

## Getting started with P-NUCLEO-IOD02A1 IO-Link v1.1 industrial multi-sensor node

### Introduction

The P-NUCLEO-IOD02A1 is an STM32 Nucleo pack composed of the X-NUCLEO-IOD02A1 and X-NUCLEO-IKS02A1 expansion boards stacked on the NUCLEO-L452RE development board.

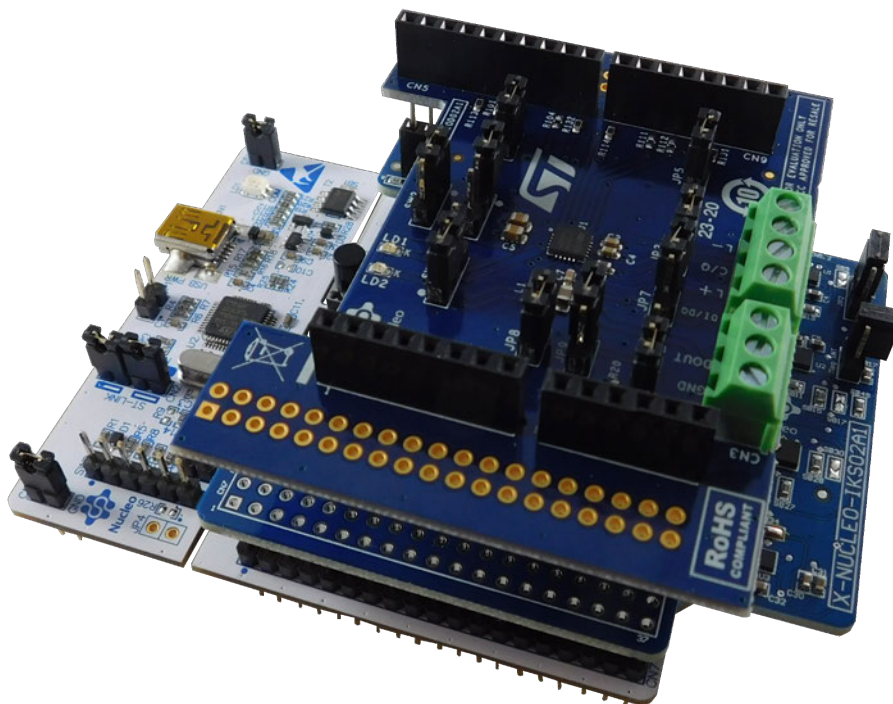
The X-NUCLEO-IOD02A1 features an IO-Link device transceiver for the physical connection to an IO-Link master, while the X-NUCLEO-IKS02A1 features a multi-sensor board for industrial applications, and the NUCLEO-L452RE features the necessary hardware resources to run the FP-IND-IODSNS1 function pack and to control the transceiver and multi-sensor boards.

The FP-IND-IODSNS1 combines an IO-Link demo stack library (derived from X-CUBE-IOD02) with the X-CUBE-MEMS1 and features an example of IO-Link device multi-sensor node.

The P-NUCLEO-IOD02A1 can be used for evaluation purpose and as development environment.

The STM32 Nucleo pack provides an affordable and easy-to-use solution for the development of IO-Link and SIO applications, evaluation of L6364Q communication features and robustness, together with the STM32L452RET6U computation performance.

