

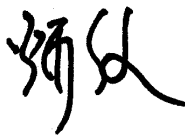
Halogen free



MSL Level 1

ROHS-Y

승 인 원

제 품 명	칩 안테나		
사 용 자	모본		
적 용 모 델	R2		
사용자 CODE			
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공급자 CODE	ACS2450HDW5		
모본	기안자	검토자	승인자
	/	/	/
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	10/23	10/23	10/23

2008. 10. 23



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Halogen free

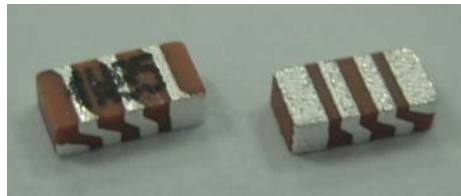


MSL Level 1

ROHS-Y

모델 : ACS2450HDW5

3차원 구조



상측면

하측면

기안자	검토자	승인자
연구 5팀	품질보증파트	연구소
전찬익	민남식	임병준
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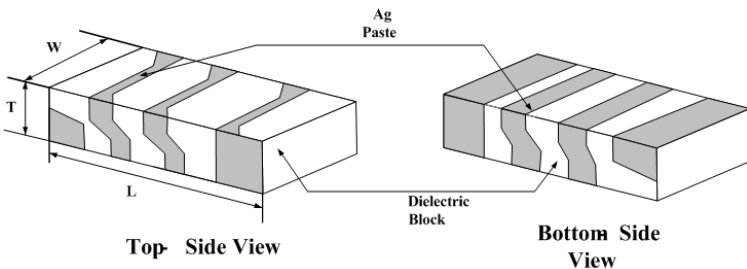
[illegible]

2. 부품의 개요 및 치수 규격

2.1 부품 개요

본 제품은 유전체 무선 통신 기기 내장형 칩 안테나로 직방의 형상을 갖는 유전체에 은(Ag) 도금으로 패턴을 형성하여 특성을 구현한다.

2.2 부품 치수 규격

형 태	직방형의 세라믹	
재 질	유전체	Mg_2SiO_4 (Magnesium Silicate)
	전극 도금	은(Ag)
크 기 [mm]	$W = 2.0 \pm 0.1$	
	$L = 4.0 \pm 0.1$	
	$T = 1.2 \pm 0.1$	
평탄도	0.04(소체기준)	
MSL LEVEL	MSL LEVEL 1	
ESD LEVEL	15 KV 이상 (HBM CLASS 3B)	
Version	Revision 1.0	

3. 중점 관리 항목()

— 아래 항목에 대하여 중점관리 항목으로 지정하여 관리한다.

제품의 CTQ 항목	지정 사유
성형무게, 치수	성형무게 및 치수에 따라 소성 후 소체 크기가 결정되며 소체 크기가 인쇄 정밀도에 영향을 미침
소성치수	소성 후 치수가 인쇄 정밀도에 영향을 줌
인쇄치수	인쇄치수 정밀도가 블루투스 안테나의 특성의 핵심적 항목임

제품의 CTF 항목 	지정 사유
단품 측정 SWR	제품의 전기적 특성을 분별하는 주요 변수임

— 아래 항목에 대하여 주의를 요함.

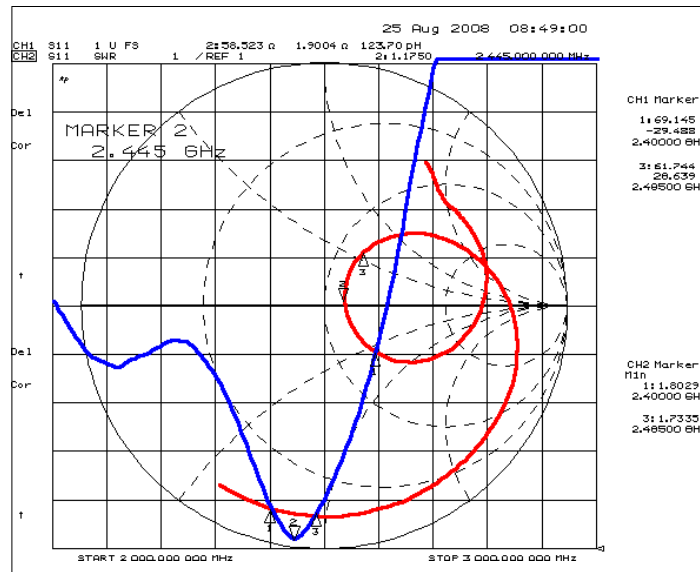
항 목	내 용
보 관	상온에 장시간 보관 시 밀봉하여 보관
동 작	임의의 설계 변경 시 특성이 변경될 수 있음

4. 전기적 특성

4.1 시료 실장 측정

항 목				특 성
Frequency Range [MHz]				2400 ~ 2485
SWR [Max]				3 : 1 (Typ 2.5 : 1)
Input Impedance [Ω]				50 Ohm
Polarization				Linear
Gain [dBi]	Total Gain (Peak / Avg) [dBi]			0.86/-2.27
	Azimuth	Theta	Peak	0.79
			Average	-2.27
		Phi	Peak	-0.78
			Average	-6.24
	Elevation 1	Theta	Peak	-2.13
			Average	-6.85
		Phi	Peak	-0.75
			Average	-6.51
	Elevation 2	Theta	Peak	-2.77
			Average	-7.94
		Phi	Peak	0.86
			Average	-5.99

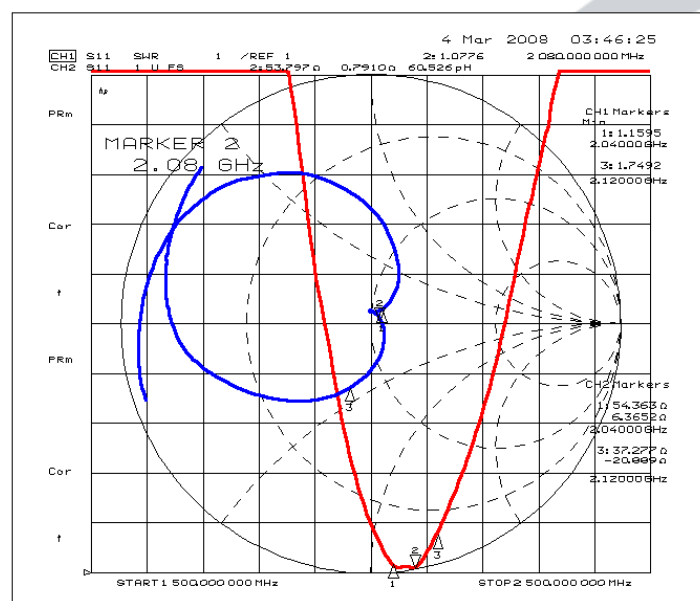
4.2 시료 실장 측정 그래프



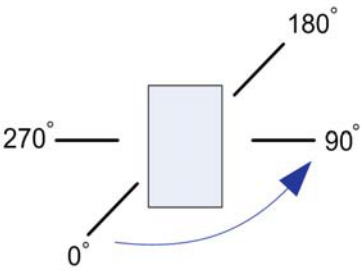
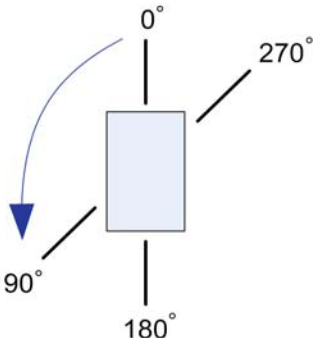
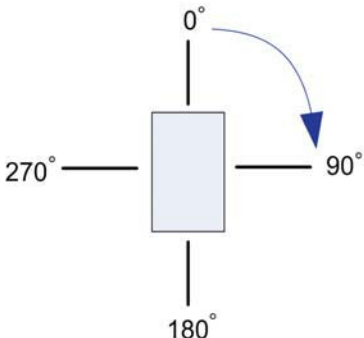
4.3 수동 지그 측정

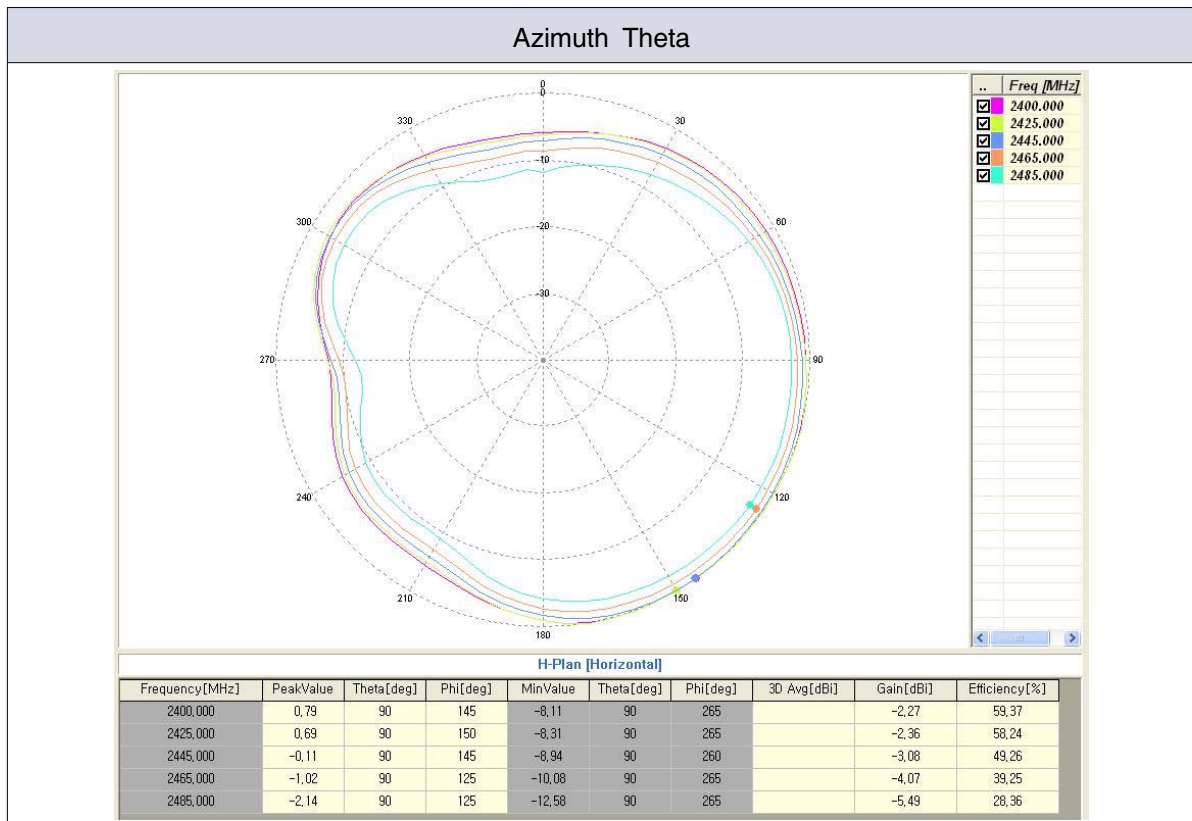
항 목	특 성
Frequency Range [MHz]	2040 ~ 2120
Lower frequency(2040 MHz) SWR [Min~Max]	1.0 ~ 3.0 : 1 (Typ 2.5 : 1)
Upper frequency(2120 MHz) SWR [Min~Max]	1.0 ~ 3.0 : 1 (Typ 2.5 : 1)

