

## **WF61 Datasheet**

Amp'ed RF Technology, Inc.

## WF61 Product Specification



12mm x 12mm x 2.2 mm (WF61A)  
12mm x 12mm x 2.7 mm (WF61L)

### Description

Amp'ed RF Tech presents the WF61 WiFi dual band module: 802.11abgn. The WF61 is a small footprint low cost RF module intended to help customers shorten product development cycles and reduce cost. It's integrated 2.4GHz and 5GHz PA provides ready to use dual band RF. It is fully compatible with Linux & Android systems or our own upper layer stack, Amp'ed UP, for a complete host & controller solution.

### Features

#### WLAN

- 802.11a/b/g/n
- Dual Band: 2.4GHz and 5GHz
- Output Power, +21.5dBm for 2.4GHz; +19dBm for 5GHz
- Power savings mode
- Wi-Fi Direct (concurrent)
- Wi-Fi Protected Setup
- Soft Access Point
- Hotspot 2.0
- Security: WPAI/WPA2, AES, WEP

#### Hardware

- Interface, SDIO 2.0 or SPI
- 1 LPO input
- Standby current, 65  $\mu$ A
- RoHS conformance
- FCC/IC certified
- 1 UART
- 7 GPIO

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## 1. Hardware Specifications

General Conditions (VIN= 3.6V and 25°C)

### 1.1. Recommended Operating Conditions

Rating	Min	Typical	Max	Unit
Operating Temperature Range	-40	-	85	°C
Supply Voltage VIN	2.3	3.6	4.8	Volts
Supply Voltage VDD_3V3	3.0	3.3	3.6	Volts
Supply Voltage VDD_1V8	1.65	1.8	1.95	Volts
Signal Pin Voltage	-	1.8	-	Volts
RF Frequency for 2.4G	2400	-	2483.5	MHz
RF Frequency for 5G	5150	-	5850	MHz

### 1.2. Absolute Maximum Ratings

Rating	Min	Typical	Max	Unit
Storage temperature range	-55	-	+150	°C
Supply voltage VIN	-0.3	-	+4.8	Volts
Supply Voltage VDD_3V3	-0.3	-	4.0	Volts
Supply Voltage VDD_1V8	-0.3	-	2.0	Volts
I/O pin voltage VIO	-0.3	-	+2.5	Volts
RF input power	-	-	-5	dBm

### 1.3. I/O Operating Conditions

Symbol	Parameter	Min	Max	Unit
V <sub>IL</sub>	Low-Level Input Voltage	-	0.6	Volts
V <sub>IH</sub>	High-Level Input Voltage	1.3	-	Volts
V <sub>OL</sub>	Low-Level Output Voltage	-	0.2	Volts
V <sub>OH</sub>	High-Level Output Voltage	WF61A: 1.6 WF61L: 2.95	-	Volts
I <sub>OL</sub>	Low –Level Output Current	-	4.0	mA
I <sub>OH</sub>	High-Level Output Current	-	4.0	mA

#### 1.4. Current Consumption

<b>Modes (WLAN Max Power Consumption)</b> <b>VBAT=3.6v</b>	<b>Avg</b>	<b>Unit</b>
Complete Power Down (PMUEN low)	17	μA
Sleep	101	μA
Power save (beacon period including DTIM 100ms, beacon length 1ms) -proprietary power saving features enabled	0.77	mA
RX (idle, 2.4GHz)	62.07	mA
RX (active, 2.4GHz, OFDM)	65.87	mA
TX (active, 2.4GHz, OFDM), 15.5dBm @RF port	257.67	mA
TX (active, 2.4GHz, OFDM), 20.5dBm @RF port	279.67	mA
Video streaming; the device is receiving 2.0 Mbps of data using legacy PSM mode (for example, MPEG-4@2Mbps)	13.31	mA
I <sub>peak</sub> : system maximum peak current draw	378	mA

