

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	:	MSQAAM6KTPB2
Product Name	:	Wireless ADSL Router
Model Name	:	AAM6XXXTPB2; 6238-I2-XXX; AM200g
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 (1) or (2), 1) Model: DVS-180A10FUS [DVE] I/P: 100-240VAC 50/60Hz 0.7A O/P: 18VDC 1A 190cm length, non-shielded, with ferrite core 2) Model: ADS6818-1818-W 1810 [OEM] I/P: 100-240VAC 50-60Hz 0.5A O/P: 18VDC 1A 18W 190cm length, non-shielded, no 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:

$$\text{Friis Transmission Formula: } S = \frac{PG}{4\pi R^2} = \frac{97.051 \times 2.056}{4\pi(20)^2} = 0.03970 \text{ mW/cm}^2$$

$$\text{Estimated safe separation: } R = \sqrt{\frac{PG}{4\pi}} = \sqrt{\frac{97.051 \times 2.056}{4\pi}} = 3.98480 \text{ cm}$$

Note: "The safe estimated separation that the user must maintain from the antenna is at least 3.98cm"

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:

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

$$G = \text{Log}^{-1} (3.13 / 10) = 2.05589$$

Appendix

Antenna Specification



規格承認書

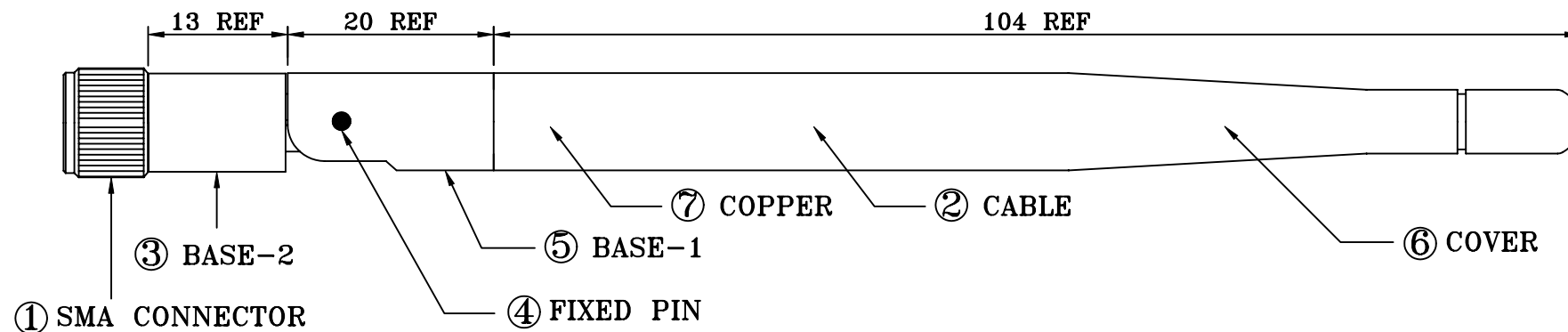
Specification for Approval

客 戶：華 碩
Customer
品 名：2.4GHz SMA Antenna
Part name
料 號：GY111C163-010
Part No.

客戶承認印 CUSTOMER APPROVED BY		
APPROVAL	CHIEF	SUPERVISOR
Approval No.		
Model		
Part No.		

CHIEF	SALES	R&D	DESIGN
Leo	Gary	Hui	Kao
Date: August.19.2005		Date: August.19.2005	
驊 陞 科 技 股 份 有 限 公 司 WIESON TECHNOLOGIES CO., LTD.			

REV	DATE	DESCRIPTION	NAME
01	05.08.18	NEW RELEASE	Hui



NOTES:

FREQUENCY : 2.4GHz ~ 2.4835GHz
VSWR : 2.0 MAX

7.	COPPER	COPPER TUBE , TIN PLATED	1	 WIESON TECHNOLOGIES CO., LTD	PART NO.: GY111C163-010		
6.	COVER	COVER , WHITE	1		TITLE: 2.4GHz SMA ANTENNA		
5.	BASE-1	BASE-1 , WHITE	1				
4.	FIXED PIN	FIXED PIN , NICKEL PLATED	2				
3.	BASE-2	BASE-2 , WHITE	1	DRAWN BY	Hui (WST)	DRAWING NO.	WSTS032116
2.	RG-178BUN01D18C	RG-178 COAXIAL CABLE , OD : 1.8mm , FEP TINT BROWN JACKET	1	CHECKED BY		DRAWING SIZE	A3
1.	CONNECTOR	SMA MALE (REVERSE POLARITY) , NICKEL PLATED	1	APPROVED BY		UNIT	mm
NO.	ITEM	DESCRIPTION	QTY	SORTING NO.	WST	PAGE	1 OF 1

TEST METHODS OF THE CHAMBER

I. Pattern Measurement :

(a) **Instruments** : anechoic chamber, network analyzer, standard gain antenna.

