

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)

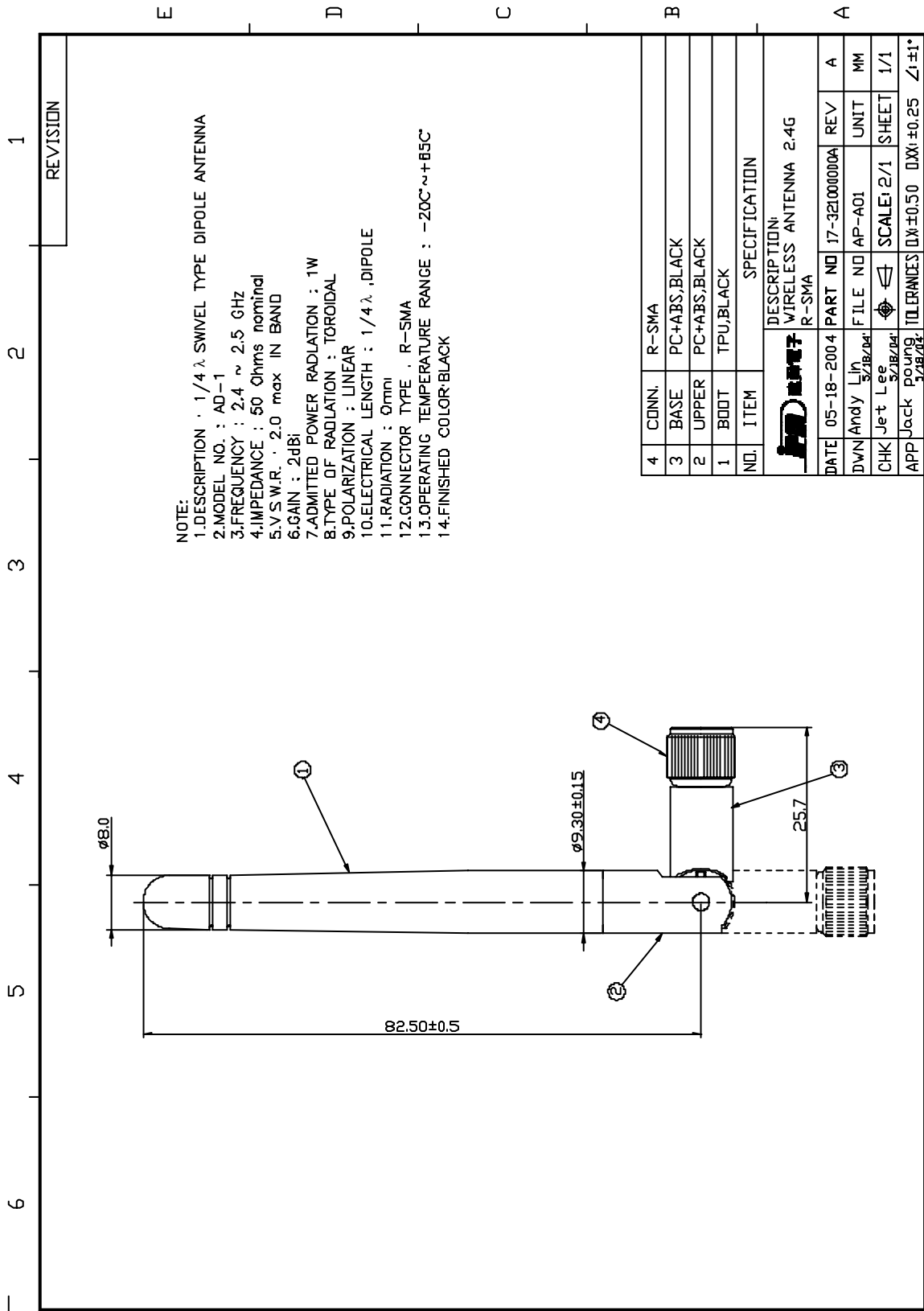




QUICK REFERENCE DATA

| | |
|------------------------------|--------------------|
| Antenna Dimension | $\Phi 9.3*82.5$ 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



