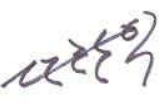
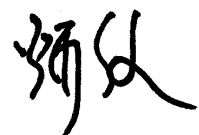


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**MSL Level 1**
**ROHS-Y**

# Approval Sheet

|               |                                                                                     |                                                                                      |                                                                                       |
|---------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Products      | Dielectric Chip Antenna                                                             |                                                                                      |                                                                                       |
| Customer      | Zenocom                                                                             |                                                                                      |                                                                                       |
| Model         | I720                                                                                |                                                                                      |                                                                                       |
| Customer CODE |                                                                                     |                                                                                      |                                                                                       |
| Supplier      | PARTRON                                                                             |                                                                                      |                                                                                       |
| Supplier CODE | ACS2450ICA172                                                                       |                                                                                      |                                                                                       |
| Zenocom       | 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                                                                        |
|               | 02/26                                                                               | 02/26                                                                                | 02/26                                                                                 |

**2008. 02. 26**


22-6 Seokwoo-dong, Hwaseong-si, Gyeonggi-do, Korea 455-300

Tel : 82-31-201-7870~6

Fax : 82-31-201-7800

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

TBBP-A free


**MSL Level 1**
**ROHS-Y**

# SPECIFICATION

**MODEL : ACS2450ICAI72**

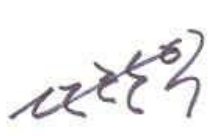
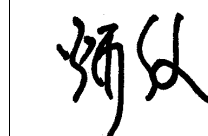
3D Structure



Top View



Bottom View

| By designed                                                                         | By checked                                                                          | By approved                                                                          |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|  |  |  |
| Research 5 Team                                                                     | Quality Assurance                                                                   | Laboratory                                                                           |
| Chanik.Jeon                                                                         | Nam-Sik. Min                                                                        | Byoung-Jun.Yim                                                                       |
| 02/26                                                                               | 02/26                                                                               | 02/26                                                                                |

**2008. 02. 26**

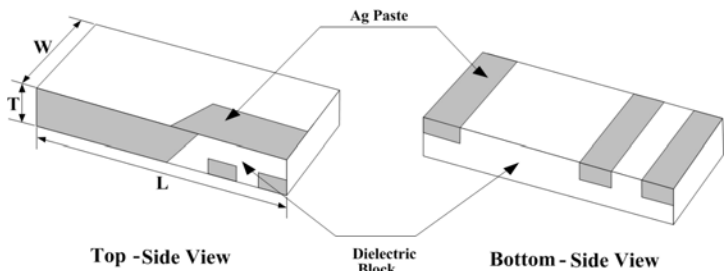
**- Contents -**

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## 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 <sub>2</sub> SiO <sub>4</sub> (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 measur  t<br>SWR | An important Parameter classifying the electrical characteristics. |

- require attention for the following list.

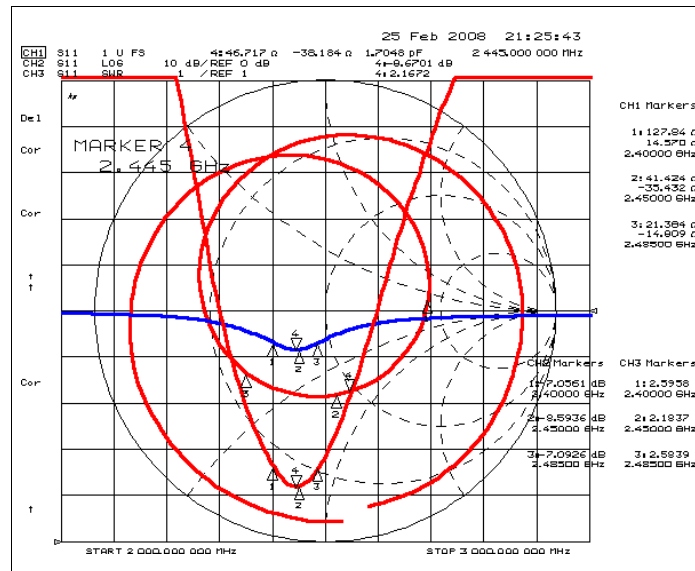
| ITEM    | Content                                                 |
|---------|---------------------------------------------------------|
| Keeping | Sealing tightly when keeping for a long time.           |
| Action  | Maybe characteristics changes when changing any design. |

## 4. Electrical Characteristics

### 4.1 Set Condition

| ITEM                         |                                 |       |         | SPEC                  |
|------------------------------|---------------------------------|-------|---------|-----------------------|
| Frequency Range [MHz]        |                                 |       |         | 2400 ~ 2485           |
| SWR [Max]                    |                                 |       |         | 3.5 : 1 (Typ 3.0 : 1) |
| Input Impedance [ $\Omega$ ] |                                 |       |         | 50 Ohm                |
| Polarization                 |                                 |       |         | Linear                |
| Gain[dBi]                    | Total Gain ( Peak / Avg ) [dBi] |       |         | 1.1 / -5.5            |
|                              | Azimuth                         | Theta | Peak    | 1.11                  |
|                              |                                 |       | Average | -1.61                 |
|                              |                                 | Phi   | Peak    | -7.63                 |
|                              |                                 |       | Average | -12.18                |
|                              | Elevation 1                     | Theta | Peak    | -5.94                 |
|                              |                                 |       | Average | -9.49                 |
|                              |                                 | Phi   | Peak    | -0.50                 |
|                              |                                 |       | Average | -4.29                 |
|                              | Elevation 2                     | Theta | Peak    | -6.95                 |
|                              |                                 |       | Average | -12.24                |
|                              |                                 | Phi   | Peak    | 0.14                  |
|                              |                                 |       | Average | -4.20                 |

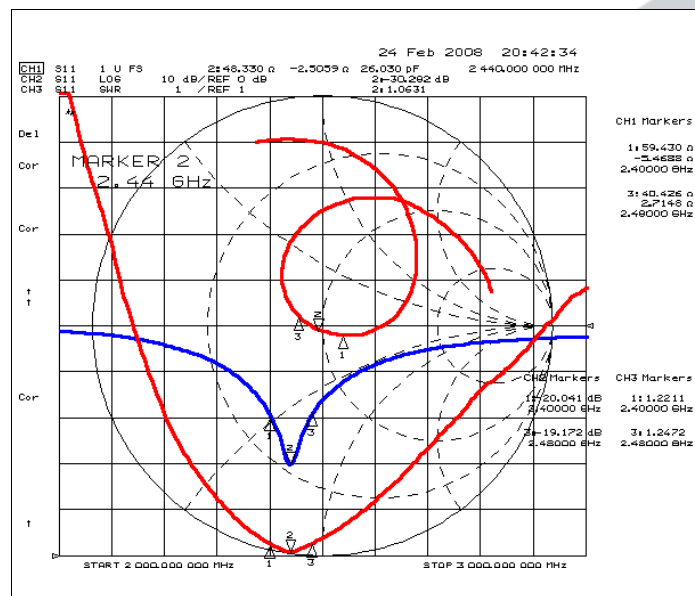
#### 4.2 S11 Graph of Set Condition



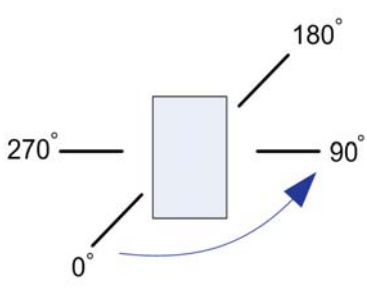
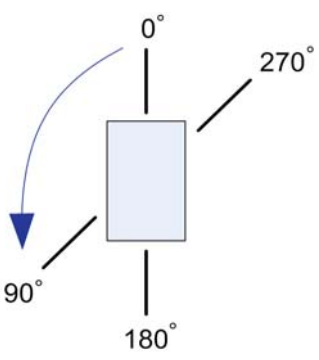
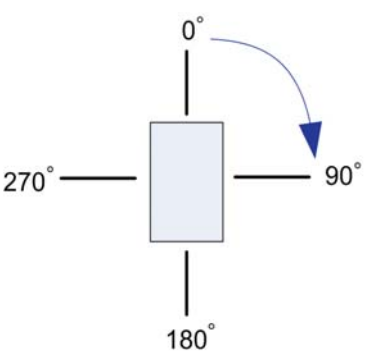
#### 4.3 Test Fixture Condition

