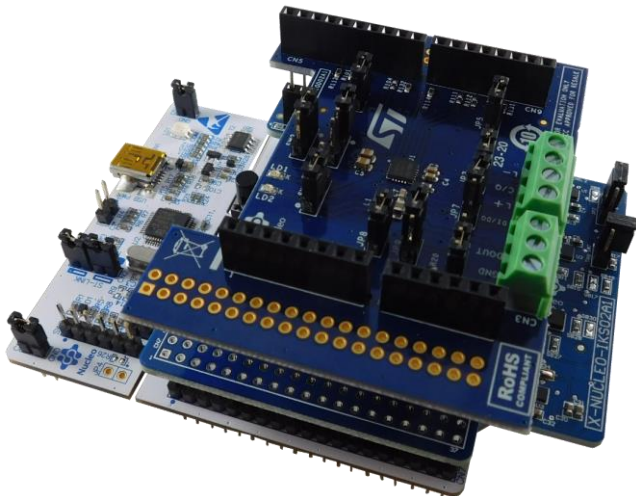# Quick Start Guide

P-NUCLEO-IOD02A1:
Industrial IO-Link node with transceiver (L6364Q), 3-axis acc./gyroscope (ISM330DHCX), 3-axis/magnetometer (IIS2MDC), 3-axis acc. (IIS2DLPC) and digital microphone (IMP34DT05).

FP-IND-IODSNS1:
STM32Cube function pack for P-NUCLEO-IOD02A1, with IO-Link stack, IODD and control software for industrial sensors.
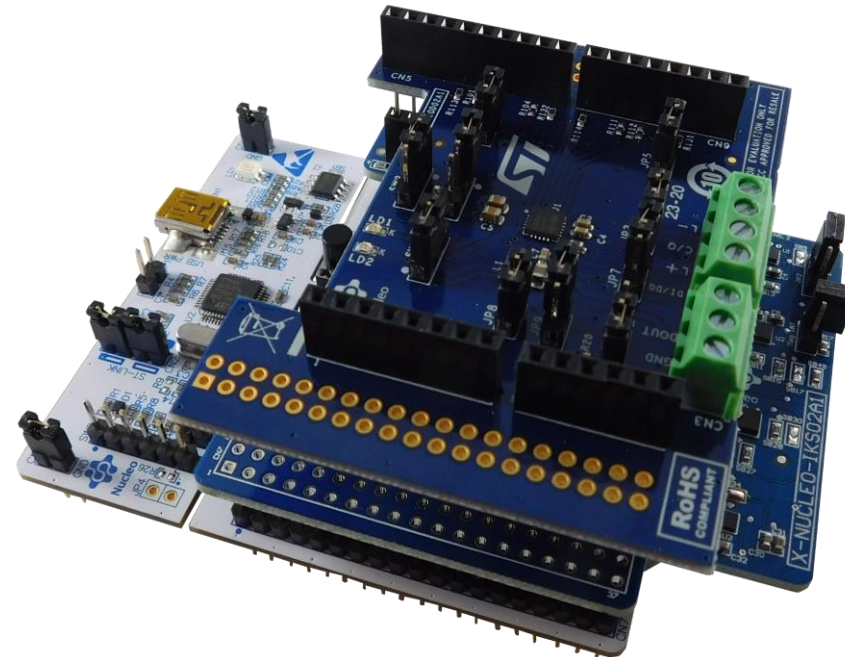
Version 1.0 (Nov 2nd, 2020)

# 1- Hardware and Software overview

# Hardware Overview

P-NUCLEO-IOD02A1

STM32 Nucleo with expansion boards

- NUCLEO-L452RE

- X-NUCLEO-IOD02A1

- X-NUCLEO-IKS02A1

## Hardware Description

- The X-NUCLEO-IOD02A1 is an evaluation board based on the L6364Q dual channel IO-Link and SIO Transceiver with embedded EMC, Overload and Over-temperature protections, 50mA 3v3 and 5v0 LDOs, SPI and UART interfaces, automatic wake-up detection, M-sequence & Checksum management, suitable both for COM2 and COM3 sensor applications.

- The X-NUCLEO-IOD02A1 interfaces with the microcontroller on the STM32 Nucleo via Arduino™ UNO R3.

- The expansion board should be connected to either a NUCLEO-L073RZ or NUCLEO-G071RB development board (X-CUBE-IOD02) and can also be stacked with other sensor shields and NUCLEO-L452RE (FP-IND-IODSNS1).

