

MK11A Bluetooth Module

Datasheet

MOKO TECHNOLOGY LTD.
MOKO TECHNOLOGY LIMITED

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1. Product Instruction

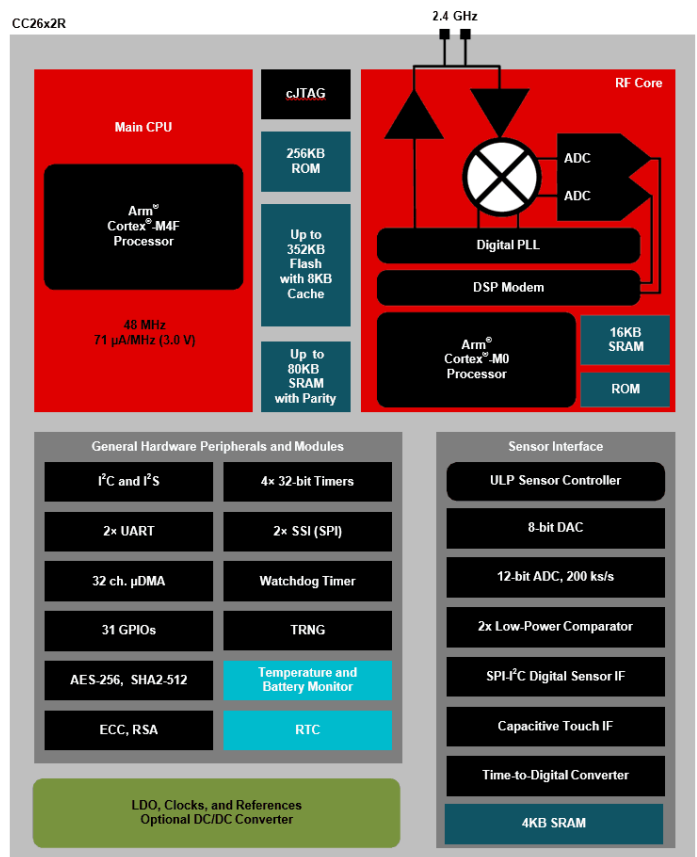
MK11A is a low-cost and low-power consumption **Bluetooth®** module based on **Texas Instruments CC2642R SoC** solution, which has a powerful 48-MHz Arm® Cortex™-M4F processor supporting Bluetooth® 5.1 Low Energy and Proprietary 2.4 GHz applications.

The system CPU is the foundation of a high-performance, low-cost platform that meets the system requirements of minimal memory implementation, and low-power consumption, while delivering outstanding computational performance and exceptional system response to interrupts.

MK11A has a size of 25mm x 17mm x 2.8mm with 36 pins providing 30 GPIOs and integrates a high-performance PCB trace antenna.

1.1 Key Features

- **Bluetooth 5.1 features**
 - LE 2M PHY (High Speed)
 - LE Coded PHYs (Long Range)
 - Multiple Advertisement Sets
 - CSA#2
- **Microcontroller**
 - Powerful 48-MHz Arm® Cortex®-M4F processor
 - EEMBC CoreMark® score: 148
 - 352KB of in-system Programmable Flash
 - 256KB of ROM for protocols and library functions
 - 8KB of Cache SRAM (Alternatively available as general-purpose RAM)
 - 80KB of ultra-low leakage SRAM. The SRAM is protected by parity to ensure high reliability of operation.
 - Supports Over-the-Air upgrade (OTA)
- **Ultra-low power sensor controller with 4KB of SRAM**
 - Sample, store, and process sensor data
 - Operation independent from system CPU
 - Fast wake-up for low-power operation



1.2 Applications

- **IoT**
 - Home automation
 - Sensor networks
 - Building automation
 - Industrial automation
- **Personal area networks**
 - Health/fitness sensor and monitor devices
 - Medical devices
 - Key fobs and wrist watches
- **Interactive entertainment devices**
 - Remote controls
 - Gaming controllers
 - VR/AR
- **Beacons**
- **Remote control toys**
- **Computer peripherals and I/O devices**
 - Mouse
 - Keyboard
 - Multi-touch trackpad
 - Gaming

