



# APPLICATION SPECIFICATION

## TITLE

### 868/915MHZ ISM STAND ALONE ANTENNA

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| REVISION:            | ECR/ECN INFORMATION:              | TITLE:                                                                  | SHEET No.             |
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| DOCUMENT NUMBER:     | CREATED / REVISED BY:             | CHECKED BY:                                                             | APPROVED BY:          |
| <b>AS-1052620001</b> | Liu Hai 2020/04/18                | Cheng Kang 2020/04/18                                                   | Andy Zhang 2020/04/18 |

## 865/915MHZ ISM STAND ALONE ANTENNA

### 1.0 SCOPE

This specification describes the antenna application and surrounding. 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.

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

#### 2.1 PRODUCT NAME AND SERIES NUMBER (S)

Product name: 865/915MHz ISM Stand Alone Antenna

Series Number: 105262

#### 2.2 DESCRIPTION

Series 105262 is a ISM standard alone antenna for 868/915 MHz applications, including LoRa, Neul, SigFox, Z-Wave, Zigbee and others. This antenna is made from poly flexible material with size 79\*10\*0.1mm, and has double-sided adhesive tape for easy "peel and stick" mounting. This balanced antenna with ground plane independent design offers various cable length options for ease of integration into various devices.

#### 2.3 PRODUCT STRUCTURE INFORMATION

Please refer to PS-1052620100 for full information.



MOLEX ANTENNA 3D VIEW

|                      |                                   |                                                                         |                       |
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| <b>AS-1052620001</b> | Liu Hai 2020/04/18                | Cheng Kang 2020/04/18                                                   | Andy Zhang 2020/04/18 |

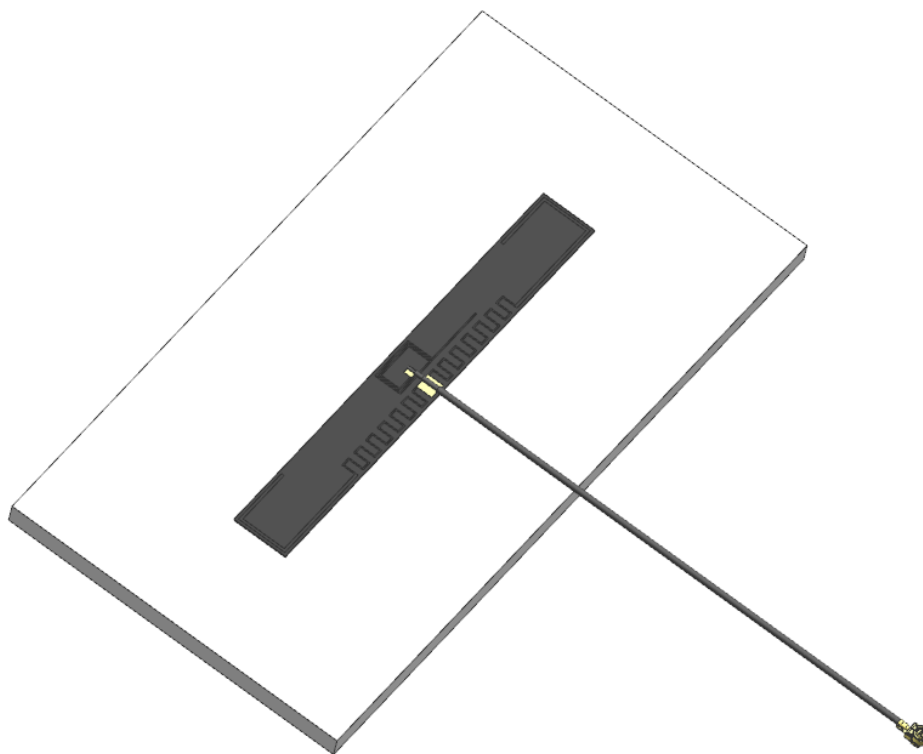
## 3.0 APPLICABLE DOCUMENTS

| DOCUMENT                   | NUMBER        | DESCRIPTION                         |
|----------------------------|---------------|-------------------------------------|
| Sale Drawing (SD)          | SD-1052620001 | Mechanical Dimension of the product |
| Product Specification (PS) | PS-1052620001 | Product Specification               |
| Packing Drawing (PK)       | PK-1052620001 | Product packaging specifications    |

## 4.0 ANTENNA PERFORMANCE

### 4.1 RF TEST CONDITIONS

All measurements are done of the antenna mounted on a PC/ABS material block of 2mm thickness with VNA Agilent 5071C and Over-The-Air (OTA) chamber. All measurements in this document are done with the part No.1052620001 with a cable length of 100mm.



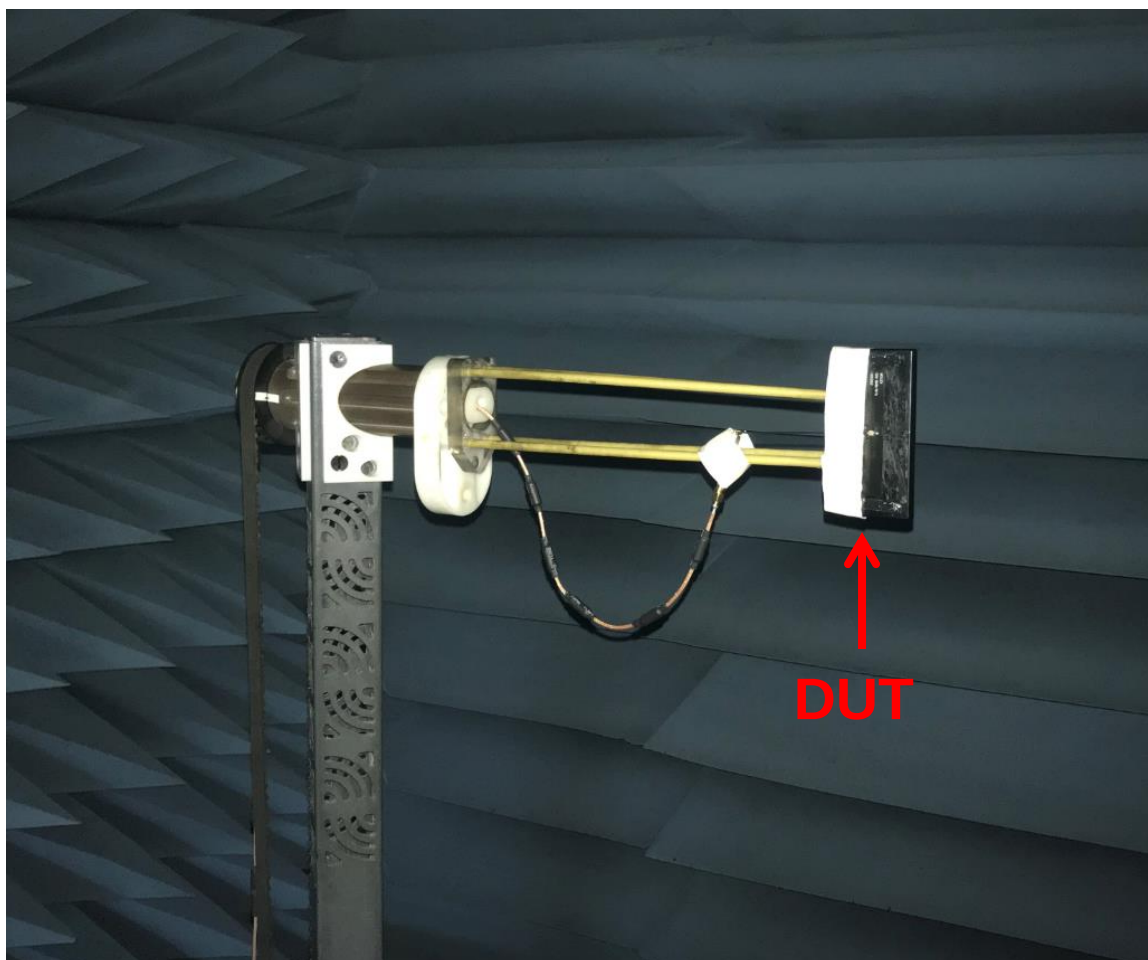
**FIGURE4.1.1 ANTENNA LOADED WITH PC/ABS BLOCK OF 2MM THICKNESS**

|                      |                                   |                                                                         |                       |
|----------------------|-----------------------------------|-------------------------------------------------------------------------|-----------------------|
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| <b>AS-1052620001</b> | Liu Hai 2020/04/18                | Cheng Kang 2020/04/18                                                   | Andy Zhang 2020/04/18 |



