

How to use X-NUCLEO-60K1A1 expansion kit with ST60A3H1 connectivity transceiver for USB2, UART or I²C contactless communication applications

Introduction

The X-NUCLEO-60K1A1 is a kit composed of 2 expansion boards, a X-NUCLEO-60L1A1 expansion board, and a X-NUCLEO-60R1A1 expansion board, working as a pair, which can be plugged onto most STM32 Nucleo boards equipped with the Arduino R3 connectors. It provides a complete evaluation kit that allows you to learn, evaluate, and develop applications based on the ST60A3H1 transceiver, for contactless connectivity up to 480 Mbit/s.

The ST60A3H1 is a full RF transceiver with a dual-linear-polarization integrated antenna, operating in Half-Duplex mode. It provides an optimized solution for a high-speed, low-power, short-range point to point 60 GHz RF link.

The X-NUCLEO-60L1A1 expansion board which hosts an ST60A3H1 configured as Local is the only board needing to be plugged onto an STM32 Nucleo development board (e.g. NUCLEO-L476RG with ultra-low power STM32 microcontroller). The other X-NUCLEO-60R1A1 expansion board, which hosts a ST60A3H1 configured as Remote, is used in standalone mode, its configuration will be performed from the X-NUCLEO-60L1A1 side.

Figure 1. X-NUCLEO-60L1A1 expansion board

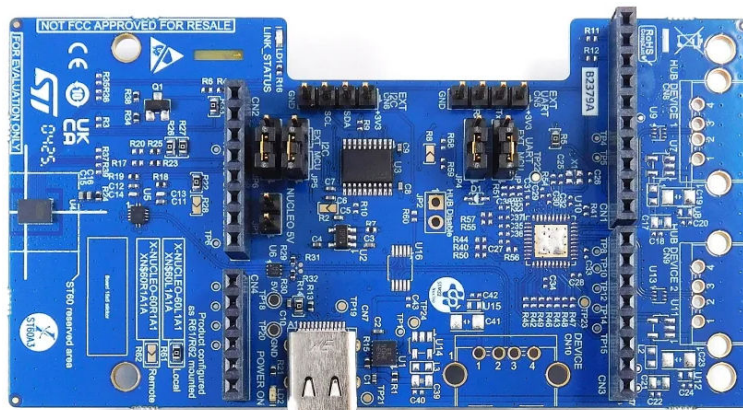
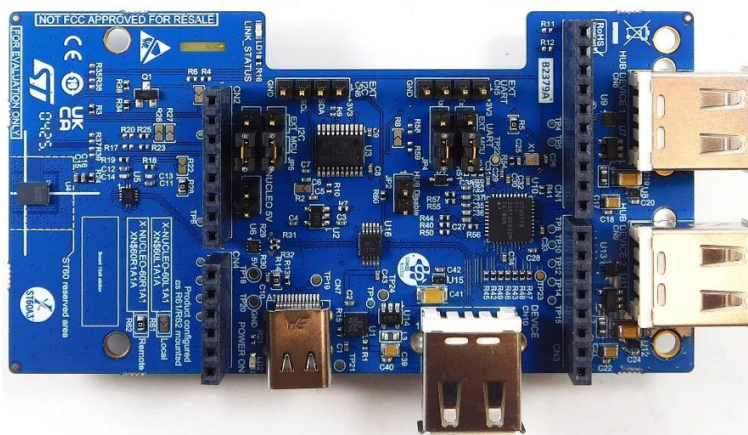


Figure 2. X-NUCLEO-60R1A1 expansion board



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

1 Safety information

1.1 Electrostatic precautions

Warning: Take electrostatic precautions, including ground straps, when using the *X-NUCLEO-60L1A1* and *X-NUCLEO-60R1A1* expansion boards. Failure to prevent electrostatic discharge could damage the device.

Figure 3. Electrostatic logo



1.2 X-NUCLEO-60L1A1 and X-NUCLEO-60R1A1 power

A USB-C connector is present on both *X-NUCLEO-60L1A1* and *X-NUCLEO-60R1A1*. When power is delivered on this USB-C connector, JP1 jumper MUST not be fitted.

This is to prevent +5V going from USB-C into the STM32 Nucleo board plugged into X-NUCLEO.

2 Getting started

2.1 Overview

The [X-NUCLEO-60L1A1](#) and [X-NUCLEO-60R1A1](#) main features are:

- 60 GHz V-band contactless connectivity transceiver expansion board kit, based on the [ST60A3H1](#) for STM32 Nucleo.
The [X-NUCLEO-60K1A1](#) kit is composed of 2 boards:
 - [X-NUCLEO-60L1A1](#) expansion board with an [ST60A3H1](#) configured as Local
 - [X-NUCLEO-60R1A1](#) expansion board with an [ST60A3H1](#) configured as Remote
- Emitted RF power: 5.6 dBm EIRP
- Operating frequency band: 57-64 GHz
- Range up to 3 cm
- eUSB2, UART, GPIO or I²C RF tunneling
- Embedded eUSB2 repeater
- Bypassable USB2 hub on Remote [ST60A3H1](#) side
- Compatible with most [STM32 Nucleo](#) boards
- Equipped with Arduino UNO R3 connector
- Free comprehensive development firmware library and examples for [ST60A3H1](#), compatible with [STM32Cube](#)
- ETSI certified
- RoHS, CE and UKCA compliant

The [X-NUCLEO-60L1A1](#) and [X-NUCLEO-60R1A1](#) expansion boards can be used for the evaluation of the [ST60A3H1](#) in multiple applications:

- USB2 contactless communication, aka USB Tunneling.
- UART contactless communication, aka UART Tunneling.
- I²C contactless communication, aka I²C Tunneling.

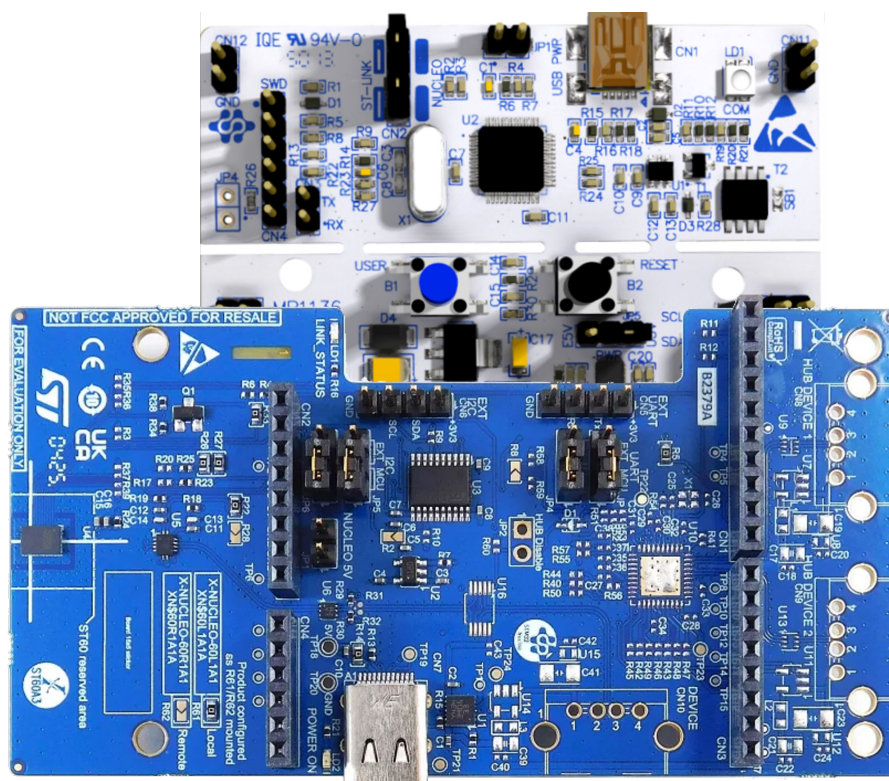
For USB2 contactless communication, both [ST60A3H1](#) devices are configured in eUSB2 Tunneling. USB2 contactless connectivity is achieved through eUSB2-to-USB2 repeaters present on [X-NUCLEO-60L1A1](#) and [X-NUCLEO-60R1A1](#) expansion boards.

