

DEEPCRAFT™ Audio Enhancement on PSOC™ Edge E84 MCU

Quick start guide

About this document

Scope and purpose

This document provides engineers steps to get started in evaluating DEEPCRAFT™ Audio Enhancement.

DEEPCRAFT™ Audio Enhancement from Infineon is an Edge AI product that enhances audio quality on Infineon's PSOC™ Edge MCUs.

The solution is composed of:

- Evaluation and Commercial versions of core libraries (audio-voice-core) via DEEPCRAFT™ Audio Pack
- Audio Front End (AFE) Middleware
- AFE Configurator via DEEPCRAFT™ Audio Enhancement Tech Pack
- PSOC™ Edge DEEPCRAFT™ Audio Enhancement Code Example

Intended audience

The intended audiences for this document are design engineers, technicians, and developers of electronic systems that require audio processing capabilities.

About this product group

Target applications

Wearable, Human Machine Interface (HMI), Smart Home, Robotics, Security

Product family

DEEPCRAFT™ AI Suite

PSOC™ Edge MCUs

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1 Requirements and Setup

1 Requirements and Setup

1.1 Software Requirements

- Install Infineon Developer Center Launcher and register your account [Infineon Developer Center Launcher](#)
- From the Infineon Developer Center Launcher application on your PC:
 - Install ModusToolbox™ Tools Package (3.6)
 - Install Eclipse for ModusToolbox™
 - Run the ModusToolbox™ SetupTool and install the GCC package
 - Install ModusToolbox™ Edge Protect Security Suite
 - Install DEEPCRAFT™ Audio Enhancement Tech Pack

• Install Arm® Compiler for Embedded version 6.22

Note: Arm® account and license are required for [Arm® compiler](#)

- Alternatively, install [LLVM Compiler](#) which do not require license
- Optional: Install [Audacity](#)

1.2 Environment Variables

- Depending on your choice of compiler (Arm®, LLVM) set these env variables in PC settings or uncomment the following variables in common.mk and set the path.
 - Arm® Compiler for Embedded
 - CY_COMPILER_ARM_DIR=[path to Arm® compiler installation]
 - For example: C:/Program Files/ArmCompilerforEmbedded6.22
 - LLVM compiler
 - CY_COMPILER_LLVM_ARM_DIR=[path to LLVM compiler location]
 - For example: C:/llvm/LLVM-ET-Arm-19.1.5-Windows-x86_64

1.3 Import and Build the Audio Enhancement Code Example

- Create a new folder for the ModusToolbox™ workspace for example C:/examples/ae
- Open Eclipse for ModusToolbox™ and choose this folder as your workspace
- Click “New Application” and choose from PSOC™ Edge BSP (Board Support Package).
 - Depending on the kit you are using choose either KIT_PSE84_EVAL_EPC2 or KIT_PSE84_EVAL_EPC4
- Import the DEEPCRAFT™ Audio Enhancement Code Example
- After importing the application, in common.mk, ensure to choose the right compiler.
TOOLCHAIN=LLVM_ARM for LLVM and TOOLCHAIN=ARM for Arm®. This code example supports only Arm® or LLVM compiler

Note: The Audio Enhancement example application is for evaluation purposes and is limited to operate for 15 minutes without a reset. When you are ready to move toward commercialization you will need to contact Infineon for the unlimited version of the Audio Enhancement libraries in DEEPCRAFT™ Audio Pack.

1 Requirements and Setup

1.4 Hardware Requirements

- PSOC™ Edge E84 Evaluation Kit (KIT_PSE84_EVAL_EPC2/KIT_PSE84_EVAL_EPC4)
- Two USB Type A to Type C cables or Type C to Type C cables

1.5 Hardware Setup

Set the following jumper and switch configurations on the evaluation kit:

- Ensure BOOT SW is in High/On position
- Ensure J20 and J21 should be in Tristate/Not-Connected (NC) position

2 Normal Operation in Functional Mode

2 Normal Operation in Functional Mode

- Refer to the **README.md** file in PSOC™ Edge MCU: [DEEPCRAFT™ Audio Enhancement Application](#)

Note: *The Design Guide section(ae_design_guide.md) have detailed description of the code example and its various operations*

- Ensure CONFIG_AE_MODE=FUNCTIONAL is set in common.mk
- Build and flash the code to the kit
- Connect Type C to KITPROG USB port
- Insert a new Type C cable to “Device USB” port to enumerate the kit as USB microphone and speaker to the PC

