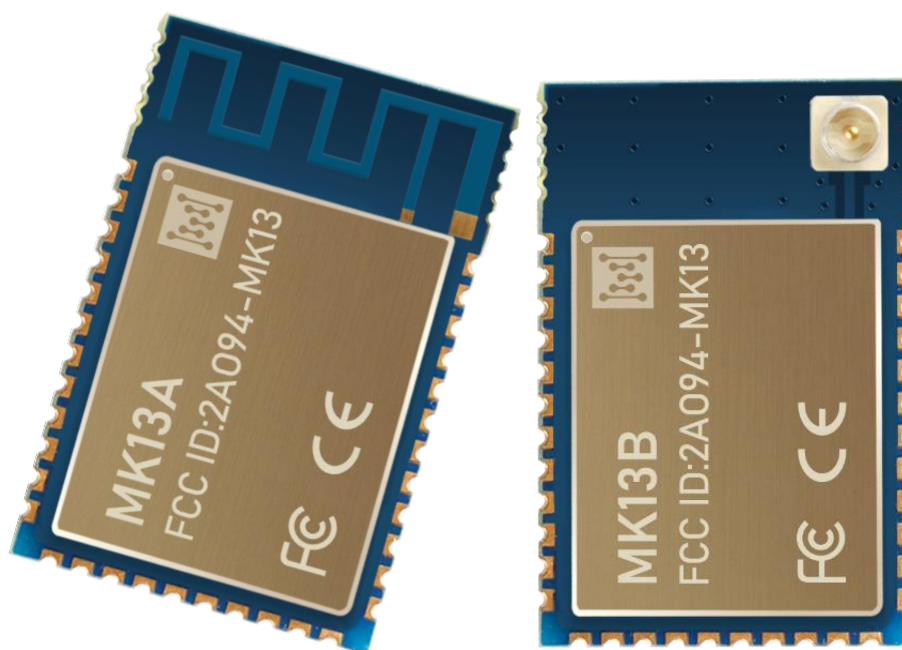




MOKO SMART

MK13 Bluetooth Module Datasheet



MK13 Bluetooth Module

Datasheet

Version 1.0

MOKO TECHNOLOGY LTD.

www.mokosmart.com

www.mokoblue.com

Contents

1 Instruction	1
1.1 Features and benefits	2
1.2 Applications	2
1.3 Product options	3
1.3.1 Hardware options	3
1.3.2 Firmware options	3
1.3.3 Ordering information	4
2 Specifications	5
3 Hardware design	7
3.Pin assignments	7
4 Mechanical details	10
4.1 PCBA mechanical dimensions	10
4.2 PCB land pads dimensions	11
4.3 u.FL connector dimensions	12
5. Power specifications	13
5.1 Normal voltage mode	13
5.2 High voltage mode	14
6. Peripheral interfaces	15
6.1 Memory descriptions	15
6.2 Real-time counter (RTC)	16
6.3 Pulse width modulation (PWM)	16
6.4 General purpose input/output (GPIO)	17
6.5 Serial peripheral interface (SPI)	18
6.6 Universal asynchronous receiver/transmitter (UART)	20
6.7 Successive approximation analog-to-digital converter (SAADC) ...	21
6.8 EasyDMA	23
7. Mounting design suggestions	24
7.1 Recommended mounting and PCB layout	24

7.2 Mechanical enclosure	25
8. Cautions	26
8.1 Reflow soldering	26
8.2 Usage condition notes	27
8.3 Storage notes	28
9. Qualification and Approvals	28
9.1 United States	28
9.2 European Union Regulatory Compliance	30
9.2.1 Radio Equipment Directive (RED) 2014/53/EU	30
9.2.2 Labeling and User Information Requirements	30



1 Instruction

MK13 series is a powerful, highly flexible and ultra-low-power Bluetooth® 5.2 module based on the world's first wireless SoC with two Arm® Cortex®-M33 processors. The combination of two flexible processors, the advanced feature set, and an operating temperature up to 105 °C, makes it the ideal choice for LE Audio, professional lighting, advanced wearables, and other complex IoT applications.

The MK13 is an all-in-one Bluetooth module, including a superset of the most prominent nRF5340® Series features. Features like Bluetooth® 5.2, high-speed SPI, QSPI, USB, up to 105 °C operating temperature, and more, are combined with more performance, memory and integration, while minimizing current consumption.

The MK13 module supports an extensive range of wireless protocols. It supports Bluetooth Low Energy and is capable of all angle-of-arrival (AoA) and angle-of-departure (AoD) roles in Bluetooth Direction Finding. In addition it supports LE Audio, high-throughput 2 Mbps, Advertising Extensions and Long Range. Mesh protocols like Bluetooth mesh can be run concurrently with Bluetooth LE, enabling smartphones to provision, commission, configure and control mesh nodes.

MK13 series modules will be programmed default MOKO MKBN series firmware and custom firmware can be programmed by MOKO smart too.

After you choose MK13 series module, MOKO Smart will provide technical support for your development or even help you to complete all hardware and firmware design. We can power demanding applications, while simplifying designs and reducing BOM costs.

1.1 Features and benefits

- Bluetooth® 5
 - Direction Finding
 - 2Mbps
 - CSA#2
 - Advertising Extensions
 - Long Range
- Supported data rates
 - Bluetooth®: 2 Mbps, 1Mbps, 500 kbps, and 125 kbps
- Wide supply voltage range: 1.7V to 5.5V
- 1MB Flash and 512kB 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
- Dimension: 21.0 x 13.8 x 2.3mm (with shield)
- 46 GPIOs

1.2 Applications

- **Internet of things (IOT)**
 - Smart home sensors and controllers
 - Industrial IoT sensors and controllers
- **Advanced wearables**
 - Health/fitness sensor and monitor devices
 - Wireless payment enabled devices
- **Wireless audio devices**
 - Bluetooth Low Energy Audio
 - True wireless earbuds
 - Headphones, microphones and speakers
- **Advanced computer peripherals and I/O devices**
 - Mouse
 - Keyboard
 - Multi-touch trackpad
- **Interactive entertainment devices**
 - Remote controls
 - Gaming controllers
- **Professional lighting**
 - Wireless connected luminaire

1.3 Product options

1.3.1 Hardware options

There are different module models of **MK13** series Bluetooth module. All models have same dimensions and pin assignments.

Currently MK13 is mainly divided into **A series (MK13A)** and **B series (MK13B)**. The difference is in the antenna design.

MK13A embeds a high-performance PCB antenna.

MK13B uses a u.FL connector (receptacle) and requires an external 2.4Ghz antenna.

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

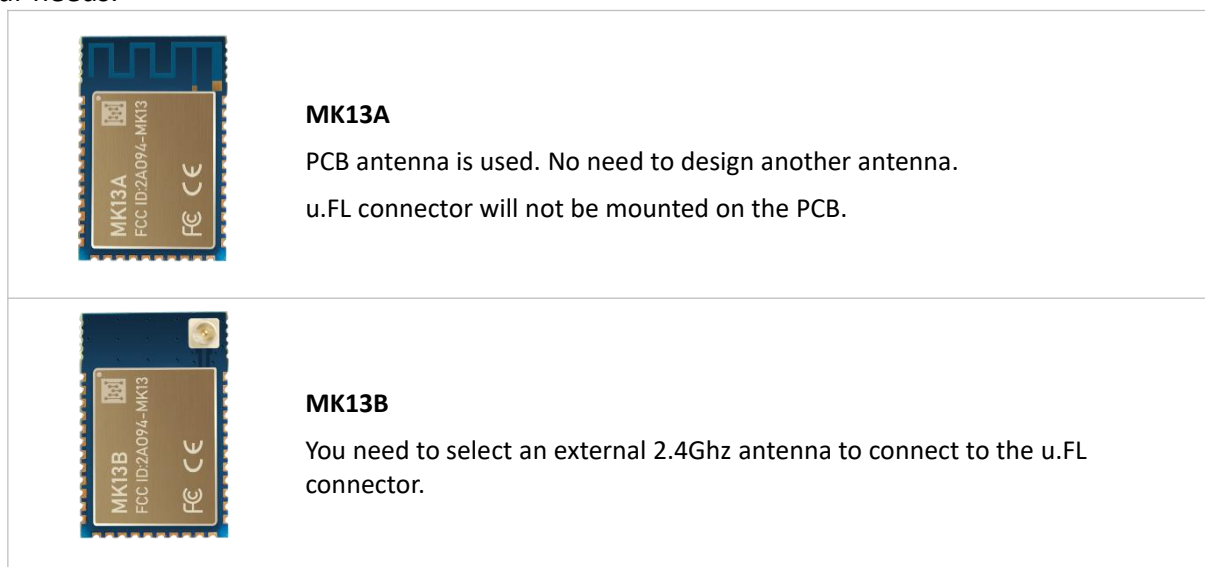


Figure 1: MK13A and MK13B

1.3.2 Firmware options

For customers to use, MK13 series module will be programmed default MOKO MKBN-J01 series firmware, which has the functions of UART Wireless Transparent Transmission and AT commands.

