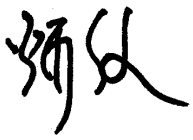
HF BFRs/CFRs/PVC-Free LEAD-FREE MSL Level 1 ROHS-Y

Approval Sheet

Products	Dielectric Chip Antenna		
Customer	UMID		
Model	Metallifer		
Customer CODE			
Supplier	PARTRON		
Supplier CODE	ACS2450ICAMEB		
CLIPCOM	By designed	By checked	By approved
PARTRON	By designed	By checked	By approved
			
	Research 5 Team	Quality Assurance	Laboratory
	Chanik.Jeon	Nam-Sik.Min	Byoung-Jun.Yim
	02 / 09	02 / 09	02 / 09

2009. 02. 09

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HF BFRs/CFRs/PVC-Free

LEAD-FREE

MSL Level 1

ROHS-Y

SPECIFICATION

MODEL : ACS2450ICAMEB

3D Structure		
 Top View		 Bottom View
By designed	By checked	By approved
Research 5 Team	Quality Assurance	Laboratory
Chanik.Jeon	Nam-Sik.Min	Byoung-Jun.Yim
02 / 09	02 / 09	02 / 09

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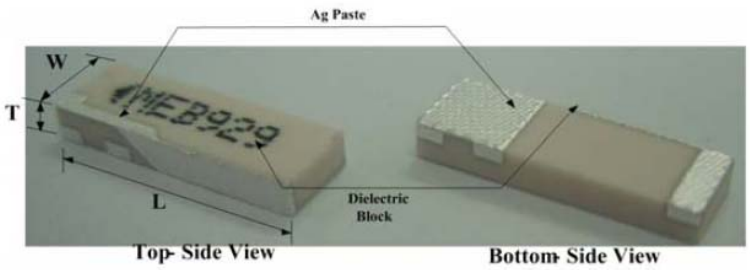
1. Revision

Revision No	Originator	Description of changes	Date of changes
Ver 1.0	Chanik.Jeon	Issued	2009.02.09

2. Summary of Parts

- This product is the internal dielectric chip antenna of radio communication, forms the pattern with Ag paste on the brick of dielectric block and materializes the characteristics

Type	Only Bulk Ceramic	
Material	Dielectric Block	Mg_2SiO_4(Magnesium Silicate)
	Electrode Paste	Ag
Size[mm]	W = 3.0±0.1	
	L = 9.0±0.1	
	T = 1.2±0.1	
Flatness Level	0.04	
MSL Level	MSL Level 1	
ESD Level	More than 15 kV (HBM CLASS 3B)	
Version	Revision 1.0	

3. Critical to Quality (CTQ)

- The following list is specified as the emphasis management list and managed.

CTQ ITEM	Specification Reason
Shape weight, size	Shape weight and size determines the electric block size after plastic and the dielectric block size effects the level of detail for the printing.
Plastic Size	The size after plastic effects the level of detail for the printing.
Printing Size	The level of detail for printing size is an essential list of the BT antenna.

CTF ITEM	Specification Reason
Single Element measurement SWR	An important Parameter classifying the electrical characteristics.

- require attention for the following list.

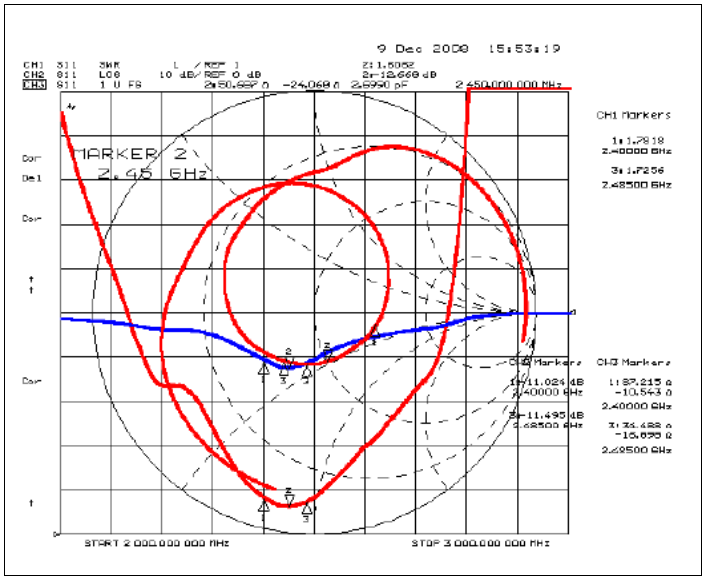
ITEM	Content
Keeping	Sealing tightly when keeping for a long time.
Action	Maybe characteristics changes when changing any design.

4. Electrical Characteristics

4.1 Set Condition

ITEM				SPEC
Frequency Range [MHz]				2400 ~ 2485
SWR [Max]				3.0 : 1 [Typ 2.0:1]
Input Impedance [Ω]				50 Ohm
Polarization				Linear
Gain[dBi]	Total Gain (Peak / Avg) [dBi]			-0.9 / -6.6
	Azimuth	Theta	Peak	-1.38
			Average	-5.77
		Phi	Peak	-1.13
			Average	-6.58
	Elevation 1	Theta	Peak	-2.99
			Average	-7.74
		Phi	Peak	-2.17
			Average	-6.94
	Elevation 2	Theta	Peak	-2.45
			Average	-7.78
		Phi	Peak	-0.83
			Average	-5.23

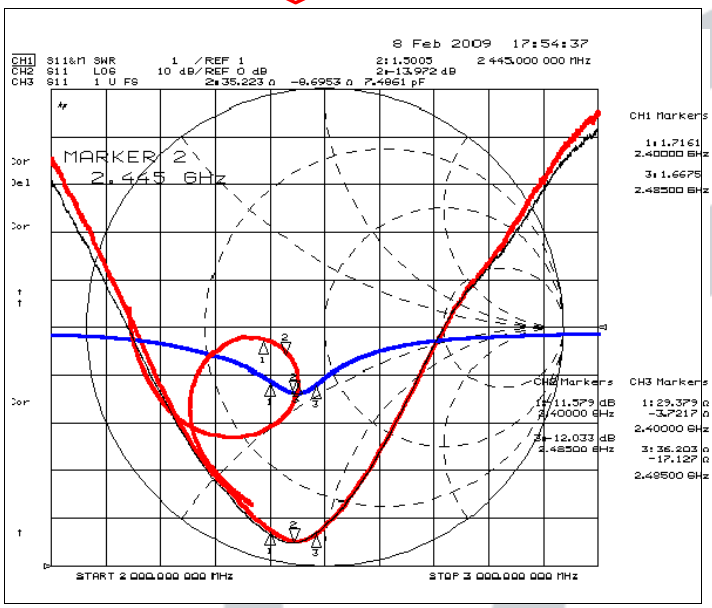
4.2 S11 Graph of Set Condition



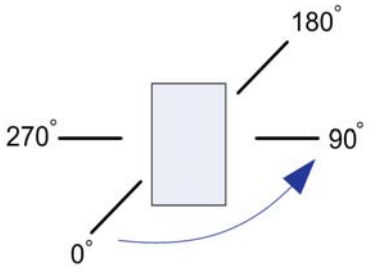
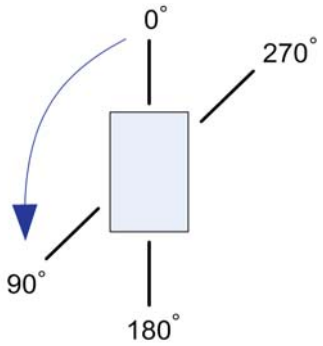
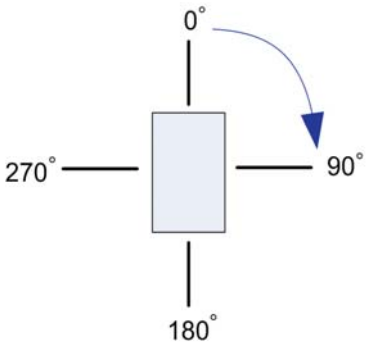
4.3 Test Fixture Condition

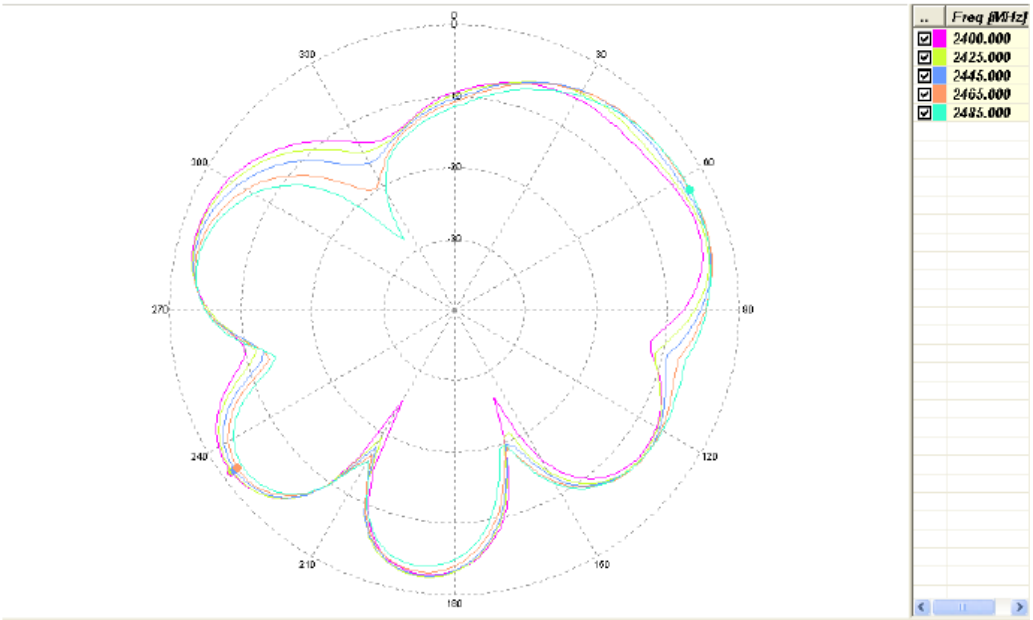
ITEM	SPEC
Frequency Range [MHz]	2400 ~ 2485
Lower frequency(2400MHz) SWR [Min~Max]	3.0 : 1(Typ 2.0 :1)
Upper frequency(2485MHz) SWR [Min~Max]	3.0 : 1(Typ 2.0 :1)

