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ROHM Co., Ltd.
April 1, 2024

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

Antenna radiation characteristics

Issue Date: November 18, 2020

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LAPIS Technology Co.,Ltd.

2-4-8 Shinyokohama, Kouhoku-ku, Yokohama 222-8575, Japan
<https://www.lapis-tech.com/en>

Preface

This application note describes the antenna radiation characteristics of MK715x1 evaluation boards equipped with Bluetooth® 5 compatible Bluetooth low energy modules (MK71511 and MK71521) made by Lapis Technology.

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

MK71511 Datasheet

MK71521 Datasheet

【Note】

MK715x1 is intended for both MK71511 and MK71521 in this document.

- Bluetooth® is a registered trademark of Bluetooth SIG, Inc.
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1. MK71511/MK71521 Evaluation Board Antenna directiyity Example

This antenna application note is a reference document for an example of antenna characteristics of an evaluation board equipped with a Bluetooth low energy module (MK71511/MK71521). It is not intended to secure or guarantee communication performance or flight distance.

1.1. Evaluation Board Overview

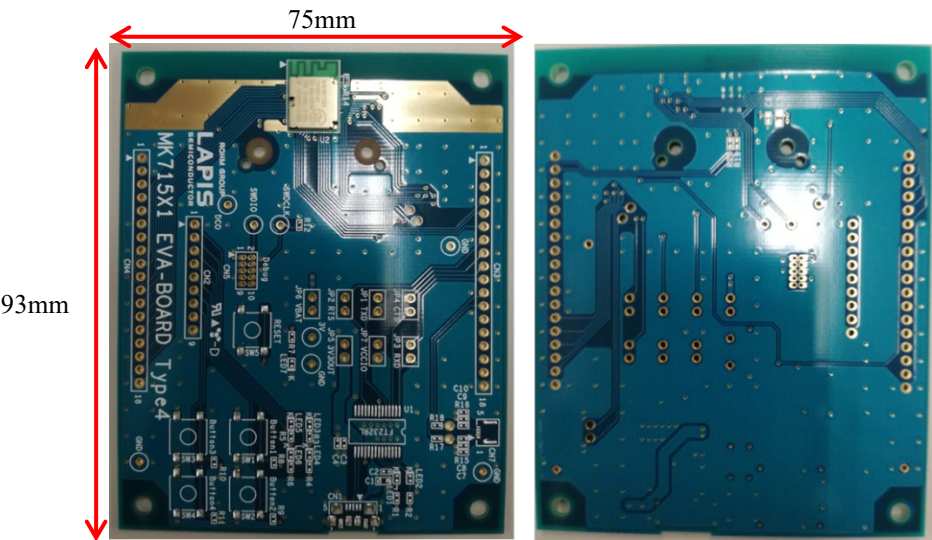


Figure1. Overall view of Evaluation Board

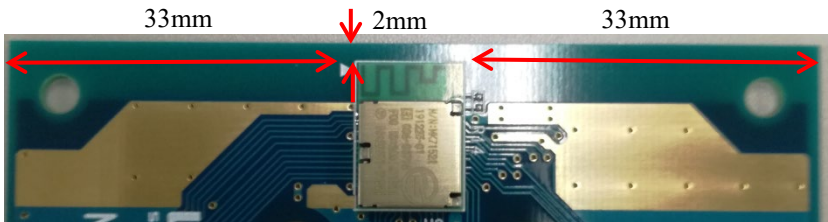


Figure2. View around the module

Table1. Substrate Information

Size	75mm x 93mm x 1.0mm
Material	R-1766 (Panasonic)
Relative permittivity [1GHz]	4.3
Loss tangent[1GHz]	0.016

