WiFi Module

WK515

User Manual

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Document Revision History

Version	Revision Description	Revised By	Date
V1.0	Initial Release	Luo Jiading	2022/07/15

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1. Product Overview

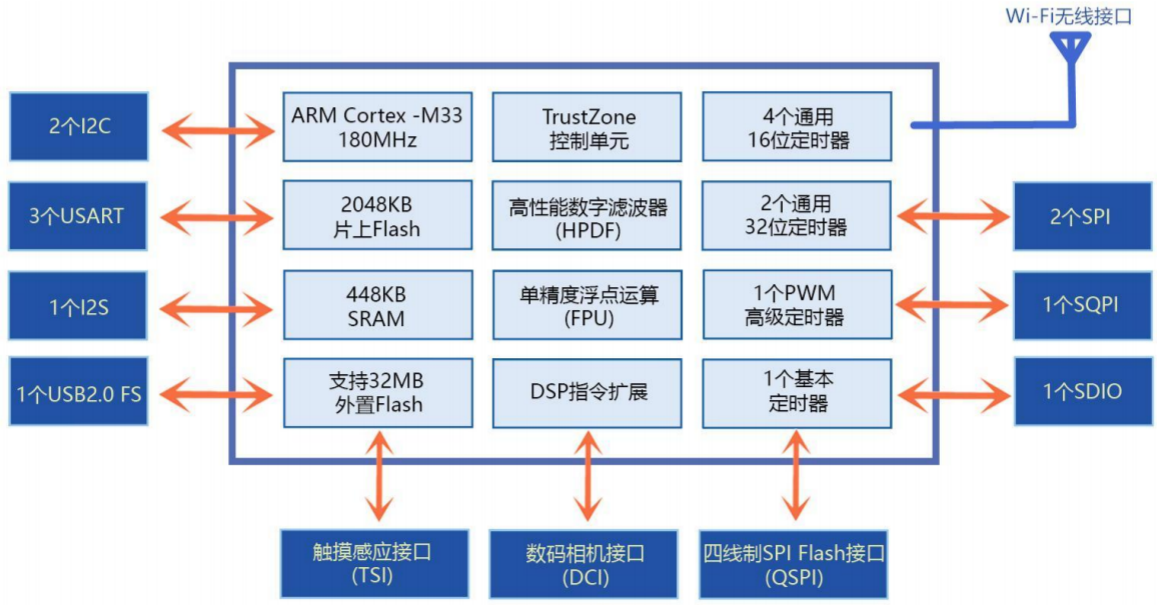
The WK515 SMD Module is a highly integrated 2.4GHz Wi-Fi module based on the GD32W515 chipset. The chip features an embedded ARM Cortex-M33 processor with TrustZone technology, operating at a clock frequency of up to 180MHz. It is an optimized SoC specifically designed for smart devices across a wide range of Internet of Things (IoT) applications.

The Cortex-M33 is a 32-bit processor based on the ARMv8-M architecture, offering low interrupt latency and cost-effective debugging capabilities. It supports a powerful and scalable instruction set, including general-purpose data processing, I/O control tasks, advanced data processing, bit-field operations, and DSP functions. Its high level of integration makes the Cortex-M33 an ideal choice for microcontroller-based products that require both high performance and low power consumption.

The WK515 SMD Module is suitable for a broad range of applications, particularly in:

- Industrial control systems
- Motor drive applications
- Human-machine interfaces (HMI)
- Power monitoring and alarm systems
- Consumer electronics and handheld devices
- Gaming and GPS products
- Electric bicycles (E-bikes)
- Optical modules
- Various IoT smart devices

The block diagram of the chipset is shown below:



1.1 Features

- Arm Cortex-M33 Core
  - Operating frequency up to 180 MHz
  - Integrated 2.4GHz single-stream IEEE 802.11b/g/n MAC/Baseband/RF wireless module
  - DSP instruction extensions and single-precision Floating Point Unit (FPU)
  - TrustZone hardware security architecture

- Memory
  - Up to 2048KB on-chip Flash
  - Up to 448KB SRAM
  - Supports up to 32MB external Flash

- RF Performance
  - Maximum transmit power up to 21 dBm
  - Receiver sensitivity as low as -97.6 dBm
  - Adjacent Channel Rejection (ACR) up to 48 dB
  - Iperf throughput up to 50 Mbps, with laboratory shielded-room testing achieving up to 80 Mbps

- High-Precision Analog Peripheral
  - 1 × 12-bit ADC

- Integrated Peripheral Interfaces
  - 2 × SPI
  - 1 × SQPI
  - 1 × SDIO
  - 2 × I²C
  - 3 × USART
  - 1 × I²S
  - 1 × USB 2.0 Full-Speed (FS)
  - Wi-Fi wireless interface

- On-Chip Resources
  - 4 × General-Purpose 16-bit Timers
  - 2 × General-Purpose 32-bit Timers
  - 1 × Basic Timer
  - 1 × Advanced PWM Timer
  - TrustZone Protection Control Unit (TZPCU)
  - Digital Camera Interface (DCI)
  - Touch Sensing Interface (TSI)
  - Quad SPI Flash Interface (QSPI)
  - High-Performance Digital Filter (HPDF)

2. Electrical Characteristics

2.1 General Specifications

2.1.1 Absolute Maximum Ratings

Symbol	Min.	Max.	Unit
VDD	-0.3	3.63	V
VDDA	-0.3	3.63	V
Storage Temperature	-65	+150	℃

