TRC® Since1985
Training Research Co., Ltd.
255 Nanyang Street, Shijr, Taipei Hsien 221, Taiwan, R.O.C.
TEL: 886-2-26935155 FAX: 886-2-26934440

Measurement of MPE

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

EUT	:	ASUS SpaceLink WL-230 PCI Card
Model No.	:	WL-230
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
FCC ID	:	MSQWL230
Frequency Range	:	2.4GHz-2.4835GHz / 5.725GHz-5.85GHz
Frequency Range	:	2.4GHz-2.4835GHz / 5.725GHz-5.85GHz
Modulation Skill	:	DBPSK, DQPSK, CCK / OFDM
Interface	:	PCI interface
Power Type	:	By PCI slot of the client' s device
Applicant	:	ASUSTeK COMPUTER INC.
		4/F, No. 150, Li-Te Rd., Peitou, Taipei, Taiwan, R.O.C.

3a. Limits for *Maximum Permissible Exposure (MPE) (DSS - 2.4GHz band)*

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, by the *Friis Transmission Formula*:**

Power density at the specific separation (Mobile): $S = \frac{PG}{4pR^2} = \frac{3.55 \times 1.892}{4p\,(20)^2} = 1.336 \times 10^{-3} mW/cm^2$

Estimated safe separation: $R = \sqrt{\frac{PG}{4p}} = \sqrt{\frac{3.55 \times 1.892}{4p}} = 0.731cm$

Remarks: "The safe estimated separation that the user must maintain from the antenna is at least 0.731 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:

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

$G = \text{Log}^{-1}$ (2.77 / 10) = 1.892

3b. Limits for *Maximum Permissible Exposure (MPE) (DTS - 2.4GHz band)*

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, by the *Friis Transmission Formula*:**

Power density at the specific separation (Mobile): $S = \frac{PG}{4pR^2} = \frac{61.94 \times 1.892}{4p\,(20)^2} = 2.331 \times 10^{-2} mW/cm^2$

Estimated safe separation: $R = \sqrt{\frac{PG}{4p}} = \sqrt{\frac{61.94 \times 1.892}{4p}} = 3.054cm$

Remarks: "The safe estimated separation that the user must maintain from the antenna is at least 3.054 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:

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

$G = \text{Log}^{-1}$ (1.13 / 10) = 1.297

3c. Limits for *Maximum Permissible Exposure (MPE) (DTS & NII – 5.1 & 5.7GHz band)*

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, by the *Friis Transmission Formula*:**

Power density at the specific separation (Mobile): $S = \frac{PG}{4pR^2} = \frac{111.17 \times 1.297}{4p\,(20)^2} = 2.869 \times 10^{-2}\, mW/cm^2$

Estimated safe separation: $R = \sqrt{\frac{PG}{4p}} = \sqrt{\frac{111.17 \times 1.297}{4p}} = 3.387 cm$

Remarks: "The safe estimated separation that the user must maintain from the antenna is at least 3.387 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:

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

$G = \text{Log}^{-1}$ (1.13 / 10) = 1.297

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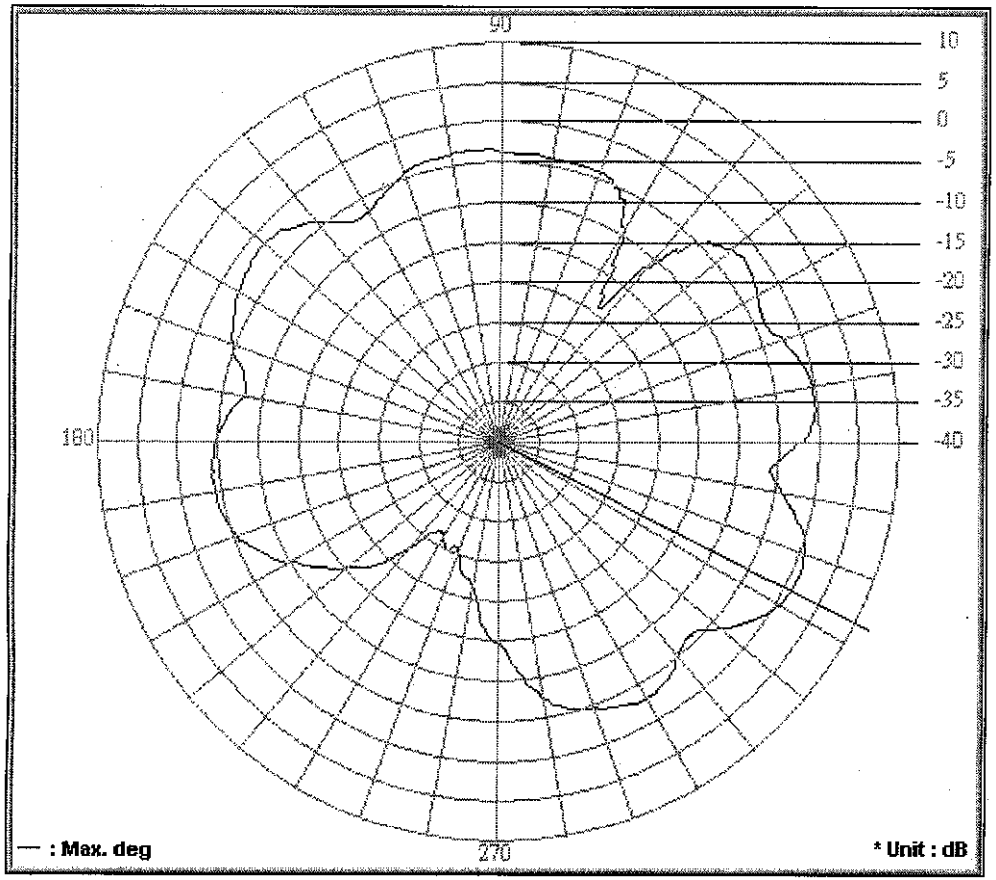
http://www.adt.com.tw/ E-mail: service@mail.adt.com.tw TEL: 886-3-5935343 FAX: 886-3-5935342

Brand / Model : ASUS
Remark : E-Plan ; 2400MHz
Tested by : Bruce
EUT description : Antenna - 1

Location: **RF Chamber C** Date: **2002/12/18** Time: **下午 03:12:22**

Temperatuer (℃): **25** Humidity (%): **60** Approved by:



Frequency (MHz) : **2400.00** Antenna Polarity : **Horizontal** Average Gain (dB) : **-4.29**

Maximum Gain (dB) : **1.10** Maximum Gain (degree) : **333**

Minimum Gain (dB) : **-26.90** Minimum Gain (degree) : **239**

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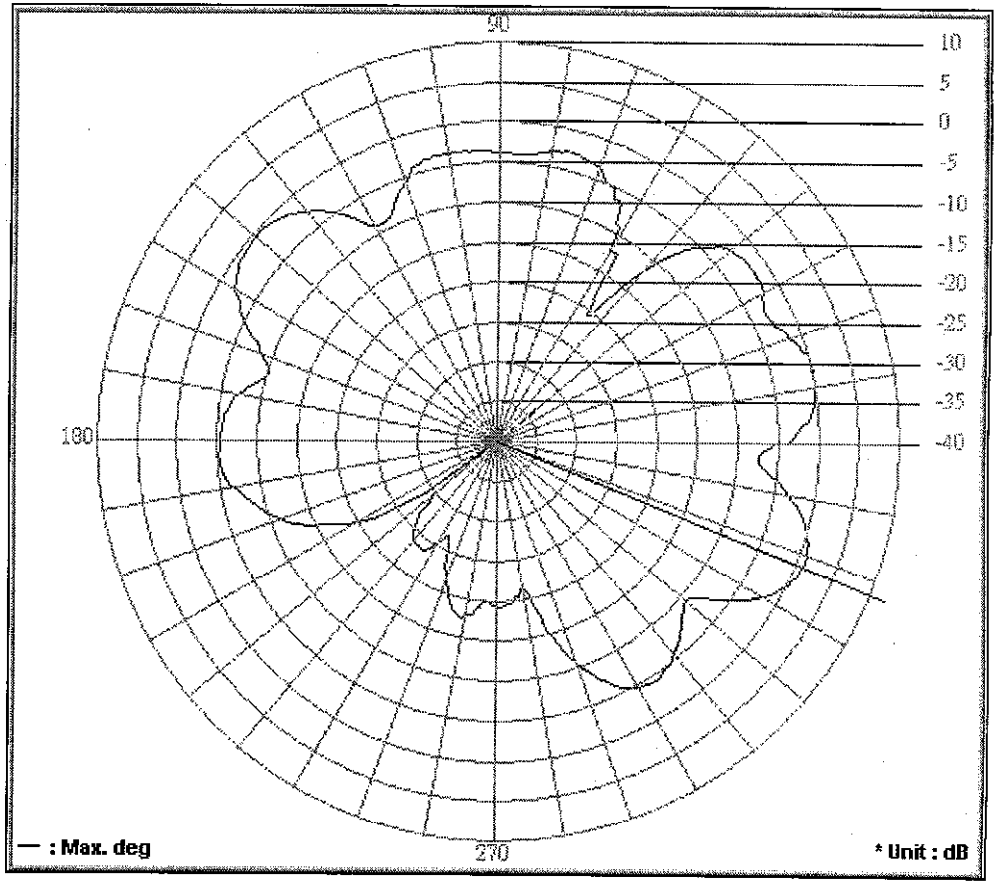
http://www.adt.com.tw/ E-mail: service@mail.adt.com.tw TEL: 886-3-5935343 FAX: 886-3-5935342

