



Quectel

Nanjing Autoai Technology/South Korea Ssangyong Motor IVI Antenna Debugging Report

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Revision History



Revision	Date	Reporter	Reviewer	Note
1.0	2023/12/12	Jialin.Chen	Tony.Dai	First Prototype Debugging Antenna
1.1	2023/12/19	Jialin.Chen	Tony.Dai	Added WIFI OTA data
1.2	2024/02/02	Jialin.Chen	Tony.Dai	Verify X2 version antenna sample and update OTA data
1.3	2024/03/04	Jialin.Chen	Tony.Dai	Verify X3 version antenna sample and update OTA data
1.4	2024/03/30	Jialin.Chen	Tony.Dai	Verify OTA data of the latest machine



Project Overview

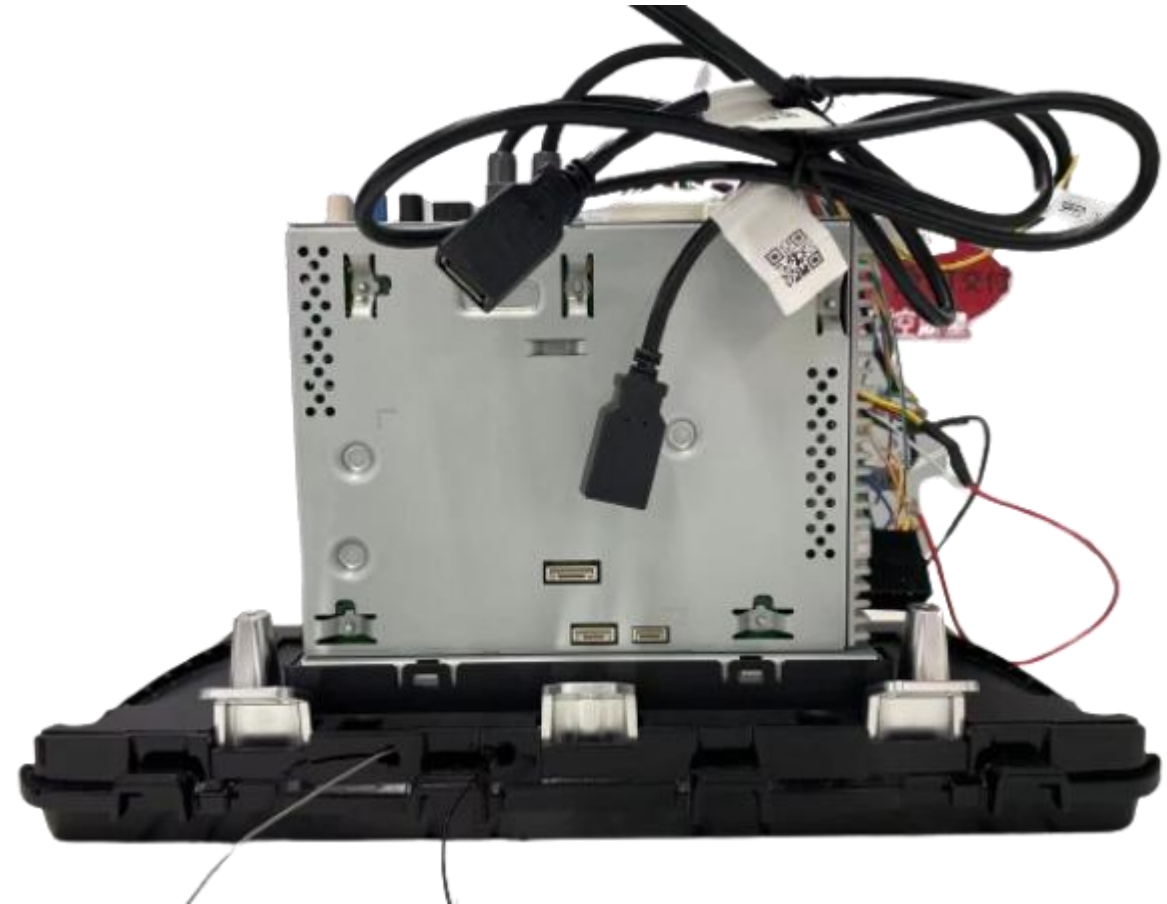
Antenna Performance Evaluation and Debugging
Conclusion and Suggestion

Build a Smarter World



Project Overview

- Device Dimensions: 325*155*190mm
- Mainboard Dimensions: 162mm*139mm
- Antenna Quantity: 2
- Antenna OC:Y0SWZ00A0AA/Y0SWZ00A0BA
- Network Standard and Frequency Band:
 - ✓ WiFi*1: 2400-2500MHz&5150-5850MHz
 - ✓ BT*1: 2400-2500MHz
- Module Model: NF3406
- Performance Requirements:
 - Efficiency: TBD
 - Isolation : TBD



Prototype Schematic



Project Overview

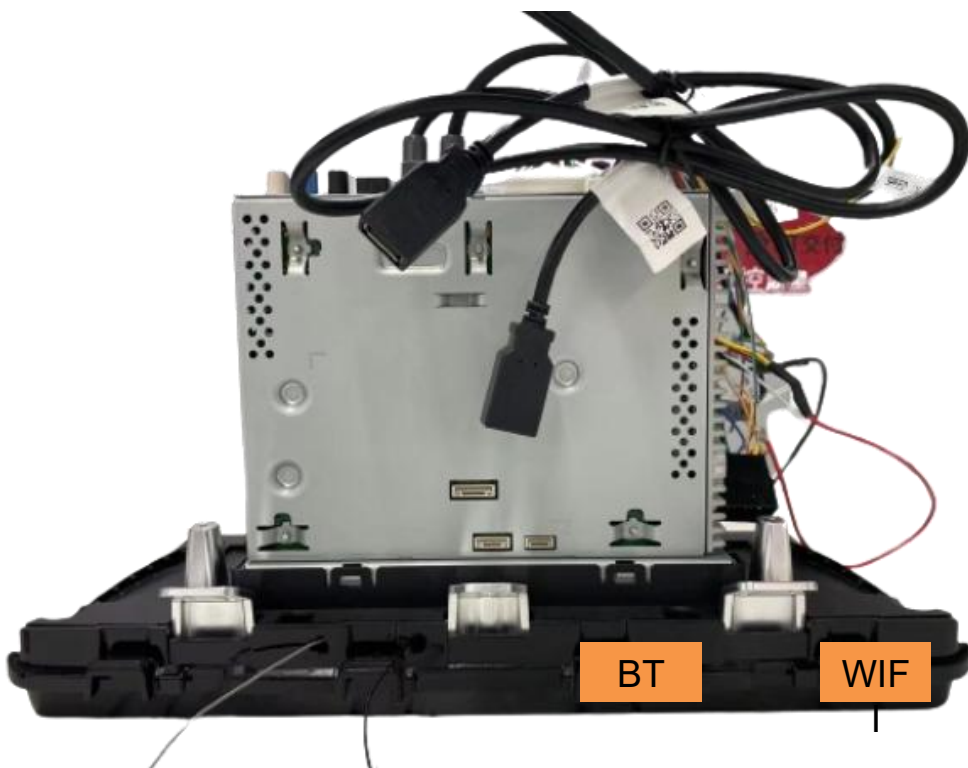
Antenna Performance Evaluation and Debugging

Conclusion and Suggestion

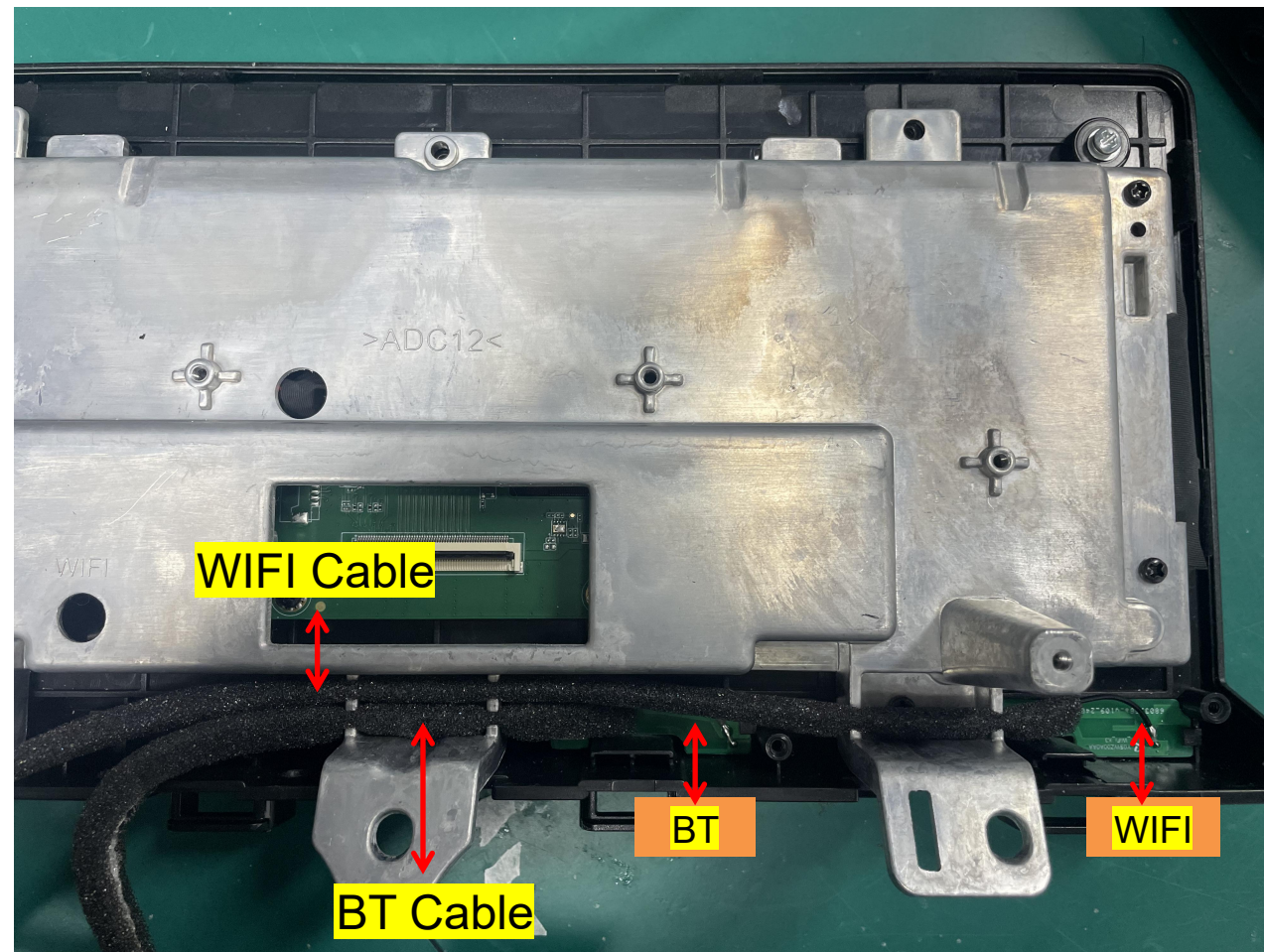
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Antenna Placement Analysis

