

MK02 Bluetooth Module

(MK02D、MK02E)

Datasheet

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1. Product Instruction

MK02 series is a powerful, highly flexible, ultra low power **Bluetooth® 5** module based on **Nordic® Semiconductor nRF52832 SoC** solution, which has a 32bit Arm® Cortex™-M4 CPU with floating point unit running at 64MHz.

MK02 module is multiprotocol capable with full protocol concurrency. It supports **BLE®** (Bluetooth Low Energy), including the high-speed 2 Mbps feature. Bluetooth mesh can be run concurrently with Bluetooth LE, enabling smartphones to provision, commission, configure and control mesh nodes. NFC, ANT and 2.4GHz proprietary protocols are also supported.

1.1 Model Classification

There are two models of **MK02** series Bluetooth module — **MK02D and MK02E**. The two models have a small size of 21 x 13.8 x 2.3mm with 30 GPIOs of nRF52832QFAA (QFN48 package).

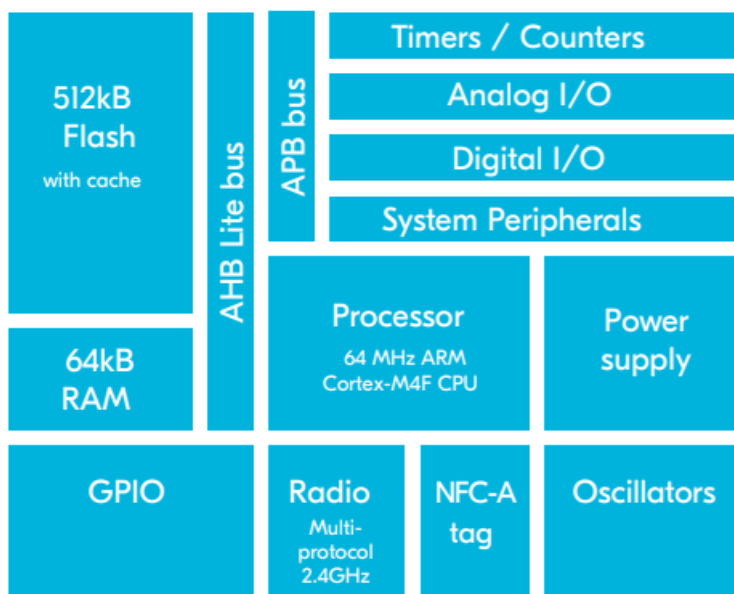
The difference between MK02D and MK02E is the antenna design.

MK02D integrates a high-performance PCB antenna.

MK02E 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
 - Advertising Extensions
- 512kB Flash and 64kB RAM
- Supports 1 Mbps and 2 Mbps Bluetooth LE modes
- Sensitivity of -96 dBm for Bluetooth LE
- Wide supply voltage range: 1.7 V to 3.6 V
- Full set of digital interfaces including: SPI, 2-wire, I²S, UART, PDM, QDEC with EasyDMA
- 12-bit, 200ksps ADC
- 128-bit AES ECB/CCM/AAR co-processor
- RAM mapped FIFOs using EasyDMA
- Type 2 near field communication (NFC-A) tag with wakeup-on-field and touch-to-pair capabilities (P09 and P10)
- RAM mapped FIFOs using EasyDMA
- Individual power management for all peripherals
- On-chip DC/DC buck converter
- Small size: 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
- **Beacons**
- **A4WP wireless chargers and devices**
- **Remote control toys**
- **Computer peripherals and I/O devices**
 - Mouse
 - Keyboard
 - Multi-touch trackpad
 - Gaming

