

Wireless Module

ML-MW01A

Muuselabs NV/SA

Revision History

Date	Revision Content	Revised By	Version
2017/11/16	- Preliminary	Bruce	1.0

1. Introduction

ML-MW01A would like to announce a low-cost and low-power consumption module which has all of the WiFi and Bluetooth functionalities. The highly integrated module makes the possibilities of web browsing, VoIP, Bluetooth headsets, and other applications. With seamless roaming capabilities and advanced security, also could interact with different vendors' 802.11b/g/n Access Points in the wireless LAN.

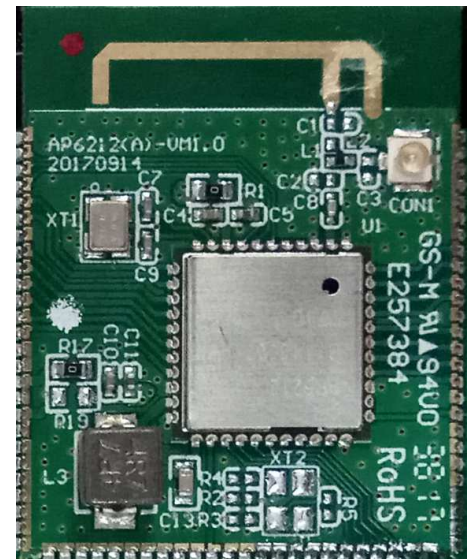
The wireless module complies with IEEE 802.11 b/g/n standard and it can achieve up to a speed of 72.2Mbps with single stream in 802.11n draft, 54Mbps as specified in IEEE 802.11g, or 11Mbps for IEEE 802.11b to connect to the wireless LAN. The integrated module provides SDIO interface for WiFi, and UART / I2S / PCM interface for Bluetooth

This compact module is a total solution for a combination of WiFi + BT technologies.

The module is specifically developed for Smart phones and Portable devices.

Features

- 802.11b/g/n single-band radio
- Bluetooth V4.1 with integrated Class 1.5 PA and Low Energy (BLE) support
- Concurrent Bluetooth, and WLAN operation
- Simultaneous BT/WLAN receive with single antenna
- WLAN host interface options:
- SDIO v2.0 — up to 50 MHz clock rate
- BT host digital interface:
- UART (up to 4 Mbps)
- IEEE Co-existence technologies are integrated die solution
- ECI — enhanced coexistence support, ability to coordinate BT SCO transmissions around WLAN receives

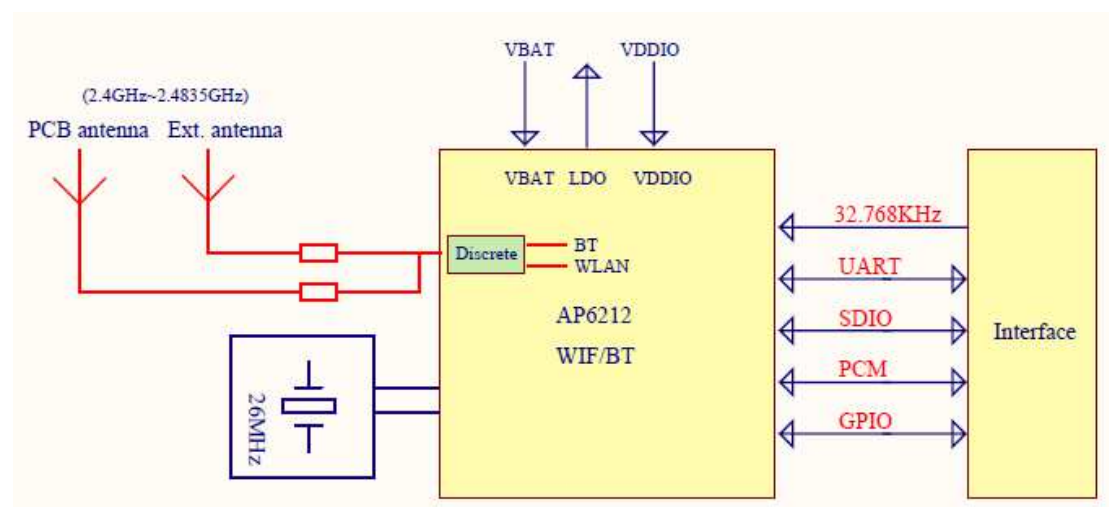


ML-MW01A-EA: Ext. antenna
ML-MW01A-IA: PCB antenna
ML-MW01A

Applications

- Stereo Wireless Headsets.
- Wired stereo headsets and headphones.
- Portable stereo speakers.
- Home Audio System.
- Smart phones.

A simplified block diagram of the module is depicted in the figure below.



