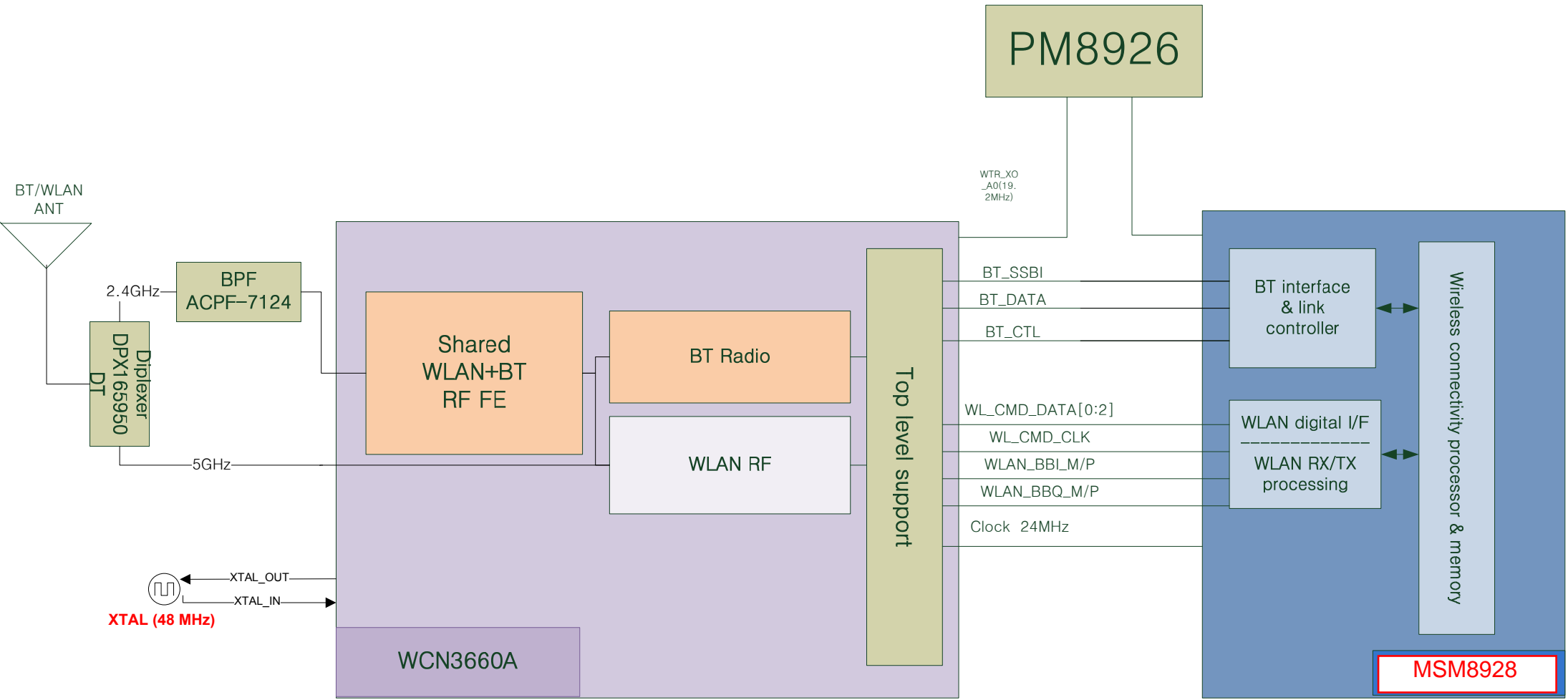


## 10. Bluetooth Operational Description

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

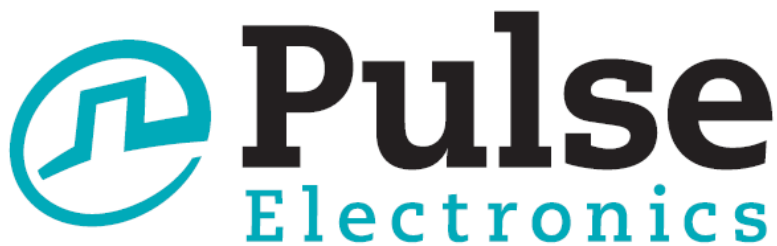
#### 2.3.1 Hopping Characteristics

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**

|                                 |                      |
|---------------------------------|----------------------|
| <b>Mold manufacture company</b> | <b>PARANG(Korea)</b> |
| <b>Plating company name</b>     | <b>REETU(China)</b>  |
| <b>Painting company name</b>    | <b>JINCO(China)</b>  |

**NOVEMBER 28. 2013 DOCUMENT UPDATED**

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

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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<br>2. Plating Damage<br>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)                         |      |     |      |

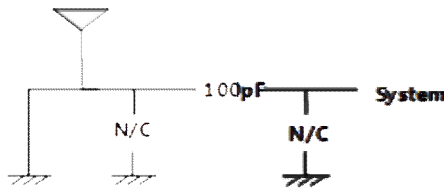
◆ **Item of development phase critical issue**

◆ Item of development phase issue

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



# 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                                   |                        |       |  <p>[BT/Wi-Fi]</p> |                     |             |             |             |       |

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

|                            |                  |
|----------------------------|------------------|
| <b>Operate temperature</b> | -30 °C ~ + 80 °C |
| <b>Operate humidity</b>    | 10% ~ 90%        |
| <b>Others</b>              | -                |

## CE RADIO 시험용

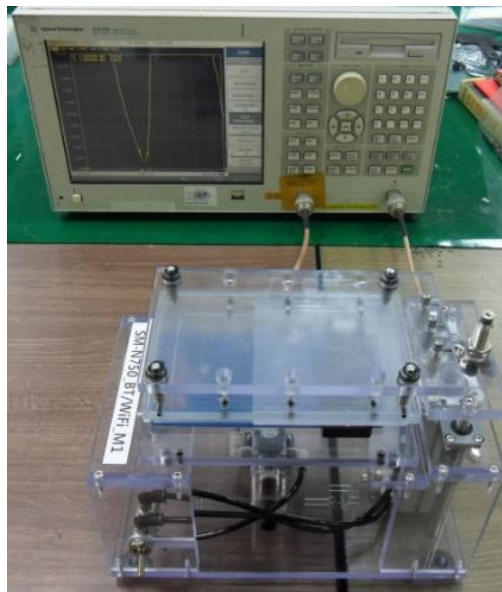
| Frequency [MHz]<br>of Hand Set |          |      | 2400 ~ 2484 MHz | 5250 MHz ~ 5825 MHz |              |              |              |
|--------------------------------|----------|------|-----------------|---------------------|--------------|--------------|--------------|
|                       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

