3D 微波暗室测试报告

3D CHAMBER TEST REPORT

客　户： Customer:	广世创
专案名称 Project Name:	RP-SMA（P）- 2.4/5.8GHz-L156mm 黑（3DB 六边形）
兆赫技术料号 MHZ.TD P/N:	A100-0008
客户料号 Customer P/N:	
天线系列 Antenna Type:	WIFI Antenna
测试人员 Testers：	梁森 (Liang Sen)
测试时间 Test Time：	2023.06.27
测试地点 Test Location：	6th Floor, Building A3, Yinlong Industrial City, Shenshan Road (Longgang Section), Longgang District, Shenzhen

联系方式

Contact Information:

Tel:0755-82630472

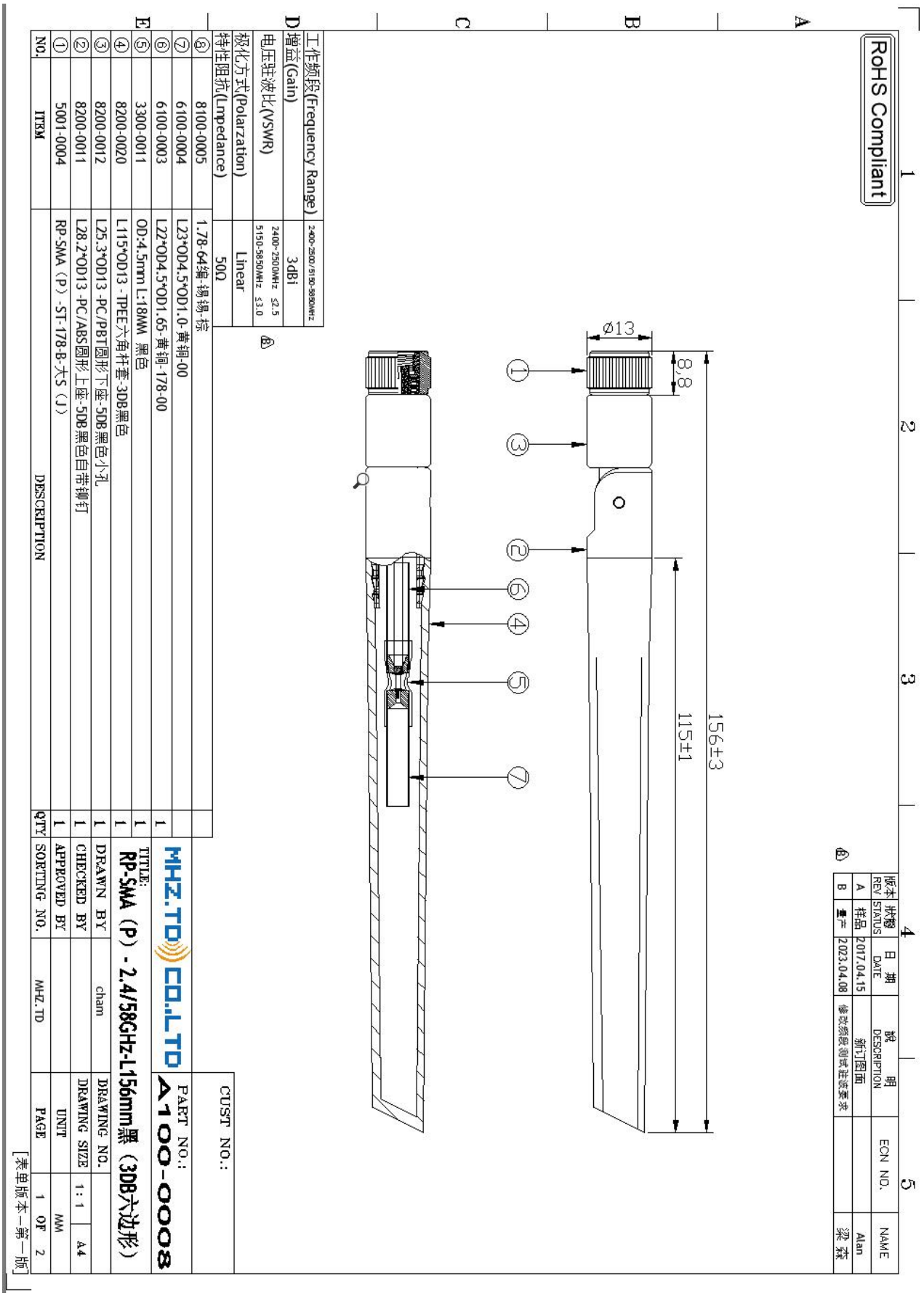
Sales: Jerry Jiang

E-mail:jerry@mhz-td.com **Ext:**188 1950 2137

产品特性表（Product Characteristics Table）

产 品 类 型 / product type	WIFI Antenna
DESCRIPTION	VALUE
Frequency Range（工作频段）	2400-2500/5150~5850 MHZ
V.S.W.R(电压驻波比)	2.0 Max
Impedance（特性阻抗）	50Ω
Gain（增益）	0-4 dBi
Radiation（方向性）	Omni-directional
Radiating element	1/4 Wave Helical
Polarization（线化方式）	linear Vertical
Admitted power（功率）	1W
Connector（接头型号）	SMA(母 pin)
Operating temp（工作温度）	-10℃~+60℃
产品图片(Product Image)	

