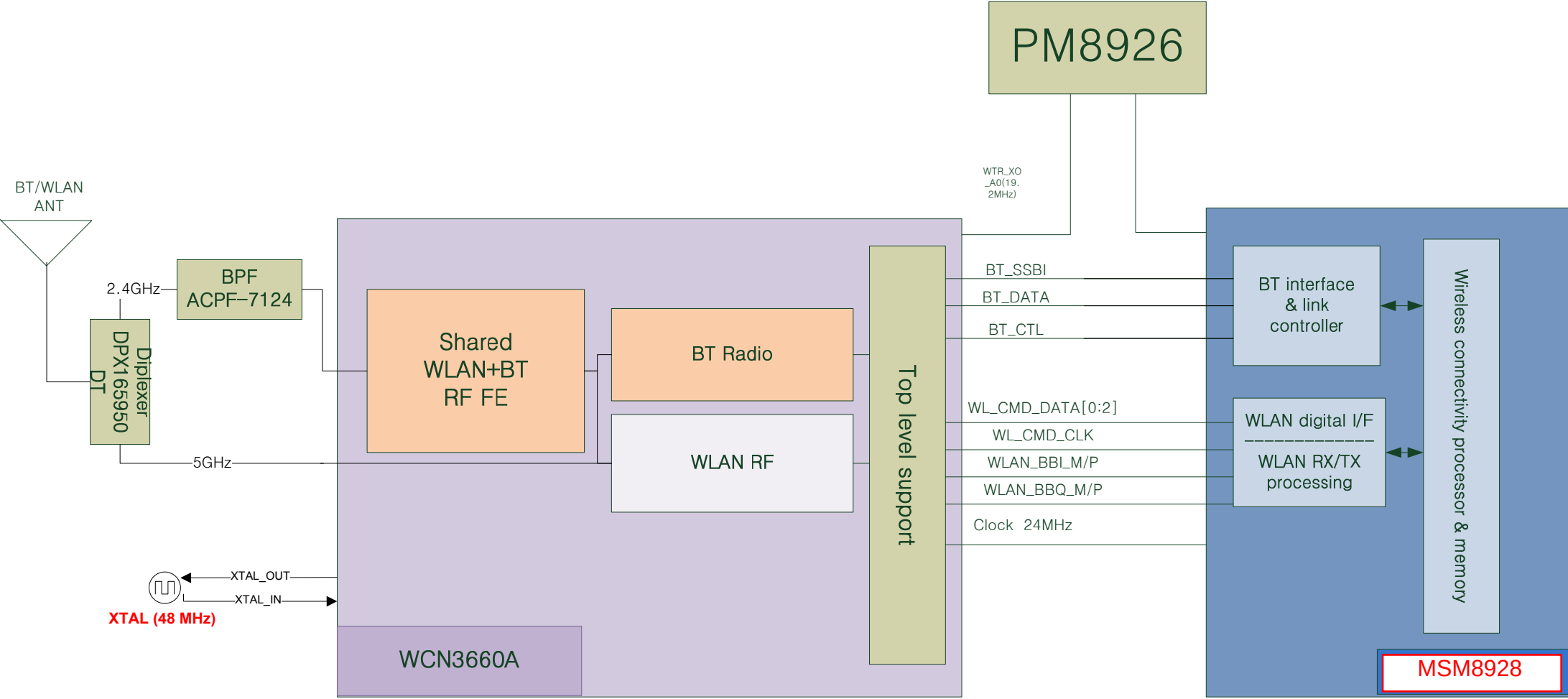


10. Bluetooth Operational Description

Please find below the capabilities that are operational for this device:

- Bluetooth v4.0 LE

Although the chipset documentation may indicate possible functions, the following have been permanently hardware disabled in this device and cannot be enabled by the end user or service provider



Operation Description – BT (WCN3680/WCN3660A)

The WCN3680/WCN3660A IC integrates four different wireless connectivity technologies into a single device suitable for handsets and other mobile devices. Then, WCN3680/WCN3660A supports Bluetooth (BT) compliant with the BT specification version 4.0 (BR/EDR + BLE) and ANT+ support. The WCN3680/WCN3660A IC ensures hardware and software compatibility with companion Qualcomm chipsets to simplify the design cycle and reduce OEM time-to-market.

Transmitter / Receiver

The WCN3680/WCN3660A IC uses low-power 65 nm RF CMOS fabrication technology, making it perfectly suited for battery-operated devices where power consumption and performance are critical. The WCN3680/WCN3660A IC highly integrated front-end eliminates external PA and LNA matching, and antenna Tx/Rx switching. It can support for class 1 and class 2 power-level transmissions without requiring an external PA and no factory calibration required.

Host Interface and modulation

The WCN3680/WCN3660A IC integrates baseband modem and 2.4 GHz transceiver and improved Rx sensitivity. Two-line digital data interface supports Rx and Tx and Single-wire serial bus interface (SSBI) for status and control. The supported modulation is GFSK, $\pi/4$ -DQPSK, and 8DPSK (in both directions) and digital processing support for all BR, EDR, and BLE packet types.

@ Firmware Code Reference (llm_afh.c)

```
#define CHAN_CLASS_MIN_CHAN_AFH 20
```

@Bluetooth Specification Requirement

2.3 ADAPTED PICONET PHYSICAL CHANNEL

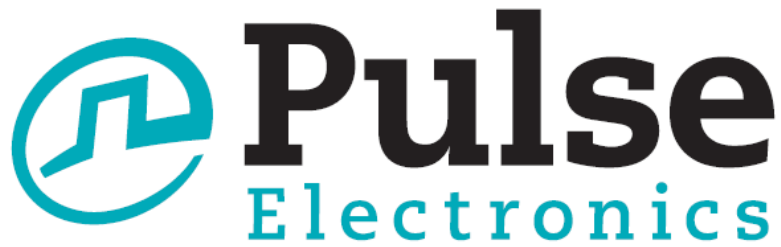
2.3.1 Hopping Characteristics

The adapted piconet physical channel shall use at least $N_{\min}$ RF channels (where $N_{\min}$ is 20).

The adapted piconet physical channel uses the adapted channel hopping sequence described in [Section 2.6 on page 83](#).

* AFH (Adaptive Frequency Hopping)

- Adaptive frequency hopping (AFH) capability was designed to reduce interference between wireless technologies sharing the 2.4 GHz spectrum.
- AFH works within the spectrum to take advantage of the available frequency.
- This adaptive hopping allows for more efficient transmission within the spectrum.
- The signal hops among 79 frequencies at 1 MHz intervals.
- The number of hopping channel is random by other wireless technologies in 2.4 GHz spectrum. But according to Bluetooth standard, at least 20 hopping channels has to be used.



ANTENNA SPECIFICATION

Samsung model name: SM-N7506V BT / Wi-Fi Antenna

Samsung code: GH42-04644A

Pulse code: KB0159B

ANT Type : LDS

Mold manufacture company	PARANG(Korea)
Plating company name	REETU(China)
Painting company name	JINCO(China)

NOVEMBER 28. 2013 DOCUMENT UPDATED

		Prepared		Checked	Quality	Approved
	Name					
SAMSUNG	Signatures					
PULSE		Prepared (RF, Mech.)		Checked (Chief engineers)	Quality (Quality engineer)	Approved (Project manager)
	Name	Shim Bas	David Yu	Eddie Kim	Sean Hong	Tobin Roh
	Signatures					

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◆ New Component Approval Information

Manufacture Date	Yield Rate	Output/Input Q'ty	Capability/Day	Worst 3
2013.12.17	97.5%	1950/2000pcs	15K/Day	1. Painting Particle 2. Plating Damage 3. LDS Scratch

◆ CTF (Critical To Factor/Function)

■ Electrical Character

Only Antenna				Assemble Rear			
ITEM	SPEC	CPK	Note	ITEM	SPEC	CPK	Note

- 장비별, JIG 별 편차가 존재하므로 **Marker** 는 표준샘플의 **VSWR** 값을 기준으로 변경합니다.

