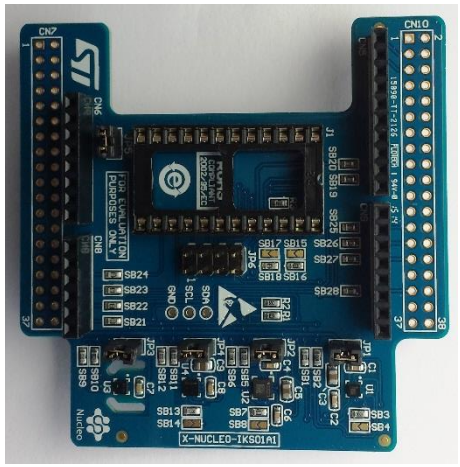
Quick Start Guide

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



Version 1.1 (Jun 15, 2015)

life.augmented

Overview

1. Introduction to the STM32 Open Development Environment
2. STM32 Nucleo Motion MEMS and environmental sensor expansion board
   - Hardware overview
   - Software overview
3. Documents & related resources
4. Setup & demo examples

Overview

1. Introduction to the STM32 Open Development Environment
2. STM32 Nucleo Motion MEMS and environmental sensor expansion board
   - Hardware overview
   - Software overview
3. Documents & related resources
4. Setup & demo examples

STM32 Open Development Environment

Lowering the barriers for “developers”

Easy access to technology

Idea

Device prototype

Application software development

Form-factor device

Field testing

Final device

Commercial software

Market

Fast, flexible, affordable and based on commercial components

Scalable software for faster time to market

life.augmented

STM32 Open Development Environment

The STM32 Open Development Environment consists of a set of **modular developer boards** and a **software environment** designed around the **STM32 microcontroller** family

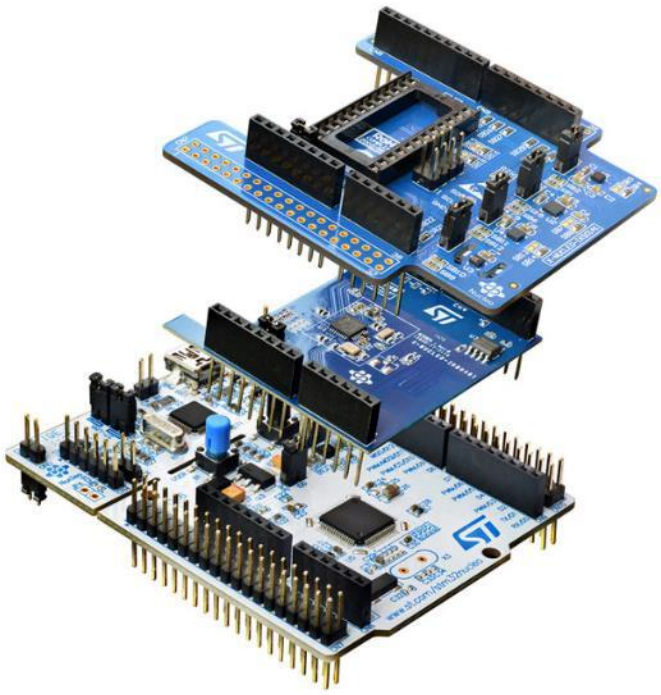
STM32 Nucleo development boards

STM32Cube development software

STM32 Nucleo expansion boards

STM32Cube expansion software

Compatibility with multiple development environments



STM32 Nucleo

STM32 Cube

STM32 Open Development Environment

Building block approach

The building blocks	Your need	Our answer

Accelerometer, gyroscope,
Inertial modules, magnetometer,
Pressure, temperature, humidity, UV,
Proximity, microphone

Sense — COLLECT

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

Connect — TRANSMIT

Audio amplifier
Touch controller
Operational amplifier

Translate — ACCESS

Stepper motor driver
DC & BLDC motor driver

Move / Actuate — CREATE

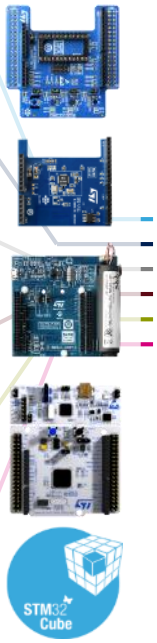
Energy management & battery

Power — POWER

General-purpose microcontrollers
Secure microcontrollers

Process — PROCESS

Software

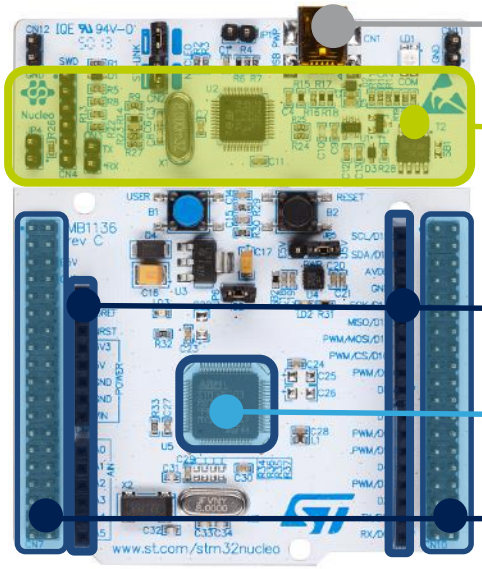


www.st.com/stm32ode

life.augmented

STM32 Nucleo Development Board

- Based on ST's 32-bit ARM Cortex-M based STM32 microprocessors
  - Development boards with 1 MCU and hardware to program/debug
- Two connectors for companion chip boards
- For all STM32 families



STM32 L0 STM32 L1 STM32 F0 STM32 F1 STM32 F2 STM32 F3 STM32 F4 STM32 F7

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

(*) Thanks to its electrical compatibility, it can be used as a shield for Arduino UNO R3 or similar.

