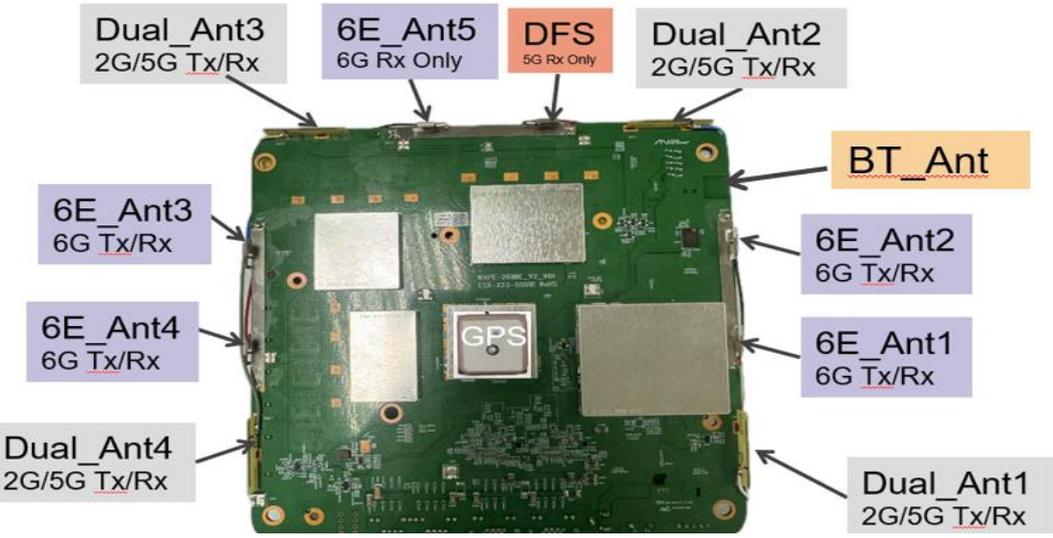


Antenna Test Report

Antenna System Description																																																											
Brand name	Gemtek																																																										
Model name	W1700K																																																										
Manufacturer	Gemtek Technology Co., Ltd. No. 15-1 Zhonghua Road, Hsinchu Industrial Park, Hukou, Hsinchu, Taiwan, 30352.																																																										
Geometric placement	 <table border="1"> <thead> <tr> <th>Ant NO</th> <th>Tx-Rx</th> <th>Type</th> <th>connector</th> <th>Support Band</th> </tr> </thead> <tbody> <tr> <td>BT</td> <td>2.4G Tx-Rx</td> <td>PIFA</td> <td>UFL</td> <td>2.4GHz</td> </tr> <tr> <td>Dual_Ant1</td> <td rowspan="4">2.4G/5G Tx-Rx</td> <td>PIFA</td> <td>UFL</td> <td>2.4GHz/5GHz</td> </tr> <tr> <td>Dual_Ant2</td> <td>PIFA</td> <td>UFL</td> <td>2.4GHz/5GHz</td> </tr> <tr> <td>Dual_Ant3</td> <td>PIFA</td> <td>UFL</td> <td>2.4GHz/5GHz</td> </tr> <tr> <td>Dual_Ant4</td> <td>PIFA</td> <td>UFL</td> <td>2.4GHz/5GHz</td> </tr> <tr> <td>6E_Ant1</td> <td rowspan="5">6G 4Tx-5Rx</td> <td>PIFA</td> <td>UFL</td> <td>6GHz</td> </tr> <tr> <td>6E_Ant2</td> <td>PIFA</td> <td>UFL</td> <td>6GHz</td> </tr> <tr> <td>6E_Ant3</td> <td>PIFA</td> <td>UFL</td> <td>6GHz</td> </tr> <tr> <td>6E_Ant4</td> <td>PIFA</td> <td>UFL</td> <td>6GHz</td> </tr> <tr> <td>6E_Ant5</td> <td>PIFA</td> <td>UFL</td> <td>6GHz Rx only</td> </tr> <tr> <td>DFS</td> <td>5G Rx</td> <td>PIFA</td> <td>UFL</td> <td>5GHz Rx only</td> </tr> <tr> <td>GPS</td> <td>GPS Rx</td> <td>Patch</td> <td>UFL</td> <td>1575.42MHx</td> </tr> </tbody> </table>	Ant NO	Tx-Rx	Type	connector	Support Band	BT	2.4G Tx-Rx	PIFA	UFL	2.4GHz	Dual_Ant1	2.4G/5G Tx-Rx	PIFA	UFL	2.4GHz/5GHz	Dual_Ant2	PIFA	UFL	2.4GHz/5GHz	Dual_Ant3	PIFA	UFL	2.4GHz/5GHz	Dual_Ant4	PIFA	UFL	2.4GHz/5GHz	6E_Ant1	6G 4Tx-5Rx	PIFA	UFL	6GHz	6E_Ant2	PIFA	UFL	6GHz	6E_Ant3	PIFA	UFL	6GHz	6E_Ant4	PIFA	UFL	6GHz	6E_Ant5	PIFA	UFL	6GHz Rx only	DFS	5G Rx	PIFA	UFL	5GHz Rx only	GPS	GPS Rx	Patch	UFL	1575.42MHx
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GPS	GPS Rx	Patch	UFL	1575.42MHx																																																							
Generate multiple beams	No supports																																																										

