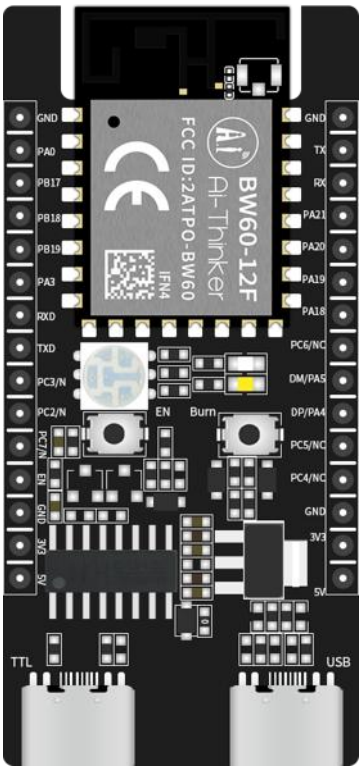
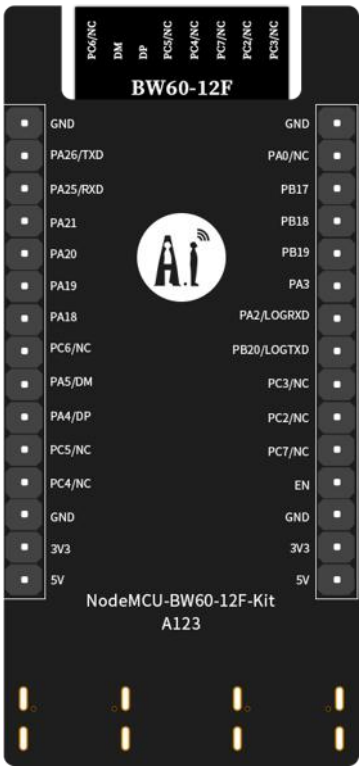
NodeMCU-BW60-12F-Kit Specification

Version V1.1.2

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Document Revision History

Version	Date	Created / Revised Content	Prepared by	Approved by
V1.1.0	2026-06-23	First edition	Zeng Xiangfei	Xu Hong
V1.1.1	2026-10-29	Updated the descriptions of the CPU clock frequency, peripherals, RF parameters, etc.	Zeng Xiangfei	Xu Hong
V1.1.2	2026-11-13	1. Updated the main chip architecture diagram. 2. Added descriptions of peripherals, application scenarios, and security features. 3. Changed the recommended power supply current to above 800mA. 4. Added the description of the pin_mux document to the pin definition table. 5. Added the RF regulatory limit table for various countries and regions. 6. Added the description of the memory.	Zeng Xiangfei	Xu Hong

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1 Product Overview

NodeMCU-BW60-12F-Kit is a development board developed by Shenzhen Ai-Thinker Technology Co., Ltd. based on the BW60-12F module. The module uses the Realtek RTL8711FA series chip as its core and integrates Wi-Fi 6 + BLE 5.4. It supports 2.4GHz and 5GHz dual bands and 802.11a/b/g/n/ac/ax protocols.

The RTL8711FA integrates dual RISC cores compatible with the Arm Cortex-M55 instruction set and based on the Armv8.1-M architecture. With a maximum clock frequency of 240MHz, it features fine-grained clock gating, multiple power modes and dynamic power adjustment, balancing high performance and ultra-low power consumption.

The BW60-12F module features a rich set of peripheral interfaces, integrating general-purpose and sensor interfaces such as UART, SPI, I2C, CAN, ADC, RMII, capacitive touch, and temperature control. It is equipped with high-speed SDIO and USB interfaces, as well as RGB, DMIC, and I2S audio/video interfaces. The GPIOs are flexibly configurable. It can be widely applied in IoT, mobile devices, wearable electronics, smart home and other scenarios.