Overview

1 Introduction to the STM32 Open Development Environment

2 STM32 Nucleo Motion MEMS and environmental sensor expansion board
- Hardware overview
- Software overview

3 Documents & related resources

4 Setup & demo examples

Motion MEMS and environmental sensor expansion board

Hardware overview (1/2)

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

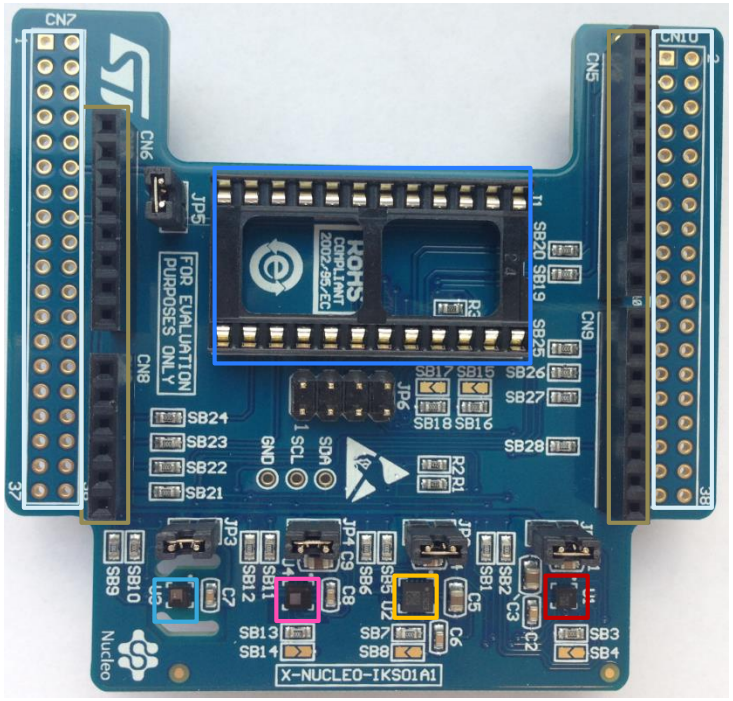
LSM6DS0: MEMS 3D accelerometer (±2/±4/±8 g) + 3D gyroscope (±245/±500/±2000 dps)

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 LSM6DS0 ST Morpho connector**

LPS25HB LIS3MDL Arduino UNO R3 connector

DIL 24-pin

Latest info available at
X-NUCLEO-IKS01A1

Order code: X-NUCLEO-IKS01A1

** Connector for the STM32 Nucleo Board

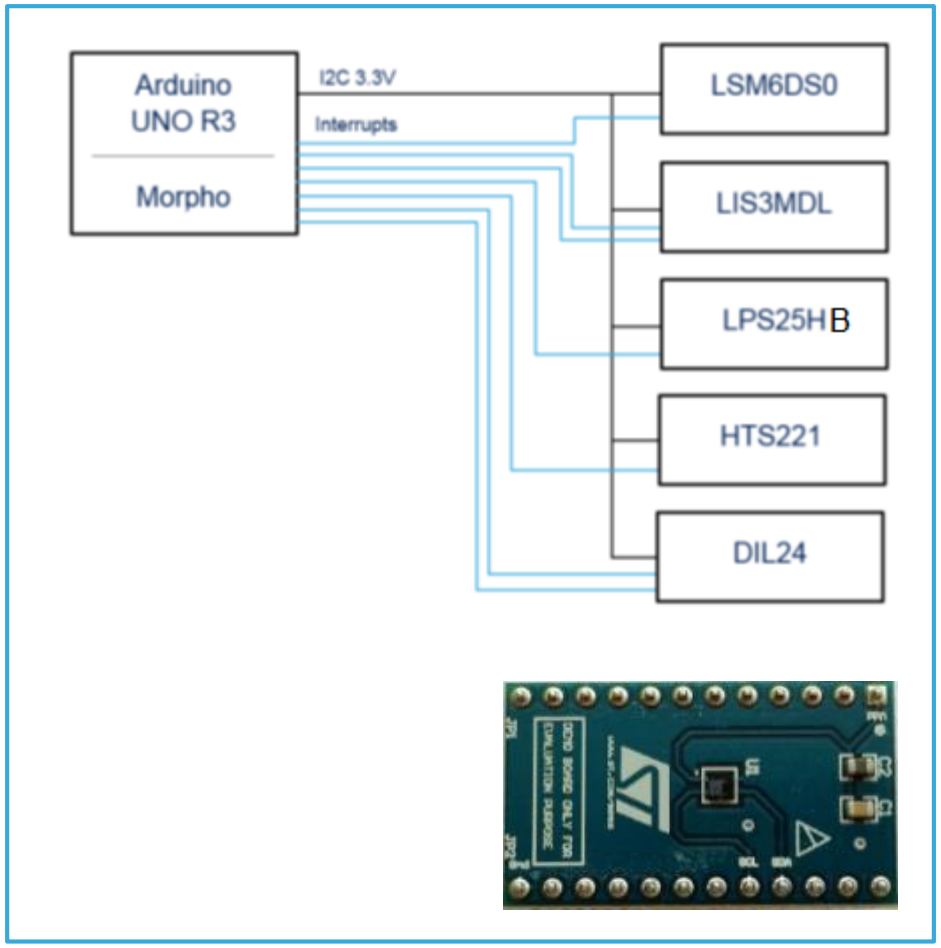
life.augmented

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-MKI***V* MEMS adapter boards)