(b) **chamber description** :

- (1) The anechoic chamber is a far-field measurement system with size of 3.25M*2.84M*6.4M. The quiet zone region is 44cm*44cm*44cm at frequency range of 2.4GHz in the center of the rotator.

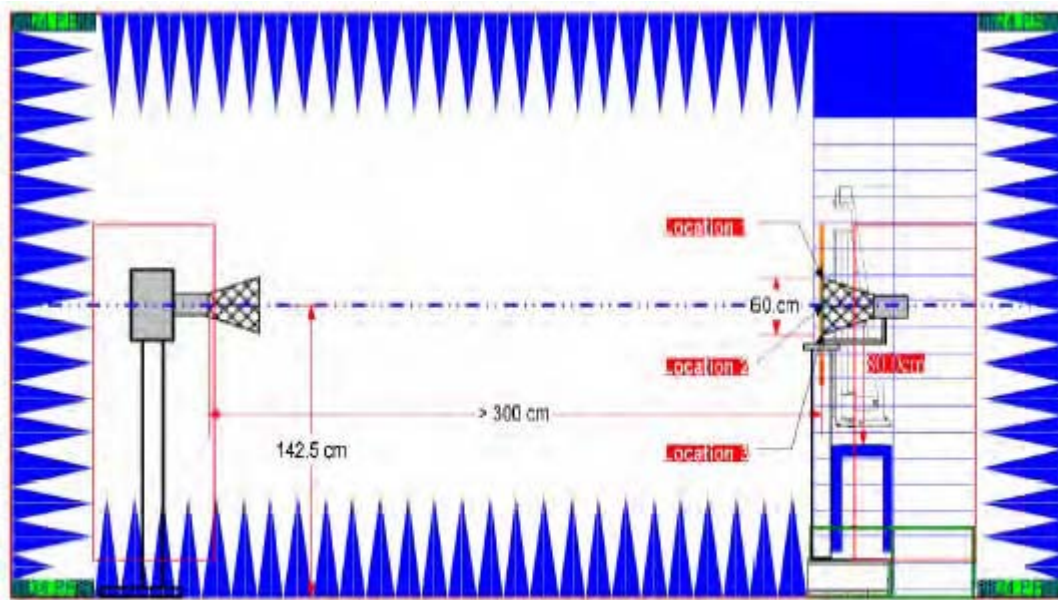


Fig.1. The interior components of the anechoic

- (2) Fig. 1. shows the interior components of the anechoic chamber. The antenna standard antenna as probe and antenna under test is 3M. The antenna under test is fixed on a step rotator. We can control the rotating angle for accurate or rough measurement.
- (3) While we measure the radiation patterns by rotating AUT with 360 degrees and repeat again by replacing the AUT with the standard gain antenna under test, we compare both data and using a formula to obtain the

$$G_{AUT} = G_{stand} + P_{AUT} - P_{stand}$$

G_{AUT} : Gain of AUT

G_{stand} : Gain of Standard Gain Antenna

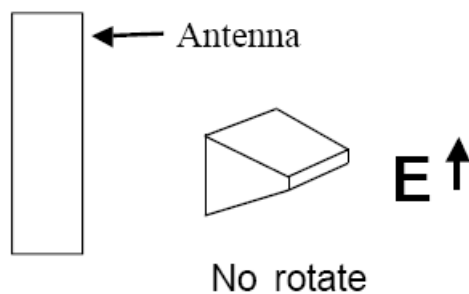
P_{AUT} : Measured Power of AUT

TEST METHODS OF THE CHAMBER

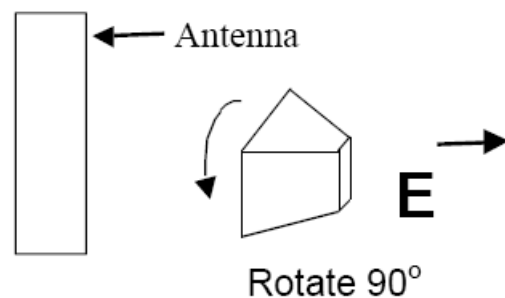
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P_{stand} : Measured Power of Standard Gain Antenna

- (4) Gain of AUT. The standard gain antenna is a gain horn(SG-430 1.7GHz ~ 2.6GHz).
- (5) The planes defined in the Fig. 4 which we want to measure are H(X-Y) and E(X-Z) planes. The vertical or horizontal polarization's power is measured by rotating the antenna probe to 0 degree or to 90 degree shown in Fig. 3, respectively. While we combine both vertical and horizontal power, we obtain total power.
- (6) From the total power in three basic planes(H, and E), we can analyze the performance of the antenna is good or not.



(a) Antenna Probe at 0 degree as a vertical polarization.



(b) Antenna Probe at 90 degree as a horizontal polarization.

Fig. 3. The definition of vertical and horizontal polarization.