1.3 Product Specifications

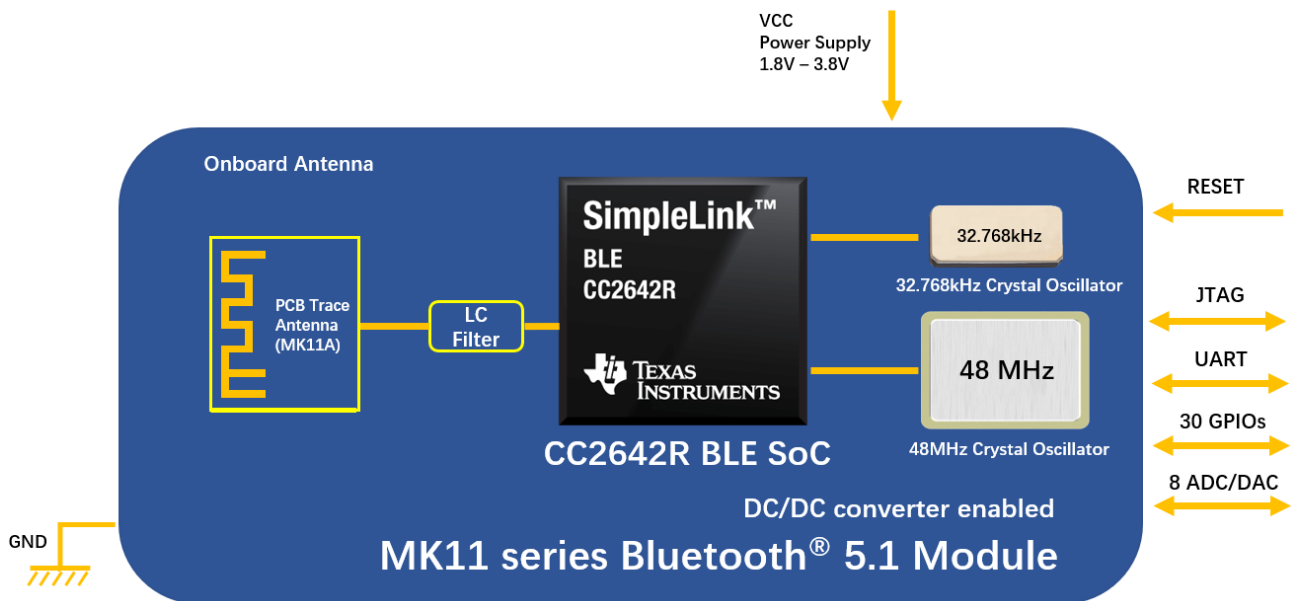
Detail	Description
Bluetooth	
Features	Bluetooth® Low Energy Bluetooth® Mesh Direction finding(AoA) LE 1M PHY LE 2M PHY LE Coded PHY (Long Range) Advertising Extensions CSA #2
Security	AES 128- and 256-bit Crypto Accelerator
LE connections	Concurrent central, observer, peripheral, and broadcaster roles with up to twenty concurrent connections along with one observer and one broadcaster
Low Power	
Active-Mode RX	6.9 mA
Active-Mode TX 0 dBm	7.3 mA
Active-Mode TX 5 dBm	9.6 mA
Active-Mode MCU 48 MHz (CoreMark)	3.4 mA (71µA/MHz)
Sensor Controller Low Power-Mode, 2 MHz running infinite loop	30.1µA
Sensor Controller Active-Mode, 24 MHz running infinite loop	808µA
Standby	0.94µA (RTC on, 80KB RAM and CPU retention)
Shutdown	150nA (wakeup on external events)
Radio	
Frequency	2402MHz - 2480MHz
Modulations	GFSK at 1Mbps, 2Mbps data rates
Receiver sensitivity	-105 dBm for Bluetooth 125kbps (LE Coded PHY) -97 dBm for 1Mbps PHY
Antenna	PCB trace antenna
Advertising distance @1Mbps (Open area)	More than 115 meters
Mechanical design	
Dimensions	Length: 25mm±0.2mm Width: 17mm±0.2mm Height: 2.8mm+0.1mm/-0.15mm
Package	36 Plated Half-hole pins
PCB material	FR-4
Impedance	50Ω

