AW-HM610

IEEE 802.11ah Wireless LAN Module

Datasheet

Rev. D

DF

(For STD)

Features

General

- Supports 902 ~ 928MHz frequency band
- Supports single-stream 150kbps ~ 15Mbps data rate
- Supports AP and STA mode

Host interface

- UART and HSPI support for host interface

Standards Supported

- IEEE Std 802.11ah standard
- Security: OPEN, WPA2-PSK(AES), WPA3-OWE, WPA3-SAE

MAC Features

- S1G Beacon, NDP Control frame, TIM compression, unified scaling factor for max Idle period/listen interval/WNM-sleep interval, STA Type, S1G baseline functions (DCF, HCF, multi-rate support, A-MPDU), and S1G BSS operation
- Network efficiency enhancements: NDP PS-Poll/PS-Poll Ack/Probe Req./Probe Resp., RAW avoidance, TSBTT, and differentiated EDCA Parameter
- Power saving: Non-TIM operation, dynamic AID assignment and TWT
- BSS scalability (up to 8192 STAs): Multicast AID, and authentication control
- Low-cost STA/AP: EL operation, Flow Control
- Supports transmission of Standby Radio frame

Peripheral Interfaces

- I2C, SPI and UART
- A Wi-Fi dedicated HSPI for data transfer to Host

Peripheral Interfaces

- Full IEEE 802.11ah compatibility with enhanced performance
- Single-stream up to 15Mbps data rate
- Supports 1/2/4 MHz channel with optional SGI
- Supports S1G_1M, Short/Long format
- Modulation: OFDM with BPSK, QPSK, 16QAM, 64QAM

Revision History

Document NO: R2-2610-DST-01

Version	Revision Date	DCN NO.	Description	Initials	Approved
A	2024/01/09	DCN030861	● Initial version	Daniel Lee	N.C. Chen
B	2024/06/21	DCN031812	● Add Japan band spec.	Daniel Lee	N.C. Chen
C	2024/11/29	DCN032892	● Modify VDDIO spec.	Daniel Lee	N.C. Chen
D	2025/02/12	DCN033449	● Modify Rx spec.	Daniel Lee	N.C. Chen

AzureWave Technologies, Inc.

