Quick Start Guide

STM32Cube Function Pack for the Pro Mode of the SensorTile.box wireless multi sensor development kit (STEVAL-MKS1BOX1)

(FP-SNS-STBOX1)

Version 1.0 (September 01, 2019)
Quick Start Guide Contents

- FP-SNS-STBOX1: STM32Cube Function Pack for the Pro Mode of the SensorTile.box wireless multi sensor development kit (STEVAL-MKS1BOX1)
  Hardware and Software overview

- Setup & Demo Examples

- Documents & Related Resources

- STM32 Open Development Environment: Overview
Sample implementations available for:

STEVAL-MKSBOX1V1 evaluation board

Blister Content:
- STEVAL-MKSBOX1V1 with 2 different cases, SD-Card and rechargeable battery
- JTAG20 to STDC14 adapter
- STDC14 cable
Multi sensor kit with portable sensor box and smart sensor app

Hardware Description

The STEVAL-MKSBOX1V1 (SensorTile.box) is a ready-to-use box kit with wireless IoT and wearable sensor platform to help you use and develop apps based on remote motion and environmental sensor data, regardless of your level of expertise.

The SensorTile.box board fits into a small plastic shroud with a long-life rechargeable battery, and the ST BLE Sensor app on your smartphone connects via Bluetooth to the board and allows you to immediately begin using the wide range of default IoT and wearable sensor applications.

SensorTile.box includes a firmware programming and debugging interface that allows professional developers to engage in more complex firmware code development using the STM32 Open Development Environment (STM32 ODE), which includes a sensing AI function pack with neural network libraries.

Key Product on board

- Ultra-low-power STM32L4 Series MCUs based on ARM® Cortex® -M4 MCU 120 MHz with 2048 kbytes Flash (STM32L4R9ZI)
- Accurate temperature: STTS751
- Low power precise 6x IMU: LSM6DSOX
- Stand-alone XLs: LIS3DHH, LIS2DW12
- Magnetometer: LIS2MDL
- Altimeter / pressure sensor: LPS22HH
- Wide-band microphone: MP23ABS1
- Humidity sensor: HTS221

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STEVAL-MKSBOX1V1
Software Description

The FP-SNS-STBOX1 is STM32Cube Function Pack for the Pro Mode of the SensorTile.box wireless multi sensor development kit (STEVAL-MKS1BOX1).

The purpose of this functional pack is to provide simple applications and examples that show how to build custom applications for STEVAL-MKS1BOX1 Pro Mode.

The expansion is built on STM32Cube software technology to ease portability across different STM32 microcontrollers.

Key features

• Complete examples and applications to develop node with BLE connectivity, analog microphone, environmental and motion sensors, and perform real-time monitoring of sensors and audio data

• Example of how use Ultra-low power implementation based on the use of an RTOS for transmitting the data with BLE

• Example of how create one Boot Loader and one application for allowing Firmware Over the Air update

• Compatible with ST BLE Sensor application for Android/iOS, to perform sensor data reading, audio and motion algorithm feature demo, and firmware update over the air (FOTA)

• Easy portability across different MCU families, thanks to STM32Cube

• Free, user-friendly license terms.

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- **Setup & Demo Examples**
  - Documents & Related Resources

- **STM32 Open Development Environment: Overview**
Setup & Application Examples

HW prerequisites

- 1x STEVAL-MKSBOX1V1 evaluation board
- Laptop/PC with Windows 7, 8 or 10
- 1 x micro USB cable
- 1x USB type A to Mini-B USB cable
- ST-Link/V2 in-circuit debugger/programmer for STM8 and STM32
• **STSW-LINK004**
  - STM32 ST-LINK Utility (STSW-LINK004) is a full-featured software interface for programming STM32 microcontrollers

• **FP-SNS-STBOX1**
  - Copy the .zip file content into a folder on your PC. The package will contain source code example (Keil, IAR, STM32Cube IDE) based on **STEVAL-MKSBOX1V1**

• **ST BLE Sensor** Application for [Android/iOS](https://play.google.com) to download from Google Store / iTunes
1. www.st.com/stm32ode-fp
2. Select FP-SNS-STBOX1
3. Download & unpack
4. FP-SNS-STBOX1 package structure
   - Docs
     - BSP, HAL and drivers
     - BlueNRG-1, FatFs, FreeRTOS
   - Applications & Examples
   - Boot loader binary
5. Compile/Flash and Run the project
6. Android™/iOS™ smartphone and ST ST BLE Sensor application
**FP-SNS-STBOX1**

**Installation procedure for BLEFOTA application**

**Important Note:** The BLEFOTA is different from the other applications/examples included in this functional pack. It must work with the Boot Loader to enable the Firmware Over the Air Update, and it requires a special installation procedure.