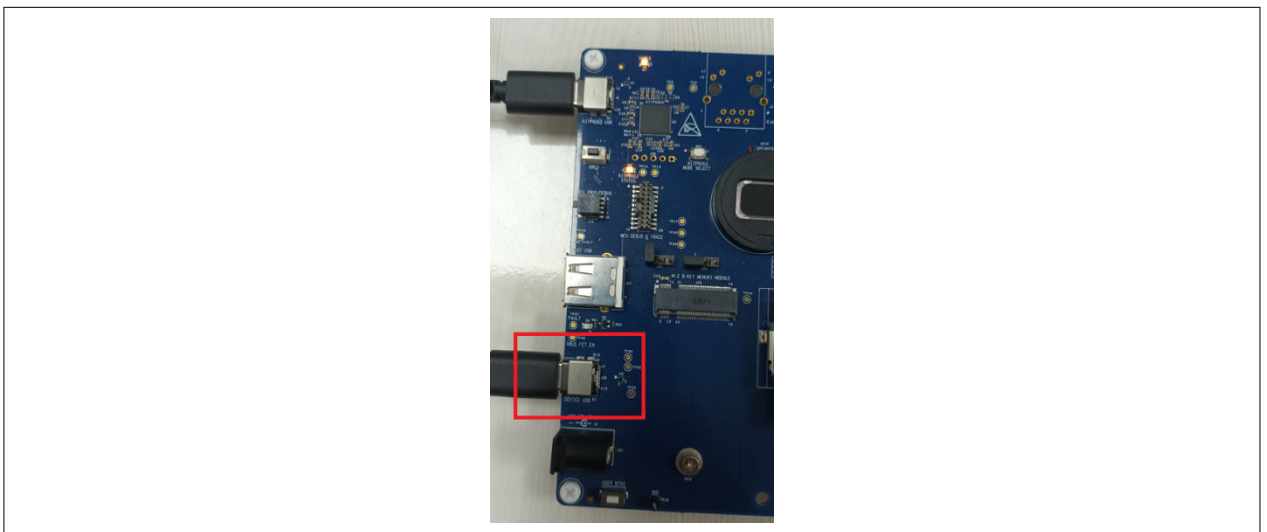


Figure 1 **Device USB port**

- Select playback speaker of PC as “Audio Control”
- Play any audio from PC such as music, speech from local files or the Internet

Note:

- *For ease of use, the code example has a sample test stream included which can be used. (ae_test_stream/ae_test_stream.wav)*
- *This is needed only to check Acoustic Echo Cancellation (AEC) component of AFE. Playing audio content from the PC is optional when evaluating other AFE components*

- Open Audacity, select Microphone as “Audio Control” and number of channels as 1 (mono)

2 Normal Operation in Functional Mode

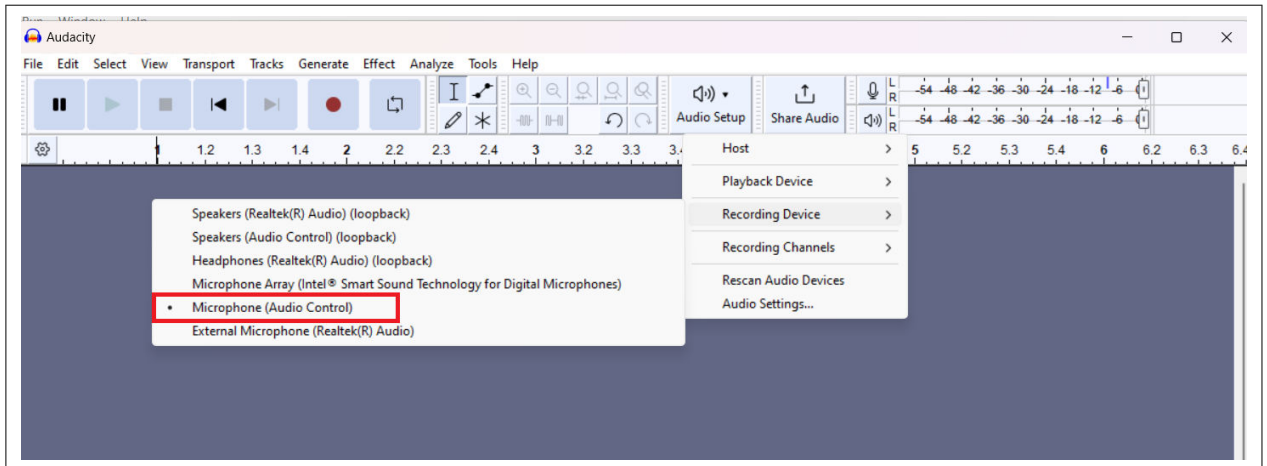


Figure 2 Audacity setup to capture audio from the kit via USB

- Click record and Audacity starts recording the audio from PSOC™ Edge MCU kit
- Observe Blue LED on the kit.
 - If it is ON, Audio Enhancement is enabled and processing the audio before sending to the PC via USB
 - If it is OFF, Audio Enhancement is disabled, and raw audio is being sent to the PC via USB

