

### **TITLE**

### **WIFI 6E FLEX CABLE BALANCE ANTENNA**

### **TABLE OF CONTENTS**

- 1.0 SCOPE
- 2.0 PRODUCT DESCRIPTION
- 3.0 APPLICABLE DOCUMENTS
- 4.0 ANTENNA PERFORMANCE
- **5.0 ASSEMBLY GUIDELINE**
- 6.0 RF PERFORMANCE AS A FUNCTION OF IMPLEMENTATION
- 7.0 THE ANTENNA PERFORMANCE VARIATION WITH CABLE LENGTH
- **8.0 OTHER MOLEX ANTENNA PRODUCTS**
- 9.0 CHANGE HISTORY

| J1               | ECR/ECN INFORMATION: EC No: 729862  DATE: 2022/11/25 | WIFI 6E FLEX          | CABLE BALANCE A |         | 1 of 31 |
|------------------|--|-----------------------|-----------------|---------|---------|
| DOCUMENT NUMBER: |  | CREATED / REVISED BY: | CHECKED BY:     | APPRO\  | /ED BY: |
| AS-1461530100    |  | Liu Hai               | Andy Zhang      | Chris Z | Zhong   |



### WIFI 6E FLEX CABLE BALANCE 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: WIFI 6E flex cable balance antenna

Series Number: 146153

REVISION: | ECR/ECN INFORMATION: | TITLE:

#### 2.2 DESCRIPTION

Series 146153 is a balanced, dipole-type, high efficiency antenna for 2.4/5/6 GHz applications, including WiFi 6E, Bluetooth, Zigbee and others. This antenna is made from poly flexible material with small size 35\*9\*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-1461530100 for full information.



ANTENNA 3D VIEW

| J1               | EC No: <b>729862</b> DATE: <b>2022/11/25</b> | WIFI 6E FLEX<br>APPLIC     |             | 2 of 31       |        |
|------------------|--|----------------------------|-------------|---------------|--------|
| DOCUMENT NUMBER: |  | CREATED / REVISED BY:      | CHECKED BY: | <u>APPROV</u> | ED BY: |
| AS-1461530100    |  | Liu Hai Andy Zhang Chris 2 |             | <b>Z</b> hong |        |

SHEET No.



#### 3.0 APPLICABLE DOCUMENTS

| DOCUMENT                   | NUMBER        | DESCRIPTION                         |
|----------------------------|---------------|-------------------------------------|
| Sale Drawing (SD)          | SD-1461530050 | Machanical Dimension of the product |
| Sale Drawing (SD)          | SD-1461531050 | Mechanical Dimension of the product |
| Product Specification (PS) | PS-1461530100 | Product Specification               |
| Packing Drawing (PK)       | PK-1461530100 | 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 1.5mm thickness with VNA Agilent E5071C and Over-The-Air (OTA) chamber. All measurements in this document are done with the part no.1461530100 with a cable length of 100mm.



FIGURE4.1.1 ANTENNA LOADED WITH PC/ABS BLOCK OF 1.5 MM THICKNESS

| J1               | EC No: 729862  DATE: 2022/11/25 | WIFI 6E FLEX CABLE BALANCE ANTENNA APPLICATION SPECIFICATION |             |         | 3 of 31 |
|------------------|---------------------------------|--|-------------|---------|---------|
| DOCUMENT NUMBER: |                                 | CREATED / REVISED BY:  | CHECKED BY: | APPRO\  | /ED BY: |
| AS-1461530100    |                                 | Liu Hai  | Andy Zhang  | Chris Z | Zhong   |



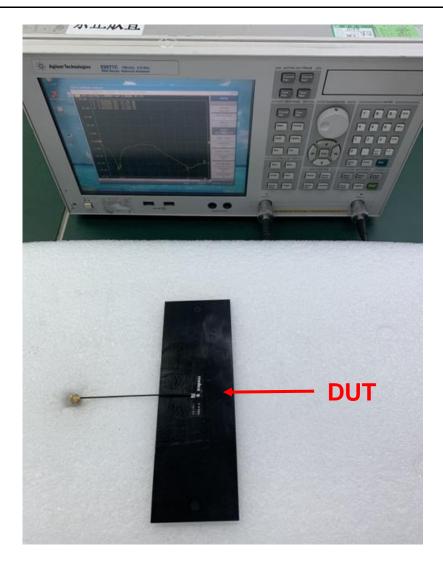


FIGURE4.1.2 ANTENNA LOADED WITH PC/ABS BLOCK OF 1.5 MM THICKNESS WITH VNA

| REVISION: | ECR/ECN INFORMATION: EC No: 729862  DATE: 2022/11/25 | WIFI 6E FLEX          | WIFI 6E FLEX CABLE BALANCE ANTENNA<br>APPLICATION SPECIFICATION |        | SHEET No. 4 of 31 |
|-----------|--|-----------------------|---|--------|-------------------|
| DOCUMEN   | T NUMBER:  | CREATED / REVISED BY: | CHECKED BY:   | APPROV | <u>'</u> ED BY:   |

Liu Hai

AS-1461530100

TEMPLATE FILENAME: APPLICATION\_SPEC[SIZE\_A](V.1).DOC

**Andy Zhang** 

**Chris Zhong** 



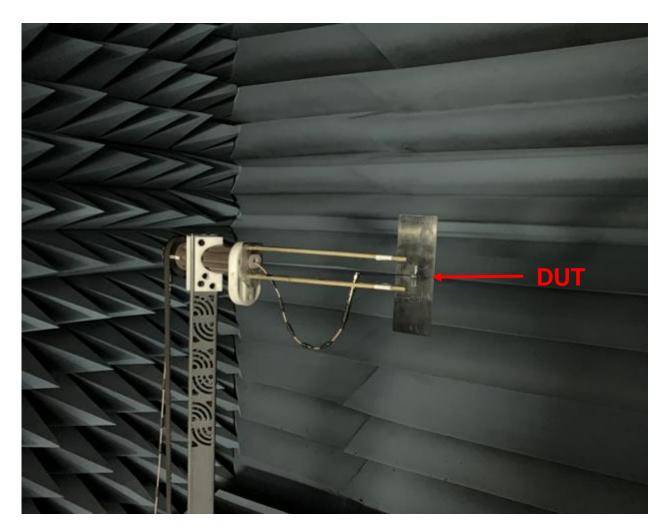


FIGURE4.1.3 ANTENNA LOADED WITH PC/ABS BLOCK OF 1.5 MM THICKNESS WITH OTA CHAMBER

| REVISION:             | ECR/ECN INFORMATION: | TITLE:                |                                    |          | SHEET No.             |  |
|-----------------------|----------------------|-----------------------|------------------------------------|----------|-----------------------|--|
| 14                    | EC No: <b>729862</b> |                       | WIFI 6E FLEX CABLE BALANCE ANTENNA |          |                       |  |
| DATE: 2022/11/25      |                      | APPLIC                | ATION SPECIFICAT                   | ION      | <b>5</b> of <b>31</b> |  |
| DOCUMENT NUMBER: CREA |                      | CREATED / REVISED BV: | CHECKED BV:                        | \ DDP(\) | /ED BV:               |  |

AS-1461530100 | CREATED / REVISED BY: CHECKED BY: APPROVED BY

Liu Hai Andy Zhang Chris Zhong



#### **4.2 ANTENNA PERFORMANCE**

All measurements in this document are done with the part no.1461530100 with a cable length of 100mm

| DESCRIPTION EQUIPMENT       |             | REQUIREMENT |              |                    |  |
|-----------------------------|-------------|-------------|--------------|--------------------|--|
| Frequency Range             | VNA E5071C  | 2.4-2.5GHz  | 5.15-5.85GHz | 5.925-<br>7.125GHz |  |
| Return Loss                 | VNA E5071C  | <- 10dB     |              |                    |  |
| Peak Gain (Max)             | OTA Chamber | 3.0dBi      | 4.0dBi       | 5.5dBi             |  |
| Average Total<br>Efficiency | OTA Chamber | >75%        | >75%         | >70%               |  |
| 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.

