

Specification

For

LTCC Chip Antenna

Model Name : RCA2450P90

Customer :

Title:

Name :

APPROVED

By Date : _____

Signature : _____

RN2 Technologies co., Ltd.

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Issued Date : _____

KI TAE KIM

1. Description and Application

MODEL : RCA2450P90

Description

Surface mount, LTCC Chip Antenna

Features

- Multilayer LTCC(Low Temperature Cofired Ceramics) Technology
- SMD (Surface Mounted Device)
- Miniature Size
- High Stability in Temperature/Humidity Change
- Free Impedance Matching
- Suitable for 2450MHz Working Frequency Operation

Applications

- Bluetooth device (mobile Phone, headset, carkit, serial port, dongle, MP3)
- WLAN (Access Point, Notebook, PDA)
- DMB(receiver)
- HPi(High speed Portable internet)

2. Temperature Range

Operating temperature range : -40 to + 85 °C

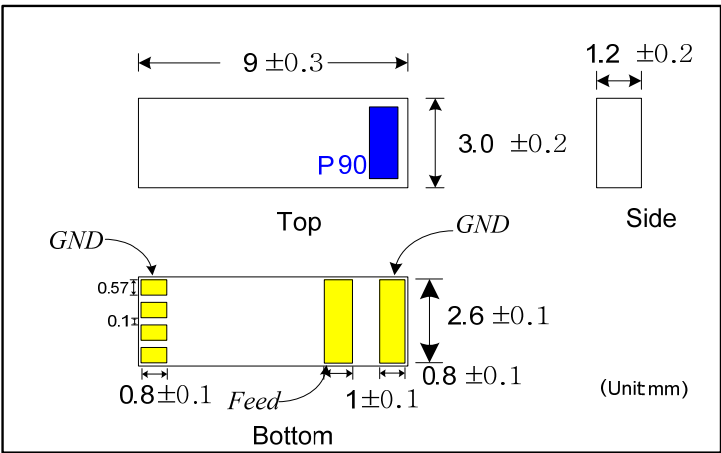
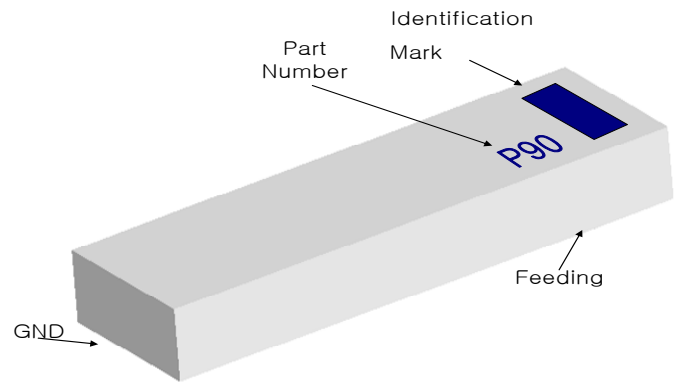
3. Properties

3.1 Electrical Specification :

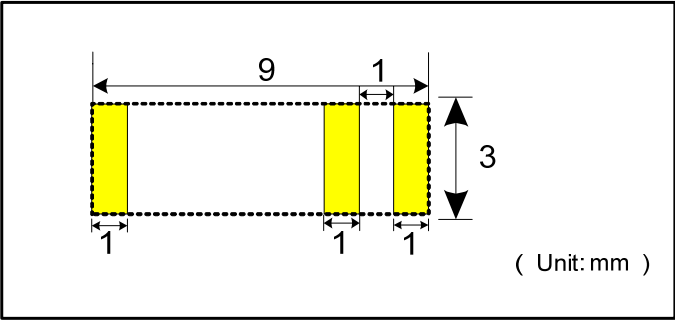
ITEM	Specification	Meas. Conditions
Model	P90	
Center frequency	2.45 GHz	Test board
Bandwidth	100 MHz min.	Test board / Matching
Gain	2.18 dBi	Test board / Matching
VSWR	2 Max	Test board / Matching
Polarization	Linear	
Azimuth Beamwidth	Omni	
Impedance	50 Ω	

3.2 Mechanical Specification

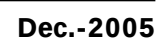
Mechanical Outline & Feeding

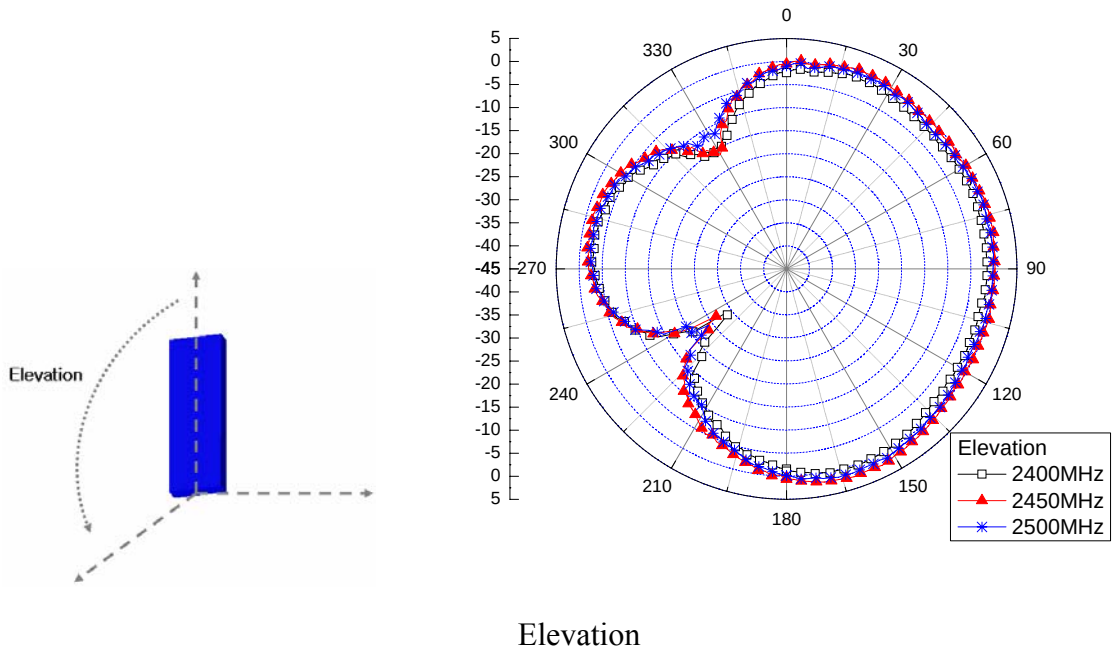


3.3 Land Layout



4.1 Measurement Data (S11 & Smith chart)



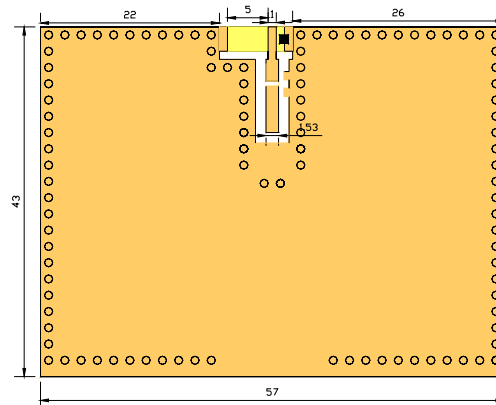


R.F. Anechoic Antenna Chamber (10.0m×6.0m×4.0m)

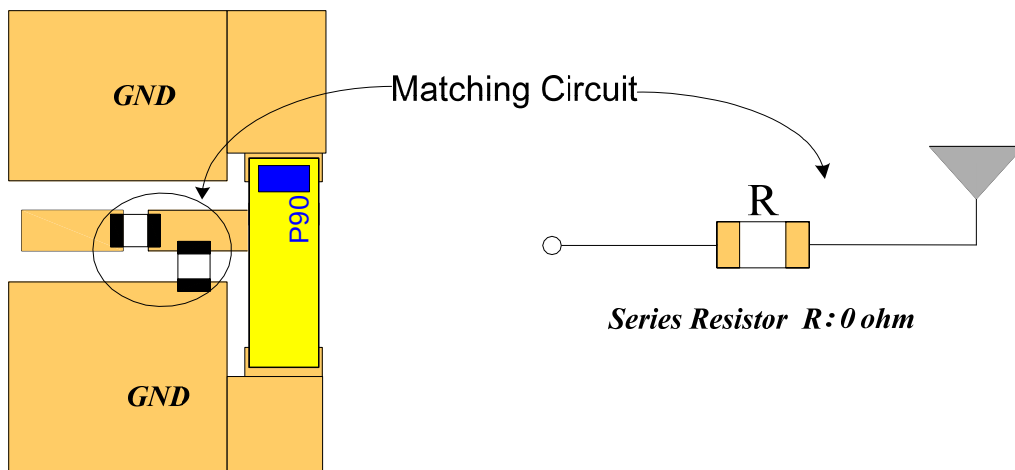
Units(dBi)	Frequency (MHz)	Gain		
		Average	Min	Max
Azimuth	2400	-1.53	-5.32	0.80
	2450	0.04	-2.86	2.07
	2500	-1.63	-3.93	0.34
Elevation	2400	-2.86	-32.94	1.12
	2450	-1.33	-18.50	2.18
	2500	-2.88	-23.90	0.55

5. Test board and matching circuit for measurements

Test board



5.2 Matching Circuits for measurements



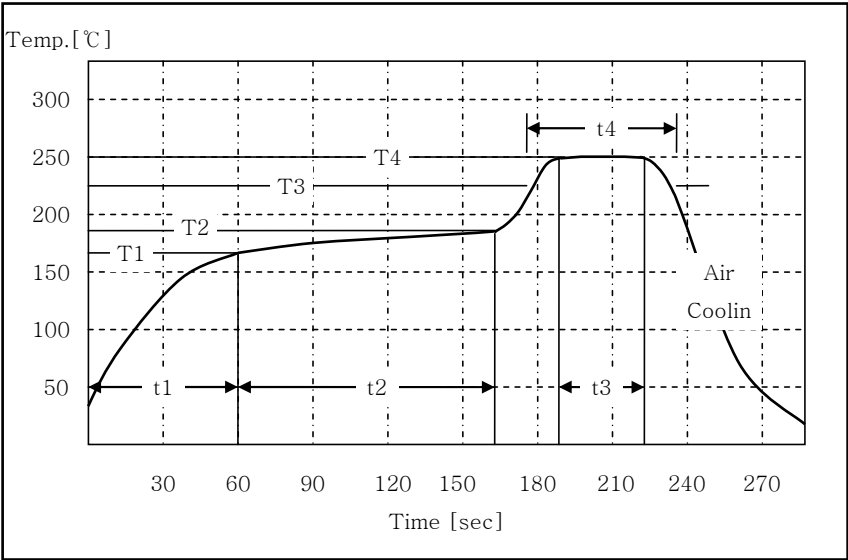
In such case of internal SMD antenna, the resonant frequency is dependent on the GND size or other nearby active/passive components, and therefore can be different from what is measured on our test board.

6. Soldering Conditions

6.1 Recommended Solder

- A lead free alloy solder, **Sn/Ag/Cu ratio of 96.5/3.0/0.5** is recommended
- Do not allow the iron-tip to directly touch the ceramic element

6.2 Solder reflow Profile

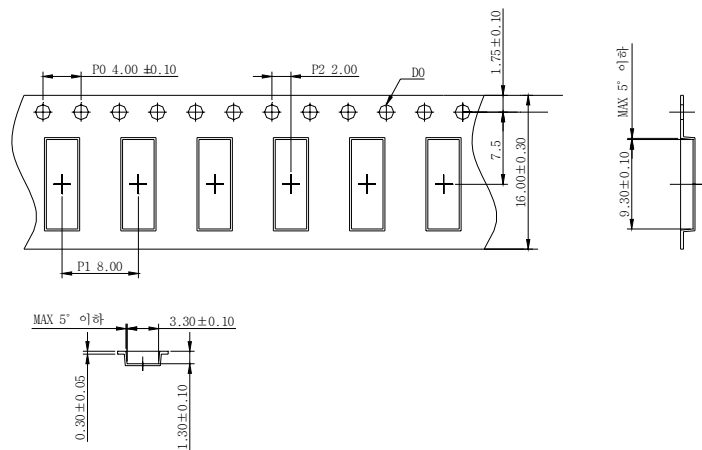


	Ramp Up	Pre-Heating	Peak	Soaking
Temp. [°C]	T1:160±5℃	T2:180±5℃	T4:250±5℃	T3:230±5℃
Time [sec]	t1:60±5sec	t2:100±15sec	t3:30±5sec	t4:60±10sec

7. Packaging

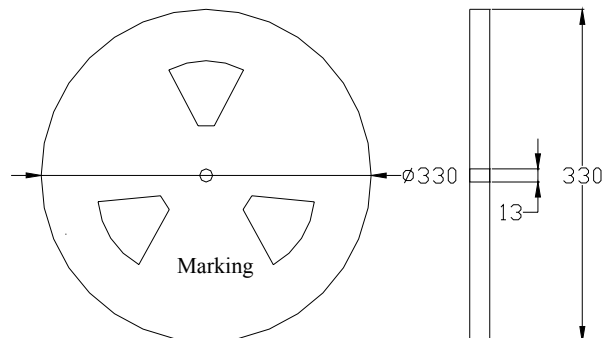
7.1 Dimension of the tape

(Unit : mm)



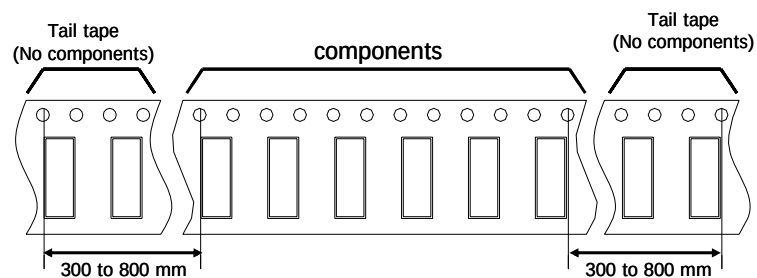
7.2 Dimension of the reel

(Unit : mm)



Quantity per reel : 5000 pcs

7.3 Leader and Tail tape



8. Environmental Specification.

ITEM	PROCEDURE	REQUIREMENTS/RESULT
Temperature Cycle	Test Sample on the testing Jig 1. One Cycle : Step1: $85 \pm 5^{\circ}\text{C}$ for 30min Step2: $-40 \pm 5^{\circ}\text{C}$ for 30min 2. Number of Cycles : 100 3. Normal Condition in 1 hour	1. Meet the electrial Specification after test
Thermal Shock	Test Sample on the testing Jig 1. One Cycle : Step1: $85 \pm 5^{\circ}\text{C}$ for 30min Step2: $-40 \pm 5^{\circ}\text{C}$ for 30min 2. Number of Cycles : 100 3. Normal Condition in 1 hour	1. Meet the electrial Specification after test
Solderability	Test Sample on the testing Jig 1. Solder : $250 \pm 5^{\circ}\text{C}$ for 5 ± 1 sec.	1. More than 85% of the electrode pad shall be covered with solder.
Heat Resistance	Test Sample on the testing Jig 1. Temperature : $85 \pm 2^{\circ}\text{C}$ 2. Duration : 1000 + 48 hours	1. Meet the electrial Specification after test
Low Temp. Resistance	Test Sample on the testing Jig 1. Temperature : $-40 \pm 5^{\circ}\text{C}$ 2. Duration : 1000 + 48 hours	1. Meet the electrial Specification after test
Vibration Resistance	Test Sample on the testing Jig 1. Frequency: 10~ 55MHz 2. Acceleration : 10g 3. Sweep Time: 1.5 mm, 2hours/axis 4. Axis : X, Y and Z direction	1. No appearance damage 2. Meet the electrial Specification after test
Humidity Resistance	Test Sample on the testing Jig 1. One Cycle : Step1:Temperature 85°C for 500 hours with humidity 85% Step2: Decrease Temperature 85°C to 25°C 2. Maintain for 1~2 hour after decreasing temperature 25°C	1. Meet the electrial Specification after test

Drop Shock	Test Sample on the testing Jig 1. Dropped onto hard wood from height of 150 cm for 5 times; each -x, x, -y, y and -z, z direction except I/O direction.	1. No appearance damage 2. Meet the electrical Specification after test
Shock /Deflection	Test Sample on the testing Jig Shown Fig 1 Acceleration : 980m/s ² Period : 6ms Cycle : 10 Times	No appearance damage and 2mm Deflection
Soldering Strength	Pushing Force at 0.5mm/s until electrode pads are peeled off or ceramics are broken Test Sample on the testing Jig Shown Fig 2	7kgf Minimum (electrode pads are peeled off or ceramics are broken)
Tensile Strength	Test Sample on the testing Jig Shown Fig 3	1. No mechanical damage by forces applied on the right 2. Strength (F) > 4kgf
Dipping test	Step1 : 120~150 °C for 1min preheating Step2 : 270 ± 5 °C for 20± 0.5sec	1. No appearance damage 2. More than 85% of the electrode pad shall be covered with solder.
Reflow test	Preheat Temp. : 160± 10 °C Preheat Period : 60sec Peak Temp. : 255± 5 °C Peak Period : 30sec	1. No appearance damage 2. More than 85% of the electrode pad shall be covered with solder.