■ Mechanical Character

ITEM	SPEC	CPK	Note
Total length of the antenna carrier (dim #1)			
Total width of the antenna carrier (dim #2)			
Total high of the antenna carrier (dim #15)			
LDS Pattern (dim #1)			
LDS Pattern (dim #2)			
LDS Pattern (dim #7)			
LDS Pattern (dim #9)			
Plating Thickness(Cu)			
Plating Thickness(Ni)			

◆ Item of development phase critical issue

◆ Item of development phase issue

06-11-2013	SM-N7506V BT/Wi-Fi Antenna kick-off	

◆ REVISION HISTORY

Date	Version number	Page	Done by	Description (if drawing has changed, picture of change has to be shown here)

Date	Before modification	After modification	Reason	Rev

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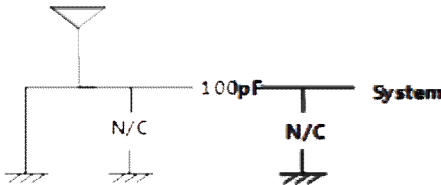
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1 TECHNICAL SPECIFICATIONS

Electrical Specification Sheet								
SET TYPE				Bar Type				
Frequency [MHz] of Jig with only antenna (Pulse)								
V.S.W.R of Jig with only antenna (Pulse)								
Frequency [MHz] of Jig with Rear Assemble								
V.S.W.R of Jig with Rear Assemble								
Frequency [MHz] of Hand Set				2400 ~ 2484 MHz	5250 MHz ~ 5825 MHz			
				2440MHz	5100MHz	5300MHz	5500MHz	5800MHz
Gain [dBi]	Total (PEAK/AVG) [dBi]			-1.73/-4.90	-1.06/-2.89	-0.45/-4.23	-2.13/-2.89	-1.42/-2.92
	H-Plane	Theta	PEAK	-4.43	-1.68	-0.82	-1.98	-2.01
			AVG	-8.63	-2.15	-3.54	-3.14	-4.60
		Phi	PEAK	-7.84	-1.99	-5.66	-4.07	-2.33
			AVG	-12.75	-7.10	-10.09	-8.26	-7.91
	E1-Plane	Theta	PEAK	-2.97	-1.51	-0.62	-1.77	-1.07
			AVG	-7.64	-3.68	-5.31	-4.68	-5.79
		Phi	PEAK	-3.16	-1.94	-4.51	-3.19	-2.14
			AVG	-6.94	-6.26	-8.82	-7.19	-6.11
	E2-Plane	Theta	PEAK	-2.76	-0.08	-1.08	-0.24	-1.23
			AVG	-6.39	-5.21	-6.55	-6.03	-7.22
		Phi	PEAK	-10.32	-3.28	-5.01	-4.18	-3.79
AVG			-13.51	-9.65	-10.51	-8.70	-7.65	
Input Impedance				50 (Ω)				
Polarization				Vertical / Linear				
Power (Max)				2Watt				
Matching Value				 [BT/Wi-Fi]				

Mechanical Specification Sheet	
Contact form	CONTACT PIN TYPE
Full length	Refer to drawing
Weight	0.15 ±0.2 (g)

Operate temperature	-30 °C ~ + 80 °C
Operate humidity	10% ~ 90%
Others	-

CE RADIO 시험용

Frequency [MHz] of Hand Set			2400 ~ 2484 MHz	5250 MHz ~ 5825 MHz			
			2440MHz	5100MHz	5300MHz	5500MHz	5800MHz
Gain [dBi]	E1-Plane	PEAK	-2.97	-1.51	-0.62	-1.77	-1.07
		AVG	-7.64	-3.68	-5.31	-4.68	-5.79

2 MEASUREMENT SET UP

Measurement setup of SM-N7506V BT/Wi-Fi antenna is shown in Figure1,2 below

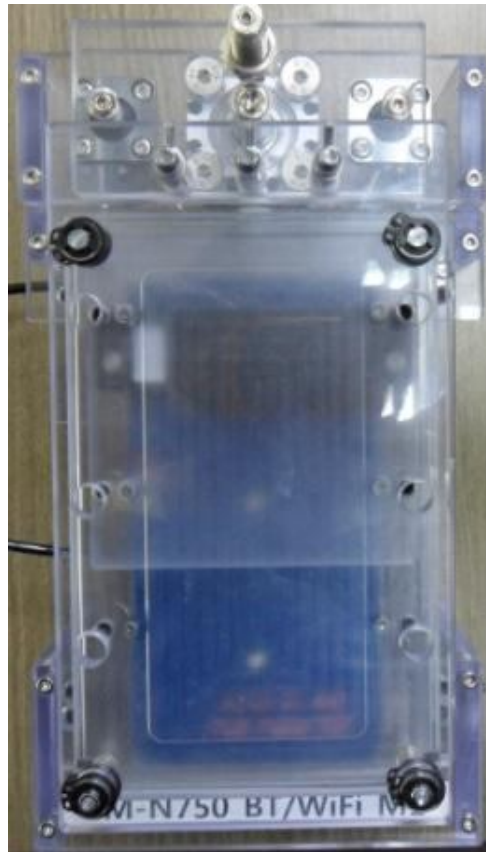


Figures 2-1. Measurement setup of SM-N7506V BT/Wi-Fi antenna.

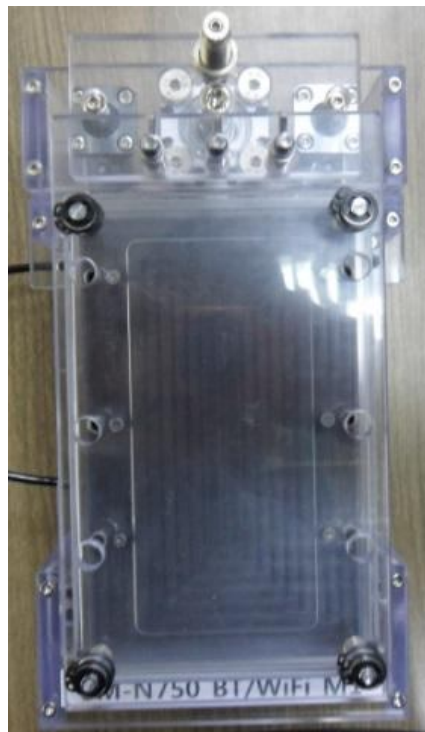


Figures 2-2. Measurement Jig setup of SM-N7506V BT/Wi-Fi antenna.

