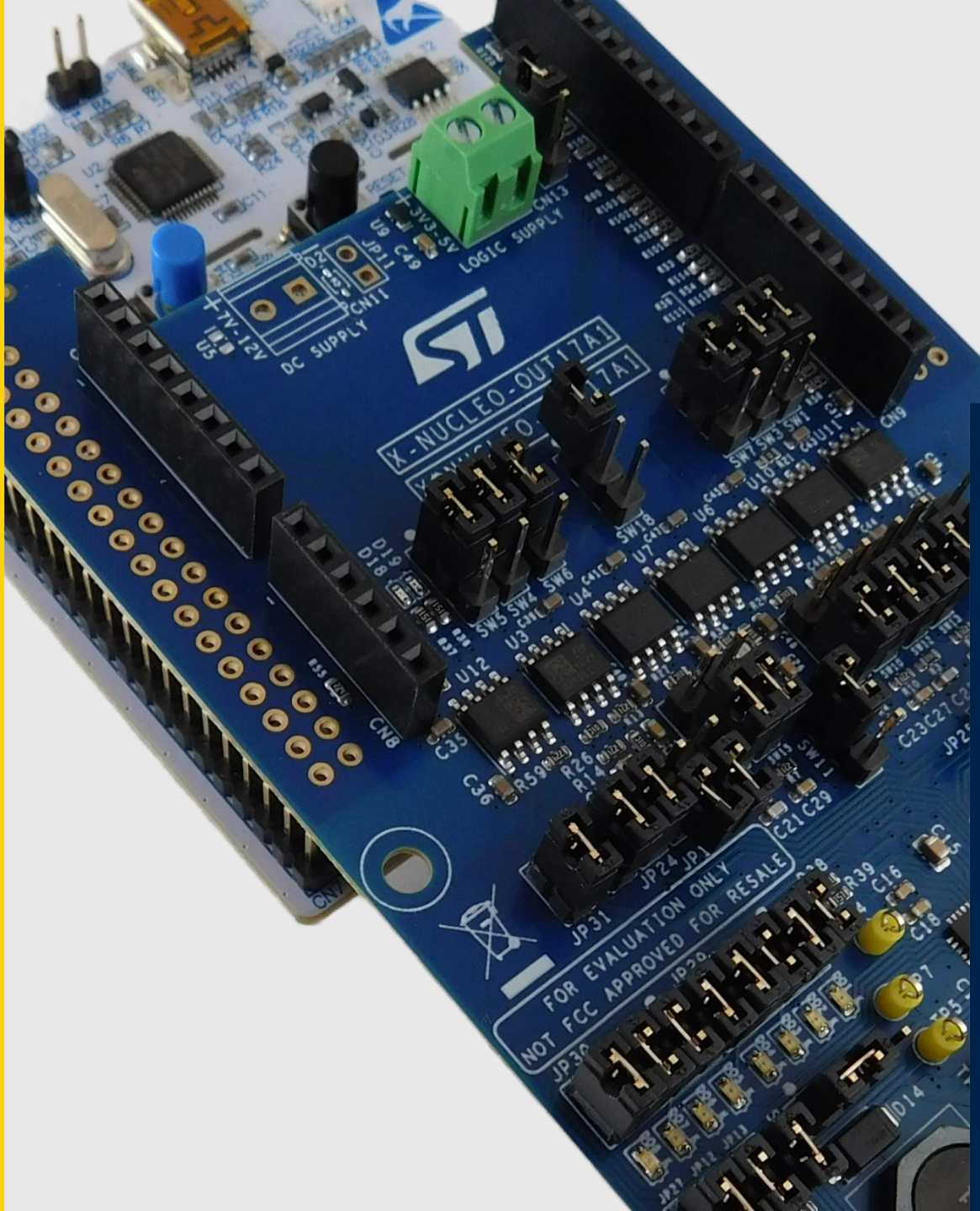

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Quick Start Guide X-NUCLEO-OUT17A1

Industrial digital output expansion board based on IPS8200HQ-1 for STM32 Nucleo

V1.0

STM32 Open Development Environment

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X-NUCLEO-OUT17A1 expansion board

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Hardware Description

The X-NUCLEO-OUT17A1 industrial digital output expansion board for STM32 Nucleo provides a powerful and flexible environment for the evaluation of the driving and diagnostic capabilities of the IPS8200HQ-1 (Octal High Side Switch, with embedded 100mA step-down converter, GPIO or 5MHz SPI (8-bits or 16-bits, and allowing daisy chaining) driving mode, 4x2 Output Status LED Matrix driver, extended diagnostic (per-channel over-temperature, process stage power good, global thermal warning) in a digital output module connected to 1.0 A (max. per channel) industrial loads.

