

MK14 Bluetooth Module

(MK14A、MK14B)

Datasheet

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1. Product Instruction

MK14 series is a powerful, highly flexible, ultra low power **Bluetooth® 5** module based on **Nordic® Semiconductor nRF52805 SoC** solution, which has a 32bit Arm® Cortex™-M4 CPU with floating point unit running at 64MHz.

MK14 module is multiprotocol capable with full protocol concurrency. It supports **BLE®** (Bluetooth Low Energy) and 2 Mbps of Bluetooth 5 giving increased application throughput and up to 50 % savings in energy usage. It supports channel selection algorithm #2 (CSA#2), improving the ability to coexist with other Bluetooth LE devices.

1.1 Model Classification

There are two models of **MK14** series Bluetooth module — **MK14A** and **MK14B**. The two models both have a small size of 12.1 x 8.9 x 2.0mm with 8 GPIOs of nRF52805 (WLCSP package).

The difference between MK14A and MK14B is the antenna design.

MK14A integrates a high-performance PCB antenna.

MK14B uses a u.FL connector and requires an external 2.4Ghz antenna.

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

1.2 Key Features

- Bluetooth 5
 - 2Mbps
 - CSA#2
- Wide supply voltage range: 1.7 V to 3.6 V
- ARM® Cortex®-M4 32-bit processor, 64 MHz
 - 144 EEMBC CoreMark® score running from flash memory
 - 34.4 µA/MHz running CoreMark from flash memory
 - 32.8 µA/MHz running CoreMark from RAM memory
 - Serial wire debug (SWD)
- 192kB Flash and 24kB RAM
- Full set of digital interfaces including: SPI, TWI, UART
- 12-bit, 200ksps ADC
- Individual power management for all peripherals
- On-chip DC/DC buck converter
- Quadrature decoder
- I²C compatible 2-wire master/slave
- Dimension: 12.1 x 8.9 x 2.0mm (with shield)
- 8 GPIOs

1.3 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
- **Enterprise lighting**
 - Industrial
 - Commercial
 - Retail
- **Beacons**