2. General Specification

2.1 General Specification

Model Name	ML-MW01A
Product Description	Support WiFi/Bluetooth functionalities
Dimension	L x W x H: 33.4 x 26.5 x 1.0 (typical) mm
WiFi Interface	SDIOV2.0
BT Interface	UART / PCM
Operating temperature	-30°C to 65°C
Storage temperature	-40°C to 85°C
Humidity	Operating Humidity 10% to 95% Non-Condensing

2.2 Voltages

2.2.1 Absolute Maximum Ratings

Symbol	Description	Min.	Max.	Unit
VBAT	Input supply Voltage	-0.5	5.5	V
WL_VIO_SD	Digital/Bluetooth/SDIO/ I/O Voltage	-0.5	3.6	V

2.2.2 Recommended Operating Rating

The module requires two power supplies: VBAT and VDDIO.

	Min.	Typ.	Max.	Unit
Operating Temperature	-30	25	65	deg.C
VBAT	3.0	3.6	4.8	V
VDDIO	1.7	3.3	3.6	V

3. WiFi RF Specification

3.1 2.4GHz RF Specification

Conditions : VBAT=3.6V ; VDDIO=3.3V ; Temp:25°C

Feature	Description
WLAN Standard	IEEE 802.11b/g/n, WiFi compliant
Frequency Range	2.400 GHz ~ 2.483.5 GHz (2.4 GHz ISM Band)
Number of Channels	2.4GHz : Ch1 ~ Ch11
Modulation	802.11b : DQPSK, DBPSK, CCK 802.11 g/n : OFDM /64-QAM,16-QAM, QPSK, BPSK
Output Power	802.11b /11Mbps : 11 dBm $\pm$ 1 dB @ EVM $\leq$ -9dB
	802.11g /54Mbps : 12 dBm $\pm$ 1 dB @ EVM $\leq$ -25dB
	802.11n /65Mbps : 11 dBm $\pm$ 1 dB @ EVM $\leq$ -28dB
Receive Sensitivity (11n,20MHz) @10% PER	- MCS=0 PER @ -85 dBm, typical
	- MCS=1 PER @ -84 dBm, typical
	- MCS=2 PER @ -82 dBm, typical
	- MCS=3 PER @ -80 dBm, typical
	- MCS=4 PER @ -77 dBm, typical
	- MCS=5 PER @ -73 dBm, typical
	- MCS=6 PER @ -71 dBm, typical
	- MCS=7 PER @ -68 dBm, typical
Receive Sensitivity (11g) @10% PER	- 6Mbps PER @ -86 dBm, typical
	- 9Mbps PER @ -85 dBm, typical
	- 12Mbps PER @ -85 dBm, typical
	- 18Mbps PER @ -83 dBm, typical
	- 24Mbps PER @ -81 dBm, typical
	- 36Mbps PER @ -78 dBm, typical
	- 48Mbps PER @ -73 dBm, typical
	- 54Mbps PER @ -71 dBm, typical
Receive Sensitivity (11b) @8% PER	- 1Mbps PER @ -90 dBm, typical
	- 2Mbps PER @ -88 dBm, typical
	- 5.5Mbps PER @ -87 dBm, typical
	- 11Mbps PER @ -84 dBm, typical
Data Rate	802.11b : 1, 2, 5.5, 11Mbps

	802.11g : 6, 9, 12, 18, 24, 36, 48, 54Mbps
Data Rate (20MHz ,Long GI,800ns)	802.11n: 6.5, 13, 19.5, 26, 39, 52, 58.5, 65Mbps
Data Rate (20MHz ,short GI,400ns)	802.11n : 7.2, 14.4, 21.7, 28.9, 43.3, 57.8, 65,72.2Mbps
Maximum Input Level	802.11b : -10 dBm
	802.11g/n : -20 dBm
Antenna Reference	Small antennas with 0~2 dBi peak gain

4. Bluetooth Specification

4.1 Bluetooth Specification

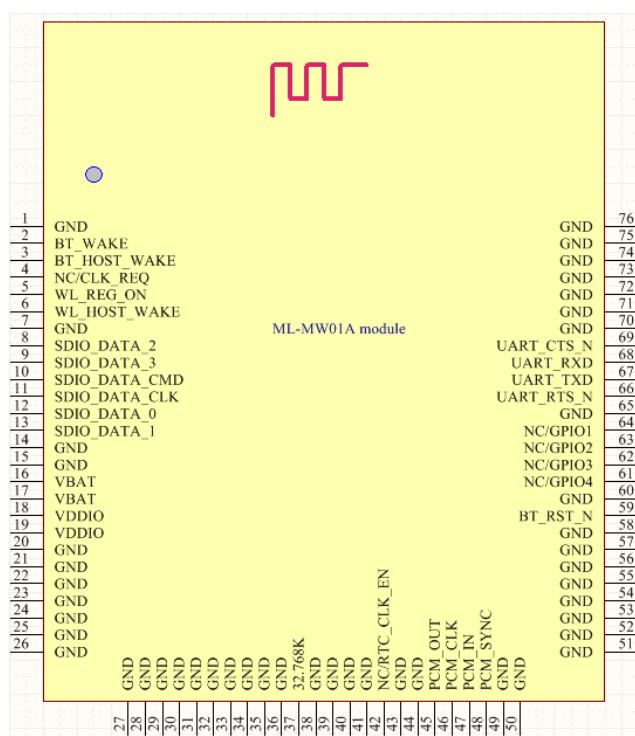
Conditions : VBAT=3.6V ; VDDIO=3.3V ; Temp:25°C