(c) Plane definition :

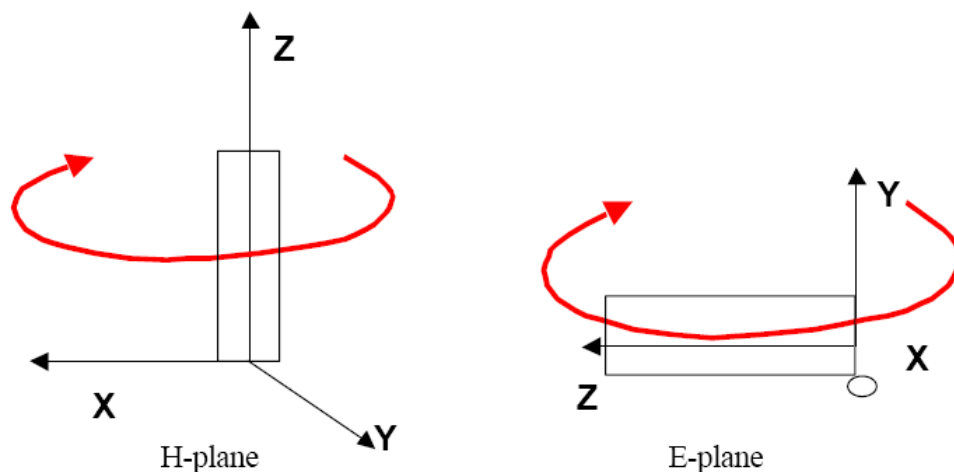


Fig. 4. The plane definition : H-Planes and E-Planes.

TEST METHODS OF THE CHAMBER

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II. Gain and Radiation Pattern :

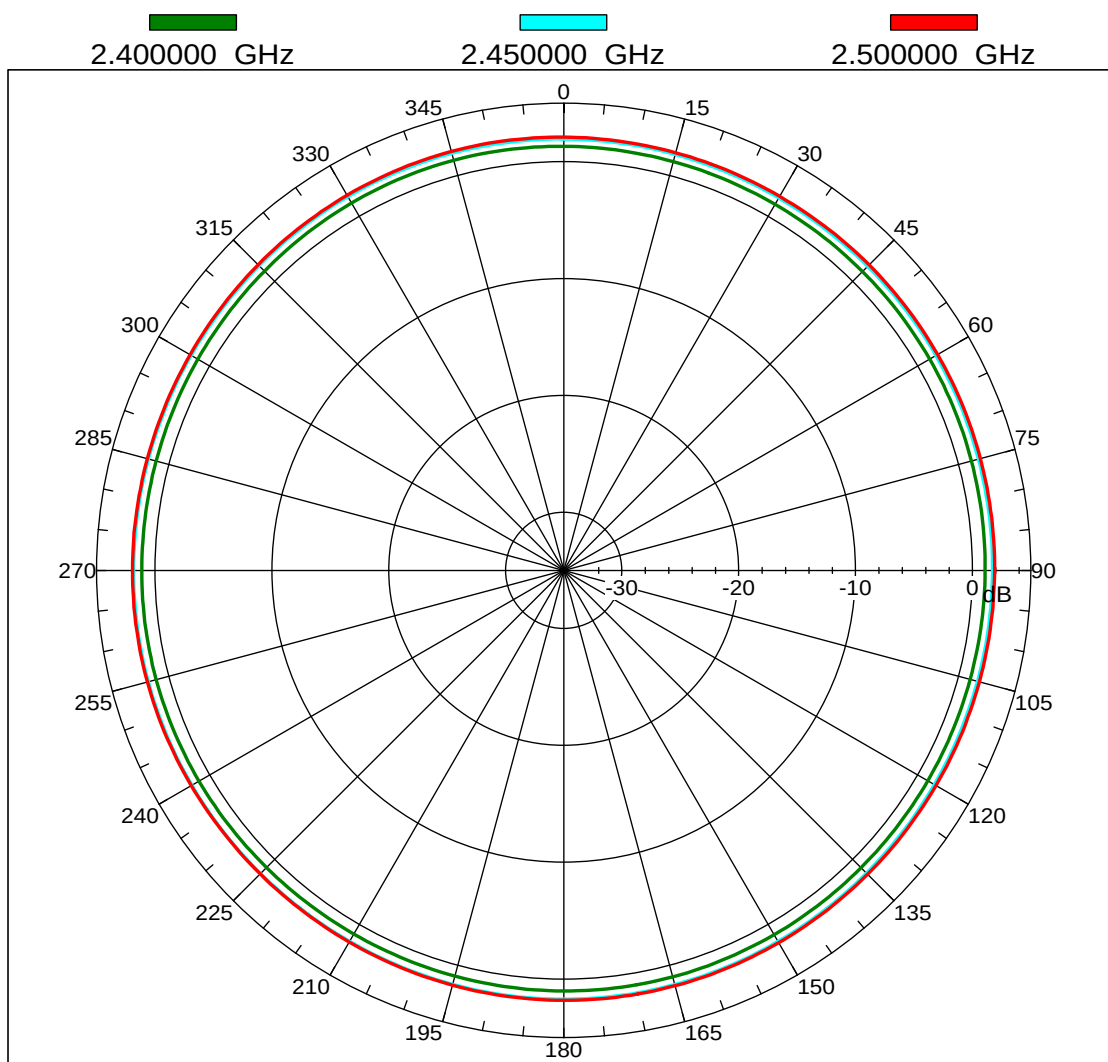
(a) H-PALNE :

