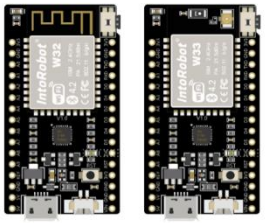
IntoRobot

Fig Datasheet



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Category

Chart Category

1 Overview

1.1 Introduction

IntoRobot-Fig is a WiFi and dual-mode Bluetooth development board designed by MOLMC Co., Ltd. It is integrated with high performance microprocessor ESP32 as the main processing core, and can be applied to many applications with low power and high computation requirements, like robotics, automation control, voice encoding, audio stream and MP3 decoding. ESP32 is a low cost, low power microcontroller with integrated Wi-Fi & dual-mode Bluetooth, which employs a dual-core Tensilica Xtensa LX6 microprocessor; the two cores can be individually controlled and powered. ESP32 operates at 7-stage pipeline to support the clock frequency of up to 240 MHz, and perform at up to 600 DMIPS. The users can power off the main CPUs, and monitor the important situations with the low-power co-processor. ESP32 integrates the antenna switch, RF balun, power amplifier, low noise receive amplifier, filters, power management modules, and self-calibration circuit. As such, the entire solution occupies minimal Printed Circuit Board (PCB) area.

IntoRobot-Fig provides rich peripheral interfaces, including capacitive touch sensor, hall sensor, temperature sensor, ultra-low noise analog pre-amplifier, SD/SDIO/MMC Host Controller, Ethernet MAC interface, UART, I2S and I2C.

CP2104, the serial chip with best compatibility and without need of driver, is integrated in IntoRobot-Fig; the chip supports Windows 7/8/10/Vista/XP/Server 2003/2000/ Windows CE ® 6.0, 5.0 and 4.2. Furthermore, a tiny light sensor is also integrated in IntoRobot-Fig for debug usage or other applications.

IntoRobot-Fig supports both offline Arduino programming and IntoRobot online development. IntoRobot-Fig integrates the ImLink technology, and makes the WiFi configuration convenient and fast. The board can greatly reduce development workload and shorten development cycle. IntoRobot-Fig, IntoRobot-Cloud, and IntoRobot App can work together to achieve many interesting and creative applications, such as remote robot control, building automation, safe and smart home, telemedicine, and other IoTs applications.

IntoRobot-Fig supports both long-range communication and internet connection via a router. In addition, Bluetooth can make users connected to mobile phones or broadcast BLE Beacon so that signals can be detected. The rate of data transmission for IntoRobot-Fig can be up to 150Mbps and the output power amplified by power amplifier can be up to 22dBm so that maximum-range wireless communication can be achieved. All in all, the type of Wi-Fi, Bluetooth module possesses excellent characteristics when compared with other existing ones and has more advantages from the perspectives of wireless transmission distance, power consumption,

internet connectivity and degree of integration. Some fields which this production can be used in are listed as follows:

- Universal low-energy-consumption IoT sensor, recorder;
- Video and picture transmission for cameras;
- Smart home appliances;
- Smart gardens;
- Wi-Fi toys;
- Web music players;
- Audio stream media devices;
- Wi-Fi speech recognition devices;
- Mesh internet;
- Industrial wireless control;’
- Baby monitors;
- Wi-Fi based position sensor;
- Safe ID tag;
- Healthcare;
- Motion monitor;
- Temperature recorder.

