

Measurement of Maximum Permissible Exposure

1. Foreword

In adopt with the Human Exposure IEEE C95.1, and according to the FCC 1.1310. The *Maximum Permissible Exposure (MPE)* is obligated to measure in order to prove the safety of radiation harmfulness to the human body.

The *Gain* of the antenna used is measured in an *Anechoic chamber*. The *maximum total power to the antenna* is to be recorded. By adopting the ***Friis Transmission Formula*** and the *power gain of the antenna*, we can find the distance right away from the product, where the limit of the MPE is.

2. Description of EUT

FCC ID	:	MSQWL550GE
Product Name	:	ASUS Wireless Router
Model Name	:	WL-550gE
Frequency Range	:	2.412GHz ~ 2.462GHz
Channel Spacing	:	5MHz
Support Channel	:	11 Channels
Modulation Skill	:	DBPSK, DQPSK, CCK, OFDM
Power Type	:	Powered by the switching adapter, Model: DSA-0101F-05 A (Mfg.: DVE) I/P: 100-240VAC 50/60Hz 0.3A 30VA O/P: +5VDC 2A 188cm length, non-shielded, incorporating a ferrite core

3. Limits for Maximum Permissible Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time E ² , H ² or S (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	100	6
3.0-30	1842/f	4.89/f	900/f ²	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	100	30
1.34-30	824/f	2.19/f	180/f ²	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30

[The EUT is tested in transmit and receive modes and in the first, middle and the last channel separately. The following shows only our observation have the greatest emissions.]

According to OET BULLETIN 56 Fourth Edition/August 1999, Equation for Predicting RF Fields:

$$\text{Friis Transmission Formula: } S = \frac{PG}{4\pi R^2} = \frac{136.773 \times 1.585}{4\pi(20)^2} = 5.289e^{-3} \text{ mW/cm}^2$$

$$\text{Estimated safe separation: } R = \sqrt{\frac{PG}{4\pi}} = \sqrt{\frac{136.773 \times 1.585}{4\pi}} = 4.153 \text{ cm}$$

Remarks: "The safe estimated separation that the user must maintain from the antenna is at least 4.15 cm"

Where: S = power density (in appropriate units, e.g. mW/cm²)

P = power input to the antenna (in appropriate units, e.g., mW)

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

The Numeric gain G of antenna with a gain specified in dB is determined by:

$$G = \text{Log}^{-1} (\text{dB antenna gain} / 10)$$

$$G = \text{Log}^{-1} (2.0 / 10) = 1.58489$$

Appendix

Antenna Specification



JOINSOON ELECTRONICS MFG.CO.,LTD.

建舜電子製造股份有限公司

承認書

APPROVAL SHEET

客戶名稱(CUSTOMER): ASUS

品 名(DESCRIPTION): Antenna 2.4G + R-SMA

品 號(PART NO): IQ-040481

承認號碼(APPROVAL SHEET NO): 040049

客戶承認 (CUSTOMER APPROVAL)