Feature	Description		
General Specification			
Bluetooth Standard	Bluetooth V4.1 of 1, 2 and 3 Mbps.		
Host Interface	UART		
Antenna Reference	Small antennas with 0~2 dBi peak gain		
Frequency Band	2402MHz ~ 2480MHz		
Number of Channels	79 channels; 40 channels for BLE		
Modulation	FHSS, GFSK, DPSK, DQPSK		
RF Specification			
	Min.	Typical.	Max.
Output Power (Class 1.5)		9 dBm	
Sensitivity @ BER=0.1% for GFSK (1Mbps)		-86 dBm	
Sensitivity @ BER=0.01% for $\pi/4$ -DQPSK (2Mbps)		-86 dBm	
Sensitivity @ BER=0.01% for 8DPSK (3Mbps)		-80 dBm	
Maximum Input Level	GFSK (1Mbps):-20dBm		
	$\pi/4$ -DQPSK (2Mbps) :-20dBm		
	8DPSK (3Mbps) :-20dBm		

5. Pin Assignments

5.1 Pin Outline

< TOP VIEW >



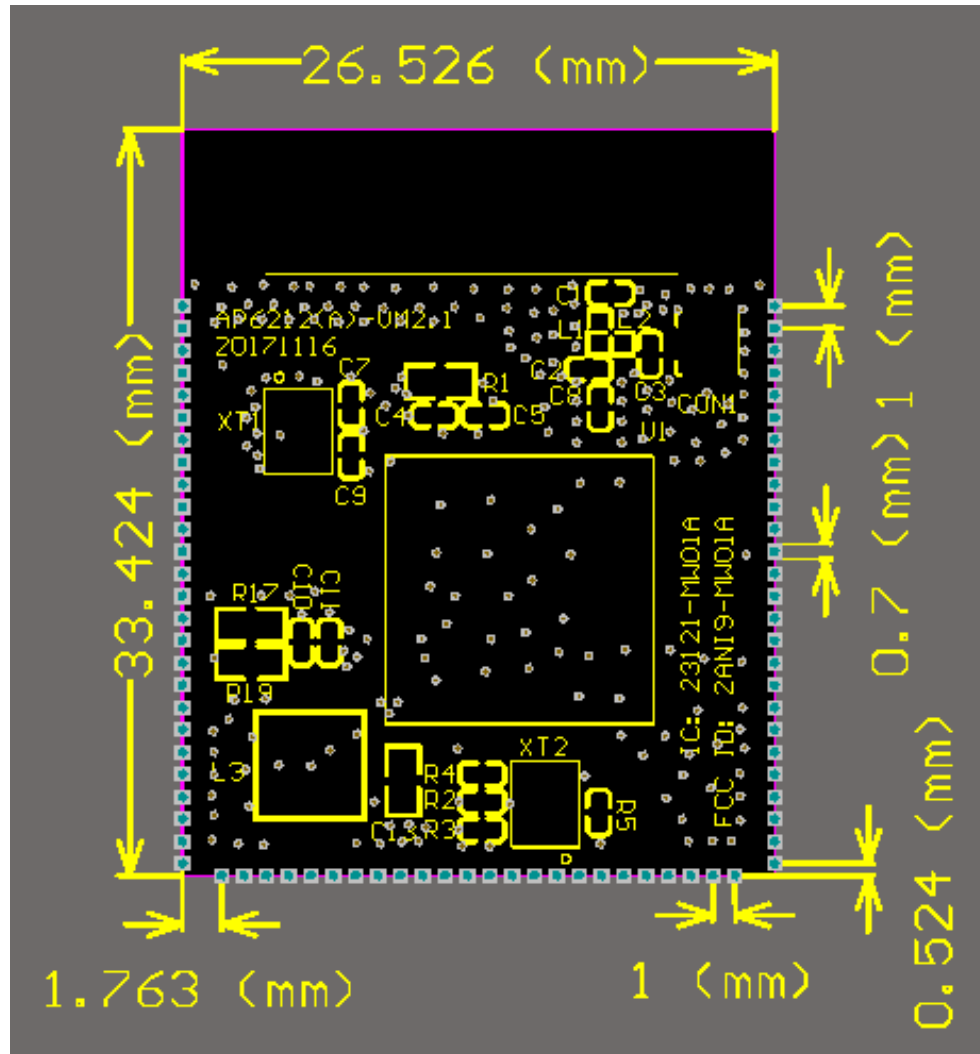
5.2 Pin Definition

NO	Name	Type	Description
1	GND	—	Ground connections
2	BT_WAKE	I	HOST wake-up Bluetooth device
3	BT_HOST_WAKE	O	Bluetooth device to wake-up HOST
4	NC/CLK_REQ	—	Floating (Don't connected to ground)
5	WL_REG_ON	I	Internal regulators power enable/disable
6	WL_HOST_WAKE	O	WLAN to wake-up HOST
7	GND	—	Ground connections
8	SDIO_DATA_2	I/O	SDIO data line 2
9	SDIO_DATA_3	I/O	SDIO data line 3
10	SDIO_DATA_CMD	I/O	SDIO command line
11	SDIO_DATA_CLK	I/O	SDIO clock line
12	SDIO_DATA_0	I/O	SDIO data line 0
13	SDIO_DATA_1	I/O	SDIO data line 1

