

*Specification*  
*For*  
*LTCC 3dB Hybrid Coupler*

*Model Name : RCP650B03N*

*Customer :*

*Title:*

*Name :*

*APPROVED*

*By Date : \_\_\_\_\_*

*Signature : \_\_\_\_\_*

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*Issued Date : \_\_\_\_\_*

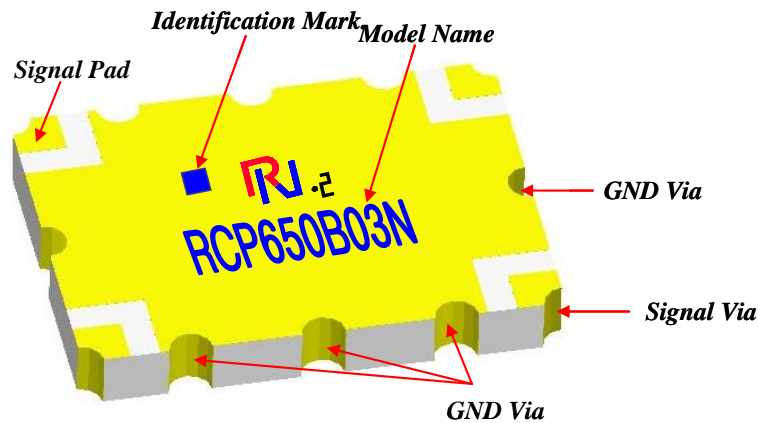
*Designed : \_\_\_\_\_*

*Approved : \_\_\_\_\_*



## 1. Description

### 1-1. Part number: RCP650B03N



### 1-2. Features


- Hybrid Coupler 3dB, 90°
- Surface mount type
- Suitable for operation frequency 470~860MHz
- **RoHS** compliance
- High stability in temperature and humidity for LTCC base
- Low loss for Silver(Ag) conductor
- Miniature size and high power capability
- Lead-free alloy solderable
- Thermal expansion corresponding with common substrate

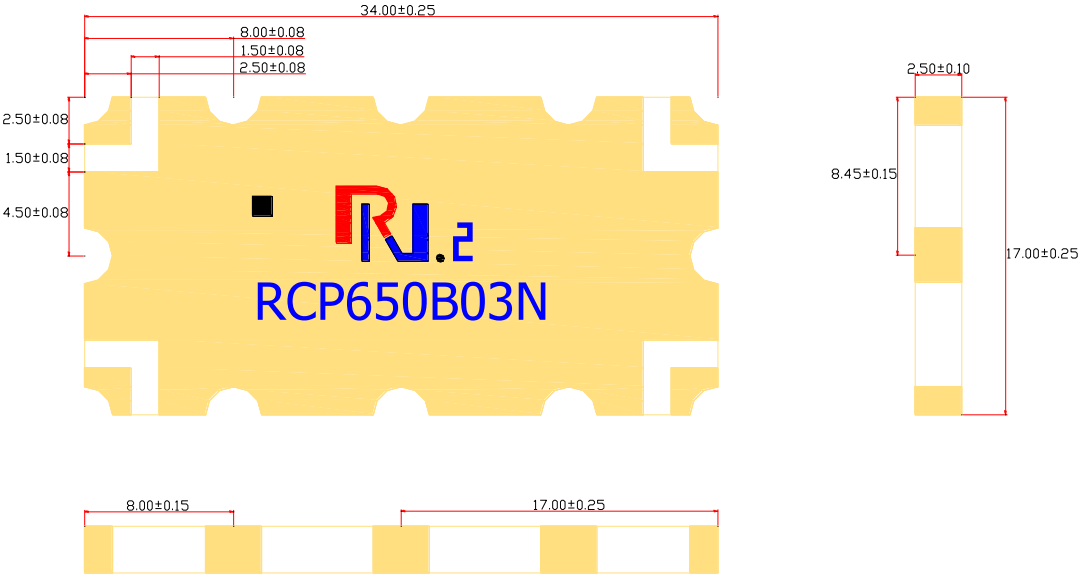
## 2. Electrical Specification

| <b>Freq.</b><br>(MHz) | <b>Amplitude Balance</b><br>max (dB) | <b>Isolation</b><br>min (dB)         | <b>Insertion Loss</b><br>max (dB) |
|-----------------------|--------------------------------------|--------------------------------------|-----------------------------------|
| 470-510               | ± 0.30                               | -18                                  | -0.15                             |
| 510-780               | ± 0.40                               | -20                                  | -0.15                             |
| 780-860               | ± 0.45                               | -23                                  | -0.20                             |
| <b>VSWR</b><br>Max    | <b>Phase</b><br>(degrees)            | <b>Power Capacity</b><br>Avg. (Watt) | <b>Operating Temp.</b><br>(°C)    |
| 1.3                   | 90 ± 3.0                             | 500                                  | -55 to +125                       |

### 3. Mechanical Specification

#### 3-1. Outline Dimension

| PROJECTION  | NO. | DATE       | REVISION & DESCRIPTION | SIGNATURE |         |
|---|-----|------------|------------------------|-----------|---------|
|   |     |            |                        | REVIEWED  | CHECKED |
|  | 1   | 2008.06.17 | New-Drawing            |           |         |
|   | 2   | 2011.11.10 | Size tol. revision     |           |         |
|   | 3   |            |                        |           |         |

Note.