4.4 수동 지그 측정 그래프

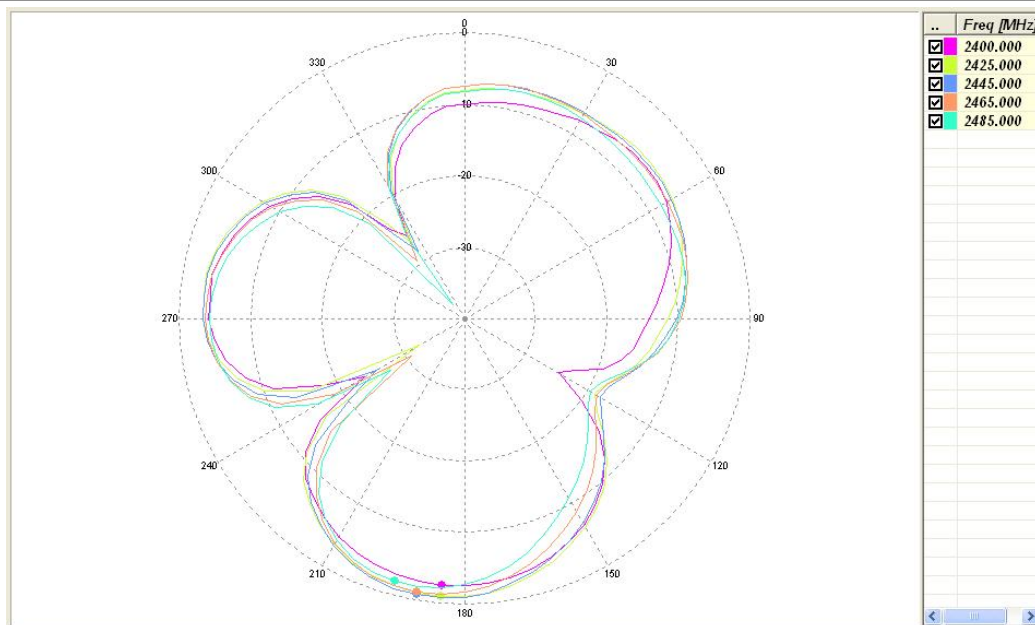


4.5 방사 패턴

Azimuth Plane	Elevation1 Plane	Elevation2 Plane
		
Theta	Vertical field of measured plane	
Phi	Horizontal field of measured plane	



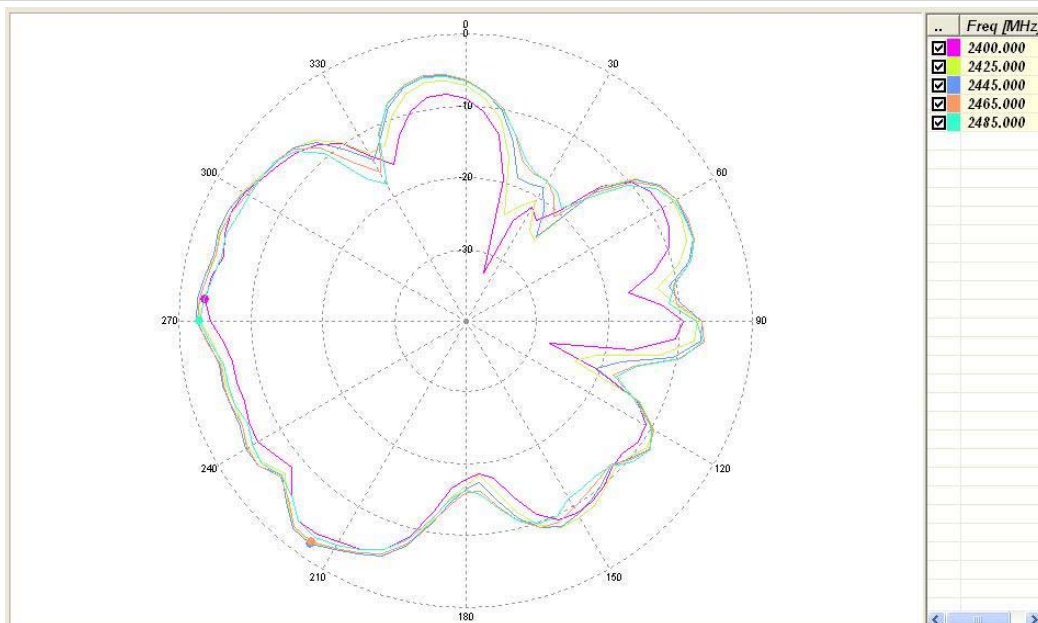
Azimuth Phi



H-Plan [Vertical]

Frequency[MHz]	PeakValue	Theta[deg]	Phi[deg]	MinValue	Theta[deg]	Phi[deg]	3D Avg[dBi]	Gain[dBi]	Efficiency[%]
2400,000	-2,55	90	185	-25,73	90	325		-7,49	17,93
2425,000	-0,99	90	185	-32,48	90	240		-6,28	23,66
2445,000	-0,78	90	190	-28,43	90	325		-6,24	23,89
2465,000	-1,19	90	190	-30,82	90	235		-6,75	21,26
2485,000	-1,91	90	195	-37,37	90	320		-7,51	17,84

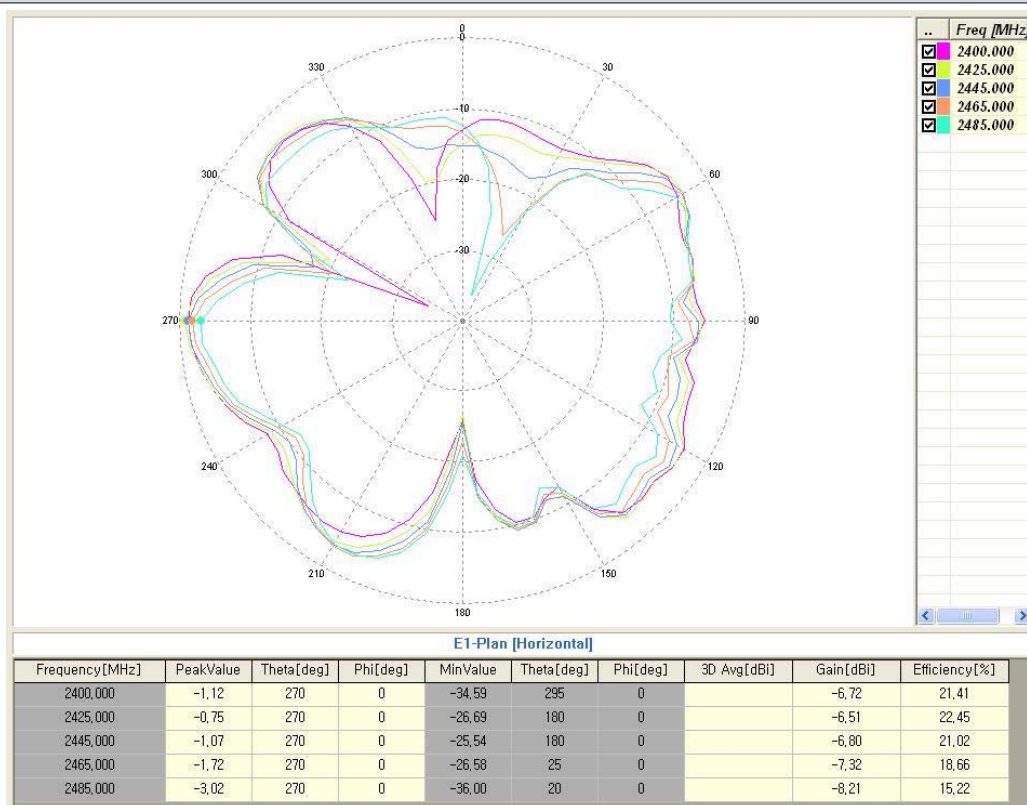
Elevation1 Theta



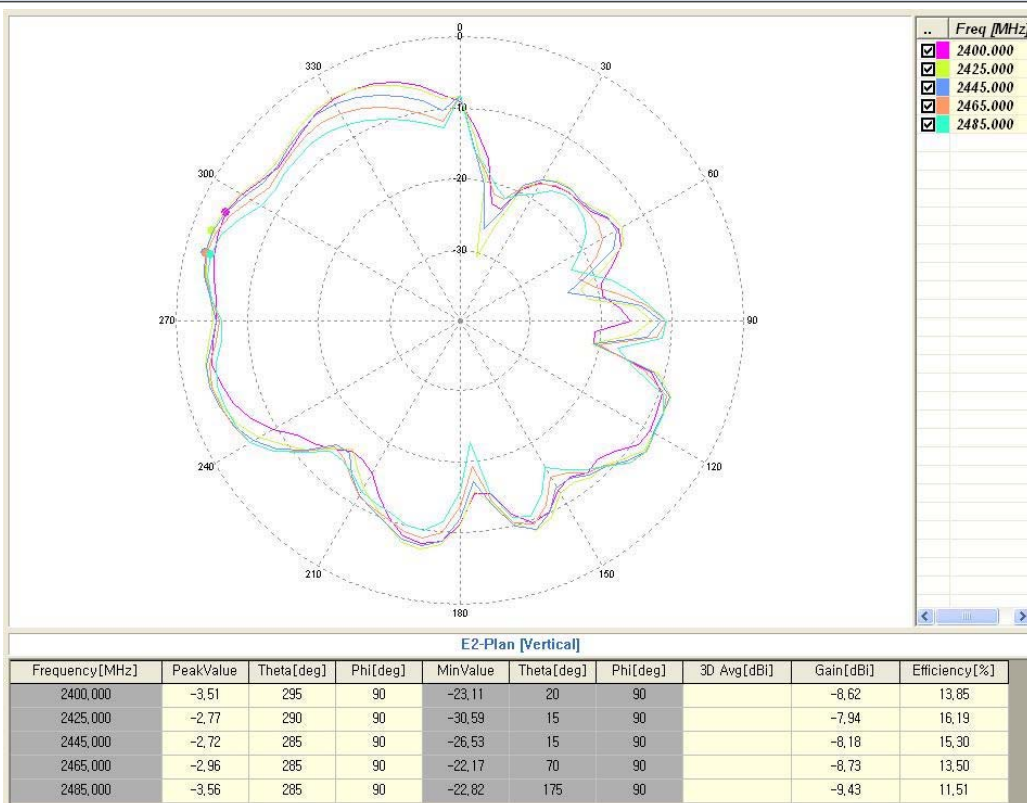
E1-Plan [Vertical]

