Free walk Technology

深 圳 自 由 行 通 信 技 术 有 限 公 司

# 天线测试报告
# Antenna Test Report

Project :WLS261
Data:2021-10-11
Ver.1.0

# Introduction to prototype

| Customer name | both wings | both wings | WLS261 |
|---|---|---|---|

| NO. | ITEMS | DETAILS |
|---|---|---|
| 1 | Frequency band | WiFi （2.4GHz+5GHz ） |
| 2 | model | Router |
| 3 | Antenna type | External |
| 4 | Antenna implementation form | 2.4GHz External antenna（PCB+Spring）<br>5GHz External antenna（PCB+Spring） |
| 5 | Antenna material | PCB+Spring |
| 6 | | |
| 7 | | |
| 8 | | |
| RF | 李文科 | |
| ME | | |

# Test system :

**Test Equipment & Conditions**

**Network Analyzers :**

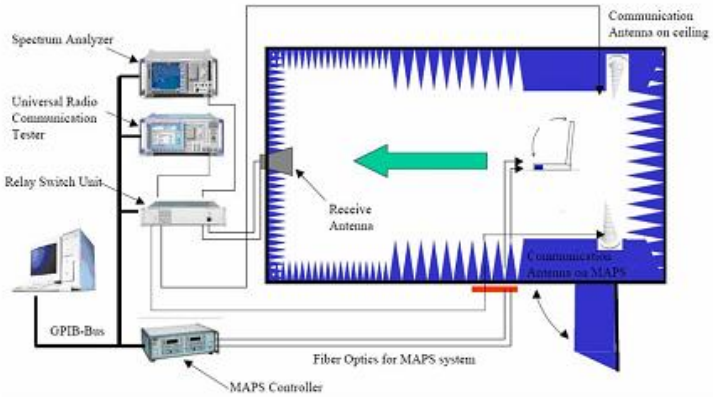
Agilent 5071C

**Communications Test Set:**

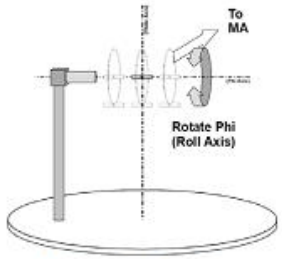
CMW500

**3D Chamber Test System:**

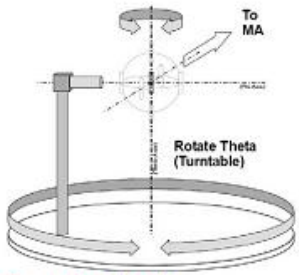
ETS




(Testing by 3D anechoic chamber)

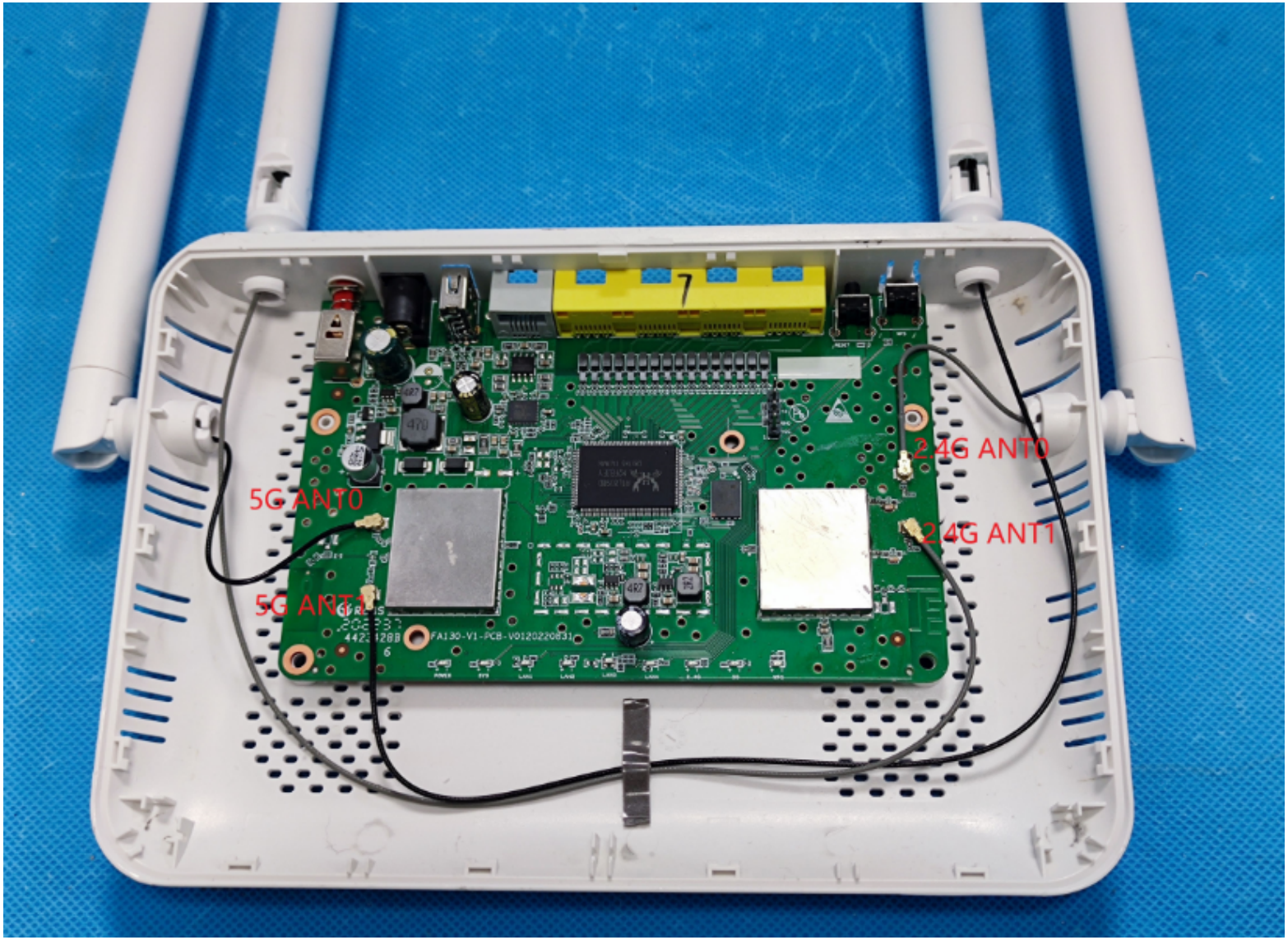



Phi axis test

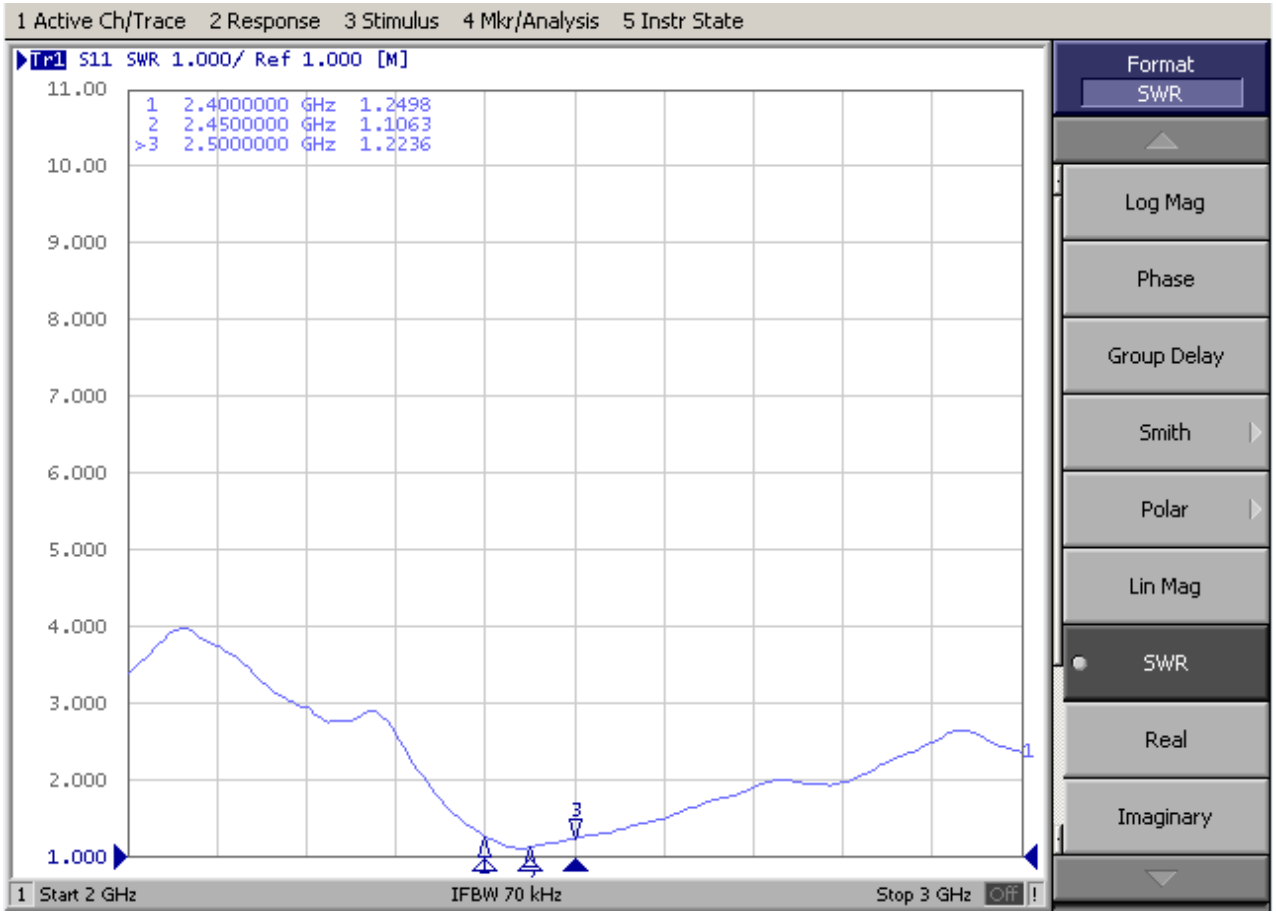



Theta axis test

# Antenna position

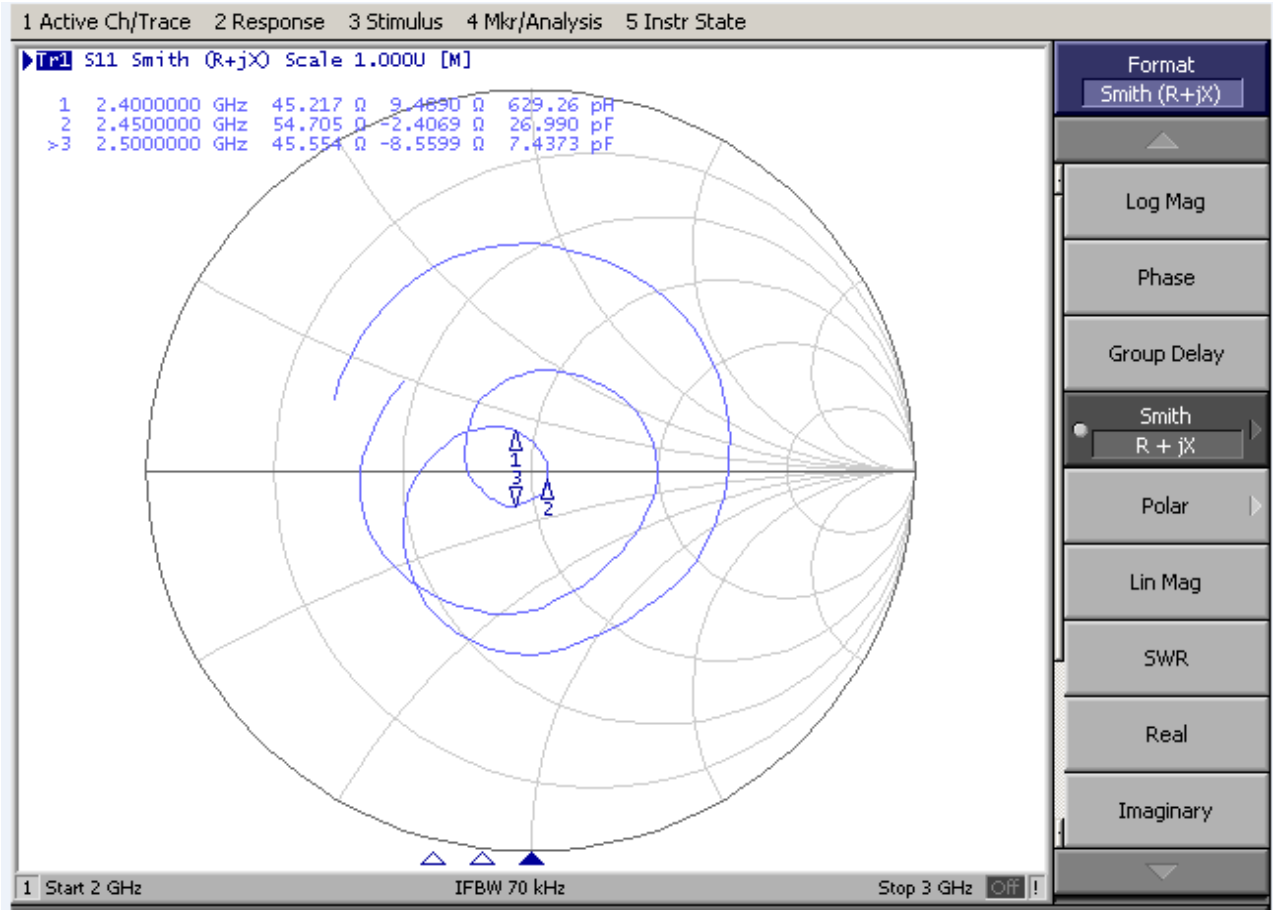


# 2.4G-0 SWR




Test equipment： Agilent E5071B

# 2.4G-0 Smith(R+jx)




Test equipment： Agilent E5071B

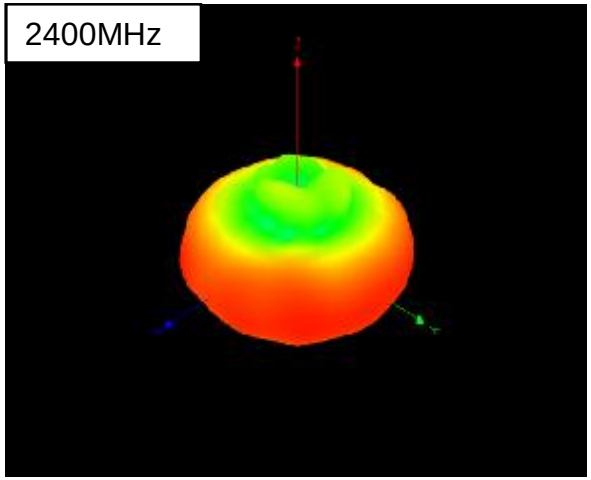
# 2.4G test data

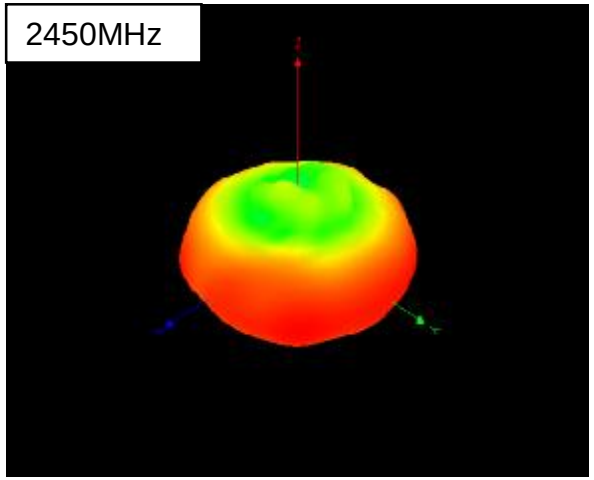
## Antenna efficiency and gain

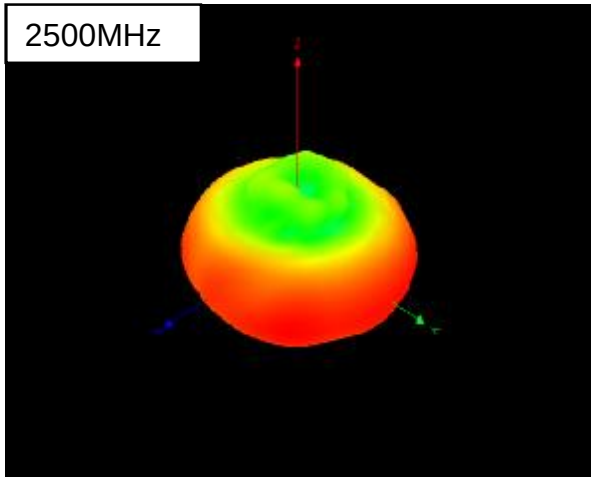
2.4G Efficiency and gain

| Frequency / MHz | Efficiency / % | Gain/ dBi |
|---|---|---|
| 2400 | 73.68 | 5.59 |
| 2410 | 74.45 | 5.22 |
| 2420 | 73.07 | 4.73 |
| 2430 | 74.92 | 4.66 |
| 2440 | 76.12 | 4.66 |
| 2450 | 75.39 | 4.71 |
| 2460 | 73.83 | 4.70 |
| 2470 | 72.92 | 5.17 |
| 2480 | 71.71 | 5.23 |
| 2490 | 72.92 | 5.15 |
| 2500 | 70.39 | 4.77 |

