
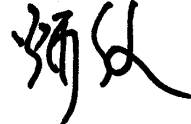


**RoHS**
**H/F**

**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](http://www.partron.co.kr)

RoHS

H/F


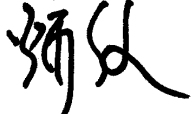


MSL Level 1

# 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



22-6, Seokwoo-dong, Hwaseong-si, Gyeonggi-do, 445-170, KOREA  
Tel : 82-31-201-7870~6  
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www.partron.co.kr

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## 2. Electrical Characteristics

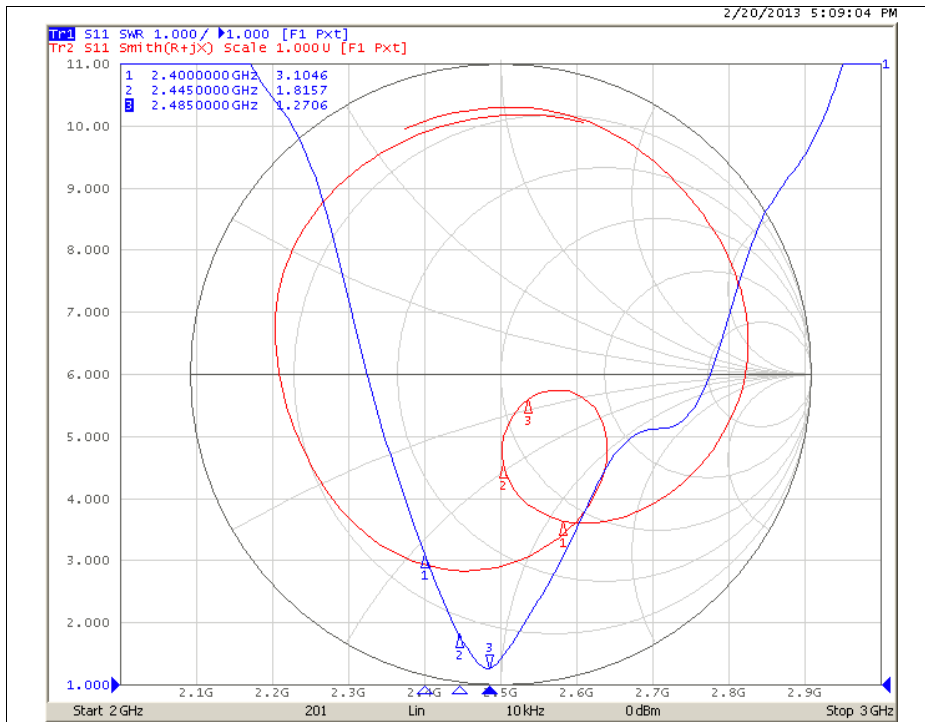
### 2.1 Set Condition

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

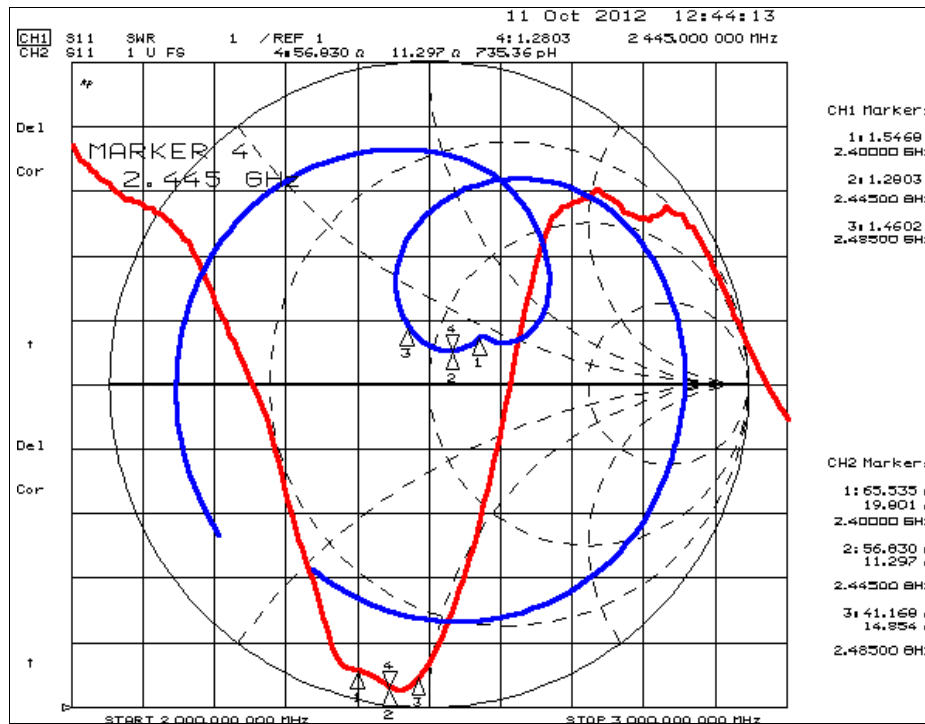
### 2.2 Test Fixture Condition

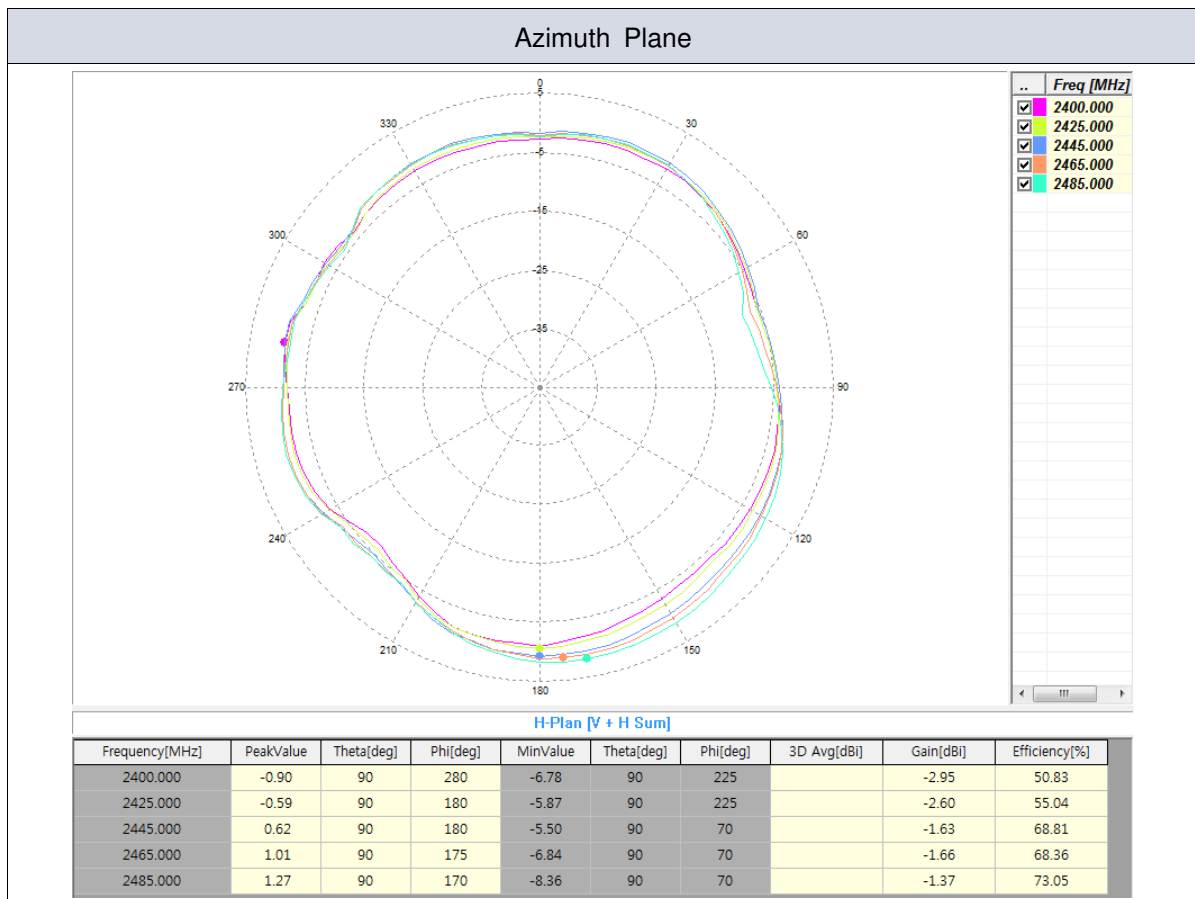
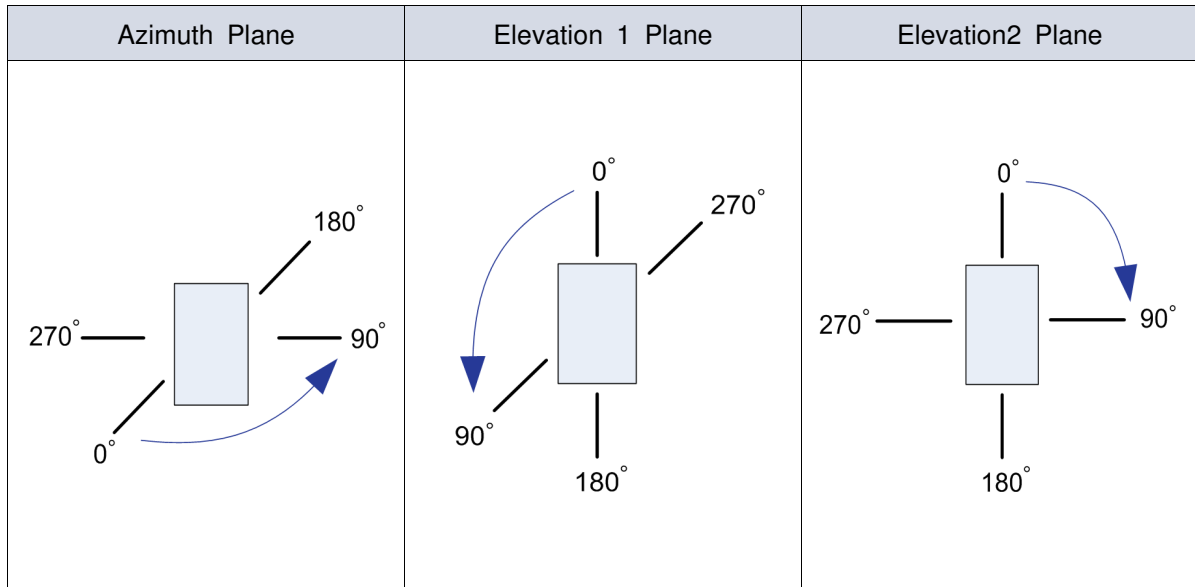
ITEM	SPEC
Frequency Range [MHz]	1840 ~ 1920
SWR [Max]	4.0 : 1
Bandwidth [MHz]	80

