

Getting started with the X-NUCLEO-LIV4A1 expansion board based on the Teseo-LIV4F Tiny GNSS dual-bands low power module for STM32 Nucleo

Introduction

The **X-NUCLEO-LIV4A1** expansion board is based on the **Teseo-LIV4F** tiny dual-band GNSS Low power and measurement engine modules.

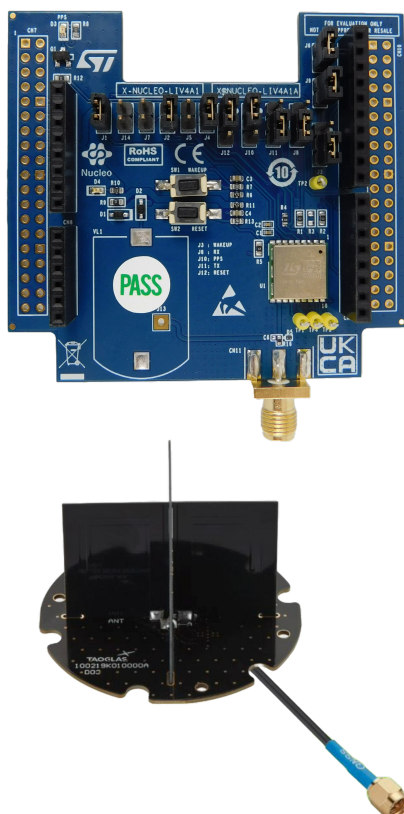
It represents an affordable, easy-to-use, global navigation satellite system (GNSS) module, embedding TESEO IV single die GNSS receiver IC working simultaneously on multiple constellations GPS/Galileo/ Glonass/BeiDou/QZSS) able to provide positioning (Teseo-LIV4F) in your **STM32 Nucleo** project.

The Teseo-LIV4F is a compact (9.7 x 10.1 mm) module that provides superior accuracy thanks to the on-board temperature-compensated crystal oscillator (TCXO) and a reduced time-to-first fix (TTFF) with its dedicated real-time clock (RTC) oscillator.

The Teseo-LIV4F module runs the GNSS firmware (**X-CUBE-GNSS1**) to perform all GNSS operations including acquisition, tracking, navigation, and data output without external memory support.

The **X-NUCLEO-LIV4A1** expansion board is compatible with the Arduino® UNO R3 connector and the ST morpho connector, so it can be plugged to the STM32 Nucleo development board and stacked with additional STM32 Nucleo expansion boards

Figure 1. X-NUCLEO-LIV4A1 expansion board



1 Getting started

1.1 Board overview

The **X-NUCLEO-LIV4A1** expansion board for **STM32 Nucleo** is a GNSS multiconstellation and multibands receiver with that covers a wide range of applications where geo-location is required.

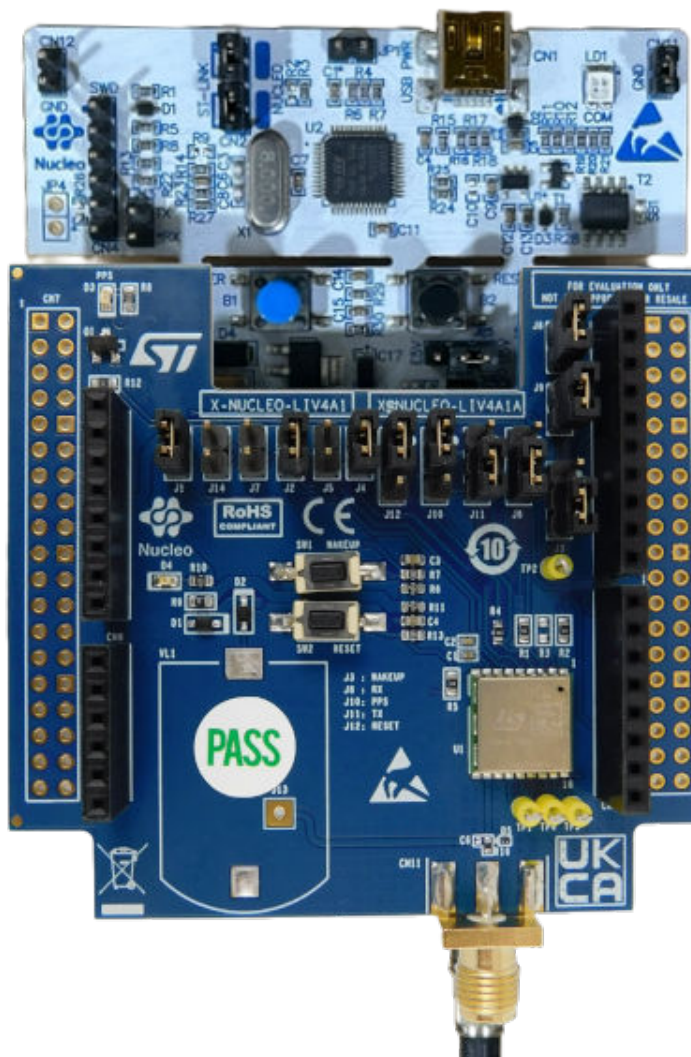
The key features are:

- Operating supply voltage: 3.3 - 5 V
- Ambient temperature: +10/+50 °C
- Sensitivity: -162 dBm (tracking mode)
- Interfaces:
 - a UARTport
 - an I²Cport
 - Configurable digital I/O
 - EXTINT input for wakeup
- NMEA protocol
- Assisted GNSS:
 - Autonomous AGNSS
 - Real-timeserver-based
- Simultaneous multi constellation and multi band GNSS
 - GPS
 - Galileo
 - Glonass
 - BeiDou
 - QZSS
- Compatible with **STM32 Nucleo** boards
- Compatible with the Arduino™ UNO R3 connector
- SMA female antenna connector
- CE Certified
- RoHS and WEEE compliant

1.2 Hardware and software requirements

The X-NUCLEO-LIV4A1 must be plugged onto an STM32 Nucleo development board through the Arduino UNO R3 connectors, as shown in the figure below.

Figure 2. X-NUCLEO-LIV4A1 expansion board connected to an STM32 Nucleo development board



The X-NUCLEO-LIV4A1 can be connected to any STM32 Nucleo development board, even though complete testing has been performed on the NUCLEO-F401RE board.

To use the STM32 Nucleo development boards with the X-NUCLEO-LIV4A1 expansion board, the following software and hardware specifications are required:

- a PC with Microsoft Windows® 10 to install the software package (X-CUBE-GNSS1);
- an STM32 Nucleo development board (NUCLEO-F401RE);
- a type A to mini-B USB cable to connect the STM32 Nucleo to the PC;
- the X-CUBE-GNSS1 software package;
- TESEO-SUITE.

The installation of the X-CUBE-GNSS1 and the TESEO-SUITE graphical user interface utility on the user PC requires:

- 128 MB of RAM;
- 40 MB of hard disk space.

1.3 Board setup

To set up the **X-NUCLEO-LIV4A1** expansion board, follow the procedure below.

Step 1. Check the jumper position shown below:

Table 1. X-NUCLEO-LIV4A1 expansion board - jumper 1 default settings

Signal	Jumper	Configuration
I ² C-SCL	J6	Closed
I ² C-SDA	J9	Closed
VCC-VCC_IO	J1	Closed
VBATT	J2	Closed
PRG	J5	Open
PRG	J4	Open
PRG	J7	Open
PRG	J14	Open
WAKEUP	J3	2-3
SYS_nRESET	J12	1-2
UART1-RX	J8	1-2
UART1_TX	J11	2-3
SYS_PPS	J10	1-2

Step 2. Connect the **X-NUCLEO-LIV4A1** to the **STM32 Nucleo** development board.

Step 3. Power the **STM32 Nucleo** development board using the type A mini-B USB cable.

Step 4. Program the **STM32 Nucleo** development board using the firmware example provided.

Step 5. Reset the MCU via the **STM32 Nucleo** development board **[reset]** button.
 The evaluation kit is ready-to-use.

2 Hardware description

2.1 X-NUCLEO-LIV4A1 expansion board for STM32 Nucleo

The X-NUCLEO-LIV4A1 allows testing the [Teseo-LIV4F](#) GNSS module functionality via the firmware package contained in the [X-CUBE-GNSS1](#) software.

