

## 2.4G PCB Fiberglass Printed Antenna Specification

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Application: Remote Control Car 2.4G

### I. Basic Project Information

| No. | Item                      | Parameter                                                      |
|-----|---------------------------|----------------------------------------------------------------|
| 1   | Operating Frequency (MHz) | 2400 ~ 2480MHz (2.4G WIFI)                                     |
| 2   | Applicable Device         | Remote Control Car                                             |
| 3   | Antenna Type              | FR4 Fiberglass PCB On-board Printed Antenna                    |
| 4   | Feeding Method            | PCB Pad + Via Conductive, No External Wire                     |
| 5   | Manufacturing Method      | PCB Circuit Etching, Vias Connecting Top / Bottom Layer Traces |

### II. Electrical Performance Parameters

| Item                 | Specification                    |
|----------------------|----------------------------------|
| Operating Frequency  | 2400~2480MHz                     |
| VSWR                 | across full frequency band < 1.5 |
| Antenna Gain         | 2.78dBi                          |
| Radiation Efficiency | 2400~2480MHz > 60%               |

|                   |     |
|-------------------|-----|
| Nominal Impedance | 50Ω |
|-------------------|-----|

### III. Board Structure Parameters

1. Substrate: FR4 fiberglass board, thickness 1.0mm, copper foil 10Z (35μm)
2. Structure: Via board; antenna traces printed on the top layer, key points connected to the bottom-layer auxiliary feeder through metal vias
3. 50Ω microstrip feeder: 1.0mm FR4 board, trace width 0.15mm, short-distance routing
4. Keep-out requirement: No copper pour, no components, no metal traces around the antenna; reserved keep-out area  $\geq 7.5\text{mm}$

### IV. Environmental Parameters

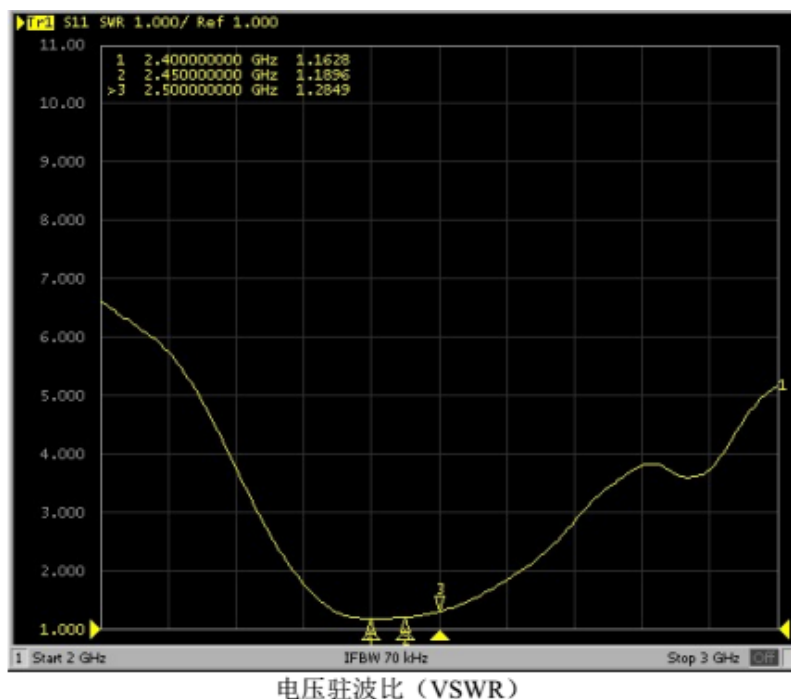
Operating Temperature:  $-30^{\circ}\text{C} \sim +85^{\circ}\text{C}$

