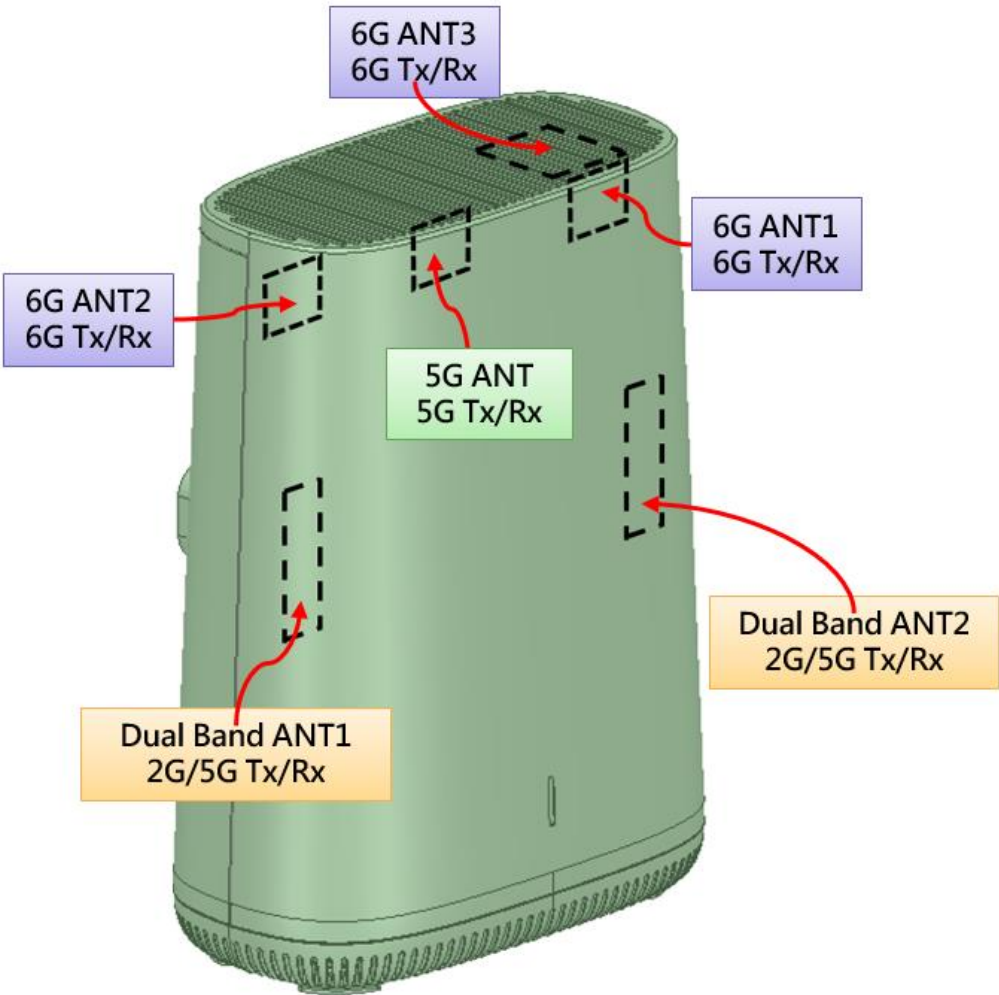
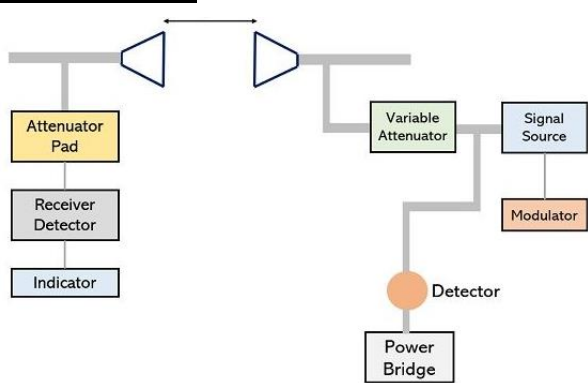
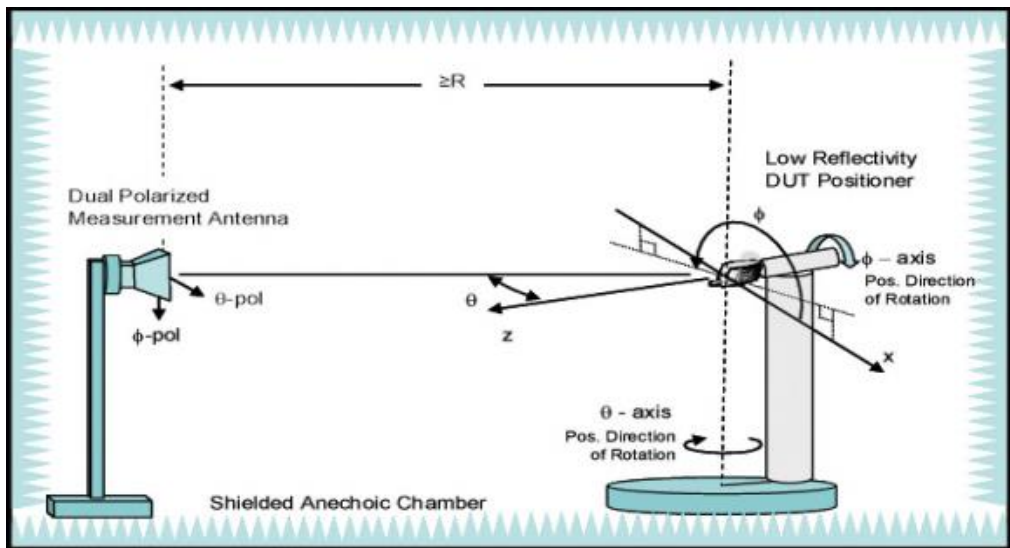