- The X-NUCLEO-IOD02A1 combined with the respective development board where the X-CUBE-IOD02 runs, allows you to evaluate the basic functionalities of the L6364Q when connected to an IO-Link master. All the combinations of transmission mode (Single octet, Multi octet and Transparent) and speed (COM2, COM3) can be evaluated.

- The X-NUCLEO-IOD02A1 connected to a sensor shield (e.g. X-NUCLEO-IKS02A1) and to a development board allows you to evaluate sensor applications.

## Features

- Based on the L6364Q
- Normal operating Voltage range 5 to 35 V
- Process side ($V_{PLUS}$, CQ, GND) reverse polarity protection
- CQ&DIO output capability configurable up to 250mA
- Joint Mode output capability configurable up to 500mA
- CQ switching time supporting COM2 and COM3
- 50mA 3v0 and 5v0 LDOs
- 50mA Configurable ($V_{OUT}$ and $F_{SW}$) DC-DC (Step-down)
- Configurable ULVO threshold
- Configurable Thermal Shutdown Threshold
- 7-bit calibrated Thermal measurement
- Automatic wake-up detection
- M-Sequence and Checksum automatic management
- Green and Red diagnostic LEDs
- Compliance with IEC 61131-9 and IEC 60947-5-2
- Equipped with Arduino™ UNO R3 connectors
- Wide application development potential in STM32 Nucleo development environment
- CE certified
- RoHS and China RoHS compliant
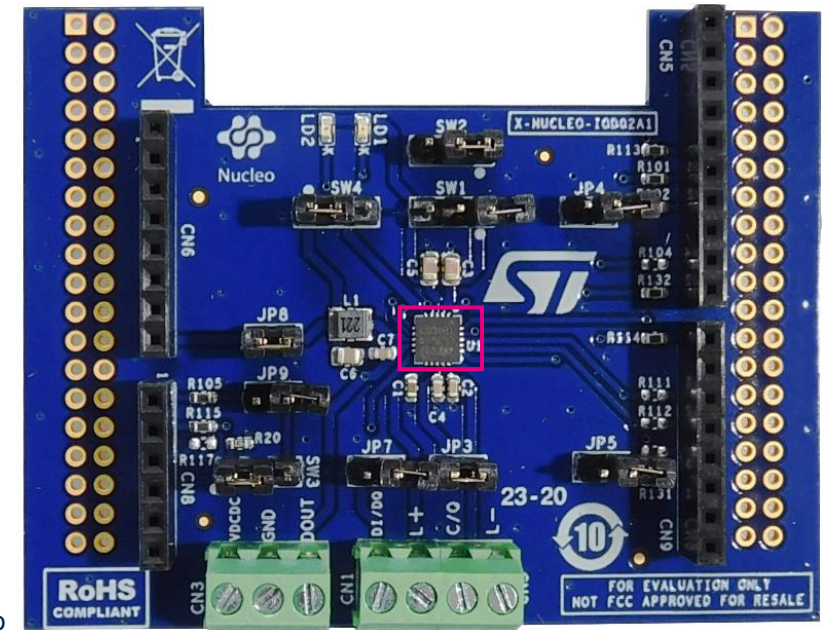


L6364Q

**Key Products on board**
**L6364Q:**
Dual channel transceiver IC for SIO and IO-Link sensor applications

Latest info available at www.st.com
**X-NUCLEO-IOD02A1**

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# Motion MEMS and microphone MEMS expansion board
## STM32 Nucleo with Expansion boards - Hardware Overview (2/2)

## Hardware Description

- The X-NUCLEO-IKS02A1 industrial motion MEMS sensor expansion board is compatible with the Arduino UNO R3 connector layout.

- It embeds the ISM330DHCX 3-axis accelerometer and 3-axis gyroscope, the IIS2MDC 3-axis magnetometer, the IIS2DLPC 3-axis accelerometer, the IMP34DT05 digital microphone.

- The X-NUCLEO-IKS02A1 interfaces with the STM32 microcontroller via I²C pin, with the possibility of changing the default I²C port.

