

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	:	VUIUPWL6024
Product Name	:	WIFI module
Model Name	:	UPWL6024
Frequency Range	:	IEEE 802.11b/g/n Draft 1.0 20M: 2.412GHz ~ 2.462GHz IEEE 802.11n Draft 1.0 40M: 2.422GHz ~ 2.452GHz
Channel Spacing	:	5MHz
Support Channel	:	IEEE 802.11b/g/n Draft 1.0 20M: 11 Channels IEEE 802.11n Draft 1.0 40M: 7 Channels
Modulation Skill	:	DBPSK, DQPSK, CCK, OFDM
Power Type	:	Powered by PCI Express interface of client's device

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:

$$\text{Friis Transmission Formula: } S = \frac{PG}{4\pi R^2} = \frac{431.49 \times 2.67}{4\pi(20)^2} = 0.229 \text{ mW/cm}^2$$

$$\text{Estimated safe separation: } R = \sqrt{\frac{PG}{4\pi}} = \sqrt{\frac{431.49 \times 2.67}{4\pi}} = 9.574 \text{ cm}$$

Note: "The safe estimated separation that the user must maintain from the antenna is at least 6.5cm"

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:

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

$$G = \text{Log}^{-1} (4.27 / 10) = 2.67$$

Appendix

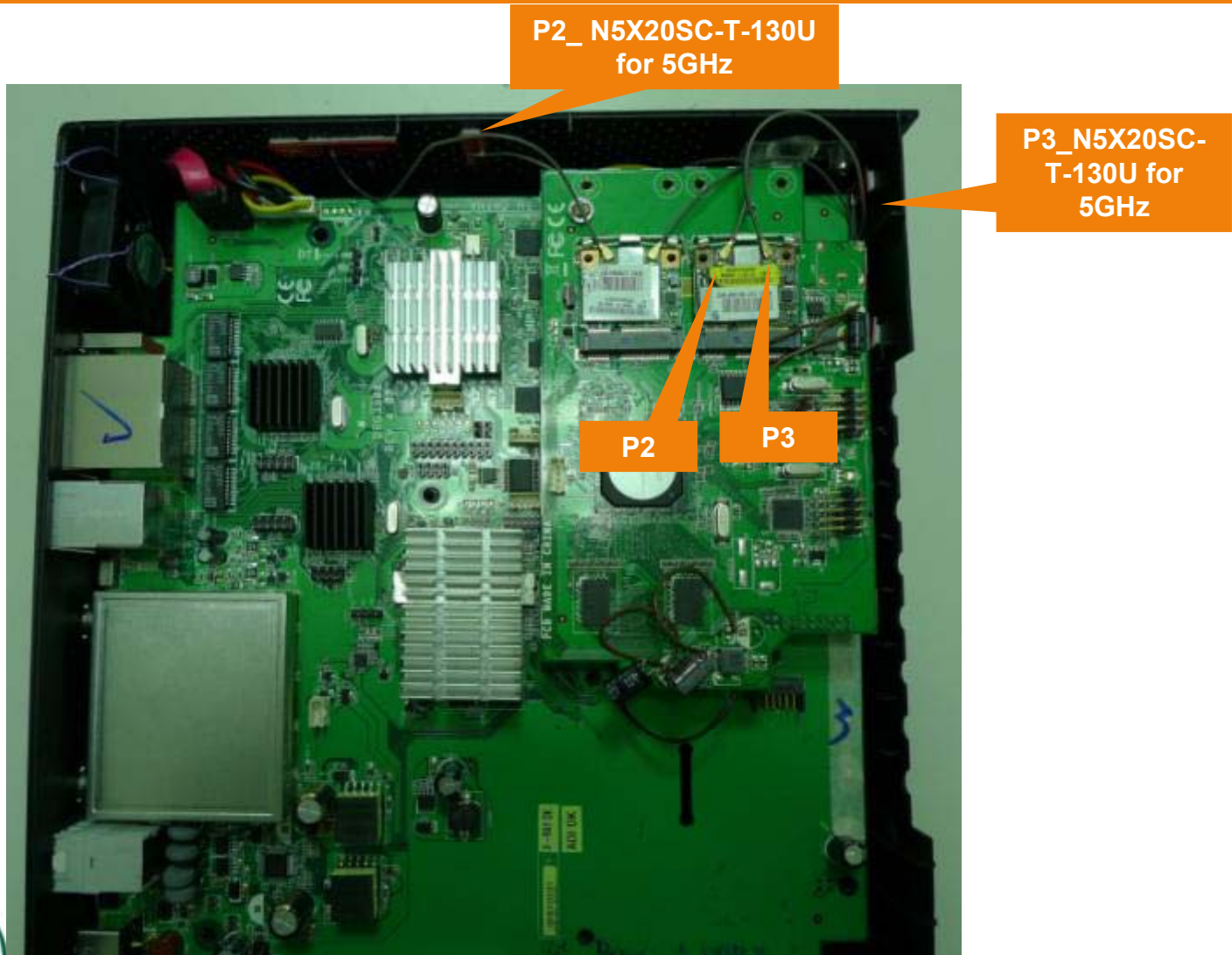
Antenna Specification (Antenna #1 & #2 N5X20SC T-130U)



UNIHAN DRG7908 Antenna solution Report(N5X20SC-T-130U)

July 22, 2011

Antenna Installation method



N5X20SC

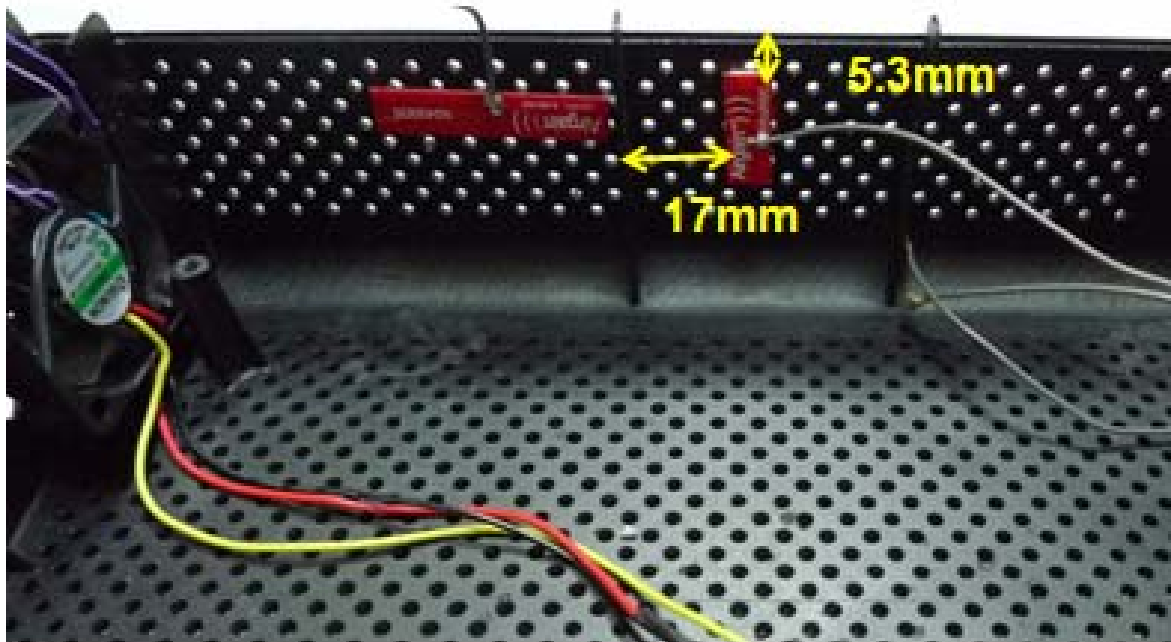
■ Features

- Single-Band
- Single feed, low profile design
- Superior performance in both vertical and horizontal orientations
- Simple case mount accommodates easy integration in existing form factors

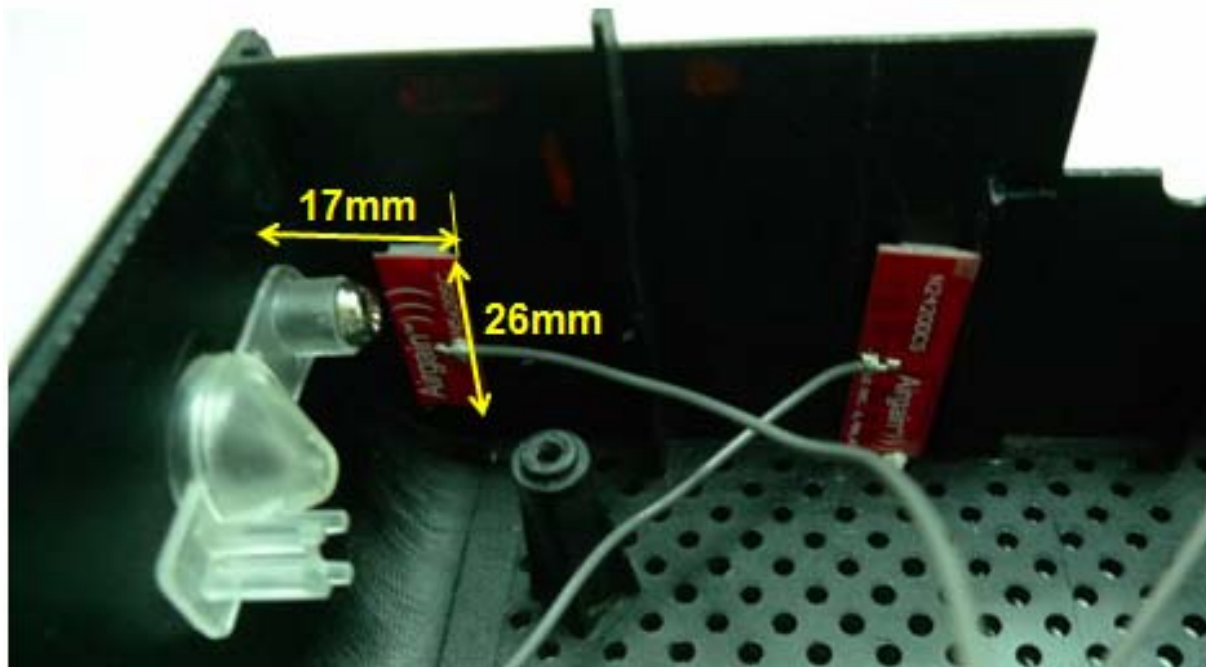


Standard	IEEE 802.11n and 802.11a
Frequency Range	4.9 to 5.9 GHz
Peak Gain	2.4GHz→-6.57dBi ; 5GHz→5.12dBi ; (With DRG7908)
VSWR	2:1
Feed Impedance	50 Ohms
Power Handling	30 dBm
Interface	50 ohm, 1.13mm diameter, micro coax cable, U.FL Compatible Plug
Antenna Dimensions (LxWxH)	21x8x0.5(mm)
Antenna type	PCB type