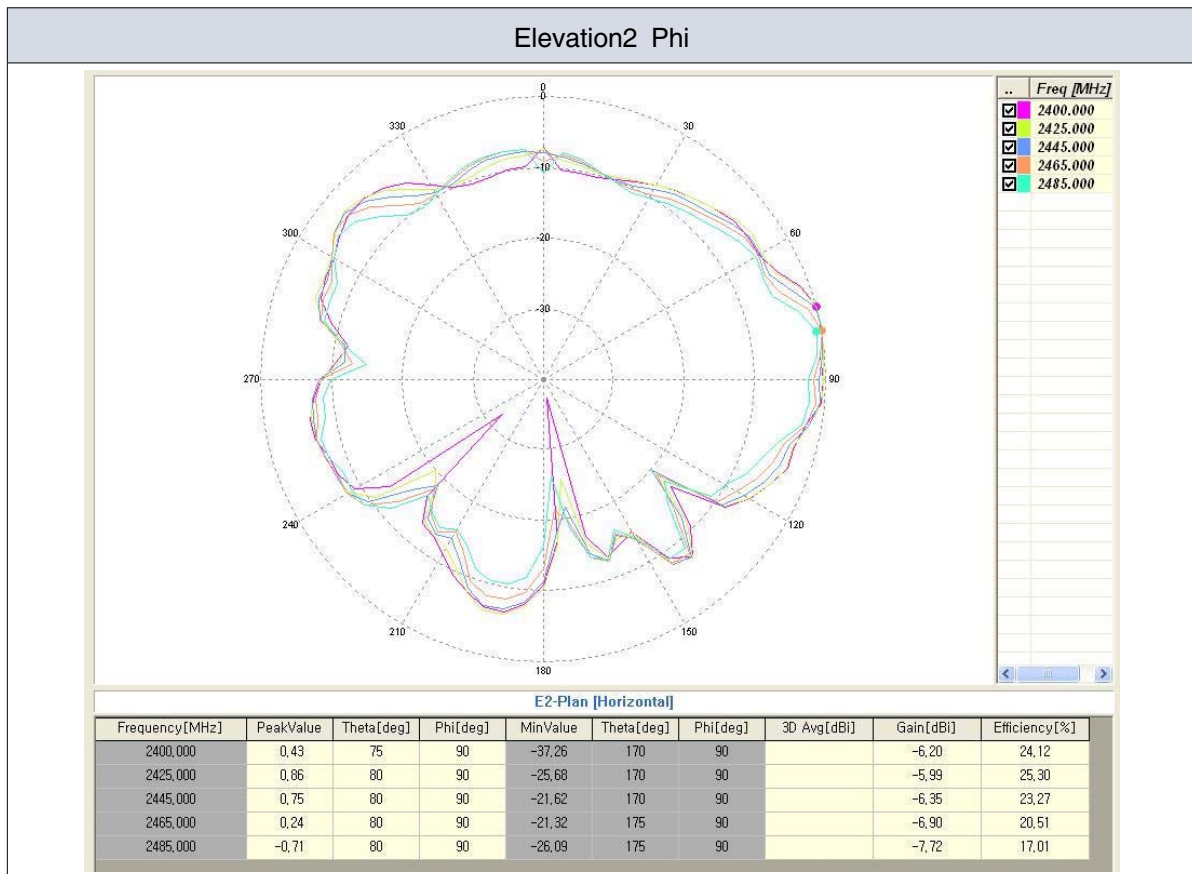
Frequency[MHz]	PeakValue	Theta[deg]	Phi[deg]	MinValue	Theta[deg]	Phi[deg]	3D Avg[dBi]	Gain[dBi]	Efficiency[%]
2400,000	-3,46	275	0	-32,84	20	0		-8,38	14,62
2425,000	-2,33	215	0	-25,13	40	0		-7,14	19,41
2445,000	-2,13	215	0	-24,63	40	0		-6,85	20,79
2465,000	-2,41	215	0	-20,89	40	0		-6,97	20,21
2485,000	-2,88	270	0	-19,31	40	0		-7,47	18,03

Elevation1 Phi



Elevation2 Theta

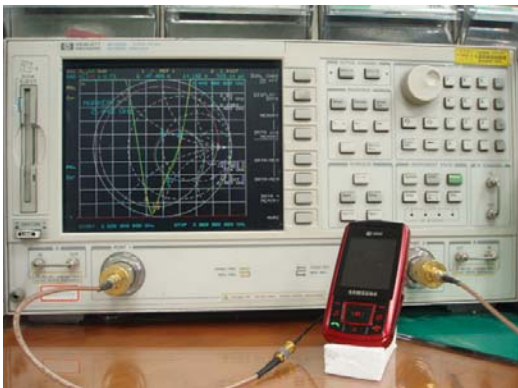
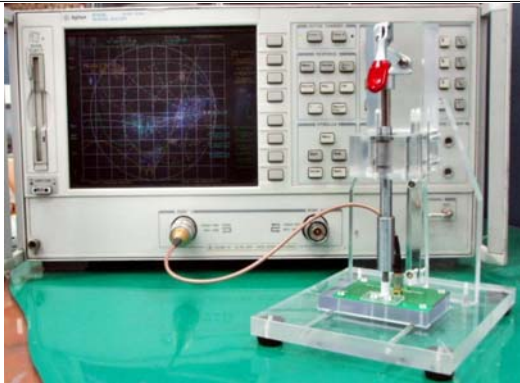




5. 시험 방법

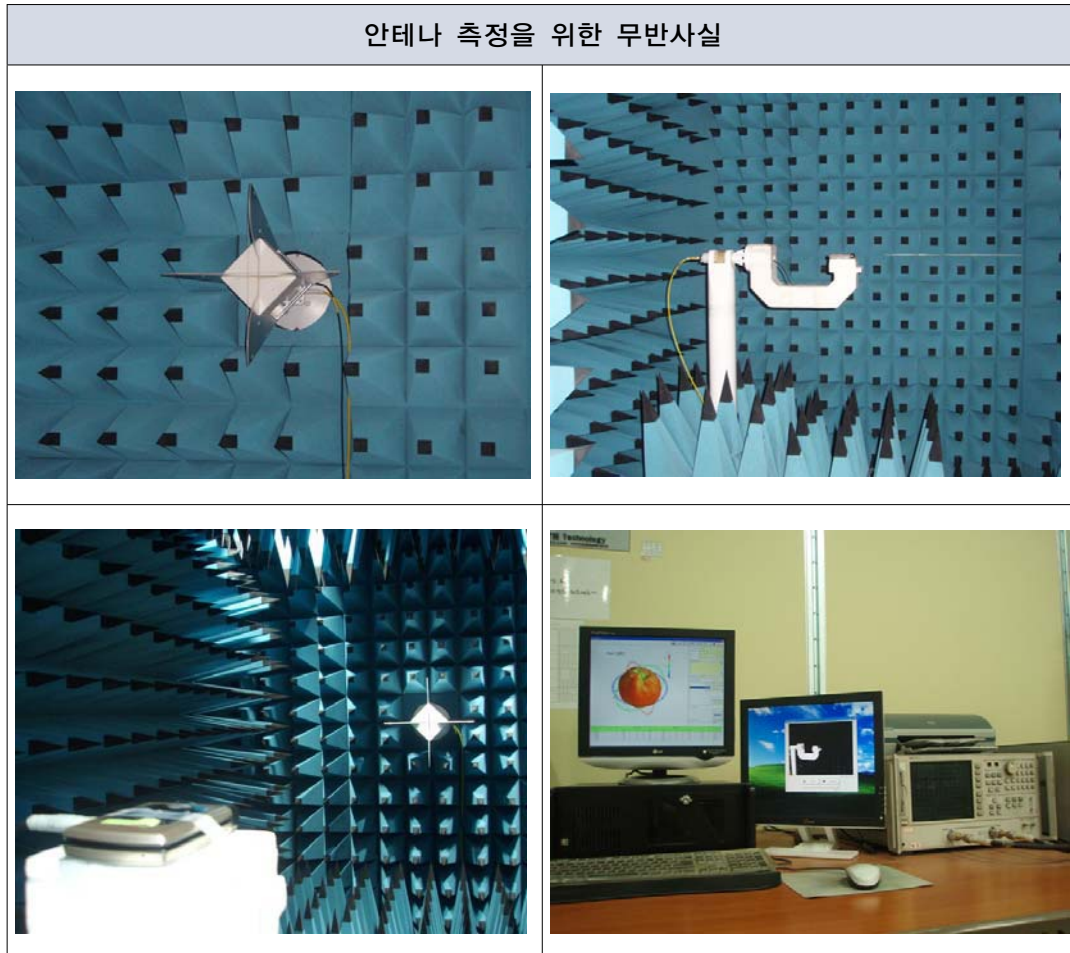
5.1 SWR / Return Loss

Network Analyzer를 이용하여 SWR / Return Loss를 측정하며 표본 샘플을 선별 수동 측정 지그 또는 자동화 검사장비를 이용하여 양품과 불량품을 선별한다.

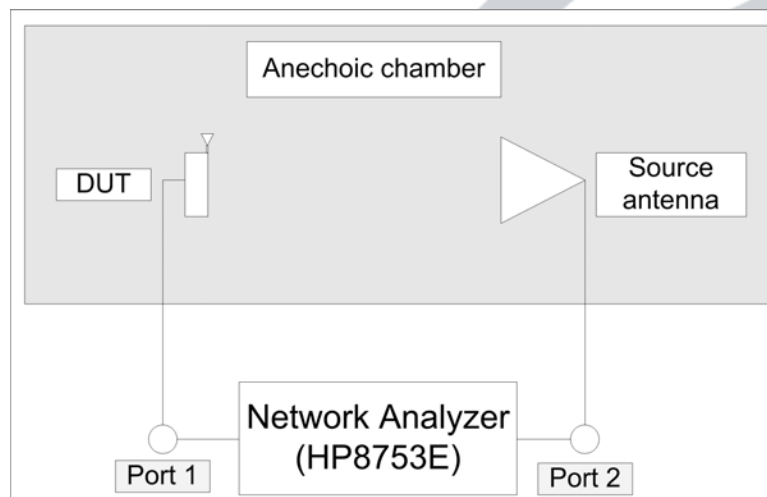
	시료 측정 조건	수동 지그 측정 조건
Network Analyzer	Agilent HP8753E	Agilent HP8753E or Advantest R3765CH
Cable	RF cable(300 mm)	RF cable(300 mm)
Test condition		

5.2 이득

당사가 보유한 전파 무반사실에서 상기 4.1에서 측정된 시료를 이용하여 안테나 이득을 측정한다.

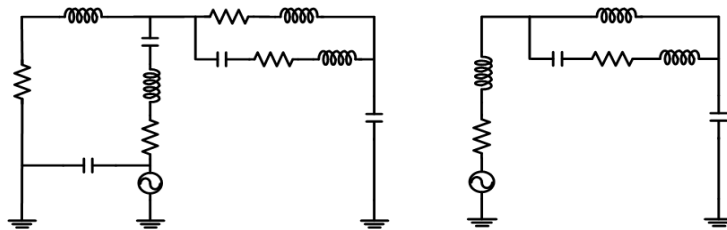


5.3 이득 측정을 위한 회로 구성도



6. 내부 회로 구성도

본 제품은 유전체를 재료로 한 직방형의 소체 표면에 은(Ag) 패턴의 구조적인 변경을 통하여 아래와 같은 구조적인 등가회로의 매칭 값을 조절하여 성능을 구현하는 RF 부품이다.



