Getting started with the X-NUCLEO-ISO1A1 industrial input/output expansion board for STM32 Nucleo

Introduction

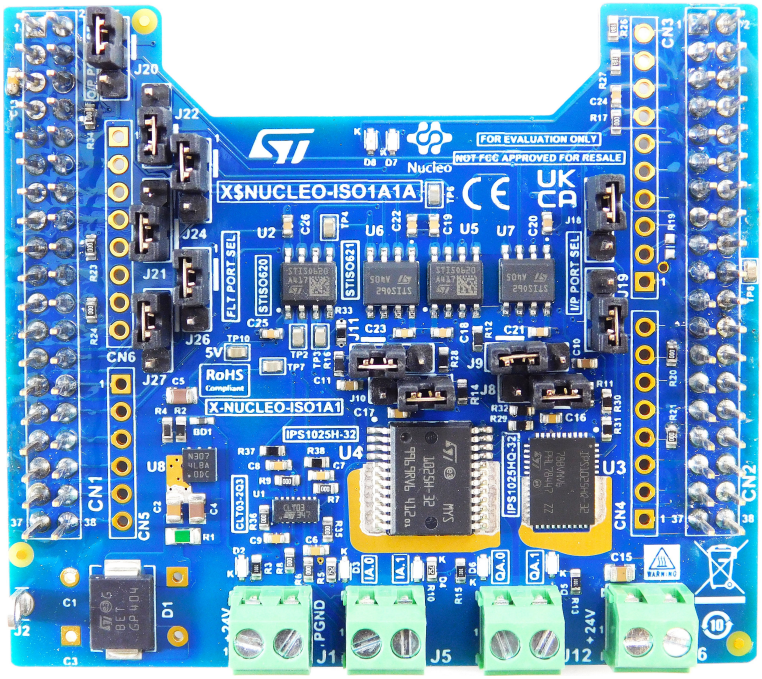
The X-NUCLEO-ISO1A1 evaluation board is designed to expand the STM32 Nucleo board and provide micro-PLC functionality with isolated industrial input and output. Isolation between logic and process side components is provided by the UL1577 certified digital isolators STISO620 and STISO621.

Two current-limited high-side inputs from the process side are realized through the CLT03-2Q3. Protected outputs with diagnostics and smart driving features are provided by one each of the high-side switches IPS1025H/HQ and IPS1025H-32/HQ-32 which can drive capacitive, resistive, or inductive loads up to 5.6 A.

Two X-NUCLEO-ISO1A1 boards can be stacked together on top of an STM32 Nucleo board via ST morpho connectors with the appropriate selection of jumpers on the expansion boards to avoid conflict in GPIO interfaces.

Rapid evaluation of the onboard ICs is facilitated by the X-NUCLEO-ISO1A1 using the X-CUBE-ISO1 software package. Provision for ARDUINO® connections is provided on the board.

Figure 1. X-NUCLEO-ISO1A1 expansion board



Notice: *For dedicated assistance, submit a request through our online support portal at **www.st.com/support**.*

1 Safety and compliance information

The side switches IPS1025HQs may get heated with high load current. Care must be taken while touching the IC or adjoining areas on the boards. particularly with higher loads.

1.1 Compliance information (Reference)

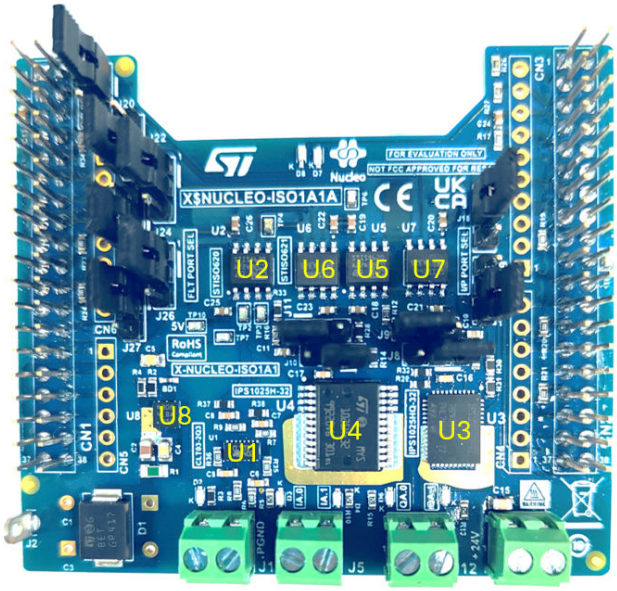
Both CLT03-2Q3 and IPS1025H are designed to meet common industrial requirements, including IEC61000-4-2, IEC61000-4-4, and IEC61000-4-5 standards. For a more detailed evaluation of these components, refer to the single-product evaluation boards available at www.st.com. The X-NUCLEO-ISO1A1 serves as an excellent tool for initial assessments and rapid prototyping, providing a robust platform for developing industrial applications with STM32 Nucleo boards. Additionally, the board is RoHS compliant and comes with a free comprehensive development firmware library and examples compatible with STM32Cube firmware.

2 Component diagram

The different components on the board are shown here, with description.

- *U1 - CLT03-2Q3: Input current limiter*
- *U2, U5 - STISO620: ST digital isolator unidirectional*
- *U6, U7 - STISO621: ST digital isolator bidirectional.*
- *U3 - IPS1025HQ-32: high-side switch (package: 48-VFQFN Exposed Pad)*
- *U4 - IPS1025H-32: high-side switch (package: PowerSSO-24).*
- *U8 - LDO40LPURY: Voltage regulator*

Figure 2. Different ST ICs and their position



3 Overview

The X-NUCLEO-ISO1A1 is an industrial I/O evaluation board with two inputs and outputs. It is designed to be operated with an STM32 Nucleo board such as NUCLEO-G071RB. Compatible with the ARDUINO® UNO R3 layout, it features the STISO620 dual-channel digital isolator and IPS1025H-32 and IPS1025HQ-32 high-side switches. The IPS1025H-32 and IPS1025HQ-32 are single high-side switch ICs capable of driving capacitive, resistive, or inductive loads. The CLT03-2Q3 provides protection and isolation in industrial operating conditions and offers an 'energy-less' status indication for each of the two input channels, featuring minimal power consumption. It is designed for situations that require compliance with IEC61000-4-2 standards. The STM32 MCU on board the controls and monitors all the devices via GPIOs. Each input and output have an LED indication. In addition, there are two programmable LEDs for customizable indications. The X-NUCLEO-ISO1A1 enables rapid evaluation of the onboard ICs by performing a basic set of operations in conjunction with the X-CUBE-ISO1 software package. The key features of the constituent components are given below.

3.1 Dual-channel digital isolator

The STISO620 and STISO621 are dual-channel digital isolators based on the ST thick oxide galvanic isolation technology.

The devices provide two independent channels in the opposite direction (STISO621) and in the same direction (STISO620) with Schmitt trigger input as shown in Figure 3, providing robustness to noise and high-speed input/output switching time.

It is designed to operate within a wide ambient temperature range from -40 ºC to 125 ºC, making it suitable for various environmental conditions. The device boasts a high common-mode transient immunity exceeding 50 kV/µs, ensuring robust performance in electrically noisy environments. It supports supply levels ranging from 3 V to 5.5 V and provides level translation between 3.3 V and 5 V. The isolator is engineered for low-power consumption and features pulse width distortions of less than 3 ns. It offers 6 kV (STISO621) and 4 kV (STISO620) galvanic isolation, enhancing safety and reliability in critical applications. The product is available in both SO-8 narrow and wide package options, providing flexibility in design. Additionally, it has received safety and regulatory approvals, including UL1577 certification.

Figure 3. ST digital isolators

3.2 High-side switches IPS1025H-32 and IPS1025HQ-32

The X-NUCLEO-ISO1A1 embeds the IPS1025H-32 and IPS1025HQ-32 intelligent power switch (IPS), featuring overcurrent and overtemperature protection for safe output load control.

The board is designed to meet application requirements in terms of galvanic isolation between user and power interfaces using ST's new technology STISO620 and STISO621 ICs. This requirement is satisfied by a dual-channel digital isolator based on the ST thick oxide galvanic isolation technology.

The system utilizes two STISO621 bidirectional isolators, labeled as U6 and U7, to facilitate the forward transmission of signals to the device, as well as to handle the FLT pins for feedback diagnostic signals. Each high-side switch generates two fault signals, necessitating the inclusion of an additional unidirectional isolator, designated as U5, which is digital isolator STISO620. This configuration ensures that all diagnostic feedback is accurately isolated and transmitted, maintaining the integrity and reliability of the system's fault detection and signaling mechanisms.

