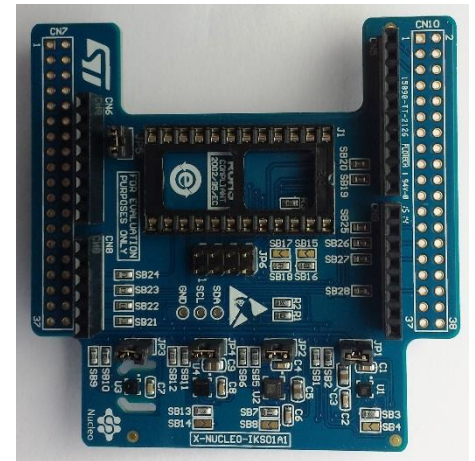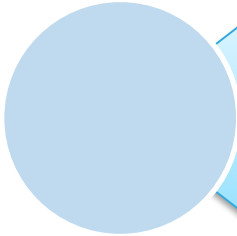# Quick Start Guide

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

life.augmented

Version 1.2.0 (May 26, 2016)

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)
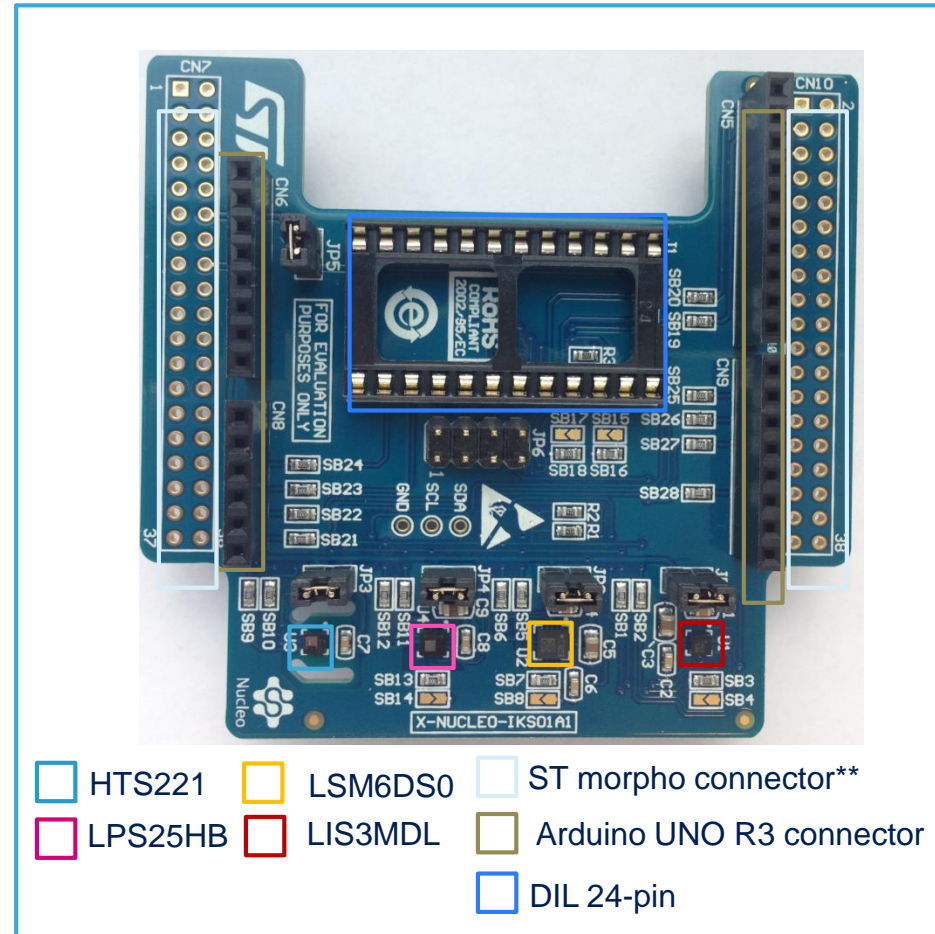
LPS25HB

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)

- ☐ HTS221
- ☐ LPS25HB
- ☐ LSM6DS0
- ☐ LIS3MDL
- ☐ ST morpho connector**
- ☐ Arduino UNO R3 connector
- ☐ DIL 24-pin

Latest info available at www.st.com
X-NUCLEO-IKS01A1

** Connector for the STM32 Nucleo Board

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-MKI***V* MEMS adapter boards)
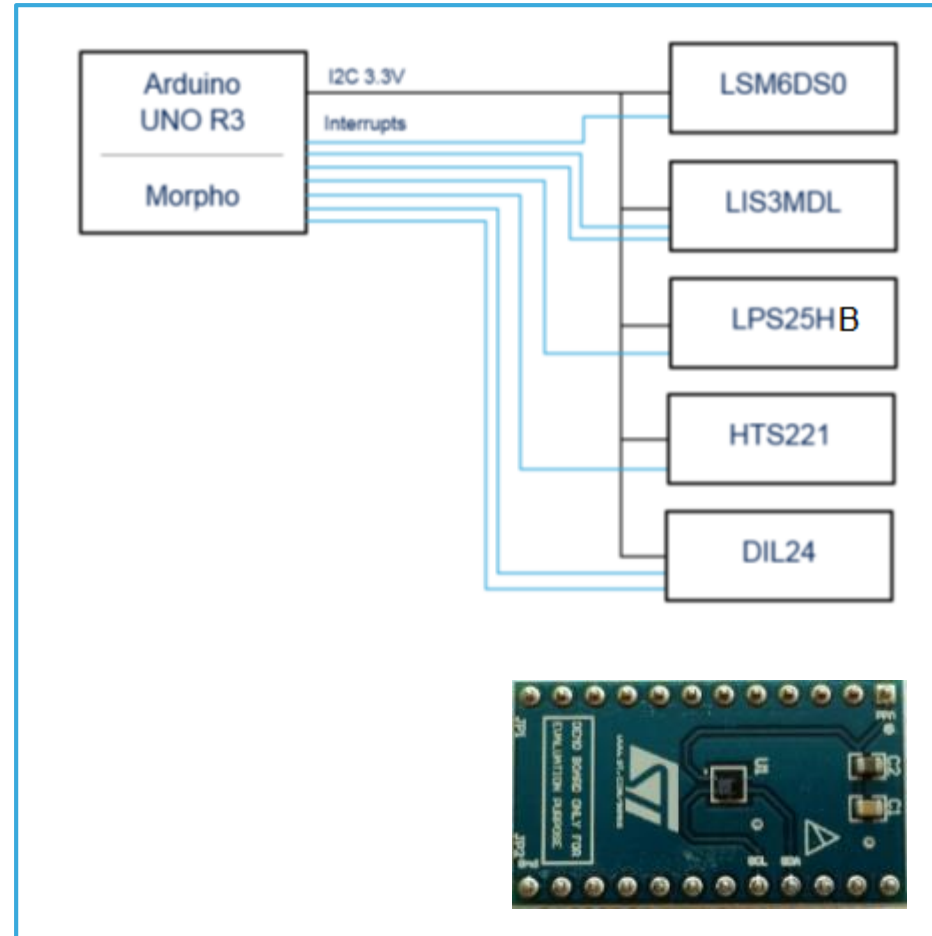
X-CUBE-MEMS1 Software description