〈3패드 구조〉

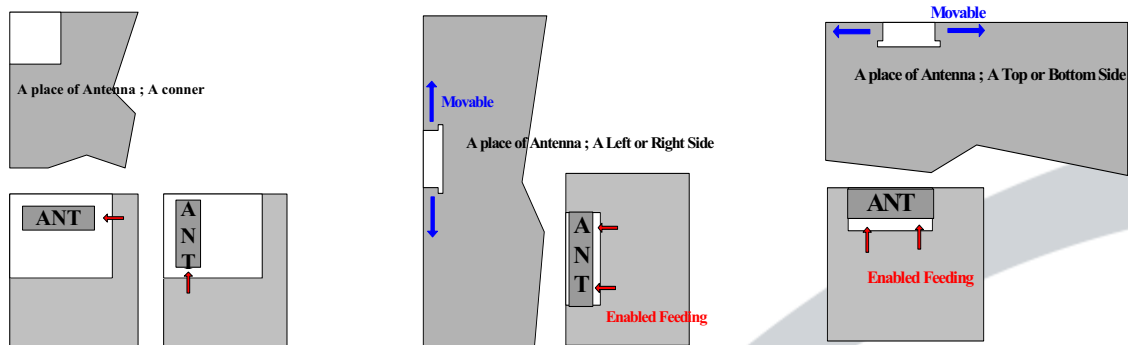
〈2패드 구조〉

7. 기본 동작 및 응용 방식

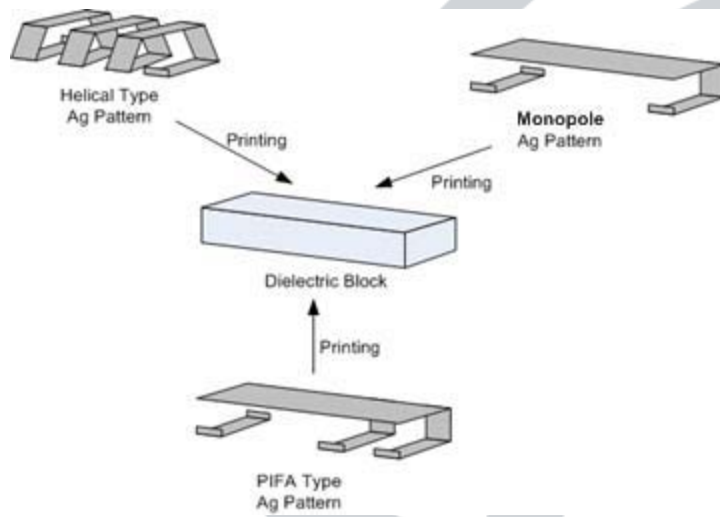
본 제품은 무선 통신 기기 내장형 유전체 칩 안테나로 전송선로를 따라 진행해 온 전기적 신호를 자유공간파(FREE SPACE WAVE)로 변환하는 장치이다.

본 제품은 원하는 어떠한 위치에도 실장이 가능하며 실장 조건에 따라 그 설계를 달리 한다.

다만 본 제품은 방사 부품으로 주변 경계 조건에 따라 그 특성을 달리 하므로 위치 선정에 각별한 주의를 기울여야 한다.

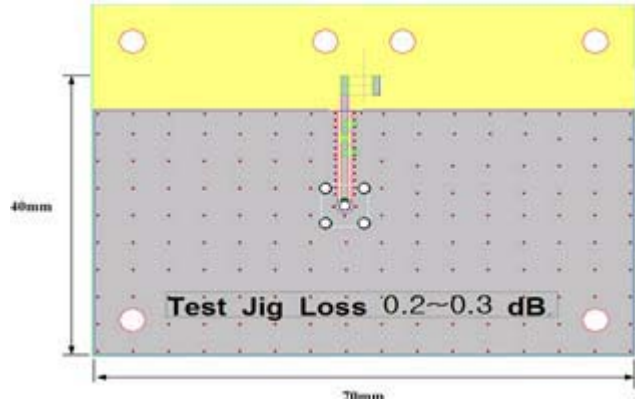


본 제품은 실장 주변 조건에 맞추어 아래와 같이 다양한 안테나 형태로 설계 변경이 용이하다.



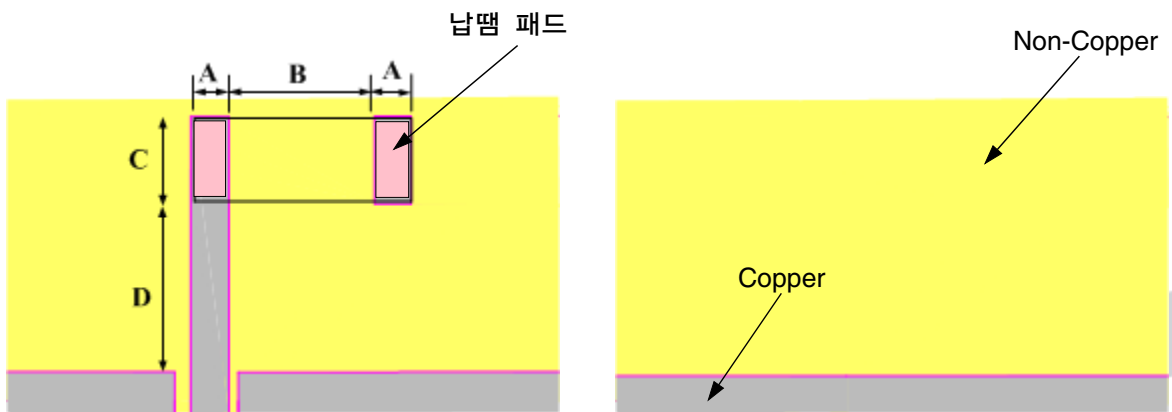
8. 측정 지그 사양

8.1 수동 측정 지그와 그라운드 조건



※ Ev B'd 와 수동 측정 지그는 동일함.(Ev B'd는 접촉 방식이 납땜, 수동 측정 지그는 동편 접촉 방식)

8.2 PCB 구조 및 납땜 패드 치수



Top Layout

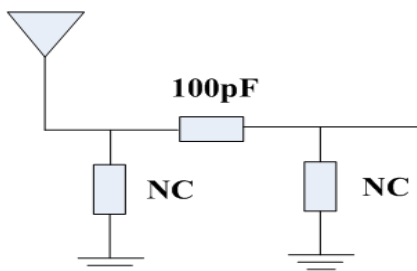
변수	A	B	C	D
값 [mm]	1.2	2.0	2.0	2.4

Bottom Pattern

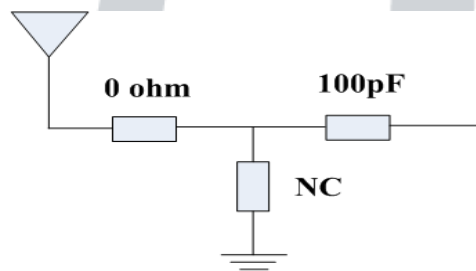
Unit ; mm

Unless specified tolerances are ± 0.05

8.3 매칭 회로와 기본값



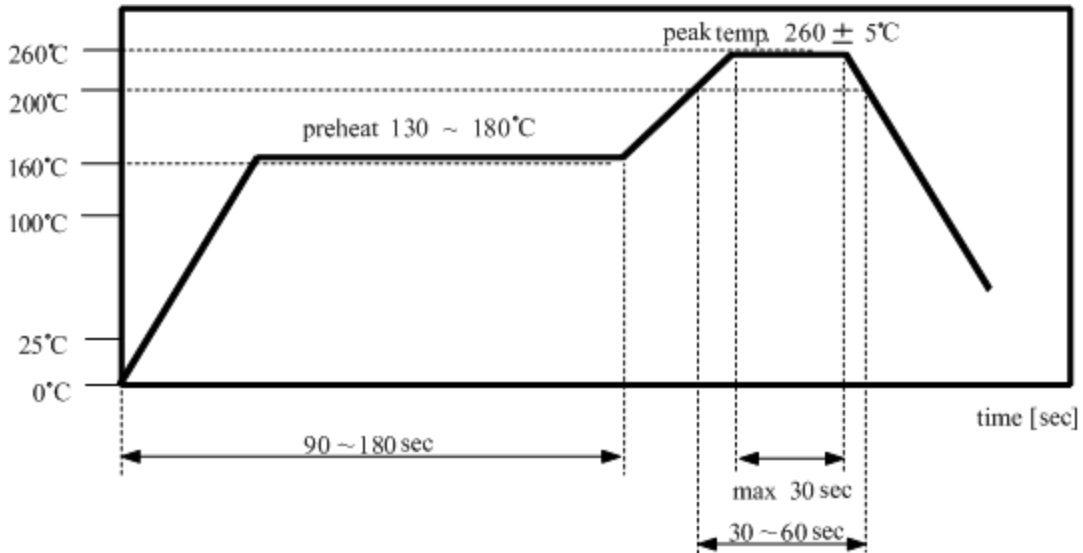
π Matching



T Matching

9. 표준 열경화 조건(REFLOW PROFILE)

9.1 표준 열경화(Reflow) 조건



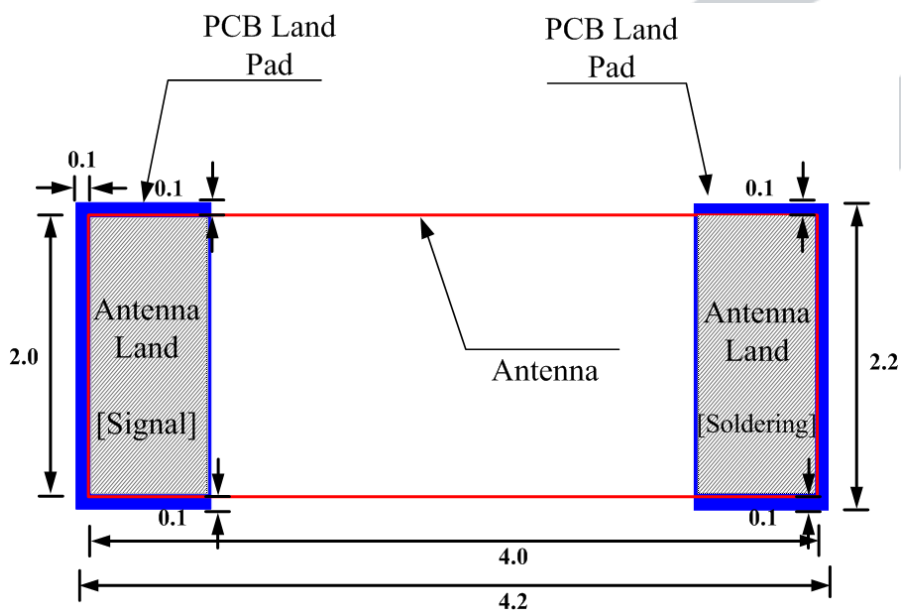
9.2 수동 납땜 (납땜 인두기를 사용할 경우)

예 열 : 120°C / 시간 : 60 ~ 300 sec.
인두온도 : 340°C±5°C / 시간 : 각 단 최대 5 sec.

9.3 PCB 패턴 설계 제안

PCB 패드 패턴은 제시한 안테나의 패드 치수보다 아래 그림에서 보여지는 것과 같이 0.1 mm 이상 외각으로 확장된 형태로 설계된다.

* 8.2 PCB 구조 및 납땜 패드 치수 항목과 동일함.



