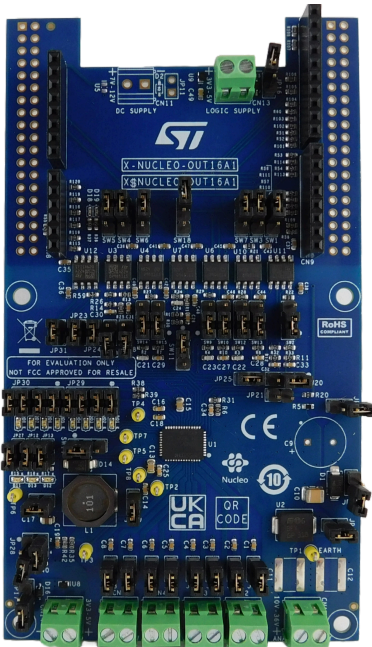


Industrial digital output expansion board based on IPS8200HQ for STM32 Nucleo



Features

- Based on the [IPS8200HQ](#) octal high-side switch, which features:
 - Operating range 10.5 to 36 V
 - Operating output current $\leq 0.7A$
 - Low power dissipation ($R_{ON(MAX)} = 200\text{ m}\Omega$)
 - Undervoltage lock-out
 - Selectable driving modes parallel or 5 MHz SPI (8 or 16 bits)
 - Embedded step-down converter
 - 4x2 LED matrix for efficient status indication
 - MCU freeze detection
 - Fast decay for inductive loads
 - Overload and overtemperature protections
 - Loss of ground protection
 - Junction Overtemperature and parity check diagnostic pin (FAULT)
 - Case overtemperature diagnostic pin (TWARN)
 - Supply voltage Level diagnostic pin (PGOOD)
 - QFN48L 8x6 mm package
- Application board voltage operating range: 12 to 33 V
- Extended voltage operating range (J9 open) up to 36 V
- Operating current: up to 0.7 A per channel
- Blue LED showing SPI mode selection
- Yellow LED showing SPI mode 16-bits selection
- Red LED for FAULT diagnostic pin (JP12 closed)
- Red LED for PGOOD diagnostic pin (JP13 closed)
- Red LED for TWARN diagnostic pin (JP27 closed)
- 4 kV_{PK} galvanic isolation guaranteed by [STISO620](#) and [STISO621](#)
- Supply rail reverse polarity protection
- Compatible with [STM32 Nucleo](#) development boards
- Equipped with Arduino® UNO R3 connectors
- RoHS and China RoHS compliant
- CE certified

Product summary	
Industrial digital output expansion board based on IPS8200HQ for STM32 Nucleo	X-NUCLEO-OUT16A1
Software expansion for STM32Cube driving industrial digital output based on intelligent power switch (IPS)	X-CUBE-IPS
Octal high-side smart power solid-state relay	IPS8200HQ
Applications	Programmable Logic Controllers

Description

The [X-NUCLEO-OUT16A1](#) industrial digital output expansion board, for [STM32Nucleo](#), provides a powerful and flexible environment for the evaluation of the driving and diagnostic capabilities of the [IPS8200HQ](#) octal high-side smart power solid state relay, in a digital output module connected to 0.7 A industrial loads.

The [X-NUCLEO-OUT16A1](#) interfaces with the microcontroller on the STM32 Nucleo via [STISO620](#) and [STISO621](#) and Arduino® R3 connectors. The user can select which driving mode controls the [IPS8200HQ](#): Parallel (SEL2 = L by JP21 = open) or SPI (SEL2 = H by JP21 = closed). In the case of SPI selection, the user can select the communication protocol between 8 bits (SEL1 = L by JP22 = open) or 16 bits (SEL1 = H by JP22 = closed).

The V_{CC} supply pin of the **IPS8200HQ** is provided by the connector CN1, while the loads (driven by the eight output channels of the **IPS8200HQ**) can be connected between the connectors CN2, CN3, CN4, CN12, and the pin 2 of the connector CN1.

