

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

*Model Name : RCP650A03*

*Customer :*

*Title:*

*Name :*

*APPROVED*

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

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

***RN2 Technologies co., Ltd.***

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

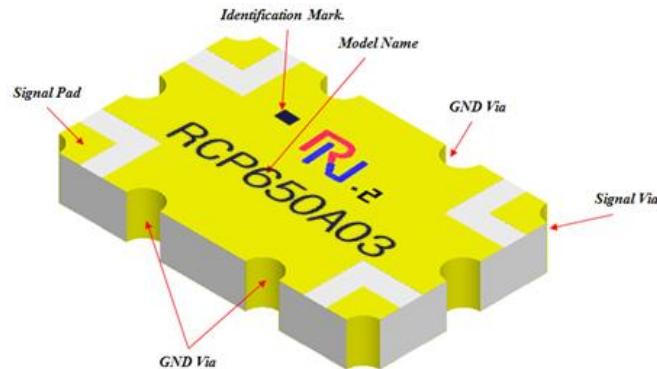
*Designed : \_\_\_\_\_*

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



## 1. Description

### 1-1. Part number: RCP650A03



### 1-2. Features

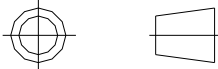
- Hybrid Coupler 3dB, 90°
- Surface mount type
- Suitable for operation frequency 470~860MHz
- **RoHS** compliance
- High stability in temperature and humidity for LTCC base
- Low loss for Silver(Ag) conductor
- Miniature size and high power capability
- Lead-free alloy solderable
- Thermal expansion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

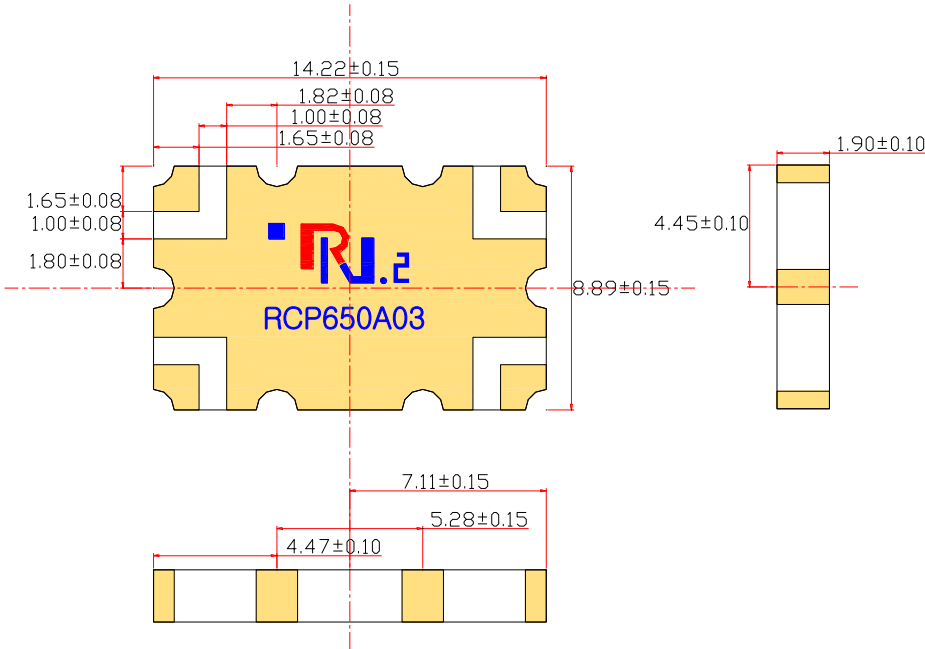
## 2. Electrical Specification

<b>Freq.</b> (MHz)	<b>Amplitude Balance</b> max (dB)	<b>Isolation</b> min (dB)	<b>Insertion Loss</b> max (dB)
470-510	± 0.45	-20	-0.20
510-780	± 0.35	-20	-0.23
780-860	± 0.35	-23	-0.30
<b>VSWR</b> Max	<b>Phase</b> (degrees)	<b>Power Capacity</b> Avg. (Watt)	<b>Operating Temp.</b> (°C)
1.2	90 ± 3.0	200	-55 to +125

### 3. Mechanical Specification

#### 3-1. Outline Dimension

PROJECTION	NO.	DATE	REVISION & DESCRIPTION	SIGNATURE	
				REVIEWED	CHECKED
	1	2008.07.15	New-Drawing		
	2				
	3				

Note.