Order code: X-NUCLEO-IKS01A1

* is used as a wildcard character for related part number

Motion MEMS and environmental sensor expansion board

Software overview (1/2)

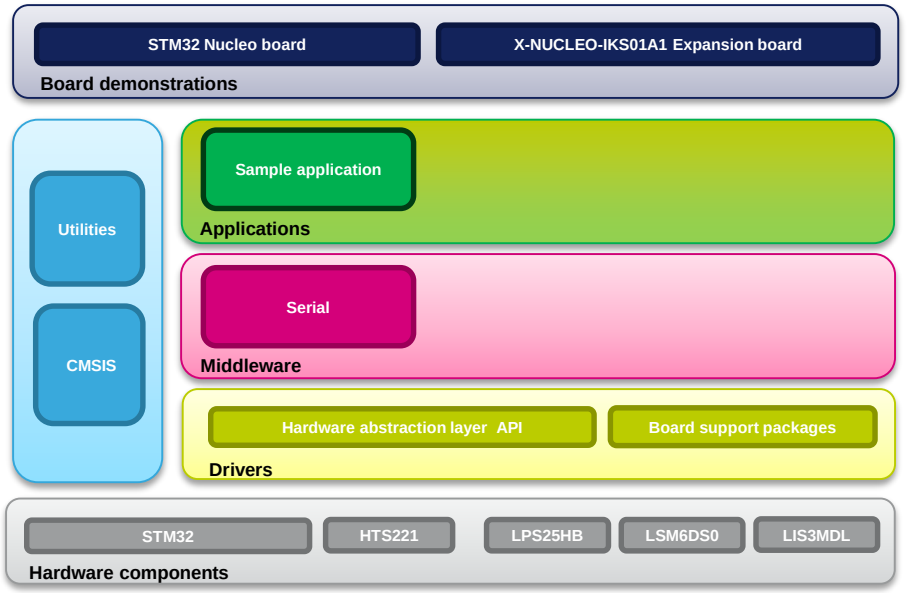
X-CUBE-MEMS1 software description

- 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



Latest software available at

X-CUBE-MEMS1

life.augmented

Motion MEMS and environmental sensor expansion board

Software overview (2/2)

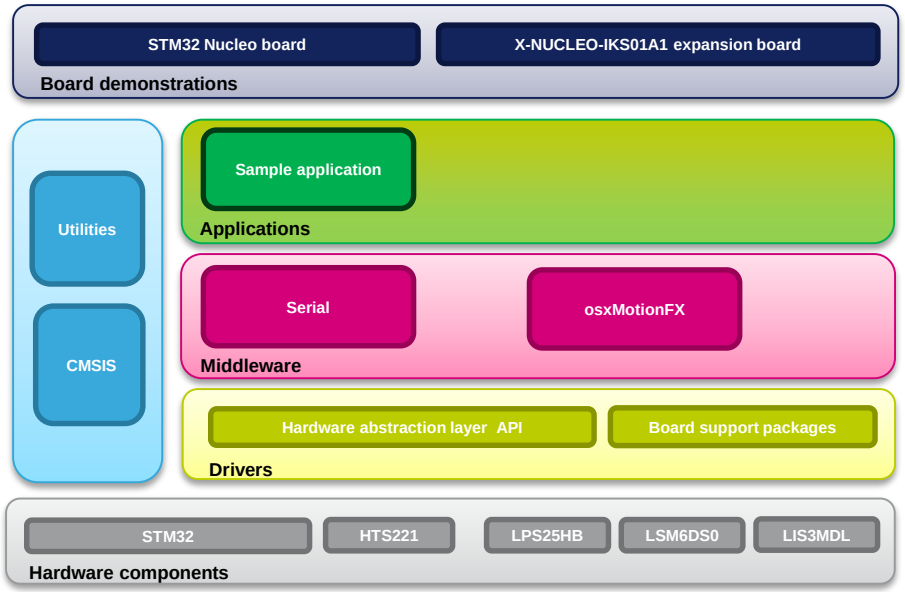
osxMotionFX software description

- 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



Software webpage:

osxMotionFX

life.augmented

Overview

1 Introduction to the STM32 Open Development Environment

2 STM32 Nucleo Motion MEMS and environmental sensor expansion board
- Hardware overview
- Software overview

3 Documents & related resources

4 Setup & demo examples

Documents & related resources

All documents are available in the Design Resources tab of the product webpage

X-NUCLEO-IKS01A1: Product webpage (Link)

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

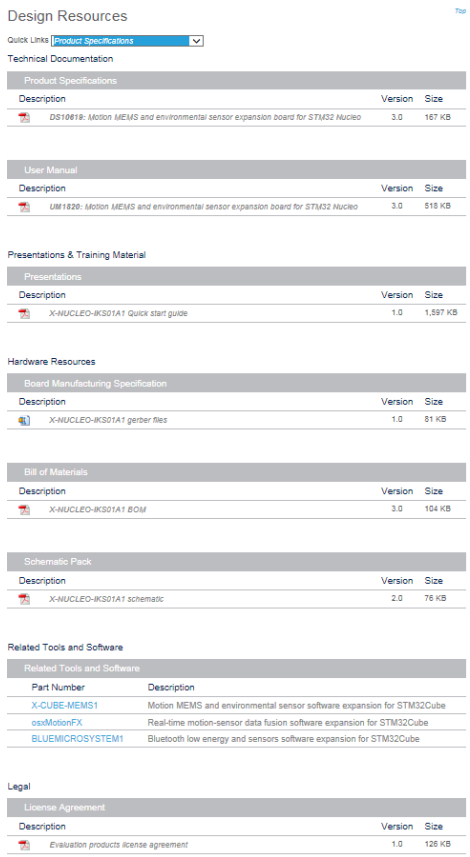
X-CUBE-MEMS1: Product webpage (Link)