**FIGURE4.1.2 ANTENNA LOADED WITH PC/ABS BLOCK OF 2MM THICKNESS TESTED WITH VNA E5071C**

|                      |                                   |                                                                         |                       |
|----------------------|-----------------------------------|-------------------------------------------------------------------------|-----------------------|
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| <b>AS-1052620001</b> | Liu Hai 2020/04/18                | Cheng Kang 2020/04/18                                                   | Andy Zhang 2020/04/18 |



**FIGURE4.1.3 ANTENNA LOADED WITH PC/ABS BLOCK OF 2MM THICKNESS TESTED IN OTA CHAMBER**

|                                          |                                                                         |                                                                                   |                                       |
|------------------------------------------|-------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------|
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| DOCUMENT NUMBER:<br><b>AS-1052620001</b> | CREATED / REVISED BY:<br>Liu Hai 2020/04/18                             | CHECKED BY:<br>Cheng Kang 2020/04/18                                              | APPROVED BY:<br>Andy Zhang 2020/04/18 |



# APPLICATION SPECIFICATION

## 4.2 ANTENNA PERFORMANCE

| DESCRIPTION              | EQUIPMENT   | REQUIREMENT<br>(CABLE LENGTH:100MM) |            |
|--------------------------|-------------|-------------------------------------|------------|
| Frequency Range          | VNA E5071C  | 868-870MHz                          | 902-928MHz |
| Return Loss              | VNA E5071C  | < -6 dB                             |            |
| Peak Gain (Max)          | OTA Chamber | 0.4 dBi                             | 1.6 dBi    |
| Average Total Efficiency | OTA Chamber | >55%                                | >65%       |
| Polarization             | OTA Chamber | Linear                              |            |
| Input Impedance          | VNA E5071C  | 50 Ohms                             |            |

Note that the above antenna performance is measured with just the antenna mounted on a PC/ABS block to similar a free-space condition. When implement into the system, the frequency resonant might be off-tune due to the loading of surrounding components especially metal plane. This off-tune can be compensated through matching. Although module manufacturers specify a peak gain limit, it is based on free-space conditions. The peak gain will be degraded by 1 to 2dBi in the actual implementation as the radiation pattern will change due to the surround components. As such, during selection of antenna, you can select one with high peak gain to compensate for the loss. Molex can offer assistant to choose the best location and best tuning in-order to meet this peak gain requirement.

|                      |                                   |                                                                         |                       |
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| <b>AS-1052620001</b> | Liu Hai 2020/04/18                | Cheng Kang 2020/04/18                                                   | Andy Zhang 2020/04/18 |

## 4.3 RETURN LOSS PLOT

All measurements in this document are done with cable length of 100mm.

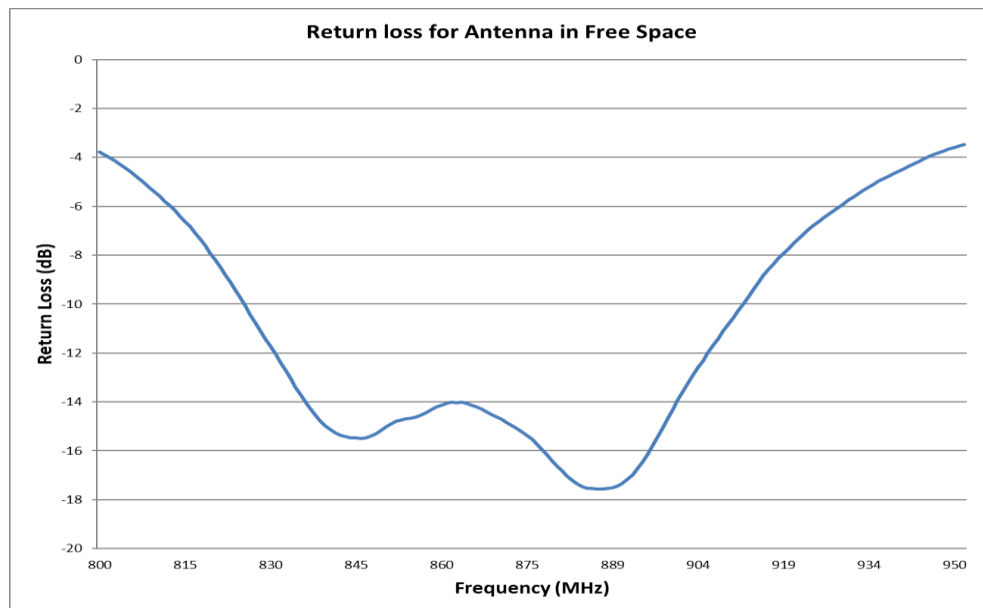


FIGURE 4.3.1 RETURN LOSS OF ANTENNA IN FREE SPACE WITH

## 4.4 EFFICIENCY PLOT

All measurements in this document are done with cable length of 100mm.

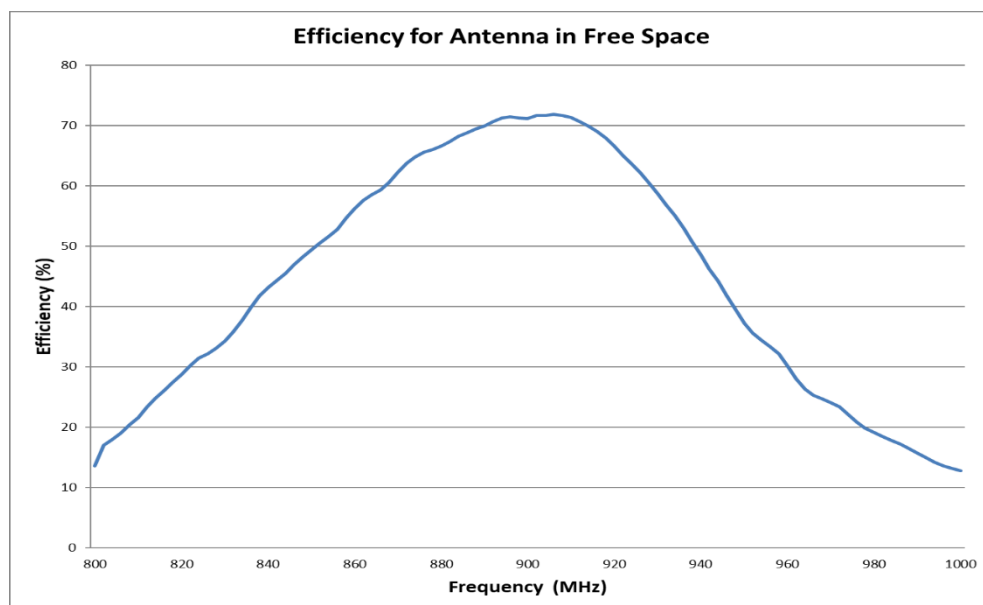


FIGURE 4.4.1 EFFICIENCY OF ANTENNA IN FREE SPACE

|                      |                                   |                                                                         |                       |
|----------------------|-----------------------------------|-------------------------------------------------------------------------|-----------------------|
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| <b>AS-1052620001</b> | Liu Hai 2020/04/18                | Cheng Kang 2020/04/18                                                   | Andy Zhang 2020/04/18 |

## 4.5 2D RADIATION PATTERN

All measurements in this document are done with cable length of 100mm.

