

Getting started with the X-NUCLEO-GNSS1A1 expansion board based on Teseo-LIV3F tiny GNSS module for STM32 Nucleo

Introduction

The X-NUCLEO-GNSS1A1 expansion board is based on the Teseo-LIV3F tiny GNSS module.

It represents an affordable, easy-to-use, global navigation satellite system (GNSS) module, embedding a TeseoIII single die standalone positioning receiver IC, usable in different configurations in your STM32 Nucleo project.

The Teseo-LIV3F is a compact (9.7x10.1 mm) module that provides superior accuracy thanks to the on-board 26 MHz temperature compensated crystal oscillator (TCXO) and a reduced time-to-first fix (TTFF) with its dedicated 32 KHz real-time clock (RTC) oscillator.

The Teseo-LIV3F 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-GNSS1A1 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-GNSS1A1 expansion board



1 Getting started

1.1 Board overview

The X-NUCLEO-GNSS1A1 expansion board for [STM32 Nucleo](#) is a GNSS multi-constellation receiver covering a wide range of applications where geo-location is required.

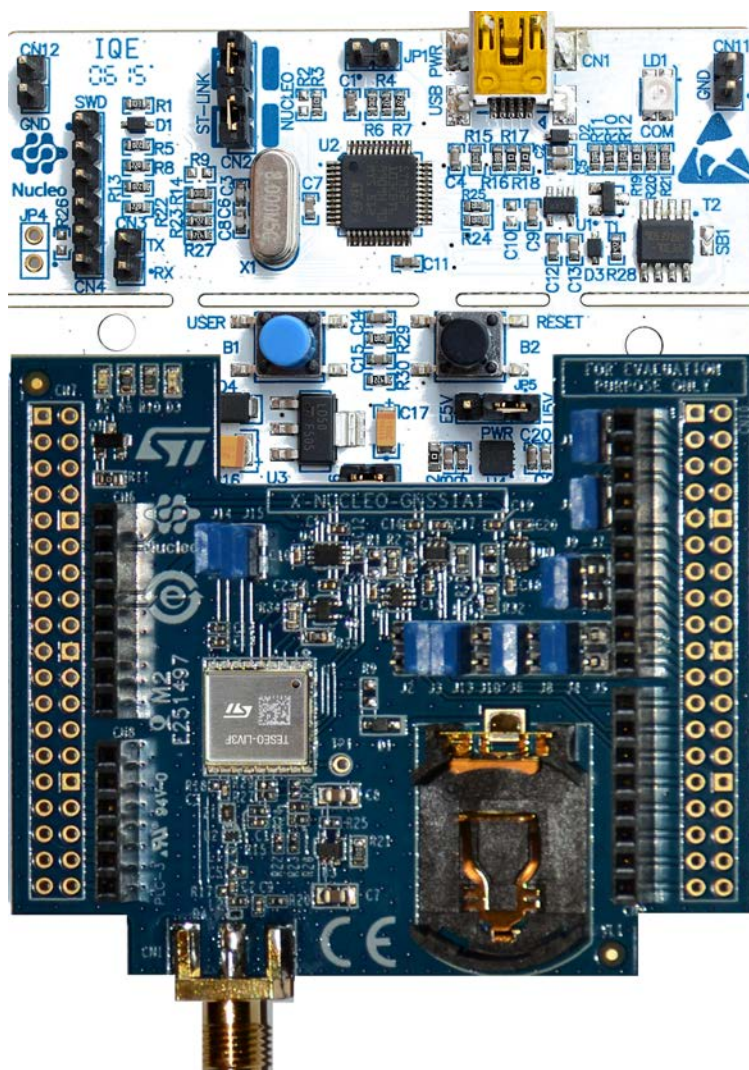
The key features are:

- Operating supply voltage: 3.3 - 5 V
- Ambient temperature: -40/+85 °C
- Sensitivity: -162 dBm indoor (tracking mode)
- Interfaces:
 - a UART port
 - an I²C port
 - Configurable digital I/O timepulse
 - EXTINT input for wakeup
- NMEA protocol
- Assisted GNSS:
 - Predictive autonomous
 - Predictive server-based
 - Real-time server-based
- Compatible with [STM32 Nucleo](#) boards
- Compatible with the Arduino™ UNO R3 connector
- LNA and SAW filter on the RF path
- SMA female antenna connector
- Battery holder
- RoHS and WEEE compliant

1.2 Hardware and software requirements

The [X-NUCLEO-GNSS1A1](#) must be plugged onto an [STM32 Nucleo](#) board through the Arduino™ UNO R3 connectors as shown in the figure below.