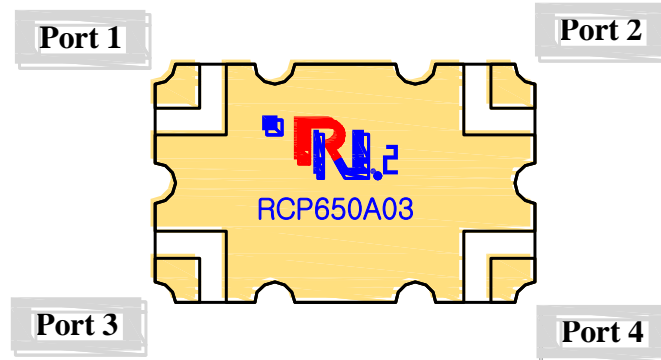
1. SMD-type, Ceramic Base.
2. Inner signal circuits : Silver(Ag) conductor
3. Surface plating : Gold(Au) finished
4. Tolerance is not cumulative.

NO.	DESCRIPTION	UNIT	TOTAL	QUANTITY		SCALE	1/1	SIZE	A4	DIMENSION	mm
TITLE	RCP650A03-Outline	RN2 DWG NO.	08-0715-01								

#### 3-2. Weight

-  $0.68 \pm 10\%$  Grams typical

#### 4. Port Configuration



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

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

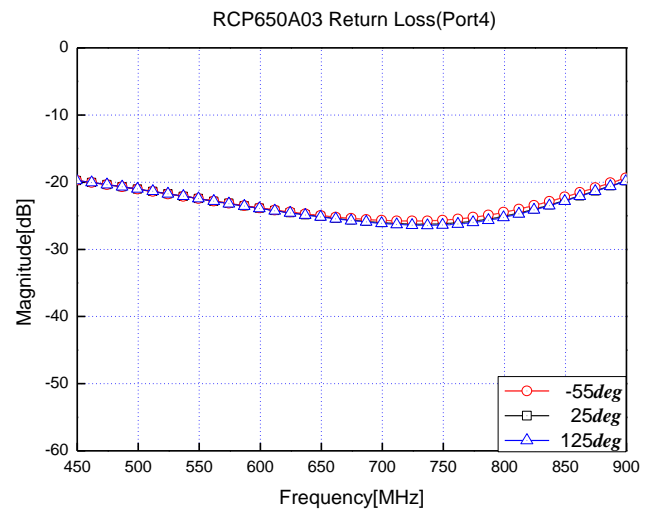
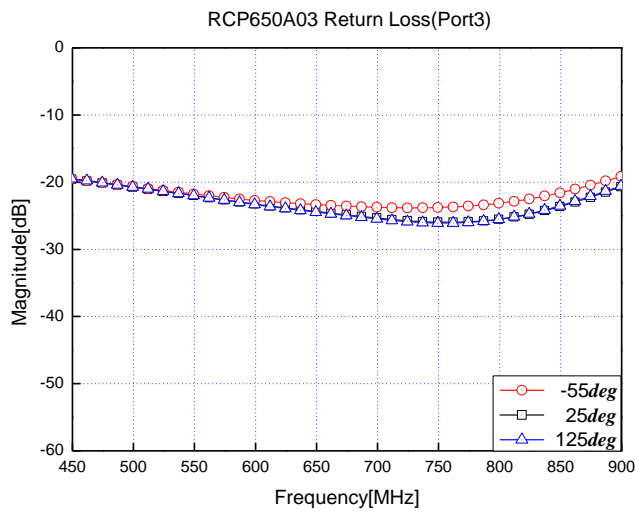
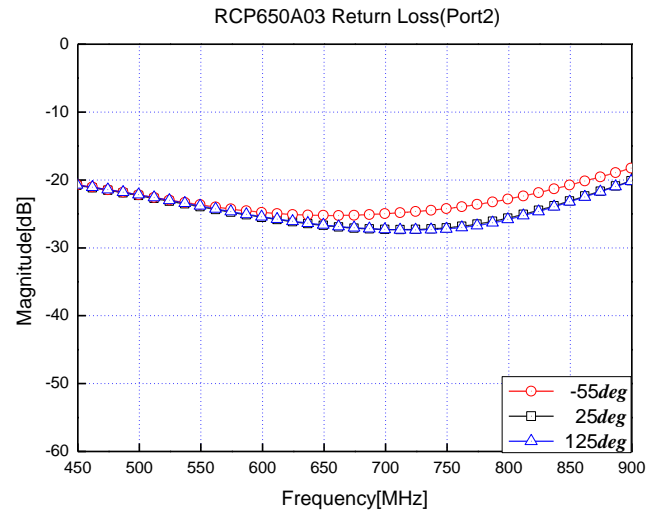
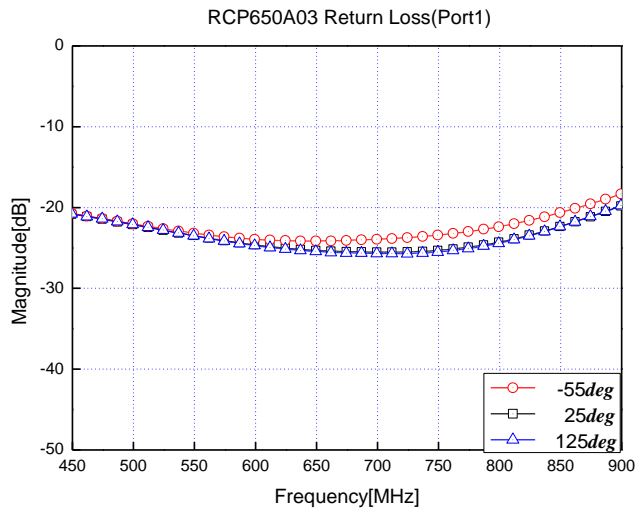
#### 5. Schematic Drawing