1.4 Product Specifications

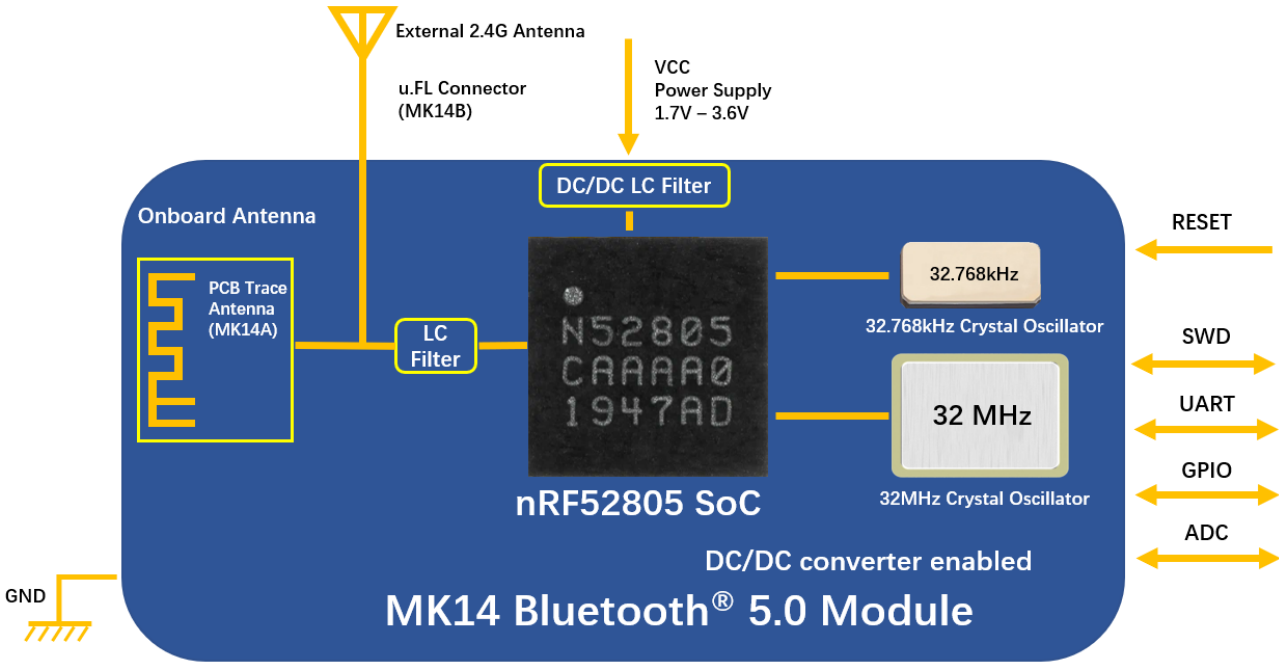
Detail	Description
Bluetooth	
Feature	Bluetooth® Low Energy 1M LE PHY 2M LE PHY CSA #2
Security	AES-128
LE connections	Concurrent peripheral and broadcaster roles
Radio	
Frequency	2402MHz - 22480MHz
Modulations	GFSK at 1 Mbps/2 Mbps
Transmit power	Configurable down to -40dBm
Receiver sensitivity	- 97 dBm at Bluetooth® LE/2.4GHz 1 Mbps mode - 94 dBm at Bluetooth® LE/2.4GHz 2 Mbps mode - 94 dBm at 1 Mbps ANT mode
Antenna	MK14A - PCB trace antenna MK14B - External 2.4Ghz antenna
Current consumption	
TX only (DCDC enabled, 3V) @ +4dBm / 0dBm / -4dBm/-20dBm/-40dBm	7mA / 4.6mA / 3.6mA / 2.5mA / 2.1mA
TX only @ +4dBm / 0dBm / -4dBm / -20dBm / -40dBm	15.4mA / 10.1mA / 7.8mA / 5.4mA / 4.3mA
RX only (DCDC enabled, 3V) @1Msps BLE	4.6mA
RX only @ 1Msps BLE	10.0mA
RX only (DCDC enabled, 3V) @2Msps BLE	5.2mA
RX only @ 2Msps BLE	11.2mA
System OFF mode(3V)	0.3uA
System OFF mode with full 24kB RAM retention(3V)	0.5uA
System ON mode with full 24 kB RAM retention, wake on RTC (3V)	1.1uA
System ON mode, no RAM retention, wake on RTC(3V)	1.0uA

