

2.4 GHz Wi-Fi Module User Manual

General Description

The 2.4 GHz Wi-Fi module is an 802.11b/g/n solution containing RF frontend circuitry, baseband, MAC, Clock Management and Power Management for direct battery attach. The module is designed to be soldered to a PCB using with three external interfaces, power, SPI bus and u.fl antenna. The module is designed for use within the mobile devices category with the antenna placed greater than 20 cm from the body. The module comes fully tested and calibrated at the factory.

Placement of FCC ID on the finished product

Use of this module requires placement of the FCC ID on the exterior of the finished product. The FCC ID must be visible on the exterior of the product and cannot be placed on a removable part. The FCC ID should be permanent (e.g. stamped, etched, engraved, printed with permanent ink or on a label with permanent adhesive, etc). Hand held devices may be permitted to place the FCC ID in the battery compartment under certain restrictions contained within KDB 784748 section 4:

<https://apps.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?id=27980&switch=P>

The finished product label must include the FCC ID of the incorporated module preceded by the phrase "This device contains" or any similar such verbiage conveying similar meaning:

This device contains FCC ID: 2ADX1-SK370-00020

Or more simply:

Contains FCC ID: 2ADX1-SK370-00020

Product Label Requirement

The ID Label of the finished product must include the following statement. However, devices which are smaller than 4x4" are permitted to place this statement in the instruction manual, pamphlet or packaging in which the device is marketed.

"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.."

Usage Restrictions

"Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment."

Manual for Products

Only one of the below statements is required to be in the finished product's users manual, depending on whether the product is either Class A or Class B.

Part 15 Class A Devices	<i>"Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules, to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to take corrective action at his own expense."</i>
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Part 15 Class B Devices

"This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules, which are designed to provide reasonable protection against harmful interference in a residential installation. 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. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.*
- Increase the separation between the equipment and receiver.*
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- Consult the dealer or an experienced radio/TV technician for help"*

Electrical Data

Absolute Maximum Ratings

The absolute maximum ratings specify the values beyond which the device may be damaged permanently. Exposure to absolute maximum ratings conditions for extended periods of time may affect reliability. Each condition is applied with all other values kept within the recommended operating condition.

Symbol	Parameter	Min.	Max.	Unit
VBAT	Direct battery connect Supply voltage	0	4.55 ¹	V
VDD_IO, VDD_SDIO	Supply voltage I/O	-0.3	3.65	V
Vin	Input voltage on any digital pin	-0.3	VDD_IO+0.3, VDD_SDIO+0.3	V
Tstg	Storage temperature	-65	125	°C

Recommended Operating Conditions

The recommended operating conditions specify the values in which region the device is operational meeting specification.

Symbol	Parameter	Min.	Typ.	Max.	Unit
T _{amb}	Operating ambient temperature	-20		70	°C
VBAT	Direct battery connect Supply voltage. - All specs guaranteed.	2.85	3.6	4.35	V V

SPI Interface Electrical Specification

Parameter	Symbol	Min	Typ	Max	Unit	Comment
Input low voltage	V _{IL}	-0.3		0.3* V _{IO}	V	
Input high voltage	V _{IH}	0.7* V _{IO}		V _{IO} +0.3	V	
Input leakage current	I _{IL}		0.05	1	uA	IO in High Z state
Output sink current, V _{OL} = 0.4 Volt	I _{OL}	4 5	7 8		mA mA	V _{IO} =1.8 Volt, V _{IO} =3.3 Volt
Output drive current, V _{OH} = V _{IO} -0.4 Volt	I _{OH}	4 5	6 7		mA mA	V _{IO} =1.8 Volt, V _{IO} =3.3 Volt

Current Consumption

VBATT = 3.6 volts.

Mode	Condition	Min	Typ	Max	Unit
Transmit 802.11b	CCK 11Mbps, Pout=20 dBm		205	230	mA
Transmit 802.11g	OFDM 54 Mbps, Pout=17 dBm OFDM 54 Mbps, Pout=5 dBm		165 115	200	mA
Transmit 802.11n	OFDM 65 Mbps, Pout=14 dBm (2.4 GHz)		140	170	mA
Receive 802.11b	Normal mode – Max sensitivity		53	59	mA
Receive 802.11g/n	Normal mode – Max sensitivity		56	64	mA
P0 (Sleep Mode)			80		μA
Power Save DTIM1	Beacon interval 100ms		2.7		mA
Power Save DTIM3	Beacon interval 300ms		1.3		mA
Shutdown			11		μA

