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# WS2116EA0 User Guide

WS2116-A0 Development Kit Revision D03

Released 0.1

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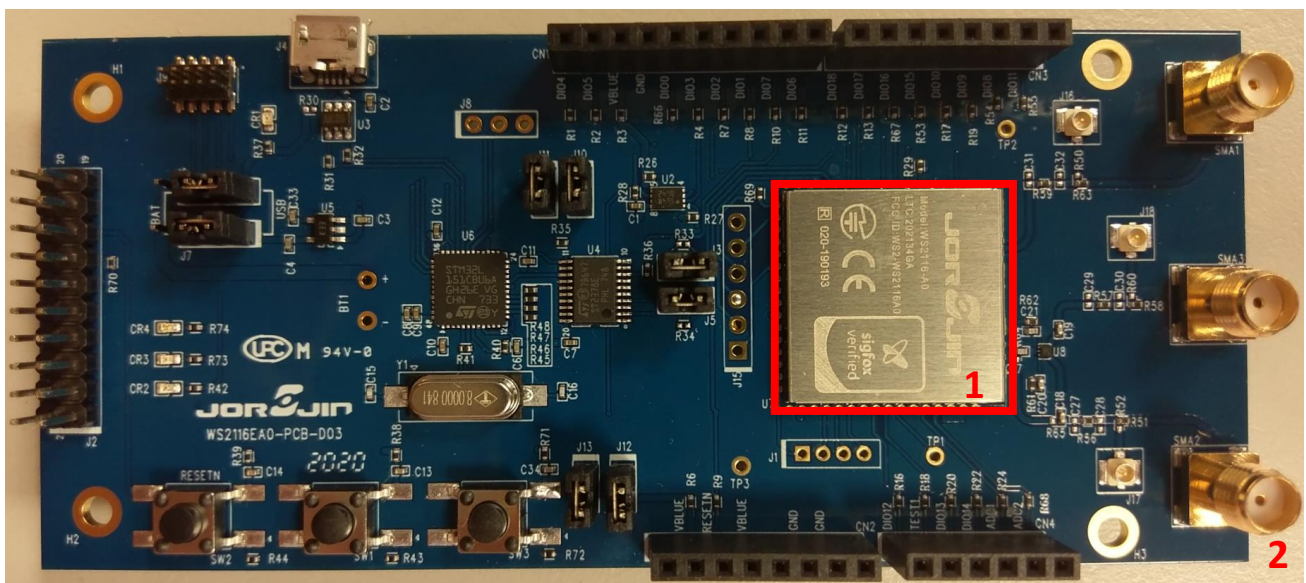
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## 1. INTRODUCTION

The Jorjin WS2116-A0 is a sub-1GHz with PA and Bluetooth® low energy ultralow power wireless MCU module. The WS2116EA0 is the development kit for WS2116-A0. The WS2116EA0 provides a set of hardware resources for RF signal evaluation of both BLE and Sub-1GHz, and development platform. It also provides a set of hardware resources for a wide range of application scenarios: sensor data (accelerometer, pressure and temperature sensor, need an additional sensor board), remote control (buttons and LEDs) and debug message management through USB virtual COM. Three power options are available (USB only, battery only and external power supply plus USB) for high application development and testing flexibility.

Figure 1: WS2116EA0 development kit



1.	WS2116-A0	Bluetooth low energy and sub-1 GHz module
2.	WS2116EA0	Development kit for WS2116-A0

## 2. GETTING STARTED

### 2.1. System requirements

The application software requirement:

- PC with Intel® or AMD® processor running one of the following Microsoft® operating systems:
  - Windows XP SP3
  - Windows Vista
  - Windows 7
  - Windows 10
- At least 128 MB of RAM
- USB ports
- At least 100MB of available hard disk space
- Adobe Acrobat Reader 6.0 or later

### 2.2. Application software setup

Please download the application from below link.

BlueNRG-2 DK SW package:

[https://www.st.com/content/st\\_com/en/products/embedded-software/evaluation-tool-software/stsw-bluenrg1-dk.html](https://www.st.com/content/st_com/en/products/embedded-software/evaluation-tool-software/stsw-bluenrg1-dk.html)

BLUENRG family GUI:

[STSW-BNRGUI - BLUENRG family GUI - STMicroelectronics](#)

And please contact Jorjin to get more application and development software.

### 3. HARDWARE DESCRIPTION

#### 3.1. Board overview

The following figure and table describe physical sections of the board.

