# APPLICATION SPECIFICATION

## 2.4/5GHZ BALANCE FLEX ANTENNA

### 1.0 SCOPE

This specification describes the antenna application and surroundings. The information in this document is for reference and benchmark purposes only. The user is responsible for verifying antenna RF performance based on the user's actual implementation.

All measurements are done of the antenna mounted on a PC/ABS material block of 1mm thickness with VNA Agilent 5071C and OTA chamber. All measurements are done with the part no. 1461530100 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 34.9mm*9mm (Figure 1).
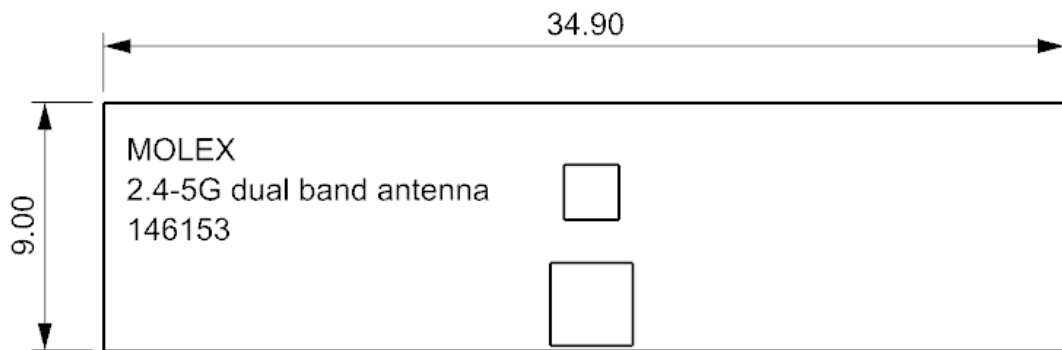


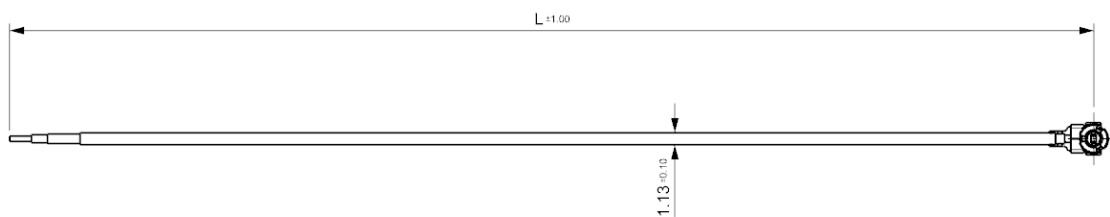**FIGURE 1. DIMENSION OF THE 2.4/5GHZ BALANCE FLEX ANTENNA**



**FIGURE 2. CABLE LINE VIEW OF WIFI 2.4/5GHZ BALANCE FLEX ANTENNA**

| REVISION: | ECR/ECN INFORMATION: | TITLE: | SHEET No. |
|---|---|---|---|
| **D** | EC No: **ABU2016-0043** <br> DATE: **2016/02/03** | **2.4/5GHz Balance Flex Antenna Application Specification** | **1** of **10** |

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|---|---|---|---|
| **AS-146153-100** | **Stephen Hu 2016/02/03** | **Ryan Liu 2016/02/03** | **Welson Tan 2016/02/03** |