4.4 S11 Graph of Test Fixture Condition CTQ



4.5 Radiation Pattern

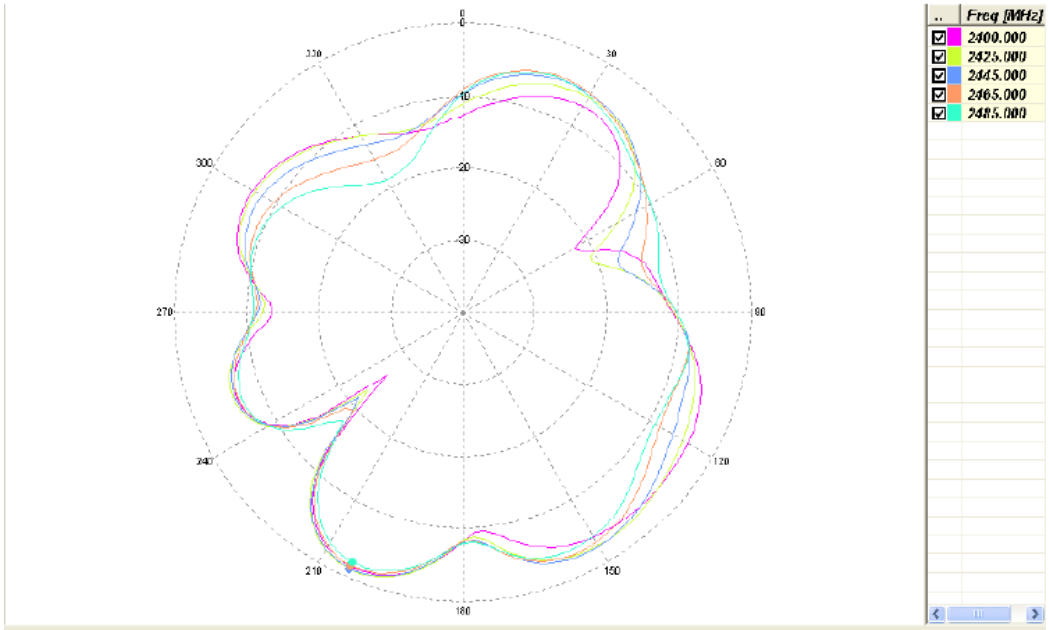
Azimuth Plane	Elevation1 Plane	Elevation2 Plane
		
Theta	Vertical field of measured plane	
Phi	Horizontal field of measured plane	

Azimuth Theta


H-Plan [Horizontal]

Frequency[MHz]	PeakValue	Theta[deg]	Phi[deg]	MinValue	Theta[deg]	Phi[deg]	3D Avg[dBi]	Gain[dBi]	Efficiency[%]
2400,000	-1,19	90	234	-26,47	90	156		-5,91	25,73
2425,000	-1,38	90	234	-21,23	90	156		-5,77	26,60
2445,000	-1,81	90	234	-19,82	90	159		-5,82	26,30
2465,000	-2,33	90	234	-19,62	90	327		-5,98	25,37
2485,000	-2,84	90	53	-27,67	90	324		-6,32	23,42

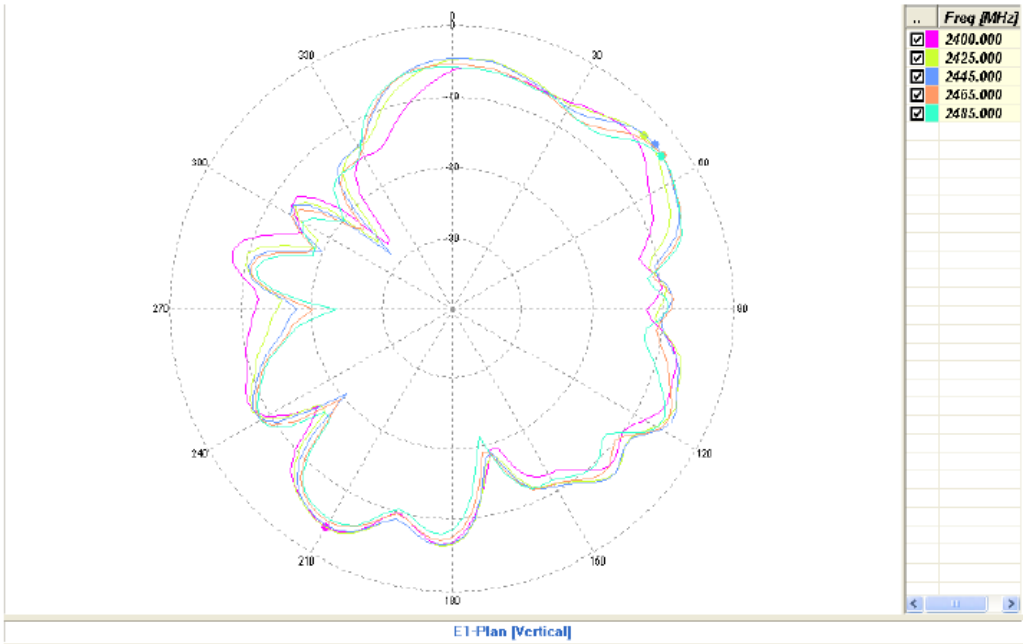
Azimuth Phi



H-Plan [Vertical]

Frequency[MHz]	PeakValue	Theta[deg]	Phi[deg]	MinValue	Theta[deg]	Phi[deg]	3D Avg[dBi]	Gain[dBi]	Efficiency[%]
2400.000	-1.54	90	204	-25.29	90	231		-7.09	19.63
2425.000	-1.13	90	204	-22.99	90	231		-6.58	22.08
2445.000	-1.23	90	204	-21.28	90	231		-6.70	21.51
2465.000	-1.70	90	204	-19.64	90	228		-7.19	19.21
2485.000	-2.15	90	204	-18.72	90	333		-7.64	17.32

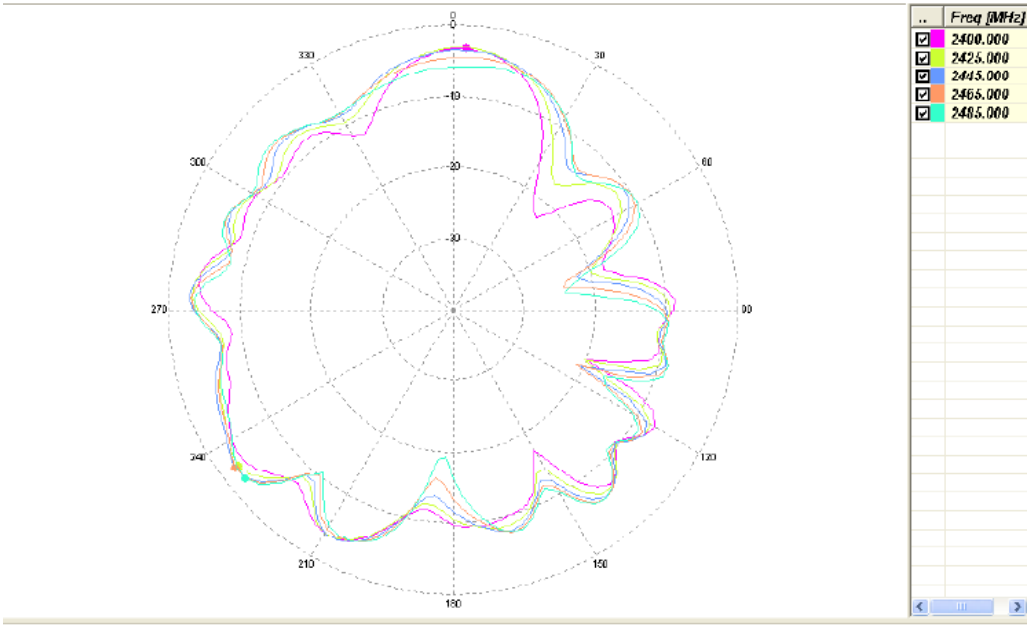
Elevation1 Theta



ET-Plan [Vertical]

Frequency[MHz]	PeakValue	Theta[deg]	Phi[deg]	MinValue	Theta[deg]	Phi[deg]	3D Avg[dBi]	Gain[dBi]	Efficiency[%]
2400.000	-4.06	210	0	-26.96	315	0		-8.59	13.96
2425.000	-3.36	48	0	-25.71	312	0		-7.84	16.54
2445.000	-2.99	51	0	-28.19	312	0		-7.74	16.95
2465.000	-3.09	54	0	-22.95	312	0		-8.27	14.99
2485.000	-3.28	54	0	-23.55	270	0		-8.68	13.65

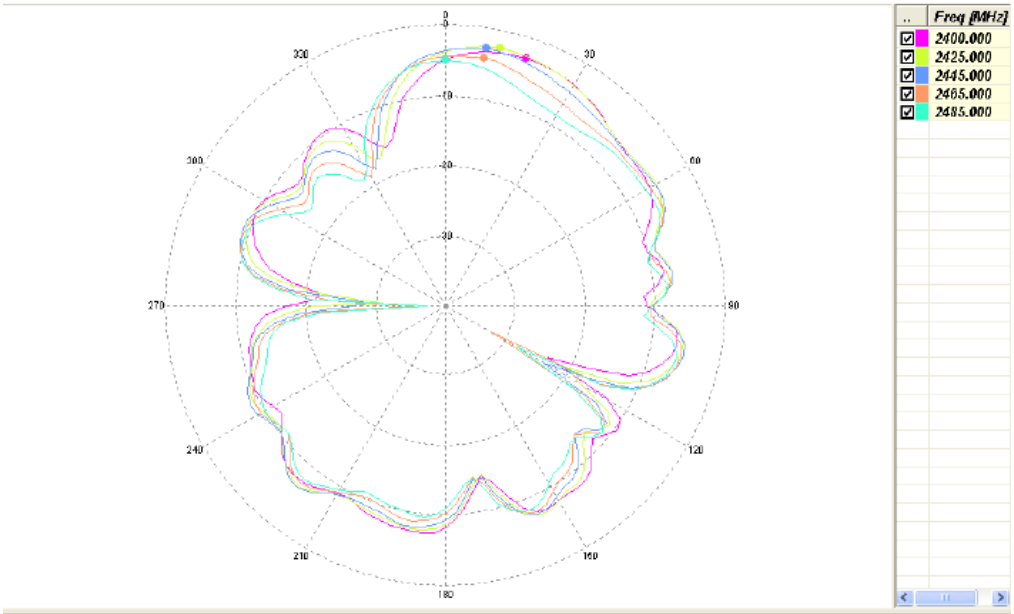
Elevation1 Phi



E1-Plan [Horizontal]