14	GND	—	Ground connections
15	GND	—	Ground connections
16	VBAT	P	Main power voltage source input
17	VBAT	P	Main power voltage source input
18	VDDIO	P	I/O Voltage supply input
19	VDDIO	P	I/O Voltage supply input
20	GND	—	Ground connections
21	GND	—	Ground connections
22	GND	—	Ground connections
23	GND	—	Ground connections
24	GND	—	Ground connections
25	GND	—	Ground connections
26	GND	—	Ground connections
27	GND	—	Ground connections
28	GND	—	Ground connections
29	GND	—	Ground connections
30	GND	—	Ground connections
31	GND	—	Ground connections
32	GND	—	Ground connections
33	GND	—	Ground connections
34	GND	—	Ground connections
35	GND	—	Ground connections
36	GND	—	Ground connections
37	32.768K	I	External Low Power Clock input (32.768KHz)
38	GND	—	Ground connections
39	GND	—	Ground connections
40	GND	—	Ground connections
41	GND	—	Ground connections
42	NC/RTC_CLK_EN	—	Floating (Don't connected to ground)
43	GND	—	Ground connections
44	GND	—	Ground connections
45	PCM_OUT	O	PCM Data output
46	PCM_CLK	I/O	PCM clock
47	PCM_IN	I	PCM data input
48	PCM_SYNC	I/O	PCM sync signal
49	GND	—	Ground connections

50	GND	—	Ground connections
51	GND	—	Ground connections
52	GND	—	Ground connections
53	GND	—	Ground connections
54	GND	—	Ground connections
55	GND	—	Ground connections
56	GND	—	Ground connections
57	GND	—	Ground connections
58	GND	—	Ground connections
59	BT_RST_N	O	Bluetooth/ UART interface
60	GND	—	Ground connections
61	NC/GPIO4	—	Floating (Don't connected to ground)
62	NC/GPIO3	—	Floating (Don't connected to ground)
63	NC/GPIO2	—	Floating (Don't connected to ground)
64	NC/GPIO1	—	Floating (Don't connected to ground)
65	GND	—	Ground connections
66	UART_RTS_N	O	Bluetooth/ UART interface
67	UART_TXD	O	Bluetooth/ UART interface
68	UART_RXD	I	Bluetooth/ UART interface
69	UART_CTS_N	I	Bluetooth/ UART interface
70	GND	—	Ground connections
71	GND	—	Ground connections
72	GND	—	Ground connections
73	GND	—	Ground connections
74	GND	—	Ground connections
75	GND	—	Ground connections
76	GND	—	Ground connections

6. Dimensions



7. External clock reference

External LPO signal characteristics

Parameter	Specification	Units
Nominal input frequency	32.768	kHz
Frequency accuracy	± 30	ppm
Duty cycle	30 - 70	%
Module input Signal Level	400~3300	mV, p-p
Signal type	Square-wave	-
Input impedance	>100k <5	Ω pF
Clock jitter (integrated over 300Hz – 15KHz)	<1	Hz

External Ref_CLK signal characteristics

No.	Item	Symb.	Electrical Specification				Remark
			Min.	Type	Max.	Units	
1	Nominal Frequency	F0	26.00000				MHz
2	Mode of Vibration		Fundamental				
3	Frequency Tolerance	$\Delta F/F0$	-10	-	10	ppm	at 25°C $\pm 3^\circ\text{C}$
4	Operating Temperature Range	T _{OPR}	-30	-	85	°C	
5	Frequency Stability	TC	-10	-	10	ppm	
6	Storage Temperature	T _{STG}	-55	-	125	°C	
7	Load capacitance	CL	-	16		pF	
8	Equivalent Series Resistance	ESR	-	-	50	Ω	
9	Drive Level	DL	-	100	200	μW	
10	Insulation Resistance	IR	500	-	-	M Ω	At 100V _{DC}
11	Shunt Capacitance	C0	-	-	3	pF	
12	Aging Per Year	Fa	-2	-	2	ppm	First Year

7.1 SDIO Pin Description

The module supports SDIO version 2.0 for 4-bit modes (100 Mbps), and high speed 4-bit (50 MHz clocks – 200 Mbps). It has the ability to stop the SDIO clock and map the interrupt signal into a GPIO pin. This 'out-of-band' interrupt signal notifies the host when the WLAN device wants to turn on the SDIO interface. The ability to force the control of the gated clocks from within the WLAN chip is also provided.

