

## Industrial digital output STM32Cube software expansion for X-NUCLEO-OUT03A1 and X-NUCLEO-OUT04A1

Application	Smart driving example
Hardware Abstraction	STM32Cube Hardware Abstraction Layer (HAL)
Hardware	STM32 Nucleo expansion boards X-NUCLEO-OUT03A1, X-NUCLEO-OUT04A1
	STM32 Nucleo development board NUCLEO-F401RE/G431RB



### Features

- Software package to build applications for **IPS2050H** and **IPS2050H-32**
- High-side switch with extended diagnostics and smart driving for capacitive loads
- Ready-to-use firmware to easily evaluate the driving and diagnostic capabilities of **IPS2050H** and **IPS2050H-32** with industrial loads
- Implementation on **X-NUCLEO-OUT03A1** or **X-NUCLEO-OUT04A1** expansion boards
- **NUCLEO-F401RE** or **NUCLEO-G431RB** development boards supported
- Driver library to control **IPS2050H** and **IPS2050H-32**
- GPIOs, PWMs and IRQs
- Fault/Diagnostics interrupt handling
- Easy portability across different MCU families, thanks to **STM32Cube**
- Free, user-friendly license terms.

### Description

The **X-CUBE-OUT3** software package expands **STM32Cube** functionality. It runs on the STM32 microcontroller and includes a driver controlling the **IPS2050H** or the **IPS2050H-32** (dual-channel high-side switches for industrial applications) mounted on an **X-NUCLEO-OUT03A1** or **X-NUCLEO-OUT04A1** expansion board.

This software allows controlling the output channels of the expansion boards when connected to a **NUCLEO-F401RE** or **NUCLEO-G431RB** development board.

It is possible to build a system with up to four stacked **X-NUCLEO-OUT03A1** and/or **X-NUCLEO-OUT04A1** expansion boards to evaluate an up to eight-channel digital output module.

The two channels of each board can be switched on or off independently in steady-state mode or in PWM mode.

In PWM mode, the software allows you to program the expansion boards to be switched on and off using a specific frequency in the 0-100 Hz range (0.1 Hz resolution), and specific duty cycle in the 0-100% range (1% resolution). These values can also be different for the two channels.

The software included in the package can be used in three integrated development environments (IDEs): IAR, KEIL and **STM32CubeIDE**.

Product summary	
STM32Cube software expansion for X-NUCLEO-OUT03A1 and X-NUCLEO-OUT04A1	<b>X-CUBE-OUT3</b>
Dual-channel high-side switches	<b>IPS2050H</b> <b>IPS2050H-32</b>
Microcontroller	<b>STM32F401RE</b> <b>STM32G431RB</b>
Applications	<b>Programmable Logic Controllers</b>

## 1 Detailed description

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### 1.1 What is STM32Cube?

**STM32Cube** is a combination of a full set of PC software tools and embedded software blocks running on STM32 microcontrollers and microprocessors:

- **STM32CubeMX** configuration tool for any STM32 device; it generates initialization C code for Cortex-M cores and the Linux device tree source for Cortex-A cores
- **STM32CubeIDE** integrated development environment based on open-source solutions like Eclipse or the GNU C/C++ toolchain, including compilation reporting features and advanced debug features
- **STM32CubeProgrammer** programming tool that provides an easy-to-use and efficient environment for reading, writing and verifying devices and external memories via a wide variety of available communication media (JTAG, SWD, UART, USB DFU, I2C, SPI, CAN, etc.)
- **STM32CubeMonitor** family of tools (**STM32CubeMonRF**, **STM32CubeMonUCPD**, **STM32CubeMonPwr**) to help developers customize their applications in real-time
- **STM32Cube MCU and MPU packages** specific to each STM32 series with drivers (HAL, low-layer, etc.), middleware, and lots of example code used in a wide variety of real-world use cases
- **STM32Cube expansion packages** for application-oriented solutions.

### 1.2 How does this software complement STM32Cube?

This software supports dual-channel digital output applications.

The package is based on the STM32CubeHAL, the hardware abstraction layer for the STM32 microcontroller. The package extends **STM32Cube** by providing a board support package (BSP) for the **STM32 Nucleo** expansion board based on the **IPS2050H** and **IPS2050H-32**.

The drivers abstract low-level details of the hardware to access the **IPS2050H** and **IPS2050H-32** device data in a hardware independent manner.

The software package includes a set of examples that the developer can use to start experimenting with the code. The **IPS2050H** and **IPS2050H-32** output channels are controlled via GPIO peripheral and application debugging is supported on the **X-NUCLEO-OUT03A1** and **X-NUCLEO-OUT04A1** through LEDs, GPIO and interrupt signals for activity and diagnostics.

## Revision history

**Table 1. Document revision history**

Date	Revision	Changes
04-Aug-2021	1	Initial release.

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