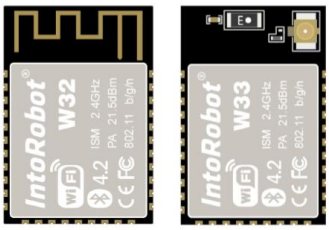
IntoRobot

W32/W33 Datasheet



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Category

Chart Category

1 Overview

1.1 Product Description

IntoRobot-W32/ IntoRobot-W33 (W32/W33, for short) is the new Wi-Fi Bluetooth dual module which integrates conventional Bluetooth, low-power-consumption Bluetooth and Wi-Fi. So it can be applied to broad situations, especially to those sensor networks which require low energy consumption such as speech encoding, audio stream, and MP3 decoding. W32/w33 has the following characteristics: a. W32/W33 serials provide several antenna forms. For instance, W32 provides onboard PCB antenna; W33 provides onboard ceramic antenna and IPEX socket. b. W32/W33 can meet the standards of Wi-Fi 802.11b/g/n/e/I and Bluetooth 4.2 completely. c. The operating system of W32/W33 is freeRTOS with LWIP. d. The chips support OTA upgrade with encryption, so developers can update the products even if they are released. e. W32/W33 is compatible with Arduino programming and integrates IntoRobot cloud platform, which means the programming work can be decreased dramatically so the product development cycle can also be reduced. f. most creative ideas can be achieved when W32 is combined with IntoRobot and IntoRobotAPP. In detail, W32 can be accessed to the internet via Imlink to reach different kinds of internet control. g. The flexible structures of RAM/ROM of W32/W33 allow users to change the configuration to satisfy some special requirements. h. W32/W33 can be used in both master mode and slavery mode.

ESP32 chip, the core of W32/W33, is a type of SoC which combines both Wi-Fi and Bluetooth, has the advantages of extensibility and self-adaption. In details, ESP32 chip has two 32-bite CPUs which can be controlled independently; adopts a seven-class pipeline architecture; main frequency ranges from 80MHZ to 240MHZ. To save energy, users can cut off the CPU power and use low-power-consumption processor to monitor external devices' state changes or detect whether some analog quantities exceed their thresholds continuously; EPS32 has a complete structure to launch/receive radio frequency, which includes RF balun, power amplifier, low noise amplifier, filter, power management module and advanced auto calibration circuit.; Besides, ESP32 also has abundant external devices such as capacitive touch sensor, hall sensor, an interface for SD card, an interface for Ethernet network, high-speed SDIO/SPI, UART, I2S, and I2C.

W32/W33 Wi-Fi 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 W32/W33 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;
- Intelligent home appliances;
- Intelligent 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.
- 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
	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	SD card、UART、SPI、SDIO、I2C、LED PWM、Motor PWM、I2S、I2C、IR
		GPIO、Capacitive touch sensor、ADC、DACLNA pre-amplifier
	Onboard Sensors	Hall sensor、Temperature sensor
	Onboard Clock	26 MHz Crystal Oscillator、32 kHz Crystal Oscillator
	Operating Voltage	2.2 ~ 3.6V
	Operating Current	80 mA on the average
	Operating	-40°C ~ +85°C *
	Environment	Normal temperature
	Package Size	18 mm x 20 mm x 3 mm
Software	Wi-Fi mode	Station／softAP／SoftAP+station ／P2P
	Security	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 platform(www.intorobot.com/)

2 Pin Description

2.1 Pin Definition

Chart 2： Pin Block Diagram (Front View)