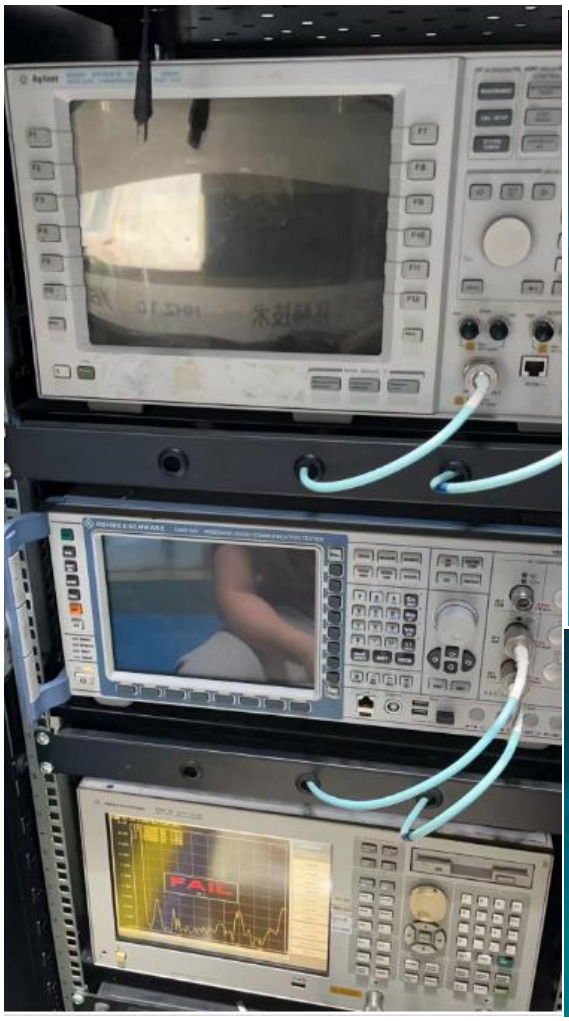
图面/ Drawing

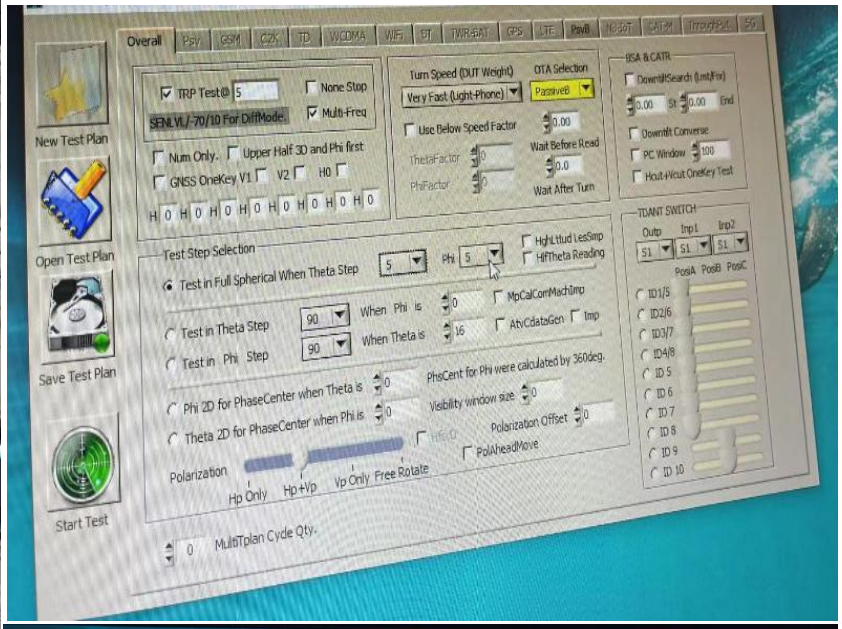

RoHS Compliant
版本 REV
拟稿 STATUS
日 期 DATE
說 明 DESCRIPTION
ECN NO.
NAME
A 样品 2017.04.15 新订图面 Alan
B 量产 2023.04.08 修改频段测试连接要求 梁森
工作频段(Frequency Range) 2400~2500/5150~5850MHz
增益(Gain) 3dBi
电压驻波比(VSWR) 2400~2500MHz ≤2.5 5150~5850MHz ≤3.0
极化方式(Polarzation) Linear
特性阻抗(Lmpedance) 50Ω
Ø13
8.8
115±1
156±3
NO. ITEM DESCRIPTION QTY
① 5001-0004 RP-SMA（P）-ST-178-B-大S（J） 1
② 8200-0011 L28.2*OD13 -PC/ABS圆形上座-5DB黑色自带铆钉 1
③ 8200-0012 L25.3*OD13 -PC/PBT圆形下座-5DB黑色小孔 1
④ 8200-0020 L115*OD13 -TPEE六角杆套-3DB黑色 1
⑤ 3300-0011 OD:4.5mm L:18MM 黑色 1
⑥ 6100-0003 L22*OD4.5*OD1.65-黄铜-178-00 1
⑦ 6100-0004 L23*OD4.5*OD1.0-黄铜-00 1
⑧ 8100-0005 1.78-64编-锡-棕 1
SORTING NO. MHZ.TD
DRAWN BY cham
CHECKED BY
APPROVED BY
MHZ.TD CO.,LTD
TITLE: RP-SMA（P）- 2.4/58GHz-L156mm黑（3DB六边形）
PART NO.: A100-0008
CUST NO.:
DRAWING NO.
DRAWING SIZE 1:1 A4
UNIT MM
PAGE 1 OF 2
[表单版本—第一版]

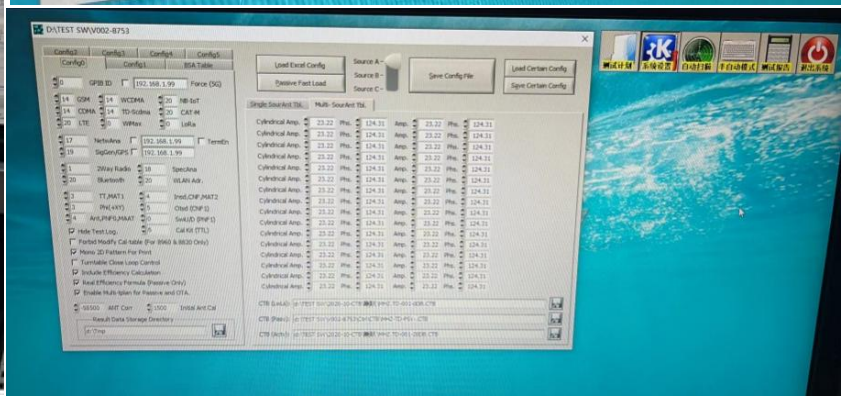
测试环境（Testing Environment）

项目(Project)	配置(Configuration)	备注（Notes）
实验室(Laboratory)	深圳市兆赫实验室 (ShenZhen Zhao He Laboratory)	天线供应商：深圳市兆赫技术有限公司(Antenna supplier: Shenzhen Zhaohe Technology Co., Ltd)
暗室系统 （Test System）	飞 图（Fei Tu）	长 x 宽 x 高（LxWxH） 6.40Mx3.25Mx 2.85M
测试仪器（Testing Instrument）	网络分析仪 E5071B (Network analyzer E5071B)	
测试仪器序列号(Test Instrument Serial Number)	E5070B*CFG001 MY42402168	
校准周期(Calibration Cycle)	1 个月（1 Month）	

测试设置参数（Test Setup Parameters）







1.Summary：

这份测试数据用于说明天线的测试环境设置和测试的结果

This Report to account for the measurement setup and result of the Antenna.

测试的结果包括了 S 参数（VSWR 或增益、天线的方向图）

The measurement setup includes s-parameter, pattern, and gain measurement.

对天线的测试数据进行了简述分析

The measured data for Antenna are presented and analysis.

2.S-Parameter Measurement：

A. 反射系数:Reflection coefficient :

(a)仪器:网络分析仪 Instrument：Network Analyzer.

(b)设置：Setup：

(1) 通过使用 O.S.L 校准装置的一个端口校准来校准网络分析仪。

Calibrate the Network Analyzer by one port calibration using O.S.L. calibration kits.

(2)将天线下的天线连接到网络分析仪。

Connect the antenna under test to the Network Analyzer.

(3)测量图 1 所示的 S11(反射系数)。Measure the S11(reflection coefficient) shown in Fig.

(4) 一般来说，S11 小于-10 分贝，以保证 90%的天线功率，只有不到 10%的功率回到系统。

Generally, the S11 is less than –10dB to ensure the 90% power into antenna and only less than 10% power back to system.

3.Antenna measured in Network Analyzer(E5071B)