## 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.

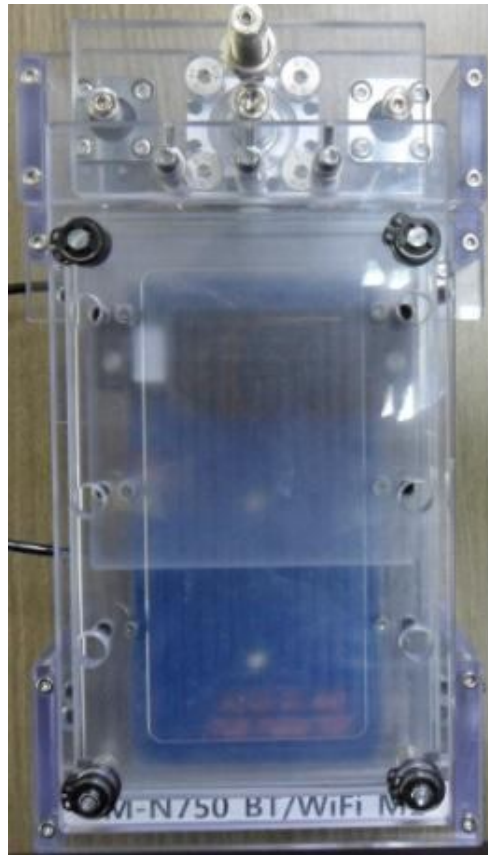


Figures 2-2. Measurement Jig setup of SM-N7506V BT/Wi-Fi antenna.

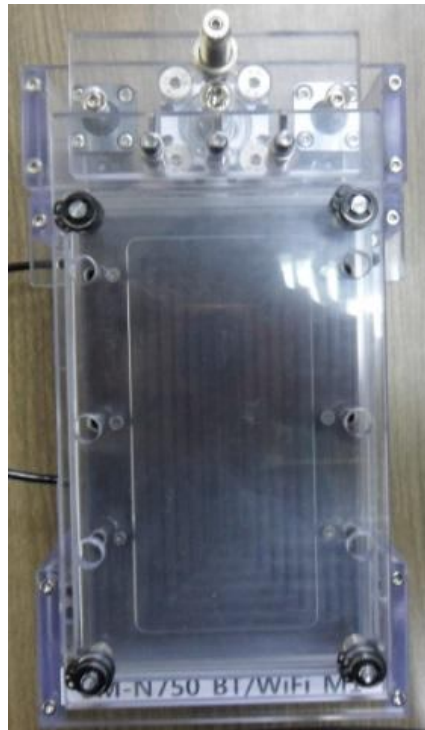
1. Measurement equipment :
2. Jig location : Network between Jig is 30Cm
3. Start frequency : 1Ghz, Stop frequency : 6Ghz
4. Using cable name : RG-158

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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