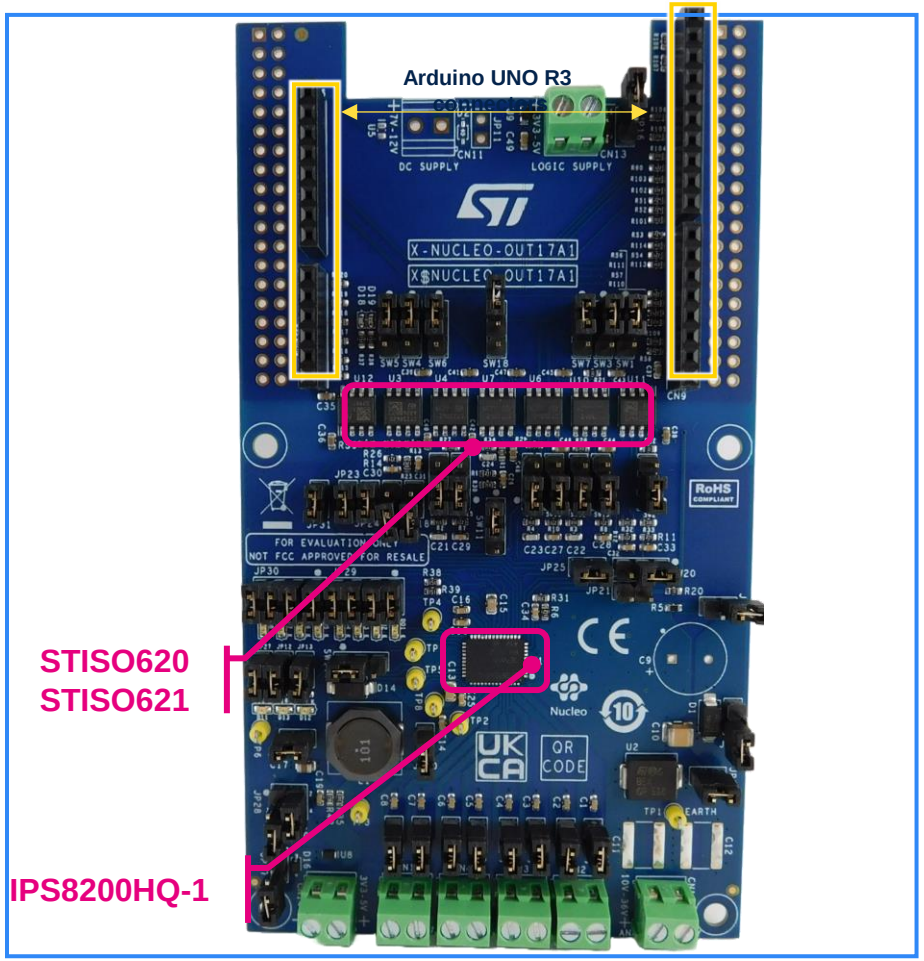
The galvanic isolation between the logic side and process side of the system is guaranteed by the 2.5k V_{RMS} isolation embedded in the STISO620 and STISO621. The expansion board can be connected to either a NUCLEO-F401RE or NUCLEO-G431RB development board.

By default, the application board is configured enabling the GPIO driving mode (SEL2 = L, by JP21 = open). The SPI driving mode can be enabled by setting JP21 = close (SEL2 = H), while the 8-bits or 16-bits mode can be selected by leaving JP22 open (SEL1 = L) or close (SEL1 = H), respectively. Apart JP21 and JP22, when SPI driving mode is selected also the following switches must be set accordingly: SW4, SW5, SW6, SW7, SW9, SW10, SW11, SW12, SW13, SW14, SW15, SW20 (= close 2-3) and SW18 (= close 1-2). When SPI driving mode is selected the MCU Freeze detection feature can be activated by the optional signals WD_EN and WD.

It is also possible to evaluate a system composed by a X-NUCLEO-OUT17A1 stacked on other expansion boards, provided the compatibility with signals mapped on Arduino connectors. In case of SPI with two boards in daisy chaining configuration it is necessary to set SW6 and SW18 = close 2-3 on the first board and SW6 and SW18 = close 1-2 on the second stacked board.