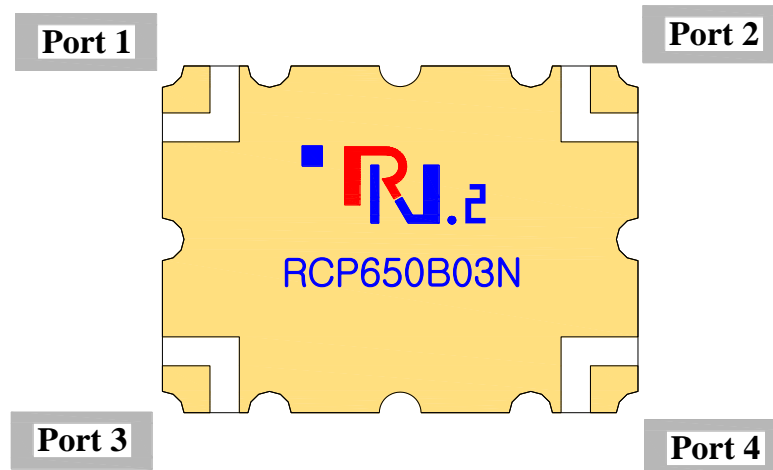
1. SMD-type, Ceramic Base.
2. Inner signal circuits : Silver(Ag) conductor
3. Surface plating : Gold(Au) finished
4. Tolerance is not cumulative.

| NO.   | DESCRIPTION         | UNIT        | TOTAL      | QUANTITY |  | SCALE | 1/1 | DIMENSION | mm |
|-------|---------------------|-------------|------------|----------|--|-------|-----|-----------|----|
|       |                     |             |            |          |  |       |     |           |    |
| TITLE | B03N Series-Outline | RN2 DWG NO. | 08-0617-02 |          |  | SCALE | 1/1 |           |    |
|       |                     |             |            |          |  | SIZE  | A4  |           |    |

#### 3-2. Weight

-  $4.0 \pm 10\%$  Grams typical

#### 4. Port Configuration



| Configuration | Port 1     | Port 2     | Port 3     | Port 4     |
|---------------|------------|------------|------------|------------|
| Case 1.       | Input      | Isolated   | -3dB, 0°   | -3dB, -90° |
| Case 2.       | Isolated   | Input      | -3dB, -90° | -3dB, 0°   |
| Case 3.       | -3dB, 0°   | -3dB, -90° | Input      | Isolated   |
| Case 4.       | -3dB, -90° | -3dB, 0°   | Isolated   | Input      |

\* Once Port 1 is determined, the other three ports are defined automatically.

