



W002

Specification V1.2

IEEE 802.11 b/g/n 2.4 GHz 1T1R Wi-Fi module

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Version	Date	Description	Drawn By	Approved By
V1.0	2016-09-16	Initial Release	Ken	
V1.1	2017-02-05	Add IO ports definition	Ken	
V1.2	2017-02-07	Modify bootstrap description	Ken	



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1 General Description

The module W002 is small form factor IEEE 802.11b/g/n/ MAC / baseband /radio that are designed to meet both the low power and high throughput application. It also contains a 32-bit RISC CPU that couldfully offload the application processor.

The W002 is a single stream 1x1 802.11n implementation providing improved link robustness, extended range, increased throughput and better performance for an unparalleled user experience. W002 is a highly integrated module for IoT applications. The application processor subsystem contains an ARM Cortex-M4F MCU. It also includes many peripherals, including UART, I2C, SPI, I2S, PWM, IrDA, and auxiliary ADC. It also includes embedded SRAM/ROM and a 2MB serial flash in package .

The W002 implements MTK' proprietary Internal Efficient Power AmplifierTM (EPA) technology with advanced linearization algorithms and an internal LNA, thereby reducing the BOM costs in the system design.

Table1:module information

Chipset	MT7687F
Core	ARMCortex-M4MCU
FPU Clock Speed	192MHz
SRAM	352KB
Internal Flash	2MB
Operation Conditions	
Humidity	Operating: -20°C ~ +70°C (Non-Condensing) Storage: -40°C ~ +85°C (Non-Condensing)
Dimension	18mmX18mmX2.2mm(Typ.)
Package	LGA44Pin



2 Characteristics

- IEEE 802.11 b/g/n compliant ,1T1R mode with data rate up to 150Mbps
- Support WLAN 20MHz/40MHz at 2.4GHz
- ARM Cortex-M4F MCU with FPU with up to 192MHz clock speed
- Embedded 352KB SRAM and 64KB boot ROM
- Supports external serial flash with Quad Peripheral Interface (QPI) mode
- Supports eXecute In Place (XIP) on flash
- 32KB cache in XIP mode
- Hardware crypto engines including AES, DES/3DES, SHA2 for network security
- 28 General Purpose IOs multiplexed with other interfaces
- Two UART interfaces with hardware flow control and one UART for debug, allmultiplexed with GPIO
- One SPI master interface multiplexed with GPIO,One SPI slave interface multiplexed with GPIO
- Two I2C master interface multiplexed with GPIO
- One I2S interface multiplexed with GPIO
- Four channel 12-bit ADC multiplexed with GPIO
- 28 PWM multiplexed with GPIO
- 25 channels DMA
- Low power RTC mode with 32KHz crystal support
- Dedicated high-performance 32-bit RISC CPU N9 up to 160MHz clock speed
- Supports STBC, LDPC
- Greenfield, mixed mode, legacy modes support
- IEEE 802.11e support
- Security support for WFA WPA/WPA2 personal, WPS2.0
- Supports 802.11w protected managed frames
- QoS support of WFA WMM
- Integrated LNA, PA, and T/R switch
- RX diversity support with additional RX input