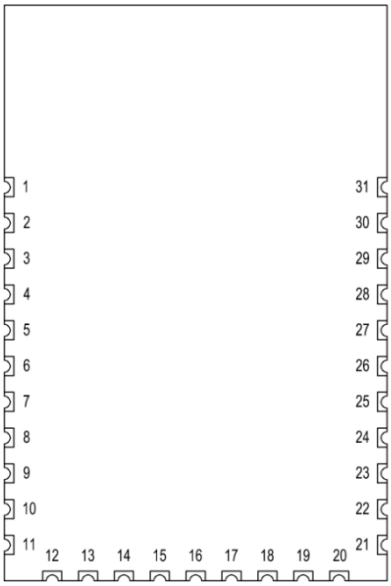

Chart 3： Pin Definition and Description

Pins	Names	Descriptions
1	GND	Ground
2	EN	Enable signal
3	SVP	SENSOR_VP, GPIO36, ADC1_CH0, RTC_GPIO0
4	SVN	SENSOR_VN, GPIO39, ADC1_CH3, RTC_GPIO3
5	GPIO34	GPIO34, ADC1_CH6, RTC_GPIO4
6	GPIO35	GPIO35, ADC2_CH7, RTC_GPIO5
7	GPIO32	GPIO32, 32K_XP, (Crystal Oscillator Input; 32.768 kHz)，ADC1_CH4, TOUCH9, RTC_GPIO9
8	GPIO33	GPIO33, 32K_XN，(Crystal Oscillator Input;32.768 kHz)，ADC1_CH5, TOUCH8, RTC_GPIO8
9	GPIO25	GPIO25, DAC_1, ADC2_CH8, RTC_GPIO6
10	GPIO26	GPIO26, DAC_2, ADC2_CH9, RTC_GPIO7
11	GPIO27	GPIO27, ADC2_CH7, TOUCH7, RTC_GPIO17
12	GPIO14	GPIO14, ADC2_CH6, TOUCH6, RTC_GPIO16, MTMS,HSPICLK
13	GPIO12	GPIO12, ADC2_CH5, TOUCH5, RTC_GPIO15, MTDI,HSPIQ
14	GPIO13	GPIO13, ADC2_CH4, TOUCH4, RTC_GPIO14, MTCK,HSPID, U0CTS
15	GPIO15	GPIO15, ADC2_CH3, TOUCH3, RTC_GPIO13, MTDO,HSPICS0, U0RTS
16	GND	Ground
17	GPIO2	GPIO2, ADC2_CH2, TOUCH2, RTC_GPIO12, HSPIWP
18	GPIO0	GPIO0, ADC2_CH1, TOUCH1, RTC_GPIO11,CLK_OUT1
19	GPIO4	GPIO4, ADC2_CH0, TOUCH0, RTC_GPIO10, HSPIHD

20	GPIO16	GPIO16, HS1_DATA4
21	3V3	3.3V Power Supply
22	GPIO17	GPIO17, HS1_DATA5
23	GPIO5	GPIO5, VSPICS0, HS1_DATA6
24	GPIO18	GPIO18, VSPICLK, HS1_DATA7
25	GPIO23	GPIO23
26	GPIO19	GPIO19, VSPIQ, HS2_DATA2
27	GPIO22	GPIO22, VSPIWP, HS2_CLK
28	RXD	U0RXD, GPIO3, CLK_OUT2, HS2_DATA0
29	TXD	U0TXD, GPIO1, CLK_OUT3, HS2_DATA1
30	GPIO21	GPIO21, VSPIHD, HS2_CMD
31	GND	Ground

2.2 Stapping Pins

There are six strapping pins in total, and the values of them can be read out from the register GPIO_STRAPPING. During the start and reset stage, the strapping pins' electric levels are sampled and stored in a latch and the values will be kept until the chip is powered off.

Each Strapping pin is pulled up/ down internally, so the internal weak pull-up/down will determine the Strapping pins' values if they are not connected or the external circuit which they are connected to are in high-impedance states.

To change the values of Strapping pins, users can apply external pulled-up/down resistors or utilize MCU' GPIO to control the Strapping pins' values when ESP chip is started or reset.

Chart 4： Strapping Pins

Internal LDO (VDD_SDIO) Voltage			
Pins	Default	3.3V	1.8V
MTDI	Pull down	0	1
System Start-up Mode			
Pins	Default	SPI Flash Start-Up Mode	Download Satrt-Up Mode
GPIO0	Pull-Up	1	0
GPIO2	Pull-Down	Irrelevant Terms	0
U0TXD Prints Log Information During System Start-Up Stage			
Pins	Default	U0TXD Overturn	U0TXD Remains Static
MTDO	Pull-Up	1	0

SDIO Input/Output Time Series of Slavary Machine Signal					
Pins	Default	Falling-Edge Input Falling-Edge Output	Falling-Edge Input Rising-Edge Output	Rising-Edge Intput Falling-Edge Output	Rising-Edge Intput Rising-Edge Output
MTDO	Pull-Up	0	0	1	1
GPIO5	Pull-Up	0	1	0	1

Remark: Firmware can change the internal LDO (VDD_SDIO) voltage and SDIO Input/Output Time Series of Slavary Machine Signal by setting some registers.