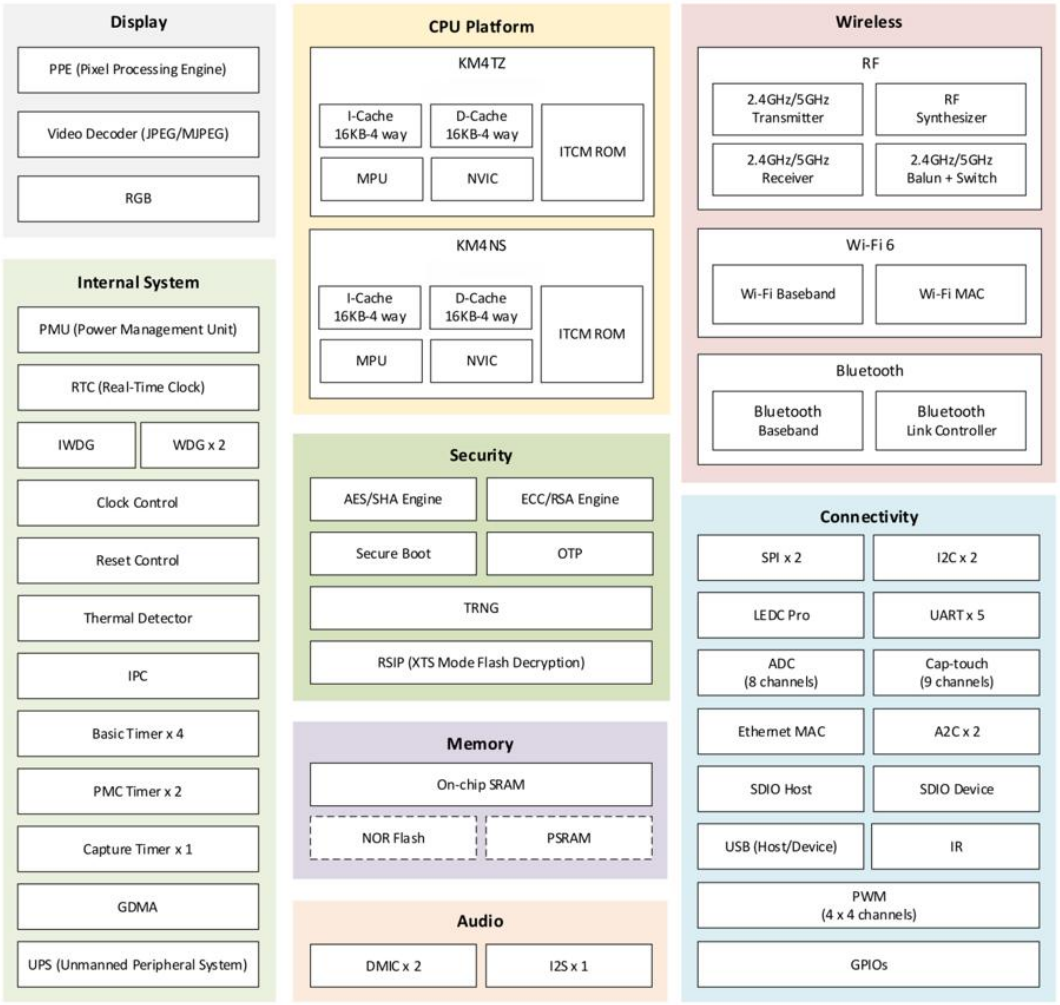


Figure 1 Main Chip Architecture Diagram

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1.1 Features

Wireless

- 2.4GHz and 5GHz RF transceiver
- Supports 802.11a/b/g/n/ac/ax protocols
- Supports BLE 5.4
- Supports SIG Mesh 1.1
- Supports LE 1Mbps, 2Mbps
- Supports LE long-range (125kbps, 500kbps)
- Supports LE Advertising Extensions
- Supports TWT (Target Wake Time) for power saving

Microcontroller Subsystem

- Dual 32-bit RISC cores based on the Armv8.1-M architecture
- Compatible with the Arm Cortex-M55 instruction set
- Maximum clock frequency up to 240MHz

Memory

- 16KB I-Cache and 16KB D-Cache
- 512KB + 152KB SRAM
- 2KB OTP
- RTL8711FA with integrated 4/8MB Flash (optional)
- Supports external Flash expansion (customized)

Security

- Secure Boot and Secure Debug
- AES/SHA Engine
- ECC/RSA Engine
- TRNG (True Random Number Generator)
- OTP

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Peripherals

- Supports USB 2.0 HS (Host/Device), SPI, UART, ADC, CAN, I2C, I2S, DMIC, RGB/MCU interface, PWM, SDIO, LEDC, IR, RMII (supports Ethernet MAC, applicable to Ethernet port and gateway applications), Cap-touch and GPIO, etc.

Package Type

- Adopts DIP-30 package

Development Environment

- Supports secondary development with integrated Linux development environment

Note: For features not marked, please refer to the official RTL8711FA chip datasheet.

