

# Yuande Electronics (Shenzhen) Co., Ltd

## Sample Approval Sheet

### Product Information:

|                        |                                                                                                                  |
|------------------------|------------------------------------------------------------------------------------------------------------------|
| Customer               | Zhong Shan City Richsound Electronic Industrial Ltd                                                              |
| Material Description   | Harwood WIFI-L Antenna                                                                                           |
| Customer's Part number |                                                                                                                  |
| Specifications         | Harwood WIFI-L Antenna: FPC (L45.2*W12.2mm)<br>+Black Coaxial Cable ( $\phi$ 1.13*53mm )<br>+Welding+UV adhesive |
| Supplier's Part number | 136-HARWD-10A                                                                                                    |
| Date                   | 2022-03-11                                                                                                       |

### Supplier:

|                |             |                 |
|----------------|-------------|-----------------|
| Prepared By    | Checked By  | Approved By     |
| Zhang Dengqiao | Chen Yanmin | Zhang Xiangting |

### Customer Approval:

|             |            |             |
|-------------|------------|-------------|
| Accepted By | Checked By | Approved By |
|             |            |             |

### Results:

- ☐ Full Approval
- ☐ Conditional Approval
- ☐ Unqualified
- ☐ Others:

This sample approval sheet is guaranteed to be true. If it is confirmed by your R&D department, please send it back to us as soon as possible. If there are other reasons, please inform us in writing.

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1、Specification

This report mainly provides the testing status of various electrical and structural performance parameters of Harwood Wifi-L Antenna.

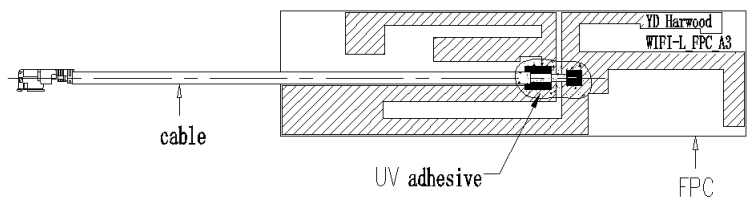


Figure 1 Antenna

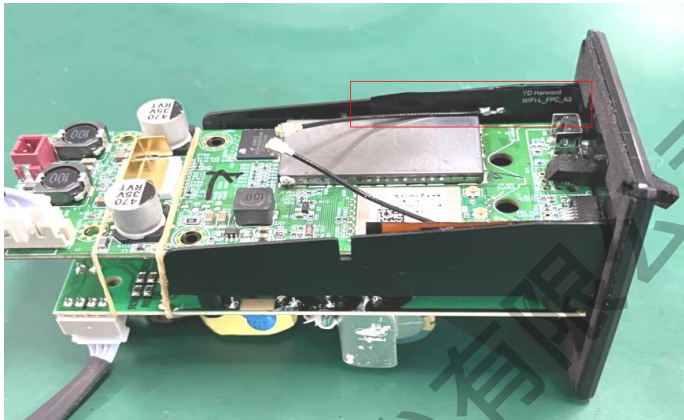


Figure 2 Antenna Placement

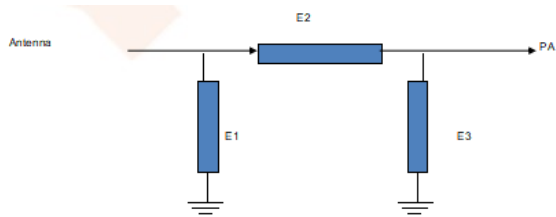
1.1 Electrical specification standard

1.1.1 Electrical Specifications

The antenna operates in the 2400-5850 MHz. The following table is the electrical performance index of the antenna designed by our company.

|                 |                        |
|-----------------|------------------------|
| Antenna         | Harwood WIFI-L Antenna |
| Frequency Range | 2400-5850MHz           |
| VSWR            | <3                     |
| Efficiency      | > 40%                  |
| Impedance       | 50 ohm                 |
| Polarization    | Linear polarization    |

1.1.2 Antenna Matching Network



| Element  | Value |
|----------|-------|
| E1(0402) | N/A   |
| E2(0402) | 0R    |
| E3(0402) | N/A   |

Schematic diagram of matching circuit modification

2、Test

The antenna was debugged and tested with the prototype provided by the customer.

2.1 Test of passive S11

2.1.1 Test connection

The passive S11 test device is connected as follows: Network Analyzer → Test Line → Test Fixture.

2.1.2 Passive S11

The following table shows the standing wave ratio values of the edge frequency points of the antenna operating frequency band. The waveform of Return Loss and VSWR obtained by the test is shown as follows.

| Harwood WIFI-L Antenna S11 |       |       |       |       |        |       |
|----------------------------|-------|-------|-------|-------|--------|-------|
| Frequency(MHz)             | 2400  | 2440  | 2480  | 5100  | 5200   | 5800  |
| VSWR                       | 2.42  | 2.23  | 2.33  | 2.63  | 1.34   | 2.29  |
| Return Loss                | -7.63 | -8.35 | -7.94 | -6.97 | -16.79 | -8.12 |



2.2 Gain and efficiency test

2.2.1 Test Position

Yuande microwave anechoic chamber, the test frequency range is 400MHz-6GHz.

### 2.2.2 Test equipment

Network analyzer, standard horn antenna, multi-probe near field antenna test system, test computer, etc

### 2.2.3 Results Summary

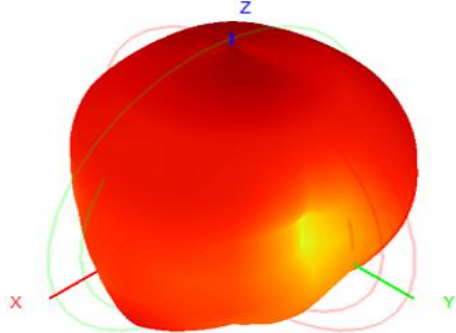
In the microwave anechoic chamber, the measured values related to efficiency and gain are shown in the table below.

| Frequency(MHz) | Efficiency(%) | Efficiency(dB) | Gain(dBi) |
|----------------|---------------|----------------|-----------|
| 2400           | 41.96%        | -4.09          | 1.02      |
| 2410           | 42.58%        | -3.71          | 1.40      |
| 2420           | 45.71%        | -3.40          | 1.58      |
| 2430           | 49.73%        | -3.03          | 1.80      |
| 2440           | 52.43%        | -2.80          | 1.93      |
| 2450           | 53.55%        | -2.55          | 2.16      |
| 2460           | 52.13%        | -2.28          | 2.45      |
| 2470           | 51.03%        | -2.14          | 2.69      |
| 2480           | 52.54%        | -1.97          | 2.99      |