2.2 Hardware and software requirements

X-NUCLEO-60L1A1 and X-NUCLEO-60R1A1 always work together to provide contactless communication (USB2, UART or I²C).

Only X-NUCLEO-60L1A1 needs to be plugged into a STM32 Nucleo board. All required ST60A3H1 configuration is performed through I²C accesses either locally (for the ST60A3H1 mounted on X-NUCLEO-60L1A1) or Over-The-Air (for the ST60A3H1 mounted on X-NUCLEO-60R1A1).

Figure 4. X-NUCLEO-60L1A1 expansion board connected to a STM32 Nucleo development board



The interconnection between the STM32 Nucleo and the X-NUCLEO-60L1A1 is designed to allow the use of any STM32 NUCLEO board, although complete testing has only been performed on the NUCLEO-L476RG board hosting the STM32L476RG microcontroller.

The minimum hardware and software requirements are listed below:

- a STM32 Nucleo board
- a PC/laptop with Microsoft Windows (7 and above) to install the software package (X-CUBE-ST60)
- a type A USB to mini-B USB cable to connect the STM32 Nucleo board to the PC/laptop
- a type A USB to USB-C or USB-C cable to power X-NUCLEO-60R1A1

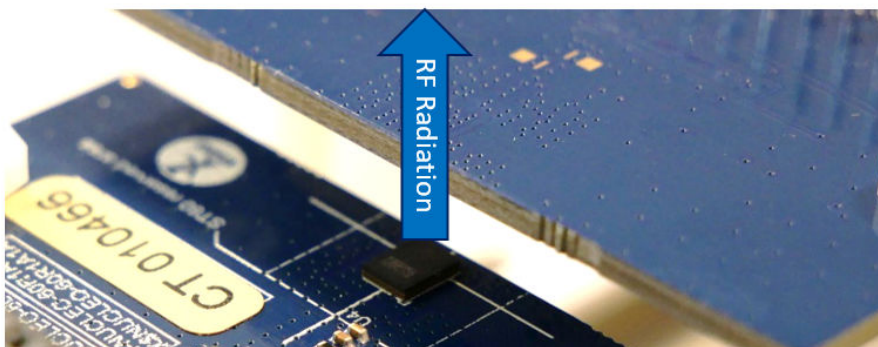
Some application examples require additional equipment:

- USB Tunneling:
 - additional type A USB to USB-C or USB-C cable to connect X-NUCLEO-60L1A1 to USB Host. In that configuration X-NUCLEO-60L1A1 JP1 must be not fitted.
- UART Tunneling:
 - additional STM32 Nucleo board
 - a type A USB to mini-B USB cable to connect the STM32 Nucleo board to the PC/laptop

In order to communicate, both ST60A3H1 devices must be within RF communication distance, i.e. aligned and within a couple of centimeters.

The ST60A3H1 includes an antenna-in-package. The antenna radiates perpendicularly to the board plane (broadside radiation) in the same direction as the ST60A3H1 assembly.

Figure 5. ST60A3H1 RF radiation direction



STEVAL-60SUPPORT optional support is available for easier alignment and boards stability.

3 Hardware description and configuration

3.1 Interconnection

The X-NUCLEO-60L1A1/X-NUCLEO-60R1A1 expansion boards and the NUCLEO-L476RG boards connections details are listed in the table below.

Table 1. X-NUCLEO-60L1A1/X-NUCLEO-60R1A1 and NUCLEO-L476RG connection details (left connector)

Signal name													
NC	IOREF	RESET	3V3	5V	GND	GND	VIN	A0	A1	A2	A3	A4	A5
NUCLEO connector name													
CN6 Power								CN8 Analog					
Pin Number													
1	2	3	4	5	6	7	8	1	2	3	4	5	6
NUCLEO-L476RG MCU port													
								PA0	PA1	PA4	PB0	PC1	PC0
X-NUCLEO-60L1A1/X-NUCLEO-60R1A1 expansion board signals													
			3V3	5V	GND	GND							

Table 2. X-NUCLEO-60L1A1/X-NUCLEO-60R1A1 and NUCLEO-L476RG connection details (right connector)

Signal name																	
D15	D14	AREF	GND	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
NUCLEO connector name																	
CN5 Digital										CN9 Digital							
Pin Number																	
10	9	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1
NUCLEO-L476RG MCU port																	
PB8	PB9	AVDD	GND	PA5	PA6	PA7	PB6	PC7	PA9	PA8	PB10	PB4	PB5	PB3	PA10	PA2	PA3
X-NUCLEO-60L1A1/X-NUCLEO-60R1A1 expansion board signals																	
SCL	SDA		GND				RF_EN ⁽¹⁾	MODE_INT ⁽¹⁾	UART_TX						UART_RX		

1. X-NUCLEO-60L1A1 only.

3.2 X-NUCLEO-60K1A1 detailed description

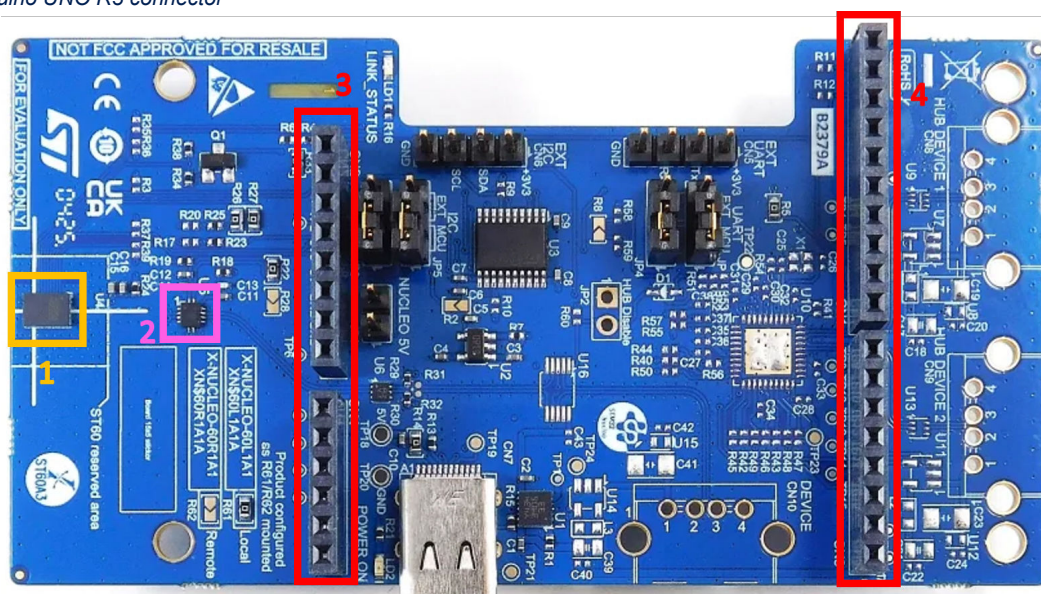
3.2.1 Components placement

The X-NUCLEO-60L1A1 and the X-NUCLEO-60R1A1 have the same PCB but different BOM.

The figure below shows the main components placement on the X-NUCLEO-60L1A1 expansion board.