Brand / Model : ASUS
Remark : E-Plan ; 2450MHz
Tested by : Bruce
EUT description : Antenna - 1

Location: **RF Chamber C** Date: **2002/12/18** Time: **下午 03:09:42**

Temperatuer (℃): **25** Humidity (%): **60** Approved by:



Frequency (MHz) : **2450.00** Antenna Polarity : **Horizontal** Average Gain (dB) : **-4.83**

Maximum Gain (dB) : **0.93** Maximum Gain (degree) : **338**

Minimum Gain (dB) : **-45.90** Minimum Gain (degree) : **219**

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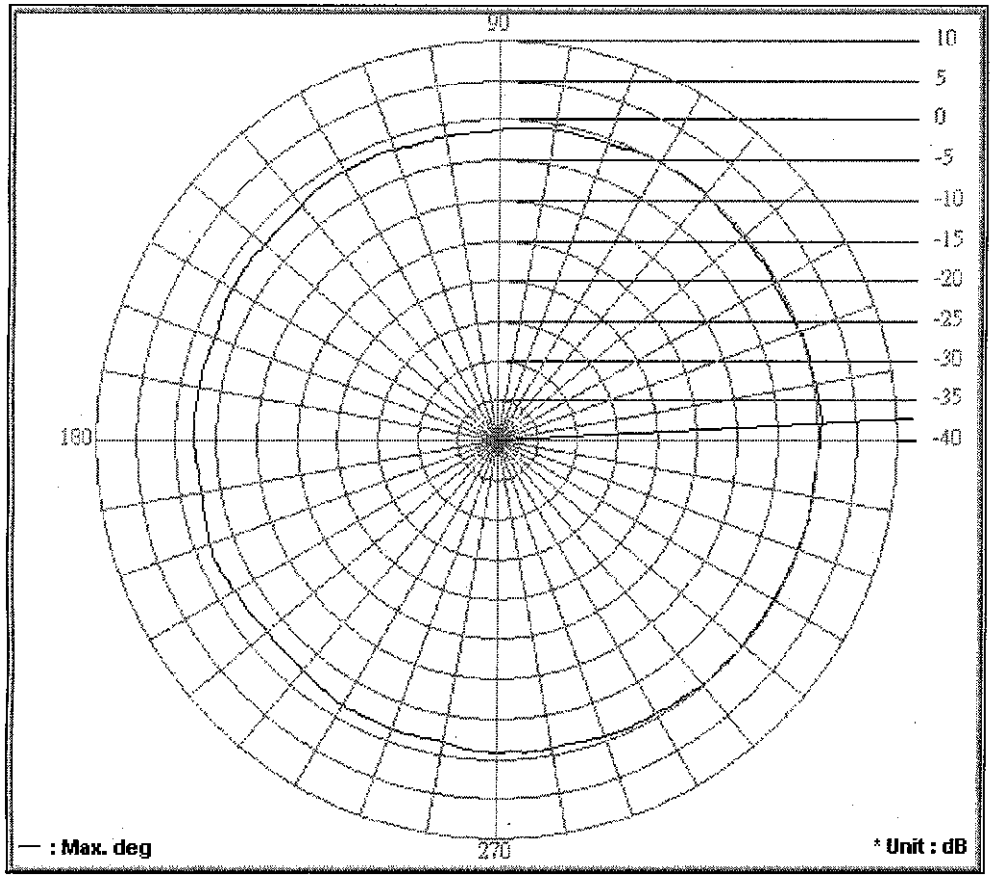
http://www.adt.com.tw/ E-mail: service@mail.adt.com.tw TEL: 886-3-5935343 FAX: 886-3-5935342

Brand / Model : ASUS
Remark : H-Plan ; 2450MHz
Tested by : Bruce
EUT description : Antenna - 1

Location: **RF Chamber C** Date: **2002/12/18** Time: **下午 02:50:56**

Temperatuer (℃): **25** Humidity (%): **60** Approved by:



Frequency (MHz) : **2450.00** Antenna Polarity : **Vertical** Average Gain (dB) : **-0.96**

Maximum Gain (dB) : **0.57** Maximum Gain (degree) : **3**

Minimum Gain (dB) : **-2.60** Minimum Gain (degree) : **185**

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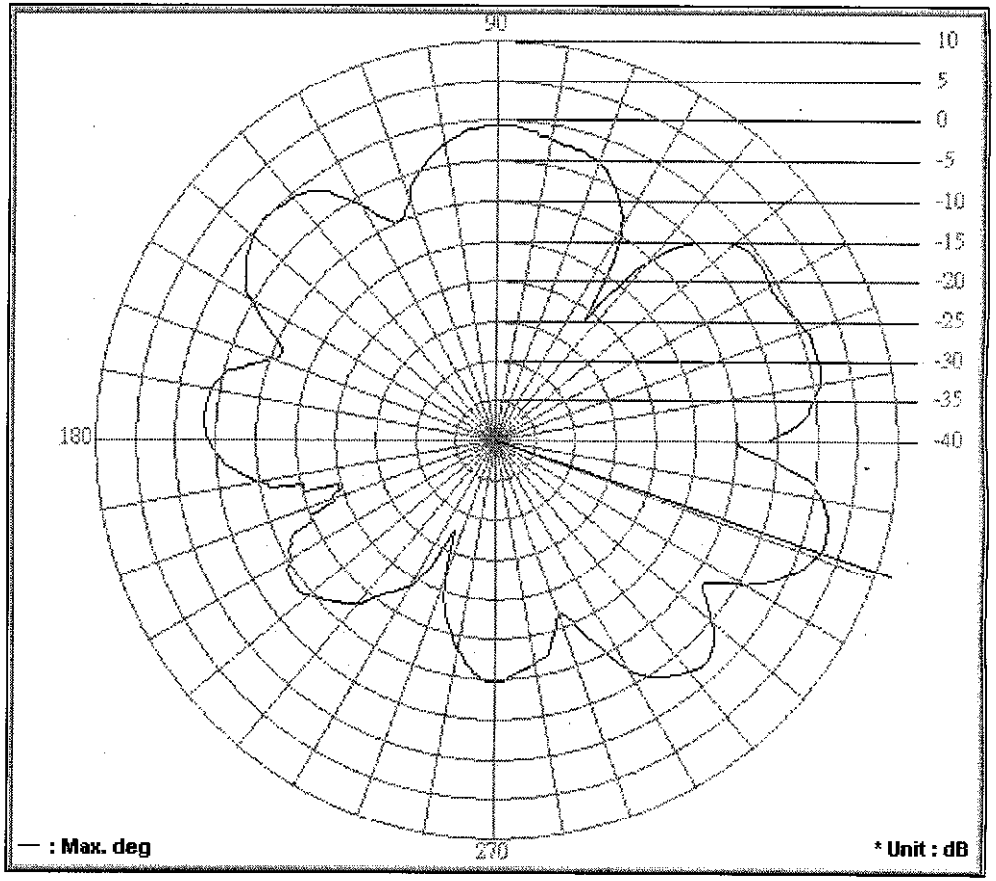
http://www.adt.com.tw/ E-mail: service@mail.adt.com.tw TEL: 886-3-5935343 FAX: 886-3-5935342

Brand / Model : ASUS
Remark : E-Plan ; 2500MHz
Tested by : Bruce
EUT description : Antenna - 1

Location: **RF Chamber C** Date: **2002/12/18** Time: **下午 03:04:19**

Temperatuer (℃): **25** Humidity (%): **60** Approved by:



Frequency (MHz) : **2500.00** Antenna Polarity : **Horizontal** Average Gain (dB) : **-3.63**