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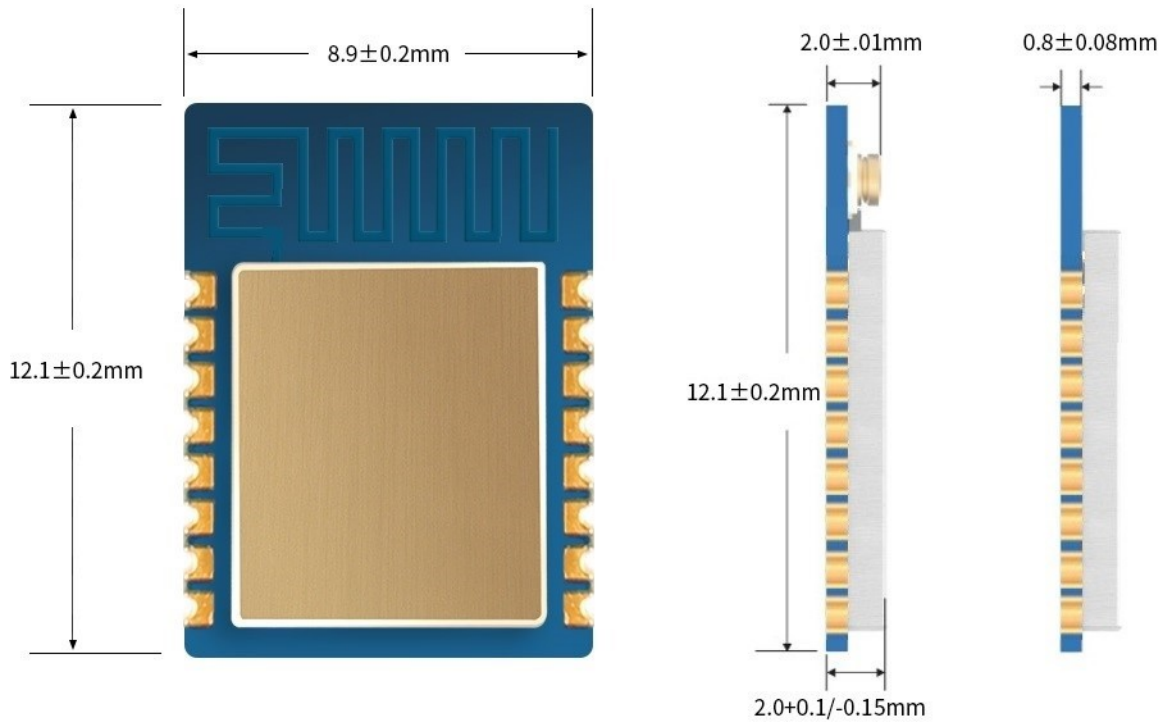
Detail	Description
Mechanical design	
Dimensions	Length: 12.1mm±0.2mm Width: 8.9mm±0.2mm Height: 2.0mm+0.1mm/-0.15mm
Package	16 Plated Half-hole pins
PCB material	FR-4
Impedance	50Ω
Hardware	
CPU	ARM® Cortex®-M4 32-bit processor with FPU, 64 MHz
Memory	192kB flash, 24 kB RAM
Interfaces	SPI master/slave with EasyDMA UART (CTS/RTS) with EasyDMA 2x 12-bit, 200ksps ADC 8 GPIOs
Power supply	1.7V to 3.6V
Operating temperature range	-40 to 85°C
Clock control	32.768 kHz +/-20 ppm crystal oscillator
Power regulator	DC/DC regulator setup
Certifications	
USA (FCC)	FCC part 15 modular certification 47 CFR Part 15, Subpart C FCC ID: 2A094-MK14
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
Canada (ISED)	Industry Canada RSS-247 and RSS-Gen certification IC: 26442-MK14
Japan (MIC)	Ministry of Internal Affairs and Communications (MIC) of Japan pursuant to the Radio Act of Japan MIC: 217-204215
Australia/New Zealand (RCM)	AS/NZS 4268: 2017, Radio equipment and systems-short range devices