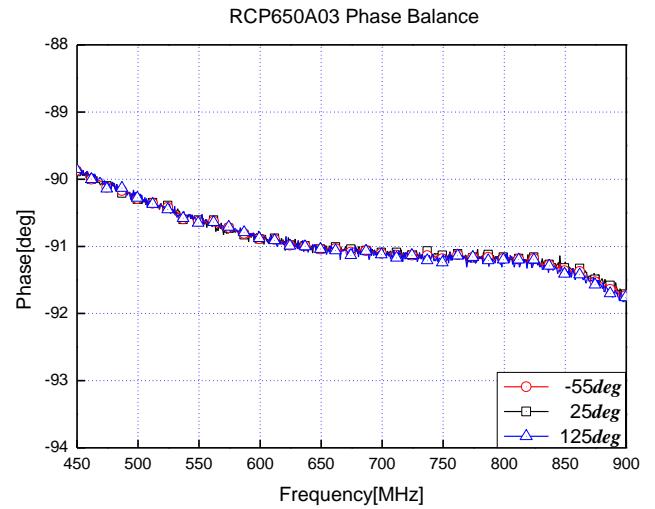
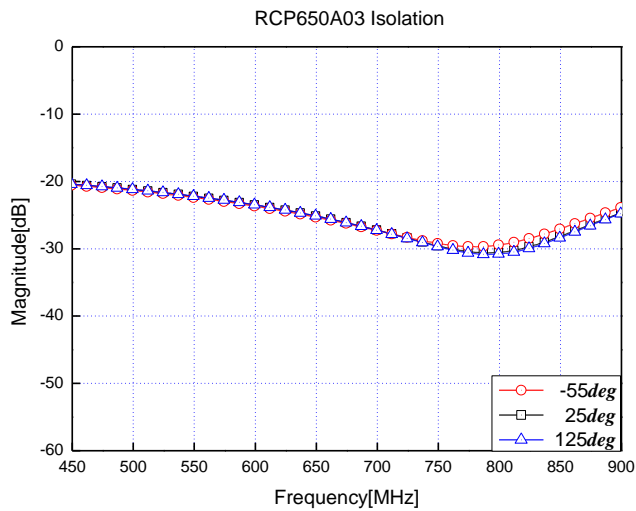
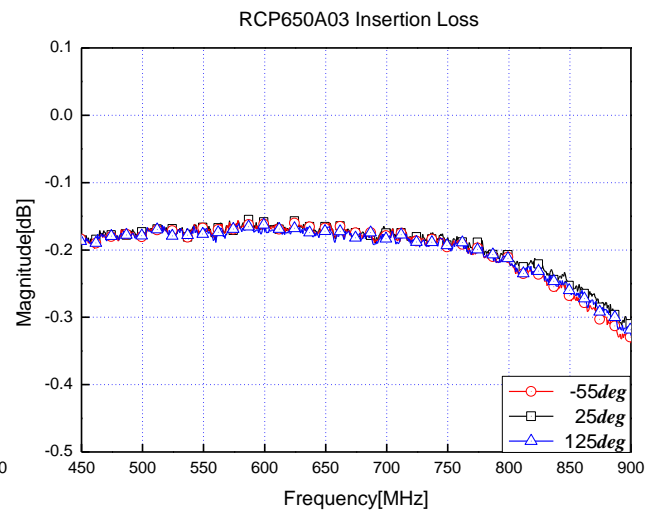
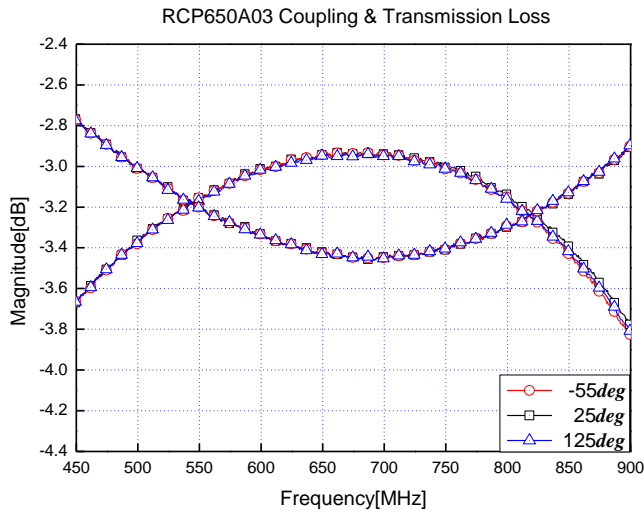
## 6. Typical Performance Data (25 °C)