Important: Program the microcontroller on the [STM32 Nucleo](#) development board.

The [Teseo-LIV4F](#) module and the [STM32 Nucleo](#) development board communicate through the expansion board connectors (CN5, CN6, CN8, and CN9) as listed in the tables below.

Table 2. Interconnection between STM32 Nucleo development board and X-NUCLEO-LIV4A1 expansion board (left-side connectors)

STM32 Nucleo pins	X-NUCLEO-LIV4A1		
	CN6 (power)		CN8 (analog)
	Pin	Signal	
NC	X		
IOREF	2	3V3	
RESET	3		
3V3	4	3V3	
5V	5		
GND	6	GND	
GND	7	GND	
VIN	8		
A0			1
A1			2
A2			3
A3			4
A4			5
A5			6

Table 3. Interconnection between STM32 Nucleo development board and X-NUCLEO-LIV4A1 expansion board (right-side connectors)

STM32 Nucleo pins	X-NUCLEO-LIV4A1			
	CN5 (digital)		CN9 (digital)	
	Pin	Signal	Pin	Signal
D15	10	SCL		
D14	9	SDA		
AREF	8			
GND	7	GND		
D13	6	WAKEUP		
D12	5			
D11	4			
D10	3			
D9	2	RESET		

STM32 Nucleo pins	X-NUCLEO-LIV4A1			
	CN5 (digital)		CN9 (digital)	
	Pin	Signal	Pin	Signal
D8	1	RX0		
D7			8	RESET
D6			7	SYS_PPS
D5			6	
D4			5	WAKEUP
D3			4	
D2			3	TX0/SYS_PPS
D1			2	RX
D0			1	TX

2.2

Teseo-LIV4F module

The **X-NUCLEO-LIV4A1** expansion board embeds the **Teseo-LIV4F** multi constellation and multi band module. The **Teseo-LIV4F** is an easy-to-use, global navigation satellite system (GNSS) module, embedding TESEO IV single die GNSS receiver IC working simultaneously on multiple constellations GPS/Galileo/ Glonass/BeiDou/ QZSS).

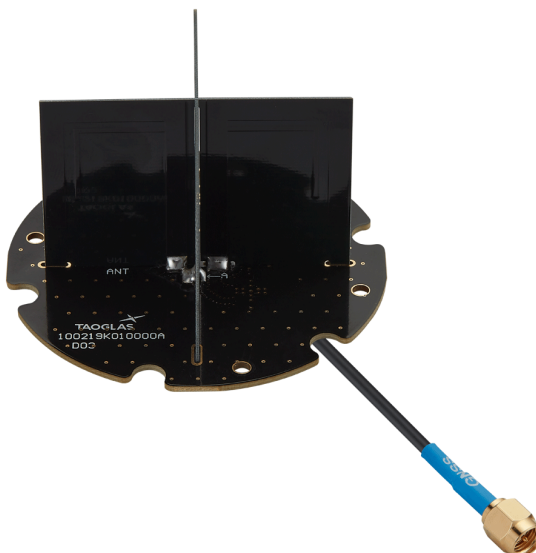
Table 4. Teseo-LIV4F module

Feature	Description
Sales type	Teseo-LIV4A1
Package	LCC-18 pins (9.7 mm x 10.1 mm)
Operating voltage	3.0 V to 3.63 V

2.3 GNSS antenna

The GNSS antenna (manufacturer Taoglas, part number EAHP.50.01.0100D) is attached to the board through a SMA connector.

Figure 3. Taoglas (EAHP.50.01.0100D) GNSS Antenna



Important: The antenna provided by the manufacturer can be replaced only with an identical one.

2.4 UART, I²C, and GPIO connection options

The [Teseo-LIV4F](#) module embedded in the [X-NUCLEO-LIV4A1](#) expansion board can be used to work with the board in different configurations when different expansion boards are used and a conflict of signals occurs.