### 1.5. Selected RF Characteristics

Parameters	Conditions	Typical	Unit
Antenna load		50	ohm
<b>Wi-Fi Receiver 2.4GHz</b>			
Sensitivity	DSSS 1Mbps@FER<8%	-98.5	dBm
Sensitivity	DSSS 2Mbps@FER<8%	-96	dBm
Sensitivity	CCK 5.5Mbps@FER<8%	-94	dBm
Sensitivity	CCK 11Mbps@FER<8%	-89	dBm
Sensitivity	BPSK 6Mbps@PER<10%	-94.5	dBm
Sensitivity	BPSK 9Mbps@PER<10%	-92.5	dBm
Sensitivity	QPSK 12Mbps@PER<10%	-91.5	dBm
Sensitivity	QPSK 18Mbps@PER<10%	-89	dBm
Sensitivity	16QAM 24Mbps@PER<10%	-86	dBm
Sensitivity	16QAM 36Mbps@PER<10%	-83	dBm
Sensitivity	64QAM 48Mbps@PER<10%	-78.5	dBm
Sensitivity	64QAM 54Mbps@PER<10%	-77	dBm
Sensitivity	BPSK 6.5Mbps@PER<10%	-92.5	dBm
Sensitivity	QPSK 13Mbps@PER<10%	-89.5	dBm
Sensitivity	QPSK 19.5Mbps@PER<10%	-87	dBm
Sensitivity	16QAM 26Mbps@PER<10%	-84.5	dBm
Sensitivity	16 QAM 39Mbps@PER<10%	-81	dBm
Sensitivity	64QAM 52Mbps@PER<10%	-77	dBm
Sensitivity	64QAM 58.5Mbps@PER<10%	-75.5	dBm
Sensitivity	64QAM 65Mbps@PER<10%	-73.5	dBm
<b>Wi-Fi Receiver 5GHz 11n</b>			
Sensitivity	BPSK 6.5Mbps@PER<10%,Nss=1	-91	dBm
Sensitivity	QPSK 13Mbps@PER<10%, Nss=1	-88	dBm
Sensitivity	16QAM 26MbpsPER<10%,Nss=1	-83	dBm
Sensitivity	64QAM 65MbpsPER<10%,Nss=1	-72.5	dBm
<b>Wi-Fi Transmitter 2.4GHz</b>			
Output Power	802.11b/g BPSK 1/2	20	dBm
Output Power	802.11b/g BPSK 3/4	20	dBm
Output Power	802.11b/g QPSK 1/2	20	dBm
Output Power	802.11b/g QPSK 3/4	20	dBm
Output Power	802.11b/g 16QAM 1/2	19.5	dBm
Output Power	802.11b/g 16QAM 3/4	18.5	dBm

Output Power	802.11b/g 64QAM 2/3	17.5	dBm
Output Power	802.11b/g 64QAM 3/4	16.5	dBm
Output Power	802.11n MCS-0	20	dBm
Output Power	802.11n MCS-1	20	dBm
Output Power	802.11n MCS-2	20	dBm
Output Power	802.11n MCS-3	19.5	dBm
Output Power	802.11n MCS-4	18.5	dBm
Output Power	802.11n MCS-5	17.5	dBm
Output Power	802.11n MCS-6	16.5	dBm
Output Power	802.11n MCS-7	15.5	dBm
<b>Wi-Fi Transmitter 5GHz, 11n</b>			
Output Power	802.11n MCS-7	17	dBm

### 1.6. Transmit Power Back-off

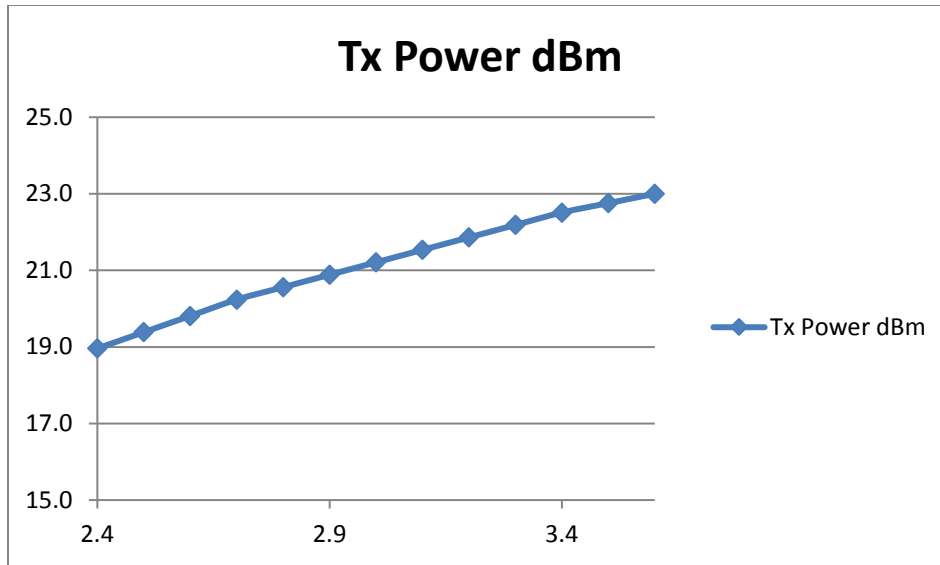
Note: Applies to 2.4GHz low band only.

When  $2.7\text{ V} < V_{IN} < 3.6\text{ V}$ , the output power shall be backed off by 0.8 dB per 300 mV drop of  $V_{IN}$  below 3.6 V to guarantee meeting spectral mask, EVM, harmonic levels, spurious emissions and regulatory requirements in general.