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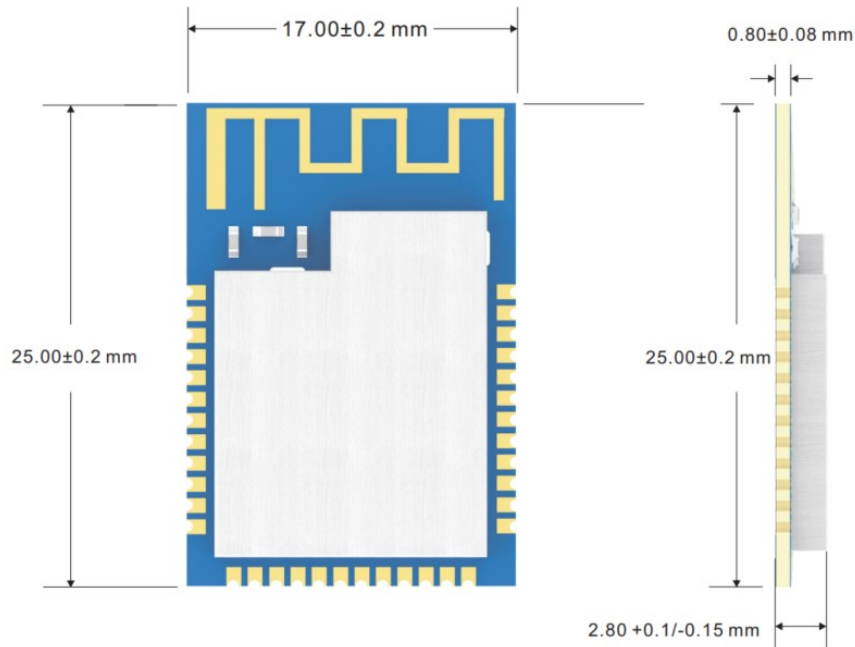
Detail	Description
Hardware	
Peripherals	2× UART 2× SSI (SPI, MICROWIRE, TI) I ² C I ² S 8 x 12bit ADC, 200k Samples/s, 8 channels 4x 32bit or 8x16bit general-purpose timers Programmable current source 30 GPIOs 2× DAC (1× continuous time, 1× ultra-low power) Real-Time Clock (RTC) ECC and RSA Public Key Hardware Accelerator SHA2 Accelerator (Full suite up to SHA-512) True Random Number Generator (TRNG) Capacitive sensing, up to 8 channels Integrated temperature and battery monitor
Power supply	1.8 V to 3.8 V
Operating temperature range	-40 to 85°C (-40 to +105 °C can be customized)
Clock control	32.768 kHz +/-20 ppm crystal oscillator
Power regulator	DC/DC converter enabled
Certifications	
USA (FCC)	FCC part 15 modular certification 47 CFR Part 15, Subpart C FCC ID: 2AO94-MK11
Europe (CE)	EN 300 328 V2.2.2 3.2: Effective use of spectrum allocated EN 301 489-1 V2.2.3 3.1(b): Electromagnetic Compatibility EN 301 489-17 V3.2.4 EN 62368-1: 2014+A11:2017 3.1(a): Health and Safety of the user EN 62479: 2010