MOKO Smart can help you develop the firmware and can also program your own firmware to modules when manufacture.

Firmware Version	Firmware Features
MKBN-J01	UART wireless transparent transmission, Scanning AT commands

Note: This document is a Hardware Datasheet only – it does not cover the software aspects of the MK13. If you want to get more information about firmware or SDKs of MK13, please contact sales of MOKO Smart.



MK13 Bluetooth Module

Datasheet

1.3.3 Ordering information

Product Model	Antenna	32.768kHz XTAL	Firmware Version	Remark
MK13A	PCB	Yes	MKBN-J01	Default model
MK13B	u.FL connector	Yes	MKBN-J01	Default model

MOKO Smart can provide the default model modules as samples to you to test or develop without MOQ. But if you want the custom models, there will be a MOQ requirement. Please contact sales team of MOKO Smart to get more ordering information.

2 Specifications

Detail	Description
General	
Application core	ARM® Cortex®-M33 with TrustZone® technology
Network core	ARM Cortex-M33
RAM	512kB
Flash	1MB
Dimensions	Length: 21mm±0.2mm Width: 13.8mm±0.2mm Height: 2.3mm+0.1mm/-0.15mm
Bluetooth	
Bluetooth Features	Bluetooth® Low Energy Bluetooth® SIG Mesh 1M LE PHY 2M LE PHY (High speed) LE Coded PHY (Long range) Advertising Extensions CSA #2 (Channel Selection Algorithm #2)
Low Energy	Direction finding Multiple level Low Energy state LE L2CAP Connection Oriented Channel support LE low duty directed advertising LE data length extension feature
Roles	Concurrent central, observer, peripheral and broadcaster
Radio	
Frequency	2402MHz – 2480MHz
Modulations	GFSK at 1 Mbps/2 Mbps Long range (125kbps and 500kbps) data rates
Transmit Power	-20dBm ~ +3dBm
Receiver Sensitivity	-98 dBm sensitivity in 1 Mbps Bluetooth® LE mode -104 dBm sensitivity in 125 kbps Bluetooth® LE mode
Antenna	MK13A series – PCB trace antenna MK13B series – u.FL connector
Hardware	
Power Supply	1.7V to 5.5V DC
Power Regulator	Switching regulator for DC/DC buck setup
Clock control	Embedded 32MHz crystal oscillator Embedded 32K RC oscillator and support external 32.768kHz crystal oscillator
Package	56 diameters of Half-holes
PCB Material	FR-4
Impedance	50Ω
Interfaces	46 flexible General Purpose IOs Up to 2x 24-bit real-time counter (RTC) Up to 5x SPI master/slave with EasyDMA 12-bit, 200 ksps ADC with EasyDMA - eight configurable channels with programmable gain Up to 3x 32-bit timer with counter mode Up to 4x I2C compatible two-wire master/slave with EasyDMA

Detail	Description
	Up to 4x pulse width modulator (PWM) units with EasyDMA Up to 4x UART (CTS/RTS) with EasyDMA Up to 2x Quadrature decoder (QDEC) Audio peripherals - I2S, digital microphone interface (PDM)
Storage Temperature	-40 to 125°C
Operating Temperature	-40 to 85°C Extended Industrial temperature -40 to +105°C can be customized
Current Consumption	
System OFF, wake on reset	0.9uA
Active Rx Mode (1Mbps, DC/DC)	Peak current 3.7mA
Active Tx Mode (1Mbps, DC/DC)	Peak current 5.3mA@ +3dBm Peak current 4.1mA@ 0dBm Peak current 2.6mA@ -40dBm
Certifications	
USA (FCC)	Under progress and completed about in 2021.Q4
Europe (CE)	Under progress and completed about in 2021.Q4
Canada (ISED)	Under progress and completed about in 2021.Q4
Japan (MIC)	Under progress and completed about in 2021.Q4
Australia/New Zealand (RCM)	Under progress and completed about in 2021.Q4
Bluetooth (BQB)	Under progress and completed about in 2021.Q4

3 Hardware design

3.Pin assignments

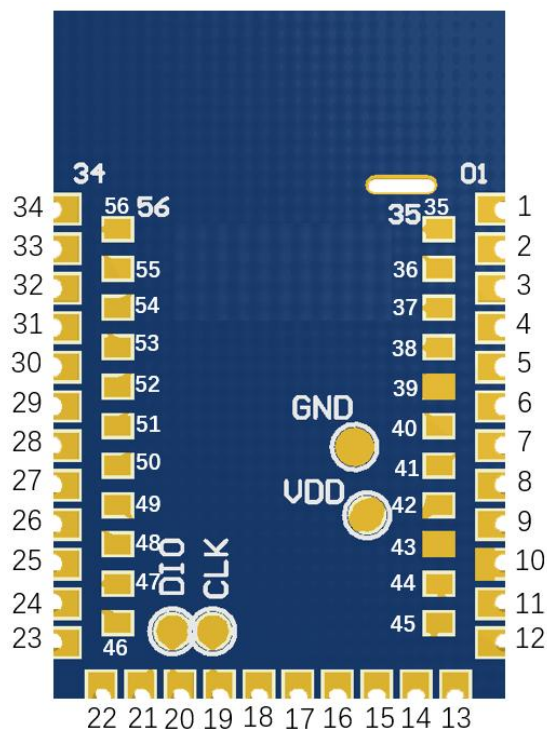


Figure 3: MK13 pin diagram (Rear View)

Pin No.	Pin Name	Function	Description
1	P1.07	Digital I/O	General purpose I/O
2	P0.23	Digital I/O	General purpose I/O
3	P0.15	Digital I/O	General purpose I/O
	IO2	IO2 for QSPI	Dedicated pin for Quad SPI
4	P0.07	Digital I/O	General purpose I/O
	AIN3	Analog input	Analog input
5	P0.31	Digital I/O	General purpose I/O
6	P1.12	Digital I/O	General purpose I/O
7	P1.14	Digital I/O	General purpose I/O
8	P1.01	Digital I/O	General purpose I/O
9	VDD_nRF	Power	Power supply
10	GND	Power	Ground
11	USB_D-	USB	USB_D-
12	USB_D+	USB	USB_D+
13	VBUS	Power	5 V input for USB 3.3 V regulator
14	P0.06	Digital I/O	General purpose I/O
	AIN2	Analog input	Analog input
15	P1.02	Digital I/O	General purpose I/O
	TWI	TWI 1 Mbps	High-speed pin for 1 Mbps TWI

Pin No.	Pin Name	Function	Description
16	P0.08	Digital I/O	General purpose I/O
	TRACEDATA3	Trace data	Trace buffer TRACEDATA [3]
	SCK	SCK for SPIM4	Dedicated pin for high-speed SPI
17	P0.02	Digital I/O	General purpose I/O
18	P0.03	Digital I/O	General purpose I/O
19	SWDCLK	Debug	Serial wire debug clock input for debug and programming
20	SWDIO	Debug	Serial wire debug I/O for debug and programming
21	P0.09	Digital I/O	General purpose I/O
	TRACEDATA2	Trace data	Trace buffer TRACEDATA [2]
	MOSI	MOSI for SPIM4	Dedicated pin for high-speed SPI
22	P0.10	Digital I/O	General purpose I/O
	TRACEDATA1	Trace data	Trace buffer TRACEDATA [1]
	MISO	MISO for SPIM4	Dedicated pin for high-speed SPI
23	P0.11	Digital I/O	General purpose I/O
	TRACEDATA0	Trace data	Trace buffer TRACEDATA [0]
	CSN	CSN for SPIM4	Dedicated pin for high-speed SPI
24	P0.13	Digital I/O	General purpose I/O
	IO0	IO0 for QSPI	Dedicated pin for Quad SPI
25	P0.16	Digital I/O	General purpose I/O
	IO3	IO3 for QSPI	Dedicated pin for Quad SPI
26	P0.18	Digital I/O	General purpose I/O
	CSN	CSN for QSPI	Dedicated pin for Quad SPI
27	P0.20	Digital I/O	General purpose I/O
28	P0.21	Digital I/O	General purpose I/O
29	P1.08	Digital I/O	General purpose I/O
30	P0.24	Digital I/O	General purpose I/O
31	P0.26	Digital I/O	General purpose I/O
	AIN5	Analog input	Analog input
32	P0.28	Digital I/O	General purpose I/O
	AIN7	Analog input	Analog input
33	P0.29	Digital I/O	General purpose I/O
34	GND	Power	Ground
35	P1.05	Digital I/O	General purpose I/O
36	P0.22	Digital I/O	General purpose I/O
37	P1.03	Digital I/O	General purpose I/O
	TWI	TWI 1 Mbps	High-speed pin for 1 Mbps TWI
38	P0.30	Digital I/O	General purpose I/O
39	P1.11	Digital I/O	General purpose I/O
40	P1.13	Digital I/O	General purpose I/O
41	P1.15	Digital I/O	General purpose I/O
42	VDDH	Power	Power supply
43	P1.00	Digital I/O	General purpose I/O
44	P0.05	Digital I/O	General purpose I/O

Pin No.	Pin Name	Function	Description
	AIN1	Analog input	Analog input
45	P0.04	Digital I/O	General purpose I/O
	AIN0	Analog input	Analog input
46	P0.12	Digital I/O	General purpose I/O
	TRACECLK	Trace clock	Trace buffer clock
	DCX	DCX for SPIM4	Dedicated pin for high-speed SPI
47	P0.14	Digital I/O	General purpose I/O
	IO1	IO1 for QSPI	Dedicated pin for Quad SPI
48	P0.17	Digital I/O	General purpose I/O
	SCK	SCK for QSPI	Dedicated pin for Quad SPI
49	P0.19	Digital I/O	General purpose I/O
50	P1.04	Digital I/O	General purpose I/O
51	P1.06	Digital I/O	General purpose I/O
52	P1.09	Digital I/O	General purpose I/O
53	P0.25	Digital I/O	General purpose I/O
	AIN4	Analog input	Analog input
54	P0.27	Digital I/O	General purpose I/O
	AIN6	Analog input	Analog input
55	RESET	Reset	Pin RESET with internal pull-up resistor
56	P1.10	Digital I/O	General purpose I/O

Note: Please refer to [Nordic nRF5340](#) Product Specifications for detailed descriptions and features supported about the Pin assignments.

