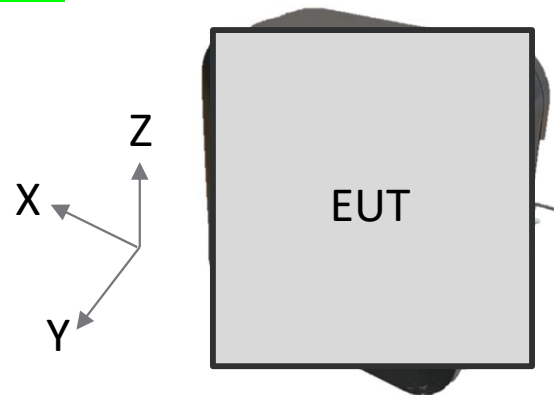
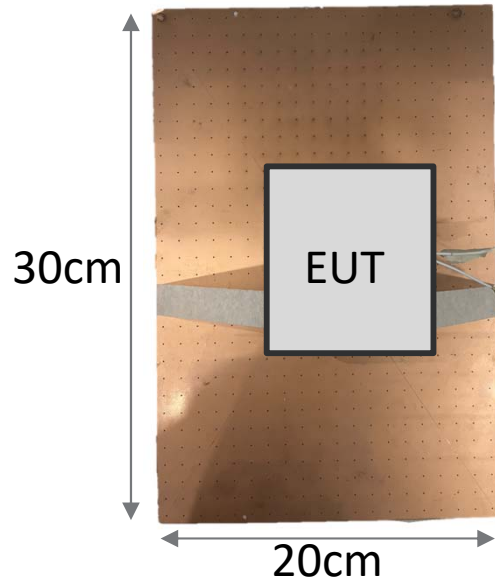


Antenna proposal and specification

Free space

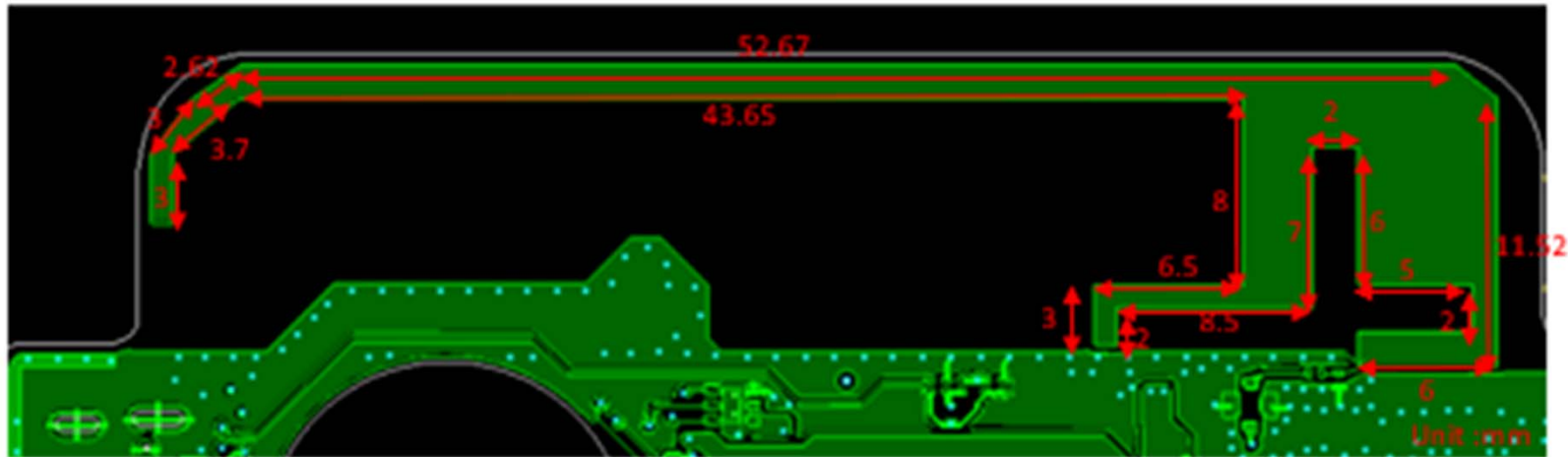


With metal plate



Antenna Proposal	
Wireless Function	900MHz 802.11ah Wifi HaLow
Antenna type	■ Wi-Fi HaLow: On board printing antenna
Measurement data	
Return loss	WiFi HaLow < -10dB
Isolation	Wi-Fi HaLow: <-20 dB
Peak Gain	WiFi HaLow < 0.03 dB (free space) WiFi HaLow < 1.65 dB (metal plate)
Efficiency	WiFi HaLow > 40% (free space) WiFi HaLow > 36% (metal plate)