Measurement Quantity

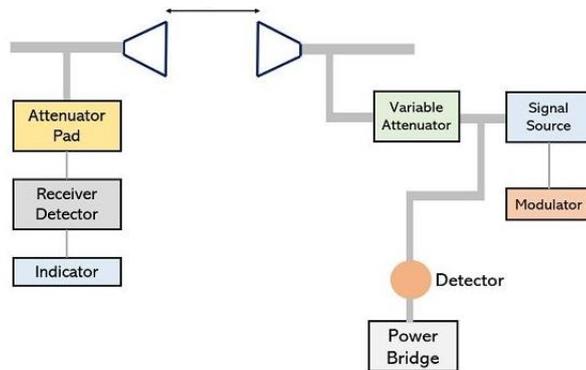
Operation bands of EUT

Wi-Fi 2.4GHz : 2.412 / 2.4835 GHz

Wi-Fi 5GHz / 6GHz : UNII-1 / 2A / 2C / 3 / 5 / 6 / 7 / 8

Measurement Method

Absolute gain



Suppose the two antennas (transmitting and receiving) are separated at a distance r . Here, P_t and P_r represent the transmitted and received power respectively. While A_{et} and A_{er} are the effective apertures of transmitting and receiving antennas.

As the two antennas are identical. Therefore, $A_{et} = A_{er} = \frac{G_0 \lambda^2}{4\pi}$

By Friis's transmission equation, $\frac{P_r}{P_t} = \left(\frac{A_{et}A_{er}}{\lambda^2 r^2}\right) = \left(\frac{G_0 \lambda^2}{4\pi}\right)\left(\frac{G_0 \lambda^2}{4\pi}\right) \frac{1}{\lambda^2 r^2}$

$$\frac{P_r}{P_t} = \left(\frac{G_0 \lambda}{4\pi r}\right)^2$$

$$\sqrt{\frac{P_r}{P_t}} = \frac{G_0 \lambda}{4\pi r}$$

Thus, $G_0 = \frac{4\pi r}{\lambda} \sqrt{\frac{P_r}{P_t}}$

While if we consider the effect of direct and indirect rays in case of ground

reflection then, $G_0 = \frac{4\pi r}{\lambda F} \sqrt{\frac{P_r}{P_t}}$

: F is the propagation constant due to interference.

$$\text{Gain} = \frac{\text{Maximum amount of power received from subject antenna}}{\text{Maximum amount of power received from reference antenna}}$$

Hence, $G = \frac{P_1}{P_2}$

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Measurement Environment

Chamber type

Operation Band: 700 MHz ~ 18 GHz
 Chamber Size: 7m(L) * 3.5m(W) * 3.5m(H)



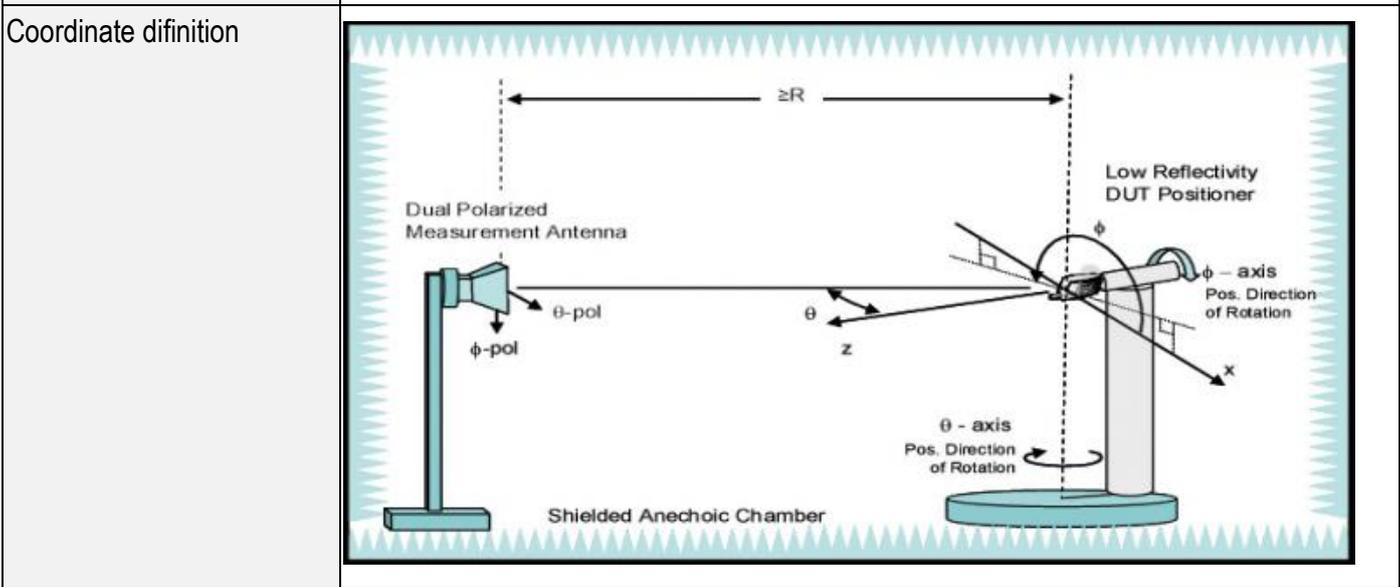

[R&S ZNB 8](#)