Antenna location (P2)

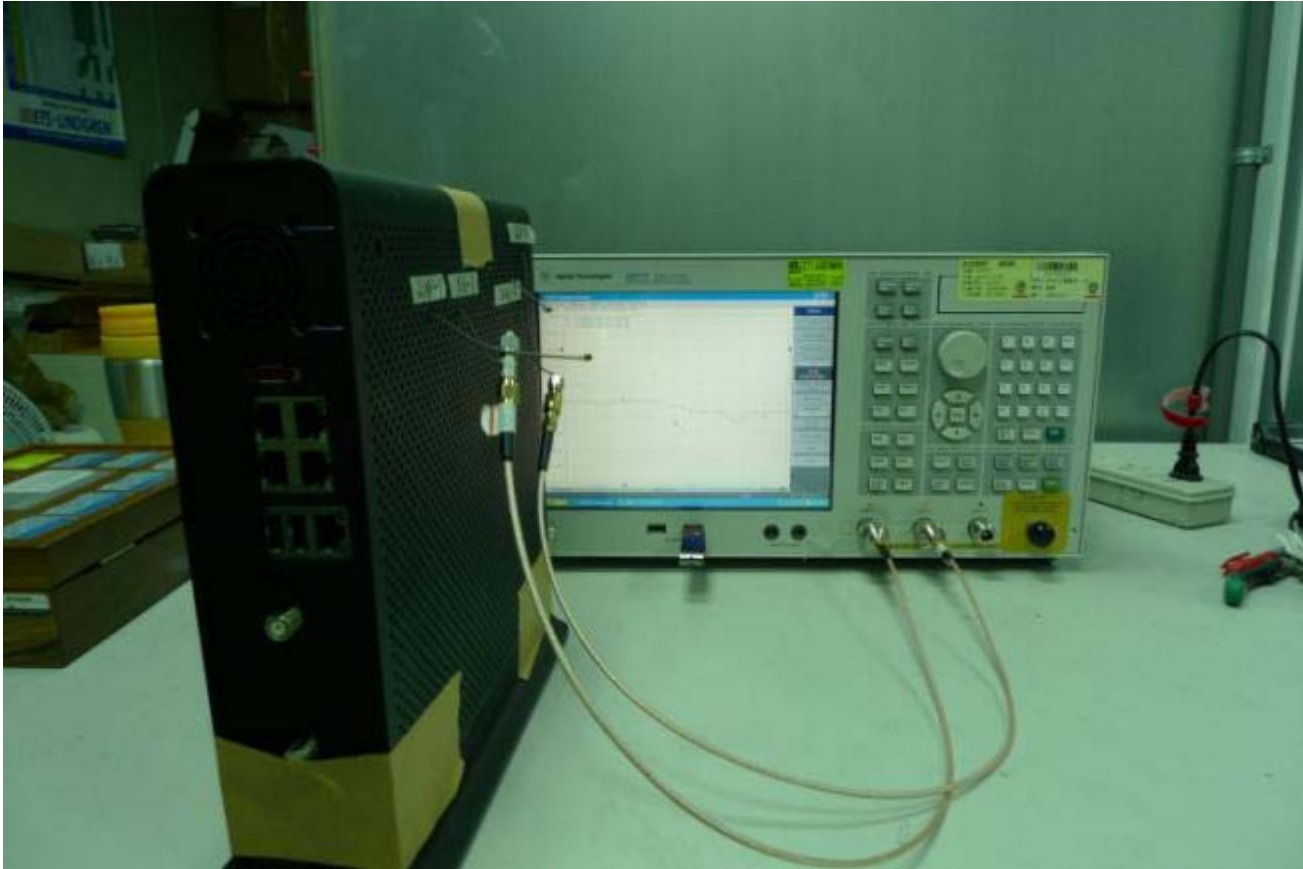


Antenna location (P3)