Figure 2: WS2116EA0 board components

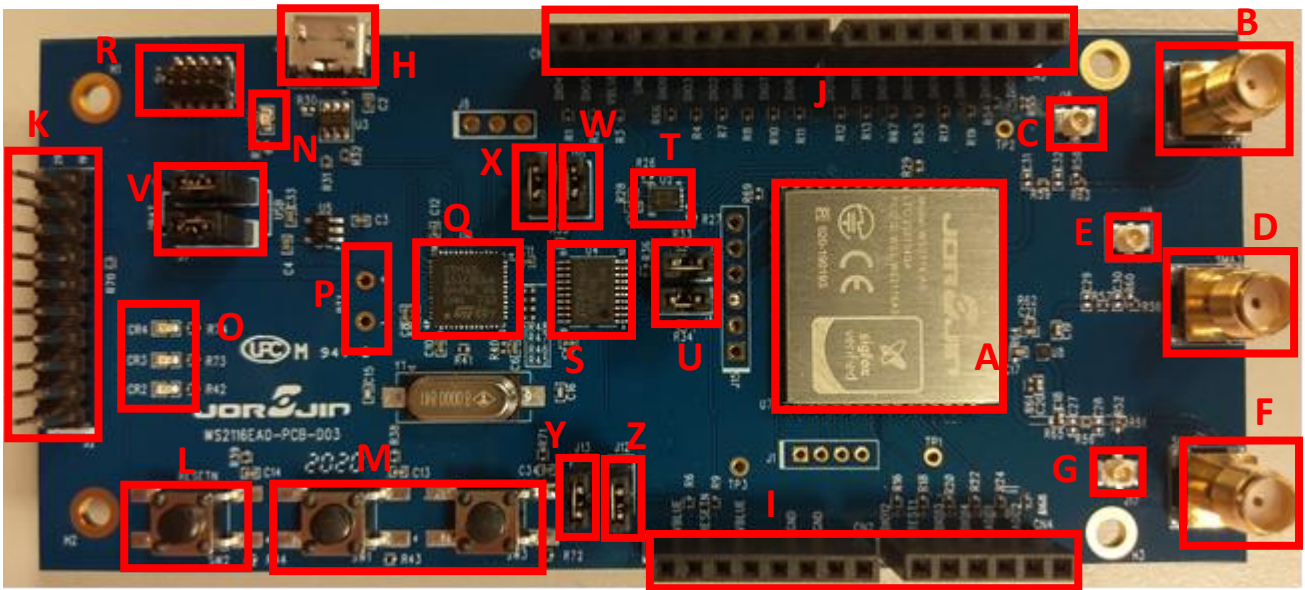


Table 1: WS2116EA0 board component descriptions

Region	Description
A	WS2116-A0 Module
B, C	BLE RF signal SMA & U.FL connector.
D, E	Sub-1GHz RF signal SMA & U.FL connector.
F, G	Sub-1GHz RF signal SMA & U.FL connector.
H	Micro USB connector for power supply and I/O
I, J	Two rows of Arduino-compliant connectors
K	JTAG connector for BlueNRG-2
L	RESET button
M	2 USER buttons
N	PWR LED
O	3 User LEDs
P	Battery power input point

Q	STM21L151CUBU6 48-pin microcontroller(USB to serial bridge for I/O channel to PC communication) <sup>(1)</sup>
R	JTAG connector for STM32L151CUBU6 <sup>(1)</sup>
S	ST2378E level translator to adapt voltage level between STM32 and BlueNRG-2
T	EEPROM
U	Serial port connection jumpers
V	Power source selection jumpers
W	DIO6 function selection jumper
X	Current measurement jumper for BlueNRG-2
Y	Current measurement jumper for S2LP
Z	Current measurement jumper for SKY66420-11

(1) STM32 is not intended to be programmed by users

### 3.2. WS2116-A0 module connections

The WS2116-A0 for BLE and sub-1GHz module has one RF connector for BLE. Two RF connectors for sub-1GHz and could choose antenna path as the RF out by setting switch parameter.

The microcontroller of BlueNRG-2 is connected to various components such as buttons, and LEDs. The following table describes the microcontroller pin functions.

Table 2: WS2116-A0 module pin description with board functions

Pin Name	Pin No	Function	Arduino Connectors			
			CN1(J1)	CN2(I1)	CN3(J2)	CN4(I2)
GND	1	GND	Pin7	Pin6,7		
RESETN	2	System reset		Pin3		
DIO13	3	Switch input (SW3)				Pin3
DIO12	4	Switch input (SW1)				Pin1
TEST	5	Test pin put to GND				
DIO11	6	UART Rx from STM32			Pin1	
DIO10	7	JTMS-SWTDIO			Pin4	
DIO9	8	JTCK-SWTCK			Pin3	
DIO25	9	SDN pin of S2-LP				
DIO7	10	Bootloader pin / LED driver (CR2)	Pin2			

DIO8	11	UART Tx to STM32			Pin2	
DIO22	12	CTX pin of SKY66420-11				
DIO23	13	CPS pin of SKY66420-11				
GND	14	GND	Pin7	Pin6,7		
VBAT	15	Power for BlueNRG-2	Pin8	Pin2,4		
GND	16	GND	Pin7	Pin6,7		
DIO24	17	CSD pin of SKY66420-11				
DIO21	18	GPIO3 pin of S2-LP				
DIO6	19	RESET pin of STSAFE-A1SX or EEPROM_CS	Pin1			
DIO4	20	I2C SCL pin	Pin10			
DIO5	21	I2C SDA pin	Pin9			
DIO20	22	CS pin of S2-LP				
DIO19	23	GPIO2 pin of S2-LP				
DIO18	24	SPDT for 868MHz/915MHz selection			Pin8	
DIO16	25				Pin6	
DIO0	26	SCLK pin of S2-LP	Pin6			
DIO17	27	SPDT for 868MHz/915MHz selection			Pin7	
DIO1	28		Pin3			
DIO2	29	SDI pin of S2-LP	Pin4			
DIO3	30	SDO pin of S2-LP	Pin5			
GND	31	GND	Pin7	Pin6,7		
GPIO3	32					
GND	33	GND	Pin7	Pin6,7		
VCC_S2LP	34	Power for S2_LP	Pin8	Pin2,4		
GND	35	GND	Pin7	Pin6,7		
GPIO2	36					
GPIO1	37					
GPIO0	38					
DIO15	39	LED driver (CR4)			Pin5	
DIO14	40	LED driver (CR3)				Pin4
ANATEST1	41					Pin2
ANATEST0	42					
GND	43	GND	Pin7	Pin6,7		
ADC1	44					Pin5

ADC2	45					Pin6
VCC_PA1	46	Power Of SKY66420-11	Pin8	Pin2,4		
VCC_PA2	47	Power Of SKY66420-11	Pin8	Pin2,4		
GND	48	GND	Pin7	Pin6,7		

### 3.3. Power supply

Green LED CR1 (Figure 2: WS2116EA0 board components"-region N) signals the board is being powered, either via:

- micro USB connector J4 (Figure 2: WS2116EA0 board components" – region H)
- batteries (region P)
- an external DC power supply plus micro USB connector

The following table describes the power supply modes available on the WS2116EA0 board and corresponding jumper settings.

