



# APPLICATION SPECIFICATION

## 2.4/5GHz BALANCE PCB ANTENNA

### 1.0 SCOPE

This specification describes the antenna application and surroundings for the 2.4/5GHz Balance PCB Antenna. The information in this document is for reference and benchmark purposes only. The user is responsible for validating antenna RF performance based on the user's actual implementation.

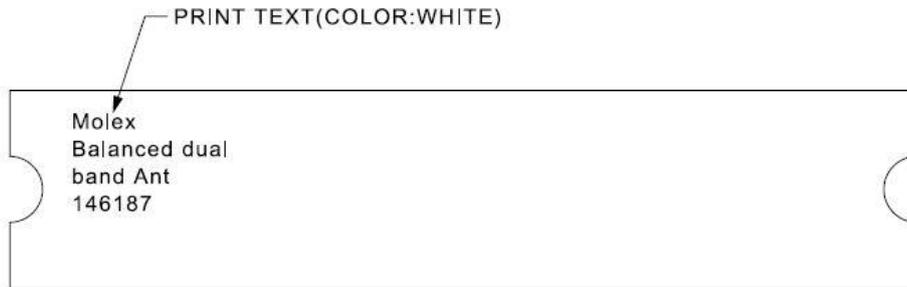
All measurements are done of the antenna in free space with VNA Agilent 5071C and OTA chamber. All measurements are done with the part no. 1461870100 with a cable length of 100mm.

Antenna illustrations in this document are generic representations. They are not intended to be an image of any antenna listed in the scope.

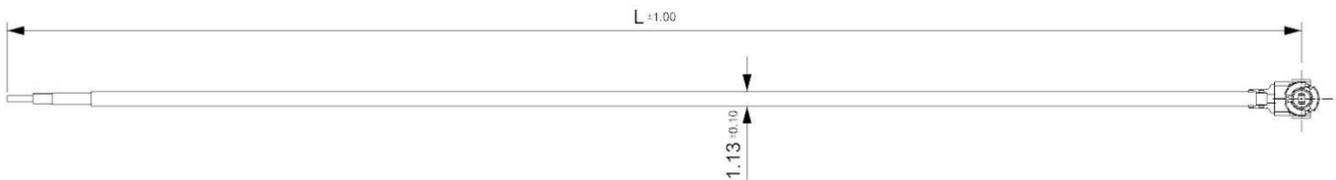
### 2.0 PRODUCT DESCRIPTION

#### A. DEFINITIONS OF TERMS

The overall antenna size is 40.95mm\*9mm (Figure 1).



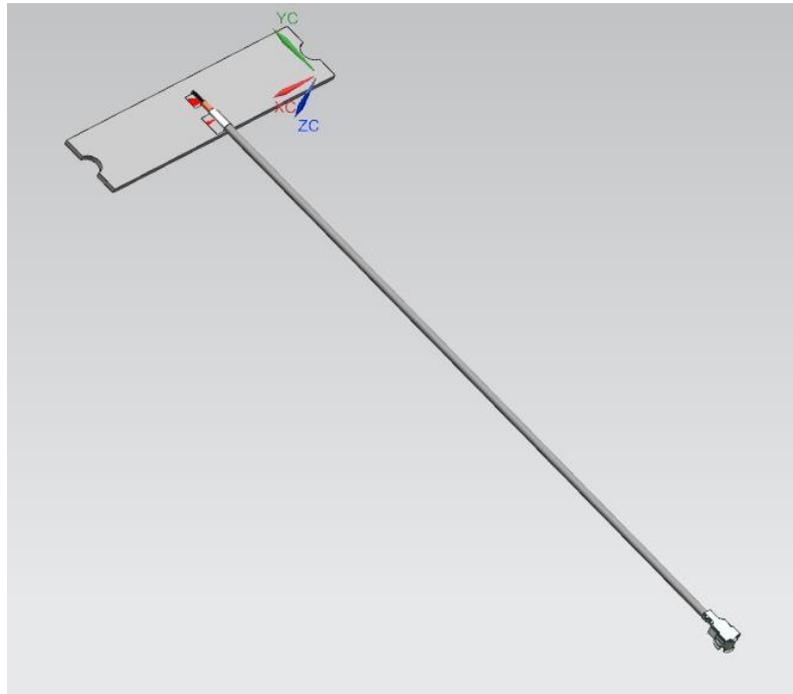
**FIGURE 1. DIMENSION OF THE 2.4/5GHz BALANCE PCB ANTENNA**



