

자재시방서(승인원)	기안자	최민규 연구원/ND연구팀 (032-650-6259)
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주관부서	사원
	정성엽
	
	11-05 09:33

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자 재 코 드	E606000170010S
자 재 명	ANTENNA,MODULE
규 격	ACS2450HFL57 DIELECTRIC CHIP ANT

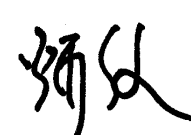
모 델 명	VUDU SPARK		
설계변경 NO	REV NO.	일자	내 용
중점 Check 사항			
환경문서번호			
검 사 방 식	수입검사 규칙(B0-B701-01)에 준하여 검사할 것.		
구 입 방 법	☒ 내수 ☐ LOCAL ☐ 수입		
협력업체명	PARTRON	제조업체명	PARTRON
첨 부 자 료	☒ 협력업체승인원 ☐ 도면 ☐ 검사성적서 ☐ 유해물질 불사용 확인서 ☐ 부품재질별 성적서		
첨부파일경로	ftp://61.73.120.6/approval/E606-00017-001-0S.pdf		

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IMS-B101-07/01(1)

개발 단가		부품 타입	SMD	LIB	
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Approval Sheet

Products	Dielectric Chip Antenna		
Customer	Inkel		
Model			
Customer CODE			
Supplier	PARTRON		
Supplier CODE	ACS2450HFL57		
Inkel	By designed	By checked	By approved
PARTRON	By designed	By checked	By approved
	김 홍 기		
	Antenna 2 Team	Quality Assurance	Laboratory
	Hongki.Kim	Nam-Sik. Min	Byoung-Jun.Yim
	10/24	10/24	10/24

2014 . 10. 24

RoHS

H/F

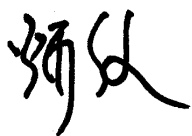


MSL Level 1

SPECIFICATION

MODEL : ACS2450HFL57

DIELECTRIC CHIP ANTENNA

By designed	By checked	By approved
김 흥 기		
Antenna 2 Team	Quality Assurance	Laboratory
Hongki.Kim	Nam-Sik. Min	Byoung-Jun.Yim
10/24	10/24	10/24

2014 . 10. 24



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2. Electrical Characteristics

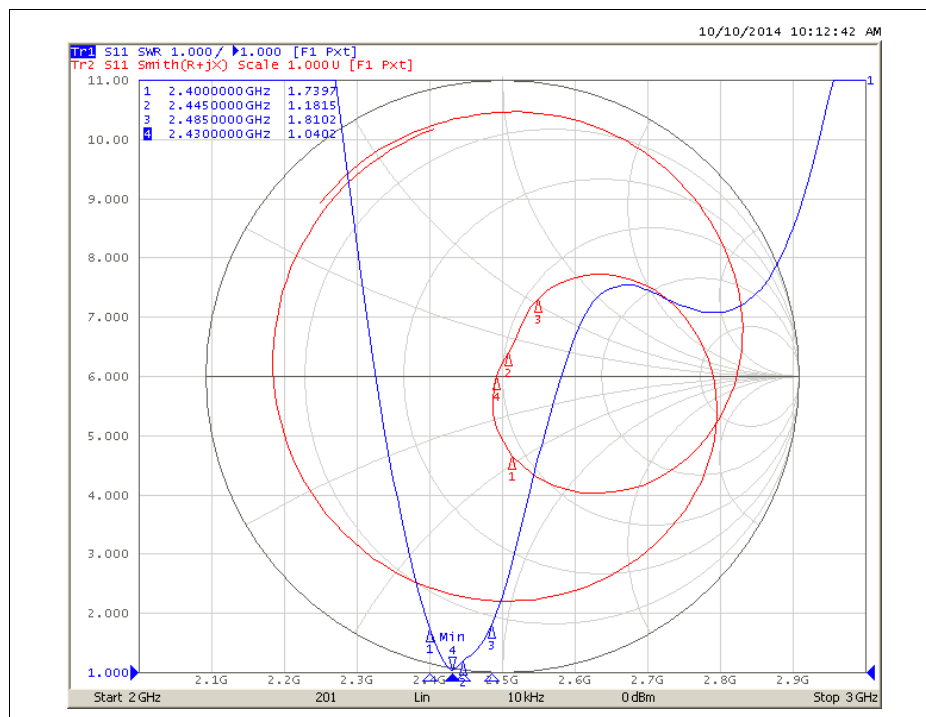
2.1 Set Condition

ITEM			SPEC
Frequency Range [MHz]			2400 ~ 2485
VSWR [Max]			3 : 1
Bandwidth [MHz]			85
Polarization			Linear
Matching Value of ANT Matching Circuit (Direction, from Antenna to Module)	Antenna Matching Circuit	Series1 (Feed)	1.8nH
	T-Matching Circuit (nearby Module)	Series2	100pF
		Series3	100pF
Gain[dBi]	Azimuth Plane	Peak	-1.43
		Average	-4.20
	Elevation1 Plane	Peak	1.93
		Average	-2.81
	Elevation2 Plane	Peak	1.98
		Average	-3.78
	3D	Peak	3.66
		Average	-2.89