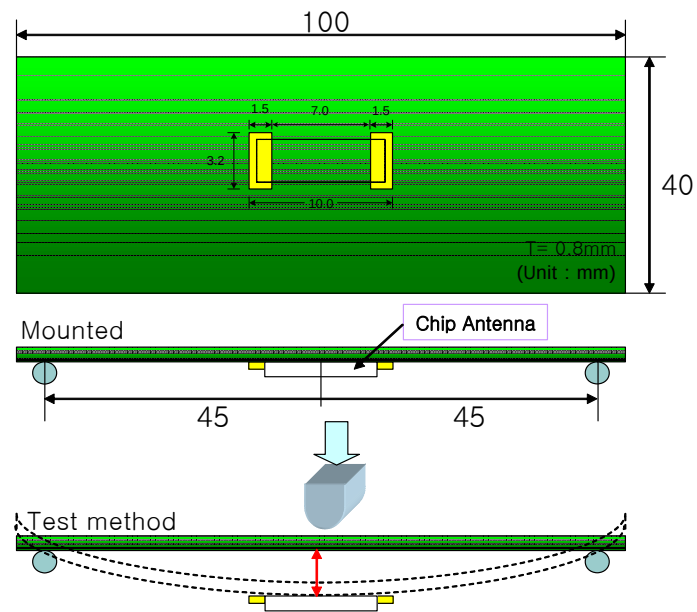


Fig 1. Deflection test board

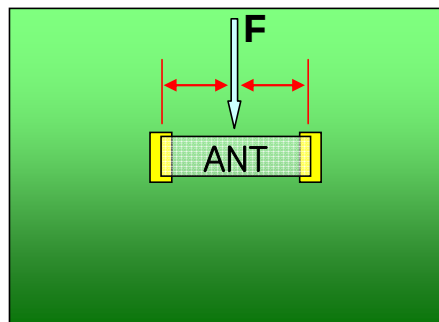


Fig 2. Soldering Strength test board

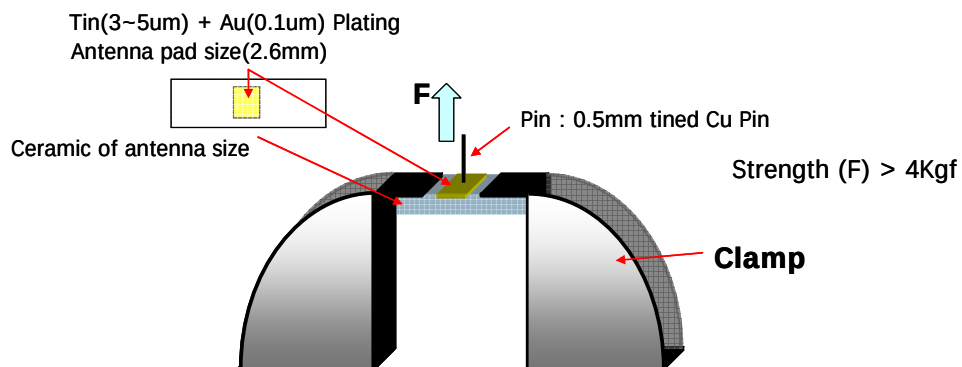


Fig 3. Tensile Strength test method

9. RoHS Test Result

RN2 Technologies warrants and represents as follows.

Test Report No. F690501/LF-CTSGP06-02938

Date: February 15, 2006

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Sample No. : GP06-02938.001
Sample Description : Chip Antenna
Style/Item No. : N/A
Comments : Material is Ceramics+Ag

Heavy Metals

Test Items	Unit	Test Method	MDL	Results
Cadmium(Cd)	mg/kg	US EPA 3050B(1996), US EPA 6010B(1996)	0.5	N.D.
Lead (Pb)	mg/kg	US EPA 3050B(1996), US EPA 6010B(1996)	5	N.D.
Mercury (Hg)	mg/kg	US EPA 3052(1996), US EPA 6010B(1996)	2	N.D.
Hexavalent Chromium (Cr VI)	mg/kg	US EPA 3060A(1996), US EPA 7196A(1992)	1	N.D.

Flame Retardants-PBBs/PBDEs

Test Items	Unit	Test Method	MDL	Results
Monobromobiphenyl	mg/kg	US EPA 3540C, GC/MS	5	N.D.
Dibromobiphenyl	mg/kg	US EPA 3540C, GC/MS	5	N.D.
Tribromobiphenyl	mg/kg	US EPA 3540C, GC/MS	5	N.D.
Tetrabromobiphenyl	mg/kg	US EPA 3540C, GC/MS	5	N.D.
Heptabromobiphenyl	mg/kg	US EPA 3540C, GC/MS	5	N.D.
Hexabromobiphenyl	mg/kg	US EPA 3540C, GC/MS	5	N.D.
Pentabromobiphenyl	mg/kg	US EPA 3540C, GC/MS	5	N.D.
Octabromobiphenyl	mg/kg	US EPA 3540C, GC/MS	5	N.D.
Nonabromobiphenyl	mg/kg	US EPA 3540C, GC/MS	5	N.D.
Decabromobiphenyl	mg/kg	US EPA 3540C, GC/MS	5	N.D.
Monobromodiphenyl ether	mg/kg	US EPA 3540C, GC/MS	5	N.D.
Dibromodiphenyl ether	mg/kg	US EPA 3540C, GC/MS	5	N.D.
Tribromodiphenyl ether	mg/kg	US EPA 3540C, GC/MS	5	N.D.
Tetrabromodiphenyl ether	mg/kg	US EPA 3540C, GC/MS	5	N.D.
Heptabromodiphenyl ether	mg/kg	US EPA 3540C, GC/MS	5	N.D.
Hexabromodiphenyl ether	mg/kg	US EPA 3540C, GC/MS	5	N.D.
Pentabromodiphenyl ether	mg/kg	US EPA 3540C, GC/MS	5	N.D.
Octabromodiphenyl ether	mg/kg	US EPA 3540C, GC/MS	5	N.D.
Nonabromodiphenyl ether	mg/kg	US EPA 3540C, GC/MS	5	N.D.
Decabromodiphenyl ether	mg/kg	US EPA 3540C, GC/MS	5	N.D.

NOTE: (1) N.D. = Not detected.(<MDL)
 (2) ppm = mg/kg
 (3) MDL = Method Detection Limit
 (4) - = No regulation
 (5) ** = Qualitative analysis (No Unit)
 (6) Negative = Undetectable / Positive = Detectable

- It is tested by SGS Testing Korea(www.sgslab.co.kr)

(주)YUKYUNG Technologies 귀중

승 인 원

품 명	Wi-MAX Cable Antenna
규 격	Wi-MAX
모 델 명	S7
코드번호	KFM-245-WM-0907
승인번호	
조건	
업체담당	김 종 훈 대리

승 인 업 체	구분	담당	검토	승인
	전자			
	기구			
승 인				신 규
				재승인
				기 타
	승인일자 . .			

2009년 07월 10일

배 포 처	☐ 개 발 실	공 급 업 체 정 보
	☐ 생산기술부	상호 : (주)맥스웨이브
	☐ 품질관리부	주소 : 서울시 금천구 가산동 월드 메르디앙벤처 센터 1202호
	☐ 구 매 부	TEL : 02-785-2777
	☐ 업 체 용	FAX : 02-785-2744

공 급 업 체	승인
	

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1. 개 요

본 제품은 Wi-MAX 송-수신용 FR4 CABLE 안테나이다.

1.1 안테나 사용 조건

☒휴대
 ☒고정
 ☒이동
 ☒실외
 ☒실내
 ☐기타

1.2 적용 범위

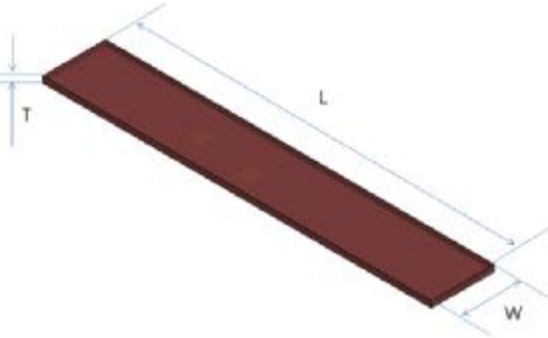
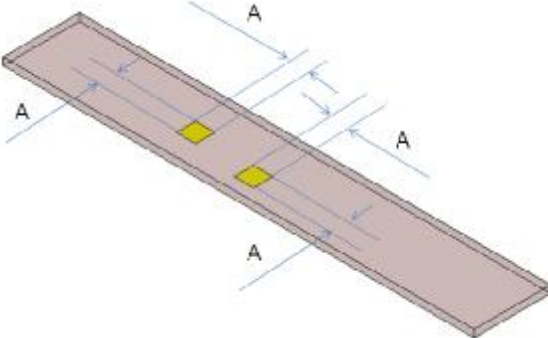
본 사양승인원은 귀사에서 개발 혹은 생산되는, 시스템에 장착되어 사용하는 Wi-MAX 송-수신용 FR4 CABLE 안테나에 대하여 규정한다.

2. 안테나 구성

NO.	부 품 명	MODEL	Q'ty	비고
1	Wi-MAX FR4 chip 안테나	KFM-245-WM-0907	1	
2	Coaxial cable		1	240mm

3. 특 성

3.1 Mechanical Specifications

Antenna Type		PIFA Type	
재 질		FR4	
크 기 [mm]	Top	W = 5 ± 0.3	
		L = 39.6 ± 0.3	
		T = 0.8 ± 0.1	
	Bottom	A = 2 ± 0.3	

3.2 Electrical Specifications

ITEM			SPEC
Frequency Range [Mhz]			2400 ~ 2500
SWR [Max]			1.26 : 1
Bandwidth [Mhz]			100
Input Impedance [Ω]			50
Polarization			Linear
Gain [dBi]	Azimuth Plane	Peak	-1.19
		Average	-4.81
	Elevation1 Plan	Peak	4.625
		Average	-2.25
	Elevation2 Plan	Peak	4.838
		Average	-2.01

4. 전기적 특성시험

4.1 네트워크 측정

4.1.1 시험조건

- (1)V.S.W.R. 측정을 위한 Network Analyzer 준비.
- (2)Rod Cable 준비.
- (3)Test용 Zig 준비.
- (4)Calibration Kit 준비.

4.1.2 시험절차

4.1.2.1 주파수 범위 설정.

Network Analyzer (E5071B)의 주파수 범위를 2350[MHz] ~ 2550[MHz]로 한다.

4.1.2.2 Calibration 방법 및 측정

- OPEN Cal Kit으로 Calibration.
- SHORT Cal Kit으로 Calibration.
- 50(Ω) TERMINATION으로 Calibration.

4.1.2.3 Test시료의 V.S.W.R 측정.

Test 시료와 Network Analyzer를 연결한 상태에서 거리를 약 30[cm]두고,V.S.W.R을 측정한다.



(그림1) Network Analyzer E5071C



(그림2) S7 테스트 시료



(그림3) Calibration Kit 85033D



(그림4) 네트워크 측정 시 연장 Cable

4.2 무반사실 측정

4.2.1 시험조건

■ CHAMBER SIZE

10m(D) * 5m(W) * 5m(H)

■ 송수신 안테나 거리 : 3m

■ 송수신 안테나 높이 : 3m

■ 송신안테나를 수직으로 놓는다.

■ Vertical Gain 측정 : 단말시료를 Test Zig 이용하여 수직으로 세운 후, LCD 정면이 송신안테나를 바라봤을 때를 0°로 기준하여 시계방향으로 360°회전시켜 Gain 측정.

■ Horizontal Gain 측정 :

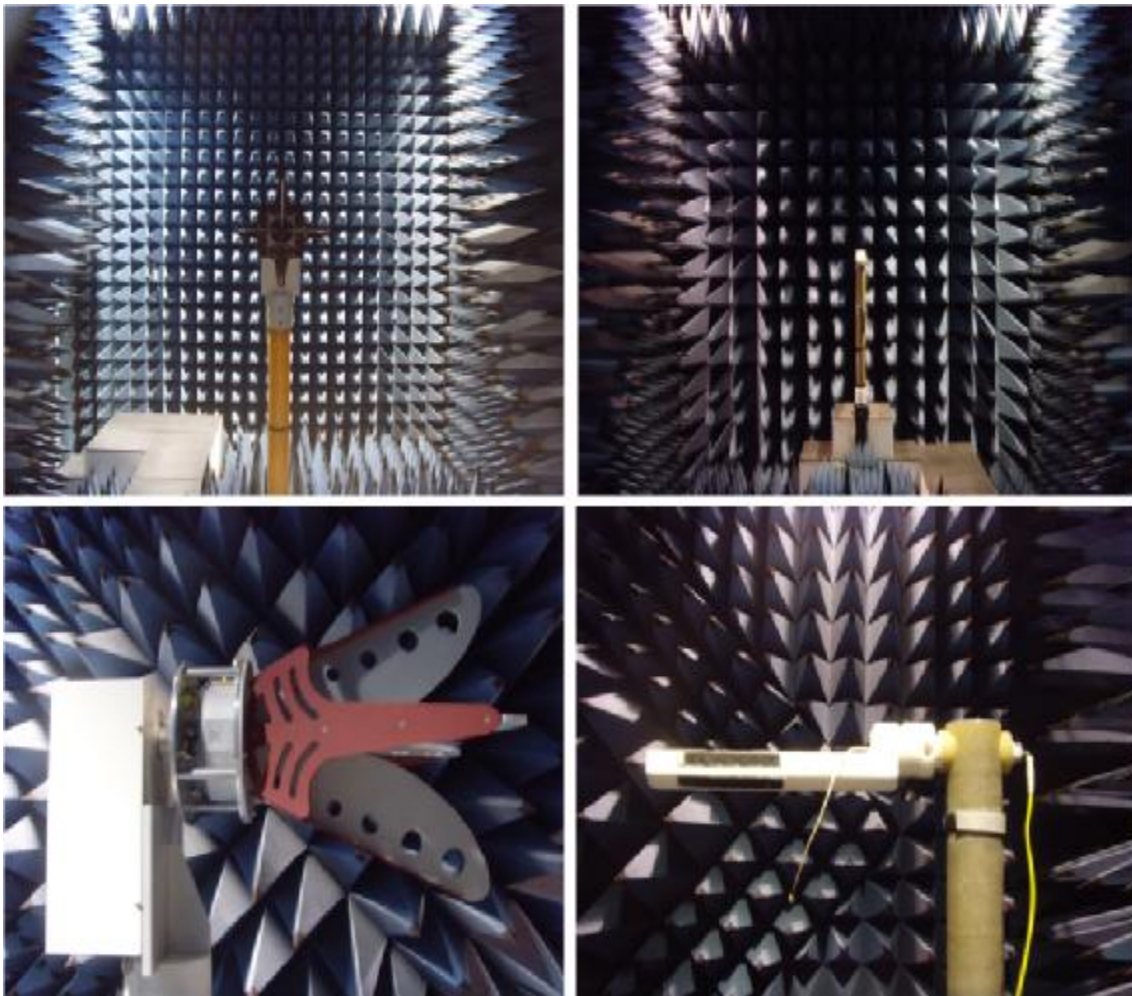
(1)Test 단말 LCD가 위를 향하도록 수평으로 놓는다.

(2)Test 단말 안테나가 송신안테나 방향으로 바라보도록 놓는다.

(3)위의 (1),(2)를 만족할 때를 0 로 기준하여 시계방향으로 360 회전시켜 Gain 측정한다.

4.2.2 시험절차

- 송신안테나를 높이 3m에 수직으로 배치한 다음, Signal Generator에 연결한다.
- Test 시료로 송신안테나와 일직선상에 배치한 다음 높이를 3m에 고정시킨다.
- Turn Table을 시계방향으로 10 간격으로 돌리며 Gain 측정한다.