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**B. RF PERFORMANCE OF ANTENNA LOADED WITH PC/ABS MATERIAL BLOCK OF 1MM THICKNESS IN FREE SPACE**
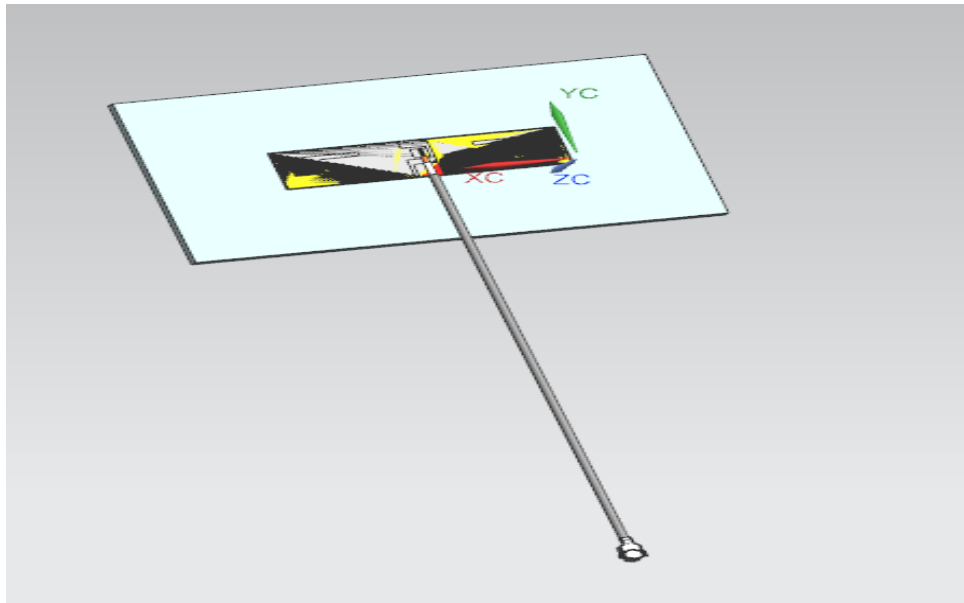


**FIGURE 3.1. ANTENNA LOADED WITH PC/ABS BLOCK OF 1MM THICKNESS**

| DESCRIPTION | TEST CONDITION | REQUIREMENTS | |
|---|---|---|---|
| Frequency Range | 2.4GHz~5.85GHz | 2.4GHz~2.5GHz | 5.15GHz~5.85GHz |
| Return Loss | Antenna loaded on PC/ABS housing (thickness 1mm) with 100mm 1.13mm diameter micro coaxial cable Measured by VNA5071C | < -10 dB | |
| Peak Gain | Measure antenna on recommended PC/ABS housing through OTA chamber | 3.0 dBi | 4.5 dBi |
| Total Efficiency | Measure antenna on recommended PC/ABS housing through OTA chamber | >75% | >70% |
| Polarization | Measure antenna on recommended PC/ABS housing through OTA chamber | Linear | |
| Input Impedance | Measure antenna on recommended PC/ABS housing through VNA E5071C | 50 Ohms | |

| REVISION: **D** | ECR/ECN INFORMATION: EC No: **ABU2016-0043** DATE: **2016/02/03** | TITLE: **2.4/5GHz Balance Flex Antenna Application Specification** | SHEET No. **2** of **10** |
|---|---|---|---|
| DOCUMENT NUMBER: **AS-146153-100** | CREATED / REVISED BY: Stephen Hu 2016/02/03 | CHECKED BY: Ryan Liu 2016/02/03 | APPROVED BY: Welson Tan 2016/02/03 |

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## 3.0 REFERENCE DOCUMENTS

- ENGINEERING DRAWING – E-146153-100

- PRODUCT SPECIFICATION – PS-146153-100

- PACKAGING INFORMATION – REFER TO THE MOLEX RELATED PACKAGING DRAWINGS.