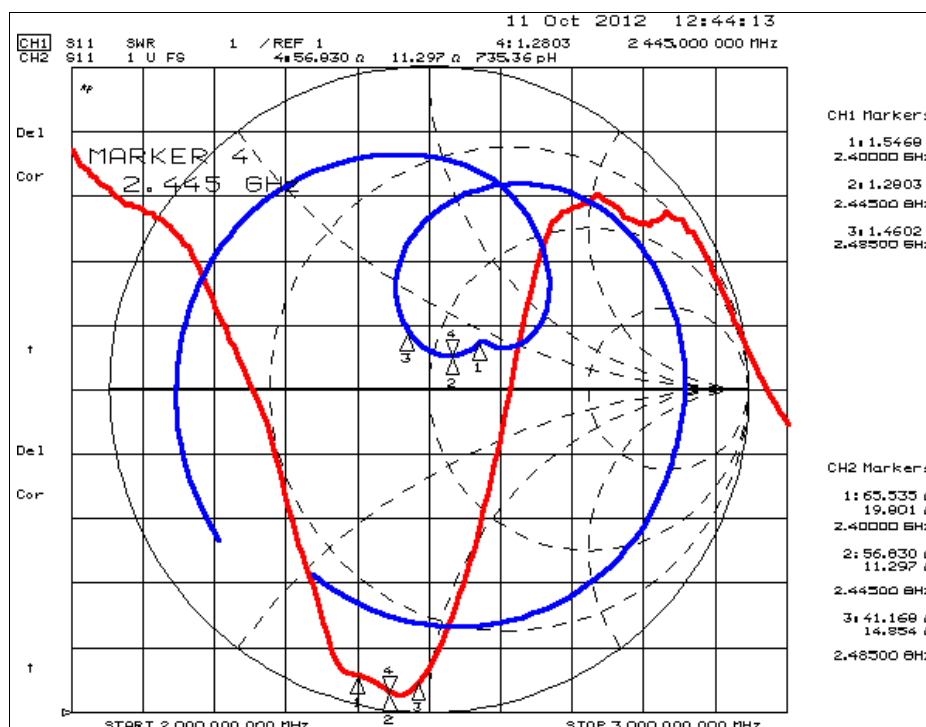
2.2 Test Fixture Condition

ITEM	SPEC
Frequency Range [MHz]	1840 ~ 1920
SWR [Max]	4.0 : 1
Bandwidth [MHz]	80

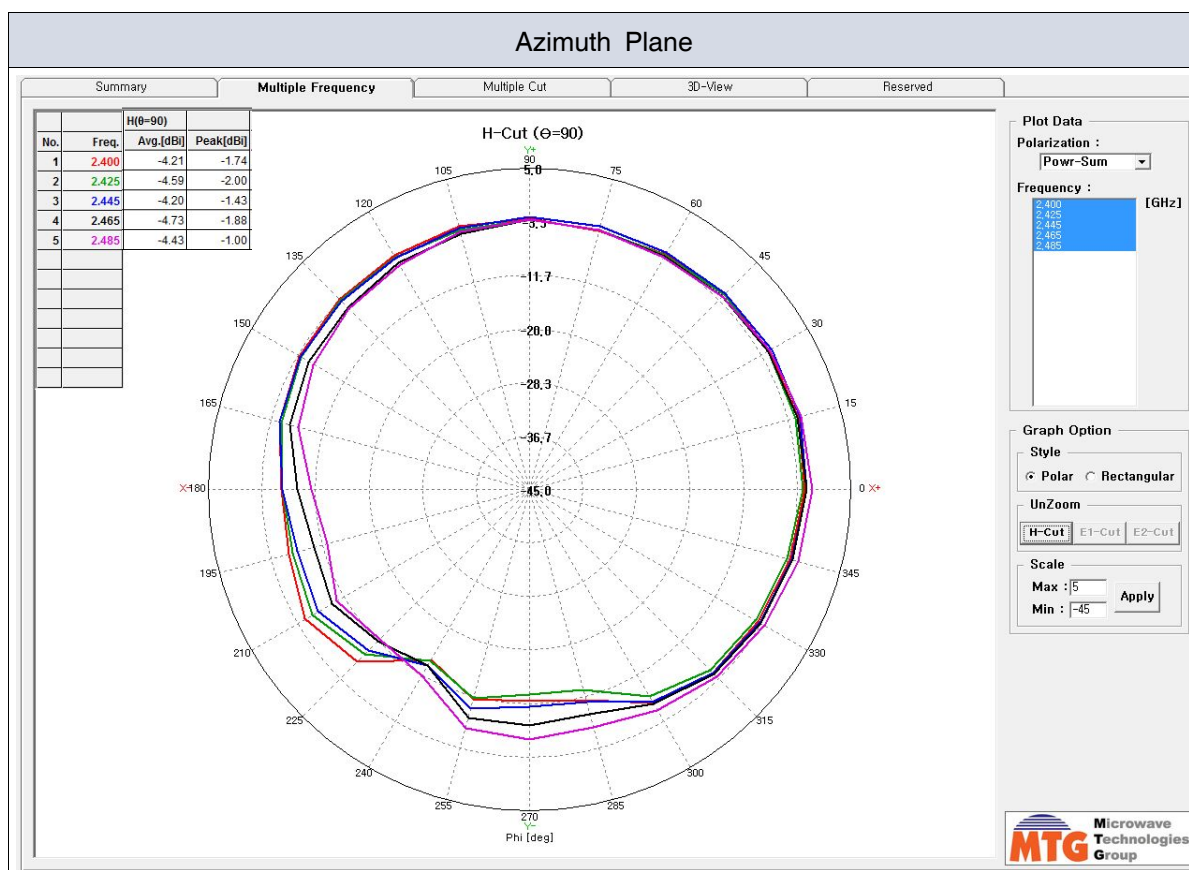
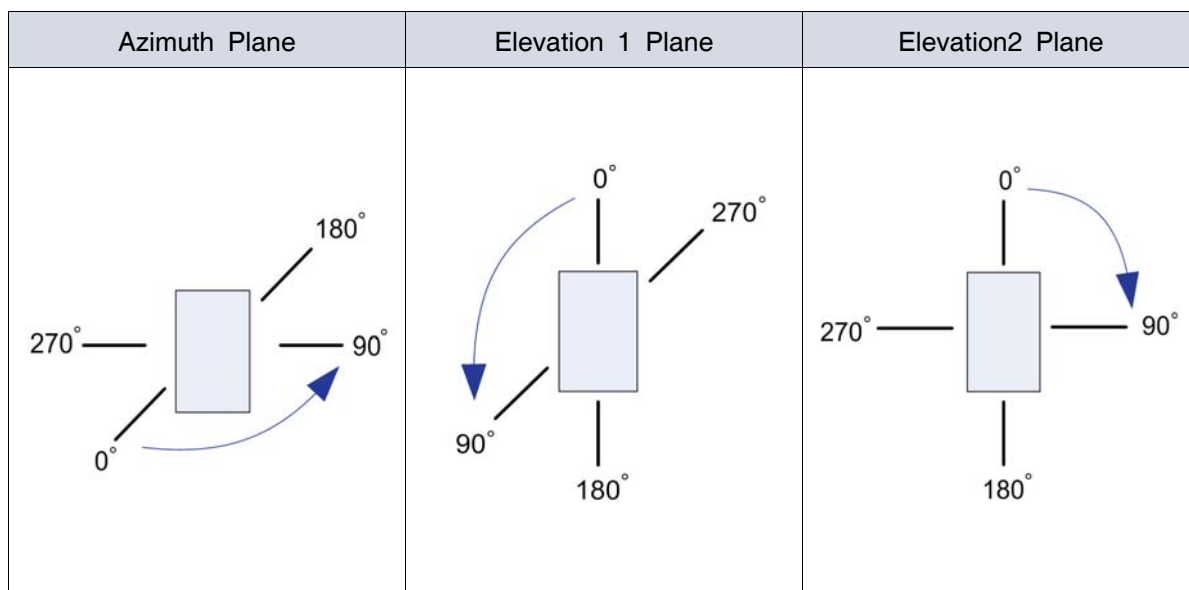
2.3 Graph of Set Condition

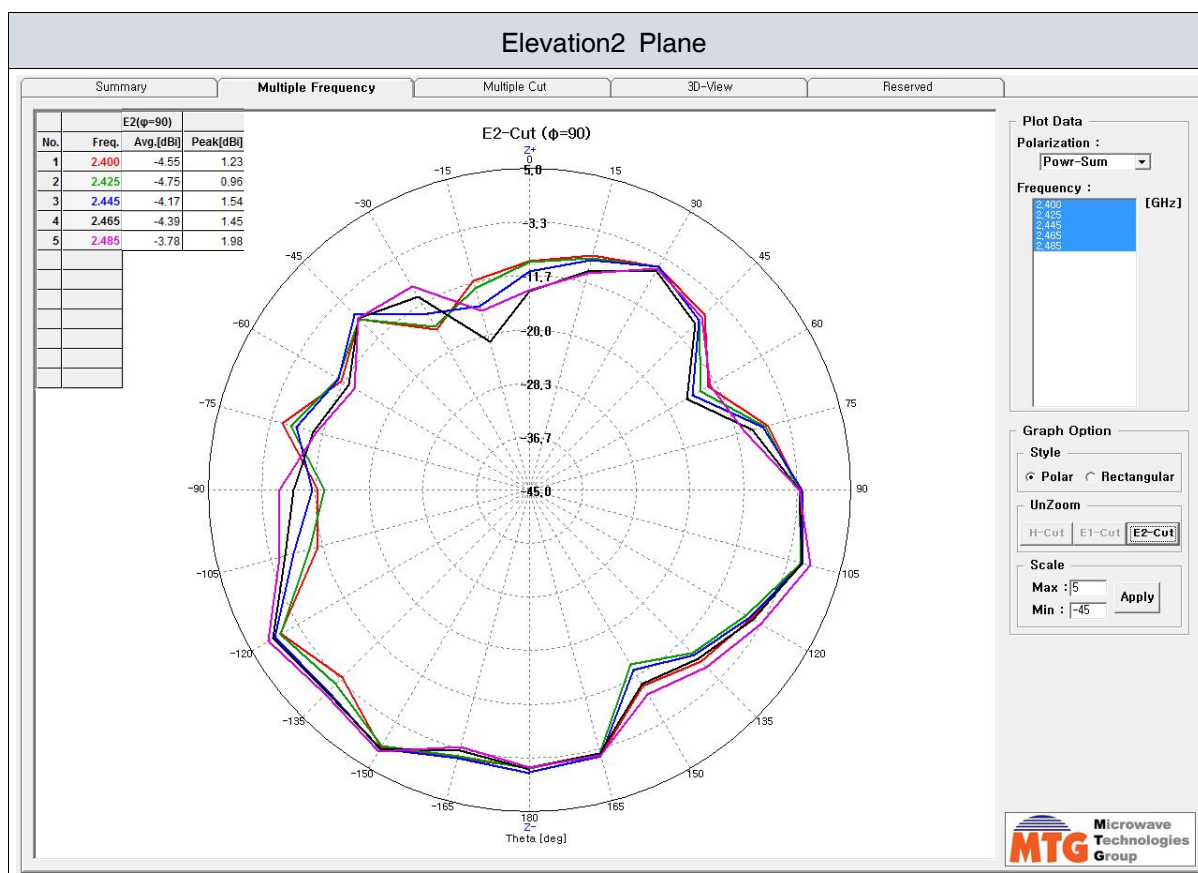
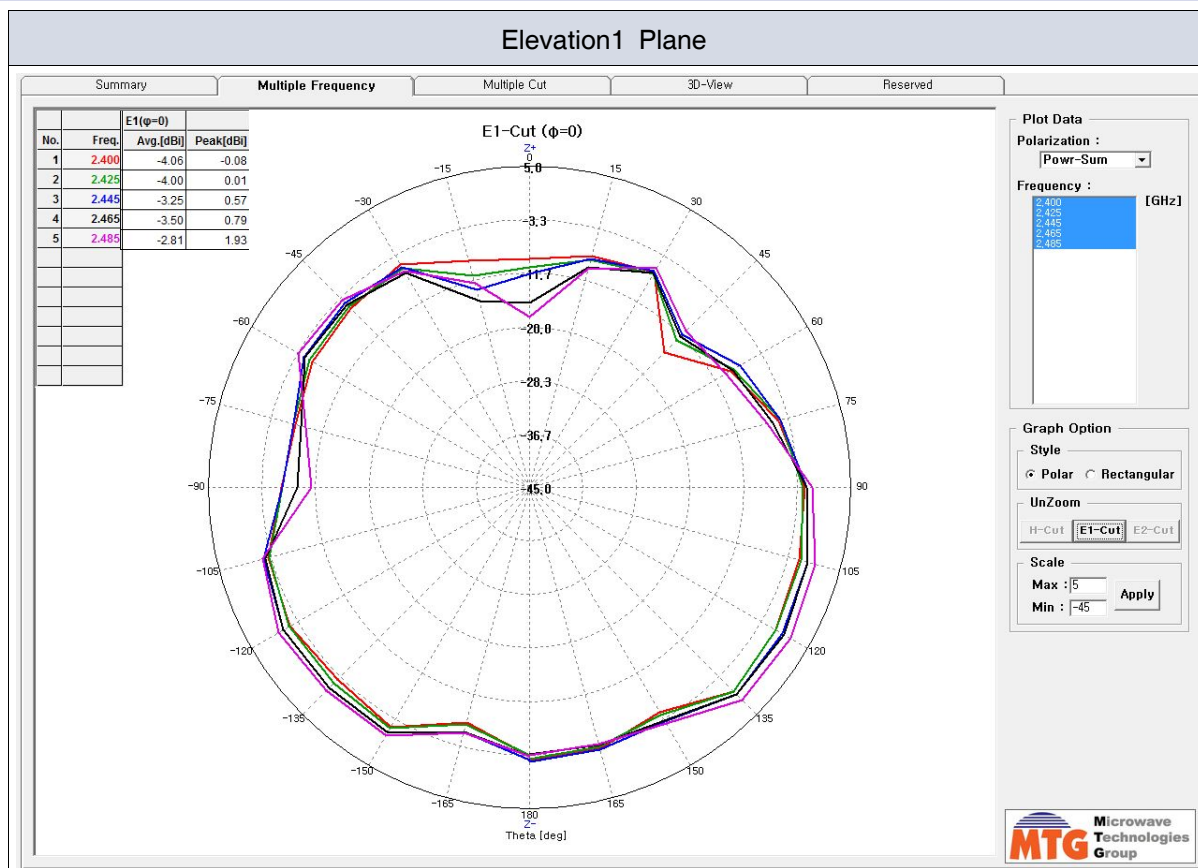