2.1. 2 Recommended Operating Conditions

Symbol	Symbol	Min.	Typ.	Max.	Unit
VDD	Supply voltage	2.7	3.3	3.63	V
VDDA	Analog Supply voltage	3.0	3.3	3.63	V
Operating Temperature	—	-40	—	85	℃

2.2 Wi-Fi RF Specifications

2.2.1 Supported Frequencies

Feature	Description
WLAN Standard	IEEE 802.11 b/g/n WiFi compliant
Frequency Range	2.400 GHz~ 2.4835GHz (2.4 GHz ISM Band)
Number of Channels	2.4GHz :Ch1~Ch14

2.2.2 WiFi Power consumption characteristics

Power Mode	MCU State	WiFi State
Active	Active	Active
WiFi Sleep	Active	Power save mode: Wi-Fi wake up periodically to listen beacon frame to stay connected to the AP
Mild Sleep	Power on, PLL off, Clock gated	Power save mode: Wi-Fi wake up periodically to listen beacon frame to stay connected to the AP
Hibernation	Mostly power off, only the wake up source is power on	Power off
Shutdown	—	Power off

2.2.3 WiFi Power consumption characteristics

Power Mode	Description	Consumption	Unit
Active	WiFi Tx 802.11b, CCK 1Mbps, Pout = +18dBm	338	mA
	WiFi Tx 802.11b, CCK 11Mbps, Pout = +17dBm	323	mA
	WiFi Tx 802.11g, OFDM 6Mbps, Pout =+18dBm	327	mA
	WiFi Tx 802.11g, OFDM 54Mbps, Pout =+15dBm	289	mA
	WiFi Tx 802.11n, HT 20M MCS0, Pout =+16dBm	297	mA
	WiFi Tx 802.11n, HT 20M MCS7, Pout =+13dBm	272	mA
	WiFi Tx 802.11n, HT 40M MCS0, Pout =+14dBm	280	mA
	WiFi Tx 802.11n, HT 40M MCS7, Pout =+12dBm	267	mA
	WiFi Rx 802.11b, CCK 1Mbps, -90dBm	101	mA
	WiFi Rx 802.11b, CCK 11Mbps, -80Bm	102	mA
	WiFi Rx 802.11g, OFDM 6Mbps, -80dBm	120	mA
	WiFi Rx 802.11g, OFDM 54Mbps, -70dBm	126	mA
	WiFi Rx 802.11n, HT 20M MCS0, -75dBm	120	mA
	WiFi Rx 802.11n, HT 20M MCS7, -65dBm	126	mA
	WiFi Rx 802.11n, HT 40M MCS0, -72dBm	124	mA
	WiFi Rx 802.11n, HT 40M MCS7, -62dBm	129	mA
Wi-Fi Sleep	MCU in Run mode	56.5	mA
Mild Sleep	DTIM=1	1.5	mA
	DTIM=3	0.75	mA
Hibernation	MCU in Standby mode	5.4	μA
Shutdown	—	—	mA