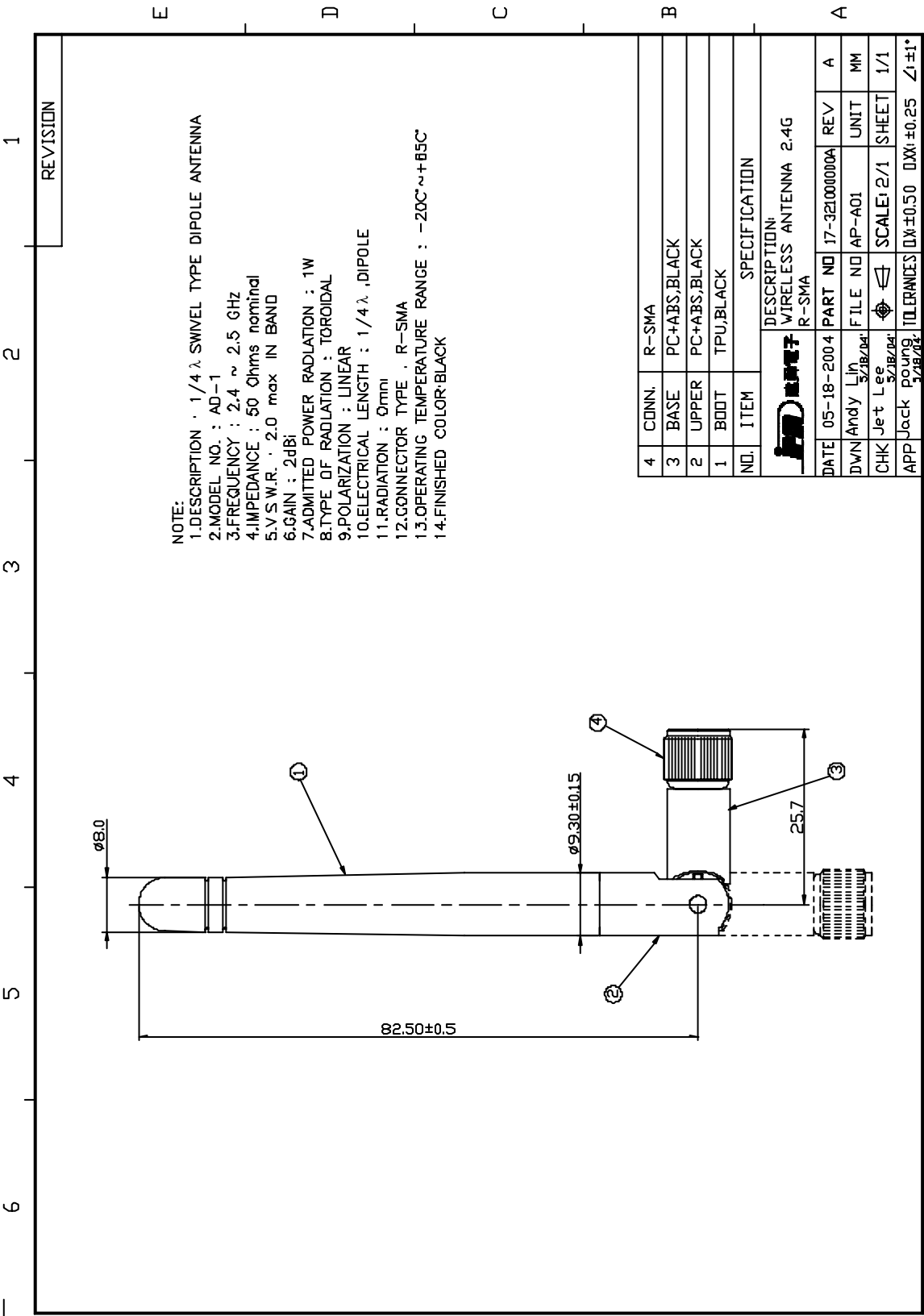


JOINSOON ELECTRONICS MFG. CO., LTD.

QUICK REFERENCE DATA

Antenna Dimension	$\Phi 9.3 \times 82.5$ mm
Connector	R-SMA
Peak Gain	≤ 2.0 dBi
VSWR	2.0
Polarization	Linear
Impedance	50 Ω
Operating Temperature	-20~65 °C
Maximum Power	1W

Product Drawing





天 線 產 品 規 格

ANTENNA SPECIFICATION PERFORMANCE

1. 一般事項(Generation)

