

Introduction

This is a description of how to get started with the osxMotionXX software packages of the open.MEMS catalog, where the letters "XX" are replaced, in each specific package, by two-letter acronyms for the library (e.g., osxMotionGR for the Gesture Recognition library, and so on for other libraries) .

Open.MEMS algorithms combine data from one or more sensors with the high level of accuracy required by portable and wearable devices and other emerging applications such as the Internet of Things (IoT).

Each algorithm is provided in static library format and is designed for use in combination with one STM32 Nucleo development board and X-NUCLEO-IKS01A1 (motion MEMS and environmental sensor expansion board) or X-NUCLEO-IKS01A1 plus STEVAL-MKI160V1 (LSM6DS3 adapter board for standard DIL24 socket).

Information about STM32Cube is available on www.st.com at <http://www.st.com/stm32cube>

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1 System setup guide

1.1 Hardware description

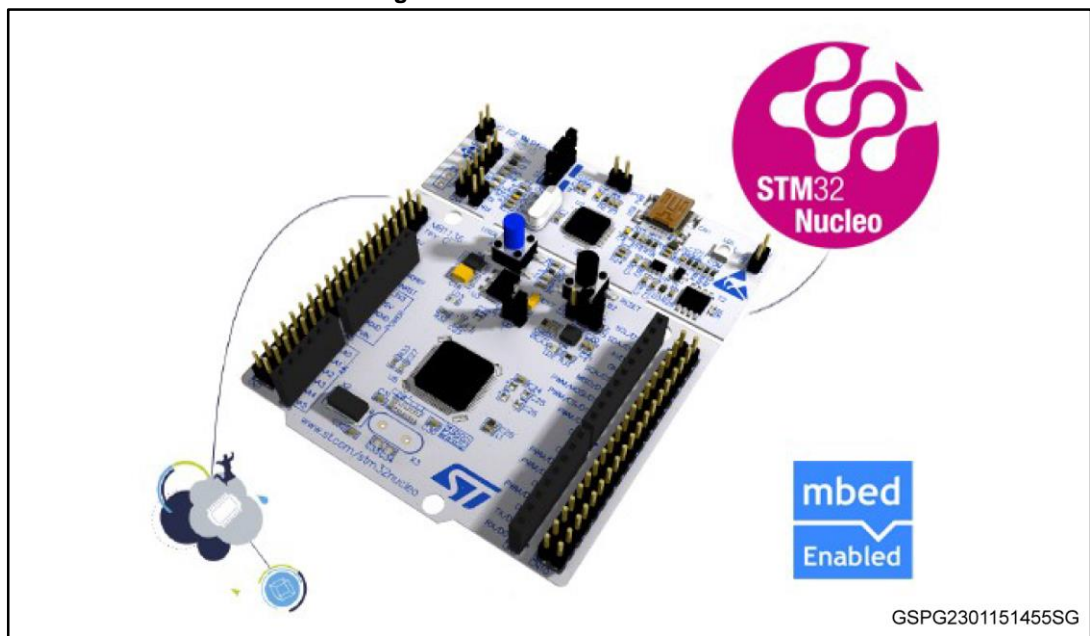
This section describes the hardware components required to develop a sensor-based application.

1.1.1 STM32 Nucleo platform

The STM32 Nucleo boards provide an affordable and flexible way for users to try out new ideas and build prototypes with any STM32 microcontroller lines. The Arduino™ connectivity support and ST morpho headers make it easy to expand the functionality of the STM32 Nucleo open development platform with a wide range of specialized expansion boards to choose from. The STM32 Nucleo board does not require any separate probe as it integrates the ST-LINK/V2-1 debugger/programmer. The STM32 Nucleo board comes with the comprehensive STM32 software HAL library together with various packaged software examples.

Information regarding STM32 Nucleo boards is available on www.st.com at <http://www.st.com/stm32nucleo>

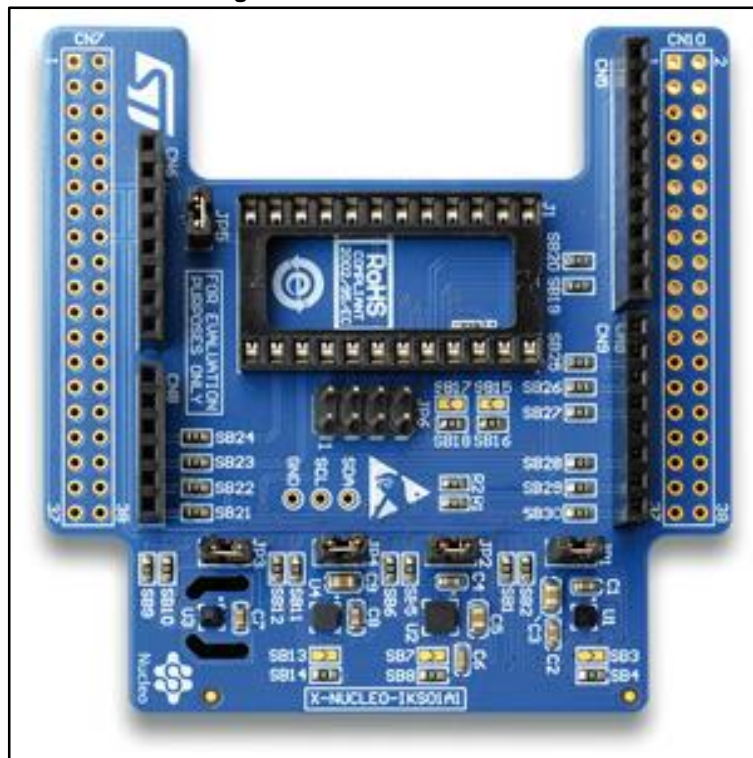
Figure 1: STM32 Nucleo board



1.1.2 X-NUCLEO-IKS01A1 expansion board

The X-NUCLEO-IKS01A1 figured below is a sensor expansion board for use with the STM32 Nucleo system. It is also compatible with the Arduino UNO R3 connector layout, and is designed around the STMicroelectronics humidity (HTS221), pressure (LPS25HB) and motion sensors (LIS3MDL and LSM6DS0). The X-NUCLEO-IKS01A1 interfaces with the STM32 MCU via an I²C pin; the user can change the default I²C address and the device IRQ by changing one resistor on the evaluation board.