2. Block Diagram



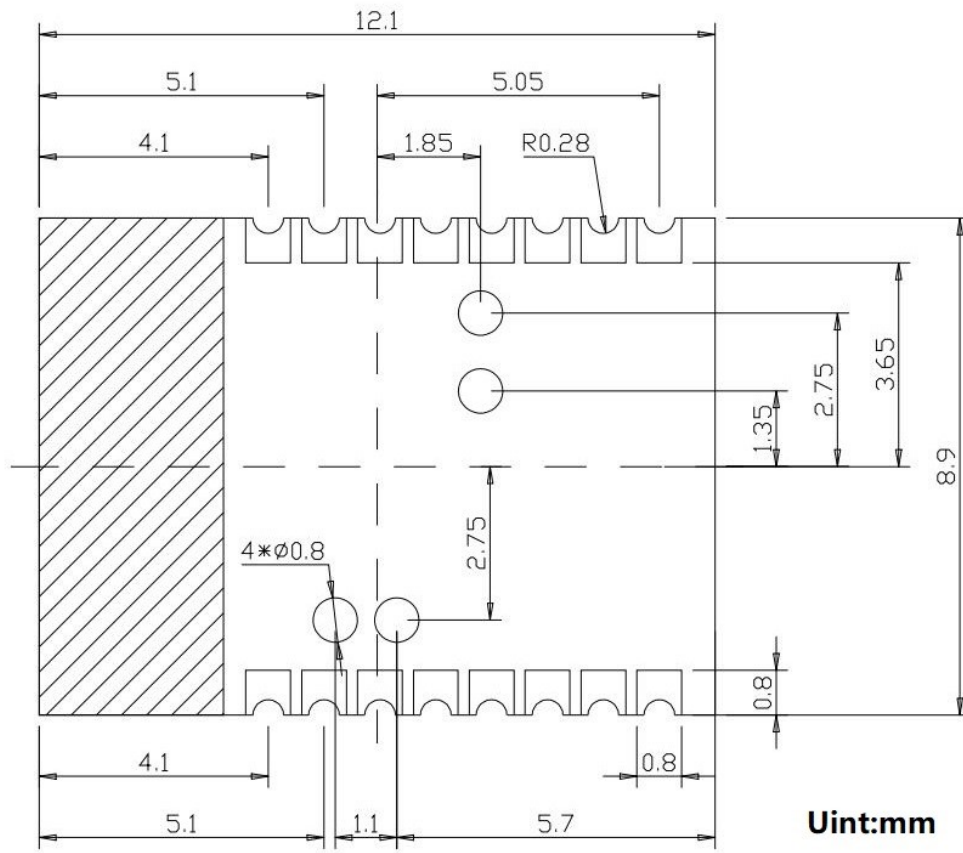
3. Mechanical specifications

3.1 Module Mechanical Dimensions



Symbol	Min.	Typ.	Max.
Length	-0.2mm	12.1mm	+0.2mm
Width	-0.2mm	8.9mm	+0.2mm
Height (PCB only)	-0.08mm	0.8mm	+0.08mm
Height (with shield)	-0.15mm	2.0mm	+0.1mm

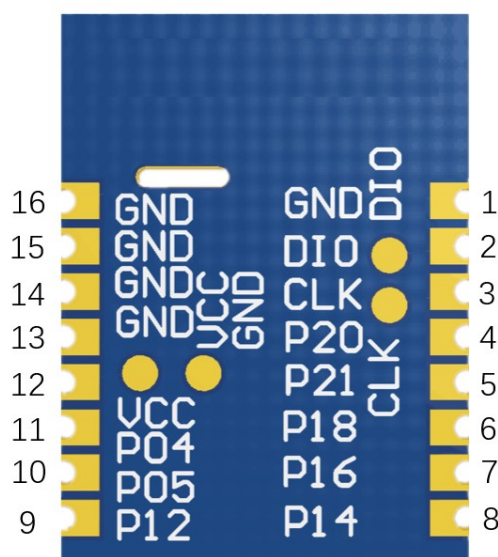
3.2 Recommended PCB land pads



MK14 PCB land pads(TOP View)

Symbol	Typ.
Half-hole Pad (Bottom)	0.8mm x 0.8mm
LGA Round Pad	0.8mm (diameter)
Diameter of Half-hole	0.55mm

4. Pin Assignment



MK14 module pin diagram(Rear View)

Pin No.	Name	Type	Description
1	GND	Power	Ground
2	DIO	Digital I/O	Serial wire debug I/O for debug and programming
3	CLK	Digital input	Serial wire debug clock input for debug and programming
4	P20	Digital I/O	General purpose I/O
5	P21	Digital I/O	General purpose I/O
	RESET		Configurable as pin reset
6	P18	Digital I/O	General purpose I/O
7	P16	Digital I/O	General purpose I/O
8	P14	Digital I/O	General purpose I/O
9	P12	Digital I/O	General purpose I/O
10	P05	Digital I/O	General purpose I/O
	AIN3	Analog input	SAADC input
11	P04	Digital I/O	General purpose I/O
	AIN2	Analog input	SAADC input
12	VCC	Power	Power Supply: 1.7V-3.6V
13	GND	Power	Ground
14	GND	Power	Ground
15	GND	Power	Ground
16	GND	Power	Ground

