

LAB 06

THE IKS01A2 MODULE



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OF TRENTO

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PRELIMINARY DOWNLOADS

PRELIMINARY DOWNLOADS

Before we start, please download all the file contained inside the drive folder:

<https://drive.google.com/drive/folders/1BfbaYt5Bvy6v2NRF1YHIKbplc5kHMwEZ?usp=sharing>



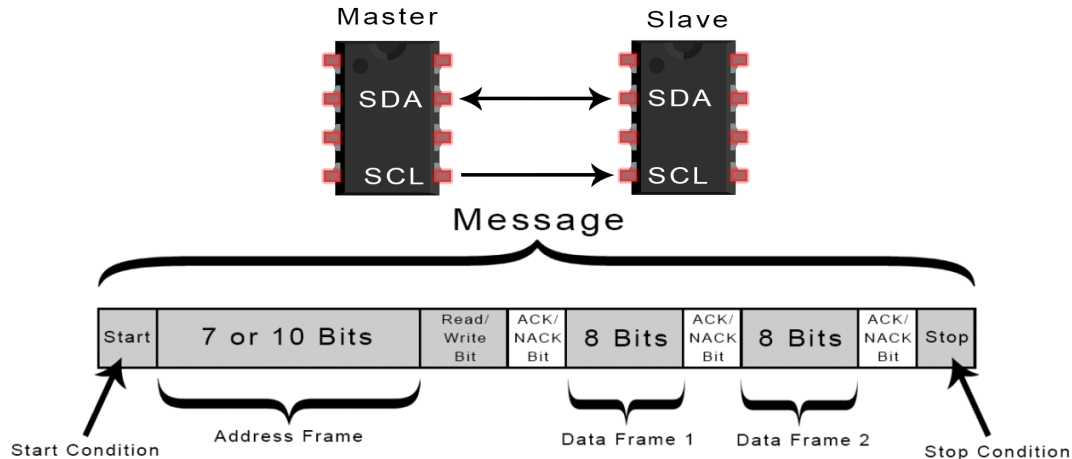
I2C

STM32 I2C

Inter Integrated Circuit (I2C) is a serial communication protocol for exchanging data between a **master** and one or more **slaves**.

The **I2C** allows for **synchronous communication** thanks to a line reserved for the clock signal (**SCL – Serial Clock**). Data are exchanged through a second line called **SDA – Serial Data**.

Addressing is done with a single line by using the address slave.

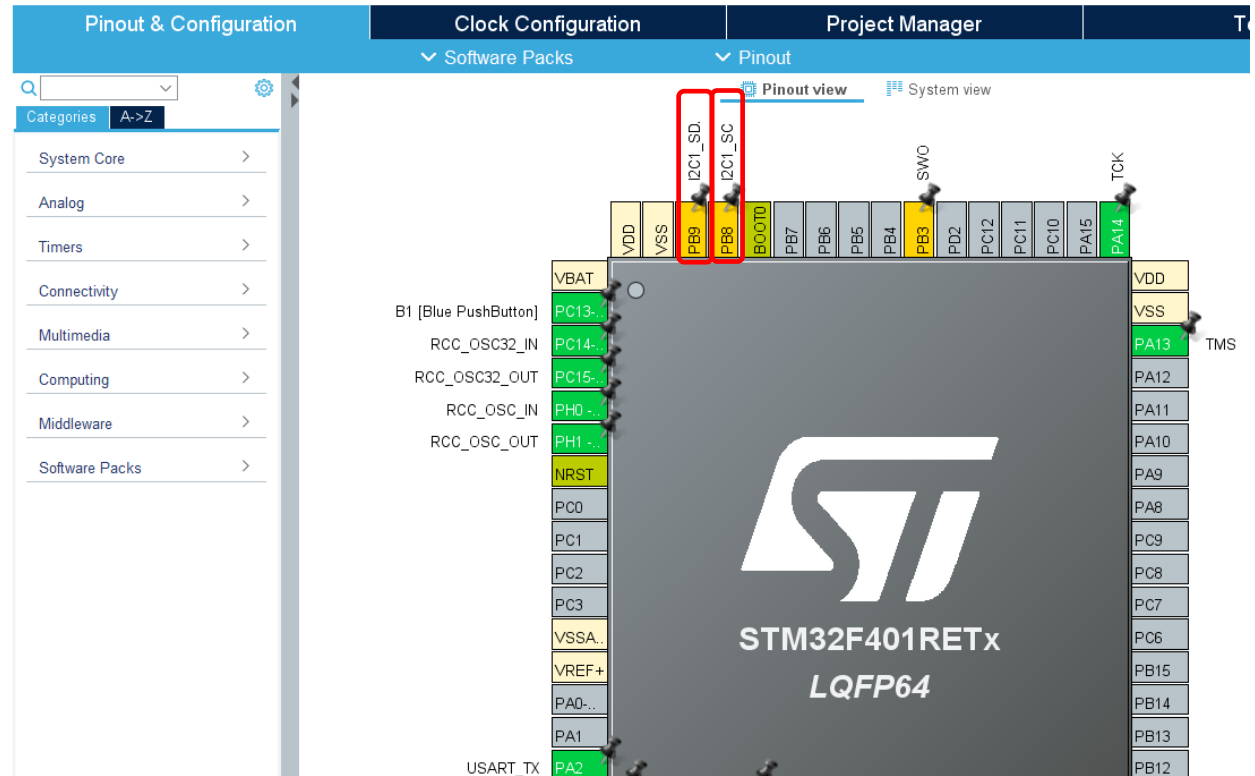


STM32 I2C

Pin PB8 and PB9 can be multiplexed to the SCL and SDA lines.

PB8 = I2C SCL

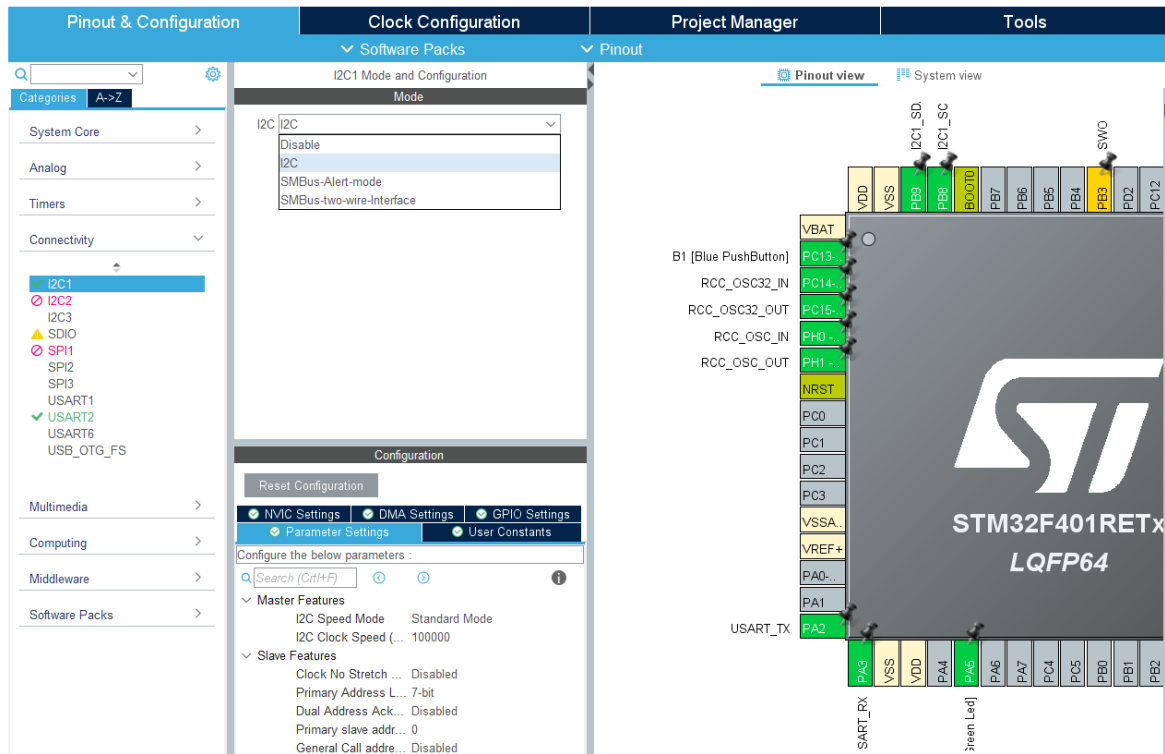
PB9 = I2C SDA



STM32 USART

I2C parameters can be configured as always using CubeMX.

As a first step, set **I2C** as the **I2CI mode**. We will come back later on this.

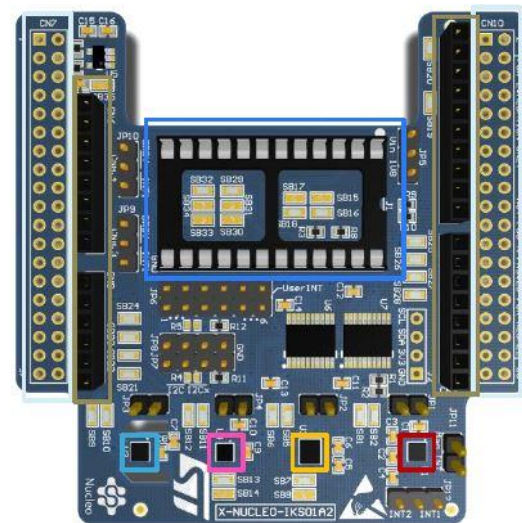



X-NUCLEO-IKS01A2

X-NUCLEO-IKS01A2

The X-NUCLEO-IKS01A2 is a motion MEMS and environmental sensor evaluation board system.

