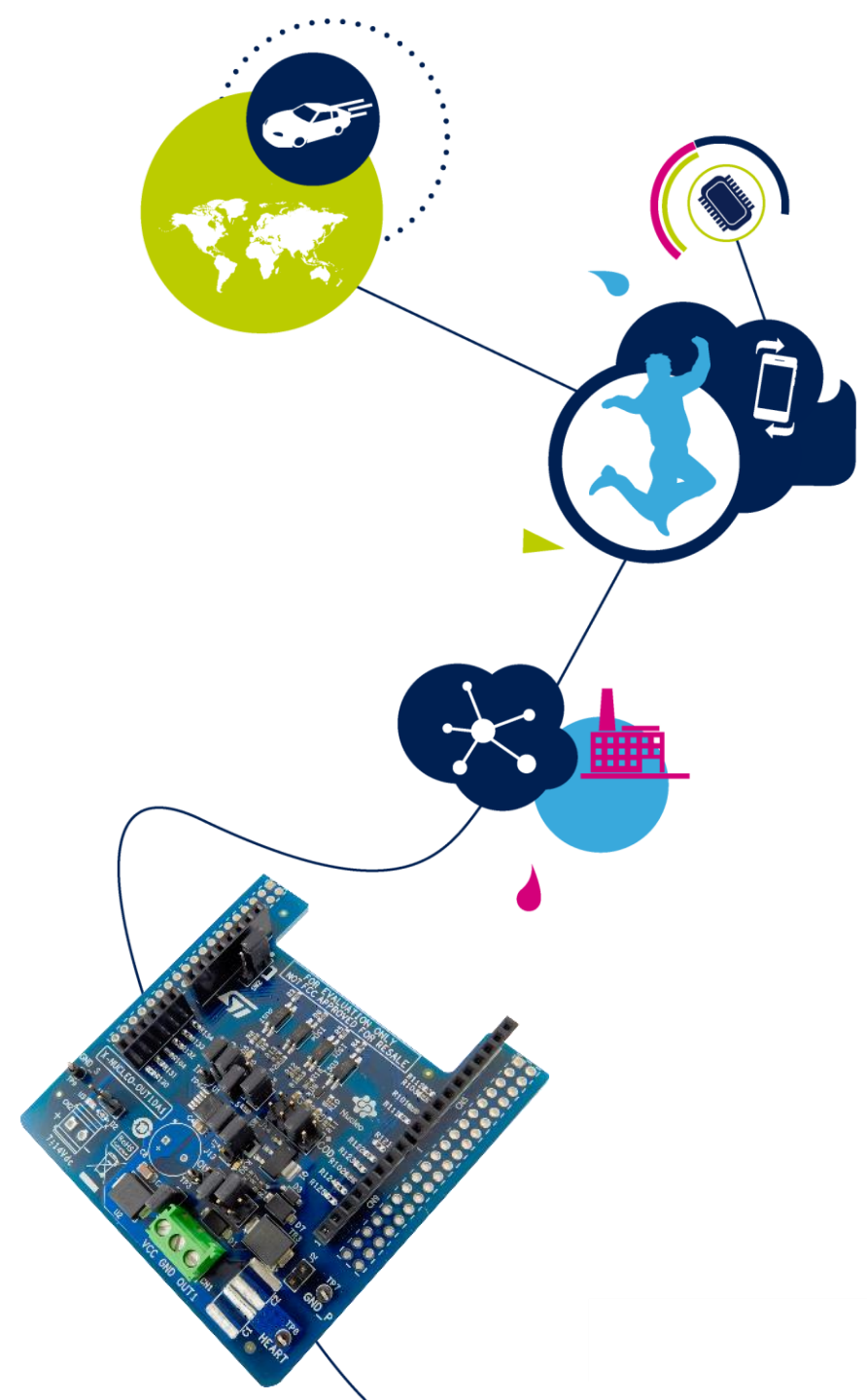


Quick Start Guide

X-NUCLEO-OUT10A1


Industrial digital output expansion board based on IPS161HF for STM32 Nucleo



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X-NUCLEO-OUT10A1 Hardware Description