## Features

- ISM330DHCX MEMS 3D accelerometer (±2/±4/±8/±16 g) plus 3D gyroscope (±125/±250/±500/±1000/±2000 dps)
- IIS2MDC MEMS 3D magnetometer (±50 gauss)
- IIS2DLPC MEMS 3D accelerometer low power (±2/±4/±8/±16 g)
- IMP34DT05 MEMS digital omnidirectional microphone (-26 dBFS, ±3 dB sensitivity)
- DIL 24-pin socket available for additional MEMS adapters and other sensors
- Available I²C sensor hub features on ISM330DHCX
- Compatible with STM32 Nucleo boards
- Equipped with Arduino UNO R3 connector
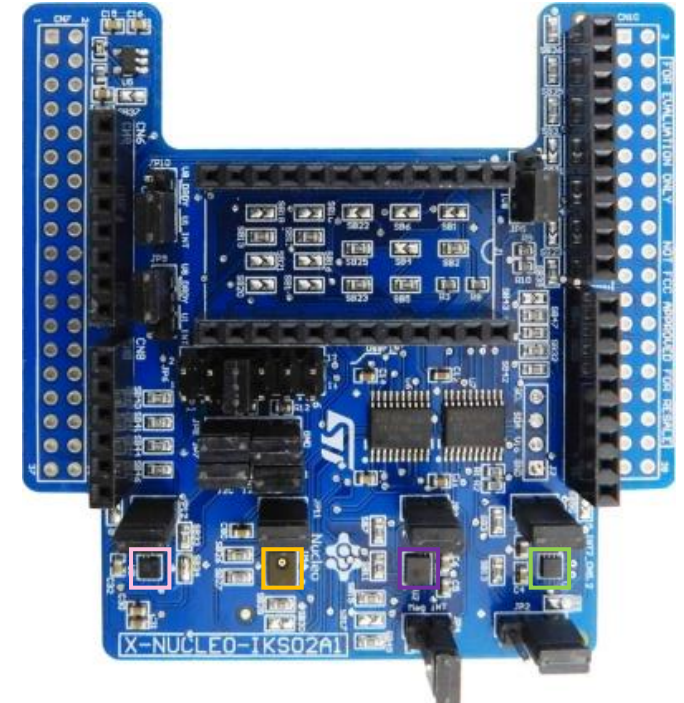- RoHS and WEEE compliant

**Key Products on board**

**ISM330DHCX:**
**MEMS 3D accelerometer plus 3D gyroscope**

**IIS2MDC:**
**MEMS 3D magnetometer**

**IIS2DLPC :**
**MEMS 3D accelerometer low power**

**IMP34DT05:**
**MEMS digital omnidirectional microphone**

IIS2MDC          ISM330DHCX

IMP34DT05          IIS2DLPC

Latest info available at www.st.com
**X-NUCLEO-IKS02A1**

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## Software Description

- The FP-IND-IODSNS1 is an STM32Cube function pack which lets your P-NUCLEO-IOD02A1 be suitable for an IO-Link communication with an IO-Link Master through a 3-wires cable.

- From the IO-Link point of view, the FP-IND-IODSNS1 includes both an IO-Link stack library and the IODD file to be uploaded in the IO-Link master side.

- The FP-IND-IODSNS1 integrates the X-CUBE-MEMS1 software package for the proper management of the four industrial sensors mounted on the X-NUCLEO-IKS02A1.

- This package, together with the P-NUCLEO-IOD02A1 can be used to evaluate the ST devices proposed for IO-Link industrial application.

- It can be also used as a starting point to develop IO-Link application with other compatible sensors.
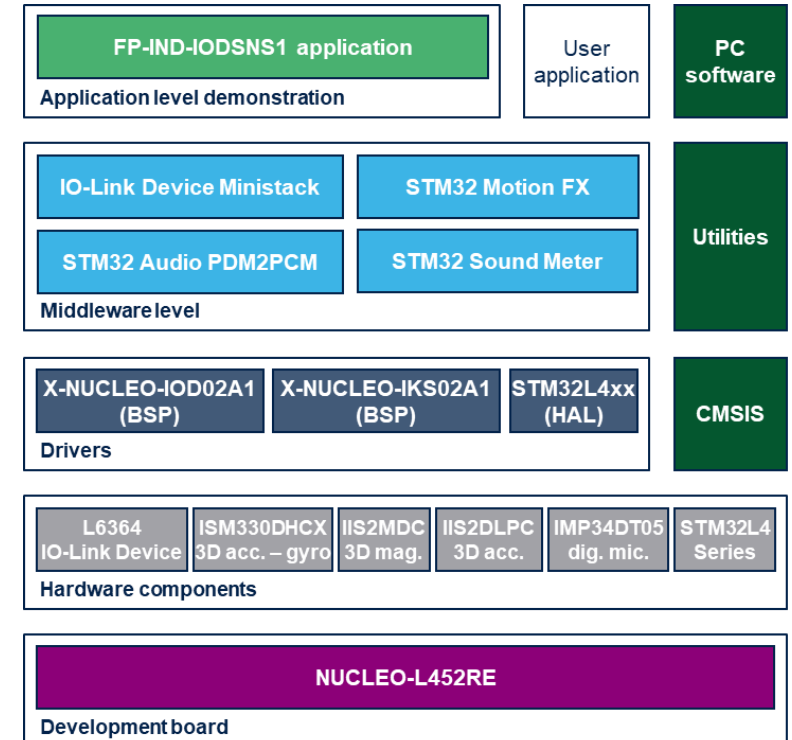
## Key features

- Complete firmware to develop an IO-Link sensor node with L6364 and industrial sensors.

