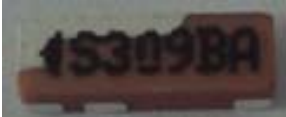





# Approval Sheet

<b>Products</b>	<b>CHIP Antenna</b>	<b>Antenna</b>
<b>Supplier CODE</b>	<b>ACS2450FBAS30</b>	 <b>TOP</b>  <b>BOTTOM</b>
<b>Model</b>	<b>GBH-S300</b>	
<b>SEC CODE</b>		
<b>Revision</b>	<b>VER.1.0 12/16</b>	
<b>Supplier</b>	<b>Partron</b>	

<b>MSL</b>	<b>LEAD FREE</b>	<b>BFRs-Free, Halogen-Free</b>
<b>MSL 1</b>		

<b>Drafter</b>	<b>Research 5Team</b>	<b>Quality Assurance</b>
구재영		
JaeYoung.Koo	Chanik.Jeon	Nam-sik.Min
12/16	12/16	12/16

**- Contents -**

※ Cover .....	1 p
※ Contents .....	2 p
1. Revision History .....	3 p
2. Introduction .....	4 p
3. Special Management .....	4 p
4. Electrical Characteristics .....	5 p
5. Measurement Process .....	10 p
6. Internal Block Diagram .....	12 p
7. Basis Action / Application Note .....	12 p
8. Measurement Jig SPEC .....	13 p
9. Soldering Condition .....	14 p
10. Primary Inspection List .....	15 p
11. Reliability Condition .....	16 p
12. Mechanical Characteristics .....	18 p
13. Structure & Material .....	20 p
14. Attention .....	21 p
15. Packing .....	22 p
16. Process Control .....	26 p
17. RoHS Data .....	29 p

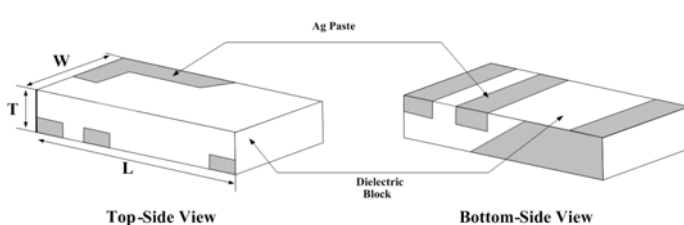
[illegible]

## 2. Introduction

### 2.1 Introduction of Product

This product is an internal dielectric chip antenna that the Ag paste is printed on the surface of dielectric block.


### 2.2 Specification and Dimension

Type	Only Bulk Ceramic					
Material	Dielectric Block	Mg <sub>2</sub> SiO <sub>4</sub> (Magnesium Silicate)				
	Electrode Paste	Ag				
Dimension [mm]	W = 2.0±0.1					
	L = 6.0±0.1					
	T = 1.2±0.1					
Flatness	0.04					
MSL LEVEL	MSL Level 1					
ESD LEVEL	More than 15 KV (HBM CLASS 3B)					
Version	Revision 1.0					
Characteristic inspection (CTF)	Frequency	VSWR(CTF)	Cycle of management	LOT	CPK	Page
	2400MHz	1.0 ~ 3.0 : 1	ALL	ALL	5.19	4,6,15 Page
	2485MHz	1.0 ~ 3.0 : 1	ALL	ALL	5.17	4,6,15 Page

## 3. Special Management( )

- The below things are special management items.

CTQ	The reason
Dimension & Weight (after forming)	The plasticity dielectric block is influenced at this item
Dimension (after Plasticity)	The accuracy of printed pattern is influenced at this item
Dimension of Printing Pattern	The accuracy of printed pattern is the most special thing at electrical characteristic of dielectric chip antenna

CTF 	The reason
SWR Measurement	This item is an important parameter that fix an electrical characteristic

- Care about the below things.

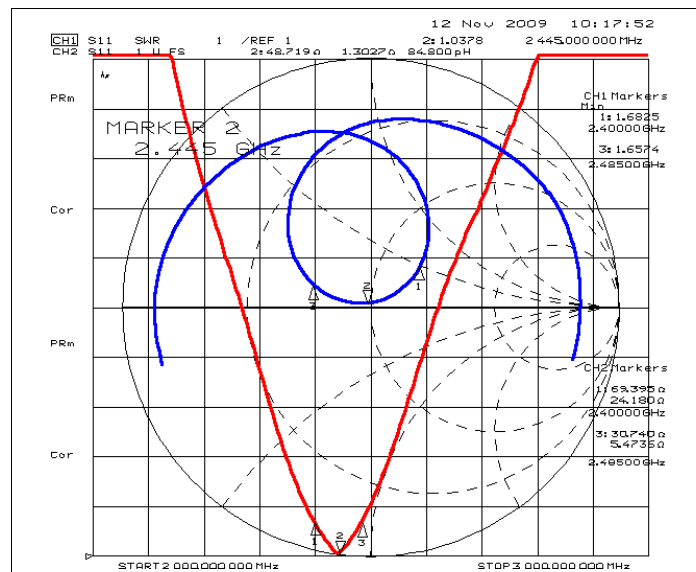
ITEM	Content
Keeping	Sealing tightly when keeping for a long time
Action	Maybe characteristics is changed when changed any design

## 4. Electrical Characteristics

### 4.1 Set Condition

ITEM				SPEC
Frequency Range [MHz]				2400 ~ 2485
SWR [Max]				3.5 : 1 (Typ 3.0 : 1)
Input Impedance [ $\Omega$ ]				50 Ohm
Polarization				Linear
Gain [dBi]	Total Gain ( Peak / Avg ) [dBi]			0.6 / -3.4
	Azimuth	Theta	Peak	3.22
			Average	1.00
		Phi	Peak	-9.15
			Average	-14.97
	Elevation 1	Theta	Peak	-3.74
			Average	-10.27
		Phi	Peak	3.08
			Average	-1.96
	Elevation 2	Theta	Peak	-9.64
			Average	-16.99
		Phi	Peak	3.24
			Average	-1.62

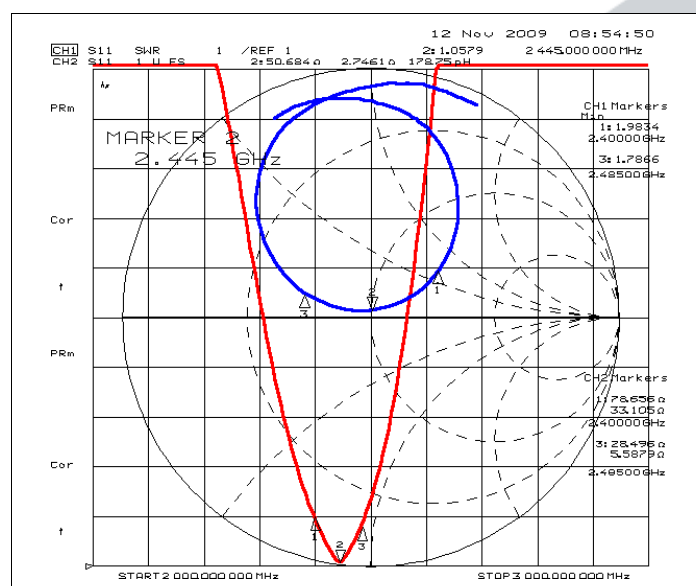
#### 4.2 S11 Graph of Set Condition



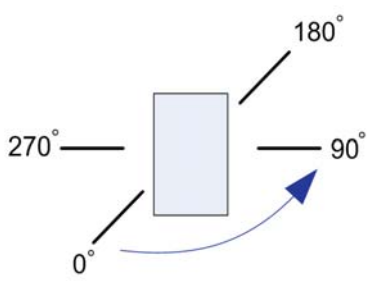
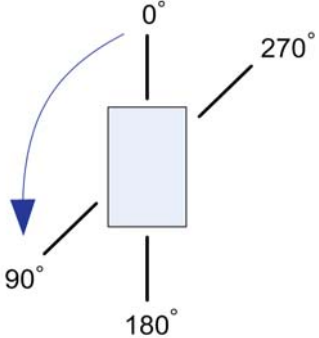
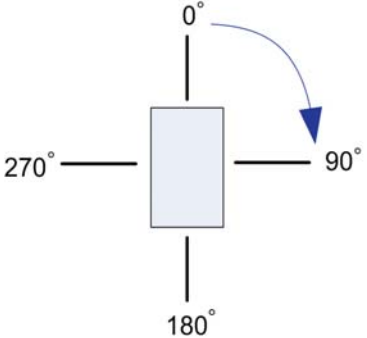
#### 4.3 Test Fixture Condition

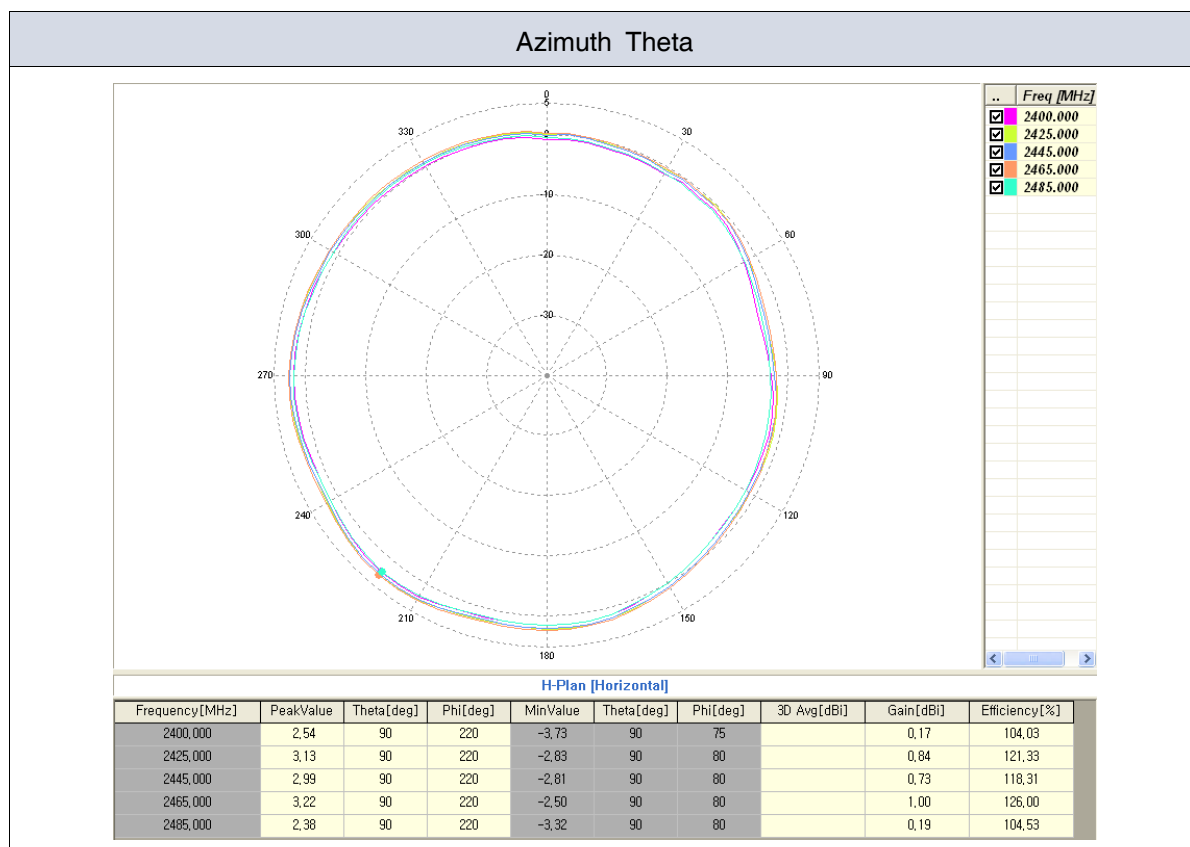
ITEM	SPEC
Frequency Range [MHz]	2400 ~ 2485
Lower Frequency ( 2400 MHz ) SWR [Min~Max]	1.0 ~ 3.0 : 1 (Typ 2.5 : 1)
Upper Frequency ( 2485 MHz ) SWR [Min~Max]	1.0 ~ 3.0 : 1 (Typ 2.5 : 1)