- **LSM6DSL** : MEMS 3D accelerometer ($\pm 2/\pm 4/\pm 8/\pm 16$ g) + 3D gyroscope ($\pm 125/\pm 245/\pm 500/\pm 1000/\pm 2000$ dps)
- **LSM303AGR** : MEMS 3D magnetometer (± 50 gauss) + MEMS 3D accelerometer ($\pm 2/\pm 4/\pm 8/\pm 16$ g)
- **LPS22HB** : 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 |  LSM6DSL |  ST morpho connector** |
|  LPS22HB |  LSM303AGR |  Arduino UNO R3 connector |
| |  DIL 24-pin | |



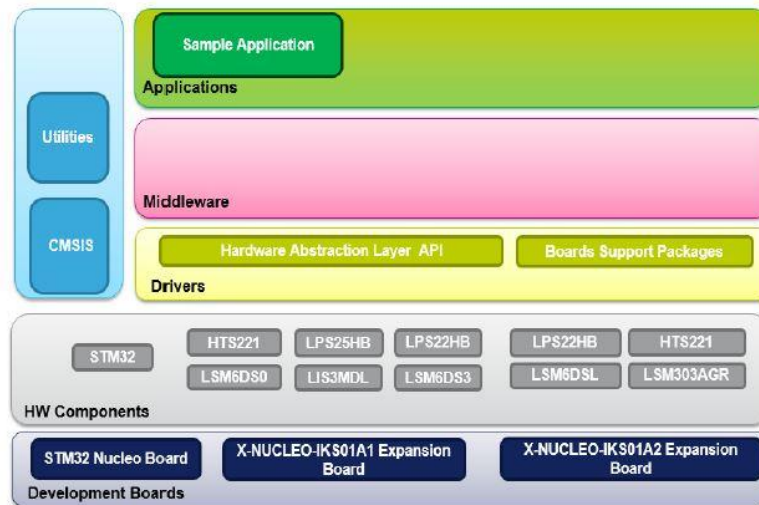
X-CUBE-MEMSI

X-CUBE-MEMSI

The X-CUBE-MEMSI software package is an expansion for STM32Cube, associated with the X-NUCLEO-IKS01A2 expansion board.

- Complete middleware to build applications using temperature and humidity sensors (HTS221), pressure sensor (LPS22HB) and motion sensors (LSM303AGR and LSM6DSL)
- 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



X-CUBE-MEMSI - INSTALLATION

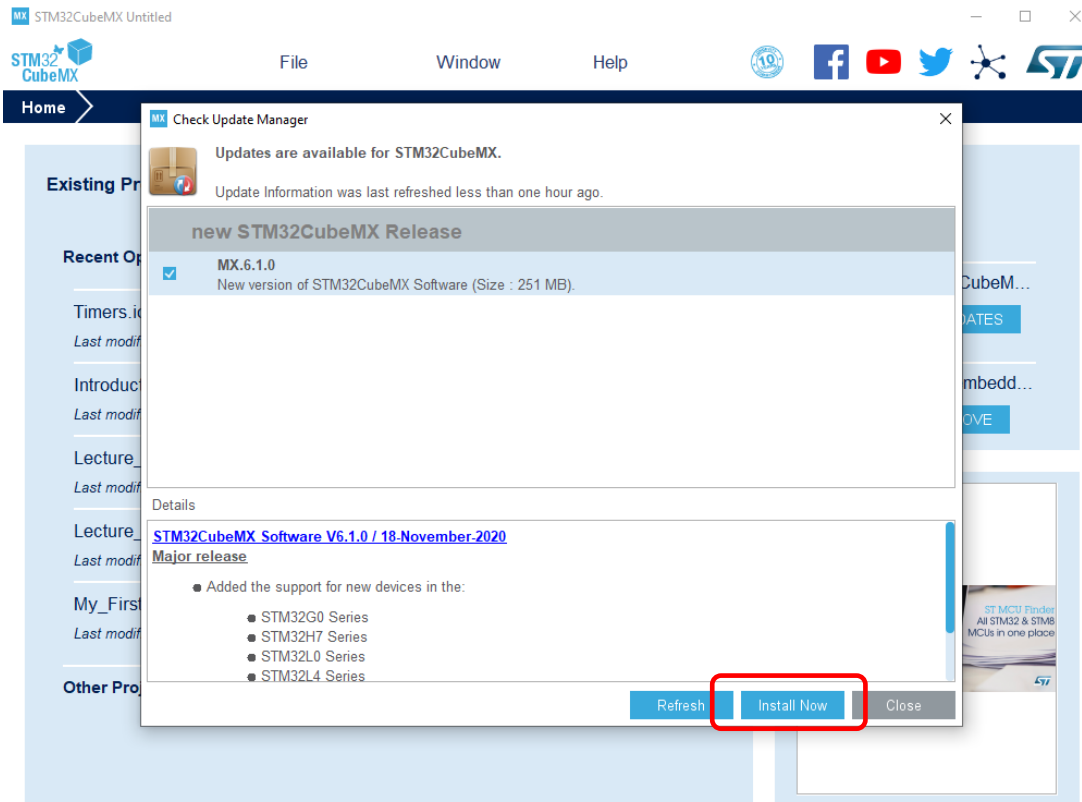
The screenshot displays the STM32CubeMX software interface. At the top, the title bar reads "STM32CubeMX Untitled". Below it is a menu bar with "File", "Window", and "Help". To the right of the menu bar are social media icons for Facebook, YouTube, Twitter, and GitHub, along with the ST logo. A "Home" button with a right-pointing arrow is located below the menu bar.

The main content area is divided into three columns:

- Existing Projects:** This column contains a section titled "Recent Opened Projects" with a list of five projects, each with a file name, a last modified date, and a small "MX" icon:
 - IKS01A2_ECompass.ioc (Last modified date : 24/11/2020 10:24:05)
 - IKS01A2_PoseEstimation.ioc (Last modified date : 24/11/2020 10:13:53)
 - IKS01A2_Data_Logging.ioc (Last modified date : 23/11/2020 16:21:30)
 - IKS01A2_6D_Orientation.ioc (Last modified date : 23/11/2020 16:21:55)
 - Timers.ioc (Last modified date : 12/10/2020 11:04:55)Below this list is a section titled "Other Projects" with a folder icon.
- New Project:** This column contains a dark blue box with the text "I need to :" followed by three options, each with a corresponding button:
 - Start My project from MCU (ACCESS TO MCU SELECTOR)
 - Start My project from ST B... (ACCESS TO BOARD SELECTOR)
 - Start My project from Exam... (ACCESS TO EXAMPLE SELECTOR)
- Manage software installations:** This column contains a section titled "Check for STM32CubeMX a..." with a red-bordered button labeled "CHECK FOR UPDATES". Below this is a section titled "Install or remove embedded ..." with a button labeled "INSTALL / REMOVE".

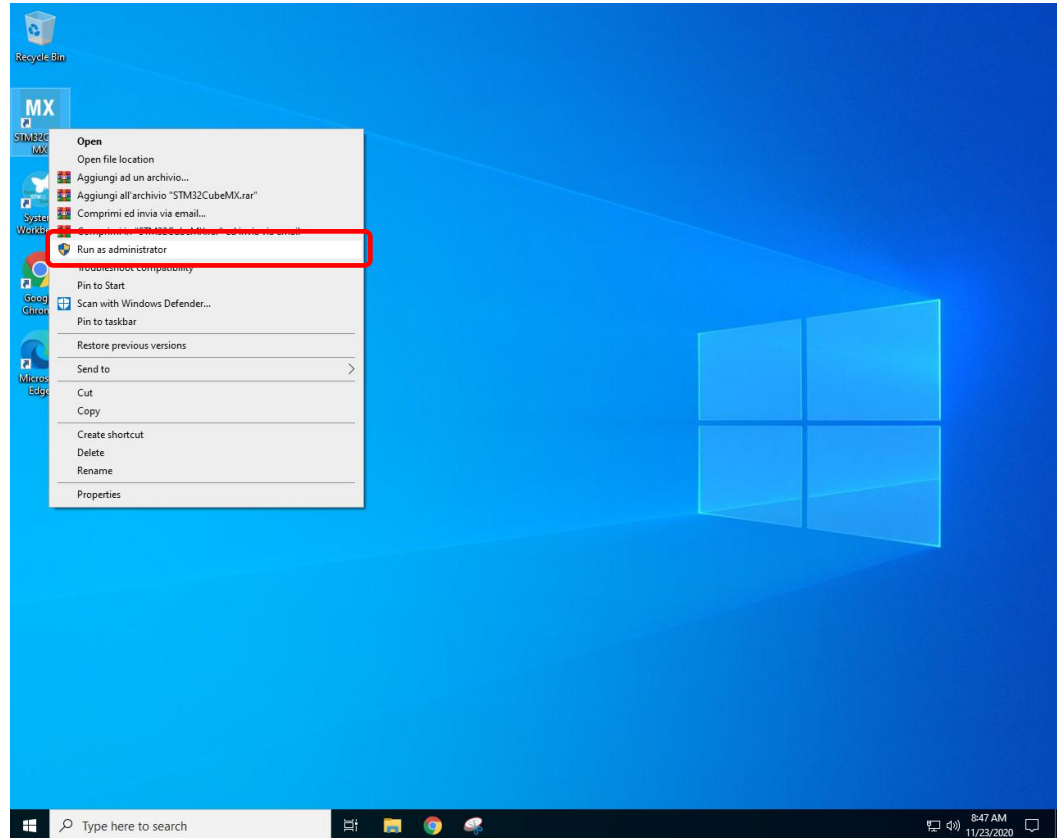
At the bottom of the interface, there is a section titled "Build your certified safety system with STM32 and STM8" featuring four shields labeled "SIL Ready", "ASIL Ready", "ClassB Ready", and "Partner Program", along with the ST logo. Below this section are links for "About STM32" and "External Tools".