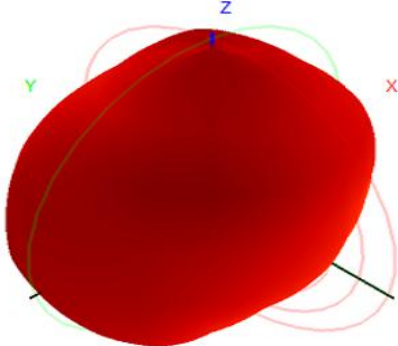
| Frequency(MHz) | Efficiency(%) | Efficiency(dB) | Gain(dBi) |
|----------------|---------------|----------------|-----------|
| 5150           | 56.75%        | -2.09          | 2.56      |
| 5200           | 55.04%        | -2.22          | 2.25      |
| 5250           | 57.82%        | -2.02          | 2.35      |
| 5300           | 57.65%        | -1.96          | 2.79      |
| 5350           | 58.31%        | -1.92          | 2.44      |
| 5400           | 56.74%        | -2.17          | 2.53      |
| 5450           | 57.12%        | -2.43          | 2.10      |
| 5500           | 53.89%        | -2.68          | 1.97      |
| 5550           | 49.22%        | -3.08          | 1.87      |
| 5600           | 45.67%        | -3.40          | 2.02      |
| 5650           | 46.40%        | -3.33          | 2.13      |
| 5700           | 44.17%        | -3.55          | 2.68      |
| 5750           | 44.20%        | -3.55          | 2.47      |
| 5800           | 45.74%        | -3.40          | 2.34      |
| 5850           | 46.26%        | -3.35          | 2.08      |