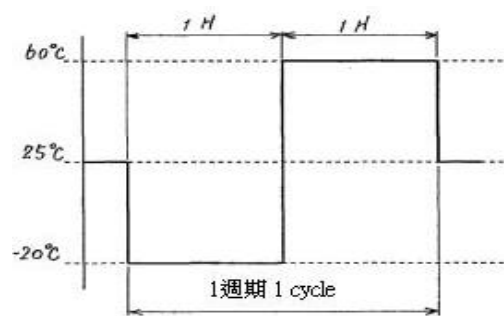
- 1.1 適用範圍 此樣式表適用於 JEM 開發之 ISM /UNII Band 的無線通訊系統所使用之天線。
 Application Field: This approval sheet only use for JEM development Wireless LAN antenna of ISM/UNII Band.
- 1.2 使用溫度範圍 -20 ~ 65 °C
 Operation : -20 ~ 65 °C
- 1.3 保存溫度範圍 -30 ~ 75 °C
 Storage : -30 ~ 75 °C
- 1.4 測試狀態 溫度 5 ~ 35 °C、相對濕度 45 ~ 85%、氣壓 860 ~ 1060 hpa 的標準狀態下進行測試。
 但是若對測試結果有質疑的話，可以於溫度 20 ± 2 °C、相對濕度 $65 \pm 5\%$ 、氣壓 860 ~ 1060hpa 的基準狀態進行測試。
 Test Condition: T=5 ~ 35 °C , Humidity=45 ~ 85%. If any doubt and you could test under the following standard T= 20 ± 2 °C , Humidity = $65 \pm 5\%$, Atmosphere=860 ~ 1060hpa

2. 外觀、構造、尺寸 (Appearance , Construction , Dimension)

- 2.1 外觀 各部位的修飾加工良好，沒有對於機能有害的生鏽、裂痕、瑕疵等等情形。
 Appearance : Good manufacture of each parts and without rusting,cracking,defect...etc to damage product.
- 2.2 機能、尺寸 依據各個製品圖。
 Construction, Dimension: According to each product drawing

3. 機械性能 Mechanical Performance

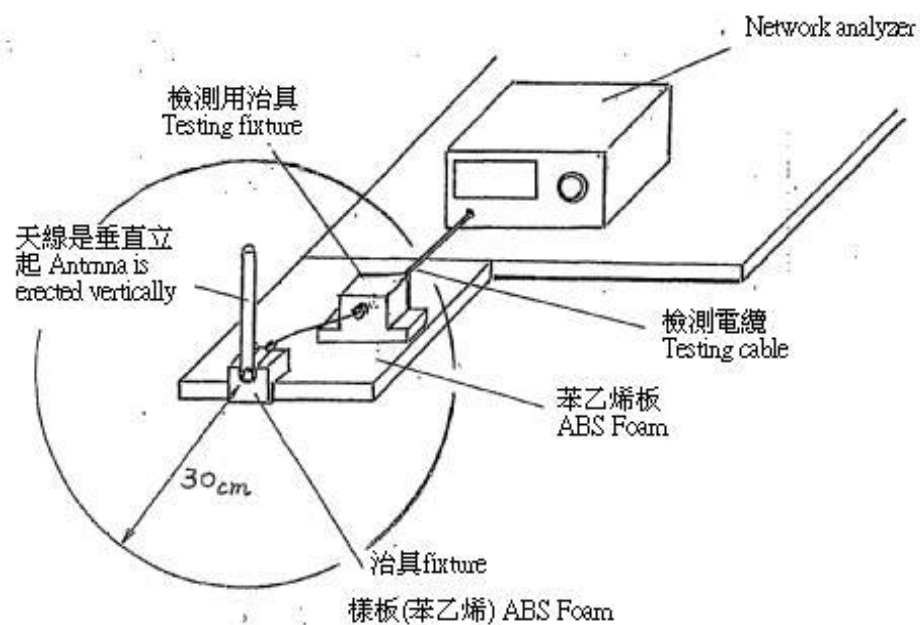
	項目 ITEM	測試條件 TEST CONDITION	規格 SPECIFICATION
3.1	抗振性 Vibration	振擺的比率 : 10 ~ 55 ~ 10 Hz/分 總振幅 : 1.5 mm X、Y、Z 方向各 2 小時 (總計 6 小時) Ratio: 10-50-10 Hz/minute. Vibration amplitude:1.5 mm To vibrate 2 hrs on X,Y,Z direction(Totally 6 hrs)	外觀、構造無異常 機械性能無異常 符合電氣性能 (4.1& 4.2 項) No abnormal of appearance, construction, mechanical. Meet electrical request(Item 4.1&4.2)
3.2	同軸電纜的抗拉強度 Tensile of Coaxial Cable	在同軸電纜的拉出方，施加 1 kgf 的靜止負荷重量一分鐘。 To load 1Kgf weight within 1 minute.	同軸電纜不會脫落 No fall of Coaxial cable. Remarks: This test only for pigtail type.