2. Block Diagram



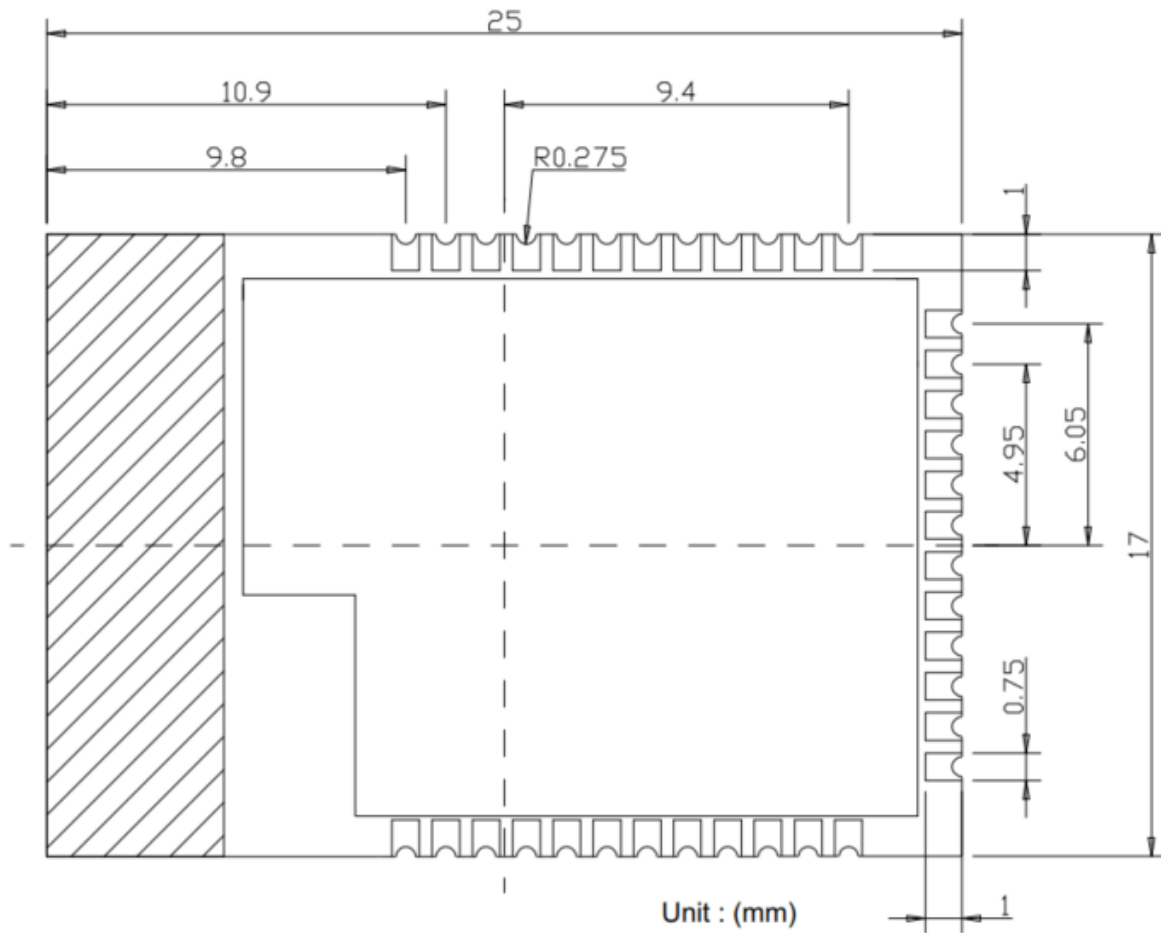
3. Mechanical specifications

3.1 Module Mechanical Dimensions



Symbol	Min.	Typ.	Max.
Length	-0.2mm	25mm	+0.2mm
Width	-0.2mm	17mm	+0.2mm
Height (PCB only)	-0.08mm	0.8mm	+0.08mm
Height (with shield)	-0.15mm	2.8mm	+0.1mm

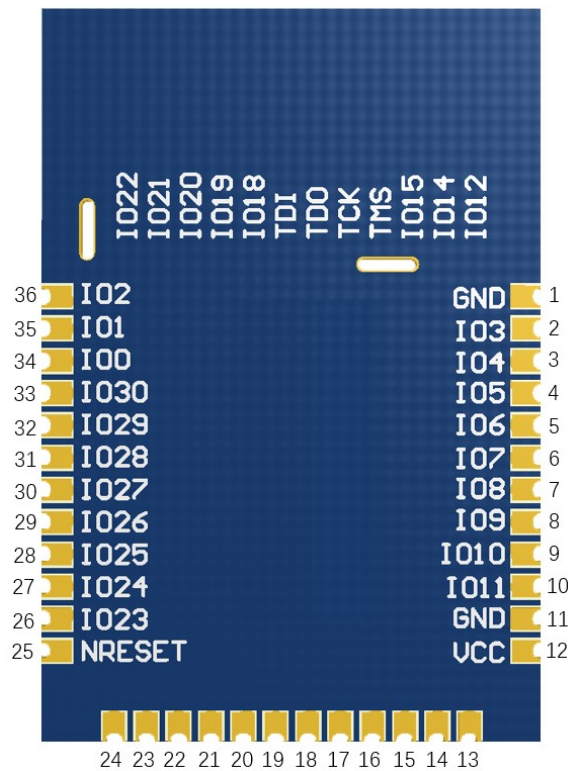
3.2 Recommended PCB land pads



MK11A PCB land pads (TOP View)