2.2.4 Radiation Pattern Results

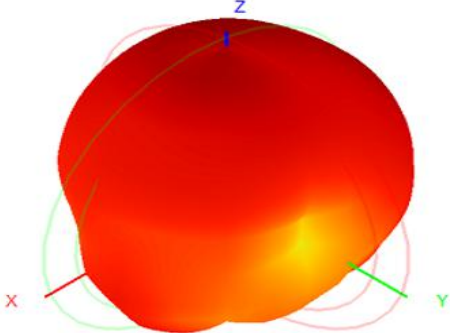
2400.0MHz H+V, Eff: 42.0%



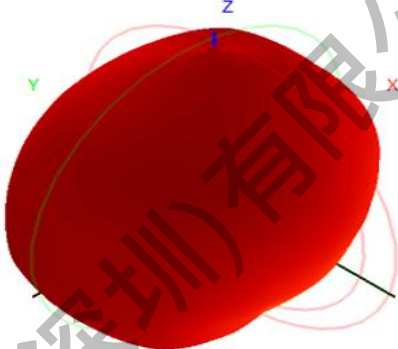
Back View



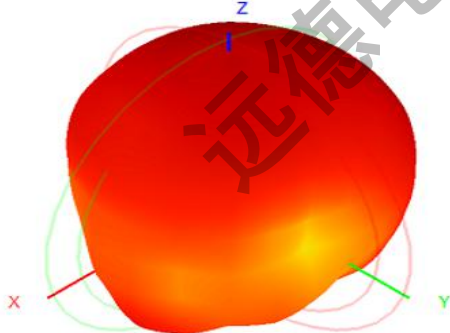
2440.0MHz H+V, Eff: 52.4%



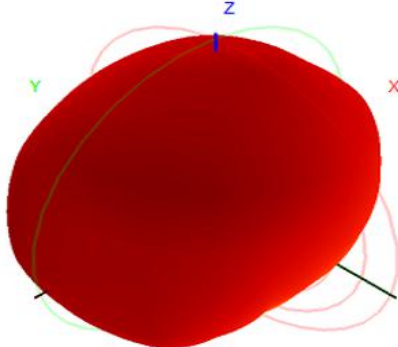
Back View



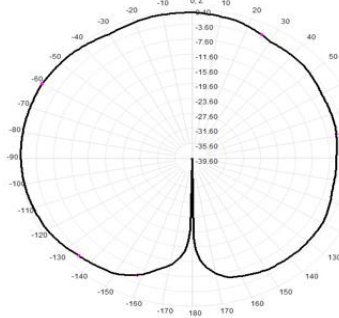
2480.0MHz H+V, Eff: 52.5%



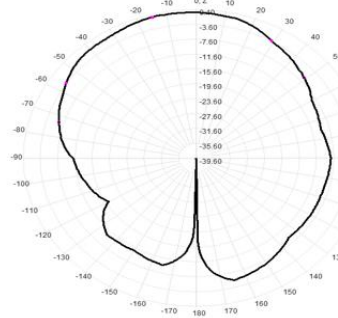
Back View



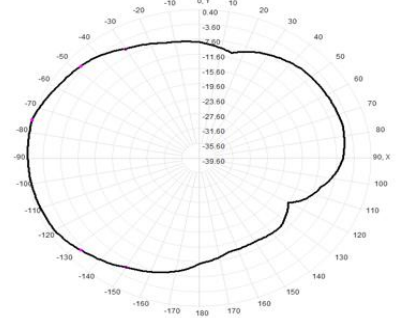
2400.0MHz Total(E1-XZ), Max= 0.40dBi



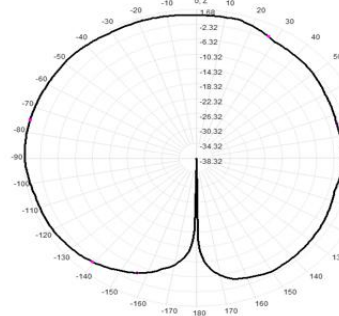
2400.0MHz Total(E2-YZ), Max= -0.33dBi



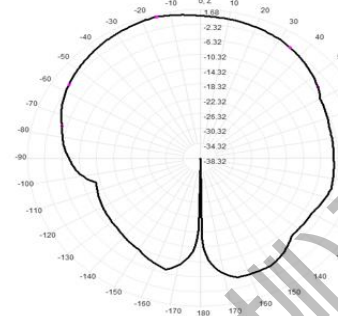
Total(H-XY), Max= 0.35dBi, CirD=16.12



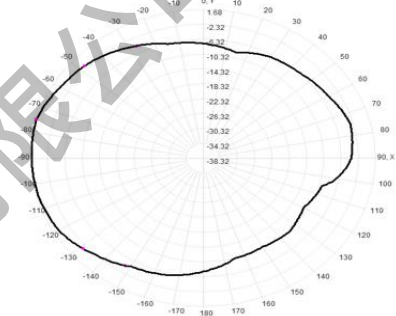
2440.0MHz Total(E1-XZ), Max= 1.49dBi



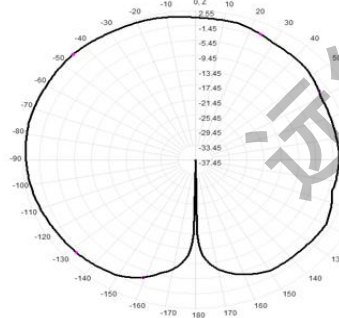
2440.0MHz Total(E2-YZ), Max= 1.03dBi



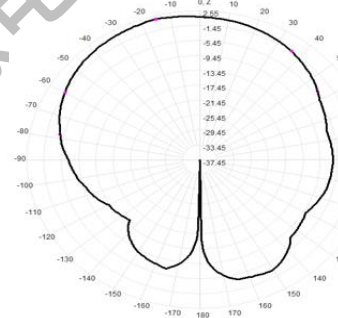
Total(H-XY), Max= 1.68dBi, CirD=13.31



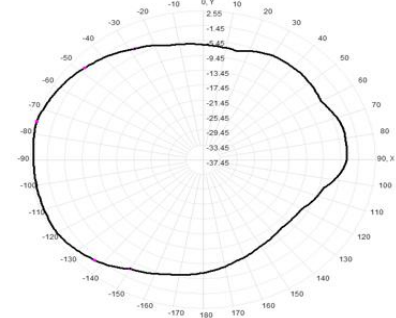
2480.0MHz Total(E1-XZ), Max= 2.55dBi



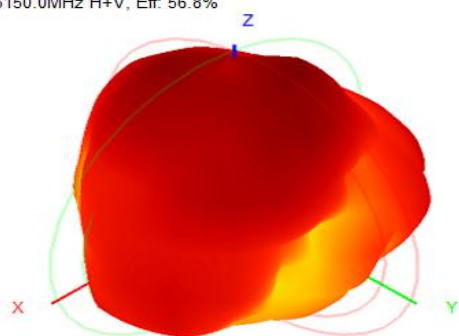
2480.0MHz Total(E2-YZ), Max= 1.60dBi



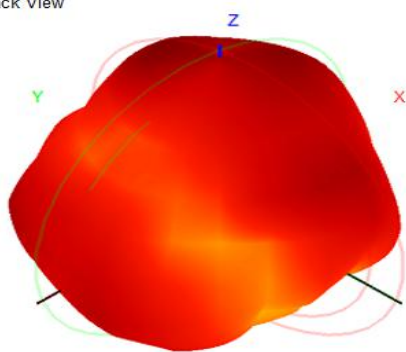
Total(H-XY), Max= 2.39dBi, CirD=14.08



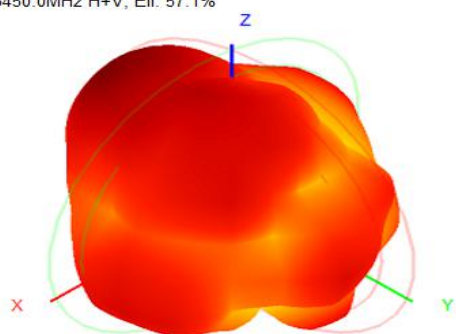
5150.0MHz H+V, Eff: 56.8%



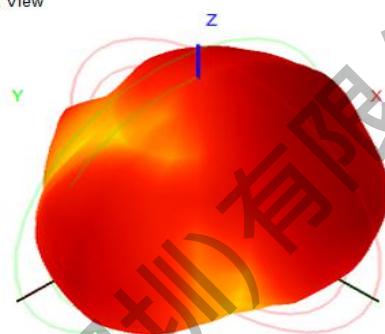
Back View



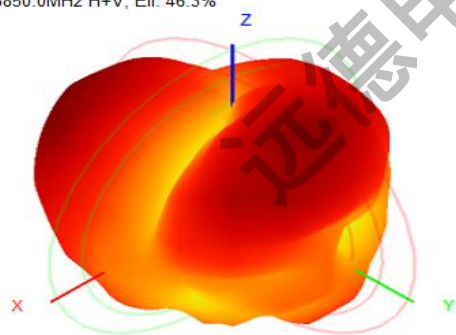
5450.0MHz H+V, Eff: 57.1%



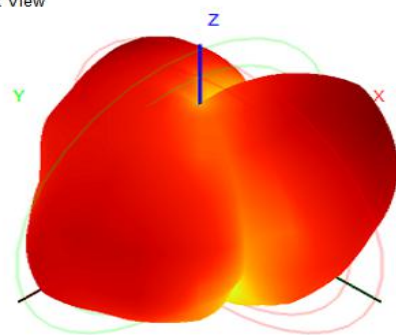
Back View



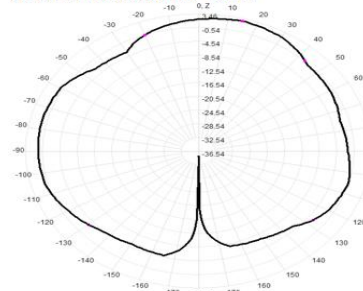
5850.0MHz H+V, Eff: 46.3%



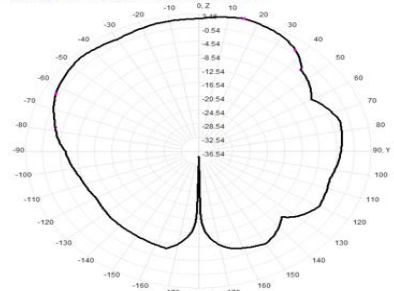
Back View



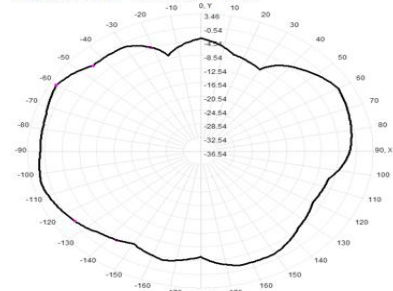
5150.0MHz Total(E1-XZ), Max= 2.67dBi



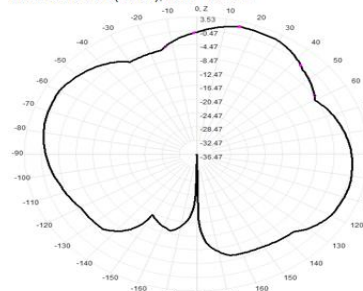
5150.0MHz Total(E2-YZ), Max= 3.46dBi



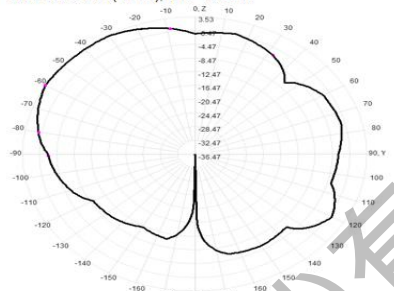
Total(H-XY), Max= 1.89dBi, CirD=11.03



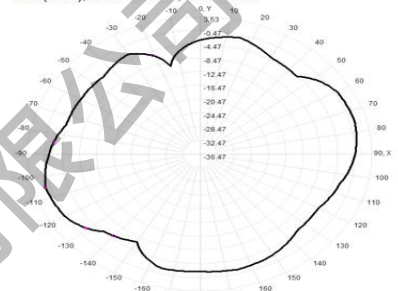
5450.0MHz Total(E1-XZ), Max= 1.96dBi



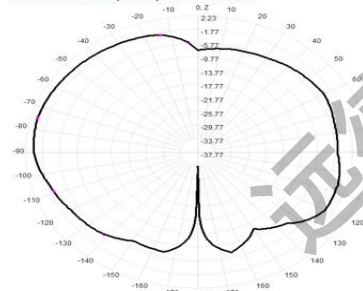
5450.0MHz Total(E2-YZ), Max= 3.53dBi



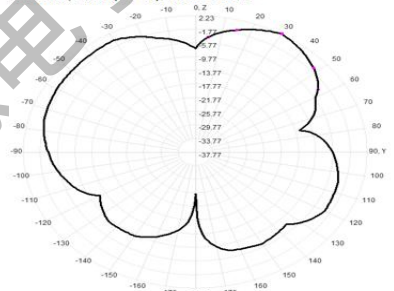
Total(H-XY), Max= 0.65dBi, CirD=10.60



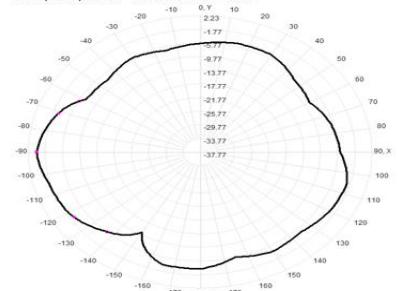
5850.0MHz Total(E1-XZ), Max= 0.64dBi



5850.0MHz Total(E2-YZ), Max= 2.23dBi



Total(H-XY), Max= 0.26dBi, CirD=10.96