When  $2.3\text{ V} < V_{IN} < 2.7\text{ V}$ , an additional back-off of the output power is needed to guarantee meeting spectral mask, EVM, harmonic levels, spurious emissions and regulatory requirements in general.

When the load is not  $50\Omega$ , the output power is backed off to guarantee meeting spectral mask, EVM, harmonic levels, spurious emissions and regulatory requirements in general. The device is able to withstand a VSWR of up to 12:1 without any damage.

When the temperature increases from  $+25^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ , the output power shall be backed off by 0.25 dB per  $10^{\circ}\text{C}$  increase to guarantee meeting spectral mask, EVM, harmonic levels, spurious emissions and regulatory requirements in general.



Tx Power vs Vin

### 1.7. Pin Assignment, Standard Modules

Name	Type	Pin #	Description	ALT Function	Logic Level WF61A	Logic Level WF61L
GND		1	Ground connections			
2.4G WL_ANT	I/O	2	Antenna port for 2.4G WIFI			
GND		3	Ground connections			
NC						
NC		5	Floating (Don't connected to ground)			
NC		6	Floating (Don't connected to ground)			
NC		7	Floating (Don't connected to ground)			
NC		8	Floating (Don't connected to ground)			
VIN		9	Main power voltage source input			
GND		10	Ground connections			
5 G WL_ANT	I/O	11	Antenna port for 5G WIFI			
WL_REG_ON	I	12	Internal regulators power enable/disable		1.8V	1.8V
WIRQ	O	13	SDIO external interrupt		1.8V	1.8V
SDIO DATA2	I/O	14	SDIO data line 2 / SDIO or SPI selection		1.8V	1.8V
SDIO DATA3	I/O	15	SDIO data line 3	SPI CSN	1.8V	1.8V
SDIO CMD	I/O	16	SDIO command line	SPI DI	1.8V	3.3V
SDIO CLK	I/O	17	SDIO clock line	SPI CLK	1.8V	3.3V



SDIO DATA0	I/O	18	SDIO data line 0	SPI DO	1.8V	3.3V
SDIO DATA1	I/O	19	SDIO data line 1	SPI INT	1.8V	1.8
GND		20	Ground connections			
NC		21	Floating (Don't connected to ground)			
VDD_3V3		22	3.3V power supply input			
NC		23	Floating (Don't connected to ground)			
LPO	I	24	low power clock 32.768KHz		1.8V	1.8V
NC		25	Floating (Don't connected to ground)			
NC		26	Floating (Don't connected to ground)			
NC		27	Floating (Don't connected to ground)			
NC		28	Floating (Don't connected to ground)			
VDD_1V8		29	1.8V power supply input			
NC		30	Floating (Don't connected to ground)			
GND		31	Ground connections			
NC		32	Floating (Don't connected to ground)			
GND		33	Ground connections			
NC		34	Floating (Don't connected to ground)			
NC		35	Floating (Don't connected to ground)			
GND		36	Ground connections			
NC		37	Floating (Don't connected to ground)			
NC		38	Floating (Don't connected to ground)			
NC		39	Floating (Don't connected to ground)			
NC		40	Floating (Don't connected to ground)			
NC		43	Floating (Don't connected to ground)			
NC		42	Floating (Don't connected to ground)			
NC		41	Floating (Don't connected to ground)			
NC		44	Floating (Don't connected to ground)			