## 4.0 RF PERFORMANCE AS A FUNCTION OF IMPLEMENTATION

### 4.1 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.
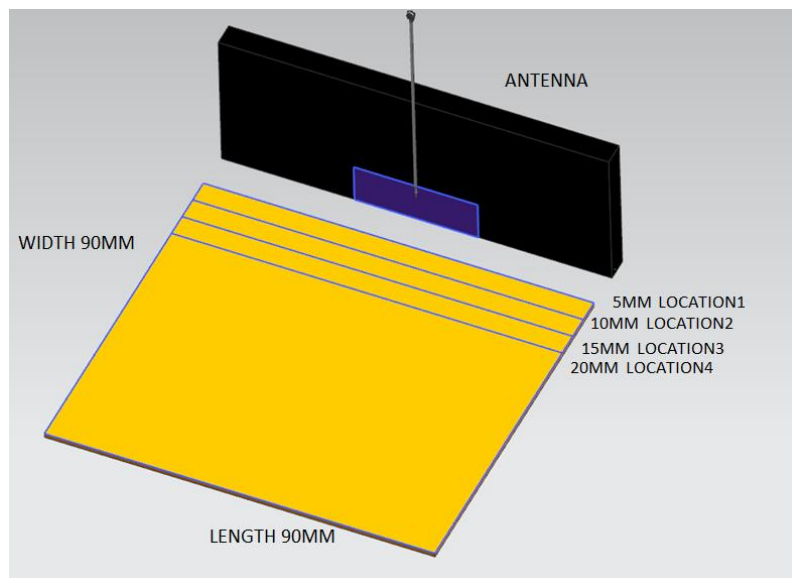


**FIGURE 4.1 FOUR LOCATIONS WITH VERTICAL GROUND**

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.

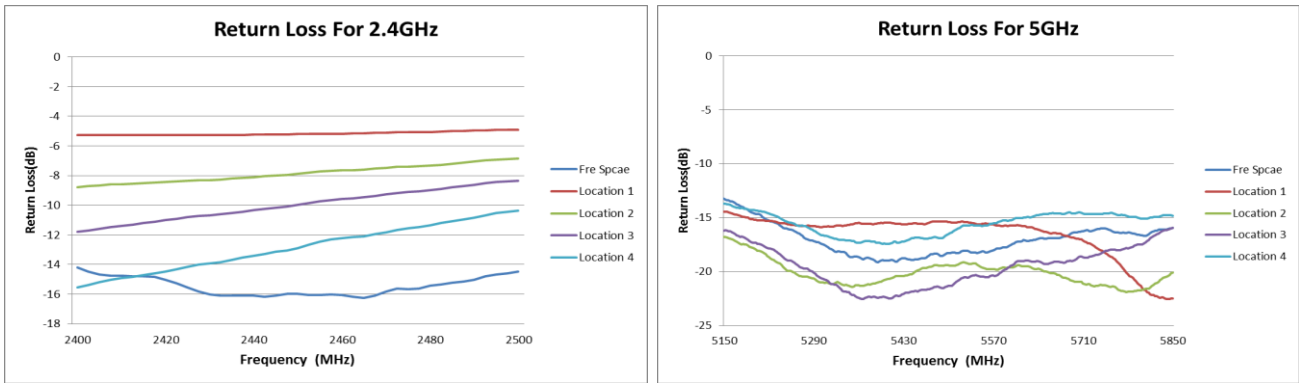| REVISION:<br>**D** | ECR/ECN INFORMATION:<br>EC No: **ABU2016-0043**<br>DATE: **2016/02/03** | TITLE:<br>**2.4/5GHz Balance Flex Antenna<br>Application Specification** | SHEET No.<br>**3** of **10** |
|---|---|---|---|
| DOCUMENT NUMBER:<br>**AS-146153-100** | CREATED / REVISED BY:<br>**Stephen Hu 2016/02/03** | CHECKED BY:<br>**Ryan Liu 2016/02/03** | APPROVED BY:<br>**Welson Tan 2016/02/03** |

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



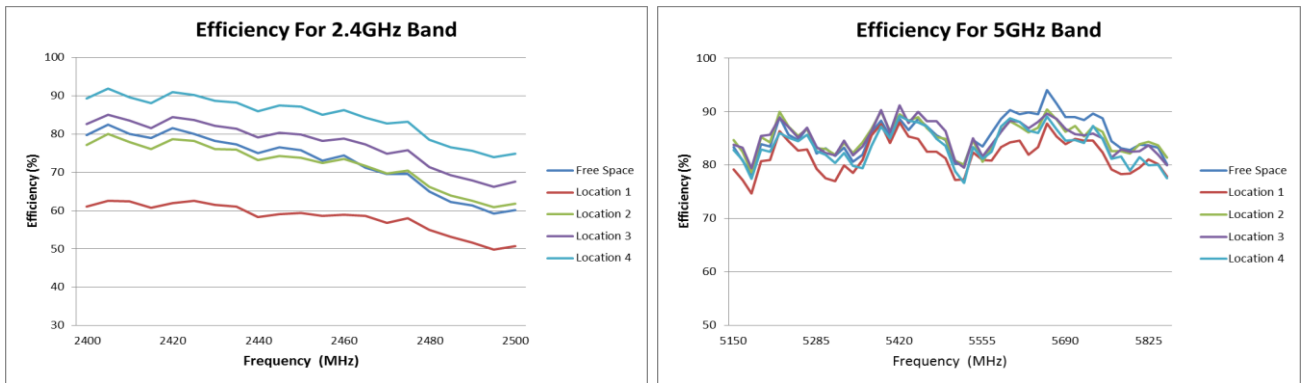**FIGURE 4.1.2 EFFICIATION OF ANTENNA AT 2.4/5GHZ BAND AT FOUR LOCATIONS WITH VERTICAL GROUND**