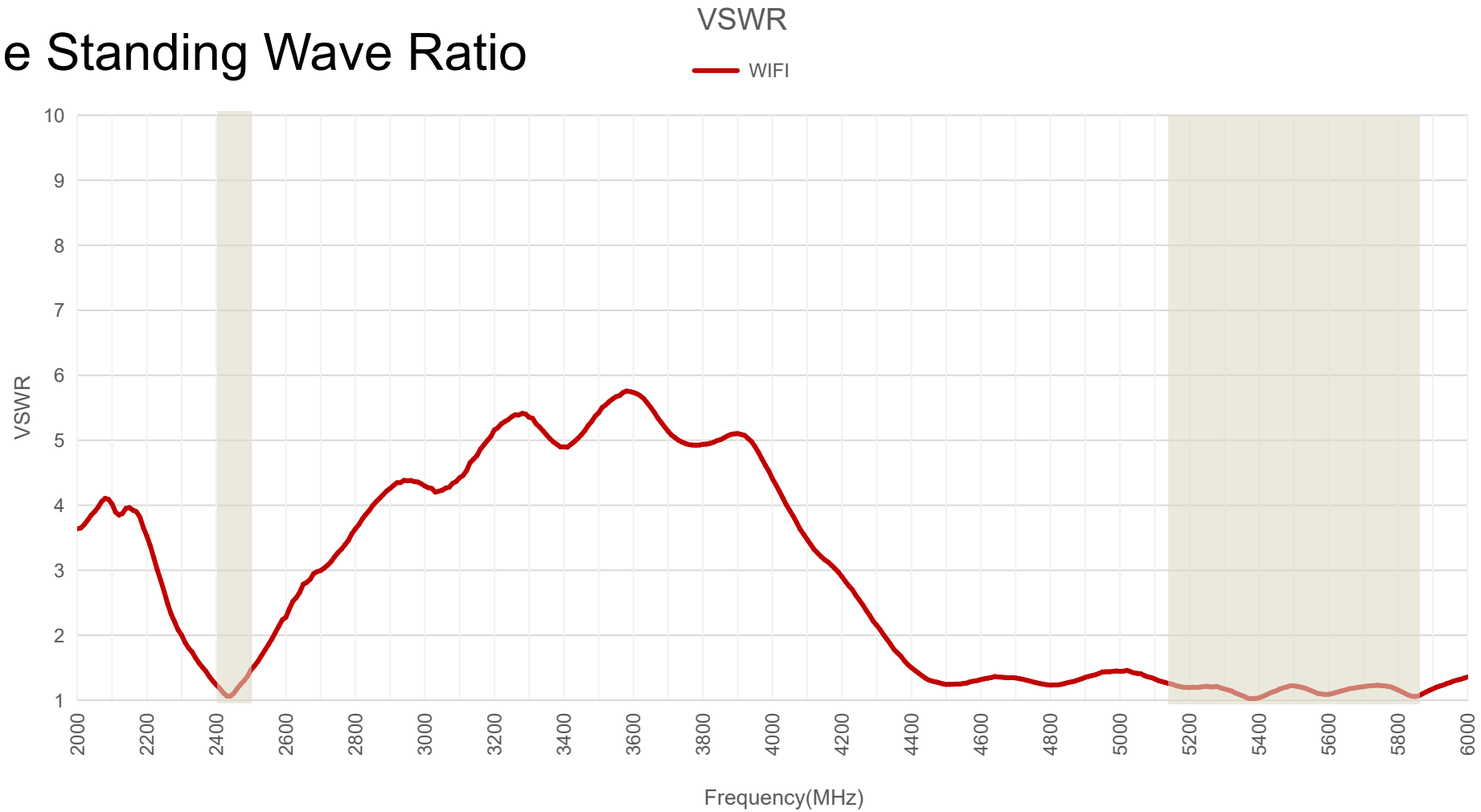


Prototype Schematic



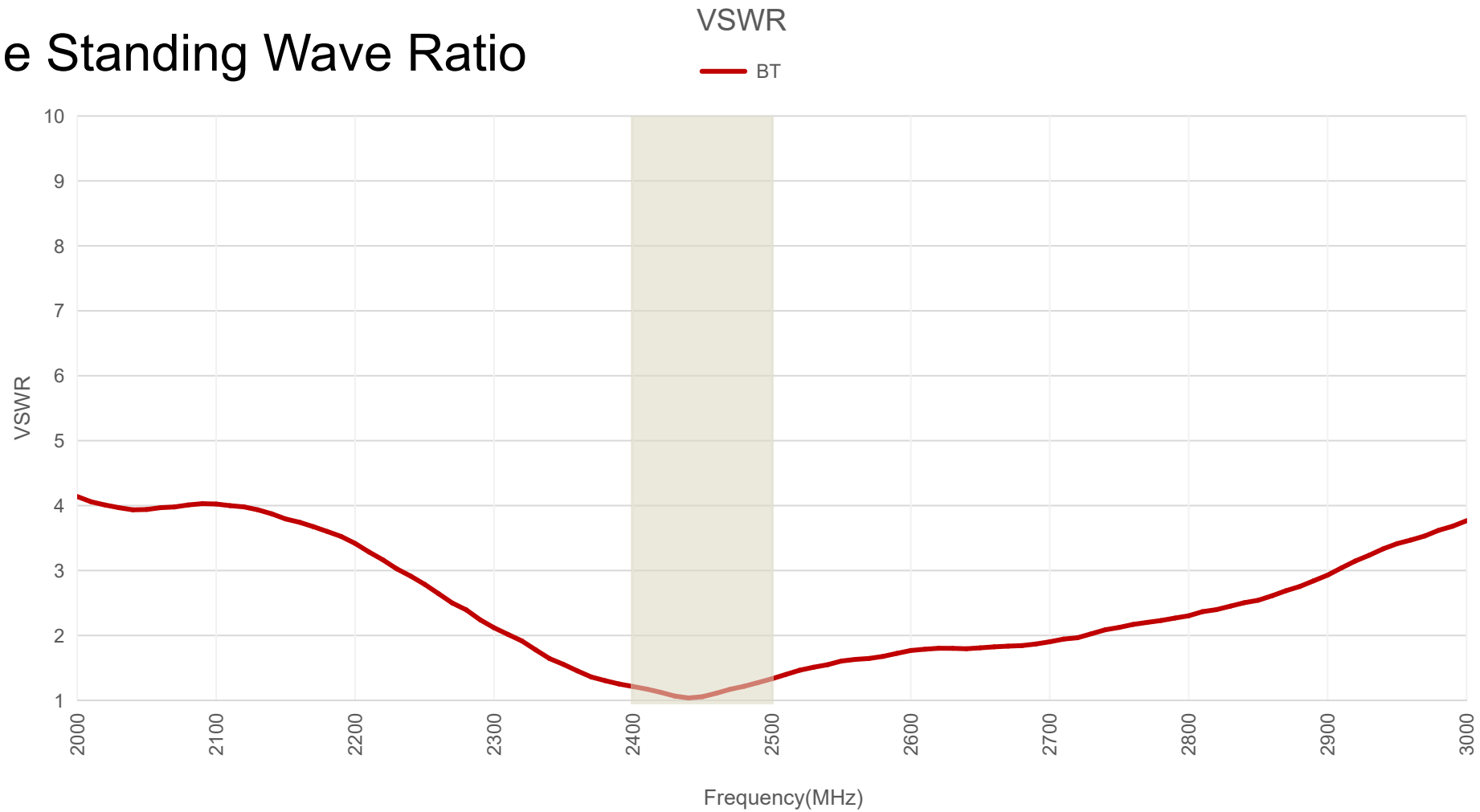
Passive Test

- Voltage Standing Wave Ratio



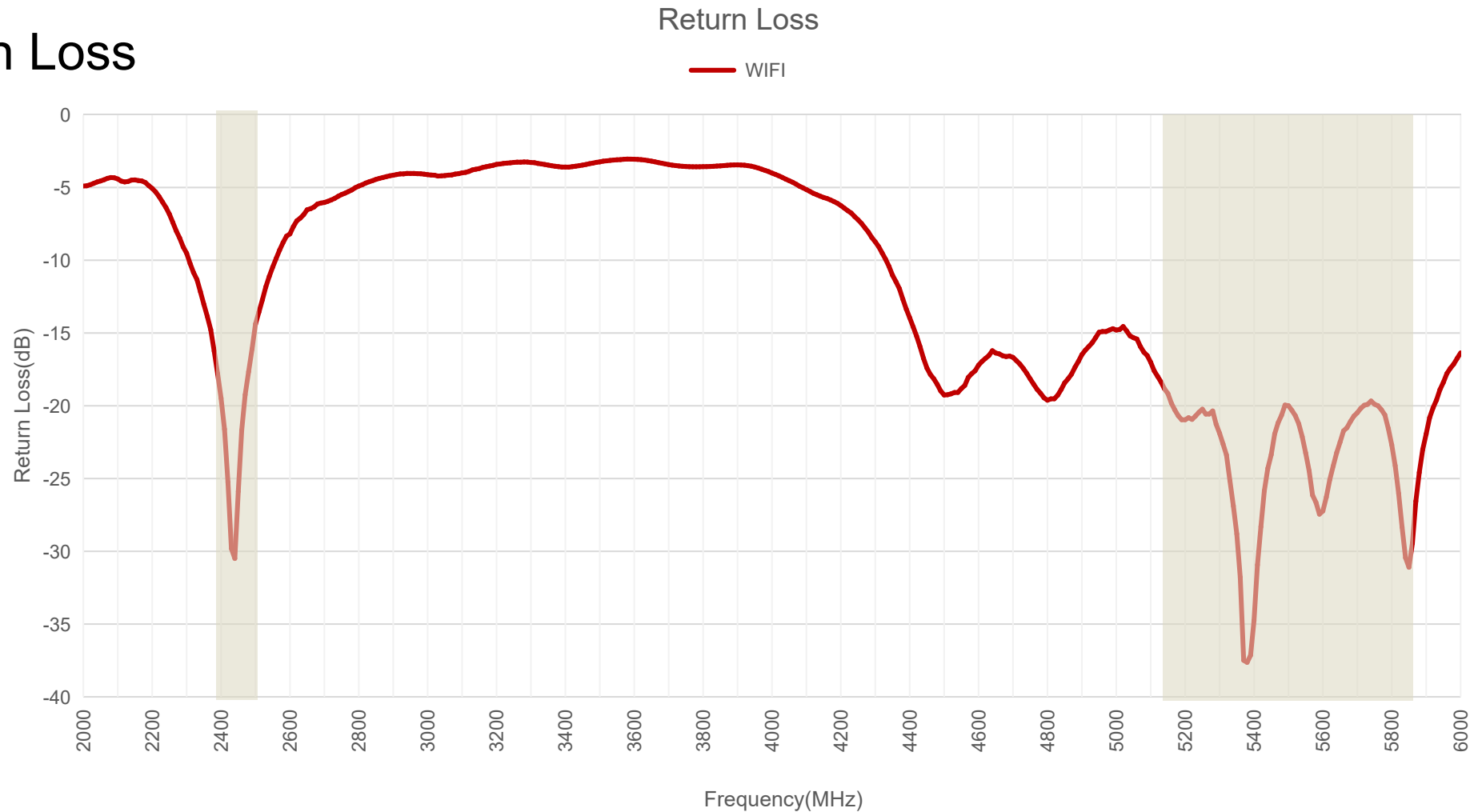
Passive Test