1.2 Application Scenarios

- Smart Home
- Educational/Children's Toys
- Industrial Equipment Interaction
- Wearable Electronics
- Internet of Things (IoT)
- Audio Multimedia
- Mobile Devices
- Gateway applications

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2 Key Specifications

Table 1 Key Specifications

Model	NodeMCU-BW60-12F-Kit
Package	DIP-30
Dimensions	60.00 × 28.00mm
Antenna Type	Onboard antenna
Frequency Range	2400 – 2483.5MHz and 5180 – 5825MHz
Operating Temperature	-40 – 85℃
Storage Conditions	-40 – 125℃, <90% RH
Power Supply Range	Supply voltage 3.3V or 5V, supply current ≥800mA
Available I/Os	21 by default
UART Baud Rate	921600bps by default
Security	WPS/WEP/WPA/WPA2/WPA3
Flash	4MByte by default, up to 16MByte

2.1 Power Supply Selection

The NodeMCU-BW60-12F-Kit supports three power supply modes:

- Type-C interface (recommended)
- 3V3 and GND pin header
- 5V and GND pin header

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3 Electrical Characteristics

3.1 Recommended Operating Conditions

Table 2 Recommended Operating Conditions

Parameter	Condition	Min	Typ	Max	Unit
Interface Power Supply	Type-C	4.5	5	5.3	V
Pin Header Power Supply	3V3	2.97	3.3	3.63	V
	5V	4.5	5	5.3	V

3.2 I/O DC Electrical Characteristics

Table 3 I/O DC Electrical Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
VIH	High-level Input Voltage	2	-	-	V
VIL	Low-level Input Voltage	-0.3	-	0.8	V
VOH	High-level Output Voltage	0.85×VDD	-	-	V
VOL	Low-level Output Voltage	-	-	0.15×VDD	V
Note: VIO = 3.3V ±10%, I_{OL} max.					

3.3 Electrostatic Discharge

The NodeMCU-BW60-12F-Kit is an ESD-sensitive device and requires special precautions during handling.



Figure 2 ESD Protection Symbol

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3.4 Wi-Fi RF Performance

Table 4 Wi-Fi RF Performance

Description	Typ			Unit
Frequency Range	2400 – 2483.5			MHz
2.4GHz Output Power				
Mode	**Min**	**Typ**	**Max**	**Unit**
802.11b, 1Mbps	-	21	-	dBm
802.11b, 11Mbps	-	20	-	dBm
802.11g, 6Mbps	-	20	-	dBm
802.11g, 54Mbps	-	18	-	dBm
802.11n, HT20 (MCS7)	-	18	-	dBm
802.11ax, HE20 (MCS9)	-	16	-	dBm
2.4GHz Receiver Sensitivity				
Mode	**Min**	**Typ**	**Max**	**Unit**
802.11b, 1Mbps	-	-99	-	dBm
802.11b, 11Mbps	-	-90	-	dBm
802.11g, 6Mbps	-	-95	-	dBm
802.11g, 54Mbps	-	-77	-	dBm
802.11n, HT20 (MCS7)	-	-76	-	dBm
802.11ax, HE20 (MCS9)	-	-68.5	-	dBm
Description	**Typ**			**Unit**
Frequency Range	5180 – 5825			MHz
5GHz Output Power				
Mode	**Min**	**Typ**	**Max**	**Unit**
802.11a, 6Mbps	-	18	-	dBm
802.11a, 54Mbps	-	18	-	dBm

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802.11n, HT20 (MCS7)	-	18	-	dBm
802.11ax, HE20 (MCS9)	-	16	-	dBm
5GHz Receiver Sensitivity				
Mode	**Min**	**Typ**	**Max**	**Unit**
802.11a, 6Mbps	-	-92	-	dBm
802.11a, 54Mbps	-	-74	-	dBm
802.11n, HT20 (MCS7)	-	-72	-	dBm
802.11ax, HE20 (MCS9)	-	-66	-	dBm

3.5 BLE RF Performance

Table 5 BLE RF Performance

Description	**Typ**			**Unit**
Frequency Range	2400 – 2483.5			MHz
Output Power				
Data Rate Mode	**Min**	**Typ**	**Max**	**Unit**
1Mbps	-	8	15	dBm
2Mbps	-	8	15	dBm
Receiver Sensitivity				
Data Rate Mode	**Min**	**Typ**	**Max**	**Unit**
1Mbps Sensitivity @ 30.8% PER	-	-97	-	dBm
2Mbps Sensitivity @ 30.8% PER	-	-94	-	dBm

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The following table lists the regulatory requirements for transmit power in common countries and regions. The product must be configured strictly in accordance with applicable regulations. The configurable 5GHz transmit power range is -24dBm to +18dBm, while the configurable 2.4GHz transmit power range is -24dBm to +21dBm.