Frequency[MHz]	PeakValue	Theta[deg]	Phi[deg]	MinValue	Theta[deg]	Phi[deg]	3D Avg[dBi]	Gain[dBi]	Efficiency[%]
2400.000	-3.05	3	0	-22.54	42	0		-7.80	16.72
2425.000	-2.80	234	0	-20.30	111	0		-7.25	18.93
2445.000	-2.17	234	0	-22.04	76	0		-6.94	20.32
2465.000	-2.23	234	0	-24.11	78	0		-7.12	19.52
2485.000	-2.31	231	0	-24.14	81	0		-7.38	18.37

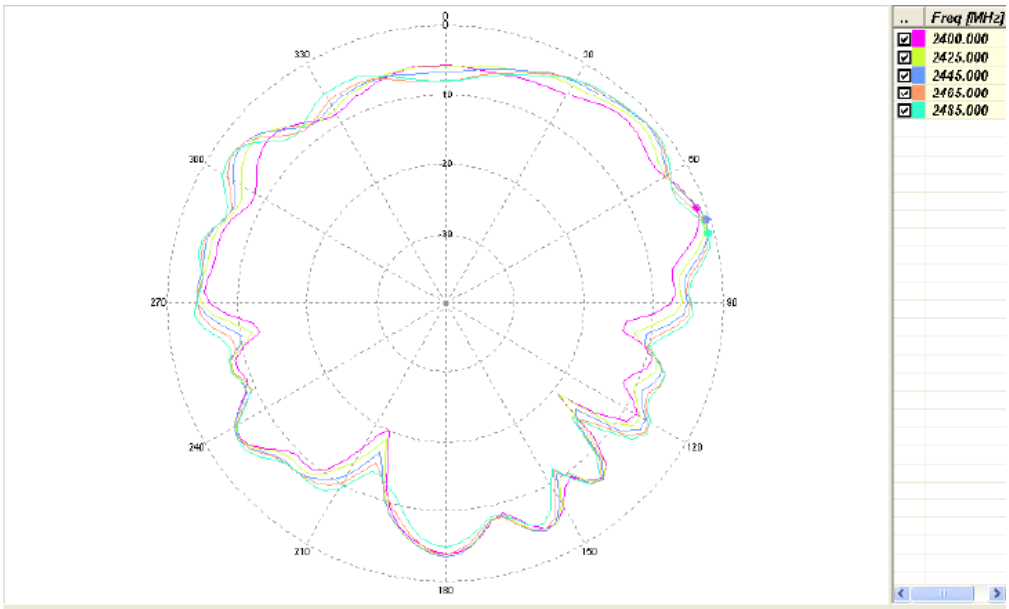
Elevation2 Theta



E2-Plan [Vertical]

Frequency[MHz]	PeakValue	Theta[deg]	Phi[deg]	MinValue	Theta[deg]	Phi[deg]	3D Avg[dBi]	Gain[dBi]	Efficiency[%]
2400.000	-2.84	18	90	-23.64	117	90		-8.12	15.52
2425.000	-2.45	12	90	-31.57	273	90		-7.78	16.80
2445.000	-2.86	9	90	-28.77	273	90		-7.95	16.14
2465.000	-4.18	9	90	-35.32	270	90		-8.75	13.44
2485.000	-4.95	0	90	-37.25	270	90		-9.47	11.41

Elevation2 Phi



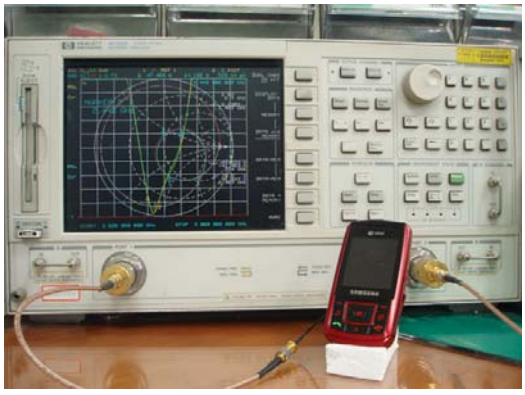
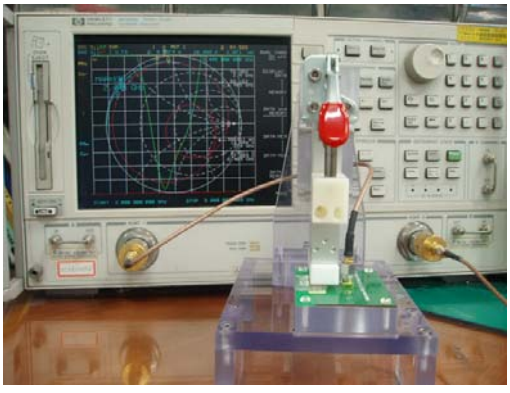
E2-Plan [Horizontal]

Frequency[MHz]	PeakValue	Theta[deg]	Phi[deg]	MinValue	Theta[deg]	Phi[deg]	3D Avg[dBi]	Gain[dBi]	Efficiency[%]
2400,000	-1,32	69	90	-19,96	204	90		-6,39	23,09
2425,000	-0,94	72	90	-19,16	129	90		-5,67	27,19
2445,000	-0,66	72	90	-16,72	204	90		-5,32	29,50
2465,000	-0,84	75	90	-15,47	132	90		-5,30	29,63
2485,000	-0,89	75	90	-15,74	132	90		-5,23	30,13

5. Measurement Process

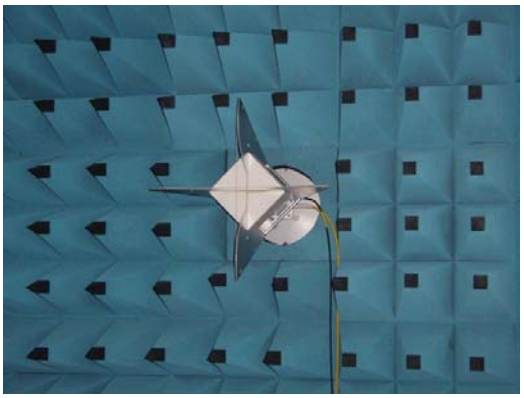
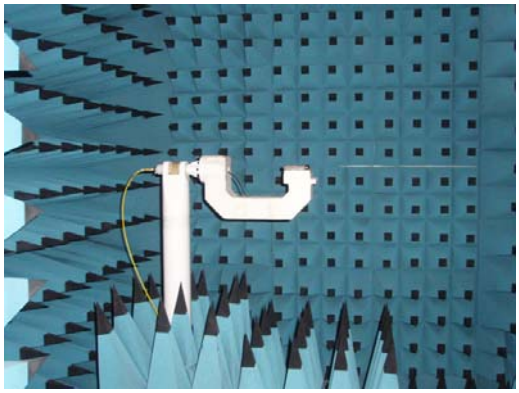
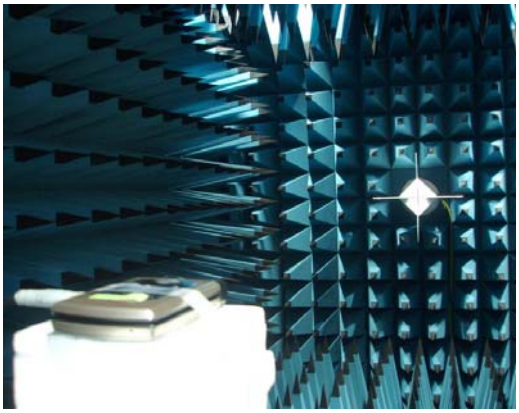
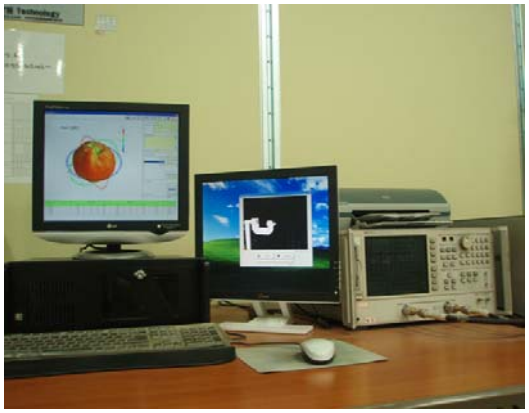
5.1 SWR/Return loss

Use Network Analyzer when measuring SWR/Return loss and selecting standard SPL, Use automatic inspection equipment when selecting superior and inferior goods.

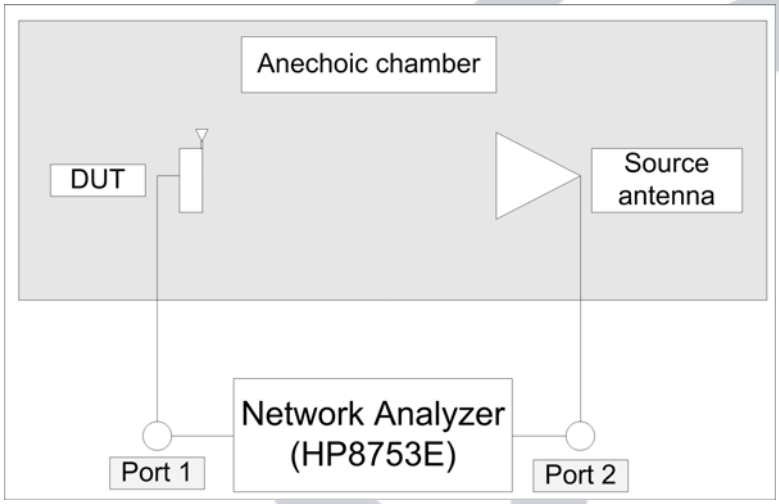
	Set Condition	Test Fixture Condition
Network Analyzer	Agilent HP8753D	Agilent HP8753D or Advantest R3765CH
Cable	RF cable(300mm)	RF cable(300mm)
Test condition		

5.2 Gain

Antenna gain is measured in the Anechoic Chamber of this company, using set above of 4.1 list.