#### 4.4 S11 Graph of Test Fixture Condition CTF

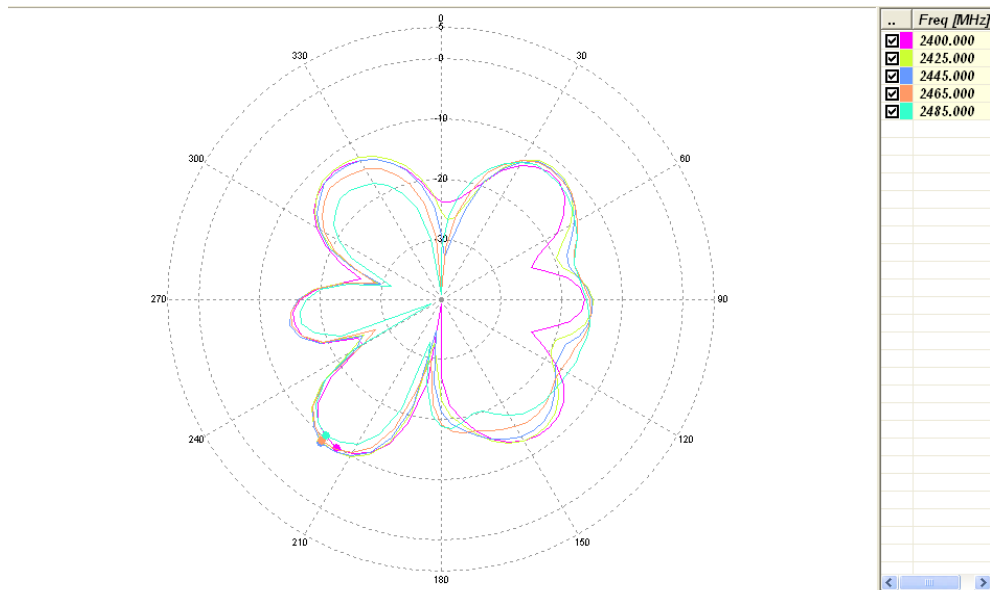


#### 4.5 Radiation Pattern

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



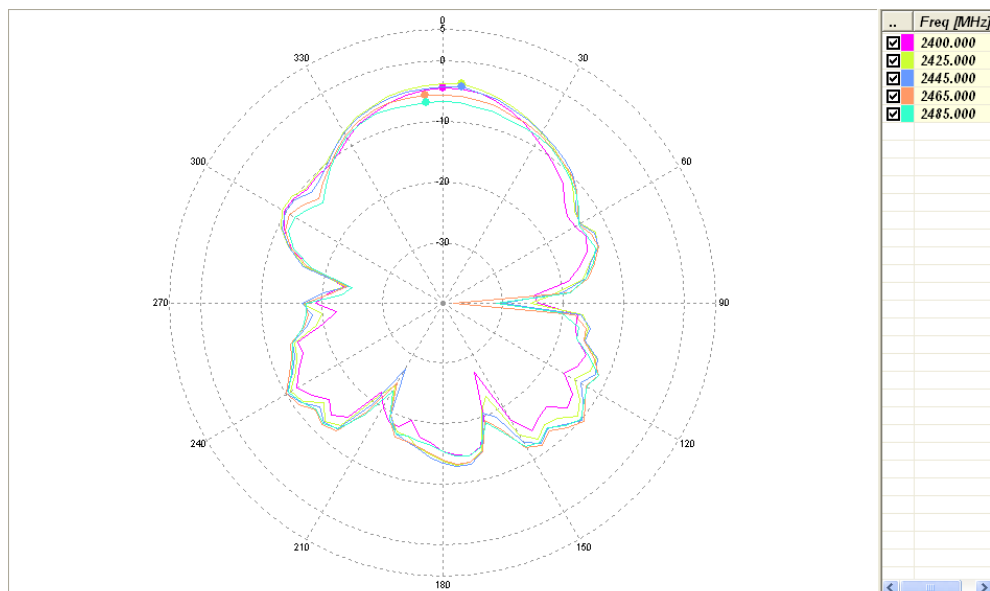
### Azimuth Phi



H-Plan [Vertical]

Frequency[MHz]	PeakValue	Theta[deg]	Phi[deg]	MinValue	Theta[deg]	Phi[deg]	3D Avg[dBi]	Gain[dBi]	Efficiency[%]
2400,000	-9,97	90	215	-39,28	90	185		-15,58	2,88
2425,000	-9,15	90	220	-32,55	90	190		-14,97	3,29
2445,000	-9,04	90	220	-34,70	90	190		-15,17	3,15
2465,000	-9,48	90	220	-38,63	90	0		-15,59	2,87
2485,000	-10,49	90	220	-39,05	90	355		-16,55	2,32

### Elevation1 Theta

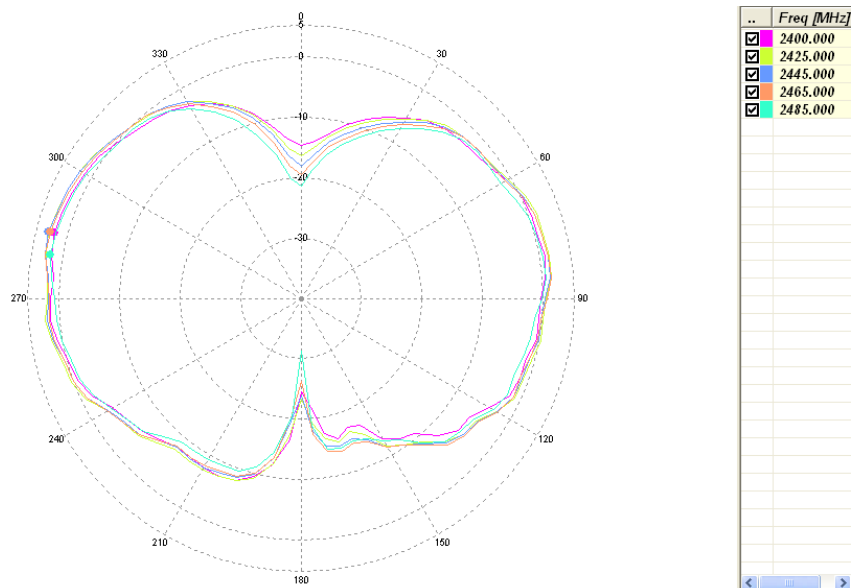


E1-Plan [Vertical]

Frequency[MHz]	PeakValue	Theta[deg]	Phi[deg]	MinValue	Theta[deg]	Phi[deg]	3D Avg[dBi]	Gain[dBi]	Efficiency[%]
2400,000	-4,50	0	0	-27,46	155	0		-11,26	7,58
2425,000	-3,74	5	0	-25,46	90	0		-10,27	9,51
2445,000	-4,18	5	0	-30,08	90	0		-10,35	9,33
2465,000	-5,61	355	0	-38,25	90	0		-10,89	8,25
2485,000	-6,83	355	0	-31,16	90	0		-11,59	7,05



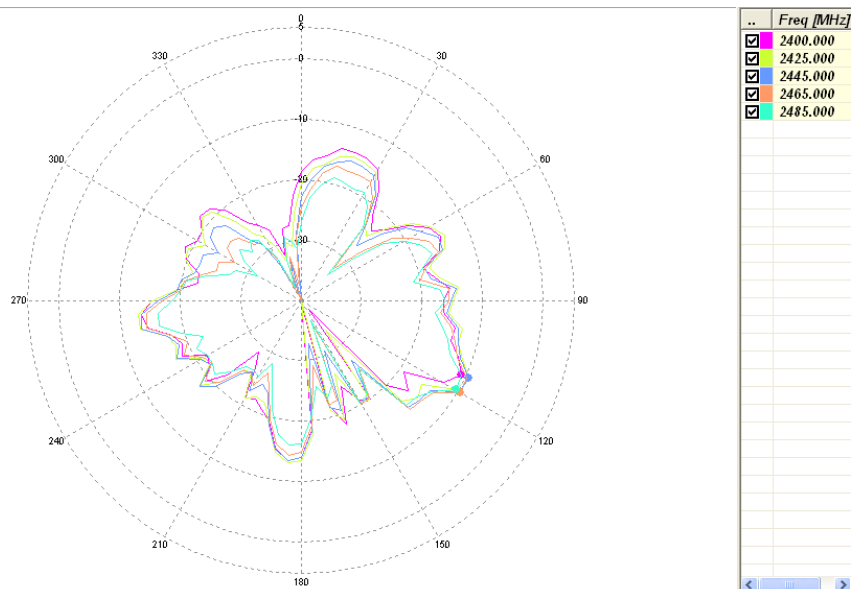
### Elevation1 Phi



E1-Plan [Horizontal]