Antenna placement and experiment structure

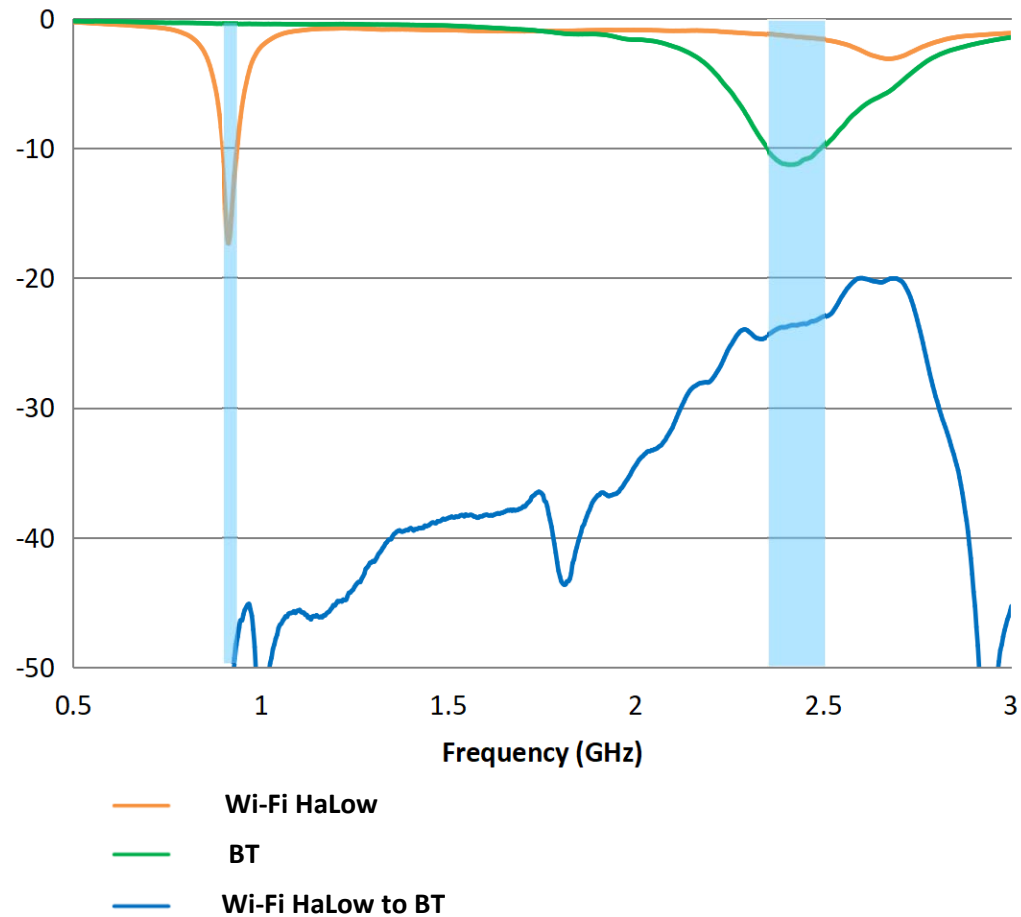


Stackup Control Required						
Lyr	Image	Foil	Thk(mil)	Generic Name	Er	Df
11		0.50Z	1.1	Foil 0.5oz(1295um)	3.35	0.02
			3.08	联茂 IT158 1080 PC71% 300um/R		
12/13		1 0Z	1.2	联茂 IT158 Core 0.650MM 1/1 86X49IN 不含铜		
		Core	25.59			
		1 0Z	1.2			
			2.98	联茂 IT158 1080 PC71% 300um/R	3.35	0.02
		0.50Z	1.1	Foil 0.5oz(1295um)		
14		0.50Z	1.1	Foil 0.5oz(1295um)		

