Quick Start Guide

Motion MEMS and environmental sensor expansion board for STM32 Nucleo (X-NUCLEO-IKS01A1)
Quick Start Guide Contents

X-NUCLEO-IKS01A1: Motion MEMS and environmental sensor expansion board
Hardware and Software overview

Setup & Demo Examples
Documents & Related Resources

STM32 Open Development Environment: Overview
X-NUCLEO-IKS01A1 Hardware description

- The X-NUCLEO-IKS01A1 is a motion MEMS and environmental sensor evaluation board system.
- It is compatible with the Arduino UNO R3 connector layout, and is designed around ST’s latest sensors.

Key products on board

**LSM6DS0**
MEMS 3D accelerometer (±2/±4/±8 g) + 3D gyroscope (±245/±500/±2000 dps)

**LIS3MDL**
MEMS 3D magnetometer (±4/±8/±12/16 gauss)

**LPS25HB**
MEMS pressure sensor, 260-1260 hPa absolute digital output barometer

**HTS221**
Capacitive digital relative humidity and temperature

DIL 24-pin
Socket available for additional MEMS adapters and other sensors (UV index)

Latest info available at www.st.com

**X-NUCLEO-IKS01A1**

**Connector for the STM32 Nucleo Board**
Motion MEMS and environmental sensor expansion board

Hardware overview (2/2)

Key features

- The X-NUCLEO-IKS01A1 is a motion MEMS and environmental sensor evaluation board system.
- All sensor sensors are connected on a single I²C bus
- Sensor I²C address selection
- Each sensor has separate power supply lines allowing power consumption measurements
- Sensor disconnection (disconnects the I²C bus as well as the power supply)
- Interrupt and DRDY signals from sensors
- DIL24 socket (compatible with STEVAL-MKIV* MEMS adapter boards)

* is used as a wildcard character for related part number
X-CUBE-MEMS1 Software description

- The X-CUBE-MEMS1 software package is an expansion for STM32Cube, associated with the X-NUCLEO-IKS01A1 expansion board.
- It is compatible with NUCLEO-F401RE, NUCLEO-L053R8 or NUCLEO-L152RE

Key features

- Complete middleware to build applications using temperature and humidity sensors (HTS221), pressure sensor (LPS25HB) and motion sensors (LIS3MDL and LSM6DS0)
- Easy portability across different MCU families, thanks to STM32Cube
- Sample application to transmit real-time sensor data to a PC
- PC-based application (Windows®) to log sensor data
- Low-power optimization (suitable for the STM32L0 MCU family)
- Free, user-friendly license terms

Latest info available at www.st.com

X-CUBE-MEMS1
osxMotionFX Software description

- The package is an add-on for X-CUBE-MEMS1 providing real-time motion sensor data fusion and gyroscope bias and magnetometer calibration routines
- The package contains source code examples (Keil, IAR, System Workbench) based only on NUCLEO-F401RE

Key features

- osxMotionFX (iNEMOEngine PRO) real-time motion-sensor data fusion (under OPEN.MEMS license)
- Complete middleware to build applications using temperature and humidity sensor (HTS221), pressure sensor (LPS25HB) and motion sensors (LIS3MDL and LSM6DS0)
- Gyroscope bias and magnetometer calibration routine
- Easy portability across different MCU families, thanks to STM32Cube
- Sample application to transmit real-time both sensor data and sensor fusion data to a PC
- Sample implementation available on board X-NUCLEO-IKS01A1 when connected to NUCLEO-F401RE

Latest info available at www.st.com osxMotionFX
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- STM32 Open Development Environment: Overview
Setup & demo examples

Hardware prerequisites

- 1x Motion MEMS and environmental sensor expansion board (X-NUCLEO-IKS01A1)

- 1x STM32 Nucleo development board (NUCLEO-F401RE or NUCLEO-L053R8 or NUCLEO-L152RE)

- Windows 8/7 - Laptop/PC

- 1 x USB type A to mini-B USB cable
Setup & demo examples
Software prerequisites

- **STSW-LINK008**: ST-LINK/V2-1 USB driver
- **STSW-LINK007**: ST-LINK/V2-1 firmware upgrade
- **X-CUBE-MEMS1**
  - Copy the .zip file content into a folder on your PC
  - The package contains source code examples (Keil, IAR, System Workbench) based on NUCLEO-F401RE or NUCLEO-L053R8 or NUCLEO-L152RE
- **OSXMotionFX**
  - The package is an add-on for X-CUBE-MEMS1 providing real-time motion sensor data fusion and gyroscope bias and magnetometer calibration routines
  - The package contains source code examples (Keil, IAR, System Workbench) based only on NUCLEO-F401RE
X-CUBE-MEMS1 in 7 steps