- 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
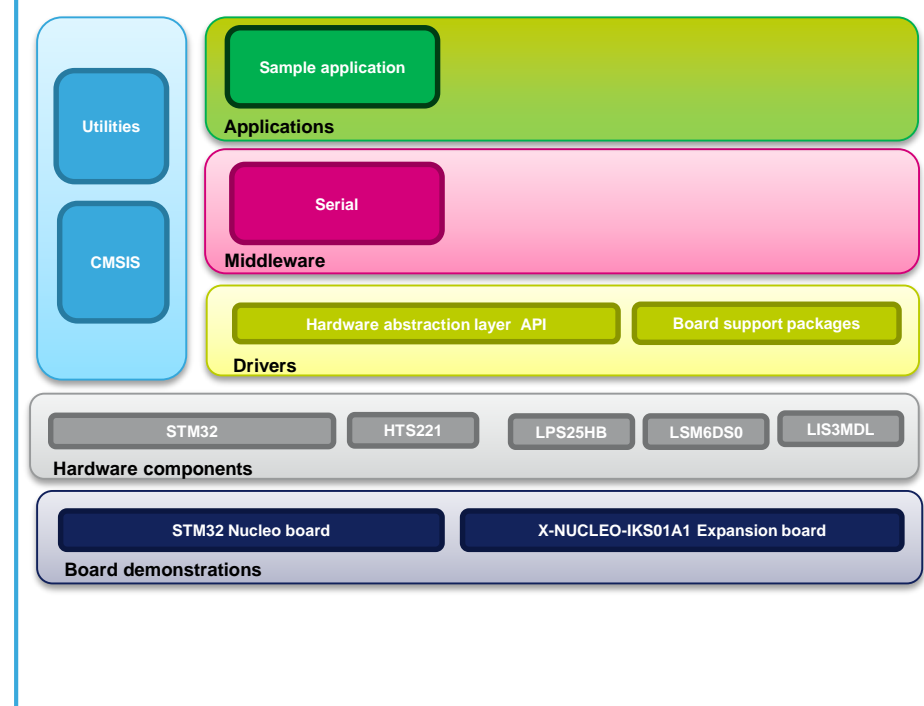
Key features

- 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

Overall Software Architecture

Utilities	Sample application
	Applications
CMSIS	Serial
	Middleware
	Hardware abstraction layer API Board support packages
	Drivers

Hardware components: STM32   HTS221   LPS25HB   LSM6DS0   LIS3MDL

Board demonstrations: STM32 Nucleo board   X-NUCLEO-IKS01A1 Expansion board

Latest info available at www.st.com
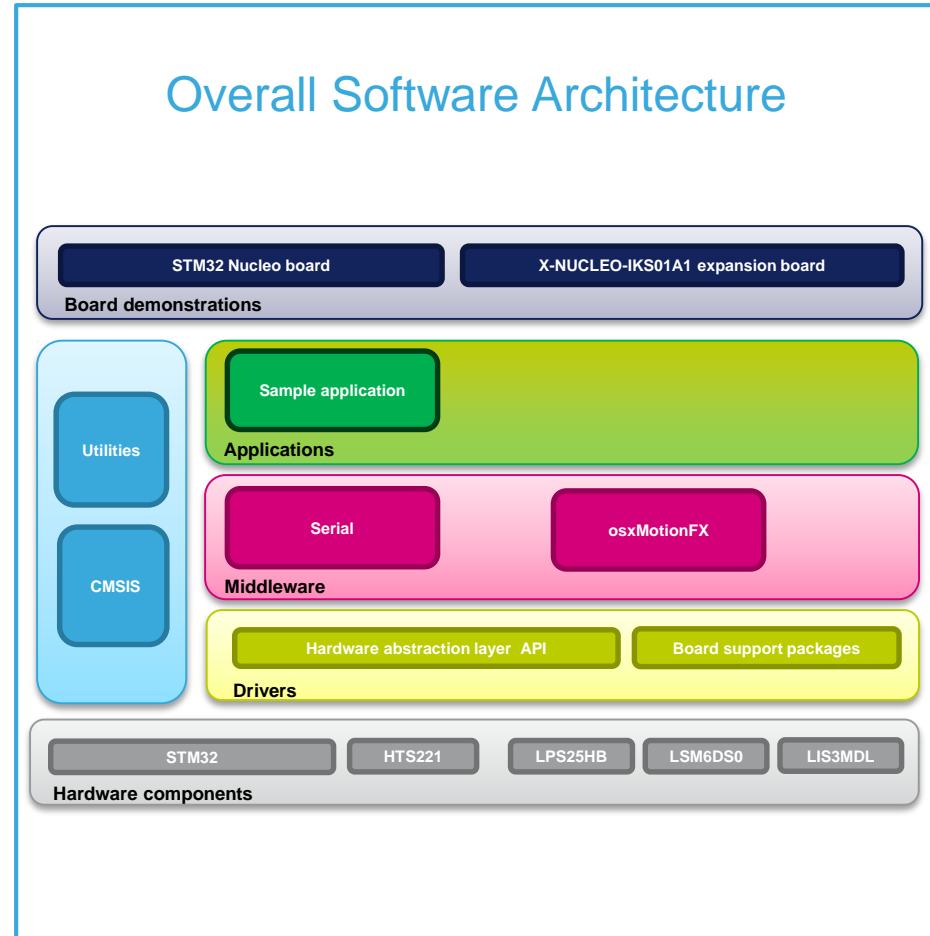**X-CUBE-MEMS1**

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
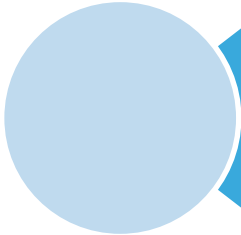
Key features

- 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
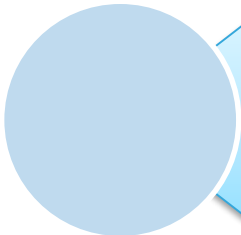
Overall Software Architecture

STM32 Nucleo board	X-NUCLEO-IKS01A1 expansion board

Board demonstrations

Utilities

CMSIS

Sample application

Applications

Serial	osxMotionFX

Middleware

Hardware abstraction layer API	Board support packages

Drivers

STM32	HTS221	LPS25HB	LSM6DS0	LIS3MDL

Hardware components

Latest info available at www.st.com
osxMotionFX

Quick Start Guide Contents

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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