The on-board digital isolators (**STISO620** and **STISO621**) feature the $2.8k V_{RMS}$ ($4k V_{PK}$) galvanic isolation between the two application sides: Logic and process sides.

Logic side is the application side of the MCU and it is supplied by the $VISO_L$ rail (3.3 V or 5.0 V). $VISO_L$ can be supplied by an external power supply connected to CN13 or, alternatively by the pin 4 (SW1 = close 1-2) or pin 5 (SW1 = close 2-3) of CN6.

The process side is the application side of the industrial loads and it is supplied by the VCC and $VISO_P$ rails. The $VISO_P$ (3.3 or 5.0 V) is usually supplied by the $VREG$ rail (JP31 = closed) that can be generated by the step-down embedded in the **IPS8200HQ** (SW17 = close 1-2, JP20 = closed, JP15 = closed and JP28 = close 2-4 ($VREG = 3.3 V$) or JP28 = 1-3 ($VREG = 5.0 V$)). Alternatively, $VREG$ can be provided by an external power supply connected to CN14 (SW17 = close 2-3, JP20 = open, JP15 = open).

In parallel driving mode (active with the default jumper and switch settings) the application board can work even without any Nucleo board: in this case, the user must provide the process side voltage (usually 24 V) by the CN1 and the $VISO_L$ (usually 3.3 V) by the CN13. The IN_x signals, available on CN5[1, 2, 3], CN8[4] and CN9[3, 5, 7, 8], drives on/off the correspondent OUT_x connected to the loads on the process side. The IN_x pins can be driven low/high swinging between 0V and $VISO_L$. The activation of each OUT_x ($OUT1... OUT8$) can be monitored by the green LEDs DO_x ($DO1... DO8$).

The activation of the three diagnostic pins (TWARN, PGOOD, FAULT) can be visualized on the correspondent red LEDs (D11, D12, D13, respectively) or monitored by an oscilloscope on CN8[5], CN5[9], CN5[10].

The SPI driving mode can be set by changing the default configuration (JP21 = close; SW4, SW5, SW6, SW7, SW9, SW10, SW11, SW12, SW13, SW14, SW15, SW20 = Close 2-3, SW18 = close 1-2). The SPI-8bits is the default mode (JP22 = open), while the SPI-16bits mode can be activated by JP22 = close.

In SPI driving mode it is also possible to activate the MCU freeze detection feature by setting SW3 = close 2-3.

The expansion board can be connected to either a **NUCLEO-F401RE** or a **NUCLEO-G431RB** development board. In this case the companion firmware **X-CUBE-IPS** detects the selected configuration (GPIO, SPI-8bits, SPI-16bits) by reading the signals $SEL2_L$ and $SEL1$ from CN8[1] and CN8[6]. The activation of the MCU freeze feature is detected by $WDEN(in)$ on CN9[4].

It is also possible to evaluate a system composed of a **X-NUCLEO-OUT16A1** stacked on other expansion boards. In fact, SPI driving mode allows the daisy-chaining communication with another **X-NUCLEO-OUT16A1** stacked through the Arduino connectors: the two stacked boards must be configured with SW6, SW18 = close 2-3 on one board, and SW6, SW18 = close 1-2 on the other board.

1 Schematic diagrams

Figure 1. X-NUCLEO-OUT16A1 circuit schematic (1 of 3)

