

## STM32 ODE function pack for IoT node with BLE connectivity, digital microphone, environmental and motion sensors

Application	FP-SNS-ALLMEMS1		
Middleware	BLE	USB Device	Audio PCM to PCM
	FatFs	MotionFX/AR/CP/GR	AcousticSLBF
Hardware Abstraction	BlueVoiceADPCM	Meta Data Manager	
	STM32Cube Hardware Abstraction Layer (HAL)		
Hardware	STM32 Nucleo expansion boards X-NUCLEO-IDB05A1 (Connect) X-NUCLEO-IKS01A1 / X-NUCLEO-IKS01A2 (Sense) X-NUCLEO-CCA02M1 (Microphone)		
	STM32 Nucleo development board STEWAL evaluation board		

### Features

- Complete firmware to develop an IoT node with BLE connectivity, digital microphone, environmental and motion sensors
- Middleware libraries for sensor data fusion and accelerometer-based real-time activity recognition, acoustic source localization and beam forming, audio processing and streaming over BLE communication profile, and SD card data logging
- Compatible with BlueMS application for Android/iOS, to perform sensor data reading, audio and motion algorithm feature demo, and firmware update over the air (FOTA)
- Sample implementation available for [STEWAL-BCNKT01V1](#) and [STEWAL-STLKT01V1](#) board and for [X-NUCLEO-CCA02M1](#), [X-NUCLEO-IKS01A1](#) (or [X-NUCLEO-IKS01A2](#)) and [X-NUCLEO-IDB05A1](#) (or [X-NUCLEO-IDB04A1](#)) connected to a [NUCLEO-F446RE](#) or [NUCLEO-F401RE](#) or [NUCLEO-L476RG](#) board
- Easy portability across different MCU families, thanks to STM32Cube
- Free, user-friendly license terms



### Description

**FP-SNS-ALLMEMS1** is an STM32 ODE function pack which lets you connect your IoT node to a smartphone via BLE and use a suitable Android™ or iOS™ application, like the BlueMS app, to view real-time environmental sensor data, motion sensor data, digital microphone levels and battery level.

The package also enables advanced functions such as voice communication over BLE, sound source localization and acoustic beam forming using inputs from multiple microphones, as well as sensor data fusion and accelerometer-based real-time activity recognition, audio data logging and MEMS sensor data logging on SD card.

This package, together with the suggested combination of STM32 and ST devices can be used to develop specific wearable applications, or smart things applications in general.

The software runs on the STM32 microcontroller and includes all the necessary drivers to recognize the devices on the [STM32 Nucleo](#) development board and expansion boards, as well as on the [STEWAL-BCNKT01V1](#) and [STEWAL-STLKT01V1](#) evaluation boards.

Summary table	
Motion MEMS and environmental sensor expansion board for STM32 Nucleo	<a href="#">X-NUCLEO-IKS01A1</a>
Motion MEMS and environmental sensor expansion board for STM32 Nucleo	<a href="#">X-NUCLEO-IKS01A2</a>
Bluetooth Low Energy expansion board based on SPBTLE-RF module for STM32 Nucleo	<a href="#">X-NUCLEO-IDB05A1</a>
Digital MEMS microphone expansion board based on MP34DT01-M for STM32 Nucleo	<a href="#">X-NUCLEO-CCA02M1</a>

## 1 Detailed description

### What can you do with STM32 ODE function packs?

The STM32 ODE function packs leverage the modularity and interoperability of STM32 Nucleo and X-NUCLEO boards with STM32Cube and X-CUBE software, to create functional examples representing some of the most common use cases in each sphere of application.

These software function packs are designed to fully exploit the underlying STM32 ODE hardware and software components to best satisfy the final user application requirements.

Function packs may also include additional libraries and frameworks not present in the original X-CUBE packages, thus enabling new functions and creating more pertinent and usable systems 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 software complement STM32Cube?

This software is based on the STM32CubeHAL. It extends STM32Cube by providing a board support package (BSP) for the [BlueNRG-MS](#), sensor expansion board and middleware components for communication with other Bluetooth low energy devices, for sensor data fusion, real-time audio library, voice communication over Bluetooth low energy and SD card data logging.