X-CUBE-MEMSI - INSTALLATION

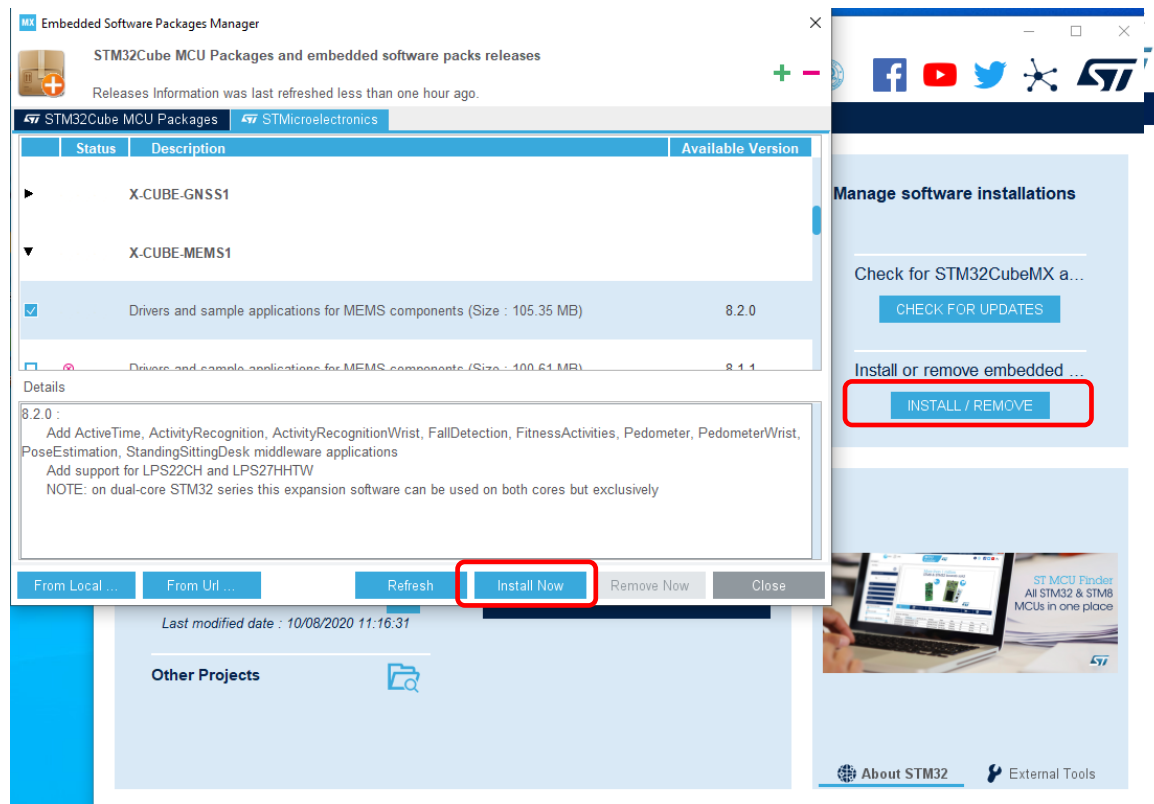


X-CUBE-MEMSI - INSTALLATION

Once updated, close it and re
open it as an administrator



X-CUBE-MEMSI - INSTALLATION



Embedded Software Packages Manager

STM32Cube MCU Packages and embedded software packs releases

Releases Information was last refreshed less than one hour ago.

STM32Cube MCU Packages | STMicroelectronics

Status	Description	Available Version
▶	X-CUBE-GNSS1	
▼	X-CUBE-MEMSI	
<input checked="" type="checkbox"/>	Drivers and sample applications for MEMS components (Size : 105.35 MB)	8.2.0
<input type="checkbox"/>	Drivers and sample applications for MEMS components (Size : 100.61 MB)	8.1.1

Details

8.2.0 :
Add ActiveTime, ActivityRecognition, ActivityRecognitionWrist, FallDetection, FitnessActivities, Pedometer, PedometerWrist, PoseEstimation, StandingSittingDesk middleware applications
Add support for LPS22CH and LPS27HHTW
NOTE: on dual-core STM32 series this expansion software can be used on both cores but exclusively

From Local ... From Url ... Refresh **Install Now** Remove Now Close

Last modified date : 10/08/2020 11:16:31

Other Projects

Manage software installations

Check for STM32CubeMX a...

CHECK FOR UPDATES

Install or remove embedded ...

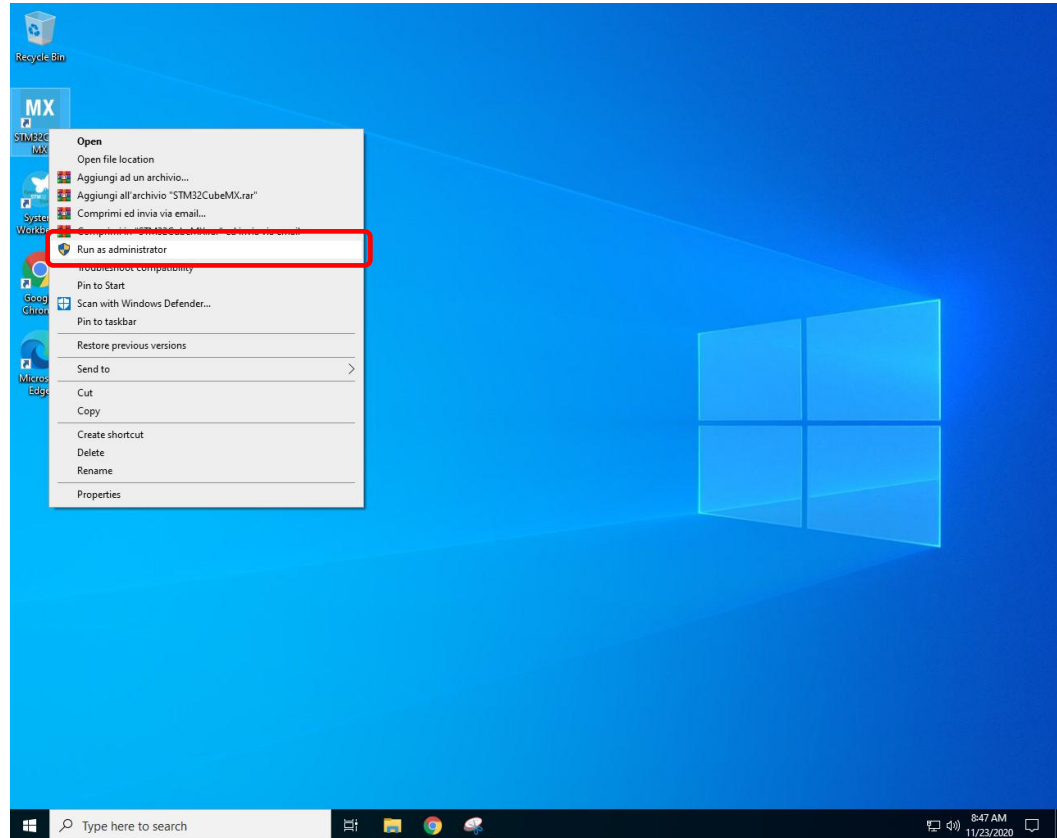
INSTALL / REMOVE

ST MCU Finder
All STM32 & STM8 MCUs in one place

About STM32 External Tools

X-CUBE-MEMSI - INSTALLATION

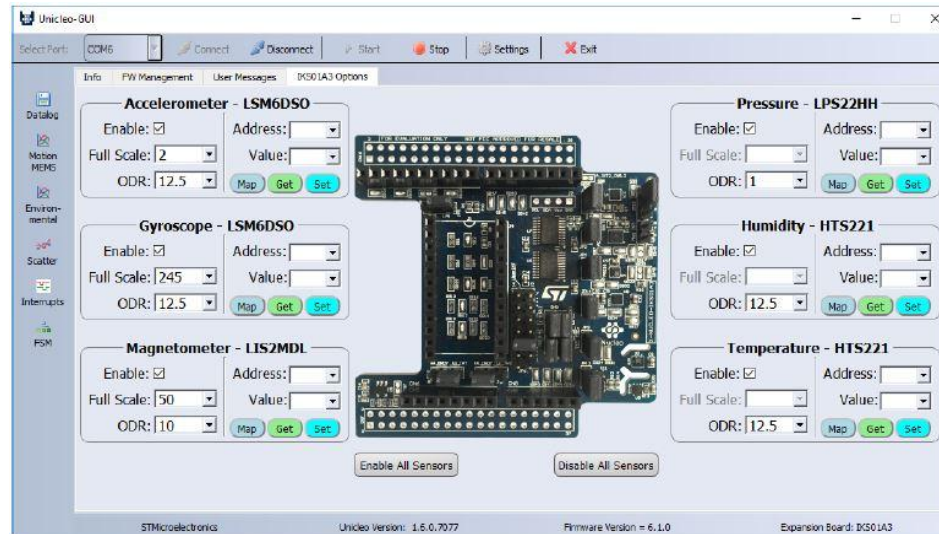
Once updated, close it and re
open it as an administrator



X-CUBE-MEMSI – UNICLEO GUI

Unicleo-GUI is a graphical user interface (GUI) for the X-CUBE-MEMSI software expansions and STM32 Nucleo expansion boards like the X-NUCLEO-IKS01A1.

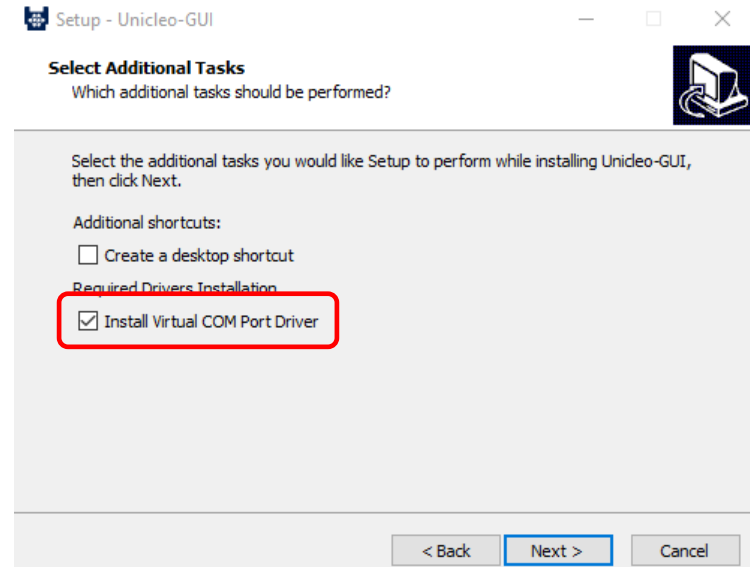
The main objective of this application is to demonstrate the functionality of the embedded ST sensors and algorithms.



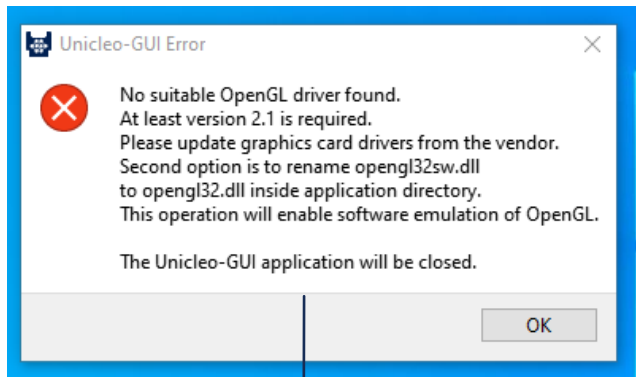
X-CUBE-MEMSI – UNICLEO GUI

Install it by unzipping the **en.Setup_Unicleo.zip** archive and **run the executable**.

