

# MK05 Bluetooth Module

(MK05A、MK05B)

Datasheet

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# 1. Product Instruction

**MK05** series is a powerful, highly flexible, ultra low power **Bluetooth® 5** module based on **Nordic® Semiconductor nRF52810 SoC** solution, which has a 32bit Arm® Cortex™-M4 CPU with floating point unit running at 64MHz.

**MK05** 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. ANT and 2.4 GHz proprietary protocols are also supported.

## 1.1 Model Classification

There are two models of **MK05** series Bluetooth module — **MK05A** and **MK05B**. The two models both have a small size of 21 x 13.8 x 2.3mm with all 30 GPIOs of nRF52810QFAA (QFN48 package).

The difference between MK05A and MK05B is the antenna design.

**MK05A** integrates a high-performance PCB antenna.

**MK05B** 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, PDM, PWM, QDEC
- 12-bit, 200ksps ADC
- 128-bit AES ECB/CCM/AAR co-processor
- Individual power management for all peripherals
- On-chip DC/DC buck converter
- Quadrature decoder
- I²C compatible 2-wire master/slave
- Digital microphone interface (PDM)
- Dimension: 21.0 x 13.8 x 2.3mm (with shield)
- 30 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**
- **Computer peripherals and I/O devices**
  - Mouse
  - Keyboard
  - Mobile HID

### 1.4 Product Specifications

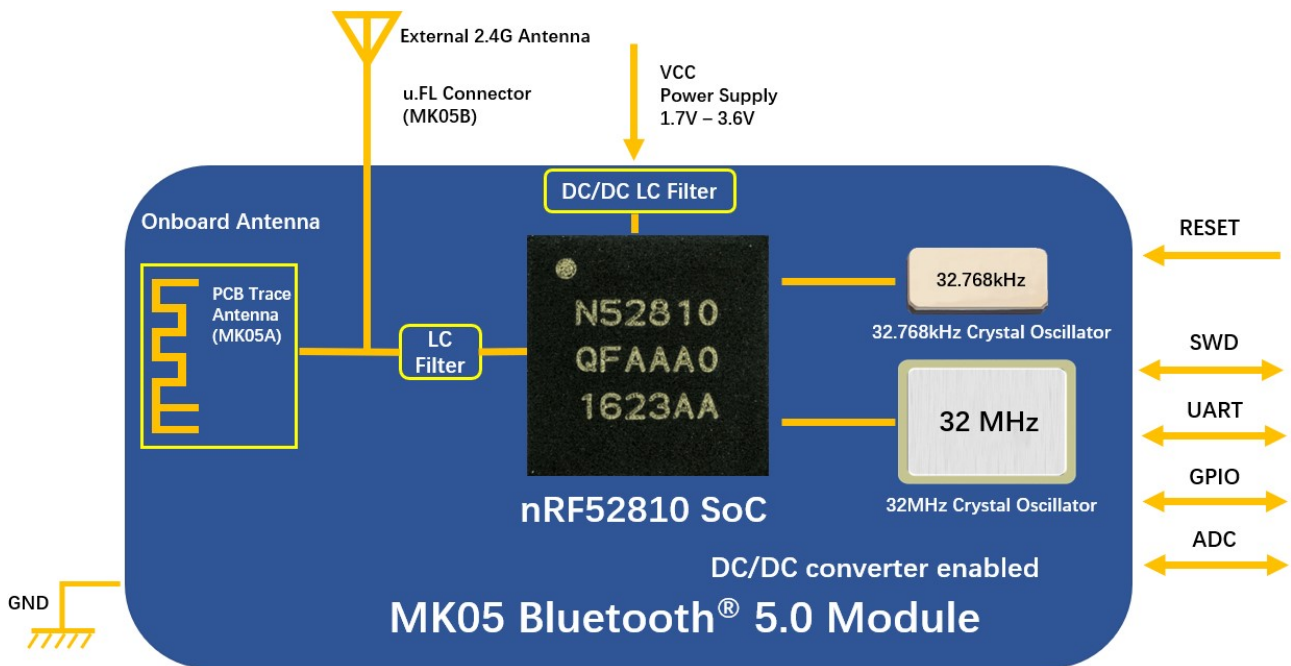
Detail	Description
<b>Bluetooth</b>	
Feature	Bluetooth® Low Energy 1M LE PHY 2M LE PHY CSA #2
Security	AES-128
LE connections	Concurrent peripheral and broadcaster roles
<b>Radio</b>	
Frequency	2360MHz - 2500MHz
Modulations	GFSK at 1 Mbps/2 Mbps data rates
Transmit power	+4 dBm maximum Configurable down to -40dBm
Receiver sensitivity	- 96 dBm at Bluetooth® LE/2.4GHz 1 Mbps mode - 93 dBm at Bluetooth® LE/2.4GHz 2 Mbps mode - 93 dBm at 1 Mbps ANT mode
Antenna	MK05A - PCB trace antenna MK05B - External 2.4Ghz antenna
Advertising distance @1Mbps (Open area)	MK05A - More than 155 meters
<b>Current consumption</b>	
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)	1.5uA
System ON mode, no RAM retention, wake on RTC(3V)	1.4uA

