Configuration**

Link type: PDM

Name: New Endpoint 0

Topology Name: new\_endpoint\_0

Virtual Bus Id: 0

Device Type: PDM

Direction: Capture

Virtual Slot:

Subsystem Id (Hex): 1

Revision Id (Hex): 1

Core Revision: ADL-R

Hw Id: INTELAUDIO/CTLR\_DEV\_51C8&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

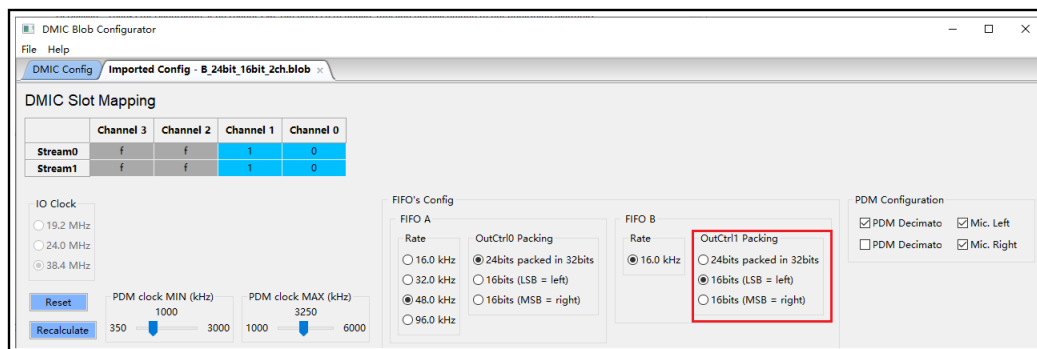
Decimators with shared filters create both 48kHz and 16kHz microphone sampling rates simultaneously.

Number of channels: ☒ 2 channels ☐ 4 channels

Frequency response optimized: ☐ For 16kHz input, 0dB gain (Intel RVP). ☒ For 48kHz input, 0dB gain.

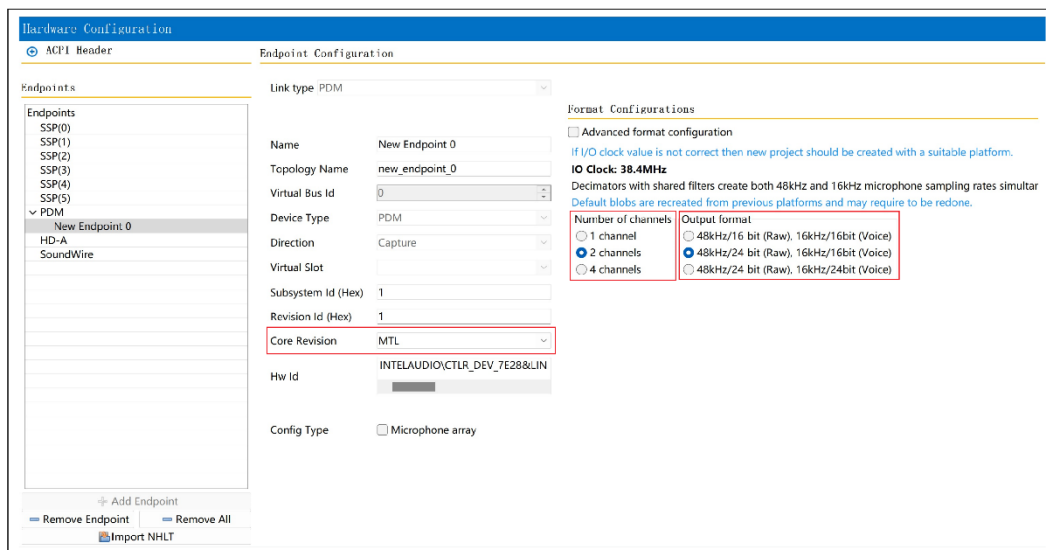
Bit depth for Raw path: ☐ 16 bit ☒ 24 bit

**Note:** When the “24-bit depth for Raw path” option has been selected, the **OutCtrl1 Packing of FIFO B** should always be set to 16-bits (LSB).



8. For MTL platform, IADK 3.0 needs to be used to configure the following information, according to the target project configurations:
  - a. **Core Revision:** The PCH ID according to target project SoC PCH information.
  - b. **Number of channels:** The number of MIC channels on the target project. Confirm with the account platform CE and HW CE if unclear about the previous two configurations.
  - c. **Output format:** Starting from MTL, the DMIC output format can only support 24-bits.

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



9. Microphone array and geometry configuration.
  - a. **Config Type:** Select if **Microphone array** is in use on the target project. The **Microphone array** checkbox activates the following array type configuration:

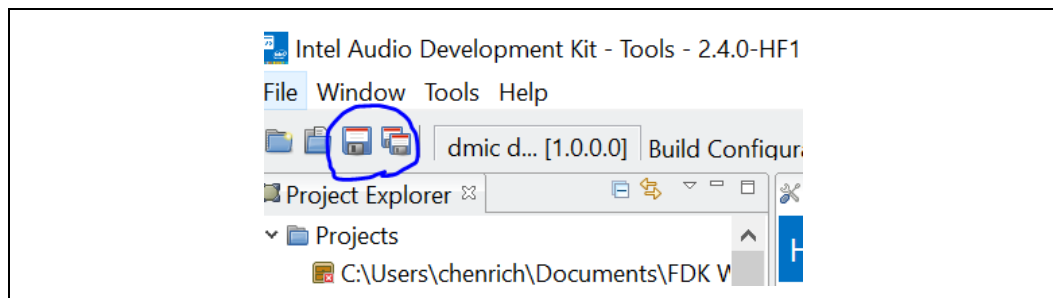
- i. **Array Type:** choose if the Microphone array placement matches one of the pre-defined geometry configurations, or choose **Vendor defined** to customize your own.
- ii. **Number of microphones:** Choose the microphone number on the **MIC array**.
- iii. **Horizontal Offset (mm):** Enter the distance offset of the microphone components.

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

For further details to define Microphone Array Geometry Descriptor Format, refer to [Ref004](#).