NUCLEO-F401RE
NUCLEO-L053R8
NUCLEO-L152RE
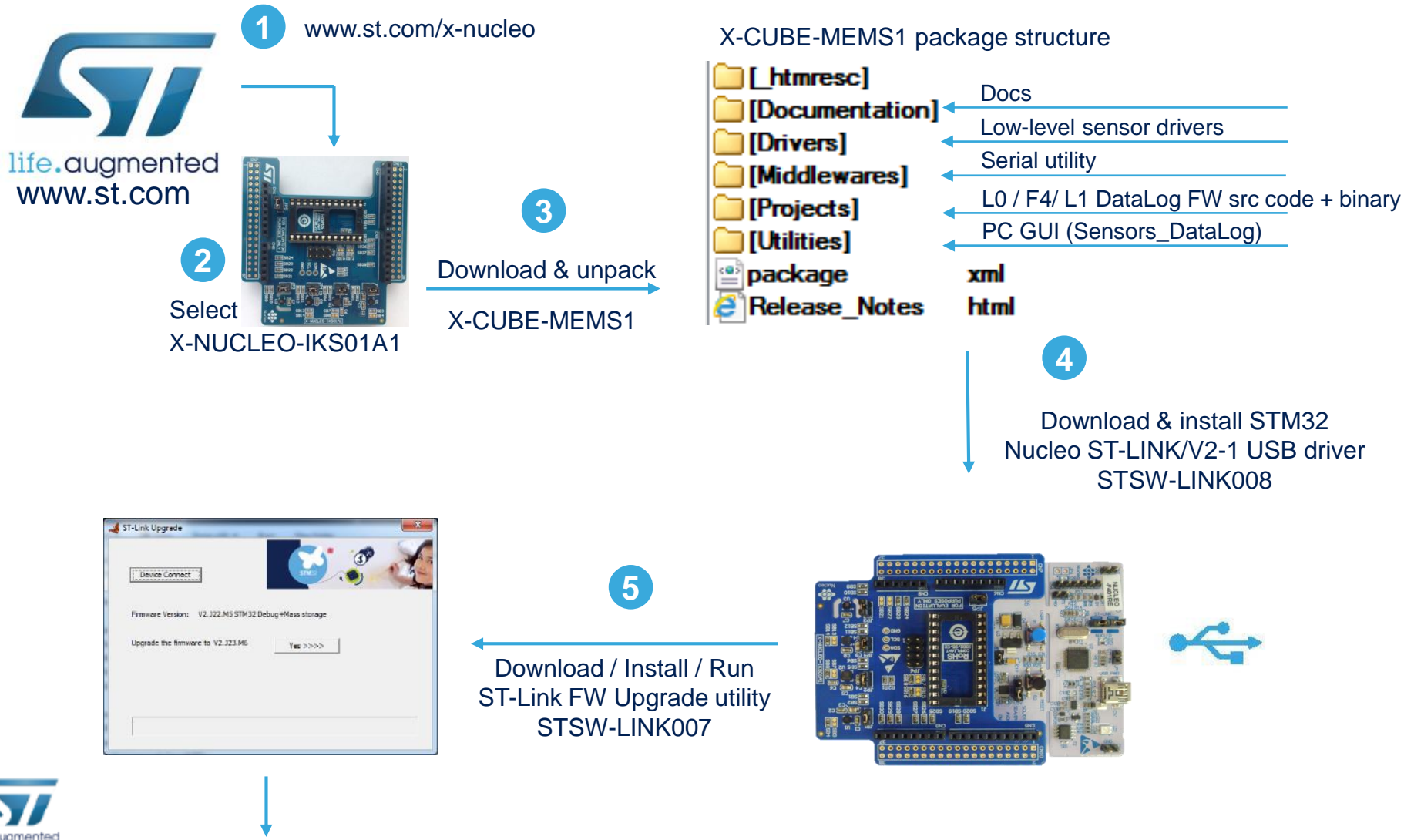
Mini USB Cable

X-NUCLEO-IKS01A1

- **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**

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

life.augmented
www.st.com

2

Select
X-NUCLEO-IKS01A1

3

Download & unpack

X-CUBE-MEMS1

X-CUBE-MEMS1 package structure

[_htmresc]
[Documentation] — Docs
[Drivers] — Low-level sensor drivers
[Middlewares] — Serial utility
[Projects] — L0 / F4/ L1 DataLog FW src code + binary
[Utilities] — PC GUI (Sensors_DataLog)
package   xml
Release_Notes   html

4

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

5

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

ST-Link Upgrade

Device Connect

Firmware Version: V2.J22.M5 STM32 Debug +Mass storage

Upgrade the firmware to V2.J23.M6   Yes >>>>

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Use of Sensors_DataLog GUI with precompiled BIN fmw

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

\STM32CubeExpansion_MEMS1_V1.3.0\Projects\Multi\Examples\DataLog\Binary\STM32F401RE-Nucleo
\STM32CubeExpansion_MEMS1_V1.3.0\Projects\Multi\Examples\DataLog\Binary\STM32L053R8-Nucleo
\STM32CubeExpansion_MEMS1_V1.3.0\Projects\Multi\Examples\DataLog\Binary\STM32L152RE-Nucleo

6

drag and drop
DataLog.bin for F4 or for L0 or for L1
on Nucleo drive
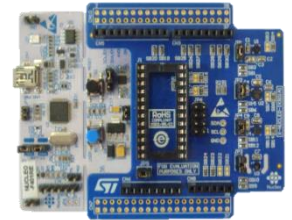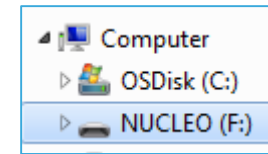
Open Utilities Folder in the X-CUBE-MEMS1 SW package

7

…and Run Sensors_DataLog
PC GUI
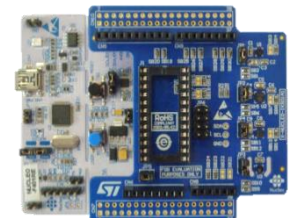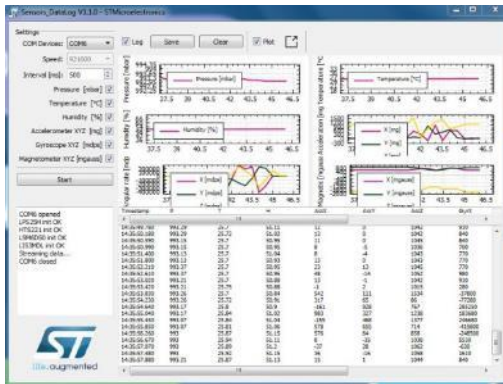
X-CUBE-MEMS1 for NUCLEO-F401RE, NUCLEO-L053R8 or NUCLEO-L152RE