2.4 Graph of Test Fixture Condition

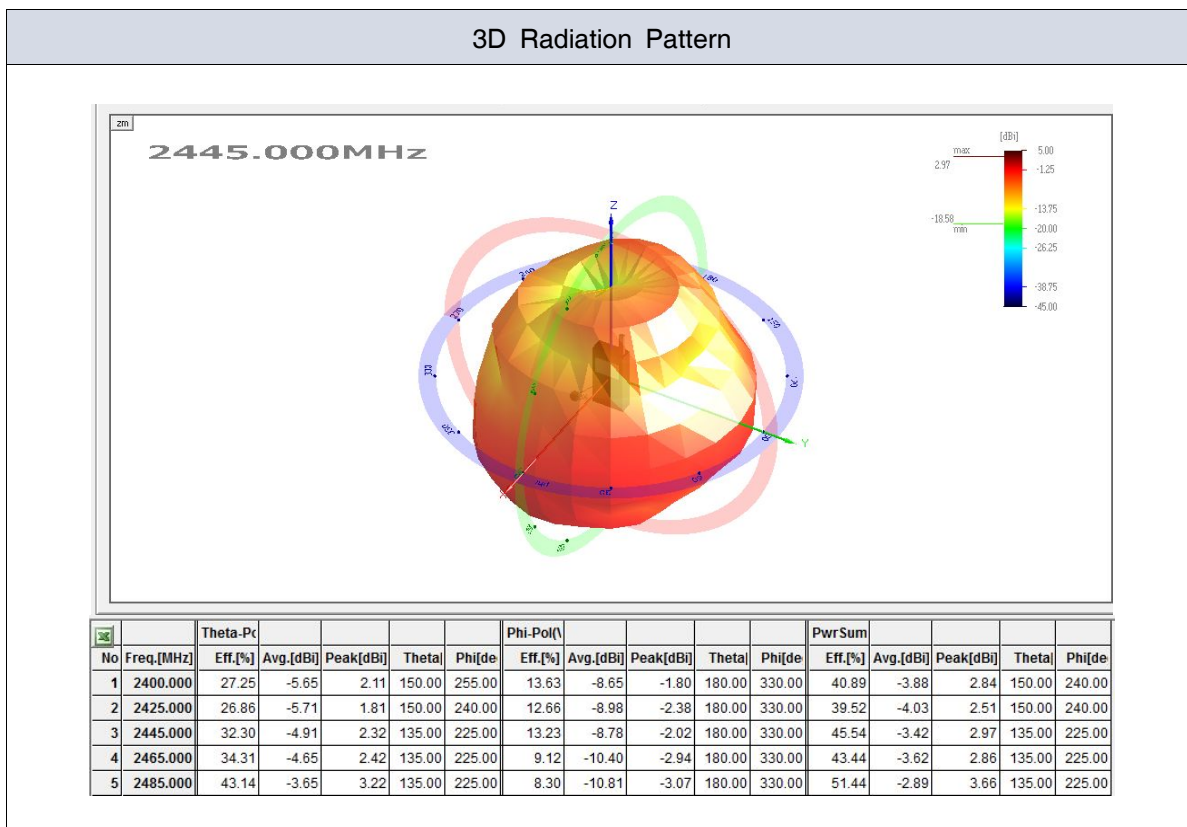


2.5 Radiation Pattern





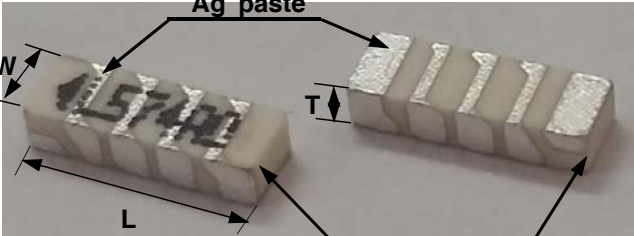
2.6 3D Radiation Pattern



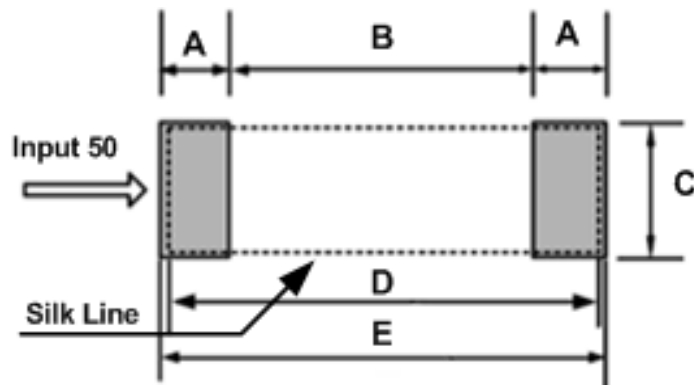
3. Mechanical Characteristics

- The structure is materialized printing Ag paste at the dielectric block

3.1 Structure and Material

Material	Dielectric Block	3D Structure	
	Ag Paste		
Size [mm]	W = 2.0±0.1		
	L = 6.0±0.1		
	T = 1.2±0.1		
Temperature [°C]	- 40 ~ +80		
Humidity [%]	At the normal temperature, RH 100		

3.2 PCB Layout & Soldering Pad Dimension



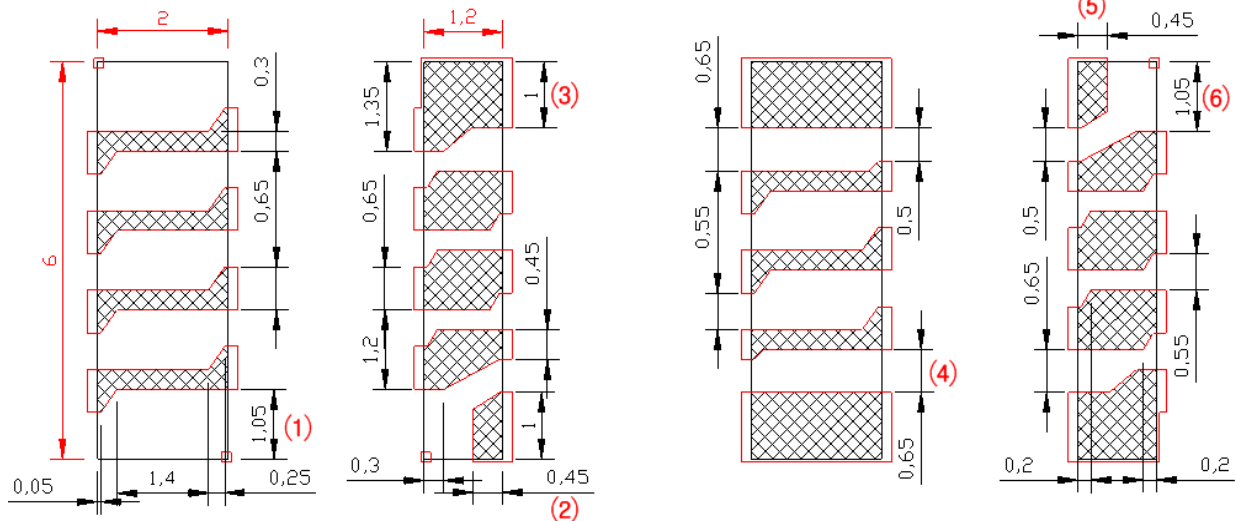
Parameter	A	B	C	D	E
Value[mm]	1.2	4.0	2.4	6.0	6.4