- Easy portability across different MCU families, thanks to STM32Cube.

- Free, user-friendly

## Important Software Additional Information

- The IO-Link stack library embeds the basic IO-Link features StartUp, PreOperate and Operate (Events and Direct Parameter not supported in this release version).

- The IO-Link stack library can run only with L6364Q (X-NUCLEO-IOD02A1) or L6364W (STEVAL-IOD002V1) and NUCLEO-L0452RE.

### Overall Software Architecture

| FP-IND-IODSNS1 application | | User application | PC software |
|---|---|---|---|
| Application level demonstration | | | |

| IO-Link Device Ministack | STM32 Motion FX | Utilities |
|---|---|---|
| STM32 Audio PDM2PCM | STM32 Sound Meter | |
| Middleware level | | |

| X-NUCLEO-IOD02A1 (BSP) | X-NUCLEO-IKS02A1 (BSP) | STM32L4xx (HAL) | CMSIS |
|---|---|---|---|
| Drivers | | | |

| L6364 IO-Link Device | ISM330DHCX 3D acc. – gyro | IIS2MDC 3D mag. | IIS2DLPC 3D acc. | IMP34DT05 dig. mic. | STM32L4 Series |
|---|---|---|---|---|---|
| Hardware components | | | | | |

| NUCLEO-L452RE |
|---|
| Development board |

**Latest info available at www.st.com**
**FP-IND-IODSNS1**

# 2- Setup & Demo Examples

- **STSW-LINK004**

  - STM32 ST-LINK Utility (STSW-LINK004) is a full-featured software interface for programming STM32 microcontrollers

- **FP-IND-IODSNS1**

  - Copy the .zip file content into a folder on your PC. The package will contain source code example (Keil, IAR, STM32CubeIDE) based only on **NUCLEO-L452RE**

# 2.1- Setup Overview: STM32 Nucleo with Expansion boards

## HW prerequisites with STM32 Nucleo Expansion boards
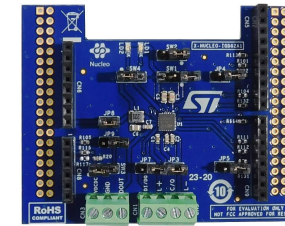
- 1 x Dual channel IO-Link Device expansion board

  (**X-NUCLEO-IOD02A1**)

- 1 x Motion MEMS and microphone MEMS expansion board

  (**X-NUCLEO-IKS02A1**)

- 1 x STM32 Nucleo development board

  **(NUCLEO-L452RE)**

- 1 x IO-Link Master

  **(e.g. P-NUCLEO-IOM01M1)**
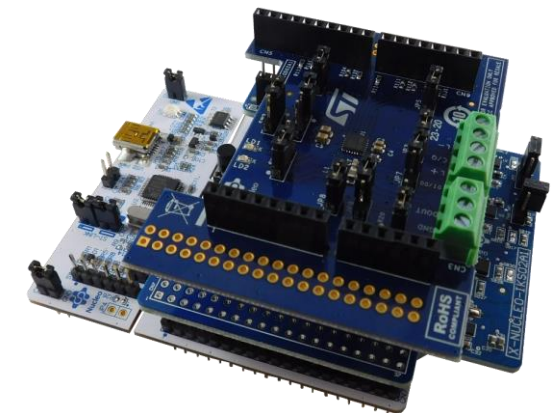
- 1 x USB type A to Mini-B USB cable
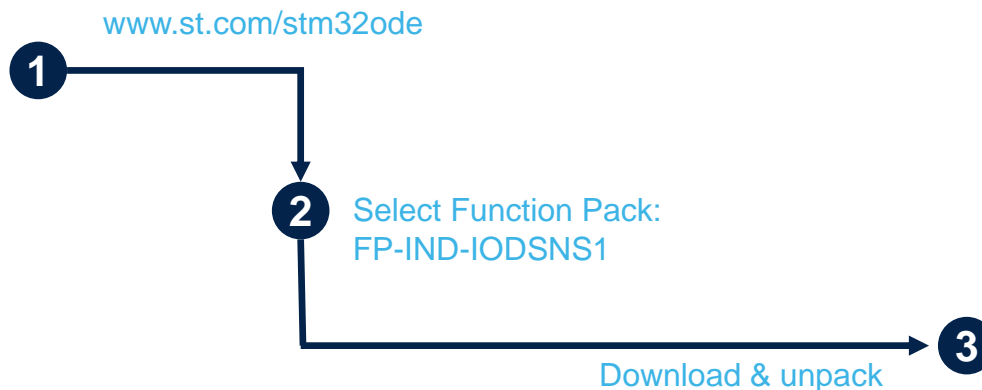
Mini USB

