

RoHS
H/F

MSL Level 1

Approval Sheet

Products	Dielectric Chip Antenna		
Customer	PARTRON		
Model	Bluetooth Headset		
Customer CODE			
Supplier	PARTRON		
Supplier CODE	ACS2450HFL57		
PARTRON	By designed	By checked	By approved
	피 강 욱		
	Antenna 2 Team	Quality Assurance	Laboratory
	Kanguk. Pi	Nam-Sik. Min	Byoung-Jun.Yim
	09/19	09/19	09/19

2014 . 09. 19


22-6, Seokwoo-dong, Hwaseong-si, Gyeonggi-do, 445-170, KOREA

Tel : 82-31-201-7870~6

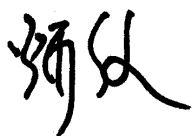
Fax : 82-31-201-7800

www.partron.co.kr

SPECIFICATION

MODEL : ACS2450HFL57

DIELECTRIC CHIP ANTENNA

By designed	By checked	By approved
피 강 욱		
Antenna 2 Team	Quality Assurance	Laboratory
Kanguk. Pi	Nam-Sik. Min	Byoung-Jun.Yim
09/19	09/19	09/19

2014 . 09. 19

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2. Electrical Characteristics

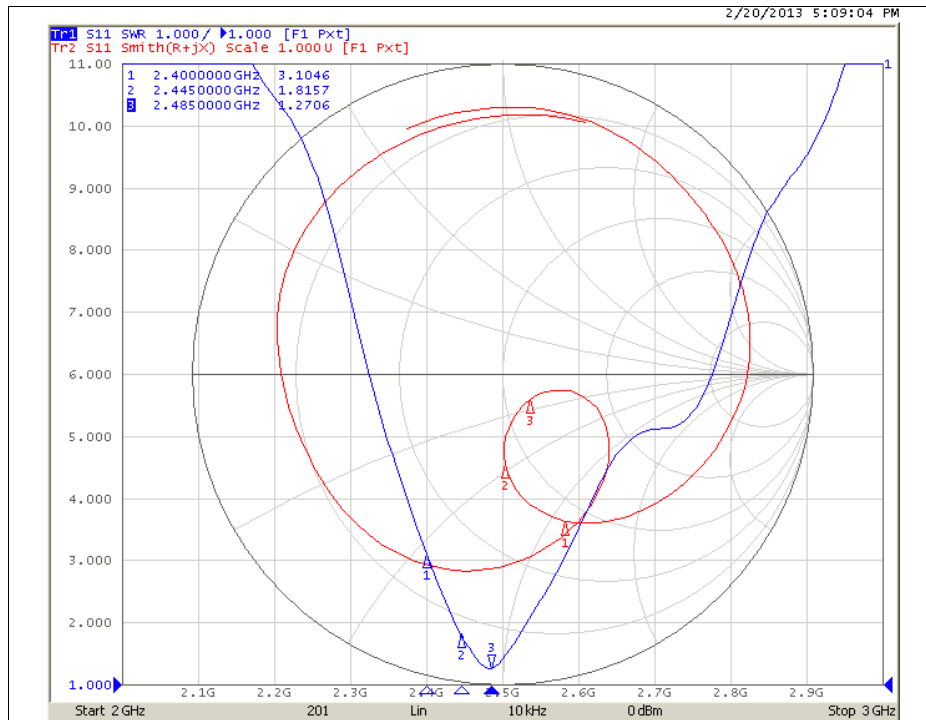
2.1 Set Condition

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	Series2 (Feed)	2.2nH
	T-Matching Circuit (nearby Module)	Shunt	1.0pF
		Series1	1.0nH
Gain[dBi]	Azimuth Plane	Peak	1.27
		Average	-1.37
	Elevation1 Plane	Peak	0.63
		Average	-4.50
	Elevation2 Plane	Peak	-1.42
		Average	-5.25
	3D	Peak	1.25
		Average	-4.21