Figure 6. X-NUCLEO-60L1A1 components placement

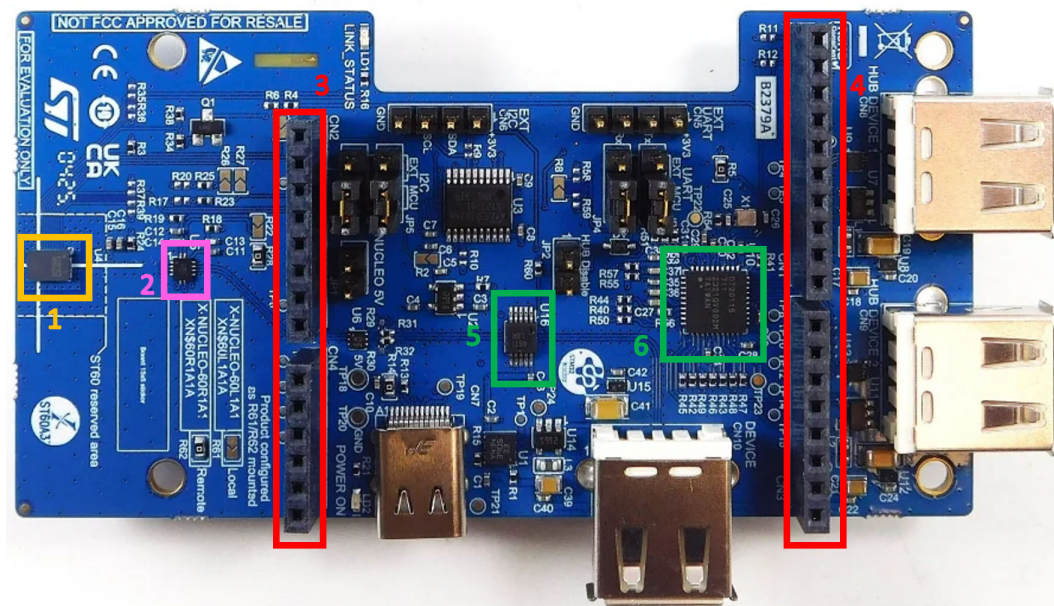
1. ST60A3H1
2. eUSB2-to-USB2 repeater
3. Arduino UNO R3 connector
4. Arduino UNO R3 connector



The figure below shows the main components placement on the X-NUCLEO-60R1A1 expansion board.

Figure 7. X-NUCLEO-60R1A1 components placement

1. ST60A3H1
2. eUSB2-to-USB2 repeater
3. Arduino UNO R3 connector
4. Arduino UNO R3 connector
5. USB2 switch
6. USB2 hub



3.2.2 Jumpers and connectors

The figure below shows the jumpers and connectors available on the X-NUCLEO-60L1A1 expansion board.

Figure 8. X-NUCLEO-60L1A1 jumpers and connectors

1. JP1: Power supply selection
2. JP3/JP4: UART source selection
3. JP5/JP6: I²C source selection
4. CN5: EXT UART connector
5. CN6: EXT I²C connector
6. CN7: USB-C connector

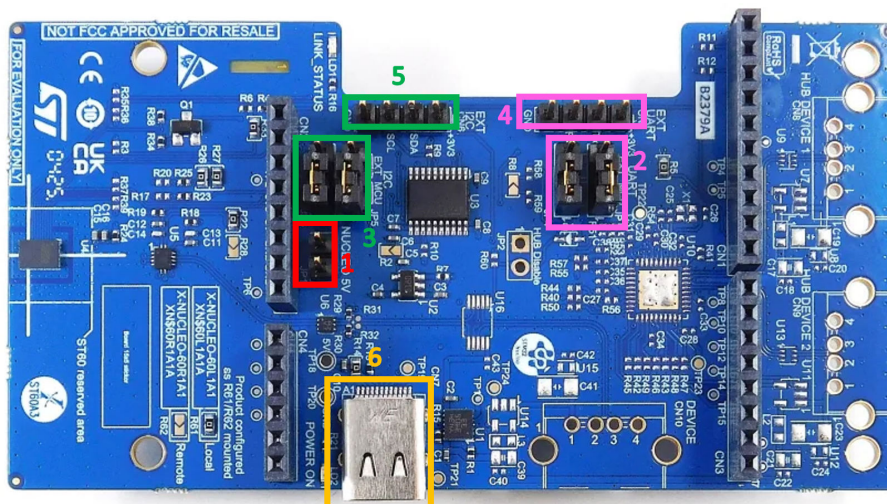


Table 3. X-NUCLEO-60L1A1 jumpers description

Jumper	Default Position	Usage
JP1	OFF	Use to isolate USB-C 5V from STM32 NUCLEO board MUST be OFF if USB-C is connected
JP3	1-2 (MCU)	UART-TX source selection: 1-2: UART-TX from STM32 Nucleo 2-3: UART-TX from CN5-2
JP4	1-2 (MCU)	UART-RX source selection: 1-2: UART-RX from STM32 Nucleo 2-3: UART-RX from CN5-3
JP5	1-2 (MCU)	I ² C SCL source selection: 1-2: I²C SCL from STM32 Nucleo 2-3: I²C SCL from CN6-3
JP6	1-2 (MCU)	I ² C SDA source selection: 1-2: I²C SDA from STM32 Nucleo 2-3: I²C SDA from CN6-2

The figure below shows the jumpers and connectors available on the X-NUCLEO-60R1A1 expansion board.

Figure 9. X-NUCLEO-60R1A1 jumpers and connectors

1. JP1: Power supply selection
2. JP2: USB path selection
3. JP3/JP4: UART source selection
4. JP5/JP6: I²C source selection
5. CN5: EXT UART connector
6. CN6: EXT I²C connector
7. CN7: USB-C connector (power only)
8. CN10: USB-A connector
9. CN8/CN9: Hub USB-A connectors

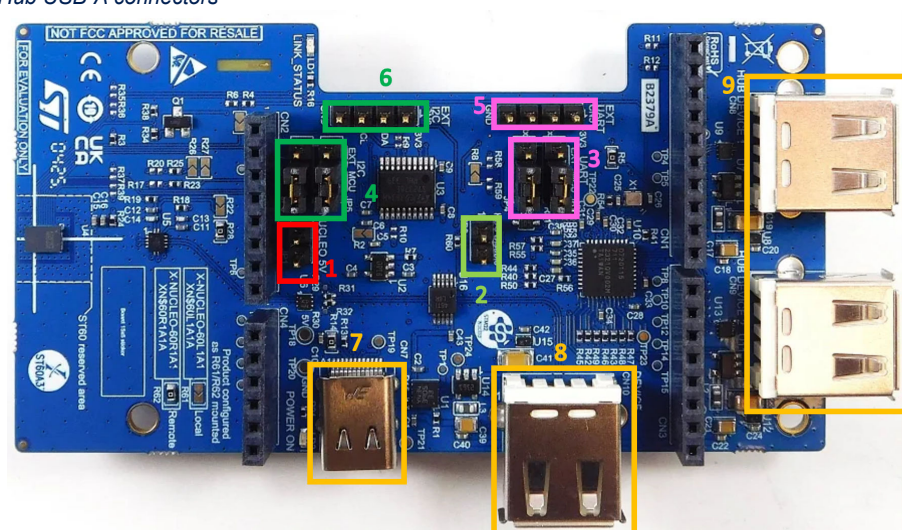


Table 4. X-NUCLEO-60R1A1 jumpers description

Jumper	Default Position	Usage
JP1	ON	Use to isolate USB-C 5V from STM32 NUCLEO board MUST be OFF if USB-C is connected
JP2	ON	USB path selection: - ON: Hub Disabled. USB2 Device in CN10 - OFF: Hub Enabled. USB2 Devices in CN8 and CN9
JP3	1-2 (MCU)	UART-TX source selection: 1-2: UART-TX from STM32 Nucleo 2-3: UART-TX from CN5-2
JP4	1-2 (MCU)	UART-RX source selection: 1-2: UART-RX from STM32 Nucleo 2-3: UART-RX from CN5-3
JP5	1-2 (MCU)	I ² C SCL source selection: 1-2: I²C SCL from STM32 Nucleo 2-3: I²C SCL from CN6-3
JP6	1-2 (MCU)	I ² C SDA source selection: 1-2: I²C SDA from STM32 Nucleo 2-3: I²C SDA from CN6-2

3.3 Board Setup

3.3.1 X-NUCLEO-60L1A1

3.3.1.1 Power from USB-C (CN7)

1. Check that the jumper on JP1 connector is NOT connected.
2. Connect the [X-NUCLEO-60L1A1](#) to the [STM32 Nucleo](#) board as shown in [Figure 4](#).
3. Power the [X-NUCLEO-60L1A1](#) using a type-A USB to USB-C or USB-C cable.
4. Power the STM32 Nucleo development board using the Mini-B USB cable.
5. Program the firmware in the STM32 on the STM32 Nucleo development board using a dedicated firmware example.
6. Press the reset button on the STM32 Nucleo development board. The evaluation kit is ready-to-use.