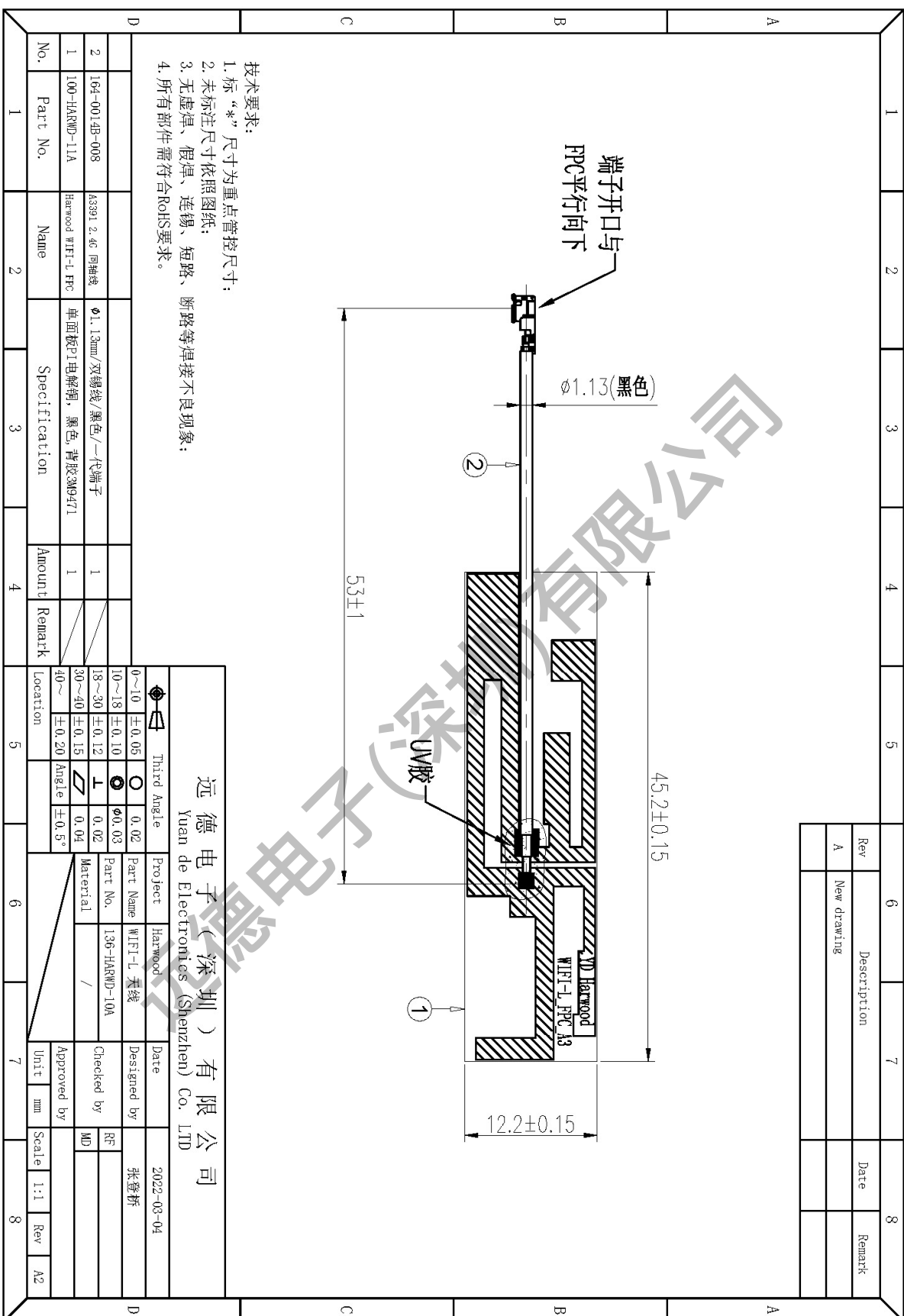


### **3、 Conclusion**

This antenna is designed on the basis of the prototype provided by the customer. The above electrical performance parameters are tested under the environmental treatment conditions of the test prototype. The electrical parameters and structural performance have met the technical requirements. Please confirm!

### **4、 Part Drawing**

远德电子(深圳)有限公司



# Yuande Electronics (Shenzhen) Co., Ltd

## Sample Approval Sheet

### Product Information:

|                        |                                                                                                                  |
|------------------------|------------------------------------------------------------------------------------------------------------------|
| Customer               | Zhong Shan City Richsound Electronic Industrial Ltd                                                              |
| Material Description   | Harwood WIFI-R Antenna                                                                                           |
| Customer's Part number |                                                                                                                  |
| Specifications         | Harwood WIFI-R Antenna: FPC (L45.2*W12.2mm)<br>+White Coaxial Cable ( $\phi$ 1.13*53mm )<br>+Welding+UV adhesive |
| Supplier's Part number | 136-HARWD-20A                                                                                                    |
| Date                   | 2022-03-11                                                                                                       |

### Supplier:

|                |             |                 |
|----------------|-------------|-----------------|
| Prepared By    | Checked By  | Approved By     |
| Zhang Dengqiao | Chen Yanmin | Zhang Xiangting |

### Customer Approval:

|             |            |             |
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| Accepted By | Checked By | Approved By |
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### Results:

- ☐ Full Approval
- ☐ Conditional Approval
- ☐ Unqualified
- ☐ Others:

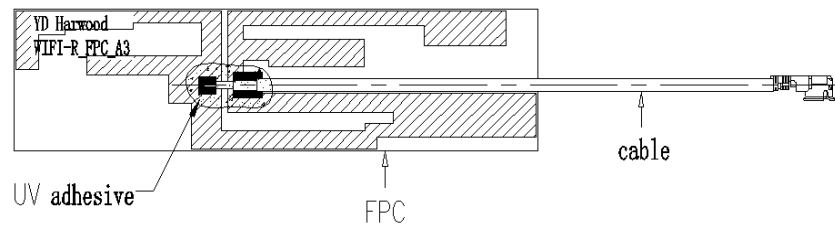
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| <b>1.1Electrical specification standard.....</b> | <b>3</b>  |
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| <b>2.1Test of passive S11.....</b>               | <b>4</b>  |
| 2.1.1 Test connection.....                       | 4         |
| 2.1.2 Passive S11.....                           | 4         |
| <b>2.2 Gain and efficiency test.....</b>         | <b>4</b>  |
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| <b>3、 Conclusion.....</b>                        | <b>10</b> |
| <b>4、 Part Drawing.....</b>                      | <b>11</b> |

## 1、Specification

This report mainly provides the testing status of various electrical and structural performance parameters of Harwood Wifi-R Antenna.



**Figure 1 Antenna**



**Figure 2 Antenna Placement**

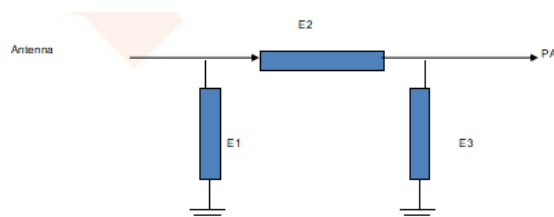
### 1.1 Electrical specification standard

#### 1.1.1 Electrical Specifications

The antenna operates in the 2400-5850 MHz. The following table is the electrical performance index of the antenna designed by our company.

|                 |                        |
|-----------------|------------------------|
| Antenna         | Harwood WIFI-R Antenna |
| Frequency Range | 2400-5850MHz           |
| VSWR            | <3                     |
| Efficiency      | > 40%                  |
| Impedance       | 50 ohm                 |
| Polarization    | Linear polarization    |

#### 1.1.2 Antenna Matching Network



| Element  | Value |
|----------|-------|
| E1(0402) | N/A   |
| E2(0402) | 0R    |
| E3(0402) | N/A   |

Schematic diagram of matching circuit modification

## 2、Test

The antenna was debugged and tested with the prototype provided by the customer.

### 2.1 Test of passive S11

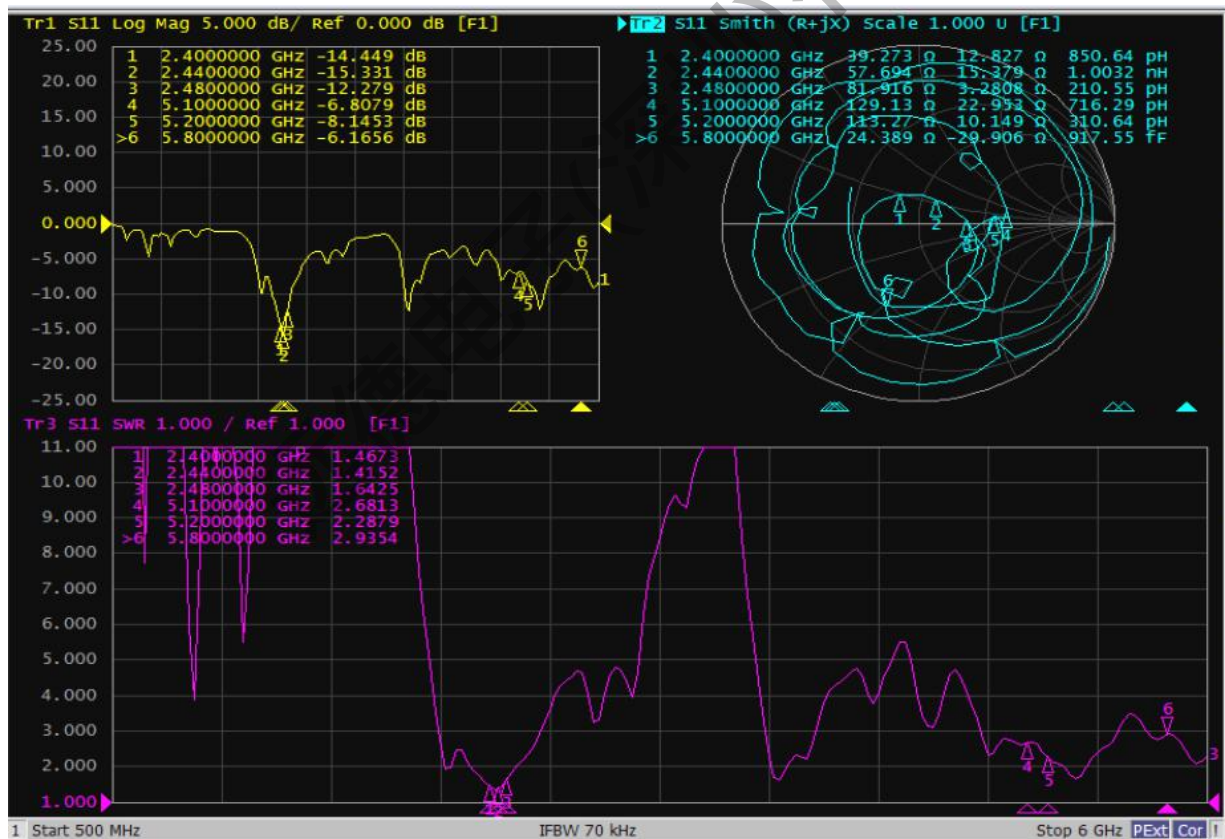
#### 2.1.1 Test connection

The passive S11 test device is connected as follows: Network Analyzer → Test Line → Test Fixture.

#### 2.1.2 Passive S11

The following table shows the standing wave ratio values of the edge frequency points of the antenna operating frequency band. The waveform of Return Loss and VSWR obtained by the test is shown as follows.

| Harwood WIFI-R Antenna S11 |        |        |        |       |       |       |
|----------------------------|--------|--------|--------|-------|-------|-------|
| Frequency(MHz)             | 2400   | 2440   | 2480   | 5100  | 5200  | 5800  |
| VSWR                       | 1.46   | 1.41   | 1.64   | 2.68  | 2.28  | 2.93  |
| Return Loss                | -14.44 | -15.33 | -12.27 | -6.80 | -8.14 | -6.16 |



### 2.2 Gain and efficiency test

#### 2.2.1 Test Position

Yuande microwave anechoic chamber, the test frequency range is 400MHz-6GHz.

