



**Hanyang Antenna Design Co.,Ltd**

# **Antenna Approval Sheet**

|              |                        |
|--------------|------------------------|
| Product name | Internal PCB Antenna   |
| Model name   | F04602000247           |
| Date         | 2023-10-31             |
| Manufacture  | Hanyang Antenna Design |

|      | R&D                                                                                 | Quality                                                                             | Approval                                                                              |
|------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Sign |  |  |  |
| Date | 10/31                                                                               | 10/31                                                                               | 10/31                                                                                 |

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# 1. Document reversion history

| No. | Date       | Detail revision and change | Reversion |
|-----|------------|----------------------------|-----------|
| 1   | 2023-10-31 | Initial release            | 1.0       |
| 2   |            |                            |           |
| 3   |            |                            |           |
| 4   |            |                            |           |
| 5   |            |                            |           |
| 6   |            |                            |           |



## 2. Material certificate

| No. | Part name              | Material     | Color | Quantity | Processing method    | Partner | Remarks |
|-----|------------------------|--------------|-------|----------|----------------------|---------|---------|
| 1   | Φ1.13<br>Coaxial cable | Tinned cable | Black | 1        | Cocentra<br>MHF plug | Shenyu  |         |
| 2   | Antenna                | FR4          | Black | 1        |                      | Yaoxian | 1.0mm   |
|     |                        |              |       |          |                      |         |         |



### 3. Technical information

#### 3.1 Electrical specifications

|                      |                  |              |
|----------------------|------------------|--------------|
| Frequency            | 2400~2500MHz     | 5150~5875MHz |
| VSWR                 | 2.0 :1 blow      | 2.0 :1 blow  |
| Peak gain            | 1.9 dBi          | 2.0 dBi      |
| Input impedance      | 50 $\Omega$      |              |
| Polarization         | Linear           |              |
| Radiation properties | Omni-directional |              |
| Maximum power        | 2Watts           |              |

#### 3.2 Mechanical specifications

|                       |                              |
|-----------------------|------------------------------|
| Antenna size          | 33.5(mm) x 9.0(mm) x 1.0(mm) |
| Material              | FR4                          |
| Connector type        | COCENTRA ANCZ1131-1B1        |
| Cable length          | 200mm                        |
| Cable color           | Black                        |
| Operating temperature | -40 °C to +80 °C             |
| Operating humidity    | 0 ~ 95%                      |

#### 3.3 Packaging specifications

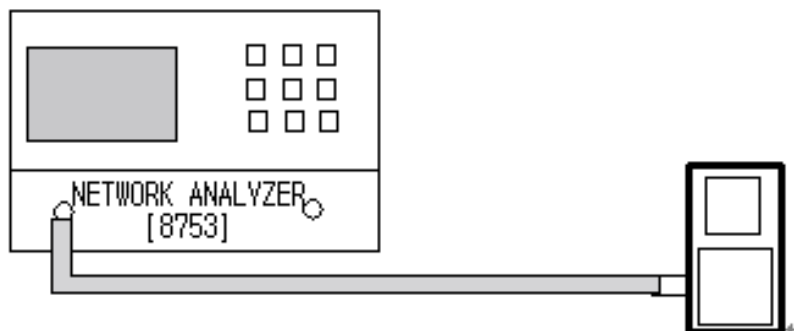
| Part name       | Quantity        | Material  | Remarks   |
|-----------------|-----------------|-----------|-----------|
| Polybag (small) | 1Bag (200pcs)   | PP        | 240x160mm |
| Polybag (large) | 1Bag (1000pcs)  | PP        | 325x220mm |
| Out box         | 1Box (4,000pcs) | K=k paper |           |