| REVISION:        | ECR/ECN INFORMATION:    | l ———                 |  |               | SHEET No.     |  |  |  |
|------------------|-------------------------|-----------------------|--|---------------|---------------|--|--|--|
| J1               | EC No: <b>729862</b>    |                       | WIFI 6E FLEX CABLE BALANCE ANTENNA APPLICATION SPECIFICATION |               |               |  |  |  |
| JI               | DATE: <b>2022/11/25</b> | Al I LIO              | AFFLICATION SPECIFICATION                                    |               |               |  |  |  |
| DOCUMENT NUMBER: |                         | CREATED / REVISED BY: | CHECKED BY:  | <u>APPROV</u> | <u>ED BY:</u> |  |  |  |
| AS-1461530100    |                         | Liu Hai               | Andy Zhang   | Chris Z       | Zhong         |  |  |  |



### 4.3 RETURN LOSS PLOT

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

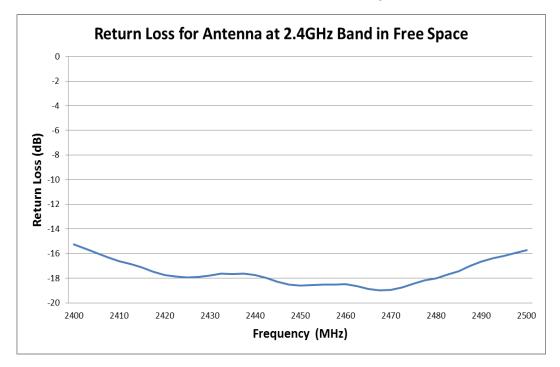


FIGURE 4.3.1 RETURN LOSS OF ANTENNA AT 2.4GHZ BAND IN FREE SPACE

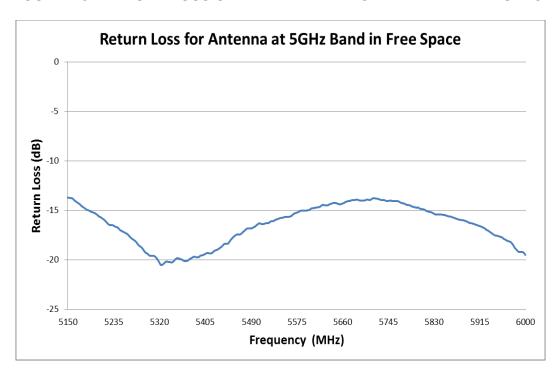


FIGURE 4.3.2 RETURN LOSS OF ANTENNA AT 5GHZ BAND IN FREE SPACE

| AS-1461530100    |                         | Liu Hai  | Andy Zhang                | Chris Z | Zhong                 |  |  |
|------------------|-------------------------|--|---------------------------|---------|-----------------------|--|--|
| DOCUMENT NUMBER: |                         | CREATED / REVISED BY:  | CHECKED BY:               | APPRO\  | /ED BY:               |  |  |
| JI               | DATE: <b>2022/11/25</b> | APPLIC   | APPLICATION SPECIFICATION |         |                       |  |  |
| J1               | EC No: <b>729862</b>    | WIFI 6E FLEX CABLE BALANCE ANTENNA APPLICATION SPECIFICATION |                           |         | <b>7</b> of <b>31</b> |  |  |
| <u>REVISION:</u> | ECR/ECN INFORMATION:    | I ———  |                           |         | SHEET No.             |  |  |



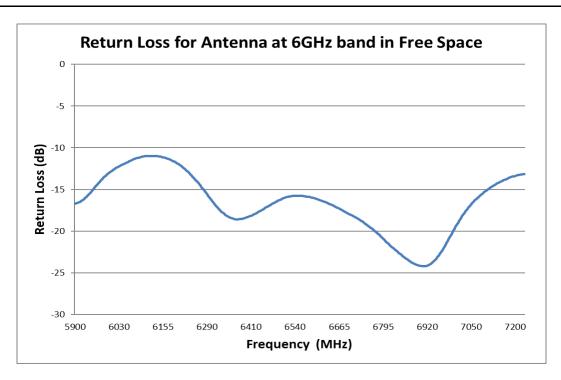


FIGURE 4.3.3 RETURN LOSS OF ANTENNA AT 6GHZ BAND IN FREE SPACE

#### **4.4 EFFICIENCY PLOT**

DEVISION: ECD/ECN INFORMATION: TITLE:

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

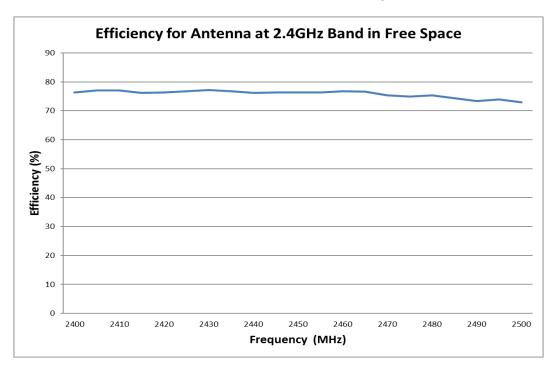
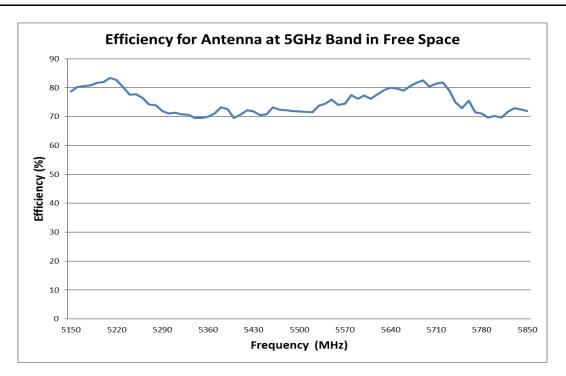


FIGURE 4.4.1 EFFICIENCY OF ANTENNA AT 2.4GHZ BAND IN FREE SPACE

| J1   EC No: 729862   DATE: 2022/11/25 | WIFI 6E FLEX<br>APPLIC | 8 of 31     |               |        |
|---------------------------------------|------------------------|-------------|---------------|--------|
| DOCUMENT NUMBER:                      | CREATED / REVISED BY:  | CHECKED BY: | <u>APPROV</u> | ED BY: |
| AS-1461530100                         | Liu Hai                | Andy Zhang  | Chris Z       | Zhong  |

CHEET No.