3. WK515-D0-A Module

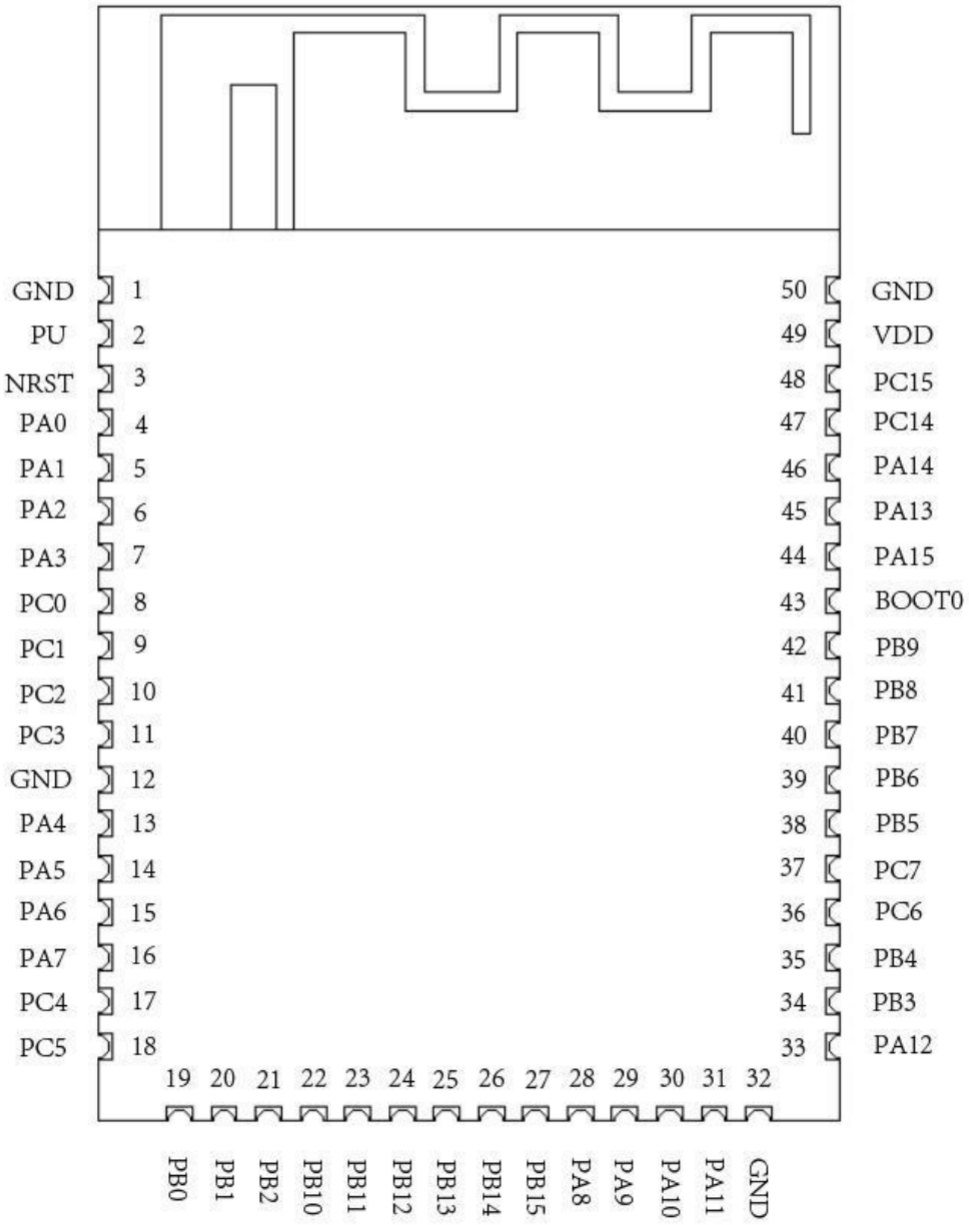
3.1 Module Overview

The WK515-D0-A is a single Wi-Fi module packaged in SMD-50 (Surface Mount Device) form factor.

The module integrates 2MB of onboard Flash memory. An external Flash can also be added based on specific application requirements.

The WK515-D0-A supports a dual-antenna design, featuring both an onboard PCB antenna and an I-PEX antenna connector. Users can select the appropriate antenna type according to their application requirements.

3.2 Pin Description



No.	Pin Name	Pin Type	Description
1	GND	POWER	Default: GND Ground connections
2	PU	I	Default: PU
3	NRST	I/O	Default: NRST
4	PA0	I/O	Default: PA0 Alternate: USART0_TX, TSI_G0_IO0, USART1_CTS, EVENTOUT, TIMER1_CH0, TIMER1_ETI, TIMER4_CH0 Additional: ADC_IN0
5	PA1	I/O	Default: PA1 Alternate: USART0_RX, TSI_G0_IO1, USART1_RTS, EVENTOUT, TIMER1_CH1, TIMER4_CH1 Additional: ADC_IN1
6	PA2	I/O	Default: PA2 Alternate: USART0_CK, TSI_G0_IO2, TIMER0_CH0, EVENTOUT, TIMER1_CH2, TIMER4_CH2, I2S1_CKIN, USART1_TX, HPDF_AUDIO Additional: ADC_IN2, WKUP0, RTC_TAMP1
7	PA3	I/O	Default: PA3 Alternate: USART1_CK, TSI_G0_IO3, TIMER0_CH0_ON, HPDF_DATA IN1, EVENTOUT, TIMER1_CH3, TIMER4_CH3, I2S1_MCK, USART1_RX, RTC_OUT Additional: ADC_IN3
8	PC0	I/O	Default: PC0 Alternate: USART1_TX, TIMER0_CH3, I2C0_SMBA, HPDF_CKIN0, EVENTOUT, DCI_D4 Additional: ADC_IN4
9	PC1	I/O	Default: PC1 Alternate: I2S1_SD, USART1_RX, DCI_HSY NC, TIMER0_BRKIN, I2C1_SMBA, HPDF_CKIN1, EVENTOUT, SPI1_MOSI, DCI_D8 Additional: ADC_IN5
10	PC2	I/O	Default: PC2 Alternate: HPDF_CKOUT, I2C1_SDA, I2C0_SCL,TIMER4_CH0, TIMER0_CH0, DCI_VSYNC, TIMER0_ETI, EVENTOUT, SPI1_MISO, I2S1_ADD_SD, DCI_D9 Additional: ADC_IN6