| REVISION: | ECR/ECN INFORMATION: | TITLE: | | SHEET No. |
|---|---|---|---|---|
| **D** | EC No: **ABU2016-0043**<br>DATE: **2016/02/03** | **2.4/5GHz Balance Flex Antenna**<br>**Application Specification** | | **4** of **10** |
| DOCUMENT NUMBER:<br>**AS-146153-100** | CREATED / REVISED BY:<br>**Stephen Hu 2016/02/03** | CHECKED BY:<br>**Ryan Liu 2016/02/03** | APPROVED BY:<br>**Welson Tan 2016/02/03** | |

## 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 ground is recommended to be 20mm from the antenna to meet the total efficiency specification.
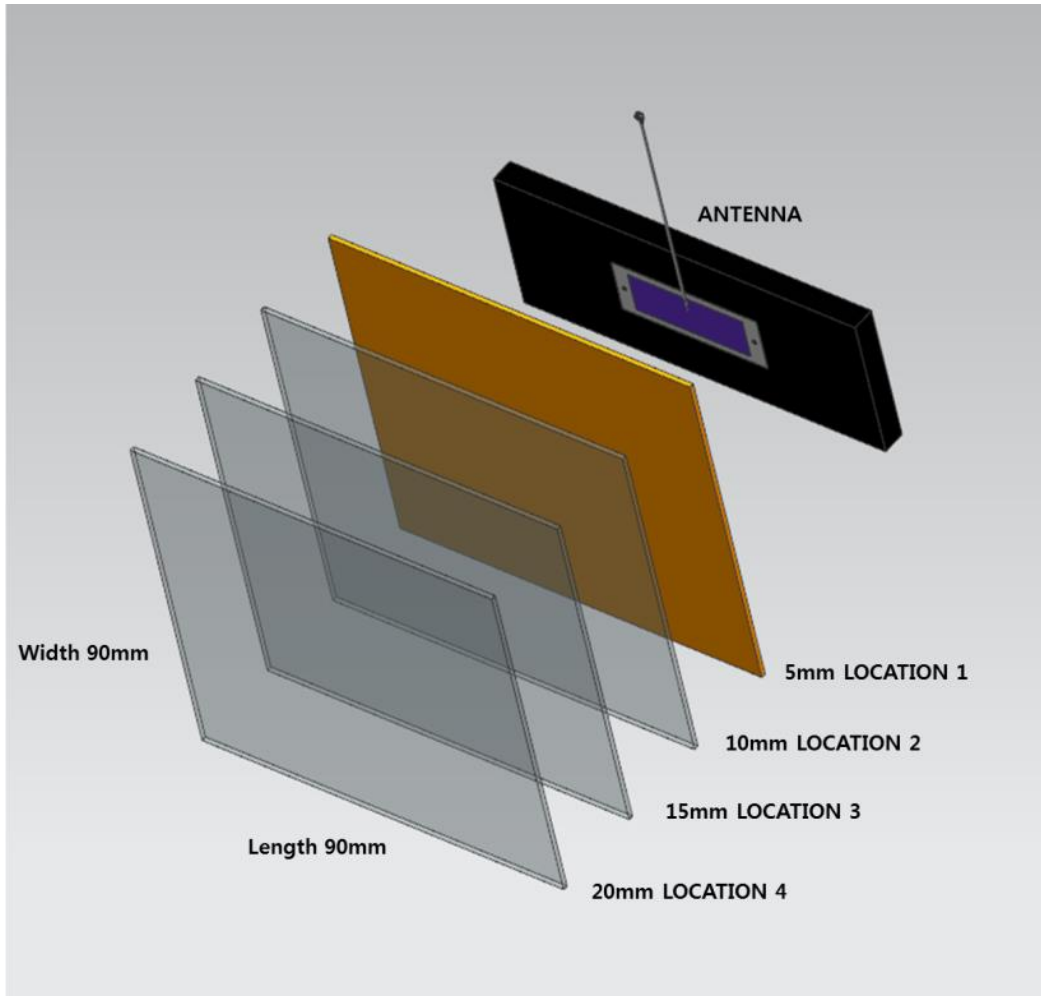