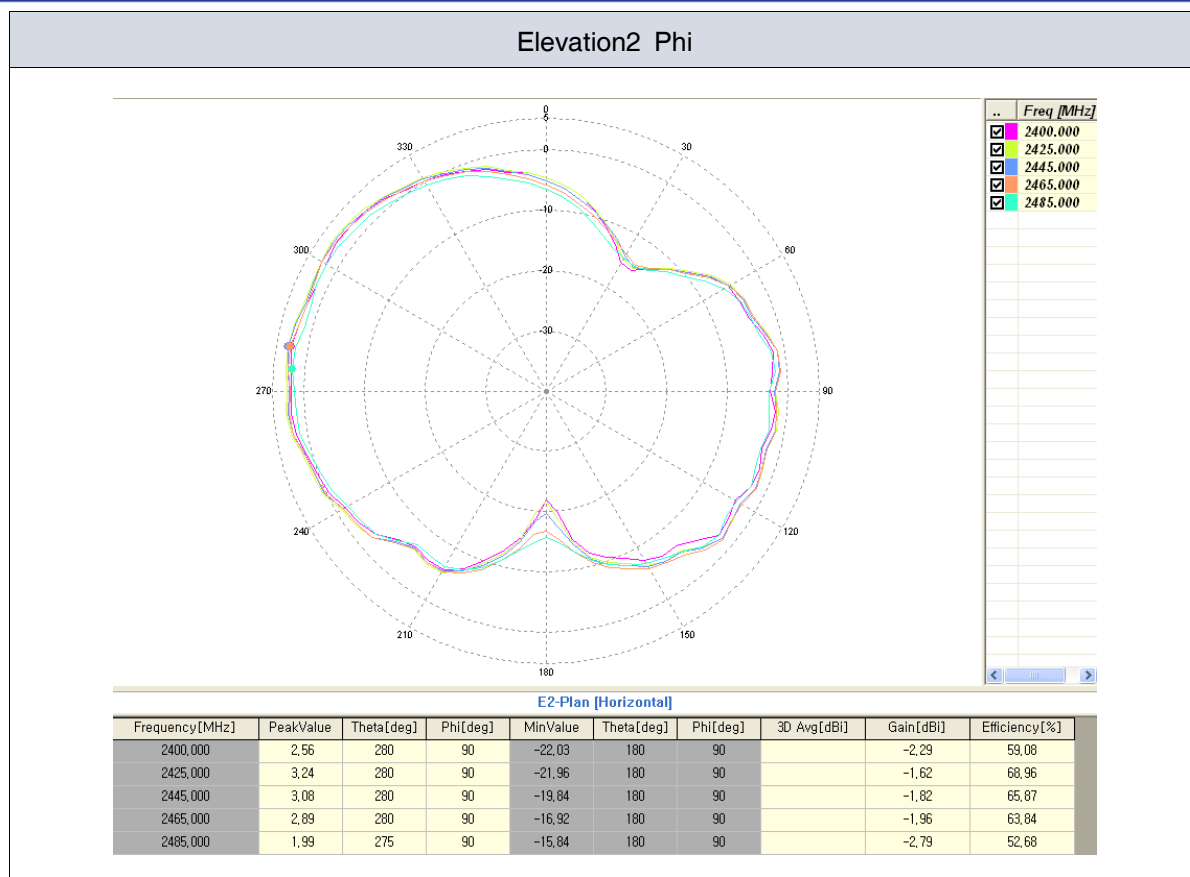
Frequency[MHz]	PeakValue	Theta[deg]	Phi[deg]	MinValue	Theta[deg]	Phi[deg]	3D Avg[dBi]	Gain[dBi]	Efficiency[%]
2400,000	2,08	285	0	-24,63	180	0		-2,76	53,03
2425,000	3,08	285	0	-23,49	180	0		-1,96	63,79
2445,000	3,11	285	0	-23,94	180	0		-2,12	61,54
2465,000	2,82	285	0	-26,38	180	0		-2,23	60,00
2485,000	2,01	280	0	-31,35	180	0		-3,12	48,83

### Elevation2 Theta



E2-Plan [Vertical]

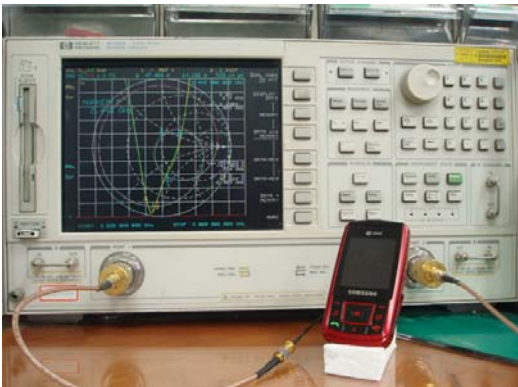
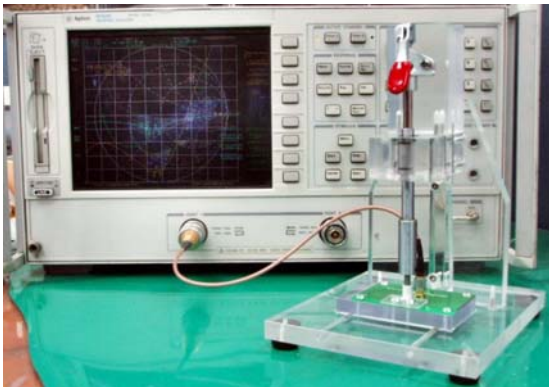
Frequency[MHz]	PeakValue	Theta[deg]	Phi[deg]	MinValue	Theta[deg]	Phi[deg]	3D Avg[dBi]	Gain[dBi]	Efficiency[%]
2400,000	-10,98	115	90	-39,64	170	90		-17,54	1,87
2425,000	-9,64	115	90	-40,56	170	90		-16,99	2,11
2445,000	-9,57	115	90	-44,93	350	90		-17,37	1,94
2465,000	-9,77	120	90	-39,75	335	90		-18,09	1,66
2485,000	-10,59	120	90	-37,43	335	90		-19,34	1,27



## 5. Measurement Process

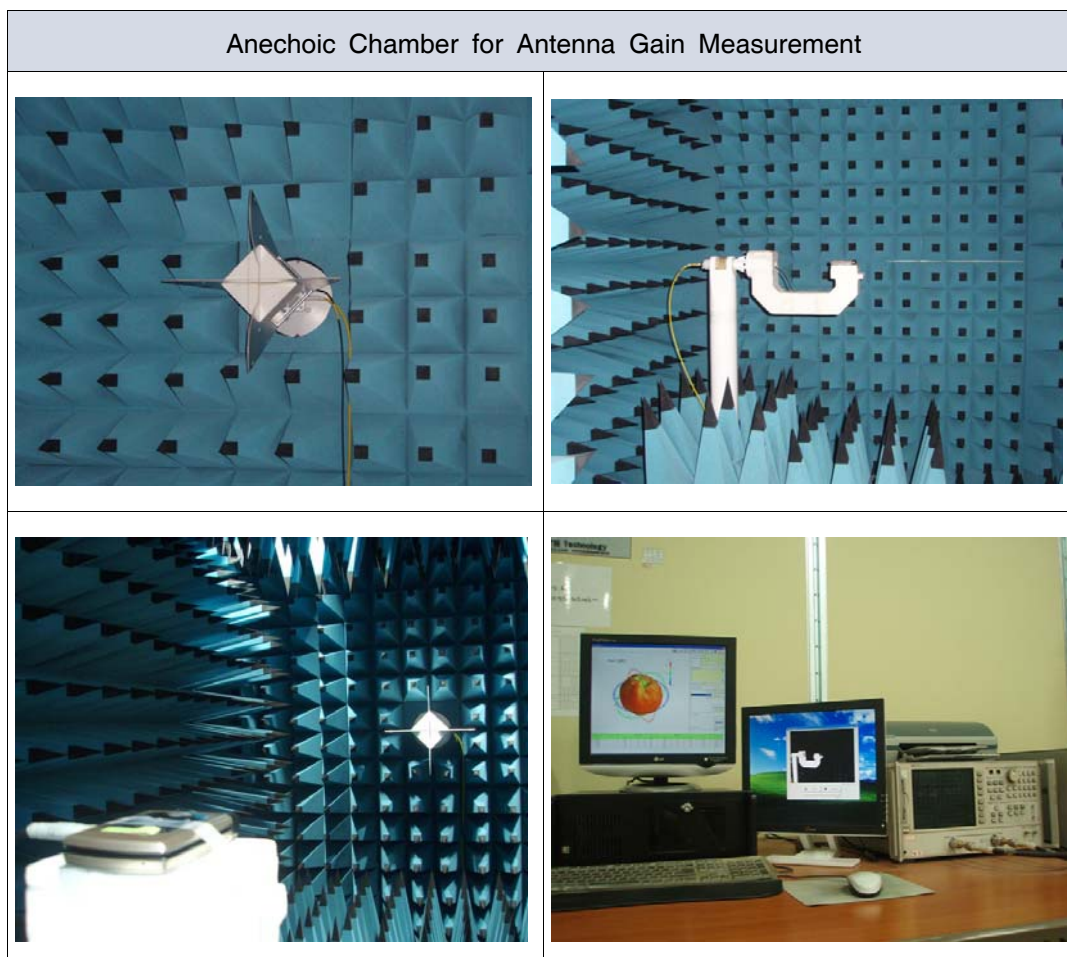
### 5.1 SWR / Return loss

The SWR / Return loss is measured by Network Analyzer. Using the test fixture, the Selected reference sample is a standard product.

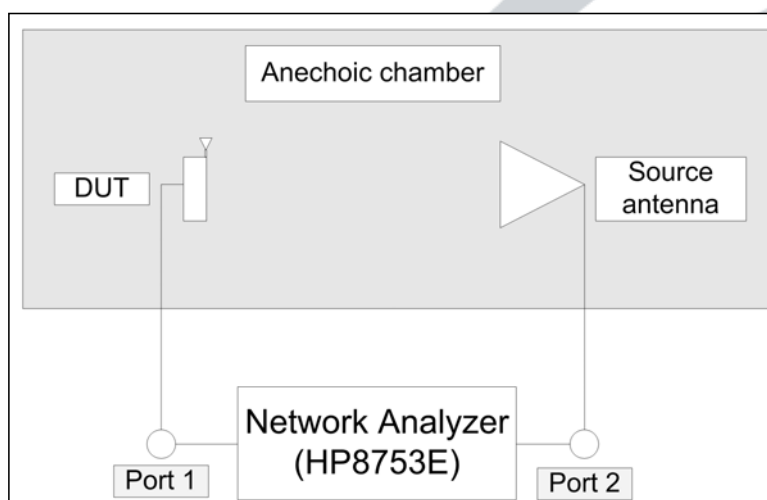
	Set Condition	Test Fixture Condition
Network Analyzer	Agilent HP8753E	Agilent HP8753E or Advantest R3765CH
Cable	RF cable(300mm)	RF cable(300mm)
Test condition		

## 5.2 Gain

The Antenna Gain is measured by using the Passive DUT at Anechoic Chamber.

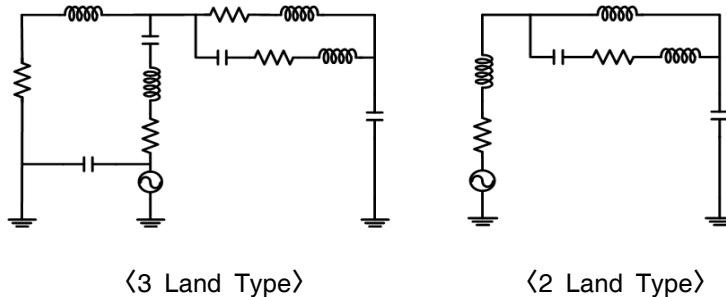


## 5.3 Gain Measurement block diagram



## 6. Internal Block Diagram

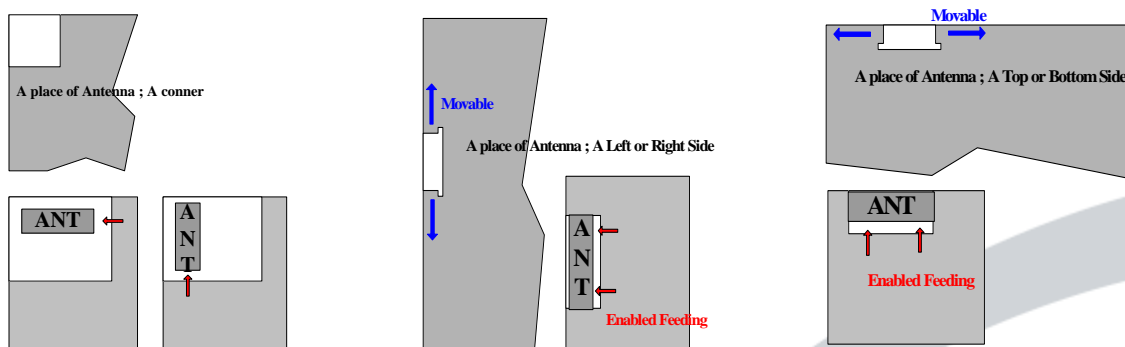
This product is made of the dielectric block and RF part materialized the characteristics by structural change of Ag pattern on the brick of dielectric block and conditioning value of the structural equivalent circuit.