Figure 1. P-NUCLEO-IOD02A1 STM32 Nucleo pack



## 1 Architecture overview

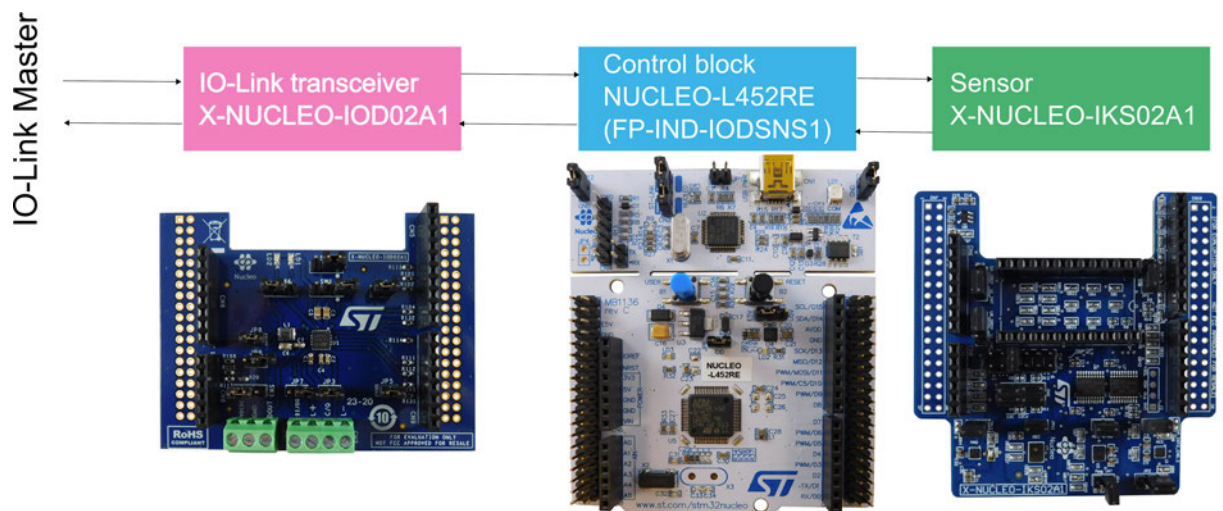
A generic IO-Link system is composed of an IO-Link Master and an IO-Link Device connected by an unshielded cable. Normally, the IO-Link Master is the connection point between the IO-Link Device and the automation system.

The IO-Link Master is installed in the control cabinet or, as a remote I/O, directly in the field. It can have several IO-Link ports (channels): an IO-Link Device can be connected to each port, hence, it is a point-to-point communication and not a field-bus.

An IO-Link Device, as the **P-NUCLEO-IOD02A1**, can be basically schematized as the arrangement of three main blocks (see Figure 2):

- **Control sub-system:** the **NUCLEO-L452RE** board runs the **FP-IND-IODSNS1** control software, the IO-Link demo stack and sensors firmware, accepting the commands and configuration parameters from the IO-Link master. It also provides all digital signals to perform the proper control of the whole IO-Link device system.
- **IO-Link physical:** the **X-NUCLEO-IOD02A1** mounts the **ST L6364Q** transceiver, which interfaces the microcontroller and the IO-Link Master with the IO-Link interface (connectors CN1 and CN2).
- **Sensor:** the **X-NUCLEO-IKS02A1** multi-sensor shield, with on-board MEMS 3D accelerometer + 3D gyroscope (**ISM330DHCX**), MEMS 3D magnetometer (**IIS2MDC**), MEMS 3D accelerometer low power (**IIS2DLPC**) and MEMS digital omnidirectional microphone (**IMP34DT05**).

Figure 2. P-NUCLEO-IOD02A1 block details



## 2 Getting started

### 2.1 Hardware requirements

To evaluate the system, you need:

- a [P-NUCLEO-IOD02A1](#) ([X-NUCLEO-IOD02A1](#) plus [NUCLEO-L452RE](#) plus [X-NUCLEO-IKS02A1](#))
- an IO-Link Master (e.g. [P-NUCLEO-IOM01M1](#)) together with a power supply (18-32.5 V for the [P-NUCLEO-IOM01M1](#))
- a USB cable (type A to mini-B)
- connection cable/wires between IO-Link master and IO-Link device
- a laptop/PC

The three boards included in the [P-NUCLEO-IOD02A1](#) are connected and communicate with each other through the Arduino connectors (CN5, CN6, CN8 and CN9).

The [P-NUCLEO-IOD02A1](#) is supplied by the IO-Link Master via the [X-NUCLEO-IOD02A1](#) CN1 and CN2 connectors (L+/24V and L-/GND pins).

The [L6364Q](#) embedded DC-DC generates a 10.4 V rail supplying the [NUCLEO-L452RE](#) through  $V_{IN}$  net: you have to set [NUCLEO-L452RE](#) JP5 on E5V position to generate the 3.3 V rail to supply the rest of the system.