4 Mechanical details

4.1 PCBA mechanical dimensions

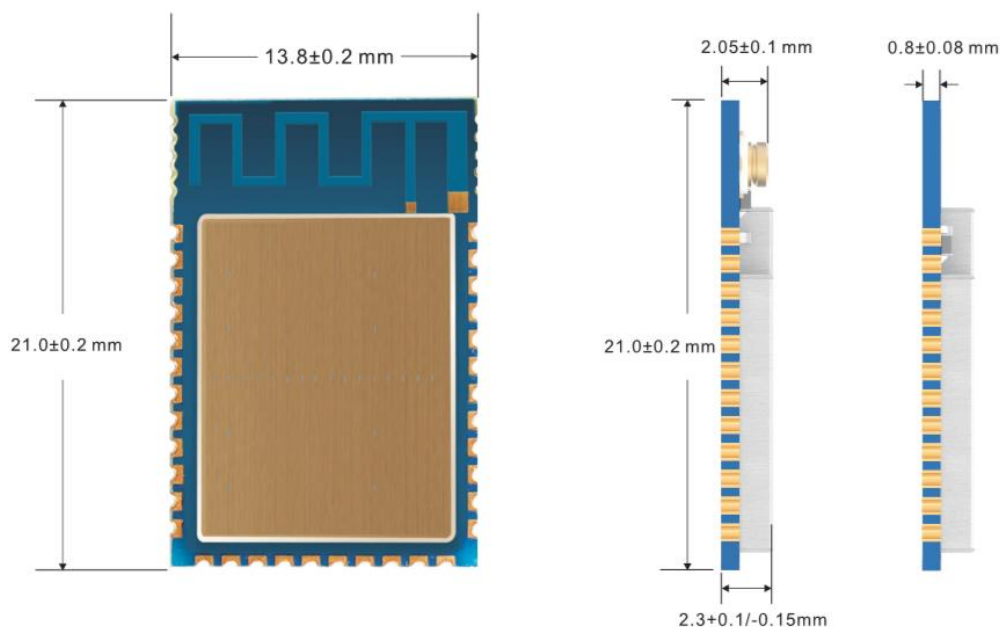


Figure 4: MK13 PCBA dimensions

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

Note: All models of MK13 series Bluetooth module have the same dimensions.

4.2 PCB land pads dimensions

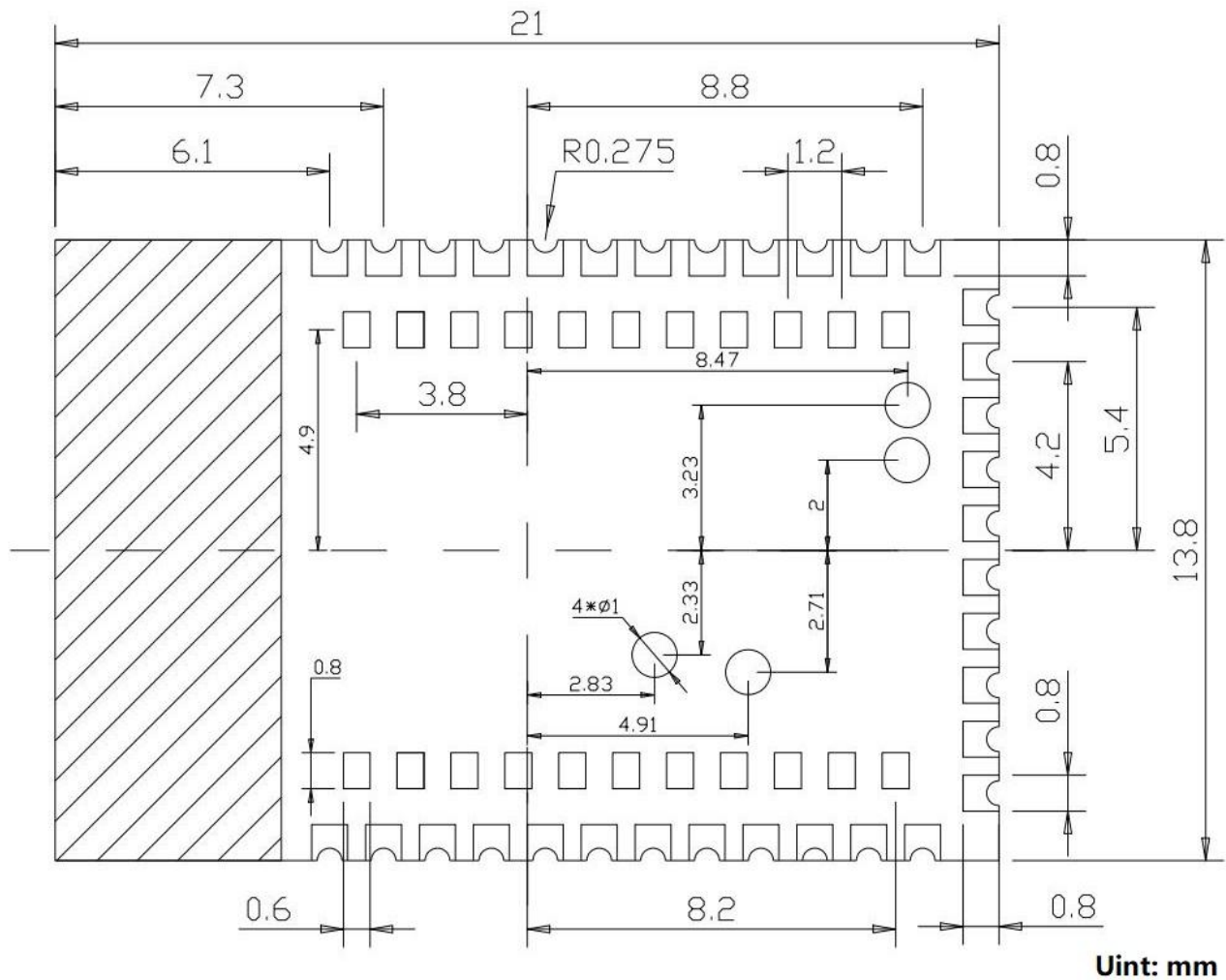


Figure 5: MK13 PCB land pads dimensions (TOP View)

Symbol	Typ.
Half-hole Pad (Bottom)	0.8mm x 0.8mm
LGA Square Pad	0.8mm x 0.6mm
Diameter of Half-hole	0.55mm
Diameter of Central Round pad	1mm (diameter)

4.3 u.FL connector dimensions

MK13B has mounted a micro SMT u.FL series connector (receptacle), which needs an external 2.4Ghz antenna to connect. The model of the connector is *u.FL-R-SMT-1(80)*.

According to the dimensions of the connector to choose an antenna with a right plug which can connect to the receptacle appropriately.

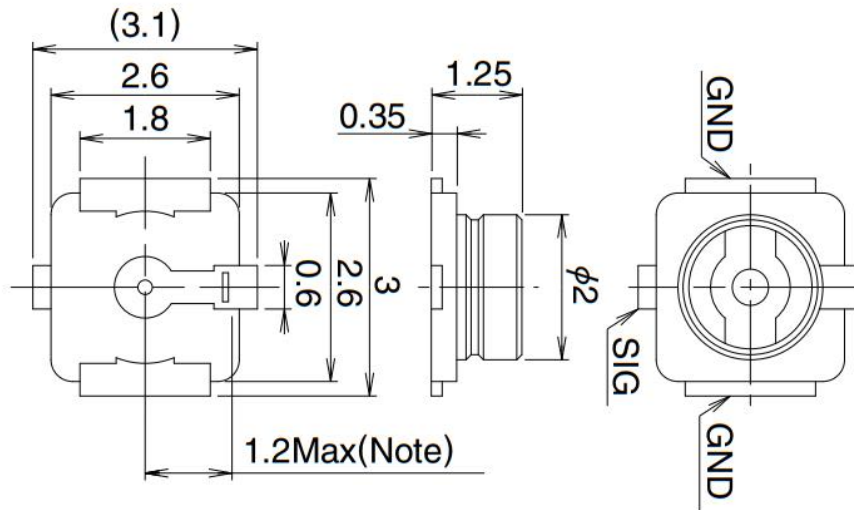


Figure 6: u.FL-R-SMT-1(80) Dimensions

Note: More information about the u.FL connector, please refer to

https://www.hirose.com/en/product/document?clcode=&productname=&series=U.FL&documenttype=Catalog&lang=en&documentid=D31697_en

5. Power specifications

MK13 supports two different power supply voltage ranges, each having a corresponding power supply pin. The PMU automatically activates the correct voltage regulator depending on which power supply pin is used.