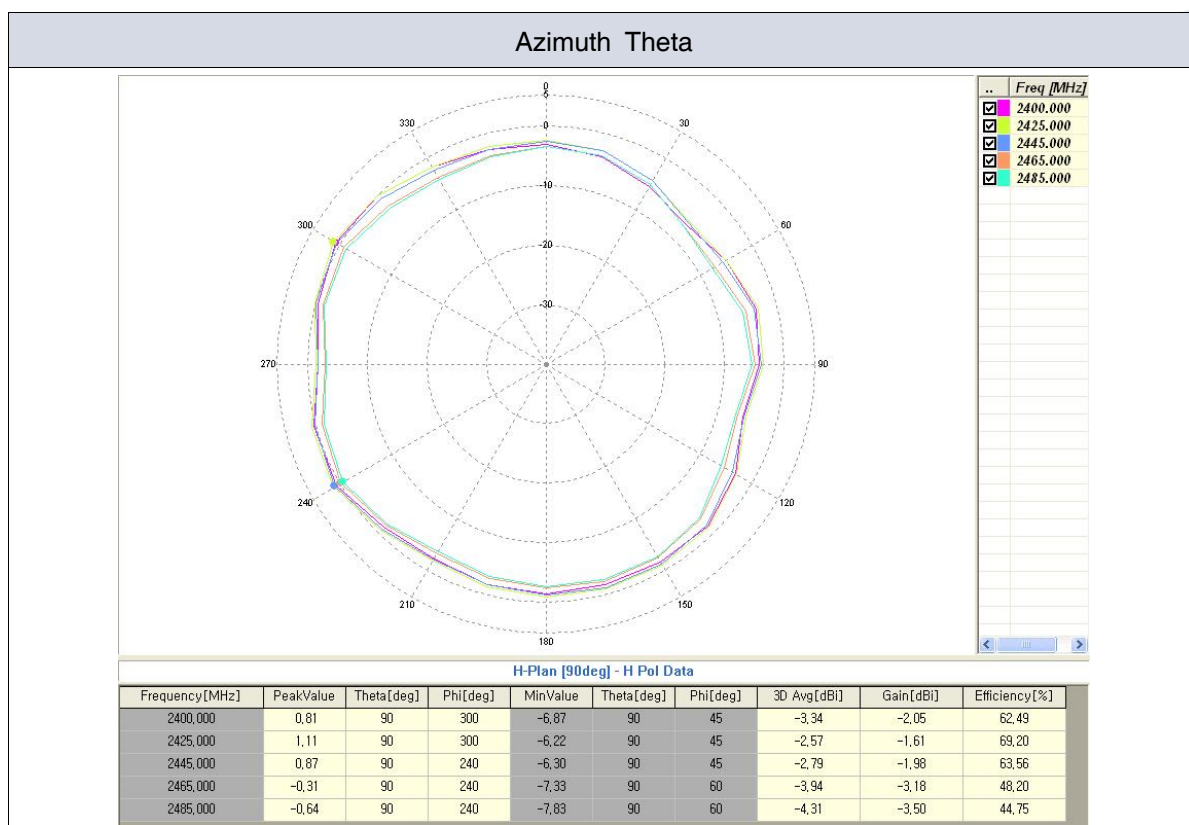
| ITEM                                   | SPEC                        |
|----------------------------------------|-----------------------------|
| Frequency Range [MHz]                  | 2400 ~ 2480                 |
| Lower frequency(2400MHz) SWR [Min~Max] | 1.0 ~ 2.5 : 1 (Typ 1.3 : 1) |
| Upper frequency(2480MHz) SWR [Min~Max] | 1.0 ~ 2.5 : 1 (Typ 1.3 : 1) |

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



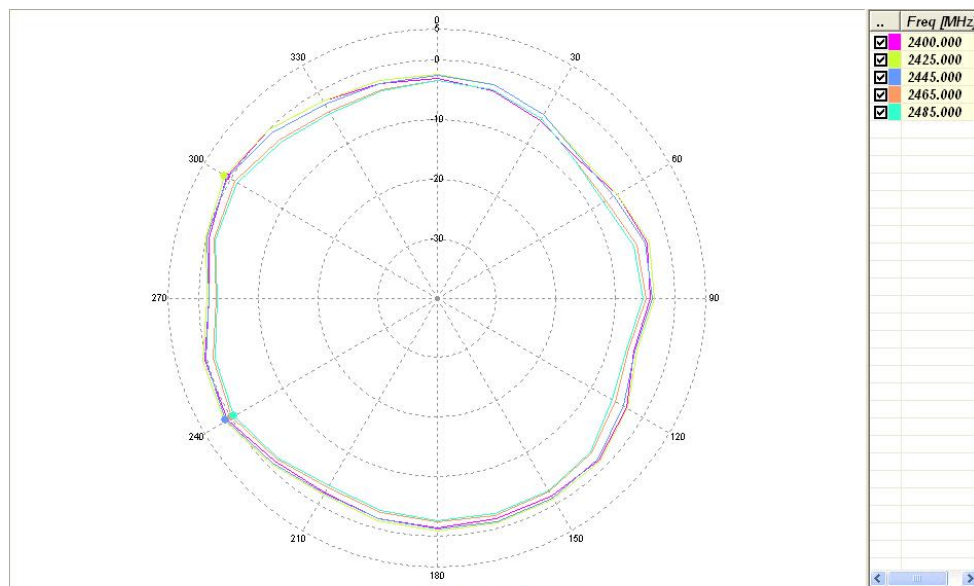
#### 4.5 Radiation Pattern

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





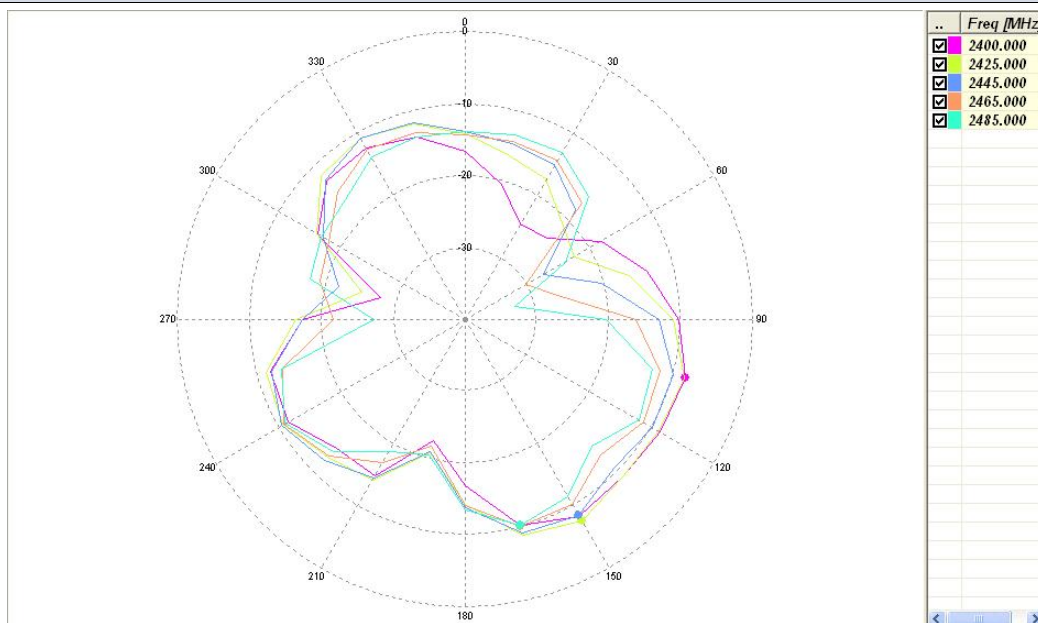
### Azimuth Phi



H-Plan [90deg] - H Pol Data

| Frequency[MHz] | PeakValue | Theta[deg] | Phi[deg] | MinValue | Theta[deg] | Phi[deg] | 3D Avg[dBi] | Gain[dBi] | Efficiency[%] |
|----------------|-----------|------------|----------|----------|------------|----------|-------------|-----------|---------------|
| 2400,000       | 0,81      | 90         | 300      | -6,87    | 90         | 45       | -3,34       | -2,05     | 62,49         |
| 2425,000       | 1,11      | 90         | 300      | -6,22    | 90         | 45       | -2,57       | -1,61     | 69,20         |
| 2445,000       | 0,87      | 90         | 240      | -6,30    | 90         | 45       | -2,79       | -1,98     | 63,56         |
| 2465,000       | -0,31     | 90         | 240      | -7,33    | 90         | 60       | -3,94       | -3,18     | 48,20         |
| 2485,000       | -0,64     | 90         | 240      | -7,83    | 90         | 60       | -4,31       | -3,50     | 44,75         |