Table 5. X-NUCLEO-LIV4A1 expansion board: Teseo-LIV4F interface with the STM32 Nucleo development board

Signal	Pins	STM32 Nucleo (optional connections)
I ² C-SCL	D15	-
I ² C-SDA	D14	-
Wakeup	D13	D4
Reset	D7	D9
PPS	D6	D2
UART-RX	D8	D1
UART-TX	D2	D0

For the optional connections, modify the firmware according to the STM32 resources to be used.

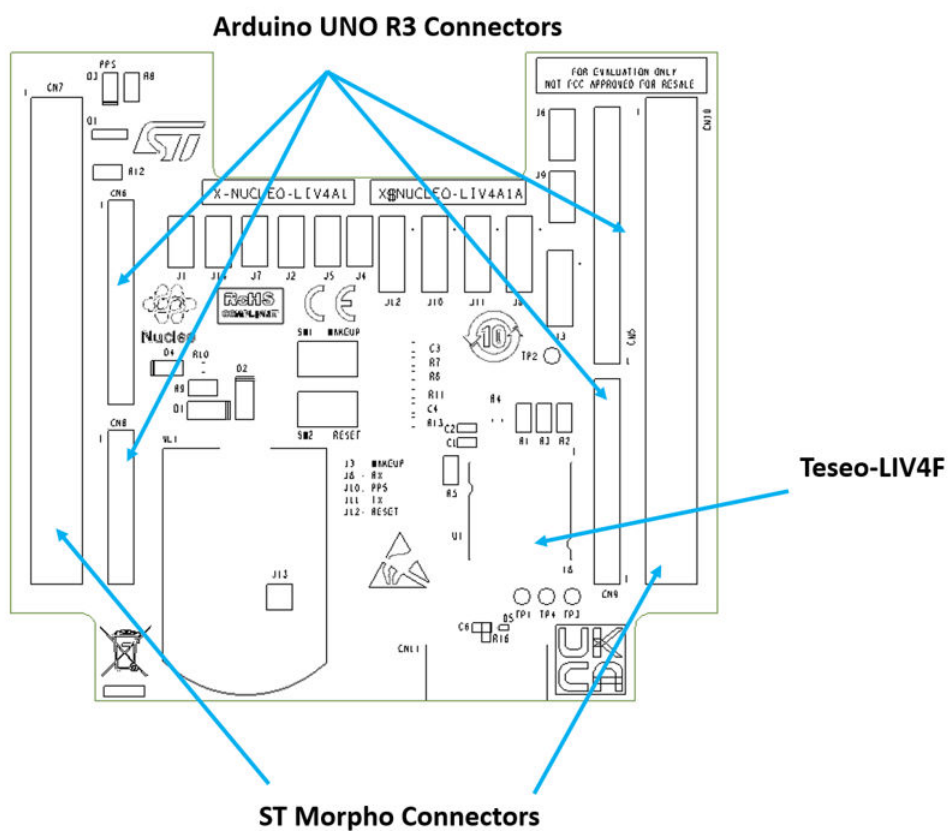
2.5 Current measurement

To monitor the [Teseo-LIV4F](#) module power consumption, insert an ammeter probe between J1 pin (VCC) and J2 pin (VBAT).

As the [Teseo-LIV4F](#) power consumption is very low during most of its operating time, an accurate instrument in the range of few μ A is required.

2.6 X-NUCLEO-LIV4A1 expansion board component placement

Figure 4. X-NUCLEO-LIV4A1 expansion board component placement details



Schematic diagrams

Figure 5. X-NUCLEO-LIV4A1 circuit schematic (1 of 3)

