

Antenna Study

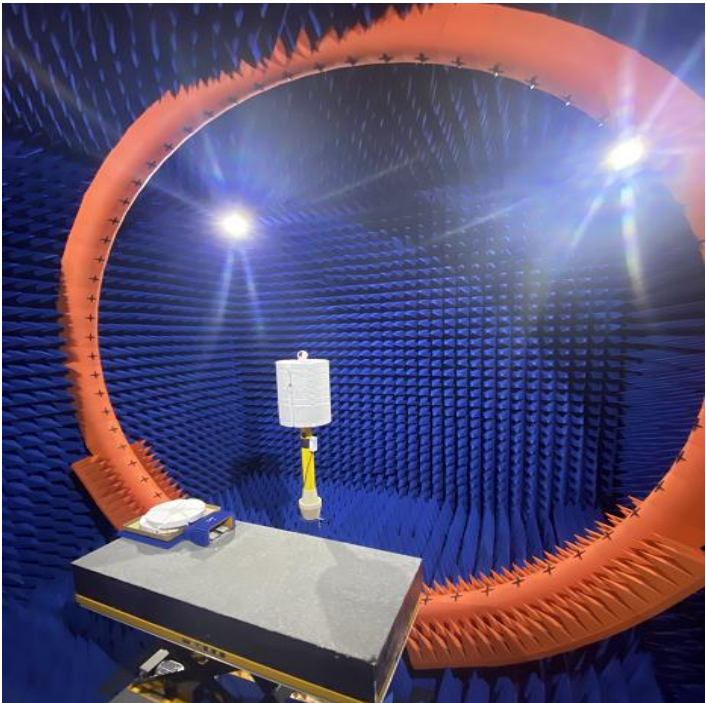
- **Client Name: 34ED LLC, DBA Centegix**
- **Project Name: CE-STR-02**
- **Debugging frequency band: 915/2400/2500MHz**
- **Valuation date: 2023.06.14**

PCB Antenna

Dongguan UB Electronics Co., Ltd



Testing environment



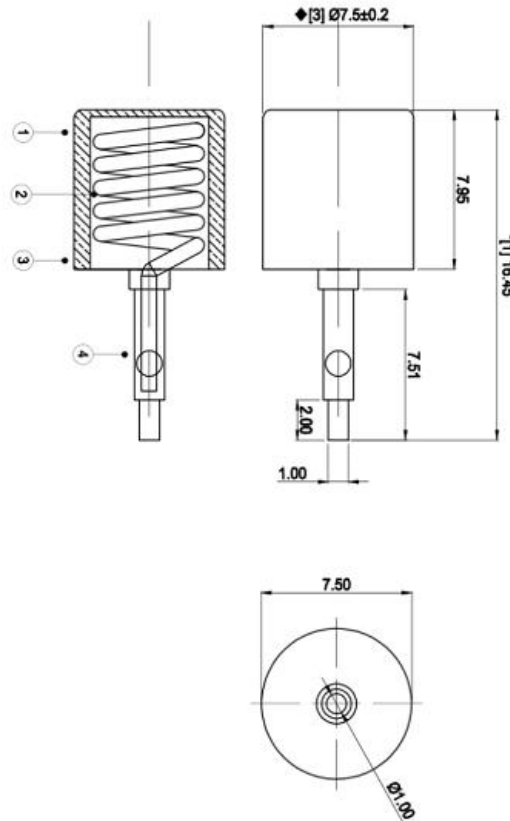
Testing 3D microwave darkroom(6m*6m*6m)