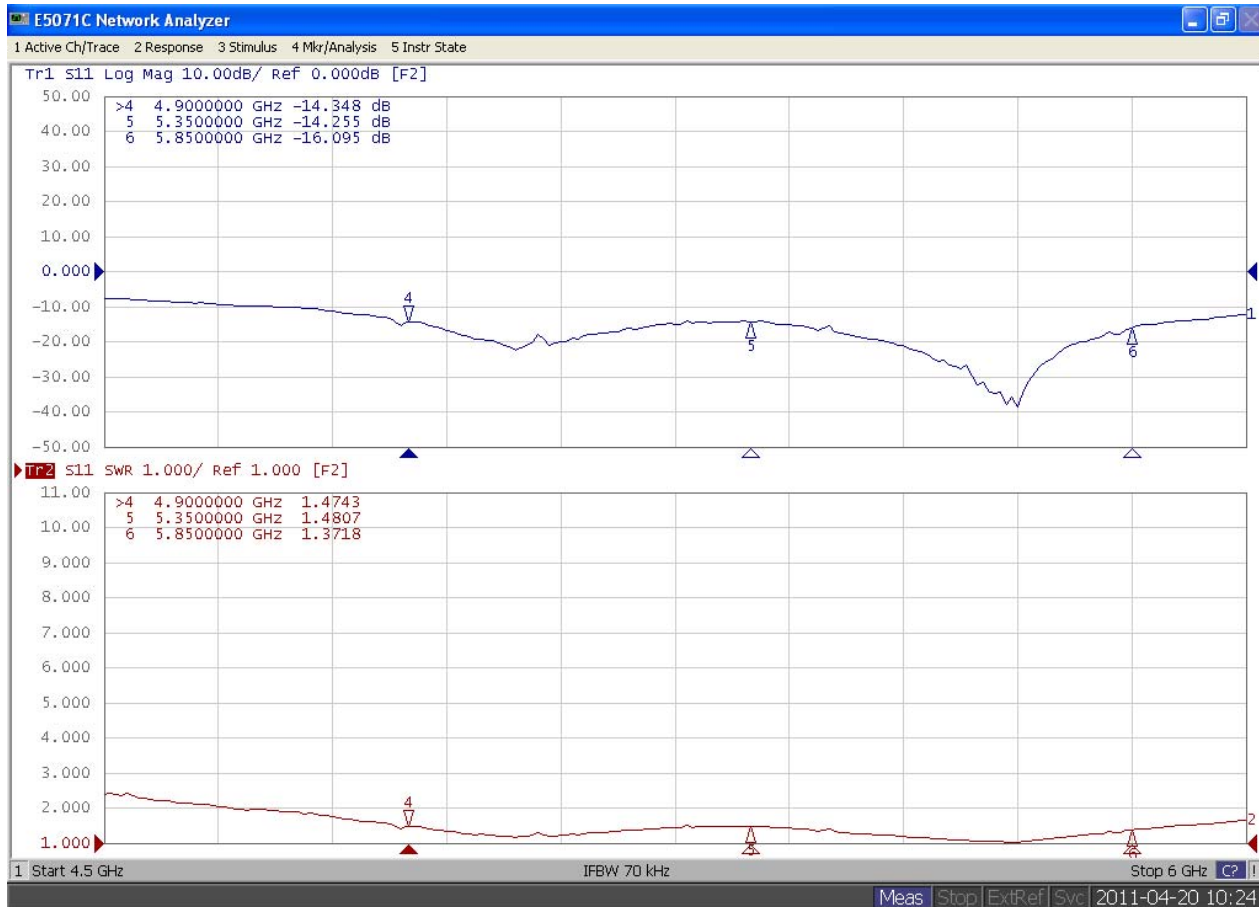
S-parameter

■ Measurement Method



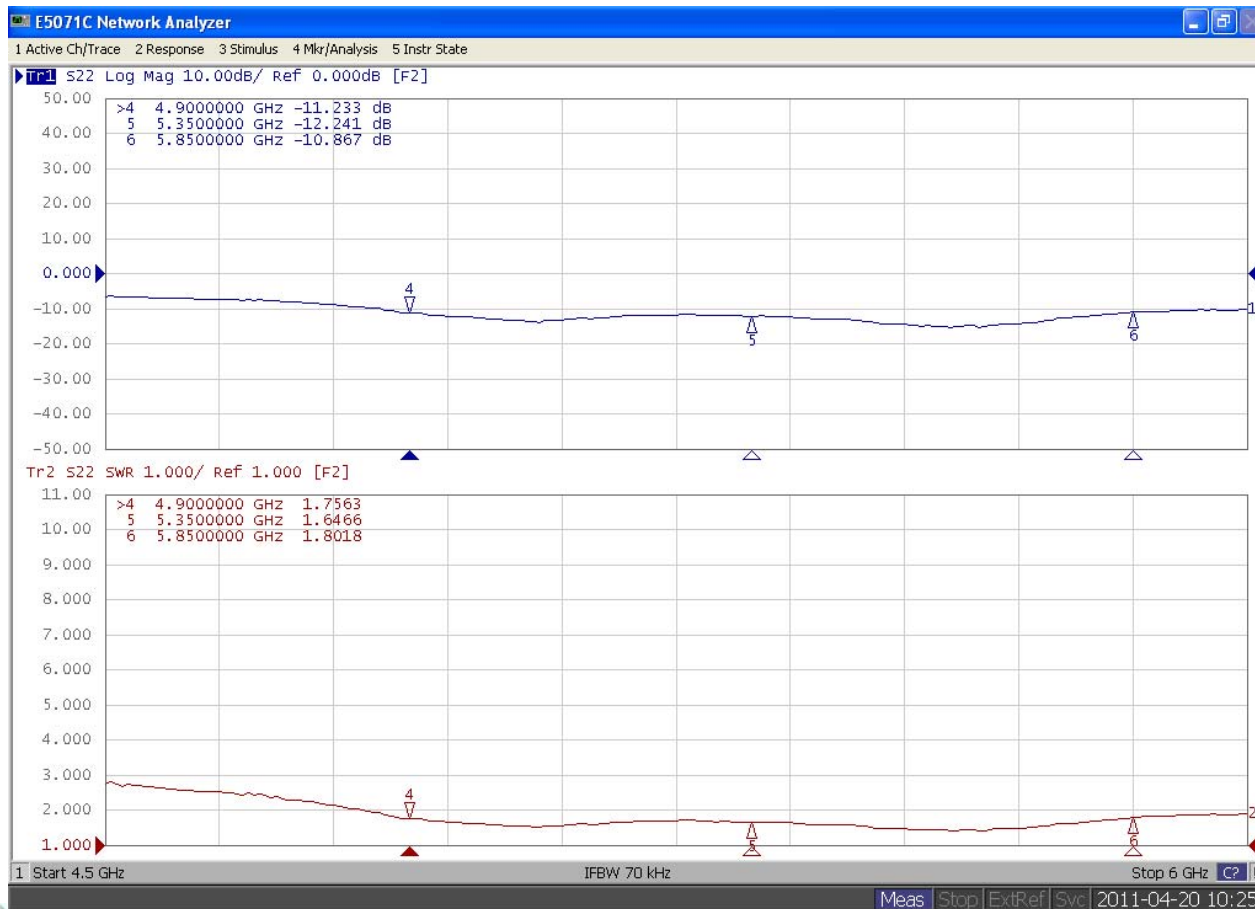
S-parameter

■ P2_ N5X20SC-T-130U for 5GHz



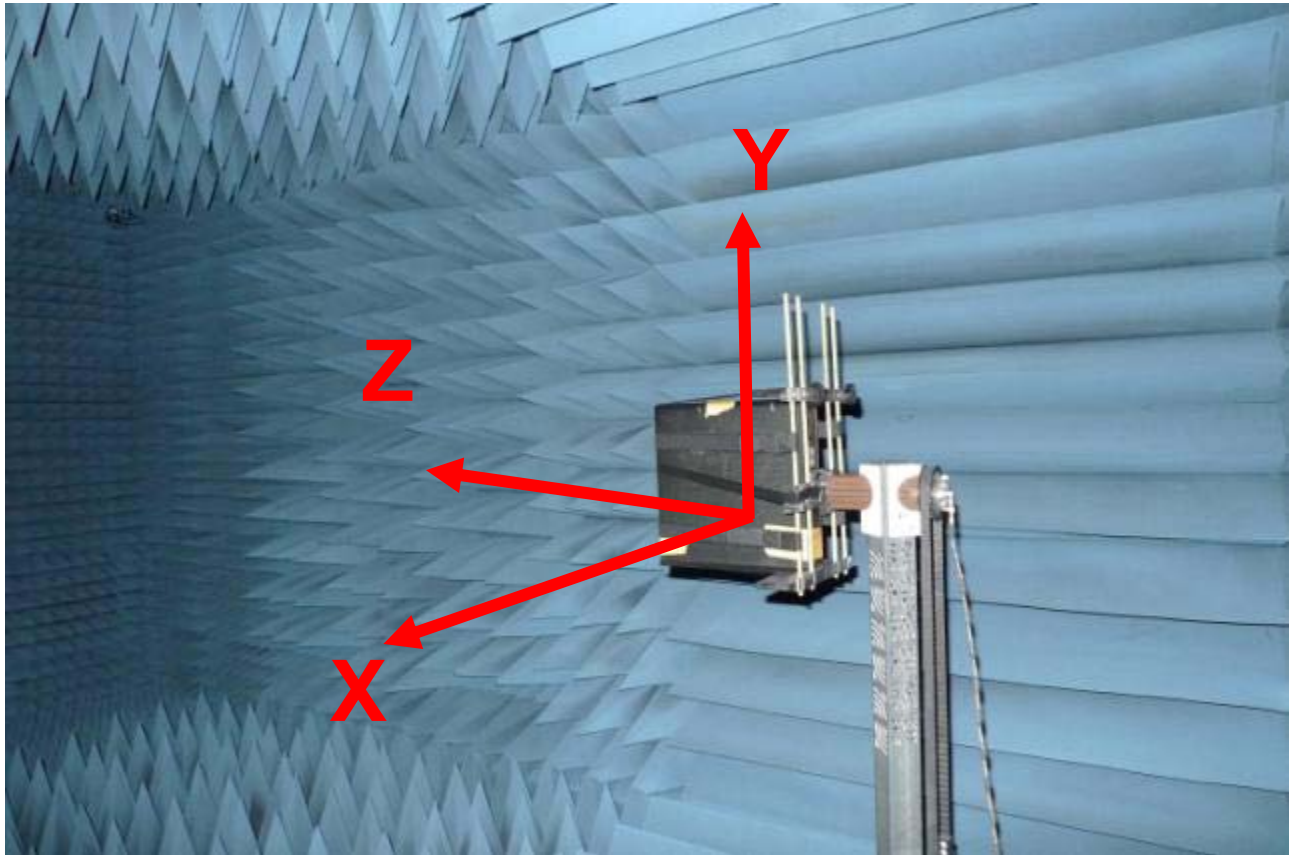
S-parameter

■ P3_ N5X20SC-T-130U for 5GHz



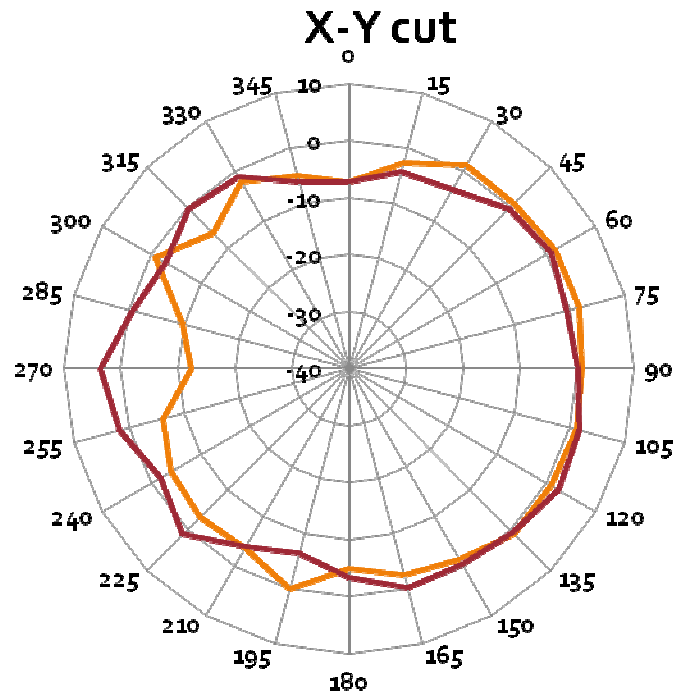
Radiation pattern

■ Chamber Orientation



Radiation pattern

■ 5.5GHZ (X-Y cut)

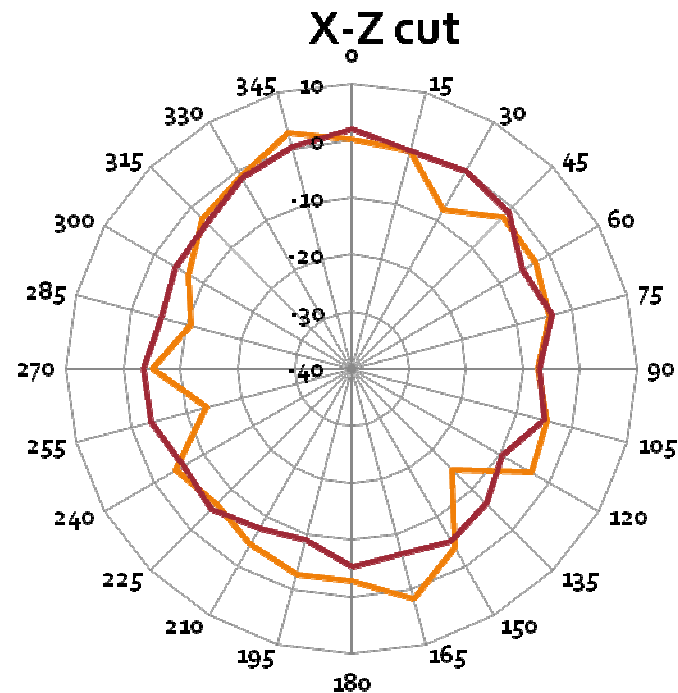


— P2_ N2401D-T-130U for 5GHz

— P3_ N2401D-T-100U for 5GHz

Radiation pattern

■ 5.5GHZ (X-Z cut)

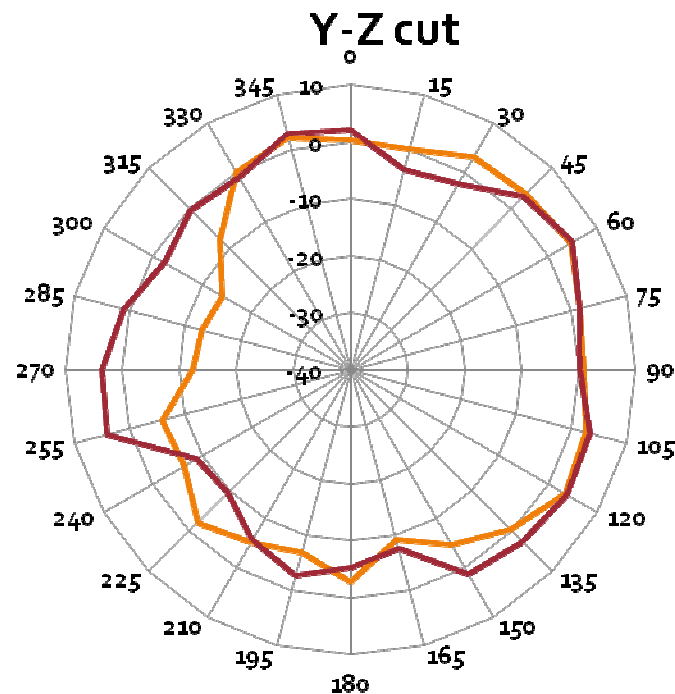


— P2_ N2401D-T-130Ufor 5GHz

— P3_ N2401D-T-100Ufor 5GHz

Radiation pattern

■ 5.5GHZ (Y-Z cut)



— P2_ N2401D-T-130U for 5GHz

— P3_ N2401D-T-100U for 5GHz

P2&P3 Peak Gain & Efficiency

3

	P2		P3	
	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)
2.412GHz	-7.85	16.39	-7.06	1.60
2.417GHz	-7.82	16.49	-6.97	1.48
2.422GHz	-7.90	16.19	-7.08	1.35
2.427GHz	-7.96	15.98	-7.05	1.25
2.432GHz	-8.06	15.60	-7.18	1.14
2.437GHz	-8.12	15.39	-7.26	1.05
2.442GHz	-8.06	15.62	-7.20	0.99
2.447GHz	-7.94	16.03	-7.09	0.96
2.452GHz	-7.84	16.41	-7.05	0.94
2.457GHz	-7.69	17.01	-6.88	0.93
2.462GHz	-7.51	17.72	-6.80	0.93
2.467GHz	-7.38	18.25	-6.67	0.92
2.472GHz	-7.31	18.54	-6.57	0.89