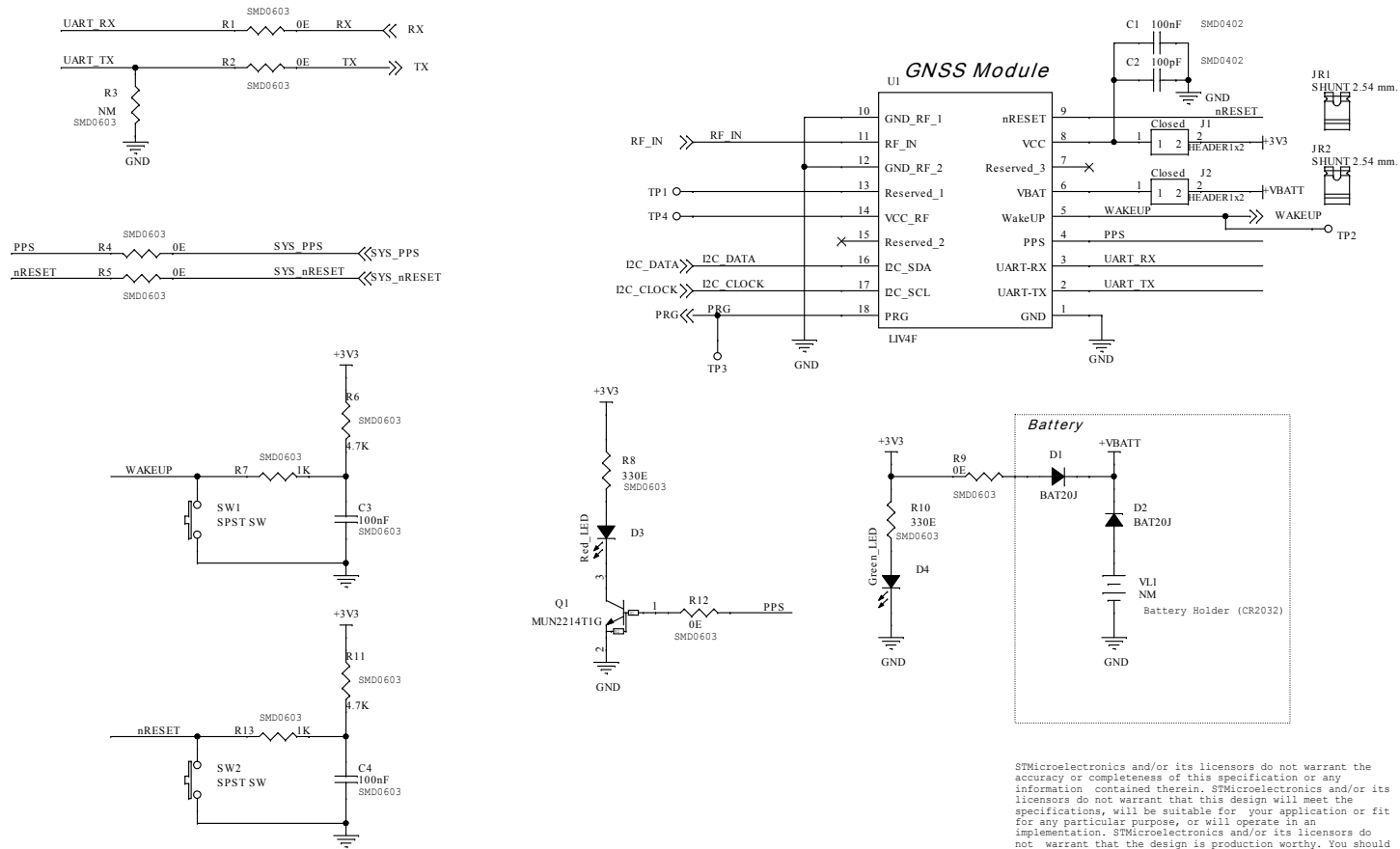


Figure 6. X-NUCLEO-LIV4A1 circuit schematic (2 of 3)