PCB Antenna

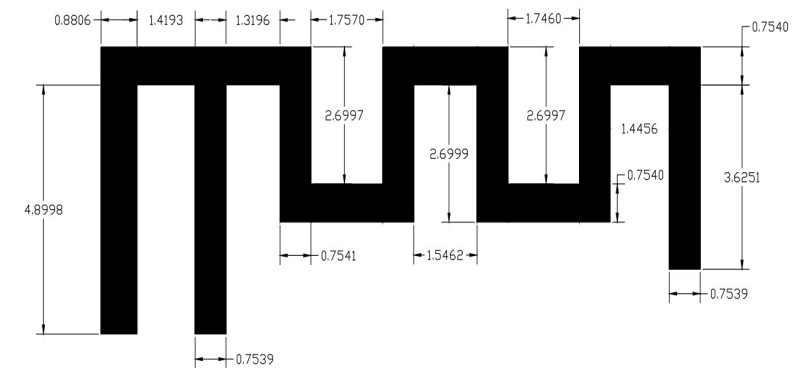
Dongguan UB Electronics Co., Ltd



Antenna

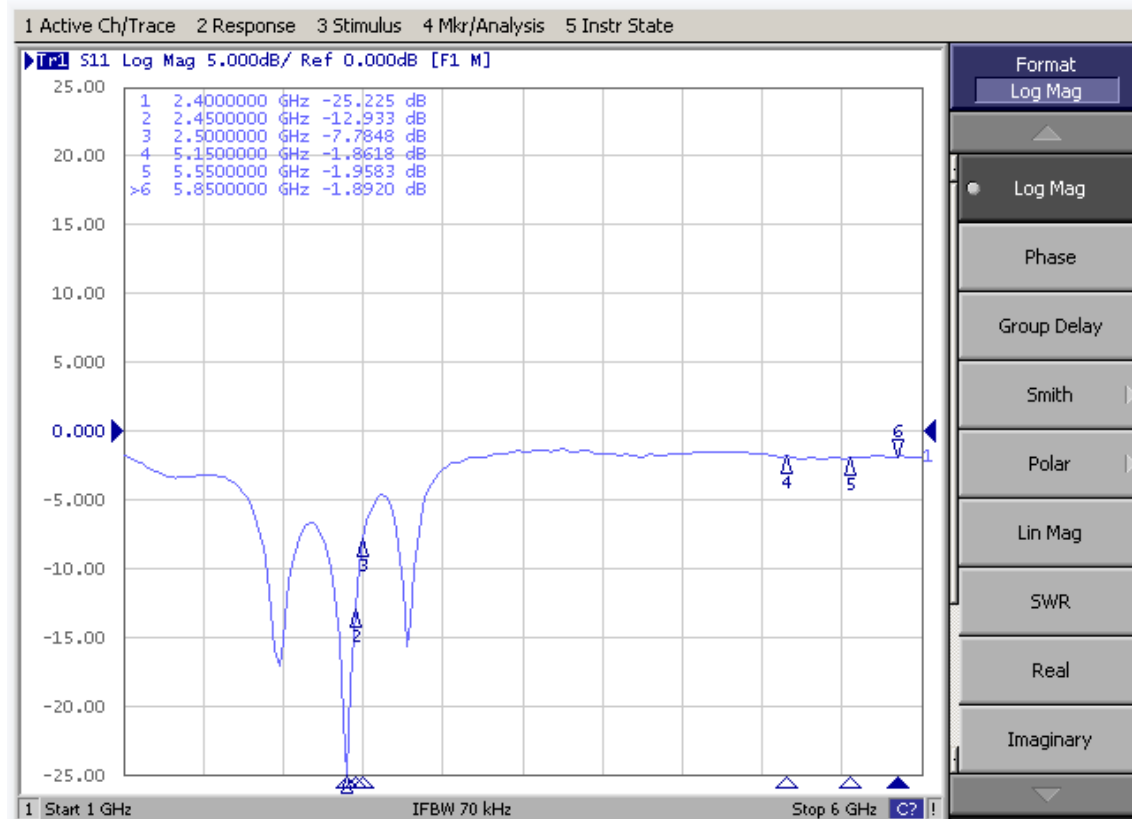
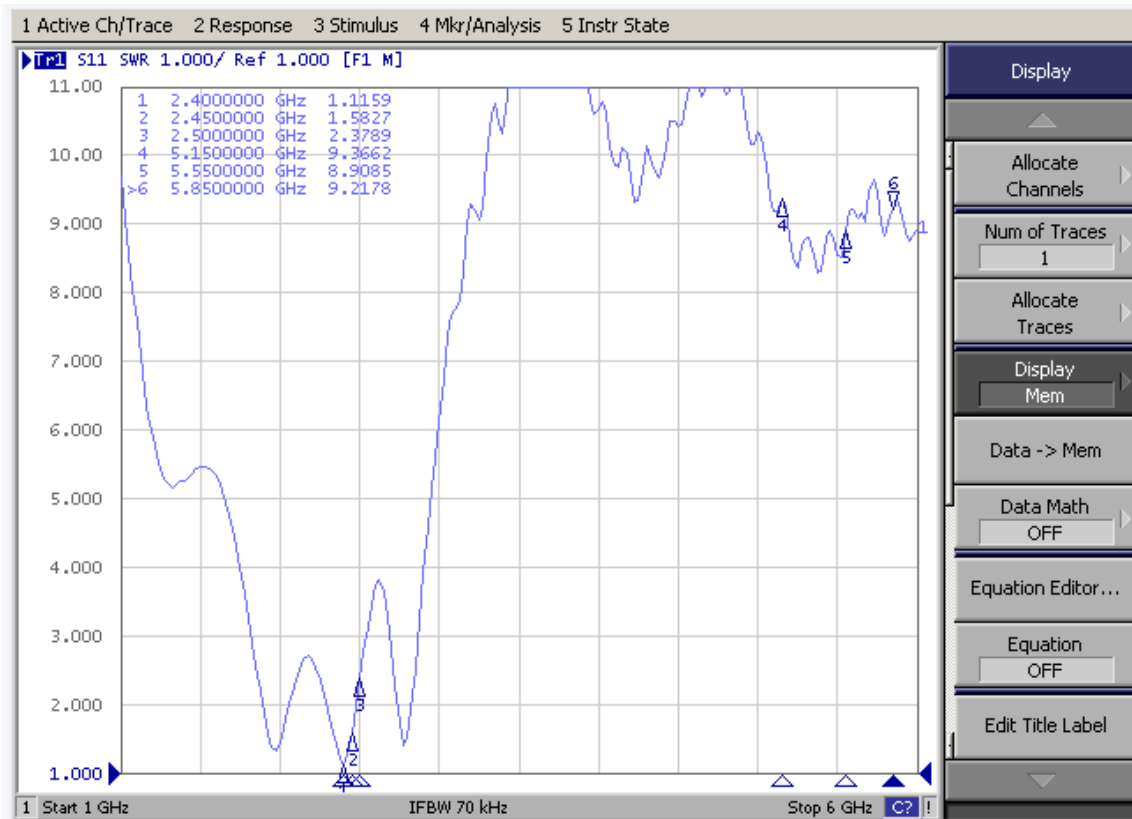


- Antenna name: 2.4G/LoRa
- Antenna Type: PIFA
- Covers : 915/2400/2500MHz



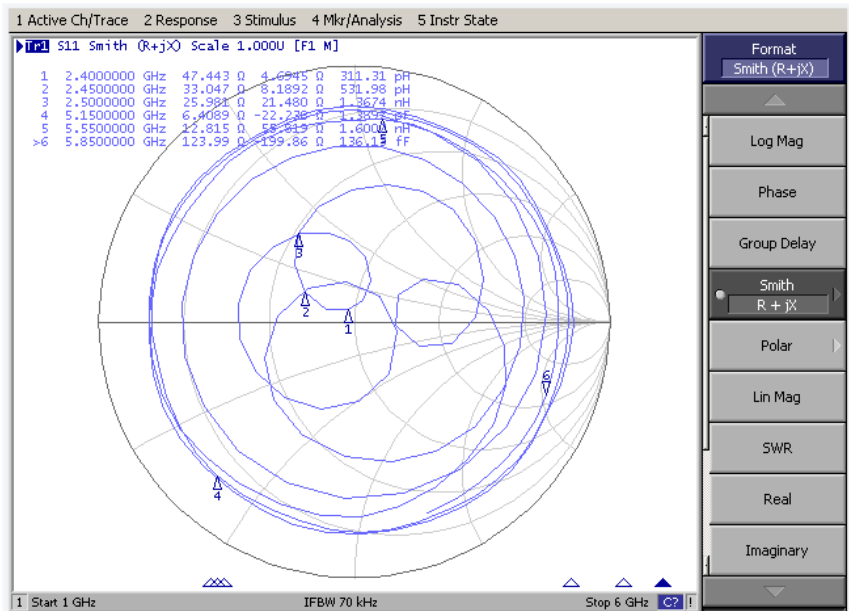
S Parameter_Return Loss&VSWR (2.4G)

Dongguan UB Electronics Co., Ltd



Efficiency and Gain-Smith (2.4G)