5.1 Normal voltage mode

Powers the device through the VDD pin.

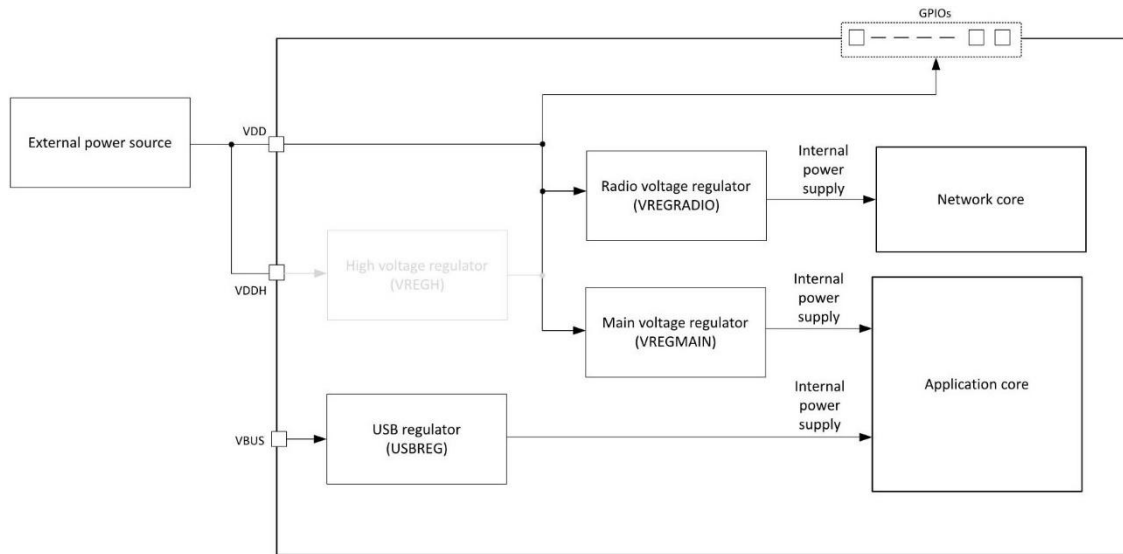


Figure 7: Regulator usage in normal voltage mode

The VDD and VDDH pins are connected together. The external power supply is connected to the both pins.

In this case, the VREGH regulator is automatically deactivated.

In normal voltage mode, each regulator can operate in LDO or DC/DC mode.

5.2 High voltage mode

Powers the device through the VDDH pin.

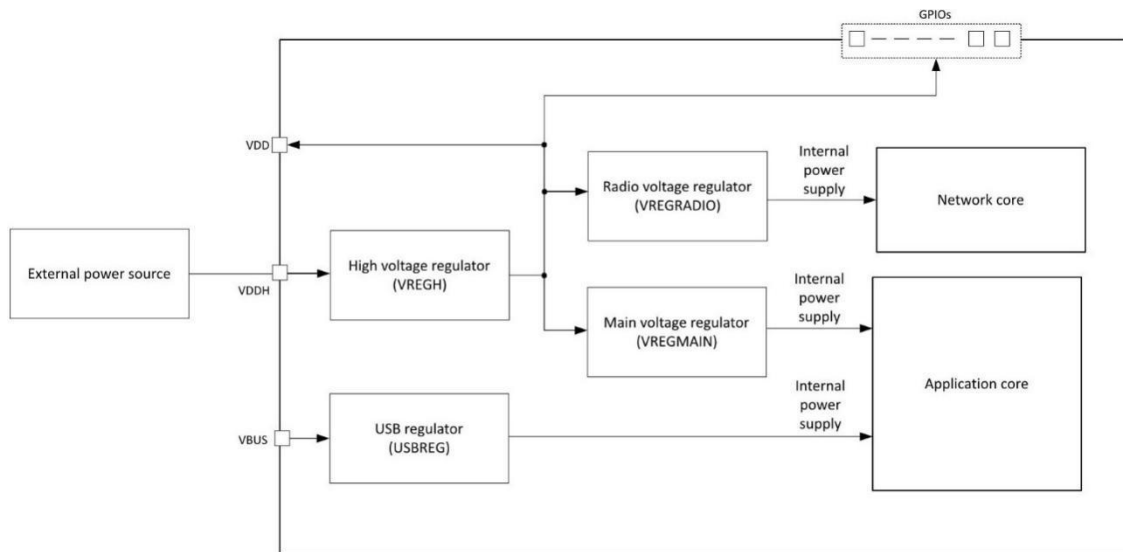


Figure 8: Regulator usage in high voltage mode

The external power supply is connected to the VDDH pin. The VREGMAIN and VREGRADIO regulators are used to power the internal circuitry from the VDD pin. The VDD pin is supplied by the VREGH regulator.

By default, the high voltage regulator is configured to also source external components from the VDD pin. To save power this feature should be disabled.

6. Peripheral interfaces

6.1 Memory descriptions

MK13 series module peripheral interfaces descriptions are shown in the table below.

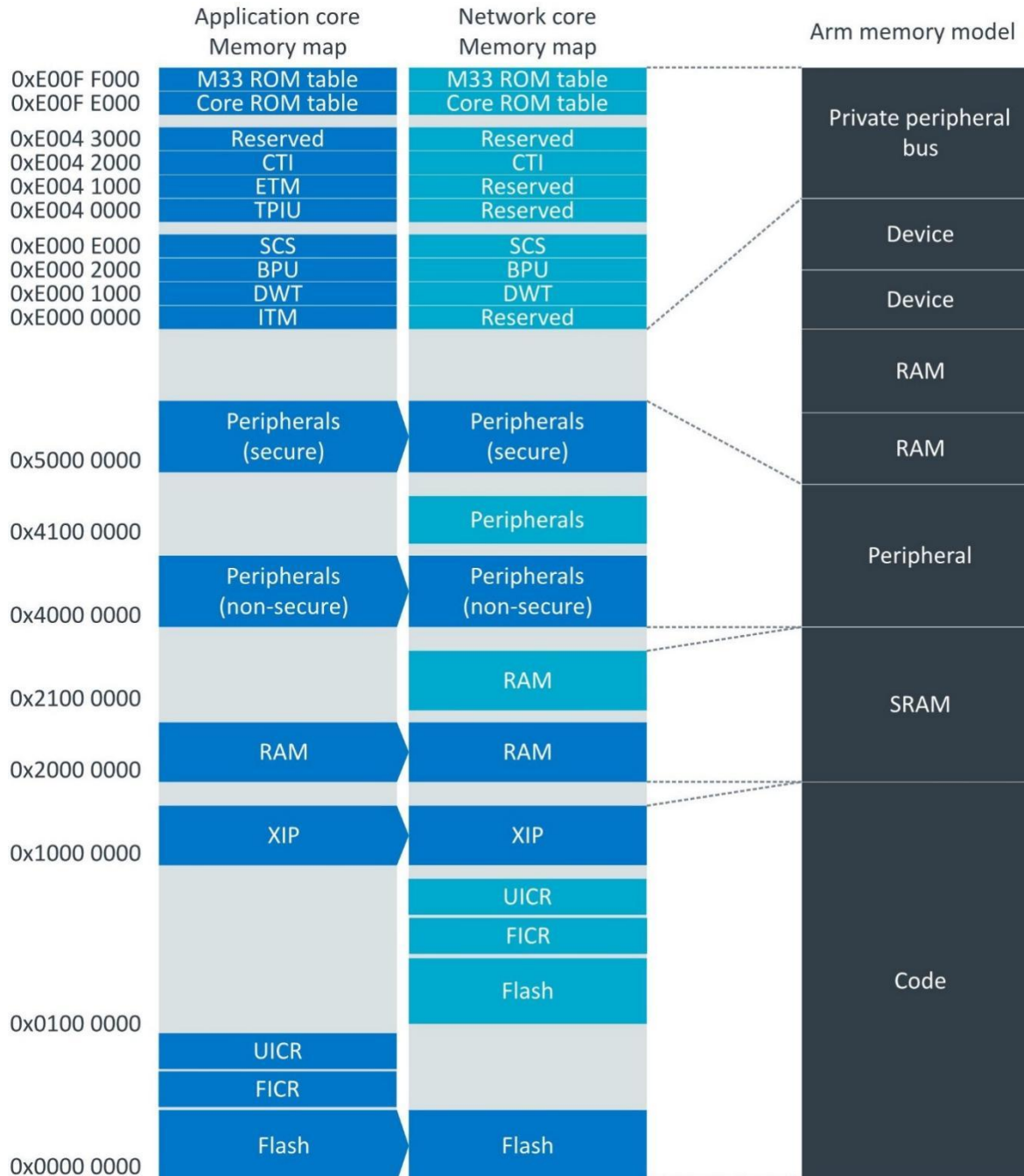


Figure 9: Memory map

6.2 Real-time counter (RTC)

The real-time counter (RTC) module provides a generic, low-power timer on the low frequency clock source (LFCLK). The RTC module features a 24-bit COUNTER, a 12-bit (1/X) prescaler, capture/compare registers, and a tick event generator. The **RTC Block Diagram** is shown in Figure 10 below.