3 Block Diagram

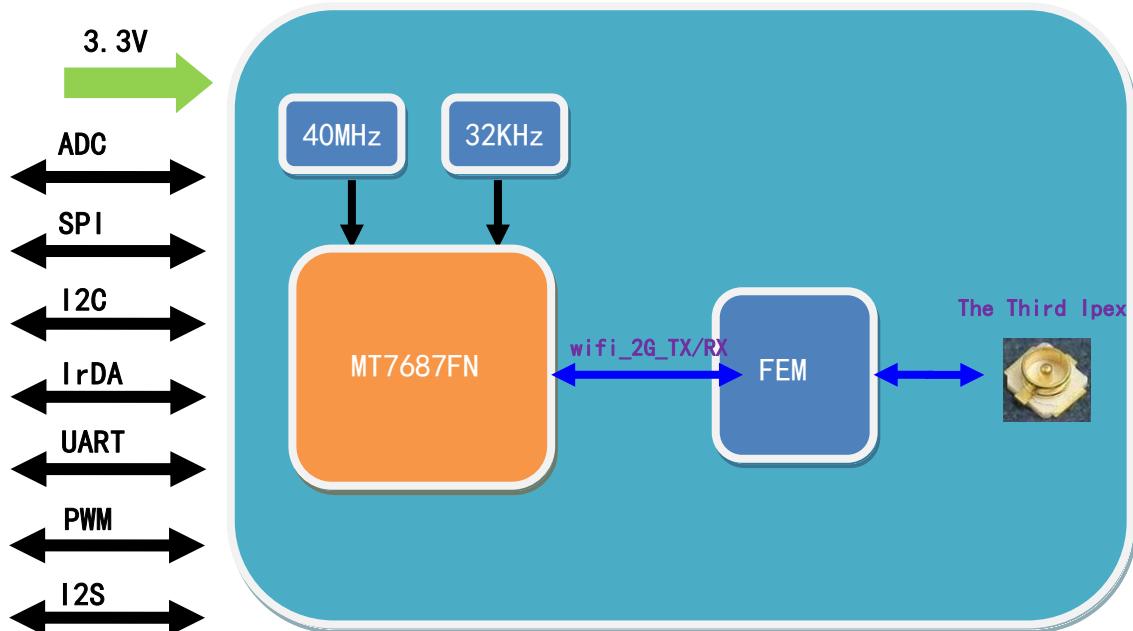


Figure1:module block diagram

4 Electrical Characteristics

Table2:Recommended operating conditions

Symbol	Parameter	Min	Typ	Max	Unit
VDD	Supply Voltage	3	3.3	3.6	V
I/OVoltage	I/O Power Supply	3	3.3	3.6	V

Table3:Current consumption in different scenarios

Scenario	Test Conditions	Typical	Unit
Legacy Sleep	★ MCU subsystem clocks are gated off ★ The entire subsystem is retained ★ Only 32KHz clock from XTAL is active	667	uA
RTC mode	★ System Off ★ No SRAM retained ★ Only RTC is alive	3	uA
WIFI Connected	★ WFI Sleep mode ★ Tickless feature enabled ★ DTIM1	15	mA
	★ Legacy Sleep mode ★ Tickless feature enabled	5	mA



	★ DTIM1		
	★ Legacy Sleep mode ★ Tickless feature enabled ★ DTIM10	3	mA

DTIM, A **delivery traffic indication map** is a kind of traffic indication map (TIM) which informs the clients about the presence of buffered multicast/broadcast data on the access point. It is generated within the periodic beacon at a frequency specified by the DTIM Interval

DTIM 1: DTIM interval = 1, WIFI wake up each beacon period (default 100 ms)

DTIM 10: DTIM interval = 10, WIFI wake up every 10 beacon period (1000ms)

5 WLAN RF Characteristics

5.1 RF Characteristics for 802.11b 11M

Table4: Wi-Fi 2.4GHz RF radio for 802.11b 11Mbps

802.11b Transmit(Conductive)					
Item	Condition	Min.	Typ.	Max.	Unit
Frequency Range		Channel1		Channel13	
Tx Power Level	DQPSK	18.0	20.0	22.0	dBm
Frequency Tolerance		-15	0	15	ppm
Spectral Mask	11MHz→22MHz		40		dBr
	> 22MHz		53		dBr
Modulation Accuracy	All Data Rate		15		%
802.11b Receiver(Conductive)					
Item	Condition	Min.	Typ.	Max.	Unit
Frequency Range		Channel1		Channel13	
Min.Input	11MbpsPER<8%	-90	-88	-86	dBm

5.2 RF Characteristics for 802.11g 54M

Table5: Wi-Fi 2.4GHz RF radio for 802.11g 54Mbps

802.11g Transmit(Conductive)					
Item	Condition	Min.	Typ.	Max.	Unit
Frequency Range		Channel1		Channel13	
Tx Power Level	OFDM	15.0	17.0	19.0	dBm



Frequency Tolerance		-15	0	15	ppm
Modulation Accuracy	AllDataRate		-31	-28	
802.11g Receiver(Conductive)					
Item	Condition	Min.	Typ.	Max.	Unit
Frequency Range		Channel1		Channel13	
Min.Input	54MbpsPER<10%	-77.0	-75.0	-73.0	

5.3 RF Characteristics for 802.11n MCS7(HT20)

Table6: Wi-Fi 2.4GHz RF radio for 802.11n MCS7(HT20)

802.11n_HT20Transmit(Conductive)					
Item	Condition	Min.	Typ.	Max.	Unit
Frequency range		Channel1		Channel13	
Tx Power Level	OFDM	15.0	17.0	19.0	dBm
Frequency Tolerance		-15	0	15	ppm
Modulation Accuracy	AllDataRate		-31	-28	dB
802.11n_HT20 Receiver(Conductive)					
Item	Condition	Min.	Typ.	Max.	Unit
Frequency Range		Channel1		Channel13	
Min.Input	MCS7PER<10%	-75	-73	-71	dBm

5.4 RF Characteristics for 802.11n MCS7(HT40)

Table7: Wi-Fi 2.4GHz RF radio for 802.11n MCS7(HT40)

802.11n_HT40Transmit(Conductive)					
Item	Condition	Min.	Typ.	Max.	Unit
Frequency range		Channel1		Channel13	
Tx Power Level	OFDM	15.0	17.0	19.0	dBm
Frequency Tolerance		-15	0	15	ppm
Modulation Accuracy	AllDataRate		-30	-28	dB
802.11n_HT40 Receiver(Conductive)					
Item	Condition	Min.	Typ.	Max.	Unit
Frequency Range		Channel1		Channel13	
Min.Input	MCS7PER<10%	-73.5	-71.5	-69.5	dBm