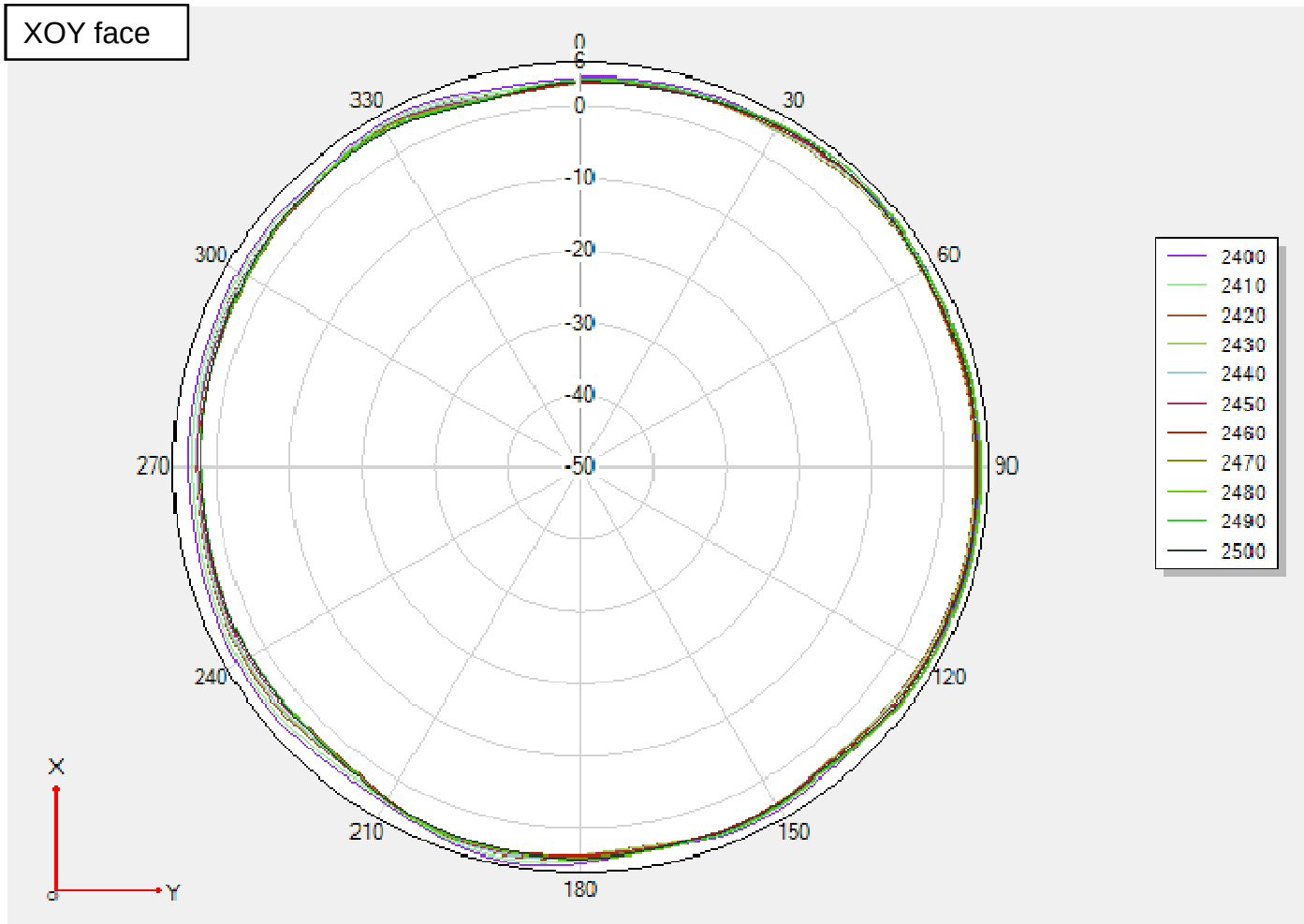
# 3D diagram



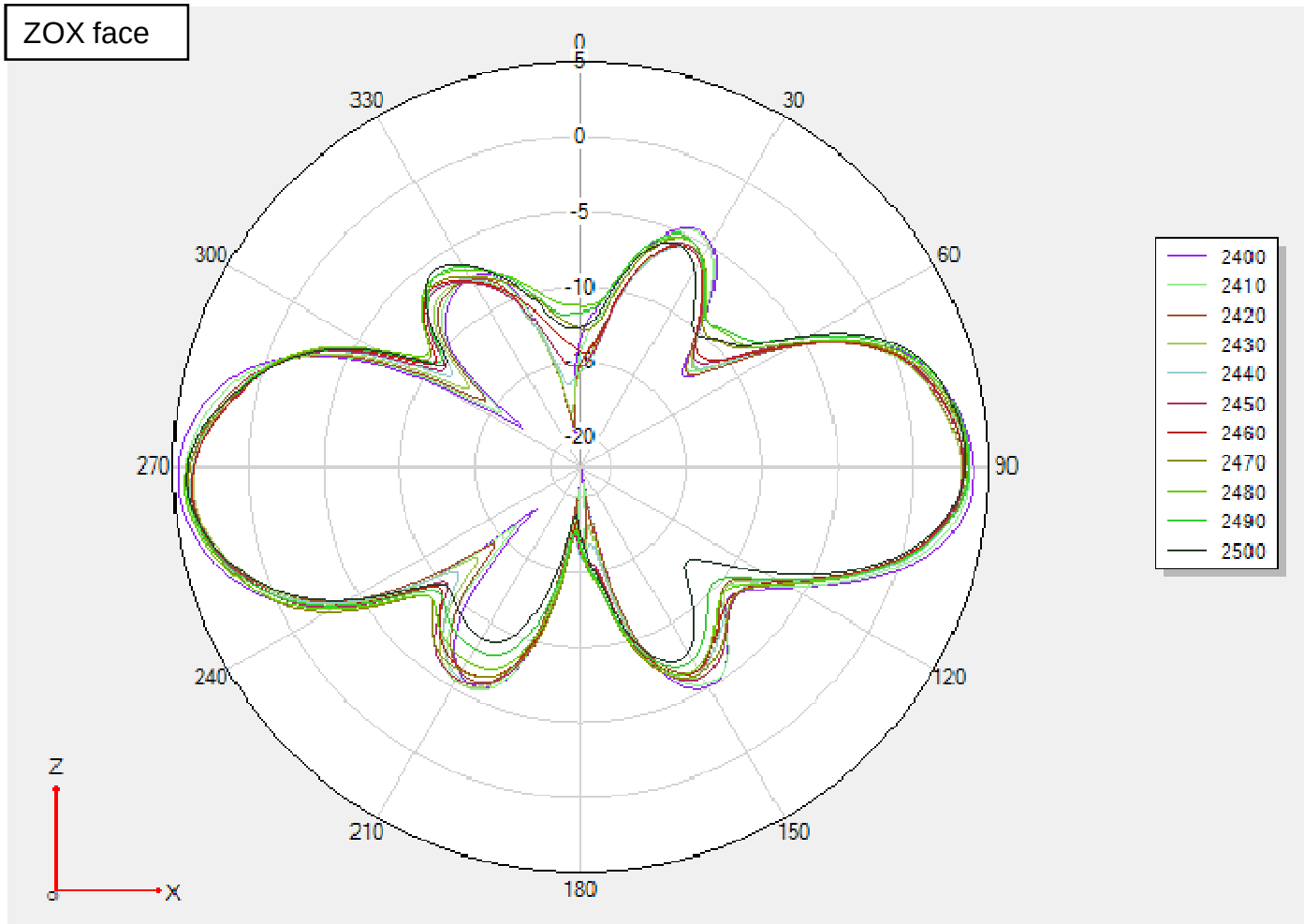



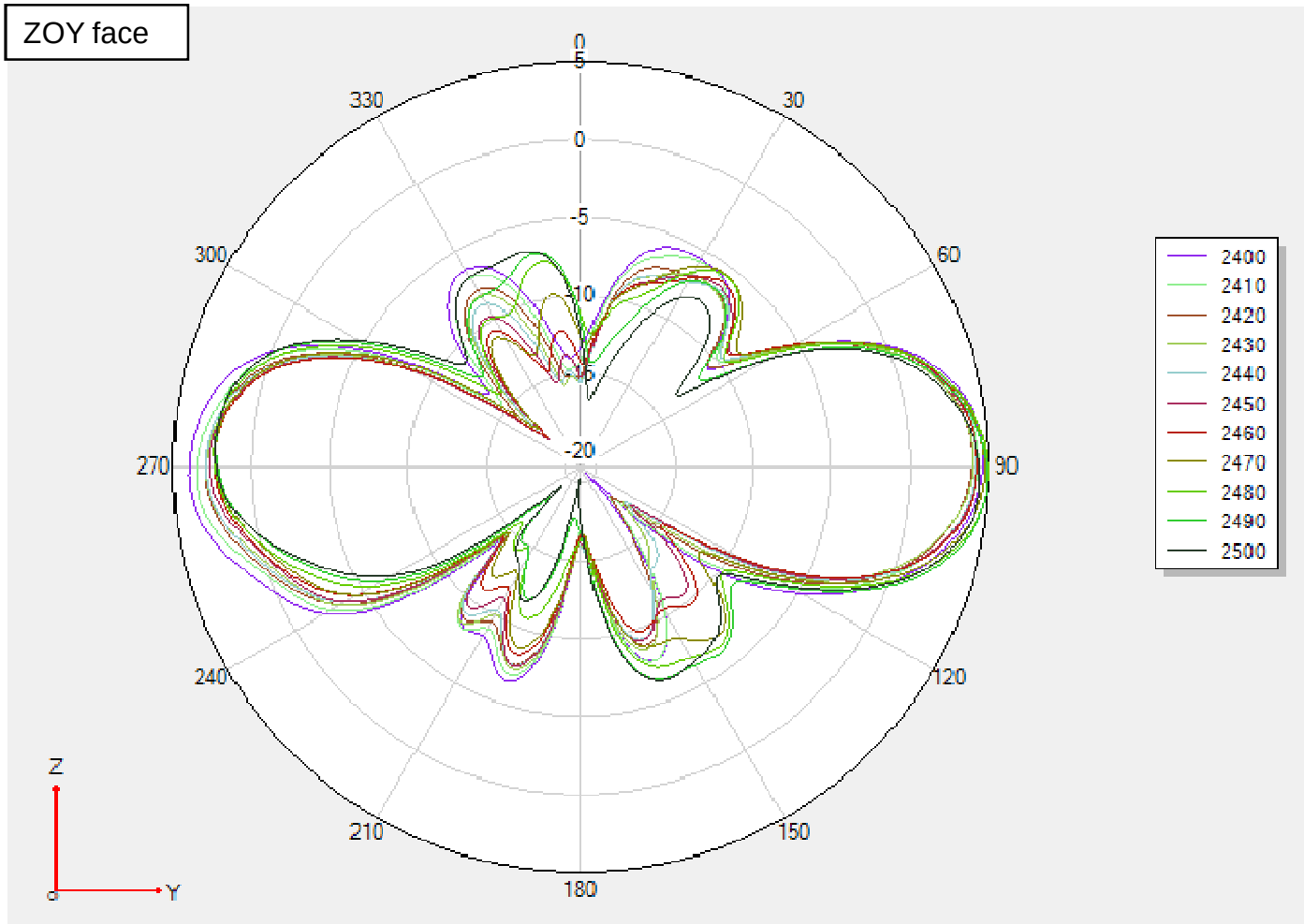
# 2D diagram


XOY face
0
30
60
90
120
150
180
210
240
270
300
330
0
-10
-20
-30
-40
-50
2400
2410
2420
2430
2440
2450
2460
2470
2480
2490
2500
X
Y

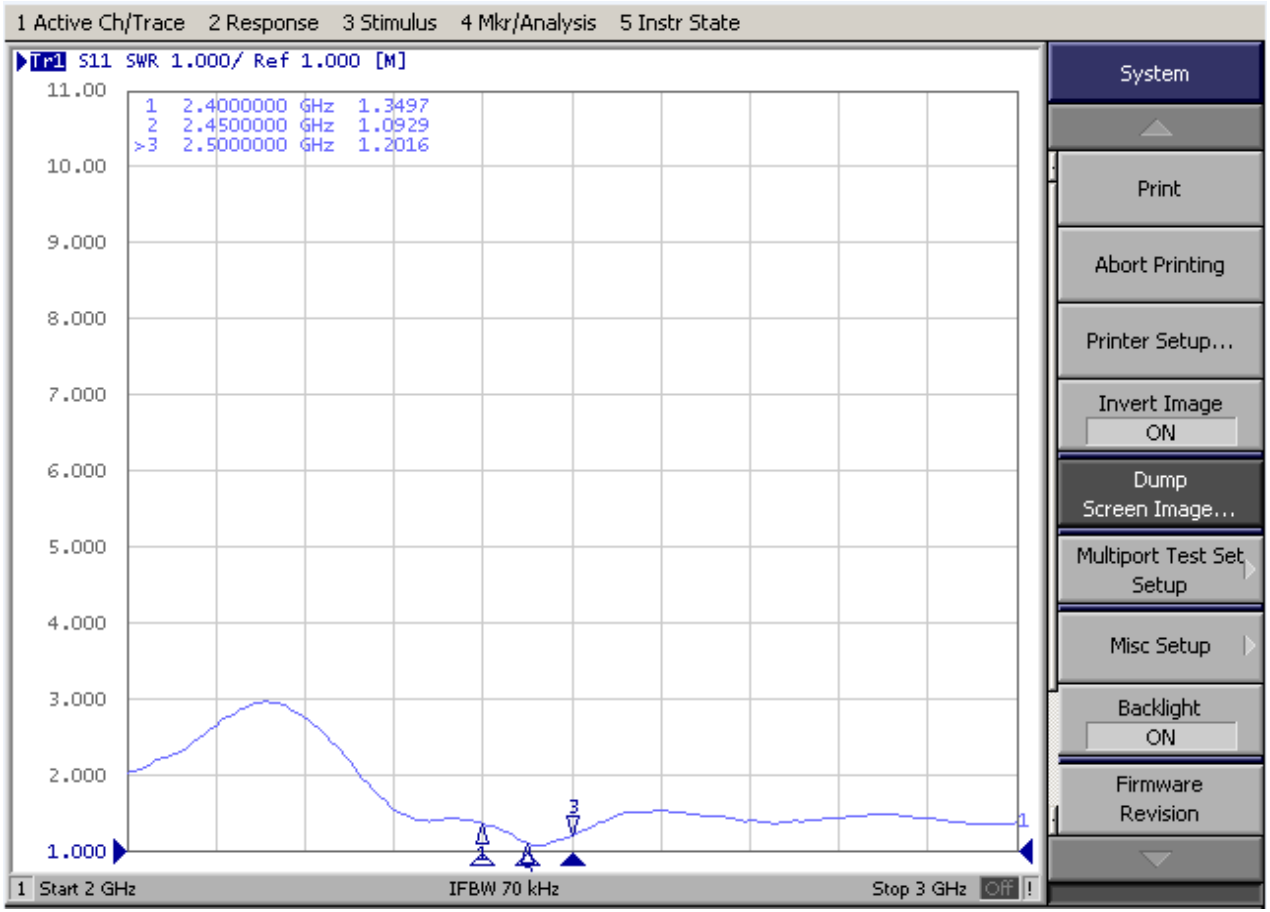
# 2D diagram


ZOX face
0
30
60
90
120
150
180
210
240
270
300
330
5
0
-5
-10
-15
-20
2400
2410
2420
2430
2440
2450
2460
2470
2480
2490
2500
Z
X

