

## **WF60 Datasheet**

Amp'ed RF Technology, Inc.

## WF60 Product Specification



13.5mm x 14.6mm x 2.7 mm



### Description

Amp'ed RF Tech presents the WF60 WiFi dual band module: 802.11abgn. The WF60 is a small footprint low cost RF module intended to help customers shorten product development cycles and reduce cost. It's 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
- Power savings mode
- Transmit power back-off
- Wi-Fi Direct (concurrent)
- Wi-Fi Display
- 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, 40  $\mu$ A
- RoHS conformance
- FCC/IC certified TBD

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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
Signal Pin Voltage	-	1.8	-	Volts
RF Frequency	2400	-	2483.5	MHz

### 1.2. Absolute Maximum Ratings

Rating	Min	Typical	Max	Unit
Storage temperature range	-55	-	+150	°C
Supply voltage VIN	-0.3	-	+5.0	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	1.6	-	Volts
I <sub>OL</sub>	Low –Level Output Current	-	4.0	mA
I <sub>OH</sub>	High-Level Output Current	-	4.0	mA
R <sub>PU</sub>	Pull-up Resistor	80	120	KΩ
R <sub>PD</sub>	Pull-down Resistor	80	120	KΩ

#### 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
A VoIP call using a standard codec G.711 (64Kb/s, 320 byte packets) and U-APSD (WMM power save) power-saving mode.	4.65	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-0	19.5	dBm
Output Power	802.11n MCS-7	14.5	dBm

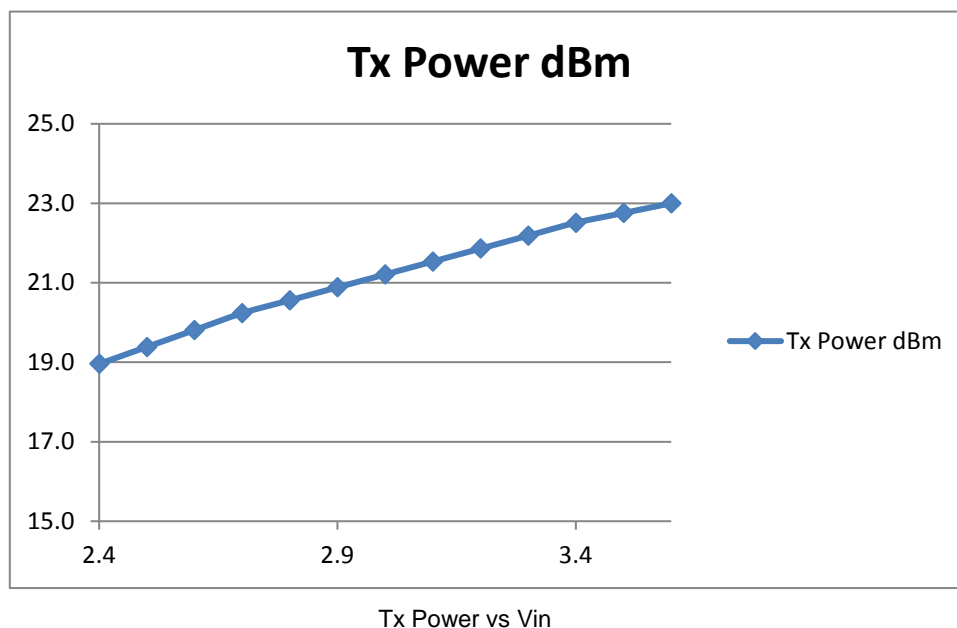
### 1.6. Transmit Power Back-off

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.