1. Measurement equipment :
2. Jig location : Network between Jig is 30Cm
3. Start frequency : 1Ghz, Stop frequency : 6Ghz
4. Using cable name : RG-158



Figures 2-3. VSWR Jig for only antenna



Figures 2-4. VSWR Jig for Ass'y antenna

3 MEASUREMENT RESULTS

Typical VSWR curve of SM-N7506V BT/Wi-Fi antenna are shown on figure below

3.1 VSWR of Hand-set

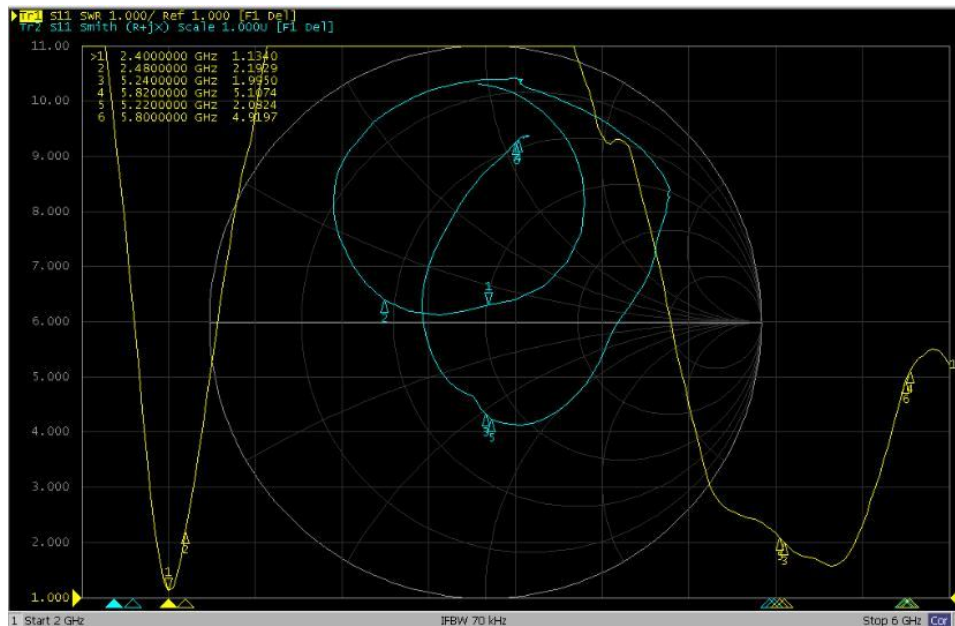


Figure 3-1.1. Typical Main curve of Hand Set

3.2 VSWR of Jig (Only Antenna)

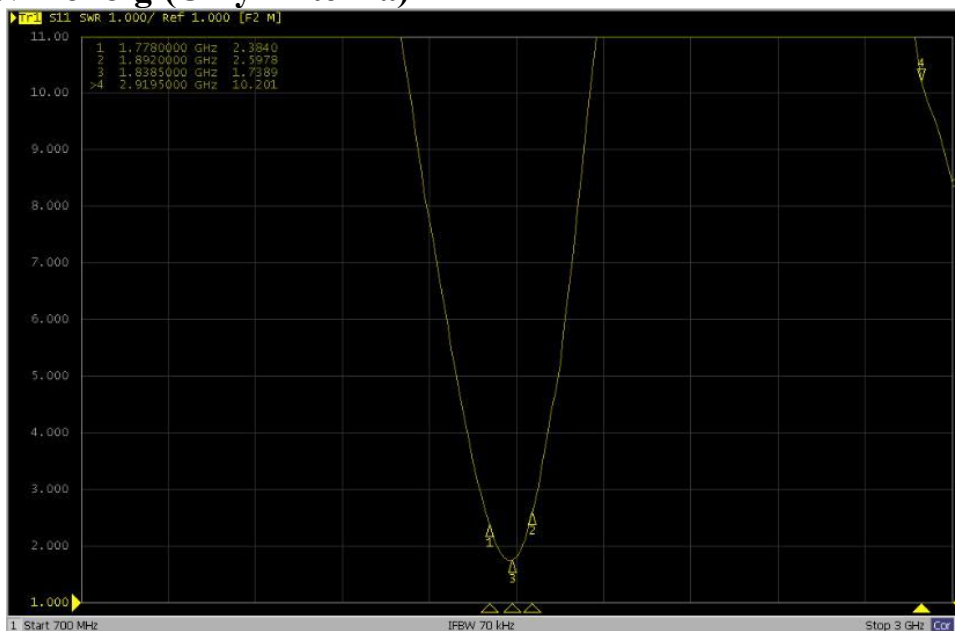
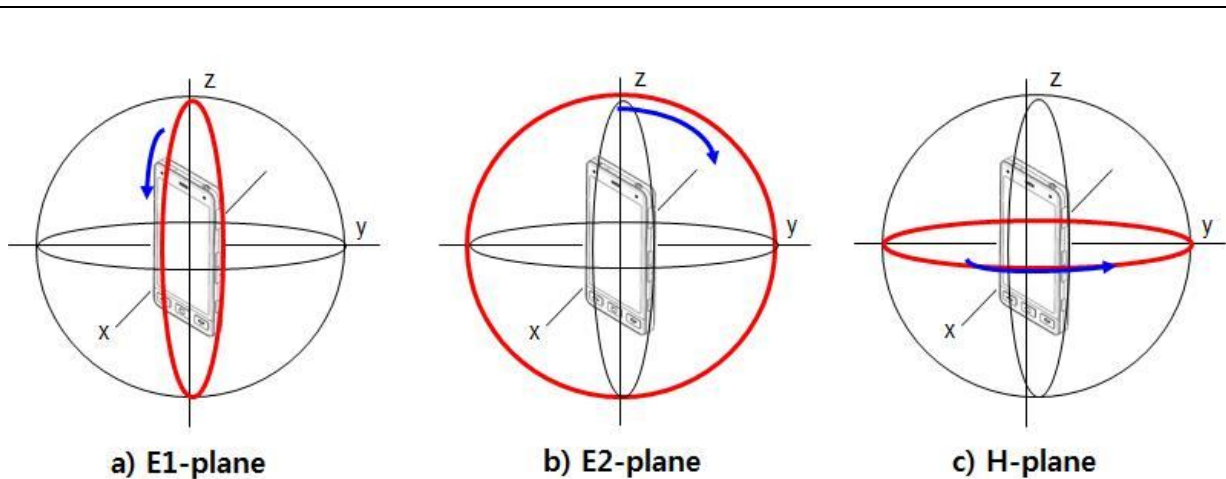


Figure 3-2.1. Typical Main curve of Jig (Only Antenna)

