

Antenna H/W Specification

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Countersign:

Chung-I Chou _____

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Revision History

Revision	Revision History	Date	Author(s)
1.0		01/24/2005	Chung-I Chou
1.1	Spec modification	06/24/2005	Chung-I Chou
1.2	Spec modification	07/07/2005	Chung-I Chou

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CONTENTS

Embedded Penta-Band Antenna Specification	P.4
Embedded Bluetooth Antenna Specification.....	P.10

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Embedded Penta-Band Antenna

1. Overview

The document is the specification of the embedded Penta-band antenna for PHONE applications. Penta-band includes GSM850, GSM900, DCS1800, PCS1900, WLAN2400.

1.1 Denotations

dBi: Decibel relative isotropic antenna

VSWR: Voltage Standing Wave Ratio

Tx: Transmit frequency

Rx: Receive frequency

GSM: Global Service for Mobile communication

PCS: Personal Communication System

DCS: Digital Communication System

WLAN: Wireless Local Area Network

SAR: Specific Absorption Rate

Peak Gain: The peak value of the antenna gain

Average Gain: The average value of the antenna gain

2. Measurement Parameters

2.1 VSWR

VSWR indicates the matching characteristics of the antenna. VSWR can be measured by a network analyzer.

2.2 Antenna Gain and Pattern

Antenna gain and far-field pattern can be determined by two measurement skills, depending on the own equipments. One is the far-field measurement; the other is the 3-D measurement system.

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3. Electrical Requirements

3.1 VSWR

	GSM850	GSM900	DCS1800	PCS1900	WLAN2400
Free space	2.5:1	2.5:1	2.5:1	2.5:1	2.5:1

Notably: The VSWR value will be degraded due to mechanical and space constrains.

3.2 Gain and Patterns (Total Field)

	GSM850	GSM900	DCS1800	PCS1900	WLAN2400
Peak gain	0.0 dBi	0.0 dBi	0.0 dBi	0.0 dBi	0.0 dBi
Average gain	-4.0 dBi	-4.0 dBi	-4.0 dBi	-4.0 dBi	-4.0 dBi

Notably: The target values (peak and average gains) will be degraded due to mechanical and space constrains.

3.3 Total Efficiency

	GSM900	DCS1800	PCS1900	WLAN2400
Total efficiency	50%	40%	40%	40%

Notably: The antenna total efficiency will be degraded due to mechanical and space constrains.

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4. Environmental Performance

4.1 Test Methods

All of the tests should be carried out with the antenna mounted on the real PHONE to the maximum extent that is possible. Notably, T_o is $20^{\circ}\text{C} \pm 3^{\circ}\text{C}$ (T_o : room temperature).

4.1.1 Temperature (steady state)

The test is according to IEC 60068-2-1 Test Ab (Cold) and IEC 60068-2-2 Test Bb (Dry heat).

The antenna is stored in a climatic chamber with the following climate and time periods (Figs. 1 and 2):

Low temperature/Duration: $T_1 = -5^{\circ}\text{C} / t_1 = 48\text{hr}$ (Fig. 1)

High temperature/Duration: $T_2 = +45^{\circ}\text{C} / t_2 = 48\text{hr}$ (Fig. 2)

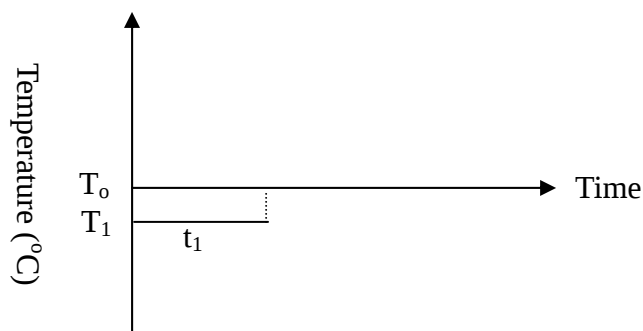


Fig. 1

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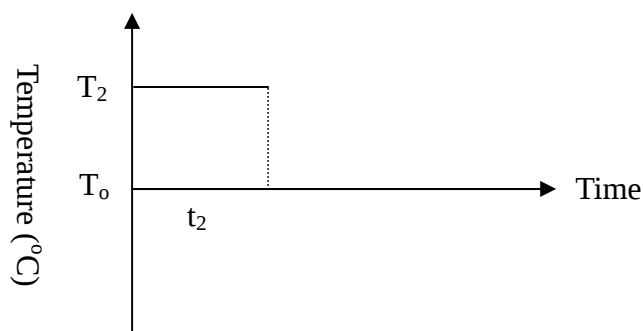


Fig. 2

4.1.2 Temperature (cycling)

The test is according to IEC 60068-2-14 Test Na (Change of temperature, Fig. 3)

Low temperature (T_1): -5°C

High temperature (T_2): $+45^{\circ}\text{C}$

Steady state time (t_1): 1hr

Transition time (t_2): $<5\text{ min}$

Duration: 4cycles

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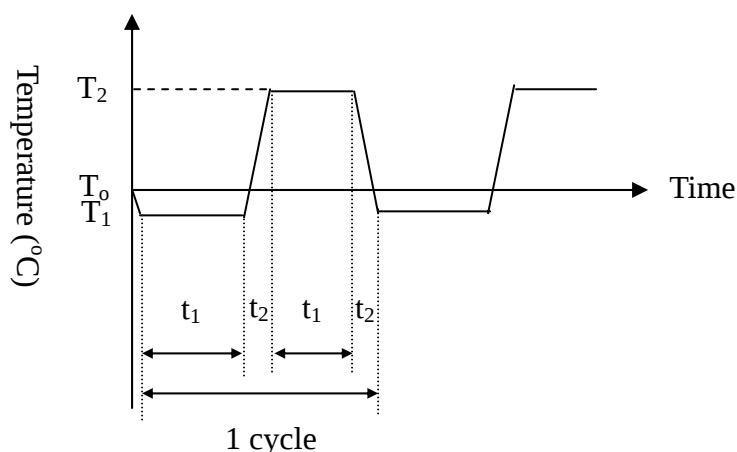


Fig. 3

4.1.3 Vibration test

The test is according to IEC 60068-2-6 Test Fc and IEC 60068-2-64 Test Fh

(a) Sinusoidal: (IEC 60068-2-6 Test Fc)

10-15.8 Hz Amplitude: 2.0 mm

15.8-1000-15.8 Hz Acceleration: 20 m/s²

15-8-10 Hz Amplitude: 2.0 mm

1 Octave/minute

Direction: x-, y-, and z-axis

Duration: 3cycles/axis (One cycle is from 10 Hz to 1000 Hz and back to 10 Hz)

(b) Random: (IEC 60068-2-64 Test Fh)

Frequency: 10-1000 Hz

3 axes, 1hr/axis, 6 Grms

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4.2 Environmental Requirements

4.2.1 Temperature (steady state)

The antenna should fulfill the mechanical and electrical requirements after recovered to the room temperature. No visual deterioration should occur.

4.2.2 Temperature (cycling)

The antenna should fulfill the mechanical and electrical requirements after recovered to the room temperature.

4.2.3 Vibration test

The antenna should fulfill the mechanical and electrical requirements after the test.

5. Antenna Materials

The antenna can not have the materials of plumbum (Pb), halogen and mercury (Hg).

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Embedded Bluetooth Antenna

Frequency range	2400 MHz ~ 2500 MHz
VSWR	2.5 : 1
Peak gain	0 dBi
Average gain	4.0 dBi
Reference impedance	50 ohm

Notably: The VSWR and gain values will be degraded due to mechanical and space constrains.