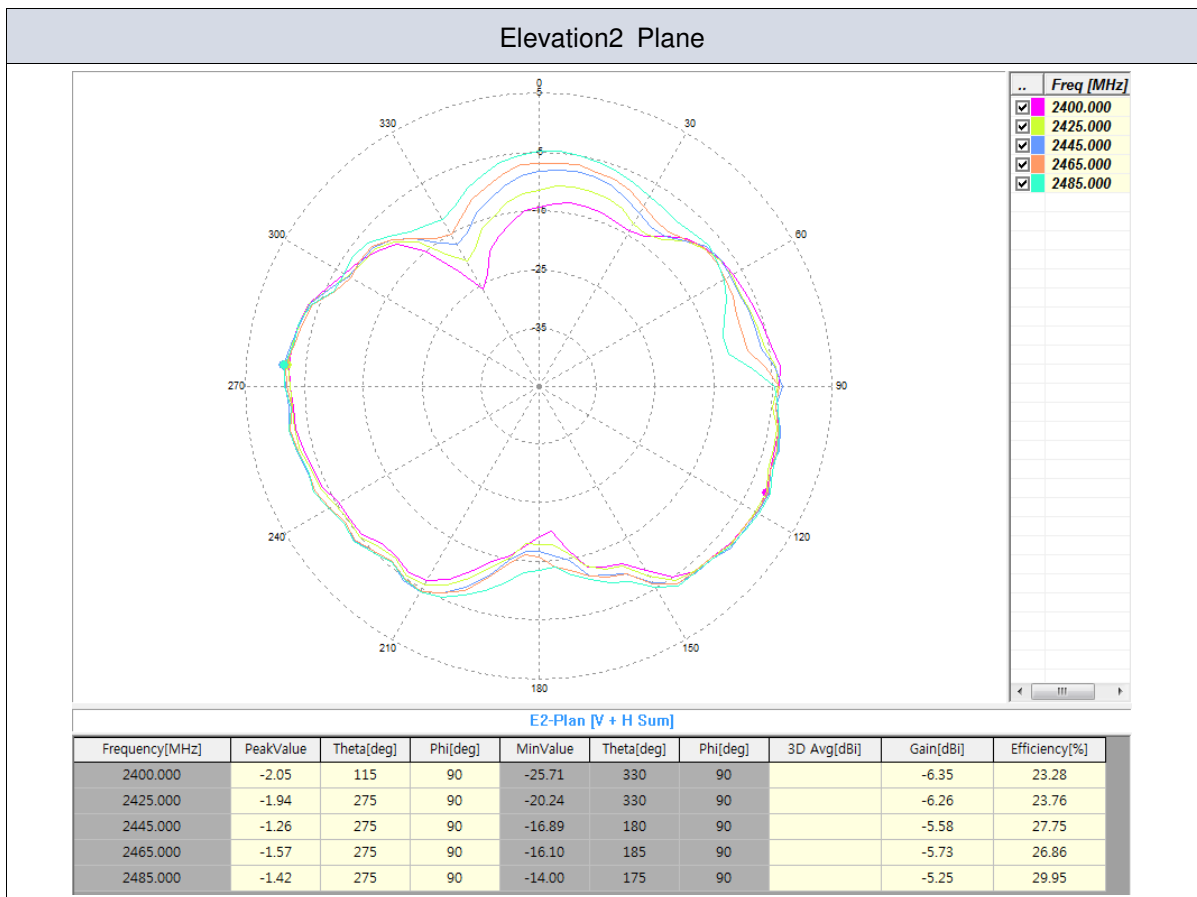
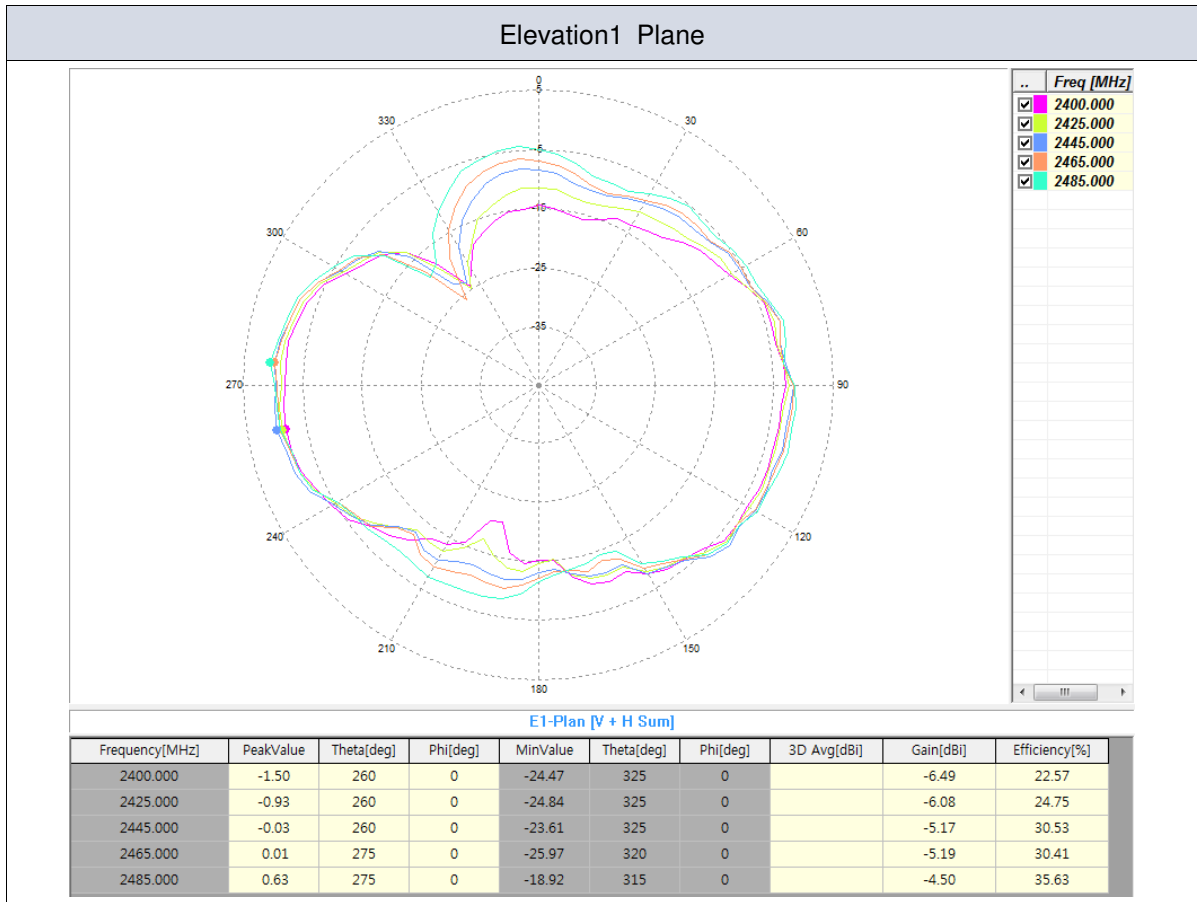
2.3 Graph of Set Condition



