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Getting started with X-NUCLEO-IDW01M1 Wi-Fi expansion board based on SPWF01SA module for STM32 Nucleo
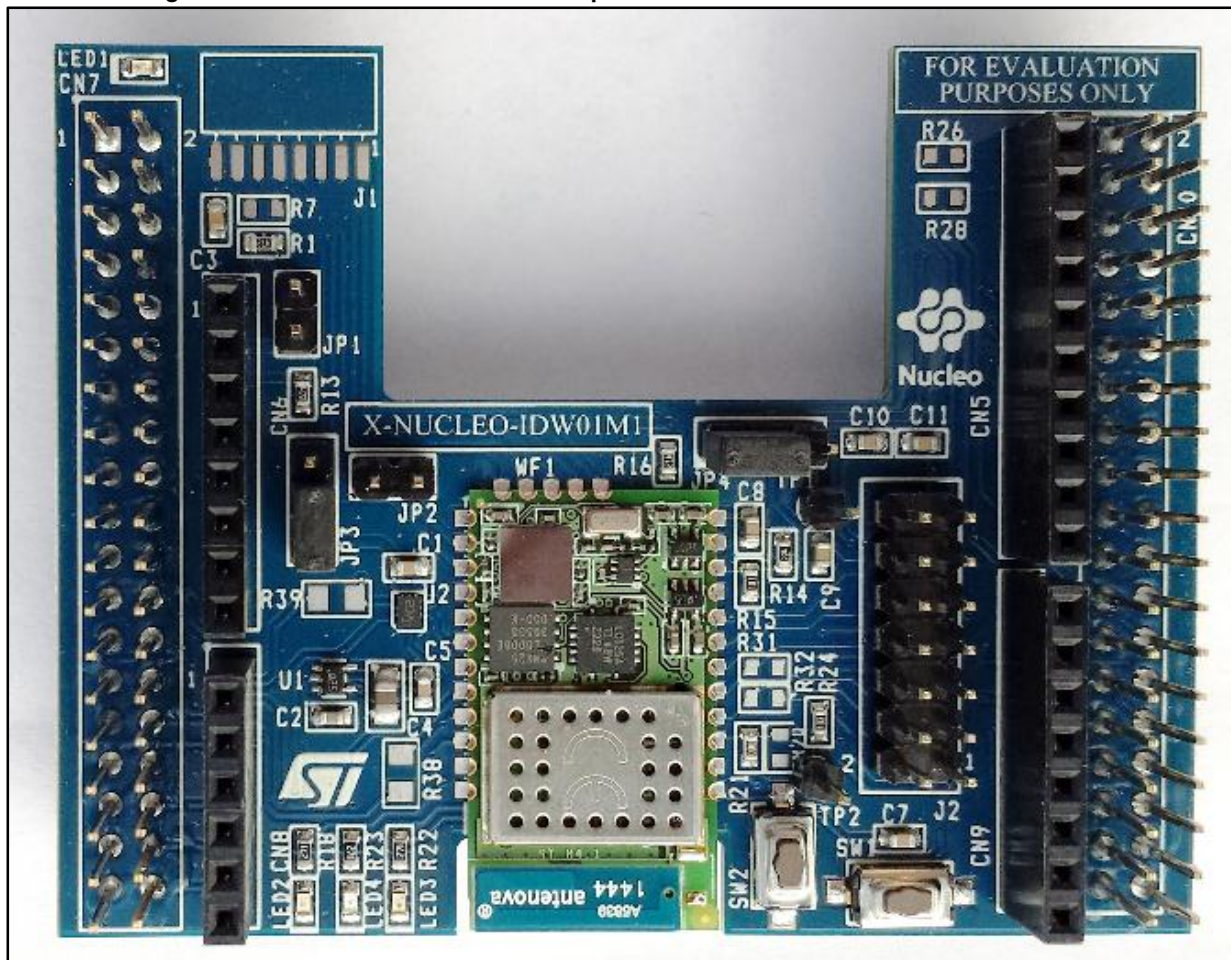
Introduction

This document provides detailed hardware requirements and board connections for the X-NUCLEO-IDW01M1 Wi-Fi board based on SPWF01SA Serial-to-Wi-Fi Modules, to allow expansion of the STM32 Nucleo boards. The SPWF01SA module is FCC (FCC ID: VRA-SG9011203), IC certified (IC: 7420A-SG9011203) and CE certified and includes an STM32 MCU, a low-power 2.4 GHz IEEE 802.11 b/g/n transceiver with integrated power amplifier and power management, and an SMD antenna.