Antenna Test Report

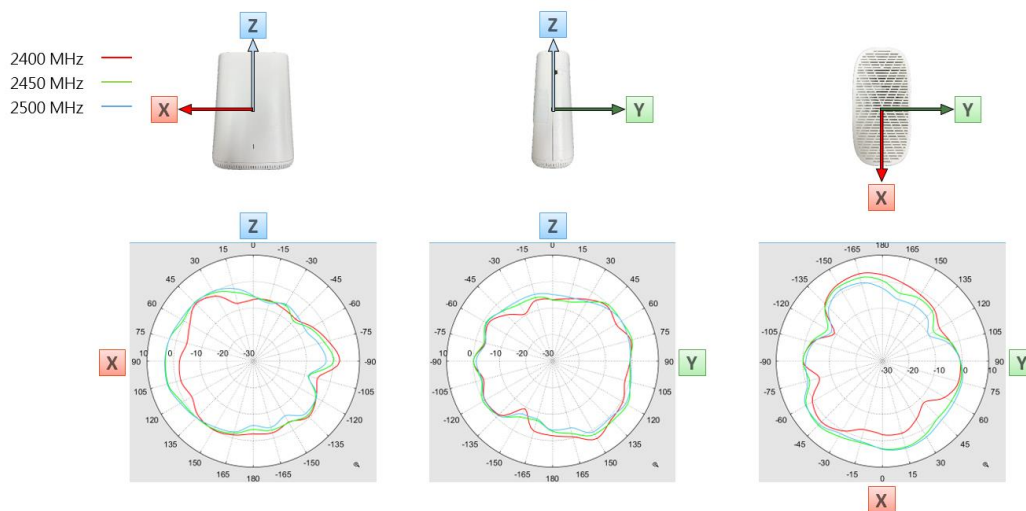
Antenna System Description				
Brand name	Gemtek			
Model name	WRTM-408BE			
Manufacturer	Gemtek Technology Co., Ltd. No. 15-1 Zhonghua Road, Hsinchu Industrial Park, Hukou, Hsinchu, Taiwan, 30352.			
Geometric placement				
	Ant NO	Tx-Rx	Type	connector
	Dual Band ANT1	2.4G/5G Tx-Rx	PIFA	UFL
	Dual Band ANT2		PIFA	UFL
	5G ANT	5G Tx-Rx	Dipole	UFL
	6G ANT1	6G Tx-Rx	Dipole	UFL
	6G ANT2	6G Tx-Rx	Dipole	UFL
	6G ANT3	6G Tx-Rx	Dipole	UFL
	Support Band			
Generate multiple beams	Not support			