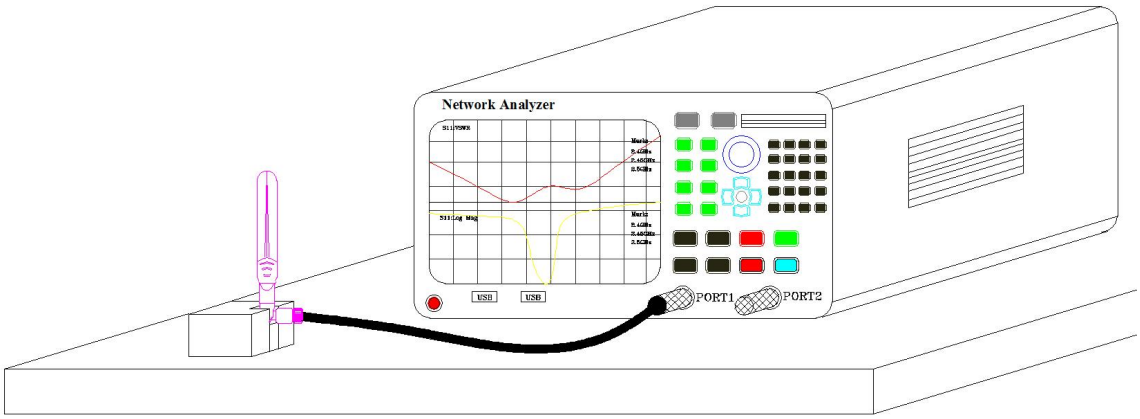


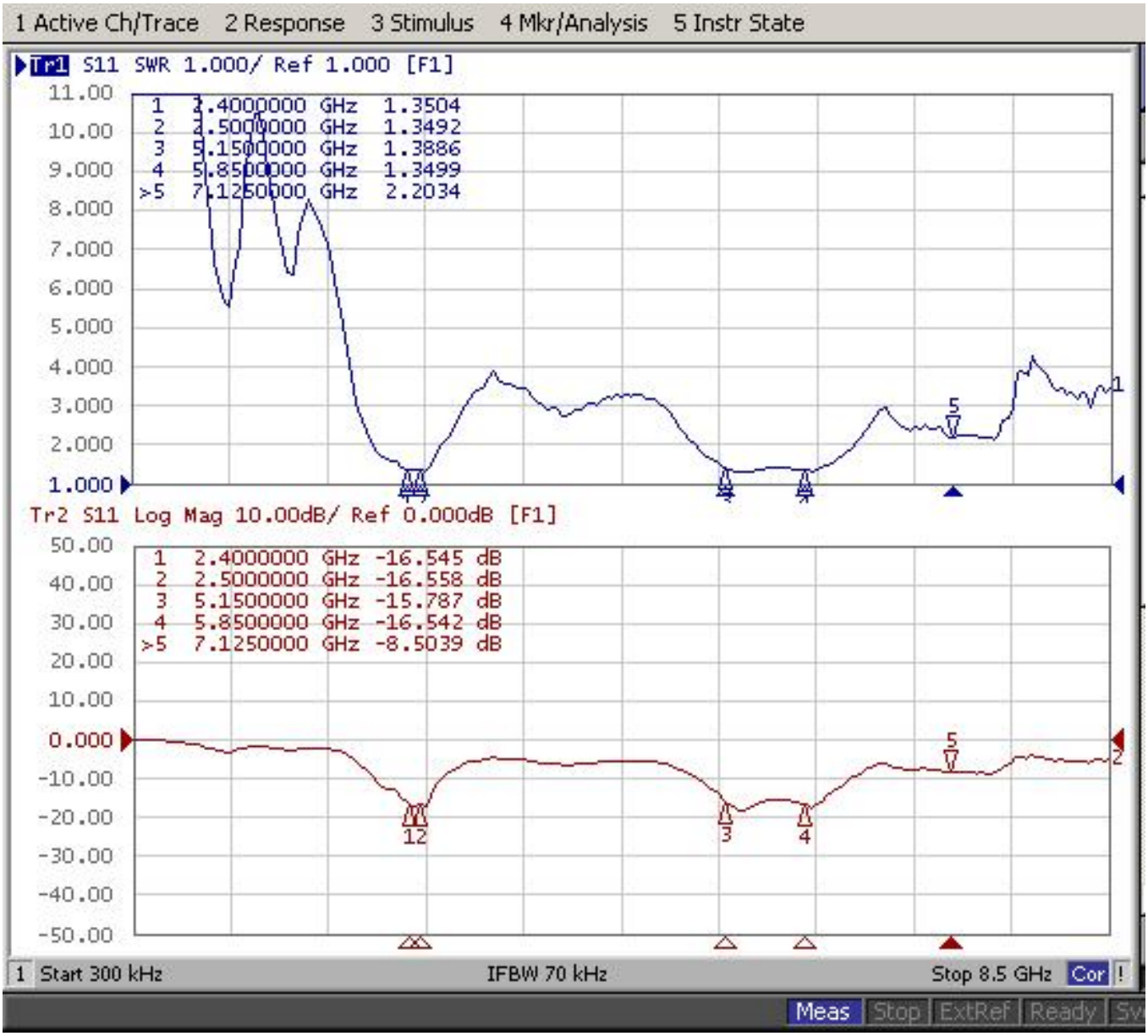
Fig.1 Antenna measured in Network Analyzer

4. S 参数测量结果/S-Parameter Measurement Result S

参数测试数据:S-Parameter test data S：

Frequency MHz 工作频段	2400MHz	2500MHz	5150MHz	5850MHz
电压驻波比/VSWR	1.35	1.35	1.38	1.34
反射系数/Lgo Mag	-16.54	-16.55	-15.78	-16.54

参数测试图片:S-Parameter test image：



5. 全电微波暗室测试/The Test Information Anechoic Chamber

A. 范围 Scope

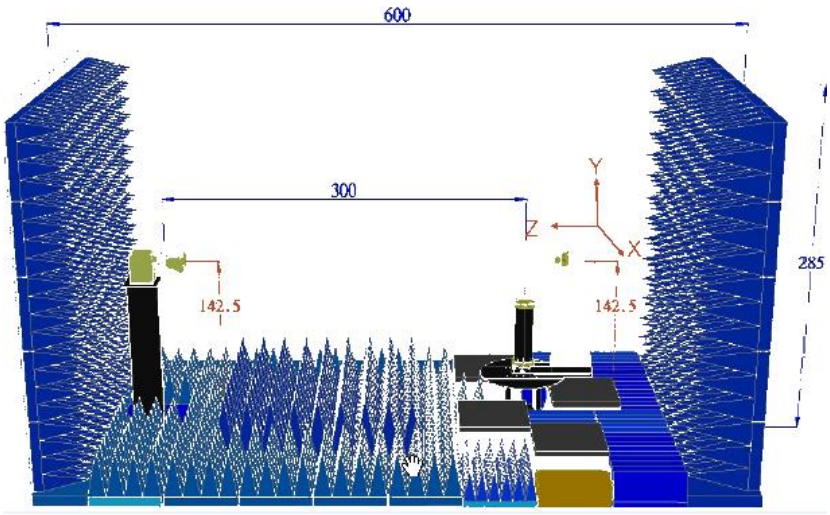
这项工作说明了远场天线测量范围的要求，包括 （This statement of work defines the requirements of a far-field antenna measurement range, which includes）

(1)一个 325 厘米(W)x 285 厘米(H)x 640 厘米(L)天线测量的微波暗室;（One 325 cm (W) x 285 cm (H) x 640 cm (L) Antenna Measurement Anechoic Chamber）

(2)一个具有旋转线性 CP 测量能力的远场天线测量系统;（One Far-field Antenna Measurement System with spinning linear CP measurement capabilities）

(3)一个宽带传输的天线； （One broad-band transmitted antenna,）

(4)3 个 nrl-4433 标准增益天线。（Three NRL-4433 standard gain antennas）



B. 天线测量微波暗室 Antenna Measurement Anechoic Chamber

全无微波暗室，宽度为 325 厘米，高度为 285 厘米，长度为 640 厘米。这个房间的安静区域应该大于 70 厘米@0.9 GHz，50 厘米@1.8 GHz，44 厘米@2.4 GHz，28 厘米@5.8 GHz，16 厘米@18 GHz。这个微波暗室被用来进行远程的天线测量（Fully anechoic chamber with dimension 325 cm in width, 285 cm in height and 640 cm in length. The quiet zone of this Chamber shall be greater than 70 cm @ 0.9 GHz, 50 cm @1.8 GHz, 44 cm @2.4 GHz, 28 cm @5.8 GHz, 16 cm @18 GHz. Contractor should be aware of this anechoic chamber is going to be used for performing far-filed antenna measurement）

C. 电气规范 Electrical specifications

频率范围:800 兆赫到 18 千兆赫，（Frequency Range: 800 MHz to 18 GHz）

安静区域的大小:70 厘米，@0.9 GHz，50 厘米@1.8 GHz，444 厘米@2.4 GHz，28 厘米@5.8 GHz，16 厘米@18 GHz（Quiet zone size: >70 cm @ 0.9 GHz, >50 cm @1.8 GHz, >44 cm @2.4 GHz, >28 cm @5.8 GHz, >16 cm @18 GHz.）

静区波纹:小于+/-0.5 分贝，1.5 2.4 GHz，小于+/-0.25 分贝@2.4 18GHz（Quiet zone ripple: < +/- 0.5 dB @1.5~2.4 GHz, < +/- 0.25 dB @2.4~18GHz）