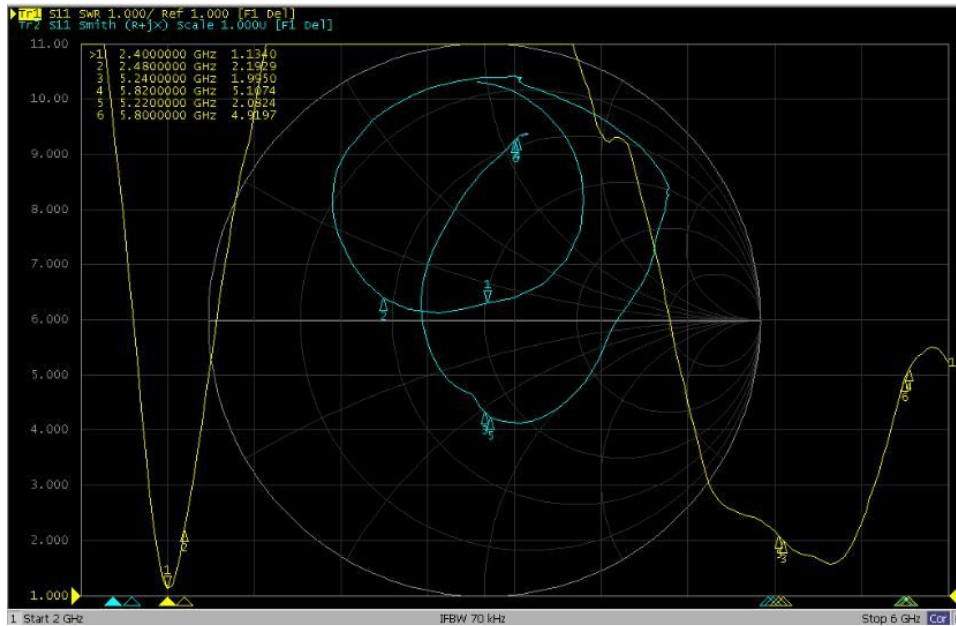


Figure 3-1.1. Typical Main curve of Hand Set

#### 3.2 VSWR of Jig (Only Antenna)

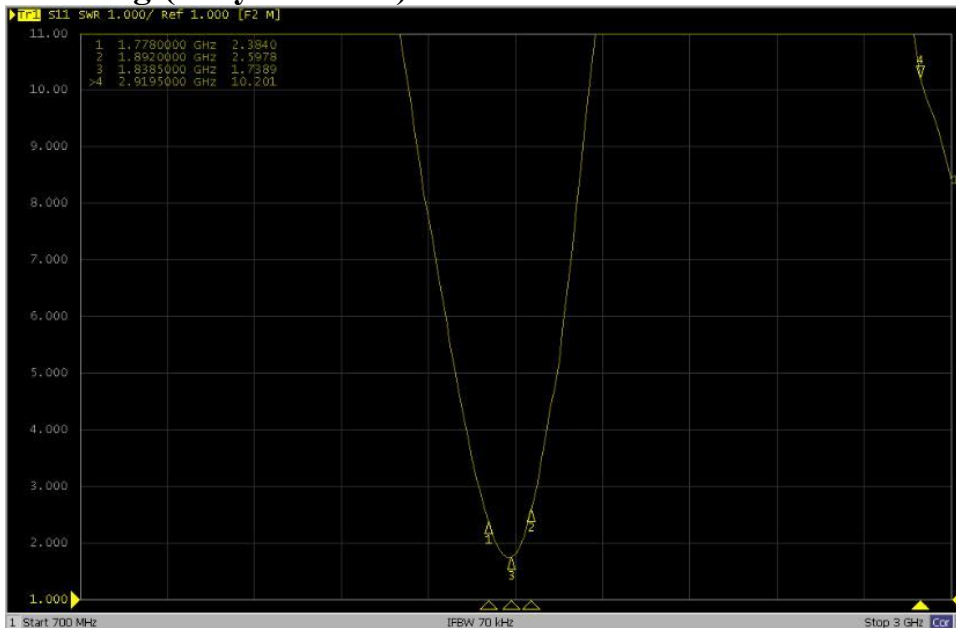
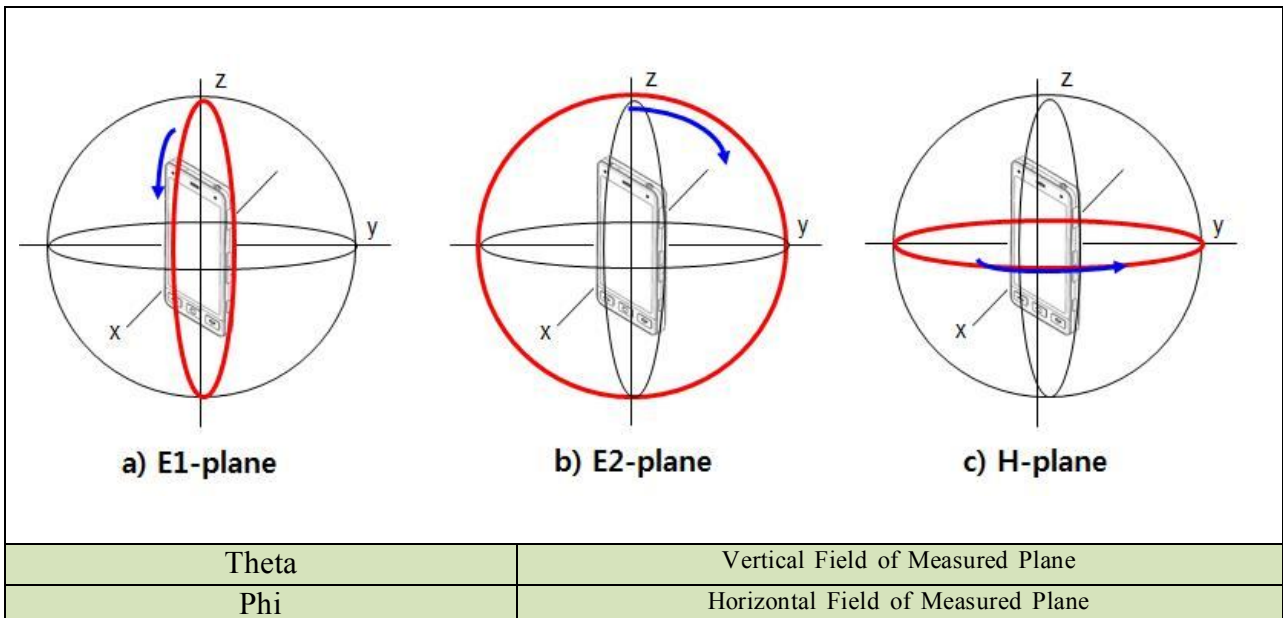


Figure 3-2.1. Typical Main curve of Jig (Only Antenna)