1.2 Antenna radiation characteristic measurement environment

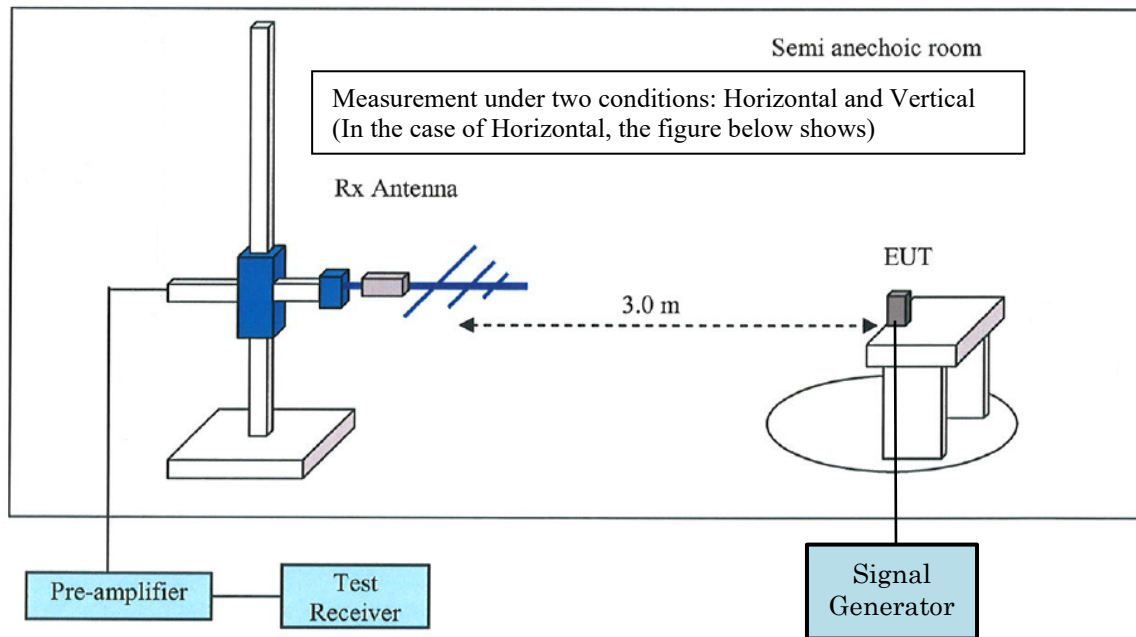


Figure3. Antenna radiation characteristic measurement environment

A semi-reject connector is attached to the ANT(3PIN) of the module (MK71511/MK71521) and the antenna radiation characteristics are measured when the signal input (Frequency = 2402,2440,2480MHz, Output Power = 0dBm) is measured from Signal Generator

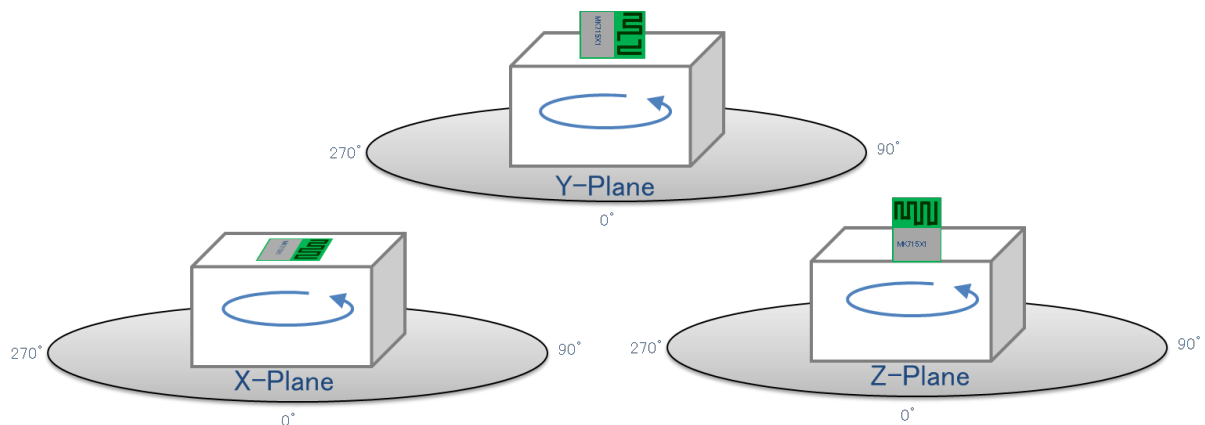


Figure4. Definition of each plane

Figure4 shows the module setup and the definition relationship between each plain.