4 FREE SPACE 2D GAIN

These typical results are measured in Samsung SM-N7506V BT/Wi-Fi Chassis rev.0.1

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Frequency(MHz)		2400	2412	2440	2460	2480	2484	2500	5150	5250	5350	5450	5550	5650	5750	5825
H θ	AVG	-7.82	-8.05	-8.63	-9.30	-9.50	-9.58	-9.91	-2.15	-2.36	-3.54	-2.82	-3.14	-2.51	-4.60	-5.21
	Peak	-3.85	-4.02	-4.43	-5.12	-5.40	-5.48	-5.75	-1.68	-1.63	-0.82	-1.61	-1.98	-2.09	-2.01	-1.21
	Min	-23.28	-22.31	-21.63	-22.35	-21.51	-21.23	-21.10	-14.68	-15.50	-22.93	-45.43	-32.81	-22.77	-31.29	-31.88
E1 θ	AVG	-6.75	-6.99	-7.64	-8.23	-8.31	-8.33	-8.57	-3.68	-3.92	-5.31	-4.36	-4.68	-4.01	-5.79	-6.48
	Peak	-1.91	-2.11	-2.97	-3.75	-3.75	-3.73	-3.94	-1.51	-1.85	-0.62	-1.43	-1.77	-1.42	-1.07	-0.72
	Min	-31.02	-32.09	-29.31	-30.84	-32.16	-33.22	-39.44	-24.42	-17.57	-21.72	-22.58	-26.25	-20.93	-27.78	-23.44
E2 θ	AVG	-5.39	-5.65	-6.39	-7.03	-7.18	-7.21	-7.50	-5.21	-5.46	-6.55	-5.54	-6.03	-5.20	-7.22	-7.76
	Peak	-1.51	-1.80	-2.76	-3.24	-3.19	-3.21	-3.50	-0.08	-0.33	-1.08	-0.27	-0.24	-0.37	-1.23	-2.03
	Min	-20.54	-25.58	-45.46	-27.73	-26.64	-27.18	-28.00	-22.45	-22.14	-25.36	-21.93	-26.88	-21.80	-23.47	-26.43
H ϕ	AVG	-11.28	-11.75	-12.75	-13.14	-12.90	-13.22	-13.12	-7.10	-8.22	-10.09	-10.06	-8.26	-6.04	-7.91	-6.96
	Peak	-6.19	-6.74	-7.84	-8.13	-7.84	-8.15	-8.07	-1.99	-3.87	-5.66	-5.70	-4.07	-1.15	-2.33	-1.76
	Min	-21.03	-21.23	-20.34	-22.85	-25.04	-26.09	-27.82	-35.08	-26.75	-23.15	-22.79	-23.23	-29.51	-20.75	-22.84
E1 ϕ	AVG	-5.77	-6.06	-6.94	-7.51	-7.63	-7.97	-8.03	-6.26	-7.40	-8.82	-8.24	-7.19	-4.71	-6.11	-5.24
	Peak	-1.92	-2.27	-3.16	-3.70	-3.67	-3.98	-3.68	-1.94	-3.19	-4.51	-4.11	-3.19	-0.71	-2.14	-1.22
	Min	-15.43	-16.75	-19.15	-18.52	-17.89	-18.00	-17.49	-30.94	-25.56	-23.86	-26.09	-25.29	-31.52	-37.55	-22.31
E2 ϕ	AVG	-12.69	-12.96	-13.51	-13.71	-13.41	-13.69	-13.54	-9.65	-9.82	-10.51	-9.92	-8.70	-6.45	-7.65	-7.01
	Peak	-10.35	-10.30	-10.32	-10.82	-10.82	-11.05	-11.22	-3.28	-4.86	-5.01	-4.97	-4.18	-2.62	-3.79	-2.77
	Min	-18.95	-20.43	-24.09	-25.67	-26.03	-26.16	-26.88	-33.84	-24.08	-26.98	-27.77	-27.78	-14.49	-16.99	-14.73
H θ +H ϕ	AVG	-9.55	-9.90	-10.69	-11.22	-11.20	-11.40	-11.52	-4.63	-5.29	-6.82	-6.44	-5.70	-4.28	-6.25	-6.08
	Peak	-5.02	-5.38	-6.14	-6.63	-6.62	-6.82	-6.91	-1.84	-2.75	-3.24	-3.66	-3.03	-1.62	-2.17	-1.49
	Min	-22.16	-21.77	-20.99	-22.60	-23.28	-23.66	-24.46	-24.88	-21.13	-23.04	-34.11	-28.02	-26.14	-26.02	-27.36
E1 θ +E1 ϕ	AVG	-6.26	-6.53	-7.29	-7.87	-7.97	-8.15	-8.30	-4.97	-5.66	-7.06	-6.30	-5.93	-4.36	-5.95	-5.86
	Peak	-1.92	-2.19	-3.07	-3.73	-3.71	-3.86	-3.81	-1.73	-2.52	-2.57	-2.77	-2.48	-1.07	-1.61	-0.97
	Min	-23.23	-24.42	-24.23	-24.68	-25.03	-25.61	-28.47	-27.68	-21.57	-22.79	-24.34	-25.77	-26.23	-32.67	-22.88
E2 θ +E2 ϕ	AVG	-9.04	-9.30	-9.95	-10.37	-10.29	-10.45	-10.52	-7.43	-7.64	-8.53	-7.73	-7.37	-5.82	-7.43	-7.38
	Peak	-5.93	-6.05	-6.54	-7.03	-7.01	-7.13	-7.36	-1.68	-2.60	-3.05	-2.62	-2.21	-1.50	-2.51	-2.40
	Min	-19.75	-23.01	-34.78	-26.70	-26.34	-26.67	-27.44	-28.15	-23.11	-26.17	-24.85	-27.33	-18.15	-20.23	-20.58