#### FIGURE 4.4.2 EFFICIENCY OF ANTENNA AT 5GHZ BAND IN FREE SPACE

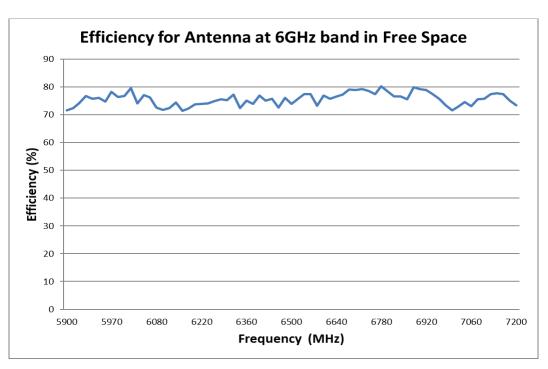


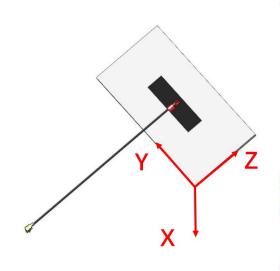
FIGURE 4.4.3 EFFICIENCY OF ANTENNA AT 6GHZ BAND IN FREE SPACE

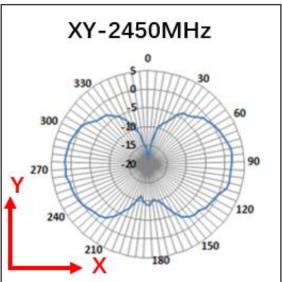
| J1               | ECR/ECN INFORMATION: EC No: 729862  DATE: 2022/11/25 | WIFI 6E FLEX APPLIC   |             | 9 of 31 |        |
|------------------|--|-----------------------|-------------|---------|--------|
| DOCUMENT NUMBER: |  | CREATED / REVISED BY: | CHECKED BY: | APPROV  | ED BY: |
| AS-1461530100    |  | Liu Hai               | Andy Zhang  | Chris Z | .hong  |

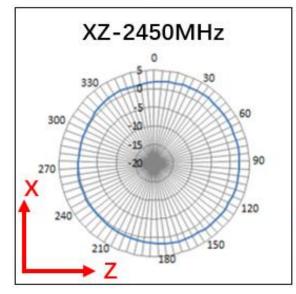


### 4.5 RADIATION PATTERN

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







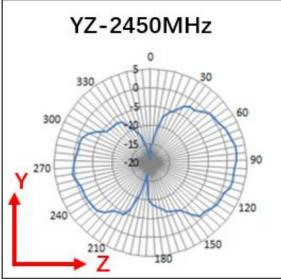


FIGURE 4.5.1 2D RADIATION PATTERN OF ANTENNA AT 2450MHZ IN FREE SPACE

REVISION:

**J1** 

ECR/ECN INFORMATION:

TITLE:

WIFI 6E FLEX CABLE BALANCE ANTENNA APPLICATION SPECIFICATION

SHEET No.

**10** of **31** 

**DOCUMENT NUMBER:** 

AS-1461530100

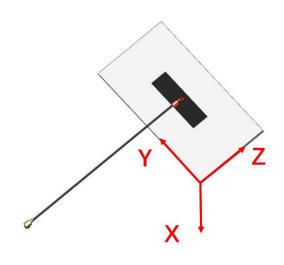
EC No: **729862** 

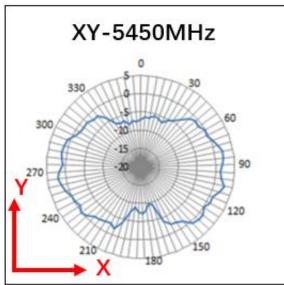
DATE: 2022/11/25

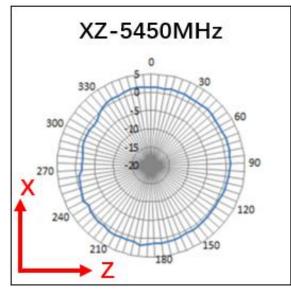
CREATED / REVISED BY: Liu Hai CHECKED BY:
Andy Zhang

APPROVED BY:
Chris Zhong









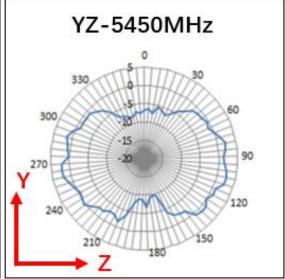


FIGURE 4.5.2 2D RADIATION PATTERN OF ANTENNA AT 5450MHZ IN FREE SPACE

| <b>REVISION:</b> |  |
|------------------|--|
|                  |  |

ECR/ECN INFORMATION:

TITLE:

SHEET No.

J1

EC No: **729862** 

DATE: 2022/11/25

WIFI 6E FLEX CABLE BALANCE ANTENNA APPLICATION SPECIFICATION

**11** of **31** 

**DOCUMENT NUMBER:** 

AS-1461530100

CREATED / REVISED BY: Liu Hai CHECKED BY:
Andy Zhang

APPROVED BY: Chris Zhong



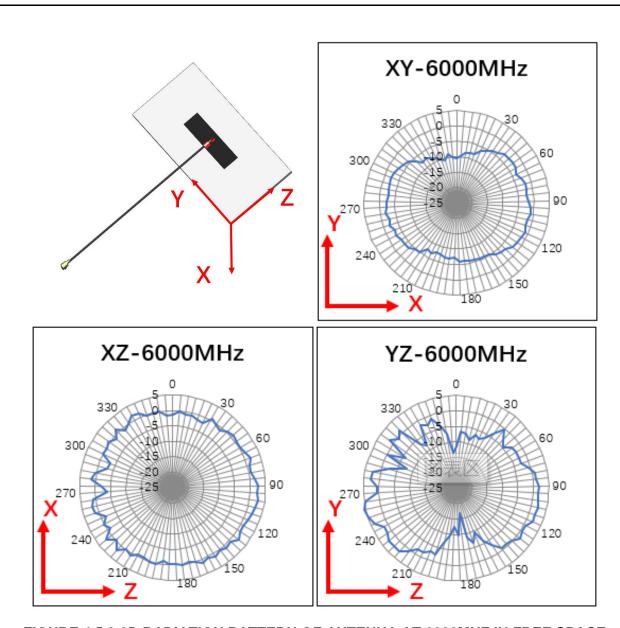


FIGURE 4.5.3 2D RADIATION PATTERN OF ANTENNA AT 6000MHZ IN FREE SPACE

| <b>REVISION:</b> | ECR/ECN INFORMATION:    | TITLE:                |                                   |         | SHEET No.              |
|------------------|-------------------------|-----------------------|-----------------------------------|---------|------------------------|
| J1               | EC No: <b>729862</b>    | =                     | CABLE BALANCE A ATION SPECIFICATI |         | <b>12</b> of <b>31</b> |
| JI               | DATE: <b>2022/11/25</b> | AFFLIC                | ATION SPECIFICATI                 | ION     | 12 01 31               |
| DOCUMENT NUMBER: |                         | CREATED / REVISED BY: | CHECKED BY:                       | APPRO\  | /ED BY:                |
| AS-1461530100    |                         | Liu Hai               | Andy Zhang                        | Chris 2 | Zhong                  |



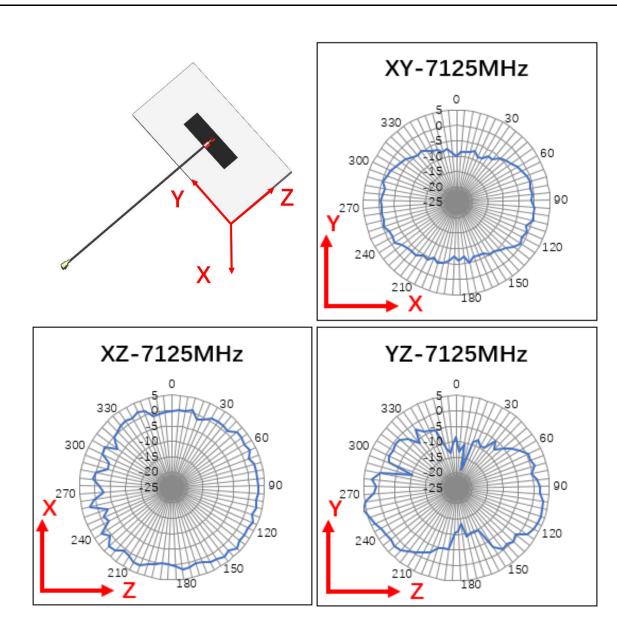


FIGURE 4.5.4 2D RADIATION PATTERN OF ANTENNA AT 7125MHZ IN FREE SPACE

| J1               | ECR/ECN INFORMATION: EC No: 729862  DATE: 2022/11/25 | WIFI 6E FLEX          | WIFI 6E FLEX CABLE BALANCE ANTENNA APPLICATION SPECIFICATION |               |        |  |
|------------------|--|-----------------------|--|---------------|--------|--|
| DOCUMENT NUMBER: |  | CREATED / REVISED BY: | CHECKED BY:  | <u>APPROV</u> | ED BY: |  |
| AS-1461530100    |  | Liu Hai               | Andy Zhang   | Chris Z       | 'hong  |  |