To flash the [NUCLEO-L452RE](#), you have to disconnect the [P-NUCLEO-IOD02A1](#) from the Master, set JP5 to U5V position and then connect it to your laptop/PC via USB cable (type A to mini-USB).

### 2.2 Software requirements

To complete the system, you need a PC/laptop with:

- Windows®(version 7 or above)
- [STSW-LINK009](#) driver installed

For system evaluation only:

- the IO-Link master control tool provided with your IO-Link master hardware. If you are using the [P-NUCLEO-IOM01M1](#) as IO-Link master, then the control tool is the IO-Link Control Tool®, property of TEConcept GmbH
- the [P-NUCLEO-IOD02A1](#) IODD file (included in the [FP-IND-IODSNS1](#) and available on [www.st.com](http://www.st.com))

For application development:

- a software development environment ([STM32CubeIDE](#), EWARM, MDK-ARM)
- the [FP-IND-IODSNS1](#) software package (including source code and IO-Link stack library, available on [www.st.com](http://www.st.com))
- the IODD file of your application

#### 2.2.1 IODD file

The IODD file (IO device description) is the electronic device description file necessary for each IO-Link device.

The file stores a variety of information for the system integration:

- communication properties
- device parameters with value range and default value
- identification, process and diagnostics data
- device data
- text description
- device illustration
- manufacturer logo

To ensure the same handling of all IO-Link devices, independently of the manufacturer, the IODD file structure is always the same for all manufacturer devices and it is always represented in the same way by the IO-Link configuration tools of the master manufacturers.

## 3 How to build and run the IO-Link device

### 3.1 System evaluation setup

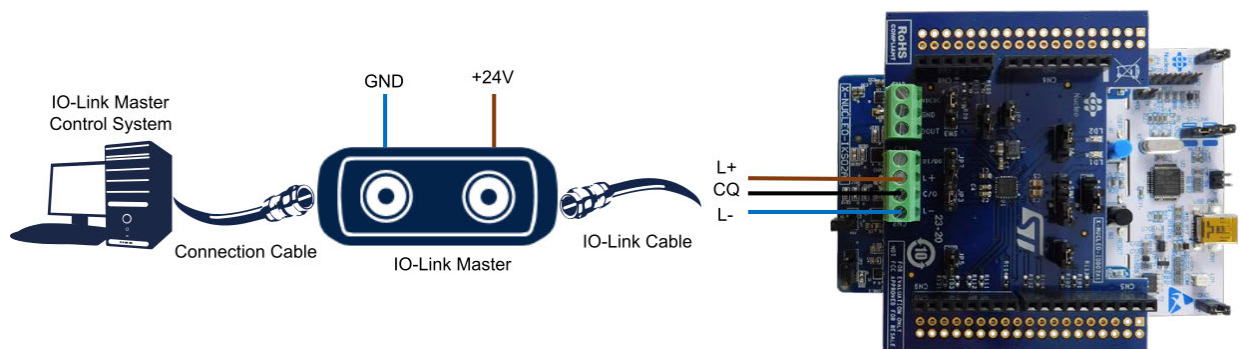
P-NUCLEO-IOD02A1 can be used as IO-Link Device evaluation system, following the hardware configuration below.

- Step 1.** Maintain the X-NUCLEO-IOD02A1 default configuration.  
Close JP4 and JP5 if the Transparent Transmission Mode is selected.
- Step 2.** For the NUCLEO-L452RE setup, enable the external supply from X-NUCLEO-IOD02A1 by setting JP5 to position "E5V".
- Step 3.** For the X-NUCLEO-IKS02A1 setup:
- enable all sensors by closing JP1, JP3, JP11 and JP12
  - JP2 closed on INT1
  - JP4 open
  - JP5 closed on 1V8
  - JP6 closed on 5-6
  - JP7 closed 1-2 and 3-4
  - JP8 closed 1-2 and 3-4
  - JP9 closed on DRDY
  - JP10 closed on INT
- Step 4.** Connect the X-NUCLEO-IOD02A1 evaluation board to the X-NUCLEO-IKS02A1 expansion board and the NUCLEO-L452RE development board through the Arduino connectors.