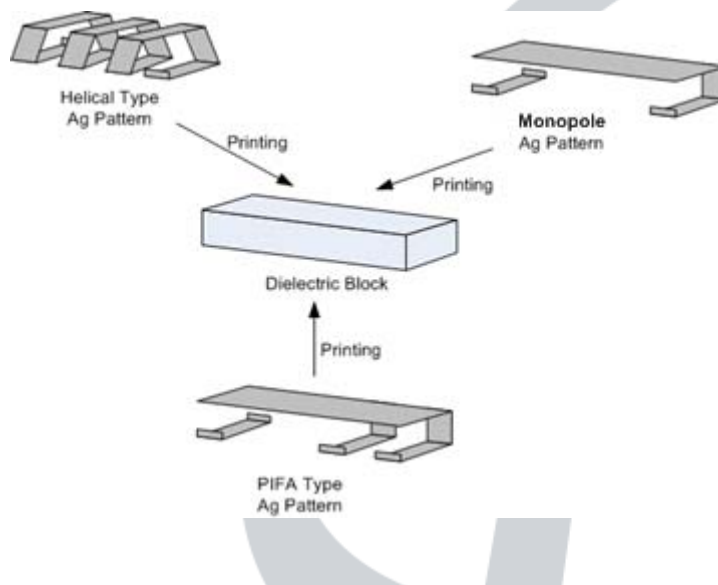
## 7. Basis Action / Application Note

This product is the internal dielectric chip antenna of radio communication, converts the electric signal advanced along by transmission line into free space wave.

This product will be mounted wherever you want and the design is revised by mount condition. But required attention to select the mount position, because this product is the radiation part and changed characteristics by boundary condition.

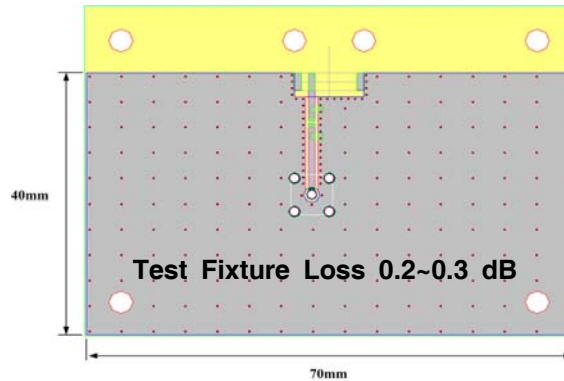


As the following, this product is easy to revise the various types for the boundary condition.



## 8. Measurement Jig SPEC

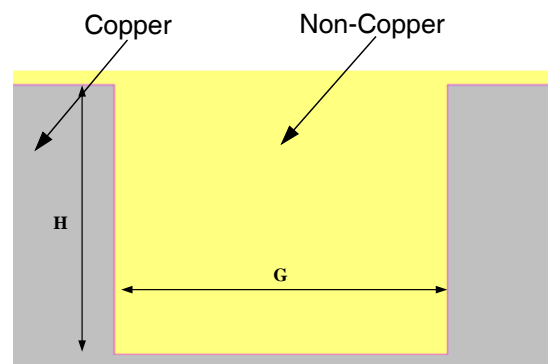
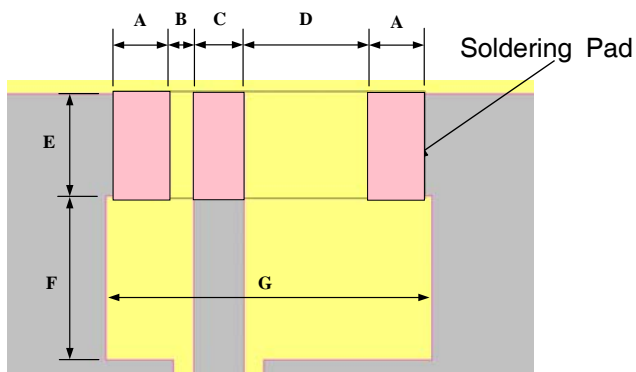
### 8.1 Test Fixture And GROUND Condition



※ Ev B'd and Test Fixture Jig is the same.

( Contact way of Ev B'd is soldering, Test Fixture is copper contact way.)

### 8.2 PCB Layout & Soldering Pad Dimension



**Top Layout**

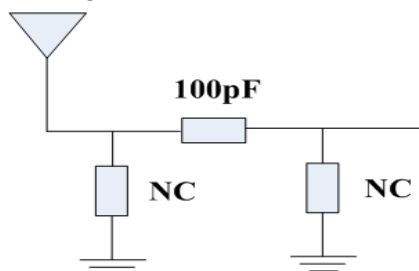
**Bottom Pattern**

Parameter	A	B	C	D	E	F	G	H
Value[mm]	1.1	0.5	1.0	2.5	2.2	1.5	6.2	3.7

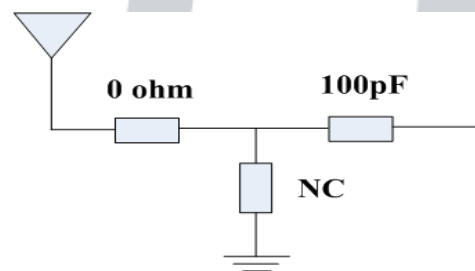
Unit ; mm

Unless specified tolerances are  $\pm 0.05$

### 8.3 Matching Circuit And Reference Value



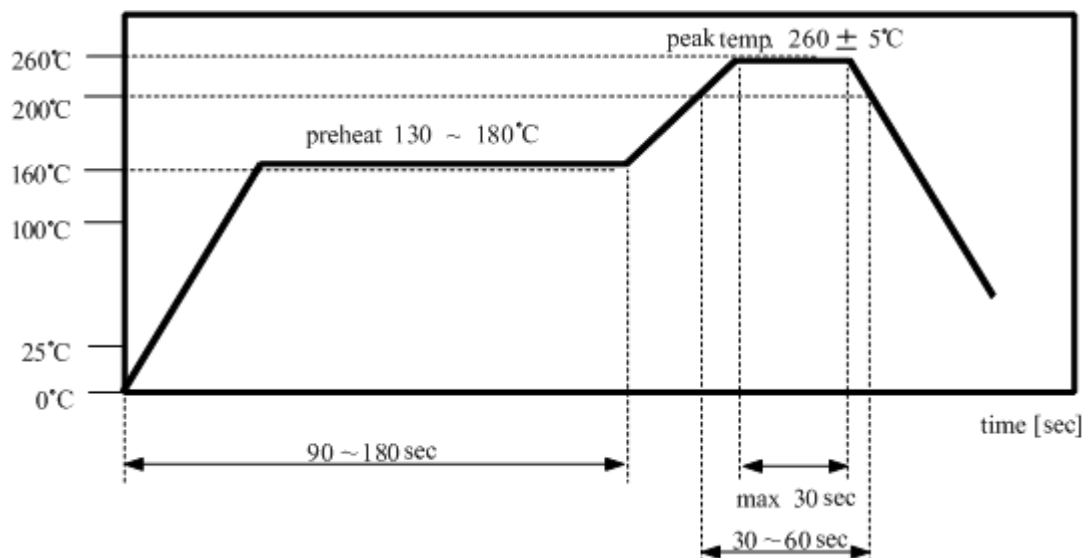
**$\pi$  Matching**



**T Matching**

## 9. Soldering Condition

### 9.1 Reflow Soldering



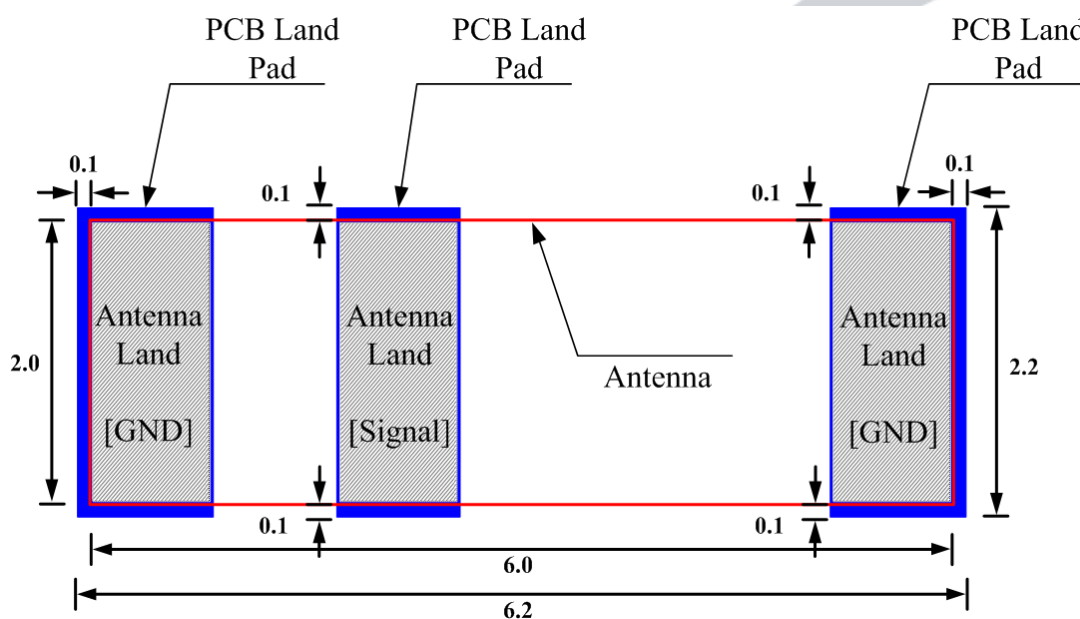
### 9.2 Manual Soldering

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


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

### 9.3 PCB Pattern Design

As the following, the PCB land pattern is laid out 0.1 mm outside land pattern of antenna more than indicated antenna land dimension.



