

# *RoHS Data*

*for*

# *Fixed Resistors*

*March 2009*

## Content

I. Profile

II. RoHS's standard

III. RoHS exemptions for materials and components

IV. China RoHS

V. Korea RoHS

VI. Comparison between RoHS and ROYALOHM

VII. Tested report number (ICP & GC Data)

VIII. Halogen 

IX. Perfluorooctane Sulfonate (PFOS) 

X. REACH 

XI. Solderability profile

## *I. Profile*

Every year, waste of electrical & electronic equipment is increasing and environmental related substances in this waste have spread and contaminate in the air, water, soil etc. Many customers and organizations have issued the directive to ban or control these hazardous substance which can affect humans and other organisms.

In Europe the RoHS Directive (EU Directive on the Restriction of certain hazardous substances in electrical and electronic equipment) will be put into effect in July 2006. To comply with this directive, Royal Ohm has already been advancing efforts to eliminate six substances from all its products. These substances are lead, cadmium, hexavalent chromium, mercury, polybrominated biphenyls (PBBs) and polybrominated diphenyl ethers (PBDEs).

“ROYALOHM” is compliant to 2002/95/CE European Directive Parliament and Council to ban all environment-related substances included in the materials (including attachments, packages, and all the matters delivered with the materials).

1. January 2002, all coated and cement type resistors are already RoHS compliant.
2. February 2004, chip Resistors terminal lead free are available.

## *Royal Ohm Environmental Policy*

1. *Unitize the energy and reduce the wastage by continuously.*
2. *Improve three kinds of waste-water, air, and used materials from production to be in accordance with the concerned organization's environment law before release them to the nature.*
3. *Frequently inform all of employees about environment knowledge to achieve the environment target of the concerned organization.*
4. *Intend to develop the product to adapt with customer's environmental related standard (ERS.& RoHS Directive).*

## The development of Pb free chip resistor

Step	Item	Detail	Due Date	Remark
Step 1	Prototype test	Send samples of overcoat Pb-free to SGS Thailand - third party laboratory.	May 14 <sup>th</sup> , 2005	Result : Chip Resistor is RoHS compliant but does not meet required specs.
Step 2	Continuously look for new Pb-free G2 & marking paste (5%) for chip resistor	Some Pb-free paste do not meet process standard so, 1. We have to test Pb-free materials and request better materials 2. To look for new vendor continuously.	May.30 <sup>th</sup> , 2005	Still looking for new vendor.
Step 3	To produce overcoat (G1, G2 & MK & C3 terminal & electroplating) Pb-free for chip resistor	1. If Pb-Free G2 & marking paste (5%) available and pass the testing process, we will proceed to pilot production. 2. If high temp. paste (5%) is not available in the market, we will replace by low temp. paste to proceed with Pb-free	Nov.1 <sup>st</sup> , 2005	

## The development of Pb free chip resistor

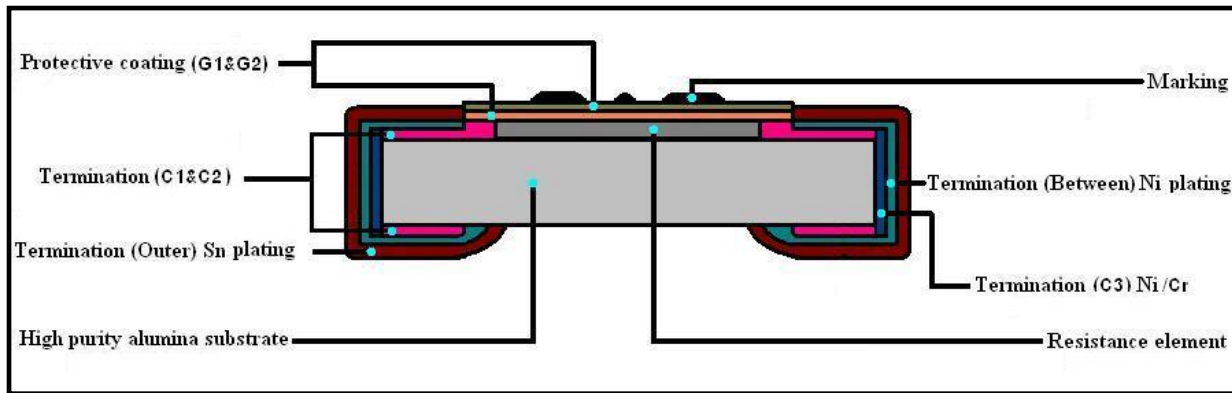
Step	Item	Due Date	Remark
Step 4	Pre-launch for Overcoat Pb-free product	Jan.1 <sup>st</sup> , 2006	
Step 5	Mass production	April.1 <sup>st</sup> , 2006	Overcoat Pb free available now.
Step 6	Whole product Pb-free	Dec. 2006	Pending