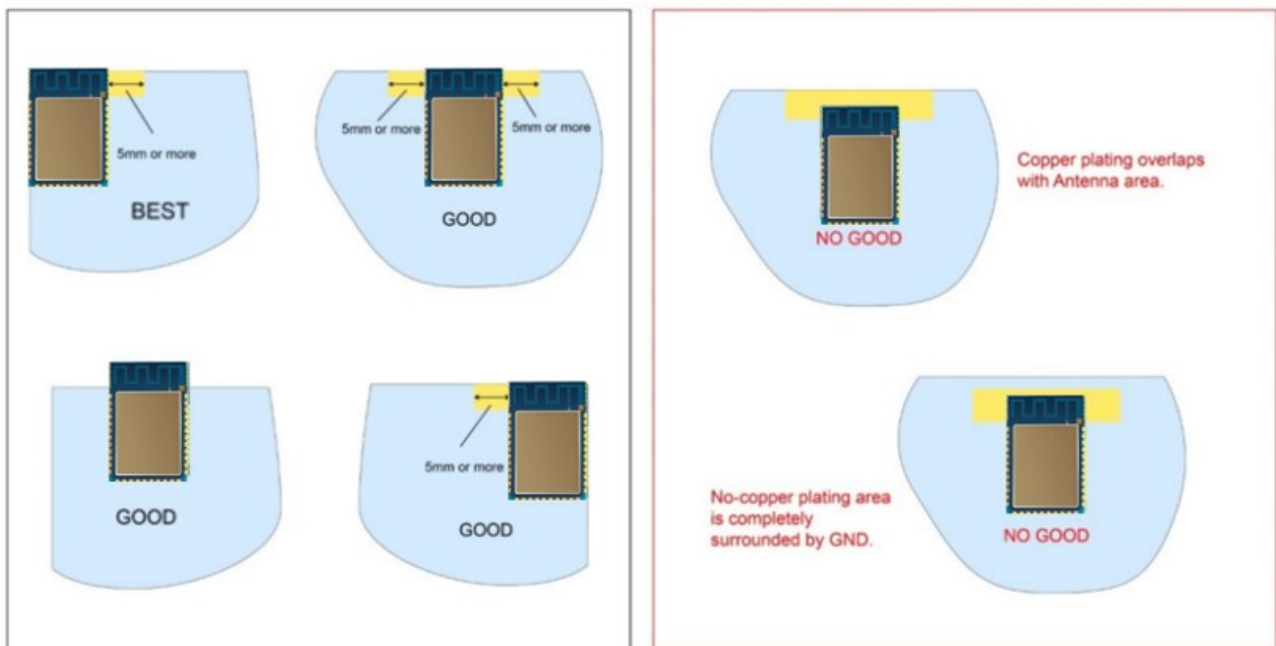
Note : Please refer to [Nordic nRF52805 Product Specifications](#) for detailed descriptions and features supported about the Pin assignments.

5. Mounting Suggestion

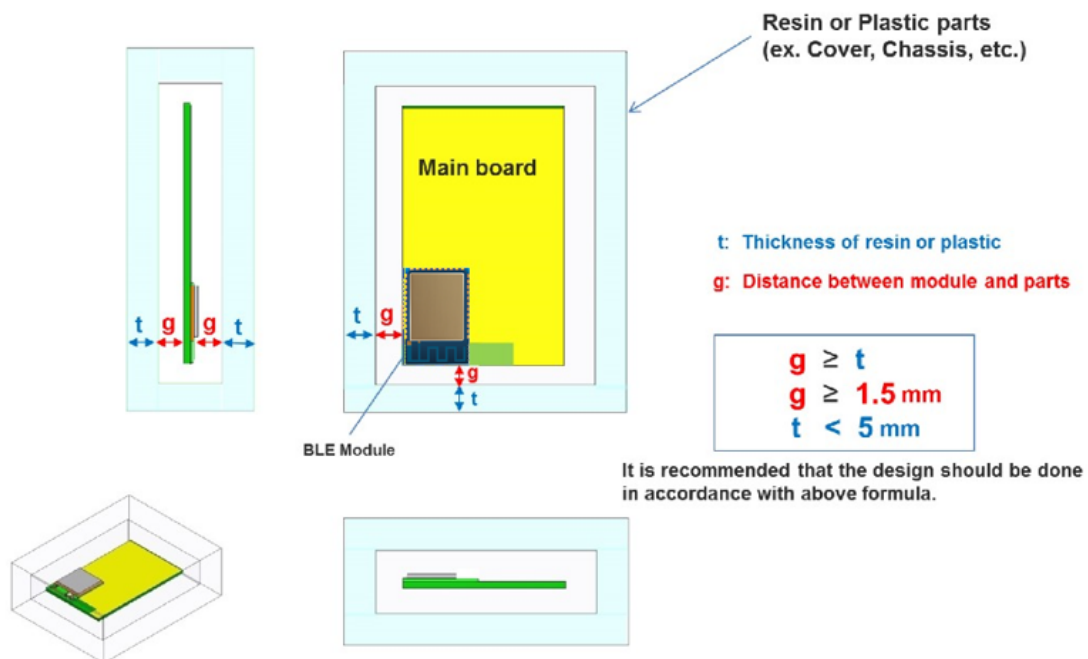
You can refer to the following references for the mounting design of the module with on-board antenna (MK14A with PCB antenna).