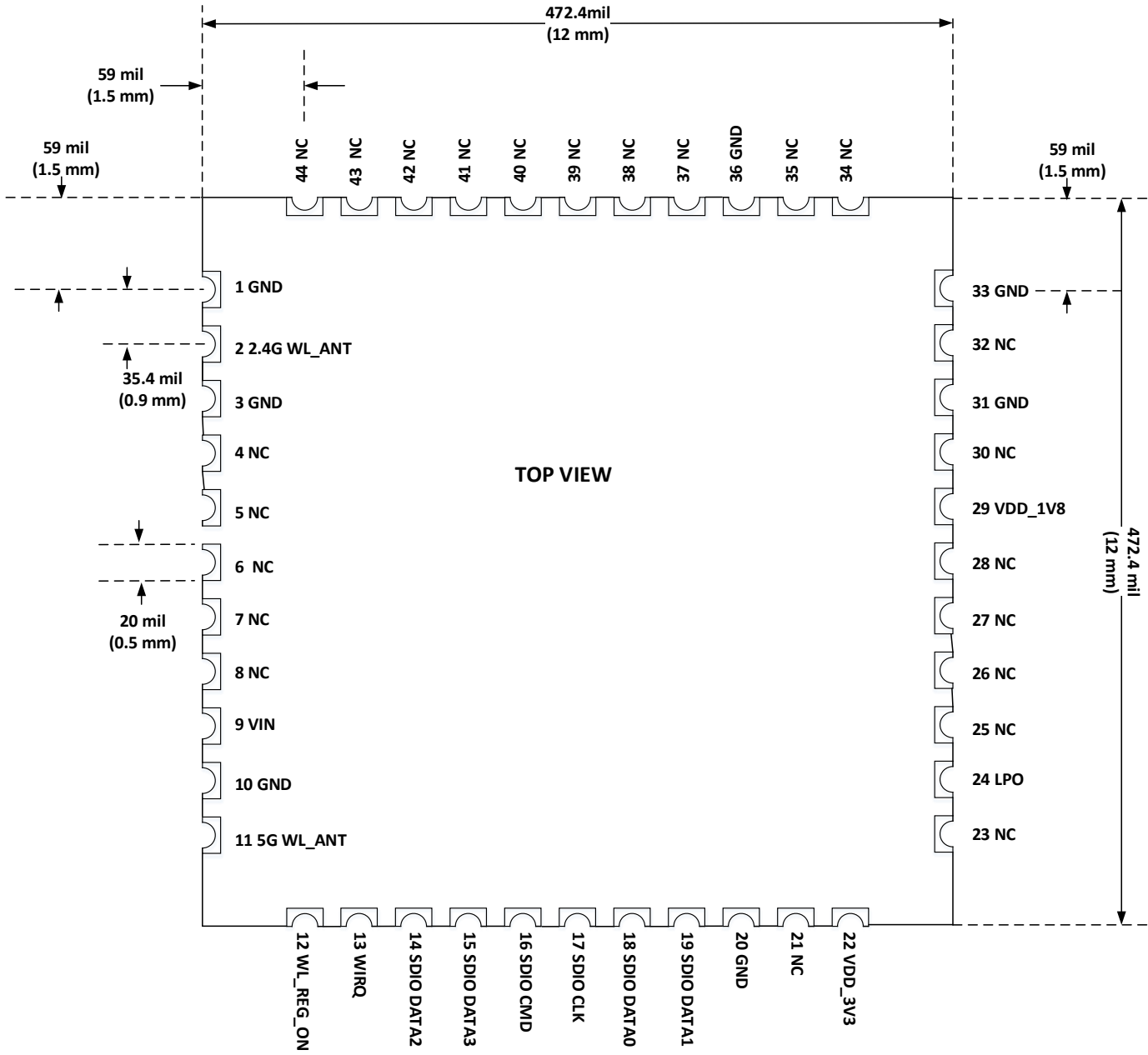
## 1.8. Pin Assignment, IoT Modules

Name	Type	Pin #	Description	ALT Function	Logic Level
GND		1	Ground connections		
2.4G WL_ANT	I/O	2	Antenna port for 2.4G WIFI		
GND		3	Ground connections		
NC					
NC		5	Floating (Don't connected to ground)		
NC		6	Floating (Don't connected to ground)		
NC		7	Floating (Don't connected to ground)		
NC		8	Floating (Don't connected to ground)		
VIN		9	Main power voltage source input		
GND		10	Ground connections		
5 G WL_ANT	I/O	11	Antenna port for 5G WIFI		
WL_REG_ON	I	12	Internal regulators power enable/disable		1.8V
WIRQ	O	13	SDIO external interrupt	GPIO_4	1.8V
SDIO DATA2	I/O	14	SDIO data line 2 / SDIO or SPI selection		1.8V
SDIO DATA3	I/O	15	SDIO data line 3	SPI CSN	1.8V
SDIO CMD	I/O	16	SDIO command line	SPI DI	1.8V
SDIO CLK	I/O	17	SDIO clock line	SPI CLK	1.8V
SDIO DATA0	I/O	18	SDIO data line 0	SPI DO	1.8V
SDIO DATA1	I/O	19	SDIO data line 1	SPI INT	1.8V
GND		20	Ground connections		
GPIO_0	I/O	21	General purpose I/O		1.8V
VDD_3V3		22	3.3V power supply input		
NC		23	Floating (Don't connected to ground)		
LPO	I	24	low power clock 32.768KHz		1.8V
GPIO_2	I/O	25	General purpose I/O		1.8V
GPIO_3	I/O	26	General purpose I/O		1.8V
GPIO_1	I/O	27	General purpose I/O)		1.8V
GPIO_7	I/O	28	General purpose I/O)		1.8v
VDD_1V8		29	1.8V power supply input		
NC		30	Floating (Don't connected to ground)		

