

## Getting started with the X-NUCLEO-OUT02A1 industrial digital output expansion board for STM32 Nucleo

### Introduction

The X-NUCLEO-OUT02A1 industrial digital output expansion board for STM32 Nucleo is based on the ISO8200AQ galvanic isolated octal high-side smart power solid state-relay.

It provides an affordable and easy-to-use solution for the development of 8-channel digital output modules, letting you easily evaluate the ISO8200AQ communication and industrial load driving features.

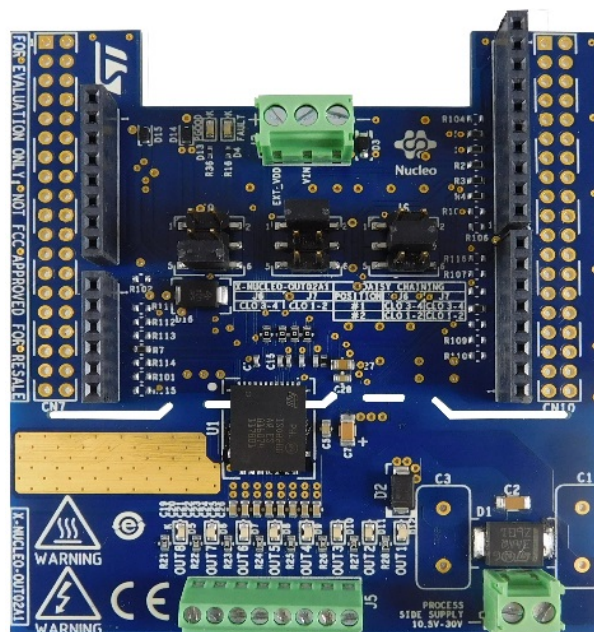
The X-NUCLEO-OUT02A1 can be connected to a NUCLEO-F401RE, NUCLEO-F103RB or NUCLEO-F302R8 development board via Arduino™ UNO R3 connectors.

You can also evaluate the 16-channel digital output modules by connecting two X-NUCLEO-OUT02A1 expansion boards and activating the daisy chaining feature.

The X-NUCLEO-OUT02A1 interfaces with the STM32 controller via SPI and GPIO pins and is compatible with the Arduino™ UNO R3 (default configuration) and ST morpho (optional, not mounted) connectors.

Industrial PLC functionality with 8 inputs and 16 outputs can be added with the X-NUCLEO-PLC01A1 expansion board.

**Figure 1. X-NUCLEO-OUT02A1 expansion board**



# 1 Getting started

## 1.1 Overview

The [X-NUCLEO-OUT02A1](#) expansion board features:

- Based on the [ISO8200AQ](#) whose main characteristics are:
  - Embedded 4kV galvanic isolation
  - Radio frequency communication between the logic and process sides for maximum noise immunity
  - Very low power dissipation ( $R_{ON(MAX)} = 220 \text{ m}\Omega$ )
  - Fast decay for inductive loads
  - 20 MHz SPI I/F on logic side
  - $V_{CC}$  power good diagnostics
  - Overload and overheating protections with thermal shutdown and diagnostics
  - QFN-32L (9x11x1 mm) package
- 10.5 to 33 V operating voltage range
- Green LED (x8) for output on/off status
- Red LED for process supply power good fault
- Red LED for overload and overheating
- Supply reverse polarity protection
- EMC compliance according to IEC61000-4-2, IEC61000-4-3, IEC61000-4-5
- Compatible with [STM32 Nucleo](#) boards
- Equipped with Arduino™ UNO R3 connectors
- CE certified
- RoHS and China RoHS compliant
- WEEE compliant