- The X-NUCLEO-OUT10A1 is an evaluation board based on the IPS161HF 60V/0.5A single channel high side switch with embedded diagnostic (Open Load, Over-Temperature, Over-Load) and protection against overheating and overheating.
- The X-NUCLEO-OUT10A1 interfaces with the microcontroller on the STM32 Nucleo via 3 kV optocouplers driven by GPIO pins and Arduino™ UNO R3.
- The expansion board should be connected to either a NUCLEO-F401RE or NUCLEO-G431RB development board, and can also be stacked with another X-NUCLEO-OUT10A1 or X-NUCLEO-OUT08A1.
- Two X-NUCLEO-OUT10A1 expansion boards allows you to evaluate a dual channel digital output module with 0.5 A capability each, or a 0.5 A single channel safety digital output module. In the second scenario, the first shield output is connected to the supply of the second one. Dedicated on-board hardware can be enabled or disabled to activate fast discharge of high capacitive loads, output voltage sensing and additional surge pulse output line protection.
- The X-NUCLEO-OUT10A1 connected to the X-NUCLEO-OUT08A1 allows you to evaluate a dual channel digital output module with output current capability of 0.5 A and 2 A, respectively.



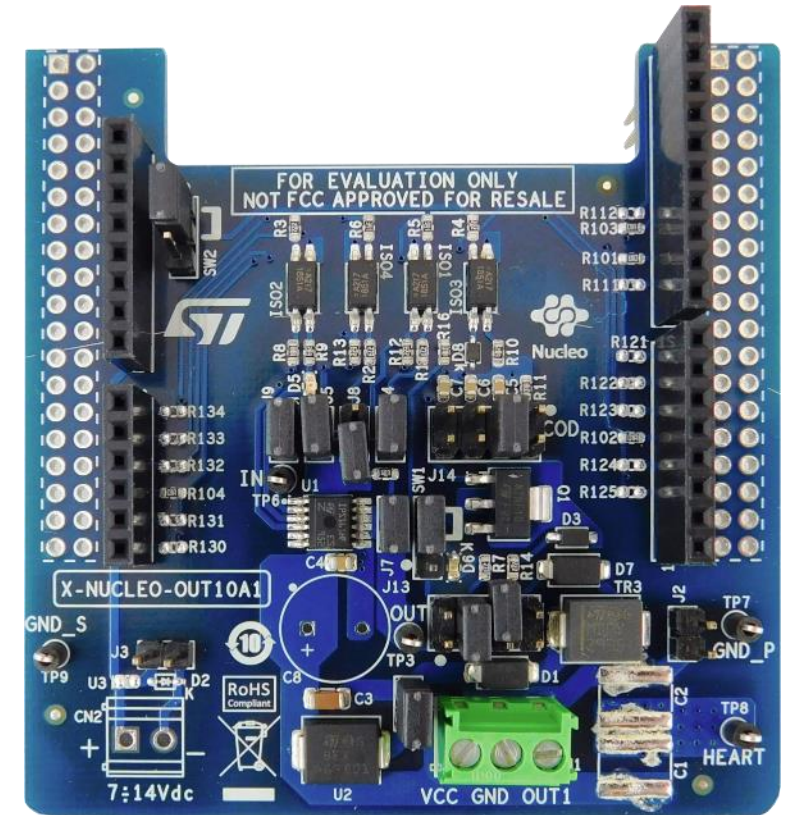
life.augmented

Features

- Based on the IPS161HF
- Normal operating Voltage range 12 to 33 V
- Extended voltage operating range (J1 open) up to 60 V
- Supply rail reverse polarity protection
- Output load capability up to 0.7A
- Output propagation delay at start-up < 60us.
- Compliance with IEC61000-4-2, IEC61000-4-3, IEC61000-4-5
- Output ON/OFF Status Green LED
- Fault Diagnostic Red LED
- Configurable Cut-off intervention time
- 3 kV galvanic isolation barrier between logic and process sides
- Equipped with Arduino™ UNO R3 connectors
- Wide application development potential in STM32 Nucleo development environment
- Ready for Safety Digital Output Architecture
- CE certified
- RoHS and China RoHS compliant