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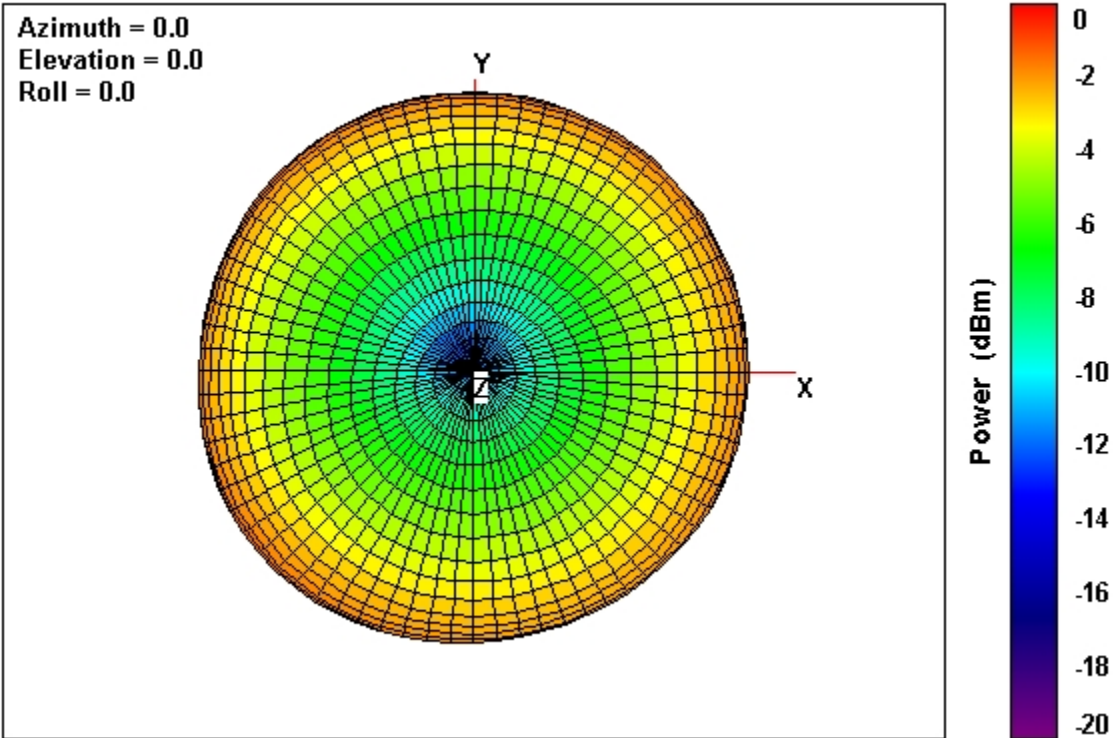
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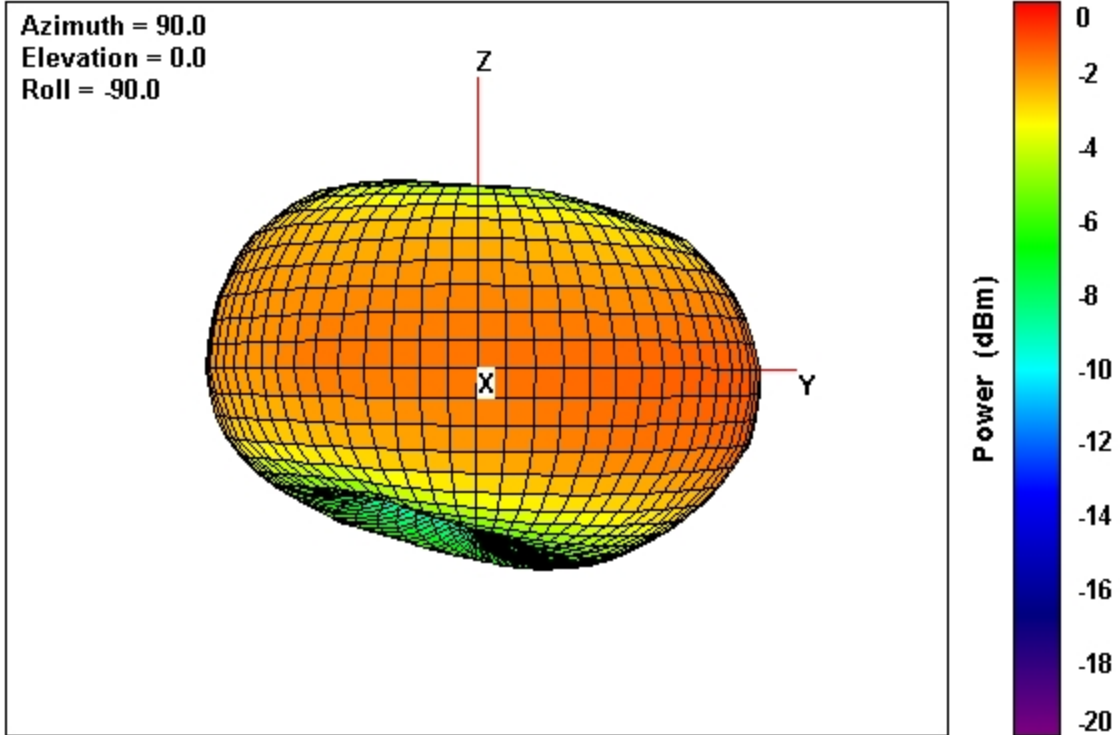
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Test / Position	Gain / Free Space (TX)											
Band	GSM850			GSM900			GSM1800			GSM1900		
Channel	824.2	836.4	848.8	880.2	898.4	914.8	1710.2	1747.4	1784.8	1850.2	1880	1909.8
Ant. Port Input Pwr. (dBm)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tot. Rad. Pwr. (dBm)	-3.69	-3.38	-3.38	-3.52	-3.69	-4.19	-2.84	-2.24	-1.85	-2.16	-2.07	-2.28
Peak EIRP (dBm)	-1.42	-1.08	-1.00	-1.26	-1.40	-1.86	2.76	3.34	3.70	3.11	3.13	2.82
Directivity (dBi)	2.27	2.31	2.38	2.26	2.29	2.33	5.60	5.58	5.55	5.27	5.20	5.10
Efficiency (dB)	-3.69	-3.38	-3.38	-3.52	-3.69	-4.19	-2.84	-2.24	-1.85	-2.16	-2.07	-2.28
Gain (dBi)	-1.42	-1.08	-1.00	-1.26	-1.40	-1.86	2.76	3.34	3.70	3.11	3.13	2.82
NHPRP ±Pi/4 (dBm)	-4.38	-4.07	-4.07	-4.21	-4.38	-4.88	-4.33	-3.76	-3.34	-3.59	-3.46	-3.64
NHPRP ±Pi/6 (dBm)	-5.46	-5.15	-5.14	-5.29	-5.45	-5.94	-6.16	-5.64	-5.21	-5.43	-5.33	-5.53
NHPRP ±Pi/8 (dBm)	-6.44	-6.12	-6.11	-6.26	-6.42	-6.91	-7.63	-7.12	-6.70	-6.88	-6.79	-7.01
Front/Back Ratio (dB)	0.40	0.58	0.67	0.49	1.07	1.38	9.01	8.27	7.99	7.17	7.22	6.63
Phi BW (°)	182.00	182.00	182.00	182.00	182.00	182.00	87.00	86.00	86.00	96.00	106.00	105.00
+ Phi BW (°)	91.00	91.00	91.00	91.00	91.00	91.00	34.00	34.00	34.00	33.00	40.00	37.00
- Phi BW (°)	91.00	91.00	91.00	91.00	91.00	91.00	53.00	52.00	52.00	63.00	66.00	68.00
Theta BW (°)	94.00	95.00	96.00	99.00	97.00	93.00	69.00	66.00	61.00	59.00	57.00	57.00
+ Th. BW (°)	49	53	54	56	40	46	47	46	42	40	34	35
- Th. BW (°)	45.00	42.00	42.00	43.00	57.00	47.00	22.00	20.00	19.00	19.00	23.00	22.00
Boresight Phi (°)	225.00	210.00	210.00	210.00	210.00	120.00	150.00	150.00	150.00	150.00	135.00	135.00
Boresight Th. (°)	90.00	90.00	90.00	90.00	105.00	105.00	120.00	120.00	120.00	120.00	120.00	120.00
Maximum Power (dBm)	-1.42	-1.08	-1.00	-1.26	-1.40	-1.86	2.76	3.34	3.70	3.11	3.13	2.82
Minimum Power (dBm)	-19.38	-18.89	-18.80	-18.13	-17.71	-18.17	-16.56	-16.51	-17.38	-15.42	-15.27	-14.90
Average Power (dBm)	-4.96	-4.65	-4.64	-4.77	-4.93	-5.42	-2.71	-2.10	-1.78	-2.25	-2.29	-2.56
Max/Min Ratio (dB)	17.96	17.81	17.80	16.87	16.32	16.31	19.32	19.84	21.08	18.53	18.40	17.72
Max/Avg Ratio (dB)	3.54	3.57	3.64	3.51	3.54	3.56	5.47	5.44	5.48	5.36	5.42	5.38
Min/Avg Ratio (dB)	-14.42	-14.24	-14.16	-13.36	-12.78	-12.75	-13.85	-14.40	-15.60	-13.17	-12.98	-12.34
Average Gain (dB)	-3.69	-3.38	-3.38	-3.52	-3.69	-4.19	-2.84	-2.24	-1.85	-2.16	-2.07	-2.28
Note												
Model	Faraday 1.5											
Test / Position	Gain / Free Space (RX)											
Band	GSM850			GSM900			GSM1800			GSM1900		
Channel	869.2	881.4	893.8	925.2	943.4	959.8	1805.2	1842.4	1879.8	1930.2	1960	1989.8
Ant. Port Input Pwr. (dBm)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tot. Rad. Pwr. (dBm)	-3.09	-3.16	-3.43	-4.07	-4.63	-5.21	-2.08	-2.10	-1.87	-2.27	-2.60	-3.15
Peak EIRP (dBm)	-0.76	-0.88	-1.16	-1.69	-2.34	-2.95	3.08	2.90	3.01	2.23	1.60	0.75
Directivity (dBi)	2.33	2.28	2.27	2.39	2.29	2.26	5.16	5.00	4.87	4.50	4.20	3.90
Efficiency (dB)	-3.09	-3.16	-3.43	-4.07	-4.63	-5.21	-2.08	-2.10	-1.87	-2.27	-2.60	-3.15
Gain (dBi)	-0.76	-0.88	-1.16	-1.69	-2.34	-2.95	3.08	2.90	3.01	2.23	1.60	0.75
NHPRP ±Pi/4 (dBm)	-3.75	-3.83	-4.10	-4.74	-5.32	-5.94	-3.56	-3.54	-3.31	-3.68	-4.00	-4.55
NHPRP ±Pi/6 (dBm)	-4.82	-4.90	-5.17	-5.79	-6.40	-7.04	-5.37	-5.34	-5.15	-5.57	-5.89	-6.41
NHPRP ±Pi/8 (dBm)	-5.78	-5.87	-6.14	-6.75	-7.36	-8.01	-6.77	-6.74	-6.57	-7.03	-7.35	-7.82
Front/Back Ratio (dB)	0.48	0.38	1.25	1.32	1.40	1.62	6.88	6.69	6.27	5.42	4.87	6.65
Phi BW (°)	182.00	182.00	182.00	182.00	182.00	182.00	94.00	109.00	110.00	114.00	120.00	133.00
+ Phi BW (°)	91.00	91.00	91.00	91.00	91.00	91.00	38.00	38.00	36.00	33.00	39.00	66.00
- Phi BW (°)	91.00	91.00	91.00	91.00	91.00	91.00	56.00	71.00	74.00	81.00	81.00	67.00
Theta BW (°)	93.00	93.00	94.00	93.00	95.00	98.00	77.00	71.00	64.00	59.00	64.00	62.00
+ Th. BW (°)	53.00	53.00	47.00	47.00	50.00	55.00	58.00	51.00	46.00	44.00	44.00	15.00
- Th. BW (°)	40.00	40.00	47.00	46.00	45.00	43.00	19.00	20.00	18.00	15.00	20.00	47.00
Boresight Phi (°)	210.00	210.00	120.00	120.00	120.00	120.00	150.00	150.00	150.00	150.00	135.00	75.00
Boresight Th. (°)	90.00	90.00	105.00	105.00	105.00	105.00	120.00	120.00	120.00	120.00	120.00	135.00
Maximum Power (dBm)	-0.76	-0.88	-1.16	-1.69	-2.34	-2.95	3.08	2.90	3.01	2.23	1.60	0.75
Minimum Power (dBm)	-19.17	-18.81	-18.52	-18.83	-19.02	-18.30	-15.79	-14.86	-12.83	-12.49	-11.73	-10.52
Average Power (dBm)	-4.42	-4.49	-4.74	-5.36	-5.87	-6.39	-1.98	-2.10	-1.99	-2.50	-2.86	-3.40
Max/Min Ratio (dB)	18.41	17.93	17.36	17.14	16.68	15.34	18.87	17.76	15.84	14.71	13.33	11.27
Max/Avg Ratio (dB)	3.66	3.61	3.58	3.67	3.53	3.44	5.06	5.01	5.00	4.73	4.46	4.15
Min/Avg Ratio (dB)	-14.75	-14.32	-13.78	-13.47	-13.15	-11.90	-13.81	-12.75	-10.84	-9.99	-8.87	-7.12
Average Gain (dB)	-3.09	-3.16	-3.43	-4.07	-4.63	-5.21	-2.08	-2.10	-1.87	-2.27	-2.60	-3.15
Note												

GSM850 CH189 881.4MHz

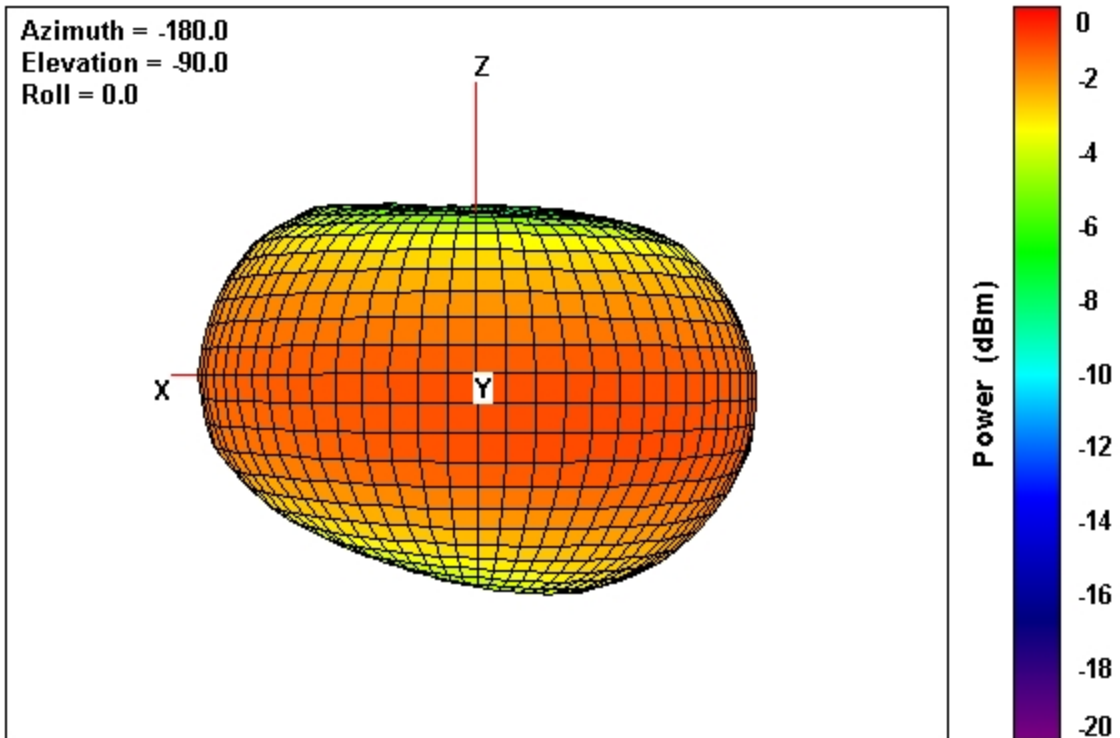
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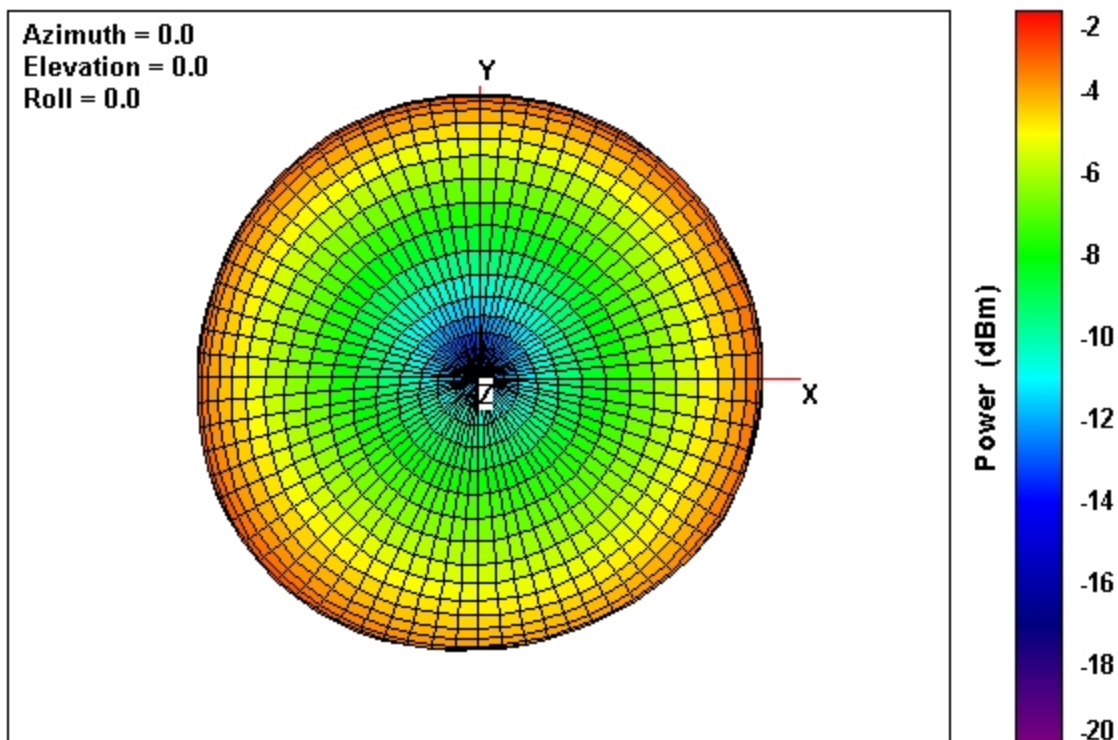