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

osxMotionFX: Product webpage (Link)

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

X-NUCLEO-IKS01A1
Product webpage
Design Resources tab



Design Resources

Quick Links: Product Specifications

Technical Documentation

Product Specifications

Description	Version	Size
DS10619: Motion MEMS and environmental sensor expansion board for STM32 Nucleo	3.0	167 KB

User Manual

Description	Version	Size
UM1820: Motion MEMS and environmental sensor expansion board for STM32 Nucleo	3.0	518 KB

Presentations & Training Material

Presentations

Description	Version	Size
X-NUCLEO-IKS01A1 Quick start guide	1.0	1,597 KB

Hardware Resources

Board Manufacturing Specification

Description	Version	Size
X-NUCLEO-IKS01A1 gerber files	1.0	81 KB

Bill of Materials

Description	Version	Size
X-NUCLEO-IKS01A1 BOM	3.0	104 KB

Schematic Pack

Description	Version	Size
X-NUCLEO-IKS01A1 schematic	2.0	76 KB

Related Tools and Software

Related Tools and Software

Part Number	Description
X-CUBE-MEMS1	Motion MEMS and environmental sensor software expansion for STM32Cube
osxMotionFX	Real-time motion-sensor data fusion software expansion for STM32Cube
BLUEMICROSYSTEM1	Bluetooth low energy and sensors software expansion for STM32Cube

Legal

License Agreement

Description	Version	Size
Evaluation products license agreement	1.0	126 KB

life.augmented

Overview

1 Introduction to the STM32 Open Development Environment

2 STM32 Nucleo Motion MEMS and environmental sensor expansion board
- Hardware overview
- Software overview

3 Documents & related resources

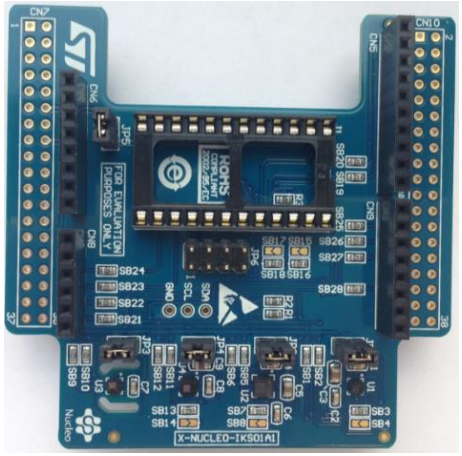
4 Setup & demo examples

Setup & demo examples
Hardware prerequisites

- Motion MEMS and environmental sensor expansion board (X-NUCLEO-IKS01A1)
- STM32 Nucleo development board (NUCLEO-F401RE, NUCLEO-L053R8 or NUCLEO-L152RE)
- Windows 8/7 - Laptop/PC
- 1 x mini USB cable

NUCLEO-F401RE / NUCLEO-L053R8 / NUCLEO-L152RE

Mini USB



X-NUCLEO-IKS01A1

Setup & demo examples
Software prerequisites

- ST-LINK/V2-1 USB driver (Link)
- ST-LINK/V2-1 firmware upgrade (Link)
- X-CUBE-MEMS1 (Link)
  - 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, NUCLEO-L053R8 or NUCLEO-L152RE
- OSXMotionFX (Link)
  - 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

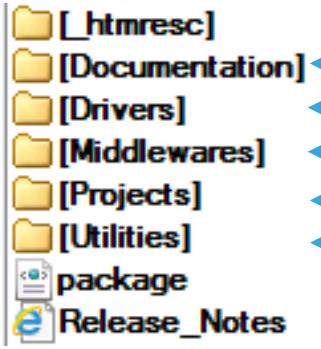
life.augmented
www.st.com

1 www.st.com/x-nucleo

2 Select X-NUCLEO-IKS01A1

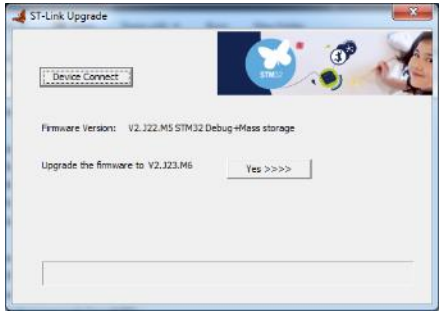
3 Download & unpack X-CUBE-MEMS1

X-CUBE-MEMS1 package structure

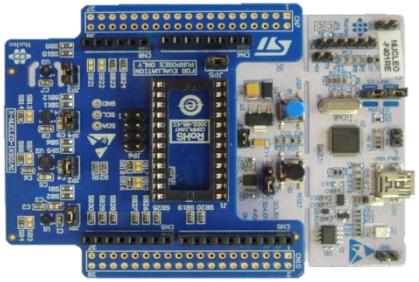


Docs
Low-level sensor drivers
Serial utility
L0 / F4/ L1 DataLog FW src code + binary
PC GUI (Sensors_DataLog)

4 Download & install STM32 Nucleo ST-LINK/V2-1 USB driver STSW-LINK009 (Link)



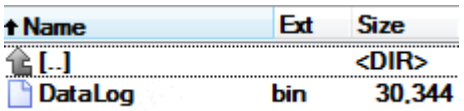
5 Download / Install / Run ST-Link FW Upgrade utility STSW-LINK007 (Link)



Use of Sensors_DataLog GUI with precompiled BIN fmw

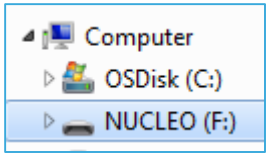
X-CUBE-MEMS1 for NUCLEO-F401RE or NUCLEO-L053R8 or NUCLEO-L152RE