## 10. Primary Inspection List

Item	Frequency [MHz] 		Size [mm]		
Standard	SWR 3.0 Max		W=2.0±0.1	L=6.0±0.1	T=1.2±0.1
	2400MHz	2485MHz			
1	1.98	1.78	2.02	6.01	1.23
2	1.79	1.96	2.03	6.02	1.23
3	1.93	1.83	2.03	6.03	1.23
4	1.84	1.89	2.03	6.01	1.22
5	1.91	1.82	2.02	6.01	1.23
6	1.77	2.04	2.04	6.01	1.24
7	1.84	1.93	2.02	6.02	1.24
8	1.87	1.89	2.03	6.02	1.22
9	1.82	1.97	2.02	6.02	1.24
10	1.91	1.86	2.03	6.02	1.24
11	1.99	1.79	2.03	6.03	1.23
12	1.81	1.97	2.02	6.03	1.24
13	1.82	1.98	2.04	6.02	1.22
14	1.89	1.92	2.02	6.01	1.23
15	1.91	1.89	2.03	6.01	1.23
16	1.83	1.94	2.03	6.02	1.24
17	1.76	1.99	2.02	6.03	1.22
18	1.92	1.89	2.04	6.03	1.24
19	1.72	2.00	2.02	6.01	1.23
20	1.90	1.87	2.02	6.02	1.24
Min	1.72	1.78	2.02	6.01	1.22
Max	1.99	2.04	2.04	6.03	1.24
X	1.86	1.91	2.02	6.01	1.23
σ	0.07	0.07	0.01	0.01	0.01
Cpk	5.17	4.97	3.28	3.38	2.91
Result	OK	OK	OK	OK	OK



## 11. Reliability Condition

### 11.1 Environment Test

ITEM	TEST CONDITION	LIMIT
High Temperature Action	85°C±3°C, 1hr	After test, Must meet the characteristics spec of 4.4 list
High Temperature Resistance	+85°C±3°C, 120hr±2hr	
Low Temperature Action	-40°C±3°C, 1hr	
Low Temperature Resistance	-40°C±3°C, 120hr±2hr	
Humidity Action	+85±3°C, RH85%	

### 11.2 Thermal shock test , Reflow test

ITEM	TEST CONDITION	LIMIT
Thermal shock	condition : -40°C±3°C/1min ↔ +85°C±3°C/1min Test Cycle : 32 cycle Temperature change time : within 5 min	After test, Must meet the characteristics spec of 4.4 list
Reflow	Pre Heating : 200±5°C, 30~60 sec Peak Heating : 260°C±5°C, 30sec Max	

### 11.3 Mechanical Test

ITEM	TEST CONDITION	LIMIT
Vibration	Freq : 10~500Hz , Acceleration : 10 ×9.8m/s <sup>2</sup> (G) Sweep time : 15 min , X.Y.Z each 5 times	After test, Must meet the characteristics spec of 4.4 list
Drop	18 times free fall Using the drop jig 152cm high Jig : 120g±20g Plastic Jig Bottom : Concrete or Iron	

### 11.4 MSL LEVEL Test

#### 1) JEDEC J-STD-020C Test

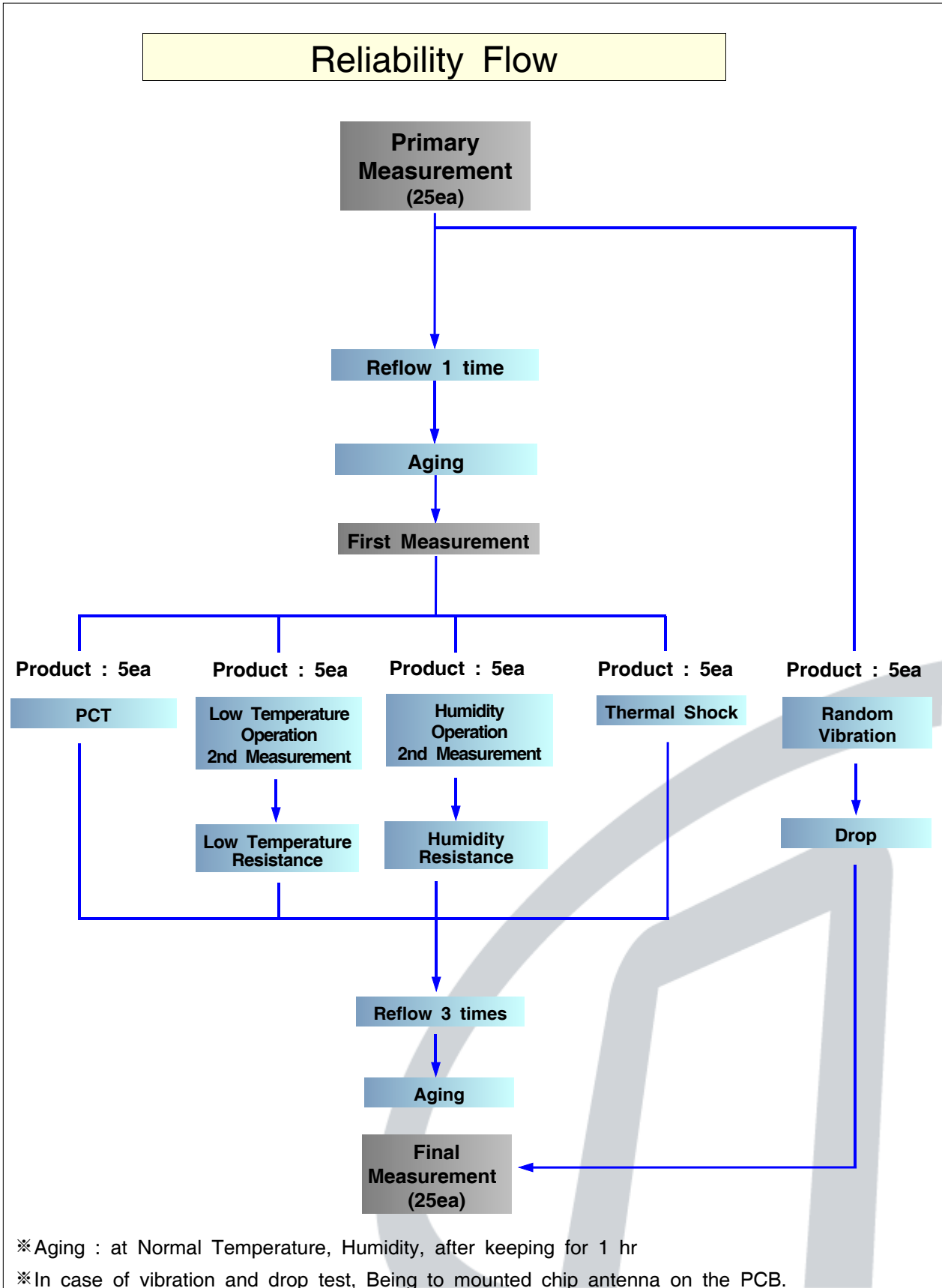
	Floor Life		Soak Requirements	
	Time	Conditions	Time	Conditions
1	Unlimited	= < 30°C/85%RH	168+5/-0	= < 85°C/85%RH

#### 2) Test Condition

ITEM	Conditon	LIMIT
Soak Requirements	After leaving +85±3°C, RH85% 168hr±2hr 2 times Reflow without aging	After test, Must meet the characteristics spec of 4.4 list

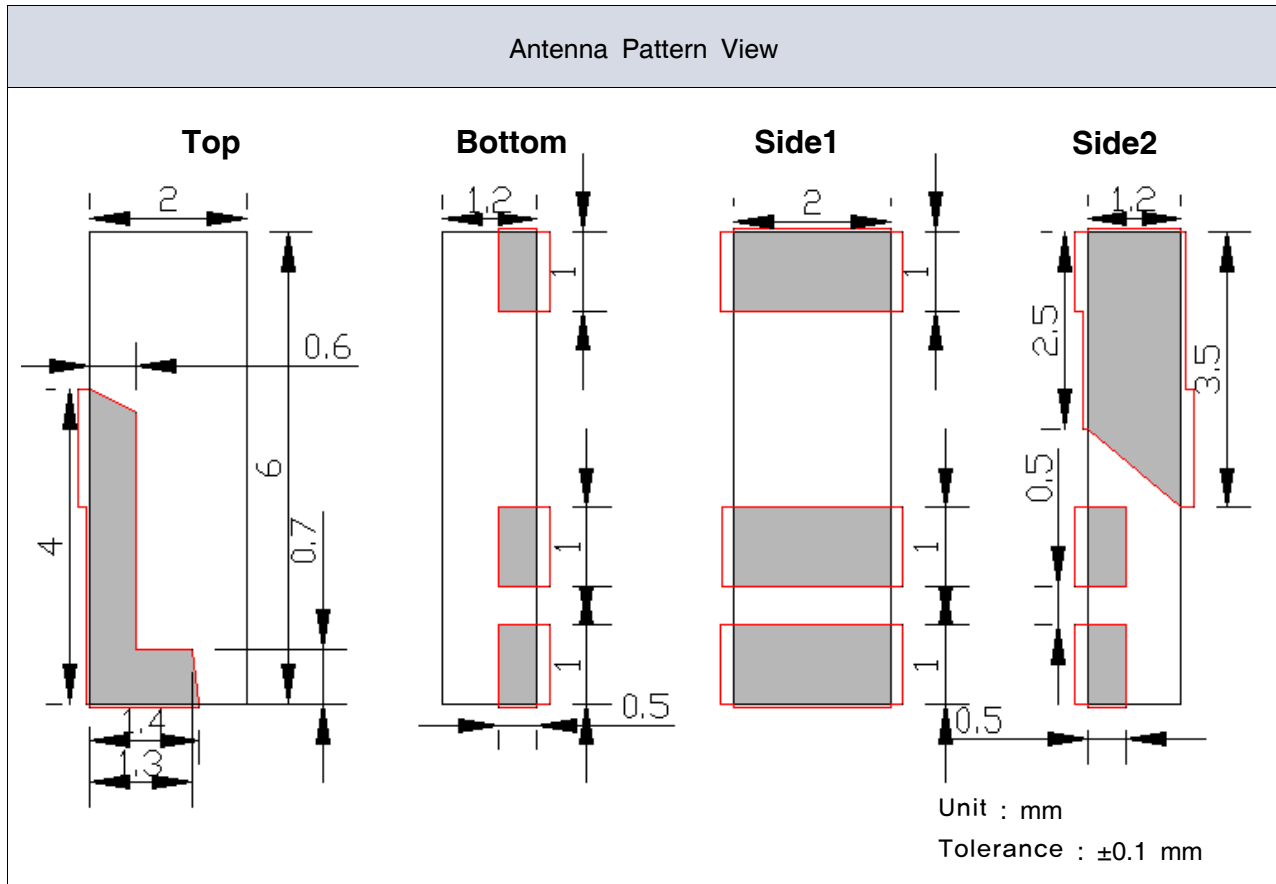


11.5 Reliability Flow

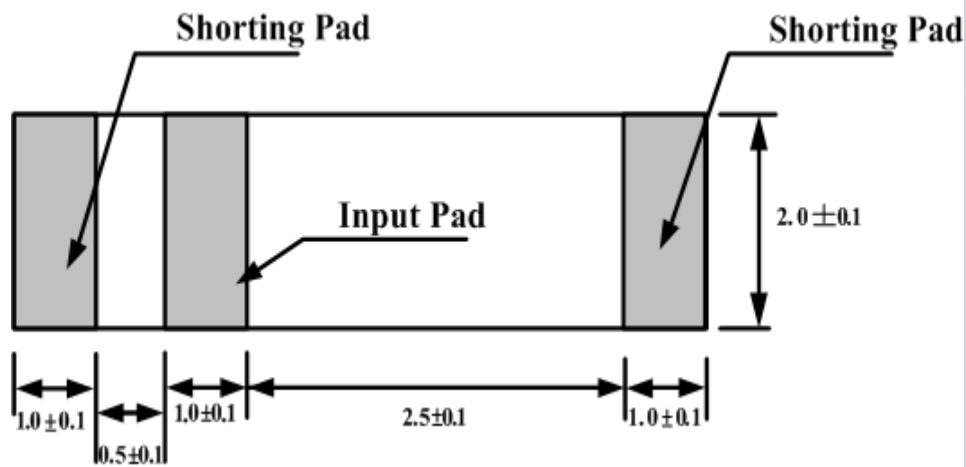


## 12. Mechanical Characteristics

### 12.1 Antenna Pattern Drawing



### 12.2 Pin name



\* PCB Layout & Soldering Pad Dimension 은 13 page 8.2 도면 참조

### 12.3 Lot Notation

<b>9</b>	<b>1</b>	<b>1</b>
①	②	③

- ① Year : 1 - 2001, 2 - 2002, .... 9 - 2009 ....
- ② Month : 1 - January, 2 - February .... 9 - September, A - October, B - November ....
- ③ Date : 1 - 1st, 2 - 2nd .... 9 - 9th, A - 10th, B - 11th ....