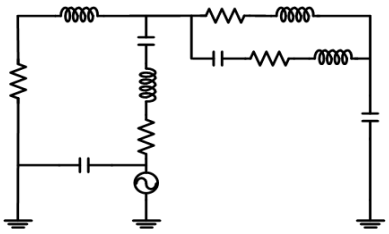
Anechoic Chamber for Antenna Gain Measurement	
	
	

5.3 Gain test block diagram

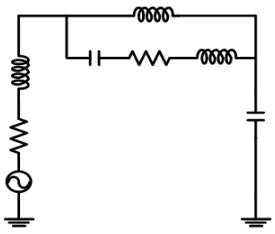


6. Internal Block Diagram

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.



3 Land Type

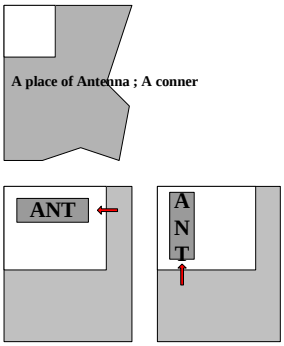


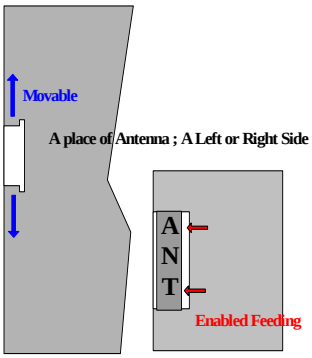
2 Land Type

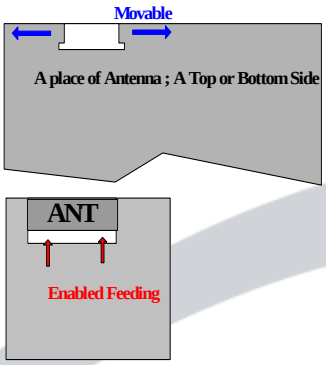
7. Basis Action / Application Note

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

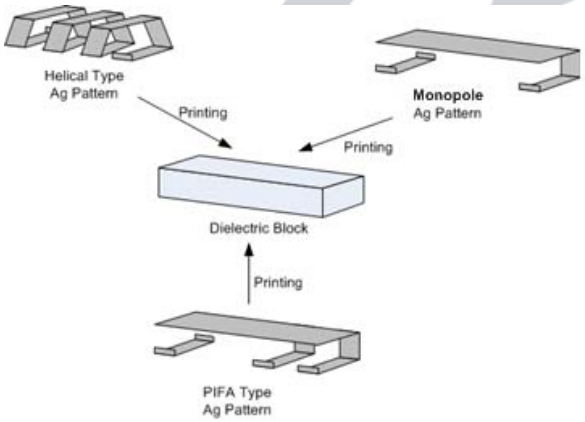
This product will be mounted wherever you want and the design is revised by mount condition. But require attention to select the mount position, because this product is the radiation part and changed characteristics by boundary condition,





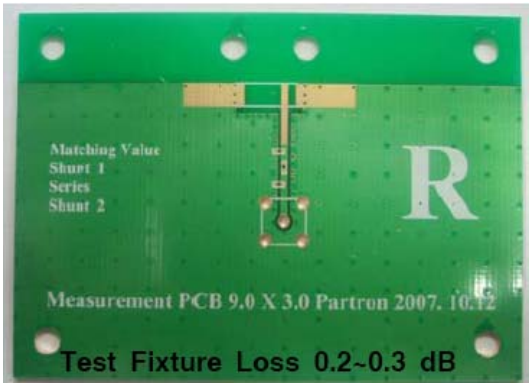


As the following, this product is easy to revise the various types for the boundary condition.



8. Measurement Jig SPEC

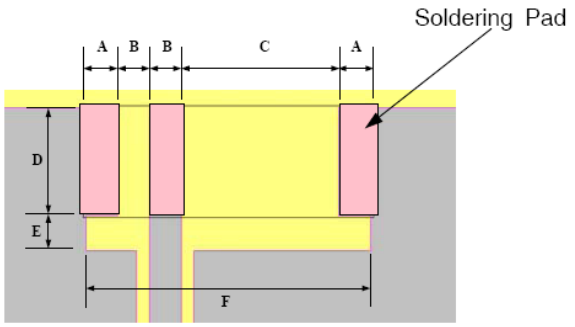
8.1 Test Fixture And GROUND Condition



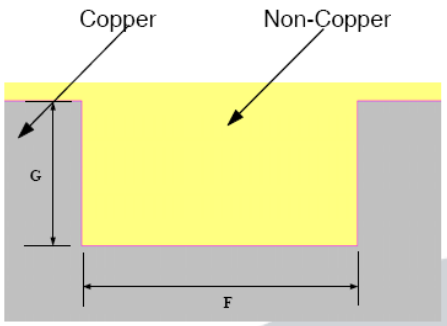
※ Ev B'd and Test Fixture Jig is the same