Figure 2. X-NUCLEO-GNSS1A1 expansion board connected to an STM32 Nucleo board



The X-NUCLEO-GNSS1A1 can be connected to any STM32 Nucleo board, even though complete testing has been performed on the [NUCLEO-F401RE](#) board.

To use the STM32 Nucleo development boards with the X-NUCLEO-GNSS1A1 expansion board, the following software and hardware specifications are required:

- a PC with Microsoft Windows® (7, 8 and above) to install the software package (X-CUBE-GNSS1A1)
- an STM32 Nucleo development board [NUCLEO-L053R8](#) or [NUCLEO-F401RE](#).
- a type A to Mini-B USB cable to connect the STM32 Nucleo board to the PC
- the X-CUBE-GNSS1A1 software package (download from the X-NUCLEO-GNSS1A1 page on www.st.com)
- [TESEO-SUITE](#)

The installation of the X-CUBE-GNSS1A1 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-GNSS1A1](#) expansion board, follow the procedure below.

Step 1. Check the jumper position shown below:

Table 1. X-NUCLEO-GNSS1A1 expansion board - jumper 1 default settings

Signal	Jumper	Pins	Configuration
I ² C-SCL	J11	d15	Open
I ² C-SDA	J12	d14	Open
Wakeup	J9	d13	Closed
Wakeup	J7	d4	Open
Reset	J10	d9	Open
Reset	J13	d7	Closed
PPS	J6	d6	Closed
PPS	J8	d2	Open
UART-RX	J3	d8	Closed
UART-TX	J4	d2	Closed
UART-RX	J2	d1	Open
UART-TX	J5	d0	Open
VCC-VCC_IO	J14	-	Closed
V14Bat	J15	-	Closed

- Step 2.** Connect the X-NUCLEO-GNSS1A1 to the [STM32 Nucleo](#) board
- Step 3.** Power the STM32 Nucleo board using the type A mini-B USB cable
- Step 4.** Program the STM32 Nucleo board using the firmware example provided
- Step 5.** Reset the MCU via the STM32 Nucleo board reset button
 The evaluation kit is ready-to-use.

2 Hardware description

2.1 X-NUCLEO-GNSS1A1 expansion board for STM32 Nucleo

The **X-NUCLEO-GNSS1A1** allows testing the **Teseo-LIV3F** GNSS module functionality via the firmware package contained in the X-CUBE-GNSS1A1 software.

Important: Program the microcontroller on the **STM32 Nucleo** development board.

The Teseo-LIV3F module and the STM32 Nucleo board communicate through the expansion board connectors(CN5, CN6, CN8 and CN9.) as listed in the tables below.

Table 2. Interconnection between STM32 Nucleo board and X-NUCLEO-GNSS1A1 expansion board - left-side connectors

STM32 Nucleo board pins	X-NUCLEO-GNSS1A1		
	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 board and X-NUCLEO-GNSS1A1 expansion board - right-side connectors

STM32 Nucleo board pins	X-NUCLEO-GNSS1A1			
	CN5 (digital)		CN9 (digital)	
	Pin	Signal	Pin	Signal
D15	10	SCL2		
D14	9	SDA2		
AREF	8			
GND	7	GND		

STM32 Nucleo board pins	X-NUCLEO-GNSS1A1			
	CN5 (digital)		CN9 (digital)	
	Pin	Signal	Pin	Signal
D13	6	WAKE_UP		
D12	5			
D11	4			
D10	3			
D9	2	RESET		
D8	1	RX0		
D7			8	RESET
D6			7	PPS
D5			6	
D4			5	WAKE_UP
D3			4	
D2			3	TX0/PPS
D1			2	RX
D0			1	TX

2.2

Teseo-LIV3F module

The **X-NUCLEO-GNSS1A1** expansion board embeds the **Teseo-LIV3F** module, an easy-to-use global navigation satellite system (GNSS) standalone module, embedding TeseoIII single die standalone positioning receiver IC working simultaneously on multiple constellations (GPS/Galileo/Glonass/BeiDou/QZSS).