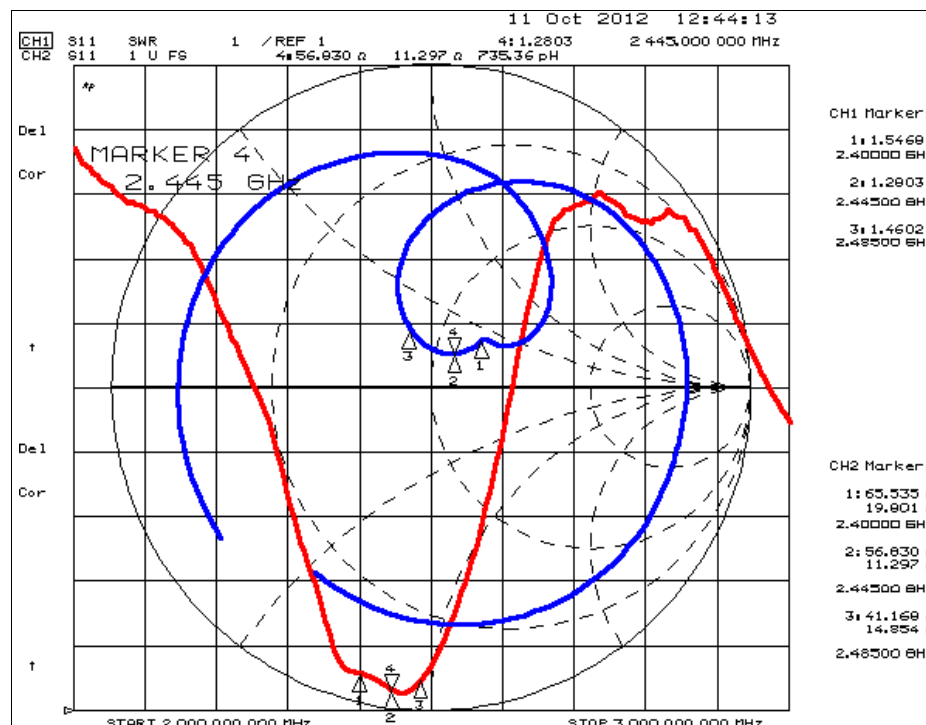
2.2 Test Fixture Condition

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

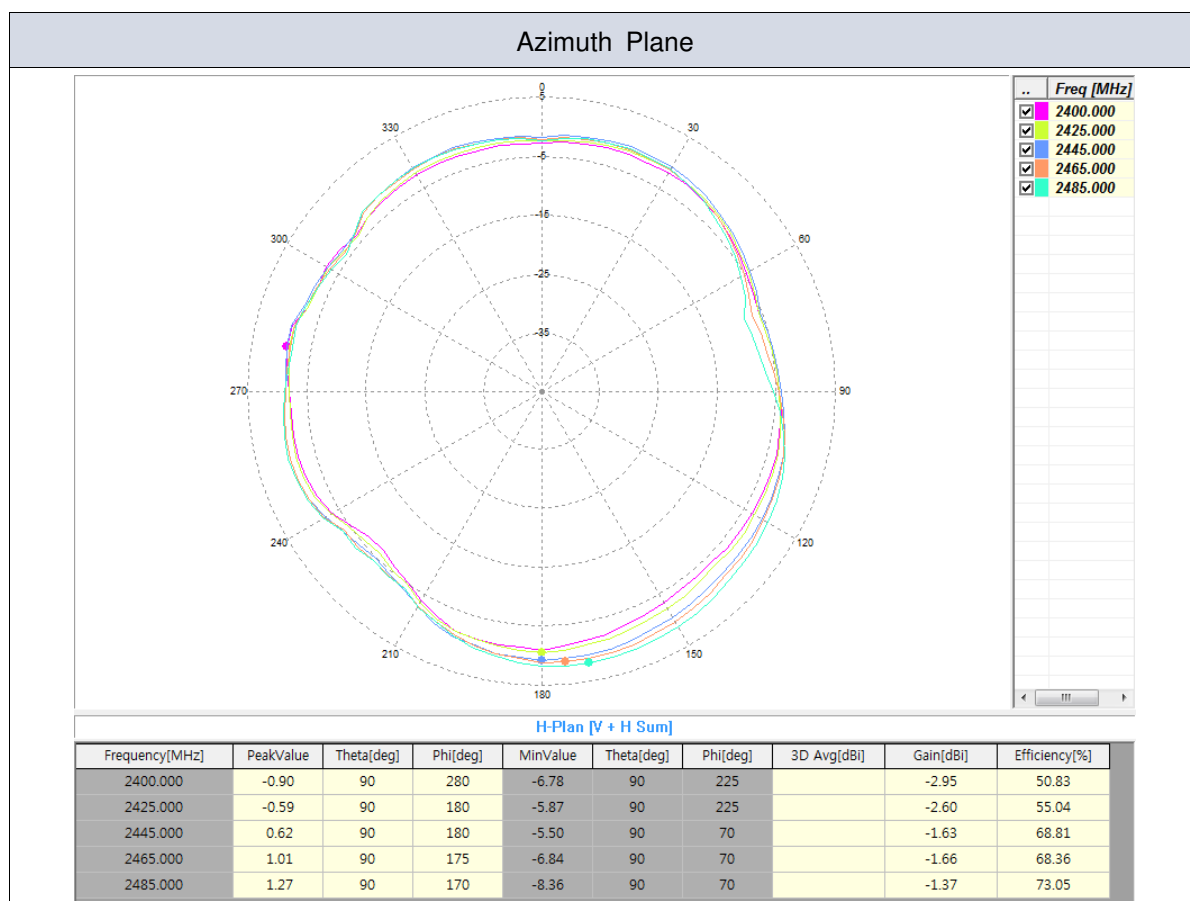
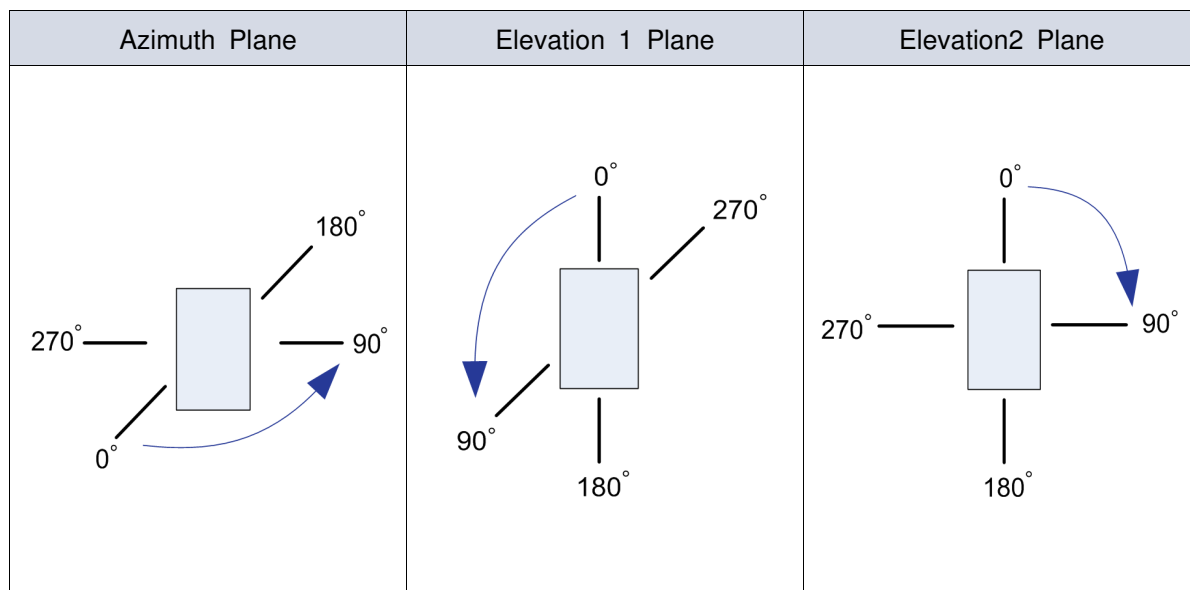
2.3 Graph of Set Condition