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

8.2 PCB Layout & Soldering Pad Dimension



Top Layout



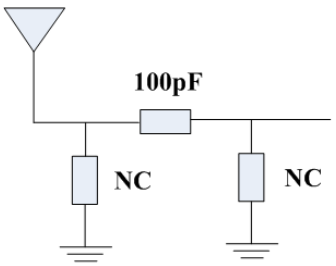
Bottom Pattern

Parameter	A	B	C	D	E	F	G
Value[mm]	1.1	1.0	5.0	3.2	1.0	9.2	4.2

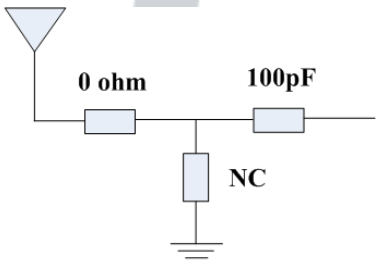
Unit ; mm

Unless specified tolerances are ±0.1

8.3 Matching Circuit And Reference Value



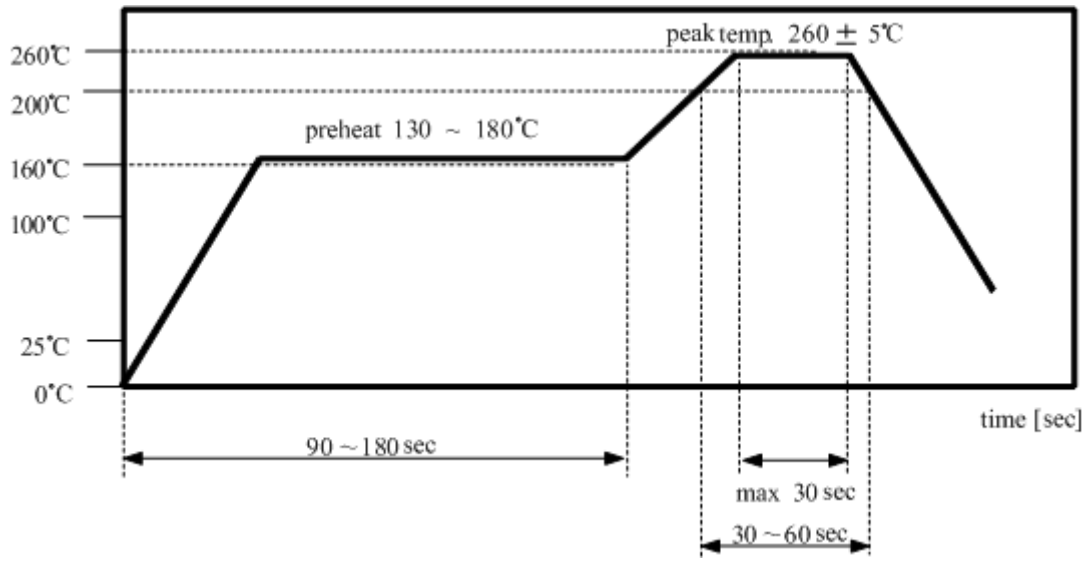
π Matching



T Matching

9. REFLOW PROFILE

9.1 Reflow Soldering



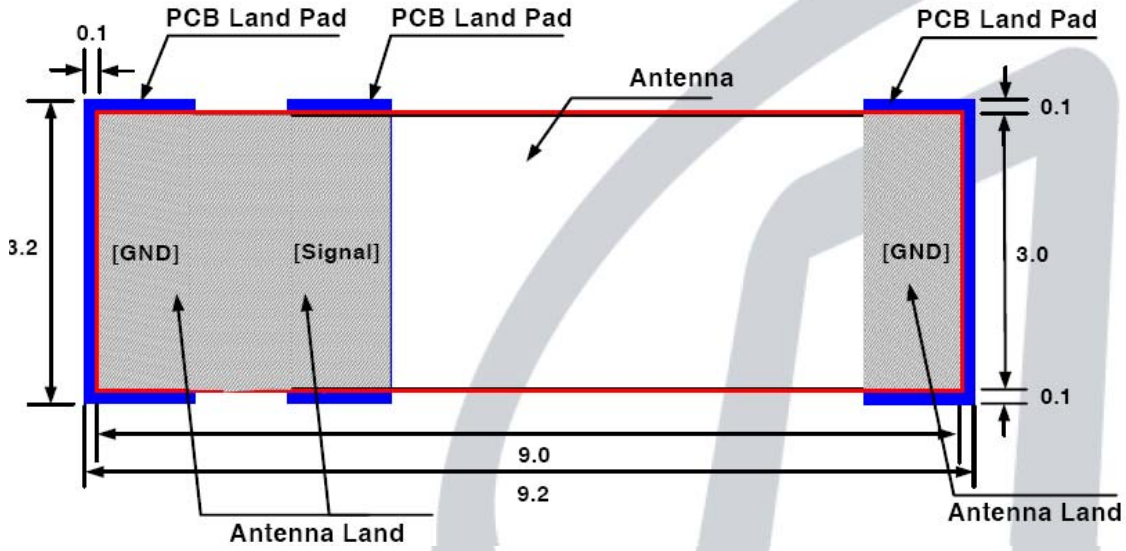
9.2 Manual Soldering

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

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

9.3 PCB Pattern Design

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



10. Primary Inspection List

Item	Electrical Characteristic[MHz] CTF		Size [mm]		
Standard	VSWR 3.0 MAX		W=3.0±0.1	L=9.0±0.1	T=1.2±0.1
	2400 MHz	2485 MHz			
1	1.71	1.66	3.03	9.02	1.21
2	1.64	1.73	3.02	9.01	1.22
3	1.64	1.72	3.02	9.02	1.22
4	1.67	1.71	3.01	9.01	1.21
5	1.65	1.73	3.02	8.99	1.24
6	1.59	1.78	3.04	9.00	1.23
7	1.77	1.59	3.01	9.03	1.22
8	1.57	1.77	3.01	9.00	1.23
9	1.57	1.80	3.04	9.02	1.23
10	1.63	1.73	3.03	9.02	1.24
11	1.65	1.78	3.02	9.01	1.21
12	1.62	1.71	3.02	9.00	1.22
13	1.58	1.78	3.04	8.99	1.21
14	1.62	1.77	3.01	9.01	1.23
15	1.70	1.64	3.01	9.01	1.24
16	1.58	1.72	3.02	9.00	1.23
17	1.58	1.74	3.01	9.01	1.22
18	1.62	1.75	3.04	9.00	1.22
19	1.65	1.71	3.03	9.02	1.21
20	1.58	1.79	3.02	9.01	1.21
Min	1.57	1.59	3.01	8.99	1.21
Max	1.77	1.60	3.04	9.03	1.24
X	1.63	1.73	3.02	9.01	1.22
σ	0.05	0.05	0.01	0.01	0.01
Cpk	8.53	7.86	2.28	2.79	2.38
Decision	ok	ok	ok	ok	ok

11. Reliability Condition

11.1 Environment Test

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

11.2 Thermal shock test , Reflow test

ITEM	TEST CONDITION	LIMIT
Thermal shock	condition : -40℃±3℃/1min ↔ +85℃±3℃/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℃, 30～60 sec Peak Heating : 260℃±5℃, 30sec Max	

11.3 Mechanical Test

ITEM	TEST CONDITION	LIMIT
Vibration	Freq : 10~500Hz , Acceleration : 10 ×9.8㎨(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℃/85%RH	168+5/-0	= < 85℃/85%RH

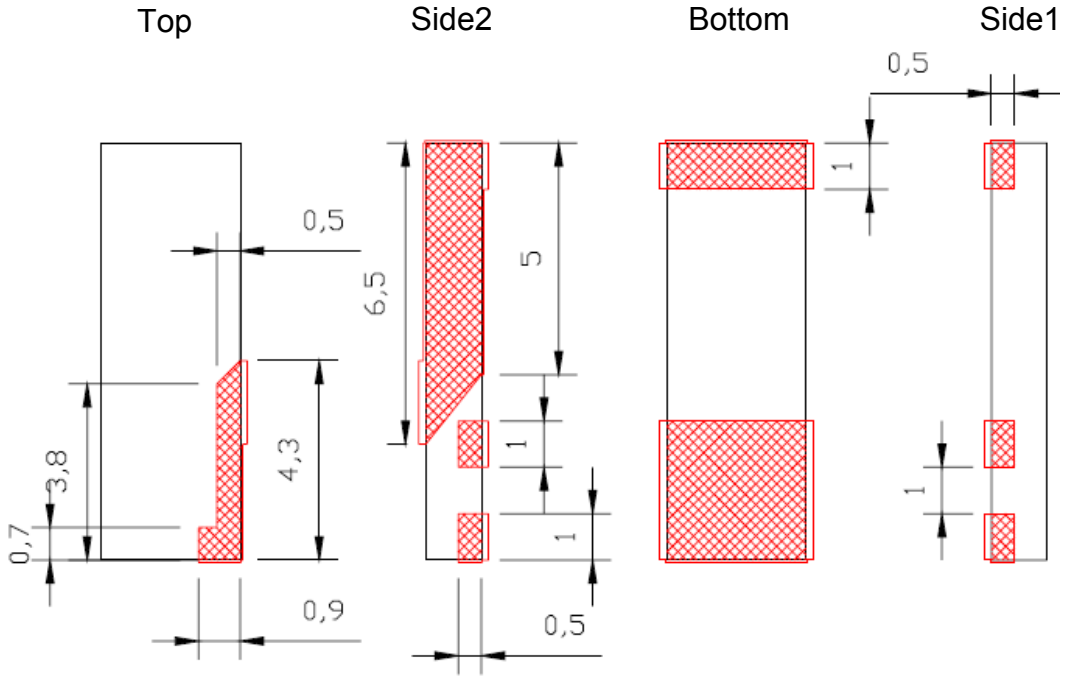
2) Test Condition

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

12. Mechanical Characteristics

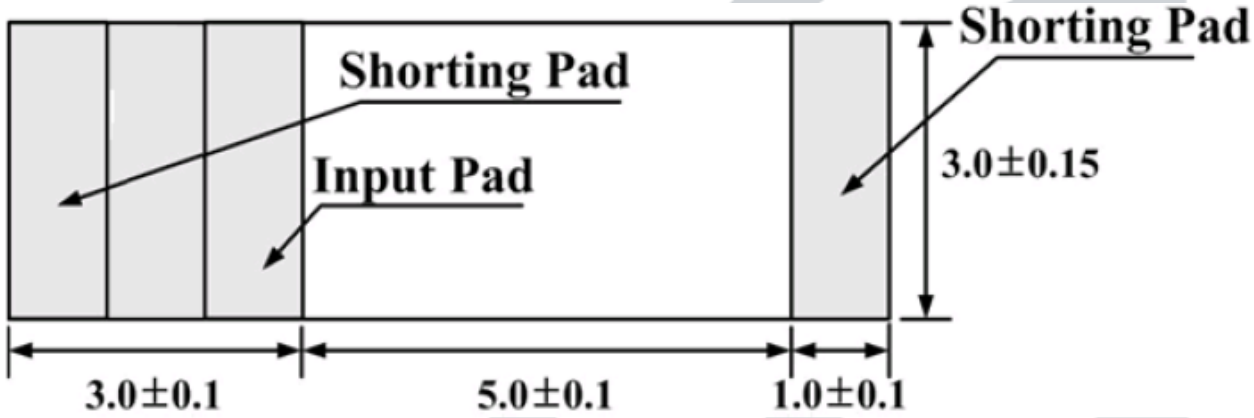
12.1 Antenna Pattern Dimension

Antenna Pattern View



Dimension : mm
Tolerance : ± 0.1mm

12.2 Pin name



12.3 Lot number notation

9	1	1
①	②	③

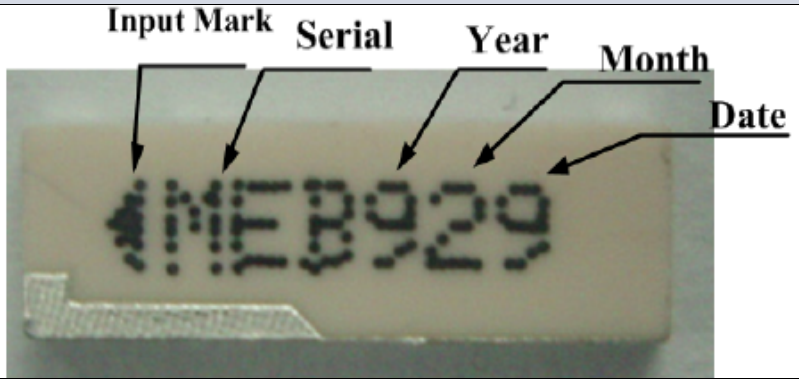
① Year : 9 - 2009 ····

② Month : 1 - January, 2 - February ·· 9 - September, A - October, B - November ··

③ Date : 1 - 1st , 2 - 2nd ···· A - 10th, B - 11th ····

12.4 Marking

Marking View



◀	M E B	9	2	9
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 ···· A - 10th, B - 11th ····

12.5 Marking type

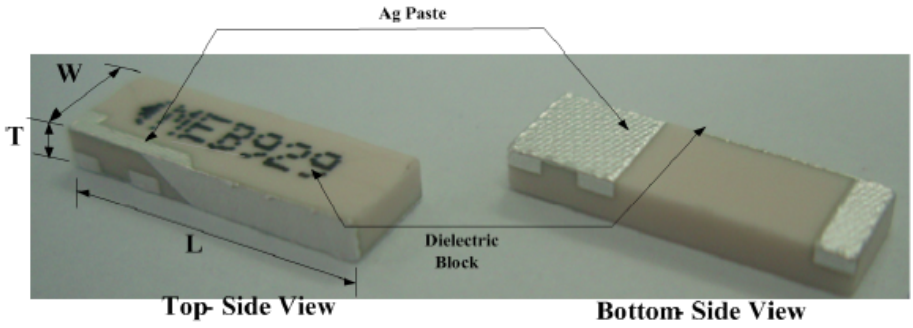
Ink marking - Using Black Ink

13. Structure and Material

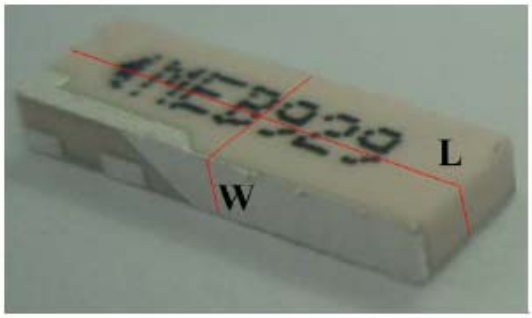
13.1 materialization method

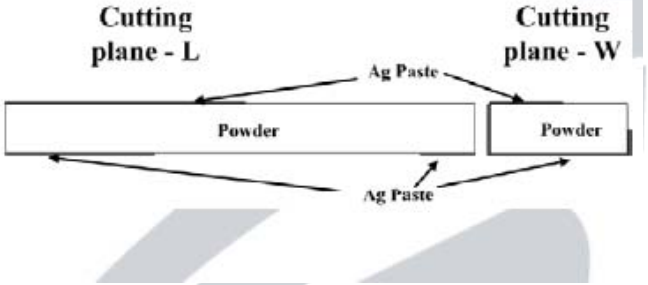
Chip antenna forms the pattern with Ag paste on the brick of dielectric block and materializes the characteristics