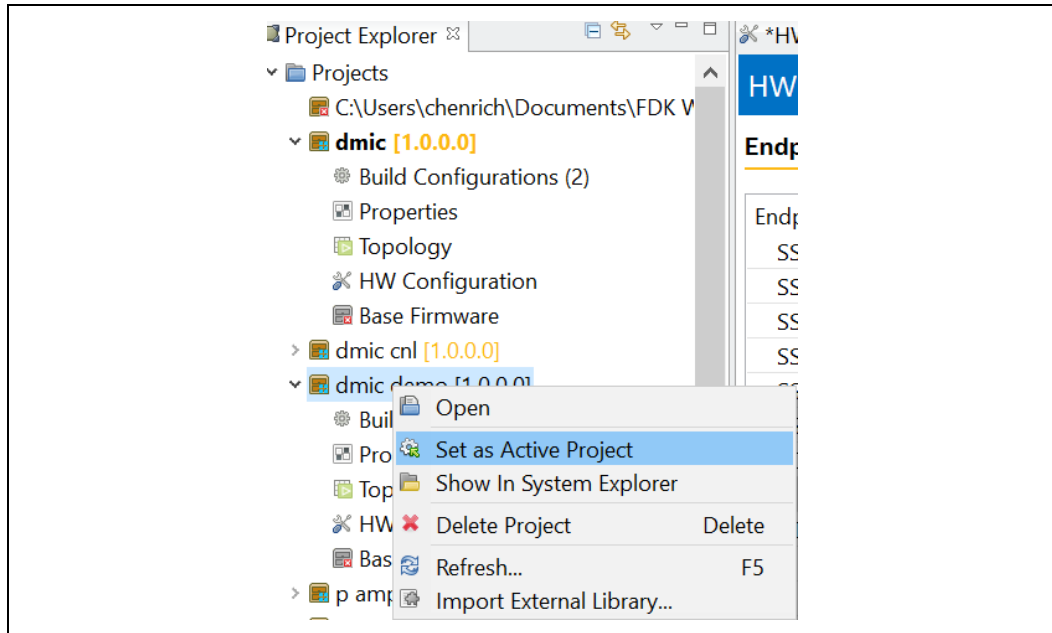
The screenshot shows the 'HW Configuration' tool with the 'Microphone Array Configuration' tab selected. The 'Endpoints' list on the left includes 'New Endpoint 0' and 'HD-A'. The 'Endpoint Configuration' section shows 'Subsystem Id (Hex)' as 1, 'Revision Id (Hex)' as 1, 'Platform Id' as 'ICL-LP', and 'Hw Id' as 'INTELAUDIO\CTRL\_DEV\_34C8&LINK'. The 'Microphone Array Configuration' section has 'Number of microphones' set to 2. Under 'Mic 0', 'Mic Type' is 'SUBCARDIOID' and 'Mic Panel' is 'FRONT'. The 'Speaker Position Distance [mm]' is 0, 'Horizontal Offset [mm]' is -39, and 'Vertical Offset [mm]' is 0. The 'Array Type' dropdown is set to 'Vendor defined'. The 'Config Type' checkbox for 'Microphone array' is checked. The 'Array Type' dropdown menu is open, showing options: 'Linear 2-element, Small', 'Linear 2-element, Big', 'Linear 4-element, 1st geometry', 'Planar L-shaped 4-element', 'Linear 4-element, 2nd geometry', and 'Vendor defined'.

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

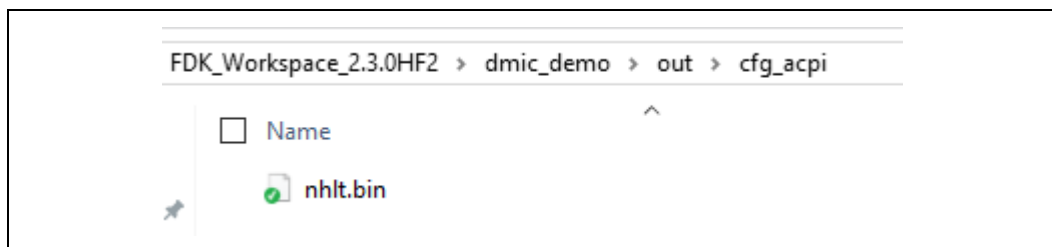
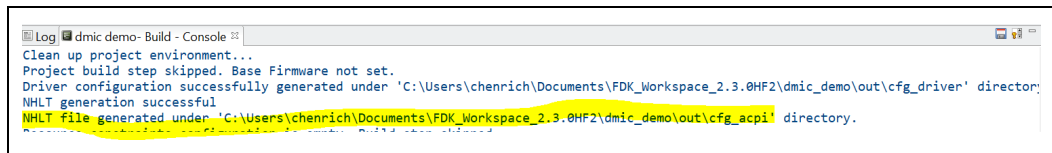


11. Set the created project as **Active Project** if the project is inactive.





12. Build the project to generate a nhlt.bin file. The nhlt.bin file will be in the following 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 the DMIC CLK and check signal.

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

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

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

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

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

- CML v2
- ICL
- TGL

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

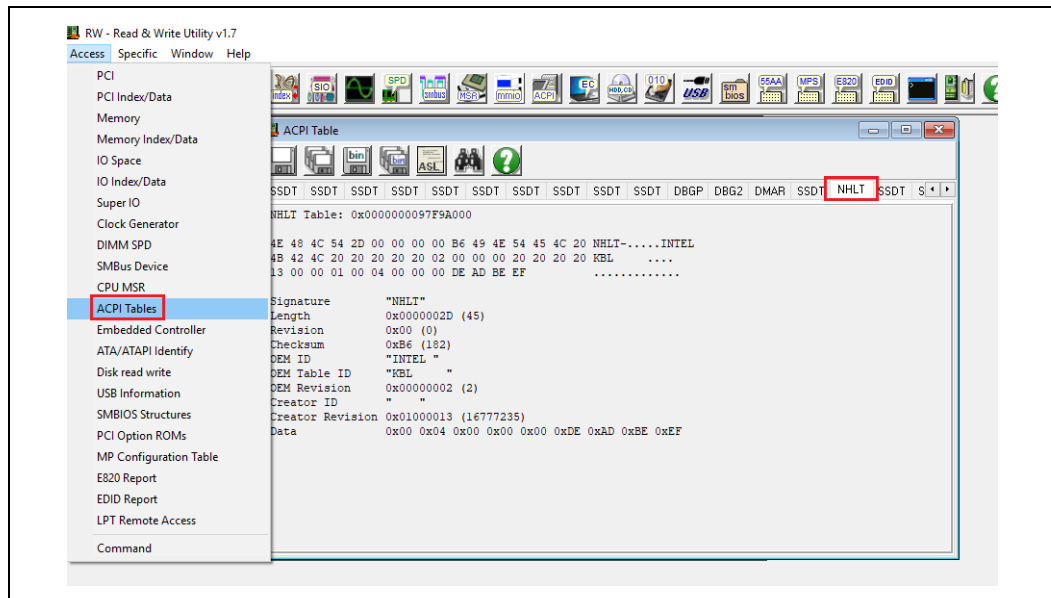
Starting from ADL, the BIOS code architecture accepts BT\* offload audio settings and DMIC configuration in separate NHLT bin files, depending on the NHLT settings enabled in the BIOS option. There is no need to combine BT\* offload and DMIC configuration in a single NHLT file. Follow the step of Audio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

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

- 2 DMIC with 38.4 MHz CLK: NhltConf1DmicX2.bin
- BT with 38.4 MHz CLK: BT\_MTL\_NHLT.bin