Storage Temperature:  $-30^{\circ}\text{C} \sim +85^{\circ}\text{C}$

### V. Measured Data Table

| Freq(M Hz) | Eff(%) | Loss (dB) | Gain(dBi) | DHIS(dB) | Max(dB) | Min(dB) | Directivity (dBi) |
|------------|--------|-----------|-----------|----------|---------|---------|-------------------|
| 2400       | 46.85  | -3.31     | 1.91      | 21.55    | 25.32   | 2.39    | -15.98            |
| 2410       | 48.22  | -3.18     | 2.18      | 22.10    | 26.21   | 2.52    | -16.69            |
| 2420       | 46.61  | -3.33     | 2.17      | 21.02    | 24.39   | 2.18    | -15.51            |
| 2430       | 46.83  | -3.30     | 2.39      | 21.61    | 25.30   | 2.38    | -15.97            |
| 2440       | 48.20  | -3.19     | 2.51      | 22.15    | 26.30   | 2.51    | -16.68            |
| 2450       | 50.92  | -2.94     | 2.78      | 23.22    | 27.75   | 2.78    | -16.88            |
| 2460       | 51.05  | -2.93     | 2.72      | 23.15    | 27.94   | 2.72    | -16.71            |
| 2470       | 51.08  | -2.93     | 2.65      | 23.21    | 28.01   | 2.65    | -15.99            |
| 2480       | 50.41  | -2.99     | 2.65      | 23.68    | 28.77   | 2.65    | -15.20            |
| 2490       | 50.79  | -2.96     | 2.49      | 24.33    | 29.38   | 2.49    | -14.69            |

|      |       |       |      |       |       |      |        |
|------|-------|-------|------|-------|-------|------|--------|
| 2500 | 50.81 | -2.96 | 2.39 | 23.90 | 28.85 | 2.39 | -14.60 |
|------|-------|-------|------|-------|-------|------|--------|



## VI. Routing & Via Process Requirements

1. The antenna shall be placed at the PCB edge; routing in the middle area of the board is prohibited.
2. Feeder turns shall be arc-shaped as much as possible to minimize right angles.
3. The feeding point shall be connected via metal vias; standard via diameter is 0.3mm.
4. LC matching pads shall be reserved at the RF end for convenient matching debugging.

## VII. Test Description

Test Instrument: Vector Network Analyzer 2GHz~3GHz, IFBW 70kHz, tested at room temperature in a shielded anechoic chamber; all full-band parameters meet specifications.

Figure 2: 2400MHz 3D Radiation Pattern & H-Plane Gain Pattern (MH Plane)