Measurement Quantity	
Operation bands of EUT Wi-Fi 2.4GHz : 2.412 / 2.4835 GHz Wi-Fi 5GHz : 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 $G_0 = \frac{4\pi r}{\lambda F} \sqrt{\frac{P_r}{P_t}}$ then, : F is the propagation constant due to interference. <i>Gain = $\frac{\text{Maximum amount of power received from subject antenna}}{\text{Maximum amount of power received from reference antenna}}$</i> Hence, $G = \frac{P_1}{P_2}$

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	<table><tr><td>Instrument</td><td>Brand</td><td>Model No.</td></tr><tr><td>VNA</td><td>ROHDE & SCHWARZ</td><td>ZNB8</td></tr><tr><td>Test Software</td><td>Atenlab</td><td>Maxwell 3.8.2</td></tr><tr><td>Switch</td><td>Atenlab</td><td>4SW_P_2019</td></tr><tr><td>Turntable</td><td>Atenlab</td><td>Aten Dual Axis</td></tr><tr><td>Horn Antenna</td><td>ETS-Lindgren</td><td>3164-10</td></tr></table>	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
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Horn Antenna	ETS-Lindgren	3164-10																	
Coordinate difinition																			

Dual Band
ANT1 Gain
Total (dBi)
Pattern

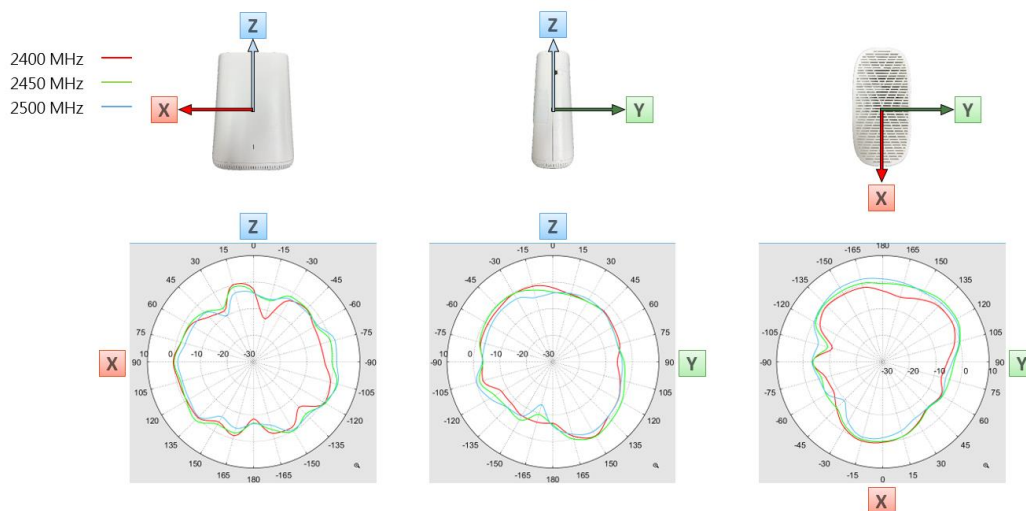
Dual Band ANT1 Gain Total (dBi) Pattern @2.4GHz



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Dual Band
ANT2 Gain
Total (dBi)
Pattern