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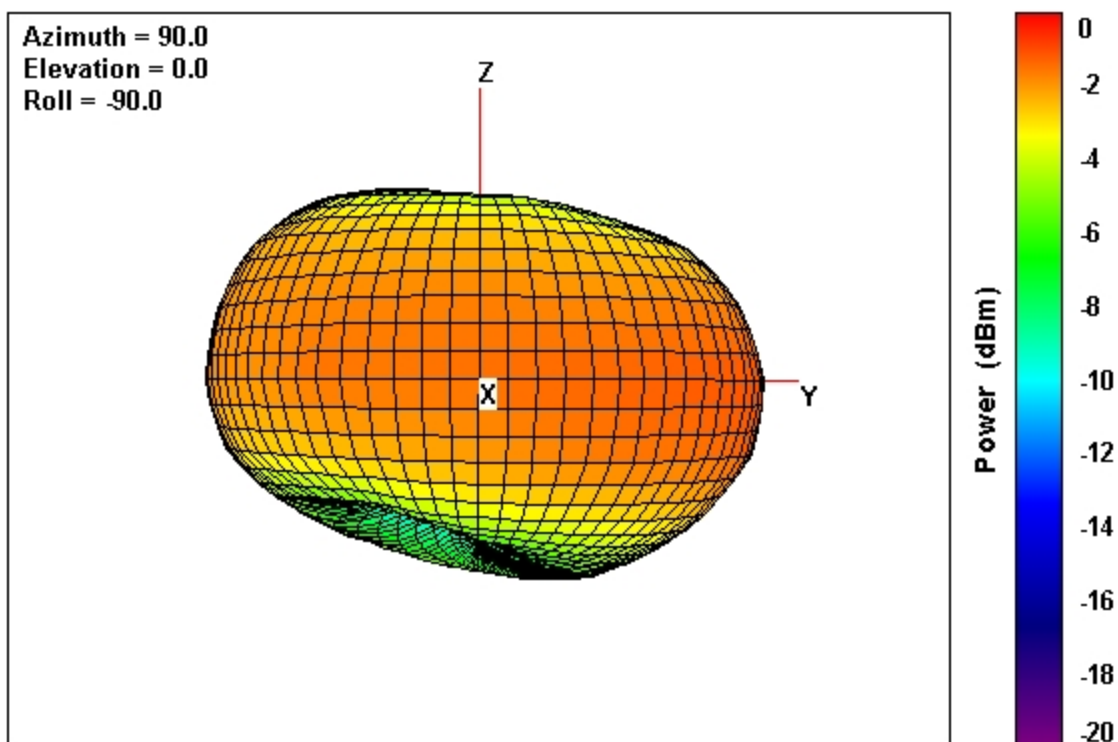


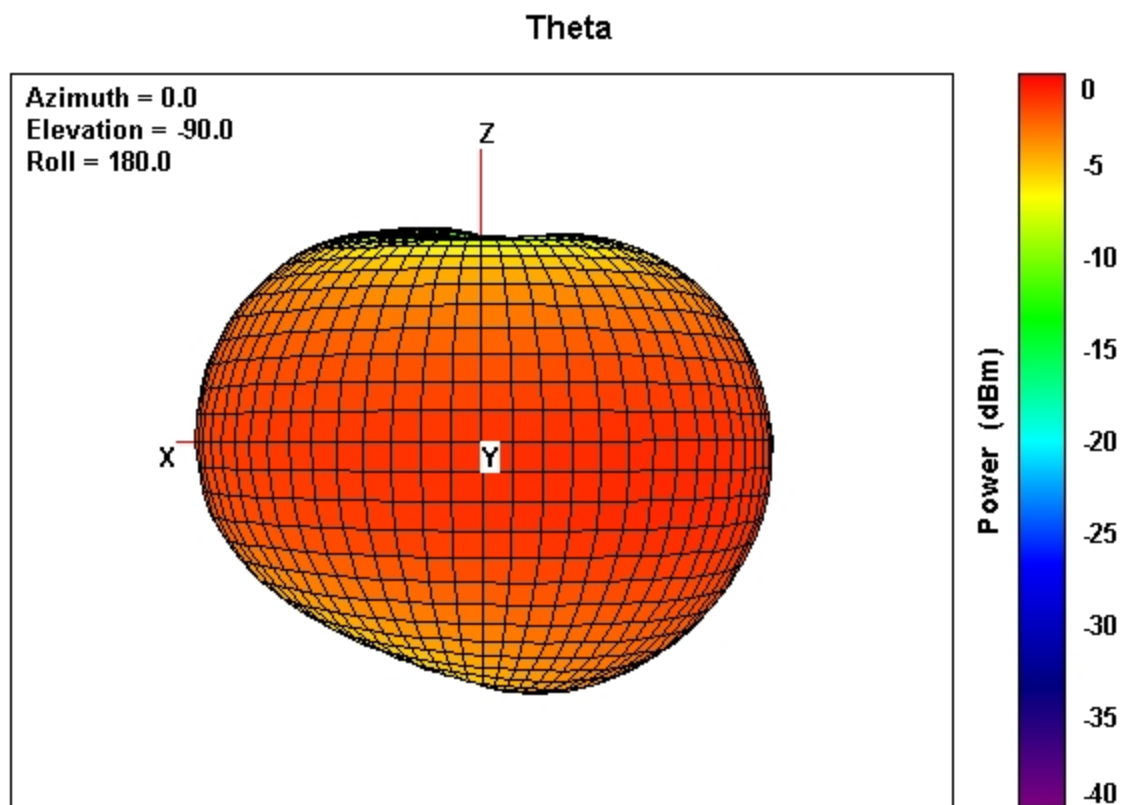
GSM900 CH42 943.4MHz

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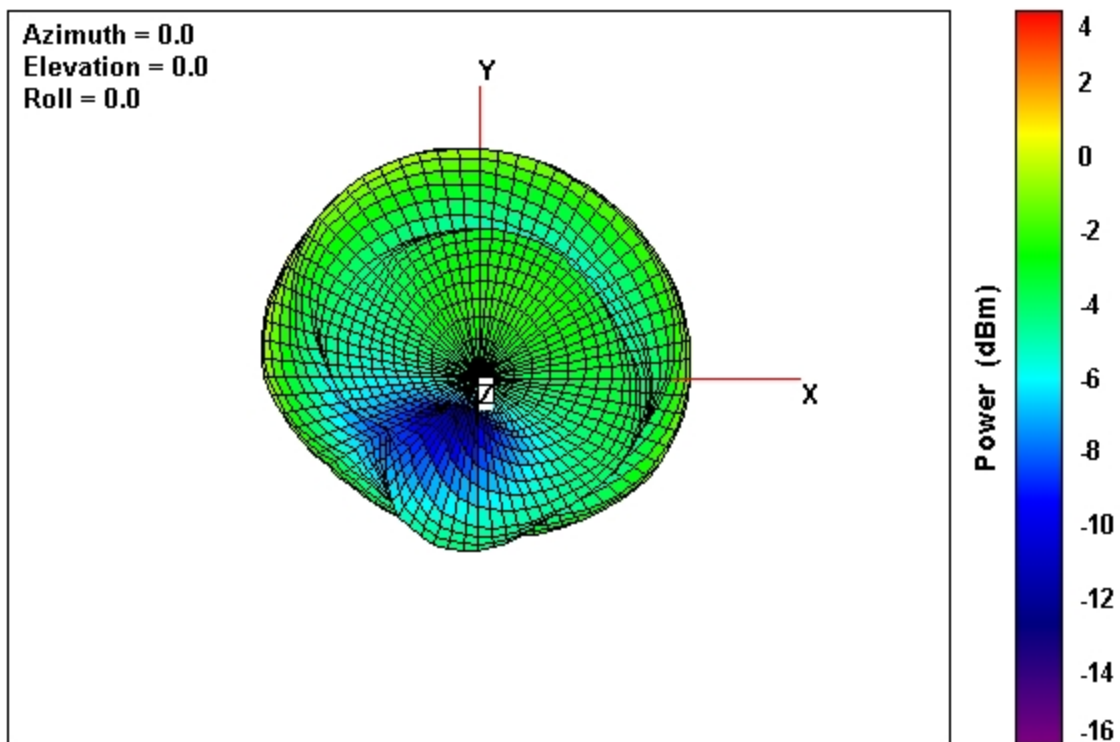
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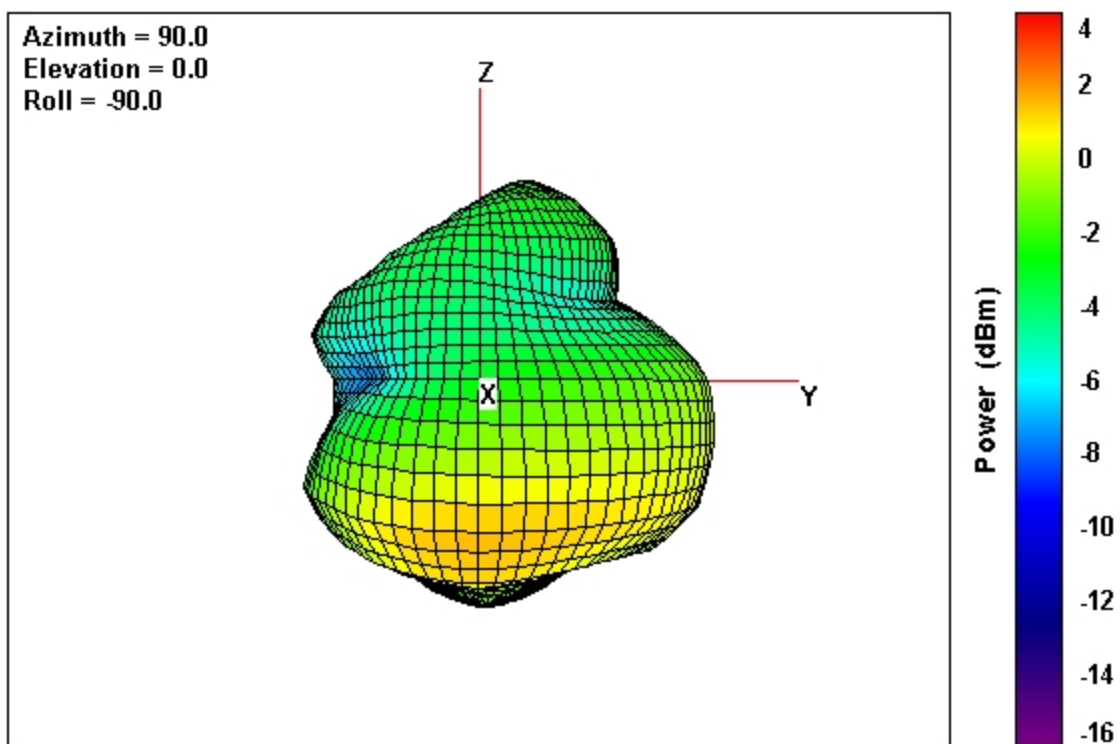