10. 초기 검사 성적서

검사항목	Frequency [MHz] 		치수 [mm]		
규격	SWR 3.0 Max		W=2.0±0.1	L=4.0±0.1	T=1.2±0.1
	2040 [MHz]	2120 [MHz]			
1	1.15	1.79	2.05	4.01	1.24
2	1.14	1.80	2.04	4.00	1.22
3	1.29	1.55	2.03	3.99	1.25
4	1.17	1.74	2.04	4.02	1.23
5	1.26	1.56	2.05	4.00	1.24
6	1.27	1.57	2.02	4.01	1.23
7	1.20	1.71	2.04	4.01	1.23
8	1.36	1.57	2.03	3.99	1.24
9	1.15	1.74	2.02	4.02	1.23
10	1.20	1.65	2.04	3.99	1.25
11	1.33	1.57	2.03	3.99	1.22
12	1.24	1.64	2.03	4.01	1.23
13	1.25	1.58	2.02	4.02	1.25
14	1.24	1.64	2.04	4.00	1.22
15	1.21	1.65	2.02	4.01	1.24
16	1.18	1.70	2.03	4.00	1.23
17	1.22	1.63	2.05	3.99	1.22
18	1.12	1.79	2.03	3.99	1.24
19	1.22	1.63	2.02	4.00	1.23
20	1.22	1.63	2.04	4.01	1.24
Min	1.12	1.55	2.02	3.99	1.22
Max	1.36	1.80	2.05	4.02	1.25
X	1.22	1.66	2.03	4.00	1.23
σ	0.06	0.08	0.01	0.01	0.01
Cpk	7.26	5.78	2.37	2.95	2.18
판정	OK	OK	OK	OK	OK

11. 신뢰성 보증 조건

11.1 환경 시험

항 목	시 험 조 건	판정기준
PCT	+121±5 °C, RH=100%, 96 hr	시험 후 4.4항의 특성 규격을 만족해야 함
저온동작	-40±3 °C에서 1시간 방치 후 시험온도 상태에서 측정	
저온방치	-40±3 °C, 120±2 hr 방치	
내습동작	+85±3 °C, RH 85%에서 1시간 방치 후 시험온도 상태에서 측정	
내습방치	+85±3 °C, RH 85%, 120±2 hr 방치	

11.2 열충격, REFLOW시험

항 목	조 건	판정기준
열충격	조 건 : -40±3 °C/min ↔ +85±3 °C/min 시험 CYCLE : 32 cycle 온도변환시간 : 5 min 미만일 것	시험 후 4.4 항의 특성 규격을 만족해야 함
Reflow	Pre Heating : 200±5 °C, 30~60 sec Peak Heating : 260±5 °C, 30 sec Max 초기측정 후 1회, 환경시험 후 3회 실시	

11.3 기계적 시험

항 목	조 건	판정기준
진동시험	주파수 : 10~500 Hz, 가속도 : 10×9.8 m/s ² (G) Sweep time : 15 min, X.Y.Z each 5 times	시험 후 4.4 항의 특성 규격을 만족해야 함
낙하시험	- 조건 : 152 cm에서 낙하 지그를 이용하여 18회 자유낙하 (6면 3회) - 지그 : 120 ± 20 g 플라스틱 지그 사용 - 바닥 : 콘크리트 또는 철판	

*진동 및 낙하시험은 Ev B'd 납땜하여 실시할 것.

11.4 MSL LEVEL 시험

1) JEDEC J-STD-020C 조건

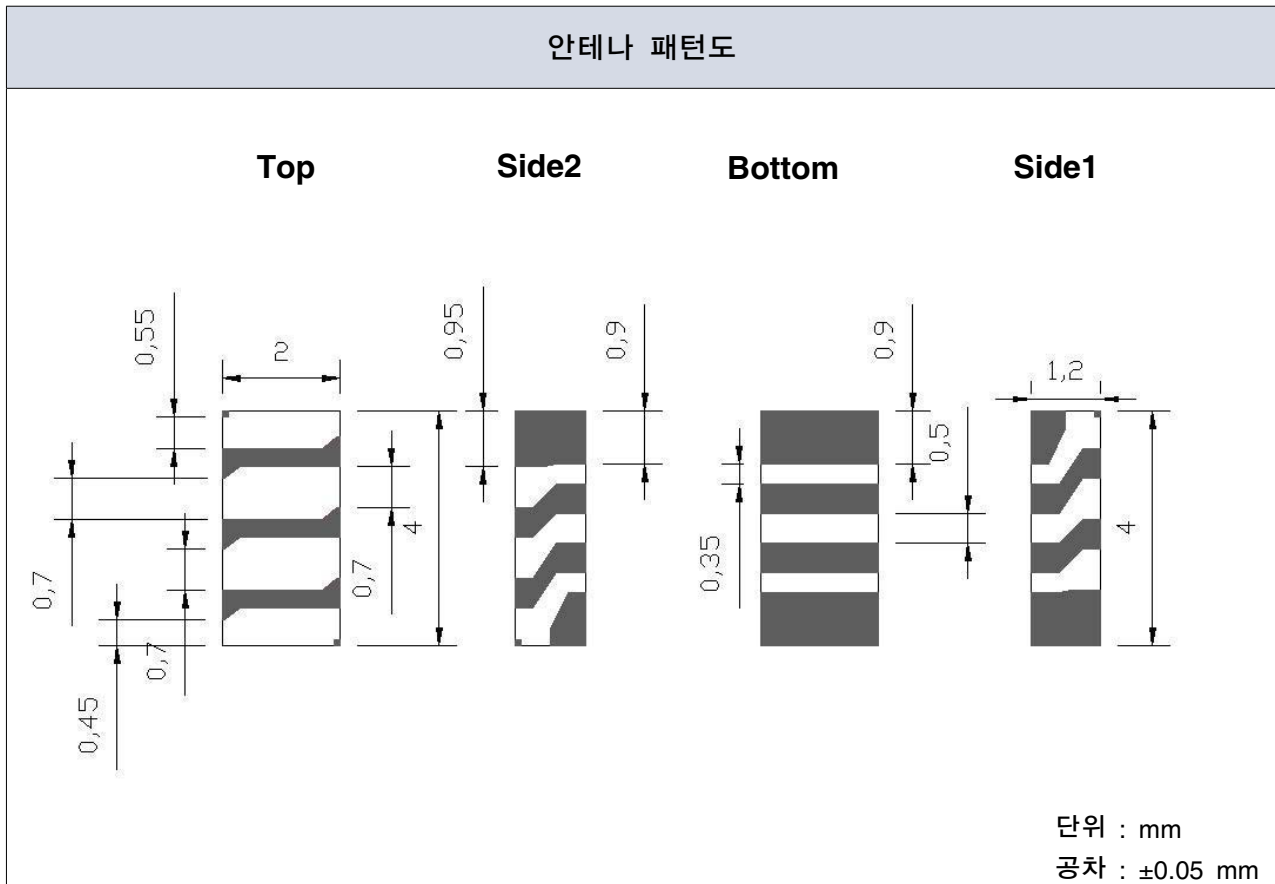
	Floor Life		Soak Requirements	
	Time	Conditions	Time	Conditions
1	Unlimited	= < 30°C / RH 85%	168+5 / -0	= < 85°C / RH 85%

2) Test 조건

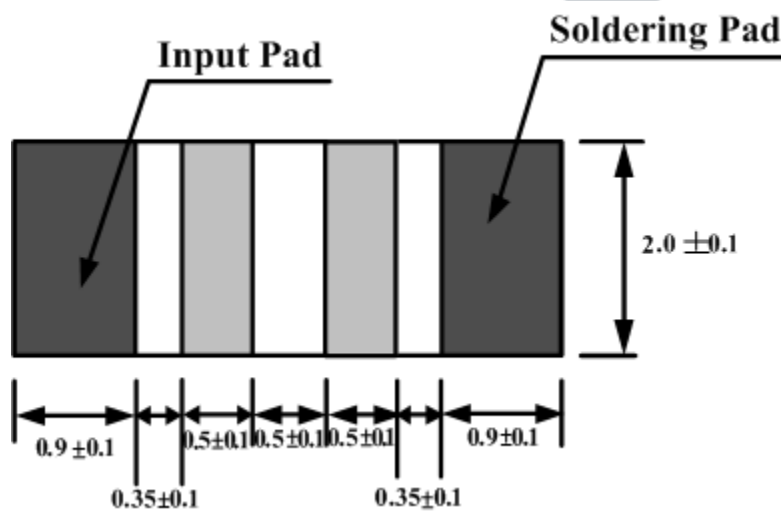
항목	조 건	비고
Soak Requirements	+85±3 °C, RH 85%, 168±2 hr 방치 후 Aging없이 Reflow 3회 실시	시험 후 4.4 항의 특성 규격을 만족해야 함

12. 기구적 특성

12.1 안테나 패턴 도면



12.2 Pin name



12.3 LOT 번호 표기법

W	8	5
①	②	③

- ① 모델 약자
- ② 연도 : 8 - 2008 ····
- ③ 달 : 1월, 2월 ···· 9월, 10월, ····

12.4 마킹 사양



◀	W	8	5
①	②	③	④

- ① 안테나 급전 방향
- ② 모델 약자
- ③ 연도 : 1 - 2001, 2 - 2002, ···· 7 - 2007 ····
- ④ 달 : 1월, 2월 ···· 9월, 10월, ····

12.5 마킹 종류

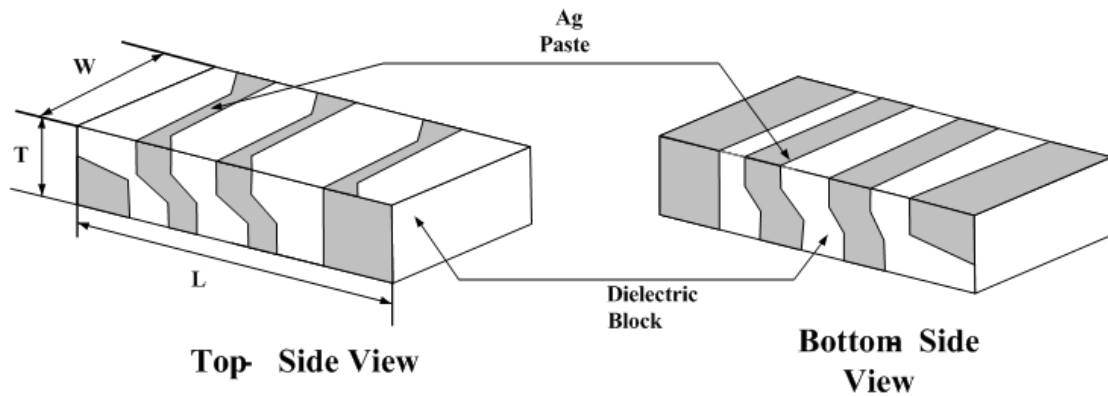
잉크 마킹 - 검정 잉크 사용

13. 구조 및 재질

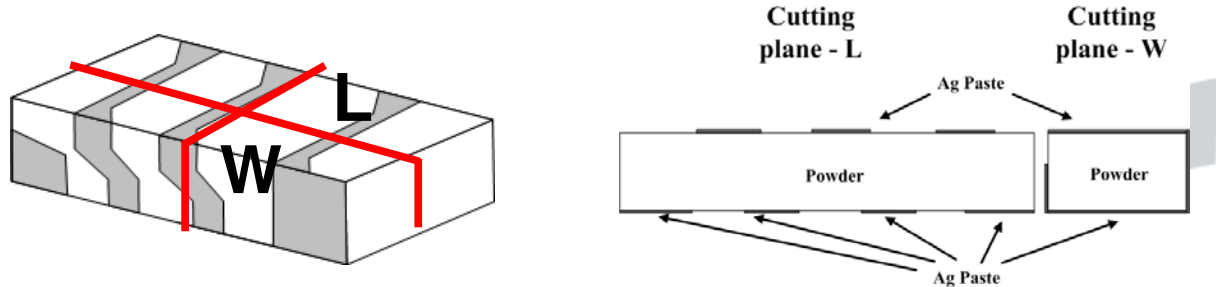
13.1 구현방법

직방체의 형상을 갖는 유전체 소체에 은(Ag) 도금으로 패턴을 형성하여 특성을 구현함.