Maximum Gain (dB) : **2.77** Maximum Gain (degree) : **341**

Minimum Gain (dB) : **-27.73** Minimum Gain (degree) : **246**

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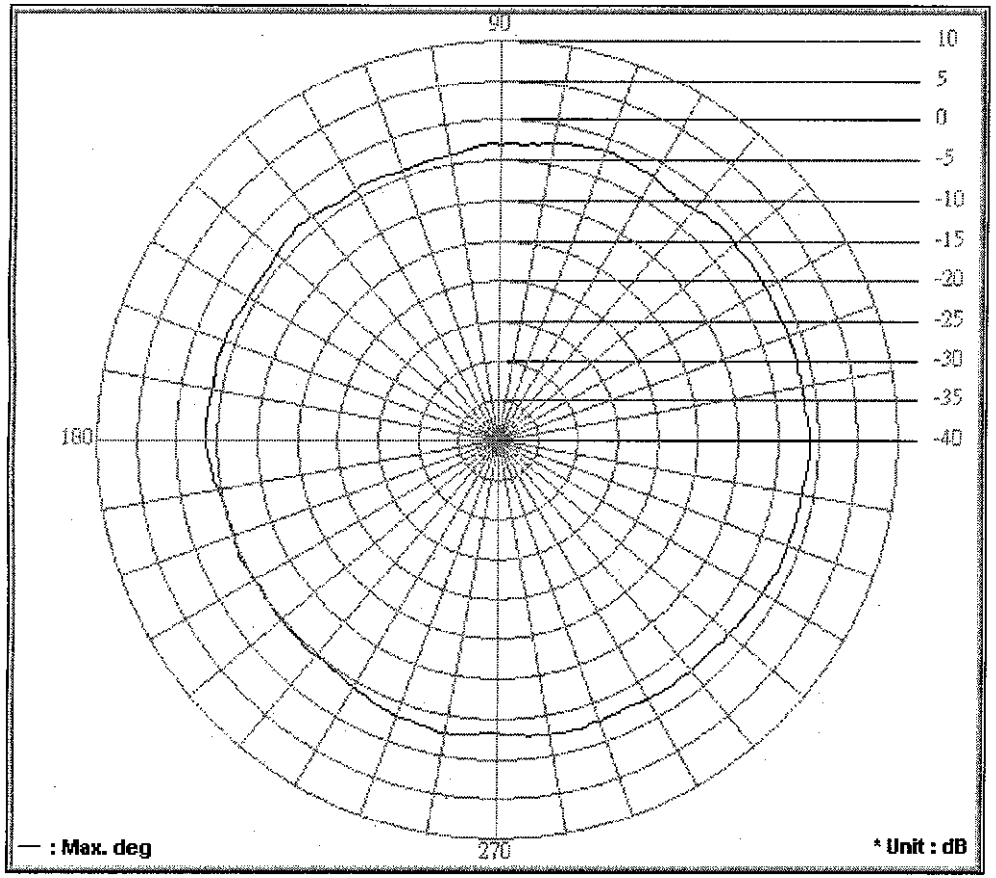
http://www.adt.com.tw/ E-mail: service@mail.adt.com.tw TEL: 886-3-5935343 FAX: 886-3-5935342

Brand / Model : ASUS
Remark : H-Plan ; 2500MHz
Tested by : Bruce
EUT description : Antenna - 1

Location: **RF Chamber C** Date: **2002/12/18** Time: **下午 02:54:09**

Temperatuer (℃): **25** Humidity (%): **60** Approved by:



Frequency (MHz) : **2500.00** Antenna Polarity : **Vertical** Average Gain (dB) : **-2.83**

Maximum Gain (dB) : **-1.10** Maximum Gain (degree) : **0**

Minimum Gain (dB) : **-5.10** Minimum Gain (degree) : **194**

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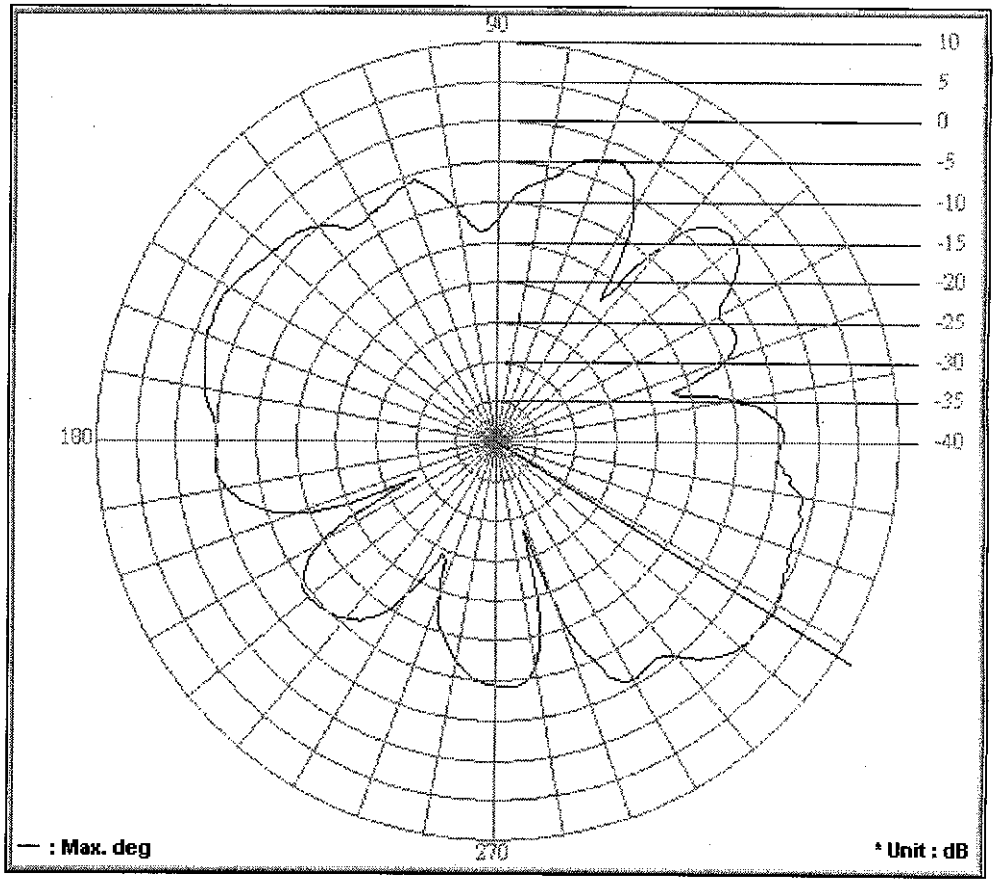
http://www.adt.com.tw/ E-mail: service@mail.adt.com.tw TEL: 886-3-5935343 FAX: 886-3-5935342

Brand / Model : ASUS
Remark : E-Plan ; 5150MHz
Tested by : Bruce
EUT description : Antenna - 1

Location: **RF Chamber C** Date: **2002/12/18** Time: **下午 03:16:15**

Temperatuer (℃): **25** Humidity (%): **60** Approved by:



Frequency (MHz) : **5150.00** Antenna Polarity : **Horizontal** Average Gain (dB) : **-5.10**

Maximum Gain (dB) : **0.47** Maximum Gain (degree) : **328**

Minimum Gain (dB) : **-28.87** Minimum Gain (degree) : **205**

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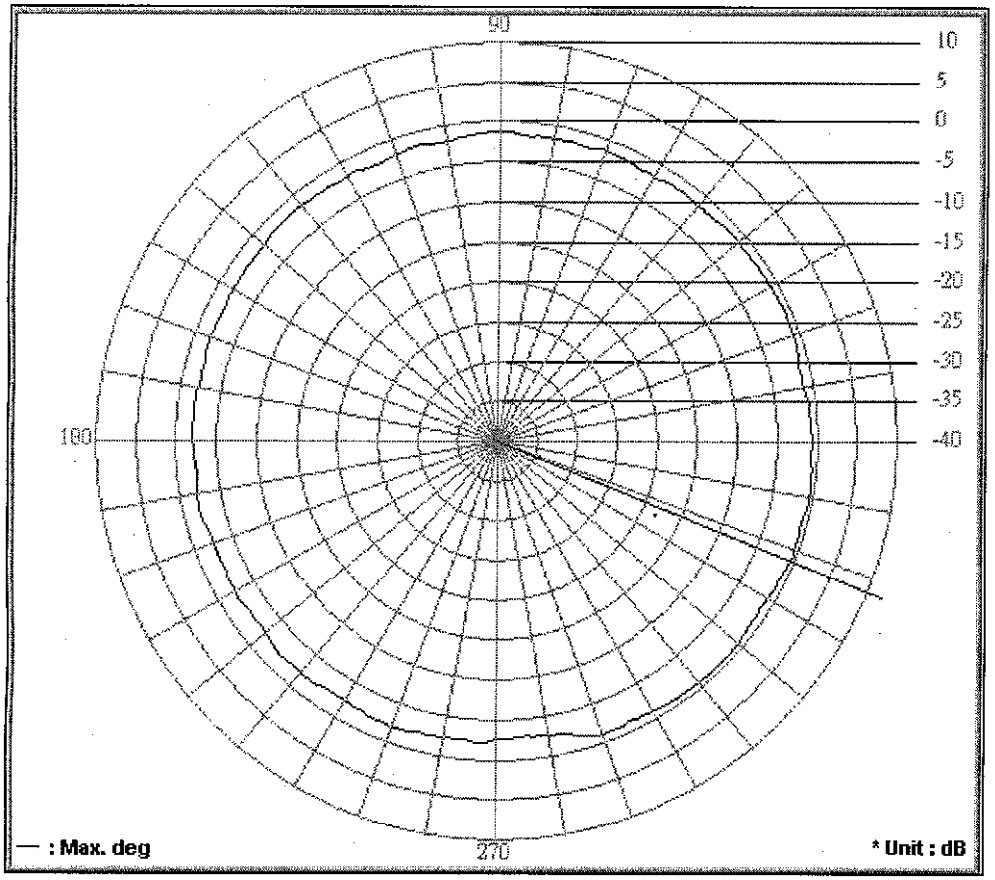
http://www.adt.com.tw/ E-mail: service@mail.adt.com.tw TEL: 886-3-5935343 FAX: 886-3-5935342