GSM1800 CH698 1842.4MHz

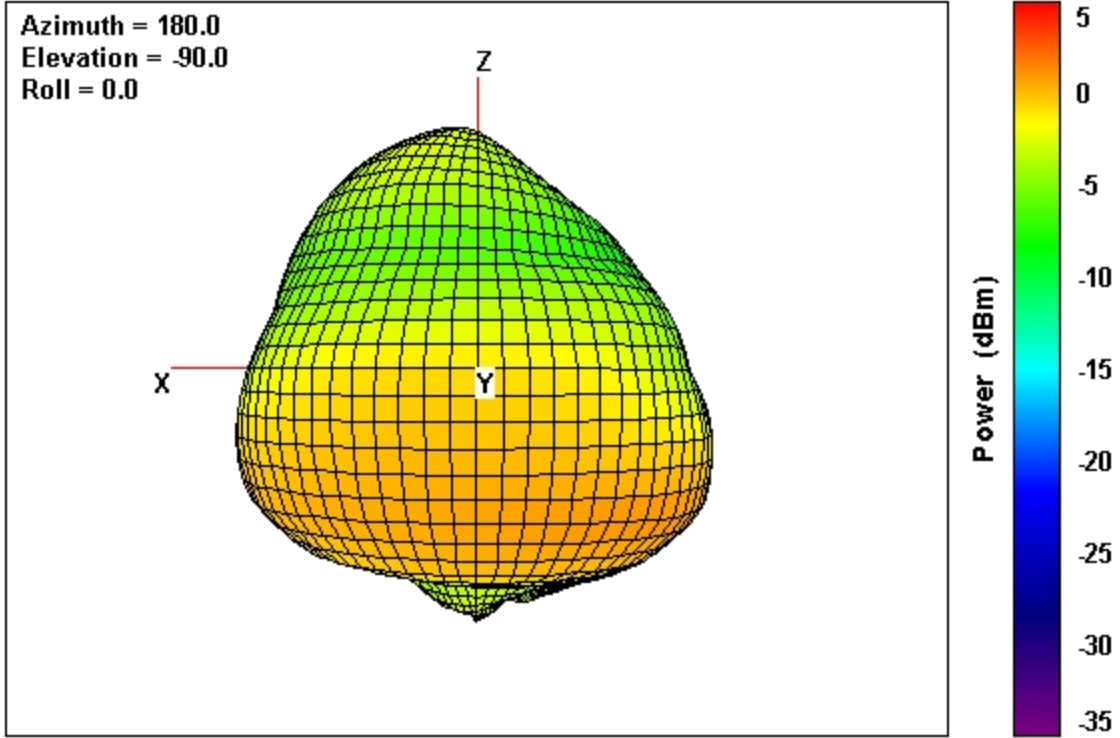
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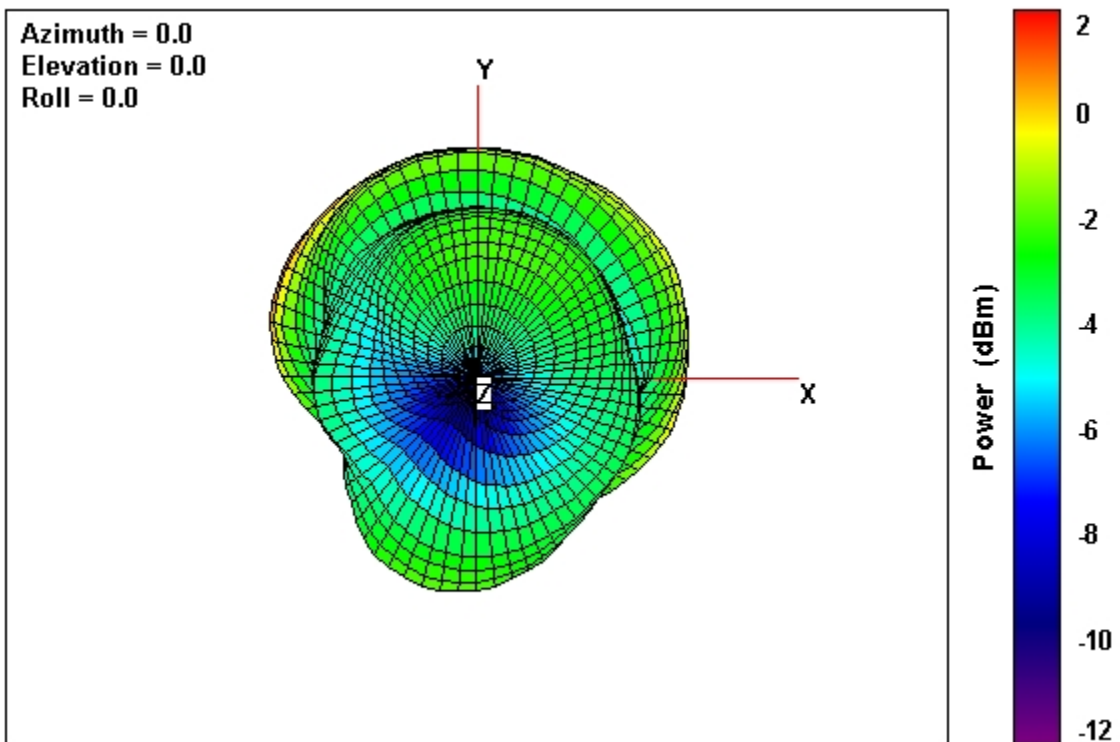


Theta

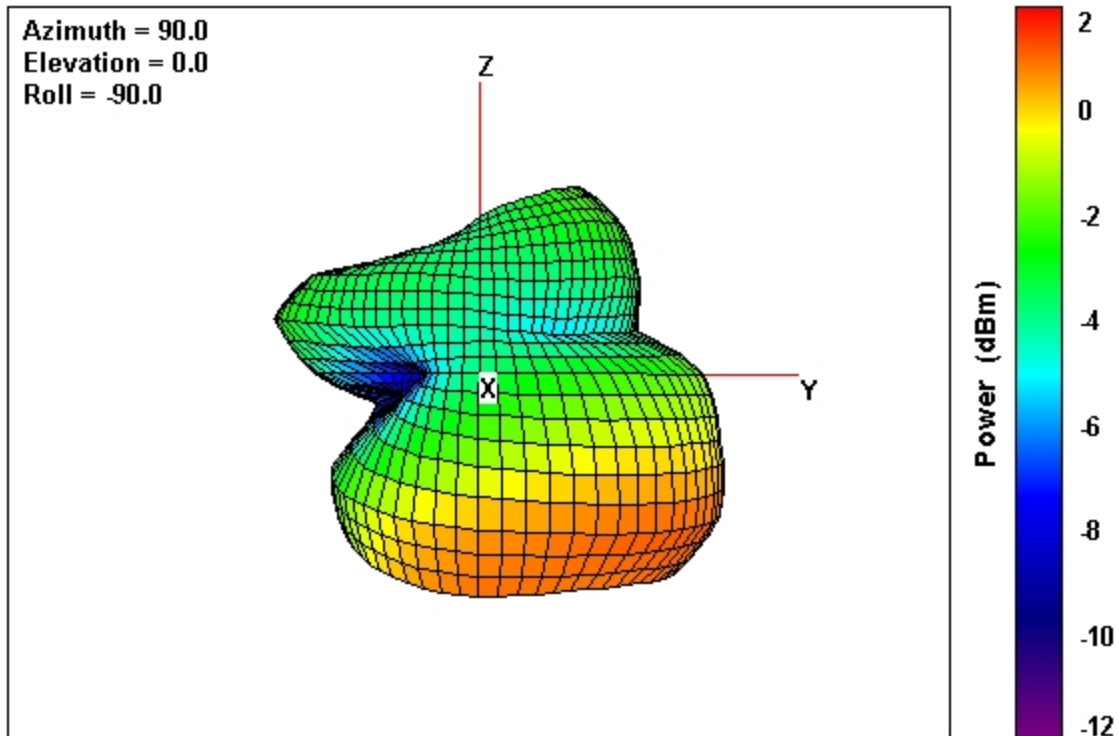


GSM1900 CH661 1960MHz

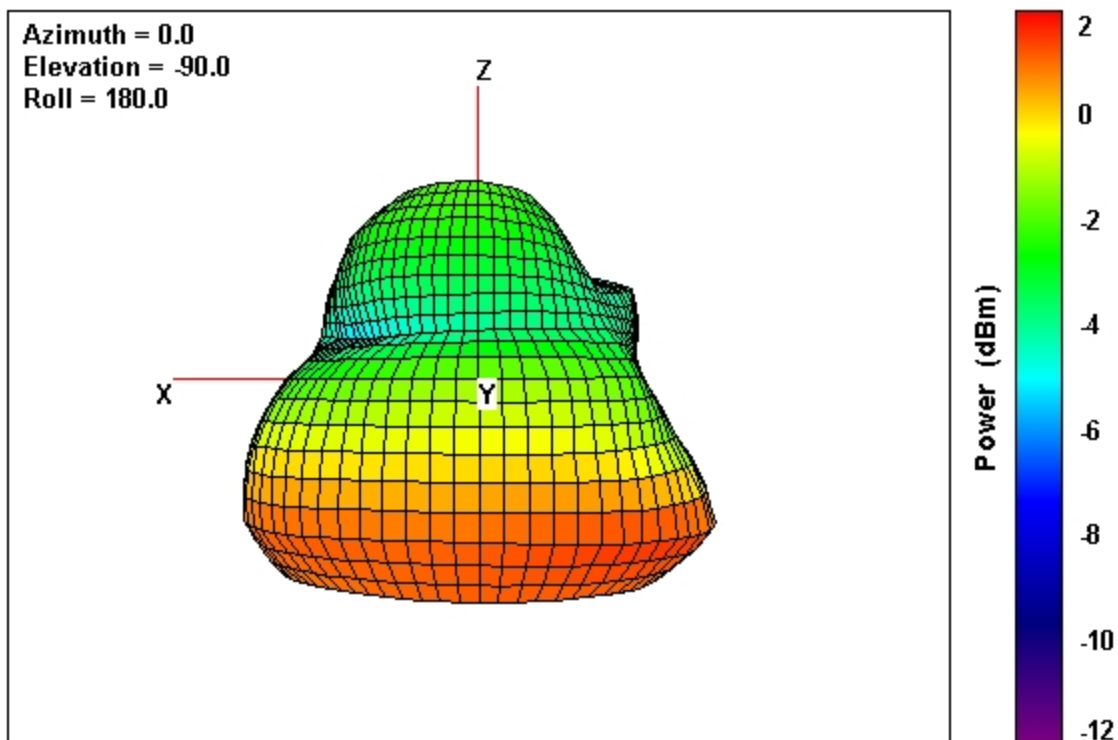
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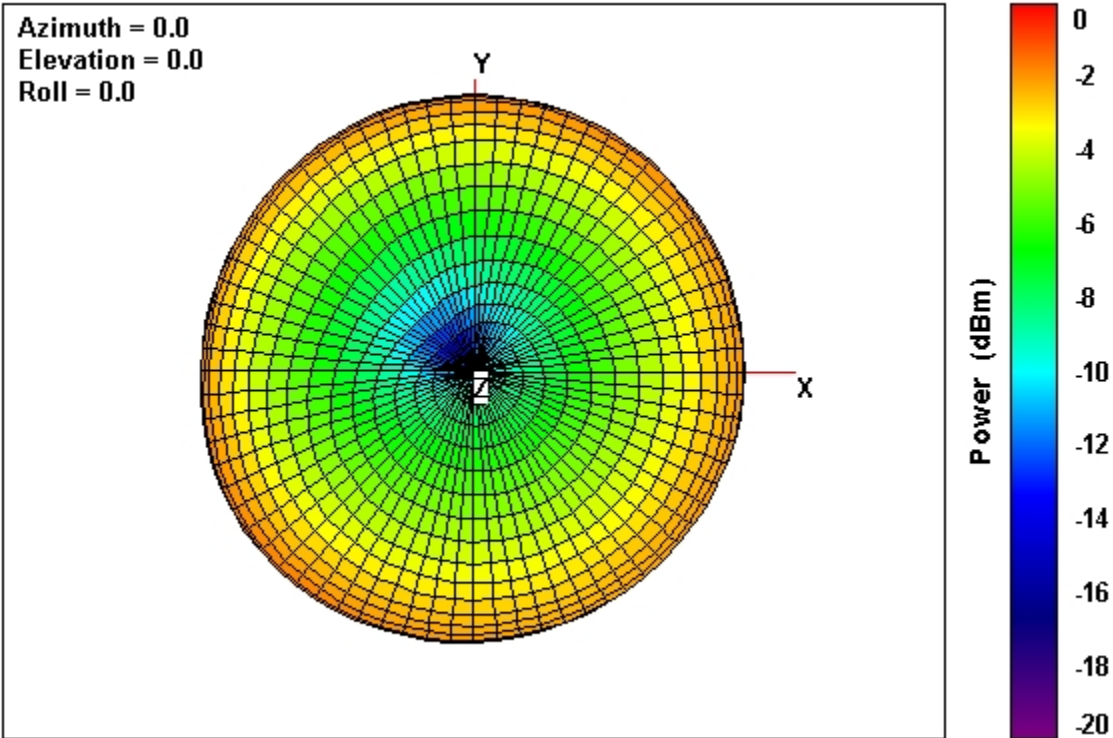