The RTC Features:

- 12-bits pre-scale counter
- 24-bits read only RTC counter
- 32.768kHz XTAL or RC oscillator clock resource
- Independent comparators (with interrupt)
- 1 tick interrupt
- RTC counter overflow interrupt

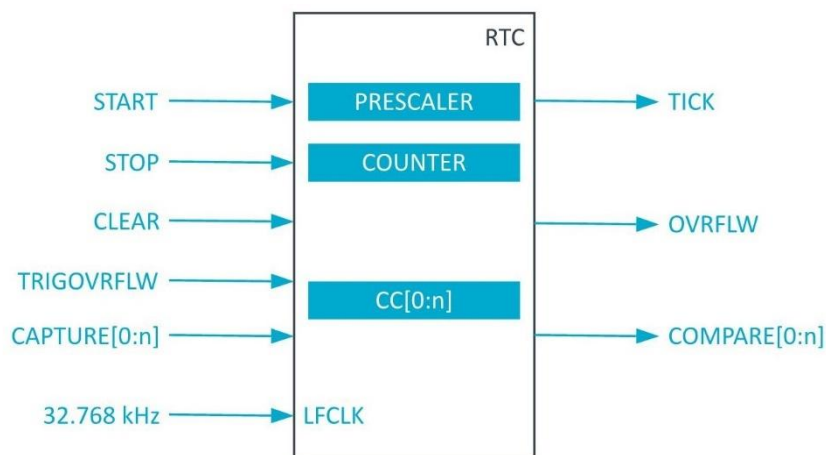


Figure 10: RTC Block Diagram

6.3 Pulse width modulation (PWM)

MK13 supports 4 PWM modules. The pulse width modulation (PWM) module enables the generation of pulse width modulated signals on GPIO. The module implements an up or up-and-down counter with four PWM channels that drive assigned GPIOs.

The following are the main features of a PWM module:

- Programmable PWM frequency
- Up to four PWM channels with individual polarity and duty cycle values
- Edge or center-aligned pulses across PWM channels
- Multiple duty cycle arrays (sequences) defined in RAM
- Autonomous and glitch-free update of duty cycle values directly from memory through EasyDMA (no CPU involvement)
- Change of polarity, duty cycle, and base frequency possibly on every PWM period

- RAM sequences can be repeated or connected into loops

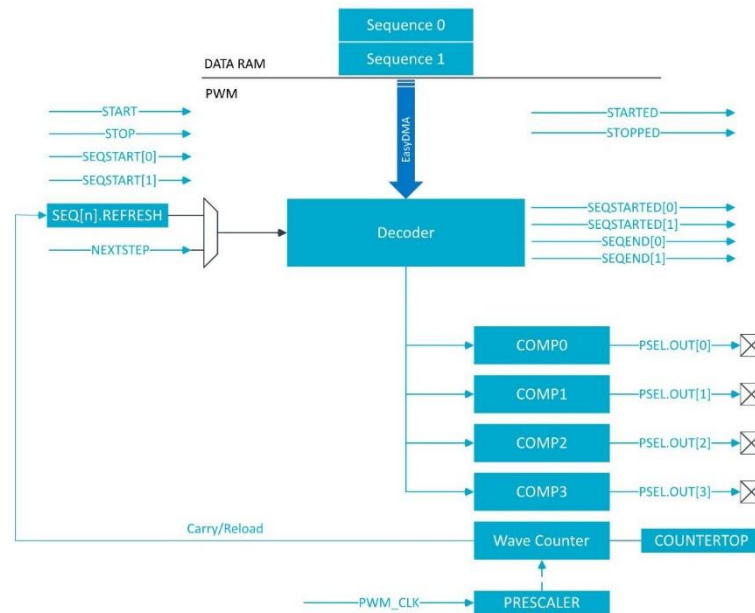


Figure 11: PWM module

6.4 General purpose input/output (GPIO)

MK13 series module provides highly flexible GPIOs for development. The general purpose input/output pins (GPIOs) are grouped as one or more ports with each port having up to 32 GPIOs. The **GPIO port and the GPIO pin details** is shown in Figure 12 below.

The GPIO Features:

- Up to 32 GPIO pins per GPIO port
- Configurable output drive strength
- Internal pull-up and pull-down resistors
- Wake-up from high or low level triggers on all pins
- Trigger interrupt on state changes on any pin
- All pins can be used by the PPI task/event system
- One or more GPIO outputs can be controlled through PPI and GPIOTE channels
- All pins can be individually mapped to interface blocks for layout flexibility
- GPIO state changes captured on SENSE signal can be stored by LATCH register
- Pin sharing in multi-MCU system
- Support for secure and non-secure attributes for pins in conjunction with the system protection unit

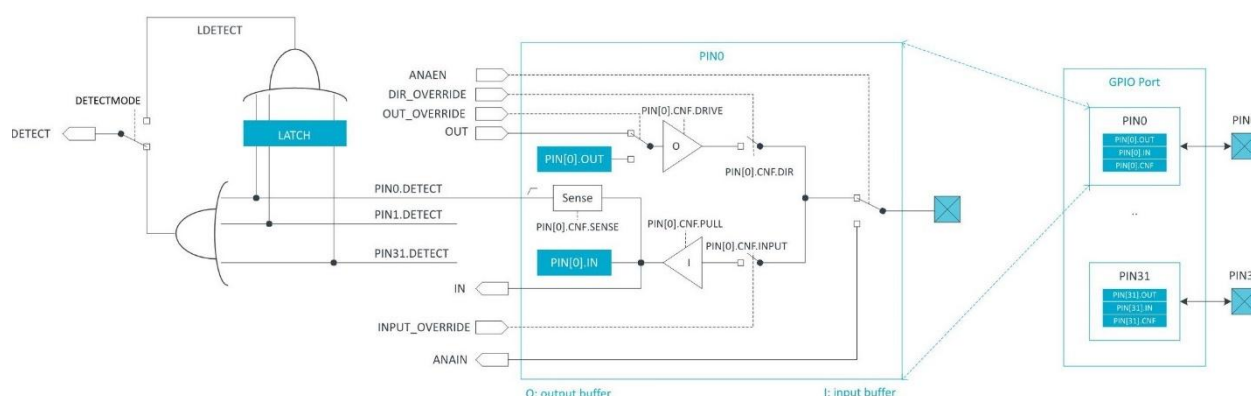


Figure 12: GPIO port and the GPIO pin details

Note: The MK13 module has a built-in 32.768kHz oscillator which occupies P0.00 and P0.01.

6.5 Serial peripheral interface (SPI)

MK13 supply up to 5x SPI master/slave with EasyDMA.

The **SPI master (SPIM)** can communicate with multiple SPI slaves using individual chip select signals for each slave.

The main features of SPIM are:

- EasyDMA direct transfer to/from RAM
- SPI mode 0-3
- Individual selection of I/O pins
- Optional D/CX output line for distinguishing between command and data bytes