Use of Sensors_DataLog GUI with precompiled BIN FW

**X-CUBE-MEMS1 for NUCLEO-F401RE or NUCLEO-L053R8 or NUCLEO-L152RE**

1. [www.st.com/x-nucleo](https://www.st.com/x-nucleo)

2. Select X-NUCLEO-IKS01A1

3. Download & unpack X-CUBE-MEMS1

4. Download & install STM32 Nucleo ST-LINK/V2-1 USB driver STSW-LINK008

5. Download / Install / Run ST-Link FW Upgrade utility STSW-LINK007

X-CUBE-MEMS1 package structure

- **Docs**
  - Low-level sensor drivers
  - Serial utility
  - L0 / F4 / L1 DataLog FW src code + binary
  - PC GUI (Sensors_DataLog)

**XML**

**HTML**
X-CUBE-MEMS1 in 7 steps

Use of Sensors_DataLog GUI with precompiled BIN fmw

X-CUBE-MEMS1 for NUCLEO-F401RE or NUCLEO-L053R8 or NUCLEO-L152RE

Open Utilities Folder in the X-CUBE-MEMS1 SW package

6

drag and drop DataLog.bin for F4 or for L0 or for L1 on Nucleo drive

7

...and Run Sensors_DataLog PC GUI
**X-CUBE-MEMS1**

**Utilities - Sensors_DataLog**

**X-CUBE-MEMS1 for NUCLEO-F401RE, NUCLEO-L053R8 or NUCLEO-L152RE**

1. Select COM port
2. Select sensor reading interval
3. Select sensors
4. Select graph plots
5. Start data logging

**Sensors_DataLog PC GUI**

**Data Log Area**
X-CUBE-MEMS1
 Compile the DataLog FW using a supported IDE

X-CUBE-MEMS1 for NUCLEO-F401RE, NUCLEO-L053R8 or NUCLEO-L152RE

1. www.st.com/x-nucleo
2. Select X-NUCLEO-IKS01A1
3. Download & unpack X-CUBE-MEMS1
4. Flash and run the project.

X-CUBE-MEMS1 package structure:
- Docs
  - Low-level sensor drivers
- Serial utility
- L0 / F4 / L1 example (DataLog FW)
- PC GUI (Sensors_DataLog)

Flash and run the project.

.\STM32CubeExpansion_MEMS1_V1.3.0\Projects\Multi\Examples\DataLog\EWARM\STM32F401RE-Nucleo
Using serial line monitor – e.g. TeraTerm

X-CUBE-MEMS1 for NUCLEO-F401RE, NUCLEO-L053R8 or NUCLEO-L152RE

- Close the Sensors_DataLog GUI
- Configure the serial line monitor (speed, LF)
- Press the **BLUE** user button on STM32Nucleo
OSXMotionFX in few steps
OSXMotionFX Sensor Fusion license request

OSXMotionFX for NUCLEO-F401RE

1. Download OSXMotionFX
   www.st.com/openmems

2. Installer
   OSXMotionFX

3. Install OSXMotionFX in the X-CUBE-MEMS1 workspace
OSXMotionFX in few steps
OSXMotionFX Sensor Fusion license request

OSXMotionFX for NUCLEO-F401RE

1. Click: Send License request email
2. c:\Program Files (x86)\STMicroelectronics\OpenSoftwareX\OSX_LicenseWizard\c:\Program Files (x86)\STMicroelectronics\OpenSoftwareX\OSX_LicenseWizard\c:\Program Files (x86)\STMicroelectronics\OpenSoftwareX\OSX_LicenseWizard\c:\Program Files (x86)\STMicroelectronics\OpenSoftwareX\OSX_LicenseWizard\c:\Program Files (x86)\STMicroelectronics\OpenSoftwareX\OSX_LicenseWizard\c:\Program Files (x86)\STMicroelectronics\OpenSoftwareX\OSX_LicenseWizard\c:\Program Files (x86)\STMicroelectronics\OpenSoftwareX\OSX_LicenseWizard\c:\Program Files (x86)\STMicroelectronics\OpenSoftwareX\OSX_LicenseWizard\c:\Program Files (x86)\STMicroelectronics\OpenSoftwareX\OSX_LicenseWizard
3. Click: Identify STM32Nucleo board
4. Enter user information
5. Click: Generate license request
6. Run OsX License wizard

Click: Send License request email
Click: Identify STM32Nucleo board
Enter user information
Click: Generate license request
OSXMotionFX in 5 steps
Start using the DataLogFusion or coding your ideas in just few minutes

OSXMotionFX for NUCLEO-F401RE

1. License activation email received

2. Copy the license key in osx_license.h located in

   \STM32CubeExpansion_MEMS1_V1.3.0\Middlewares\ST\STM32_OSX_MotionFX_Library\n
3. Open for example IAR project from

   \STM32CubeExpansion_MEMS1_V1.3.0\Projects\STM32F4xx-Nucleo\Applications\DataLogFusion\EWARM\n
4. Flash and Run the project

