

Antenna Specification

Antenna Type: Meander-line Monopole PCB On-board Antenna

Application: 2.4GHz Band Wireless Devices

Remark: This antenna is implemented by PCB copper trace without independent component model. The final performance depends on PCB layout, substrate material, mechanical structure and RF matching circuit.

1. Product Overview

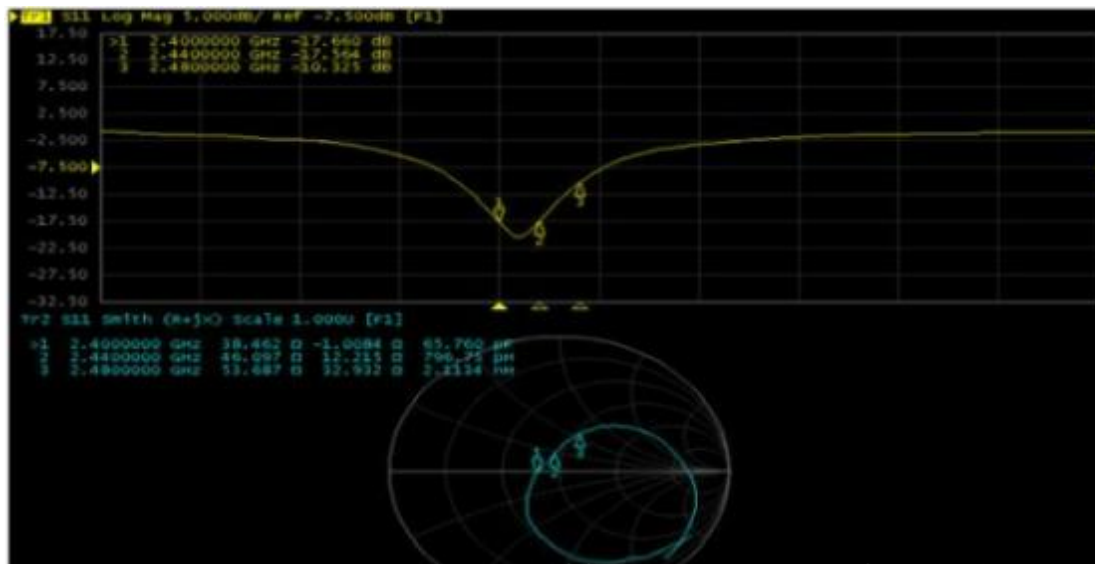
This antenna is a meander-line monopole radiator designed on the top PCB layer, operating in the 2400~2484 MHz ISM band for wireless communication applications. It eliminates external antenna components and reduces BOM cost. An RF matching network is mandatory to match the antenna impedance to 50Ω system impedance. Antenna performance is sensitive to nearby metal parts, battery, shield cover, housing and human hand effect. Full OTA testing with complete assembly is required for final verification.

2. Electrical Specifications

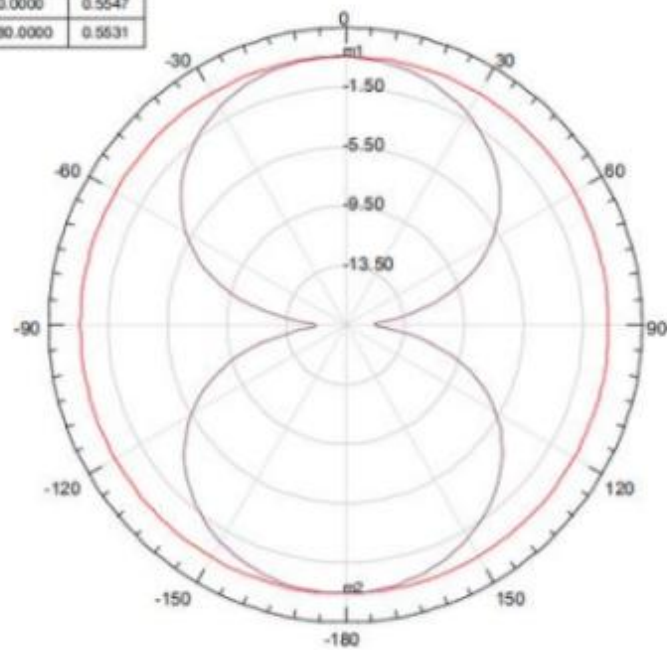
Parameter	Specification	Remarks
Frequency Range	2400MHz ~ 2484MHz	2.4GHz ISM band for BLE / 2.4G RF
Antenna Type	PCB Meander-line Monopole	Top layer copper radiator
System Impedance	50Ω	Tuned by L-type / Π-type matching network
VSWR	≤ 2.0	With full product assembly & housing
Return Loss (S11)	≤ -10dB	Within full operating bandwidth
Peak Gain	1.71dBi Max	Typical for PCB onboard antenna

Radiation Efficiency	$\geq 40\%$	Ideal environment without metal obstruction
Polarization	Linear	Near omnidirectional radiation
EMC Compliance	Meet FCC Part15 / CE-RED	EIRP complies with regional certification requirements