NOTE:
 1. DESCRIPTION : $1/4 \lambda$ SWIVEL TYPE DIPOLE ANTENNA
 2. MODEL NO. : AD-1
 3. FREQUENCY : $2.4 \sim 2.5$ GHz
 4. IMPEDANCE : 50 Ohms nominal
 5. V.S.W.R. : 2.0 max IN BAND
 6. GAIN : 2dBi
 7. ADMITTED POWER RADIATION : 1W
 8. TYPE OF RADIATION : TOROIDAL
 9. POLARIZATION : LINEAR
 10. ELECTRICAL LENGTH : $1/4 \lambda$, DIPOLE
 11. RADIATION : Omni
 12. CONNECTOR TYPE : R-SMA
 13. OPERATING TEMPERATURE RANGE : $-20^{\circ}\text{C} \sim +65^{\circ}\text{C}$
 14. FINISHED COLOR: BLACK

| REVISION |
|----------|
| 1 |

| | | | | | |
|--|------------|---------------|--------------|-----------|--------|
| 4 | CONN. | R-SMA | | | |
| 3 | BASE | PC+ABS, BLACK | | | |
| 2 | UPPER | PC+ABS, BLACK | | | |
| 1 | BOOT | TPU, BLACK | | | |
| NO. | ITEM | SPECIFICATION | | | |
| FD DESCRIPTION: WIRELESS ANTENNA 2.4G R-SMA | | | | | |
| DATE | 05-18-2004 | PART NO | I7-32100000A | REV | A |
| DWN | Andy Lin | FILE NO | AP-A01 | UNIT | MM |
| CHK | Jet Lee | SCALE | 2/1 | SHEET | 1/1 |
| APP | Jack | TOLERANCES | DX: ±0.50 | DX: ±0.25 | ∠: ±1° |



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 ± 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±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

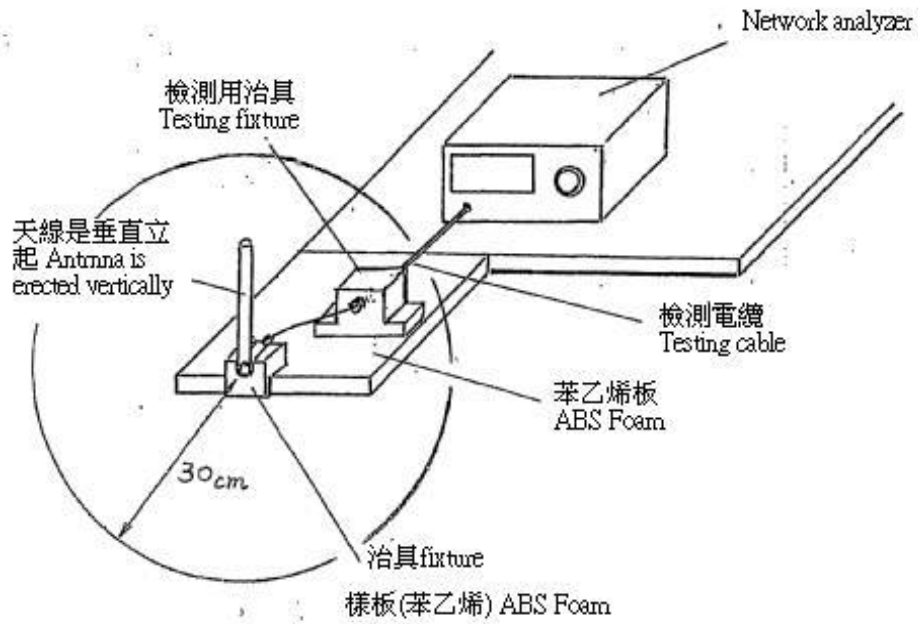
| | 項目 ITEM | 測試條件 TEST CONDITION | 規格 SPECIFICATION |
|-----|--|---|--|
| 3.1 | 抗振性 Vibration | 振擺的比率 : 10 ~ 55 ~ 10 Hz/分 總振幅 : 1.5 mm X、Y、Z 方向各 2 小時 (總計 6 小時) Ratio: 10-50-10 Hz/minute. Vibration amplitude:1.5 mm To vibrate 2 hrs on X,Y,Z direction(Totally 6 hrs) | 外觀、構造無異常 機械性能無異常 符合電氣性能 (4.1& 4.2 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 $60 \pm 2^\circ\text{C}$ 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 $60 \pm 2^\circ\text{C}$ 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 $-10 \pm 2^\circ\text{C}$ 中，96 小時以後，再置於正常溫濕度 1 小時進行檢測。 To keep in $-10 \pm 2^\circ\text{C}$ within 96hrs and take out to put at normal environment within 1 hour later to detect. | |
| 5.3 | 耐濕性 (穩定狀態) Humidity (Stable) | 放置在 $+40 \pm 2^\circ\text{C}$ ，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 $+40 \pm 2^\circ\text{C}$, 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°C ， $+60^\circ\text{C}$ 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°C & $+60^\circ\text{C}$ 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