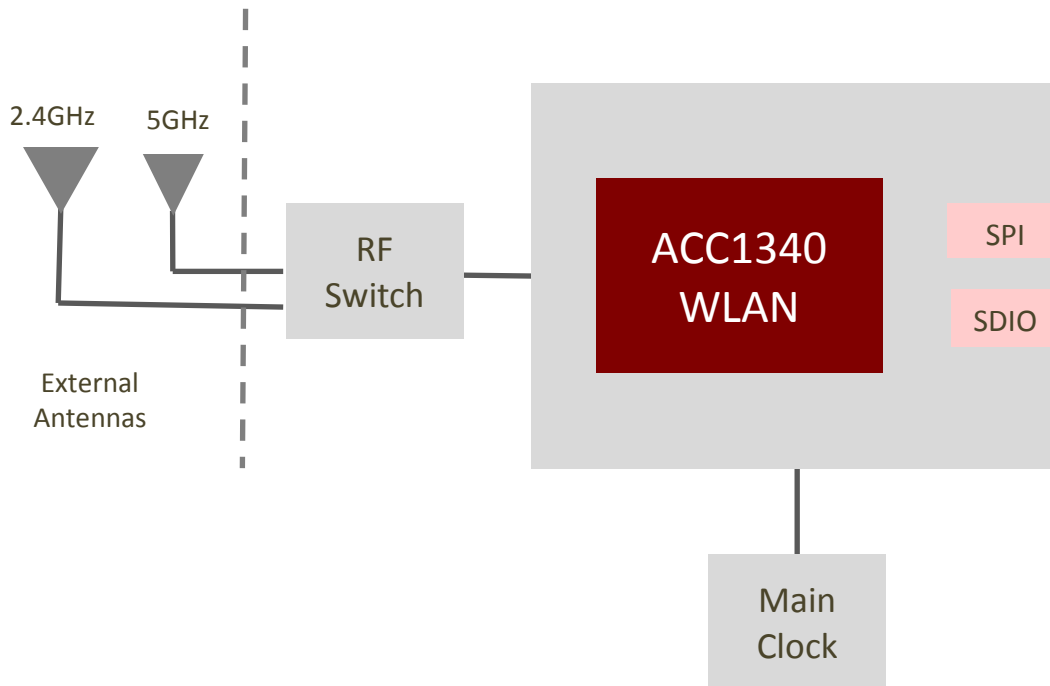
GND		31	Ground connections		
NC		32	Floating (Don't connected to ground)		
GND		33	Ground connections		
UART_RXD	I	34	UART receive data		1.8V
UART_TXD	O	35	UART transmit data		1.8V
GND		36	Ground connections		
NC		37	Floating (Don't connected to ground)		
NC		38	Floating (Don't connected to ground)		
NC		39	Floating (Don't connected to ground)		
NC		40	Floating (Don't connected to ground)		
NC		43	Floating (Don't connected to ground)		
NC		42	Floating (Don't connected to ground)		
NC		41	Floating (Don't connected to ground)		
NC		44	Floating (Don't connected to ground)		

### 1.9. Layout Drawing

Size: 12 mm x 12 mm x 2.7 mm



## 2. Hardware Block Diagram



### 3. Hardware Design

#### 3.1. PCB layout guide

- All unused pins should be left floating; do not ground.
- All GND pins must be well grounded.
- Traces should not be routed underneath the module.
- Use short, 50 ohm impedance, RF traces. Routing should be on the top layer.
- A diplexer may be used to combine 2.4GHz and 5GHz RF signals.
- Keep the clock and power signals far away from RF signals.
- Use a 22uF capacitor near Vin pin 9.
- SDIO signal traces should be equal length and their offset should be under  $\pm 50$ mil according to the clock of SDIO.
- All power supply lines should meet their power requirements.
- LPO traces should keep clear from other low frequency traces, such as IIC.

