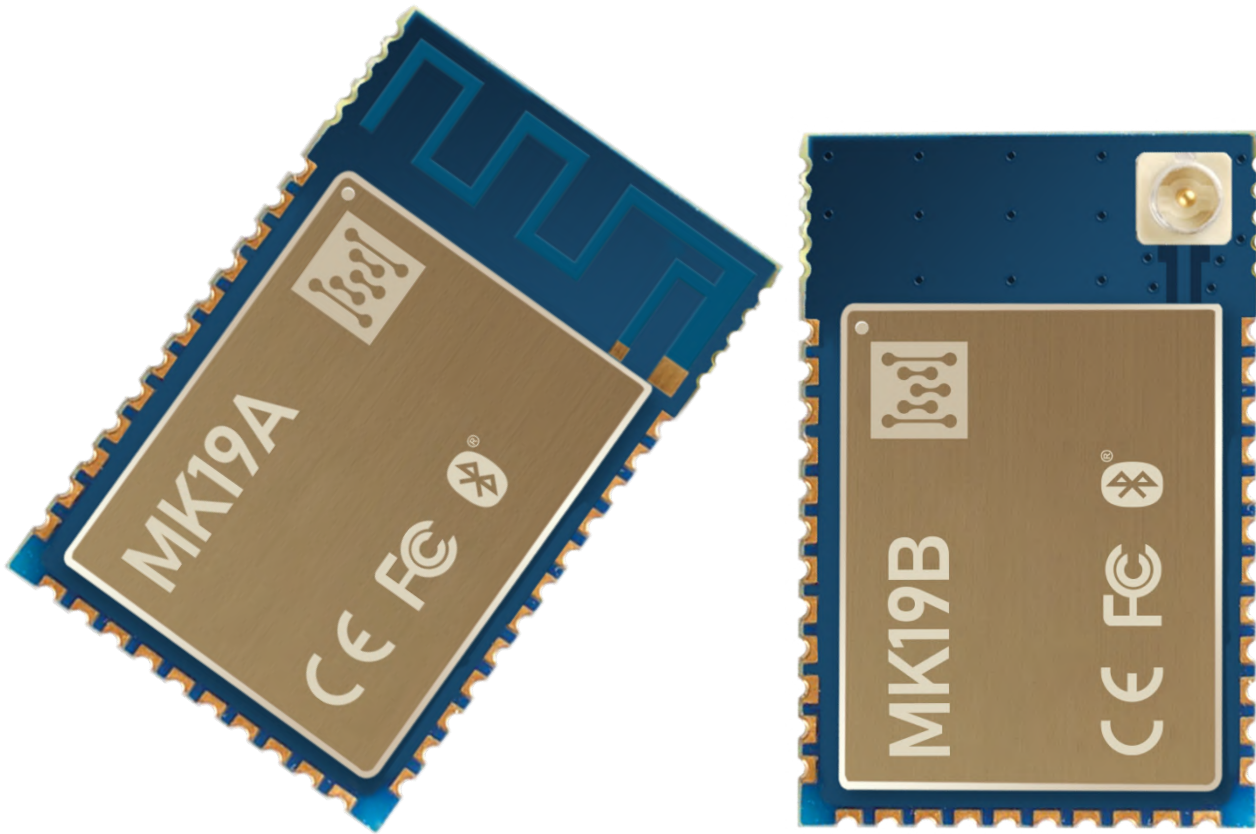




MOKO SMART

MK19 Bluetooth Module Datasheet



MK19 Bluetooth Module

Datasheet

Version 1.0

MOKO TECHNOLOGY LTD.

www.mokosmart.com



Revision History

Version	Description	Contributor(s)	Date
V1.0	Initial Release	YK Huang	December 25, 2024

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1 Instructions

MK19 is powerful, highly flexible and cost-effective Bluetooth module based on world-leading **Nordic® Semiconductor nRF54L15** SoC solution, which integrates an ultra-low power multi-protocol 2.4GHz radio and MCU functionality featuring a 128 MHz Arm® Cortex™-M33 processor, comprehensive peripheral set, and scalable memory configurations to 1.5 MB NVM and 256 KB RAM.

MK19 is suited to enable a broad range of applications. The multi-protocol 2.4 GHz radio supports the latest **Bluetooth® 6.0** features including Bluetooth Channel Sounding, as well as 802.15.4-2020 for standards such as Thread, Matter, and Zigbee, and a proprietary 2.4 GHz mode supporting up to 4 Mbps for higher throughput.

MK19 module brings out all nRF54L15 hardware features and capabilities like RISC-V Coprocessor, high-speed SPI, SPIM, UART, Global RTC, NFC, and up to +8dBm Tx Power and more.

MK19 module follows the size and package of most MOKO Bluetooth modules such as the MK02 (nRF52832 SoC), MK07 (nRF52833 SoC), MK08 (nRF52840 SoC) and MK13 (nRF5340 SoC), allowing you to easily and quickly upgrade your hardware to the latest and powerful nRF54L15 Bluetooth solution without re-designing hardware.

MK19 module will be programmed using the default MOKO MKBN series firmware and client's own firmware can be programmed for mass production. After you choose MK19 series module, MOKO Smart will provide technical support for your development. We can power demanding applications, while simplifying designs and reducing BOM costs.