Brand / Model : ASUS
Remark : H-Plan ; 5150MHz
Tested by : Bruce
EUT description : Antenna - 1

Location: **RF Chamber C** Date: **2002/12/18** Time: **下午 02:26:20**

Temperatuer (℃): **25** Humidity (%): **60** Approved by:



Frequency (MHz) : **5150.00** Antenna Polarity : **Vertical** Average Gain (dB) : **-1.53**

Maximum Gain (dB) : **-0.37** Maximum Gain (degree) : **338**

Minimum Gain (dB) : **-2.87** Minimum Gain (degree) : **276**

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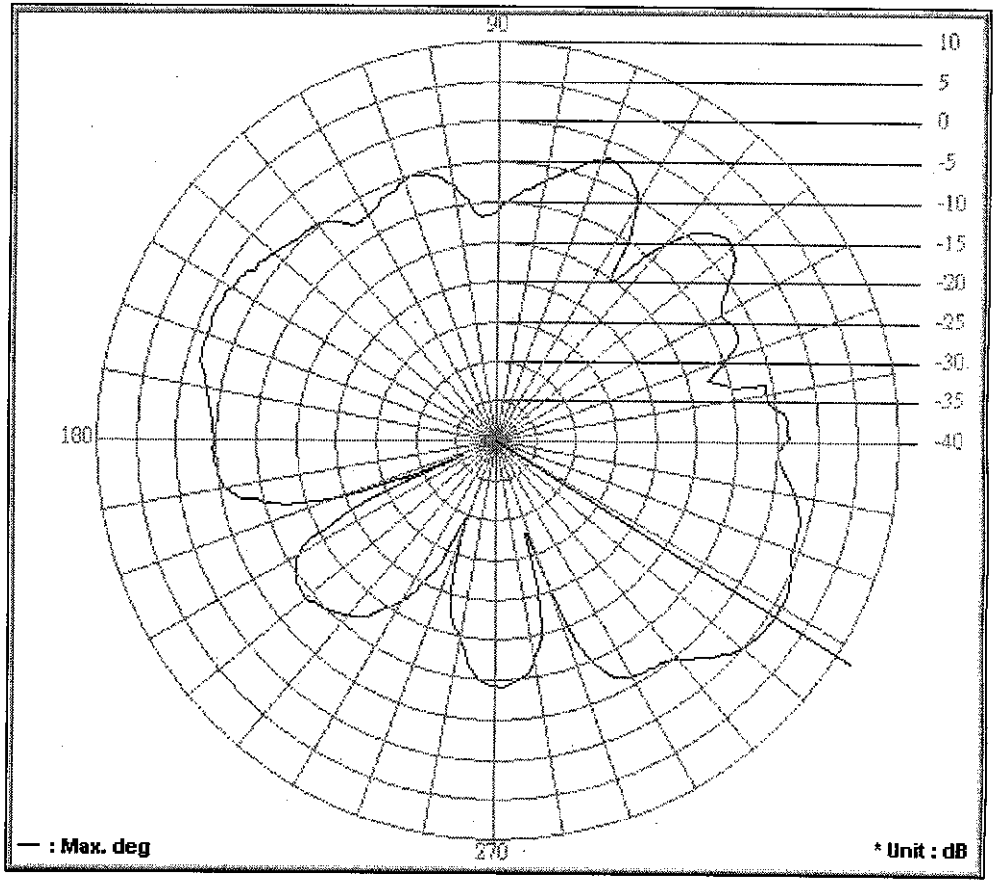
http://www.adt.com.tw/ E-mail: service@mail.adt.com.tw TEL: 886-3-5935343 FAX: 886-3-5935342

Brand / Model : ASUS
Remark : E-Plan ; 5250MHz
Tested by : Bruce
EUT description : Antenna - 1

Location: **RF Chamber C** Date: **2002/12/18** Time: **下午 03:19:30**

Temperatuer (℃): **25** Humidity (%): **60** Approved by:



Frequency (MHz) : **5250.00** Antenna Polarity : **Horizontal** Average Gain (dB) : **-4.93**

Maximum Gain (dB) : **1.13** Maximum Gain (degree) : **328**

Minimum Gain (dB) : **-35.37** Minimum Gain (degree) : **203**

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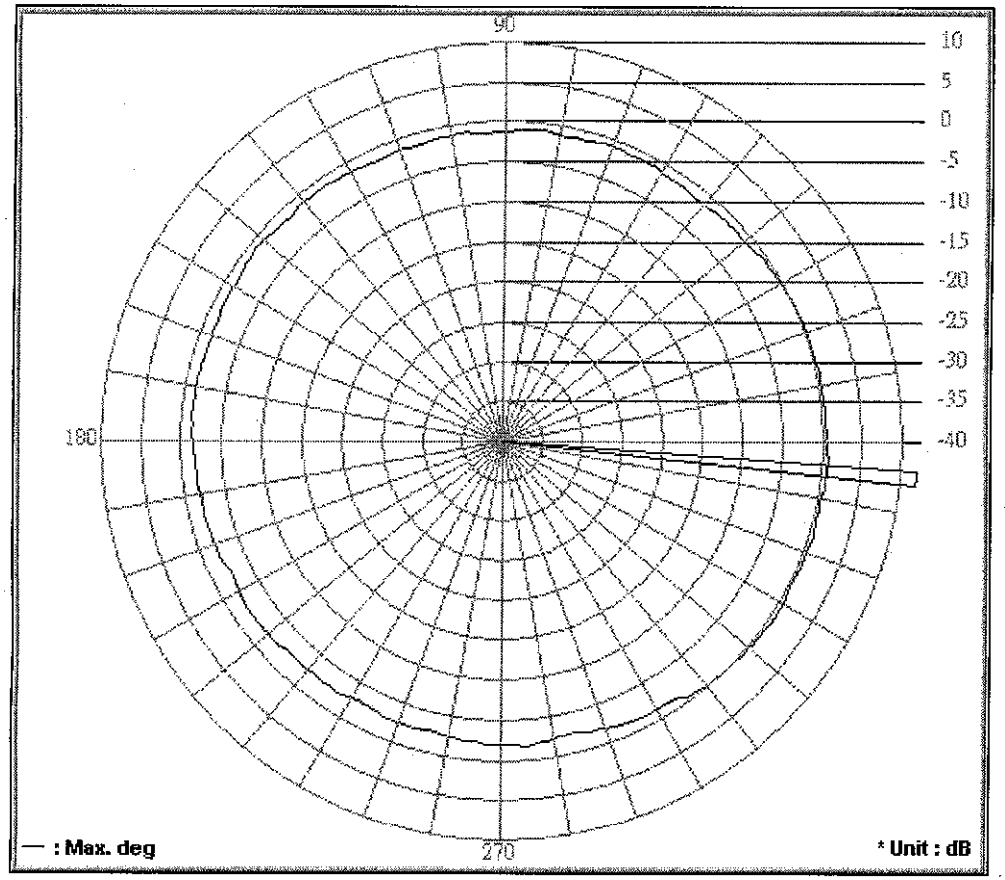
http://www.adt.com.tw/ E-mail: service@mail.adt.com.tw TEL: 886-3-5935343 FAX: 886-3-5935342

Brand / Model : ASUS
Remark : H-Plan ; 5250MHz
Tested by : Bruce
EUT description : Antenna - 1

Location: **RF Chamber C** Date: **2002/12/18** Time: **下午 02:28:00**

Temperatuer (℃): **25** Humidity (%): **60** Approved by:



Frequency (MHz) : **5250.00** Antenna Polarity : **Vertical** Average Gain (dB) : **-0.99**