NUCLEO-L452RE

X-NUCLEO-IOD02A1

X-NUCLEO-IKS02A1

P-NUCLEO-IOD02A1

## Start coding in just a few minutes

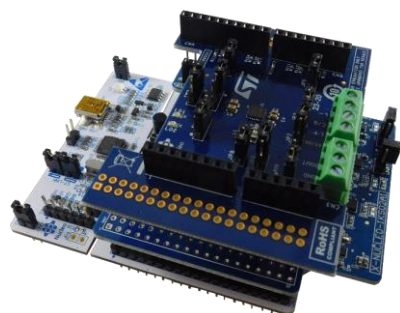www.st.com/stm32ode

**1**

**2** Select Function Pack:
FP-IND-IODSNS1

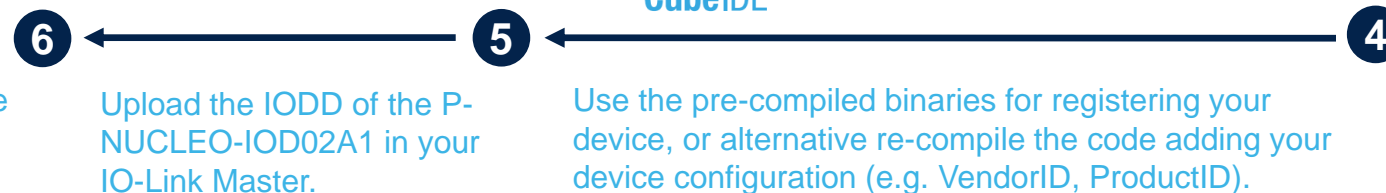**3** Download & unpack

FP-IND-IODSNS1 package structure

Name

_htmresc

Documentation → Docs

Drivers → BSP, HAL and drivers

Middlewares → Io-Link Stack and sensors Library

Projects → Application example

.\Projects\STM32L452RE-Nucleo\Applications\IOD02A1_IKS02A1

Note:
The P-NUCLEO-IOD02A1 kit is provided with a pre-flashed firmware for immediate use. Also, the NUCLEO-L452RE in the kit is configured with JP5 in E5V position: set JP5 to U5V when you want to flash with a new binary.

STM32 CubeIDE    KEIL Tools by ARM    IAR SYSTEMS

**6** ← **5** ← **4**

P-NUCLEO-IOD02A1 is ready to be connected and to communicated with the IO-Link Master where you uploaded the IODD.

Upload the IODD of the P-NUCLEO-IOD02A1 in your IO-Link Master.

