Bluetooth® low energy Module (MK71511/MK71521) Application Note

PCB Design Guidelines for MK71511/MK71521

Issue Date: October 1, 2020

NOTES

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LAPIS Technology Co.,Ltd.

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Preface

This application note describes the contents that you should be careful when designing a board equipped with Bluetooth® 5 compatible Bluetooth low energy module MK71511 and MK71521 made by Lapis Technology.

The following related documents are available, so please refer to them if necessary.

MK71511 Datasheet
MK71521 Datasheet

Table of Contents

1. MK71511/MK71521 Board Design Precautions

This document describes the contents that you should be careful when designing a board equipped with a Bluetooth low energy radio module (MK71511/MK71521).

1.1. Module bottom layout

In Figure 1, The GND area is shown in red. The green areas represent individual signals. Resist is applied to the parts other than the terminals of the lowest layer. However, its effect may not be guaranteed in some cases.

When placing signal lines from each terminal of the MK71511/71521 module on layer 1 of the motherboard in use, or placing VIAs for signals, it is recommended to employ board design where such signal lines and VIAs are not placed on red and green areas in the lowest layer wiring diagram shown above to prevent signal short-circuit between boards.

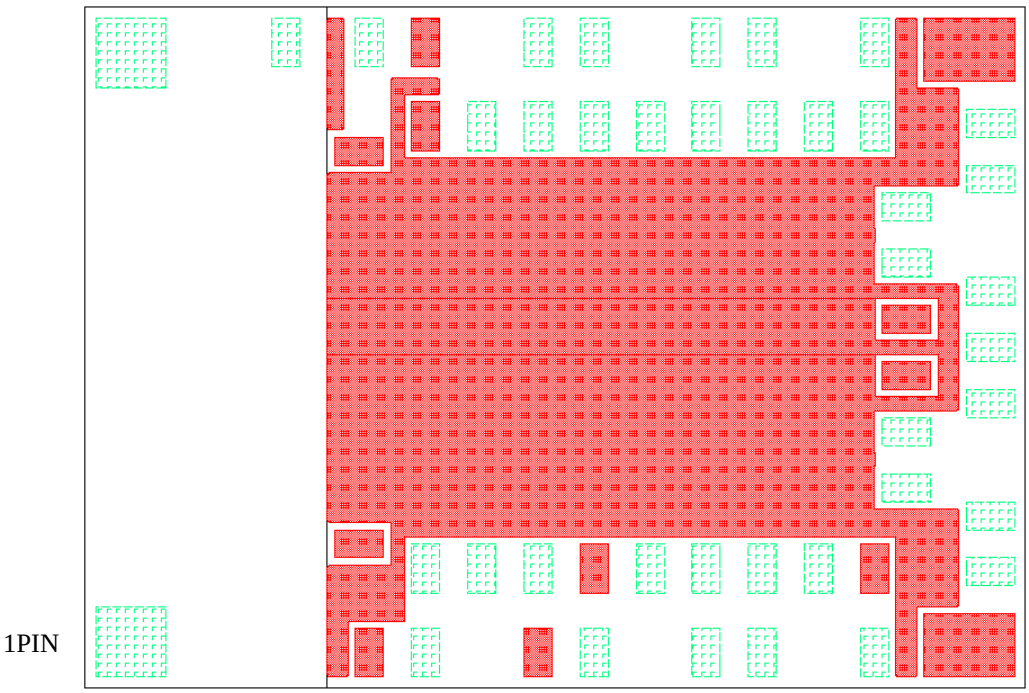


Figure 1. MK71511/MK71521 Bottom layer layout

1.2. PCB layout

Figuire 2 shows a PCB top layer example.