### 2.2.2 Test equipment

Network analyzer, standard horn antenna, multi-probe near field antenna test system, test computer, etc

### 2.2.3 Results Summary

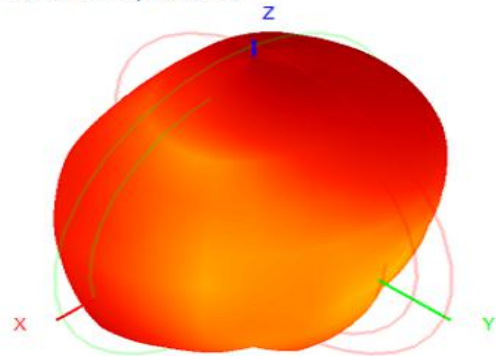
In the microwave anechoic chamber, the measured values related to efficiency and gain are shown in the table below.

| Frequency(MHz) | Efficiency(%) | Efficiency(dB) | Gain(dBi) |
|----------------|---------------|----------------|-----------|
| 2400           | 54.50%        | -2.64          | 2.29      |
| 2410           | 55.08%        | -2.36          | 2.59      |
| 2420           | 56.84%        | -2.16          | 2.85      |
| 2430           | 54.15%        | -1.93          | 2.13      |
| 2440           | 55.77%        | -1.82          | 2.26      |
| 2450           | 57.76%        | -1.69          | 2.38      |
| 2460           | 56.94%        | -1.55          | 2.49      |
| 2470           | 56.25%        | -1.53          | 2.58      |
| 2480           | 56.80%        | -1.44          | 2.71      |

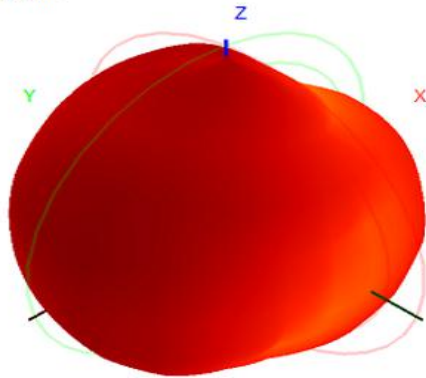
| Frequency(MHz) | Efficiency(%) | Efficiency(dB) | Gain(dBi) |
|----------------|---------------|----------------|-----------|
| 5150           | 56.43%        | -2.48          | 2.42      |
| 5200           | 59.11%        | -2.28          | 2.10      |
| 5250           | 53.54%        | -1.97          | 2.20      |
| 5300           | 53.73%        | -1.96          | 2.37      |
| 5350           | 52.88%        | -2.02          | 2.56      |
| 5400           | 50.63%        | -2.17          | 2.26      |
| 5450           | 49.93%        | -2.22          | 2.64      |
| 5500           | 49.30%        | -2.27          | 1.98      |
| 5550           | 47.46%        | -2.41          | 2.20      |
| 5600           | 44.91%        | -2.60          | 2.61      |
| 5650           | 45.47%        | -2.56          | 2.19      |
| 5700           | 45.47%        | -2.56          | 1.78      |
| 5750           | 45.39%        | -2.57          | 1.91      |
| 5800           | 44.93%        | -2.60          | 1.74      |
| 5850           | 46.91%        | -2.45          | 1.90      |