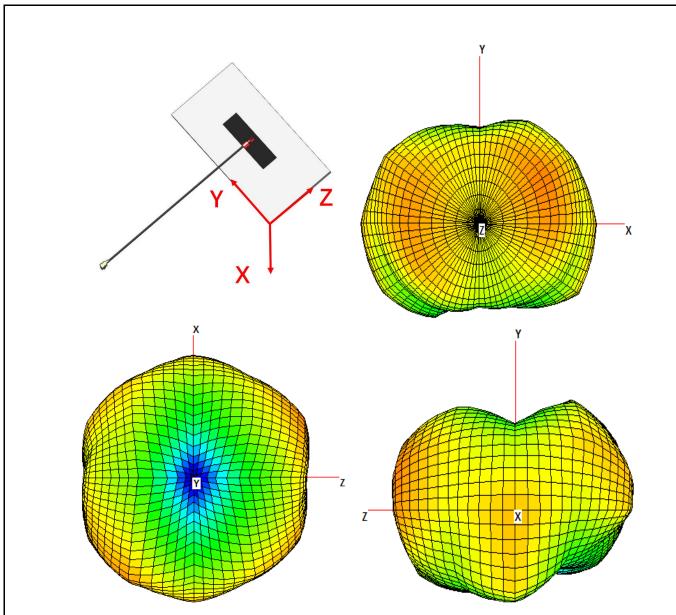


FIGURE 4.5.5 3D RADIATION PATTERN OF ANTENNA AT 2450MHZ BAND IN FREE SPACE

TITLE:

WIFI 6E FLEX CABLE BALANCE ANTENNA
APPLICATION SPECIFICATION

14 of 31

DOCUMENT NUMBER: CREATED / REVISED BY: CHECKED BY: APPROVED BY:

AS-1461530100 Liu Hai Andy Zhang Chris Zhong



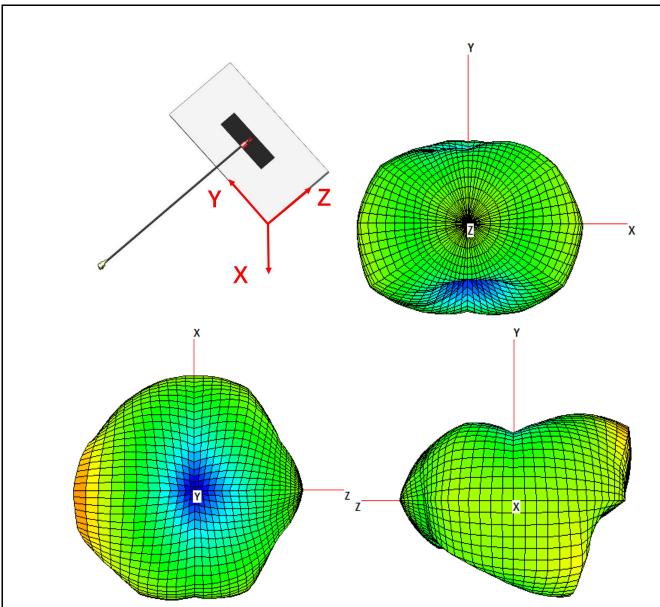


FIGURE 4.5.6 3D RADIATION PATTERN OF ANTENNA AT 5450MHZ BAND IN FREE SPACE

| SHEET No. | SHEE

AS-1461530100 Liu Hai Andy Zhang Chris Zhong



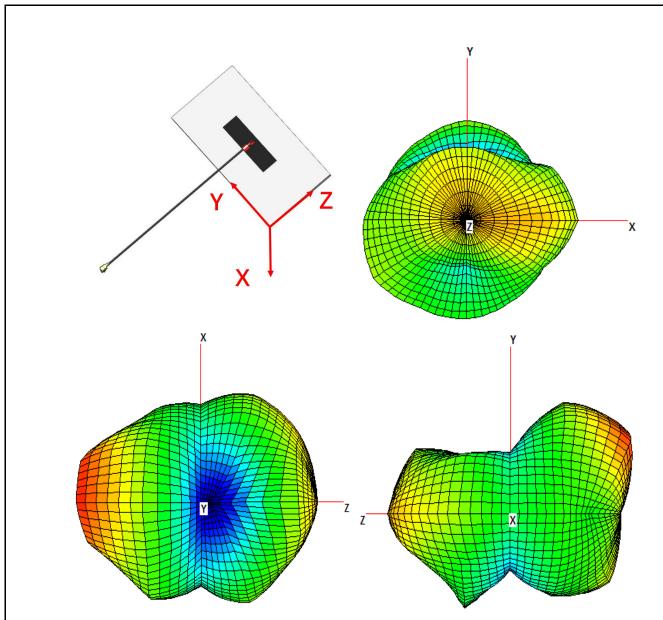


FIGURE 4.5.7 3D RADIATION PATTERN OF ANTENNA AT 6000MHZ BAND IN FREE SPACE

| REVISION:     | ECR/ECN INFORMATION:    | TITLE:                |                                   |         | SHEET No.              |
|---------------|-------------------------|-----------------------|-----------------------------------|---------|------------------------|
| J1            | EC No: <b>729862</b>    |                       | CABLE BALANCE A ATION SPECIFICATI |         | <b>16</b> of <b>31</b> |
| JI            | DATE: <b>2022/11/25</b> | AFFLIO                | ATION SPECIFICATI                 | ON      | 100131                 |
| DOCUMEN       | T NUMBER:               | CREATED / REVISED BY: | CHECKED BY:                       | APPRO\  | /ED BY:                |
| AS-1461530100 |                         | Liu Hai               | Andy Zhang                        | Chris Z | Zhong                  |



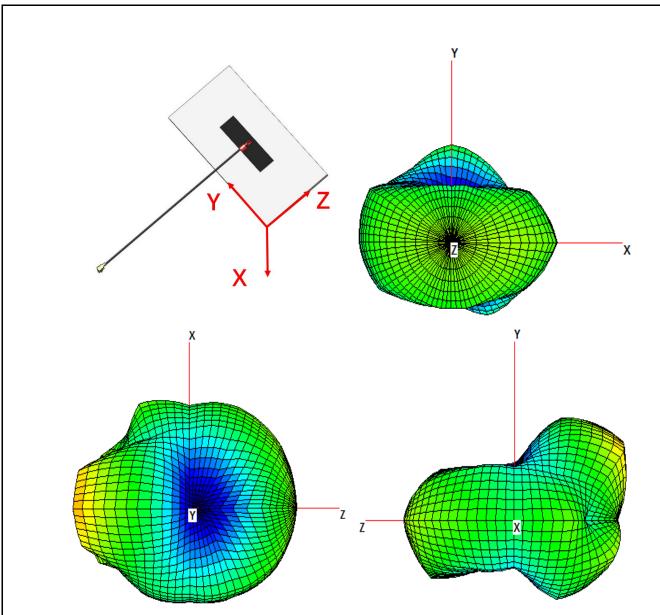


FIGURE 4.5.8 3D RADIATION PATTERN OF ANTENNA AT 7125MHZ BAND IN FREE SPACE

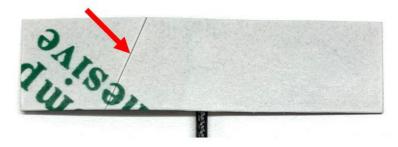
| REVISION:     | ECR/ECN INFORMATION:    | TITLE:                |                                   |         | SHEET No.              |
|---------------|-------------------------|-----------------------|-----------------------------------|---------|------------------------|
| J1            | EC No: <b>729862</b>    |                       | CABLE BALANCE A ATION SPECIFICATI |         | <b>17</b> of <b>31</b> |
| JI            | DATE: <b>2022/11/25</b> | AFFLIO                | ATION SPECIFICATI                 | ON      | 17 01 31               |
| DOCUMEN       | T NUMBER:               | CREATED / REVISED BY: | CHECKED BY:                       | APPRO\  | /ED BY:                |
| AS-1461530100 |                         | Liu Hai               | Andy Zhang                        | Chris Z | Zhong                  |



#### 5.0 ASSEMBLY GUIDELINE

The flex antenna comes with an adhesive 3m9077 for assemble onto the plastic wall of the system. The surface should be smooth with Ra<1.6um and need to clean the surface before sticking this product. The antenna cannot be placed on a metallic surface.