6 Module Package Information:Pin out Diagram

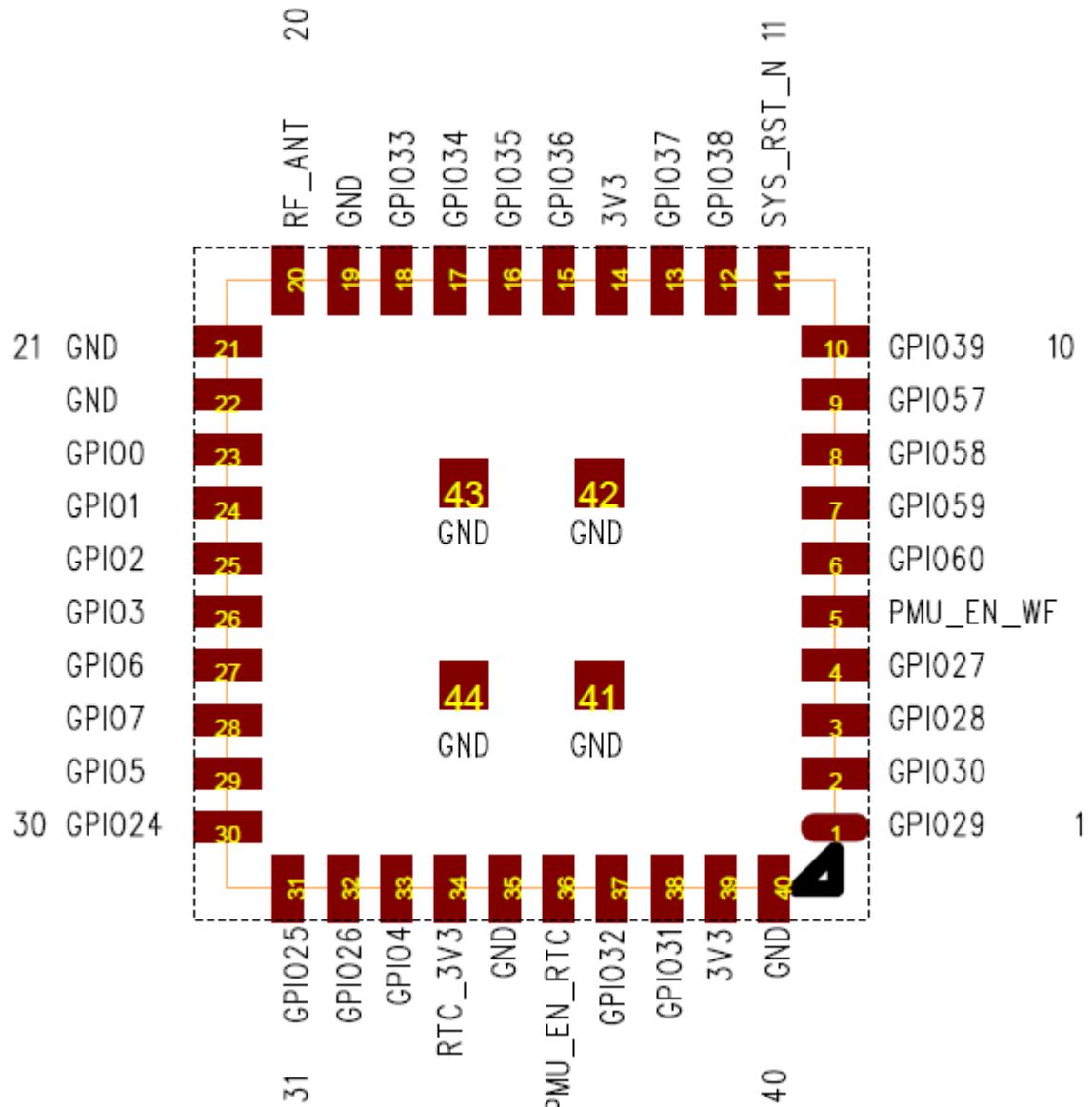


Figure2: Pin out Diagram

Table8:The Pin Definition

No.	Pin Name	TYPE	Description
1	GPIO29	I/O	Programmable input/output
2	GPIO30	I/O	Programmable input/output
3	GPIO28	I/O	Programmable input/output
4	GPIO27	I/O	Programmable input/output
5	PMU_EN_WF	Input	External PMU enable, active High
6	GPIO60	I/O	Programmable input/output
7	GPIO59	I/O	Programmable input/output
8	GPIO58	I/O	Programmable input/output