1.3 Antenna radiation pattern

Antenna radiation patternn 2402MHz

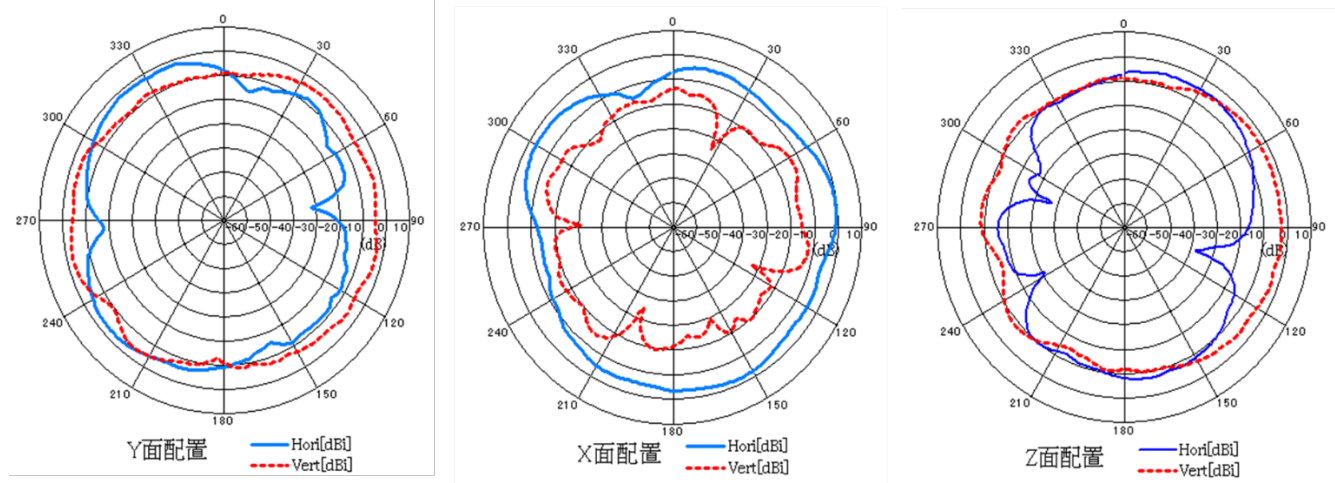


Figure5. Antenna Radiation Pattern (2402MHz)

Table 3. Antenna Gain (2402MHz)

	horizontal			vertical		
	MAX[dBi]	MIN[dBi]	AVE[dBi]	MAX[dBi]	MIN[dBi]	AVE[dBi]
X-Plain	-0.66	-14.96	-5.03	-12.16	-35.16	-17.6
Y-Plain	-1.81	-32.35	-7.2	-2.7	-12.56	-5.71
Z-Plain	-4.6	-38.1	-10	-2.59	-15.5	-6.76

Antenna radiation patternn 2440MHz

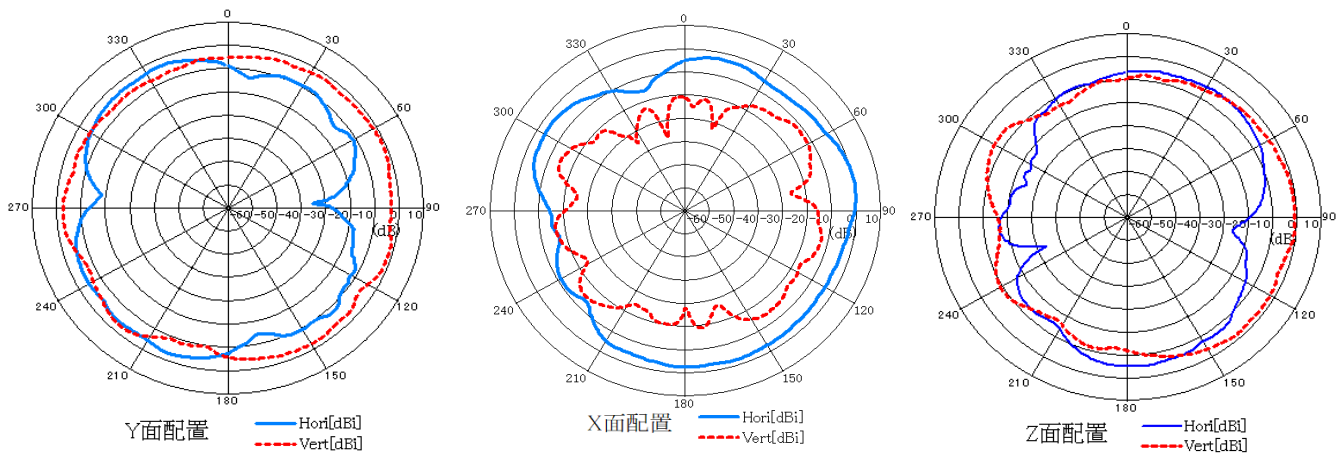


Figure6. Antenna Radiation Pattern (2440MHz)

Table 4. Antenna Gain (2440MHz)

	horizontal			vertical		
	MAX[dBi]	MIN[dBi]	AVE[dBi]	MAX[dBi]	MIN[dBi]	AVE[dBi]
X-Plain	0.4	-17.5	-4.5	-11.8	-37.6	-17.6
Y-Plain	-2.9	-35.7	-7.3	-1.3	-10	-4.0
Z-Plain	-4.3	-34.3	-9.1	0.8	-17.1	-5.7