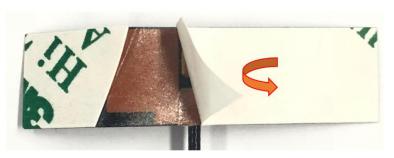
#### 5.1 HOW TO TEAR FLEX RELEASE PAPER



1. Find cut line on flex back side



2. Bend flex slight along cut line



3. Tear release paper

| REVISION: | ECR/ECN INFORMATION:    | TITLE:               |                                  |          | SHEET No.              |
|-----------|-------------------------|----------------------|----------------------------------|----------|------------------------|
| J1        | EC No: <b>729862</b>    |                      | CABLE BALANCE A ATION SPECIFICAT |          | <b>18</b> of <b>31</b> |
| • •       | DATE: <b>2022/11/25</b> |                      |                                  |          |                        |
| DOCUMEN   | T NILIMED.              | ODEATED / DEVICED DV | OUEOVED DV                       | 4 DDD () | /ED DV                 |

DOCUMENT NUMBER:

AS-1461530100

CREATED / REVISED BY:

Liu Hai

CHECKED BY:

APPROVED BY:

Chris Zhong



#### 5.2 CABLE BENDING

AS-1461530100

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 Flex edge at least 5mm as shown in figure 5.2.1. If the cable bends into the antenna flex, the antenna performance will be degraded.

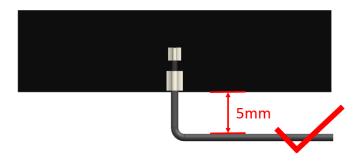


FIGURE 5.2.1 RECOMMENDED CABLE BENDING RANGE

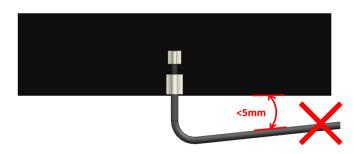


FIGURE 5.2.2 UNRECOMMENDED CABLE BENDING RANGE

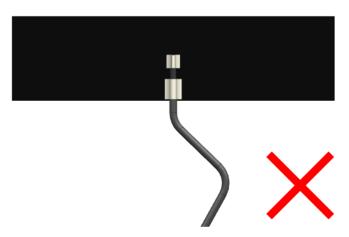


FIGURE 5.2.3 MULTIPLE BENDING OF CABLES IS NOT RECOMMENDED

 REVISION:
 ECR/ECN INFORMATION:
 TITLE:
 WIFI 6E FLEX CABLE BALANCE ANTENNA APPLICATION SPECIFICATION
 19 of 31

 DOCUMENT NUMBER:
 CREATED / REVISED BY:
 CHECKED BY:
 APPROVED BY:

Liu Hai

TEMPLATE FILENAME: APPLICATION\_SPEC[SIZE\_A](V.1).DOC

Andy Zhang

**Chris Zhong** 



#### 6.0 RF PERFORMANCE AS A FUNCTION OF IMPLEMENTATION

# 6.1 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 6.1.1. 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. The minimum distance between antenna and plane ground is recommended to be 15mm to achieve acceptable RF performance.

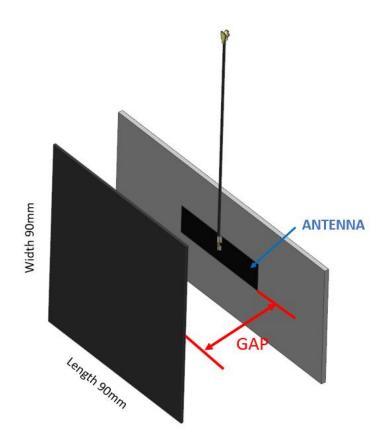


FIGURE 6.1.1 FOUR LOCATIONS WITH PARALLEL PLANE GROUND

Ground Size: 90mm\*90mm;

Location 1: Distance between antenna and plane (GAP) ground is about 5mm; Location 2: Distance between antenna and plane (GAP) ground is about 10mm; Location 3: Distance between antenna and plane (GAP) ground is about 15mm; Location 4: Distance between antenna and plane (GAP) ground is about 20mm.

| REVISION:        | ECR/ECN INFORMATION:    | TITLE:                |                  |        | SHEET No.              |
|------------------|-------------------------|-----------------------|------------------|--------|------------------------|
| 14               | EC No: <b>729862</b>    |                       | CABLE BALANCE    |        | 00 104                 |
| J1               | DATE: <b>2022/11/25</b> | APPLIC                | ATION SPECIFICAT | ION    | <b>20</b> of <b>31</b> |
| DOCUMENT NUMBER: |                         | CREATED / REVISED BY: | CHECKED BY:      | APPRO\ | /FD DV:                |

Liu Hai

AS-1461530100

**Chris Zhong** 



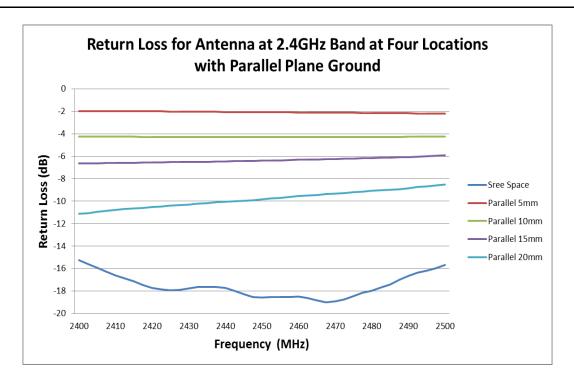


FIGURE 6.1.2 RETURN LOSS OF ANTENNA AT 2.4GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

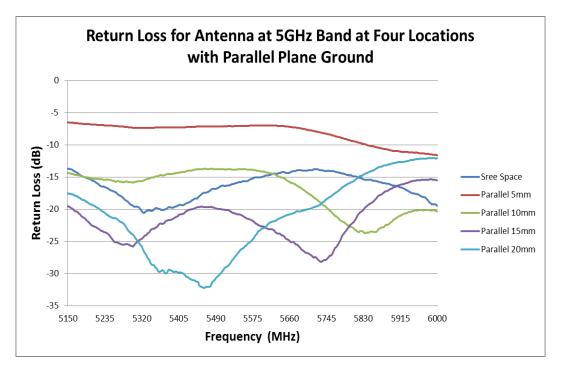


FIGURE 6.1.3 RERURN LOSS OF ANTENNA AT 5GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

| ]             | J1               | ECR/ECN INFORMATION: EC No: 729862  DATE: 2022/11/25 | WIFI 6E FLEX          | WIFI 6E FLEX CABLE BALANCE ANTENNA APPLICATION SPECIFICATION |               |         |  |
|---------------|------------------|--|-----------------------|--|---------------|---------|--|
|               | DOCUMENT NUMBER: |  | CREATED / REVISED BY: | CHECKED BY:  | <u>APPROV</u> | /ED BY: |  |
| AS-1461530100 |                  | -1461530100  | Liu Hai               | Andy Zhang   | Chris Z       | Zhona   |  |



