

# STM32Cube function pack for MEMS microphone acquisition, advanced audio processing and audio output

Application	FP-AUD-SMARTMIC1		
Middleware	PDM2PCM	AcousticBF	AcousticEC
	AcousticSL	USB Device	Serial Protocol
Hardware Abstraction	STM32Cube Hardware Abstraction Layer (HAL)		
Hardware	STM32 Nucleo expansion boards X-NUCLEO-CCA01M1(Translate) X-NUCLEO-CCA02M1(Sense)	STEVAL-BCNKT01V1 evaluation board	
	STM32 Nucleo development board		



## 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](#)
- Complete application including all the acoustic functions in a single sample application
- Software graphic user interface to easily control parameters and algorithms from a host PC
- Free, user-friendly license terms
- Sample implementation available on a NUCLEO-F446RE board when connected to an [X-NUCLEO-CCA01M1](#) and an [X-NUCLEO-CCA02M1](#) expansion board
- Sample implementation available on the BlueCoin starter kit ([STEVAL-BCNKT01V1](#))

## Description

[FP-AUD-SMARTMIC1](#) is an [STM32Cube](#) function pack. This software package implements a complete application targeting advanced processing for MEMS microphone arrays, including digital MEMS microphone acquisition, beamforming, source localization and acoustic echo cancellation. The processed audio is sent to a USB host and a loudspeaker connected to the relevant expansion boards.

The function pack is built on [STM32Cube](#) software technology to ease portability across different [STM32](#) microcontrollers.

This sample implementation supports two kind of systems: [STM32 NUCLEO-F446RE](#) development board equipped with the [X-NUCLEO-CCA01M1](#) or [X-NUCLEO-CCA02M1](#) expansion boards and the [STEVAL-MKI129Vx](#) digital microphone evaluation board series or the BlueCoin starter kit ([STEVAL-BCNKT01V1](#)).

Product summary	
STM32Cube function pack for MEMS microphone acquisition, advanced audio processing and audio output	<a href="#">FP-AUD-SMARTMIC1</a>
Sound terminal expansion board based on STA350BW for STM32 Nucleo	<a href="#">X-NUCLEO-CCA01M1</a>
Digital MEMS microphone expansion board based on MP34DT01-M for STM32 Nucleo	<a href="#">X-NUCLEO-CCA02M1</a>
BlueCoin starter kit	<a href="#">STEVAL-BCNKT01V1</a>

## 1 Detailed description

### ■ What can you do with STM32Cube function packs?

The [STM32Cube](#) function packs leverage the modularity and interoperability of STM32 Nucleo and X-NUCLEO boards, and STM32Cube and X-CUBE software, to create function examples, embodying some of the most common use cases, for each application area.

These software function packs are designed to exploit as much as possible the underlying [STM32 ODE](#) hardware and software components to best fit the requirements of final users' applications.

Moreover, function packs may include additional libraries and frameworks which do not present the original X-CUBE packages, thus enabling new functionalities and creating a real and usable system for developers.

### ■ What is STM32Cube?

STM32Cube™ is designed by STMicroelectronics to reduce development effort, time and cost across the entire STM32 portfolio.

STM32Cube version 1.x includes:

- STM32CubeMX, a graphical software configuration tool that allows the generation of C initialization code using graphical wizards.
- A comprehensive embedded software platform specific to each series (such as the STM32CubeF4 for the STM32F4 series), which includes:
  - the STM32Cube HAL embedded abstraction-layer software, ensuring maximized portability across the STM32 portfolio
  - a consistent set of middleware components such as RTOS, USB, TCP/IP and graphics
  - all embedded software utilities with a full set of examples

### How does this STM32Cube function pack complement STM32Cube?

The [FP-AUD-SMARTMIC1](#) firmware is based on the STM32CubeHAL hardware abstraction layer for the STM32 microcontroller, and exploits BSP and middleware layers to build a complete acoustic application based on a MEMS microphone array. The software acquires audio signals from four digital MEMS microphones, elaborates them using embedded DSP libraries and streams the processed audio to a USB host and a loudspeaker connected to the relevant expansion boards.

A software example which performs a set of operations to remotely control the device from a PC host is also provided.

The package includes several audio DSP libraries:

- the AcousticBF library provides an implementation for a real-time adaptive beamforming algorithm - using the audio signals acquired from two digital MEMS microphones, it creates a virtual directional microphone pointing to a fixed direction in space;
- the AcousticEC library provides an implementation for a real-time echo cancellation routine based on the well-known SPEEX implementation of the MDF algorithm;
- the AcousticSL library provides an implementation for a real-time sound source localization algorithm: using 2 or 4 signals acquired from digital MEMS microphones, it can estimate the arrival direction of the audio source.

The firmware provides a sample implementation supporting two systems:

- STM32 [NUCLEO-F446RE](#) development board equipped with the [X-NUCLEO-CCA01M1](#) expansion board (based on the [STA350BW](#) Sound Terminal® 2.1-channel high-efficiency digital audio output system) or [X-NUCLEO-CCA02M1](#) expansion board (based on the [MP34DT01-M](#) digital MEMS microphones) and [STEVAL-MK1129Vx](#) digital microphone evaluation board series
- BlueCoin starter kit ([STEVAL-BCNKT01V1](#))

## Revision history

**Table 1. Document revision history**

Date	Version	Changes
12-Jun-2017	1	Initial release.
19-Apr-2018	2	Updated title and cover image.

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