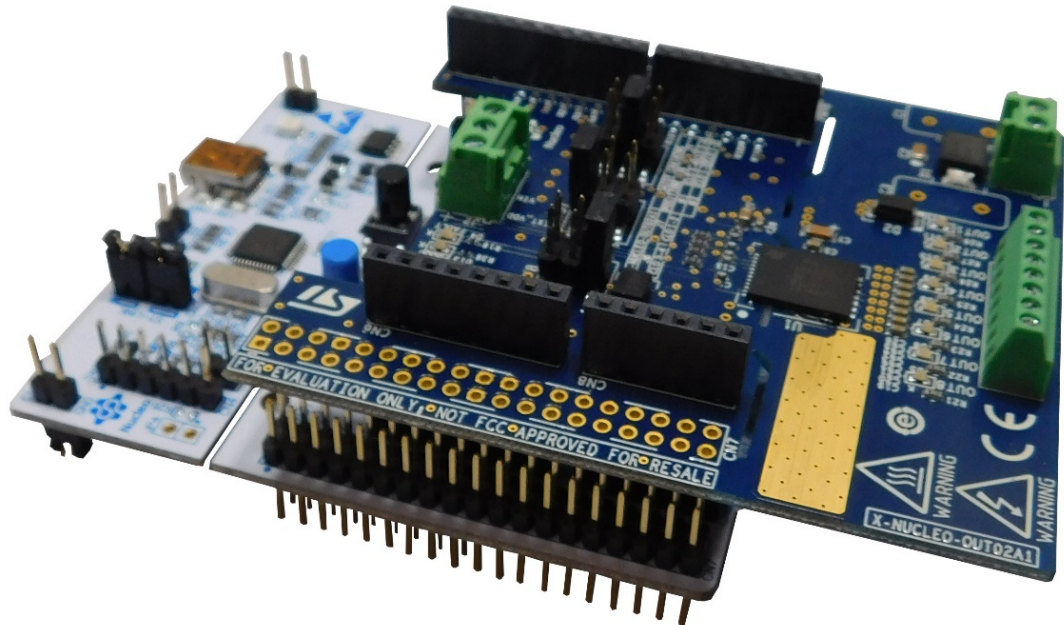
The SPI interface and the embedded power good detection allow a deeper diagnostics, daisy chaining and less MCU GPIO resources on the PLC logic stage.

*Note: The X-NUCLEO-OUT02A1 offers a digital output solution: each output stage is managed at microcontroller level. As the board has no input stage, no sensors can be connected to it.*

## 1.2 Hardware requirements

To use [STM32 Nucleo](#) development boards with the [X-NUCLEO-OUT02A1](#) expansion board, match the boards via the Arduino™ UNO R3 connector pins on the STM32 Nucleo development board.

Figure 2. X-NUCLEO-OUT02A1 expansion board connected to an STM32 Nucleo development board



The X-NUCLEO-OUT02A1 has been designed to be used with

- [NUCLEO-F103RB](#)
- [NUCLEO-F302R8](#)
- [NUCLEO-F401RE](#)

### 1.3 System requirements

To use the [STM32 Nucleo](#) boards with the [X-NUCLEO-OUT02A1](#) expansion board you need:

- a Windows PC/laptop (Windows 7 or above) to install the firmware package ([X-CUBE-OUT02](#))
- a type A to Mini-B USB cable to connect the STM32 Nucleo board to the PC
- an STM32 Nucleo development board ([NUCLEO-F103RB](#), [NUCLEO-F302R8](#) or [NUCLEO-F401RE](#))
- an X-NUCLEO-OUT02A1 expansion board

### 1.4 Board setup

**Step 1.** Connect the micro-USB cable to the PC.

**Step 2.** Download the firmware version onto the microcontroller.

**Step 3.** Set the following jumper configurations on the [STM32 Nucleo](#) board:

- Close SB62 and SB63 jumpers
- Open SB13 and SB14 jumpers

**Step 4.** Connect the [ISO8200AQ](#) device supply voltage to the [X-NUCLEO-OUT02A1](#) via J1.

**Step 5.** Provide the digital supply voltage.

- when connected to the PC: keep the micro-USB cable connected and close jumper JP5 on the STM32 Nucleo board between pins 1 and 2.
- in standalone mode: provide a 7 to 12 V external supply via J2 on the X-NUCLEO- OUT02A1 and close jumper JP5 on the STM32 Nucleo board between pins 2 and 3.