Antenna type

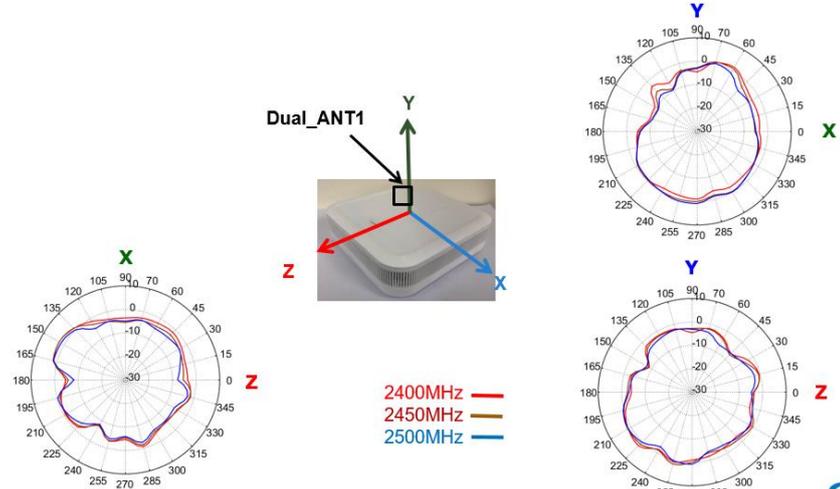
Types of measurement antennas (Frequency Range)

Test Equipment

Instrument	Brand	Model No.
VNA	ROHDE & SCHWARZ	ZNB8
Test Software	Atenlab	Maxwell 3.8.2
Switch	Atenlab	4SW_P_2019
Turntable	Atenlab	Aten Dual Axis
Horn Antenna	ETS-Lindgren	3164-10