Symbol	Typ.
Pad (Bottom)	0.75mm x 1.00mm
Diameter of Half-hole	0.55mm

4. Pin Assignment



MK11A module pin diagram (Rear View)

Pin No.	Name	Type	Description
1	GND	Power	Ground
2	IO3	Digital I/O	General purpose I/O
3	IO4	Digital I/O	General purpose I/O
4	IO5	Digital I/O	General purpose I/O high-drive capability
5	IO6	Digital I/O	General purpose I/O high-drive capability
6	IO7	Digital I/O	General purpose I/O high-drive capability
7	IO8	Digital I/O	General purpose I/O
8	IO9	Digital I/O	General purpose I/O
9	IO10	Digital I/O	General purpose I/O
10	DIO11	Digital I/O	General purpose I/O
11	GND	Power	Ground
12	VCC	Power	1.8V-3.8V supply
13	IO12	Digital I/O	General purpose I/O
14	IO14	Digital I/O	General purpose I/O
15	IO15	Digital I/O	General purpose I/O
16	TMS	Digital I/O	JTAG TMS, high-drive capability

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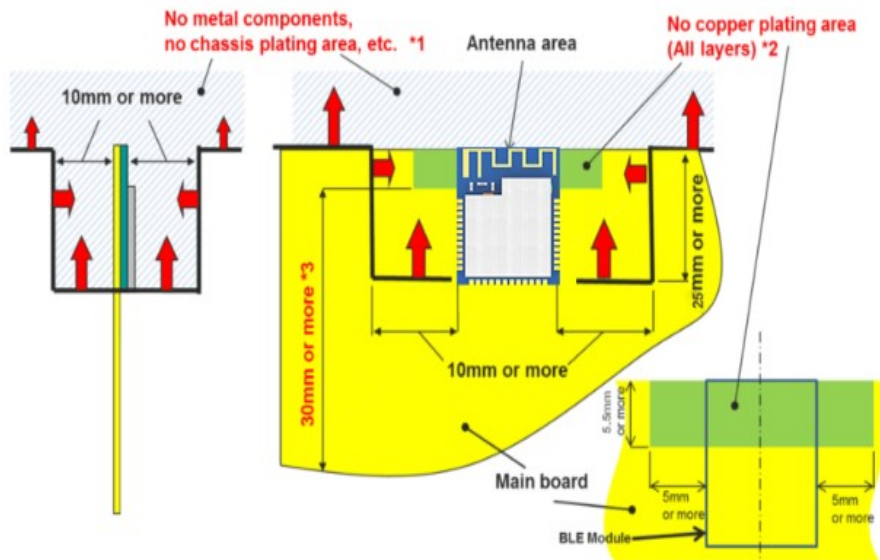
Pin No.	Name	Type	Description
17	TCK	Digital Input	JTAG TCKC
18	TDO	Digital I/O	General purpose I/O JTAG_TDO, high-drive capability
19	TDI	Digital I/O	General purpose I/O JTAG_TDI, high-drive capability
20	IO18	Digital I/O	General purpose I/O
21	IO19	Digital I/O	General purpose I/O
22	IO20	Digital I/O	General purpose I/O
23	IO21	Digital I/O	General purpose I/O
24	IO22	Digital I/O	General purpose I/O
25	NRESET	Digital Input	Reset, active low. No internal pullup resistor
26	IO23	Digital I/O Analog	General purpose I/O Analog capability
27	IO24	Digital I/O Analog	General purpose I/O Analog capability
28	IO25	Digital I/O Analog	General purpose I/O Analog capability
29	IO26	Digital I/O Analog	General purpose I/O Analog capability
30	IO27	Digital I/O Analog	General purpose I/O Analog capability
31	IO28	Digital I/O Analog	General purpose I/O Analog capability
32	IO29	Digital I/O Analog	General purpose I/O Analog capability
33	IO30	Digital I/O Analog	General purpose I/O Analog capability
34	IO0	Digital I/O	General purpose I/O
35	IO1	Digital I/O	General purpose I/O
36	IO2	Digital I/O	General purpose I/O

Note: Please refer to [TI CC2642R Datasheet](#) for detailed descriptions and features supported about the Pin assignments.