Table 3: WS2116EA0 kit platform power supply modes

Power supply mode	J7	J6	Comment
1- USB	Fitted: 1_2	Fitted: 2_3	USB supply through connector J4 (region H)
2- Battery	Fitted: 2_3	Fitted: 1_2	The supply voltage must be provided through battery pins (region P)
3- Combo	Fitted: 1_2	Optional	USB supply through connector J4 for STM32L1; J6 pin 2 external power for WS2116-A0 module

### 3.4. Other jumpers

The following jumpers are available:

Table 4: WS2116EA0 kit platform power supply modes

Part Number	Description
J1	Test points for S2-LP GPIO0-GPIO3
J3	UART TX of BlueNRG-2 is connected (Fitted) or disconnected (Not fitted) to STM32.
J5	UART RX of BlueNRG-2 is connected (Fitted) or disconnected (Not fitted) to STM32.



J8	pin 1 and 2 UART RX and TX of STM32 MCU pin 3 GND
J10	DIO6 of BlueNRG-2 could be connected (Fitted) or disconnected (Not fitted) to EEPROM_CS pin.
J11	Fitted: to provide VBLUE to BlueNRG-2. It can be used also for current measurement.
J12	Fitted: to provide VBLUE to SKY66420-11. It can be used also for current measurement.
J13	Fitted: to provide VBLUE to S2-LP. It can be used also for current measurement.

### 3.5. Extension connectors

WS2116-A0 module signal test points are shared on two Arduino-compliant connector rows: CN1, CN3 (Figure 2: "WS2116EA0 board components" – region J) and CN2, CN4 (region I). See Table 2: "WS2116-A0 module pin description with board functions".

You can also install some sensor module board in the WS2116EA0 kit platform through these extension connectors. Please contact Jorjin to get more information.

### 3.6. Push buttons

The board has one user button to reset the microcontroller (Figure 2: "WS2116EA0 board components" – region L) and two further buttons for application purposes (region M).

### 3.7. JTAG connector

A JTAG connector (Figure 2: "WS2116EA0 board components" – region K) allows BlueNRG-2 microcontroller programming and debugging with an in-circuit debugger and programmer such as ST-LINK/V2.

Only SWD mode is supported.

### 3.8. LEDs

There are 3 LED, CR2 (red), CR3 (green), CR4 (blue), available on the board (Figure 2: "WS2116EA0

board components" – regions O). They can be controlled on/off by DIO7, DIO14 and DIO15.

### 3.9. STM32L151CUB6 microcontroller

The most important feature of the STM32L151CUB6 48-pin microcontroller (Figure 2:"WS2116EA0 board components" –regions Q) is the USB to serial bridge providing an I/O channel with the BlueNRG-2 device.

The microcontroller is connected to the BlueNRG-2 device through an ST2378E level translator (region S).

The STM32L microcontroller on the board is not intended to be programmed by users. Jorjin provides a pre-programmed firmware image for the sole purpose of interfacing BlueNRG-2 to a USB host device (e.g., a PC). The JTAG connector (Figure 2: "WS2116EA0 board components" –regions R) is only for Jorjin internal used.

### 3.10. Hardware setup

1. Connect one 2.4GHz antenna to BLE SMA connector (Figure2: "WS2116EA0 board components" – regions B) and connect one 865~923MHz antenna to Sub-1GHz SMA connector (regions F or D). The RF path of Sigfox could be selected by setting switch parameter. Default Sigfox RF path is region F connector.
2. Configure the board to USB power supply mode as per the jumper settings in Table 3: "WS2116EA0 kit platform power supply modes"
3. Connect the board to a PC via USB cable (connector J4)
4. Verify the power indication LED CR1 is on.

### 3.11. Sub-1 GHz RF path setup

There are two options for Sub-1 GHz RF signal output.

1. The Sub-1 GHz RF signal can be switched to 2 different SMA connectors, SMA2 and SMA3 (Figure 2:"WS2116EA0 board components" –regions F and D). The most common application is to use two different frequency band antennas, one is 868MHz and the other is 920MHz.
2. The Sub-1GHz RF signal is fixed on an SMA connector, SMA2, and does not go through the RF switch to reduce signal attenuation. A common application is to use a wideband antenna, which can cover 865~923MHz.

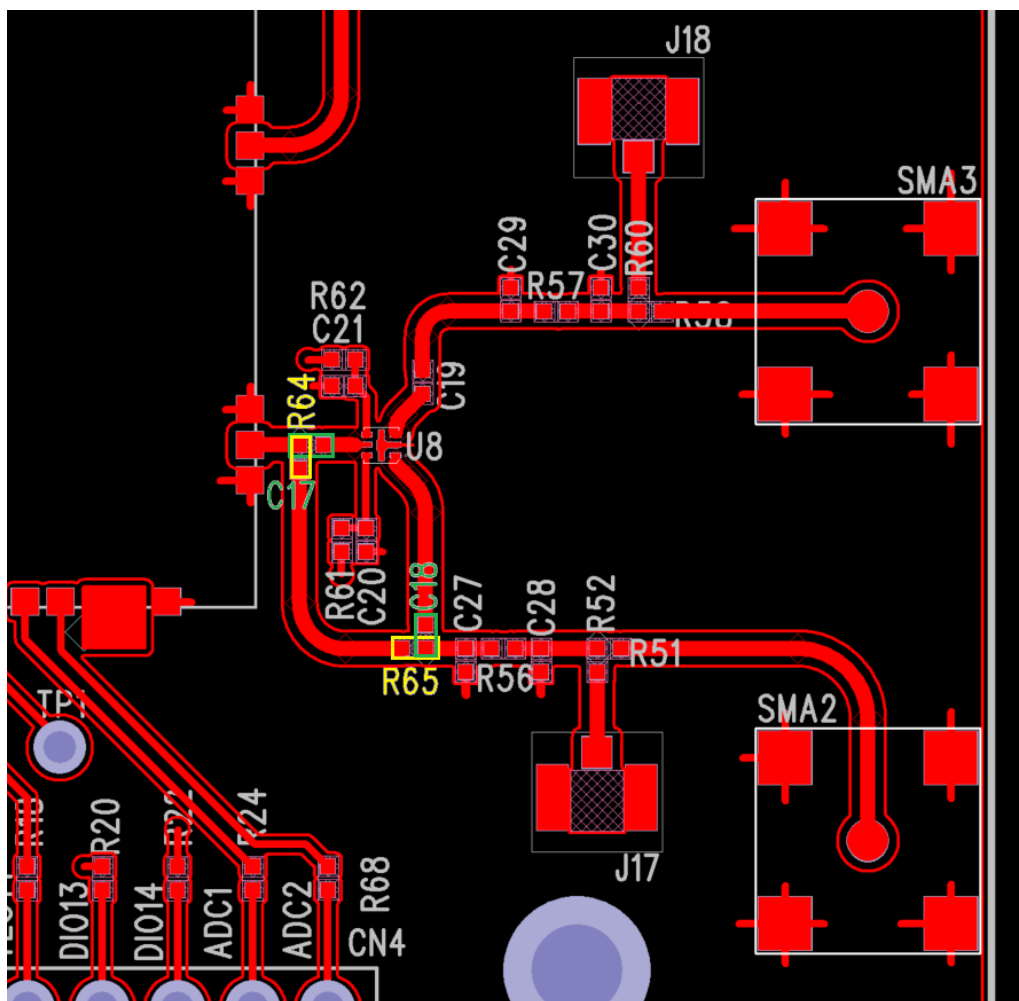
The following table describes the corresponding components settings.