2.2.4 Radiation Pattern Results

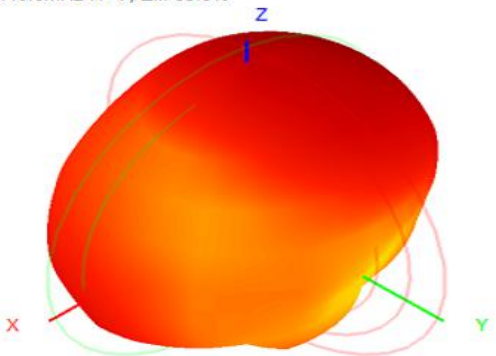
2400.0MHz H+V, Eff: 54.5%



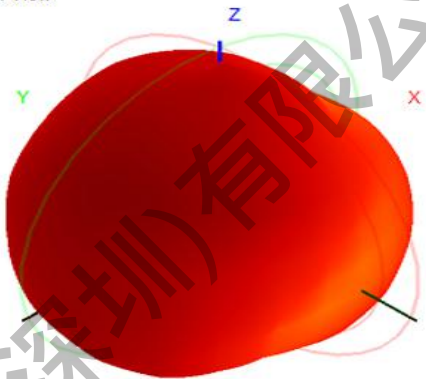
Back View



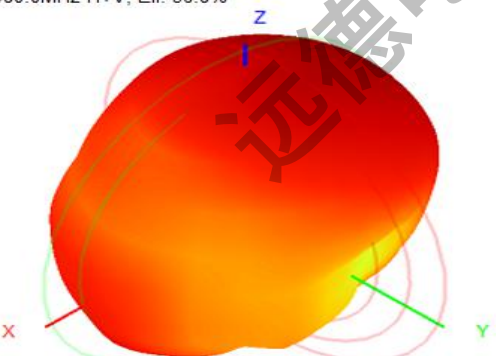
2440.0MHz H+V, Eff: 55.8%



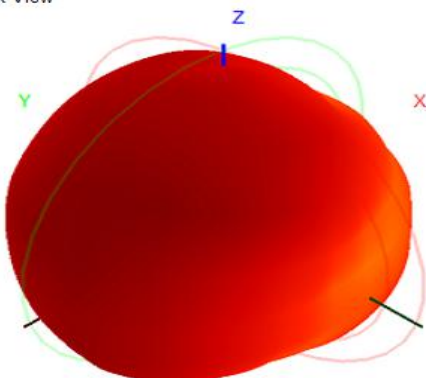
Back View



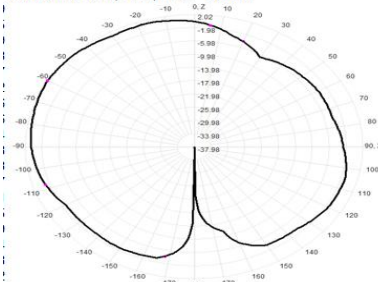
2480.0MHz H+V, Eff: 56.8%



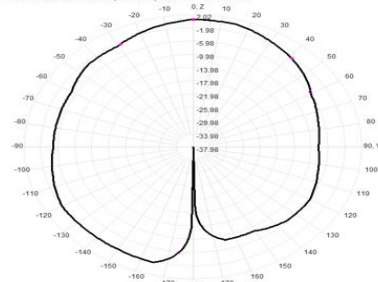
Back View



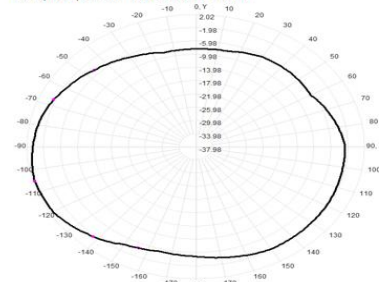
2400.0MHz Total(E1-XZ), Max= 2.02dBi



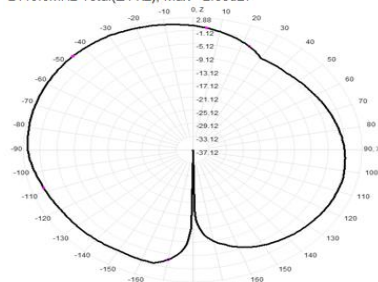
2400.0MHz Total(E2-YZ), Max= 0.50dBi



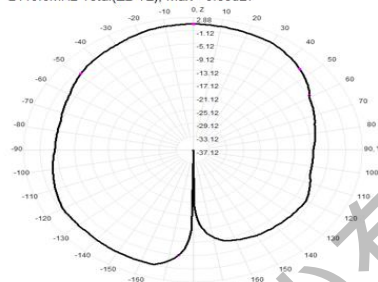
Total(H-XY), Max= 1.51dBi, CirD=10.01



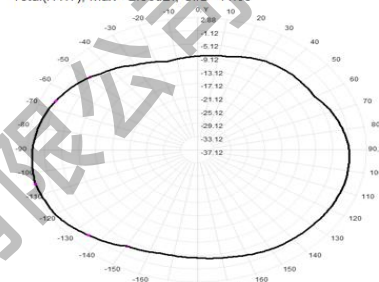
2440.0MHz Total(E1-XZ), Max= 2.88dBi



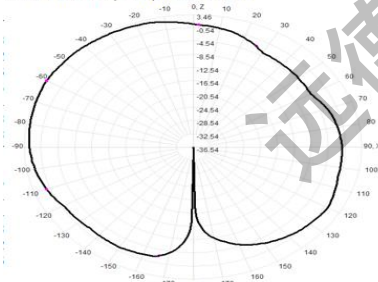
2440.0MHz Total(E2-YZ), Max= 0.88dBi



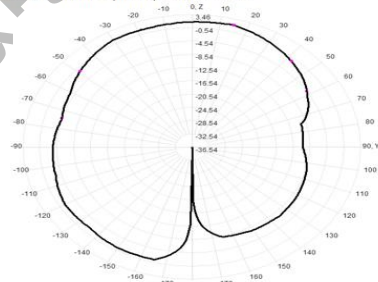
Total(H-XY), Max= 2.36dBi, CirD=11.95



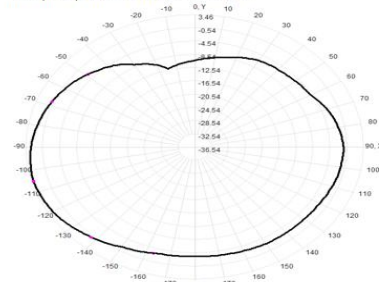
2480.0MHz Total(E1-XZ), Max= 3.46dBi



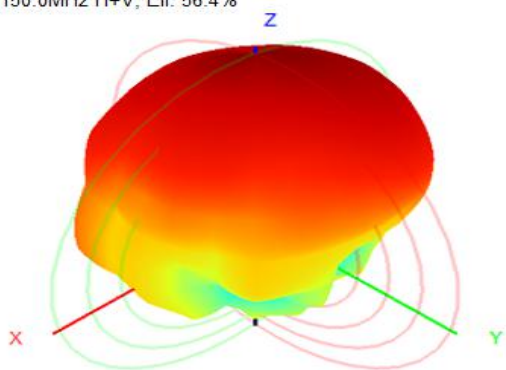
2480.0MHz Total(E2-YZ), Max= 1.52dBi



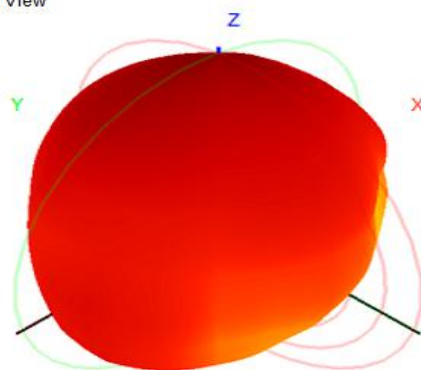
Total(H-XY), Max= 3.02dBi, CirD=15.08



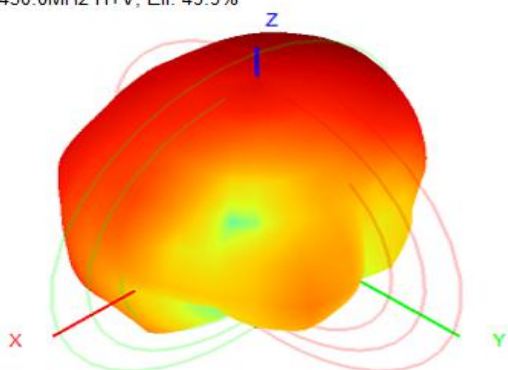
5150.0MHz H+V, Eff: 56.4%



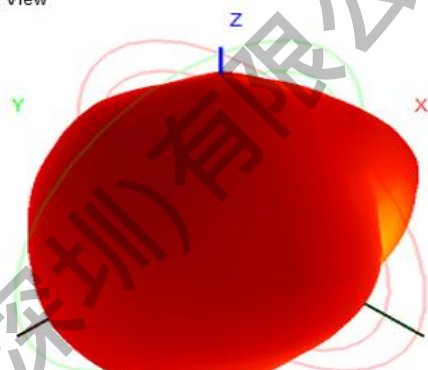
Back View



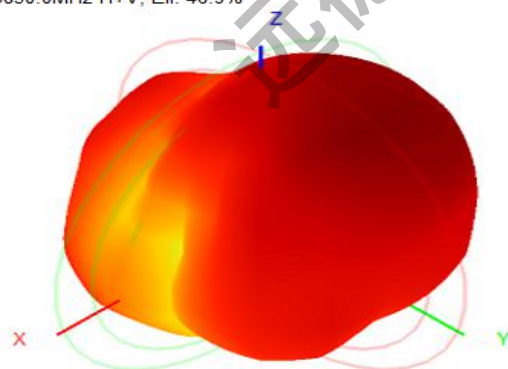
5450.0MHz H+V, Eff: 49.9%



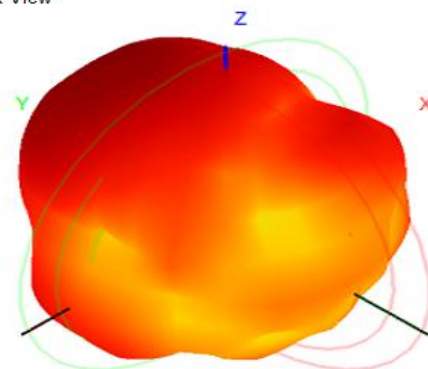
Back View



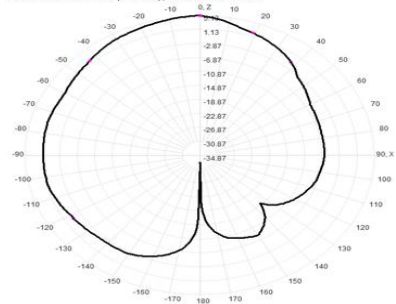
5850.0MHz H+V, Eff: 46.9%



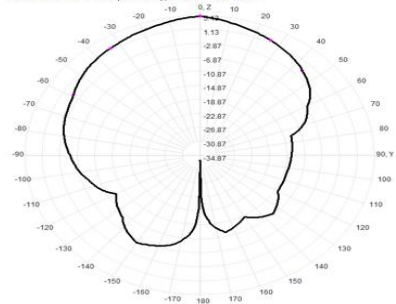
Back View



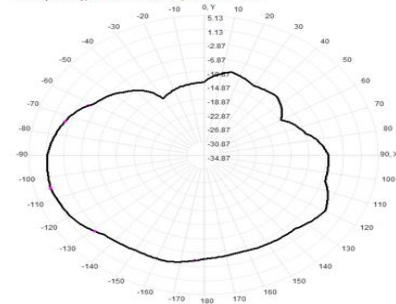
5150.0MHz Total(E1-XZ), Max= 5.13dBi



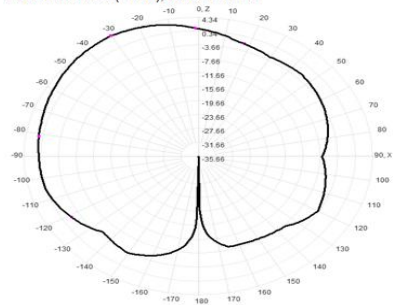
5150.0MHz Total(E2-YZ), Max= 4.88dBi



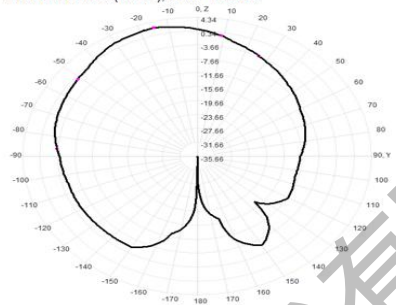
Total(H-XY), Max= 1.34dBi, CirD=17.51



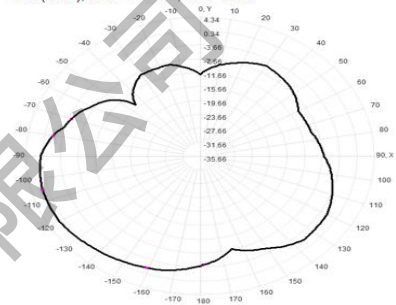
5450.0MHz Total(E1-XZ), Max= 4.34dBi



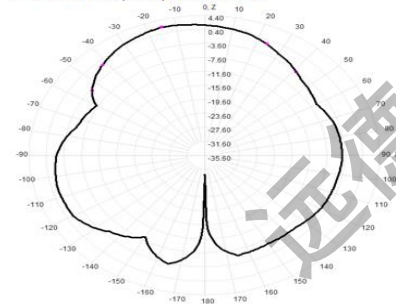
5450.0MHz Total(E2-YZ), Max= 2.58dBi



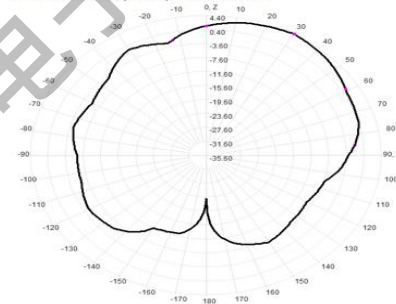
Total(H-XY), Max= 1.70dBi, CirD=16.39



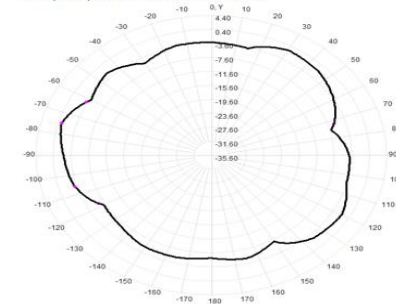
5850.0MHz Total(E1-XZ), Max= 2.29dBi



5850.0MHz Total(E2-YZ), Max= 4.40dBi



Total(H-XY), Max= -0.24dBi, CirD=7.25



### **3、 Conclusion**

This antenna is designed on the basis of the prototype provided by the customer. The above electrical performance parameters are tested under the environmental treatment conditions of the test prototype. The electrical parameters and structural performance have met the technical requirements. Please confirm!