Field Probing Frequency	Peak-to-Peak Amplitude Ripple (within specified Quiet Zone Area)	Quiet Zone Size (cm)	Compliant
0.9 GHz	< 0.8 dB	70	Yes
1.575 GHz	< 0.6 dB	55	Yes
1.8 GHz	< 0.5 dB	50	Yes
2.45 GHz	< 0.4 dB	44	Yes
4.8 GHz	< 0.3 dB	31	Yes
5.8 GHz	< 0.3 dB	28	Yes

D. 微波吸收器（Absorbers）

我们将在室内的内壁上设计和安装适当的吸收器，以保证电气规格。但是，吸收器的高度应不小于 24 英寸，使室内空间达到 203 厘米(W)x 163 厘米(H)x 533 厘米(L)。所有的吸收器都应符合 nrl-8093 防火规定（We shall design and install proper absorbers on the inner walls of the chamber to guarantee the electrical specifications . However, the absorbers height shall be no less than 24" which enables the space in the chamber to be around 203 cm (W) x 163 cm (H) x 533 cm (L). All the absorber used shall meet NRL-8093 fire retardant regulations）

E. 远场天线测量系统（Far-field Antenna Measurement System）

我们将提供能够将天线辐射模式从 30 千赫兹到 6 千兆赫的所有硬件和软件，使用现有的 Agilent 5230A pna-l 或 Agilent 8753ES 矢量网络分析仪。该系统将能够自动测量和绘制单轴振幅和相位天线模式，无论是笛卡尔坐标还是极坐标形式。We shall supply all the hardware and software which are capable of characterizing antenna radiation patterns from 30 KHz to 6 GHz Agilent 5230A PNA-L or Agilent 8753ES Vector Network Analyzer. The system shall be able to automatically measure and plot single axis amplitude and phase antenna patterns in either Cartesian or polar formats.

F. 远场测量软件 Far-field measurement software

该软件由控制或数据采集软件和数据绘图软件组成（The software consists of the control or data acquisition software and the data plotting software）

(一)数据采集软件至少具备下列功能:（The data acquisition software shall at least be capable of the following functions）

*测量单个频率的单轴频率(方位角);系统可以在扫描结束时自动切换频率。measuring single frequency per cut - single axis (azimuth); system can automatically switch frequency at the end of a scan.

*单向或双向测量数据 measuring data in Uni-direction or bi-direction

*至少用方位角 360 度测量数据（+/-180 度或 0-360 度)measuring data at least with azimuth 360 degrees. (+/- 180 degrees or 0-360 degrees)

*实时的笛卡尔坐标或极坐标形式 real time plot in Cartesian or polar format

*屏幕显示实时角度位置 screen shows real time angle position

*系统根据测量信号的波动自动计算/n 比率 system automatically calculates S/N ratio level based on measured signal fluctuation

*定位定位器零位的功能 function to set positioner zero position

*操作员可以设置数据取速度和数据采样间隔 operator can set data taking velocity and data sampling interval

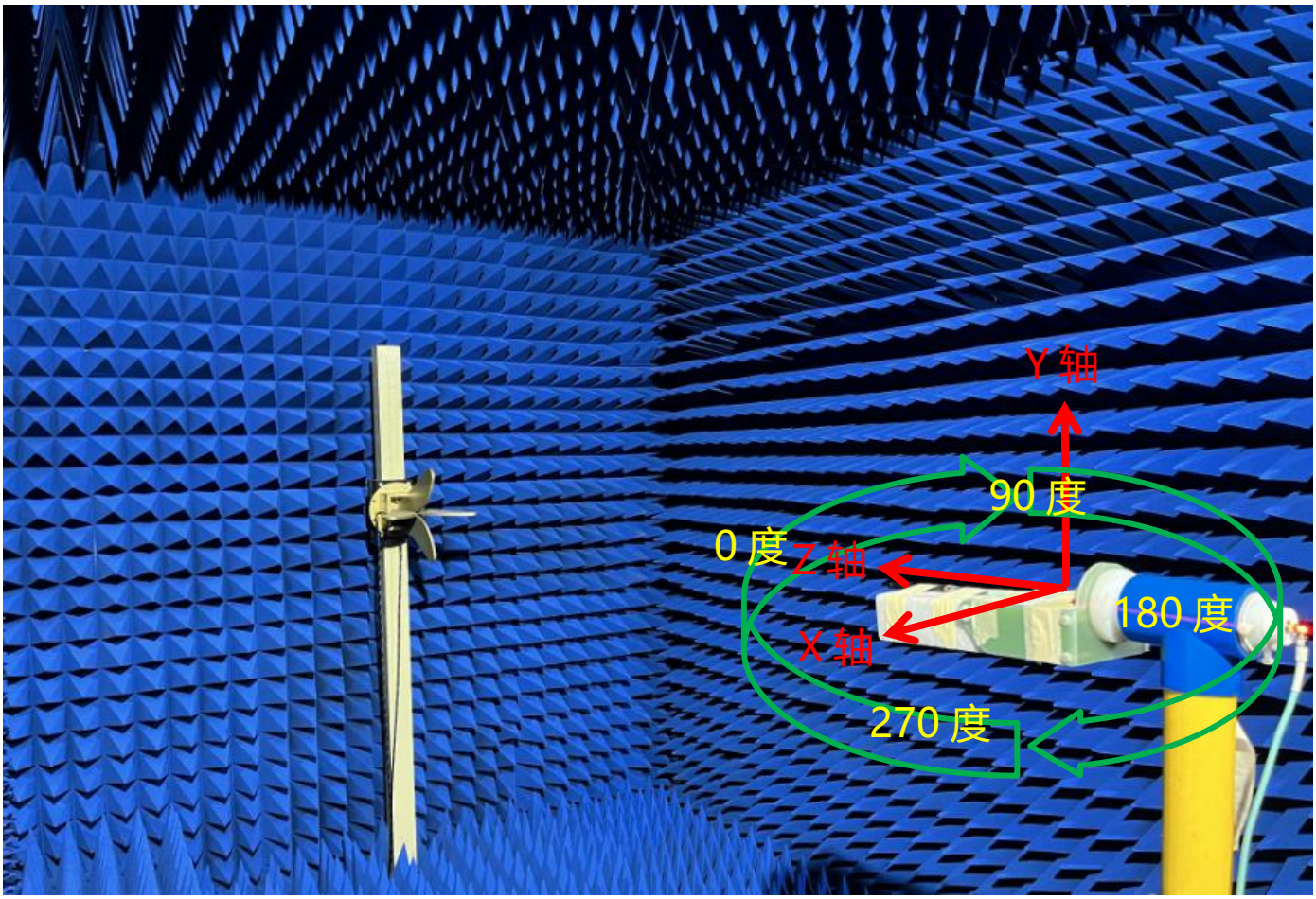
*允许定位器对任何角度的偏移 entry to allow positioner offset to any angle

G roadband 传输天线（roadband Transmitted antenna）

一个线性极化的宽带天线，其规格要优于频率:1-18 千兆赫，增益:12 dBi@10 GHz，VSWR:小于 20:1，

前回 20 分贝 We shall provide a linear-polarized broadband antenna with the specifications better than those listed hereafter in this article, Frequency: 1-18 GHz, Gain: >12 dBi @10 GHz, VSWR:<2,0:1, Front to Back Ration > 20 dB