Select COM port **1**

4 Select graph plots

2

Select sensor reading interval
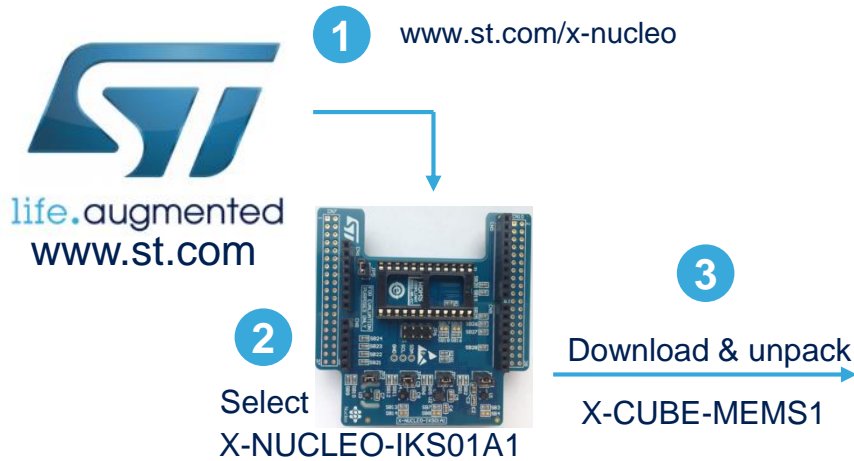
3
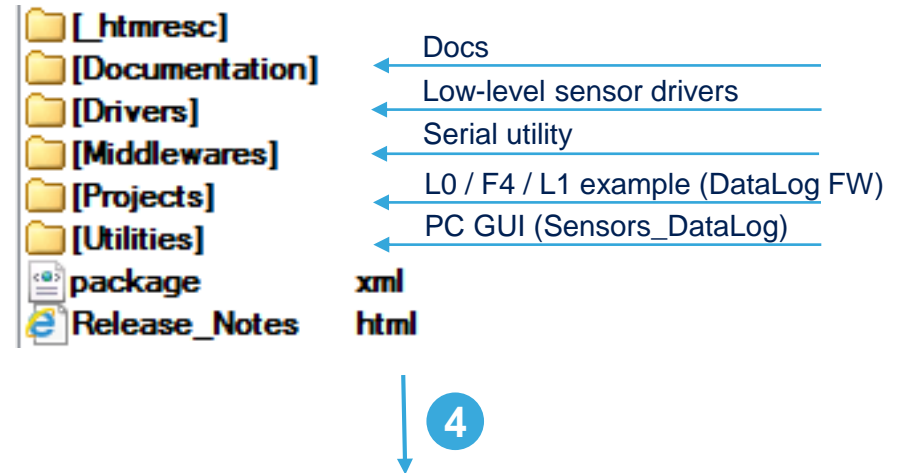
Select sensors

5

Start data logging

Sensors_DataLog **PC GUI**

Data Log Area

Compile the DataLog FW using a supported IDE

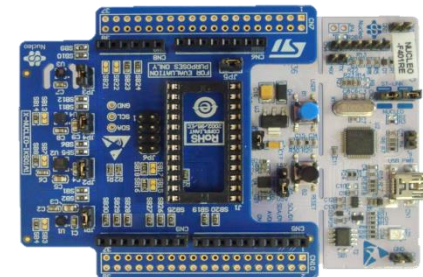## X-CUBE-MEMS1 for NUCLEO-F401RE, NUCLEO-L053R8 or NUCLEO-L152RE

1 www.st.com/x-nucleo

X-CUBE-MEMS1 package structure

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www.st.com

[_htmresc]
[Documentation] ← Docs
[Drivers] ← Low-level sensor drivers
[Middlewares] ← Serial utility
[Projects] ← L0 / F4 / L1 example (DataLog FW)
[Utilities] ← PC GUI (Sensors_DataLog)
package xml
Release_Notes html

2 Select
X-NUCLEO-IKS01A1

3 Download & unpack
X-CUBE-MEMS1

4

.\STM32CubeExpansion_MEMS1_V1.3.0\Projects\Multi\Examples\DataLog\EWARM\STM32F401RE-Nucleo

KEIL Tools by ARM

IAR SYSTEMS

Open STM32 Tools

Flash and run the project.

life.augmented
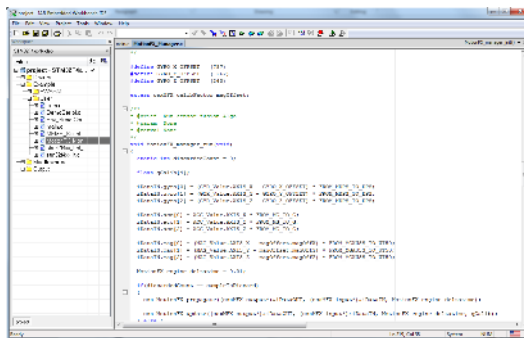
X-CUBE-MEMS1 for NUCLEO-F401RE, NUCLEO-L053R8 or NUCLEO-L152RE

- Close the Sensors_DataLog GUI

- Configure the serial line monitor (speed, LF)

- Press the **BLUE** user button on STM32Nucleo
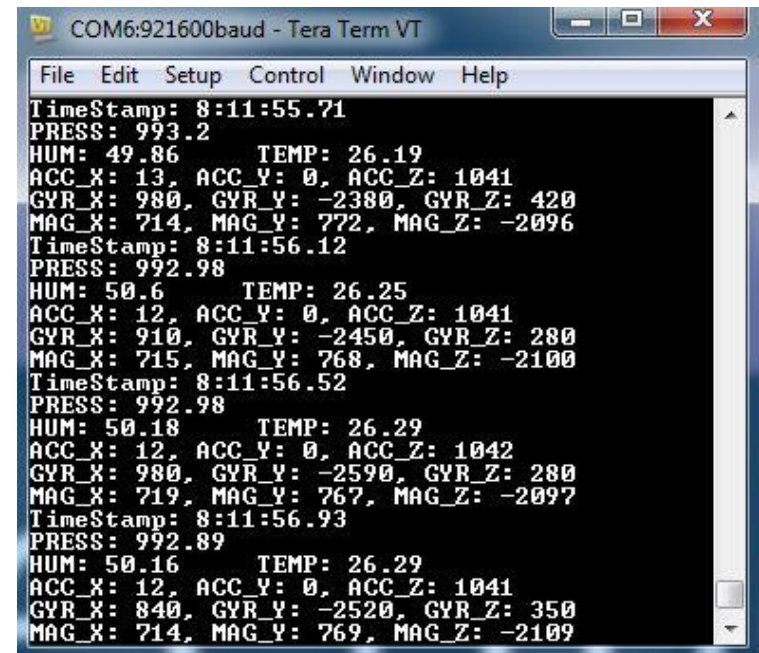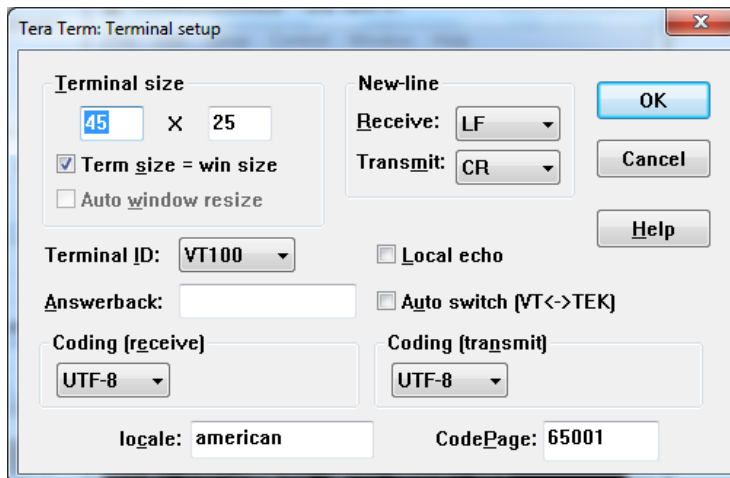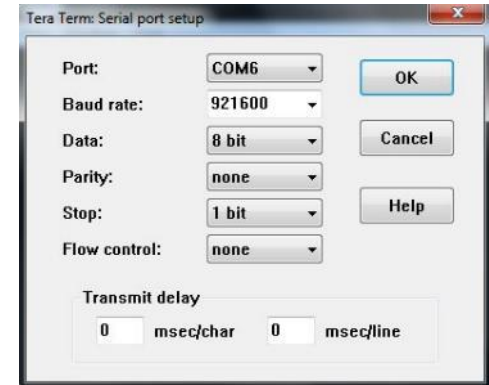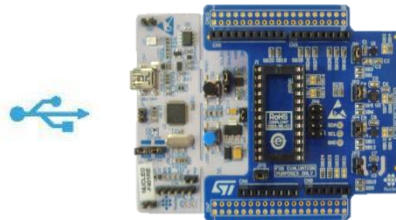
OSXMotionFX for NUCLEO-F401RE