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Detail	Description
<b>Mechanical design</b>	
Dimensions	Length: 21mm±0.2mm Width: 13.8mm±0.2mm Height: 2.3mm+0.1mm/-0.15mm
Package	34 Plated Half-hole pins
PCB material	FR-4
Impedance	50Ω
<b>Hardware</b>	
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 4-channel pulse width modulator (PWM) unit with EasyDMA Quadrature decoder (QDEC) 2x real-time counter (RTC) 8x 12-bit, 200ksps ADC 30 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
<b>Certifications</b>	
USA (FCC)	FCC part 15 modular certification 47 CFR Part 15, Subpart C FCC ID: 2AO94-MK05
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-MK05
Japan (MIC)	Ministry of Internal Affairs and Communications (MIC) of Japan pursuant to the Radio Act of Japan MIC: 217-204179
Australia/New Zealand (RCM)	AS/NZS 4268: 2017, Radio equipment and systems-short range devices

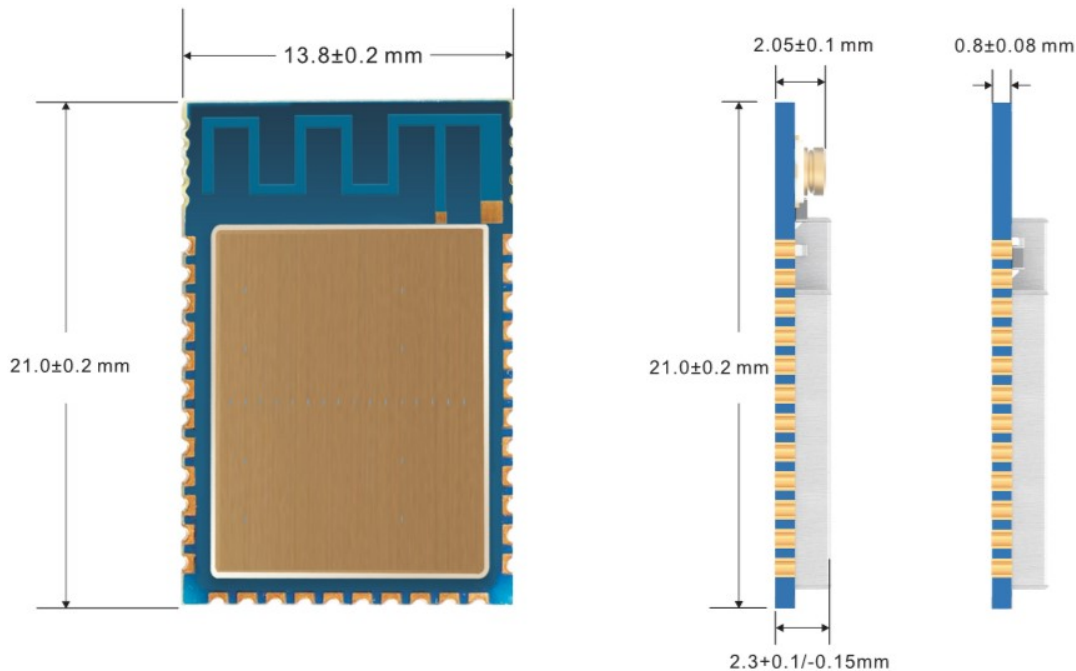
## 2. Block Diagram





### 3. Mechanical specifications

#### 3.1 Module Mechanical Dimensions



Symbol	Min.	Typ.	Max.
Length	-0.2mm	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