Main Features:

- A single expansion board allows you to evaluate an octal-channel digital output module with 1.0 A (max.) per-channel capability
- Operating range up to 36 V/5.6 A
- Low power dissipation ($R_{ON(MAX)}$ = 240 mΩ)
- Fast decay for inductive loads
- 5MHz SPI 8 or 16-bist with daisy chaining
- 100mA Step-down converter
- 4x2 LEDs matrix for output channel status
- PGOOD, TWARN and FAULT open drain diagnostic
- UVLO
- Overload and over-temperature protections
- QFN48L 8x6 mm package



Key Products on the Nucleo expansion board:

IPS8200HQ-1

Octal High Side Switch with embedded step-down, 4x2 LED Matrix, 5MHz SPI, and extended diagnostic

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X-NUCLEO-OUT17A1

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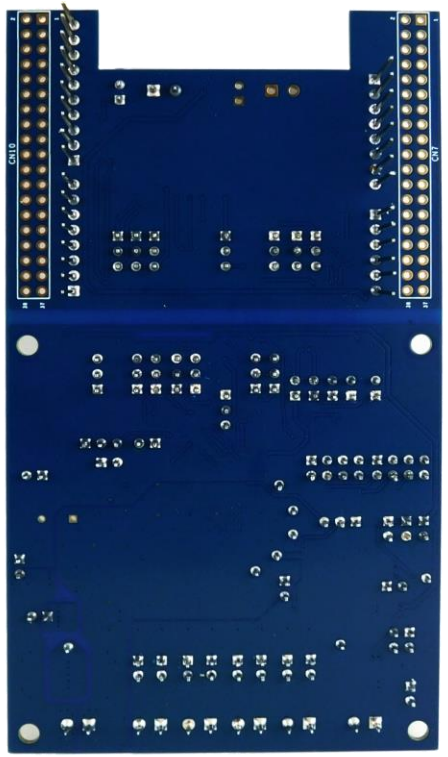
X-NUCLEO-OUT17A1 expansion board
Hardware overview 2/2

Top view

Bottom view



X-CUBE-IPS software package
SW architecture overview

Software Description :

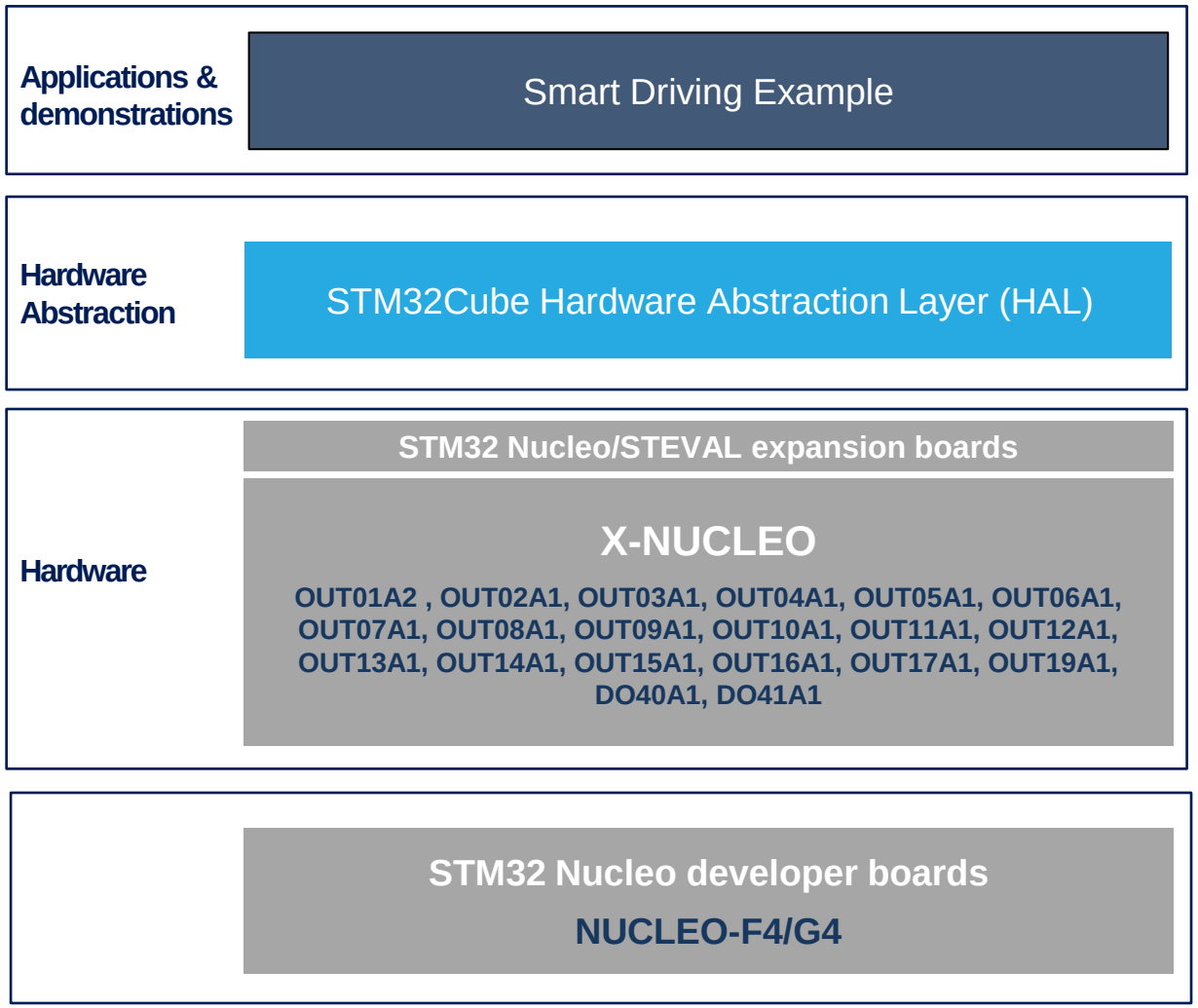
The X-CUBE-IPS expansion software package for STM32Cube runs on the STM32 microcontroller and includes a driver to control the expansion boards hosting Intelligent Power Switches ICs.

