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STMicroelectronics X-NUCLEO-OUT13A1 Industrial Digital Output Expansion Board User Guide
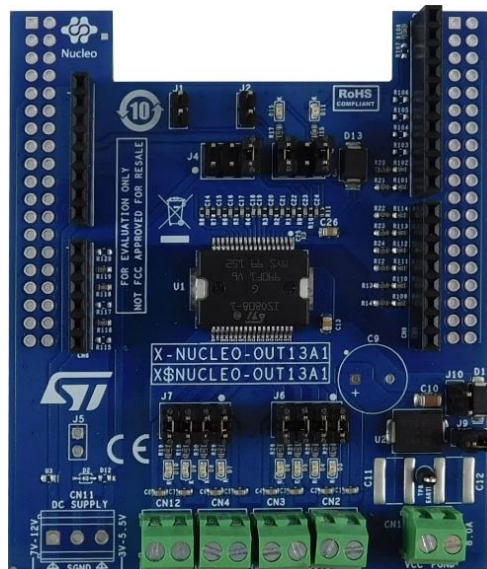
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STMicroelectronics X-NUCLEO-OUT13A1 Industrial Digital Output Expansion Board

Hardware overview

Hardware Description

- The X-NUCLEO-OUT13A1 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 ISO808-1 (Octal High Side Switch, with embedded galvanic isolation, overtemperature diagnostic, and high inductive load driving capability) in a digital output module connected to 1.0 A (max. per channel) industrial loads.
- The X-NUCLEO-OUT13A1 directly interfaces the microcontroller on the STM32 Nucleo by Arduino UNO R3 (default configuration) and ST morpho (optional, not mounted) connectors. The galvanic isolation between the logic side and process side of the system is guaranteed by the 2k VRMS isolation embedded in the ISO808-1. The expansion board can be connected to either a NUCLEO-F401RE or NUCLEO-G431RB development board.
- It is also possible to evaluate a system composed of an X-NUCLEO-OUT13A1 stacked on other expansion boards, provided the compatibility with signals mapped on Arduino connectors.

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/8.0 A
- Low power dissipation (RON(MAX) = 260 mΩ)
- Fast decay for huge inductive loads
- Direct Control mode (output jitter < 20us)
- Synch. Control mode (output jitter < 6us)
- Output enable signal
- Under-voltage lock-out
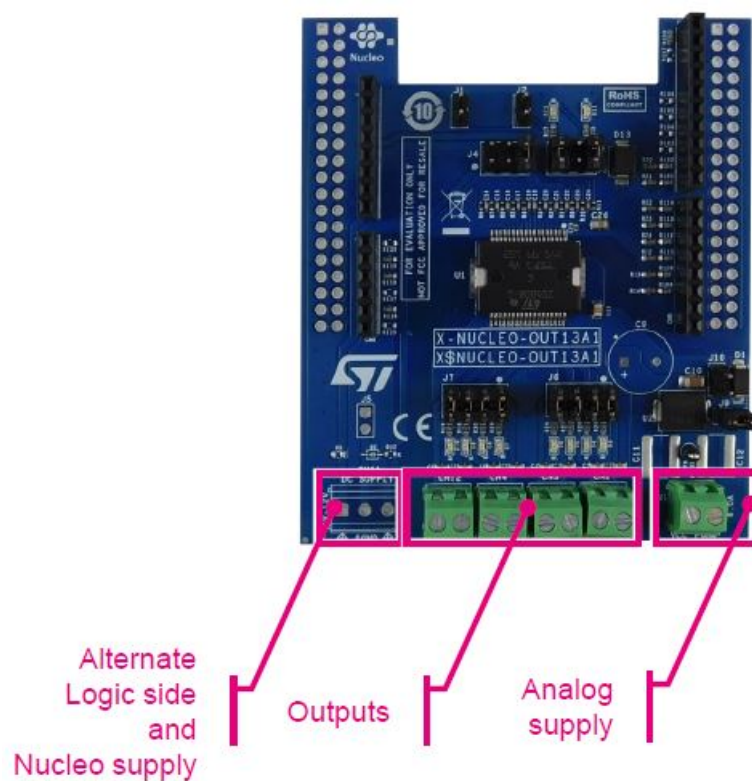- Overload and over-temperature protections
- PowerSO36 package

