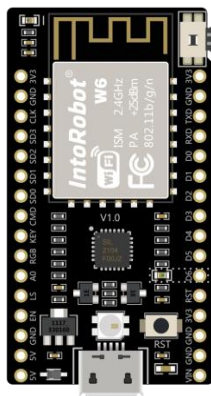


# ***IntoRobot*** **Nut Datasheet**



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## 1 Overview

IntoRobot-Nut, a highly integrated WiFi board, is an open-ware product designed by MOLMC Co., Ltd. It is compatible with Arduino programming manner. IntoRobot-Nut, 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-Nut is integrated with the powerful MCU+WiFi module IntoRobot-ESP8266MOD. The ESP8266MOD Wi-Fi module, also developed by MOLMC Co., Ltd., integrates the industry-leading ultra-low power 32-bit MCU Tensilica L106 in small package. ESP8266MOD, with either 32-bit or 16-bit simplified mode, supports real time operating system RTOS at two different clock speeds, i.e., 80 MHz and 160 MHz, respectively. The module also integrates Wi-Fi MAC/BB/RF/PA/LNA with on-board antenna, supporting standard IEEE802.11 b/g/n agreement and complete TCP/IP protocol stack. ESP8266MOD can be used not only as a Wi-Fi module to connect a device to the Cloud, but also as a separate device with powerful computation and remote-control abilities. ESP8266MOD is a SOC system with high performance, providing embedded Wi-Fi capability for other systems that require low cost and small size.

CP2104, the serial chip with best compatibility and without need of driver, is integrated in IntoRobot-Nut; 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-Nut-S for debug usage or other applications.

**2 Hardware Specification**

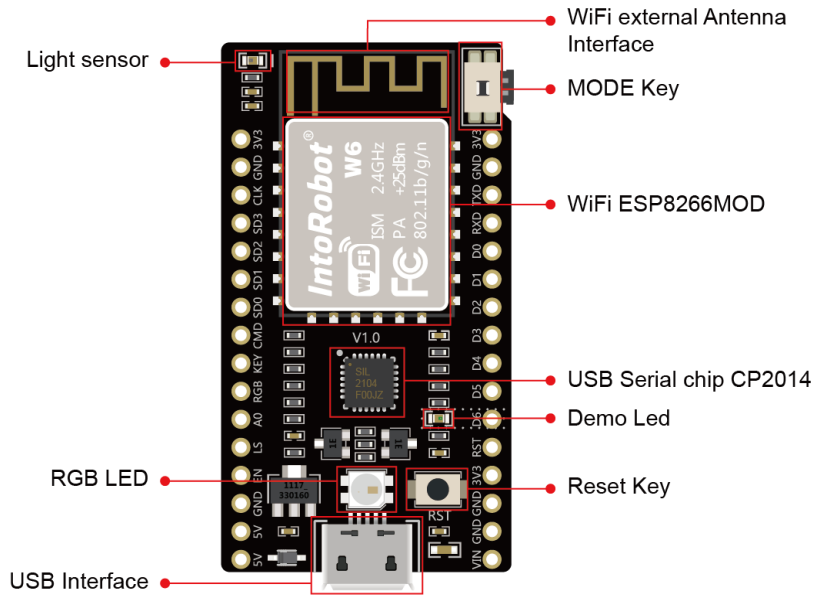
**2.1 Hardware Specification**

Chart 1: Specification

Product Name	IntoRobot-Nut
Cloud Service	IntoRobot-Cloud ( <a href="http://www.intorobot.com">http://www.intorobot.com</a> )
CPU	1.ESP8266EX CPU: Tensilica L106 32 bit, 80MHz, Max 160MHz External Flash: 4M RAM: 50KB
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.
Light Sensor	ALS-PT19 light sensor; Spectral range similar with human eye; Analog output, good linearity, wide illumination range.
DC Payload	3.3V and 5V total output current: 800mA
GPIO	9
I2C	1
SPI	1
I2S	1
Serial Port	1
PWM	4
A/D Port	1
External Interrupt	9
WiFi	Frequency range: 2.4~2.5G (2400M-2483.5M); Wi-Fi support 802.11 b/g/n; WIFI @2.4 GHz, support WPA/WPA2 Safe Mode; WIFI Integrated TR switch, balun, and LNA; Integrated PLL, +20dBm output power in 802.11b mode; Support STA/AP/STA+AP; Integrated 10 bit ADC; Build-in TCP/IP; Support Imlink ( Android and iOS ); Deep sleep current<10uA, off current < 5uA; Wake up and transmit packets time < 2ms; Standby power consumption < 1.0mW (DTIM3).