Key Products on board

IPS161HF:
0.5A Single High Side Smart Power Solid State Relay



Latest info available at www.st.com
X-NUCLEO-OUT10A1

Industrial digital output expansion board

Software Overview

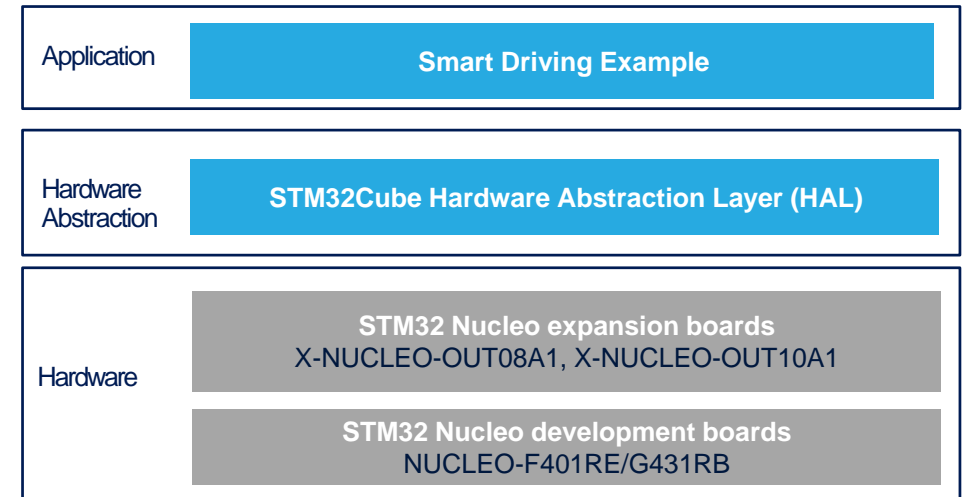
X-CUBE-OUT8 Software Description

- The X-CUBE-OUT8 expansion software package for STM32Cube runs on the STM32 and includes a driver for the IPS161HF.
- The software provides an affordable and easy-to-use solution for the development of single and dual channel digital output modules, letting you easily evaluate the IPS161HF communication and industrial load driving features.
- The expansion is built on STM32Cube software technology to ease portability across different STM32 microcontrollers.
- The software comes with a sample implementation of the driver running on the X-NUCLEO-OUT10A1 expansion board connected to a NUCLEO-F401RE or NUCLEO-G431RB development board.
- You can also perform evaluation of single channel digital output module in P-P by connecting two X-NUCLEO-OUT10A1 with the Output channel of the first connected to the supply rail of the second.

Key features

- Complete software to build applications for the IPS161HF single channel high-side smart power solid state-relay
- GPIOs, PWMs and IRQs configuration
- Fault interrupt handling
- Sample implementation available on the X-NUCLEO-OUT10A1 expansion board when connected to a NUCLEO-F401RE or NUCLEO-G431RB development board
- Easy portability across different MCU families, thanks to STM32Cube
- Free, user-friendly license terms