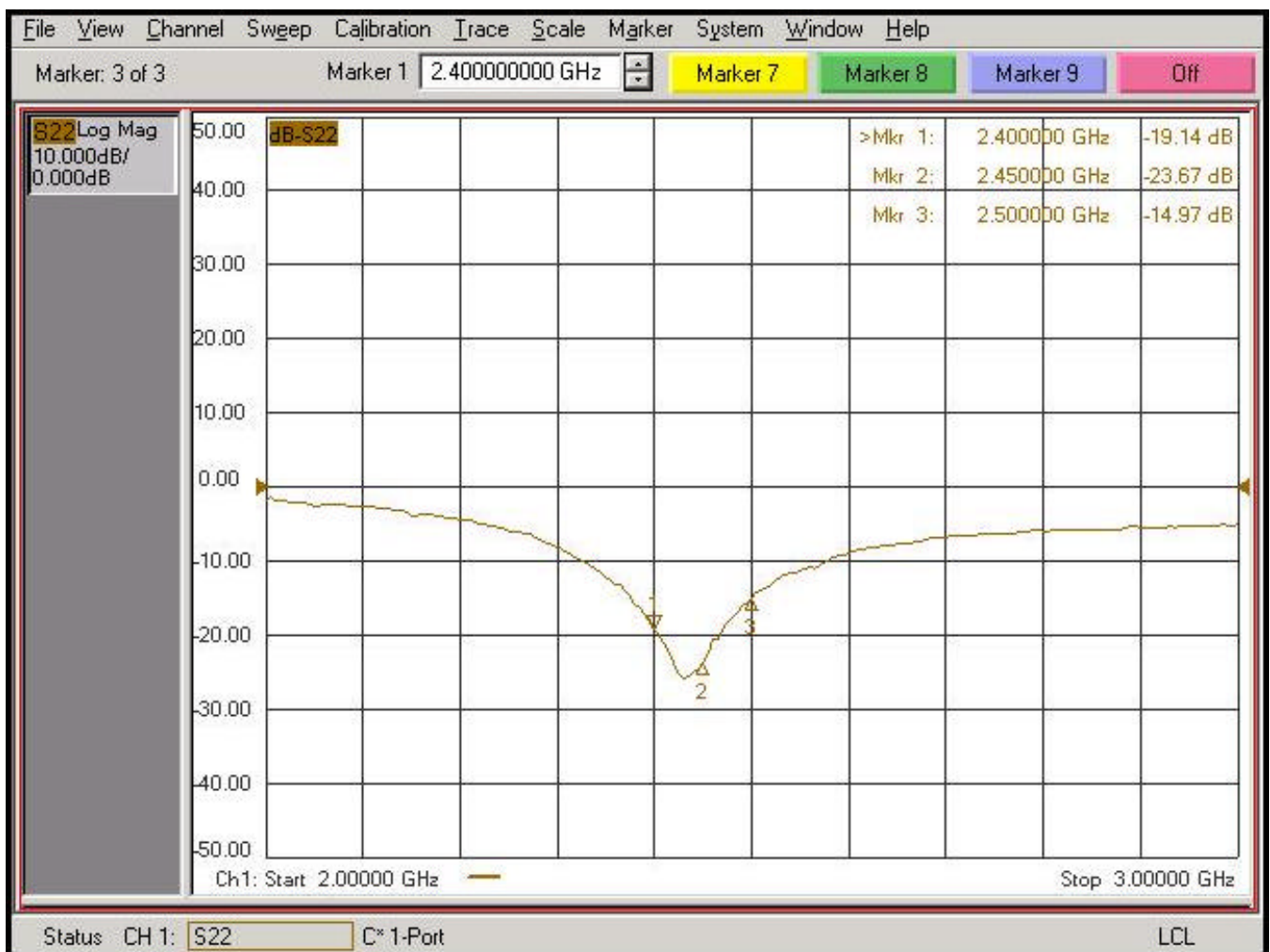
檢測器(equipment) : Agilent Network Analyzer E8358A