1 Download OSXMotionFX
www.st.com/openmems

www.st.com

2 Installer
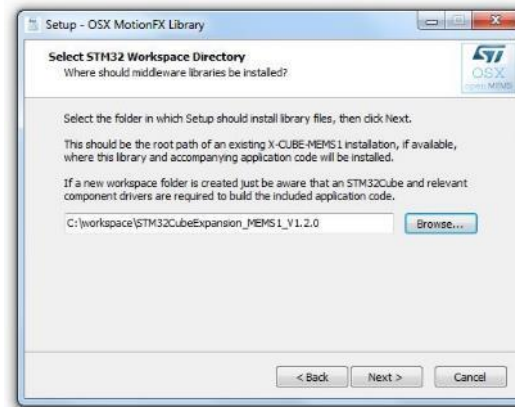
OSXMotionFX

3 Install OSXMotionFX
in the X-CUBE-MEMS1
workspace

OSXMotionFX for NUCLEO-F401RE

3
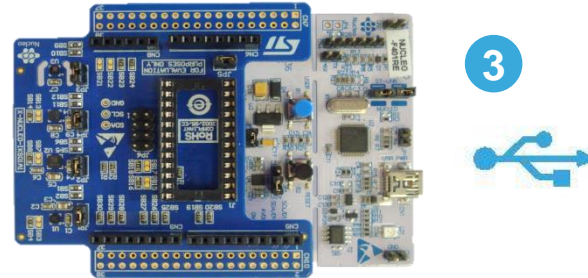
c:\Program Files (x86)\STMicroelectronics\OpenSoftwareX\OSX_LicenseWizard

OpenSoftwareX.licensing

4 Run OsX License wizard
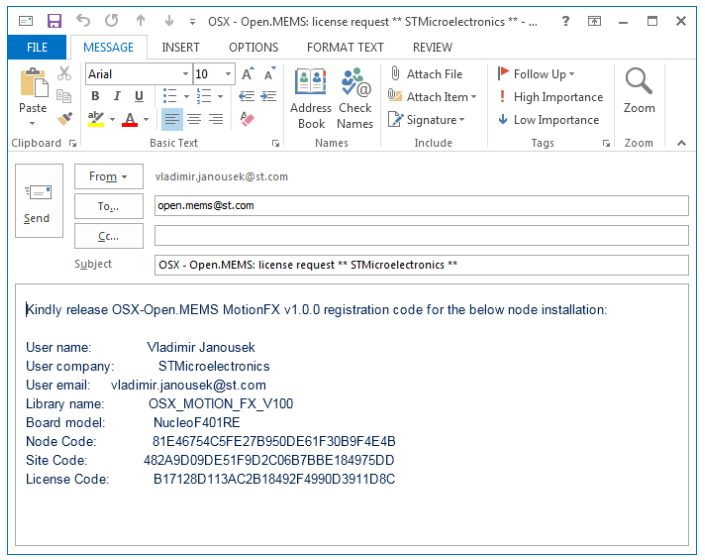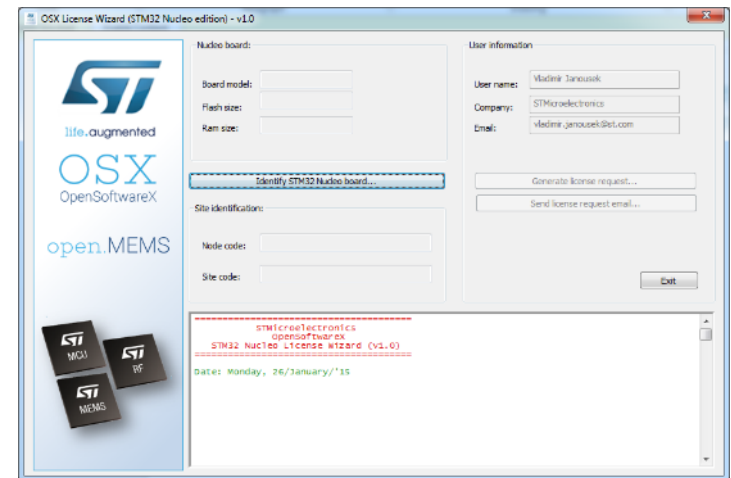
Click: Send License request email

6

- Click: Identify STM32Nucleo board
- Enter user information
- Click: Generate license request

5

Start using the DataLogFusion or coding your ideas in just few minutes

OSXMotionFX for NUCLEO-F401RE

OpenSoftwareX.licensing

1 License activation email received
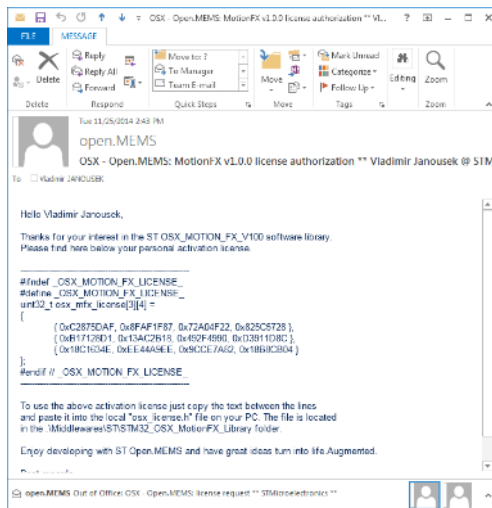
2 Copy the license key in osx_license.h located in

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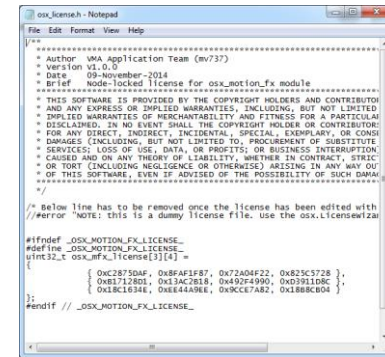
3 Open for example IAR project from

. \STM32CubeExpansion_MEMS1_V1.3.0\Projects\STM32F4xx-Nucleo\Applications\DataLogFusion\EWARM