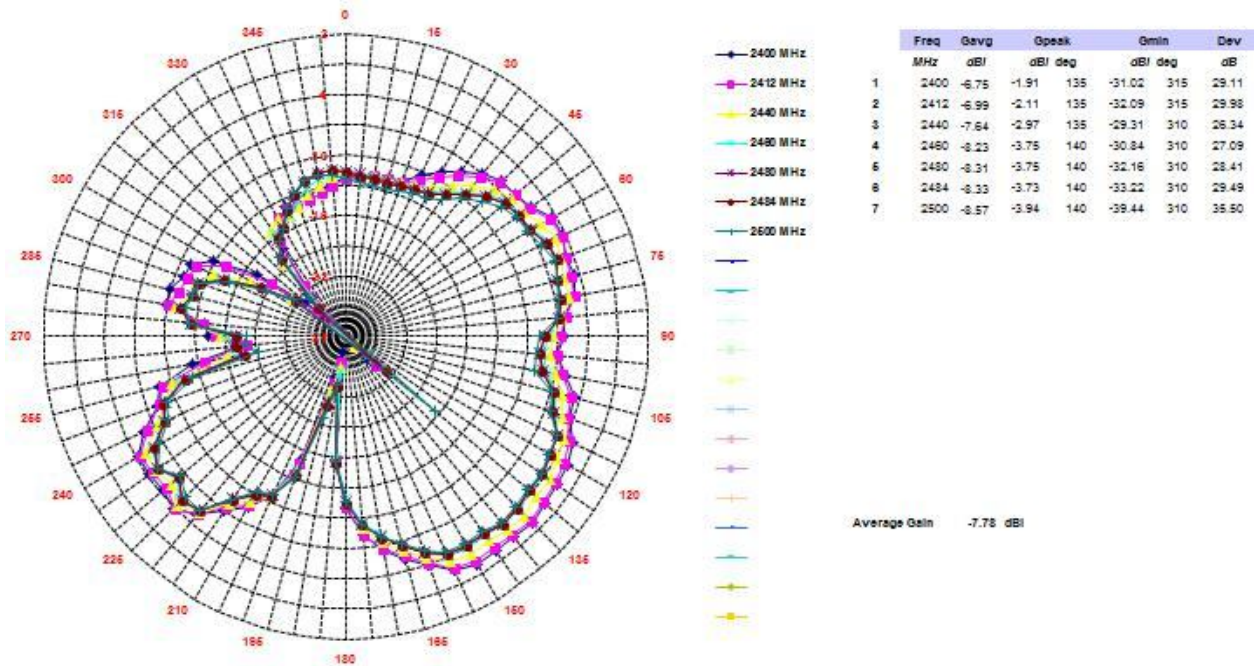
# 4 FREE SPACE 2D GAIN

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

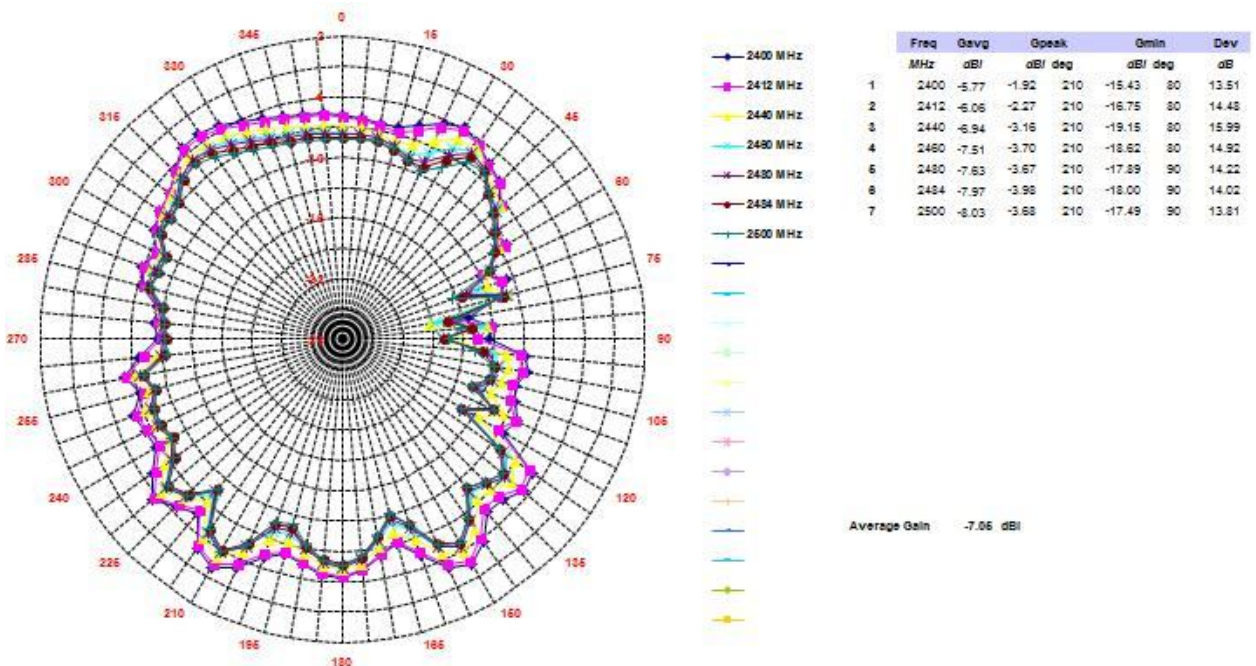
| Frequency(MHz) | 1    | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13     | 14     | 15     |        |
|----------------|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| <b>Hθ</b>      | 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 |
| <b>E1θ</b>     | 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 |
| <b>E2θ</b>     | 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 |
| <b>Hφ</b>      | 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  | -1.78  |
|                | 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 |
| <b>E1φ</b>     | 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 |
| <b>E2φ</b>     | 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 |
| <b>Hθ+Hφ</b>   | 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 |
| <b>E1θ+E1φ</b> | 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 |
| <b>E2θ+E2φ</b> | 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 |



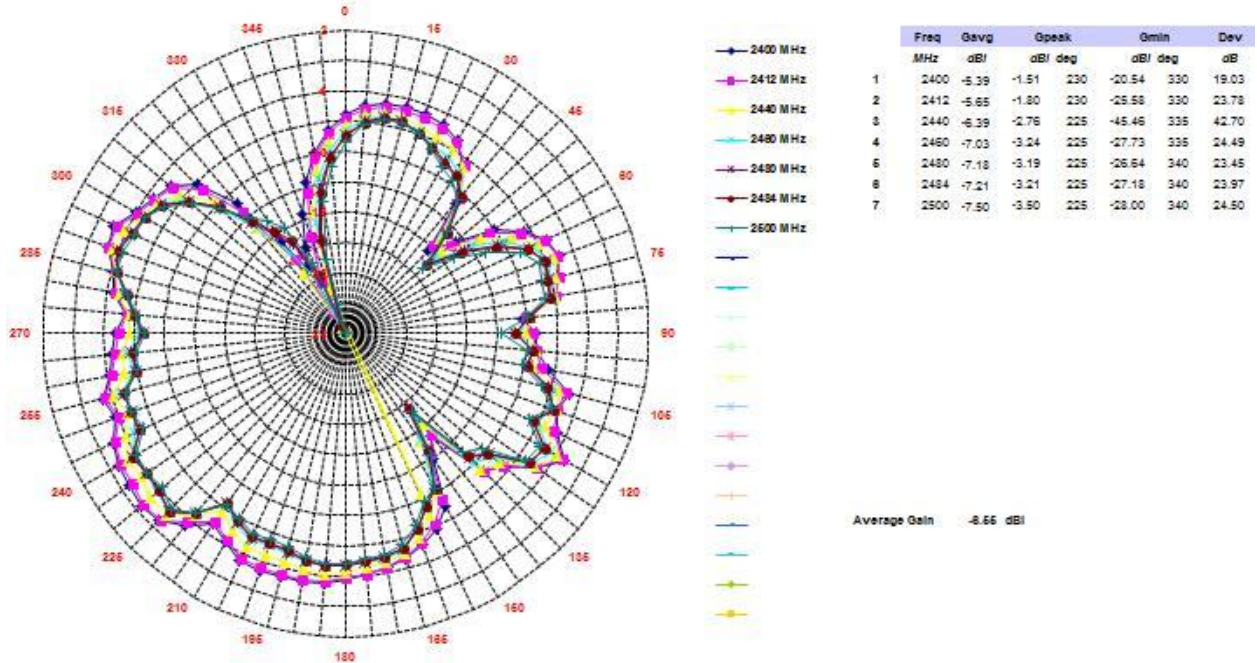
### 4.1 Radiation pattern of 2GHz 대역 [E1-Field (Theta)]