9	GPIO57	I/O	Programmable input/output
10	GPIO39	I/O	Programmable input/output
11	SYS_RST_N	Input	External system reset active low
12	GPIO38	I/O	Programmable input/output
13	GPIO37	I/O	Programmable input/output
14	3V3	Power	3.3V power supply input
15	GPIO36	I/O	Programmable input/output
16	GPIO35	I/O	Programmable input/output
17	GPIO34	I/O	Programmable input/output
18	GPIO33	I/O	Programmable input/output
19	GND	Power	Ground
20	RF_ANT		Extend the antenna(Optional), Don't use by default. use
21	GND	Power	Ground
22	GND	Power	Ground
23	GPIO00	I/O	Programmable input/output
24	GPIO01	I/O	Programmable input/output
25	GPIO02	I/O	Programmable input/output
26	GPIO03	I/O	Programmable input/output
27	GPIO06	I/O	Programmable input/output
28	GPIO07	I/O	Programmable input/output
29	GPIO05	I/O	Programmable input/output
30	GPIO24	I/O	Programmable input/output
31	GPIO25	I/O	Programmable input/output
32	GPIO26	I/O	Programmable input/output
33	GPIO04	I/O	Programmable input/output
34	RTC_3V3	Power	RTC domain power supply Input 3.3V
35	GND	Power	Ground
36	PMU_EN_RTC	Output	PMU enable
37	GPIO32	I/O	Programmable input/output
38	GPIO31	I/O	Programmable input/output
39	3V3	Power	3.3V power supply input
40	GND	Power	Ground
41	PAD_GND	Power	Ground
42	PAD_GND	Power	Ground
43	PAD_GND	Power	Ground



44	PAD_GND	Power	Ground
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7 Peripherals

Several peripheral are multiplexed GPIOs. BLW003 has two dedicated UART interfaces with flow control, one dedicated I2C interface, and one dedicated IrDA interface. BLW003 also has the 2nd I2C interface, the SPI slave interface, the I2S interface, and the SPI master interface, but only 2 of the above interfaces can be effective at a time.

7.1 GPIO Interface

GPIOs Multiplex Function

BLW003 offers GPIO, each with the following configuration options:

- Input / Output mode
- Slew rate control
- Schmitt trigger hysteresis control
- Input mode: Floating (Hi-Z), pull-up, or pull-down
- Output mode: Active driving, or open drain
- Pull up/down control. The pull-up and pull-down resistance is 75KΩ with ±20% variation over PVT condition
- Driving strength: 4mA, 8mA, 12mA, 16mA
- Input and output duty cycle tuning



GPIO60	SWD_CLK	WIC11	PWM39	GPIO60	ADC3
GPIO59	SWD_DIO	WIC10	PWM38	GPIO59	ADC2
GPIO58		WIC9	PWM37	GPIO58	ADC1
GPIO57		WIC8	PWM36	GPIO57	ADC0
GPIO28			PWM29	GPIO28	SDA1
GPIO27		WIC2	PWM28	GPIO27	SCL1
GPIO39	EINT22		PWM22	GPIO39	UART2_CTS
GPIO38	EINT21		PWM21	GPIO38	UART2_RTS
GPIO37	EINT20		PWM20	GPIO37	UART2_TX
GPIO36	WIC7		PWM19	GPIO36	UART2_RX
GPIO34	WIC6		PWM35	GPIO34	IR_RX
GPIO33	WIC5		PWM34	GPIO33	IR_TX
GPIO31	SPI_SCK	I2S_RX/TX	PWM32	GPIO31	
GPIO30	MISO	I2S_FS	PWM31	GPIO30	
GPIO29	MOSI	I2S_MCLK	PWM30	GPIO29	WIC3
GPIO32	SPI_CS0	I2S_BCLK	PWM33	GPIO32	WIC4
GPIO35	UART_DBG	I2S_TX	PWM18	GPIO35	EINT19
GPIO6	SPI_CS1		PWM4	GPIO6	EINT5
	RESERVE FOR 7607				
GPIO26	SPI_CLK_EXT		PWM27	GPIO26	
GPIO25	SPI_DATA3_EXT		PWM26	GPIO25	WIC1
GPIO24	SPI_DATA2_EXT		PWM25	GPIO24	
GPIO7	SPI_CS_EXT		PWM5	GPIO7	EINT6
GPIO5	SPI_DATA1_EXT		PWM3	GPIO5	EINT4
GPIO4	SPI_DATA0_EXT		PWM2	GPIO4	EINT3
GPIO3	UARRI_TX		PWM24	GPIO3	EINT2
GPIO2	UARRI_RX		PWM23	GPIO2	WIC0
GPIO1	UART1_CTS		PWM1	GPIO1	EINT1
GPIO0	UART1_RTS		PWM0	GPIO0	EINT0

Figure3: GPIOs Multiplex Function

7.2 UART Interface

BLW003 has two UART interfaces. The UART has M16C450 and M16550A modes of operation, which are compatible with a range of standard software drivers. And supports UART with configurable BAUD rates from 9.6Kbps, 19.2Kbps, 38.4Kbps, 115.2Kbps, and 921.6Kbps.