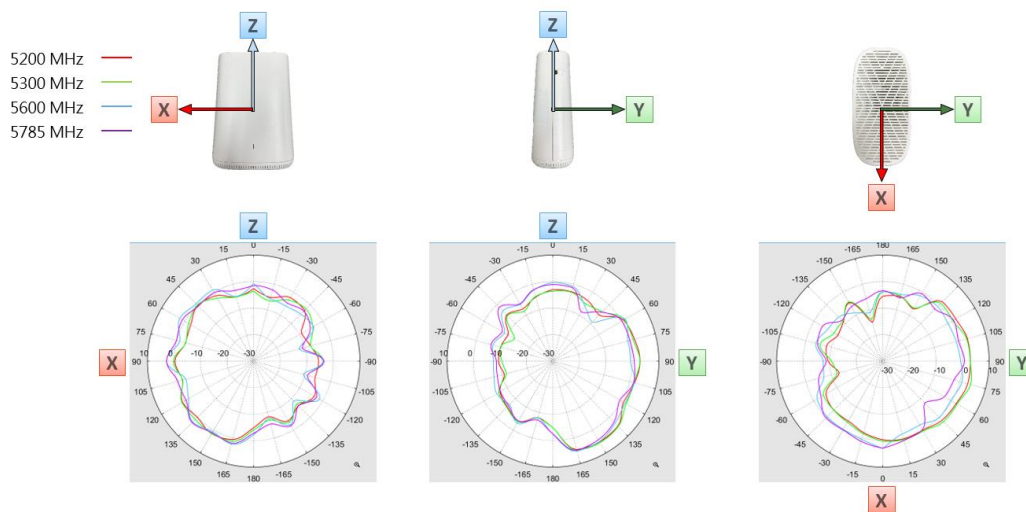
Dual Band ANT2 Gain Total (dBi) Pattern @2.4GHz