5. Mounting Suggestion

You can refer to the following references for the mounting design of **MK11A**.

Recommended module mounting example:

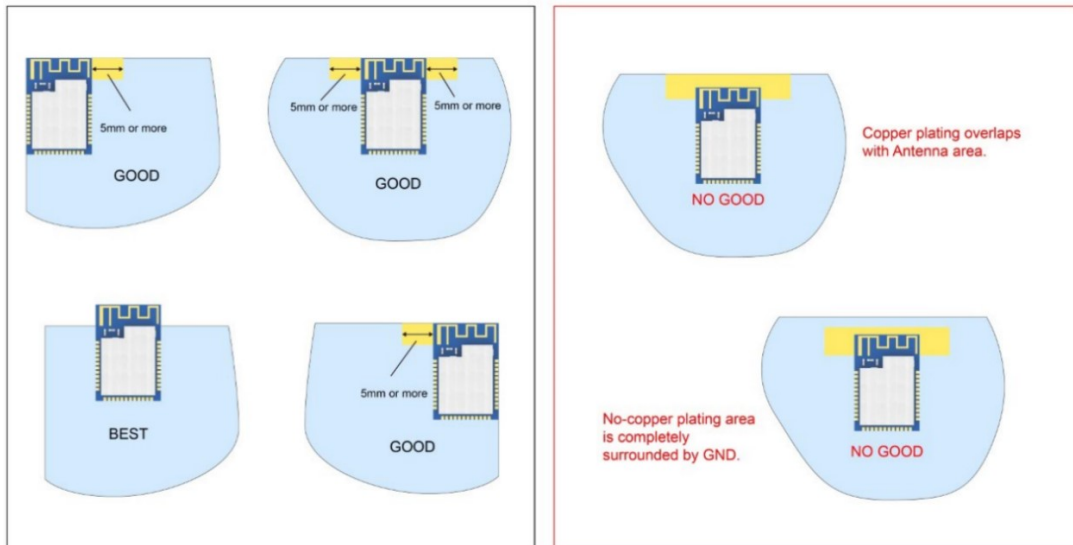


- Please do not place any metal components in blue shaded space (*1), such as signal line and metal chassis as possible except for main board while mounting the components in *1 space on the main board is allowed except for no copper plating area (*2).
- (*2) This area is routing prohibited area on the main board. Please do not place copper on any layer.
- (*3) Characteristics may deteriorate when GND pattern length is less than 30mm. It should be 30 mm or more as possible.
- For the best Bluetooth range performance, the antenna area of module shall extend 3 mm outside the edge of main board, or 3 mm outside the edge of a ground plane. Ground plane shall be at least 5 mm from the edge of the antenna area of module.
- All module GND pins MUST be connected to main board GND. Place GND vias close to module GND pads as possible. Unused PCB area on surface layer can flooded with copper but place GND vias regularly to connect copper flood to inner GND plane. If GND flood copper underside the module then connect with GND vias to inner GND plane.
- Even when above mentioned condition is satisfied, communication performance may be significantly deteriorated depending on the structure of the product. Bluetooth range performance is degraded if a module is placed in the middle of the main board.
- For main board layout:
 - Avoid running any signal line below module whenever possible.
 - No ground plane below antenna.
 - If possible, cut-off the portion of main board below antenna.