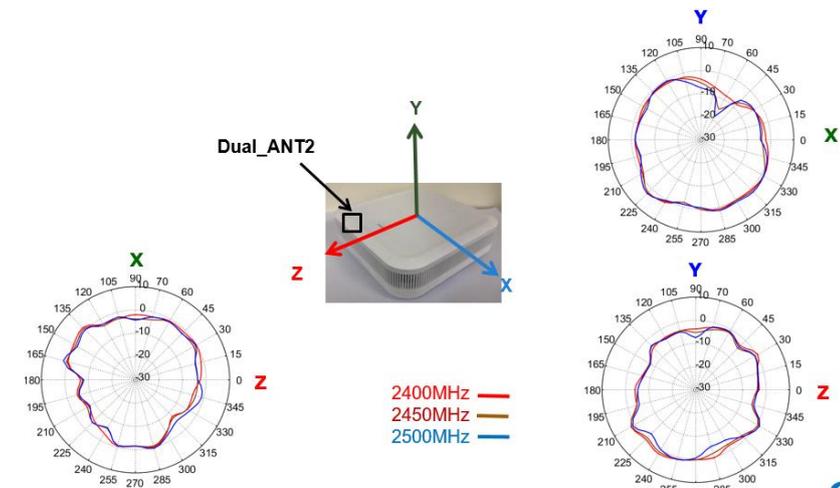


Dual_ANT1 GainTotal (dBi) Pattern



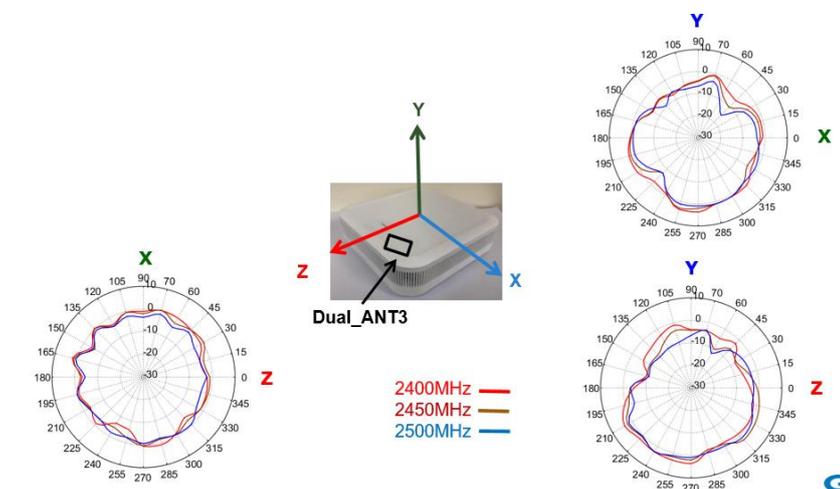
Gemtek
Wireless Broadband Anywhere

Dual_ANT2 GainTotal (dBi) Pattern



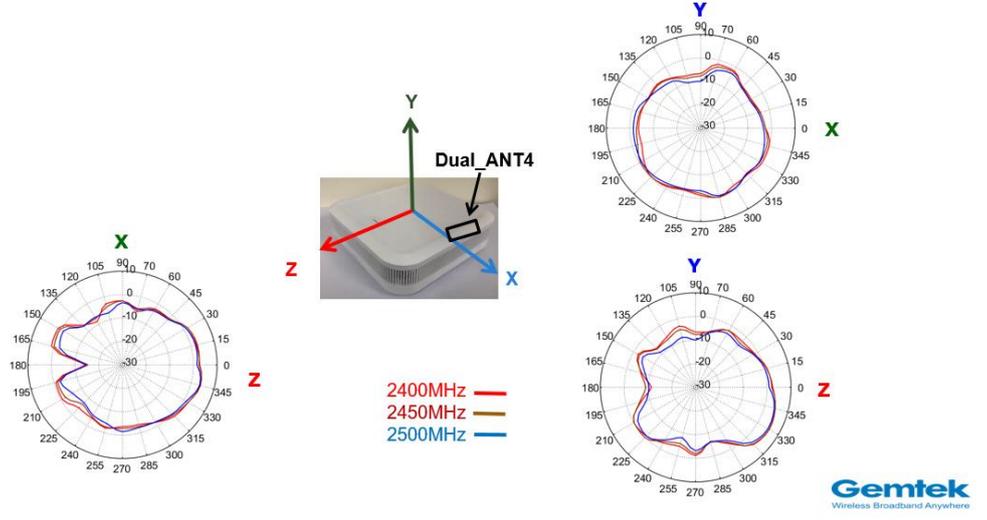
Gemtek
Wireless Broadband Anywhere

Dual_ANT3 GainTotal (dBi) Pattern

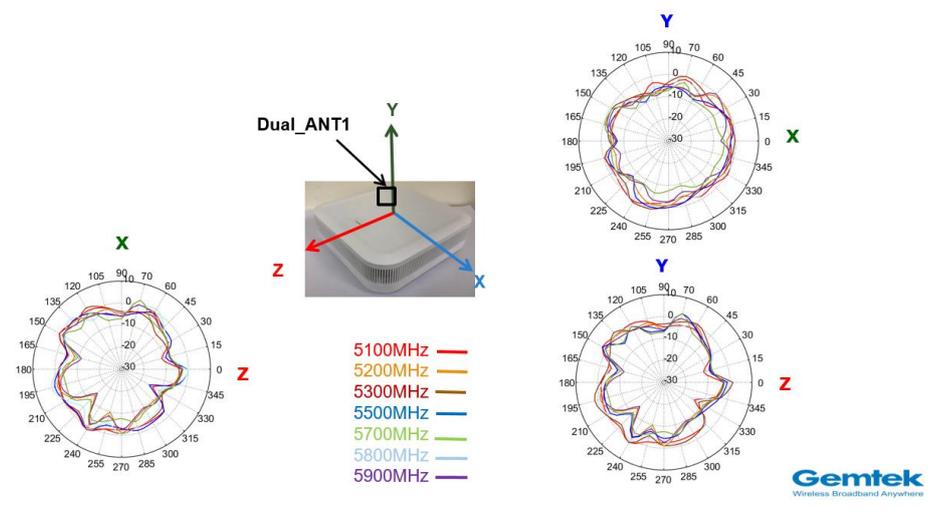


Gemtek
Wireless Broadband Anywhere

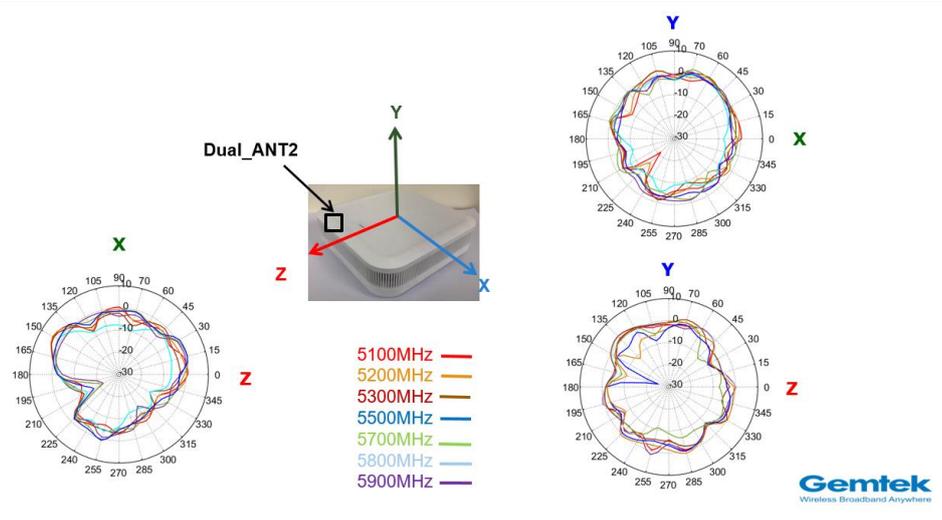
