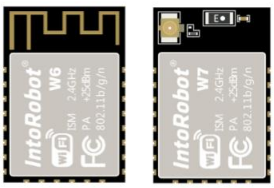
IntoRobot

W6/W7 Datasheet



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Category

Chart Category

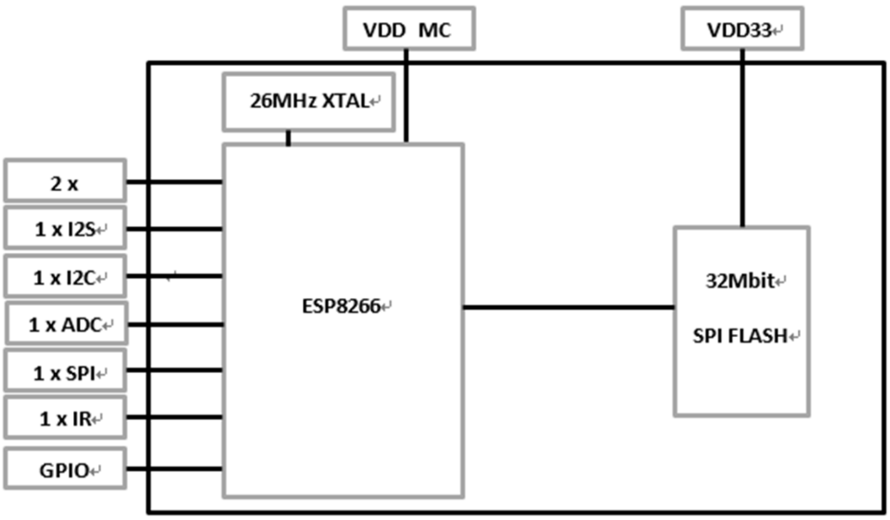
1 Overview

1.1 Product Description

The IntoRobot-W6/IntoRobot-W7 (W6/W7 in brief hereafter) are WiFi modules developed by MOLMC Co., Ltd. W6/W7 integrates WiFi MAC/BB/RF/PA/LNA with on-board antenna, supporting standard IEEE802.11 b/g/n agreement and complete TCP/IP protocol stack. They can be used not only as a WiFi module to connect a device to the Cloud, but also as a separate device with powerful computation and remote-control abilities. W6/W7 is compatible with Arduino programming manner, and is internally integrated with ImLink configuration and IntoRobot-Cloud connection firmware. W6/W7, 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.

W6/W7 offers a complete and self-contained WiFi networking solution; it can be used to host independent applications, or offer WiFi networking ability for other MCU-integrated applications. When hosting independent applications, W6/W7 boots up directly from an external flash; the flash is acting as an integrated cache to improve the system performance. Alternately, serving as a WiFi adapter, the module can be easily connected to any MCU-integrated device through simple interfaces like SPI, SDIO, I2C or UART.

Chart 1：IntoRobot-W6/W7 block diagram



As shown in Figure 1, the core chip of W6/W7 is the ESP8266EX, a SOC system with high performance, providing embedded WiFi capability for other systems that require low cost and small size. ESP8266EX is the industry-leading ultra-low power 32-bit MCU Tensilica L106 in small package. ESP8266EX, with either 32-bit normal mode or 16-bit simplified mode, supports real time operating system RTOS at two different clock speeds, i.e., 80 MHz and 160 MHz, respectively. ESP8266EX provides powerful onboard computation ability and large storage space, and also offers several GPIOs for external sensors or other devices; lots of examples and open source codes are given in IntoRobot-Cloud. W6/W7 is one of the most integrated WiFi module in industrial applications, already integrating antenna switches, RF balun, power amplifier, low noise receive amplifier, filters, and power management modules. And thus it requires very few external circuitry and very small PCB size for practical applications.

The typical features of W6/W7 include fast sleep/wake modes switching for energy-efficiency, adaptive radio biasing for low-power operation, front-end signal processing, and troubleshooting or radio co-existence features for the interferences from other modules like Bluetooth, DDR, LVDS, or LCD.