6. 微波暗室 XYZ 的示意图 Chamber XYZ Photo

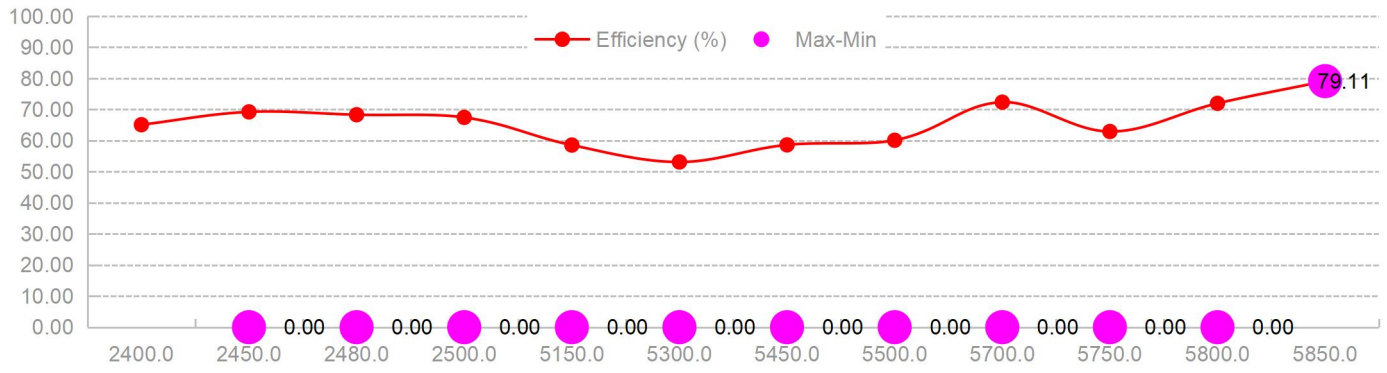


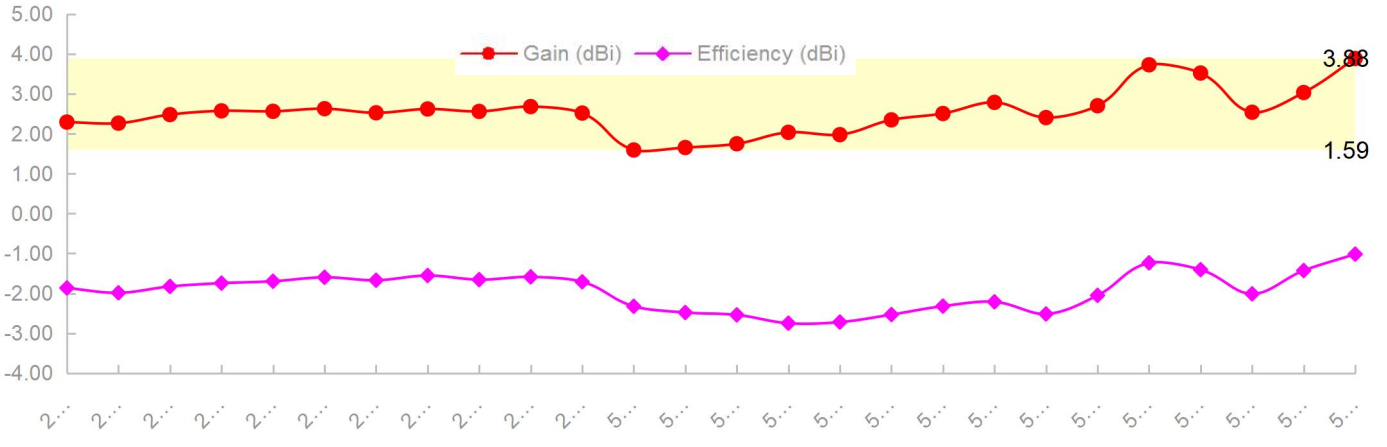
7. 微波暗室测试的效率及增益 Chamber Test Result

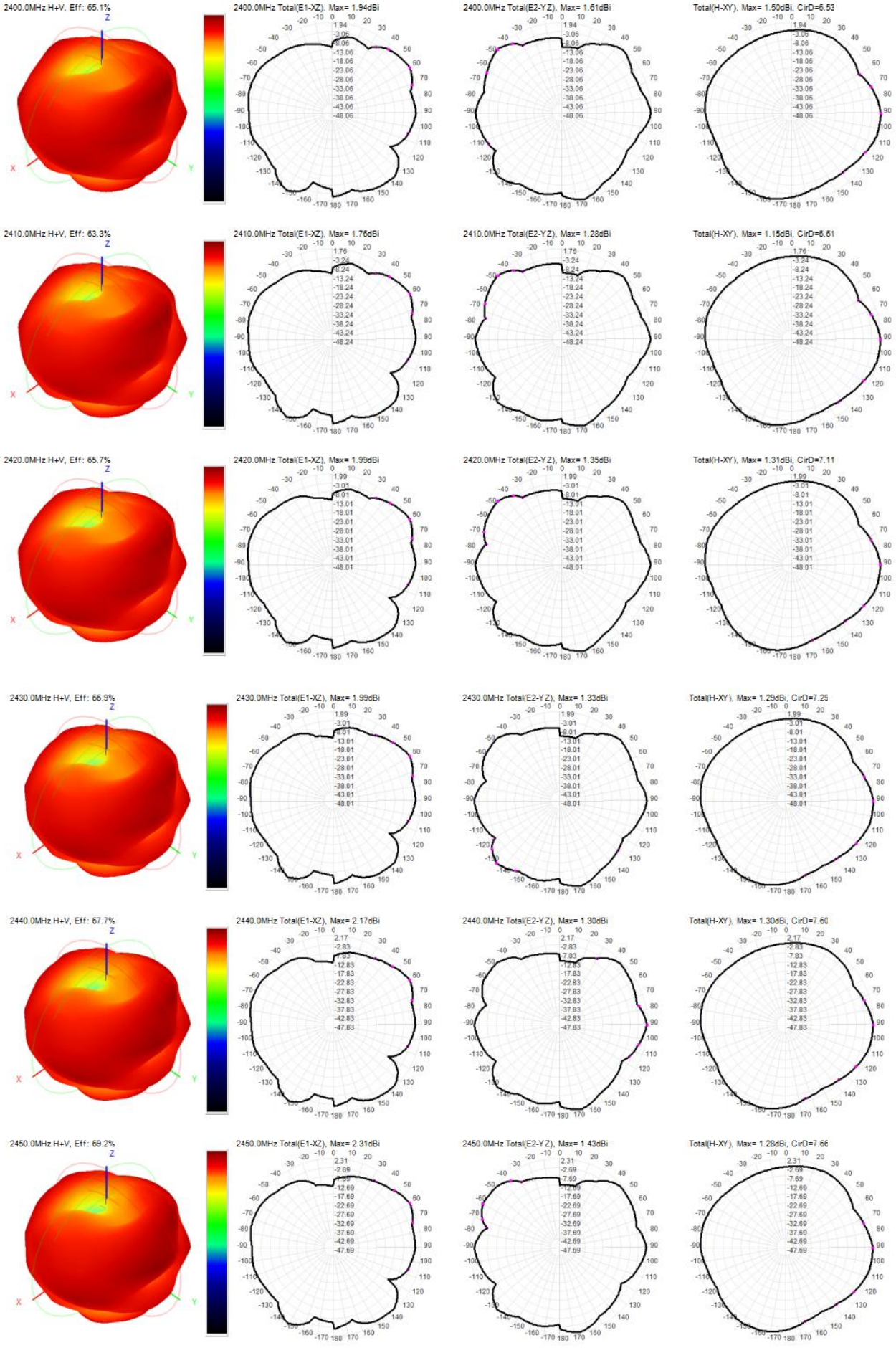
Frequency ID	1	2	3	4	5	6	7	8	9	10	11	12	13
Frequency (MHz)	2400.0	2410.0	2420.0	2430.0	2440.0	2450.0	2460.0	2470.0	2480.0	2490.0	2500.0	5150.0	5200.0
Efficiency (dBi)	-1.86	-1.99	-1.83	-1.74	-1.70	-1.60	-1.67	-1.55	-1.66	-1.59	-1.71	-2.32	-2.48
Gain (dBi)	2.29	2.26	2.48	2.57	2.56	2.63	2.52	2.62	2.56	2.68	2.52	1.59	1.65
Efficiency (%)	65.10	63.30	65.66	66.93	67.67	69.22	68.06	69.93	68.30	69.39	67.45	58.56	56.50
Directivity (dB)	4.16	4.25	4.31	4.32	4.26	4.22	4.19	4.17	4.21	4.27	4.23	3.92	4.13
Peak Gain Position (Theta)	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	60.00	150.00	90.00	75.00
Peak Gain Position (Phi)	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	180.00	30.00	150.00	315.00
Efficiency ThetaPol (%)	49.97	46.94	50.75	50.65	53.14	54.49	54.09	57.16	54.65	57.80	54.08	56.81	54.37
Efficiency PhiPol (%)	15.12	16.36	14.91	16.28	14.53	14.73	13.98	12.77	13.66	11.59	13.37	1.74	2.13
Upper Hem. Efficiency (%)	34.14	32.75	34.48	35.08	36.23	37.43	37.14	38.63	37.44	38.62	36.99	35.47	35.21
Lower Hem. Efficiency (%)	30.96	30.55	31.18	31.85	31.44	31.79	30.92	31.30	30.86	30.77	30.46	23.09	21.28