Dual_ANT4 GainTotal (dBi) Pattern



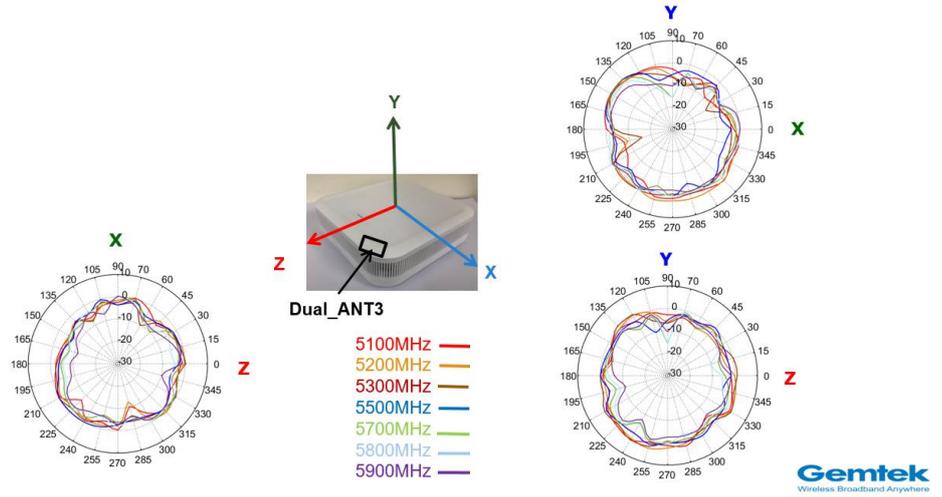
Dual_ANT1 GainTotal (dBi) Pattern



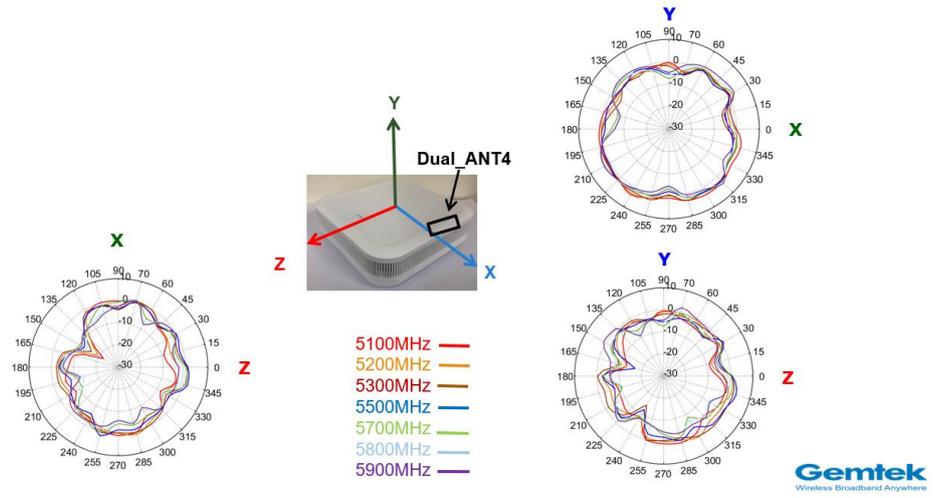
Dual_ANT2 GainTotal (dBi) Pattern



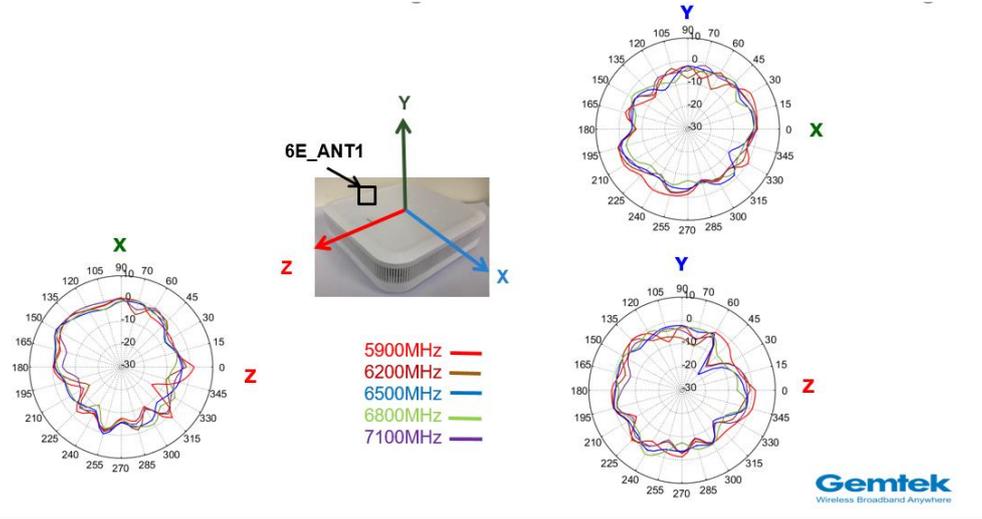
Dual_ANT3 GainTotal (dBi) Pattern



Dual_ANT4 GainTotal (dBi) Pattern

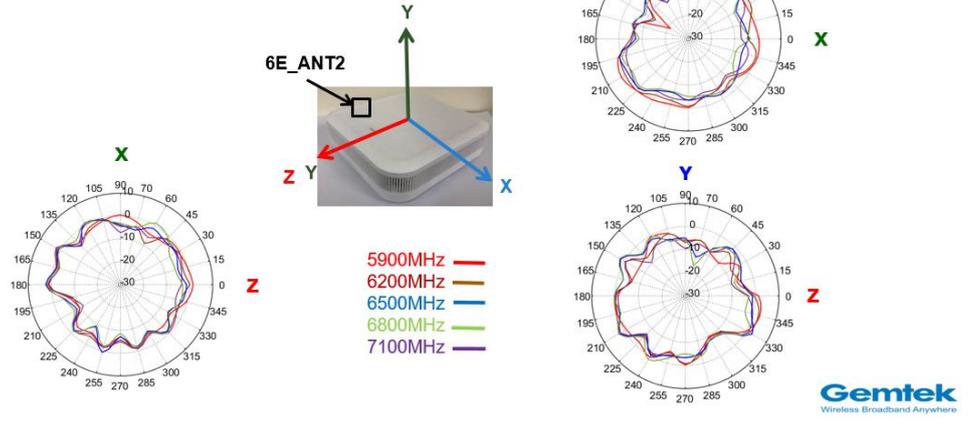


6E_ANT1 GainTotal (dBi) Pattern



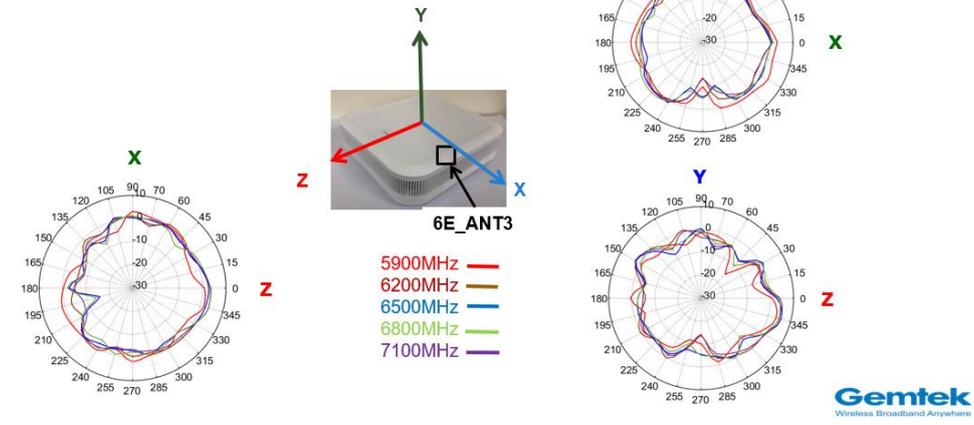
6E_ANT2 GainTotal (dBi)