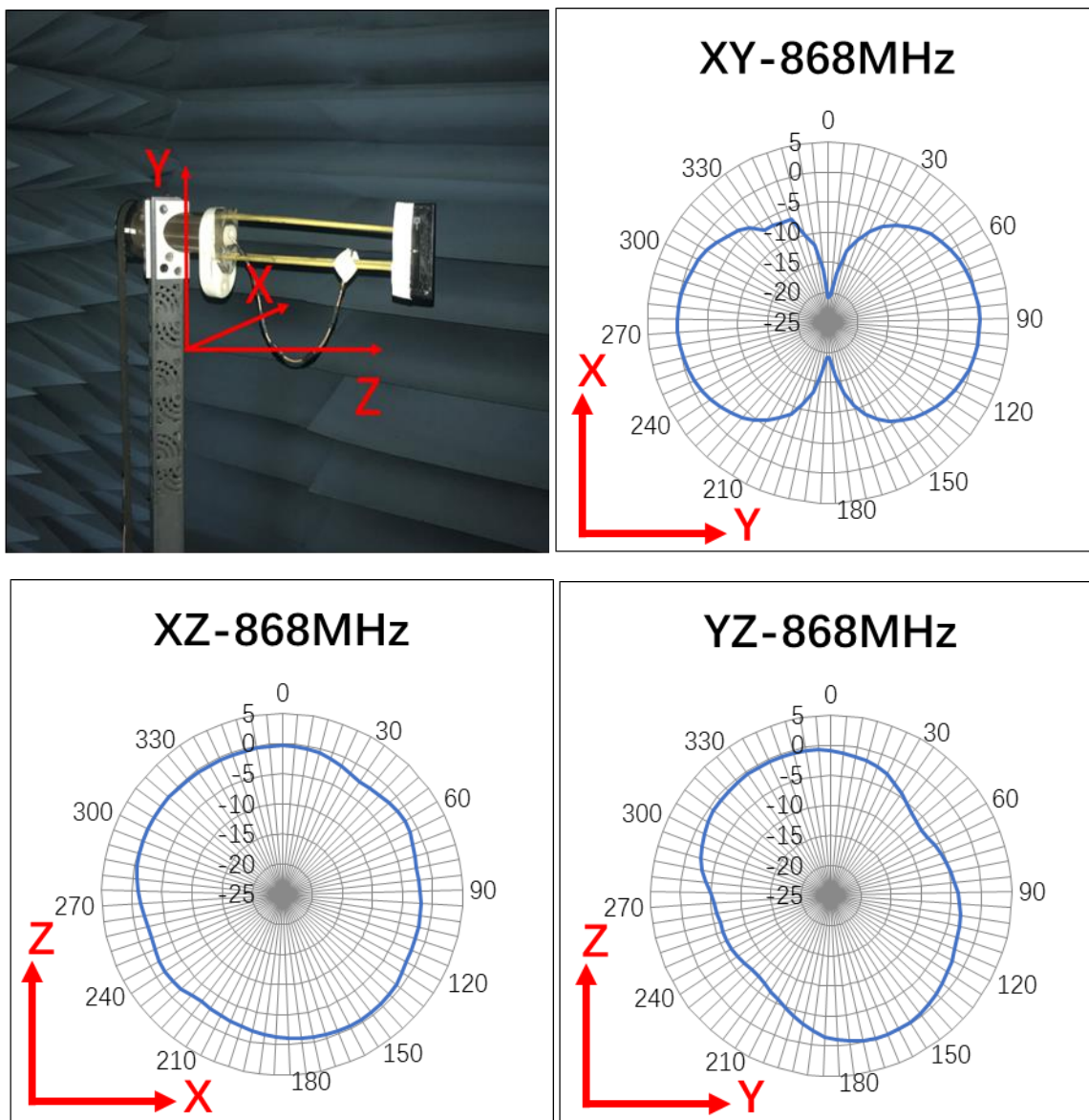


FIGURE 4.5.1 2D RADIATION PATTERN OF ANTENNA AT 868MHZ IN FREE SPACE

|                      |                                   |                                                                         |                       |
|----------------------|-----------------------------------|-------------------------------------------------------------------------|-----------------------|
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| <b>AS-1052620001</b> | Liu Hai 2020/04/18                | Cheng Kang 2020/04/18                                                   | Andy Zhang 2020/04/18 |

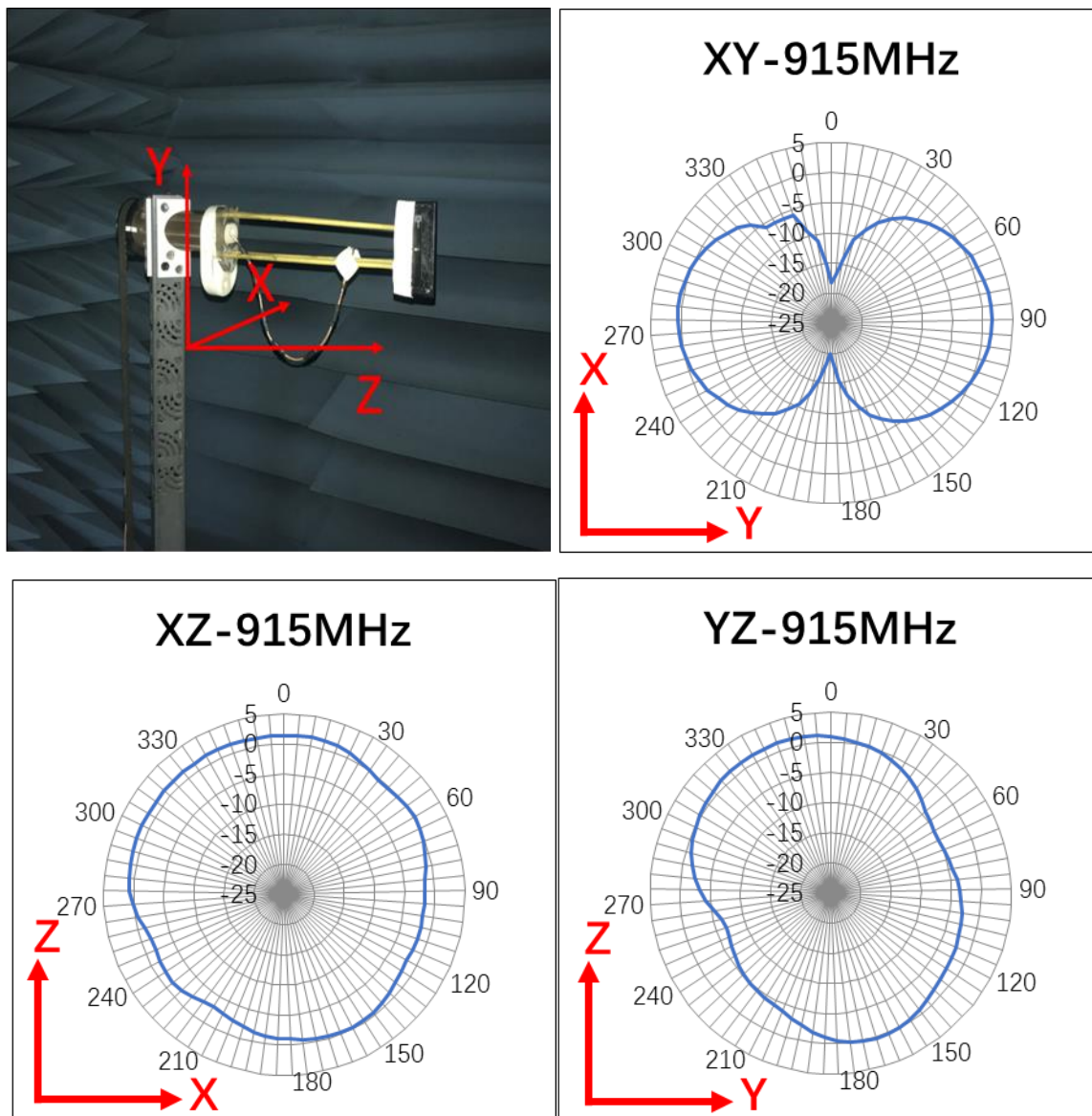


FIGURE 4.5.2 2D RADIATION PATTERN OF ANTENNA AT 915MHZ IN FREE SPACE

|                      |                                   |                                                                         |                       |
|----------------------|-----------------------------------|-------------------------------------------------------------------------|-----------------------|
| REVISION:            | ECR/ECN INFORMATION:              | TITLE:                                                                  | SHEET No.             |
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| <b>AS-1052620001</b> | Liu Hai 2020/04/18                | Cheng Kang 2020/04/18                                                   | Andy Zhang 2020/04/18 |

## 4.6 3D RADIATION PATTERN

All measurements in this document are done with cable length of 100mm.