- Voltage Standing Wave Ratio



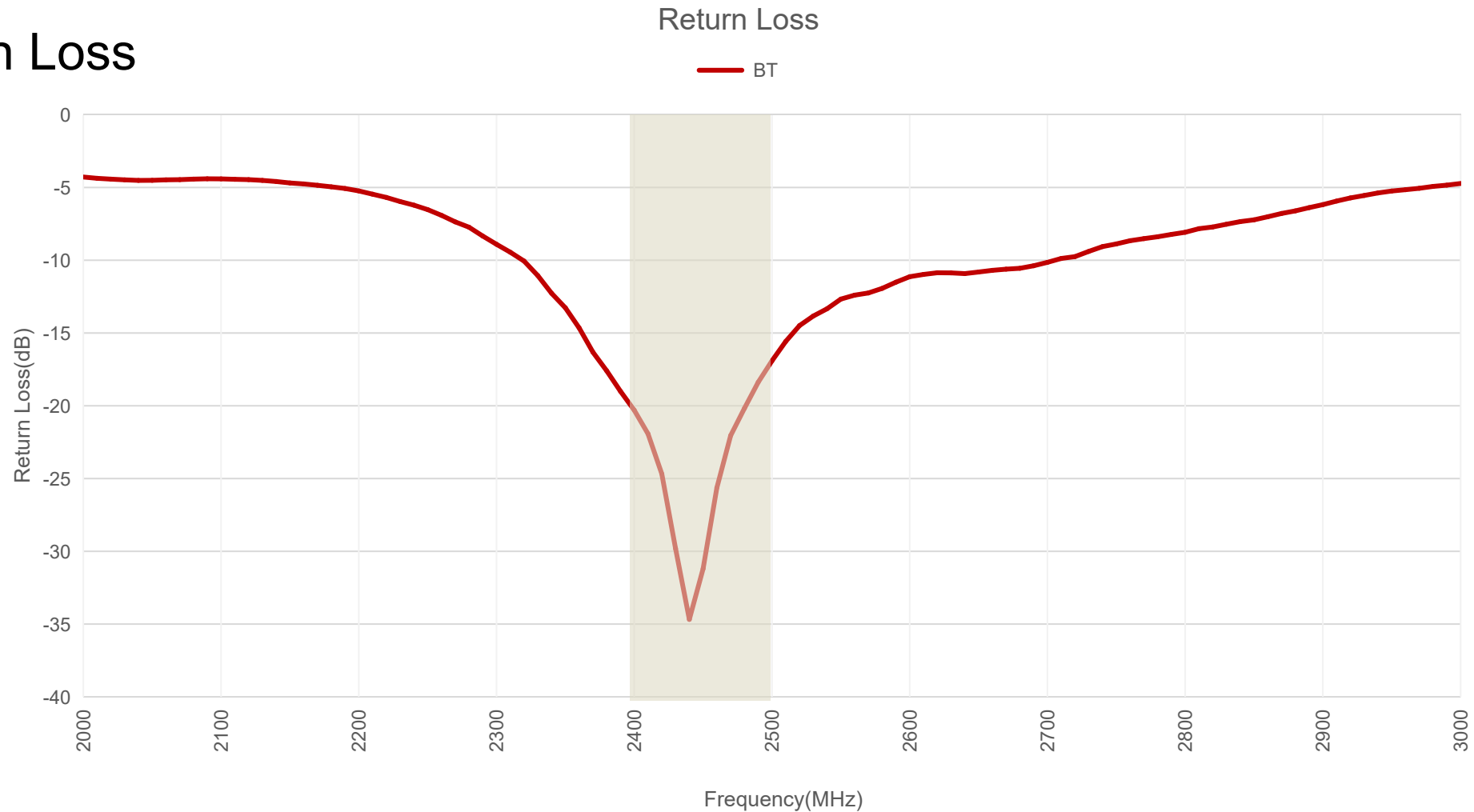
Passive Test

- Return Loss



Passive Test

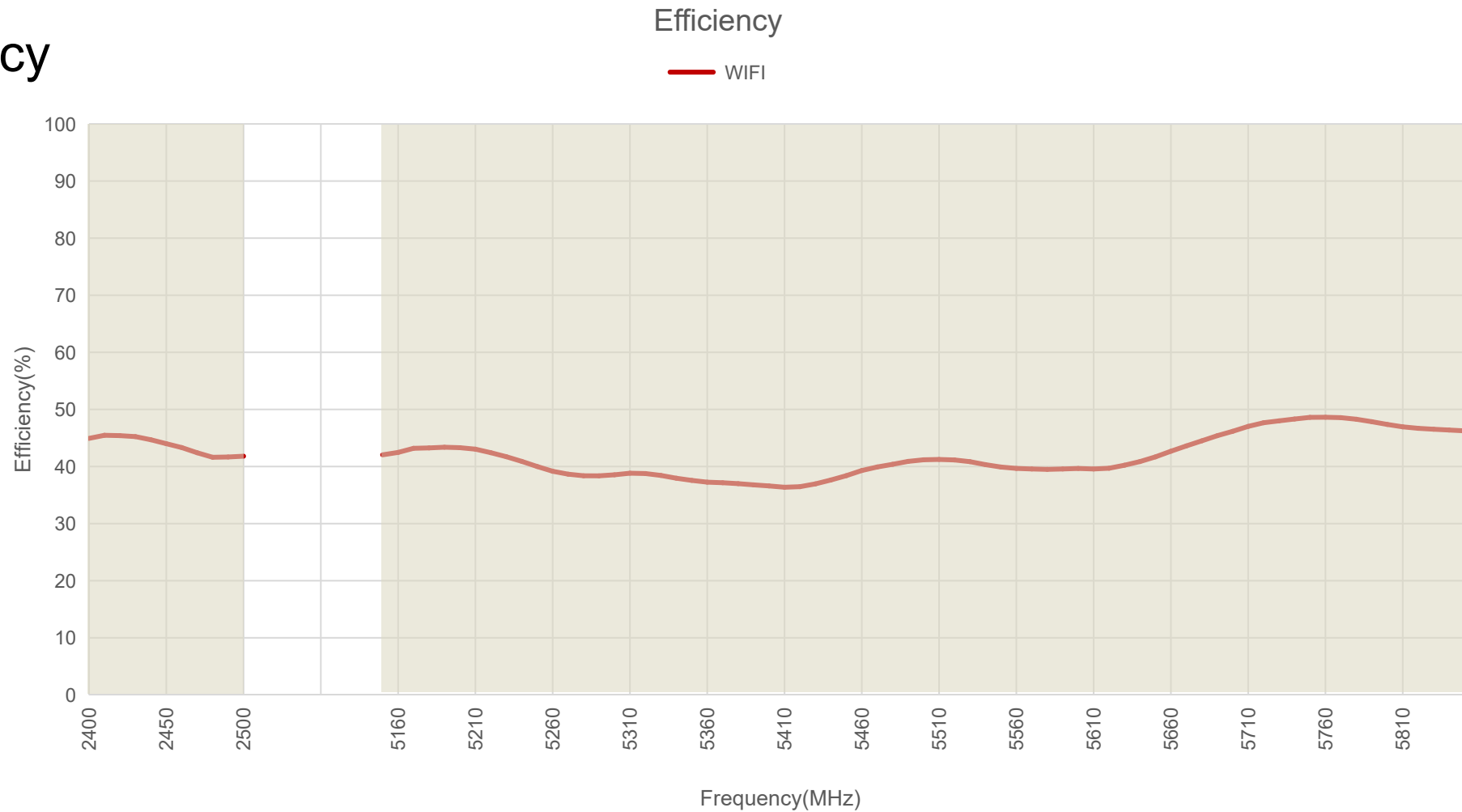
- Return Loss



Frequency(MHz)	2400	2450	2500	reference value