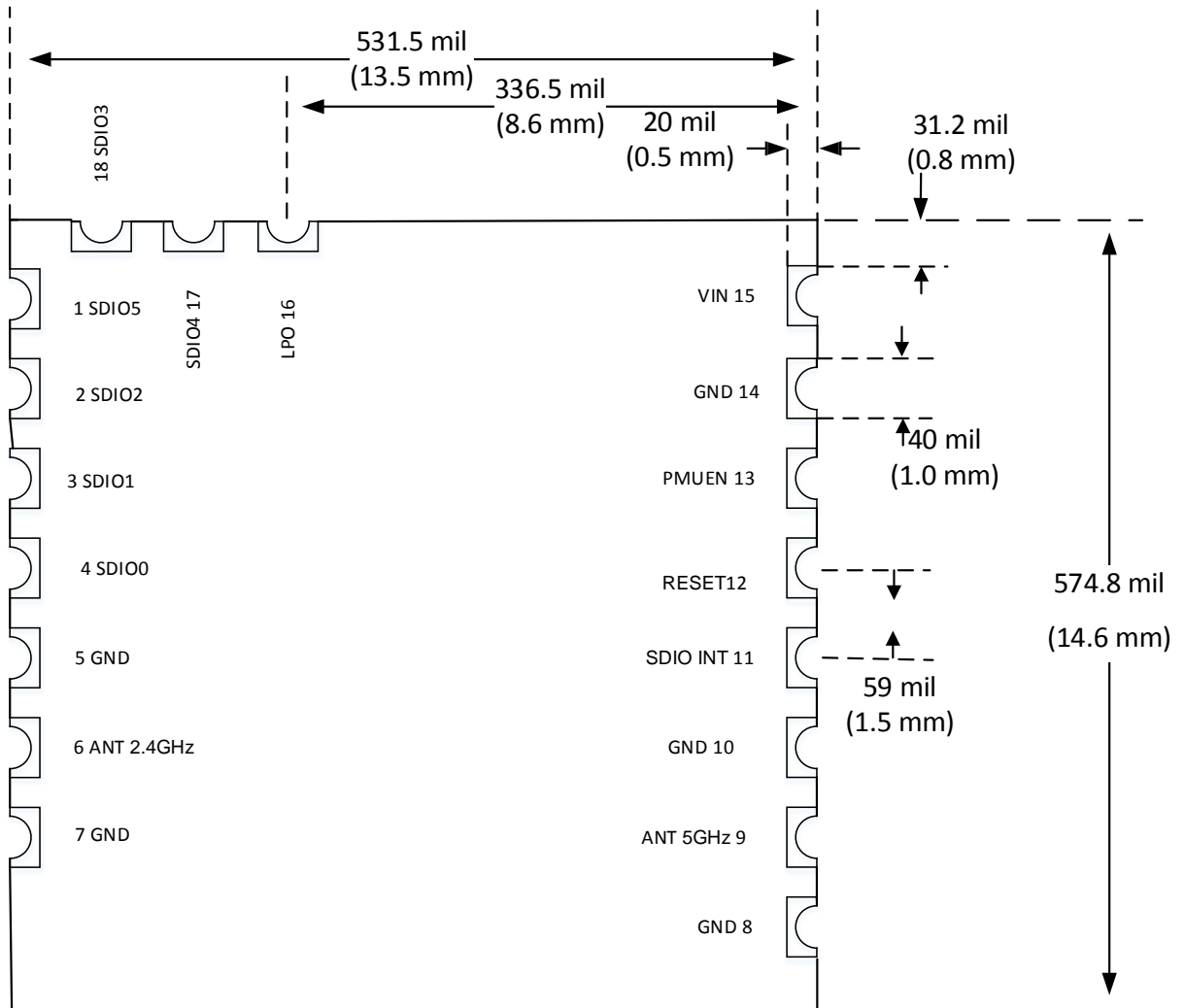
## 1.7. Pin Assignment

Name	Type	Pin #	Description	ALT Function
<b>Power and Ground</b>				
VIN		15	VIN	
GND		14	GND	
<b>Control signal</b>				
RESET	I	12	Reset input	
PMUEN	I	13	Power enable	
<b>Digital interface</b>				
SDIO [0]	I/O	4	SDIO CMD	SPI DI
SDIO [1]	I/O	3	SDIO DATA0	SPI DO
SDIO [2]	I/O	2	SDIO DATA1	SPI INT
SDIO [3]	I/O	18	SDIO DATA3	SPI CSN
SDIO [4]	I/O	17	SDIO CLK	SPI CLK
SDIO [5]	I/O	1	SDIO DATA2	
SDIO INT		11	SDIO INT	
<b>LPO</b>				
LPO	I	16	Low power clock input	
<b>External Antenna</b>				
GND		5	GND	
ANT 2.4G	I/O	6	External 2.4GHz antenna	
GND		7	GND	
GND		8	GND	
ANT 5G	I/O	9	External 5GHz antenna	
GND		10	GND	