Pattern



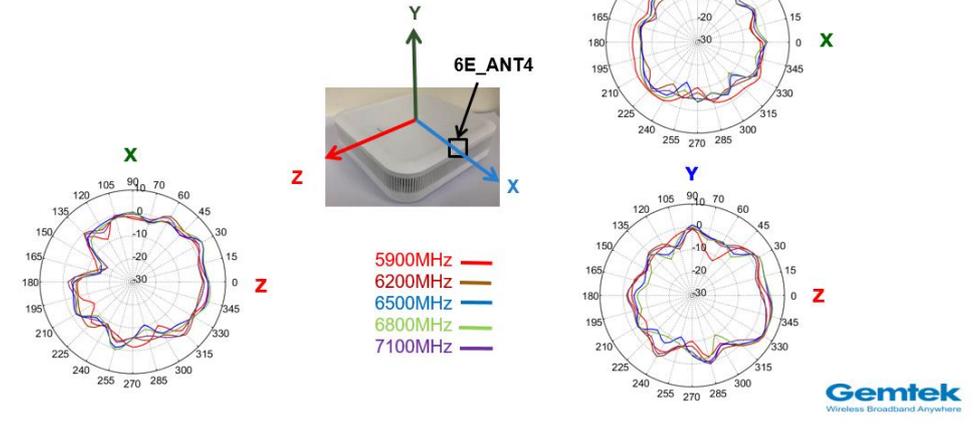
6E_ANT3 GainTotal (dBi)

Pattern

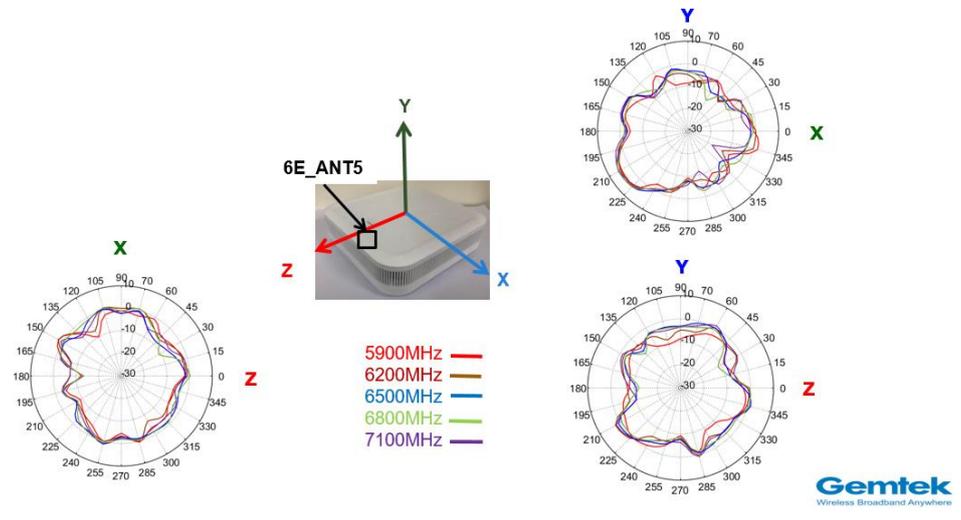


6E_ANT4 GainTotal (dBi)