Table of Contents

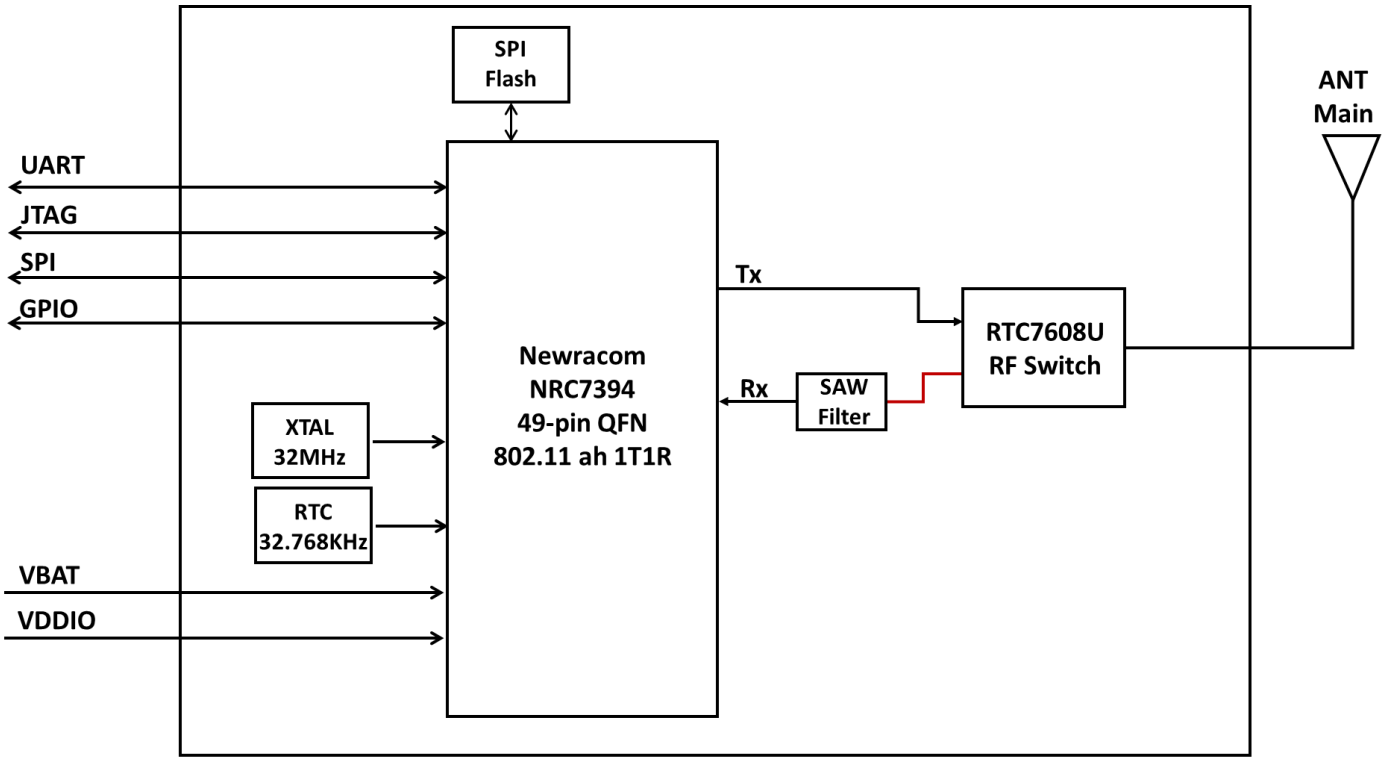
1. Introduction

1.1 Product Overview

AzureWave Technologies, Inc. introduces the pioneer of the IEEE 802.11ah WIFI solder down module --- **AW-HM610**. The **AW-HM610** is the smallest IEEE 802.11ah Wi-Fi module that operates in the Sub 1GHz license-exempt band, offering longer ranger and higher data rate for internet of things (IoT) applications. The **AW-HM610** supports 1/2/4 MHz channel bandwidth which yields 150 Kbps to 15 Mbps PHY rate that can handle low-rate sensors to high-rate surveillance camera applications. The self-contained Wi-Fi networking with huge range of data throughput offers the ideal solution to add Wi-Fi connectivity to IoT products with low power consumption requirements.

The **AW-HM610** integrated Newracom NRC7394 which is a complete radio front-end that is optimized for Sub 1 GHz band. It has a fully integrated PA and fractional-N synthesizer. An embedded Cortex-M3 ARM® processor in the NRC7394 offers enough processing power to accommodate Wi-Fi subsystem as well as user application in a single Wi-Fi SoC. NRC7394 also includes two host interfaces, HSPI and UART, and rich peripherals such as general SPI, I2C, UART, PWM, auxiliary ADC, and GPIOs. The low-leakage retention memory inside NRC7394 can be used to store code and data necessary for fast wake-up from deep-sleep mode.

1.2 Block Diagram



AW-HM610 Block Diagram

1.3 Specifications Table

1.3.1 General

Features	Description
Product Description	IEEE 802.11ah Wireless LAN Module
Major Chipset	Newracom NRC7394 (49-pin QFN)
Host Interface	SPI
Dimension	12mm x 12mm x 1.91mm (Tolerance remarked in mechanical drawing)
Form Factor	LGA module, 44 pins
Antenna	● For LGA, “1T1R, external” ANT Main：TX/RX
Weight	0.7g

1.3.2 WLAN

Features	Description
WLAN Standard	IEEE 802.11ah
Frequency Rage	US/CA: Unit MHz 1MHz Bandwidth: 902.5, 903.5, 904.5, 905.5, 906.5, 907.5, 908.5, 909.5, 910.5, 911.5, 912.5, 913.5, 914.5, 915.5, 916.5, 917.5, 918.5, 919.5, 920.5, 921.5, 922.5, 923.5, 924.5, 925.5, 926.5, 927.5 2MHz Bandwidth: 903, 905, 907, 909, 911, 913, 915, 917, 919, 921, 923, 925, 927 4MHz Bandwidth: 906, 910, 914, 918, 922, 926 JP: Unit MHz 1MHz Bandwidth: 921, 923, 924, 925, 926, 927 2MHz Bandwidth: 923.5, 924.5, 925.5, 926.5 4MHz Bandwidth: 924.5, 925.5