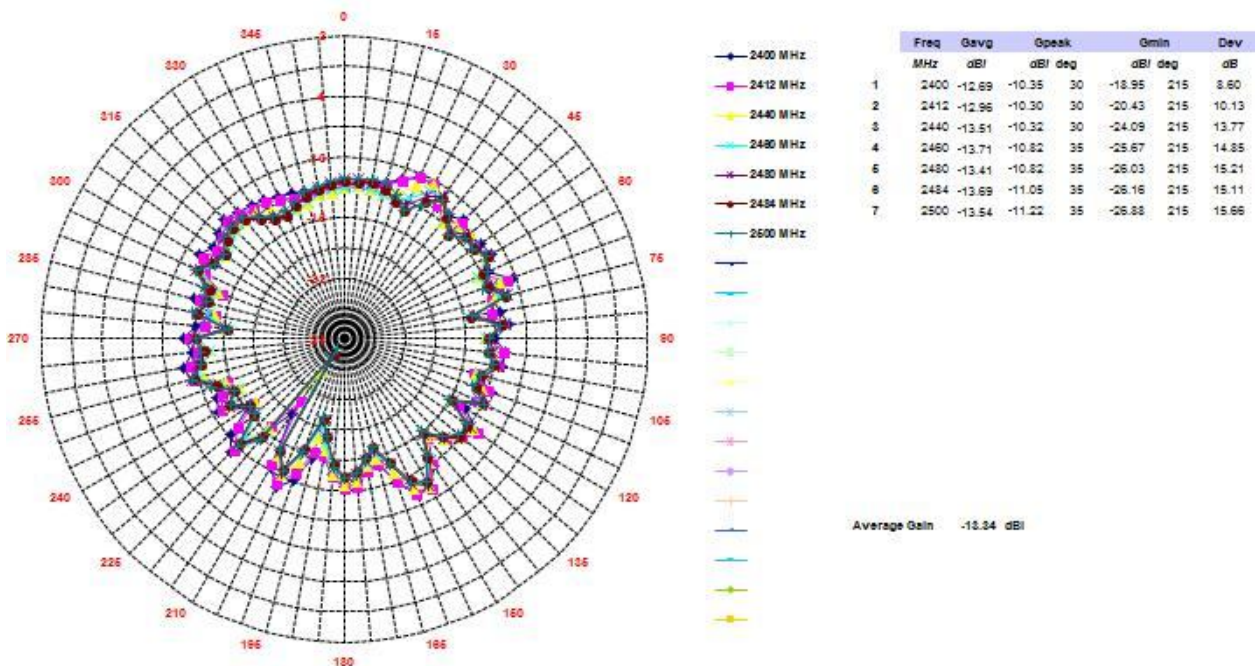
### 4.2 Radiation pattern of 2GHz 대역 [E1-Field(Phi)]



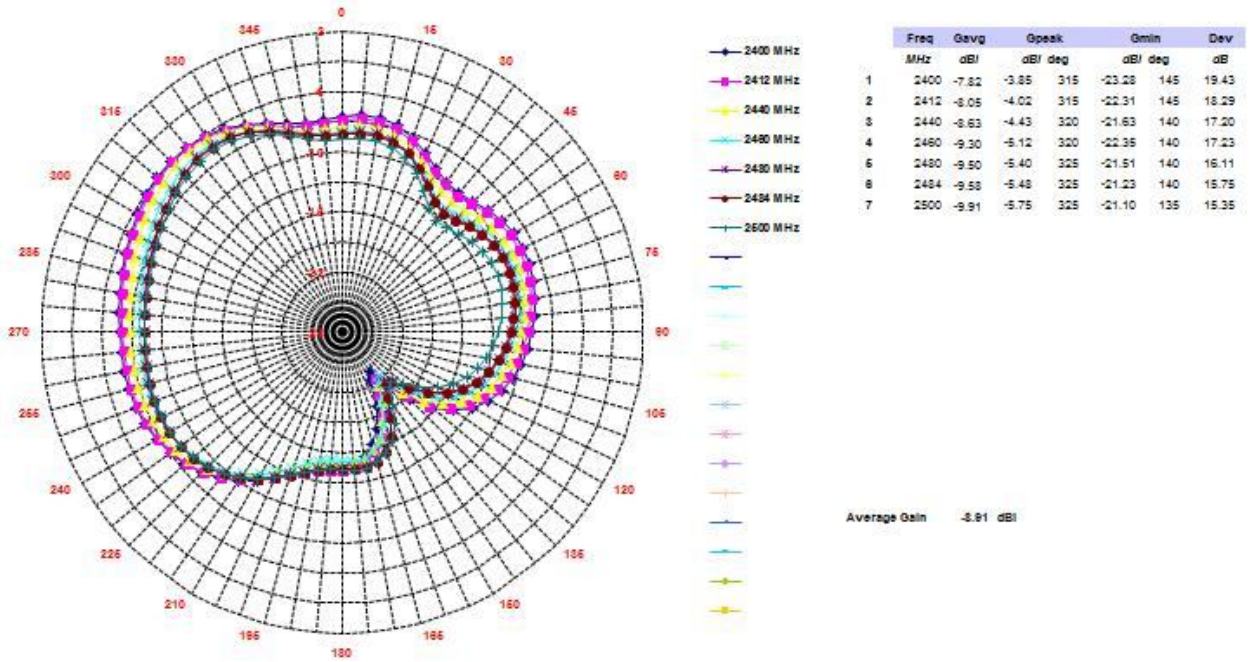
### 4.3 Radiation pattern of 2GHz 대역 [E2-Field(Theta)]



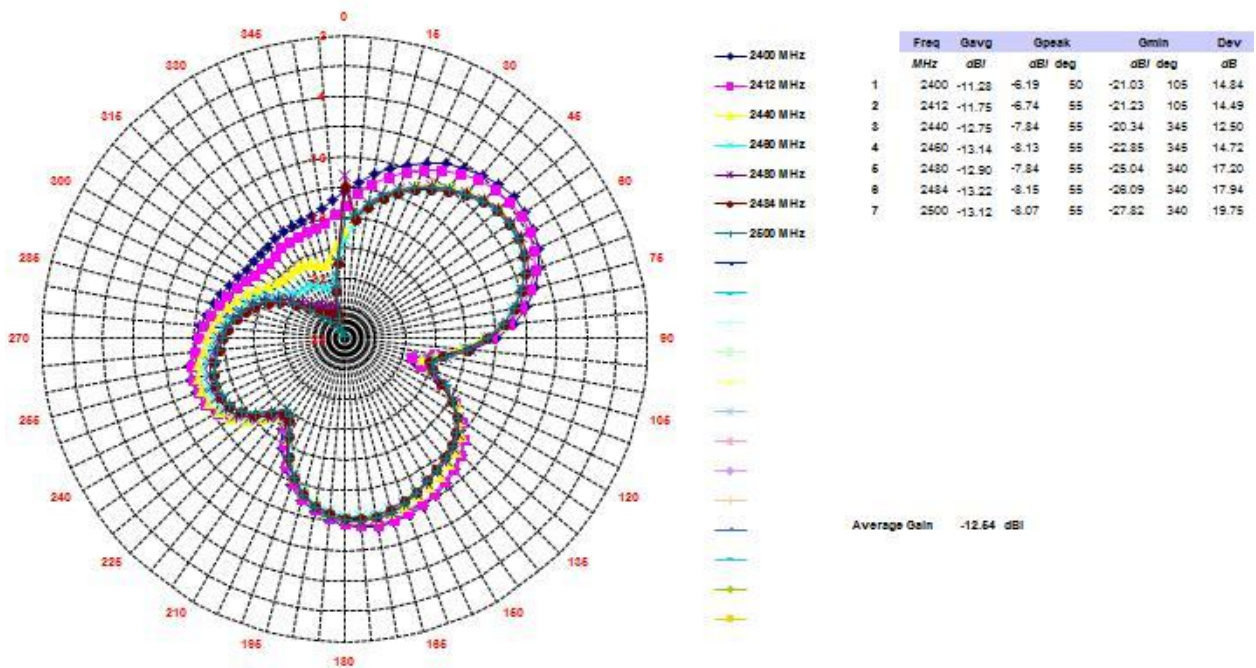
### 4.4 Radiation pattern of 2GHz 대역 [E2-Field(Phi)]