#### 3.2. Module Reflow Installation

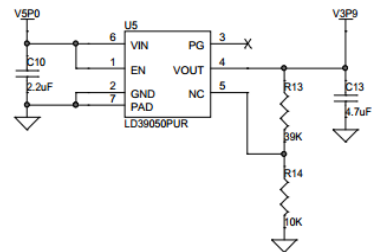
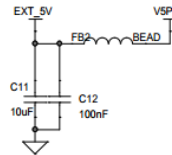
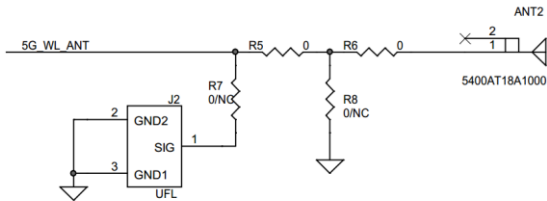
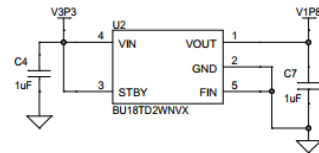
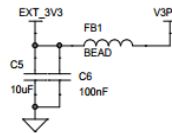
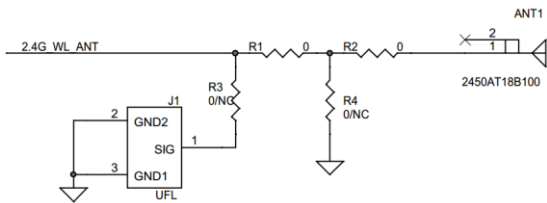
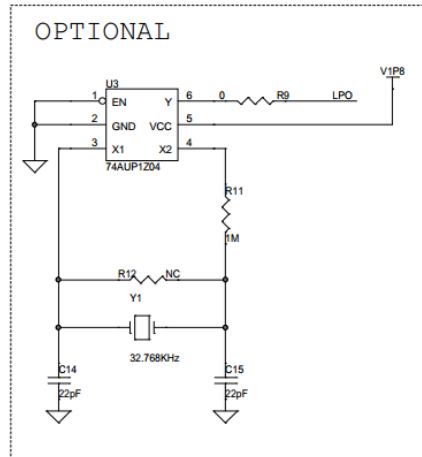
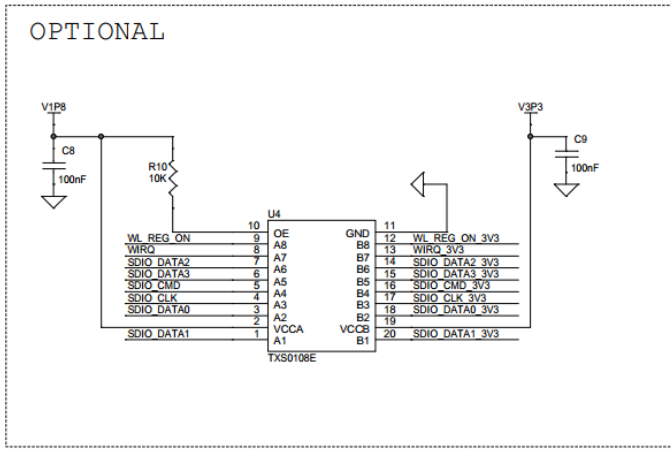
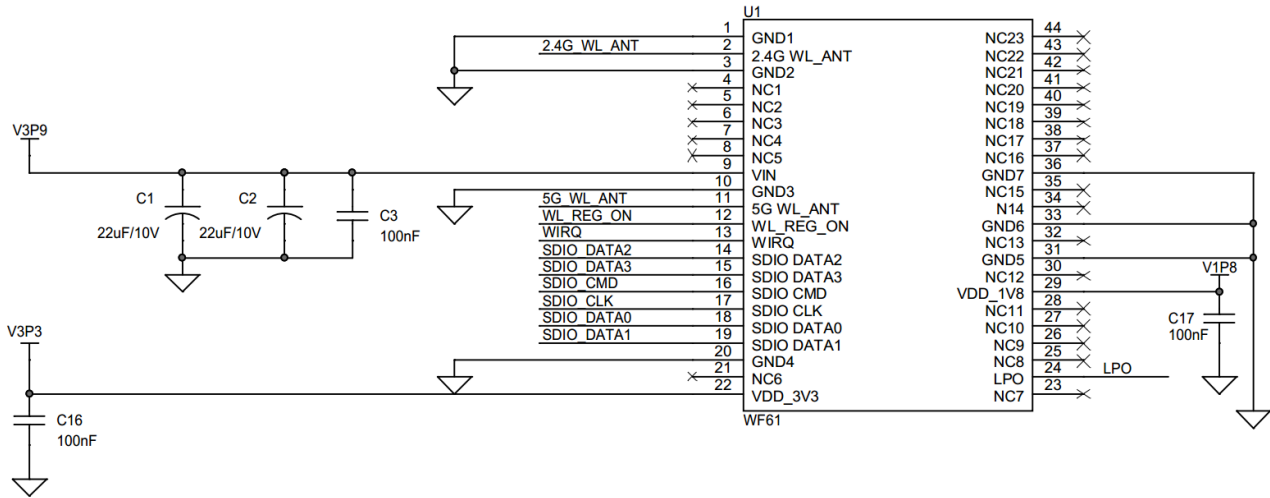
The WF61 is a surface mount WiFi module supplied on a 44 pin, 6-layer PCB. The final assembly recommended reflow profiles are:

For RoHS/Pb-free applications, Sn96.5/Ag3.0/Cu0.5 solder is recommended.