The software provides an affordable and easy-to-use solution for the development of single, dual, quad and octal digital output modules for 0.5A, 0.6A, 0.7A, 1.0A, 2.5 A and 5.7A applications, letting you easily evaluate the driving and diagnostic capabilities of the Intelligent Power Switches.

This expansion is built on STM32Cube software technology to ease portability across different STM32 microcontrollers. It is compatible with STM32CubeMX, and it can be downloaded from www.st.com or installed directly using STM32CubeMX.
This software package comes with sample implementations for NUCLEO-F401RE and NUCLEO-G431RB development boards.

Key Features:

- Sample application to evaluate basic digital output modules by stacking X-NUCLEO-OUT17A1 and a NUCLEO development board. The software also uses a PWM timer to generate the periodic patterns on the output channel for the expansion boards.
- Up to 5MHz SPI for 8-bits or 16-bits driving modes and daisy chaining.
- MCU Freeze detection feature available by dedicated enable pin and watchdog
- Sample application to interact with the STSW-IFAPGUI PC Software.



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X-CUBE-IPS

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STM32 Open Development Environment: Overview

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Demo Example: Bill Of Material

HW pre-requisites

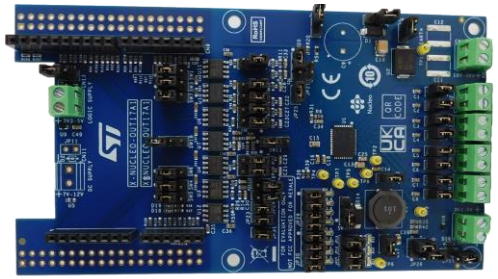
- 1x *description* expansion board:
  X-NUCLEO-OUT17A1
- 1x STM32 Nucleo development board:
  NUCLEO-F401RE, NUCLEO-G431RB
- 1x USB type A to mini-B cable (for NUCLEO-F401RE)

  or

  1x USB type A to micro-B cable (for NUCLEO-G431RB)
- 1x Laptop/PC with Windows 7, 8 or above

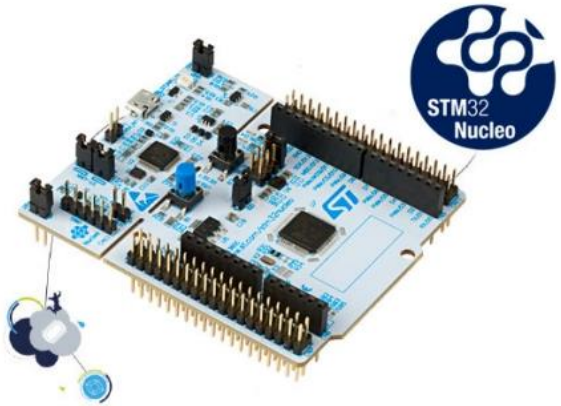
A to mini-B
USB Cable

A to micro-B
USB Cable



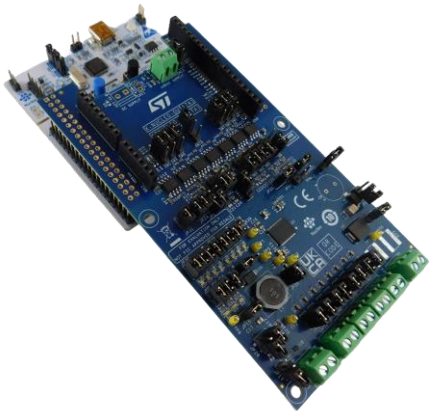
X-NUCLEO-OUT17A1

+



NUCLEO-F401RE or

NUCLEO-G431RB



NUCLEO
stacked solution

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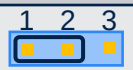
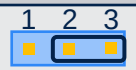
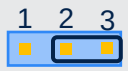
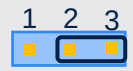
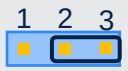
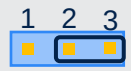
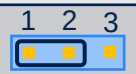
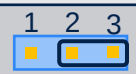
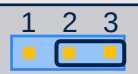
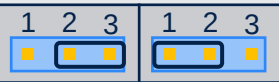
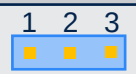
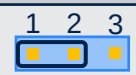
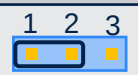
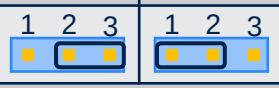
Hardware setup
Jumper and switches configuration