Table 5: WS2116EA0 kit platform Sub-1 GHz RF path selection

RF path mode	Populate	Do not populate	Comment
switched to 2 different RF connectors	C17, C18	R64, R65	C17, C18 = 100pF
fixed on an RF connector	R64, R65	C17, C18	R64, R65 = 0 ohm

Figure 3 shows the location of the RF path selection parts. The yellow ones are R64 and R65, the green ones are C17 and C18.

Figure 3: Sub-1 GHz RF path selection



### 3.12. RF switch control table

The U8 is RF switch IC, it can switch the sub-1 GHz RF signal to 2 different SMA connectors. The following table describes the corresponding control.

Table 6: Sub-1 GHz RF path control table

DIO pin	Switch to SMA2	Switch to SMA3
DIO17	High	Low
DIO18	Low	High

### 3.13. RF connector type selection

There are two types of RF connectors to choose from, one is SMA and the other is U.FL. The preset on the board is SMA. The following table describes the corresponding components settings.

Table 7: WS2116EA0 kit platform Sub-1 GHz RF path selection

	BLE RF		Sub-1 GHz RF path #1		Sub-1 GHz RF path #2	
	SMA1	U.FL (J16)	SMA3	U.FL (J18)	SMA2	U.FL (J17)
Populate	R63	R50	R58	R60	R51	R52
Do not populate	R50	R63	R60	R58	R52	R51

\*All of the resistors are 0 ohm.