Overall Software Architecture

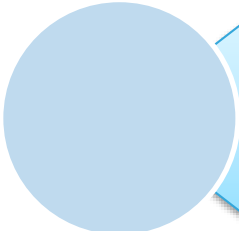


Latest info available at www.st.com
X-CUBE-OUT8

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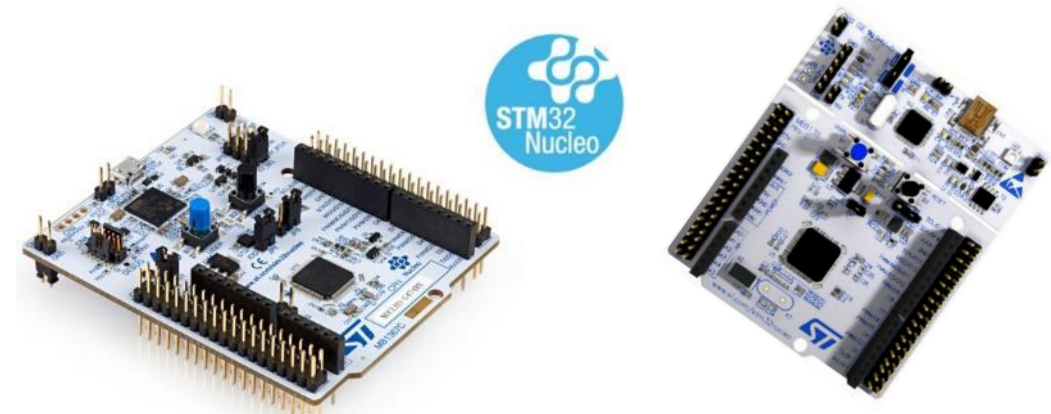
STM32 Open Development Environment: Overview

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HW prerequisites (1/2)

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- 1x STM32 Nucleo Industrial digital output expansion board
(**X-NUCLEO-OUT10A1**)
- 1x STM32 Nucleo development board
(**NUCLEO-F401RE** or **NUCLEO-G431RB**)
- 1x USB type A to Mini-B cable (for NUCLEO-F401RE) or
1x USB type A to Micro-B cable (for NUCLEO-FG431RB)
- 1x Laptop/PC running Microsoft Windows™ 7 or above
- 1x external power supply at 24 V