Table 6 RF Regulatory Limits by Country / Region

Country / Region	Regulation	Operating Band	Power Limit
Mainland China	Document No. 129 (2021)	2400 – 2483.5MHz	EIRP ≤ 20dBm
Mainland China	Document No. 129 (2021)	5150 – 5250MHz	EIRP ≤ 23dBm
Mainland China	Document No. 129 (2021)	5725 – 5850MHz	EIRP ≤ 33dBm
European Union	CE	2400 – 2483.5MHz	EIRP ≤ 20dBm
European Union	CE	5150 – 5350MHz	EIRP ≤ 23dBm
European Union	CE	5470 – 5725MHz	EIRP ≤ 30dBm
European Union	CE	5725 – 5875MHz	EIRP ≤ 14dBm
North America	FCC	2400 – 2483.5MHz	Conducted ≤ 30dBm
North America	FCC	5150 – 5250MHz	Conducted ≤ 24dBm
North America	FCC	5250 – 5350MHz	Conducted ≤ 24dBm
North America	FCC	5470 – 5725MHz	Conducted ≤ 24dBm
North America	FCC	5725 – 5850MHz	Conducted ≤ 30dBm

Notes:

- EIRP (dBm) = Pt (dBm) − Cable Loss (dB) + Antenna Gain (dBi)
- FCC regulations limit the conducted power at the antenna port.

For questions regarding the above configuration, please contact Ai-Thinker.

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3.6 Power Consumption

The following power consumption data are measured under a 3.3V power supply and 25℃ ambient temperature.

- The POUT power for all transmit modes is measured at the antenna interface.
- All transmission data are measured at 100% duty cycle in continuous transmit mode.

Table 7 Power Consumption

Mode	Min	Avg	Max	Unit
TX 802.11b, 11Mbps, POUT=+18dBm	-	275	-	mA
TX 802.11g, 54Mbps, POUT=+15dBm	-	243	-	mA
TX 802.11n (2.4GHz), MCS7, POUT=+15dBm	-	239	-	mA
TX 802.11n (5GHz), MCS7, POUT=+15dBm	-	313	-	mA
TX 802.11ax (2.4GHz), MCS9, POUT=+13dBm	-	226	-	mA
TX 802.11ax (5GHz), MCS9, POUT=+13dBm	-	291	-	mA
RX 802.11b, Packet Length 1500 Bytes	-	50	-	mA
RX 802.11g, Packet Length 1500 Bytes	-	53	-	mA
RX 802.11a, Packet Length 1500 Bytes	-	58	-	mA
RX 802.11n (2.4GHz), Packet Length 1500 Bytes	-	53	-	mA
RX 802.11n (5GHz), Packet Length 1500 Bytes	-	58	-	mA
RX 802.11ac, Packet Length 1500 Bytes	-	58	-	mA
RX 802.11ax (2.4GHz), Packet Length 1500 Bytes	-	53	-	mA
RX 802.11ax (5GHz), Packet Length 1500 Bytes	-	58	-	mA
Deep-Sleep	-	10	-	μA

