MK3431BLE Bluetooth Module

Datasheet   *Version 1.0*

Contents

1 Instruction

MK3431BLE is a powerful and highly flexible Bluetooth® 4.2 module based on Nordic® Semiconductor nRF51802 which is the Multiprotocol Bluetooth® 4.2 low energy/2.4 GHz RF SoC designed for ultra-low-power wireless. It has a 32bit ARM Cortex-M0 CPU, flash memory and analog and digital peripherals. The MK3431BLE provides a low power and ultra-low cost BLE and proprietary protocols for wireless transmission applications.

Applications:

- Bluetooth low energy applications

- Wearables

- Beacons

- Appcessories

- Computer peripherals

- CE remote controls for TV, STB and media systems

- Proximity and security alert tags

- Sports- and fitness sensors

- Healthcare and lifestyle sensors

- Game controllers for computers

- Toys and Electronic games

- Domestic/Industrial control and data-acquisition

- Intelligent domestic appliances

2 Specifications

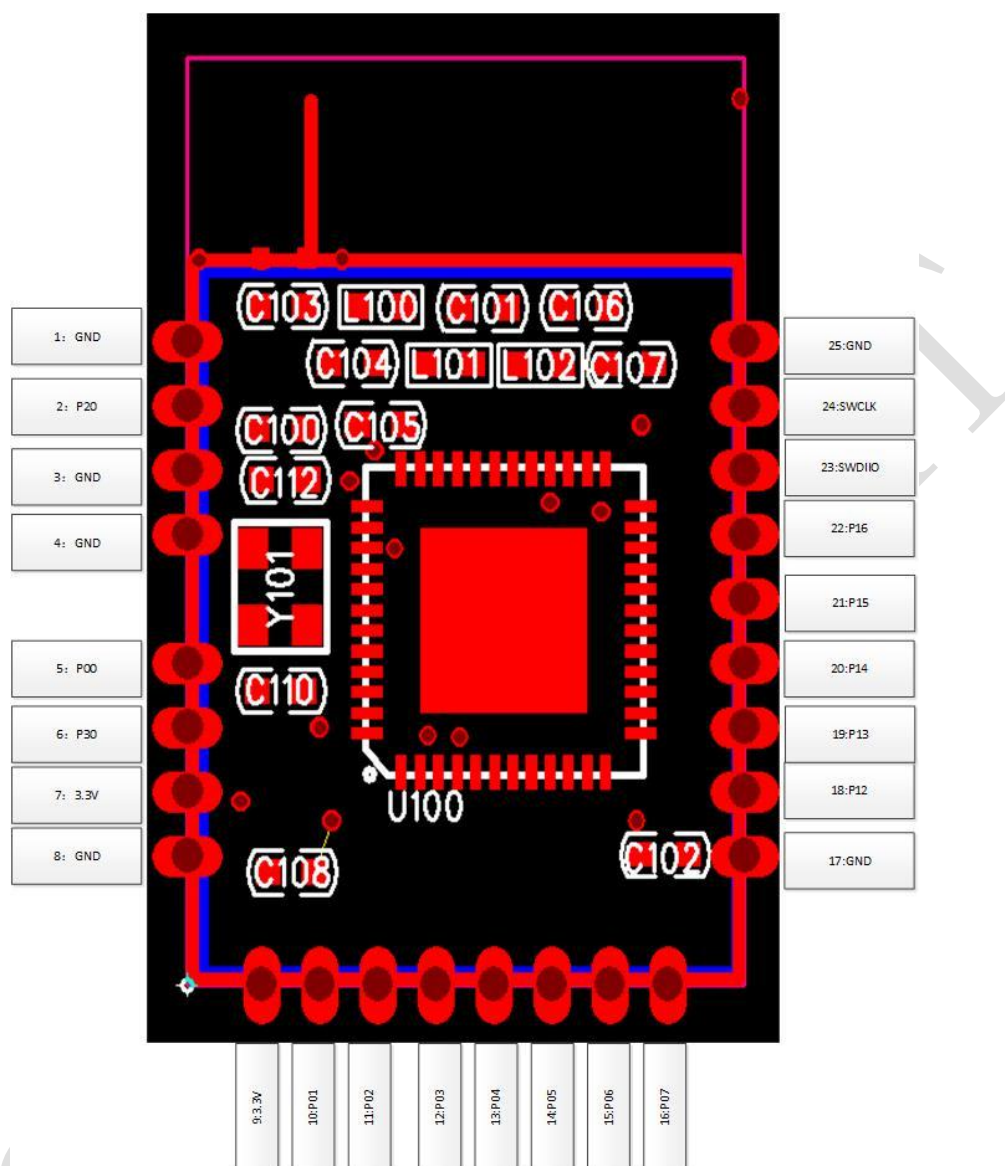| Detail	Description
General	
SoC	Nordic nRF51802
Microcontroller	32-bit ARM Cortex M0
Program Memory	256kB
RAM	16kB
Dimension	18mm x 12mm x 1.7mm
Radio	
Frequency band	2.4GHz ISM (2.4000 – 2.4835GHz)
On-air data rate	250 kbps, 1Mbps or 2Mbps
Modulation	GFSK
Output power	Programmable: +4dBm to -20dBm in 4dB steps
Sensitivity	-91dBm Bluetooth Low Energy -94dBm at 250kbps -88dBm at 1Mbps -83dBm at 2Mbps
Hardware	
Security	128-bit AES ECB/CCM/AAR co-processor
GPIO	15 configurable
Digital I/O	X2 Hardware SPI master 2X 2-wire master UART Quadrature demodulator
Oscillators	16MHz crystal oscillator 32kHz RX oscillator ($\pm$250 ppm)
Peripherals	10-bit ADC RNG Temperature sensor RTC
PPI	16-channel
Timers/counters	2 x 16bit, 1 x 24bit, 2 x 24bit, RTC
Voltage regulator	1.8V to 3.6V
Current Consumption	
LDO at 1.8V	16mA – TX at +4dBm output power 10.5mA – TX at 0dBm output power 13mA – RX at 1Mbps
System current	0.6uA – No RAM retention 1.2uA – 8k RAM retention 2.6uA – All peripherals in IDLE mode