NUCLEO-G431RB

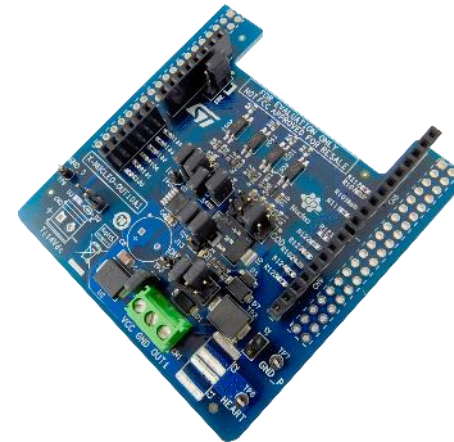
NUCLEO-F401RE



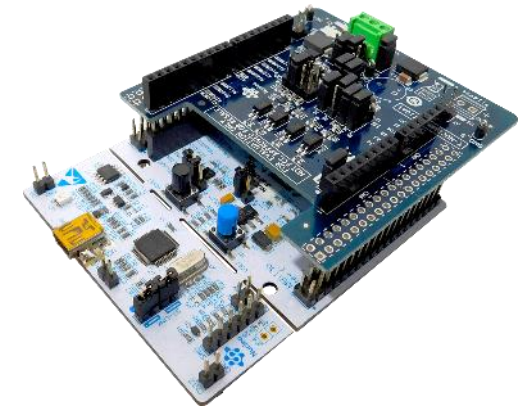
USB type A to
Mini-B cable



USB type A to
Micro-B cable



X-NUCLEO-OUT08A1



X-NUCLEO-OUT08A1 plugged on to a
compatible STM32 Nucleo board

Setup & Demo Examples

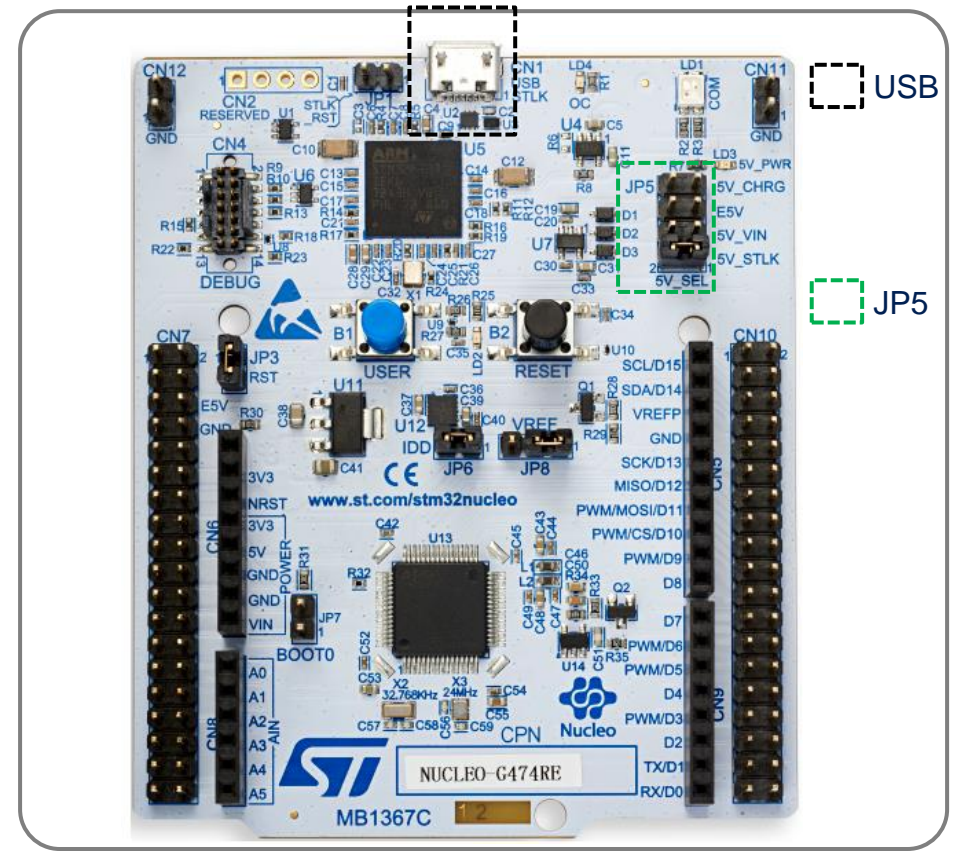
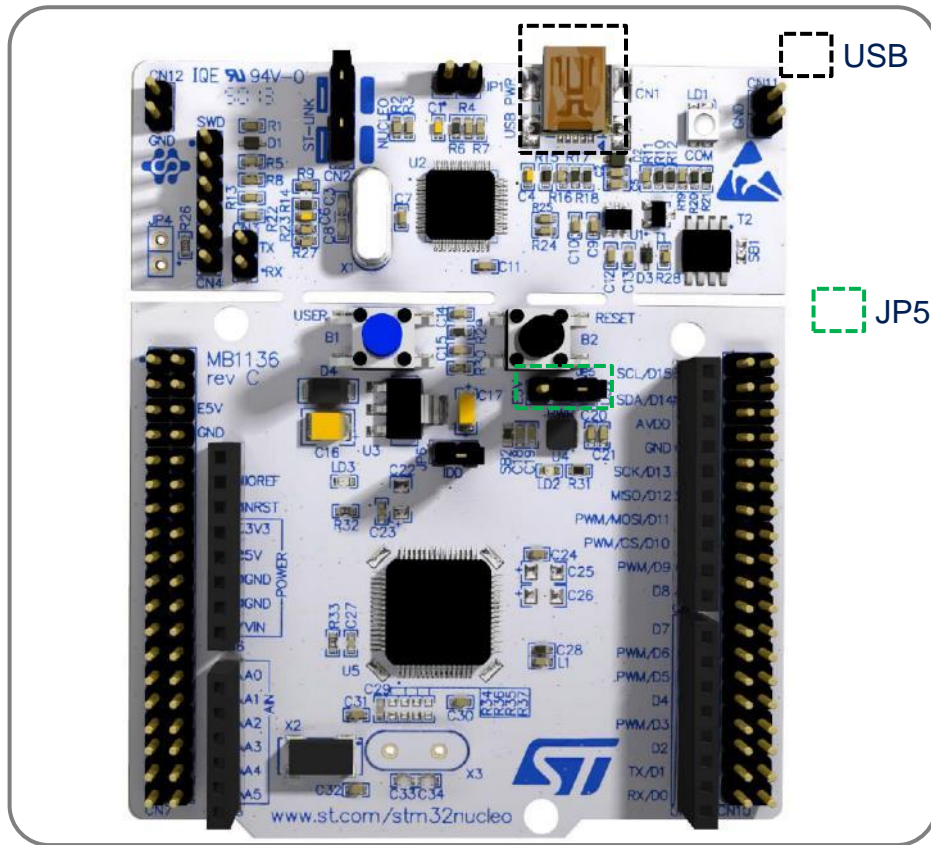
HW prerequisites 2/2