NUCLEO CONNECTORS

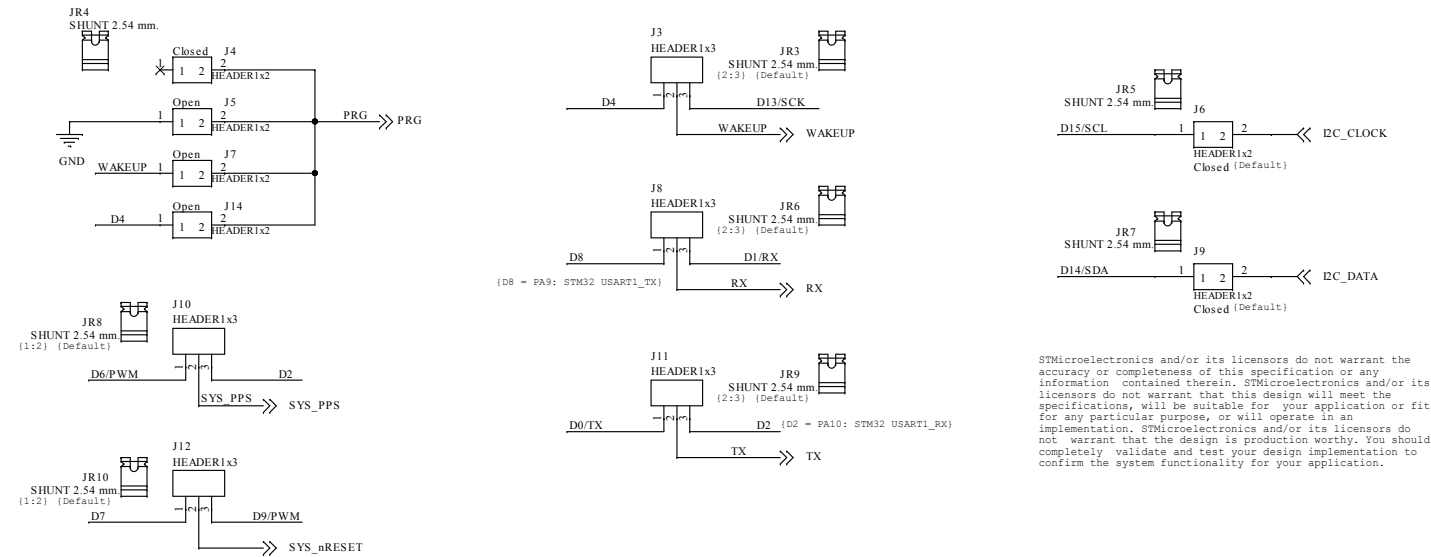