The X-NUCLEO-IDW01M1 can be plugged onto STM32 Nucleo boards thanks to the ST morpho and Arduino™ UNO R3 connectors, and the same connectors allow different expansion boards to be easily stacked on the X-NUCLEO-IDW01M1 board so you can evaluate Wi-Fi connectivity with different devices in several applications.

The expansion board has the following features:

- Onboard SPWF01SA module (order code: SPWF01SA.11) based on the STM32 MCU and a low power Wi-Fi b/g/n transceiver SoC
- USART configurable connections
- Jumpers to obtain the SPWF01SA module RESET and I/O board signals (user software dependent)

Figure 1: X-NUCLEO-IDW01M1 Wi-Fi expansion board based on SPWF01SA module

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1 Getting Started

This section describes the hardware requirements for the X-NUCLEO-IDW01M1 expansion board.

1.1 Hardware requirements

The X-NUCLEO-IDW01M1 is an expansion board for the STM32 Nucleo boards. To function correctly, the X-NUCLEO-IDW01M1 must be plugged to the STM32 Nucleo board through the ST morpho or ARDUINO UNO R3 connectors as shown in the figure below.

Information on STM32 Nucleo is available on ST website at *http://www.st.com/stm32nucleo*

Figure 2: X-NUCLEO-IDW01M1 plugged with STM32 Nucleo board
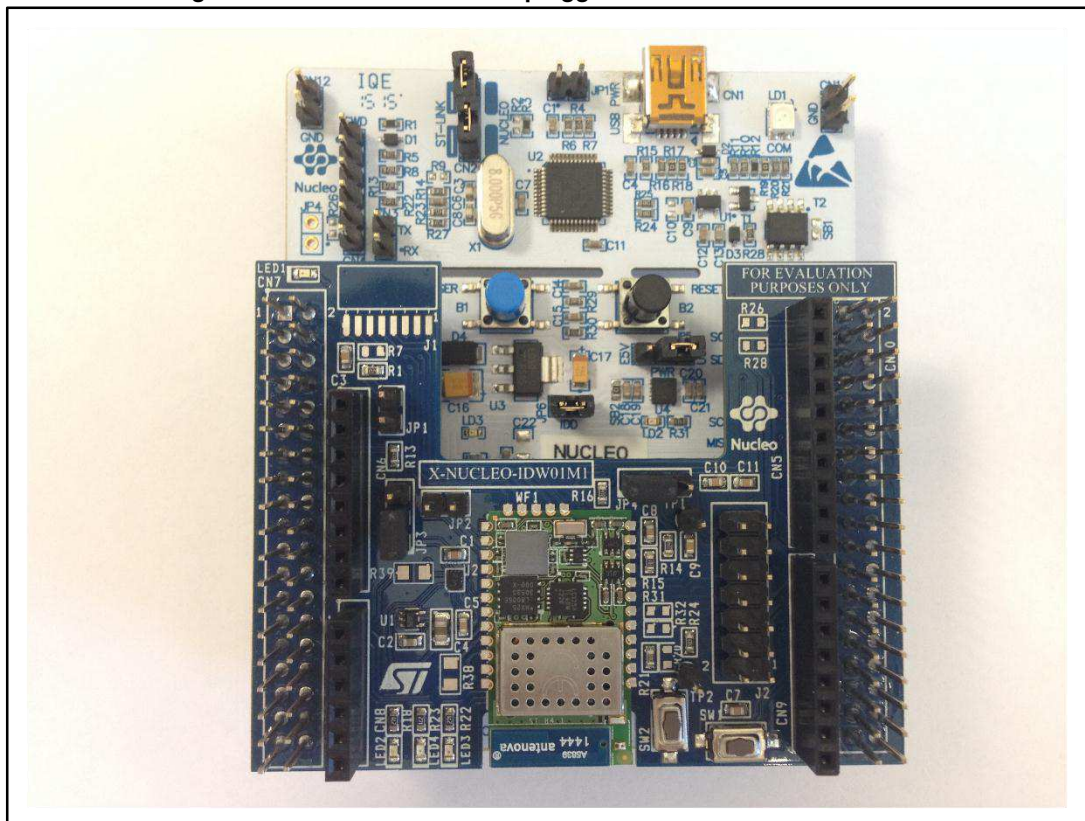
The interconnection between the STM32 Nucleo board and the X-NUCLEO-IDW01M1 is designed to work with any STM32 Nucleo board, even though complete testing was focused on the NUCLEO-L053R8 hosting the ultra-low power STM32L053R8T6, the NUCLEO-F401RE hosting the dynamic efficiency STM32F401RET6 and the NUCLEO-F103RB hosting the Mainstream Performance line STM32F103RBT6.