1.2 Specification

Chart 2：Specification

Product Name	IntoRobot-W6/W7		
Cloud Service	IntoRobot-Cloud (www.intorobot.com)		
CPU	1. ESP8266EX CPU: Tensilica L106 32 bit@80MHz, max:160MHz External Flash: 4M RAM: 50KB		
GPIO	16	Serial Port	1
I2C	1	PWM	4
SPI	1	A/D Port	1
I2S	1	External Interrupt	16
WiFi	RF range: 2.4~2.5G（2400M-2483.5M）; WiFi 802.11 b/g/n; WIFI @2.4 GHz; support WPA/WPA2 safe mode; Integrated TR switch, balun, LNA, power amplifier and matching network; Integrated PLL, Regulator and Power manager, +20dBm output power in 802.11b mode; Support STA/AP/STA+AP; Integrated 10-bit ADC; Integrated TCP/IP protocol stack; Support ImLink（Android and iOS）; Deep sleep power consumption <10uA, shutdown current < 5uA; Wake up time < 2ms; Standby power consumption < 1.0mW (DTIM3)		

Note: ImLink is a technology for fast WiFi configuration provided by IntoRobot.

2 Pin Description

2.1 Pin Definition

Chart 3：Pin Block Diagram (Front View)

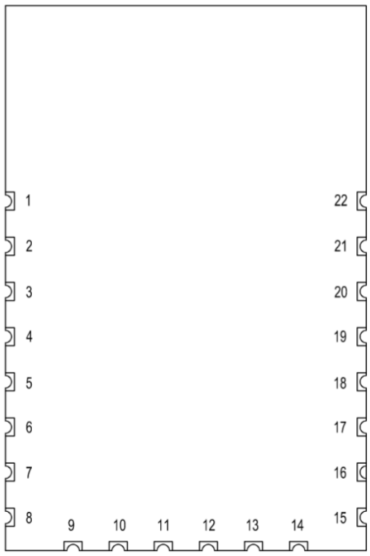


Chart 4：Pin Definition

Pin No.	Symbol	Functions
1	RST	Reset the module, LOW Active
2	ADC	A/D Conversion. Input voltage range 0-1v, scope value: 0-1024
3	EN	Chip enable pin. Active HIGH
4	GPIO16	If connected to RST, can be used to wake up the chipset from deep sleep mode
5	GPIO14	HSPI_CLK
6	GPIO12	HSPI_MISO
7	GPIO13	HSPI_MOSI; UART0_CTS
8	VCC	3.3V power supply (VDD)
9	CS0	Chip selection
10	MISO	Master input ,slave output
11	GPIO9	GPIO9
12	GPIO10	GPIO10
13	MOSI	Master output , slave input
14	SCLK	SPI Clock
15	GND	GND

16	GPIO15	MTDO; HSPICS; UART0_RTS
17	GPIO2	UART1_TXD (UART1 features only Tx)
18	GPIO0	GPIO0
19	GPIO4	GPIO4
20	GPIO5	GPIO5
21	RXD	UART0_RXD; GPIO3
22	TXD	UART0_TXD; GPIO1

2.2 Stapping Pins

Chart 5： Pin mode

Mode	GPIO15	GPIO0	GPIO2
UART Download	Low	Low	High
Flash Boot	Low	High	High

2.3 Interface Function

Chart 6： Interface function

Interface	Pin Name	Description
HSPI	GPIO13 (SPI_MOSI), GPIO12 (SPI_MISO), GPIO14 (SPI_SCK), GPIO15 (SPI_CS)	Connection for SPI Flash, display screen, or MCU.
PWM	GPIO4, GPIO14, GPIO12, GPIO15	PWM interface can be used to control LED lights, buzzers, relays, electronic machines, and so on.
ADC	A0	A/D input signal. Input voltage range of 0 ~ 3V, 1: 3 converted to ESP8266; Output scope: 0 to 1024.
I2C	GPIO2(I2C-SCL), GPIO4(I2C-SDA)	I2C interface can be used to connect different modules, like sensors, display screens, and MCUs, etc.
USART	GPIO1(UART-TXD), GPIO3(UART-RXD)	Used for external sensors connection, or serial debugging through TTL serial connection to PC.
I2S	GPIO3(I2SO-DATA), GPIO2(I2SO-WS) , GPIO14(I2SI-WS) , GPIO12(I2SI-DATA) , GPIO13(I2SI-BCK) , GPIO15(I2SO-BCK)	Mainly used for sensors with I2S interface.