3.3.1.2 Power from STM32 Nucleo board

1. Check that the jumper on JP1 connector is connected to provide the required voltage to the board.
2. Connect the [X-NUCLEO-60L1A1](#) to the [STM32 Nucleo](#) board as shown in [Figure 4](#).
3. Power the STM32 Nucleo development board using the Mini-B USB cable.
4. Program the firmware in the STM32 on the STM32 Nucleo development board using a dedicated firmware example.
5. Press the reset button on the STM32 Nucleo development board. The evaluation kit is ready-to-use.

3.3.2 X-NUCLEO-60R1A1

[STM32 Nucleo](#) board is not required on [X-NUCLEO-60R1A1](#) side. For some use cases, a [STM32 Nucleo](#) board can be used as part of the contactless data exchange.

3.3.2.1 Power from USB-C (CN7)

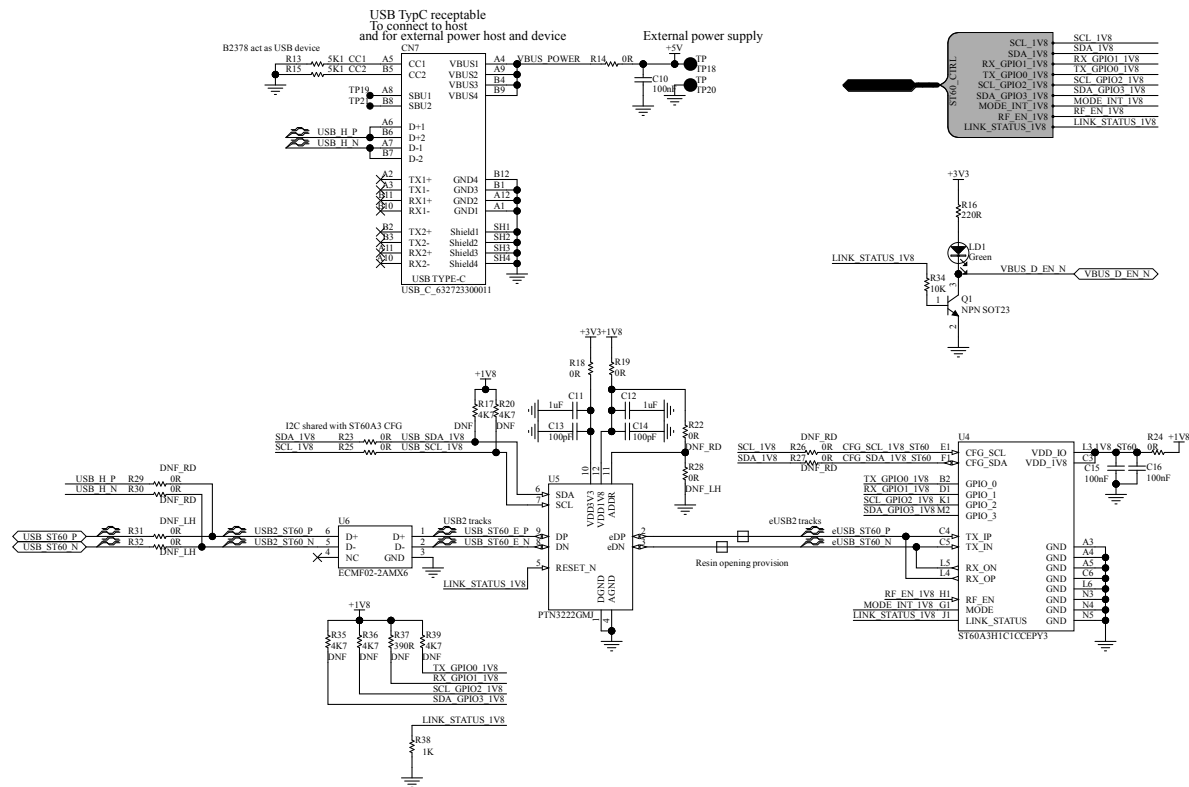
1. Check that the jumper on JP1 connector is NOT connected.
2. Power the [X-NUCLEO-60R1A1](#) using a type-A USB to USB-C or USB-C cable. The evaluation kit is ready-to-use.

3.3.2.2 Power from STM32 Nucleo board

1. Check that the jumper on JP1 connector is connected to provide the required voltage to the board.
2. Connect the [X-NUCLEO-60R1A1](#) to the [STM32 Nucleo](#) board as shown in [Figure 4](#).
3. Power the STM32 Nucleo development board using the Mini-B USB cable.
4. Program the firmware in the STM32 on the STM32 Nucleo development board using a dedicated firmware example.
5. Press the reset button on the STM32 Nucleo development board. The evaluation kit is ready-to-use.