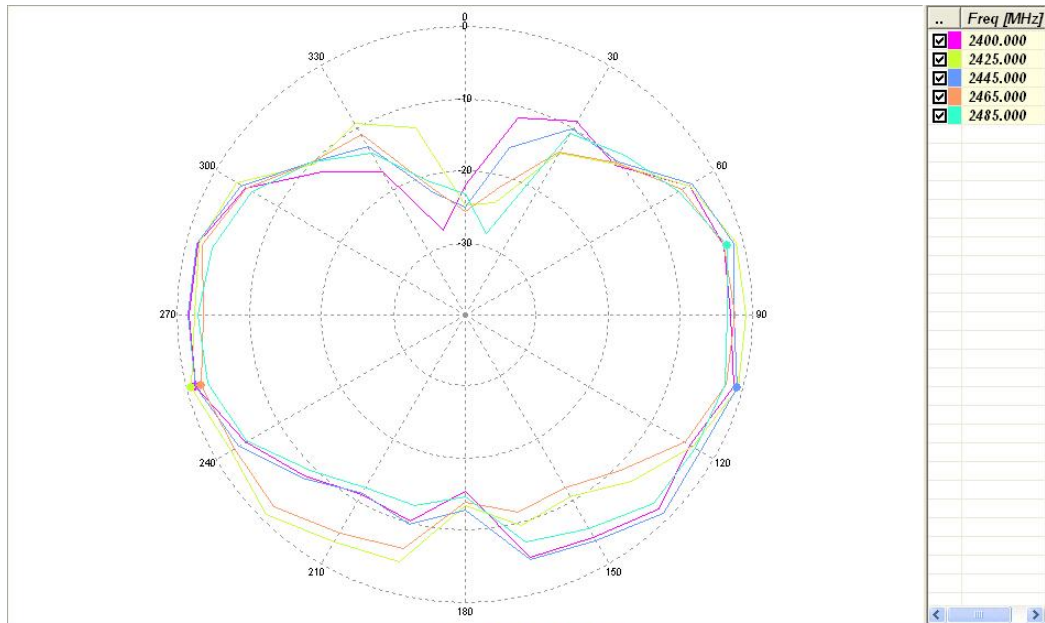
### Elevation1 Theta



H-Plan [90deg] - V Pol Data

| Frequency[MHz] | PeakValue | Theta[deg] | Phi[deg] | MinValue | Theta[deg] | Phi[deg] | 3D Avg[dBi] | Gain[dBi] | Efficiency[%] |
|----------------|-----------|------------|----------|----------|------------|----------|-------------|-----------|---------------|
| 2400,000       | -8,30     | 90         | 105      | -27,76   | 90         | 285      | -3,34       | -12,80    | 5,36          |
| 2425,000       | -7,63     | 90         | 150      | -25,08   | 90         | 285      | -2,57       | -12,18    | 6,17          |
| 2445,000       | -8,47     | 90         | 150      | -27,38   | 90         | 60       | -2,79       | -12,75    | 5,42          |
| 2465,000       | -10,20    | 90         | 165      | -30,18   | 90         | 60       | -3,94       | -14,07    | 4,03          |
| 2485,000       | -10,39    | 90         | 165      | -32,82   | 90         | 75       | -4,31       | -14,44    | 3,71          |

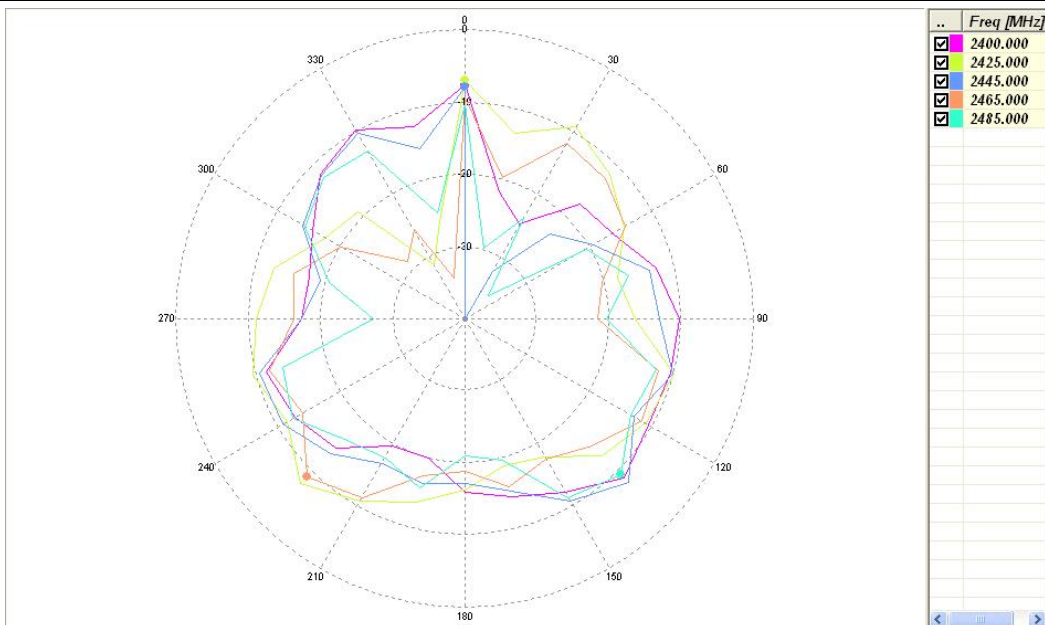
### Elevation1 Phi



E-Plan [0deg] - H Pol Data

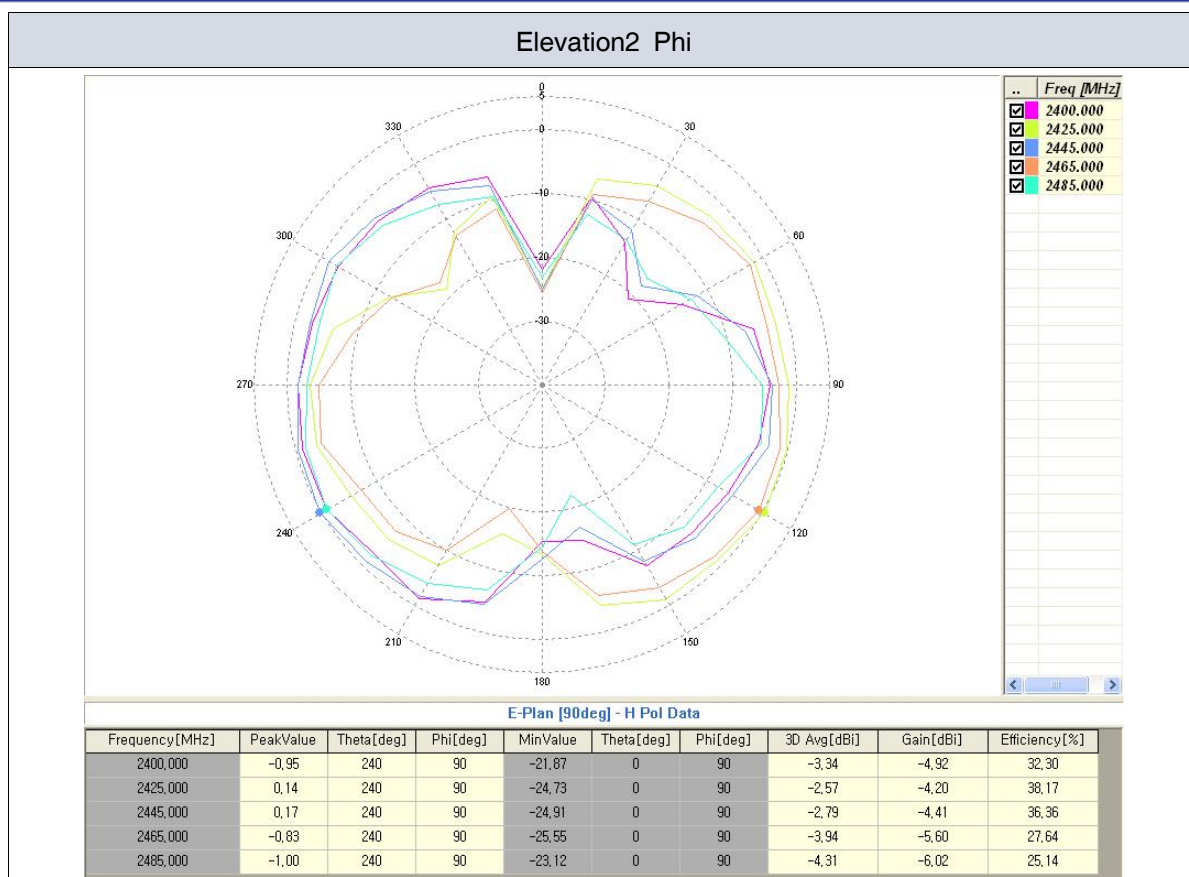
| Frequency[MHz] | PeakValue | Theta[deg] | Phi[deg] | MinValue | Theta[deg] | Phi[deg] | 3D Avg[dBi] | Gain[dBi] | Efficiency[%] |
|----------------|-----------|------------|----------|----------|------------|----------|-------------|-----------|---------------|
| 2400,000       | -1,26     | 255        | 0        | -27,69   | 345        | 0        | -3,34       | -5,07     | 31,25         |
| 2425,000       | -0,50     | 105        | 0        | -24,73   | 0          | 0        | -2,57       | -4,29     | 37,32         |
| 2445,000       | -0,81     | 105        | 0        | -24,91   | 0          | 0        | -2,79       | -4,48     | 35,73         |
| 2465,000       | -2,05     | 105        | 0        | -25,55   | 0          | 0        | -3,94       | -5,63     | 27,45         |
| 2485,000       | -2,37     | 75         | 0        | -28,24   | 15         | 0        | -4,31       | -6,02     | 25,09         |