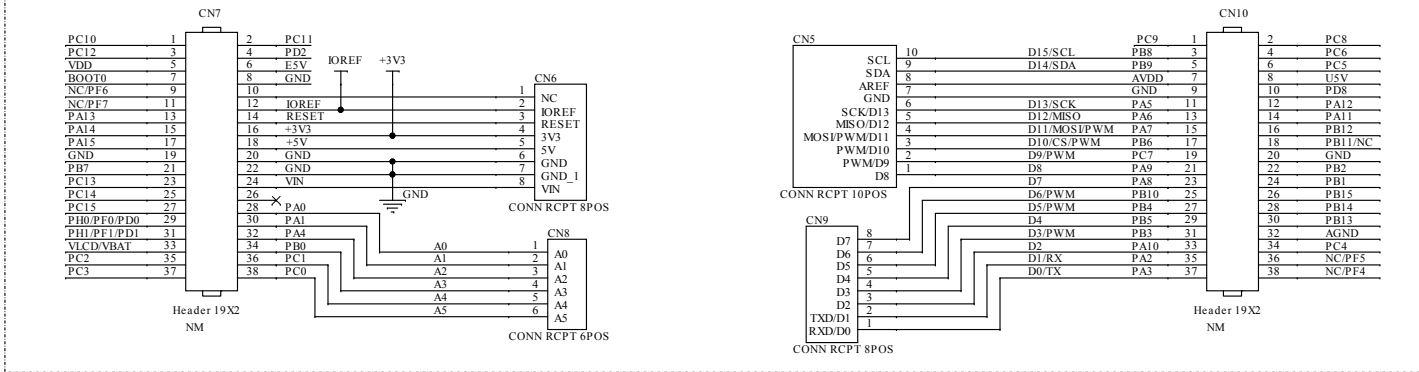
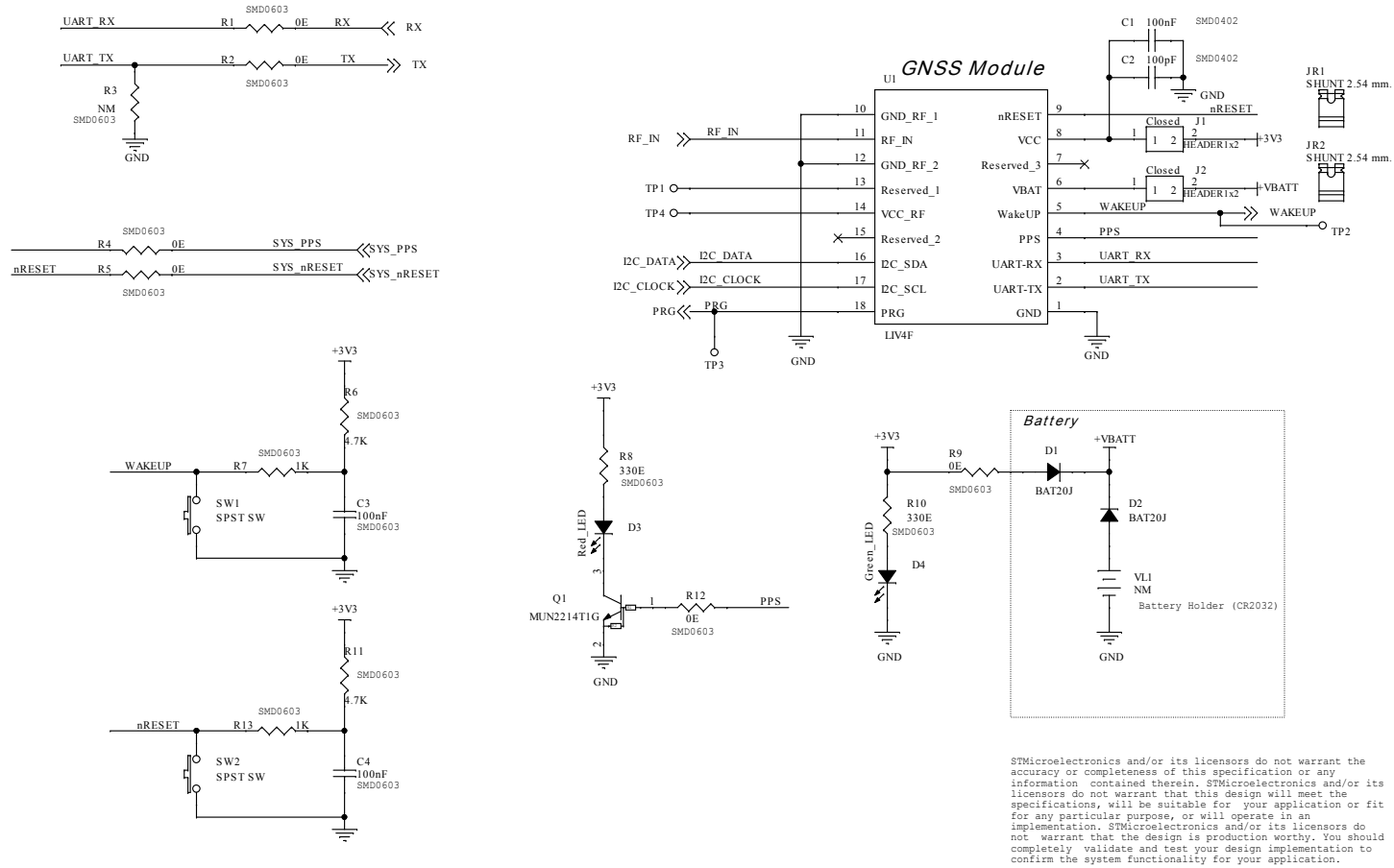