X-NUCLEO-OUT17A1	VREG by embedded DC-DC	VREG by external supply	GPIO Driving Mode	SPI 8-bits Driving Mode	SPI 16-bits Driving Mode	Daisy Chaining (SPI Mode only)	MCU Freeze (SPI Mode only)
JP15 JP20			←				
SW17			←				
JP28	 3v3 5v0		←				
JP1 JP2 JP3 JP4 JP5 JP6 JP7 JP8 JP9 JP12 JP13 JP15 JP23 JP24 JP25 JP27 JP31	→	→					
JP10 JP14 JP16 JP17 JP18 JP19	→	→					
JP21	→	→					
JP22	→	→					
SW4 SW5 SW7 SW9 SW10 SW11 SW12 SW13 SW14 SW15 SW20	→	→					
SW6	→	→					←
SW18	→	→					←
SW3						→	

Demo Example: software tools

SW pre-requisites

- STM32CubeProg: All-in-one multi-OS software tool for programming STM32 products or
  STSW-LINK009: ST-LINK/V2-1 (NUCLEO-F401RE), ST-LINK/V3 (NUCLEO-G431RB) USB driver

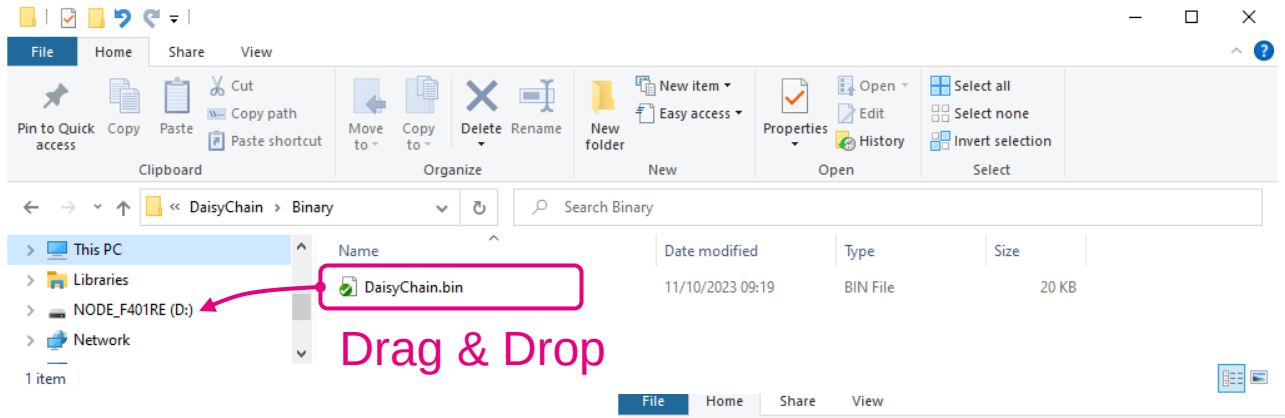
- X-CUBE-IPS: software package including the application examples for NUCLEO-F401RE, NUCLEO-G431RB to be associated with the:
  X-NUCLEO-OUT01A2 , X-NUCLEO-OUT02A1, X-NUCLEO-OUT03A1, X-NUCLEO-OUT04A1,
  X-NUCLEO-OUT05A1, X-NUCLEO-OUT06A1, X-NUCLEO-OUT07A1, X-NUCLEO-OUT08A1, X-NUCLEO-OUT09A1,
  X-NUCLEO-OUT10A1, X-NUCLEO-OUT11A1, X-NUCLEO-OUT12A1, X-NUCLEO-OUT13A1, X-NUCLEO-OUT14A1,
  X-NUCLEO-OUT15A1, X-NUCLEO-OUT16A1, X-NUCLEO-OUT17A1, X-NUCLEO-OUT19A1, X-NUCLEO-DO40A1,
  X-NUCLEO-DO41A1