### Elevation2 Theta



E-Plan [90deg] - V Pol Data

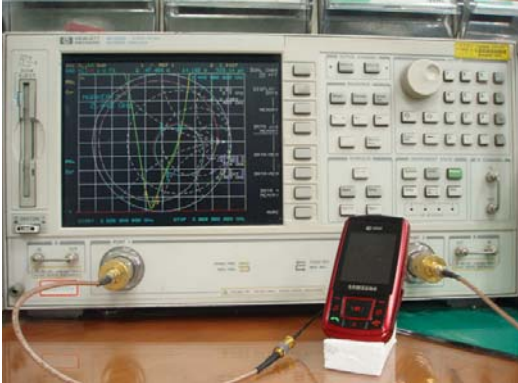
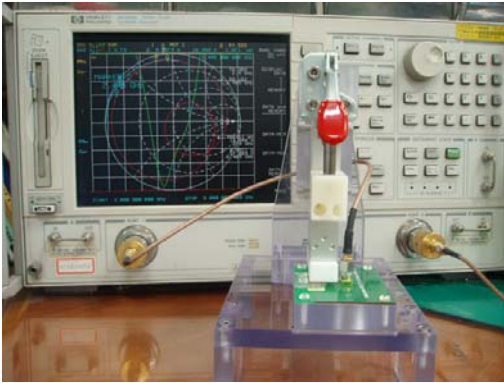
| Frequency[MHz] | PeakValue | Theta[deg] | Phi[deg] | MinValue | Theta[deg] | Phi[deg] | 3D Avg[dBi] | Gain[dBi] | Efficiency[%] |
|----------------|-----------|------------|----------|----------|------------|----------|-------------|-----------|---------------|
| 2400,000       | -7,55     | 0          | 90       | -24,79   | 30         | 90       | -3,34       | -12,73    | 5,44          |
| 2425,000       | -6,95     | 0          | 90       | -31,32   | 30         | 90       | -2,57       | -12,24    | 6,07          |
| 2445,000       | -7,82     | 0          | 90       | -40,84   | 15         | 90       | -2,79       | -12,91    | 5,22          |
| 2465,000       | -9,07     | 135        | 90       | -34,05   | 15         | 90       | -3,94       | -14,26    | 3,86          |
| 2485,000       | -9,45     | 135        | 90       | -35,26   | 45         | 90       | -4,31       | -14,94    | 3,32          |



## 5. Measurement Process

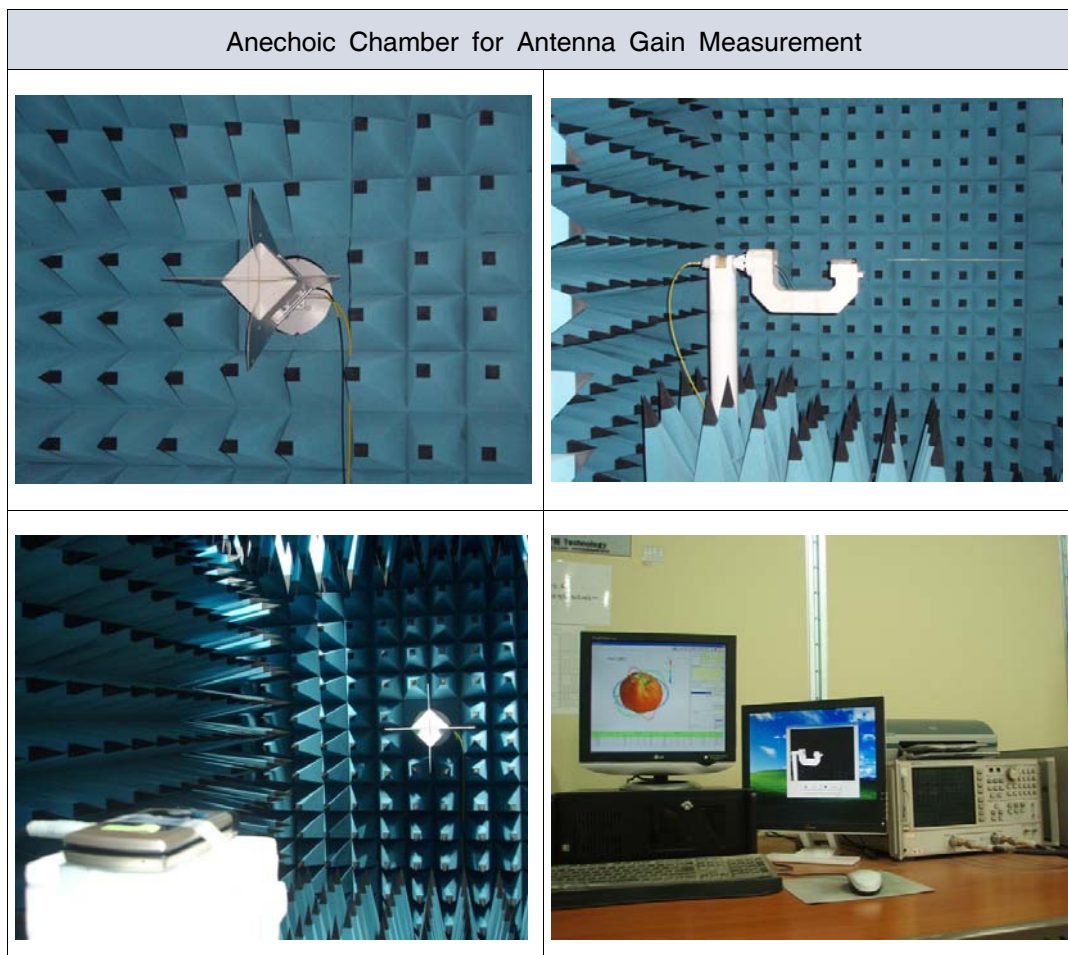
### 5.1 SWR/Return loss

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

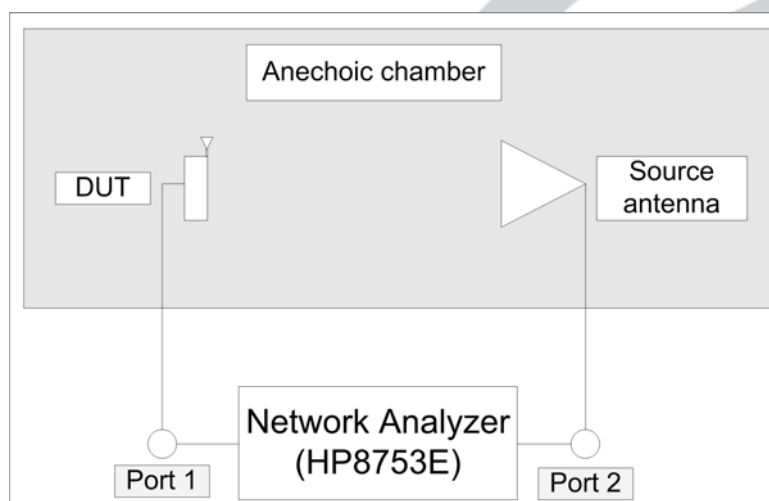
|                  | Set Condition                                                                       | Test Fixture Condition                                                               |
|------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 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.



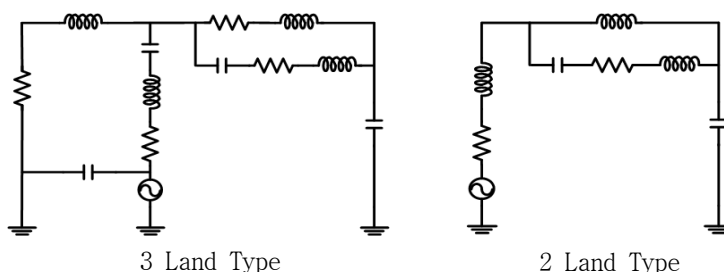
## 5.3 Gain test block diagram





## 6. Internal Block Diagram

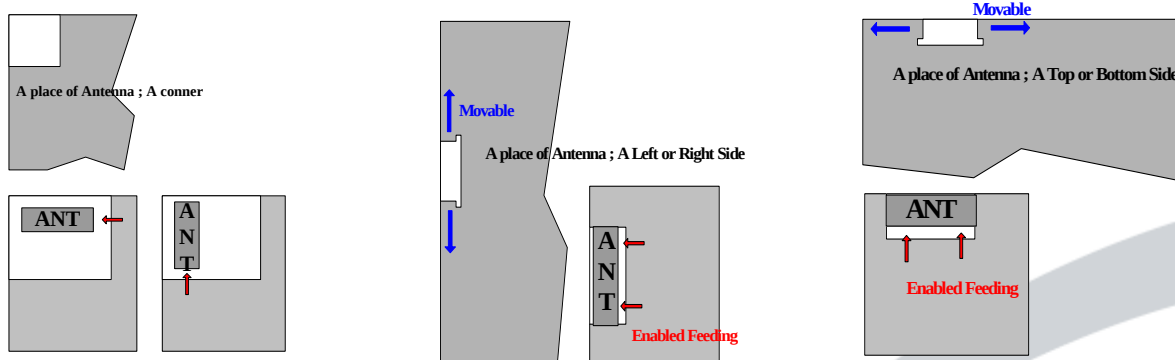
This product is made of the dielectric block and RF part materialized the characteristics by structural change of Ag pattern on the brick of dielectric block and conditioning value of the structural equivalent circuit.