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4 Mechanical Specifications

4.1 Development Board Dimensions

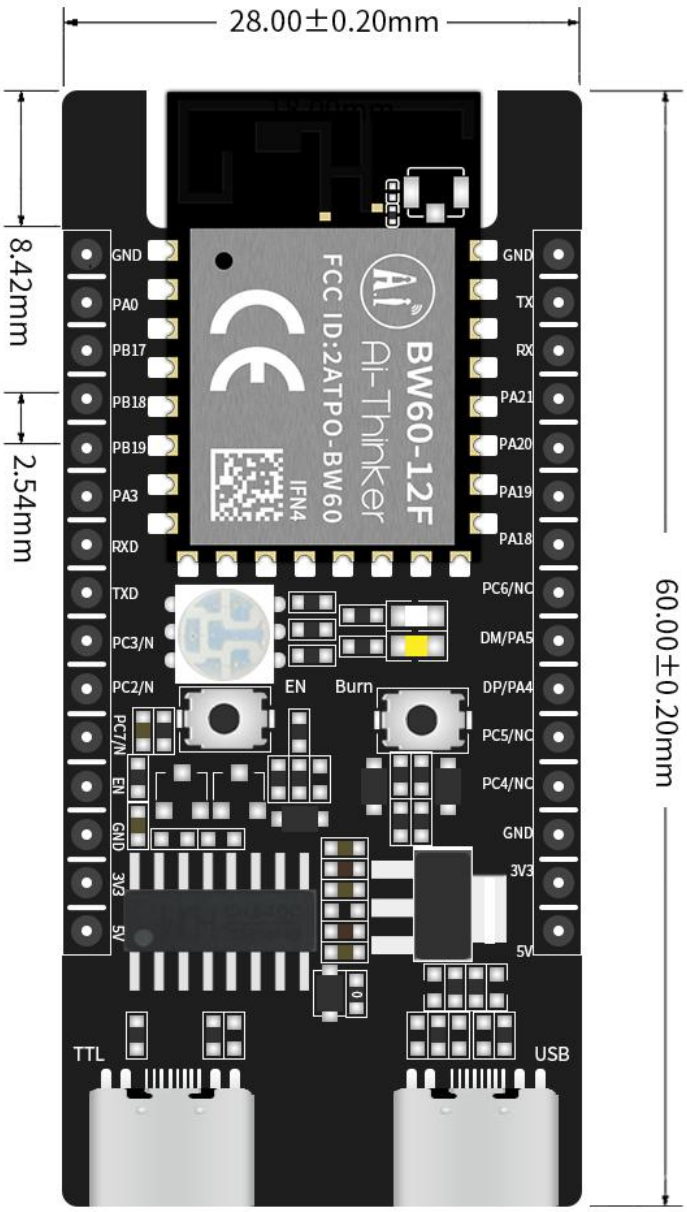


Figure 3 Development Board Dimensions

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5 LED and Button Description

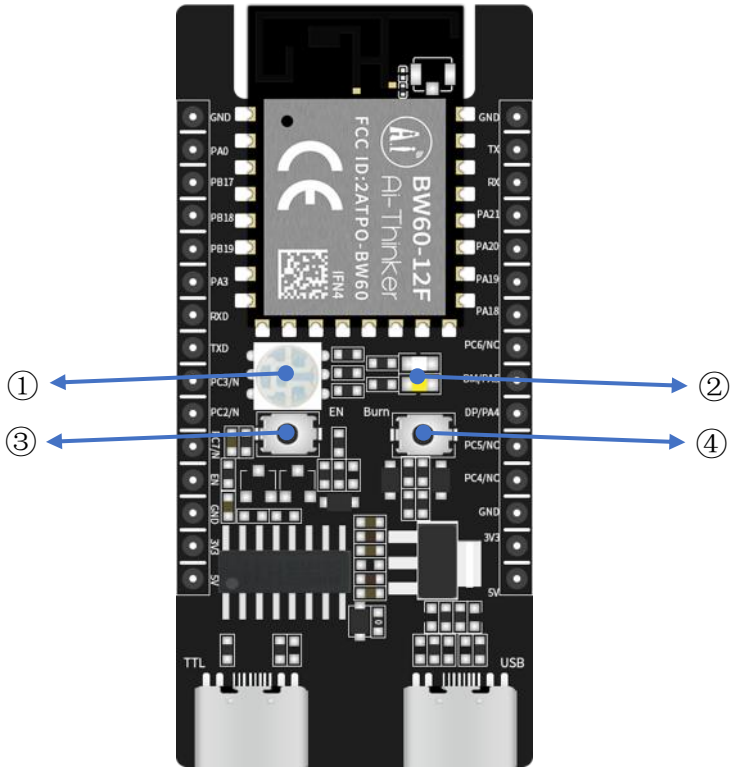


Figure 4 LED and Button Location

Table 8 LED and Button Function Description

No.	Function Description
①	RGB LED (The red LED is connected to PB17, the green LED is connected to PB18, and the blue LED is connected to PB19. Active high.)
②	LED lights (The upper cool LED is connected to PA19, and the lower warm LED is connected to PA20. Active high.)
③	Reset button
④	Flash button. When flashing firmware, press and hold the Flash button, and while holding it, briefly press Reset button.

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6 Pin Definition

The NodeMCU-BW60-12F-Kit exposes a total of 30 pins, as shown in the pin diagram. The pin function definition table provides the detailed interface specifications.