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

Flash and Run the project
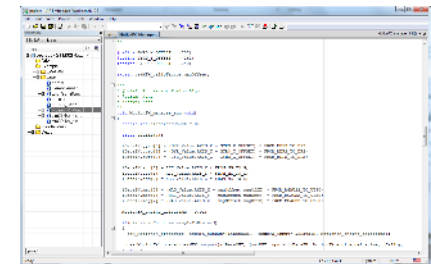
4

Start developing
(demo project included)
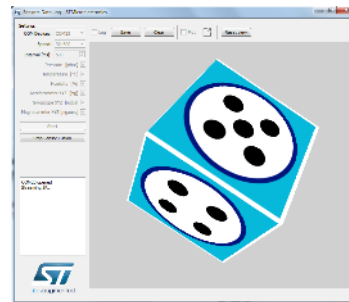
. \STM32CubeExpansion_MEMS1_V1.3.0\Utilities\PC_software\Sensors_DataLog

Documents & related resources

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

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**
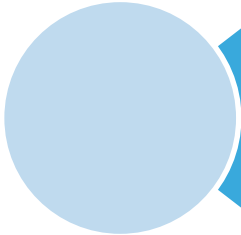
X-CUBE-MEMS1:

- **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
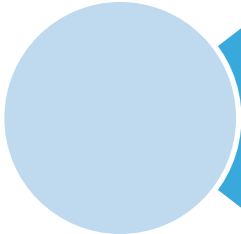
osxMotionFX:

- **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
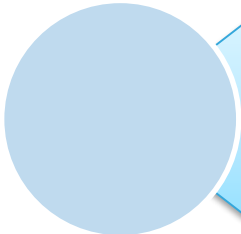
Consult www.st.com for the complete list

Quick Start Guide Contents

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

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Documents & Related Resources

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
expansion boards
(X-NUCLEO)

STM32 Open Development Environment

STM32 Nucleo
development boards

STM32Cube
expansion software
(X-CUBE)

Function Packs
(FP)
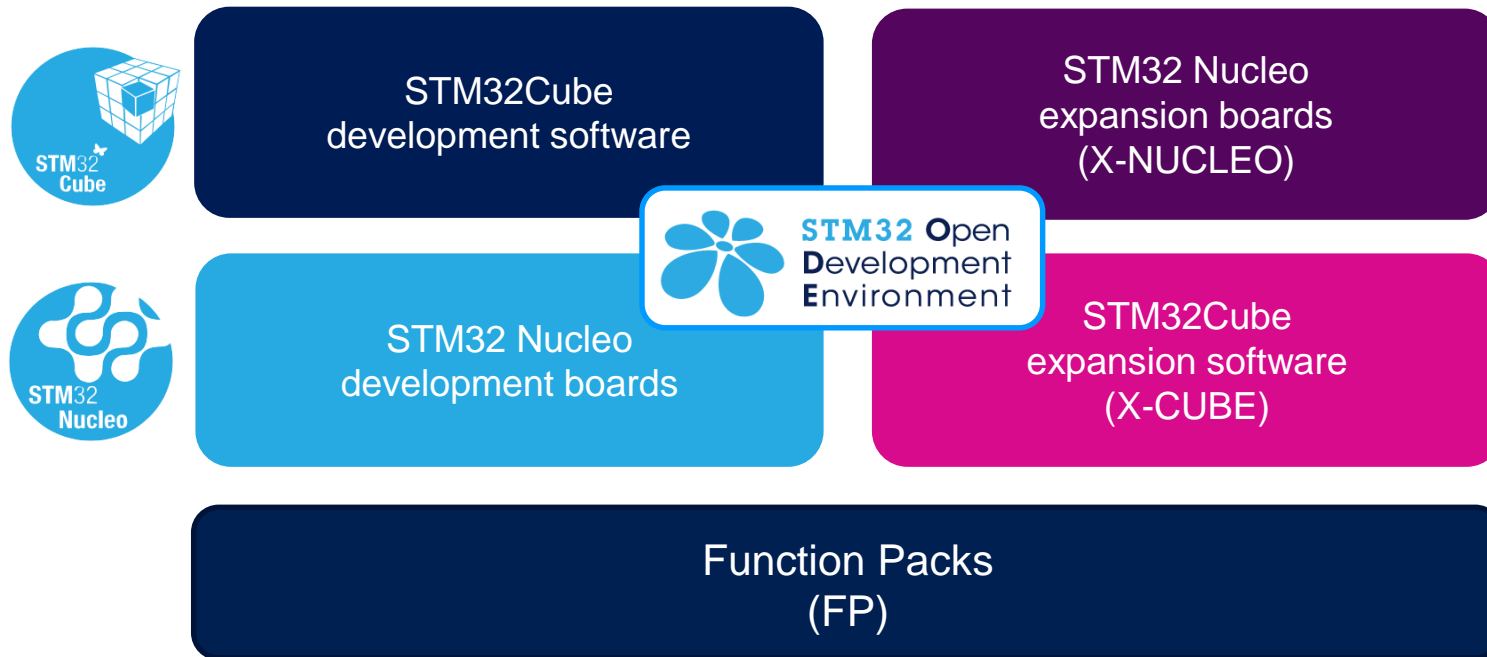
www.st.com/stm32ode

- 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

Integrated debugging and programming ST-LINK probe

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

ST morpho extension header

Arduino™ UNO R3 extension headers
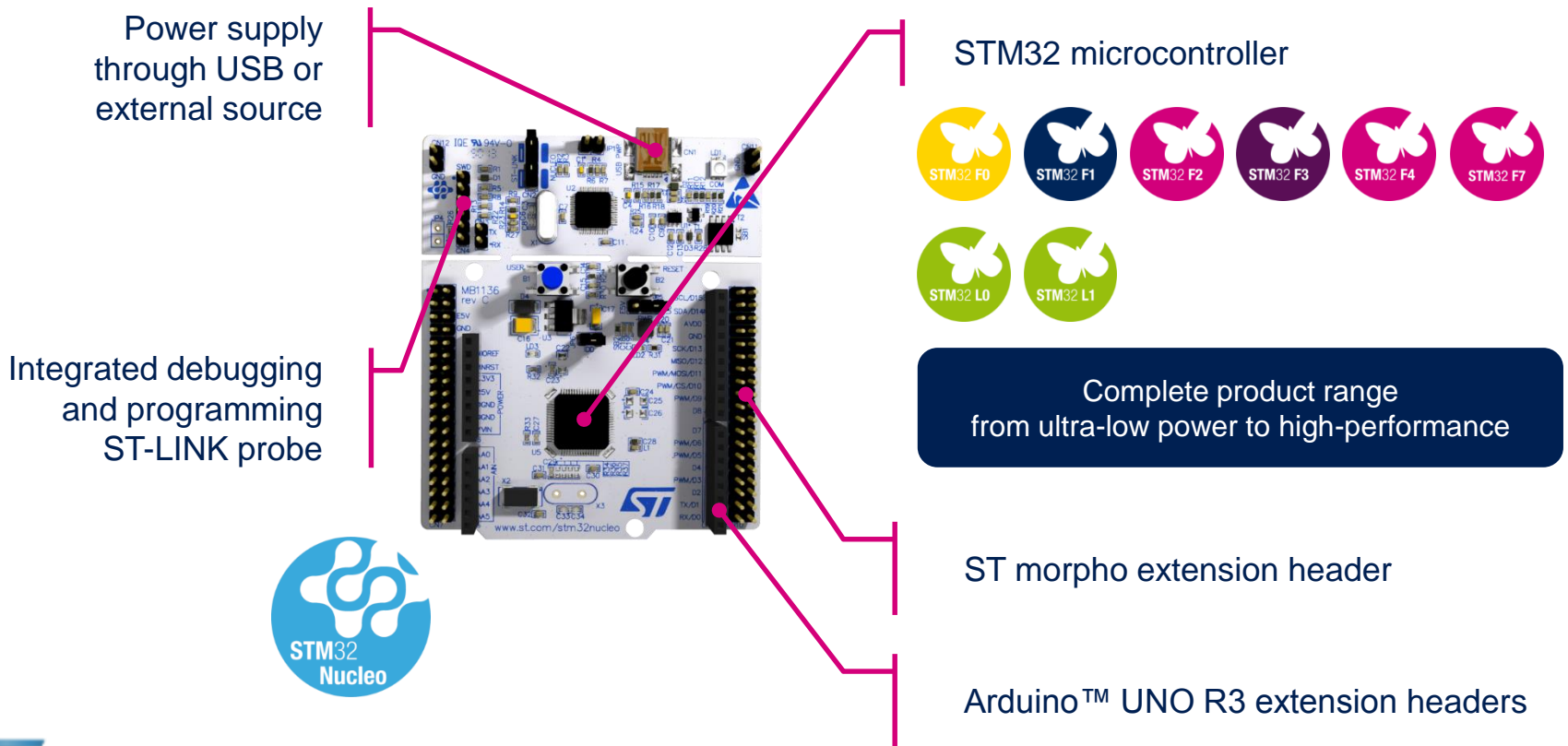
STM32 Nucleo
Expansion Boards (X-NUCLEO)