1.4 Product Specifications

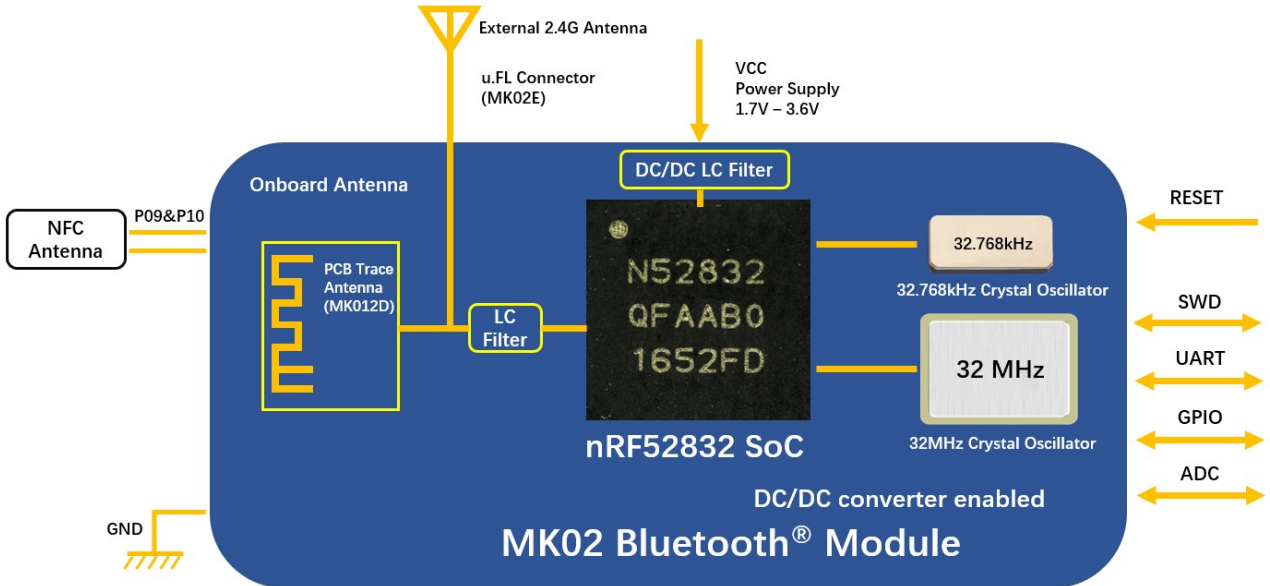
Detail	Description
Bluetooth	
Features	Bluetooth® Low Energy Bluetooth® Mesh 1M LE PHY 2M LE PHY Advertising Extensions CSA #2
Security	AES-128
LE connections	Concurrent central, observer, peripheral, and broadcaster roles with up to twenty concurrent connections along with one observer and one broadcaster
Radio	
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 in 1 Mbps Bluetooth® low energy mode -89 dBm in 2 Mbps Bluetooth® low energy mode -93 dBm in 1 Mbps ANT mode -30 dBm in whisper mode
Antenna	MK02D - PCB trace antenna MK02E - External 2.4Ghz antenna
Advertising distance @1Mbps (Open area)	MK02D - More than 155 meters
Current consumption	
TX only (DCDC enabled, 3V) @ +4dBm / 0dBm / -4dBm/-20dBm/-40dBm	7.5mA / 5.3mA / 4.2mA / 3.2mA / 2.7mA
TX only @ +4dBm / 0dBm / -4dBm / -20dBm / -40dBm	16.6mA / 11.6mA / 9.3mA / 7.0mA / 5.9mA
RX only (DCDC enabled, 3V) @1Msps / 1Msps BLE	5.4mA
RX only @ 1Msps / 1Mbps BLE	11.7mA
RX only (DCDC enabled, 3V) @2Msps / 2Msps BLE	5.8mA
RX only @ 2Msps / 2Mbps BLE	12.9mA
System OFF mode(3V)	0.3uA
System OFF mode with full 64 kB RAM retention(3V)	0.7uA
System ON mode, no RAM retention, wake on RTC(3V)	1.9uA