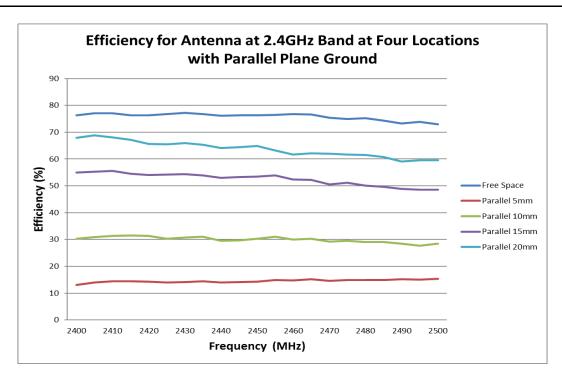


FIGURE 6.1.4 EFFICIENCY OF ANTENNA AT 2.4GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

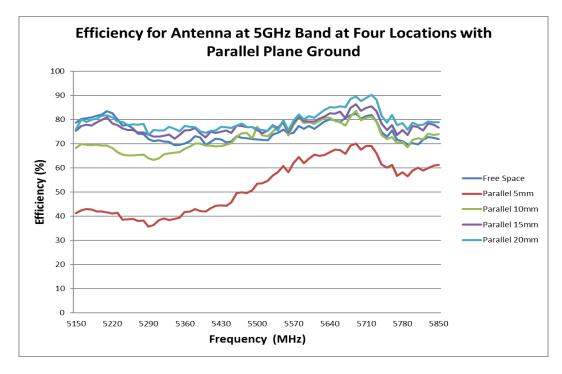


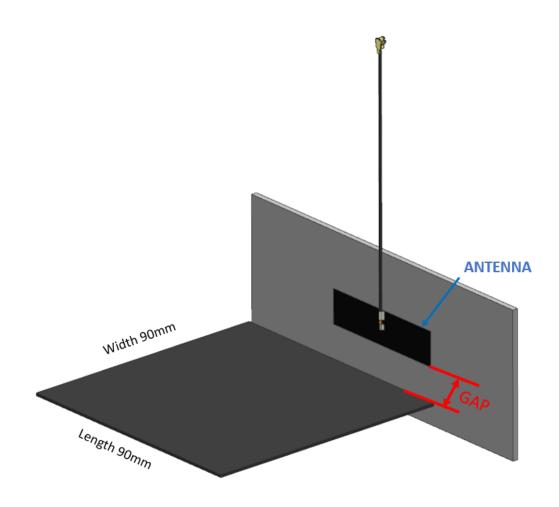
FIGURE 6.1.5 EFFICIENCY OF ANTENNA AT 5GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

| J1               | ECR/ECN INFORMATION: EC No: 729862  DATE: 2022/11/25 | WIFI 6E FLEX          | WIFI 6E FLEX CABLE BALANCE ANTENNA APPLICATION SPECIFICATION |               |                |
|------------------|--|-----------------------|--|---------------|----------------|
| DOCUMENT NUMBER: |  | CREATED / REVISED BY: | CHECKED BY:  | <u>APPROV</u> | <u>'ED BY:</u> |
| AS-1461530100    |  | Liu Hai               | Andy Zhang   | Chris Z       | Zhona          |



# 6.2 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 6.2.1. 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 vertical plane ground. The minimum distance between antenna and plane ground is recommended to be 5mm to achieve acceptable RF performance.



#### FIGURE 6.2.1 FOUR LOCATIONS WITH VERTICAL PLANE GROUND

Ground Size: 90mm\*90mm;

Location 1: Distance between antenna and plane (GAP) ground is about 5mm; Location 2: Distance between antenna and plane (GAP) ground is about 10mm; Location 3: Distance between antenna and plane (GAP) ground is about 15mm; Location 4: Distance between antenna and plane (GAP) ground is about 20mm.

| REVISION:        | ECR/ECN INFORMATION: | ·                     |                                   |         | SHEET No.              |
|------------------|----------------------|-----------------------|-----------------------------------|---------|------------------------|
| J1               | EC No: <b>729862</b> |                       | CABLE BALANCE A ATION SPECIFICATI |         | <b>23</b> of <b>31</b> |
| JI               | DATE: 2022/11/25     | APPLIC                | ATION SPECIFICATI                 | ION     | 23 01 31               |
| DOCUMENT NUMBER: |                      | CREATED / REVISED BY: | CHECKED BY:                       | APPRO\  | /ED BY:                |
| AS-1461530100    |                      | Liu Hai               | Andy Zhang                        | Chris 2 | Zhong                  |



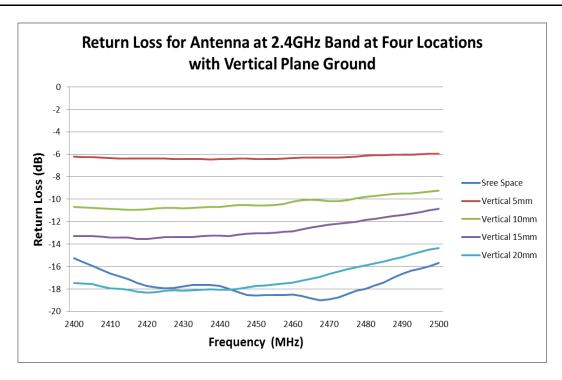


FIGURE 6.2.2 RETURN LOSS OF ANTENNA AT 2.4GHZ BAND AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND

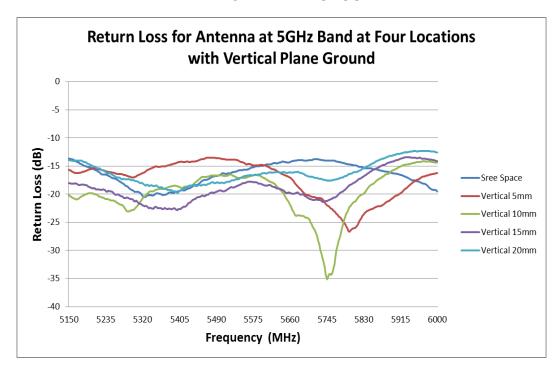


FIGURE 6.2.3 RETURN LOSS OF ANTENNA AT 5GHZ BAND AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND

| <u>R</u>      | J1               | ECR/ECN INFORMATION: EC No: 729862  DATE: 2022/11/25 | WIFI 6E FLEX          | WIFI 6E FLEX CABLE BALANCE ANTENNA APPLICATION SPECIFICATION |               |         |  |
|---------------|------------------|--|-----------------------|--|---------------|---------|--|
| <u>[</u>      | DOCUMENT NUMBER: |  | CREATED / REVISED BY: | CHECKED BY:  | <u>APPROV</u> | /ED BY: |  |
| AS-1461530100 |                  | -1461530100  | Liu Hai               | Andy Zhang   | Chris Z       | Zhona   |  |