Maximum Gain (dB) : **0.80** Maximum Gain (degree) : **354**

Minimum Gain (dB) : **-2.87** Minimum Gain (degree) : **241**

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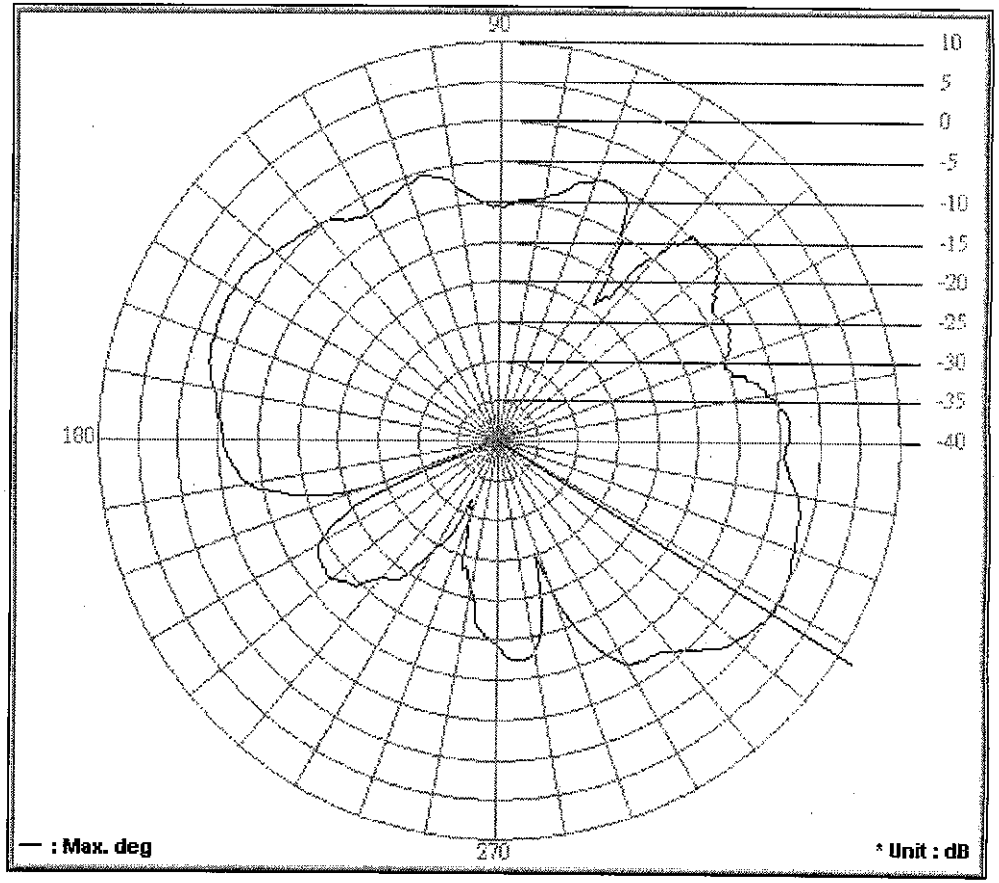
http://www.adt.com.tw/ E-mail: service@mail.adt.com.tw TEL: 886-3-5935343 FAX: 886-3-5935342

Brand / Model : ASUS
Remark : E-Plan ; 5350MHz
Tested by : Bruce
EUT description : Antenna - 1

Location: **RF Chamber C** Date: **2002/12/18** Time: **下午 03:22:21**

Temperatuer (℃): **25** Humidity (%): **60** Approved by:



Frequency (MHz) : **5350.00** Antenna Polarity : **Horizontal** Average Gain (dB) : **-5.83**

Maximum Gain (dB) : **0.30** Maximum Gain (degree) : **328**

Minimum Gain (dB) : **-43.03** Minimum Gain (degree) : **201**

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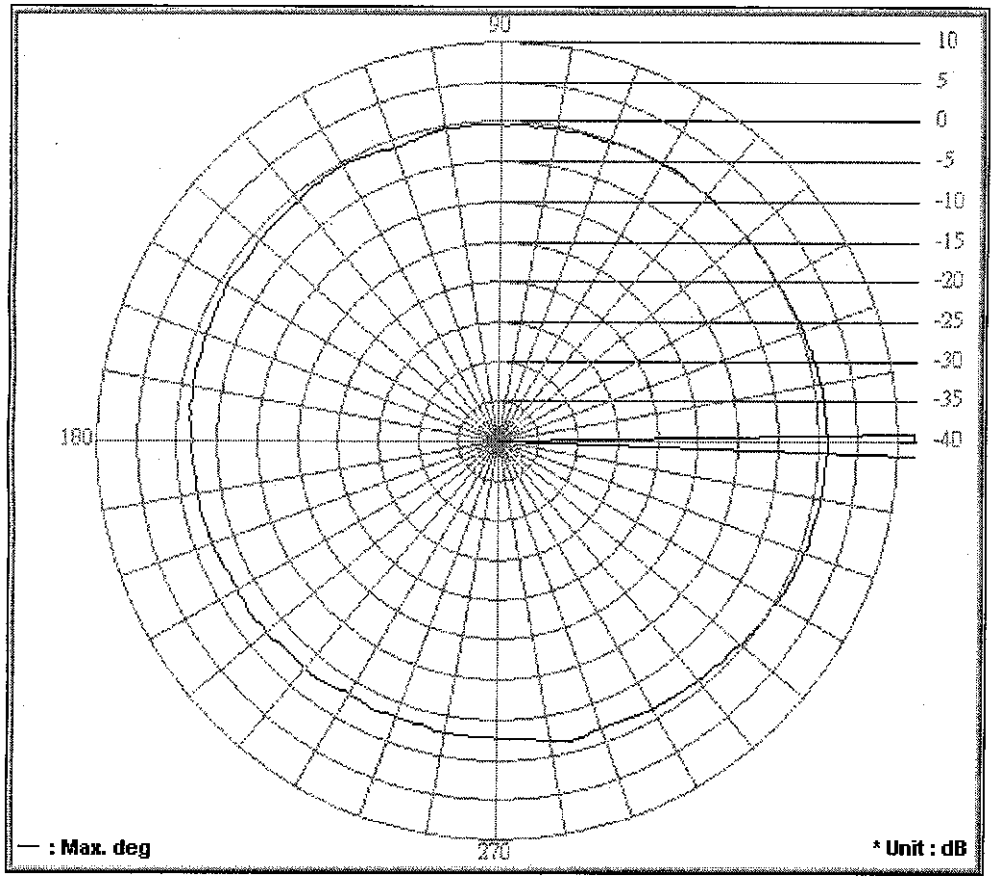
http://www.adt.com.tw/ E-mail: service@mail.adt.com.tw TEL: 886-3-5935343 FAX: 886-3-5935342

Brand / Model : ASUS
Remark : H-Plan ; 5350MHz
Tested by : Bruce
EUT description : Antenna - 1

Location: **RF Chamber C** Date: **2002/12/18** Time: **下午 02:32:46**

Temperatuer (℃): **25** Humidity (%): **60** Approved by:



Frequency (MHz) : **5350.00** Antenna Polarity : **Vertical** Average Gain (dB) : **-0.78**

Maximum Gain (dB) : **1.17** Maximum Gain (degree) : **0**

Minimum Gain (dB) : **-3.33** Minimum Gain (degree) : **239**

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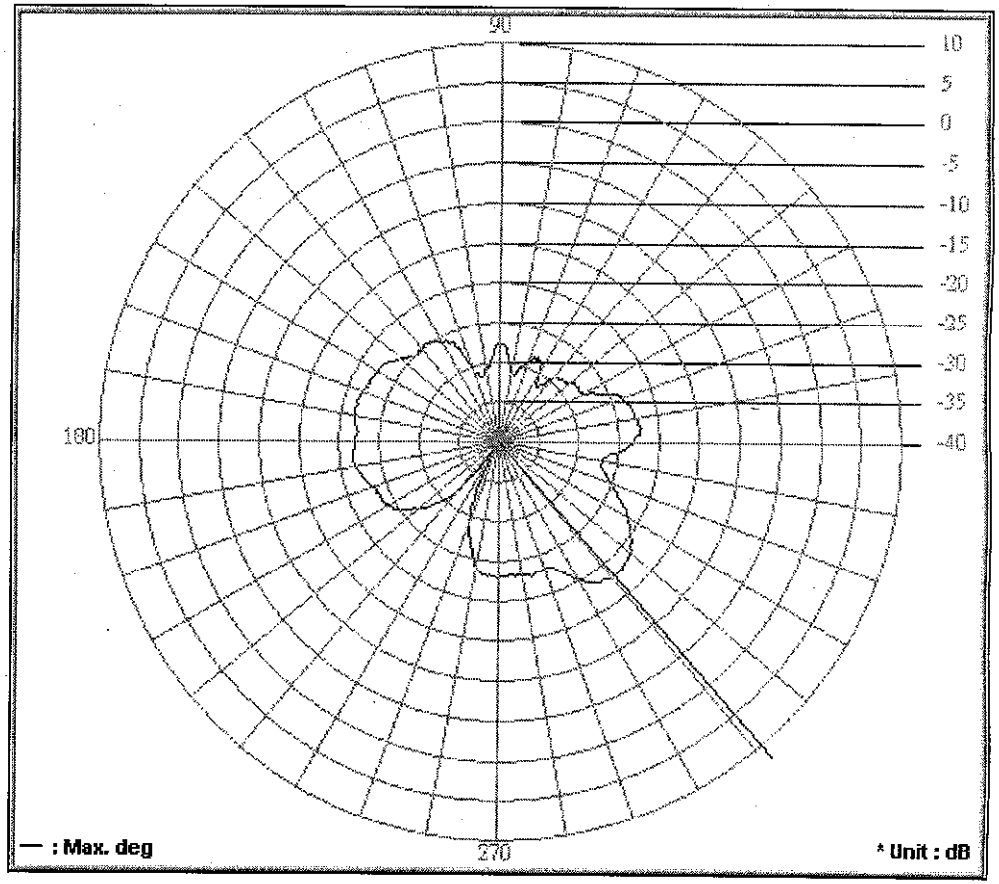
http://www.adt.com.tw/ E-mail: service@mail.adt.com.tw TEL: 886-3-5935343 FAX: 886-3-5935342

Brand / Model : ASUS
Remark : E-H Plan(cross) ; 2450MHz
Tested by : Bruce
EUT description : Dualband Ant.