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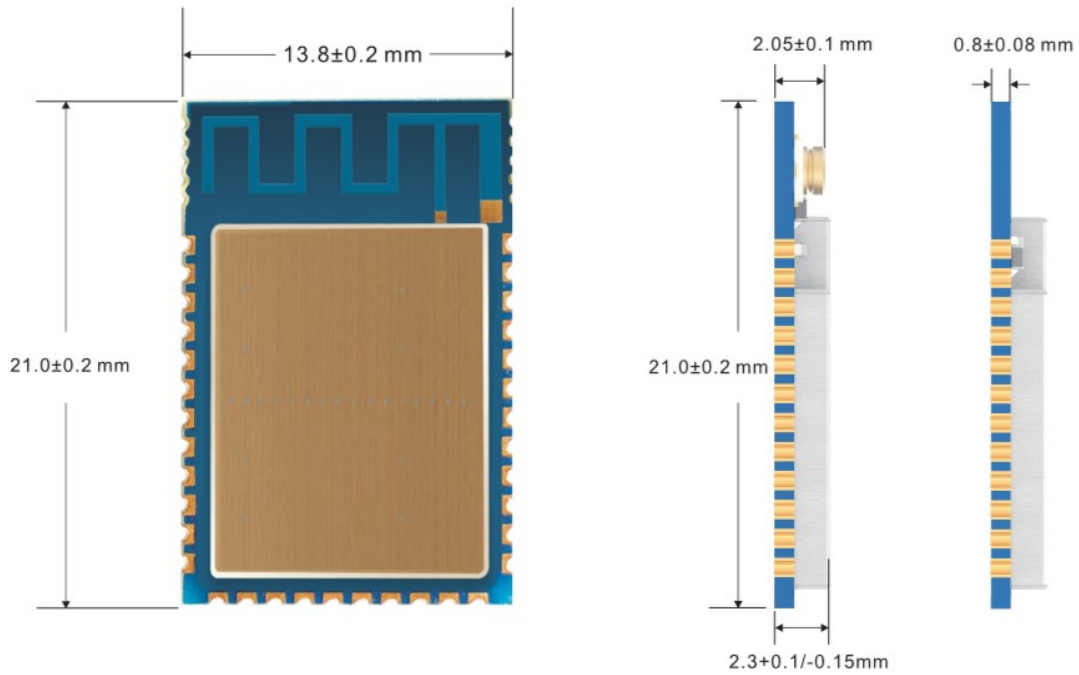
Detail	Description
Mechanical design	
Dimensions	Length: 21mm±0.2mm Width: 13.8mm±0.2mm Height: 2.3mm+0.1mm/-0.15mm
Package	34 Plated Half-hole pins
PCB material	FR-4
Impedance	50Ω
Hardware	
CPU	ARM® Cortex®-M4 32-bit processor with FPU, 64MHz
Memory	512 kB flash, 64 kB RAM
Interfaces	3x SPI master/slave with EasyDMA 2x I ² C compatible 2-wire master/slave 30 GPIOs 8x 12 bit, 200ksps ADC 3x real-time counter (RTC) 3x 4-channel pulse width modulator (PWM) unit with EasyDMA UART (CTS/RTS) with EasyDMA I ² S with EasyDMA Digital microphone interface (PDM) Quadrature decoder (QDEC) NFC-A Tag
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-MK02
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-MK02
Japan (MIC)	Ministry of Internal Affairs and Communications (MIC) of Japan pursuant to the Radio Act of Japan MIC: 210-149849
Australia/New Zealand (RCM)	AS/NZS 4268: 2017, Radio equipment and systems-short range devices