Note: To toggle between these modes, use the USER BTN1 on the kit. You should be able to observe the difference between processed and raw audio

- The Audacity recording shows the data captures so that you can see the difference between Audio Enhancement processed and unprocessed data by acoustically listening or viewing the spectrogram

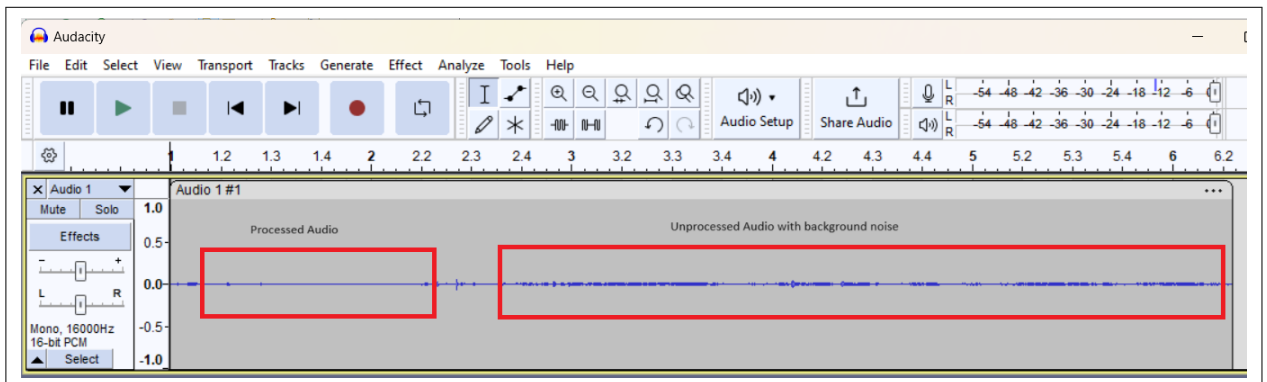


Figure 3 Audacity capturing audio from the kit in both modes (processed, raw)

- In the next section user will customize the Audio Enhancement pipeline. For example, user can change the noise suppressor level

3 Customization via AFE Configurator

3 Customization via AFE Configurator

- The AFE configurator tool provides you options to customize the AFE middleware that run on PSOC™ Edge MCU
- The AFE configurator is installed via the DEEPCRAFT™ Audio Enhancement Tech Pack
- The AFE configurator tool requires the AFE configurator project file

Note: The AFE configurator project is provided in the code example. It is available in `proj_cm55\source\audio_enhancement_application\audio_enhancement\ae_configuration.mtbafe` path

- To open the project file, use the “Audio FE Configurator” from the “Quick Panel” on Eclipse IDE
- Connect to the device and ensure the Bridge Status is shown as “Connected”