Unit ; mm

Unless specified tolerances are ± 0.1

3.3 Antenna Pattern Dimension

Antenna Pattern View



Top

Side1

Bottom

Side2

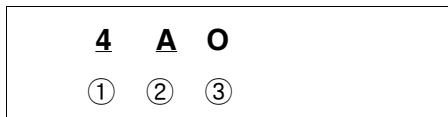
Unit ; mm

Unless specified tolerances are ± 0.1

3.3.1 Real Measurement Value

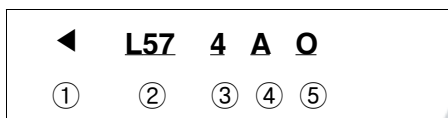
	(1)	(2)	(3)	(4)	(5)	(6)
Drawing Dimension [mm]	1.05±0.1	0.45±0.1	1.0±0.1	0.65±0.1	0.45±0.1	1.05±0.1
1	1.136	0.440	1.033	0.640	0.513	1.099
2	0.962	0.460	0.953	0.634	0.509	1.036
3	1.036	0.507	1.026	0.645	0.470	1.108
4	1.122	0.490	1.022	0.640	0.474	1.080
5	0.982	0.461	0.970	0.669	0.503	1.073
Min [mm]	0.962	0.440	0.953	0.634	0.470	1.036
Max [mm]	1.136	0.507	1.033	0.669	0.513	1.108
Average [mm]	1.048	0.472	1.001	0.646	0.494	1.079

3.4 LOT Notation



- ① Year ; 3 - 2013, 4 - 2014, 9 - 2019, 0 - 2020
- ② Month ; 1 - January, 2 - February, A - October, B - November
- ③ Date ; 1 - 1st, 2 - 2nd, 3 - 3rd O - 24th, P - 25th

3.5 Marking

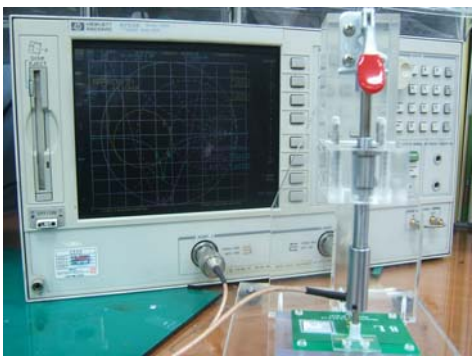


- ① Input Signal
- ② Serial
- ③ Year ; 3 - 2013, 4 - 2014, 9 - 2019, 0 - 2020
- ④ Month ; 1 - January, 2 - February, A - October, B - November
- ⑤ Date ; 1 - 1st, 2 - 2nd, 3 - 3rd O - 24th, P - 25th

4. Measurement Process

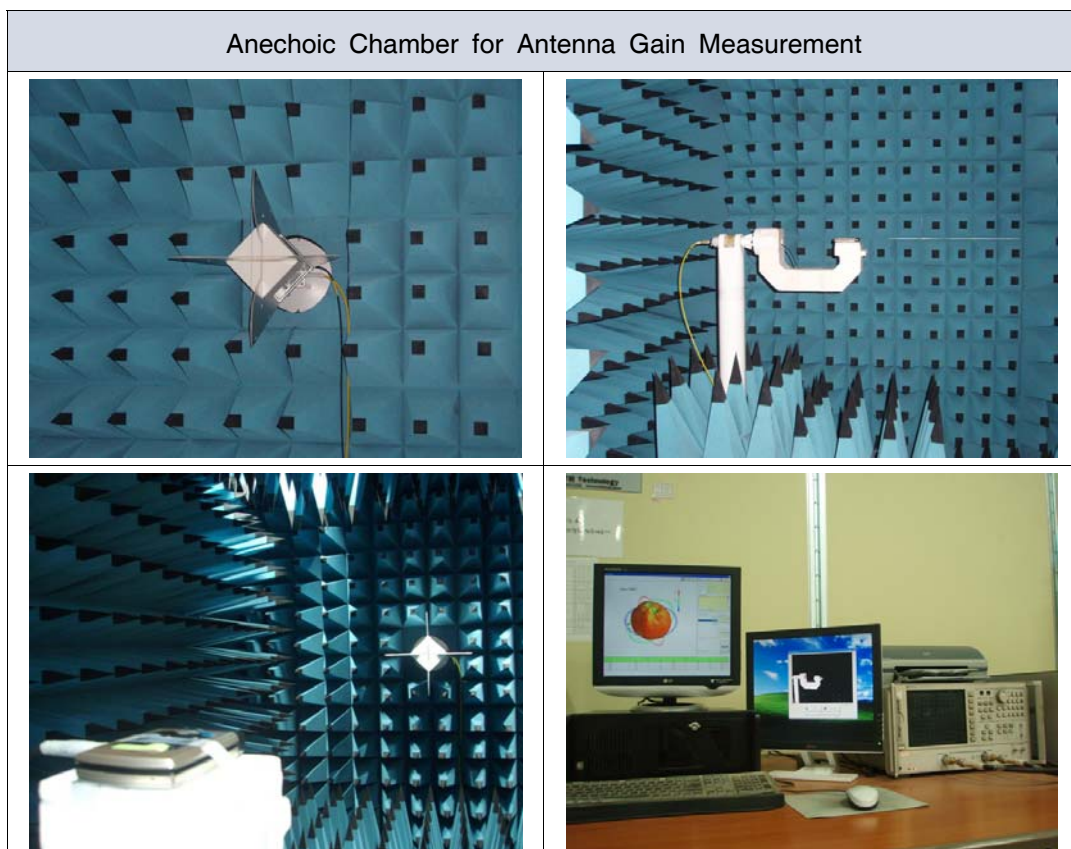
4.1 SWR/Returnloss

-The SWR/Returnloss is measured by Network Analyzer

	Set Condition	Test Fixture Condition
Network Analyzer	Agilent HP8753D or Advantest R3765CG	Agilent HP8753D or Advantest R3765CH
Cable	RF cable(300mm)	RF cable(300mm)
Test condition		

4.2 Gain

-The Antenna Gain is measured using the set at Anechoic Chamber



5. Primary Inspection List

Item	Electrical Characteristic [MHz]		Mechanical Dimension [mm]		
	VSWR 4.0 : 1 [Max]		W=2.0±0.1	L=6.0±0.1	T=1.2±0.1 
	1840 MHz	1920 MHz			
1	2.21	1.99	2.03	6.02	1.23
2	2.06	2.13	2.04	6.01	1.24
3	1.96	2.11	2.04	6.00	1.24
4	2.09	2.06	2.05	6.01	1.24
5	1.98	2.23	2.04	6.00	1.24
6	2.10	1.97	2.04	6.01	1.25
7	1.95	2.27	2.04	6.01	1.24
8	1.88	2.38	2.03	6.00	1.23
9	2.04	2.14	2.04	6.01	1.24
10	2.08	2.04	2.03	6.01	1.24
11	1.81	2.38	2.04	6.02	1.24
12	2.03	1.99	2.05	6.01	1.25
13	2.32	1.84	2.04	6.03	1.24
14	1.94	2.16	2.05	6.00	1.25
15	1.83	2.44	2.04	5.99	1.24
16	2.28	1.83	2.06	6.02	1.24
17	2.33	1.79	2.04	6.00	1.25
18	2.17	1.89	2.04	6.01	1.25
19	1.66	2.22	2.03	6.01	1.24
20	1.68	2.33	2.04	6.00	1.23
X	2.02	2.11	2.04	6.01	1.24
σ	0.19	0.19	0.01	0.01	0.01
Cpk	3.42	3.20	2.58	3.23	4.67
Decision	OK	OK	OK	OK	OK

6. Reliability Condition

6.1 ENVIRONMENT TEST

ITEM	TEST CONDITION	LIMIT
High Temperature Resistance	+85℃±3℃, 120hr	*After the test, specimen would be kept at 25℃±5℃ for 1 hours
Low Temperature Resistance	-40℃±3℃, 120hr	
Humidity Resistance	+60±3℃, RH90~95%, 120hr	*specimen sheet meet the electrical specification