BW60-12F Development Board Pin Function Diagram

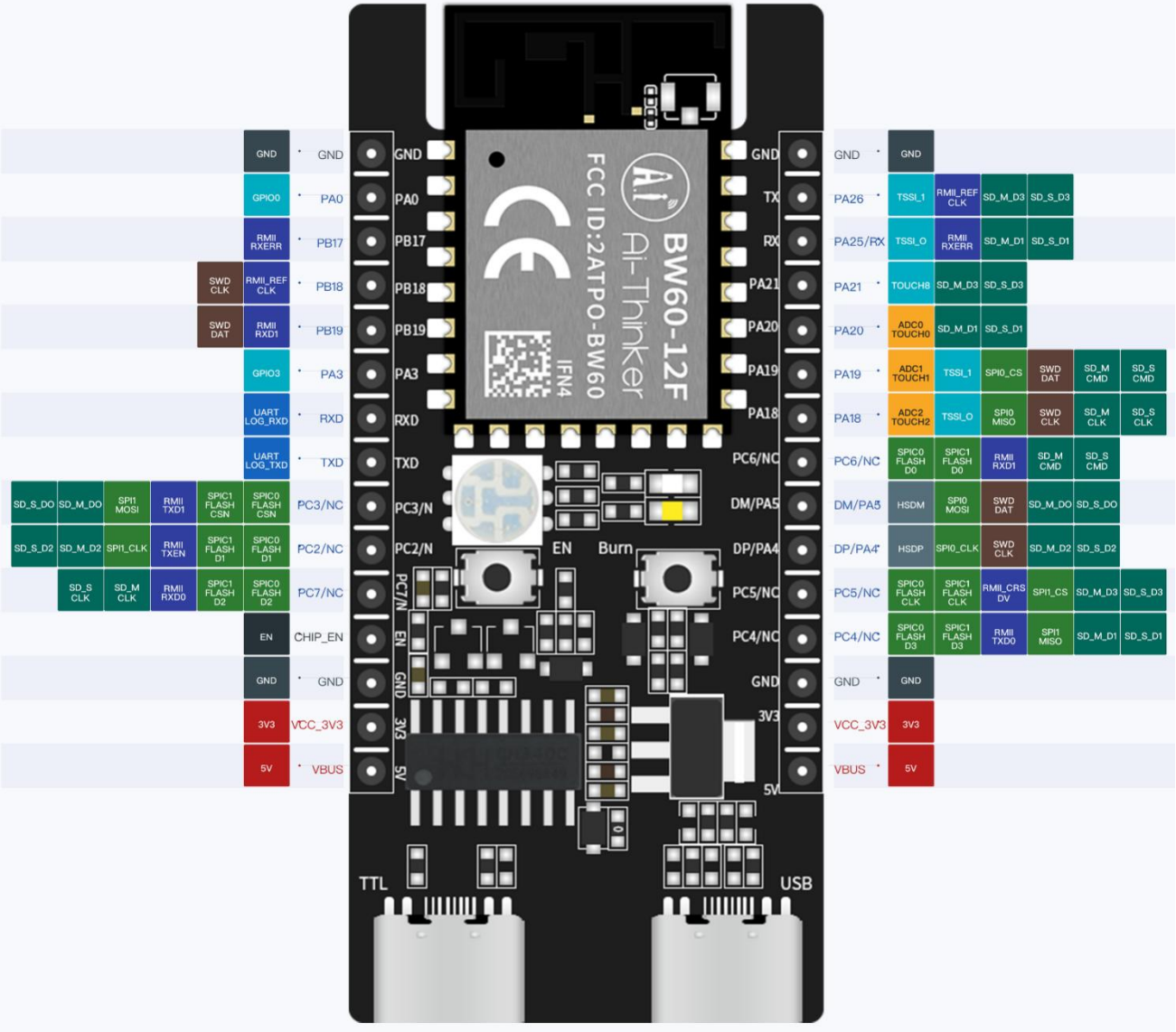


Figure 5 Pin Diagram (Top View)