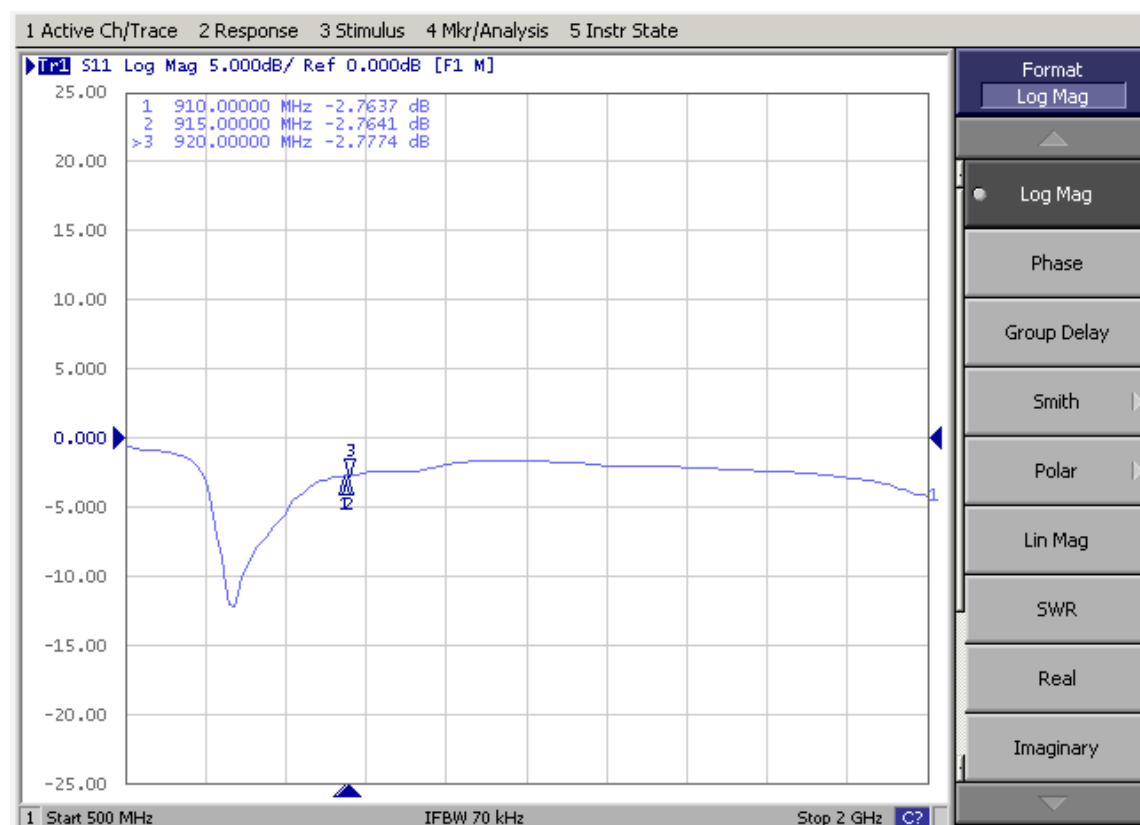
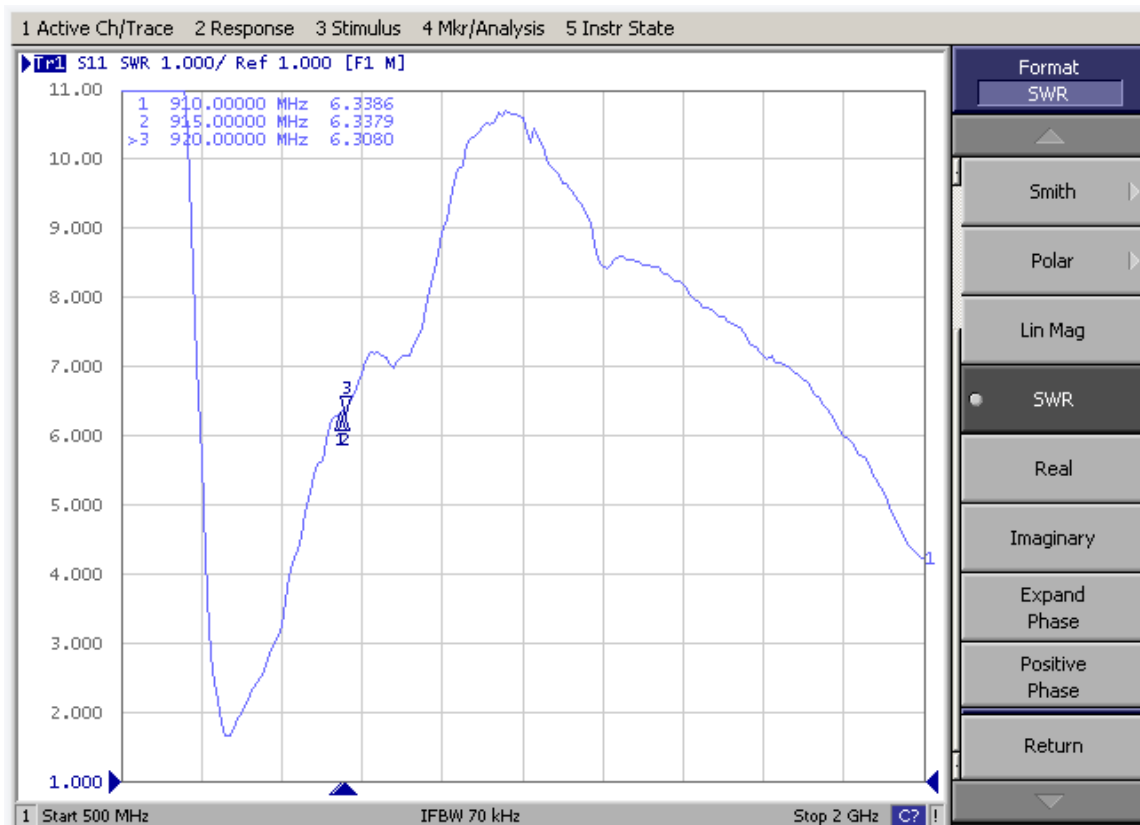
Dongguan UB Electronics Co., Ltd



Frequency ID	1	2	3	4	5	6	7	8	9	10	11
Frequency (MHz)	2400.0	2410.0	2420.0	2430.0	2440.0	2450.0	2460.0	2470.0	2480.0	2490.0	2500.0
Gain (dBi)	1.79	1.86	1.36	0.61	0.23	0.14	0.04	-0.10	-0.64	-1.31	-1.77
Efficiency (%)	46.26	45.31	43.38	41.01	38.11	36.37	35.87	34.32	31.05	28.65	25.94