2.4 Graph of Test Fixture Condition

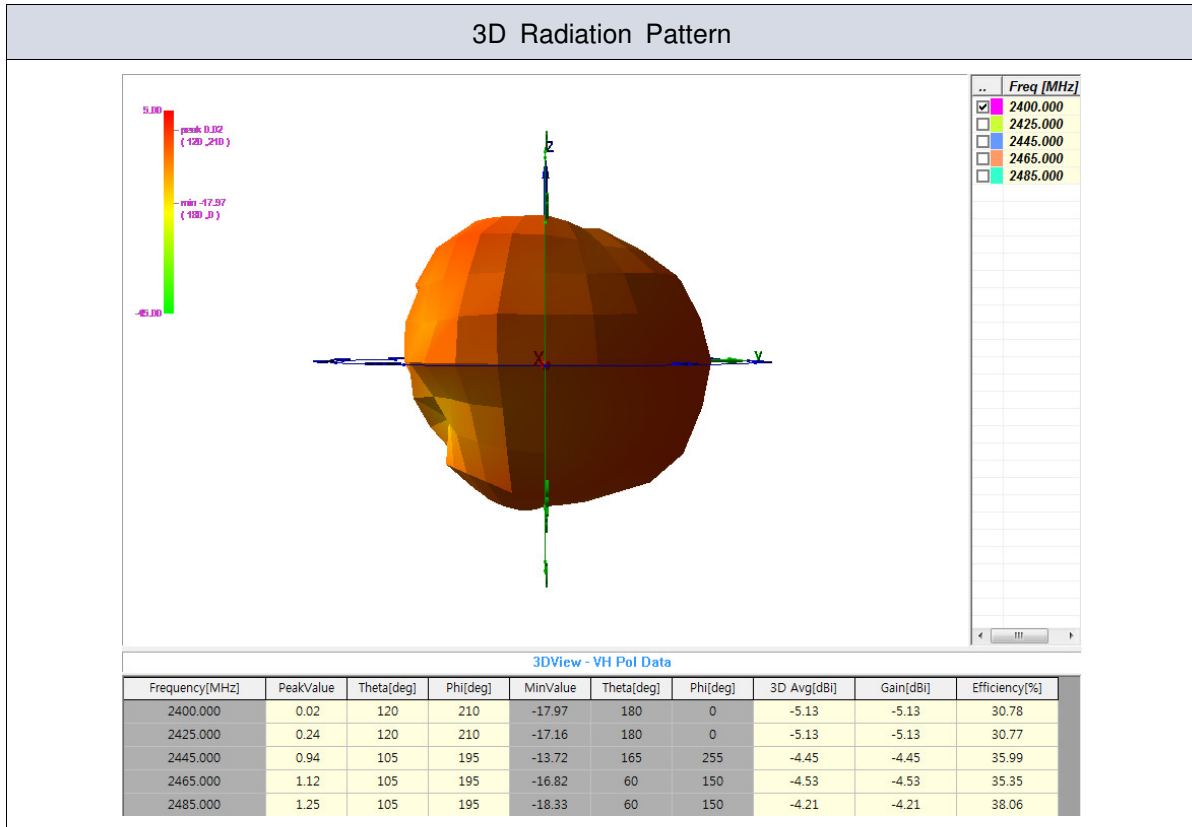


**2.5 Radiation Pattern**






2.6 3D Radiation Pattern



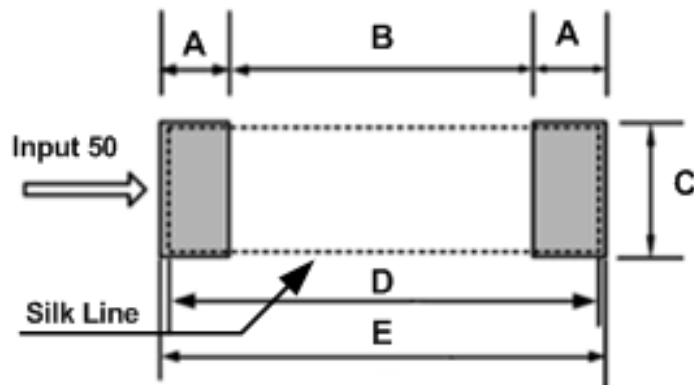
**3. Mechanical Characteristics**

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

3.1 Structure and Material

Material	Dielectric Block	3D Structure	
		Ag Paste	<p style="text-align: center;"><b>Top-Side View</b>                      <b>Bottom-Side View</b></p>
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

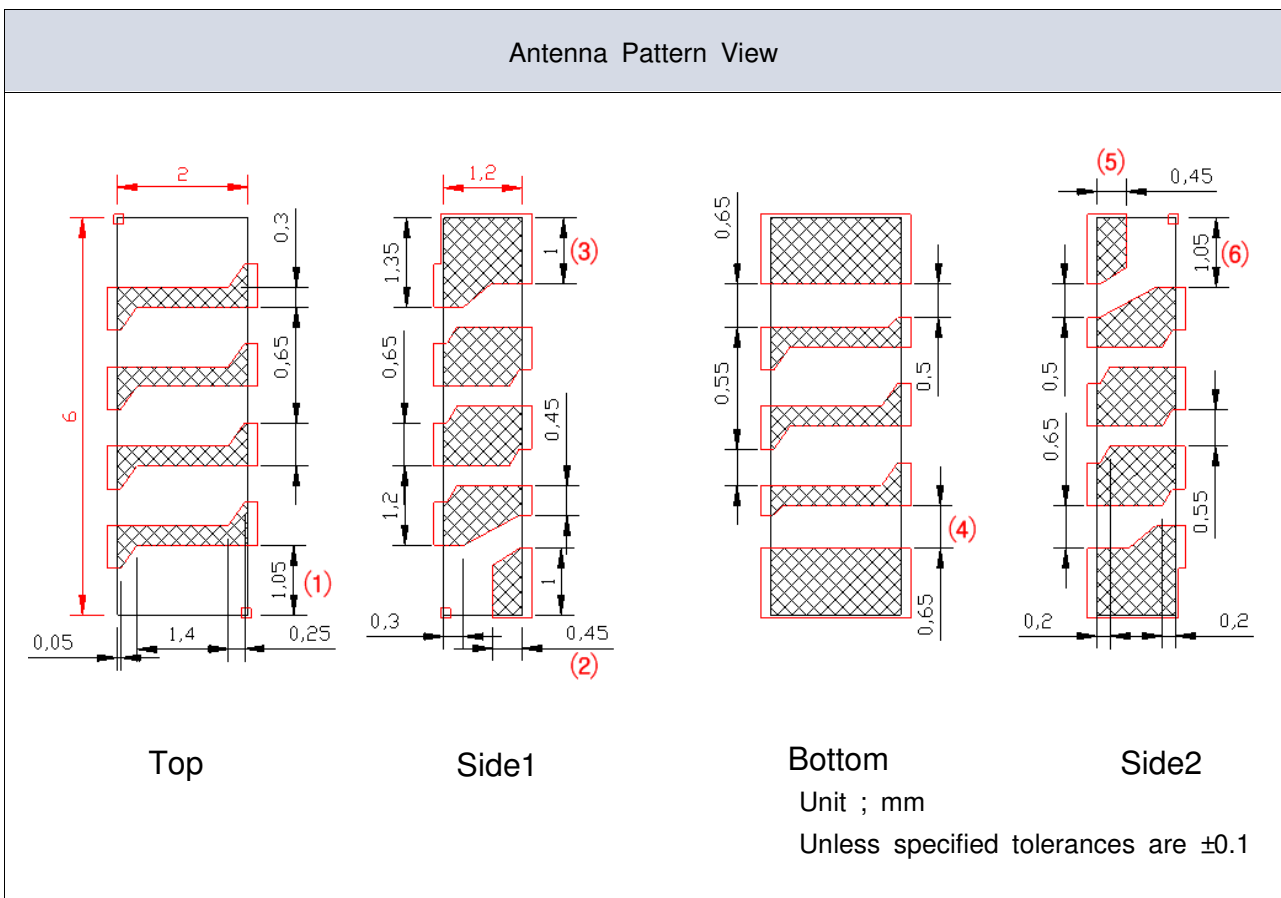


Parameter	A	B	C	D	E
Value[mm]	1.2	4.0	2.4	6.0	6.4