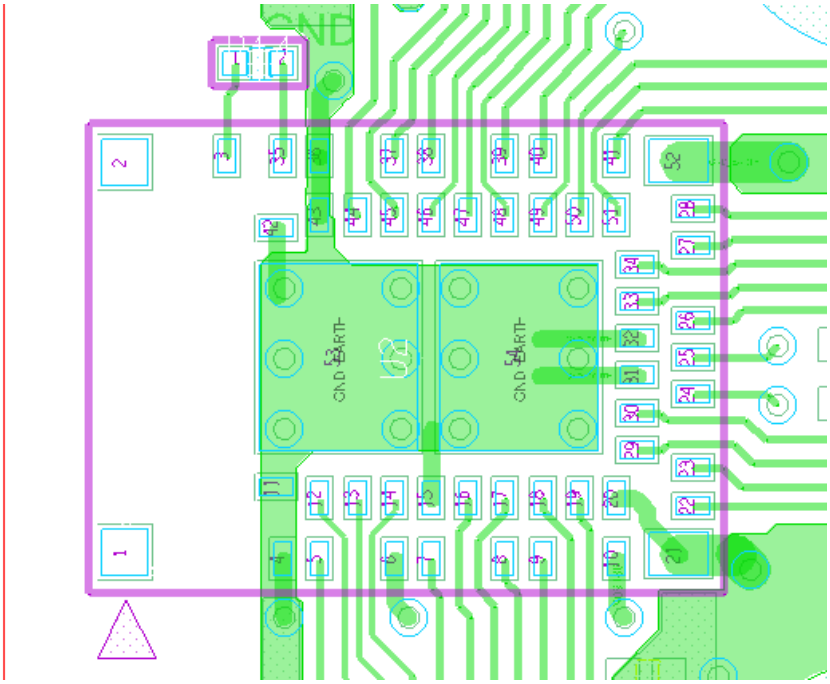


Figure 2. Example of PCB top layer

1.3. Antenna Connection Wiring

The ANT terminal (3PIN) and the RFIO terminal (35PIN) must be connected via the wiring of the customer manufactured board top layer . In addition, please mount jumper resistors such as antenna line wiring examples in the wiring line.
Regarding wiring, it is desirable to use 50Ω impedance-controlled line at 2.4GHz, but if difficult, connect with as short a wire length as possible.

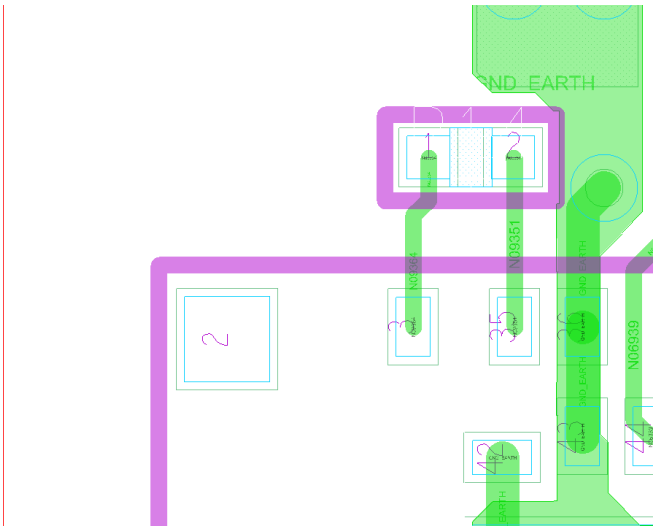


Figure 3. Example of antenna wiring

1.4. Power line

When wiring on the power terminal (VBAT 10PIN), we recommend a wiring width of 0.5 mm or more and a VIA diameter of 0.2 mm or more. If it is difficult to deploy a large VIA, use multiple smaller VIAs.

If the power line is noisy or the power supply voltage fluctuates frequently, it is recommended that the decoupling capacitor (example: 1 to 10 μF) and bypass capacitor (example: 10 to 100 pF) be ground-aligned in parallel to the most recent power terminal (VBAT 10PIN).