2.2 Pin Description

Chart 2: Hardware Architecture



9 Groups GPIO、 1 Group AD、 4 Groups PWM、 1 Group serial ports 、  
1 Group I2C、 2 Groups I2S、 1 Group SPI

Chart 3 : Pin Map

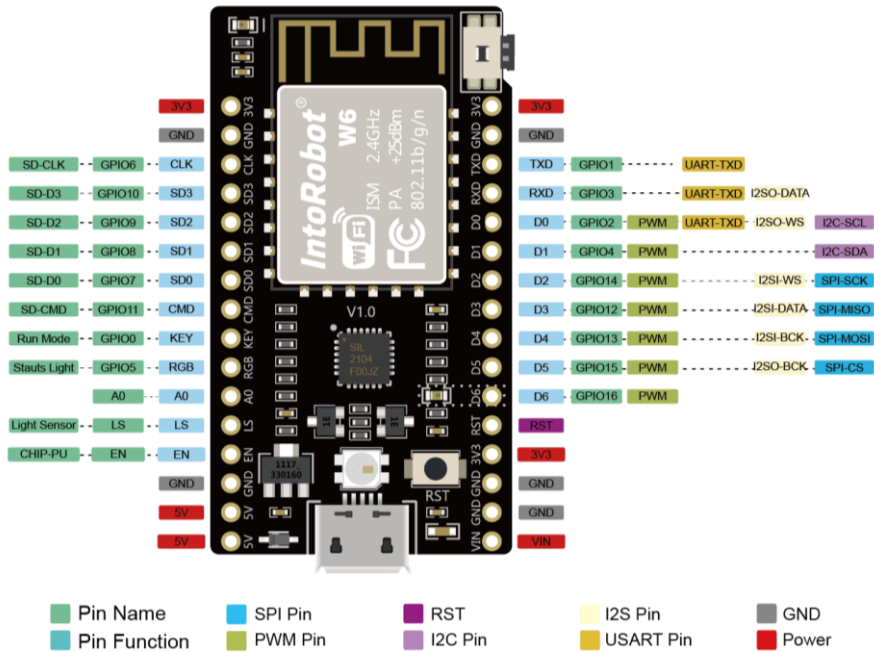


Chart 4: Pin definition

Index	Pin name	Description
1	3V3	3.3V output
2	GND	GND
3	CLK	ESP8266 external SPI FLASH CLK Clock signal (esp8266 module)
4	SD3	ESP8266 external SPI FLASH SD3 data signal (esp8266 module)
5	SD2	ESP8266 external SPI FLASH SD2 data signal (esp8266 module)
6	SD1	ESP8266 external SPI FLASH SD1 data signal (esp8266 module)
7	SD0	ESP8266 external SPI FLASH SD0 data signal (esp8266 module)
8	CMD	ESP8266 external SPI FLASH chip selection (esp8266 module)
9	KEY	GPIO0, connected to Mode Key (esp8266 module)
10	RGB	Connect to RGB led signal (esp8266 module)
11	A0	A/D Input voltage range: 0 ~ 3V , 1:3 partial voltage to ESP8266 Range: 0 ~ 1024
12	LS	Light sensor
13	EN	Chip enable pin. HIGH active (esp8266 module)
14	GND	GND
15	5V	5V output
16	5V	5V output
17	VIN	Power input (4.75V-5.25V)
18	GND	GND
19	GND	GND
20	3V3	3.3V output
21	RST	Reset signal (esp8266 module)
22	D6	GPIO16 (esp8266 module)
23	D5	GPIO15 (esp8266 module)
24	D4	GPIO13 (esp8266 module)
25	D3	GPIO12 (esp8266 module)
26	D2	GPIO14 (esp8266 module)
27	D1	GPIO4 (esp8266 module)
28	D0	GPIO2 (esp8266 module)
29	RXD	GPIO3 (esp8266 module)
30	TXD	GPIO1 (esp8266 module)
31	GND	GND
32	3V3	3.3V Output