Unit ; mm

Unless specified tolerances are  $\pm 0.1$

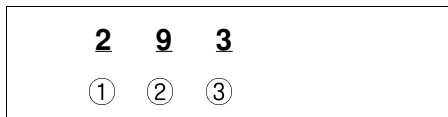
### 3.3 Antenna Pattern Dimension



### 3.3.1 Real Measurement Value

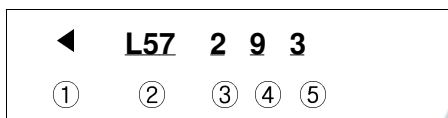
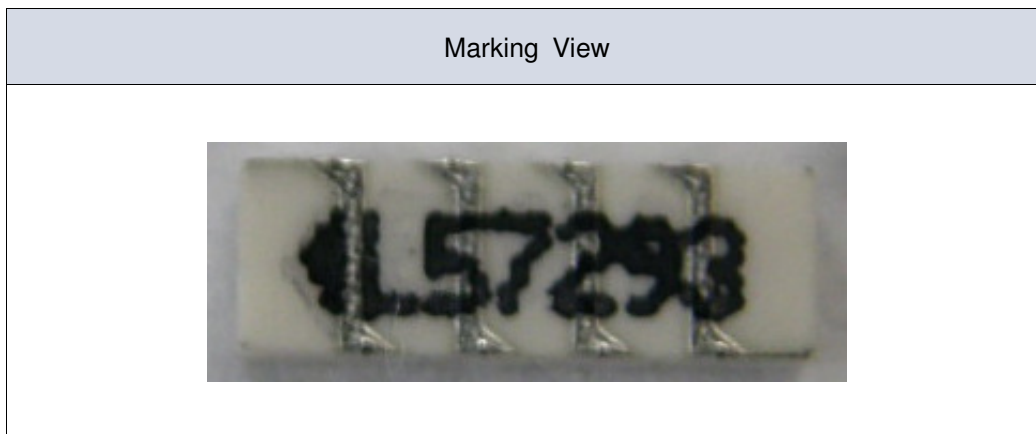
	(1)	(2)	(3)	(4)	(5)	(6)
Drawing Dimension [mm]	1.05±0.1	0.45±0.1	1.0±0.1	0.65±0.1	0.45±0.1	1.05±0.1
1	1.136	0.440	1.033	0.640	0.513	1.099
2	0.962	0.460	0.953	0.634	0.509	1.036
3	1.036	0.507	1.026	0.645	0.470	1.108
4	1.122	0.490	1.022	0.640	0.474	1.080
5	0.982	0.461	0.970	0.669	0.503	1.073
Min [mm]	0.962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