1.1 Features and Benefits

- **Multi-protocol radio supporting**
 - Bluetooth 6.0 – 2 Mbps, 1 Mbps, 500 kbps, and 125 kbps
 - IEEE 802.15.4-2020 (Thread, Matter, Zigbee)
 - Proprietary 2.4 GHz (up to 4 Mbps data rates)
- **MCU**
 - Arm® Cortex™-M33, 128 MHz
 - 1524 KB non-volatile memory (RRAM) and 256 KB RAM
 - 505 EEMBC CoreMark® score running from non-volatile memory, 3.95 CoreMark per MHz
 - Single-precision floating-point unit (FPU)
 - Memory protection unit (MPU)
 - Digital signal processing (DSP) instructions
- **Peripherals**
 - 128 Mhz RISC-V Coprocessor
 - Two realtime counters (RTC), and one global RTC (GRTC) that can run in System OFF mode and implement a shared system timer.
 - Five fully featured serial interfaces with EasyDMA, supporting I²C, SPI controller/peripheral, and UART
 - 14-bit ADC
 - Three pulse width modulator (PWM) units with EasyDMA
 - I²S two channel Inter-IC sound interface
 - Pulse density modulation (PDM) interface
 - Near field communication (NFC)
 - Two quadrature decoders (QDEC)
 - Embedded inductors for DC/DC converter
 - 32.768 kHz crystal oscillator
 - 34 half-hole pins and 4 debug pads
 - 28 GPIOs
 - 1.7V to 3.6V supply voltage

1.2 Applications

- **Internet of things (IOT)**
 - Smart home sensors and controllers
 - Industrial IoT sensors and controllers

- **Advanced wearables**
 - Health/fitness sensor and monitor devices
 - Wireless payment enabled devices

- **Advanced computer peripherals and I/O devices**
 - Mouse
 - Keyboard
 - Multi-touch trackpad

- **Interactive entertainment devices**
 - Remote controls
 - Gaming controllers

1.3 Product Options

1.3.1 Hardware Options

There are two different models (**MK19A** and **MK19B**) of **MK19** series Bluetooth modules. Both models have same dimensions and pin assignments. The difference is in the antenna design.

MK19A embeds a high-performance PCB antenna.

MK19B uses a u.FL connector (receptacle) and requires an external 2.4Ghz antenna.

MOKO smart development team can assist you in selecting high-performance antennas that suit your needs.



	<p>MK19A</p> <p>PCB antenna is used. No need to design another antenna. u.FL connector will not be mounted on the PCB.</p>
	<p>MK19B</p> <p>The PCB antenna is disabled. You need to select an external 2.4Ghz antenna to connect to the u.FL connector.</p>

Figure 1: MK19A and MK19B

1.3.2 Firmware Options

For customers to use, MK19 series modules will be programmed default MOKO MKBN-L01 series firmware, which has the functions of UART Wireless Transparent Transmission.

MOKO Smart can help you develop the firmware and can also program your own firmware to modules when manufacture.

Firmware Version	Firmware Features
MKBN-L01	UART wireless transparent transmission

Note: This document is a Hardware Datasheet only – it does not cover the software aspects of the MK19. If you want to get more information about firmware or SDKs of MK19, please contact sales of MOKO Smart.

1.3.3 Ordering Information

Product Model	Antenna	32.768kHz XTAL	Firmware Version	Remark
MK19A	PCB	Yes	MKBN-L01	Default model
MK19B	u.FL connector	Yes	MKBN-L01	Default model

MOKO Smart can provide the default model modules as samples to you to test or develop without MOQ. But if you want the custom models, there will be a MOQ requirement. Please contact sales team of MOKO Smart to get more ordering information.

2 Specifications

Detail	Description
Chip	nRF54L15
Bluetooth Version	Bluetooth 6.0
MCU	ARM® Cortex®-M33, 128 MHz
RAM	256 KB
Flash	1524 KB non-volatile memory (RRAM)
Tx Power	-46 dBm to +8 dBm, 1 dB step size from -10 dBm to +8 dBm
Receiver Sensitivity	-96 dBm sensitivity in 1 Mbps Bluetooth® LE mode -104 dBm sensitivity in 125 kbps Bluetooth® LE mode -101 dBm sensitivity in IEEE 802.15.4 with a 37 bytes packet length
Clock Control	On-chip 128 MHz phase-locked loop (PLL) with internal oscillator 32MHz crystal oscillator Embedded 32.768 kHz RC oscillator and external 32.768kHz crystal oscillator
Power Supply	1.7V to 3.6V DC
Power Regulator	Switching regulator for DC/DC buck setup
Power Consumption	Peak current 10.0 mA (BLE TX 1 Mbps @ +8 dBm and 3.0V) 3.0 uA (System ON IDLE with GRTC (XOSC) and 256 KB RAM) 0.6 uA (System OFF)
Antenna	MK19A – PCB trace antenna MK19B – u.FL connector
Quantity of Pin	34 half-hole pins and 4 round debug pad pins
GPIO	28
Operating Temperature	-40 to 85°C Extended Industrial temperature -40 to +105°C can be customized
Module Dimensions	Length: 21mm±0.2mm Width: 13.8mm±0.2mm Height: 2.3mm+0.1mm/-0.15mm