## 4. Electrical test environment

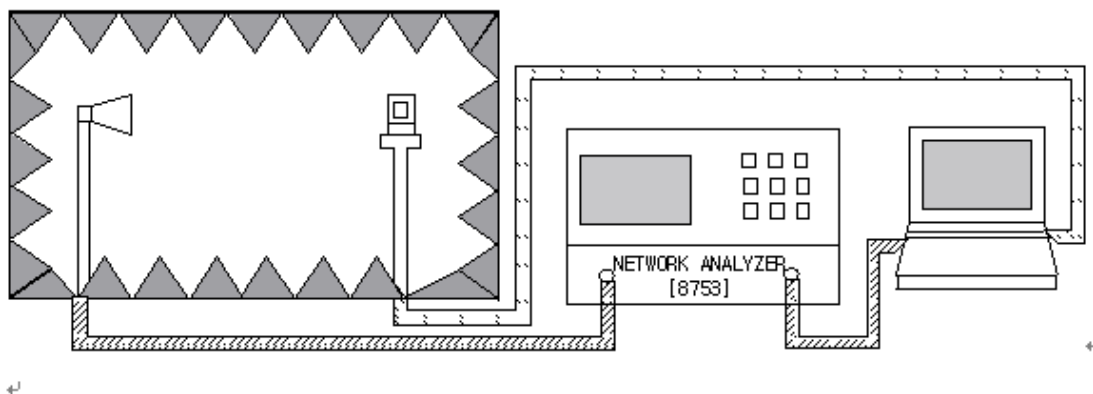
### 4.1 VSWR

- ① Connect the measurement cable to the Network analyzer.
- ② Set and calibrate the Network analyzer to match the measurement frequency.
- ③ Install the antenna and measure the VSWR.



### 4.2 Radiation pattern & Gain

- ① Calibrate the chamber system using the reference antenna, the software for controlling the chamber system is set to the measurement frequency band.
- ② Fit the antenna in chamber.
- ③ Measure the gain, efficiency, and radiation pattern.



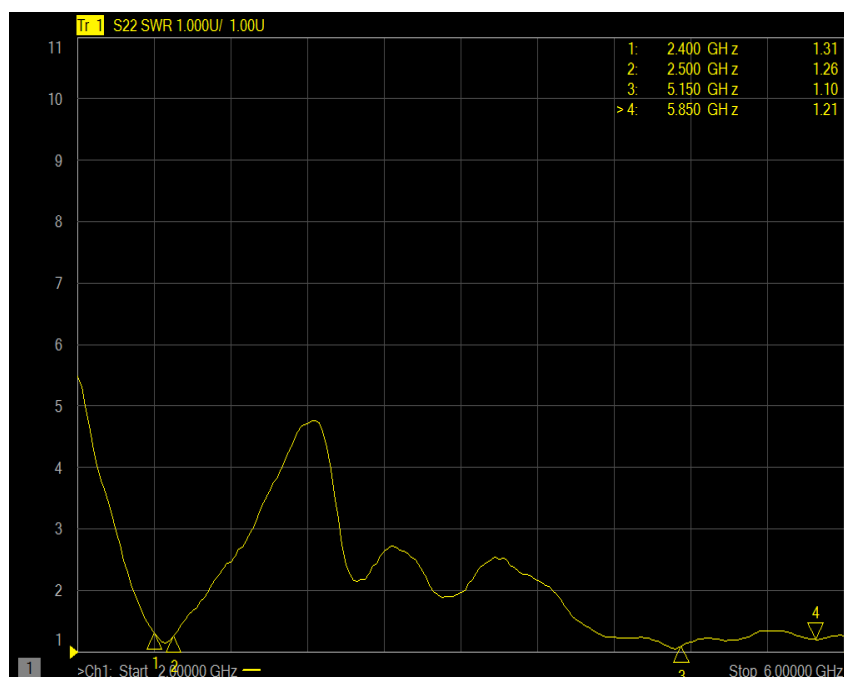


## 5. Electrical characteristic

### 5.1 VSWR

The VSWR characteristics must satisfy the following electrical demands.

| Frequency | 2400~2500MHz | 5150~5875MHz |
|-----------|--------------|--------------|
| VSWR      | 2.0 :1 blow  | 2.0 :1 blow  |





## 5.2 Gain & Efficiency

The unit of gain is “dBi” and it must satisfy the following specifications.

| Frequency | 2400~2500MHz | 5150~5875MHz |
|-----------|--------------|--------------|
| Peak gain | 1.9 dBi      | 2.0 dBi      |