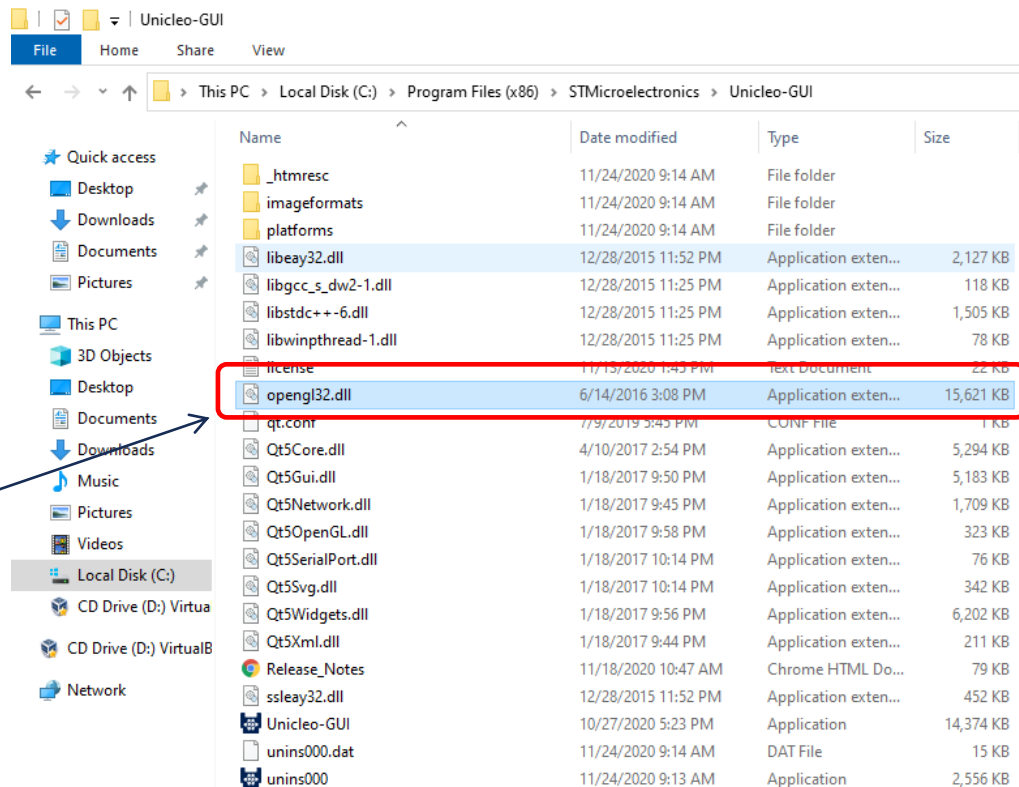
Be sure to check the *Install Virtual COM Port Driver* option.



X-CUBE-MEMSI – UNICLEO GUI



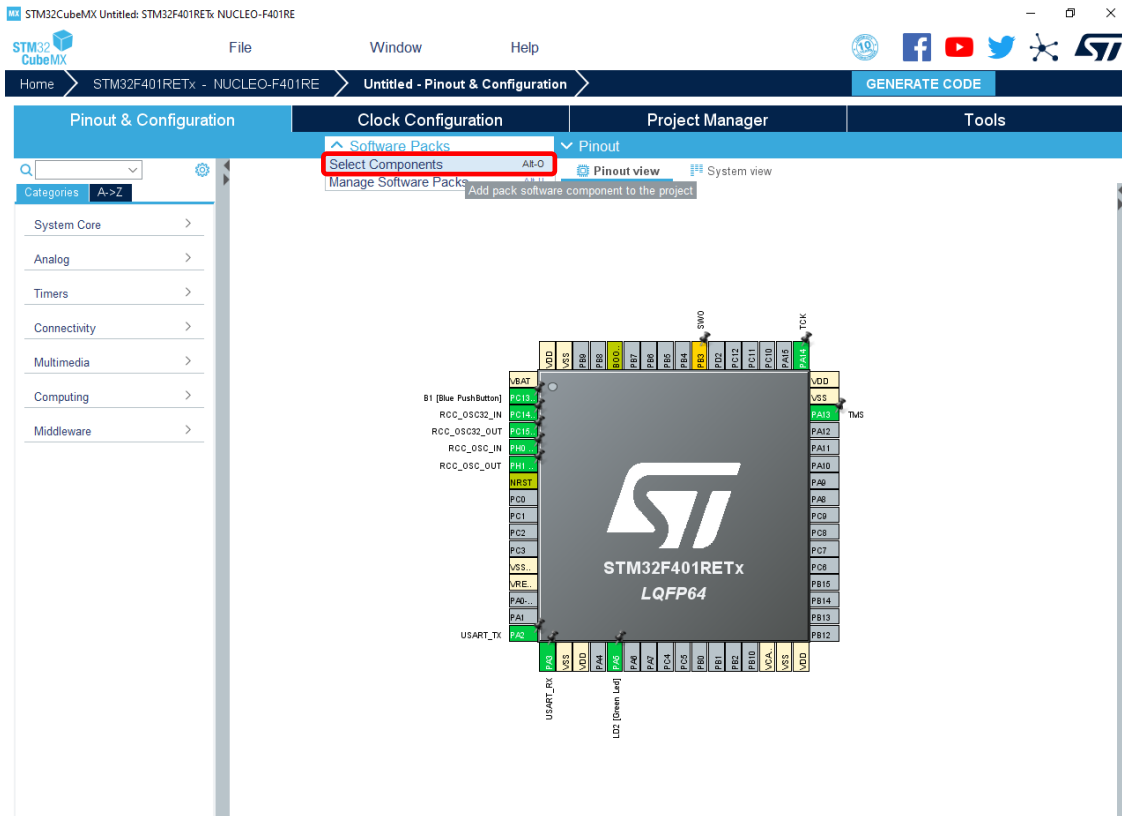
If you get this error, just browse for
the path where you installed the
Unicleo-GUI, look for the
opengl32sw.dll file and rename it
as **opengl32.dll**





IKS0 | A2 – DATA LOG TERMINAL

IKS01A2 – DATA LOG TERMINAL



IKS01A2 – DATA LOG TERMINAL

Software Packs Component Selector

Filters

Search

Pack Vendor

Software Component Class

Artificial Intelligence

Audio

Board Extension

Board Part

Board Support

CMSIS

CMSIS Driver

DSP Library

Data Exchange

Device

Extension Board

Graphics

Memory

Motion Libraries

Network

Peripheral

RF Library

RTOS

Security

Sensors

Packs

Pack / Bundle / Component	Version	Selection
> STMicroelectronics.X-CUBE-AI	5.2.0	Install
> STMicroelectronics.X-CUBE-ALGOBUILD	1.1.0	Install
> STMicroelectronics.X-CUBE-BLE1	6.1.0	Install
> STMicroelectronics.X-CUBE-BLE2	3.0.0	Install
> STMicroelectronics.X-CUBE-DISPLAY	1.0.0	Install
> STMicroelectronics.X-CUBE-EEPROMA1	3.0.0	Install
> STMicroelectronics.X-CUBE-GNSS1	5.1.0	Install
> STMicroelectronics.X-CUBE-MEMS1	2.0	Install
Board Part AccGyr / LSM6DSL		Not selected
Board Part AccGyr / LSM6DSO		Not selected
Board Part AccMag / LSM303AGR		Not selected
Board Part Acc / LIS2DW12		Not selected
Board Part Mag / LIS3MDL		Not selected
Board Part Mag / LIS2MDL		Not selected
Board Part HumTemp / HTS221		Not selected
Board Part PressTemp / LPS22HB		Not selected
Board Part PressTemp / LPS22HH		Not selected
Board Part Temp / STTS751		Not selected