### 12.4 Marking Specification



◀	<b>S30</b>	<b>9</b>	<b>1</b>	<b>1</b>
①	②	③	④	⑤

- ① Input Signal
- ② Serial
- ③ Year : 1 - 2001, 2 - 2002, .... 9 - 2009 ....
- ④ Month : 1 - January, 2 - February .... 9 - September, A - October, B - November ....
- ⑤ Date : 1 - 1st , 2 - 2nd .... 9 - 9th, A - 10th, B - 11th ....

### 12.5 Marking Method

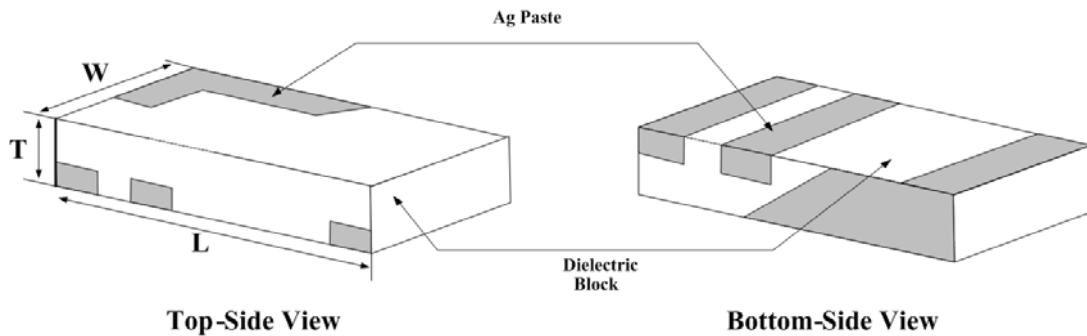
Ink marking - Black Ink

## 13. Structure & Material

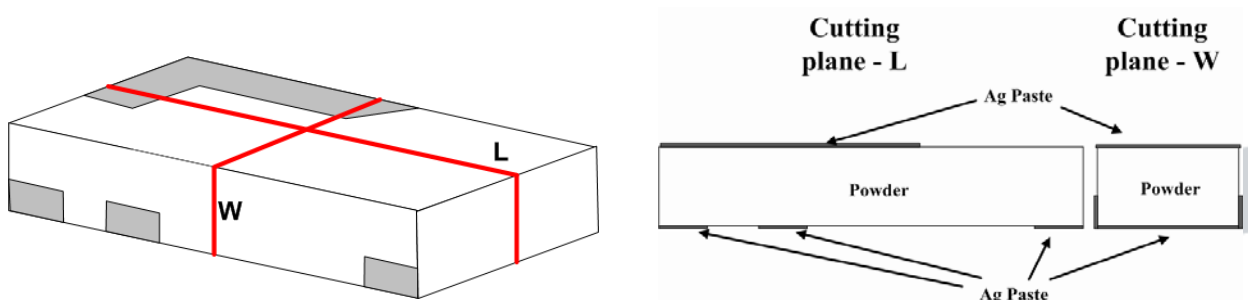
### 13.1 Fabrication

The structure is materialized by printing Ag paste at the dielectric block.

### 13.2 Structure



### 13.3 The cross section



### 13.4 Material

ITEM	Material	Maker	Printing pattern SPEC
Dielectric Block	Powder	SAM B00 CERAMIC	
PATTERN	Ag Paste	METECH	Thickness : TYP 10 $\mu\text{m}$
PAD	Ag paste	METECH	Thickness : Min 10 $\mu\text{m}$ (TYP 16 ~ 20 $\mu\text{m}$ )

## 14. Attention

### 14.1 Temperature Condition

	Range	Unit
Operating Temperature	-40 ~ +100℃	℃
Keeping Temperature	-40 ~ +70℃	℃

### 14.2 Temperature Test Condition

Item	Condition	Temperature Range
Operating Temperature	Low	at -75 ℃, for 24 hr, Good Operating
	High	at +150 ℃, for 24 hr, Good Operating
Keeping Temperature	Low	at -75 ℃, after 1000 hr, Good Operating
	High	at +85 ℃, after 1000 hr, Good Operating

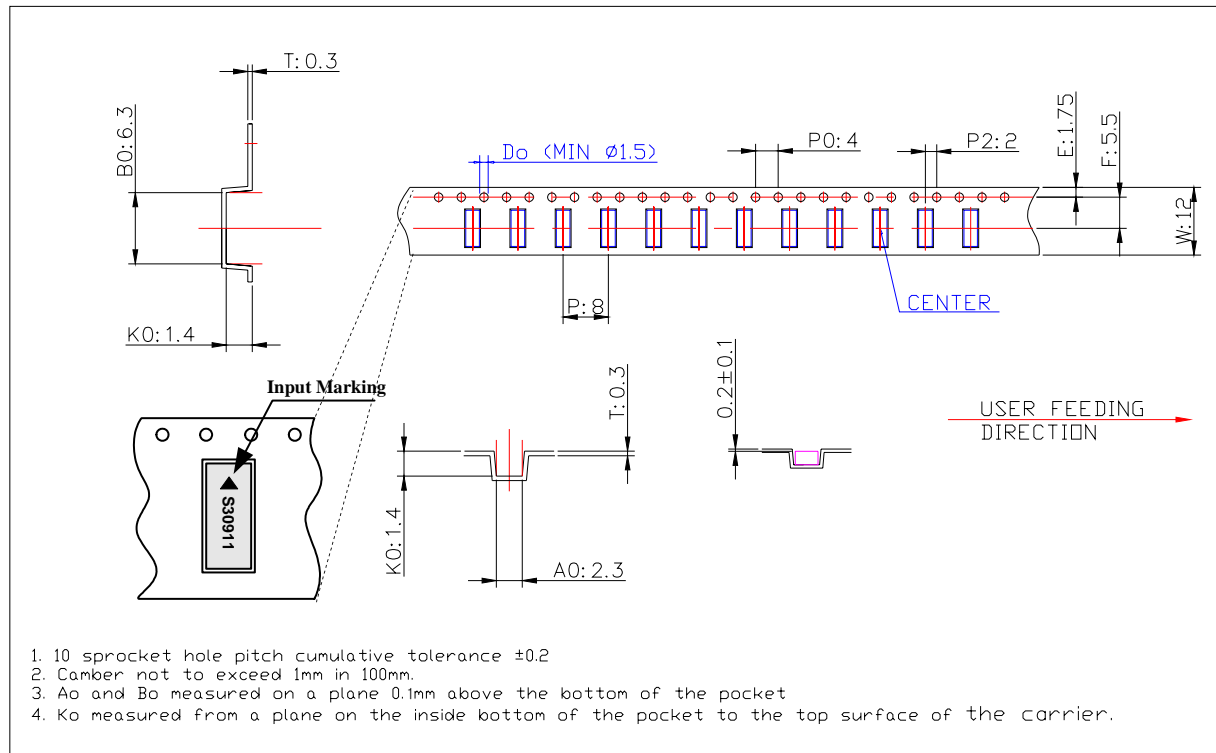
\* In case of "High Temperature Resistance", because the packing material is broken at higher temperature than +85 ℃, the test is not able.



## 15. Packing

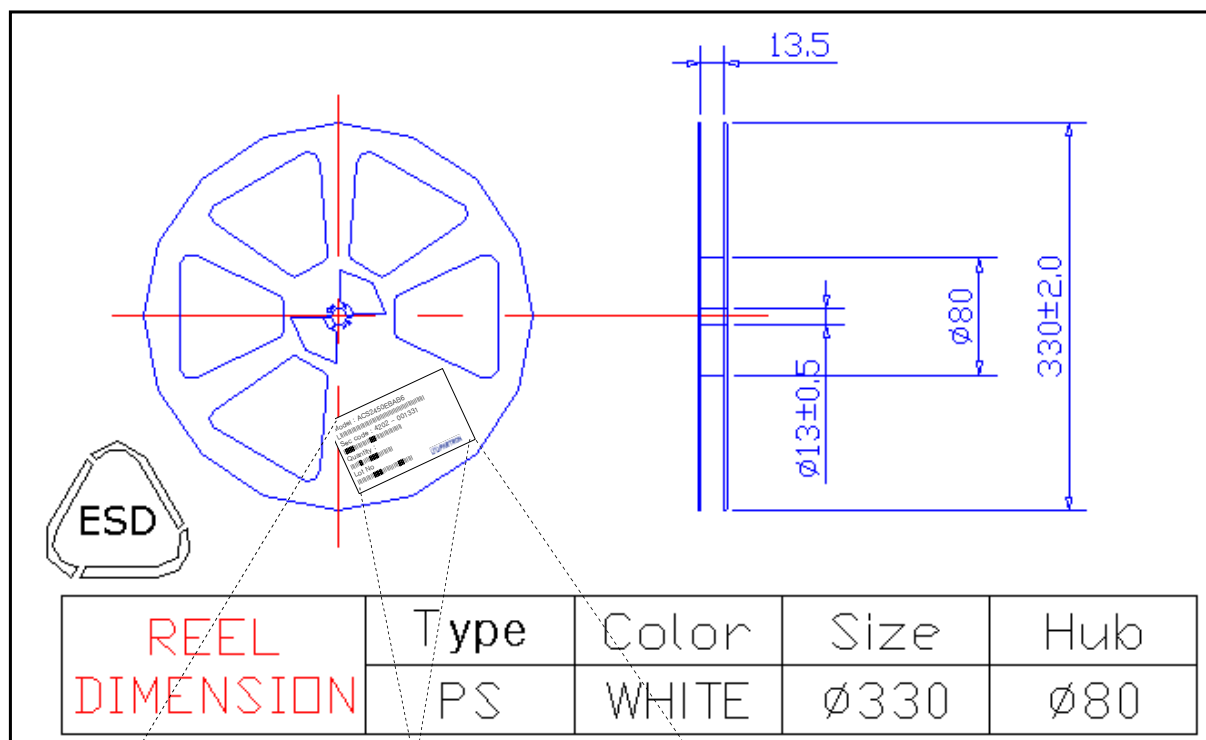
### 15.1 Carrier/Reel

ITEM	Material	Surface Resistance	Electricity	method
Carrier	A-PET	Typical $10^8\Omega$	10V MAX	Heat press
Cover tape	PET	Typical $10^8\Omega$	30V MAX	
Reel	PS	Typical $10^8\Omega$	30V MAX	-



DKC DWG. No.	D-1208-052
DIMENSIONAL UNIT	
UNTOLERANCED DIMENSION	$\pm 0.1$
CAD FILE NAME	050504
DESIGNED BY	K. M. J
SCALE	1/1
TITLE	CARRIER TAPE 2*6*1.2P(신)
PART.	CARRIER TAPE
MATERIAL	C-PET
LENGTH	50.6M
COUNT	6320P

NAME	SPEC.
W	$12.0 \pm 0.2$
E	$1.75 \pm 0.1$
F	$5.5 \pm 0.1$
Do	$1.5 \pm 0.1$
P	$8.0 \pm 0.1$
Po	$4.0 \pm 0.1$
P2	$2.0 \pm 0.1$
Ao	$2.3 \pm 0.1$
Bo	$6.3 \pm 0.1$
Ko	$1.4 \pm 0.1$
T	$0.3 \pm 0.05$