Location: **RF Chamber C** Date: **2002/12/18** Time: **下午 04:04:43**

Temperatuer (℃): **25** Humidity (%): **60** Approved by:



Frequency (MHz) : **2450.00** Antenna Polarity : **Horizontal** Average Gain (dB) : **-23.85**

Maximum Gain (dB) : **-17.93** Maximum Gain (degree) : **311**

Minimum Gain (dB) : **-43.27** Minimum Gain (degree) : **239**

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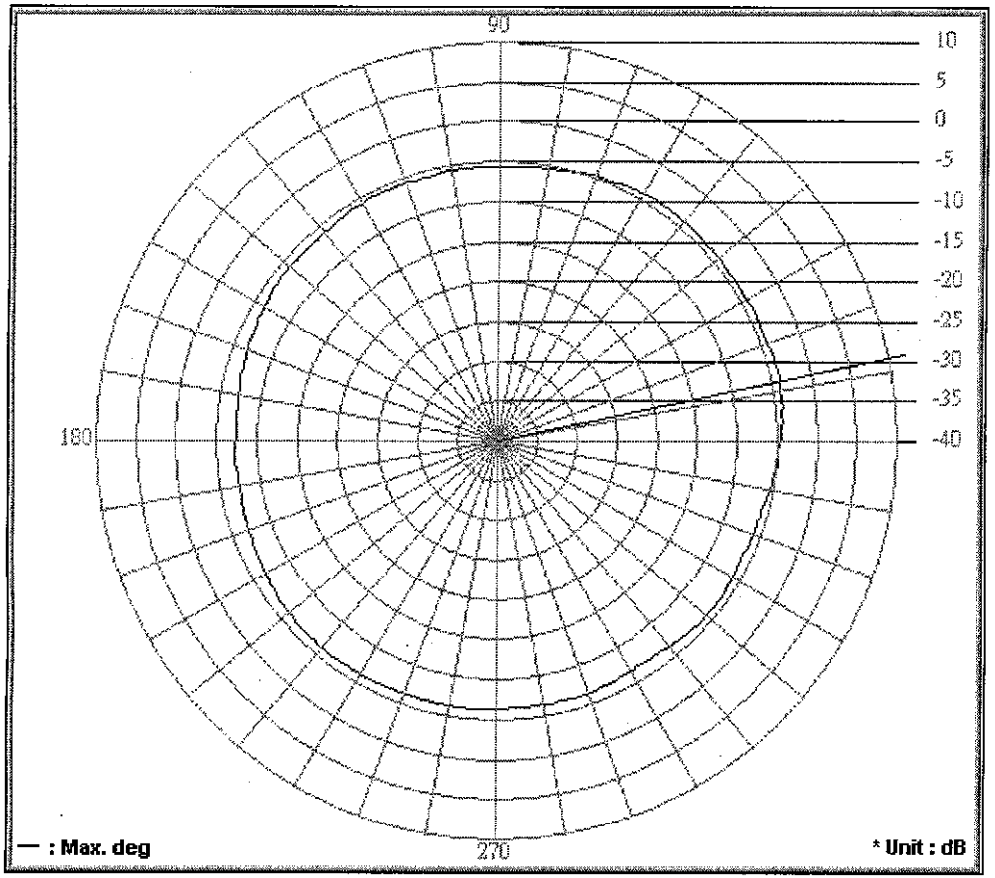
http://www.adt.com.tw/ E-mail: service@mail.adt.com.tw TEL: 886-3-5935343 FAX: 886-3-5935342

Brand / Model : ASUS
Remark : H-Plan ; 2450MHz
Tested by : Bruce
EUT description : Dualband Ant.

Location: **RF Chamber C** Date: **2002/12/18** Time: **下午 03:46:40**

Temperatuer (℃): **25** Humidity (%): **60** Approved by:



Frequency (MHz) : **2450.00** Antenna Polarity : **Vertical** Average Gain (dB) : **-5.71**

Maximum Gain (dB) : **-3.93** Maximum Gain (degree) : **12**

Minimum Gain (dB) : **-7.43** Minimum Gain (degree) : **172**

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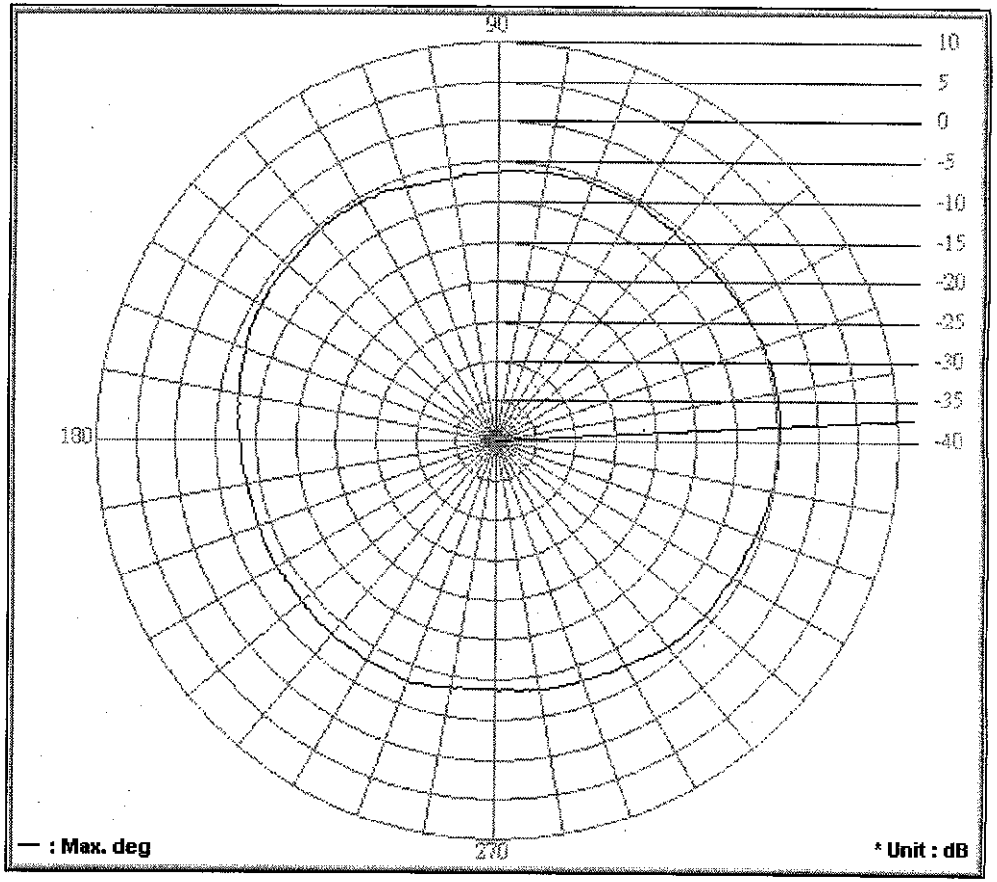
http://www.adt.com.tw/ E-mail: service@mail.adt.com.tw TEL: 886-3-5935343 FAX: 886-3-5935342

Brand / Model : ASUS
Remark : H-Plan ; 2400MHz
Tested by : Bruce
EUT description : Dualband Ant.

