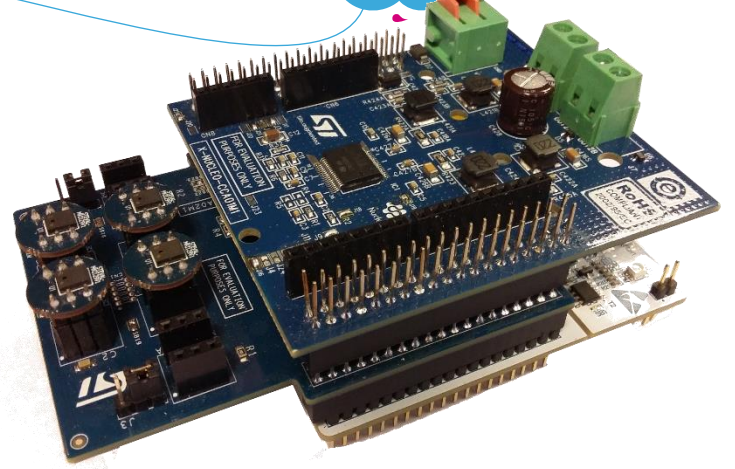
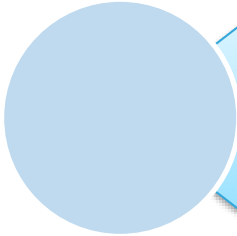




Quick Start Guide

STM32Cube function pack for MEMS microphones acquisition,
advanced audio processing and audio output
(FP-AUD-SMARTMIC1)





FP-AUD-SMARTMIC1: STM32Cube function pack for MEMS microphones acquisition, advanced audio processing and audio output

Hardware and software overview



Setup & Demo Examples

Documents & Related Resources



STM32 Open Development Environment: Overview

Sound terminal expansion board

Hardware Overview

3

X-NUCLEO-CCA01M1 Hardware Description

The X-NUCLEO-CCA01M1 is an expansion board based on STA350BW Sound Terminal® device, a 2.1-channel high-efficiency digital audio output system. It enables the output of digital audio streams to a speakers pairs connected directly to the board and allows the evaluation of the STA350BW digital audio output component.

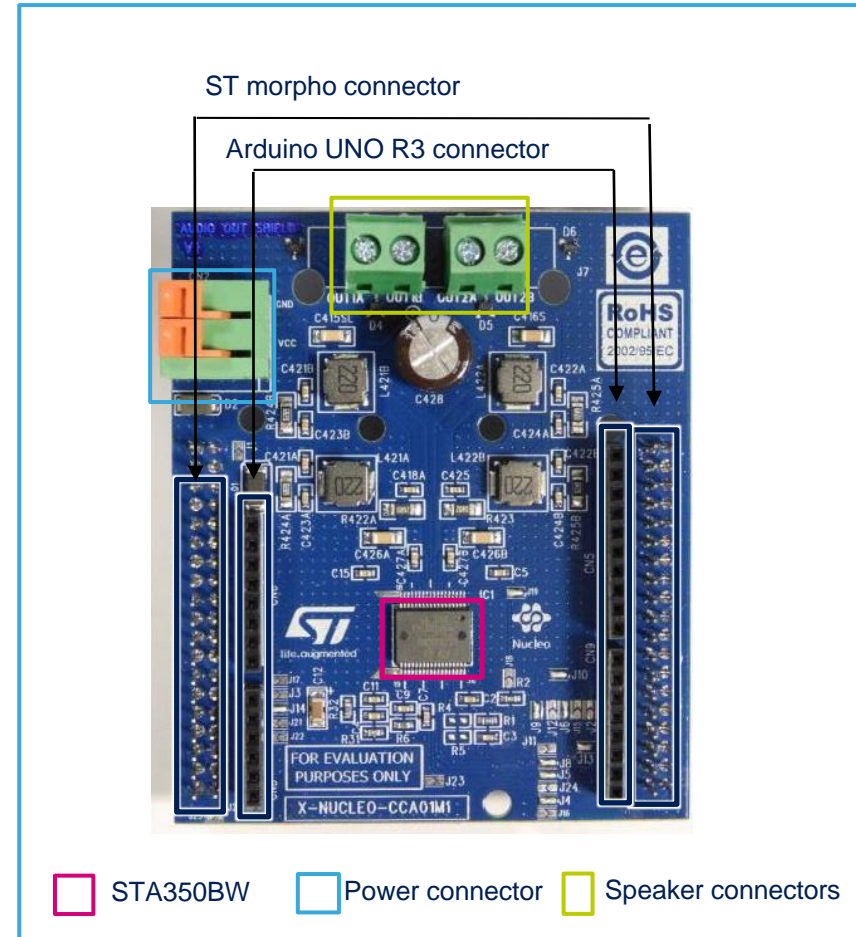
Key Features

- 2 channels of ternary PWM 2 x 50W @ 25 V 6 Ω
- FFX™ 100 dB SNR and dynamic range
- I²C control with selectable device address
- Digital gain +48 dB -80 dB with 0.125 dB/step
- Two independent DRCs configurable as a dual-band anti-clipper (B2DRC) or independent limiters/compressors
- I²S input interface
- 3 coefficients banks for EQ preset storing with fast recall via I²C interface
- Up to 8 user-programmable biquads per channel
- Compatible with STM32 Nucleo boards
- Free comprehensive development firmware library and example compatible with STM32Cube firmware

Key Product on board

STA350BW

An integrated solution of digital audio processing, digital amplifier control, and FFX-power output stage, thereby creating a high-power single-chip FFX™ solution comprising high-quality, high-efficiency, and all-digital amplification