2 Hardware Specification

2.1 Specification Table

Chart 1：Specification Table

Category	Parameters	Specifications
Wi-Fi	Standard	FCC/CE/TELEC/KCC
	Protocol	802.11 b/g/n/d/e/i/k/r（802.11n，up to 150 Mbps）
		Combine A-MPDU and A-MSDU，support 0.4 μs protection interval
	Frequency Range	2.4~2.5 GHz
Bluetooth	Protocol	Satisfy the standards of Bluetooth v4.2 BR/EDR and BLE
	Radio Frequency	Possess NZIF receiver with -98 dBm sensitivity
		Class-1, Class-2 and Class-3 launcher
		AFH
	Audio Frequency	CVSD and SBC audio frequency
Hardware	CPU	Xtensa® 32-bit LX6 dual-core processor, up to 600 DMIPS 448 KByte ROM 520 KByte SRAM RTC 16 KByte SRAM Up to four Flash /SRAM，each flash can have 16 Mbytes storage
	Interfaces	19GPIOs, 2 I2C, 2 SPI, 2 I2S, 3 Serial Port, 3 PWM, 16 ADC, 2 DAC, 19 External Interupts
	Onboard Sensors	Touch sensor, Hall sensor, Temperature sensor, Light Sensor
	Operating	-40°C~+85°C *
	Serial Chip	CP2104,USB transceiver; Driver-free for Windows7/8/10/Vista/XP/Server 2003/2000/Windows CE ®6.0,5.0 and 4.2.
	DC Payload	3.3V 800mA
Software	Wi-Fi mode	Station/softAP/SoftAP+station /P2P
	Security Mechanism	WPA / WPA2 / WPA2-Enterprise/WPS
	Encryption Type	AES/RSA/ECC/SHA
	Firmware Upgrade	UART download/OTA
	Software Development	Support cloud servicer-based development/SDK for firmware development
	Network Protocol	IPv4、IPv6、SSL、TCP/UDP /HTTP/FTP/MQTT
	User configuration	AT+ instruction set、Cloud servicer、Android/iOS APP
	Cloud Service	**IntoRobot-Cloud (www.intorobot.com)**

