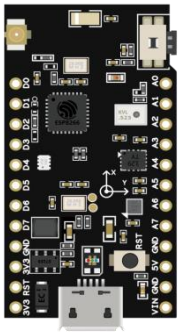
IntoRobot

Neutron Plus Datasheet



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Category

Chart Category

1 Overview

IntoRobot-Neutron and IntoRobot-Neutron-Plus are two highly integrated hardware and software open-source products, compatible with Arduino programming mode. They are designed with the same PCB, but with different sensor configuration; IntoRobot-Neutron-Plus integrates 6 sensors, i.e., accelerometer, gyroscope, magnetometer, barometer, sound sensor, and light sensor. IntoRobot-Neutron or IntoRobot-Neutron-Plus, working together with IntoRobot-Cloud and IntoRobot-App can achieve many interesting and creative applications, satisfying the needs for building automation, security, smart home, telemedicine applications and other IoTs needs.

Either IntoRobot-Neutron or IntoRobot-Neutron-Plus is integrated with two powerful MCUs. One is ESP8266 in smaller size, which integrates Tensilica L106. The ESP8266, 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. The ESP8266 also 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. It can be used not only as a WiFi module to connect a device to the Cloud, but also as a separate device with remote-control ability. ESP8266MOD is a SOC system with high performance, providing embedded WiFi capability for other systems that require low cost and small size.

Another kind of MCU on IntoRobot-Neutron and IntoRobot-Neutron-Plus is STM32F411CE. As a leading chip of ARM® Cortex®-M4, it is an ultra-low power-consumption 32-bit micro MCU. The working frequency supports 92 MHz, with 125 DMIPS and integrated DSP and DFU. Therefore, the presented two products can fully satisfy the needs of flight control, robotic motion control and other generic arithmetic operations.

2 Hardware Specification

2.1 Hardware Specification

Chart 1：Specification

Product Name	IntoRobot-Neutron / IntoRobot-Neutron-Plus
Cloud Service	IntoRobot-Cloud (www.intorobot.com)
CPU	1. STM32F411CEU6 Cortex-M4 32 bit @100 MHz Flash: 512 KB RAM: 128 KB 2. ESP8266EX CPU: Tensilica L106 32 Bit@80 MHz, Max 160 MHz External Flash: 4 M RAM: 50 KB
DC Payload	3.3V: 1000 mA
GPIO	16
I2C	1
SPI	2
I2S	1
Serial port	1
PWM	11
A/D Port	8 (12 Bit)
External Interrupt	16
WiFi	Frequency range: 2.4~2.5G (2400 - 2483.5 MHz); WiFi support 802.11 b/g/n; WIFI @2.4 GHz, support WPA/WPA2 safe mode; WIFI Integrated TR switch, balun, LNA, power amplifier and matching network; Integrated PLL, +20 dBm output power in 802.11b mode; Support STA/AP/STA+AP.
Accelerometer and gyroscope (BMI160)(only for Neutron-Plus)	16-bit digital tri-axial accelerometer; 16-bit digital tri-axial gyroscope; Hardware Synchronization; Low power consumption (920 uA); Default accelerometer range:16G, accuracy: 2048 LSB/G; Default gyrometer range: 2000°/s, accuracy:16.4LSB/(°/s).
Magnetic sensor(BMM150) (only for Neutron-Plus)	Digital tri-axial magnetometer Range: x, y axis, ±1300 μT; z axis, ±2500 μT Accuracy: 0.3 μT
Barometer (BMP280) (only for Neutron-Plus)	Barometer (temperature available) Range: 300-1100 hPa (Altitude range: - 500m to 900 m) Relative accuracy: ±0.12 hPa, relative to ±1 m (950-1050 hPa @ 25°C) Absolute accuracy: ±1 hPa（950-1050 hPa @ 0-+40°C） Current consumption: 2.7uA@1Hz Temp range: -40 ~ 85°C
Sound sensor (MP34DT02) (Only for Neutron Plus)	Sound sensor Single-channel digital signal, PCM output, 8-bit, 8 KHz RF Sensitivity: 26 dBFS SNR: 60dB
Light sensor (ALS-PT19) (Only for Neutron Plus)	Light sensor with spectral range similar with human eye; Analog output, good linearity, wide illumination range