3 Function Description

This chapter describes the detailed functions of W32/W33.

3.1 MPU

ESP8266EX integrates Tensilica L106 32-bit micro controller (MCU) and ultra-low-power 16-bit RSIC. The CPU clock speed is 80 MHz, and can also reach 160 MHz maximum. It supports Real Time Operation System (RTOS). Currently, the Wi-Fi stack occupies only 20% of MIPS, where the rest can all be used for user application. The CPU includes the interfaces as below.

• Programmable RAM/ROM interfaces (iBus), which have been connected with memory controller, and can also be used to visit flash.

• Data RAM interface (dBus), which can be connected with memory controller.

• AHB interface, which can be used to visit the register.

3.2 Memory and Flash

3.2.1 Internal SRAM and ROM

ESP8266EX integrates memory controller and memory units including SRAM and ROM. The MCU can access the memory units through iBus, dBus, and AHB interfaces. All memory units can be accessed upon request, while a memory arbiter will decide the running sequence according to the time when these requests are received by the processor. According to our current SDK, SRAM space available to users is assigned as below.

• RAM size < 36 kB, that is, when ESP8266EX is working under the station mode and connects to the router, programmable space accessible in heap + data section is around 36kB.

• There is no programmable ROM in the SoC, and therefore, user program must be stored in an external SPI flash.

3.2.2 SPI Flash

ESP8266EX uses external SPI flash to store user programs, and supports up to 16 Mbytes memory capacity theoretically. A 4MB SPI Flash is currently connected to W6/W7. ESP8266EX supports the standard SPI, dual SPI, DIO SPI, QIO SPI, and QuadSPI. W6/W7 uses QuadSPI mode, and thus the corresponding mode should be selected in the download tool, otherwise it can’t be able to download the firmware successfully.

3.3 Crystal

The high frequency clock on ESP8266EX is used to drive both transmit and receive mixers. This clock is generated from internal crystal oscillator and external crystal. The crystal frequency ranges from 26 MHz to 52 MHz. The internal calibration inside the crystal oscillator ensures that a wide range of crystals can be used, nevertheless the quality of the crystal is still a factor to consider to have reasonable phase noise and good Wi-Fi sensitivity.

W6/W7 uses the 26MHz crystal, and the corresponding frequency should be selected in the download tools. The parallel resonant crystal's external load capacitance could be at range of 6pF-22pF; the actual value should be determined based on practical system test. Now W6/W7 uses 10pF.

4 Electrical Characteristics

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

4.1 Rating Values

Chart 7： 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 8： Recommended Working Conditions

Parameter	Symbol	Min	Typ	Max	Unit
Operating Temperature	-	-40	20	85	°C
Supply Voltage	VDD	3.0	3.3	3.6	V

4.3 I/O Port Characteristics

Chart 9：I/O 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

Note: Test conditions: VDD = 3.3V, Temperature = 20°C.

4.4 RF Performance

Chart 10：RF performance

Parameter	Min	Typ	Max	Unit
Input frequency	2400	-	2483.5	MHz
Input impedance	-	50	-	ohm
Input reflection	-	-	-10	dB
Output power of PA for 72.2mbps	15.5	16.5	17.5	dBm
Output power of PA for 11b mode	19.5	20.5	21.5	dBm
Sensitivity				
CCK, 1 Mbps	-	-98	-	dBm
CCK, 11 Mbps	-	-91	-	dBm
6 Mbps (1/2 BPSK)	-	-93	-	dBm
54 Mbps (3/4 64-QAM)	-	-75	-	dBm
HT20, MCS7 (65 Mbps, 72.2 Mbps)	-	-72	-	dBm
Adjacent channel suppression				
OFDM, 6 Mbps	-	37	-	dB
OFDM, 54 Mbps	-	21	-	dB
HT20, MCS0	-	37	-	dB
HT20, MCS7	-	20	-	dB