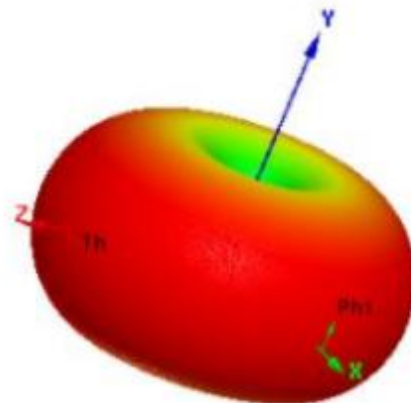
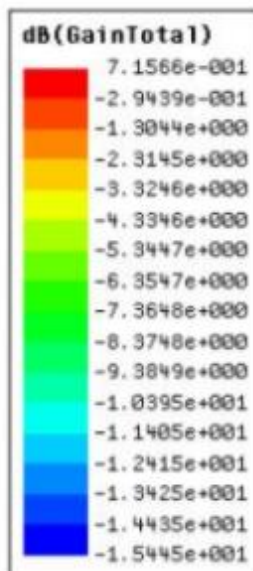
Center Frequency	Horizontal			Vertical		
	2400MHz	2450MHz	2500MHz	2400MHz	2450MHz	2500MHz
	0.84	1.66	1.71	-6.16	-3.65	-2.21



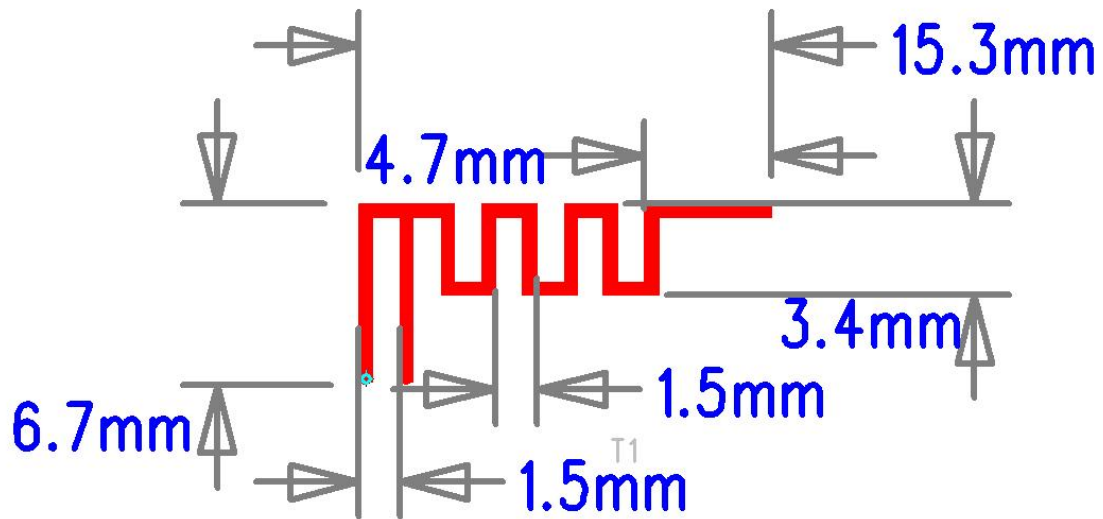
Name	Theta	Ang	Mag
m1	0.0000	0.0000	0.5547
m2	180.0000	180.0000	0.5531



Curve Info
dB(GainTotal)
Setup1 : Sweep1
Phi=0deg
dB(GainTotal)
Setup1 : Sweep1
Phi=90deg



3. Antenna DIMENSIONS & PCB Layout & Mechanical Requirements



Item	Specification	Description
PCB Material	FR-4	$\epsilon_r=4.2\sim4.4$, $\tan\delta\approx0.02$
PCB Thickness	0.8~1.0mm	1.0mm preferred
Antenna Layer	Top Layer	Inner layer antenna is prohibited
Trace Width	0.4~0.6mm	Keep uniform width
Total Trace Length	25~30mm	1/4 wavelength in FR4; reserve 2~3mm trimming margin
Clearance Rule	Full clear zone	No GND copper, no traces, no vias under antenna radiator
Isolation Distance	$\geq 5\text{mm}$	Keep away from battery, shield, connector and metal parts
GND Layout	GND only at feed side	GND shall not extend into meander radiator area

4. RF Matching Circuit Requirement

1. The original impedance of this PCB antenna is 15~25 Ω . A dedicated **L-type or Π -type LC matching network** is required between RF chip port and antenna feed point

to achieve 50Ω impedance matching.

2. Use high-frequency RF grade capacitor & inductor (0402/0603 package). Ordinary power inductors are not allowed for RF matching.
3. Tuning procedure: Adjust matching components based on VNA S11 measurement to ensure $S_{11} \leq -10\text{dB}$ across 2400~2484MHz after full assembly.
4. RF signal trace shall be 50Ω controlled impedance, short and direct with minimal vias.

5. Environmental Conditions

Operating Temperature	-40°C ~ +85°C
Storage Temperature	-40°C ~ +85°C
Humidity	5%~95%RH, non-condensing

6. Acceptance Criteria

All tests shall be performed with **full product assembly (housing, battery and all components)** under actual usage state.

1. Return Loss: $S_{11} \leq -10\text{dB}$ in 2400~2484MHz;
2. Antenna radiation efficiency $\geq 40\%$;
3. OTA performance (sensitivity & EIRP) meets product specification and certification standards;
4. No severe performance degradation under hand grip test.

7. Important Notes

1. The antenna projection area must keep fully clear without GND copper and vias. Ground coverage will cause detuning and severe communication distance attenuation.
2. Metal housing, shield can and battery must not cover or approach the antenna radiator.
3. Reserve trimming margin at antenna tail for frequency tuning during prototype verification.
4. Plastic housing is acceptable. High permittivity plastic may cause frequency offset and require re-matching.
5. All specifications are for reference; final performance is subject to OTA chamber test results.