Finish Board Thickness: 1mm+0.1mm/-0.1mm

Measurement data

❖ S-parameter : Return loss & Isolation

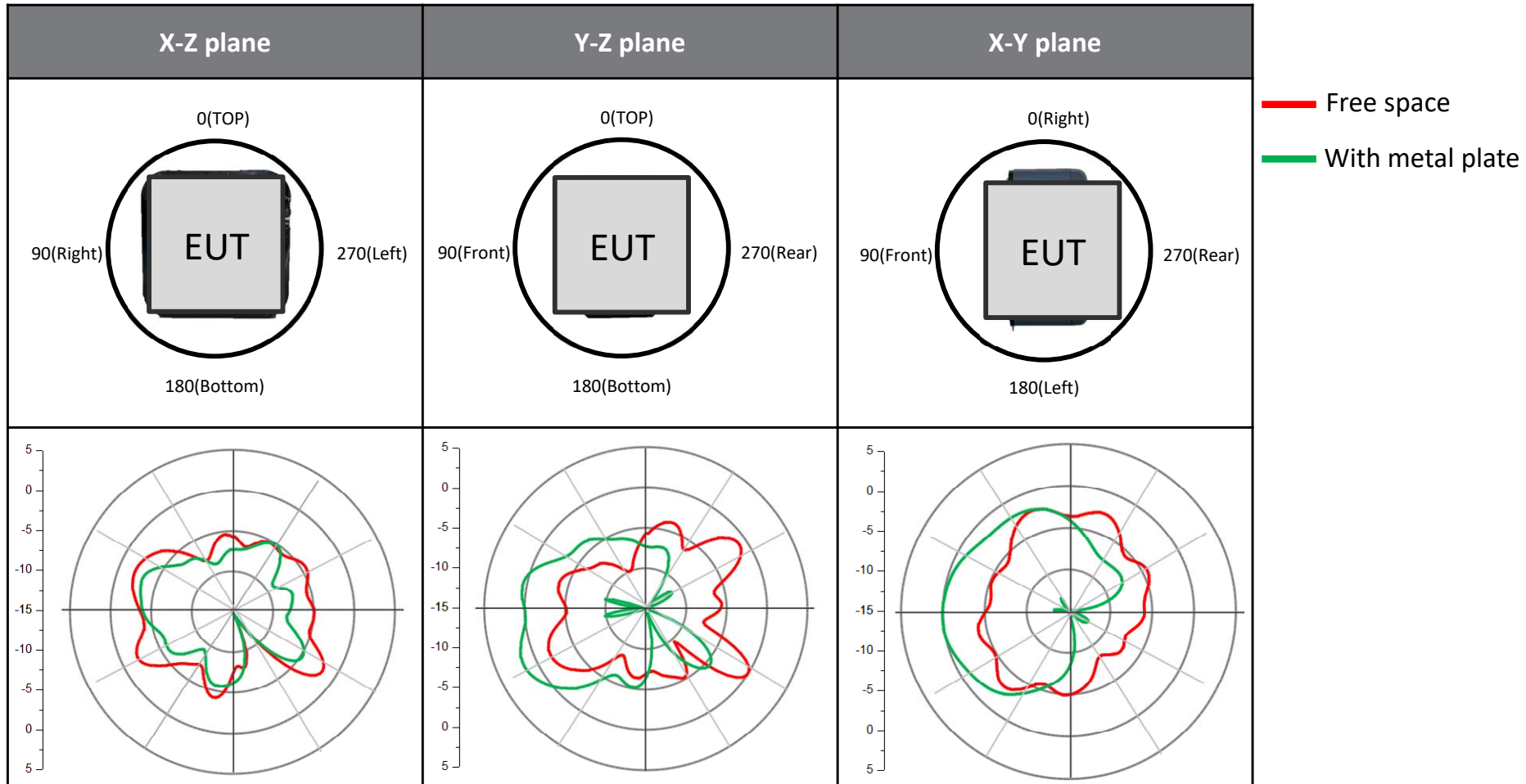


Frequency (MHz)	Wi-Fi HaLow	BT	Wi-Fi HaLow to BT
902	-11.03	--	-61.44
908	-14.73	--	-55.70
916	-16.57	--	-52.36
920	-16.76	--	-51.46
928	-13.60	--	-50.19
2400	--	-11.25	-23.84
2450	--	-10.91	-23.55
2500	--	-10.07	-23.12