Figure 2: STM32 Nucleo board



Information about the X-NUCLEO-IKS01A1 expansion board is available on www.st.com at: <http://www.st.com/x-nucleo>.

The LSM6DS3 adapter board below can be plugged on top of the X-NUCLEO-IKS01A1 expansion board, as shown in [Figure 4: "Sensor expansion board and adapter connected to the STM32 Nucleo"](#).

Figure 3: LSM6DS3 adapter board

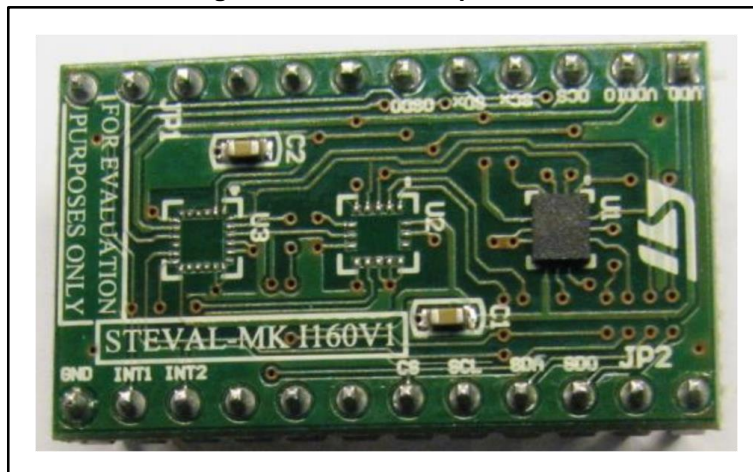
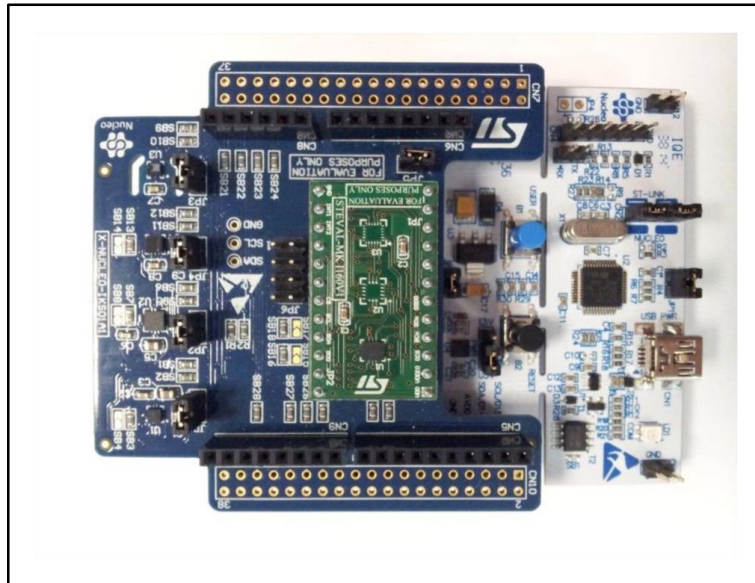


Figure 4: Sensor expansion board and adapter connected to the STM32 Nucleo

1.2 Software description

The following software components are required to set up a suitable development environment for creating applications using the osxMotionXX libraries for the STM32 Nucleo, equipped with the sensor expansion board:

- X-CUBE-MEMS1: an expansion for STM32Cube dedicated to sensor application development. The X-CUBE-MEMS1 firmware and related documentation is available on st.com.
- osxMotionXX: an add-on software package for X-CUBE-MEMS1 that provides specific algorithms APIs. The osxMotionXX firmware and related documentation is available on st.com.
- Development tool-chain and compiler: The STM32Cube expansion software supports the following three IDEs:
 - IAR Embedded Workbench for ARM® (EWARM) toolchain + ST-LINK
 - µVision(MDK-ARM) toolchain + ST-LINK
 - System Workbench for STM32

1.3 Hardware setup

The following hardware components are required:

- One STM32 Nucleo development platform (order code: NUCLEO-F401RE or NUCLEO-F476RG)
- One sensor expansion board (order code: X-NUCLEO-IKS01A1) optionally mounted with the LSM6DS3 adapter board (order code: STEVAL-MKI160V1)
- One USB type A to Mini-B USB cable to connect the STM32 Nucleo to the PC
- One battery pack to run the application example

1.4 Software setup

This section lists the minimum requirements for the developer to set up the SDK, run the sample testing scenario based on the GUI utility and customize applications.

1.4.1 Development tool-chains and compilers

Please select one of the integrated development environments supported by the STM32Cube expansion software, and read the system requirements and setup information provided by the selected IDE provider.

1.4.2 PC utility

The Sensors DataLog utility for PC has following minimum requirements:

- PC with Intel or AMD processor running one of the following Microsoft operating systems:
 - Windows XP SP3
 - Windows Vista
 - Windows 7
- At least 128 MBs of RAM
- 2 X USB ports
- 40 MB of hard disk space

1.5 System setup

This section describes how to set up different hardware components before writing and executing an application on the STM32 Nucleo board with the sensor expansion board.

1.5.1 STM32 Nucleo and sensor expansion boards setup

The STM32 Nucleo board includes the ST-LINK/V2-1 debugger/programmer. The developer can download the relevant version of the ST-LINK/V2-1 USB driver by accessing the STSW-LINK008 or STSW-LINK009 on www.st.com (according to which MS Windows OS is used).

The sensor expansion board X-NUCLEO-IKS01A1 can be easily connected to the STM32 Nucleo motherboard through the Arduino UNO R3 extension connector (see [Figure 4: "Sensor expansion board and adapter connected to the STM32 Nucleo"](#)). The LSM6DS3 adapter board (STEVAL-MKI160V1) is plugged on top of the expansion board. The sensor expansion boards are capable of interfacing with the external STM32 microcontroller on the STM32 Nucleo via an inter-integrated circuit (I²C) transport layer.

1.5.2 Sensors_DataLog GUI setup

The Sensors_DataLog GUI included in the X-CUBE-MEMS1 software package is a graphical user interface that can be used to obtain and subsequently plot and save sensor data and library output data.

Please refer to the specific osxMotionXX User Manual for a description of the how this PC utility works.