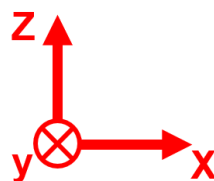
| Passive Performance         |                          |         |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |
|-----------------------------|--------------------------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|--|--|--|
| EUT                         |                          |         |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |
| Test Date                   | Mon 30/Oct/2023 16:55:00 |         |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |
| Event Status                |                          |         |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |
| Serial Number               |                          |         |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |
| Hardware Version            |                          |         |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |
|                             | 1                        | 2       | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13     | 14     |  |  |  |  |
| Frequency [MHz]             | 2400                     | 2420    | 2440   | 2460   | 2480   | 2500   | 5150   | 5250   | 5350   | 5450   | 5550   | 5650   | 5750   | 5850   |  |  |  |  |
| Efficiency [dB]             | -2.88                    | -2.67   | -2.44  | -2.33  | -2.36  | -2.04  | -1.17  | -1.20  | -1.76  | -1.48  | -1.00  | -1.44  | -1.56  | -1.81  |  |  |  |  |
| Efficiency [%]              | 51.5                     | 54.0    | 57.1   | 58.4   | 58.0   | 62.6   | 76.4   | 75.9   | 66.7   | 71.1   | 79.5   | 71.7   | 69.9   | 66.0   |  |  |  |  |
| TRG <sub>g</sub> [dB]       | -8.35                    | -8.18   | -8.12  | -8.17  | -8.29  | -8.06  | -5.71  | -5.92  | -6.15  | -6.90  | -6.21  | -6.89  | -7.07  | -7.43  |  |  |  |  |
| Gain <sub>g Peak</sub> [dB] | -3.19                    | -2.50   | -1.89  | -1.33  | -0.86  | -0.25  | 0.95   | 1.13   | 1.21   | 0.24   | 1.27   | 0.88   | 1.65   | 1.19   |  |  |  |  |
| Gain <sub>g Min</sub> [dB]  | -25.48                   | -27.94  | -27.00 | -27.66 | -29.11 | -31.58 | -22.82 | -25.71 | -24.41 | -26.38 | -22.40 | -26.81 | -32.97 | -29.39 |  |  |  |  |
| TRG <sub>p</sub> [dB]       | -4.33                    | -4.11   | -3.81  | -3.64  | -3.65  | -3.29  | -3.05  | -2.98  | -3.72  | -2.95  | -2.55  | -2.91  | -2.99  | -3.20  |  |  |  |  |
| Gain <sub>p Peak</sub> [dB] | 0.75                     | 0.89    | 1.47   | 1.70   | 1.47   | 1.64   | 0.97   | 1.53   | 0.32   | 1.38   | 2.03   | 1.98   | 2.00   | 2.01   |  |  |  |  |
| Gain <sub>p Min</sub> [dB]  | -34.84                   | -29.65  | -28.91 | -31.33 | -33.44 | -48.40 | -23.23 | -33.25 | -33.44 | -24.35 | -27.95 | -34.92 | -35.50 | -28.99 |  |  |  |  |
| UHRG [dB]                   | -5.50                    | -5.24   | -5.04  | -4.93  | -4.94  | -4.58  | -3.86  | -3.64  | -4.08  | -3.50  | -2.88  | -3.25  | -3.30  | -3.50  |  |  |  |  |
| UHRG/TRG [%]                | 54.7                     | 55.4    | 55.0   | 55.0   | 55.2   | 55.7   | 53.8   | 57.0   | 58.5   | 62.7   | 64.8   | 66.0   | 66.9   | 67.8   |  |  |  |  |
| H-Plane                     | -9.32                    | -9.76   | -10.51 | -11.52 | -12.58 | -12.91 | -9.18  | -10.47 | -11.22 | -11.90 | -11.72 | -12.78 | -13.97 | -13.16 |  |  |  |  |
| E1-Plane, AVG [dB]          | -11.63                   | -12.08  | -12.79 | -13.63 | -14.64 | -14.88 | -12.86 | -14.74 | -15.44 | -16.73 | -17.34 | -19.01 | -18.98 | -18.81 |  |  |  |  |
| E2-Plane, AVG [dB]          | -4.57                    | -4.19   | -3.87  | -3.69  | -3.59  | -3.20  | -2.08  | -2.44  | -2.67  | -3.46  | -2.38  | -2.93  | -2.72  | -2.95  |  |  |  |  |
| Peak Gain [dB]              | 1.55                     | 1.75    | 1.78   | 1.94   | 1.66   | 1.83   | 2.07   | 2.03   | 2.02   | 2.01   | 2.08   | 2.06   | 2.05   | 2.09   |  |  |  |  |
| Directivity [dB]            | 4.43                     | 4.42    | 4.21   | 4.27   | 4.03   | 3.87   | 3.24   | 3.22   | 3.77   | 3.49   | 3.07   | 3.50   | 3.61   | 3.89   |  |  |  |  |
| Minimum Gain [dB]           | -12.08                   | -13.99  | -17.82 | -21.45 | -19.87 | -16.77 | -8.01  | -9.56  | -10.60 | -11.82 | -11.80 | -11.75 | -14.50 | -16.52 |  |  |  |  |
| Test Condition              | FS                       |         |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |
| Antenna Type                |                          |         |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |
| Average Efficiency          | -1.83 dB                 | 65.63 % |        |        |        |        |        |        |        |        |        |        |        |        |  |  |  |  |