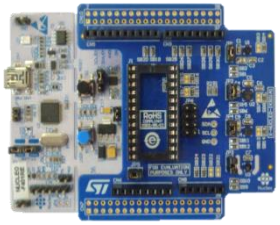
\STM32CubeExpansion_MEMS1_V1.3.0\Projects\Multi\Examples\DataLog\Binary\STM32F401RE-Nucleo
\STM32CubeExpansion_MEMS1_V1.3.0\Projects\Multi\Examples\DataLog\Binary\STM32L053R8-Nucleo
\STM32CubeExpansion_MEMS1_V1.3.0\Projects\Multi\Examples\DataLog\Binary\STM32L152RE-Nucleo



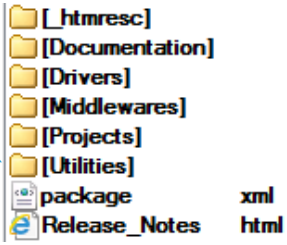
6

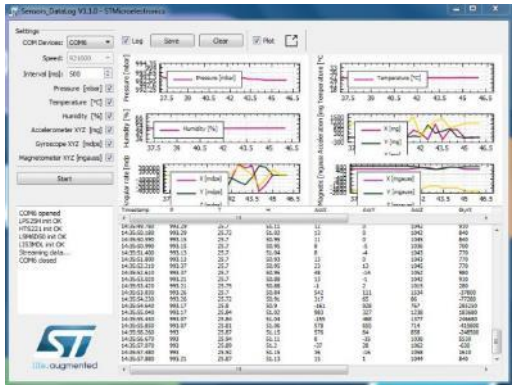
drag and drop
DataLog.bin for F4 or for L0 or for L1
on Nucleo drive





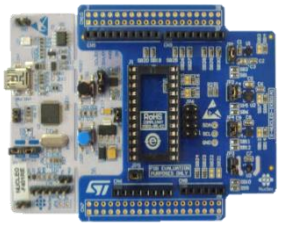
Open Utilities Folder in the X-CUBE-MEMS1 SW package