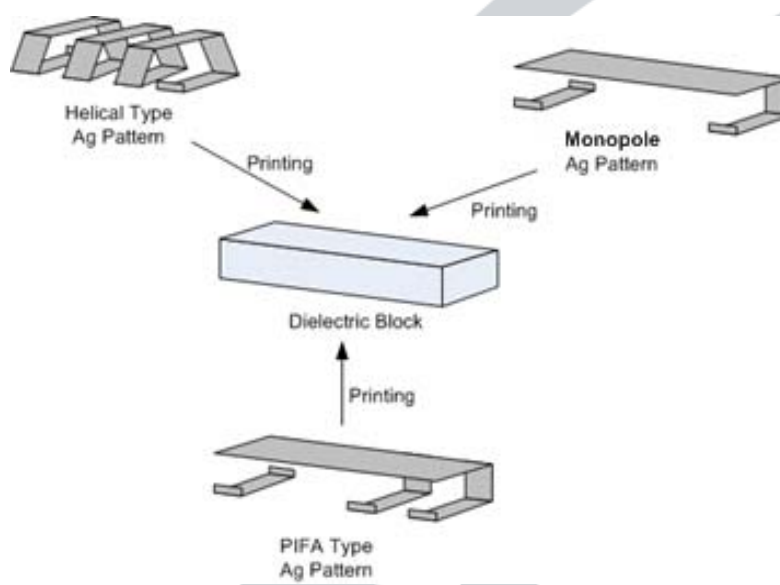
## 7. Basis Action / Application Note

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 require attention to select the mount position, because this product is the radiation part and changed characteristics by boundary condition,

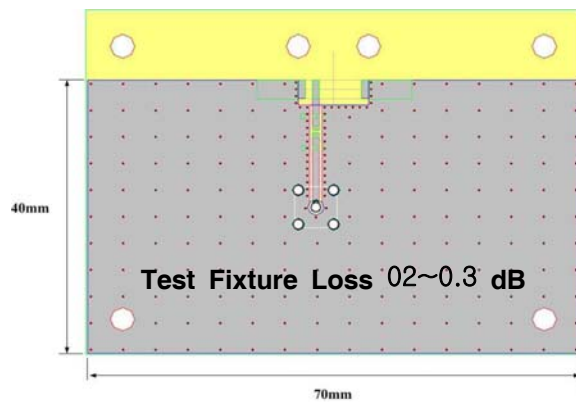


As the following, this product is easy to revise the various types for the boundary condition.



## 8. Measurement Jig SPEC

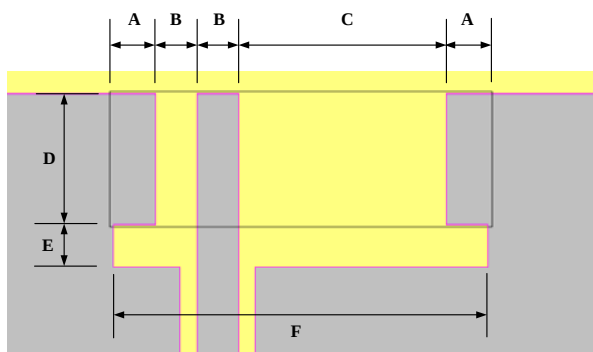
### 8.1 Test Fixture And GROUND Condition



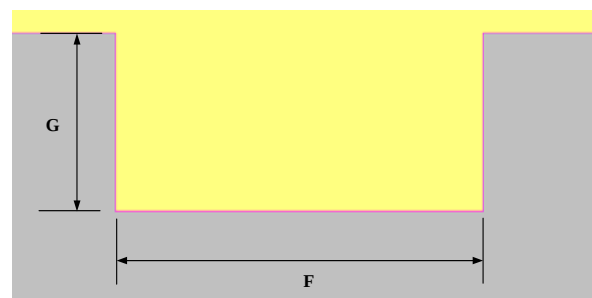
※ Ev B'd and Test Fixture Jig is the same

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

### 8.2 PCB Layout & Soldering Pad Dimension



**Top Layout**



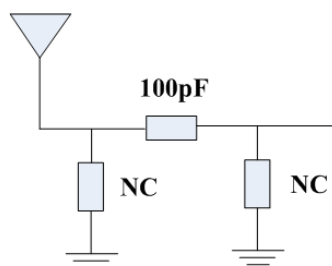
**Bottom Pattern**

| Parameter | A   | B   | C   | D   | E   | F   | G   |
|-----------|-----|-----|-----|-----|-----|-----|-----|
| Value[mm] | 1.1 | 1.0 | 5.0 | 3.2 | 1.0 | 9.0 | 4.2 |