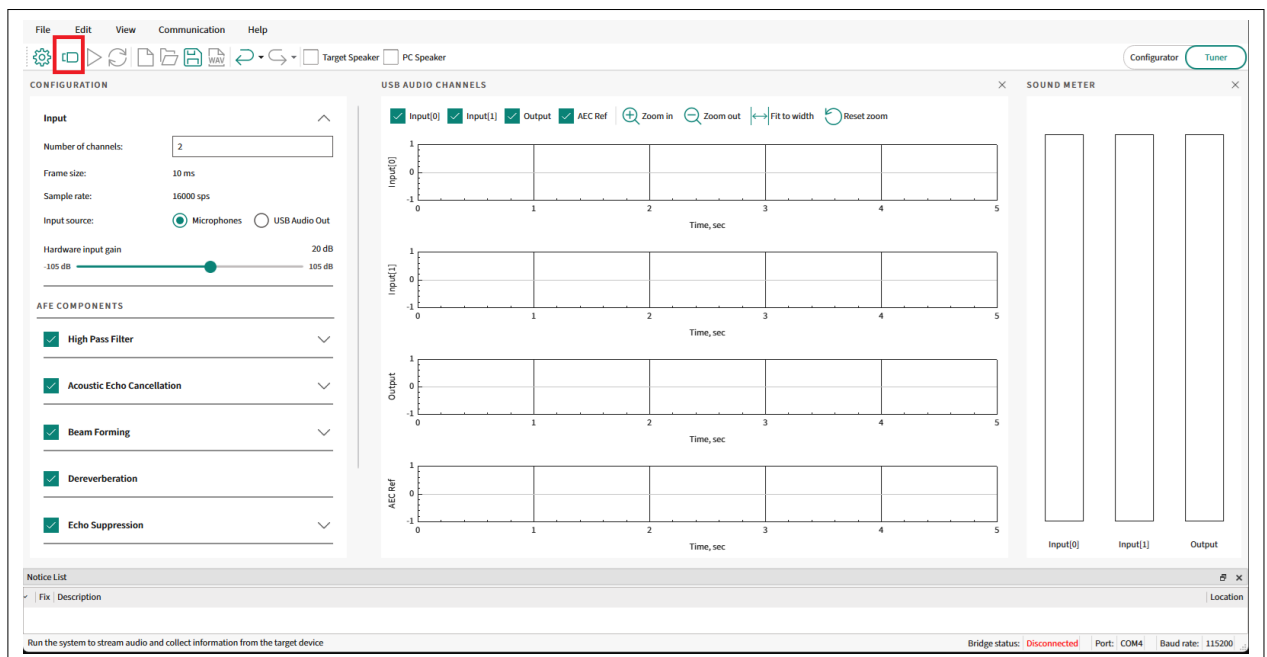


Figure 4 AFE Configurator – click the connect button

3 Customization via AFE Configurator

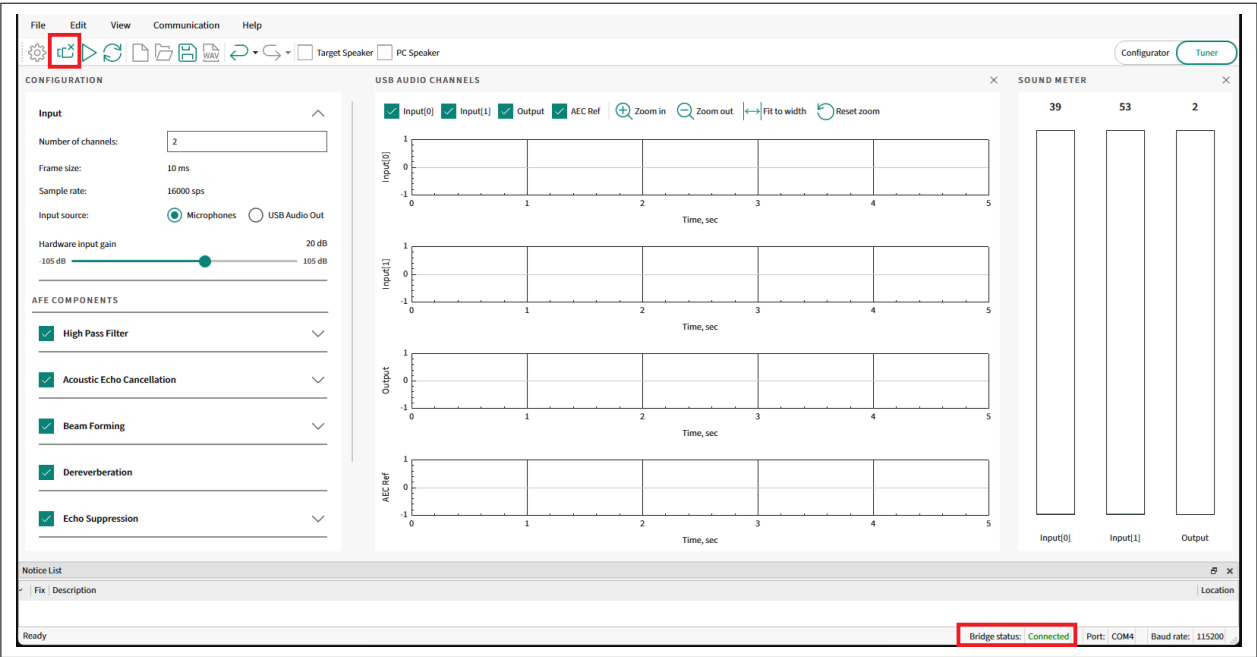


Figure 5 AFE Configurator – verify bridge status = Connected

- The following parameters can be dynamically configured via the AFE configurator. The rest of the parameters can only be statically configured, once the values are changed, save the AFE project and build/flash the code to the kit

Filter Type	Parameter Name
Input	Hardware input gain (dB)
Acoustic Echo Cancellation	Enable echo cancellation
	Bulk delay (ms)
Beam Forming	Enable beam forming
	Interference canceller aggressiveness
Dereverberation	Enable dereverberation
Echo Suppression	Enable echo suppression
	Echo suppressor aggressiveness
Noise Suppression	Enable noise suppression
	Noise suppressor level (dB)
Audio channels	Channel 0
	Channel 1
	Channel 2
	Channel 3

Figure 6 Dynamic Parameters

- Try enabling and disabling Noise Suppression:
 - Toggle Noise Suppression between enable/disable
 - Click “Sync the settings to the device”
 - Use Audacity to record and observe the audio