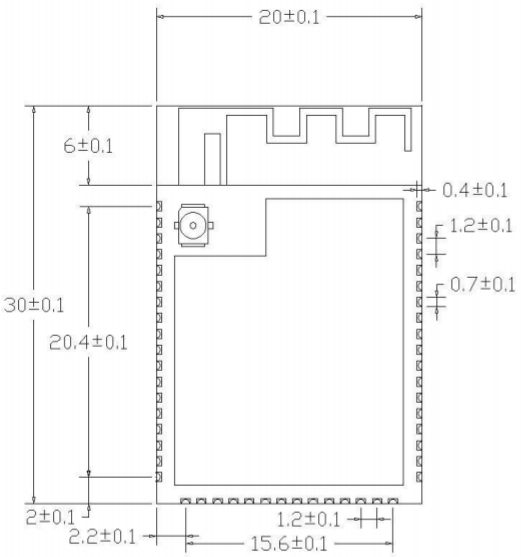
No.	Pin Name	Pin Type	Description
11	PC3	I/O	Default: PC3 Alternate: I2S1_SD, HPDF_DATA IN0, I2C1_SCL, I2C0_SDA, TIMER4_CH1, TIMER0_CH0_ON, DCI_PIXCLK, TIMER1_CH0, TIMER1_ETI, EVENTOUT, SPI1_MOSI, DCI_D11 Additional: ADC_IN7
12	GND	POWER	Default: GND Ground connections
13	PA4	I/O	Default: PA4 Alternate: I2S1_ADD_SD, SPI1_MOSI, I2S1_SD, SPI0_MOSI, QSPI_SCK, TIMER4_CH2, DCI_HSYNC, USART1_TX, TIMER0_CH1, EVENTOUT, SPI0_NSS, USART1_CK Additional: ADC_IN8
14	PA5	I/O	Default: PA5 Alternate: I2S1_MCK, SPI0_MISO, QSPI_CSN, TIMER4_CH3, DCI_VSYNC, USART1_RX, TIMER0_CH1_ON, EVENTOUT, SPI0_SCK
15	PA6	I/O	Default: PA6 Alternate: I2S1_CKIN, SPI0_SCK, QSPI_IO0, TIMER2_CH0, DCI_PIXCLK, USART2_TX, TIMER0_CH1, TIMER1_CH1, EVENTOUT, SPI0_MISO, I2S1_MCK, SDIO_CMD, HPDF_A UDIO
16	PA7	I/O	Default: PA7 Alternate: SPI1_NSS, I2S1_WS, SPI0_NSS, QSPI_IO1, TIMER2_CH1, DCI_D7, USART2_RX, TIMER0_CH1_ON, TIMER1_CH2, EVENTOUT, TIMER0_CH0_ON, SPI0_MOSI
17	PC4	I/O	Default: PC4 Alternate: I2S1_ADD_SD, SPI0_IO2, QSPI_IO2, TIMER2_CH2, DCI_D6, EVENTOUT, SQPI_CLK, DCI_D12
18	PC5	I/O	Default: PC5 Alternate: CK_OUT1, SPI0_IO3, QSPI_IO3, TIMER2_CH3, TIMER2_CH0, DCI_D5, DCI_D7, EVENTOUT, USART2_RX, SQPI_CSN, DCI_D13
19	PB0	I/O	Default: PB0 Alternate: TSI_G1_IO0, TIMER3_CH0, TIMER2_CH1, DCI_D4, DCI_D6, EVENTOUT, TIMER0_CH1_ON,SDIO_D1

No.	Pin Name	Pin Type	Description
20	PB1	I/O	Default: PB1 Alternate: TSI_G1_IO1, TIMER3_CH1, TIMER2_CH2, DCI_D3, DCI_D5, EVENTOUT, TIMER0_CH2_ON, SDIO_D2
21	PB2	I/O	Default: PB2 Alternate: TSI_G1_IO2, TIMER3_CH2, TIMER2_CH3, DCI_D2, DCI_D4, EVENTOUT, TIMER1_CH3, SDIO_CK Additional: WKUP2
22	PB10	I/O	Default: PB10 Alternate: TSI_G1_IO3, TIMER3_CH3, TIMER0_CH1, DCI_D1, DCI_D3, IFRP_OUT, EVENTOUT, TIMER1_CH2, TIMER3_ETI, USART2_TX, SDIO_D7
23	PB11	I/O	Default: PB11 Alternate: USBFS_ID, TSI_G2_IO0, TIMER0_CH1_ON, DCI_D0, DCI_D2, EVENTOUT, I2S1_CKIN, USART2_RX, SDIO_D6
24	PB12	I/O	Default: PB12 Alternate: I2S1_WS, USBFS_DP, TSI_G2_IO1, DCI_D1, TIMER0_CH3, EVENTOUT, TIMER0_BRKIN, SPI1_NSS, USART2_CK
25	PB13	I/O	Default: PB13 Alternate: USBFS_DM, TSI_G2_IO2, DCI_D0, EVENTOUT, TIMER15_CH0, TIMER0_CH0_ON, SPI1_SCK, I2S1_CK, USART2_CTS
26	PB14	I/O	Default: PB14 Alternate: TSI_G2_IO3, EVENTOUT, TIMER15_BRKIN, TIMER0_CH1_ON, SPI1_MISO, I2S1_ADD_SD, USART2_RTS Additional: USBFS_VBUS
27	PB15	I/O	Default: PB15 Alternate: I2S1_SD, USART1_TX, USART0_TX, I2C0_SCL, I2C1_SCL, IFRP_OUT, EVENTOUT, RTC_REFIN, TIMER0_CH2_ON, SPI1_MOSI
28	PA8	I/O	Default: PA8 Alternate: CK_OUT0, USART1_RX, USART0_RX, I2C0_SDA, I2C1_SDA, EVENTOUT, TIMER15_CH0, TIMER0_CH0, USART0_CK, USBFS_SOF, SDIO_D1, RTC_OUT