Technical drawing of a mechanical part with dimensions in mm. The drawing shows a cross-section of a component with a total width of 21 mm and a total height of 13.8 mm. The left side features a hatched rectangular area. The top edge has a radius of R0.275. The right edge has a series of vertical slots and a circular feature. Dimensions are provided for various features and distances.

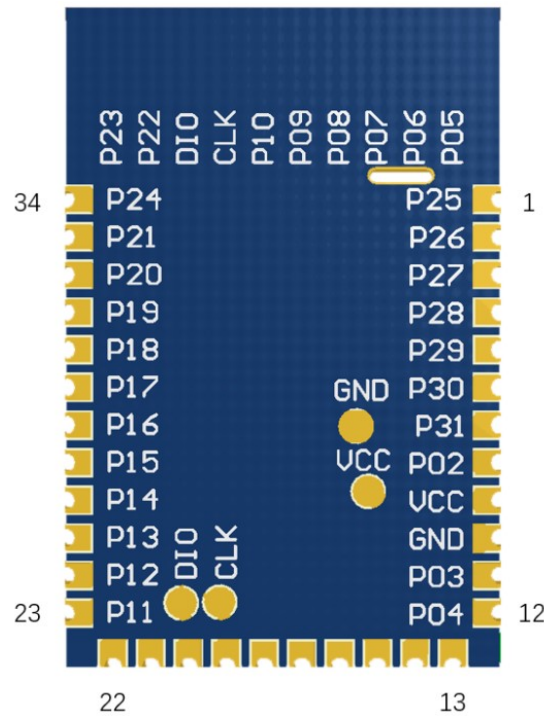
Dimensions (mm):

- Overall width: 21
- Overall height: 13.8
- Top left horizontal distance: 7.3
- Top left horizontal distance: 6.1
- Top right horizontal distance: 2.03
- Top right vertical distance: 0.8
- Right side vertical distance: 5.4
- Right side vertical distance: 4.2
- Right side vertical distance: 3.23
- Right side vertical distance: 2
- Right side vertical distance: 2.71
- Right side vertical distance: 0.8
- Bottom right horizontal distance: 0.8
- Bottom left horizontal distance: 2.83
- Bottom left horizontal distance: 2.08
- Internal horizontal distance: 2.33
- Internal vertical distance: 2.33
- Internal circular feature: 4\* $\phi 1$
- Radius: R0.275

Unit : mm

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

### 4. Pin Assignment



**MK05 module pin diagram (Rear View)**

Pin No.	Name	Type	Description
1	P25	Digital I/O	General purpose I/O
2	P26	Digital I/O	General purpose I/O
3	P27	Digital I/O	General purpose I/O
4	P28	Digital I/O	General purpose I/O
	AIN4	Analog input 4	SAADC/COMP/LPCOMP input
5	P29	Digital I/O	General purpose I/O
	AIN5	Analog input 5	SAADC/COMP/LPCOMP input
6	P30	Digital I/O	General purpose I/O
	AIN6	Analog input 6	SAADC/COMP/LPCOMP input
7	P31	Digital I/O	General purpose I/O
	AIN7	Analog input 7	SAADC/COMP/LPCOMP input
8	P02	Digital I/O	General purpose I/O
	AIN0	Analog input 0	SAADC/COMP/LPCOMP input
9	VCC	Power	Power Supply: 1.7V-3.6V
10	GND	Power	Ground
11	P03	Digital I/O	General purpose I/O
	AIN1	Analog input 1	SAADC/COMP/LPCOMP input
12	P04	Digital I/O	General purpose I/O
	AIN2	Analog input 2	SAADC/COMP/LPCOMP input