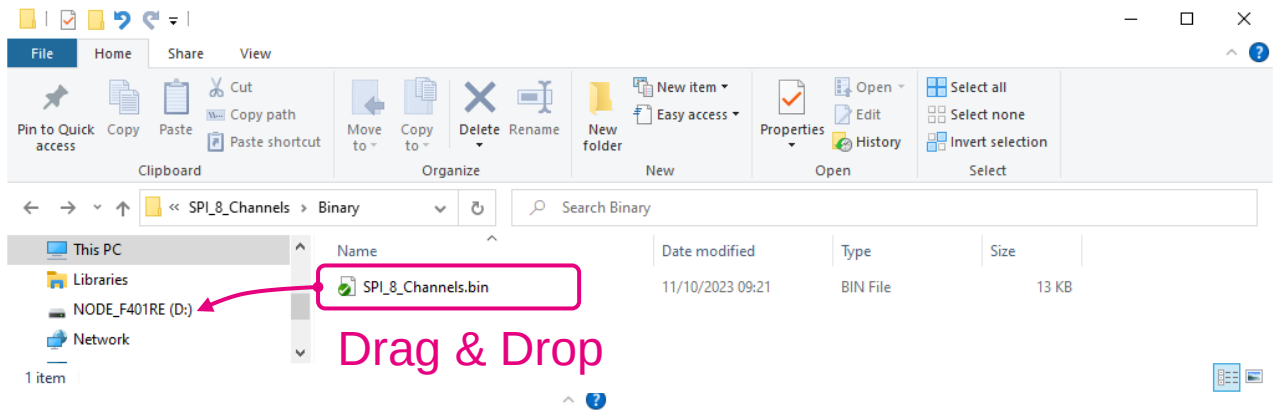
Demo Examples for different operating modes

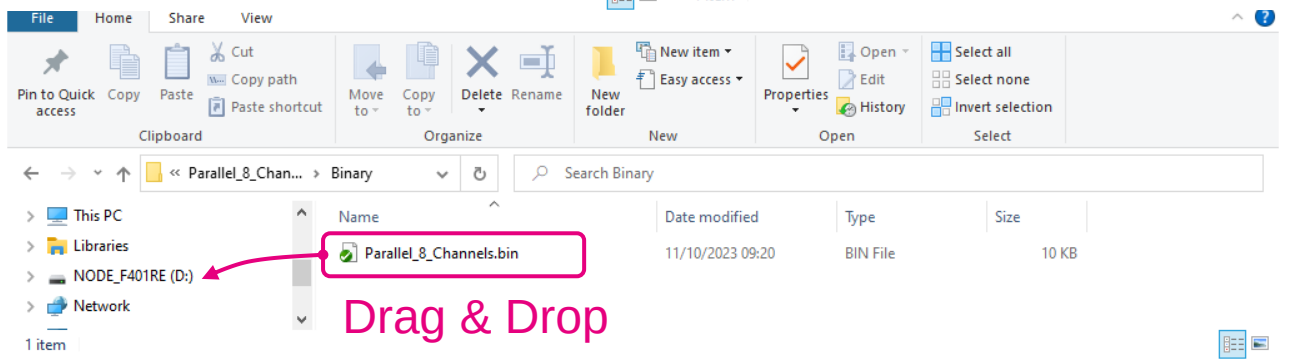
X-NUCLEO-OUT17A1 comes with three demo FW binary sets (per nucleo board)

- Application example binaries in the package X-CUBE-IPS
  - DaisyChain.bin
  - SPI_8_Channels.bin
  - Parallel_8_Channels.bin
- Application example binaries (per nucleo boards) compatible with STSW-IFAPGUI
  - STSW-OUT16F4
  - STSW-OUT16G4

Once the Nucleo board is plugged into the PC, an USB_STORAGE like device is detected, the FW binary can be programmed into the Nucleo board by just a drag & drop operation







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Interact with the STSW-IFAPGUI

- The Firmware binaries STSW-OUT16F4.bin and STSW-OUT16G4.bin allow the interaction of the X-NUCLEO-OUT17A1 with a SW application running on PC (STSW-IFAPGUI).
- The SW app (STSW-IFAPGUI) is available for free download at the following link.
- For the usage of the STSW-IFAPGUI, please refer to the document available at: https://www.st.com/en/embedded-software/stsw-ifapgui.html#documentation

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Documents & related resources

All documents are available in the DOCUMENTATION tab of the related products webpage

X-NUCLEO-OUT17A1

- **DB5105:** Industrial digital output expansion board based on IPS8200HQ-1 for STM32 Nucleo – **Data Brief**
- **UM3247:** Getting started with the X-NUCLEO-OUT17A1 industrial digital output expansion board for STM32 Nucleo - **User manual**
- Schematics, Gerber files, BOM

X-CUBE-IPS

- **DB4735:** Software expansion for STM32Cube driving industrial digital output based on IPS - **Data Brief**
- **UM3035:** Getting started with X-CUBE-IPS industrial digital output software for STM32 Nucleo - **User manual**

STSW-IFAPGUI (Avail. Q4-2023)