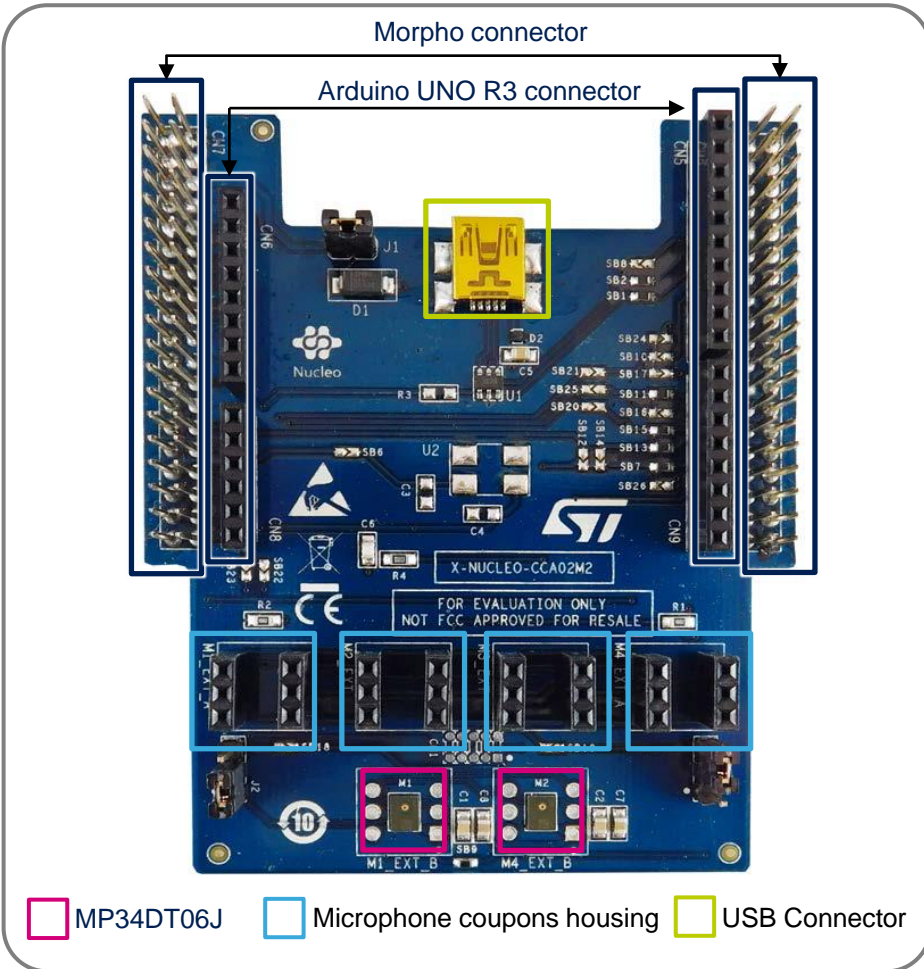
Hardware Description

- The X-NUCLEO-CCA02M2 is an expansion board that has been designed around MP34DT06J digital MEMS microphone. It is compatible with the ST morpho connector layout and with digital microphone coupon boards such as STEVAL-MIC001V1, STEVAL-MIC002V1 and STEVAL-MIC003V1.
- The X-NUCLEO-CCA02M2 embeds two MP34DT06J microphones and allows synchronized acquisition and streaming of up to 4 microphones through I²S, SPI, DFSDM or SAI peripherals.

Key Products on board

MP34DT06J

ultra-compact, low-power, omnidirectional, digital MEMS microphone built with a capacitive sensing element and an IC interface.



Latest info available at www.st.com
X-NUCLEO-CCA02M2

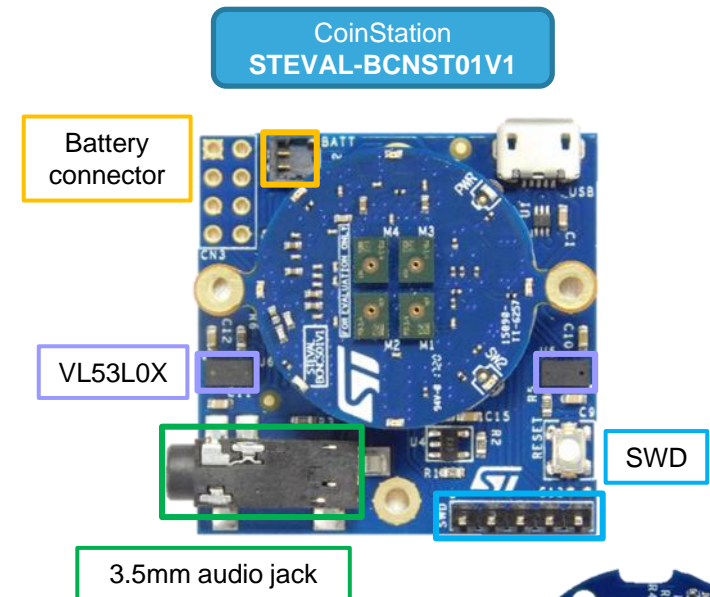
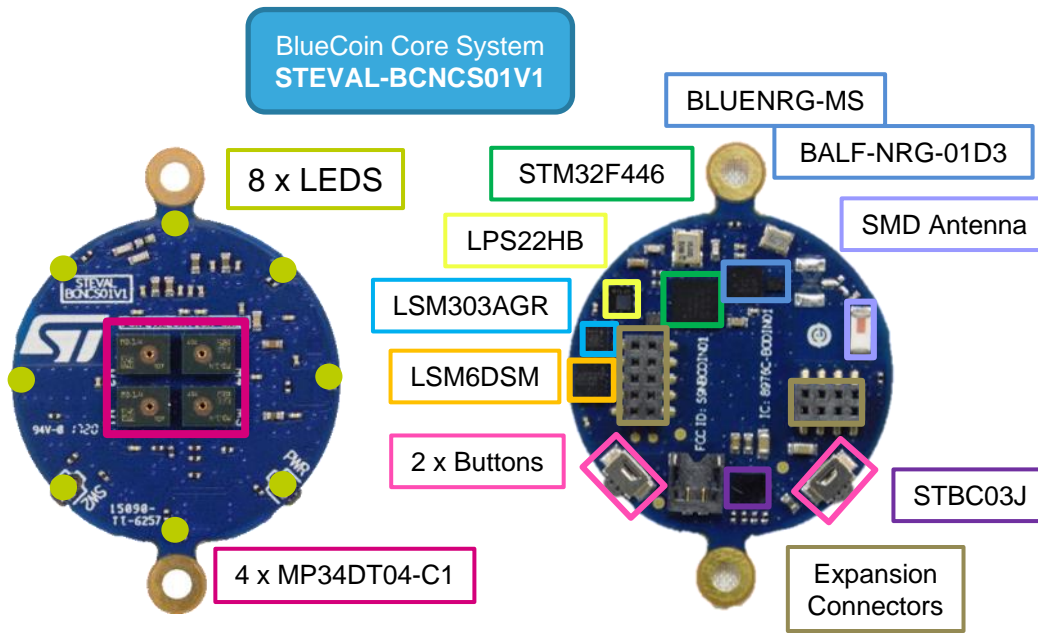
BlueCoin Platform