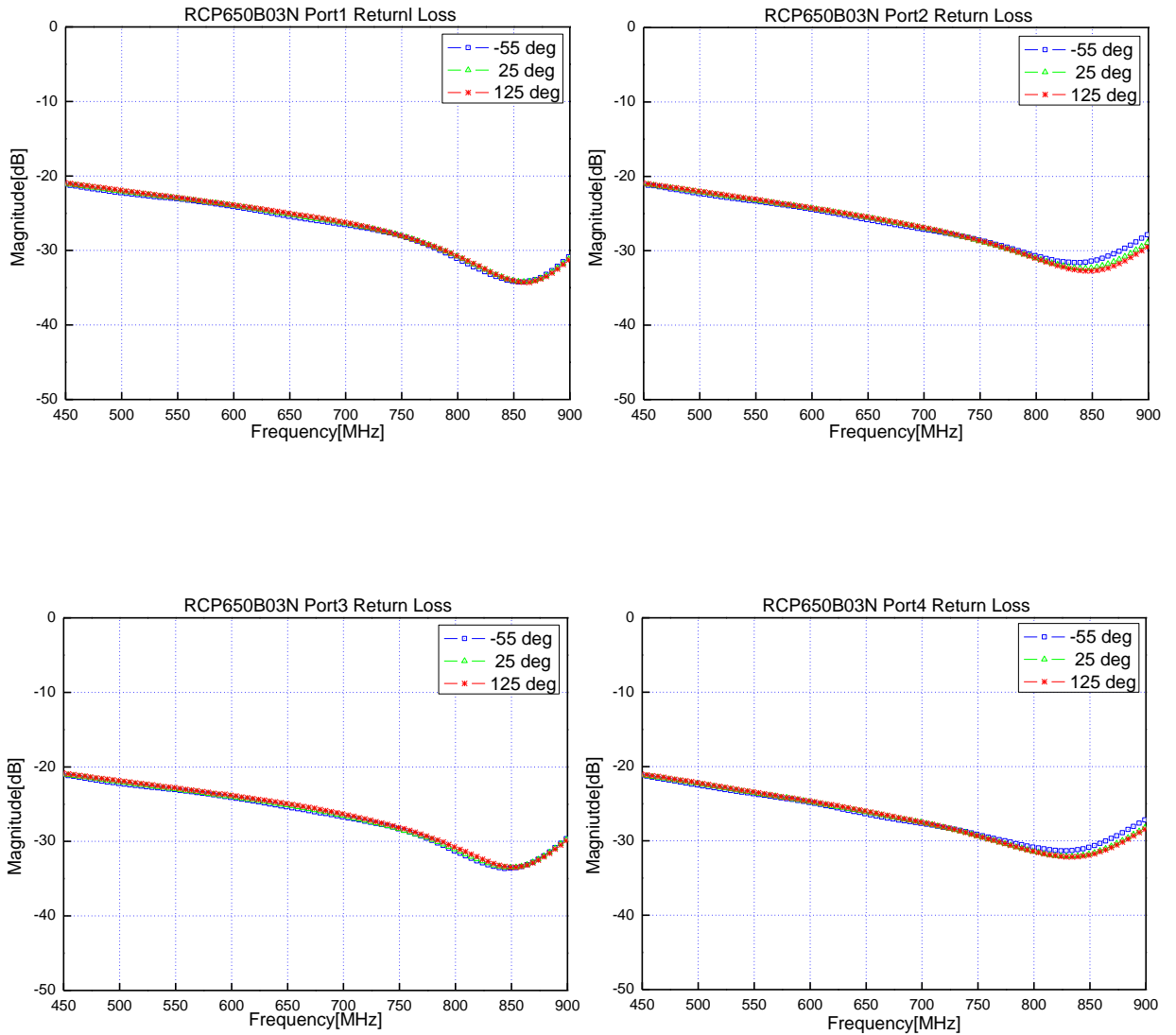
#### 5. Schematic Drawing



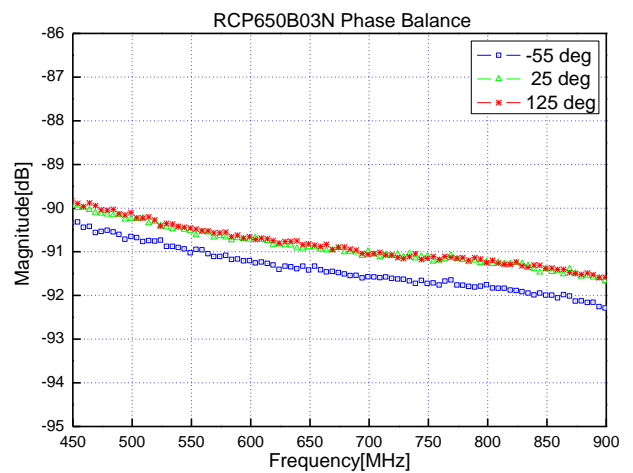
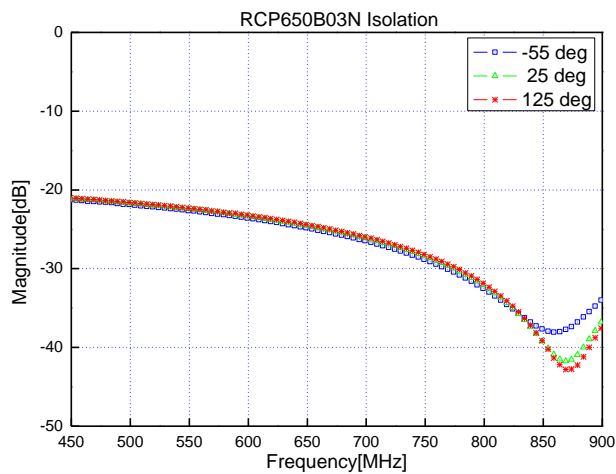
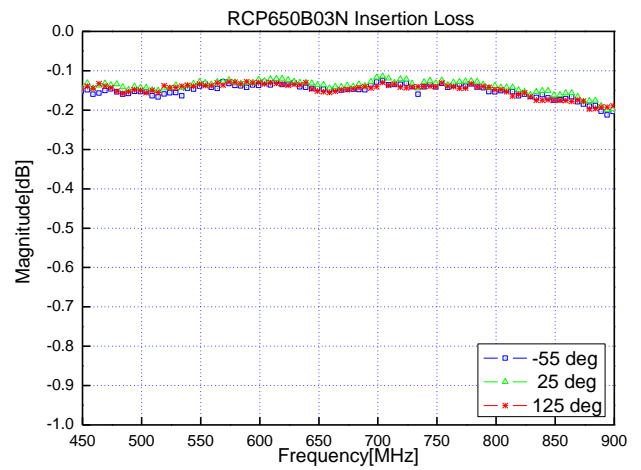
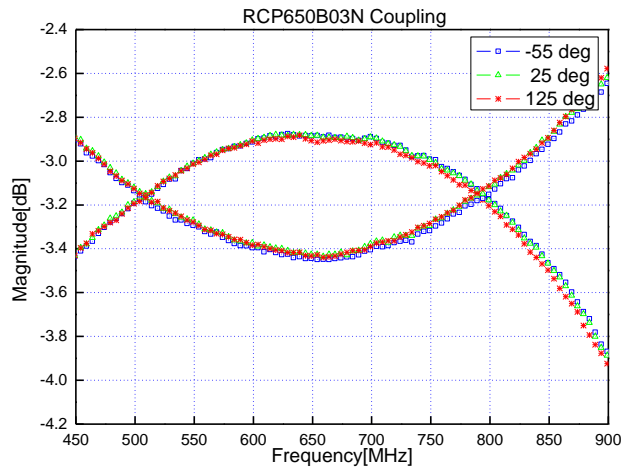
## 6. Typical Performance Data (25 °C)