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

Sense

Connect

Power

Move/Actuate

Interact

Motion MEMS sensors

Environmental sensors

DIL24 support for new devices
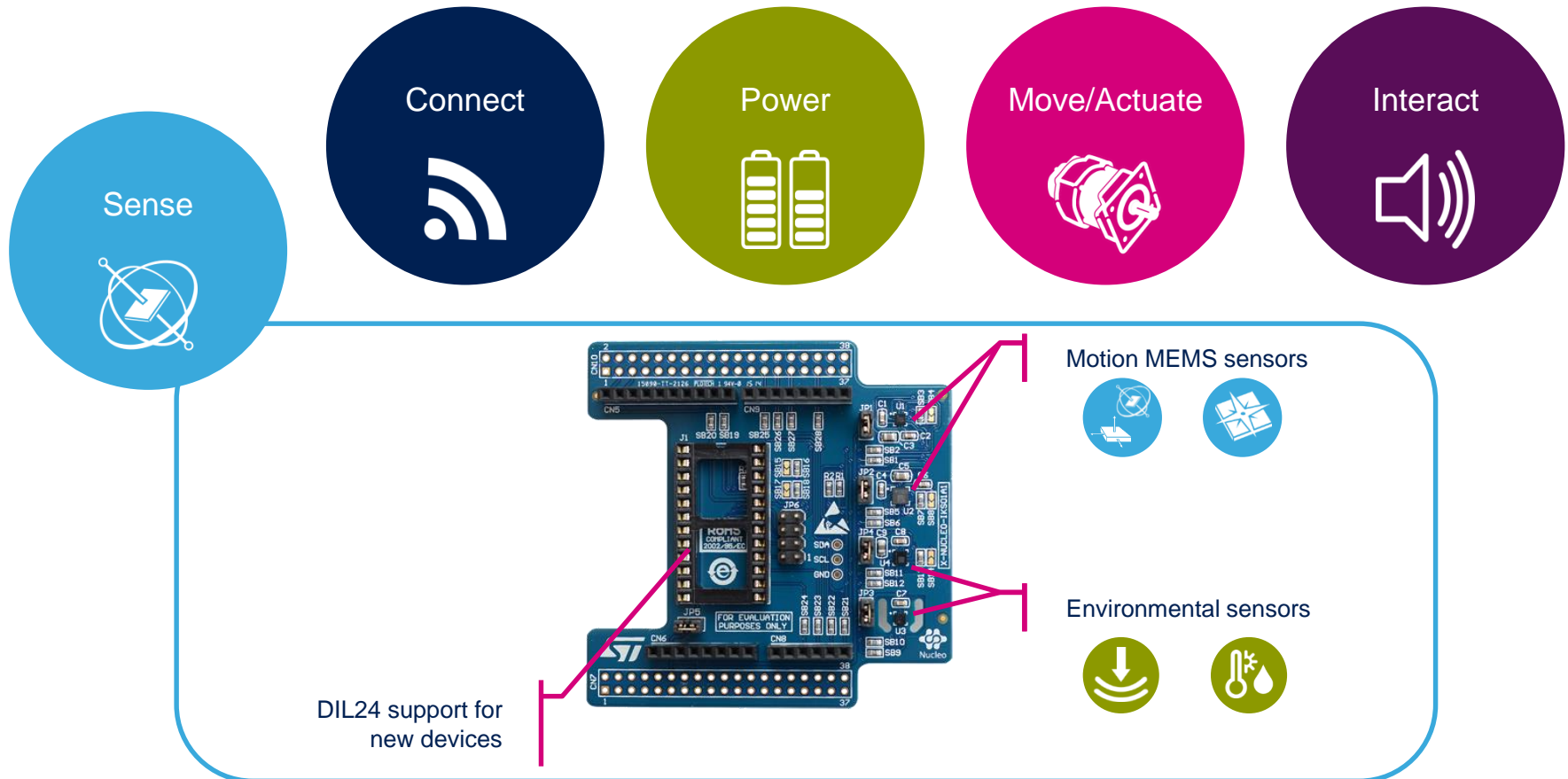
Example of STM32 expansion board (X-NUCLEO-IKS01A1)

www.st.com/x-nucleo

- **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.