Theta

Vertical Field of Measured Plane

Phi

Horizontal Field of Measured Plane

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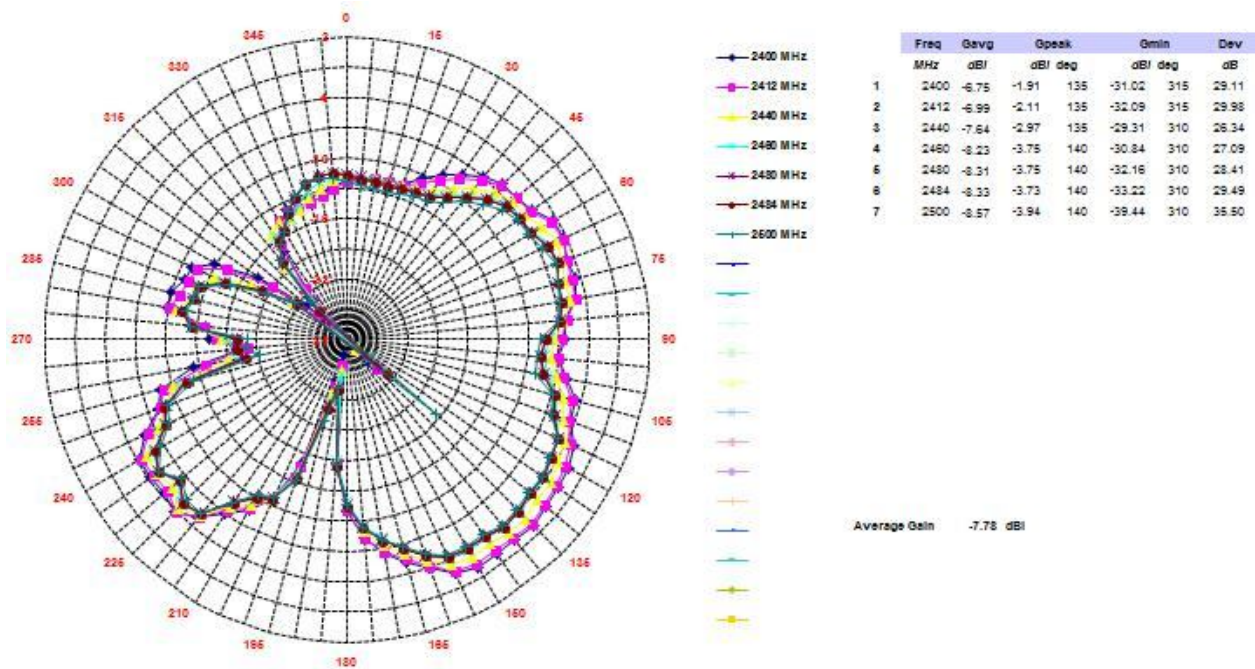
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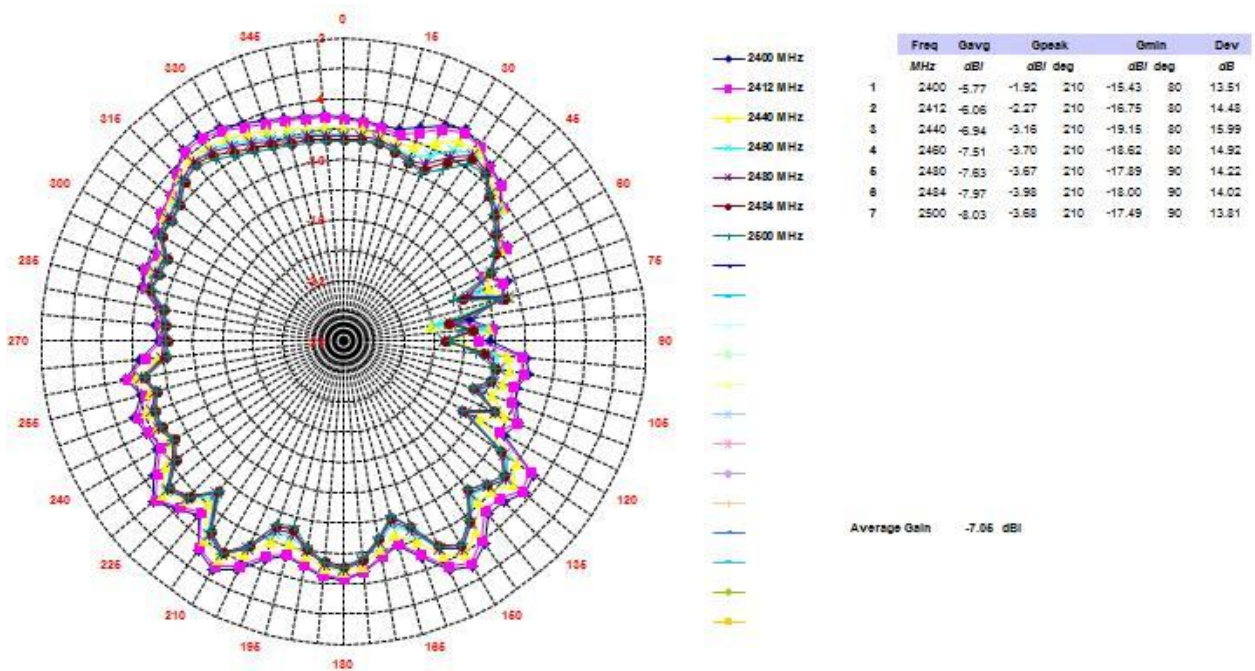
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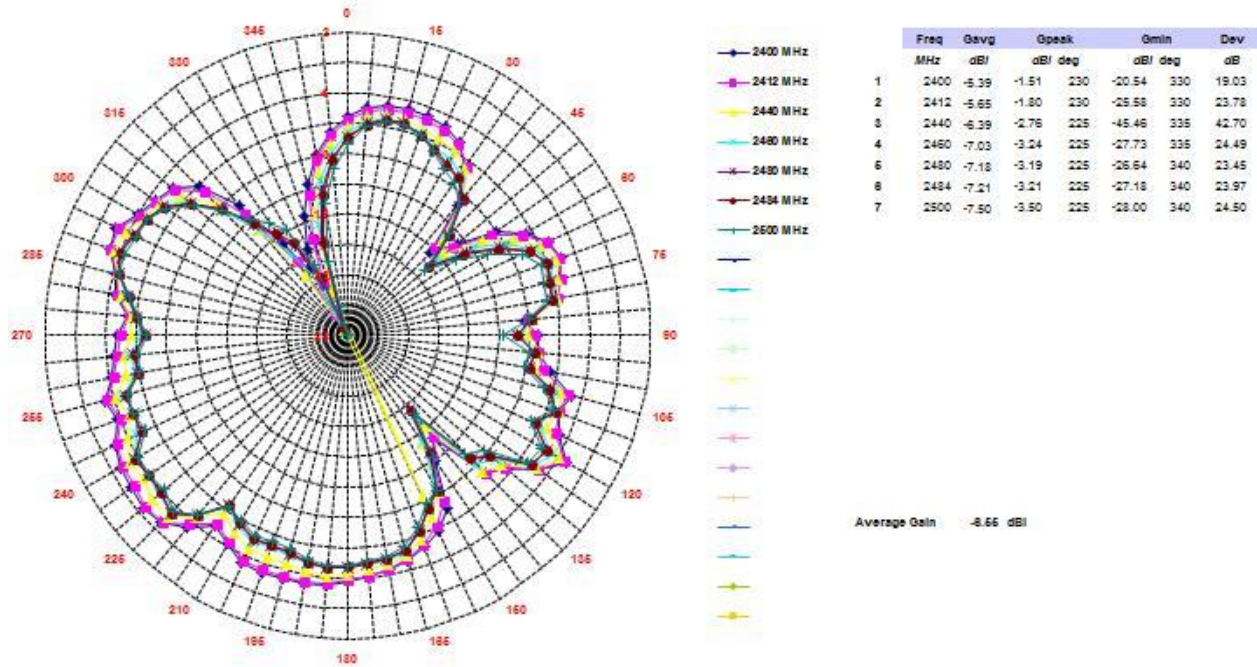
4.1 Radiation pattern of 2GHz 대역 [E1-Field (Theta)]



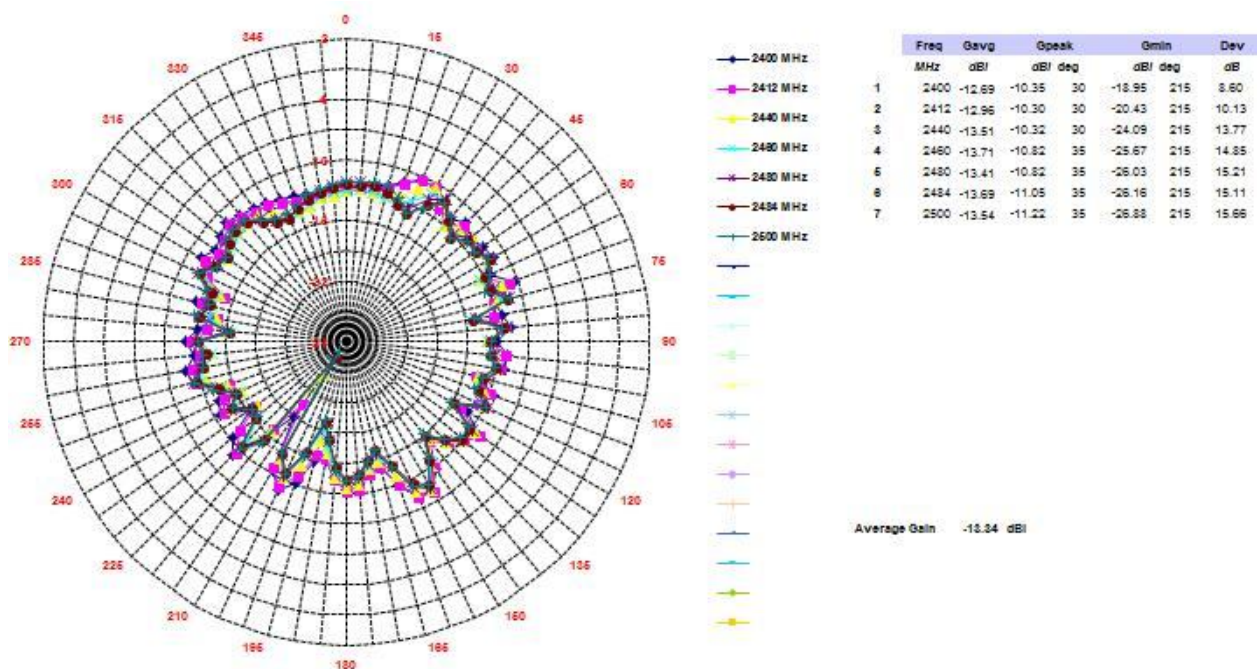
4.2 Radiation pattern of 2GHz 대역 [E1-Field(Phi)]