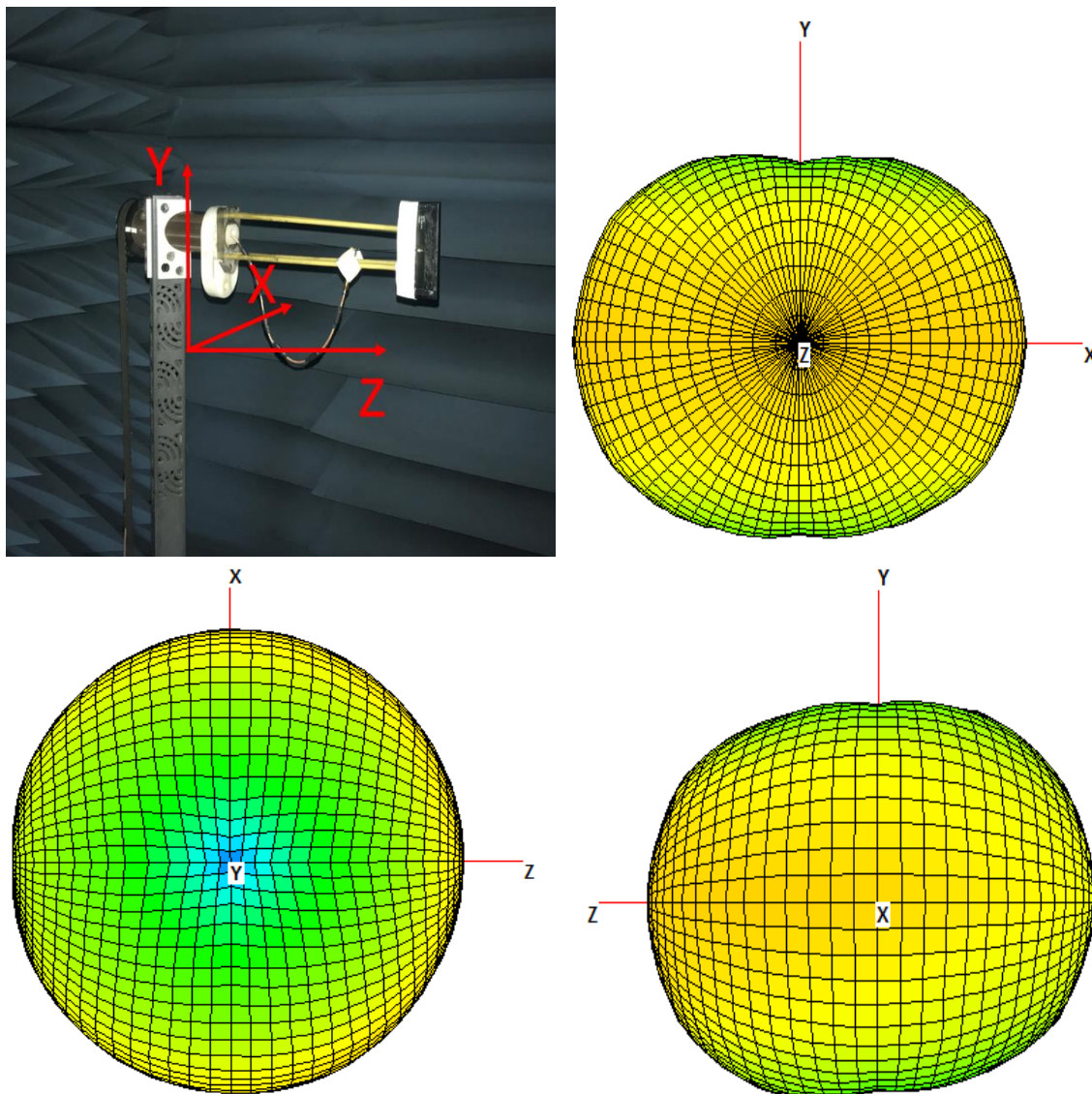
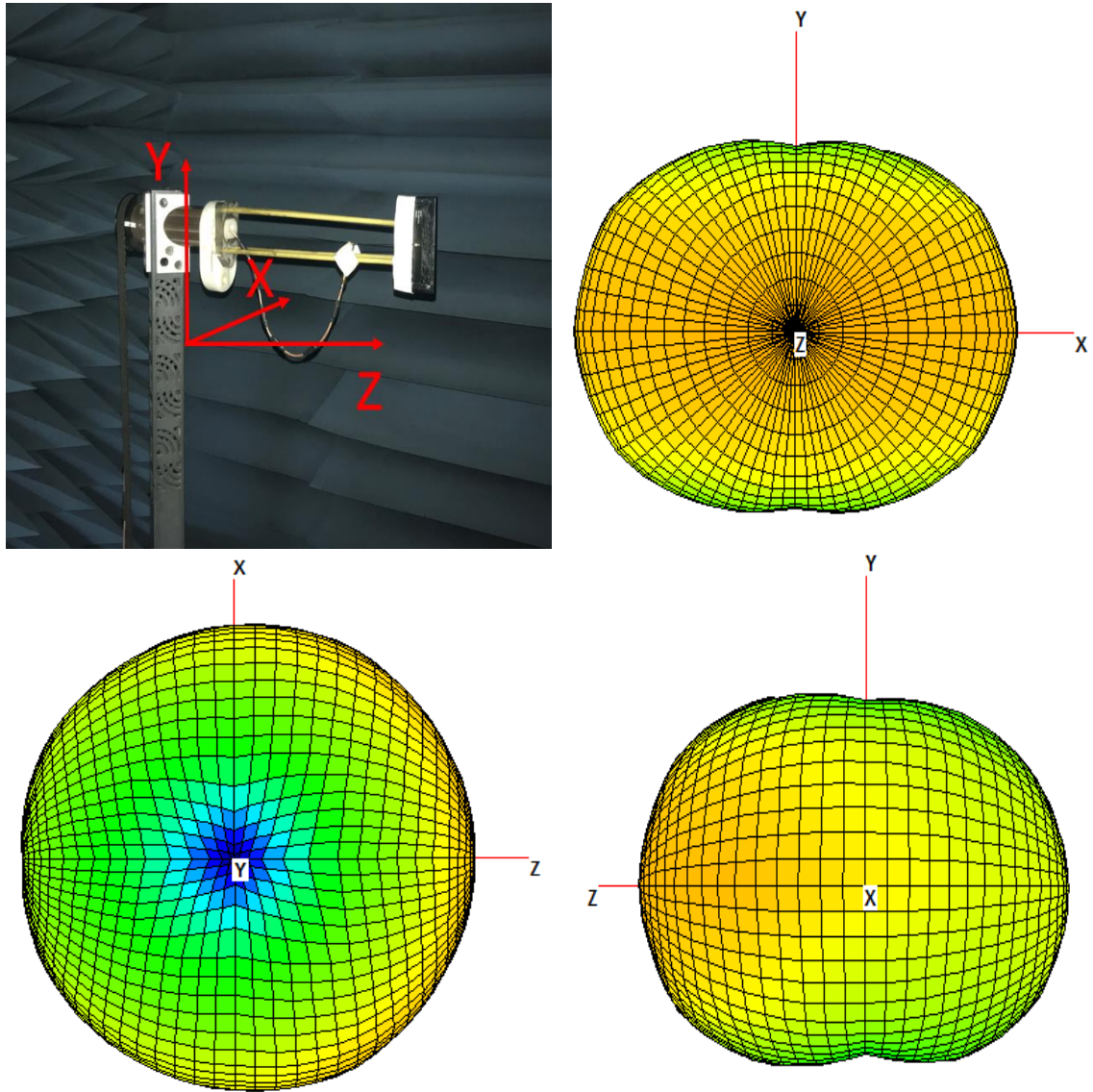


FIGURE 4.6.1 3D RADIATION PATTERN OF ANTENNA AT 868MHZ IN FREE SPACE

|                      |                                   |                                                                         |                       |
|----------------------|-----------------------------------|-------------------------------------------------------------------------|-----------------------|
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| <b>AS-1052620001</b> | Liu Hai 2020/04/18                | Cheng Kang 2020/04/18                                                   | Andy Zhang 2020/04/18 |



**FIGURE 4.6.2 3D RADIATION PATTERN OF ANTENNA AT 915MHZ IN FREE SPACE**

|                      |                      |                                                                         |                       |                       |
|----------------------|----------------------|-------------------------------------------------------------------------|-----------------------|-----------------------|
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| <b>AS-1052620001</b> |                      | Liu Hai 2020/04/18                                                      | Cheng Kang 2020/04/18 | Andy Zhang 2020/04/18 |

## 5.0 ASSEMBLY GUIDELINE

The flex antenna comes with an adhesive 3M 9077 for assemble onto the plastic wall of the system. The surface should be smooth with  $Ra < 1.6\mu m$ , and need to clean the surface before sticking this product. The antenna cannot be placed on a metallic surface.