4 Schematic diagrams

Figure 10. X-NUCLEO-60L1A1 circuit schematic (1 of 4) - ST60A3H1





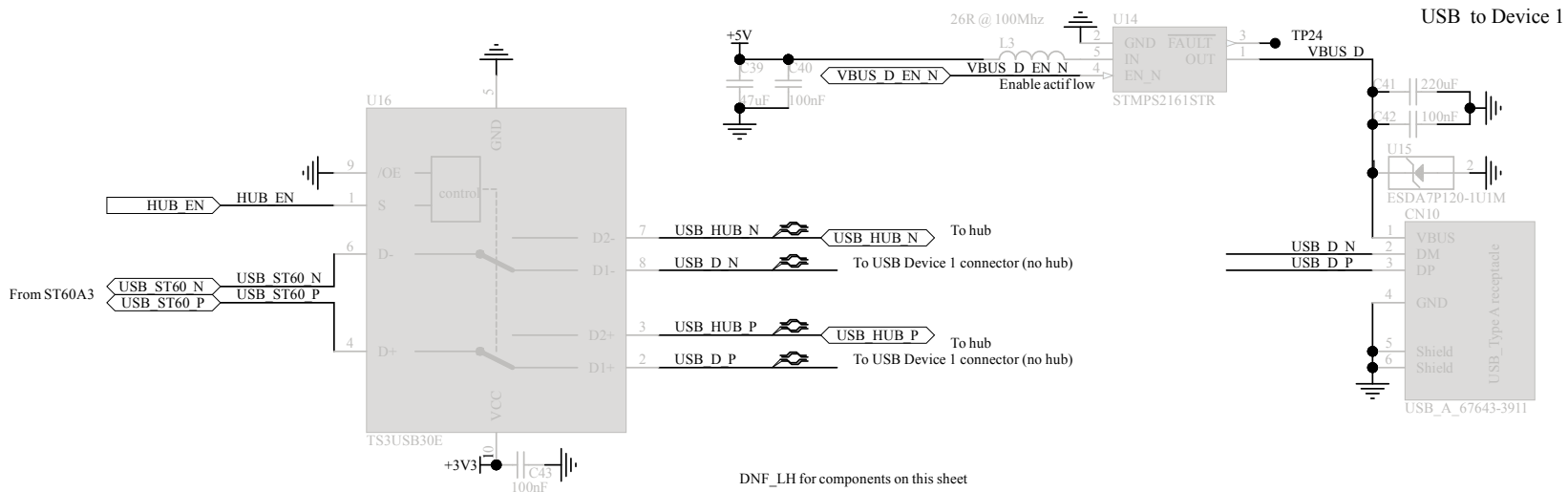


Figure 13. X-NUCLEO-60L1A1 circuit schematic (4 of 4) - Hub

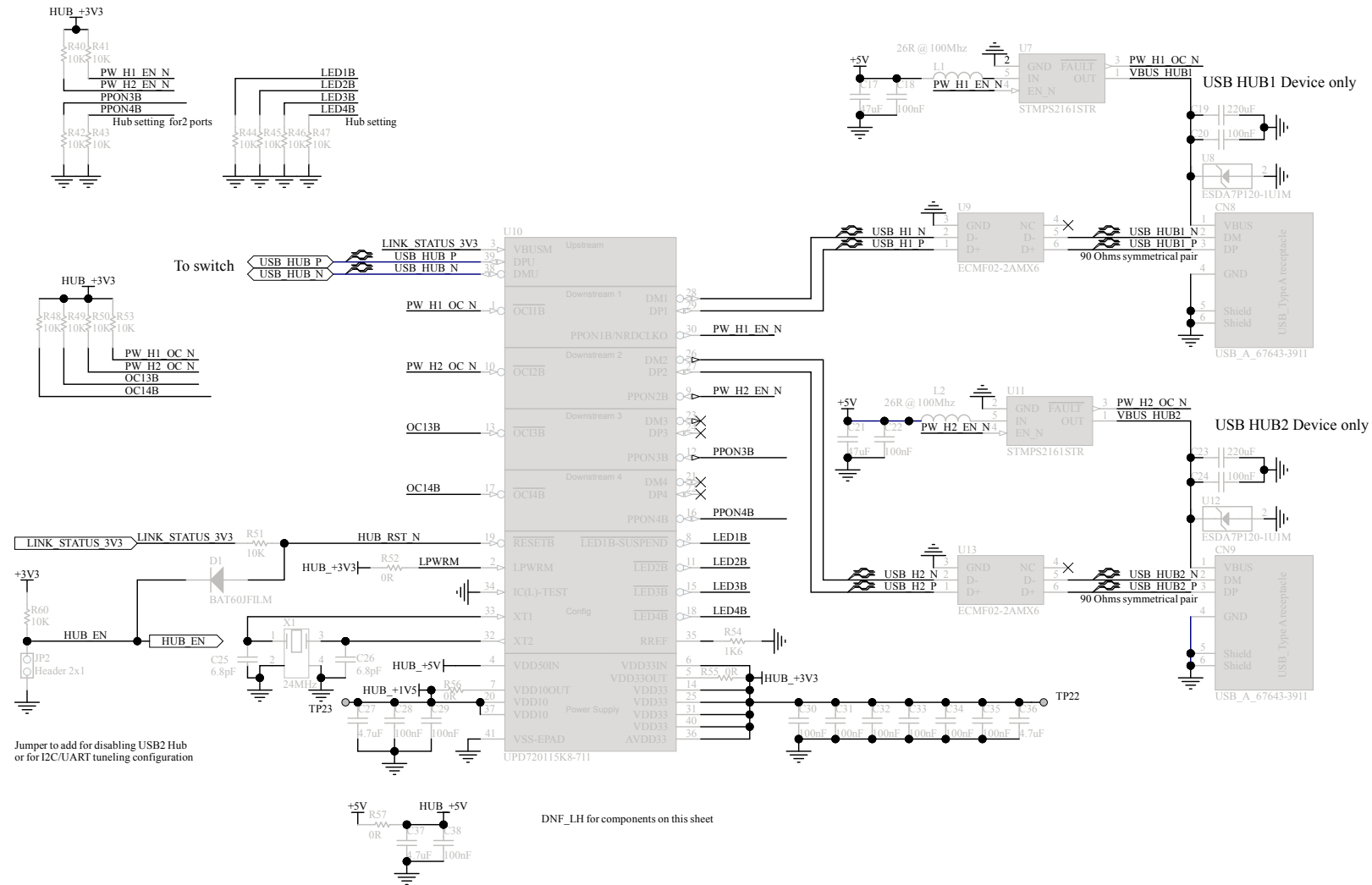
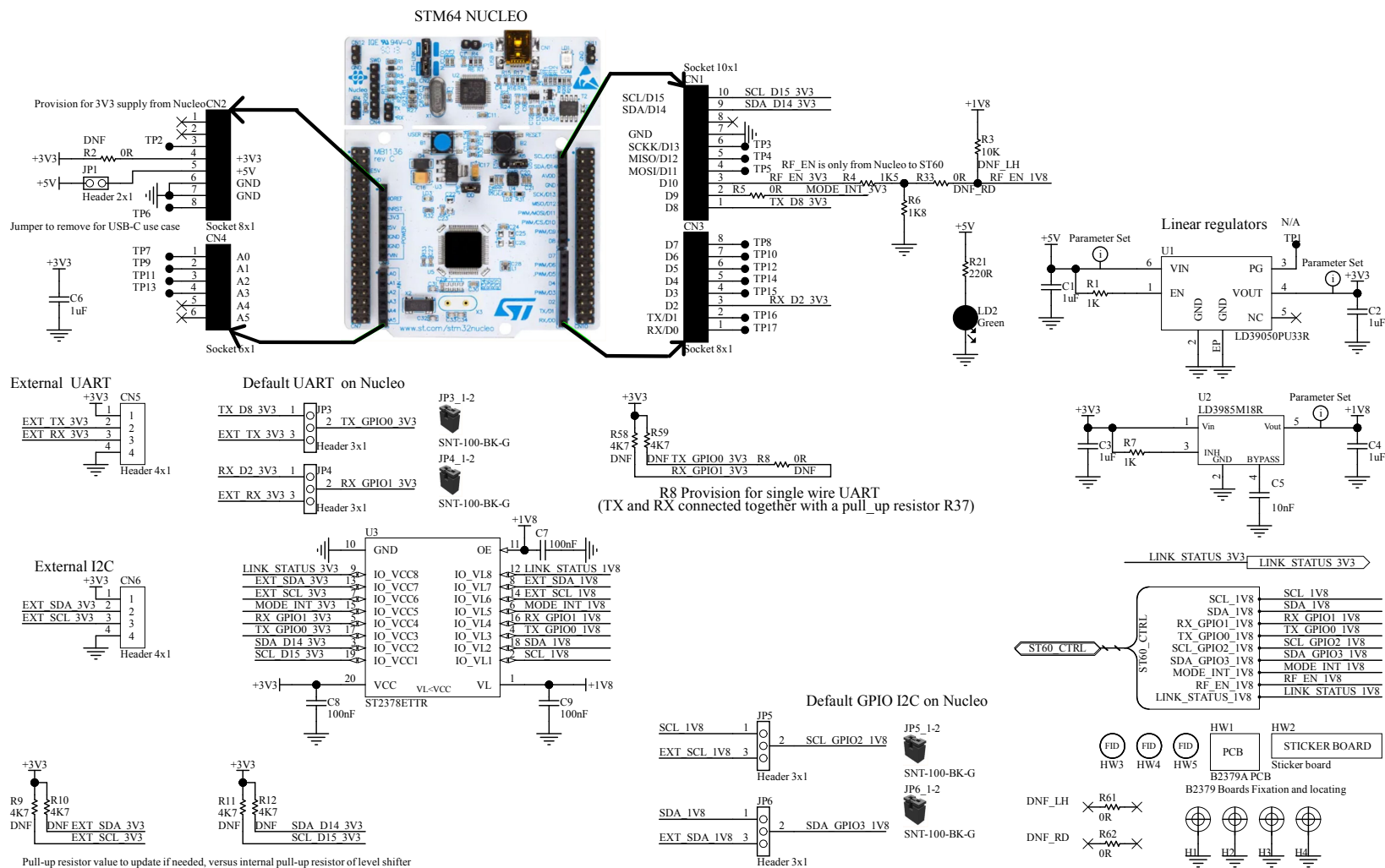
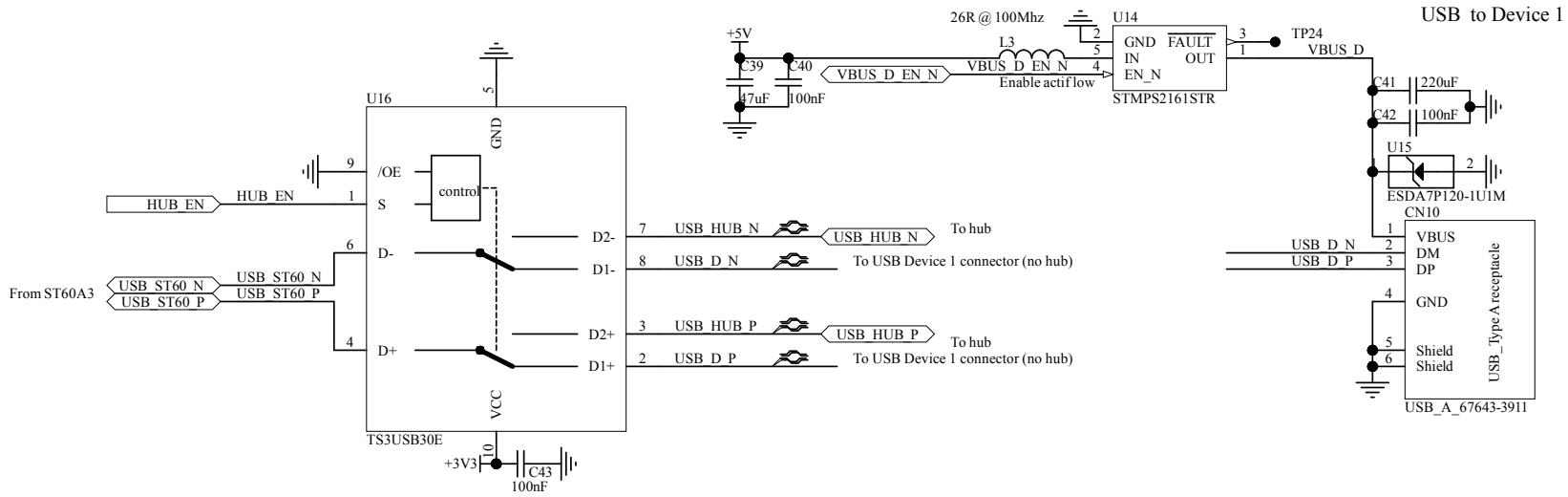