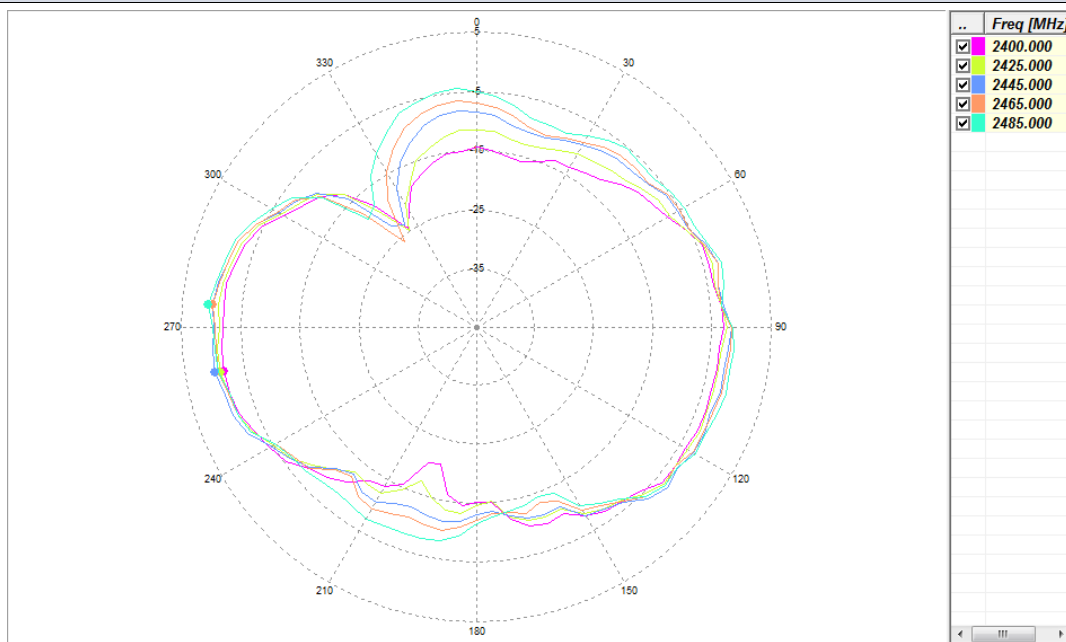
2.4 Graph of Test Fixture Condition



2.5 Radiation Pattern



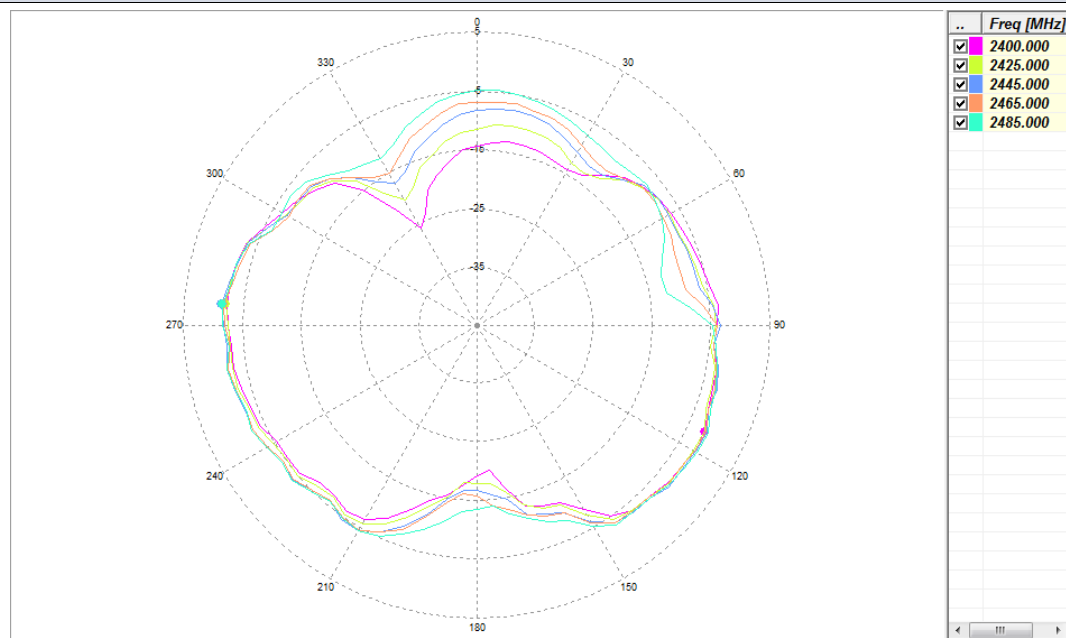
Elevation1 Plane



E1-Plan [V + H Sum]

Frequency[MHz]	PeakValue	Theta[deg]	Phi[deg]	MinValue	Theta[deg]	Phi[deg]	3D Avg[dBi]	Gain[dBi]	Efficiency[%]
2400.000	-1.50	260	0	-24.47	325	0		-6.49	22.57
2425.000	-0.93	260	0	-24.84	325	0		-6.08	24.75
2445.000	-0.03	260	0	-23.61	325	0		-5.17	30.53
2465.000	0.01	275	0	-25.97	320	0		-5.19	30.41
2485.000	0.63	275	0	-18.92	315	0		-4.50	35.63

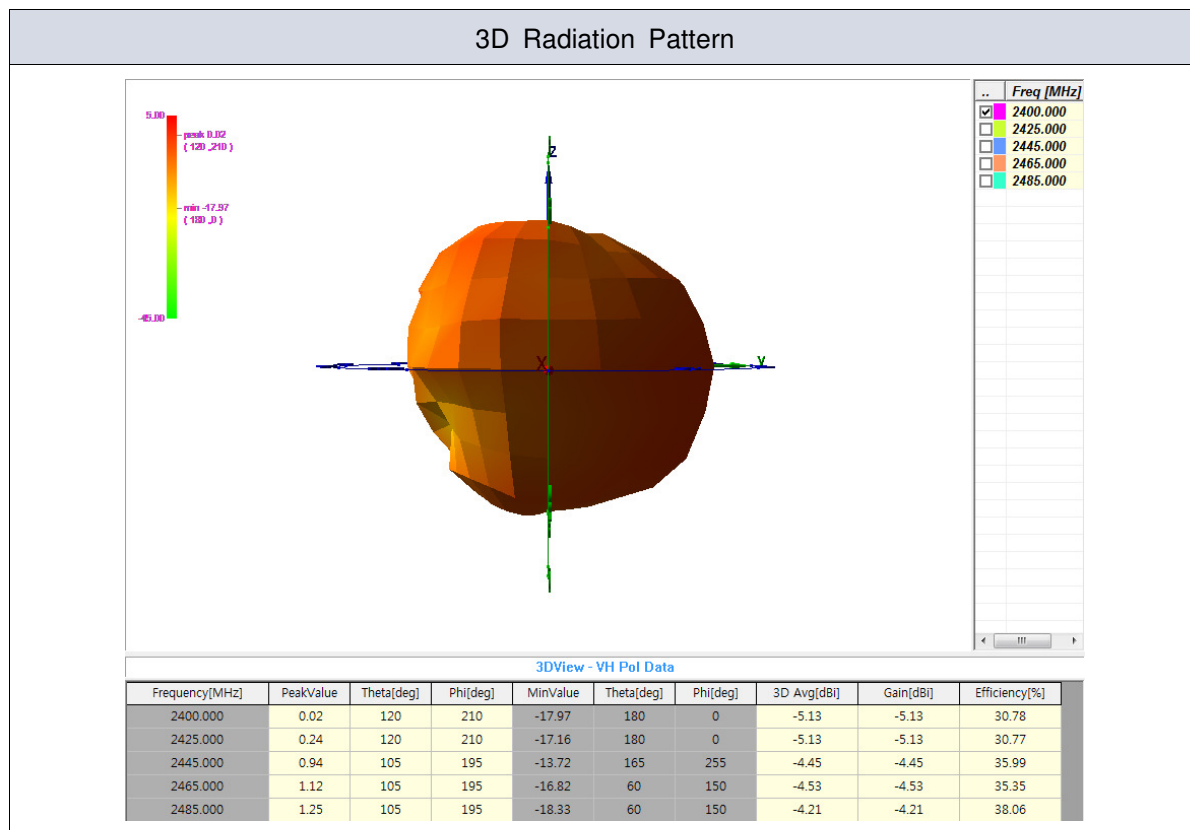
Elevation2 Plane



E2-Plan [V + H Sum]

Frequency[MHz]	PeakValue	Theta[deg]	Phi[deg]	MinValue	Theta[deg]	Phi[deg]	3D Avg[dBi]	Gain[dBi]	Efficiency[%]
2400.000	-2.05	115	90	-25.71	330	90		-6.35	23.28
2425.000	-1.94	275	90	-20.24	330	90		-6.26	23.76
2445.000	-1.26	275	90	-16.89	180	90		-5.58	27.75
2465.000	-1.57	275	90	-16.10	185	90		-5.73	26.86
2485.000	-1.42	275	90	-14.00	175	90		-5.25	29.95