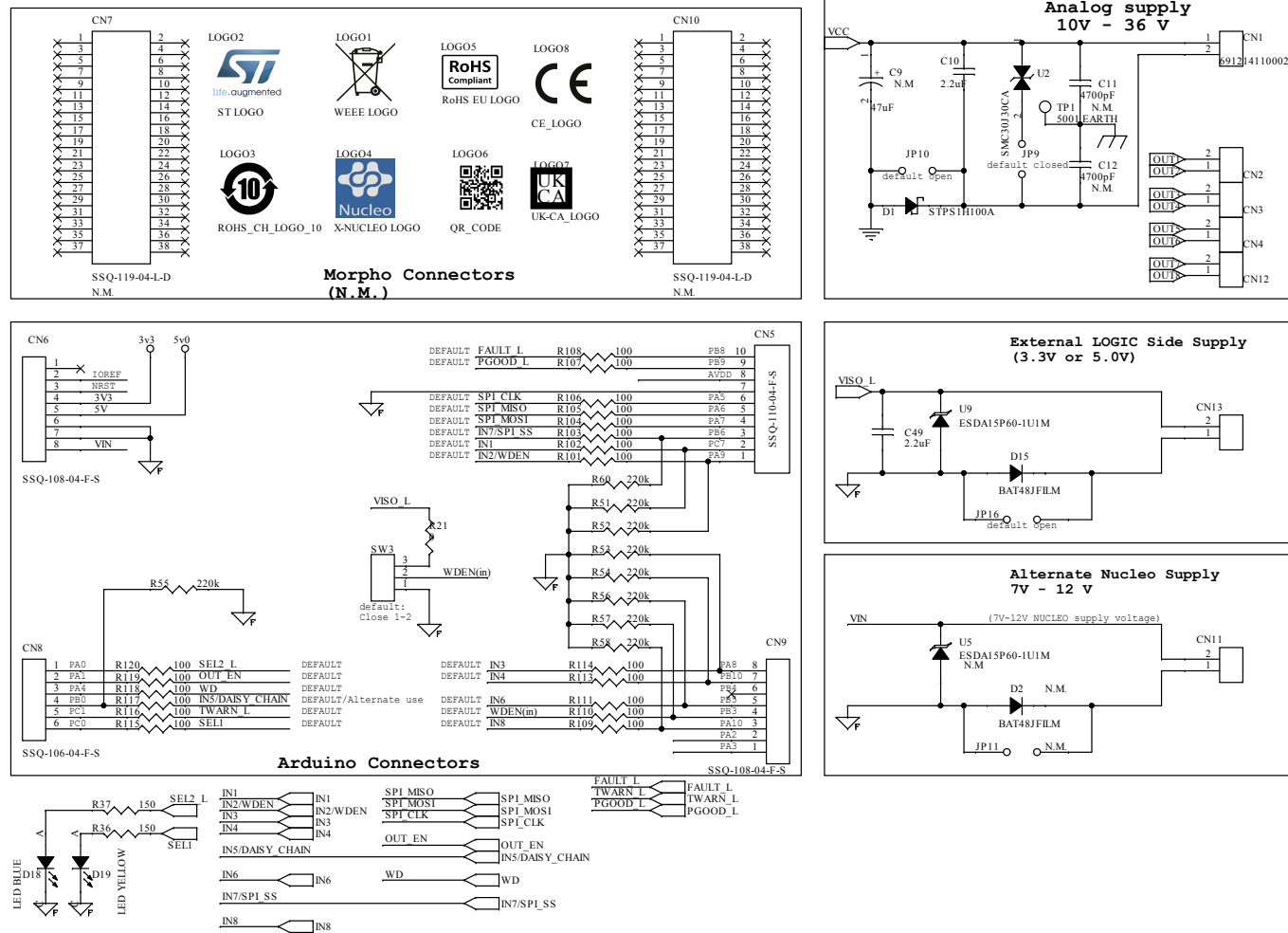


Figure 2. X-NUCLEO-OUT16A1 circuit schematic (2 of 3)