Figure 15. X-NUCLEO-60R1A1 circuit schematic (2 of 4) - Nucleo



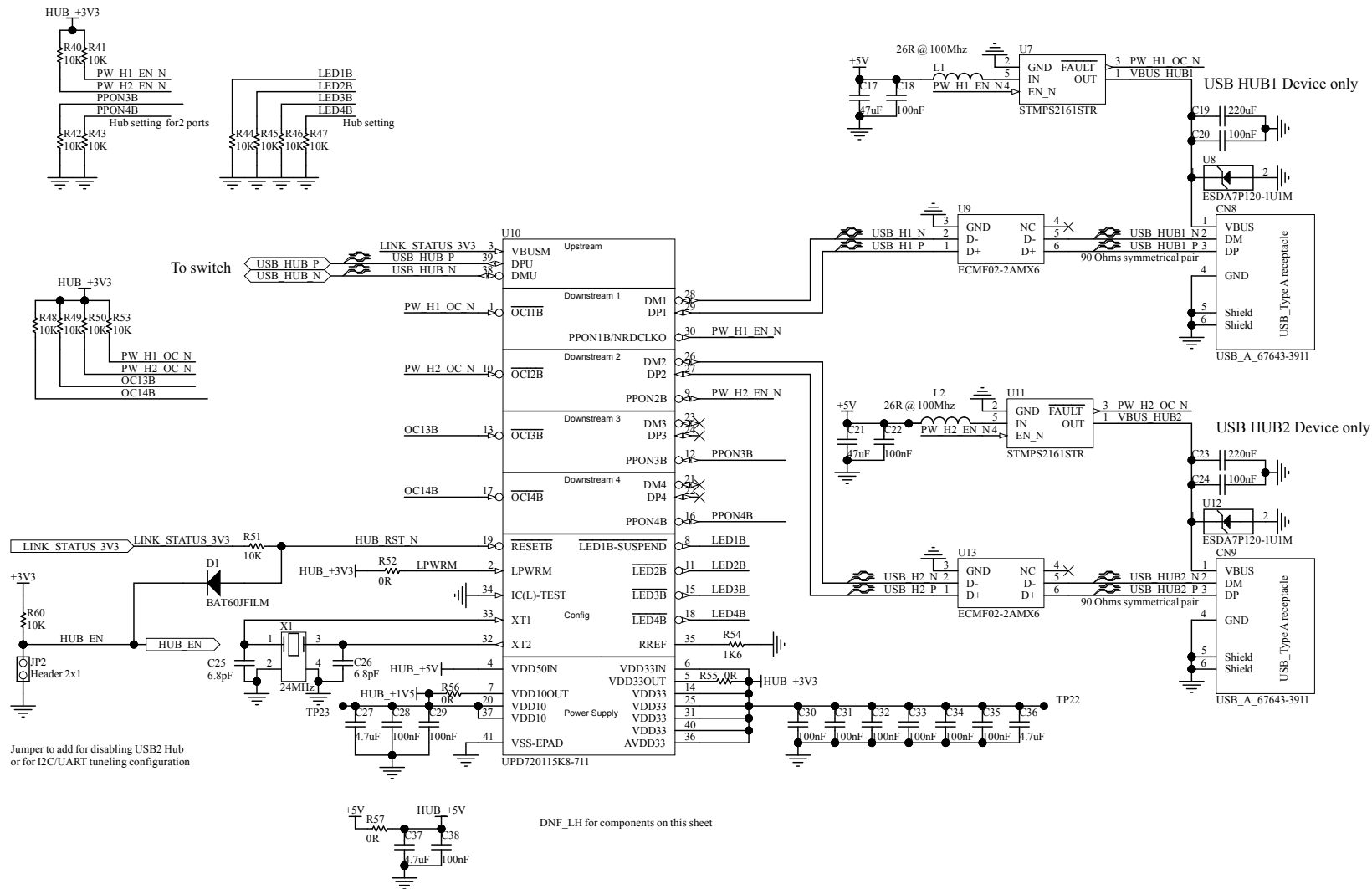


DNF_LH for components on this sheet

Figure 16. X-NUCLEO-60R1A1 circuit schematic (3 of 4) - Switch



Figure 17. X-NUCLEO-60R1A1 circuit schematic (4 of 4) - Hub



5 Bill of materials

Table 5. X-NUCLEO-60K1A1 bill of materials

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
1	1	-	Table 6. X-NUCLEO-60L1A1	B2379A Local assembly	ST	X-NUCLEO-60L1A1
2	1	-	Table 7. X-NUCLEO-60R1A1	B2379A Remote assembly	ST	X-NUCLEO-60R1A1

Table 6. X-NUCLEO-60L1A1 bill of materials

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
1	7	C1, C2, C3, C4, C6, C11, C12	1uF	Capacitor, MLCC, 1uF, 6.3V, X5R, +/- 10%, 0402, T=0.5mm	MURATA	GRM155R70J105KA12
2	1	C5	10nF	WCAP-CSGP Ceramic Capacitors 0402	WURTH ELEKTRONIK	885012205067
3	6	C7, C8, C9, C10, C15, C16	100nF	WCAP-CSGP Ceramic Capacitors 0402	WURTH ELEKTRONIK	885012205037
4	2	C13, C14	100pF	WCAP-CSGP Ceramic Capacitors 0402	WURTH ELEKTRONIK	885012005061
5	1	CN1	Socket 10x1	Socket, 10x1, 2.54mm, VR, TH, T=8.51mm/10mm	SAMTEC	SSQ-110-03-F-S
6	2	CN2, CN3	Socket 8x1	Socket, 8x1, 2.54mm, VR, TH, T=8.51mm/10mm	SAMTEC	SSQ-108-03-F-S
7	1	CN4	Socket 6x1	Socket, 6x1, 2.54mm, VR, TH, T=8.51mm/10mm	SAMTEC	SSQ-106-03-F-S
8	2	CN5, CN6	Header 4x1	Header, 4x1, 2.54mm, VR, TH, T=5.84mm/2.54mm	SAMTEC	TSW-104-07-G-S
9	1	CN7	USB_C_632723300011	Connector_USB_TypeC, 24pins, RA, TH, T=1.9mm (USB certified)	WURTH ELEKTRONIK	632723300011
10	1	HW1	B2379A PCB	PCB_B2379A		
11	1	JP1	Header 2x1	Header, 2x1, 2.54mm, VR, TH, T=5.84mm/2.54mm	SAMTEC	TSW-102-07-G-S
12	4	JP3, JP4, JP5, JP6	Header 3x1	Header, 3x1, 2.54mm, VR, TH, T=5.84mm/2.54mm	SAMTEC	TSW-103-07-F-S