3 Customization via AFE Configurator

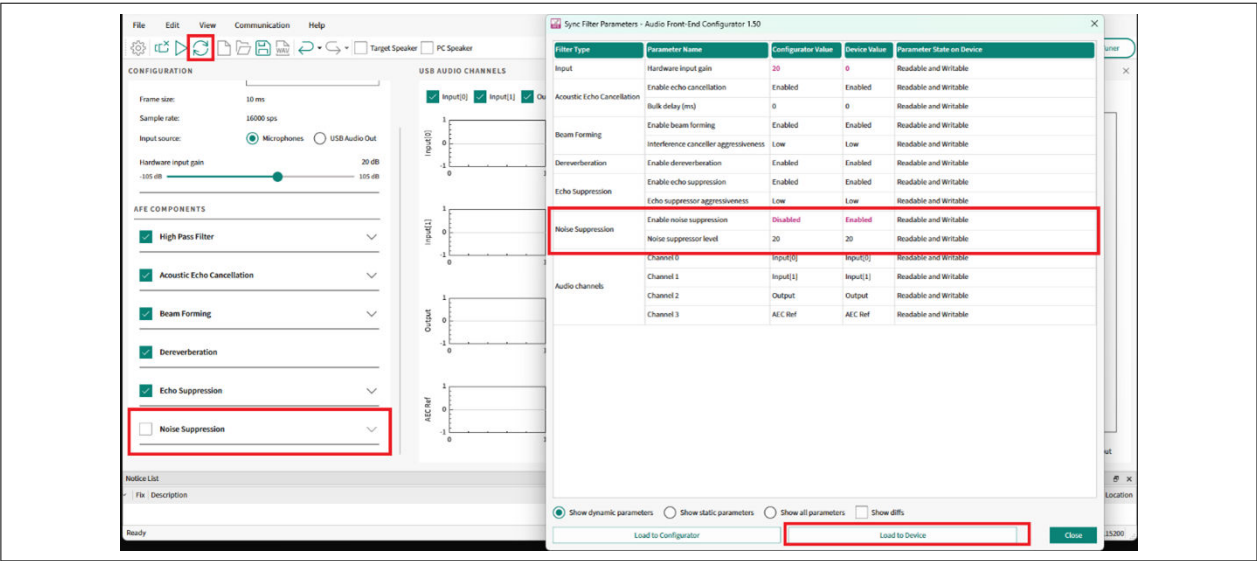


Figure 7 AFE Configurator – making dynamic configuration changes to the connected device

4 Tuning Mode

4 Tuning Mode

- The Audio Enhancement Example also supports tuning/debugging of AFE middleware via USB. In tuning mode, PSOC™ Edge MCU will be enumerated as a 4 channel (Quad) Microphone to the PC
- Ensure to set CONFIG_AE_MODE=TUNING in common.mk
- Select the streams to be populated in the 4 channels via AFE configurator