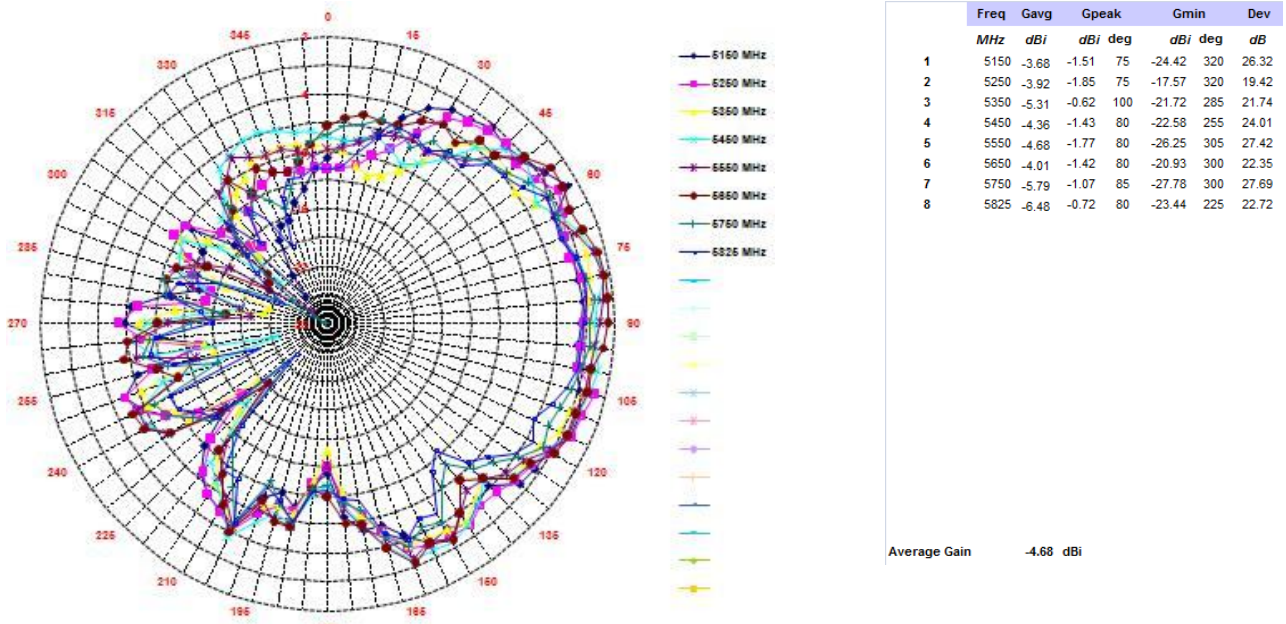
### 4.5 Radiation pattern of 2GHz 대역 [H-Field(Theta)]



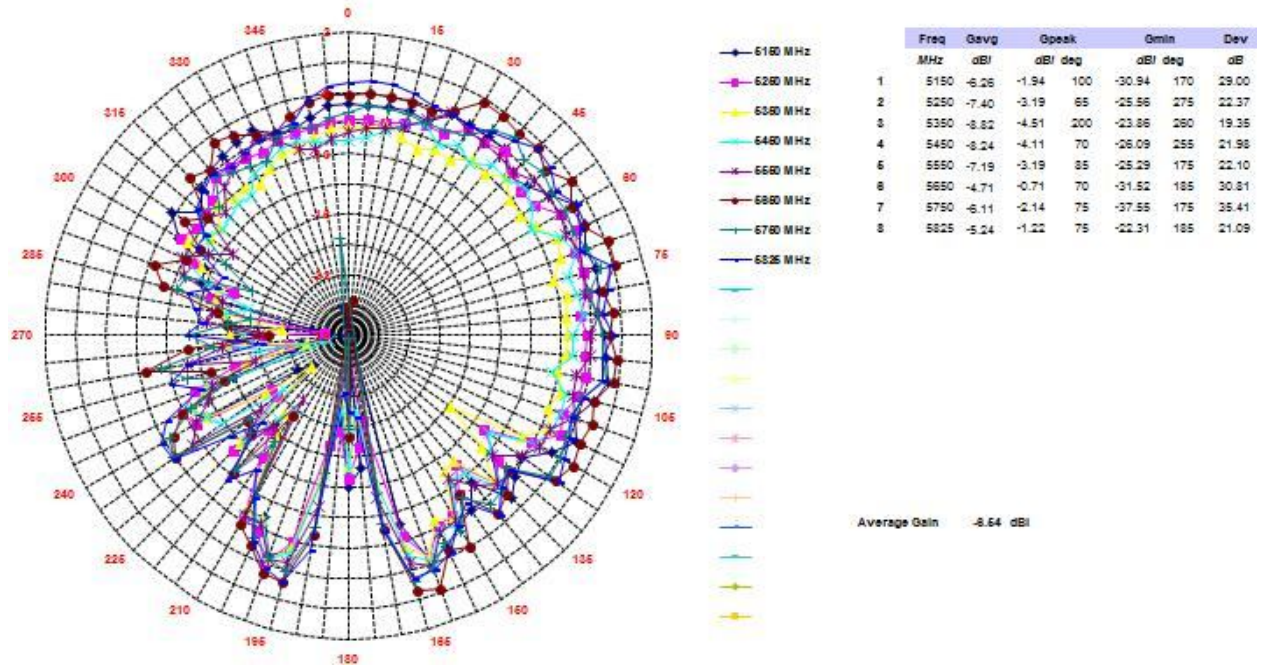
### 4.6 Radiation pattern of 2GHz 대역 [H-Field(Phi)]