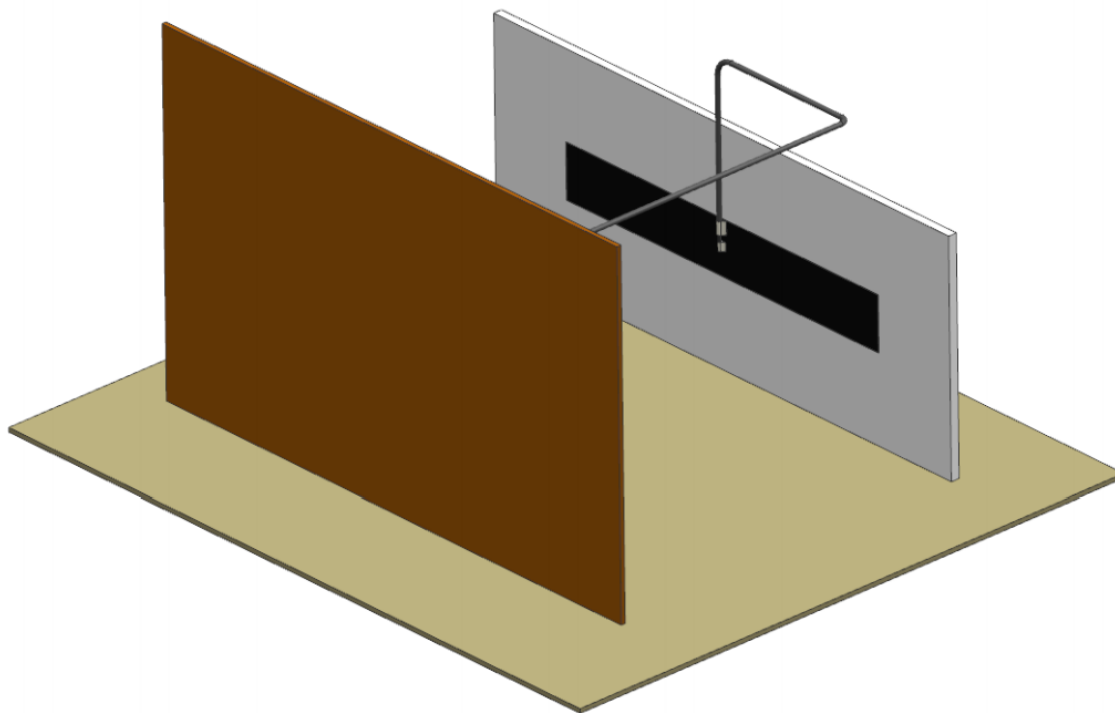
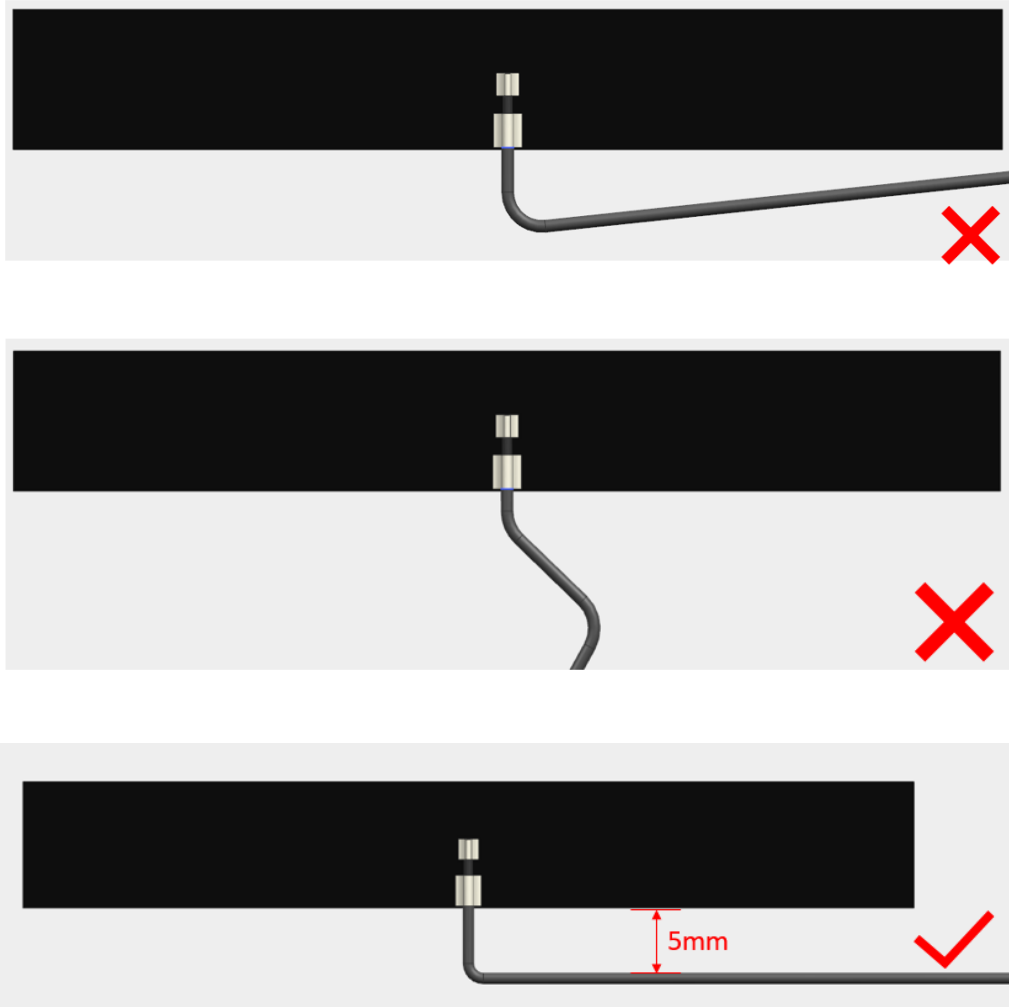


FIGURE 5.1 ASSEMBLY GUIDELINE

|                      |                                   |                                                                         |                       |
|----------------------|-----------------------------------|-------------------------------------------------------------------------|-----------------------|
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| <b>AS-1052620001</b> | Liu Hai 2020/04/18                | Cheng Kang 2020/04/18                                                   | Andy Zhang 2020/04/18 |

During the assembly of the antenna in a device, the cable needs to be positioned away from the antenna flex to achieve best performance. The cable must be away from the pattern at least 5mm as shown in figure 5.2. If the cable crosses into the antenna flex, the antenna performance will be degraded.



**FIGURE 5.2 CABLE BENDING**

|                                          |                                                                         |                                                                                   |                                       |
|------------------------------------------|-------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------|
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# APPLICATION SPECIFICATION

## 6.0 THE ANTENNA PERFORMANCE VARIATION WITH CABLE LENGTH

### 6.0.1 CABLE LOSS

| ITEM    | DESCRIPTION     | TEST CONDITION                | REQUIREMENT           |
|---------|-----------------|-------------------------------|-----------------------|
| 6.0.1.1 | Frequency Range | 500MHz~1GHz                   | 500MHz~1GHz           |
| 6.0.1.2 | Attenuation     | 1m cable measured by VNA5071C | $\leq 1.8\text{dB/m}$ |

### 6.0.2 CABLE LENGTH AFFECT THE ANTENNA PERFORMANCE

Balance antenna resonance is insensitive by cable length, but the cable 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.