2.3 External Device Interfaces

Chart 5：External Device 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 depeding 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 Ethenet 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_1	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 Function Description

This chapter describes the detailed functions of W32/W33.

3.1 CPU and RAM

There are two internal low-energy-consumption Xtensa® 32-bit LX6 MCU in W32/W33. On-chip memories mainly includes:

- 448-KBytes ROM for starting program and calling kernel functions;
- 520-KBytes SRAM for data and command storage;
- 8-KBytes SRAM in RTC(slow-speed memory of RTC) can be visited by co-processor under the deep-sleep mode;
- 8-KBytes SRAM in RTC(fast-speed memory of RTC) can be used to store data and be visited by master CPU when RTC is started under the deep-sleep mode;
- 1-Kbytes EFUSE among which 256 bits are only available for system(MAC address and chip configuration), the rest 768 bits are reserved for user applications(flash encryption and chip ID)

3.2 External Flash and SRAM

EPS32 can support four 16-Mbytes external QSPI flash and SRAM at most and has AES based hardware encryption function which can protect developers' programs and data.

- ESP32 can visit external QSPI Flash and SRAM via high-speed buffer. The external Flash which is up to 18 Mbytes can be mapped to CPU program space and can be visited, executed by 8-bit, 16-bit and 32-bit method.
- Flash can only be read, however, SRAM can be read and written.

3.3 Crystal Oscillator

The chip is compatible with 40MHZ, 26MHZ and 24MHZ crystal oscillator. The accuracy of the crystal Oscillators is between 10PPM and -10PPM; the working temperature is between -40°C and 85°C.

The type of crystal oscillator should be chosen correctly when a programmer is used. Tuning capacities C1 and C2 are added to the input port and output port of crystal oscillator respectively. The values of the two capacities can be set very flexibly and the range can be from 6 pf to 22 pf. However, the values of capacities have to be matched with the frequency of the crystal oscillator. The values of C1 and C2 are less than 10pf if the frequency of the crystal oscillator is 26MHZ; the

values of C1 and C2 are larger than 10pf and less than 22pf if the frequency of the crystal oscillator is 40MHZ.

The frequency of RTC crystal oscillator is 32KHZ or 32.768KHZ. The frequency drifts maybe more than ±20 PPM because of the usage of internal calibration circuit. The device should choose external low-speed 32KHZ crystal oscillator clock rather than internal RC oscillator to acquire accurate wake-up time when the chip works under low-energy-consumption mode.

4 Electrical Characteristics

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

4.1 Maximum Rating Values

Chart 6： Maximum Rating Values

Items	Conditions	Values	Unit
Storage Temperature	/	-40 to 125	°C
Supply Voltage	IPC/JEDEC J-STD-020	+3.0 to +3.6	V

4.2 Recommended Working Conditions

Chart 7： Recommended Working Conditions

Items	Conditions	Values	Unit
Storage Temperature	/	-40 to 125	°C
Supply Voltage	IPC/JEDEC J-STD-020	+3.0 to +3.6	V

4.3 Digital Port Characteristics

Chart 8： 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

4.4 Wi-Fi RF Characteristics

Chart 9： 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

4.5 Low-Energy-Consumption Bluetooth FR

4.5.1 Receiver

Chart 10： BLE Receiver Characteristics

Parameters	Conditions	Minimum	Typical	Maximum Values	Unit
灵敏度@0.1% BER	-	-	-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 GHz	-10	-	-	dBm
Intermodulation	-	-36	-	-	dBm

4.5.2 Transmitter

Chart 11：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 12：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.

4.6 Power Consumption

W32 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 13： 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	2.5μA

5 Mechanical Characteristics

5.1 Recommended Temperature of SMT

Chart 14： Recommended Temperature of SMT

Temperature increases from TS to TL	Maximum value 3℃/s
Warm-up Minimum temperature (TS Min.) Typical temperature (TS Typ.) Maximum temperature (TS Max.) Time(TS)	150℃ 175℃ 200℃ 60~180 seconds
Temperature increases from TL to TP	Maximum value 3℃/s
Temperature(TL)/Duration period	217℃/60~150 seconds
Peak temperature (TP)	Maximum value 260℃， duration period 10 ″
Target temperature	260℃+0/-5℃
Real peak temperature (TP) 5℃ duration period	20~40 ″
Temperature decreases	Maximum value 6℃/s
The time that Temperature increases from 25℃ to peak value(t)	8 minutes at most