Return Loss(dB)	-20.3	-31.2	-16.9	≤ -6

Passive Test

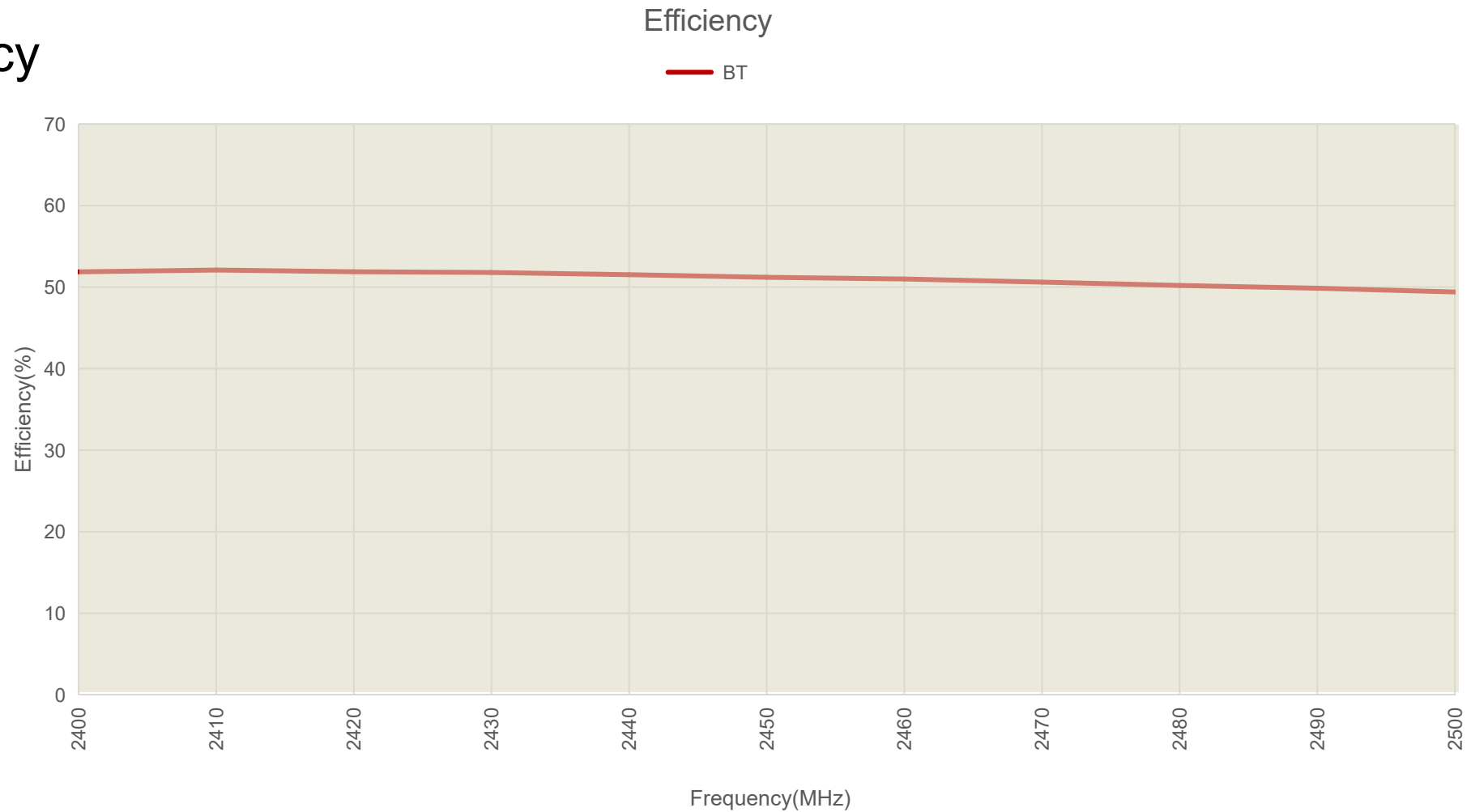
- Efficiency



Frequency(MHz)	2400	2450	2500	5150	5500	5850	reference value
Efficiency(%)	44.9	44.0	41.8	42.1	41.2	46.3	≥30