For external antenna modules (MK14B needs to connect an external antenna to the u.FL connector), you need to refer to the external antenna design requirements.

Recommended module mounting example:



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. Qualification and approvals

6.1 United States (FCC)

The MK14 has received Federal Communications Commission (FCC) CFR47 Telecommunications, Part 15 Subpart C “Intentional Radiators” modular approval in accordance with Part 15.247 Modular Transmitter approval. The modular approval allows the end user to integrate the module into a finished product without obtaining subsequent and separate FCC approvals for intentional radiation, provided no changes or modifications are made to the module circuitry. Changes or modifications could void the user’s authority to operate the equipment. The end user must comply with all of the instructions provided by the Grantee, which indicate installation and/or operating conditions necessary for compliance.

The finished product is required to comply with all applicable FCC equipment authorizations regulations, requirements and equipment functions not associated with the transmitter module portion. For example, compliance must be demonstrated to regulations for other transmitter components within the host product; to requirements for unintentional radiators (Part 15 Subpart B “Unintentional Radiators”), such as digital devices, computer peripherals, radio receivers, etc.; and to additional authorization requirements for the non-transmitter functions on the transmitter module (i.e., Verification, or Declaration of Conformity) (e.g., transmitter modules may also contain digital logic functions) as appropriate.

Note:

Modification to this product will void the users’ authority to operate this equipment.

The OEM is still responsible for verifying end product compliance with FCC Part 15, subpart B limits for unintentional radiators through an accredited test facility.

6.1.1 Labeling and user information requirements

The MK14 is assigned the FCC ID number: 2A094-MK14

If the FCC ID is not visible when the module is installed inside another device, then the outside of the finished product into which the module is installed must also display a label referring to the enclosed module. This exterior label can use the following or similar wording:

Contains FCC ID: 2A094-MK14

In addition to marking the product with the appropriate FCC ID, the end product user manual may also require specific information based on the digital device classification. Refer to the [FCC Rules, Title 47, Subchapter A, Part 15, Subpart B, Chapter §15.105](#) for specific wording of the notices.

6.1.2 RF exposure

All transmitters regulated by FCC must comply with RF exposure requirements. [KDB 447498 General RF Exposure Guidance](#) provides guidance in determining whether proposed or existing transmitting facilities, operations or devices comply with limits for human exposure to Radio Frequency (RF) fields adopted by the Federal Communications Commission (FCC).

This module is approved for installation into mobile and/or portable host platforms and must not be

co-located or operating in conjunction with any other antenna or transmitter except in accordance with FCC multi-transmitter guidelines. End users must be provided with transmitter operating conditions for satisfying RF Exposure compliance.

6.2 Canada (ISED)

The MK14 module is certified for use in Canada under Innovation, Science and Economic Development Canada (ISED) Radio Standards Specification (RSS) RSS-247 and RSSGen.

6.2.1 Labeling and user information requirements

The MK14 is assigned the ISED number: 26442-MK14

Labeling Requirements for the Host Device (from Section 3.2.1, RSS-Gen, Issue 3, December 2010): The host device shall be properly labeled to identify the module within the host device. The Industry Canada certification label of a module shall be clearly visible at all times when installed in the host device, otherwise the host device must be labeled to display the Industry Canada certification number of the module, preceded by the words “Contains transmitter module”, or the word “Contains”, or similar wording expressing the same meaning, as follows:

Contains transmitter module IC: 26442-MK14

User Manual Notice for License-Exempt Radio Apparatus (from Section 7.1.3 RSS-Gen, Issue 3, December 2010): User manuals for license-exempt radio apparatus shall contain the following or equivalent notice in a conspicuous location in the user manual or alternatively on the device or both:

This device complies with Industry Canada license exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Transmitter Antenna (from Section 7.1.2 RSS-Gen, Issue 3, December 2010): User manuals for transmitters shall display the following notice in a conspicuous location:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

6.2.2 RF exposure

All transmitters regulated by IC must comply with RF exposure requirements listed in RSS-102 - Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands). This module is approved for installation into mobile and/or portable host platforms and must not be co-located or operating in conjunction with any other antenna or transmitter except in accordance with Industry Canada's multi-transmitter guidelines. End users must be provided with transmitter operating conditions for satisfying RF Exposure compliance.