- The industrial outputs on the board are based on the IPS1025H-32 and IPS1025HQ-32 single high-side switch, which features:
  - Operating range up to 60 V
  - Low-power dissipation (R_{ON} = 12 mΩ)
  - Fast decay for inductive loads
  - Smart driving of capacitive loads
  - Undervoltage lockout
  - Overload and overtemperature protection
  - PowerSSO-24 and QFN48L 8x6x0.9mm package
- Application board operating range: 8 to 33 V/0 to 2.5 A
- Extended voltage operating range (J3 open) up to 60 V
- 5 kV galvanic isolation
- Supply rail reverse polarity protection
- EMC compliance with IEC61000-4-2, IEC61000-4-3, IEC61000-4-4, IEC61000-4-5, IEC61000-4-8
- Compatible with STM32 Nucleo development boards
- Equipped with Arduino® UNO R3 connectors
- CE certified:
  - EN 55032:2015 + A1:2020
  - EN 55035:2017 + A11:2020.

Green LED corresponding to each output indicates when a switch is ON. Also Red LEDs indicates overload and overheating diagnostics.

3.3 High-side current limiter CLT03-2Q3

The X-NUCLEO-ISO1A1 board has two input connectors for any industrial digital sensors, such as proximity, capacitive, optical, ultrasonic, and touch sensors. Two of the inputs are intended for isolated lines with opto-couplers on the outputs. Each input then feeds directly into one of the two independent channels in CLT03-2Q3 current limiters. The channels in the current limiter immediately limit the current as per the standard and proceed to filter and regulate the signals to deliver appropriate outputs for the isolated lines destined for the GPIO ports of a logic processor, such as a microcontroller in a programmable logic controller (PLC). The board also includes jumpers to enable test pulses through any of the channels to verify normal operation.

Isolator STISO620 (U2) is used for Galvanic isolation between process and login side.

Important features:

- The 2 isolated channel input current limiter can be configured for both high-side and low-side applications
- 60 V and reverse input plugin capable
- No power supply required
- Safety test pulse
- High EMI robustness thanks to integrated digital filter
- IEC61131-2 type 1 and type 3 compliant
- RoHS compliant

The input side of the CLT03-2Q3 current limiter is characterized by certain voltage and current ranges that delimit ON and OFF regions, as well as transition regions between these logical high and low states. The device enters Fault Mode when the input voltage exceeds 30 V.

Figure 4. Input characteristics of CLT03-2Q3

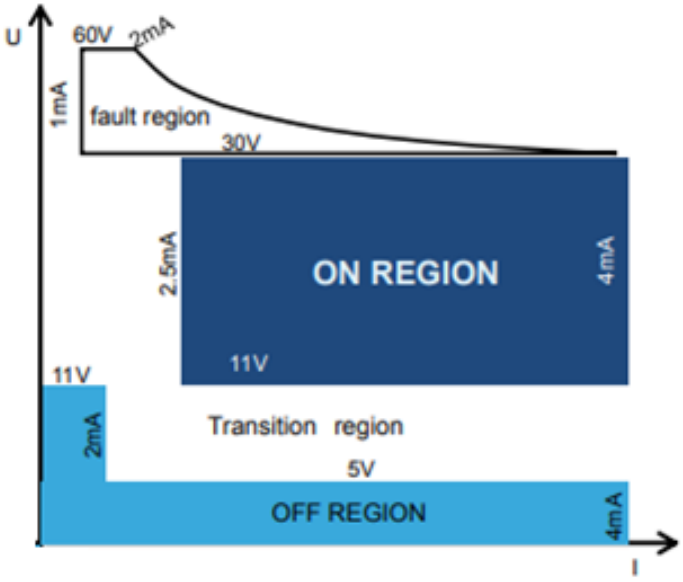
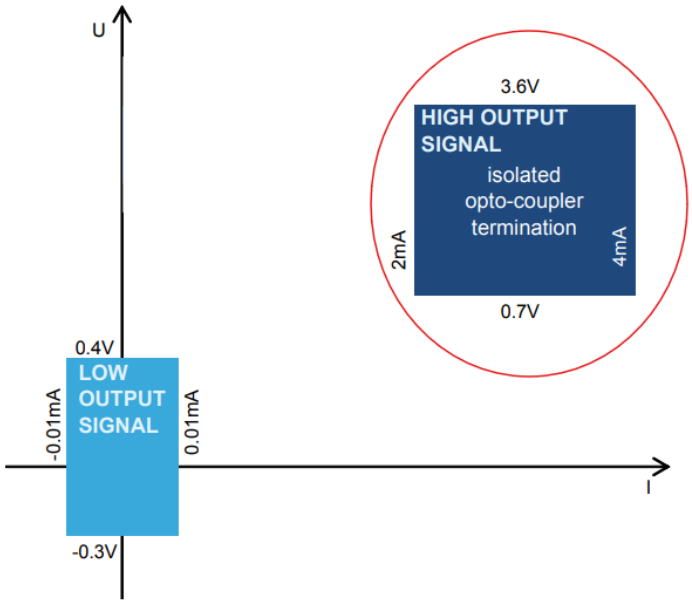


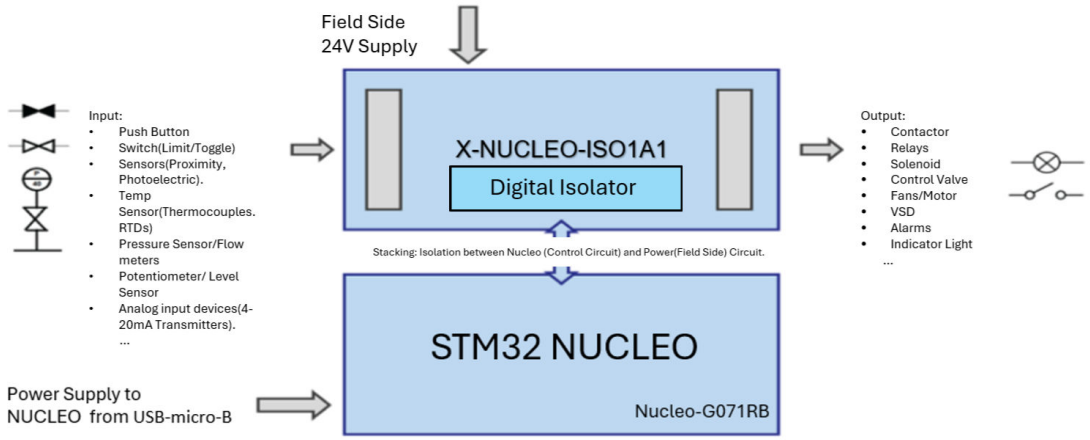
Figure 5. **Output operating region of CLT03-2Q3**



4 Functional blocks

The board is designed to operate with nominal 24V input which powers the process side circuitry. The logic component on the other side of isolators are powered by 5 V input to the X-NUCLEO board which is typically powered by a USB port of a PC.

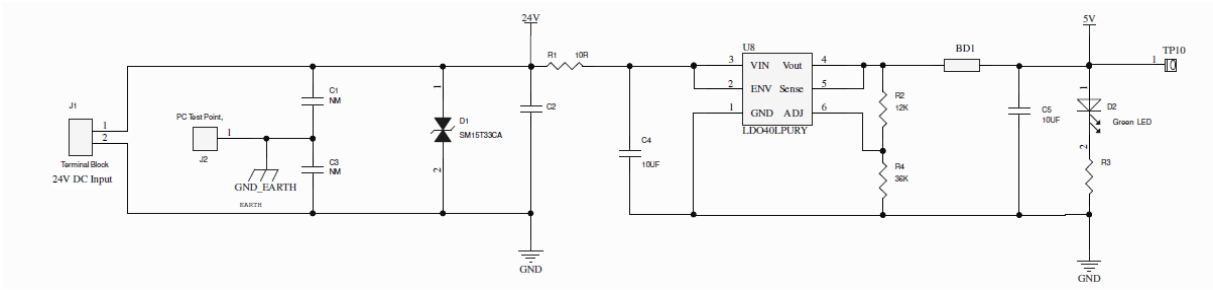
Figure 6. Block diagram



4.1 Process side 5 V supply

A 5V supply is derived from 24V input with low drop regulator LDO40L with built in protection functions. The voltage regulator has a self-overheating turn-off feature. The output voltage can be adjusted and kept just below the 5V utilising a retorsion network feeback from output. The LDO has DFN6 (Wettable flanks), which make this IC suitable for board size optimization.