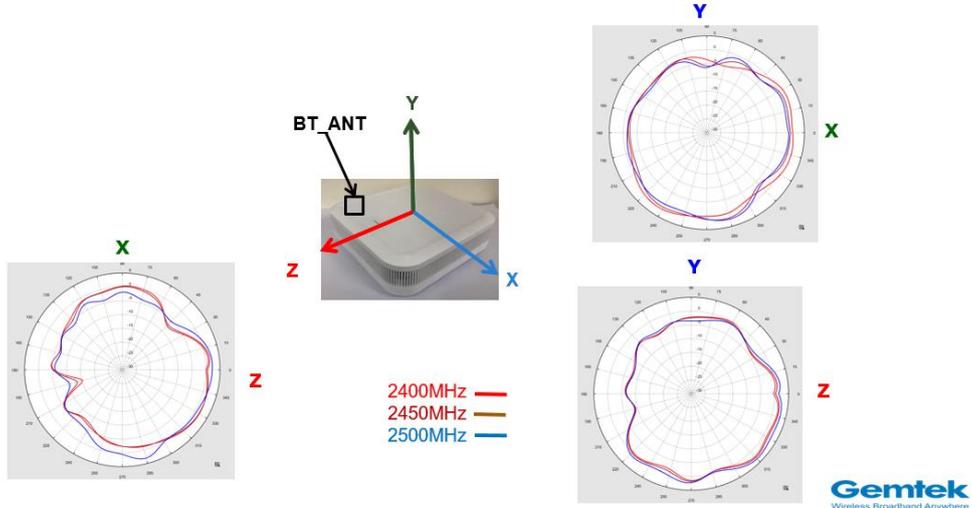
Pattern



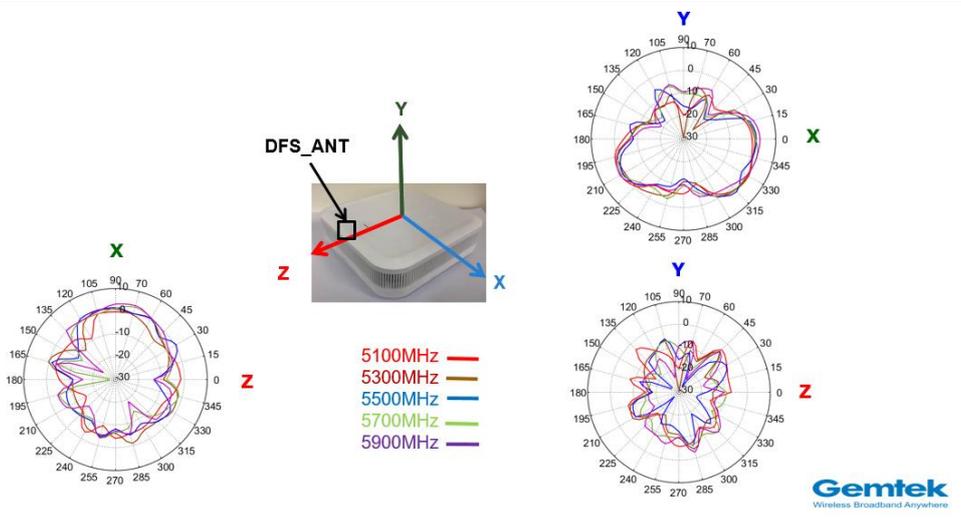
**6E_ANT5 GainTotal (dBi)
Pattern**



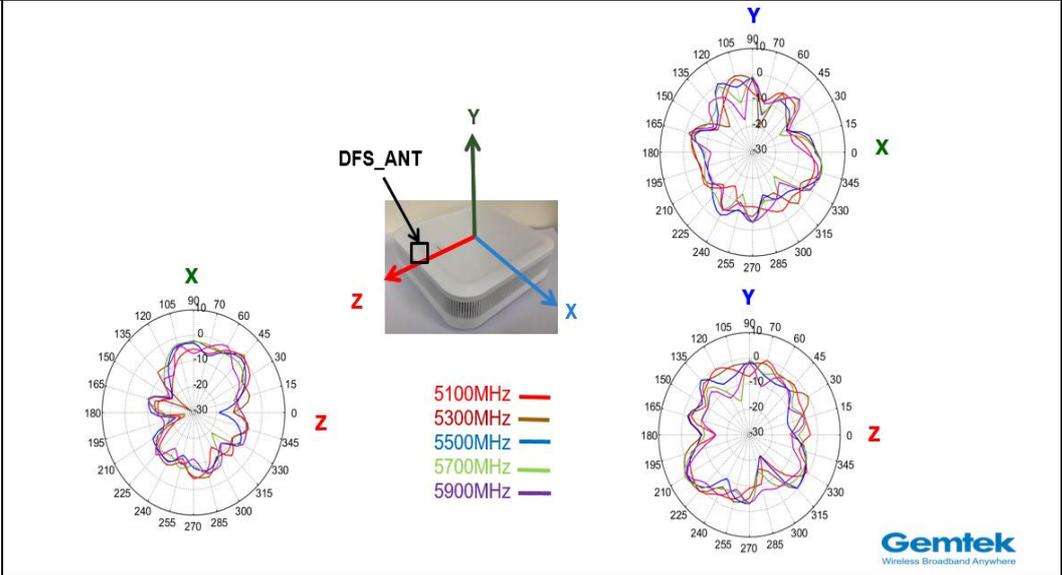
**BT_ANT GainTotal (dBi)
Pattern**



**DFS_ANT Gain (dBi)
Pattern (Vertical
Polarization)**



**DFS_ANT Gain (dBi)
Pattern (Horizontal
Polarization)**



BT Antenna Efficiency & Peak Gain

Antenna Efficiency (%)

Frequency (MHz)	2400	2450	2500
BT_ANT	70.45	72.27	71.21

Antenna Peak Gain (dB)

Frequency (MHz)	2400	2450	2500
BT_ANT	2.82	2.88	2.94

6E-Band Antenna Efficiency & Peak Gain

WIFI 6E Band Antenna Efficiency (%)

Frequency (MHz)	5900	6200	6500	6800	7100
6E_Ant5	72.59	72.67	73.39	71.29	72.34

WIFI 6E Band Antenna Peak Gain (dB)

Frequency (MHz)	5900	6200	6500	6800	7100
6E_Ant5	4.29	4.22	4.48	4.39	4.43

DFS Antenna Efficiency & Peak Gain

WIFI A Band Antenna Efficiency (%)

Frequency (MHz)	5100	5300	5500	5700	5900
DFS	73.03	72.79	76.56	71.34	70.45

WIFI A Band Antenna Peak Gain (dB)