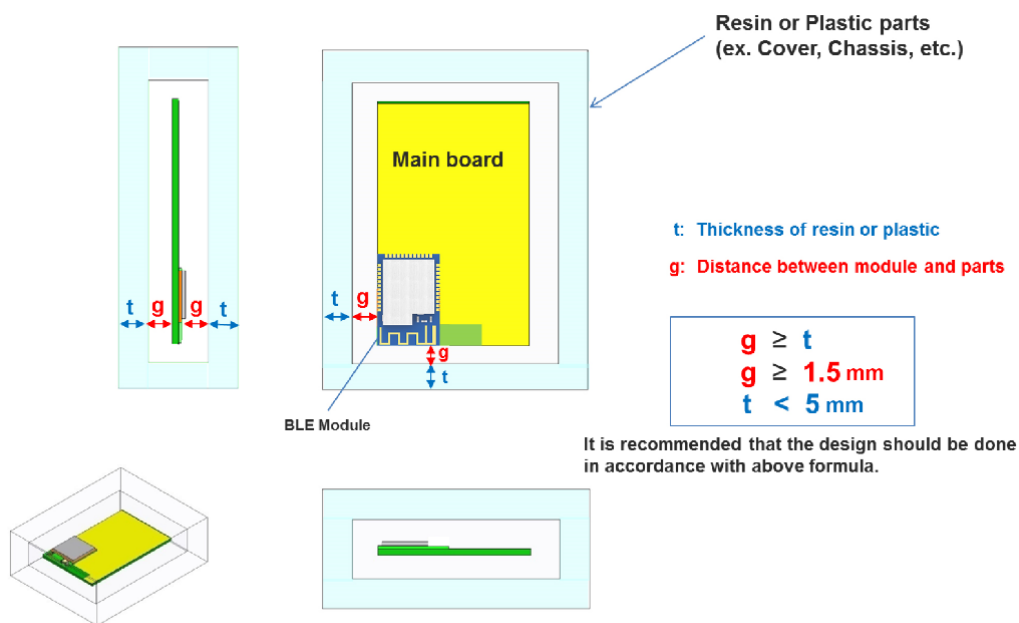
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Other module mounting examples:



Placement of resin or plastic parts:



Please do not apply molding over the antenna area of BLE module.

Placement of metal parts

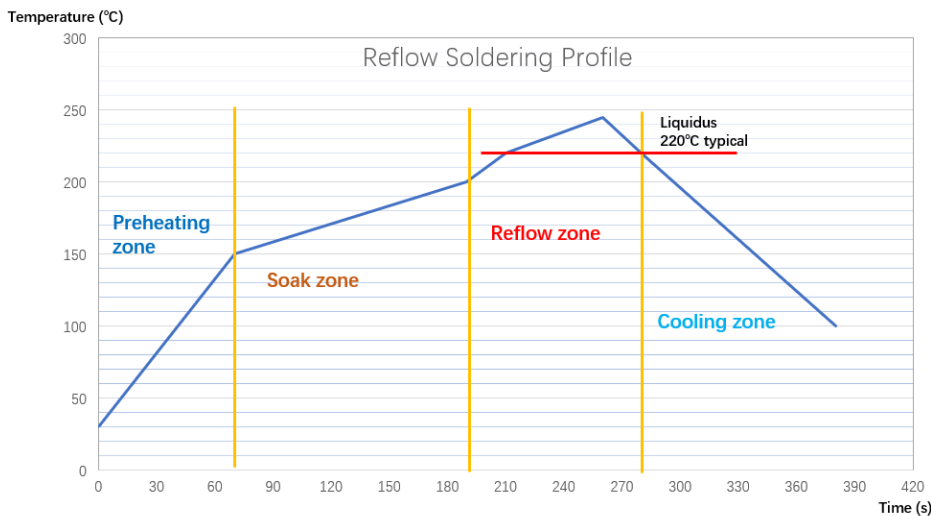
- Minimum safe distance for metal parts without seriously compromising the antenna (tuning) is 40 mm top/bottom and 30 mm left or right.
- Metal close to the module antenna (bottom, top, left, right, any direction) will have degradation on the antenna performance. The amount of that degradation is entirely 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.

Temperature-Time Profile for Reflow Soldering:



- 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.

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 Liquidous	45-90s
Reflow Temperature	230-250°C
Absolute Peak Temperature	260°C

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Example of MOKO SMT reflow soldering:



Note: The module is LGA package. Please be careful of the amount of solder paste. The module may be lifted due to excess solder.

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.
- 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.

Revision History

Revision	Description of changes	Approved	Revision Date
V1.0	Initial Release	Kevin	2020.09.04
V1.1	Updated Section 1.3	Victor	2020.10.15

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Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01

2.1 Antennas

The MK11A is an BLE Module beams signals and communicates with its antenna, which is PCB Antenna .

Antenna could not be in no-load state when module is working. During debugging, it is suggested to add 50 ohms load to the antenna port to avoid damage or performance degradation of the module under long-time no-load condition.