- ❖ Function 0 Standard SDIO function (Max BlockSize / ByteCount = 32B)
- ❖ Function 1 Backplane Function to access the internal System On Chip (SOC) address space (Max BlockSize / ByteCount = 64B)
- ❖ Function 2 WLAN Function for efficient WLAN packet transfer through DMA (Max BlockSize/ByteCount=512B)

SDIO Pin Description

SD 4-Bit Mode	
DATA0	Data Line 0
DATA1	Data Line 1 or Interrupt
DATA2	Data Line 2 or Read Wait
DATA3	Data Line 3
CLK	Clock
CMD	Command Line

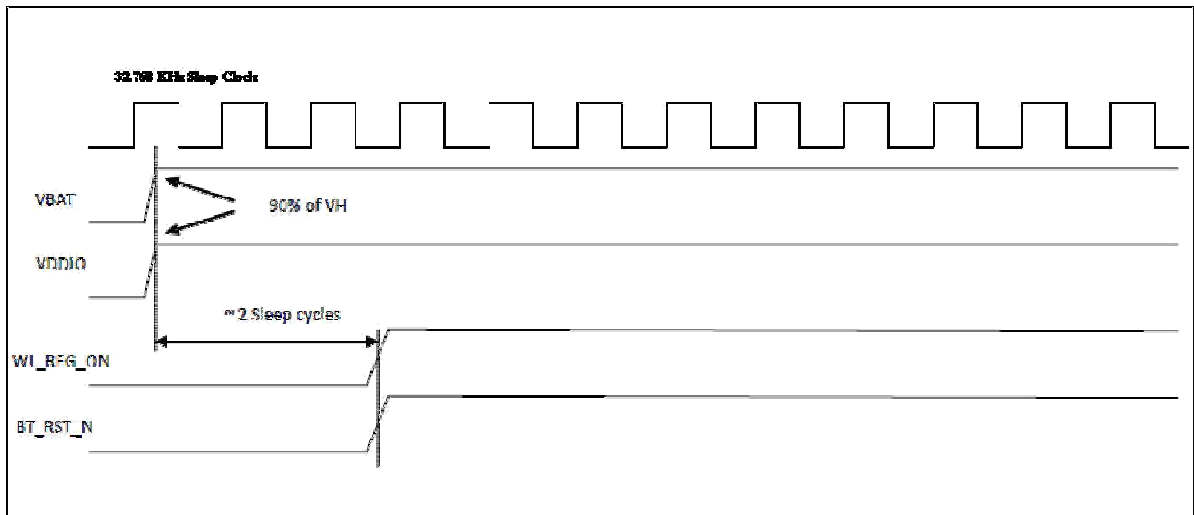
8. Host Interface Timing Diagram

8.1 Power-up Sequence Timing Diagram

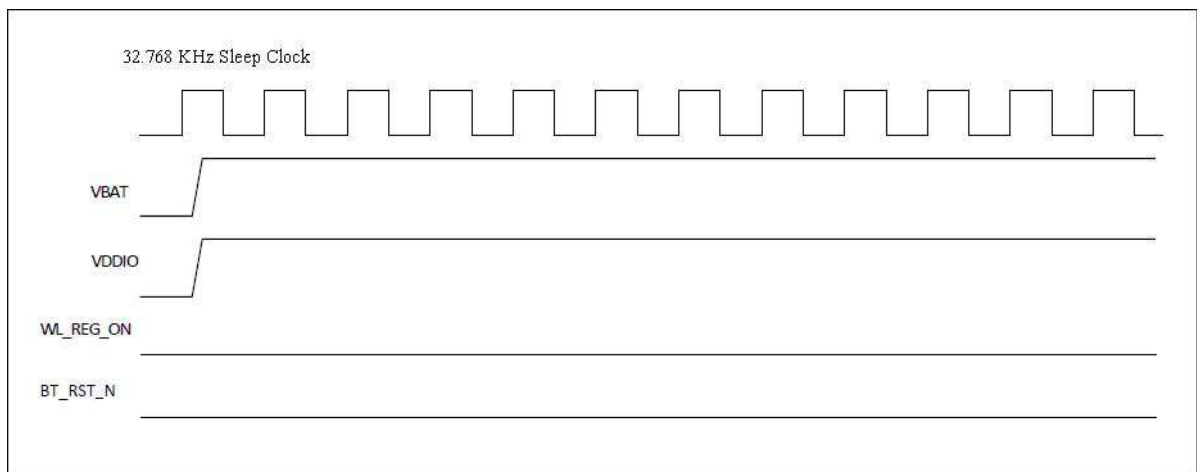
The module has signals that allow the host to control power consumption by enabling or disabling the Bluetooth, WLAN and internal regulator blocks. These signals are described below.

Additionally, diagrams are provided to indicate proper sequencing of the signals for various operating states. The timing value indicated are minimum required values: longer delays are also acceptable.