Table 4. Teseo-LIV3F details

Feature	Description
Sales type	Teseo-LIV3F
Package	LLC 18 pins (9.7 x10.1 mm)
Operating voltage	3.3 V

2.3

UART, I²C and GPIO connection options

UART, I²C and GPIO connection options between the **STM32 Nucleo** and TeseoIII (hosted on the **Teseo-LIV3F** module embedded in the **X-NUCLEO-GNSS1A1** 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-GNSS1A1 expansion board: Teseo-LIV3F interface with the STM32 Nucleo 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.

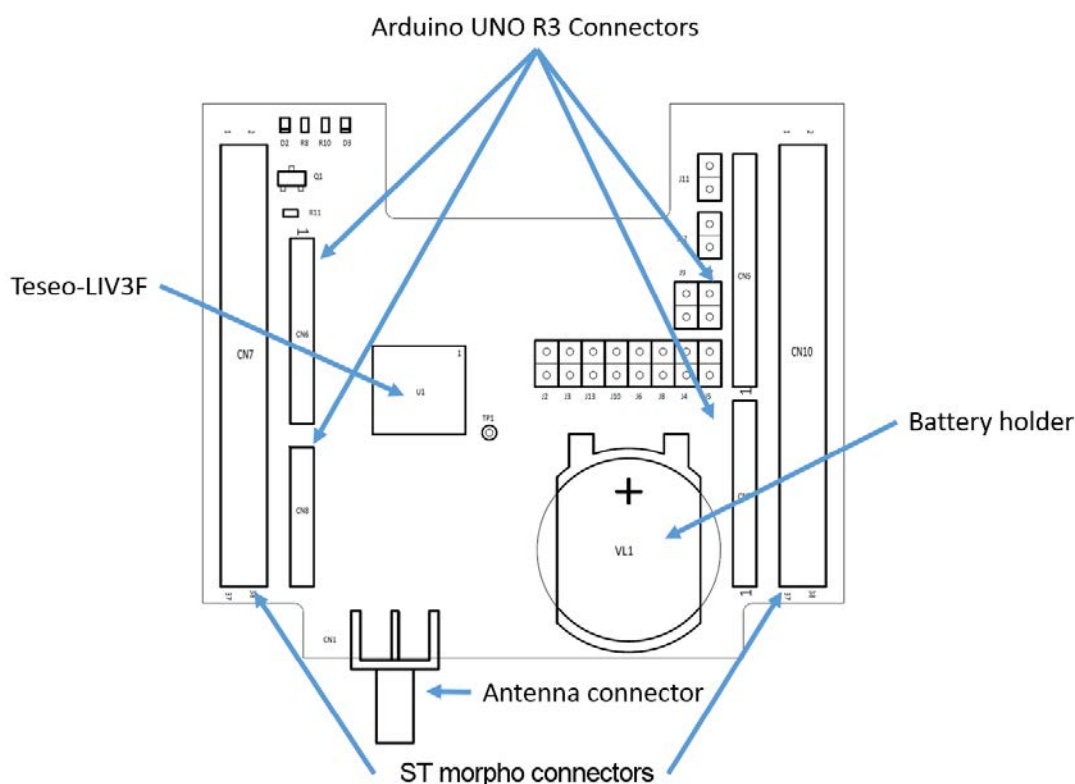
2.4 Current measurement

To monitor the [Teseo-LIV3F](#) module power consumption, insert an ammeter probe between J14 pin (VCC) and J15 pin (VBAT).

As the Teseo-LIV3F power consumption is very low during most of its operating time, an accurate instrument in the range of few μA is required.