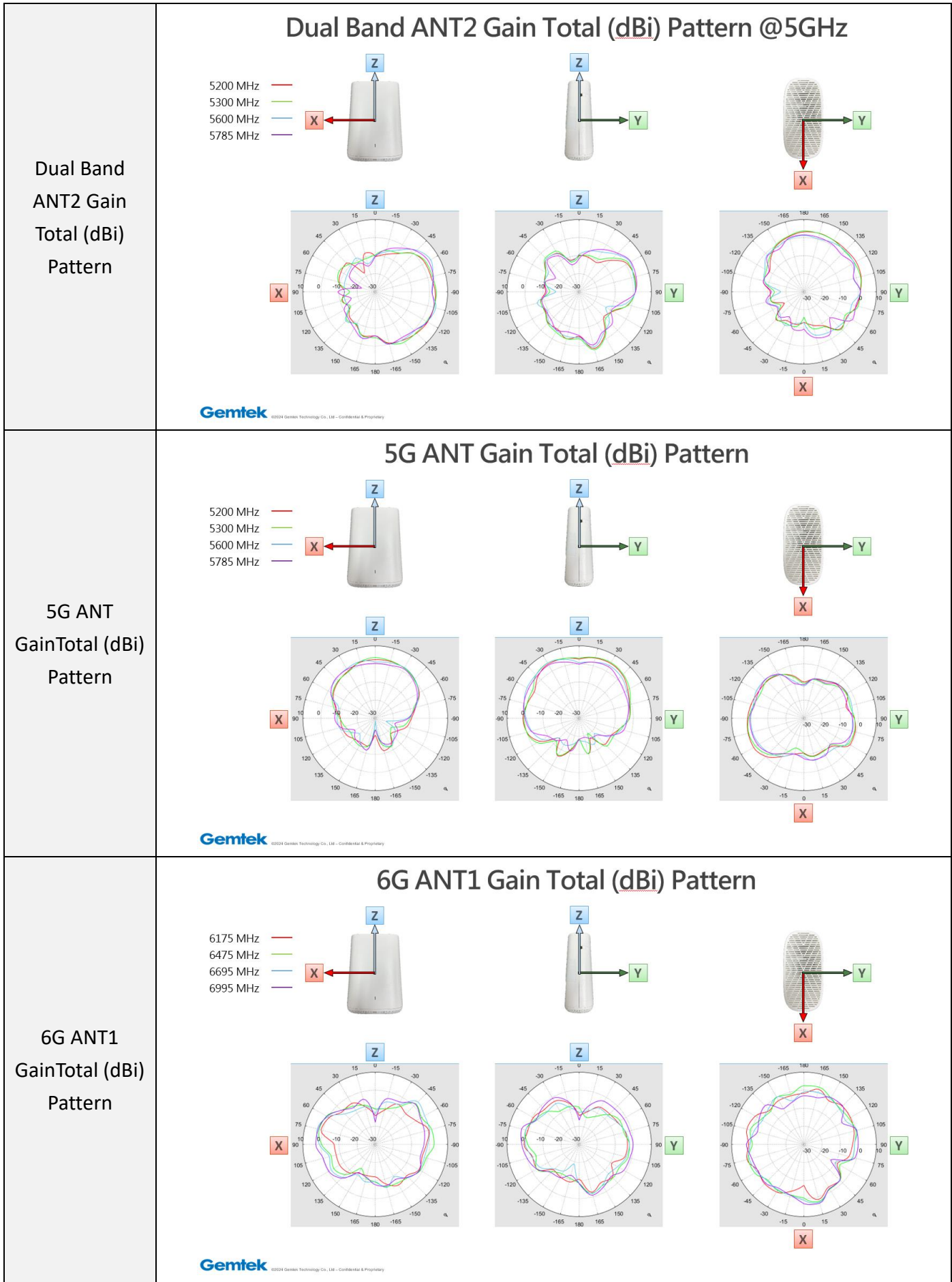
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