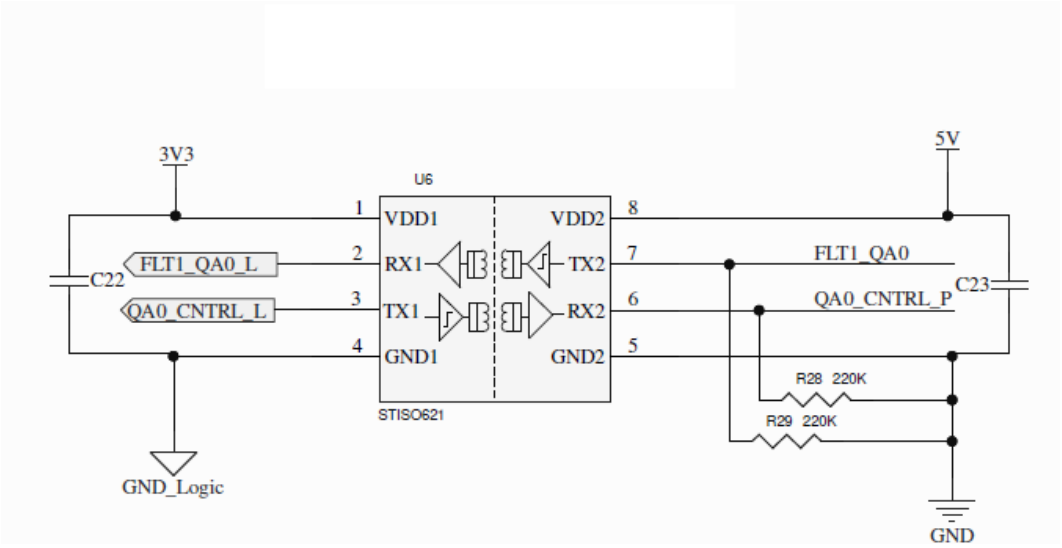
Figure 7. Process side 5 V supply



4.2 Isolator STISO621

The STISO621 digital isolator has 1-to-1 directionality, with 100MBPS data rate. It can withstand, 6KV galvanic isolation and high common-mode transient: >50 k V/µs.

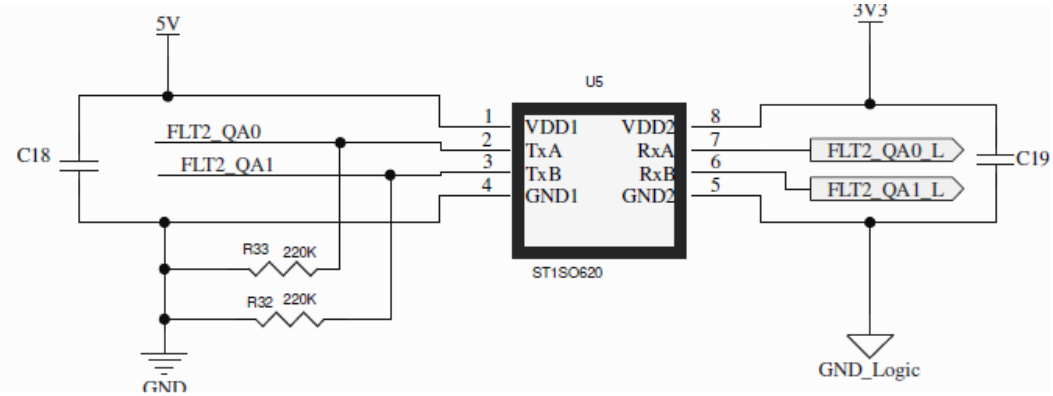
Figure 8. Isolator STISO621



4.3 Isolator STISO620

The STISO620 digital isolator has from 2-to-0 directionality, with 100MBPS data rate as the STISO621. It can withstand, 4KV galvanic isolation and has a Schmitt trigger input.

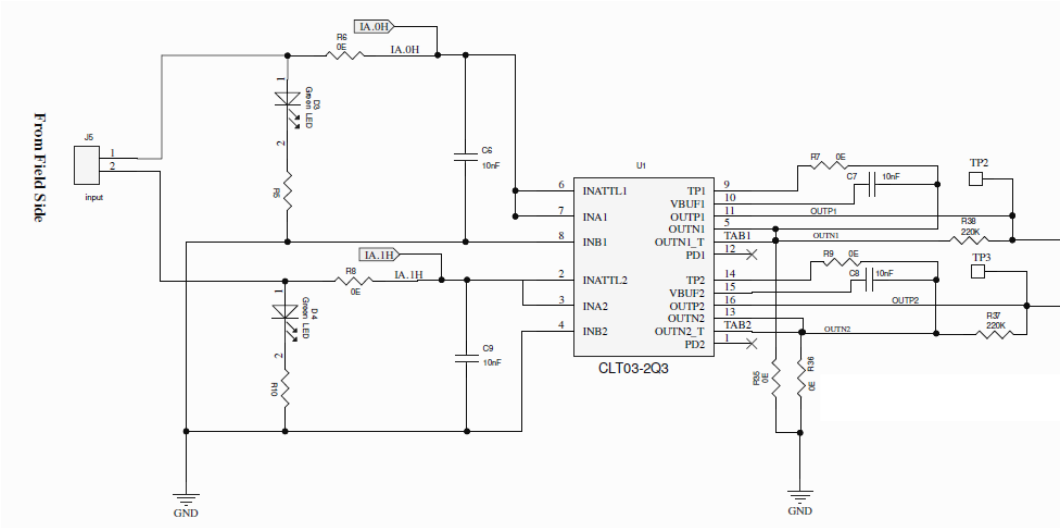
Figure 9. Isolator STISO620



4.4 Current limited digital input

The current limiter IC CLT03-2Q3 has two isolated channels, where we can connect isolated inputs. The board has an input excitation LED indicator.

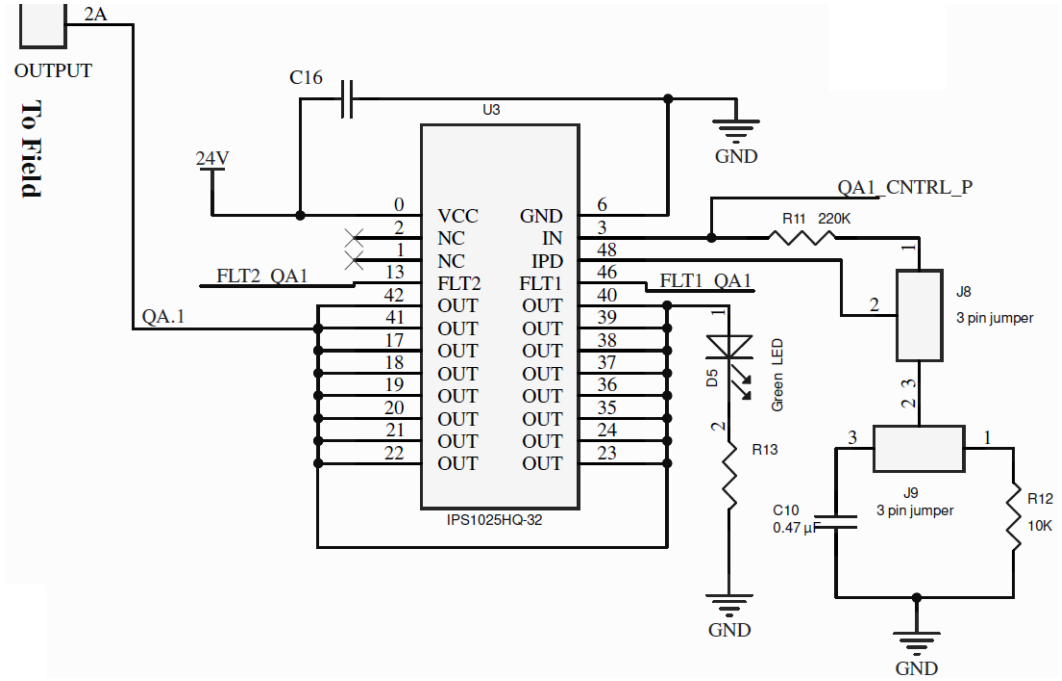
Figure 10. Current-limited digital input



4.5 High-side switch (with dynamic current control)

The high-side switches are available in two packages with identical features. In this board, both the packages, that is, POWER SSO-24 and 48-QFN(8*x6), are used. The details features are mentioned in the Overview section.