1.3 System requirements

Using the STM32 Nucleo boards with the X-NUCLEO-IDW01M1 expansion board requires the following software and hardware:

- Windows PC (XP, Vista, 7, 8) to install the firmware package
- USB type A to Mini-B USB cable to connect the STM32 Nucleo board to the PC

Installation of the board firmware package (order code: X-CUBE-WIFI1) and the Wi-Fi graphical user interface utility on the user PC requires the following:

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

The X-CUBE-WIFI1 firmware and relative documentation are available on www.st.com

1.4 Setting up the board

To set up the board:

1. Ensure that a jumper on the JP3 (position 1-2) connector is connected. This jumper provides the RESET signal to the SPWF01SA module on the board.
2. Ensure that a jumper on the JP4 (position 1-2) connector is connected. This jumper provides the 2.5 V internal power supply to the GPIO6_ADC0 module signal.
3. Plug the X-NUCLEO-IDW01M1 on the STM32 Nucleo board, as shown in *Figure 2: "X-NUCLEO-IDW01M1 plugged with STM32 Nucleo board"*
4. Power the STM32 Nucleo board through the Mini-B USB cable
5. Program the STM32 Nucleo board using the sample firmware provided
6. Reset the STM32 Nucleo board MCU with the onboard Reset button
7. The solution is ready to be used to evaluate Wi-Fi connectivity

2 Hardware description

This section describes the X-NUCLEO-IDW01M1 features and provides useful information for understanding the board schematics.

2.1 X-NUCLEO-IDW01M1 expansion board for STM32 Nucleo

The expansion board allows the user to test the functionality of the module. The SPWF01SA module embeds a low power Wi-Fi b/g/n transceiver SoC, SMD antenna and STM32 MCU.

Board functionality can be manipulated through the firmware packaged with the X-CUBE-WIFI1 software, which must be programmed on the STM32 Nucleo board microcontroller. Please, refer to user manuals UM1724 and UM1725 available on *www.st.com* for further information on STM32 Nucleo boards.

The SPWF01SA module and the STM32 Nucleo board are connected through connectors CN7 (see *Table 1: "Interconnection between STM32 Nucleo board and X-NUCLEO-IDW01M1 (ST morpho connector - CN7)"*) and CN10 *Table 2: "Interconnection between STM32 Nucleo board and X-NUCLEO-IDW01M1 (ST morpho connector - CN10)"*. Moreover, considering that signals available on CN5, CN6, CN8 and CN9 are also replicated on CN7 even and CN10 odd pin, it useful to indicate the indirect connection between STM32 Nucleo board and X-NUCLEO-IDW01M1 (see tables from *Table 3: "Interconnection between STM32 Nucleo board and X-NUCLEO-IDW01M1 (Arduino UNO R3 Connector CN6 - Power)"* to *Table 6: "Interconnection between STM32 Nucleo board and X-NUCLEO-IDW01M1 through (Arduino UNO R3 Connectors CN9 - Digital)"*).

> Pins marked with an asterisk (*) indicate an alternative pin for that specific function and pins marked with a hash (#) indicate a specific function reserved for future use and, not yet implemented on the module SPWF01SA.