6.2 Thermal Shock Test, Reflow Test

ITEM	TEST CONDITION	LIMIT
Thermal Shock	-40℃±3℃/30min ↔ +85℃±3℃/30min cycle : 15 cycle recovery time : with in 5min	SAME as 6-1
Reflow	Pre Heating 200±5℃, 30~60 sec Peak Heating 260℃±5℃, 30sec Max	

6.3 Mechanical Test

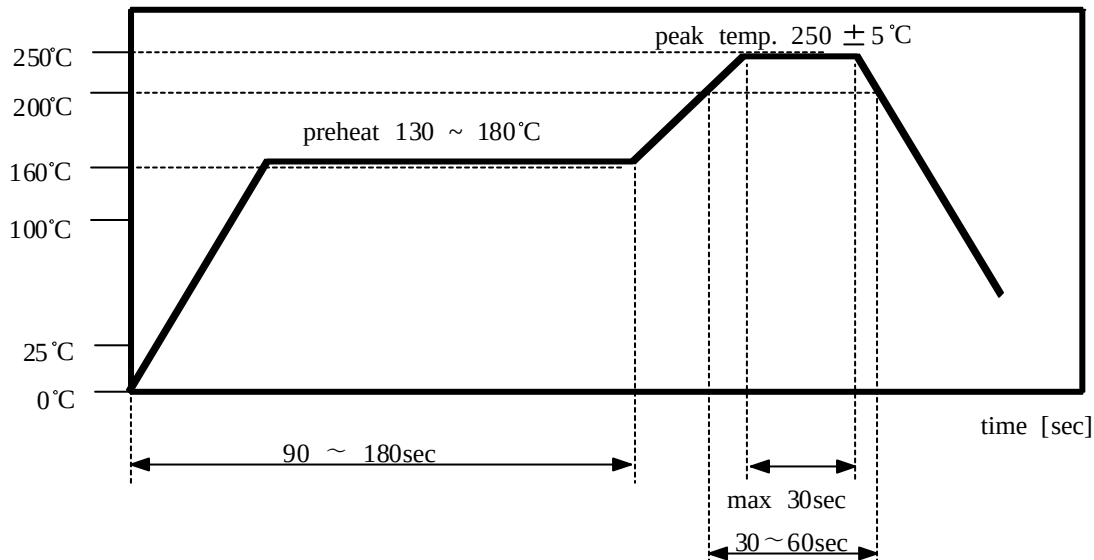
ITEM	TEST CONDITION	LIMIT
Random Vibration	Frequency 10~500Hz - 10 ×9.8m/s ² (G) Sweep time 15min, X.Y.Z each 5 times	*After the test, specimen sheet meet the electrical specification
Drop	Height 152cm, 5 times (Each Surface)	

6.4 Reliability Test Result

※ Appendix

7. Soldering Condon

7.1 Reflow Soldering



7.2 Manual Soldering

Pre-heating Temperature : 120°C , 60 ~ 300 sec.

Soldering Temperature : 340°C±5°C , 5sec max per each terminal

8. Attention

8.1 Temperature Condition

	Range of Temperature	unit
Application	-40 ~ +85	°C
Keeping	-40 ~ +85	°C

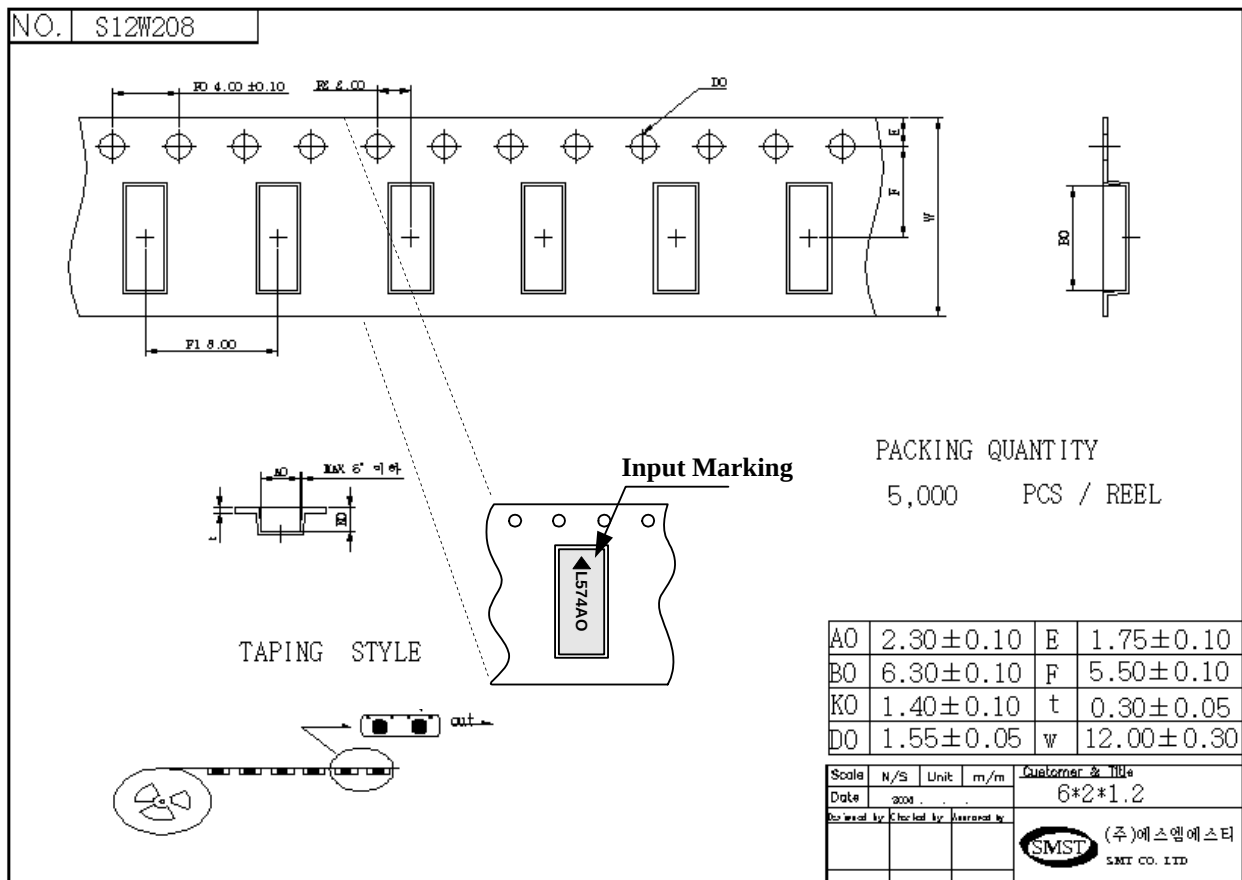
8.2 MSL LEVEL 1 (JEDEC J-STD-020C)

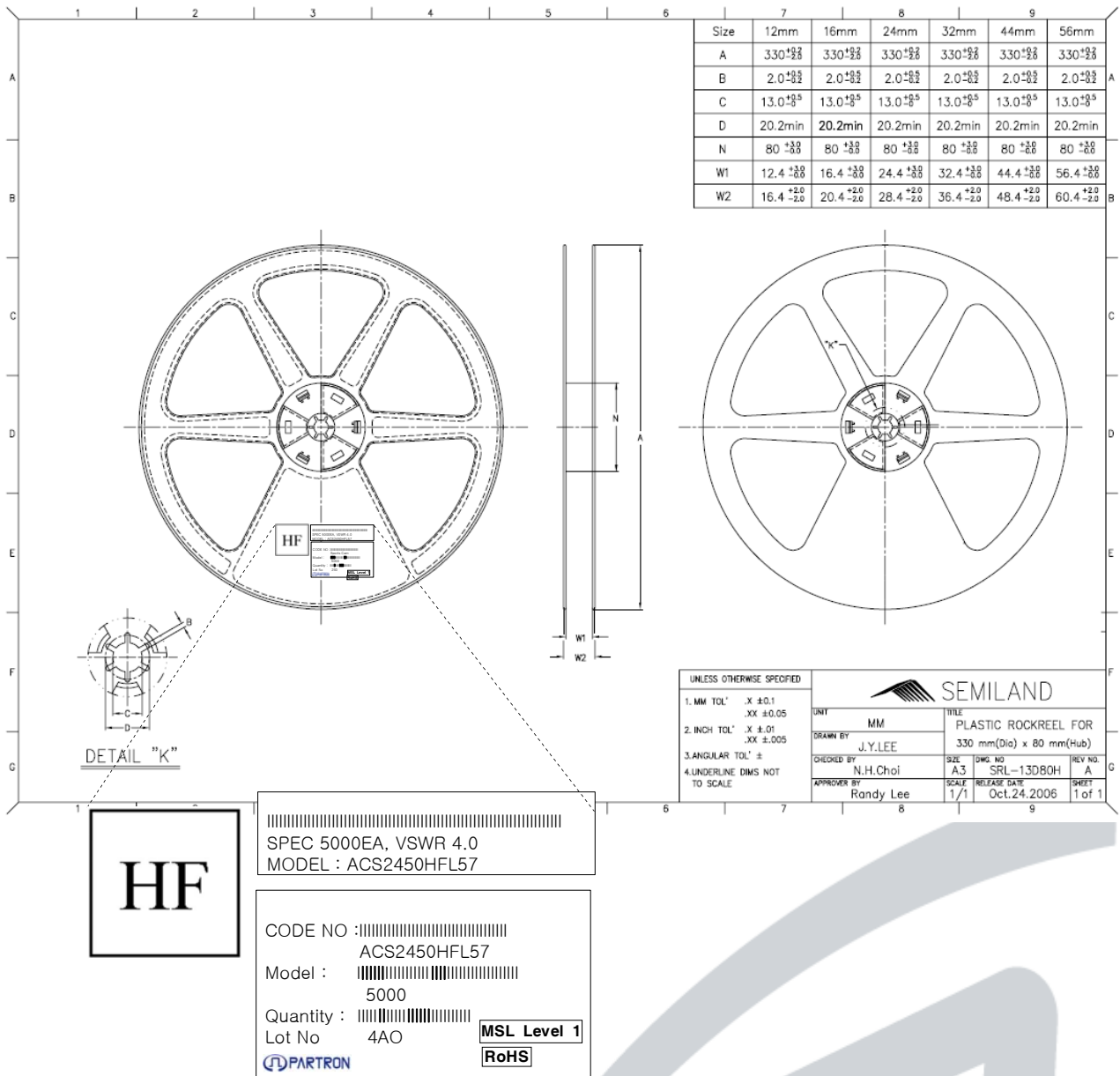
	Floor Life		Soak Requirements	
	Time	Conditions	Time	Conditions
1	Unlimited	= < 30°C/85%RH	168+5/-0	= < 85°C/85%RH