Hardware Overview

5

STEVAL-BCNKT01V1 Hardware Description

- STEVAL-BCNKT01V1 is the starter kit for the BlueCoin board (STEVAL-BCNCS01V1), a highly integrated development and prototyping platform for augmented acoustic and motion sensing, aiming to improve system design cycle and accelerate delivery of results
- Two host boards are also provided as part of the kit:
 - The CoinStation provides audio output, battery management and two Time-of-flight ranging sensors.
 - The Cradle is a small host board featuring USB and SD card interfaces, it is useful for on-the-field testing and data acquisition campaigns.



FP-AUD-SMARTMIC1 Software

- FP-AUD-SMARTMIC1 is an STM32Cube function pack. The firmware runs on the STM32 and includes drivers and middleware for digital MEMS microphones and audio output management. It includes middleware for audio DSP, performing acoustic Beam Forming, Echo Cancellation, and Source Localization. The expansion is built on STM32Cube software technology to ease portability across different STM32 microcontrollers. The package includes a PC software package which runs with a host PC system connected using a USB cable and showcases basic demonstration of the firmware capabilities.
- Implementation examples are available for STM32 Nucleo digital MEMS microphone expansion board (X-NUCLEO-CCA02M2) and Sound Terminal® expansion board X-NUCLEO-CCA01M1) plugged on top of an STM32 Nucleo development board (NUCLEO-F446RE). The software is also compatible with BlueCoin starter kit (STEVAL-BCNKT01V1)

Key features

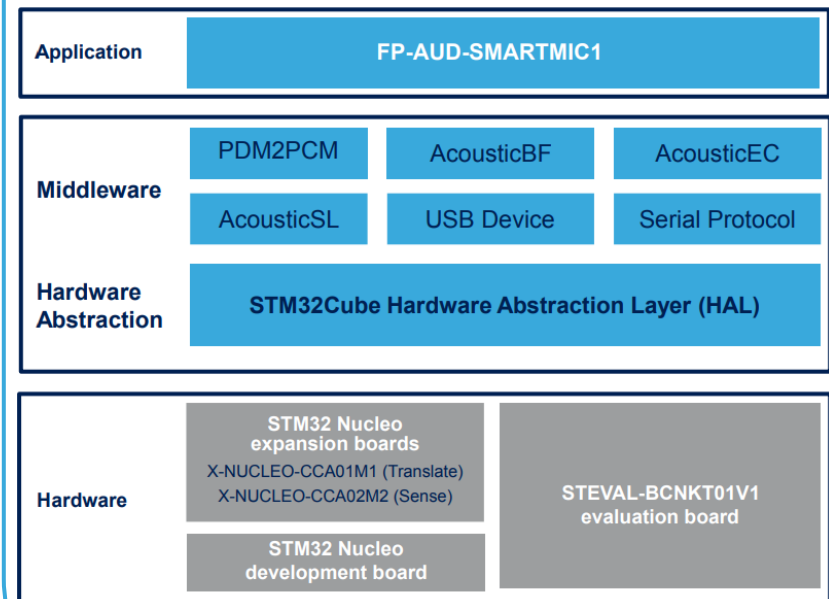
- AcousticBF Real-time beam forming software expansion for STM32Cube
- AcousticEC Real-time acoustic echo cancellation software expansion for STM32Cube
- AcousticSL Real-time sound source localization software expansion for STM32Cube
- Easy portability across different MCU families thanks to STM32Cube.
- Sample applications (both for STM32 and host PC) that the developer can use to start experimenting with the code
- Complete middleware to build applications using digital MEMS microphones and advanced DSP functionalities
- Free, user-friendly license terms

FP-AUD-SMARTMIC1

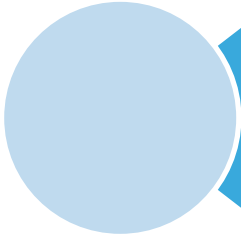
Software Overview

6

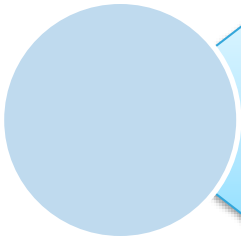
Overall Software Architecture



Latest info available at
FP-AUD-SMARTMIC1



FP-AUD-SMARTMIC1: STM32Cube function pack for MEMS microphones acquisition, advanced audio processing and audio output
Hardware and software overview



Setup & Demo Examples
Documents & Related Resources



STM32 Open Development Environment: Overview

- **STSW-LINK009**

- ST-LINK/V2-1 USB driver

- **FP-AUD-SMARTMIC1**

- Copy the .zip file content into a folder on your PC. The package will contain source code example (Keil, IAR, STM32CubeIDE) based on **NUCLEO-F446RE** and **BlueCoin**
- The package includes custom PC software (GUI and command line based) which allow to easily control the system at run-time
- Third party software for audio acquisition
 - Audacity® is free, open source, cross-platform software for recording and editing sounds.
 - It is available for Windows®, Mac®, GNU/Linux®, and other operating systems.
 - Link: <http://audacity.sourceforge.net>