(1) Gain

Frequency(GHz)	2.40	2.45	2.5
Gain(dBi)			
Peak Gain	1.34762	1.96789	2.12256
Avg Gain	1.115	1.778	1.902

(2) Radiation Pattern

Far-field amplitude of 2.4GHz SMA Antenna H-Plane.nsi



TEST METHODS OF THE CHAMBER

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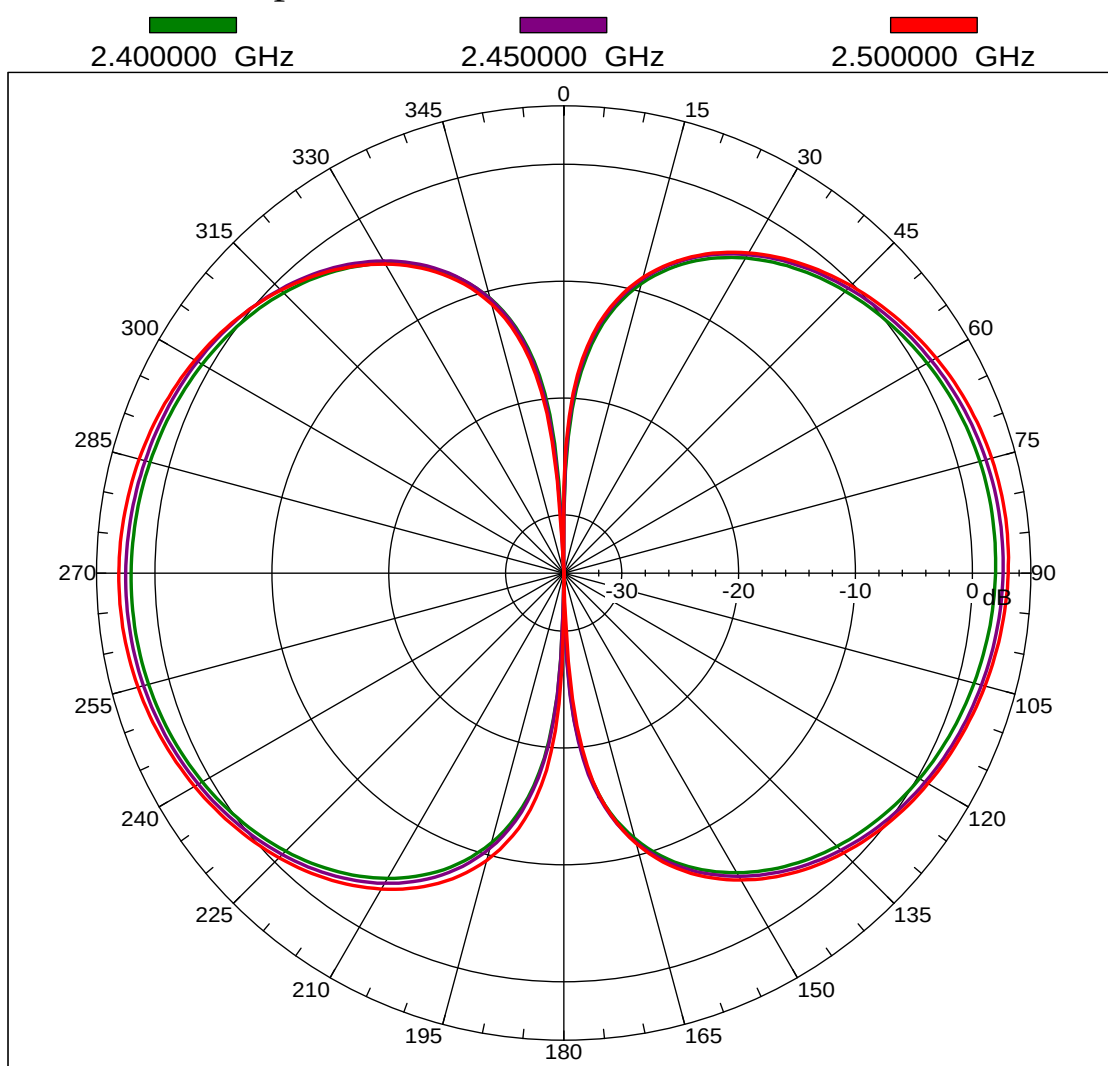
(c) E-Plane