4.5 WIFI Power Consumption

4.5.1 WIFI Power Consumption

Chart 11: Operating consumption

Item	Conditions	Rate	Typ	Unit
Tx	11b	1 Mbps	215	mA
	-	11 Mbps	197	
	11g	6 Mbps	197	
	-	54 Mbps	145	
	11n	MCS7	120	
Rx	All rates		56	mA

4.5.2 Standby Power Consumption

Chart 12: WiFi standby power consumption

Conditions	Mode	Typ				
Standby	Modem Sleep①	15mA				
	Light Sleep②	0.9mA				
	Deep Sleep③	20uA				
	Off	0.5uA				
Power Save Mode (2.4G) (Low Power Listen disabled)	DTIM period	Current Cons. (mA)	T1 (ms)	T2 (ms)	Tbeacon (ms)	T3 (ms)
	DTIM 1	1.2	2.01	0.36	0.99	0.39
	DTIM 3	0.9	1.99	0.32	1.06	0.41

Note ①: Modem-Sleep is used for applications like PWM output or I2S communication that require CPU be working. According to the 802.11 standard (such as U-APSD), the WiFi modem can be turned off to save power while keeping WiFi connection at the same time, if no data is transmitted. For example, in DTIM3 mode, the module can wake up for 3ms per 300mS to receive the Beacon packets from AP; the average current is only about 15mA.

Note ②: Light-Sleep is used for applications like WiFi switch where CPU can be suspended. According to the 802.11 standard (such as U-APSD), the WiFi modem can be turned off to save power and keep WiFi connection at the same time, if no data is transmitted. For example, in DTIM3 mode, the module can wake up for 3ms per 300mS to receive the Beacon packets from AP; the average current is only about 0.9mA.

Note ③: Deep-sleep is used for applications where the WiFi connection is only needed once within a long time to transmit a small data packet; for example, the temperature is measured once every 100 seconds. And it only needs to wake up for about 0.3s-1s per 300s, connect to the AP and then send out the measurements; the average current is much less than 1 mA.

Above consumption data is measured where all the transmit data is of 90% duty ratio in continuous transmission tests, at conditions of 3.3V power supply and the 25°C ambient temperature.

4.6 RF Characteristics

4.6.1 RF wireless LAN Configuration and General Specifications

Chart 13： RF wireless LAN configuration and general specifications

Parameter	Specification		Unit
Country/Domain Code	Reserved		-
Center Frequency	11b	2.412-2.472	GHz
	11g	2.412-2.472	GHz
	11n HT20	2.412-2.472	GHz
Rate	11b	1, 2, 5.5, 11	Mbps
	11g	6, 9, 12, 18, 24, 36, 48, 54	Mbps
	11n 1stream	MCS0, 1, 2, 3, 4, 5, 6, 7	Mbps
Modulation type	11b	DSSS	-
	11g/n	OFDM	-

4.6.2 RF Emission Characteristics

Chart 14： Reception characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Frx	Input Frequency	-	2.412	-	2.484	GHz
Srf	Sensitivity					
	DSSS	1 Mbps	-	-98	-	dBm
		11 Mbps	-	-91	-	dBm
	OFDM	6 Mbps	-	-93	-	dBm
		54 Mbps	-	-75	-	dBm
	HT20	MCS7	-	-71	-	dBm

4.6.3 RF Emission Characteristics

Chart 15： Reception characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Frx	Input Frequency	-	2.412	-	2.484	GHz
Srf	Sensitivity					
	DSSS	1 Mbps	-	-98	-	dBm
		11 Mbps	-	-91	-	dBm
	OFDM	6 Mbps	-	-93	-	dBm
		54 Mbps	-	-75	-	dBm
	HT20	MCS7	-	-71	-	dBm