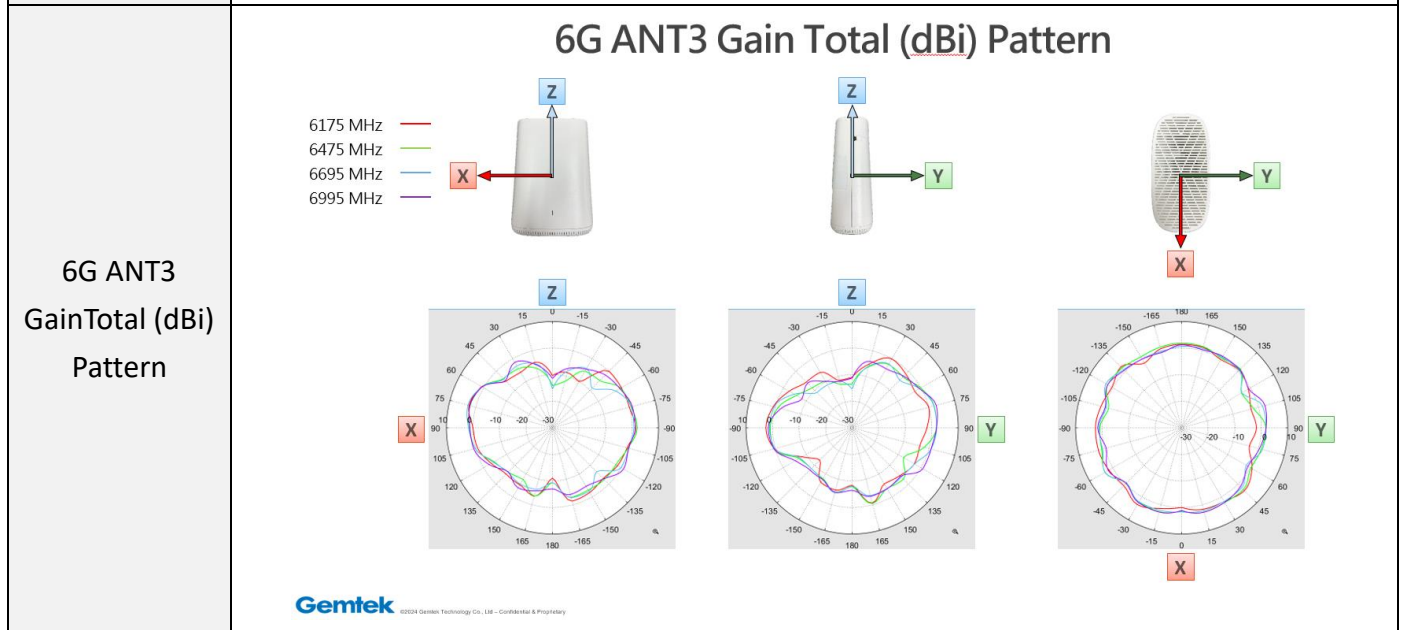
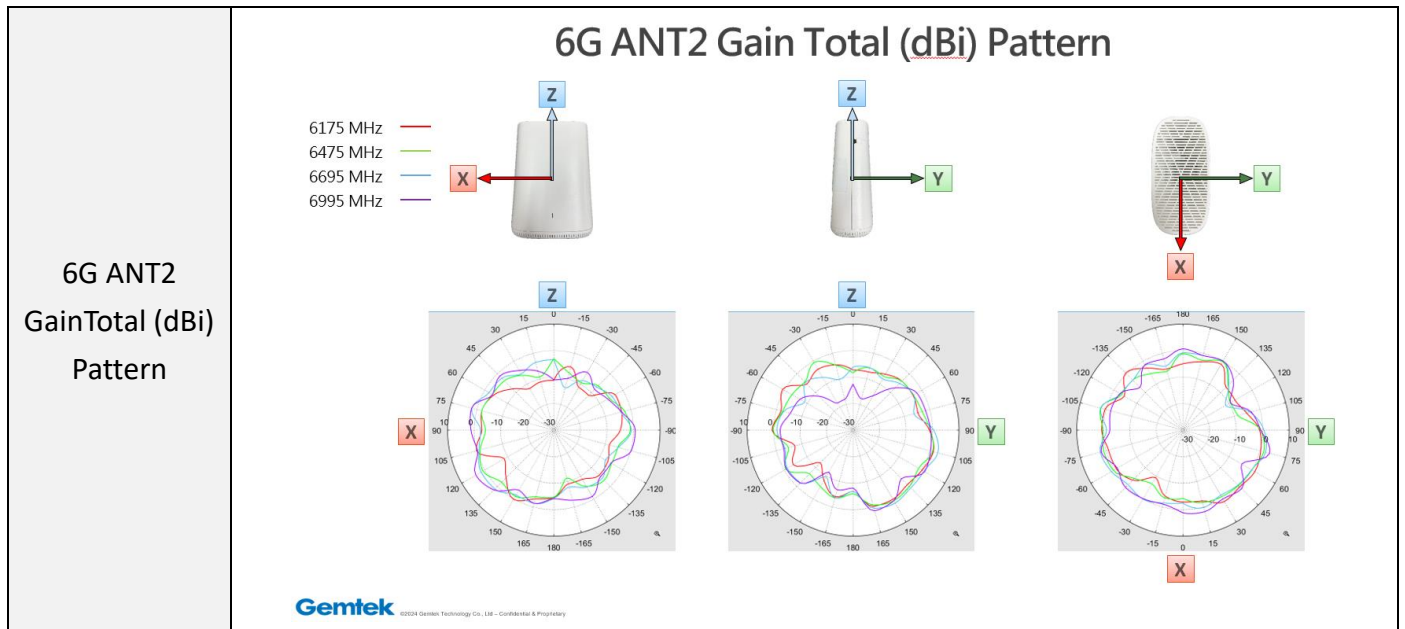
Dual Band
ANT1 Gain
Total (dBi)
Pattern