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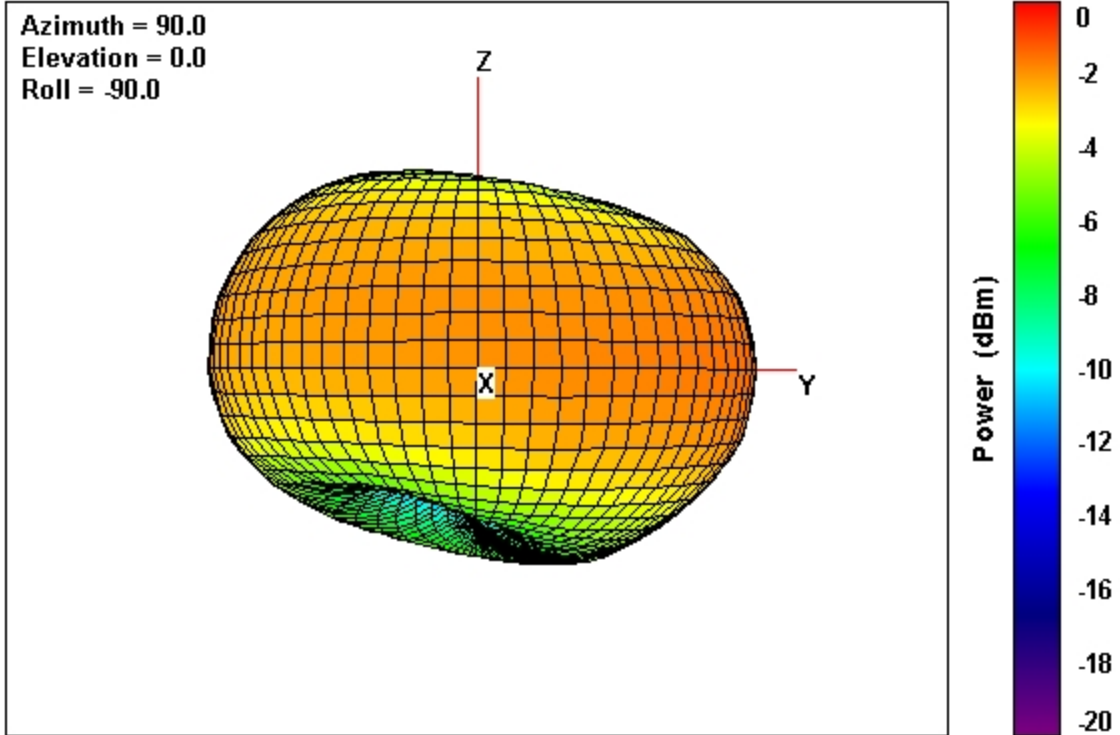


GSM850 CH189 836.4MHz

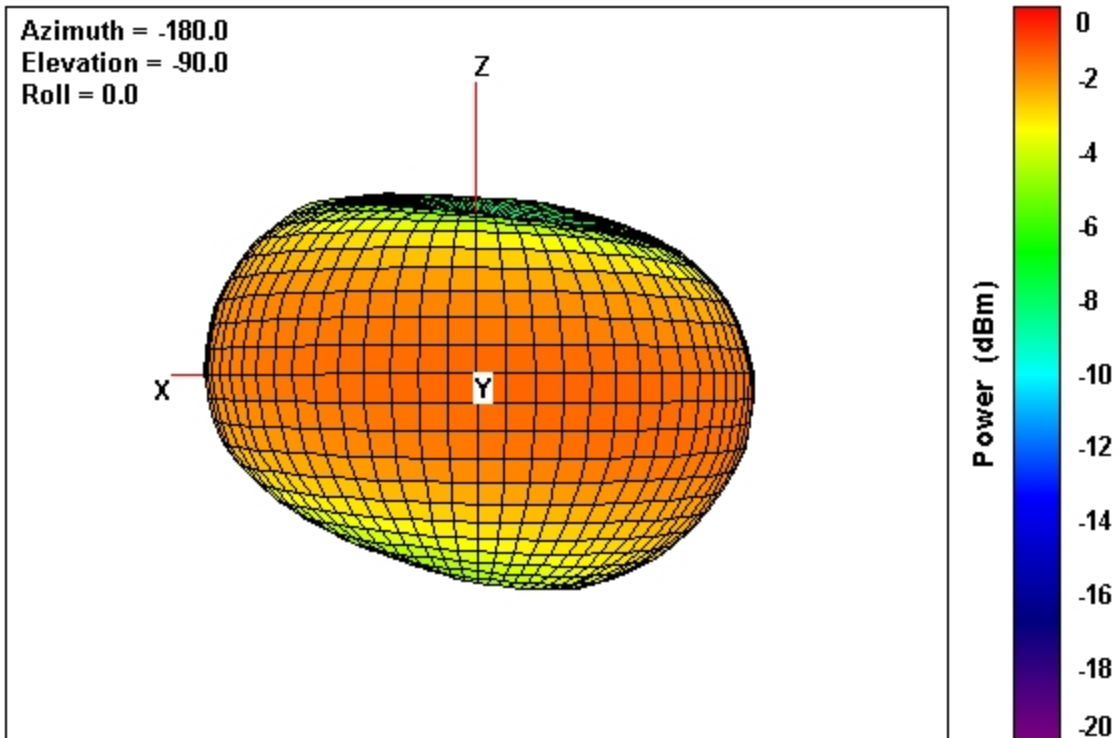
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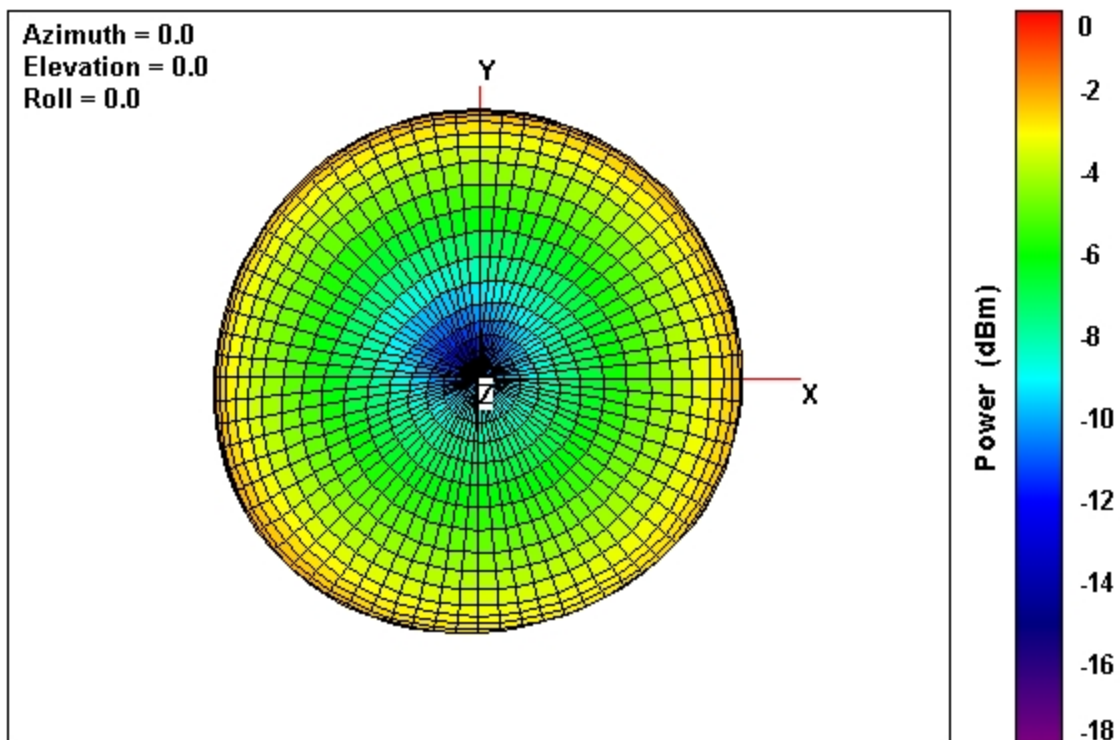


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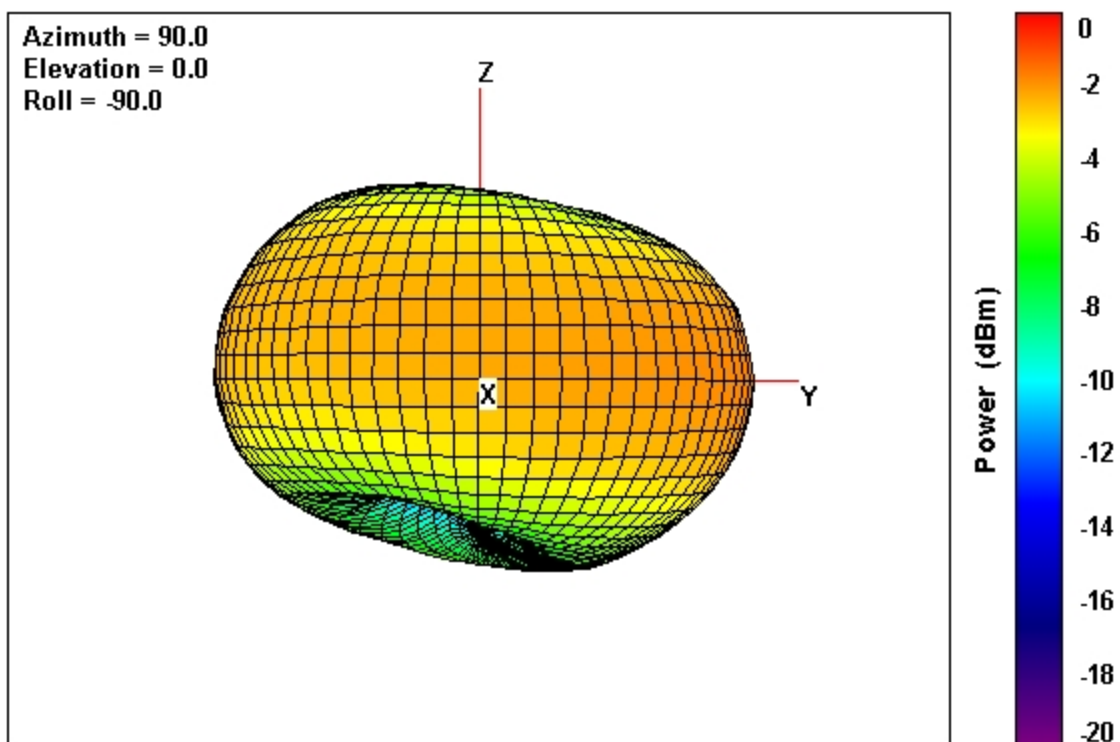