If the feature is available in the specific library, you may also retrieve data from the connected STM32 MCU flash memory. Data can then be stored in a table format which can be exported for offline analysis.

To use the Sensors_DataLog GUI, you must first set up the hardware and software correctly.

Double-click on the Sensors_DataLog.exe file located in the "Utilities\PC_software\Sensors_DataLog" folder to launch the application.

1.5.3 osxMotionXX installer setup

Each software package is provided with a Windows installer (osxMotionXX_Setup_vXXX.exe, where the 'X's are replaced by library acronyms and version numbers, respectively), that guides the user through the correct installation of the software package. The installer also includes the OSX License Wizard tool which allows the user to automatically obtain a valid node-locked license for individual Nucleo boards (see [Section 1.5.4: "osxMotionXX license wizard"](#)).

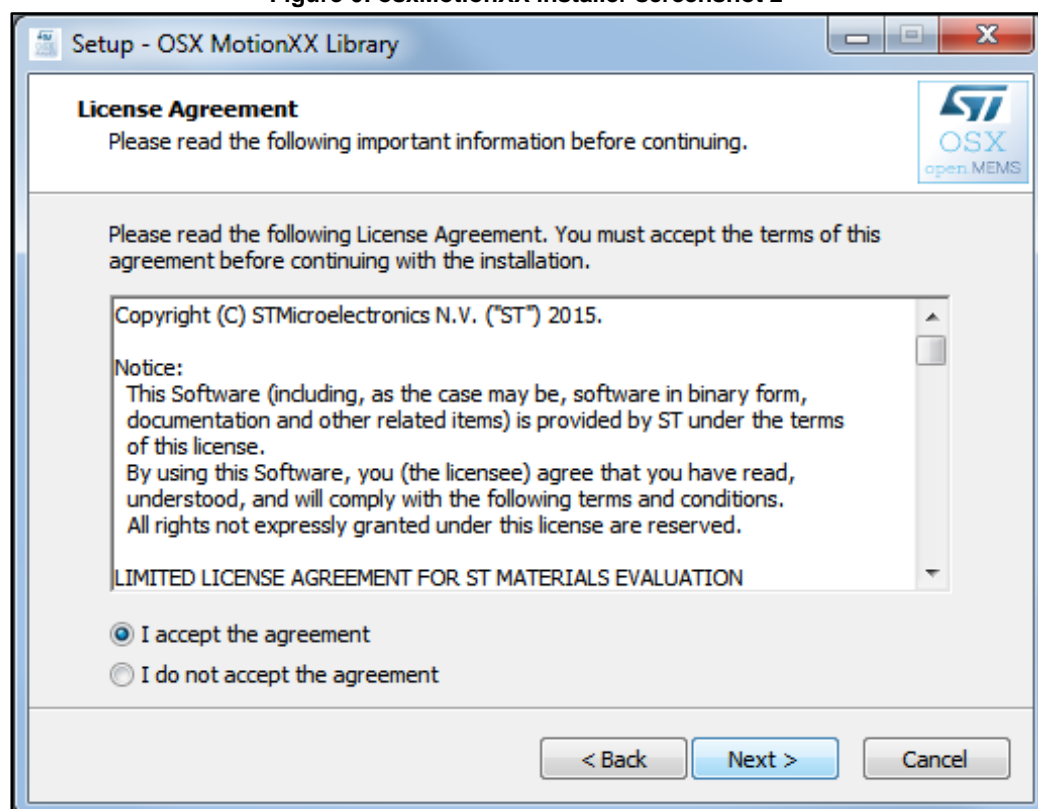
- 1 Before running the installer, download the latest release of the X-CUBE-MEMS1 software package and unzip this package in the relative workspace. For example, if the X-CUBE-MEMS1 package is located in "C:\workspace\STM32CubeExpansion_MEMS1_V2.0.0", the installer will display:

Figure 5: osxMotionXX installer screenshot 1



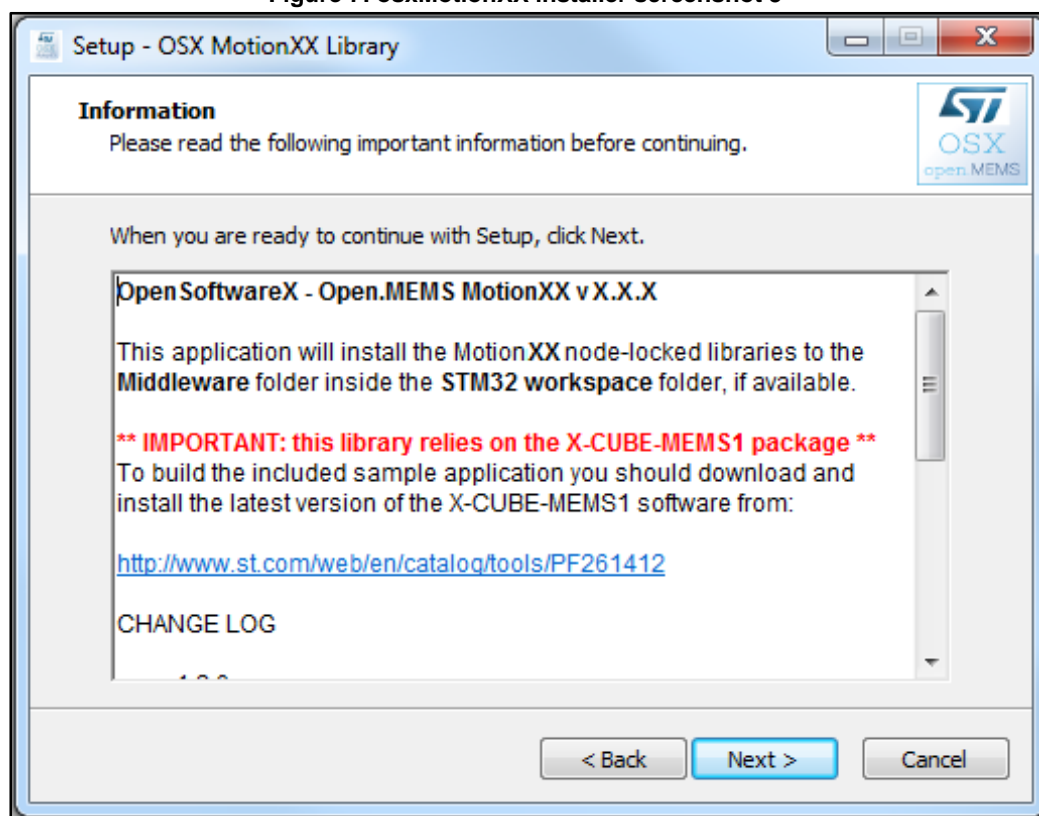
- 2 The license agreement must be accepted, as shown below.