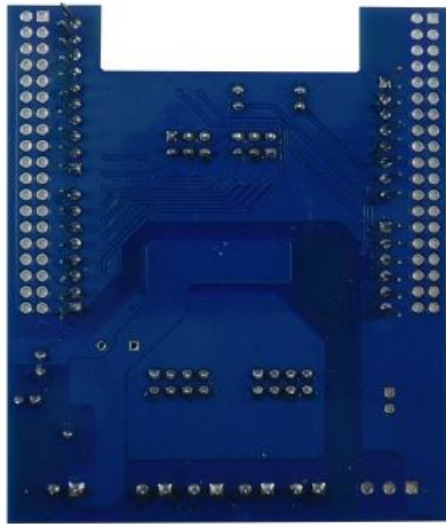### Key Products on the Nucleo expansion board:

ISO808-1

Octal High Side Switch with embedded galvanic isolation and high inductive load driving capability.
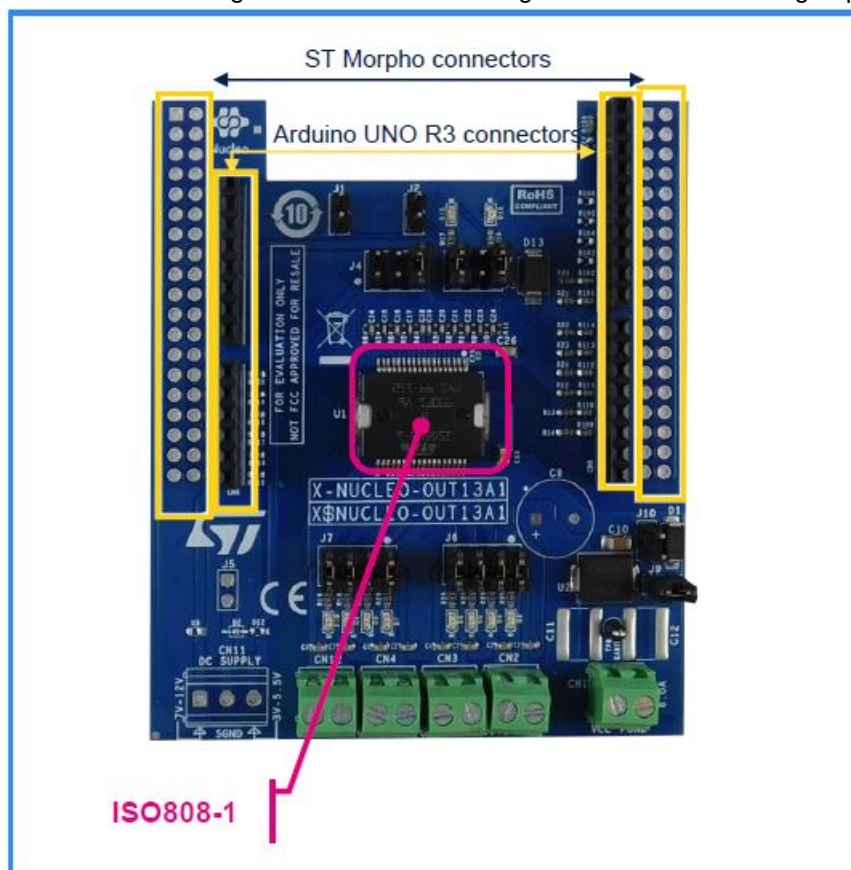
Top view

Bottom view

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 0.7A, 1.0A, 2.5 A, and 5.7A applications, letting you easily evaluate the driving and diagnostic capabilities of the Intelligent Power Switches.

The expansion is built on STM32Cube software technology to ease portability across different STM32 microcontrollers. It is compatible with NUCLEO-F401RE or NUCLEO-G431RB development boards.