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
13	4	JP3_1-2, JP4_1-2, JP5_1-2, JP6_1-2	SNT-100-BK-G	Shunt, 2.54mm, Black, 4.3A, 6.1mm, 5mR	SAMTEC	SNT-100-BK-G
14	2	LD1, LD2	Green	LED, Green, 2V, 20mA, 0603	EVERLIGHT	19-213SYGC/S530-E2/5T
15	1	Q1	BSR14	NPN Bipolar Transistor	ON SEMICONDUCTOR	BSR14
16	3	R1, R7, R38	1K	Resistor, 1K, 0402, +/-1%, 1/16W	YAGEO	RC0402FR-071KL
17	1	R4	1K5	Resistor, 1K5, 0402, +/-1%, 1/16W	YAGEO	RC0402FR-071K5L
18	7	R5, R14, R22, R26, R27, R33, R61	0R	Resistor, 0R, 0603, +/-5%, 1/10W	YAGEO	RC0603JR-070RL
19	1	R6	1K8	Resistor, 1K8, 0402, +/-1%, 1/16W	YAGEO	RC0402FR-071K8L
20	2	R13, R15	5K1	Resistor, 5K1, 0402, +/-1%, 1/16W	YAGEO	RC0402FR-075K1L
21	2	R16, R21	220R	Resistor, 220R, 0402, +/-1%, 1/16W	YAGEO	RC0402FR-07220RL
22	7	R18, R19, R23, R24, R25, R29, R30	0R	Resistor, 0R, 0402, +/-5%, 1/16W	YAGEO	RC0402JR-070RL
23	1	R34	10K	Resistor, 10K, 0402, +/-1%, 1/16W	YAGEO	RC0402FR-0710KL
24	1	U1	LD39050PU33R	LDO, 500mA, Low quiescent current and low noise voltage regulator	ST	LD39050PU33R
25	1	U2	LD3985M18R	LDO, Ultra low drop and low noise BiCMOS voltage regulators	ST	LD3985M18R
26	1	U3	ST2378ETTR	Translator, 8-bit, dual supply 1.71 V to 5.5 V, I/O VCC +/-15 kV ESD protection	ST	ST2378ETTR

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
27	1	U4	ST60A3H1C1CCEPY3	Transceiver, 60GHz, V-band contactless connectivity, with eUSB2, UART, GPIO, or I2C tunneling, VDDIO 1V8	ST	ST60A3H1C1CCEPY3
28	1	U5	PTN3222GMJ	1-port PTN3222 implements Repeater mode (eUSB2 to USB2 redriver)	NXP	PTN3222GMJ
29	1	U6	ECMF02-2AMX6	Diode, ESD protection, 1V5, 100nA, 6V, QFN-6	ST	ECMF02-2AMX6
30	0	C17, C21, C39	47uF	Capacitor, MLCC, 47uF, 10V, X5R, +/-20%, 0805, T=1.25mm	MURATA	GRM21BR61A476ME15 K
31	0	C18, C20, C22, C24, C28, C29, C30, C31, C32, C33, C34, C35, C38, C40, C42, C43	100nF	Capacitor, MLCC, 100nF, 16V, X7R, +/-10%, 0402, T=0.5mm	YAGEO	CC0402KRX7R7BB104
32	0	C19, C23, C41	220uF	Capacitor, MLCC, 220uF, 6V3, X5R, +/-20%, 1206, T=1.6mm	MURATA	GRM31CR60J227ME11
33	0	C25, C26	6.8pF	Capacitor, MLCC, 6.8pF, 50V, NPO, +/-0.25pF, 0402, T=0.5mm	YAGEO	CC0402CRNPO9BN6R8
34	0	C27, C36, C37	4.7uF	Capacitor, MLCC, 4.7uF, 6V3, X5R, +/-20%, 0402, T=0.5mm	MURATA	GRM155R60J475ME47
35	0	CN8, CN9, CN10	USB_A_67643-3911	USB_TypeA, RA, TH, T= 7.73mm (USB certified)	MOLEX	67643-3911
36	0	D1	BAT60JFILM	Diode, Schottky, 0V53, 1A, 10V, SOD323	ST	BAT60JFILM
37	0	JP1_1-2, JP2_1-2	SNT-100-BK-G	Shunt, 2.54mm, Black, 4.3A, 6.1mm, 5mR	SAMTEC	SNT-100-BK-G

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
38	0	JP2	Header 2x1	Header, 2x1, 2.54mm, VR, TH, T=5.84mm/ 2.54mm	SAMTEC	TSW-102-07-G-S
39	0	L1, L2, L3	26R @ 100Mhz	Ferrite bead, 26R @ 100Mhz, +/-25%, 6000mA, 0R007, 0603, T=0.75mm	MURATA	BLM18KG260TN1
40	0	R2, R8, R28, R62	0R	Resistor, 0R, 0603, +/-5%, 1/10W	YAGEO	RC0603JR-070RL
41	0	R3, R35, R36, R37, R39, R40, R41, R42, R43, R44, R45, R46, R47, R48, R49, R50, R51, R53, R60	10K	Resistor, 10K, 0402, +/-1%, 1/16W	YAGEO	RC0402FR-0710KL
42	0	R9, R10, R11, R12, R17, R20, R58, R59	4K7	Resistor, 4K7, 0402, +/-1%, 1/16W	YAGEO	RC0402FR-074K7L
43	0	R31, R32, R52, R55, R56, R57	0R	Resistor, 0R, 0402, +/-5%, 1/16W	YAGEO	RC0402JR-070RL
44	0	R54	1K6	Resistor, 1K6, 0402, +/-1%, 1/16W	YAGEO	RC0402FR-071K6L
45	0	U7, U11, U14	STMPS2161STR	Switch, Enhanced single channel power switches, SOT23-5L	ST	STMPS2161STR
46	0	U8, U12, U15	ESDA7P120-1U1M	Diode, ESD TVS, 5V5, 1.5uA, 6V8, QFN1610	ST	ESDA7P120-1U1M
47	0	U9, U13	ECMF02-2AMX6	Diode, ESD protection, 1V5, 100nA, 6V, QFN-6	ST	ECMF02-2AMX6

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
48	0	U10	UPD720115K8-711	IC, USB 2.0, 4 ports, Hi-Speed hub controller, -40° To +85°	RENESAS ELECTRONICS	UPD720115K8-711
49	0	U16	TS3USB30EDGSR	USB Switch, ESD-Protected, High-Speed USB 2.0, 480Mbit/s, 1:2 Multiplexer/ Demultiplexer switch with single enable	TEXAS INSTRUMENTS	TS3USB30EDGSR
50	0	X1	24MHz	Crystal, 24MHz, 6pF, +/-20ppm, 80R, 2x1.6mm	NDK	NX2016SA-24MHZ-EXS00A-CS10820

Table 7. X-NUCLEO-60R1A1 bill of materials

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
1	7	C1, C2, C3, C4, C6, C11, C12	1uF	Capacitor, MLCC, 1uF, 6.3V, X5R, +/- 10%, 0402, T=0.5mm	MURATA	GRM155R70J105KA12
2	1	C5	10nF	WCAP-CSGP Ceramic Capacitors 0402	WURTH ELEKTRONIK	885012205067
3	22	C7, C8, C9, C10, C15, C16, C18, C20, C22, C24, C28, C29, C30, C31, C32, C33, C34, C35, C38, C40, C42, C43	100nF	WCAP-CSGP Ceramic Capacitors 0402	WURTH ELEKTRONIK	885012205037
4	2	C13, C14	100pF	WCAP-CSGP Ceramic Capacitors 0402	WURTH ELEKTRONIK	885012005061
5	3	C17, C21, C39	47uF	Capacitor, MLCC, 47uF, 10V, X5R, +/-20%, 0805, T=1.25mm	MURATA	GRM21BR61A476ME15K
6	3	C19, C23, C41	220uF	Capacitor, MLCC, 220uF, 6V3, X5R, +/-20%, 1206, T=1.6mm	MURATA	GRM31CR60J227ME11
7	2	C25, C26	6.8pF	WCAP-CSRF High Frequency MLCC	WURTH ELEKTRONIK	885392005074
8	3	C27, C36, C37	4.7uF	WCAP-CSGP Ceramic Capacitors 0402	WURTH ELEKTRONIK	885012105008
9	1	CN1	Socket 10x1	Socket, 10x1, 2.54mm, VR, TH, T=8.51mm/ 10mm	SAMTEC	SSQ-110-03-F-S