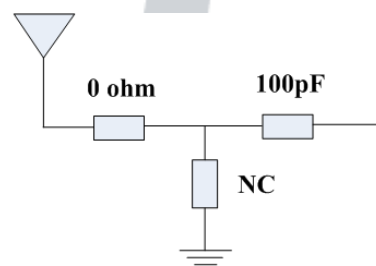
Unit ; mm

Unless specified tolerances are  $\pm 0.1$

### 8.3 Matching Circuit And Reference Value



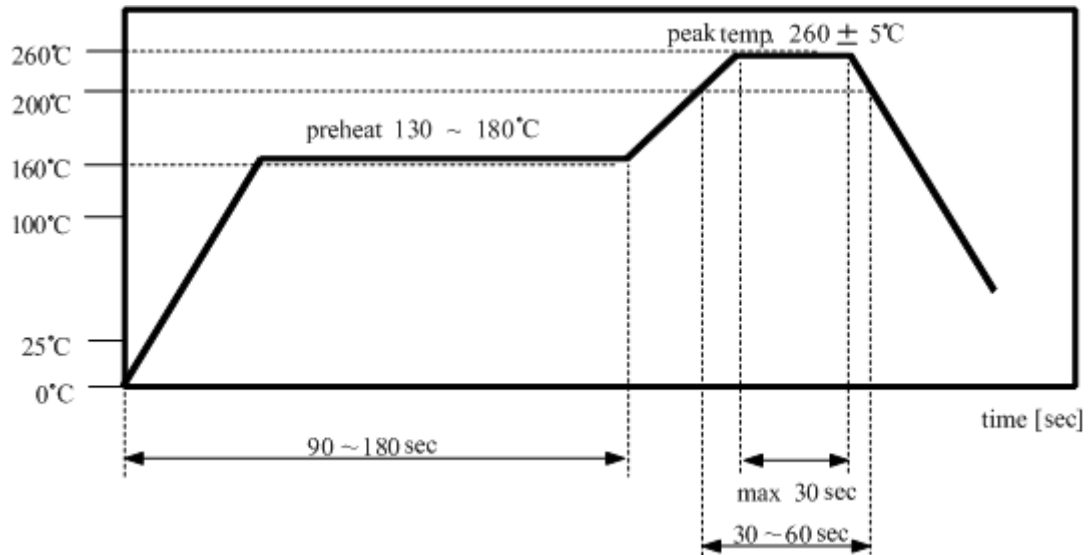
**$\pi$  Matching**



**T Matching**

## 9. REFLOW PROFILE

### 9.1 Reflow Soldering



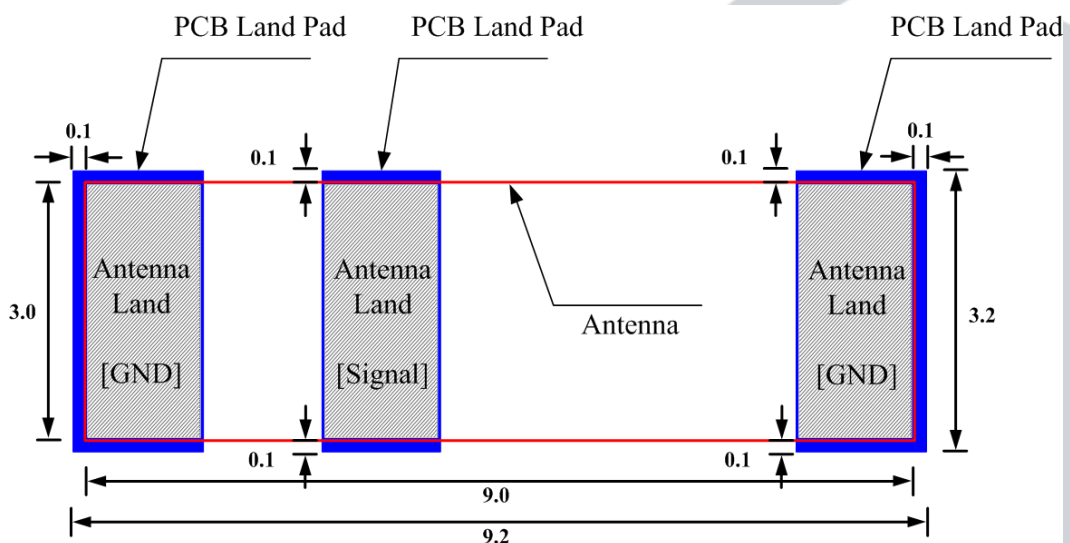
### 9.2 Manual Soldering

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

Soldering Temperature : 340°C±5°C , 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]  |         | Size [mm] |           |           |
|----------|------------------------------------------------------------------------------------------------------------------|---------|-----------|-----------|-----------|
| Standard | VSWR 3.0 MAX                                                                                                     |         | W=3.0±0.1 | L=9.0±0.1 | T=1.2±0.1 |
|          | 2400MHz                                                                                                          | 2480MHz |           |           |           |
| 1        | 1.22                                                                                                             | 1.34    | 3.01      | 9.01      | 1.23      |
| 2        | 1.30                                                                                                             | 1.23    | 3.03      | 9.00      | 1.24      |
| 3        | 1.21                                                                                                             | 1.29    | 3.03      | 9.01      | 1.23      |
| 4        | 1.25                                                                                                             | 1.19    | 3.03      | 9.00      | 1.22      |
| 5        | 1.31                                                                                                             | 1.19    | 3.02      | 8.99      | 1.23      |
| 6        | 1.26                                                                                                             | 1.24    | 3.04      | 9.01      | 1.23      |
| 7        | 1.26                                                                                                             | 1.20    | 3.02      | 9.02      | 1.24      |
| 8        | 1.33                                                                                                             | 1.17    | 3.03      | 9.01      | 1.22      |
| 9        | 1.31                                                                                                             | 1.22    | 3.02      | 9.01      | 1.24      |
| 10       | 1.29                                                                                                             | 1.23    | 3.03      | 9.01      | 1.24      |
| 11       | 1.24                                                                                                             | 1.26    | 3.03      | 9.00      | 1.23      |
| 12       | 1.18                                                                                                             | 1.29    | 3.02      | 9.00      | 1.24      |
| 13       | 1.27                                                                                                             | 1.19    | 3.01      | 8.99      | 1.22      |
| 14       | 1.26                                                                                                             | 1.26    | 3.02      | 9.01      | 1.23      |
| 15       | 1.25                                                                                                             | 1.20    | 3.03      | 9.02      | 1.23      |
| 16       | 1.29                                                                                                             | 1.20    | 3.03      | 9.00      | 1.22      |
| 17       | 1.30                                                                                                             | 1.19    | 3.03      | 9.01      | 1.23      |
| 18       | 1.32                                                                                                             | 1.19    | 3.04      | 9.02      | 1.24      |
| 19       | 1.26                                                                                                             | 1.24    | 3.02      | 9.01      | 1.23      |
| 20       | 1.20                                                                                                             | 1.27    | 3.04      | 9.00      | 1.23      |
| Min      | 1.20                                                                                                             | 1.17    | 3.01      | 8.99      | 1.22      |
| Max      | 1.33                                                                                                             | 1.34    | 3.04      | 9.02      | 1.24      |
| X        | 1.26                                                                                                             | 1.22    | 3.03      | 9.01      | 1.23      |
| σ        | 0.04                                                                                                             | 0.04    | 0.01      | 0.01      | 0.01      |
| Cpk      | 1.86                                                                                                             | 1.70    | 2.76      | 3.51      | 3.16      |
| 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<br>Test Cycle : 32 cycle<br>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<br>Peak Heating : 260℃±5℃, 30sec Max                                       |                                                            |

### 11.3 Mechanical Test

| ITEM      | TEST CONDITION                                                                                              | LIMIT                                                      |
|-----------|-------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|
| Vibration | Freq : 10~500Hz , Acceleration : 10 ×9.8 <sup>m/s²</sup> (G)<br>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<br>Jig : 120g±20g Plastic Jig<br>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<br>2 times Reflow without aging | After test, Must meet the characteristics spec of 4.4 list |

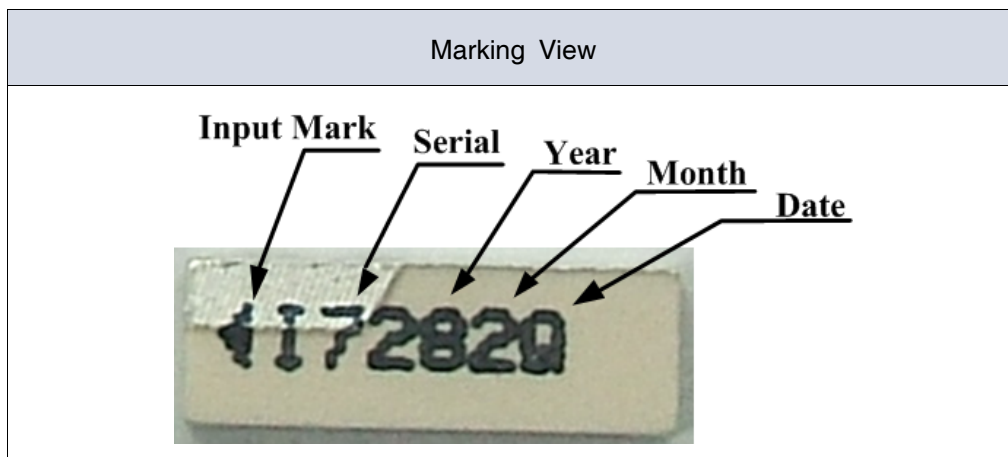


### 12.3 Lot number notation

|          |          |          |
|----------|----------|----------|
| <b>8</b> | <b>2</b> | <b>Q</b> |
| ①        | ②        | ③        |

- ① Year : 7 - 2007 ····
- 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



|   |          |          |          |          |          |          |
|---|----------|----------|----------|----------|----------|----------|
| ◀ | <u>1</u> | <u>7</u> | <u>2</u> | <u>8</u> | <u>2</u> | <u>Q</u> |
| ① | ②        | ③        | ④        | ⑤        |          |          |

- ① Input Signal
- ② Serial
- ③ Year; 1 - 2001, 2 - 2002, ···· 7 - 2007 ····
- 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

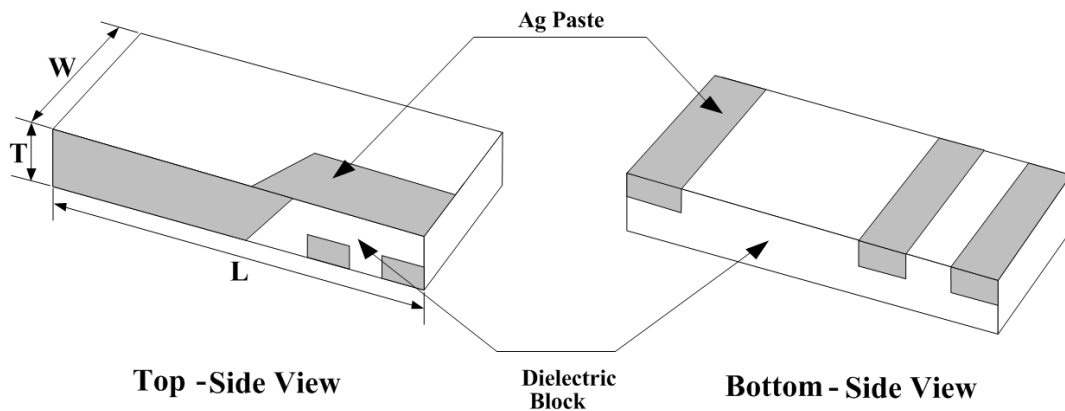
Ink marking - Using Black Ink

## 13. Structure and Material

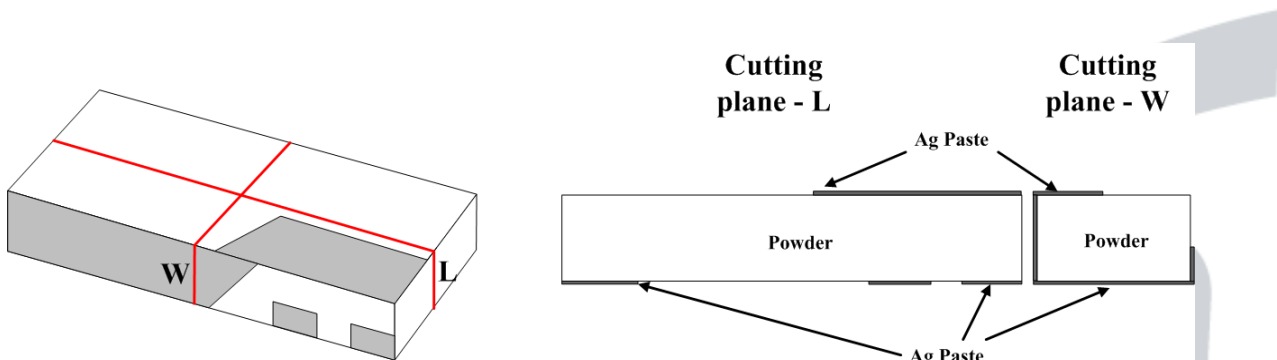
### 13.1 materialization method

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 $10\mu\text{m}$                               |
| PAD              | Ag paste | METECH | Thickness : Min $10\mu\text{m}$ (TYP $16\sim 20\mu\text{m}$ ) |

## 14. Attention

### 14.1 Temperature Condition

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

### 14.2 Temperature Test Condition

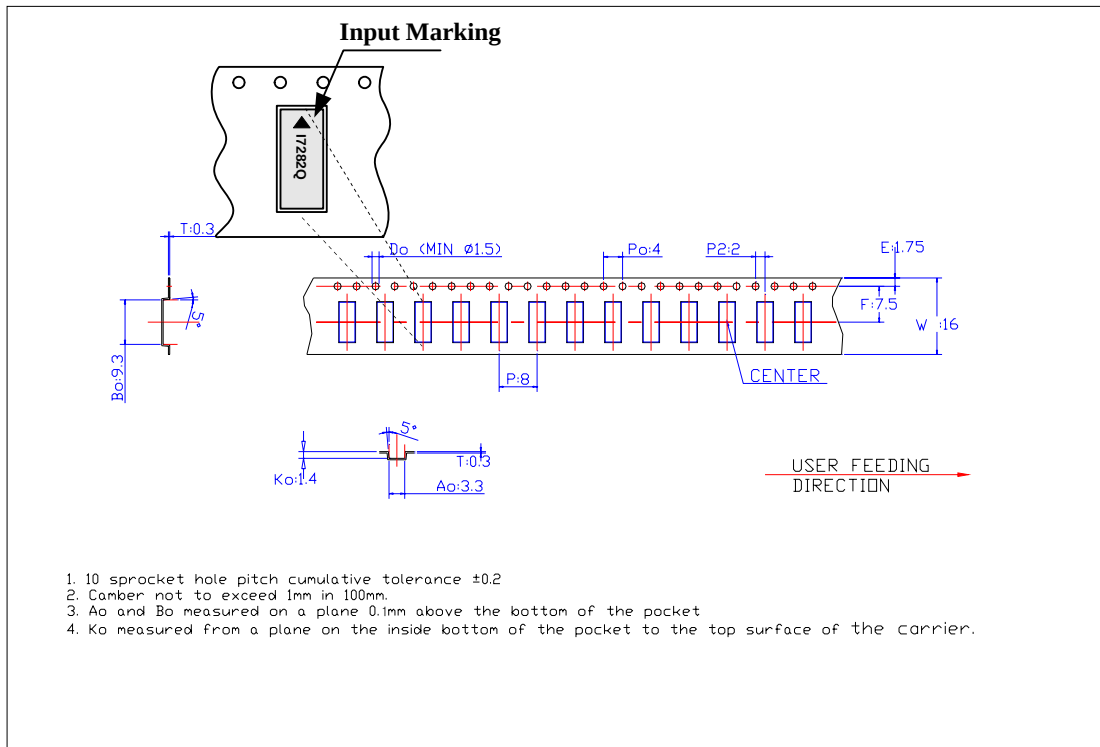
|                         | Condition | Range of Temperature                       |
|-------------------------|-----------|--------------------------------------------|
| Application temperature | Low       | 24hr normal action at -75℃                 |
|                         | High      | 24hr normal 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