2.2 Pin Description

Chart 1：Hardware Architecture

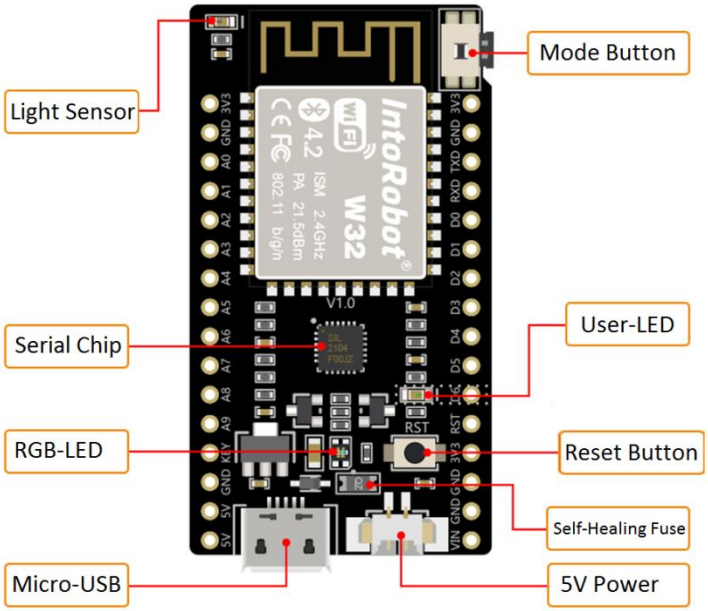

Chart 2：Pin Map

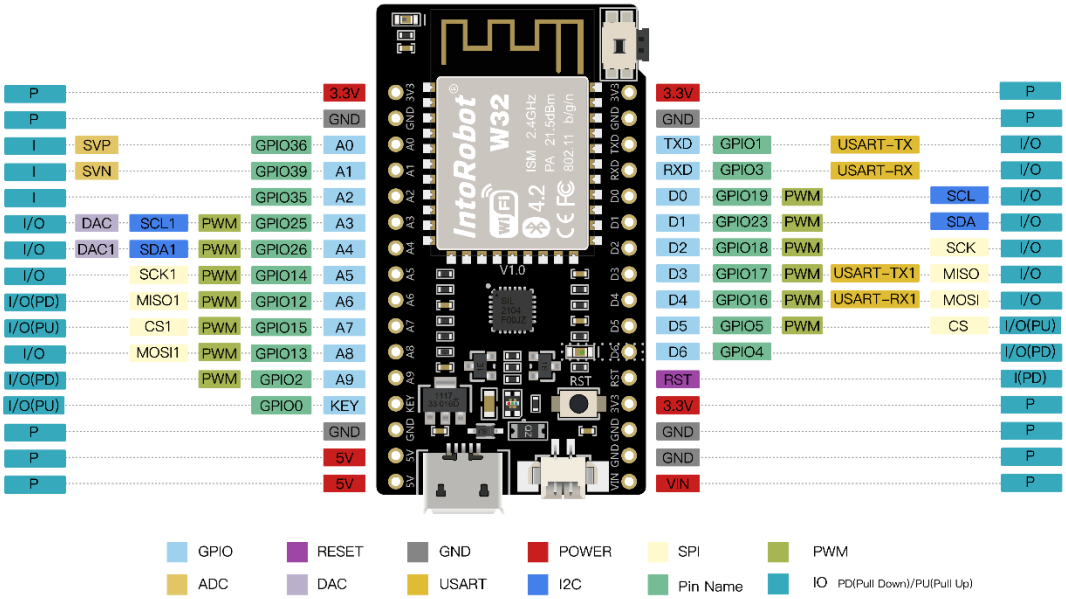

Chart 3：Pin Definition and Description

Pins	Names	Description
1	3V3	3.3V Power Input
2	GND	GND
3	A0	GPIO36, SENSOR_VP, ADC1_CH0, RTC_GPIO0
4	A1	GPIO39, SENSOR_VN, ADC1_CH3, RTC_GPIO3
5	A2	GPIO35, ADC2_CH7, RTC_GPIO5
6	A3	GPIO25, DAC_1, ADC2_CH8, RTC_GPIO6
7	A4	GPIO26, DAC_2, ADC2_CH9, RTC_GPIO7
8	A5	GPIO14, ADC2_CH6, TOUCH6, RTC_GPIO16, MTMS,HSPICLK
9	A6	GPIO12, ADC2_CH5, TOUCH5, RTC_GPIO15, MTDI,HSPIQ
10	A7	GPIO15, ADC2_CH3, TOUCH3, RTC_GPIO13, MTDO,HSPICS0, U0RTS
11	A8	GPIO13, ADC2_CH4, TOUCH4, RTC_GPIO14, MTCK,HSPID, U0CTS
12	A9	GPIO2, ADC2_CH2, TOUCH2, RTC_GPIO12, HSPIWP
13	KEY	GPIO0, ADC2_CH1, TOUCH1, RTC_GPIO11,CLK_OUT1
14	GND	GND
15	5V	5V Power Output
16	5V	5V Power Output
17	VIN	External 5V Power Input
18	GND	GND
19	GND	GND
20	3V3	3.3V Power Output
21	RST	ESP32 reset signal, HIGH active, LOW reset
22	D6	GPIO4, ADC2_CH0, TOUCH0, RTC_GPIO10, HSPIHD
23	D5	GPIO5, VSPICS0, HS1_DATA6
24	D4	GPIO16, HS1_DATA4
25	D3	GPIO17, HS1_DATA5
26	D2	GPIO18, VSPICLK, HS1_DATA7
27	D1	GPIO23
28	D0	GPIO19, VSPIQ, HS2_DATA2
29	RXD	GPIO3, U0RXD, CLK_OUT2, HS2_DATA0
30	TXD	GPIO1, U0TXD, CLK_OUT3, HS2_DATA1
31	GND	GND
32	3V3	3.3V Power Output

Chart 4： Interfaces

Interface	Signal	Pin	Function
ADC	ADC1_CH0	SENSOR_VP	Two 12-bit SAR ADCs
	ADC1_CH3	SENSOR_VN	
	ADC1_CH4	IO32	
	ADC1_CH5	IO33	
	ADC1_CH6	IO34	
	ADC1_CH7	IO35	
	ADC2_CH0	IO4	
	ADC2_CH1	IO0	
	ADC2_CH2	IO2	
	ADC2_CH3	IO15	
	ADC2_CH4	IO13	
	ADC2_CH5	IO12	
	ADC2_CH6	IO14	
	ADC2_CH7	IO27	
	ADC2_CH8	IO25	
	ADC2_CH9	IO26	
Ultralow Noise Pre-Amplifier	SENSOR_VP	IO36	Supply about 60 dB gain for ADC by implementing larger capacity on PCB
	SENSOR_VN	IO39	
DAC	DAC_1	IO25	Two 8-bit DACs
	DAC_2	IO26	
Touch Sensor	TOUCH0	IO4	Capacitive Touch Sensor
	TOUCH1	IO0	
	TOUCH2	IO2	
	TOUCH3	IO15	
	TOUCH4	IO13	
	TOUCH5	IO12	
	TOUCH6	IO14	
	TOUCH7	IO27	
	TOUCH8	IO33	
	TOUCH9	IO32	
SDSDIO / MMC Master Machine Controller	HS2_CLK	MTMS	SD card which satisfies V3.01 standard
	HS2_CMD	MTDO	
	HS2_DATA0	IO2	
	HS2_DATA1	IO4	
	HS2_DATA2	MTDI	
	HS2_DATA3	MTCK	