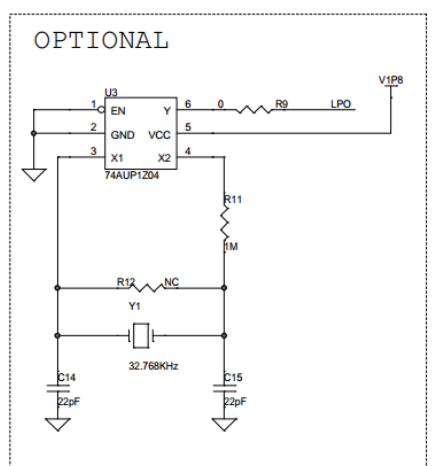
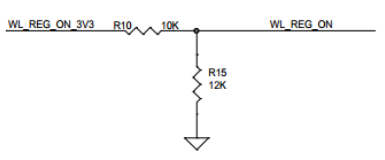
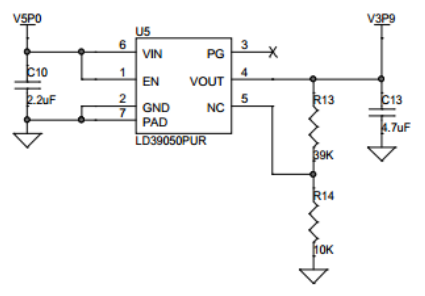
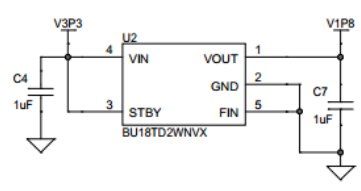
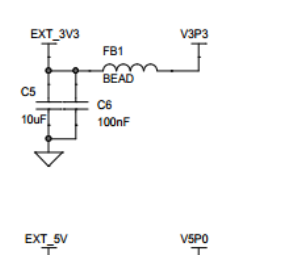
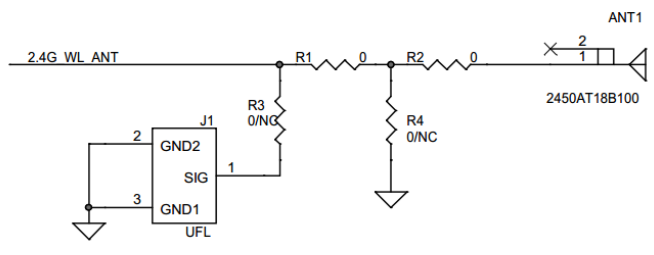
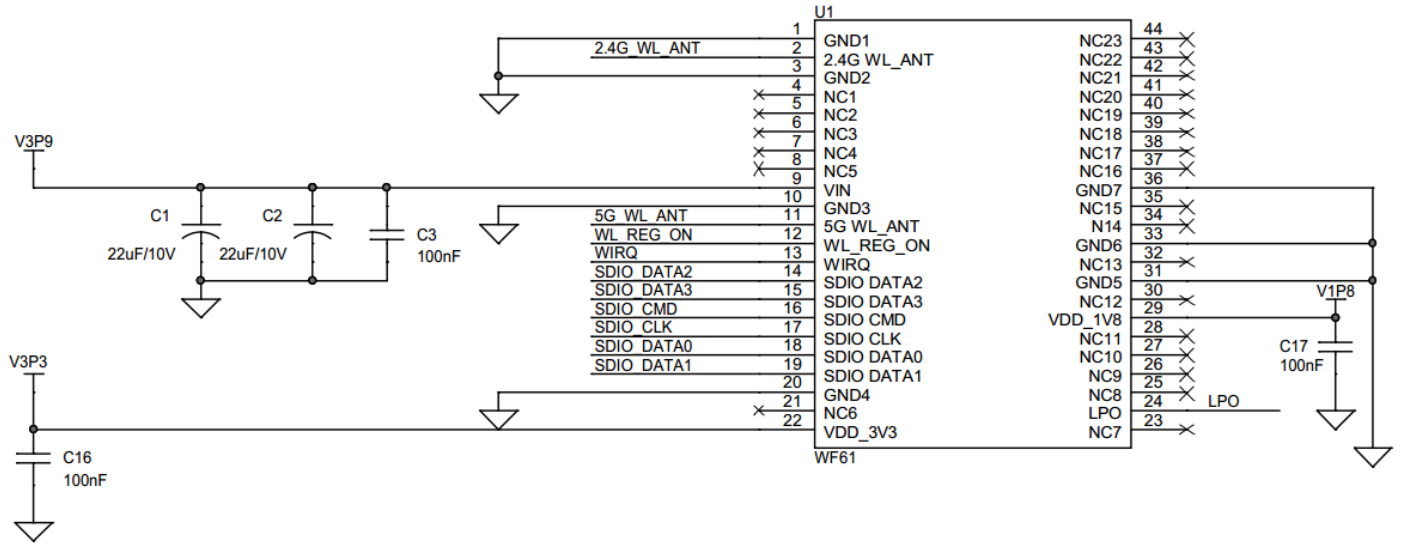
- Maximum peak temperature of 230° - 240°C (below 250°C).
- Maximum rise and fall slope after liquidous of  $< 2^{\circ}\text{C}/\text{second}$ .
- Maximum rise and fall slope after liquidous of  $< 3^{\circ}\text{C}/\text{second}$ .
- Maximum time at liquidous of 40 – 80 seconds.