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 |





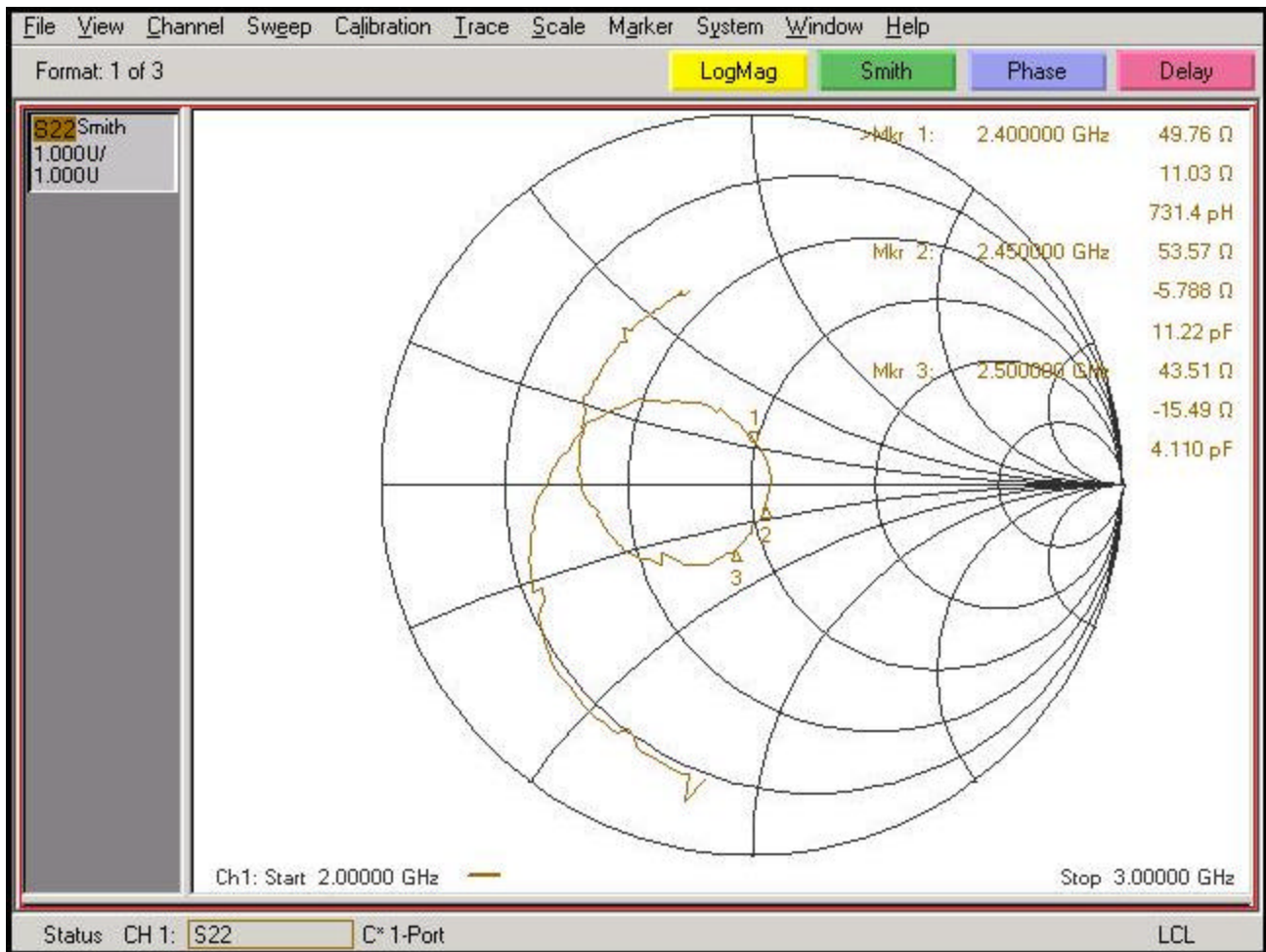
2. VSWR

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