P2&P3 Peak Gain & Efficiency

4

	P2		P3	
	Peak Gain (dBi)	Efficiency (%)	Peak Gain (dBi)	Efficiency (%)
5.180GHz	4.92	75.59	5.04	77.21
5.200GHz	4.87	72.79	4.83	74.76
5.250GHz	4.79	74.36	4.62	73.10
5.300GHz	4.10	71.70	4.23	68.50
5.350GHz	4.61	77.43	4.41	77.94
5.400GHz	4.71	75.75	4.67	77.33
5.450GHz	4.98	71.58	4.58	73.09
5.500GHz	4.64	69.01	4.91	70.90
5.550GHz	4.45	70.54	5.08	75.72
5.600GHz	4.65	69.36	4.96	75.73
5.650GHz	4.90	72.62	4.59	75.48
5.700GHz	4.97	71.24	4.26	71.29
5.750GHz	5.12	76.00	4.90	76.70
5.800GHz	4.85	71.62	4.55	71.42
5.806GHz	4.95	73.27	4.60	73.19

Appendix

Antenna Specification (Antenna #3 WPB210 & WPB211)

納入仕様書

《新規・~~變更~~》

客戶 UNIHAN

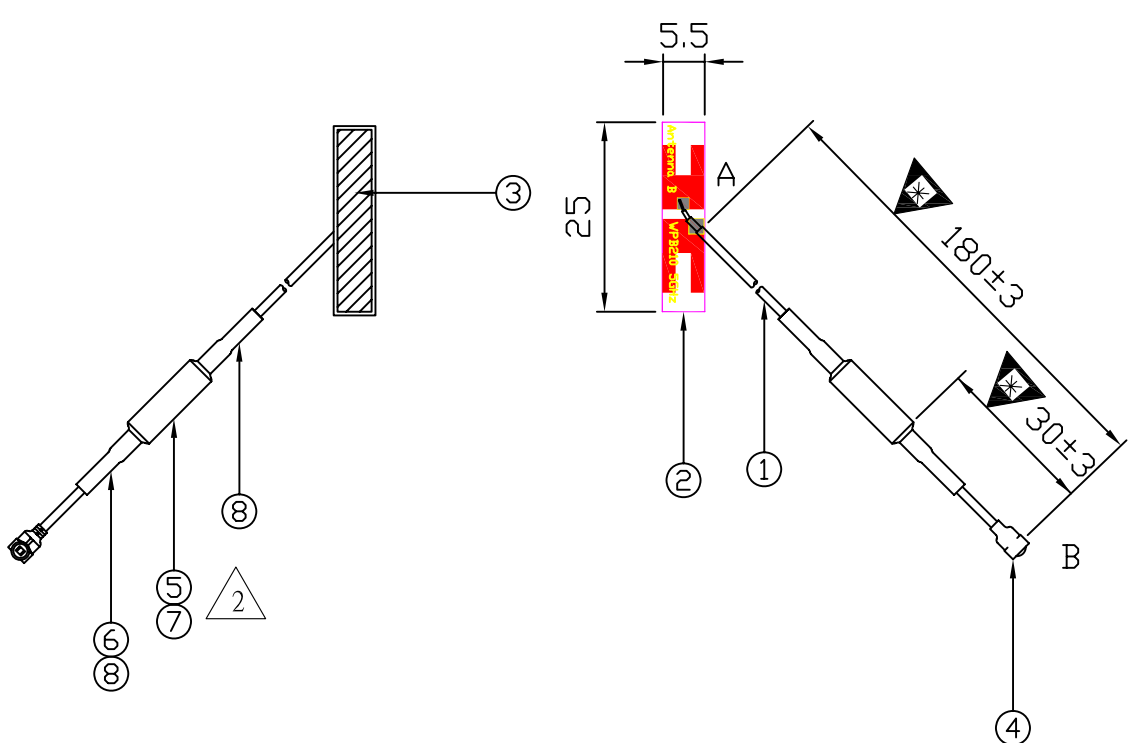
制 定	2011 年 04 月 21 日
部品番號	1415-01UD000
品 名	WPB210 5GHz Antenna with MHF L180mm(F5B)
公司番號	UC3WFI0044

〔 驗收印欄 〕

蘇州萬旭電子元件有限公司
江蘇省蘇州市相城區望亭鎮問渡路168號
PC:215155
TEL:86-512-66381105
FAX:86-512-65381104

作 成	檢 圖	確 認	核 準
曹 吉	沈天華	邢麗芬	邢胜华

1		2		3		4		5		6		7	
一般未注公差(mm)				客户		客户						承认图面	
X		±1.0		变更点指示符									
X.X		±0.5		重点尺寸指示符									
X.XX		±0.3											
ANGULAR		±5.0°											
成品单重(g):		X.Xg											



Technical drawing of an antenna assembly. The drawing shows a perspective view of the antenna with various dimensions and callouts. Key dimensions include a length of 180±3mm, a width of 30±3mm, and a height of 25mm. Callouts 1 through 8 indicate specific features or components. A red rectangular area is highlighted on the antenna body, labeled 'A' and 'B'. A yellow rectangular area is also highlighted, labeled 'C'.

加工注意项：

1. 天線組立依據天線組立作業指導書規定製作。
依據QC管理工程圖，執行品質管制。

第3角法	圖面不用實測				機種料号	1415-01UD000		
單位: mm	作成	檢圖	確認	核准	品名	WPB210 5GHz Antenna with MHF L180mm(F5B)		
比例: FREE	曹吉	沈天华	邢丽芬	邢胜华	产品分类	☒ A成品	☐ B半成品	☐ C样品
11年04月20日					图面编号			UC3WFI0044
S.Z成品编号：UC3WFI0044A		T.W成品编号：		文件编号：RD-4-037A		页次: 1/2		

蘇州萬旭電子元件有限公司

	1	1	2	1	3	1	4	1	5	1	6	1	7	
	變更內容履歷簡述 REVISIONS DESCRIPTION					版次 REV.	年月日 DATE	變更切換方式			作成			
	△	增加CORE;原外露200mm變更為180mm					A2	2011.04.22				曹吉		
	△	F5B T 8*4*4 變更為F5B RH 4*10*2					A3	2011.04.25				曹吉		
	△													
A														A
														
B														B
C														C
D														D
E														E
F														F
G														G
H	8	熱縮套管		CB 無鹵套管 2.5 黑					HF	黑		2		H
	7	熱縮套管		CB 無鹵套管 4.0 黑					HF	黑		1		
	6	熱縮套管		CB 無鹵套管 1.5 黑					HF	黑		1		
	5	CORE		F5B RH 4*10*2					HF	黑		1		
	4	MHF Connector		20278-112R-13					HF	金		1		
	3	泡棉膠帶		3M 4945壓克力泡棉膠帶 W9mm*H1.1mm*L23.5mm					HF			1		
	2	PCB		WPB210					HF			1		I
	1	MINI1.13 Coaxial Cable		MINI OD:1.13 TD 白 鍍錫編織					HF	白		1		
	NO.	材 料 名 稱	廠 商	零 件 規 格					顏色	切斷尺寸 & 備註			用量	
	第3角法		圖面不用實測				機種料号		1415-01UD000					
	單位: mm		作 成	檢 圖	確 認	核 准	品 名		WPB210 5GHz Antenna with MHF L180mm(F5B)					
	比例: FREE		曹 吉	沈天华	邢丽芬	邢胜华	产品分类		☒ A 成品	☐ B 半成品	☐ C 样品			
	11年04月20日						圖面编号		UC3WFI0044					
	S.Z成品编号: UC3WFI0044A					T.W成品编号:			文件编号: RD-4-037A			页次: 2/2		

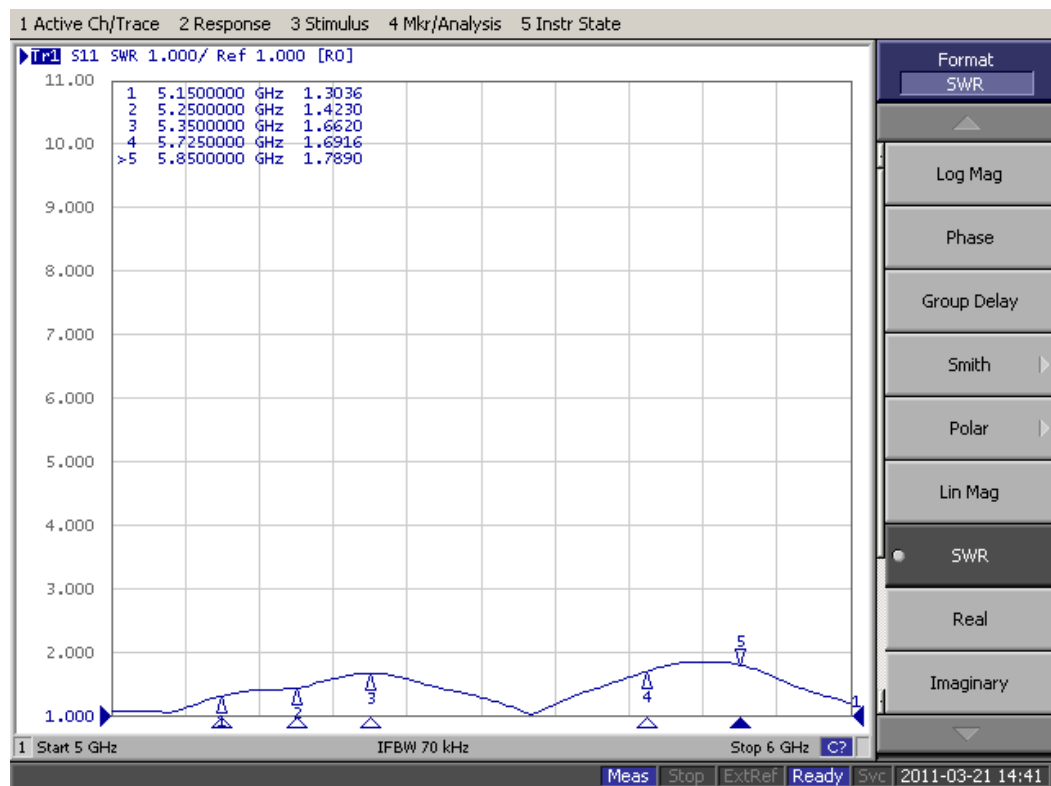
SPECIFICATION

- a. Description : WPB210 5GHz Antenna with MHF
L180mm(F5B)
- b. Customer : 永碩聯合國際股份有限公司
- c. Part No. : 1415-01UD000
- d. Model No. : DRG7908
- e. Standard : IEEE 802.11 a Wireless LAN
- f. Antenna Profile : 25*5.5*0.8 mm
- g. Lead Length : 180 mm
- h. Electrical Characteristics
 - Operating Frequency : 5.15~5.35 / 5.725~5.85 GHz
 - Antenna Type : PCB
 - Polarization Type : Linear
 - Impedance : 50 Ohm nominal
 - Antenna Peak Gain : 4.4 dBi
- i. Mechanical Characteristics
 - Connector : MHF
 - Core : F5B 4*10*2
- j. Raw Material
 - Coaxial Cable : Mini 1.13