Interface	Signal	Pin	Function
Motor PWM	PWM0_OUT0~2	All GPIOs	Three 16-bit timers for PWM production ,and each timer produce a pair of PWM signals; Three fault detection signals; Three even capture signals; Three synchronous signals
	PWM1_OUT_IN0~2		
	PWM0_FLT_IN0~2		
	PWM1_FLT_IN0~2		
	PWM0_CAP_IN0~2		
	PWM1_CAP_IN0~2		
	PWM0_SYNC_IN0~2		
	PWM1_SYNC_IN0~2		
LED PWM	LEDC_HS_SIG_OUT0~7	All GPIOs	16 independent channels use 80 MHz-RTC clock. Bit of Duty of Cycle: 16-bit.
	LEDC_LS_SIG_OUT 0~7		
UART	U0RXD_in	All GPIOs	Two UART devices with DMA and hardware flow control
	U0CTS_in		
	U0DSR_in		
	U0TXD_out		
	U0RTS_out		
	U0DTR_out		
	U1RXD_in		
	U1CTS_in		
	U1TXD_out		
	U1RTS_out		
	U2RXD_in		
	U2CTS_in		
	U2TXD_out		
	U2RTS_out		
I2C	I2CEXT0_SCL_in	All GPIOs	Two I2C devices，work in master mode or in slavery mode
	I2CEXT0_SDA_in		
	I2CEXT1_SCL_in		
	I2CEXT1_SDA_in		
	I2CEXT0_SCL_out		
	I2CEXT0_SDA_out		
	I2CEXT1_SCL_out		
	I2CEXT1_SDA_out		

Interface	Signal	Pin	Function
I2S	I2S0I_DATA_in0~15	all GPIOs	For the input ,output of serial stereo data and the output of parallel LCD data
	I2S0O_BCK_in		
	I2S0O_WS_in		
	I2S0I_BCK_in		
	I2S0I_WS_in		
	I2S0I_H_SYNC		
	I2S0I_V_SYNC		
	I2S0I_H_ENABLE		
	I2S0O_BCK_out		
	I2S0O_WS_out		
	I2S0I_BCK_out		
	I2S0I_WS_out		
	I2S0O_DATA_out0~23		
	I2S1I_DATA_in0~15		
	I2S1O_BCK_in		
	I2S1O_WS_in		
	I2S1I_BCK_in		
	I2S1I_WS_in		
	I2S1I_H_SYNC		
	I2S1I_V_SYNC		
	I2S1I_H_ENABLE		
	I2S1O_BCK_out		
	I2S1O_WS_out		
	I2S1I_BCK_out		
	I2S1I_WS_out		
	I2S1O_DATA_out0~23		
IR remote control	RMT_SIG_IN0~7	all GPIOs	Eight IR Receivers/Launchers，support different waveform standards
	RMT_SIG_OUT0~7		

Interface	Signal	Pin	Function
Parallel QSPI	SPIHD	SHD/SD2	Support Standard SPI, Dual SPI and Quad SPI，can be connected to external Flash and SRAM
	SPIWP	SWP/SD3	
	SPICS0	SCS/CMD	
	SPICLK	SCK/CLK	
	SPIQ	SDO/SD0	
	SPID	SDI/SD1	
	HSPICLK	IO14	
	HSPICS0	IO15	
	HSPIQ	IO12	
	HSPID	IO13	
	HSPIHD	IO4	
	HSPIWP	IO2	
	VSPICLK	IO18	
	VSPICS0	IO5	
	VSPIQ	IO19	
	VSPID	IO23	
	VSPIHD	IO21	
	VSPIWP	IO22	
Universal SPI	HSPIQ_in/_out	all GPIOs	Standard SPI includes clocks, chip selection, MOSI and MISO. These SPI can be connected to LCD and other external devices. They have the following characteristics: (a) Master and slavery modes; (b) Four SPI transmission forms selection depending on polarity and phase; (c)Configurable CLK frequency; (d) 64-Byte FIFO and DMA.
	HSPID_in/_out		
	HSPICLK_in/_out		
	HSPI_CS0_in/_out		
	HSPI_CS1_out		
	HSPI_CS2_out		
	VSPIQ_in/_out		
	VSPID_in/_out		
	VSPICLK_in/_out		
	VSPI_CS0_in/_out		
	VSPI_CS1_out		
	VSPI_CS2_out		