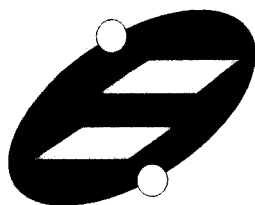
(1) Gain

Frequency(GHz)	2.40	2.45	2.5
Gain(dBi)			
Peak Gain	2.04376	2.64689	3.12879
Avg Gain	-2.132	-1.680	-1.328

(2) Radiation Pattern

Far-field amplitude of 2.4GHz SMA Antenna E-Plane.nsi





WHA YU INDUSTRIAL CO., LTD. (HEAD OFFICE)
TAI HWA ELECTRONIC CO., LTD.(CHINA)
SHANGHAI HUA YU ELECTRONIC CO., LTD.(CHINA)
AEON TECH CO., LTD. (CHINA)

SPECIFICATION FOR APPROVAL

CUSTOMER: 華碩電腦股份有限公司

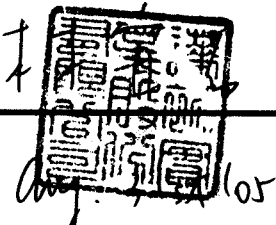
PART NAME: RF Antenna Assembly

PART NO.:

REVISION:

W. Y. P/NO.: C660-510059-A

REV.: X2

	MANUFACTURER SIGNATURE	CUSTOMER SIGNATURE
APPROVED BY :		
DATE :		

WHA YU GROUP

WHA YU INDUSTRIAL CO., LTD.(HEAD OFFICE)

譚裕實業股份有限公司

Address: No.326, Sec 2, Kung Tao 5 Road, Hsin Chu City, Taiwan, R.O.C.

Tel:+886-3-5714225(REP.)

Fax:+ 886-3-5713853 · + 886-3-5723600

TAI HWA ELECTRONIC CO., LTD. (CHINA)

台樺電業製品廠

Address: Pak Ho District, Hiu Street Town, Dong Guan City, Guangdong, China

Tel: + 86-769-5599375 · + 86-769-5912375

Fax: + 86-769-5599376

HUA HONG INTERNATIONAL LTD.

華弘國際有限公司

Rm.1103A,President Commercial Centre,608 Nathan Road,Mong Kok,Kowloon,Hong Kong

Tel: + 86-852-27712210

Fax: + 86-852-23843747

SHANGHAI HUA YU ELECTRONIC CO., LTD. (CHINA)

上海譚裕電子有限公司

Address:3586,Wai Qing Song Road, Qing Pu County, Shanghai China

Tel: + 86-21-59741348 · + 86-21-59744101~4

Fax: + 86-21-59741347

SU ZHOU AEON TECH CO., LTD. (CHINA)

蘇州華廣電通有限公司

Address:Limin North Road, LiLi Town,LiLi Industrial Park,LinHu Economic Zone

Wujiang City,Jiangsu Province,China

Tel: + 86-512-63627980

Fax: + 86-512-63627981

RF Antenna Cable Assembly

Specification

1. Electrical Properties :

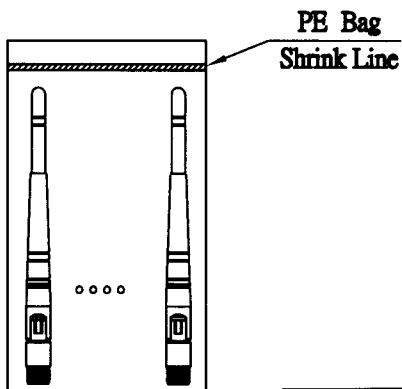
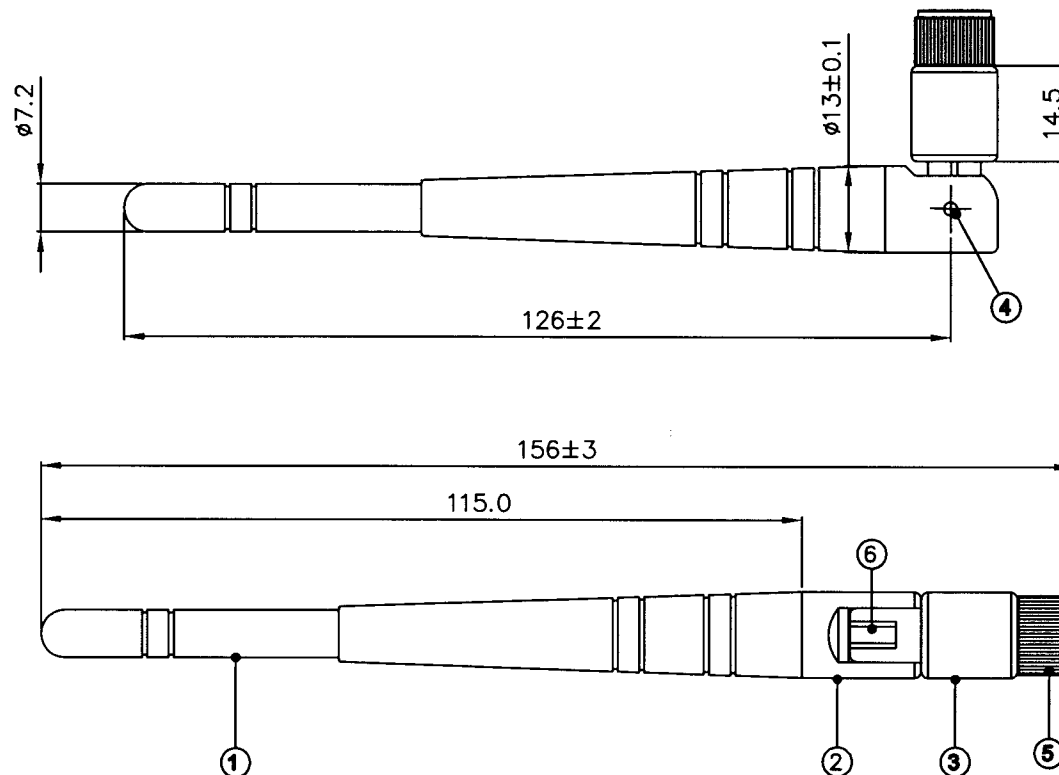
- 1.1 Frequency Range..... 2.4GHz ~ 2.5GHz
- 1.2 Impedance 50 Ω Nominal
- 1.3 VSWR 1.92 Max.
- 1.4 Return Loss..... -10 dB Maximum
- 1.5 Radiation Omni-directional
- 1.6 Gain(peak)..... 1.8dBi
- 1.7 Polarization..... Linear Vertical
- 1.8 Admitted Power..... 1W