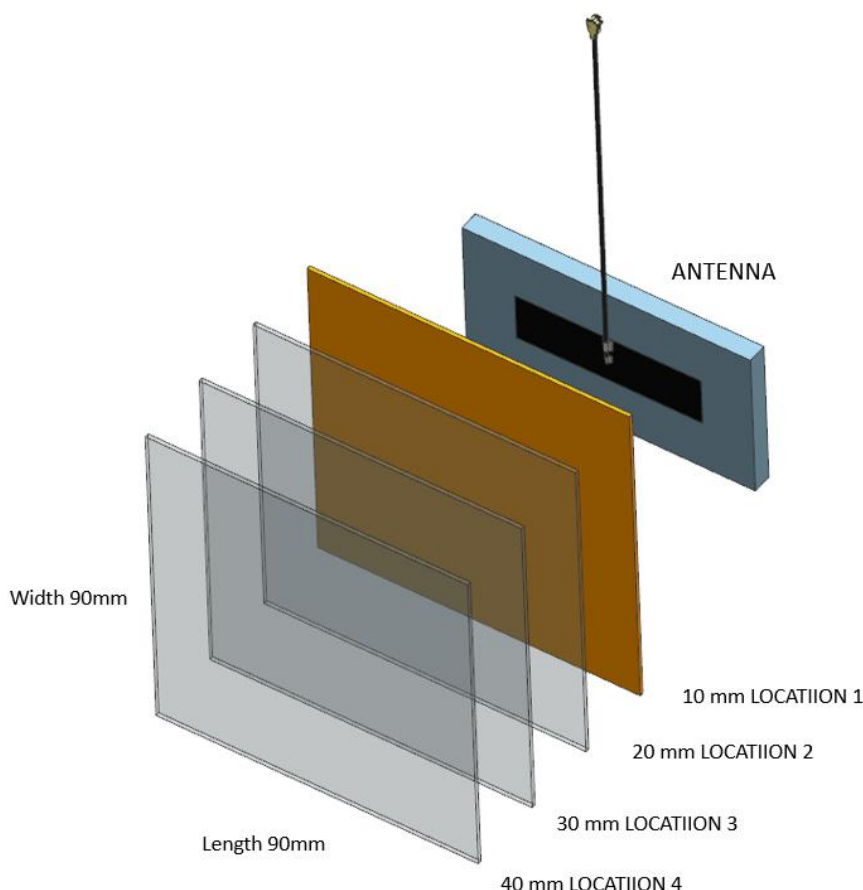
|                 | 100mm cable     |                |              | 300mm cable     |                |
|-----------------|-----------------|----------------|--------------|-----------------|----------------|
| Frequency (MHz) | Efficiency (dB) | Efficiency (%) | cable loss   | Efficiency (dB) | Efficiency (%) |
|                 | X               |                | X-LOSS=Y     | Y               |                |
| 868             | -2.18           | 60.58          | 0.2m*1.8dB/m | -2.54           | 55.76          |
| 870             | -2.06           | 62.27          |              | -2.42           | 57.32          |
| 902             | -1.45           | 71.66          |              | -1.81           | 65.96          |
| 904             | -1.44           | 71.70          |              | -1.80           | 66.00          |
| 906             | -1.44           | 71.86          |              | -1.80           | 66.14          |
| 908             | -1.45           | 71.62          |              | -1.81           | 65.92          |
| 910             | -1.47           | 71.31          |              | -1.83           | 65.64          |
| 912             | -1.51           | 70.63          |              | -1.87           | 65.01          |
| 914             | -1.55           | 69.94          |              | -1.91           | 64.37          |
| 916             | -1.61           | 69.04          |              | -1.97           | 63.55          |
| 918             | -1.68           | 67.94          |              | -2.04           | 62.54          |
| 920             | -1.76           | 66.61          |              | -2.12           | 61.31          |
| 922             | -1.87           | 64.99          |              | -2.23           | 59.82          |
| 924             | -1.96           | 63.66          |              | -2.32           | 58.60          |
| 926             | -2.06           | 62.18          |              | -2.42           | 57.23          |
| 928             | -2.18           | 60.59          |              | -2.54           | 55.77          |
| 868             | -2.18           | 60.58          |              | -2.54           | 55.76          |

|                      |                                   |                                                                         |                       |                       |
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| <b>AS-1052620001</b> |                                   | Liu Hai 2020/04/18                                                      | Cheng Kang 2020/04/18 | Andy Zhang 2020/04/18 |

## 7.0 RF PERFORMANCE AS A FUNCTION OF IMPLEMENTATION

### 7.1 ANTENNA RF PERFORMANCE AS A FUNCTION OF DIFFERENT LOCATIONS WITH PARALLEL PLANE GROUND

Four locations with parallel plane ground have been evaluated and these locations are shown in figure 7.1. The plane ground size is 90mm\*90mm and we move the plane ground to four locations for each test. The antenna performance is better with larger distance between antenna and parallel plane ground at high band. The minimum distance between antenna and plane ground is recommended to be 20mm to achieve acceptable RF performance.



**FIGURE 7.1 FOUR LOCATIONS WITH PARALLEL PLANE GROUND**

Ground Size: 90mm\*90mm;

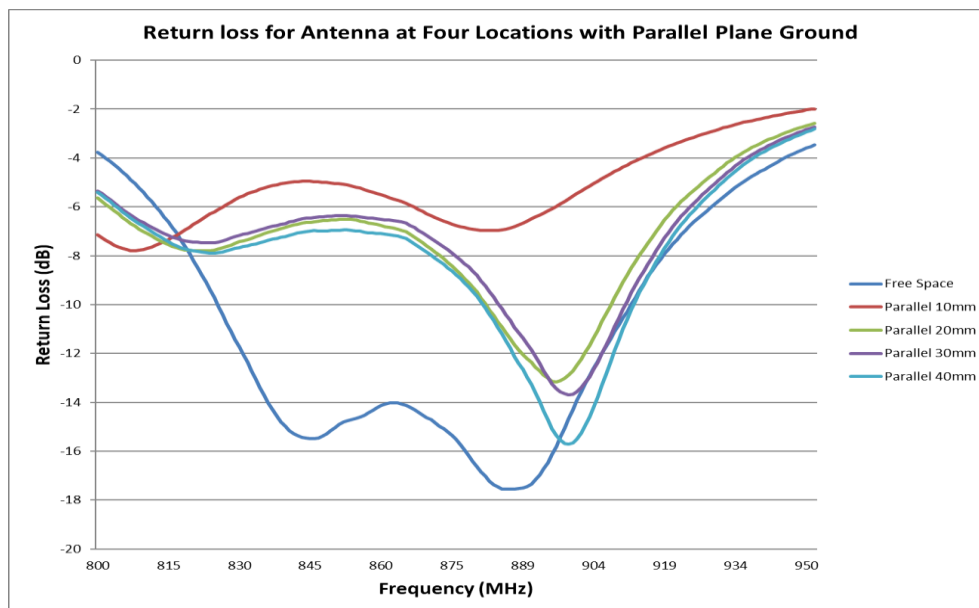
Location 1: Distance between antenna and plane ground is about 10mm;

Location 2: Distance between antenna and plane ground is about 20mm;

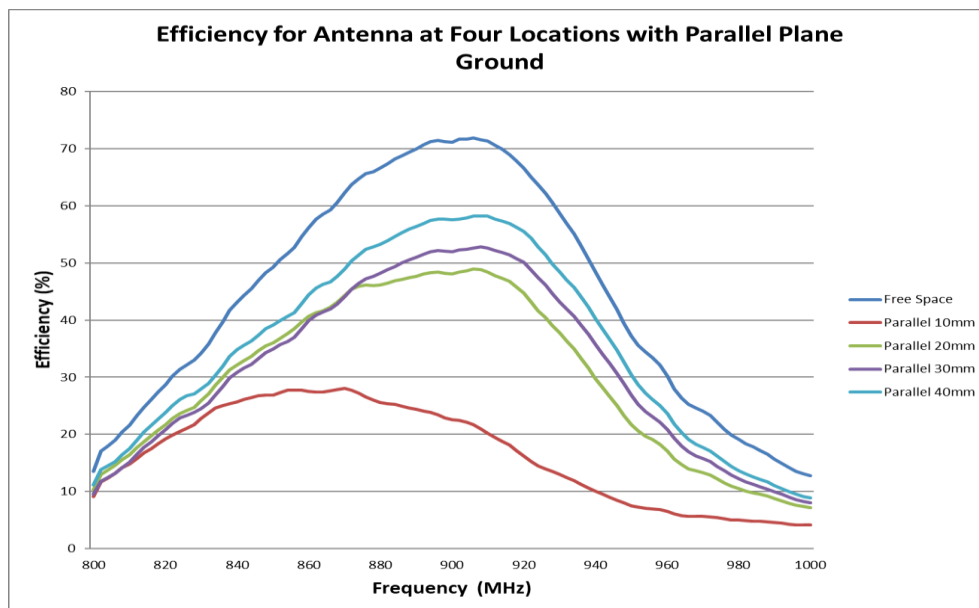
Location 3: Distance between antenna and plane ground is about 30mm;