| Freq.<br>[MHz] | Coupling<br>[dB] | Out<br>[dB] | IL<br>[dB] | Amp. Bal<br>[dB] | Phase<br>[degree] | Isolation<br>[dB] | Return Loss [dB] |        |        |        |
|----------------|------------------|-------------|------------|------------------|-------------------|-------------------|------------------|--------|--------|--------|
|                |                  |             |            |                  |                   |                   | S11              | S22    | S33    | S44    |
| 470            | -3.31            | -2.99       | -0.14      | ±0.16            | -90.06            | -21.32            | -21.47           | -21.46 | -21.42 | -21.61 |
| 480            | -3.26            | -3.03       | -0.14      | ±0.11            | -90.14            | -21.47            | -21.68           | -21.69 | -21.62 | -21.81 |
| 500            | -3.18            | -3.12       | -0.14      | ±0.03            | -90.19            | -21.69            | -22.08           | -22.15 | -22.04 | -22.34 |
| 520            | -3.11            | -3.20       | -0.14      | ±0.04            | -90.29            | -21.95            | -22.46           | -22.58 | -22.44 | -22.84 |
| 540            | -3.04            | -3.26       | -0.13      | ±0.11            | -90.50            | -22.29            | -22.83           | -23.00 | -22.80 | -23.33 |
| 560            | -2.99            | -3.31       | -0.13      | ±0.16            | -90.56            | -22.61            | -23.20           | -23.46 | -23.22 | -23.76 |
| 580            | -2.94            | -3.35       | -0.13      | ±0.21            | -90.68            | -22.94            | -23.59           | -23.89 | -23.60 | -24.27 |
| 600            | -2.90            | -3.38       | -0.13      | ±0.25            | -90.77            | -23.37            | -24.00           | -24.32 | -24.07 | -24.75 |
| 620            | -2.88            | -3.40       | -0.13      | ±0.27            | -90.84            | -23.80            | -24.45           | -24.80 | -24.46 | -25.29 |
| 640            | -2.87            | -3.42       | -0.13      | ±0.28            | -90.91            | -24.29            | -24.95           | -25.31 | -24.93 | -25.87 |
| 660            | -2.89            | -3.43       | -0.14      | ±0.27            | -90.94            | -24.84            | -25.44           | -25.83 | -25.42 | -26.43 |
| 680            | -2.90            | -3.42       | -0.14      | ±0.27            | -90.94            | -25.47            | -25.90           | -26.38 | -25.96 | -27.00 |
| 700            | -2.90            | -3.38       | -0.12      | ±0.25            | -91.07            | -26.13            | -26.39           | -26.98 | -26.57 | -27.55 |
| 720            | -2.93            | -3.35       | -0.13      | ±0.22            | -91.07            | -26.97            | -26.98           | -27.62 | -27.25 | -28.21 |
| 740            | -2.96            | -3.31       | -0.12      | ±0.18            | -91.12            | -27.91            | -27.65           | -28.32 | -27.96 | -28.95 |
| 760            | -3.02            | -3.25       | -0.12      | ±0.11            | -91.23            | -29.05            | -28.50           | -29.14 | -28.81 | -29.82 |
| 780            | -3.09            | -3.18       | -0.12      | ±0.05            | -91.18            | -30.42            | -29.56           | -30.07 | -29.85 | -30.65 |
| 800            | -3.19            | -3.11       | -0.14      | ±0.04            | -91.28            | -32.18            | -30.84           | -31.04 | -31.10 | -31.43 |
| 820            | -3.29            | -3.03       | -0.15      | ±0.13            | -91.33            | -34.46            | -32.29           | -31.91 | -32.41 | -32.00 |
| 840            | -3.40            | -2.94       | -0.16      | ±0.22            | -91.35            | -37.52            | -33.64           | -32.39 | -33.40 | -32.04 |
| 860            | -3.54            | -2.83       | -0.16      | ±0.34            | -91.49            | -41.05            | -34.25           | -31.98 | -33.33 | -31.26 |

## 7. Operation Temperature Curve (a)

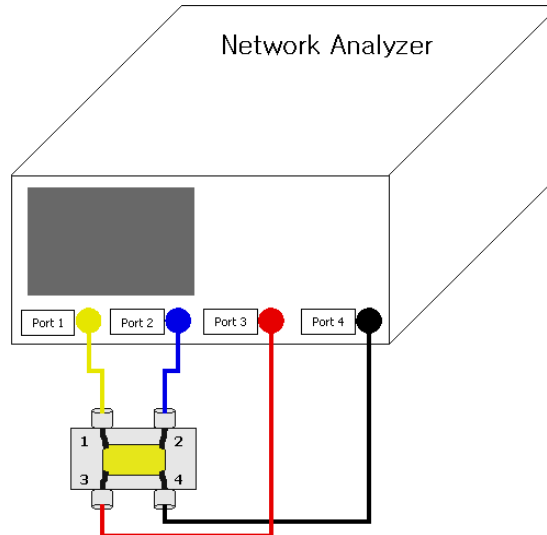


## 8. Operation Temperature Curve (b)





## 9. Test Method



- Refer to 'Case 1' of '4. Port Configuration' on page 4
- Have the network analyzer calibrated properly.
- Measure the data of **Coupling** through port 1 to port 3. (S31)
- Measure the data of **Transmission** through port 1 to port 4. (S41)
- Measure the data of **Isolation** through port 1 to port 2. (S21)
- Calculate the **Insertion Loss** and **Amplitude Balance** of coupler on the below power method formula.

|                   | S-Parameter[dB]                               | Power Method[dB]  |
|-------------------|---|---|
| Coupling          | S31   | $10 \cdot \log\left(\frac{P_{cou}}{P_{in}}\right)$                      |
| Transmission Loss | S41   | $10 \cdot \log\left(\frac{P_{out}}{P_{in}}\right)$                      |
| Isolation         | S21   | $10 \cdot \log\left(\frac{P_{iso}}{P_{in}}\right)$                      |
| Insertion Loss    |   | $10 \cdot \log\left(\frac{P_{in}}{P_{cou} + P_{out}}\right)$            |
| Amplitude Balance |   | $10 \cdot \log\left(\frac{P_{cou}}{\frac{P_{cou} + P_{out}}{2}}\right)$ |
| Phase Balance     | $\text{Phase}(S_{31}) - \text{Phase}(S_{41})$ |   |