6.3 European Union regulatory compliance

Information about regulatory compliance of the European Union for the MK14 module is available in the MK14 Declaration of Conformity.

6.3.1 Radio Equipment Directive (RED) 2014/53/EU

The MK14 module complies with the essential requirements and other relevant provisions of Radio Equipment Directive (RED) 2014/53/EU.

6.3.2 Labeling and user information requirements

The label on the final products which contain the MK14 module must follow CE marking requirements. The "R&TTE Compliance Association Technical Guidance Note 01" provides guidance on final product CE marking.

6.4 Japan (MIC)

The MK14 module has received type certification and is labeled with its own technical conformity mark and certification number as required to conform to the technical standards regulated by the Ministry of Internal Affairs and Communications (MIC) of Japan pursuant to the Radio Act of Japan. Integration of this module into a final end product does not require additional radio certification provided installation instructions are followed and no modifications of the module are allowed.

Additional testing may be required:

- If the host product is subject to electrical appliance safety (for example, powered from an AC mains), the host product may require Product Safety Electrical Appliance and Material (PSE) testing. The integrator should contact their conformance laboratory to determine if this testing is required.
- There is a voluntary Electromagnetic Compatibility (EMC) test for the host product administered by VCCI: http://www.vcci.jp/vcci_e/index.html

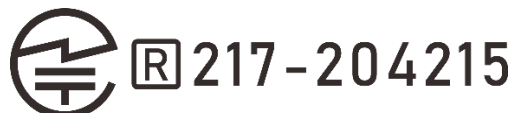
The label on the end product which contains a MK14 module must follow the MIC marking requirements. Labeling requirements for Japan available at the Ministry of Internal Affairs and Communications (MIC) website: <http://www.tele.soumu.go.jp/e/index.htm>.

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The MK14 module is labeled with its assigned technical conformity mark and certification number. The end product in which this module is being used must have an external label referring to the type certified module inside:

Contains transmitter module with certificate number: 217-204215



6.5 Australia / New Zealand (RCM)

The MK14 has been tested to comply with the AS/NZS 4268:2017, Radio equipment and systems - Short range devices - Limits and methods of measurement. The report may be obtained from your local FAE, and may be used as evidence in obtaining permission to use the Regulatory Compliance Mark (RCM).

Information on registration as a Responsible Party, license and labeling requirements may be found at the following websites:

Australia: <http://www.acma.gov.au/theACMA/radiocommunications-short-range-devices-standard-2004>

New Zealand: <https://www.rsm.govt.nz/business-individuals/compliance-information-for-licence-holders/licence-compliance-requirements/>

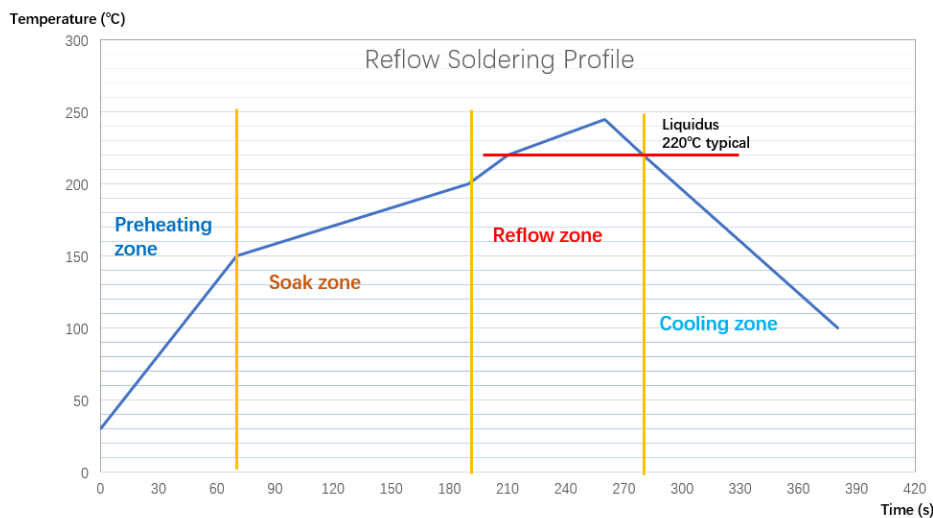
Only Australian-based and New Zealand-based companies who are registered may be granted permission to use the RCM. An Australian-based or New Zealand-based agent or importer may also register as a Responsible Party to use the RCM on behalf of a company not in Australia or New Zealand.