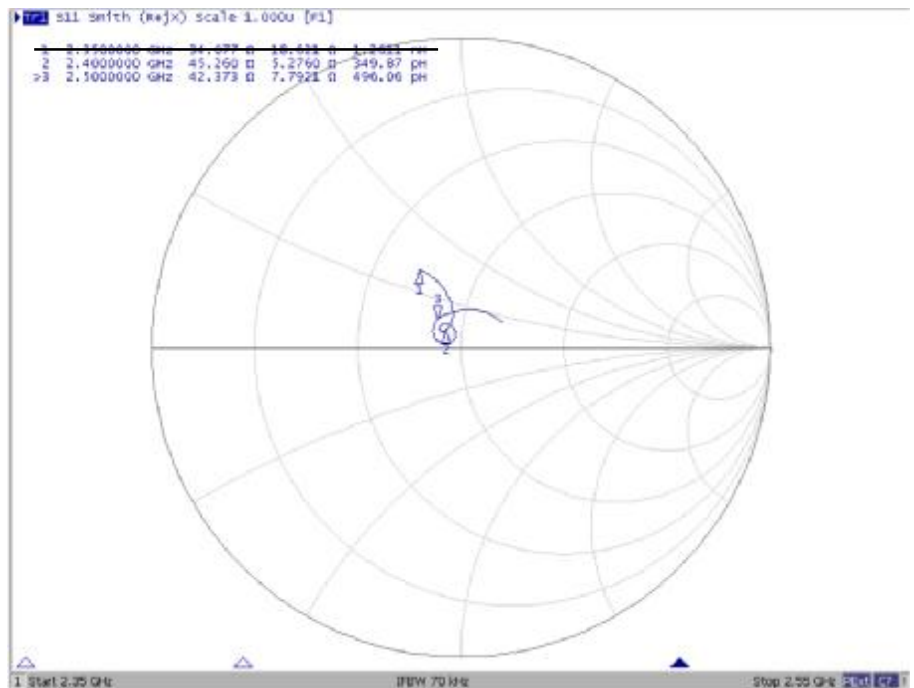
(그림 5) 무반사실 측정 Test SetUp

4.3 시험결과 [NETWORK DATA]

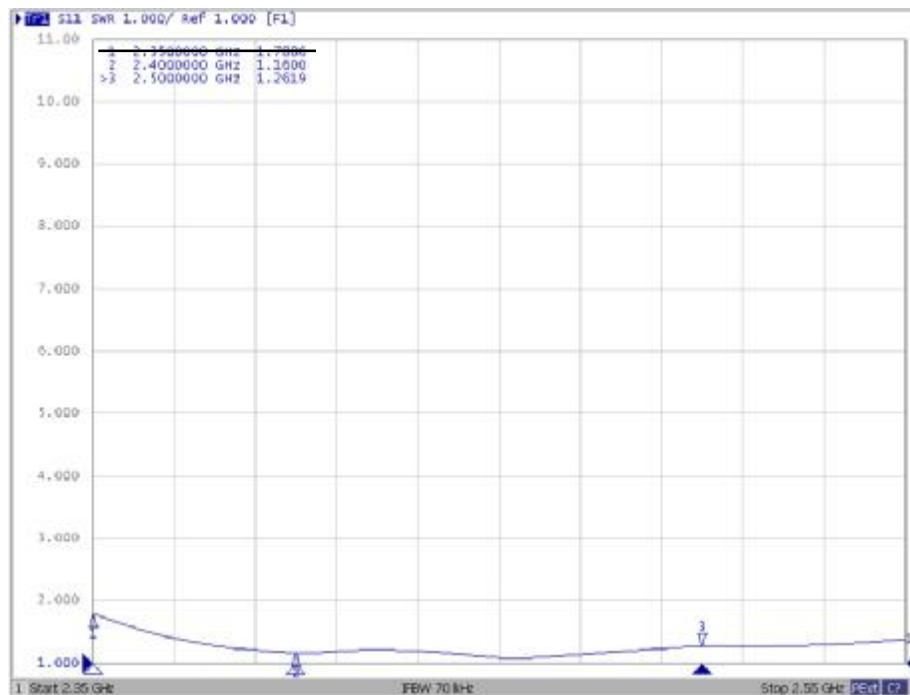
4.3.1 In Put Return Loss (반사손실)



4.3.2 SMITH CHART



4.3.3 VSWR(정재파비)



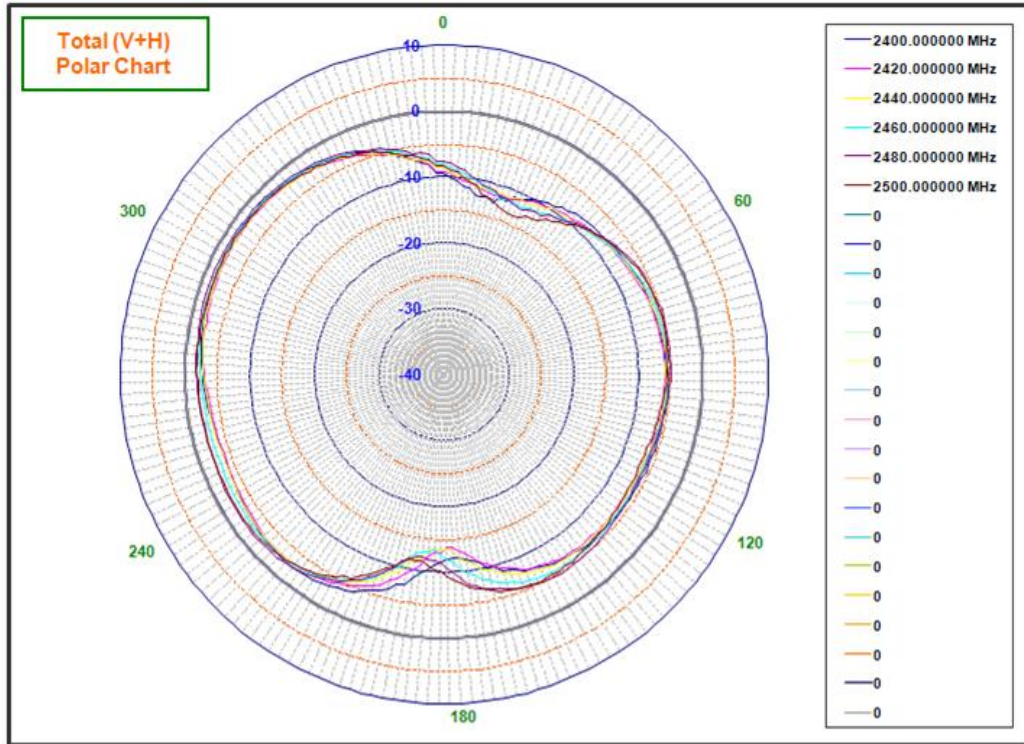
4.4 방사패턴

Azimuth Plane	Elevation1 Plane	Elevation2 Plane

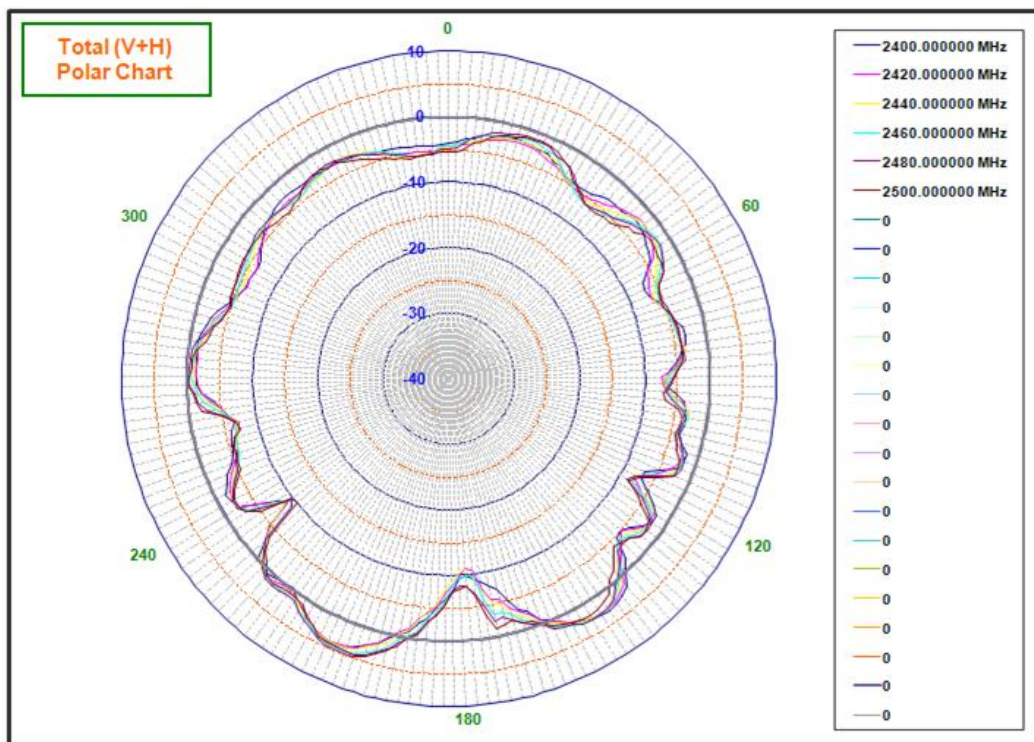
4.5 2D Passive Chamber Data

4.5.1 Wi-MAX

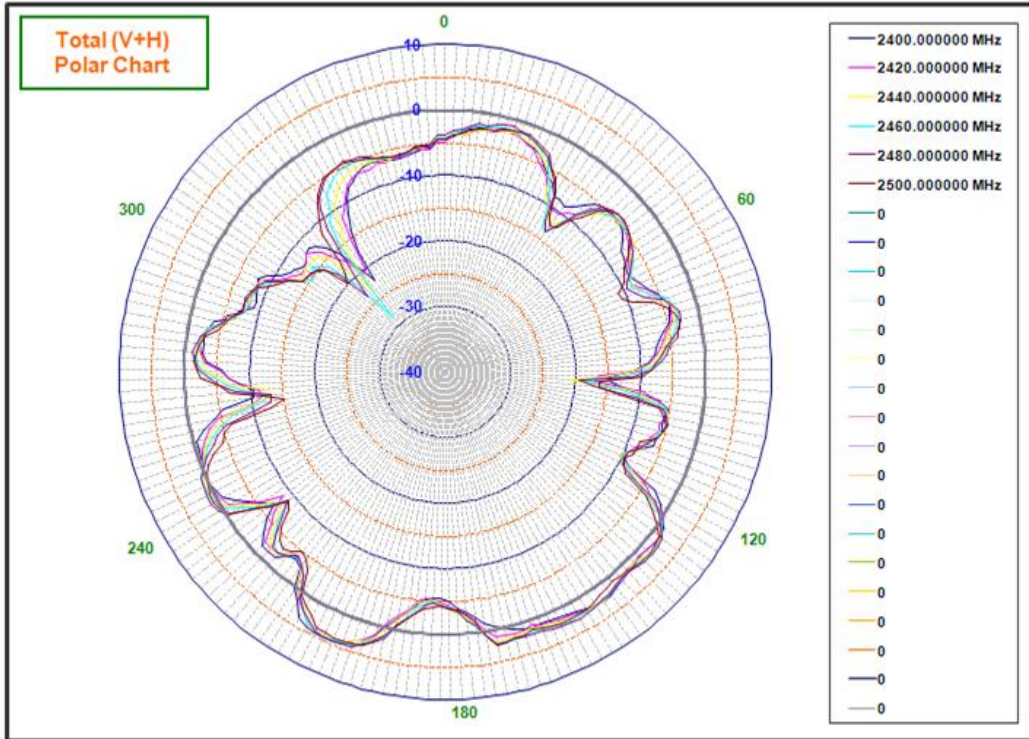
- Azimuth Plane



- Elevation1 Plane



- Elevation2 Plane



5. 신뢰성 검사 결과

신뢰성 검사 결과 보고서

모델명 : KFM-245-WM-0907

검사항목 : 고온고습 시험 - 항온항습기

열 충격 시험 - 열충격기 (대전 고주파 지원센터 의뢰)

염수분무 시험 - 5% 농도 염수

REFLOW 시험 - REFLOW OVEN (협력업체 의뢰)

No.	시 험 명	시 험 조 건	결 과
1	고온 고습 시험	온도 $85^{\circ}\text{C} \pm 2^{\circ}\text{C}$ 습도 $85\% \pm 2\%$ 120Hr	합 격
2	열 충격 시험	-40°C (2Hr), 85°C (2Hr) 1Cycle로 하여 15회 연속	합 격
3	염수 분무 시험	Sample 5% 농도염수 침수후 $35^{\circ}\text{C} \pm 2^{\circ}\text{C}$ 에서 72Hr	합 격
4	REFLOW 시험	Per Heating $220^{\circ}\text{C} \pm 5^{\circ}\text{C}$ 50sec Peak Heating $245^{\circ}\text{C} \pm 5^{\circ}\text{C}$ 30sec	합 격

[개 선 사 항]

[특 기 사 항]

[측 정 결 과]

상기 결과와 같이 KFM-245-WM-0907 신뢰성 시험 결과를 합격으로 판정함.

고 온 고 습 시 험

제 품 명	Wi-MAX Cable Antenna	작 성 일	측 정 결 과
모 델 명	KFM-245-WM-0907	09. 06. 23	합 격
시 험 명	고온고습시험		
측 정 횟 수	1 회		

1. 시험목적

KFM-245-WM-0907 신뢰성 검증 및 품질 확인을 위함.

2. 시험 조건 및 결과

N0.	시 험 명	시 험 조 건	시 료 수	측정결과
1	고온고습시험	온도 85℃±2℃ 습도 85%±2% 120Hr	5Set	합 격

3. 특이사항

- 1) 효율성(전기적 특성) 이상유무 : 무
- 2) 외관변형 유무 : 무
- 3) 측정조건 변경 유무 : 무

4. 측정결과

상기 결과와 같이 본 시험을 합격으로 판정함.

상기 결과와 같이 KFM-245-WM-0907 신뢰성 시험결과를 **합격**으로 판정함.

배포처

열 충격 시험

제 품 명	Wi-MAX Cable Antenna	작 성 일	측 정 결 과
모 델 명	KFM-245-WM-0907	09. 06. 23	합 격
시 험 명	열충격시험		
측 정 횟 수	1 회		

1. 시험목적

KFM-245-WM-0907 신뢰성 검증 및 품질 확인을 위함.

2. 시험 조건 및 결과

N0.	시 험 명	시 험 조 건	시 료 수	측정결과
1	열충격시험	-40℃(2Hr), 85℃(2Hr) 1Cycle로 하여 15회 연속	5Set	합 격

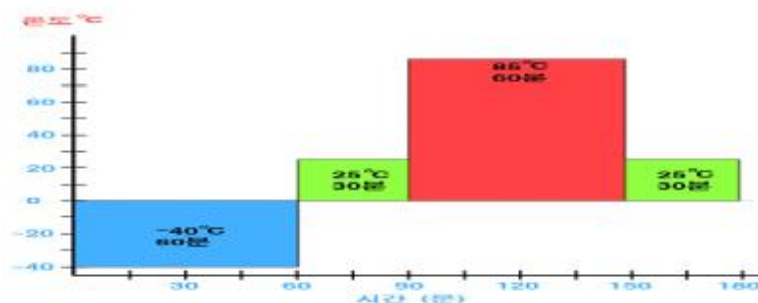
3. 특이사항

- 1) 효율성(전기적 특성) 이상유무 : 무
- 2) 외관변형 유무 : 무
- 3) 측정조건 변경 유무 : 무

4. 측정결과

상기 결과와 같이 본 시험을 합격으로 판정함.

5. 온도 Cycle 시험



상기 결과와 같이 KFM-245-WM-0907 신뢰성 시험결과를 **합격**으로 판정함.

배포처

염 수 분 무 시 험

제 품 명	Wi-MAX Cable Antenna	작 성 일	측 정 결 과
모 델 명	KFM-245-WM-0907	09. 06. 23	합 격
시 험 명	염수분무시험		
측 정 횟 수	3 회		

1. 시험목적

KFM-234-WB-0904 신뢰성 검증 및 품질 확인을 위함.

2. 시험 조건 및 결과

N0.	시 험 명	시 험 조 건	시 료 수	측정결과
1	염수분무시험	Sample 5% 농도염수 침수후 35℃±2℃에서 72Hr	5Set	합 격

3. 특이사항

- 1) 효율성(전기적 특성) 이상유무 : 무
- 2) 외관변형 유무 : 무
- 3) 측정조건 변경 유무 : 무

4. 측정결과

상기 결과와 같이 본 시험을 합격으로 판정함.

상기 결과와 같이 KFM-245-WM-0907 신뢰성 시험결과를 **합격**으로 판정함.

배포처

R E F L O W 시험														
제 품 명	Wi-MAX Cable Antenna	작 성 일	측 정 결 과											
모 델 명	KFM-245-WM-0907	09. 06. 23	합 격											
시 험 명	REFLOW시험													
측 정 횟 수	1 회													
1. 시험목적 KFM-234-WB-0904 신뢰성 검증 및 품질 확인을 위함. 2. 시험 조건 및 결과 <table><tr><td>N0.</td><td>시 험 명</td><td>시 험 조 건</td><td>시 료 수</td><td>측정결과</td></tr><tr><td>1</td><td>REFLOW시험</td><td>Per Heating 220℃±5℃ 50sec Peak Heating 245℃±5℃ 30sec</td><td>5Set</td><td>합 격</td></tr></table> 3. 특이사항 1) 효율성(전기적 특성) 이상유무 : 무 2) 외관변형 유무 : 무 3) 측정조건 변경 유무 : 무 4. 측정결과 상기 결과와 같이 본 시험을 합격으로 판정함. 상기 결과와 같이 KFM-245-WM-0907 신뢰성 시험결과를 합격으로 판정함. 배포처					N0.	시 험 명	시 험 조 건	시 료 수	측정결과	1	REFLOW시험	Per Heating 220℃±5℃ 50sec Peak Heating 245℃±5℃ 30sec	5Set	합 격
N0.	시 험 명	시 험 조 건	시 료 수	측정결과										
1	REFLOW시험	Per Heating 220℃±5℃ 50sec Peak Heating 245℃±5℃ 30sec	5Set	합 격										

6. 안테나 승인도

1	2	3	4	5	6
NO	DESCRIPTION	Designed by	Checked by	Approved by	Date
△					

A

A

B

B

C

C

D

D

E

E

F

F

G

NOTE

1. * 표시부 중요 치수 (C.T.Q) 항목임.