Interface	Signal	Pin	Function
JTAG	MTDI	IO12	JTAG for software debug
	MTCK	IO13	
	MTMS	IO14	
	MTDO	IO15	
SDIO Slavery	SD_CLK	IO6	SDIO interface satisfies V2.0 standards
	SD_CMD	IO11	
	SD_DATA0	IO7	
	SD_DATA1	IO8	
	SD_DATA2	IO9	
	SD_DATA3	IO10	
EMAC	EMAC_TX_CLK	IO0	MAC Ethernet MAC with MII/RMII interface
	EMAC_RX_CLK	IO5	
	EMAC_TX_EN	IO21	
	EMAC_TXD0	IO19	
	EMAC_TXD1	IO22	
	EMAC_TXD2	IO14	
	EMAC_TXD3	IO12	
	EMAC_RX_ER	IO13	
	EMAC_RX_DV	IO27	
	EMAC_RXD0	IO25	
	EMAC_RXD1	IO26	
	EMAC_RXD2	TXD	
	EMAC_RXD3	IO15	
	EMAC_CLK_OUT	IO16	
	EMAC_CLK_OUT_180	IO17	
	EMAC_TX_ER	IO4	
	EMAC_MDC_out	Any GPIO	
	EMAC_MDI_in	Any GPIO	
	EMAC_MDO_out	Any GPIO	
	EMAC_CRS_out	Any GPIO	
	EMAC_COL_out	Any GPIO	

Remark: Any GPIO can be set for motor PWM, LED PWM, UART, I2C, I2S, universal SPI and IR remote controller.

3 Electrical Characteristics

Remark: The following test environment is VBAT = 3.3V, TA = 27°C if there is no special notifications.

3.1 Maximum Rating Values

Chart 5： Maximum Rating Value

Symbol	Condition	Min	Typ	Max	Unit
Output current	3.3V and 5V total output current	-	-	800	mA
Supply Voltage	I_{OUT}=300mA	4.5	5	6	V
	I_{OUT}=600mA	4.5	5	5.5	V

3.2 Recommended Working Conditions

Chart 6： Recommended Working Conditions

Parameter	Symbol	Min	Typ	Max	Unit
Operating Temperature	-	-40	20	85	°C
Storage Temperature	-	-40	20	125	°C

3.3 Digital Port Characteristics

Chart 7： Digital Port Characteristics

Ports	Typical Values	Minimum	Maximum	Unit
Input Low	V_{IL}	-0.3	0.25VDD	V
Input High	V_{IH}	0.75VDD	VDD+0.3	V
Output Low	V_{OL}	-	0.1VDD	V
Output High	V_{OH}	0.8VDD	-	V

3.4 Wi-Fi RF Characteristics

Chart 8： Wi-Fi RF Characteristics

Items	Minimum Values	Typical Values	Maximum Values	Unit
Input Frequency	2412	-	2484	MHz
Input Impedance	-	50	-	ohm
Input Reflection Value	-	-	-10	dB

PA Output Power	15.5	16.5	21.5	dBm
Receive Accuracy				
DSSS, 1 Mbps	-	-98	-	dBm
CCK, 11 Mbps	-	-90	-	dBm
OFDM, 6 Mbps	-	-93	-	dBm
OFDM, 54 Mbps	-	-75	-	dBm
HT20, MCS0	-	-93	-	dBm
HT20, MCS7	-	-73	-	dBm
HT40, MCS0	-	-90	-	dBm
HT40, MCS7	-	-70	-	dBm
MCS32	-	-91	-	dBm
Near Frequency Suppression				
OFDM, 6 Mbps	-	37	-	dB
OFDM, 54 Mbps	-	21	-	dB
HT20, MCS0	-	37	-	dB
HT20, MCS7	-	20	-	dB

3.5 Low-Energy-Consumption Bluetooth FR

3.5.1 Receiver

Chart 9： BLE Receiver Characteristics

Parameters	Conditions	Minimum	Typical	Maximum	Unit
	-	-	-98	-	dBm
Maximum Receive Signal @0.1% BER	-	0	-	-	dBm
co-channe C/I	-	-	+10	-	dB
Adjacent Channel C/I	F = F0 + 1 MHz	-	-5	-	dB
	F = F0 - 1 MHz	-	-5	-	dB
	F = F0 + 2 MHz	-	-25	-	dB
	F = F0 - 2 MHz	-	-35	-	dB
	F = F0 + 3 MHz	-	-25	-	dB
	F = F0 - 3 MHz	-	-45	-	dB
Anti Out-Of-Band Block Performance	30 MHz - 2000 MHz	-10	-	-	dBm
	2000 MHz - 2400	-27	-	-	dBm
	2500 MHz - 3000	-27	-	-	dBm
	3000 MHz - 12.5	-10	-	-	dBm
Intermodulation Performance	-	-36	-	-	dBm