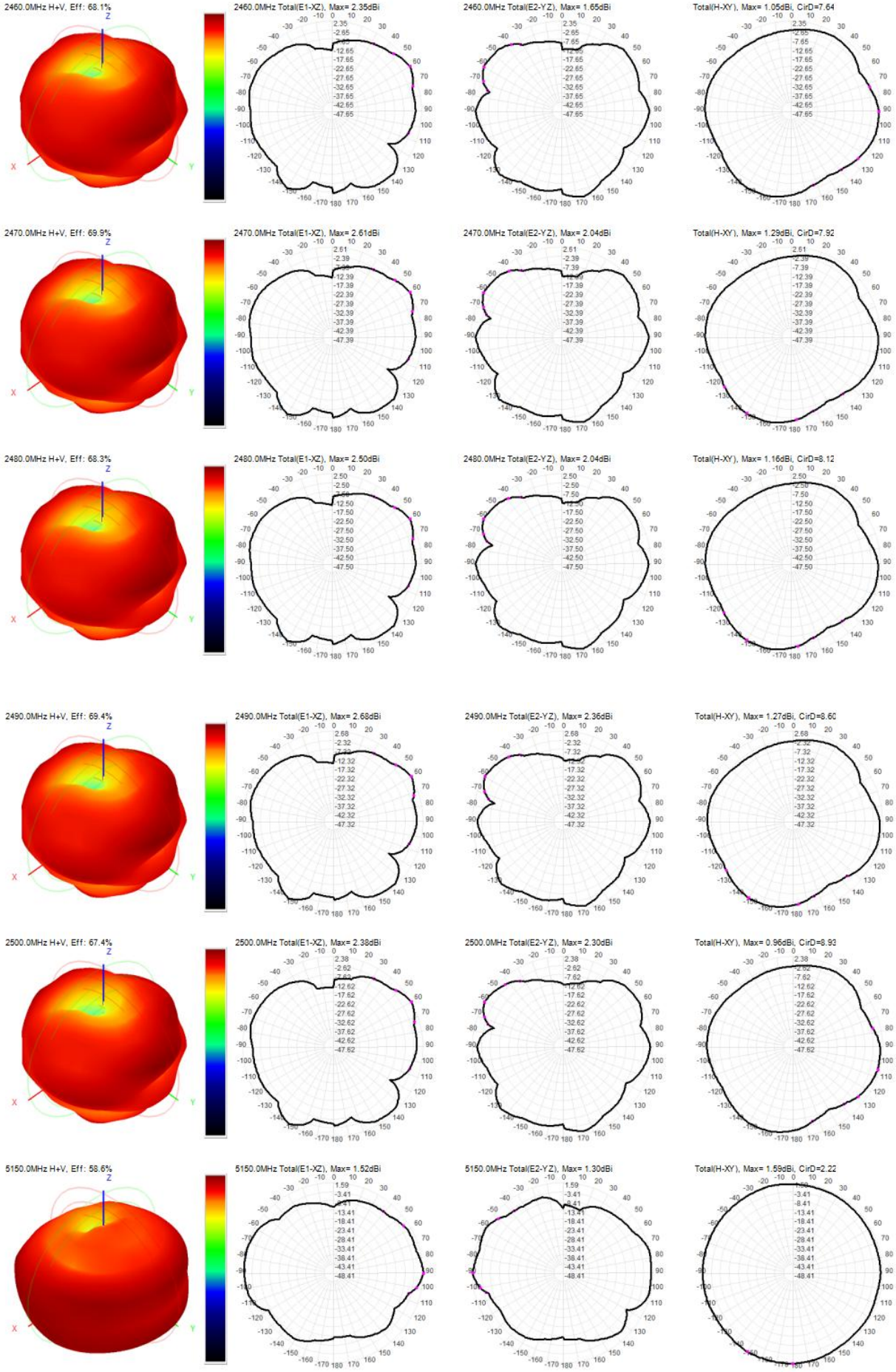
Frequency ID	14	15	16	17	18	19	20	21	22	23	24	25	26
Frequency (MHz)	5250.0	5300.0	5350.0	5400.0	5450.0	5500.0	5550.0	5600.0	5650.0	5700.0	5750.0	5800.0	5850.0
Efficiency (dBi)	-2.54	-2.75	-2.72	-2.53	-2.32	-2.21	-2.52	-2.05	-1.24	-1.41	-2.01	-1.43	-1.02
Gain (dBi)	1.75	2.03	1.98	2.35	2.51	2.78	2.40	2.70	3.73	3.52	2.54	3.03	3.88
Efficiency (%)	55.74	53.12	53.46	55.83	58.62	60.09	56.02	62.38	75.24	72.34	62.91	71.96	79.11
Directivity (dB)	4.29	4.78	4.70	4.88	4.83	5.00	4.92	4.75	4.96	4.93	4.55	4.46	4.90
Peak Gain Position (Theta)	75.00	75.00	75.00	75.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00
Peak Gain Position (Phi)	0.00	345.00	345.00	195.00	210.00	210.00	210.00	210.00	210.00	210.00	210.00	210.00	225.00
Efficiency ThetaPol (%)	53.50	50.77	50.57	52.33	54.51	55.33	49.17	56.39	71.35	64.96	52.58	63.79	70.40
Efficiency PhiPol (%)	2.23	2.35	2.89	3.49	4.11	4.76	6.85	5.98	3.89	7.38	10.34	8.17	8.71
Upper Hem. Efficiency (%)	35.03	33.64	33.76	35.42	36.13	36.06	32.26	36.31	44.70	41.98	35.93	43.07	48.06
Lower Hem. Efficiency (%)	20.71	19.48	19.70	20.41	22.48	24.04	23.77	26.07	30.54	30.36	26.98	28.89	31.05