**FIGURE 4.2 FOUR LOCATIONS WITH PARALLEL GROUND**

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.

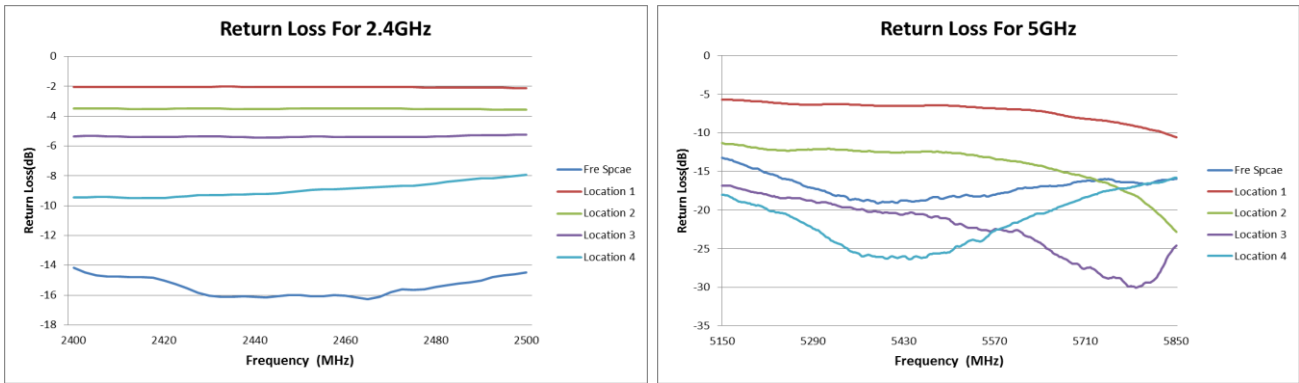| REVISION: | ECR/ECN INFORMATION: | TITLE: | | SHEET No. |
|---|---|---|---|---|
| **D** | EC No: **ABU2016-0043** <br> DATE: **2016/02/03** | **2.4/5GHz Balance Flex Antenna Application Specification** | | **5** of **10** |
| DOCUMENT NUMBER: <br> **AS-146153-100** | CREATED / REVISED BY: <br> **Stephen Hu 2016/02/03** | CHECKED BY: <br> **Ryan Liu 2016/02/03** | APPROVED BY: <br> **Welson Tan 2016/02/03** | |

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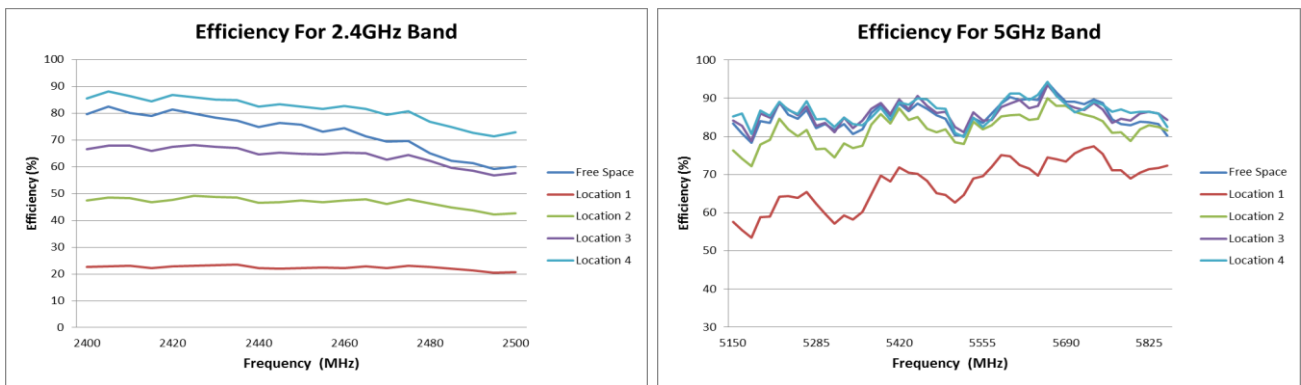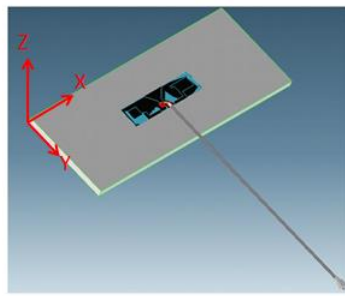**FIGURE 4.2.1 RETURN LOSS OF ANTENNA AT 2.4/5GHZ BAND AT FOUR LOCATIONS WITH PARALLEL GROUND**