Setup & demo examples

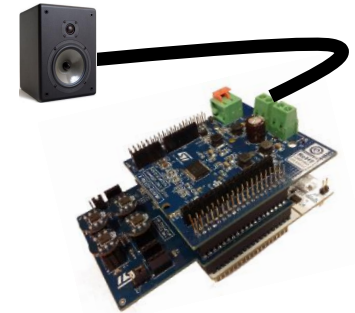
STM32Nucleo - HW prerequisites

9

- 1x STM32 Nucleo development board (**NUCLEO-F446RE**)
- 1x Sound terminal expansion board based on STA350BW (**X-NUCLEO-CCA01M1**)
- 1x Digital MEMS microphone expansion board (**X-NUCLEO-CCA02M2**)
- 1x Microphone coupon board based on the MP34DT05-A digital MEMS microphone (for example: **STEVAL-MIC001V1**)
- 1x 8 Ω passive speaker to be connected to the X-NUCLEO-CCA01M1 expansion board
- 2x USB type A to mini-B USB cable
- 1x Windows® (XP, Vista, 7 or above) - PC/Laptop
- Please refer to the user manual for correct hardware setup



NUCLEO F446RE



Boards stacking



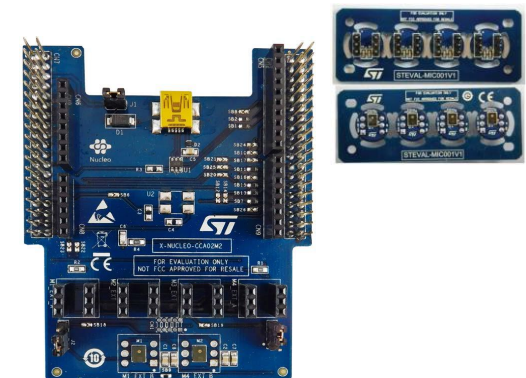
Mini USB Cable



Speaker



X-NUCLEO-CCA01M1



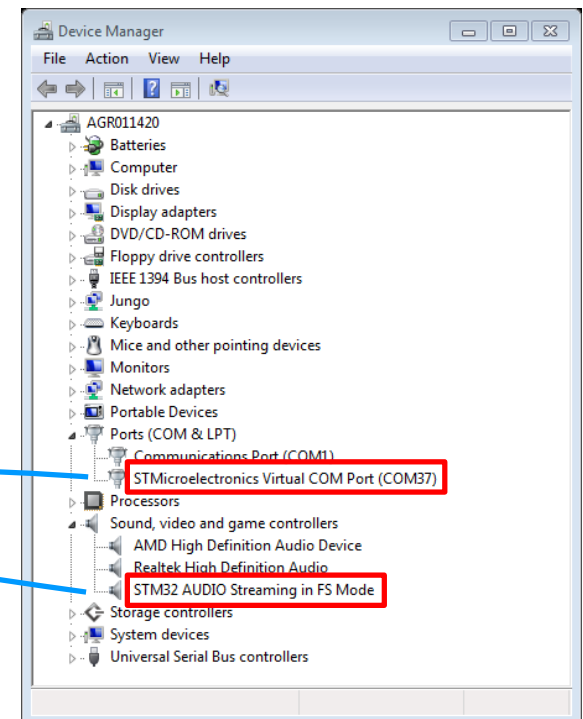
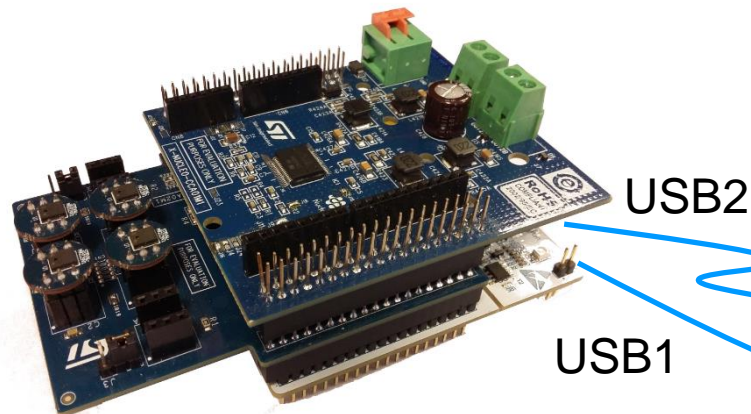
X-NUCLEO-CCA02M2
with STEVAL-MIC001V1

Setup & demo examples

STM32Nucleo – USB Connection

10

- Dual USB connection with the host PC.
- USB1 cable goes from Nucleo-F446RE to the PC: the board is recognized as STMicroelectronics Virtual COM Port (ST-Link driver must be installed, available at www.st.com). This channel is used to exchange messages between a host PC and the MCU unit and control the demo at runtime.
- USB2 cable is connected to X-NUCLEO-CCA02M2 board: the device is recognized as a Standard USB microphone without the need of any PC driver. This channel is used to stream audio toward the host PC.