Receiver Performance

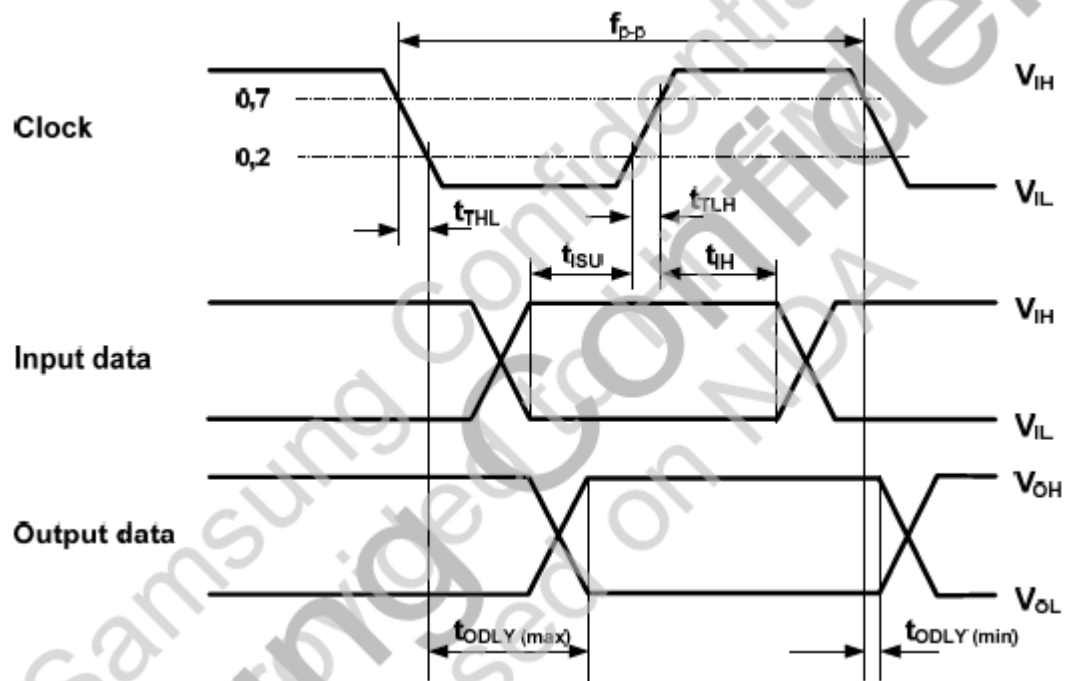
VBAT = 3.6 V, Tamb = 25°C.

Mode	Condition	Min	Typ	Max	Unit
Input level	All data rates, CCK FER < 8%, OFDM PER < 10%			-20	dBm
Adjacent channel rejection	11 Mbit/s, Pwanted = - 70 dBm	35			dB
Adjacent channel rejection	6 Mbit/s, Pwanted = - 79 dBm	16			dB
Adjacent channel rejection	54 Mbit/s, Pwanted = - 62 dBm	-1			dB
Adjacent channel rejection	65 Mbit/s, Pwanted = - 64 dBm	-2			dB