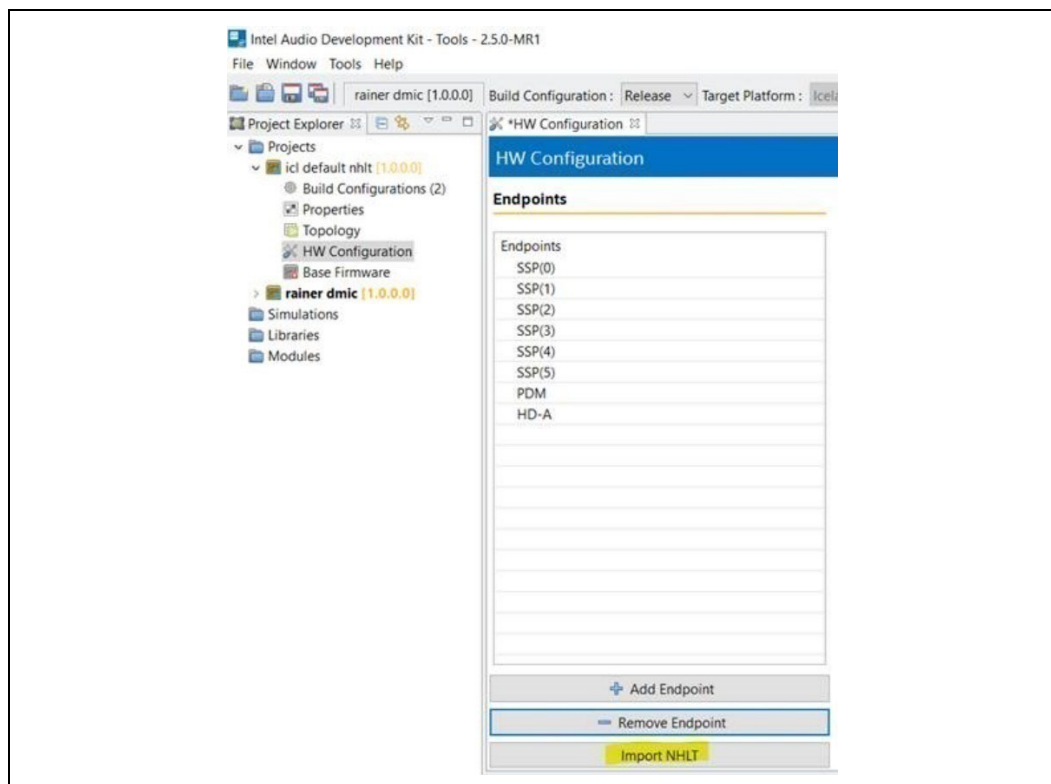
### 3.4.1 IADK Usage Procedure

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



**Note:** The configuration may change on different platforms.

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



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

**HW Configuration**

ACPI Header Endpoint Configuration

Link type: SSP

**Endpoints**

- Endpoints
  - SSP(0)
  - SSP(1)
  - SSP(2)
    - Imported from S0027NHILT 1
    - Imported from S0027NHILT 2
  - SSP(3)
  - SSP(4)
  - SSP(5)
  - PDM
  - HD-A
  - SoundWire

Add Endpoint Remove Endpoint Remove All

**Format Configurations**

Sample Per ...	Bits Per Sa...	Valid Bits Pe...	Channel Ma...	Blob Path	Blot
8000	16	16	Mono	C:\Users\kh...	Gen
16000	16	16	Mono	C:\Users\kh...	Gen
48000	16	16	Stereo	C:\Users\kh...	Gen

Name: Imported from S0027NHILT 1

Topology Name: imported\_from\_s0027nhilt\_1

Virtual Bus Id: 2

Device Type: BT Sideband

Direction: Render

Virtual Slot: tdm 0

Subsystem Id (Hex): 1

Revision Id (Hex): 1

Platform Id: ADL-P

Hw Id: INTELAUDIO\CTLR\_DEV\_51C8&LIN

**HW Configuration**

ACPI Header Endpoint Configuration

Link type: SSP

**Endpoints**

- Endpoints
  - SSP(0)
  - SSP(1)
  - SSP(2)
    - Imported from S0027NHILT 1
    - Imported from S0027NHILT 2
  - SSP(3)
  - SSP(4)
  - SSP(5)
  - PDM
  - HD-A
  - SoundWire

Add Endpoint Remove Endpoint Remove All

**Format Configurations**

Sample Per ...	Bits Per Sa...	Valid Bits Pe...	Channel Ma...	Blob Path	Blot
8000	16	16	Mono	C:\Users\kh...	Gen
16000	16	16	Mono	C:\Users\kh...	Gen

Name: Imported from S0027NHILT 2

Topology Name: imported\_from\_s0027nhilt\_2

Virtual Bus Id: 2

Device Type: BT Sideband

Direction: Capture

Virtual Slot: tdm 0

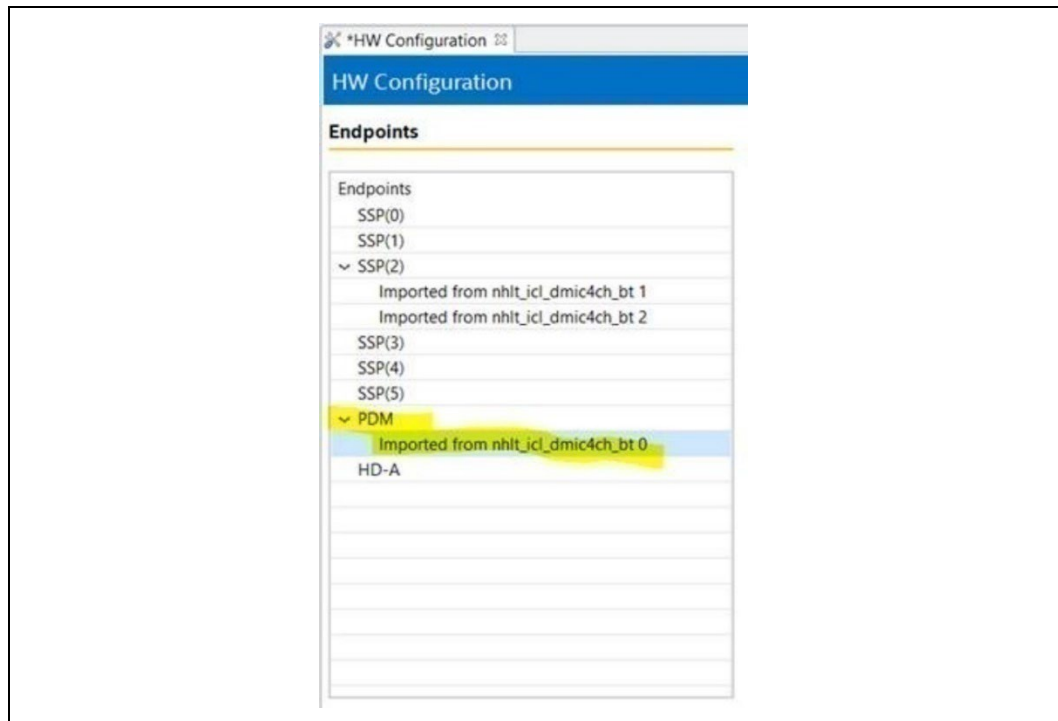
Subsystem Id (Hex): 1

Revision Id (Hex): 1

Platform Id: ADL-P

Hw Id: INTELAUDIO\CTLR\_DEV\_51C8&LIN

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



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

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## 4 Driver/Application Installation

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

Follow the below procedure to install the Intel® SST Driver.

### 4.1 Folder and Main File Introduction

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

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

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

**Note:** 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 steps:

1. Install the 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 the 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 the 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 and MTL only)

4. Install the 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 the 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 the 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 the 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 the Intel® SDW driver (IntcSDW.inf) from the subfolder Drivers.
10. Install the 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 the ProductionFW driver, and for ES samples, install the NonProductionFW driver. A yellow band is seen on the OED device otherwise.
2. Install the appropriate Intel® SST driver based on the platforms that the drivers are being installed on (for example, ICL Intel® SST drivers in ICL platforms).
3. For a TGL system installed with a 20H1 OS, install a GFX driver before the Intel® SST driver, as GFX will enable the SGPC (Shared Graphics Power Component). Otherwise, there will be a 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 that the other drivers are automatically installed when the BUS driver is installed.