Freq. [MHz]	Coupling [dB]	Out [dB]	IL [dB]	Amp.Bal. [dB]	Phase [degree]	Return Loss [dB]			
						S11	S22	S33	S44
470	-3.5363	-2.8655	-0.1777	±0.34	-90.06	-21.33	-21.37	-20.00	-20.11
490	-3.42	-2.9587	-0.1729	±0.23	-90.2	-21.87	-22.04	-20.48	-20.46
510	-3.3201	-3.0477	-0.1715	±0.14	-90.33	-22.42	-22.65	-21.01	-20.96
530	-3.2321	-3.1301	-0.1705	±0.05	-90.49	-22.98	-23.32	-21.51	-21.50
550	-3.1485	-3.1975	-0.1626	±0.02	-90.57	-23.49	-23.97	-22.02	-22.01
570	-3.094	-3.2573	-0.1646	±0.08	-90.83	-24.01	-24.61	-22.55	-22.55
590	-3.0387	-3.3168	-0.1652	±0.14	-90.81	-24.43	-25.22	-23.02	-23.08
610	-2.9971	-3.3577	-0.1634	±0.18	-90.92	-24.79	-25.78	-23.49	-23.57
630	-2.969	-3.3952	-0.1666	±0.21	-91.01	-25.07	-26.29	-23.95	-24.05
650	-2.9349	-3.4229	-0.1617	±0.24	-91.02	-25.29	-26.73	-24.36	-24.46
670	-2.9378	-3.4465	-0.1744	±0.25	-91	-25.44	-27.06	-24.77	-24.88
690	-2.9431	-3.4656	-0.1862	±0.26	-91.02	-25.49	-27.25	-25.15	-25.28
710	-2.9544	-3.4467	-0.1833	±0.25	-91.07	-25.51	-27.33	-25.51	-25.66
730	-2.9661	-3.4279	-0.1806	±0.23	-91.18	-25.48	-27.26	-25.81	-25.95
750	-2.9919	-3.4013	-0.1815	±0.20	-91.17	-25.27	-27.04	-25.94	-26.07
770	-3.0482	-3.3729	-0.1972	±0.16	-91.2	-24.99	-26.63	-25.92	-26.01
790	-3.1114	-3.3335	-0.2107	±0.11	-91.09	-24.54	-25.99	-25.72	-25.75
810	-3.1963	-3.2801	-0.2277	±0.04	-91.2	-23.92	-25.17	-25.25	-25.23
830	-3.2842	-3.2028	-0.233	±0.04	-91.27	-23.20	-24.17	-24.54	-24.48
850	-3.4034	-3.136	-0.2573	±0.13	-91.23	-22.32	-23.08	-23.59	-23.49
860	-3.4587	-3.0824	-0.2562	±0.19	-91.32	-21.85	-22.50	-23.06	-22.94