13.2 Struture



13.3 Internal cross section





13.4 Material

ITEM	Material	Maker	Printing pattern SPEC
Dielectric Block	Powder	Fuji	
PATTERN	Ag Paste	Metech	Thickness : TYP 10㎛
PAD	Ag paste	Metech	Thickness : Min 10㎛ (TYP 16~20㎛)

14. Attention

14.1 Temperature Condition

	Range of Temperature	Unit
Application temperature	-40 ~ +85	℃
Keeping temperature	-40 ~ +85	℃

14.2 Temperature Test Condition

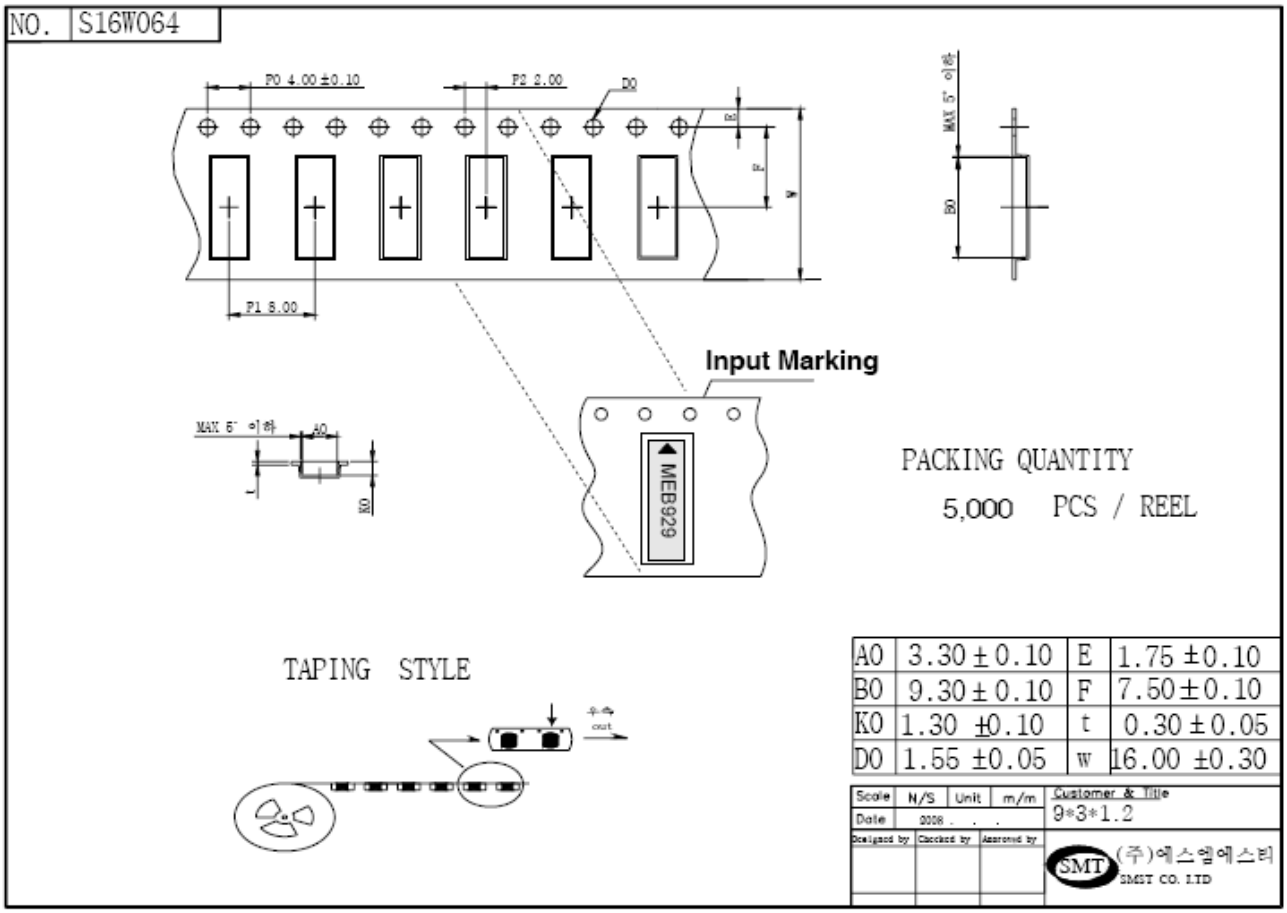
	Condition	Range of Temperature
Application temperature	Low	24hr normal action at -75℃
	High	24hr normal action at +150℃
Keeping temperature	Low	normal action when left for 1000hr at -75℃
	High	normal action when left for 1000hr at +85℃

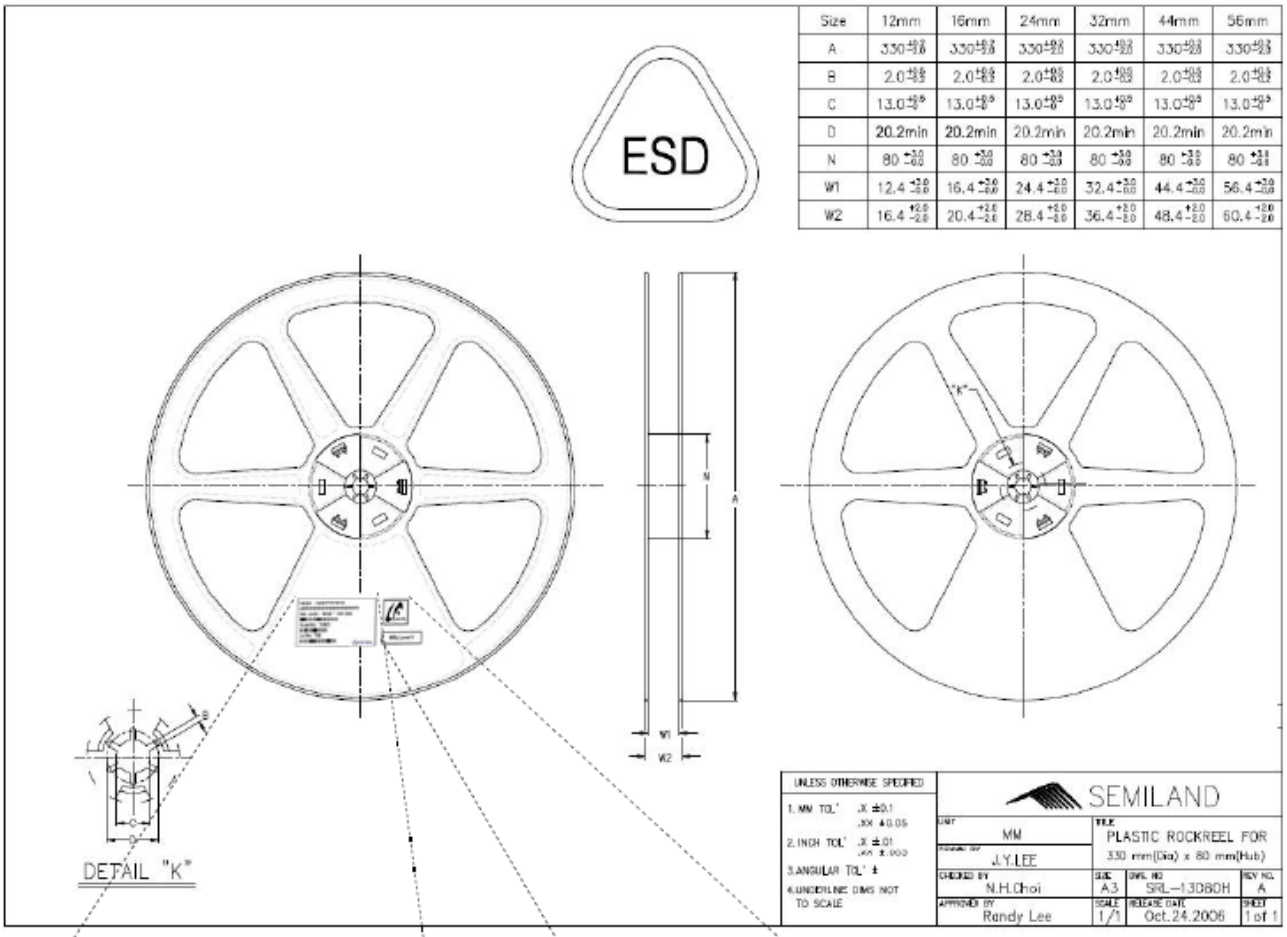
* Because of the keeping temperature problem, no admission when left over +85℃

15. Packing

15.1 Carrier/Reel

ITEM	Material	Surface Resistance	electrostatic emission	Packing method
Carrier tape	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	-





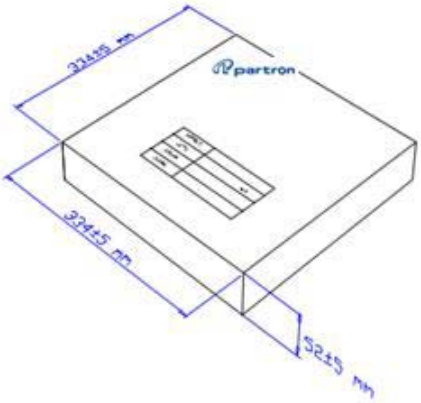
Size	12mm	16mm	24mm	32mm	44mm	56mm
A	330	330	330	330	330	330
B	2.0	2.0	2.0	2.0	2.0	2.0
C	13.0	13.0	13.0	13.0	13.0	13.0
D	20.2min	20.2min	20.2min	20.2min	20.2min	20.2min
N	80	80	80	80	80	80
W1	12.4	16.4	24.4	32.4	44.4	56.4
W2	16.4	20.4	28.4	36.4	48.4	60.4