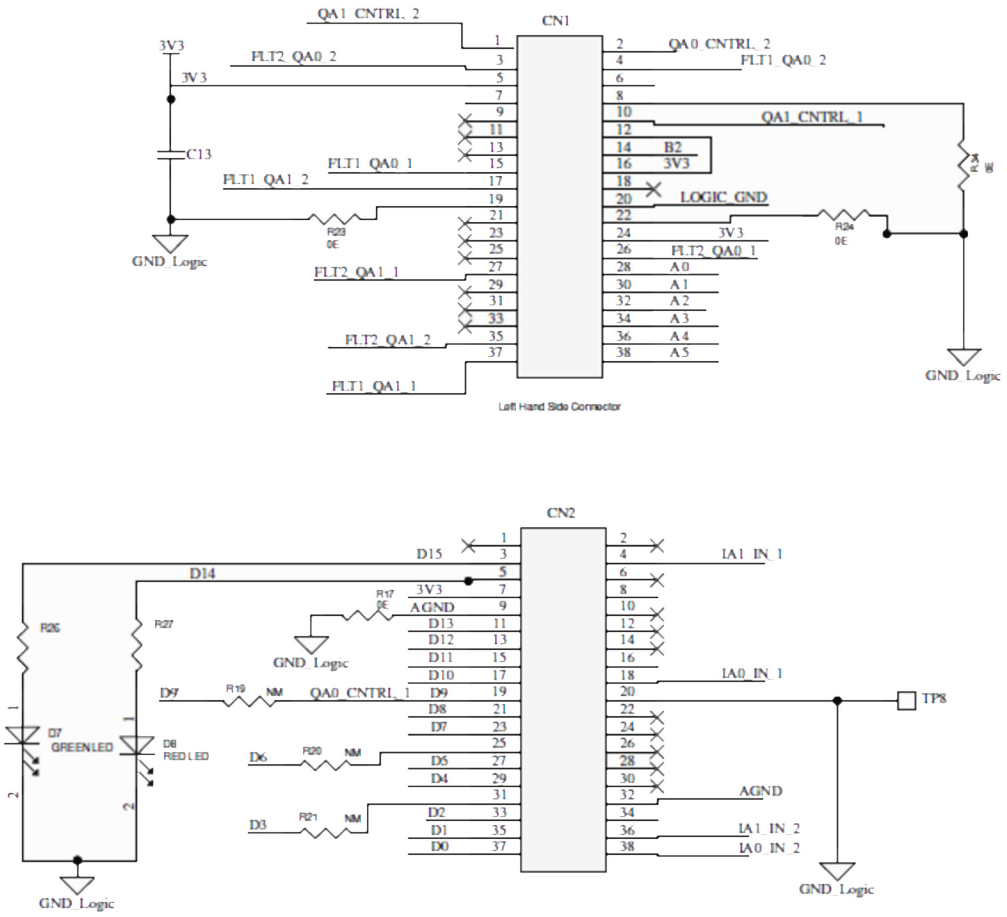
Figure 11. High-side switch



4.6 Jumper setting options

The control and status pins of the I/O devices are connected through jumpers to the MCU GPIO. The jumper selection allows connection of each control pin to one of two possible GPIOs. To simplify, these GPIOs are clubbed in two sets marked as default and alternate. The serigraphy on the boards includes bars that indicate the jumper positions for default connections. The standard firmware assumes that one of the sets, marked as default and alternate, is selected for a board. The figure below depicts the jumper information for routing control and status signals between the X-NUCLEO and suitable Nucleo boards through the Morpho connectors for various configurations.

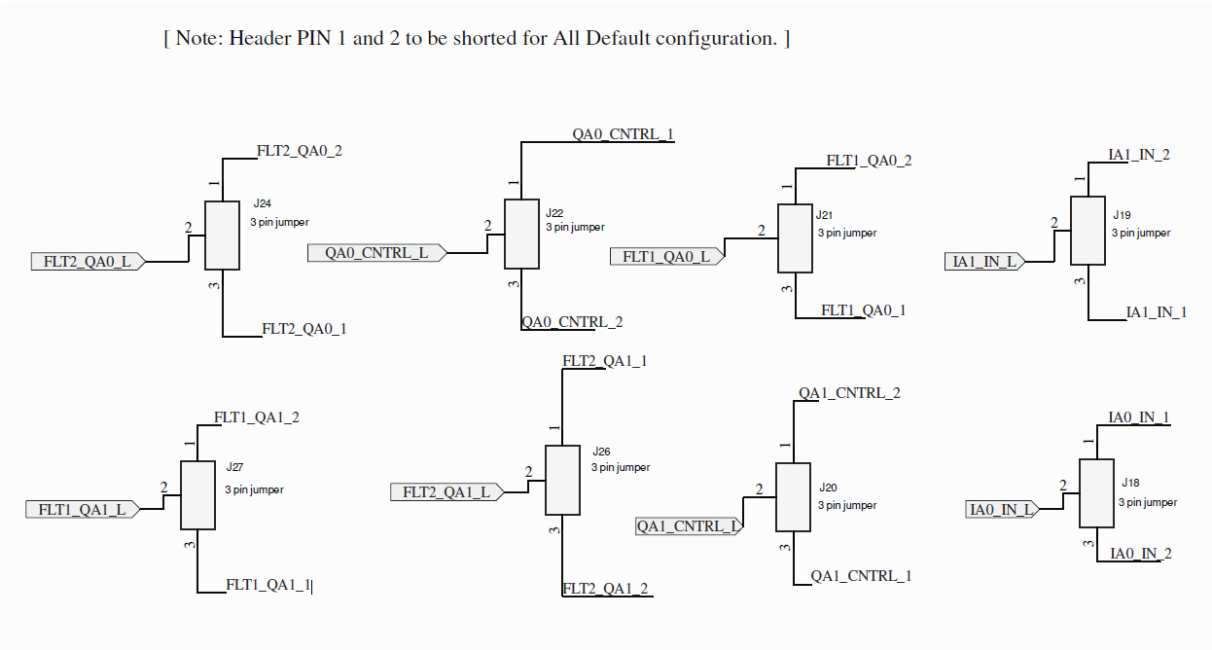
Figure 12. Morpho connectors



Morpho Connectors

Through this jumper connection, we can stack one more X-NUCLEO, which is fully functional.

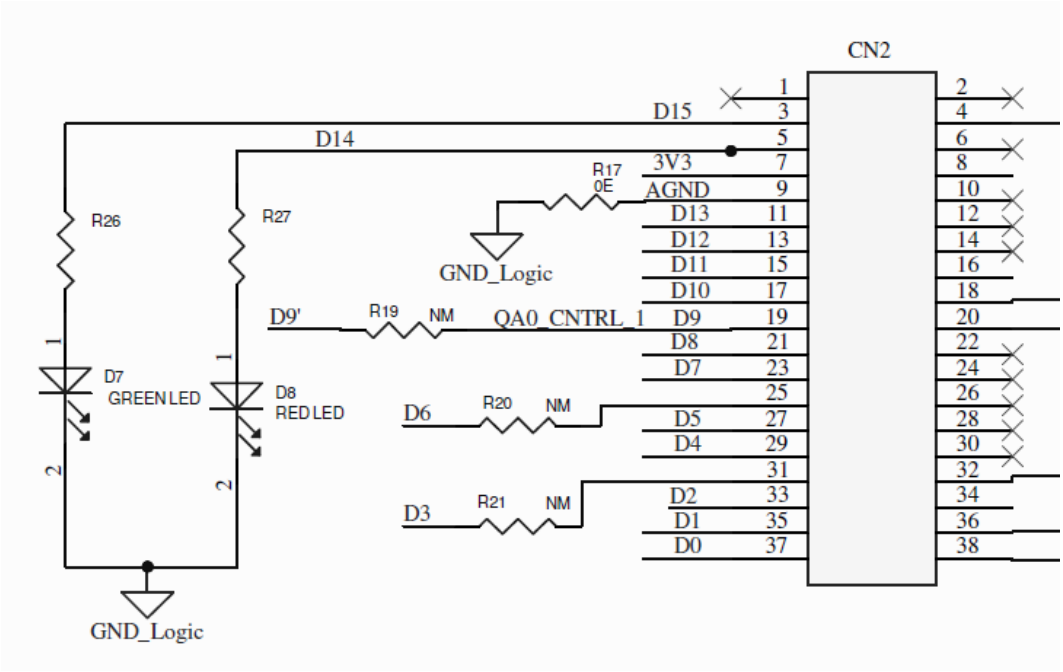
Figure 13. MCU interface routing options



4.7 LED indicators

Two LEDs, D7 and D8 are provided on the board to have programmable LED indications. Refer to the software user manual for detailed information on various LED configurations and features, including power status and error states.