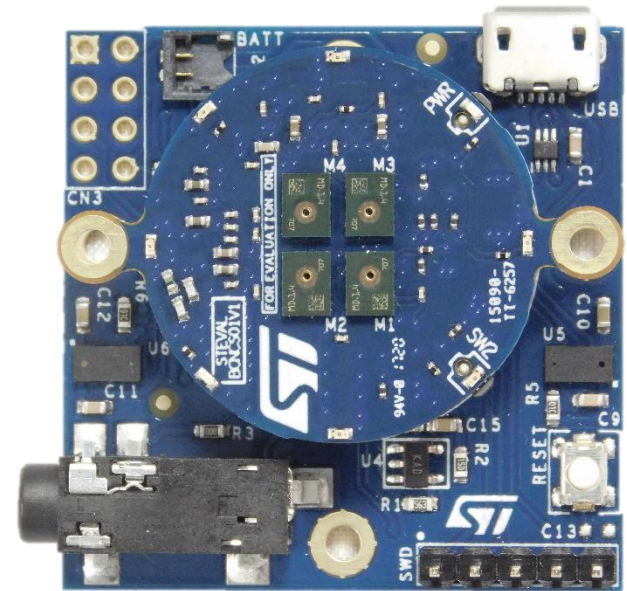


Setup & Demo Examples

BlueCoin - HW prerequisites

11

- 1x BlueCoin evaluation kit (STEVAL-BCNKT01V1):
STEVAL-BCNCS01V1 connected to the STEVAL-BCNST01V1
- 1x active loudspeaker or headphones to be connected to the STEVAL-BCNST01V1
- 1x USB type A to micro-B USB cable
- 1x Windows® (XP, Vista, 7, or above) - PC/Laptop
- Please refer to UM2219 for correct hardware setup



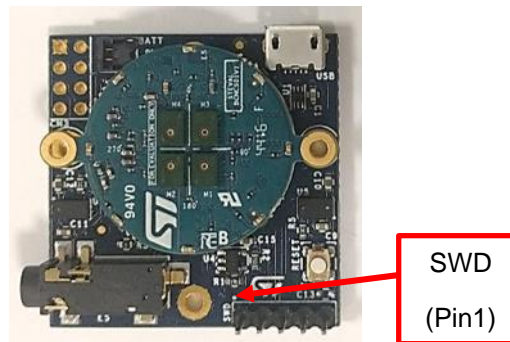
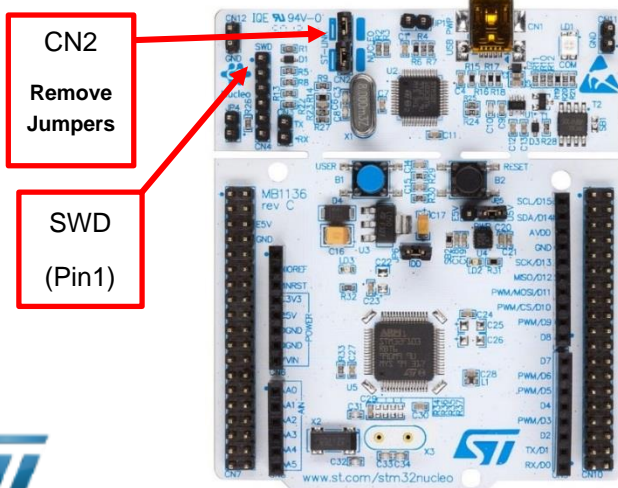
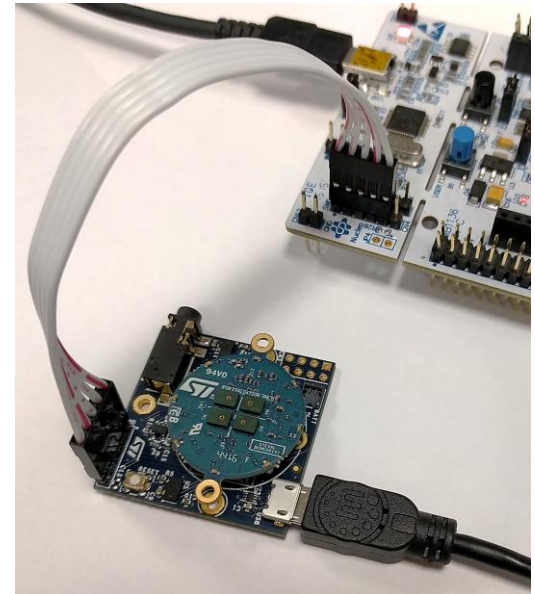
Setup & Demo Examples

BlueCoin - HW setup

12

- In order to program the board you need to connect an external ST-Link to the SWD connector on the BlueCoin Station, a 5pin flat cable is provided within the BlueCoin Kit package.
- The easiest way is to get an STM32-Nucleo board which includes an ST-Link V2.1 programmer.
- Be sure that CN2 Jumpers are OFF and connect your STM32 Nucleo board to the BlueCoin Station through the provided cable paying attention to the polarity of the connectors. Pin 1 can be identified by a little circle on the PCB silkscreen (STM32 Nucleo board and BlueCoin Station).