$P_{in}$  : Power of Input Port

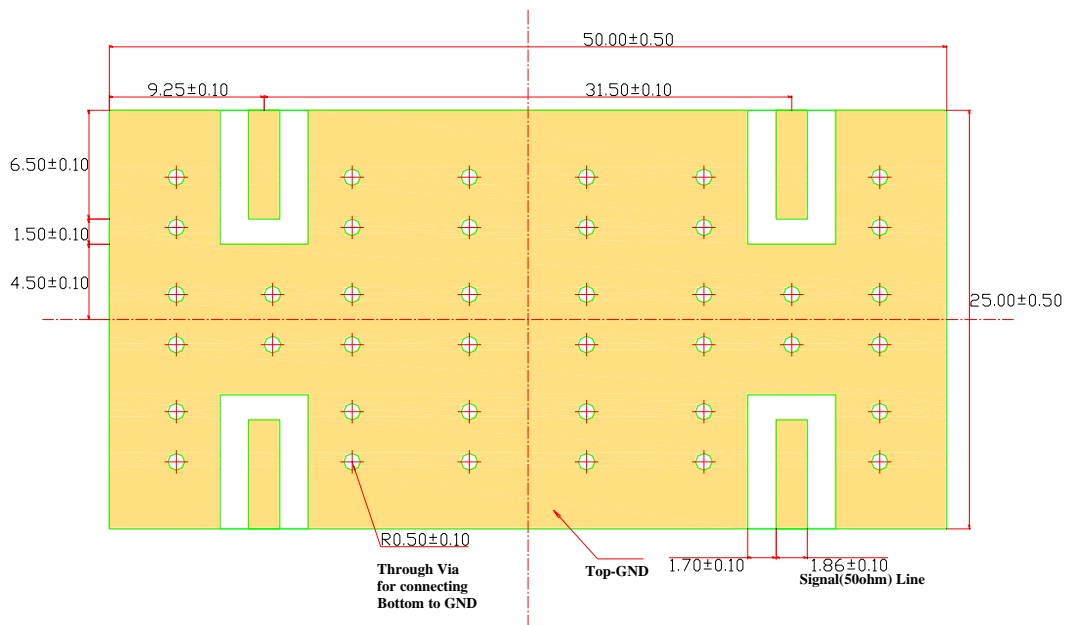
$P_{out}$  : Power of Output Port

$P_{cou}$  : Power of Coupling Port

$P_{iso}$  : Power of Isolated Port

10. Measurement board layout

| PROJECTION | No. | DATE       | REVISION & DESCRIPTION | SIGNATURE |         |
|------------|-----|------------|------------------------|-----------|---------|
|            |     |            |                        | REVIEWED  | CHECKED |
|            | 1   | 2008.06.18 | New - Drawing          |           |         |
|            | 2   |            |                        |           |         |
|            | 3   |            |                        |           |         |

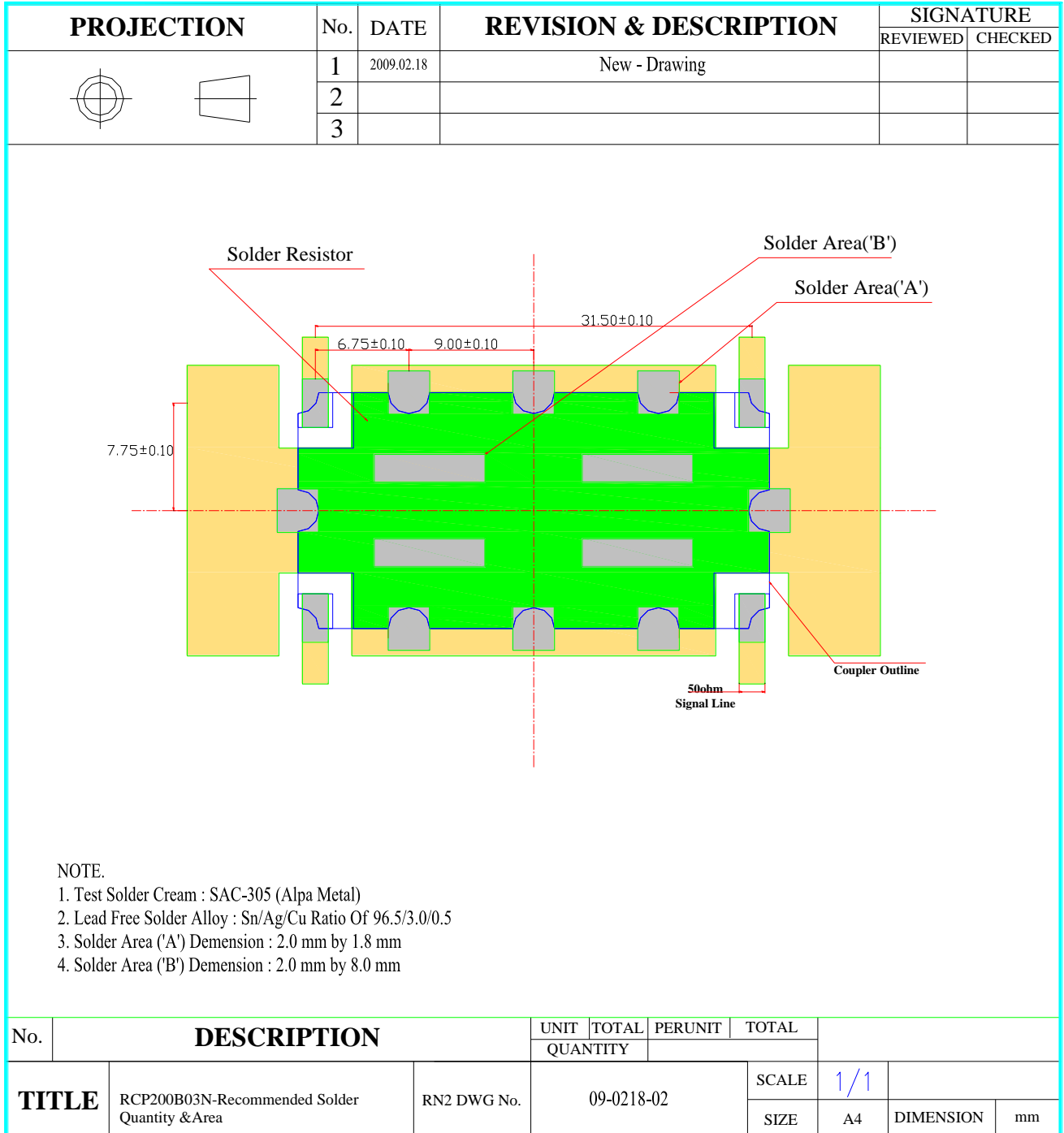


NOTE. Signal line width is shown for the conditions of;