### 4. SCHEMATIC DIAGRAMS

Figure 4: WS2116EA0 Arduino-compliant connector

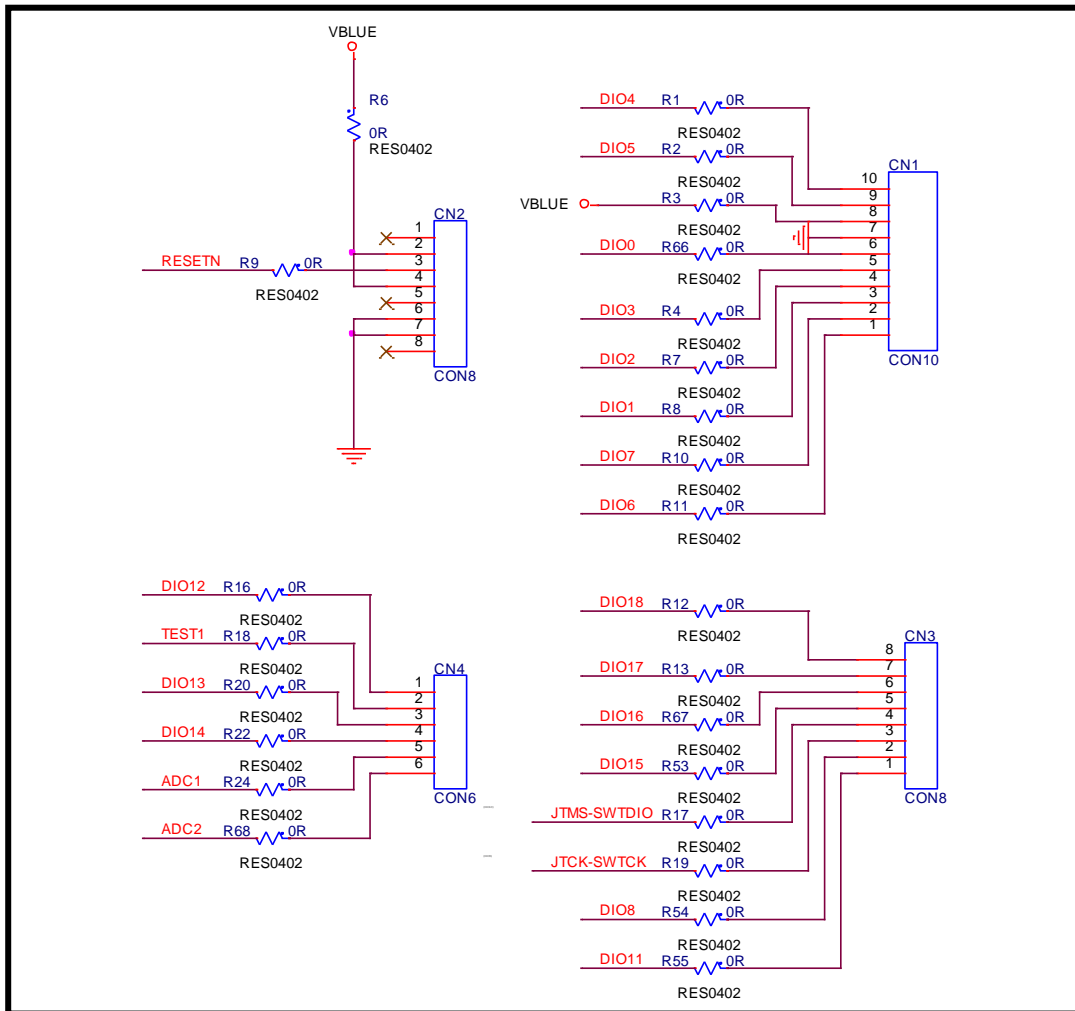


Figure 5: WS2116EA0 JTAG and EEPROM