- **DB3775:** Graphical user interface for the industrial IPS evaluation boards based on STM32 Nucleo – **Data Brief**
- **UM2509:** STSW-IFAPGUI, common graphical user interface for the expansion boards of Intelligent Power Switches – **User manual**

STSW-OUT16F4

- **DB5139:** Demonstration firmware for NUCLEO-F401RE enabling STSW-IFAPGUI on X-NUCLEO-OUT16A1 expansion board – **Data Brief**
- **UM3433:** Getting started with STSW-OUT16F4 demonstration firmware for NUCLEO-F401RE enabling STSW-IFAPGUI on X-NUCLEO-OUT16A1 and X-NUCLEO-OUT17A1 expansion boards – **User manual**

STSW-OUT16G4

- **DB5138:** Demonstration firmware for NUCLEO-G431RB enabling STSW-IFAPGUI on X-NUCLEO-OUT16A1 expansion board – **Data Brief**
- **UM3434:** Getting started with STSW-OUT16G4 demonstration firmware for NUCLEO-G431RB enabling STSW-IFAPGUI on X-NUCLEO-OUT16A1 and X-NUCLEO-OUT17A1 expansion boards – **User manual**

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STM32 ODE Ecosystem

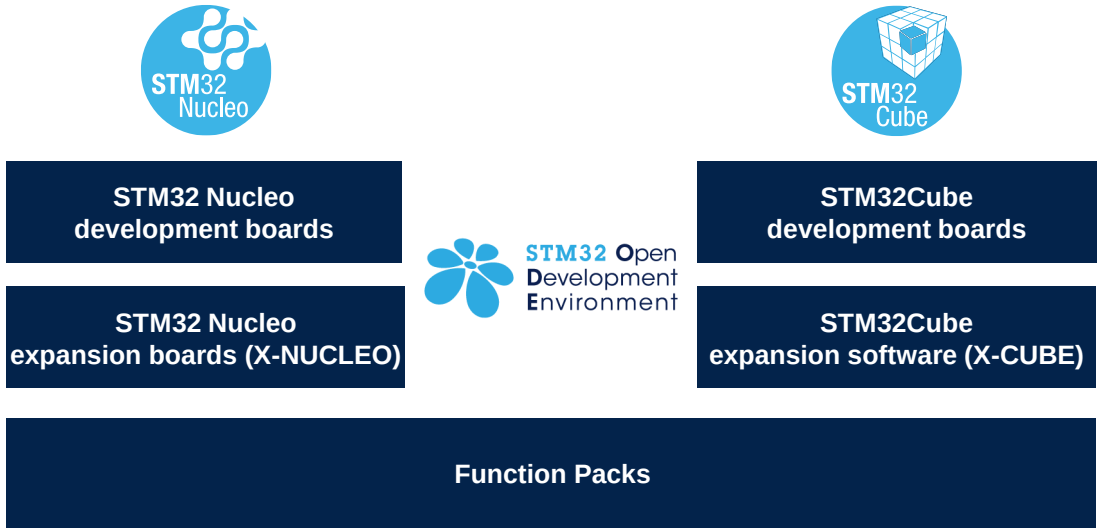
FAST, AFFORDABLE PROTOTYPING AND DEVELOPMENT

The STM32 Open Development Environment (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.

The STM32 ODE includes the following five elements:

- STM32 Nucleo development boards. A comprehensive range of affordable development boards for all STM32 microcontroller series, with unlimited unified expansion capability, and with integrated debugger/programmer
- STM32 Nucleo expansion boards. Boards with additional functionality to add sensing, control, connectivity, power, audio or other functions as needed. The expansion boards are plugged on top of the STM32 Nucleo development boards. More complex functionalities can be achieved by stacking additional expansion boards
- STM32Cube software. A set of free-of-charge tools and embedded software bricks to enable fast and easy development on the STM32, including a Hardware Abstraction Layer, middleware and the STM32CubeMX PC-based configurator and code generator
- STM32Cube expansion software. Expansion software provided free of charge for use with STM32 Nucleo expansion boards, and compatible with the STM32Cube software framework
- STM32Cube Function Packs. Set of function examples for some of the most common application cases built by leveraging the modularity and interoperability of STM32 Nucleo development boards and expansions, with STM32Cube software and expansions.

The STM32 Open Development Environment is compatible with a number of IDEs including IAR EWARM, Keil MDK, mbed and GCC-based environments.