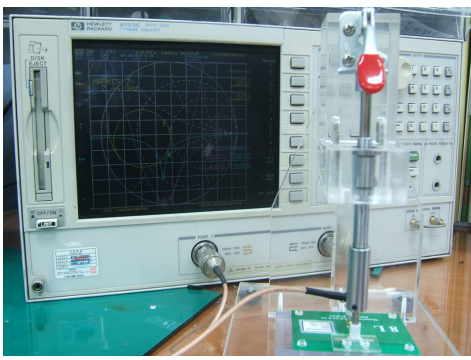


- ① Input Signal
- ② Serial
- ③ Year ; 1 - 2011, 2 - 2012, ..... 9 - 2019, 0 - 2020 .....
- ④ Month ; 1 - January, 2 - February, ..... A - October, B - November .....
- ⑤ Date ; 1 - 1st, 2 - 2nd, 3 - 3rd ..... H - 17th, I - 18th .....

### 4. Measurement Process

#### 4.1 SWR/Returnloss

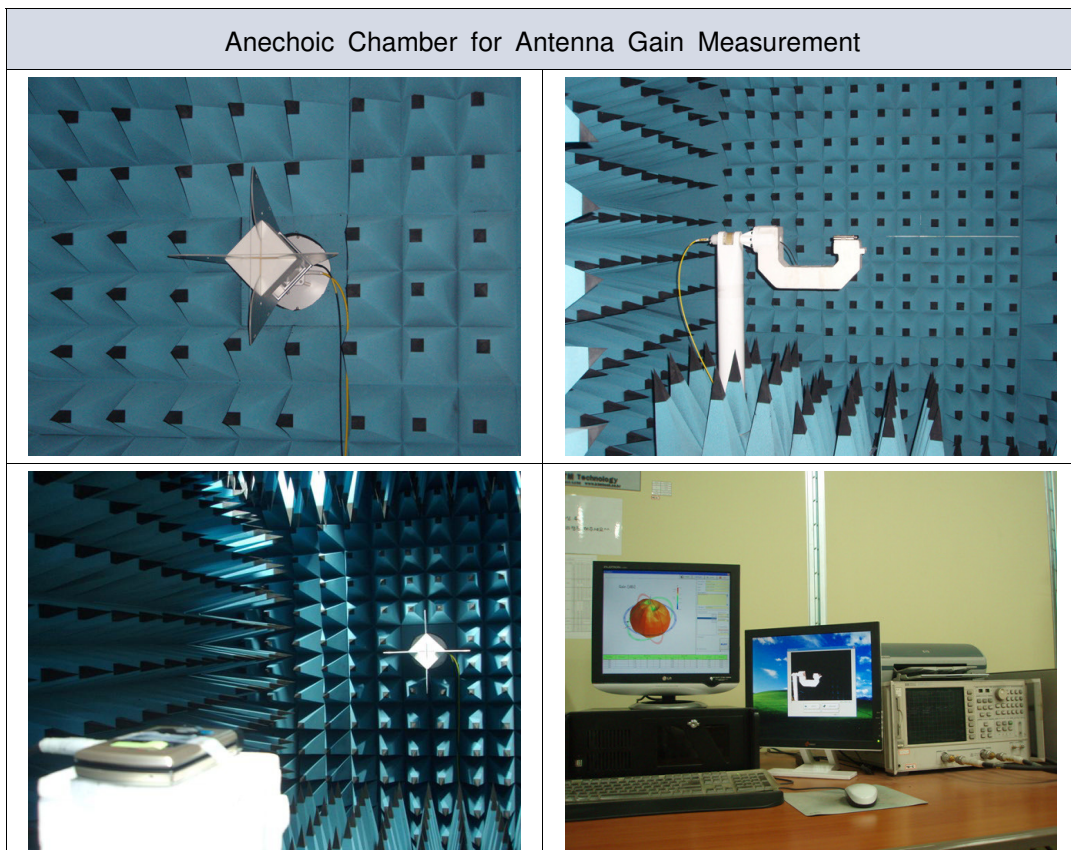
-The SWR/Returnloss is measured by Network Analyzer

	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

Anechoic Chamber for Antenna Gain Measurement



The image shows four views of an anechoic chamber used for antenna gain measurement. The top-left view shows a horn antenna mounted on a stand. The top-right view shows a U-shaped antenna structure. The bottom-left view shows a mobile phone on a stand. The bottom-right view shows the control room with a computer monitor displaying a radiation pattern graph and a network analyzer.

**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

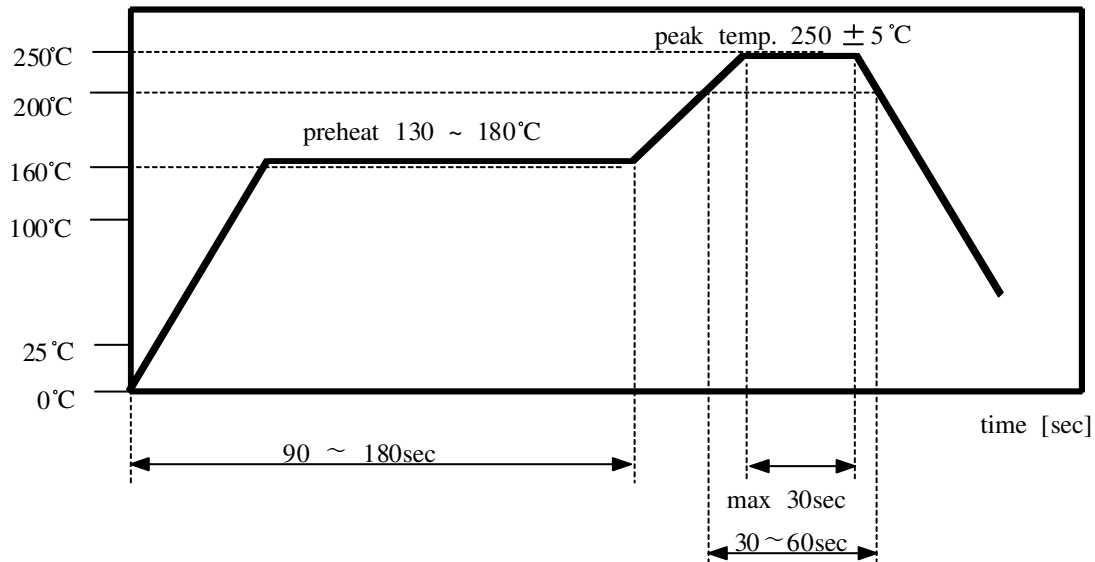
ITEM	TEST CONDITION	LIMIT
Random Vibration	Frequency 10~500Hz - 10 ×9.8m/s <sup>2</sup> (G) Sweep time 15min, X.Y.Z each 5 times	*After the test, specimen sheet meet the electrical specification
Drop	Height 152cm, 5 times (Each Surface)	