CODE NO : ACS2450ICAMEB
Model : 5000
Quantity :
Lot No : 929
PARTRON

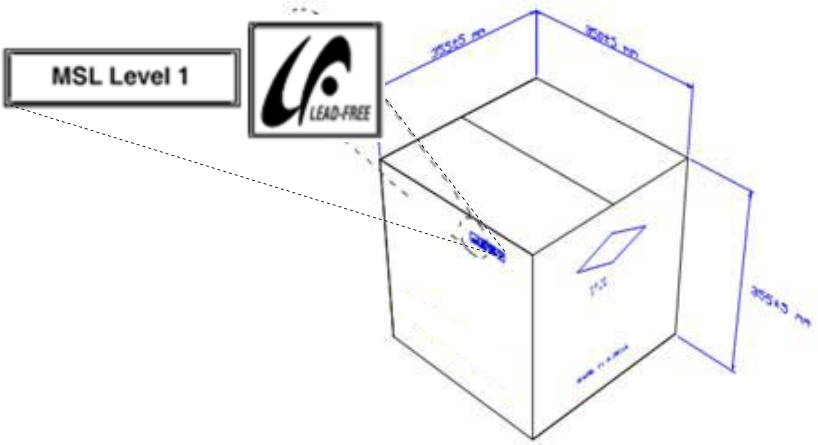
LEAD-FREE

MSL Level 1

15.2 BOX



Material : SK/S/K-B
Corrugated cardboard



15.3 Actual packing Picture

Reel

Internal Box

External Box

Reel / Internal Box label

External 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	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						wide length shape	refer to Guide Sheet	Micrometer Calipers Visual Inspection	20ea/LOT 20ea/LOT all	C/sheet	Exhaust
AG PASTE		○	SIDE1 PAD Printing	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			
	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
AG PASTE		◯	SIDE 2 PAD Printing	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	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

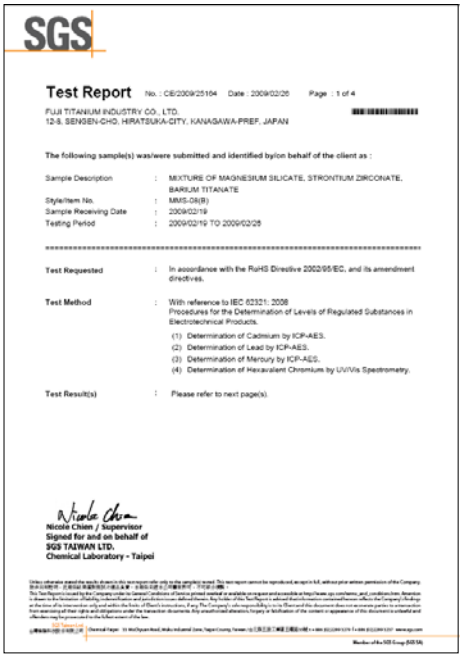
Product	Issued/Revision		Process Control	Record	By designed	By checked	By approved
CHIP ANTENNA	Issued	04.04.06		PRCP-C001			
	Revised	05.04.03					

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
	○		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	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

17. RoHS Data

17.1 Ceramic Powder

Parts Name	White Powder(MMS-08)
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. : CE/2009/25164 Date : 2009/02/26 Page : 1 of 4

FUJI TITANIUM INDUSTRY CO., LTD.
12-8, SENGEN-CHO, HIRATSUKA-CITY, KANAGAWA-PREF, JAPAN

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

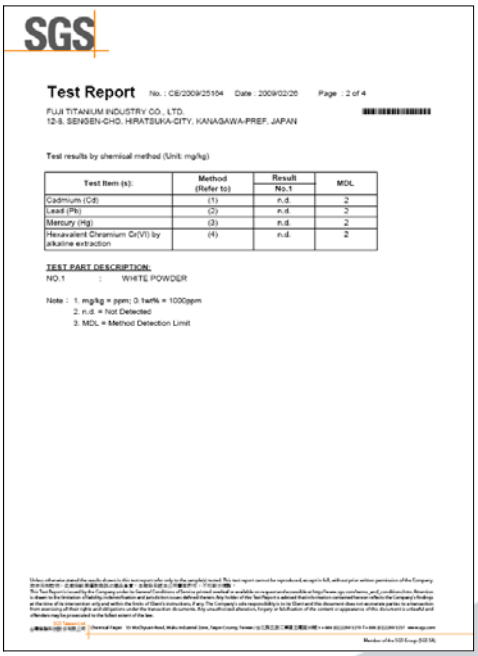
Sample Description : MIXTURE OF MAGNESIUM SILICATE, STRONTIUM ZIRCONATE, BARIUM TITANATE
Style/Item No. : MMS-08(B)
Sample Receiving Date : 2009/02/19
Testing Period : 2009/02/19 TO 2009/03/26

Test Requested : In accordance with the RoHS Directive 2002/95/EC, and its amendment directives.

Test Method : With reference to IEC 62321: 2008 Procedures for the Determination of Levels of Regulated Substances in Electrotechnical Products.
(1) Determination of Cadmium by ICP-AES.
(2) Determination of Lead by ICP-AES.
(3) Determination of Mercury by ICP-AES.
(4) Determination of Hexavalent Chromium by UV/Vis Spectrometry.

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

Nicole Chien / Supervisor
Signed for and on behalf of
SGS TAIWAN LTD.
Chemical Laboratory - Taipei



SGS

Test Report No. : CE/2009/25164 Date : 2009/02/26 Page : 2 of 4

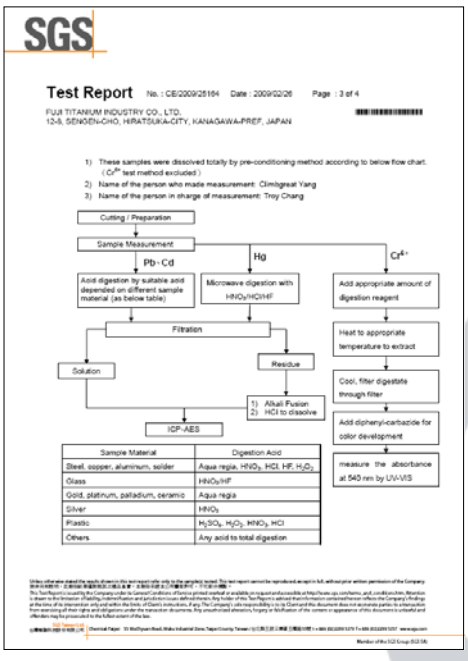
FUJI TITANIUM INDUSTRY CO., LTD.
12-8, SENGEN-CHO, HIRATSUKA-CITY, KANAGAWA-PREF, JAPAN

Test results by chemical method (Unit: mg/kg)

Test Item (s):	Method (Refer to)	Result No.1	MDL
Cadmium (Cd)	(1)	n.d.	2
Lead (Pb)	(2)	n.d.	2
Mercury (Hg)	(3)	n.d.	2
Hexavalent Chromium Cr(VI) by alkaline extraction	(4)	n.d.	2

TEST PART DESCRIPTION:
NO.1 : WHITE POWDER

Note : 1. mg/kg = ppm; 0.1wt% = 1000ppm
2. n.d. = Not Detected
3. MDL = Method Detection Limit



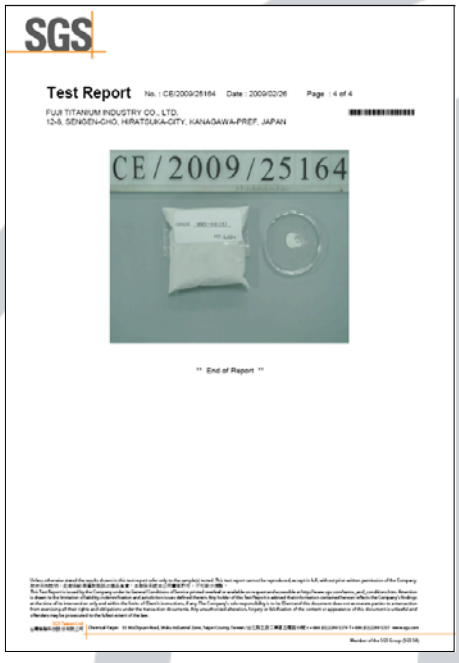
SGS

Test Report No. : CE/2009/25164 Date : 2009/02/26 Page : 3 of 4

FUJI TITANIUM INDUSTRY CO., LTD.
12-8, SENGEN-CHO, HIRATSUKA-CITY, KANAGAWA-PREF, JAPAN

1) These samples were dissolved totally by pre-conditioning method according to below flow chart. (Cr^{6+} test method excluded.)
2) Name of the person who made measurement: Climbgreat Yang
3) Name of the person in charge of measurement: Troy Chang

Sample Material	Digestion Acid
Steel, copper, aluminum, solder	Aqua regia, HNO_3, HCl, HF, H_2O_2
Glass	HNO_3/HF
Gold, platinum, palladium, ceramic	Aqua regia
Silver	HNO_3
Plastic	H_2SO_4, H_2O_2, HNO_3, HCl
Others	Any acid to total digestion



SGS

Test Report No. : CE/2009/25164 Date : 2009/02/26 Page : 4 of 4

FUJI TITANIUM INDUSTRY CO., LTD.
12-8, SENGEN-CHO, HIRATSUKA-CITY, KANAGAWA-PREF, JAPAN

** End of Report **

17.2 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. F830501/LF-CTSAYAA08-27371 Issued Date: October 10, 2008 Page 1 of 2

To: METECH KOREA CO., LTD.
B-501 Dongyang Paragon officetel 17-2 Jeongja-dong
Bundang-gu
Sungnam-city
GYEONGGI-DO
Korea

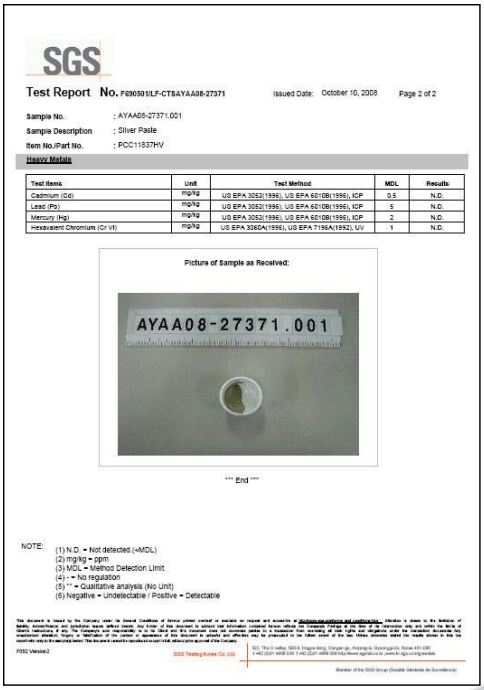
The following merchandise was submitted and identified by the client as :

Product Name : Silver Paste
SGS File No. : AYAA08-27371
Received Date : October 06, 2008
Test Performing Date : October 07, 2008
Test Performed : SGS Testing Korea tested the sample(s) selected by applicant with following results
Test Results : For further details, please refer to following page(s)

SGS Testing Korea Co. Ltd.