Figure 7. X-NUCLEO-LIV4A1 circuit schematic (3 of 3)



4 Bill of materials

Table 6. X-NUCLEO-LIV4A1 bill of materials

Item	Q.ty	Ref.	Value	Description	Manufacturer	Order code
1	1	CN11	SMA	SMA JACK - EDGE MOUT	Molex	73251-1150
2	1	CN5	ARDUINO_10x1	ELEVATED SOCKET	4UCONN	15286
3	2	CN6,CN9	ARDUINO_8x1	ELEVATED SOCKET	4UCONN	15284
4	2	CN7,CN10	ST_MORPHO_19 x2	ELEVATED SOCKET	4UCONN	8413
5	1	CN8	ARDUINO_6x1	ELEVATED SOCKET	4UCONN	15282
6	1	C1	100nF	X7R SMD Chip Capacitor	MURATA	GRM155R71C104KA88 D
7	1	C2	100pF	COG SMD Chip Capacitor	MURATA	GRM1555C1H101JA01 D
8	2	C3,C4	100nF	X7R SMD Chip Capacitor	Taiyo Yuden	EMK107B7104KA-T
9	1	C6	56pF	X7R SMD Chip Capacitor	MURATA	GRM1555C1H560JA01 D
10	2	D1,D2	BAT20JFILM, SOD323	Diode Schottky	ST	BAT20JFILM
11	1	D3	Red_LED	Diode LED	Lite-On	LTST-C193KRKT-5A
12	1	D4	Green_LED	Diode LED	Lite-On	LTST-C191KGKT
13	1	D5	ESDARF02-1BU2 CK	Diode - ESD protection	ST	ESDARF02-1BU2CK
14	10	JR1 JR2 JR3 JR4 JR5 JR6 JR7 JR8 JR9 JR10	2.54 mm	JUMPER	TE Connectivity / AMP	1-382811-6
15	8	J1 J2 J4 J5 J6 J7 J9 J14	HEADER1x2	2.54 PIN HEADER SINGLE ROW 2 PIN	Würth Elektronik	61300211121
16	5	J3 J8 J10 J11 J12	HEADER1x3	2.54 PIN HEADER SINGLE ROW 3 PIN	Würth Elektronik	61300311121
17	1	J13	Taoglas GVLB258.A	Antenna(RF Antenna, Patch)	TAOGLAS	CGGBP.18.4.A.02
18	1	Q1	MUN2214T1G	NPN Digital Transistor	ON Semiconductor	MUN2214T1G
19	2	R8,R10	330E	SMD Chip Resistor	Stackpole Electronics Inc	RMCF0603FT330RTR- ND
20	6	R1 R2 R4 R5 R9 R12	0E	SMD Chip Resistor	Stackpole Electronics Inc	RMCF0603ZT0R00
21	1	R3	10K	SMD Chip Resistor	Stackpole Electronics Inc	RMCF0603FT10K0
22	2	R6 R11	4.7K	SMD Chip Resistor	Yageo	RC0603FR-074K7L

Item	Q.ty	Ref.	Value	Description	Manufacturer	Order code
23	2	R7 R13	1K	SMD Chip Resistor	Yageo	AF0603FR-071KL
24	1	R16	0E	SMD Chip Resistor	Stackpole Electronics Inc	RMCF0402ZT0R00
25	2	SW1 SW2	SPST SW	6.0*3.5mm Tact Switch	TE Connectivity ALCOSWITCH	1437566-3
26	4	TP1 TP2 TP3 TP4	TP	TESTPOINT	Keystone Electronics	5117 (or 5000 or 5001)
27	1	U1	Teseo-LIV4F, 18LD LGA 9.7X10.1X2.55M M PITCH	Simultaneous multiconstellation and multi band GNSS (GPS/ Galileo/Glonass/ BeiDou/QZSS) GNSS RECIEVR	ST	TESEO-LIV4FTR
28	1	VL1	Battery Holder	COIN BATTERY HOLDER (CR2032)	Harwin Inc.	S8421-45R
Other Parts						
29	1	Antenna			Taoglas	EAHP.50.01.0100D

5 Board versions

Table 7. X-NUCLEO-LIV4A1 versions

Finished good	Schematic diagrams	Bill of materials
X\$NUCLEO-LIV4A1A ⁽¹⁾	X\$NUCLEO-LIV4A1A schematic diagrams	X\$NUCLEO-LIV4A1A bill of materials

1. This code identifies the X-NUCLEO-LIV4A1 evaluation board first version.

6 Regulatory compliance information

Formal Notices Required by the U.S. Federal Communications Commission (FCC)

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.

Formal Product Notice Required by Industry Canada

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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 evaluation kit is in conformity with the essential requirements of the Directive 2014/53/EU (RED) and of the Directive 2015/863/EU (RoHS). Applied harmonized standards are listed in the EU Declaration of Conformity.

Notice for United Kingdom

The evaluation kit 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 8. Document revision history

Date	Revision	Changes
12-Feb-2024	1	Initial release.

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