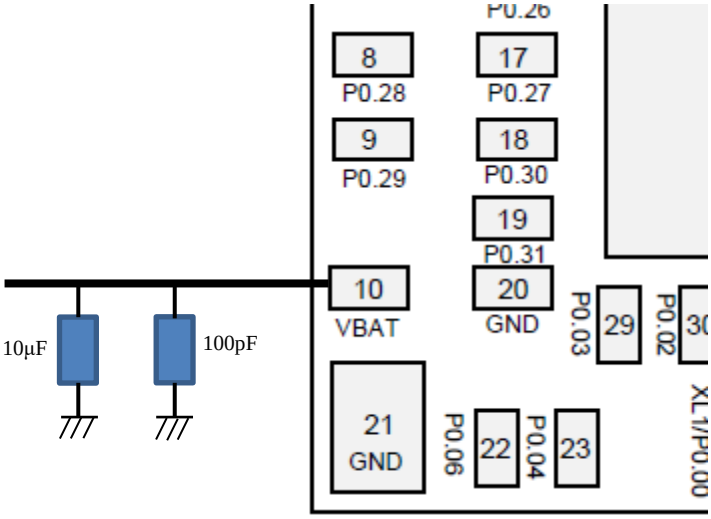


Figure 4. Example of Power line

1.5. Unconnected terminals

XL1 terminal (24PIN) and XL2 terminal (25PIN)

On the MK71511/MK71521, the XL1 terminal (24PIN) and XL2 terminal (25PIN) are connected to the crystal oscillator inside the module. Therefore, leave the terminals unconnected.
The MK71511A/MK71521A can be used as GPIO terminal forXL1 (24PIN) and XL2 (25PIN) terminal.

DCO terminal (7PIN)

The DCO terminal (7PIN) is a terminal for our testing. In either case, should not be connected.

P0.25 terminal (14PIN) and P0.26 terminal (16PIN) MK71521/MK71521A only

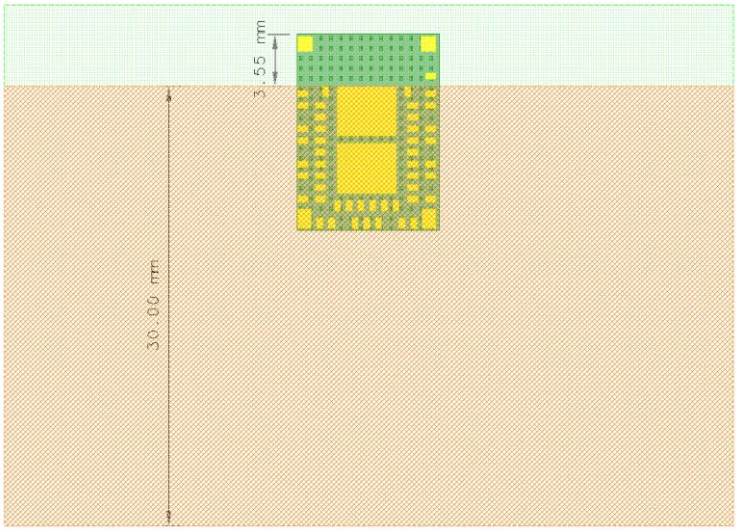
P0.02–0.31 is the GPIO terminal, and unused pins are usually open. However, if you are shipping products to the United States, when you use P0.25 terminal (14PIN) and P0.26 terminal (16PIN), connect a 10pF bypass capacitor between the two terminals and GND. If it is not used, connect to GND.

1.6. Case 1 around the antenna (with no conductors placed to the left and right of antenna)

Please place the upper side of the module on the board end of the customer manufactured board to the extent that the module can be mounted. There is no problem even if it is placed in the center part of the board as in the module mounting example (1) , even if it is placed on the right edge and the left edge of the board as in the module mounting example (2).
However, be sure to mount the module so that there is the customer manufactured board under the antenna area.