7. Cautions

7.1 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:



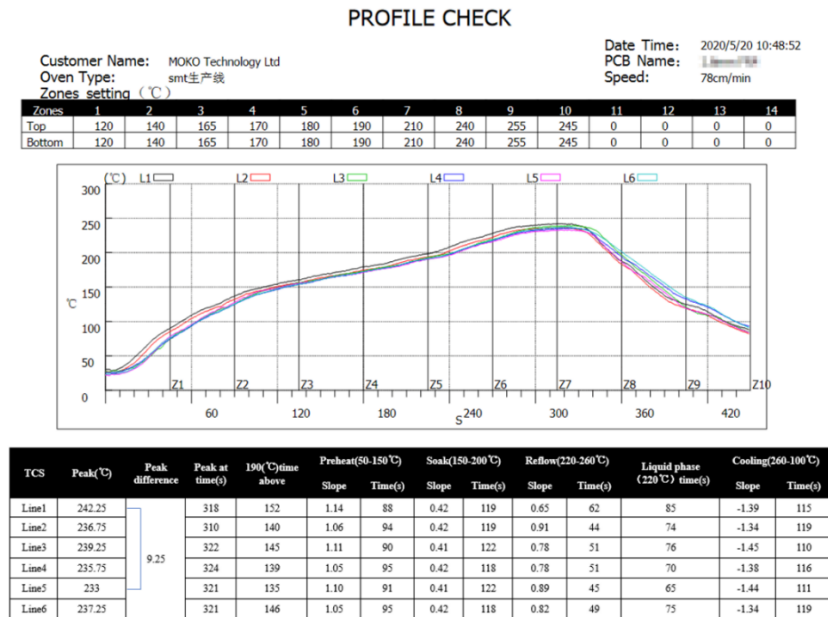
- The standard reflow profile has four zones: ①preheat, ②soak, ③reflow, ④cooling. The profile describes the ideal temperature curve of the top layer of the PCB.
- During reflow, modules should not be above 260°C and not for more than 30 seconds.

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.

7.2 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.

7.3 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	Victor	2020.11.25
V1.1	Added Section 6 Qualification and approvals	Victor	2020.12.24

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

Manual v01

2.1 Antennas

The MK14 is an BLE Module beams signals and communicates with its antenna, which is PCB Antenna and External 2.4Ghz 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 MK14A

BLE Antenna Gain: 1.20dBi For Model MK14A


BLE Antenna Designation: External FPC antenna For Model MK14B


BLE Antenna Gain: Max. 2.0 dBi For Model MK14B

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.mokoblue.com> to get more related information if needed.

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

2.2 List of applicable FCC rules

The MK14 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 MK14 is a BLE Module

Operation Frequency: 2402 - 2480MHz

Modulation Type: GFSK

Number Of Channel: 40CH

Antenna Designation: PCB Antenna and External 2.4Ghz FPC antenna

MK14 series is a powerful, highly flexible, ultra low power Bluetooth® 5 module based on Nordic® Semiconductor nRF52805 SoC solution, which has a 32bit Arm® Cortex™-M4 CPU with floating point unit running at 64MHz.

MK14 module is multiprotocol capable with full protocol concurrency. It supports BLE® (Bluetooth Low Energy) and 2 Mbps of Bluetooth 5 giving increased application throughput and up to 50 % savings in energy usage. It supports channel selection algorithm #2 (CSA#2), improving the ability to coexist with other Bluetooth LE devices.

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 MK14 is an BLE Module beams signals and communicates with its antenna, which is PCB Antenna and External 2.4Ghz 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 Contains FCC ID: 2AO94-MK14. 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.

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3) For all products market in US, OEM has to limit the Operating Frequency: 2402MHz - 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:

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.