**FIGURE 2. CABLE LINE VIEW OF WIFI 2.4/5GHz BALANCE PCB ANTENNA**

REVISION: <b>E</b>	ECR/ECN INFORMATION: EC No: 121094 DATE: 2017/09/05	TITLE: <b>2.4/5GHz BALANCE PCB ANTENNA</b>	SHEET No. <b>1 of 11</b>
DOCUMENT NUMBER: <b>1461870100</b>		CREATED / REVISED BY: Benson Liu 2017/09/05	CHECKED BY: Colin Xu 2017/09/05
		APPROVED BY: Chris Zhong 2017/09/05	

## B. RF PERFORMANCE OF ANTENNA IN FREE SPACE



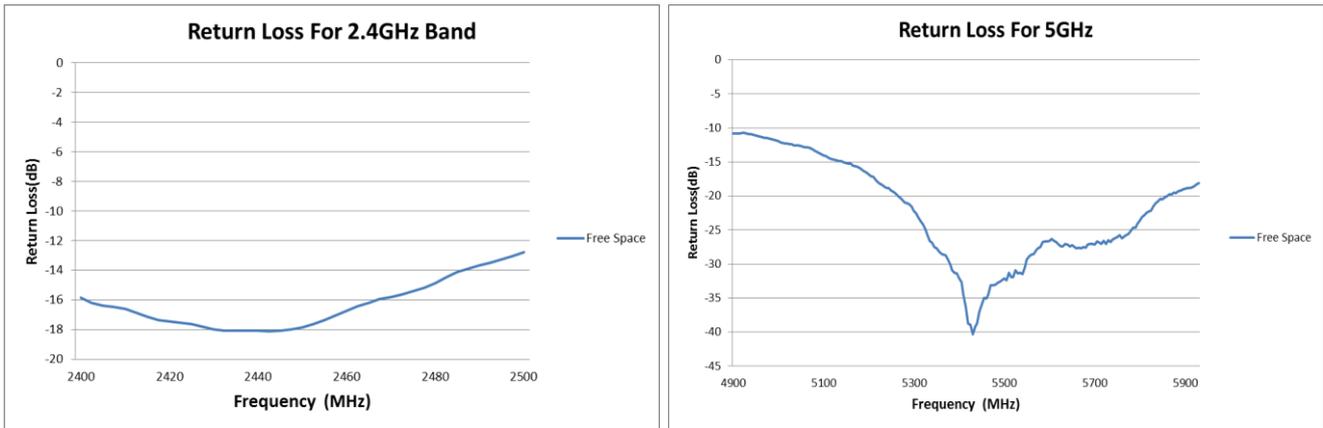
**FIGURE 2.1 ANTENNA IN FREE SPACE**

DESCRIPTION	TEST CONDITION	REQUIREMENT	
Frequency Range	2.4GHz~5.85GHz	2.4GHz~2.5GHz	5.15GHz~5.85GHz
Return Loss	Antenna with 100mm long, 1.13mm diameter micro coaxial cable in free space Measured by VNA5071C	< -10 dB	
Peak Gain (Max)	Measure antenna in free space through OTA chamber	3.2 dBi	4.5 dBi
Total Efficiency	Measure antenna in free space through OTA chamber	>80%	>75%
Polarization	Measure antenna in free space through OTA chamber	Linear	
Input Impedance	Measure antenna in free space through VNA E5071C	50 Ohms	

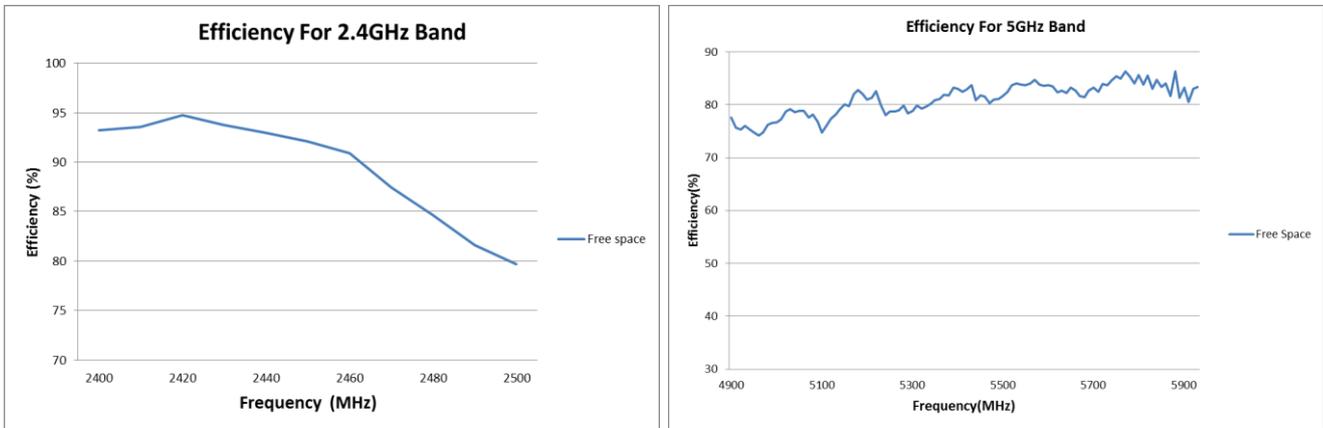
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**FIGURE 2.2 RETURN LOSS OF ANTENNA AT 2.4/5GHZ BAND IN FREE SPACE**