2. Physical Properties :

- 2.1 Cable..... RG-178 Coaxial Cable
- 2.2 Antenna Cover..... TPE
- 2.3 Antenna Base..... PC
- 2.4 Antenna Base..... PBT
- 2.5 Operating Temp. -20°C ~ +65°C
- 2.6 Storage Temp. -30°C ~ +75°C
- 2.7 Color Black
- 2.8 Connector..... SMA Plug Reverse

CG-

REV	DATE	DESCRIPTION
X1	7/22-2005	New Issue



6	Cable	RG-178 Cable	1	
5	Connector	SMA Plug Reverse	1	
4	Rivet	POM ; Black	2	
3	Antenna Base	PBT ; Color : Black	1	
2	Antenna Base	PC ; Color : Black	1	
1	Antenna Body	TPE ; Color : Black	1	
NO	DESCRIPTION		QTY	REMARK

CUSTOMER'S SIGNATURE

XX	±5
X	±3.0
X	±1.0
XX	±0.5
XXX	±0.1

APPROVED
CHECKED
DRAWING
程淑娟

CUSTOMER: 華碩電腦股份有限公司

PART NO :

PARTNAME: RF Antenna Assembly

W.Y PNO : C660-510059-A

REV UNIT FILE :

X1 m/m SHEET: 1/1

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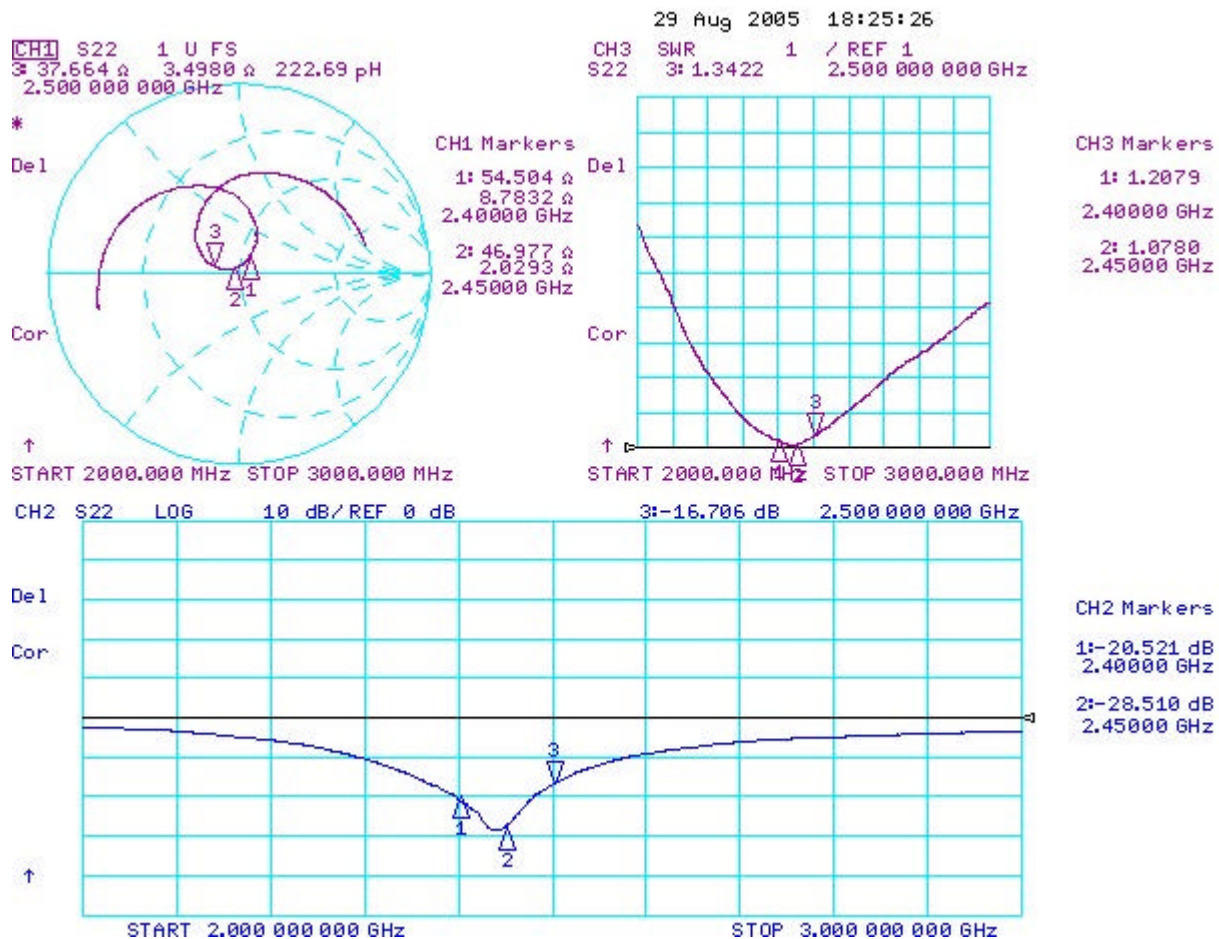