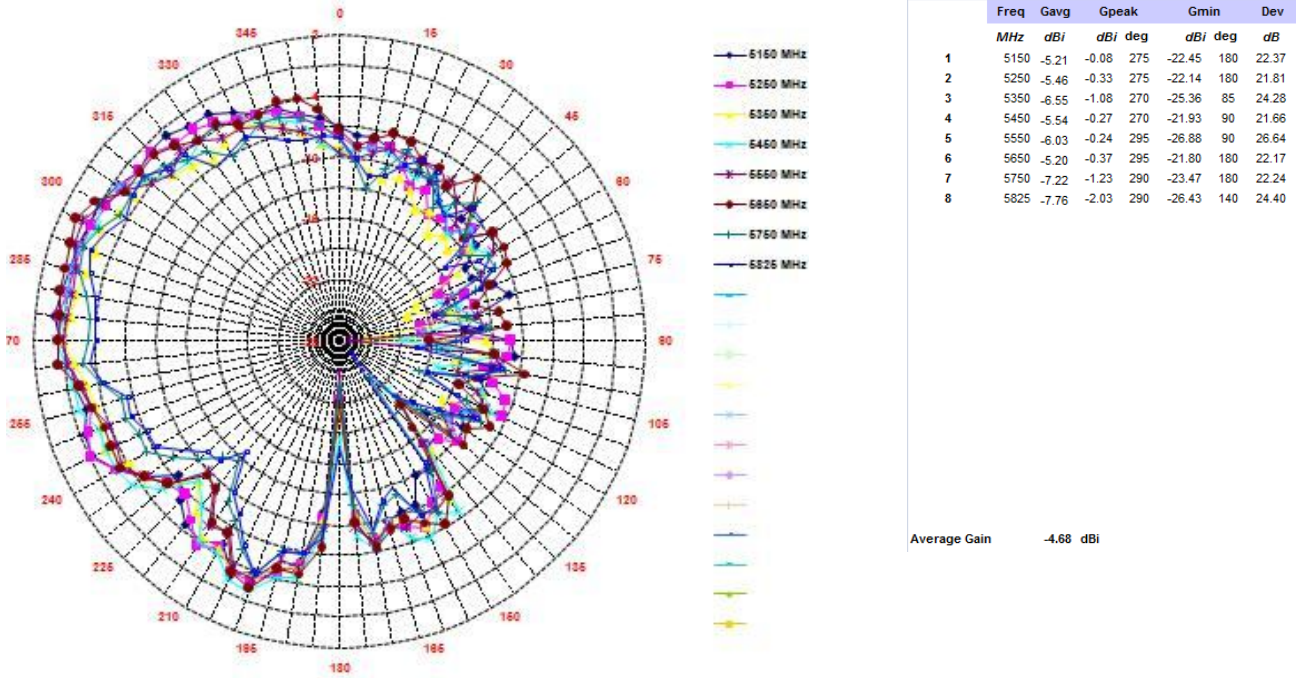
### 4.7 Radiation pattern of 5GHz 대역 [E1-Field (Theta)]



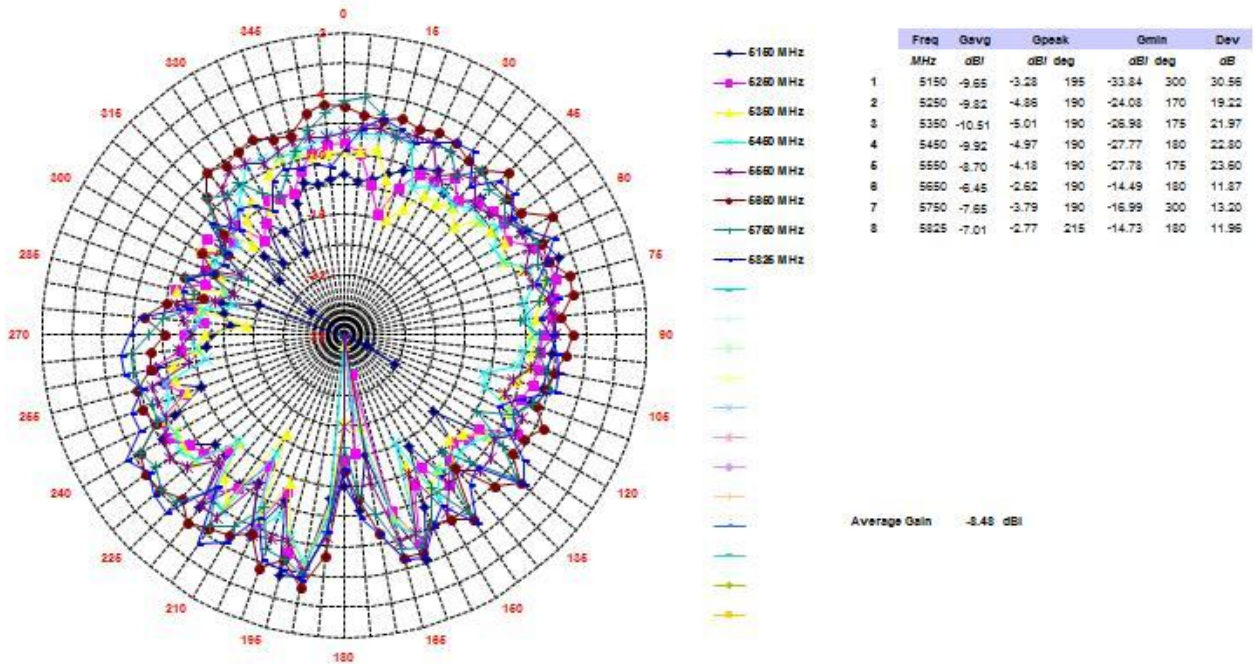
### 4.8 Radiation pattern of 5GHz 대역 [E1-Field (Phi)]