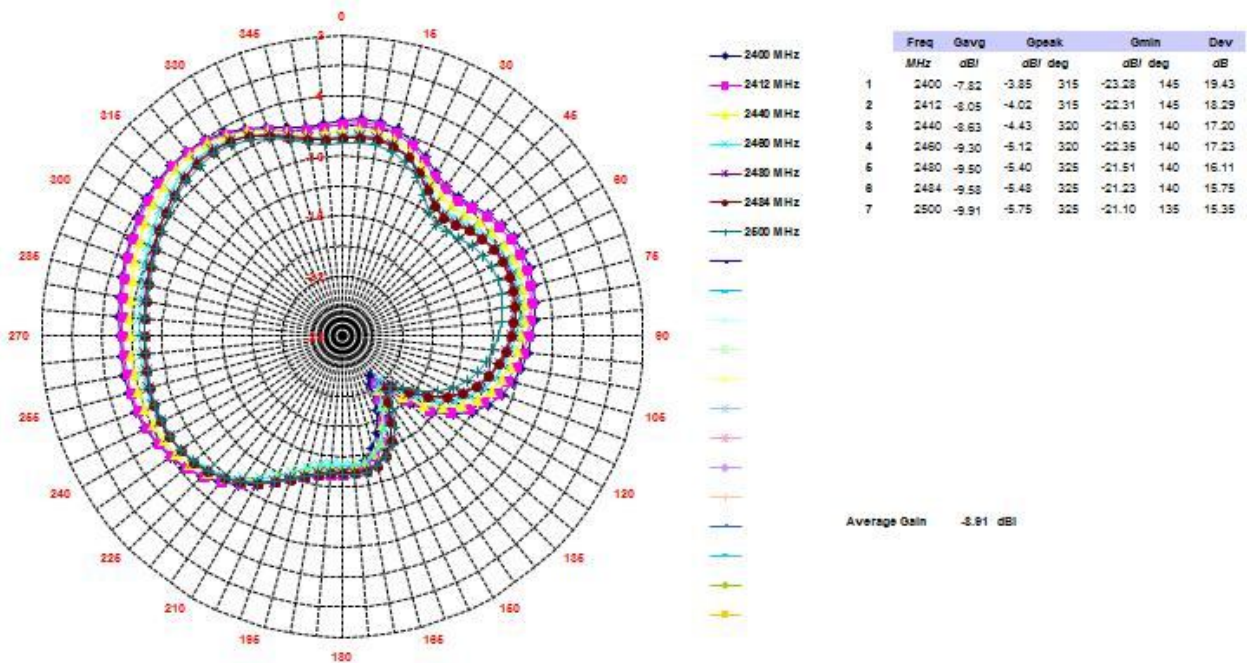
4.3 Radiation pattern of 2GHz 대역 [E2-Field(Theta)]



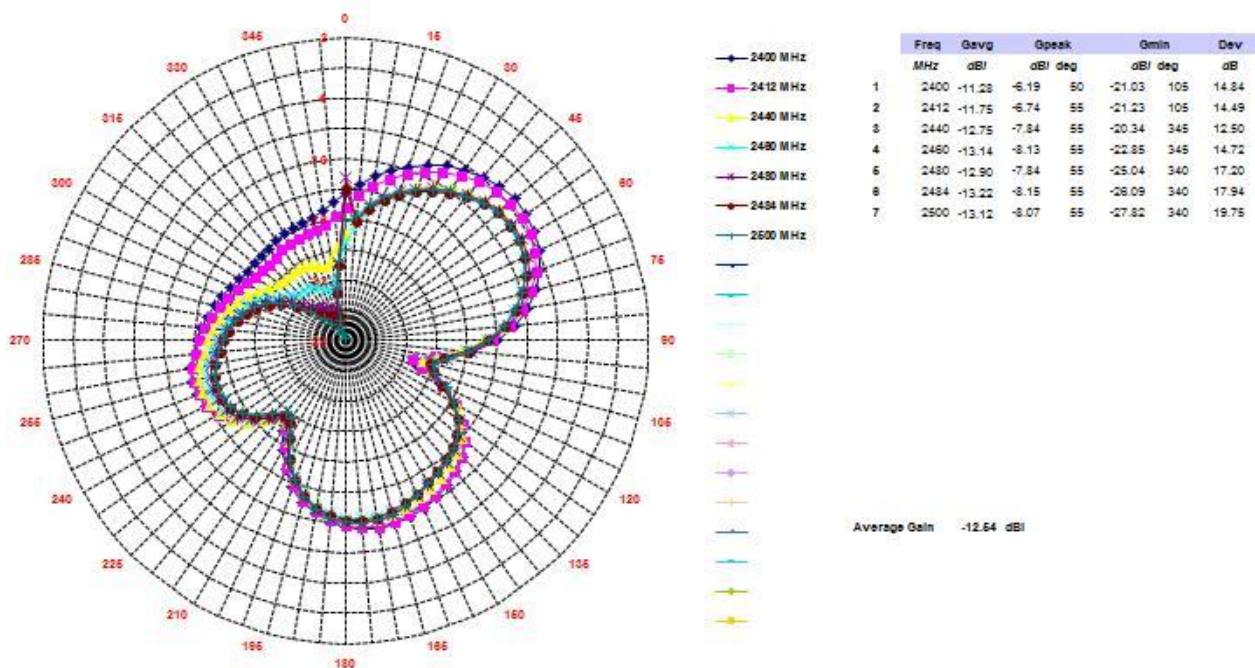
4.4 Radiation pattern of 2GHz 대역 [E2-Field(Phi)]



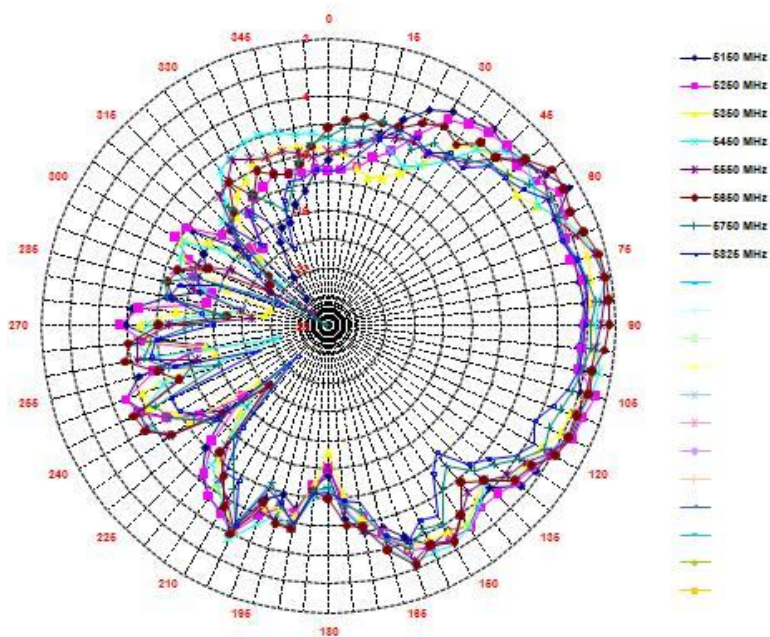
4.5 Radiation pattern of 2GHz 대역 [H-Field(Theta)]