**Step 6.** Connect the load on the output connector.

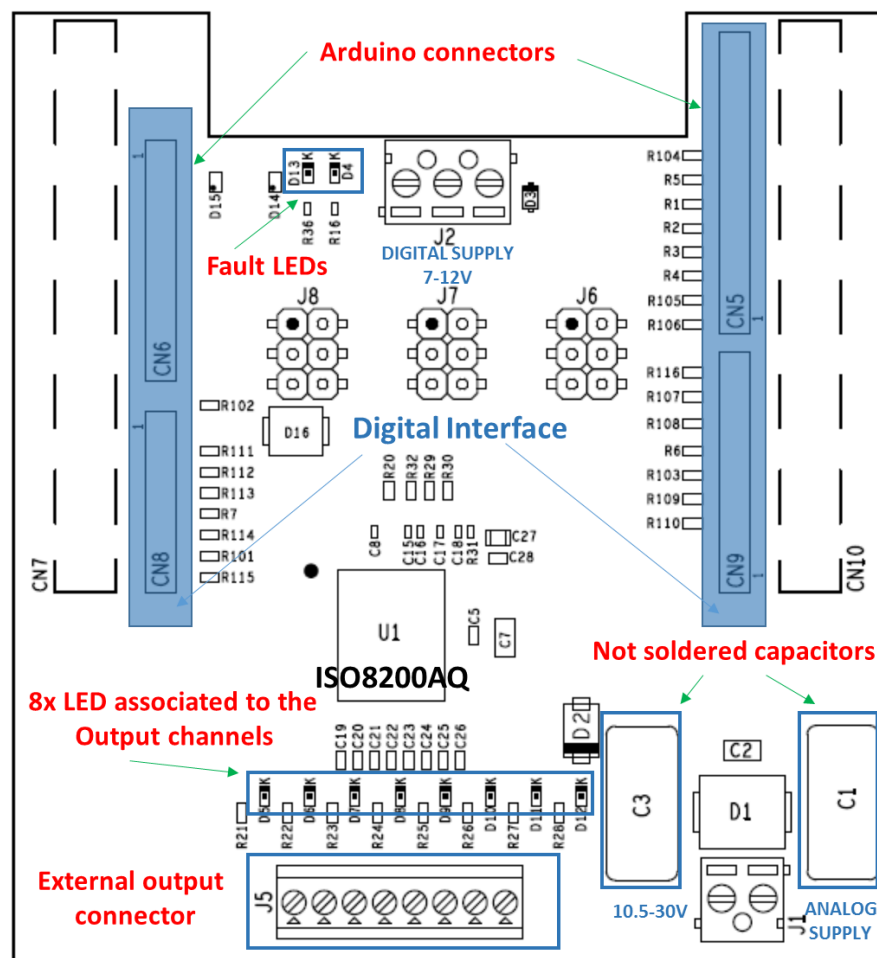
**Step 7.** Run the STM32 and push the blue button on the STM32 Nucleo board to select the example provided in the firmware package.

## 2 Hardware description and configuration

### 2.1 Digital section

The digital section is associated with the STM32 interface and digital supply voltage to and from the X-NUCLEO-OUT02A1 expansion board.

Figure 3. X-NUCLEO-OUT02A1 expansion board: digital interface components



The four Arduino™ UNO R3 connectors:

- allow the ISO8200AQ communication with the STM32 Nucleo board microcontroller and access to the STM32 peripheral and GPIO resources;
- provide digital supply voltage to/from the STM32 Nucleo development board and the X-NUCLEO-OUT02A1 expansion board.