3 Pin assignments

Figure 1: MK3431BLE pin diagram (Top View)

Pin No.	Pin Name	Function	Description
1	GND	Power	Ground
2	P0.20	Digital I/O	General purpose I/O
3	GND	Power	Ground
4	GND	Power	Ground
5	P0.00	Digital I/O	General purpose I/O
	AREF0	Analog input	ADC/LPCOMP reference input 0
6	P0.30	Digital I/O	General purpose I/O
7	VDD	Digital I/O	Power supply
8	GND	Power	Ground
9	VDD	Digital I/O	Power supply

Pin No.	Pin Name	Function	Description
10	P0.01	Digital I/O	General purpose I/O
	AIN2	Analog input	ADC/LPCOMP input 2
11	P0.02	Digital I/O	General purpose I/O
	AIN3	Analog input	ADC/LPCOMP input 3
12	P0.03	Digital I/O	General purpose I/O
	AIN4	Analog input	ADC/LPCOMP input 4
13	P0.04	Digital I/O	General purpose I/O
	AIN5	Analog input	ADC/LPCOMP input 5
14	P0.05	Digital I/O	General purpose I/O
	AIN6	Analog input	ADC/LPCOMP input 6
15	P0.06	Digital I/O	General purpose I/O
	AIN7	Analog input	ADC/LPCOMP input 7
	AREF1	Analog input	ADC/LPCOMP reference input 1
16	P0.07	Digital I/O	General purpose I/O
17	GND	Power	Ground
18	P0.12	Digital I/O	General purpose I/O
19	P0.13	Digital I/O	General purpose I/O
20	P0.14	Digital I/O	General purpose I/O
21	P0.15	Digital I/O	General purpose I/O
22	P0.16	Digital I/O	General purpose I/O
23	SWDIO	Debug	Serial wire debug I/O for debug and programming
24	SWDCLK	Debug	Serial wire debug clock input for debug and programming
25	GND	Power	Ground

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4. Mounting design suggestions

4.1 Recommended mounting and PCB layout

You can refer to the following references for the mounting design and PCB layout of the MK3431BLE module.

The recommended mounting and PCB layout suggestion:

- Locate MK3431BLE module close to the edge of the host PCB.

- Ensure there is no copper in the antenna keep-out area on any layers of the host PCB. Keep all mounting hardware and metal clear of the area to allow proper antenna radiation.

- Keep the antenna area as far away as possible from the power supply and metal components.

- Ensure no exposed copper is on the underside of the module.

- A different host PCB thickness dielectric will have small effect on antenna.

- Use solid GND plane on inner layer (for best EMC and RF performance).

- All module GND pins must be connected to the host PCB GND.

- Place GND vias close to module GND pads as possible.