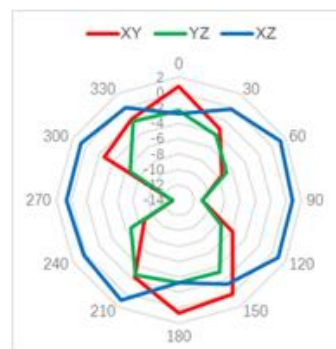
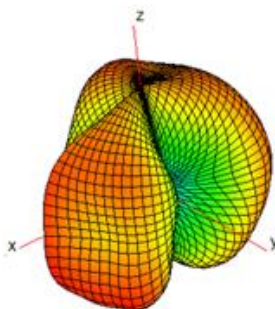
## 5.3 Radiation pattern

Radiation pattern of the antenna has Omni-directional pattern in H-Plane.

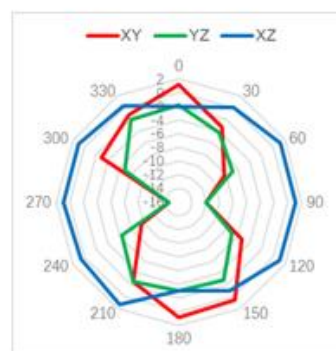
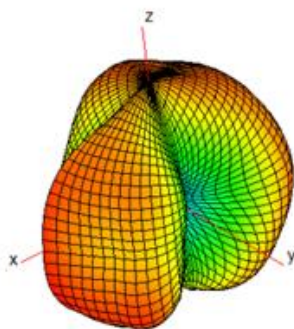


### 5.3.1 2.4G

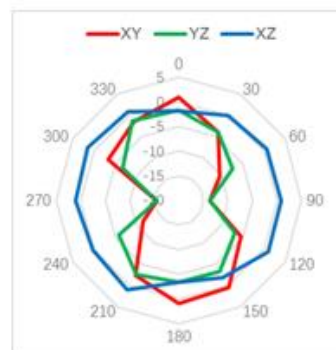
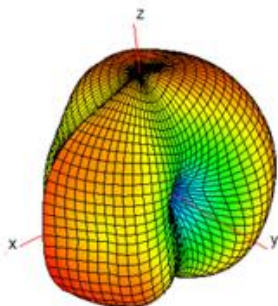
2400MHz



2440MHz



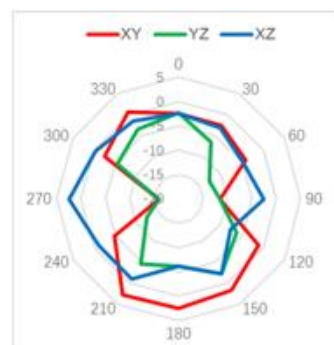
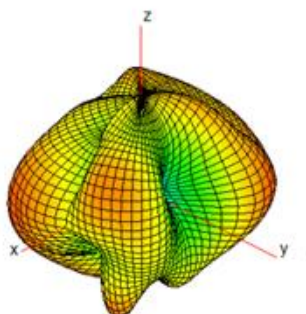
2500MHz