### 6.4 Reliability Test Result

※ Appendix

## 7. Soldering Condiion

### 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)

NO. S12W208

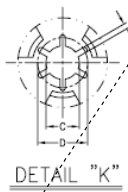
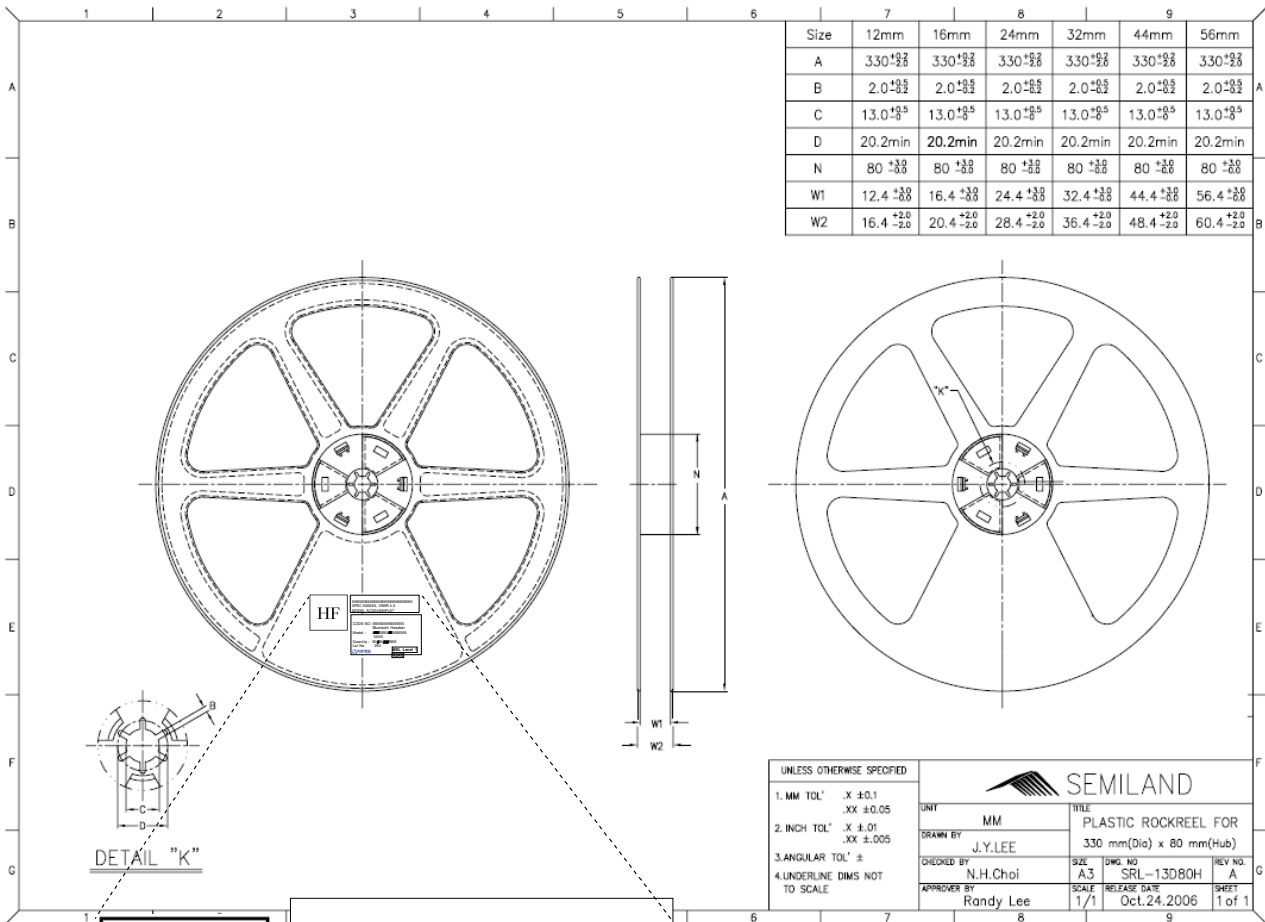
PACKING QUANTITY  
5,000 PCS / REEL

AO	2.30 ± 0.10	E	1.75 ± 0.10
BO	6.30 ± 0.10	F	5.50 ± 0.10
KO	1.40 ± 0.10	t	0.30 ± 0.05
DO	1.55 ± 0.05	w	12.00 ± 0.30

Scale	N/S	Unit	m/m	Customer & Title
Date	2004			6*2*1.2
Designed by	Checked by	Approved by		