Passive Test

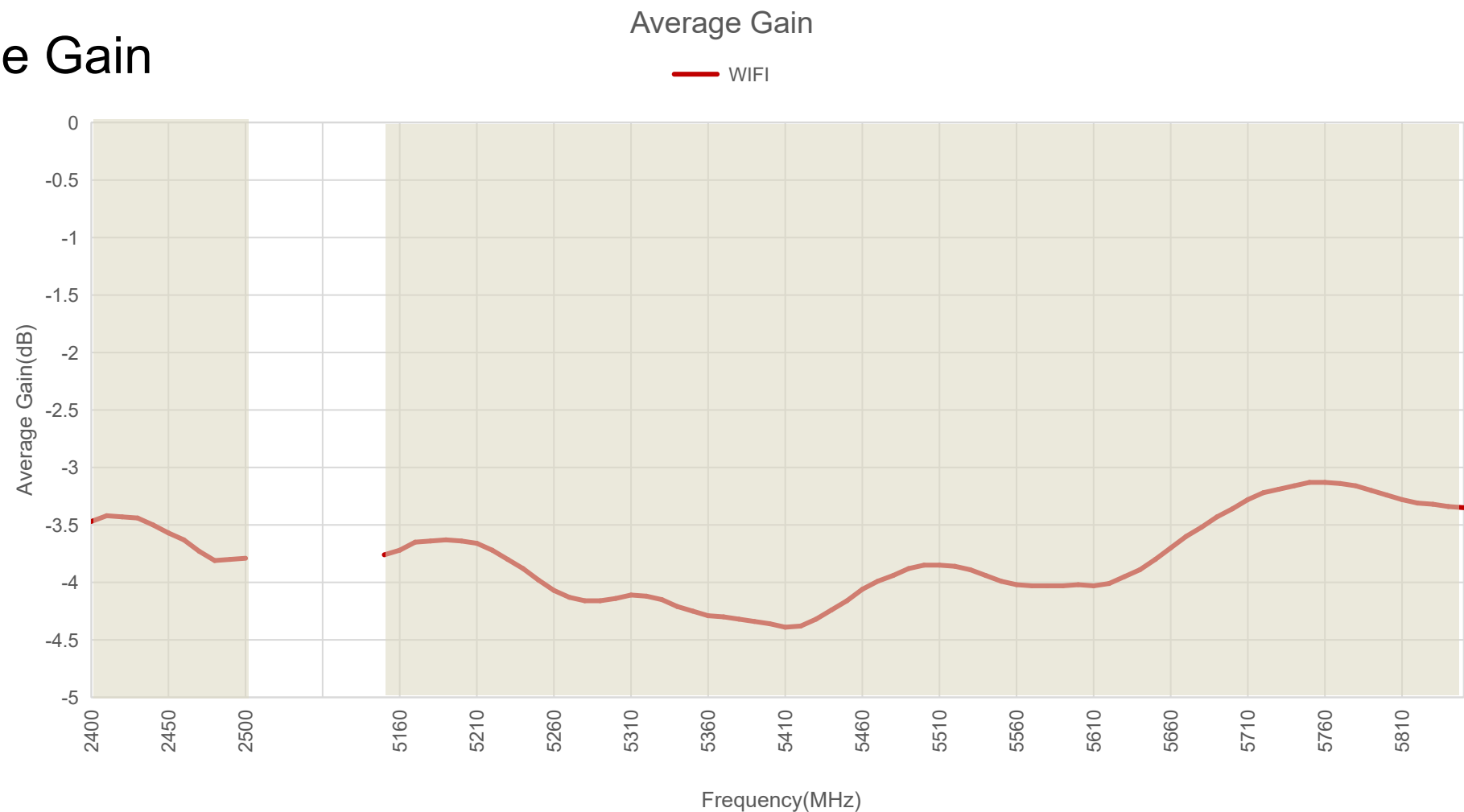
- Efficiency



Frequency(MHz)	2400	2450	2500	reference value
Efficiency(%)	51.9	51.2	49.4	≥30

Passive Test

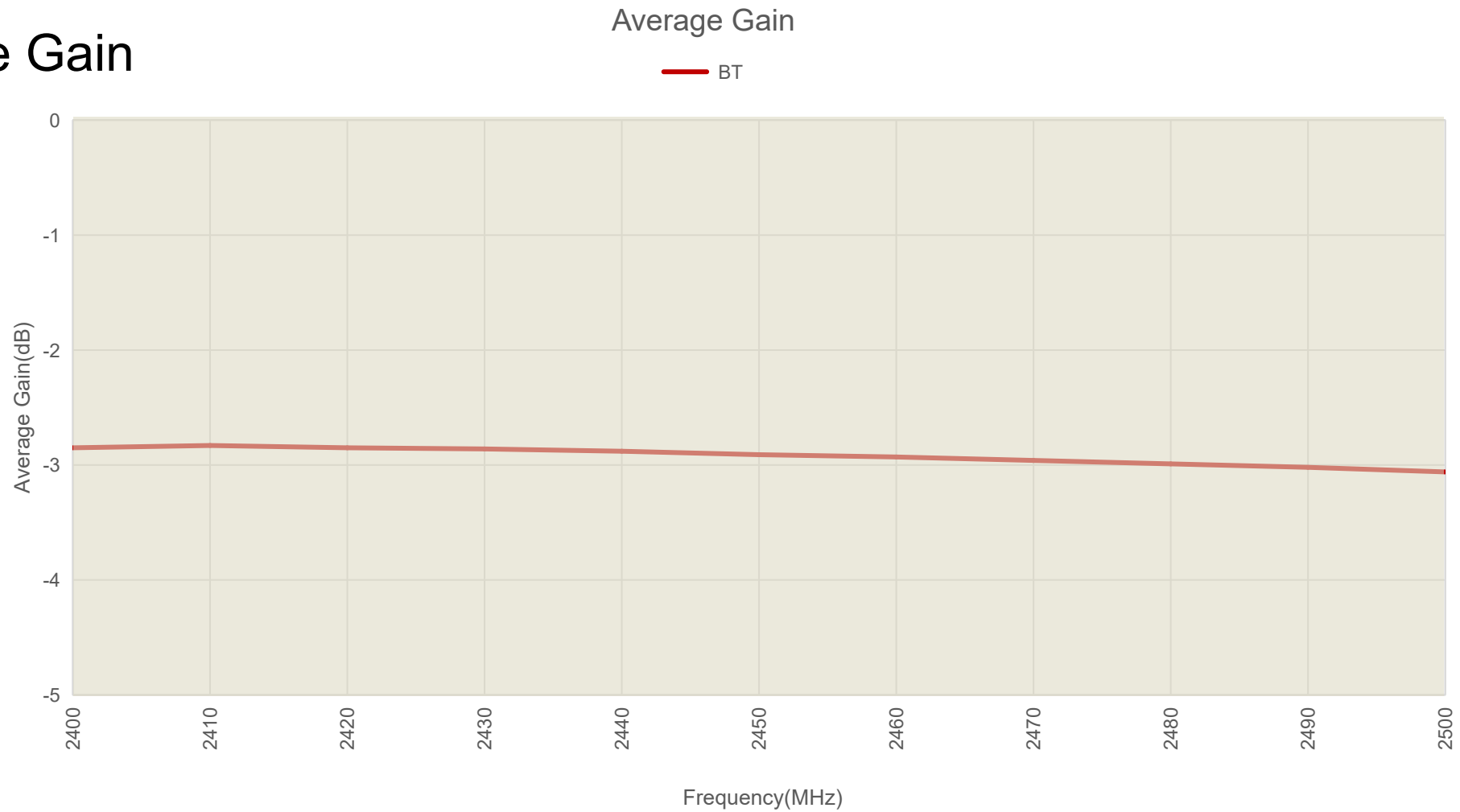
- Average Gain



Frequency(MHz)	2400	2450	2500	5150	5500	5850	reference value
Average Gain(dB)	-3.5	-3.6	-3.8	-3.8	-3.9	-3.4	≥-5.2

Passive Test

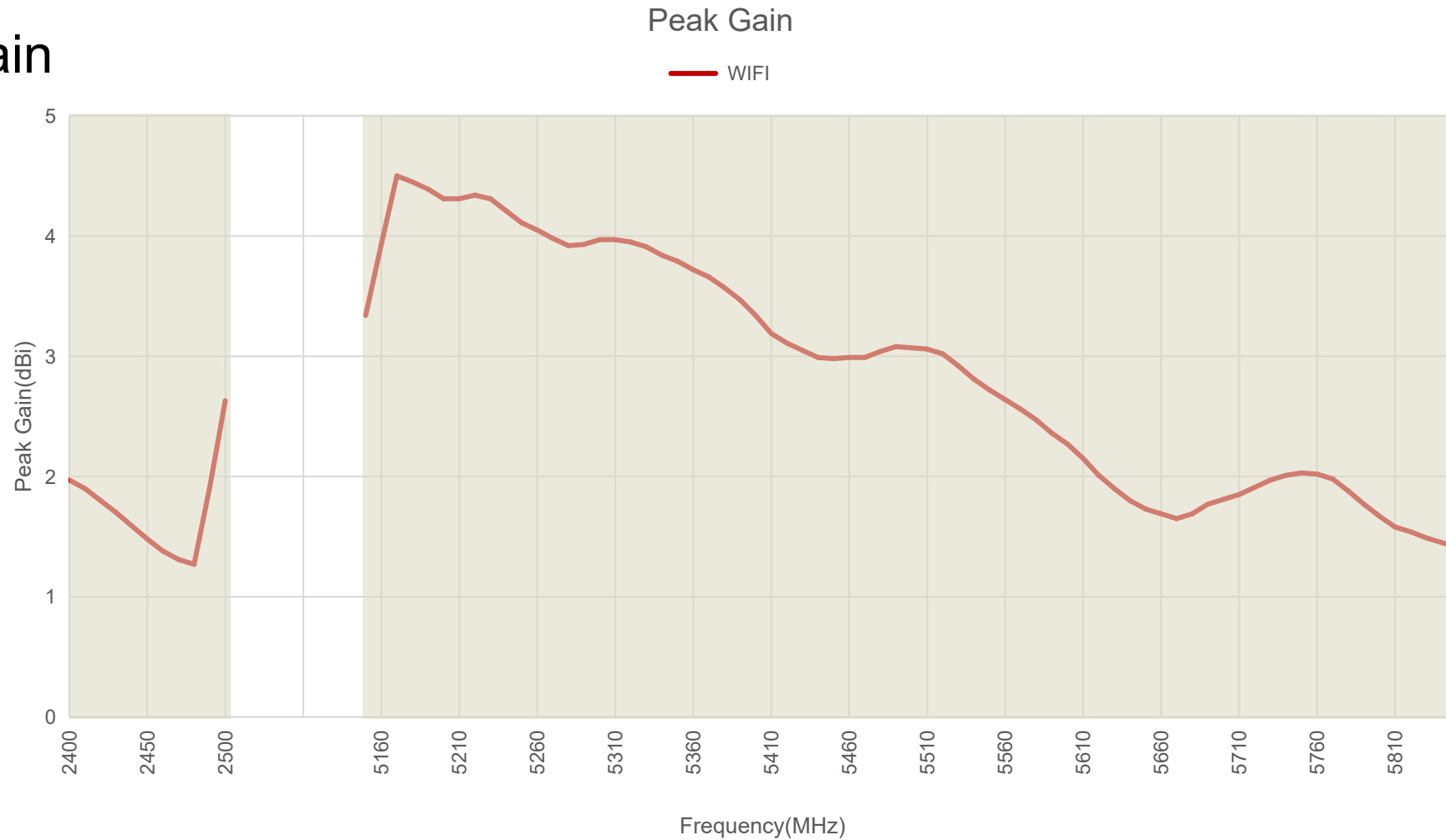
- Average Gain



Frequency(MHz)	2400	2450	2500	reference value
Average Gain(dB)	-2.9	-2.9	-3.1	≥-5.2