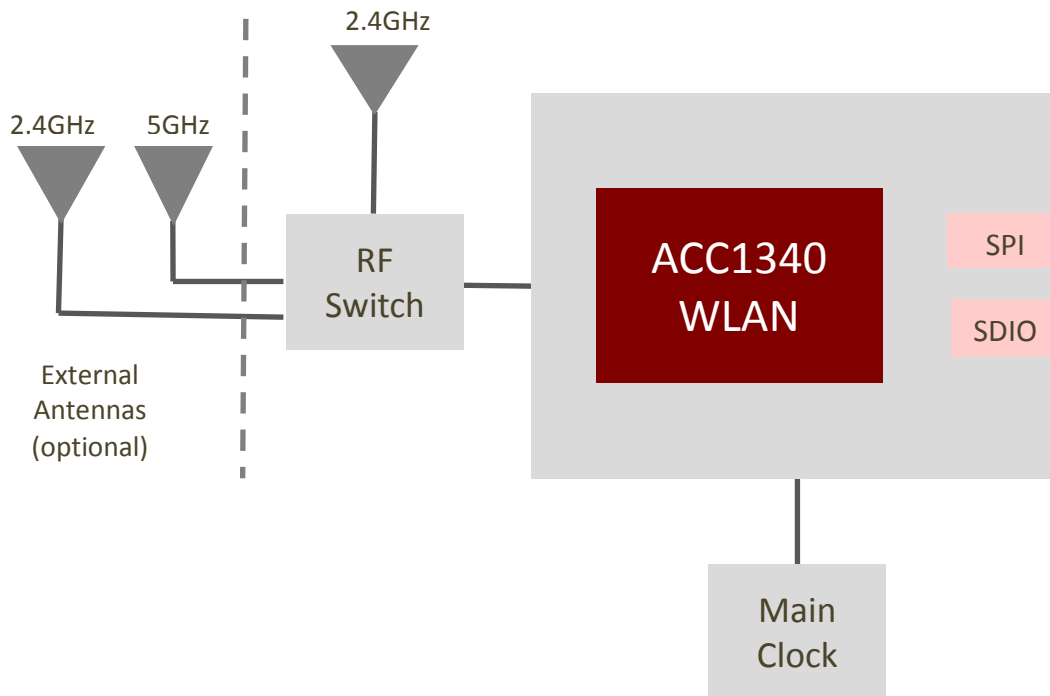


### 1.8. Layout Drawing

Size: 13.5 mm x 14.6 mm x 2.7 mm



## 2. Hardware Block Diagram



### 3. Hardware Design

- All unused pins should be left floating; do not ground.
- All GND pins must be well grounded.
- The area around the antenna should be free of any ground planes, power planes, trace routings, or metal for at least 6.5 mm in all directions.
- Traces should not be routed underneath the module.