Figure 14. LED indicators

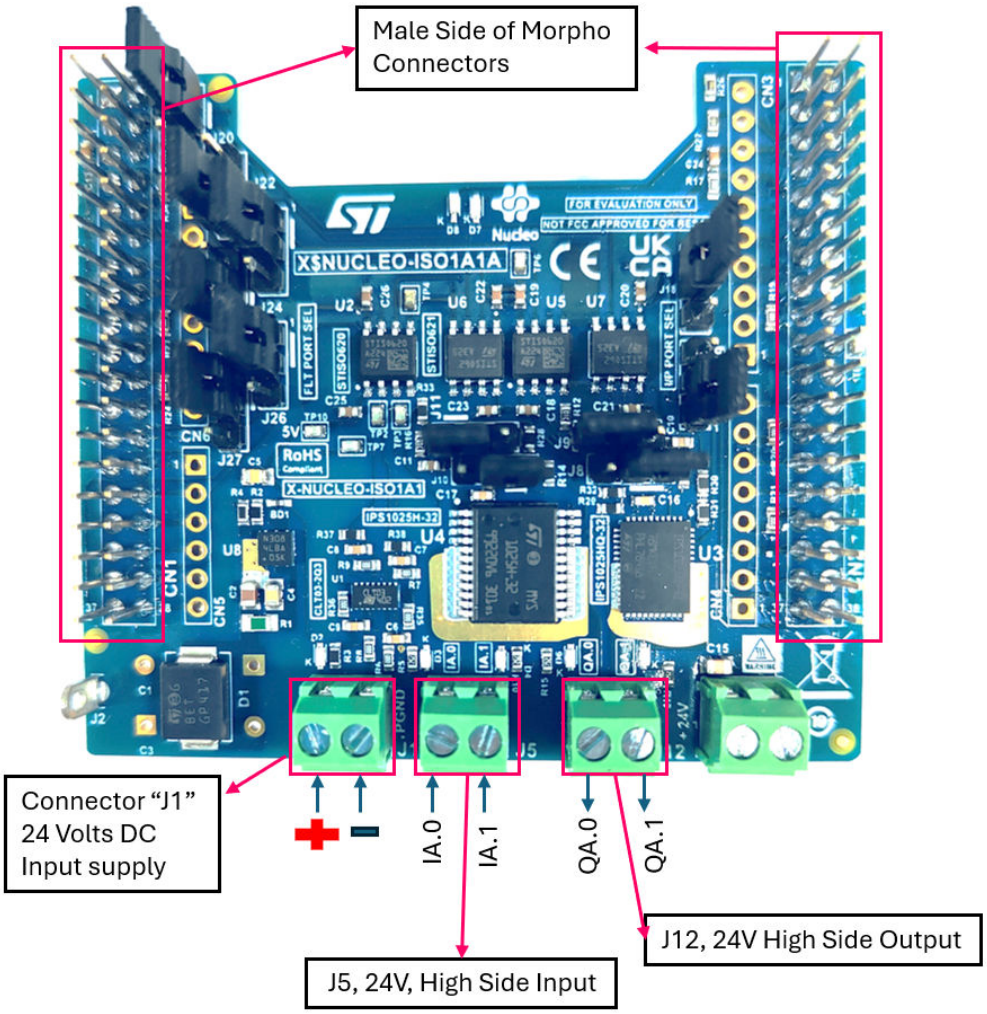


5 Board setup and configuration

5.1 Get started with the board

A detailed image is provided to help you become familiar with the board and its various connections. This image serves as a comprehensive visual guide, illustrating the layout and specific points of interest on the board. Terminal J1 is provided to connect 24V supply to power the process side of the board. Terminal J5 is also connected to the 24V DC input. However J5 is provided easy connection of external Loads and Sensors which are connected to Input terminal J5 and high side output terminal J12.

Figure 15. Different connecting ports of X-NUCLEO



5.2 System setup requirements

1. **24 V DC Power Supply**: The 2$V input should have sufficient capability to drive the board along with external load. Ideally this should be short circuit protected externals.
2. **NUCLEO-G071RB Board**: The NUCLEO-G071RB board is a Nucleo development board. It serves as the main microcontroller unit for driving outputs, monitoring output health status, and fetching process side inputs.
3. **X-NUCLEO-ISO1A1 Board**: The Micro PLC board for evaluation of specific functionality of the devices. We can stack two X-NUCLEO as well.
4. **USB-micro-B Cable**: The USB-micro-B cable is used to connect the NUCLEO-G071RB board to a computer or a 5 V adapter. This cable is essential for flashing the binary file onto the mentioned Nucleo board and subsequently powering it through any 5 V charger or adapter.
5. **Wires to connect the Input Supply**: Connecting wire for the load and inputs, it is highly recommended to use thick wires for the output high-side switches.
6. **Laptop/PC**: A laptop or PC has to be used to flash the test firmware onto the NUCLEO-G071RB board. This process only needs to be performed once when using the Nucleo board to test multiple X-NUCLEO boards.
7. **STM32CubeProgrammer (optional)**: The STM32CubeProgrammer is used to flash the binary after erasing the MCU chip. It is a versatile software tool designed for all STM32 microcontrollers, providing an efficient way to program and debug the devices. More information and the software can be found at STM32CubeProg - STM32CubeProgrammer software for all STM32 - STMicroelectronics.
8. **Software (optional)**: Install the 'Tera Term' software on your desktop to facilitate communication with the Nucleo board. This terminal emulator allows for easy interaction with the board during testing and debugging. The software can be downloaded from Tera-Term.

5.3 Safety precautions and protective equipment

Applying a heavy load through the high-side switches may cause the board to overheat. A warning sign is placed near the IC to indicate this risk.

It has been observed that the board has reduced tolerance to relatively high voltage surges. Therefore, it is advised not to connect excessive inductive loads or apply increased voltage beyond the specified reference values. It is expected that the board should be handled by an individual with basic electrical knowledge.

5.4 Stacking of two X-NUCLEO board on Nucleo

The board is designed with a jumper configuration that enables the Nucleo to drive two X-NUCLEO boards, each with two outputs and two inputs. Additionally, the fault signal is configured separately. Please refer to the table below as well as the schematic described in the previous section to configure and route control and monitoring signal between the MCU and devices. Either Default or alternate jumper can used while using single X-Nucleo board. But the both the X-nucleo boards should have different jumper selection to avod clash incase they are stacked on top another.

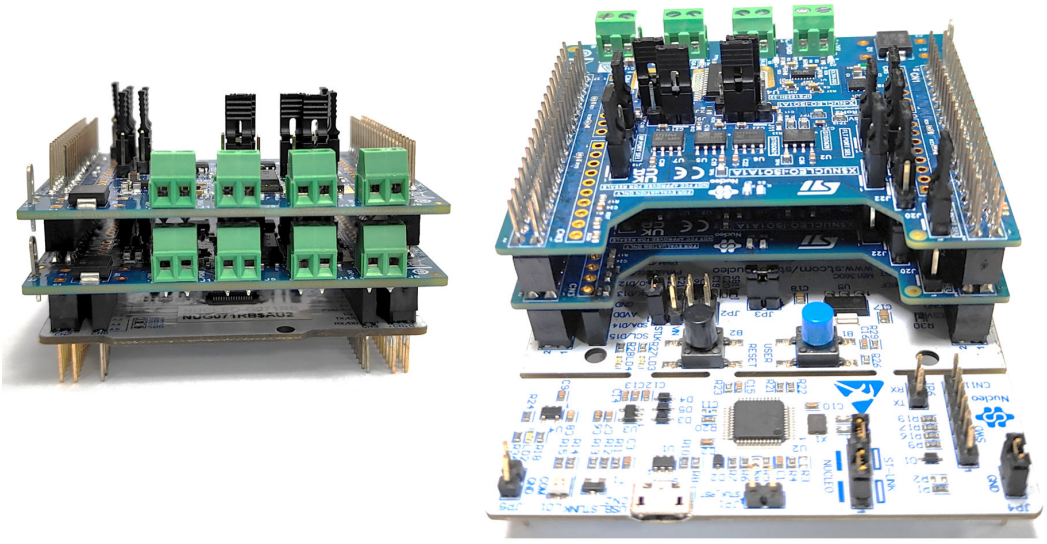
Table 1. Jumper selection chart for the default and alternate configuration

PIN feature	Serigraphy on board	Schematic name	Jumper	Default configuration		Alternate configuration	
				Header setting	Name	Header setting	Name
Input (CLT03)	IA.0	IA0_IN_L	J18	1-2(CN2-PIN-18)	IA0_IN_1	2-3(CN2-PIN-38)	IA0_IN_2
	IA.1	IA1_IN_L	J19	1-2(CN2-PIN-36)	IA1_IN_2	2-3(CN2-PIN-4)	IA1_IN_1

PIN feature	Serigraphy on board	Schematic name	Jumper	Default configuration		Alternate configuration	
				Header setting	Name	Header setting	Name
Output (IPS-1025)	QA.0	QA0_CNTRL_L	J22	1-2(CN2-PIN-19)	QA0_CNTRL_1	2-3(CN1-PIN-2)	QA0_CNTRL_2
	QA.1	QA1_CNTRL_L	J20	1-2(CN1- PIN-1)	QA1_CNTRL_2	2-3(CN1-PIN-10)	QA1_CNTRL_1
Fault PIN configuration		FLT1_QA0_L	J21	1-2(CN1- PIN-4)	FLT1_QA0_2	2-3(CN1-PIN-15)	FLT1_QA0_1
		FLT1_QA1_L	J27	1-2(CN1-PIN-17)	FLT1_QA1_2	2-3(CN1-PIN-37)	FLT1_QA1_1
		FLT2_QA0_L	J24	1-2(CN1- PIN-3)	FLT2_QA0_2	2-3(CN1-PIN-26)	FLT2_QA0_1
		FLT2_QA1_L	J26	1-2(CN1-PIN-27)	FLT2_QA1_1	2-3(CN1-PIN-35)	FLT2_QA1_2

The image indicates the different views of the X-NUCLEO stacking.