# 2D diagram

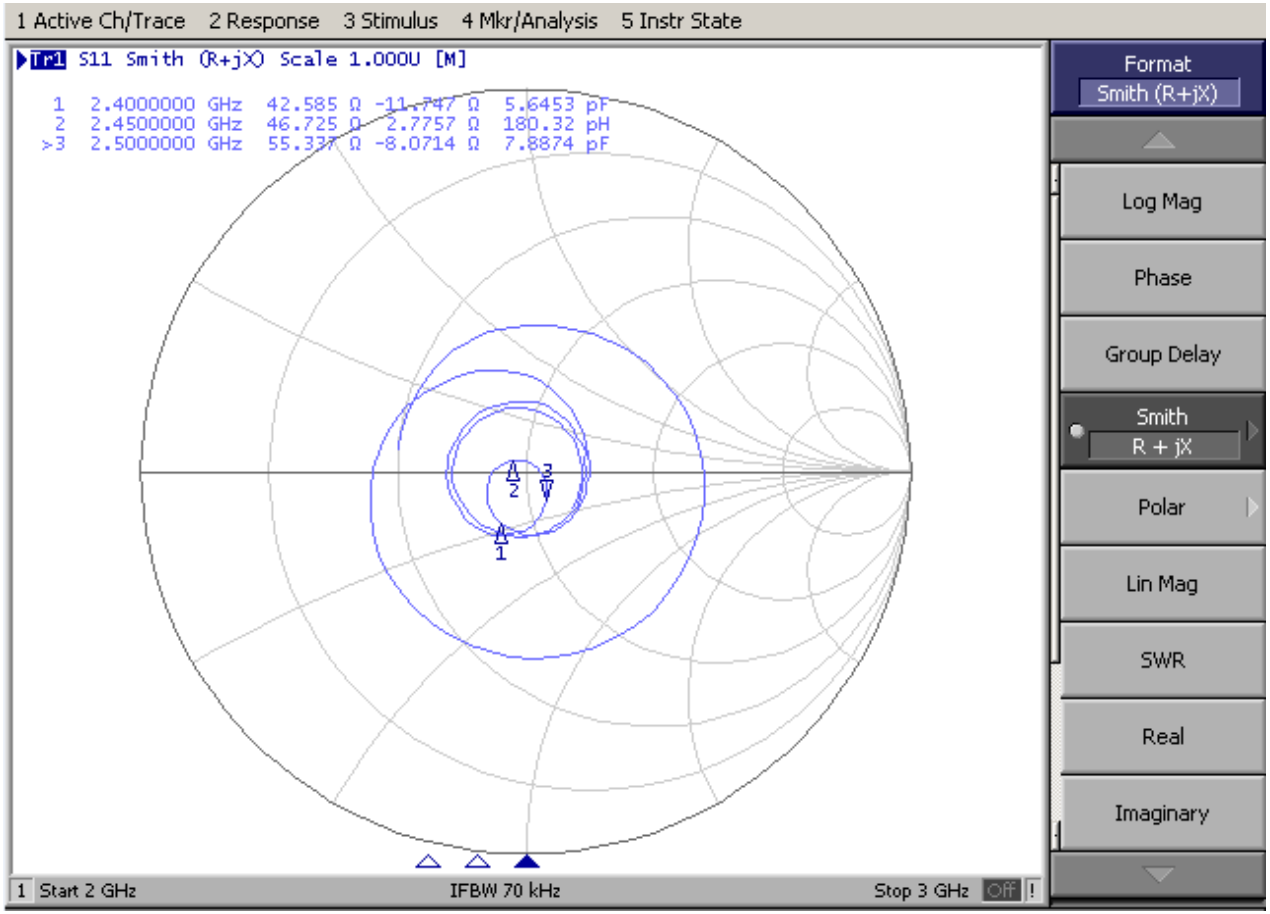

ZOY face
0
5
0
-5
-10
-15
-20
30
60
90
120
150
180
210
240
270
300
330
2400
2410
2420
2430
2440
2450
2460
2470
2480
2490
2500
Z
Y

# 2.4G-1 SWR



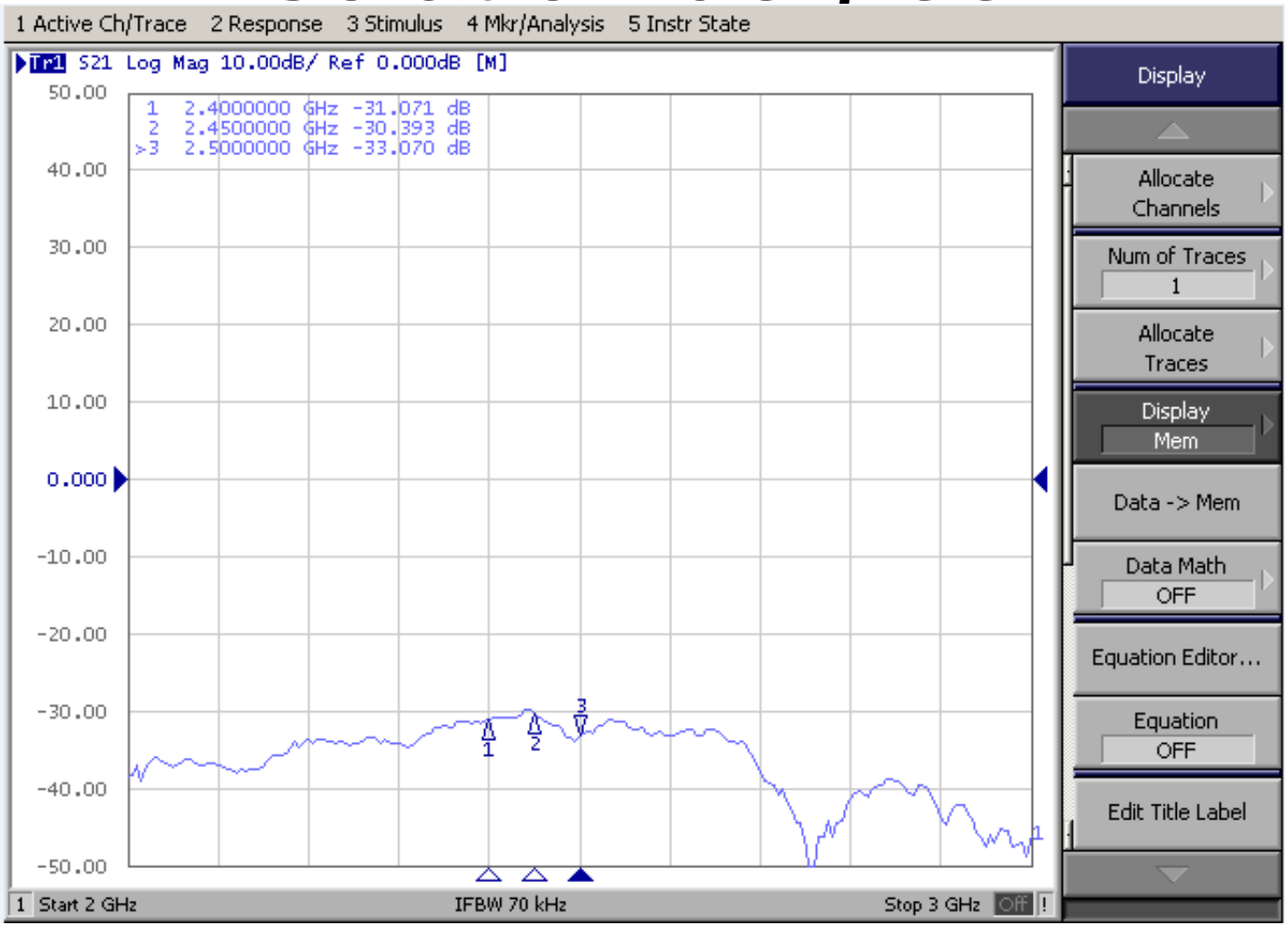

Test equipment： Agilent E5071B

# 2.4G-1 Smith(R+jx)




Test equipment： Agilent E5071B

# Isolation degree




| frequency（MHz） | 2400 | 2450 | 2500 |
|---|---|---|---|
| Isolation degree | -31.701 | -30.393 | -33.070 |

Test equipment： Agilent E5071B

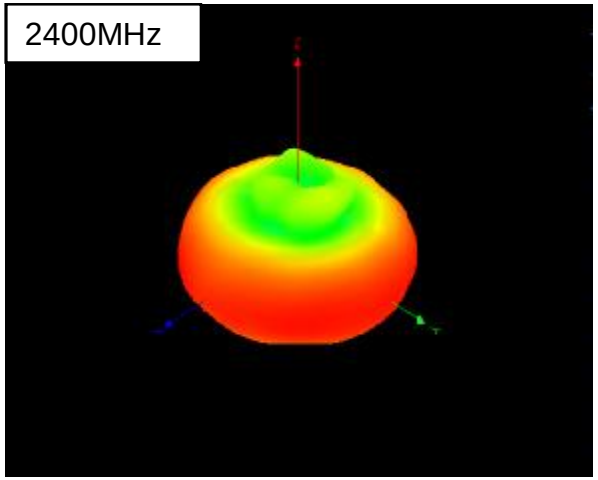
# 2.4G test data

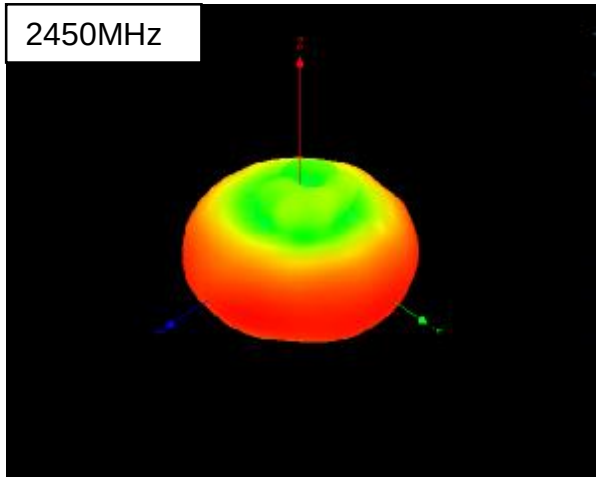
## Antenna efficiency and gain

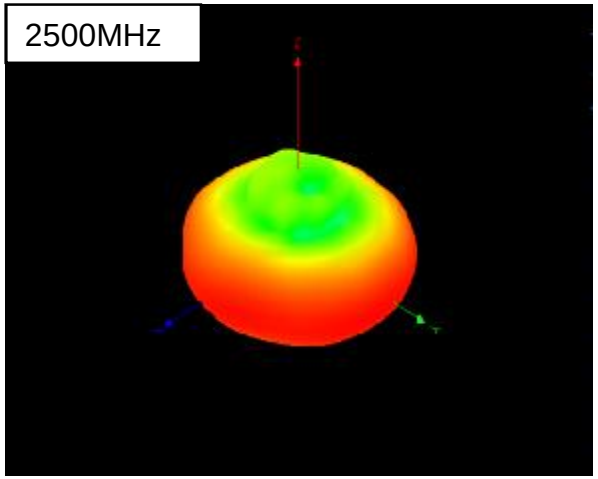
2.4G Efficiency and gain

| Frequency / MHz | Efficiency / % | Gain/ dBi |
|---|---|---|
| 2400 | 71.77 | 5.14 |
| 2410 | 73.14 | 4.94 |
| 2420 | 72.37 | 4.70 |
| 2430 | 74.23 | 4.72 |
| 2440 | 77.12 | 4.90 |
| 2450 | 74.55 | 4.89 |
| 2460 | 72.83 | 4.80 |
| 2470 | 71.77 | 5.10 |
| 2480 | 69.83 | 5.12 |
| 2490 | 70.71 | 4.99 |
| 2500 | 68.09 | 4.77 |