Use the pre-compiled binaries for registering your device, or alternative re-compile the code adding your device configuration (e.g. VendorID, ProductID).
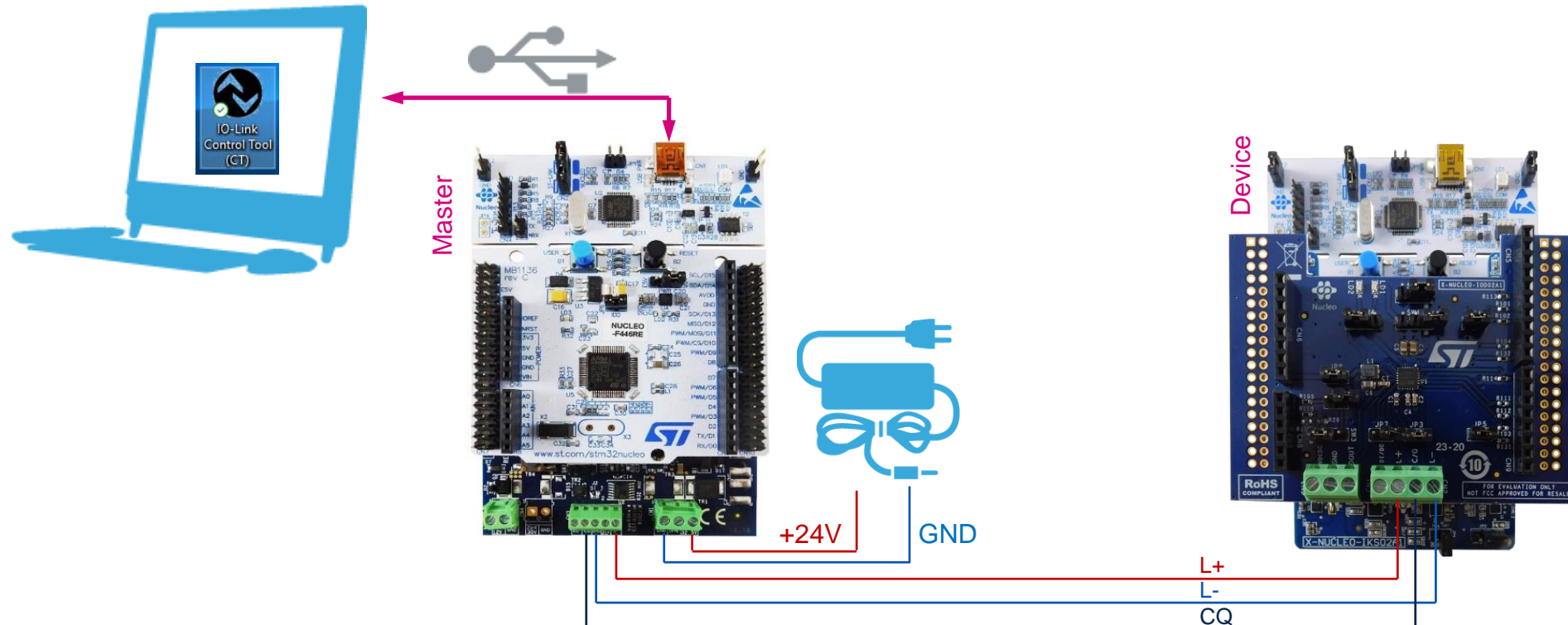
# 2.2- Demo Examples
# with IO-Link Master P-NUCLEO-IOM01M1

## Example of Set-up with IO-Link Master P-NUCLEO-IOM01M1 (1/2)

P-NUCLEO-IOM01M1 is an ST IO-Link Master evaluation kit controlled by the license-free IO-Link Control Tool, developed by TEConcept (ST Partner).

1) Connect the P-NUCLEO-IOM01M1 and P-NUCLEO-IOD02A1 by 3 wires (L+, L-/GND and CQ) as reported below and in the serigraphy of the two kits.
2) Connect the P-NUCLEO-IOM01M1 to 24V/0.5A power supply
3) Install and launch IO-Link Control Tool on your laptop/PC
4) Connect by mini-USB cable the P-NUCLEO-IOM01M1 to your laptop/PC where IO-Link Control Tool is running.



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## Example of Set-up with IO-Link Master P-NUCLEO-IOM01M1  (2/2)

IO-Link Control Tool

5) In the IO-Link Control Tool
- Upload the IODD of the P-NUCLEO-IOD02A1 in the IO-Link Control Tool (click on "**Select device**" and follow the instructions).
- Connect the Master by clicking on the green icon (top left corner)
- Click on "Power ON" so that P-NUCLE-IOD02A1 will be supplied
- Click on "**IO-Link**" to initiate an IO-Link Communication
- By default the communication with IIS2DLPC (low power accelerometer) starts. You can **plot** data or activate the data-exchange with another sensor by the selection window appearing after double click on the sensor name (**green text, under Parameter Menu➔ Process Input Selection**) and finally click on "**Write Selected**" button.
- Click on "**Inactive**" to close the IO-Link communication.
- Click on "Power Off" to stop supplying the P-NUCLEO-IOD02A1.