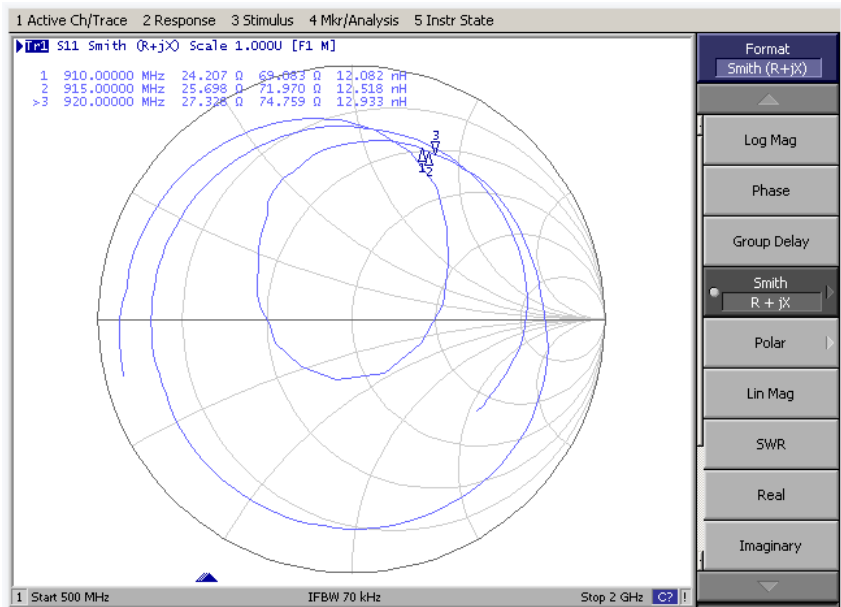
S Parameter_Return Loss&VSWR (LoRa)

Dongguan UB Electronics Co., Ltd



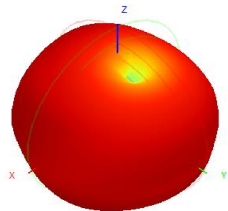
Efficiency and Gain-Smith (LoRa)

Dongguan UB Electronics Co., Ltd

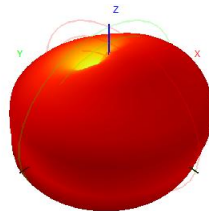


Frequency ID	1	2	3	4	5	6	7	8	9	10	11
Frequency (MHz)	910.0	911.0	912.0	913.0	914.0	915.0	916.0	917.0	918.0	919.0	920.0
Gain (dBi)	-13.27	-13.36	-13.46	-13.57	-13.70	-13.85	-13.99	-14.16	-14.34	-14.52	-14.71
Efficiency (%)	2.46	2.39	2.33	2.26	2.19	2.12	2.04	1.97	1.88	1.80	1.72