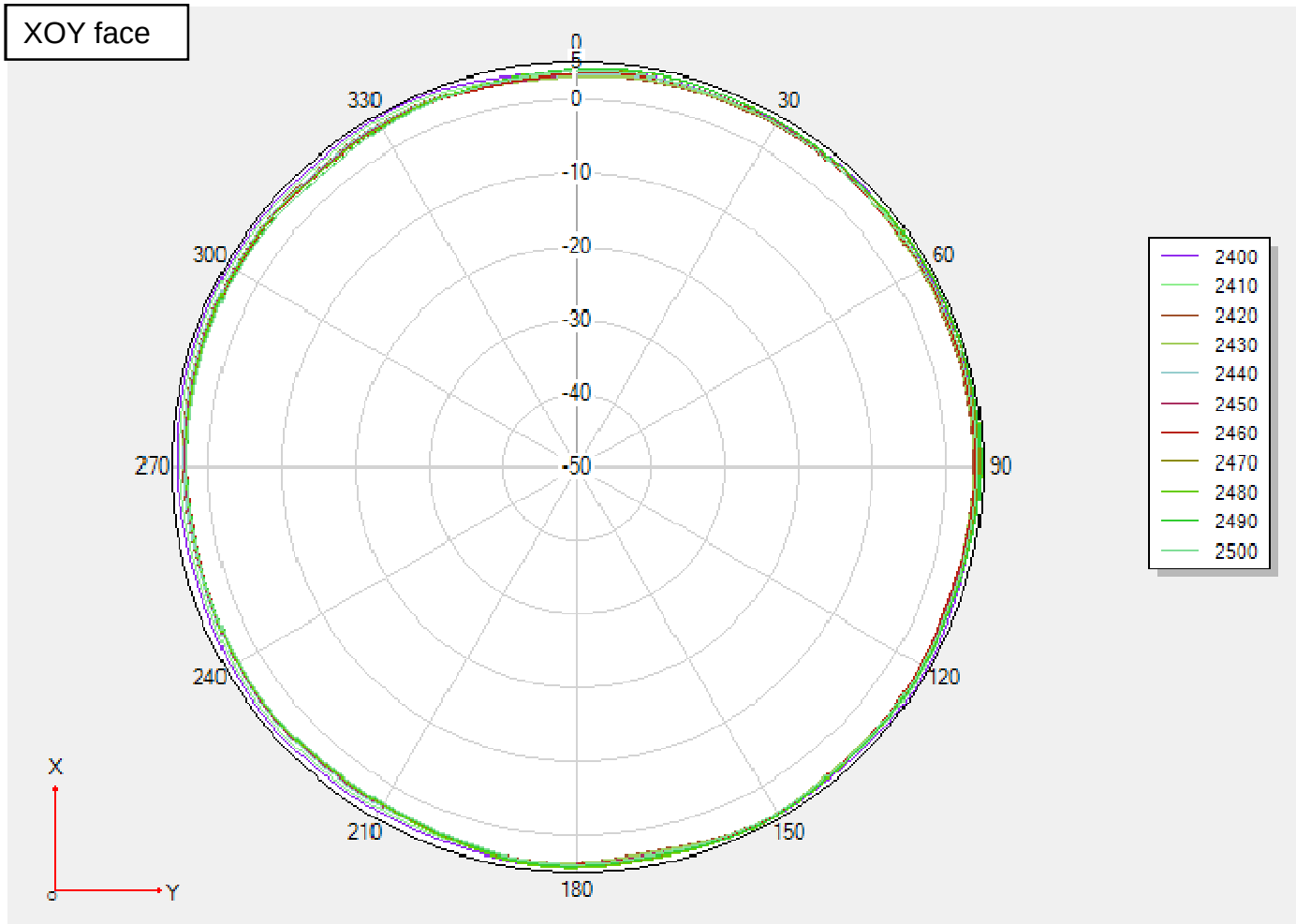
# 3D diagram



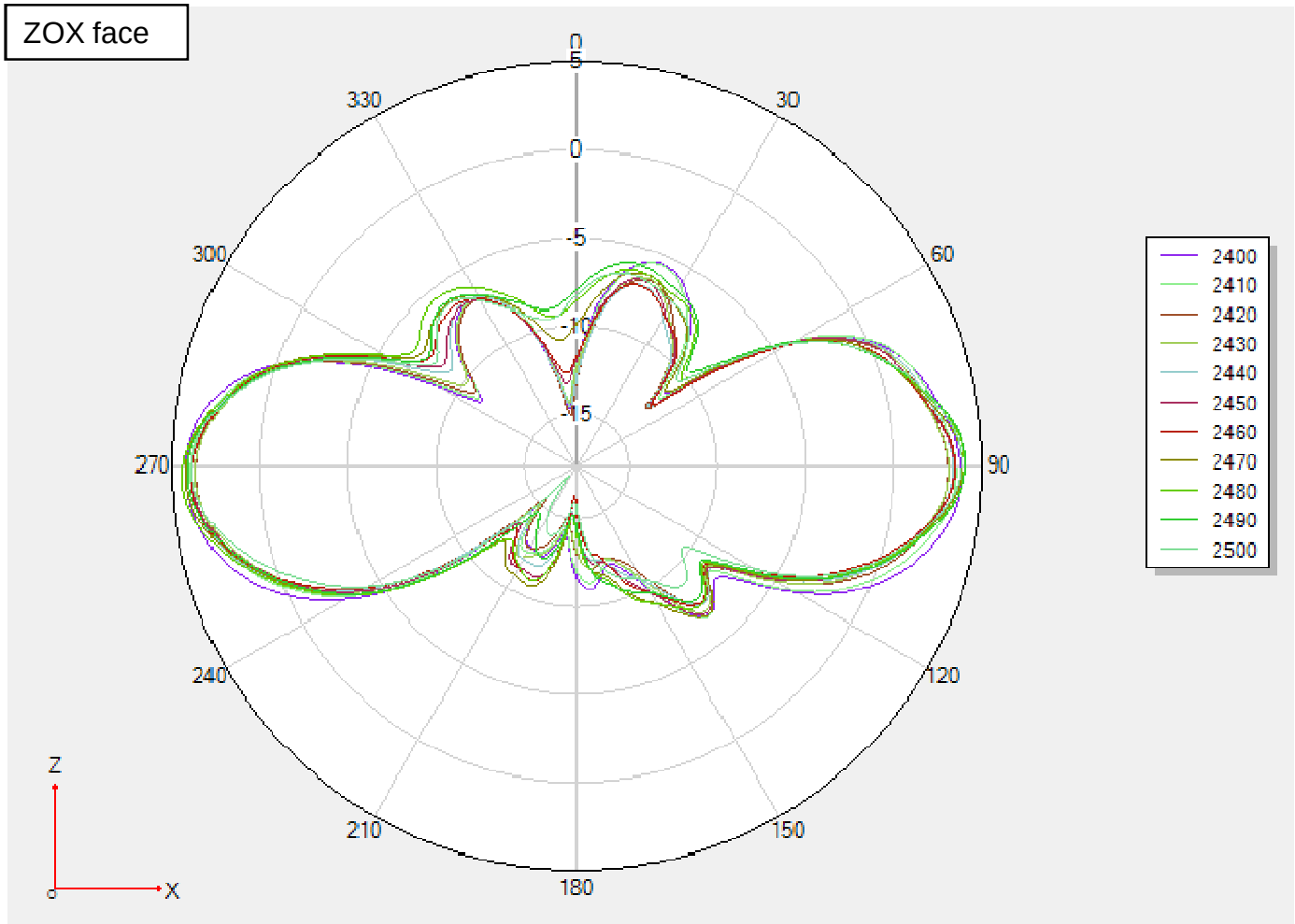



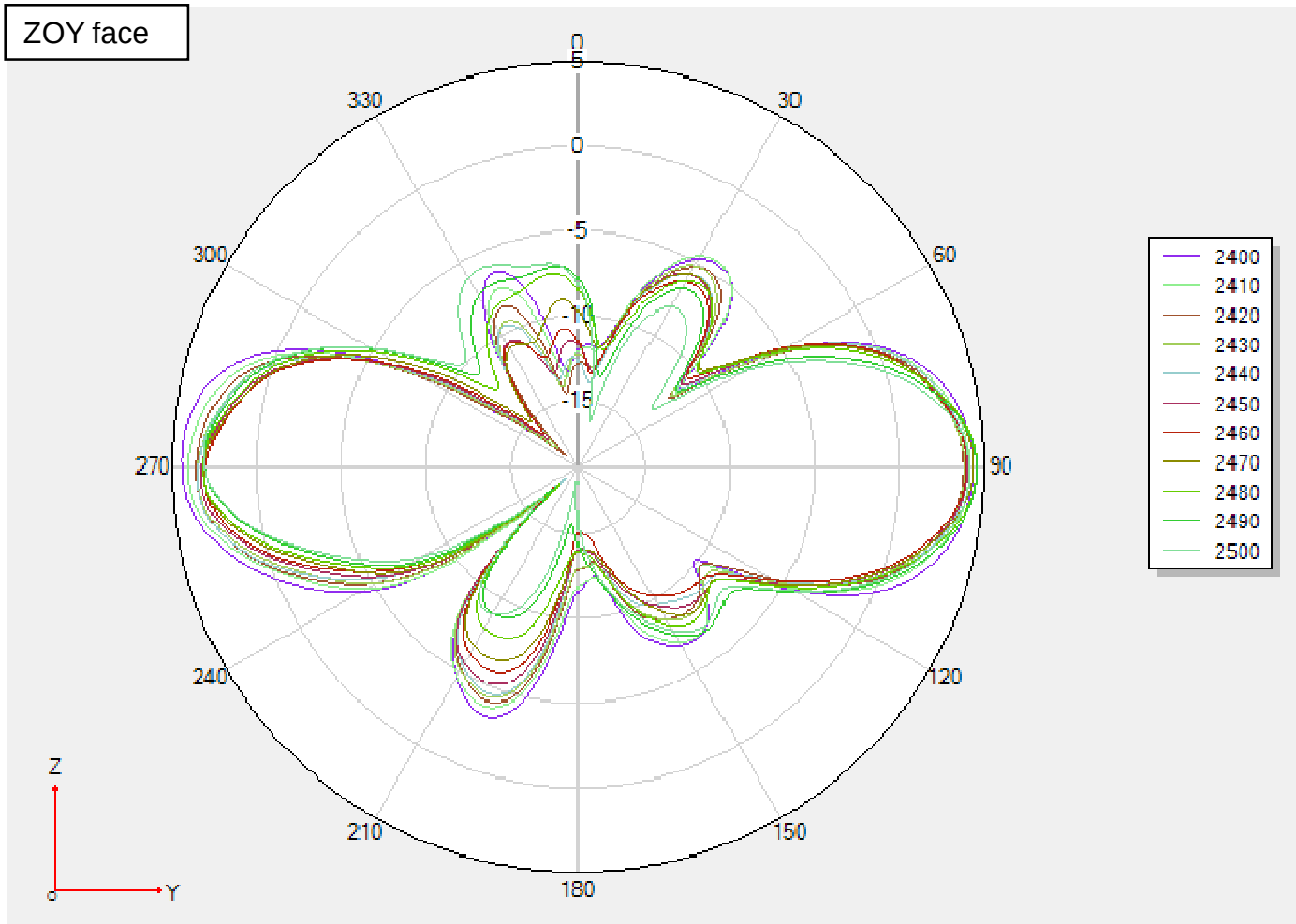
# 2D diagram


XOY face
0
5
0
-10
-20
-30
-40
-50
30
60
90
120
150
180
210
240
270
300
330
2400
2410
2420
2430
2440
2450
2460
2470
2480
2490
2500
X
Y
O

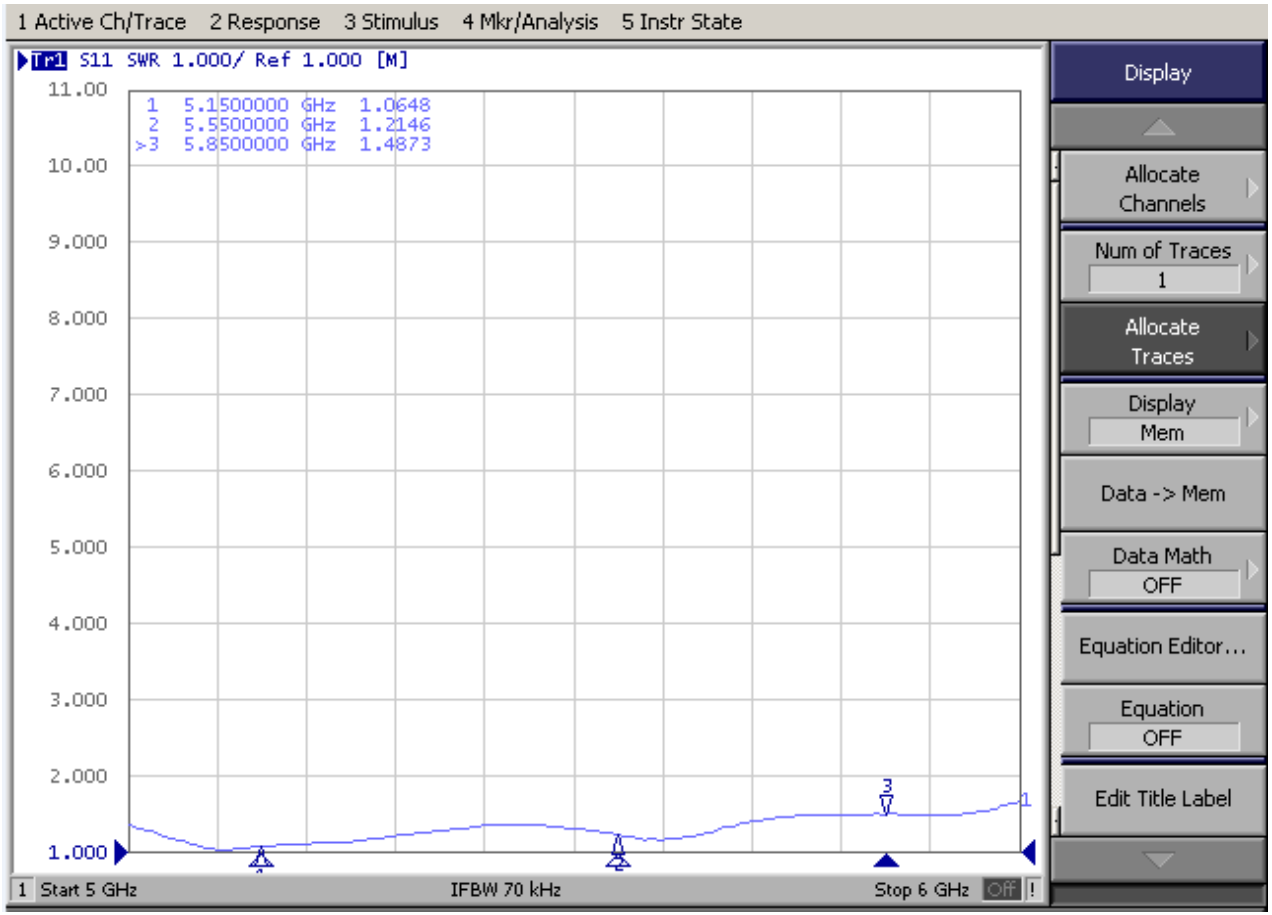
# 2D diagram


ZOX face
0
5
0
-5
-10
-15
30
60
90
120
150
180
210
240
270
300
330
2400
2410
2420
2430
2440
2450
2460
2470
2480
2490
2500
Z
X

# 2D diagram

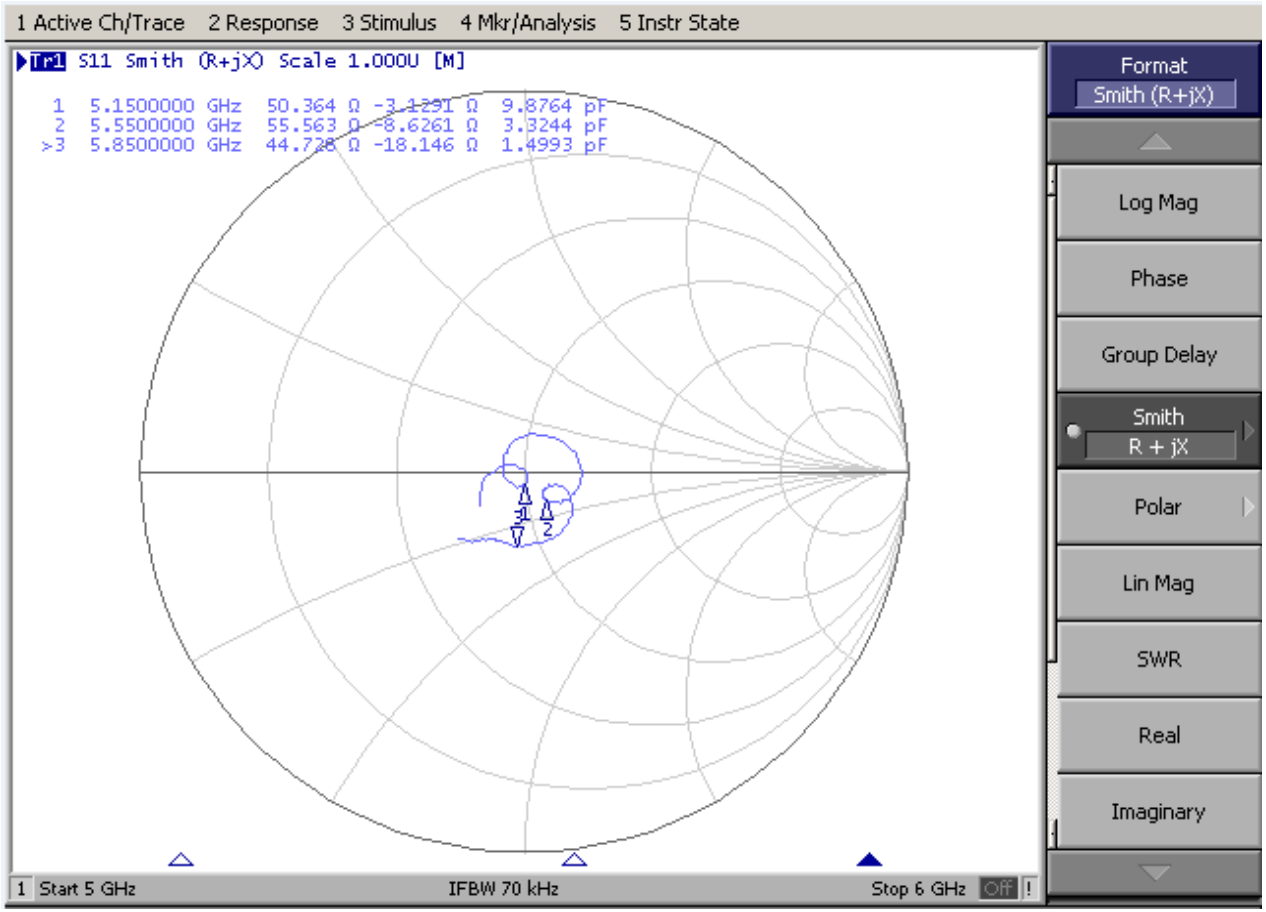

ZOY face
0
5
0
-5
-10
-15
30
60
90
120
150
180
210
240
270
300
330
2400
2410
2420
2430
2440
2450
2460
2470
2480
2490
2500
Z
Y