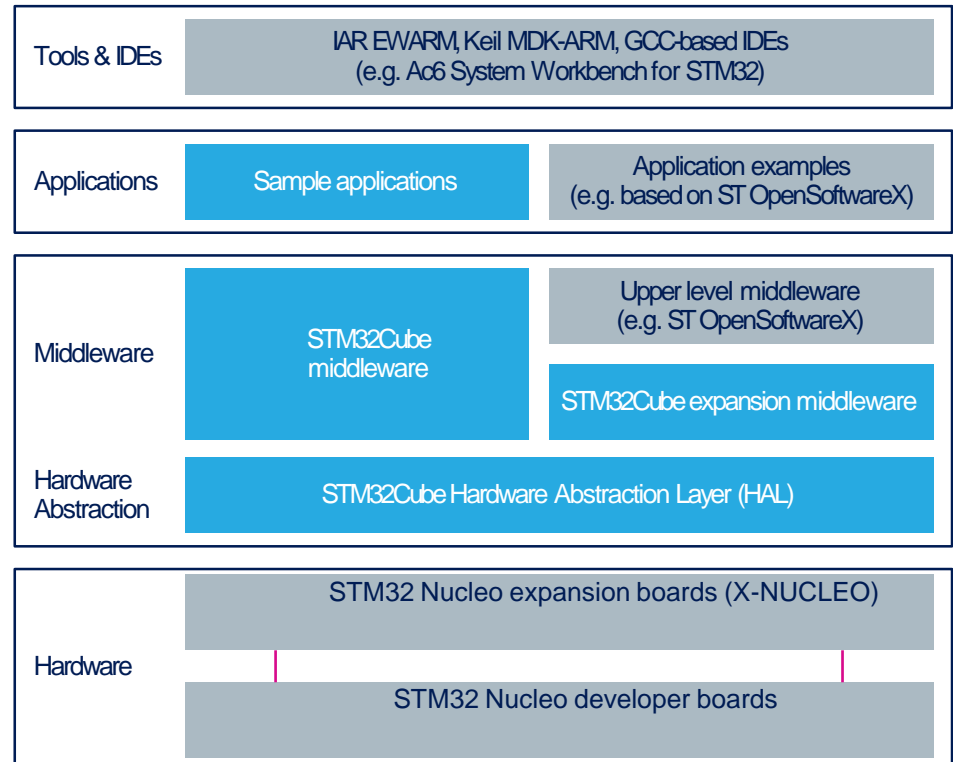| Tools & IDEs	IAR EWARM, Keil MDK-ARM, GCC-based IDEs (e.g. Ac6 System Workbench for STM32)	
Applications	Sample applications	Application examples (e.g. based on ST OpenSoftwareX)
Middleware	STM32Cube middleware	Upper level middleware (e.g. ST OpenSoftwareX)
		STM32Cube expansion middleware
Hardware Abstraction	STM32Cube Hardware Abstraction Layer (HAL)	

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

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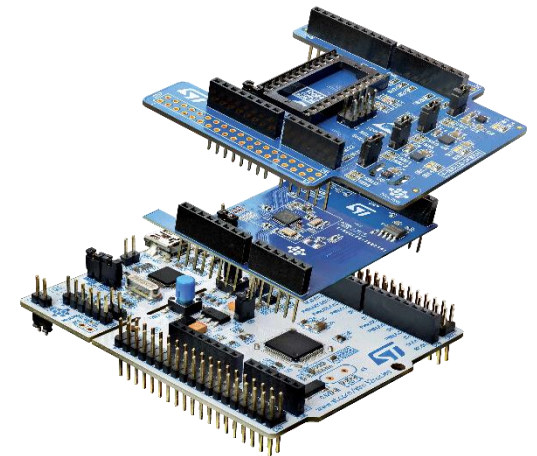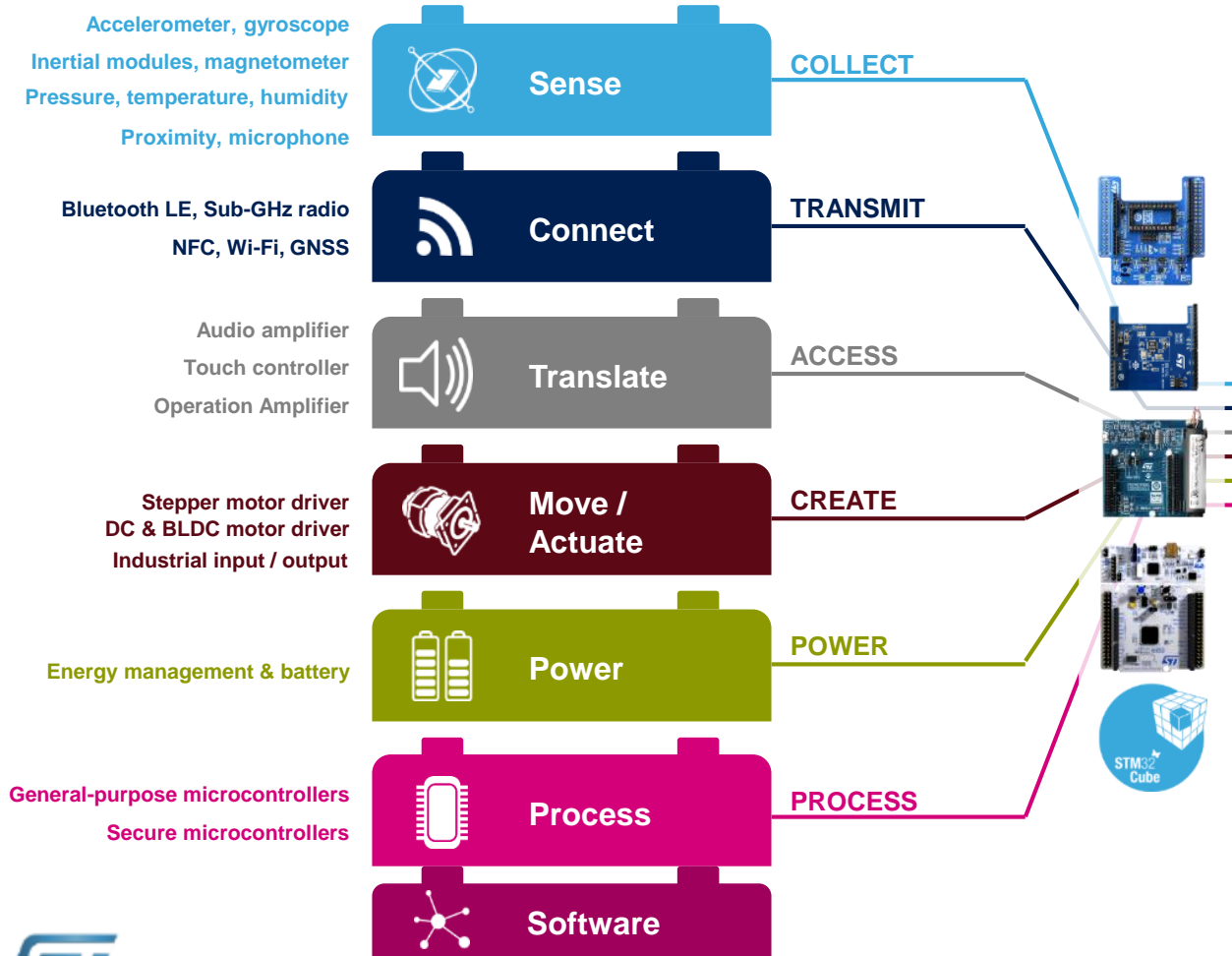
OPEN LICENSE MODELS: STM32Cube software and sample applications are covered by a mix of fully open source BSD license and ST licenses with very permissive terms.

www.st.com/stm32cube

www.st.com/x-cube

The building blocks	Your need	Our answer

Sense
- Accelerometer, gyroscope
- Inertial modules, magnetometer
- Pressure, temperature, humidity
- Proximity, microphone

COLLECT

Connect
- Bluetooth LE, Sub-GHz radio
- NFC, Wi-Fi, GNSS

TRANSMIT

Translate
- Audio amplifier
- Touch controller
- Operation Amplifier

ACCESS

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

CREATE

Power
- Energy management & battery

POWER

Process
- General-purpose microcontrollers
- Secure microcontrollers

PROCESS

Software

STM32 Open Development Environment

STM32 Cube

www.st.com/stm32ode