Antenna Test Data

Antenna 2(5GHz) VSWR



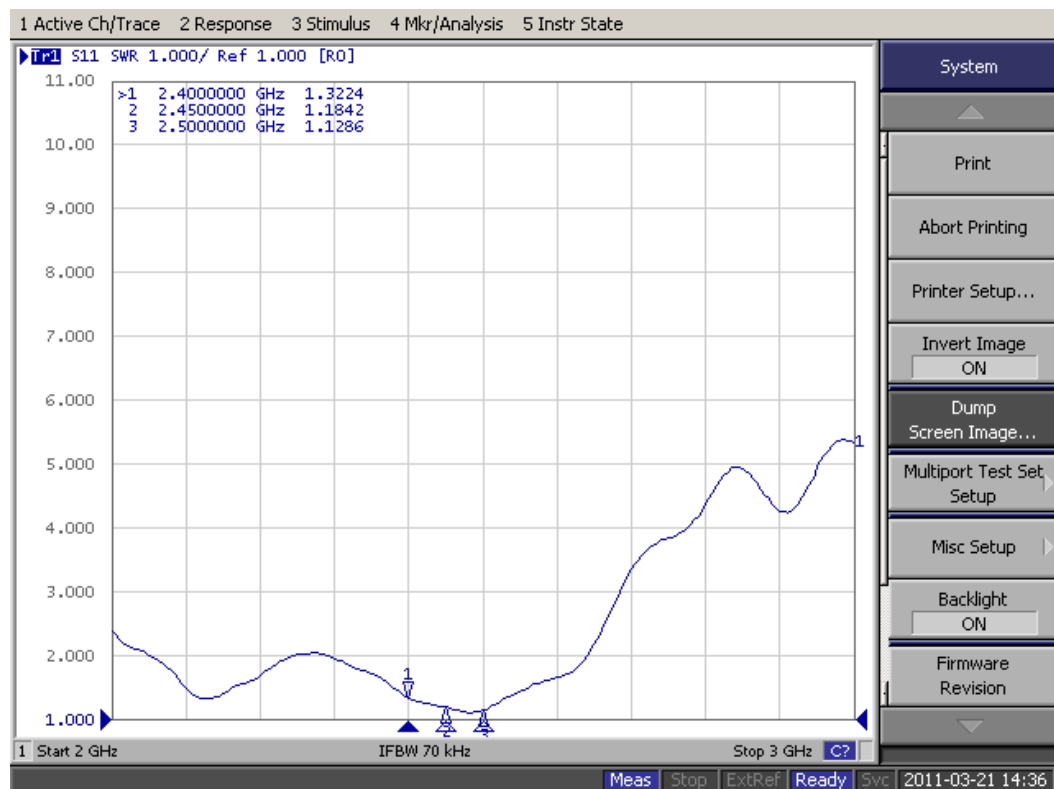
Radiation Pattern

Antenna 2(5GHz)

Antenna 2 Gain			
Frequency	Peak Gain (dBi)	Average Gain(dB)	Efficiency %
5.15GHz	3.49	-1.88	64.91
5.25GHz	4.11	-1.82	65.70
5.35GHz	4.31	-1.79	66.21
5.725GHz	3.90	-2.09	61.48
5.85GHz	4.40	-1.93	64.06

Antenna Test Data

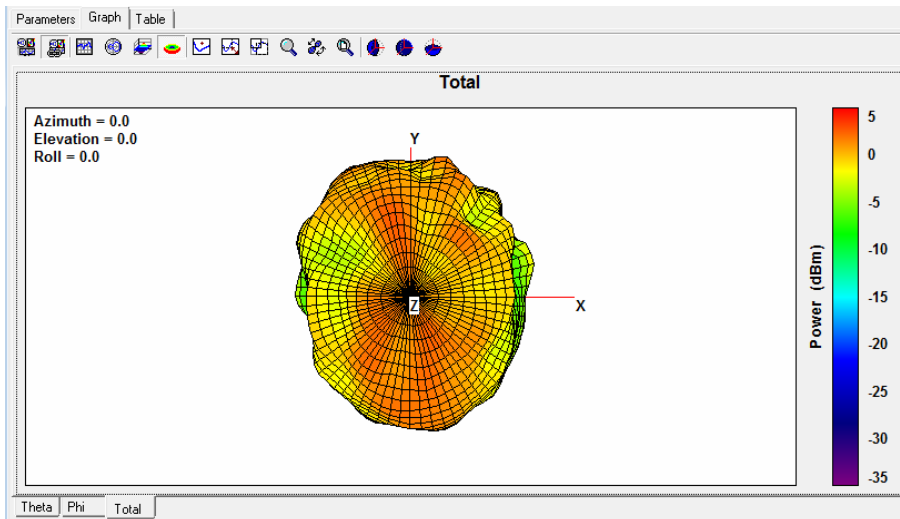
Antenna 3(2.4GHz) VSWR



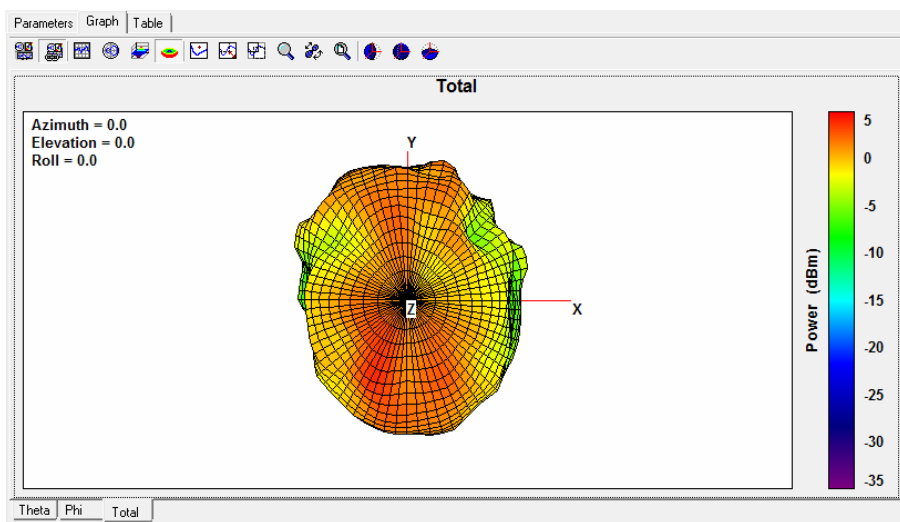
Radiation Pattern Antenna 3(2.4GHz)

Antenna 3 Gain			
Frequency	Peak Gain (dBi)	Average Gain(dB)	Efficiency %
2.40GHz	3.26	-2.39	57.70
2.45GHz	4.04	-2.15	60.98
2.50GHz	3.66	-2.33	58.54