<table>
<tr><td>Modulation</td><td>OFDM, BPSK, QPSK, 16-QAM, 64-QAM</td></tr>
<tr><td>Channel Bandwidth</td><td>1/2/4 MHz</td></tr>
<tr><td>Output Power
(Board Level Limit)*</td><td>US/CA
<table>
<tr><th></th><th>Min</th><th>Typ</th><th>Max</th><th>Unit</th></tr>
<tr><td>MCS0 (1/2/4 MHz)
@EVM≦-5dB</td><td>14.5</td><td>16</td><td>17.5</td><td>dBm</td></tr>
<tr><td>MCS7 (1/2/4 MHz)
@EVM≦-27dB</td><td>10.5</td><td>12</td><td>13.5</td><td>dBm</td></tr>
</table>
JP
<table>
<tr><th></th><th>Min</th><th>Typ</th><th>Max</th><th>Unit</th></tr>
<tr><td>MCS0 (1/2/4 MHz)
@EVM≦-5dB</td><td>11.5</td><td>13</td><td>14.5</td><td>dBm</td></tr>
<tr><td>MCS7 (1/2/4 MHz)
@EVM≦-27dB</td><td>10.5</td><td>12</td><td>13.5</td><td>dBm</td></tr>
</table></td></tr>
<tr><td>Receiver Sensitivity</td><td>US/CA/JP
<table>
<tr><th></th><th>Min</th><th>Typ</th><th>Max</th><th>Unit</th></tr>
<tr><td>MCS0 (1 MHz)</td><td></td><td>-101</td><td>-98</td><td>dBm</td></tr>
<tr><td>MCS0 (2 MHz)</td><td></td><td>-98</td><td>-95</td><td>dBm</td></tr>
<tr><td>MCS0 (4 MHz)</td><td></td><td>-96</td><td>-93</td><td>dBm</td></tr>
<tr><td>MCS7 (1 MHz)</td><td></td><td>-83</td><td>-80</td><td>dBm</td></tr>
<tr><td>MCS7 (2 MHz)</td><td></td><td>-80</td><td>-77</td><td>dBm</td></tr>
<tr><td>MCS7 (4 MHz)</td><td></td><td>-77</td><td>-74</td><td>dBm</td></tr>
</table></td></tr>
<tr><td>Data Rate</td><td>■ 1 MHz Bandwidth: up to 3Mbps
■ 2 MHz Bandwidth: up to 6.5Mbps
■ 4 MHz Bandwidth: up to 13.5Mbps</td></tr>
<tr><td>Security</td><td>■ OPEN, WPA2-PSK(AES), WPA3-OWE, WPA3-SAE
standard</td></tr>
</table>

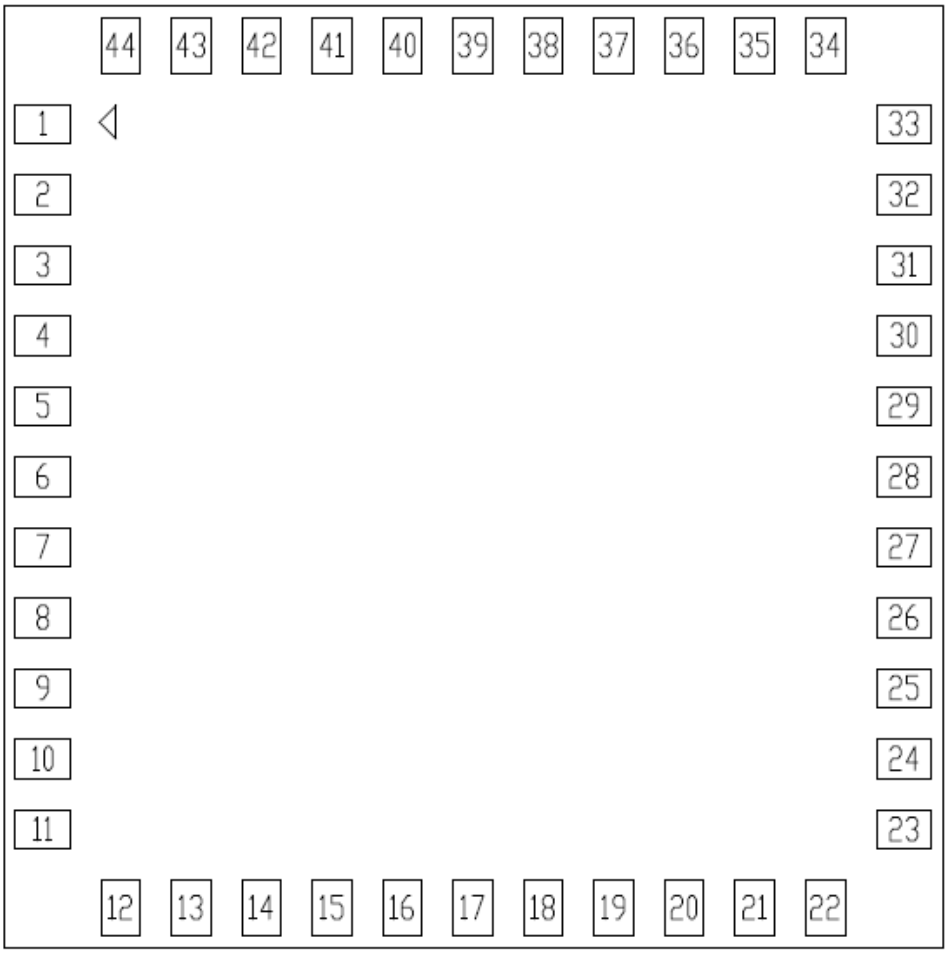
*** If you have any certification questions about output power please contact FAE directly.**
*** Output power and receiver sensitivity is based on VBAT with +/- 5% of typical value.**