Table 1: Interconnection between STM32 Nucleo board and X-NUCLEO-IDW01M1 (ST morpho connector - CN7)

CN7 odd			CN7 even		
Pin	Name	Fcn	Fcn	Name	Pin
1					2
3	PC12	WIFI_RST	GPIO10	PD2	4
5	VDD			E5V	6
7				GND	8
9					10
11				IOREF	12
13				RESET	14
15	PA14	GPIO13		+3V3	16
17				+5V	18
19	GND			GND	20
21	PB7	USART_RX*		GND	22
23				VIN	24

CN7 odd			CN7 even		
25					26
27			USART_CTS*	PA0	28
29			USART_RTS*	PA1	30
31					32
33	VBAT				34
35					36
37					38

Table 2: Interconnection between STM32 Nucleo board and X-NUCLEO-IDW01M1 (ST morpho connector - CN10)

CN10 odd			CN10 even		
Pin	Name	Fcn	Fcn	Name	Pin
1			GPIO6	PC8	2
3	PB8	I2C_SCL#			4
5	PB9	I2C_SDA#	USART_RX*	PC5	6
7	AVDD			U5V	8
9	GND				10
11			USART_RTS	PA12	12
13			USART_CTS	PA11	14
15			SPI_CS#	PB12	16
17	PB6	USART_TX*			18
19				GND	20
21	PA9	USART_TX			22
23					24
25			SPI_MOSI#	PB15	26
27			SPI_MISO#	PB14	28
29			SPI_CLK#	PB13	30
31				AGND	32
33	PA10	USART_RX	USART_TX*	PC4	34
35	PA2	USART_TX*			36
37	PA3	USART_RX*			38

Table 3: Interconnection between STM32 Nucleo board and X-NUCLEO-IDW01M1 (Arduino UNO R3 Connector CN6 - Power)

Signal Name	NC	IOREF	RESET	3V3	5V	GND	GND	VIN
Pin	1	2	3	4	5	6	7	8
MCU Name								
Fcn				3V3		GND	GND	

Table 4: Interconnection between STM32 Nucleo board and X-NUCLEO-IDW01M1 (Arduino UNO R3 Connector CN8 - Analog)

Signal Name	A0	A1	A2	A3	A4	A5
Pin	1	2	3	4	5	6
MCU Name	PA0	PA1	PA4	PB0	PC1/ PB9	PC0/ PB8
Fcn	USART_CTS*	USART_RTS*	GPIO13*			

Table 5: Interconnection between STM32 Nucleo board and X-NUCLEO-IDW01M1 through (Arduino UNO R3 Connector CN5 - Digital)

Signal Name	D15	D14	AREF	GND	D13	D12	D11	D10	D9	D8
Pin	10	9	8	7	6	5	4	3	2	1
MCU Name	PB8	PB9			PA5	PA6	PA7	PB6	PC7	PA9
Fcn	I2C_SCL#	I2C_SDA#		GND				UART_TX*		UART_TX

Table 6: Interconnection between STM32 Nucleo board and X-NUCLEO-IDW01M1 through (Arduino UNO R3 Connectors CN9 - Digital)

Signal Name	D7	D6	D5	D4	D3	D2	D1	D0
Pin	8	7	6	5	4	3	2	1
MCU Name	PA8	PB10	PB4	PB5	PB3	PA10	PA2	PA3
Fcn						UART_RX	USART_RX[1]	USART_TX[1]

Notes:

[1]used by STM32 on Nucleo board and connected to ST-LINK

2.2 UART and GPIO connection options

As stated previously, the connection between the SPWF01SA and the STM32 Nucleo boards is made via a four wire UART (with hardware flow control) and some GPIOs. A multiple connection arrangement offers maximum modularity (See Table 4). The alternative pins could be useful in case of conflicts with additional X-NUCLEO expansion boards.