The STM32F401RE can be supplied:

- (DEFAULT) by USB cable of the STM32 Nucleo development board
 - CLOSE JP5 to U5V position on the STM32 Nucleo development board
- By external supply of the X-NUCLEO-OUT10A1
 - Connect the external supply (from 7 to 12V) to CN2 of X-NUCLEO-OUT10A1
 - CLOSE JP5 to E5V position on the STM32 Nucleo development board

The STM32G431RBT6U can be supplied:

- (DEFAULT) by USB cable of the STM32 Nucleo development board
 - CLOSE JP5 to 5V_STLK position on the STM32 Nucleo development board
- By external supply of the X-NUCLEO-OUT08A1
 - Connect the external supply (from 7 to 12V) to CN2 of X-NUCLEO-OUT08A1
 - CLOSE JP5 to 5V_VIN position on the STM32 Nucleo development board



Setup & Demo Examples

SW prerequisites

Execution of the example code

- **X-CUBE-OUT8:**
 - The package contains the source code example (Keil, IAR, STM32CubeIDE) based on **NUCLEO-F401RE** and **NUCLEO-G431RB**
 - Also, you can find the binary files of the example (one for each of the supported Nucleo boards).

Evaluation by Graphical User Interface

- **STSW-IFAPGUI**
 - Common GUI for IPS products.
- **STSW-OUT8F4**
 - Demonstration binary file for NUCLEO-F401RE enabling the GUI
- **STSW-OUT8G4**
 - Demonstration binary file for NUCLEO-G431RB enabling the GUI

Quick start-up procedure (see HW and SW prerequisites)