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
10	2	CN2, CN3	Socket 8x1	Socket, 8x1, 2.54mm, VR, TH, T=8.51mm/ 10mm	SAMTEC	SSQ-108-03-F-S
11	1	CN4	Socket 6x1	Socket, 6x1, 2.54mm, VR, TH, T=8.51mm/ 10mm	SAMTEC	SSQ-106-03-F-S
12	2	CN5, CN6	Header 4x1	Header, 4x1, 2.54mm, VR, TH, T=5.84mm/ 2.54mm	SAMTEC	TSW-104-07-G-S
13	1	CN7	USB_C_632723300011	Connector_USB_TypeC, 24pins, RA, TH, T=1.9mm (USB certified)	WURTH ELEKTRONIK	632723300011
14	3	CN8, CN9, CN10	USB_A_67643-3911	USB_TypeA, RA, TH, T= 7.73mm (USB certified)	MOLEX	67643-3911
15	1	D1	BAT60JFILM	Diode, Schottky, 0V53, 1A, 10V, SOD323	ST	BAT60JFILM
16	1	HW1	B2379A PCB	PCB_B2379A		
17	2	JP1, JP2	Header 2x1	Header, 2x1, 2.54mm, VR, TH, T=5.84mm/ 2.54mm	SAMTEC	TSW-102-07-G-S
18	6	JP1_1-2, JP2_1-2, JP3_1-2, JP4_1-2, JP5_1-2, JP6_1-2	SNT-100-BK-G	Shunt, 2.54mm, Black, 4.3A, 6.1mm, 5mR	SAMTEC	SNT-100-BK-G
19	4	JP3, JP4, JP5, JP6	Header 3x1	Header, 3x1, 2.54mm, VR, TH, T=5.84mm/ 2.54mm	SAMTEC	TSW-103-07-F-S
20	3	L1, L2, L3	26R @ 100Mhz	WE-MPSB EMI Multilayer Power Suppression Bead	WURTH ELEKTRONIK	74279228260
21	2	LD1, LD2	Green	LED, Green, 2V, 20mA, 0603	EVERLIGHT	19-213SYGC/S530-E2/5T
22	1	Q1	BSR14	NPN Bipolar Transistor	ON SEMICONDUCTOR	BSR14
23	3	R1, R7, R38	1K	Resistor, 1K, 0402, +/-1%, 1/16W	YAGEO	RC0402FR-071KL
24	16	R3, R34, R40, R41, R42, R43, R44, R45, R46, R47, R48, R49, R50, R51, R53, R60	10K	Resistor, 10K, 0402, +/-1%, 1/16W	YAGEO	RC0402FR-0710KL
25	1	R4	1K5	Resistor, 1K5, 0402, +/-1%, 1/16W	YAGEO	RC0402FR-071K5L
26	4	R5, R14, R28, R62	0R	Resistor, 0R, 0603, +/-5%, 1/10W	YAGEO	RC0603JR-070RL

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
27	1	R6	1K8	Resistor, 1K8, 0402, +/-1%, 1/16W	YAGEO	RC0402FR-071K8L
28	2	R13, R15	5K1	Resistor, 5K1, 0402, +/-1%, 1/16W	YAGEO	RC0402FR-075K1L
29	2	R16, R21	220R	Resistor, 220R, 0402, +/-1%, 1/16W	YAGEO	RC0402FR-07220RL
30	11	R18, R19, R23, R24, R25, R31, R32, R52, R55, R56, R57	0R	Resistor, 0R, 0402, +/-5%, 1/16W	YAGEO	RC0402JR-070RL
31	1	R54	1K6	Resistor, 1K6, 0402, +/-1%, 1/16W	YAGEO	RC0402FR-071K6L
32	1	U1	LD39050PU33R, DFN6 3x3	LDO, 500mA, Low quiescent current and low noise voltage regulator	ST	LD39050PU33R
33	1	U2	LD3985M18R, SOT23-5L	LDO, Ultra low drop and low noise BiCMOS voltage regulators	ST	LD3985M18R
34	1	U3	ST2378ETTR, TSSOP-20	Translator, 8-bit, dual supply 1.71 V to 5.5 V, I/O VCC +/-15 kV ESD protection	ST	ST2378ETTR
35	1	U4	ST60A3H1C1CCEPY3, VFBGA 23 AiP LP 2.9x4.1x0.8 mm	Transceiver, 60GHz, V-band contactless connectivity, with eUSB2, UART, GPIO, or I2C tunneling, VDDIO 1V8	ST	ST60A3H1C1CCEPY3
36	1	U5	PTN3222GMJ	1-port PTN3222 implements Repeater mode (eUSB2 to USB2 redriver)	NXP	PTN3222GMJ
37	3	U6, U9, U13	ECMF02-2AMX6, QFN-6L	Diode, ESD protection, 1V5, 100nA, 6V, QFN-6	ST	ECMF02-2AMX6
38	3	U7, U11, U14	STMP2161STR, SOT23-5L	Switch, Enhanced single channel power switches	ST	STMP2161STR
39	3	U8, U12, U15	ESDA7P120-1U1M	Diode, ESD TVS, 5V5, 1.5uA, 6V8, QFN1610	ST	ESDA7P120-1U1M
40	1	U10	UPD720115K8-711	IC, USB 2.0, 4 ports, Hi-Speed hub controller, -40° To +85°	RENESAS ELECTRONICS	UPD720115K8-711
41	1	U16	TS3USB30EDGSR	USB Switch, ESD-Protected, High-Speed USB 2.0, 480Mbit/s, 1:2 Multiplexer/Demultiplexer switch with single enable	TEXAS INSTRUMENTS	TS3USB30EDGSR
42	1	X1	24MHz	Crystal, 24MHz, 6pF, +/-20ppm, 80R, 2x1.6mm	NDK	NX2016SA-24MHZ-EXS00A-CS10820

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
43	0	R2, R8, R22, R26, R27, R33, R61	0R		YAGEO	RC0603JR-070RL
44	0	R9, R10, R11, R12, R17, R20, R58, R59	4K7	Resistor, 0R, 0603, +/-5%, 1/10W	YAGEO	RC0402FR-074K7L
45	0	R29, R30	0R	Resistor, 4K7, 0402, +/-1%, 1/16W	YAGEO	RC0402JR-070RL
46	0	R35, R36, R37, R39	10K	Resistor, 0R, 0402, +/-5%, 1/16W	YAGEO	RC0402FR-0710KL
				Resistor, 10K, 0402, +/-1%, 1/16W		

6 Kit versions

Table 8. X-NUCLEO-60K1A1 versions

PCB version	Schematic diagrams	Bill of materials
XN\$60K1A1A ⁽¹⁾	XN\$60K1A1A schematic diagrams	XN\$60K1A1A bill of materials

1. This code identifies the X-NUCLEO-60K1A1 evaluation kit first version. The kit consists of an X-NUCLEO-60L1A1 whose version is identified by the code XN\$60L1A1A and an X-NUCLEO-60R1A1 whose version is identified by the code XN\$60R1A1A.

7 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

The kit X-NUCLEO-60K1A1 is in conformity with the essential requirements of the Directive 2014/53/EU (RED) and of the Directive 2011/65/EU (RoHS II), including subsequent revisions and additions, as well as amended by the Delegated Directive 2015/863/EU (RoHS III). Applied harmonized standards are listed in the EU Declaration of Conformity.

Notice for the United Kingdom

The kit X-NUCLEO-60K1A1 is in compliance with the UK Radio Equipment Regulations 2017 (UK SI 2017 No. 1206 and amendments) and with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 (UK SI 2012 No. 3032 and amendments). Applied standards are listed in the UK Declaration of Conformity.

Revision history

Table 9. Document revision history

Date	Revision	Changes
16-Apr-2025	1	Initial release.
06-May-2025	2	Updated Section 2.1: Overview .

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