1.3.3 Operating Conditions

Features	Description
Operating Conditions	
Voltage	VBAT: 3.3V VDDIO: 1.8/3.3V
Operating Temperature	-40℃~85 ℃
Operating Humidity	less than 85%R.H
Storage Temperature	-40℃~85 ℃
Storage Humidity	less than 60%R.H
ESD Protection	
Human Body Model	±1KV per ANSI/ESDA/JEDEC JS-001-2017
Changed Device Model	±500V per ESDA/JEDEC JS-002-2018

2. Pin Definition

2.1 Pin Map



AW-HM610 Pin Map (Top View)

2.2 Pin Table

Pin No.	Definition	Basic Description	Voltage	Type
1	GND	GROUND		GND
2	ANT	RF IN/OUT		I/O
3	GND	GROUND		GND
4	NC	No Connection		
5	NC	No Connection		
6	GP25	General IO port 25		I/O
7	NC	No Connection		
8	NC	No Connection		
9	VBAT	3.3V power supply	3.3V	Power
10	GND	GROUND		GND
11	GND	GROUND		GND
12	RSTn / PMS_POR_O	Hardware reset input and POR reset output. (active low)		I/O
13	NC	No Connection		
14	NC	No Connection		
15	HSPI_nCS	HSPI chip select		I/O
16	HSPI_MOSI	HSPI MOSI		I/O
17	HSPI_CLK	HSPI clock		I/O
18	HSPI_MISO	HSPI MISO		I/O
19	NC	No Connection		
20	GND	GROUND		GND
21	NC	No Connection		
22	VDDIO	I/O supply Input		Power

23	NC	No Connection		
24	NC	No Connection		
25	MODE	Chip boot mode For XIP boot, connect to VDD For ROM boot, connect to GND		I
26	HSPI_EIRQ	HSPI external IRQ EIRQ will be Hi-z by every reset condition External pull-up or pull-down may be required depends on system application		I/O
27	GP20	General IO port 20		I/O
28	GP8 / UART0_TXD	If MODE is connected to GND, default serial TXD. General IO port 8.		I/O
29	GP9 / UART0_RXD	If MODE is connected to GND, default serial RXD. General IO port 9.		I/O
30	GP14 / JTAG_nTRST	JTAG nTRST input General IO port 14		I/O
31	GND	GROUND		GND
32	NC	No Connection		
33	GND	GROUND		GND
34	GP18 / AUXADCIN1	AUX ADC input 1 General IO port 18		I/O
35	GP17 / AUXADCIN0	AUX ADC input 0 General IO port 17		I/O
36	GND	GROUND		GND
37	NC	No Connection		
38	GP24	General IO port 24		I/O
39	GP12 / JTAG_TDO	JTAG data output General IO port 12		I/O
40	NC	No Connection		
41	GP10 / JTAG_TMS	JTAG mode selection General IO port 10		I/O

42	GP13 / JTAG_TDI	JTAG data input. General IO port 13		I/O
43	NC	No Connection		
44	GP11 / JTAG_TCK	JTAG clock General IO port 11		I/O

3. Electrical Characteristics

3.1 Absolute Maximum Ratings

Symbol	Parameter	Minimum	Typical	Maximum	Unit
VBAT	3.3V power supply	-0.5		3.8	
VDDIO	I/O supply Input	-0.5		3.8	
T_{stg}	Storage temperature	-40	-	85	℃

3.2 Recommended Operating Conditions

Symbol	Parameter	Minimum	Typical	Maximum	Unit
VBAT	3.3V power supply	3.135	3.3	3.465	V
VDDIO	3.3V I/O supply Input	3.0	3.3	3.6	V
VDDIO	1.8V I/O supply Input	1.68	1.8	1.92	V

3.3 Digital IO Pin DC Characteristics

VDDIO = 3.3V

Symbol	Parameter	Minimum	Typical	Maximum	Unit
V_{IH}	Input high voltage	2	-	3.6	V
V_{IL}	Input low voltage	-0.3	-	0.8	V
V_{OH}	Output high voltage	2.4	-		V
V_{OL}	Output low voltage		-	0.4	V