Execution of the example code

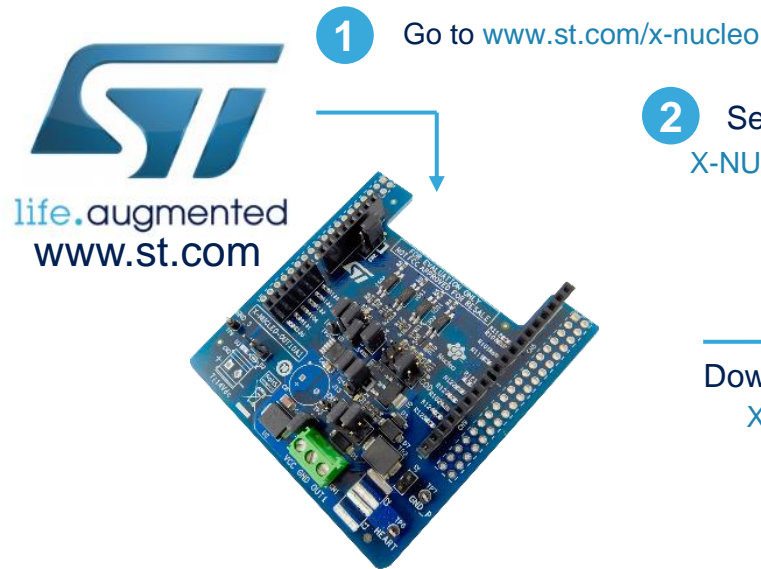
- Download the X-CUBE-OUT8 (.zip file) into a folder of your Laptop/PC
- Connect the NUCLEO board and the X-NUCLEO-OUT10A1 by Arduino connectors.
- Connect the USB cable between Laptop/PC and Nucleo board
- Select the example binary file according to your Nucleo board (F401 or G431) and flash it (by your IDE, or by ST-Link Utility or by STM32 Cube Programmer).
- Connect by CN1 the X-NUCLEO-OUT10A1 to a 24V power supply and turn it on.
- Click on the blue button of the Nucleo board to switch between the different pre-loaded driving modes of the output.

Evaluation by Graphical User Interface

- Download and install the latest version of the STSW-IFAPGUI
- Download the STSW-OUT8F4 or STSW-OUT8G4 according to your Nucleo board (F401 or G431).
- Connect the NUCLEO board and the X-NUCLEO-OUT10A1 by Arduino connectors.
- Connect the USB cable between Laptop/PC and Nucleo board
- Flash the demonstration binary file to your Nucleo board (F401 or G431) by your IDE, or by ST-Link Utility or by STM32 Cube Programmer.
- Connect by CN1 the X-NUCLEO-OUT10A1 to a 24V power supply and turn it on.
- Launch the STSW-IFAPGUI. The self recognition phase checks the firmware running on the Nucleo board and then the GUI starts
- Set your preferred duty cycle and PWM for the output driving and check it on the application board.

Start coding in just a few minutes with X-CUBE-OUT8

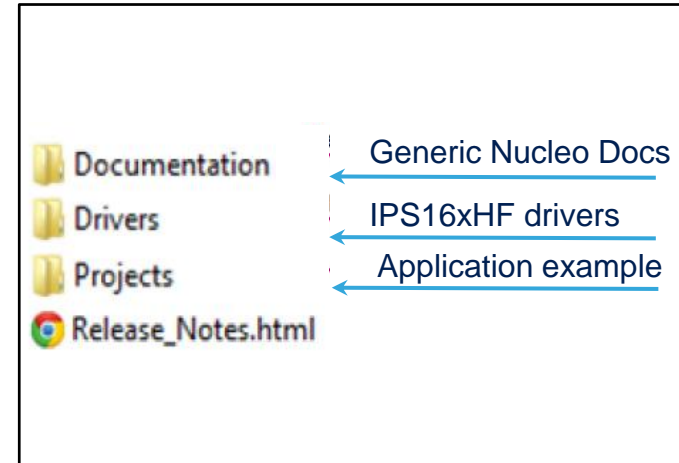
1 Go to www.st.com/x-nucleo



The ST logo is shown in blue. Below it, the text "life.augmented" and "www.st.com" are displayed. To the right, a blue X-CUBE-OUT8 development board is shown at an angle, highlighting its various components and connectors.