BLE Antenna Designation: PCB antenna For Model MK11A


Antenna gain:-0.7dBi


The contents of this datasheet are subject to change without prior notice for further improvement. MOKO team reserves all the rights for the final explanation.

Please contact MOKO sales team or visit <https://www.mokosmart.com> to get more related information if needed.

MOKO TECHNOLOGY LTD.

MOKO TECHNOLOGY LIMITED

 4F,Buidling2, Guanghui Technology Park,
MinQing Rd, Longhua, Shenzhen, Guangdong, China

 Tel:86-755-23573370-829

 Support_BLE@mokotechnology.com

 <https://www.mokosmart.com>



Integration instructions for host product manufacturers according to KDB 996369 D03
OEM Manual v01

2.2 List of applicable FCC rules

The Bluetooth Low Energy Module is an BLE Module with digitally modulated systems using an GFSK modulation. It operates on the 2402- 2480MHz band. Complies with FCC CFR Title 47 Part 15 Subpart C Section 15.247.

2.3 Specific operational use conditions

The MK11A is a BLE Module

Operation Frequency: 2402 - 2480MHz

Modulation Type: GFSK

Number Of Channel: 40CH

Antenna Designation: PCB Antenna

MK11A is a low-cost and low-power consumption Bluetooth® module based on Texas Instruments CC2642R SoC solution, which has a powerful 48-MHz Arm® Cortex™-M4F processor supporting Bluetooth® 5.1 Low Energy and Proprietary 2.4 GHz applications. Its application can be automatic meter reading, home building automation, security system, remote irrigation system.

2.4 Limited module procedures

not applicable; Single Modular Approval Request

2.5 Trace antenna designs

Not applicable;

2.6 RF exposure considerations

The equipment complies with FCC Radiation exposure limits set forth for uncontrolled environment.

This equipment should be installed and operated with minimum distance 5mm between the radiator and your body.

2.7 Antennas

The MK11A is an BLE Module beams signals and communicates with its antenna, which is PCB Antenna. Antenna could not be in no-load state when module is working. During debugging, it is suggested to add 50 ohms load to the antenna port to avoid damage or performance degradation of the module under long-time no-load condition.

2.8 Label and compliance information

The final end product must display the following content in the visible area

Host must Contain FCC ID: 2AO94-MK11. If the size of the end product is larger than 8x10cm, then the following FCC part 15.19 statement has to also be available on the label: This device complies with Part 15 of FCC rules. Operation is subject to the following two conditions:

- (1) this device may not cause harmful interference and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

2.9 Information on test modes and additional testing requirements

Data transfer module demo board can control the EUT work in RF test mode at specified test channel.

2.10 Additional testing, Part 15 Subpart B disclaimer

The module without unintentional-radiator digital circuit, so the module does not required an evaluation by FCC Part 15 Subpart B. The host should be evaluated by the FCC Subpart B.

ATTENTION

This device is intended only for OEM integrators under the following conditions:

- 1) The antenna must be installed such that 5mm is maintained between the antenna and users, and
- 2) This device and its antenna(s) must not be co - located with any other transmitters except in accordance with FCC multi - transmitter product procedures. Referring to the multi - transmitter policy, multiple transmitter(s) and module(s) can be operated simultaneously without C2P.
- 3) For all products market in US, OEM has to limit the Operating Frequency: 2402 - 2480MHz by supplied firmware programming tool. OEM shall not supply any tool or info to the end - user regarding to Regulatory Domain change.

USERS MANUAL OF THE END PRODUCT:

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Datasheet

In the user manual of the end product, the end user has to be informed to keep at least 5mm separation with the antenna while this end product is installed and operated. The end user has to be informed that the FCC radio - frequency exposure guidelines for an uncontrolled environment can be satisfied. The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

If the size of the end product is smaller than 8x10cm, then additional FCC part 15.19 statement is required to be available in the users manual: This device complies with Part 15 of FCC rules.

Operation is subject to the following two conditions:

- (1) this device may not cause harmful interference and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC WARNING

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generate, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

Reorient or relocate the receiving antenna.

Increase the separation between the equipment and receiver.

Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

Consult the dealer or an experienced radio/TV technician for help.