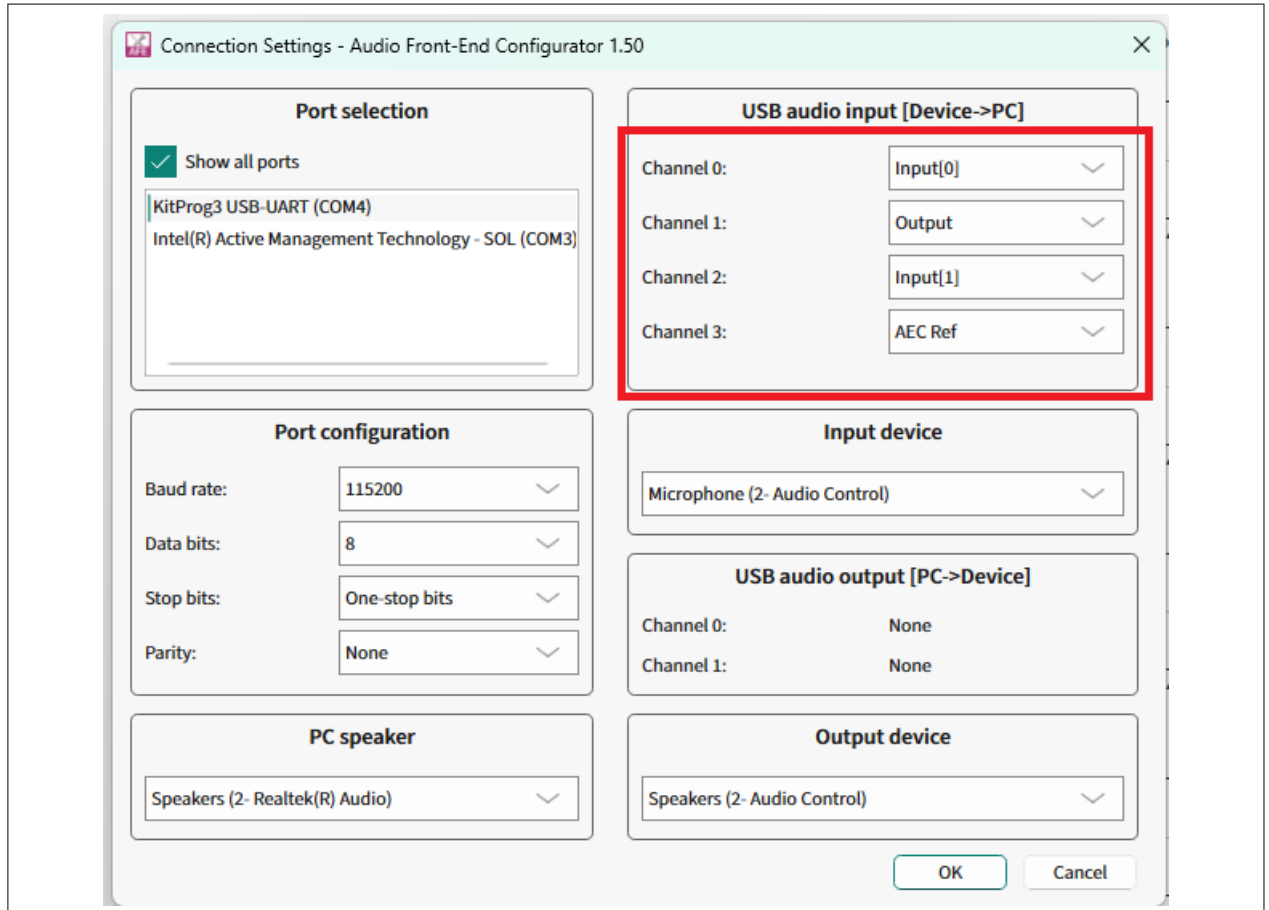


Figure 8 Using the AFE Configurator to select which streams to send to the PC via USB

- Enable/Disable the AFE components in the AFE configurator or adjust the parameters of related components
- Save the configuration and flash the firmware to the device
- In Audacity, set the driver to WASAPI and Microphone channels to 4. Ensure to set sampling rate to 16 kHz