7

…and Run Sensors_DataLog
PC GUI



life.augmented

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

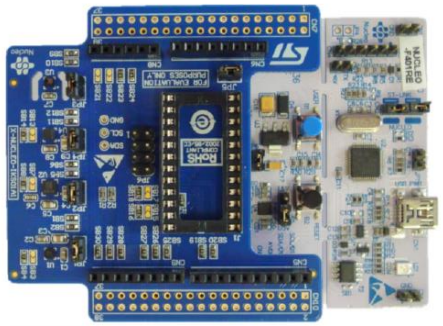
1 Select COM port

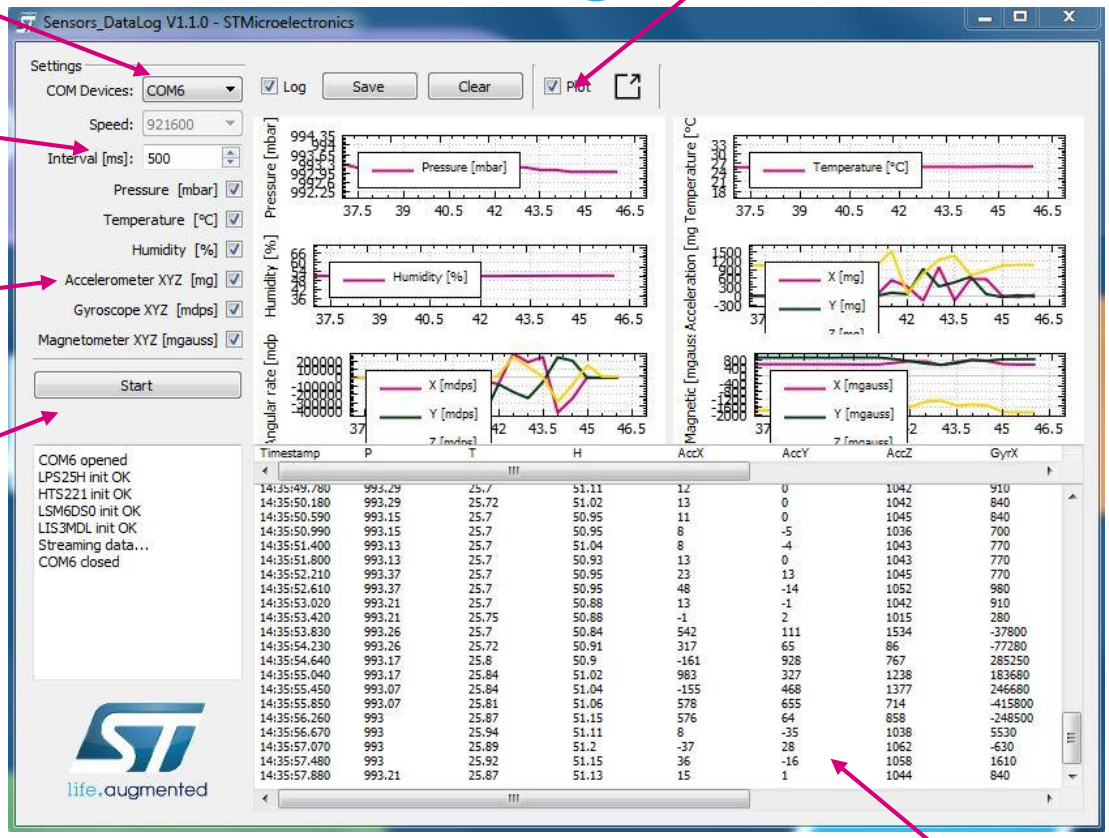
2 Select sensor reading interval

3 Select sensors

4 Select graph plots

5 Start data logging





Data Log Area

Sensors_DataLog **PC GUI**

Compile the DataLog FW using a supported IDE

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

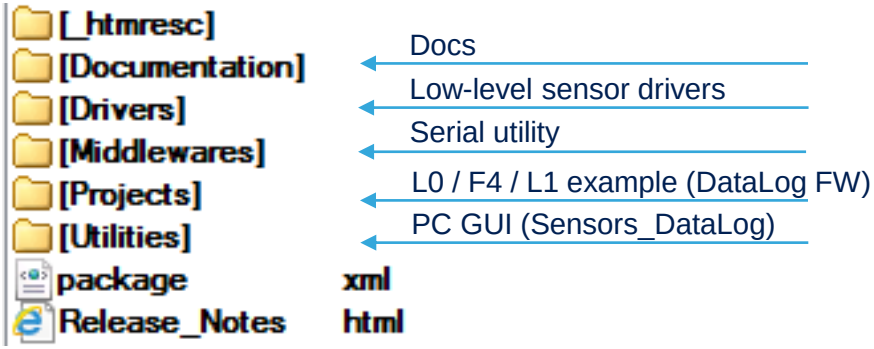
life.augmented
www.st.com

1 www.st.com/x-nucleo

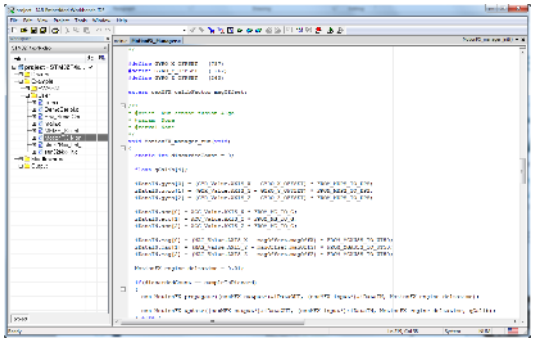
2 Select X-NUCLEO-IKS01A1

3 Download & unpack X-CUBE-MEMS1

X-CUBE-MEMS1 package structure



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

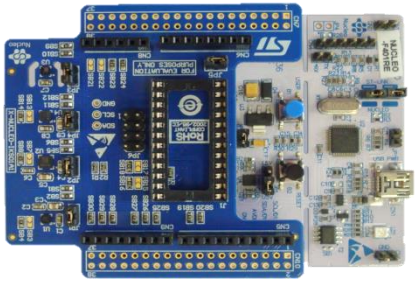


KEIL Tools by ARM

IAR SYSTEMS

Open STM32 Tools

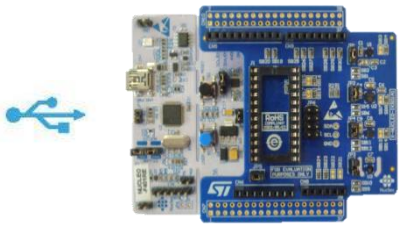
Flash and run the project.

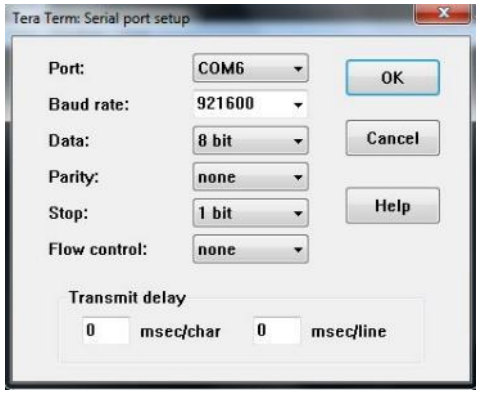


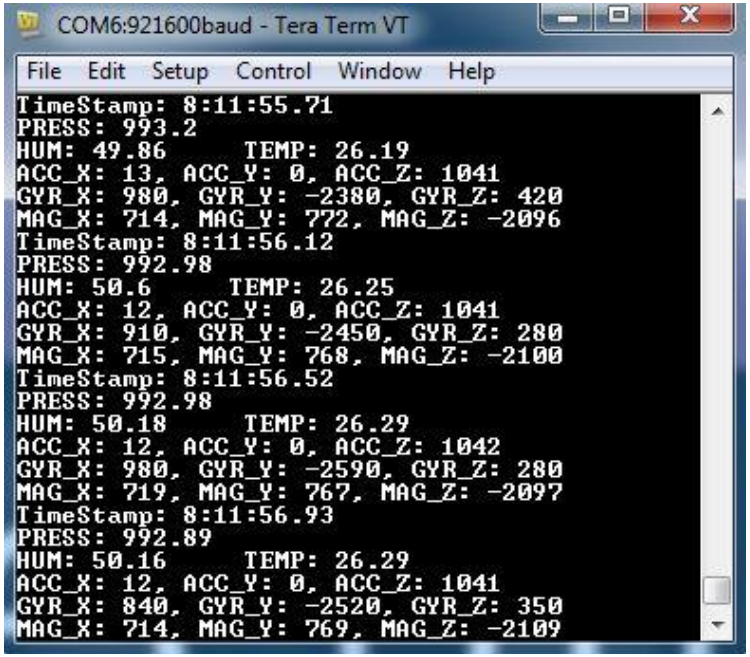
Using serial line monitor – e.g.TeraTerm