Table 7: SPWF01SA module UART interface - (optional) with STM32 Nucleo board

SPWF01SA Pin / Signal	STM32 Pin	Placement
6 / TXDI	PA10 (default)	CN10 – pin 33 CN9 – Pin 3 To use this connection: mount R4 and remove R33, R34, R37
	PC5	CN10 – pin 6 To use this optional connection: mount R33 and remove R4, R34, R37
	PB7	CN7 – pin 21 To use this optional connection: mount R34 and remove R4, R33, R37
	PA3	CN9 – pin 2 CN10 - pin 35 To use this optional connection: mount R37 and remove R4[(1)]), R33, R34
8 / RXDI	PA9 (default)	CN10 – pin 21 CN5 – pin 1 To use this optional connection: mount R11 and remove R9, R35, R36
	PC4	CN10 – pin 34 To use this optional connection: mount R35 and remove R8, R9, R36
	PB6	CN10 – pin 17 CN5 – Pin 3 To use this optional connection: mount R9 and remove R8, R35, R36
	PA2	CN9 – pin 1 CN10 – pin 37 To use this optional connection: mount R36 and remove R8[(1)], R9, R35
9 / CTS1_DN	PA11(default)	CN10 – pin 14 To use this connection: mount R2 and remove R39
	PA0	CN8 – pin 1 CN7 – pin 28 To use this optional connection: mount R39 and remove R2
10 / RTS1_DP	PA12	CN10 – pin 12 To use this connection: mount R6 and remove R38
	PA1	CN8 – pin 2 CN7 – pin 30 To use this optional connection: mount R38 and remove R6

Notes:

[(1)] please refer to UM1724 for instructions on how to modify the STM32 Nucleo board to use these pins.

To use the optional connections, you need to modify the firmware for the right allocation of STM32 resources.

2.3 Current measurement

To monitor the power consumption of the onboard SPWF01SA module, remove the R3 (0 Ω resistor) and, using jumper JP1 contacts as connectors, insert an ammeter probe between pins 1 and 2 of the connector and measure current absorption.

Since the power consumption of the SPWF01SA module is usually very low, accurate instrumentation able to take measurements in the order of a few µA may be required.

2.4 X-NUCLEO-IDW01M1 component placement details

The following figure shows component placement on the X-NUCLEO-IDW01M1 board

Figure 3: X-NUCLEO-IDW01M1 component placement details
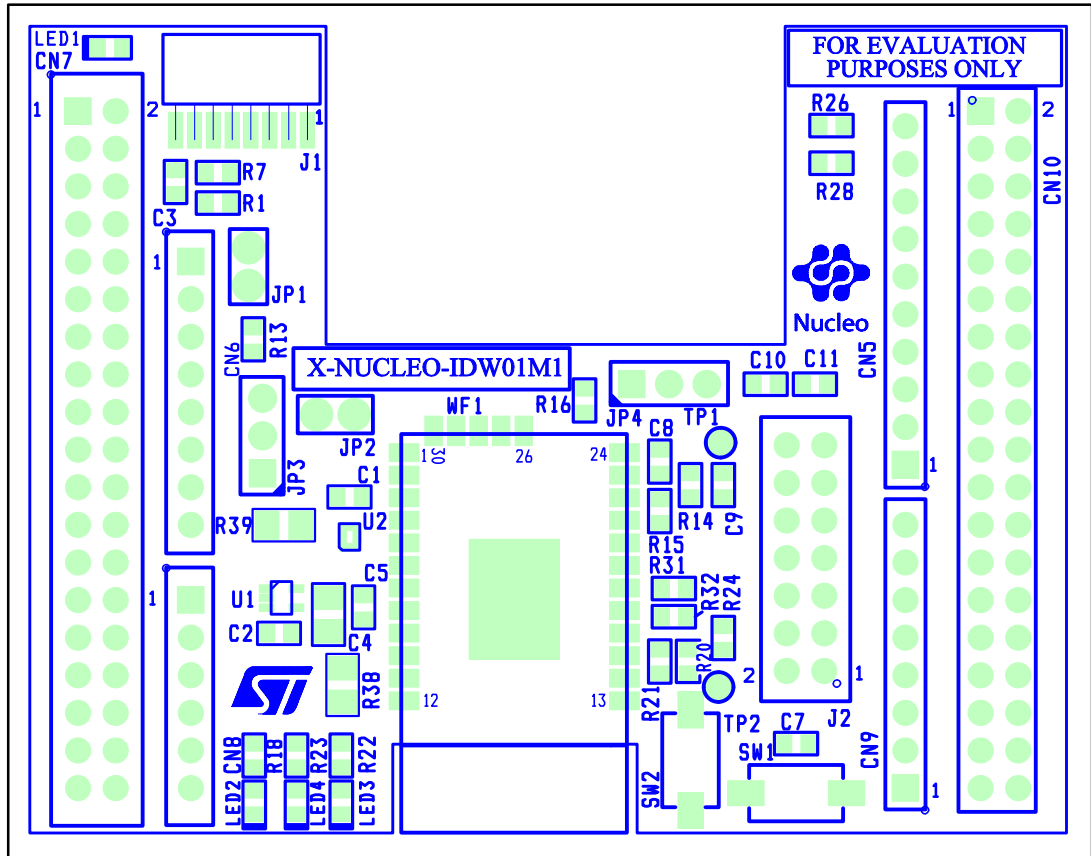
3   Component descriptions

This section describes the devices included on the X-NUCLEO-IDW01M1 expansion board.