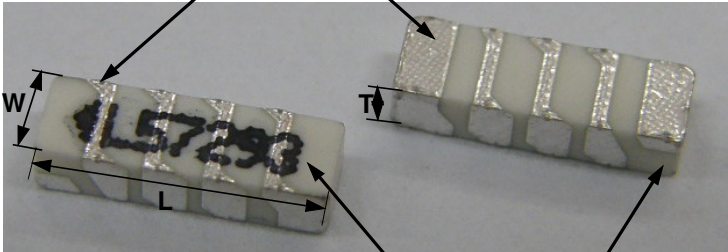
2.6 3D Radiation Pattern



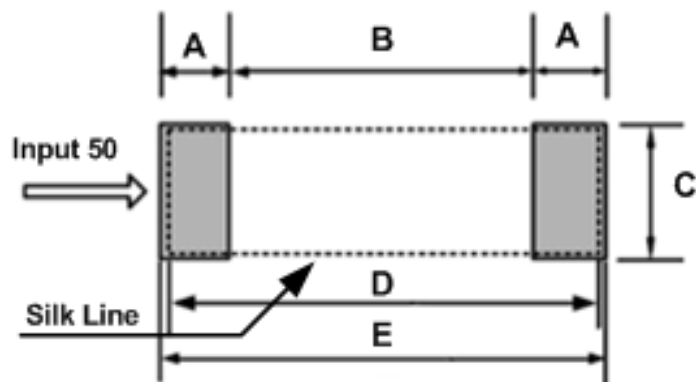
3. Mechanical Characteristics

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

3.1 Structure and Material

Material	Dielectric Block	3D Structure	
	Ag Paste	 Top-Side View Bottom-Side View	
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



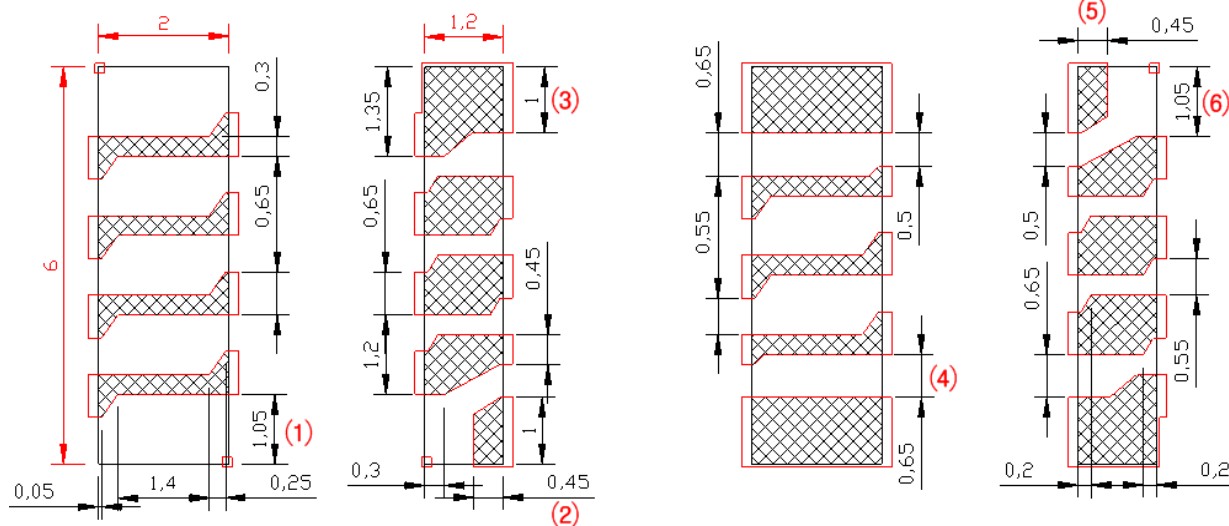
Parameter	A	B	C	D	E
Value[mm]	1.2	4.0	2.4	6.0	6.4

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

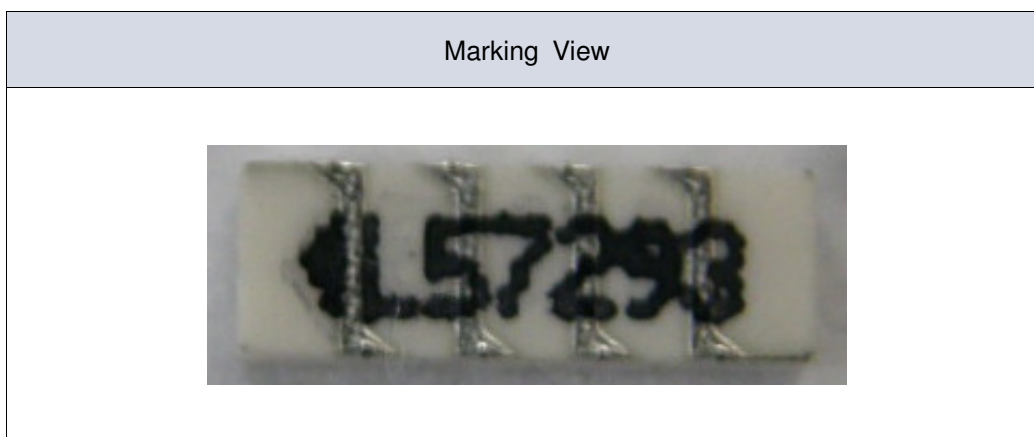
	(1)	(2)	(3)	(4)	(5)	(6)
Drawing Dimension [mm]	1.05±0.1	0.45±0.1	1.0±0.1	0.65±0.1	0.45±0.1	1.05±0.1
1	1.136	0.440	1.033	0.640	0.513	1.099
2	0.962	0.460	0.953	0.634	0.509	1.036
3	1.036	0.507	1.026	0.645	0.470	1.108
4	1.122	0.490	1.022	0.640	0.474	1.080
5	0.982	0.461	0.970	0.669	0.503	1.073
Min [mm]	0.962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

2 9 3
① ② ③

- ① Year ; 1 - 2011, 2 - 2012, 9 - 2019, 0 - 2020
 ② Month ; 1 - January, 2 - February, A - October, B - November
 ③ Date ; 1 - 1st, 2 - 2nd, 3 - 3rd H - 17th, I - 18th

3.5 Marking



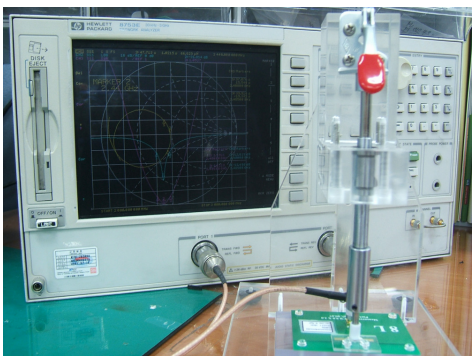
◀ L57 2 9 3
① ② ③ ④ ⑤

- ① Input Signal
 ② Serial
 ③ Year ; 1 - 2011, 2 - 2012, 9 - 2019, 0 - 2020
 ④ Month ; 1 - January, 2 - February, A - October, B - November
 ⑤ Date ; 1 - 1st, 2 - 2nd, 3 - 3rd H - 17th, I - 18th