5 Mechanical Specification

5.1 SMT Operating Conditions

Chart 16： Recommended Temperature of SMT

Profile Feature	Sn-Free Electric Assembly
Average ramp-up rate (TL-TP)	3°C /second max
Preheat -Temperature Min. (Tsmin) -Temperature Typ. (Tstyp) -Temperature Max. (Tsmax)	60~180 seconds 150°C 175°C 200°C
Tsmax to TL -Ramp-up Rate	3°C /second
Time maintained above TL	217°C /60~150 seconds
Peak Temperature (TP)	260°C +0/-5°C for 10 seconds
Time within 5°C of Actual Peak Temperature (TP)	20~40 seconds
Ramp-down Rate	6°C /second max
Time 25°C to Peak Temperature	8 minutes max

5.2 Module Weight

Chart 17： Module Weight

Module	Weight
IntoRobot_W6	1.5 g
IntoRobot_W7	1.7 g

5.3 Dimensions

Chart 18： Fig.1- Board dimensions: Top view (Units: mm)

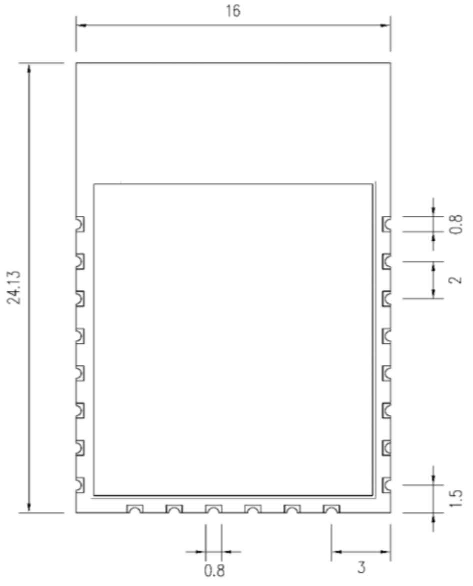


Chart 19： Fig.2- Board dimensions: Side view (Units: mm)

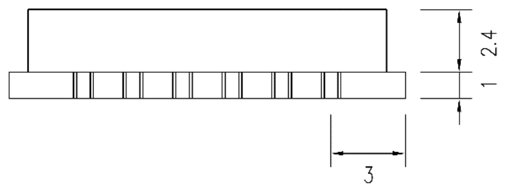


Chart 20： Fig.3- Board dimensions: Side view (Units: mm)

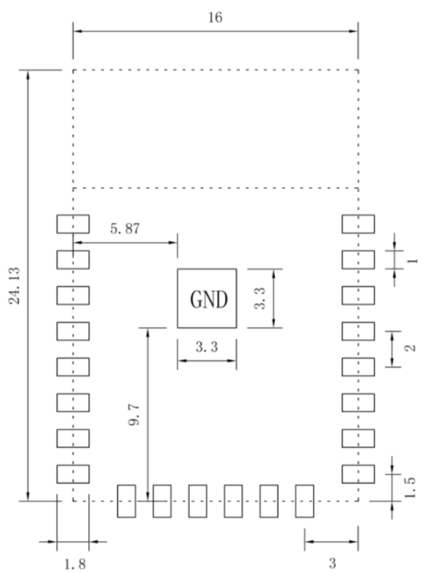


Chart 21： Fig.4-Recommended PCB packaging: Top view (Units: mm)

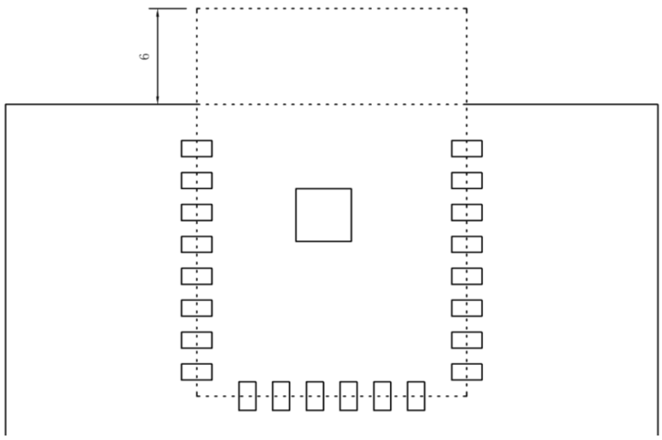


Chart 22： Fig.5-Module layout solution 1: the antenna is outside the board. (Units: mm)