Component dependencies

Pack STMicroelectronics.X-CUBE-MEMS1.2.0

Cannot show dependencies at pack level

Details and warnings

Pack details

Name X-CUBE-MEMS1

Vendor STMicroelectronics

Version 8.2.0

Add to favorites

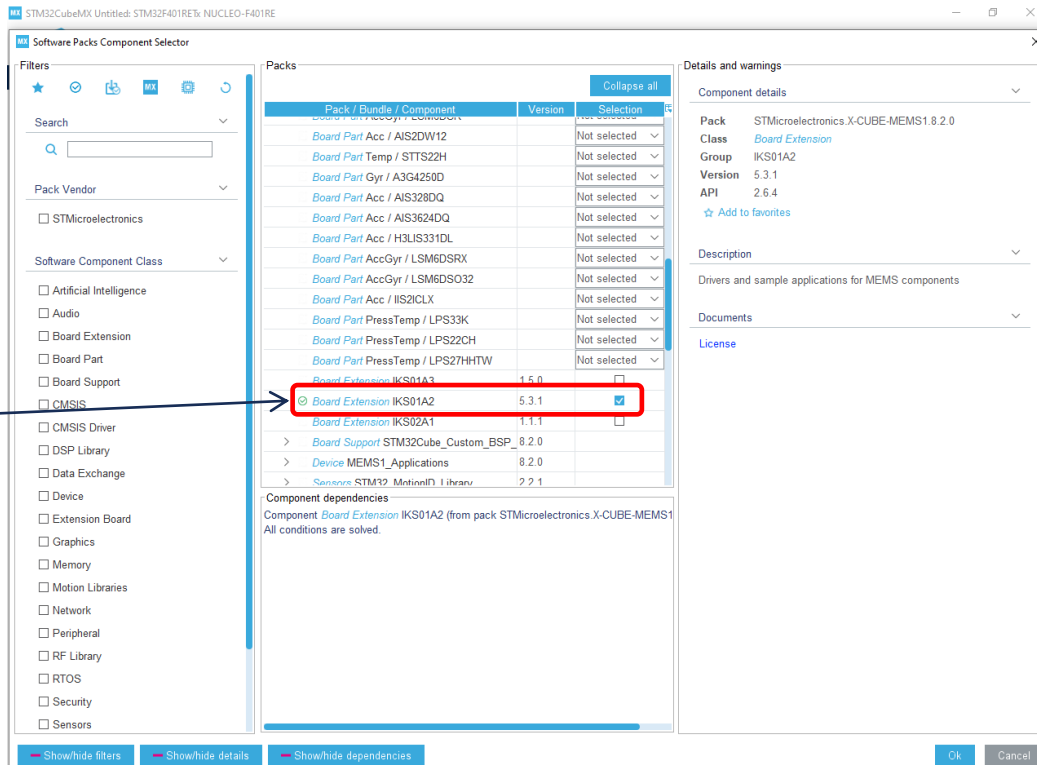
Documents

License

Show/hide filters Show/hide details Show/hide dependencies Ok Cancel

IKS01A2 – DATA LOG TERMINAL

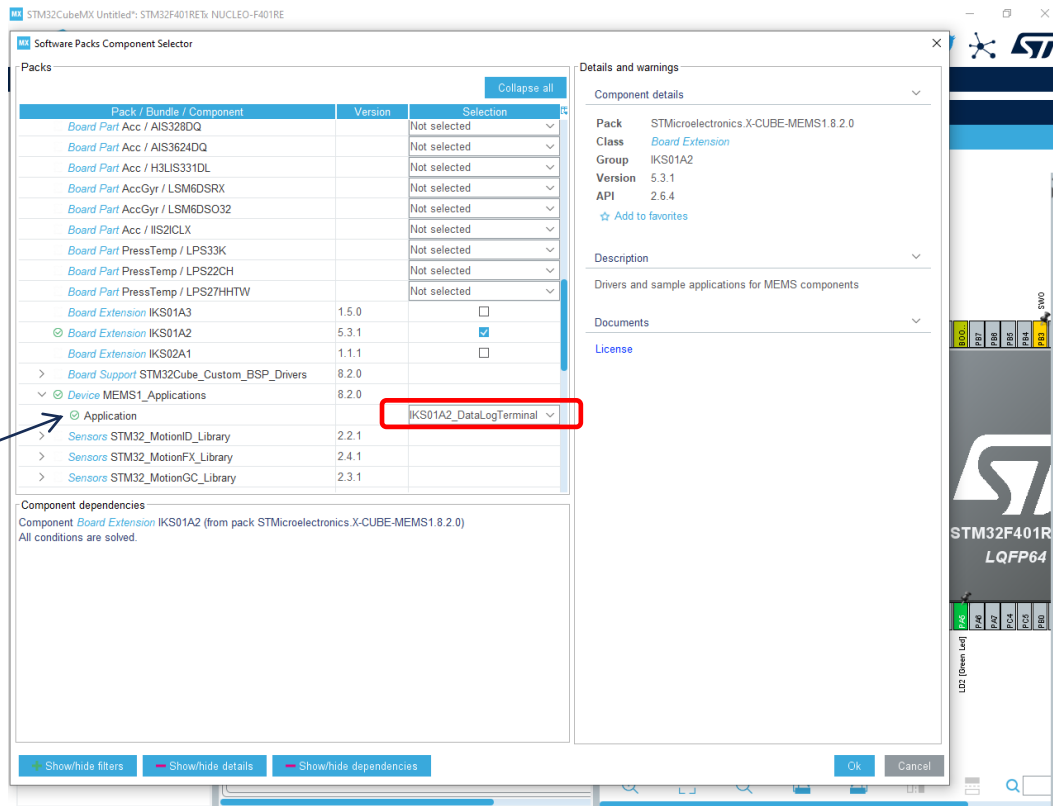
Scroll down and check
IKS01A2 as Board Extension



IKS01A2 – DATA LOG TERMINAL

Here you can select the pre-compiled application to test.

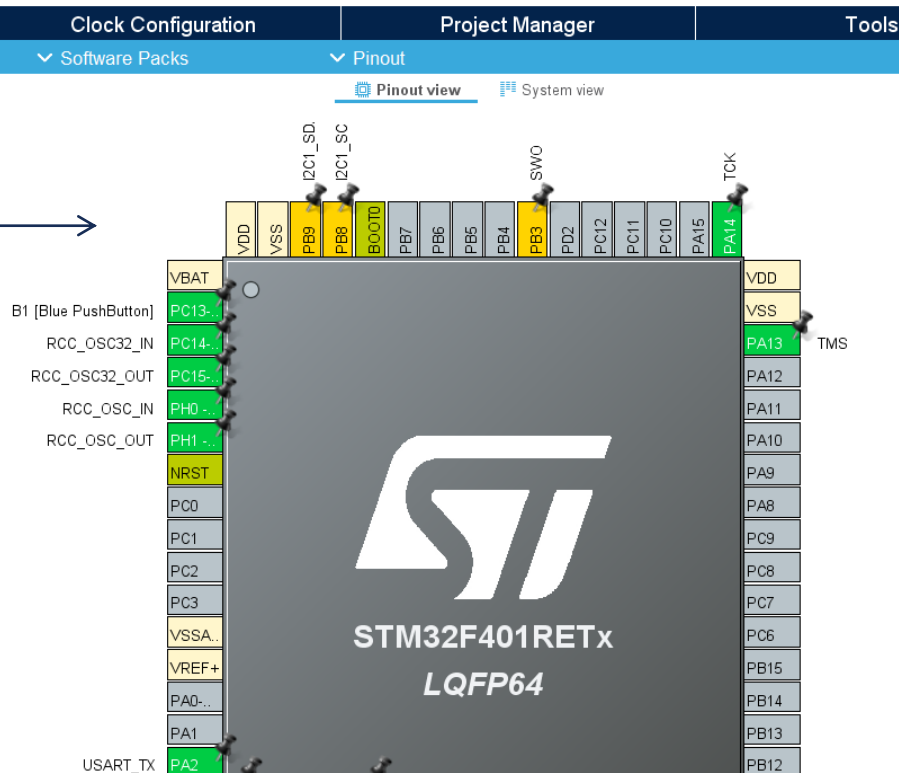
Select
IKS01A2_DataLogTerminal



IKS01A2 – DATA LOG TERMINAL

From the **Pinout** scheme, if not already set, set:

Nucleo 64		
PIN	Mode	Label
PB5	GPIO_EXTI5	
PB4	GPIO_EXTI4	
PB10	GPIO_EXTI10	
PA2	USART2_TX	USART_TX
PA3	USART2_RX	USART_RX
PA5	GPIO_Output	LD2 [Green Led]
PC13	GPIO_EXTI13	B1 [Blue PushButton]



IKS01A2 – DATA LOG TERMINAL

The screenshot shows the STM32CubeMX software interface. The 'Pinout & Configuration' tab is selected. The 'Software Packs' section is expanded, showing a list of categories on the left and a list of software packs on the right. A red box highlights the 'Board Extension IKS01A2' and 'Device MEMS1 Applications' options. Another red box highlights the 'STMicroelectronics X-CUBE-1' option in the 'Software Packs' list. The 'Configuration' section shows the 'Platform Settings' tab, which displays a table of BSP components and their configurations.

Name	IPs or Components	Found Solutions	I2C Addr	BSP API
IKS01A2 BUS IO driver	I2C:I2C	Undefined	N/A	BSP_BUS_DRIVER
BSP BUTTON	GPIO:EXTI	Undefined		BSP_COMMON_DRIVER
BSP USART	USART:Asynchronous	Undefined		BSP_COMMON_DRIVER
BSP LED	GPIO:Output	Undefined		BSP_COMMON_DRIVER

IKS01A2 – DATA LOG TERMINAL

STM32CubeMX IDE Configuration for IKS01A2

Pinout & Configuration | Clock Configuration | Project Manager | Tools

Software Packs | Pinout

STMMicroelectronics X-CUBE-MEMS1.8.2.0 Mode and Configuration

Mode

- ☒ Board Extension IKS01A2
- ☒ Device MEMS1 Applications

Configuration

Reset Configuration

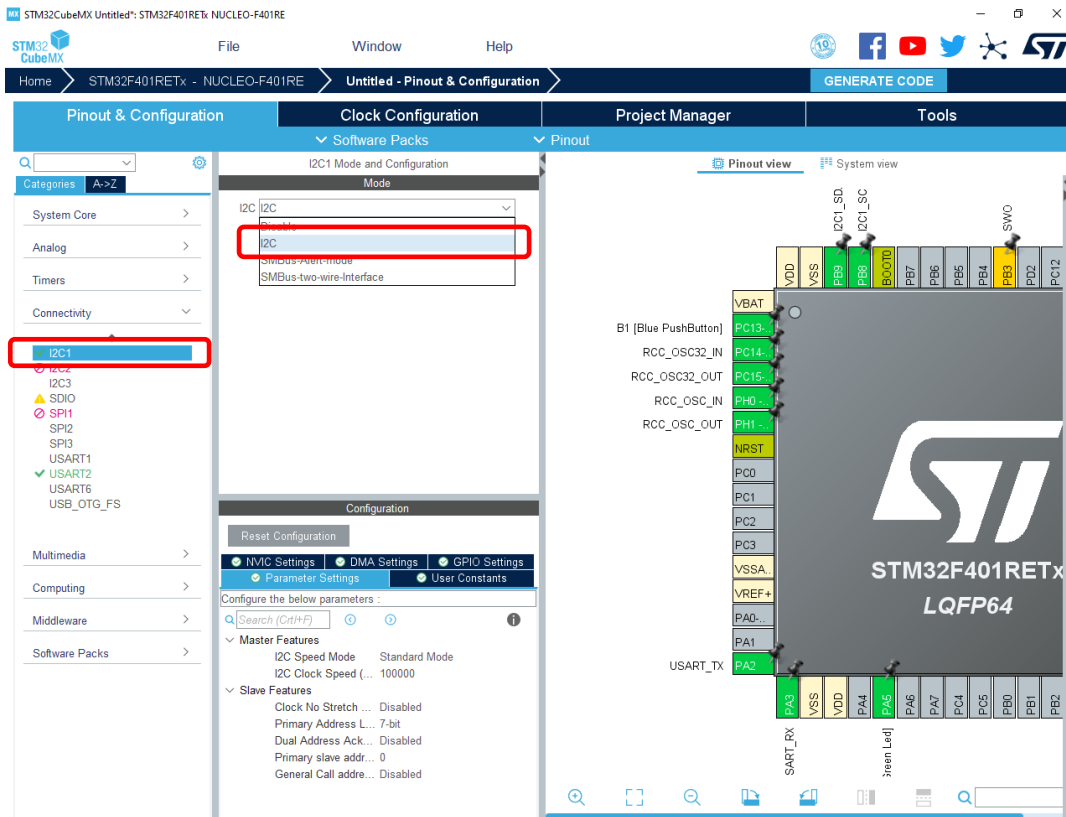
Parameter Settings | Platform Settings

Platform proposal

BSP

Name	IPs or Components	Found Solutions	I2C Addr	BSP API
IKS01A2 BUS IO driver	I2C:I2C	I2C1	0	BSP_BUS_DRIVER
BSP BUTTON	GPIO:EXTI	PC13-ANTI_TAMP [B1 [Blue PushButton]]		BSP_COMMON_DRIVER
BSP USART	USART:Asynchronous	USART2		BSP_COMMON_DRIVER
BSP LED	GPIO:Output	PA5		BSP_COMMON_DRIVER