2. 본 제품의 외관은 한도 견본에 준한다.

G

1	S5CA-03A-00	CONNECTOR	1ea		MP01-1.130-SP-240
1	S5CA-02A-00	COAXIAL CABLE	1ea		Dia 1.13mm
1	S5CA-01A-00	ANTENNA	1ea	FR4 0.8t	
NO	Part No.	Part Name	Qty	Material	Remark

GENERAL TOLERANCE						Part No.	Designed by	Checked by	Approved by	Released by
						KFM-24S-WM-0907	d.y. Choi	k.v. Park	s.k. Park	2025.07.15
H TYPE	0-10	10-50	50-120	120-250	250+	Part Name Cable Antenna Ass'y		Product name S7 Cable Antenna		
	A	0.05	0.03	0.2	0.05					
	B	0.1	0.05	0.3	0.05					
	C	0.25	0.35	0.5	0.7					
						MENIX Co., Ltd.	단위 Units : mm	Code No. MX-UK-S5CA-RO		1/1 Units

7. 관리공정도

품질보증공정도			MAXIMAVESMENIX		구분	일 자	제, 개정 내용		검 査 자	작 성 자	검 토 자	승 인 자
			제품명	모델명	1	2008. 11. 18.	신규제정					
					SHEET METAL	전공정						
공 정			공 정 관 리					기 록	기 관			
흐름도	기호	내 용	품 질 특 성	관 리 방 법			수 량 단 위					
수입검사			표, 홀, 포장상태	검사규격 참조	육안	자료검증	전체	구매자	WILL SHEET			
		외관&특성	재질, 치수, 부조									
자재확인			표, 홀	검사규격, 도면	육안	V-Calipers	전체	부서장	자재입고대장			
		외관	재질, 두께	사양서참조	마이크로미터							
금형Setting									금형목록표			
		금형확인및 Setting	모델명, 재질, 두께	불러두게 (다이하이트) 및 슬라이드 위치	육안	V-Calipers	전체	부서장				
PRESS									공정 CHECK SHEET			
		Unoolier	수평상태, 홀집, 기스	도면 참조	육안	V-Calipers	전체	작업자				
		Feeder	Piton 확인		육안		전체	부서장	공정 CHECK SHEET			
		PIEROING	BURR 상태, 칩상승	작업지도서, 도면 참조	육안	V-Calipers	9PL	작업자				
		NOTCHING	BURR 상태, 칩상승	작업지도서, 도면 참조	육안	V-Calipers	9PL	작업자	공정 CHECK SHEET			
		BENDING	각도	작업지도서, 도면 참조	육안	V-Calipers	9PL	작업자				
		CUTTING	BURR 상태	작업지도서, 도면 참조	육안	V-Calipers	9PL	작업자	공정 CHECK SHEET			
중간검사												공정 CHECK SHEET
		검사	부조, 치수	도면참조	육안, 투영기	9PL	작업자					
검사, 포장												
		완중확인	영립, 형상	포장상태	육안	전체	작업자					
출하검사									출하검사 성적서			
		출하검사	치수, 표면외관	검사규격, 도면 현도견본	육안	9PL	공정00					
출 하									입출고전표			
		출하	포장상태	주문서	육안	전체	영업담당					

8. 유해물질 성적서

8.1 FR4



Test Report

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KINGBOARD LAMINATES (MACAO COMMERCIAL OFFSHORE) LIMITED
AV DA PRAIA GRANDE NO. 589, EDIFICIO COMMERCIAL RODRIGUES, 3RD
ANDAR 8, MACAO

The following sample(s) was/were submitted and identified by/on behalf of the client as:

Sample Description	:	KB-81808150R0808080
Style/Item No.	:	ANSI TYPE: FR-4 CCLUP(TG130°C)
Supplier	:	KINGBOARD
SGS Ref. No.	:	GL10648801EC-3.3
Sample Receiving Date	:	2007/10/04
Testing Period	:	2007/10/04 TO 2007/11/31 AND 2007/11/08 TO 2007/11/12

Test Result(s): Please refer to next page(s).

* This report added testing and combined with CE/2007/AS438 *



Chinyo Kung / Operation Manager
Signed for and on behalf of
SGS Taiwan LTD.
Chemical Laboratory - Taipei

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Test Report

No.: CE/2007/AS4388 Date: 2007/11/18 Page: 2 of 11

KINGBOARD LAMINATES (MACAO COMMERCIAL OFFSHORE) LIMITED
AV DA PRAIA GRANDE NO. 589, EDIFICIO COMMERCIAL RODRIGUES, 3RD
ANDAR 8, MACAO

Test Result(s):

PART NAME NO.1 YELLOW LAMINATE WITH RED PRINTING

Test Item (s)	Unit	Method	MDL	Result No.1
Cadmium (Cd)	mg/kg	With reference to US EPA Method 3052 for Cadmium Content. Analysis was performed by ICP-AES.	2	n.d.
Lead (Pb)	mg/kg	With reference to US EPA Method 3052 for Lead Content. Analysis was performed by ICP-AES.	2	n.d.
Mercury (Hg)	mg/kg	With reference to US EPA Method 3052 for Mercury Content. Analysis was performed by ICP-AES.	2	n.d.
Hexavalent Chromium (Cr(VI))	mg/kg	With reference to US EPA Method 3060A & 7196A for Hexavalent Chromium for non-metallic samples. Analysis was performed by UV/VIS Spectrometry.	2	n.d.
PVC	%	Analysis was performed by FTIR and Pyrolysis-GC/MS.	1	Negative
Tetrakisbromophenyl A (TBBP-A) (CAS No.: 000719-84-7)	mg/kg	With reference to DIN 53313. Analysis was performed by GC/MS.	10	n.d.
Polychlorinated Biphenyls (PCBs) (CAS No.: 001335-34-3)	mg/kg	With reference to US EPA 8270 method. Analysis was performed by GC/MS.	0.5	n.d.
Polychlorinated Naphthalene (PCNs)	mg/kg	With reference to US EPA 8270 method. Analysis was performed by GC/MS.	5	n.d.
Polychlorinated Terphenyls (PCTs)	mg/kg	With reference to US EPA 8270 method. Analysis was performed by GC/MS.	0.5	n.d.
Chlorinated Paraffin (C10-C13) (CAS No.: 010871-26-2)	%	With reference to US EPA 8270 method. Analysis was performed by GC/MS.	0.01	n.d.
Styrene (CAS No.: 002386-85-5)	mg/kg	With reference to US EPA 8270 method. Analysis was performed by GC/MS.	4	n.d.
Formaldehyde content	mg/kg	As per BS EN ISO 14184-1	3	n.d.
Octadecylphenyl ether (CAS No.: 000889-34-8)	mg/kg	With reference to DIN 38401-13. Analysis was performed by GC/MS.	0.03	n.d.
Triphenyl Tin (TBT) (CAS No.: 000889-73-3)	mg/kg	With reference to DIN 38401-13. Analysis was performed by GC/MS.	0.03	n.d.

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Test Report

No.: CE/2007/AS4388 Date: 2007/11/18 Page: 3 of 11

KINGBOARD LAMINATES (MACAO COMMERCIAL OFFSHORE) LIMITED
AV DA PRAIA GRANDE NO. 589, EDIFICIO COMMERCIAL RODRIGUES, 3RD
ANDAR 8, MACAO

Test Item (s)	Unit	Method	MDL	Result No.1
Asbestos	---	---	---	---
Amoxicillin (CAS No.: 012172-73-6)	%	As per HPLC 8000 method. Analysis was performed by XRD.	1	Negative
Chrysotile (CAS No.: 012091-24-5)	%	As per HPLC 8000 method. Analysis was performed by XRD.	1	Negative
Crocidolite (CAS No.: 012091-28-4)	%	As per HPLC 8000 method. Analysis was performed by XRD.	1	Negative
Anthophyllite (CAS No.: 017988-78-8)	%	As per HPLC 8000 method. Analysis was performed by XRD.	1	Negative
Tremolite (CAS No.: 014367-73-8)	%	As per HPLC 8000 method. Analysis was performed by XRD.	1	Negative
Actinolite (CAS No.: 013798-00-8)	%	As per HPLC 8000 method. Analysis was performed by XRD.	1	Negative
ADP	---	---	---	---
1) 4-AMINO-2-CHLOROPHENYL (CAS No.: 000902-67-1)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.
2) BENZONITRILE (CAS No.: 000902-87-5)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.
3) 4-CHLORO-2-FLUOROBENZENE (CAS No.: 000905-69-2)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.
4) 3-AMINO-2-FLUOROBENZENE (CAS No.: 000901-58-8)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.
5) 4-AMINO-2-FLUOROBENZENE (CAS No.: 000907-56-3)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.
6) 2-AMINO-4-NITROFLUOROBENZENE (CAS No.: 000906-55-8)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.
7) 1-CHLORO-2-NITROBENZENE (CAS No.: 000906-47-8)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.
8) 2-AMINO-4-NITROFLUOROBENZENE (CAS No.: 000906-55-8)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.
9) 4,4'-DIAMINODIPHENYL METHANE (CAS No.: 000901-80-4)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.
10) 3,3'-DIAMINODIPHENYL METHANE (CAS No.: 000901-80-4)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.
11) 3,3'-DIAMINODIPHENYL METHANE (CAS No.: 000901-80-4)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.

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KINGBOARD LAMINATES (MACAO COMMERCIAL OFFSHORE) LIMITED
AV DA PRAIA GRANDE NO. 589, EDIFICIO COMMERCIAL RODRIGUES, 3RD
ANDAR 8, MACAO

Test Item (s)	Unit	Method	MDL	Result No.1
13) 3,3'-DIMETHYL-4,4'-DIAMINODIPHENYL METHANE (CAS No.: 000901-80-4)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.
14) 3,3'-DIMETHYL-4,4'-DIAMINODIPHENYL METHANE (CAS No.: 000901-80-4)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.
15) 4,4'-DIETHYLENE-BIS-2-CHLOROBENZENE (CAS No.: 000121-14-4)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.
16) 4,4'-DIETHYLENE-BIS-2-CHLOROBENZENE (CAS No.: 000121-14-4)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.
17) 4,4'-THIOBIS(2-CHLOROBENZENE) (CAS No.: 000134-68-1)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.
18) 2,2'-BIS(4-CHLOROPHENYL) PROpane (CAS No.: 000905-53-4)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.
19) 2,2'-BIS(4-CHLOROPHENYL) PROpane (CAS No.: 000905-53-4)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.
20) 2,2'-BIS(4-CHLOROPHENYL) PROpane (CAS No.: 000137-17-7)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.
21) 2,2'-BIS(4-CHLOROPHENYL) PROpane (CAS No.: 000905-53-4)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.
22) 2,2'-BIS(4-CHLOROPHENYL) PROpane (CAS No.: 000905-53-4)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.
23) 2,2'-BIS(4-CHLOROPHENYL) PROpane (CAS No.: 000905-53-4)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.
24) 2,2'-BIS(4-CHLOROPHENYL) PROpane (CAS No.: 000905-53-4)	mg/kg	With reference to LMBG 82 02-2. Analysis was performed by GC/MS.	3	n.d.
Phthalates	---	---	---	---
DEHP (Di-n-octyl phthalate) (CAS No.: 000684-74-2)	%	With reference to Chromatography V61.47, No. 784, 1998. Analysis was performed by GC/MS. (prohibited by 2005/94/EC)	0.003	n.d.
DEHP (Di-n-octyl phthalate) (CAS No.: 000684-74-2)	%	With reference to Chromatography V61.47, No. 784, 1998. Analysis was performed by GC/MS. (prohibited by 2005/94/EC)	0.003	n.d.
DEHP (Di-n-octyl phthalate) (CAS No.: 000684-74-2)	%	With reference to Chromatography V61.47, No. 784, 1998. Analysis was performed by GC/MS. (prohibited by 2005/94/EC)	0.003	n.d.

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Test Report

No.: CE/2007/AS4388 Date: 2007/11/16 Page: 5 of 11

KINGBOARD LAMINATES (MACAO COMMERCIAL OFFSHORE) LIMITED
AV DA PRAIA GRANDE NO. 596, EDIFICIO COMMERCIAL RODRIGUES, 3RD
ANDAR B, MACAO

Test Item (s):	Unit	Method	MDL	Result
DiOP (Di-n-octyl phthalate) (CAS No.: 026761-43-5)	%	With reference to Chromatographia Vol.47, No.784, 1998. Analysis was performed by GC/MS. (prohibited by 2005/84/EC)	0.003	n.d.
DNOP (Di-n-octyl phthalate) (CAS No.: 000117-84-5)	%	With reference to Chromatographia Vol.47, No.784, 1998. Analysis was performed by GC/MS. (prohibited by 2005/84/EC)	0.003	n.d.
BBP (Benzyl butyl phthalate) (CAS No.: 000085-68-7)	%	With reference to Chromatographia Vol.47, No.784, 1998. Analysis was performed by GC/MS. (prohibited by 2005/84/EC)	0.003	n.d.
DHP (Di-phenyl phthalate) (CAS No.: 000084-75-3)	%	With reference to Chromatographia Vol.47, No.784, 1998. Analysis was performed by GC/MS.	0.003	n.d.
Hydrofluorocarbon, fluorinated hydrocarbon, fluoro hydrocarbon (HFC)	---	---	---	---
HFC-23 (CHF ₃)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
HFC-32 (CHF ₂)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
HFC-41 (CHF ₃)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
HFC-43-10mix (C ₂ H ₂ ClF ₅)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
HFC-125 (C ₂ H ₅ F ₅)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
HFC-134 (C ₂ H ₂ ClF ₄)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
HFC-134a (C ₂ H ₂ ClF ₄)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
HFC-143 (C ₂ H ₃ F ₃)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.

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SGS (China) Co., Ltd. 3651 Yibei Road, Shanghai, China. Tel: 86-21-5890 9595 Fax: 86-21-5890 9596



Test Report

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KINGBOARD LAMINATES (MACAO COMMERCIAL OFFSHORE) LIMITED
AV DA PRAIA GRANDE NO. 596, EDIFICIO COMMERCIAL RODRIGUES, 3RD
ANDAR B, MACAO

Test Item (s):	Unit	Method	MDL	Result
HFC-143a (C ₂ H ₃ F ₃)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
HFC-152a (C ₂ H ₂ F ₄)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
HFC-227ea (C ₃ H ₂ F ₆)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
HFC-236fa (C ₃ H ₂ F ₆)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
HFC-236faa (C ₃ H ₂ F ₆)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
HFC-245ca (C ₃ H ₂ F ₅)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
HFC-245fa (C ₃ H ₂ F ₅)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
HFC-365mle (C ₄ H ₉ F ₅)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
Sum of PBBs				-
Monobromobiphenyl				5
Dibromobiphenyl				5
Tribromobiphenyl				5
Tetrabromobiphenyl				5
Pentabromobiphenyl				5
Hexabromobiphenyl				5
Heptabromobiphenyl				5
Octabromobiphenyl				5
Nonabromobiphenyl				5
Decabromobiphenyl				5

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Test Report

No.: CE/2007/AS4388 Date: 2007/11/16 Page: 7 of 11

KINGBOARD LAMINATES (MACAO COMMERCIAL OFFSHORE) LIMITED
AV DA PRAIA GRANDE NO. 596, EDIFICIO COMMERCIAL RODRIGUES, 3RD
ANDAR B, MACAO

Test Item (s):	Unit	Method	MDL	Result
Sum of PBBs (Mono to Deca) (Note 4)			-	n.d.
Monobromobiphenyl ether			5	n.d.
Dibromobiphenyl ether			5	n.d.
Tribromobiphenyl ether			5	n.d.
Tetrabromobiphenyl ether			5	n.d.
Pentabromobiphenyl ether			5	n.d.
Hexabromobiphenyl ether			5	n.d.
Heptabromobiphenyl ether			5	n.d.
Octabromobiphenyl ether			5	n.d.
Nonabromobiphenyl ether			5	n.d.
Decabromobiphenyl ether			5	n.d.
Sum of PBBs (Mono to Deca)			-	n.d.
Perfluorocarbon (PFC)	---	---	---	---
Pf14 (CAS No.: 000075-73-0)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
Fluorocarbon 118 (CAS No.: 000076-16-4)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
Freon 218 (CAS No.: 000076-19-7)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
Decafluorobutane (CAS No.: 000095-25-8)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
Freon C318 (CAS No.: 000115-25-3)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
Perfluoro-1-butane (CAS No.: 000357-28-6)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
perfluorobutane (CAS No.: 000361-21-8)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
1,4-dihydrotafluorobutane (CAS No.: 000377-36-8)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
nonafluoro-2,2-difluoroethylbutane (CAS No.: 000584-91-2)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.