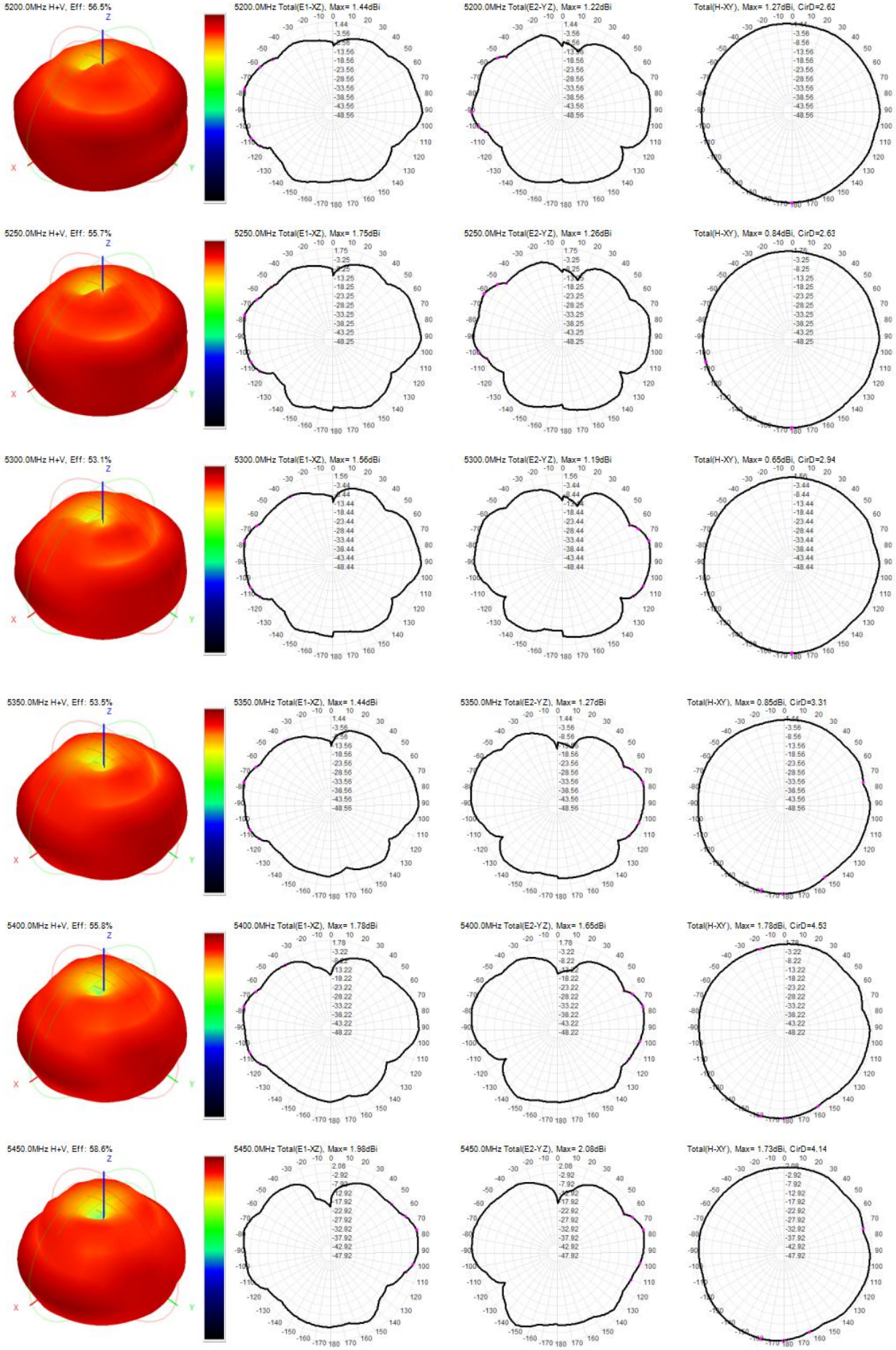
8.微波暗室测试的方向图 Chamber Radiation Pattern

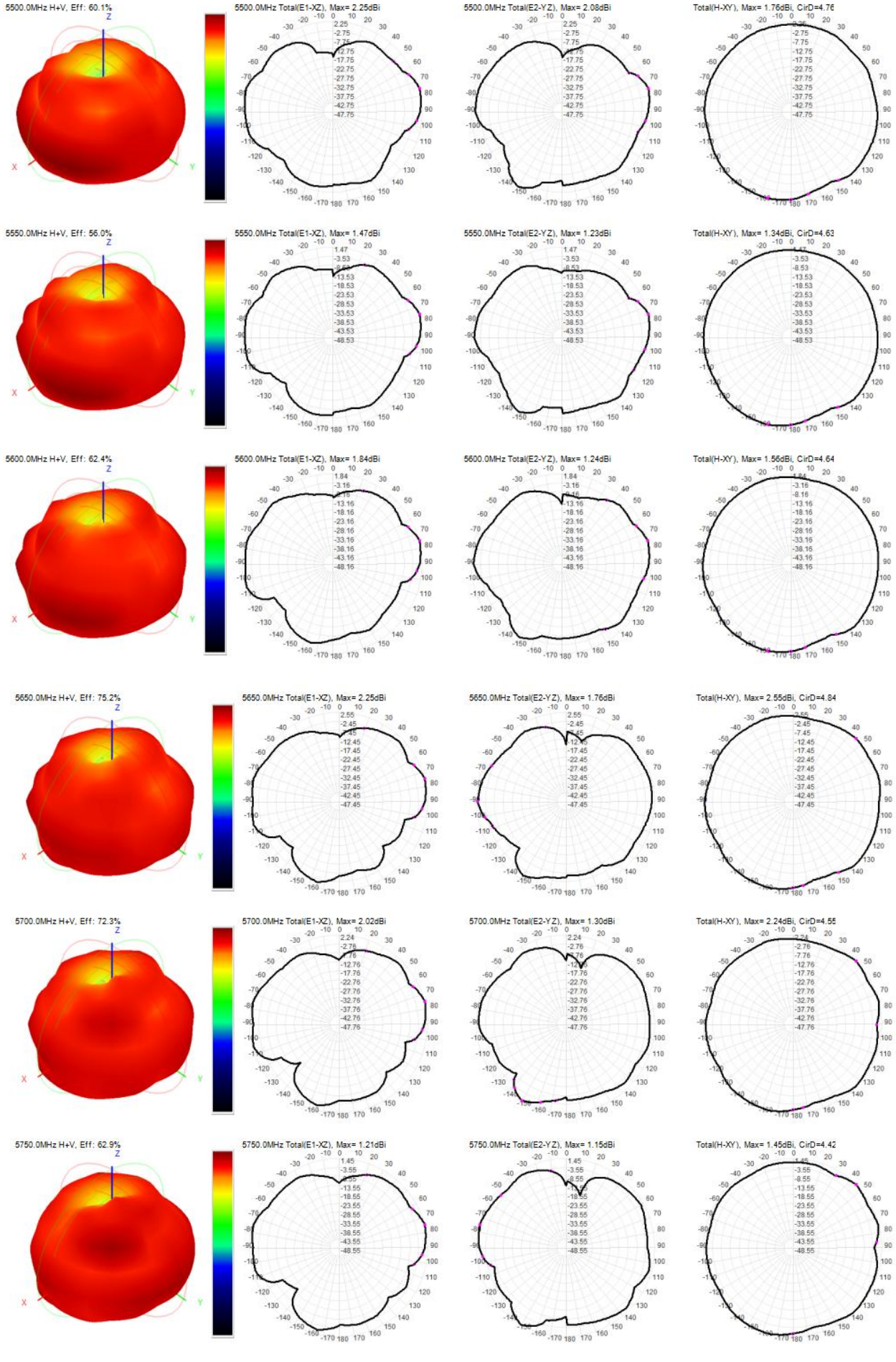


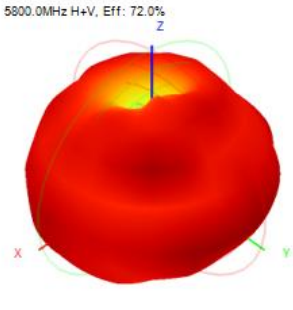


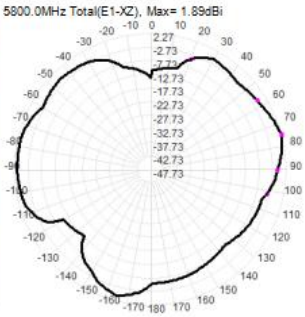

2400.0MHz H+V, Eff: 65.1%
2400.0MHz Total(E1-XZ), Max= 1.94dBi
2400.0MHz Total(E2-YZ), Max= 1.61dBi
Total(H-XY), Max= 1.50dBi, CirD=6.53
2410.0MHz H+V, Eff: 63.3%
2410.0MHz Total(E1-XZ), Max= 1.76dBi
2410.0MHz Total(E2-YZ), Max= 1.28dBi
Total(H-XY), Max= 1.15dBi, CirD=6.61
2420.0MHz H+V, Eff: 65.7%
2420.0MHz Total(E1-XZ), Max= 1.99dBi
2420.0MHz Total(E2-YZ), Max= 1.35dBi
Total(H-XY), Max= 1.31dBi, CirD=7.11
2430.0MHz H+V, Eff: 66.9%
2430.0MHz Total(E1-XZ), Max= 1.99dBi
2430.0MHz Total(E2-YZ), Max= 1.33dBi
Total(H-XY), Max= 1.29dBi, CirD=7.25
2440.0MHz H+V, Eff: 67.7%
2440.0MHz Total(E1-XZ), Max= 2.17dBi
2440.0MHz Total(E2-YZ), Max= 1.30dBi
Total(H-XY), Max= 1.30dBi, CirD=7.60
2450.0MHz H+V, Eff: 69.2%
2450.0MHz Total(E1-XZ), Max= 2.31dBi
2450.0MHz Total(E2-YZ), Max= 1.43dBi
Total(H-XY), Max= 1.28dBi, CirD=7.66

