

## 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.

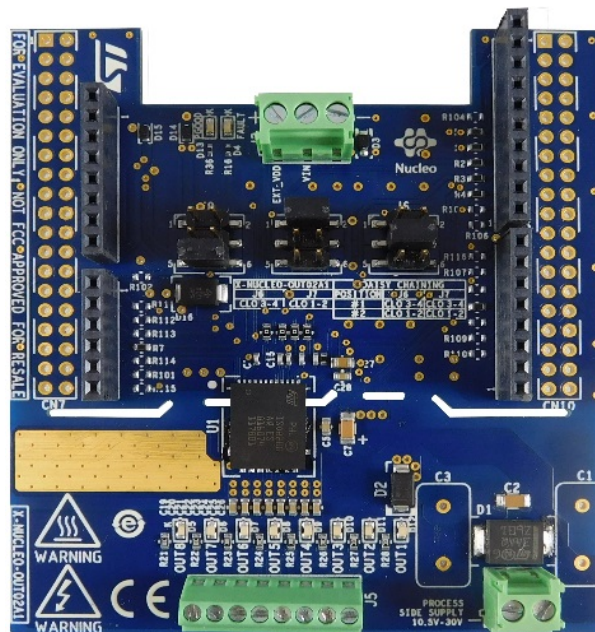
The X-NUCLEO-OUT02A1 can be connected to a NUCLEO-F401RE, NUCLEO-F103RB or NUCLEO-F302R8 development board via Arduino™ UNO R3 connectors.

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

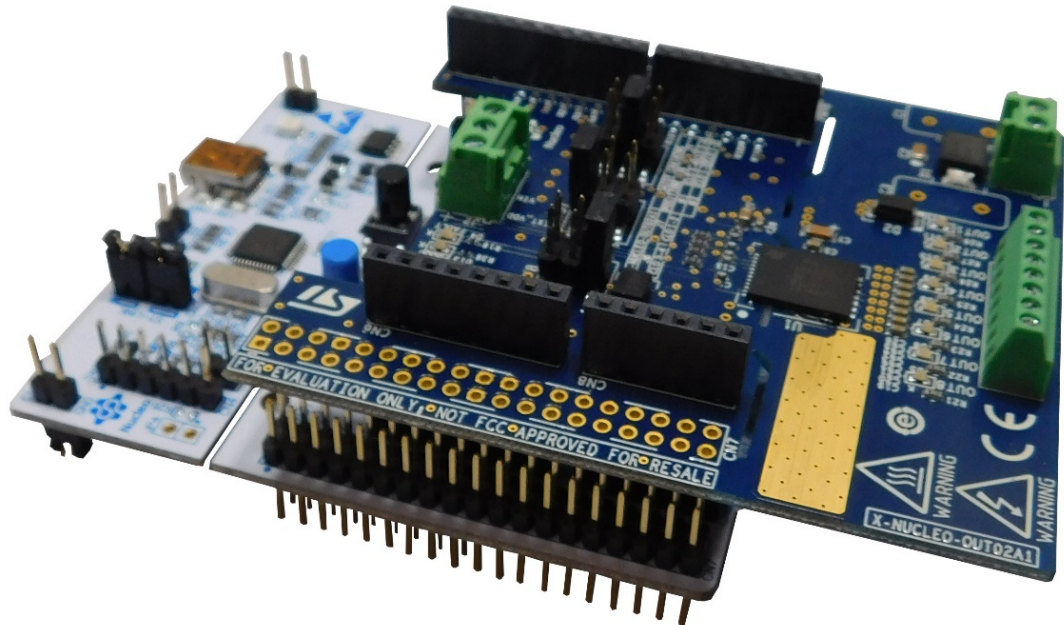
The SPI interface and the embedded power good detection allow a deeper diagnostics, daisy chaining and less MCU GPIO resources on the PLC logic stage.

*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.