4.6 Radiation pattern of 2GHz 대역 [H-Field(Phi)]



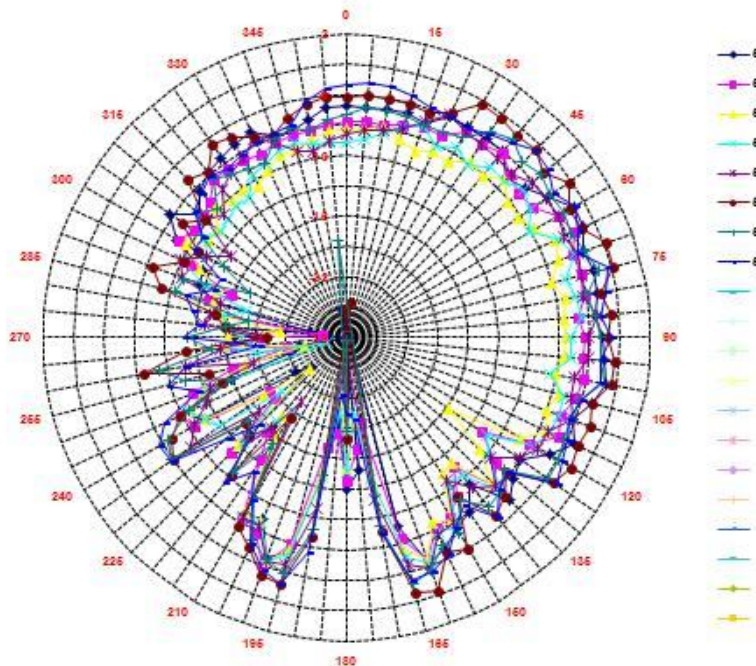
4.7 Radiation pattern of 5GHz 대역 [E1-Field (Theta)]



	Freq	Gavg	Gpeak	Gmin	Dev
	MHz	dBi	dBi deg	dBi deg	dB
1	5150	-3.68	-1.51	-24.42	26.32
2	5250	-3.92	-1.85	-17.57	19.42
3	5350	-5.31	-0.62	-21.72	21.74
4	5450	-4.36	-1.43	-22.58	24.01
5	5550	-4.68	-1.77	-26.25	27.42
6	5650	-4.01	-1.42	-20.93	22.35
7	5750	-5.79	-1.07	-27.78	27.69
8	5825	-6.48	-0.72	-23.44	22.72

Average Gain -4.68 dBi

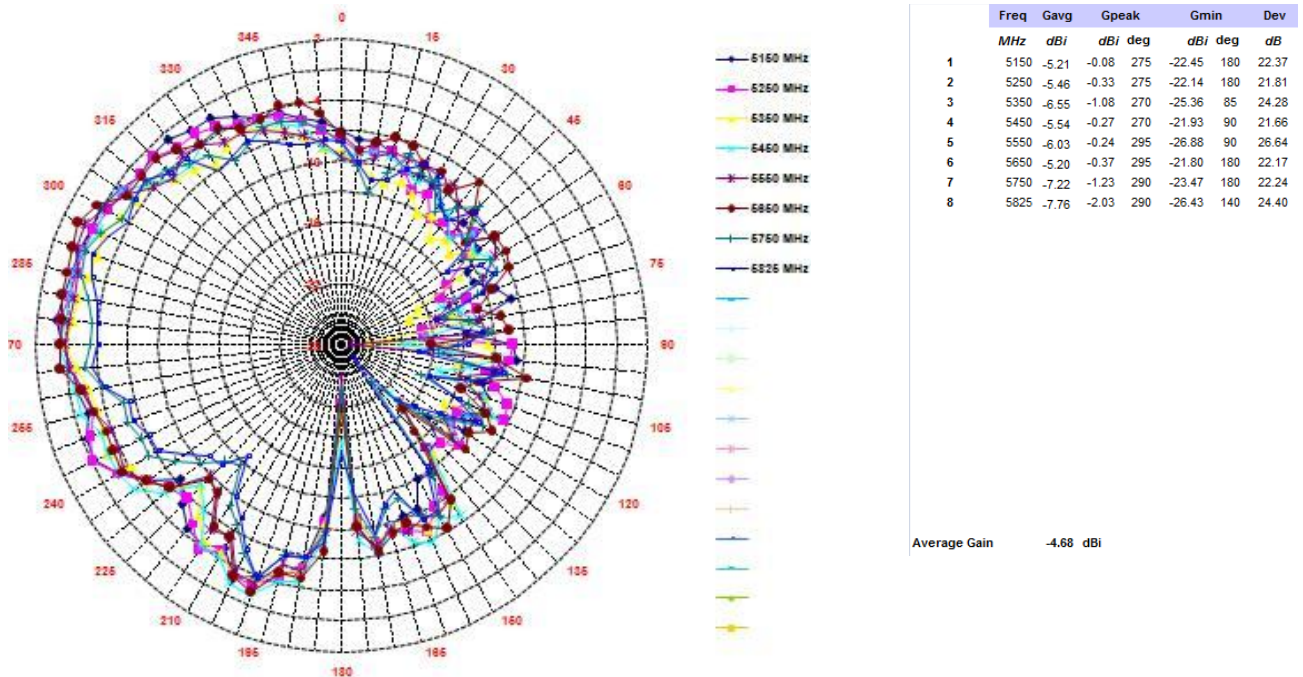
4.8 Radiation pattern of 5GHz 대역 [E1-Field (Phi)]



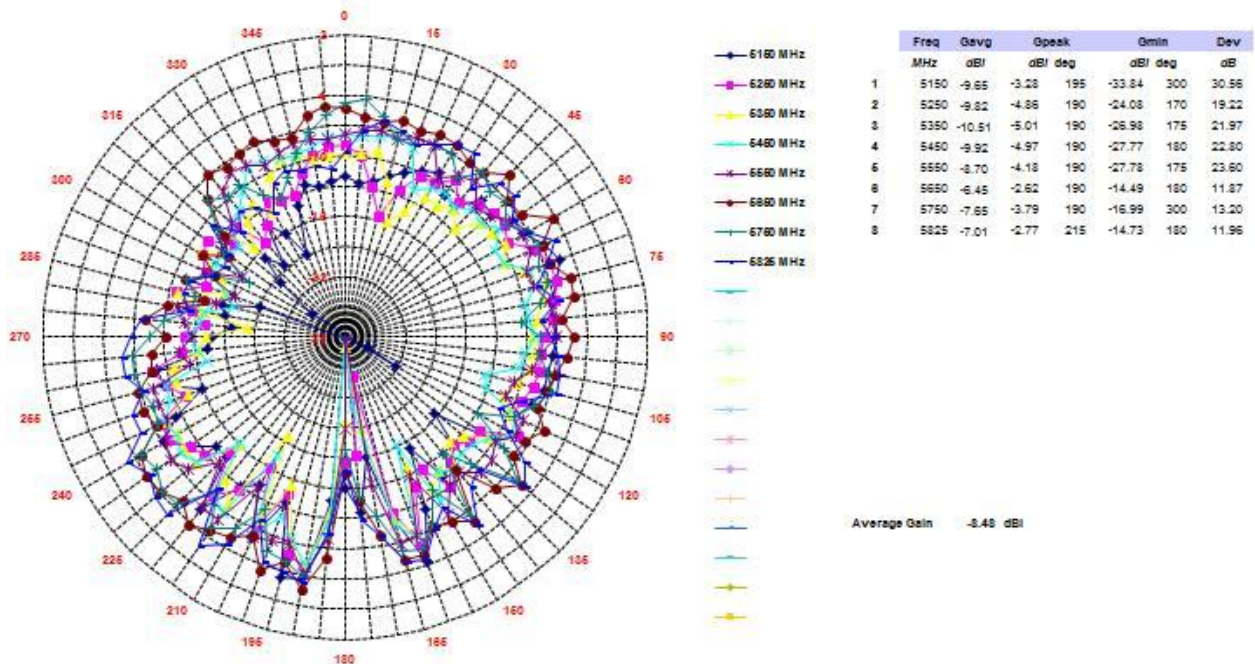
	Freq	Gavg	Gpeak	Gmin	Dev
	MHz	dBi	dBi deg	dBi deg	dB
1	5150	-6.26	-1.94	-30.94	29.00
2	5250	-7.40	-3.19	-25.56	22.37
3	5350	-8.82	-4.51	-23.86	19.35
4	5450	-8.24	-4.11	-26.09	21.98
5	5550	-7.19	-3.19	-25.29	22.10
6	5650	-4.71	-0.71	-31.52	30.81
7	5750	-6.11	-2.14	-37.55	35.41
8	5825	-5.24	-1.22	-22.31	21.09