4 Tuning Mode

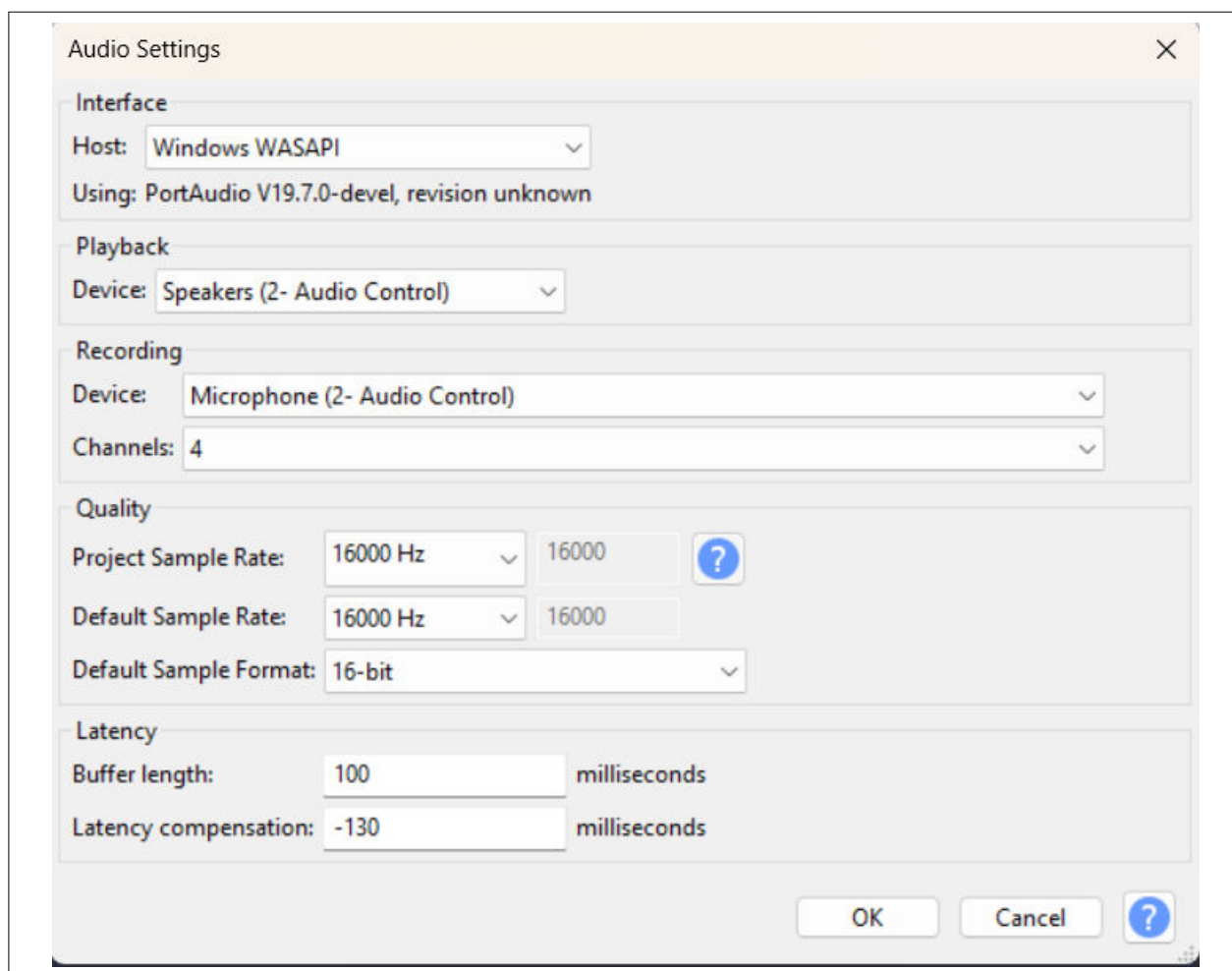


Figure 9 Audacity audio settings

- Observe the 4 channels recorded in Audacity

Note: User can use the AFE configurator with this setup to adjust parameters and then easily observe the changes on the streams selected

4 Tuning Mode

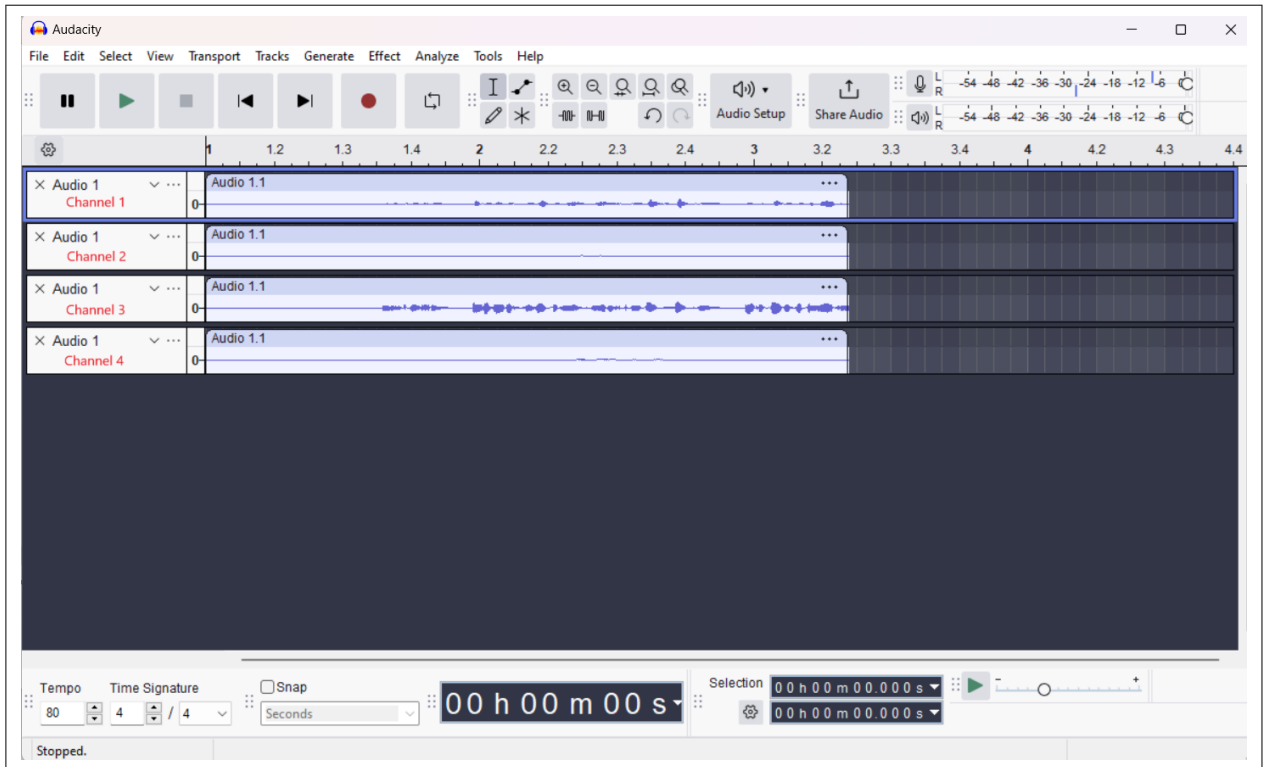


Figure 10 Using Audacity to inspect the streams you have selected for tuning

- AFE configurator also has the capability to display the 4 audio channels via USB
- Use the Play and Stop button in AFE configurator for the streams to be displayed on AFE configurator
- Save the recording and export it to Audacity for further analysis