I/O Characteristics

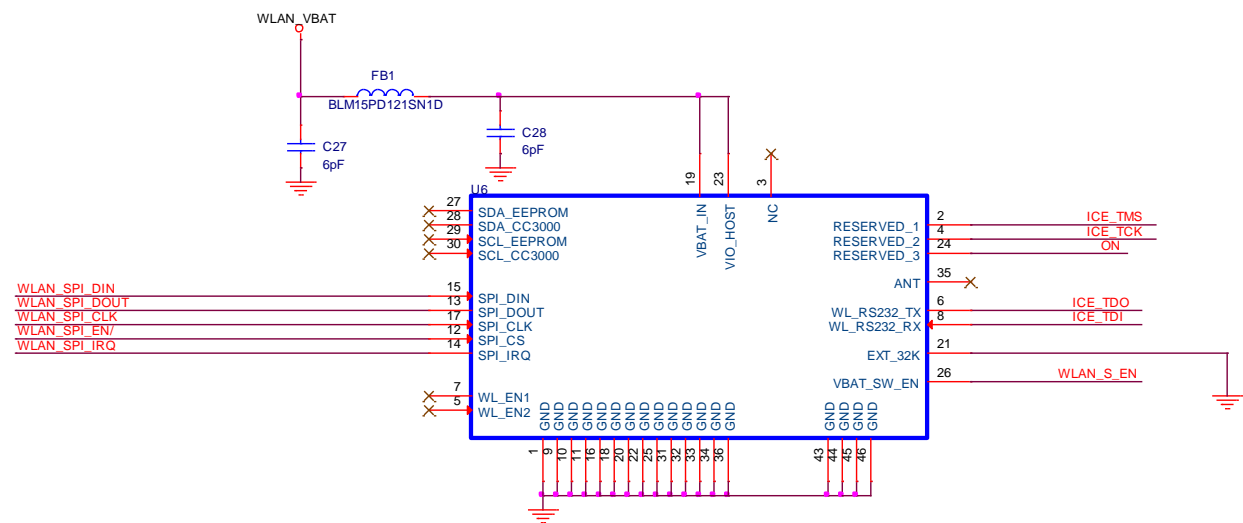
SPI timing characteristics

SPI interface waveforms and timing are below:



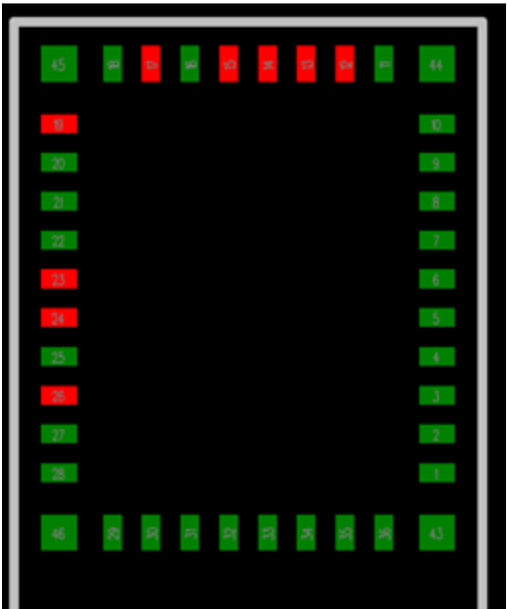
Parameter	Symbol	Min	Max	Unit	Comment
Input set-up time	t_{ISU}	5		ns	
Input hold time	t_{IH}	5		ns	
Clock fall time	t_{THL}		10	ns	
Clock rise time	t_{TLH}		10	ns	
Output delay time	t_{ODLY}	0	14	ns	
Clock Frequency	f_{SDIO_CL}		25	MHz	

Reference Use Schematic



Module Pinout

Bottom View



WLAN Firmware

The firmware is executed from on-chip ROM. Firmware patches are downloaded from host at Power on Reset, or loaded into RAM from a serial Flash Memory connected to the SPI interface. The firmware implements the full IEEE 802.11b/g/n wireless LAN MAC protocol, an embedded IP stack together with a few commonly used applications that can be easily configured and controlled via the chip interface. The wireless LAN MAC stack supports basic service set (BSS), Mobile AP and WiFi Direct. Low-level protocol functions such as RTS/CTS, acknowledgement, fragmentation, defragmentation, frame encapsulation (802.11h/RFC1042) and automatic beacon monitoring / scanning are handled by the baseband MAC. The IP stack supports TCP, UDP, RTP, and ICMP over IPv4. On top of the IP stack there is web server with support for Server-Side Includes (SSI) and Common Gateway Interface (CGI) available. The web pages can be customized via the serial interface.

4.7.1 Features

- 802.11 b/g/n/d/e/i/support
- Infrastructure mode support
- Supports WiFi Direct
- Supports Mobile AP and Mobile router functionality (Soft AP mode) supporting WPS2/WPA2
- IPv4 stack with TCP, UDP and ICMP support
- Web server with Server-Side Includes (SSI) and Common Gateway Interface (CGI)
- Zero config support through support of the mDNS protocol
- Hardware accelerators (software managed hardware) for CCM (CBC-MAC, Counter Mode), TKIP (MIC, RC4), WAPI (SMS4) and WEP (RC4) along with CRC.
- Supports WPA/WPA2, PSK and Enterprise
- Supports WPS 2.0
- Supports 802.11n up to MCS6 (Tx/Rx). Supporting block ACK, MIMO 1x1 & 2X1, STBC, A-MPDU aggregation and 0.4us guard interval.
- WMM Power Save U-APSD
- Multiple queue management to fully utilize traffic prioritization defined by the 802.11e standard.
- 802.11h/RFC1042 Frame encapsulation.
- Scattered DMA for optimal CPU off load on Zero Copy data transfers operations.
- Clock/Power gating combined with 802.11-compliant power management dynamically adapted to the current connection condition providing minimal power consumption.