Figure 16. Stack of two X-NUCLEO boards

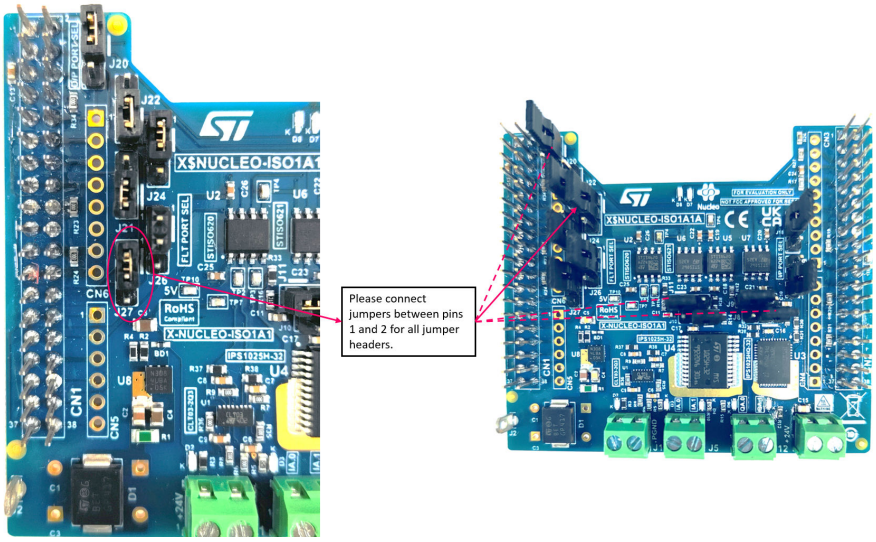


6 How to set up the board (tasks)

Jumper connection

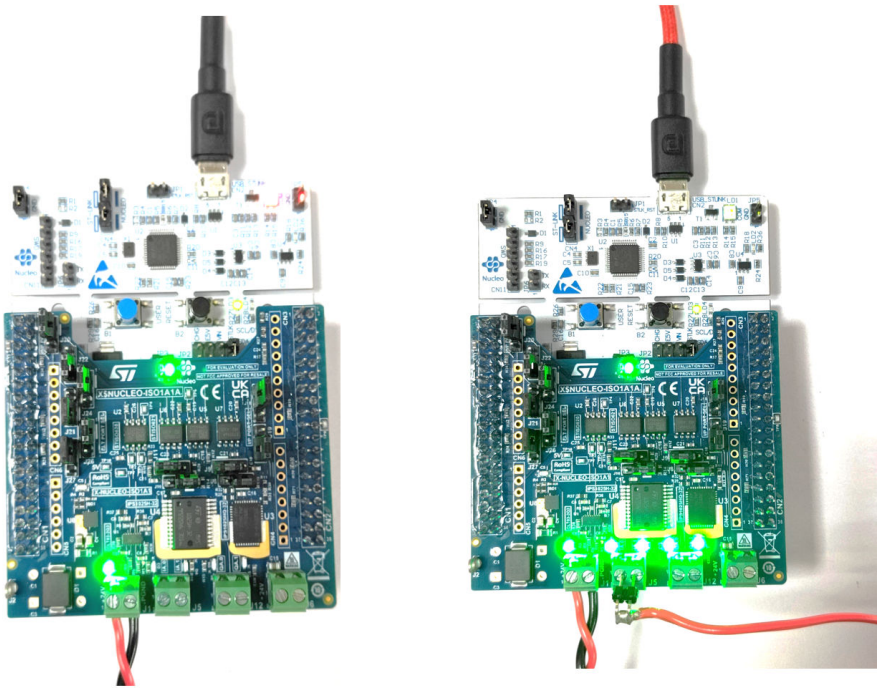
Make sure all the jumpers are in the default state; a white bar indicates the default connection. As shown in Figure 2. The FW is configure d for default jumper selection. appropriate modifications are needed to use alternate jumper selections.

Figure 17. Jumper connection of X-NUCLEO-ISO1A1



1. Connect the Nucleo board via a micro-USB cable to the computer
2. Place the X-NUCLEO on top of Nucleo as shown in Figure 18
3. Copy the X-CUBE-ISO1.bin to the Nucleo disc, or refer to the software user manual for software debugging
4. Check the D7 LED on the stacked X-NUCLEO Board; it should blink 1 second ON and 2 seconds OFF as shown in Figure 5. You can also debug the X-CUBE-ISO1 firmware using STM32CubeIDE and other supported IDEs.Fig. 18 below shows LED indications with all Inputs as low followed by all high input to the board. Output mimics the corresponding input.

Figure 18. **LED indication pattern during normal board operation**



7 Schematic diagrams

Figure 19. **X-NUCLEO-ISO1A1 circuit schematic (1 of 4)**

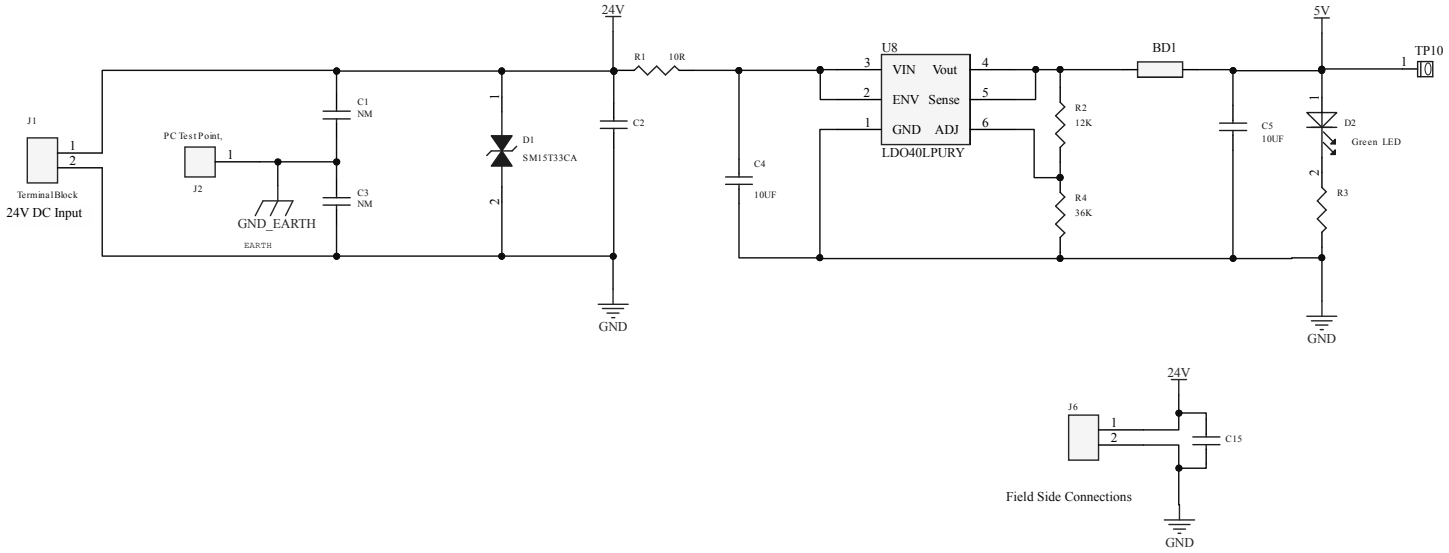
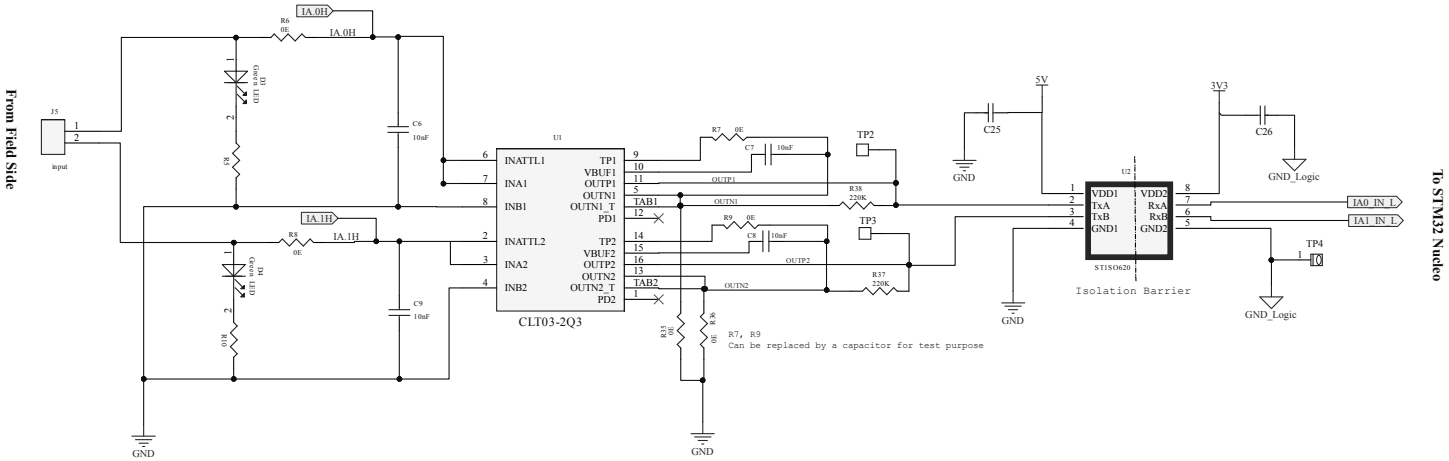