- Unused PCB area on surface layer can flooded with copper but place GND vias regularly to connect the copper flood to the inner GND plane. If GND flood copper is on the bottom of the module, then connect it with GND vias to the inner GND plane.

- Use a good layout method to avoid excessive noise coupling with signal lines or supply voltage lines.
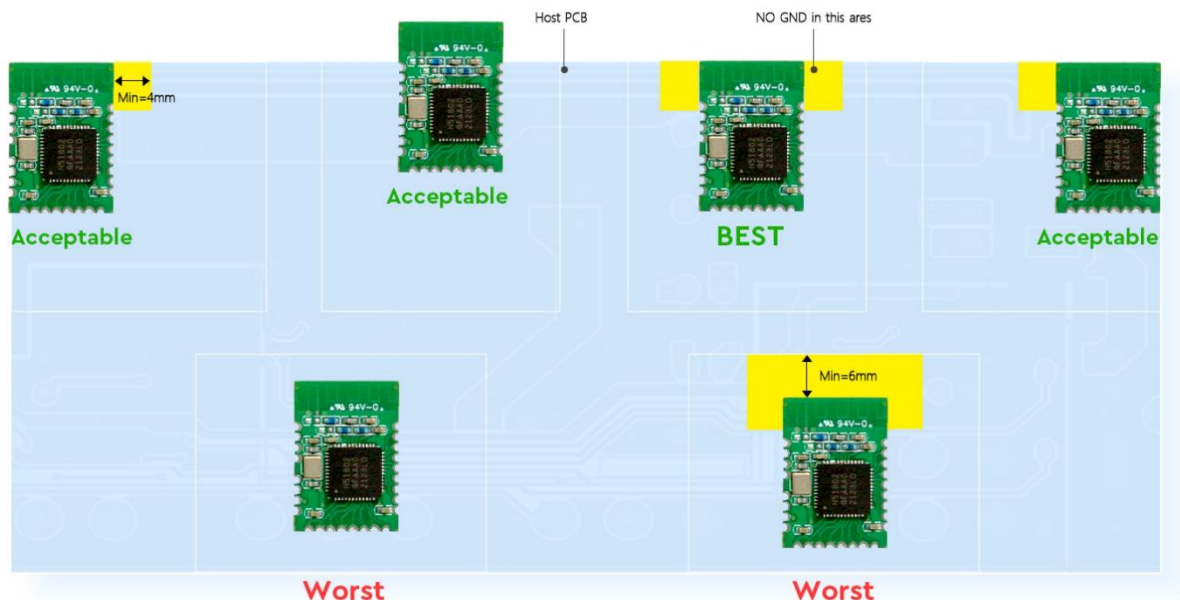

Figure 2: Recommended Module Mounting Examples

4.2 Mechanical enclosure

Care should be taken when designing and placing the MK3431BLE module into an enclosure. Metal should be kept clear from the antenna area, both above and below. Any metal around the module

can negatively impact RF performance.

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

Placement of metal/plastic enclosure:

- Minimum safe distance for metal parts without seriously compromising the antenna (tuning) is 40 mm top/bottom and 30 mm left or right.

- Metal close to the MK3431BLE 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).

5. Cautions

5.1 Reflow soldering

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

- The standard reflow profile has four zones: ①preheat, ②soak, ③reflow, ④cooling. The profile describes the ideal temperature curve of the top layer of the PCB.