No.	Pin Name	Pin Type	Description
29	PA9	I/O	Default: PA9 Alternate: SPI0_MOSI, SDIO_CMD, SQPI_CLK,QSPI_SCK, EVENTOUT, TIMER15_CH0_ON, TIMER0_CH1, SPI1_SCK, I2S1_CK, USART0_TX, SDIO_D2, DCI_D0
30	PA10	I/O	Default: PA10 Alternate: SPI0_MISO, SDIO_D0, SQPI_CSN, QSPI_CSN, EVENTOUT, TIMER16_CH0, TIMER0_CH2, DCI_D1
31	PA11	I/O	Default: PA11 Alternate: SPI0_SCK, SDIO_CK, SQPI_D0, QSPI_IO0, EVENTOUT, TIMER16_BRKIN, TIMER0_CH3, DCI_D2
32	GND	POWER	Default: GND Ground connections
33	PA12	I/O	Default: PA12 Alternate: SPI0_NSS, SDIO_D1, SQPI_D1, QSPI_IO1, EVENTOUT, TIMER16_CH0_ON, TIMER0_ETI, USART0_RTS, DCI_D3 Additional: WKUP3
34	PB3	I/O	Default: JTDO, TRACESWO, PB3 Alternate: USART2_CTS, SPI0_IO2, SDIO_D2, SQPI_D2, QSPI_IO2, EVENTOUT, TIMER15_BRKIN, TIMER1_CH1, SPI0_SCK, USART0_RX
35	PB4	I/O	Default: NJTRST, PB4 Alternate: USART2_RTS, SPI0_IO3, SDIO_D3, SQPI_D3, QSPI_IO3, TIMER1_CH0, TIMER1_ETI, EVENTOUT, SPI0_MISO
36	PC6	I/O	Default: PC6 Alternate: USART2_TX, TIMER1_CH1, TIMER0_CH1, TIMER0_BRKIN, TRACECK, TIMER16_BRKIN, TIMER2_CH0, I2S1_MCK, SDIO_D6, DCI_D0
37	PC7	I/O	Default: PC7 Alternate: USART2_RX, TIMER1_CH2, TIMER0_CH1_ON, TIMER0_ETI, TIMER16_CH0, TIMER2_CH1, SPI1_SCK, I2S1_CK, SDIO_D7, DCI_D1
38	PB5	I/O	Default: PB5 Alternate: USART2_CK, TIMER1_CH3, IFRP_OUT, EVENTOUT, TSITG, SPI0_MOSI, DCI_D10
39	PB6	I/O	Default: PB6 Alternate: SPI1_MISO, EVENTOUT, TRACED0, DCI_D5

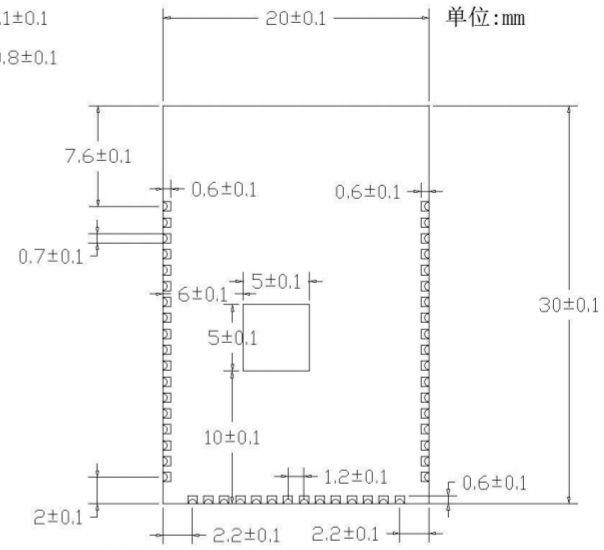
No.	Pin Name	Pin Type	Description
40	PB7	I/O	Default: PB7 Alternate: I2S1_WS, SPI1_NSS, EVENTOUT, TRACED1, TIMER3_CH1, I2C0_SDA, USART0_RX, DCI_VSYNC
41	PB8	I/O	Default: PB8 Alternate: SPI1_SCK, I2S1_CK, EVENTOUT, TRACED2, TIMER3_CH2, SDIO_D4, DCI_D6
42	PB9	I/O	Default: PB9 Alternate: I2S1_SD, SPI1_MOSI, EVENTOUT, TRACED3, TIMER1_CH1, TIMER3_CH3, SDIO_D5, DCI_D7
43	PC8	I/O	Default: PC8 Alternate: I2C0_SDA, USART0_TX, I2C1_SDA, EVENTOUT, TIMER2_CH2, SDIO_D0, DCI_D2 Additional: BOOT0
44	PA15	I/O	Default: JTDI, PA15 Alternate: I2C0_SCL, USART0_RX, I2C1_SCL, EVENTOUT, SPI0_NSS Additional: WKUP1
45	PA13	I/O	Default: JTMS, SWDIO, PA13 Alternate: USART0_CTS, USART1_CTS, I2C0_SMBA, EVENTOUT, TSITG
46	PA14	I/O	Default: JTCK, SWCLK, PA14 Alternate: USART0_RTS, USART1_RTS, I2C1_SMBA, EVENTOUT Additional: BOOT1
47	PC14	I/O	Default: PC14 Alternate: USART0_CK, USART1_CK, EVENTOUT Additional: OSC32IN
48	PC15	I/O	Default: PC15 Alternate: IFRP_OUT, EVENTOUT Additional: RTC_TAMP0, RTC_OUT, RTC_TS, OSC32OUT
49	VDD	POWER	Default: VDD
50	GND	POWER	Default: GND Ground connections