> check whether resistor R21 is present on the X-NUCLEO-IDW01M1 board; if it is, please remove it as it may interfere with JTAG debug.

3.1   SPWF01SA module

The SPWF01SA module is FCC (FCC ID: VRA-SG9011203), IC (IC: 7420A-SG9011203) and CE certified. The SPWF01SA contains a low power Wi-Fi b/g/n transceiver SoC - a highly integrated Wi-Fi system dedicated to the WLAN management and compliant with Wi-Fi network specifications. The interface of the device to the STM32 Nucleo boards is via a UART interface and some GPIO pins. The SPWF01SA module also integrates an SMD antenna and has an embedded 38.4 MHz oscillator for the embedded Wi-Fi radio.

Table 8: SPWF01SA details

Feature	Description
Sales type	SPWF01SA.11
Package	SMD 30 pin
Operating voltage	Typ. 3.3 V

3.2   User push-buttons and LED

To command certain I/O signals and signal SPWF01SA module status information, the X-NUCLEO-IDW01M1 expansion board has two push-buttons and four LEDs.

The hardware and firmware functions associated with the push-buttons and LEDs are shown in the following table:

Table 9: Push-buttons and LED functions

Feature	Description
RESET (hardware, by the user)	Push the SW1 push-button on the board
GPIO7_ADC1 module signal (hardware & firmware dependent, by the user)	Push the SW2 push-button on the board
3.3 V board power supply on	LED 1 (green) lit
GPIO10 mod. signal (firmware dependent)	LED 2 (blue) lit
GPIO14 mod. signal (firmware dependent)	LED 3 (red) lit
GPIO13 mod. signal (firmware dependent)	LED 4 (yellow) lit

3.4 Radio certification

3.4.1 Formal notices required by the U.S. Federal Communications Commission (FCC)

Any changes or modifications to this equipment not expressly approved by STMicroelectronics may cause harmful interference and void the user's authority to operate this equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including any interference that may cause undesired operation.

This device uses, generates and radiates radio frequency energy. The radio frequency energy produced by this device is well below the maximum exposure limit established by the Federal Communications Commission (FCC).

The X-NUCLEO-IDW01M1 contains the FCC certified SPWF01SA module (FCC ID: VRA-SG9011203).

3.4.2 Formal notices required by Industry Canada (IC)

English:

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

French:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. 'Exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

The X-NUCLEO-IDW01M1 contains the IC certified SPWF01SA module (IC: 7420A-SG9011203)

3.4.3 Formal notices required by the ETSI (CE)

This module complies with the following European EMI/EMC and safety directives and standards:

- ETSI EN 300 328 V1.8.1:2012
- EN 301 489-1 V1.9.2:2011 + EN 301 489-17 V2.2.1:2009
- EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011 + A2:2013
- EN 62479:2010

4 Board schematic and bill of materials

4.1 STM32 Nucleo connections

The X-NUCLEO-IDW01M1 expansion board is designed to be plugged directly on the STM32 Nucleo board connectors. The X-NUCLEO-IDW01M1 is configured by default to be compatible with the highest number of STM32 Nucleo boards possible. It may be also be configured, via resistor placement, to use different I/O configurations in order to match specific customer targets. Refer to the X-NUCLEO-IDW01M1 user manual for more detailed information regarding the possible I/O configuration options.

Check to see if resistor R21 is present; if it is, please remove it as it may interfere with JTAG debug.