7.3 I2C Serial Interface

BLW003 features two I2C serial interface master controllers. The two signals of I2C channel 0 are I2C0_CLK and I2C0_DATA.

- I2C0_CLK is a clock signal that is driven by the master.



- I2C0_DATA is a bi-directional data signal that can be driven by either the master or the slave. It supports the clock rate of 50, 100, 200, and 400 KHz.
- I2C channel 1 supports the same feature as channel 0.

7.4 Auxiliary ADC function

BLW003 features one auxiliary ADC function. The ADC function contains a 4-channel analog switch, a single-end input asynchronous 12-bit SAR (Successive Approximation Register) ADC, and a digital averaging function. The digital averaging function can perform on-the-fly averaging function of 1/2/4/8/16/32/64 points. The ADC features the dithering function to enhance the DNL performance. The ADC uses an external VREF20 as a reference voltage.

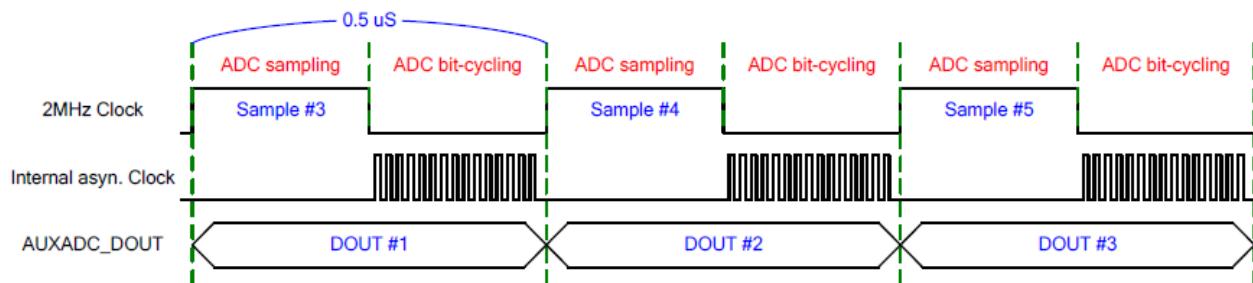


Figure4:Auxiliary ADC Clock Timing Diagram

Auxiliary ADC Features:

- ❑ Input channel number: 4 channels
- ❑ Sampling and output data rate: 2MS/s
- ❑ DNL without dithering and averaging: <±2LSB
- ❑ DNL with dithering and averaging: <±1LSB
- ❑ Dithering function: 16 levels with step size of 4LSB.

7.5 SPI Master Interface

BLW003 features one SPI master controller. It is used as an extension interface to control the peripheral device on expansion port. The SPI master controller supports the clock rates of 0.25, 0.5, 1, 2, 4, 6, 8, 10, and 12MHz. It supports two options of clock polarity (CPOL) and two options of initial clock phase (CPHA). SPI pins are multiplexed with I2S pins.

7.6 I2S Interface

BLW003 features one I2S interface, which is used to connect to an external audio codec. The I2S interface can support the I2S slave mode only. The five I2S signals are shown below. The I2S_MLK clock frequency is 16MHz. The external CODEC generates BCLK and LRCLK from MCLK. When configured as the I2S slave mode, the I2S interface can support two modes.



Table9: I2S Pin Description

Signal Name	Signal Description	Direction (Slave Mode)
I2S_MCLK	The base clock of the function.	Output
I2S_BCLK	The bit clock of the interface	Input
I2S_FS (LRCLK)	The left/right word select line of the interface	Input
I2S_TX	Digital audio output	Output
I2S_RX	Digital audio input	Input

Table10: I2S Slave Mode

Slave Mode	Bit Width	Input Sample (Uplink)	Output Sample (Downlink)	BCLK (Input)	FS (Input)
Mode 1	16b	16KHz, mono	16KHz, mono	512KHz	16KHz
Mode 2	16b	24KHz, mono	24KHz, mono	768KHz	24KHz

The I2S pins are multiplexed with SPI pins. The signal waveform of I2S is shown below.

