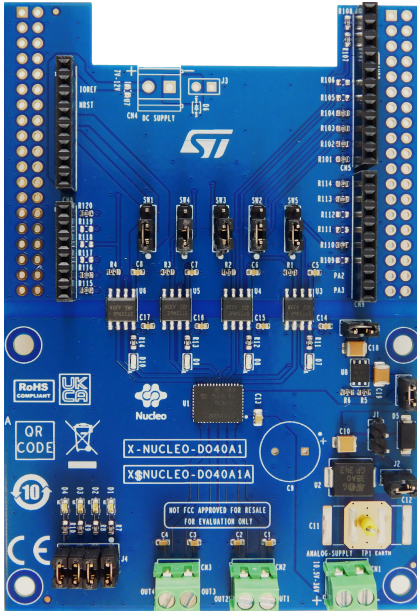


Industrial digital output expansion board based on IPS4140HQ for STM32 Nucleo



Features

- Based on the [IPS4140HQ](#) quad high-side switch, which features:
 - Operating voltage range 10.5 to 36 V
 - Operating current range ≤ 0.6 A per channel
 - 3.3 V and 5 V compatible I/O
 - Low-power dissipation (Standby current $=250 \mu\text{A}$, $R_{\text{ON(TYP)}} = 80 \text{ m}\Omega$)
 - Can drive resistive, capacitive and inductive loads (with fast demagnetization)
 - Undervoltage shutdown with hysteresis
 - Per-channel open-drain thermal fault diagnostic pins
 - Per-channel overload, short circuit, and thermal junction protections
 - Thermal case protection
 - Not simultaneous channel reactivation at thermal case reset
 - Loss of GND protection
 - Designed to meet IEC61131-2, IEC 61000-4-2 (up to $\pm 25 \text{ kV}$), IEC61000-4-4, and IEC61000-4-5
 - QFN48L 8x6 mm package
- Process side operating range: 11 V or 36 V
- Process side reverse polarity protection (J1 open) by [STPS1H100A](#)
- Supply rail surge pulse protection (J2 closed) by [SMC30J30CA](#)
- On board high efficiency 24 V to 3.3 V LDO ([LDO40LPU33](#))
- Green LEDs for outputs on/off status (J4 close 1-2, 3-4, 5-6, 7-8)
- Red LEDs for thermal faults (D7, D8, D9, D10) visualization
- Galvanic isolation between logic and process sides by [STISO621](#) digital isolators
- Logic side operating voltage 3.3 V (SW1 close 1-2) or 5 V (SW1 close 2-3)
- Logic side equipped with Arduino® UNO R3 connectors
- Digital signals driving output channels (default = CN5[1,2], CN9[7,8])
- Digital signals for thermal diagnostic (default = CN5[9,10] and CN8[5, 6])
- Easy digital signals reconfigurability by SW2, SW3, SW4, SW5
- Compatible with STM32 Nucleo development boards
- RoHS and China RoHS compliant
- CE certified

Product summary	
Industrial digital output expansion board based on IPS4140HQ for STM32 Nucleo	X-NUCLEO-DO40A1
Quad high-side intelligent power switch	IPS4140HQ
STM32 Nucleo-64 development board with STM32F401RE MCU, supports Arduino and ST morpho connectivity	NUCLEO-F401RE
STM32 Nucleo-64 development board with STM32G431RB MCU, supports Arduino and ST morpho connectivity	NUCLEO-G431RB
Applications	Programmable Logic Controllers

Description

The [X-NUCLEO-DO40A1](#) industrial digital output expansion board for STM32 Nucleo provides a powerful and flexible environment for the evaluation of the driving and diagnostic capabilities of the [IPS4140HQ](#) quad high-side smart power solid state relay, in a digital output module connected to ≤ 0.6 A industrial loads.

The [X-NUCLEO-DO40A1](#) expansion board offers two different application sides (logic side and process side) electrically separated by the $2.8 \text{ kV}_{\text{RMS}}$ galvanic isolation featured by the digital isolators [STISO621](#).

The logic side is the application side where the MCU operates and it is supplied by the VISO_L rail (3.3 V or 5.0 V, according to setting of SW1). The on-board Arduino® UNO R3 connectors enable the connection to either a [NUCLEO-F401RE](#) or a [NUCLEO-G431RB](#) development board.

When the [X-NUCLEO-DO40A1](#) is stacked on a [NUCLEO-F401RE](#), or on a [NUCLEO-G431RB](#), the VISO_L is supplied by the Nucleo board if connected to a PC/Laptop by USB cable. If the [X-NUCLEO-DO40A1](#) is used standalone, then VISO_L can be supplied by the CN6[4] (SW1 = close 1-2) or CN6[5] (SW1 = close 2-3). By default, the signals on CN5[1, 2] and CN9[7, 8] can be driven high/low to activate/inactivate the loads on the process side connected to CN2[1, 2] and CN3[1, 2]. The thermal diagnostic signals of the four output switches embedded in the [IPS4140HQ](#) are reported on CN5[9, 10] and CN8[5, 6]. The switches SW2, SW3, SW4, SW5 offer to the user some flexibility for the remapping of the driving signals IN1, IN2, IN3 and STATUS1 on CN5, CN8 and CN9 (see the schematic for further details).