Get access at
http://www.teconcept.de/en/CloudAccess/

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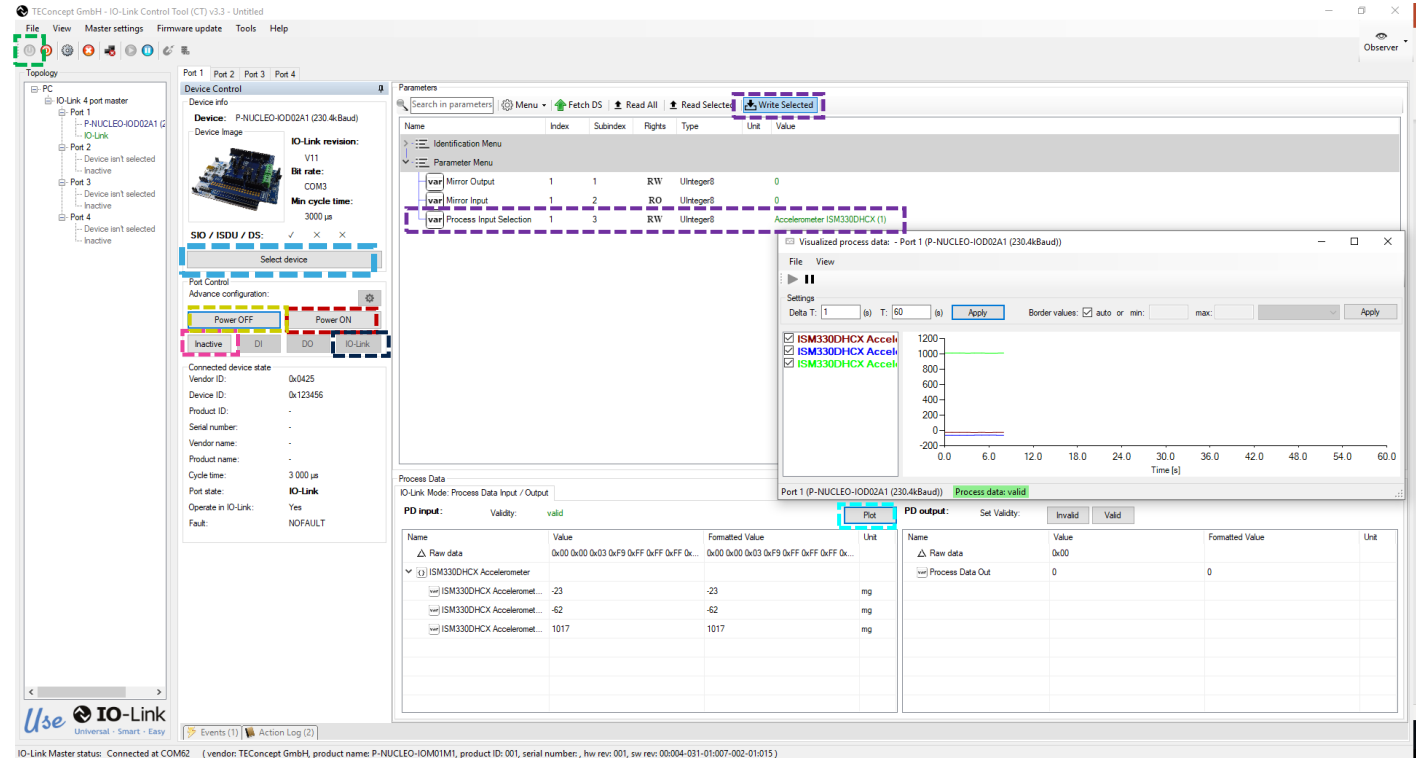
# 3- Documents & Related Resources

# Documents & Related Resources

**P-NUCLEO-IOD02A1:**

- **DB4304**: STM32 Nucleo Pack for IO-Link Device applications based on L6364Q Transceiver, Industrial sensors and STM32L452 – **data brief**
- **UM2782**: P-NUCLEO-IOD02A1 IO-Link (v1.1) industrial multi-sensor node – **user manual**

**FP-IND-IODSNS1:**

- **DB4338**: STM32 Nucleo Pack for IO-Link Device applications based on L6364Q Transceiver, Industrial sensors and STM32L452RET6U MCU – **data brief**
- **UM2796**: Getting started with the STM32Cube function pack for IO-Link industrial sensor node – **user manual**
- **Software setup file**

**X-NUCLEO-IOD02A1**

- **Gerber files, BOM, Schematic**
- **DB3883:** Dual channel IO-Link device expansion board based on L6364Q for STM32 Nucleo – **data brief**
- **UM2741:** Getting started with the dual channel IO-Link device expansion board for STM32– **user manual**

**X-CUBE-IOD02**:

- **DB3884 :** Industrial sensor software expansion for STM32Cube– **data brief**
- **UM2749:** Getting started with the X-CUBE-IOD02 industrial IO-Link device transceiver software expansion for STM32Cube – **user manual**