5.2 Module Weight

Chart 15： Module Weight

Module Type	Weight
IntoRobot_W32	1.6 g
IntoRobot_W33	1.8 g

5.3 Module Size

Chart 16： Fig.1-Module Size (Top View, Unit: mm)

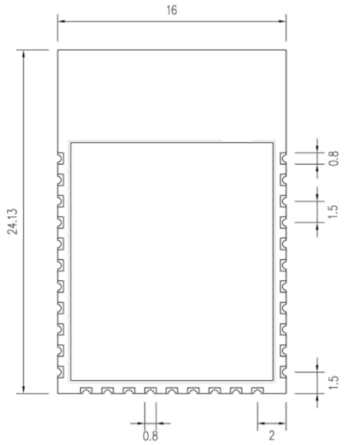

Chart 17： Fig.2-Module Size (Top View, Unit: mm)

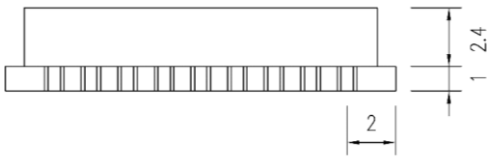

Chart 18： Fig.3-Recommended PCB Layout (Top View, Unit: mm)

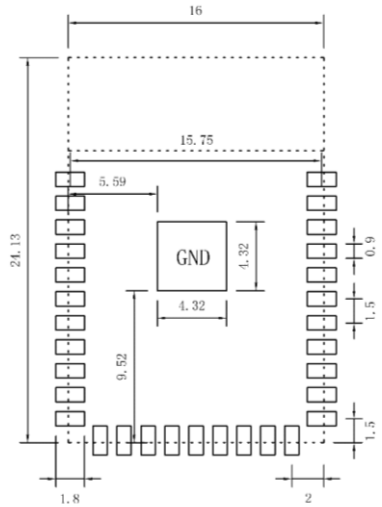

Chart 19： Fig.4-Module Layout Scheme 1(antenna is out of the frame, Unit: mm)

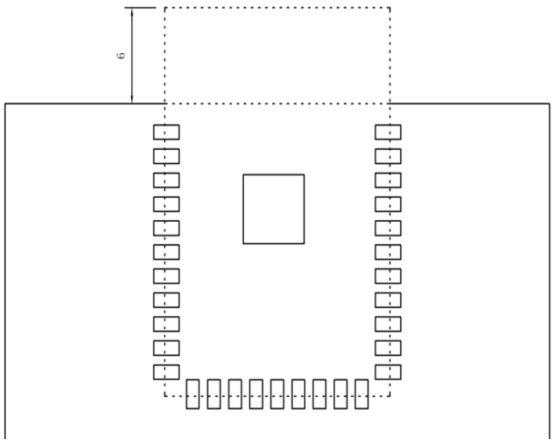

Chart 20： Fig.5-Module Layout Scheme 2(antenna is placed at the board side and the corresponding place is excluded, Unit: mm)

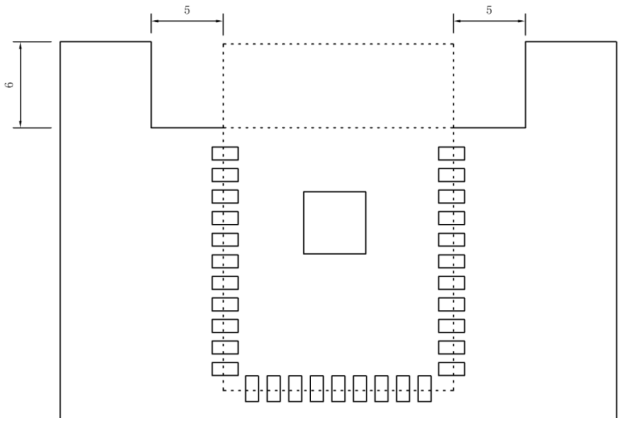

Chart 21： Fig.6-Module Layout Scheme 3 (antenna is placed at the board side and the corresponding below layers are not covered by copper, Unit: mm)

The performances of the module layout scheme 1, 2 are close to that of recommended layout scheme. Scheme 3 is recommended if the antenna has to be placed on the base board ,however, the corresponding RF performance will be damaged slightly.

6 Hardware Schematics

6.1 Hardware Schematics

Chart 22：Hardware Schematics