(주)에스엠에스티  
SMT CO. LTD



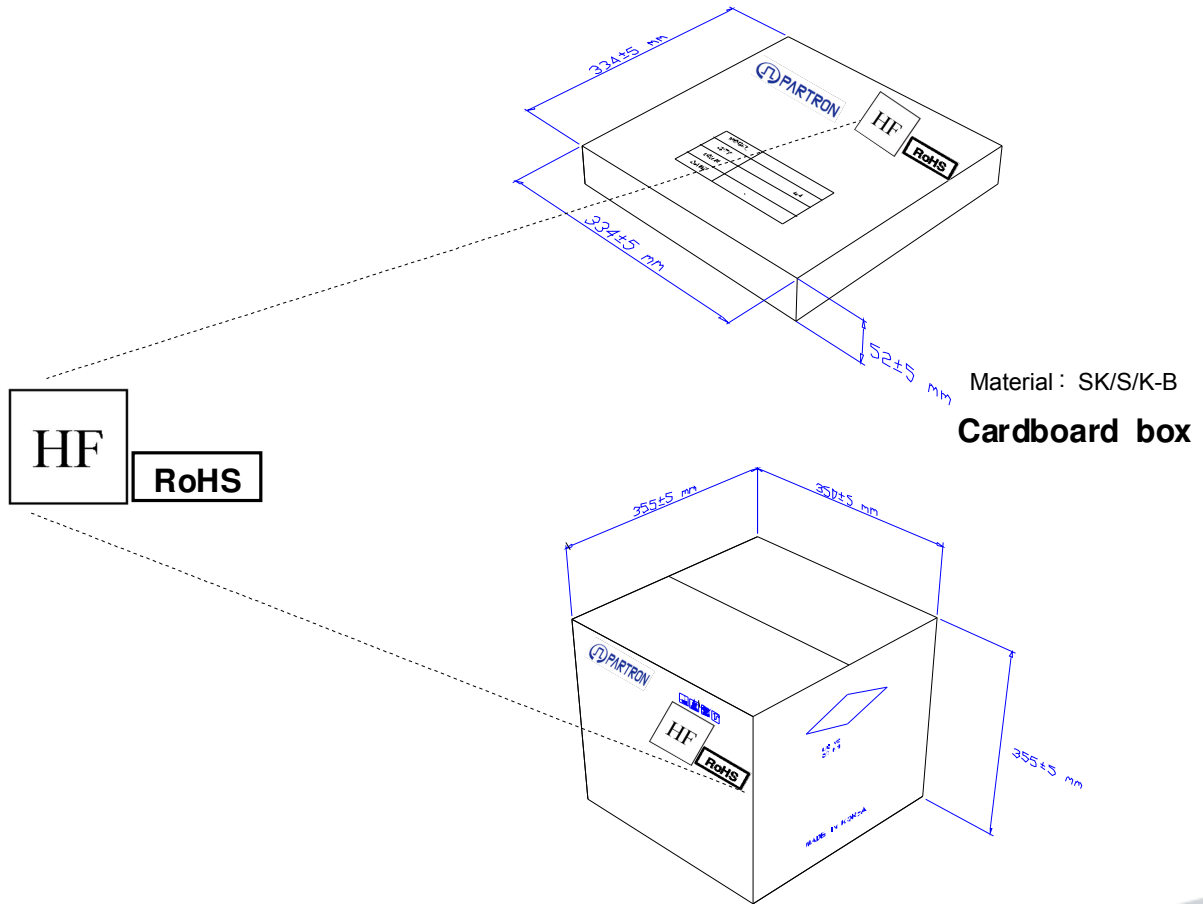


**HF**

SPEC 5000EA, VSWR 4.0  
 MODEL : ACS2450HFL57  
 CODE NO :  
 Bluetooth Headset  
 Model :  
 5000  
 Quantity :  
 Lot No 293  
**MSL Level 1**  
**RoHS**  
**PARTRON**

UNLESS OTHERWISE SPECIFIED		<b>SEMILAND</b>	
1. MM TOL' .X ±0.1 .XX ±0.05	2. INCH TOL' .X ±0.01 .XX ±.005	3. ANGULAR TOL' ±	4. UNDERLINE DIMS NOT TO SCALE
UNIT: <b>MM</b> DRAWN BY: <b>J.Y.LEE</b> CHECKED BY: <b>N.H.Choi</b> APPROVER BY: <b>Randy Lee</b>		TITLE: <b>PLASTIC ROCKREEL FOR</b> 330 mm(Dia) x 80 mm(Hub) SIZE: <b>A3</b> DWG. NO: <b>SRL-13D80H</b> SCALE: <b>1/1</b> RELEASE DATE: <b>Oct.24.2006</b>	
		REV. NO. <b>A</b>	SHEET <b>1 of 1</b>

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						Revised	05.04.03	PRCP-C001			
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/pressure 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						Record					
		Revised	05.04.03	PRCP-C001										
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
AG PASTE		○	SIDE 2 PAD Printing CTQ	Printer screen	Squeeze velocity/pressure 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/pressure 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/pressure 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	04.04.06						Revised	05.04.03	PRCP-C001			
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
		○	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. SHAE1413319701 Date: 17 Jul 2014 Page 1 of 7

WUXI INANOTECH CO.,LTD  
NO.518-3 ZHONGHUI ROAD, WUXI, JIANGSU, CHINA (214174)

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

SGS Job No.: SP14-021760 - SH  
Model No.: BA1C35  
Composition: BA1C03  
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, Polybrominated biphenyls (PBBs), Polybrominated diphenyl ethers (PBDEs) comply with the limits as set by RoHS Directive 2011/65/EC Annex II, recasting 2002/95/EC.

Signed for and on behalf of SGS-CSTC Ltd  
*Mary Ma*  
Mary Ma  
Approved Signatory

**Test Report** No. SHAE1413319701 Date: 17 Jul 2014 Page 2 of 7

Test Results:

**Test Part Description:**

Specimen No.	SGS Sample ID	Description
SN1	SHA14-133197.001	Coffee 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/EC**

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 62321-2:2008, determination of Hexavalent Chromium by Colorimetric Method using UV-VIS.  
(5) With reference to IEC 62321-2:2008, determination of PBBs and PBDEs by GC-MS.

Test Item(s)	Limit	Unit	MDL	∅/∅
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

**Test Report** No. SHAE1413319701 Date: 17 Jul 2014 Page 3 of 7

Test Item(s)	Limit	Unit	MDL	∅/∅
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/EC, Annex II

**Chemical**

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

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

**Halogen**

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

Test Item(s)	Limit	MDL	∅/∅
Chlorine (Cl)	50	mg/kg	ND
Bromine (Br)	50	mg/kg	ND

**Test Report** No. SHAE1413319701 Date: 17 Jul 2014 Page 4 of 7

**ATTACHMENTS**

**RoHS Testing Flow Chart**

1) Name of the person who made testing: Jan ShyStar Wang/Shara Wang/Gary Xu  
2) Name of the person in charge of testing: Jeff Zhang/ Jessy Huang

```

graph TD
    A[Sample Preparation] --> B[Sample Measurement]
    B --> C{Pb/Cd/Hg}
    B --> D{PBBs/PBDEs}
    B --> E{Cr6+}
    
    C --> C1[Acid digestion with microwave hotplate]
    C --> C2[Filtration]
    C1 --> C3[Solution]
    C2 --> C4[Residue]
    C3 --> C5[ICP-OES]
    C4 --> C6[1) Alkali Fusion / Dry Ashing / 2) Acid to dissolve]
    C6 --> C5
    
    D --> D1[Sample solvent extraction]
    D --> D2[Nonmetallic material]
    D --> D3[Metallic material]
    
    D1 --> D4[Concentration / Dilution of extraction solution]
    D1 --> D5[Adding digestion reagent]
    D4 --> D6[Filtration]
    D5 --> D6
    
    D6 --> D7[GC/MS]
    D7 --> D8[DATA]
    
    D2 --> D9[Heating to 50-55°C for extraction]
    D9 --> D10[Filtration and pH adjustment]
    D10 --> D11[Adding 1,5-diphenylcarbazide for color development]
    D11 --> D12[UV-VIS]
    D12 --> D13[DATA]
    
    D3 --> D14[Positive / Spot test]
    D14 --> D15[Boiling water extraction]
    D15 --> D16[Adding 1,5-diphenylcarbazide for color development]
    D16 --> D17[A red color indicates the presence of Cr6+. If necessary, confirm with UV-VIS]
    D17 --> D18[DATA]
    
    E --> E1[ICP-OES]
    E1 --> E2[DATA]
  
```

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

Sample photo:

SHAEC1413319701

SHA-14-133197-001

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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. F690101.F-CTSAYAA14-28567** Issued Date : 2014. 05. 17 Page 1 of 0

DAEJOO ELECTRONICS MATERIALS CO. LTD.  
146, Saphae-ro  
Sehaung-eub, 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. 05. 09  
Test Period : 2014. 05. 10 to 2014. 05. 17  
Report Comments : By the applicant's request, Item No./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*  
Jeff Jang / Chemical Lab Mgr

SGS Korea Co., Ltd.  
322, The City Hall, 36, 1-6, Dongguk-ro, Gyeonggi-do, Gyeonggi-do, Korea 41030  
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FA01 version2

**SGS**

**Test Report No. F690101.F-CTSAYAA14-28567** Issued Date : 2014. 05. 17 Page 2 of 0

Sample No. : AYAA14-28567-001  
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 62321:2008, ICP	5	N.D.
Cadmium (Cd)	mg/kg	With reference to IEC 62321:2008, ICP	0.5	N.D.
Mercury (Hg)	mg/kg	With reference to IEC 62321:2008, ICP	2	N.D.
Hexavalent Chromium (Cr(VI))	mg/kg	With reference to IEC 62321:2008, UV-Vis	1	N.D.