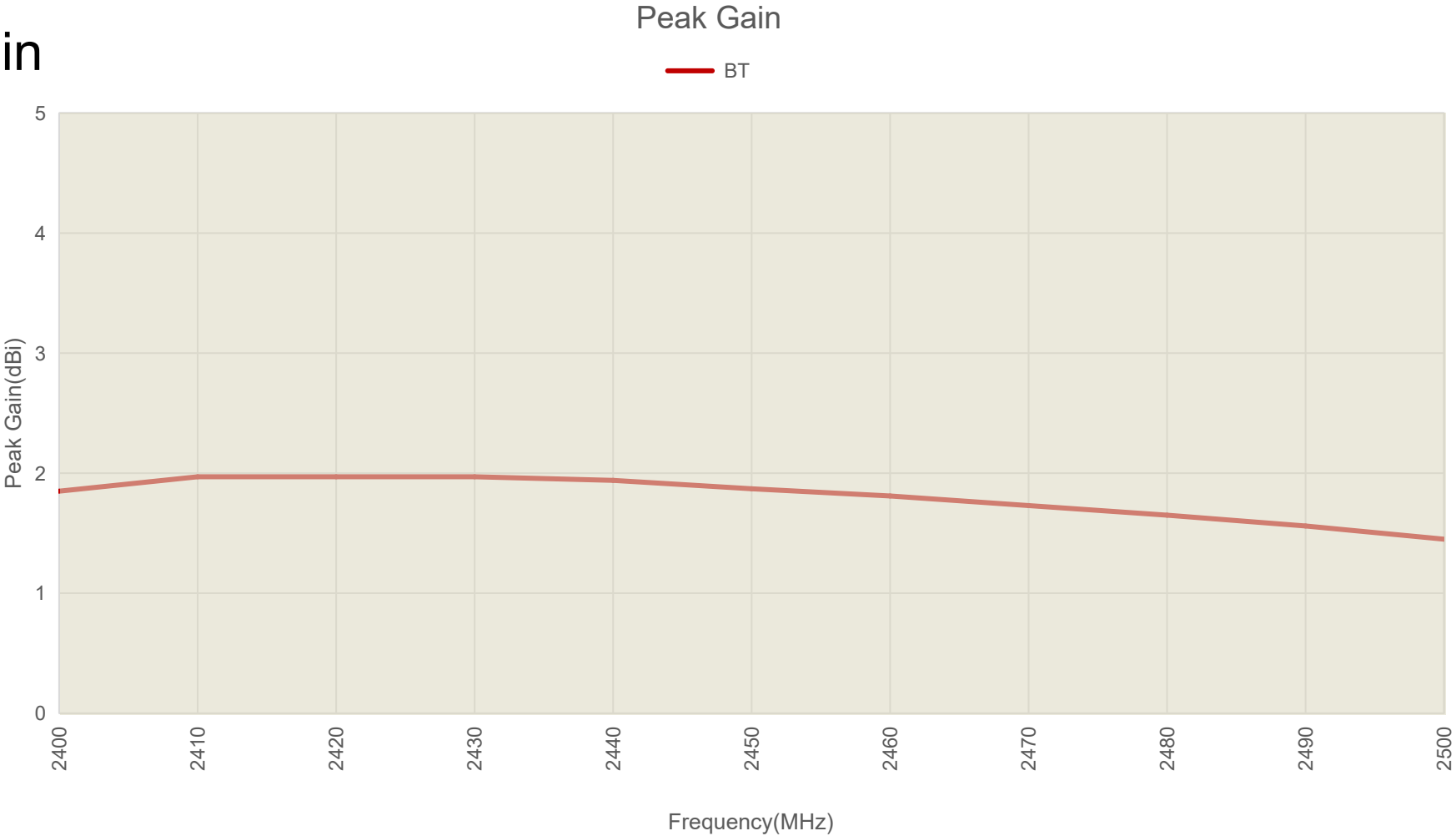
Passive Test

- Peak Gain



Passive Test

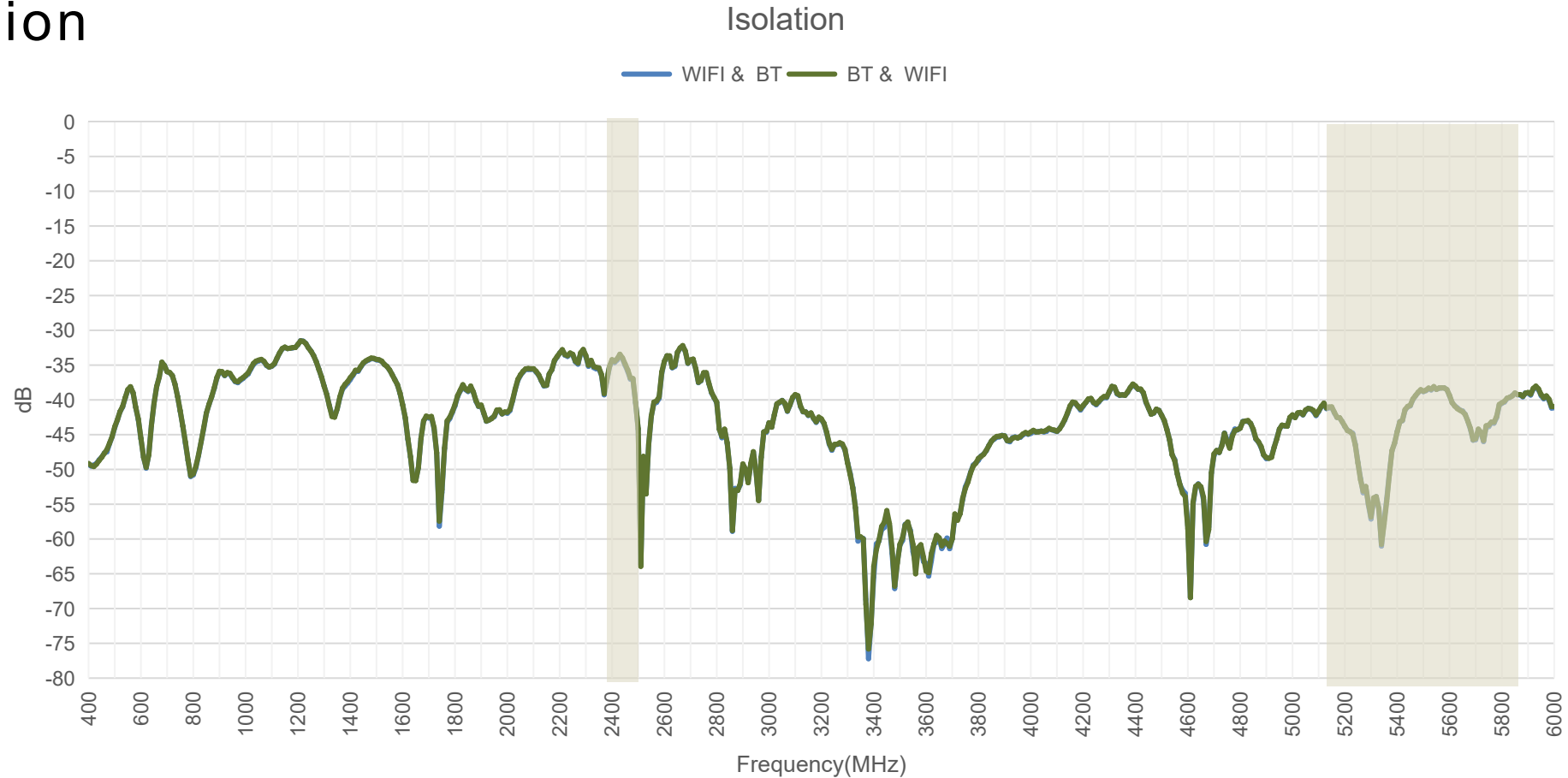
- Peak Gain



Frequency(MHz)	2400	2450	2500	reference value
Peak Gain(dBi)	1.9	1.9	1.5	≥0

Passive Test

- Isolation

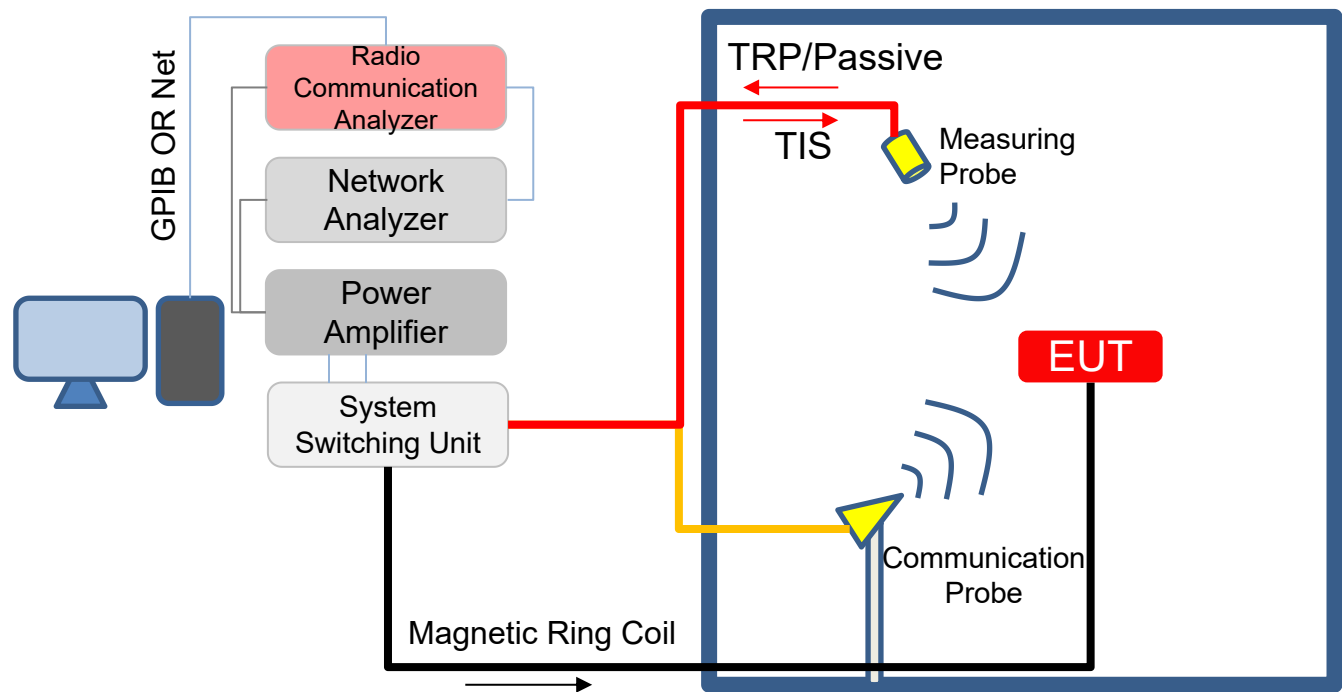


Frequency(MHz)	2400 - 2500	5150 - 5850	reference value
Max Isolation(dB) WIFI	-33.6	-38.2	≤ -10
Max Isolation(dB) BT	-33.4	-38.1	≤ -10