## 7. Operation Temperature Curve (a)

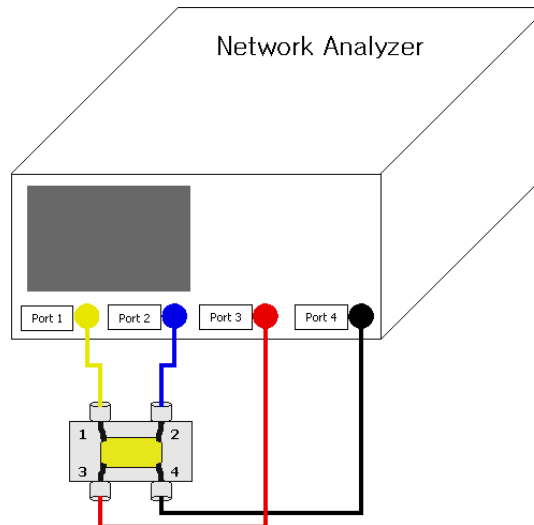


## 8. Operation Temperature Curve (b)





## 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	Phase(S31) — Phase(S41)	

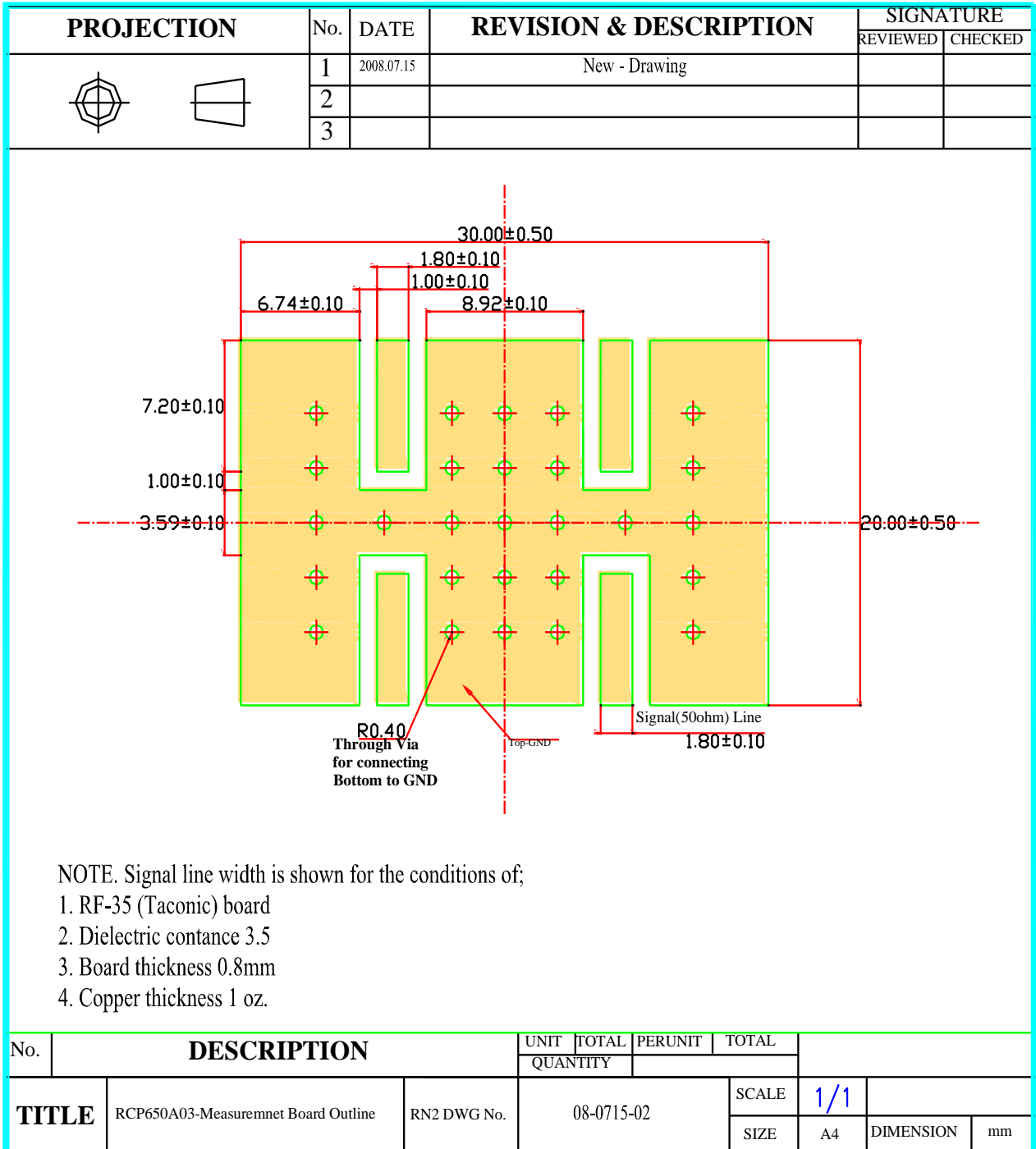
$P_{in}$  : Power of Input Port

$P_{out}$  : Power of Output Port

$P_{cou}$  : Power of Coupling Port

$P_{iso}$  : Power of Isolated Port

10. Measurement board layout