2. Block Diagram



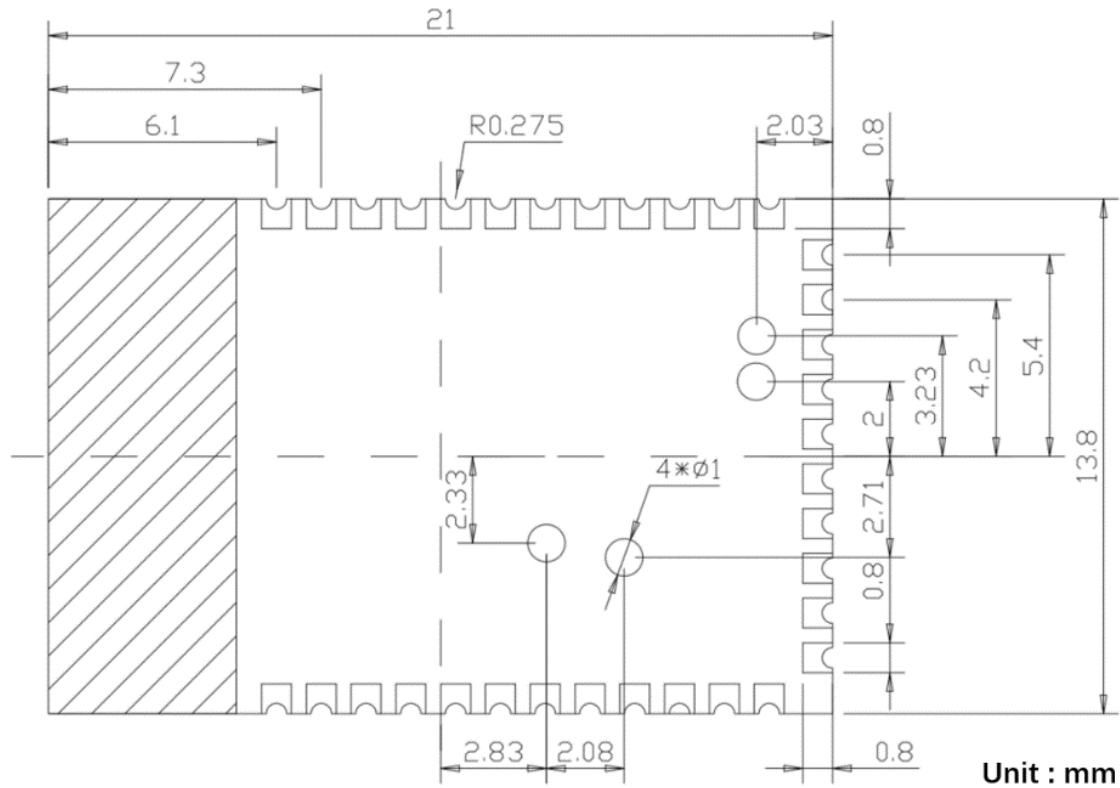
3. Mechanical Specifications

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

3.2 Recommended PCB Land Pads



MK02 PCB land pads (TOP View)

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

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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
	NFC1	NFC input	NFC antenna connection
18	P10	Digital I/O	General purpose I/O
	NFC2	NFC input	NFC antenna connection
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
	P14	Digital I/O	General purpose I/O
26	TRACEDATA[3]		Trace port output
	P15	Digital I/O	General purpose I/O
27	TRACEDATA[2]		Trace port output
	P16	Digital I/O	General purpose I/O
28	TRACEDATA[1]		Trace port output
	P17	Digital I/O	General purpose I/O
29	P18	Digital I/O	General purpose I/O
	TRACEDATA[0]/SWO		Trace port output/Single wire output
30	P19	Digital I/O	General purpose I/O
31	P20	Digital I/O	General purpose I/O
	TRACECLK		Trace port clock output
32	P21	Digital I/O	General purpose I/O
	RESET		Configurable as pin reset
33	P24	Digital I/O	General purpose I/O

Note: Please refer to [Nordic nRF52832 Product Specifications](#) for detailed descriptions and features supported about the Pin assignments.

1. Radio performance parameters, such as sensitivity, may be affected by high frequency digital I/O with large sink/source current close to the Radio power supply and antenna pins. Recommended usage: Low drive, low frequency I/O only.

5. Interfaces

5.1 Power Supply

Regulated power for the **MK02** is required. The input voltage VCC range should be 1.7V to 3.6V. Suitable decoupling must be provided by external decoupling circuitry (10uF and 0.1uF). It can reduce the noise from power supply and increase power stability.