Frequency (MHz)	5100	5300	5500	5700	5900
DFS	4.34	4.42	4.41	4.43	4.34

Peak Gain & D.G @2.4G/5G					
peak gain & D.G					
Frequency (GHz)	2.45	5.2	5.3	5.6	5.785
Dual_Ant1.Max Gain(dBi)	3.01	2.84	2.71	2.09	2.21
Dual_Ant2.Max Gain(dBi)	2.64	1.9	1.96	1.55	1.43
Dual_Ant3.Max Gain(dBi)	2.43	2.92	1.75	1.59	2.03
Dual_Ant4.Max Gain(dBi)	1.89	1.63	1.84	1.63	1.48
Dual_Ant1 Polarization/ $\theta(^{\circ})/\Phi(^{\circ})$	Phi/150/45	theta/150/105	theta/150/105	theta/150/120	theta/150/120
Dual_Ant2 Polarization/ $\theta(^{\circ})/\Phi(^{\circ})$	phi/180/240	phi/150/0	phi/150/0	phi/90/45	phi/90/45
Dual_Ant3 Polarization/ $\theta(^{\circ})/\Phi(^{\circ})$	Phi/150/240	theta/105/285	theta/45/30	theta/75/255	theta/75/255
Dual_Ant4 Polarization/ $\theta(^{\circ})/\Phi(^{\circ})$	Phi/15/255	theta/60/345	theta/30/150	theta/15/255	theta/15/255
Max Gain (dBi)	3.01	2.92	2.71	2.09	2.21
DG [1SS] (dBi)	5.62	6.35	6.14	5.63	5.74
DG [2SS] (dBi)	3.01	3.35	3.14	2.63	2.74
DG [4SS] (dBi)	3.01	2.92	2.71	2.09	2.21
Peak Gain & D.G @6G					
peak gain & D.G					
Frequency (GHz)	6.175	6.475	6.695	6.995	
6E_Ant1.(dBi)	1.32	2.27	2.26	2.28	
6E_Ant2.(dBi)	2.35	2.04	2.75	2.18	
6E_Ant3.(dBi)	3.32	2.11	3.14	1.94	
6E_Ant4.(dBi)	2.73	2.08	2.6	2.08	
6E_Ant1 Polarization/ $\theta(^{\circ})/\Phi(^{\circ})$	theta/90/195	theta/165/30	theta/135/60	theta/150/15	
6E_Ant2 Polarization/ $\theta(^{\circ})/\Phi(^{\circ})$	theta/90/210	theta/150/330	theta/150/345	theta/150/285	
6E_Ant3 Polarization/ $\theta(^{\circ})/\Phi(^{\circ})$	theta/15/255	theta/0/195	theta/0/195	theta/120/225	
6E_Ant4 Polarization/ $\theta(^{\circ})/\Phi(^{\circ})$	theta/30/105	theta/30/105	theta/30/120	theta/30/120	
Max Gain (dBi)	3.32	2.27	3.14	2.28	
DG [1SS] (dBi)	5.63	5.50	5.45	5.39	
DG [2SS] (dBi)	3.32	2.5	3.14	2.39	
DG [4SS] (dBi)	3.32	2.27	3.14	2.28	
D.G @2.4G/5G					
D.G					
Frequency (GHz)	2.45	5.2	5.3	5.6	5.785
Dual_Ant.1 (dBi)	1.11	-2.13	2.36	1.86	1.24
Dual_Ant.2 (dBi)	1.95	2.45	-2.12	-3.83	-1.20
Dual_Ant.3 (dBi)	-1.38	3.24	-3.15	0.40	-4.21
Dual_Ant.4 (dBi)	-4.75	-4.54	2.03	-0.99	1.82
DG [1SS] (dBi)	5.62	6.35	6.14	5.63	5.74

Polarization	phi	theta	theta	theta	theta
Theta	150	150	150	150	150
Phi	330	0	15	15	0
Frequency (GHz)	2.45	5.2	5.3	5.6	5.785
Dual_Ant.1 [10^(G/20)]	10^(1.11/20)	10^(-2.13/20)	10^(2.36/20)	10^(1.86/20)	10^(1.24/20)
Dual_Ant.2 [10^(G/20)]	10^(1.95/20)	10^(2.45/20)	10^(-2.12/20)	10^(-3.83/20)	10^(-1.20/20)
Dual_Ant.3 [10^(G/20)]	10^(-1.38/20)	10^(3.24/20)	10^(-3.15/20)	10^(-0.40/20)	10^(-4.21/20)
Dual_Ant.4 [10^(G/20)]	10^(-4.75/20)	10^(-4.54/20)	10^(2.03/20)	10^(-0.99/20)	10^(1.82/20)
Dual_Ant.1 [10^(G/20)] Value	1.14	0.78	1.31	1.24	1.15
Dual_Ant.2 [10^(G/20)] Value	1.25	1.33	0.78	0.64	0.87
Dual_Ant.3 [10^(G/20)] Value	0.85	1.45	0.70	1.05	0.62
Dual_Ant.4 [10^(G/20)] Value	0.58	0.59	1.26	0.89	1.23
Sum All Antenna [Amax]	3.82	4.15	4.05	3.82	3.87
DG [10*log(Amax^2/Nant)]	5.62	6.35	6.14	5.63	5.74

D.G @6G

D.G				
Frequency (GHz)	6.175	6.475	6.695	6.995
6E_Ant.1 (dBi)	-0.16	1.65	1.17	-2.03
6E_Ant.2 (dBi)	0.91	-1.54	-1.87	-0.66
6E_Ant.3 (dBi)	-1.64	-3.27	1.13	2.82
6E_Ant.4 (dBi)	-0.85	0.27	-3.66	-4.18
DG [1SS] (dBi)	5.63	5.50	5.45	5.39
Polarization	phi	phi	phi	phi
Theta	15	0	15	15
Phi	240	240	240	240
Frequency (GHz)	6.175	6.475	6.695	6.995
6E_Ant.1 [10^(G/20)]	10^(-0.16/20)	10^(1.65/20)	10^(1.17/20)	10^(-2.03/20)
6E_Ant.2 [10^(G/20)]	10^(0.91/20)	10^(-1.54/20)	10^(-1.87/20)	10^(-0.66/20)
6E_Ant.3 [10^(G/20)]	10^(-1.64/20)	10^(-3.27/20)	10^(1.13/20)	10^(2.82/20)
6E_Ant.4 [10^(G/20)]	10^(-0.85/20)	10^(0.27/20)	10^(-3.66/20)	10^(-4.18/20)
6E_Ant.1 [10^(G/20)] Value	0.98	1.21	1.14	0.79
6E_Ant.2 [10^(G/20)] Value	1.11	0.84	0.81	0.93
6E_Ant.3 [10^(G/20)] Value	0.83	0.69	1.14	1.38
6E_Ant.4 [10^(G/20)] Value	0.91	1.03	0.66	0.62
Sum All Antenna [Amax]	3.83	3.77	3.75	3.72
DG [10*log(Amax^2/Nant)]	5.63	5.50	5.45	5.39