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	:	MSQWL520G
Product name	:	125 High Speed Wireless Router
Model	:	WL-520G
Classification	:	Mobile Device (i) Under normal use condition, the antenna is at least 20cm away from the user; (ii) Warning statement for keeping 20cm separation distance and the prohibition of operating next to the person has been printed in the user's manual
Frequency Range	:	2.412 GHz ~ 2.462GHz
Supported Channel	:	11 Channels
Modulation Skill	:	DBPSK, DQPSK, CCK, OFDM
Power Type	:	Powered by the AC-DC adapter, Model: DV-0980S-B20 I/P: 120VAC, 60Hz, 14W O/P: 9VDC, 800mA 190cm length, non-shielded, no ferrite core

3. Limits for *Maximum Permissible Exposure (MPE)*

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Filed Strength (H) (A/m)	Power Density (S) (mW/cm2)	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:**

Friis Transmission Formula: $S = \frac{PG}{4\pi R^2} = \frac{177.42 \times 1.58}{4\pi(20)^2} = 0.05594 mW/cm^2$

Estimated safe separation: $R = \sqrt{\frac{PG}{4\pi}} = \sqrt{\frac{177.42 \times 1.58}{4\pi}} = 4.73038 cm$

Remarks: "The safe estimated separation that the user must maintain from the antenna is at least 4.73cm"

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:

$G = \text{Log}^{-1}$ (***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

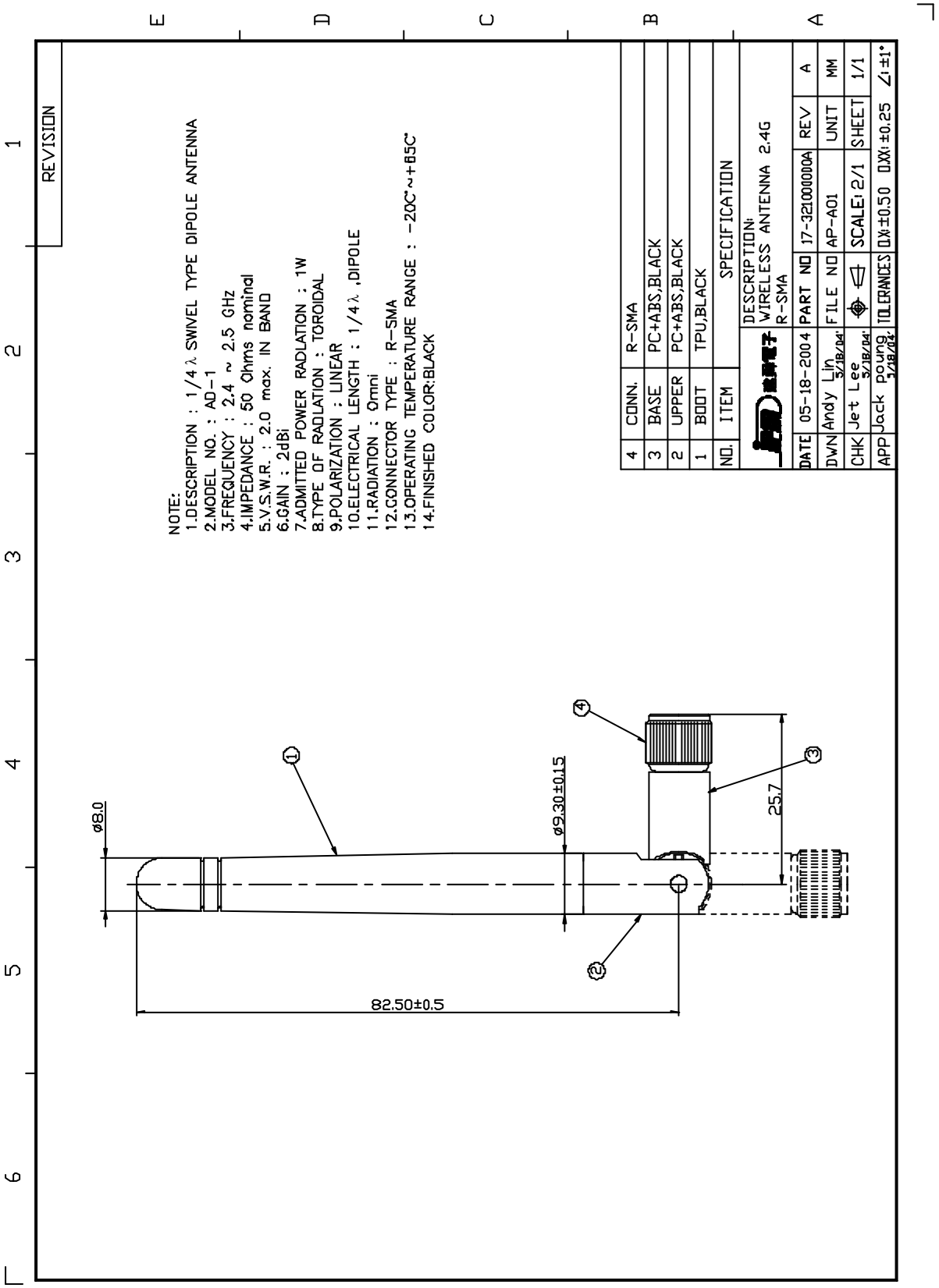
承認號碼(APPROVAL SHEET NO): 040049

客戶承認 (CUSTOMER APPROVAL)

QUICK REFERENCE DATA

Antenna Dimension	Φ9.3*82.5 mm
Connector	R-SMA
Peak Gain	≦2.0 dBi
VSWR	2.0
Polarization	Linear
Impedance	50Ω
Operating Temperature	-20~65 ℃
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 ℃

Operation : -20 ~ 65 ℃

1.3 保存溫度範圍 -30 ~ 75 ℃

Storage : -30 ~ 75 ℃

1.4 測試狀態 溫度 5 ~ 35 ℃、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 ℃、相對濕度 65 ± 5%、氣壓 860 ~ 1060hpa 的基準狀態進行測試。

Test Condition: T=5 ~ 35 ℃ , Humidity=45 ~ 85%. If any doubt and you could test under the following standard T= 20 ±2℃ , Humidity = 65±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銹、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

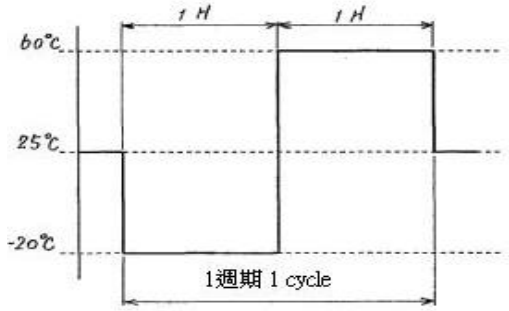
3. 機械性能 Mechanical Performance

	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		50O
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.