4. 電氣的性能 Electrical Properties			
	項目 ITEM	測試條件 TEST CONDITION	規格 SPECIFICATION
4.1	駐波比 VSWR	放置在任何空間進行檢測。 (VSWR & Return Loss 的檢測方式參考次頁明細圖) To detect on any space. (VSWR & Return Loss testing to read next figure for ref.)	2.0 以下 2.0 Max. (2.4 GHz ~ 2.5 GHz)
4.2	反射損失 Return Loss		-10 dB 以下 -10 dB Max. (2.4 GHz ~ 2.5 GHz)
4.3	特徵阻抗 Impedance		500
4.4	指向性 Certain direction		
4.5	最大增益 Max GAIN		-5~3 dBi 以上（絕對增益） -5~3 dBi Min.
5. 耐氣候性 Environmental Performance			
	項目 ITEM	測試條件 TEST CONDITION	規格 SPECIFICATION
5.1	耐熱性 Temperature Life	放置在溫度 60±2℃ 中，96 小時後在正常溫濕度下放置 1 小時進行檢測。 To put antenna at 60±2℃ within 96 hrs then take it out to put at normal environment within 1 hour later to detect.	外觀、構造無異常 機械性能無異常 符合電氣性能（4.1& 4.2 項） No abnormal of appearance, construction, mechanical. Meet electrical request(Item 4.1& 4.2)
5.2	耐寒性 Cold	放置在 -10±2℃ 中，96 小時以後，再置於正常溫濕度 1 小時進行檢測。 To keep in -10±2℃ within 96hrs and take out to put at normal environment within 1 hour later to detect.	
5.3	耐溫性 穩定狀態) Humidity (Stable)	放置在+40±2℃，相對濕度 90～95%的狀態，96 小時以後，再置於正常溫濕度 1 小時進行檢測。 To keep in +40±2℃，damp=90~95% within 96 hrs and take it out to put at normal environment within 1 hour later to detect.	
5.4	熱沖擊測試 Thermal Shock	-20℃，+60℃的狀態各放置 1 小時視為 1 週期，測試 10 週期後，再放置於正常溫濕度 1 小時後進行檢測。 To put antenna at -20℃ & +60℃ and each degree for 1 hour as a cycle，totally need to repeat 10 cycles then put at normal environment within 1 hour later to detect. 	