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Test Report

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KINGBOARD LAMINATES (MACAO COMMERCIAL OFFSHORE) LIMITED
AV DA PRAIA GRANDE NO. 596, EDIFICIO COMMERCIAL RODRIGUES, 3RD
ANDAR B, MACAO

Test Item (s):	Unit	Method	MDL	Result
perfluoro-n-pentane (CAS No.: 000076-26-2)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
2-perfluoromethylpentane (CAS No.: 000355-04-4)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.
perfluorohexane (CAS No.: 000355-42-0)	mg/kg	With reference to US EPA 5021 method. Analysis was performed by GC/MS.	1	n.d.

- Note: 1. mg/kg = ppm
2. n.d. = Not Detected
3. MDL = Method Detection Limit
4. According to 2005/717/EC DecaBDE is exempt.
5. "-" = Not Conducted
6. "-" = Not Regulated
7. Negative = "< 1.0 %", Positive = "> 1.0 %"
8. The MDL is given for the single compound of CP
9. According to the 22nd Council Directive 76/769/EEC notified under document 2005/84/EC, total concentration of three compounds (DHP, DBP and BBP) shall not be greater than 0.1% and total concentration of three compounds (DHP, DiOP and DNOP) shall not be greater than 0.1%.

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Test Report

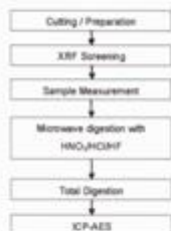
No. : CE/2007/A4388 Date : 2007/11/18 Page : 9 of 11

KINGBOARD LAMINATES (MACAO COMMERCIAL OFFSHORE) LIMITED
AV DA PRAIA GRANDE NO. 589, EDIFICIO COMMERCIAL RODRIGUES, 3RD
ANDAR, S. MACAO

Per requirements of SONY QAR-05-002:

- 1) These samples were dissolved totally by pre-conditioning method according to below flow chart.
- 2) Name of the person who made measurement: Troy Chang
- 3) Name of the person in charge of measurement: Chanya Kung

Flow Chart of Digestion for Plastic (EPA882 for Pb - Cd without residue)



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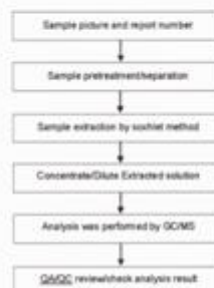
SGS (SINGAPORE) PTE. LTD.
100, Robinson Road, Singapore 068902. Tel: 65 6336 8888 Fax: 65 6336 0555

Test Report

No. : CE/2007/A4388 Date : 2007/11/18 Page : 10 of 11

KINGBOARD LAMINATES (MACAO COMMERCIAL OFFSHORE) LIMITED
AV DA PRAIA GRANDE NO. 589, EDIFICIO COMMERCIAL RODRIGUES, 3RD
ANDAR, S. MACAO

Analytical flow chart of phthalate content



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KINGBOARD LAMINATES (MACAO COMMERCIAL OFFSHORE) LIMITED
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ANDAR, S. MACAO

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SGS

ENGBORD LAMINATES (MACAO COMMERCIAL OFFSHORE) LIMITED
AV. DA PRAIA GRANDE NO. 586, EDIFICIO COMMERCIAL
RODRIGUES, 3RD ANDAR S, MACAO

No. : CE/2007/41248
Date : 2007/06/14
Page : 1 of 3

Sample Description	K8-6160C8150G (AN3 TYPE FR-4 HIGH CT)
SGS Ref No.	SZ10315825-4.1
Model No.	FR-4
Lot No.	K8-6160C8150G
Material	FR-4 CCL (HIGH CT)
Supplier	KN28-0ARD
Sample Receiving Date	2007/04/09
Testing Period	2007/04/09 TO 2007/04/14


Gary V. M. Operation Manager
Signed for and on behalf of
BOE TAIWAN LTD.

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KINGBOARD LAMINATES (MACAO COMMERCIAL OFFSHORE)
LIMITED
AV. DA PRAIA GRANDE NO. 598, EDIFICIO COMMERCIAL
RODRIGUES, 3RD ANGAR 8, MACAO

PART NAME NO 1 : YELLOW LAMINATE

Test item (s)	Unit	Method	MDL	Result No.1
Analogen	—	With reference to prN14562 method B. Analysis was performed by IC method for C, D, I content	—	—
Analogen-Chlorine (C) (CAS NO. 007782-50-5)	mg/kg	With reference to prN14562 method B. Analysis was performed by IC method for Chlorine content	50	n.d.
Analogen-Fluorine (F) (CAS NO. 007782-41-4)	mg/kg	With reference to prN14562 method B. Analysis was performed by IC method for Fluorine content	50	n.d.
Analogen-Bromine (Br) (CAS NO. 007726-45-6)	mg/kg	With reference to prN14562 method B. Analysis was performed by IC method for Bromine content	50	22500
Analogen-Iodine (I) (CAS NO. 007953-56-2)	mg/kg	With reference to prN14562 method B. Analysis was performed by IC method for	50	n.d.

Note: 1. mg/kg = parts
2. n.d. = Not Detected
3. MDL = Method Detection Limit
4. "—" = Not Conducted

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KEYBOARD LAMINATES (MACAO COMMERCIAL OFFSHORE)
 LIMITED
 AV. DA PRAIA GRANDE NO. 586, EDIFICIO COMMERCIAL
 RODRIGUES, 3RD ANDAR, MACAO

No. C/000741248
 Date 2007/04/14
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— End of Report —

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(주)유경테크놀로지스 귀중

승 인 원

품 명	GSM/DCS/PCS/WCDMA 송·수신용 Swivel Antenna
모 델	S10
코드번호	KRM-S5-G2DPW-0905
승인번호	
업체담당	김 종 훈 대리
조 건	가.
	나.
	다.
	라.

상기 제품에 대해 승인합니다.

공급업체	구 분	담 당	검 토	승 인
	전 자			
	기 구			
승 인	구 분	담 당	검 토	승 인
	전 자			
	기 구			
	승인일자	년 월 일		

제출일: 2009년05월 28일

공 급 업 체 정 보	
상 호	(주)맥스웨이브아이
주 소	서울시 금천구 가산동 월드 메르디 앙벤처 센터 1202호
TEL	02-785-2777
FAX	02-785-2744

업체 대표 직인


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1. 개 요

본 제품은 GSM/DCS/PCS/WCDMA 송·수신용 Swivel 안테나이다.

1.1 안테나 사용 조건

■휴대 □고정 ■이동 ■실외 ■실내 □기타

1.2 적용범위

본 사양승인원은 귀사에서 개발 혹은 생산되는, 시스템에 장착되어 사용하는 GSM/DCS/PCS/WCDMA 송·수신용 Swivel 안테나에 대하여 규정한다.

2. 안테나 구성

No.	부품명	MODEL	Q'ty	비고
1	송·수신용 Antenna	KRM-S5-G2DPW-0905	1	승인도 참조
2	Antenna Matching 단		1	0Ω

3. 특 성

3.1 전기적 특성

Frequency(Mhz)			824	894	960	1710	1850	1990	2170
VSWR			2.53:1	3.69:1	3.66:1	3.62:1	2.11:1	1.87:1	1.32:1
Gain [dBi]	H Plane	Peak	-1.74	-1.87	-1.66	-3.01	-1.63	-2.87	-3.22
		Average	-2.96	-3.41	-2.31	-5.33	-4.08	-4.95	-7.22
	E1 Plane	Peak	-7.29	-5.04	-3.21	-6.8	-3.26	-1.14	-3.69
		Average	-8.39	-7.29	-5.16	-10.2	-7.21	-5.77	-7.48
	E2 Plane	Peak	-11.3	-12.5	-11.0	-15.1	-9.61	-10.3	-11.1
		Average	-14.8	-16.5	-15.3	-19.8	-12.3	-13.6	-17.3
Polarization			Vertical						
Impedance [Ω]			50						
Temperature			-30°C ~ +85°C						

4. 전기적 특성시험

4.1 네트워크 측정

4.1.1 시험조건

- (1)V.S.W.R. 측정을 위한 Network Analyzer 준비.
- (2)Rod Cable 준비.
- (3)Test용 Zig 준비.
- (4)Calibration Kit 준비.

4.1.2 시험절차

4.1.2.1 주파수 범위 설정.

Network Analyzer (E5071B)의 주파수 범위를 824[MHz] ~ 2170[MHz]로 한다.

4.1.2.2 Calibration 방법 및 측정

- OPEN Cal Kit으로 Calibration.
- SHORT Cal Kit으로 Calibration.
- 50(Ω) TERMINATION으로 Calibration.

4.1.2.3 Test시료의 V.S.W.R. 측정.

Test 시료와 Network Analyzer를 연결한 상태에서 거리를 약 30[cm]두고,
V.S.W.R.을 측정한다.



(그림1) Network Analyzer E5071C



(그림2) 테스트 시료



(그림3) Calibration Kit 85033D



(그림4) 네트워크 측정 시 연장 Cable

4.2 무반사실 측정

4.2.1 시험조건

■ CHAMBER SIZE

10m(D) * 5m(W) * 5m(H)

■ 송수신 안테나 거리 : 6.5m

■ 송수신 안테나 높이 : 3m

■ 송신안테나를 수직으로 놓는다.

■ Vertical Gain 측정 : 단말시료를 Test Zig 이용하여 수직으로 세운 후, LCD 정면이 송신안테나를 바라봤을 때를 0°로 기준하여 시계방향으로 360° 회전시켜 Gain을 측정한다.

■ Horizontal Gain 측정 :

(1)Test 단말 LCD가 위를 향하도록 수평으로 놓는다.

(2)Test 단말 안테나가 송신안테나 방향으로 바라보도록 놓는다.

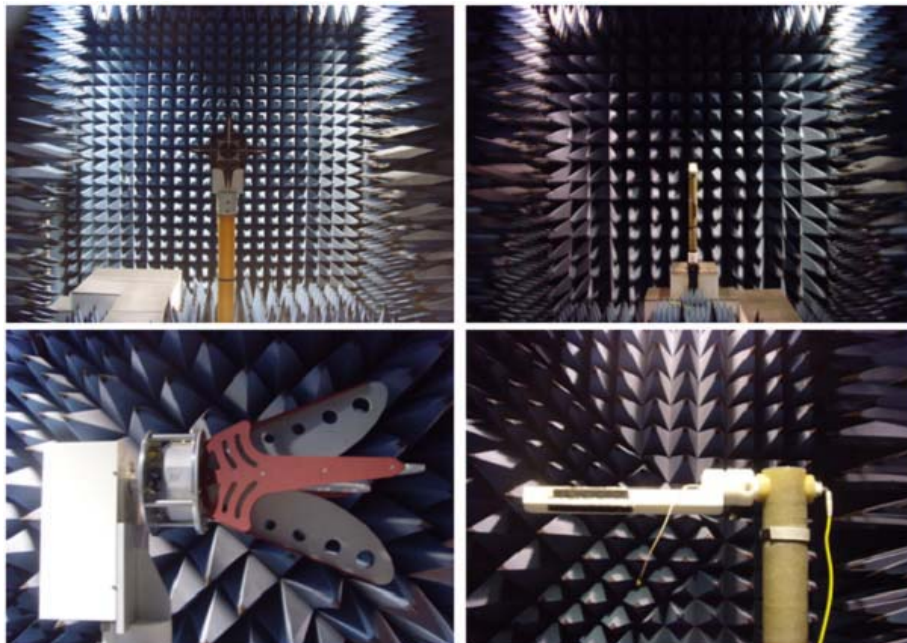
(3)위의 (1),(2)를 만족할 때를 0°로 기준하여 시계방향으로 360° 회전시켜
Gain을 측정한다.

4.2.2 시험절차

■ 송신안테나를 높이 2m에 수직으로 배치한 다음, Network Analyzer에 연결한다.

■ Test 시료로 송신안테나와 일직선상에 배치한 다음 높이를 3m에 고정시킨다.

■ Turn Table을 시계방향으로 10° 간격으로 돌리며 Gain을 측정한다.

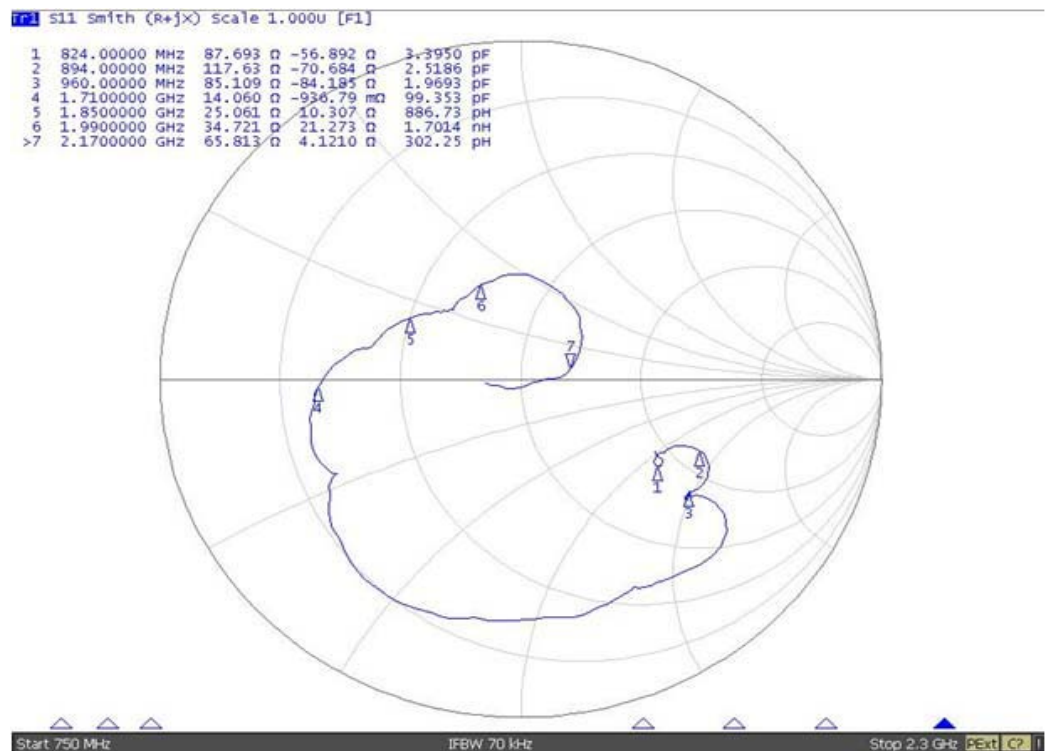


4.3 시험결과 [NETWORK DATA]

4.3.1 In Put Return Loss (반사손실)



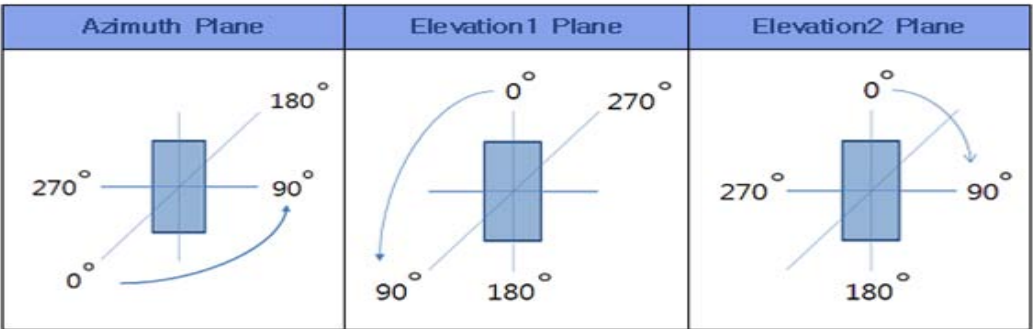
4.3.2 SMITH CHART



4.3.2 VSWR(정재 파비)



4.4 방사패턴



4.5 2D Passive Chamber Data

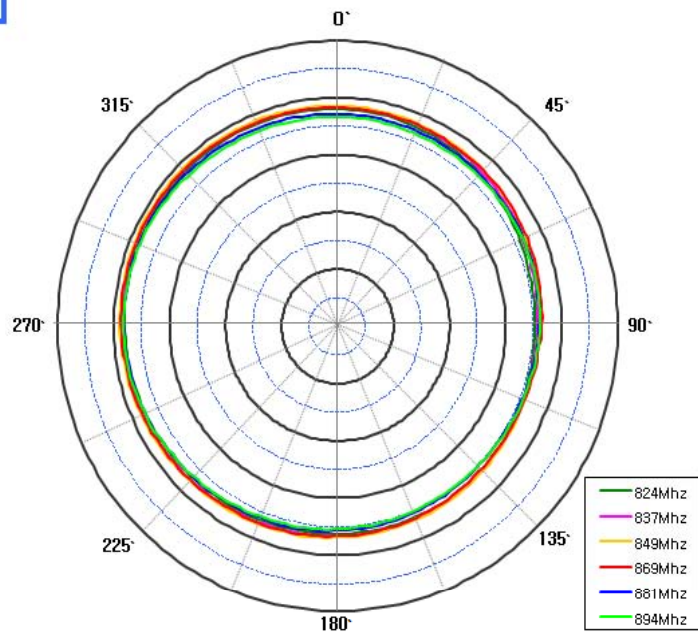
4.5.1 GSM850

– Azimuth Plane

Gain & Radiation Pattern

Model Name:	FileName
Test Band :	GSM850
Test Date :	
Tester Name:	
User Name :	
Memo :	