11. Recommended PCB layout and Solder mask pattern

PROJECTION	NO.	DATE	REVISION & DESCRIPTION	SIGNATURE	
				REVIEWED	CHECKED
	1	2008.07.15	New-Drawing		
	2				
	3				

**Solder Area('A')**  
**Solder Area('B')**  
**Solder Resistor**  
**50ohm Signal Line**  
**Coupler Outline**

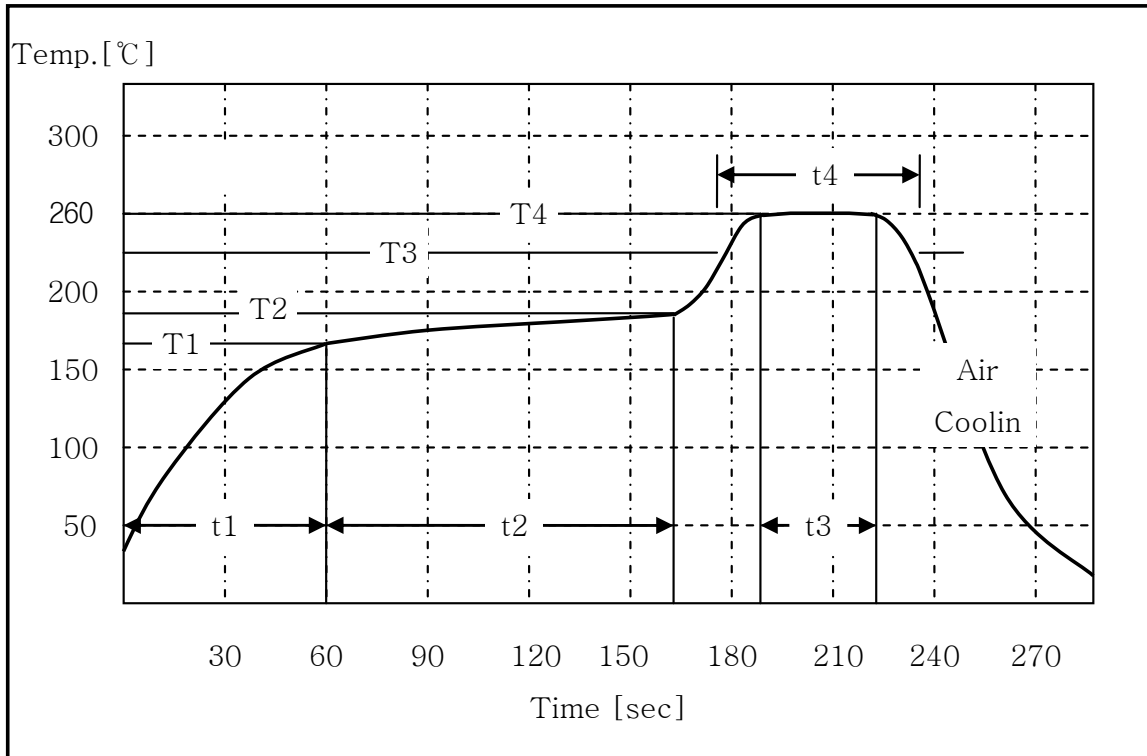
Dimensions: 3.72±0.08, 5.28±0.08, 3.72±0.08, 1.00±0.08, 3.59±0.08, 3.79±0.08, 8.92±0.08, 1.00, 6.91±0.08

NOTE.