The process side is the application side on the industrial field (24 V operating rail). On the process side there are two supply rails: the VCC rail (typically connected to the 24 V rail) and the VISO_P (3.3 V) generated by the on board [LDO40LPU33](#) (U8).

The VCC rail is protected both from reverse polarity on CN1 (by the [STPS1H100A](#), provided that J1 remains open) and against surge pulse (by [SMC30J30CA](#) (U2), provided that J2 is set closed). The VCC rail supply both the [IPS4140HQ](#) and the [LDO40LPU33](#).

The VISO_P rail supplies both the digital isolators and the red diagnostic LEDs D7, D8, D9, D10 reporting the per-over-temperature fault of output channels OUT1, OUT2, OUT3, OUT4, respectively.

Up to four industrial loads can be connected between the CN2[1, 2] and CN3[1, 2] connectors and the process side ground (CN1[2]). The four green LEDs D1, D2, D3, D4 can be used to monitor the status on/off of the respective output switches OUT1, OUT2, OUT3, OUT4. The above four green LEDs can be disabled by opening the J4 positions 1-2, 3-4, 5-6, 7-8.

It is also possible to evaluate a system composed of a [X-NUCLEO-DO40A1](#) stacked on other expansion boards.

1 Schematic diagrams

Figure 1. X-NUCLEO-DO40A1 circuit schematic (1 of 2)