Key Features

- Sample application to evaluate basic digital output modules by stacking X-NUCLEO-OUT11A1 or X-NUCLEO-OUT13A1. The software also uses a PWM timer to generate the periodic patterns on the output channel for the expansion boards.
- Direct and Synchronous driving control modes
- Sample application to interact with the STSW-IFAPGUI PC Software.
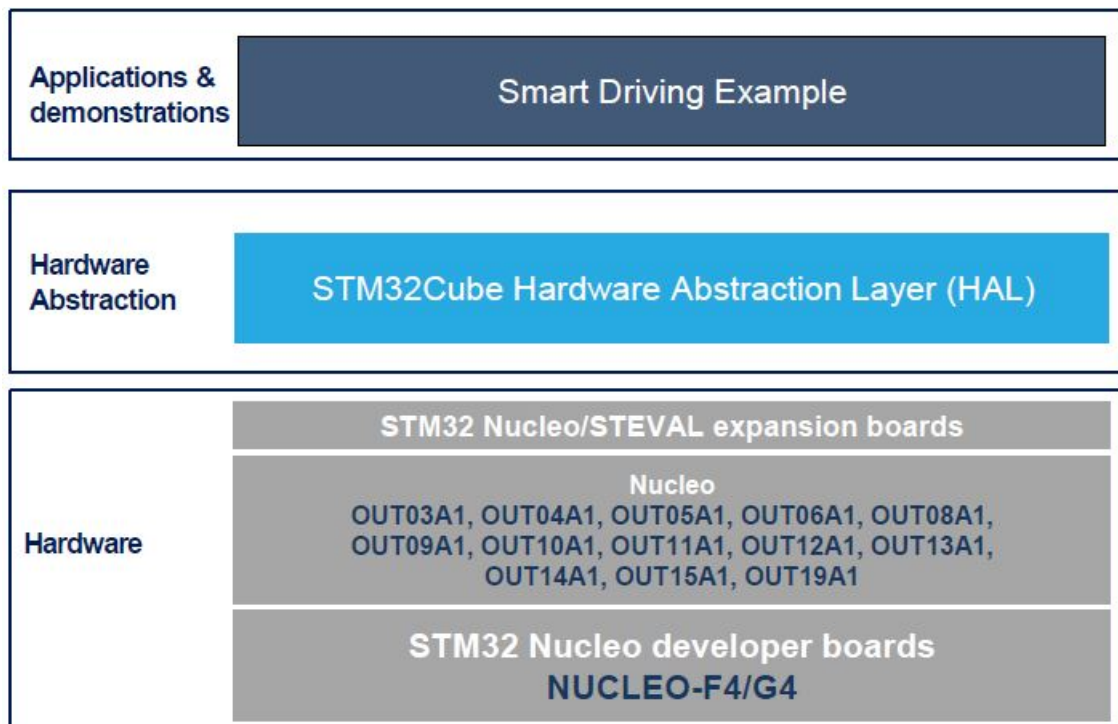
Demo Example Bill Of Material