1. Test Solder Cream : SAC-305 (Alpa Metal)
2. Lead Free Solder Alloy : Sn/Ag/Cu Ratio Of 96.5/3.0/0.5
3. Solder Area ('A') Demension : 2.0 mm by 1.8 mm
4. Solder Area ('B') Demension : 2.0 mm by 8.0 mm

NO.	DESCRIPTION	UNIT	TOTAL			
		QUANTITY				
<b>TITLE</b>	<i>A-Size_Recommended Solder Quantity &amp; Area</i>	RN2 DWG NO.	08-0715-03	SCALE	1/1	
				SIZE	A4	DIMENSION mm

## 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.

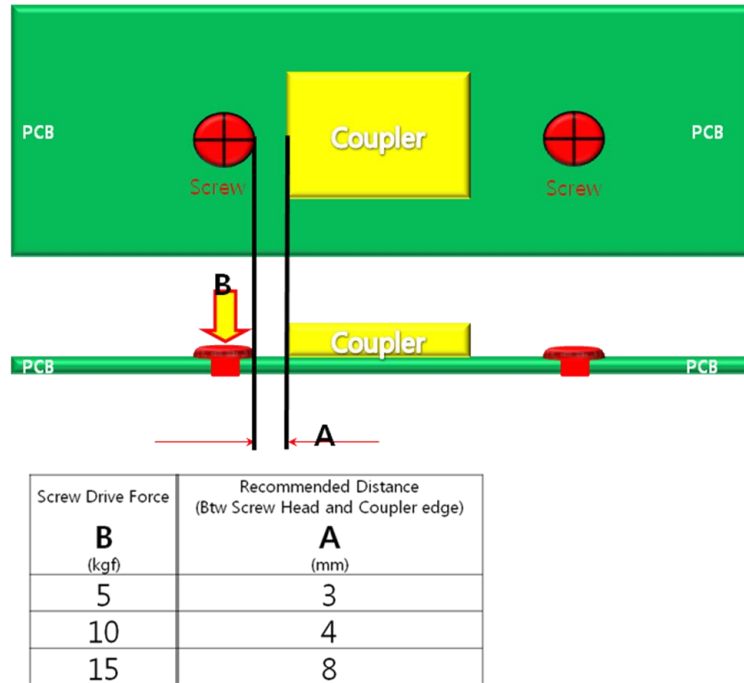
#### II. Be careful during storage

- 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

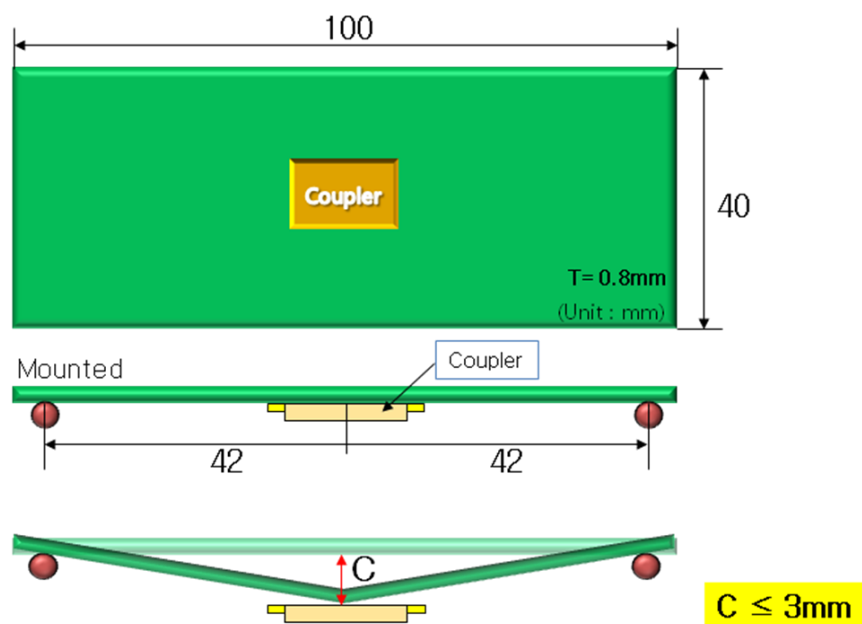
- A. All the ground terminals, IN and OUT pad of coupler should be soldered on the ground plane of the PCB.
- B. Products may be cracked or broken by uneven forces from a claw or suction device.
- C. Mechanical stress by any other devices may damage products when positioning them on PCB.
- D. A dropped 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