Frequency	Max.	Min.	Avg.	Beam Peak
824Mhz	-1.74	-4.76	-2.96	306°
837Mhz	-1.24	-4.42	-2.52	300°
849Mhz	-1.00	-4.13	-2.24	292°
869Mhz	-1.22	-4.26	-2.45	294°
881Mhz	-1.81	-4.95	-3.20	286°
894Mhz	-1.87	-5.07	-3.41	272°

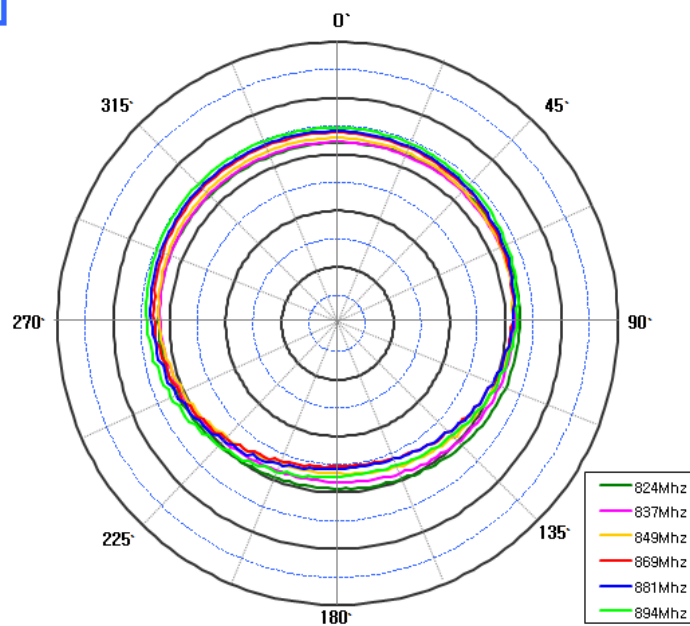


– Elevation1 Plane

Gain & Radiation Pattern

Model Name:	FileName
Test Band :	GSM850
Test Date :	
Tester Name:	
User Name :	
Memo :	

Frequency	Max.	Min.	Avg.	Beam Peak
824Mhz	-7.29	-10.69	-8.39	62°
837Mhz	-7.68	-11.91	-8.85	316°
849Mhz	-7.00	-13.32	-8.83	324°
869Mhz	-6.01	-14.59	-8.33	324°
881Mhz	-5.69	-14.23	-8.03	318°
894Mhz	-5.04	-12.91	-7.29	318°

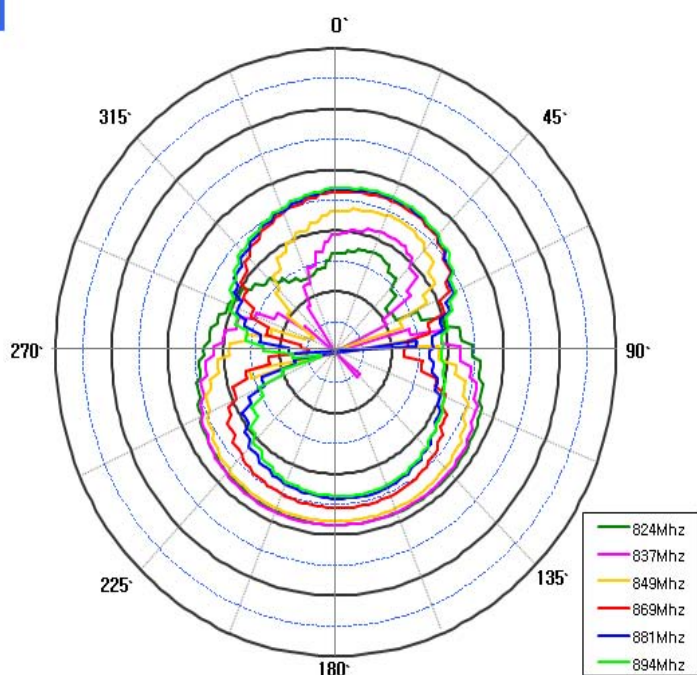


– Elevation2 Plane

Gain & Radiation Pattern

Model Name:	FileName
Test Band :	GSM850
Test Date :	
Tester Name:	
User Name :	
Memo :	

Frequency	Max.	Min.	Avg.	Beam Peak
824Mhz	-11.31	-28.54	-14.80	146°
837Mhz	-11.47	-45.69	-15.00	160°
849Mhz	-12.13	-55.57	-15.50	160°
869Mhz	-13.15	-35.26	-16.30	24°
881Mhz	-12.81	-54.45	-16.70	16°
894Mhz	-12.55	-37.36	-16.50	16°



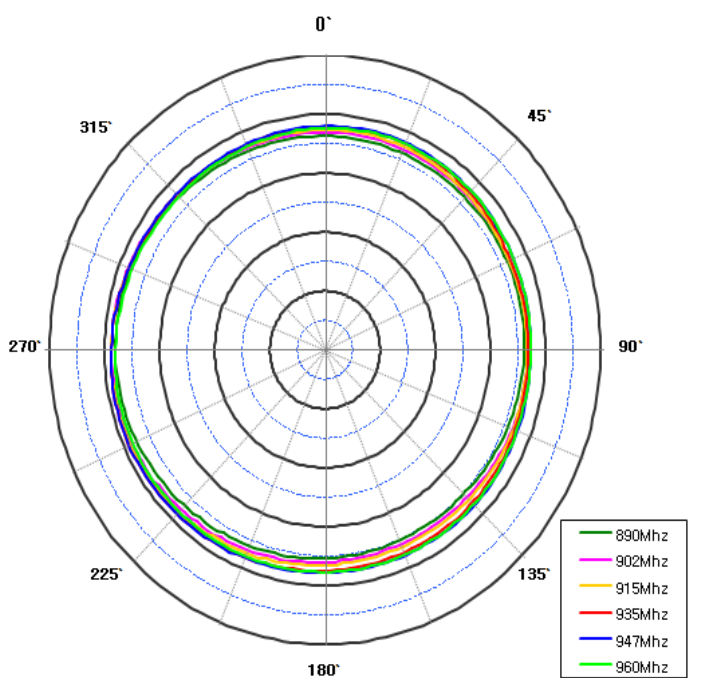
4.5.2 GSM900

– Azimuth Plane

Gain & Radiation Pattern

Model Name:	FileName
Test Band :	GSM900
Test Date :	
Tester Name:	
User Name :	
Memo :	

Frequency	Max.	Min.	Avg.	Beam Peak
890Mhz	-1.93	-5.13	-3.55	272°
902Mhz	-1.19	-4.37	-2.86	266°
915Mhz	-1.02	-3.90	-2.62	258°
935Mhz	-0.90	-3.21	-2.22	244°
947Mhz	-0.92	-2.72	-1.99	252°
960Mhz	-1.66	-2.77	-2.31	246°

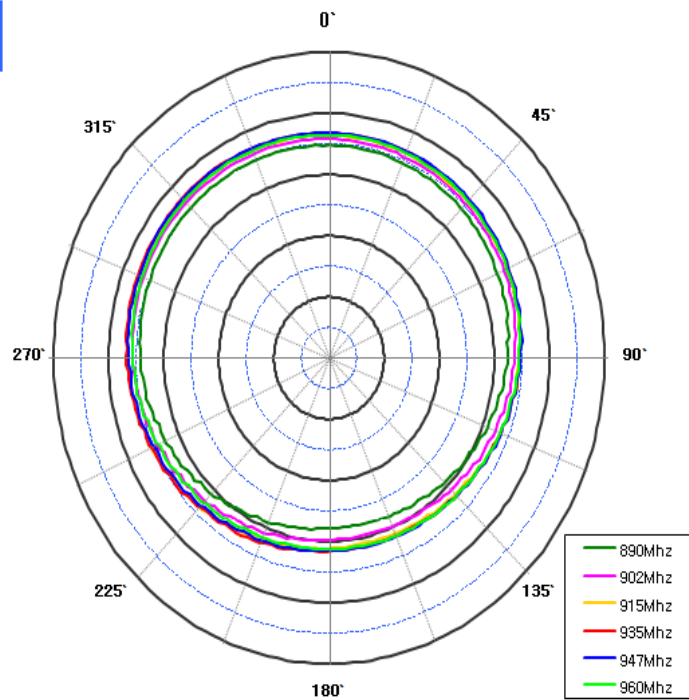


– Elevation1 Plane

Gain & Radiation Pattern

Model Name:	FileName
Test Band :	GSM900
Test Date :	
Tester Name:	
User Name :	
Memo :	

Frequency	Max.	Min.	Avg.	Beam Peak
890Mhz	-4.84	-12.31	-7.02	312°
902Mhz	-3.67	-10.46	-5.74	304°
915Mhz	-2.93	-9.15	-4.94	304°
935Mhz	-2.63	-8.64	-4.63	306°
947Mhz	-2.76	-8.60	-4.71	312°
960Mhz	-3.21	-8.82	-5.16	320°

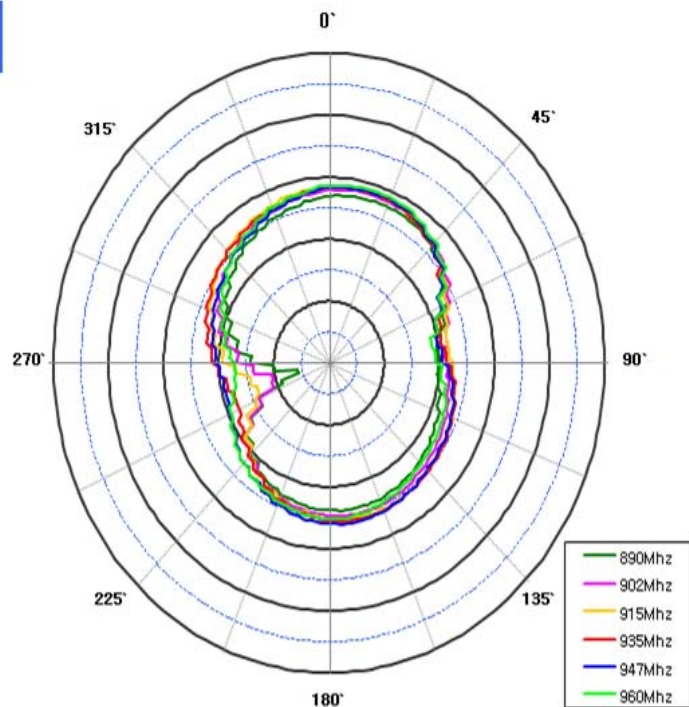


– Elevation2 Plane

Gain & Radiation Pattern

Model Name:	FileName
Test Band :	GSM900
Test Date :	
Tester Name:	
User Name :	
Memo :	

Frequency	Max.	Min.	Avg.	Beam Peak
890Mhz	-12.61	-34.15	-16.50	18°
902Mhz	-11.78	-29.52	-15.50	18°
915Mhz	-11.35	-26.33	-15.00	10°
935Mhz	-11.46	-22.10	-15.00	12°
947Mhz	-11.37	-20.65	-15.00	18°
960Mhz	-11.01	-22.88	-15.30	20°



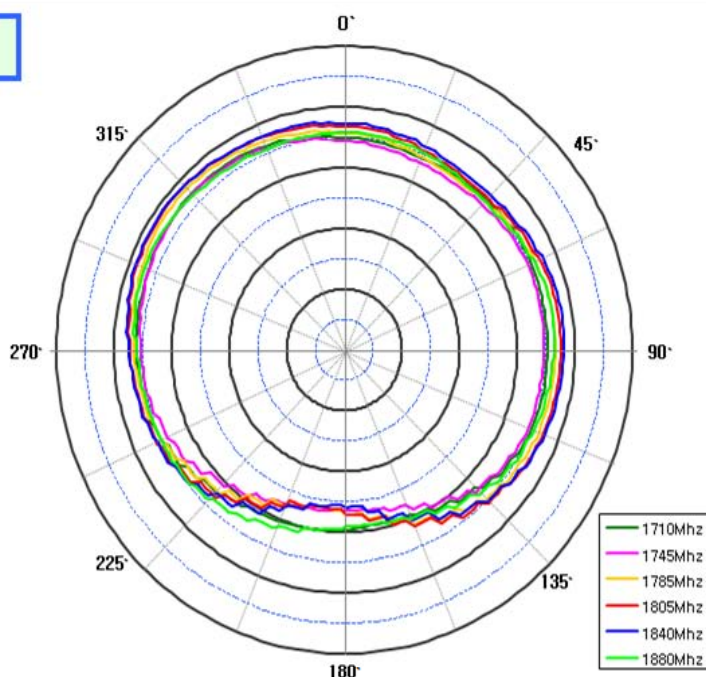
4.5.3 DCS1800

– Azimuth Plane

Gain & Radiation Pattern

Model Name:	FileName
Test Band :	DCS1800
Test Date :	
Tester Name:	
User Name :	
Memo :	

Frequency	Max.	Min.	Avg.	Beam Peak
1710Mhz	-3.01	-10.82	-5.33	312°
1745Mhz	-3.18	-13.60	-6.01	312°
1785Mhz	-1.86	-13.82	-4.66	304°
1805Mhz	-1.15	-13.89	-3.86	306°
1840Mhz	-1.04	-14.56	-3.57	306°
1880Mhz	-2.83	-11.03	-4.95	292°

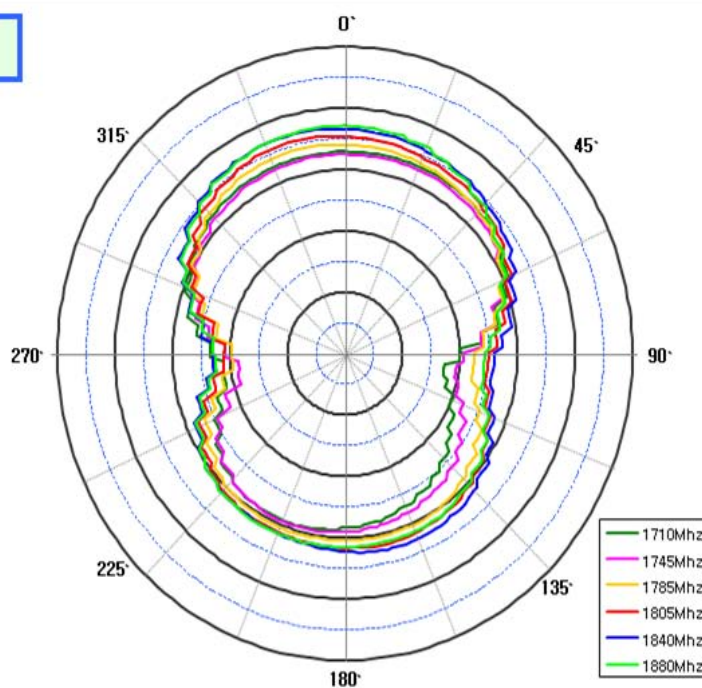


– Elevation1 Plane

Gain & Radiation Pattern

Model Name:	FileName
Test Band :	DCS1800
Test Date :	
Tester Name:	
User Name :	
Memo :	

Frequency	Max.	Min.	Avg.	Beam Peak
1710Mhz	-6.80	-18.85	-10.20	30°
1745Mhz	-7.36	-21.52	-10.60	16°
1785Mhz	-5.67	-20.52	-9.28	344°
1805Mhz	-4.21	-19.08	-8.07	344°
1840Mhz	-3.09	-17.11	-7.00	344°
1880Mhz	-2.77	-17.55	-7.29	358°

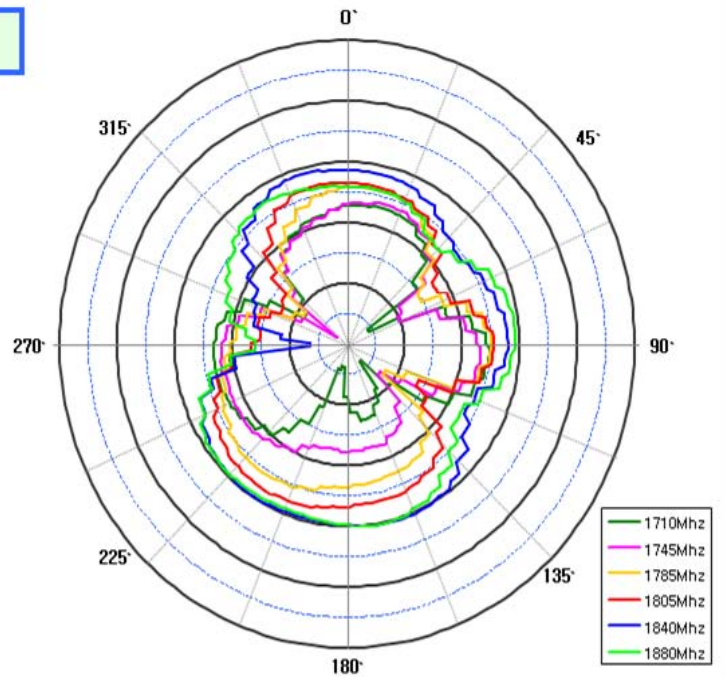


– Elevation2 Plane

Gain & Radiation Pattern

Model Name:	FileName
Test Band :	DCS1800
Test Date :	
Tester Name:	
User Name :	
Memo :	