5.2 System Function Interfaces

5.2.1 GPIO

The general purpose I/O is organized as one port with up to 30 I/Os enabling access and control of up to 30 pins through one port. Each GPIO can be accessed individually with the following user configurable features:

- Input/output direction
- Output drive strength
- Internal pull-up and pull-down resistors
- Wake-up from high or low level triggers on all pins
- Trigger interrupt on all pins
- All pins can be used by the PPI task/event system; the maximum number of pins that can be interfaced through the PPI at the same time is limited by the number of GPIOTE channels
- All pins can be individually configured to carry serial interface or quadrature demodulator signals
- All pins can be configured as PWM signal

5.2.2 Two-wire Interface (I²C Compatible)

The two-wire interface can communicate with a bi-directional wired-AND bus with two lines (SCL, SDA). The protocol makes it possible to interconnect up to 127 individually addressable devices. The interface is capable of clock stretching, supporting data rates of 100kbps, 250kbps and 400kbps. The module has 2 TWI ports and they properties like following table.

Instance	Master/Slave
TWI 0	Master
TWI 1	Master

5.2.3 Flash Program I/O

The module has two programmer pins, respectively SWDCLK pin and SWDIO pin. The two pin Serial Wire Debug (SWD) interface provided as a part of the Debug Access Port (DAP) offers a flexible and powerful mechanism for non-intrusive debugging of program code. Breakpoints and single stepping are part of this support.

5.2.4 Serial Peripheral Interface

The SPI interfaces enable full duplex synchronous communication between devices. They support a three-wire (SCK, MISO, MOSI) bi-directional bus with fast data transfers. The SPI Master can communicate with multiple slaves using individual chip select signals for each of the slave devices attached to a bus. Control of chip select signals is left to the application through use of GPIO signals. SPI Master has double buffered I/O data. The SPI Slave includes EasyDMA for data transfer directly to and from RAM allowing Slave data transfers to occur while the CPU is IDLE. The GPIOs are used for each SPI interface line can be chosen from any GPIOs on the device and independently. This enables great flexibility in device pinout and efficient use of printed circuit board space and signal routing.

5.2.5 UART

The Universal Asynchronous Receiver/Transmitter offers fast, full-duplex, asynchronous serial communication with built-in flow control (CTS, RTS), support in hardware up to 1 Mbps baud. Parity checking is supported.

Note: The GPIOs are used for each SPI/TWI/UART interface line can be chosen from any GPIOs on the device and configured independently.

5.2.6 Low Power Comparator (LPCOMP)

In System ON, the block can generate separate events on rising and falling edges of a signal, or sample the current state of the pin as being above or below the threshold. The block can be configured to use any of the analog inputs on the device. Additionally, the low power comparator can be used as an analog wakeup source from System OFF or System ON. The comparator threshold can be programmed to a range of fractions of the supply voltage.

5.2.7 Analog to Digital Converter (ADC)

The 12bit incremental Analog to Digital Converter (ADC) enables sampling of up to 8 external signals through a front-end multiplexer. The ADC has configurable input and reference prescaling, and sample resolution (8,10, and 12bit).

- Note: The ADC module uses the same analog inputs as the LPCOMP module. Only one of the modules can be enabled at the same time.

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MK02 PIN NO.	Name	Type	Description
4	P28	Digital I/O	General purpose I/O ²
	AIN4	Analog input 4	SAADC/COMP/LPCOMP input
5	P29	Digital I/O	General purpose I/O ²
	AIN5	Analog input 5	SAADC/COMP/LPCOMP input
6	P30	Digital I/O	General purpose I/O ²
	AIN6	Analog input 6	AADC/COMP/LPCOMP input
7	P31	Digital I/O	General purpose I/O ²
	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
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
13	P05	Digital I/O	General purpose I/O
	AIN3	Analog input 3	SAADC/COMP/LPCOMP input