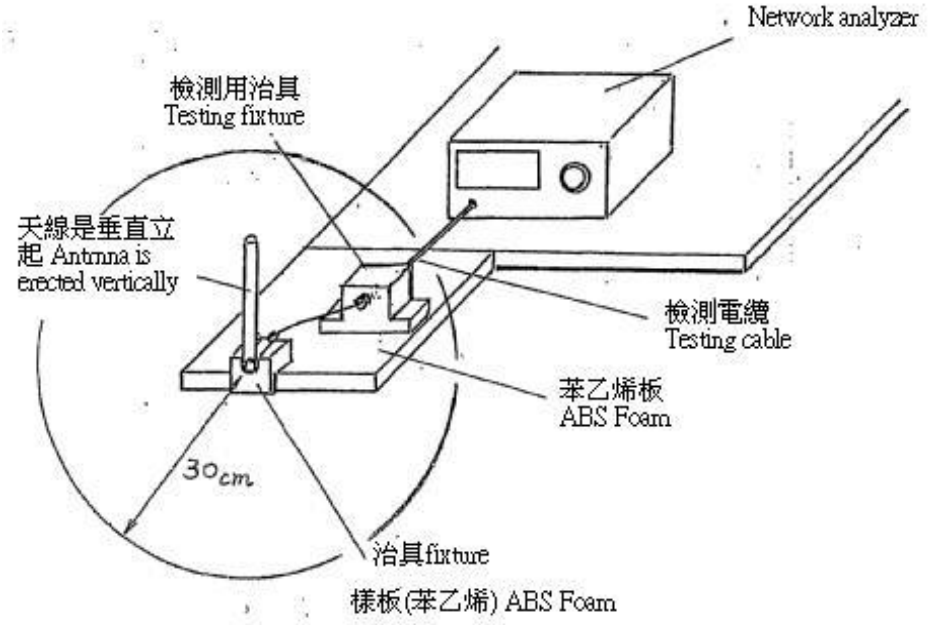
5. **耐氣候性** Environmental Performance

	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

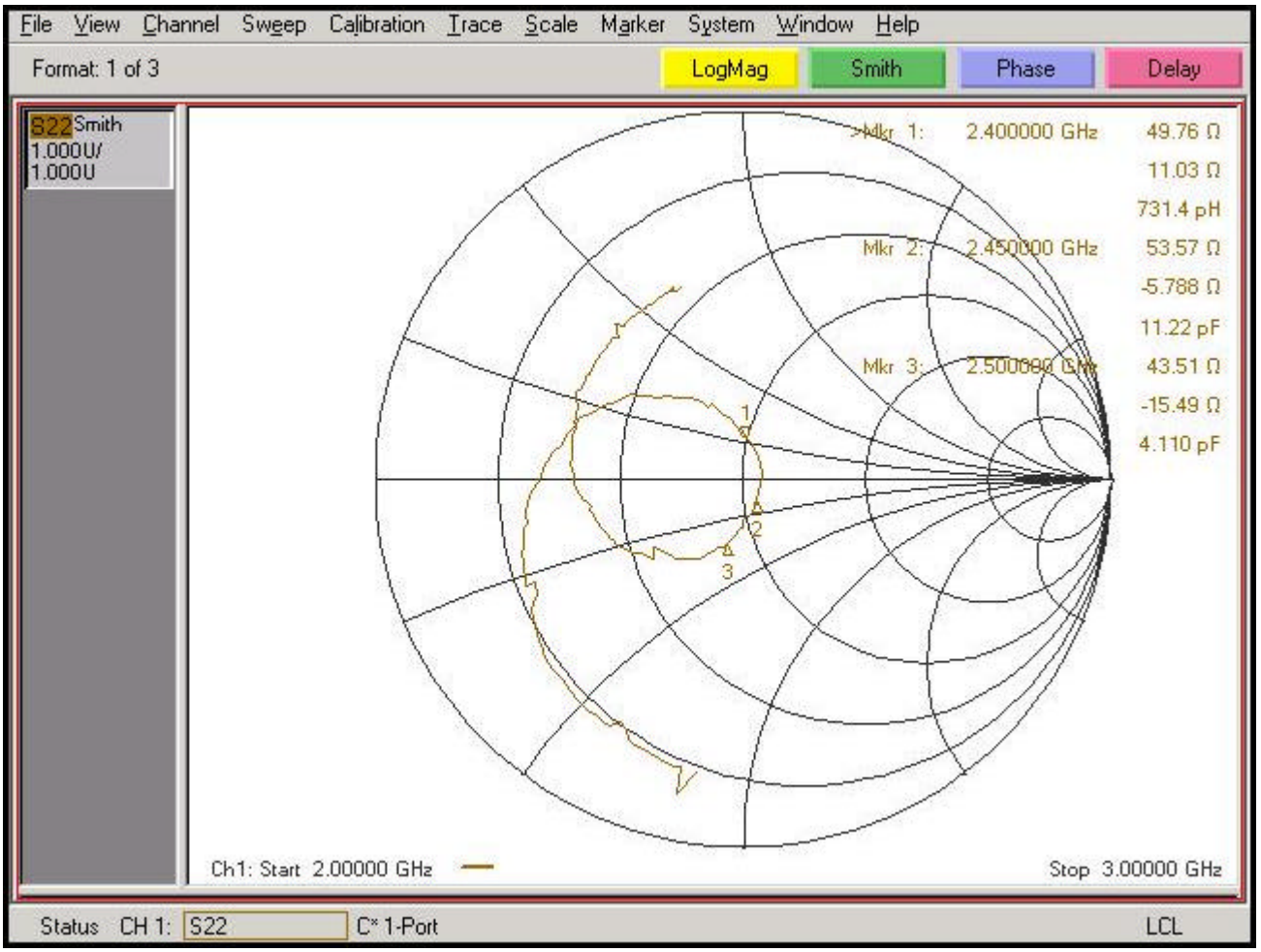