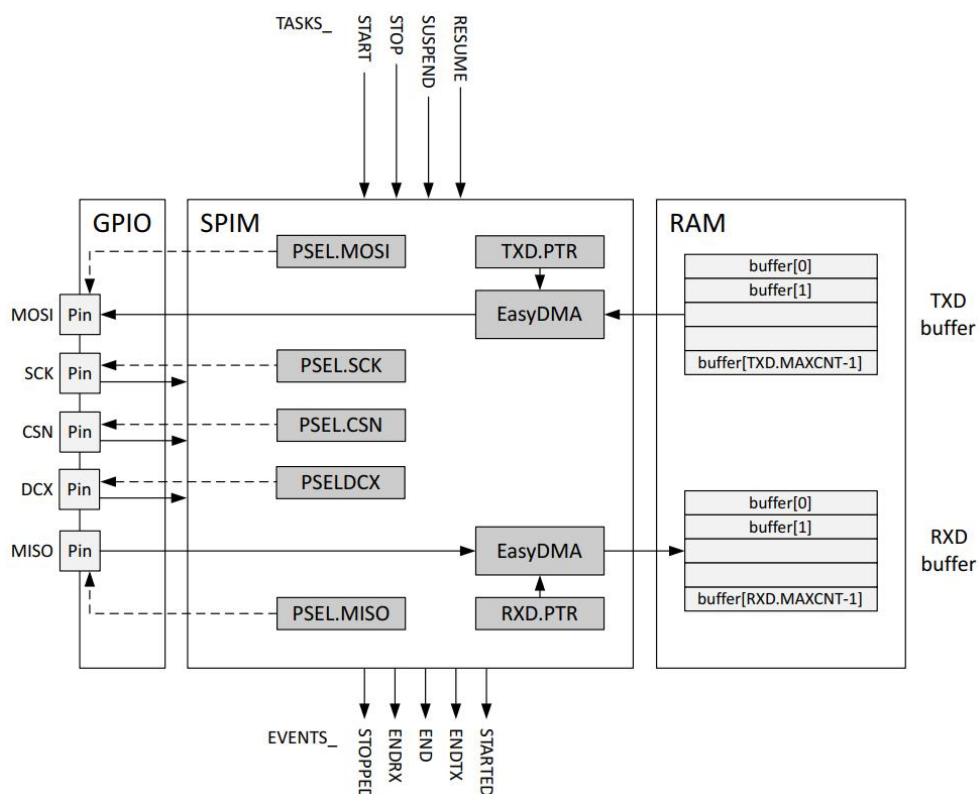


Figure 13: SPIM with EasyDMA

SPI slave (SPIS) is implemented with EasyDMA support for ultra-low power serial communication from an external SPI master. EasyDMA in conjunction with hardware-based semaphore mechanisms removes all real-time requirements associated with controlling the SPI slave from a low priority CPU execution context.

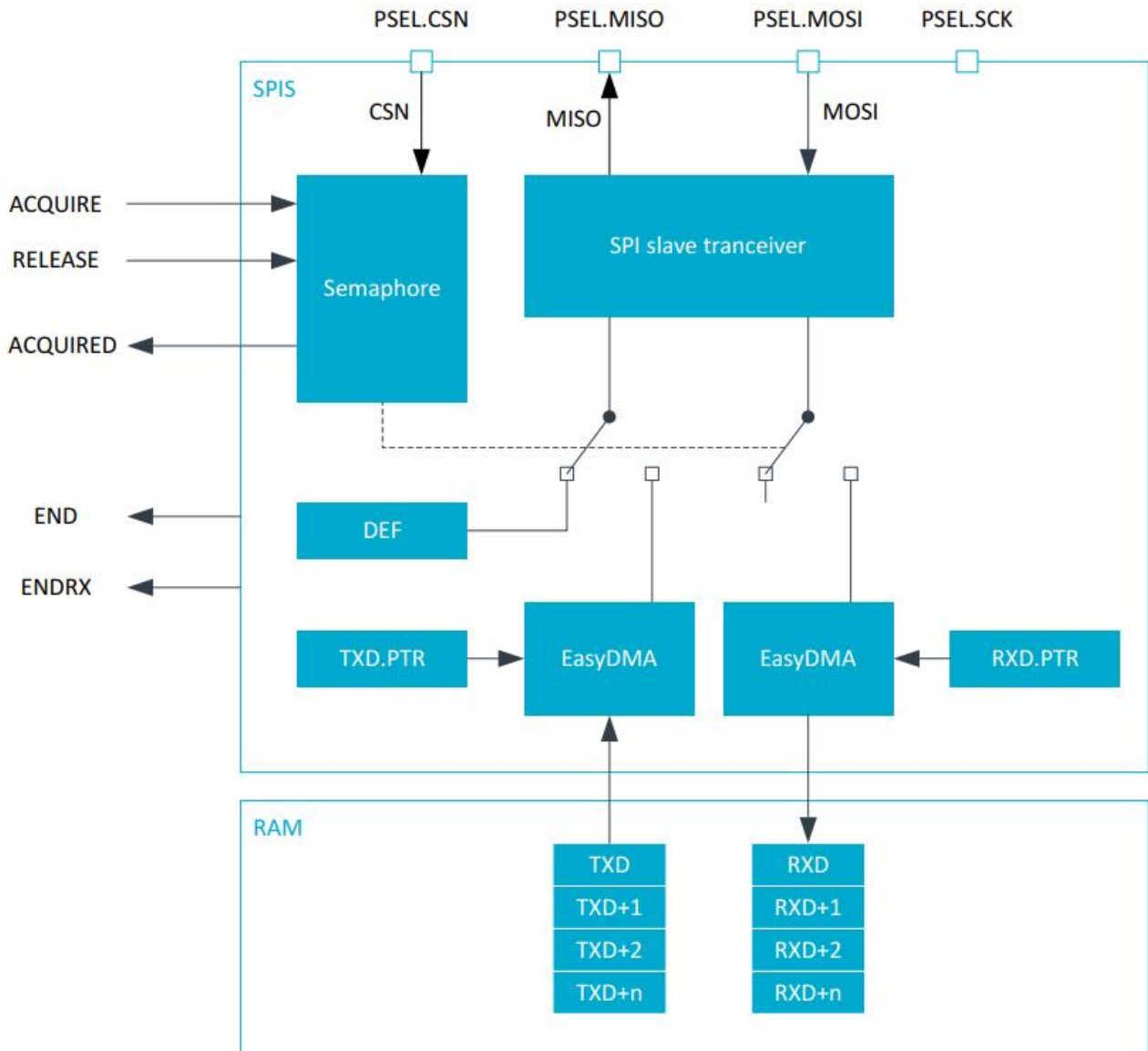


Figure 14: SPI slave

6.6 Universal asynchronous receiver/transmitter (UART)

MK13 supply up to 4x UART(CTS/RTS) with EasyDMA. The GPIOs used for each UART interface can be chosen from any GPIO on the device and are independently configurable. This enables device pinout flexibility and efficient use of board space and signal routing.

The main features of UARTE are the following:

- Full-duplex operation
- Automatic hardware flow control
- Optional even parity bit checking and generation
- EasyDMA
- Up to 1 Mbps baudrate
- Return to IDLE between transactions supported (when using HW flow control)
- One or two stop bit
- Least significant bit (LSB) first

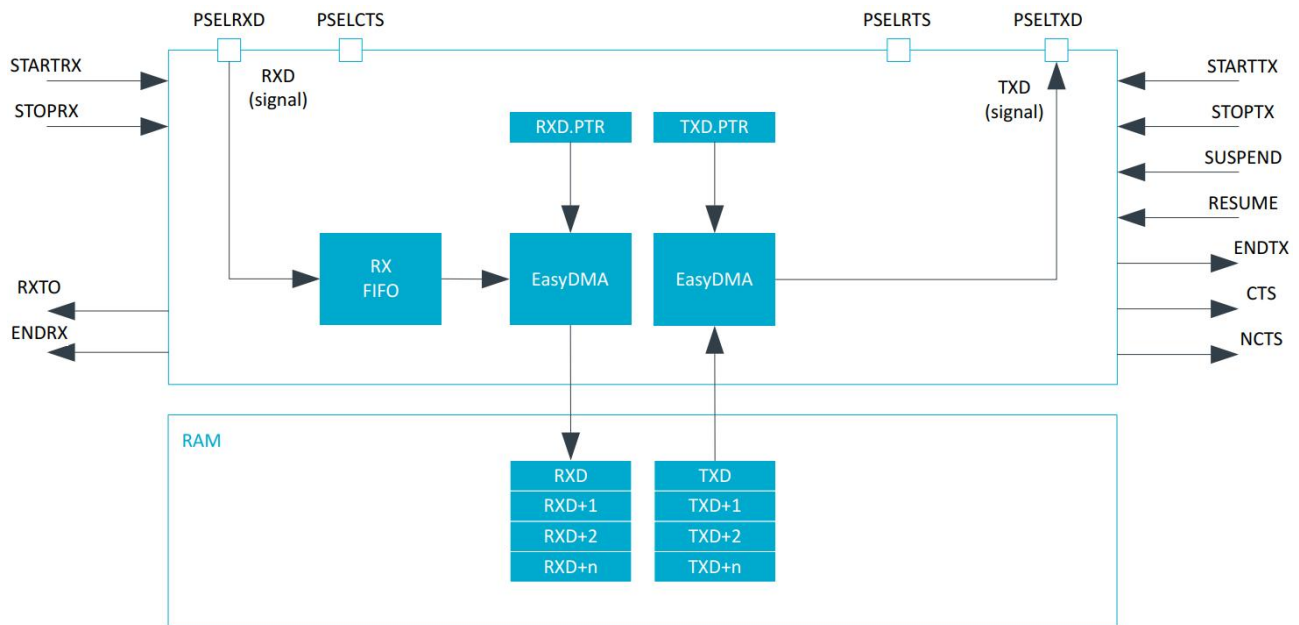


Figure 14: UART configuration

Note: The external crystal oscillator must be enabled to obtain sufficient clock accuracy for stable communication.

6.7 Successive approximation analog-to-digital converter (SAADC)

The MK15 module provides 8 configurable channels 12bits, 200kbps ADC with EasyDMA.