Please place the GND surface like the example of module mounting (1) from 3.55mm below the antenna area board end of the module. Part placement and copper foil pattern placement are prohibited in areas above 3.55 mm. In addition, although it is a GND surface size, we recommend a size of 30mm x 25mm or more from the viewpoint of antenna performance.
It is a substrate material, but please choose the board thickness from 0.8mm to 1.6mm in a typical FR-4. As the board thickness is reduced and thickened, the antenna gain performance gradually decreases. From the viewpoint of antenna gain performance, the board thickness is recommended from 1.0 mm to 1.2 mm.
In the upper side and the upper and lower spaces of the antenna area, please do not place within 10.0 mm for metals (less than 2 mm thick) and within 5.0 mm of resins (less than 2 mm thick). In addition, antenna radiation is weakened in the direction in which metals are placed.
It is recommended, even in non-prohibited areas, to avoid placing high-permittivity materials whenever possible.

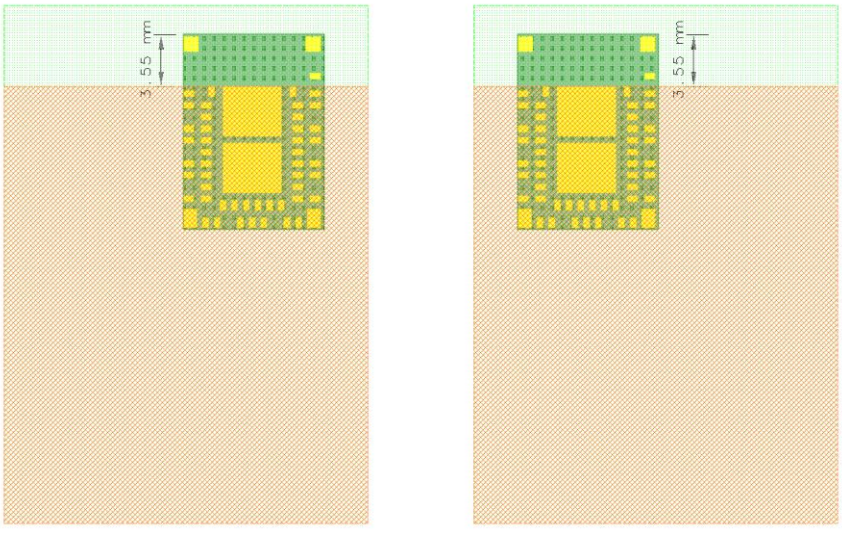
Even if the above conditions are satisfied, communication performance may decrease significantly depending on the structure of the product and the surrounding structure environment.



Example of module (1)

is the outline of the motherboard.

is the copper foil placeable area of the customer manufactured board.



Example of module (2)

is the outline of the motherboard.

is the copper foil placeable area of the customer manufactured board

1.7. Case 2 around the antenna (with conductors placed to the left and right of antenna)

Please place the upper side of the module on the board end of the customer manufactured board to the extent that the module can be mounted.
There is no problem even if it is placed in the center part of the board as shown in the module mounting example (3) , even if it is placed on the right edge and the left edge of the board as in the module mounting example (4).

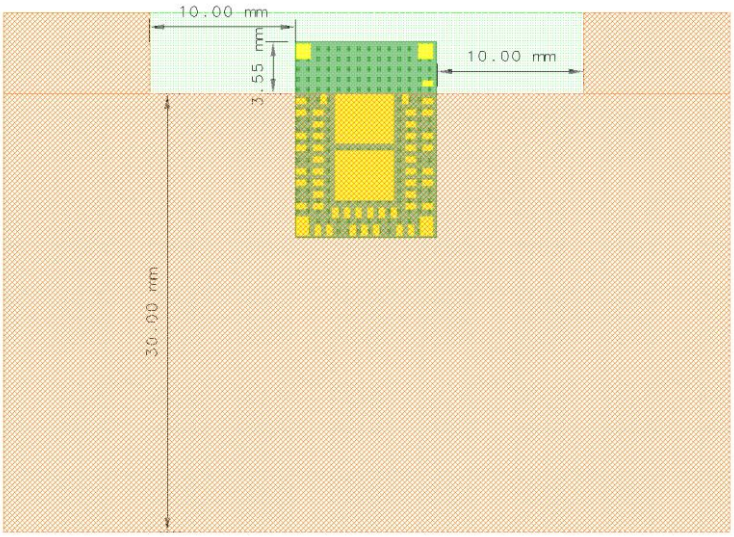
However, be sure to mount the module so that there is the customer manufacturing board under the antenna area.