- 1x description expansion board
  (X-NUCLEO-OUT13A1)
- 1x STM32 Nucleo development board of
  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)
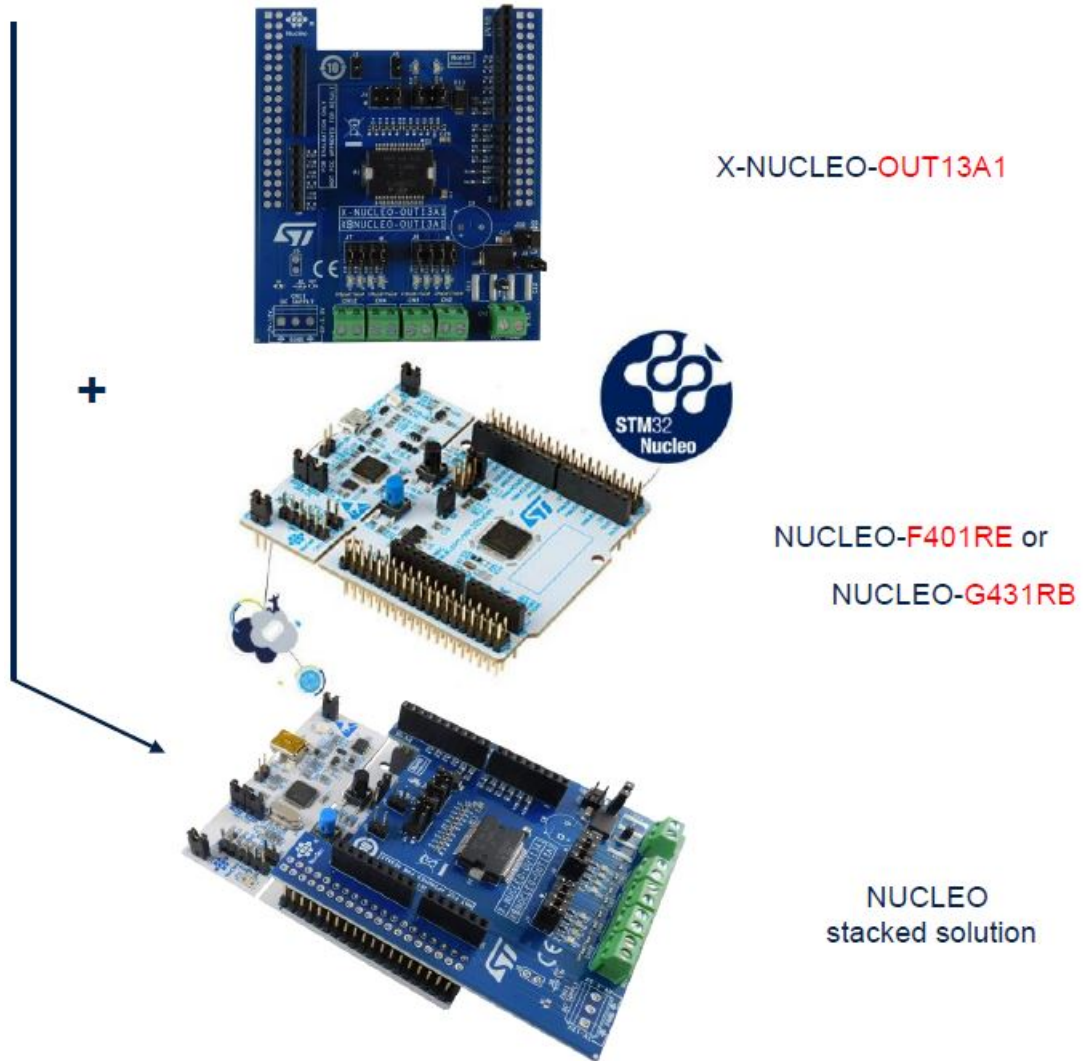- 1x Laptop/PC with Windows 7, 8, or above

A to mini-B
USB Cable
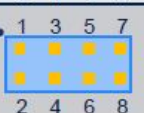
A to micro-B
USB Cable

HW pre-requisites

X-NUCLEO-OUT13A1

+

NUCLEO-F401RE or

NUCLEO-G431RB

NUCLEO
stacked solution

Hardware setup

Jumpers' configuration

J4	1 5 2 6	Logic Side of ISO808-1 supplied by the 3v3 rail
	1 5 2 6	Logic Side of ISO808-1 supplied by the EXT_Vdd rail
J3	1 5 2 6	STATUS and OUT_EN signals not pulled up (D11 and D15 not active)
	1 5 2 6	STATUS and OUT_EN signals pulled up (D11 and D15 active)
J9	1 2	Disables EMC protection on supply rail (analog supply ≤ 33V)
	1 2	Enables EMC protection on supply rail (analog supply ≤ 36V)
J10	1 2	Enables the reverse polarity protection on analog supply rail
	1 2	Disables the reverse polarity protection on analog supply rail
J6, J7	1 3 5 7 2 4 6 8	Enables the green LEDs D3 to D6, and D7 to D10
	1 3 5 7 2 4 6 8	Disables the green LEDs D3 to D6, and D7 to D10
J1, J2	1 2	Load / Synch driven by CN8[5] / CN8[3] for Synch. Control Mode
	1 2	Load / Synch to GND for Direct Control Mode