# 5G-0 SWR




Test equipment： Agilent E5071B

# 5G-0 Smith(R+jx)




Test equipment： Agilent E5071B

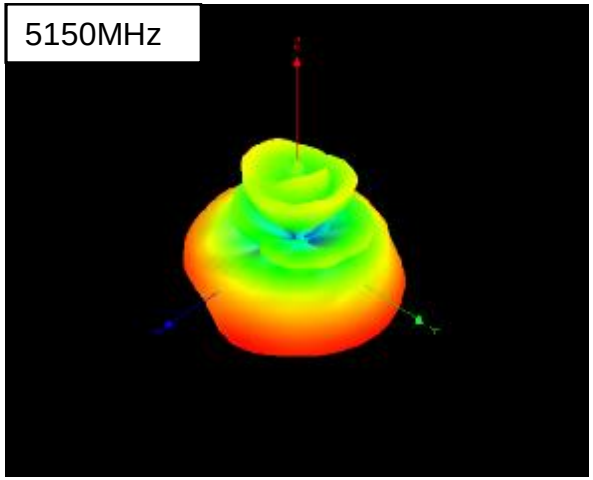
# 5G test data

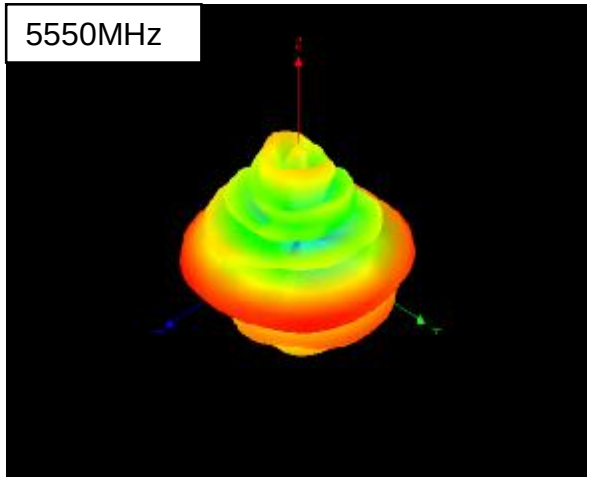
## Antenna efficiency and gain

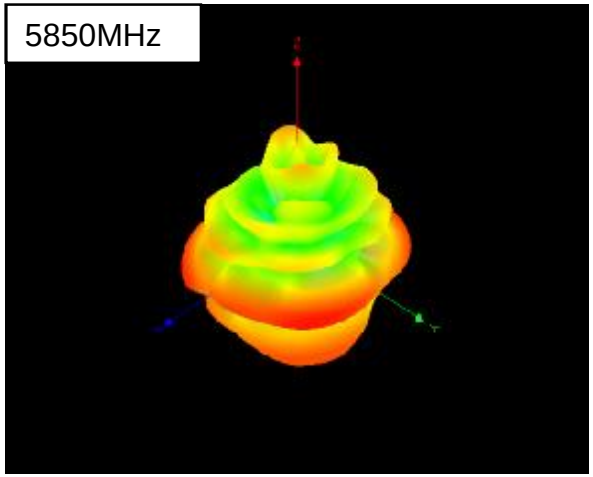
5G Efficiency and gain

| Frequency / MHz | Efficiency / % | Gain/ dBi |
|---|---|---|
| 5150 | 76.55 | 5.42 |
| 5200 | 74.37 | 5.38 |
| 5250 | 75.29 | 5.47 |
| 5300 | 74.22 | 4.93 |
| 5350 | 70.09 | 4.79 |
| 5400 | 79.61 | 4.88 |
| 5450 | 73.31 | 4.72 |
| 5500 | 72.57 | 4.89 |
| 5550 | 73.61 | 5.10 |
| 5600 | 74.37 | 5.66 |
| 5650 | 74.37 | 5.57 |
| 5700 | 69.24 | 5.12 |
| 5750 | 72.27 | 4.83 |
| 5800 | 68.39 | 4.68 |
| 5850 | 70.81 | 4.50 |

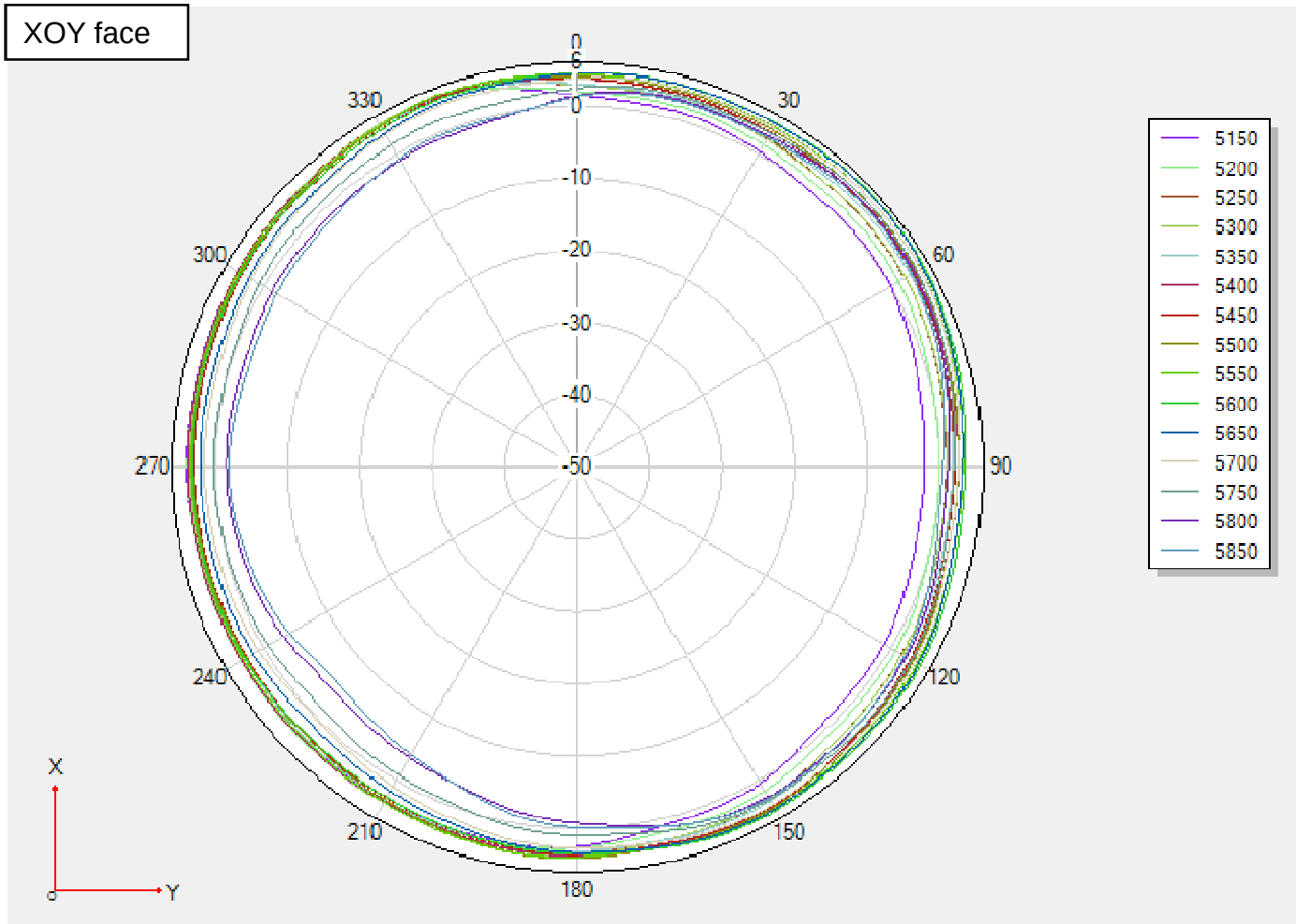
# 3D diagram



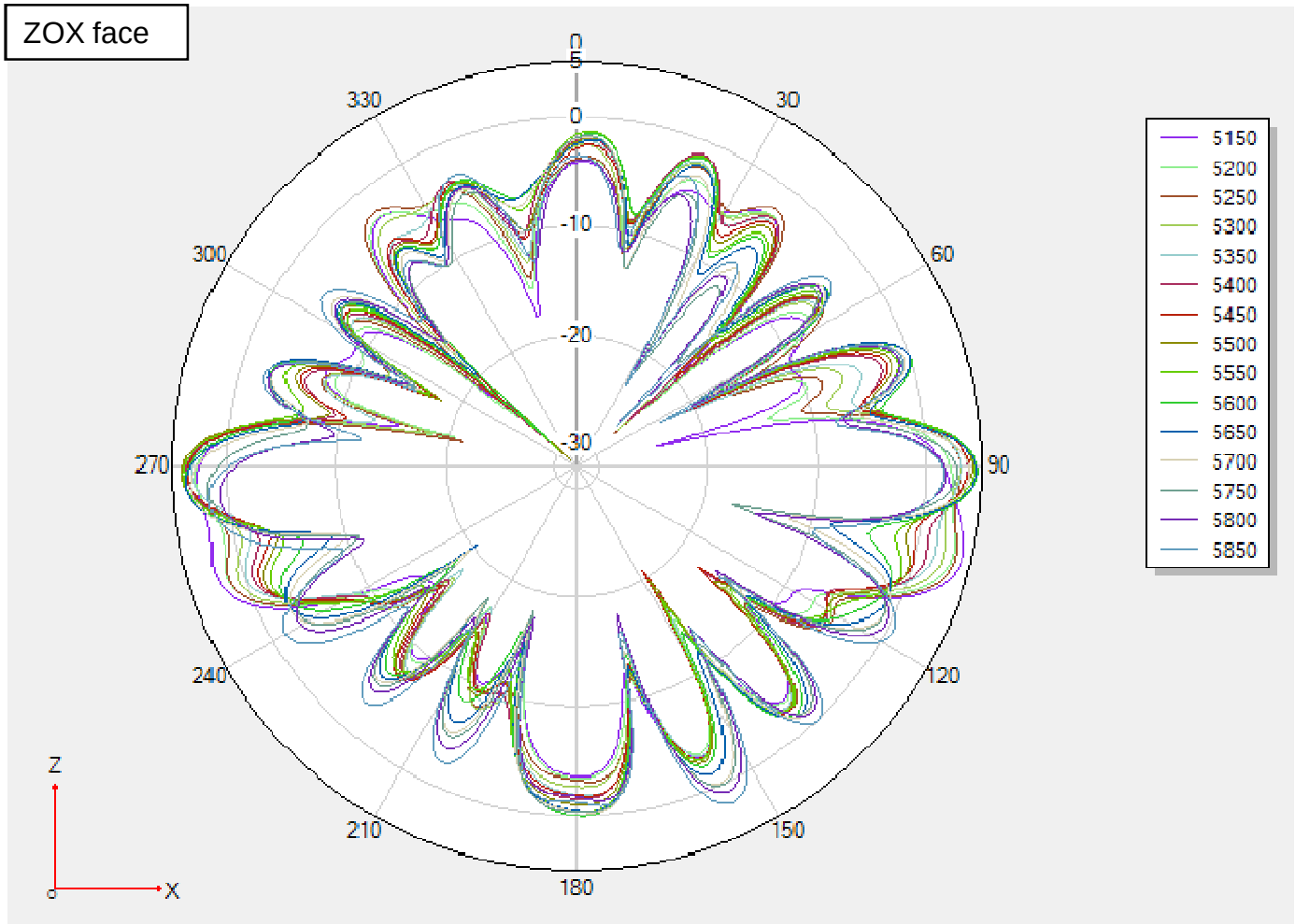



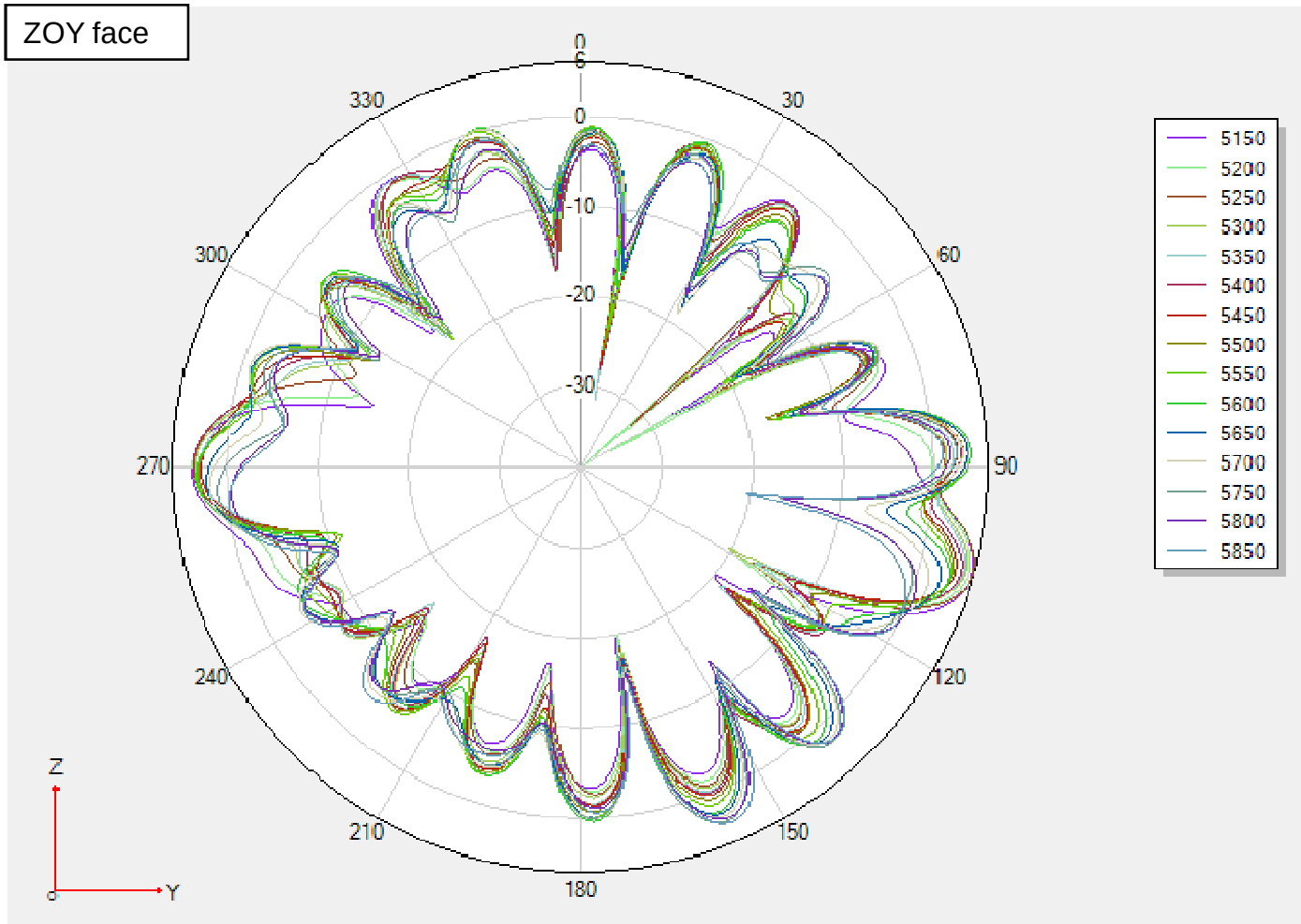
# 2D diagram


XOY face
0
30
60
90
120
150
180
210
240
270
300
330
6
0
-10
-20
-30
-40
-50
5150
5200
5250
5300
5350
5400
5450
5500
5550
5600
5650
5700
5750
5800
5850
X
Y

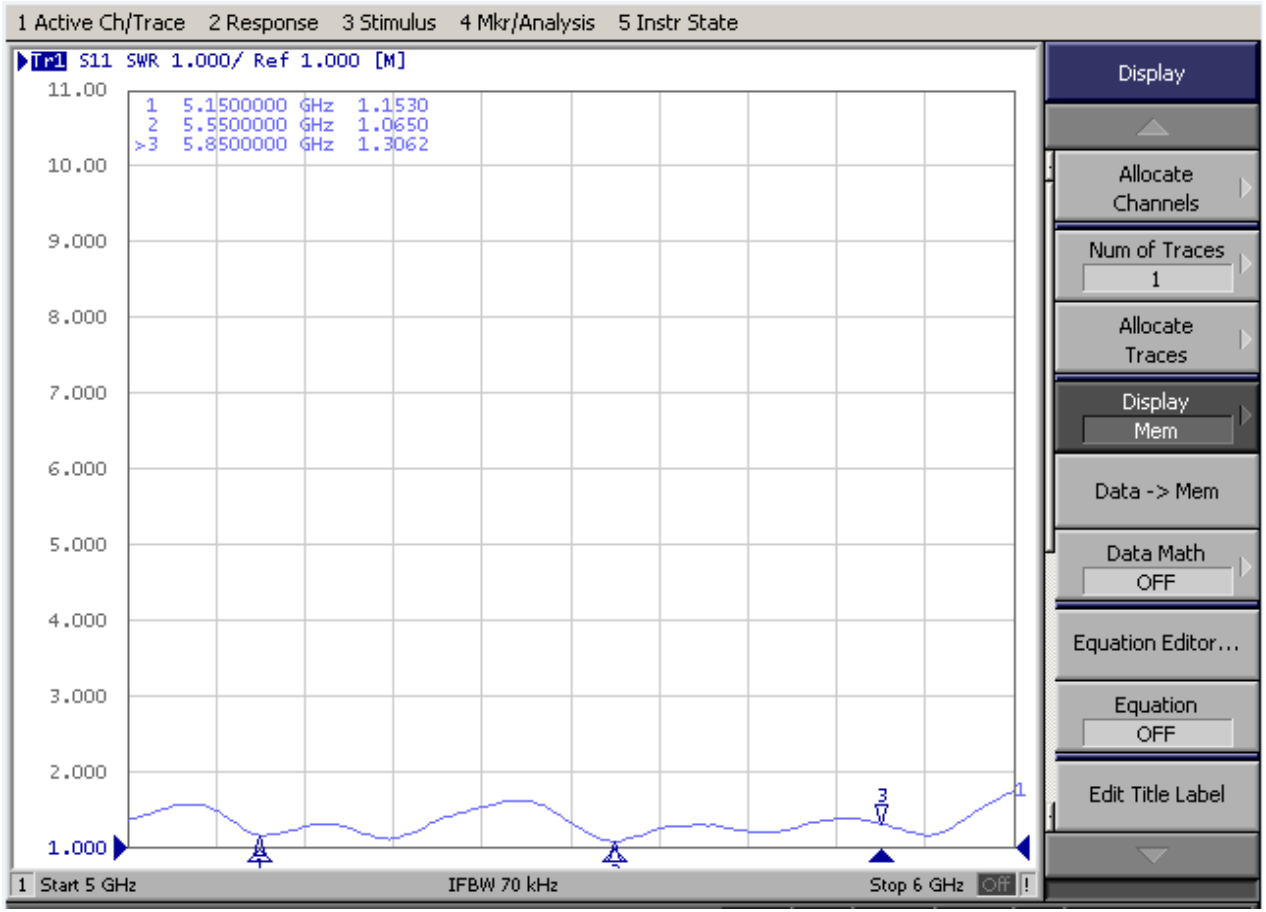
# 2D diagram


ZOX face
0
5
0
-10
-20
-30
30
60
90
120
150
180
210
240
270
300
330
5150
5200
5250
5300
5350
5400
5450
5500
5550
5600
5650
5700
5750
5800
5850
Z
X