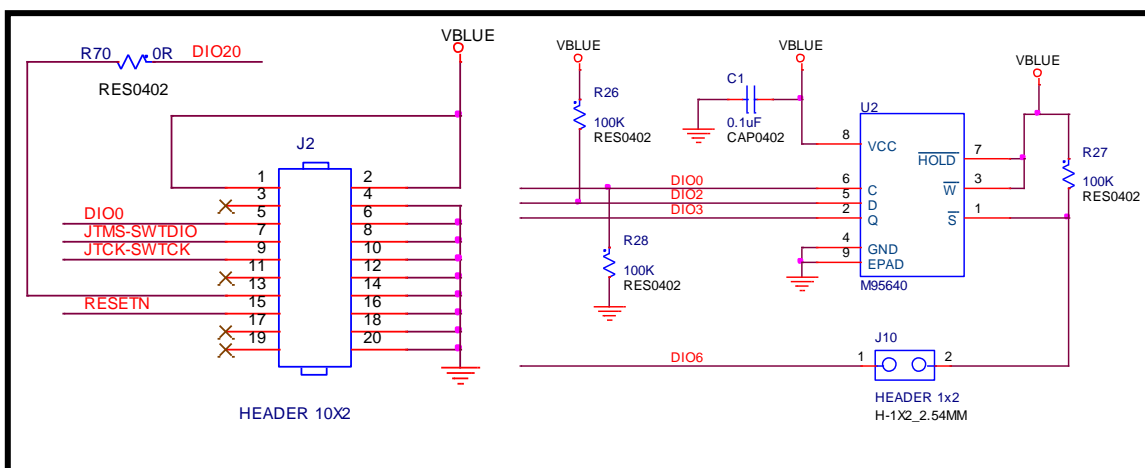
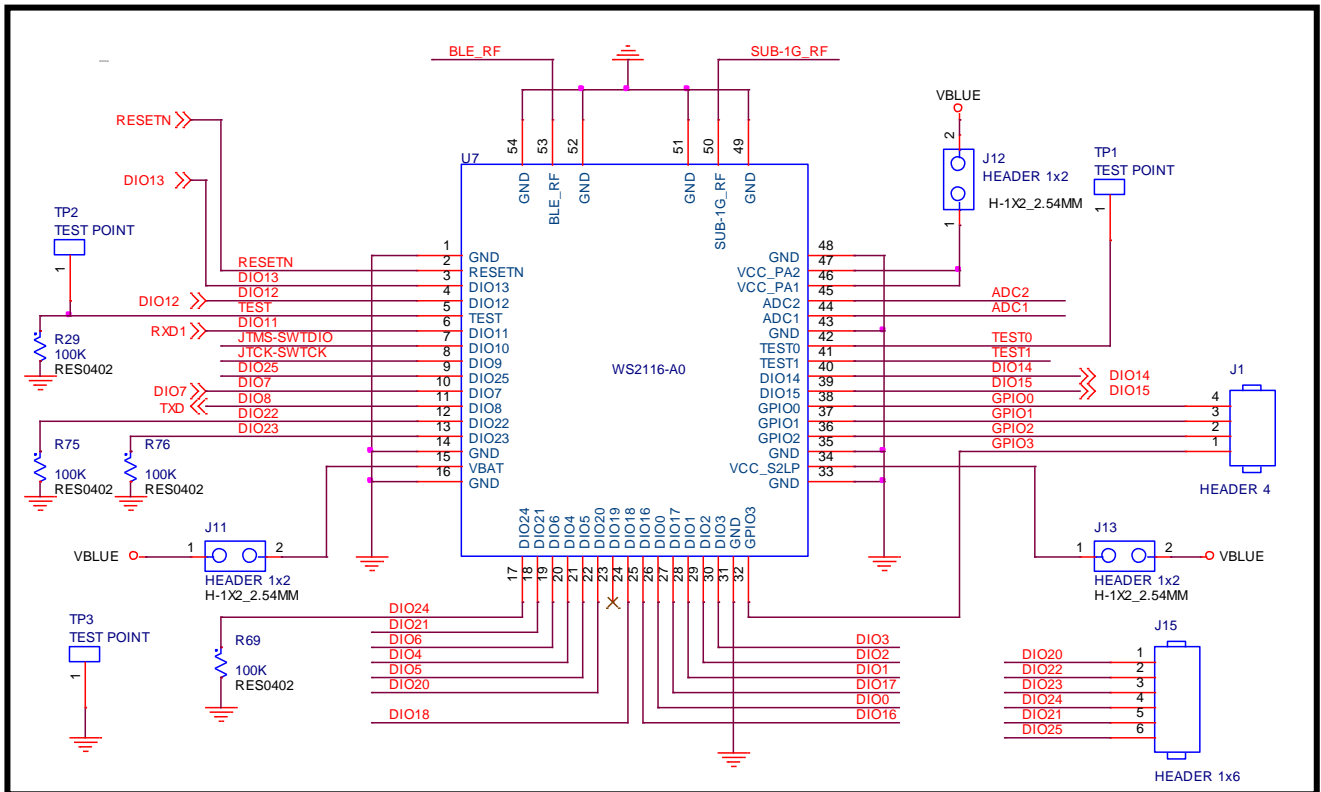
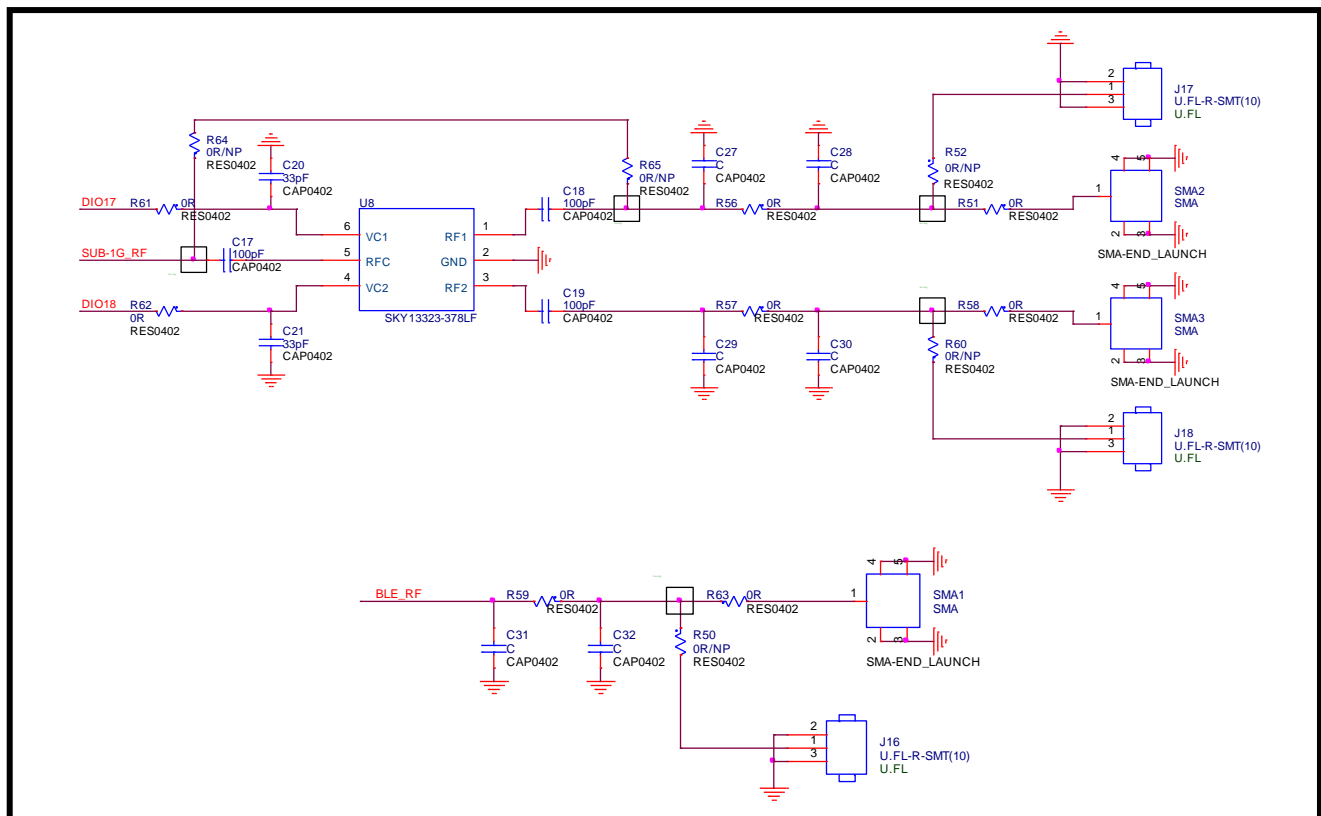