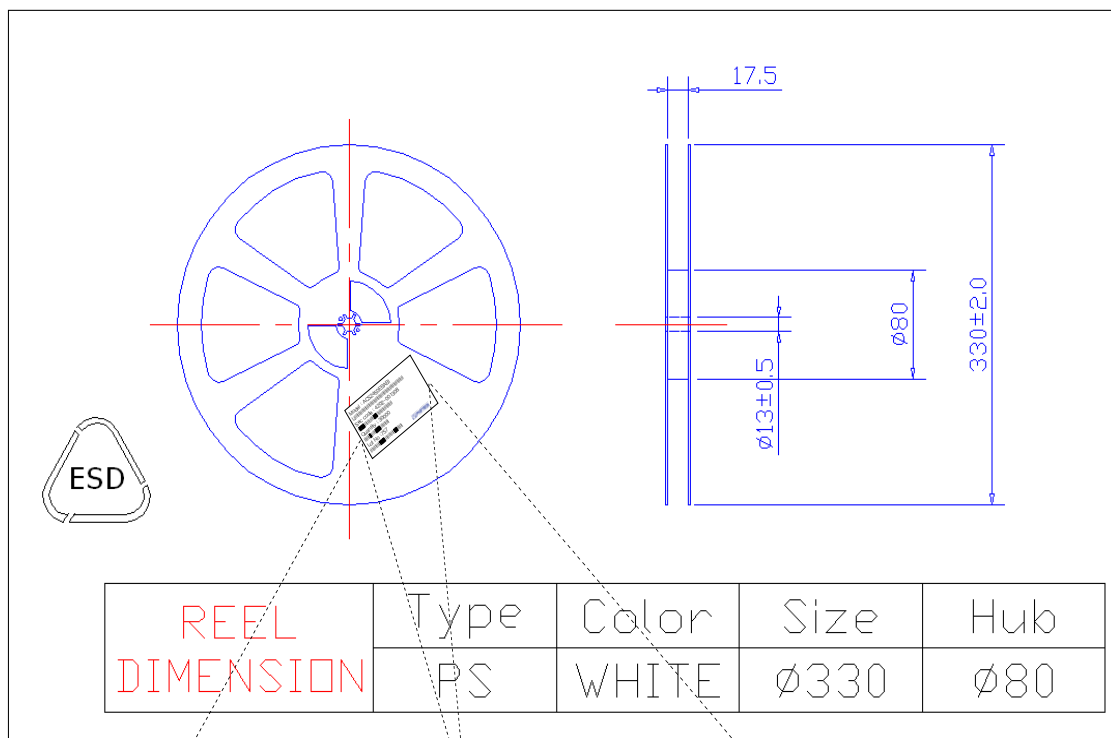
### 15.1 Carrier/Reel

| 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                | -              |



|                        |                              |
|------------------------|------------------------------|
| DKC DWG. No.           | D-1608-023                   |
| DIMENSIONAL UNIT       | MM                           |
| UNTOLERANCED DIMENSION | $\pm 0.1$                    |
| CAD FILE NAME          | 050423                       |
| DESIGNED BY            | K. M. J                      |
| SCALE                  | 1/1                          |
| TITLE                  | CARRIER TAPE<br>3.0*9.0*1.2P |
| PART.                  | CARRIER TAPE                 |
| MATERIAL               | C-PET                        |
| LENGTH                 | 46.81                        |
| COUNT                  | 5850P                        |

| NAME | SPEC.          |
|------|----------------|
| W    | 16.0 $\pm 0.2$ |
| E    | 1.75 $\pm 0.1$ |
| F    | 7.5 $\pm 0.1$  |
| 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   | 3.3 $\pm 0.1$  |
| Bo   | 9.3 $\pm 0.1$  |
| Ko   | 1.4 $\pm 0.1$  |
| T    | 0.3 $\pm 0.05$ |



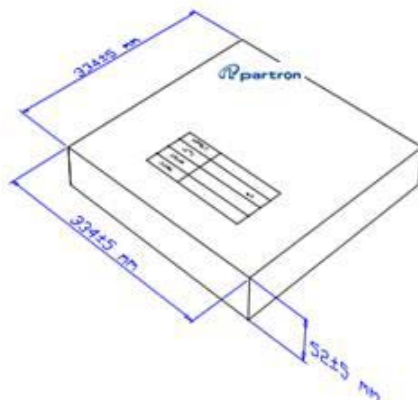
Model : ACS2450ICA172  
 Quantity : 5000  
 Lot No : 82Q  


MSL Level 1

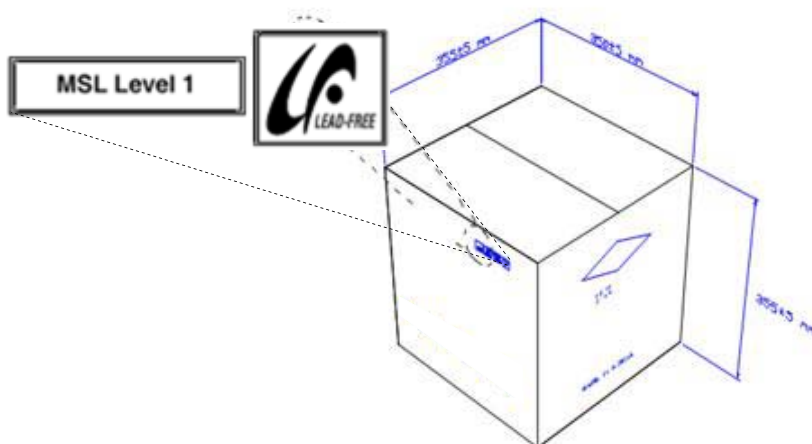




## 15.2 BOX



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              |                                    |                      |                     |                   | 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            | 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                                |                      |                       |                     |          |                |
| 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<br>CTQ | printer screen        | Squeeze velocity/presure SNAP | refer to Guide Sheet | 1/day               | -                 | PATTERN dimension aspect                 | refer to Guide Sheet | measure<br>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                                         |                                          |                                            |                            |                                 |                   |
| 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<br>Dry Jig          | Temperature<br>Belt speed | refer to<br>Guide Sheet | 1/week              | Parameter            | Dry Condition<br>Printed condition<br>breakage    | refer to<br>Guide Sheet                  | Visual Inspection                          | all                        | Lot card                        | Rework            |
|                          |             | ○            | Baking                       | Baking Hole<br>mesh net   | Temperature<br>Belt speed | refer to<br>Guide Sheet | 1/week              | Parameter<br>C/Sheet | Breakage<br>Pollution                             | refer to<br>Guide Sheet                  | Visual Inspection                          | all                        | Lot card                        | Exhaust<br>Rework |
|                          |             | ◇            | aspect<br>inspection         |                           |                           |                         |                     |                      | aspect                                            | Reference SPL<br>refer to<br>Guide Sheet | Visual Inspection<br>microscope            | all                        | Lot card<br>production<br>diary | Exhaust<br>repair |
|                          |             | ○            | MARKING                      | Marking<br>Machine        |                           |                         |                     |                      | marking                                           | Reference SPL                            | Visual Inspection                          | all                        | Lot card<br>production<br>diary | Rework<br>Exhaust |
|                          |             | ◇            | Electrical<br>Characteristic | NETWORK<br>Inspection Jig | proofreading<br>Condition | refer to<br>Guide Sheet | 1/2hour             | C/sheet              | Electrical<br>Characteristic                      | refer to<br>Guide Sheet                  | Network                                    | all                        | Lot card<br>production<br>diary | Exhaust<br>repair |
|                          |             | ◇            | aspect<br>inspection         |                           |                           |                         |                     |                      | aspect<br>dimension                               | Reference SPL<br>refer to<br>Guide Sheet | Visual Inspection<br>microscope            | all                        | Lot card<br>production<br>diary | Exhaust<br>repair |
| Carrier<br>cover<br>reel |             | ○            | Taping                       |                           |                           |                         |                     |                      | Quantity<br>Direction<br>aspect                   | refer to<br>Guide Sheet                  | Manual                                     | all                        | Lot card<br>production<br>diary | Rework            |
|                          |             | ◇            | shipper<br>inspection        | NETWORK<br>Inspection Jig | proofreading<br>Condition | refer to<br>Guide Sheet | 1/person            | C/sheet              | Electrical<br>Characteristic<br>aspect<br>packing | refer to<br>Guide Sheet                  | Network<br>microscope<br>Visual Inspection | refer<br>to Guide<br>Sheet | Result<br>Paper                 | return<br>Exhaust |
| packing<br>box<br>label  |             | ○            | packing                      | bar code<br>printer       |                           |                         |                     |                      | packing<br>P/N<br>Quantity                        | refer to<br>Guide Sheet                  | Visual Inspection                          | all                        | -                               | Rework            |
|                          |             | ◇            | packing<br>inspection        |                           |                           |                         |                     |                      | packing<br>P/N<br>Quantity                        | refer to<br>Guide Sheet                  | Visual Inspection                          | all                        | -                               | return            |