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

| REVISION: | ECR/ECN INFORMATION: | TITLE: | | SHEET No. |
|---|---|---|---|---|
| **D** | EC No: **ABU2016-0043** <br> DATE: **2016/02/03** | **2.4/5GHz Balance Flex Antenna** <br> **Application Specification** | | **6** of **10** |
| DOCUMENT NUMBER: <br> **AS-146153-100** | CREATED / REVISED BY: <br> **Stephen Hu 2016/02/03** | CHECKED BY: <br> **Ryan Liu 2016/02/03** | APPROVED BY: <br> **Welson Tan 2016/02/03** | |

# APPLICATION SPECIFICATION

## 5.0 RADIATION PATTERN

**XY-2450MHz**
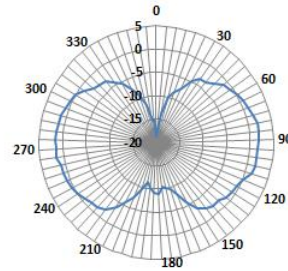
**XZ-2450MHz**

**YZ-2450MHz**

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

**XY-5450MHz**
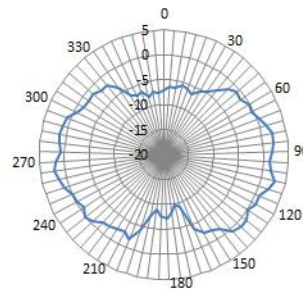
**XZ-5450MHZ**
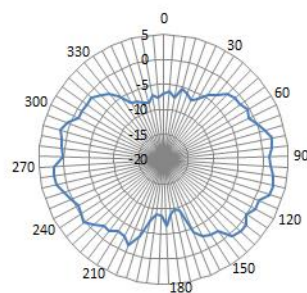
**YZ-5450MHz**
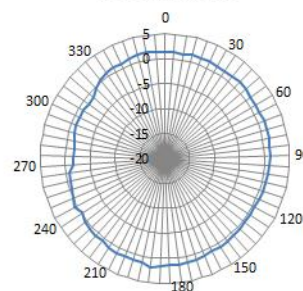
**FIGURE 5.2 RADIATION PATTERN OF ANTENNA AT 5.45GHZ IN FREE SPACE**

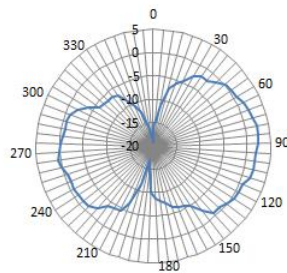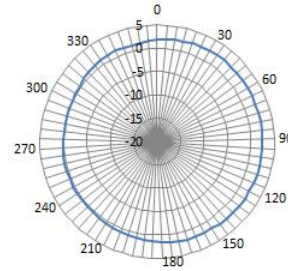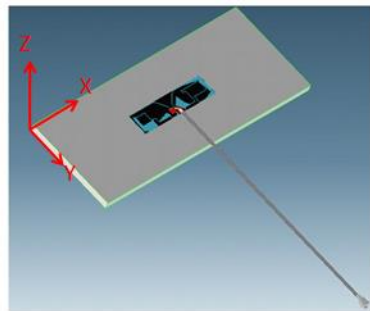| REVISION: | ECR/ECN INFORMATION: | TITLE: | | SHEET No. |
|---|---|---|---|---|
| **D** | EC No: **ABU2016-0043** <br> DATE: **2016/02/03** | **2.4/5GHz Balance Flex Antenna** <br> **Application Specification** | | **7** of **10** |
| DOCUMENT NUMBER: <br> **AS-146153-100** | CREATED / REVISED BY: <br> **Stephen Hu 2016/02/03** | CHECKED BY: <br> **Ryan Liu 2016/02/03** | APPROVED BY: <br> **Welson Tan 2016/02/03** | |