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

## 4.3 Checking Driver Version

To check the Intel® SST Driver version:

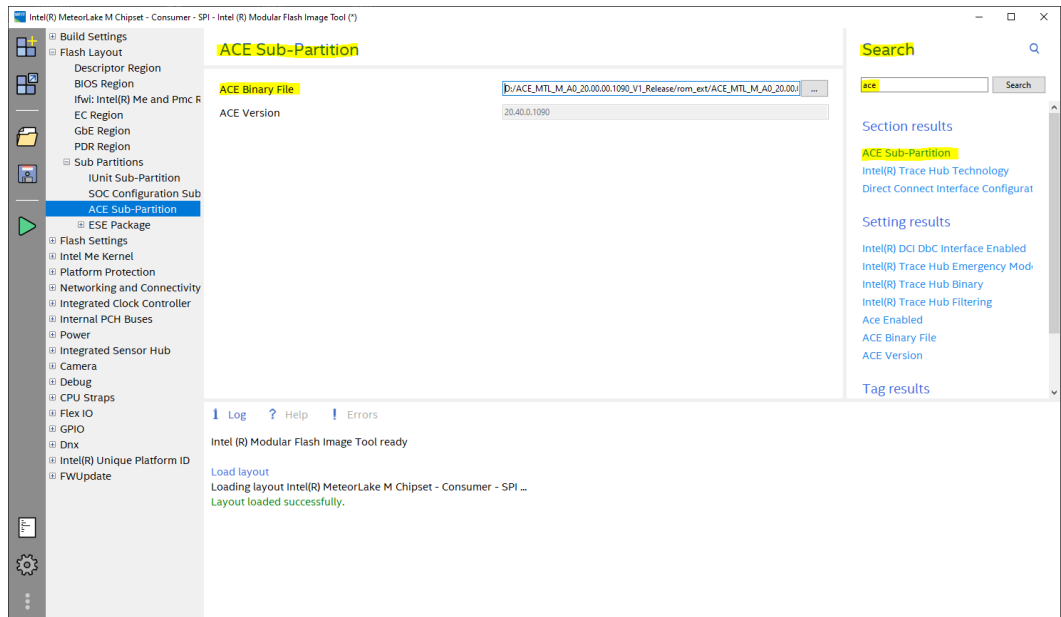
1. Open the **Device Manager**.
2. Click the **Sound, Video, and Game controllers'** arrow to open the list of audio/sound devices.
3. Double click the device named **Intel® Smart Sound Technology**.
4. Select the **Driver** tab and verify that the **Intel® SST** driver version is correct.
5. Double click **HW Audio Codec** device.
6. 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 will be released separately.

Follow the steps below to integrate the ROM EXT driver to the Intel® Converged Security and Management Engine (Intel® CSME) image.

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



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## 5 Basic Audio DSP Features Check

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### 5.1 Playback on System Pin

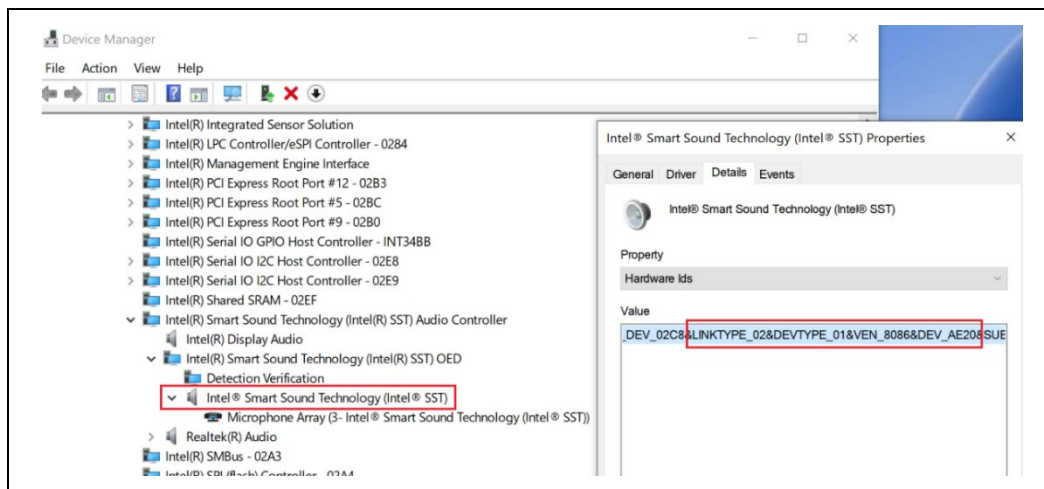
1. Prepare .wav sound file (for example 24-bit, 48 khz, stereo).
2. Open Windows\* Media Player.
3. Select and play the .wav sound file.
4. Check if the sound is audible.
5. Try **different sound file extensions (.mp3, .aac)**.

### 5.2 Playback on Offload Pin

1. Prepare .wav sound file (for example 24-bit, 48 khz, 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 the **Recording** page in **Sound** from the speaker icon in bottom right corner.
4. Try to adjust the volume bar to check recording volume.
5. Check if recording volume takes effect as expected or not.
6. Check the description of HWID in the **Properties** page of the Device Manger as well. The full string of the 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 an analog AGC when the DMIC is connected to the PCH, a third-party party SW APO is required to support SW gain control for volume adjustment.

## 5.4 Bluetooth\* Audio on Offload Pin

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

**Note:** Refer to [Ref002](#) for more details.

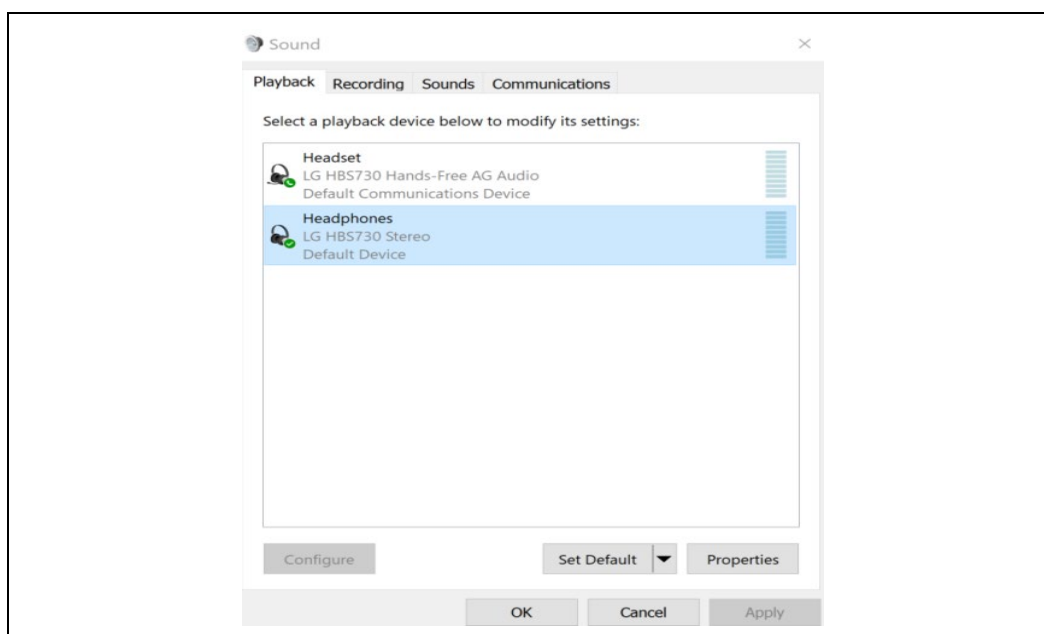
1. For TGL, contact a BIOS member to ensure that the GPIOs for BT\* Offload (**GPPC\_A\_7** and **GPPC\_A\_10**) are configured as **GPIO mode**.  
For ADL, the ODM should not expose I2S2 externally

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_SD11 / I2S2_SFRM / DMIC_DATA0	GPP_R5	5	VCCPRIM_1P8 or VCCPRIM_3P3	1.8 V or 3.3 V	HDA_SD11	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