#### 3.1. Module Reflow Installation

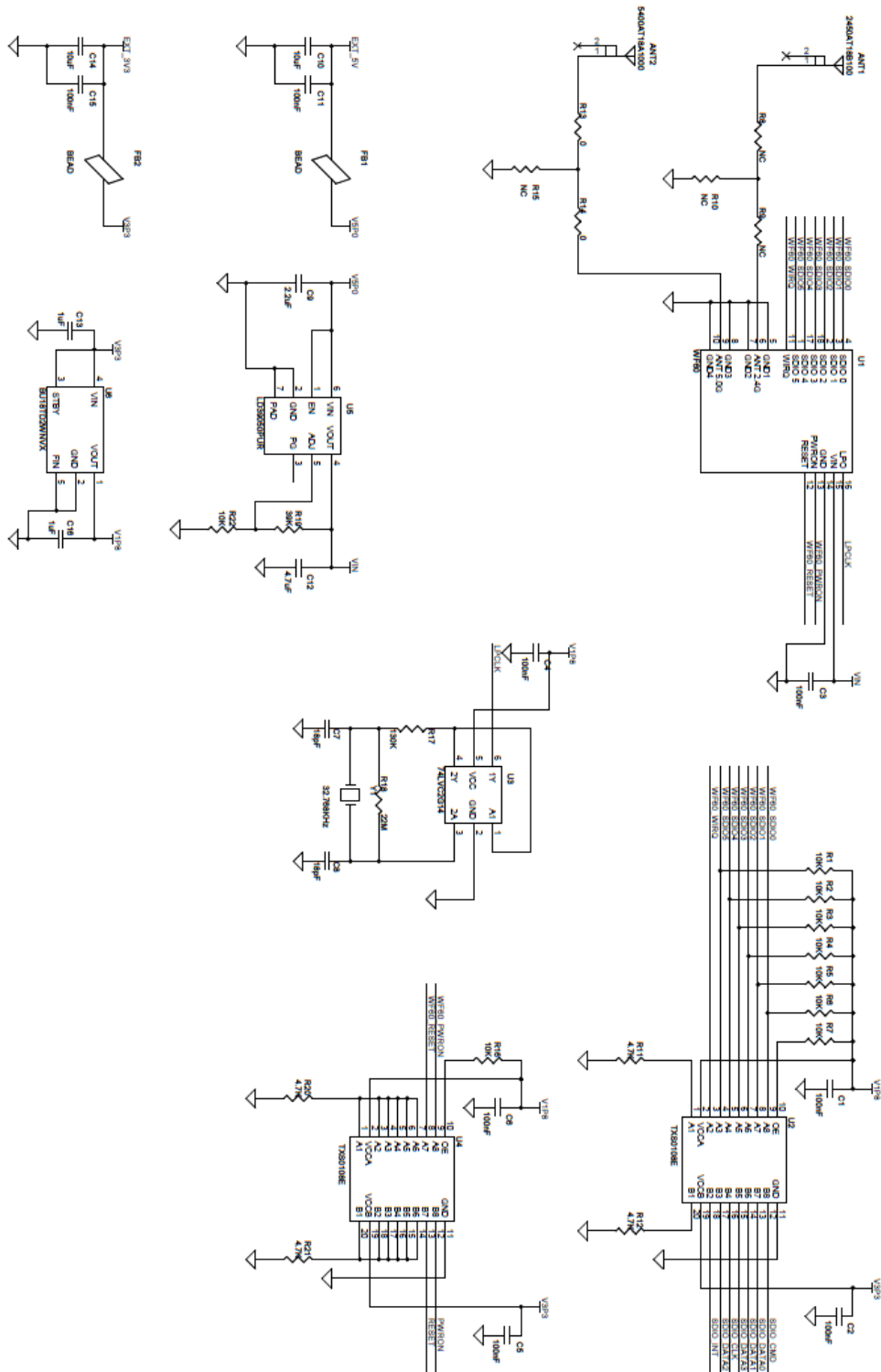
The WF60 is a surface mount Bluetooth module supplied on a 18 pin, 6-layer PCB. The final assembly recommended reflow profiles are:

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°C/second.
- Maximum rise and fall slope after liquidous of < 3°C/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 WF60 module.



## 5. Startup behavior

### 5.1. RESET and PMUEN

A valid reset shall be obtained by maintaining RESET 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 5 is the selection pin; the state of this pin is monitored on the rising edge of RESET.

- LOW selects SPI
- HIGH selects SDIO

## 6. Ordering Information

Part Name	Description
WF60-DB	Dual band, internal antenna for 2.4GHz, 5GHz ext antenna
WF60-DB-EXT	Dual band, external antenna option for 2.4GHz, 5GHz ext antenna
WF60-LB	Low band only, 2.4GHz, internal antenna
WF60-LB-EXT	Low band only, 2.4GHz, ext antenna

## 7. Revision History

Date	Revision	Description
14-June-2016	1.0	First release