2.5 X-NUCLEO-GNSS1A1 expansion board component placement

Figure 3. X-NUCLEO-GNSS1A1 expansion board component placement details



3 Schematic diagram

Figure 4. X-NUCLEO-GNSS1A1 circuit schematic (1 of 3)

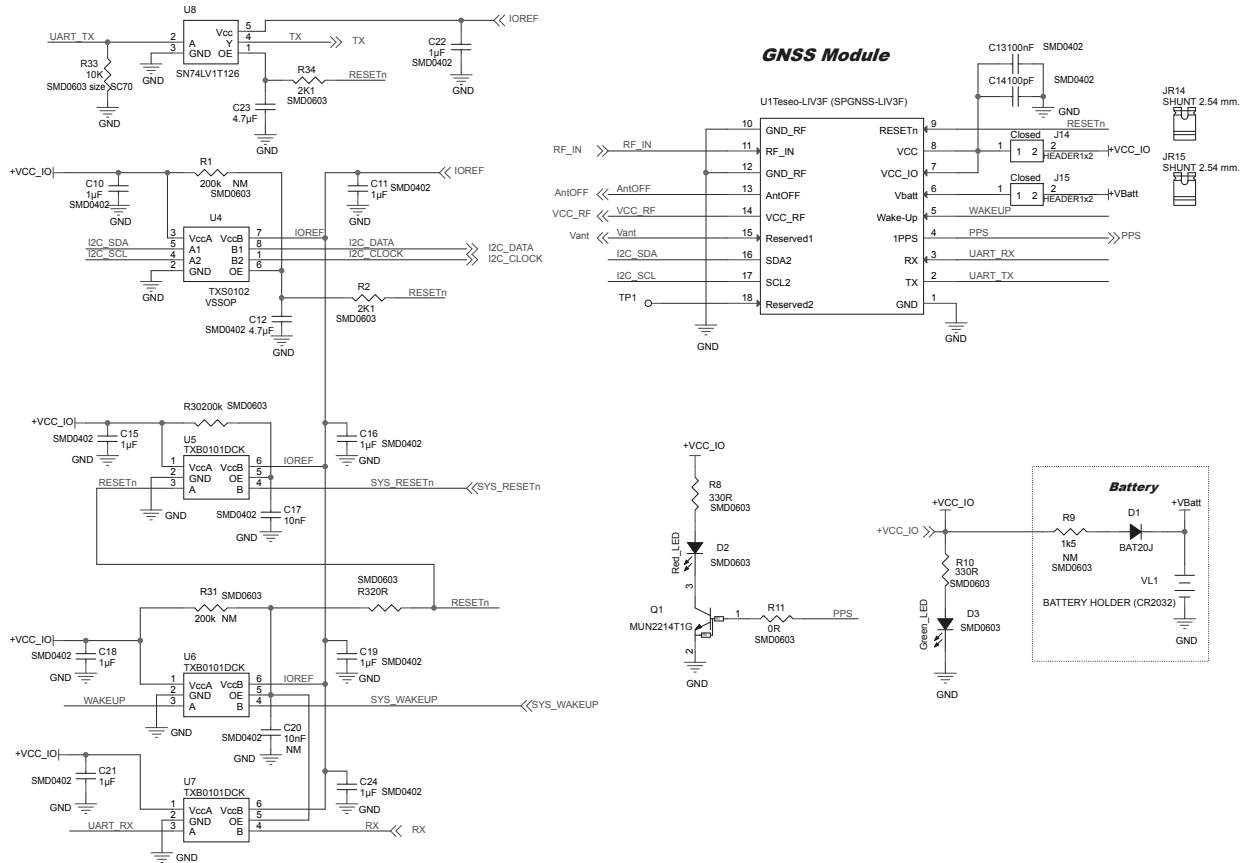


Figure 5. X-NUCLEO-GNSS1A1 circuit schematic (2 of 3)