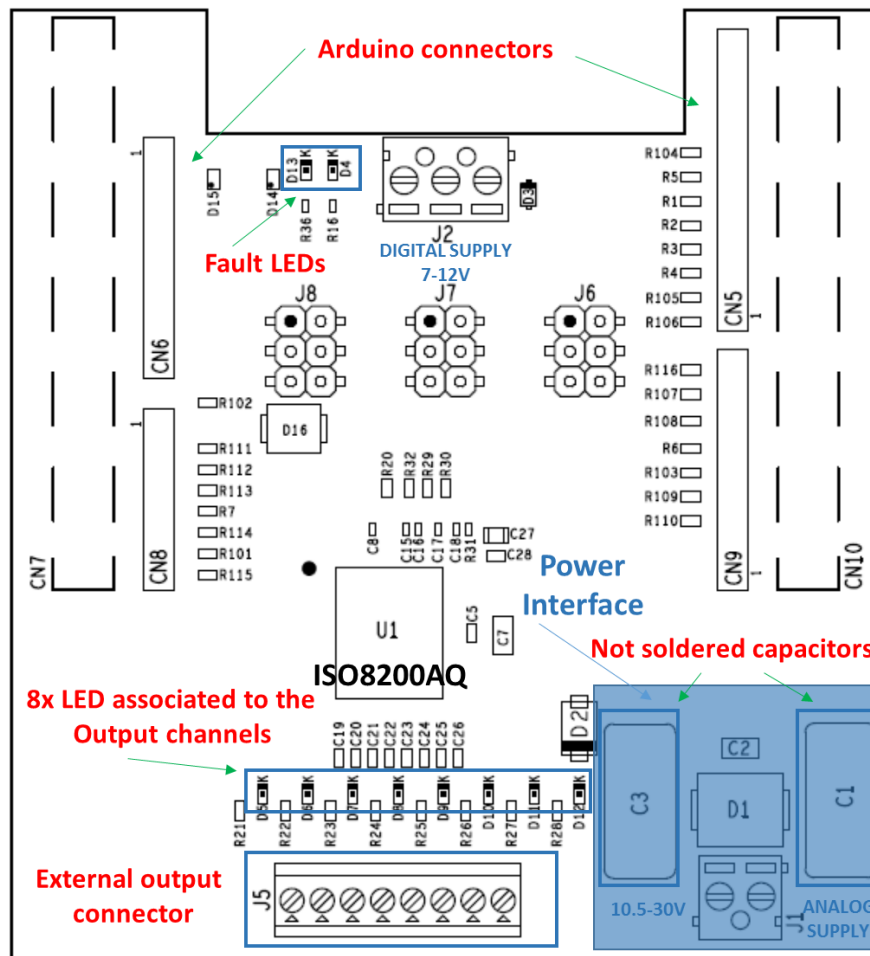
To provide an external digital supply:

- close jumper JP5 between pins 2 and 3 on the STM32 Nucleo development board;
- connect a 7 to 12 V supply at screw connector J2 on the X-NUCLEO-OUT02A1 expansion board.

### 2.2 Power section

The power section involves the power supply voltage, load connection and electromagnetic compatibility (EMC) protections.

Figure 4. X-NUCLEO-OUT02A1 expansion board: power section components



For EMC:

- a Transil™ diode [SMC30J30CA](#) is placed on  $V_{CC}$  track to protect the [ISO8200AQ](#) against surge discharge;
- for common mode surge testing, two single-layer capacitors (C1 and C3, not mounted) must be soldered;
- 22 nF capacitors are included on the output lines for burst disturbance filtering.

To supply the load, connect the supply voltage to the J1 2-way screw connector. The load is connected to the 8-way output.