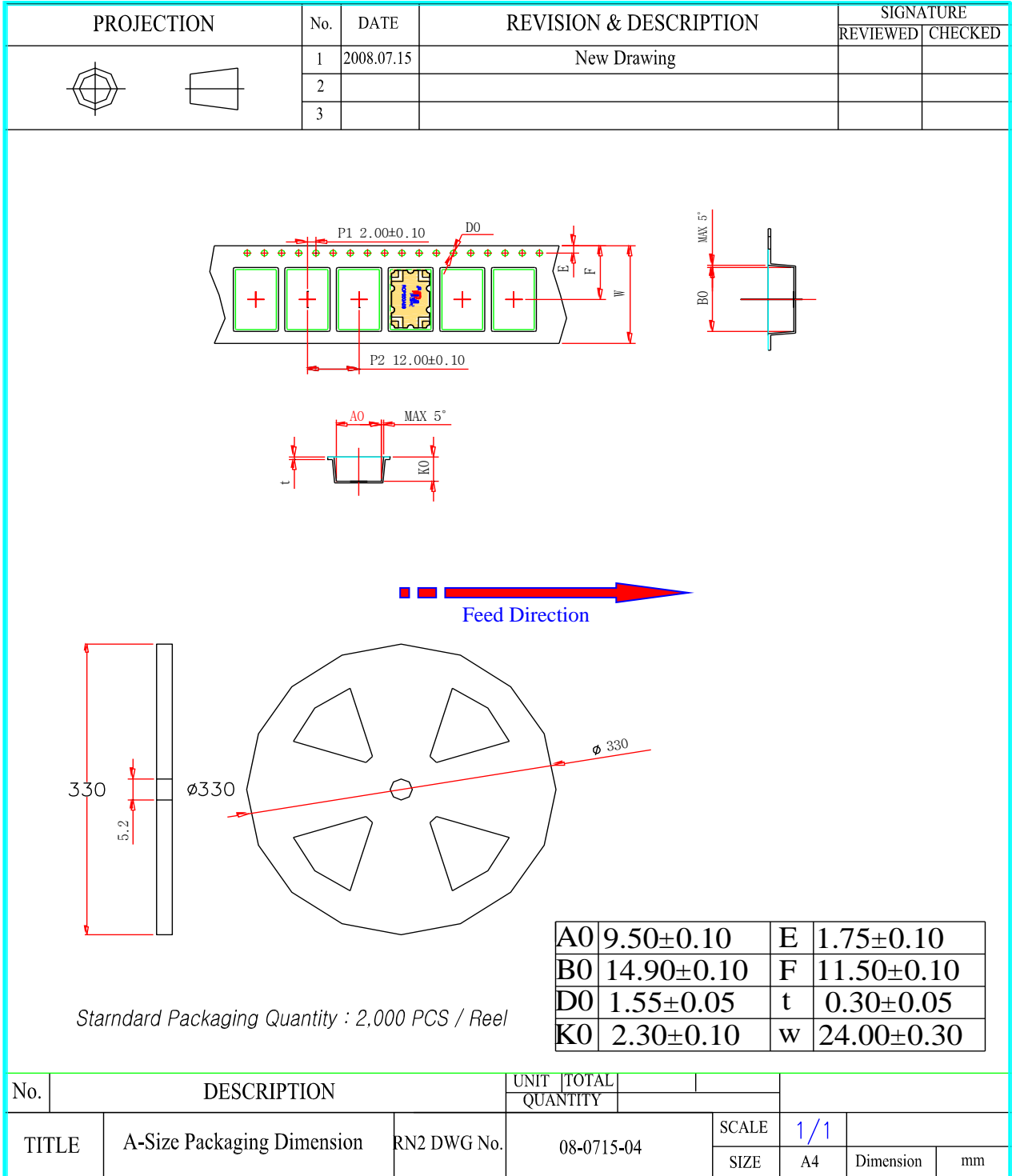


#### V. Be careful when SMD or Assembly

- 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 (Thermal Shock)	1. One Cycle : 30 min Step1: $125 \pm 5$ °C for 15 min Step2: $-55 \pm 5$ °C for 15 min 2. Approach high or low temperature in 10 seconds 3. Number of Cycles : 100 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 2. Duration : $96 \pm 2$ hours	1. Meet the electrical Specification after test
Low Temp. Resistance	1. Temperature : $-55 \pm 5$ °C 2. Duration : $24 \pm 2$ hours	1. Meet the electrical Specification after test
Vibration Resistance	1. Frequency: 5~ 15MHz 2. Acceleration : 10g 3. Sweep Time: 0.1 oct/min, 15min/axis 4. Axis : X, Y and Z direction	1. No appearance damage 2. Meet the electrical Specification after test
Humidity Resistance	1. One Cycle : Step1: increase Temperature $-25 \sim 65$ °C for 2hours with humidity 85% Step2: Maintain for 4 hour after increasing Humidity 90% to 95% Step3: Decrease Temperature $65$ °C to $25$ °C 2. Number of Cycles : 10 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 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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