9. Packing

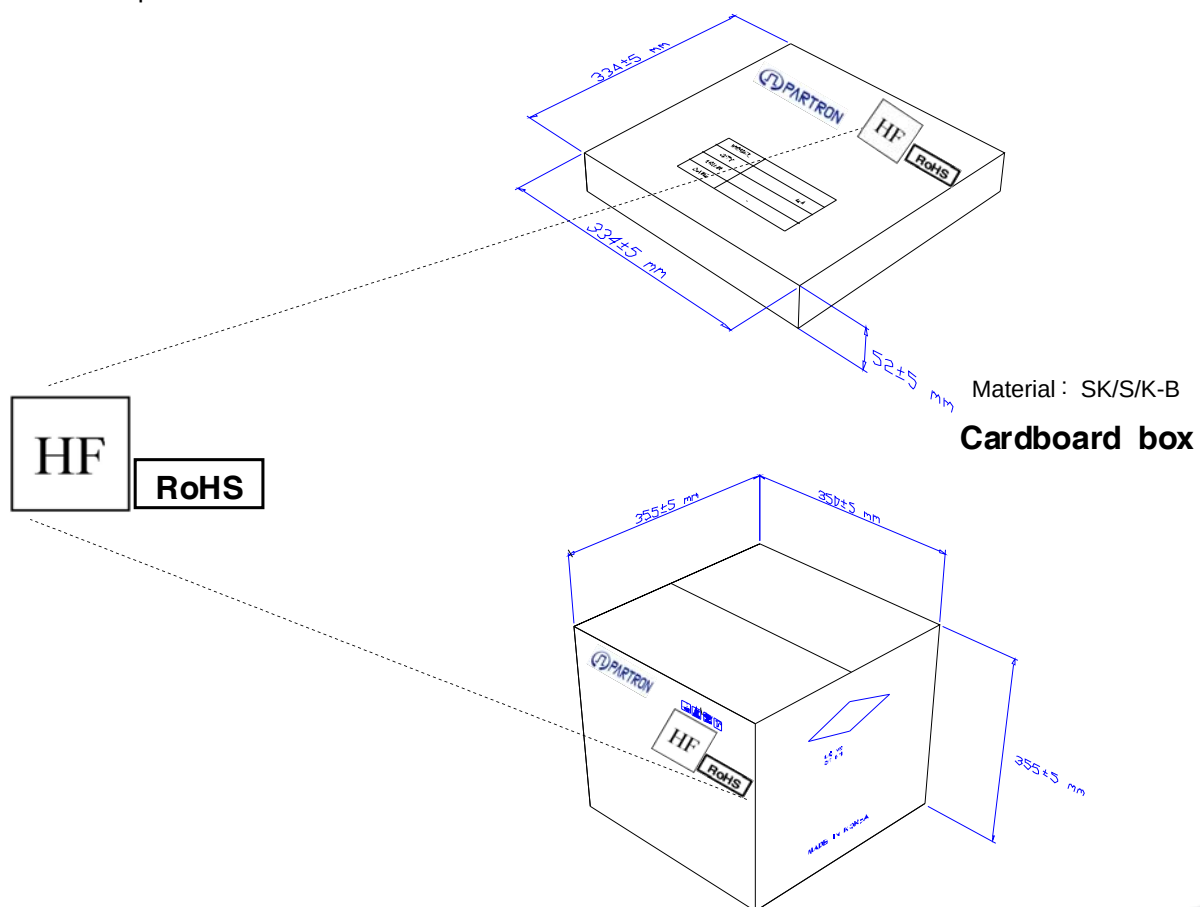
9.1 Carrier/Reel

ITEM	Material	Surface Resistance	Packing Method
Carrier	A-PET	Typical $10^8\Omega$	Heat press
Reel	A-PET		Air press (Using S-460G)





9.2 Box Specification



10. Process Control

Product		Issued/Revision		Process Control					Record	By designed	By checked	By approved		
CHIP ANTENNA		Issued	04.04.06						PRCP-C001					
		Revised	05.04.03											
Input Materials	FLOW CHART		Process name	Management of Factors					Management of quality					
	preparation	Main Process		Equipment Name	Checked	Condition	Cycle of management	Record	Checked Item	Margin	Method of Inspection	Cycle of management	Record	Action
Ceramic POWDER		◇	Import Inspection						shrinking rate permittivity	refer to Guide Sheet	Micrometer Network	10ea/LOT	C/sheet	Return
POWDER lubricant	○		powder	Mixer					mixing	POWDER lubricant	Scale	PER MIXING	-	Exhaust
		○	Shaping CTQ Process (Weight, dimension)	Press	pressure Mold Condition	refer to Guide Sheet	Per LOT 1/day	parameter C/SHEET	dimension weight density aspect	refer to Guide Sheet	Micrometer scale Calculated Visual	5/100EA 10ea/lot	LOT CARD	Exhaust
		○	Plasticity	Plasticity Hole	SETTER Outside Temperature PROFILE	refer to Guide Sheet	all 2/day 1/month	C/sheet						
		◇	Block CTQ Process (dimension)						wide length shape	refer to Guide Sheet	Micrometer Calipers Visual Inspection	20ea/LOT 20ea/LOT all	C/sheet	Exhaust
AG PASTE		○	SIDE1 PAD Printing CTQ Process (Printing dimension)	Printer screen	Squeeze velocity/presure SNAP	refer to Guide Sheet	1/day	-	PATTERN Dimension aspect	refer to Guide Sheet	Microscope	10ea/3Jig	c/sheet	Rework
		○	Dry	Dryer Dry Jig	Temperature Belt speed	refer to Guide Sheet	1/week	Parameter	Dry Condition Printed condition breakage	refer to Guide Sheet	Visual Inspection	all	Lot card	Rework

Product		Issued/Revision		Process Control					Record	By designed	By checked	By approved		
CHIP ANTENNA		Issued	04.04.06						PRCP-C001					
Input Materials	FLOW CHART		Process name	Management of Factors					Management of quality					
	prepara tion	Main Process		Equipment Name	Checked	Condition	Cycle of managem ent	Record	Checked Item	Margin	Method of Inspection	Cycle of management	Record	Action
AG PASTE			SIDE 2 PAD Printing CTQ	Printer screen	Squeeze velocity/presure SNAP	refer to Guide Sheet	1/day	-	PATTERN Dimension aspect	refer to Guide Sheet	Microscope	10ea/3Jig	c/sheet	Rework
			Dry	Dryer Dry Jig	Temperature Belt speed	refer to Guide Sheet	1/week	Parameter	Dry Condition Printed condition breakage	refer to Guide Sheet	Visual Inspection	all	Lot card	Rework
			Baking	Baking Hole mesh net	Temperature Belt speed	refer to Guide Sheet	1/week	Parameter C/Sheet	Breakage Pollution	refer to Guide Sheet	Visual Inspection	all	Lot card	Exhaust Rework
AG PASTE			TOP printing CTQ	Printer screen	Squeeze velocity/presure SNAP	refer to Guide Sheet	1/day	-	PATTERN dimension	refer to Guide Sheet	measure	10ea/3Jig	c/sheet	Rework
			Dry	Dryer Dry Jig	Temperature Belt speed	refer to Guide Sheet	1/week	Parameter	Dry Condition Printed condition breakage	refer to Guide Sheet	Visual Inspection	all	Lot card	Rework
AG PASTE			BOTTOM PAD Printing CTQ	printer screen	Squeeze velocity/presure SNAP	refer to Guide Sheet	1/day	-	PATTERN dimension aspect	refer to Guide Sheet	measure Microscope	10ea/3Jig	c/sheet	Rework