BlueNRG-MS is a very low power Bluetooth low energy (BLE) single-mode network processor.

The FusionFX filtering and predictive suite uses advanced algorithms to intelligently integrate multiple MEMS sensor outputs, regardless of environmental conditions achieving an optimal performance. Real-time motion sensor data fusion is set to increase accuracy, resolution, stability and response time.

The MotionAR real-time software acquires data from the accelerometer to recognize user activities. The software can also be combined with other human motion recognition algorithms and, as well as the FusionFX, can significantly improve user experience in advanced motion-based applications in consumer, computer, industrial and medical fields.

The MotionCP real-time software acquires data from the accelerometer and recognizes the board position (on desk, on head, near head, shirt pocket, trouser pocket and swinging arm) (feature not available on [NUCLEO-F446RE](#), [NUCLEO-F401RE](#) and [STEVAL-BCNKT01V1](#))

The MotionGR real-time software acquires data from the accelerometer and recognizes user gestures (pick up, glance and wake up) (feature not available on [NUCLEO-F446RE](#), [NUCLEO-F401RE](#) and [STEVAL-BCNKT01V1](#)).

The AcousticSL real-time sound source localization software estimates the direction of arrival of audio sources using data acquired by two digital MEMS microphones (feature not available on the [STEVAL-STLKT01V1](#)).

The AcousticBF software provides real-time beam forming software, using the audio signals acquired from two digital MEMS microphones, it creates a virtual directional microphone pointing to a fixed direction in space (feature not available on [STEVAL-STLKT01V1](#) and [NUCLEO-L476RG](#)).

The BlueVoiceADPCM software enables real-time voice communication over Bluetooth low energy. It includes one characteristic for audio transmission and one for synchronization and is responsible for server side audio encoding and data transmission and client side decoding of received voice data.

FatFs generic FAT file system module provides access to storage devices such as memory card and hard disk (feature available only for the [STEVAL-STLCS01V1](#) evaluation board).

Activity recognition, carry position and gesture recognition are managed through special software designed for mobile and wearable applications; the respective algorithms are strictly limited to work with accelerometer data only to facilitate low power consumption strategies commonly required in these applications, in compliance with Bluetooth specifications core 4.0 ([X-NUCLEO-IDB04A1](#)) or 4.1 ([X-NUCLEO-IDB05A1](#)) for [STM32 Nucleo](#) boards and core 4.1 for the [STEVAL-BCNKT01V1](#) and [STEVAL-STLKT01V1](#) boards.

The provided drivers abstract low-level hardware details, so middleware components and applications can access the sensors in a hardware-independent manner. The package includes a sample application to transmit the values read from all the sensors (temperature, humidity, pressure, accelerometer, magnetometer, gyroscope, microphone level and battery information for [STEVAL-STLKT01V1](#) and [STEVAL-BCNKT01V1](#)) to a Bluetooth low energy-enabled device such as an Android™ or iOS™-based smartphone.

The BlueMS Android/iOS application, available on the respective application stores, displays the values read from accelerometer, magnetometer, gyroscope, temperature, humidity, pressure and microphone sensors. The application also allows firmware update over the air (with [X-NUCLEO-IDB05A1](#) Bluetooth low energy expansion boards only) as well as displaying battery information.

For the [STEVAL-STLKT01V1](#), when the Android/iOS device is not connected for a period longer than a fixed range time, the board shuts down. In this case, the accelerometer can be used to wake the board up and connect it again to Android or iOS.

## Revision history

**Table 1. Document revision history**

Date	Version	Changes
12-Apr-2016	1	Initial release.
13-Jun-2016	2	Updated cover page image. Updated cover page features and description.
12-Oct-2016	3	Added reference to Gas Gauge for STEVAL-STLKT01V1
15-Dec-2016	4	Added X-NUCLEO-IKS01A2 expansion board support information
08-May-2017	5	Updated cover page image, features and description. Updated How does this software complement STM32Cube?
03-July-2017	6	Minor text and formatting changes. Updated cover page image, features and description.
19-Oct-2017	7	Updated cover page image, features, description and How does this software complement STM32Cube?
29-Jan-2018	8	Updated cover page image and <i>How does this software complement STM32Cube?</i>

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