3.5.2 Transmitter

Chart 10：BLE Transmitter Characteristics

Parameters	Conditions	Minimum	Typical	Maximum	Unit
RF Transmitter Power	-	-	+7.5	+10	dBm
RF Power Control Range	-	-	25	-	dB
Adjacent Channel Transmitter Power	F = F0 + 1 MHz	-	-14.6	-	dBm
	F = F0 - 1 MHz	-	-12.7	-	dBm
	F = F0 + 2 MHz	-	-44.3	-	dBm
	F = F0 - 2 MHz	-	-38.7	-	dBm
	F = F0 + 3 MHz	-	-49.2	-	dBm
	F = F0 - 3 MHz	-	-44.7	-	dBm
	F = F0 + > 3 MHz	-	-50	-	dBm
	F = F0 - > 3 MHz	-	-50	-	dBm
Δ f1avg	-	-	-	265	kHz
Δ f2max	-	247	-	-	kHz
Δ f2avg /Δ f1avg	-	-	-0.92	-	-
ICFT	-	-	-10	-	kHz
Frequency Drift ratio	-	-	0.7	-	kHz/50 μs
Frequency Drift	-	-	2	-	kHz

Chart 11：Operating Power Consumption

modes	Standards	Speed	Typical Values	Values
Tx	11b	1 Mbps	215	mA
		11 Mbps	197	
	11g	6 Mbps	197	
		54 Mbps	145	
	11n	MCS7	120	
Rx	All rates		56	mA

Remark: The transmission package contains 2014 bytes under RX mode.

3.5.3 Power Consumption

IntoRobot-Fig possesses advanced battery management technology and can switch among different power-save modes.

- Power-save mode

- Active mode: Chip RF is under the working state, and the chip can receive, transmit and detect signal;

- Modem-sleep mode: CPU keeps working, the clock can be configured, Wi-Fi/Bluetooth baseband and RF are turned off;

- Light-sleep mode: CPU is suspended, and RTC, ULP co-processor work. Any events (MAC, Master, RTC timer or External interrupt) can wake up the chip;

- Deep-sleep mode: Only RTC keeps working, the data of Wi-Fi and Bluetooth is stored in RTC. ULP co-processor keeps running;

- Hibernate mode: The internal 8-MHZ crystal oscillator and ULP co-processor are both prohibited, the RTC memory recycle power is cut off. Only an RTC timer on the slow clock and some RTC GPIO are activated, so RTC timer, and RTC GPIO can wake up the chip from hibernate mode.

- Sleep mode

- Associated sleep mode: The power-save mode can switch among active mode, modem-sleep mode, light-sleep mode. CPU, Wi-Fi, Bluetooth, and RF can wake up periodically according to the pre-set mode so that Wi-Fi/Bluetooth connection can be guaranteed.

- The detection method of ultraslow-power-consumption sensor: The main processor is under the Deep-sleep mode, and ULP co-processor is turned on, turned off periodically to measure the sensor data, according to which ULP co-processor determines whether to wake up the main CPU or not.

Specifically, the power consumption depends on whether the chip runs under the power-save mode or sleep mode. Besides these, the working states of functional modules also can influence power consumption.

Chart 12： Power Consumption Under Different power-Save Modes

Power-Save Modes	Description	Power Consumption
Active(RF works)	Wi-Fi Tx packet 13 dBm~21 dBm	160~260 mA
	Wi-Fi /BT Tx packet 0 dBm	120 mA
	Wi-Fi /BT Rx and intercept	80~90 mA
	Associated sleep mode(Associated with Light-sleep)	0.9 mA@DTIM3, 1.2 mA@DTIM1
Modem-sleep	CPU works	Maximum speed: 20 mA
		Normal speed: 5~10 mA
		Minimum speed: 3 mA
Light-sleep	-	0.8 mA
Deep-sleep	ULP co-processor works	0.5 mA
	Monitoring with ultra-low energy	25 μA @1% duty
	RTC timer+ RTC storage	20 μA
Hibernate	Only RTC timer runs	2.5 μA

4 Board Size

4.1 Board Size

Chart 13： Board Size (Top View, Unit: mm)