**Fluoride, Barium, Lead, Phosphorus**

Test Items	Unit	Test Method	MDL	Results
Monoarobromophenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Dibromophenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tribromophenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tetraarobromophenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Pentaarobromophenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Hexaarobromophenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Heptaarobromophenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Octaarobromophenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Nonaarobromophenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Decaarobromophenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Monoarobromophenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Dibromophenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tribromophenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tetraarobromophenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Pentaarobromophenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Hexaarobromophenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Heptaarobromophenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Octaarobromophenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Nonaarobromophenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Decaarobromophenyl ether	mg/kg	With reference to IEC 62321:2008, 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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322, The City Hall, 36, 1-6, Dongguk-ro, Gyeonggi-do, Gyeonggi-do, Korea 41030  
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**SGS**

**Test Report No. F690101.F-CTSAYAA14-28567** Issued Date : 2014. 05. 17 Page 3 of 0

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 cm<sup>2</sup> sample surface area.

Picture of Sample as Received:

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FA01 version2

**SGS**

**Test Report No. F690101.F-CTSAYAA14-28567** Issued Date : 2014. 05. 17 Page 4 of 0

**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]
  
```

Sample material	Digestion Acid
Metal: Fe, Cu, Al, etc.	Aqua regia, HCl, HNO <sub>3</sub>
Plastic	HNO <sub>3</sub> , HCl, HF, HClO <sub>4</sub>
Silver	HNO <sub>3</sub> , H <sub>2</sub> O <sub>2</sub>
Solder, Au, Pt, Pd, Sb, Sn	Aqua regia
Glass	HNO <sub>3</sub> , HF
Ti, Zr, W, Mo, Bi, Hf, Nb, Ta	HNO <sub>3</sub> , HCl, HF
Slugs (IEC 62321)	HNO <sub>3</sub> , HCl, H <sub>2</sub> O <sub>2</sub> , HBr
Others	Any acid

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

SGS Korea Co., Ltd.  
322, The City Hall, 36, 1-6, Dongguk-ro, Gyeonggi-do, Gyeonggi-do, Korea 41030  
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**SGS**  
**Test Report** No. F890101LF-CTSAYAA14-28567 Issued Date : 2014. 09. 17 Page 6 of 6

**Flow Chart of Cr<sup>6+</sup>, PBB/PBDEs Testing**

```

    graph TD
      subgraph Cr6plus [Cr6+]
        Cr6plus_Mech[Mechanic_Sample] --> Cr6plus_Samp[Sample Measurement]
        Cr6plus_Samp --> Cr6plus_Ext[Solvent Extraction of the Sample]
        Cr6plus_Ext --> Cr6plus_Scr[Screen Analysis]
        Cr6plus_Scr --> Cr6plus_Conc[Concentration/Dilution of Extraction Solution]
        Cr6plus_Conc --> Cr6plus_GC[GC/MS]
        Cr6plus_GC --> Cr6plus_Data[DATA]
      end

      subgraph PBBPBDEs [PBB/PBDEs]
        PBBPBDEs_Mech[Mechanic_Sample] --> PBBPBDEs_Samp[Sample Measurement]
        PBBPBDEs_Samp --> PBBPBDEs_Non[Nonmetallic Material]
        PBBPBDEs_Non --> PBBPBDEs_Ext[Adding Extraction Solution]
        PBBPBDEs_Ext --> PBBPBDEs_Heat[Heating to 90-95°C for Extraction]
        PBBPBDEs_Heat --> PBBPBDEs_Filt[Filtration and pH Adjustment]
        PBBPBDEs_Filt --> PBBPBDEs_Color[Adding 1,5-Diphenylcarbazide for Color Development]
        PBBPBDEs_Color --> PBBPBDEs_UV[UV-Vis]
        PBBPBDEs_UV --> PBBPBDEs_Data[DATA]
      end

      subgraph Cr6plus2 [Cr6+]
        Cr6plus2_Mech[Mechanic_Sample] --> Cr6plus2_Samp[Sample Measurement]
        Cr6plus2_Samp --> Cr6plus2_Test[Spot Test / Boiling Water Extraction]
        Cr6plus2_Test --> Cr6plus2_Color[Adding 1,5-Diphenylcarbazide for Color Development]
        Cr6plus2_Color --> Cr6plus2_Conf[Confirm with UV-Vis]
        Cr6plus2_Conf --> Cr6plus2_Data[DATA]
      end
  
```

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**Test Report** No. F890101LF-CTSAYAA14-28567 Issued Date : 2014. 09. 17 Page 6 of 6

**Flow Chart for Halogen Test**

```

    graph TD
      Start[Sample screening using XRF] --> Q1{Liquid containing water (>80%)}
      Q1 -- No --> Weigh[Weigh the samples into the combustion boat.]
      Q1 -- Yes --> Dilute[Dilute the solution (EPA300)]
      Weigh --> AddSol[Add absorption solution into the bomb or tube.]
      AddSol --> Admit[Admit O2 gas or O2 +Ar2 gas and start the combustion.]
      Admit --> Allow[Allow during absorption of the burnt gas.]
      Allow --> Analyze[Analyze absorbed solution using Ion Chromatography.]
      Analyze --> Data[Data]
      Data --> End[*** End of Report ***]
  
```

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11.3 Marking Ink

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 1 of 7

YANTAI PARTRON ELECTRONICS CO.,LTD  
 352# MUXIN ROAD ECONOMIC, DEVELOPMENT ZONE MUPING YANTAI SHANDONGS CHINA

The following sample(s) was/were submitted and identified on behalf of the clients as : INK  
 SGS Job No. : TP13-006610 - 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, Polychlorinated biphenyls (PBB), Polychlorinated 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.  
 Reabeca Zhou  
 Approved Signatory

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**SGS**  
**Test Report** No. TSNEC1301308502 Date: 26 Dec 2013 Page 2 of 7

**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 Requested

**RoHS Directive 2011/65/EU**

**Test Method :**

- (1) With reference to IEC 62321-6:2013, 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	002
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 Report No. TSNEC1301308502 Date: 26 Dec 2013 Page 7 of 7

Sample photo:



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