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Pin No.	Name	Type	Description
13	P05	Digital I/O	General purpose I/O
	AIN3	Analog input 3	SAADC/COMP/LPCOMP input
14	P06	Digital I/O	General purpose I/O
15	P07	Digital I/O	General purpose I/O
16	P08	Digital I/O	General purpose I/O
17	P09	Digital I/O	General purpose I/O
18	P10	Digital I/O	General purpose I/O
19	SWDCLK	Digital input	Serial wire debug clock input for debug and programming
20	SWDIO	Digital I/O	Serial wire debug I/O for debug and programming
21	P22	Digital I/O	General purpose I/O
22	P23	Digital I/O	General purpose I/O
23	P11	Digital I/O	General purpose I/O
24	P12	Digital I/O	General purpose I/O
25	P13	Digital I/O	General purpose I/O
26	P14	Digital I/O	General purpose I/O
27	P15	Digital I/O	General purpose I/O
28	P16	Digital I/O	General purpose I/O
29	P17	Digital I/O	General purpose I/O
30	P18	Digital I/O	General purpose I/O
31	P19	Digital I/O	General purpose I/O
32	P20	Digital I/O	General purpose I/O
33	P21	Digital I/O	General purpose I/O
	RESET		Configurable as pin reset
34	P24	Digital I/O	General purpose I/O

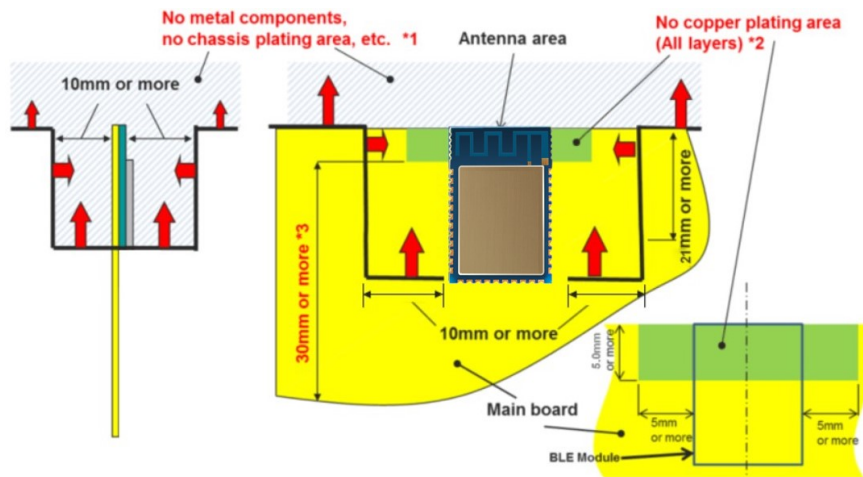
**Note :** Please refer to [Nordic nRF52810 Product Specifications](#) for detailed descriptions and features supported about the Pin assignments.

### 5. Mounting Suggestion

You can refer to the following references for the mounting design of the module with on-board antenna (MK05A with PCB antenna).

For external antenna modules (MK05B 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:

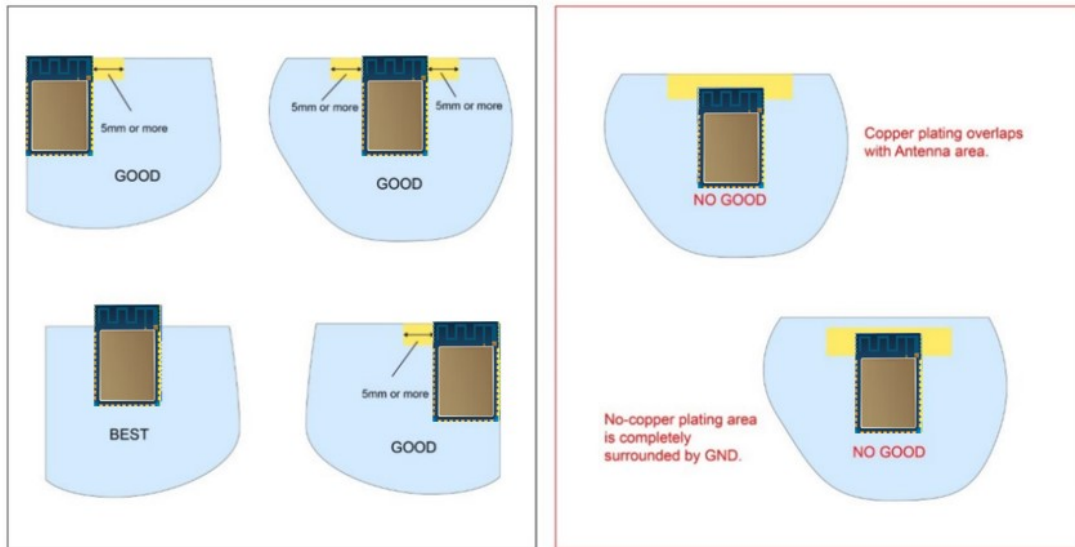


- Please do not place any metal components in blue shaded space (\*1), such as signal line and metal chassis as possible except for main board while mounting the components in \*1 space on the main board is allowed except for no copper plating area (\*2).
- (\*2) This area is routing prohibited area 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 be 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.

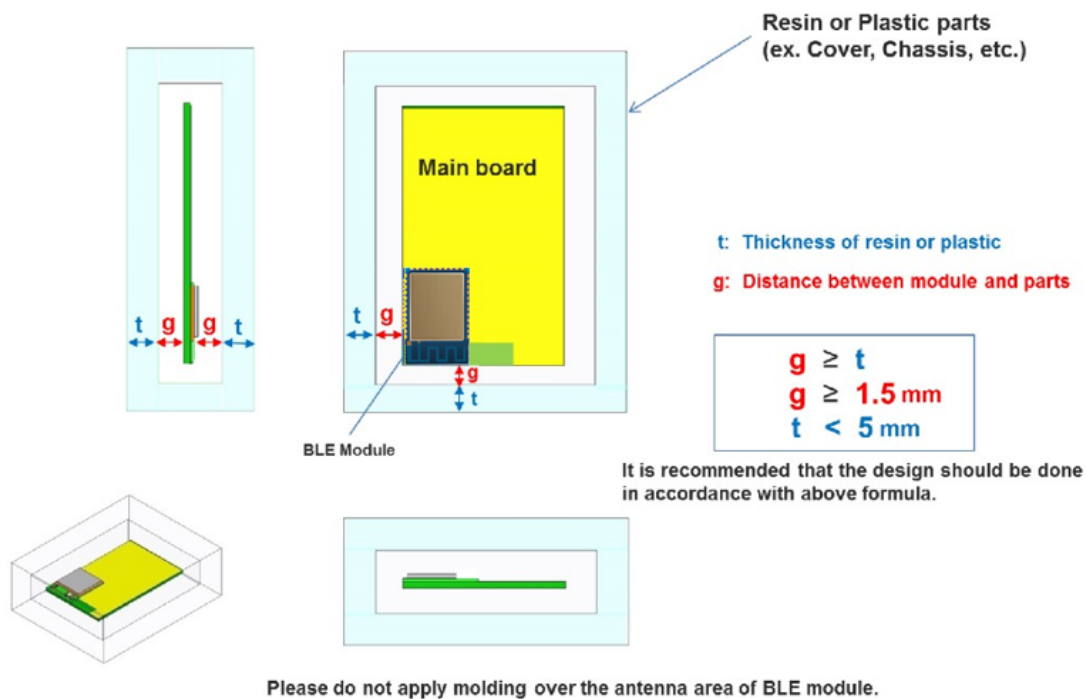
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### Other module mounting examples:



### Placement of resin or plastic parts:



### 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 MK05 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 MK05 is assigned the FCC ID number: 2AO94-MK05**

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: 2AO94-MK05

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 MK05 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 MK05 is assigned the ISED number: 26442-MK05**

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-MK05

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 MK05 module is available in the MK05 Declaration of Conformity.