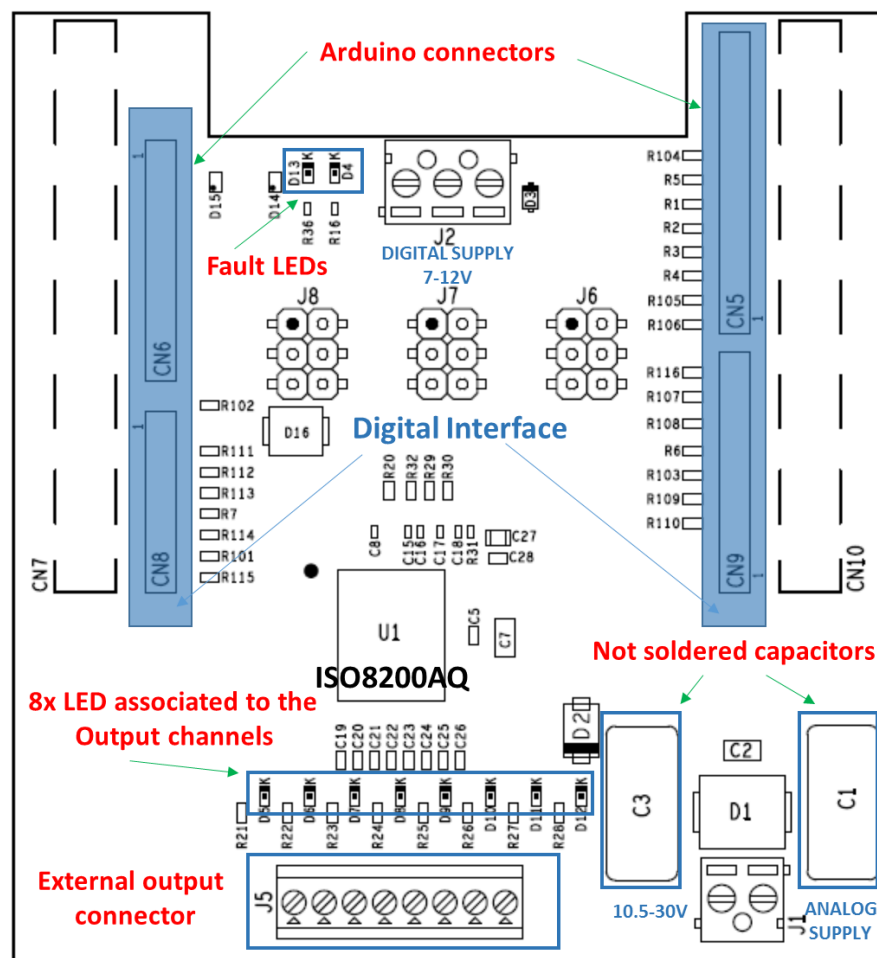
**Step 7.** Run the STM32 and push the blue button on the STM32 Nucleo board to select the example provided in the firmware package.

## 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.

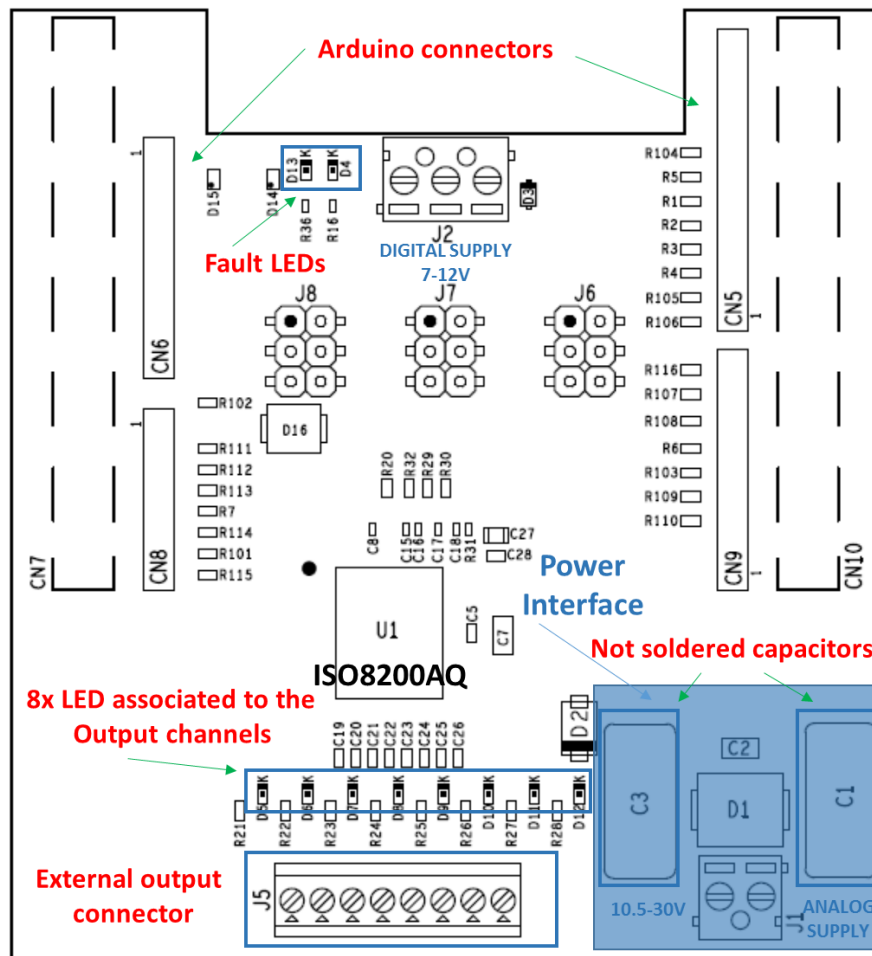
To provide an external digital supply:

- 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>

# 4 Schematic diagrams

Figure 5. X-NUCLEO-OUT02A1 circuit schematic (1 of 2)

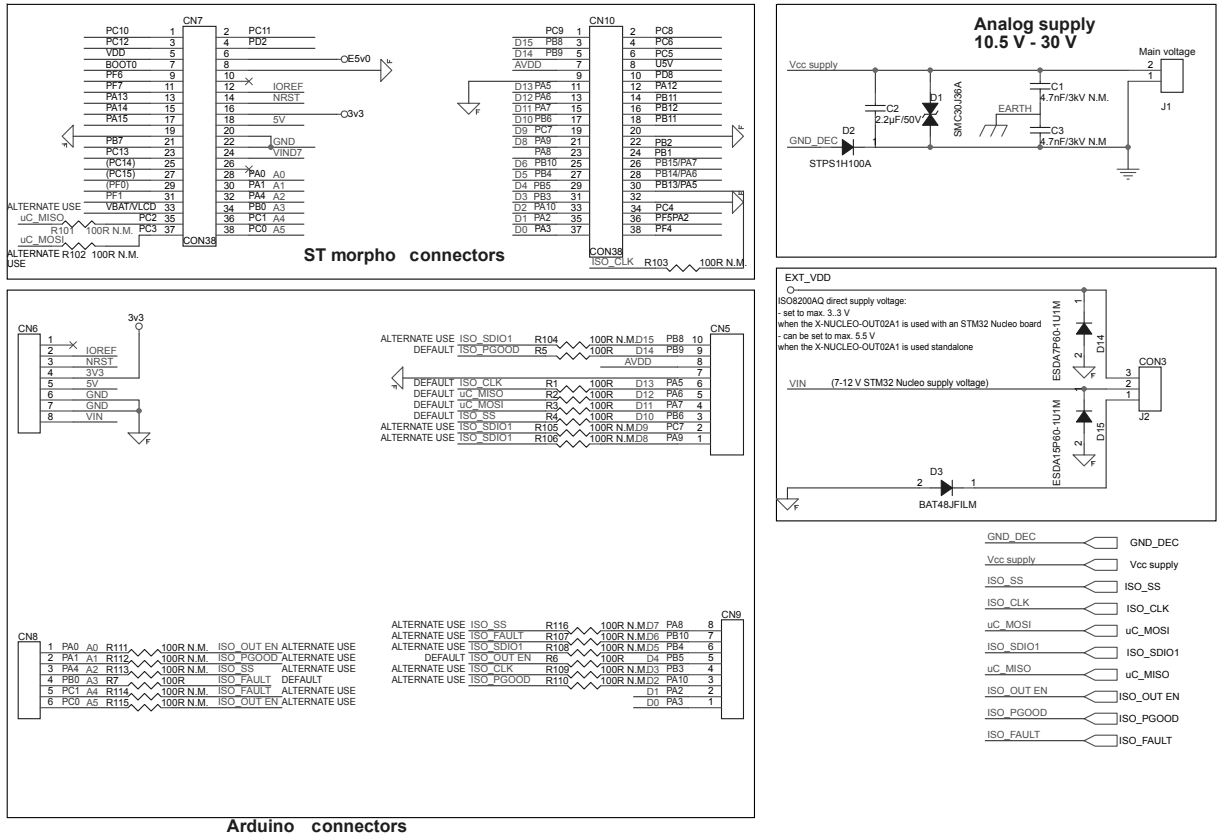
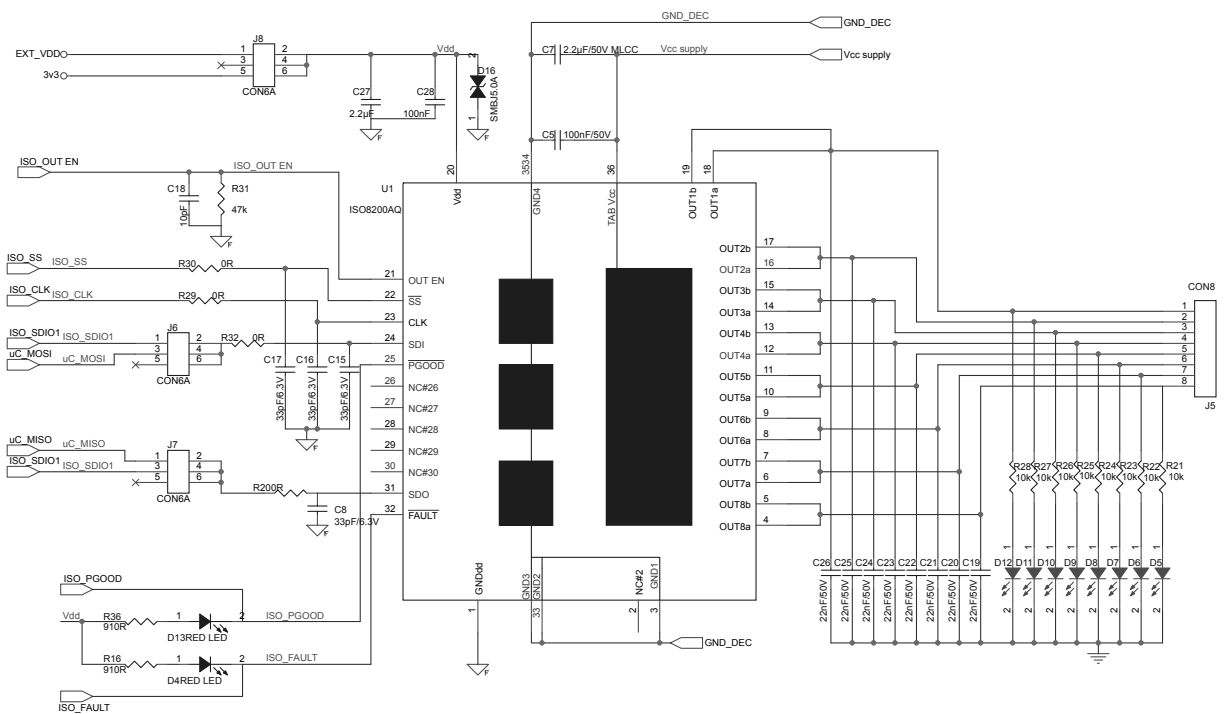