4. Measurement Process

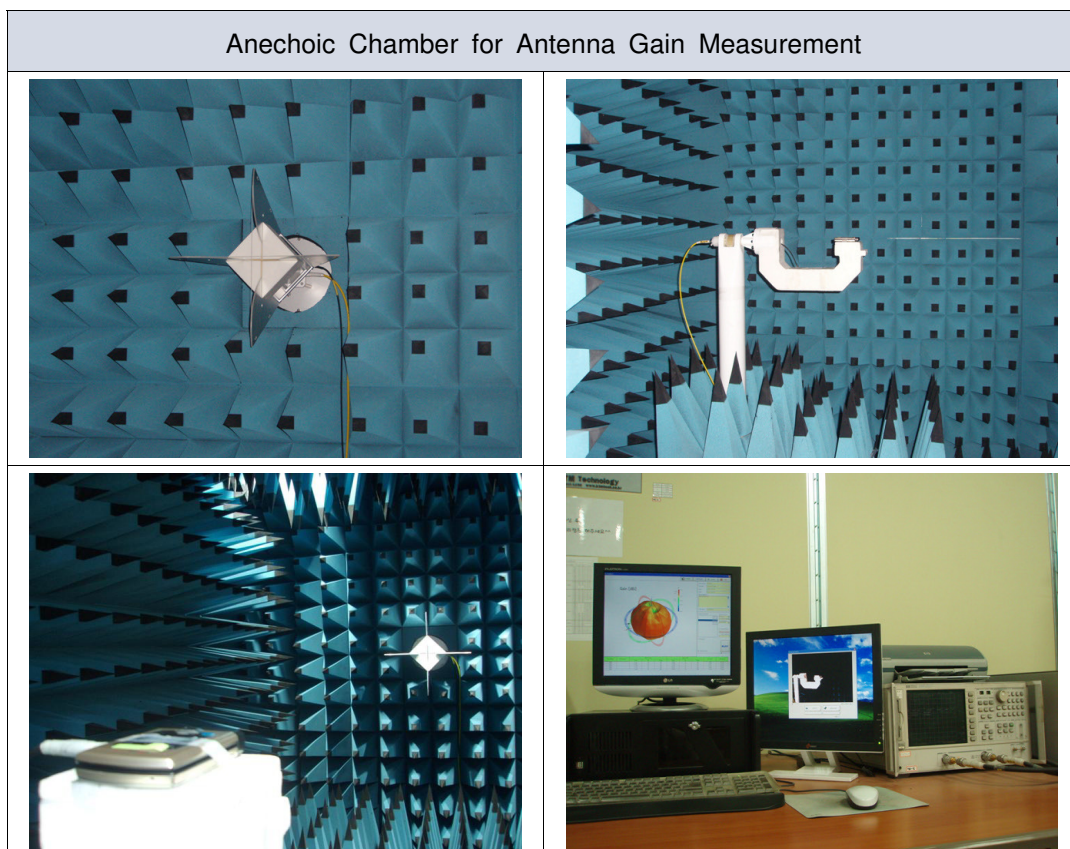
4.1 SWR/Returnloss

-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 *specimen sheet meet the electrical specification
Low Temperature Resistance	-40℃±3℃, 120hr	
Humidity Resistance	+60±3℃, RH90~95%, 120hr	

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

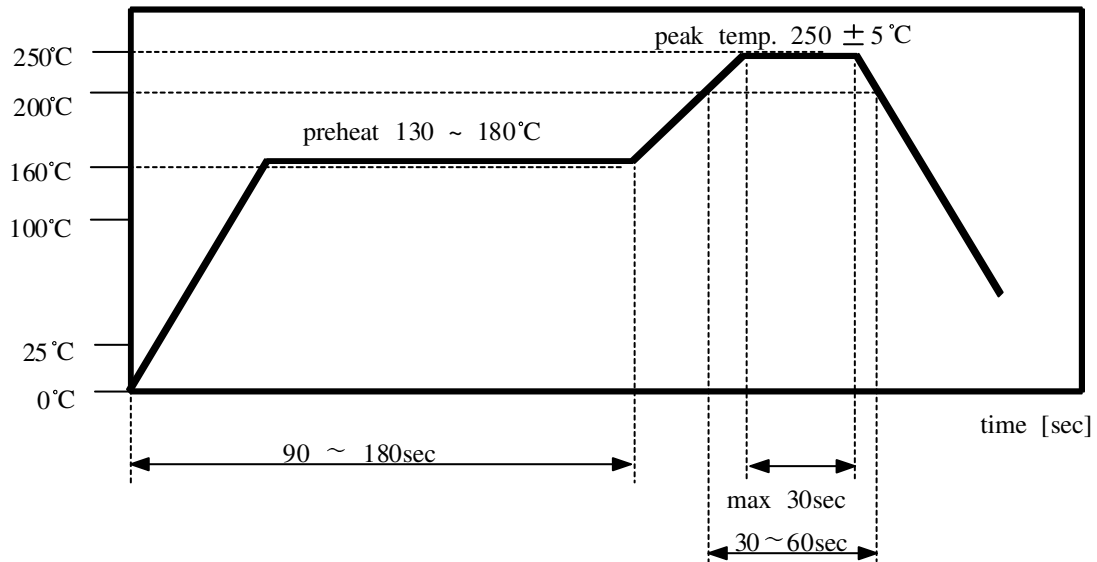
ITEM	TEST CONDITION	LIMIT
Random Vibration	Frequency 10~500Hz - 10 ×9.8m/s ² (G) Sweep time 15min, X.Y.Z each 5 times	*After the test, specimen sheet meet the electrical specification
Drop	Height 152cm, 5 times (Each Surface)	