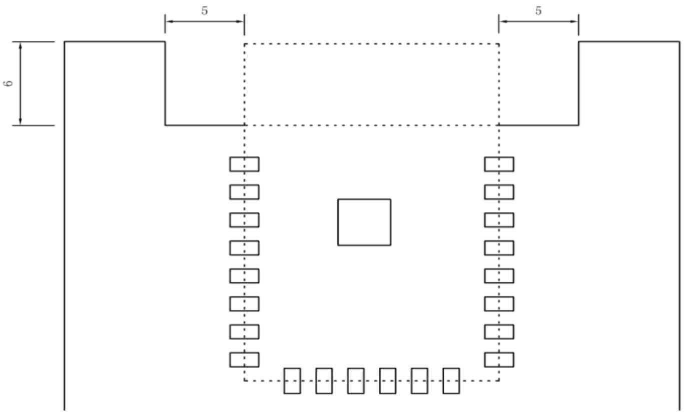


Chart 23： Fig.6-Module layout solution 2: the antenna is at the hollowed out edge. (Units: mm)

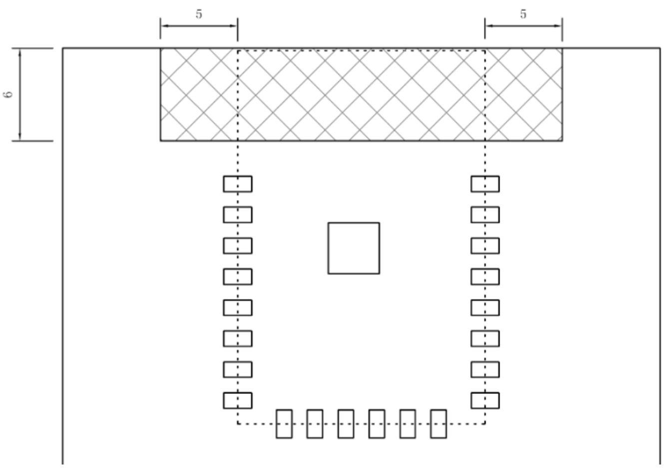
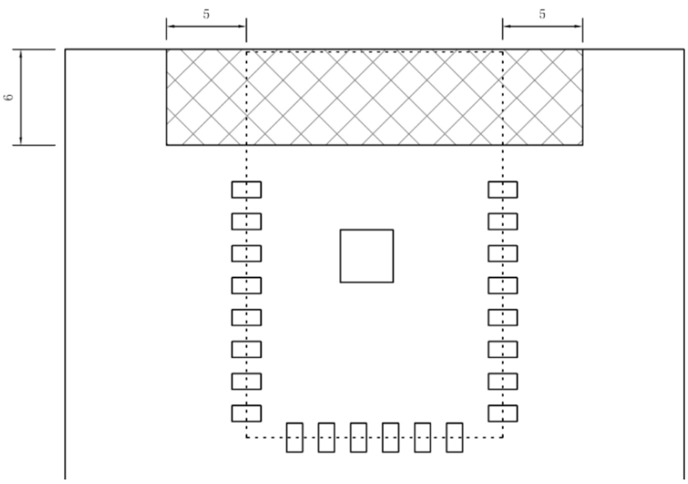


Chart 24： Fig.7- Module layout solution 3: the antenna is at the board edge without any copper plate or lines. (Units: mm)



Note: Module layout solutions 1 and 2 are recommended. If the design is limited in space or cost, solution 3 can be used but with a slight loss of the RF performance.

6 Schematics

6.1 Schematics

Chart 25： Schematics of IntoRobot-ESP8266MOD