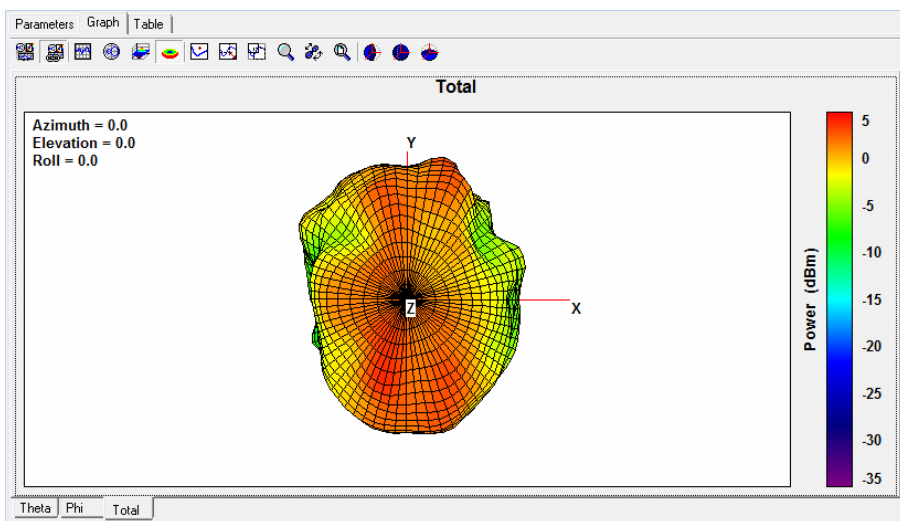
5.15GHz



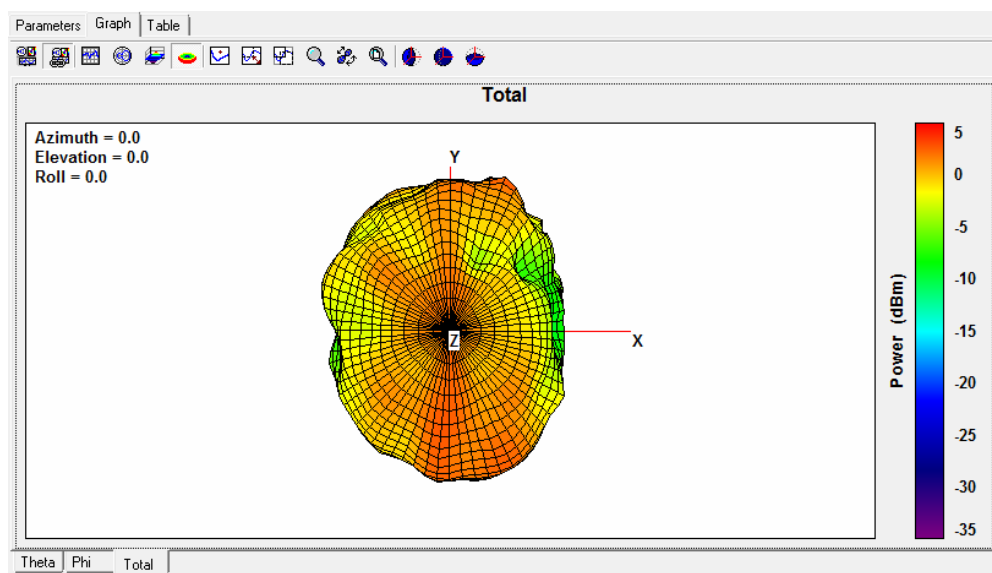
5.25GHz



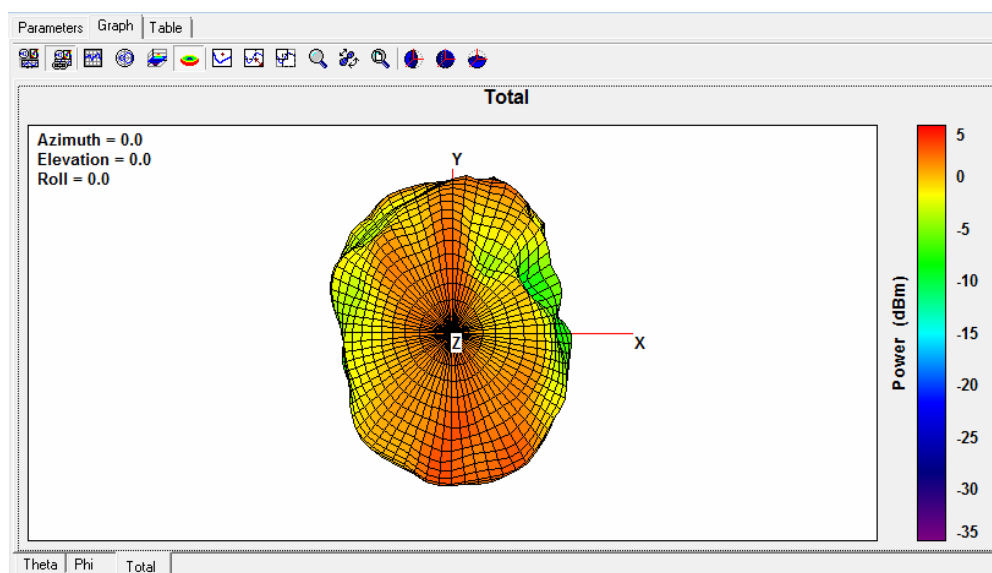
5.35GHz



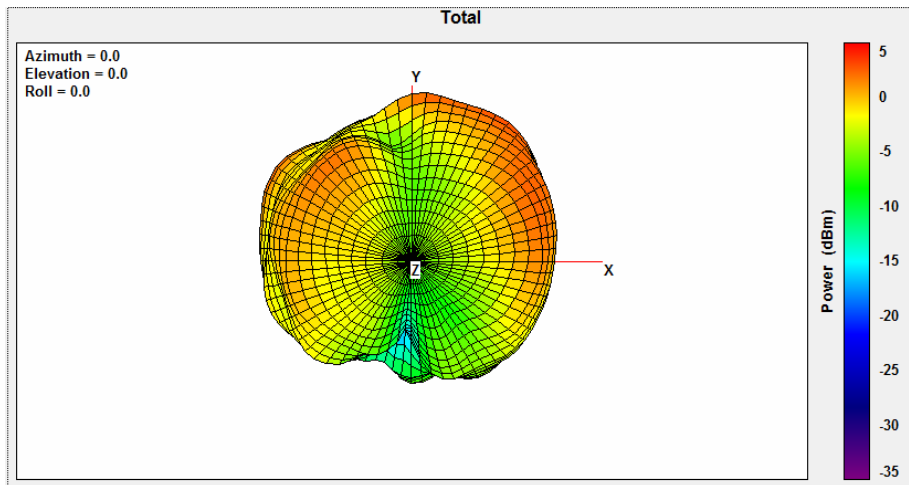
5.725GHz



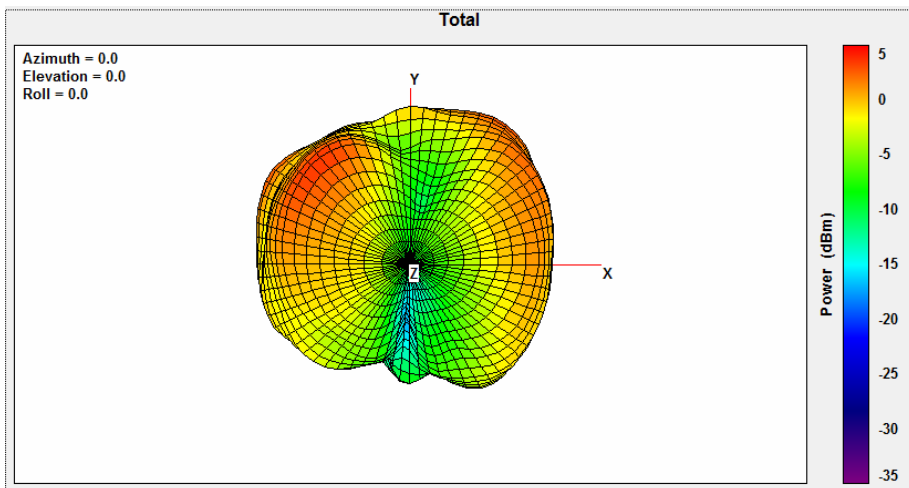
5.85GHz



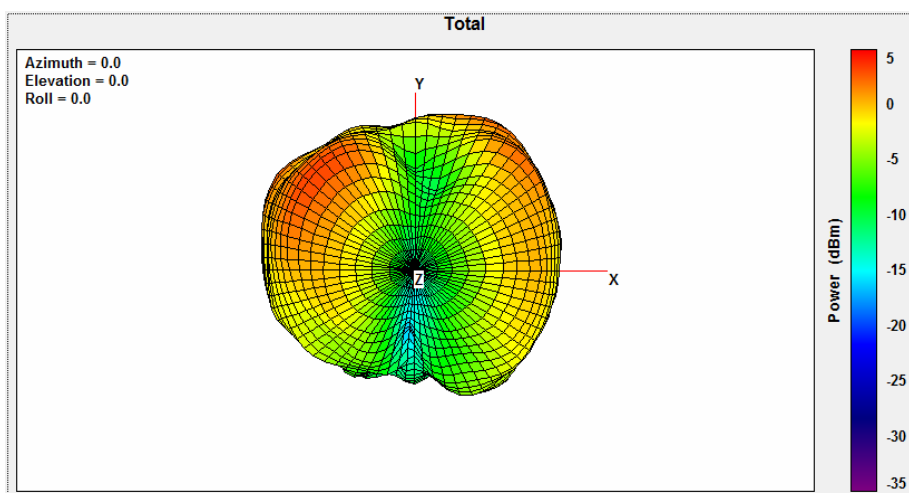
2.4GHz



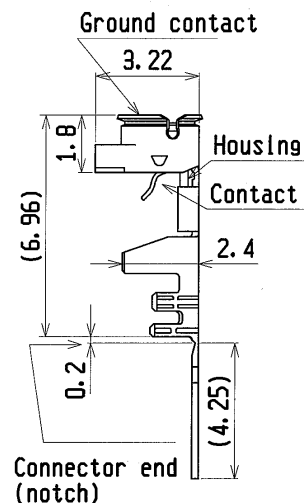
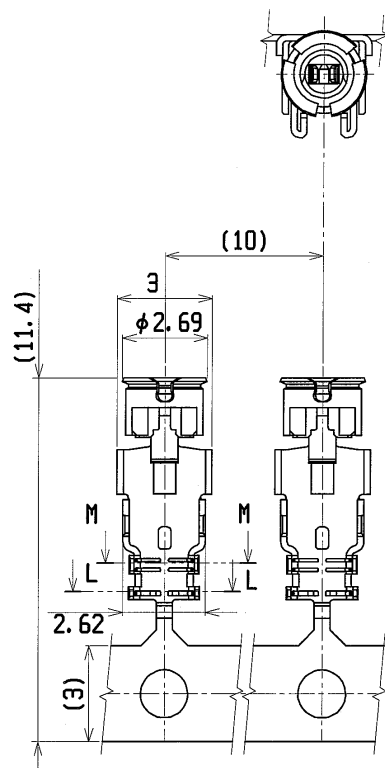
2.45GHz



2.5GHz

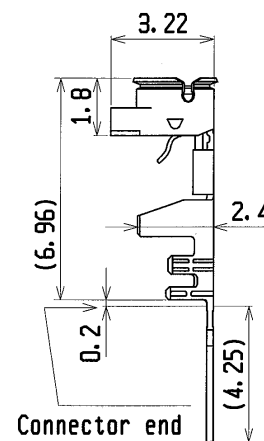


PART NO.
20278-...R-...



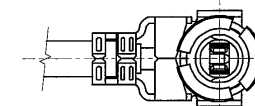
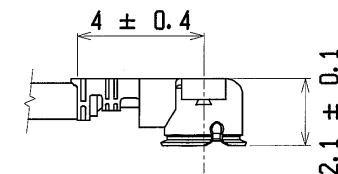
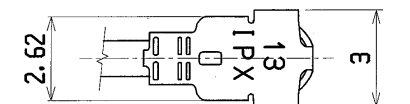
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20278-102R-08
20278-101R-13
20278-102R-13
20278-101R-32
20278-102R-32

For hand tool
(with notch)



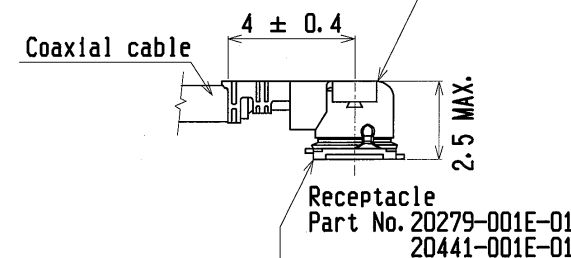
Part No. 20278-111R-08
20278-112R-08
20278-111R-13
20278-112R-13
20278-111R-32
20278-112R-32

For semi auto
termination machine
(without notch)



Cable Ass'y

Plug
P/N 20278-1...R-08
P/N 20278-1...R-13
P/N 20278-1...R-32



MATING

GENERAL TOLERANCE	
6 MAX.	±0.2
6 OVER MAX. 30	±0.3
30 OVER MAX. 120	±0.5
ANGLE	±2°

19C	Z08056	K.O	Feb/04/08	EK	DESIGN'D BY	DATE	I-PEX Interconnect and Packaging Electronics TOKYO, JAPAN	General			
18C	Z07346	K.O	Jul/10/08	E.K	K. Ohbayashi	JUN/13/01					
17C	Z05233	K.O	May/18/05	T.H	CHK'D BY	DATE					
16C	Z05024	K.O	Jan/20/05	T.H							
15C	Z04398	K.O	Nov/12/04	T.H	APP'D BY	DATE					
REV	ECN	BY	DATE	APP	K. Katabuchi	JUN/13/01	TITLE				
							MHF series micro coaxial connector plug vertical (ground contact : gold plating)				
REV. RECORD					CUSTOMER	PROJECTION	SCALE	UNIT	DWG. No.	SHEET	REV.
					COPY		6/1	mm	20278	1/4	19C
SERIES No.					2814						