3 Hardware Design

3.1 Block Diagram

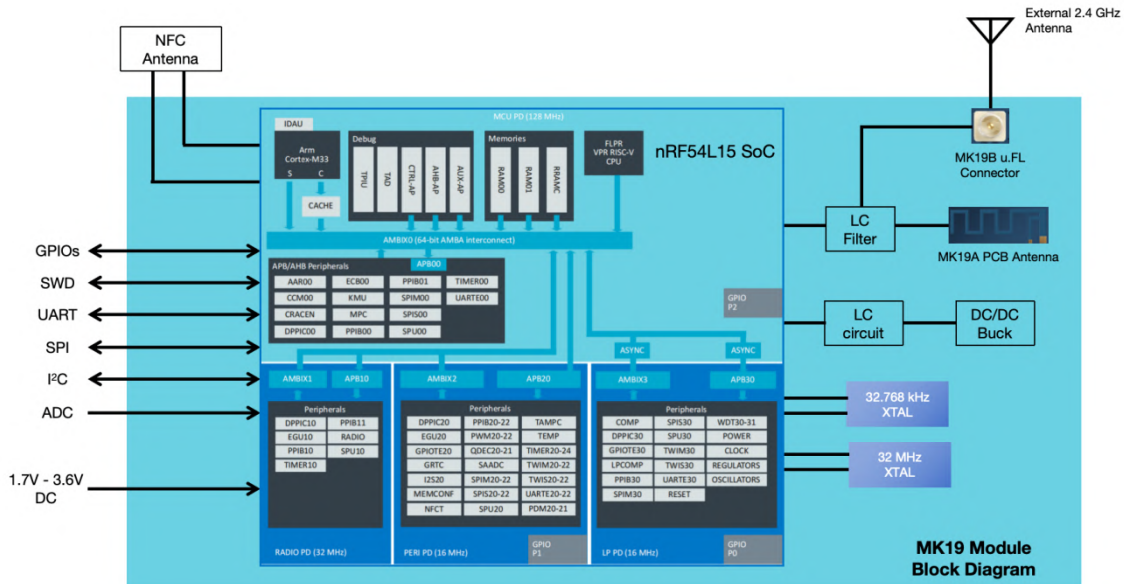


Figure 2: MK19 Block Diagram

3.2 Pin-out and Pin Assignments

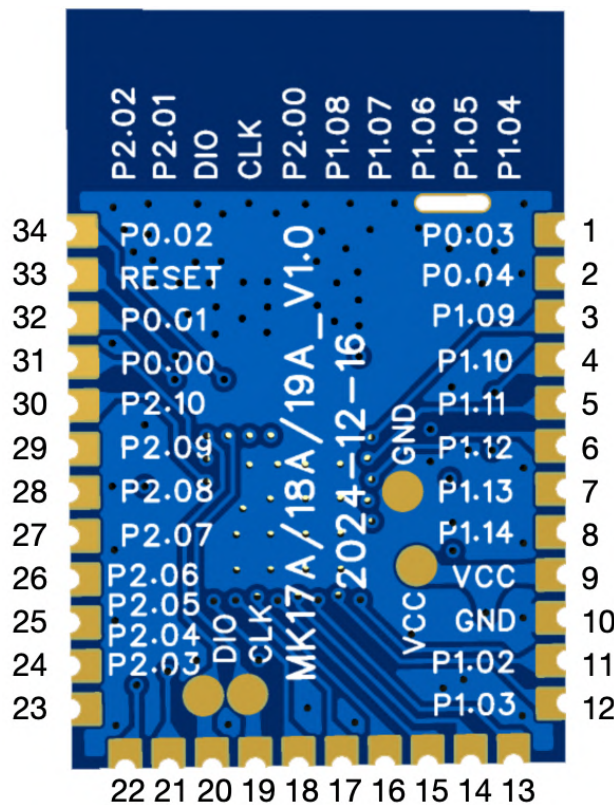


Figure 3: MK19 pin diagram (Rear View)



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Module Pin No.	nRF54L15 Pin No.	nRF54L15 Pin Name	Function	Description	Dedicated function
1	28	P0.03 GRTCPWM	Digital I/O Digital I/O	General purpose I/O GRTC PWM output	GRTC
2	29	P0.04 GRTCLFCLKOUT	Digital I/O Digital I/O	General purpose I/O GRTC LF clock output	GRTC
3	37	P1.09 ASO [2] RADIO [0]	Digital I/O Digital I/O Digital I/O	General purpose I/O TAMPC active shield 2 output RADIO DFEGPIO	TAMPC RADIO
4	38	P1.10 ASI [2] RADIO [1]	Digital I/O Digital I/O Digital I/O	General purpose I/O TAMPC active shield 2 input RADIO DFEGPIO	TAMPC RADIO
5	39	P1.11 ASO [3] RADIO [2] AIN4	Digital I/O Digital I/O Digital I/O Analog input	General purpose I/O TAMPC active shield 3 output RADIO DFEGPIO Analog input	TAMPC RADIO
6	40	P1.12 ASI [3] RADIO [3] AIN5	Digital I/O Digital I/O Digital I/O Analog input	General purpose I/O TAMPC active shield 3 input RADIO DFEGPIO Analog input	TAMPC RADIO
7	41	P1.13 RADIO [4] AIN6	Digital I/O Digital I/O Analog input	General purpose I/O RADIO DFEGPIO Analog input	RADIO
8	42	P1.14 RADIO [5] AIN7	Digital I/O Digital I/O Analog input	General purpose I/O RADIO DFEGPIO Analog input	RADIO
9	10,22,36,47,48	VDD	Power	Power supply	
10	44	VSS, Die pad	Power	Ground	
11	3	P1.02 NFC1	Digital I/O NFC input	General purpose I/O NFC antenna connection	
12	4	P1.03 NFC2	Digital I/O NFC input	General purpose I/O NFC antenna connection	
13	5	P1.04 ASO [0] AIN0	Digital I/O Digital I/O Analog input	General purpose I/O TAMPC active shield 0 output Analog input	TAMPC