### **4、 Part Drawing**

远德电子(深圳)有限公司

|   |  |   |  |   |  |   |  |   |  |     |  |             |  |      |  |        |  |
|---|--|---|--|---|--|---|--|---|--|-----|--|-------------|--|------|--|--------|--|
| 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6   |  | 7           |  | 8    |  |        |  |
|   |  |   |  |   |  |   |  |   |  | Rev |  | Description |  | Date |  | Remark |  |
|   |  |   |  |   |  |   |  |   |  | A   |  | New drawing |  |      |  |        |  |

技术要求:

1. 标“\*”尺寸为重点管控尺寸;
2. 未标注尺寸依照图纸;
3. 无虚焊、假焊、连锡、短路、断路等焊接不良现象;
4. 所有部件需符合RoHS要求。

|     |  |               |  |                   |  |                        |  |        |  |        |  |
|-----|--|---------------|--|-------------------|--|------------------------|--|--------|--|--------|--|
| No. |  | Part No.      |  | Name              |  | Specification          |  | Amount |  | Remark |  |
| 1   |  | 100-HARWD-21A |  | Harwood WIF-R FPC |  | 单面镀PI电解铜, 黑色, 背胶3M9471 |  | 1      |  |        |  |
| 2   |  | 164-HARWD-22A |  | Harwood WIF-R同轴线  |  | Ø1.13mm/双导线/白色/-一代端子   |  | 1      |  |        |  |

|                                                        |  |           |  |               |  |             |  |            |  |
|--------------------------------------------------------|--|-----------|--|---------------|--|-------------|--|------------|--|
| 远德电子(深圳)有限公司<br>Yuan de Electronics (Shenzhen) Co. LTD |  |           |  |               |  |             |  |            |  |
| Third Angle                                            |  | Project   |  | Harwood       |  | Date        |  | 2022-03-04 |  |
| 0~10 ±0.05                                             |  | Part Name |  | WIFI-R 天线     |  | Designed by |  | 张彦桥        |  |
| 10~18 ±0.10                                            |  | Part No.  |  | 136-HARWD-20A |  | Checked by  |  | RF         |  |
| 18~30 ±0.12                                            |  | Material  |  | /             |  | Approved by |  | MD         |  |
| 30~40 ±0.15                                            |  | Angle     |  | ±0.04         |  | Unit        |  | mm         |  |
| 40~ ±0.20                                              |  |           |  | ±0.5°         |  | Scale       |  | 1:1        |  |
|                                                        |  |           |  |               |  | Rev         |  | A2         |  |