3. Smith Chart

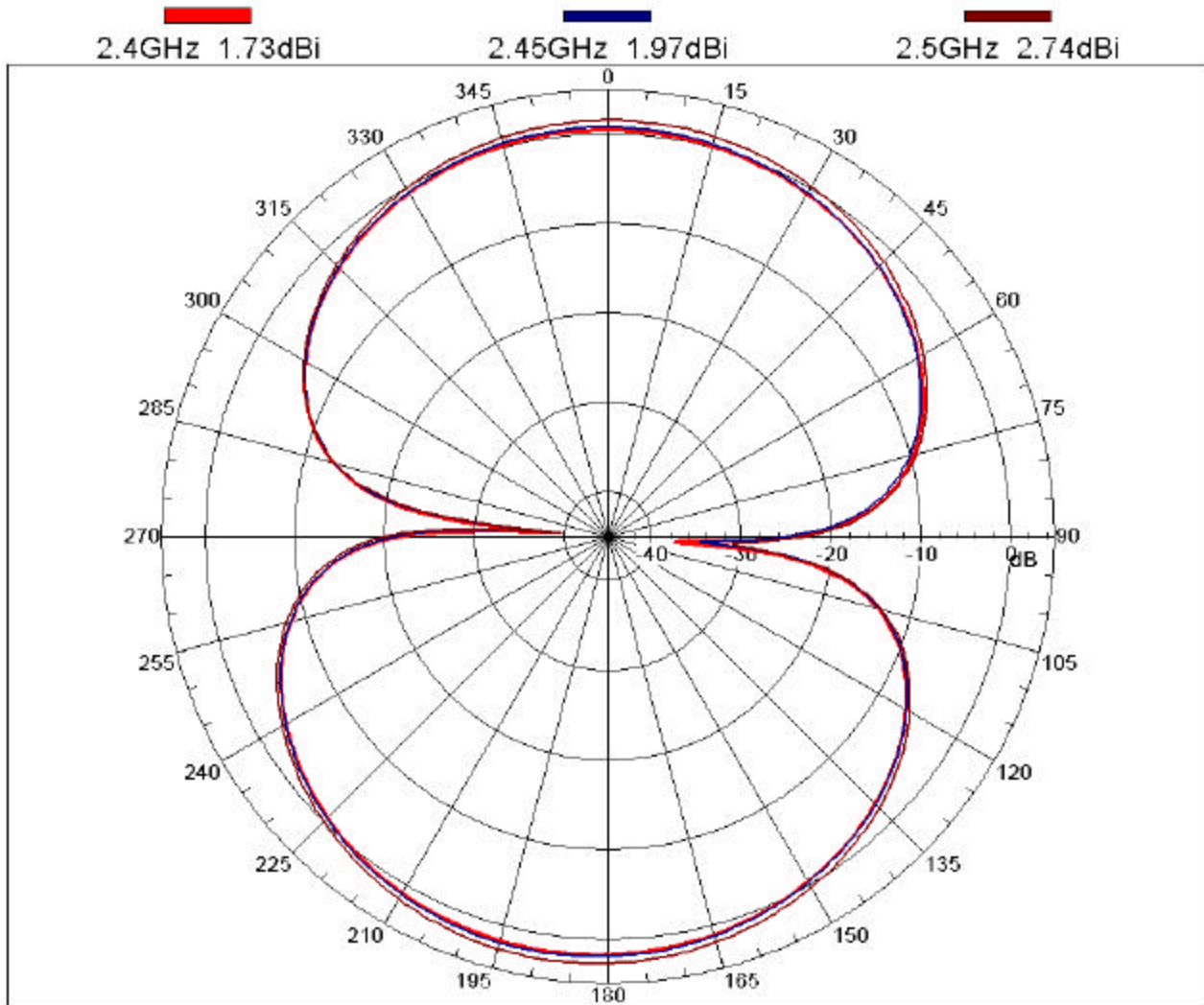




Free Space 天線輻射場形：

1. Radiation Pattern of H Plane

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