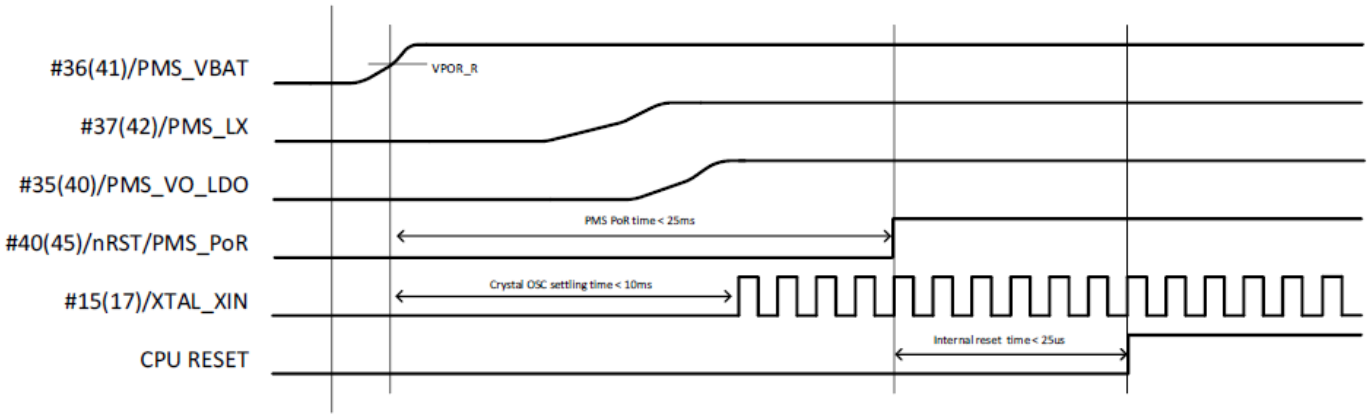
VDDIO = 1.8V

Symbol	Parameter	Minimum	Typical	Maximum	Unit
V_{IH}	Input high voltage	1.17	-	1.98	V
V_{IL}	Input low voltage	-0.3	-	0.63	V
V_{OH}	Output high voltage	1.35	-		V
V_{OL}	Output low voltage		-	0.45	V

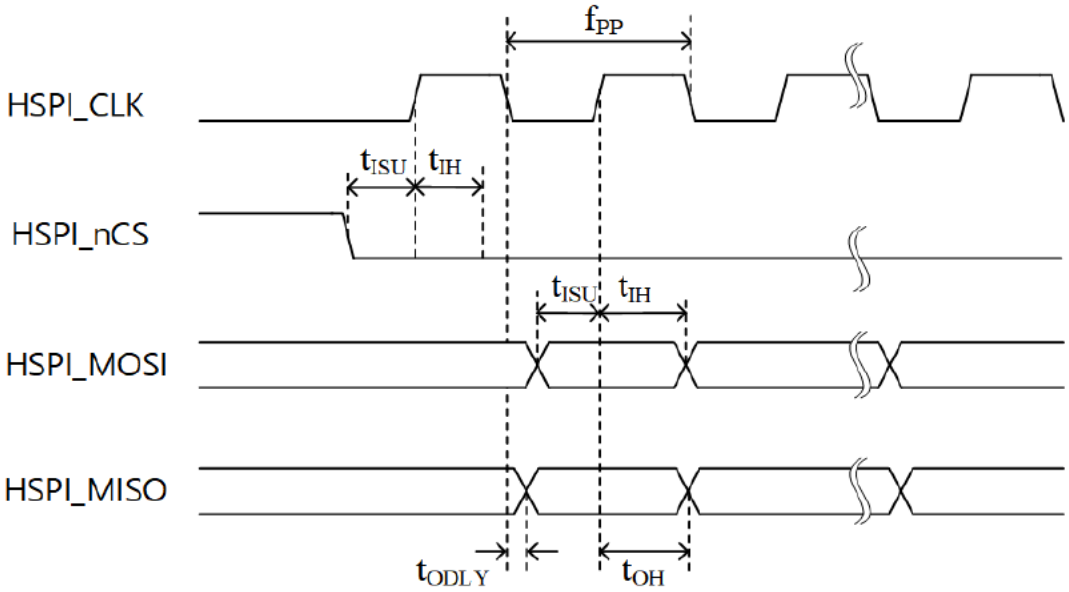
3.4 Timing Sequence

3.4.1 Power on sequence

The figure below shows the module power on sequence. The start of the POR circuit in the PMS block and BUCK oscillator are triggered by VBAT when the level exceeds a predefined voltage level. The main 32 MHz crystal oscillator starts to run when the internal power supply is stable. The PMS_PoR (active low) is de-asserted after a pre-defined settling time for stable crystal oscillation to ensure reliable SoC operation. PMS_PoR is open-drain circuit with internal pull-up resistor and connected with external RSTn pin. When the PMS_PoR releases RSTn pin to HIGH, the power-on sequence is completed and the SoC can control the entire system after the internal 25usec reset time.