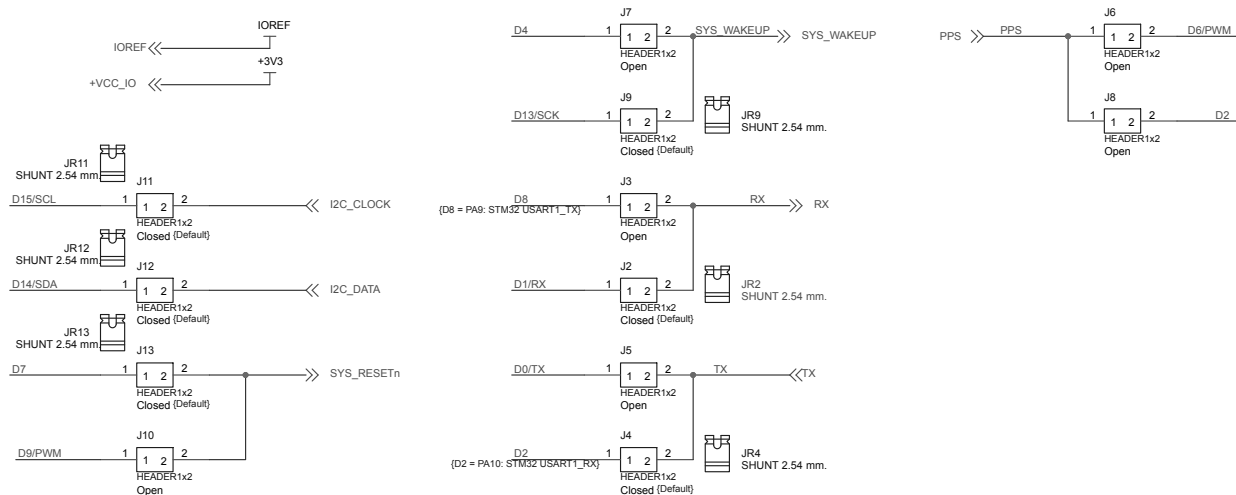
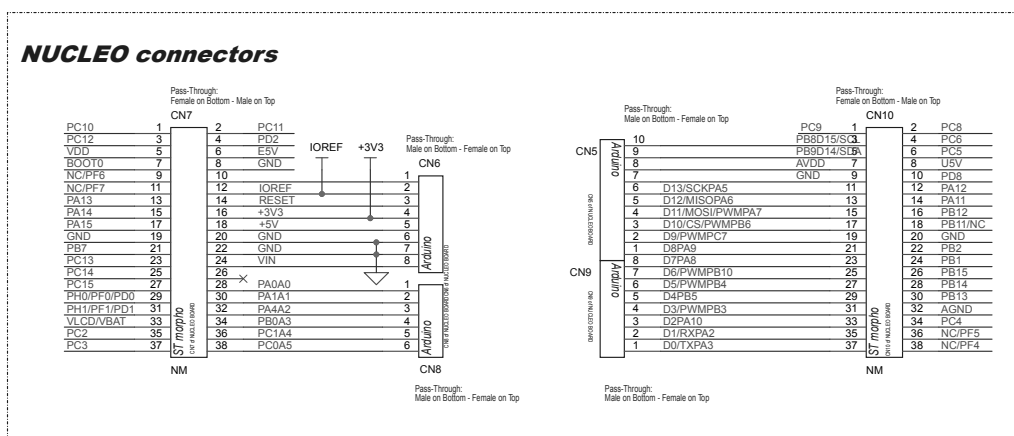
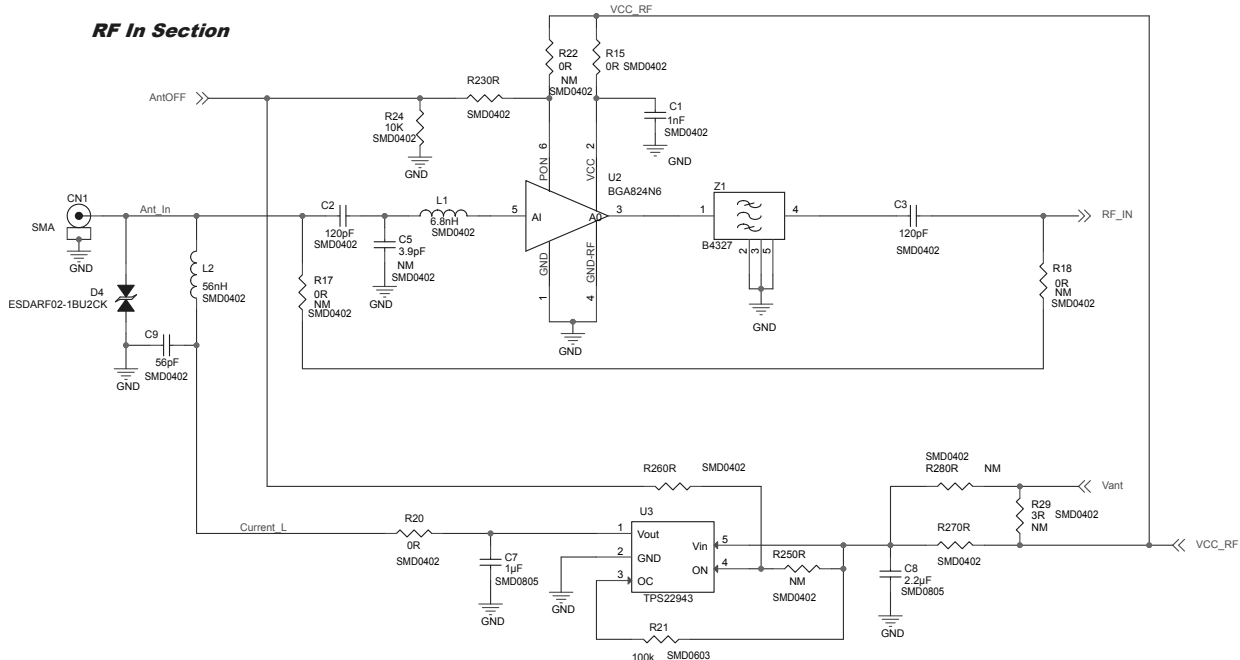