BlueCoin Station SWD connection

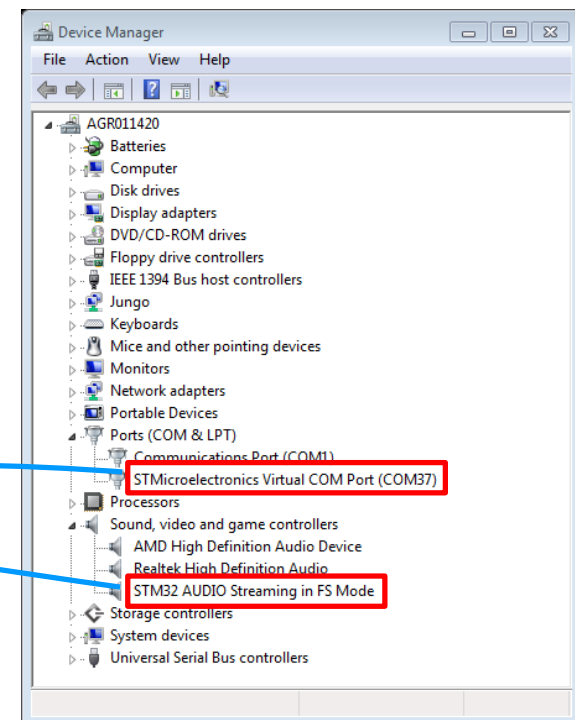


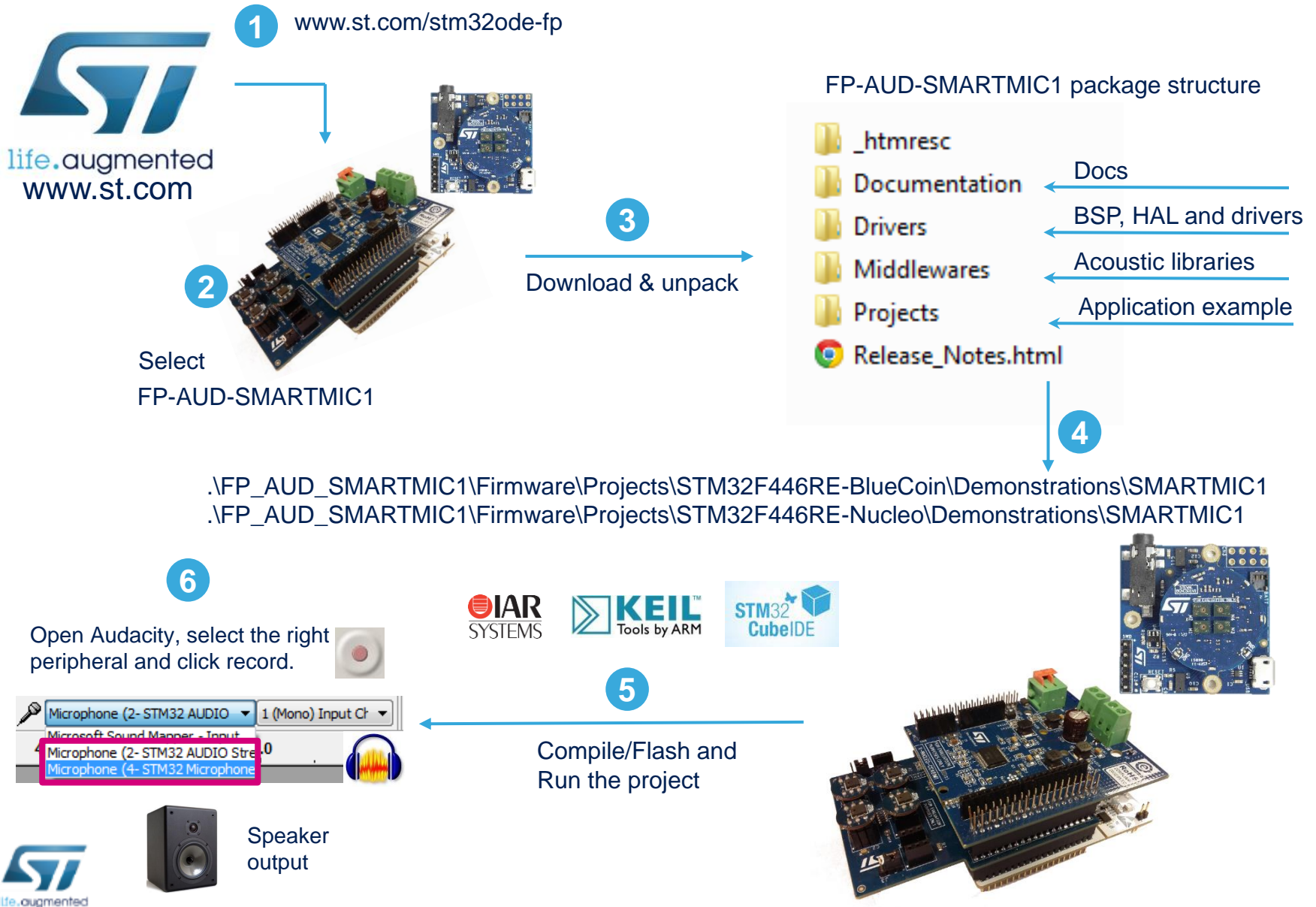
Setup & demo examples

BlueCoin – USB Connection

13

- Single USB connection with the host PC.
- Windows 10: the system is automatically recognized as a composite device exposing:
 - A standard stereo microphone used audio streaming towards an host PC
 - A Virtual Com Port, used for communication
- Windows 7: an additional .inf driver (included) is needed in order to correctly recognize the system
 - Additional information can be found on UM2219