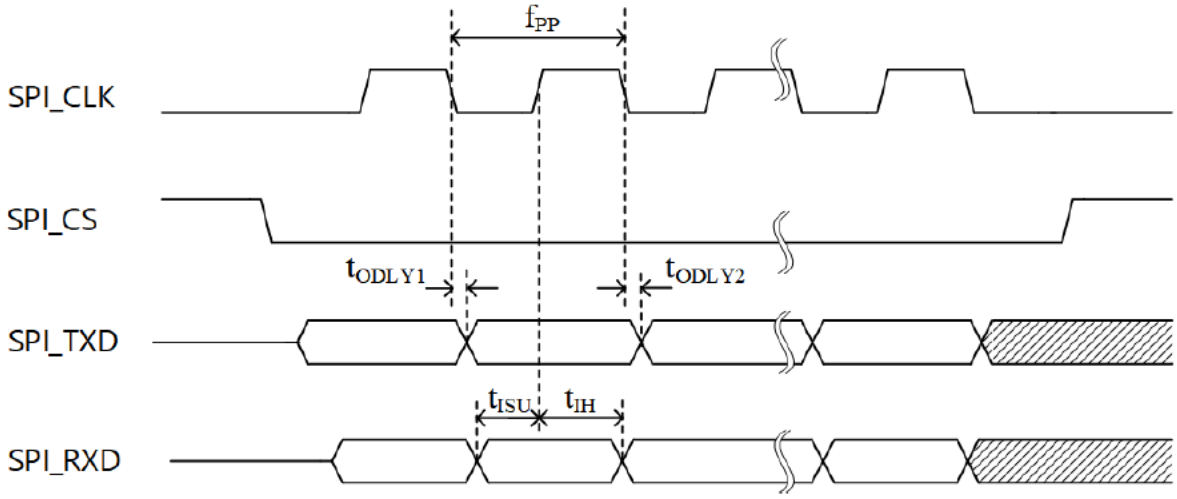


3.4.2 HSPI Timing



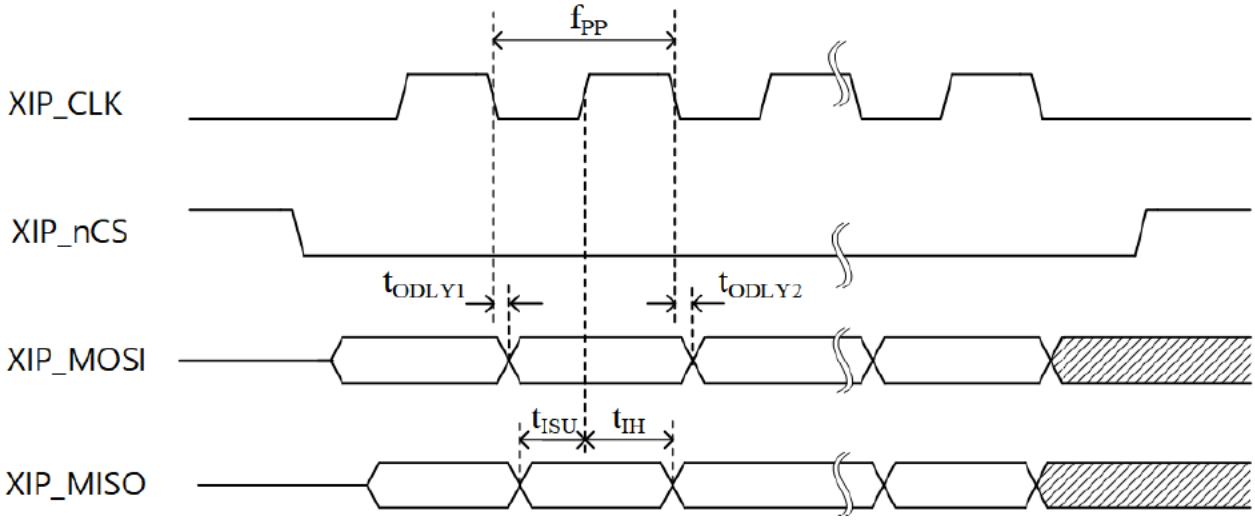
Symbol	Parameter	Min	Typ	Max	Unit
f_{PP}	Frequency	-	-	20	MHz
t_{ODLY}	Output delay time	2.7	-	20.2	ns
t_{OH}	Output hold time	25	-	-	ns
t_{ISU}	Input setup time	-	-	21.6	ns
t_{IH}	Input hold time	5.8	-	-	ns