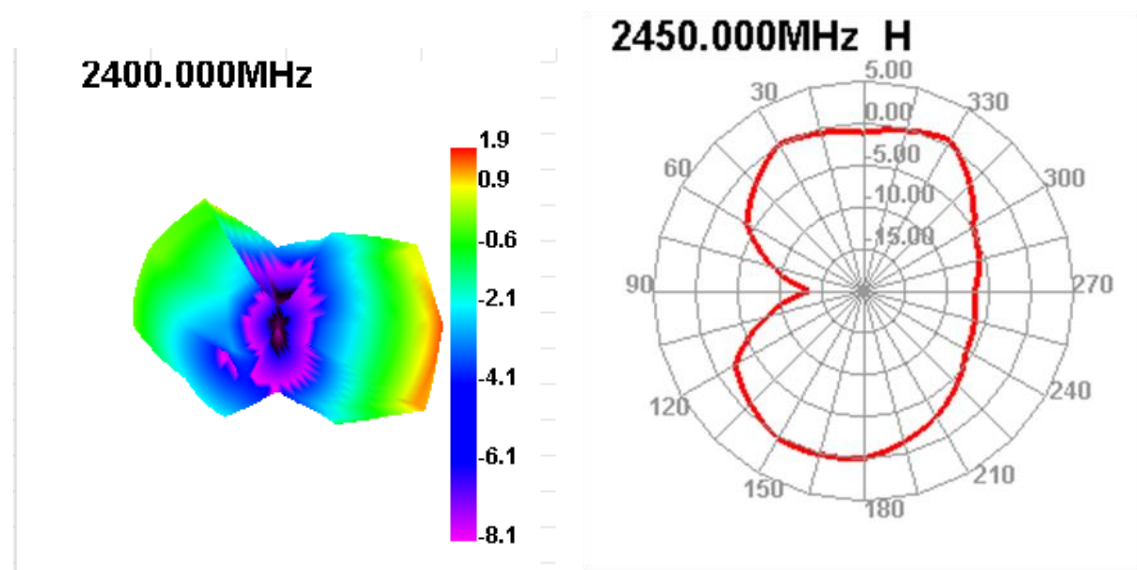
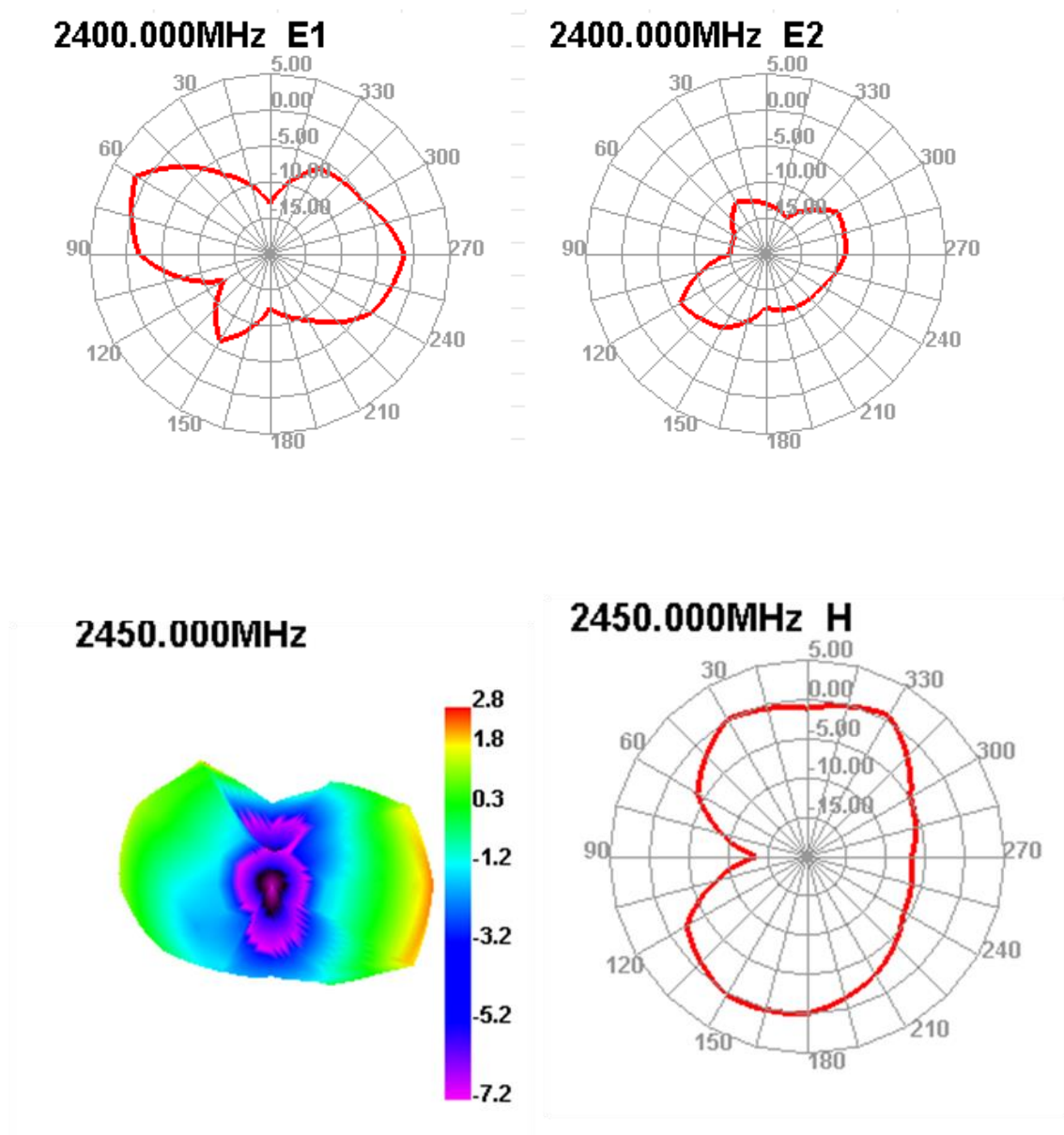
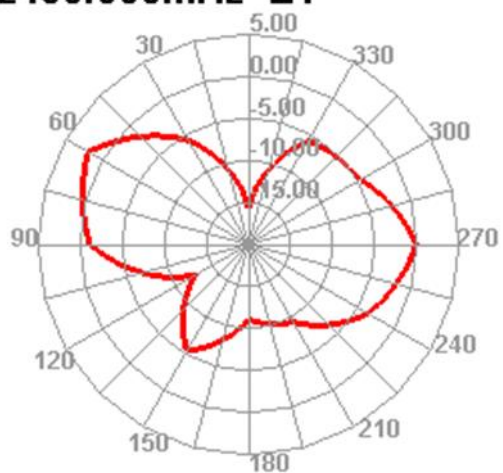