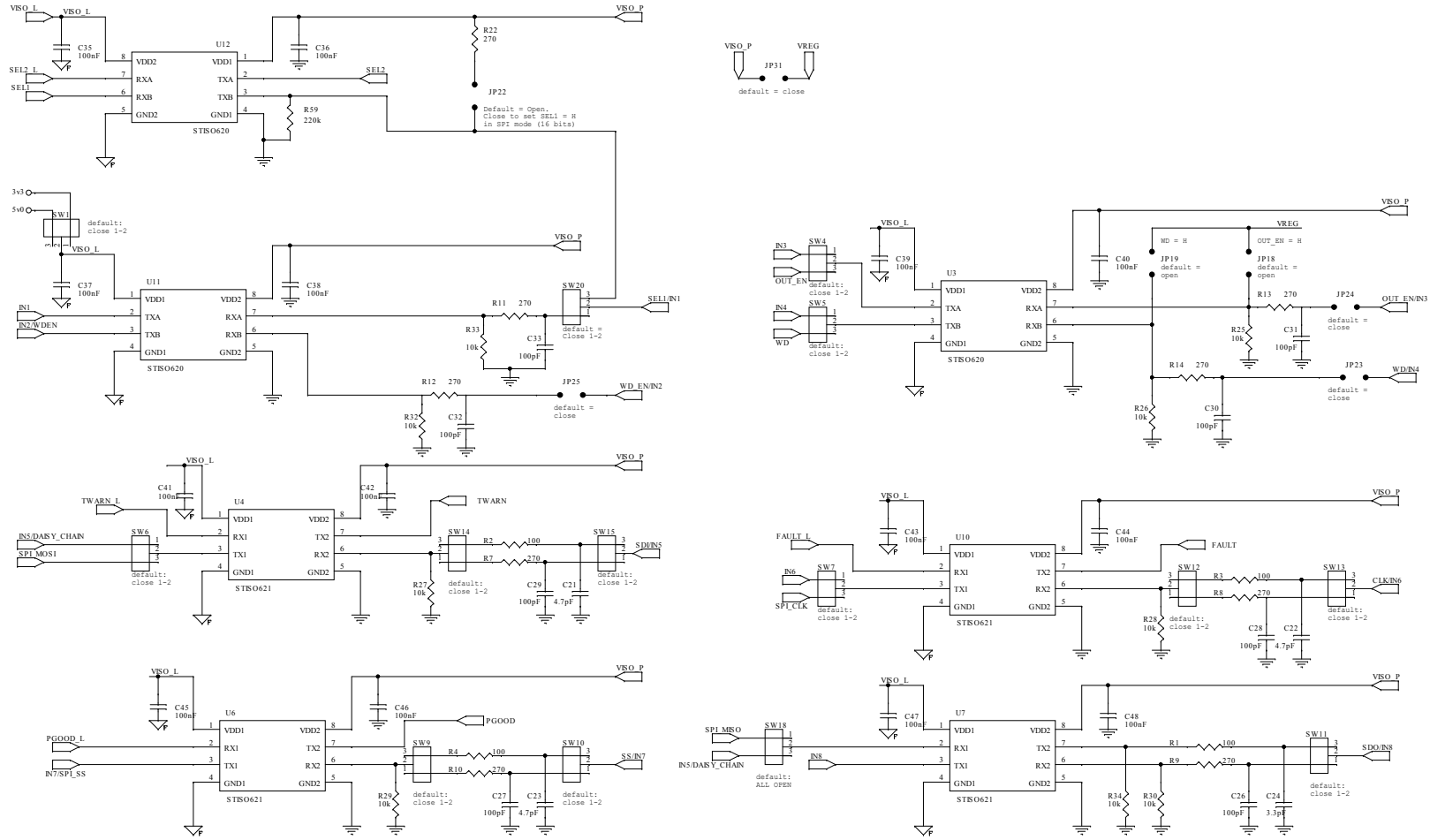
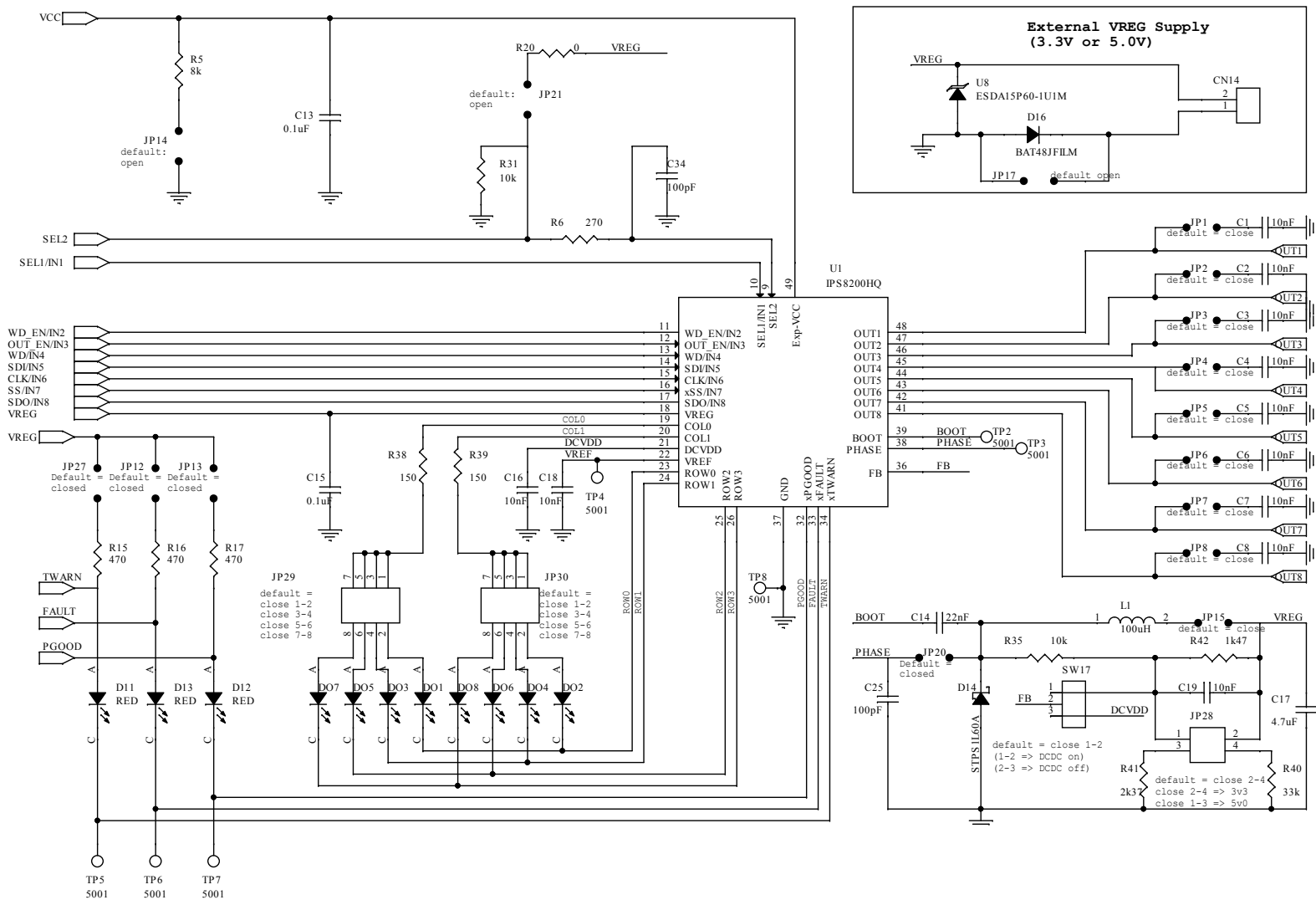


Figure 3. X-NUCLEO-OUT16A1 circuit schematic (3 of 3)



2 Board versions

Table 1. X-NUCLEO-OUT16A1 versions

Finished good	Schematic diagrams	Bill of materials
X\$NUCLEO-OUT16A1 ⁽¹⁾	X\$NUCLEO-OUT16A1 schematic diagrams	X\$NUCLEO-OUT16A1 bill of materials

1. This code identifies the X-NUCLEO-OUT16A1 evaluation board first version.

Revision history

Table 2. Document revision history

Date	Revision	Changes
13-Oct-2023	1	Initial release.

IMPORTANT NOTICE – 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 acknowledgment.

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. For additional information about ST trademarks, refer to www.st.com/trademarks. 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.

© 2023 STMicroelectronics – All rights reserved