Please place the GND surface as shown in the module mounting example (3) from 3.55mm below the antenna area board end of the module. Part placement and copper foil pattern placement are prohibited in areas above 3.55 mm and within 10 mm of the left and right antenna area edges. In addition, although it is a GND surface size, we recommend a size of 30mm x 25mm or more from the viewpoint of antenna performance.

It is a substrate material, but please choose the board thickness from 0.8mm to 1.6mm in a typical FR-4. As the board thickness is reduced and thickened, the antenna gain gradually decreases.
1.0mm to 1.2mm is recommended for board thickness.
It is recommended, even in non-prohibited areas, to avoid placing high-permittivity materials whenever possible.

In the upper side and the upper and lower spaces of the antenna area, please do not place within 10.0 mm for metals (less than 2 mm thick) and within 5.0 mm of resins (less than 2 mm thick). In addition, antenna radiation is weakened in the direction in which metals are placed.
It is also recommended that you avoid placing parts with high dielectric constants as much as possible, even in non-prohibited areas.

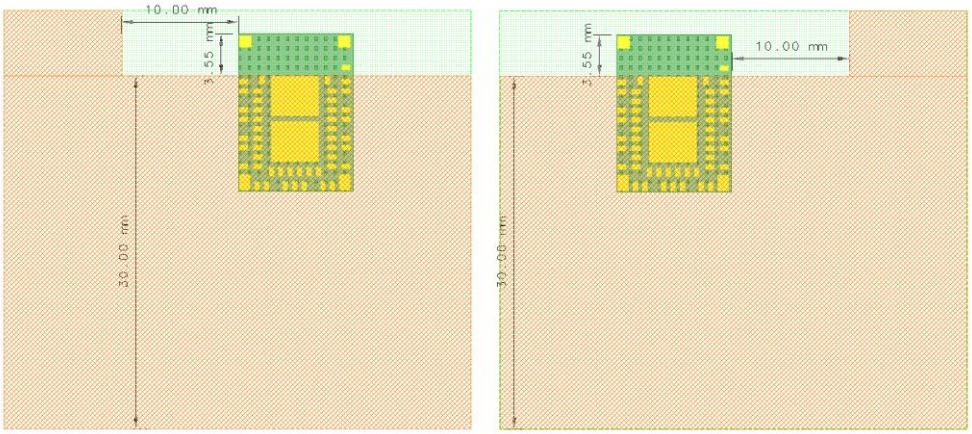
Even if you satisfy the above conditions, communication performance may decrease significantly depending on the structure of the product and the surrounding structure environment.



Example of module (3)

is the outline of the motherboard.