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-OUT03A1, X-NUCLEO-OUT04A1, X-NUCLEO-OUT05A1, X-NUCLEO-OUT06A1, X-NUCLEO-OUT08A1, X-NUCLEO-OUT09A1, X-NUCLEO-OUT10A1, X-NUCLEO-OUT13A1, X-NUCLEO-OUT12A1, X- NUCLEO-OUT13A1, X-NUCLEO-OUT14A1, X-NUCLEO-OUT15A1, X-NUCLEO-OUT19A1

Demo Examples for different operating modes

X- NUCLEO-OUT13A1 comes with 2 demo FW binary sets (per nucleo board)

- Application example binaries for the three reference IDEs in the package X-CUBE-IPS
    - EWARM-OUT11_13-STM32F4xx_Nucleo.bin | EWARM-OUT11_13-STM32G4xx_Nucleo.bin
    - MDK-ARM-OUT11_13-STM32F4xx_Nucleo.bin | MDK-ARM-OUT11_13-STM32G4xx_Nucleo.bin
    - STM32CubeIDE-OUT11_13-STM32F4xx_Nucleo.bin | STM32CubeIDE-OUT11_13-STM32G4xx_Nucleo.bin
- Application example binaries (per nucleo boards) compatible with STSW-IFAPGUI
    - STSW-OUT11F4

- STSW-OUT11G4

Once the Nucleo board is plugged into the PC, a USB_STORAGE-like device is detected, and the FW binary can be programmed into the Nucleo board by just a drag & drop operation
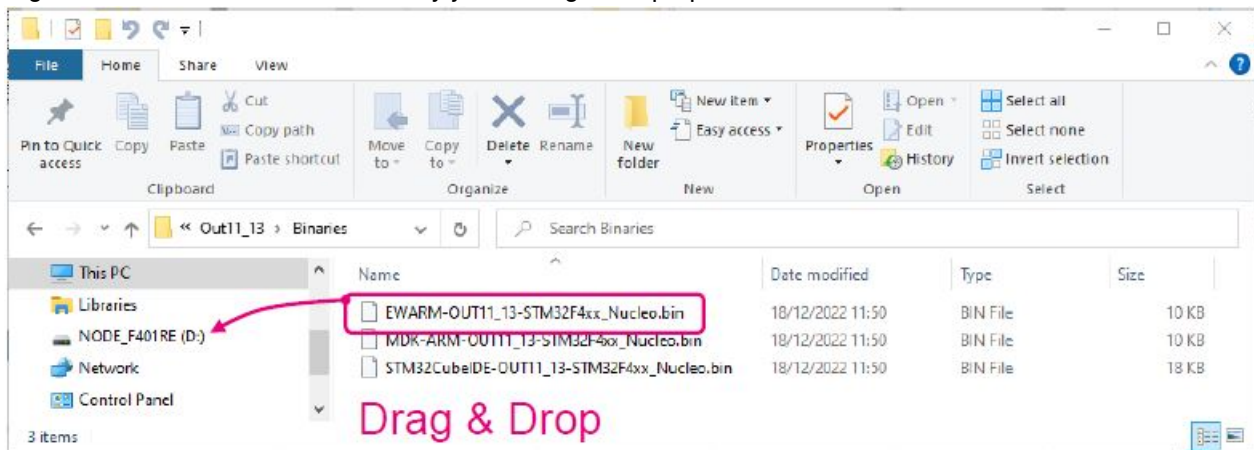
Interact with the STSW-IFAPGUI

- The Firmware binaries STSW-OUT11F4.bin and STSW-OUT11G4.bin allow the interaction of the X-NUCLEO-OUT13A1 with an 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
- Planned availability for the X-NUCLEO-OUT13A1 management through STSW-IFAPGUI: Q1-2023

Documents & related resources

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

X-NUCLEO-OUT13A1

- **DB4835:** Industrial digital output expansion board based on ISO808-1 for STM32 Nucleo – Data Brief
- **UM3081:** Getting started with the X-NUCLEO-OUT13A1 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. Q1-2023)