4.2 Bill of materials

Table 10: Bill of materials (1 of 2)

Item	Quantity	Reference	Description	Note
1	10	C1,C3,C5,C6,C7,C8, C9,C10,C11,C12	Bypass capacitor / signal delay / filtering	
2	1	C2	Bypass capacitor	
3	1	C4	Bypass capacitor	
4	1	CN8	Arduino UNO R3 connector	
5	2	CN6,CN9	Arduino UNO R3 connector	
6	1	CN5	Arduino UNO R3 connector	
7	2	CN7,CN10	ST morpho connector	
8	1	J1	Debug connector	Not Mounted
9	2	J2	Module IO for Development	
10	2	JP1,JP2	Option jumper	
11	2	JP3,JP4	Option jumper	
12	1	LED1	Power LED	
13	1	LED2	Blinking while module is running	
14	1	LED3	Wi-Fi power UP	
15	1	LED4	Wi-Fi link UP	
16	3	R3,R19,R21	Option resistor (default)	
17	1	R15	Filter for IRQ signal	
18	3	R18,R22,R23	Current polarization for LEDs	
19	1	R5	Current polarization for power LED	

Item	Quantity	Reference	Description	Note
20	4	R1,R13,R16,R17	Current limitation for 3.3 V signal	
21	1	R24	Signal pull-up	
22	1	R14	Signal pull-down	
23	0	R7,R20,R26,R28,R29,R30,R31,R32	Option selection (optional)	Not Mounted
24	4	R2,R4,R6,R8	Option selection (default)	
25	0	R9,R33,R34,R35,R36,R37,R38,R39	Option selection (optional)	Not Mounted
26	1	U1	LDO power supply	
27	1	U2	Signal level shifter	
28	2	SW1,SW2	User push button	
29	2	TP1,TP2	Test point	
30	1	WF1	SPWF01SA Serial-to-Wi-Fi Modules	
31	1	PCB	X-NUCLEO-IDW01M1 PCB	

Table 11: Bill of materials (2 of 2)

Item	Package	Manufacturer	Manufacturer's ordering code	Value
1	0603	MURATA	GRM188R71C104KA01D	100 nF 16 V
2	0603	MURATA	GCM188R71C105KA64D	1 uF 16 V
3	0805	MURATA	GCM21BR70J106KE22L	10 uF 6.3 V
4	FEMALE ON TOP	HARWIN SAMTEC	M20-7820646 SSQ-106-03-G-S	6 pins, 2.54 F
5	FEMALE ON TOP	HARWIN SAMTEC	M20-7820846 SSQ-108-03-F-S	8 pins, 2.54 F
6	FEMALE ON TOP	HARWIN SAMTEC	M20-7821046 SSQ-110-03-F-S	10 pins, 2.5 F
7	FEMALE ON BOTTOM	4UCON	18507 20565 20600	Strip 19 x 2p 2.54
8	Female in top	STELVIO KONTEK	6778268508410-R	SOCKET CONNECTOR 8p R/A SINGLE ROW pitch = 1.27 mm
9	7pins x 2lines	--	--	strip 7x2p 2.54
10	2pins x 1line	--	--	strip 2p 2.54
11	3pins x 1line	--	--	strip 3p 2.54
12	0603	--	--	GREEN LED

Item	Package	Manufacturer	Manufacturer's ordering code	Value
13	0603	--	--	BLUE LED
14	0603	--	--	RED LED
15	0603	--	--	YELLOW LED
16	0603	--	--	0 Ω
17	0603	--	--	100 Ω ±5%
18	0603	--	--	270 Ω ±5%
19	0603	--	--	470 Ω ±5%
20	0603	--	--	4.7 kΩ ±5%
21	0603	--	--	10 kΩ ±5%
22	0603	--	--	220 kΩ ±5%
23	0603	--	--	Not mounted
24	0805	--	--	0 Ω
25	0805	--	--	Not mounted
26	SOT323-5L	STMicroelectronics	STLQ50C25R	STLQ50C25R
27	QFN10 (1.8 x 1.4)	Any	Interface between a 3.3 V bus and a 2.5 V	Mounted on board - STMicroelectronics ST2G3236QTR
28	SMD	ITT IN SUNG METAL CO ALPS or equivalent	KSR221J IT-1210-S SKQYAB (G4822969M)	
29	1 pin	--	--	strip 1p
30	15.24x26.924	STMicroelectronics	SPWF01SA.11	SPWF01SA.11 Serial-to-Wi-Fi Modules)
31	54.5x70mm	--	--	P.C.B. PC91A.V03