5.2.8

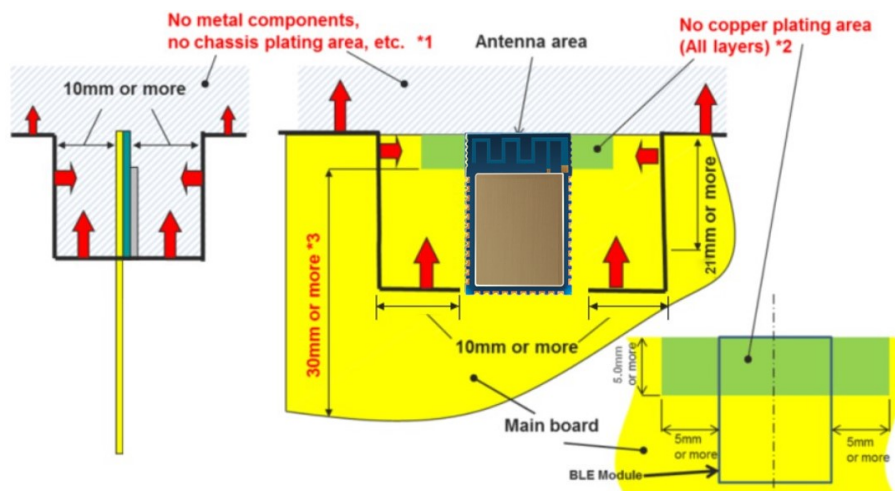


6. Mounting Suggestion

You can refer to the following references for the mounting design of the module with on-board antenna (MK02D with PCB antenna).

For external antenna modules (MK02E needs to connect an external antenna to the u.FL connector), you need to refer to the external antenna design requirements.

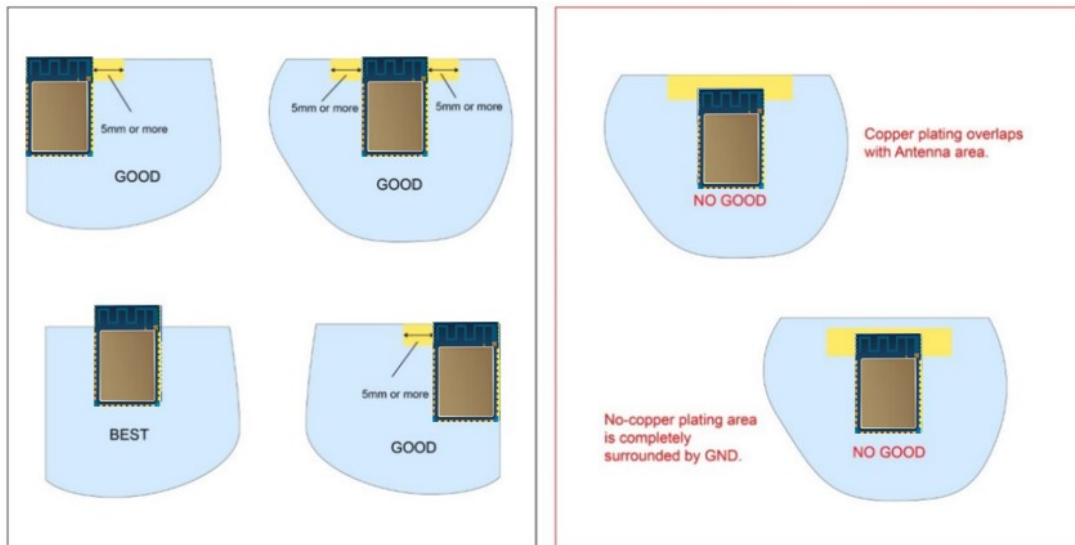
Recommended module mounting example:



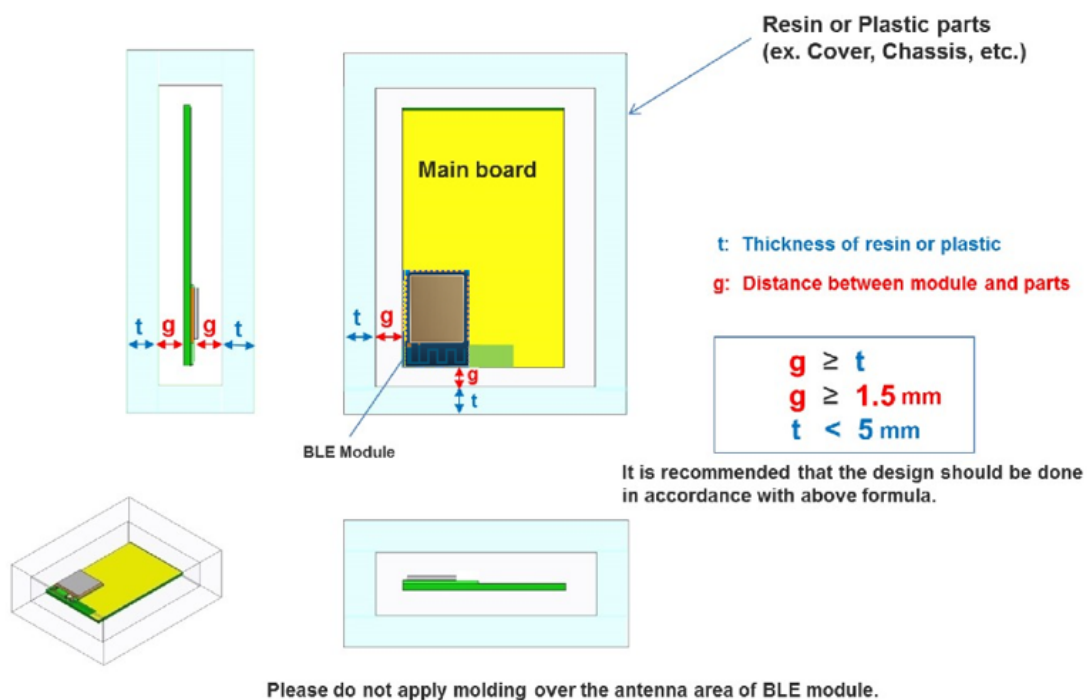
- Please do not place any metal components in blue shaded space(*1), such as signal line and metal chassis as possible except for main board while mounting the components in *1 space on the main board is allowed except for no copper plating area(*2).
- (*2)This area is routing prohibited area on the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

7. Qualification and approvals

7.1 United States (FCC)

The MK02 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.

7.1.1 Labeling and user information requirements

The MK02 is assigned the FCC ID number: 2A094-MK02

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-MK02

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.

7.1.2 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).

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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.

7.2 Canada (ISED)

The MK02 module is certified for use in Canada under Innovation, Science and Economic Development Canada (ISED) Radio Standards Specification (RSS) RSS-247 and RSSGen.

7.2.1 Labeling and user information requirements

The MK02 is assigned the ISED number: 26442-MK02

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-MK02

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.

7.2.2 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.

7.3 European Union regulatory compliance

Information about regulatory compliance of the European Union for the MK02 module is available in the MK02 Declaration of Conformity.

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

The MK02 module complies with the essential requirements and other relevant provisions of Radio Equipment Directive (RED) 2014/53/EU.

7.3.2 Labeling and user information requirements

The label on the final products which contain the MK02 module must follow CE marking requirements. The “R&TTE Compliance Association Technical Guidance Note 01” provides guidance on final product CE marking.

7.4 Japan (MIC)

The MK02 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 MK02 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 MK02 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: 210-149849



7.5 Australia / New Zealand (RCM)

The MK02 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/>

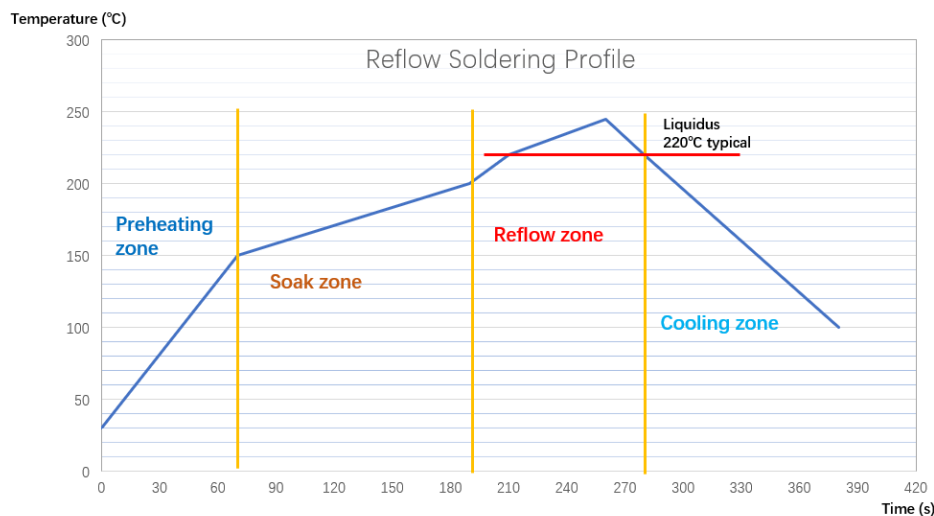
Only Australian-based and New Zealand-based companies who are registered may be granted permission to use the RCM. An Australian-based or New Zealand-based agent or importer may also register as a Responsible Party to use the RCM on behalf of a company not in Australia or New Zealand.