Antenna radiation patternn 2480MHz

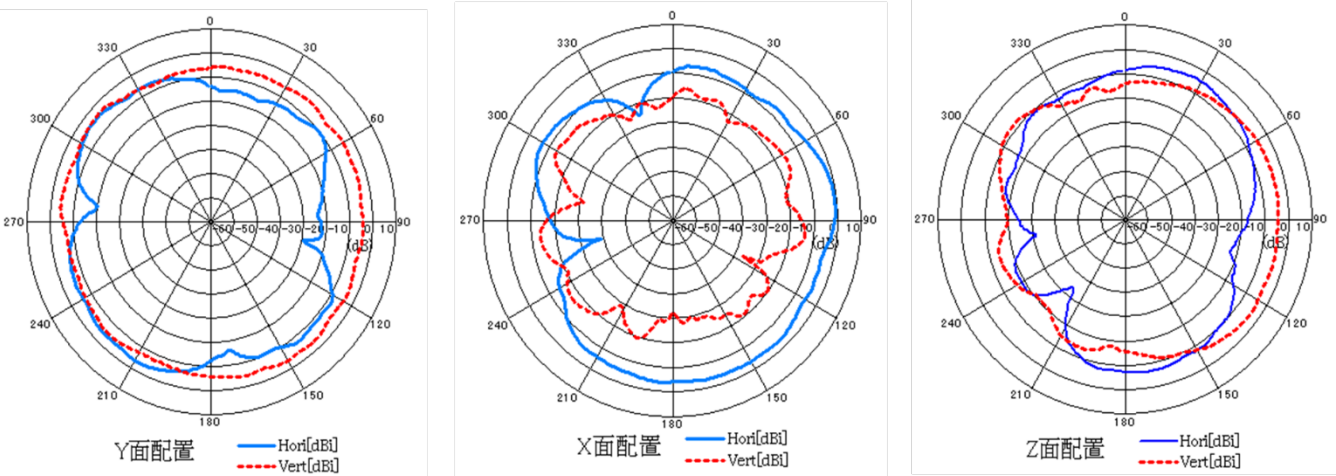


Figure7. Antenna Radiation Pattern (2480MHz)

Table 5. Antenna Gain (2480MHz)

	horizontal			vertical		
	MAX[dBi]	MIN[dBi]	AVE[dBi]	MAX[dBi]	MIN[dBi]	AVE[dBi]
X-Plain	-0.97	-38.72	-6.1	-13.44	-37.11	-18.84
Y-Plain	-3.65	-29.3	-8.57	-3.39	-7.88	-5.27
Z-Plain	-4.46	-34.48	-10.3	-3.74	-21.05	-8.67