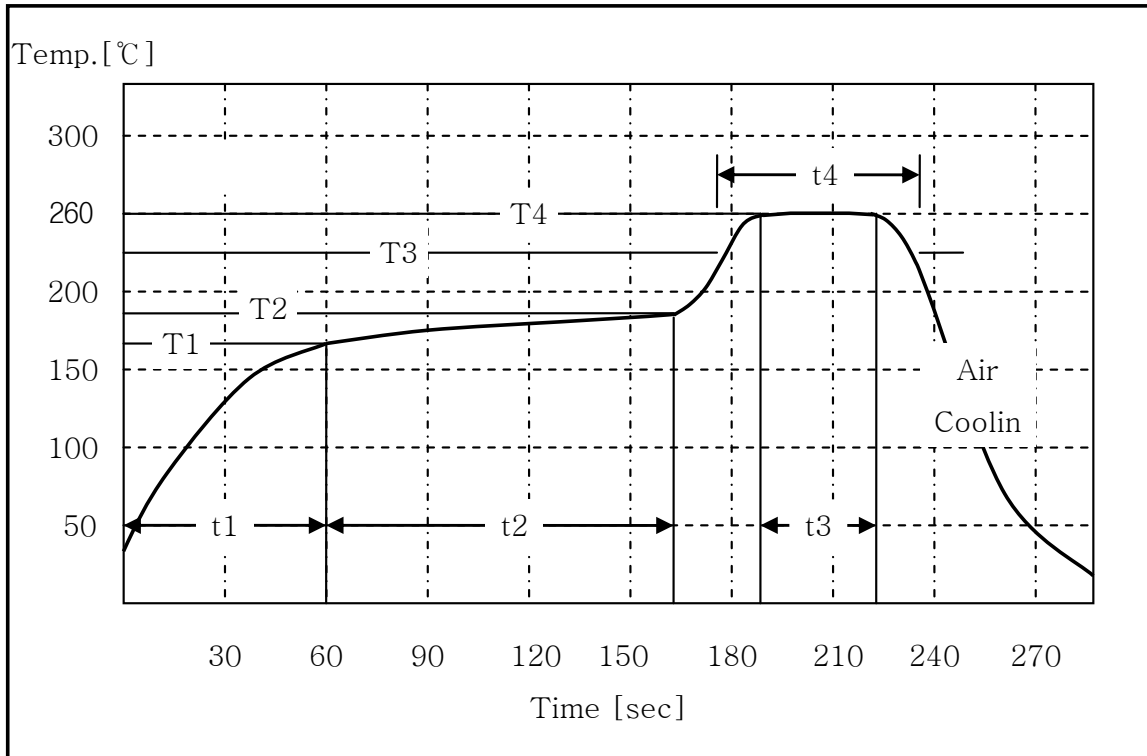
1. RF-35 (Taconic) board
2. Dielectric contance 3.5
3. Board thickness 0.8mm
4. Copper thickness 1/2 oz.

| No.          | DESCRIPTION                          | UNIT        | TOTAL      | PERUNIT | TOTAL |          |              |
|--------------|--------------------------------------|-------------|------------|---------|-------|----------|--------------|
|              |                                      |             |            |         |       | QUANTITY |              |
| <b>TITLE</b> | RCP650B03N-Measuremnet Board Outline | RN2 DWG No. | 08-0618-02 |         | SCALE | 1/1      |              |
|              |                                      |             |            |         | SIZE  | A4       | DIMENSION mm |

11. Recommended PCB layout and Solder mask pattern



## 12. Reflow profile



|            | Ramp Up    | Pre-Heating  | Peak       | Soaking     |
|------------|------------|--------------|------------|-------------|
| Temp.[°C]  | T1:160±5°C | T2:180±5°C   | T4:260±5°C | T3:230±5°C  |
| Time [sec] | t1:60±5sec | t2:100±15sec | t3:30±5sec | t4:60±10sec |



### 13. Using note for LTCC Couplers

#### I. Be careful when transporting

- A. Excessive stress or shock may make products broken or cracked due to the nature of ceramics structure.
- B. The products cracked or damaged on terminals may have their property changed.