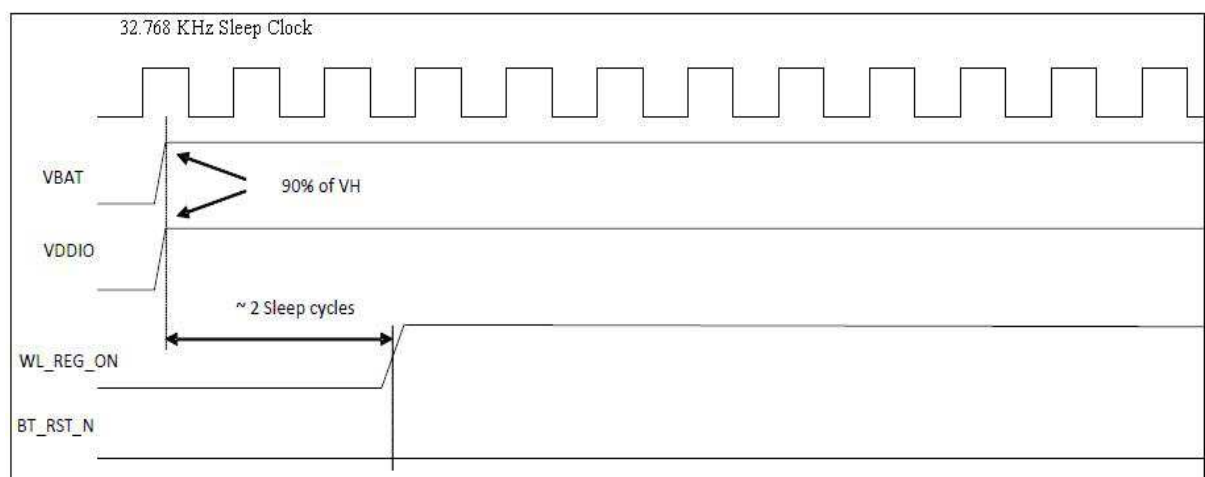
- ※ WL_REG_ON: Used by the PMU to power up the WLAN section. When this pin is high, the regulators are enabled and the WLAN section is out of reset. When this pin is low the WLAN section is in reset.
- ※ BT_RST_N: Low asserting reset for Bluetooth only. This pin has no effect on WLAN and does not control any PMU functions. This pin must be driven high or low (not left floating).