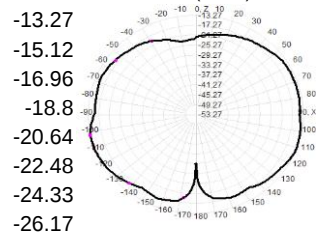
910.0MHz H+V, Eff: 2.5%



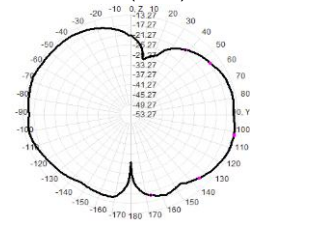
Back View



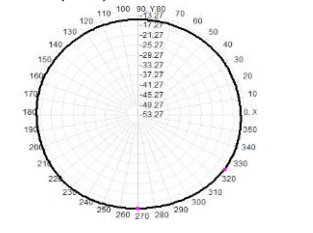
910.0MHz Total(E1-XZ), Max= -13.27dBi



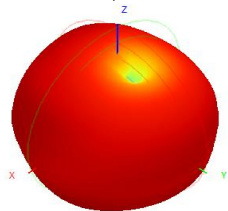
910.0MHz Total(E2-YZ), Max= -14.02dBi



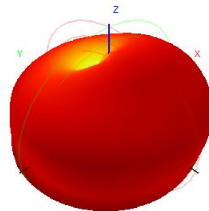
Total(H-XY), Max= -14.26dBi, CirD=1.51



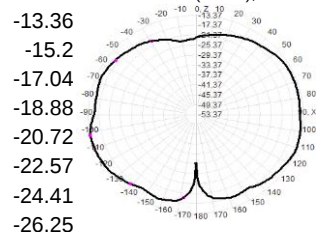
911.0MHz H+V, Eff: 2.4%



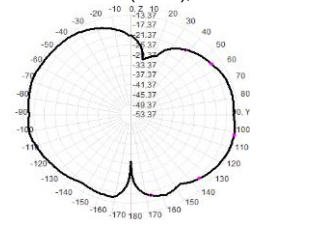
Back View



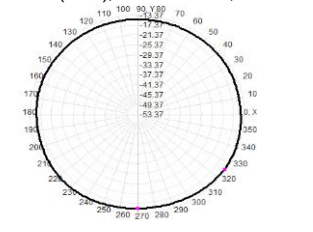
911.0MHz Total(E1-XZ), Max= -13.37dBi



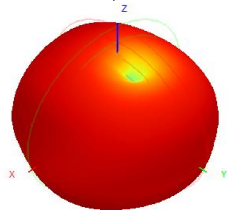
911.0MHz Total(E2-YZ), Max= -14.06dBi



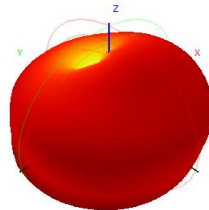
Total(H-XY), Max= -14.33dBi, CirD=1.52



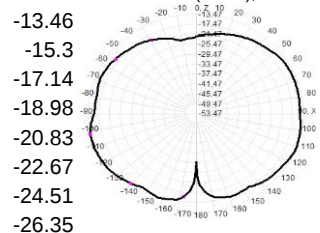
912.0MHz H+V, Eff: 2.3%



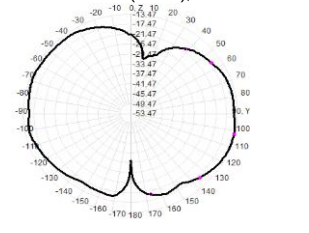
Back View



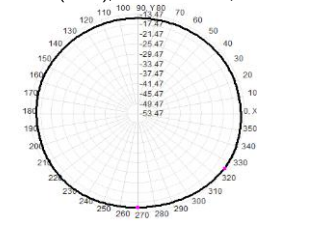
912.0MHz Total(E1-XZ), Max= -13.47dBi



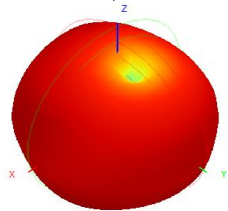
912.0MHz Total(E2-YZ), Max= -14.15dBi



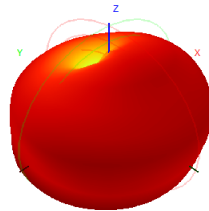
Total(H-XY), Max= -14.43dBi, CirD=1.50



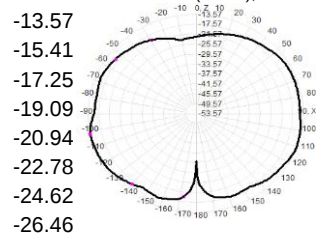
913.0MHz H+V, Eff: 2.3%



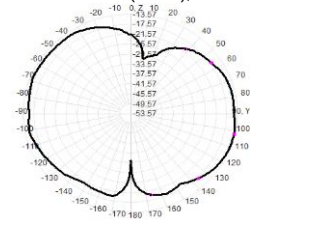
Back View



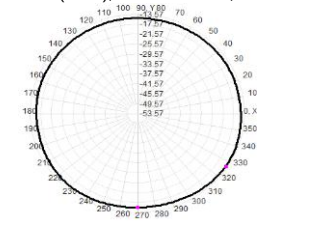
913.0MHz Total(E1-XZ), Max= -13.57dBi



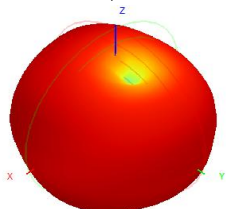
913.0MHz Total(E2-YZ), Max= -14.22dBi



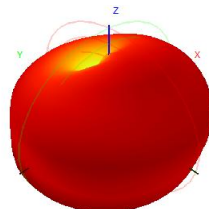
Total(H-XY), Max= -14.54dBi, CirD=1.47



914.0MHz H+V, Eff: 2.2%

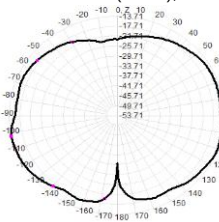


Back View

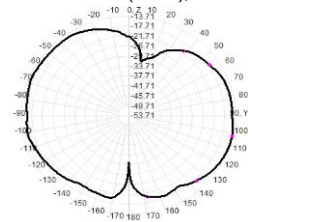


914.0MHz Total(E1-XZ), Max= -13.71dBi

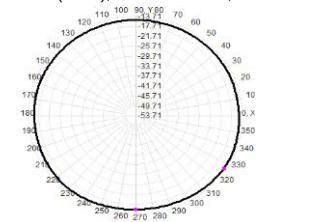
-13.7
-15.55
-17.39
-19.23
-21.07
-22.91
-24.76
-26.6



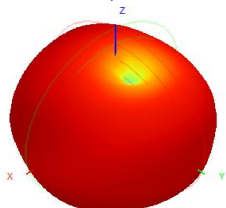
914.0MHz Total(E2-YZ), Max= -14.34dBi



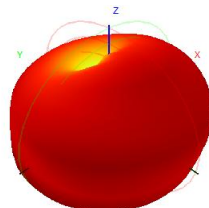
Total(H-XY), Max= -14.65dBi, CirD=1.46



915.0MHz H+V, Eff: 2.1%

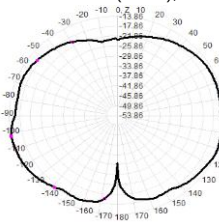


Back View

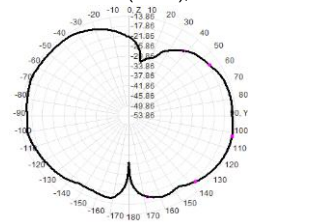


915.0MHz Total(E1-XZ), Max= -13.86dBi

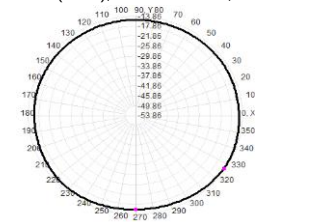
-13.85
-15.7
-17.54
-19.38
-21.22
-23.07
-24.91
-26.75



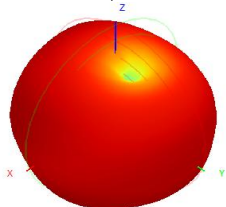
915.0MHz Total(E2-YZ), Max= -14.46dBi



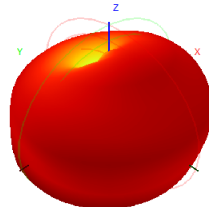
Total(H-XY), Max= -14.78dBi, CirD=1.44



916.0MHz H+V, Eff: 2.0%

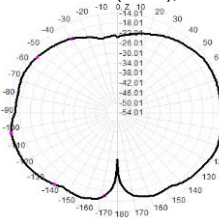


Back View

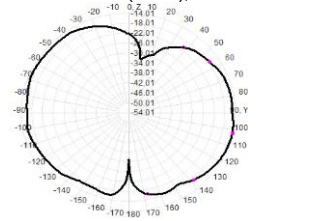


916.0MHz Total(E1-XZ), Max= -14.01dBi

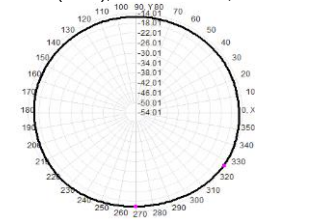
-13.99
-15.84
-17.68
-19.52
-21.36
-23.2
-25.05
-26.89



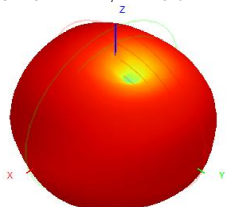
916.0MHz Total(E2-YZ), Max= -14.57dBi



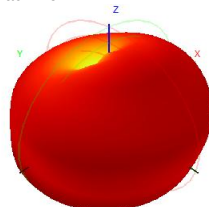
Total(H-XY), Max= -14.95dBi, CirD=1.41



917.0MHz H+V, Eff: 2.0%

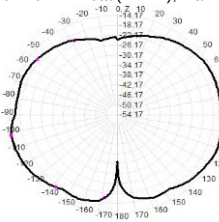


Back View

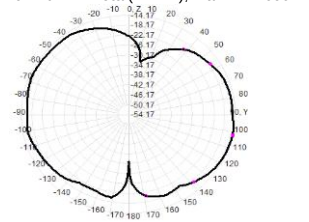


917.0MHz Total(E1-XZ), Max= -14.17dBi

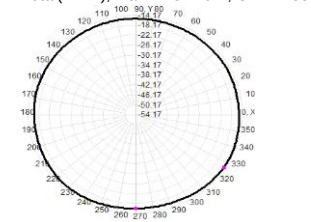
-14.16
-16
-17.84
-19.68
-21.53
-23.37
-25.21
-27.05