謹裕實業股份有限公司

WHA YU INDUSTRIAL CO., LTD

RF Antenna Assembly

P/NO :C660-510059-A SPEC : 2.4GHz



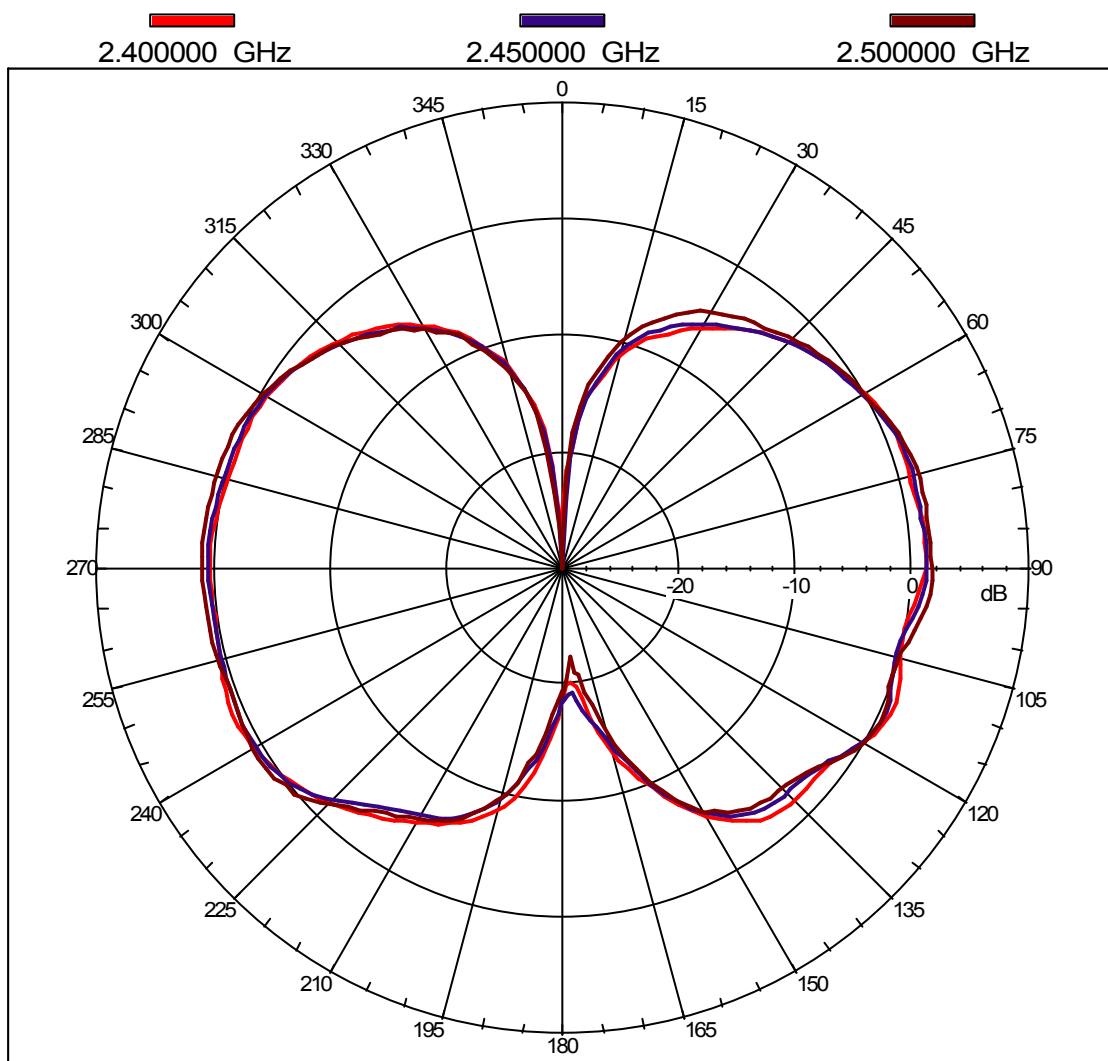
8/29/2005



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Far-field