*Note:* Connect the boards as shown in Figure 3, leaving the two user buttons (the blue and the black ones) out.

- Step 5.** Connect the X-NUCLEO-IOD02A1 to the IO-Link Master by screwing cables on the CN1 connector, taking care of the pin/signal correspondence.

**Figure 3. P-NUCLEO-IOD02A1 connections to the IO-Link Master**



- Step 6.** Install the P-NUCLEO-IOD02A1 IODD file (included in the FP-IND-IODSNS1) in the laptop/PC where the control tool of your master is running. Depending on the control system of your master, it could be required that you launch the control tool first and then load the IODD file.
- The system is ready to operate: the IO-Link master control tool allows the user to supply, configure and activate the data transfer (in SIO or IO-Link mode) with the IO-Link device. If the master is the P-NUCLEO-IOM01M1, refer to its user manual (UM2421 on [www.st.com](http://www.st.com)) for the detailed procedure to use the related control tool.

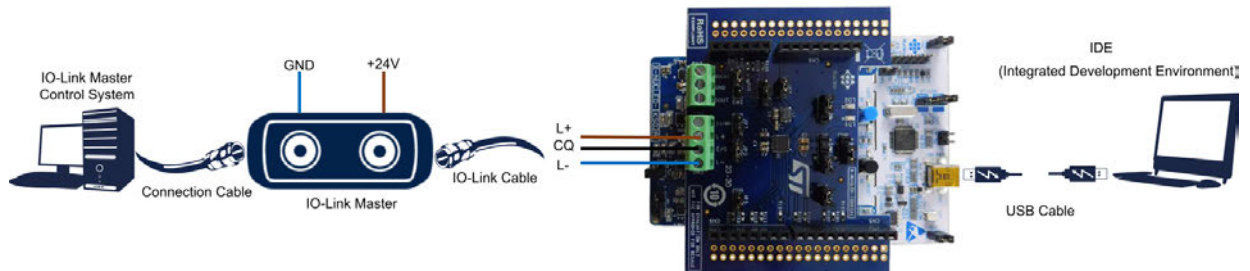
### 3.2 System development setup

You can use the P-NUCLEO-IOD02A1 evaluation pack as a development platform for an IO-Link device sensor node, but with a different firmware managing the sensors.

You can use just a subset of the sensors mounted on the **X-NUCLEO-IKS02A1** or manage them differently from the proposed available source code (refer to the **X-NUCLEO-IKS02A1** documentation on [www.st.com](http://www.st.com) to properly set up the jumpers for the hardware activation/deactivation of each sensor as the software has to be modified accordingly, otherwise the system may be stuck, for example, as in the I<sup>2</sup>C polling sequence).

In this setup, you have to connect the **NUCLEO-L452RE** to the laptop/PC where your IDE is running via the USB cable.

**Figure 4. P-NUCLEO-IOD02A1 connections to the development system**



### 3.3 System development setup with other sensors

You can develop application cases also for sensors not mounted on the **X-NUCLEO-IKS02A1** expansion board.

You can easily connect an alternative I<sup>2</sup>C sensor to the **P-NUCLEO-IOD02A1** by connecting it to J1, the 24 DIL connector available on the **X-NUCLEO-IKS02A1** (refer to UM2633 on [www.st.com](http://www.st.com) for the proper jumper setup).

## Appendix A References

The following resources are freely available on [www.st.com](http://www.st.com).

1. [L6364Q](#) datasheet
2. [P-NUCLEO-IOD02A1](#) data brief
3. [X-NUCLEO-IOD02A1](#) data brief and user manual
4. [P-NUCLEO-IOM01M1](#) data brief and user manual
5. [X-NUCLEO-IKS02A1](#) data brief and user manual
6. [FP-IND-IODSNS1](#) data brief and user manual

## Revision history

**Table 1. Document revision history**

Date	Revision	Changes
04-Dec-2020	1	Initial release.

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