Figure 6: WS2116-A0 module pinout

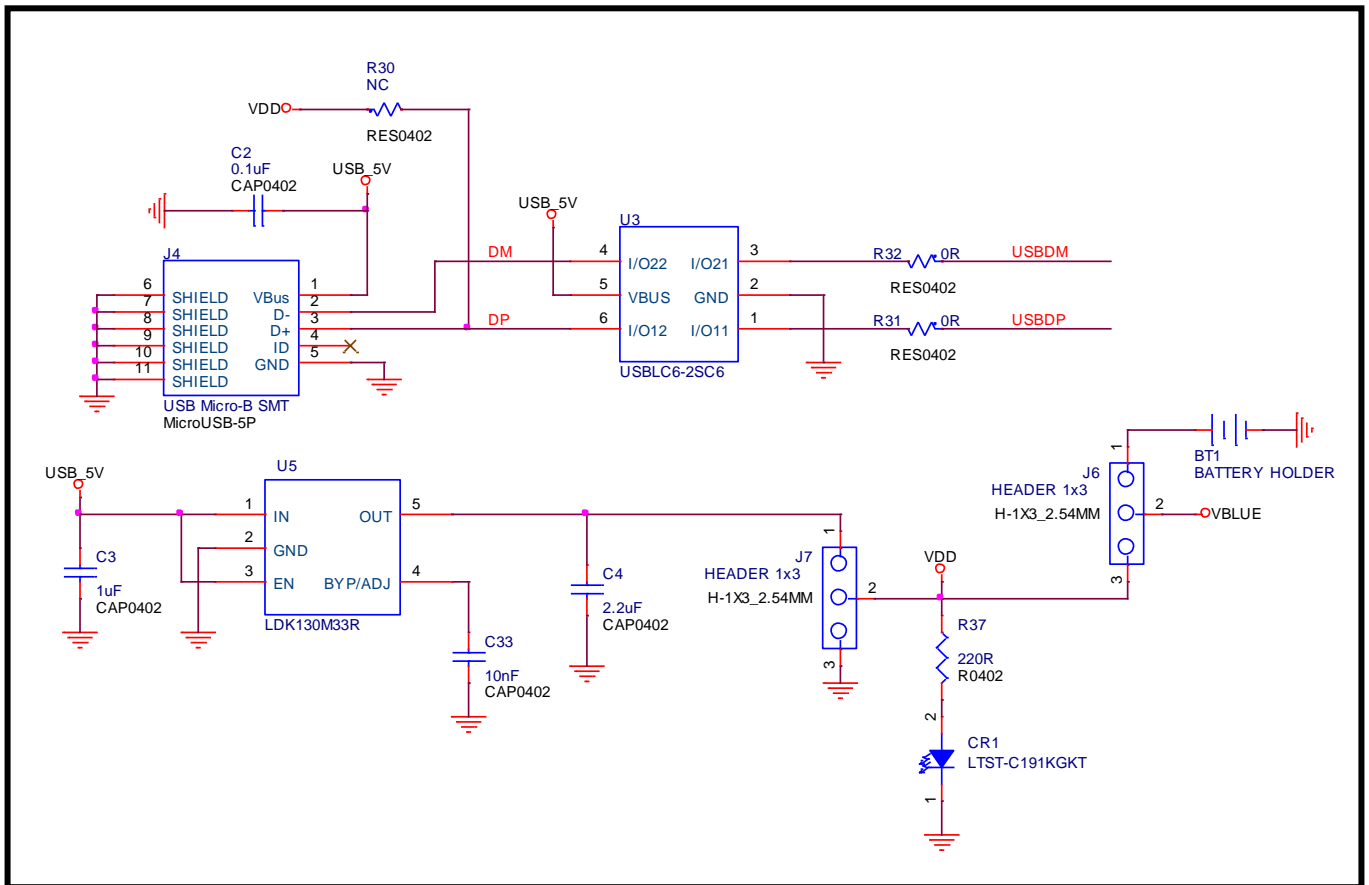


\*R75 and R76 are manual soldering on the PCB.