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MK19 Bluetooth Module

Datasheet

Module Pin No.	nRF54L15 Pin No.	nRF54L15 Pin Name	Function	Description	Dedicated function
14	6	P1.05 ASI [0] RADIO [6] AIN1	Digital I/O Digital I/O Digital I/O Analog input	General purpose I/O TAMPC active shield 0 input RADIO DFEGPIO Analog input	TAMPC RADIO
15	7	P1.06 ASO [1] AIN2	Digital I/O Digital I/O Analog input	General purpose I/O TAMPC active shield 1 output Analog input	TAMPC
16	8	P1.07 ASI [1] AIN3	Digital I/O Digital I/O Analog input	General purpose I/O TAMPC active shield 1 output Analog input	TAMPC
17	9	P1.08 CLK16M EXTREF	Digital I/O Digital I/O Analog input	General purpose I/O GRTC HF clock output External reference for SAADC	
18	11	P2.00	Digital I/O Digital I/O Digital I/O Digital I/O	General purpose I/O SPIM DCX UARTE RXD QSPI D3	SPIM00/20 UARTE00/20 FLPR (QSPI)
19	26	SWDCLK	Debug	Serial wire clock. Input with onchip pull-up.	
20	25	SWDIO	Debug	Serial wire data. Bidirectional with standard-drive and on-chip pull-down.	
21	12	P2.01	Digital I/O Digital I/O Digital I/O Digital I/O	General purpose I/O SPIM SCK SPIS SCK QSPI SCK	SPIM00/20 SPIS00/S20 FLPR
22	13	P2.02	Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O	General purpose I/O SPIM SDO SPIS SDO UARTE TXD QSPI D0 Serial wire output (SWO)	SPIM00/20 SPIS00/20 UARTE00/20 FLPR Trace
23	14	P2.03	Digital I/O Digital I/O	General purpose I/O QSPI D2	FLPR
24	15	P2.04	Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O	General purpose I/O SPIM SDI SPIS SDI UARTE CTS QSPI D1	SPIM00/20 SPIS00/20 UARTE00/20 FLPR



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Module Pin No.	nRF54L15 Pin No.	nRF54L15 Pin Name	Function	Description	Dedicated function
25	16	P2.05	Digital I/O Digital I/O Digital I/O Digital I/O	General purpose I/O SPIM CS UARTE RTS QSPI CS	SPIM00/20 UARTE00/20 FLPR
26	17	P2.06 TRACECLK	Digital I/O Digital I/O Digital I/O Digital I/O	General purpose I/O SPIM SCK SPIS SCK Trace clock	SPIM00/21 SPIS20/21 Trace
27	18	P2.07 TRACEDATA [0] SWO	Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O	General purpose I/O Trace data Serial wire output (SWO) SPIM DCX UARTE RXD	Trace Trace SPIM00/21 UARTE00/21
28	19	P2.08	Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O	General purpose I/O Trace data SPIM SDO SPIS SDO UARTE TXD	Trace SPIM00/21 SPIS00/21 UARTE00/21
29	20	P2.09	Digital I/O Digital I/O Digital I/O Digital I/O Digital I/O	General purpose I/O Trace data SPIM SDI SPIS SDI UARTE CTS	Trace SPIM00/21 SPIS00/21 UARTE00/21
30	21	P2.10	Digital I/O Digital I/O Digital I/O Digital I/O	General purpose I/O Trace data SPIM CS UARTE RTS	Trace SPIM00/21 UARTE00/21
31	23	P0.00	Digital I/O	General purpose I/O	
32	24	P0.01	Digital I/O	General purpose I/O	
33	30	nRESET	Reset	Pin reset with on-chip pull-up	
34	27	P0.02	Digital I/O	General purpose I/O	
VCC (round pad)	10,22,36,47,48	VDD	Power	Power supply	
GND (round pad)	44	VSS, Die pad	Power	Ground	
DIO (round pad)	25	SWDIO	Debug	Serial wire data. Bidirectional with standard-drive and on-chip pull-down.	



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MK19 Bluetooth Module

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Module Pin No.	nRF54L15 Pin No.	nRF54L15 Pin Name	Function	Description	Dedicated function
CLK (round pad)	26	SWDCLK	Debug	Serial wire clock. Input with onchip pull-up.	

Note:

1. Please refer to [Nordic nRF54L15 | nRF54L10 | nRF54L05 Datasheet](#) for detailed descriptions and features supported about the SoC pin assignments.
2. Package of nRF54L15 SoC embedded on MK19 Bluetooth module is QFN48 6.0x6.0 mm.

4 Mechanical Details

4.1 PCBA Mechanical Dimensions

MK19A and MK19B Bluetooth modules have the same dimensions.

