

## Industrial digital output STM32Cube software expansion for X-NUCLEO-OUT05A1 and X-NUCLEO-OUT06A1

Application	Smart driving example
Hardware Abstraction	STM32Cube Hardware Abstraction Layer (HAL)
Hardware	STM32 Nucleo expansion boards X-NUCLEO-OUT05A1, X-NUCLEO-OUT06A1
	STM32 Nucleo development board NUCLEO-F401RE/G431RB



### Features

- Software package to build applications for [IPS1025H](#) and [IPS1025H-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 [IPS1025H](#) and [IPS1025H-32](#) with industrial loads
- Implementation on [X-NUCLEO-OUT05A1](#) or [X-NUCLEO-OUT06A1](#) expansion boards
- [NUCLEO-F401RE](#) or [NUCLEO-G431RB](#) development boards supported
- Driver library to control [IPS1025H](#) and [IPS1025H-32](#)
- GPIOs, PWMs and IRQs
- Fault/Diagnostics interrupt handling
- Easy portability across different MCU families, thanks to [STM32Cube](#)
- Free, user-friendly license terms

Product summary	
STM32Cube software expansion for X-NUCLEO-OUT05A1 and X-NUCLEO-OUT06A1	<a href="#">X-CUBE-OUT5</a>
Industrial digital output expansion boards	<a href="#">X-NUCLEO-OUT05A1</a> <a href="#">X-NUCLEO-OUT06A1</a>
Single channel high side switches	<a href="#">IPS1025H</a> <a href="#">IPS1025H-32</a>
Microcontrollers	<a href="#">STM32F401RE</a> <a href="#">STM32G431RB</a>
Applications	<a href="#">Programmable Logic Controllers</a>

### Description

The [X-CUBE-OUT5](#) software package expands the functionality provided by [STM32Cube](#). It runs on the STM32 microcontroller and includes a driver controlling the [IPS1025H](#) or the [IPS1025H-32](#) (single-channel high-side switches for industrial applications) mounted on [X-NUCLEO-OUT05A1](#) or [X-NUCLEO-OUT06A1](#) expansion boards.

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-OUT05A1](#) and/or [X-NUCLEO-OUT06A1](#) boards to evaluate an up to four-channel digital output module.

Each board channel can be switched into 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).

The software included in the package can be used in three integrated development environments (IDE): [IAR](#), [KEIL](#) and [STM32CubeIDE](#).

## 1 Detailed description

### 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?

The software supports single 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 [IPS1025H](#) or [IPS1025H-32](#).

The drivers abstract low-level details of the hardware to access the [IPS1025H](#) and [IPS1025H-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 [IPS1025H](#) and [IPS1025H-32](#) output channel is controlled via GPIO peripheral and application debugging is supported on the [X-NUCLEO-OUT05A1](#) and [X-NUCLEO-OUT06A1](#) through LEDs, GPIO and interrupt signals for activity and diagnostics.

## Revision history

**Table 1. Document revision history**

Date	Revision	Changes
24-Mar-2022	1	Initial release.

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