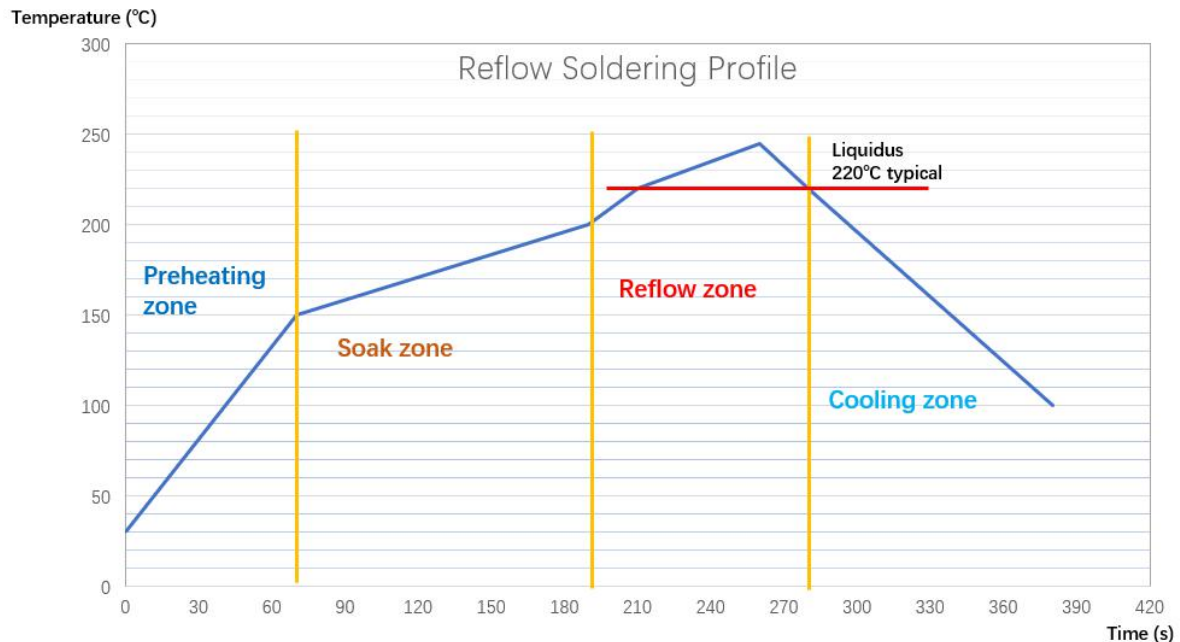- During reflow, modules should not be above 260°C and not for more than 30 seconds.

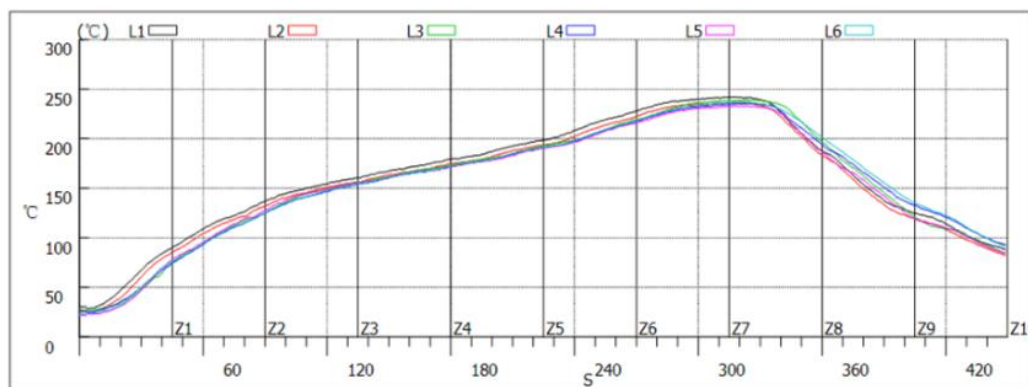*Figure 19: Temperature-Time Profile for Reflow Soldering*

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

PROFILE CHECK

Customer Name: MOKO Technology Ltd
Oven Type: smt生产线
Date Time: 2020/5/20 10:48:52
PCB Name:
Speed: 78cm/min

Zones setting (℃)

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

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

Figure 20: Example of MOKO Smart SMT reflow soldering

5.2 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.

5.3 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:

  o Storage in salty air or in an environment with a high concentration of corrosive gas.

  o Storage in direct sunlight

  o Storage in an environment where the temperature may be outside the range specified.

  o 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.

FCC Warnning:

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 generates, 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.

Caution: Any changes or modifications to this device not explicitly approved by manufacturer could void your authority to operate this equipment.

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

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

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

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

2.2 List of applicable FCC rules

CFR 47 FCC PART 15 SUBPART C has been investigated. It is applicable to the modular transmitter

2.3 Specific operational use conditions

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system.

2.4 Limited module procedures

Not applicable

2.5 Trace antenna designs

Not applicable

2.6 RF exposure considerations

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

2.7 Antennas

This radio transmitter FCC ID:2A43B-MK3431BLE has been approved by Federal Communications Commission to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Antenna No.	Operate frequency band	Antenna Type	Maximum antenna gain
Antenna	2400-2500MHz	PCB Antenna	-0.58dBi

2.8 Label and compliance information

The final end product must be labeled in a visible area with the following" Contains FCC ID:2A43B-MK3431BLE".

2.9 Information on test modes and additional testing requirements
Host manufacturer is strongly recommended to confirm compliance with FCC requirements for the transmitter when the module is installed in the host.

2.10 Additional testing, Part 15 Subpart B disclaimer

Host manufacturer is responsible for compliance of the host system with module installed with all other applicable requirements for the system such as Part 15 B.