Figure 6. X-NUCLEO-OUT02A1 circuit schematic (2 of 2)





## 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.

## Contents

<b>1</b>	<b>Getting started</b>	<b>2</b>
1.1	Overview	2
1.2	Hardware requirements	2
1.3	System requirements	3
1.4	Board setup	3
<b>2</b>	<b>Hardware description and configuration</b>	<b>4</b>
2.1	Digital section	4
2.2	Power section	4
<b>3</b>	<b>Bill of materials</b>	<b>6</b>
<b>4</b>	<b>Schematic diagrams</b>	<b>8</b>
<b>A</b>	<b>References</b>	<b>9</b>
	<b>Revision history</b>	<b>10</b>

## List of tables

<b>Table 1.</b>	X-NUCLEO-OUT02A1 bill of materials .....	6
<b>Table 2.</b>	Document revision history .....	10

## List of figures

<b>Figure 1.</b>	X-NUCLEO-OUT02A1 expansion board. . . . .	1
<b>Figure 2.</b>	X-NUCLEO-OUT02A1 expansion board connected to an STM32 Nucleo development board . . . . .	3
<b>Figure 3.</b>	X-NUCLEO-OUT02A1 expansion board: digital interface components . . . . .	4
<b>Figure 4.</b>	X-NUCLEO-OUT02A1 expansion board: power section components . . . . .	5
<b>Figure 5.</b>	X-NUCLEO-OUT02A1 circuit schematic (1 of 2) . . . . .	8
<b>Figure 6.</b>	X-NUCLEO-OUT02A1 circuit schematic (2 of 2) . . . . .	8

**IMPORTANT NOTICE – PLEASE READ CAREFULLY**

STMicroelectronics NV and its subsidiaries (“ST”) reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST’s terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers’ products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2018 STMicroelectronics – All rights reserved