Figure 6: osxMotionXX installer screenshot 2



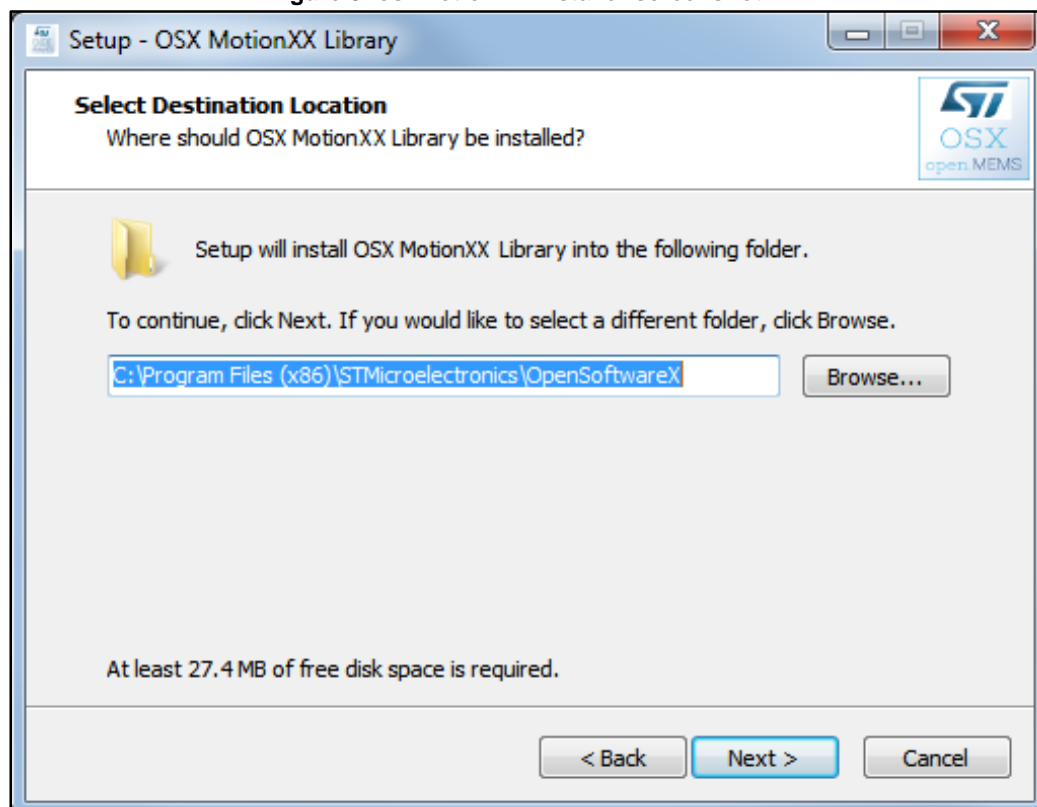
- 3 The installer provides information such as the requirements of the latest release of the X-CUBE-MEMS1 software package:

Figure 7: osxMotionXX installer screenshot 3



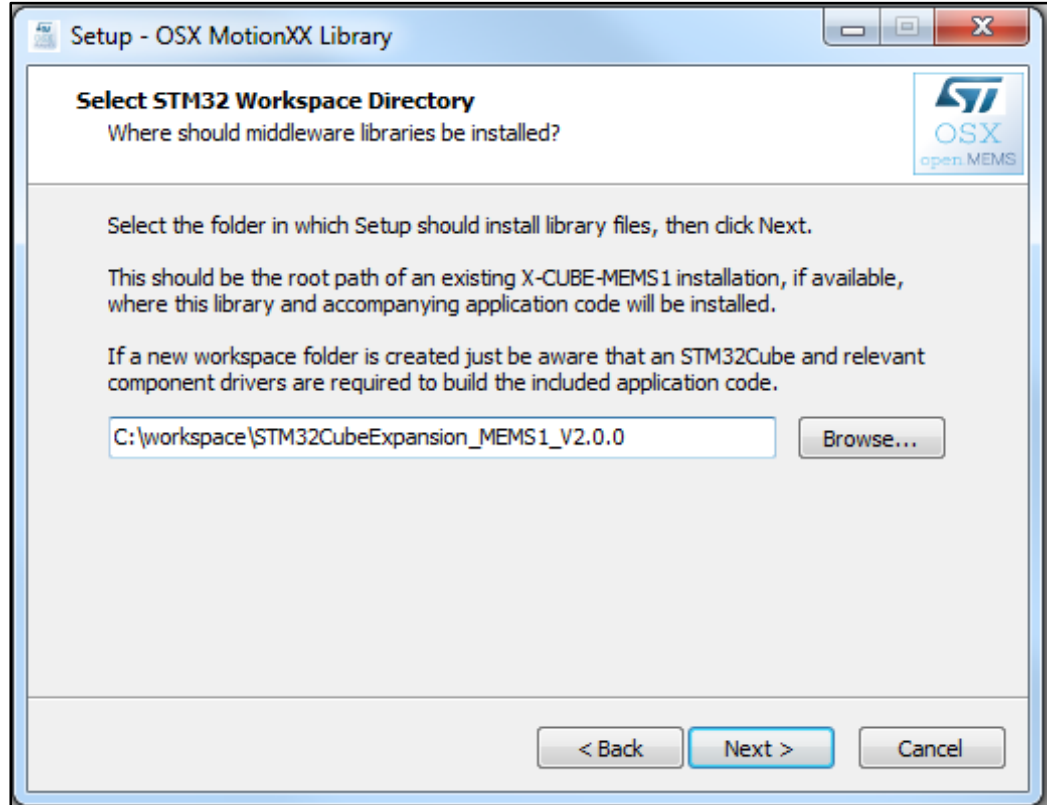
- 4 The installer then asks for the destination location of the osxMotionXX library:

Figure 8: osxMotionXX installer screenshot 4



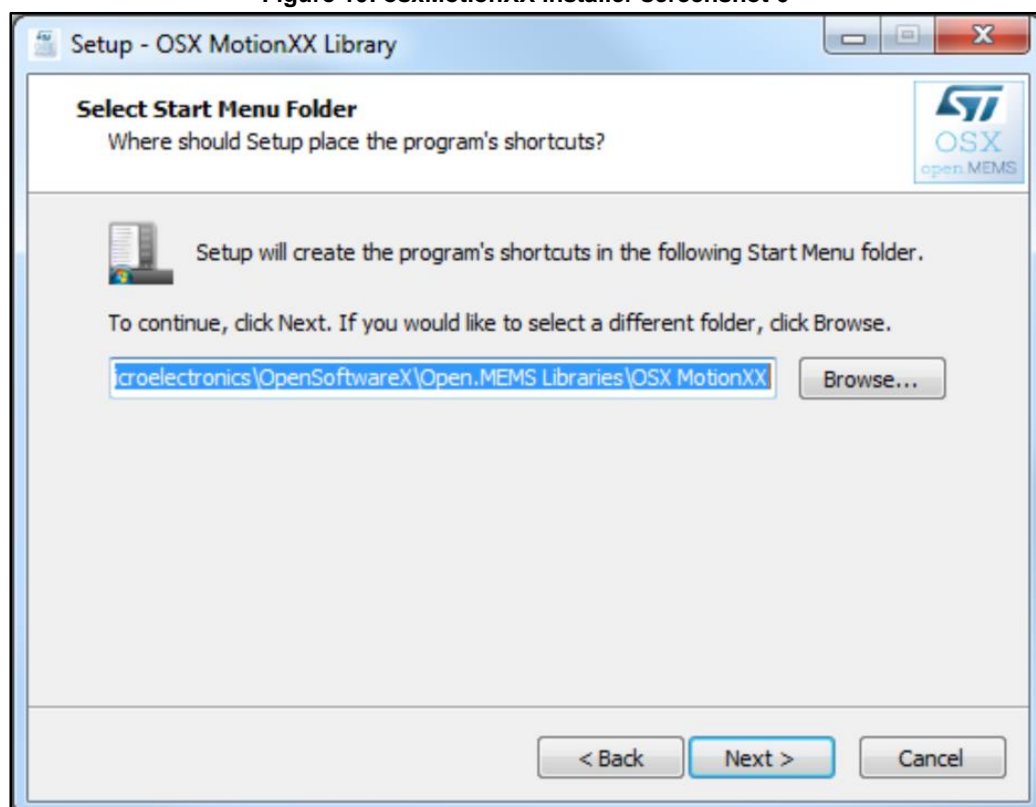
- 5 The user must then provide the path to the X-CUBE-MEMS1 package. If the path to the X-CUBEMEMS1 package is incorrect, the sample application will not compile. Use the path containing the "Documentation", "Projects", "Drivers", "Utilities", etc., folders in the X-CUBE-MEMS1 software package. In this example, it is "C:\workspace\STM32CubeExpansion_MEMS1_V2.0.0".

Figure 9: osxMotionXX installer screenshot 5



- 6 The user must then provide the path to the Start menu folder where the shortcuts are installed to complete the osxMotionXX installation.

Figure 10: osxMotionXX installer screenshot 6



1.5.4 osxMotionXX license wizard

Each osxMotionXX engine is provided as a node-locked library which allows derivative firmware images to run on a specific STM32 Nucleo device only. License activation codes must be requested from ST and included in the project (and becomes part of the build process) prior to attempting its usage. The resulting firmware binary image will therefore be node-locked.

The License wizard allows the user to automatically obtain a valid node-locked license for their STM32 Nucleo board. Before running this tool, connect the STM32 Nucleo to be linked to the node-locked license via USB cable.

The user will receive an email with the license to be included in the Middlewares\ST\STM32_OSX_MotionXX_Library folder of the workspace.

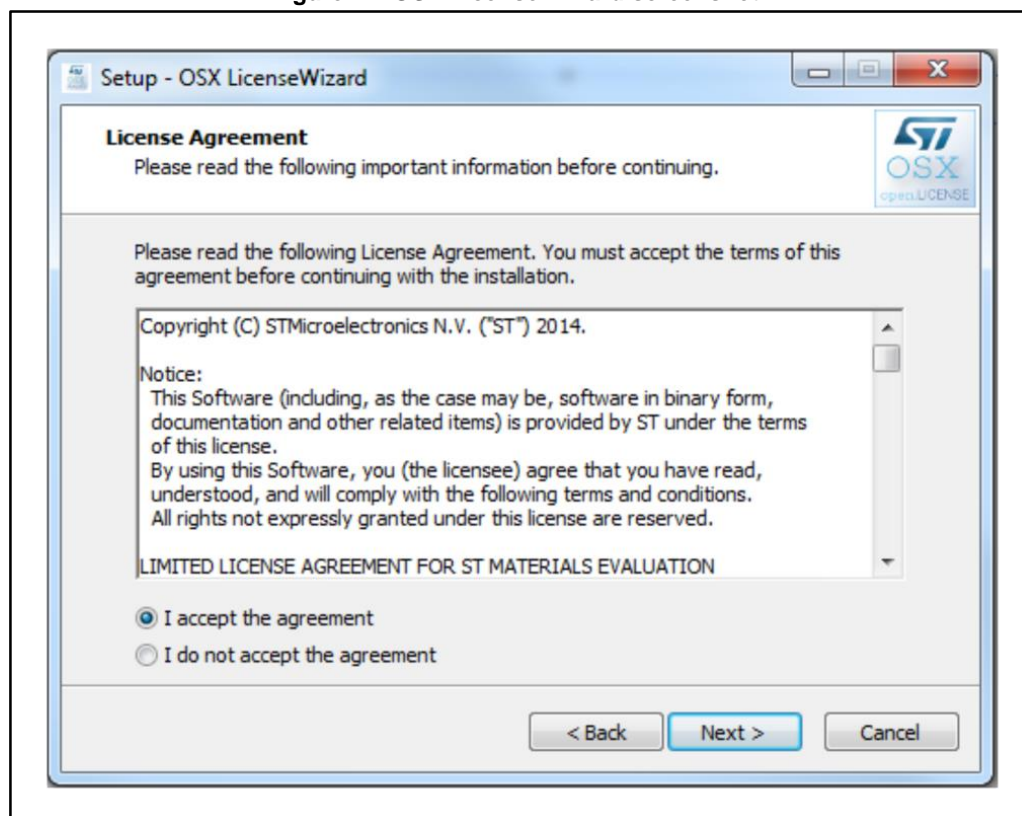
The steps below detail the licensing procedure.