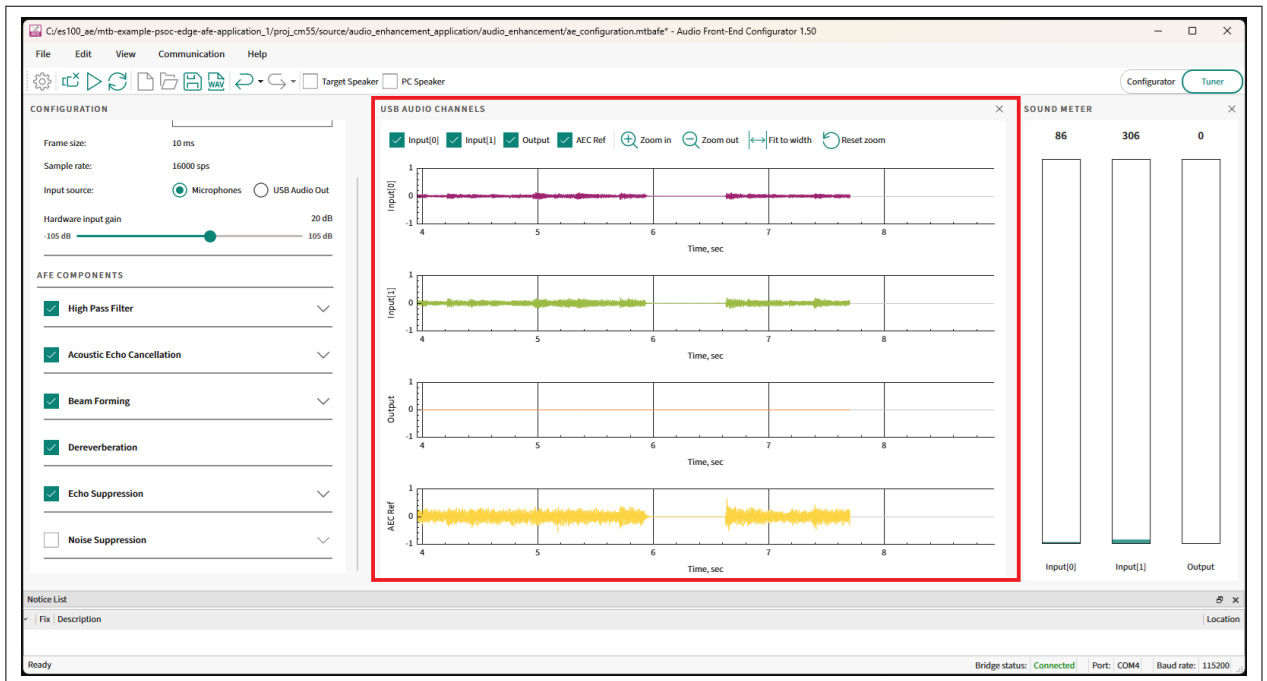


Figure 11 Viewing streams directly in the AFE Configurator

For more information on the code example usage, refer to the **README.md** and **ae_design_guide.md** included in **PSOC™ Edge DEEPCRAFT™ Audio Enhancement Application**.

5 Related resources

- Datasheet: [PSOC™ Edge Arm® Cortex® M55/M33 datasheet](#)
- Reference manual: [PSOC™ Edge Arm® Cortex® M55/M33 reference manual](#)
- Code Example: [PSOC™-edge-ae-application](#)
- Application Note: [AN240916](#) - DEEPCRAFT™ Audio Enhancement on PSOC™ Edge E84 MCU
- ModusToolbox™ Audio Front-End Configurator user guide

Glossary

AE

Audio Enhancement

AFE Middleware

Audio Front End Middleware

Middleware that interfaces to audio-voice-core library that enhances audio before further processing.

HMI

Human Machine Interface

LED

Light Emitting Diode

MCU

Microcontroller Unit

PSOC

Programmable System-on-Chip

USB

Universal Serial Bus

Revision history

Document revision	Date	Description of changes
**	2025-10-10	Initial release

Trademarks

PSOC™, formerly known as PSoC™, is a trademark of Infineon Technologies. Any references to PSoC™ in this document or others shall be deemed to refer to PSOC™.

Trademarks

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