Figure 7: WS2116EA0 RF Circuit



**Figure 8: WS2116EA0 power**



**Figure 9: WS2116EA0 Level translator**

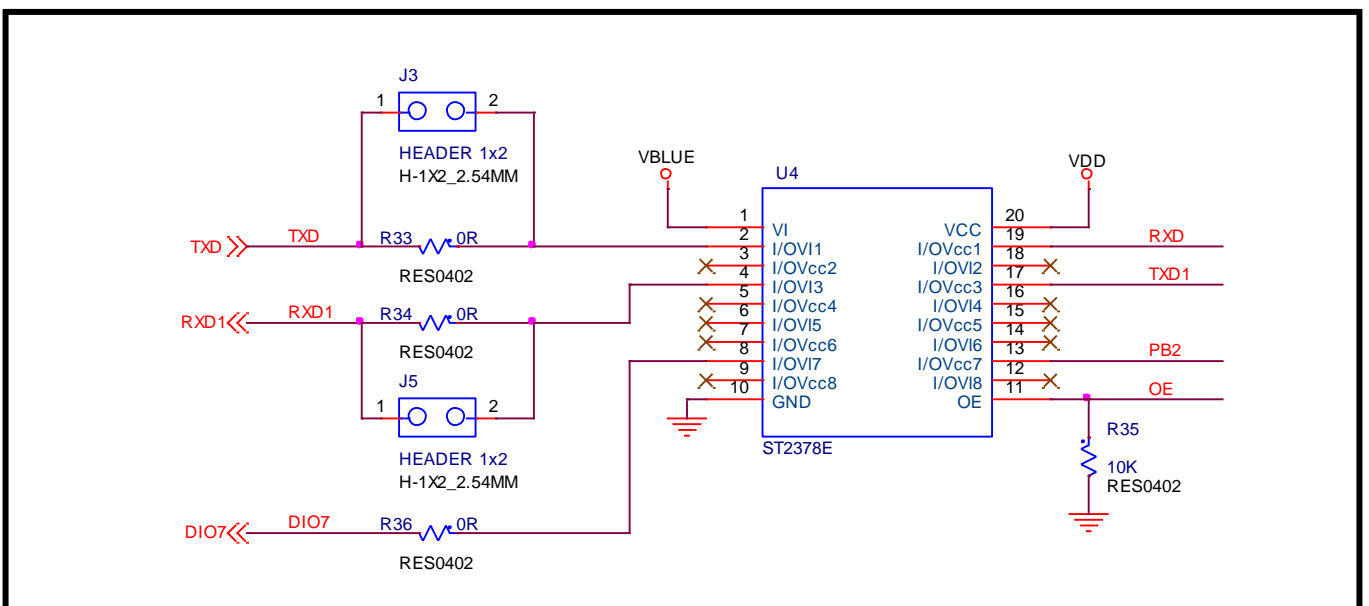


Figure 10: WS2116EA0 Micro controller

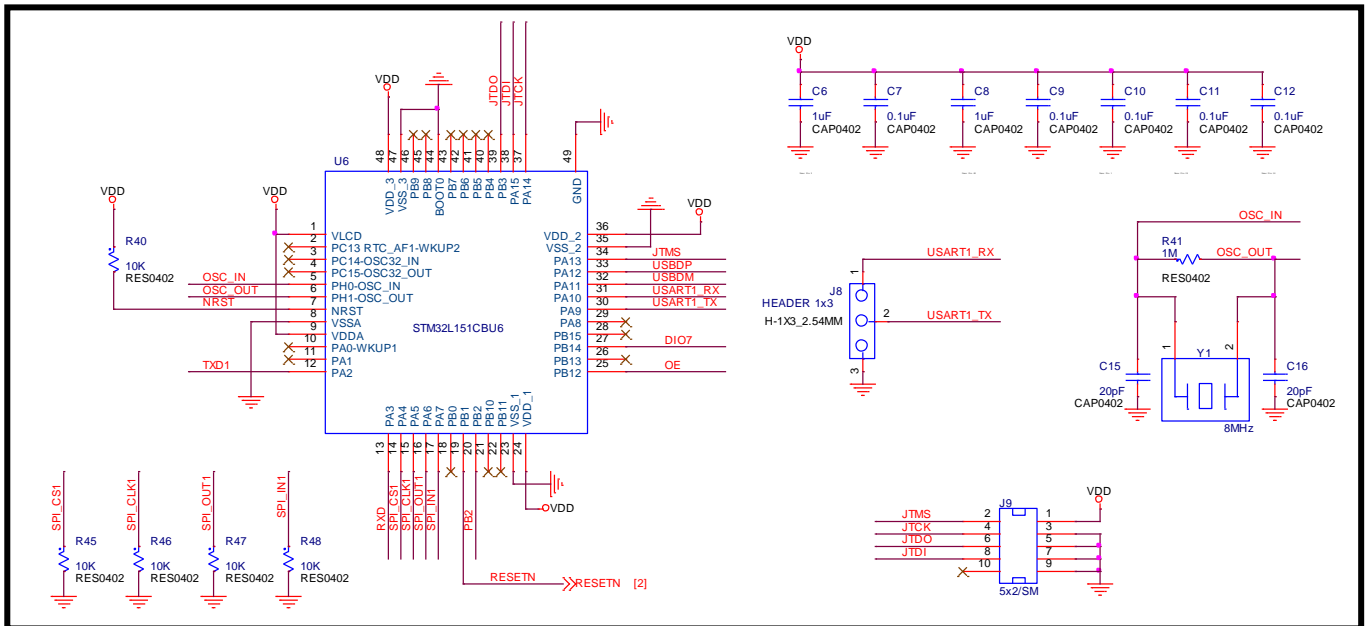
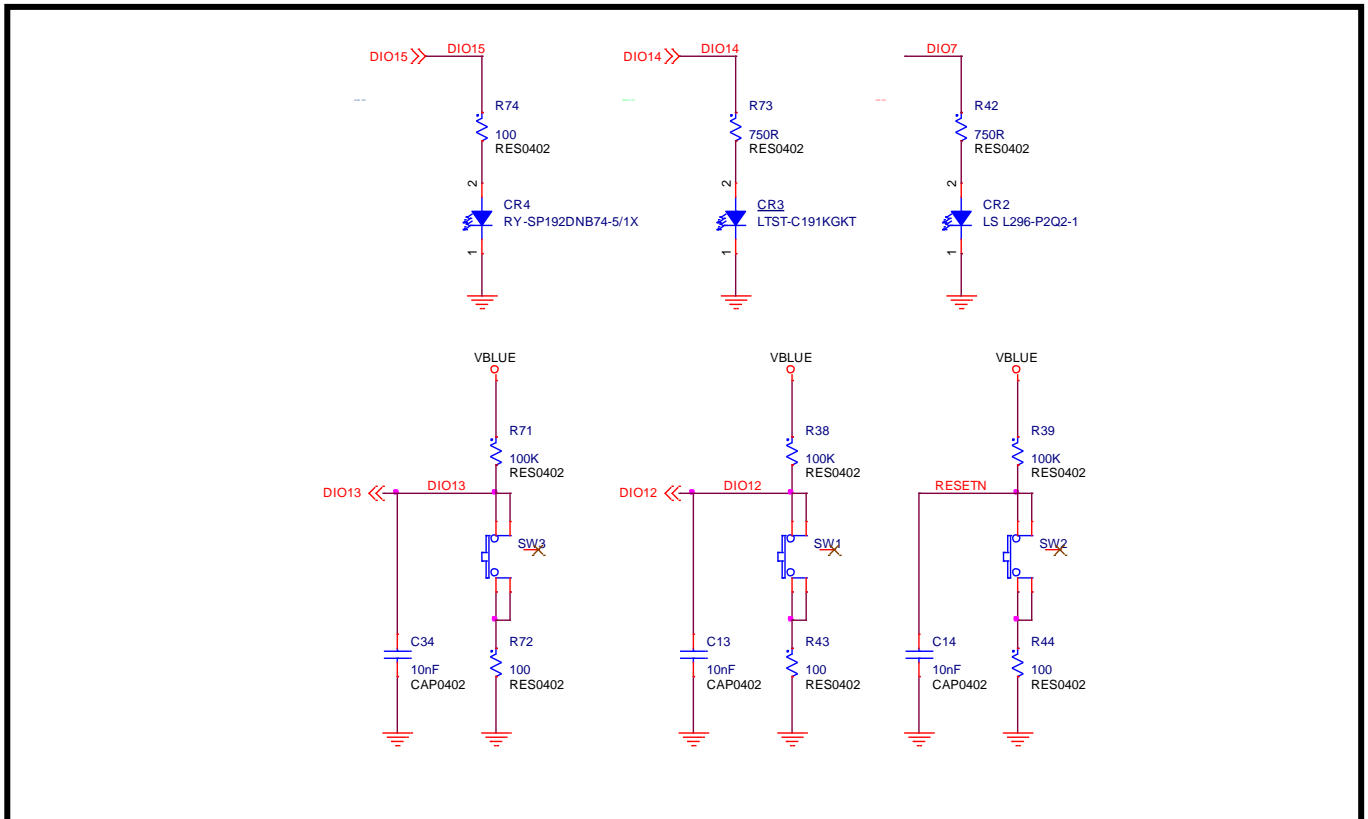


Figure 11: WS2116EA0 LEDs and Switches





## 5. HISTORY CHANGE

Revision	Date	Description
D 0.1	2019/02/22	Initial release
	2019/10/03	Add more description at introduction & Hardware description
R 0.1	2020/Jun/10	Update to version D03 board.