3.3 Mechanical Dimensions



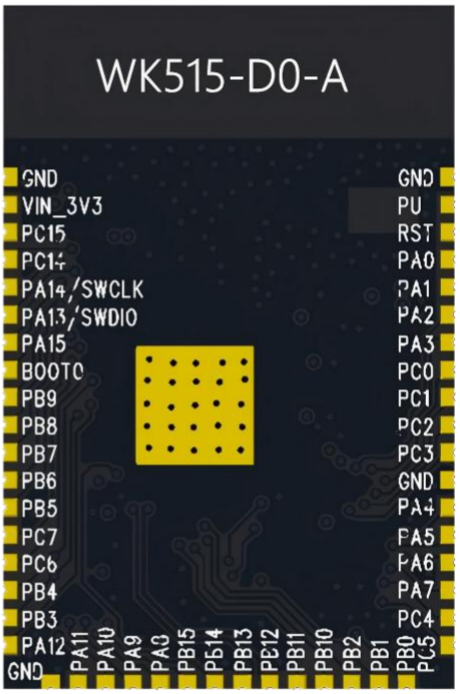
Top View

Side View



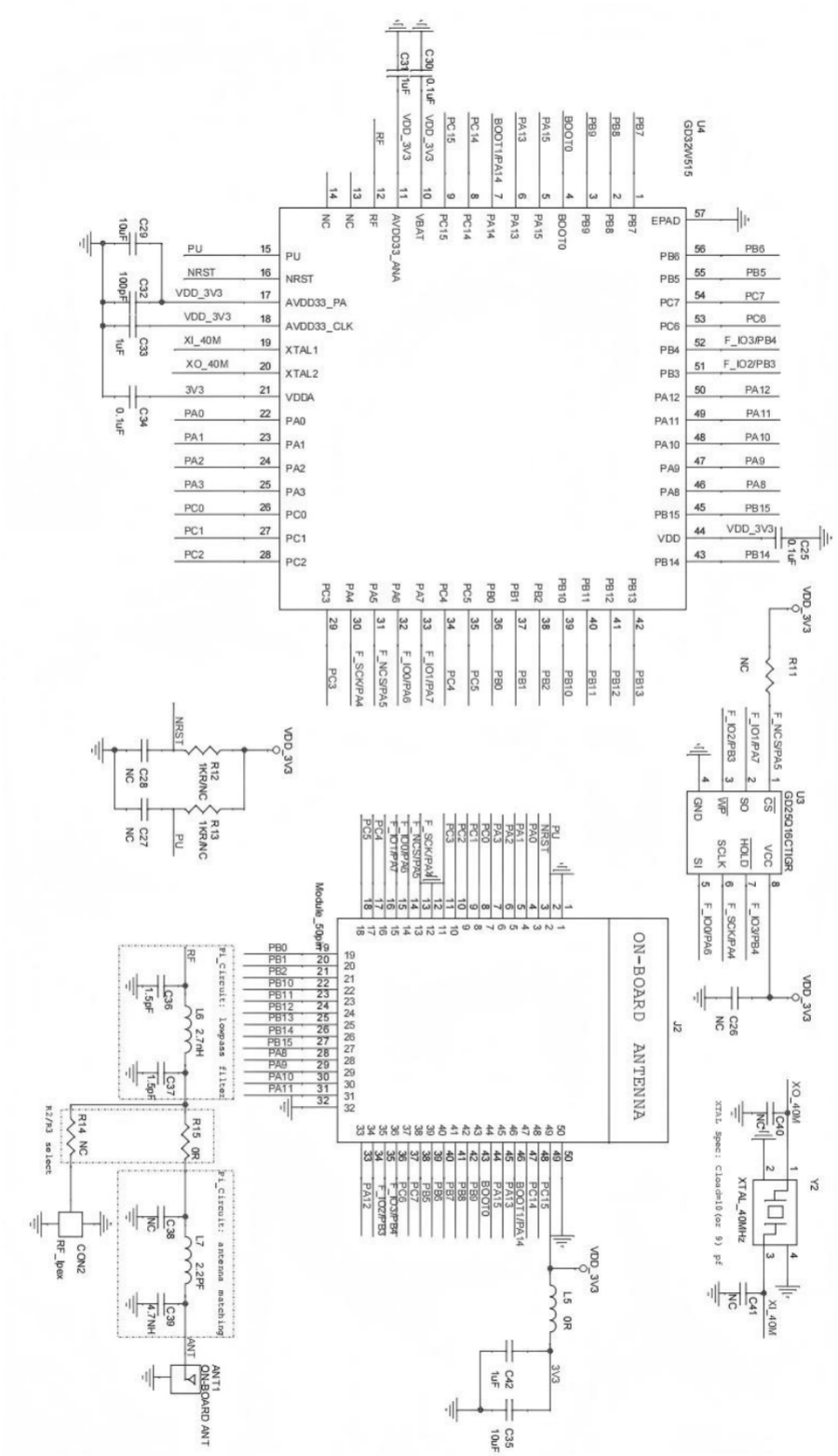
Bottom View

Front

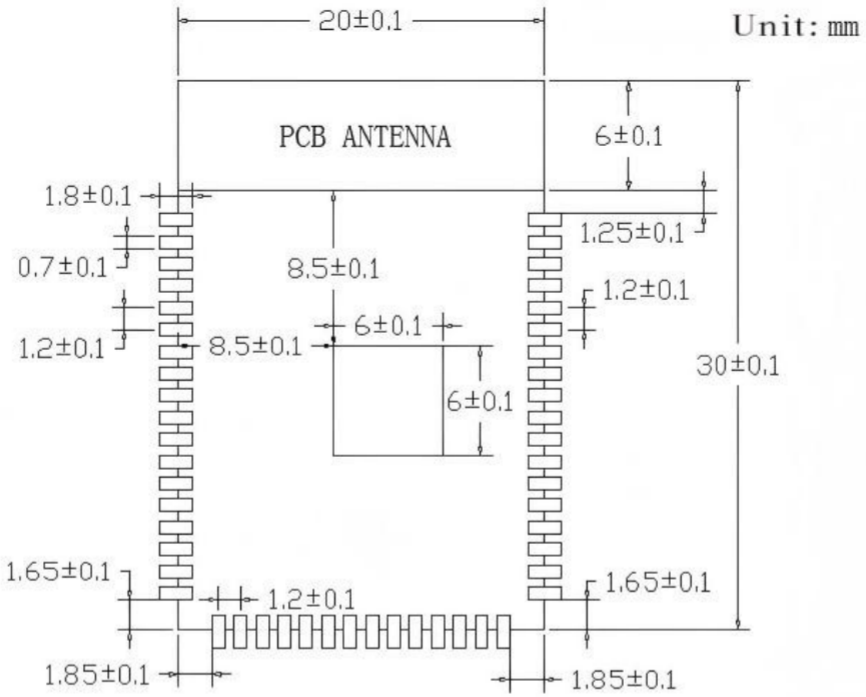


Back

3.4 Reference Schematic

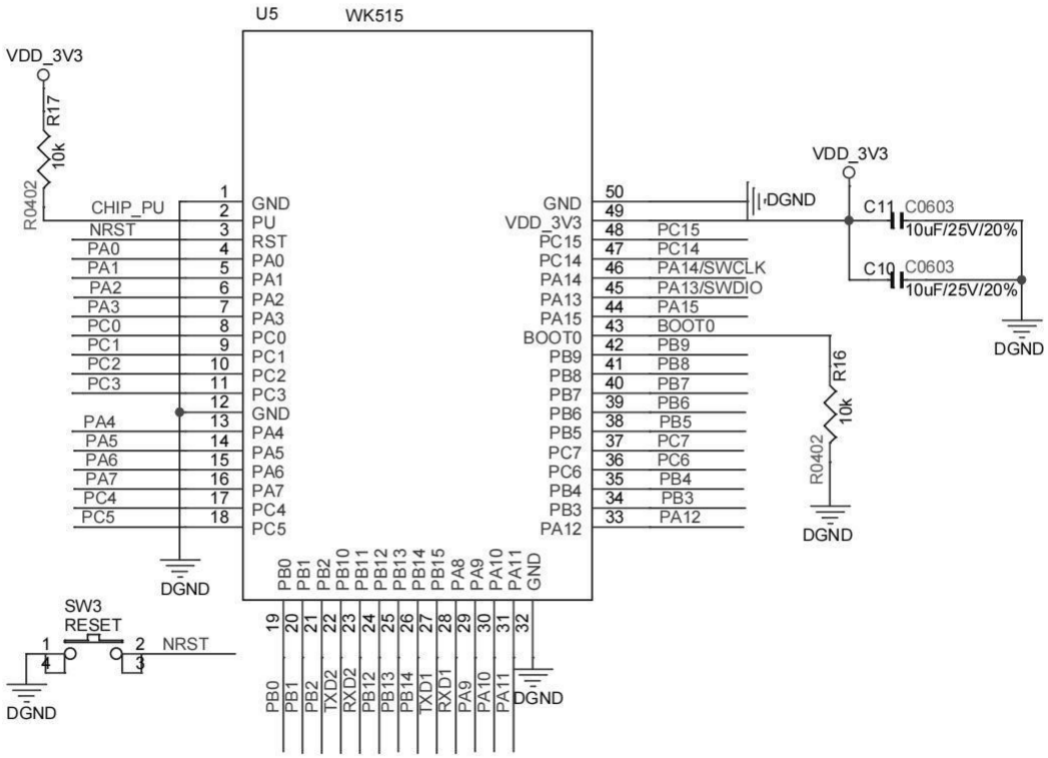


3.5 PCB Footprint



3.6 Design Guidelines

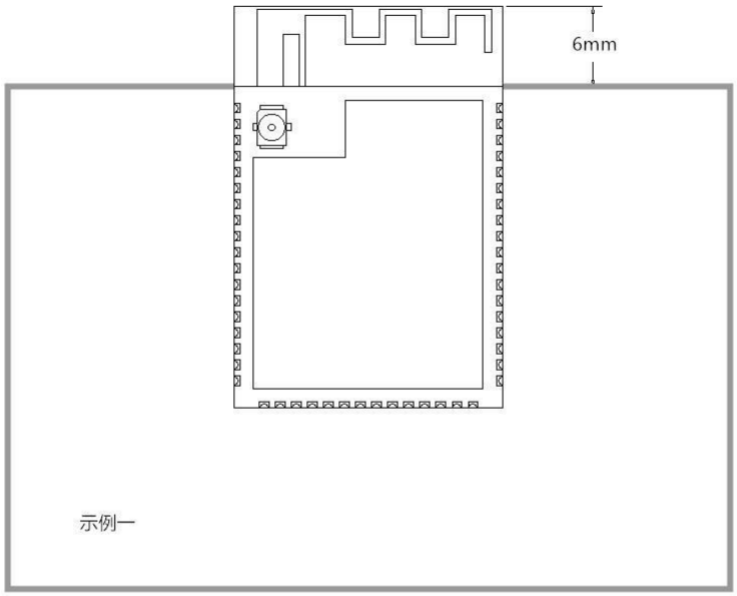