is the copper foil placeable area of the customer manufactured board

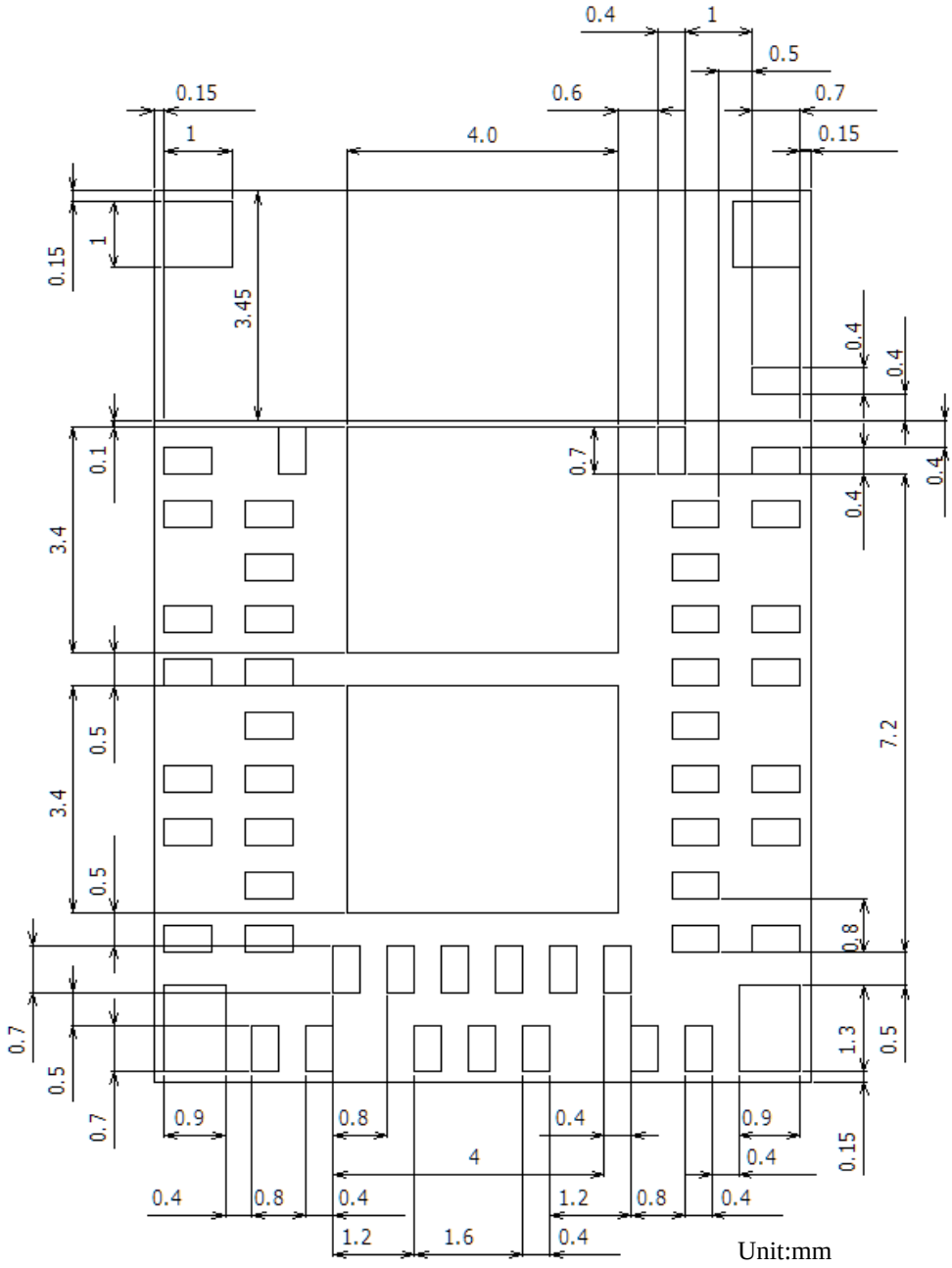


Example of module (4)

is the outline of the motherboard.

is the copper foil placeable area of the customer manufactured board

2. Reference Land Pattern



Note:
The land pattern of the 53PIN and 54PIN terminals may cause air bubbles because the soldering area is large, causing voids. Depending on the void situation, please consider measures such as dividing the land pattern and changing the solder material to a low-void version.

Please fully evaluate various conditions (soldering conditions, etc.) by the customer and adjust it at the customer's responsibility. The figures in this document do not accurately show the actual shape and dimensions.

Please do not design with the value by measuring from the figure.

Revision history

Document No.	Date	Page		Remarks
		Before	After	
FEXK715x1_AN_PCB_ design_Guidelines-01	2020.10.1	–	–	First edition