Product			Issued/Revision		Process Control				Record	By	By	By		
CHIP ANTENNA			Issued Revised	04.04.06 05.04.03					PRCP-C001					
Input Materials	FLOW CHART		Process name	Management of Factors					Management of quality					
	prepara tion	Main Process		Equipment Name	Checked	Condition	Cycle of management	Record	Checked Item	Margin	Method of Inspection	Cycle of management	Record	Action
		○	Dry	Dryer Dry Jig	Temperature Belt speed	refer to Guide Sheet	1/week	Parameter	Dry Condition Printed condition breakage	refer to Guide Sheet	Visual Inspection	all	Lot card	Rework
		○	Baking	Baking Hole mesh net	Temperature Belt speed	refer to Guide Sheet	1/week	Parameter C/Sheet	Breakage Pollution	refer to Guide Sheet	Visual Inspection	all	Lot card	Exhaust Rework
		◇	aspect inspection						aspect	Reference SPL refer to Guide Sheet	Visual Inspection microscope	all	Lot card production diary	Exhaust repair
		○	MARKING	Marking Machine					marking	Reference SPL	Visual Inspection	all	Lot card production diary	Rework Exhaust
		◇	Electrical Characteristic CTQ	NETWORK Inspection Jig	proofreading Condition	refer to Guide Sheet	1/2hour	C/sheet	Electrical Characteristic	refer to Guide Sheet	Network	all	Lot card production diary	Exhaust repair
		◇	aspect inspection						aspect dimension	Reference SPL refer to Guide Sheet	Visual Inspection microscope	all	Lot card production diary	Exhaust repair
Carrier cover reel		○	Taping						Quantity Direction aspect	refer to Guide Sheet	Manual	all	Lot card production diary	Rework
		◇	shipper inspection	NETWORK Inspection Jig	proofreading Condition	refer to Guide Sheet	1/person	C/sheet	Electrical Characteristic aspect packing	refer to Guide Sheet	Network microscope Visual Inspection	refer to Guide Sheet	Result Paper	return Exhaust
packing box label		○	packing	bar code printer					packing P/N Quantity	refer to Guide Sheet	Visual Inspection	all	-	Rework
		◇	packing inspection						packing P/N Quantity	refer to Guide Sheet	Visual Inspection	all	-	return

11. RoHS Data

1) Ceramic Powder

Parts Name	iM-K8
Tester Organization	SGS Testing KOREA co. Ltd.
Measurement Tester	Please see the 'method' in the test report
Measurement Data	Please see the report under the table

[illegible]

SGS				
Test Report No. 191461 (C141732)0401 Date: 13 Sep 2014 Page 2 of 2				
Test Results				
Test/Find Description:				
Specimen No. SH1	SGS Sample ID SH116-173284.001	Description Grey powder		
Remarks:				
(1) 1 mg/kg = 0.0001% (2) MDL = Method Detection Limit (3) ND = Not Detected (< MDL) (4) "-" = Not Regulated				
RoHS Directive 2011/65/EU				
Test Method:				
(1) With reference to IEC 62321-4:2013, determination of Cadmium by ICP-OES. (2) With reference to IEC 62321-4:2013, determination of Lead by ICP-OES. (3) With reference to IEC 62321-4:2013, determination of Mercury by GC-ECD. (4) With reference to IEC 62321-2008, determination of Hexavalent Chromium by Colorimetric Method using UV-Vis. (5) With reference to IEC 62321-2008, determination of Phthalates and Phthalic Acid by GC-MS.				
Test Item(s)	Limit	Unit	MDL	ND?
Cadmium (Cd)	100	mg/kg	2	ND
Lead (Pb)	1000	mg/kg	2	ND
Mercury (Hg)	1000	mg/kg	2	ND
Hexavalent Chromium (Cr(VI))	1000	mg/kg	2	ND
Sum of Phthalates	1000	mg/kg	-	ND
Monobromophenyl	-	mg/kg	5	ND
Dibromophenyl	-	mg/kg	5	ND
Tribromophenyl	-	mg/kg	5	ND
Tetrabromophenyl	-	mg/kg	5	ND
Pentabromophenyl	-	mg/kg	5	ND
Hexabromophenyl	-	mg/kg	5	ND
Heptabromophenyl	-	mg/kg	5	ND
Octabromophenyl	-	mg/kg	5	ND
Nona bromophenyl	-	mg/kg	5	ND
Decabromophenyl	-	mg/kg	5	ND
Sum of Phthalates	1000	mg/kg	-	ND
Monobromophenyl ether	-	mg/kg	5	ND



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Member of the SGS Group (SGS SA)

SGS				
Test Report				
No. SH4EC1417328401		Date: 13 Sep 2014		Page 3 of 7
<u>Test Item(s)</u>	<u>Limit</u>	<u>Unit</u>	<u>MDL</u>	<u>207</u>
Dibromodiphenyl ether	-	mg/kg	5	ND
Tribromodiphenyl ether	-	mg/kg	5	ND
Tetrabromodiphenyl ether	-	mg/kg	5	ND
Pentabromodiphenyl ether	-	mg/kg	5	ND
Hexabromodiphenyl ether	-	mg/kg	5	ND
Heptabromodiphenyl ether	-	mg/kg	5	ND
Octabromodiphenyl ether	-	mg/kg	5	ND
Nonabromodiphenyl ether	-	mg/kg	5	ND
Decabromodiphenyl ether	-	mg/kg	5	ND
Notes: (1) The maximum permissible limit is quoted from directive 2011/65/EU, Annex II				
<u>Element(s)</u>				
Test Method : With reference to US EPA Method 3052-1996, analysis was performed by ICP-OES.				
<u>Test Item(s)</u>	<u>Limit</u>	<u>MDL</u>	<u>207</u>	
Antimony (Sb)	mg/kg	10	ND	
<u>Halogen</u>				
Test Method : With reference to EN 14562: 2007, analysis was performed by Ion Chromatogram (IC).				
<u>Test Item(s)</u>	<u>Limit</u>	<u>MDL</u>	<u>207</u>	
Chlorine (Cl)	mg/kg	50	ND	
Bromine (Br)	mg/kg	50	ND	
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[illegible]



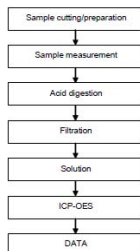
No. SHAEC1417328401

Date: 13 Sep 2014

Page 5 of 7

Elements Testing Flow Chart

- 1) Name of the person who made testing: Star Wang/ Jan Shi
2) Name of the person in charge of testing: Jeff Zhang



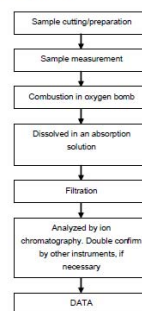
No. SHAEC1417328401

Date: 13 Sep 2014

Page 6 of 7

Halogen Testing (oxygen bomb) Flow Chart

- 1) Name of the person who made testing: Sisily Yin
2) Name of the person in charge of testing: Linda U



No. SHAEC1417328401

Date: 13 Sep 2014

Page 7 of 7

Sample photo:



SGS authenticate the photo on original report only

*** End of Report ***



2) Ag Paste

Parts Name	DNF2010C
Tester Organization	SGS Testing KOREA co. Ltd.
Measurement Tester	Please see the 'method' in the test report
Measurement Data	Please see the report under the table

SGS

Test Report No. F800101LF-CTSAIAA14-28567

Issued Date : 2014. 08. 17

Page 1 of 6

DAEJOO ELECTRONICS MATERIALS CO., LTD.
148 Seohyeon-ro
Seungnam-si, Gyeonggi-do
Korea

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

SGS File No. : AYAA14-28567
Product Name : Ag Paste
Item No./Part No. : N/A
Client Reference Data : DNF8010C(Y140409),DNF8010(Y140407),DNF8010(Y140401)
Received Date : 2014. 08. 09
Test Period : 2014. 08. 10 to 2014. 08. 17
Report Comments : (If by the applicant's request, item No. and part No. is a client reference information are stated/added on report.)
Test Results : For further details, please refer to following page(s)

SGS Korea Co., Ltd.