3.6.1 Reference Application Circuit



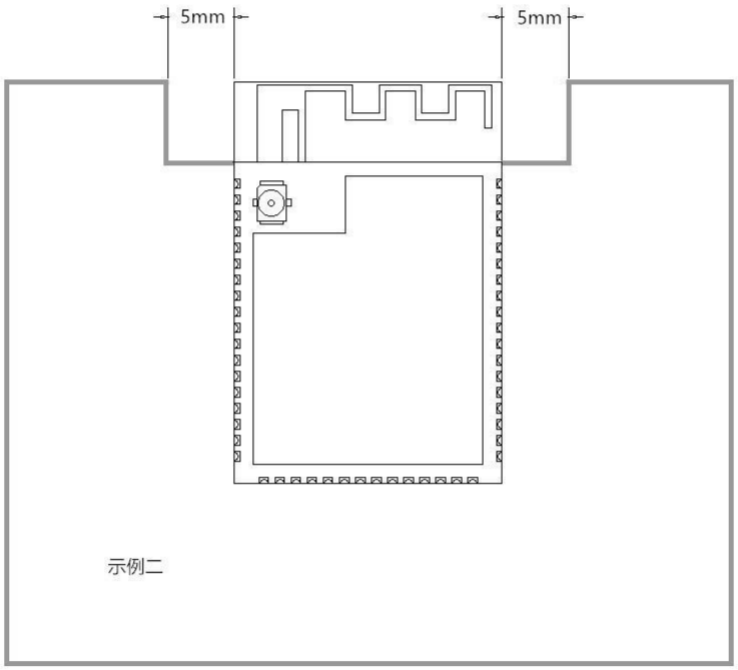
3.6.2 Onboard Antenna Placement Guidelines

To achieve the best RF performance, keep the antenna area free from metal objects, ground copper, shielding enclosures, and high-frequency components.
Recommended module placement examples are shown below.

Example 1