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

The MK05 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 MK05 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 MK05 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](http://www.vcci.jp/vcci_e/index.html)

The label on the end product which contains a MK05 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 MK05 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: 217-204179



## 6.5 Australia / New Zealand (RCM)

The MK05 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/>

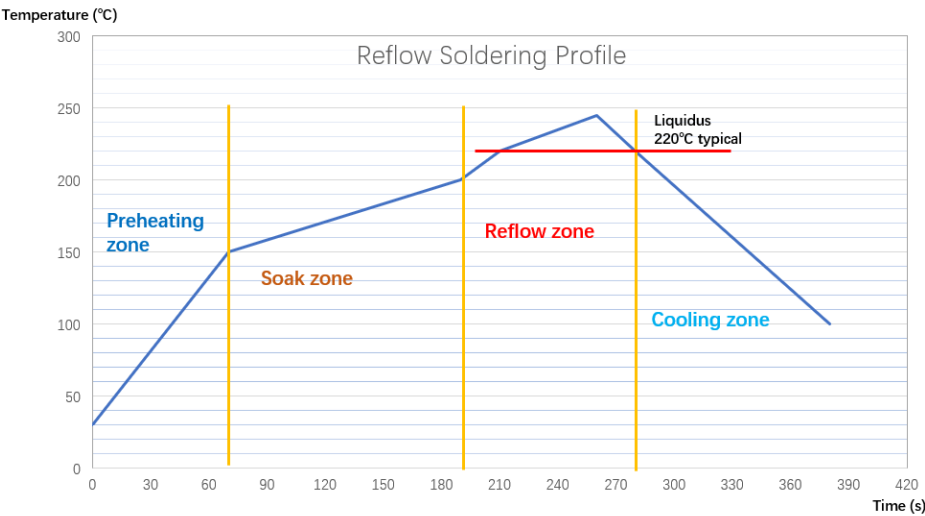
Only Australian-based and New Zealand-based companies who are registered may be granted permission to use the RCM. An Australian-based or New Zealand-based agent or importer may also register as a Responsible Party to use the RCM on behalf of a company not in Australia or New Zealand.

# 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:



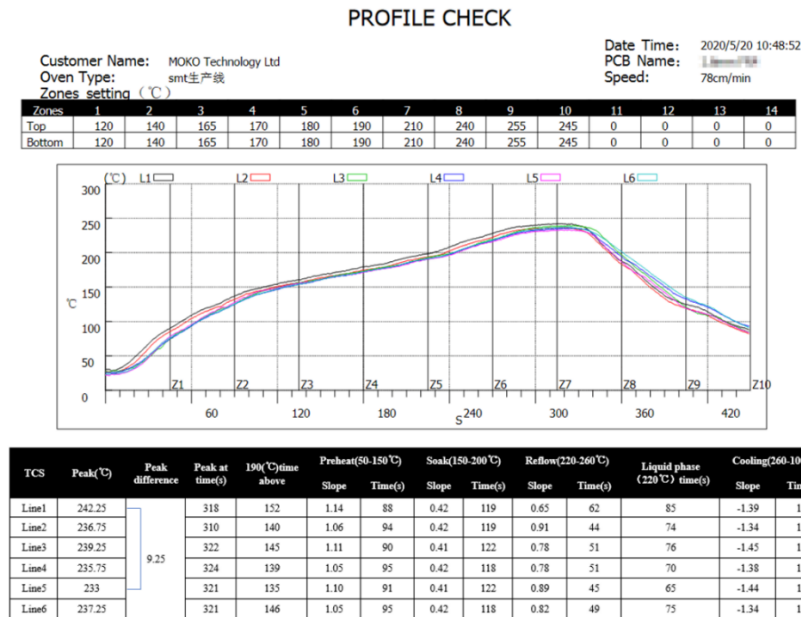
- The standard reflow profile has four zones: ①preheat, ②soak, ③reflow, ④cooling. The profile describes the ideal temperature curve of the top layer of the PCB.
- During reflow, modules should not be above 260°C and not for more than 30 seconds.

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	Kevin	2020.09.04
V1.1	Updated Section 1.4	Victor	2020.10.15
V1.2	Added Section 6 Qualification and approvals	Victor	2020.12.24


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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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