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

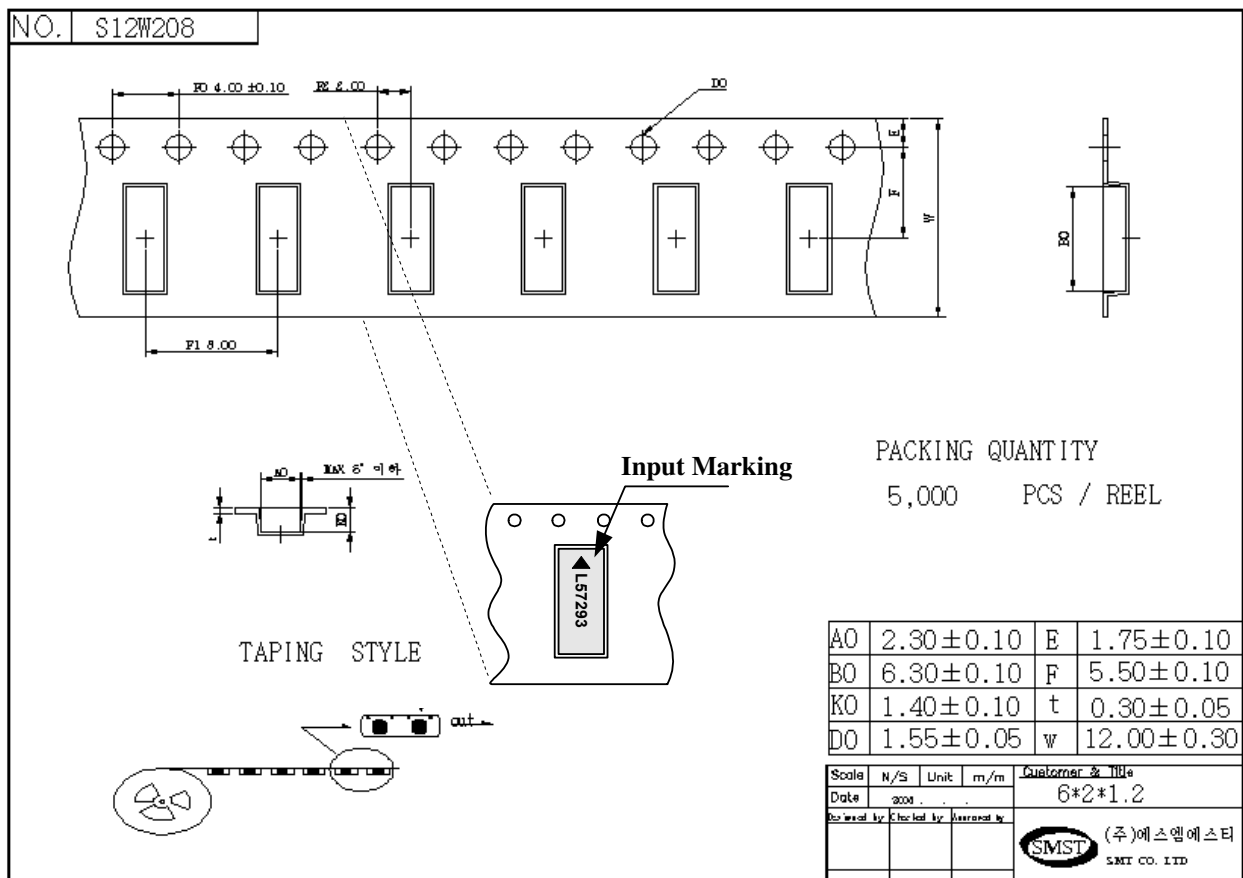
8.2 MSL LEVEL 1 (JEDEC J-STD-020C)

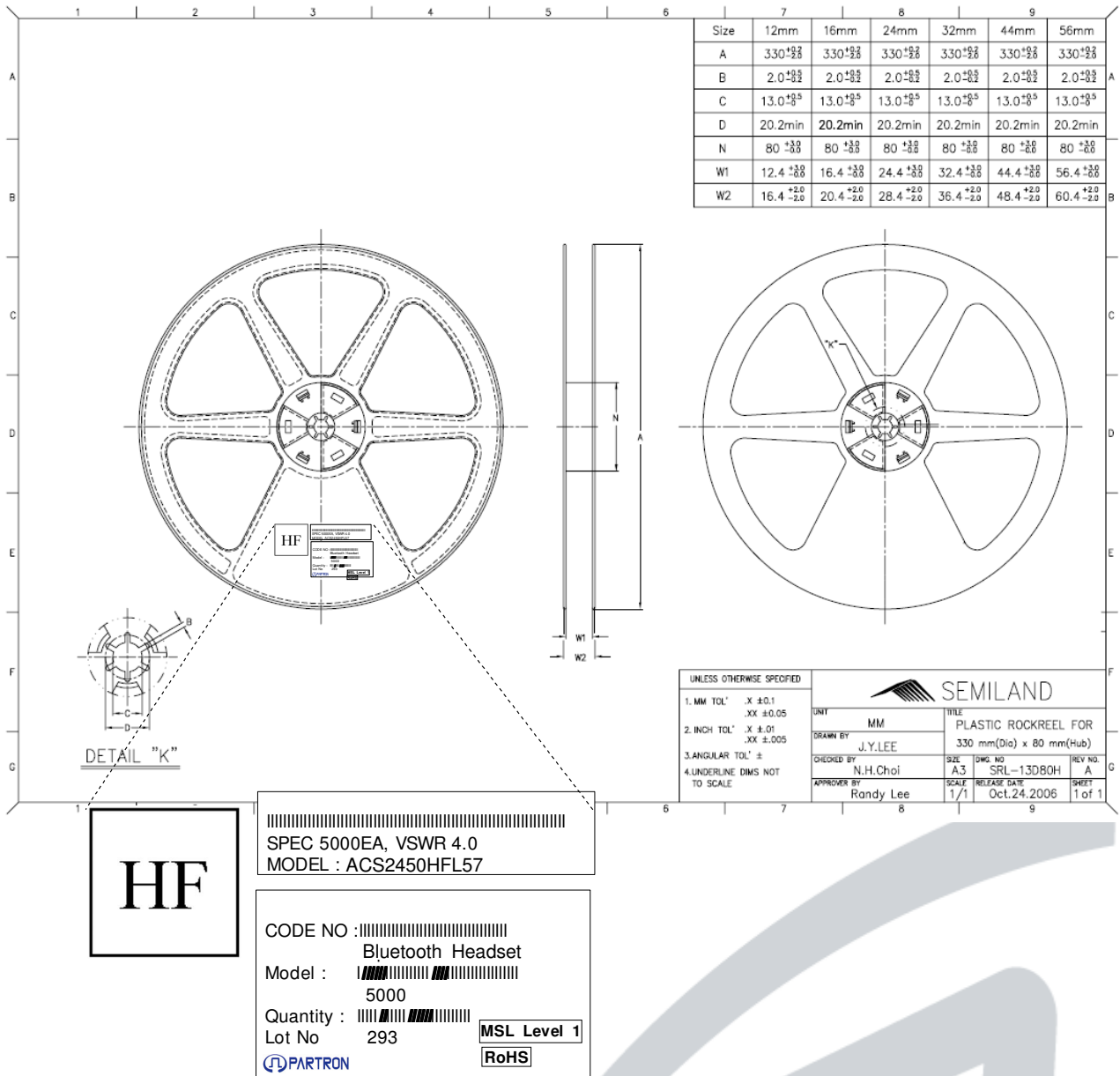
	Floor Life		Soak Requirements	
	Time	Conditions	Time	Conditions
1	Unlimited	= < 30°C/85%RH	168+5/-0	= < 85°C/85%RH