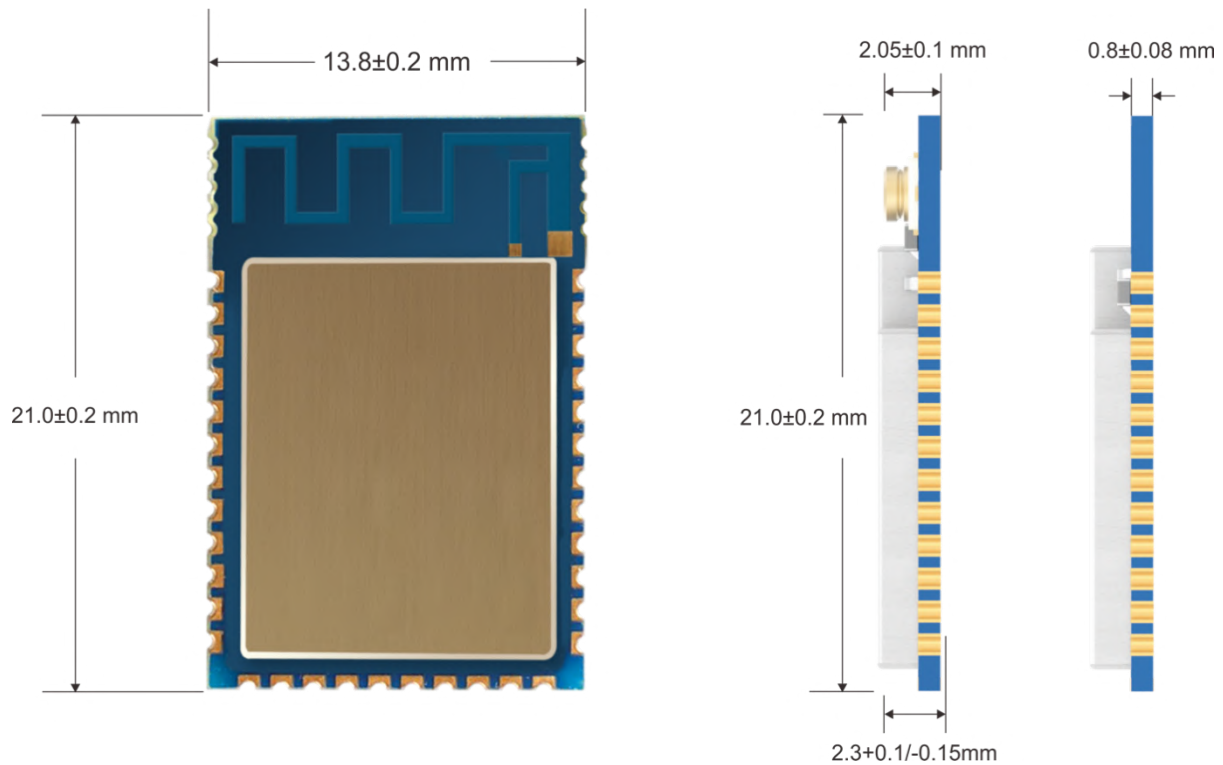


Figure 4: MK19 PCBA dimensions

Symbol	Min.	Typ.	Max.
Length	-0.2mm	21mm	+0.2mm
Width	-0.2mm	13.8mm	+0.2mm
Height (PCB only)	-0.08mm	0.8mm	+0.08mm
Height (with shield)	-0.15mm	2.3mm	+0.1mm



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4.2 PCB Land Pads Dimensions