3.4.3 SPI Timing



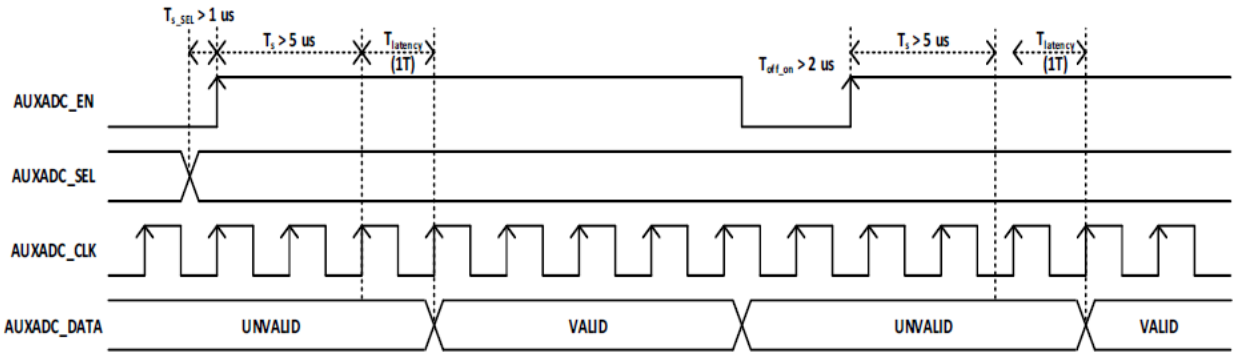
Symbol	Parameter		Min	Typ	Max	Unit
f_{PP}	Frequency	master	-	-	16	MHz
		slave	-	-	2	MHz
t_{ODLY1}	Output delay time1		0	-	23	ns
t_{ODLY2}	Output delay time2		0	-	23	ns
t_{ISU}	Input setup time		18	-	-	ns
t_{IH}	Input hold time		20	-	-	ns

3.4.4 XIP(eXecute In Place) Timing



Symbol	Parameter	Min	Typ	Max	Unit
f_{PP}	Frequency	-	-	32	MHz
t_{ODLY1}	Output delay time1	0	-	15	ns
t_{ODLY2}	Output delay time2	0	-	15	ns
t_{ISU}	Input setup time	-	-	5.1	ns
t_{IH}	Input hold time	7.7	-	-	ns

3.4.5 AUXADC Timing



Symbol	Parameter	Min	Typ	Max	Unit
Input Range	Input signal range	0.1		0.9	V
Output Range	Output Code Range (After s/w compensation)	100		900	10-bit
FS	Sampling Clock	-	2	-	MHz
Latency	Conversion latency (1 cycle = T)	-	1	-	cycle
N	Resolution	-	10	-	Bit
RIN	Input impedance	-	4	-	Mohms
Ts	Settling time after enable	5			us
Ts_sel	Setup time of AUXADC_SEL	1			us
Toff_on	Reset time	2			us
I_active	Current consumption (1.1 V)	-	-	150	uA
I_down	Power-down current (1.1 V)	-	-	2	uA