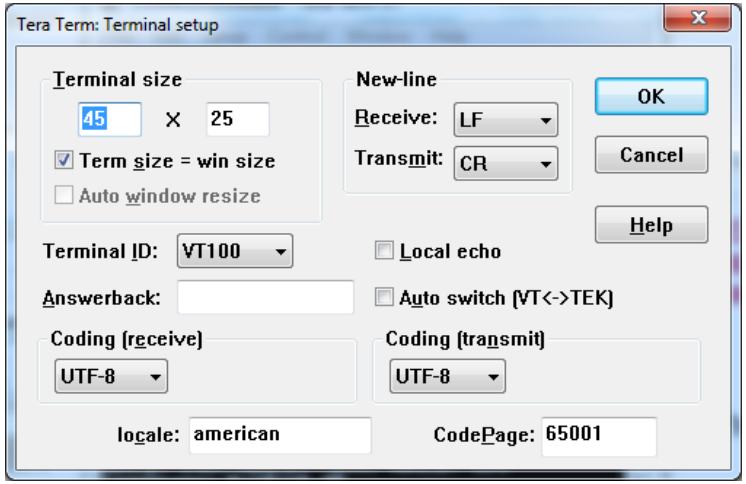
X-CUBE-MEMS1 for NUCLEO-F401RE, NUCLEO-L053R8 or NUCLEO-L152RE

- Close the Sensors_DataLog GUI
- Configure the serial line monitor (speed, LF)
- Press the **BLUE** user button on STM32Nucleo









OSXMotionFX Sensor Fusion license request

OSXMotionFX for NUCLEO-F401RE

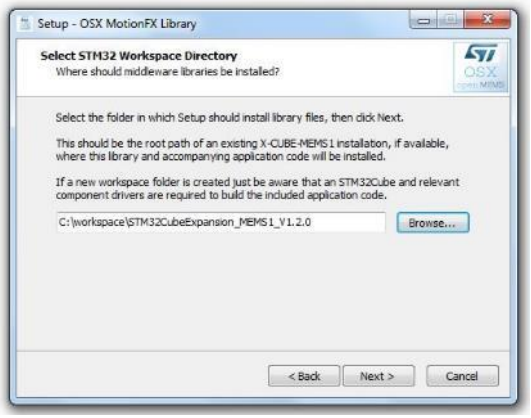
life.augmented
www.st.com

1 Download OSXMotionFX
www.st.com/openmems

OSX MotionFX

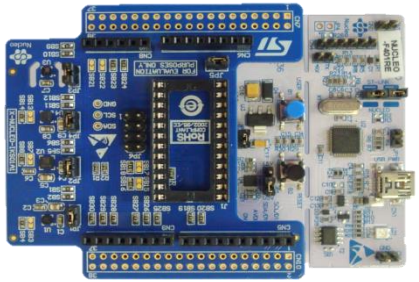
2 Installer
OSXMotionFX

3 Install OSXMotionFX in the X-CUBE-MEMS1 workspace



OSXMotionFX Sensor Fusion license request

OSXMotionFX for NUCLEO-F401RE

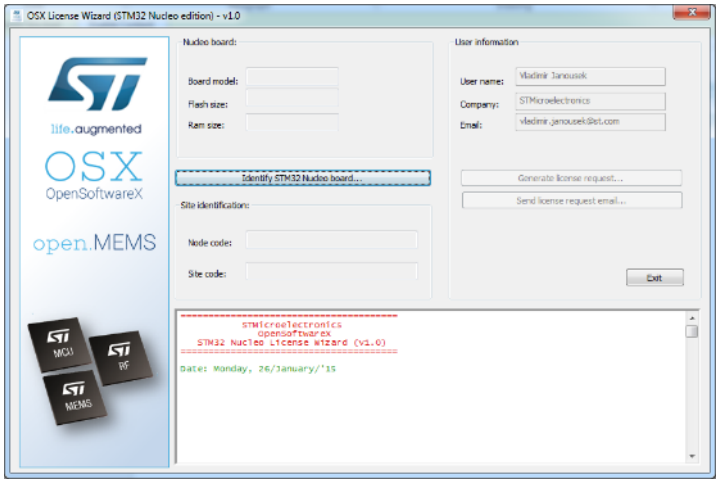


3

OpenSoftwareX.licensing

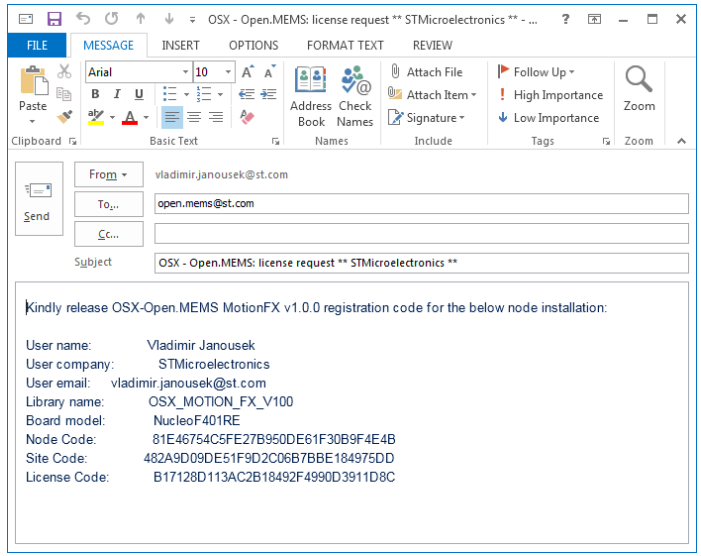
c:\Program Files (x86)\STMicroelectronics\OpenSoftwareX\OSX_LicenseWizard\