SAADC is a differential successive approximation register (SAR) analog-to-digital converter (ADC).

The main features of SAADC are the following:

- 8/10/12-bit resolution, 14-bit resolution with oversampling
- Multiple analog inputs:
 - AIN0 to AIN7 pins
 - VDD pin
 - VDDHDIV5 (through VDDH pin)
- Up to eight input channels:
 - One channel per single-ended input and two channels per differential input
 - Scan mode can be configured with both single-ended channels and differential channels
 - Each channel can be configured to select any of the above analog inputs
- Full scale input range (0 to VDD)
- Sampling triggered via a task from software or a PPI channel for full flexibility on sample frequency source from a low-power 32.768 kHz RTC or more accurate 1/16 MHz timers
- One-shot conversion mode to sample a single channel
- Scan mode to sample a series of channels in sequence with configurable sample delay
- Support for direct sample transfer to RAM using EasyDMA
- Interrupts on single sample and full buffer events
- Samples stored as 16-bit two's complement values for differential and single-ended sampling
- Continuous sampling without the need of an external timer
- Internal resistor string
- On-the-fly limit checking

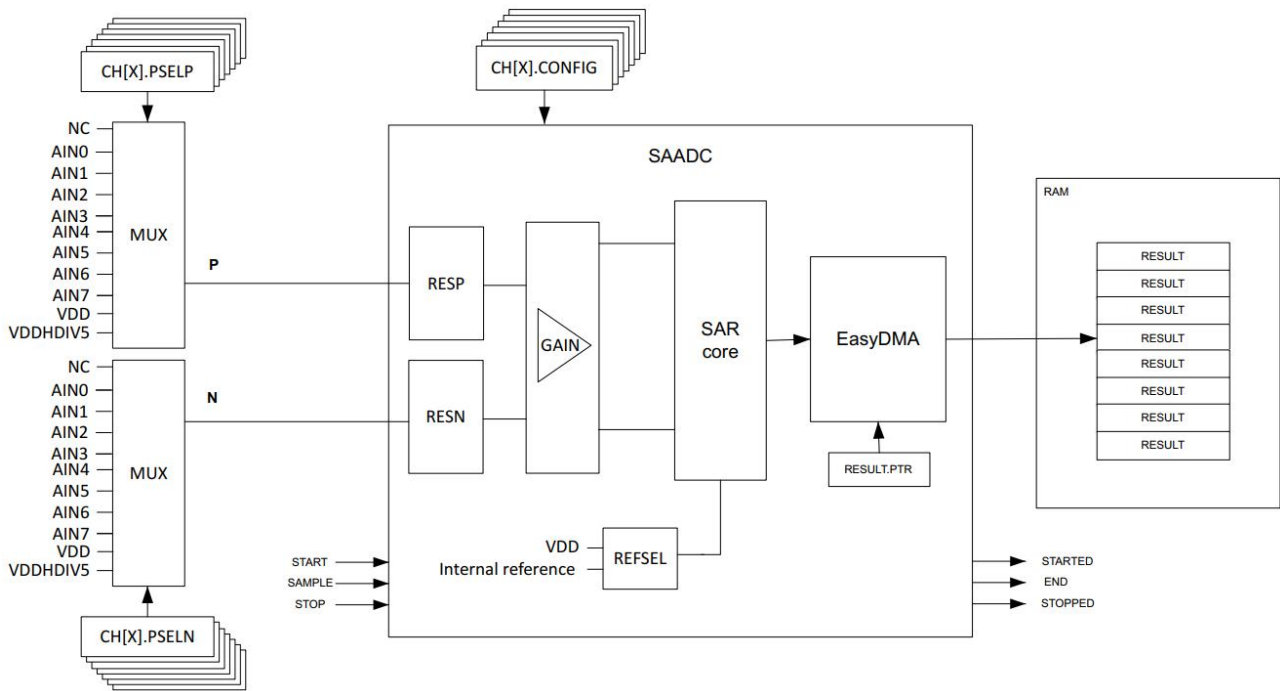


Figure 15: Simplified ADC block diagram

ADC Pin:

Pin No.	Pin Name	ADC channel
45	P0.04	Analog input 0
44	P0.05	Analog input 1
14	P0.06	Analog input 2
4	P0.07	Analog input 3
53	P0.25	Analog input 4
31	P0.26	Analog input 5
54	P0.27	Analog input 6
32	P0.28	Analog input 7

6.8 EasyDMA

EasyDMA is a module implemented by some peripherals to gain direct access to Data RAM. EasyDMA is an AHB bus master similar to CPU and is connected to the AHB multilayer interconnect for direct access to Data RAM. EasyDMA cannot access flash memory. A peripheral can implement multiple EasyDMA instances to provide dedicated channels. For example, for reading and writing of data between the peripheral and RAM. This concept is illustrated in the following figure 17.

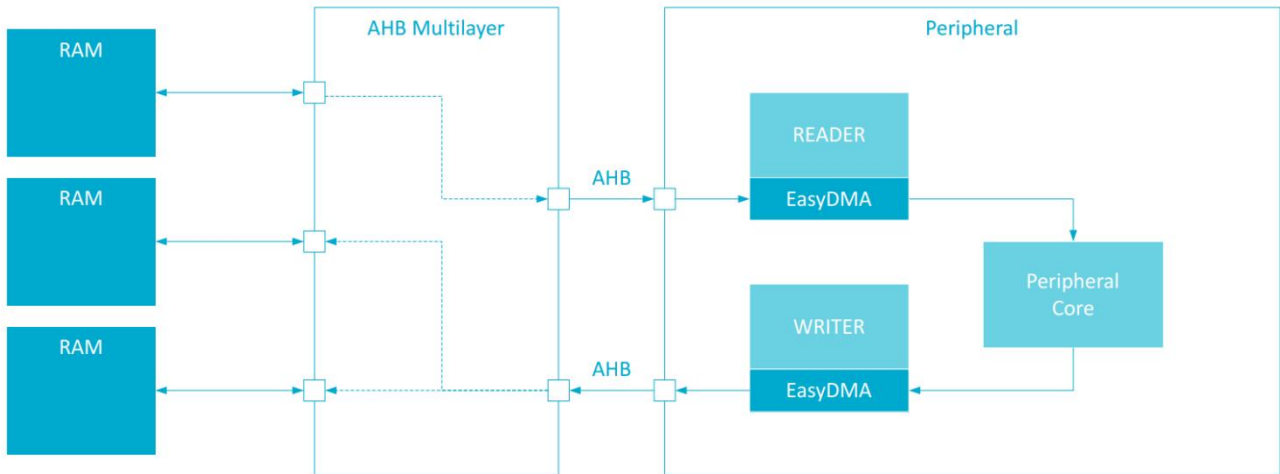


Figure 17: EasyDMA example

7. Mounting design suggestions

7.1 Recommended mounting and PCB layout

You can refer to the following references for the mounting design and PCB layout of the MK13 module, especially for the MK13A model which has PCB on-board antenna.

For external antenna modules (MK13B needs to connect an external antenna to the u.FL connector), you also need to refer to the external antenna design requirements.

The recommended mounting and PCB layout suggestion:

- Locate MK13 series module close to the edge of the host PCB (mandatory for MK13A for on-board PCB trace antenna to radiate properly).
- 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 be 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.

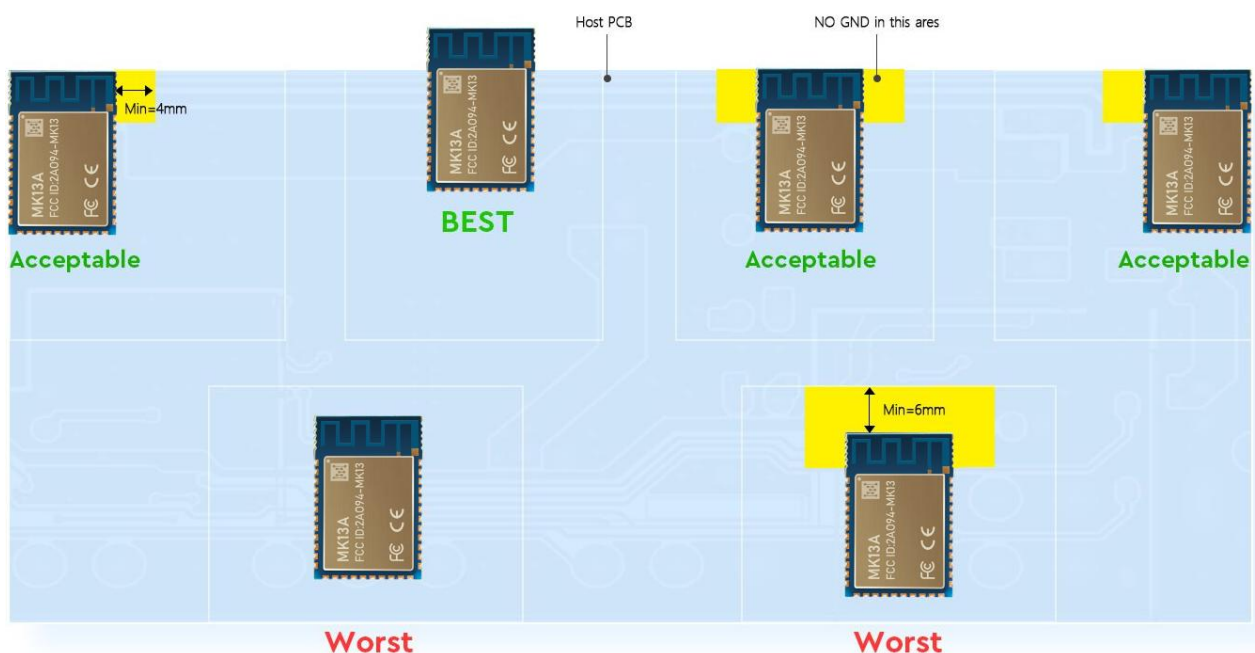


Figure 18: Recommended Module Mounting Examples

7.2 Mechanical enclosure

Care should be taken when designing and placing the MK13 series 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 MK13 series 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).