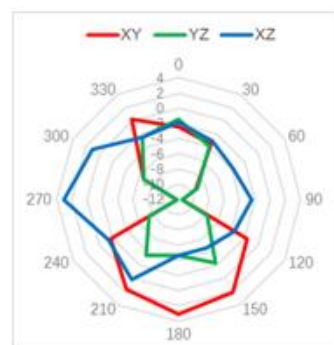
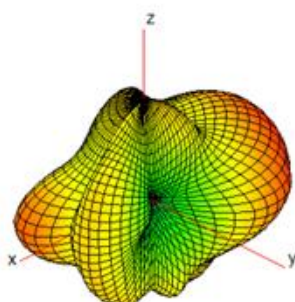


### 5.3.2 5G

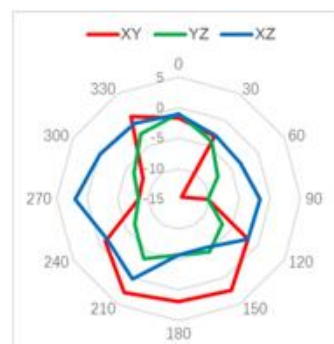
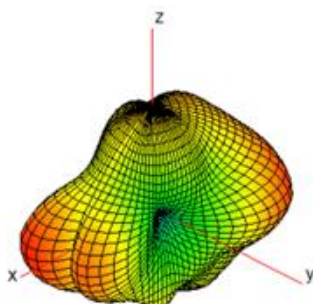
5150MHz



5550MHz



5850MHz





## 6. Environmental reliability test

| Test item                     | Test method                                                                                                                                                                                                                                                                                                                                                                       | Test Standard                                                                                                                                                                                                                                            | Test result | Number of samples |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------------|
| High temperature and Humidity | <ol style="list-style-type: none"><li>1. Check the test surface to keep it clean and dry without bubbles and scratches.</li><li>2. T=60±2°C, RH=93±3%, test time 48 hours. After 48 hours, recover at room temperature for 2 hours, take out the product and inspect the appearance of the sample, check the mechanical properties, and test the electrical properties.</li></ol> | <ul style="list-style-type: none"><li>- No cracks, obvious deformation, falling off, RF test pass is qualified;</li><li>- When the tape is peeled off, the coating cannot be peeled off, otherwise it is judged NG.</li></ul>                            | Pass        | 10pcs             |
| High temperature storage      | <ol style="list-style-type: none"><li>1. Check the test surface to keep it clean and dry without bubbles and scratches.</li><li>2. The sample was placed in a precision constant temperature and humidity test chamber, and stored at 70°C±2°C for 72h. After the test, it was placed in room temperature for 2h to check the appearance of the product.</li></ol>                | <ul style="list-style-type: none"><li>- Parts without cracks, obvious deformation, falling off, paint adhesion test OK, RF test qualified;</li><li>- When the tape is peeled off, the coating cannot be peeled off, otherwise it is judged NG.</li></ul> | Pass        | 10pcs             |
| Low temperature storage       | <ol style="list-style-type: none"><li>1. Check the test surface to keep it clean and dry without bubbles and scratches.</li><li>2. The sample was placed in a precision constant temperature and humidity test chamber and stored at -40°C±2°C for 72h. After the test, it was placed in room temperature for 2 hours to check the appearance of the product.</li></ol>           | <ul style="list-style-type: none"><li>- Parts without cracks, obvious deformation, falling off, paint adhesion test OK, RF test qualified;</li><li>- When the tape is peeled off, the coating cannot be peeled off, otherwise it is judged NG.</li></ul> | Pass        | 10pcs             |
|                               |                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                          |             |                   |



|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                       |      |       |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|
| Salt spray tester | <ol style="list-style-type: none"><li>1. Put the test sample into the salt spray tester.</li><li>2. Close the test chamber door and set the spray parameters. At <math>35^{\circ}\text{C}\pm 2^{\circ}\text{C}</math>, humidity <math>&gt;85\%</math>, pH value in the range of 6.5-7.2, with <math>5\%\pm 1\%</math> NaCl solution continuously sprayed 48h salt water,</li><li>3. After the above cycle, take out the product, rinse it with tap water, dry it at room temperature, and test the test surface.</li></ol> | - Inspect the surface of the specimen without any cracks, corrosion, foaming, obvious deformation, discoloration, wrinkling or poor overall shedding. | Pass | 10pcs |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|