Location: **RF Chamber C** Date: **2002/12/18** Time: **下午 03:49:32**

Temperatuer (℃): **25** Humidity (%): **60** Approved by:



Frequency (MHz) : **2400.00** Antenna Polarity : **Vertical** Average Gain (dB) : **-6.51**

Maximum Gain (dB) : **-4.60** Maximum Gain (degree) : **3**

Minimum Gain (dB) : **-8.93** Minimum Gain (degree) : **266**

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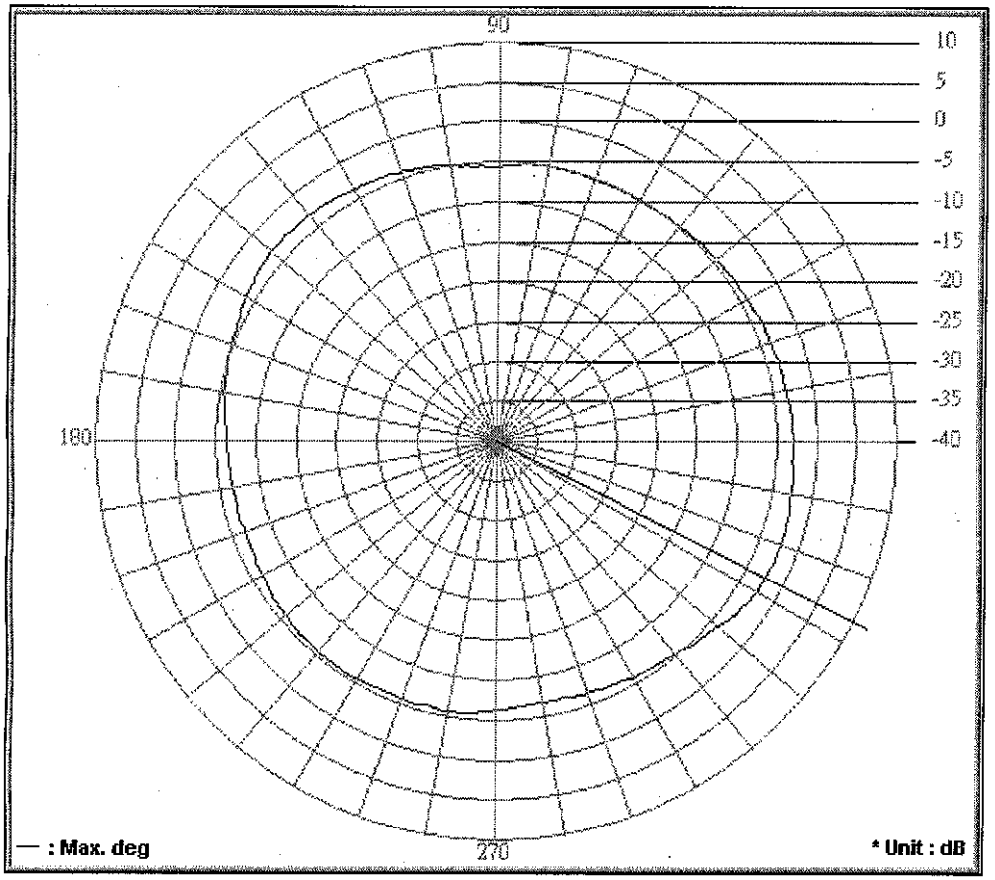
http://www.adt.com.tw/ E-mail: service@mail.adt.com.tw TEL: 886-3-5935343 FAX: 886-3-5935342

Brand / Model : ASUS
Remark : H-Plan ; 2500MHz
Tested by : Bruce
EUT description : Dualband Ant.

Location: **RF Chamber C** Date: **2002/12/18** Time: **下午 03:43:38**

Temperatuer (℃): **25** Humidity (%): **60** Approved by:



Frequency (MHz) : **2500.00** Antenna Polarity : **Vertical** Average Gain (dB) : **-4.60**

Maximum Gain (dB) : **-2.27** Maximum Gain (degree) : **333**

Minimum Gain (dB) : **-6.77** Minimum Gain (degree) : **191**

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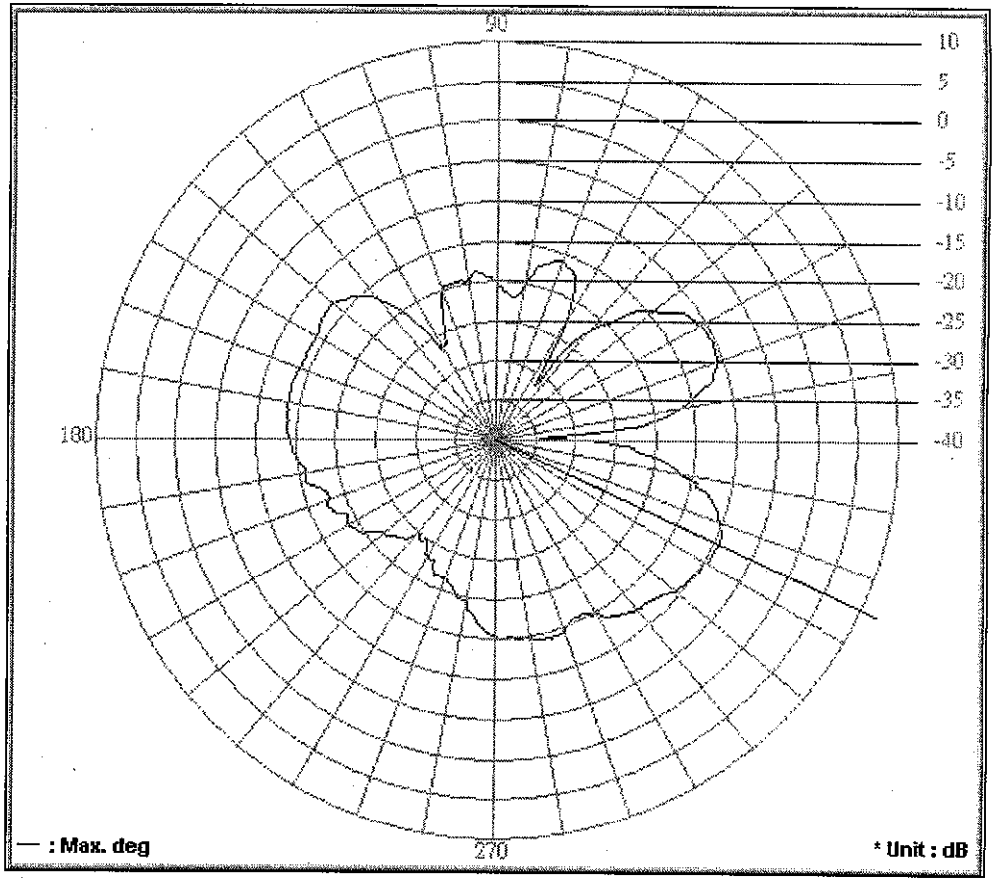
http://www.adt.com.tw/ E-mail: service@mail.adt.com.tw TEL: 886-3-5935343 FAX: 886-3-5935342

Brand / Model : ASUS
Remark : E-H Plan(cross) ; 5150MHz
Tested by : Bruce
EUT description : Dualband Ant.

Location: **RF Chamber C** Date: **2002/12/18** Time: **下午 04:00:27**

Temperatuer (℃): **25** Humidity (%): **60** Approved by:



Frequency (MHz) : **5150.00** Antenna Polarity : **Horizontal** Average Gain (dB) : **-15.14**

Maximum Gain (dB) : **-9.20** Maximum Gain (degree) : **335**

Minimum Gain (dB) : **-34.53** Minimum Gain (degree) : **2**

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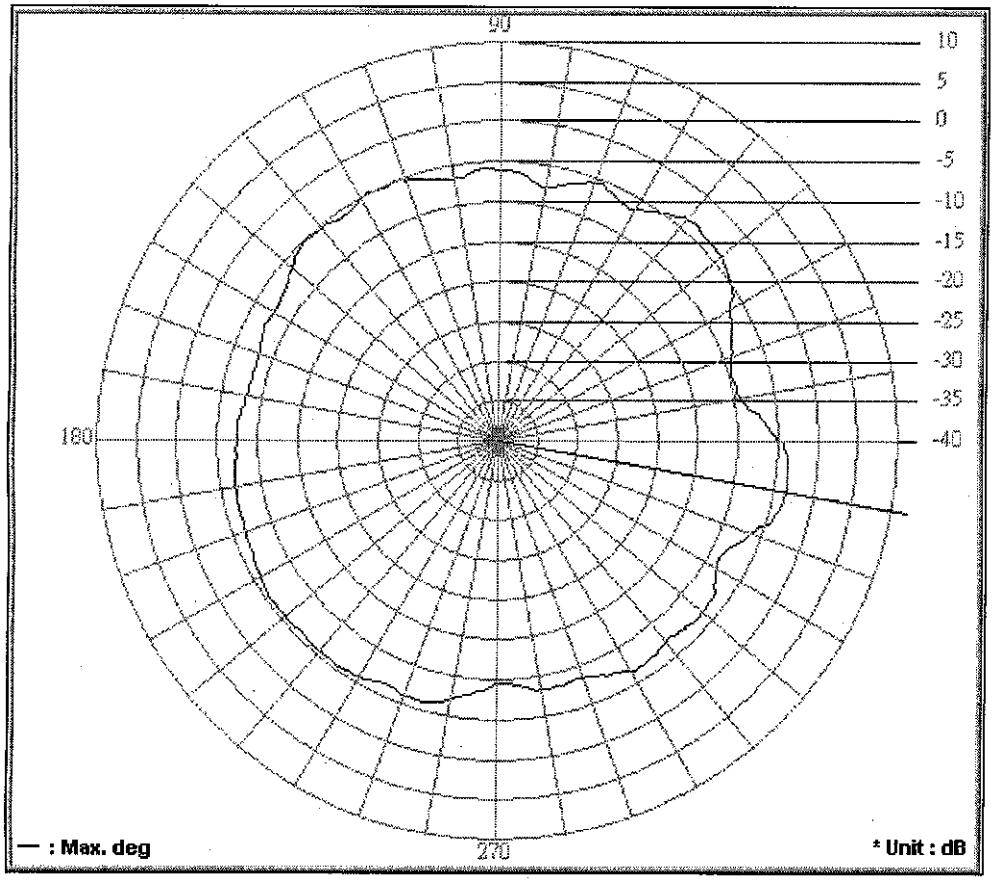
http://www.adt.com.tw/ E-mail: service@mail.adt.com.tw TEL: 886-3-5935343 FAX: 886-3-5935342

Brand / Model : ASUS
Remark : H-Plan ; 5150MHz
Tested by : Bruce
EUT description : Dualband Ant.