Figure 6. X-NUCLEO-GNSS1A1 circuit schematic (3 of 3)



4 Bill of materials

Table 6. X-NUCLEO-GNSS1A1 bill of materials

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
1	1	CN1	SMA	SMA jack-edge mount	Molex	73251-1150
2	1	CN5	ARDUINO_10x1 TH	Elevated socket	4UCONN	15286
					Samtec	ESQ-110-24-T-S
3	2	CN6,CN9	ARDUINO_8x1 TH	Elevated socket	4UCONN	15284
					Samtec	ESQ-108-24-T-S
4	2	CN7,CN10	ST_MORPHO_19x2 TH	Elevated socket	4UCONN	8413
					Samtec	ESQ-119-24-T-D
5	1	CN8	ARDUINO_6x1 TH	Elevated socket	4UCONN	15282
					Samtec	ESQ-106-24-T-S
6	1	C1	1 nF $\pm 10\%$ 50 V SMD 0402 X7R	Capacitor	Murata	GRM155R71H102KA01D
7	2	C2,C3	120 pF $\pm 10\%$ 50 V SMD 0402 NPO	Capacitor	Murata	GRM1555C1H121JA01D
8	1	C5	3.9 pF $\pm 10\%$ 50 V SMD 0402 NPO	Chip capacitor (not mounted)	Murata	GRM1555C1H3R9WA01D
9	1	C7	1 μ F $\pm 10\%$ 16 V SMD 0805 X7R	Capacitor	Taiyo Yuden	EMK212B7105KGHT
10	1	C8	2.2 μ F $\pm 10\%$ 16 V SMD 0805 X7R	Capacitor	Taiyo Yuden	EMK212B7225KGHT
11	1	C9	56 pF $\pm 10\%$ 50 V SMD 0402 X7R	Capacitor	Murata	GRM1555C1H560JA01D
12	9	C10,C11,C15,C16,C18,C19,C21,C22,C24	1 μ F $\pm 10\%$ 10 V SMD 0402 X5R	Capacitor	Murata	GRM155R61A105KE15D
13	2	C12,C23	4.7 μ F $\pm 20\%$ 6.3 V SMD 0402 X5R	Capacitor	Murata	GRM155R60J475ME47D
14	1	C13	100 nF $\pm 10\%$ 16 V SMD 0402 X7R	Capacitor	Murata	GRM155R71C104KA88D
15	1	C14	100 pF $\pm 5\%$ 50 V SMD 0402 COG	Capacitor	Murata	GRM1555C1H101JA01D
16	1	C17	10 nF $\pm 10\%$ 25 V SMD 0402 X7R	Capacitor	Murata	GRM155R71E103KA01D
17	1	C20	10 nF $\pm 10\%$ 25 V SMD 0402 X7R	Capacitor (not mounted)	Murata	GRM155R71E103KA01D