8. Cautions

8.1 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:



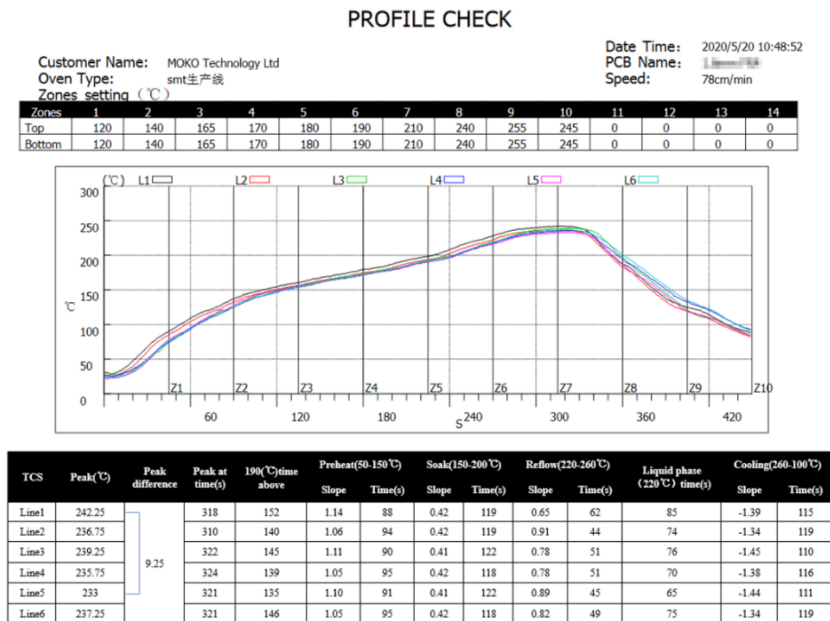
- The standard reflow profile has four zones: ①preheat, ②soak, ③reflow, ④cooling. The profile describes the ideal temperature curve of the top layer of the PCB.
- During reflow, modules should not be above 260°C and not for more than 30 seconds.

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 Liquidus	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.

8.2 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.

8.3 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 7 about certification information.	Victor	2020.12.24

MK02 Bluetooth Module

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

2.1 Antennas

The MK02 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 MK02D

BLE Antenna Gain: -0.1 dBi For Model MK02D

BLE Antenna Designation: External FPC antenna For Model MK02E

BLE Antenna Gain: Max. 2.0 dBi For Model MK02E

2.2 List of applicable FCC rules

The MK02 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 MK02 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

MK02 series is a powerful, highly flexible, ultra low power Bluetooth® 5 module based on Nordic® Semiconductor nRF52832 SoC solution, which has a 32bit Arm® Cortex™-M4 CPU with floating point unit running at 64MHz.

MK02 module is multiprotocol capable with full protocol concurrency. It supports BLE® (Bluetooth Low Energy), including the high-speed 2Mbps feature. Bluetooth mesh can be run concurrently with Bluetooth LE, enabling smartphones to provision, commission, configure and control mesh nodes. 2.4GHz proprietary protocols are also supported.

Its application can be automatic meter reading, home building automation, security system, remote irrigation system.

MK02 Bluetooth Module

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

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.

2.8 Label and compliance information

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

Host must Contain FCC ID: 2AO94-MK02. 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.
- (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 require 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
- 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: 2402MHz - 2480MHz by supplied firmware programming

MK02 Bluetooth Module

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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.
- (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.

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.