## 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 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.

| Frequency (MHz) | 100mm cable Efficiency (dB) | Efficiency (%) | cable loss | 300mm cable Efficiency (dB) | Efficiency (%) |
|---|---|---|---|---|---|
| | X | | X-LOSS=Y | Y | |
| 2400 | -1.06132 | 78.3192 | 0.2m*3.5dB/m | -1.76132 | 66.66 |
| 2410 | -1.00181 | 79.3997 | | -1.70181 | 67.58 |
| 2420 | -1.03427 | 78.8086 | | -1.73427 | 67.08 |
| 2430 | -0.929705 | 80.729 | | -1.629705 | 68.71 |
| 2440 | -1.06668 | 78.2226 | | -1.76668 | 66.58 |
| 2450 | -1.05499 | 78.4334 | | -1.75499 | 66.76 |
| 2460 | -1.03892 | 78.7241 | | -1.73892 | 67.01 |
| 2470 | -1.15769 | 76.6004 | | -1.85769 | 65.20 |
| 2480 | -1.12229 | 77.2274 | | -1.82229 | 65.73 |
| 2490 | -1.24719 | 75.0379 | | -1.94719 | 63.87 |
| 2500 | -1.20995 | 75.6841 | | -1.90995 | 64.42 |

REVISION: **D** | ECR/ECN INFORMATION: EC No: **ABU2016-0043** DATE: **2016/02/03** | TITLE: **2.4/5GHz Balance Flex Antenna Application Specification** | SHEET No. **8** of **10**

DOCUMENT NUMBER: **AS-146153-100** | CREATED / REVISED BY: **Stephen Hu 2016/02/03** | CHECKED BY: **Ryan Liu 2016/02/03** | APPROVED BY: **Welson Tan 2016/02/03**

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| Frequency (MHz) | 100mm cable | | cable loss | 300mm cable | |
|---|---|---|---|---|---|
| | Efficiency (dB) | Efficiency (%) | | Efficiency (dB) | Efficiency (%) |
| | X | | X-LOSS=Y | Y | |
| 5150 | -0.770398 | 83.7453 | 0.2*5dB/m | -1.770398 | 66.52 |
| 5180 | -0.711782 | 84.8832 | | -1.711782 | 67.43 |
| 5210 | -0.952011 | 80.3154 | | -1.952011 | 63.80 |
| 5240 | -1.1463 | 76.8016 | | -2.1463 | 61.01 |
| 5270 | -1.14173 | 76.8824 | | -2.14173 | 61.07 |
| 5300 | -1.22177 | 75.4784 | | -2.22177 | 59.95 |
| 5330 | -1.08976 | 77.8079 | | -2.08976 | 61.81 |
| 5360 | -1.15375 | 76.67 | | -2.15375 | 60.90 |
| 5390 | -1.23326 | 75.2791 | | -2.23326 | 59.80 |
| 5420 | -0.984162 | 79.723 | | -1.984162 | 63.33 |
| 5450 | -0.929805 | 80.7271 | | -1.929805 | 64.12 |
| 5480 | -0.772094 | 83.7126 | | -1.772094 | 66.50 |
| 5510 | -0.813659 | 82.9152 | | -1.813659 | 65.86 |
| 5540 | -0.922461 | 80.8637 | | -1.922461 | 64.23 |
| 5570 | -0.713125 | 84.857 | | -1.713125 | 67.40 |
| 5600 | -0.584359 | 87.4106 | | -1.584359 | 69.43 |
| 5630 | -0.321743 | 92.8594 | | -1.321743 | 73.76 |
| 5660 | -0.644595 | 86.2066 | | -1.644595 | 68.48 |
| 5690 | -0.739671 | 84.3399 | | -1.739671 | 66.99 |
| 5720 | -0.818499 | 82.8228 | | -1.818499 | 65.79 |
| 5750 | -0.913087 | 81.0385 | | -1.913087 | 64.37 |
| 5780 | -1.2365 | 75.2229 | | -2.2365 | 59.75 |
| 5810 | -1.18849 | 76.059 | | -2.18849 | 60.42 |
| 5840 | -1.24776 | 75.0281 | | -2.24776 | 59.60 |
| 5850 | -1.13398 | 77.0197 | | -2.13398 | 61.18 |