納入仕様書

《新規・変更》

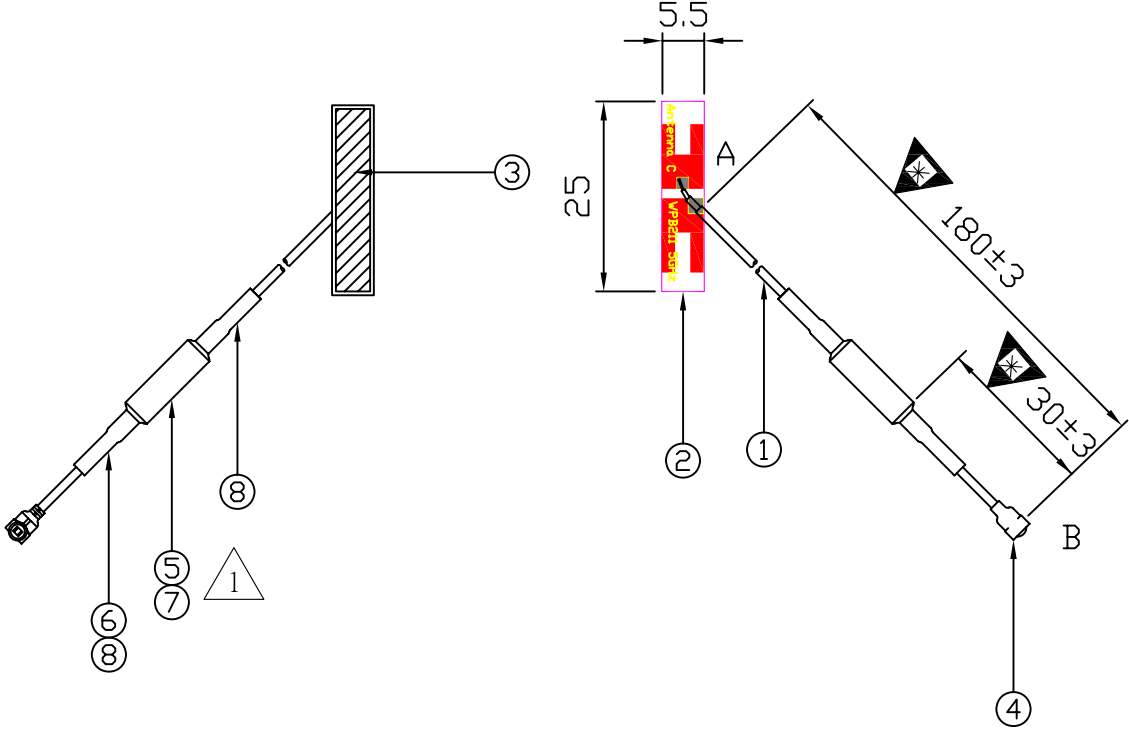
客戸 UNIHAN

制 定	2011 年 04 月 21 日
部品番號	1415-01UC000
品 名	WPB211 5GHz Antenna with MHF L180mm(F5B)
公司番號	UC3WFI0046

〔 驗收印欄 〕

蘇州萬旭電子元件有限公司
江蘇省蘇州市相城區望亭鎮問渡路168號
PC:215155
TEL:86-512-66381105
FAX:86-512-65381104

作 成	檢 圖	確 認	核 準
曹 吉	沈天華	邢雨芬	邢胜华

1		2		3		4		5		6		7	
一般未注公差(mm)						客户 签名						客 户 承认图面	
X	±1.0			变更点 指示符									
X.X	±0.5												
X.XX	±0.3												
ANGULAR	±5.0°												
成品单重(g):	X.Xg			重点尺寸 指示符									
 加工注意项： 1. 天線組立依據天線組立作業指導書規定製作。 依據QC管理工程圖，執行品質管制。													
第3角法		圖面不用實測				机种料号		1415-01UC000					
單位: mm		作 成		檢 圖		確 認		核 准		品 名		WPB211 5GHz Antenna with MHF L180mm(F5B)	
比例: FREE		曹 吉		沈天华		邢丽芬		邢胜华		产品分类		☒ A成品 ☐ B半成品 ☐ C样品	
11年04月22日										图面编号		UC3WFI0046	
S.Z成品编号：UC3WFI0046A				T.W成品编号：				文件编号：RD-4-037A				页次: 1/2	
 蘇州萬旭電子元件有限公司													

1		2		3		4		5		6		7	
变更内容履历简述 REVISIONS DESCRIPTION								版次 REV.	年月日 DATE	變更切换方式			作成
△ F5B T 8*4*4 变更为F5B RH 4*10*2								A3	2011.04.25				曹吉
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SPECIFICATION

a. Description : WPB211 5GHz Antenna with MHF
L180mm(F5B)

b. Customer : 永碩聯合國際股份有限公司

c. Part No. : 1415-01UC000

d. Model No. : DRG7908

e. Standard : IEEE 802.11 a Wireless LAN

f. Antenna Profile : 25*5.5*0.8 mm

g. Lead Length : 180 mm

h. Electrical Characteristics

Operating Frequency : 5.15~5.35 / 5.725~5.85 GHz

Antenna Type : PCB

Polarization Type : Linear

Impedance : 50 Ohm nominal

Antenna Peak Gain : 4.71 dBi

i. Mechanical Characteristics

Connector : MHF

Core : F5B 4*10*2

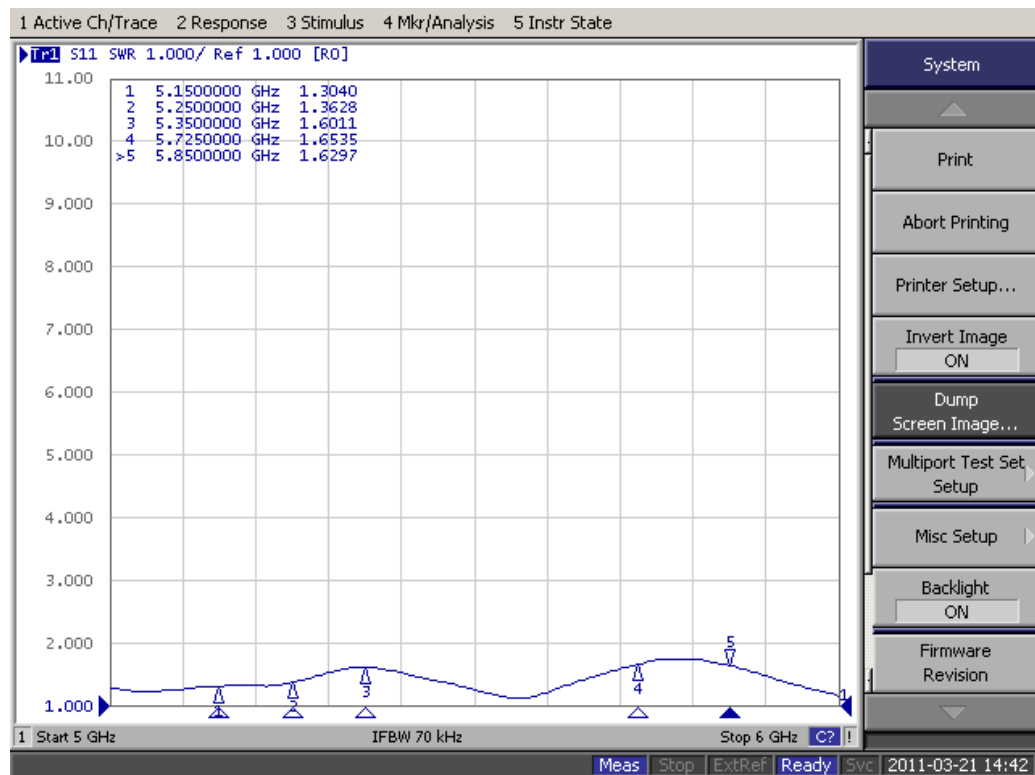
j. Raw Material

Coaxial Cable : Mini 1.13



Antenna Test Data

Antenna4 (5GHz) VSWR



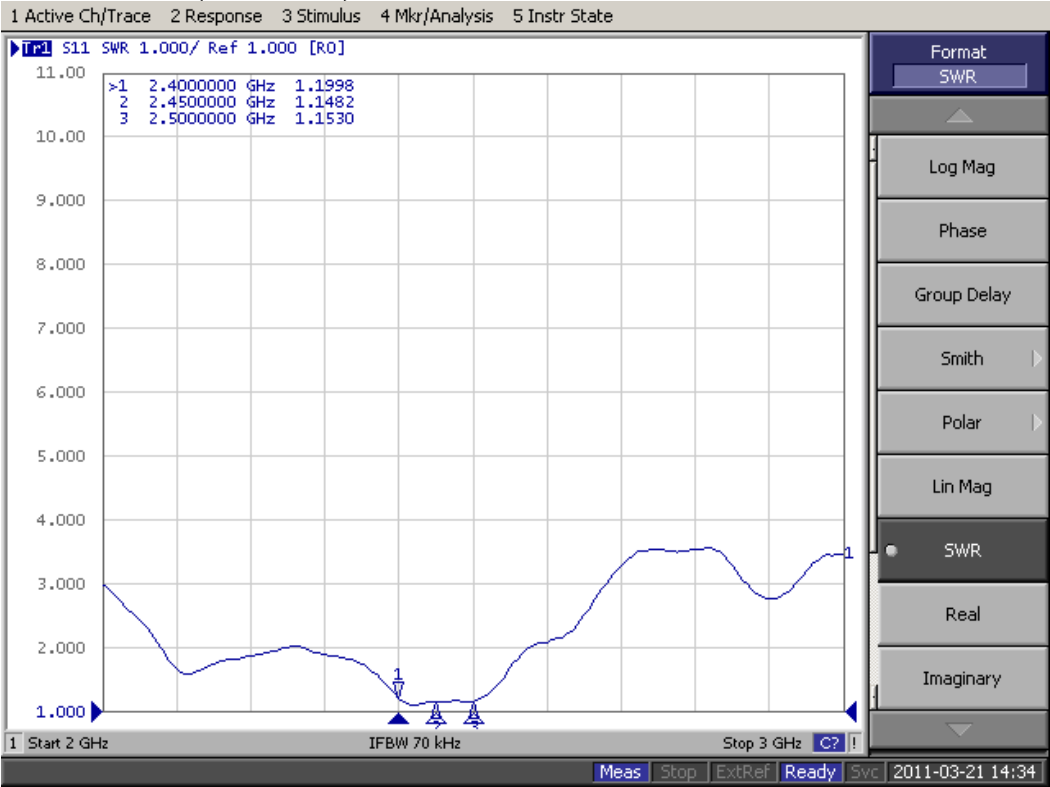
Radiation Pattern

Antenna 4(5GHz)

Antenna 4 Gain			
Frequency	Peak Gain (dBi)	Average Gain(dB)	Efficiency %
5.15GHz	3.55	-2.15	60.92
5.25GHz	3.76	-1.86	65.12
5.35GHz	3.87	-1.86	65.21
5.725GHz	4.56	-1.96	63.69
5.85GHz	4.71	-1.69	67.75