### 4. Reference Design Example

The follow circuits are examples of typical Linux based platform connections to the WF61A module.



The follow circuits are examples of typical Linux based platform connections to the WF61L module.





## 5. Startup behavior

### 5.1. WL\_REG\_ON

A valid reset shall be obtained by maintaining WL\_REG\_ON active (low) for at least two cycles of LPO after VIN is stable within its operating range. There is no constraint on the activation of the other supplies during this process.

### 5.2. SDIO and SPI interface

SDIO DATA2 is the selection pin; the state of this pin is monitored on the rising edge of RESET.

- LOW selects SPI
- HIGH selects SDIO

## 6. Regulatory Compliance

### **Federal Communications Commission statement:**

This module has been tested and found to comply with the FCC Part 15.

These limits are designed to provide reasonable protection against harmful interference in approved installations. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

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 interference that may cause undesired operation.

Modifications or changes to this equipment not expressly approved by Amp'ed RF Technology may void the user's authority to operate this equipment.

The modular transmitter must be equipped with either a permanently affixed label or must be capable of electronically displaying its FCC identification number

(A) If using a permanently affixed label, the modular transmitter must be labeled with its own FCC identification number, and, if the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains Transmitter Module FCC ID: X3ZWFMOD9" or "Contains FCC ID: X3ZWFMOD9."

(B) If the modular transmitter uses an electronic display of the FCC identification number, the information must be readily accessible and visible on the modular transmitter or on the device in which it is installed. If the module is installed inside another device, then the outside of the device into which the module is installed must display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains FCC certified transmitter module(s)."

To satisfy FCC RF Exposure requirements for mobile and base station transmission devices, a separation distance of 20 cm or more should be maintained between the antenna of this device and persons during operation. To ensure compliance, operation at closer than this distance is not recommended. The antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

### **Industry Canada statement:**

Label of the end product:

The final end product must be labeled in a visible area with the following "Contains transmitter module IC: 8828A-MOD9"

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

This device complies with RSS-210 of the Industry Canada 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 interference that may cause undesired operation.

Ce dispositif est conforme à la norme CNR-210 d'Industrie Canada applicable aux appareils radio exempts de licence. Son fonctionnement est sujet aux deux conditions suivantes: (1) le dispositif ne doit pas produire de brouillage préjudiciable, et (2) ce dispositif doit accepter tout brouillage reçu, y compris un brouillage susceptible de provoquer un fonctionnement indésirable.

#### 6.1. Modular Approval, FCC and IC

FCC ID: X3ZWFMOD9

IC: 8828A-MOD9

In accordance with FCC Part 15, the WF61 is listed above as a Limited Modular Transmitter device.

#### 6.2. FCC Label Instructions

The outside of final products that contain a WF61 device must display a label referring to the enclosed module.

This exterior label can use wording such as the following:

Contains Transmitter Module

FCC ID: X3ZWFMOD9

IC: 8828A-MOD9

Any similar wording that expresses the same meaning may be used.

## 7. Ordering Information

Part Name	Description
WF61A-DB	Dual band, external antenna 2.4GHz and 5GHz. 1.8V SDIO logic level. With no RF shielding use: WF61A-DB-NS.
WF61A-HB	High band, external antenna 5GHz. 1.8V SDIO logic level. With no RF shielding use: WF61A-HB-NS.
WF61A-LB	Low band, external antenna 2.4GHz. 1.8V SDIO logic level. With no RF shielding use: WF61A-LB-NS.
WF61L-HB	High band, external antenna 5GHz. 3.3V SDIO logic level, with RF shielding. With no RF shielding use: WF61L-HB-NS.
WF61AS-IOT	IOT version of the WF61 module.

## 8. Revision History

Date	Revision	Description
27-Apr-2017	1.0	Initial release
2-May-2017	1.1	Added level shifter option
8-May-2017	1.2	Update WF61L reference design
30-Jun-2017	1.3	Add PCB layout guide and add some PN
8-Sept-2017	1.4	Ordering part numbers updated
6-Feb-2018	1.5	Removed DB and LB options for WF61L
30-Aug-18	1.6	Updated 5GHz power output
15-Jan-19	1.7	Updated FCC/IC details
3-March-21	1.8	Add IOT version of WF61