IKS01A2 – DATA LOG TERMINAL

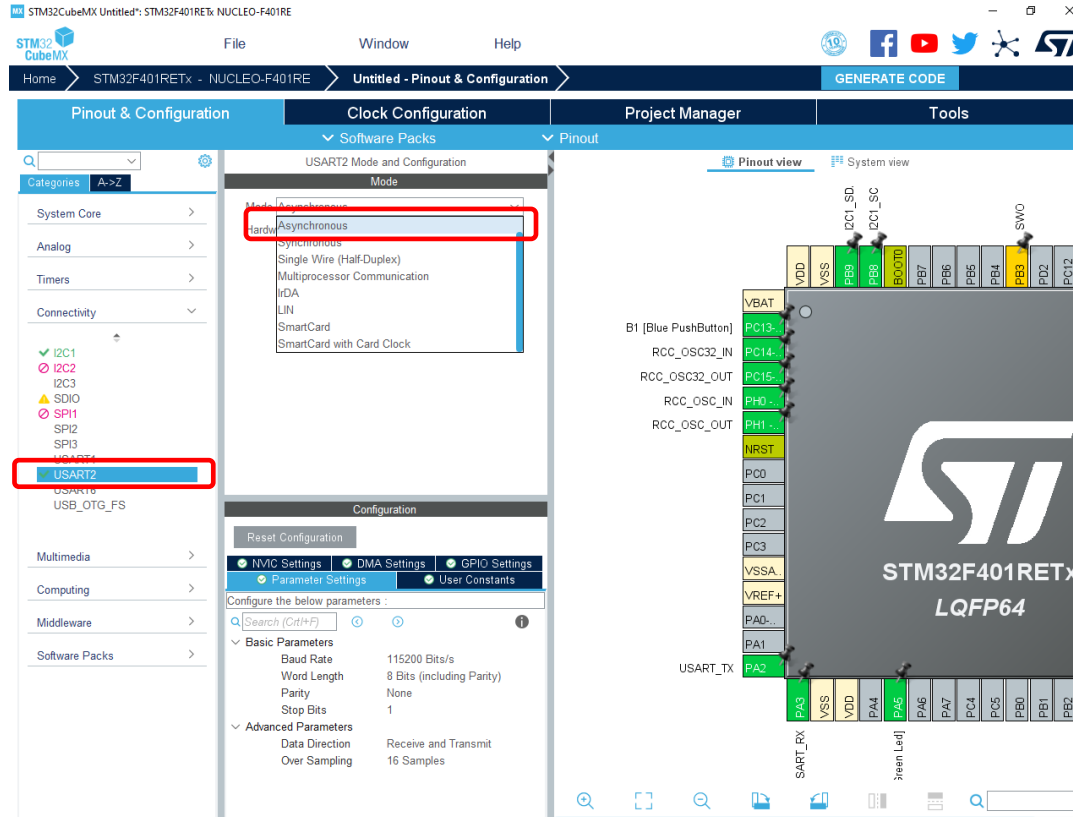


IKS01A2 – DATA LOG TERMINAL

The screenshot displays the IKS01A2 configuration interface. On the left, a sidebar lists peripherals: I2C1 (selected), I2C2, I2C3, SDIO, SPI1, SPI2, SPI3, USART1, USART2 (checked), USART6, and USB_OTG_FS. Below this are sections for Multimedia, Computing, Middleware, and Software Packs. The main area is titled 'Configuration' and includes a 'Reset Configuration' button. A tab bar shows 'Parameter Settings' (selected), 'User Constants', 'NVIC Settings', 'DMA Settings', and 'GPIO Settings'. Below the tabs, a search bar is present. The 'Master Features' section is expanded and highlighted with a red box, showing the following configuration:

Master Features	
I2C Speed Mode	Fast Mode
* I2C Clock Speed (Hz)	400000

IKS01A2 – DATA LOG TERMINAL



IKS01A2 – DATA LOG TERMINAL

The screenshot shows the STM32CubeMX Configuration window for the USART2 peripheral. The left sidebar lists the project components: USART2 (checked), USART6, and USB_OTG_FS. The main configuration area is titled 'Configuration' and includes a 'Reset Configuration' button. Below this, there are tabs for 'Parameter Settings' (checked), 'User Constants', 'NVIC Settings', 'DMA Settings', and 'GPIO Settings'. A search bar is present with the text 'Search (Ctrl+F)'. The 'Basic Parameters' section is expanded and highlighted with a red box, displaying the following settings:

Parameter	Value
Baud Rate	115200 Bits/s
Word Length	8 Bits (including Parity)
Parity	None
Stop Bits	1

IKS01A2 – DATA LOG TERMINAL

Pinout & Configuration | Clock Configuration | Project Manager | Tools

▼ Software Packs | ▼ Pinout

NVIC Mode and Configuration

Configuration

✓ NVIC | ✓ Code generation

Priority Group: 0 bits for pre-emption priority 4 bits for subpriority | ☐ Sort by Preemption Priority and Sub Priority

Search: Search (Ctrl+F) | ☐ Show only enabled interrupts | ☒ Force DMA channels interrupts

NVIC Interrupt Table	Enabled	Preemption Priority	Sub Priority
Non maskable interrupt	<input checked="" type="checkbox"/>	0	0
Hard fault interrupt	<input checked="" type="checkbox"/>	0	0
Memory management fault	<input checked="" type="checkbox"/>	0	0
Pre-fetch fault, memory access fault	<input checked="" type="checkbox"/>	0	0
Undefined instruction or illegal state	<input checked="" type="checkbox"/>	0	0
System service call via SWI instruction	<input checked="" type="checkbox"/>	0	0
Debug monitor	<input checked="" type="checkbox"/>	0	0
Pendable request for system service	<input checked="" type="checkbox"/>	0	0
Time base: System tick timer	<input checked="" type="checkbox"/>	0	0
PVD interrupt through EXTI line 16	<input type="checkbox"/>	0	0
Flash global interrupt	<input type="checkbox"/>	0	0
RCC global interrupt	<input type="checkbox"/>	0	0
EXTI line4 interrupt	<input checked="" type="checkbox"/>	0	0
EXTI line[9:5] interrupts	<input checked="" type="checkbox"/>	0	0
I2C1 event interrupt	<input type="checkbox"/>	0	0
I2C1 error interrupt	<input type="checkbox"/>	0	0
USART2 global interrupt	<input type="checkbox"/>	0	0
EXTI line[15:10] interrupts	<input checked="" type="checkbox"/>	0	0
FPU global interrupt	<input type="checkbox"/>	0	0

Categories: A->Z

System Core

- DMA
- GPIO
- IWDG
- ✓ NVIC
- ✓ RCC
- ▲ SYS
- WWDG

Analog >

Timers >

Connectivity >

Multimedia >

Computing >

Middleware >

Software Packs

- ✓ STMicroelectronics X-CUBE-⤵

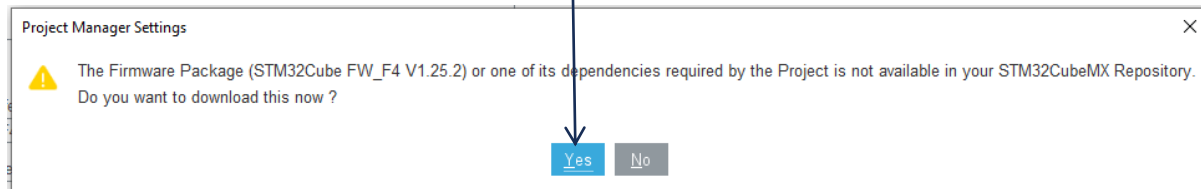
IKS01A2 – DATA LOG TERMINAL

[Home](#) > [STM32F401RETx - NUCLEO-F401RE](#) > [Untitled - Project Manager](#) > [GENERATE CODE](#)

	Pinout & Configuration	Clock Configuration	Project Manager	Tools
Project	<div>Project Settings</div> <div>Project Name IKS01A2_Data_Logging</div> <div>Project Location C:\Users\Embedded Systems\Documents\ Browse</div> <div>Application Structure Advanced <input type="checkbox"/> Do not generate the ma...</div> <div>Toolchain Folder Location C:\Users\Embedded Systems\Documents\IKS01A2_Data_Logging\</div> <div>Toolchain / IDE SW4STM32 <input checked="" type="checkbox"/> Generate Under ...</div>			
Code Generator				
Advanced Settings	<div>Linker Settings</div> <div>Minimum Heap Size 0x200</div> <div>Minimum Stack Size 0x400</div> <div>Mcu and Firmware Package</div> <div>Mcu Reference STM32F401RETx</div> <div>Firmware Package Name and Version STM32Cube_FW_F4 V1.25.2 <input checked="" type="checkbox"/> Use latest available version</div> <div><input checked="" type="checkbox"/> Use Default Firmware Location ems/STM32Cube/Repository/STM32Cube_FW_F4_V1.25.2 Browse</div>			

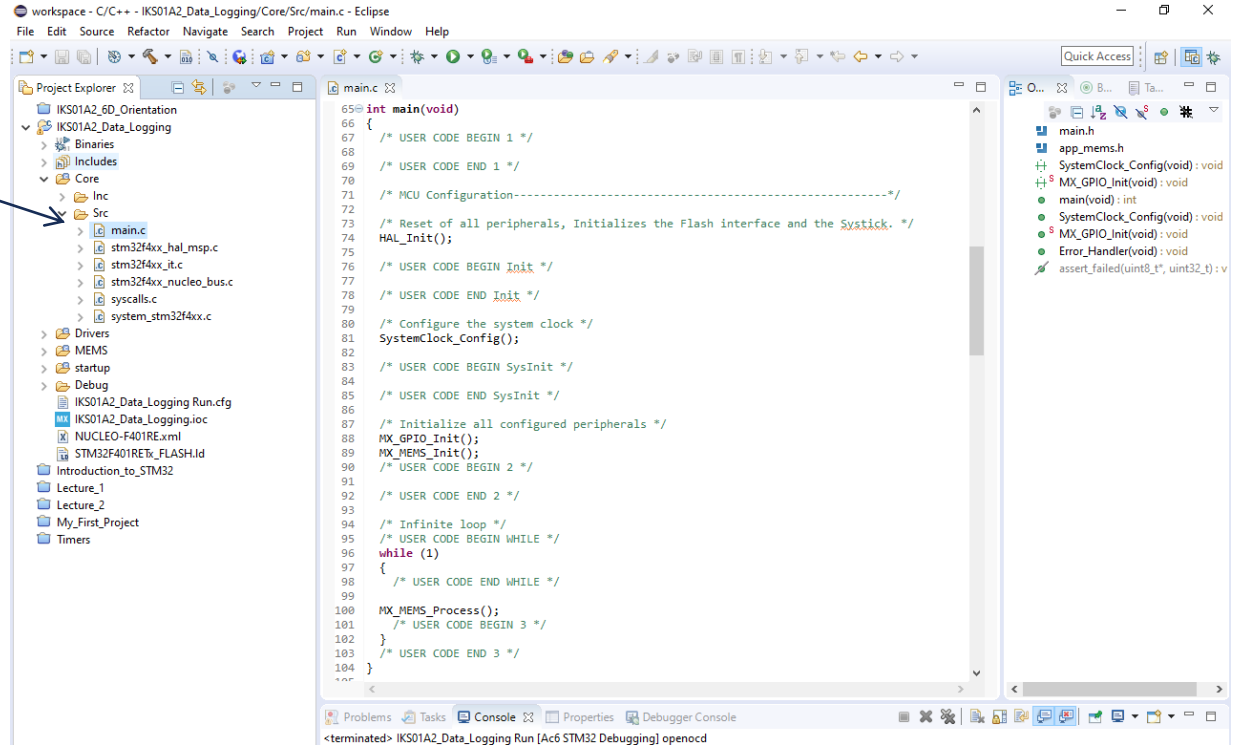
IKS01A2 – DATA LOG TERMINAL

Download the **Firmware package** and you are ready to go!