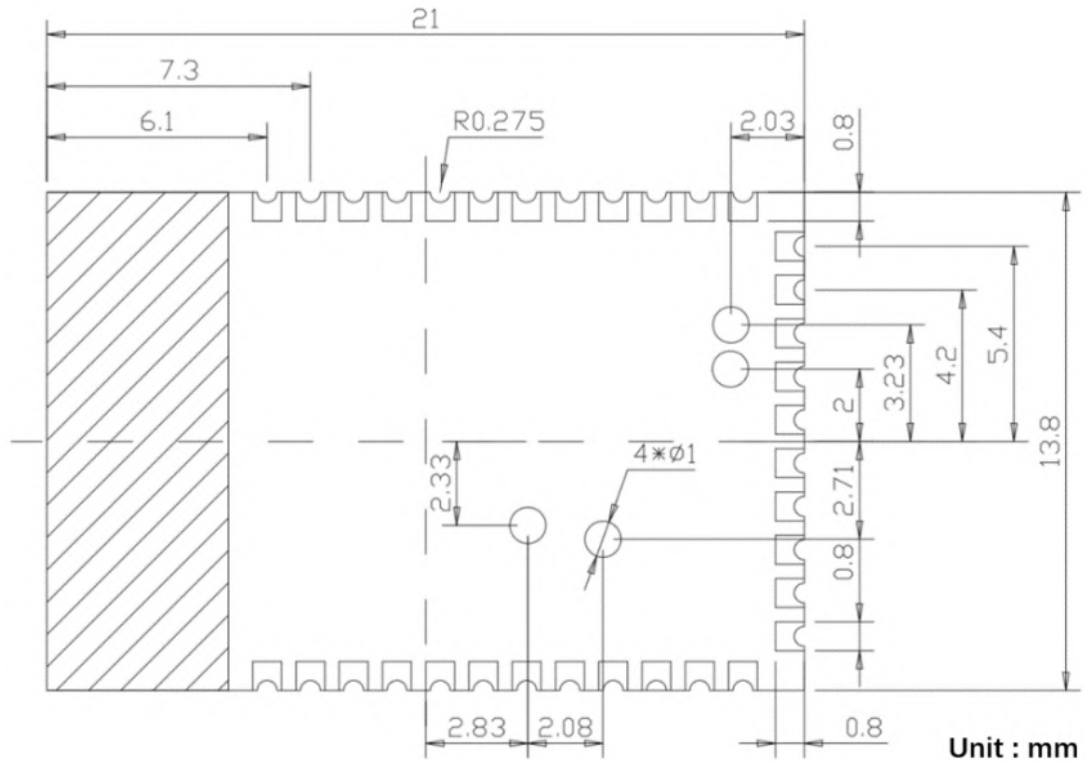


Figure 5: MK19 PCB land pads dimensions (TOP View)

Symbol	Typ.
Half-hole Pad (Bottom)	0.8mm x 0.8mm
Diameter of Half-hole	0.55mm
Diameter of Central Round pad	1mm

4.3 u.FL Connector Dimensions

MK19B has mounted a micro SMT u.FL series connector (receptacle), which needs an external 2.4Ghz antenna to connect. The model of the connector is *u.FL-R-SMT-1(80)*.

According to the dimensions of the connector to choose an antenna with a right plug which can connect to the receptacle appropriately.

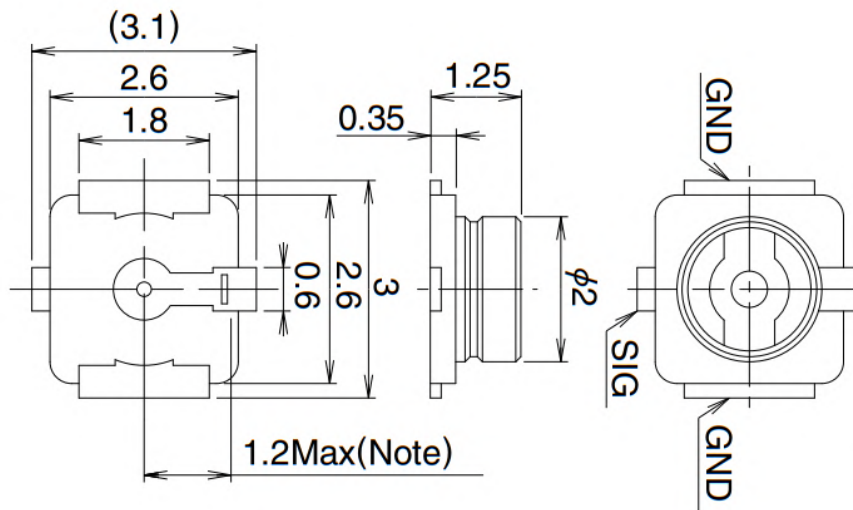


Figure 6: u.FL-R-SMT-1(80) Dimensions

5. Mounting Design Suggestions

5.1 Recommended Mounting and PCB Layout

You can refer to the following references for the mounting design and PCB layout of the MK19 module, especially for the MK19A model which has PCB on-board antenna.

For external antenna modules (MK19B needs to connect an external antenna to the u.FL connector), you also need to refer to the external antenna design requirements.

The recommended mounting and PCB layout suggestion:

- Locate MK19 series module close to the edge of the host PCB (mandatory for MK19A for on-board PCB trace antenna to radiate properly).
- Ensure there is no copper in the antenna keep-out area on any layers of the host PCB. Keep all mounting hardware and metal clear of the area to allow proper antenna radiation.
- Keep the antenna area as far away as possible from the power supply and metal components.
- Ensure no exposed copper is on the underside of the module.
- A different host PCB thickness dielectric will have small effect on antenna.
- Use solid GND plane on inner layer (for best EMC and RF performance).
- All module GND pins must be connected to the host PCB GND.
- Place GND vias close to module GND pads as possible.
- Unused PCB area on surface layer can be flooded with copper but place GND vias regularly to connect the copper flood to the inner GND plane. If GND flood copper is on the bottom of the module, then connect it with GND vias to the inner GND plane.
- Use a good layout method to avoid excessive noise coupling with signal lines or supply voltage lines.