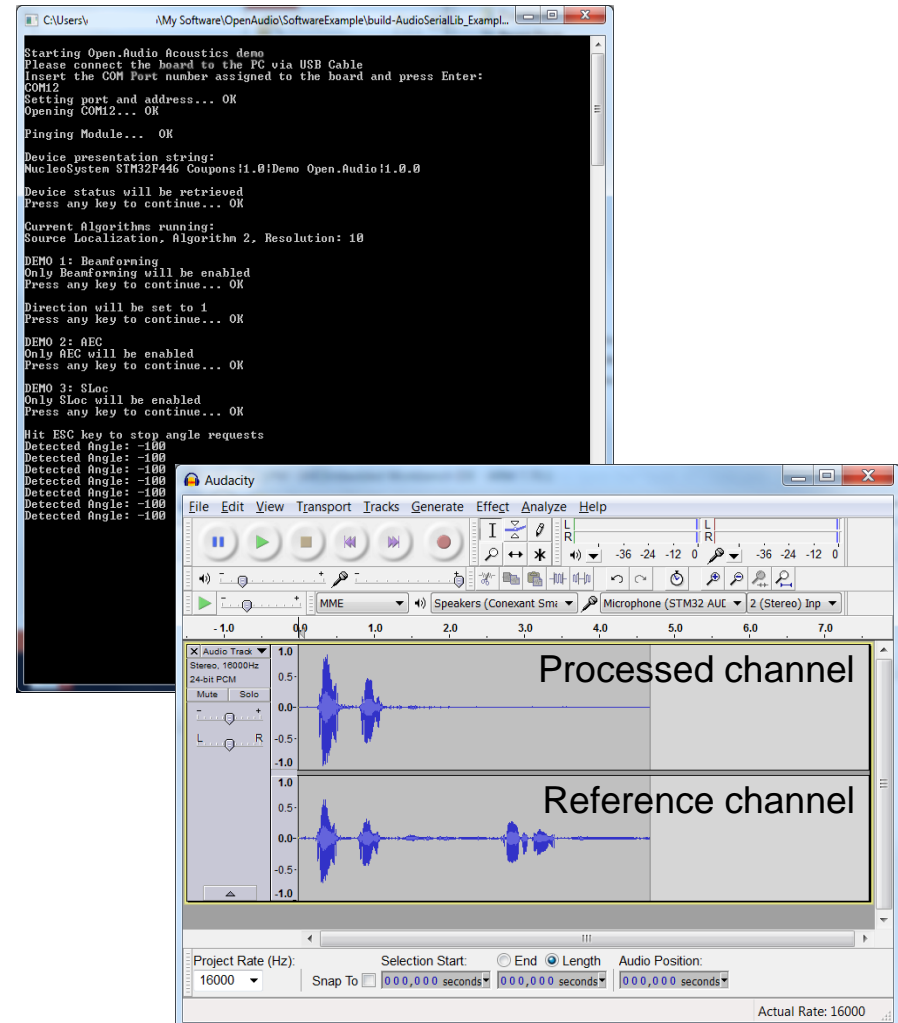


Host PC software examples

Command Line Interface Tool

15

- Utilities\PC_Software\Control_SW_Executable\FP-AUD-SMARTMIC1 CLI.exe: command line tool (available in source code also) implementing an example of communication between FP-AUD-SMARTMIC1 system and a host PC.
- The software performs this sequence of operations:
 - 1) Connect to the serial port specified by the user
 - 2) Retrieve a string that describe the firmware version
 - 3) Retrieve the currently running algorithms
 - 4) Activate beamforming only
 - 5) Switch beamforming direction
 - 6) Activate AEC only
 - 7) Activate Source Localization and start asking for the estimated direction

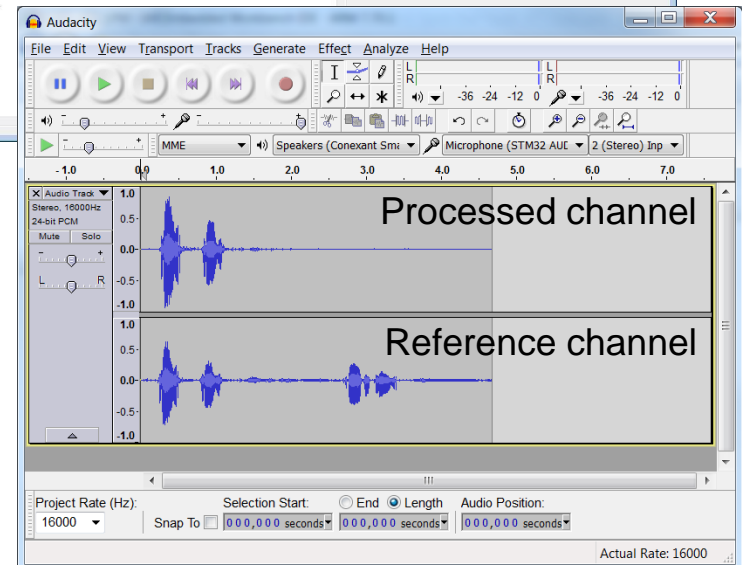
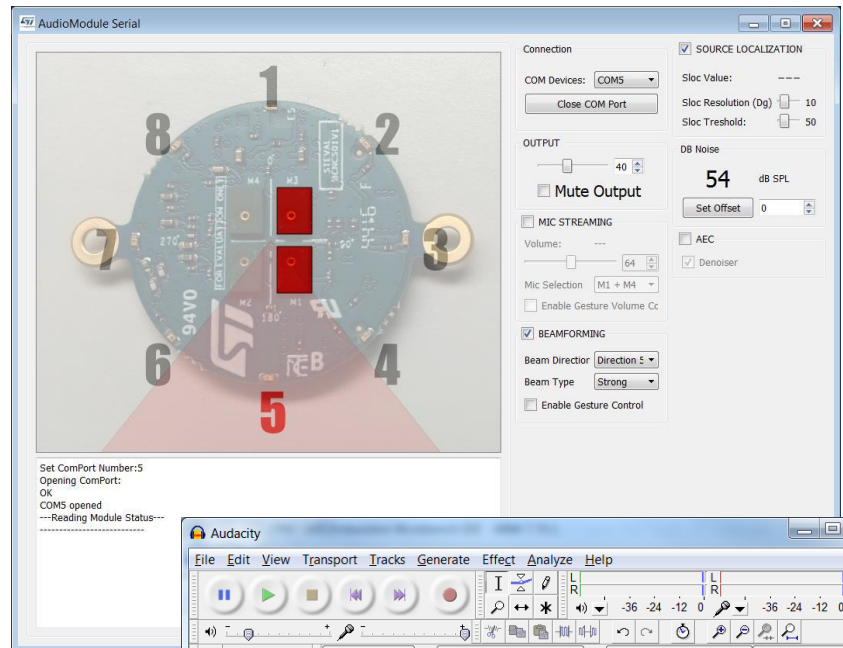


Host PC software examples

Graphic User Interface Tool

16

- Utilities\PC_Software\Control_SW_Executable\FP-AUD-SMARTMIC1 GUI.exe: graphic user interface, implementing the communication between FP-AUD-SMARTMIC1 system and a host PC, to be used, together with Audacity, to explore all the implemented functionalities
- The software GUI can control these functionalities
 - Beamforming
 - Enable/Disable
 - Choose direction
 - Choose algorithm type
 - Enable Time of Flight demo for direction change (Available on BlueCoin only)
 - AEC
 - Enable/Disable
 - Activate / de-activate denoiser step
 - Source Localization
 - Enable/Disable
 - Set parameters
 - Streaming and Output
 - Set parameters and levels
 - Enable Time of Flight demo for volume adjustment (Available on BlueCoin only)