9. Packing

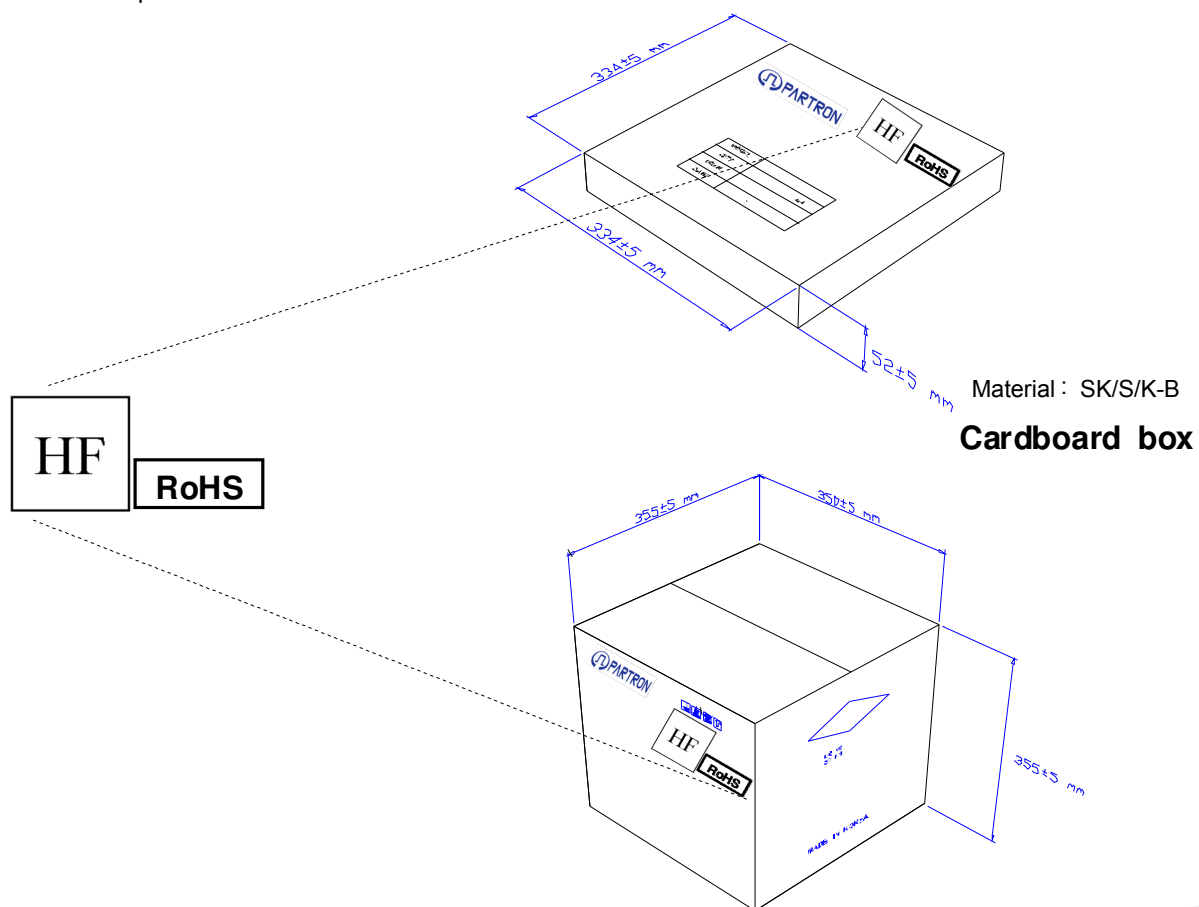
9.1 Carrier/Reel

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. 유해물질 성적서

11.1 Ceramic Powder

Parts Name	Powder(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

	
Test Report	No. SHAEIC1413319701 Date: 17 Jul 2014 Page 1 of 7
WUXI INANOTECH CO.,LTD NO.518-3 ZHONGSHU ROAD, WUXI, JIANGSU, CHINA (214174)	
The following sample(s) was/were submitted and identified on behalf of the client as : CERAMIC POWDER	
SGS Job No. :	SP14-021760 - SHI
Model No. :	IM-H38
Composition :	BaTiO ₃
Date of Sample Received :	15 Jul 2014
Testing Period :	15 Jul 2014 - 17 Jul 2014
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 sample(s), the results of Lead, Mercury, Cadmium, Hexavalent chromium, Polychlorinated biphenyls (PCBs), Polychlorinated diphenyl ethers (PCDEs) comply with the limits as set by RoHS Directive 2011/65/EU Annex II; recasting 2002/95/EC.
Signed for and on behalf of  Mary Ma Approved Signatory	
 SGS Société Générale de Surveillance Switzerland	

[illegible][illegible][illegible]

SGS

Test Report No. SHAEC1413319701 Date: 17 Jul 2014 Page 5 of 7

ATTACHMENTS

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

```

graph TD
    A[Sample cutting/preparation] --> B[Sample measurement]
    B --> C[Add digestion]
    C --> D[Filtration]
    D --> E[Solution]
    E --> F[ICP-OES]
    F --> G[DATA]
  
```

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SGS Testing Services
中國 - 上海 德意志安山路888號9樓 郵箱 200333 TEL: (86-21) 41452594 HL: (86-21) 41452593 E: sgs@sgs.com

Member of the SGS Group (SGS SA)

SGS

Test Report No. SHAEC1413319701 Date: 17 Jul 2014 Page 6 of 7

ATTACHMENTS

Halogen Testing (oxygen bomb) Flow Chart

1) Name of the person who made testing: Sissy Yin
2) Name of the person in charge of testing: Linda Li

```

graph TD
    A[Sample cutting/preparation] --> B[Sample measurement]
    B --> C[Combustion in oxygen bomb]
    C --> D[Dissolved in an absorption solution]
    D --> E[Filtration]
    E --> F[Analyzed by ion chromatography. Double confirm by other instruments, if necessary]
    F --> G[DATA]
  
```

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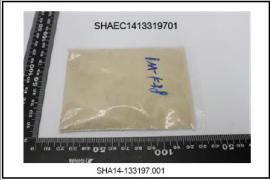
SGS Testing Services
中國 - 上海 德意志安山路888號9樓 郵箱 200333 TEL: (86-21) 41452594 HL: (86-21) 41452593 E: sgs@sgs.com

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Test Report No. SHAEC1413319701 Date: 17 Jul 2014 Page 7 of 7

Sample photo:



SHAEC1413319701

SGS authenticates the photo on original report only
*** End of Report ***

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SGS Testing Services
中國 - 上海 德意志安山路888號9樓 郵箱 200333 TEL: (86-21) 41452594 HL: (86-21) 41452593 E: sgs@sgs.com

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11.2 Ag Paste

Parts Name	Silver Paste
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. F690101LF-CTSAVA14-28567 Issued Date : 2014. 08. 17 Page 1 of 6

DAEJOO ELECTRONICS MATERIALS CO., LTD.
148, Sapsaewon-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. : AVAA14-28567
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 : By the applicant's request, item No.s part No.s & 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 / Chemical Lab Mgr

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Test Report No. F690101LF-CTSAVA14-28567 Issued Date : 2014. 08. 17 Page 2 of 6

Sample No. : AVAA14-28567 D01
Sample Description : Ag Paste
Item No./Part No. : N/A
Materials : N/A

Heavy Metals

Test Items	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 62321:2013, U-PVS	1	N.D.