**FIGURE 2.3 EFFICIENCY OF ANTENNA AT 2.4/5GHZ BAND IN FREE SPACE**

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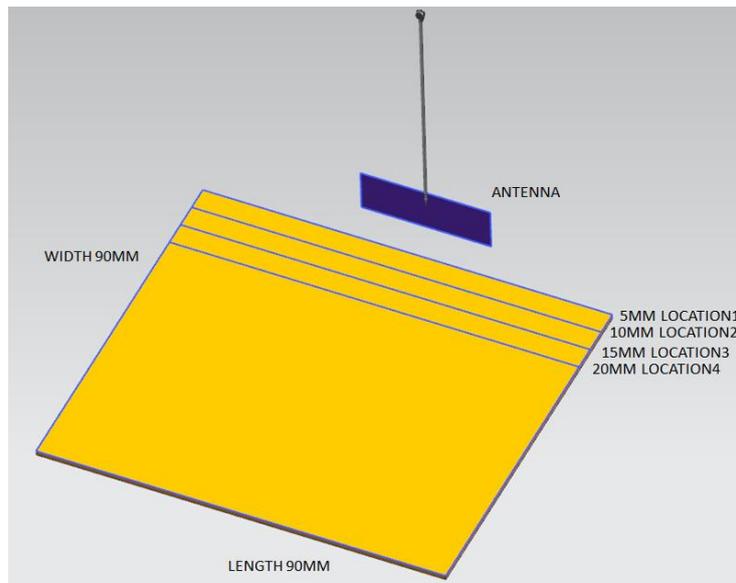
### 3.0 REFERENCE DOCUMENTS

- Sales Drawing :SD-1461870100
- Product Specification: PS-1461870100
- Packaging Information – Refer to the Molex related packaging drawings.

### 4.0 RF PERFORMANCE AS A FUNCTION OF IMPLEMENTATION

#### 4.0.1 ANTENNA RF PERFORMANCE AS A FUNCTION OF DIFFERENT LOCATION WITH VERTICAL GROUND

Four ground locations with vertical ground have been evaluated, with different distances from the antenna and these locations are shown in figure 4.1. The PCB size is 90mm\*90mm and we move the PCB to four locations for each test. The antennas meet the spec of the return loss and the total efficiency specification at location 4. The minimum ground distance from antenna is recommended to be 20mm to meet the antenna specification.



**FIGURE 4.1 FOUR LOCATIONS WITH VERTICAL GROUND**

Ground Area: 90mm\*90mm

- (a)Location 1: Distance between antenna and ground is about 5mm.
- (b)Location 2: Distance between antenna and ground is about 10mm
- (c)Location 3: Distance between antenna and ground is about 15mm.
- (d)Location 4: Distance between antenna and ground is about 20mm.