**X-NUCLEO-IKS02A1:**

- **Gerber files, BOM, Schematic**
- **DB4015 :** Motion MEMS and microphone MEMS expansion board for STM32 Nucleo – **data brief**
- **UM2633:** Getting started with the X-NUCLEO-IKS02A1 industrial motion MEMS sensor expansion board for STM32 Nucleo – **user manual**
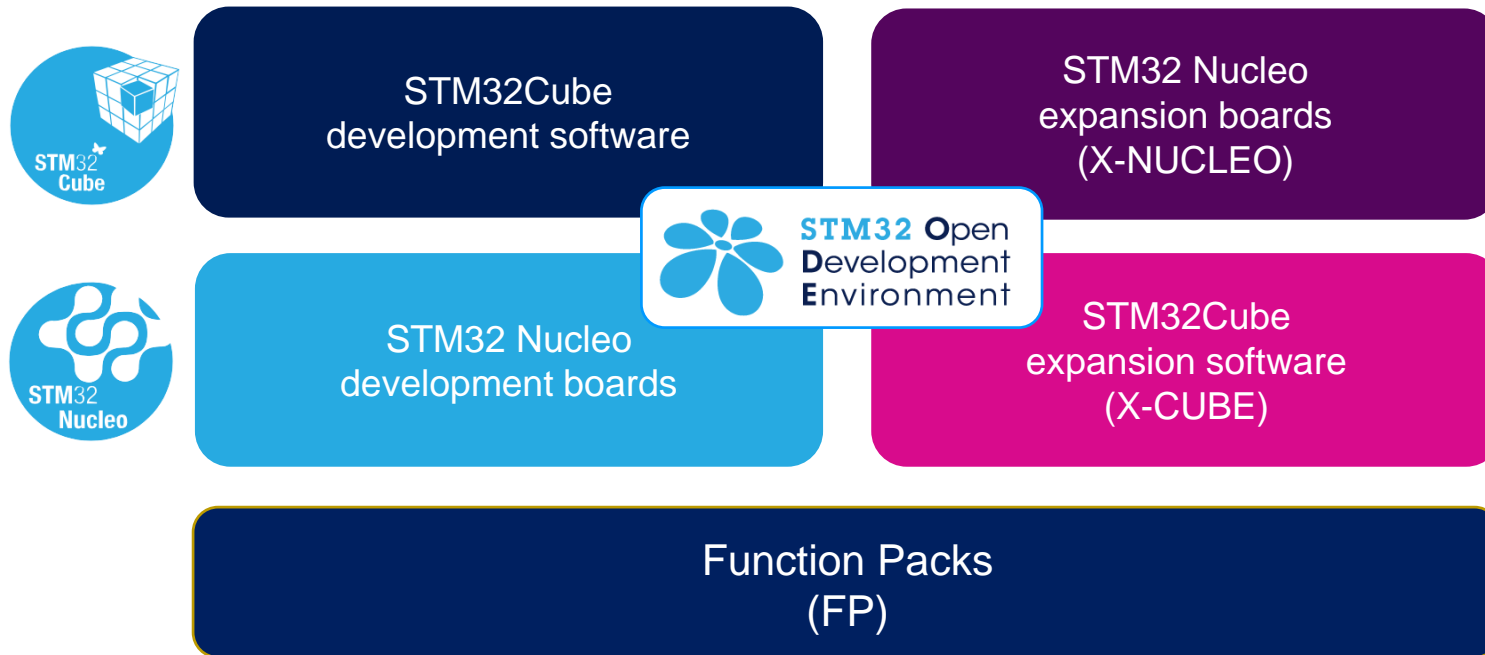
**X-CUBE-MEMS1**:

- **DB2242 :** Sensor and motion algorithm software expansion for STM32Cube – **data brief**

Consult www.st.com for the complete list

# 4- STM32 Open Development Environment: Overview

# STM32 Open Development Environment
## Fast, affordable Prototyping and Development

- The STM32 Open Development Environment (STM32 ODE) is an open, flexible, easy, and affordable way to develop innovative devices and applications based on the STM32 32-bit microcontroller family combined with other state-of-the-art ST components connected via expansion boards. It enables fast prototyping with leading-edge components that can quickly be transformed into final designs

STM32Cube
development software

STM32 Nucleo
expansion boards
(X-NUCLEO)

STM32 Nucleo
development boards

STM32Cube
expansion software
(X-CUBE)

Function Packs
(FP)

For further information, please visit www.st.com/stm32ode

# Thank you

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