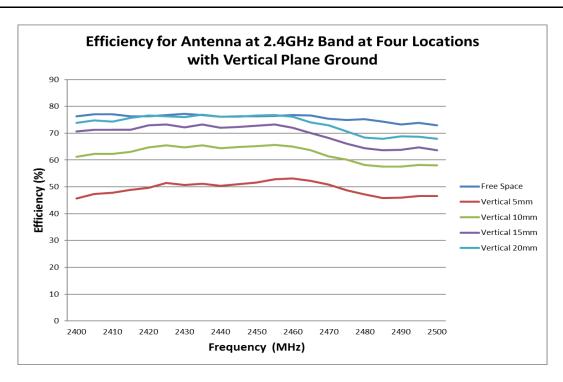


FIGURE 6.2.4 EFFICIENCY OF ANTENNA AT 2.4GHZ BAND AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND

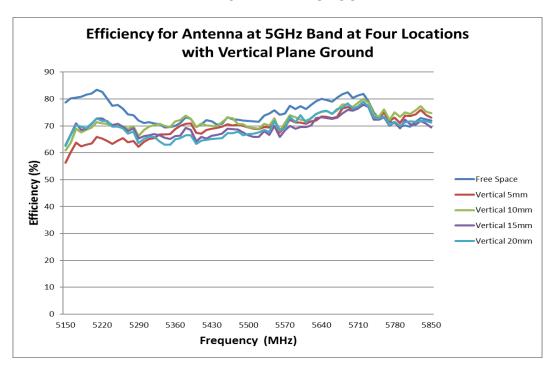


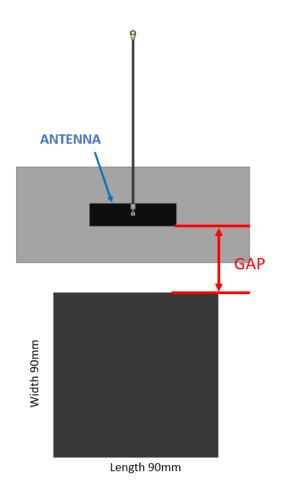
FIGURE 6.2.5 EFFICIENCY OF ANTENNA AT 5GHZ BAND AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND

| <b>REVISION</b> : | ECR/ECN INFORMATION:    | TITLE:                |                                   |         | SHEET No.              |
|-------------------|-------------------------|-----------------------|-----------------------------------|---------|------------------------|
| J1                | EC No: <b>729862</b>    | _                     | CABLE BALANCE A ATION SPECIFICATI |         | <b>25</b> of <b>31</b> |
| JI                | DATE: <b>2022/11/25</b> | AFFLIO                | ATION SPECIFICATI                 | ON      | 23 01 31               |
| DOCUMEN           | T NUMBER:               | CREATED / REVISED BY: | CHECKED BY:                       | APPRO\  | /ED BY:                |
| AS-1461530100     |                         | Liu Hai               | Andy Zhang                        | Chris Z | Zhong                  |



# 6.3 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 6.3.1. 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 the antenna and the parallel plane ground. The minimum distance between the antenna and the plane ground is recommended to be 5mm to achieve acceptable RF performance.



#### FIGURE 6.3.1 FOUR LOCATIONS WITH PARALLEL PLANE GROUND

Ground Size: 90mm\*90mm;

Location 1: Distance between antenna and plane (GAP) ground is about 5mm; Location 2: Distance between antenna and plane (GAP) ground is about 10mm; Location 3: Distance between antenna and plane (GAP) ground is about 15mm; Location 4: Distance between antenna and plane (GAP) ground is about 20mm.

| REVISION:   | ECR/ECN INFORMATION: | l <del></del> -       |                        |         | SHEET No. |
|---|----------------------|-----------------------|------------------------|---------|-----------|
| J1  EC No: 729862 WIFI 6E FLEX CABLE BALANCE ANTENN APPLICATION SPECIFICATION |                      |                       | <b>26</b> of <b>31</b> |         |           |
| JI  | DATE: 2022/11/25     | APPLIC                | ATION SPECIFICATI      | ION     | 20 01 31  |
| DOCUMENT NUMBER:  |                      | CREATED / REVISED BY: | CHECKED BY:            | APPRO\  | /ED BY:   |
| AS-1461530100   |                      | Liu Hai               | Andy Zhang             | Chris 2 | Zhong     |



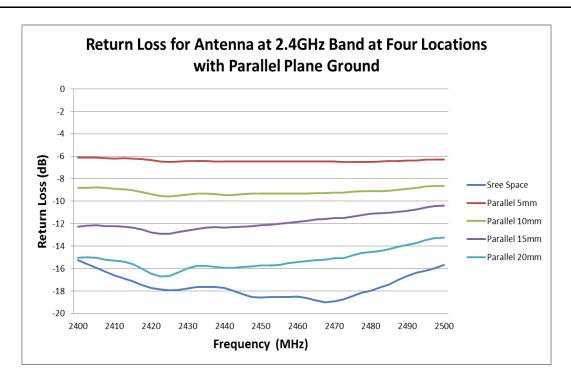


FIGURE 6.3.2 RETURN LOSS OF ANTENNA AT 2.4GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

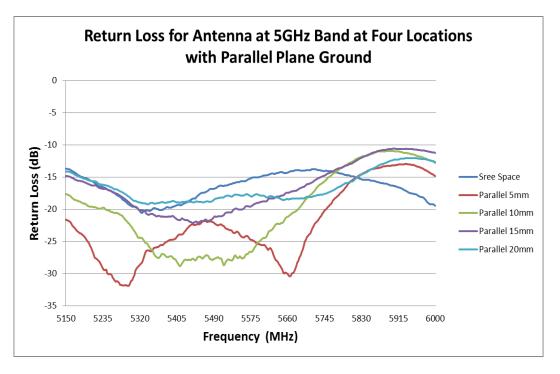


FIGURE 6.3.3 RETURN LOSS OF ANTENNA AT 5GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

|                         | J1 | ECR/ECN INFORMATION: EC No: 729862  DATE: 2022/11/25 | WIFI 6E FLEX          | WIFI 6E FLEX CABLE BALANCE ANTENNA APPLICATION SPECIFICATION |               |                |  |
|-------------------------|----|--|-----------------------|--|---------------|----------------|--|
| <b>DOCUMENT NUMBER:</b> |    | T NUMBER:  | CREATED / REVISED BY: | CHECKED BY:  | <u>APPROV</u> | <u>'ED BY:</u> |  |
| AS-1461530100           |    | -1461530100  | Liu Hai               | Andy Zhang   | Chris Z       | Zhona          |  |



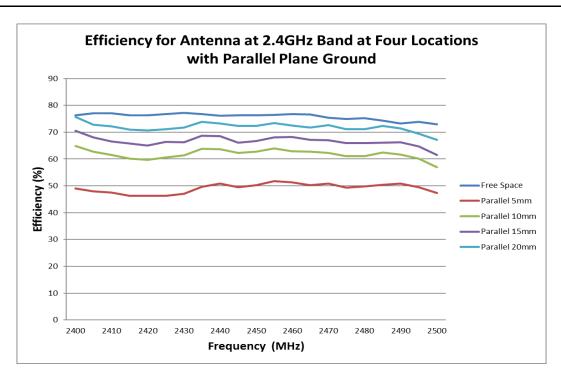


FIGURE 6.3.4 EFFICIENCY OF ANTENNA AT 2.4GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

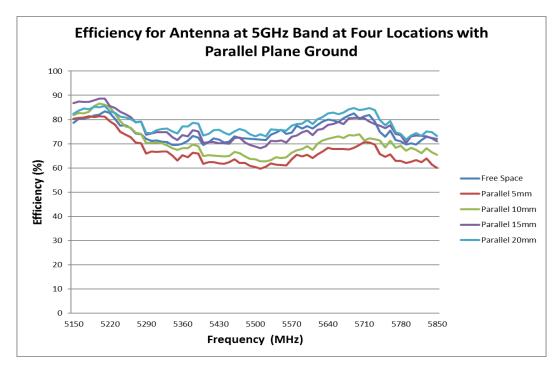


FIGURE 6.3.5 EFFICIENCY OF ANTENNA AT 5GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

| J1               | EC No: 729862  DATE: 2022/11/25 | WIFI 6E FLEX          | WIFI 6E FLEX CABLE BALANCE ANTENNA APPLICATION SPECIFICATION |               |         |  |
|------------------|---------------------------------|-----------------------|--|---------------|---------|--|
| DOCUMENT NUMBER: |                                 | CREATED / REVISED BY: | CHECKED BY:  | <u>APPROV</u> | 'ED BY: |  |
| ΔS-1461530100    |                                 | l iu Hai              | Andy Zhang   | Chris 7       | hona .  |  |