- 1 The figure below shows the welcome screen.

Figure 11: OSX License Wizard screenshot 1

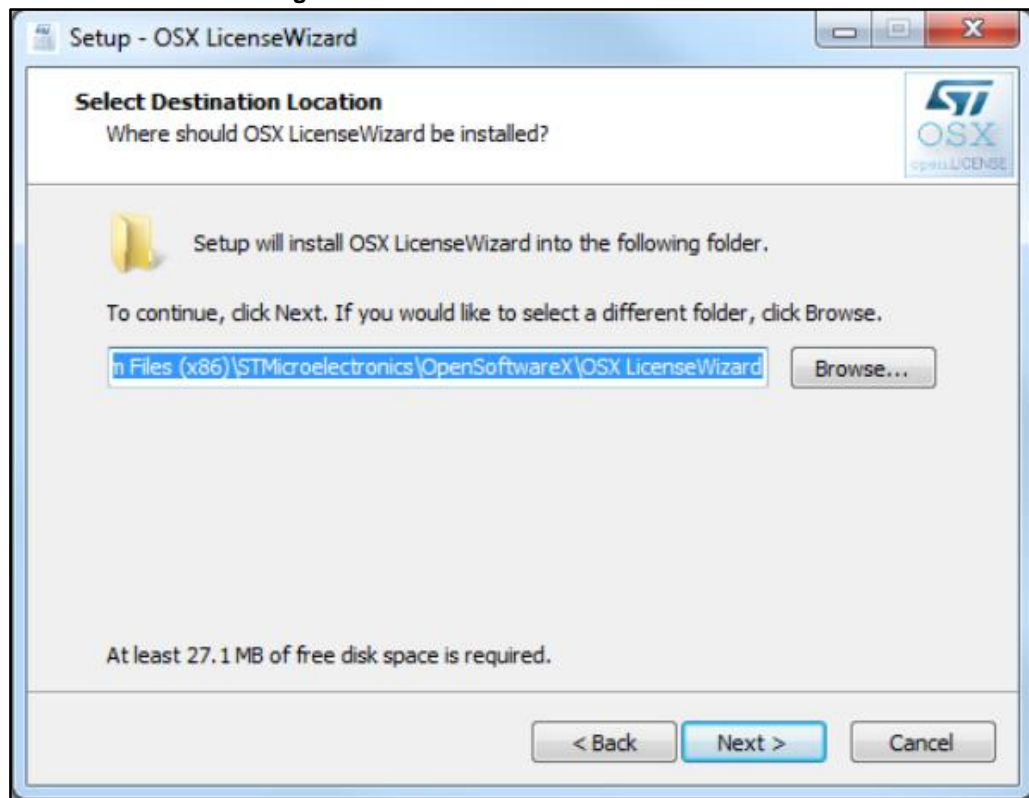


- 2 Accept the license agreement to proceed with the installation.

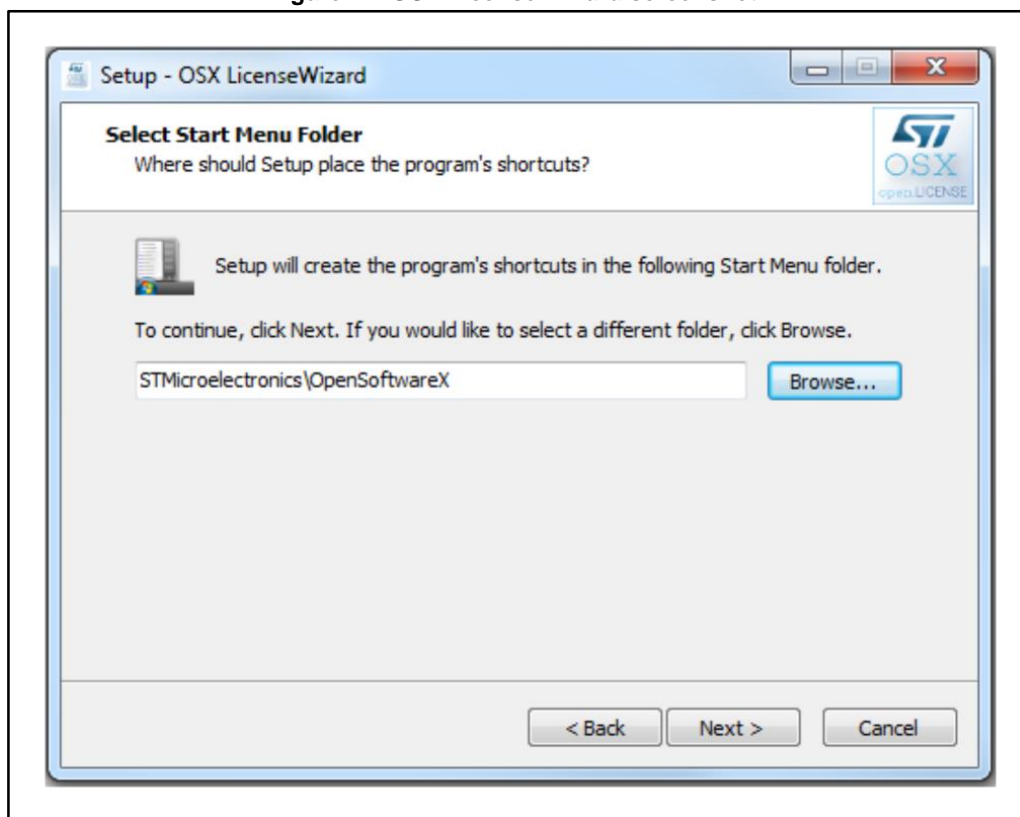
Figure 12: OSX License Wizard screenshot 2

- 3 The wizard then asks for the destination location of the OSX License Wizard.