Location: **RF Chamber C** Date: **2002/12/18** Time: **下午 03:40:02**

Temperatuer (℃): **25** Humidity (%): **60** Approved by:



Frequency (MHz) : **5150.00** Antenna Polarity : **Vertical** Average Gain (dB) : **-6.34**

Maximum Gain (dB) : **-3.37** Maximum Gain (degree) : **350**

Minimum Gain (dB) : **-9.70** Minimum Gain (degree) : **14**

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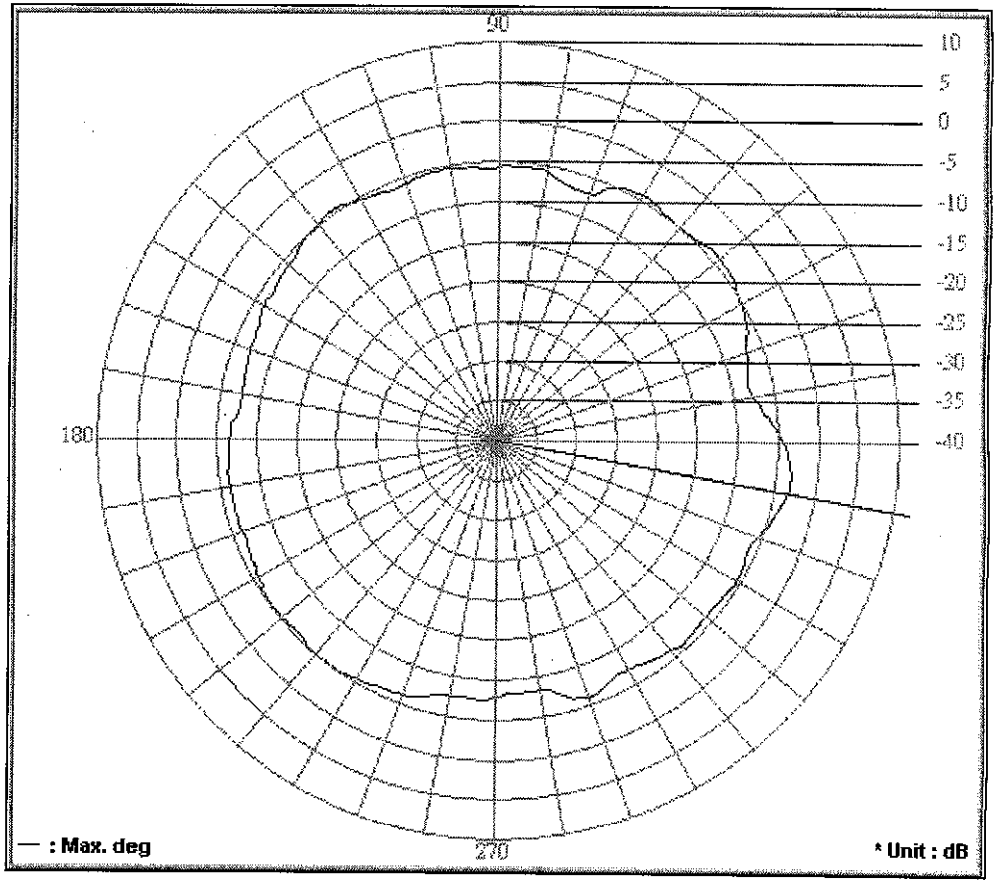
http://www.adt.com.tw/ E-mail: service@mail.adt.com.tw TEL: 886-3-5935343 FAX: 886-3-5935342

Brand / Model : ASUS
Remark : H-Plan ; 5250MHz
Tested by : Bruce
EUT description : Dualband Ant.

Location: **RF Chamber C** Date: **2002/12/18** Time: **下午 03:36:53**

Temperatuer (℃): **25** Humidity (%): **60** Approved by:



Frequency (MHz) : **5250.00** Antenna Polarity : **Vertical** Average Gain (dB) : **-5.81**

Maximum Gain (dB) : **-3.20** Maximum Gain (degree) : **350**

Minimum Gain (dB) : **-8.37** Minimum Gain (degree) : **273**

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http://www.adt.com.tw/ E-mail: service@mail.adt.com.tw TEL: 886-3-5935343 FAX: 886-3-5935342
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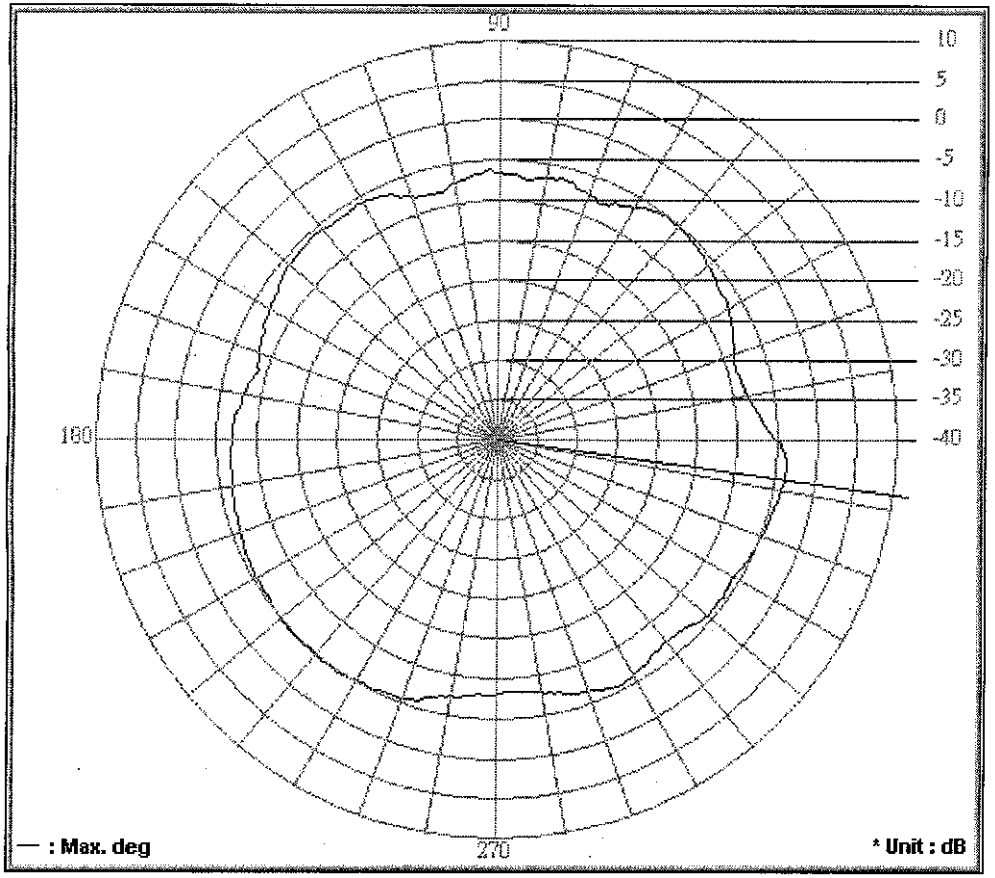
Brand / Model : ASUS
Remark : H-Plan ; 5350MHz
Tested by : Bruce
EUT description : Dualband Ant.

Location: **RF Chamber C** Date: **2002/12/18** Time: **下午 03:33:01**

Temperatuer (℃): **25** Humidity (%): **60** Approved by:



Frequency (MHz) : **5350.00** Antenna Polarity : **Vertical** Average Gain (dB) : **-6.29**

Maximum Gain (dB) : **-3.70** Maximum Gain (degree) : **352**

Minimum Gain (dB) : **-9.03** Minimum Gain (degree) : **16**

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