# 2D diagram

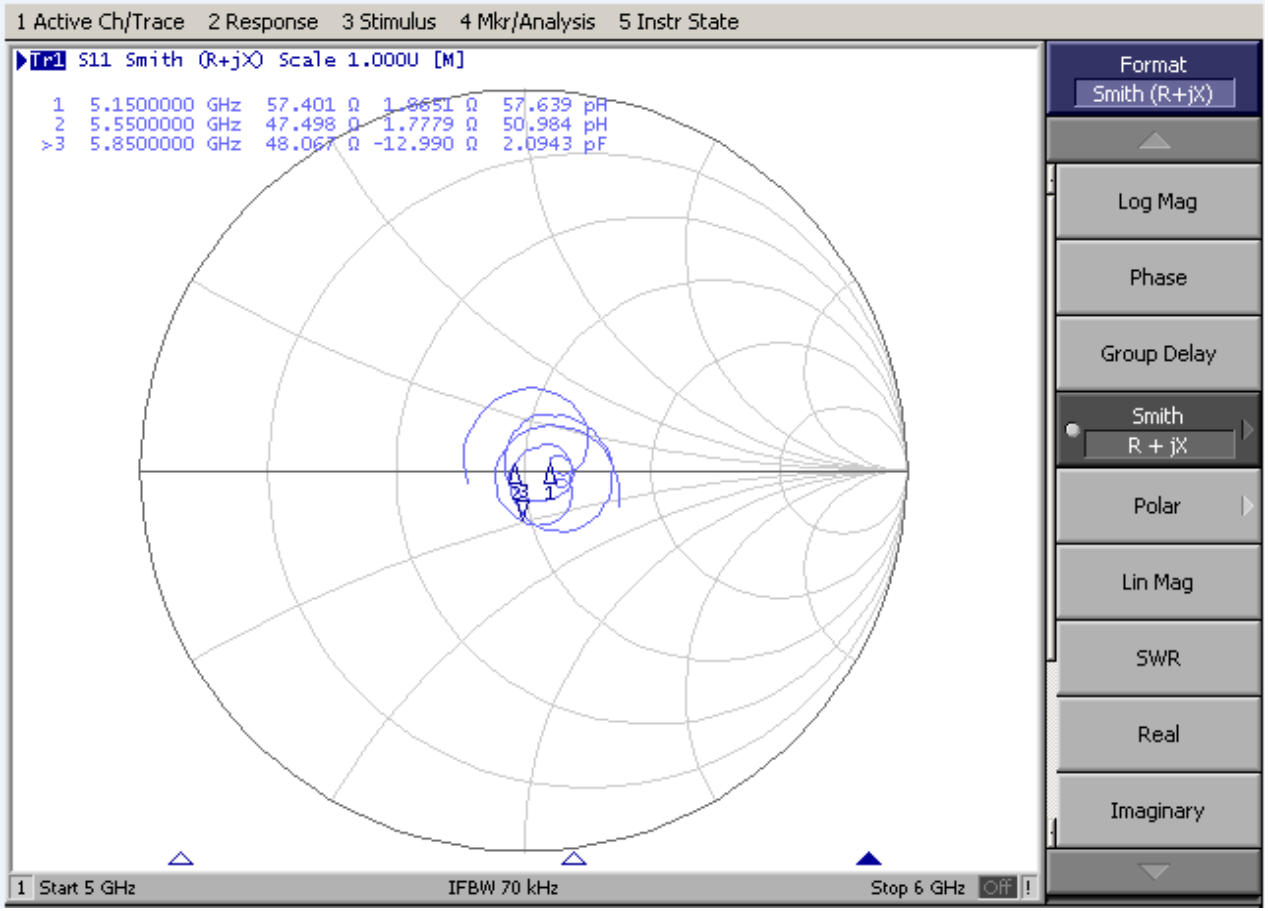

ZOY face
0
30
60
90
120
150
180
210
240
270
300
330
6
0
-10
-20
-30
5150
5200
5250
5300
5350
5400
5450
5500
5550
5600
5650
5700
5750
5800
5850
Z
Y

# 5G-1 SWR



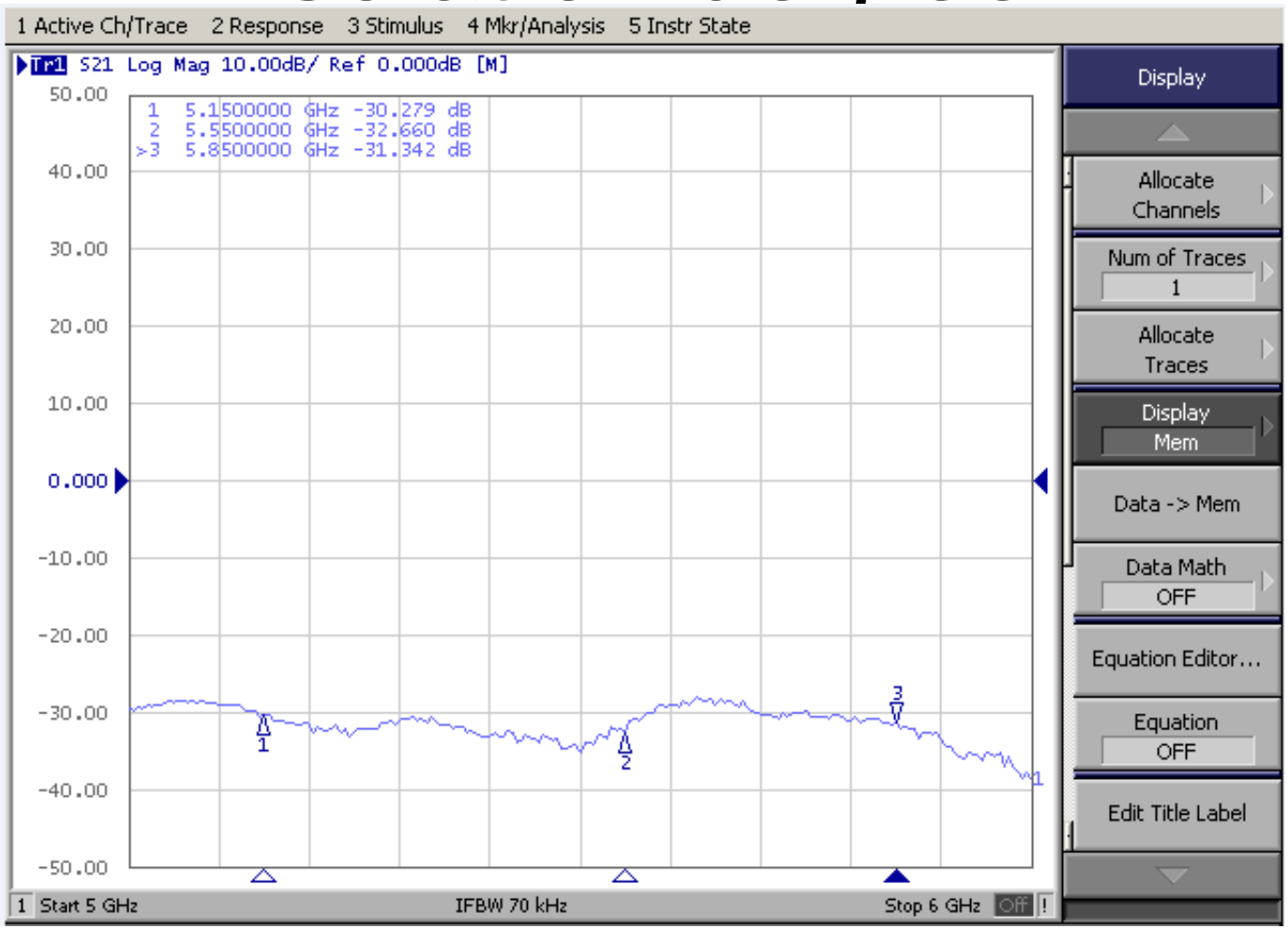

Test equipment： Agilent E5071B

# 5G-1 Smith(R+jx)




Test equipment： Agilent E5071B

# Isolation degree




| frequency（MHz） | 5150 | 5550 | 5850 |
|---|---|---|---|
| Isolation degree | -30.279 | -32.660 | -31.342 |

Test equipment： Agilent E5071B

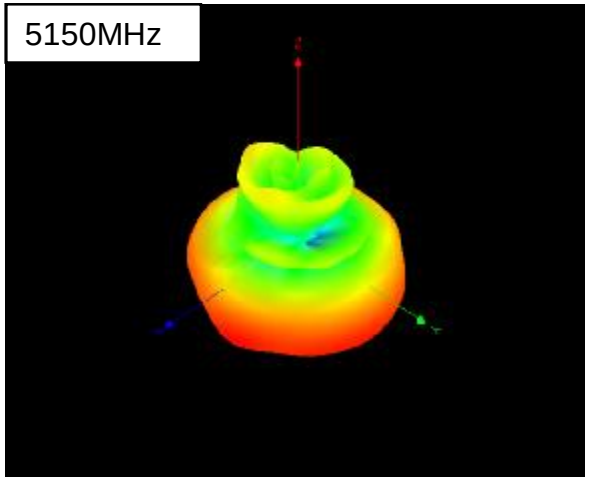
# 5G test data

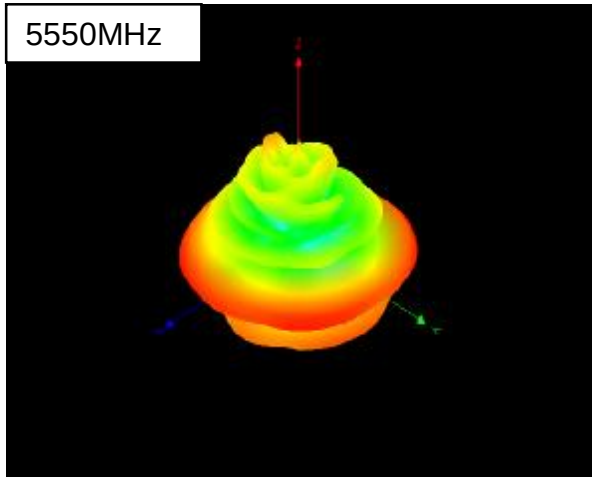
## Antenna efficiency and gain

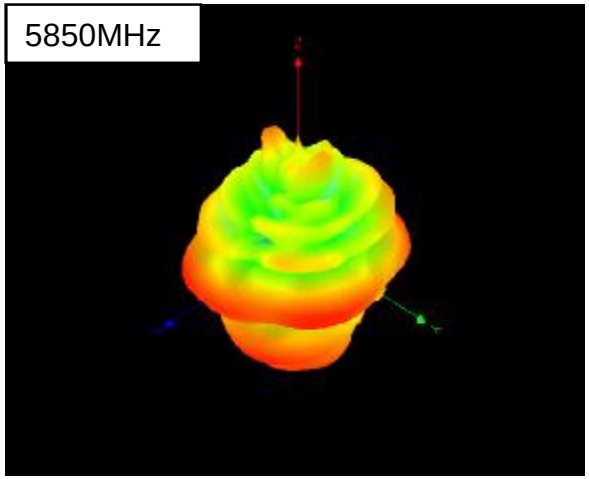
5G Efficiency and gain

| Frequency / MHz | Efficiency / % | Gain/ dBi |
|---|---|---|
| 5150 | 74.39 | 5.48 |
| 5200 | 72.37 | 5.37 |
| 5250 | 75.98 | 5.55 |
| 5300 | 72.99 | 4.79 |
| 5350 | 68.37 | 4.51 |
| 5400 | 76.63 | 4.96 |
| 5450 | 70.71 | 4.79 |
| 5500 | 70.57 | 5.02 |
| 5550 | 71.46 | 5.17 |
| 5600 | 71.46 | 5.29 |
| 5650 | 71.16 | 5.14 |
| 5700 | 68.52 | 4.82 |
| 5750 | 69.68 | 4.77 |
| 5800 | 67.43 | 4.45 |
| 5850 | 68.52 | 4.77 |