Pluto Kim
Monet Jeong
Billy Oh / Testing Person

Jeff Jang / Chemical Lab Mgr



SGS

Test Report No. F830501/LF-CTSAYAA08-27371 Issued Date: October 10, 2008 Page 2 of 2

Sample No. : AYAA08-27371.001
Sample Description : Silver Paste
Item No./Part No. : PCC11837HV

Heavy Metals

Test Items	Unit	Test Method	MDL	Results
Cadmium (Cd)	mg/kg	US EPA 3052(1996), US EPA 6010B(1996), ICP	0.5	N.D.
Lead (Pb)	mg/kg	US EPA 3052(1996), US EPA 6010B(1996), ICP	5	N.D.
Mercury (Hg)	mg/kg	US EPA 3052(1996), US EPA 6010B(1996), ICP	2	N.D.
Hexavalent Chromium (Cr VI)	mg/kg	US EPA 3060A(1996), US EPA 7196A(1992), UV	1	N.D.

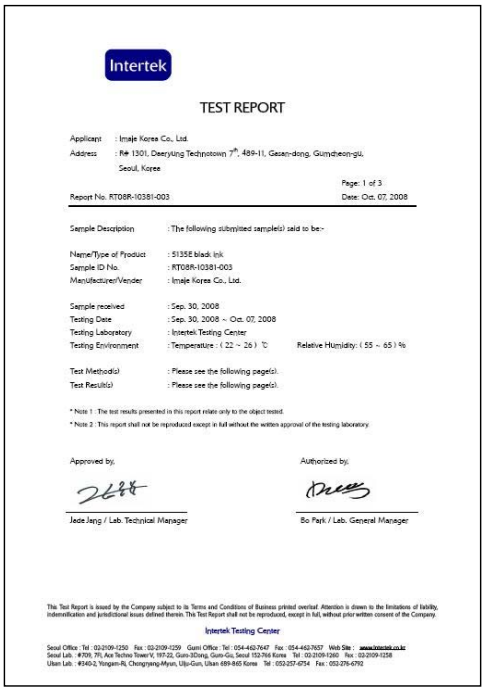
Picture of Sample as Received:

*** 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

17.3 Marking Ink(Black Ink)

Parts Name	Black Ink
Tester Organization	Intertek Testing Center
Measurement Tester	Please see the 'method' in the test report
Measurement Data	Please see the report under the table



Intertek

TEST REPORT

Applicant : Imaje Korea Co., Ltd.
Address : R# 1301, Daeryung Technotown 7th, 489-11, Gasan-dong, Gumcheon-gu, Seoul, Korea

Page: 1 of 3
Report No. RT08R-10381-003 Date: Oct. 07, 2008

Sample Description : The following submitted sample(s) said to be:-

Name/Type of Product : 5135E black ink
Sample ID No. : RT08R-10381-003
Manufacturer/Vender : Imaje Korea Co., Ltd.

Sample received : Sep. 30, 2008
Testing Date : Sep. 30, 2008 ~ Oct. 07, 2008
Testing Laboratory : Intertek Testing Center
Testing Environment : Temperature : (22 ~ 26) °C Relative Humidity: (55 ~ 65) %

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 approval of the testing laboratory.

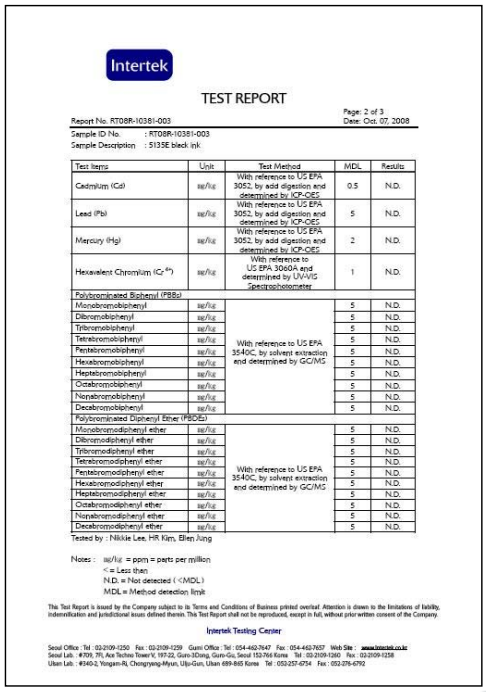
Approved by: Authorized by:

Jade Jang / Lab. Technical Manager 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 : 02-2109-1250 Fax : 02-2109-1259 Gumi Office : Tel : 054-462-7647 Fax : 054-462-7657 Web Site : www.intertek.co.kr
Seoul Lab. : #709, 7Fl, Ace Techno Tower V, 197-22, Guro-3Dong, Guro-Gu, Seoul 152-766 Korea Tel : 02-2109-1260 Fax : 02-2109-1258
Ulsan Lab. : #340-2, Yongam-Ri, Chongryang-Myun, Ulju-Gun, Ulsan 689-865 Korea Tel : 052-257-6754 Fax : 052-276-6792



Intertek

TEST REPORT

Report No. RT08R-10381-003 Page: 2 of 3 Date: Oct. 07, 2008

Sample ID No. : RT08R-10381-003
Sample Description : 5135E black ink

Test Items	Unit	Test Method	MDL	Results
Cadmium (Cd)	mg/kg	With reference to US EPA 3052, by add digestion and determined by ICP-OES	0.5	N.D.
Lead (Pb)	mg/kg	With reference to US EPA 3052, by add digestion and determined by ICP-OES	5	N.D.
Mercury (Hg)	mg/kg	With reference to US EPA 3052, by add digestion and determined by ICP-OES	2	N.D.
Hexavalent Chromium (Cr^{6+})	mg/kg	With reference to US EPA 3060A and determined by UV-VIS Spectrophotometer	1	N.D.
Polybrominated Biphenyl (PBBs)				
Monobromobiphenyl	mg/kg	With reference to US EPA 3540C, by solvent extraction and determined by GC/MS	5	N.D.
Dibromobiphenyl	mg/kg		5	N.D.
Tribromobiphenyl	mg/kg		5	N.D.
Tetrabromobiphenyl	mg/kg		5	N.D.
Pentabromobiphenyl	mg/kg		5	N.D.
Hexabromobiphenyl	mg/kg		5	N.D.
Heptabromobiphenyl	mg/kg		5	N.D.
Octabromobiphenyl	mg/kg		5	N.D.
Nonabromobiphenyl	mg/kg		5	N.D.
Decabromobiphenyl	mg/kg		5	N.D.
Polybrominated Diphenyl Ether (PBDEs)				
Monobromodiphenyl ether	mg/kg	With reference to US EPA 3540C, by solvent extraction and determined by GC/MS	5	N.D.
Dibromodiphenyl ether	mg/kg		5	N.D.
Tribromodiphenyl ether	mg/kg		5	N.D.
Tetrabromodiphenyl ether	mg/kg		5	N.D.
Pentabromodiphenyl ether	mg/kg		5	N.D.
Hexabromodiphenyl ether	mg/kg		5	N.D.
Heptabromodiphenyl ether	mg/kg		5	N.D.
Octabromodiphenyl ether	mg/kg		5	N.D.
Nonabromodiphenyl ether	mg/kg		5	N.D.
Decabromodiphenyl ether	mg/kg		5	N.D.

Tested by : Nikkie Lee, HR Kim, Ellen Jung

Notes : mg/kg = ppm = parts per million
< = Less than
N.D. = Not detected (<MDL)
MDL = Method detection limit

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Intertek Testing Center

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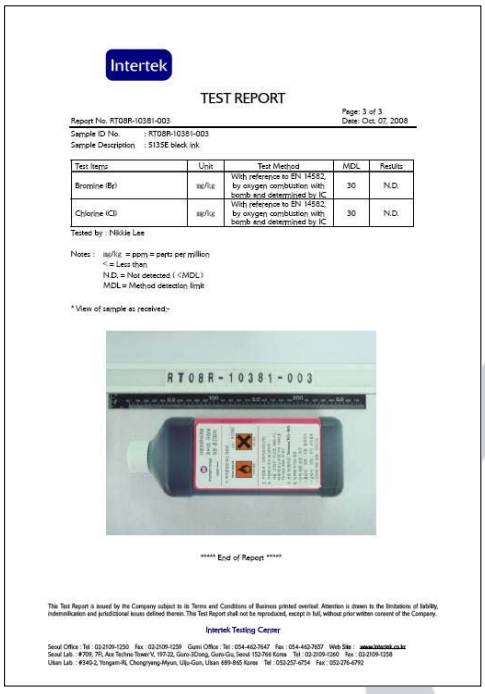

Intertek

TEST REPORT

Report No. RT08R-10381-003 Page: 3 of 3 Date: Oct. 07, 2008

Sample ID No. : RT08R-10381-003
Sample Description : 5135E black ink

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

Tested by : Nikkie Lee

Notes : mg/kg = ppm = parts per million
< = Less than
N.D. = Not detected (<MDL)
MDL = Method detection limit

* View of sample as received:-

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

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