Getting started with P-NUCLEO-IOD01A1 IO-Link (v1.1.3) multi-sensor node
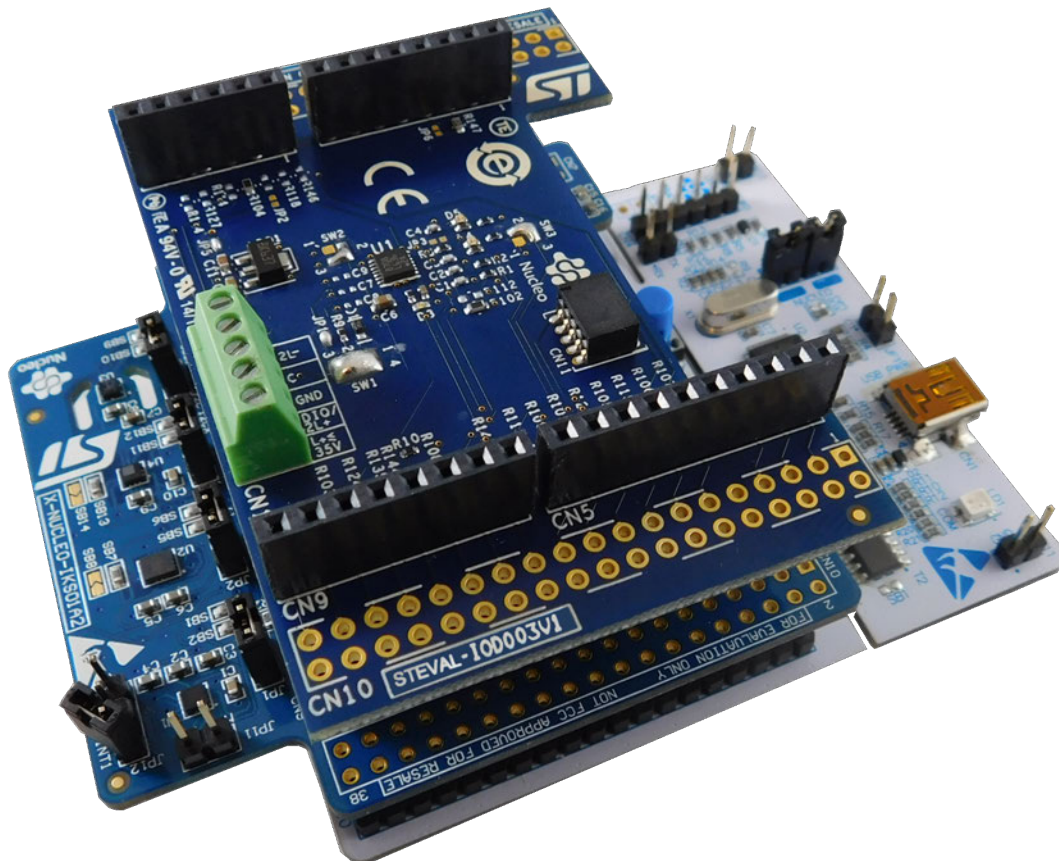
Introduction

The P-NUCLEO-IOD01A1 is an STM32 Nucleo pack composed of the NUCLEO-L073RZ development board, the STEVAL-IOD003V1 evaluation board and the X-NUCLEO-IKS01A2 expansion board.

The STEVAL-IOD003V1 offers an IO-Link device PHY layer (L6362A) while the NUCLEO-L073RZ runs the IO-Link stack v1.1.3 included in the STSW-IOD01 (developed by and property of TEConcept Gmbh) and the firmware controlling the X-NUCLEO-IKS01A2 sensors.

The STM32 Nucleo pack provides an affordable and easy-to-use solution for the development of IO-Link and SIO applications, L6362A communication features and robustness, together with the STM32L073RZT6 computation performance.

Figure 1. P-NUCLEO-IOD01A1 STM32 Nucleo evaluation pack

UM2425 - Rev 3 - June 2020
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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 fieldbus.