Dual Band ANT1 Gain Total (dBi) Pattern @5GHz



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Peak Gain @2.4G/5G					
Frequency (GHz)	2.45	5.2	5.3	5.6	5.785
Dual Band ANT1.Max Gain(dBi)	3.72	5.21	5.46	5.87	5.71
Dual Band ANT2.Max Gain(dBi)	1.81	3.05	3.59	4.49	4.41
5G ANT.Max Gain(dBi)	N/O	4.75	5.17	5.16	3.99
Dual Band ANT1 Polarization/Θ(°)/Φ(°)	phi/90/315	theta/165/75	theta/165/75	theta/165/60	phi/165/60
Dual Band ANT2 Polarization/Θ(°)/Φ(°)	theta/135/105	phi/135/210	theta/75/135	theta/60/165	theta/60/165
5G ANT Polarization/Θ(°)/Φ(°)	N/O	phi/30/90	phi/30/90	phi/30/285	phi/30/285
Max Gain (dBi)	3.72	5.21	5.46	5.87	5.71
DG [1SS] (dBi)	4.49	4.23	4.82	4.97	4.94
DG [2SS] (dBi)	3.72	5.21	5.46	5.87	5.71
DG [4SS] (dBi)	3.72	5.21	5.46	5.87	5.71

Peak Gain @6G				
Frequency (GHz)	6.175	6.475	6.695	6.995
6G ANT1.Max Gain(dBi)	2.4	2.78	3.24	3.42
6G ANT2.Max Gain(dBi)	3.47	3.88	4.25	3.85
6G ANT3.Max Gain(dBi)	3.42	3.37	3.47	3.68
6G ANT1 Polarization/ $\Theta(^{\circ})/\Phi(^{\circ})$	theta/90/285	theta/120/120	theta/45/180	theta/105/15
6G ANT2 Polarization/ $\Theta(^{\circ})/\Phi(^{\circ})$	theta/150/30	phi/150/30	theta/120/300	theta/120/0
6G ANT3 Polarization/ $\Theta(^{\circ})/\Phi(^{\circ})$	phi/75/15	phi/90/300	phi/90/300	phi/105/105
Max Gain (dBi)	3.47	3.88	4.25	3.85
DG [1SS] (dBi)	3.77	3.30	4.75	4.19
DG [2SS] (dBi)	3.47	3.88	4.25	3.85
DG [4SS] (dBi)	3.47	3.88	4.25	3.85

D.G. @2.4G/5G					
Frequency (GHz)	2.45	5.2	5.3	5.6	5.785
Dual Band ANT1 (dBi)	2.83	5.21	-1.25	6.27	2.29
Dual Band ANT2 (dBi)	-0.13	-1.19	3.42	-0.45	3.37
5G ANT (dBi)	N/O	-17.96	-3.51	-24.42	-10.91
DG [1SS] (dBi)	4.49	4.23	4.82	4.97	4.94
Polarization	phi	theta	theta	theta	theta
Theta	90	165	60	165	75
Phi	0	75	135	60	105
Dual Band ANT1 [$10^{(G/20)}$]	$10^{(2.83/20)}$	$10^{(5.21/20)}$	$10^{(-1.25/20)}$	$10^{(6.27/20)}$	$10^{(2.29/20)}$
Dual Band ANT2 [$10^{(G/20)}$]	$10^{(-0.13/20)}$	$10^{(-1.19/20)}$	$10^{(3.42/20)}$	$10^{(-0.45/20)}$	$10^{(3.37/20)}$
5G ANT [$10^{(G/20)}$]	N/O	$10^{(-17.96/20)}$	$10^{(-3.51/20)}$	$10^{(-24.42/20)}$	$10^{(-10.91/20)}$
Dual Band ANT1 [$10^{(G/20)}$] Value	1.39	1.82	0.87	2.06	1.30
Dual Band ANT2 [$10^{(G/20)}$] Value	0.99	0.87	1.48	0.95	1.47
5G ANT [$10^{(G/20)}$] Value	N/O	0.13	0.67	0.06	0.28
Sum All Antenna [Amax]	2.38	2.82	3.02	3.07	3.05
DG [$10 \cdot \log(A_{max}^2/N_{ant})$]	4.49	4.23	4.82	4.97	4.94

D.G. @6G				
Frequency (GHz)	6.175	6.475	6.695	6.995
6G_ANT1 (dBi)	2.02	1.73	2.90	-7.13
6G_ANT2 (dBi)	0.34	0.75	1.87	-0.34
6G_ANT3 (dBi)	-8.58	-13.06	-9.01	2.94
DG [1SS] (dBi)	3.77	3.30	4.75	4.19
Polarization	theta	theta	theta	phi
Theta	75	90	75	105
Phi	285	285	0	225
6G_ANT1 [10^(G/20)]	$10^{(2.02/20)}$	$10^{(1.73/20)}$	$10^{(2.9/20)}$	$10^{(-7.13/20)}$
6G_ANT2 [10^(G/20)]	$10^{(0.34/20)}$	$10^{(0.75/20)}$	$10^{(1.87/20)}$	$10^{(-0.34/20)}$
6G_ANT3 [10^(G/20)]	$10^{(-8.58/20)}$	$10^{(-13.06/20)}$	$10^{(-9.01/20)}$	$10^{(2.94/20)}$
6G_ANT1 [10^(G/20)] Value	1.26	1.22	1.4	0.44
6G_ANT2 [10^(G/20)] Value	1.04	1.09	1.24	0.96
6G_ANT3 [10^(G/20)] Value	0.37	0.22	0.35	1.4
Sum All Antenna [Amax]	2.67	2.53	2.99	2.80
DG [10*log(Amax^2/Nant)]	3.77	3.30	4.75	4.19