Figure 20. **X-NUCLEO-ISO1A1 circuit schematic (2 of 4)**



Input Current Limiter with Digital Isolation

Figure 21. **X-NUCLEO-ISO1A1 circuit schematic (3 of 4)**

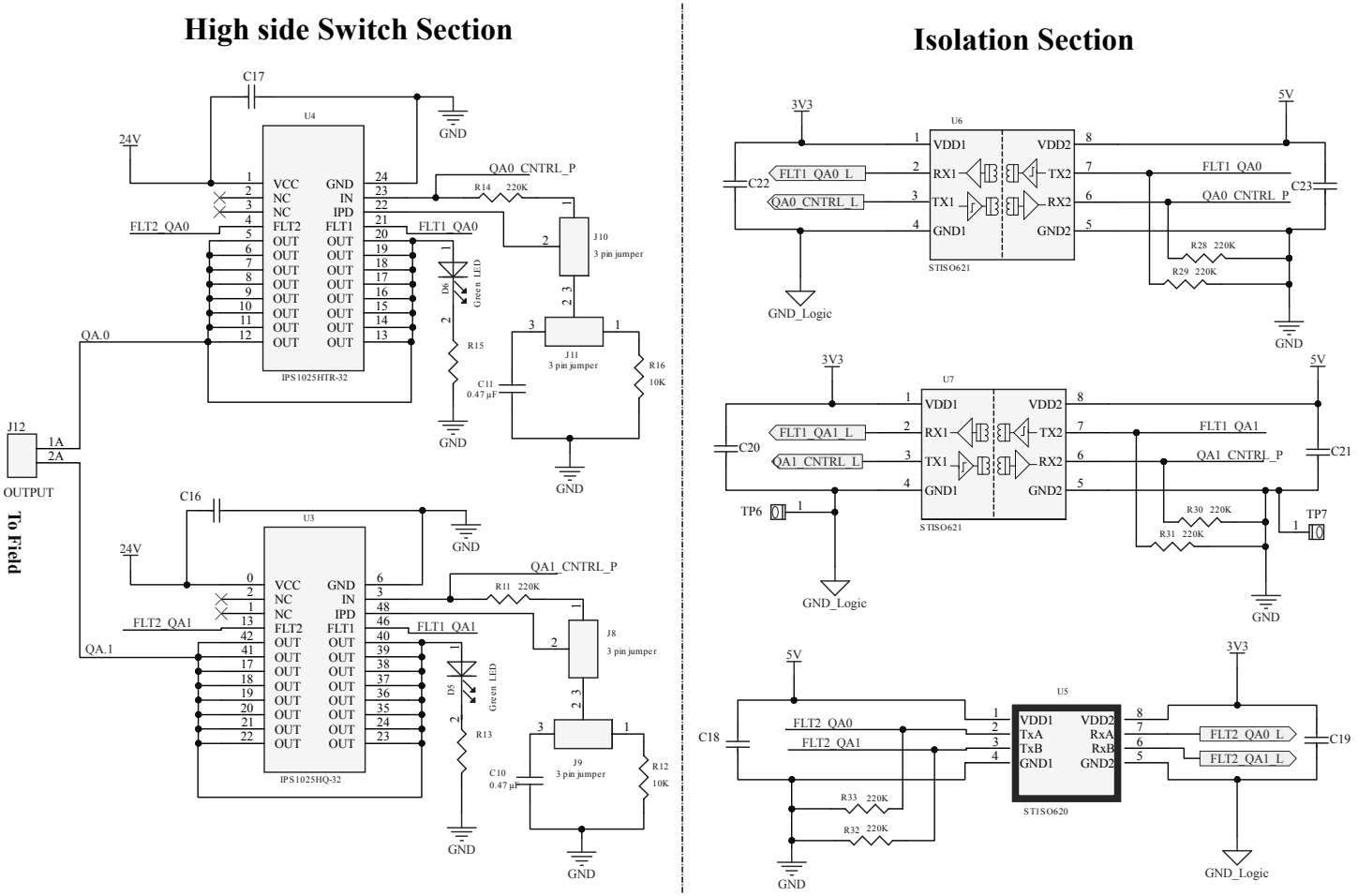
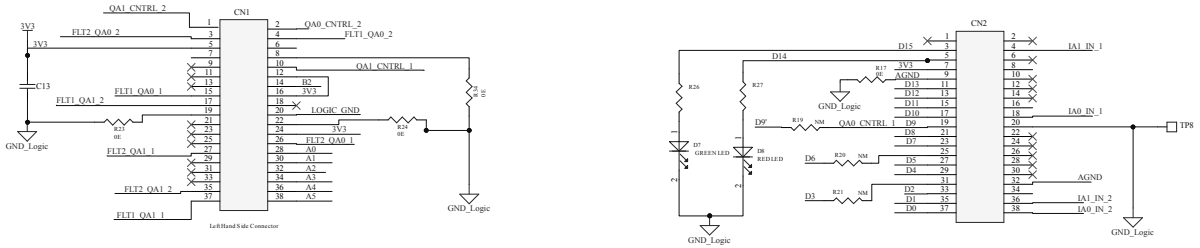
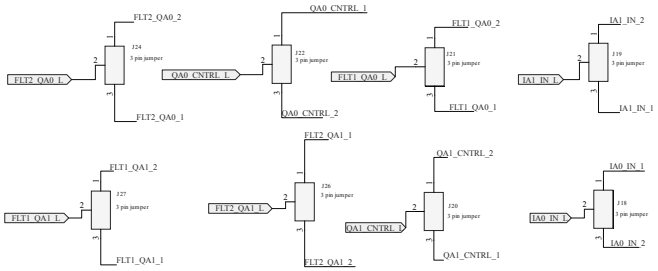


Figure 22. X-NUCLEO-ISO1A1 circuit schematic (4 of 4)

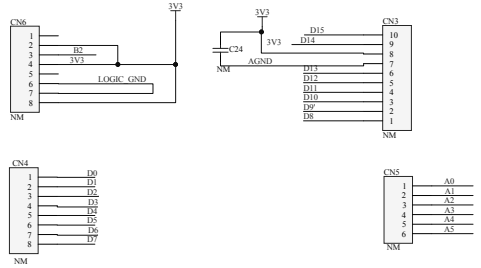


Morpho Connectors

[Note: Header PIN 1 and 2 to be shorted for All Default configuration.]



MCU Interface Routing Options



Arduino Connectors

8 Bill of materials

Table 2. **X-NUCLEO-ISO1A1 bill of materials**

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
1	1	BD1	10OHM	Ferrite Beads WE-CBF	Würth Elektronik	7427927310
2	2	C1, C3	4700pF	Safety Capacitors 4700pF	Vishay	VY1472M63Y5UQ63V0
3	2	C10, C11	0.47uF	Multilayer Ceramic Capacitors	Würth Elektronik	885012206050
4	10	C13, C18, C19, C20, C21, C22, C23, C24, C25, C26	100nF	Multilayer Ceramic Capacitors	Würth Elektronik	885012206046
5	2	C2, C15	1uF	Multilayer Ceramic Capacitors	Würth Elektronik	885012207103
6	2	C16, C17	100nF	Multilayer Ceramic Capacitors	Würth Elektronik	885382206004
7	1	C4	10uF	Multilayer Ceramic Capacitors	Murata Electronics	GRM21BR61H106KE43K
8	1	C5	10uF	Multilayer Ceramic Capacitors, X5R	Murata Electronics	GRM21BR61C106KE15K
9	4	C6, C7, C8, C9	10nF	Multilayer Ceramic Capacitors	Würth Elektronik	885382206002
10	2	CN1, CN2		Headers & Wire Housings	Samtec	SSQ-119-04-L-D
11	1	CN3	465 VAC, 655 VDC	Headers & Wire Housings	Samtec	SSQ-110-03-L-S
12	2	CN4, CN6	465 VAC, 655 VDC	8 Position Receptacle Connector	Samtec	SSQ-108-03-L-S
13	1	CN5	5.1A	Headers & Wire Housings	Samtec	SSQ-106-03-L-S
14	1	D1, SMC	1.5kW(ESD)	ESD Suppressors / TVS Diodes	STMicroelectronics	SM15T33CA
15	6	D2, D3, D4, D5, D6, D7	20mA	Standard LEDs - SMD(Green)	Broadcom Limited	ASCKCG00-NW5X5020302
16	1	D8	20mA	Standard LEDs - SMD(Red)	Broadcom Limited	ASCKCR00-BU5V5020402
17	2	HW1, HW2	Jumper CAP	Jumper	Würth Elektronik	609002115121
18	1	J1	300VAC	Fixed Terminal Blocks	Würth Elektronik	691214110002
19	1	J2		Test Plugs & Test Jacks	Keystone Electronics	4952
20	1	J5	300VAC	Fixed Terminal Blocks	Würth Elektronik	691214110002
21	2	J6, J12	300VAC	Fixed Terminal Blocks	Würth Elektronik	691214110002
22	12	J8, J9, J10, J11, J18, J19, J20, J21, J22, J24, J26, J27		Headers & Wire Housings	Würth Elektronik	61300311121
23	1	R1	10OHM	Thin Film Resistors - SMD	Vishay	TNPW080510R0FEEA
24	8	R11, R14, R28, R29, R30, R31, R32, R33	220 kOhms	Thick Film Resistors - SMD	Vishay	RCS0603220KJNEA