1.4 Antenna Input Impedance

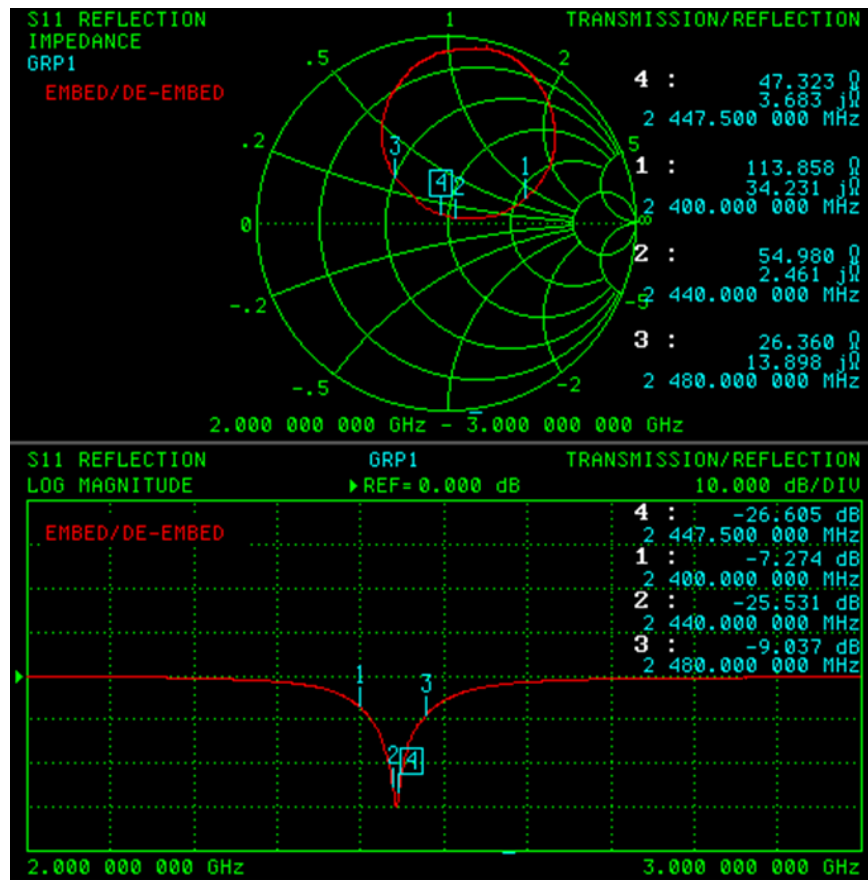


Figure 8. Antenna input impedance

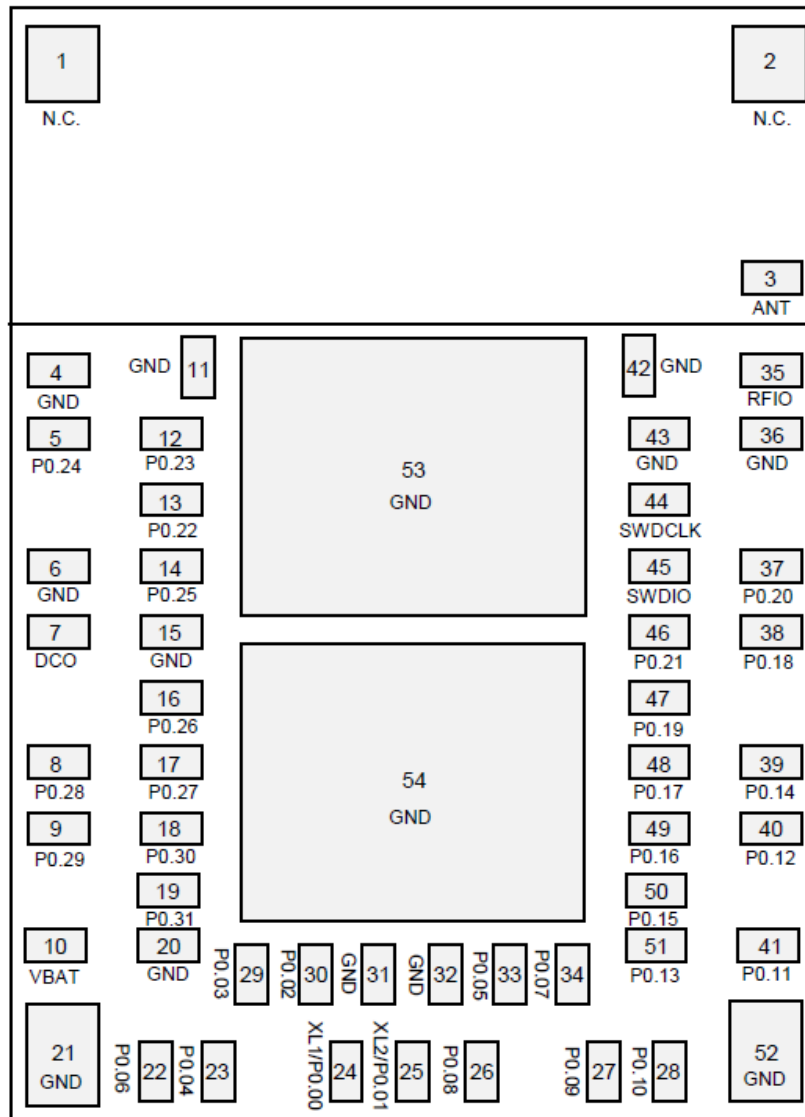
Table 6. Antenna input impedance

Frequency[MHz]	S11[dB]
2400	-7.27
2440	-25.53
2480	-9.04

* Antenna input impedance measures the S11 characteristics of ANT (3PIN) of the module (MK71511/MK71521).

* The impedance of RFIO (35PIN) adjusts to 50 Ω/2440 MHz.

2 MK71511/MK71521 Terminal Name



TOP VIEW

Revision history

Document No.	Date	Page		Remarks
		Before	After	
FEXK715x1_AN_Antenna_radiation_characteristics-01	2020.10.01	—	—	First edition
FEXK715x1_AN_Antenna_radiation_characteristics-02	2020.11.18	—	3,4	1.3 Antenna radiation pattern Add 2402MHz 2480MHz radiation pattern