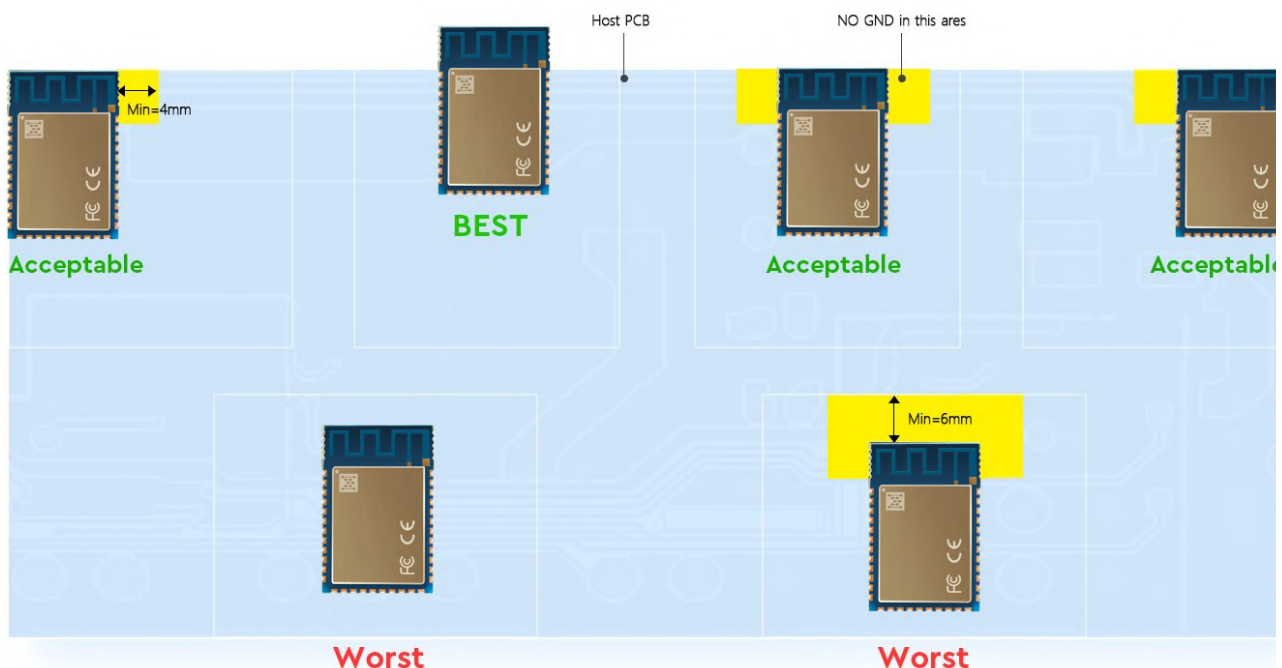


Figure 7: Recommended Module Mounting Examples

5.2 Mechanical Enclosure

Care should be taken when designing and placing the MK19 series module into an enclosure. Metal should be kept clear from the antenna area, both above and below. Any metal around the module can negatively impact RF performance.

The module is designed and tuned for the antenna and RF components to be in free air. Any potting, epoxy fill, plastic over-molding, or conformal coating can negatively impact RF performance and must be evaluated by the customer.

Placement of metal/plastic enclosure:

- Minimum safe distance for metal parts without seriously compromising the antenna (tuning) is 40 mm top/bottom and 30 mm left or right.
- Metal close to the series module antenna (bottom, top, left, right, any direction) will have degradation on the antenna performance. The amount of that degradation is entirely system dependent, meaning you will need to perform some testing with your host application.
- Any metal closer than 20 mm will begin to significantly degrade performance (S11, gain, radiation efficiency).
- It is best that you test the range with a mock-up (or actual prototype) of the product to assess effects of enclosure height (and materials, whether metal or plastic).

6. Cautions

6.1 Reflow Soldering

Reflow soldering is a vitally important step in the SMT process. The temperature curve associated with the reflow is an essential parameter to control to ensure the correct connection of parts. The parameters of certain components will also directly impact the temperature curve selected for this step in the process.

- The standard reflow profile has four zones: ①preheat, ②soak, ③reflow, ④cooling. The profile describes the ideal temperature curve of the top layer of the PCB.
- During reflow, modules should not be above 260°C and not for more than 30 seconds.