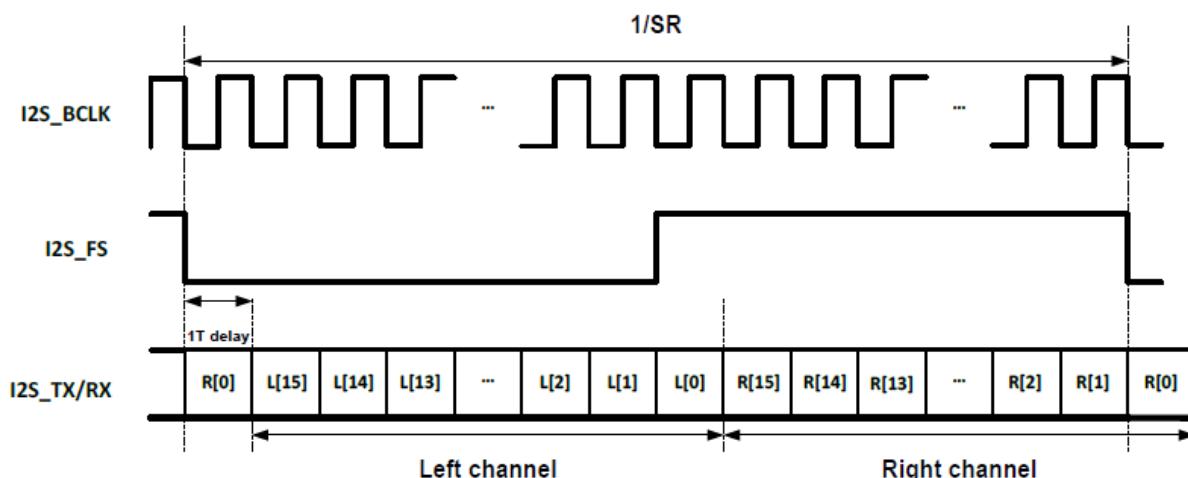


Figure5: I2S Signal Waveform

7.7 RTC

BLW003 features one RTC (Real Time Clock) module. The clock source is the 32.768 KHz Crystal .RTC has built in an accurate timer to wake up the system when it expires.



RTC uses a different power rail from PMU. In the hibernate mode, the PMU is turned off while the RTC module is remained powered on. The RTC module only consumes 3uA in hibernate mode.

RTC has a dedicated PMU control pin PMU_EN_RTC (pin 36 of module) used to turn on the power to the chip when the RTC timer expires and turn off the power to the chip when it intends to enter the deep sleep mode.

8 Bootstrap

The chip modes are sensed from the device pin during power up. After chip reset, the pull configuration are stored in a register and determine the device operation mode. the module use normal mode/40MHz/external 32.768KHz clock(not from 40MHz clock)

The module's Pin29"GPIO5",Pin27 " GPIO6", Pin 28" GPIO7", Pin16" GPIO35", Pin13" GPIO37", and Pin12" GPIO38" are used for bootstrap. The system design should follow the following guide line:

- Those pins shall not be used as input functions because the signals from another device might affect the values sensed.
- Those pins shall not be used as an open-drain function because the pull-up resistor would affect the values sensed.

Table11: Bootstrap

Sub-Function	Pin	Value	Description
Flash mode (when SIP_MODE=1)	GPIO37	0	Flash normal mode
		1	Flash recovery mode
rtc_mode/external 32KHz	GPIO6	0	ext 32KHz clock disable
		1	ext 32KHz clock enable

9 Package Dimensions

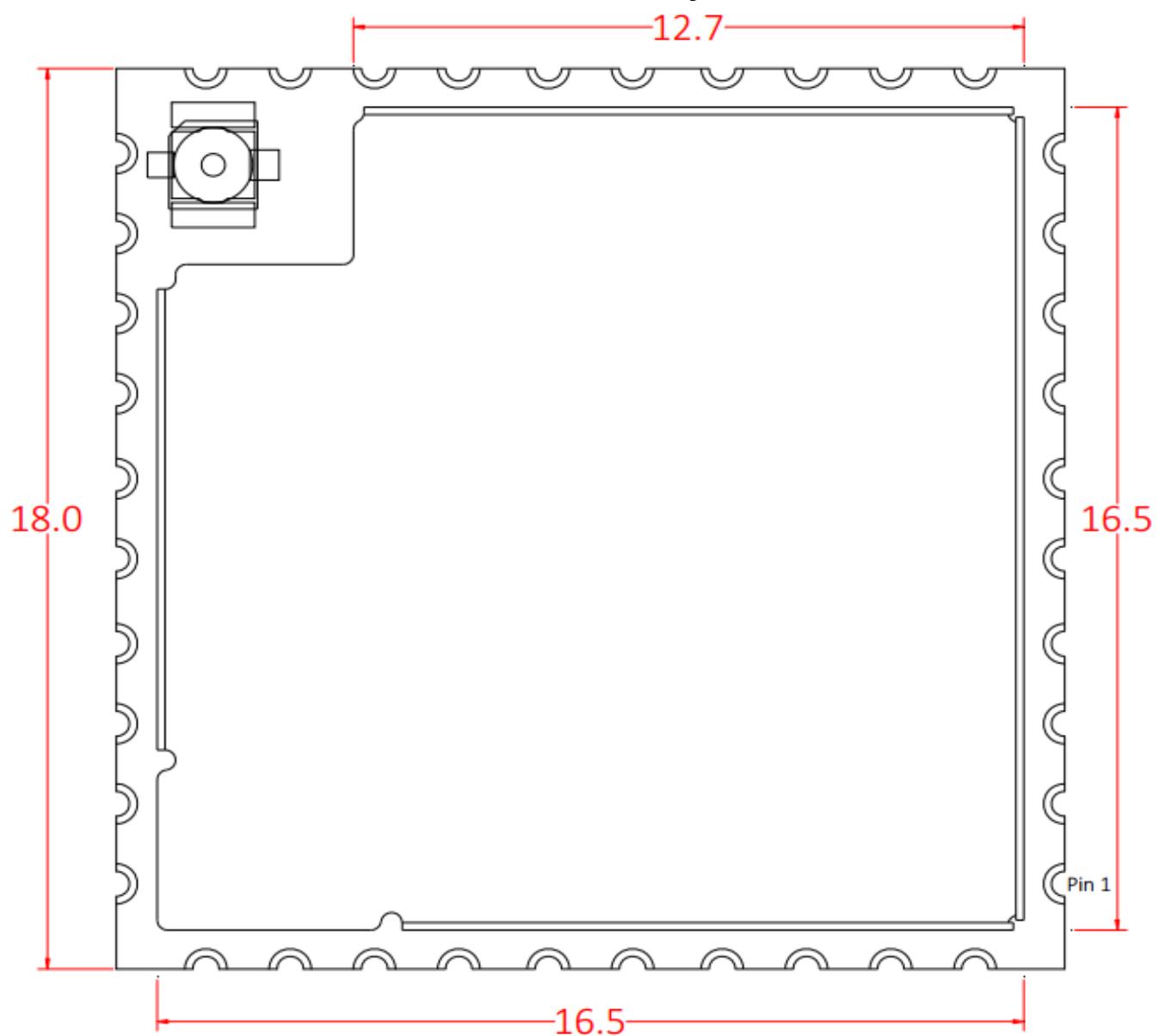
Dimension:18mmX18mm (WXL)