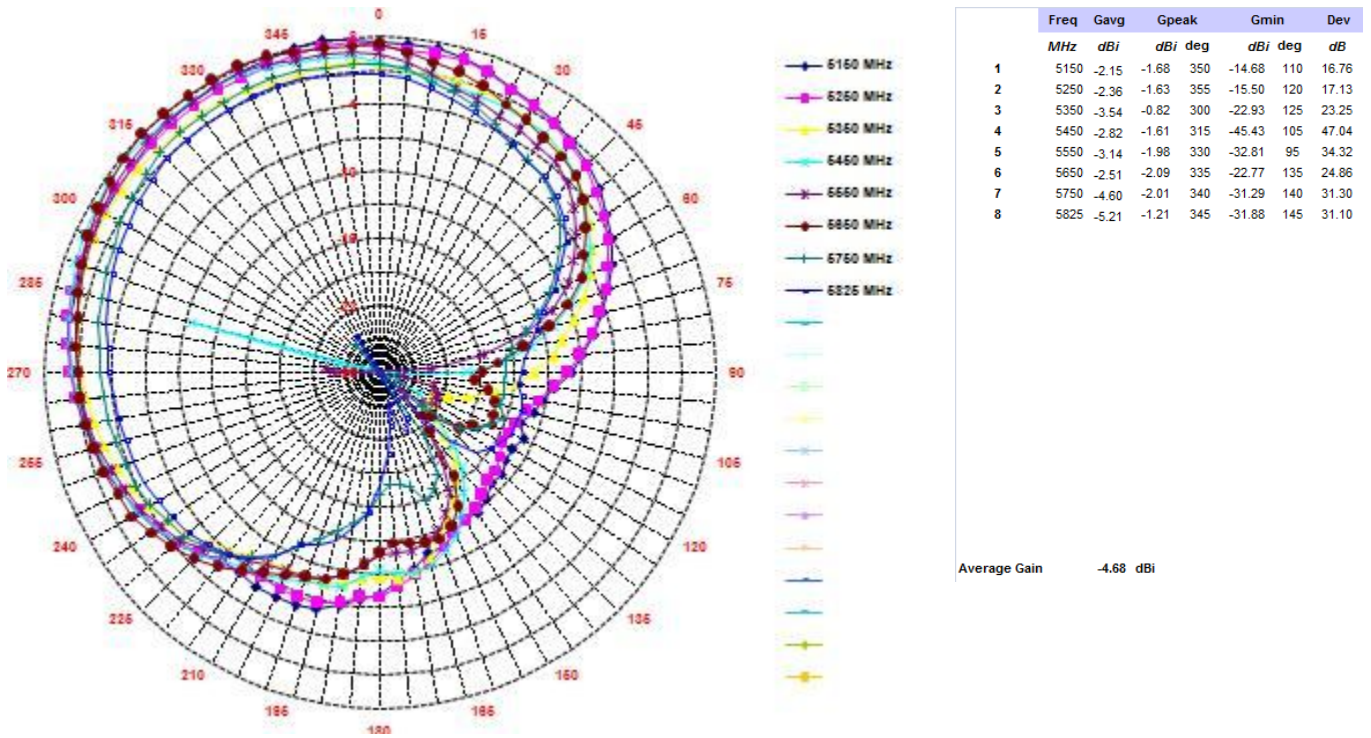
### 4.9 Radiation pattern of 5GHz 대역 [E2-Field (Theta)]



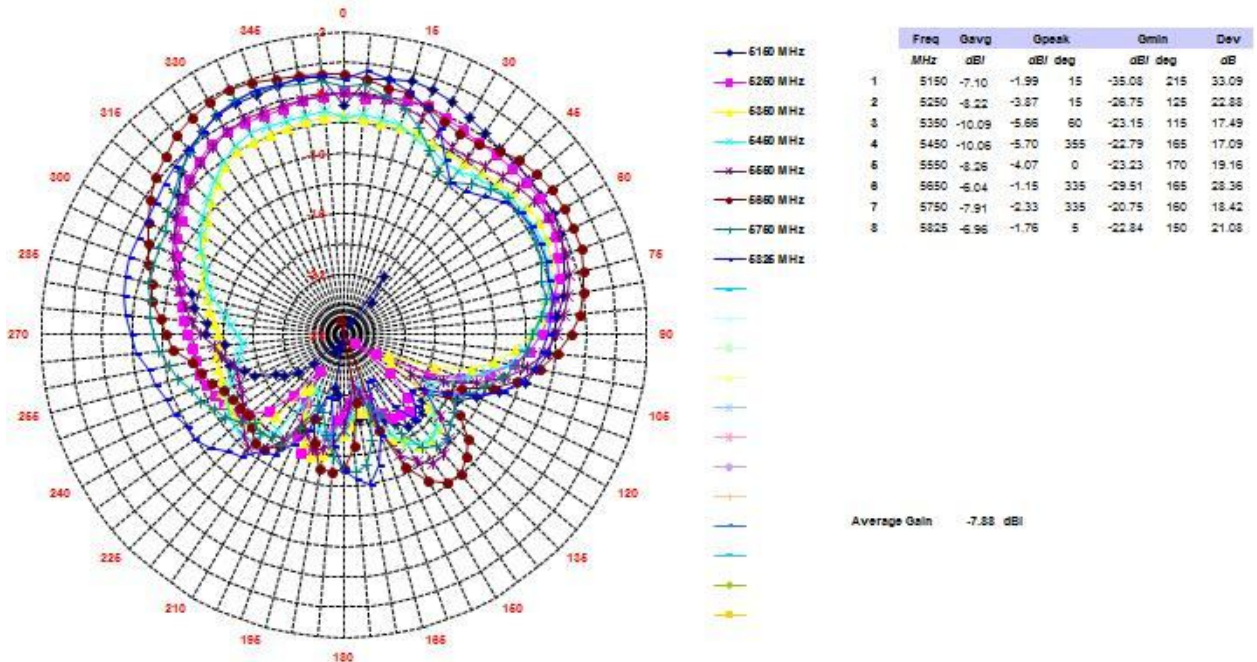
### 4.10 Radiation pattern of 5GHz 대역 [E2-Field (Phi)]



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



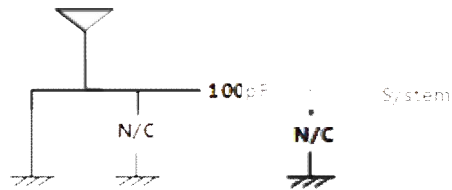
### 4.12 Radiation pattern of 5GHz 대역 [H-Field(Phi)]



## 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)