An IO-Link device, as the P-NUCLEO-IOD01A1, can be basically schematized as the arrangement of three main blocks (see Figure 2. P-NUCLEO-IOD01A1 block details):

- **Control sub-system**: the NUCLEO-L073RZ board runs the control software, the IO-Link 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 STEVAL-IOD003V1 mounts the ST transceiver L6362A, which interfaces with the micro-controller by digital interfaces UART for IO-Link data transfer, GPIO and interrupts) and the IO-Link master by the IO-Link interface (connector CN1).
- **Sensor**: the X-NUCLEO-IKS01A2 multi-sensor shield, with on-board temperature and humidity sensor (HTS221), MEMS 3D accelerometer and 3D gyroscope (LSM6DSL), MEMS 3D accelerometer and magnetometer (LSM303AGR), MEMS pressures sensor (LPS22HB).

Figure 2. P-NUCLEO-IOD01A1 block details
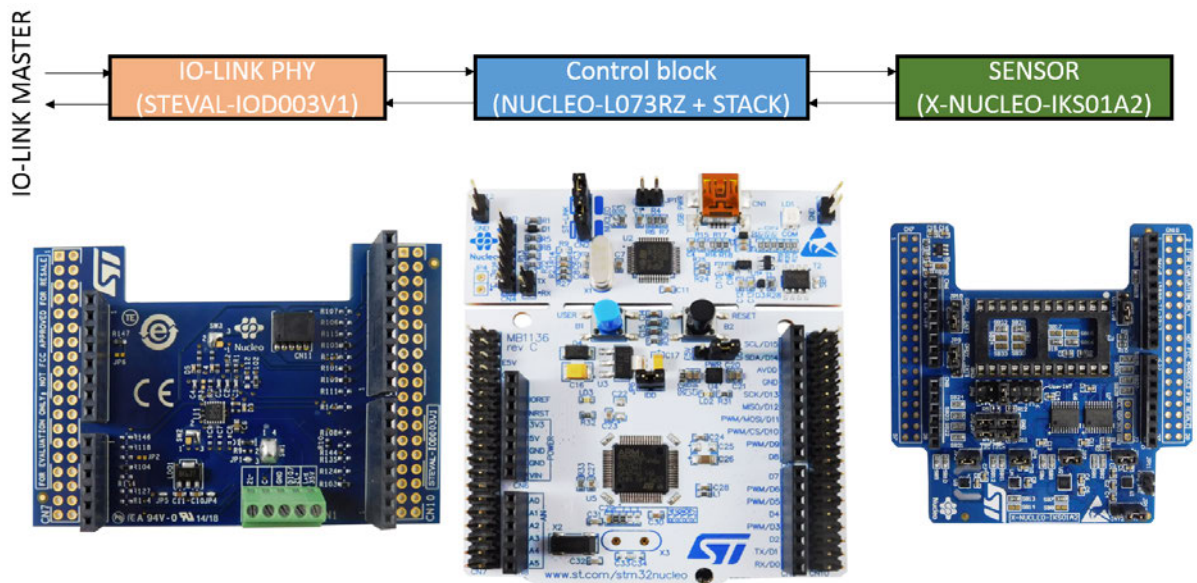
2 Getting started

2.1 Hardware requirements

To evaluate the system, the hardware requirements are:

- a P-NUCLEO-IOD01A1 (STEVAL-IOD003V1 plus NUCLEO-L073RZ plus X-NUCLEO-IKS01A2)
- 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 P-NUCLEO-IOD01A1 is a complete IO-Link multi-sensor composed of three application boards (STEVAL-IOD003V1, NUCLEO-L073RZ and X-NUCLEO-IKS01A2) connected via the Arduino connectors (CN5, CN6, CN8 and CN9).

A supply rail (up to 35 V) is necessary to supply the STEVAL-IOD003V1 via CN1 connector, while the NUCLEO-L073RZ can be supplied in two different ways:

1. by enabling the LDO1 mounted on the STEVAL-IOD003V1 (open JP3; close JP4 and JP5) and setting JP5 on the STM32 Nucleo development board to position "E5V";
2. by connecting the mini-USB port of the STM32 Nucleo development board to your laptop/PC through a USB type A to mini-B USB cable. In this case, the STM32 Nucleo development board JP5 must be closed in the position "U5V" and the STEVAL-IOD003V1 jumpers JP3, JP4 and JP5 must be open.

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-IOD01A1 IODD file (included in the STSW-IOD01 and available on www.st.com)

For application development:

- a software development environment (STM32CubeIDE 1.3.0, EWARM v8.32.3 or MDK-ARM v5.29.0)
- the STSW-IOD01 software package (including source code and IO-Link stack library, available on www.st.com)
- the IODD file of your application

The P-NUCLEO-IOD01A1 is provided with the IO-Link stack included in the STSW-IOD01 software.