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

STSW-OUT11F4

- **DB4922:** Demonstration firmware for NUCLEO-F401RE enabling STSW-IFAPGUI on X-NUCLEO-OUT11A1 and X-NUCLEO-OUT13A1 expansion boards – Data Brief

STSW-OUT11G4

- **DB4923:** Demonstration firmware for NUCLEO-G431RB enabling STSW-IFAPGUI on X-NUCLEO-OUT11A1 and X-NUCLEO-OUT13A1 expansion boards – Data Brief

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 is provided free of charge for use with STM32 Nucleo expansion boards and is 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.
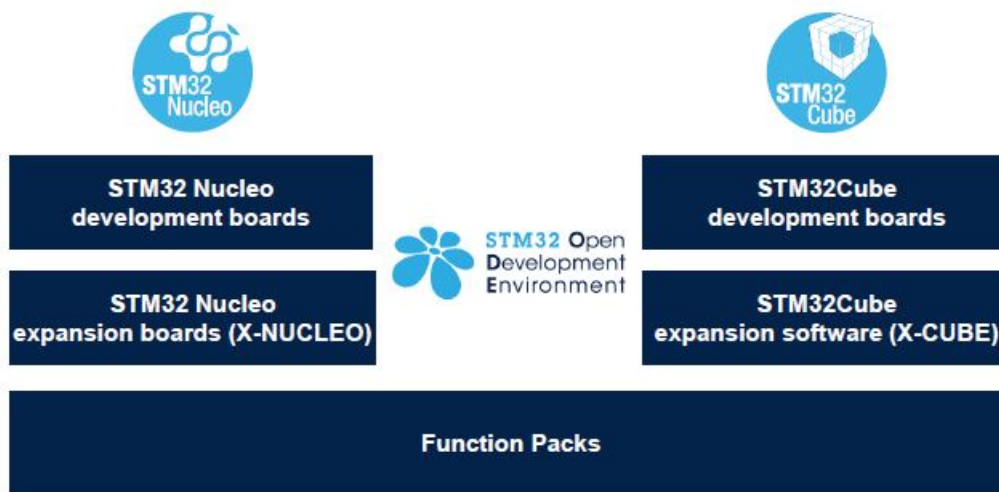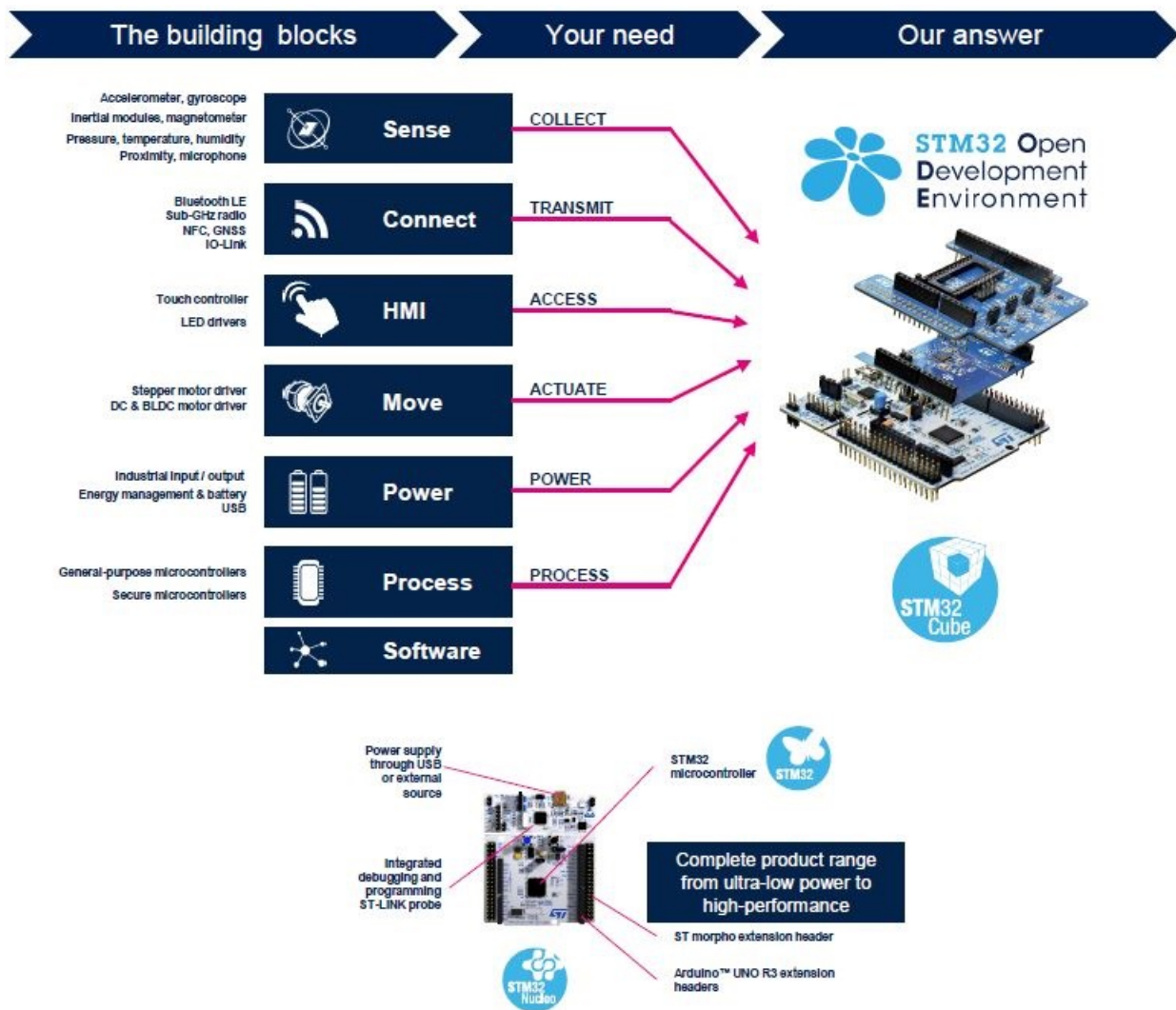
STM32 Open Development Environment