1. Return Loss

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

2. VSWR

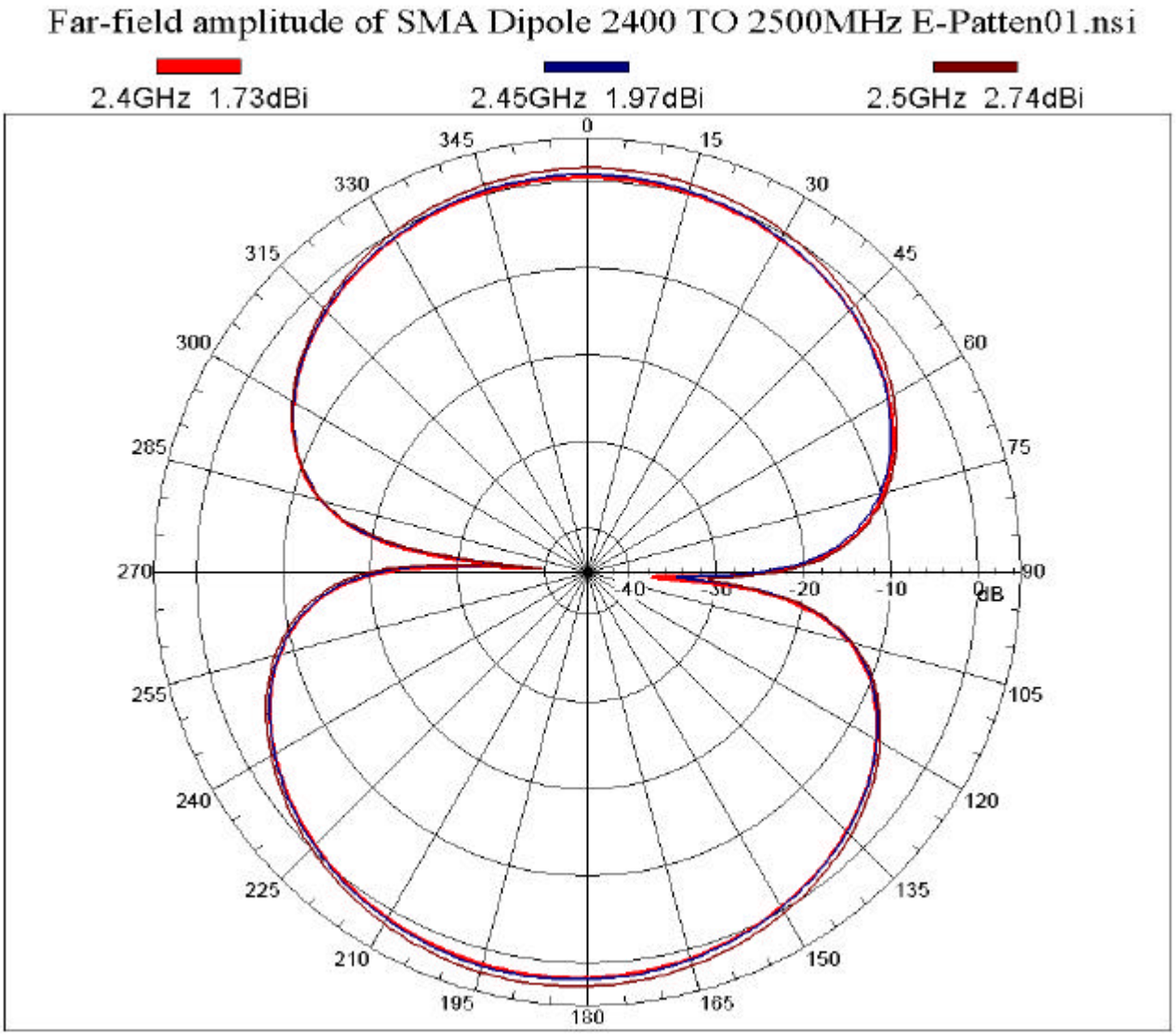
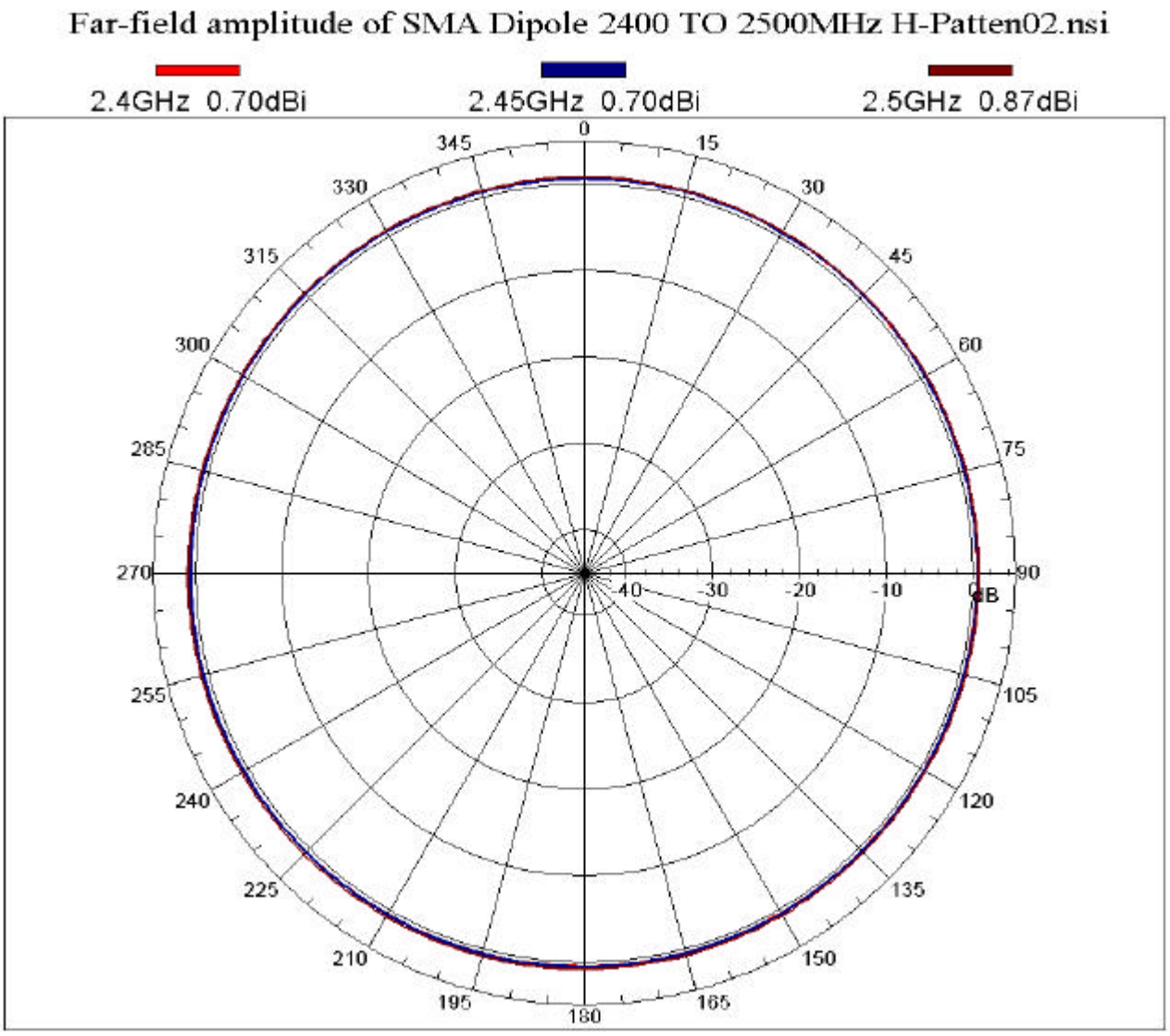
Antenna	Center freg. @MHz	BW @MHz	VSWR		
			2.4GHz	2.45GHz	2.5GHz
	2450	240	1.246	1.141	1.432

3.Smith Chart



Free Space **天線輻射場形：**

1. Radiation Pattern of **H Plane**



2. Radiation Pattern of **V Plane**