Antenna Test Data

Antenna 1(2.4GHz) VSWR

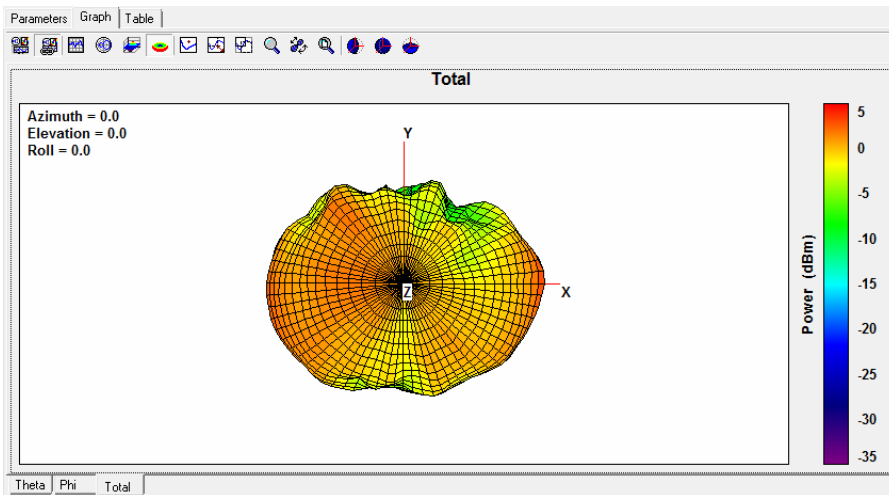


Radiation Pattern

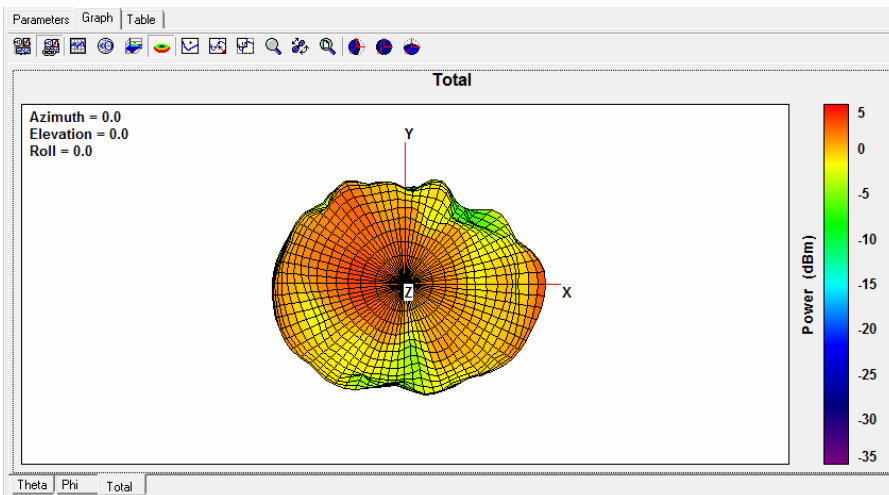
Antenna 1(2.4GHz)

Antenna A1Gain			
Frequency	Peak Gain (dBi)	Average Gain(dB)	Efficiency %
2.40GHz	3.81	-2.80	52.49
2.45GHz	4.27	-2.11	61.58
2.50GHz	3.92	-2.20	60.21

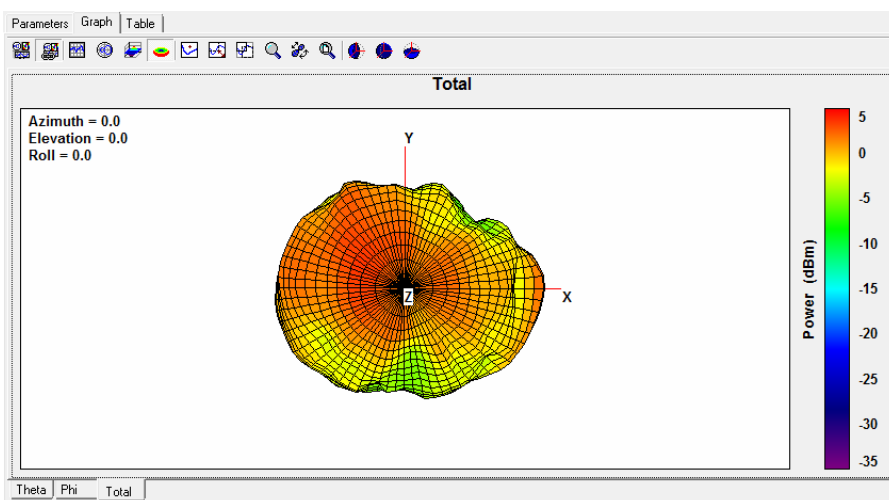
5.15GHz



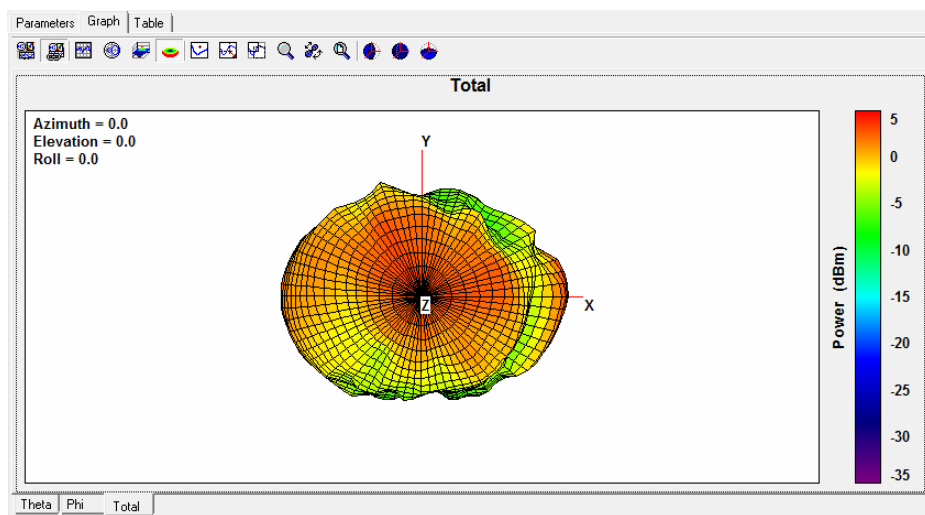
5.25GHz



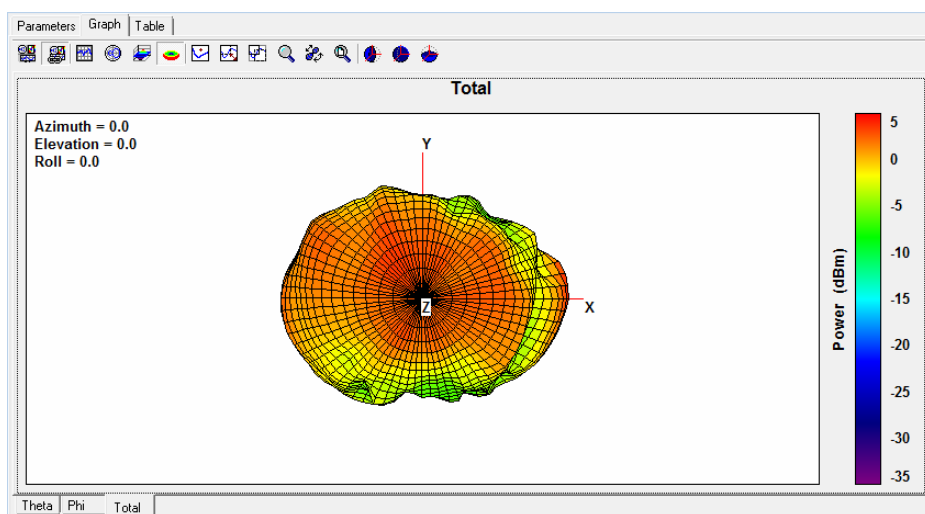
5.35GHz



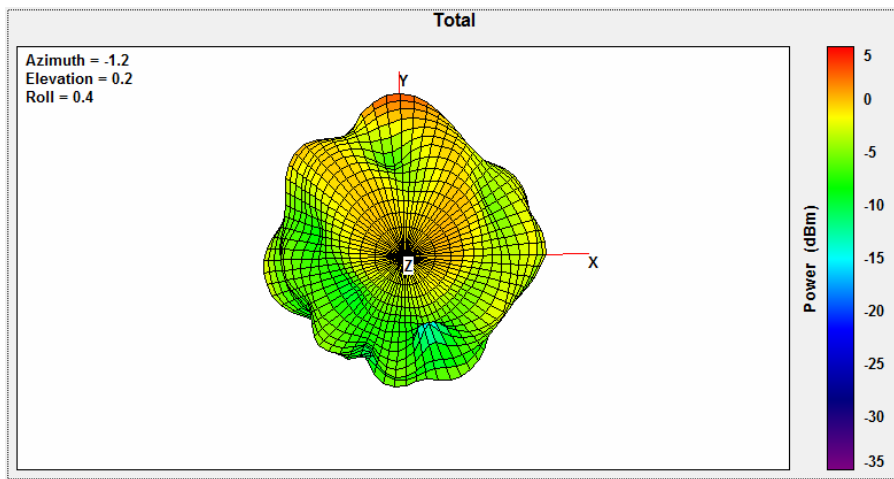
5.725GHz



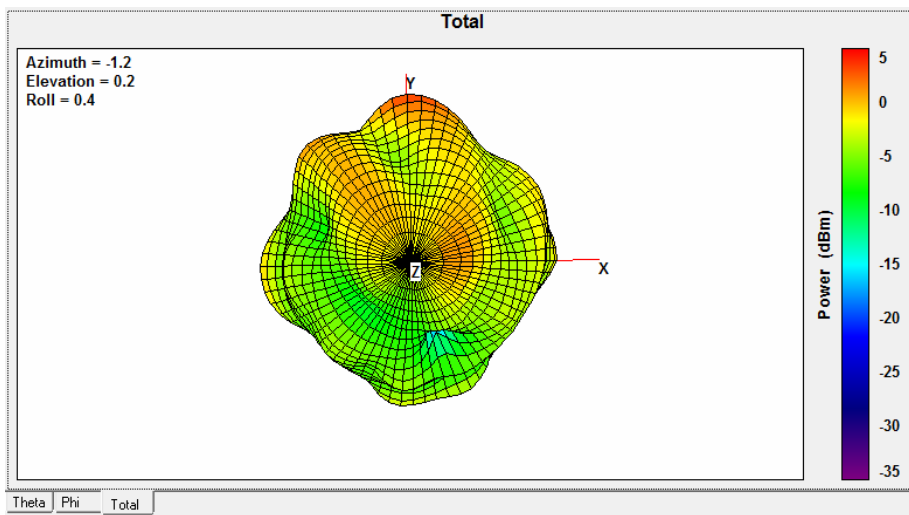
5.85GHz



2.4GHz



2.45GHz



2.5GHz