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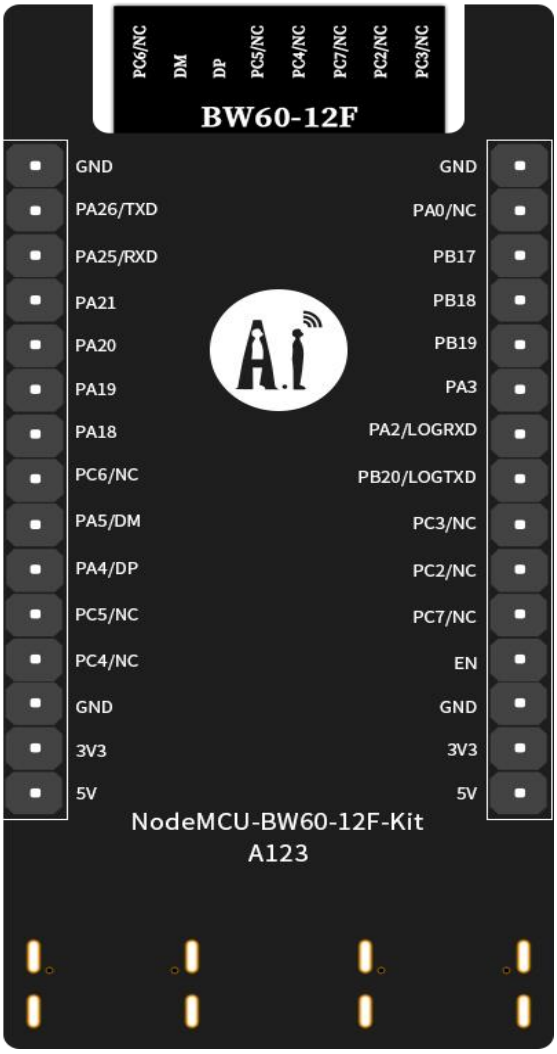


Figure 6 Pin Diagram (Bottom View)

Table 9 Pin Function Definition

No.	Name	Function
1	GND	Ground
2	PA0/NC	GPIO/WAKE_PIN3; unavailable on versions with internal PSRAM due to internal multiplexing.
3	PB17	GPIO/RMII_RXERR
4	PB18	GPIO/RMII_REF_CLK/SWD_CLK
5	PB19	GPIO/RMII_RXD1/SWD_DAT
6	PA3	GPIO/WAKE_PIN0
7	PA2/LOGRXD	PA2/OTP_DIS/WAKE_PIN1; programming UART and LOG_RXD pin.
8	PB20/LOGTXD	PB20/UD_DIS;

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		programming UART and LOG_TXD pin; also used for boot configuration. See notes below.
9	PC3/NC	GPIO/RMII_TXD1/SPI1_MOSI/SD_D0; on the external Flash version, this I/O is shared with the on-chip Flash and is not brought out.
10	PC2/NC	GPIO/RMII_TXEN/SPI1_CLK/SD_D2; on the external Flash version, this I/O is shared with the on-chip Flash and is not brought out.
11	PC7/NC	GPIO/RMII_RXD0/SD_CLK; on the external Flash version, this I/O is shared with the on-chip Flash and is not brought out.
12	EN	Chip enable pin, active high.
13	GND	Ground
14	3V3	3.3V supply (VDD); the external power supply output current is recommended to be above 800mA.
15	5V	5V supply (VBUS); the external power supply output current is recommended to be above 800mA.
16	GND	Ground
17	PA26/TXD	GPIO/TSSI_1/RMII_REF_CLK/SD_D3
18	PA25/RXD	GPIO/TSSI_0/RMII_RXERR
19	PA21	GPIO/TOUCH8/SD_D3
20	PA20	GPIO/ADC0_TOUCH0/SD_D1
21	PA19	GPIO/ADC1_TOUCH1/TSSI_1/SPI0_CS/SWD_DAT/SD_CMD
22	PA18	GPIO/ADC2_TOUCH2/TSSI_0/SPI0_MISO/SWD_CLK/SD_CLK
23	PC6/NC	SPIC(0/1)_FLASH_D0/RMII_RXD1/SD_CMD; on the external Flash version, this I/O is shared with the on-chip Flash and is not brought out.
24	PA5/DM	GPIO/HSDM/SPI0_MOSI/SWD_DAT/SD_D0
25	PA4/DP	GPIO/HSDP/SPI0_CLK/SWD_CLK/SD_D2
26	PC5/NC	SPIC(0/1)_FLASH_CLK/GPIO/RMII_CRS_DV/SPI1_CS/SD_D3; on the external Flash version, this I/O is shared with the on-chip Flash and is not brought out.
27	PC4/NC	GPIO/RMII_TXD0/SPI1_MISO/SD_D1; on the external Flash version, this I/O is shared with the on-chip Flash and is not brought out.

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28	GND	Ground
29	3V3	3.3V supply (VDD); the external power supply output current is recommended to be above 800mA.
30	5V	5V supply (VBUS); the external power supply output current is recommended to be above 800mA.