Fluoride Determination (FBB, FBOCs)

Test Items	Unit	Test Method	MDL	Results
Monoaromobiphenyl	mg/kg	With reference to IEC 62321:2013, GC-MS	5	N.D.
Dibromobiphenyl	mg/kg	With reference to IEC 62321:2013, GC-MS	5	N.D.
Tribromobiphenyl	mg/kg	With reference to IEC 62321:2013, GC-MS	5	N.D.
Tetraaromobiphenyl	mg/kg	With reference to IEC 62321:2013, GC-MS	5	N.D.
Pentaaromobiphenyl	mg/kg	With reference to IEC 62321:2013, GC-MS	5	N.D.
Hexaaromobiphenyl	mg/kg	With reference to IEC 62321:2013, GC-MS	5	N.D.
Heptaaromobiphenyl	mg/kg	With reference to IEC 62321:2013, GC-MS	5	N.D.
Octaaromobiphenyl	mg/kg	With reference to IEC 62321:2013, GC-MS	5	N.D.
Nonaaromobiphenyl	mg/kg	With reference to IEC 62321:2013, GC-MS	5	N.D.
Decaaromobiphenyl	mg/kg	With reference to IEC 62321:2013, GC-MS	5	N.D.
Monoaromobiphenyl ether	mg/kg	With reference to IEC 62321:2013, GC-MS	5	N.D.
Dibromobiphenyl ether	mg/kg	With reference to IEC 62321:2013, GC-MS	5	N.D.
Tribromobiphenyl ether	mg/kg	With reference to IEC 62321:2013, GC-MS	5	N.D.
Tetraaromobiphenyl ether	mg/kg	With reference to IEC 62321:2013, GC-MS	5	N.D.
Hexaaromobiphenyl ether	mg/kg	With reference to IEC 62321:2013, GC-MS	5	N.D.
Heptaaromobiphenyl ether	mg/kg	With reference to IEC 62321:2013, GC-MS	5	N.D.
Octaaromobiphenyl ether	mg/kg	With reference to IEC 62321:2013, GC-MS	5	N.D.
Nonaaromobiphenyl ether	mg/kg	With reference to IEC 62321:2013, GC-MS	5	N.D.
Decaaromobiphenyl ether	mg/kg	With reference to IEC 62321:2013, GC-MS	5	N.D.

Halogen Content

Test Items	Unit	Test Method	MDL	Results
Chlorine(Cl)	mg/kg	BS EN 14562:2007, IC	30	N.D.
Bromine(Br)	mg/kg	BS EN 14562:2007, IC	30	N.D.

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Test Report No. F690101LF-CTSAVA14-28567 Issued Date : 2014. 08. 17 Page 3 of 6

NOTE: (1) N.D. = Not detected (-MDL)
(2) mg/kg = ppm
(3) MDL = Method Detection Limit
(4) = No regulation
(5) Negative = Undetectable / Positive = Detectable
(6) = Qualitative analysis (No Unit)
(7) = Boiling water-extraction
Negative = Absence of Cr(VI) coating
Positive = Presence of Cr(VI) coating. The detected concentration in boiling-water-extraction solution is equal or greater than 0.02 mg/kg with 50 cm² sample surface area.

Picture of Sample as Received:

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Test Report No. F690101LF-CTSAVA14-28567 Issued Date : 2014. 08. 17 Page 4 of 6

Flow Chart of Digestion

```

graph TD
    A[Cutting/Preparation] --> B[Sample Measurement]
    B --> C[Cd,Pb]
    B --> D[Hg]
    C --> E[Decomposition under closed(microwave) or open(acid digestion) system by suitable acid for each sample matrix.]
    D --> F[Decomposition under closed(microwave) system by suitable acid for each sample matrix.]
    E --> G[Filtration]
    F --> G
    G --> H[Solution]
    G --> I[Residue]
    H --> J[ICP-AES]
    I --> K[Alkali Fusion]
  
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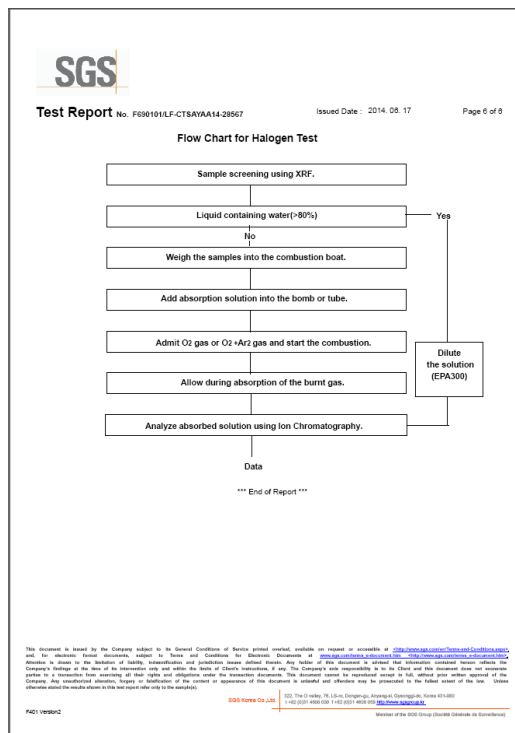
Sample material	Digestion Acid
Metal: Fe, Cu, Al, etc.	Aqua regia, HCl, HNO ₃
Plastic	HNO ₃ , HCl, HF, HClO ₄
Silver	HNO ₃ , H ₂ SO ₄
Solder, Au, Pt, Pd, Sb, Sn	Aqua regia
Glass	HNO ₃ , HF
Ti, Zr, W, Mo, Bi, Hf, Nb, Ta	HNO ₃ , HCl, HF
Sn (IEC 62321)	HNO ₃ , HCl, H ₂ SO ₄ , HBr
Others	Any acid

The samples were dissolved totally by pre-conditioning method according to above flow chart.
Section Chief : Ghae Yi

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Parts Name	Black 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

SGS

Test Report

No. TSNEC1301308502

Date: 26 Dec 2013

Page 2 of 7

Test Results :

Test Parameter 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

ReHS 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 ICP-AAS.
- (4) With reference to IEC 62321:2008, determination of Hexavalent Chromium by Colometric 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	g/g
Cadmium (Cd)	100	mg/kg	ND	2
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
Mono bromobiphenyl	-	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
Mono bromodiphenyl ether	-	mg/kg	5	ND

We warrant that the Test Certificate applies to the General Description of Items, quantity of Items submitted and/or as requested or measured by SGS (Type, Quantity, Composition, and conditions), and to the laboratory Internal documents relating to Terms and Conditions for Business Document as shown in our website (www.sgs.com). Attention is drawn to the limitation of liability and disclaimer of warranty contained therein. Any use of the document for purposes other than those intended by the Company involves the user's acceptance of all terms and conditions of sale and discharges under the business document. This document cannot be reproduced or used in full without prior written permission from the Company. The reproduction or unauthorized use of this document or its contents or any part thereof is strictly prohibited and may be prosecuted if the Company receives information to that effect.

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Test Report No. TSNEC1301308502 Date: 26 Dec 2013 Page 3 of 7

Test Item(s)	Unit	Limit	MDL	202
Dibromodiphenyl 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 Chromatograph (IC).

Test Item(s)	Unit	Limit	MDL	202
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	Limit	MDL	202
Antimony (Sb)	mg/kg	10	ND	

Result shown is of the total weight of wet sample

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