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

| REVISION: **D** | ECR/ECN INFORMATION: EC No: **ABU2016-0043** DATE: **2016/02/03** | TITLE: **2.4/5GHz Balance Flex Antenna Application Specification** | SHEET No. **9** of **10** |
|---|---|---|---|
| DOCUMENT NUMBER: **AS-146153-100** | CREATED / REVISED BY: **Stephen Hu 2016/02/03** | CHECKED BY: **Ryan Liu 2016/02/03** | APPROVED BY: **Welson Tan 2016/02/03** |

**7.0 ASSEMBLY GUIDELINES**

During the assembly of the antenna in a device, the cable needs to be positioned away from the antenna flex. The antenna cable should not be close to the antenna flex. The cable has to be away from the pattern at least 5mm.
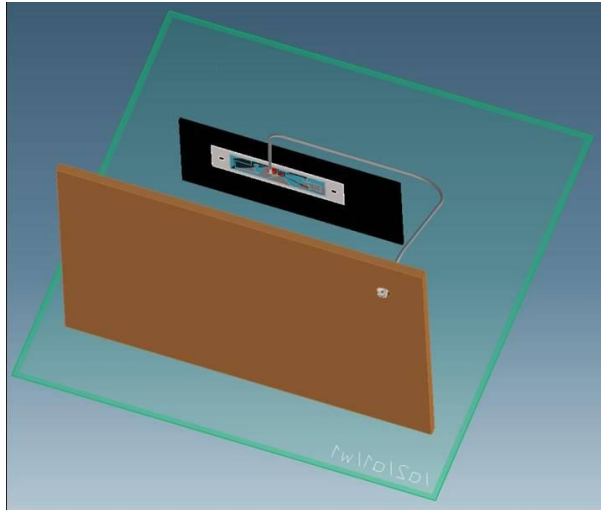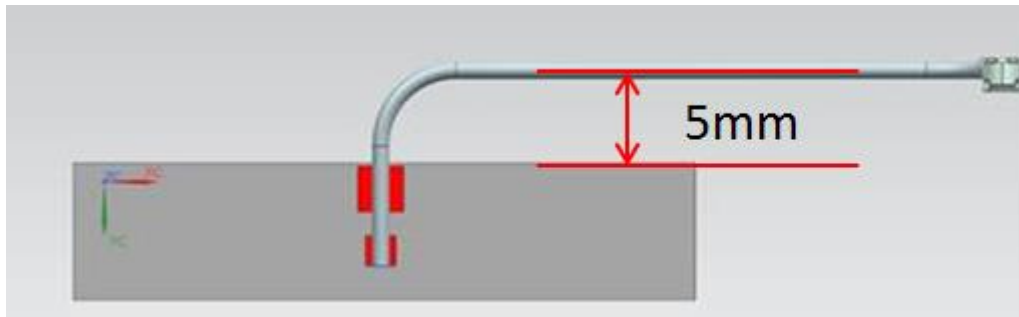
**FIGURE 7.1 ASSEMBLY GUIDELINE**

**FIGURE 7.2 CABLE BENDING**

| REVISION: | ECR/ECN INFORMATION: | TITLE: | | SHEET No. |
|---|---|---|---|---|
| **D** | EC No: **ABU2016-0043** <br> DATE: **2016/02/03** | **2.4/5GHz Balance Flex Antenna Application Specification** | | **10** of **10** |
| DOCUMENT NUMBER: | CREATED / REVISED BY: | CHECKED BY: | APPROVED BY: | |
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