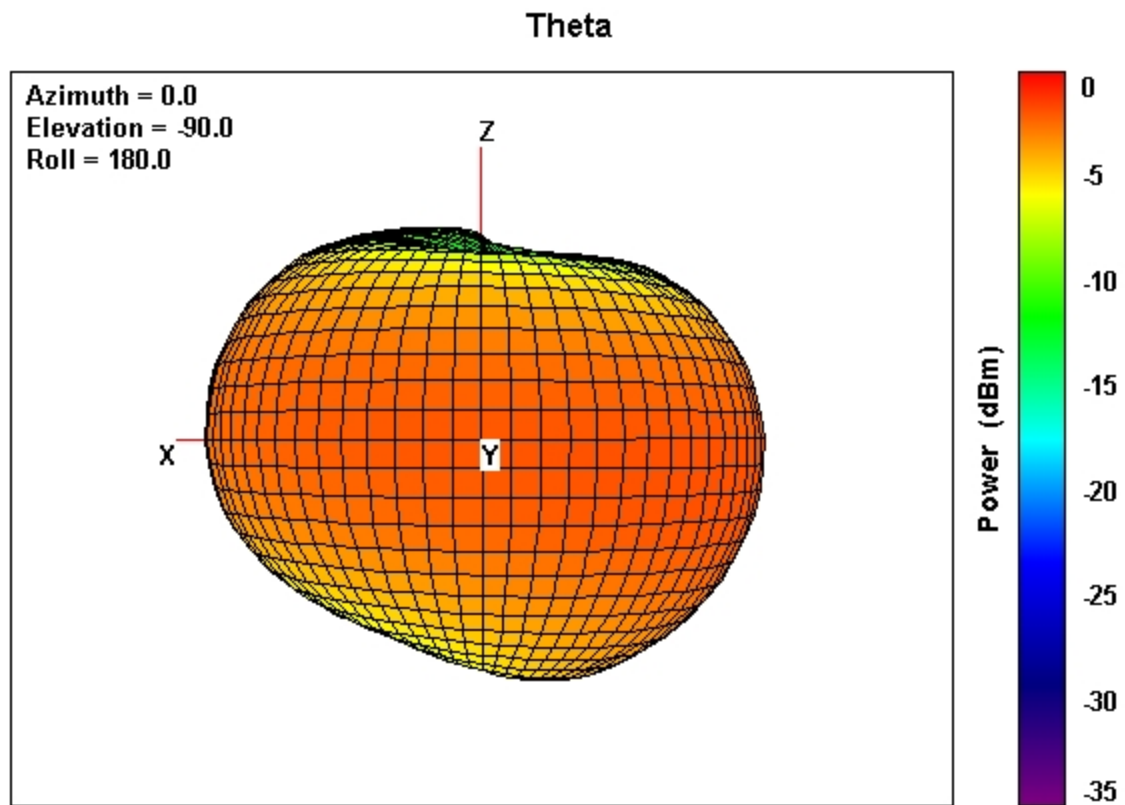
GSM900 CH42 898.4MHz

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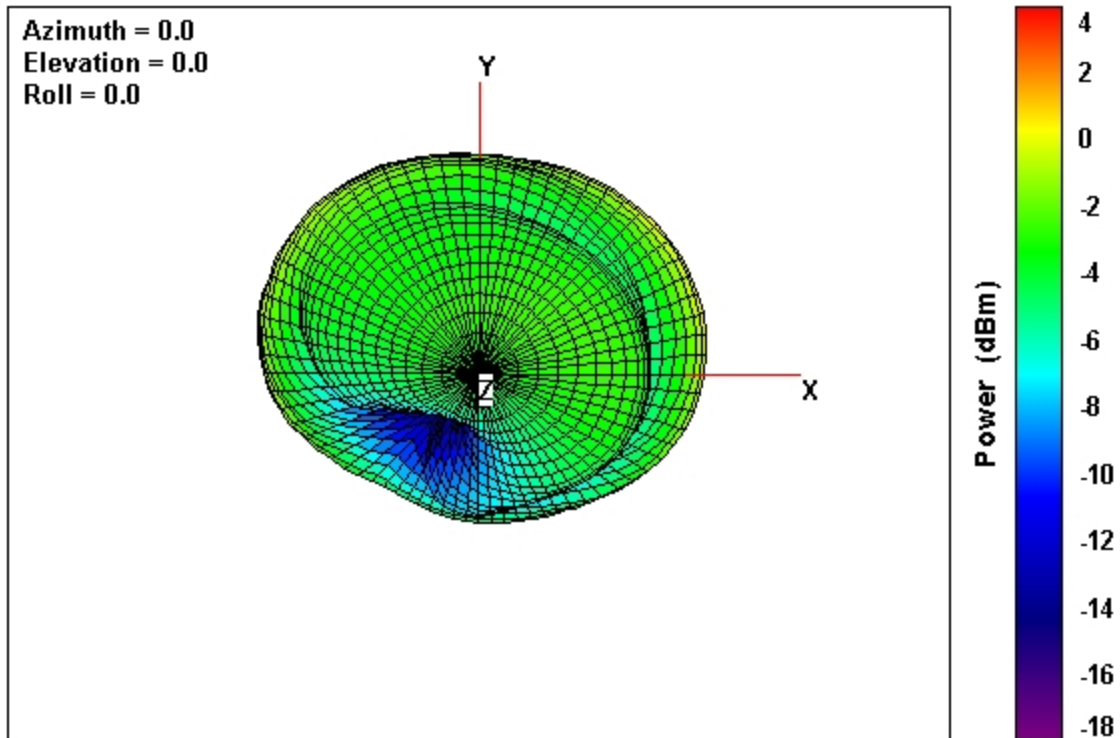
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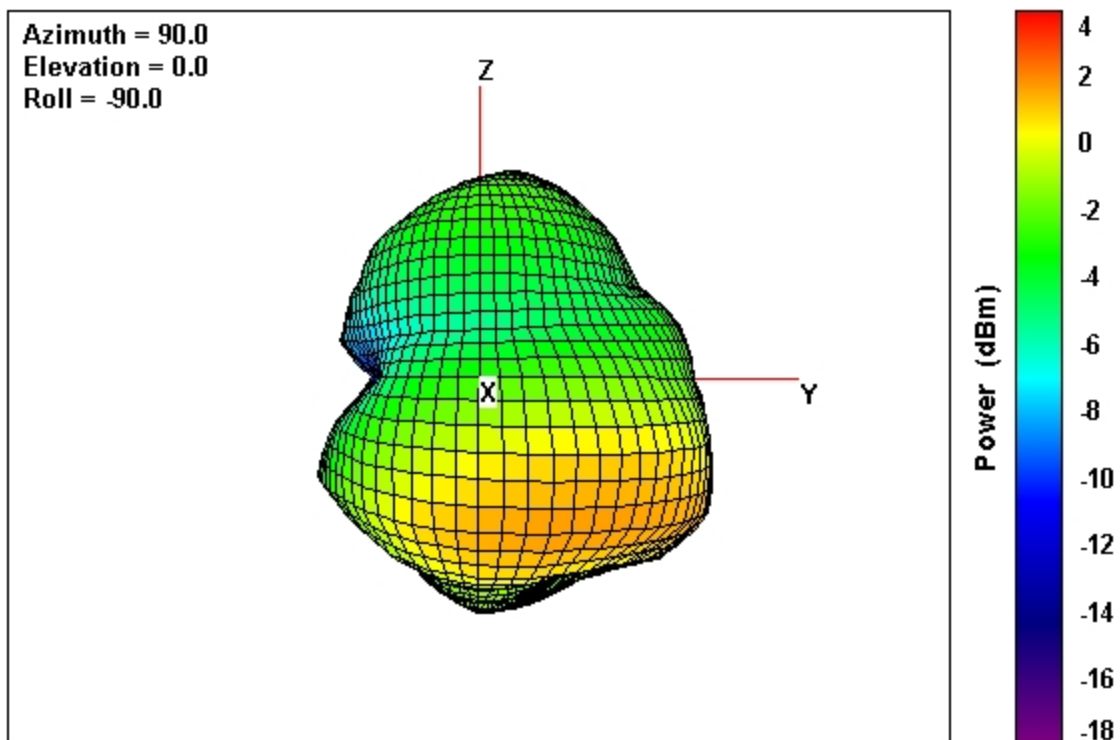


GSM1800 CH698 1747.4MHz

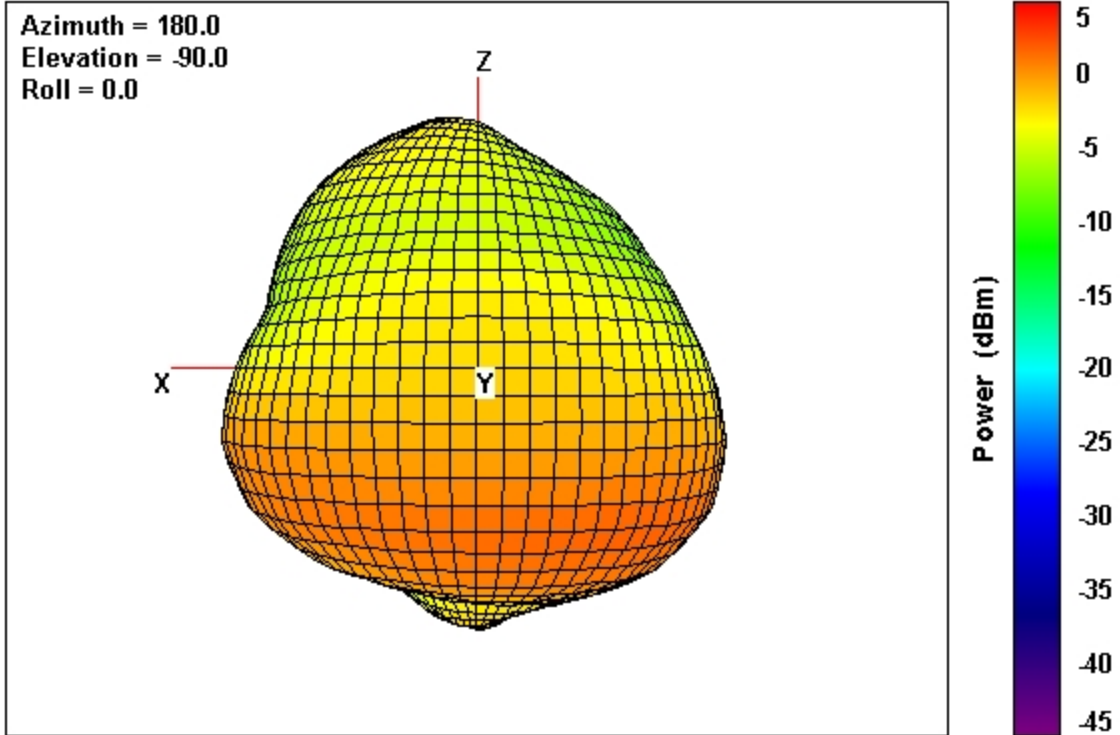
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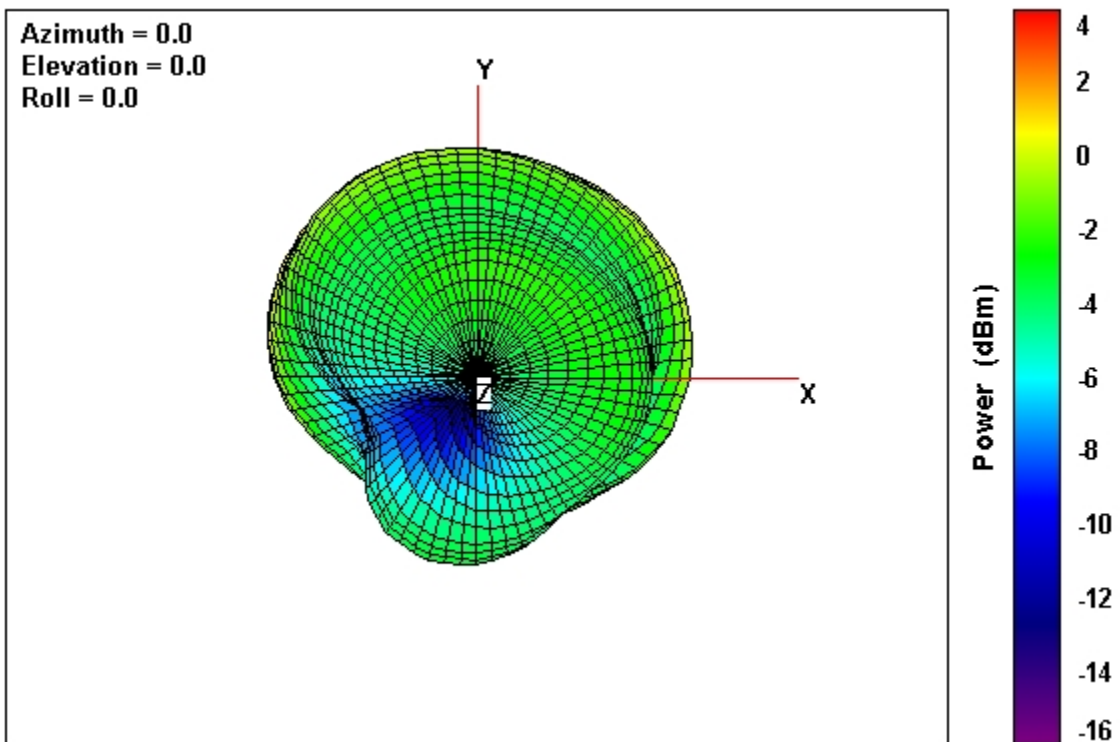