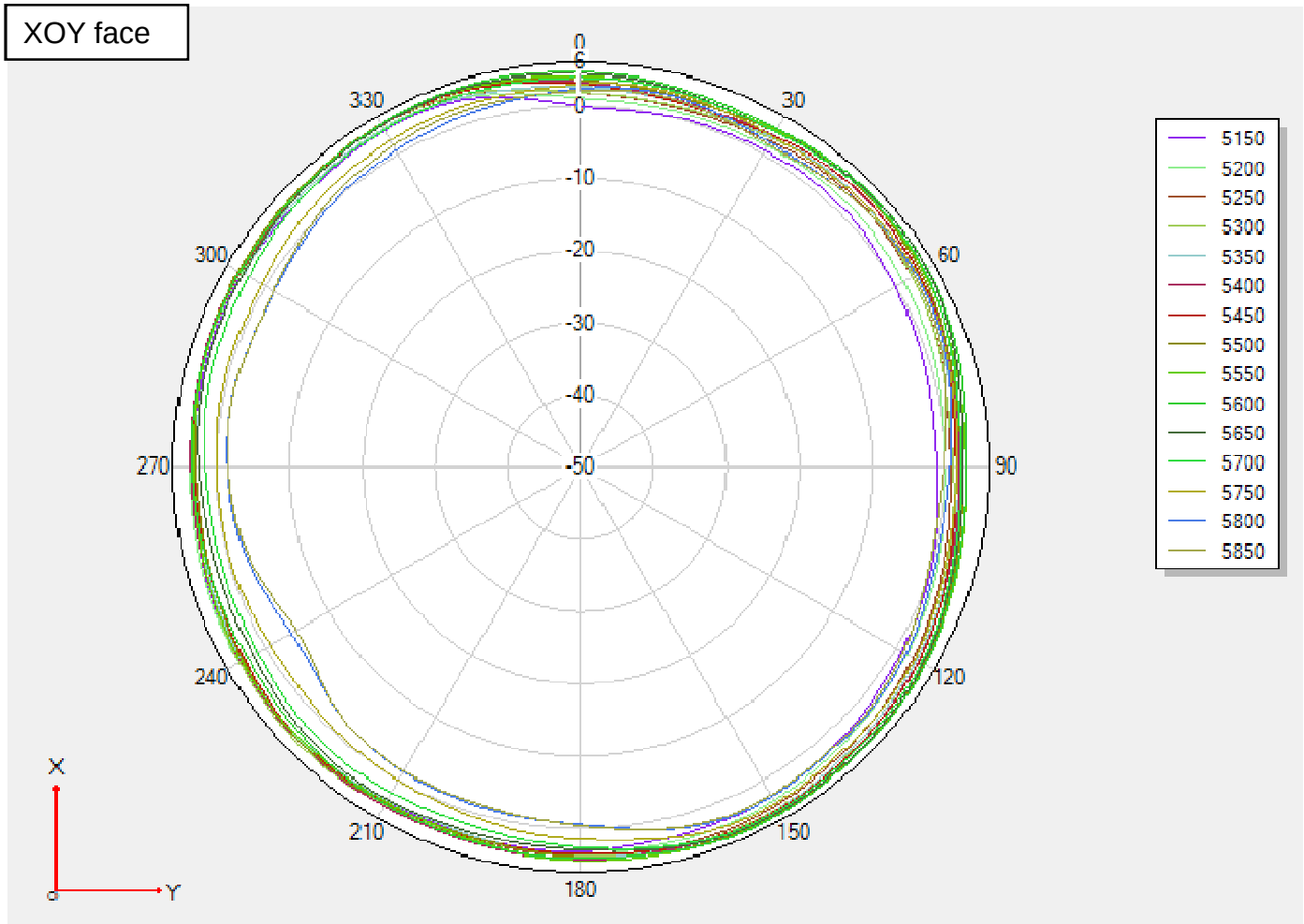
# 3D diagram



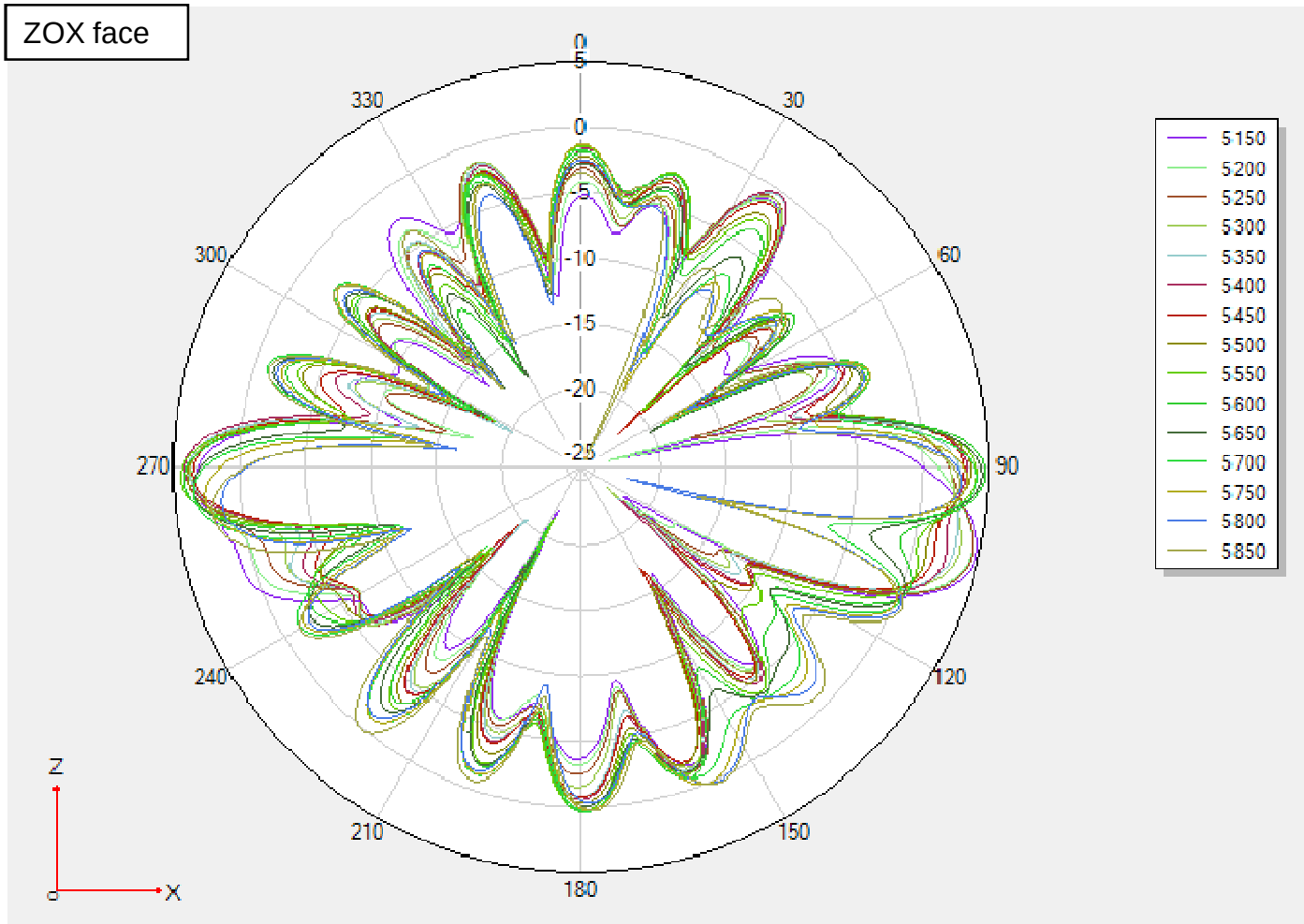



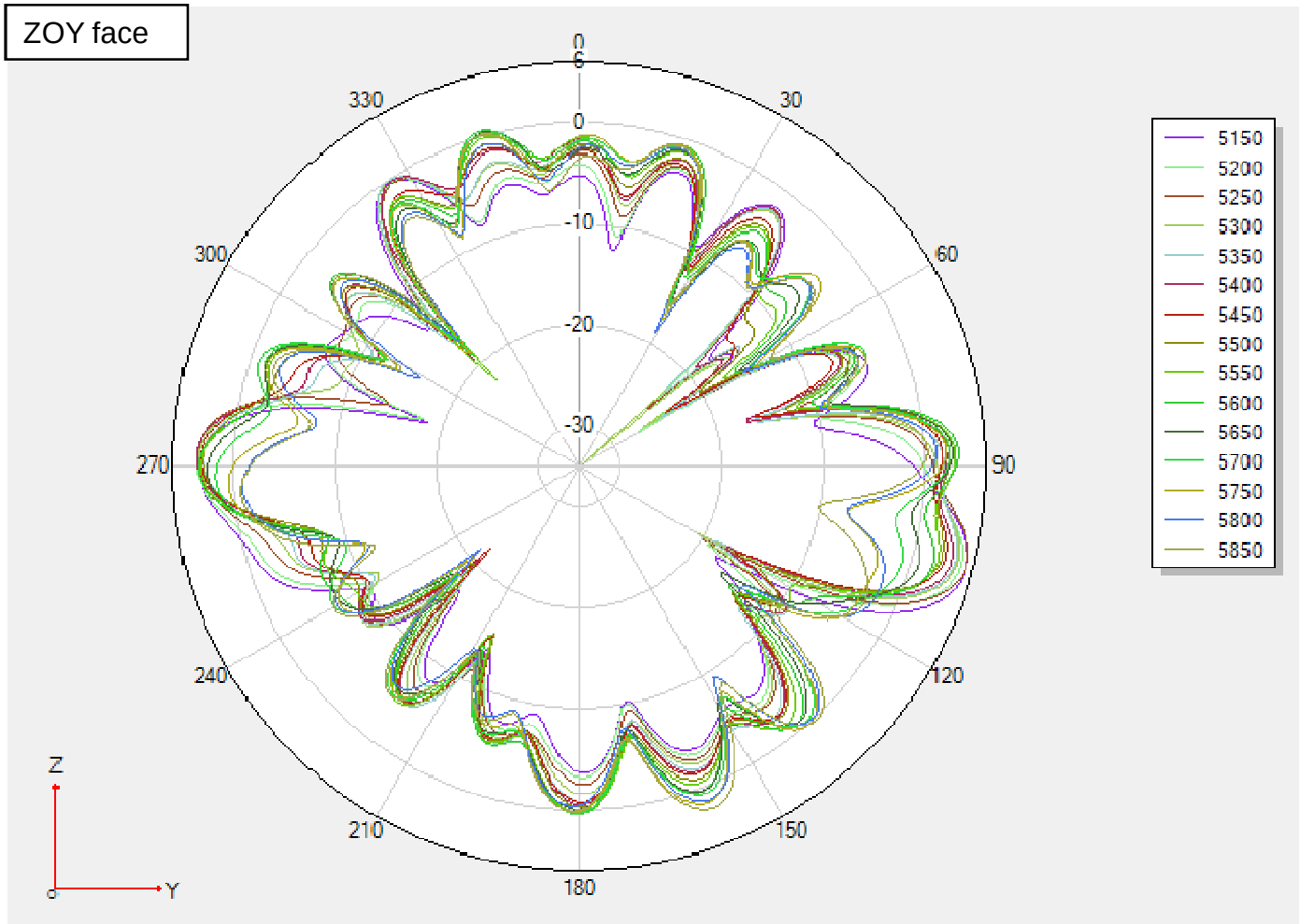
# 2D diagram


XOY face
0
30
60
90
120
150
180
210
240
270
300
330
0
-10
-20
-30
-40
-50
5150
5200
5250
5300
5350
5400
5450
5500
5550
5600
5650
5700
5750
5800
5850
X
Y

# 2D diagram


ZOX face
0
30
60
90
120
150
180
210
240
270
300
330
5
0
-5
-10
-15
-20
-25
5150
5200
5250
5300
5350
5400
5450
5500
5550
5600
5650
5700
5750
5800
5850
Z
X

# 2D diagram


ZOY face
0
30
60
90
120
150
180
210
240
270
300
330
0
-10
-20
-30
5150
5200
5250
5300
5350
5400
5450
5500
5550
5600
5650
5700
5750
5800
5850
Z
Y

# 2.4GHz TRP TIS test data

Paste copper foil on the back of the main board

Test mode： 802.11b 11MBps

| Test | Wifi 2G TRP | | |
|---|---|---|---|
| Result | 1 | 6 | 11 |
| Frequency (MHz) | 2412 | 2437 | 2462 |
| TRP(dBm) | 19.3 | 20.01 | 19.96 |

| Test | Wifi 2G TIS | | |
|---|---|---|---|
| Result | 1 | 6 | 11 |
| Frequency (MHz) | 2412 | 2437 | 2462 |
| TIS(dBm) | -84.14 | -85.17 | -85.98 |

Test mode： 802.11g 54MBps

| Test | Wifi 2G TRP | | |
|---|---|---|---|
| Result | 1 | 6 | 11 |
| Frequency (MHz) | 2412 | 2437 | 2462 |
| TRP(dBm) | 20.47 | 19.96 | 20.22 |

| Test | Wifi 2G TIS | | |
|---|---|---|---|
| Result | 1 | 6 | 11 |
| Frequency (MHz) | 2412 | 2437 | 2462 |
| TIS(dBm) | -76.48 | -75.09 | -75.72 |

Test mode： 802.11n MCS7 20M

| Test | Wifi 2G TRP | | |
|---|---|---|---|
| Result | 1 | 6 | 11 |
| Frequency (MHz) | 2412 | 2437 | 2462 |
| TRP(dBm) | 19.75 | 19.59 | 20.29 |

| Test | Wifi 2G TIS | | |
|---|---|---|---|
| Result | 1 | 6 | 11 |
| Frequency (MHz) | 2412 | 2437 | 2462 |
| TIS(dBm) | -70.25 | -70.99 | -71.21 |

# 5GHz TRP TIS test data

Paste copper foil on the back of the main board

Test mode： 802.11A 54M

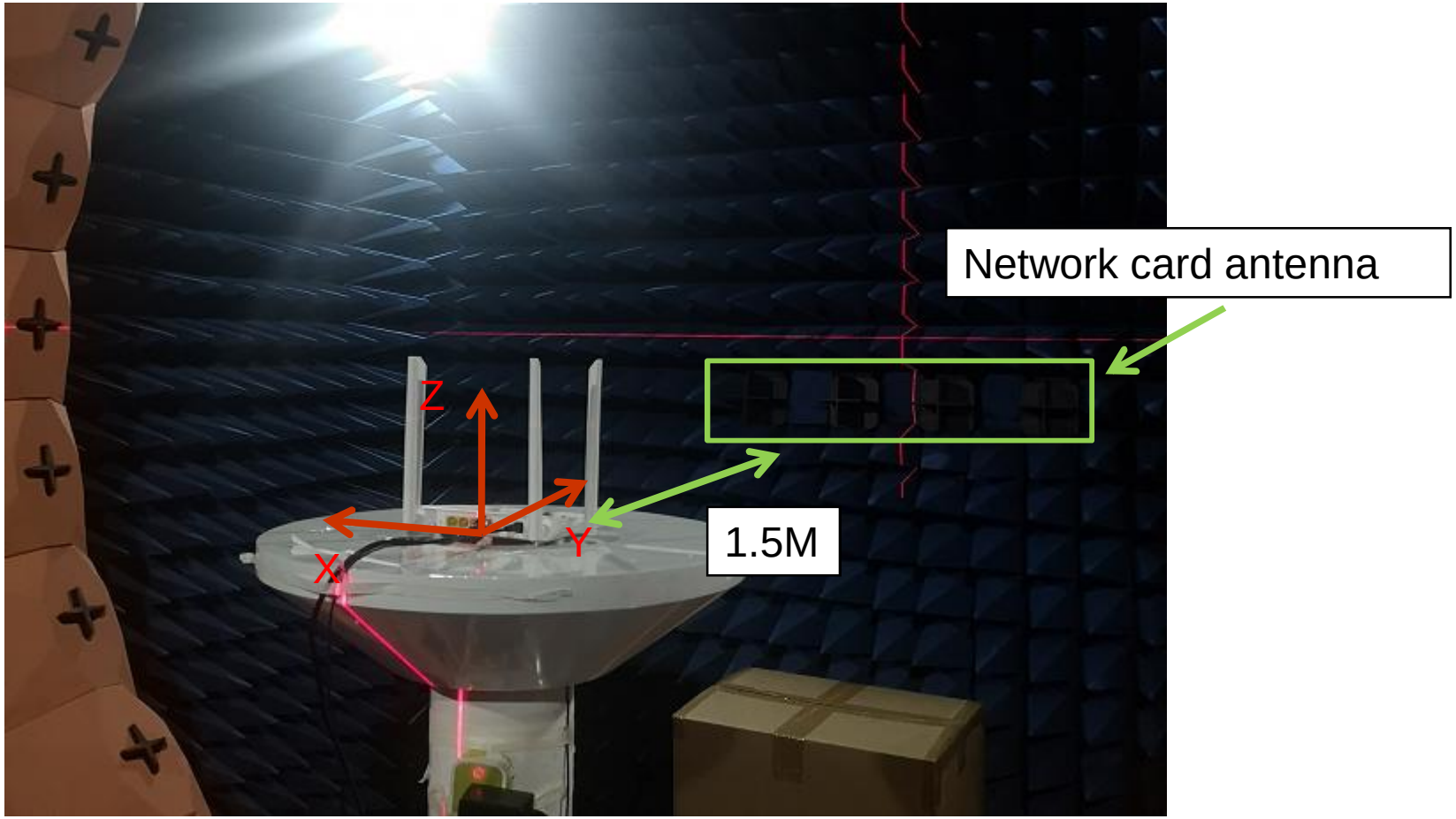
| Test | Wifi 5G TRP | | | |
|---|---|---|---|---|
| Result | 36 | 48 | 149 | 161 |
| Frequency (MHz) | 5180 | 5240 | 5745 | 5805 |
| TRP(dBm) | 21.07 | 20.9 | 23.15 | 23.39 |

| Test | Wifi 5G TIS | | | |
|---|---|---|---|---|
| Result | 36 | 48 | 149 | 161 |
| Frequency (MHz) | 5180 | 5240 | 5745 | 5805 |
| TIS(dBm) | -76.92 | -75.57 | -75.48 | -75.81 |

# Throughput test environment

Test equipment：
Lenovo computer win10 system （ Gigabit wired network card ）
HP computer win10 system （ ASUS wireless network card （ model： PCE-AX58BT）
testing software：
IxChariot（ edition 670）
testing environment：
ETS 3D darkroom (4 * 4 * 3): the distance between the machine and the network card antenna is 1.5 meters
Throughput test settings:Router mode: 2.4G (Mixed 11b/g/n) 5G (Mixed 11ac/n/a/AX)
Router bandwidth: 2.4G (HT20/HT40) 5G (HT40/HT80)
Test code stream: 10
Test angle: rotate once every 90 degrees
Test attenuation: 0~90 (once every 5dB)
Test time: 1 minute for each point
PC1 IPAddr: 192.168.1.2
PC2 IPAddr: 192.168.1.3
Test time: October 11, 2021