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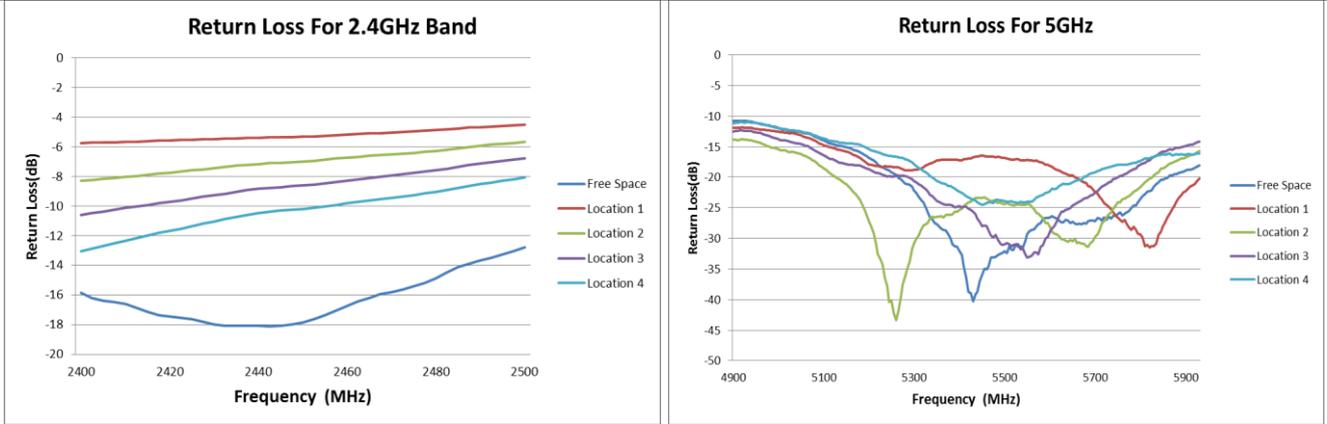


FIGURE 4.1.1 RETURN LOSS OF ANTENNA AT 2.4/5GHZ BAND AT FOUR LOCATIONS WITH VERTICAL GROUND

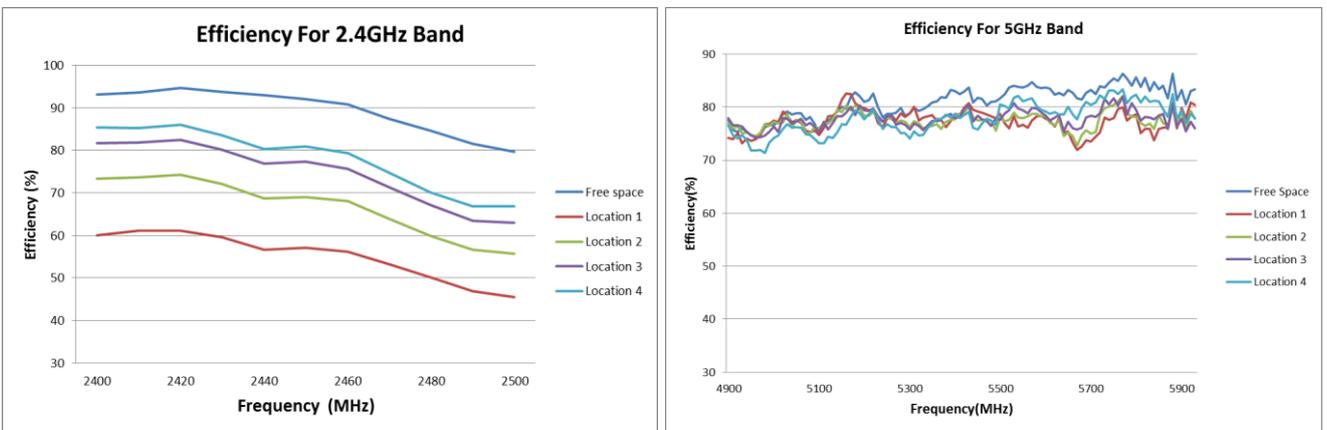
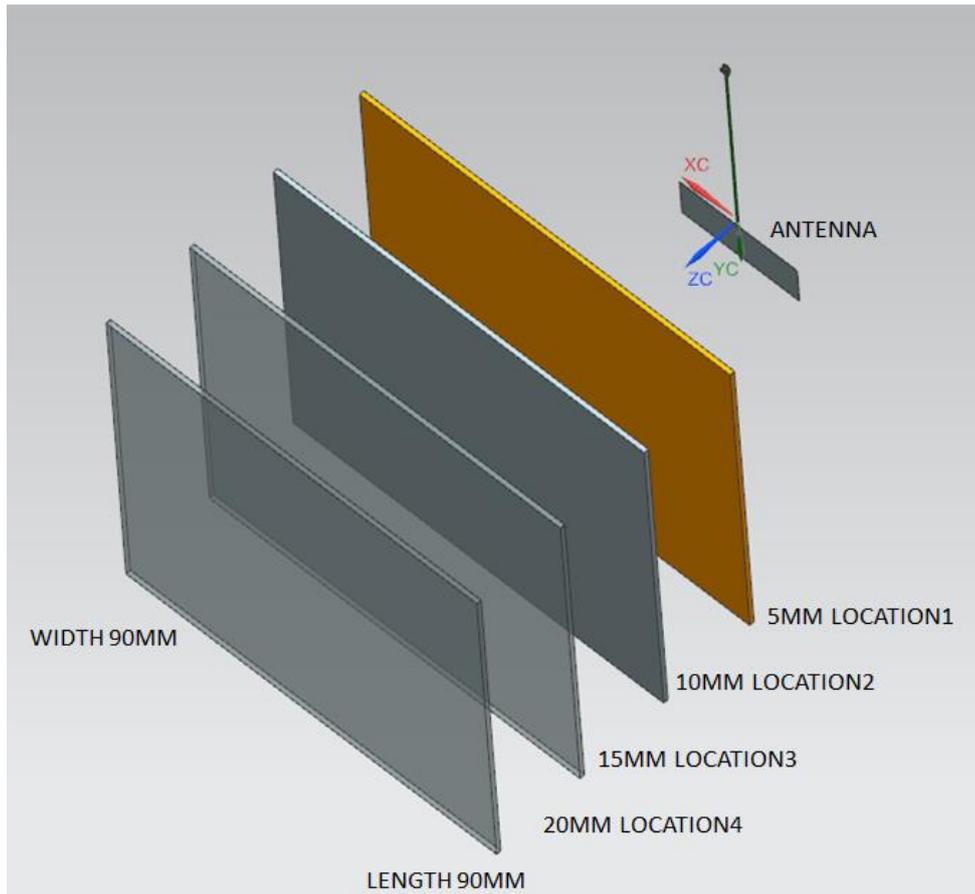