**How Install the code after compiling the project:**

- Compile the project with your preferred IDE
- On Windows: for each IDE there are two scripts:
  - **IAR toolchain Embedded Workbench:**
    - CleanBLEFOTA.bat (for using ST-Link)
    - CleanBLEFOTA_DFU.bat (for using STM32Cube Programmer when the board is in DFU mode)
  - **STM32CubeIDE toolchain:**
    - CleanBLEFOTA.bat (for using ST-Link)
    - CleanBLEFOTA_DFU.bat (for using STM32Cube Programmer when the board is in DFU mode)
  - **µVision toolchain - MDK-ARM Professional:**
    - CleanBLEFOTA.bat (for using ST-Link)
    - CleanBLEFOTA_DFU.bat (for using STM32Cube Programmer when the board is in DFU mode)
- For Linux/iOS: only for STM32CubeIDE there is one script that uses OpenOCD:
  - CleanBLEFOTA.sh

*It’s necessary to edit this file for setting the right installation and Library path*

- These scripts perform the following steps:
  1. Full Flash Erase
  2. Flash the right BootLoader at the right position (0x08000000)
  3. Flash the BLEFOTA firmware at the right position (0x08004000)
     - This is the firmware that was compiled with the IDE
     - This firmware is compatible with the FOTA update procedure
  4. Save a complete Binary FW that includes both BLEFOTA and the BootLoader
     - This binary can be directly flashed to STEVAL-MKSBOX1V1 board
     - **Important Note:** this additional pre-compiled binary is not compatible with the FOTA update procedure
When recompiling the code enabling the define called: `STBOX1_ENABLE_PRINTF` in `Inc/STBOX1_config.h` it is possible to enable the Virtual Com Port (USBD device) for the applications that use Bluetooth Low Energy:

- BLEFOTA
- BLELowPower
- BLESensors
- BLEMLC

In this way it is possible to control the initialization phase, to decide the board name [7chars] and to control what happens during the connection with the smartphone.

When you start the board, you can see the initialization phase and decide the Board Name.

When the board is connected to an Android or iOS device, you can see what happen.
The purpose of this application is to show an example for doing a Firmware Over the Air Update, asking a PIN (default==123456) for a secure BLE pairing. If the USDB Virtual Com Port is enabled, the BLE device will propose a random number that must be used for pairing.
ST BLE Sensor Application for Android/iOS

The purpose of this application is to show an example about how to program the Machine Learning Core present on LSM6DSOX 3D digital accelerometer and a 3D digital gyroscope. The example is able to program the accelerometer for running one Activity Recognition algorithm or one Vibration monitoring algorithm.
The purpose of this application is to show an example on how it is possible to send, in the easiest possible way, the output of the inertial and environmental sensors present on the board using Bluetooth Low Energy to a mobile device running the ST BLE Sensor app.
FP-SNS-STBOX1 (BLELowPower)

ST BLE Sensor Application for Android/iOS

The purpose of this application is to show an example of the use of FreeRTOS and Low Power techniques for sending the output of the inertial and environmental sensors present on the board, and the dB measured by the Analog microphone, using Bluetooth Low Energy to a mobile device running the ST BLE Sensor app.
The purpose of this application is to show an example of the use of FreeRTOS for saving the output of the inertial and environmental sensors present on the board, and the output of the Analog microphone, to the SD-card without loosing samples.

After the boot is possible to press the User button for starting/stoping the SD data logging.

At the end of each logging there will be 3 different files saved on SD-card:

- **Sens000.csv** in which the values of Acc/Gyro/Mag/Pressure/Temperature/Humidity are stored
- **Mic000.wav** in which the wave file for Analog Microphone at 16Khz is stored
- **Rep000.txt** in which the summary of used FreeRTOS queues and Max time for writing the Audio Buffer to the .wav file is stored

This is an example of such Report File:

```
------------------------------------------------------------
STMicroelectronics DataLog
  Version 1.0.0
  STM32L4R9ZI-SensorTile.box board
    (HAL 1.10.0_0)
  Compiled Jul 22 2019 14:21:31 (IAR)
------------------------------------------------------------
Pool Queue:
  Max Size  =2
  Released  =514
  Allocated =514
Message Queue:
  Max Size  =2
  Released  =526
  Allocated =526
Max time for writing 16384bytes for Audio =7 mSec
```
• The purpose of the BootLoader application is to show an example about how could be possible to create one Boot Loader for adding the Firmware update capability to one application.

• This project provides the source code of the pre-compiled bootloader binary used by the BLEFOTA application
The purpose of this application is to show how the USBD Virtual Com Port is able to dialog with the Unicleo-GUI. Further information on Unicleo-GUI is available at:
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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