### 7.0 THE ANTENNA PERFORMANCE VARIATION WITH CABLE LENGTH

### 7.0.1 CABLE LOSS

| ITEM    | DESCRIPTION     | TEST CONDITION                | REQUIREMENT |           |            |
|---------|-----------------|-------------------------------|-------------|-----------|------------|
| 7.0.1.1 | Frequency Range | 2 GHz~7.125GHz                | 2GHz~3GHz   | 5GHz~6GHz | 6-7.125GHz |
| 7.0.1.2 | Attenuation     | 1m cable measured by VNA5071C | ≤3.5dB/m    | ≤5.5dB/m  | ≤6.5dB/m   |

#### 7.0.2 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 7.0.1

#### 7.0.3 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 (%) |
|                 | Х               |                | X-LOSS=Y     | Υ               |                |
| 2400            | -1.09           | 77.77          | 0.2m*3.5dB/m | -1.79           | 66.19          |
| 2420            | -1.05           | 78.43          |              | -1.75           | 66.76          |
| 2440            | -1.15           | 76.82          |              | -1.85           | 65.38          |
| 2460            | -1.17           | 76.41          |              | -1.87           | 65.03          |
| 2480            | -1.19           | 76.00          |              | -1.89           | 64.68          |
| 2500            | -1.23           | 75.37          |              | -1.93           | 64.15          |
| 5150            | -1.10           | 77.71          | 0.2*5.5dB/m  | -2.20           | 60.32          |
| 5200            | -1.13           | 77.08          |              | -2.23           | 59.83          |
| 5250            | -1.13           | 77.11          |              | -2.23           | 59.85          |
| 5300            | -1.20           | 75.88          |              | -2.30           | 58.90          |
| 5350            | -1.33           | 73.54          |              | -2.43           | 57.08          |
| 5400            | -1.23           | 75.30          |              | -2.33           | 58.45          |
| 5450            | -1.16           | 76.50          |              | -2.26           | 59.38          |
| 5500            | -0.92           | 80.93          |              | -2.02           | 62.82          |
| 5550            | -0.92           | 80.95          |              | -2.02           | 62.84          |
| 5600            | -0.95           | 80.42          |              | -2.05           | 62.42          |
| 5650            | -0.97           | 79.94          |              | -2.07           | 62.05          |
| 5700            | -1.00           | 79.37          |              | -2.10           | 61.61          |
| 5750            | -1.06           | 78.38          |              | -2.16           | 60.84          |
| 5800            | -1.20           | 75.94          |              | -2.30           | 58.95          |
| 5850            | -1.11           | 77.51          |              | -2.21           | 60.17          |
| 5900            | -1.27           | 74.69          |              | -2.37           | 57.98          |
| 5925            | -1.30           | 74.20          |              | -2.40           | 57.60          |
| 5950            | -1.19           | 76.11          |              | -2.29           | 59.08          |

| REVISION:        | ECR/ECN INFORMATION: EC No: 729862 DATE: 2022/11/25 | WIFI 6E FLEX          | WIFI 6E FLEX CABLE BALANCE ANTENNA APPLICATION SPECIFICATION |         |         |  |
|------------------|---|-----------------------|--|---------|---------|--|
| DOCUMENT NUMBER: |   | CREATED / REVISED BY: | TED / REVISED BY: CHECKED BY: APPRO                          |         | /ED BY: |  |
| AS-1461530100    |   | l iu Hai              | Andy Zhang   | Chris 7 | 7hona   |  |



|                 | 100mm cable     |                |             | 300mm cable     |                |
|-----------------|-----------------|----------------|-------------|-----------------|----------------|
| Frequency (MHz) | Efficiency (dB) | Efficiency (%) | cable loss  | Efficiency (dB) | Efficiency (%) |
|                 | Х               |                | X-LOSS=Y    | Υ               |                |
| 6000            | -1.00           | 79.43          | 0.2*6.5dB/m | -2.30           | 58.88          |
| 6100            | -1.44           | 71.71          |             | -2.74           | 53.16          |
| 6200            | -1.32           | 73.73          |             | -2.62           | 54.66          |
| 6300            | -1.23           | 75.26          |             | -2.53           | 55.79          |
| 6400            | -1.14           | 76.91          |             | -2.44           | 57.01          |
| 6500            | -1.32           | 73.72          |             | -2.62           | 54.65          |
| 6600            | -1.12           | 77.19          |             | -2.42           | 57.22          |
| 6700            | -1.03           | 78.87          |             | -2.33           | 58.46          |
| 6800            | -1.05           | 78.50          |             | -2.35           | 58.20          |
| 6900            | -1.01           | 79.23          |             | -2.31           | 58.73          |
| 7000            | -1.45           | 71.60          |             | -2.75           | 53.07          |
| 7100            | -1.20           | 75.84          |             | -2.50           | 56.22          |
| 7125            | -1.11           | 77.44          |             | -2.41           | 57.41          |

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

### **8.0 OTHER MOLEX ANTENNA PRODUCT**

Please refer to the Antenna products in Molex home page to view all the Molex Antenna products.

https://www.molex.com Molex, LLC 2222 Wellington Court Lisle, IL 60532 USA

| REVISION:        | ECR/ECN INFORMATION:    | TITLE:                |                                  |         | SHEET No.              |
|------------------|-------------------------|-----------------------|----------------------------------|---------|------------------------|
| J1               | EC No: <b>729862</b>    | =                     | CABLE BALANCE A ATION SPECIFICAT |         | <b>30</b> of <b>31</b> |
| JI               | DATE: <b>2022/11/25</b> | AFFLIG                | ATION SELCIFICATI                | ON      | 30 01 31               |
| DOCUMENT NUMBER: |                         | CREATED / REVISED BY: | CHECKED BY:                      | APPRO\  | /ED BY:                |
| AS-1461530100    |                         | Liu Hai               | Andy Zhang                       | Chris 2 | Zhong                  |



### 9.0 CHANGE HISTORY

|     | CHANGE HISTORY |   |  |  |  |  |  |  |
|-----|----------------|---|--|--|--|--|--|--|
| REV | DATA           | DESCRIPTION                                 |  |  |  |  |  |  |
| Н   | 2020/06/18     | Update 2D Figure and add 6-7.125GHz band    |  |  |  |  |  |  |
| H1  | 2020/08/26     | Change 2D 2450MHz 5450MHz pattern           |  |  |  |  |  |  |
| J   | 2021/08/12     | Change 2D of 6000MHz 7125MHz pattern        |  |  |  |  |  |  |
| J1  | 2022/11/14     | Added section : Other Molex Antenna Product |  |  |  |  |  |  |

| REVISION:        | ECR/ECN INFORMATION:    | TITLE:                |                  |         | SHEET No.              |
|------------------|-------------------------|-----------------------|------------------|---------|------------------------|
| 14               | EC No: <b>729862</b>    |                       | CABLE BALANCE    |         | 24 - ( 24              |
| J1               | DATE: <b>2022/11/25</b> | APPLIC                | ATION SPECIFICAT | ION     | <b>31</b> of <b>31</b> |
| DOCUMENT NUMBER: |                         | CREATED / REVISED BY: | CHECKED BY:      | APPRO\  | /ED BY:                |
| AS-1461530100    |                         | Liu Hai               | Andy Zhang       | Chris 2 | Zhong                  |