FIGURE 4.1.2 EFFICIATION OF ANTENNA AT 2.4/5GHZ BAND AT FOUR LOCATIONS WITH VERTICAL GROUND

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## 4.2 ANTENNA RF PERFORMANCE AS A FUNCTION OF DIFFERENT LOCATION WITH PARALLEL GROUND

Four ground locations with parallel ground have been evaluated, and these locations are shown in figure 4.2. The PCB size is 90mm\*90mm and we move the PCB to four locations for each test. Though the antenna cannot meet the return loss specification at 2.4GHz band at location 4 but it can fulfill the efficiency specification. The minimum ground distance from the antenna is recommended to be 20mm from the antenna to meet the total efficiency specification.



**FIGURE 4.2 FOUR LOCATIONS WITH PARALLEL GROUND**

Ground Area: 90mm\*90mm

- (a) Location 1: Distance between antenna and ground is about 5mm.
- (b) Location 2: Distance between antenna and ground is about 10mm.
- (c) Location 3: Distance between antenna and ground is about 15mm.
- (d) Location 4: Distance between antenna and ground is about 20mm.

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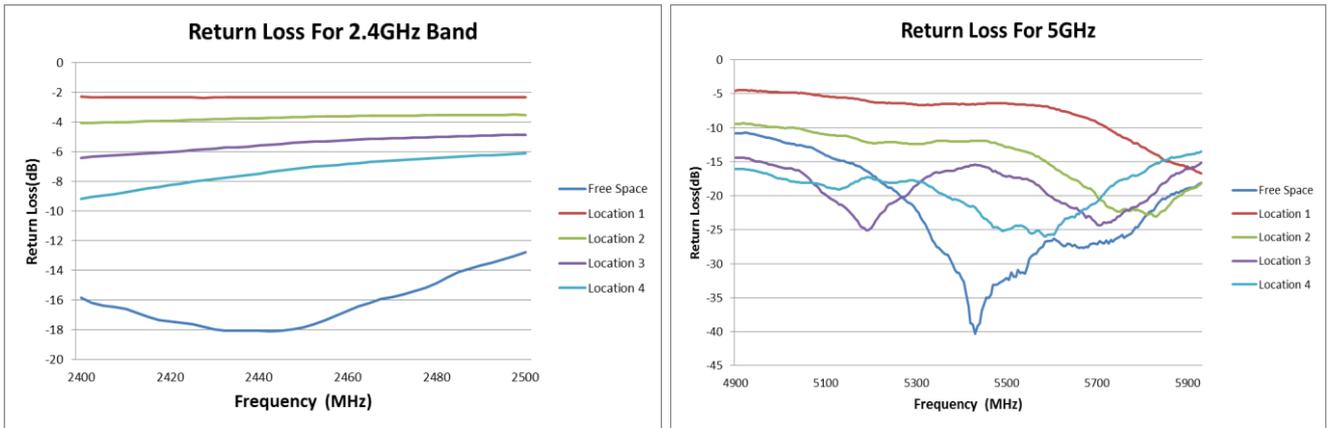