Unit: dB

Measurement data

❖ Radiation pattern : HaLow 908 MHz



Measurement data (Free space)

❖ Gain table: (In Free space)

HaLow antenna

Frequency (MHz)	E-total (dBi)	Efficiency (%)
902	-0.3	40
908	-0.01	42
916	0.03	44
920	-0.31	42
928	-0.28	40

❖ Gain table: (with metal plate)

HaLow antenna

Frequency (MHz)	E-total (dBi)	Efficiency (%)
902	0.81	37
908	1.48	39
916	1.65	40
920	0.97	38
928	0.82	36

Summary

◆ Return loss

HaLow and BT antenna are under -10 dB.

◆ Efficiency

HaLow antenna has 40% up in free space and has around 36% when having the metal plate at the backside.

◆ Radiation

When the metal plate is in the back of the DUT , HaLow antenna radiation will be impacted by metal plate . There is null point at the backside and antenna gain would be increase in the front side.

Antenna Vendor Info & Measurement Setup

- Antenna Vendor: Pegatron
- Test Date: 20240815
- Test Engineer :Angus Huang
- Measurement Setup:

- Reflection Coefficient Measurement:

1. Network Analyzer (Keysight Agilent E5071C)
2. Setup:

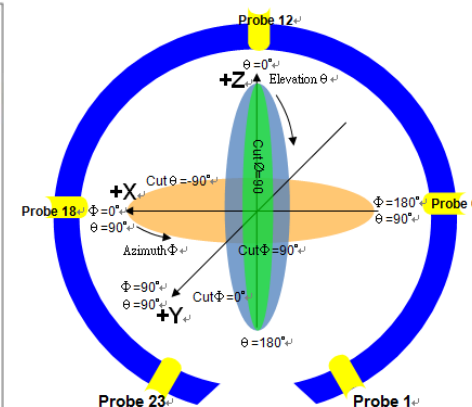
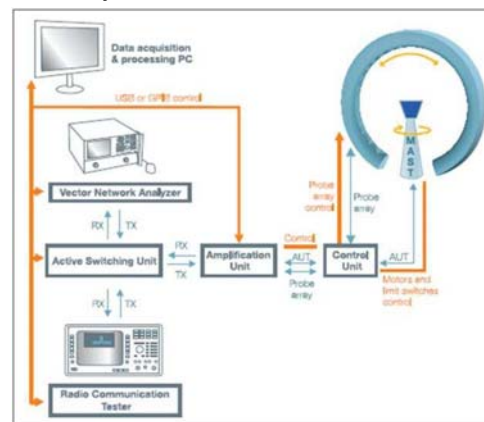
- calibrate the Network Analyzer by one port calibration using 85033E calibration kit.
- connect the antenna under test to the Network Analyzer.
- measure the S11 (return loss)& S12(isolation)

- Pattern & Gain measurement:

1. Satimo chamber (SG24)
2. Satimo program (wave studio)
3. system overview :

- Test Item

1. Antenna passive test 400MHz~6GHz



Description	Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
OTA Chamber	Satimo	SG24	MVG/HKG0147S	2023/09/16	2024/09/15
Network Analyzer	Keysight	E5071C	MY46212481	2024/5/16	2025/5/15

Test Procedure

- a) sub-divide the whole sphere surface into many 2x2 degree subsection.
- b) Measure the gain contributed from each antenna within each subsection position.
- c) Apply the KDB 662911 D01 correlated directional gain formula to calculate directional gain for each subsection.
- d) After all subsections have been evaluated, the largest calculated value among all positions evaluated is picked as the worst-case directional gain for the system and used in RF/EMC test report.