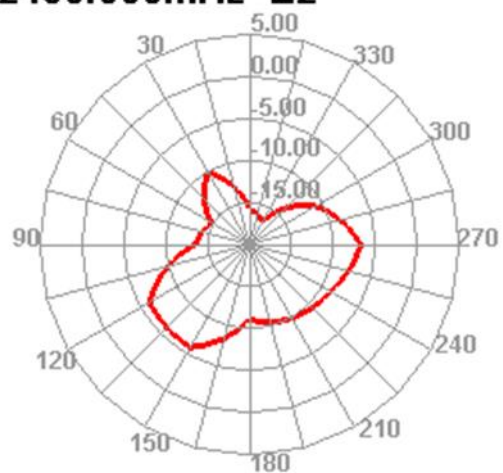
Figure 3: 2400MHz E1, E2-Plane Gain Patterns



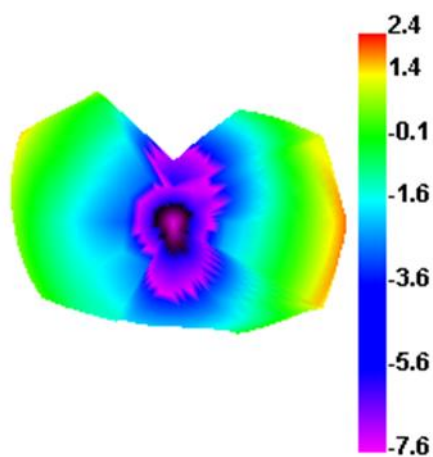
**2450.000MHz E1**



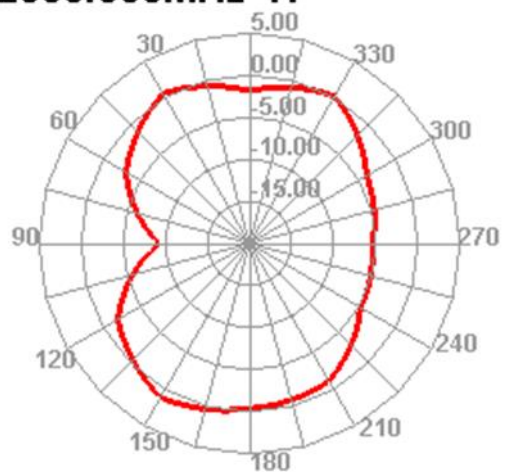
**2450.000MHz E2**



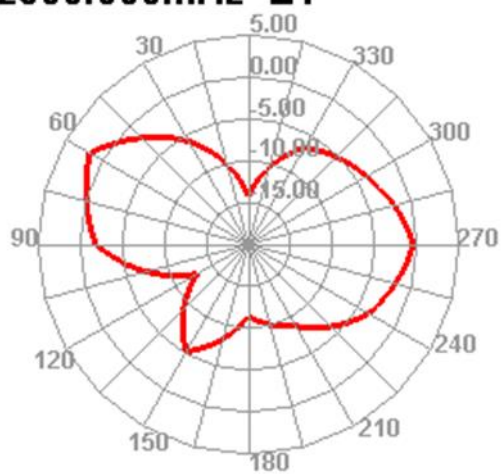
**2500.000MHz**



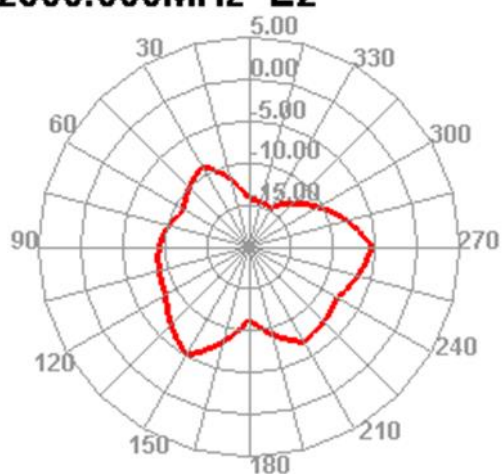
**2500.000MHz H**



**2500.000MHz E1**



**2500.000MHz E2**



## 7.1 Description of M&H (H-Plane / M-Plane) Frequency-Gain Patterns

- 1.M-Plane (Meridional Plane / E-Plane): E1 and E2 polar-coordinate gain patterns, which characterize radiation-gain distribution of the electric-field cross-section.
- 2.H-Plane (Equatorial Plane / H-Plane): The red polar-coordinate curve on the right side of Figure 2, representing the H-plane gain pattern at 2400 MHz.
- 3.Test Conditions: Far-field test in an anechoic chamber, referenced to a  $50\ \Omega$  standard probe; unit: dBi.
- 4.Gain Coverage Band: 2400-2480 MHz. Maximum measured gain: 2.78 dBi @2450 MHz; Minimum measured gain:1.91 dBi @2400 MHz.

Figure 4: Antenna Layout Drawing

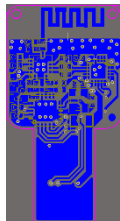
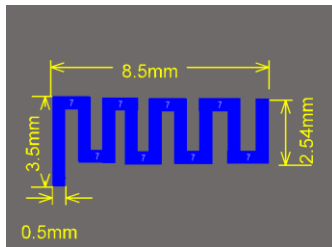


Figure 5: Antenna Dimension Drawing



## 7.2 Supplementary Description for Antenna Layout and Dimensions

Antenna Body: Etched trace on PCB top-layer. Outline dimension: 8.5 mm(L) ×2.54 mm(W), copper trace width:0.50 mm.

1. Antenna Body: Etched trace on PCB top-layer. Outline dimension: 8.5 mm(L) ×2.54 mm(W), copper trace width:0.50 mm.
2. Feed Via: Hole diameter  $\Phi 0.3$  mm, provides electrical conduction between top-layer antenna and bottom-layer auxiliary feed trace.

3.50  $\Omega$  Microstrip Feed Line: Trace width 0.5 mm, physical feed-line length 8.5 mm.

4. Layout Constraints of PCB Prototype: The antenna unit is placed at the PCB edge. The actual achieved clearance around the antenna is 4.3 mm. No copper pour, components or metal traces are arranged within the clearance zone.

Remark: 7.5 mm is the ideal recommended clearance for this antenna design. Restricted by the overall mechanical structure of this RC car product, only 4.3 mm clearance is realized on the actual hardware. All test data in this report including VSWR, gain and radiation efficiency are obtained from anechoic-chamber tests using the prototype PCB with 4.3 mm clearance.