FIGURE 4.2.1 RETURN LOSS OF ANTENNA AT 2.4/5GHZ BAND AT FOUR LOCATIONS WITH PARALLEL GROUND

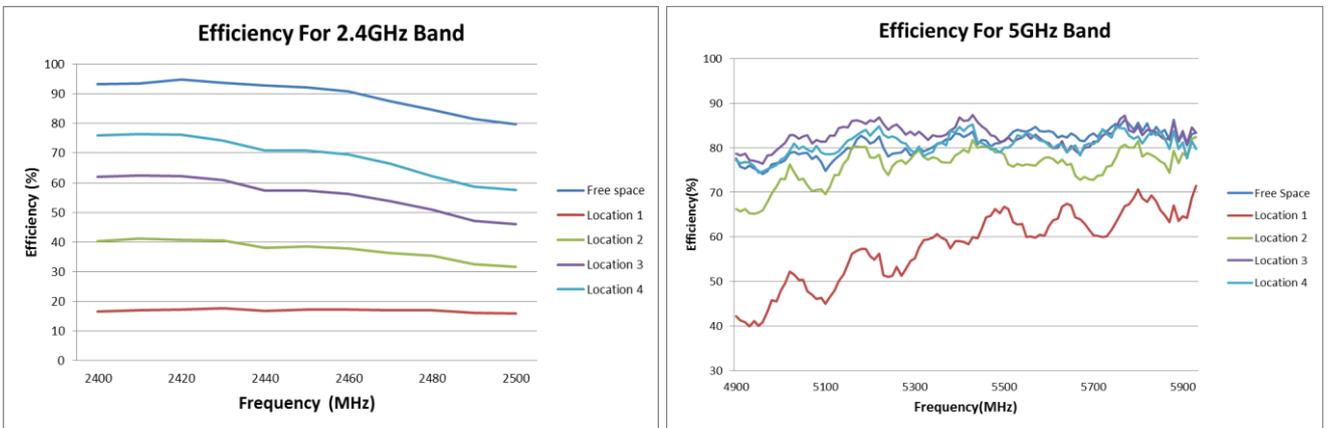


FIGURE 4.2.2 EFFICIENCY OF ANTENNA AT 2.4/5GHZ BAND AT FOUR LOCATIONS WITH PARALLEL GROUND

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<b>1461870100</b>	<b>Benson Liu 2017/09/05</b>	<b>Colin Xu 2017/09/05</b>	<b>Chris Zhong 2017/09/05</b>