Figure 13: OSX License Wizard screenshot 3



- 4 Provide the path to the Start menu folder where the shortcuts are installed to complete the OSX License Wizard software installation.

Figure 14: OSX License Wizard screenshot 4

- 5 The OSX License Wizard needs to access some information on the STM32 Nucleo board in order to create the request for the node-locked license. For this reason, the OSX License Wizard requires the installation of some additional packages ("Microsoft VS 2013 redistributable" and "STM32 ST-LINK Utility"), if the user has not already done so.

Figure 15: OSX License Wizard screenshot 5



- 6 Before launching the OSX License Wizard, connect the STM32 Nucleo board to be linked to the node-locked license via USB cable. First, select the library to be activated as per the figure below.

Figure 16: OSX License Wizard screenshot 6

OSX License Wizard - vX.XXX

Tools Help

ST
life.augmented
OSX
OpenSoftwareX

open.MEMS
open.AUDIO

MCU RF MEMS

Nucleo board:

Board model:

Flash size:

Ram size:

User information

User name:

Company:

Email:

Site identification:

Node code:

Site code:

< Select the library to be activated... >

Identify STM32 Nucleo board...

Generate license request...

Send license request email...

Show library info

Exit

=====

STMicroelectronics
OpenSoftwareX
STM32 Nucleo License Wizard (vX.XXX)

=====

Date: Monday, 05/October/'15

- 7 Next click on the "Identify STM32 Nucleo board" button.

Figure 17: OSX License Wizard screenshot 7

OSX License Wizard - vX.XXX

Tools Help

ST
life.augmented
OSX
OpenSoftwareX

open.MEMS
open.AUDIO

ST MCU ST RF ST MEMS

Nucleo board:

Board model:

Flash size:

Ram size:

Site identification:

Node code:

Site code: 65FE0C24629F8B5BFB9860A961620C88

User information:

User name: john smith

Company: stmicroelectronics

Email: john.smith@st.com

MotionXX vX.X.X - lib name

Identify STM32 Nucleo board...

Generate license request...

Send license request email...

Show library info

Exit

=====
STMicroelectronics
OpenSoftwareX
STM32 Nucleo License Wizard (vX.XXX)
=====
Date: Monday, 05/October/'15

- 8 At this point, information about the connected STM32 Nucleo board is available to the user, together with a node code associated with the same board. Complete the form with the "User name", "Company" and "Email" information and click on "Generate license request".

Figure 18: OSX License Wizard screenshot 8

OSX License Wizard - vX.XXX

Tools Help

ST
life.augmented
OSX
OpenSoftwareX

open.MEMS
open.AUDIO

Nucleo board:

Board model: NucleoF401RE
Flash size: 512 KB
Ram size: 96 KB

User information

User name: john smith
Company: stmicroelectronics
Email: john.smith@st.com

Site identification:

Node code: 617C076316924652116099EBC1AF3E7C
Site code: 65FE0C24629F8B5BFB9860A961620C88

MotionXX vX.X.X - lib name

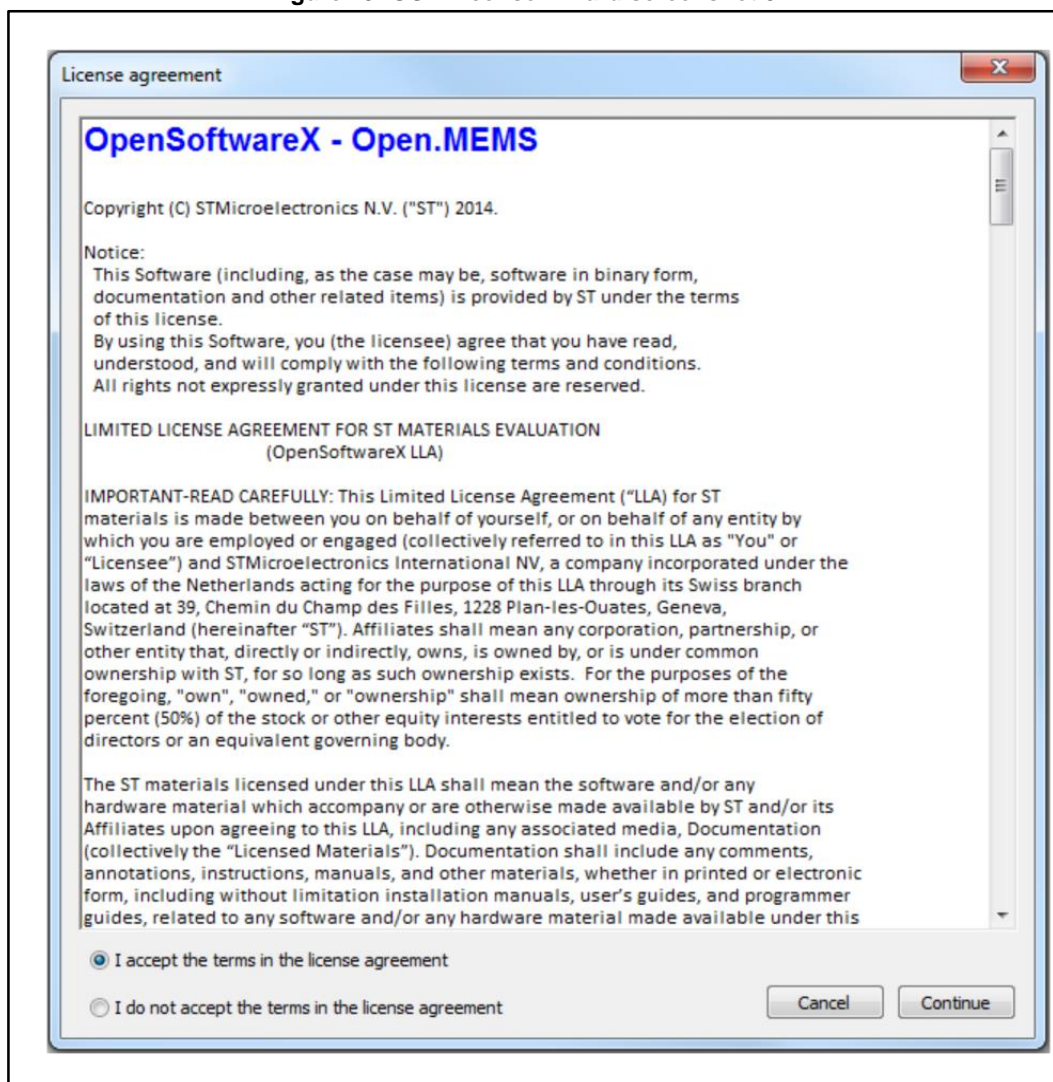
Identify STM32 Nucleo board...
Generate license request...
Send license request email...
Show library info
Exit

STM1croelectronics
OpenSoftwareX
STM32 Nucleo License Wizard (vX.XXX)

Date: Monday, 05/October/'15

- 9 A new window concerning the license agreement will appear and you can accept the conditions and click on the "Continue" button to proceed.