2.2 Pin Definition

Chart 2： Pin map

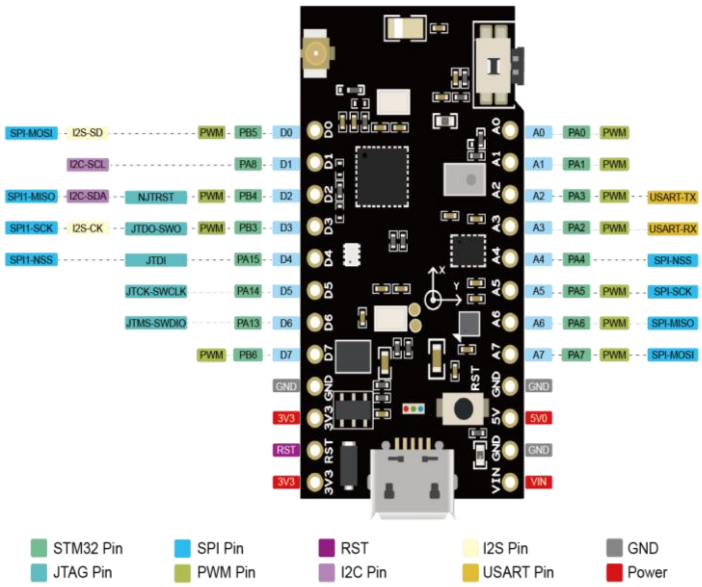

Chart 3： Pin definition

Pin No.	Name	Description
1	D0	PB5, SPI3_MOSI/I2S3_SD,TIM3_CH2
2	D1	PA8, I2C3_SCL, TIM1_CH1
3	D2	PB4,JTAG_JTRST, SPI3_MISO, I2C3_SDA, TIM3_CH1
4	D3	PB3, JTAG_JTDO, SPI3_SCK/I2S3_CK, TIM2_CH2
5	D4	PA15, JTAG_JTDI,SPI3_NSS, I2S3_WS, TIM2_CH1
6	D5	PA14, SWD_SWCLK
7	D6	PA13, SWD_SWDIO
8	D7	PB6, TIM4_CH1
9	GND	GND
10	3V3	3.3V power output
11	RST	Reset
12	3V3	3.3V power output
13	VIN	Power input (4.75V-5.25V)
14	GND	GND
15	5V	5V power output
16	GND	GND
17	A7	PA7, SPI1_MOSI,TIM1_CH1N, TIM3_CH2
18	A6	PA6, SPI1_MISO, TIM3_CH1
19	A5	PA5, SPI1_SCK, TIM2_CH1
20	A4	PA4, SPI1_NSS
21	A3	PA3, USART2_RX, TIM2_CH4, TIM5_CH4, TIM9_CH2
22	A2	PA2, USART2_TX, TIM2_CH3, TIM5_CH3, TIM9_CH1
23	A1	PA1, TIM2_CH2, TIM5_CH2
24	A0	PA0, TIM2_CH1, TIM5_CH1

Chart 4：Interface function

Interface	Pin name	Functions
SPI	D0 (SPI3_MOSI), D2 (SPI3_MIS0), D3 (SPI3_SCK), D4 (SPI3_NSS)	Connection for SPI Flash, display screen, or MCU.
	A4 (SPI1_NSS), A5 (SPI1_SCK), A6 (SPI1_MISO), A7 (SPI1_MOSI)	
PWM	D0 (TIM3_CH2), D2 (TIM3_CH1), D3 (TIM2_CH2), D7 (TIM4_CH1), A0 (TIM5_CH2), A1 (TIM5_CH1), A2 (TIM5_CH3), A3 (TIM5_CH4), A5 (TIM2_CH1), A6 (TIM3_CH1), A7 (TIM3_CH2)	The PWM interface can be used to control LED lights, buzzers, relays, motors, and so on.
ADC	A0(ADC1_0), A1 (ADC1_1), A2 (ADC1_2), A3 (ADC1_3), A4 (ADC1_4), A5 (ADC1_5), A6 (ADC1_6), A7 (ADC1_7)	12-bit ADC, used for sensing.
I2C	D1(SCL), D2(SDA)	I2C interface can be used to connect different modules, like sensors, display screens, and MCUs, etc.
USART Serial ports	A2(USART2_TX), A3(USART2_RX)	Used for external sensors connection, or serial debugging through TTL serial connection to PC
I2S	D0(I2S-SD), D3(I2S-CK)	Mainly used for sensors with I2S interface.

2.3 Electrical Characteristics

2.3.1 Rating Values

Chart 5： Rating values

Parameter	Conditions	Value	Units
Storage Temperature	-	-40 to 125	°C
Supply Voltage	IPC/JEDEC J-STD-020	+3.0 to +3.6	V

2.3.2 Recommended Operating Conditions

Chart 6： Recommended operating conditions

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

2.3.3 I/O Port Characteristics

Chart 7： I/O port characteristics

Parameter	Symbol	Min	Max	Unit
Input Low Voltage	V_{IL}	-	0.3VDD	V
Input High Voltage	V_{IH}	0.7VDD	-	V
Output Low Voltage	V_{OL}	-AA	0.4	V
Out High Voltage	V_{OH}	VDD-0.4	-	V

2.4 WIFI Consumption

2.4.1 WIFI Operating Consumption

Chart 8： Operating consumption

Parameter	Conditions	Rate (Mbps)	Value	Unit
Tx	11b	1	215	mA
		11	197	
	11g	6	197	
		54	145	
	11n	MCS7	120	
Rx	All rates		56	mA

NOTE: RX transport packet size is 1024 bytes.

2.4.2 WIFI Standby Consumption

Chart 9： WiFi standby power consumption

Conditions	Mode	Value				
Standby	Modem Sleep①	15mA				
	Light Sleep②	0.9mA				
	Deep Sleep③	20uA				
	Off	0.5uA				
Power Save Mode (2.4G) (Low Power Listen disabled)[1]	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 Wireless LAN Configuration and General Specifications

Chart 10： 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 11： 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 12： RF 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

3 Dimensions

3.1 Board Dimensions

Chart 13： Board dimensions