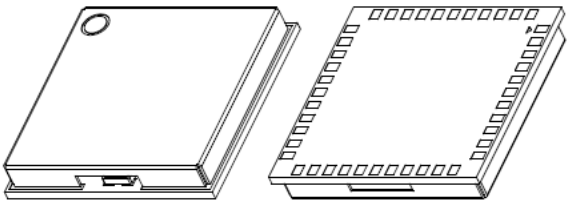
3.5 Power Consumption

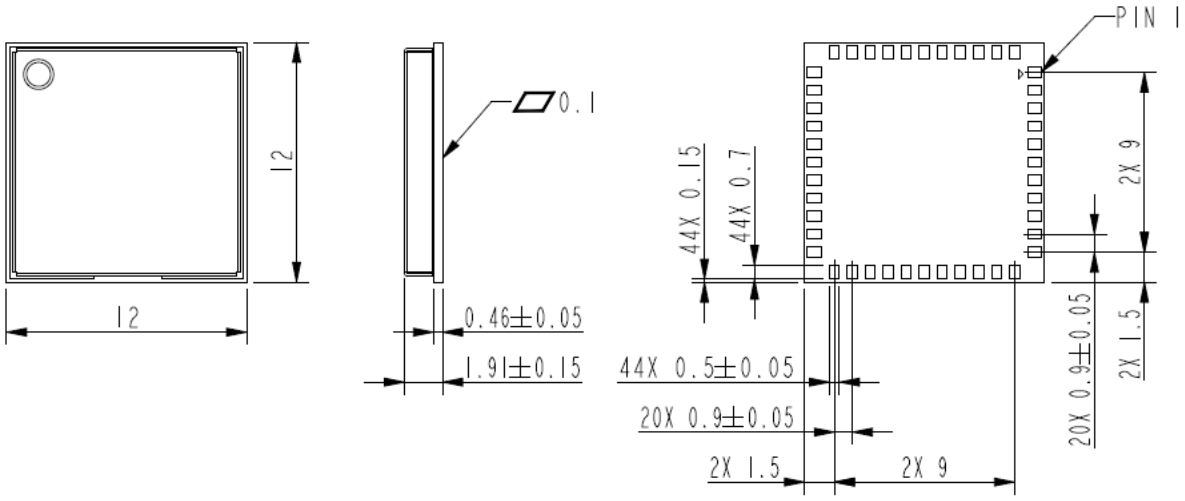
3.5.1 Current Consumption Results

MODE	DUT Status	VDDIO (mA) 3.3V	VBAT (mA) 3.3V
802.11ah (1/2/4MHz BW)	**Tx@10dBm**	1.9mA	164mA
	Tx@13dBm	1.93mA	174mA
	Tx@15dBm	1.95mA	186mA
	Continuous Rx @ -85 dBm	1.61mA	21mA
	Deep Sleep mode	0.0001mA	0.0035mA

4. Mechanical Information

4.1 Mechanical Drawing



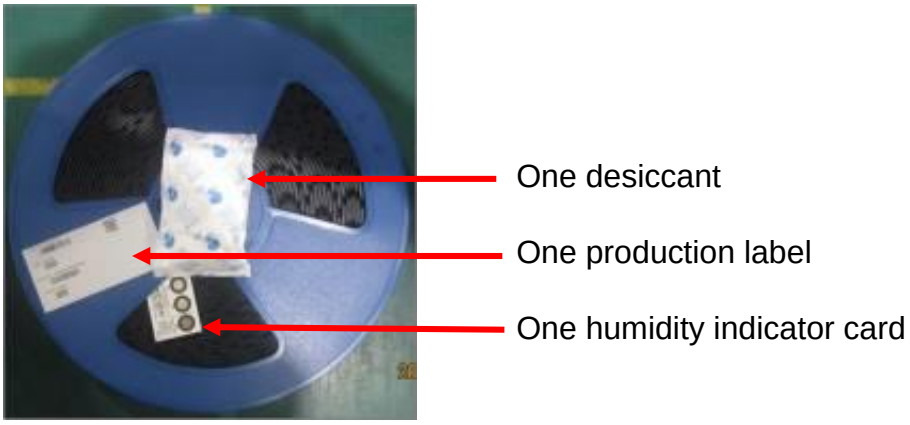


TOLERANCE UNLESS OTHERWISE SPECIFIED:±0.1mm

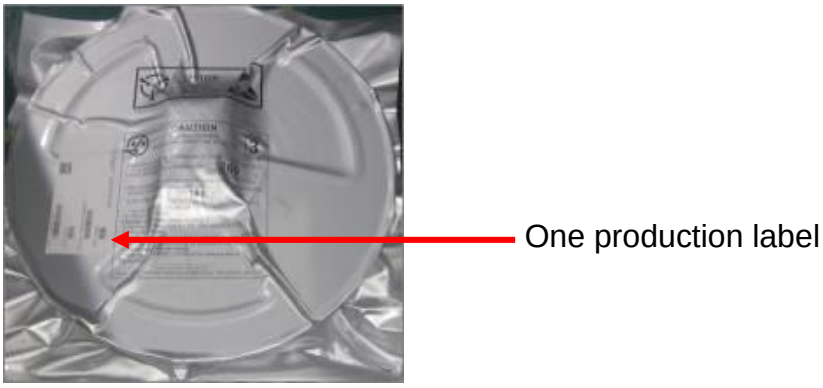
5. Package information

1. One reel can pack 1500pcs

2. One production label is pasted on the reel, one desiccant and one humidity indicator card are put on the reel



3. One reel is put into the anti-static moisture barrier bag, and then one label is pasted on the bag



4. A bag is put into the anti-static pink bubble wrap

5. A bubble wrap is put into the inner box and then one label is pasted on the inner box

6. **5 inner boxes** could be put into one carton

7. Sealing the carton by AzureWave tape

8. One carton label and one box label are pasted on the carton. If one carton is not full, one balance label pasted on the carton

Example of carton label	AzureWave Technologies Inc. AzureWave P/N: AW-HM610 Customer: 由業務提供 Customer P/N: 由業務提供 Customer PO: 由業務提供 Description: AW-XXXXXX QTY: 1200 pcs C/N: N.W.: G.W. RoHS COMPLIANT
Example of box label	
Example of production label	P/N: AW-HM610 D/C: 1309 PCK NO.: PCKNO0069097 QTY: 294 BAG SEAL DATE: _____

Example of balance label