# Test placement



# throughput(2.4G HT20 CH6 )

| Tx(Mbps)-CH6 | | | | | |
|---|---|---|---|---|---|
| Atten(dB) | 0° | 90° | 180° | 270° | Aver |
| 0 | 108.5 | 107.5 | 108.2 | 109.4 | 108.4 |
| 5 | 108.4 | 109.2 | 109.9 | 108.7 | 109.1 |
| 10 | 108.2 | 108.2 | 108.3 | 109.8 | 108.6 |
| 15 | 108.9 | 107.2 | 109.0 | 110.8 | 109.0 |
| 20 | 108.4 | 109.0 | 110.8 | 109.0 | 109.3 |
| 25 | 109.0 | 110.3 | 110.9 | 111.1 | 110.4 |
| 30 | 110.9 | 104.8 | 112.4 | 111.4 | 109.9 |
| 35 | 111.2 | 109.9 | 112.7 | 112.4 | 111.6 |
| 40 | 111.6 | 109.6 | 111.7 | 111.7 | 111.2 |
| 45 | 111.0 | 112.7 | 111.6 | 110.9 | 111.5 |
| 50 | 111.0 | 111.1 | 111.1 | 111.6 | 111.2 |
| 55 | 110.9 | 102.3 | 111.8 | 111.8 | 109.2 |
| 60 | 89.5 | 72.3 | 88.6 | 81.0 | 82.8 |
| 65 | 60.9 | 55.1 | 61.9 | 62.0 | 60.0 |
| 70 | 49.8 | 40.4 | 59.5 | 40.2 | 47.5 |
| 75 | 29.3 | 27.7 | 29.1 | 29.3 | 28.8 |
| 80 | 8.8 | 9.9 | 9.3 | 10.0 | 9.5 |

| Rx(Mbps)-CH6 | | | | | |
|---|---|---|---|---|---|
| Atten(dB) | 0° | 90° | 180° | 270° | Aver |
| 0 | 116.6 | 112.7 | 116.2 | 115.7 | 115.3 |
| 5 | 116.5 | 112.4 | 116.8 | 114.2 | 115.0 |
| 10 | 116.8 | 113.6 | 116.2 | 114.8 | 115.4 |
| 15 | 115.4 | 115.7 | 116.2 | 114.1 | 115.4 |
| 20 | 115.9 | 115.7 | 116.3 | 116.0 | 116.0 |
| 25 | 116.1 | 114.0 | 115.5 | 115.9 | 115.4 |
| 30 | 116.7 | 112.0 | 116.3 | 114.2 | 114.8 |
| 35 | 115.8 | 110.5 | 116.4 | 114.1 | 114.2 |
| 40 | 116.8 | 113.4 | 115.6 | 113.9 | 114.9 |
| 45 | 115.5 | 114.9 | 116.3 | 110.3 | 114.3 |
| 50 | 116.1 | 100.8 | 114.6 | 100.9 | 108.1 |
| 55 | 106.8 | 89.2 | 94.4 | 86.6 | 94.2 |
| 60 | 70.6 | 68.7 | 70.3 | 70.3 | 70.0 |
| 65 | 46.4 | 35.4 | 48.5 | 35.8 | 41.5 |
| 70 | 24.2 | 25.4 | 22.0 | 26.1 | 24.4 |
| 75 | 11.6 | 16.1 | 11.6 | 17.0 | 14.1 |
| 80 | 5.6 | 9.9 | 5.0 | 5.7 | 6.5 |

# throughput(2.4G HT40 CH6 )

| Tx(Mbps)-CH6 | | | | | |
|---|---|---|---|---|---|
| Atten(dB) | 0° | 90° | 180° | 270° | Aver |
| 0 | 205.2 | 202.2 | 204.2 | 206.5 | 204.5 |
| 5 | 208.0 | 207.3 | 205.8 | 207.5 | 207.2 |
| 10 | 204.6 | 205.0 | 207.9 | 206.1 | 205.9 |
| 15 | 202.8 | 204.4 | 204.9 | 204.1 | 204.0 |
| 20 | 204.4 | 207.5 | 208.7 | 205.1 | 206.4 |
| 25 | 207.3 | 205.1 | 206.9 | 205.6 | 206.2 |
| 30 | 208.9 | 207.1 | 204.5 | 204.7 | 206.3 |
| 35 | 207.7 | 207.0 | 211.0 | 209.9 | 208.9 |
| 40 | 207.3 | 207.8 | 208.5 | 206.8 | 207.6 |
| 45 | 209.9 | 211.2 | 210.5 | 210.0 | 210.4 |
| 50 | 205.5 | 202.0 | 211.7 | 208.8 | 207.0 |
| 55 | 206.2 | 182.8 | 209.1 | 172.8 | 192.7 |
| 60 | 152.5 | 146.0 | 157.2 | 141.7 | 149.3 |
| 65 | 123.6 | 107.6 | 118.9 | 102.6 | 113.2 |
| 70 | 78.0 | 55.8 | 55.4 | 56.6 | 61.4 |
| 75 | 38.4 | 36.8 | 38.0 | 37.7 | 37.7 |
| 80 | 15.2 | 16.0 | 12.3 | 14.6 | 14.5 |

| Rx(Mbps)-CH6 | | | | | |
|---|---|---|---|---|---|
| Atten(dB) | 0° | 90° | 180° | 270° | Aver |
| 0 | 218.7 | 211.5 | 219.1 | 219.0 | 217.1 |
| 5 | 221.0 | 214.8 | 221.0 | 219.7 | 219.1 |
| 10 | 219.4 | 213.2 | 218.8 | 218.8 | 217.6 |
| 15 | 220.7 | 214.8 | 219.9 | 219.2 | 218.6 |
| 20 | 218.8 | 213.2 | 221.0 | 220.6 | 218.4 |
| 25 | 218.1 | 215.3 | 219.6 | 220.7 | 218.4 |
| 30 | 220.3 | 217.5 | 215.3 | 215.4 | 217.1 |
| 35 | 219.3 | 210.2 | 221.6 | 220.5 | 217.9 |
| 40 | 219.3 | 214.6 | 221.1 | 217.8 | 218.2 |
| 45 | 219.7 | 214.6 | 221.7 | 217.9 | 218.5 |
| 50 | 189.7 | 169.0 | 182.8 | 160.4 | 175.5 |
| 55 | 139.8 | 119.4 | 139.3 | 114.1 | 128.2 |
| 60 | 73.7 | 89.0 | 72.9 | 90.6 | 81.6 |
| 65 | 46.2 | 61.1 | 39.4 | 61.5 | 52.0 |
| 70 | 23.9 | 29.1 | 24.4 | 25.3 | 25.7 |
| 75 | 11.1 | 20.5 | 11.6 | 13.2 | 14.1 |

# throughput(5G HT40 CH44)

| Tx(Mbps)-CH44 | | | | | |
|---|---|---|---|---|---|
| Atten(dB) | 0° | 90° | 180° | 270° | Aver |
| 0 | 479.0 | 478.0 | 482.2 | 482.5 | 480.4 |
| 5 | 481.9 | 482.1 | 479.2 | 478.6 | 480.5 |
| 10 | 482.9 | 483.2 | 470.9 | 495.9 | 483.2 |
| 15 | 482.6 | 483.4 | 471.3 | 482.3 | 479.9 |
| 20 | 479.6 | 483.1 | 483.2 | 482.9 | 482.2 |
| 25 | 479.4 | 478.5 | 482.7 | 482.4 | 480.7 |
| 30 | 471.5 | 476.1 | 485.4 | 482.1 | 478.8 |
| 35 | 483.0 | 455.1 | 480.1 | 458.6 | 469.2 |
| 40 | 402.8 | 387.9 | 422.5 | 394.4 | 401.9 |
| 45 | 371.9 | 352.1 | 375.9 | 351.8 | 362.9 |
| 50 | 253.0 | 241.3 | 282.9 | 252.5 | 257.4 |
| 55 | 210.9 | 198.0 | 218.9 | 191.4 | 204.8 |
| 60 | 165.2 | 148.6 | 163.0 | 143.3 | 155.0 |
| 65 | 88.2 | 76.0 | 81.2 | 82.7 | 82.0 |
| 70 | 23.9 | 19.2 | 32.7 | 28.3 | 26.0 |

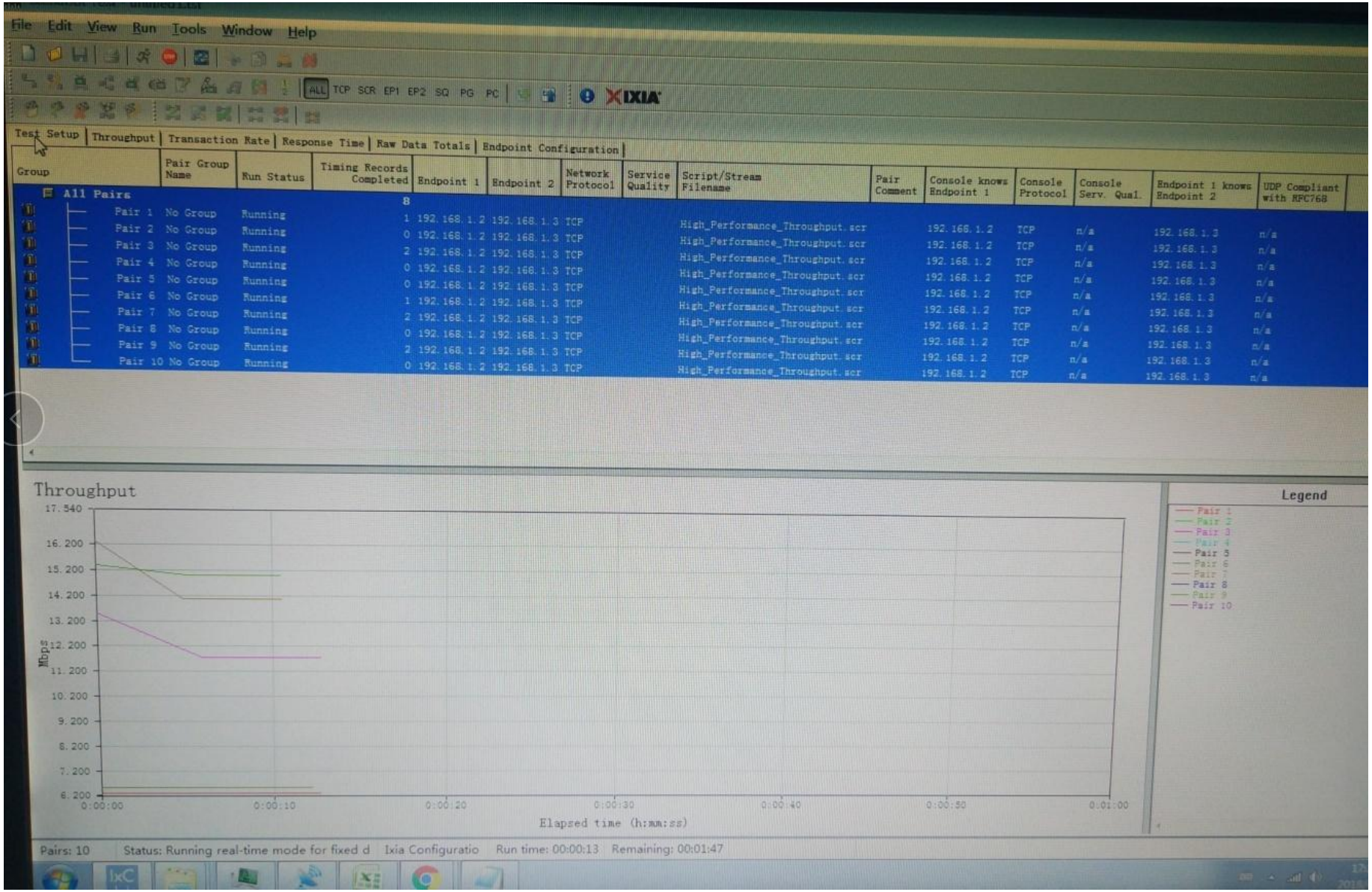
| Rx(Mbps)-CH44 | | | | | |
|---|---|---|---|---|---|
| Atten(dB) | 0° | 90° | 180° | 270° | Aver |
| 0 | 453.1 | 424.5 | 451.7 | 427.9 | 439.3 |
| 5 | 455.4 | 427.2 | 459.5 | 429.4 | 442.8 |
| 10 | 441.2 | 424.6 | 459.9 | 423.3 | 437.2 |
| 15 | 455.1 | 427.8 | 453.8 | 422.7 | 439.8 |
| 20 | 451.1 | 428.0 | 446.1 | 421.9 | 436.7 |
| 25 | 449.7 | 411.9 | 446.3 | 415.0 | 430.7 |
| 30 | 401.8 | 383.9 | 421.8 | 385.9 | 398.3 |
| 35 | 341.2 | 329.6 | 360.3 | 331.7 | 340.7 |
| 40 | 318.2 | 290.1 | 337.3 | 290.3 | 309.0 |
| 45 | 246.6 | 222.8 | 269.8 | 220.8 | 240.0 |
| 50 | 166.2 | 135.8 | 168.3 | 132.7 | 150.8 |
| 55 | 96.6 | 81.7 | 104.7 | 99.1 | 95.5 |
| 60 | 51.2 | 41.3 | 59.6 | 52.3 | 51.1 |
| 65 | 25.6 | 17.6 | 36.3 | 31.4 | 27.7 |
| 70 | 10.0 | 8.7 | 13.2 | 17.6 | 12.4 |

# throughput(5G HT80 CH44)

| Tx(Mbps)-CH44 | | | | | |
|---|---|---|---|---|---|
| Atten(dB) | 0° | 90° | 180° | 270° | Aver |
| 0 | 916.5 | 903.3 | 910.2 | 915.5 | 911.4 |
| 5 | 918.2 | 908.9 | 923.7 | 903.6 | 913.6 |
| 10 | 916.4 | 908.6 | 915.8 | 914.1 | 913.7 |
| 15 | 908.2 | 906.0 | 922.7 | 915.8 | 913.2 |
| 20 | 902.7 | 921.2 | 926.8 | 916.7 | 916.9 |
| 25 | 912.7 | 909.6 | 922.2 | 918.0 | 915.6 |
| 30 | 924.5 | 866.6 | 915.1 | 853.8 | 890.0 |
| 35 | 834.7 | 808.3 | 854.5 | 805.8 | 825.8 |
| 40 | 768.6 | 693.0 | 764.0 | 719.0 | 736.1 |
| 45 | 691.6 | 649.1 | 702.9 | 677.2 | 680.2 |
| 50 | 575.1 | 528.0 | 593.1 | 555.9 | 563.0 |
| 55 | 344.5 | 303.7 | 373.7 | 350.3 | 343.0 |
| 60 | 233.1 | 194.0 | 252.6 | 206.4 | 221.5 |
| 65 | 162.7 | 116.5 | 175.5 | 119.0 | 143.4 |
| 70 | 68.2 | 47.8 | 65.3 | 59.5 | 60.2 |
| 75 | 12.3 | 5.6 | 10.9 | 17.3 | 11.5 |

| Rx(Mbps)-CH44 | | | | | |
|---|---|---|---|---|---|
| Atten(dB) | 0° | 90° | 180° | 270° | Aver |
| 0 | 907.4 | 887.0 | 910.8 | 880.5 | 896.4 |
| 5 | 907.2 | 881.3 | 907.7 | 881.7 | 894.5 |
| 10 | 908.0 | 884.4 | 905.0 | 879.7 | 894.3 |
| 15 | 906.7 | 886.4 | 912.3 | 884.4 | 897.4 |
| 20 | 880.6 | 879.4 | 880.4 | 878.7 | 879.7 |
| 25 | 874.0 | 885.6 | 876.6 | 880.5 | 879.2 |
| 30 | 873.7 | 827.1 | 868.1 | 812.3 | 845.3 |
| 35 | 802.0 | 738.7 | 797.9 | 726.2 | 766.2 |
| 40 | 712.3 | 662.2 | 702.6 | 667.1 | 686.1 |
| 45 | 561.0 | 507.2 | 587.1 | 522.9 | 544.5 |
| 50 | 436.9 | 396.9 | 459.7 | 385.2 | 419.7 |
| 55 | 274.4 | 244.9 | 302.1 | 256.4 | 269.5 |
| 60 | 153.4 | 139.3 | 167.0 | 169.5 | 157.3 |
| 65 | 81.6 | 60.1 | 83.9 | 84.7 | 77.6 |
| 70 | 24.2 | 23.6 | 48.6 | 42.2 | 34.7 |
| 75 | 5.8 | 3.2 | 5.0 | 10.7 | 6.2 |

# testing software



Thank you!