Figure 19: OSX License Wizard screenshot 9



- 10 Click the "Send license request email" button shown in the figure below.

Figure 20: OSX License Wizard screenshot 10

OSX License Wizard - vX.XXX

Tools Help

ST
life.augmented
OSX
OpenSoftwareX

open.MEMS
open.AUDIO

Nucleo board:
Board model: NucleoF401RE
Flash size: 512 KB
Ram size: 96 KB

Site identification:
Node code: 617C076316924652116099EBC1AF3E7C
Site code: 65FE0C24629F8B58FB9860A961620C88

User information:
User name: john smith
Company: stmicroelectronics
Email: john.smith@st.com

MotionXX vX.X.X - lib name
Identify STM32 Nucleo board...
Generate license request...
Send license request email...
Show library info
Exit

Copy the text in the below section (between the lines) and send it via email to open.license@st.com

NOTE: the message is digitally-signed, do NOT modify the fields or text. Failure to do so will prevent license authorization by the licensing server.

OSX Open.MEMS: <MotionXX vX.X.X - Library name> license request

User name: john smith
User company: stmicroelectronics
User email: john.smith@st.com
Library name: OSX_MOTION_XX_VXXX
Board model: NucleoF401RE
Node Code: 617C076316924652116099EBC1AF3E7C
Site Code: 65FE0C24629F8B58FB9860A961620C88
License Code: 2F41C8141287A1FC8C0A76274637EA3B
License Type: EVALUATION

This email has been generated by the OSX License Wizard vX.XXX

Your license will then be processed by the licensing server and you'll receive authorization license via email.
Enjoy the ST OpenSoftwareX development tools!

- 11 Once the license activation codes have been received, edit the content of the osx_license.h file with the license number. You must also delete or comment the "#error...." line, found in the Middlewares\ST\STM32_OSX_MotionXX_Library folder of your workspace.

2 Appendix

2.1 Production license

You can obtain an additional *production* (i.e., node-free) license following specific authorization form ST. This license is usable on any STM32-based platform, provided it is compatible with the Cortex core.

The request of this license type must first be authorized by ST through a user-specific certificate. Ownership of a valid certificate enables the end-user to initiate a production license request, which is then automatically processed by the server.

Please note that ST will only authorize end-users for *production* license requests after a two-party License User Agreement (LUA) has been signed.

Once you have obtained a valid certificate, proceeds as follows:

- 1 In the tools menu, select “Enter Production Certificate...” and insert a valid code in the relative window, as shown below.

Figure 21: OSX License Wizard screenshot 11

Enter production certificate...

IMPORTANT INFORMATION

Production certificates are issued by STMicroelectronics in order to allow end-users to generate a license request for production. If you have not received such certificate you should not use this dialog.

Contact an ST sale representative to get more information about how to initiate the request for a production license and obtain the production certificate.

Production license certificate (as provided by STMicroelectronics)

Library name: OSX_MOTION_XX_VXXX

User name: john smith

Company: stmicroelectronics

Email: john.smith@st.com

Site code: 65FE0C24629F8B5BFB9860A961620C88

Certificate: 0123456789ABCDEF

OK Cancel

- 2 After a valid certificate has been inserted, the node-free license request flag becomes visible and the production license can be requested. Once received, the new license can replace the old node-locked license in the `osx_license.h` file.

Figure 22: OSX License Wizard screenshot 12

OSX License Wizard - vX.XXX

Tools Help

ST
life.augmented
OSX
OpenSoftwareX

open.MEMS
open.AUDIO

Nucleo board:

Board model: NucleoF401RE
Flash size: 512 KB
Ram size: 96 KB

Site identification:

Node code: 617C076316924652116099EBC1AF3E7C
Site code: 65FE0C24629F8B5BFB9860A961620C88
☒ Request production license (node-free)

User information

User name: john smith
Company: stmicroelectronics
Email: john.smith@st.com

MotionXX vX.X.X - lib name
Identify STM32 Nucleo board...
Generate license request...
Send license request email...
Show library info
Exit

Copy the text in the below section (between the lines) and send it via email to open.license@st.com

NOTE: the message is digitally-signed, do NOT modify the fields or text. Failure to do so will prevent license authorization by the licensing server.

OSX Open.MEMS: <MotionXX vX.X.X - Library name> license request

User name: john smith
User company: stmicroelectronics
User email: john.smith@st.com
Library name: OSX_MOTION_XX_VXXX
Board model: NucleoF401RE
Node Code: 617C076316924652116099EBC1AF3E7C
Site Code: 65FE0C24629F8B5BFB9860A961620C88
License Code: 2F41CB141287A1FC8C0A76274637EA38
License Type: PRODUCTION

This email has been generated by the OSX License Wizard vX.XXX

Your license will then be processed by the licensing server and you'll receive authorization license via email.

Enjoy the ST OpenSoftwareX development tools!

3 Acronyms and abbreviations

Table 1: Acronyms

Acronym	Description
API	application programming interface
GUI	graphical user interface
HAL	hardware abstraction layer
IDE	integrated development environments
LUA	licence user agreement
SDK	software development kit

4 References

- *UM1859: Getting started with the X-CUBE-MEMS1 motion MEMS and environmental sensor software expansion for STM32Cube*
- *UM1724: STM32 Nucleo boards*

5 Revision history

Table 2: Document revision history

Date	Revision	Changes
01-Feb-2016	1	First release.

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