Frequency	Max.	Min.	Avg.	Beam Peak
1710Mhz	-15.11	-36.39	-19.80	92°
1745Mhz	-16.05	-38.03	-19.90	20°
1785Mhz	-14.05	-32.02	-17.20	6°
1805Mhz	-12.08	-27.38	-15.40	210°
1840Mhz	-9.67	-33.73	-12.40	158°
1880Mhz	-9.79	-24.09	-12.80	166°



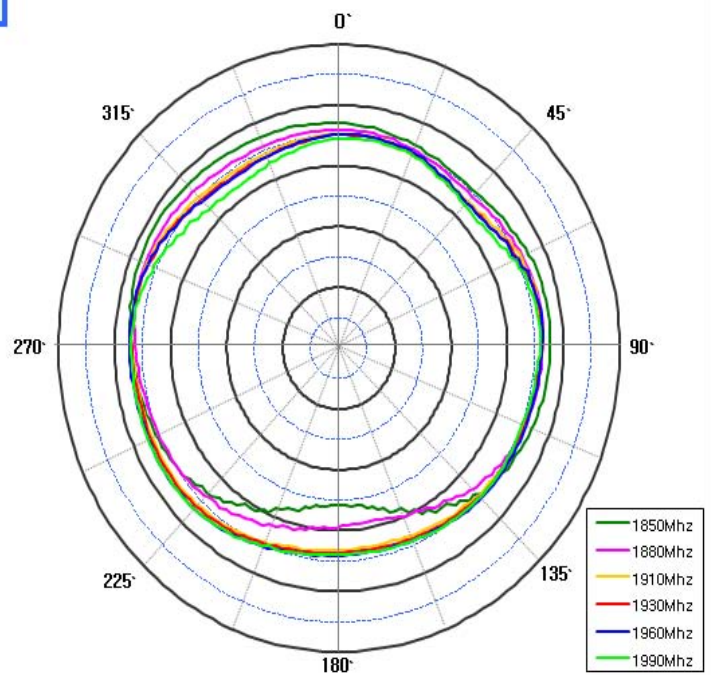
4.5.4 DCS1900

– Azimuth Plane

Gain & Radiation Pattern

Model Name:	FileName
Test Band :	DCS1900
Test Date :	
Tester Name:	
User Name :	
Memo :	

Frequency	Max.	Min.	Avg.	Beam Peak
1850Mhz	-1.63	-14.18	-4.08	300°
1880Mhz	-2.81	-10.91	-4.98	292°
1910Mhz	-2.89	-6.90	-4.71	282°
1930Mhz	-2.96	-7.00	-4.73	278°
1960Mhz	-2.71	-6.91	-4.50	274°
1990Mhz	-2.87	-8.00	-4.95	240°

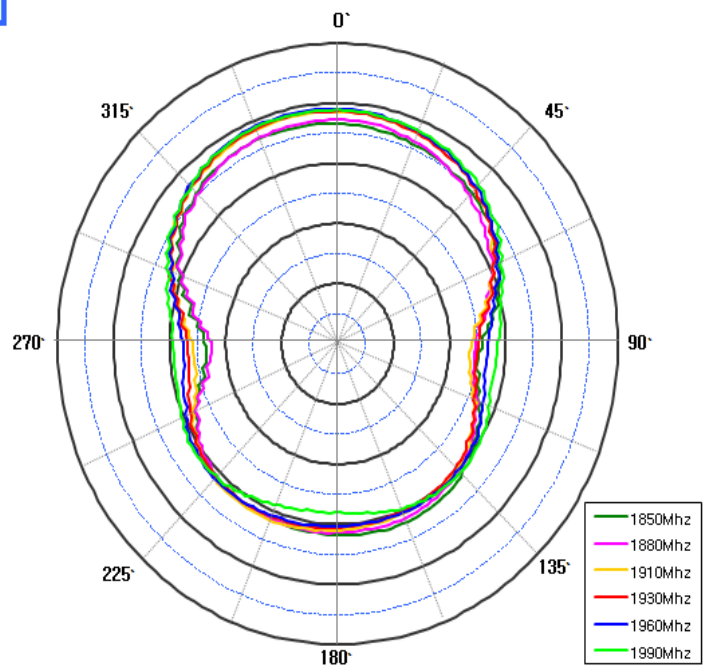


– Elevation1 Plane

Gain & Radiation Pattern

Model Name:	FileName
Test Band :	DCS1900
Test Date :	
Tester Name:	
User Name :	
Memo :	

Frequency	Max.	Min.	Avg.	Beam Peak
1850Mhz	-3.26	-16.58	-7.21	338°
1880Mhz	-2.77	-17.66	-7.31	358°
1910Mhz	-1.40	-16.37	-6.21	350°
1930Mhz	-1.23	-15.06	-6.19	350°
1960Mhz	-0.90	-13.23	-5.81	350°
1990Mhz	-1.14	-11.87	-5.77	350°

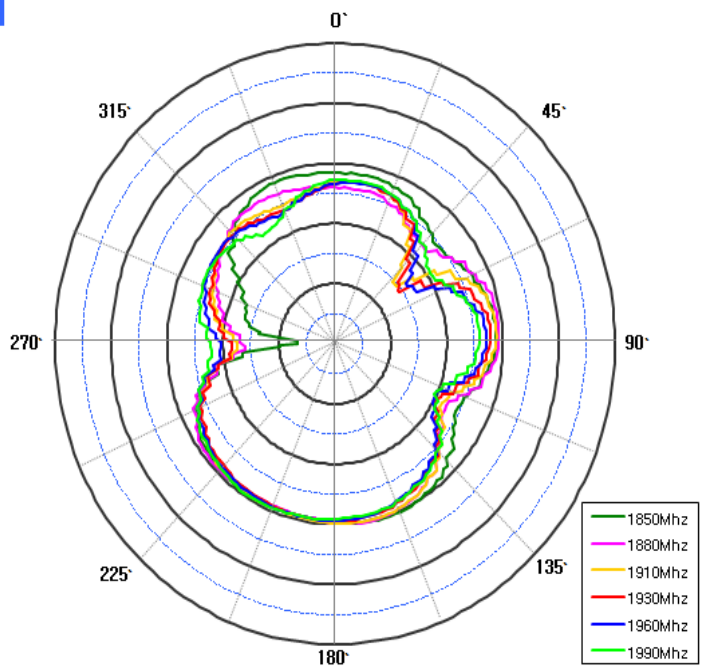


– Elevation2 Plane

Gain & Radiation Pattern

Model Name:	FileName
Test Band :	DCS1900
Test Date :	
Tester Name:	
User Name :	
Memo :	

Frequency	Max.	Min.	Avg.	Beam Peak
1850Mhz	-9.61	-33.43	-12.30	164°
1880Mhz	-9.81	-24.02	-12.80	168°
1910Mhz	-9.90	-25.38	-13.10	170°
1930Mhz	-10.44	-25.64	-13.70	180°
1960Mhz	-10.51	-23.81	-13.70	184°
1990Mhz	-10.35	-20.20	-13.60	214°



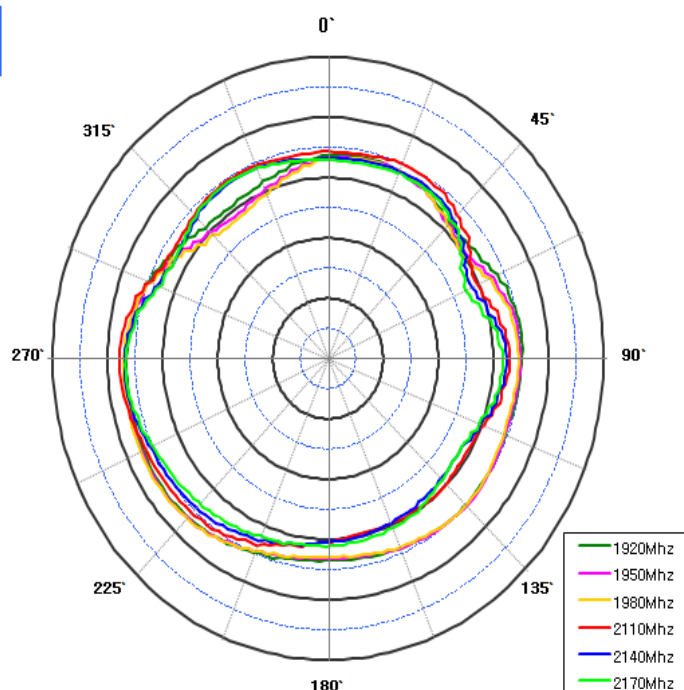
4.5.5 WCDMA

– Azimuth Plane

Gain & Radiation Pattern

Model Name:	FileName
Test Band :	WCDMA
Test Date :	
Tester Name:	
User Name :	
Memo :	

Frequency	Max.	Min.	Avg.	Beam Peak
1920Mhz	-3.11	-9.24	-5.50	242°
1950Mhz	-2.82	-10.89	-5.64	236°
1980Mhz	-2.60	-11.63	-5.73	242°
2110Mhz	-2.11	-10.51	-6.08	270°
2140Mhz	-3.04	-11.71	-6.94	266°
2170Mhz	-3.22	-12.63	-7.22	266°

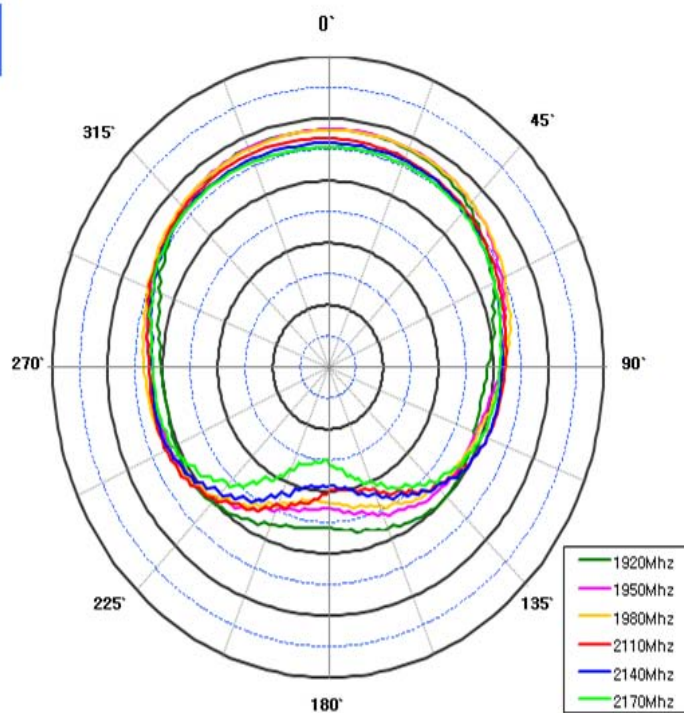


– Elevation1 Plan

Gain & Radiation Pattern

Model Name:	FileName
Test Band :	WCDMA
Test Date :	
Tester Name:	
User Name :	
Memo :	

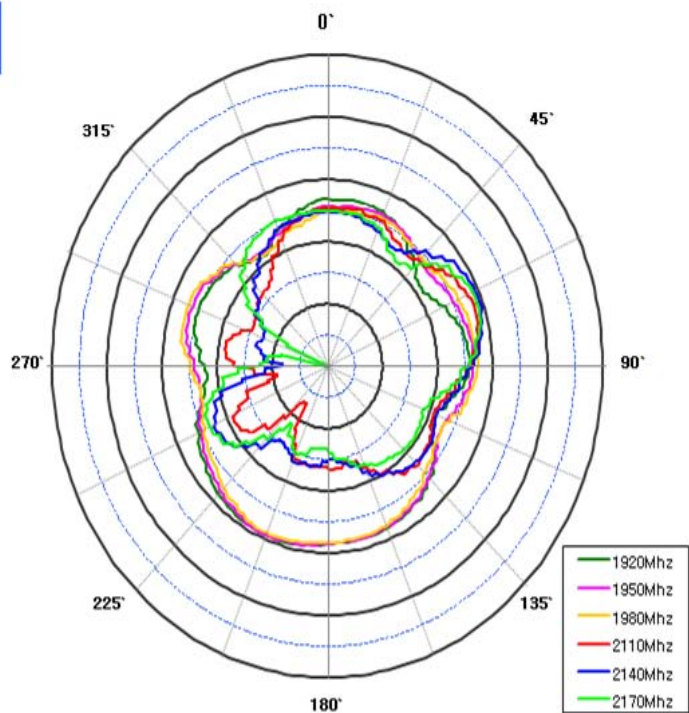
Frequency	Max.	Min.	Avg.	Beam Peak
1920Mhz	-1.72	-14.13	-6.10	350°
1950Mhz	-1.65	-17.35	-5.71	0°
1980Mhz	-1.72	-18.44	-5.58	4°
2110Mhz	-2.90	-20.24	-6.49	342°
2140Mhz	-3.69	-20.86	-7.05	328°
2170Mhz	-3.89	-25.03	-7.48	324°

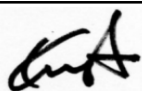


Gain & Radiation Pattern

Model Name:	FileName
Test Band :	WCDMA
Test Date :	
Tester Name:	
User Name :	
Memo :	

Frequency	Max.	Min.	Avg.	Beam Peak
1920Mhz	-10.72	-19.15	-14.00	200°
1950Mhz	-10.72	-18.44	-13.80	204°
1980Mhz	-11.11	-18.77	-13.90	200°
2110Mhz	-11.76	-32.94	-17.70	68°
2140Mhz	-10.51	-31.77	-17.00	68°
2170Mhz	-11.10	-39.83	-17.30	68°

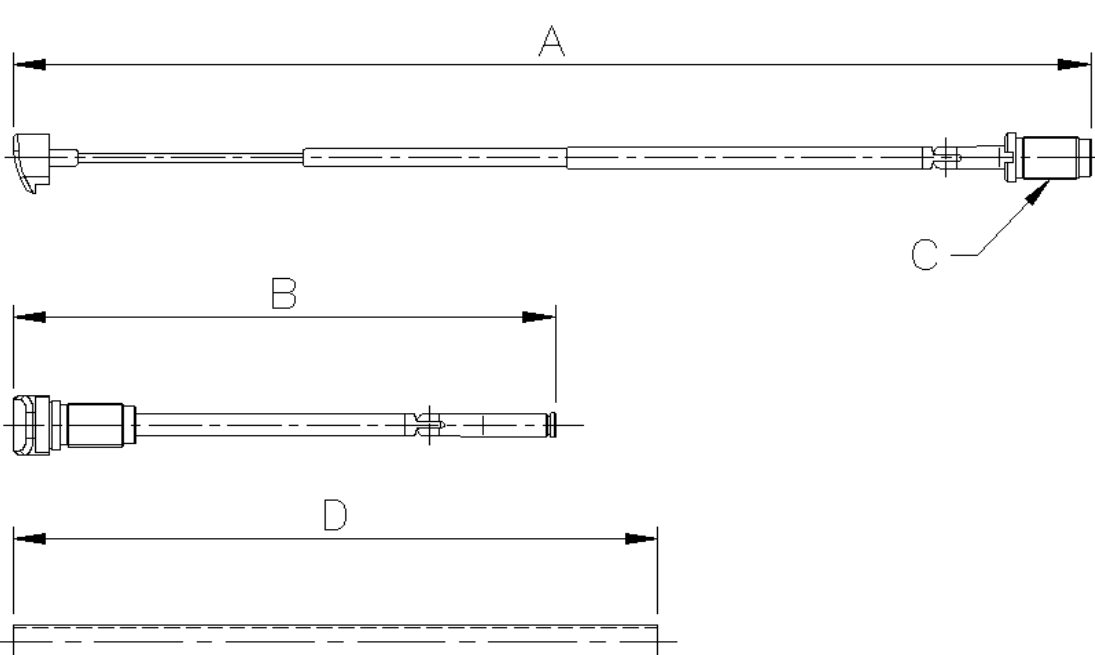


5. 신뢰성 기준		작 성 자	검 토 자	승 인 자
				
		김 진아	배 진섭	박 승교
5.1 기구 신뢰성				
NO	신뢰성 항 목	검사 방법	판정 기준	
1	외관 및 구조	육안으로 확인하여 Shape, 구조, 색상이 한도 견본 및 해당사양과 일치하는지 여부 확인	파손, 부식, 함몰 등의 결함이 없을 것	
2	형 합 성	Rear Case에 취부시 Antenna 형합부위 치수가 도면치수 허용차와 일치여부 및 유해한 결함 없을 것	개별사양 및 좌동에 준함	
3	외관 치수	해당사양 사내 승인도면 또는 고객의 최종 승인원을 만족할 것	개별사양 및 좌동에 준함	
4	삽발거 수명시험 (인출/삽입력)	안테나를 상대물(치구)에 Antenna Rod 일단을 고정하여 지그로 5,000회(10회/분) 삽•발거력을 실시한 후 각 단의 중간 지점에서삽•발거력을 측정한다.	자력으로 삽발거 되지 않을 것	
5	Hinge 수명시험	Hinge Post를 고정하고 적합 JIG로 5,000회(20회/분) 좌우 90도 반복절곡 후, Push Pull Gauge로 회전 지지력을 체크한다.	20gf.cm이상 관리	
6	회전강도 시험	Holder고정하고 적합 JIG로 3,000회(10회/분)360도 Swing을 실시한 후 Torque Gauge로 회전 지지력을 체크한다.	20gf.cm이상 관리	
7	Pulling(몸체)강도시험	강도시험기에 TOP 과 Holder 고정후 Push Pull Gauge로 5Kgf을 5초간 당긴 후 확인 한다	외관 및 기구적인 손상이 없어야 하며 ,전기적 성능을 만족해야 한다.	
5.2 도금 신뢰성				
NO	신뢰성 항 목	검사 방법	판정 기준	
1	고온고습	① 온도 : 60±2℃ ② 상대습도 : 80% ③ 시험시간 : 96±2시간	EMI: 저항 값 및 TAPE밀착 력 만족할 것	
2	염수분무 시험	① 염수농도 : 35±2도,5% 48Hr 시험후 10분내염수제거 >상온24시간방치	부식,외관 이상 없을 것 EMI경우 TAPE밀착 력,저항치 만족할 것	