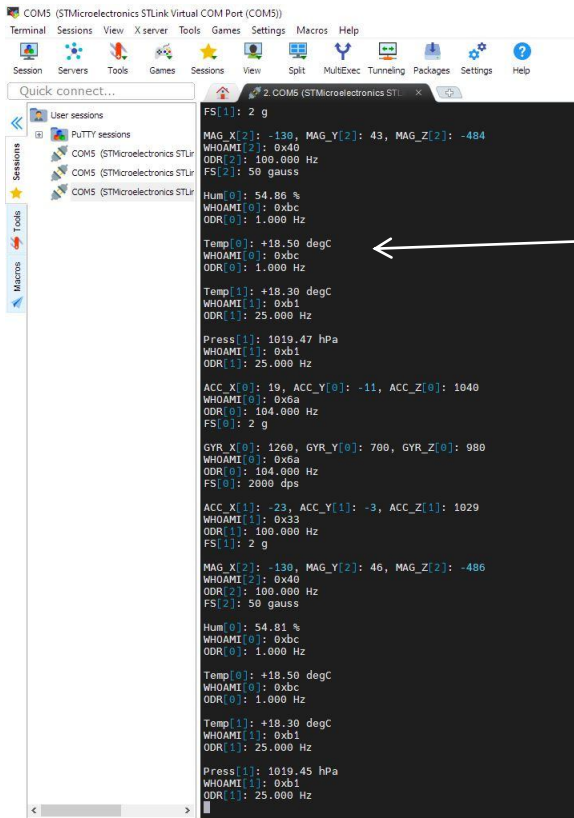


IKS01A2 – DATA LOG TERMINAL

You can find the **main.c** file in
Core->Src



IKS01A2 – DATA LOG TERMINAL



Once you flash the firmware, you can visualize the streaming data through MobaXTerm by setting a **Serial session with Baudrate 115200**

IKS01A2 – 6D ORIENTATION ESTIMATOR

6D ORIENTATION ESTIMATOR

Import the 6D Orientation estimator application and flash it on your Nucleo board.

1. Use CubeMX to select the **IKS01A2_LSM6DSL_6DOrientation** in Software Packs->Select Components as we have done for the datalogger.
2. **Set the Platform settings as shown in the next slide**
3. Flash your Nucleo board.
4. Look at the data streaming using MobaXTerm.

6D ORIENTATION ESTIMATOR

Access the X-Cube-MEMS Software pack

Pinout & Configuration | Clock Configuration | Project Manager | Tools

Software Packs | Pinout

STM32CubeMX: STM32F405 (STM32F405) Mode and Configuration

Categories: A-Z

- System Core
- Analog
- Timers
- Connectivity
 - I2C1
 - I2C2
 - I2C3
 - SDIO
 - SPI1
 - SPI2
 - SPI3
 - USART1
 - USART2
 - USART6
 - USB_OTG_FS
- Multimedia
- Computing
- Middleware
- Software Packs
 - STM32CubeMX

Board Extension IKS01A2

Device MEMS1 Applications

Configuration

Reset Configuration

Parameter Settings | User Constants | Platform Settings

Platform proposal

Application

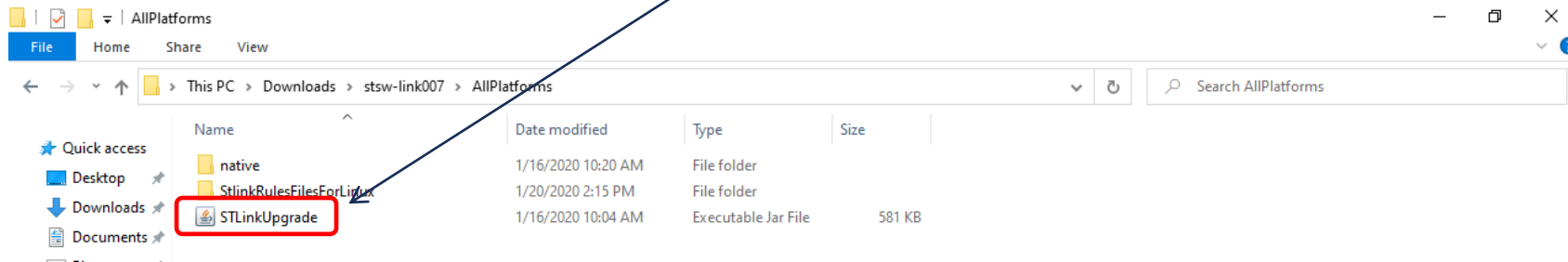
Name	IPs or Components	Found Solutions	I2C Addr	BSP API
MEMS_INT_PIN_A [GPIO:EXTI]		PB4		HAL_EXTI_DRIVER
BSP				
IKS01A2 BUS IO driver	I2C:I2C	I2C1	0	BSP_BUS_DRIVER
BSP BUTTON	GPIO:EXTI	PC13-ANTI_TAMP [B1 [Blue PushButton]]		BSP_COMMON_DRIVER
BSP USART	USART:Asynchronous	USART2		BSP_COMMON_DRIVER
BSP LED	GPIO:Output	PA5		BSP_COMMON_DRIVER

Activate Windows
Go to Settings to activate Windows

IKS01A2 – TESTING APPLICATIONS WITH THE UNICLEO GUI

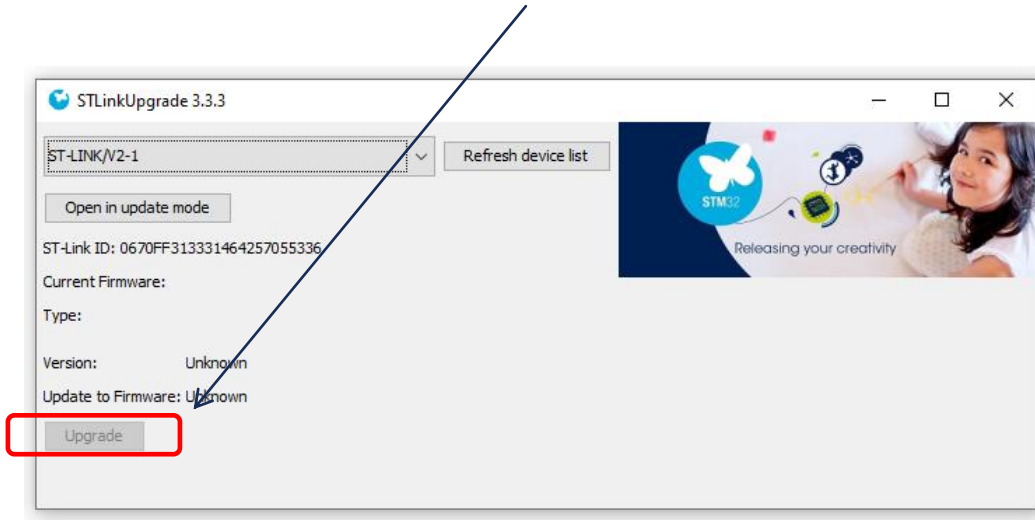
UNICLEO GUI AND APPLICATIONS

Extract the archive *en.stsw-link007_V2-36-26.zip* and run the **STLinkUpgrade** file in *stsw-link007->AllPlatforms*

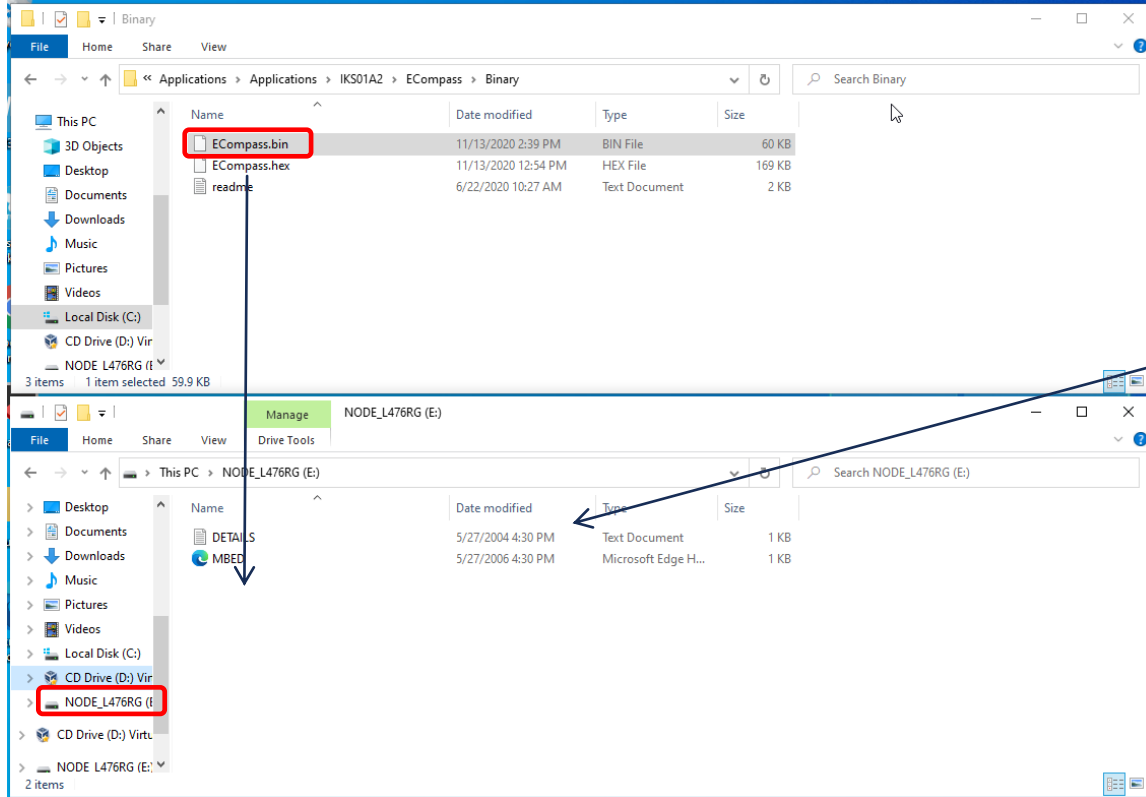


UNICLEO GUI AND APPLICATIONS

If not greyed out, hit the **Upgrade** option to upgrade your ST-LINK firmware



UNCLEO GUI AND APPLICATIONS



Unzip the *Applications_L476RG.rar* archive, enter the *IKS01A2* folder and click on the folder of the application you want to flash onto the Nucleo board.