Location 4: Distance between antenna and plane ground is about 40mm.

|                      |                                   |                                                                         |                       |
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**FIGURE 7.1.1 RETURN LOSS OF ANTENNA AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND**

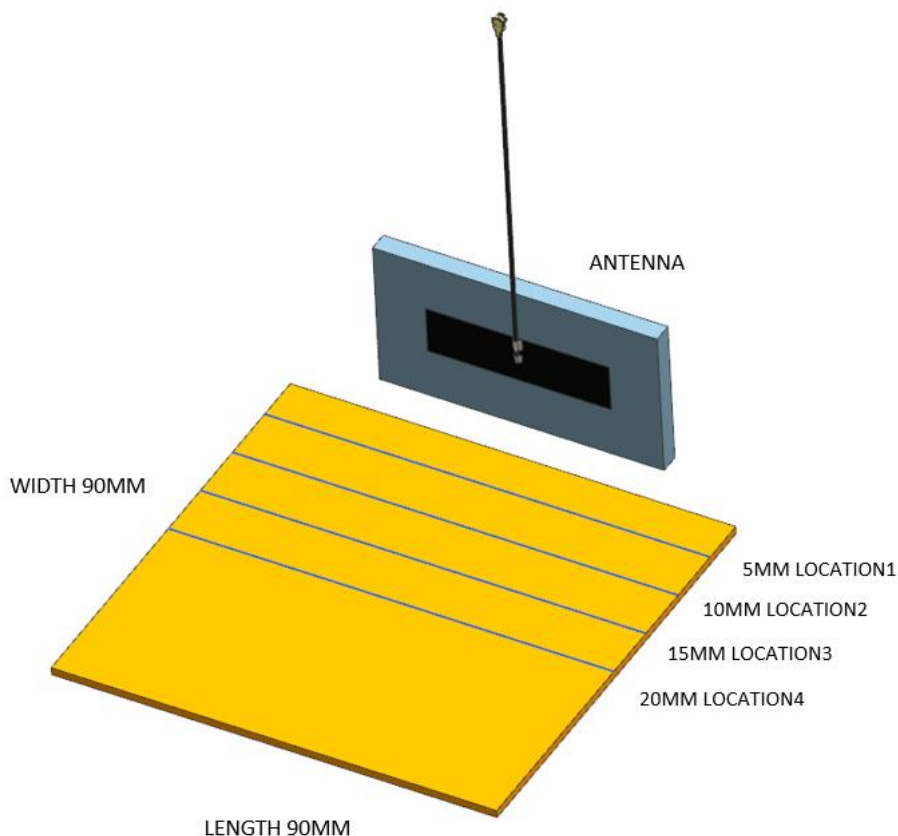


**FIGURE 7.1.2 EFFICIENCY OF ANTENNA AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND**

|                                          |                                                                         |                                                                                   |                                              |
|------------------------------------------|-------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------|
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## 7.2 ANTENNA RF PERFORMANCE AS A FUNCTION OF DIFFERENT LOCATIONS WITH VERTICAL PLANE GROUND

Four locations with vertical plane ground have been evaluated and these locations are shown in figure 7.2. The plane ground size is 90mm\*90mm and we move the plane ground to four locations for each test. The distance between antenna and vertical plane ground affect the antenna performance slightly. We still suggest the minimum distance between antenna and plane ground is recommended to be 10mm.



**FIGURE 7.2 FOUR LOCATIONS WITH VERTICAL PLANE GROUND**

Ground Size: 90mm\*90mm;

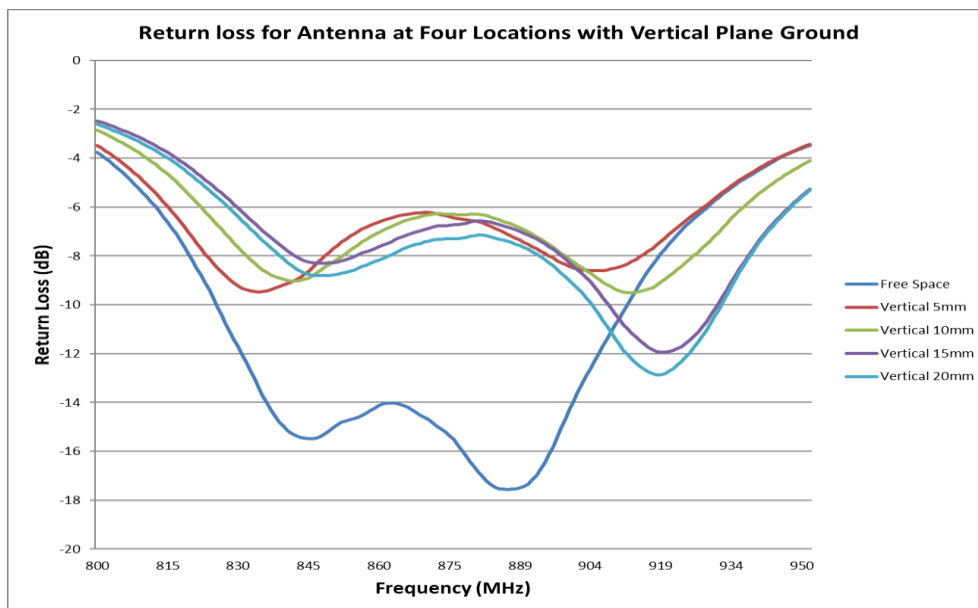
Location 1: Distance between antenna and plane ground is about 5mm;

Location 2: Distance between antenna and plane ground is about 10mm;

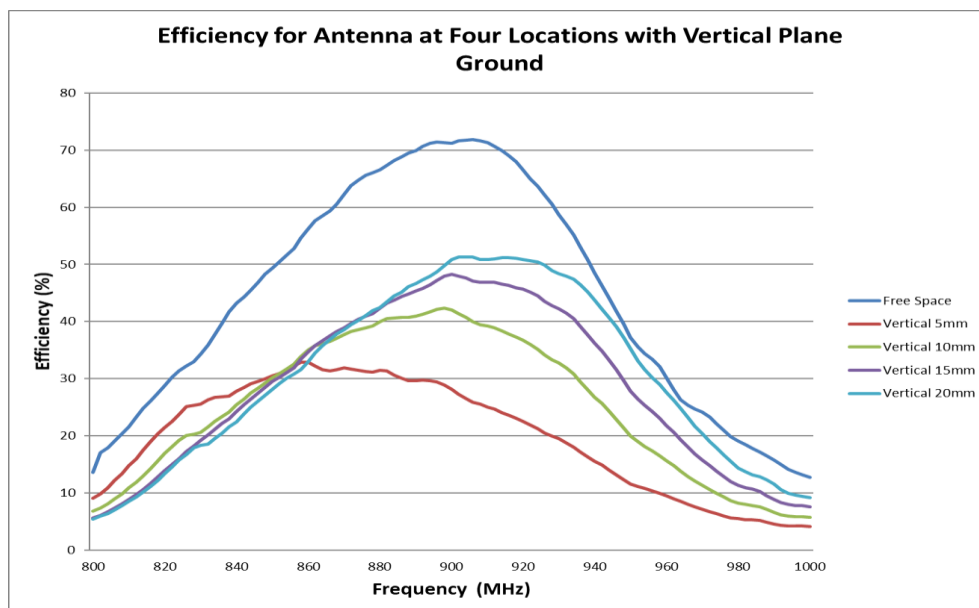
Location 3: Distance between antenna and plane ground is about 15mm;

Location 4: Distance between antenna and plane ground is about 20mm.

|                      |                                   |                                                                         |                       |
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| <b>AS-1052620001</b> | Liu Hai 2020/04/18                | Cheng Kang 2020/04/18                                                   | Andy Zhang 2020/04/18 |