### 3 Bill of materials

**Table 1. X-NUCLEO-OUT02A1 bill of materials**

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
1	1	U1	ISO8200AQ TFQFPN32	Galvanic isolated octal high-side smart power solid state-relay	ST	ISO8200AQ
2	8	C19, C20, C21, C22, C23, C24, C25, 26	22 nF 50 V ±10% 0603 X7R	Capacitors	TDK	C1608X7R1H223K080AA
3	8	D5, D6, D7, D8 D9, D10, D11, D12	0603 AlGaInP	Green LEDs	OSRAM	LG L29K-G2J1-24
4	8	R21, R22, R23, R24 R25, R26, R27, R28	10 kΩ 0.1 W ±1% 0603	Resistors	Bourns	CR0603-FX-1002ELF
5	1	J5	8 ways, 1 row, screw connector TH 2.54 mm	Jumper	Phoenix Contact	1725711
6	1	C2, C7	2.2 μF 50 V ±10% 1206 X7R	Capacitors	Murata	GRM31C71H225KA88K
7	1	C5	100 nF 50 V ±10% 0603 X7R	Capacitor	TDK	CGA3E2X7R1H104K080AA
8	1	C28	100 nF 16 V ±5% 0603 X7R	Capacitor	AVX	0603YC104JAT2A
9	1	C27	2.2 μF 16 V ±10% 0805 X7R	Capacitor	Murata	GCM21BR71C225KA64L
10	1	R31	47 kΩ 63 mW ±5% 0402	Resistor	Vishay	CRCW040247k0JNED
11	1	C18	10 pF 50 V ±5% 0402 COG	Capacitor	YAGEO	CC0402JRNP09BN100
12	4	R20, R29, R30, R32	0 Ω 100 mW ±1% 0603	Resistors	TE Connectivity	CRG0603ZR
14	4	C8, C15, C16, C17	33 pF 50 V ±5% 0402	Capacitors	Phycomp	2.23887E+11
15	2	R16, R36	910 Ω 63 mW ±1% 0402	Resistors	Vishay	CRCW0402910RFKED
16	2	D13, D4	AlGaInP 0603	Red LEDs	OSRAM	LS L29K-G1 J2-1
17	3	J6, J7, J8	6 ways, 2 rows connector SMD 2.54mm	Jumpers	Harwin	M20-8760342
18	7	R1, R2, R3, R4 R5, R6, R7	100 Ω 0.1 W ±0.5% 0603	Resistors	Panasonic	ERJ3BD1000V
19	0	R101, R102, R103, R104, R105, R106, R107, R108, R109, R110, R111, R112, R113, R114, R115, R116	DNM 0603	Resistors (not mounted)	Any	
20	1	CN5	10 ways, 1 row TH 2.54 mm	Capacitor	SAMTEC	SSQ-110-04-F-S
21	2	CN6, CN9	8 ways, 1row TH 2.54 mm	Capacitors	SAMTEC	SSQ-108-04-F-S
22	0	CN7, CN10	TH 2.54 mm	Capacitors (not mounted)	SAMTEC	SSQ-119-04-L-D

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
23	1	CN8	6 ways, 1 row TH 2.54 mm	Capacitor	SAMTEC	SSQ-106-04-F-S
24	1	J1	2 ways, 1 row (ISO8200AQ HV supply) TH 3.5 mm	Jumper	RS	790-1149
25	1	J2	3 ways, 1 row (STM32, ISO8200AQ LV supply) TH 3.5 mm	Jumper	RS	790-1143
26	0	C1, C3	4.7 nF 3.15 kV TH	Capacitors (not mounted)	Murata	DEBE33F472ZC3B
27	1	D1	SMC	3000 W TVS in SMC package	ST	<a href="#">SMC30J36A</a>
28	1	D2	1 A, 100 V SMA	Power Schottky rectifier	ST	<a href="#">STPS1H100A</a>
29	1	D3	0.35 A, 40 V SOD-323	Small signal Schottky diodes	ST	<a href="#">BAT48JFILM</a>
30	1	D14	700 W $V_{BR} = 6.8$ V; $V_{CL} = 10.2$ V 1610	High-power transient voltage suppressor (TVS)	ST	<a href="#">ESDA7P60-1U1M</a>
31	1	D15	1200 W $V_{BR} = 6.8$ V; $V_{CL} = 10.2$ V 1610	High-power transient voltage suppressor (TVS)	ST	<a href="#">ESDA15P60-1U1M</a>
32	1	D16	600 W $V_{BR} = 14.3$ V; $V_{CL} = 20.8$ V SMB	600 W TVS in SMB	ST	<a href="#">SMBJ5.0A-TR</a>







## A References

Freely available on [www.st.com](http://www.st.com):

- [ISO8200AQ](#) datasheet
- [X-CUBE-OUT02A1](#) user manual
- [X-NUCLEO-PLC01A1](#) user manual
- [ST-PLC](#) data brief

## Revision history

**Table 2. Document revision history**

Date	Revision	Changes
08-Nov-2018	1	Initial release.

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