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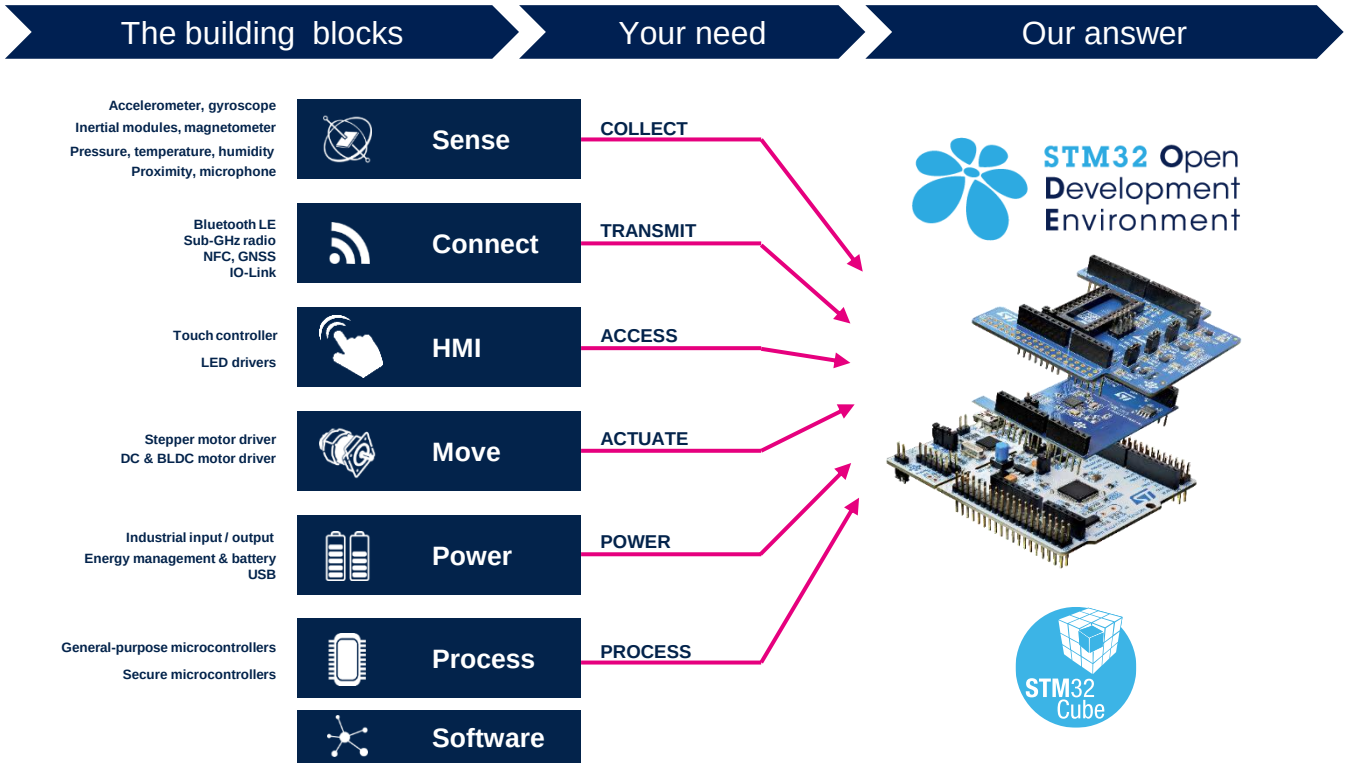
STM32 Open Development Environment: all that you need

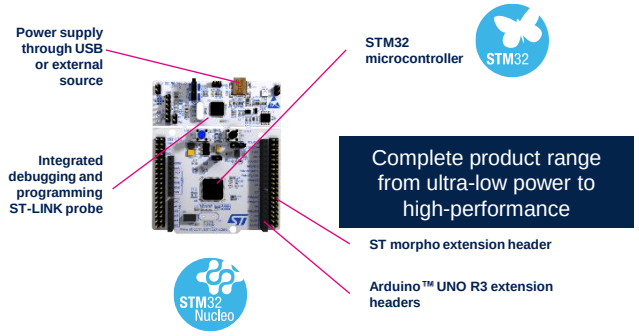
The combination of a broad range of expandable boards based on leading-edge commercial products and modular software, from driver to application level, enables fast prototyping of ideas that can be smoothly transformed into final designs.

To start your design:

- Choose the appropriate STM32 Nucleo development board (MCU) and expansion (X-NUCLEO) boards (sensors, connectivity, audio, motor control etc.) for the functionality you need
- Select your development environment (IAR EWARM, Keil MDK, and GCC-based IDEs) and use the free STM32Cube tools and software.
- Download all the necessary software to run the functionality on the selected STM32 Nucleo expansion boards.
- Compile your design and upload it to the STM32 Nucleo development board.
- Then start developing and testing your application.

Software developed on the STM32 Open Development Environment prototyping hardware can be directly used in an advanced prototyping board or in and end product design using the same commercial ST components, or components from the same family as those found on the STM32 Nucleo boards.





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