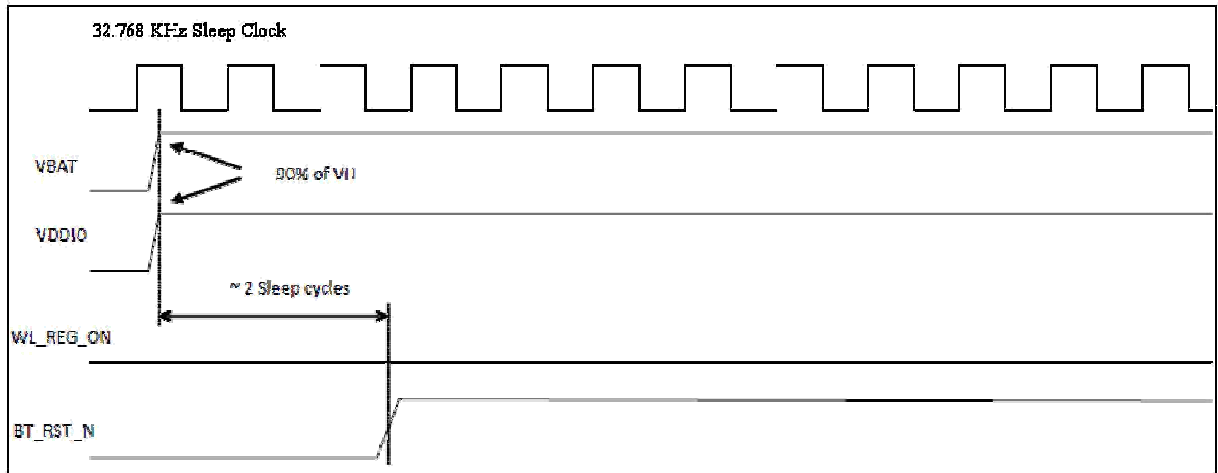
WLAN=ON, Bluetooth=ON



WLAN=OFF, Bluetooth=OFF

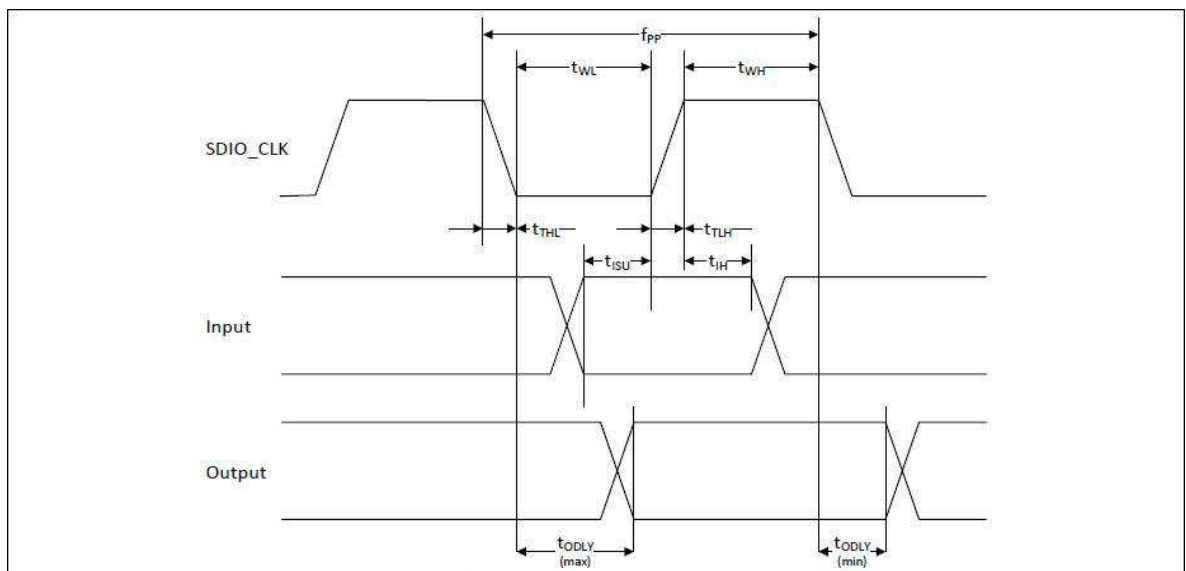


WLAN=ON, Bluetooth=OFF



WLAN=OFF, Bluetooth=ON

8.2 SDIO Default Mode Timing Diagram

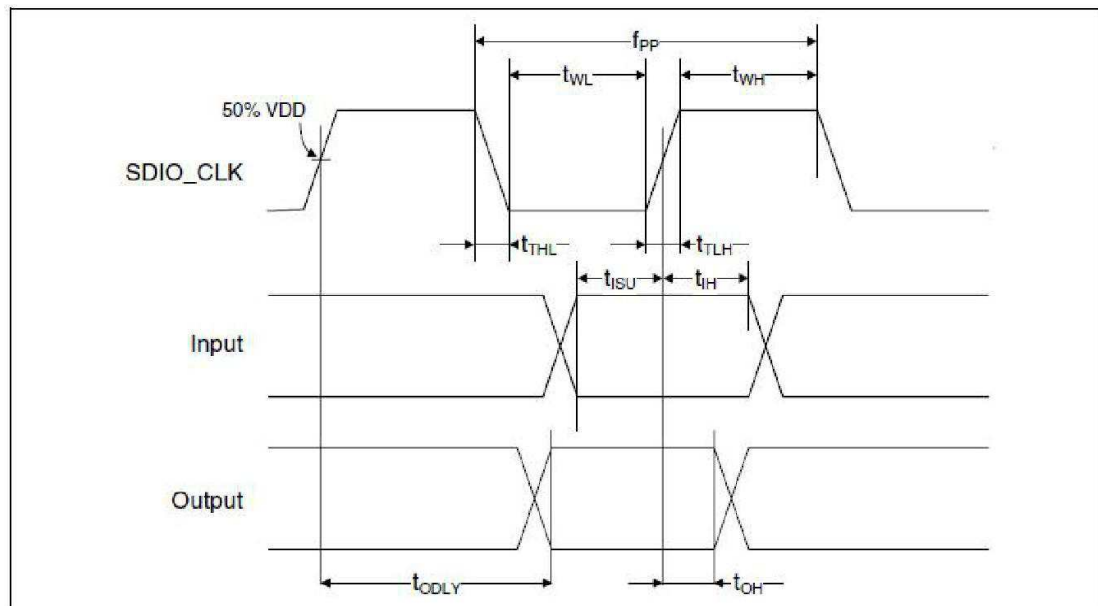


Parameter	Symbol	Minimum	Typical	Maximum	Unit
SDIO CLK (All values are referred to minimum VIH and maximum VIL^b)					
Frequency-Data Transfer mode	fPP	0	-	25	MHz
Frequency-Identification mode	fOD	0	-	400	kHz
Clock low time	tWL	10	-	-	ns
Clock high time	tWH	10	-	-	ns
Clock rise time	tTLH	-	-	10	ns
Clock low time	tTHL	-	-	10	ns
Inputs: CMD, DAT (referenced to CLK)					
Input setup time	tISU	5	-	-	ns
Input hold time	tIH	5	-	-	ns
Outputs: CMD, DAT (referenced to CLK)					
Output delay time – Data Transfer mode	tODLY	0	-	14	ns
Output delay time – Identification mode	tODLY	0	-	50	ns

a. Timing is based on CL ≤ 40pF load on CMD and Data.

b. min(Vih) = 0.7 x VDDIO and max(Vil) = 0.2 x VDDIO.