\* Whole product Pb-free pending development schedule from supplier

## The development of Pb free chip resistor

Item	2002	2003	2004	2005	2006
Sn/Pb electroplating	~May.02				
Pb-free electroplating		May.02 – Feb.04			
Terminal Pb-free			Feb.04 - Apr.06		
Overcoat Pb-free					Apr.06-Dec.06
Whole product Pb-free					Pending

## Overcoat Pb-free type



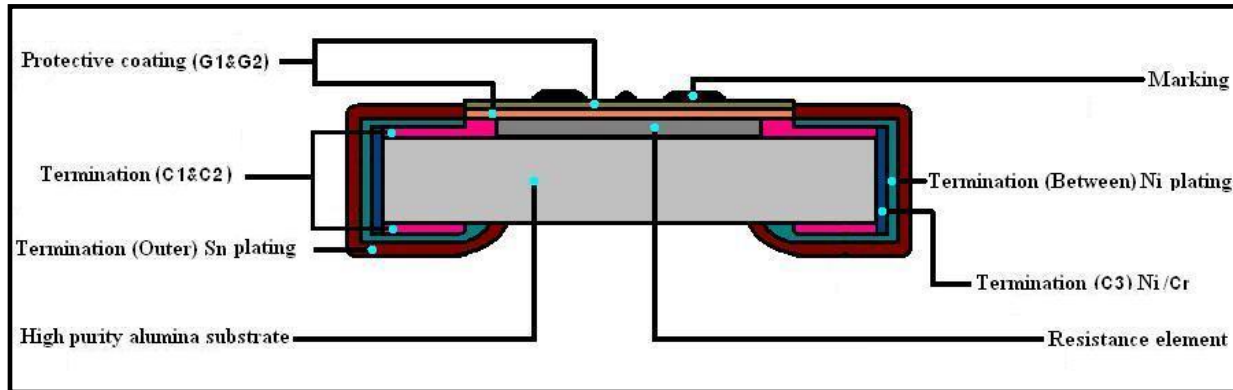
### Overcoat Pb free :

- ◇ High purity alumina substrate : Pb free
- ◇ Termination (all) : Pb free
- ◇ Protective coating (all) Pb free
- ◇ Marking : Pb free

Remark : Exclude resistance element



## Whole Product Pb-free type



### Whole product Pb free :

- ◆ High purity alumina substrate : Pb free
- ◆ Termination (all) : Pb free
- ◆ Protective coating (all) Pb free
- ◆ Marking : Pb free
- ◆ Resistance element

## ROYALOHM Pb-free development's history

### Apr. 2006 - Present

- \* Overcoat Pb free for chip resistor  
(included terminal, G1, G2 and marking)

### Feb. 2004 - March 2006

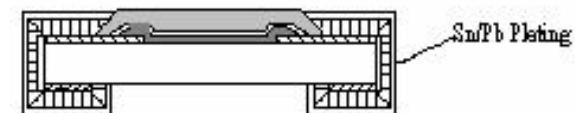
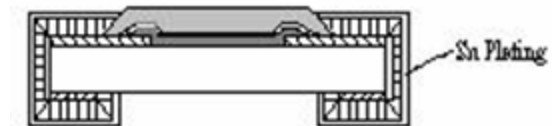
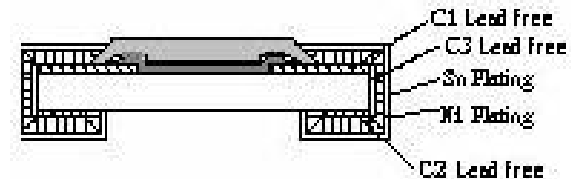
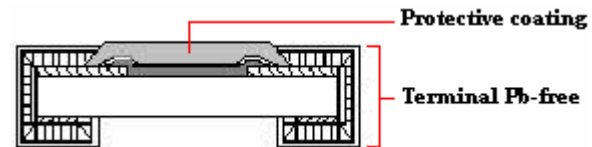
- \* Terminal Pb-free for chip resistor  
(included C1, C2, C3 and electroplating)

### May 2002 - Feb.2004

- \* Pb-free electroplating

### May 2002

- \* Sn/Pb electroplating



## *II. RoHS's standard*

**The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive 2002/95/EC**

**From 1<sup>st</sup> July 2006, new electrical and electronic equipment placed in the market shall not contain:**

<b>1. Cadmium (Cd)</b>	<b>Limit 100 ppm (mg/kg or 0.01% by weight)</b>
<b>2. Mercury (Hg)</b>	<b>Limit 1000 ppm (mg/kg or 0.1% by weight)</b>
<b>3. Hexavalent chromium (Cr<sup>+6</sup>)</b>	<b>Limit 1000 ppm (mg/kg or 0.1% by weight)</b>
<b>4. Lead (Pb)</b>	<b>Limit 1000 ppm (mg/kg or 0.1% by weight)</b>
<b>5. Polybrominated biphenyls (PBBs)</b>	<b>Limit 1000 ppm (mg/kg or 0.1% by weight)</b>
<b>6. Polybrominated diphenyl ethers (PBDEs)</b>	<b>Limit 1000 ppm (mg/kg or 0.1% by weight)</b>