## 17. RoHS Data

### 1) Ceramic Powder

**SGS**

**Test Report** No. : CE/2007/76776 Date : 2007/08/03 Page : 1 of 3

FUJII TITANIUM IND. CO., LTD.  
12-8, SENGEN-CHO, HIRATSUKA-CITY, KANAKAWA-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  
Style Item No. : XMS-08 (B)  
Sample Receiving Date : 2007/07/27  
Testing Period : 2007/07/27 TO 2007/08/03

Test Requested : In accordance with the RoHS Directive 2002/95/EC, and its amendment directives.  
Test Method : With reference to IEC 62321, Ed.1 111/54/CDV 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 for non-metallic samples by UV/Vis Spectrometry.  
(5) Determination of PBB and PBDE by GC/MS.

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

*David Yen, M.B. Operation Manager*  
Signed for and on behalf of  
SGS TAIWAN LTD.  
Chemical Laboratory - Taipei

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886-2-22899999 886-2-2289-3257 www.sgs.com.tw

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**Test Report** No. : CE/2007/76776 Date : 2007/08/03 Page : 2 of 3

FUJII TITANIUM IND. CO., LTD.  
12-8, SENGEN-CHO, HIRATSUKA-CITY, KANAKAWA-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   |
| Sum of PBBs                                       |                   | n.d.        | -   |
| Monobromobiphenyl                                 |                   | n.d.        | 5   |
| Dibromobiphenyl                                   |                   | n.d.        | 5   |
| Tribromobiphenyl                                  |                   | n.d.        | 5   |
| Tetrabromobiphenyl                                |                   | n.d.        | 5   |
| Pentabromobiphenyl                                |                   | n.d.        | 5   |
| Hexabromobiphenyl                                 |                   | n.d.        | 5   |
| Heptabromobiphenyl                                |                   | n.d.        | 5   |
| Octabromobiphenyl                                 |                   | n.d.        | 5   |
| Nonabromobiphenyl                                 |                   | n.d.        | 5   |
| Decabromobiphenyl                                 |                   | n.d.        | 5   |
| Sum of PBDEs (Mono to Nona) (Note 4)              | (5)               | n.d.        | -   |
| Monobromobiphenyl ether                           |                   | n.d.        | 5   |
| Dibromobiphenyl ether                             |                   | n.d.        | 5   |
| Tribromobiphenyl ether                            |                   | n.d.        | 5   |
| Tetrabromobiphenyl ether                          |                   | n.d.        | 5   |
| Pentabromobiphenyl ether                          |                   | n.d.        | 5   |
| Hexabromobiphenyl ether                           |                   | n.d.        | 5   |
| Heptabromobiphenyl ether                          |                   | n.d.        | 5   |
| Octabromobiphenyl ether                           |                   | n.d.        | 5   |
| Nonabromobiphenyl ether                           |                   | n.d.        | 5   |
| Decabromobiphenyl ether                           |                   | n.d.        | 5   |
| Sum of PBDEs (Mono to Deca)                       |                   | n.d.        | -   |

**TEST PART DESCRIPTION:**  
NO.1 : OFF-WHITE POWDER

Note : 1. mg/kg = ppm  
2. n.d. = Not Detected  
3. MDL = Method Detection Limit  
4. According to 2005/717/EC DecaBDE is exempt.  
5. "-" = Not Regulated

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**Test Report** No. : CE/2007/76776 Date : 2007/08/03 Page : 3 of 3

FUJII TITANIUM IND. CO., LTD.  
12-8, SENGEN-CHO, HIRATSUKA-CITY, KANAKAWA-PREF. JAPAN.



\*\* End of Report \*\*

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## 2) Ag Paste

**SGS**

**Test Report No.** F690561LF-CTSAAY67-22595 **Issued Date:** October 18, 2007 **Page 1 of 2**

**To:** METECH KOREA CO., LTD.  
B-501 Dongyang Paragon office1 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.** : AYA07-22595

**Received Date** : October 12, 2007

**Test Performing Date** : October 15, 2007

**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.

Plato Kim  
Monet Jeong  
Billy Oh / Testing Person

Jeff Jang  
Jeff Jang / Chemical Lab Mgr

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F052 Version2

**SGS**

**Test Report No.** F690561LF-CTSAAY67-22595 **Issued Date:** October 18, 2007 **Page 2 of 2**

**Sample No.** : AYA07-22595.001

**Sample Description** : Silver Paste

**Item No./Part No.** : PCC11537HV

**Heavy Metals**

| Test Item                   | Unit  | Test Method                                | MDL | Results |
|-----------------------------|-------|--------------------------------------------|-----|---------|
| Cadmium (Cd)                | mg/kg | US EPA 3052(1995), US EPA 6010B(1995), ICP | 0.5 | N.D.    |
| Lead (Pb)                   | mg/kg | US EPA 3052(1995), US EPA 6010B(1995), ICP | 5   | N.D.    |
| Mercury (Hg)                | mg/kg | US EPA 3052(1995), US EPA 6010B(1995), ICP | 2   | N.D.    |
| Hexavalent Chromium (Cr VI) | mg/kg | US EPA 3060A(1996), US EPA 7198A(1992), UV | 1   | N.D.    |

Picture of Sample as Received:

Sample Color : Gray



\*\*\* 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

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### 3) Marking Ink

**SGS**  
**Test Report No. F690501LF-CTSA7-24109R1** Issued Date: November 05, 2007 Page 1 of 3

To: **IMAJE KOREA CO., LTD**  
 #1302 7th Daerang Techno Town 459-11  
 Gaseon-dong  
 Gaseon-si  
 Seoul  
 Korea

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

**Product Name** : S135E Black Ink  
**SGS File No.** : AYAD7-24109R1  
**Received Date** : October 31, 2007  
**Test Performing Date** : November 01, 2007  
**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)  
**Buyer(s)** : LG ELECTRONICS  
**Comments** : This Report cancels and supercedes the Report No.F690501LF-CTSA7-24109 dated November 05, 2007 issued by SGS Testing Korea Co., Ltd. The Item No/part No. had changed from Gamet to S135E by customer's request.

**SGS Testing Korea Co. Ltd.**  
 Pluto Kim  
 Monal Jeong  
 Billy Oh / Testing Person

**Jeff Jang / Chemical Lab Mgr**

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F692 Version2

**SGS**  
**Test Report No. F690501LF-CTSA7-24109R1** Issued Date: November 05, 2007 Page 2 of 3

**Sample No.** : AYAD7-24109R1.001  
**Sample Description** : S135E Black Ink  
**Item No./Part No.** : S135E  
**Comments** : Material is butanone.

**Heavy Metals**

| Test Items                  | Unit  | Test Method                                | MDL | Results |
|-----------------------------|-------|--------------------------------------------|-----|---------|
| Cadmium (Cd)                | mg/kg | US EPA 3052(1996), US EPA 8210B(1996), ICP | 0.5 | N.D.    |
| Lead (Pb)                   | mg/kg | US EPA 3052(1996), US EPA 8210B(1996), ICP | 5   | N.D.    |
| Mercury (Hg)                | mg/kg | US EPA 3052(1996), US EPA 8210B(1996), ICP | 2   | N.D.    |
| Hexavalent Chromium (Cr VI) | mg/kg | US EPA 3060A(1996), US EPA 7196A(1992), UV | 1   | N.D.    |

**Phthalates and related compounds**

| Test Items                  | Unit  | Test Method         | MDL | Results |
|-----------------------------|-------|---------------------|-----|---------|
| Mandelonitrophenyl          | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Chloronitrophenyl           | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Tribromonitrophenyl         | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Tetrabromonitrophenyl       | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Pentabromonitrophenyl       | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Hexabromonitrophenyl        | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Heptabromonitrophenyl       | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Octabromonitrophenyl        | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Nonabromonitrophenyl        | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Decabromonitrophenyl        | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Monobromonitrophenyl ether  | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Dibromonitrophenyl ether    | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Tribromonitrophenyl ether   | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Tetrabromonitrophenyl ether | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Pentabromonitrophenyl ether | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Hexabromonitrophenyl ether  | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Heptabromonitrophenyl ether | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Octabromonitrophenyl ether  | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Nonabromonitrophenyl ether  | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Decabromonitrophenyl ether  | mg/kg | US EPA 3540C, 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) Negative = Undetectable / Positive = Detectable

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**Picture of Sample as Received:**  
**Sample Color** : Black



--- End ---

**NOTE:** (1) N.D. = Not detected (<MDL)  
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