## 5.0 RADIATION PATTERN

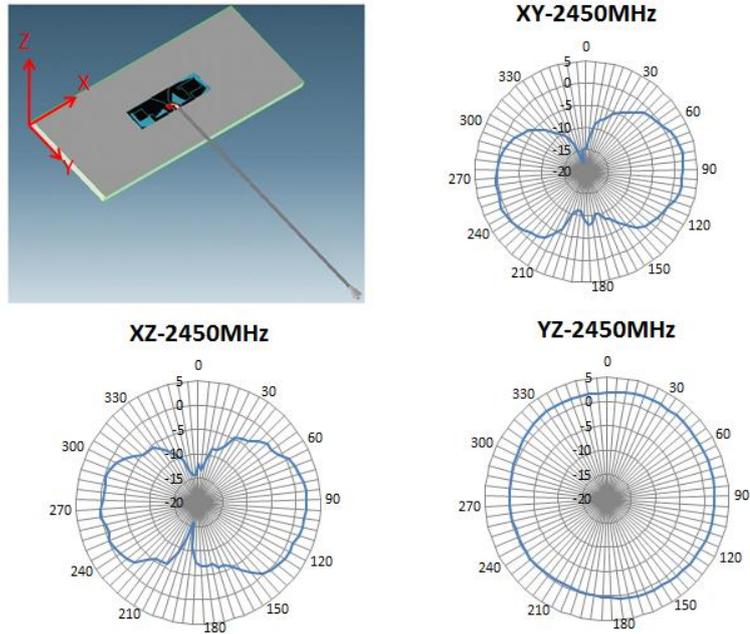


FIGURE 5.1 RADIATION PATTERN OF ANTENNA AT 2.45GHZ IN FREE SPACE

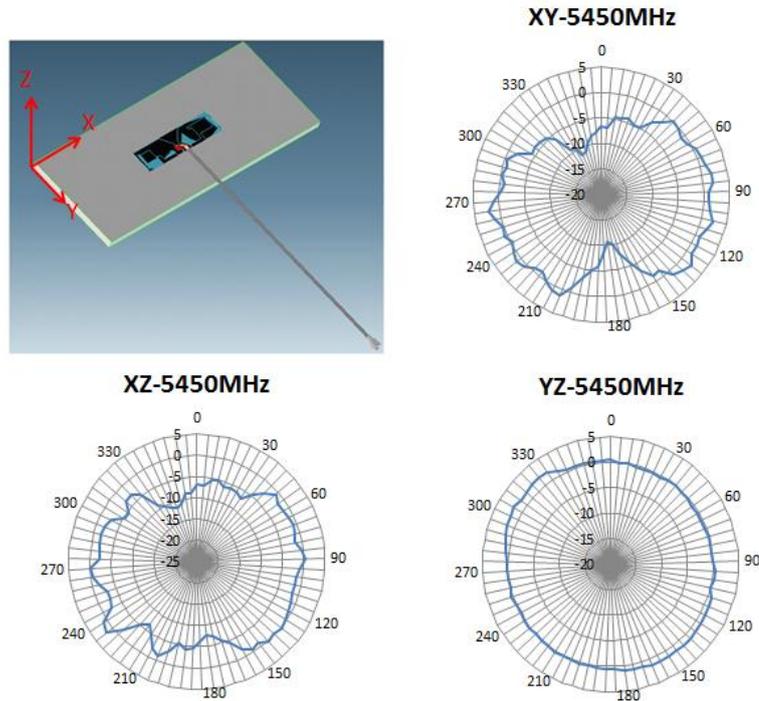


FIGURE 5.2 RADIATION PATTERN OF ANTENNA AT 5.45GHZ IN FREE SPACE

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## 6.0 THE ANTENNA PERFORMANCE VARIATION WITH CABLE LENGTH

### 6.0.1 CABLE LOSS

ITEM	DESCRIPTION	TEST CONDITION	REQUIREMENT	
			2GHz~3GHz	5GHz~6.0GHz
6.0.1.1	Frequency Range	2 GHz~6GHz	2GHz~3GHz	5GHz~6.0GHz
6.0.1.2	Attenuation	1m cable measured by VNA5071C	≤3.5dB/m	≤5dB/m

### 6.0.2 CABLE LENGTH AFFECT THE ANTENNA PERFORMANCE

Balance antenna resonance is insensitive by cable's length, but the cable's loss will affect the total efficiency. Refer to 6.0.1

### 6.0.3 FOR EXAMPLE

Base on the 100mm cable performance, we can mostly compute the 300mm cable's.

Frequency (MHz)	100mm cable		cable loss	300mm cable	
	Efficiency (dB)	Efficiency (%)		Efficiency (dB)	Efficiency (%)
	X		X-LOSS=Y	Y	
2400	-0.53	88.54	0.2m*3.5dB/m	-1.23	75.36
2410	-0.46	89.98		-1.16	76.58
2420	-0.54	88.37		-1.24	75.21
2430	-0.42	90.71		-1.12	77.21
2440	-0.48	89.47		-1.18	76.15
2450	-0.52	88.69		-1.22	75.49
2460	-0.54	88.24		-1.24	75.10
2470	-0.62	86.72		-1.32	73.81
2480	-0.77	83.80		-1.47	71.33
2490	-0.83	82.55		-1.53	70.26
2500	-0.84	82.36		-1.54	70.10