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 the 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 an end product design using the same commercial ST components, or components from the same family as those found on the STM32 Nucleo boards.

The latest info is available at **www.st.com**.
X-CUBE-IPS.

Documents / Resources

	STMicroelectronics X-NUCLEO-OUT13A1 Industrial Digital Output Expansion Board [pdf] User Guide X-NUCLEO-OUT13A1 Industrial Digital Output Expansion Board, X-NUCLEO-OUT13A1, Industrial Digital Output Expansion Board, Digital Output Expansion Board, Output Expansion Board, Expansion Board, Board

References

- **STMicroelectronics: Our technology starts with you**
- **STM32 Open Development Environment - STMicroelectronics**
- **STM32CubeProg - STM32CubeProgrammer software for all STM32 - STMicroelectronics**
- **STSW-LINK009 - ST-LINK, ST-LINK/V2, ST-LINK/V2-1, STLINK-V3 USB driver signed for Windows7, Windows8, Windows10 - STMicroelectronics**
- **STM32 Nucleo Expansion Boards - STMicroelectronics**
- **STM32 Nucleo Development Boards (supports Arduino) - STMicroelectronics**
- **STM32 ODE Function Packs - STMicroelectronics**
- **STM32Cube Expansion Software - STMicroelectronics**

- ☑ [STM32Cube Development Software - STM32 Open Development Environment - STMicroelectronics](#)
- ☑ [STSW-IFAPGUI - Graphical user interface for the industrial IPS and IO-Link transceiver evaluation boards based on STM32 Nucleo - STMicroelectronics](#)
- ☑ [STSW-IFAPGUI - Graphical user interface for the industrial IPS and IO-Link transceiver evaluation boards based on STM32 Nucleo - STMicroelectronics](#)
- ☑ [X-CUBE-IPS - Software expansion for STM32Cube driving industrial digital output based on IPS - STMicroelectronics](#)

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