The software also includes an IO-Link library that developers can use to compile and link their sensor code.

The stack library contains a 30-minute runtime limited version of the TEConcept IO-Link stack.

The library is intended for evaluation purposes and its limitations are:

- data storage and block parametrization are not supported
- vendor ID, product ID, product name and device ID cannot be changed
- 30-minute execution time

After 30 minutes, a notification event that indicates "FW test phase expired" is shown and the IO-Link stack stops working. A power-on reset is required to restore the operation.

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.

The STSW-IOD01 software package includes an IODD file for P-NUCLEO-IOD01A1 complete evaluation.

3 How to build and run the IO-Link device

3.1 System evaluation setup

P-NUCLEO-IOD01A1 can be used as IO-Link device evaluation system, following the hardware configuration below.

Step 1. For the STEVAL-IOD003V1 setup:
– enable V_{IN} supply by LDO1 (close JP4 and JP5, open JP3)
– configure the L6362A output as IO-Link by closing JP1 and all positions of SW1 to its pin 4
– verify that SW2 and SW3 pins 2 and 3 are closed and JP2 and JP6 are open

Step 2. For the NUCLEO-L073RZ setup, enable the external supply from STEVAL-IOD003V1 by setting JP5 to position "E5V".

Step 3. For the X-NUCLEO-IKS01A2 setup:
– enable all sensors by closing JP1, JP2, JP3, JP4
– close JP5 between pins 1-2
– leave JP6 open
– close J7 and J8 pins 1-2 and 3-4
– leave J9, J10, J11 and J12 open

Step 4. Connect the STEVAL-IOD003V1 evaluation board to the X-NUCLEO-IKS01A2 expansion board and the NUCLEO-L073RZ development board through the Arduino connectors.

Note: *Connect the boards as shown in Figure 1. P-NUCLEO-IOD01A1 STM32 Nucleo evaluation pack, leaving the two user buttons (the blue and the black ones) out.*

Step 5. Connect the STEVAL-IOD003V1 to the IO-Link master by screwing cables on the CN1 connector, taking care of the pin/signal correspondence.

Figure 3. P-NUCLEO-IOD01A1 connections to the IO-Link master
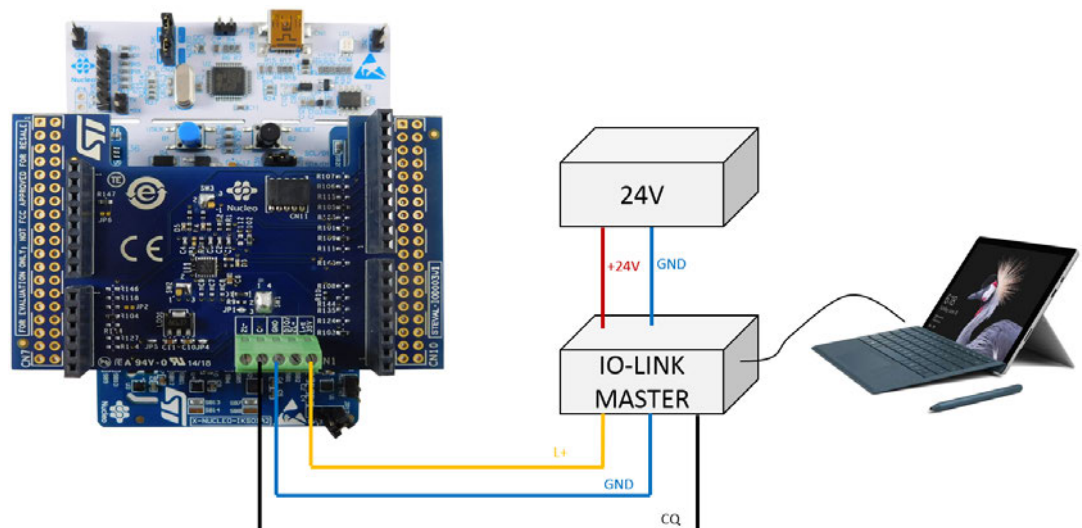
Step 6. Install the P-NUCLEO-IOD01A1 IODD file (included in the STSW-IOD01) in the laptop/PC where the control tool of your master is running. Depending on the control system of your master, it could be required that you launch the control tool first and then load the IODD file.