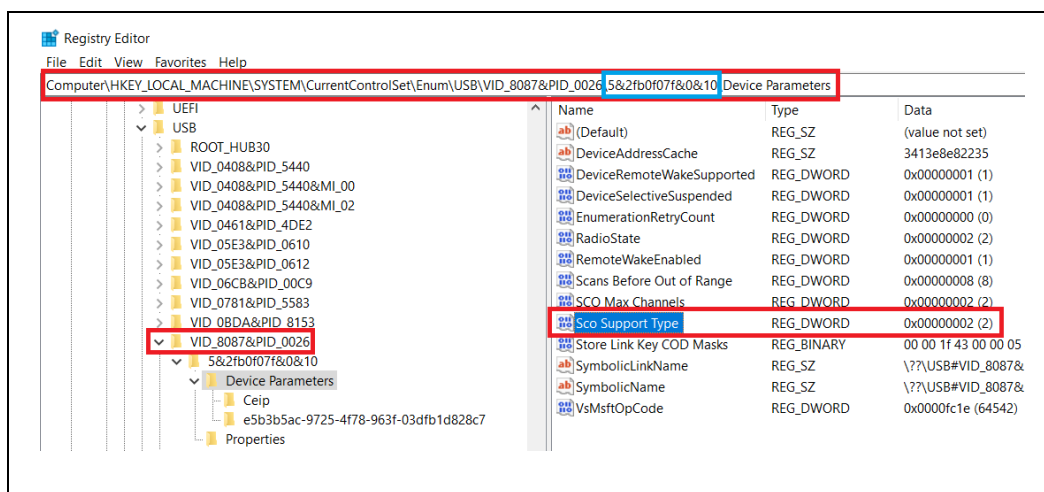
The ADL/RPL RVP Design is recommended as follows:

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

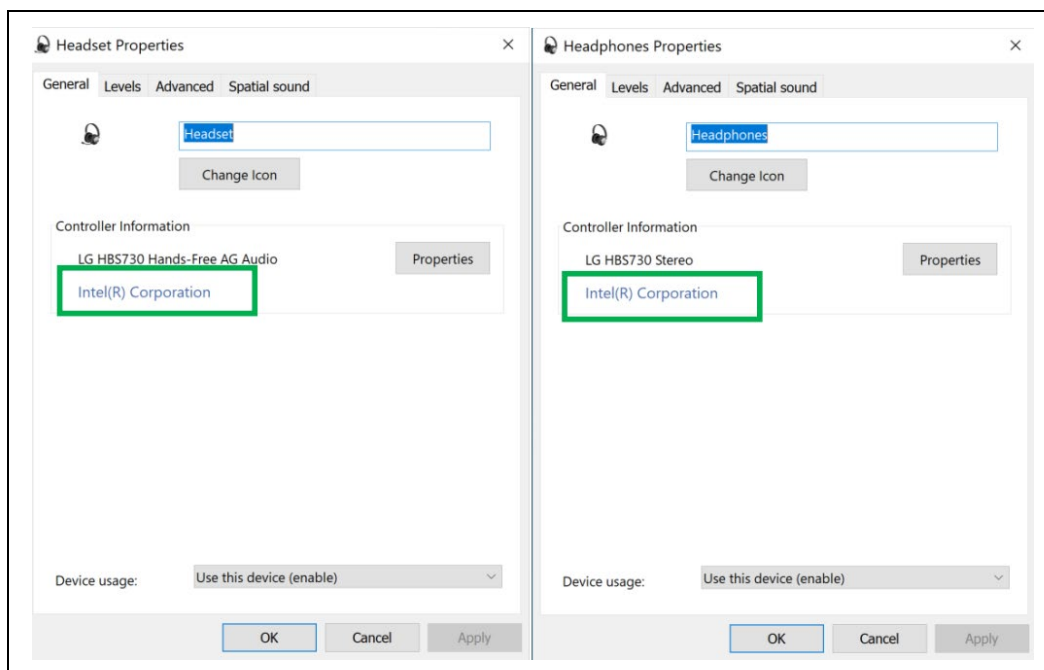
2. Follow [Section 2.3](#) to configure BT\* Audio offload in BIOS.
3. For audio device setup:
  - a. Pair with Bluetooth\* Headset.
  - b. Go to the **Playback** tab in **Sound**.
  - c. Verify that the Bluetooth\* "Headset (Hands-Free)" and Bluetooth\* "Headphones (Stereo)" is available.



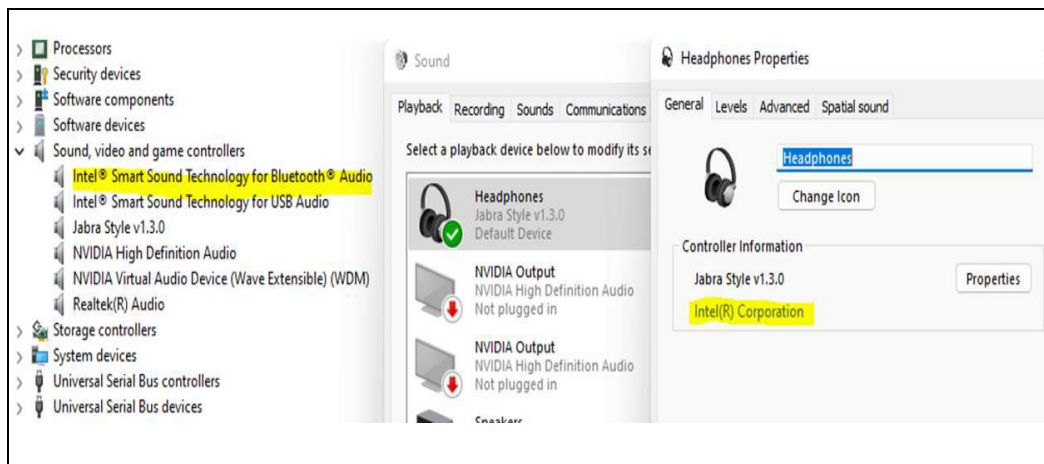
4. The BT\* driver will query the BIOS and write into the registry with the appropriate audio offload support value – applies to both HFP and A2DP:
  - a. **[HKEY\_LOCAL\_MACHINE\SYSTEM\CurrentControlSet\Enum\USB\VID\_<VID>&PID\_<PID>\<DEV\_ID>\Device Parameters]**
    - i. If BT\* Audio Offload is to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