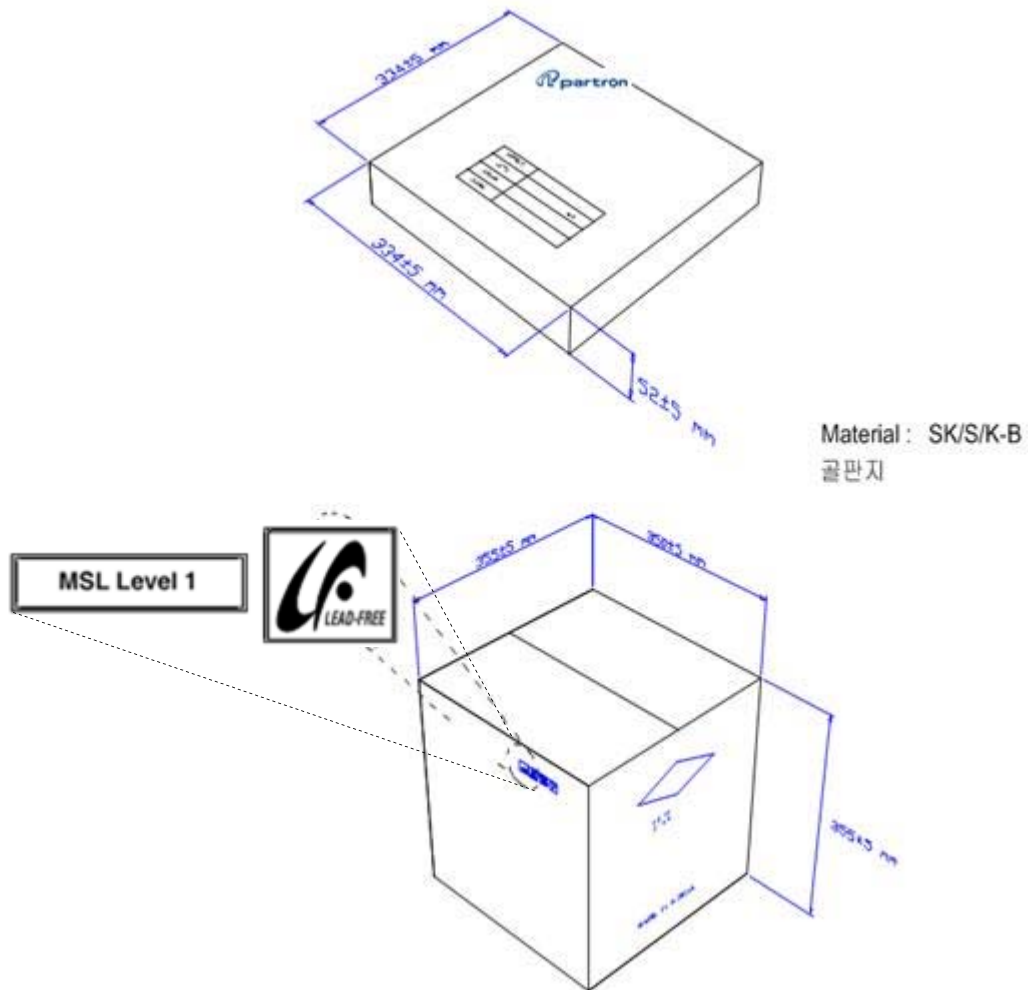


CODE NO :  
 ACS2450FBAS30  
 Model :   
 5000  
 Quantity :   
 Lot No : 911  


MSL Level 1



## 15.2 BOX



## 15.3 Real Picture



Reel



Internal Box





Outer Box

CODE NO :		
	<b>GBH-S300</b>	
MODEL :		
	<b>5000</b>	
QUANTITY :		
LOT NO : 911		
		<b>MSL LEVEL 1</b>








Reel / Inner Box label







FROM PARTRON. CO. LTD SEOKWOO-DONG 22-6 HWASEONG - SI GYEONGGI - DO 445-170.KOREA	
CODE NO : 	
MODEL : GBH-S300 	
QUANTITY : 30000 	
DATE : 2009/11/17	
LOT NO : 911	
<b>CHIP ANT</b> 	

Outer Box label

## 16. 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	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						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	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					
	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/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 designed	By checked	By approved
CHIP ANTENNA	Issued Revised	04.04.06 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 CTF	NETWORK Inspection Jig	proofreading Condition	refer to Guide Sheet	1/2hour	C/sheet	VSWR 2400MHz:3.0:1 2485MHz:3.0:1 CTF	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

## 17. RoHS Data

### 1) Ceramic Powder

**SGS**

**Test Report No. F695091LF-CT8AYAU09-02655** Issued Date: June 05, 2009 Page 1 of 2

To: **SAM BOO CERAMICS CO.,LTD.**  
717-6  
Daecheon-dong  
Dalseo-gu  
DAEGU  
Korea

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

Product name : Ceramic Powder

SGS File No. : AYAU09-02655

Received Date : June 02, 2009

Test Performing Date : June 03, 2009

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. / Gimhae Laboratory

Sharpless Park  
Annie Lim  
Hein Yao / Testing Person

Thomas Hwang / Gimhae Lab. Mgr

*THWang*

This document is issued by the Company subject to the General Conditions of Service in effect on the date of issuance of this document and is valid only for the purpose stated. It is not to be used for any other purpose without the written consent of the Company. The Company is not responsible for any damage or loss of any kind arising from the use of this document. The Company is not responsible for any damage or loss of any kind arising from the use of this document. The Company is not responsible for any damage or loss of any kind arising from the use of this document.

SGS Testing Korea Co. Ltd. 254, GIBANG, 105-1, Bangeom-dong, Gyeongju-si, Gyeongbuk, Korea 813-842  
T +82 (0)55 3100 830 F +82 (0)55 3100 839 E korea@sgstesting.com

Member of the SGS Group (Swiss Group of Companies)

**SGS**

**Test Report No. F695091LF-CT8AYAU09-02655** Issued Date: June 05, 2009 Page 2 of 2

Sample No. : AYAU09-02655.001

Sample Description : Ceramic Powder

Item No./Part No. : SMW-20

Comments : Material is ceramic.

**Heavy Metals**

Test Items	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 3060A, UV-VIS	1	N.D.

Picture of Sample as Received:



\*\*\* 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

This document is issued by the Company subject to the General Conditions of Service in effect on the date of issuance of this document and is valid only for the purpose stated. It is not to be used for any other purpose without the written consent of the Company. The Company is not responsible for any damage or loss of any kind arising from the use of this document. The Company is not responsible for any damage or loss of any kind arising from the use of this document. The Company is not responsible for any damage or loss of any kind arising from the use of this document.

SGS Testing Korea Co. Ltd. 254, GIBANG, 105-1, Bangeom-dong, Gyeongju-si, Gyeongbuk, Korea 813-842  
T +82 (0)55 3100 830 F +82 (0)55 3100 839 E korea@sgstesting.com

Member of the SGS Group (Swiss Group of Companies)

## 2) Ag Paste

**SGS**

**Test Report No. F69591LF-CT8YAA09-27959** Issued Date: October 13, 2009 Page 1 of 3

To: **METECH KOREA CO., LTD.**  
8-401 Dongyang Paragon office 17-2 Jeongdong-gu  
Sungnam-si  
GYEONGGI-DO  
Korea

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

**Product Name** : Silver Paste  
**SGS File No.** : AYAA09-27959  
**Received Date** : October 08, 2009  
**Test Performing Date** : October 08, 2009  
**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.  
*Jeff Jang*  
Jeff Jang / Chemical Lab Mgr

Photo Kim  
Cindy Park  
Jinhee Song/ Testing Person

**SGS**

**Test Report No. F69591LF-CT8YAA09-27959** Issued Date: October 13, 2009 Page 2 of 3

**Sample No.** : AYAA09-27959-001  
**Sample Description** : Silver Paste  
**Item No./Part No.** : PCC11836HV  
**Comments** : Material is silver.

**Heavy Metals**

Test Items	Unit	Test Method	MDL	Results
Cadmium (Cd)	mg/kg	With reference to IEC 62321:2005, ICP	0.5	N.D.
Lead (Pb)	mg/kg	With reference to IEC 62321:2005, ICP	5	N.D.
Mercury (Hg)	mg/kg	With reference to IEC 62321:2005, ICP	2	N.D.
Hexavalent Chromium (Cr VI)	mg/kg	With reference to IEC 62321:2005, UV-VIS	1	N.D.

**Flame Retardant: PBBs/PBCEs**

Test Items	Unit	Test Method	MDL	Results
Monobromodiphenyl	mg/kg	With reference to IEC 62321:2005, GC-MS	5	N.D.
Dibromodiphenyl	mg/kg	With reference to IEC 62321:2005, GC-MS	5	N.D.
Tribromodiphenyl	mg/kg	With reference to IEC 62321:2005, GC-MS	5	N.D.
Tetrabromodiphenyl	mg/kg	With reference to IEC 62321:2005, GC-MS	5	N.D.
Pentabromodiphenyl	mg/kg	With reference to IEC 62321:2005, GC-MS	5	N.D.
Hexabromodiphenyl	mg/kg	With reference to IEC 62321:2005, GC-MS	5	N.D.
Heptabromodiphenyl	mg/kg	With reference to IEC 62321:2005, GC-MS	5	N.D.
Octabromodiphenyl	mg/kg	With reference to IEC 62321:2005, GC-MS	5	N.D.
Nonabromodiphenyl	mg/kg	With reference to IEC 62321:2005, GC-MS	5	N.D.
Decabromodiphenyl	mg/kg	With reference to IEC 62321:2005, GC-MS	5	N.D.
Monobromodiphenyl ether	mg/kg	With reference to IEC 62321:2005, GC-MS	5	N.D.
Dibromodiphenyl ether	mg/kg	With reference to IEC 62321:2005, GC-MS	5	N.D.
Tribromodiphenyl ether	mg/kg	With reference to IEC 62321:2005, GC-MS	5	N.D.
Tetrabromodiphenyl ether	mg/kg	With reference to IEC 62321:2005, GC-MS	5	N.D.
Pentabromodiphenyl ether	mg/kg	With reference to IEC 62321:2005, GC-MS	5	N.D.
Hexabromodiphenyl ether	mg/kg	With reference to IEC 62321:2005, GC-MS	5	N.D.
Heptabromodiphenyl ether	mg/kg	With reference to IEC 62321:2005, GC-MS	5	N.D.
Octabromodiphenyl ether	mg/kg	With reference to IEC 62321:2005, GC-MS	5	N.D.
Nonabromodiphenyl ether	mg/kg	With reference to IEC 62321:2005, GC-MS	5	N.D.
Decabromodiphenyl ether	mg/kg	With reference to IEC 62321:2005, 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) \* = 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.

**SGS**

**Test Report No. F69591LF-CT8YAA09-27959** Issued Date: October 13, 2009 Page 3 of 3

**Sample No.** : AYAA09-27959-001  
**Sample Description** : Silver Paste  
**Item No./Part No.** : PCC11836HV  
**Comments** : Material is silver.

**Halogen Content**

Test Items	Unit	Test Method	MDL	Results
Bromine(Br)	mg/kg	With reference to ASTM D 7159-08, IC	30	N.D.
Chlorine(Cl)	mg/kg	With reference to ASTM D 7159-08, IC	30	N.D.