(註) 電氣性能項目的檢測機器

(Remarks) Testing equipments

檢測器(equipment)：Agilent Network Analyzer E8358A

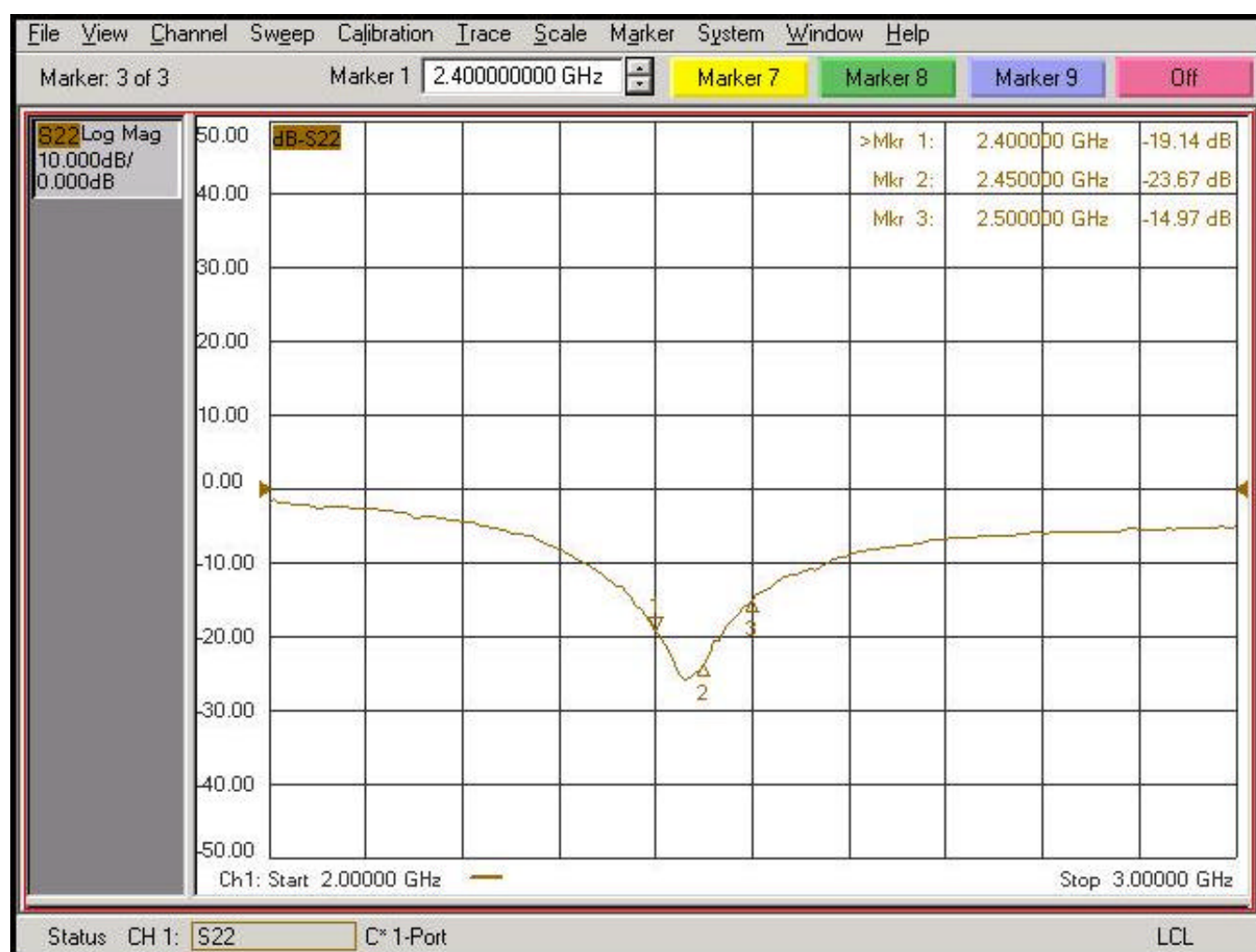




Test results

1. Return Loss

Antenna	Center freq. @MHz	BW @MHz	Return Loss		
			2.4GHz	2.45GHz	2.5GHz
	2450	240	-19.14	-23.67	-14.97