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



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



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

## 5.5 USB Audio Offload

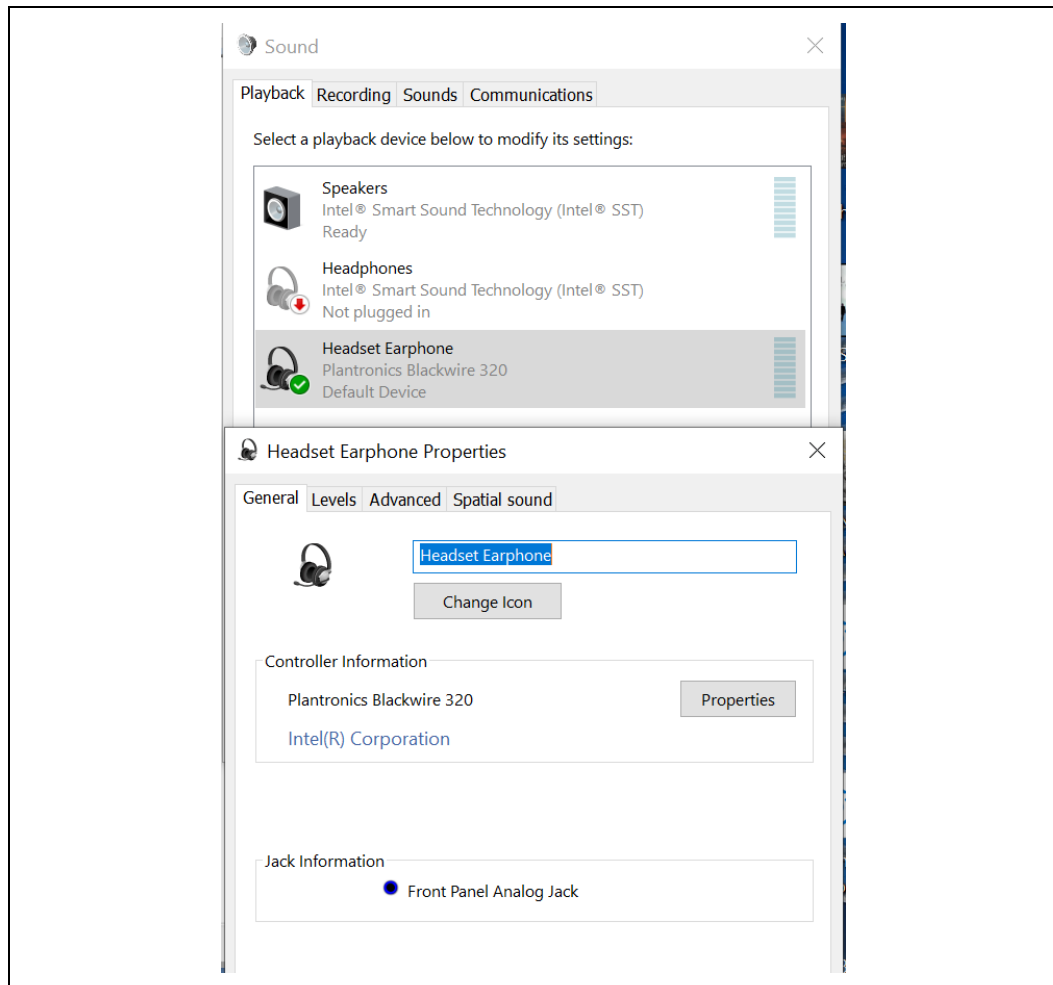
**Note:** Refer to [Ref012](#) for more details.

USB audio offload is supported only on **UAC 1.0 devices**, and not on UAC 2.0 or other devices. Customers can use the 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, the BIOS must set **HCCPARAMS2.GSPC** on 1. When the GSPC is 0, the Microsoft\* inbox driver will not expose the interface to OED, and IntcUSB will not be enumerated.

Refer to the list below to check if UAOL is enabled successfully or not.

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

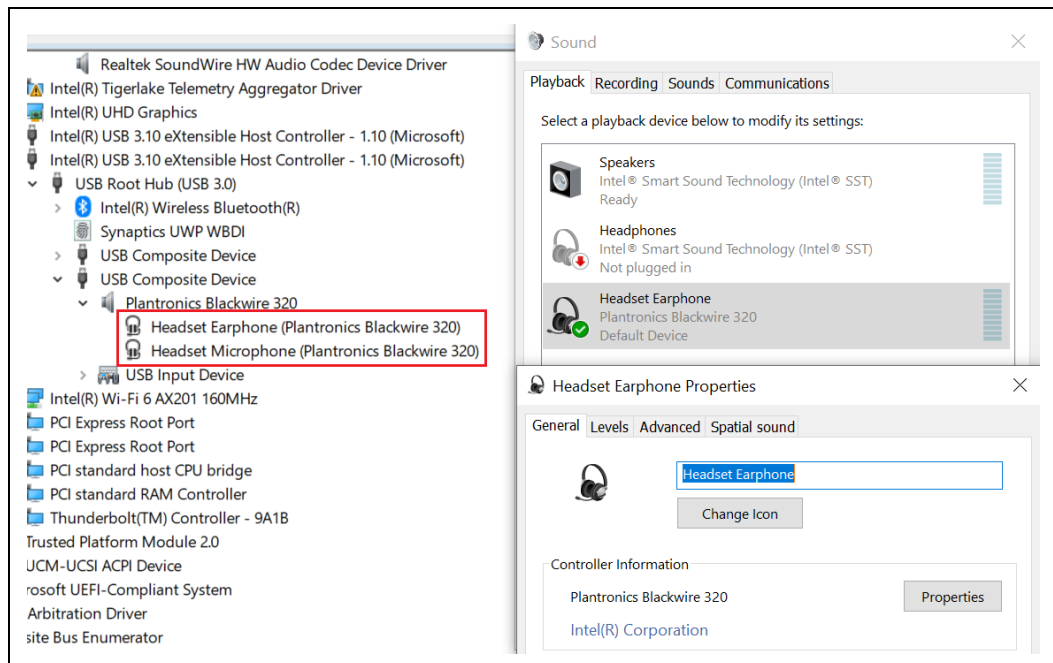
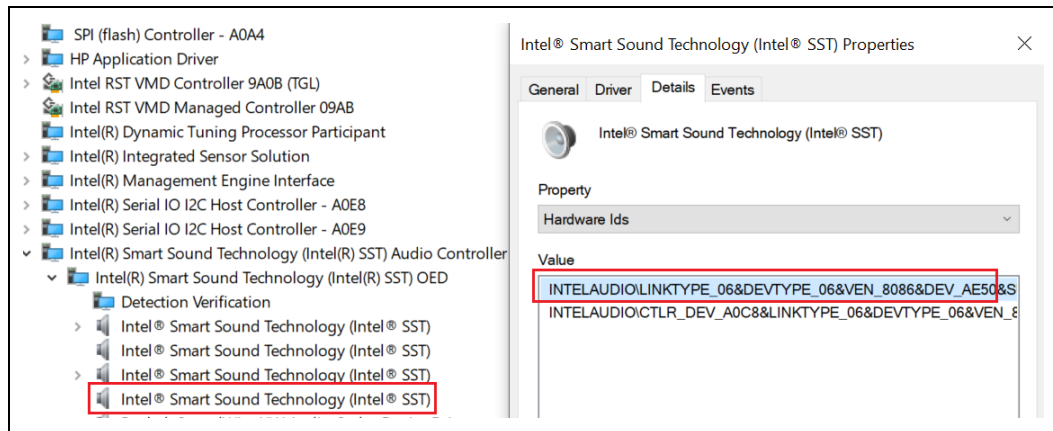


2. Check if the USB headset device is a child device of Intel® SST OED.

**Note:** USB headset endpoints will still appear under xHCI in the device manager. Check the description of HWID in the **Properties** page of the Device Manger as well. The full string of the USB Audio device descriptor is as follows:

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

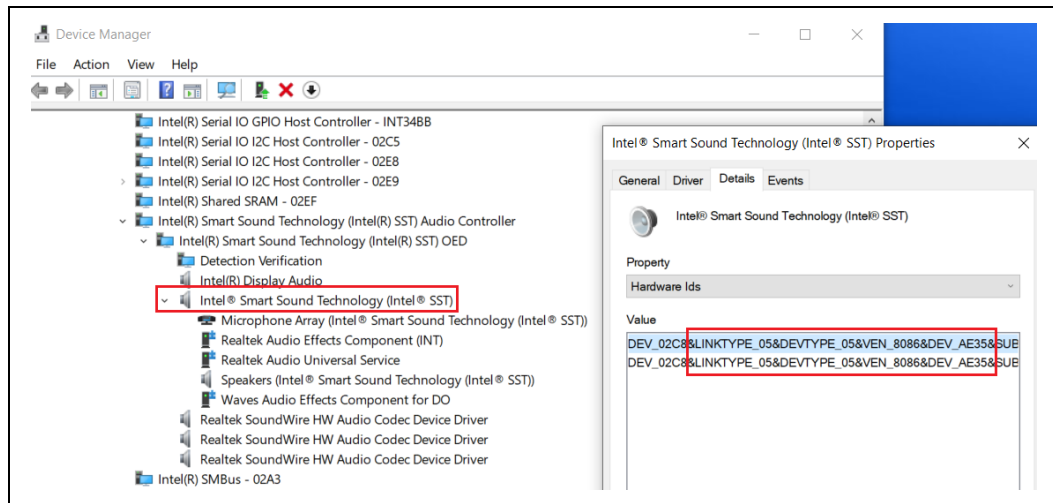




## 5.6 SoundWire\* Audio Device

In the SoundWire\* design, there is one SoundWire\* audio device as a child device under Intel® OED, after the driver of IntcSDW is installed. Check the description of HWID in the **Properties** page of Device Manager as well. The full string of the SoundWire\* endpoint descriptor is as follows:

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



## 5.7 Intel® WOV with Multi-Voice Assistant

**Note:** Refer to Ref006 for more details. The MVA extension inf and Intel® SST driver binaries are separate links in the Microsoft\* partner website, and need to be resold separately. The 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 the 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 the 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%
```

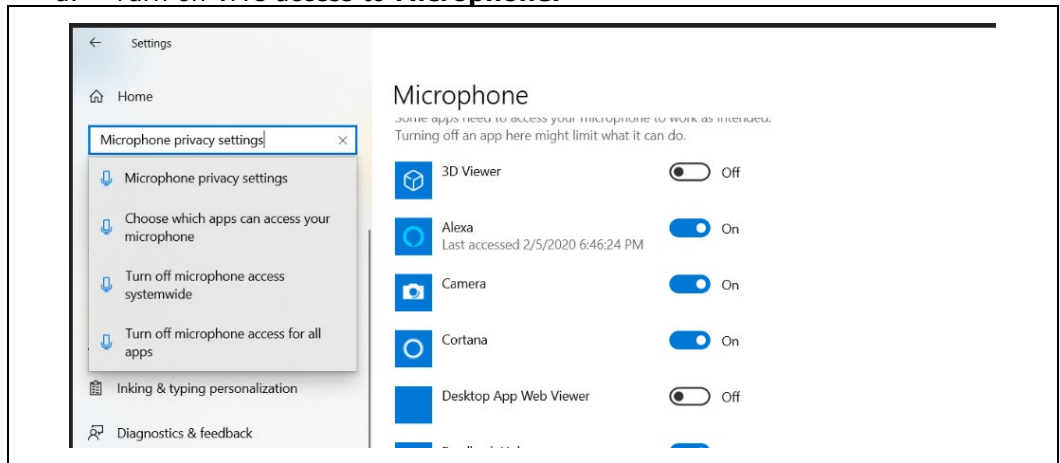
Check the MVA extension installation and version by command with Administrator right "**dism /Online /Get-Drivers /Format:table |findstr mva**".