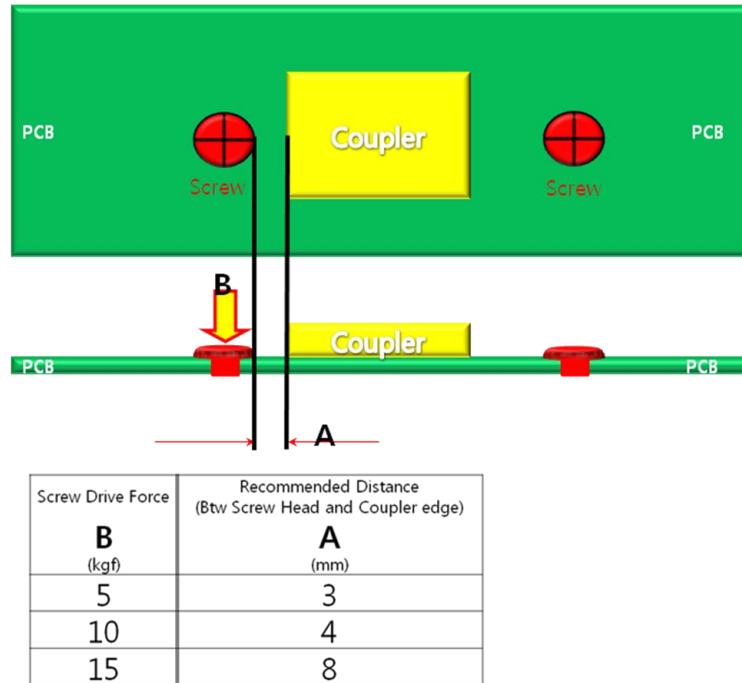
#### II. Be careful during storage

- A. Store the products in the temperature of  $-55 \sim 125^{\circ}\text{C}$
- B. Keep the humidity at  $45 \sim 75\%$  around the products.
- C. Prevent corrosive gas ( $\text{Cl}_2$ ,  $\text{NH}_3$ ,  $\text{SO}_x$ ,  $\text{NO}_x$ , etc.) from contacting the products.
- D. It is recommended to use the products within 6 months of receipt. If the period exceeds 6 months, solderability may need to be verified.

#### III. Be careful when soldering

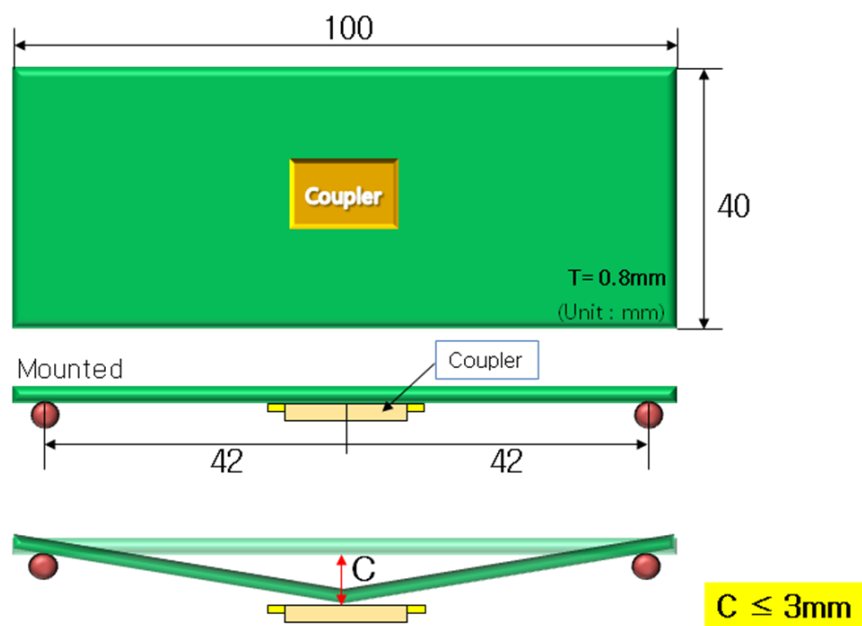
- A. All the ground terminals, IN and OUT pad of coupler should be soldered on the ground plane of the PCB.
- B. Products may be cracked or broken by uneven forces from a claw or suction device.
- C. Mechanical stress by any other devices may damage products when positioning them on PCB.
- D. A dropped product is recommended not to be used.
- E. Soldering must be carried out by the condition of specification sheet.
- F. Any couplers which are de-soldered from PCB should not be used again.