2 Select X-NUCLEO-OUT10A1

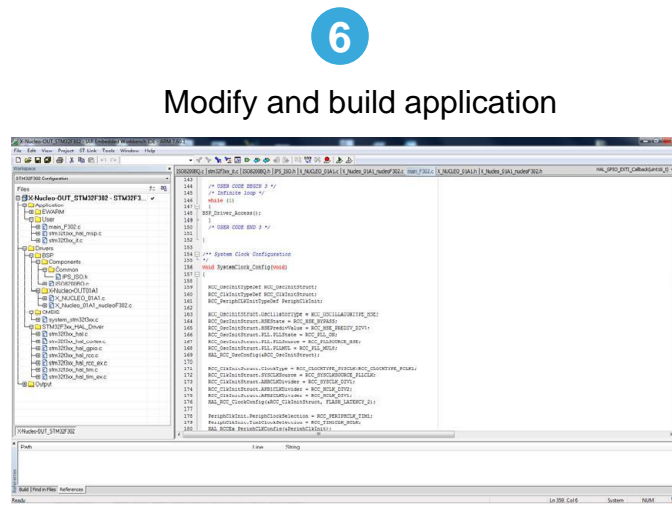
3 Download & unpack X-CUBE-OUT8



A screenshot of a file explorer window showing a directory structure. On the left, there are folders for "Documentation", "Drivers", and "Projects", and a file named "Release_Notes.html". On the right, there are three items with arrows pointing to them: "Generic Nucleo Docs", "IPS16xHF drivers", and "Application example".

4 Download and install (ST-LINK/V2-1 USB driver, STM32 Cube Programmer)

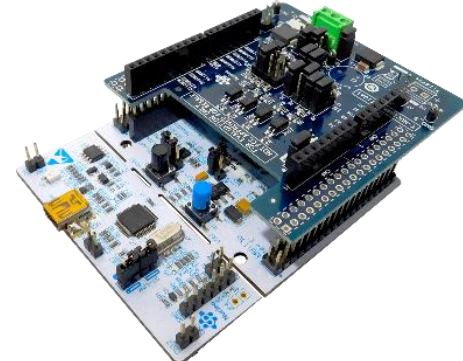
6 Modify and build application



A screenshot of the Keil IDE showing a project view. The project tree on the left includes folders for "X-CUBE-OUT8", "Drivers", and "Projects". The main window displays a list of source files and their dependencies.



5 Open project example



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

X-NUCLEO-OUT10A1:

- **DB4176:** Industrial digital output expansion board based on IPS161HF for STM32 Nucleo – **Data Brief**
- **UM2716:** Getting started with X-NUCLEO-OUT10A1 industrial digital output expansion board for STM32Nucleo – **User Manual**
- Gerber files, BOM, Schematic

X-CUBE-OUT8:

- **DB4178:** Industrial Digital Output software expansion for STM32Cube – **Data Brief**
- **UM2707:** Getting started with the X-CUBE-OUT8 industrial digital output software expansion for STM32Cube – **User Manual**
- Software set-up file

STSW-OUT8F4:

- **DB4179:** Demonstration firmware for NUCLEO-F401RE enabling STSW-IFAPGUI on X-NUCLEO-OUT08A1 and X-NUCLEO-OUT10A1 expansion boards– **Data Brief**

STSW-OUT8G4:

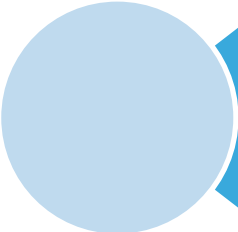
- **DB4180:** Demonstration firmware for NUCLEO-G431RB enabling STSW-IFAPGUI on X-NUCLEO-OUT08A1 and X-NUCLEO-OUT10A1 expansion boards– **Data Brief**

STSW-IFAPGUI:

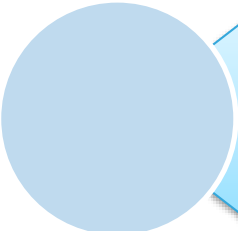
- **DB3775:** Graphical user interface for the industrial IPS evaluation boards based on STM32 Nucleo – **Data Brief**
- **UM2509:** STSW-IFAPGUI, common graphical user interface for the expansion boards of Intelligent Power Switches – **User Manual**



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STM32 Open Development Environment: Overview

STM32 Open Development Environment

Fast, affordable Prototyping and Development

- The STM32 Open Development Environment (ODE) consists of a set of stackable boards and a modular open SW environment designed around the STM32 microcontroller family.