All documents are available in the RESOURCES tab of the related products webpage

FP-AUD-SMARTMIC1:

- **DB3275:** STM32 ODE Function Pack for MEMS microphones acquisition, advanced audio processing and audio output. – **data brief**
- **UM2219:** Getting started with STM32 ODE function pack for MEMS microphones acquisition, advanced audio processing and audio output – **user manual**

X-NUCLEO-CCA01M1:

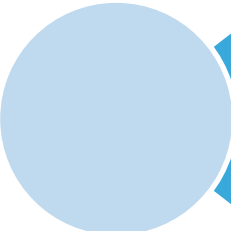
- Gerber files, BOM, and schematics
- **DB2756:** Sound terminal expansion board based on STA350BW for STM32 Nucleo – **data brief**
- **UM1972:** Getting started with sound terminal expansion board based on STA350BW for STM32 Nucleo – **user manual**

X-NUCLEO-CCA02M2:

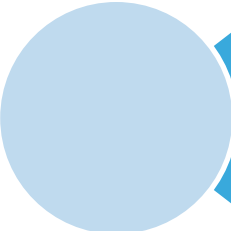
- Gerber files, BOM, and schematics
- **DB4016:** Digital MEMS microphone expansion board based on MP34DT06J for STM32 Nucleo– **Data brief**
- **UM2631:** Getting started with the digital MEMS microphone expansion board based on MP34DT06J for STM32 Nucleo – **User Manual**

STEVAL-BCNKT01V1:

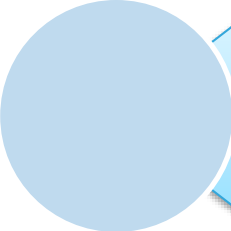
- Gerber files, BOM, and schematics
- **DB3258:** BlueCoin starter kit– **data brief**
- **UM2240:** Getting started with the STEVAL-BCNKT01V1 BlueCoin kit: augmented acoustics and motion sensing development platform – **user manual**



FP-AUD-SMARTMIC1: STM32Cube function pack for MEMS microphones acquisition, advanced audio processing and audio output
Hardware and software overview



Setup & Demo Examples
Documents & Related Resources



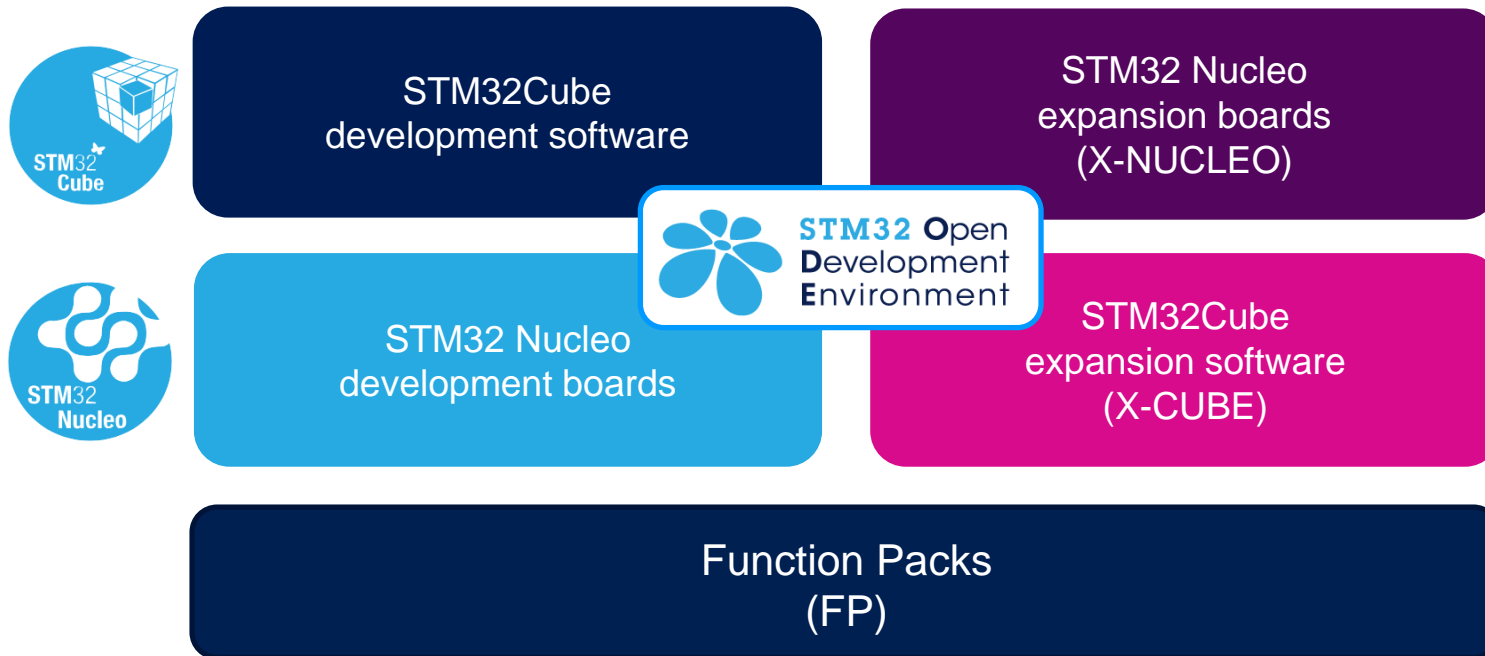
STM32 Open Development Environment: Overview

STM32 Open Development Environment

Fast, affordable Prototyping and Development

19

- The STM32 Open Development Environment (STM32 ODE) is an open, flexible, easy and affordable way to develop innovative devices and applications based on the STM32 32-bit microcontroller family combined with other state-of-the-art ST components connected via expansion boards. It enables fast prototyping with leading-edge components that can quickly be transformed into final designs



For further information, please visit www.st.com/stm32ode