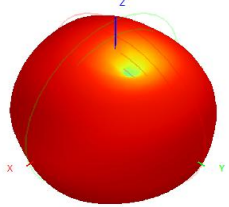
917.0MHz Total(E2-YZ), Max= -14.69dBi



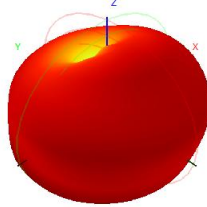
Total(H-XY), Max= -15.11dBi, CirD=1.38



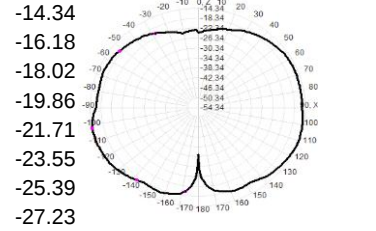
918.0MHz H+V, Eff: 1.9%



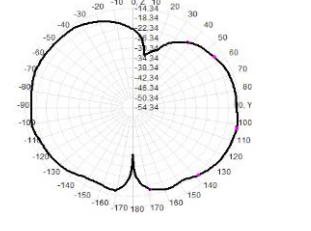
Back View



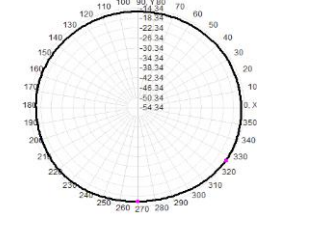
918.0MHz Total(E1-XZ), Max= -14.34dBi



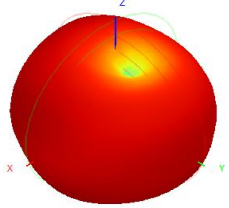
918.0MHz Total(E2-YZ), Max= -14.83dBi



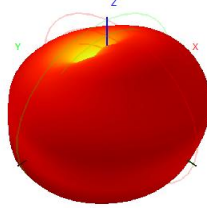
Total(H-XY), Max= -15.27dBi, CirD=1.37



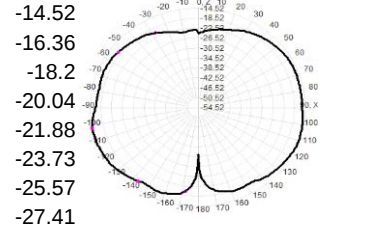
919.0MHz H+V, Eff: 1.8%



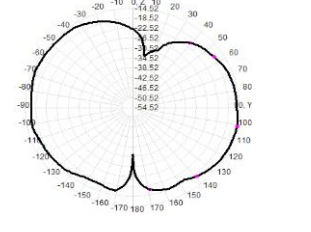
Back View



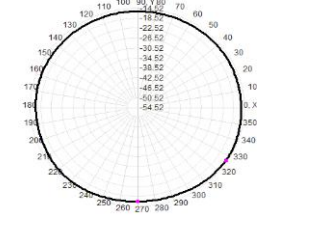
919.0MHz Total(E1-XZ), Max= -14.52dBi



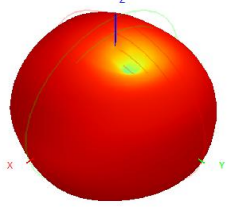
919.0MHz Total(E2-YZ), Max= -14.97dBi



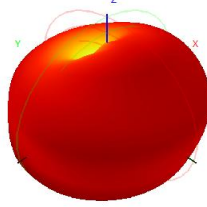
Total(H-XY), Max= -15.43dBi, CirD=1.38



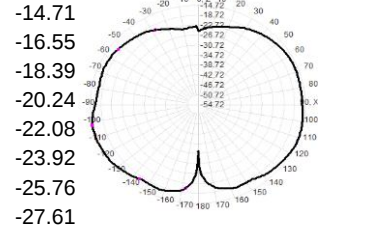
920.0MHz H+V, Eff: 1.7%



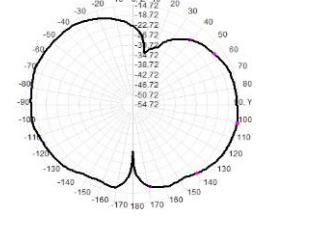
Back View



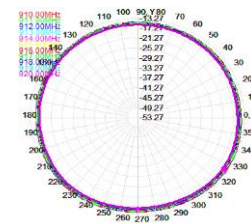
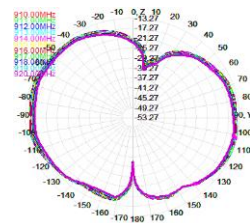
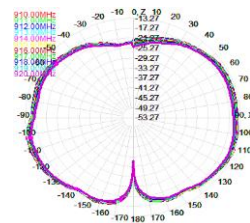
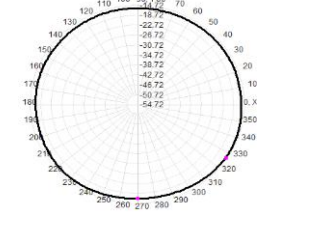
920.0MHz Total(E1-XZ), Max= -14.72dBi