**FIGURE 7.2.1 RETURN LOSS OF ANTENNA AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND**

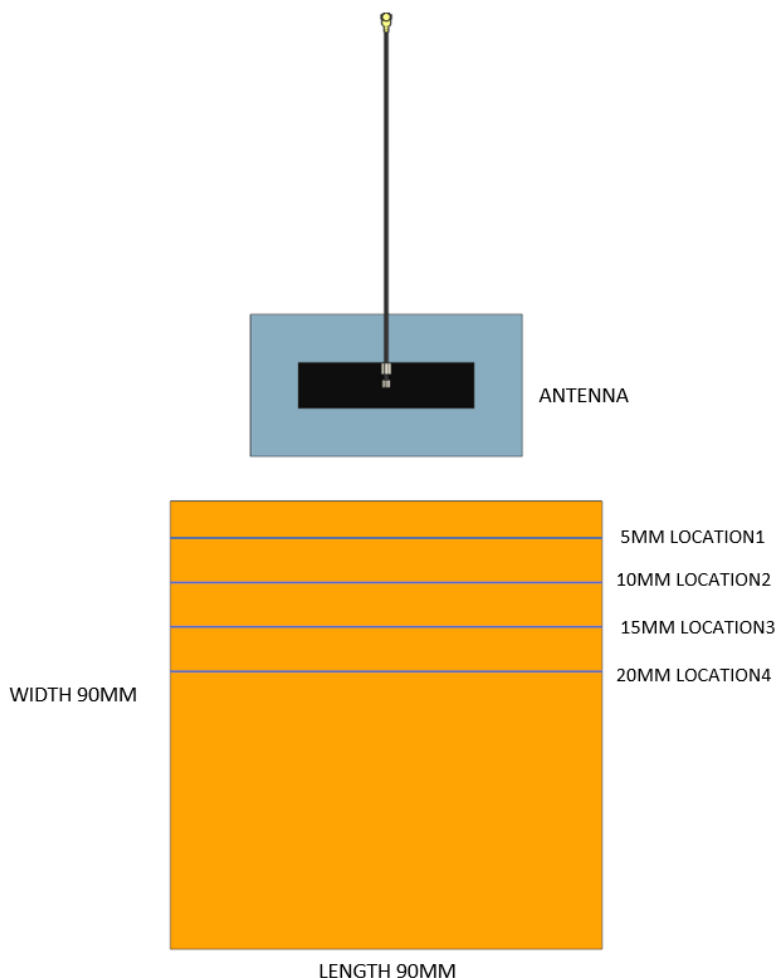


**FIGURE 7.2.2 EFFICIENCY OF ANTENNA AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND**

|                      |                                   |                                                                         |                       |
|----------------------|-----------------------------------|-------------------------------------------------------------------------|-----------------------|
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| <b>AS-1052620001</b> | Liu Hai 2020/04/18                | Cheng Kang 2020/04/18                                                   | Andy Zhang 2020/04/18 |

## 7.3 ANTENNA RF PERFORMANCE AS A FUNCTION OF DIFFERENT DISTANCES WITH PARALLEL PLANE GROUND

Four locations with the parallel plane ground have been evaluated and these locations are shown in figure 7.3. The plane ground size is 90mm\*90mm and we move the plane ground to four locations for each test. The distance between the antenna and the parallel plane ground affect the antenna performance slightly. We still suggest the minimum distance between the antenna and the plane ground is recommended to be 15mm.



**FIGURE 7.3 FOUR LOCATIONS WITH PARALLEL PLANE GROUND**

Ground Size: 90mm\*90mm;

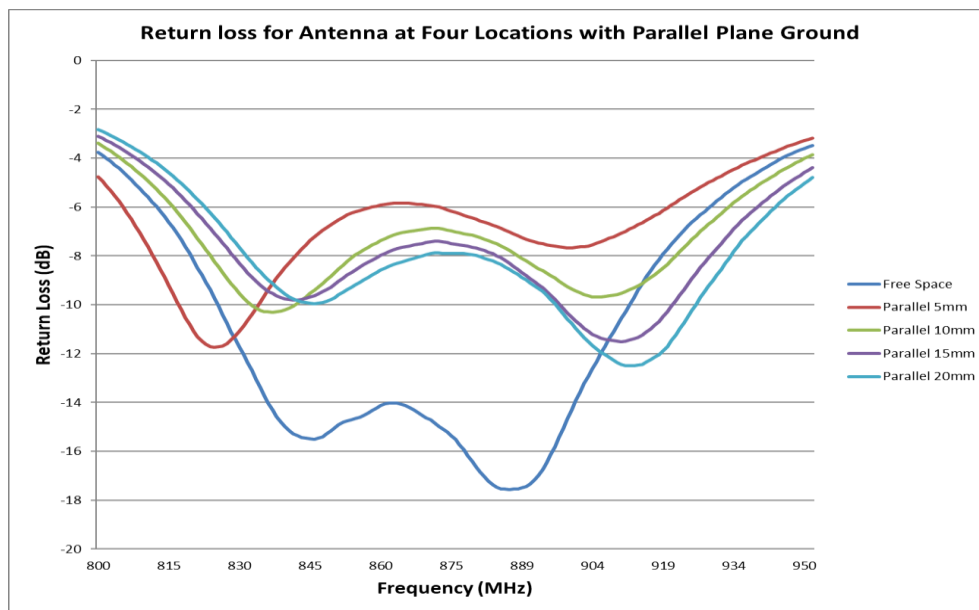
Location 1: Distance between antenna and plane ground is about 5mm;

Location 2: Distance between antenna and plane ground is about 10mm;

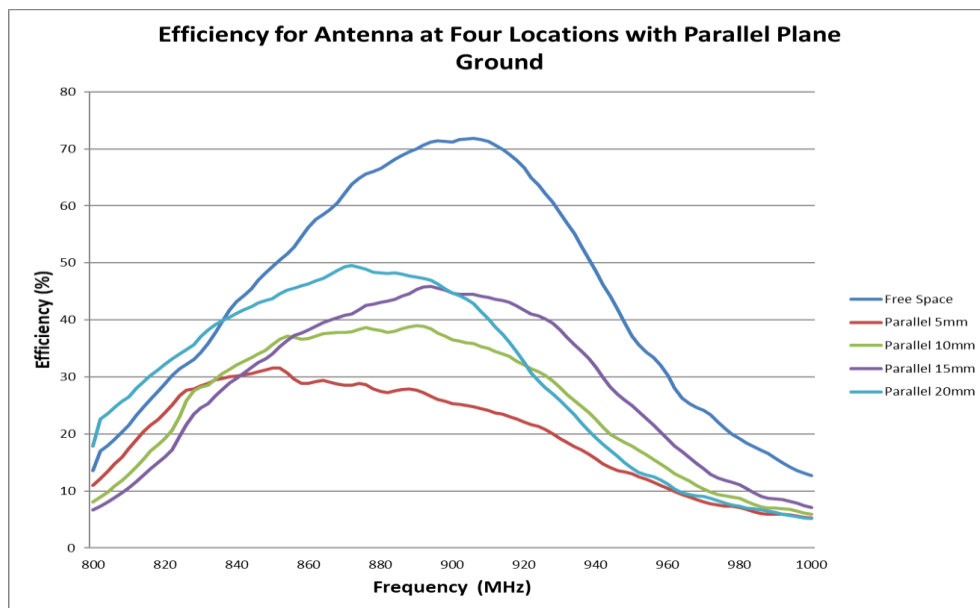
Location 3: Distance between antenna and plane ground is about 15mm;

Location 4: Distance between antenna and plane ground is about 20mm.

|                      |                                                 |                                                                         |                       |
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| DOCUMENT NUMBER:     | CREATED / REVISED BY:                           | CHECKED BY:                                                             | APPROVED BY:          |
| <b>AS-1052620001</b> | Liu Hai 2020/04/18                              | Cheng Kang 2020/04/18                                                   | Andy Zhang 2020/04/18 |



**FIGURE 7.3.1 RETURN LOSS OF ANTENNA AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND**



**FIGURE 7.3.2 EFFICIENCY OF ANTENNA AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND**

|                      |                                   |                                                                         |                       |
|----------------------|-----------------------------------|-------------------------------------------------------------------------|-----------------------|
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| DOCUMENT NUMBER:     | CREATED / REVISED BY:             | CHECKED BY:                                                             | APPROVED BY:          |
| <b>AS-1052620001</b> | Liu Hai 2020/04/18                | Cheng Kang 2020/04/18                                                   | Andy Zhang 2020/04/18 |