Example 2

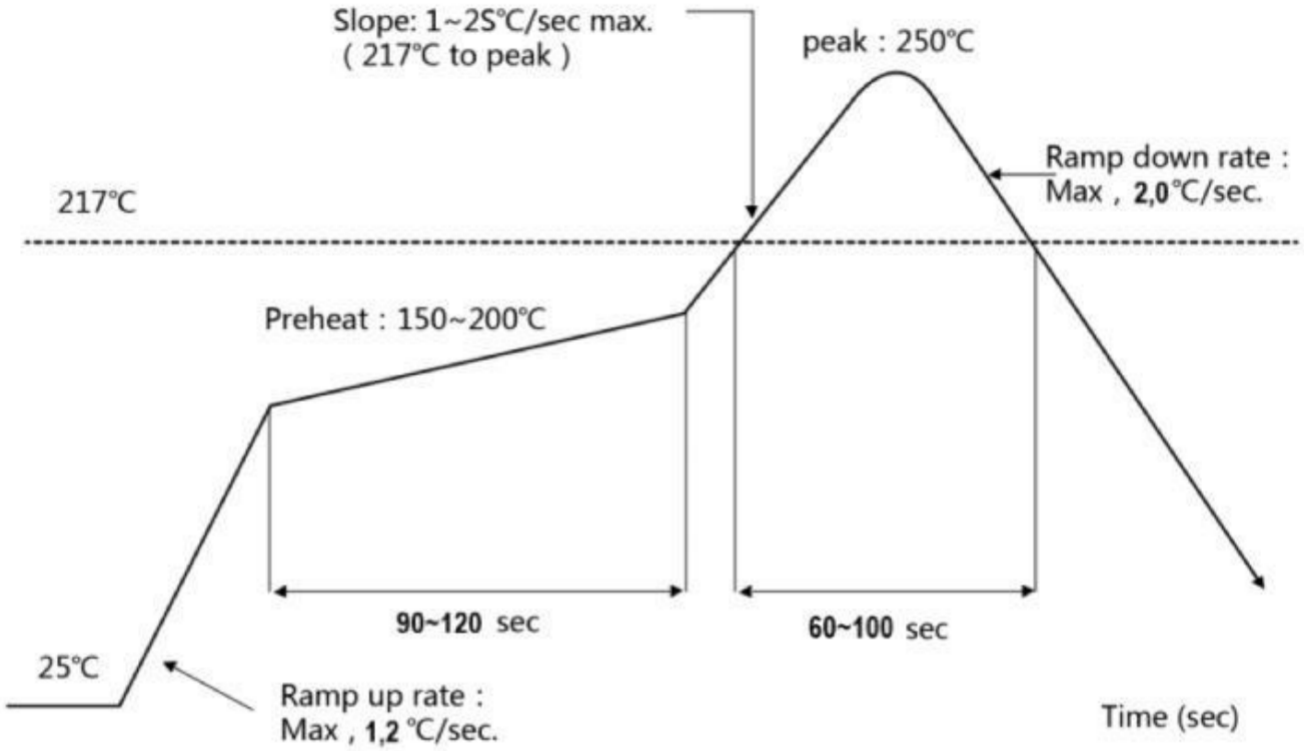


4. Reflow Soldering Profile

Compliant with IPC/JEDEC reflow soldering standards.

Peak reflow temperature: 250°C maximum.

Recommended reflow cycles: no more than 2 times.



5. Contact Us

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6. References

1.《GD32W515xx_Datasheet_Rev1.0.pdf》