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
18	1	D1	BAT20J 1 A SOD323	High efficiency switching and ultra low leakage current Schottky diode	ST	BAT20J
19	1	D2	SMD 0603	Red LED	Lite-on	LTST-C193KRKT-5A
20	1	D3	SMD 0603	Green LED	Lite-On	LTST-C191KGKT
21	1	D4	ESDARF02-1B U2CK SMD 0201	Single line bidirectional ESD protection for high speed interface	ST	ESDARF02-1BU2CK
22	8	J2,J4,J9,J11,J12,J13,J14,J15	HEADER1x2 TH 2.54 mm 2 pins	Header	Any	
23	6	J3,J5,J6,J7,J8,J10	HEADER1x2 TH 2.54 mm 2 pins	Header	Any	
24	8	JR2,JR4,JR9,JR11,JR12,JR13,JR14,JR15	SHUNT 2.54 mm. 3 A max. 2.54 mm.	Jumper	TE Connectivity / AMP	1-382811-6
25	1	L1	6.8 nH $\pm 2\%$ 0.7 A SMD 0402	Inductor	Murata	LQW15AN6N8G00D
26	1	L2	56n H $\pm 5\%$ 0.2 A SMD 0402	Inductor	Würth Elektronik	744784156A
27	1	Q1	MUN2214T1G SC-59 NPN	Digital transistor	ONSemiconductors	MUN2214T1G
28	2	R1,R31	200 k $\pm 1\%$ SMD 0603	Resistor (not mounted)	Any	
29	1	R30	200 k $\pm 1\%$ SMD 0603	Resistor	Any	
30	2	R2,R34	2 K1 $\pm 1\%$ SMD 0603	Resistor	Any	
31	2	R11,R32	0 R $\pm 1\%$ SMD 0603	Resistor	Any	
32	2	R8,R10	330 R $\pm 1\%$ SMD 0603	Resistor	Any	
33	1	R9	1k5 $\pm 1\%$ SMD 0603	Resistor (not mounted)	Any	
34	5	R15,R20,R23,R26,R27	0 R $\pm 1\%$ SMD 0402	Resistor	Any	
35	5	R17,R18,R22,R25,R28	0 R $\pm 1\%$ SMD 0402	Resistor (not mounted)	Any	
36	1	R21	100 k $\pm 1\%$ SMD 0603	Resistor	Any	
37	1	R24	10 K $\pm 1\%$ SMD 0402	Resistor	Any	
38	1	R29	3 R $\pm 1\%$ SMD 0402	Resistor (not mounted)	Any	
39	1	R33	10 k $\pm 1\%$ SMD 0603	Resistor	Any	
40	1	TP1	TESTPOINT TH	Test point	Keystone Electronics	5117 (or 5000 or 5001)

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
41	1	U1	SPGNSS-LIV3F SMD	Tiny GNSS module	ST	Teseo-LIV3F
42	1	U2	BGA824N6 TSNP-6-2	Low noise amplifier for GNSS	Infineon	BGA824N6
43	1	U3	TPS22943 SC70-5	IC load switch	Texas Instruments	TPS22943DCKR
44	1	U4	TXS0102 VSSOP-8	Bidirectional voltage-level translator	Texas Instruments	TXS0102DCU
45	3	U5,U6,U7	TXB0101DCK SC70-6	Bidirectional level-translator	Texas Instruments	TXB0101DCK
46	1	U8	SN74LV1T126 SC70-5	Single-supply voltage translator	Texas Instruments	SN74LV1T126DCKR
47	1	VL1	BATTERY HOLDER (CR2032) SMD	Coin battery holder (CR2032)	Harwin Inc.	S8421-45R
48	1	Z1	B4327 QCS5P	RF filter	TDK	B39162B4327P810

Revision history

Table 7. Document revision history

Date	Version	Changes
05-Dec-2017	1	Initial release.
15-Oct-2018	2	Updated Introduction, Section 1.1 Board overview, Figure 2. X-NUCLEO-GNSS1A1 expansion board connected to an STM32 Nucleo board, Figure 3. X-NUCLEO-GNSS1A1 expansion board component placement details, Section 3 Schematic diagram and Section 4 Bill of materials.

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