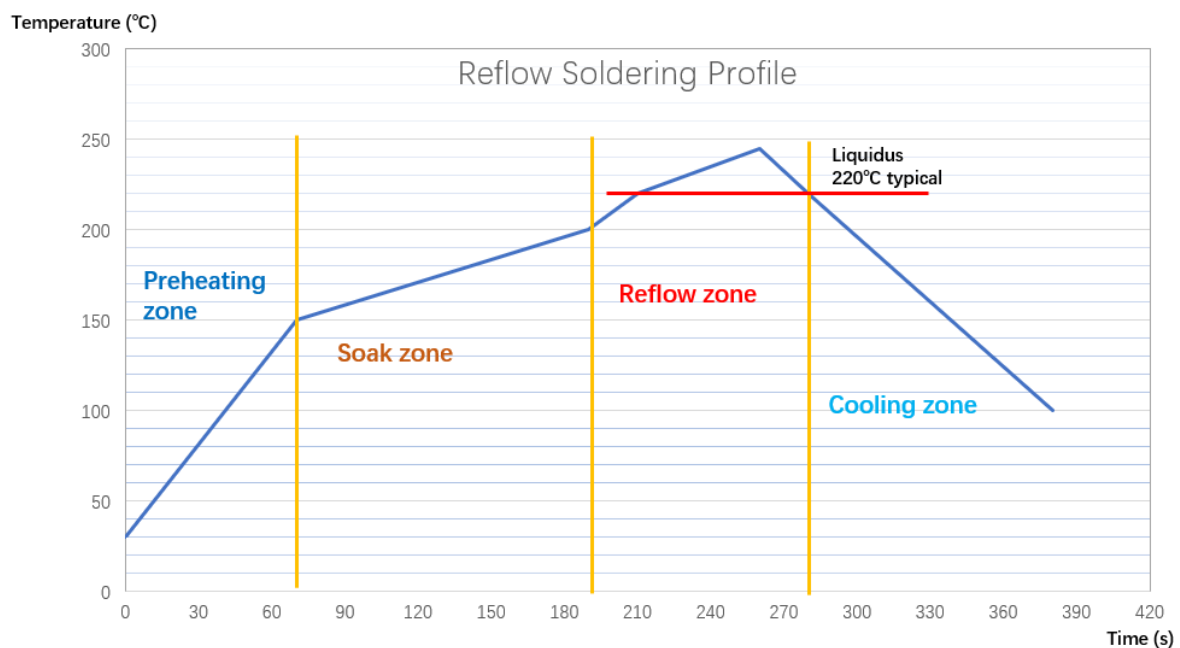


Figure 8: Temperature-Time Profile for Reflow Soldering

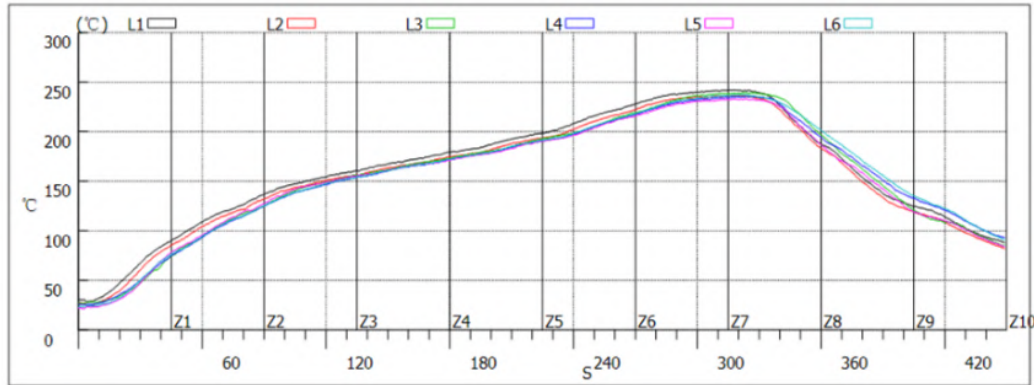
Specification	Value
Temperature Increase Rate	<2.5°C/s
Temperature Decrease Rate	Free air cooling
Preheat Temperature	0-150°C
Preheat Period (Typical)	40-90s
Soak Temp Increase Rate	0.4-1°C/s
Soak Temperature	150-200°C
Soak Period	60-120s
Liquidus Temperature (SAC305)	220°C
Time Above Liquidus	45-90s
Reflow Temperature	230-250°C
Absolute Peak Temperature	260°C

PROFILE CHECK

Customer Name: MOKO Technology Ltd
 Oven Type: smt生产线
 Zones setting (°C)

Date Time: 2020/5/20 10:48:52
 PCB Name:
 Speed: 78cm/min

Zones	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Top	120	140	165	170	180	190	210	240	255	245	0	0	0	0
Bottom	120	140	165	170	180	190	210	240	255	245	0	0	0	0



TCS	Peak(°C)	Peak difference	Peak at time(s)	190(°C)time above	Preheat(50-150°C)		Soak(150-200°C)		Reflow(220-260°C)		Liquid phase (220°C) time(s)	Cooling(260-100°C)	
					Slope	Time(s)	Slope	Time(s)	Slope	Time(s)		Slope	Time(s)
Line1	242.25	9.25	318	152	1.14	88	0.42	119	0.65	62	85	-1.39	115
Line2	236.75		310	140	1.06	94	0.42	119	0.91	44	74	-1.34	119
Line3	239.25		322	145	1.11	90	0.41	122	0.78	51	76	-1.45	110
Line4	235.75		324	139	1.05	95	0.42	118	0.78	51	70	-1.38	116
Line5	233		321	135	1.10	91	0.41	122	0.89	45	65	-1.44	111
Line6	237.25		321	146	1.05	95	0.42	118	0.82	49	75	-1.34	119

Figure 9: Example of MOKO Smart SMT reflow soldering

6.2 Usage Condition Notes

- Follow the conditions written in this specification, especially the recommended condition ratings about the power supply applied to this product.
- The supply voltage has to be free of AC ripple voltage (for example from a battery or a low noise regulator output). For noisy supply voltages, provide a decoupling circuit (for example a ferrite in series connection and a bypass capacitor to ground of at least 47Uf directly at the module).
- Take measures to protect the unit against static electricity. If pulses or other transient loads (a large load applied in a short time) are applied to the products, check and evaluate their operation before assembly on the final products.
- The supply voltage should not be exceedingly high or reversed. It should not carry noise and/or spikes.
- This product away from other high frequency circuits.
- Keep this product away from heat. Heat is the major cause of decreasing the life of these products.
- Avoid assembly and use of the target equipment in conditions where the products' temperature may exceed the maximum tolerance.



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- This product should not be mechanically stressed when installed.
- Do not use dropped products.
- Do not touch, damage or soil the pins.
- Pressing on parts of the metal shield or fastening objects to the metal shield will cause damage.

6.3 Storage Notes

- The module should not be stressed mechanically during storage.
- Do not store these products in the following conditions or the performance characteristics of the product, such as RF performance will be adversely affected:
 - Storage in salty air or in an environment with a high concentration of corrosive gas.
 - Storage in direct sunlight
 - Storage in an environment where the temperature may be outside the range specified.
 - Storage of the products for more than one year after the date of delivery storage period.
- Keep this product away from water, poisonous gas and corrosive gas.
- This product should not be stressed or shocked when transported.



MK19 Bluetooth Module

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