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.

- 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.

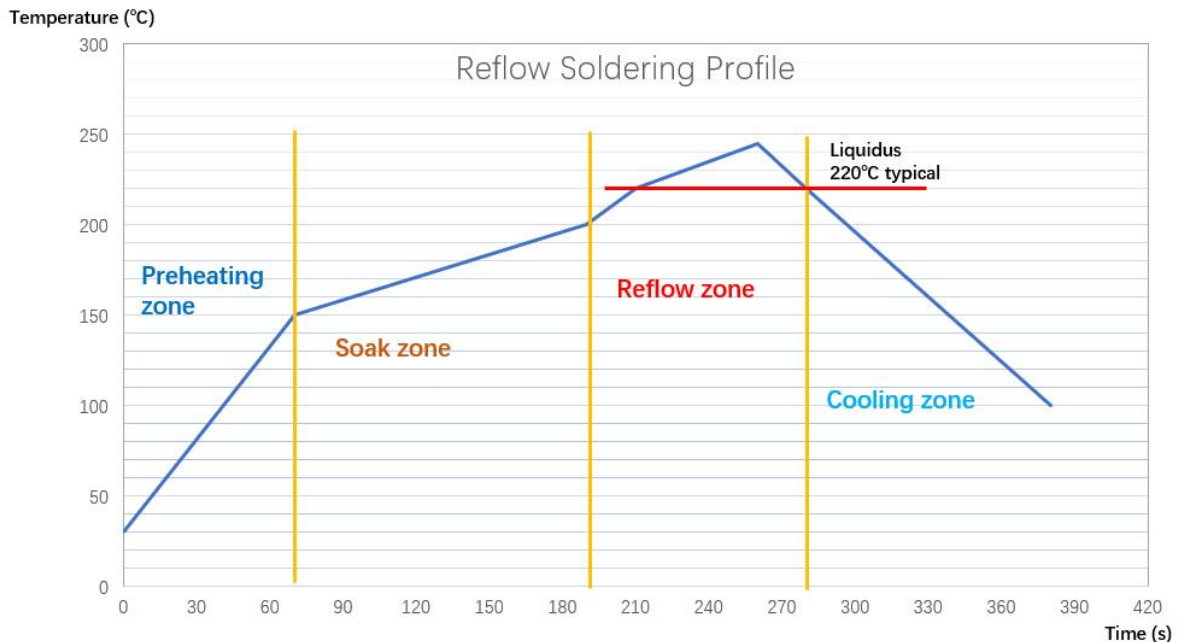


Figure 19: Temperature-Time Profile for Reflow Soldering

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

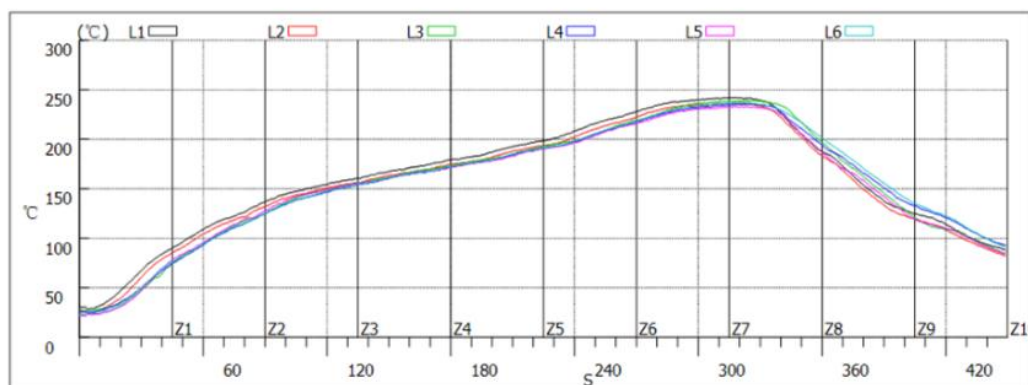
Absolute Peak Temperature 260°C

PROFILE CHECK

Customer Name: MOKO Technology Ltd
Oven Type: smt生产线
Zones setting (°C)

Date Time: 2020/5/20 10:48:52
PCB Name: 
Speed: 78cm/min

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(°C)	Peak difference	Peak at time(s)	190(°C)time above	Preheat(50-150°C)		Soak(150-200°C)		Reflow(220-260°C)		Liquid phase (220°C) time(s)	Cooling(260-100°C)	
					Slope	Time(s)	Slope	Time(s)	Slope	Time(s)		Slope	Time(s)
Line1	242.25	9.25	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		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

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 470uF 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.

9. Qualification and Approvals

9.1 United States

FCC WARNING

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

This device complies with Part 15 of the 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.

This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

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 generates,



MK13 Bluetooth Module

Datasheet

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.

Radiation Exposure Statement:

To maintain compliance with FCC's RF Exposure guidelines, The equipment complies with FCC Radiation exposure limits set forth for uncontrolled environment.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

The availability of some specific channels and/or operational frequency bands are country dependent and are firmware programmed at the factory to match the intended destination.

The firmware setting is not accessible by the end user. The final end product must be labelled in a visible area with the following:

"Contains Transmitter Module FCC ID:2AO94-MK13"

Requirement per KDB996369 D03

2.2 List of applicable FCC rules

This module meets the requirements of FCC part 15C(15.247).

2.3 Limited module procedures

The module is not a limited module. It's a single(full) module.

2.4 Trace antenna designs

Not applicable.

2.5 RF exposure considerations

To maintain compliance with FCC's RF Exposure guidelines, The equipment complies with FCC Radiation exposure limits set forth for uncontrolled environment.

This module is designed to comply with the FCC statement, FCC ID: 2AO94-MK13.

2.6 Antennas

The MK13A only has a PCB antenna and the antenna gain is -0.09dBi. The MK13B has a u.FL



connector, and the lab's engineer uses a FPC antenna for testing, which antenna gain is 4.21 dBi. You have to select an 2.4G FPC antenna which antenna gain is no more than 4.21dBi.

Please refer to the Antenna Report for details.

2.7 Label and compliance information

The host system using this module, should have label in a visible area indicated the following texts: "Contains FCC ID: 2AO94- MK13.

2.8 Information on test modes and additional testing requirements

This testing is performed with the host product configured in typical operational modes to check the fundamental-frequency and spurious emissions for compliance with all the applicable rules. The transmitters can be enabled by using publicly-available drivers and turned on, so the transmitters are active. In certain conditions it might be appropriate to use a technology-specific call box (test set) where accessory devices or drivers are not available. When testing for emissions from the unintentional radiator, the transmitter shall be placed in the receive mode or idle mode, if possible. If receive mode only is not possible then, the radio shall be passive (preferred) and/or active scanning. In these cases, this would need to enable activity on the communication BUS (i.e., PCIe, SDIO, USB) to ensure the unintentional radiator circuitry is enabled.

2.9 Additional testing, Part 15 Subpart B disclaimer

Host Product Manufacture that uses this module that Part 15B evaluation of the finished product is still required.

9.2 European Union Regulatory Compliance

Information about regulatory compliance of the European Union for the MK13 module is available in the MK13 Declaration of Conformity.

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

The MK13 module complies with the essential requirements and other relevant provisions of Radio Equipment Directive (RED) 2014/53/ EU.

9.2.2 Labeling and User Information Requirements

The label on the final products which contain the MK13 module must follow CE marking requirements. The "R&TTE Compliance Association Technical Guidance Note 01" provides guidance on final product on final product CE marking.



MK13 Bluetooth Module

Datasheet

Revision history

Version	Comments	Contributor(s)	Revision Date
V1.0	Initial Release	Kevin Huang	2021/04/16

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.

MOKO TECHNOLOGY LTD.

 Factory 201, 107 Pinshun Rd Guixiang community, Guanlan Street, Longhua, Shenzhen, China 518110

 Tel:86-755-23573370-829

 Support_BLE@mokotechnology.com

 <https://www.mokoblue.com>
<https://www.mokosmart.com>