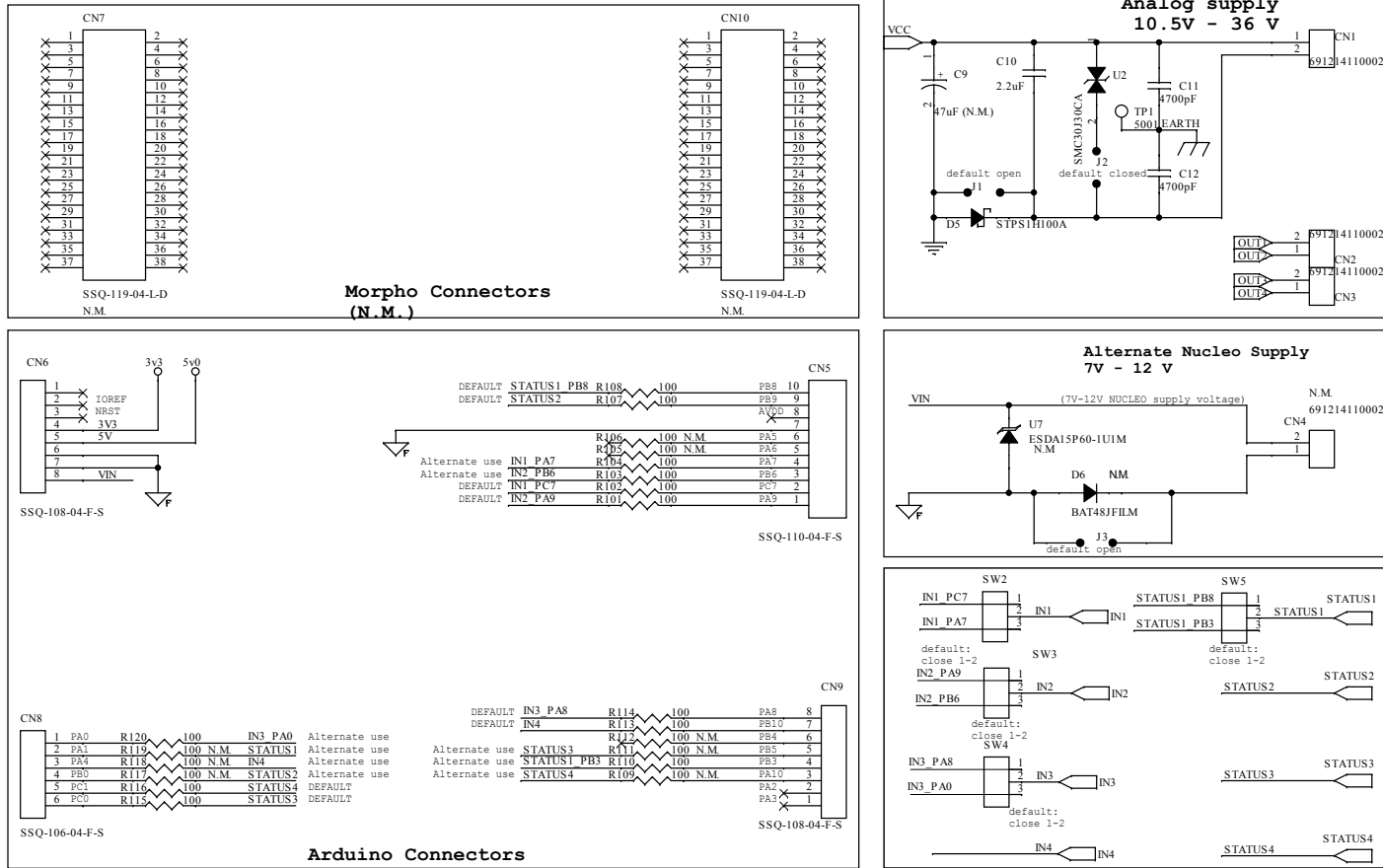
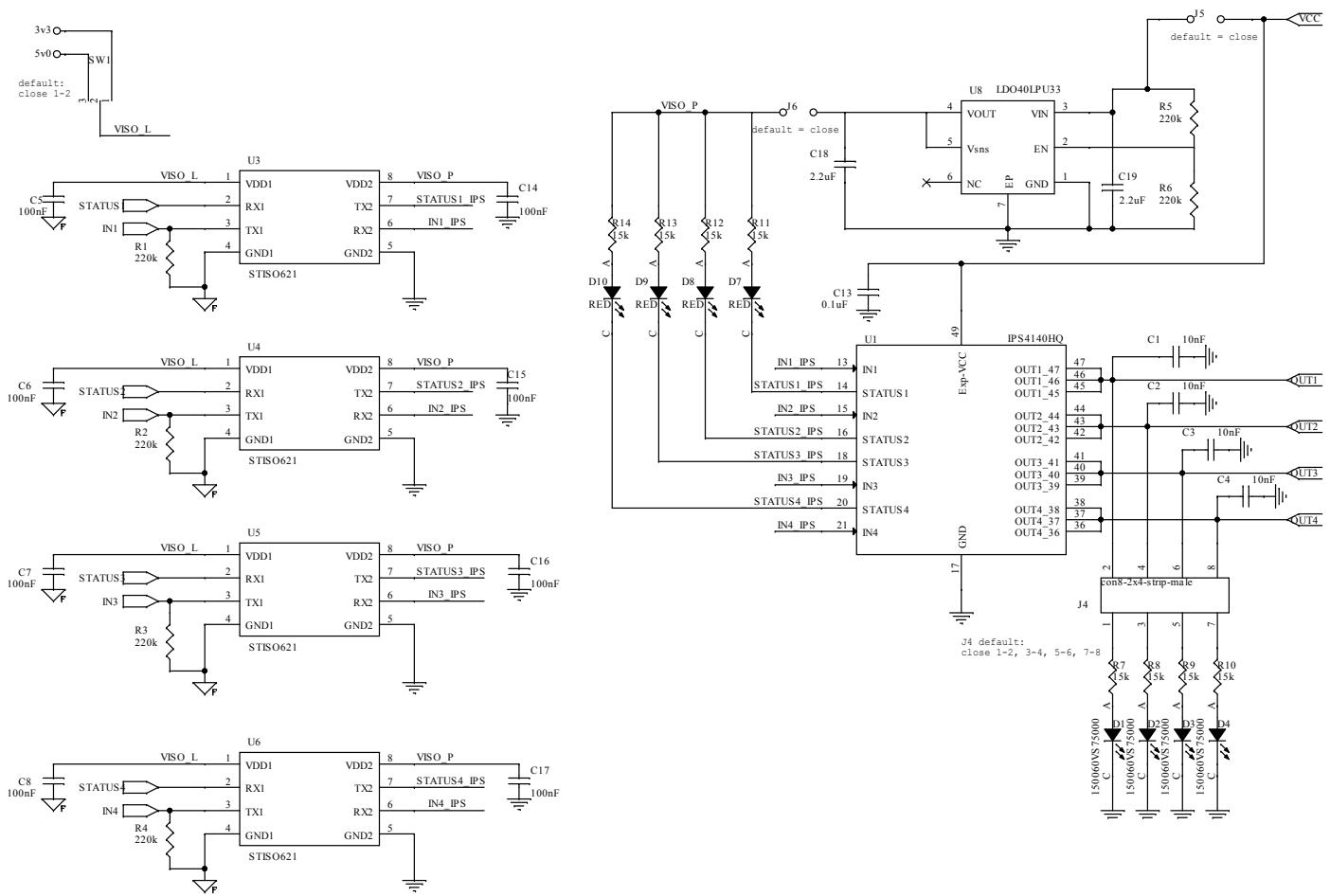


Figure 2. X-NUCLEO-DO40A1 circuit schematic (2 of 2)



2 Board versions

Table 1. X-NUCLEO-DO40A1 versions

PCB version	Schematic diagrams	Bill of materials
X\$NUCLEO-DO40A1A ⁽¹⁾	X\$NUCLEO-DO40A1A schematic diagrams	X\$NUCLEO-DO40A1A bill of materials

1. This code identifies the X-NUCLEO-DO40A1 evaluation board first version. It is printed on the board PCB.

Revision history

Table 2. Document revision history

Date	Revision	Changes
23-Sep-2024	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.

© 2024 STMicroelectronics – All rights reserved