Theta

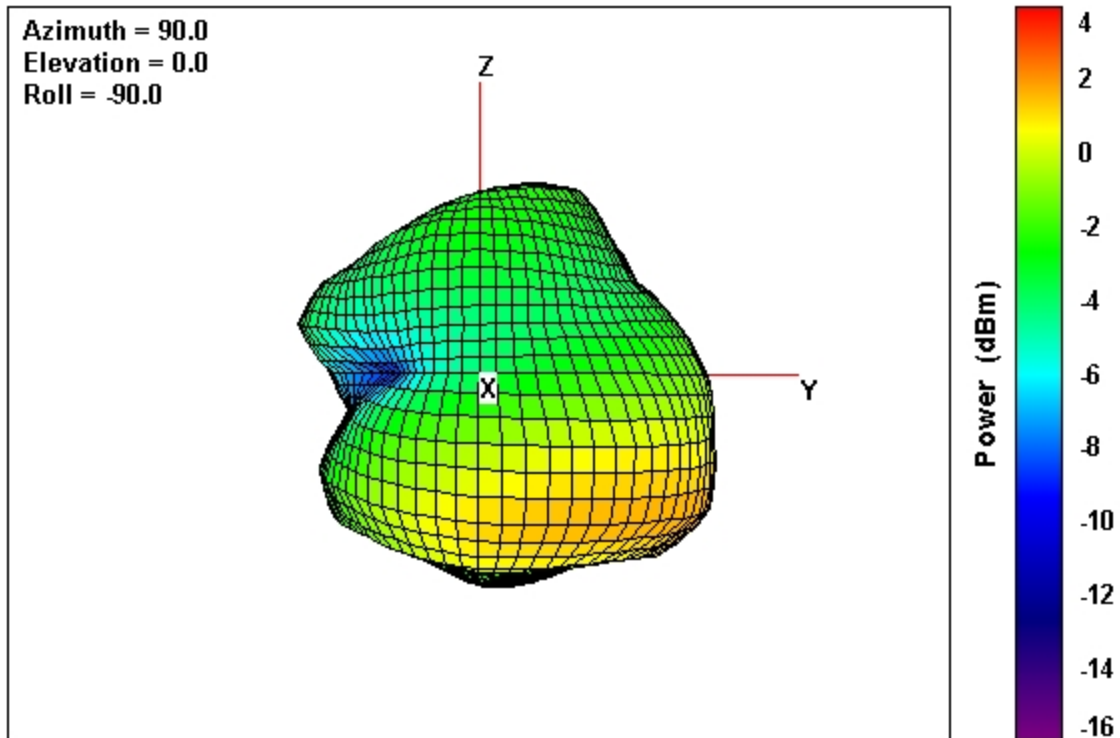


GSM1900 CH661 1880MHz

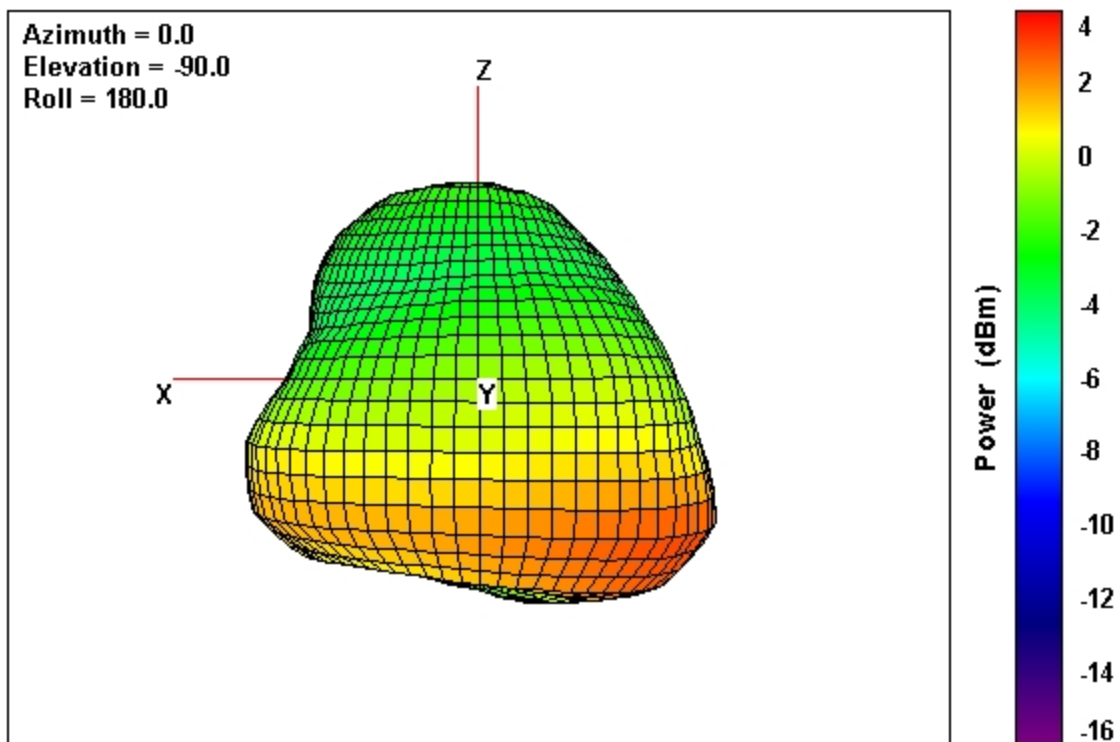
Total



Total



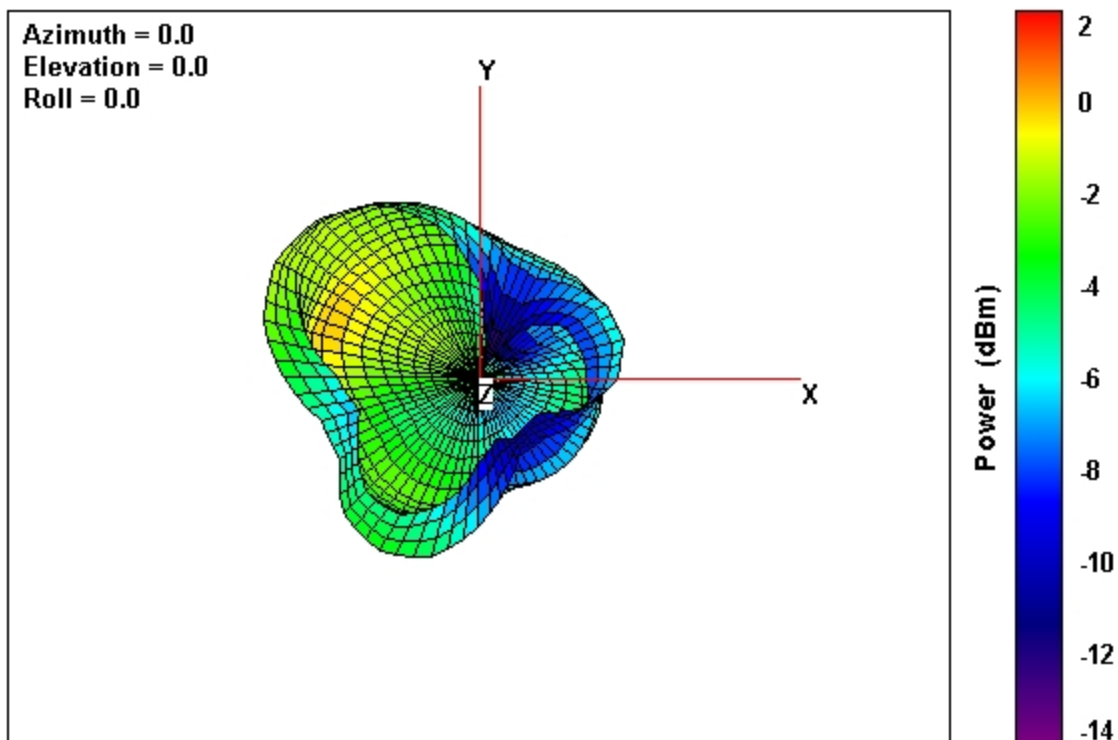
Total



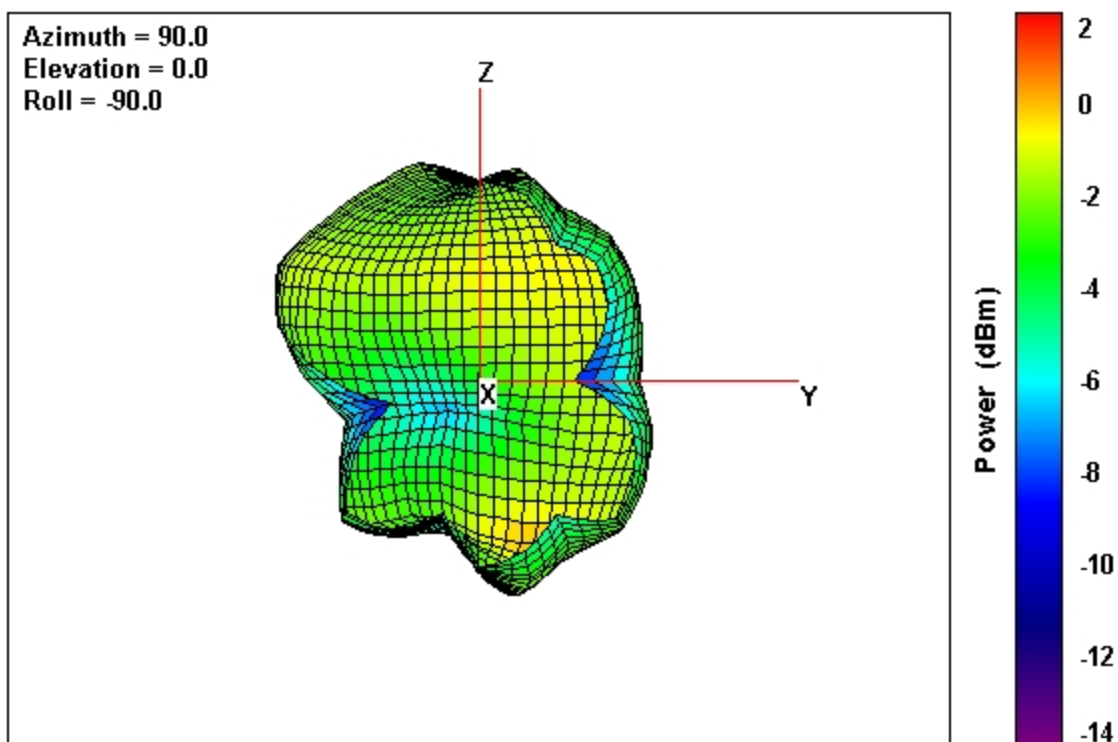
Model	Faraday 1.5			TRP / Talking Position			TRP / Free Space			TRP / Free Space			TRP / Free Space			TRP / Free Space			TRP / Free Space			TRP / Free Space			TRP / Free Space		
Test / Position	Gain / Free Space																										
Channel	2412	2442	2472																								
Ant. Port Input Pwr. (dBm)	0.00	0.00	0.00																								
Tot. Rad. Pwr. (dBm)	-2.74	-3.55	-3.94																								
Peak EIRP (dBm)	1.03	0.13	-0.68																								
Directivity (dBi)	3.77	3.68	3.26																								
Efficiency (dB)	-2.74	-3.55	-3.94																								
Gain (dBi)	1.03	0.13	-0.68																								
NHPRP ±Pi/4 (dBm)	-4.36	-5.17	-5.53																								
NHPRP ±Pi/6 (dBm)	-6.30	-7.13	-7.41																								
NHPRP ±Pi/8 (dBm)	-7.75	-8.60	-8.81																								
Front/Back Ratio (dB)	1.54	1.05	2.01																								
Phi BW (°)	83.00	79.00	104.00																								
+ Phi BW (°)	29.00	29.00	40.00																								
- Phi BW (°)	54.00	50.00	64.00																								
Theta BW (°)	69.00	65.00	81.00																								
+ Th. BW (°)	40.00	39.00	22.00																								
- Th. BW (°)	29.00	26.00	59.00																								
Boresight Phi (°)	165.00	165.00	345.00																								
Boresight Th. (°)	135.00	135.00	60.00																								
Maximum Power (dBm)	1.03	0.13	-0.68																								
Minimum Power (dBm)	-11.95	-13.29	-13.30																								
Average Power (dBm)	-2.65	-3.49	-3.91																								
Max/Min Ratio (dB)	12.98	13.42	12.62																								
Max/Avg Ratio (dB)	3.68	3.62	3.24																								
Min/Avg Ratio (dB)	-9.30	-9.80	-9.39																								
Average Gain (dB)	-2.74	-3.55	-3.94																								
Note																											