The Max height is 2.20mm .



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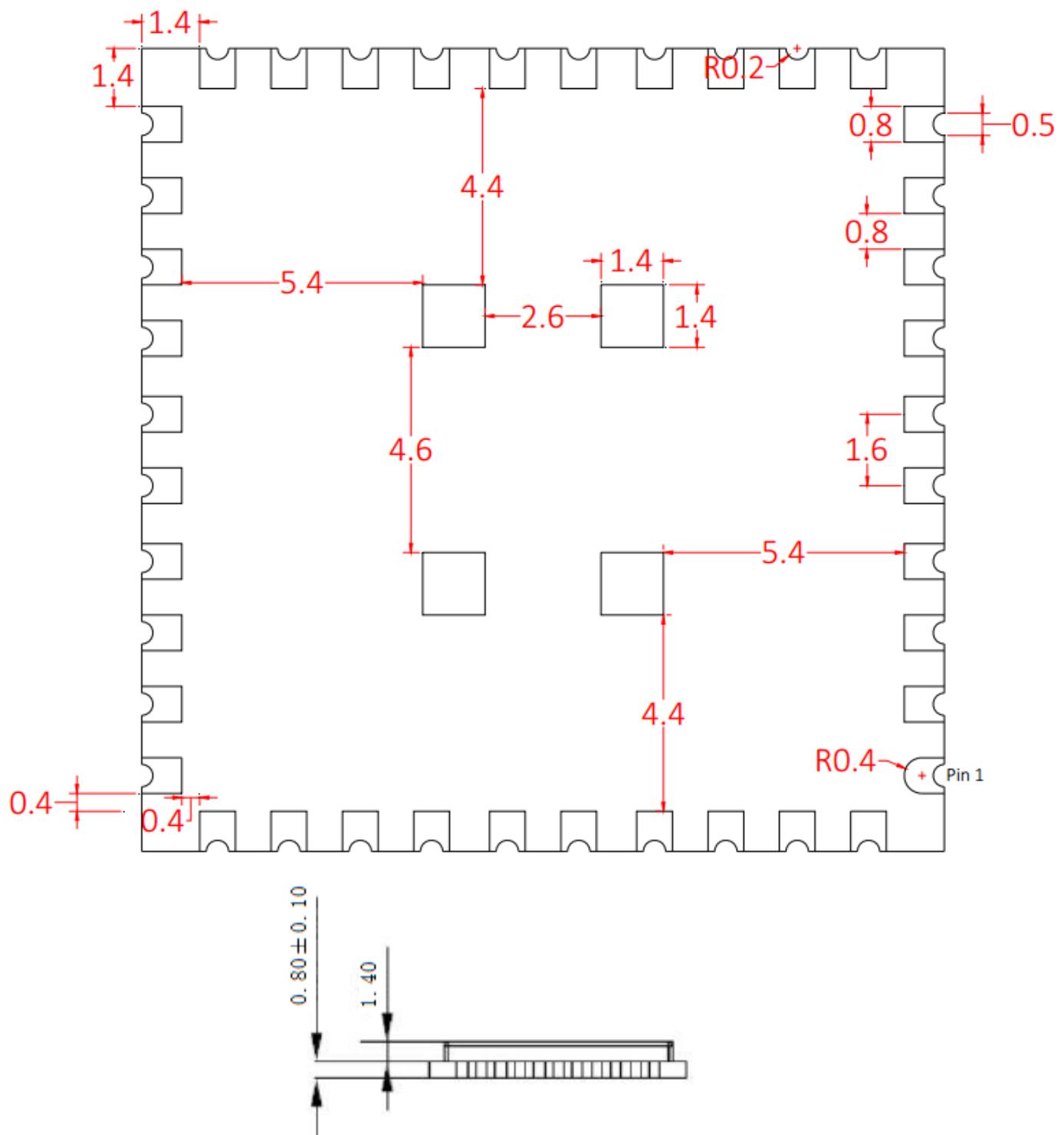