4.4 Schematic diagram

Figure 4: X-NUCLEO-IDW01M1 board schematic
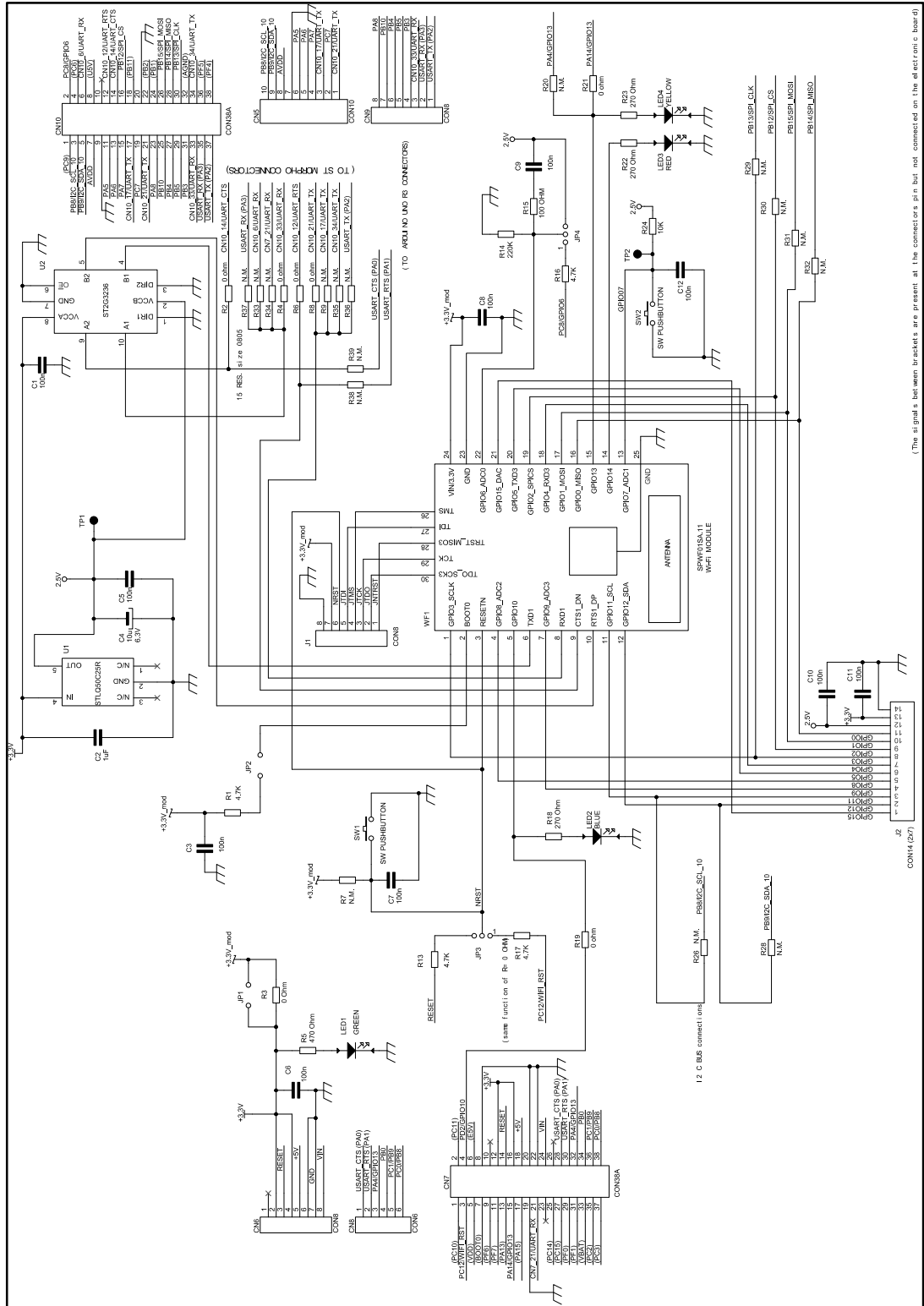
4.5 Revision history

Table 12: Document revision history

Date	Version	Changes
06-Nov-2015	1	Initial release.

IMPORTANT NOTICE – PLEASE READ CAREFULLY