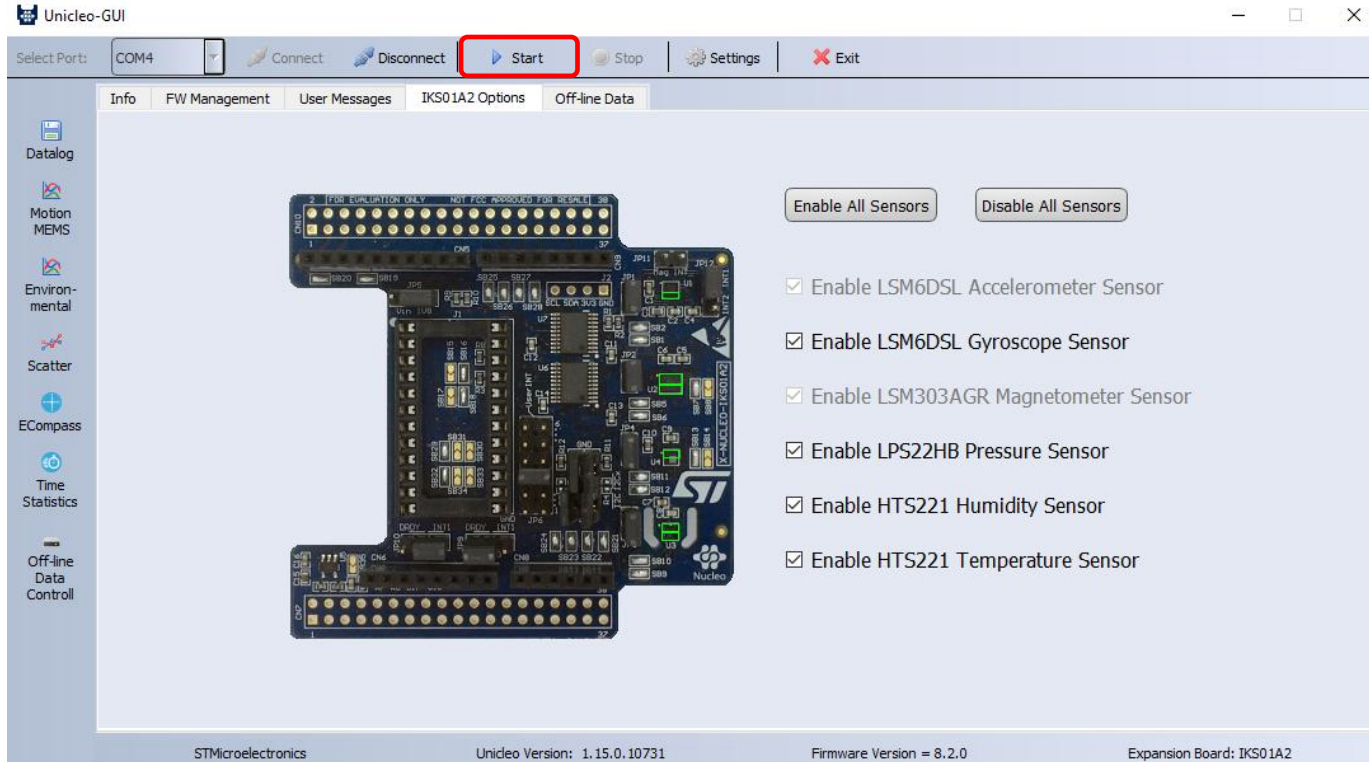
Then enter the *Binary* folder and copy the .bin file onto your Nucleo board (access your board by clicking on the *NODE_L476RG* drive)

UNICLEO GUI AND APPLICATIONS

Run the Unicleo-GUI, select the proper COM port and hit **Connect**

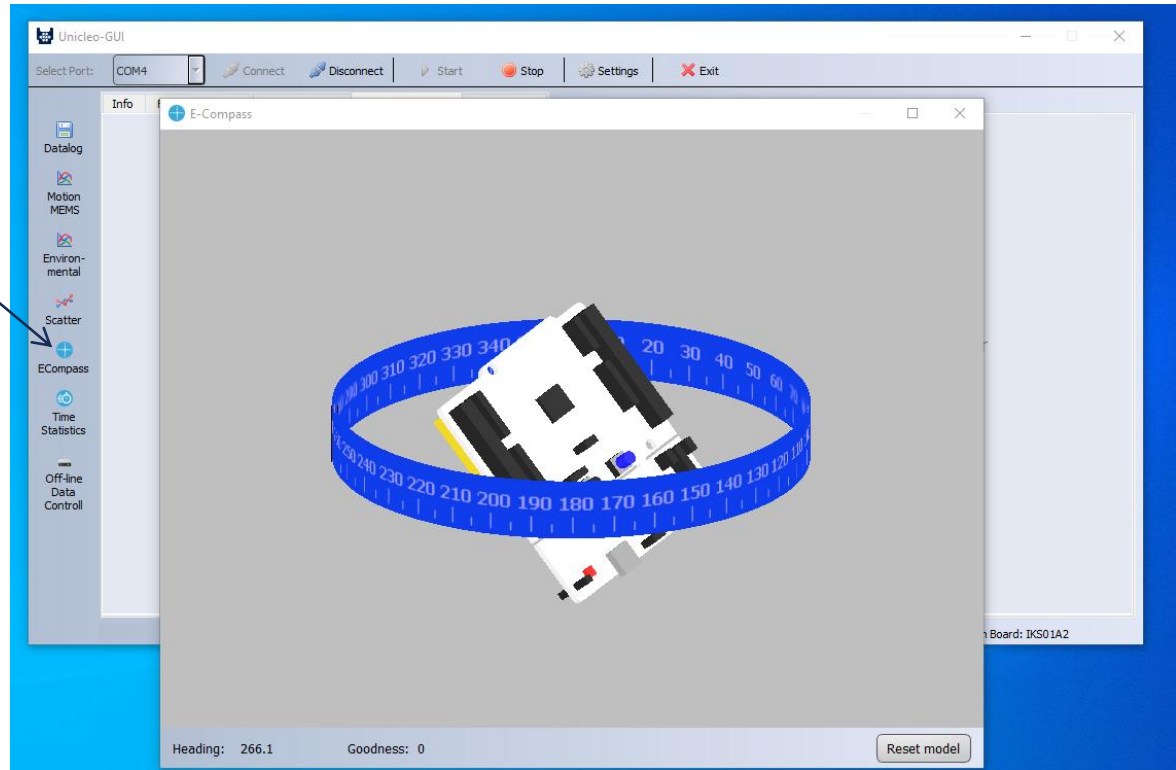


UNCLEO GUI AND APPLICATIONS



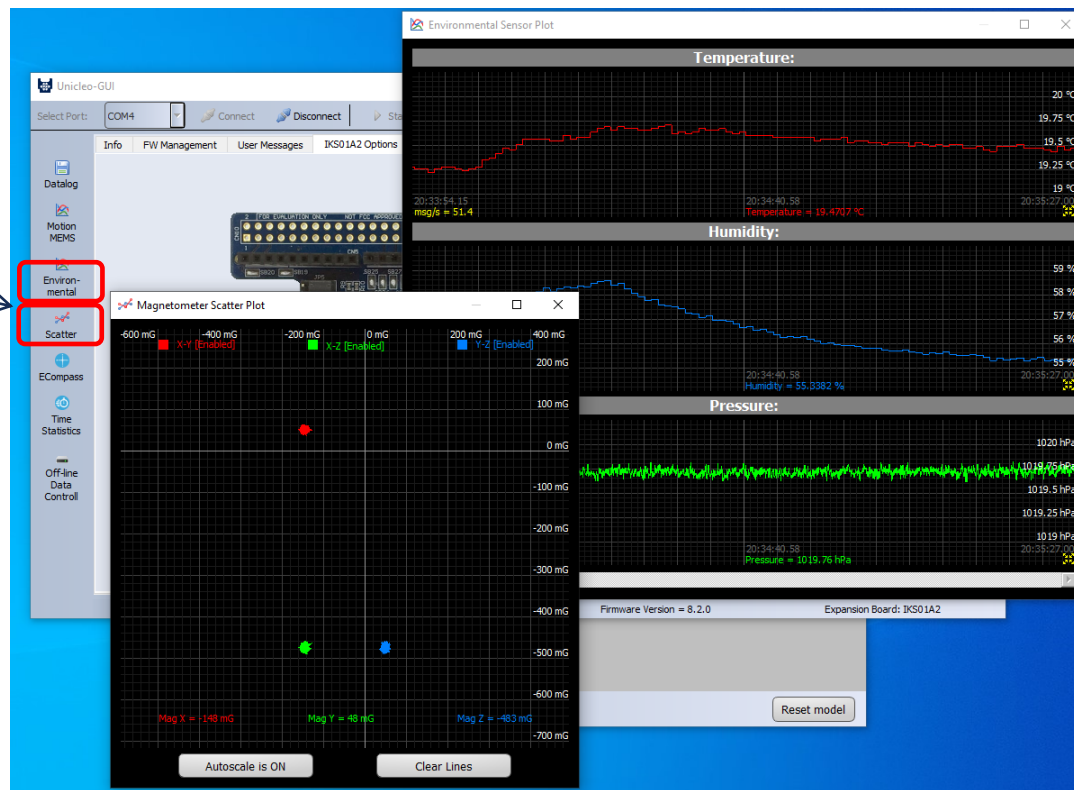
UNICLEO GUI AND APPLICATIONS

Click on the icon with the name of the flashed application to **visualize its HMI**



UNCLEO GUI AND APPLICATIONS

You can even visualize additional data



ADDITIONAL RESOURCES

You can find a complete overview of Cube MEMS as well as all the details for the applications contained in the *Applications.rar* archive in the pdf **STMicroelectronics.X-CUBE-MEMSI_GettingStarted**.

You can find a complete overview of the Unicleo-GUI in the pdf **dm00337036**

This two pdf as well as all the file mentioned in these slides are contained in the drive folder:

<https://drive.google.com/drive/folders/1BfbaYt5Bvy6v2NRF1YHIKbplc5kHMwEZ?usp=sharing>