Average Gain -8.54 dBi

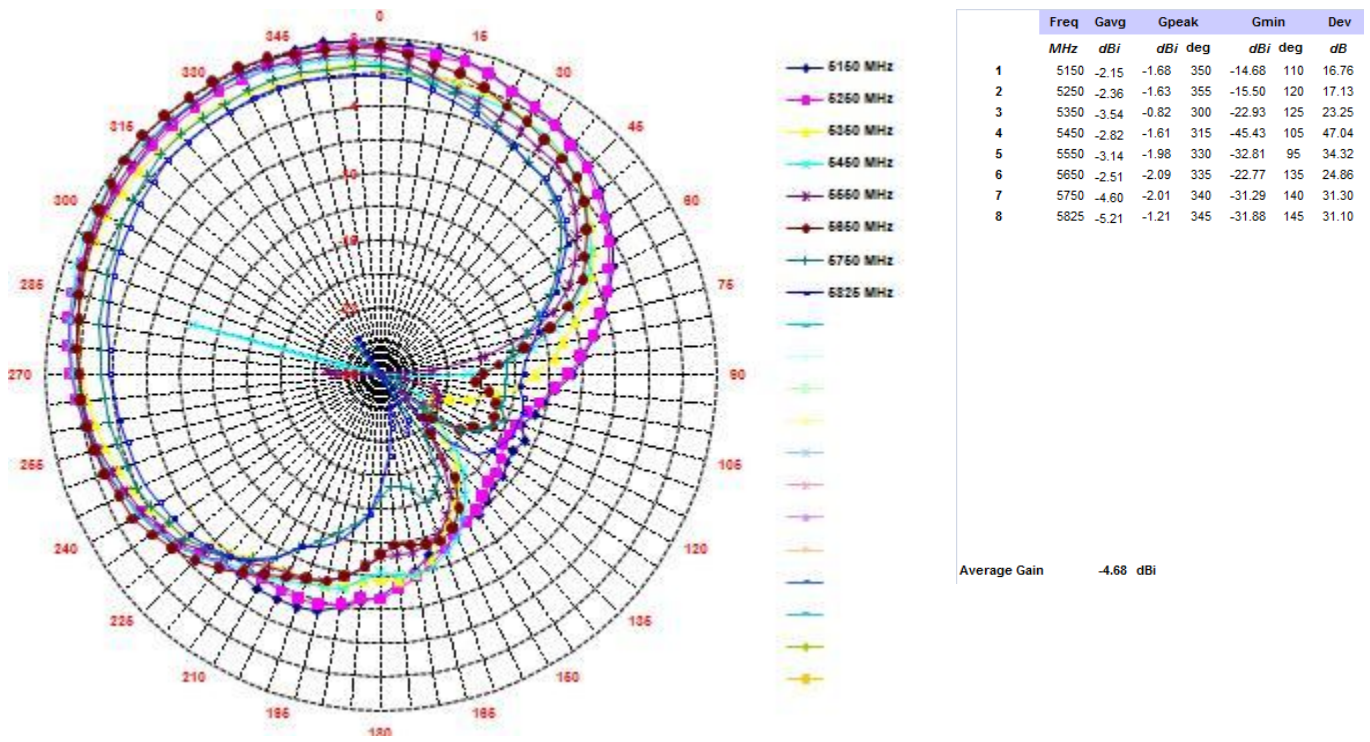
4.9 Radiation pattern of 5GHz 대역 [E2-Field (Theta)]



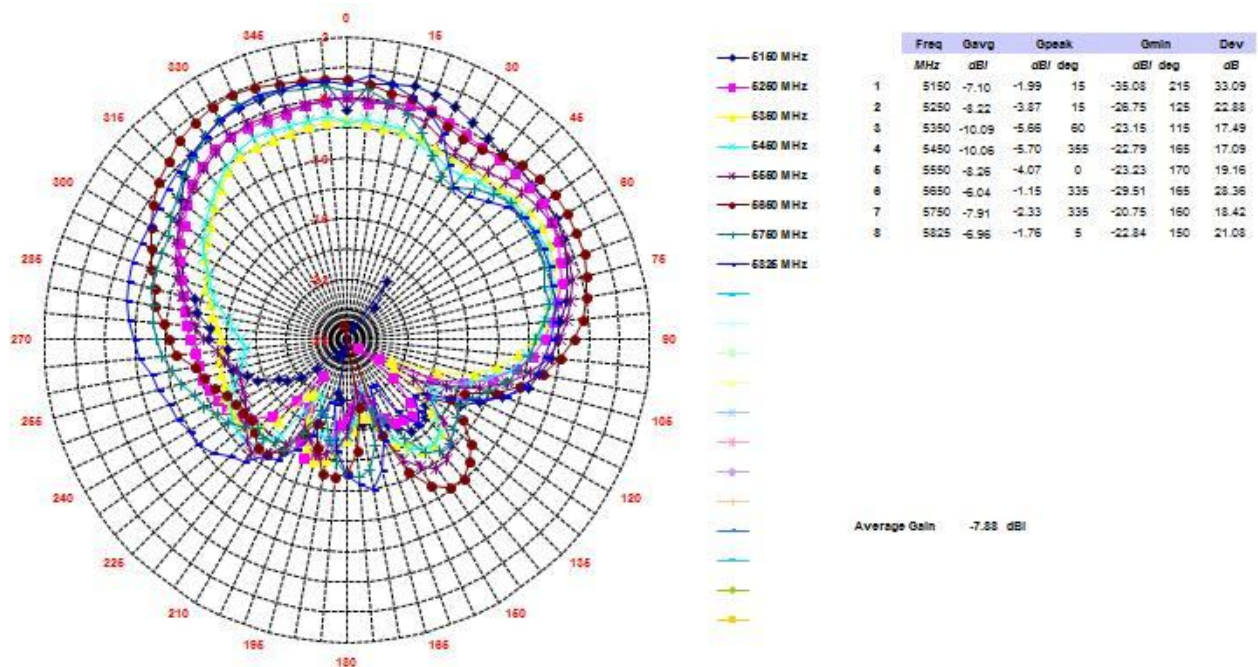
4.10 Radiation pattern of 5GHz 대역 [E2-Field (Phi)]



4.11 Radiation pattern of 5GHz 대역 [H-Field(Theta)]



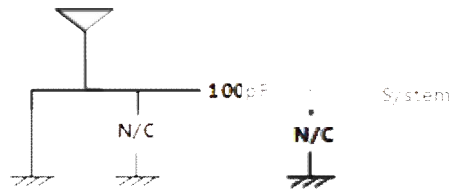
4.12 Radiation pattern of 5GHz 대역 [H-Field(Phi)]



5 PASSIVE COMPARISON DATA (3D)

BAND	BT(WiFi_2GHz)			WiFi_5GHz		
Freq.	2400	2440	2480	5150	5450	5825
Total	-4.21	-4.22	-4.83	-2.28	-2.31	-3.27
Eff.(%)	37.95	37.84	32.90	59.19	58.71	47.05
Theta	-6.11	-6.11	-6.76	-4.13	-3.60	-6.37
Phi	-8.71	-8.75	-9.28	-6.86	-8.22	-6.20
Average	-4.42			-2.62		

6 MATCHING NETWORK



Figures 4-1. BT/Wi-Fi matching network

7 AGREEMENT OF VSWR CONTROL SPEC (TOLERANCE)