13.2 구 조



13.3 내부 단면도



13.4 재 질

구 분	재질	제조사	인쇄패턴 사양
직방체	POWDER	삼부	
패턴	은(Ag) 도금	METECH	인쇄두께 : TYP 10 μm
패드	은(Ag) 도금	METECH	인쇄두께 : Min 10 μm (TYP 16~20 μm)

14. 주의 사항

14.1 온도조건

	온도범위	단위
사용온도	-40 ~ +100	℃
보관온도	-40 ~ +70	℃

14.2 시험 온도조건

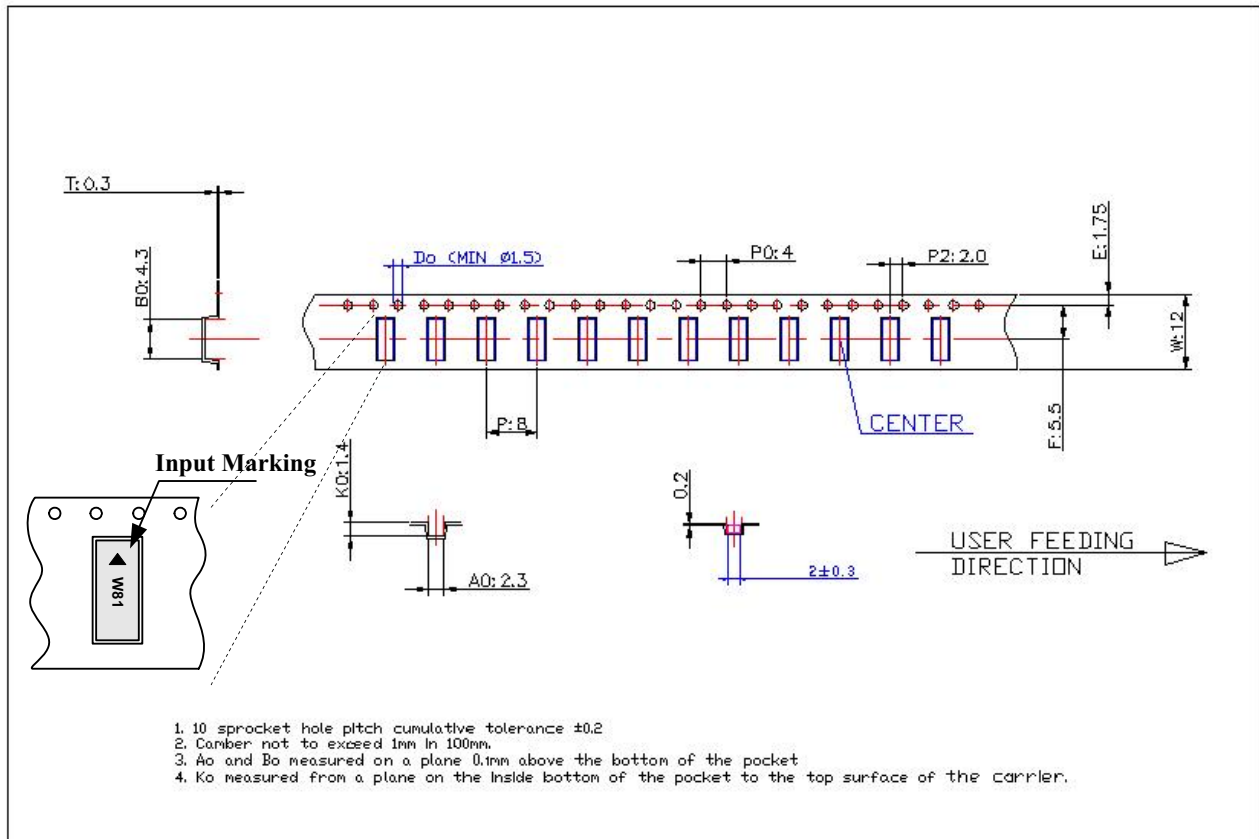
	항목	온도범위
사용온도	저온	-75 ℃에서 24시간 정상동작
	고온	+150 ℃에서 24시간 정상동작
보관온도	저온	-75 ℃에서 1000 hr 방치 시 정상동작
	고온	+85 ℃에서 1000 hr 방치 시 정상동작

* 고온방치 시 포장재 보관온도 문제로 85 ℃ 이상 불가함.

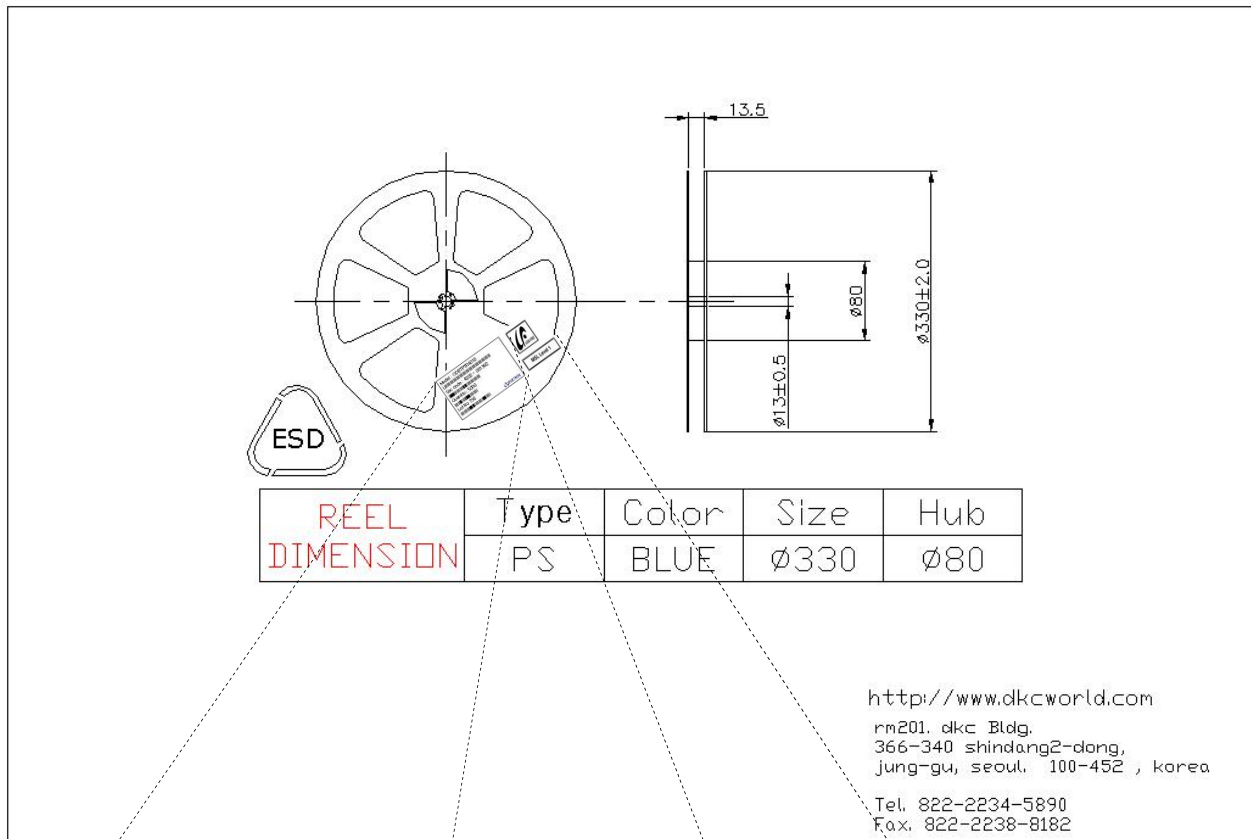
15. 포장 사양

15.1 Carrier/Reel 사양

품목	재질	표면저항	정전기 발생량	포장방식
Carrier	A-PET	Typical $10^8\Omega$	10V MAX	열 압착식
Cover 테이프	PET	Typical $10^8\Omega$	30V MAX	
Reel	PS	Typical $10^8\Omega$	30V MAX	-



DKC DWG. No.	D-1208-057	NAME	SPEC.
DIMENSIONAL UNIT	MM	W	12.0 $\pm$ 0.2
UNTOLERANCED DIMENSION	± 0.1	E	1.75 $\pm$ 0.1
CAD FILE NAME	051011	F	5.5 $\pm$ 0.1
DESIGNED BY	K. M. C	Do	1.5 $\pm$ 0.1
SCALE	1/1	P	8.0 $\pm$ 0.1
TITLE	CARRIER TAPE 2.0*4.0*1.2P	P0	4.0 $\pm$ 0.1
PART.	CARRIER TAPE	P2	2.0 $\pm$ 0.1
MATERIAL	A-PET	A0	2.3 $\pm$ 0.1
LENGTH	50.3M	B0	4.3 $\pm$ 0.1
COUNT	6290P	K0	1.4 $\pm$ 0.1
		T	0.3 $\pm$ 0.05



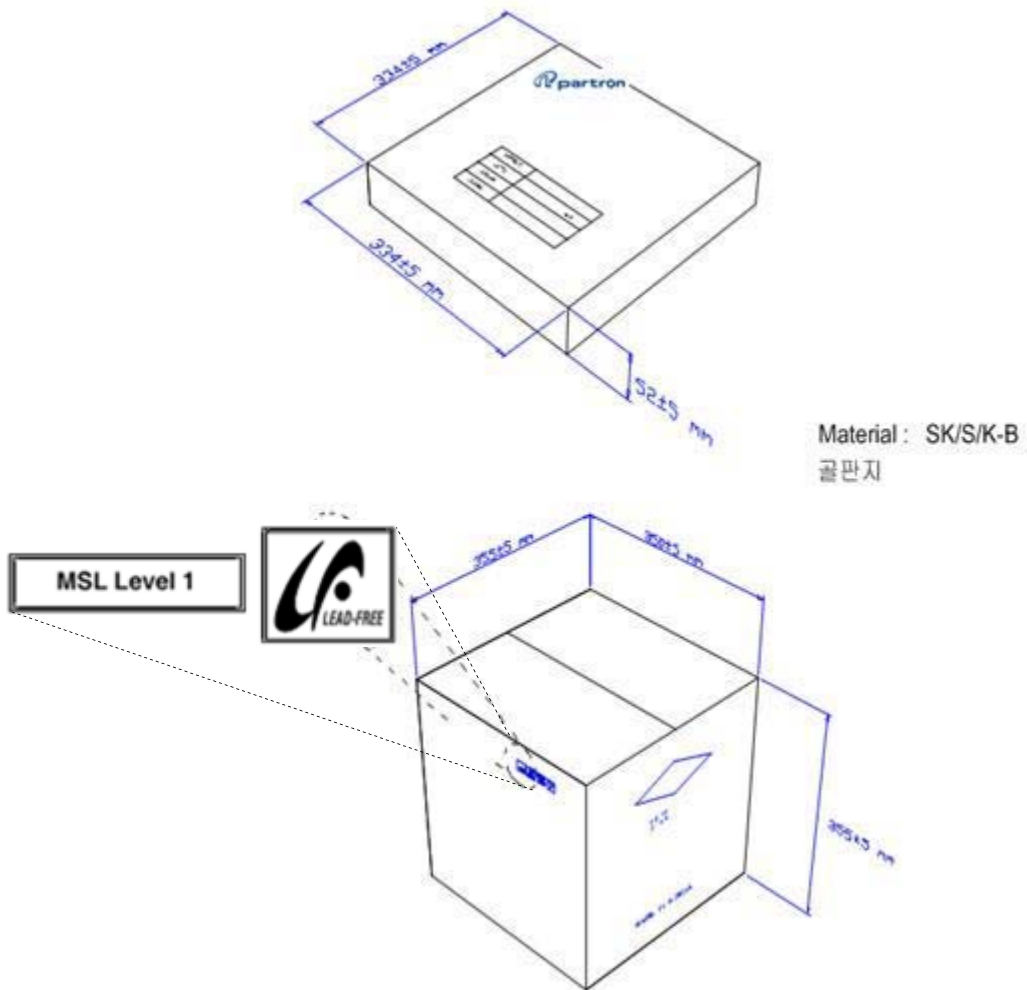
CODE NO : 
 R2
 Model : 
 5000
 Quantity : 
 Lot No : 811