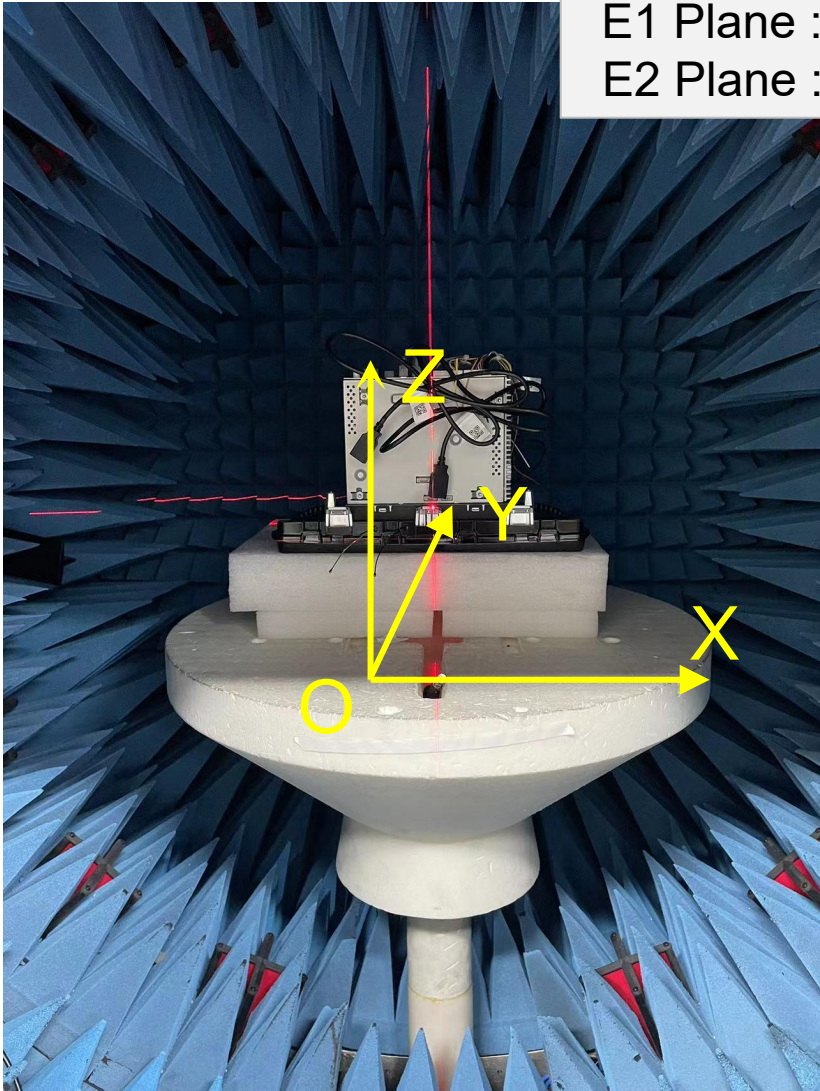
Antenna Test



- Chamber Coordinate System SZ-S-1(ID)

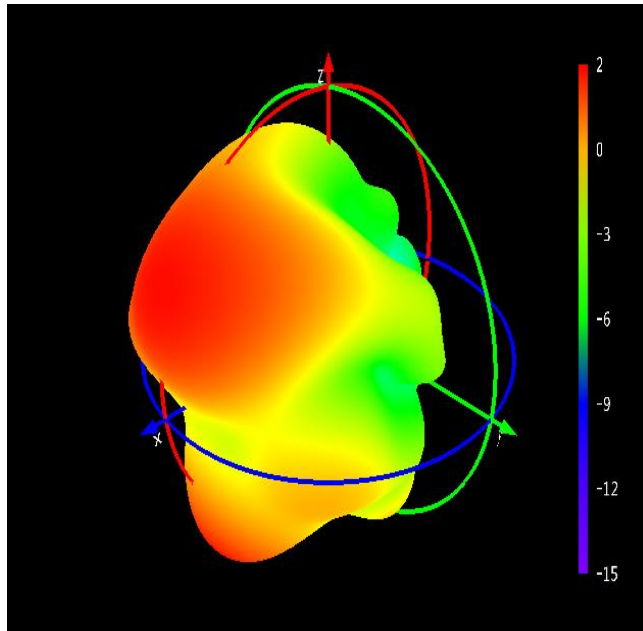


H Plane : XY
E1 Plane : XZ
E2 Plane : YZ

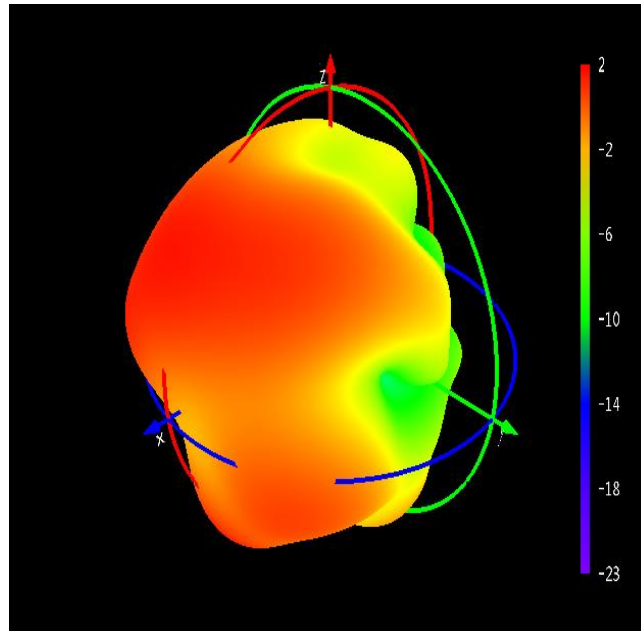


Passive Test

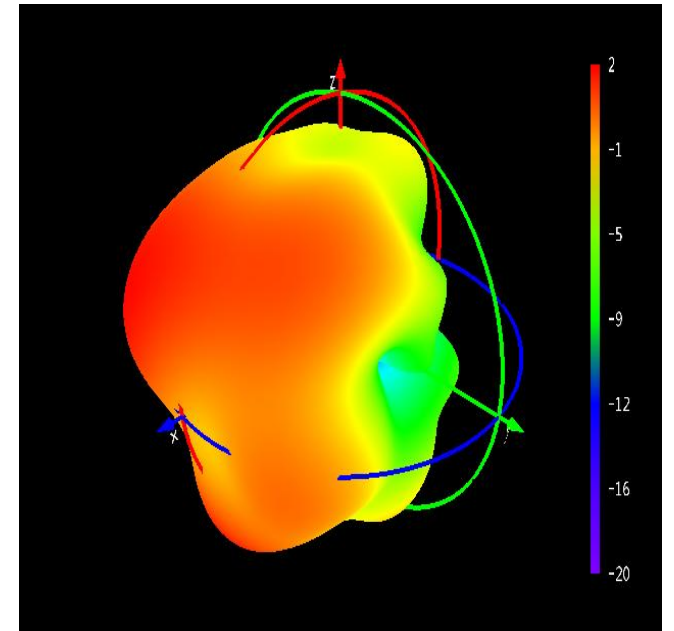
- Radiation Pattern (WIFI)