**IV. Be careful when Screw**

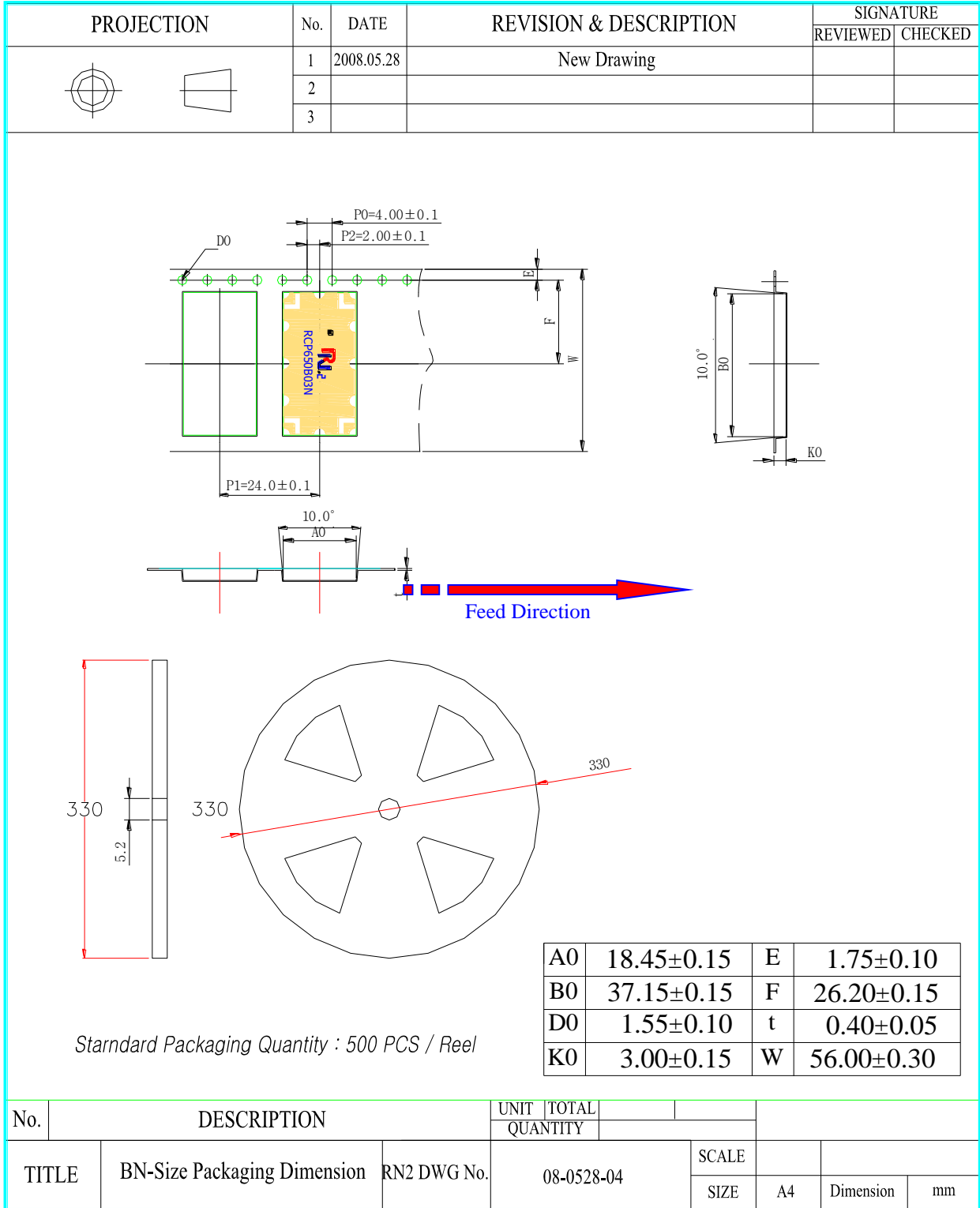


**V. Be careful when SMD or Assembly**

- A.** LTCC couplers require appropriate measures to avoid its base PCB from warping.
- B.** PCB excessively warping over defined standard may result in crack of LTCC couplers potentially.



14. Packaging



## 15. Environmental Reliability

| ITEM                                 | PROCEDURE   | REQUIREMENTS/RESULT  |
|--------------------------------------|---|--|
| Temperature Cycle<br>(Thermal Shock) | 1. One Cycle : 30 min<br>Step1: $125 \pm 5$ °C for 15 min<br>Step2: $-55 \pm 5$ °C for 15 min<br>2. Approach high or low temperature in 10 seconds<br>3. Number of Cycles : 100<br>4. Normal temperature for 1 hour   | 1. Meet the electrical Specification after test                            |
| Solderability                        | 1. Solder : $230 \pm 5$ °C for $5 \pm 1$ sec.   | 1. More than 85% of the I/O electrode pad shall be covered with solder.    |
| Heat Resistance                      | 1. Temperature : $100 \pm 2$ °C<br>2. Duration : $96 \pm 2$ hours   | 1. Meet the electrical Specification after test                            |
| Low Temp. Resistance                 | 1. Temperature : $-55 \pm 5$ °C<br>2. Duration : $24 \pm 2$ hours   | 1. Meet the electrical Specification after test                            |
| Vibration Resistance                 | 1. Frequency: 5~ 15MHz<br>2. Acceleration : 10g<br>3. Sweep Time: 0.1 oct/min, 15min/axis<br>4. Axis : X, Y and Z direction   | 1. No appearance damage<br>2. Meet the electrical Specification after test |
| Humidity Resistance                  | 1. One Cycle :<br>Step1: increase Temperature $-25 \sim 65$ °C for 2hours with humidity 85%<br>Step2: Maintain for 4 hour after increasing Humidity 90% to 95%<br>Step3: Decrease Temperature $65$ °C to $25$ °C<br>2. Number of Cycles : 10<br>3. Maintain for 3hour after decreasing temperature $-10$ °C | 1. Meet the electrical Specification after test                            |
| Drop Shock                           | 1. Dropped onto hard wood from height of 50 cm for 5 times; each x, y and z direction except I/O direction.   | 1. No appearance damage<br>2. Meet the electrical Specification after test |



## 16. RoHS test result

- RN2 Technologies warrants and represents as follows.

**Test Report No.** F690501/LF-CTSGP06-16067

**Date:** June 29, 2006

**Page 2 of 3**

**Sample No.** : GP06-16067.001  
**Sample Description** : LTCC COUPLER  
**Style/Item No.** : N/A  
**Comments** : Materials are ceramics, Ag.

### Heavy Metals

| Test items                  | Unit  | Test Method                                 | MDL | Results |
|-----------------------------|-------|---|-----|---------|
| Cadmium(Cd)                 | mg/kg | US EPA 3050B(1996), US EPA 6010B(1996), ICP | 0.5 | N.D.    |
| Lead (Pb)                   | mg/kg | US EPA 3050B(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.    |

### Flame Retardants-PBBs/PBDEs

| Test items               | Unit  | Test Method         | MDL | Results |
|--------------------------|-------|---------------------|-----|---------|
| Monobromobiphenyl        | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Dibromobiphenyl          | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Tribromobiphenyl         | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Tetrabromobiphenyl       | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Pentabromobiphenyl       | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Hexabromobiphenyl        | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Heptabromobiphenyl       | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Octabromobiphenyl        | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Nonabromobiphenyl        | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Decabromobiphenyl        | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Monobromodiphenyl ether  | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Dibromodiphenyl ether    | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Tribromodiphenyl ether   | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Tetrabromodiphenyl ether | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Pentabromodiphenyl ether | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Hexabromodiphenyl ether  | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Heptabromodiphenyl ether | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Octabromodiphenyl ether  | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Nonabromodiphenyl ether  | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |
| Decabromodiphenyl ether  | mg/kg | US EPA 3540C, GC/MS | 5   | N.D.    |

NOTE: (1) N.D. = Not detected.(<MDL)  
 (2) ppm = mg/kg  
 (3) MDL = Method Detection Limit  
 (4) - = No regulation  
 (5) \*\* = Qualitative analysis (No Unit)  
 (6) Negative = Undetectable / Positive = Detectable

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