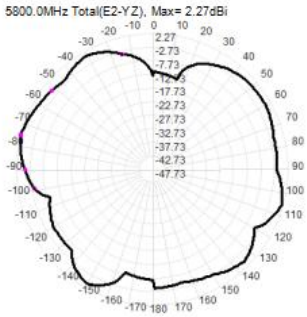

2460.0MHz H+V, Eff: 68.1%
2460.0MHz Total(E1-XZ), Max= 2.35dBi
2460.0MHz Total(E2-YZ), Max= 1.65dBi
Total(H-XY), Max= 1.05dBi, CirD=7.64
2470.0MHz H+V, Eff: 69.9%
2470.0MHz Total(E1-XZ), Max= 2.61dBi
2470.0MHz Total(E2-YZ), Max= 2.04dBi
Total(H-XY), Max= 1.29dBi, CirD=7.92
2480.0MHz H+V, Eff: 68.3%
2480.0MHz Total(E1-XZ), Max= 2.50dBi
2480.0MHz Total(E2-YZ), Max= 2.04dBi
Total(H-XY), Max= 1.16dBi, CirD=8.12
2490.0MHz H+V, Eff: 69.4%
2490.0MHz Total(E1-XZ), Max= 2.68dBi
2490.0MHz Total(E2-YZ), Max= 2.36dBi
Total(H-XY), Max= 1.27dBi, CirD=8.60
2500.0MHz H+V, Eff: 67.4%
2500.0MHz Total(E1-XZ), Max= 2.38dBi
2500.0MHz Total(E2-YZ), Max= 2.30dBi
Total(H-XY), Max= 0.96dBi, CirD=8.93
5150.0MHz H+V, Eff: 58.6%
5150.0MHz Total(E1-XZ), Max= 1.52dBi
5150.0MHz Total(E2-YZ), Max= 1.30dBi
Total(H-XY), Max= 1.59dBi, CirD=2.22

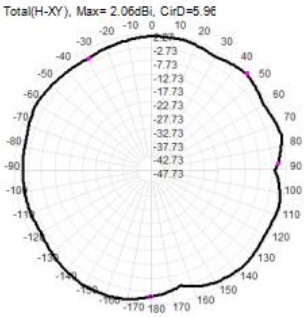

5200.0MHz H+V, Eff: 56.5%
5200.0MHz Total(E1-XZ), Max= 1.44dBi
5200.0MHz Total(E2-YZ), Max= 1.22dBi
Total(H-XY), Max= 1.27dBi, CirD=2.62
5250.0MHz H+V, Eff: 55.7%
5250.0MHz Total(E1-XZ), Max= 1.75dBi
5250.0MHz Total(E2-YZ), Max= 1.26dBi
Total(H-XY), Max= 0.84dBi, CirD=2.63
5300.0MHz H+V, Eff: 53.1%
5300.0MHz Total(E1-XZ), Max= 1.56dBi
5300.0MHz Total(E2-YZ), Max= 1.19dBi
Total(H-XY), Max= 0.65dBi, CirD=2.94
5350.0MHz H+V, Eff: 53.5%
5350.0MHz Total(E1-XZ), Max= 1.44dBi
5350.0MHz Total(E2-YZ), Max= 1.27dBi
Total(H-XY), Max= 0.85dBi, CirD=3.31
5400.0MHz H+V, Eff: 55.8%
5400.0MHz Total(E1-XZ), Max= 1.78dBi
5400.0MHz Total(E2-YZ), Max= 1.65dBi
Total(H-XY), Max= 1.78dBi, CirD=4.53
5450.0MHz H+V, Eff: 58.6%
5450.0MHz Total(E1-XZ), Max= 1.98dBi
5450.0MHz Total(E2-YZ), Max= 2.08dBi
Total(H-XY), Max= 1.73dBi, CirD=4.14

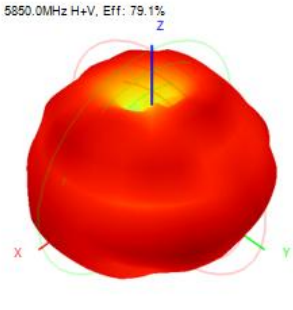

5500.0MHz H+V, Eff: 60.1%
5500.0MHz Total(E1-XZ), Max= 2.25dBi
5500.0MHz Total(E2-YZ), Max= 2.08dBi
Total(H-XY), Max= 1.76dBi, CirD=4.76
5550.0MHz H+V, Eff: 56.0%
5550.0MHz Total(E1-XZ), Max= 1.47dBi
5550.0MHz Total(E2-YZ), Max= 1.23dBi
Total(H-XY), Max= 1.34dBi, CirD=4.63
5600.0MHz H+V, Eff: 62.4%
5600.0MHz Total(E1-XZ), Max= 1.84dBi
5600.0MHz Total(E2-YZ), Max= 1.24dBi
Total(H-XY), Max= 1.56dBi, CirD=4.64
5650.0MHz H+V, Eff: 75.2%
5650.0MHz Total(E1-XZ), Max= 2.25dBi
5650.0MHz Total(E2-YZ), Max= 1.76dBi
Total(H-XY), Max= 2.55dBi, CirD=4.84
5700.0MHz H+V, Eff: 72.3%
5700.0MHz Total(E1-XZ), Max= 2.02dBi
5700.0MHz Total(E2-YZ), Max= 1.30dBi
Total(H-XY), Max= 2.24dBi, CirD=4.55
5750.0MHz H+V, Eff: 62.9%
5750.0MHz Total(E1-XZ), Max= 1.21dBi
5750.0MHz Total(E2-YZ), Max= 1.15dBi
Total(H-XY), Max= 1.45dBi, CirD=4.42

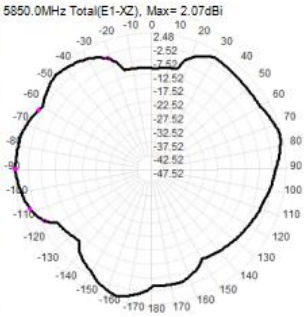

5800.0MHz H+V, Eff: 72.0%
Z
X
Y

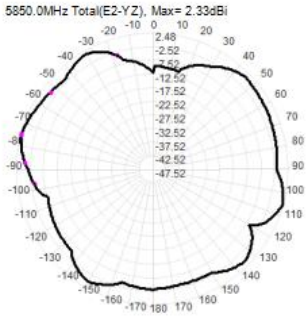

5800.0MHz Total(E1-XZ), Max= 1.89dBi

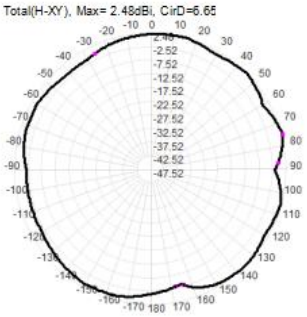

5800.0MHz Total(E2-YZ), Max= 2.27dBi


Total(H-XY), Max= 2.06dBi, CirD=5.96


5850.0MHz H+V, Eff: 79.1%
Z
X
Y


5850.0MHz Total(E1-XZ), Max= 2.07dBi


5850.0MHz Total(E2-YZ), Max= 2.33dBi


Total(H-XY), Max= 2.48dBi, CirD=6.65