Picture of Sample as Received:



\*\*\* 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) \* = 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.

**SGS**

**Test Report No. F69591LF-CT8YAA09-27959** Issued Date: October 13, 2009 Page 3 of 3

**Sample No.** : AYAA09-27959-001  
**Sample Description** : Silver Paste  
**Item No./Part No.** : PCC11836HV  
**Comments** : Material is silver.

**Halogen Content**

Test Items	Unit	Test Method	MDL	Results
Bromine(Br)	mg/kg	With reference to ASTM D 7159-08, IC	30	N.D.
Chlorine(Cl)	mg/kg	With reference to ASTM D 7159-08, IC	30	N.D.

Picture of Sample as Received:



\*\*\* 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) \* = 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.

### 3) Marking Ink

**Intertek**

**TEST REPORT**

Page: 1 of 5  
Date: Sep. 29, 2009

Report No. RT09R-54289-003-E



Sample ID No. : RT09R-54289-003  
Sample Description : S135E BLACK Ink

Applicant : Markem-Ink Co., Ltd.  
Address : #1301, Daewoo Techno Tower 7th, 489-11, Gaecheon-Dong, Gyeongsang, Seoul, Korea

Sample received : Sep. 24, 2009  
Testing Date : Sep. 24, 2009 ~ Sep. 29, 2009  
Testing Laboratory : Intertek Testing Center  
Testing Environment : Temperature : ( 24 ± 2 ) °C, Humidity : ( 60 ± 5 ) % R.H.

Test Method(s) : Please see the following page(s).  
Test Result(s) : Please see the following page(s).

\* Note 1 : The test results presented in this report relate only to the object tested.  
\* Note 2 : This report shall not be reproduced except in full without the written consent of the testing laboratory.

Approved by:  **Jade Jang / Lab. Technical Manager**  
Authorized by:  **Bo Park / Lab. General Manager**

This Test Report is issued by the Company subject to its Terms and Conditions of Business printed overleaf. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. This Test Report shall not be reproduced, except in full, without prior written consent of the Company.

Intertek Testing Center

Seoul Office: Tel: 02-2019-1250 Fax: 02-2019-1259 Gumi Office: Tel: 054-462-7647 Fax: 054-462-7657 Web Site: [www.intertek.co.kr](http://www.intertek.co.kr)  
Seoul Lab.: #100, 7th, Ase Techno Tower, 197-22, Gumi-Dong, Gumi-Gu, Seoul 152-766 Korea Tel: 02-2019-1260 Fax: 02-2019-1258  
Ulsan Lab.: #140-2, Yongnam-Rd, CheongsangMyeon, Ulsan-Gu, Ulsan 689-665 Korea Tel: 052-257-4754 Fax: 052-276-4792

**Intertek**

**TEST REPORT**

Page: 2 of 5  
Date: Sep. 29, 2009

Report No. RT09R-54289-003-E

Sample ID No. : RT09R-54289-003  
Sample Description : S135E BLACK Ink

Test Items	Unit	Test Method	MDL	Results
Cadmium (Cd)	μg/g	With reference to US EPA 3052, by acid digestion and determined by ICP-OES	0.5	N.D.
Lead (Pb)	μg/g	With reference to US EPA 3052, by acid digestion and determined by ICP-OES	5	N.D.
Mercury (Hg)	μg/g	With reference to US EPA 3052, by acid digestion and determined by ICP-OES	2	N.D.
Hexavalent Chromium (Cr <sup>VI</sup> )	μg/g	With reference to US EPA 3060A and determined by UV-VIS Spectrophotometer	1	N.D.
Polybrominated Biphenyl (PBBs)	μg/g			
Monobromobiphenyl	μg/g		5	N.D.
Dibromobiphenyl	μg/g		5	N.D.
Tribromobiphenyl	μg/g		5	N.D.
Tetrabromobiphenyl	μg/g		5	N.D.
Pentabromobiphenyl	μg/g		5	N.D.
Hexabromobiphenyl	μg/g		5	N.D.
Heptabromobiphenyl	μg/g		5	N.D.
Octabromobiphenyl	μg/g		5	N.D.
Nonabromobiphenyl	μg/g		5	N.D.
Decabromobiphenyl	μg/g		5	N.D.
Polybrominated Diphenyl Ether (PBDEs)	μg/g			
Monobromodiphenyl ether	μg/g		5	N.D.
Dibromodiphenyl ether	μg/g		5	N.D.
Tribromodiphenyl ether	μg/g		5	N.D.
Tetrabromodiphenyl ether	μg/g		5	N.D.
Pentabromodiphenyl ether	μg/g		5	N.D.
Hexabromodiphenyl ether	μg/g		5	N.D.
Heptabromodiphenyl ether	μg/g		5	N.D.
Octabromodiphenyl ether	μg/g		5	N.D.
Nonabromodiphenyl ether	μg/g		5	N.D.
Decabromodiphenyl ether	μg/g		5	N.D.

Notes : μg/g = ppm = parts per million  
N.D. = Not detected (< MDL)  
MDL = Method detection limit

Tested by : Nikkie Lee, Peter Kim, Ellen Jung, Jessica Kang

This Test Report is issued by the Company subject to its Terms and Conditions of Business printed overleaf. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. This Test Report shall not be reproduced, except in full, without prior written consent of the Company.

Intertek Testing Center

Seoul Office: Tel: 02-2019-1250 Fax: 02-2019-1259 Gumi Office: Tel: 054-462-7647 Fax: 054-462-7657 Web Site: [www.intertek.co.kr](http://www.intertek.co.kr)  
Seoul Lab.: #100, 7th, Ase Techno Tower, 197-22, Gumi-Dong, Gumi-Gu, Seoul 152-766 Korea Tel: 02-2019-1260 Fax: 02-2019-1258  
Ulsan Lab.: #140-2, Yongnam-Rd, CheongsangMyeon, Ulsan-Gu, Ulsan 689-665 Korea Tel: 052-257-4754 Fax: 052-276-4792

**Intertek**

**TEST REPORT**

Page: 3 of 5  
Date: Sep. 29, 2009

Report No. RT09R-54289-003-E


Sample ID No. : RT09R-54289-003  
Sample Description : S135E BLACK Ink

Test Items	Unit	Test Method	MDL	Results
Bromine (Br)	μg/g	With reference to EN 14582, by oxygen combustion with bomb and determined by IC	30	N.D.
Chlorine (Cl)	μg/g	With reference to EN 14582, by oxygen combustion with bomb and determined by IC	30	N.D.

Tested by : Nikkie Lee

Notes : μg/g = ppm = parts per million  
N.D. = Not detected (< MDL)  
MDL = Method detection limit

\* View of sample as received:



This Test Report is issued by the Company subject to its Terms and Conditions of Business printed overleaf. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. This Test Report shall not be reproduced, except in full, without prior written consent of the Company.

Intertek Testing Center

Seoul Office: Tel: 02-2019-1250 Fax: 02-2019-1259 Gumi Office: Tel: 054-462-7647 Fax: 054-462-7657 Web Site: [www.intertek.co.kr](http://www.intertek.co.kr)  
Seoul Lab.: #100, 7th, Ase Techno Tower, 197-22, Gumi-Dong, Gumi-Gu, Seoul 152-766 Korea Tel: 02-2019-1260 Fax: 02-2019-1258  
Ulsan Lab.: #140-2, Yongnam-Rd, CheongsangMyeon, Ulsan-Gu, Ulsan 689-665 Korea Tel: 052-257-4754 Fax: 052-276-4792

**Intertek**

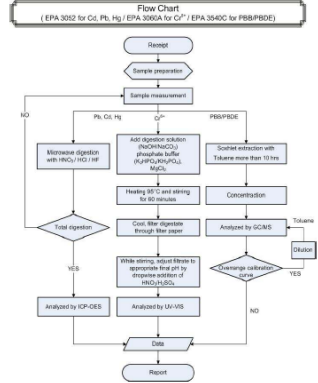
**TEST REPORT**

Page: 4 of 5  
Date: Sep. 29, 2009

Report No. RT09R-54289-003-E

Sample ID No. : RT09R-54289-003  
Sample Description : S135E BLACK Ink

Flow Chart  
( EPA 3052 for Cd, Pb, Hg / EPA 3060A for Cr<sup>VI</sup> / EPA 3540C for PBB/PBDE )



\*\* Remarks : The samples were dissolved totally by pre-conditioning method according to above flow chart.

This Test Report is issued by the Company subject to its Terms and Conditions of Business printed overleaf. Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. This Test Report shall not be reproduced, except in full, without prior written consent of the Company.

Intertek Testing Center

Seoul Office: Tel: 02-2019-1250 Fax: 02-2019-1259 Gumi Office: Tel: 054-462-7647 Fax: 054-462-7657 Web Site: [www.intertek.co.kr](http://www.intertek.co.kr)  
Seoul Lab.: #100, 7th, Ase Techno Tower, 197-22, Gumi-Dong, Gumi-Gu, Seoul 152-766 Korea Tel: 02-2019-1260 Fax: 02-2019-1258  
Ulsan Lab.: #140-2, Yongnam-Rd, CheongsangMyeon, Ulsan-Gu, Ulsan 689-665 Korea Tel: 052-257-4754 Fax: 052-276-4792

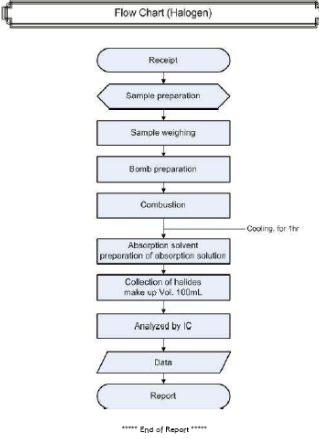
**Intertek**

Report No. RT09R-54289-003-E  
Sample ID No. : RT09R-54289-003  
Sample Description : 5135E BLACK ink

**TEST REPORT**

Page: 5 of 5  
Date: Sep. 28, 2009

**Flow Chart (Halogen)**



```

graph TD
    A[Receipt] --> B[/Sample preparation/]
    B --> C[Sample weighing]
    C --> D[Bomb preparation]
    D --> E[Combustion]
    E --> F[Absorption solvent preparation of absorption solution]
    F --> G[Collection of halides make up Vol. 100mL]
    G --> H[Analyzed by IC]
    H --> I[/Data/]
    I --> J[Report]
    J --> K[**** End of Report ****]
            
```

\*\*\*\*\* End of Report \*\*\*\*\*

This Test Report is issued by the Company subject to its Terms and Conditions of Business printed overleaf. Attention is drawn to the limitations of liability, indemnification and arbitration issues defined therein. This Test Report shall not be reproduced, except in full, without prior written consent of the Company.

**Intertek Testing Center**

Seoul Office : Tel : 02-2109-1230 Fax : 02-2109-1239 Gumi Office : Tel : 054-462-7647 Fax : 054-462-7657 Web Site : [www.intertek.co.kr](http://www.intertek.co.kr)  
 Seoul Lab : #709, 7/F, Ace Techno Tower V, 197-22, Guro-3Dong, Guro-Gu, Seoul 152-766 Korea Tel : 02-2109-1260 Fax : 02-2109-1228  
 Ulsan Lab : #540-3, Yongsu-Rd, Chunggyung-Myeon, Ulsan-Gu, Ulsan 680-650 Korea Tel : 052-257-6754 Fax : 052-276-6770