Notes:

1. This table lists only some commonly used multiplexed functions. For detailed pin descriptions, please refer to the Realtek_RTL8711F_pin_mux table.
2. Whether pins marked NC (no connection) are available depends on the internal PSRAM and Flash configuration of the module. On the internal PSRAM version, PA0 is unavailable. On the external Flash version, PC2, PC3, PC4, PC5, PC6, and PC7 are unavailable.
3. If LOG_TX is low at the moment of power-on, the module enters programming mode. If LOG_TX is high at the moment of power-on, the module boots normally. The module has an internal pull-up by default.
4. Do not pull PA3 low at the moment of power-on. Pulling it low during boot will cause the module to enter Test Mode.
5. Do not pull PB18 low at the moment of power-on. Pulling it low will cause the NOR Flash to fail to boot. The module has an internal pull-up by default.

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7 Schematic

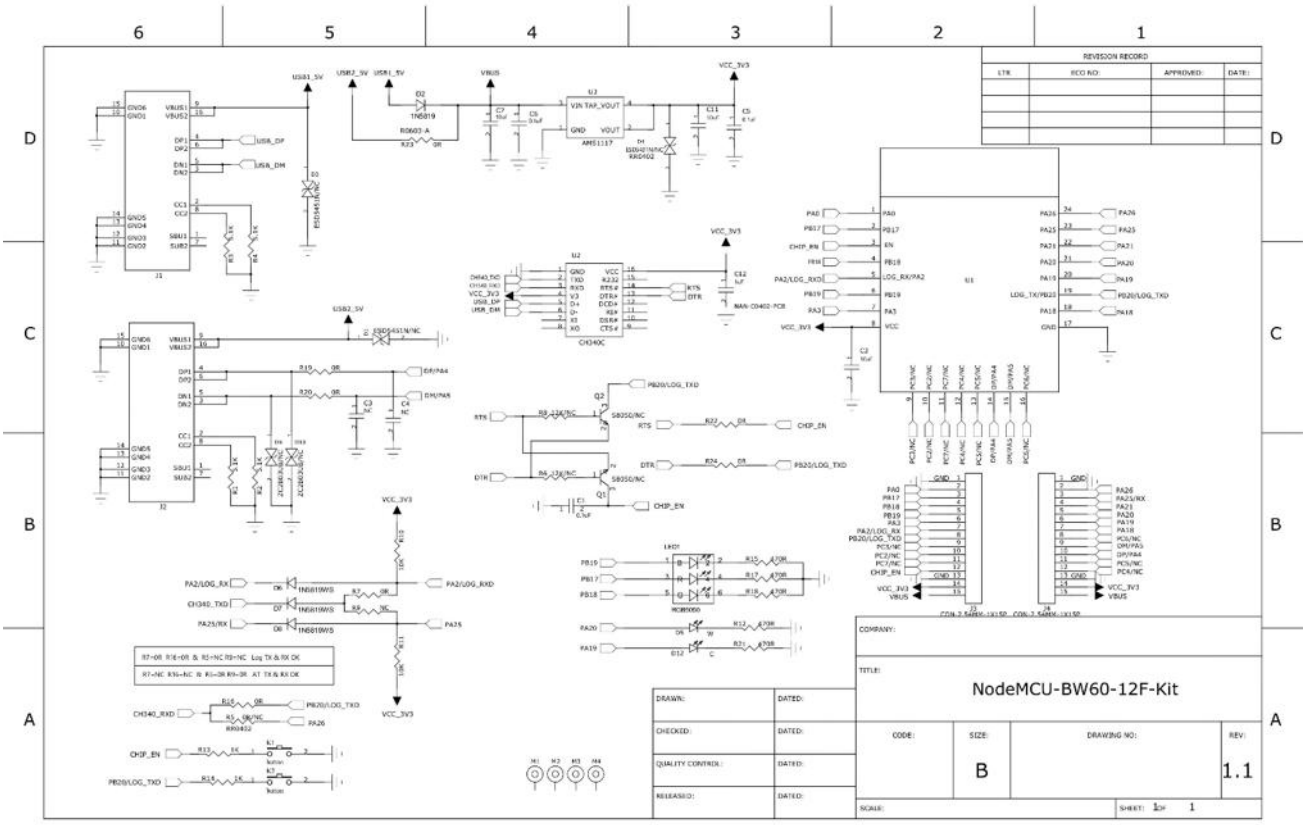


Figure 7 Schematic

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8 Packaging Information

Table 10 Packaging Information

Packing List	Packaging Method	Quantity per Bag (ESD Bag)	Quantity per Bag (Sealed Bag)
NodeMCU-BW60-12F-Kit	Foam + ESD bag	1pcs	20pcs

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