5. • Run the X-CUBE-MEMS1 GUI
   • Click: Start Sensor Fusion
   • Make figure-8 movement to calibrate magnetometer, green LED2 on

Start developing (demo project included)
X-NUCLEO-IKS01A1:

- Gerber files, BOM, Schematics
- DS10619: Motion MEMS and environmental sensor expansion board for STM32 Nucleo – Data brief
- UM1820: Getting started with motion MEMS and environmental sensor expansion board for STM32 Nucleo – User manual

X-CUBE-MEMS1:

- DB2442: Motion MEMS and environmental sensor software expansion for STM32Cube – Data brief
- UM1859: Getting started with the X-CUBE-MEMS1 motion MEMS and environmental sensor software expansion for STM32Cube – User manual
- Software Setup File

osxMotionFX:

- DB2531: Real-time motion-sensor data fusion software expansion for STM32Cube – Data brief
- UM1866: Getting started with the osxMotionFx fusion and compass library for X-CUBE-MEMS1 expansion for STM32Cube – User manual
- Software setup file

Consult www.st.com for the complete list
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STM32 Open Development Environment: Overview
The STM32 Open Development Environment (ODE) consists of a set of stackable boards and a modular open SW environment designed around the STM32 microcontroller family.

- STM32Cube development software
- STM32 Nucleo development boards
- STM32Cube expansion software (X-CUBE)
- STM32 Nucleo expansion boards (X-NUCLEO)

Function Packs (FP)

www.st.com/stm32ode
STM32 Nucleo Development Boards (NUCLEO)

- A comprehensive range of affordable development boards for all the STM32 microcontroller series, with unlimited unified expansion capabilities and integrated debugger/programmer functionality.

Power supply through USB or external source

STM32 microcontroller

Complete product range from ultra-low power to high-performance

Integrated debugging and programming ST-LINK probe

ST morpho extension header

Arduino™ UNO R3 extension headers

www.st.com/stm32nucleo
STM32 Nucleo
Expansion Boards (X-NUCLEO)

- Boards with additional functionality that can be plugged directly on top of the STM32 Nucleo development board directly or stacked on another expansion board.

Example of STM32 expansion board (X-NUCLEO-IKS01A1)

www.st.com/x-nucleo
STM32 Open Development Environment
Software components

- **STM32Cube software (CUBE)** - A set of free tools and embedded software bricks to enable fast and easy development on the STM32, including a Hardware Abstraction Layer and middleware bricks.

- **STM32Cube expansion software (X-CUBE)** - Expansion software provided free for use with the STM32 Nucleo expansion board and fully compatible with the STM32Cube software framework. It provides abstracted access to expansion board functionality through high-level APIs and sample applications.

- **Compatibility with multiple Development Environments** - The STM32 Open Development Environment is compatible with a number of IDEs including IAR EWARM, Keil MDK, and GCC-based environments. Users can choose from three IDEs from leading vendors, which are free of charge and deployed in close cooperation with ST. These include Eclipse-based IDEs such as Ac6 System Workbench for STM32 and the MDK-ARM environment.

**Tools & IDEs**
- IAR EWARM, Keil MDK-ARM, GCC-based IDEs (e.g. Ac6 System Workbench for STM32)

**Applications**
- Sample applications
- Application examples (e.g. based on ST OpenSoftwareX)

**Middleware**
- STM32Cube middleware
- Upper level middleware (e.g. ST OpenSoftwareX)
- STM32Cube expansion middleware

**Hardware Abstraction**
- STM32Cube Hardware Abstraction Layer (HAL)

**Hardware**
- STM32 Nucleo expansion boards (X-NUCLEO)
- STM32 Nucleo developer boards

**OPEN LICENSE MODELS:** STM32Cube software and sample applications are covered by a mix of fully open source BSD license and ST licenses with very permissive terms.

www.st.com/stm32cube
www.st.com/x-cube
STM32 Open Development Environment
Building block approach

The building blocks

- Sense
  - Accelerometer, gyroscope
  - Inertial modules, magnetometer
  - Pressure, temperature, humidity
  - Proximity, microphone
  - Bluetooth LE, Sub-GHz radio
  - NFC, Wi-Fi, GNSS

- Connect
  - Audio amplifier
  - Touch controller
  - Operation Amplifier
  - Stepper motor driver
  - DC & BLDC motor driver
  - Industrial input / output

- Translate
  - Energy management & battery
  - General-purpose microcontrollers
  - Secure microcontrollers

- Move / Actuate
  - Stepper motor driver
  - DC & BLDC motor driver
  - Industrial input / output

- Power

- Process

- Software

Your need

- COLLECT
- TRANSMIT
- ACCESS
- CREATE
- POWER
- PROCESS

Our answer

www.st.com/stm32ode