 **PARTRON**



MSL Level 1

15.2 박스 사양



15.3 포장 실물 사진



Reel 사진



내상 박스 사진



외상 박스 사진



Reel / 내상 박스 라벨



외상 박스 라벨

16. 관리 공정도

제품			발행 / 개정		품질관리공정도					관리번호	기안	심의	결정	
CHIP ANTENNA			Issued	04.04.06						PRCP-C001				
			Revised	05.04.03										
투입자재	FLOW CHART		공정명	요인관리				품질특성관리						
	준비	본공정		관리항목	조건	관리주기	기록관리	관리항목	관리한계	검사방법	관리주기	기록관리	조치사항	
세라믹 파우더		◇	수입검사						수축율 유전율	작업지도서 참조	Micrometer Network	10개/LOT	C/sheet	반품
파우더 윤활제	○		분말	Mixer					혼합	파우더:윤활제	저울	혼합시	-	폐기
		○	성형 CTQ공정 (무게,치수)	프레스	양압 금형상태	작업지도서 참조	매LOT 1회/일	parameter C/SHEET	치수 무게 밀도 외관	작업지도서 참조	Micrometer 저울 Calculated Visual	5'00개검사 10개/LOT	LOT CARD	폐기
		○	소성	소성로	SETTER 외관 온도 PROFILE	작업지도서 참조	전수 2회/일 1회/월	C/sheet						
		◇	소체 CTQ공정 (치수)						폭 길이 모양	검사지도서 참조	Micrometer Calipers 목시	20개/LOT 20개/LOT 전수	C/sheet	폐기
AG PASTE		○	SIDE1 PAD 인쇄 CTQ공정 (인쇄치수)	인쇄기 screen	스퀴즈 속도 /압력 SNAP	작업지도서 참조	1회/일	-	PATTERN 치수 외관	작업지도서 참조	측정기 현미경	10개/3Jig	c/sheet	제작업
		○	건조	건조기 건조Jig	온도 Belt speed	작업지도서 참조	1회/주	Parameter	건조상태 인쇄상태 파손	작업지도서 참조	목시	전수검사	Lot card	제작업

제품			발행 / 개정		품질관리공정도				관리번호	기안	심의	결정		
CHIP ANTENNA		Issued	Revised	04.04.06.					05.04.03	PRCP-C001				
투입자재	FLOW CHART		공정명	요인관리				품질특성관리						
	준비	본공정		설비명	관리항목	조건	관리주기	기록관리	관리항목	관리한계	검사방법	관리주기	기록관리	조치 사항
AG PASTE		○	SIDE 2 PAD 인쇄 CTQ공정 (인쇄치수)	인쇄기 screen	스퀴즈 속도 /압력 SNAP	작업지도서 참조	1회/일	-	PATTERN치수 외관	작업지도서 참조	측정기 현미경	10개 /3Jig	c/sheet	제작업
		○	건조	건조기 건조Jig	온도 Belt speed	작업지도서 참조	1회/주	Parameter	건조상태 인쇄상태 파손	작업지도서 참조	목시	전수검사	Lot card	제작업
		○	소부	소부로 mesh망	온도 Belt speed	작업지도서 참조	1회/주	Parameter C/Sheet	소체파손 오염	작업지도서 참조	목시	전수	Lot card	폐기 제작업
AG PASTE		○	TOP 인쇄 CTQ공정 (인쇄치수)	인쇄기 screen	스퀴즈 속도 /압력 SNAP	작업지도서 참조	1회/일	-	PATTERN치수	작업지도서 참조	측정기	10개 /3Jig	c/sheet	제작업
		○	건조	건조기 건조Jig	온도 Belt speed	작업지도서 참조	1회/주	Parameter	건조상태 인쇄상태 파손	작업지도서 참조	목시	전수검사	Lot card	제작업
AG PASTE		○	BOTTOM PAD 인쇄 CTQ공정 (인쇄치수)	인쇄기 screen	스퀴즈 속도 /압력 SNAP	작업지도서 참조	1회/일	-	PATTERN치수 외관	작업지도서 참조	측정기 현미경	10개 /3Jig	c/sheet	제작업

제품			발행 / 개정		품질관리공정도					관리번호		기안	심의	결정
CHIP ANTENNA			Issued	04.04.06.						PRCP-C001				
			Revised	05.04.03										
투입자재	FLOW CHART		공정명	설비명	관리항목	조건	관리주기	기록관리	검사항목	관리한계	검사방법	관리주기	기록관리	조치 사항
	준비	본공정												
	○		건조	건조기 건조Jig	온도 Belt speed	작업지도서 참조	1회/주	Parameter	건조상태 인쇄상태 파손	작업지도서 참조	목시	전수검사	Lot card	제작업
	○		소부	소부롤 mesh망	온도 Belt speed	작업지도서 참조	1회/주	Parameter C/Sheet	소체파손 오염	작업지도서 참조	목시	전수	Lot card	폐기 제작업
	◇		외관검사						제품외관	한도건본 작업지도서 참조	목시 현미경	전수	Lot card 생산일보	폐기 수리
	○		MARKING	마킹기					마킹외관	한도건본	목시	전수	Lot card 생산일보	제작업 폐기
	◇		특성검사 CTF공정	NETWORK 검사지그	교정상태	작업지도서 참조	1회/반	C/sheet	전기적 특성	작업지도서 참조	Network	전수	Lot card 생산일보	폐기 수리
	◇		외관검사						제품외관 제품치수	한도건본 작업지도서 참조	목시 현미경	전수	Lot card 생산일보	폐기 수리
Carrier cover reel	○		Taping						수량 역상 외관	작업지도서 참조	수작업	전수	Lot card 생산일보	제작업
	◇		출하검사	NETWORK 검사지그	교정상태	작업지도서 참조	1회/반	C/sheet	전기적특성 제품외관 포장상태	검사지도서	Network 현미경 목시	작업 지도서	성적서	return 폐기
포장 box label	○		포장	bar code printer					포장상태 기종혼입 포장수량	포장작업 지도서	목시	전수	-	제작업
	◇		포장검사						포장상태 기종혼입 포장수량	포장작업 지도서	목시	전수	-	return

17. 유해물질 성적서

1) Ceramic Powder

Test Report No. F695051/LF-CTSAYAU08-0809

Issued Date: June 17, 2008

Page 1 of 3

To: **SAM BOO CERAMICS CO.,LTD.**

717-4
Daechon-dong
Dalseo-gu
DAESU
Korea

The following merchandise was submitted and identified by the client as :

Product name : Ceramic Powder

SGS File No. : AYAUS-08080

Received Date : June 10, 2008

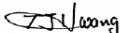
Test Performing Date : June 11, 2008

Test Performed : SGS Testing Korea tested the sample(s) selected by applicant with following results

Test Results : For further details, please refer to following page(s)

SGS Testing Korea Co. Ltd. / Ulsan Laboratory

Sharpless Park
Annie Lim
Helen Yeo /Testing Person


Thomas Hwang / Ulsan Lab. Mgr

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F695 Version1



Test Report No. F890511/LF-CTSAYAU08-08090

Issued Date: June 17, 2008

Page 2 of 3

Sample No. : AYAU08-0808.001
Sample Description : Ceramic Powder
Item No./Part No. : SMW-20
Comments : Material is Ceramic.

Heavy Metals

Test Item	Unit	Test Method	MDL	Results
Cadmium (Cd)	mg/Kg	US EPA 3052, ICP-AES	1	N.D.
Lead (Pb)	mg/Kg	US EPA 3052, ICP-AES	5	N.D.
Mercury (Hg)	mg/Kg	US EPA 3052, ICP-AES	2	N.D.
Hexavalent Chromium (Cr VI)	mg/Kg	US EPA 3050A, UV-vis	1	N.D.

Halogen Content

Test Item	Unit	Test Method	MDL	Results
Bromine(Br)	mg/Kg	EN 14582:2007, IC	30	N.D.
Chlorine(Cl)	mg/Kg	EN 14582:2007, IC	30	N.D.

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

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F050 Version1

Test Report No. F690501/LF-CTSAYA08-08080

Issued Date: June 17, 2008

Page 3 of 3

Picture of Sample as Received:

Sample Color : White

*** End ***

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

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F690 Version 1

2) Ag Paste

SGS

Test Report No. F895061LF-CTSAYL07-24812 Issued Date: November 14, 2007 Page 1 of 4

To: **METECH KOREA CO., LTD.**
B-01 Dongyang Paragon office17-2 Jeongja-dong
Bundang-gu
Sungnam-city
GYEONGGI-DO
Korea

The following merchandise was submitted and identified by the client as:

Product Name : Silver paste (PCC11837HV)
SGS File No. : AYL07-24812
Received Date : November 07, 2007
Test Performing Date : November 08, 2007
Test Performed : SGS Testing Korea tested the sample(s) selected by applicant with following results
Test Results : For further details, please refer to following page(s)

Pluto Kim
Monet Jeong
Billy Oh / Testing Person

SGS Testing Korea Co. Ltd.
Jeff Jang
Jeff Jang / Chemical Lab Mgr

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FSIQ View02

SGS

Test Report No. F895061LF-CTSAYL07-24812 Issued Date: November 14, 2007 Page 2 of 4

Sample No. : AYL07-24812.001
Sample Description : Silver paste (PCC11837HV)
Item No./Part No. : N/A

Heavy Metals

Test Item	Unit	Test Method	MDL	Results
SS (SnO ₂)	mg/kg	US EPA 3050B (1996), US EPA 6010B (1996), ICP	10	N.D.
Arsenic (As)	mg/kg	US EPA 3050A (1996), US EPA 6010B (1996), ICP	10	N.D.

Phthalates

Test Item	Unit	Test Method	MDL	Results
Diethylhexyl Phthalate (DEHP)	mg/kg	US EPA 8061A, GC/MS	50	3760
Di-iso-decyl Phthalate (DIDP)	mg/kg	US EPA 8061A, GC/MS	50	N.D.
Dimethyl Phthalate (DMP)	mg/kg	US EPA 8061A, GC/MS	50	N.D.
Di-n-octyl Phthalate (DnOP)	mg/kg	US EPA 8061A, GC/MS	50	N.D.
Diethyl Phthalate (DEP)	mg/kg	US EPA 8061A, GC/MS	50	N.D.
Butyl Benzyl Phthalate (BBP)	mg/kg	US EPA 8061A, GC/MS	50	N.D.
Diethyl Phthalate (DEP)	mg/kg	US EPA 8061A, GC/MS	50	N.D.
Di-isomyl Phthalate (DiMP)	mg/kg	US EPA 8061A, GC/MS	50	N.D.

Halogen Contents

Test Item	Unit	Test Method	MDL	Results
Bromine(Br)	mg/kg	EN 14582:2007, IC	30	N.D.
Chlorine(Cl)	mg/kg	EN 14582:2007, IC	30	N.D.
Fluorine(F)	mg/kg	EN 14582:2007, IC	30	N.D.