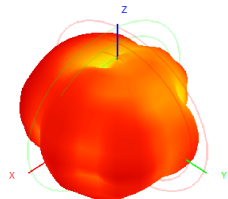
920.0MHz Total(E2-YZ), Max= -15.13dBi



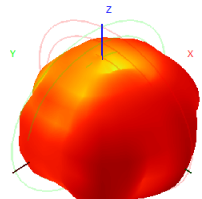
Total(H-XY), Max= -15.60dBi, CirD=1.37



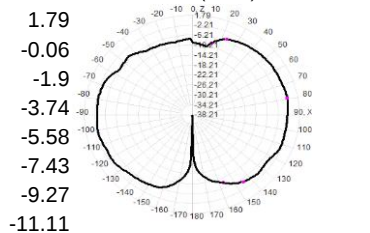
2400.0MHz H+V, Eff: 46.3%



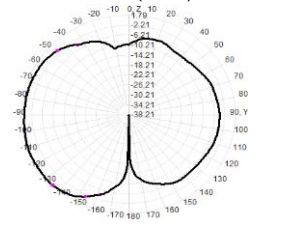
Back View



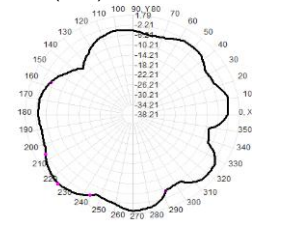
2400.0MHz Total(E1-XZ), Max= -2.33dB



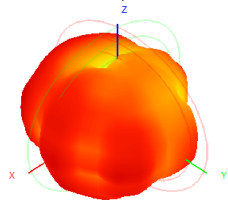
2400.0MHz Total(E2-YZ), Max= 1.79dB



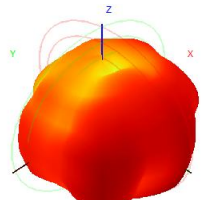
Total(H-XY), Max= 0.98dB, CirD=13.14



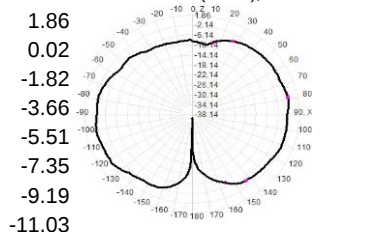
2410.0MHz H+V, Eff: 45.3%



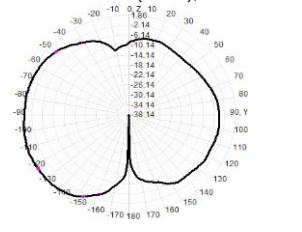
Back View



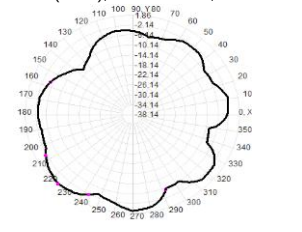
2410.0MHz Total(E1-XZ), Max= -1.99dB



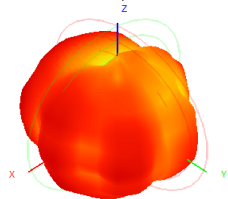
2410.0MHz Total(E2-YZ), Max= 1.86dB



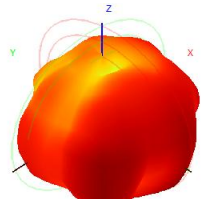
Total(H-XY), Max= 1.04dB, CirD=13.58



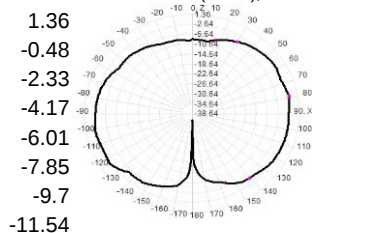
2420.0MHz H+V, Eff: 43.4%



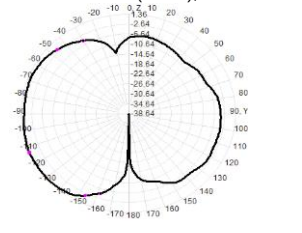
Back View



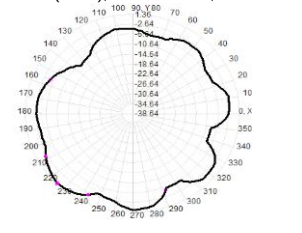
2420.0MHz Total(E1-XZ), Max= -2.10dB



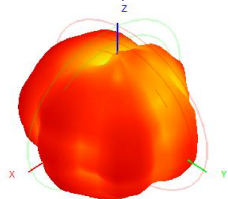
2420.0MHz Total(E2-YZ), Max= 1.36dB



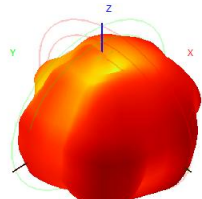
Total(H-XY), Max= 0.89dB, CirD=12.32



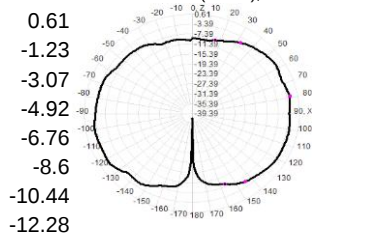
2430.0MHz H+V, Eff: 41.0%



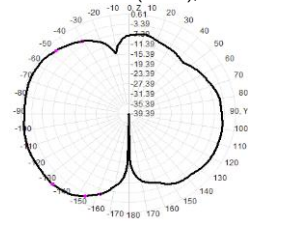
Back View



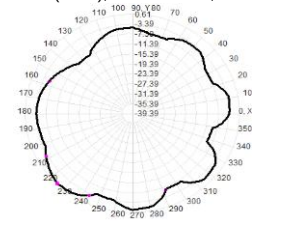
2430.0MHz Total(E1-XZ), Max= -2.68dB



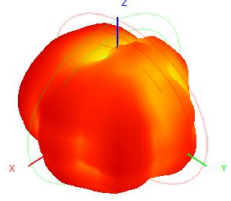
2430.0MHz Total(E2-YZ), Max= 0.61dB



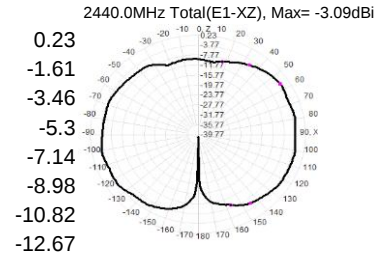
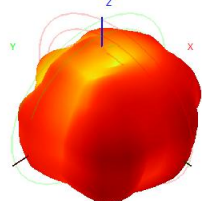
Total(H-XY), Max= 0.19dB, CirD=11.33



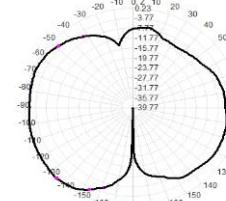
2440.0MHz H+V, Eff: 38.1%



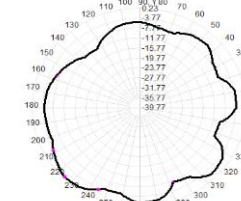
Back View



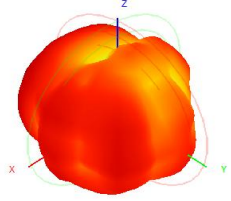
2440.0MHz Total(E2-YZ), Max= 0.23dBi



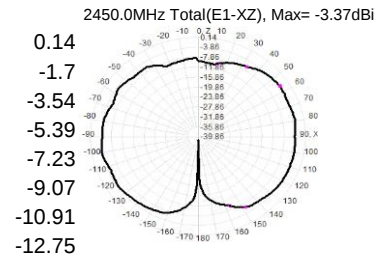
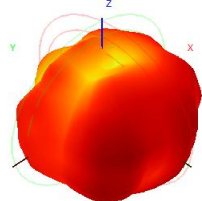
Total(H-XY), Max= -0.39dBi, CirD=11.02