Jeff Jang

Jeff Jang / Chemical Lab Mgr

SGS

Test Report No. F800101LF-CTSAIAA14-28567

Issued Date : 2014. 08. 17

Page 2 of 6

Sample No. : AYAA14-28567-001
Sample Description : Ag Paste
Item No./Part No. : N/A
Materials : N/A

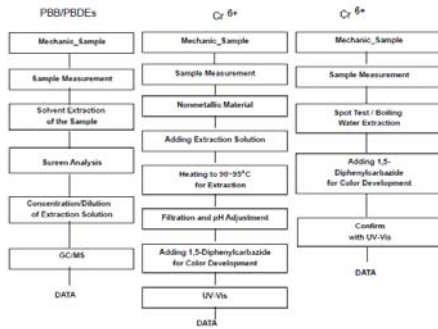
Heavy Metals

Test Item	Unit	Test Method	MDL	Results
Lead (Pb)	mg/kg	With reference to IEC 62321:2013, ICP	5	N.D.
Cadmium (Cd)	mg/kg	With reference to IEC 62321:2013, ICP	0.5	N.D.
Mercury (Hg)	mg/kg	With reference to IEC 62321:2013, ICP	2	N.D.
Hexavalent Chromium (Cr VI)	mg/kg	With reference to IEC 62321:2008, UV/VIS	1	N.D.

Trace Elements (mg/kg)

Test Item	Unit	Test Method	MDL	Results
Manganese (Mn)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Cobalt (Co)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Nickel (Ni)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Vanadium (V)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Chromium (Cr)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Iron (Fe)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Copper (Cu)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Zinc (Zn)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Aluminum (Al)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Silicon (Si)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Sulfur (S)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Phosphorus (P)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Chlorine (Cl)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Bromine (Br)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Iodine (I)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Fluorine (F)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Lithium (Li)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Ammonium (NH ₄)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Formate (HCOO)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Oxalate (C ₂ O ₄)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Malonate (C ₃ H ₂ O ₄)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Succinate (C ₄ H ₄ O ₄)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Tartrate (C ₄ H ₄ O ₆)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Citrate (C ₆ H ₅ O ₇)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Ascorbate (C ₆ H ₇ O ₆)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Glucuronate (C ₆ H ₇ O ₇)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Galacturonate (C ₆ H ₇ O ₇)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Mannuronate (C ₆ H ₇ O ₇)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Iduronate (C ₆ H ₇ O ₇)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Glucosamine (C ₆ H ₁₃ O ₅ N)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Galactosamine (C ₆ H ₁₃ O ₅ N)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
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Glucuronic acid (C ₆ H ₈ O ₇)	mg/kg	With reference to IEC 62321:2008, GFAAS	5	N.D.
Galacturonic acid (C ₆				

Flow Chart of Cr⁶⁺, PBB/PBDEs Testing

[illegible]

Fall 2008

3) Marking Ink(Black Ink)

Parts Name	IR/IC-270BK INK
Tester Organization	SGS Testing KOREA co. Ltd.
Measurement Tester	Please see the 'method' in the test report
Measurement Data	Please see the report under the table

Test Report

No. TSNEC1301308502

Date: 26 Dec 2013

Page 1 of 7

YANTAI PARTRON ELECTRONICS CO.,LTD

352# MUXIN ROAD ECONOMIC DEVELOPMENT ZONE MUPING YANTAI SHANDONG CHINA

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

SGS Job No.: TP13-006510 - TJ

Model No.: IR-270BK

Date of Sample Received: 23 Dec 2013

Testing Period: 23 Dec 2013 - 26 Dec 2013

Test Requested: Selected test(s) as requested by client.

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

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

Conclusion: Based on the performed tests on submitted samples, the results of Lead, Mercury, Cadmium, Hexavalent chromium, Polybrominated biphenyls (PBB), Polybrominated diphenyl ethers (PBDE) comply with the limits as set by RoHS Directive 2011/65/EU Annex II; recasting 2002/95/EC.

Signed for and on behalf of
SGS-CSTC Ltd.

Rebecca Zhou
Approved Signatory

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Member of the SGS Group (SGS SA)

Test Report

No. TSNEC1301308502

Date: 26 Dec 2013

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Test Results:

Test Part Description:

Specimen No.	SGS Sample ID	Description
SN1	TSN13-013085.002	black ink

Remarks:

- (1) 1 mg/kg = 0.0001%
- (2) MDL = Method Detection Limit
- (3) ND = Not Detected (< MDL)
- (4) * = Not Regulated

RoHS Directive 2011/65/EU

Test Method:

- (1) With reference to IEC 62321-5:2013, determination of Cadmium by ICP-OES.
- (2) With reference to IEC 62321-6:2013, determination of Lead by ICP-OES.
- (3) With reference to IEC 62321-4:2013, determination of Mercury by ICP-OES.
- (4) With reference to IEC 62321-2008, determination of Hexavalent Chromium by Colorimetric Method using UV-Vis.
- (5) With reference to IEC 62321-2008, determination of PBBs and PBDEs by GC-MS.

Test Item(s)	Limit	Unit	MDL	Q27
Cadmium (Cd)	100	mg/kg	2	ND
Lead (Pb)	1000	mg/kg	2	ND
Mercury (Hg)	1000	mg/kg	2	ND
Hexavalent Chromium (Cr(VI))	1000	mg/kg	2	ND
Sum of PBBs	1000	mg/kg	-	ND
Monobromobiphenyl	-	mg/kg	5	ND
Dibromobiphenyl	-	mg/kg	5	ND
Tribromobiphenyl	-	mg/kg	5	ND
Tetrabromobiphenyl	-	mg/kg	5	ND
Pentabromobiphenyl	-	mg/kg	5	ND
Hexabromobiphenyl	-	mg/kg	5	ND
Heptabromobiphenyl	-	mg/kg	5	ND
Octabromobiphenyl	-	mg/kg	5	ND
Nonabromobiphenyl	-	mg/kg	5	ND
Decabromobiphenyl	-	mg/kg	5	ND
Sum of PBDEs	1000	mg/kg	-	ND
Monobromodiphenyl ether	-	mg/kg	5	ND

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Test Item(s)	Limit	Unit	MDL	Q27
Dibromodiphenyl ether	-	mg/kg	5	ND
Tetrabromodiphenyl ether	-	mg/kg	5	ND
Tetrabromodiphenyl ether	-	mg/kg	5	ND
Pentabromodiphenyl ether	-	mg/kg	5	ND
Hexabromodiphenyl ether	-	mg/kg	5	ND
Heptabromodiphenyl ether	-	mg/kg	5	ND
Octabromodiphenyl ether	-	mg/kg	5	ND
Nonabromodiphenyl ether	-	mg/kg	5	ND
Decabromodiphenyl ether	-	mg/kg	5	ND

Notes:

(1) The maximum permissible limit is quoted from directive 2011/65/EU, Annex II.

Halogen

Test Method: With reference to EN 14582: 2007, analysis was performed by Ion Chromatography (IC).

Test Item(s)	Unit	MDL	Q27
Chlorine (Cl)	mg/kg	50	ND
Bromine (Br)	mg/kg	50	ND

Element(s)

Test Method: With reference to US EPA Method 3052:1996, analysis was performed by ICP-OES.

Test Item(s)	Unit	MDL	Q27
Antimony (Sb)	mg/kg	10	ND

Result shown is of the total weight of wet sample

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ATTACHMENTS

Cd/Pb/Hg/Cr^{VI}/PBBs/PBDEs Flow Chart

- 1) Name of the person who made testing: Aaron Wang/Jason Li /Angeli Yao
- 2) Name of the person in charge of issuing: Cindy Tin/Hao Zhu
- 3) These samples were detected totally by pre-concentration method according to below flow chart. (Cd^{VI} and PBBs/PBDEs test method excluded)

```

graph TD
    A[Sample Preparation] --> B[Sample Measurement]
    B --> C[Pb/Cd/Hg]
    B --> D[PBBs/PBDEs]
    B --> E[CrVI]
    
    C --> F[Acid digestion with microwave/boil]
    F --> G[Filtration]
    G --> H[Solution]
    G --> I[Residue]
    H --> J[ICP-DESAAS]
    I --> K["1) Alkal Fusion / Dry Ashing  
2) Acid to dissolve"]
    K --> J
    J --> L[DATA]
    
    D --> M[Sample solvent extraction]
    M --> N[Concentration / Dilution of extraction solution]
    N --> O[Filtration]
    O --> P[GC/MS]
    P --> Q[DATA]
    
    E --> R[Adding digestion reagent]
    R --> S[Heating to 90-105°C for extraction]
    S --> T[Filtration and pH adjustment]
    T --> U[Adding 1,5-diphenylcarbazide for color development]
    U --> V[UV/Vis]
    V --> W[DATA]
  
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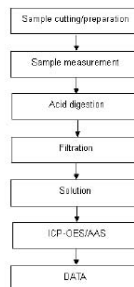
Date: 26 Dec 2013

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ATTACHMENTS

Elementary Testing Flow Chart

- 1) Name of the person who made testing: Aaron Wang
2) Name of the person in charge of testing: Cindy Yin

[illegible]

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