Organotin Compounds

Test Item	Unit	Test Method	MDL	Results
Tributyltin (TBT)	mg/kg	DIN 38407-13, GC/MS	0.03	N.D.
Triphenyltin (TPHT)	mg/kg	DIN 38407-13, GC/MS	0.1	N.D.

Asb Dyas

Test Item	Unit	Test Method	MDL	Results
4-Aminodiphenyl	mg/kg	EN 14362-1, GC/MS	5	N.D.
Benidine	mg/kg	EN 14362-1, GC/MS	5	N.D.

NOTE: (1) N.D. = Not detected (<MDL)
(2) mg/kg = ppm
(3) MDL = Method Detection Limit
(4) = No regulation
(5) ** = Qualitative analysis (No Unit)
(6) Negative = Undetectable / Positive = Detectable
(7) SnO₂: calculated from Sb by the equation = (121.760 X 2 + 15.9994 X 3) X Sb = 1.197 X Sb

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FSIQ View02

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Sample No. : AYL07-24812.001
Sample Description : Silver paste (PCC11837HV)
Item No./Part No. : N/A

Asb Dyas

Test Item	Unit	Test Method	MDL	Results
4-Chloro-2-Toluidine	mg/kg	EN 14362-1, GC/MS	5	N.D.
2-Naphthylamine	mg/kg	EN 14362-1, GC/MS	5	N.D.
o-Aminodiphenylmethane	mg/kg	EN 14362-1, GC/MS	5	N.D.
2-Amino-4-Nitrotoluene	mg/kg	EN 14362-1, GC/MS	5	N.D.
p-Chloroaniline	mg/kg	EN 14362-1, GC/MS	5	N.D.
2,4-Diaminobenzidine	mg/kg	EN 14362-1, GC/MS	5	N.D.
4,4'-diaminodiphenylmethane	mg/kg	EN 14362-1, GC/MS	5	N.D.
3,3'-Dichlorobenzidine	mg/kg	EN 14362-1, GC/MS	5	N.D.
3,3'-Dimethoxybenzidine	mg/kg	EN 14362-1, GC/MS	5	N.D.
3,3'-Dimethyl-4,4'-diaminodiphenylmethane	mg/kg	EN 14362-1, GC/MS	5	N.D.
p-Chloridine	mg/kg	EN 14362-1, GC/MS	5	N.D.
4,4'-Methylen-bis-(2-chloroaniline)	mg/kg	EN 14362-1, GC/MS	5	N.D.
4,4'-Cyanidine	mg/kg	EN 14362-1, GC/MS	5	N.D.
4,4'-Thiodidine	mg/kg	EN 14362-1, GC/MS	5	N.D.
o-Toluidine	mg/kg	EN 14362-1, GC/MS	5	N.D.
2,4-Toluidinediamine	mg/kg	EN 14362-1, GC/MS	5	N.D.
2,4,5-Trimethylaniline	mg/kg	EN 14362-1, GC/MS	5	N.D.
p-Toluenesulfonamide	mg/kg	EN 14362-1, GC/MS	5	N.D.
o-Aminidine	mg/kg	EN 14362-1, GC/MS	5	N.D.
2,4-Xyldine	mg/kg	EN 14362-1, GC/MS	5	N.D.
2,6-Xyldine	mg/kg	EN 14362-1, GC/MS	5	N.D.

Others

Test Item	Unit	Test Method	MDL	Results
Biaphenol A	mg/kg	In-House, HPLC/DAD	10	N.D.

NOTE: (1) N.D. = Not detected (<MDL)
(2) mg/kg = ppm
(3) MDL = Method Detection Limit
(4) = No regulation
(5) ** = Qualitative analysis (No Unit)
(6) Negative = Undetectable / Positive = Detectable
(7) SnO₂: calculated from Sb by the equation = (121.760 X 2 + 15.9994 X 3) X Sb = 1.197 X Sb

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SGS

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Picture of Sample as Received:
Sample Color : Gray



*** End ***

NOTE: (1) N.D. = Not detected (<MDL)
(2) mg/kg = ppm
(3) MDL = Method Detection Limit
(4) = No regulation
(5) ** = Qualitative analysis (No Unit)
(6) Negative = Undetectable / Positive = Detectable
(7) SnO₂: calculated from Sb by the equation = (121.760 X 2 + 15.9994 X 3) X Sb = 1.197 X Sb

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FSIQ View02

3) Marking Ink

SGS

Test Report No. F89591/LF-CTSA/L07-24811 Issued Date: November 13, 2007 Page 1 of 4

To: **IMAJE KOREA CO., LTD**
#1302 7th Daejeon Techno Town 480-11
Gaeun-dong
Geumcheon-gu
SEOUL
Korea

The following merchandise was submitted and identified by the client as:

Product Name : 5135E Black Ink
SGS File No. : AYL07-24811
Received Date : November 06, 2007
Test Performing Date : November 07, 2007
Test Performed : SGS Testing Korea tested the sample(s) selected by applicant with following results
Test Results : For further details, please refer to following page(s)

Pluto Kim
Moung Jeong
Billy Oh / Testing Person

SGS Testing Korea Co. Ltd.
Jeff Jay
Jeff Jay / Chemical Lab Mgr

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Test Report No. F89591/LF-CTSA/L07-24811 Issued Date: November 13, 2007 Page 2 of 4

Sample No. : AYL07-24811.001
Sample Description : 5135E Black Ink
Item No./Part No. : 5135E

Heavy Metals

Test Item	Unit	Test Method	MDL	Results
Sb (Sn2O3)	mg/kg	US EPA 8205B(1996), US EPA 6010B(1996), ICP	10	N.D.
Arsenic (As)	mg/kg	US EPA 8205B(1996), US EPA 6010B(1996), ICP	10	N.D.

Phthalates

Test Item	Unit	Test Method	MDL	Results
Diethylhexyl Phthalate (DEHP)	mg/kg	US EPA 8061A, GC/MS	50	N.D.
Di-iso-decyl Phthalate (DIDP)	mg/kg	US EPA 8061A, GC/MS	50	N.D.
Di-methyl Phthalate (DMP)	mg/kg	US EPA 8061A, GC/MS	50	N.D.
Di-n-octyl Phthalate (DNOP)	mg/kg	US EPA 8061A, GC/MS	50	N.D.
Diethyl Phthalate (DEP)	mg/kg	US EPA 8061A, GC/MS	50	N.D.
Butyl Benzyl Phthalate (BBP)	mg/kg	US EPA 8061A, GC/MS	50	N.D.
Di-ethyl Phthalate (DEP)	mg/kg	US EPA 8061A, GC/MS	50	N.D.
Dibutyl Phthalate (DBP)	mg/kg	US EPA 8061A, GC/MS	50	N.D.

Halogen Contents

Test Item	Unit	Test Method	MDL	Results
Bromine(Br)	mg/kg	EN 14582:2007, IC	30	N.D.
Chlorine(Cl)	mg/kg	EN 14582:2007, IC	30	73
Fluorine(F)	mg/kg	EN 14582:2007, IC	30	N.D.

Organotin Compounds

Test Item	Unit	Test Method	MDL	Results
Triphenyltin (TBT)	mg/kg	DIN 38407-13, GC/MS	0.03	N.D.
Triphenyltin (TPT)	mg/kg	DIN 38407-13, GC/MS	0.1	N.D.

Azo Dyes

Test Item	Unit	Test Method	MDL	Results
4-Aminodiphenyl	mg/kg	EN14362-1, GC/MS	5	N.D.
Benzidine	mg/kg	EN14362-1, GC/MS	5	N.D.

NOTE: (1) N.D. = Not detected (<MDL)
(2) mg/kg = ppm
(3) MDL = Method Detection Limit
(4) = No regulation
(5) ** = Qualitative analysis (No Unit)
(6) Negative = Undetectable / Positive = Detectable
(7) Sb2O3: calculated from Sb by the equation = (121.760 X 2 + 15.9994 X 3) X Sb = 1.197 X Sb

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Test Report No. F89591/LF-CTSA/L07-24811 Issued Date: November 13, 2007 Page 3 of 4

Sample No. : AYL07-24811.001
Sample Description : 5135E Black Ink
Item No./Part No. : 5135E

Azo Dyes

Test Item	Unit	Test Method	MDL	Results
4-Chloro-o-Toluidine	mg/kg	EN14362-1, GC/MS	5	N.D.
2-Naphthylamine	mg/kg	EN14362-1, GC/MS	5	N.D.
o-Aminodiphenylamine	mg/kg	EN14362-1, GC/MS	5	N.D.
2-Amino-4-nitrobenzene	mg/kg	EN14362-1, GC/MS	5	N.D.
p-Chloroaniline	mg/kg	EN14362-1, GC/MS	5	N.D.
2,4-Diaminobenzidine	mg/kg	EN14362-1, GC/MS	5	N.D.
4,4'-diaminodiphenylmethane	mg/kg	EN14362-1, GC/MS	5	N.D.
3,3'-Dichlorobenzidine	mg/kg	EN14362-1, GC/MS	5	N.D.
3,3'-Dimethoxybenzidine	mg/kg	EN14362-1, GC/MS	5	N.D.
3,3'-Dimethylbenzidine	mg/kg	EN14362-1, GC/MS	5	N.D.
3,3'-Dimethyl-4,4'-diaminodiphenylmethane	mg/kg	EN14362-1, GC/MS	5	N.D.
p-Chresidine	mg/kg	EN14362-1, GC/MS	5	N.D.
4,4'-Methylenedioxy-2-chloroaniline	mg/kg	EN14362-1, GC/MS	5	N.D.
4,4'-Oxydianiline	mg/kg	EN14362-1, GC/MS	5	N.D.
4,4'-Thiodianiline	mg/kg	EN14362-1, GC/MS	5	N.D.
o-Toluidine	mg/kg	EN14362-1, GC/MS	5	N.D.
2,4-Toluenediamine	mg/kg	EN14362-1, GC/MS	5	N.D.
2,4,5-Triethylaniline	mg/kg	EN14362-1, GC/MS	5	N.D.
p-Phenylenediamine	mg/kg	EN14362-1, GC/MS	5	N.D.
o-Anisidine	mg/kg	EN14362-1, GC/MS	5	N.D.
2,4-Xylylene	mg/kg	EN14362-1, GC/MS	5	N.D.
2,6-Xylylene	mg/kg	EN14362-1, GC/MS	5	N.D.

Chemicals

Test Item	Unit	Test Method	MDL	Results
Bisphenol A	mg/kg	IN-HOUSE, HPLC/CAD	10	N.D.

NOTE: (1) N.D. = Not detected (<MDL)
(2) mg/kg = ppm
(3) MDL = Method Detection Limit
(4) = No regulation
(5) ** = Qualitative analysis (No Unit)
(6) Negative = Undetectable / Positive = Detectable
(7) Sb2O3: calculated from Sb by the equation = (121.760 X 2 + 15.9994 X 3) X Sb = 1.197 X Sb

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Test Report No. F89591/LF-CTSA/L07-24811 Issued Date: November 13, 2007 Page 4 of 4

Picture of Sample as Received:
Sample Color : Black



NOTE: (1) N.D. = Not detected (<MDL)
(2) mg/kg = ppm
(3) MDL = Method Detection Limit
(4) = No regulation
(5) ** = Qualitative analysis (No Unit)
(6) Negative = Undetectable / Positive = Detectable
(7) Sb2O3: calculated from Sb by the equation = (121.760 X 2 + 15.9994 X 3) X Sb = 1.197 X Sb

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