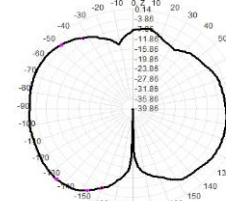
2450.0MHz H+V, Eff: 36.4%



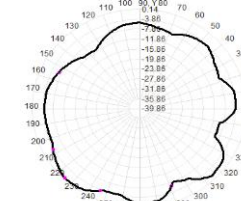
Back View



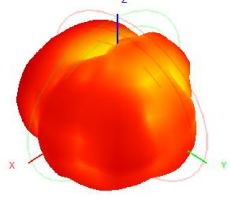
2450.0MHz Total(E2-YZ), Max= 0.14dBi



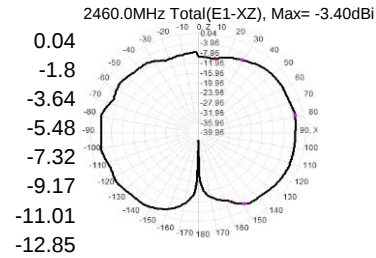
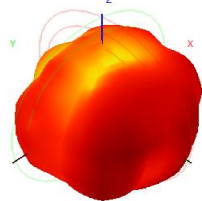
Total(H-XY), Max= -0.52dBi, CirD=10.69



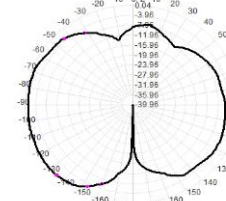
2460.0MHz H+V, Eff: 35.9%



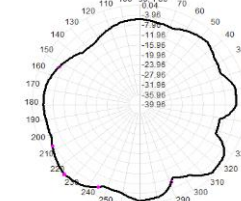
Back View



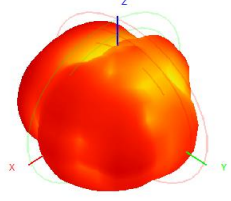
2460.0MHz Total(E2-YZ), Max= 0.04dBi



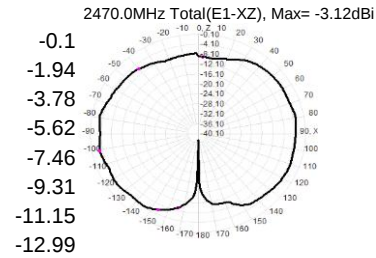
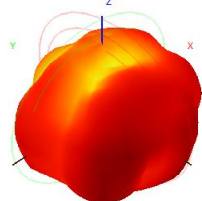
Total(H-XY), Max= -0.42dBi, CirD=9.95



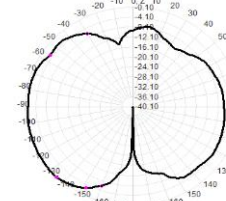
2470.0MHz H+V, Eff: 34.3%



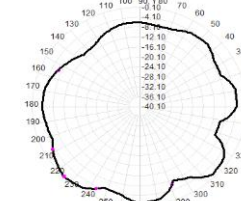
Back View



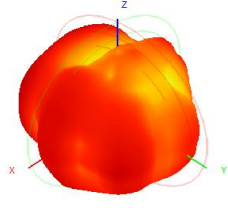
2470.0MHz Total(E2-YZ), Max= -0.10dBi



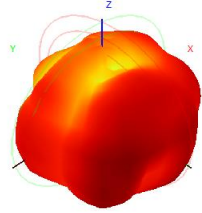
Total(H-XY), Max= -0.41dBi, CirD=10.33



2480.0MHz H+V, Eff: 31.1%

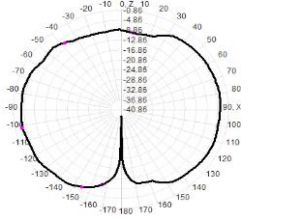


Back View

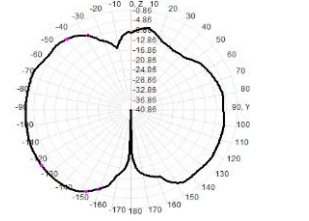


2480.0MHz Total(E1-XZ), Max= -3.61dBi

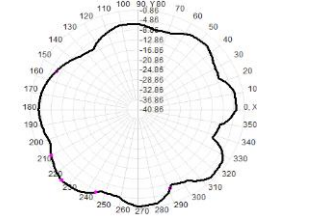
-0.64
-2.48
-4.32
-6.16
-8.01
-9.85
-11.69
-13.53



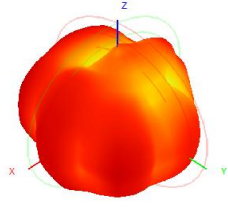
2480.0MHz Total(E2-YZ), Max= -0.89dBi



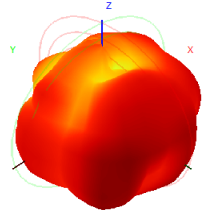
Total(H-XY), Max= -0.86dBi, CirD=10.71



2490.0MHz H+V, Eff: 28.6%

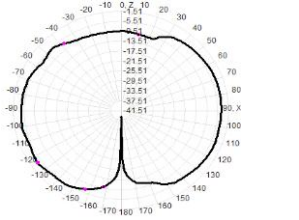


Back View

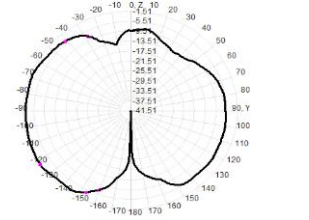


2490.0MHz Total(E1-XZ), Max= -4.19dBi

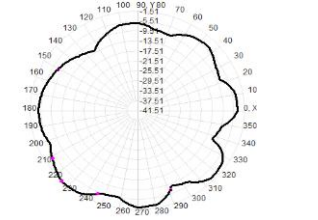
-1.31
-3.15
-5
-6.84
-8.68
-10.52
-12.36
-14.21



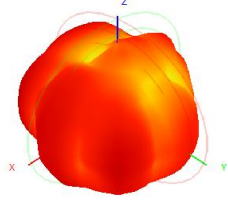
2490.0MHz Total(E2-YZ), Max= -1.52dBi



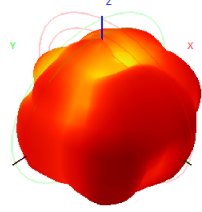
Total(H-XY), Max= -1.51dBi, CirD=11.08



2500.0MHz H+V, Eff: 25.9%

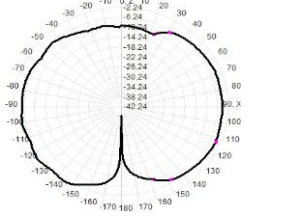


Back View

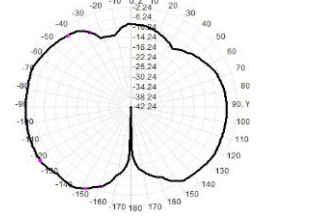


2500.0MHz Total(E1-XZ), Max= -4.46dBi

-1.77
-3.61
-5.45
-7.29
-9.13
-10.98
-12.82
-14.66



2500.0MHz Total(E2-YZ), Max= -2.30dBi



Total(H-XY), Max= -2.24dBi, CirD=10.75