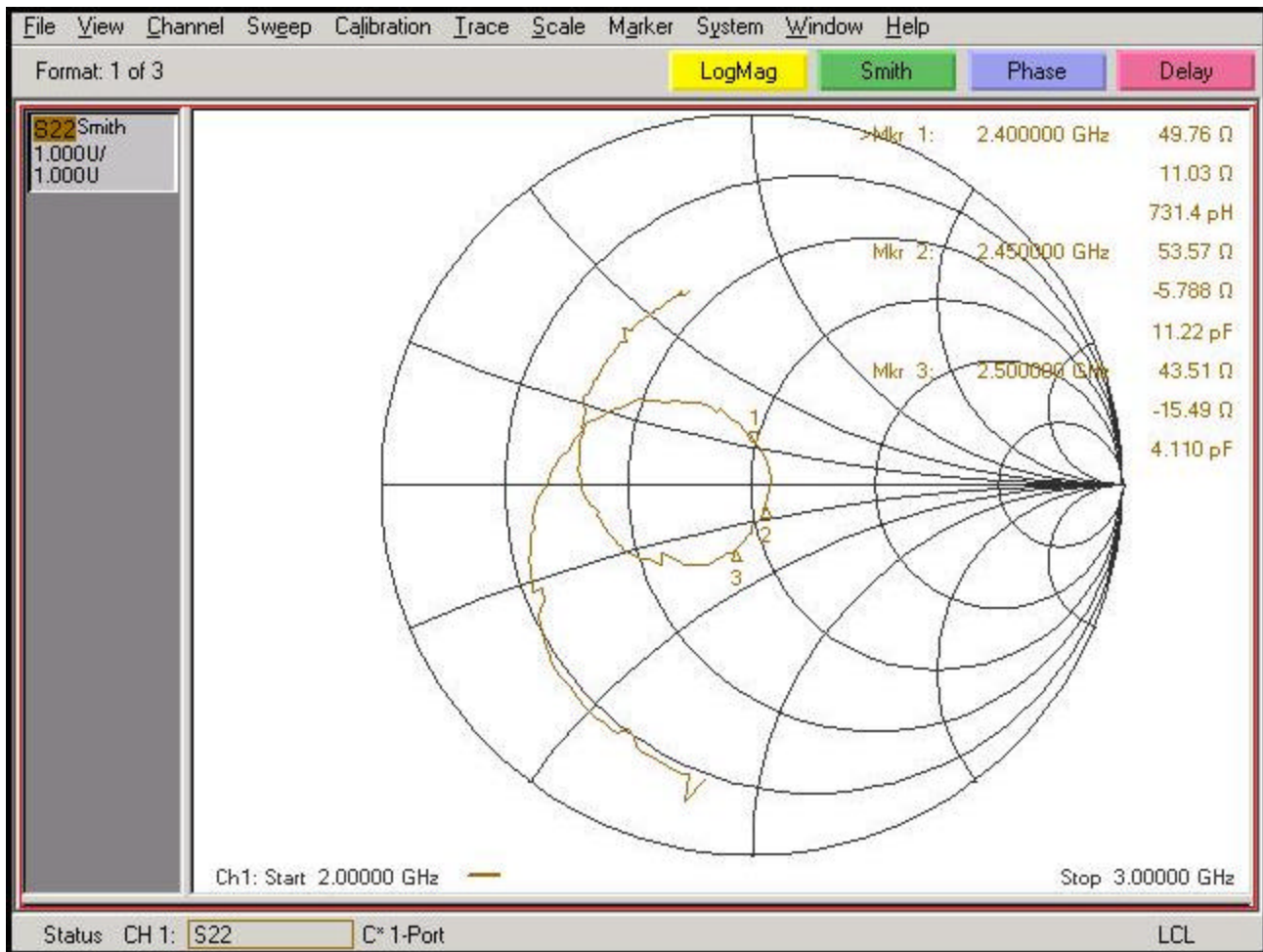
2. VSWR

Antenna	Center freq. @MHz	BW @MHz	VSWR		
			2.4GHz	2.45GHz	2.5GHz
	2450	240	1.246	1.141	1.432