amplitude of C660-510059-A-H.nsi



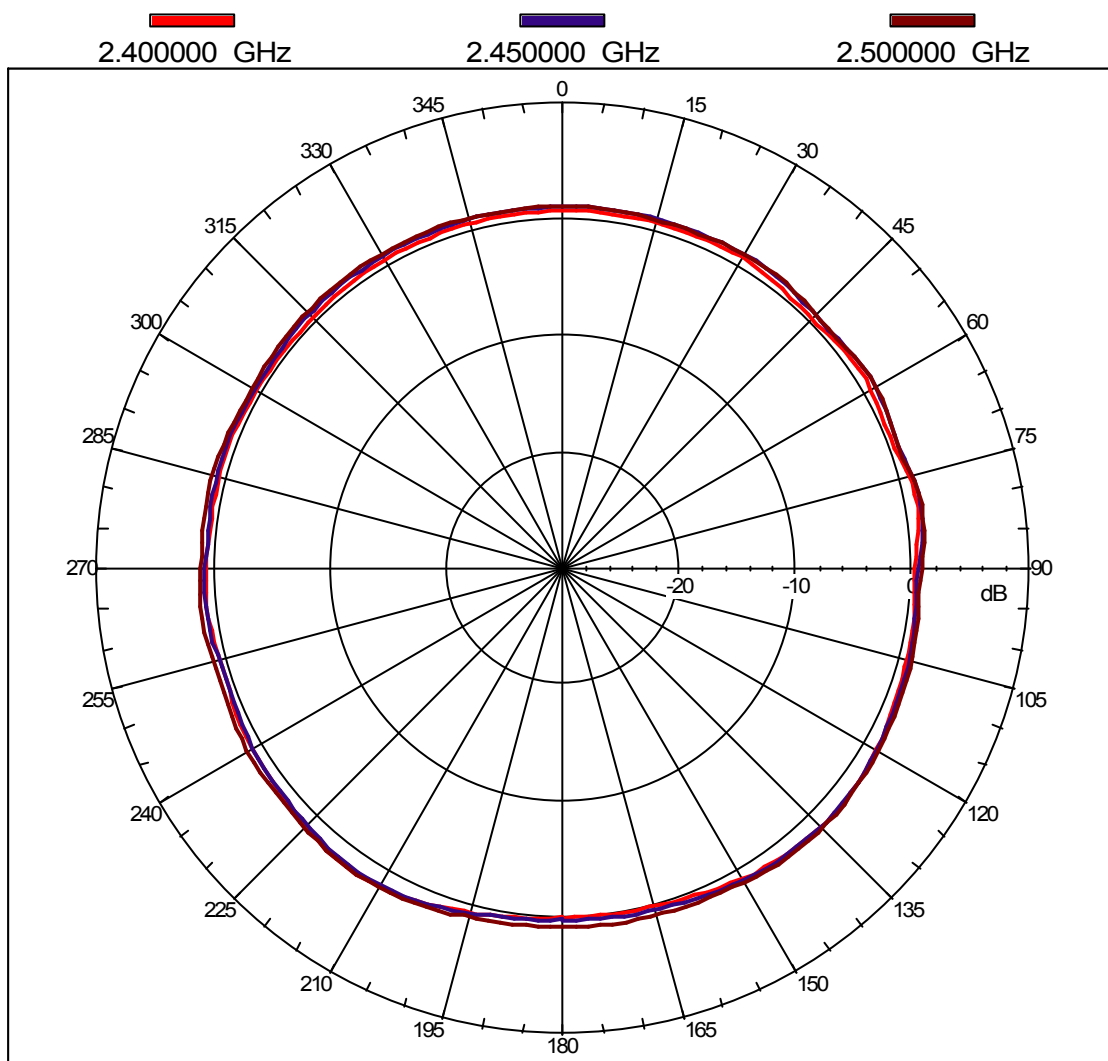
2005/8/30



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Far-field amplitude of C660-510059-A-V.nsi



2005/8/30