Model	TIS / Free Space			TIS / Free Space			TIS / Free Space			TIS / Free Space			TIS / Free Space			TIS / Free Space			TIS / Free Space			TIS / Free Space			TIS / Free Space		
Test / Position																											
Communication System																											
Channel																											
Cond. Sensitivity (dBm)																											
TIS (dBm)																											
Min. EIS (dBm)																											
Directivity (dBi)																											
Efficiency (dB)																											
Gain (dBi)																											
NHPIS ±Pi/4 (dBm)																											
NHPIS ±Pi/6 (dBm)																											
NHPIS ±Pi/8 (dBm)																											
Front/Back Ratio (dB)																											
Phi BW (°)																											
+ Phi BW (°)																											
- Phi BW (°)																											
Theta BW (°)																											
+ Th. BW (°)																											
- Th. BW (°)																											
Boresight Phi (°)																											
Boresight Th. (°)																											
Maximum Power (dBm)																											
Minimum Power (dBm)																											
Average Power (dBm)																											
Max/Min Ratio (dB)																											
Max/Avg Ratio (dB)																											
Min/Avg Ratio (dB)																											
Th. Src Pwr @ Boresight (dBm)																											
Phi Src Pwr @ Boresight (dBm)																											
Note	Horizontal	Vertical	Total	Horizontal	Vertical	Total	Horizontal	Vertical	Total	Horizontal	Vertical	Total	Horizontal	Vertical	Total	Horizontal	Vertical	Total	Horizontal	Vertical	Total	Horizontal	Vertical	Total	Horizontal	Vertical	Total

Total

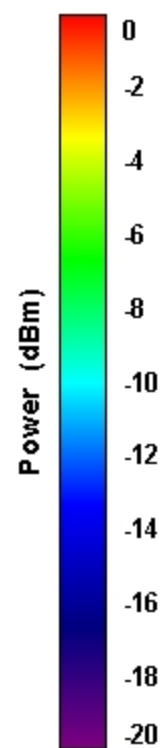
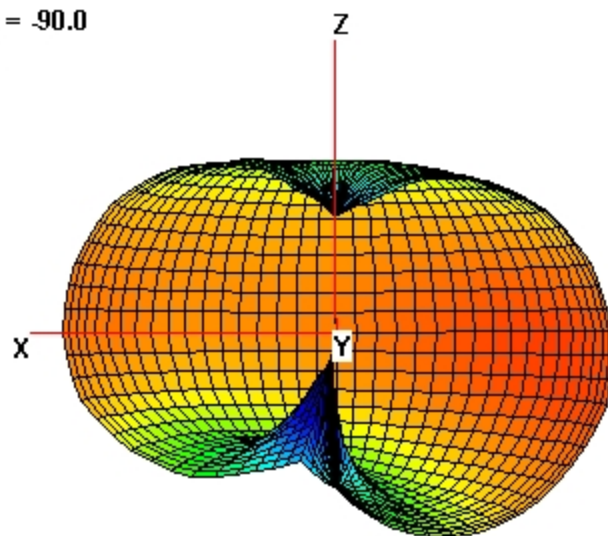


Total



Total

Azimuth = -180.0
Elevation = -90.0
Roll = 0.0



Tornado Bluetooth Chip Antenna Spec:

Frequency range	2400 MHz ~ 2500 MHz
VSWR	2.5 : 1
Peak gain	0 dBi
Average gain	-4.0 dBi
Reference impedance	50 ohm

Notably: The VSWR and gain values will be degraded due to mechanical and space constrains.

Antenna Pattern (2450MHz)

(1) E1-plane:

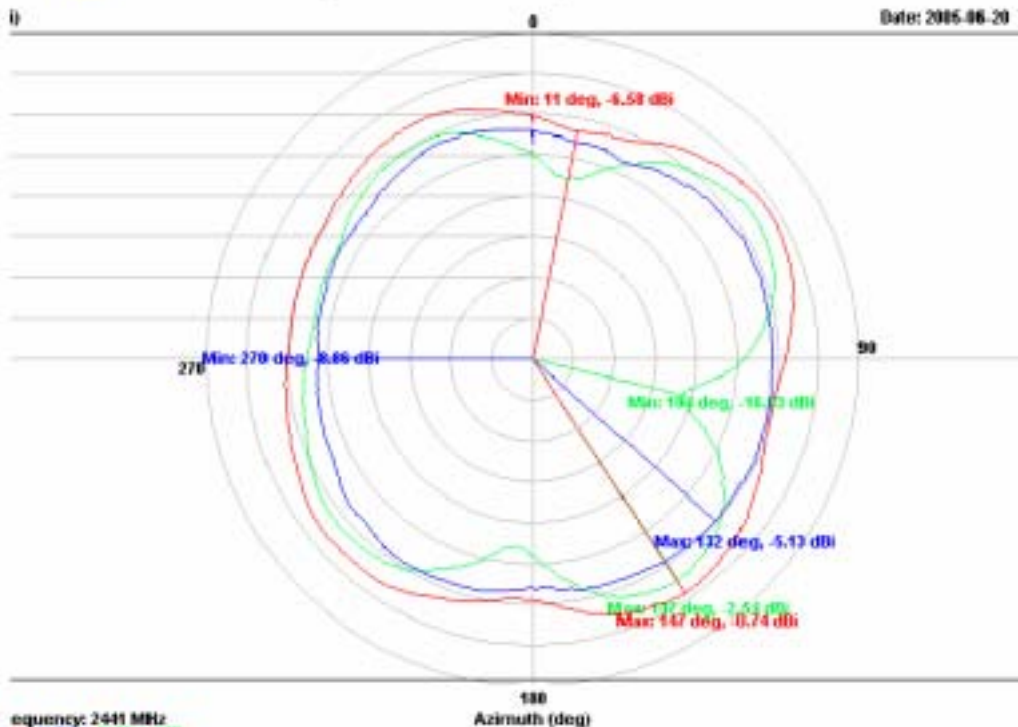


778 lm120 neihu rd sec1
taipei, taiwan r.o.c.
tel:+886-2-26594900
fax:+886-2-26594833
http://www.audio.com

Data#: 120

File#: C:\Program Files\ial\ANT\Tornado_Douton_ANT

Date: 2005-06-20 1



equency: 2448 MHz

in, V-Plan, B-Plan: 119

Site : site

Total Gain: Avg: -3.25dBi, Max: 147.0deg -0.74dBi, Min: 11.0deg -6.58dBi

V-Plan : Avg: -6.50dBi, Max: 132.0deg -5.13dBi, Min: 270.0deg -8.86dBi

H-Plan : Avg: -6.03dBi, Max: 147.0deg -2.54dBi, Min: 104.0deg -16.03dBi

project : Douton 0620 BT_1

Phase : DVT

CH : 39

plane : E1

date : 2005/06/20

(1) H-plane:

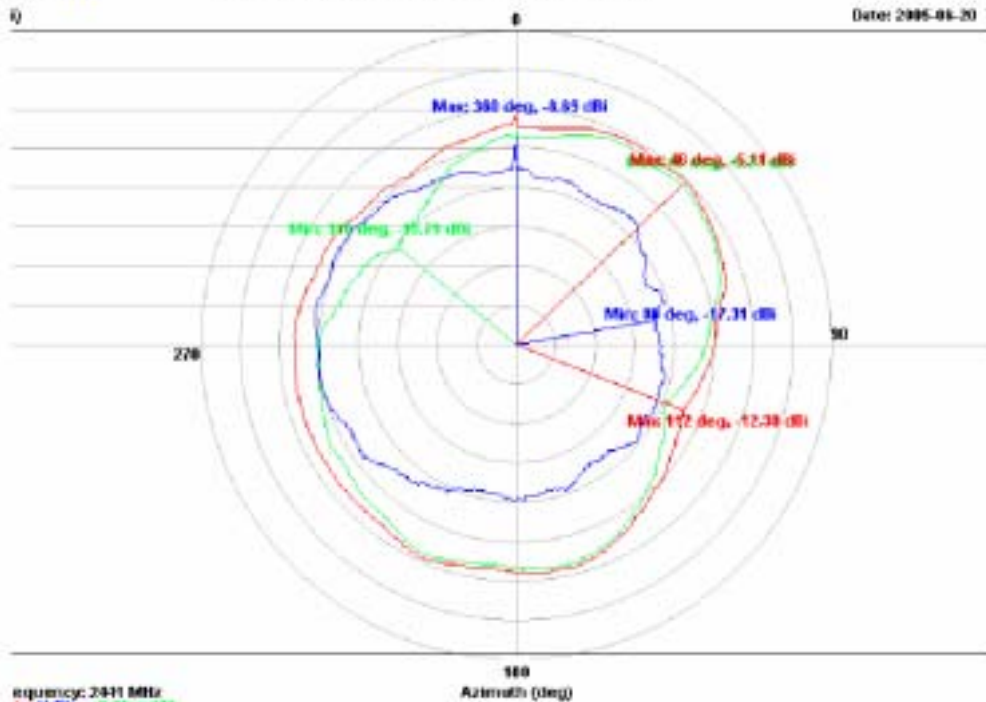


7F8 la120 neiku rd sec1
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tel:+886-2-26594900
fax:+886-2-26594833
http://www.autilx.com

Dat#: 122

File#: C:\Program Files\ai\ANT\Tornado_Debug.ANT

Date: 2005-06-20 T



frequency: 2441 MHz
 blue, V-Plan, H-Plane (dB)
 Site : site
 Total Gain: Avg: -7.26dBi, Max: 46.0deg -5.11dBi, Min: 112.0deg -12.30dBi
 V-Plan : Avg: -12.86dBi, Max: 360.0deg -8.69dBi, Min: 80.0deg -17.31dBi
 H-Plan : Avg: -8.66dBi, Max: 46.0deg -5.77dBi, Min: 310.0deg -15.79dBi
 project : Dostun 0620 NT_1
 Phase : DVT
 CH : 39
 plane : H
 date : 2005/06/20

(3) E2-plane:



7f8 (n) 20 nellu rd sec 1
taipei, taiwan r.o.c.
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fax:+886-2-26594833
http://www.audio.com

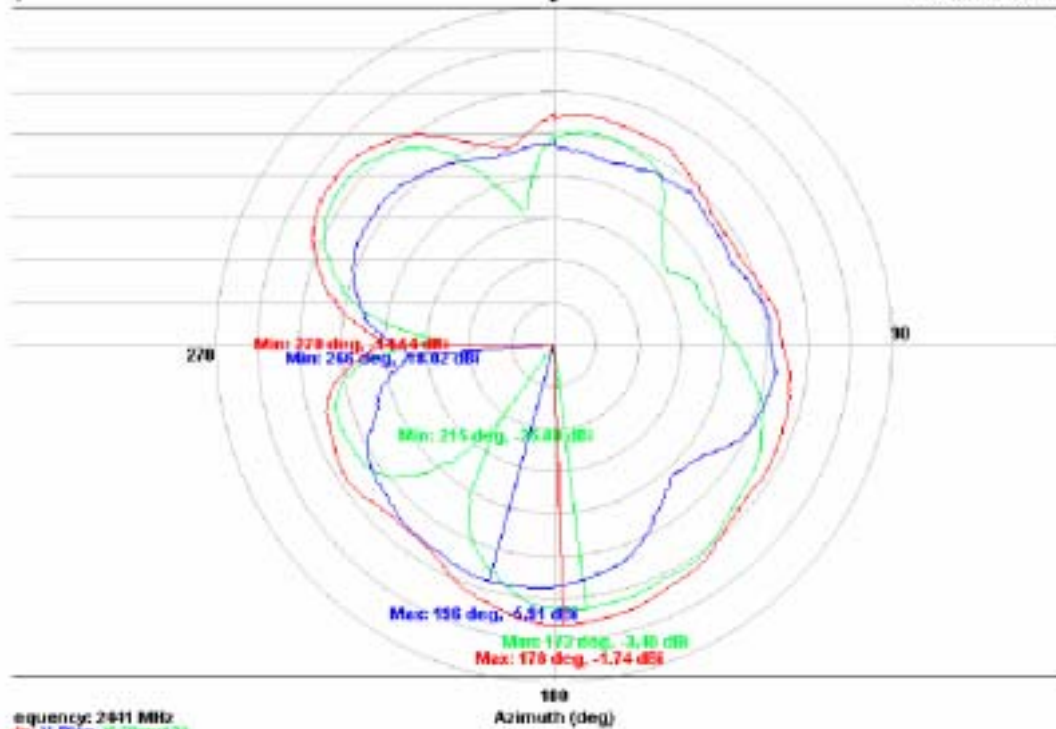
Data#: 124

File#: C:\Program Files\1\ANT\Tornado_Douton.ANT

0)

0

Date: 2005-06-20 1



equency: 2441 MHz
in, V-Plan, is 2441 MHz

Site : site

Total Gain: Avg: -5.82 dBi, Max: 170.0 deg -1.74 dBi, Min: 270.0 deg -14.54 dBi

V-Plan : Avg: -9.71 dBi, Max: 196.0 deg -5.91 dBi, Min: 266.0 deg -18.02 dBi

H-Plan : Avg: -8.10 dBi, Max: 173.0 deg -3.48 dBi, Min: 215.0 deg -25.80 dBi

project : Douton 0620 BT_1

Phase : DVT

CH : 39

plane : E2

date : 2005/06/20