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Frequency (MHz)	100mm cable		cable loss	300mm cable	
	Efficiency (dB)	Efficiency (%)		Efficiency (dB)	Efficiency (%)
	X		X-LOSS=Y	Y	
4900	-1.10	77.55	0.2*5dB/m	-2.10	61.60
4930	-1.19	76.06		-2.19	60.42
4960	-1.30	74.20		-2.30	58.94
4990	-1.16	76.54		-2.16	60.80
5020	-1.04	78.77		-2.04	62.57
5050	-1.03	78.87		-2.03	62.65
5080	-1.07	78.13		-2.07	62.06
5110	-1.19	76.10		-2.19	60.45
5140	-1.02	79.14		-2.02	62.87
5170	-0.86	81.96		-1.86	65.10
5200	-0.92	80.98		-1.92	64.32
5230	-0.97	79.96		-1.97	63.52
5260	-1.04	78.76		-2.04	62.56
5290	-1.06	78.35		-2.06	62.23
5320	-1.01	79.25		-2.01	62.95
5350	-0.92	80.89		-1.92	64.25
5380	-0.87	81.84		-1.87	65.00
5410	-0.84	82.47		-1.84	65.51
5440	-0.92	80.87		-1.92	64.24
5470	-0.95	80.30		-1.95	63.79
5500	-0.88	81.62		-1.88	64.83
5530	-0.75	84.07		-1.75	66.78
5560	-0.76	84.03		-1.76	66.75
5590	-0.78	83.61		-1.78	66.42
5620	-0.85	82.30		-1.85	65.38
5650	-0.80	83.24		-1.80	66.12
5680	-0.89	81.44		-1.89	64.69
5710	-0.84	82.43		-1.84	65.48
5740	-0.72	84.66		-1.72	67.25
5770	-0.64	86.37		-1.64	68.60
5800	-0.68	85.59		-1.68	67.98
5830	-0.81	83.02		-1.81	65.94
5860	-0.75	84.05		-1.75	66.77
5890	-0.90	81.34		-1.90	64.61
5920	-0.81	83.04		-1.81	65.96
5930	-0.79	83.38		-1.79	66.23

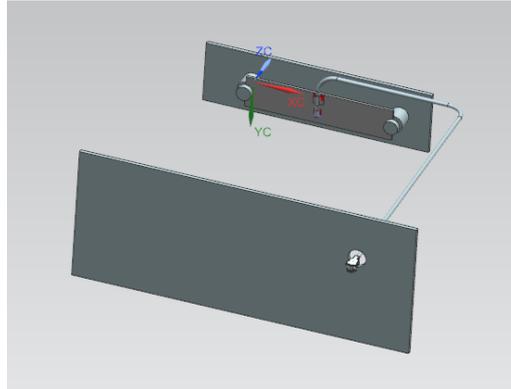
- The data is just for your reference, all accurate performance should be according to the test results in the OTA chamber.

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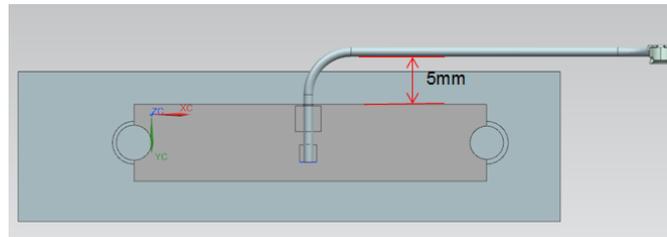
## 7.0 ASSEMBLY GUIDELINES

During the assembly of the antenna in a device, the cable needs to be positioned away from the antenna as shown in Figure 7.1. The cable has to be away from the pattern at least 5mm as shown in Figure 7.2. The PCB has to be away from the housing height at least 5mm as shown in Figure 7.3. If customer would like to paste this product on a plastic cover, we suggest using flex version of this standard antenna, whose part number is 1461570100.

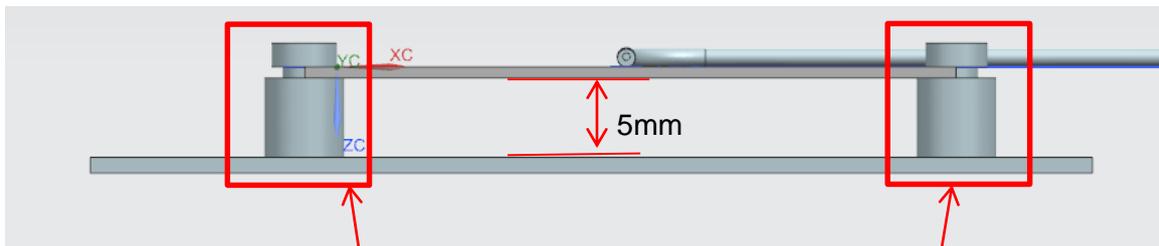
The columnar material can be plastic with metal nut or pure plastic. However, pure metal for columnar is not recommended. During the assembly of the PCB, twist force must be less than 3kgf.



**FIGURE 7.1 ASSEMBLY GUIDELINE**



**FIGURE 7.2 CABLE BENDING**



These two columnar materials can be plastic with metal nut or pure plastic. Pure metal is not recommended. During the assembly of the PCB, twist force must be less than 3kgf.

**FIGURE 7.3 ANTENNA ASSEMBLY HEIGHT**

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