```
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
```

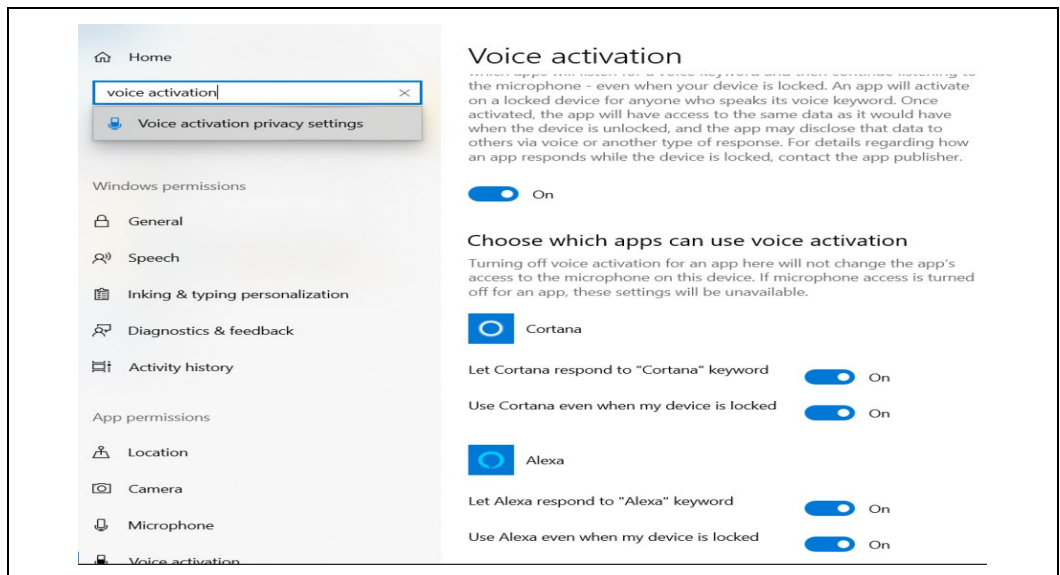
### 3. Windows\* Settings:

Turn VA's access right to **Microphone** and **Voice Activation**. Enable capture audio enhancements.

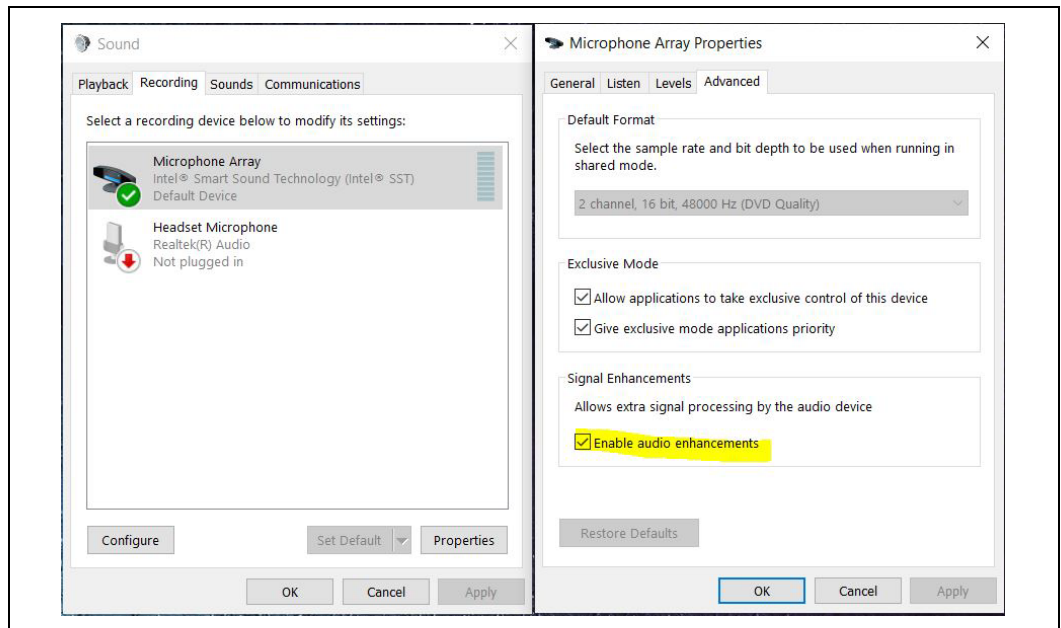
#### a. Turn on VA's access to **Microphone**.



#### b. Turn on VA's access to **Voice Activation**.



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



4. Check the Cortana\* application response when called "**Cortana**".

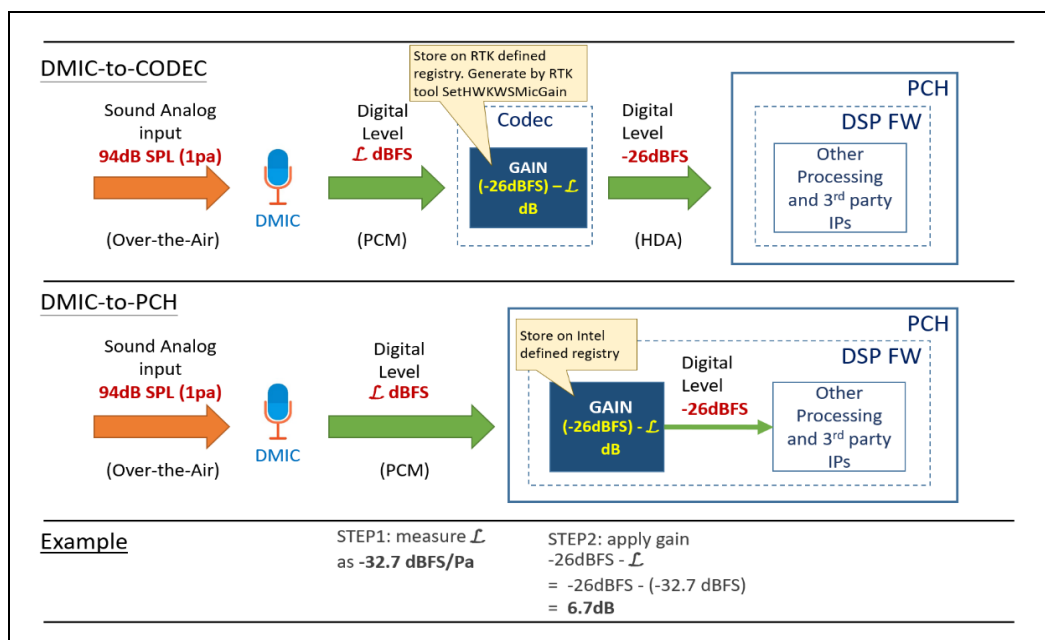
**§§**

## 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

Contact your Intel® Audio CE to enable access and get the latest SPET download link. Intel® SPET tool and documents:

- [SPET v2.0](#)
- Intel® Speech Platform Evaluation Toolset 2 (SPET2) User Guide #[728038](#)

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

## 6.3 MIC Sensitivity Calibration Process

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

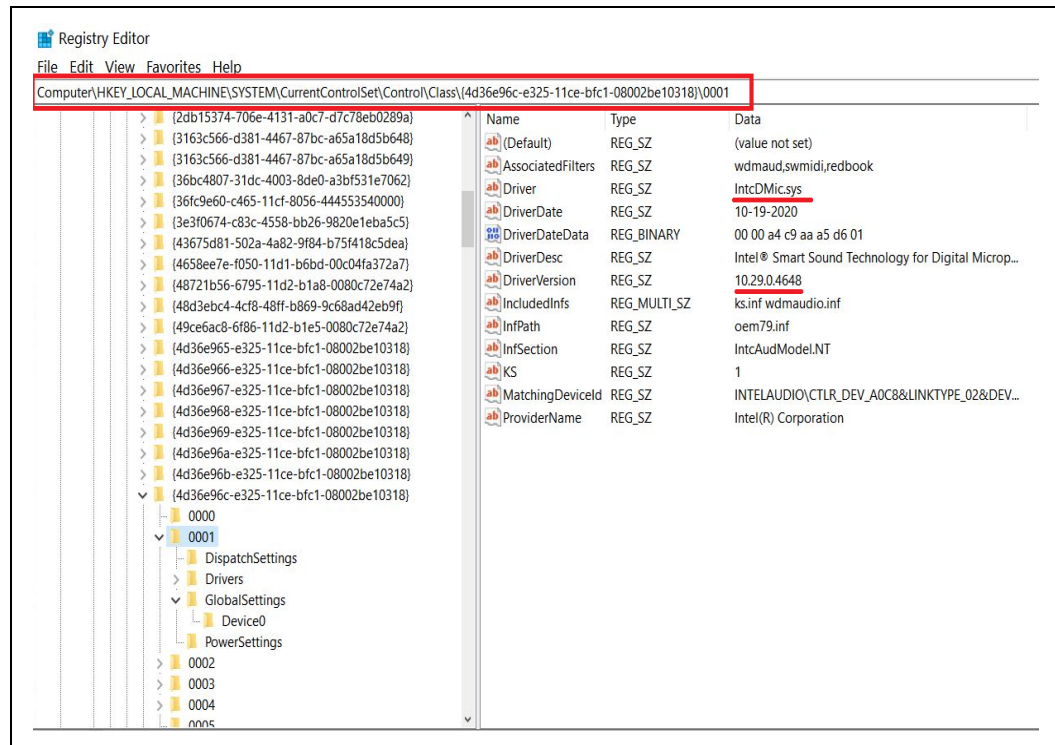
Recommended gain for all channels is +4.5 dB

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

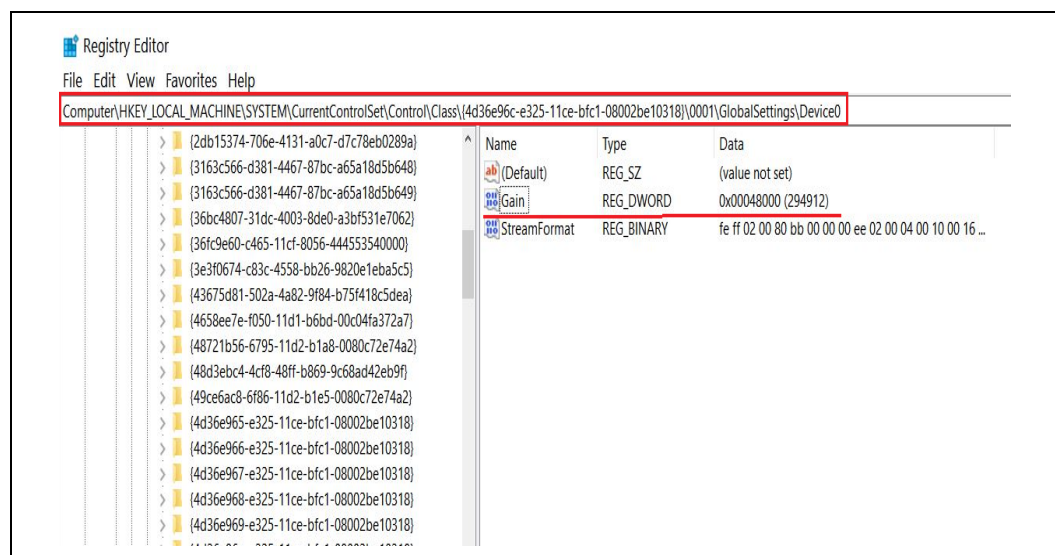
2. Set the gain to DMIC in the registry table.

**[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 the value, multiply the suggested gain in dB by 65536 and convert to a hexadecimal notation. In the example: $4.5\text{dB} \times 65536 = 294912 = 0x00048000$



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

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

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

**§§**



## 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. Find the proposals below:

- **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\..."

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 (for 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-Intel® SST systems with the DMIC attached to the HD-A Codec.
- **Row2 with class code 040380:** This value is required to be used on Intel® SST enabled systems with the 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.