2400MHz



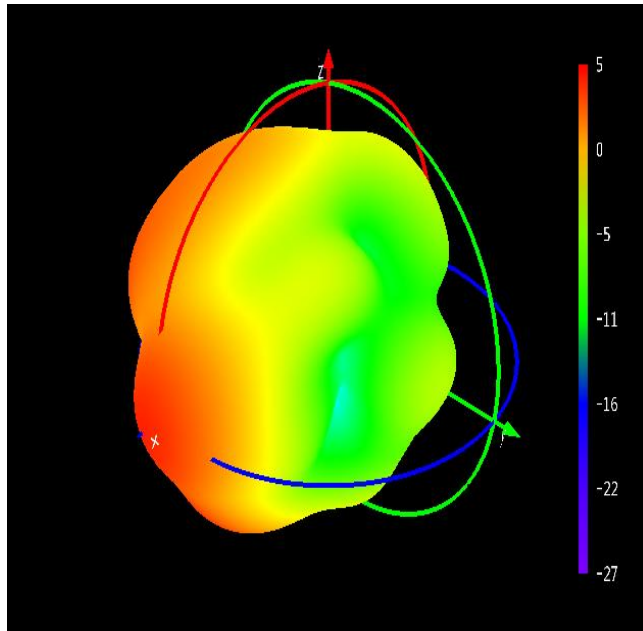
2450MHz



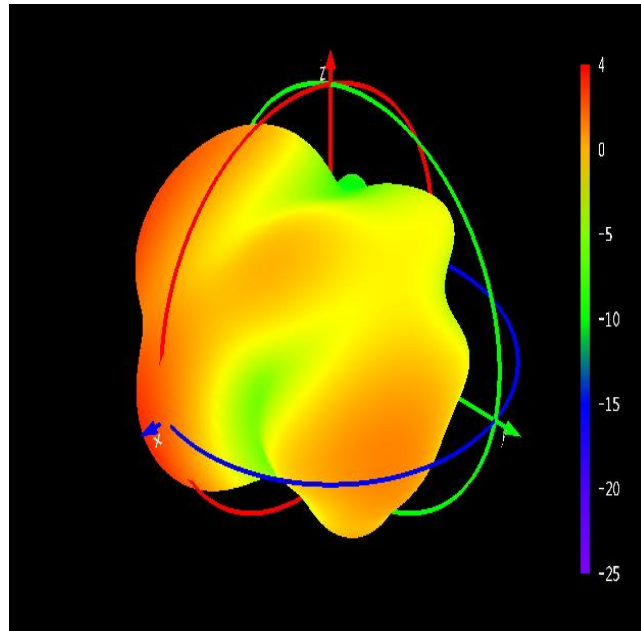
2500MHz

Passive Test

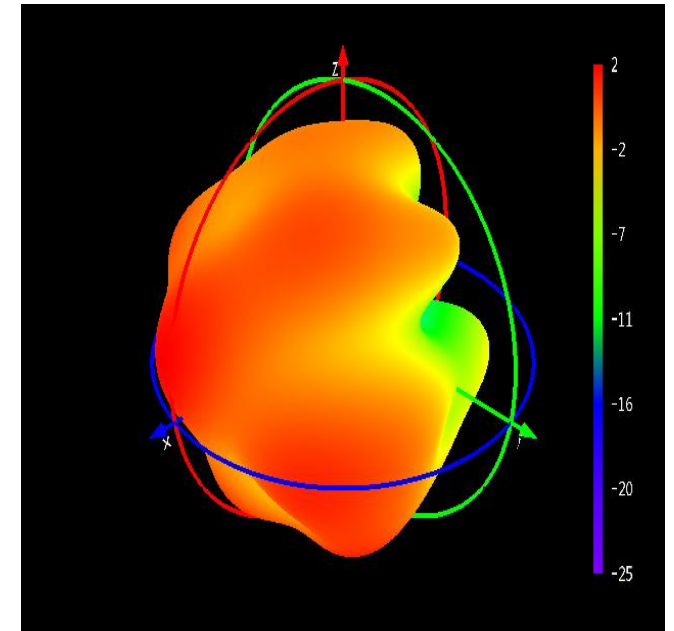
- Radiation Pattern (WIFI)



5150MHz



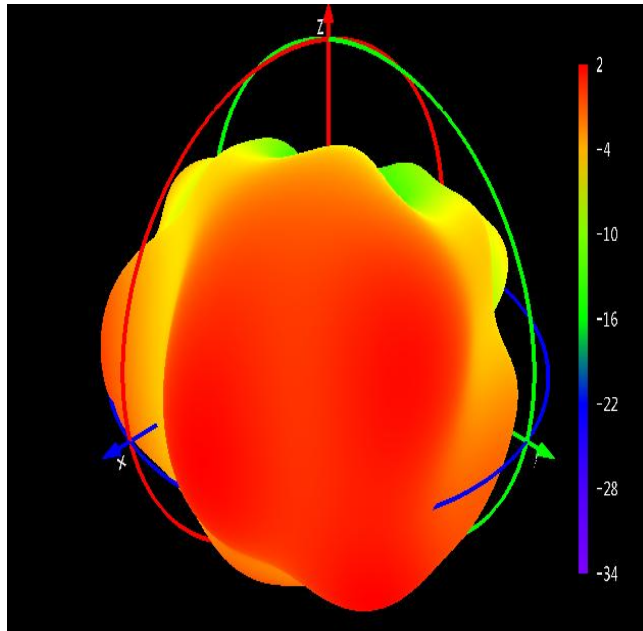
5500MHz



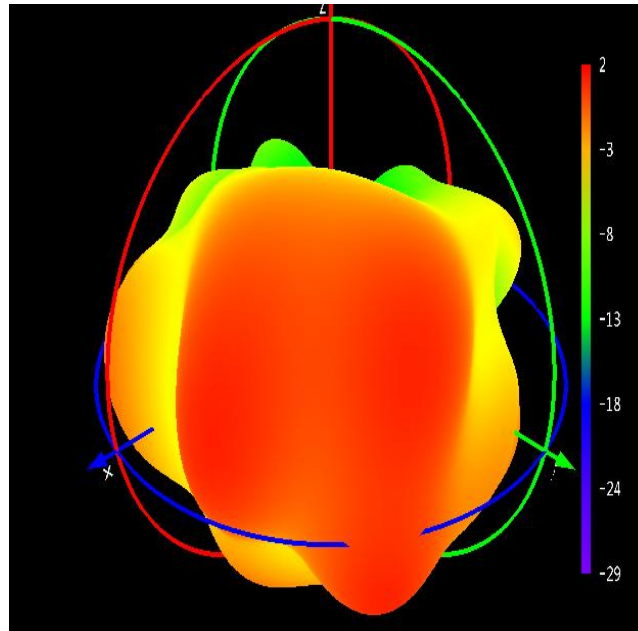
5850MHz

Passive Test

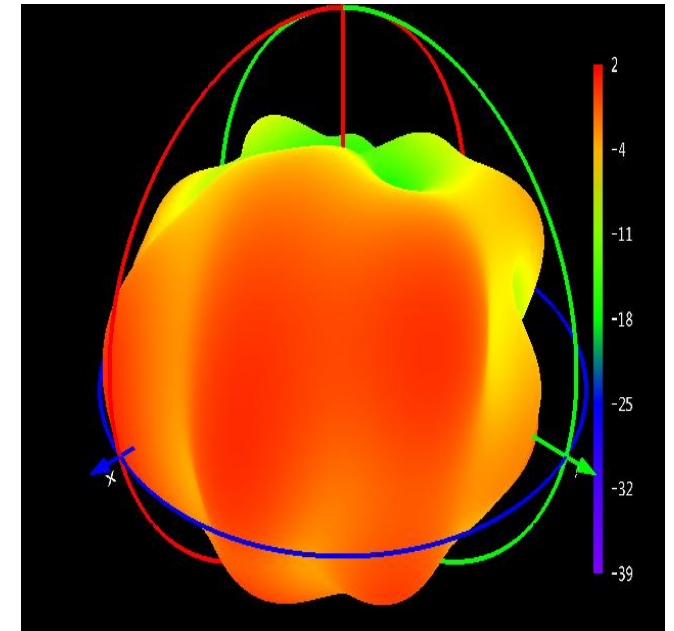
- Radiation Pattern (BT)



2400MHz



2450MHz



2500MHz

Active Test

- OTA Date

Band	Channel	Frequency	Data Rate	TRP(dBm)	Reference value	RX Data Rate	TIS(dBm)	Reference value
802.11a	36	5180	6M	12.22	10	54M	-69.76	65
	149	5785	6M	6.87	10	54M	-64.05	65
	165	5825	6M	7.2	10	54M	-65.88	65
802.11n	36	5180	MCS0	13.1	7	MCS7	-66.83	62
	149	5785	MCS0	8.93	7	MCS7	-61.99	62
	165	5825	MCS0	8.21	7	MCS7	-61.41	62
802.11b	1	2412	1M	15.39	10	11M	-84	78
	6	2437	1M	14.52	10	11M	-83.49	78
	13	2472	1M	13.28	10	11M	-80.3	78
802.11g	1	2412	6M	15.64	10	54M	-70.67	67
	6	2437	6M	15.01	10	54M	-69.75	67
	13	2472	6M	13.56	10	54M	-68.29	67
802.11n	1	2412	MCS0	15.63	7	MCS7	-64.37	62
	6	2437	MCS0	15.03	7	MCS7	-65.37	62
	13	2472	MCS0	13.42	7	MCS7	-64.06	62

The reference indicators of different module models will be different, depending on the actual performance.



Project Overview

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Conclusion and Suggestion

➤ Antenna Performance

From the passive results:

- the WIFI antenna efficiency $> 35\%$;
- the BT antenna efficiency $> 45\%$;
- the isolation is better than -30dB ;
- and the performance meets the requirements.

From the active results:

- the 2.4G WiFi TRP $12\sim 15\text{ dBm}$, TIS $-64\sim -84\text{ dBm}$;
- the 5G WiFi TRP $7\sim 13\text{ dBm}$, TIS $-61\sim -69\text{ dBm}$;
- the 2.4G WIFI performance meets the requirements, the 5G WIFI performance cannot meet the requirements.

Conclusion and Suggestion

- How to improve the 5G WIFI performance
 - We tried to skip the radio socket on the motherboard, welded the antenna directly to the front end of the radio socket, tested the 5G WIFI performance, and found that there was a great improvement;
 - This indicates that the RF socket loss on the motherboard is too large, It is suggested to modify the radio socket on the motherboard part, which can improve the antenna performance.



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Thank You

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