4 Run OsX License wizard



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

5



Click: Send License request email

6

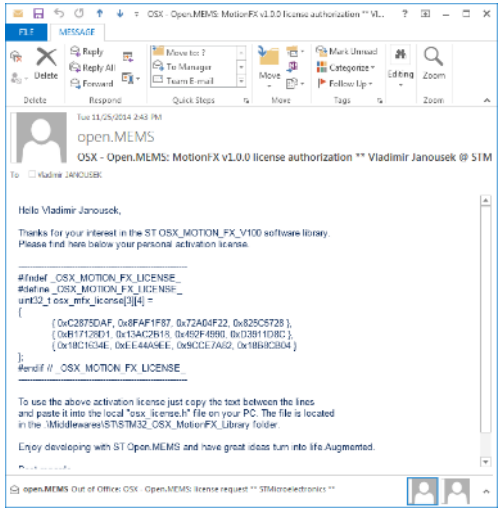
life.augmented

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

OSXMotionFX for NUCLEO-F401RE

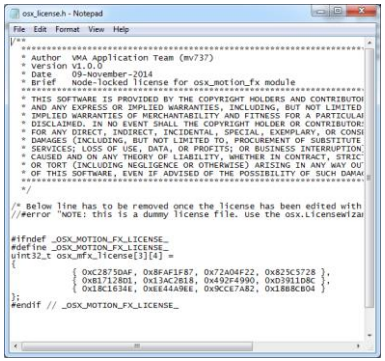
OpenSoftwareX.licensing

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



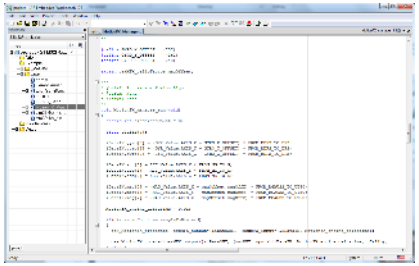
3 Open for example IAR project from

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

KEIL™ Tools by ARM

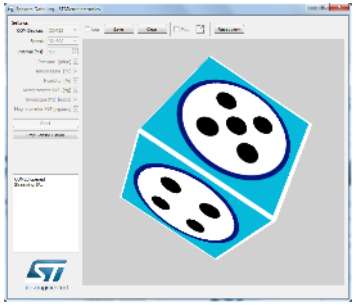
IAR SYSTEMS

Open STM32 Tools



4 Flash and Run the project

5

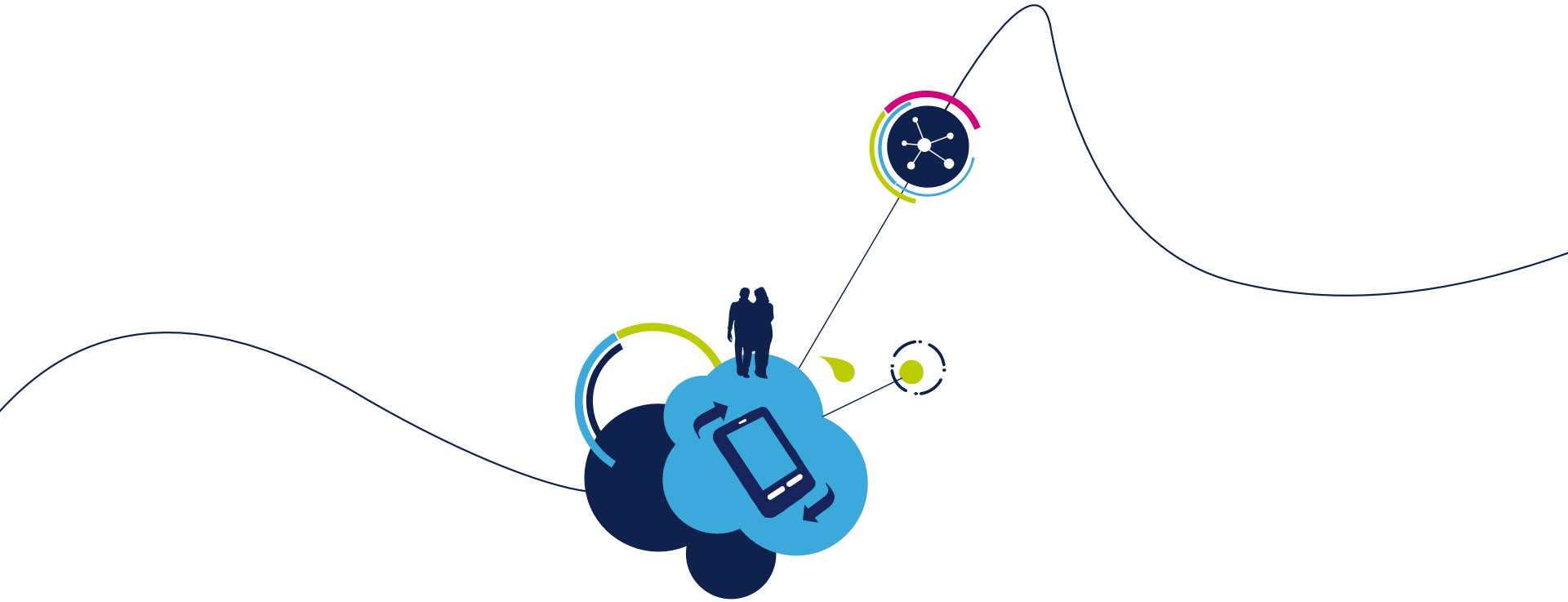


- Run the X-CUBE-MEMS1 GUI
- Click: Start Sensor Fusion
- Make figure-8 movement to calibrate magnetometer, green LED2 on

. \STM32CubeExpansion_MEMS1_V1.3.0\Utilities\PC_software\Sensors_DataLog

Start developing
(demo project included)

life.augmented



www.st.com/stm32ode

life.augmented