8.3 SDIO High Speed Mode Timing Diagram



Parameter	Symbol	Minimum	Typical	Maximum	Unit
SDIO CLK (All values are referred to minimum VIH and maximum VIL^b)					
Frequency-Data Transfer mode	fPP	0	-	50	MHz
Frequency-Identification mode	fOD	0	-	400	kHz
Clock low time	tWL	7	-	-	ns
Clock high time	tWH	7	-	-	ns
Clock rise time	tTLH	-	-	3	ns
Clock low time	tTHL	-	-	3	ns
Inputs: CMD, DAT (referenced to CLK)					
Input setup time	tISU	6	-	-	ns
Input hold time	tIH	2	-	-	ns
Outputs: CMD, DAT (referenced to CLK)					
Output delay time – Data Transfer mode	tODLY	-	-	14	ns
Output hold time	tOH	2.5	-	-	ns
Total system capacitance (each line)	CL	-	-	40	pF

a. Timing is based on CL ≤ 40pF load on CMD and Data.

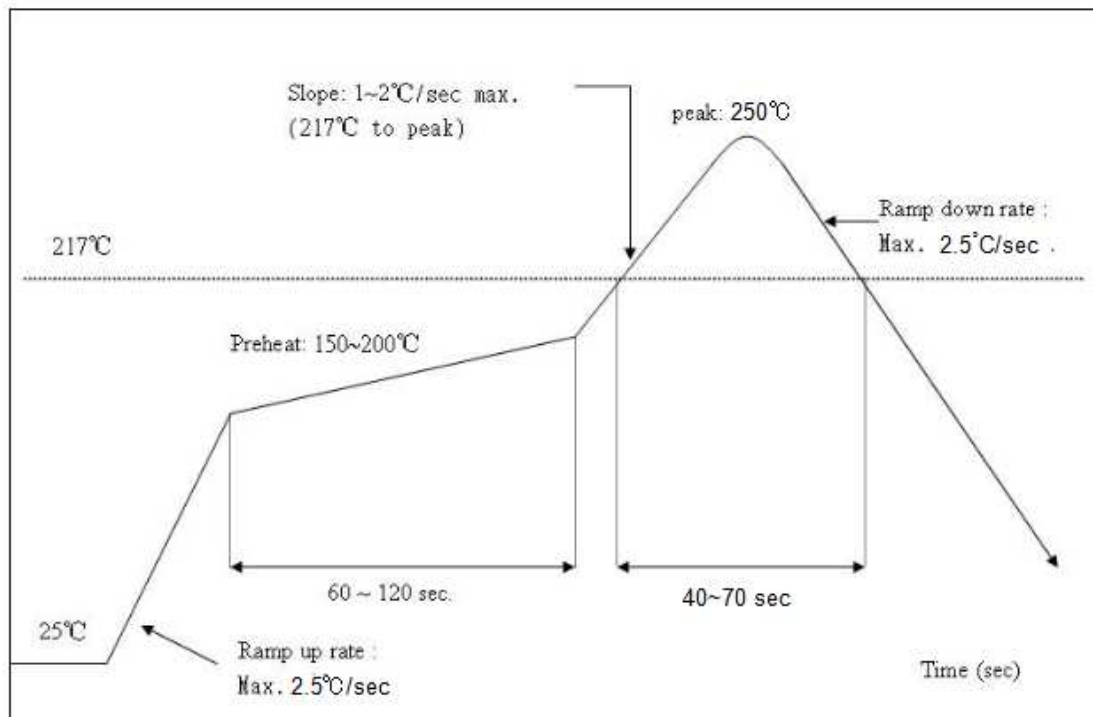
b. min(Vih) = 0.7 x VDDIO and max(Vil) = 0.2 x VDDIO.

9. Recommended Reflow Profile

Referred to IPC/JEDEC standard.

Peak Temperature : <250°C

Number of Times : ≤2 times



The notification of WiFi module before mounting:

The aperture of stencil should be larger than foot print of module, and the stencil thickness should be not less than 0.12mm.

Reflow should be used at N2, oxygen content recommended below 5000 ppm, It must use N2 for reflow and suggest the concentration of oxygen less than 5000 ppm .

Caution

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.

Cet appareil est conforme à la section 15 des réglementations de la FCC. Le fonctionnement de l'appareil est sujet aux deux conditions suivantes :

- (1) cet appareil ne doit pas provoquer d'interférences néfastes, et
- (2) cet appareil doit tolérer les interférences reçues, y compris celles qui risquent de provoquer un fonctionnement indésirable.

Note: This product has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This product 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 product 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.

Please take attention that changes or modification not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment should be installed and operated with a minimum distance 20cm between the radiator and your body

Cet équipement doit être installé et utilisé à une distance minimale de 20 cm entre le radiateur et votre corps

This device complies with Industry Canada licence-exempt RSS standard(s).

Operation is subject to the following two conditions:

- (1) this device may not cause interference, and
- (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radioexempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

- (1) l'appareil ne doit pas produire de brouillage, et
- (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

If the FCC ID of this module is not visible when it is installed inside another device, then the outside of the device into which the module is installed must be label with "Contains FCC ID: 2ANI9-MW01A and IC: 23121-MW01A".

This radio transmitter (23121-MW01A) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Gain of antenna: 2 dBi max

Type of antenna: 50ohm, external or internal PCB antenna

Le présent émetteur radio (23121-MW01A) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

Gain d'antenne: 2 dBi maximal

Type d'antenne: 50ohm, external or internal PCB antenna