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) for the detailed procedure to use the related control tool.
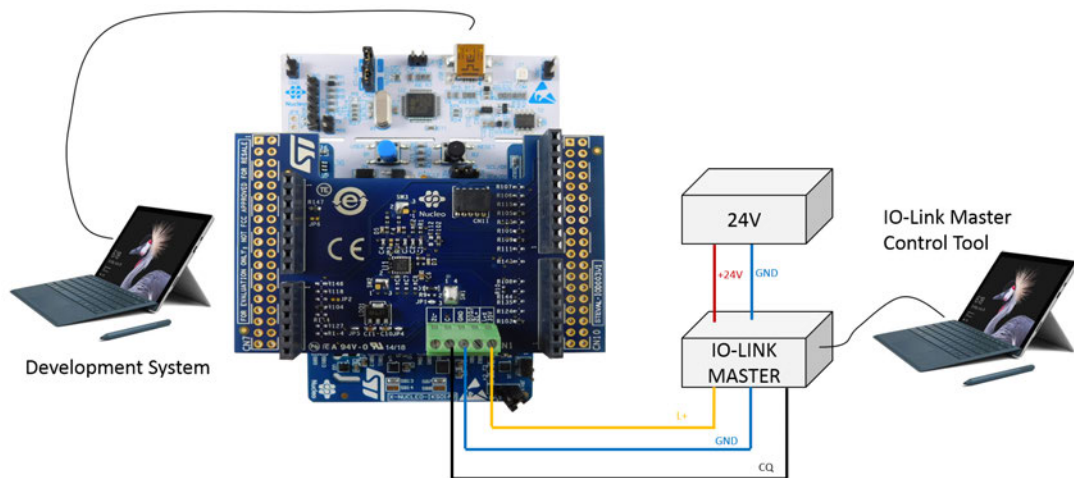
3.2 System development setup with the X-NUCLEO-IKS01A2 expansion board

You can use the P-NUCLEO-IOD01A1 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-IKS01A2 or manage them differently from the proposed available source code (refer to the X-NUCLEO-IKS01A2 documentation on 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 I²C polling sequence).

In this setup, you have to connect the NUCLEO-L073RZ to the development tool via the USB cable. The supply architecture described in Section 2.1 Hardware requirements, in the first option, can be used anyway (refer to UM1724 on www.st.com for further details).

Figure 4. P-NUCLEO-IOD01A1 connections to the development system

You can develop your application considering the IO-Link Device Stack v1.1 API User Guide published by TEConcept (document ID API_TEC_012_001) and available on request contacting info@teconcept.de.

3.3 System development setup with other sensors

You can develop application cases also for sensors not mounted on the X-NUCLEO-IKS01A2 expansion board.

You can easily connect an alternative I²C sensor to the P-NUCLEO-IOD01A1 by:

- mounting it on the STEVAL-IOD003V1 CN11 connector (in this case the X-NUCLEO-IKS01A2 can be removed)
- connecting it to J1, the 24 DIL connector available on the X-NUCLEO-IKS01A2 (refer to UM2121 on www.st.com for the proper jumper setup).

Refer to Section 3.2 System development setup with the X-NUCLEO-IKS01A2 expansion board for firmware development (interface and API to access the demo stack) and system setup (connection to the development system).

Appendix A References

The following resources are freely available on www.st.com.

1. L6362A datasheet
2. P-NUCLEO-IOD01A1 data brief
3. STEVAL-IOD003V1 data brief
4. STEVAL-IOD003V1 user manual
5. P-NUCLEO-IOM01M1 data brief
6. P-NUCLEO-IOM01M1 user manual
7. X-NUCLEO-IKS01A2 data brief and user manual
8. STSW-IOD01 data brief

Freely available on teconcept.de

1. IO-Link Device Stack v1.1 API User Guide

Revision history

Table 1. Document revision history

Date	Revision	Changes
11-Jun-2018	1	Initial release.
04-Jul-2018	2	Removed schematic diagrams and bill of materials.
10-Jun-2020	3	Added references to STSW-IOD01 IO-Link v1.1.3 sensor software.

Contents

List of figures

IMPORTANT NOTICE – PLEASE READ CAREFULLY