3.Smith Chart

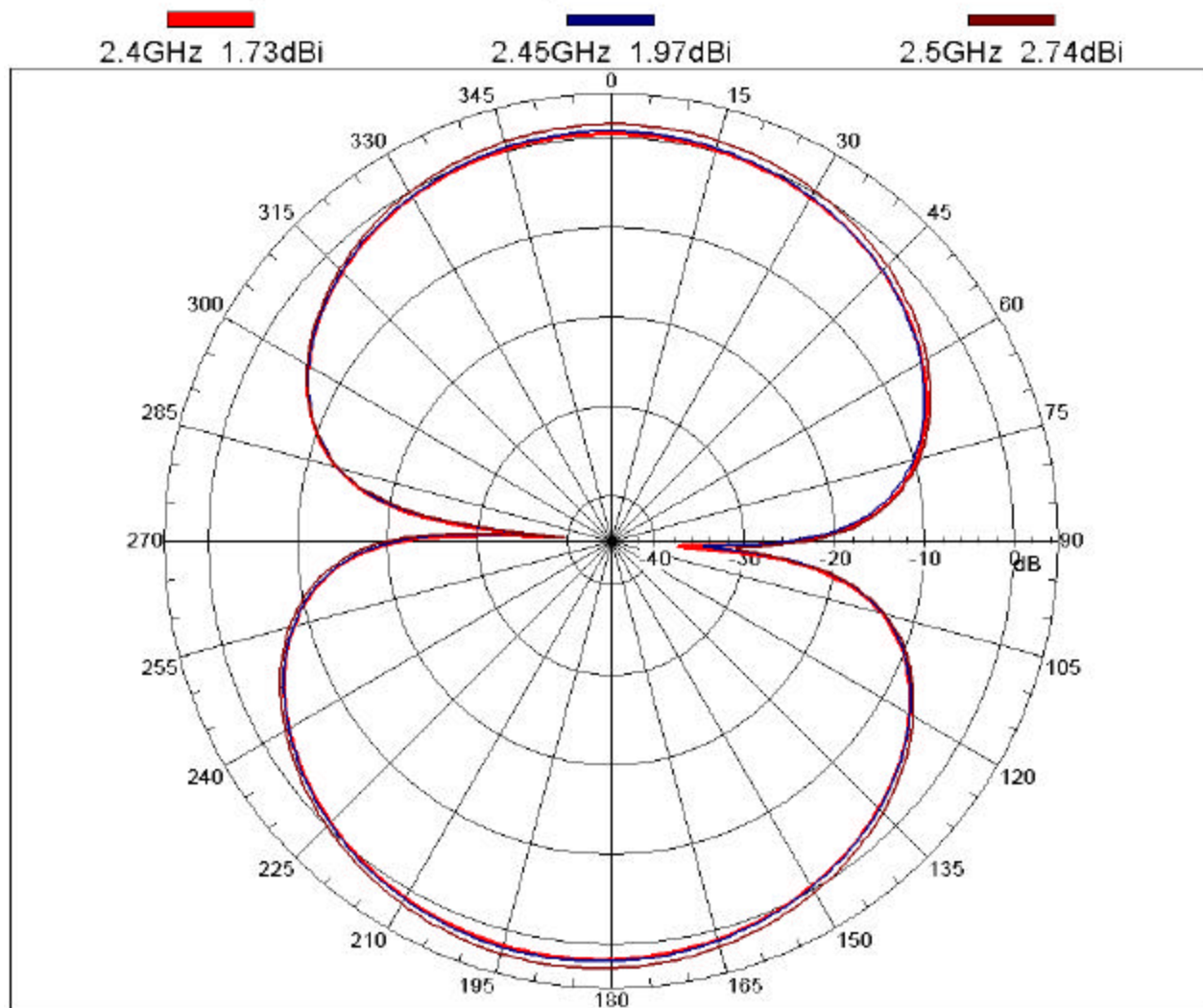




Free Space 天線輻射場形：

1. Radiation Pattern of **H Plane**

Far-field amplitude of SMA Dipole 2400 TO 2500MHz E-Patten01.nsi





2. Radiation Pattern of V Plane

Far-field amplitude of SMA Dipole 2400 TO 2500MHz H-Patten02.nsi