Chart 5: Interface function

Interface	Pin Name	Functions
HSPI	D4 (SPI_MOSI), D3 (SPI_MISO), D2 (SPI_SCK), D5 (SPI_NSS)	Connection for SPI Flash, display screen, or MCU.
PWM	D1(GPIO4), D2 (GPIO14), D3 (GPIO12), D5 (GPIO15)	PWM interface can be used to control LED lights, buzzers, relays, electronic machines, and so on.
ADC	A0(ADC)	A/D input signal. Input voltage range of 0 ~ 3V, 1:3 converted to ESP8266; Output scope: 0 to 1024.
I2C	D0(SCL), D1(SDA)	I2C interface can be used to connect different modules, like sensors, display screens, and MCUs, etc.
USART	TXD(GPIO1), RXD(GPIO3)	Used for external sensors connection, or serial debugging through TTL serial connection to PC.
I2S	RXD(I2SO-DATA), D0(I2SO-WS), D2(I2SI-WS), D3(I2SI-DATA), D4(I2SI-BCK), D5(I2SO-BCK)	Mainly used for sensors with I2S interface.

## 2.3 Electrical Characteristics

### 2.3.1 Rating Values

Chart 6: Rating values

Symbol	Condition	Min	Typ	Max	Unit
Output current	3.3V and 5V total output current	-	-	800	mA
Supply Voltage	I <sub>OUT</sub> =300mA	4.5	5	6	V
	I <sub>OUT</sub> =600mA	4.5	5	5.5	V

### 2.3.2 Recommended Operating Conditions

Chart 7: Recommended operating conditions

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

**2.3.3 I/O Port Characteristics**

Chart 8: I/O port characteristics

Parameter	Symbol	Min	Max	Unit
Input Low Voltage	VIL	-0.3	0.25VDD	V
Input High Voltage	VIH	0.75VDD	VDD+0.3	V
Output Low Voltage	VOL	-	0.1VDD	V
Output High Voltage	VOH	0.8VDD	-	V

Note: Test conditions: VDD = 3.3V, Temperature = 20 °C. if nothing special is stated.

**2.3.4 RF Performance**

Chart 9: RF performance

Description	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
<b>Sensitivity</b>				
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
<b>Adjacent Channel Suppression</b>				
OFDM, 6 Mbps	-	37	-	dB
OFDM, 54 Mbps	-	21	-	dB
HT20, MCS0	-	37	-	dB
HT20, MCS7	-	20	-	dB

**2.4 WIFI Power Consumption**

2.4.1 WIFI Power Consumption

Chart 10: 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

2.4.2 Standby Power Consumption

Chart 11: 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.

**2.5 RF Characteristics.**

**2.5.1 RF Wireless LAN Configuration and General Specifications**

Chart 12: 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	-

**2.5.2 RF Emission Characteristics**

Chart 13: RF emission characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Ftx	Input Frequency	-	2.412	-	2.484	GHz
Pout	Transmit power					
	11b	1Mbps	-	19.5	-	dBm
		11Mbps	-	18.5	-	dBm
		54Mbps	-	16	-	dBm
		MCS7	-	14	-	dBm

**2.5.3 RF Reception Characteristics**

Chart 14: Reception Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Fr <sub>x</sub>	Input Frequency	-	2.412	-	2.484	GHz
S <sub>r</sub> f	Sensitivity					
	DSSS	1 Mbps	-	-98	-	dBm
	-	11 Mbps	-	-91	-	dBm
	OFDM	6 Mbps	-	-93	-	dBm
	-	54 Mbps	-	-75	-	dBm
	HT20	MCS7	-	-71	-	dBm

**3 Nut Dimensions**

**3.1 Board Dimensions**

Chart 15: Board dimensions