6. 신뢰성 성적서

기구 신뢰성 성적서

시 험 D A T A

시료 NO	외 관	검사항목						판정
		치 수 검 사				삽, 발거력	형 합 성	
		A (117.29±1.0)	B (59.03±0.5)	C (M5x P0.5)	D (70.2±0.3)			
1	OK	118.09	59.14	OK	70.28	OK	-	OK
2	OK	117.94	59.14	OK	70.36	OK	-	OK
3	OK	117.29	59.14	OK	70.28	OK	-	OK
4	OK	117.33	59.04	OK	70.38	OK	-	OK
5	OK	118.05	59.02	OK	70.28	OK	-	OK
6	OK	118.00	59.01	OK	70.26	OK	-	OK
7	OK	117.98	59.15	OK	70.40	OK	-	OK
8	OK	117.35	59.12	OK	70.22	OK	-	OK
9	OK	117.44	59.11	OK	70.14	OK	-	OK
10	OK	118.10	59.14	OK	70.16	OK	-	OK
11	OK							
12	OK							
13	OK							
14	OK							
15	OK							
16	OK							
17	OK							
18	OK							
19	OK							
20	OK							
21	OK							
22	OK							
23	OK							
24	OK							
25	OK							
26	OK							
27	OK							
28	OK							
29	OK							
30	OK							

시 험 항 목			Hinge 수명시험														
시 험 D A T A																	
시 료 NO	검사항목																결과
	외 관 (gf.cm)		VSWR														
			824MHz		894MHz		960MHz		1710MHz		1850MHz		1990MHz		2170MHz		VSWR 4 이하
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	
1	108	76	2.6	2.5	3.7	3.7	3.6	3.6	3.6	3.6	2.2	2.1	1.9	2.0	1.3	1.2	OK
2	100	71	2.5	2.5	3.6	3.6	3.6	3.5	3.5	3.5	2.2	2.0	1.8	1.9	1.3	1.3	OK
3	121	82	2.5	2.5	3.6	3.7	3.5	3.6	3.5	3.6	2.1	2.1	1.8	2.0	1.4	1.2	OK
4	98	65	2.5	2.5	3.7	3.7	3.7	3.6	3.6	3.5	2.1	2.1	1.7	1.9	1.3	1.3	OK
5	132	85	2.7	2.5	3.7	3.7	3.5	3.6	3.4	3.4	2.1	2.2	1.8	1.9	1.4	1.3	OK
6																	
7																	
8																	
9																	
10																	

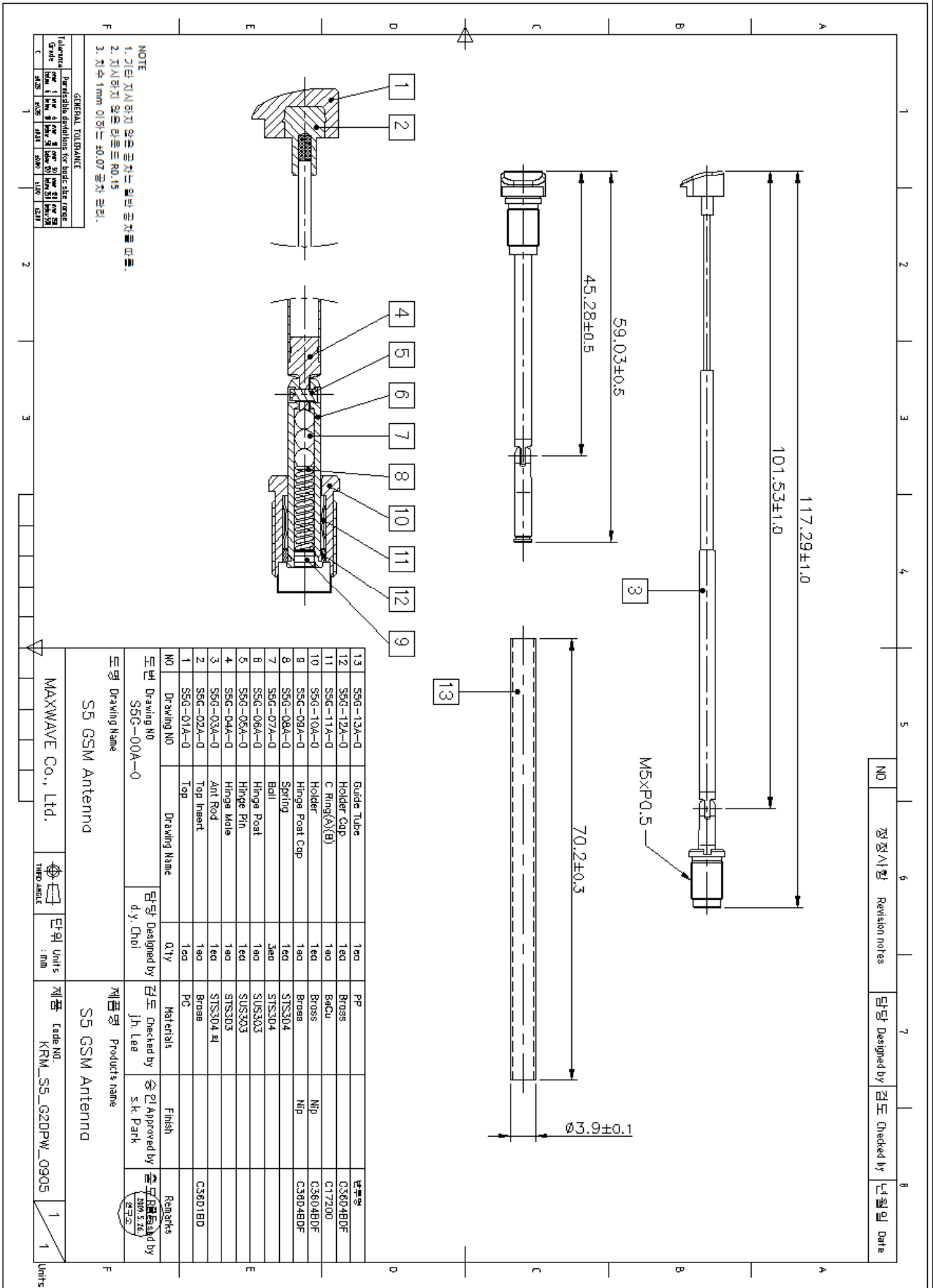
시 험 항 목			회전강도 시험														
시 험 D A T A																	
시 료 NO	검사항목																결과
	외 관 (gf.cm)		VSWR														
			824MHz		894MHz		960MHz		1710MHz		1850MHz		1990MHz		2170MHz		VSWR 4 이하
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	
1	86.4	54	2.6	2.5	3.6	3.7	3.5	3.6	3.5	3.5	2.1	2.2	1.9	1.9	1.4	1.3	OK
2	98	63	2.6	2.6	3.5	3.5	3.4	3.5	3.4	3.3	2.2	2.1	1.7	1.7	1.3	1.3	OK
3	80	51	2.6	2.6	3.8	3.7	3.8	3.7	3.7	3.8	2.0	2.1	2.0	1.9	1.1	1.1	OK
4	76	42	2.4	2.4	3.7	3.7	3.7	3.6	3.6	3.7	2.0	2.0	1.7	1.8	1.3	1.2	OK
5	82	50	2.5	2.5	3.5	3.5	3.5	4.5	3.4	3.5	2.2	2.1	2.0	1.9	1.4	1.4	OK
6																	
7																	
8																	
9																	
10																	

시 험 항 목			Pulling(몸체)강도시험														
시 험 D A T A																	
시 료 NO	검사항목																결과
	외 관		VSWR														VSWR 4 이하
			824MHz		894MHz		960MHz		1710MHz		1850MHz		1990MHz		2170MHz		
			Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	
1	OK	OK	2.8	2.7	3.7	3.6	3.6	3.6	3.6	3.6	2.2	2.1	1.8	1.8	1.3	1.3	OK
2	OK	OK	2.3	2.3	3.9	3.9	3.7	3.6	3.8	3.7	2.4	2.3	2.0	1.9	1.5	1.4	OK
3	OK	OK	2.4	2.3	3.8	3.8	3.8	3.8	3.7	3.7	2.5	2.4	2.0	2.0	1.4	1.4	OK
4	OK	OK	2.5	2.4	3.7	3.7	3.7	3.7	3.6	3.5	2.3	2.2	2.0	2.0	1.5	1.5	OK
5	OK	OK	2.6	2.5	3.6	3.6	3.6	3.5	3.5	2.5	2.1	2.0	1.8	1.8	1.3	1.2	OK
6																	
7																	
8																	
9																	
10																	
11																	
12																	
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26																	
27																	
28																	
29																	
30																	

시 험 항 목			고온고습												
시 험 D A T A															
시료 NO	검사항목														결과
	VSWR														
	824MHz		894MHz		960MHz		1710MHz		1850MHz		1990MHz		2170MHz		VSWR 4 이하
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	
1	2.7	2.8	3.7	3.6	3.7	3.7	3.6	3.6	2.3	2.2	1.8	1.8	1.4	1.3	OK
2	2.3	2.3	3.9	3.9	3.6	3.5	3.8	3.7	2.3	2.4	2.0	2.0	1.5	1.4	OK
3	2.3	2.4	3.8	3.9	3.8	3.8	3.7	3.7	2.5	2.4	2.0	1.9	1.4	1.4	OK
4	2.5	2.4	3.6	3.7	3.7	3.6	3.6	3.7	2.4	2.3	2.0	2.0	1.5	1.6	OK
5	2.6	2.6	3.6	3.6	3.6	3.6	3.6	3.5	2.1	2.1	1.9	1.8	1.3	1.3	OK
6															
7															
8															
9															
10															

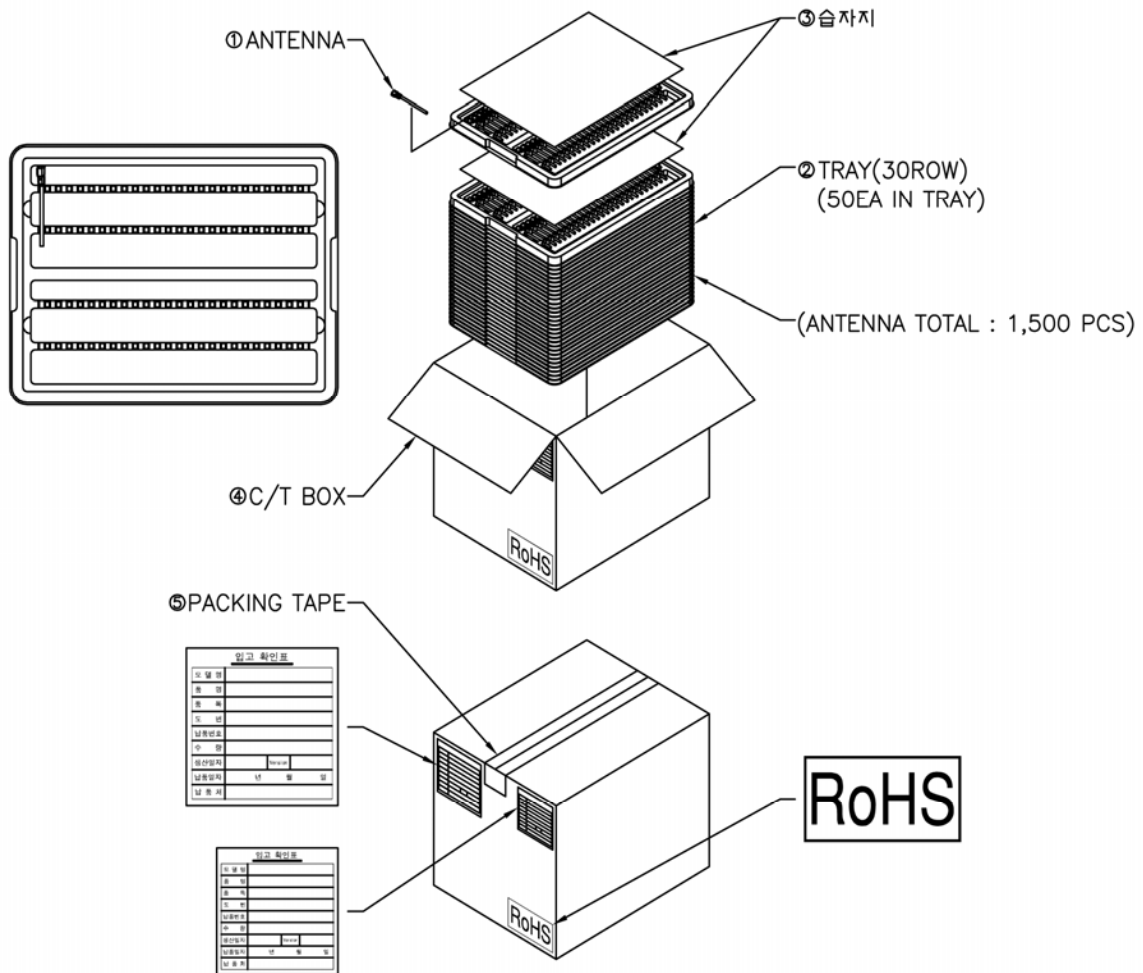
시 험 항 목			염수 분무												
시 험 D A T A															
시료 NO	검사항목														결과
	VSWR														
	824MHz		894MHz		960MHz		1710MHz		1850MHz		1990MHz		2170MHz		VSWR 4 이하
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	
1	2.7	2.7	3.7	3.6	3.6	3.6	3.7	3.6	2.2	2.1	1.9	1.8	1.4	1.3	OK
2	2.4	2.3	3.9	3.9	3.6	3.6	3.7	3.7	2.4	2.3	1.9	1.9	1.4	1.4	OK
3	2.4	2.3	3.8	3.7	3.7	2.6	3.7	3.7	2.4	2.4	2.0	2.0	1.4	1.3	OK
4	2.5	2.4	3.7	3.7	3.8	3.8	3.6	3.6	2.4	2.4	2.0	2.0	1.5	1.5	OK
5	2.6	2.5	3.6	3.5	3.5	3.5	3.5	2.5	2.1	2.1	1.9	1.8	1.3	1.2	OK
6															
7															
8															
9															
10															

7. Antenna 승인도



8. 포장사양

NO	정정사항	Revision notes	담당 Designed by	검도 Checked by	년월일 Date
①					



8	에어폼	-	-		
7	INK (MAGIC PEN MONAMI)	-	-		
6	RoHS STAMP	-	-		
5	PACKING TAPE	-	-		
4	C/T BOX	1/1500	K180		
3	습자지	1/50	-		
2	TRAY	1/50	PS		
1	ANTENNA	1500	-		
NO	Part Name	Q'ty	Materials	Finish	Remarks
도번 Drawing NO	S5G-14A-0	담당 Designed by	검도 Checked by	승인 Approved by	
		d.y. Choi	j.h. Lee	s.k. Park	
도명 Drawing Name	포장사양서		제품명 Products name	S5 GSM Antenna	
MAXWAVE Co., Ltd.		단위 Units : mm	제품명 Code NO.	KRM_S5_G2DPW_0905	
		THIRD ANGLE			1/1