Figure6:Package Dimensions

10 Environmental Requirements

10.1 Operating Environment

Working temperature: -20°C to +70°C;

Storage temperature: -40°C to +80°C (no condensation);



Operating Humidity: 10% to 90%RH no condensation;

Storage humidity: 5% to 95%RH no condensation.

10.2 Recommended Reflow Profile

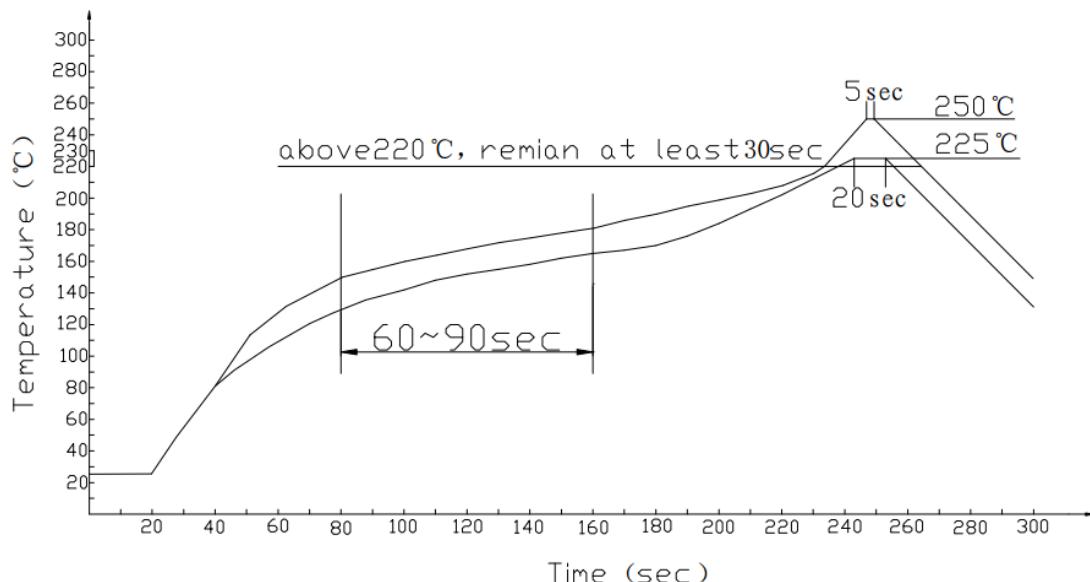


Figure7:Reflow Profile

注意:

Referred to IPC/JEDEC standard.

Peak Temperature : <250 ° C

Number of Times : ≤2 times

- Rising rate = 1~4°C /sec, 25°C to150°C AVG
- Preheating temperature = 140°C to 150°C, 60sec~90sec
- temperature fluctuation = 225°C to 250°C, about 30sec
- Cooling rate = 2~6°C/sec, to 183°C, about 15sec
- Total time = about 300sec

10.3 Patch WIFI modules installed before the notice:

1. Please press 1 : 1 and then expand outward proportion to 0.7 mm, 0.12 mm thickness When open a stencil
2. please insure the electrostatic protective measures for taking the WIFI module,
3. Reflow soldering temperature should be according to the customer the main size of the products, such as the temperature set at 250 + 5 °C.

About the module packaging, storage and use of matters needing attention are as follows:



1. The module of the reel and storage life of vacuum packing:

storage environment conditions: temperature in: < 40 °C, relative humidity: < 90% r.h.

2. The module vacuum packing once opened:

1) check the humidity Card: display value should be less than 30% (in blue), such as: 30% ~ 40% (pink) or greater than 40% (red) the module have been moisture absorption.

2.) factory environmental temperature humidity control: ≤ 30°C, ≤ 60% r.h..

3). Once opened, the workshop the preservation of life for 168 hours.

3. Once opened, if when not used up within 168 hours:

1). The module must be again to remove the module moisture absorption.

2). The baking temperature: 125 °C, 8 hours.

3.) After baking, put the right amount of desiccant to seal packages.