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
25	2	R12, R16	10KOHM	Thick Film Resistors - SMD	Bourns	CMP0603AFX-1002ELF
26	1	R19	0Ohm	Thick Film Resistors - SMD	Vishay	CRCW06030000Z0EAHP
27	1	R2	12KOHM	Thin Film Resistors - SMD	Panasonic	ERA-3VEB1202V
28	2	R26, R27	150 OHM	Thin Film Chip Resistors	Vishay	MCT06030C1500FP500
29	4	R3, R13, R15	1KOHM	Thin Film Resistors - SMD	Vishay	CRCW06031K00DHEBP
30	2	R35, R36	0Ohm	Thick Film Resistors - SMD	Vishay	CRCW06030000Z0EAHP
31	2	R37, R38	220 kOhms	Thick Film Resistors - SMD	Vishay	RCS0603220KJNEA
32	1	R4	36KOHM	Thick Film Resistors - SMD	Panasonic	ERJ-H3EF3602V
33	2	R5, R10	7.5KOHM	Thin Film Resistors - SMD	Vishay	TNPW02017K50BEED
34	2	R6, R8	0Ohm	Thick Film Resistors - SMD	Vishay	CRCW06030000Z0EAHP
35	9	R7, R9, R17, R20, R21, R23, R24, R34	0Ohm	Thick Film Resistors - SMD	Vishay	CRCW06030000Z0EAHP
36	4	TP2, TP3, TP8, TP10		Test Plugs & Test Jacks	Harwin	S2761-46R
37	3	TP4, TP6, TP7		Test Plugs & Test Jacks	Harwin	S2761-46R
38	1	U1, QFN-16L		Self-powered digital input current limiter	STMicroelectronics	CLT03-2Q3
39	2	U2, U5, SO-8	3V	Digital Isolators	STMicroelectronics	STISO620TR
40	1	U3, VFQFPN 48L 8.0 X 6.0 X .90 PITCH	3.5A	HIGH-SIDE SWITCH	STMicroelectronics	IPS1025HQ-32
41	1	U4, PowerSSO 24	3.5A	Power Switch/Driver 1:1 N-Channel 5A PowerSSO-24	STMicroelectronics	IPS1025HTR-32
42	2	U6, U7, SO-8		Digital Isolators	STMicroelectronics	STISO621
43	1	U8, DFN6 3x3		LDO Voltage Regulators	STMicroelectronics	LDO40LPURY

9 Board versions

Table 3. **X-NUCLEO-ISO1A1 versions**

Finished good	Schematic diagrams	Bill of materials
X$NUCLEO-ISO1A1A (1)	X$NUCLEO-ISO1A1A schematic diagrams	X$NUCLEO-ISOA1A bill of materials

1. *This code identifies the X-NUCLEO-ISO1A1 evaluation board first version.*

10 Regulatory compliance information

Notice for US Federal Communication Commission (FCC)

For evaluation only; not FCC approved for resale

FCC NOTICE - This kit is designed to allow:

(1) Product developers to evaluate electronic components, circuitry, or software associated with the kit to determine

whether to incorporate such items in a finished product and

(2) Software developers to write software applications for use with the end product.

This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter 3.1.2.

Notice for Innovation, Science and Economic Development Canada (ISED)

For evaluation purposes only. This kit generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to Industry Canada (IC) rules.

À des fins d'évaluation uniquement. Ce kit génère, utilise et peut émettre de l'énergie radiofréquence et n'a pas été testé pour sa conformité aux limites des appareils informatiques conformément aux règles d'Industrie Canada (IC).

Notice for the European Union

This device is in conformity with the essential requirements of the Directive 2014/30/EU (EMC) and of the Directive 2015/863/EU (RoHS).

Notice for the United Kingdom

This device is in compliance with the UK Electromagnetic Compatibility Regulations 2016 (UK S.I. 2016 No. 1091) and with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 (UK S.I. 2012 No. 3032).

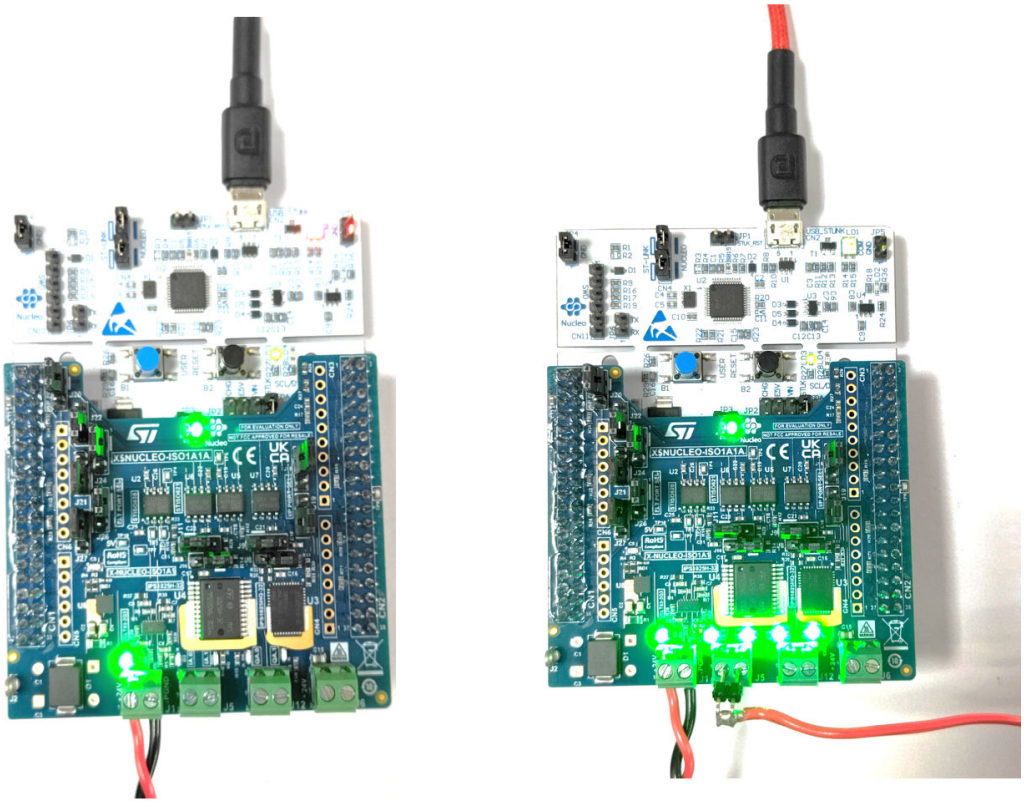
Appendices

An example is described here for the easy use and handling of the board.

Example - Digital input and Digital Output test case

1. Stack the X-NUCLEO Board onto the Nucleo board
2. Debug the code using a Micro- B Cable
3. Call this function in the main, “ST_ISO_APP_DIDOandUART”
4. Connect the 24V Power supply as shown in the image

Figure 23. Digital Input and Digital Output Implementation



5. The input and the respective output follow the chart as mentioned in the chart below. Figure on the left corresponds to row 1 and figure on the right corresponds to row 4 of Table 4.

Table 4. DIDO Logic Table

Case No.	D3 LED(IA.0) Input	D4 LED(IA.1) Input	D6 LED(QA.0) Output	D5 LED(QA.1) Output
1	0 V	0 V	OFF	OFF
2	24 V	0 V	ON	OFF
3	0 V	24 V	OFF	ON
4	24 V	24 V	ON	ON

The demo serves as an easy start guide for quick hands-on experience. Users may also invoke additional functions for their specific needs.

Revision history

Table 5. **Document revision history**

Date	Revision	Changes
05-May-2025	1	Initial release.

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