**A maximum concentration value up to 0.1% by weight and per homogeneous material, for lead, mercury hexavalent chromium, PBB and PBDE and up to 0.01% by weight and per homogeneous material for cadmium shall be tolerated**

### *III. RoHS exemptions for materials and components*

**Commission of the European Communities**  
**amending Annex II of Directive 2000/53/EC of the European Parliament and of the Council on**  
**end-of-life vehicles**  
**Annex II**  
**Materials and components exempt from Article 4(2)(a)**

<b>Materials and Component</b>	<b>Scope and expiry date of the exemption</b>
<b>Lead as an alloying element</b>	
<b>1. Steel for machining purposes and galvanized steel containing up to 0.35% lead by weight</b>	<b>NA.</b>
<b>2. a) Aluminium for machining purposes with a lead content up to 1.5% by weight</b>	<b>1 July 2008</b>
<b>2. b) Aluminium for machining purposes with a lead content up to 0.4% by weight</b>	<b>NA.</b>
<b>3. Copper alloy containing up to 4% lead by weight</b>	<b>NA.</b>
<b>4. Bearing</b>	<b>1 July 2008</b>

# Royal Electronic Factory (Thailand) Co., Ltd.

Materials and Component	Scope and expiry date of the exemption
Lead and lead compounds in components	
5. Batteries	NA.
6. Vibration dampers	NA.
7. a) Vulcanising agents and stabilizers for elastomers in fluid handling and power train applications containing up to 0.5% lead by weight	1 July 2006
7. b) Bonding agents for elastomers in power train applications containing up to 0.5% lead by weight	NA.
8. Solder in electronic circuit boards and other electric applications	NA.
9. Copper in friction materials of brake linings containing more than 0.4% lead by weight	1 July 2007
10. Valve seats	Engine types developed before 1 July 2003: 1 July 2007
11. <b>Electrical components which contain lead in glass</b> or ceramic matrix compound except glass in bulbs and glaze of spark plugs	NA.

## IV. China RoHS

**China RoHS III (Ministry of Information Industry) Order No. 39**  
**Management Measures on the Control of Pollution Caused by Electronic Information Products**  
**Enforcement: March 1, 2007**

### A. Product groups to be controlled

1. **Electronic Information Products (EIP)**
2. **Catalogue for control for pollution caused by EIP**

*Remark: - The catalogue shall be revised annually based on the actual circumstances and the level of scientific technology development .*

### B. Scope

**Design, Production, Import, Commerce to EIP included packaging materials**

*Remark: - China RoHS not enforce to export products.*

### C. Major article of China RoHS

#### 1. Design:

*- A manufacturer or an importer shall comply with the national or industrial standards for the control of toxic or hazardous substances of EIP, using non-toxic and hazardless, or low toxic and low hazardous, easily degradable and recyclable materials.*

## C. Major article of China RoHS

### 2. Manufacture:

- A manufacturer or an importer shall comply with the national or industrial standards for the control of toxic or hazardous substances of EIP. and
- Using materials, technology, easily recyclable, and environmentally friendly.

### 3. The environment-friendly use period of EIP:

- A manufacturer or an importer shall indicate the environment-friendly use period on the EIP

### 4. Pollution control logo:

- A manufacturer or an importer shall indicate the names, contents, and locations of toxics or hazardous substances, and recyclability on EIP  
example:



**Toxic or hazardous substance free**



**Contains toxic or hazardous substance. Safe use period is 10 years.**

## C. Major article of China RoHS

### 5. Packaging materials:

- A manufacturer or an importer shall comply with the national or industrial standards for the control of toxic or hazardous substances of EIP.
- A manufacturer or an importer shall indicate the names of packaging material substances of EIP

### 6. Commerce:

- A manufacturer of EIP shall rigor procurement channels and not sell EIP which do not comply with the national or industrial standards for the control of toxic or hazardous substances of EIP.

### 7. Imported goods

- Imported EIP shall comply with the national or industrial standards for the control of toxic or hazardous substances of EIP.

### 8. EIP listed in the Catalogue

- Regulated EIP listed in the Catalogue must comply with key pollution control requirements stated in the Catalogue.

### 9. EIP not listed in the Catalogue

- Those EIP not listed in the Catalogue shall comply with other rules of this measure in regard to the control of pollution caused by EIP

**Remark: Ministry of Information Industry (MII) still prepare the Catalogue**



## *V. Korea RoHS*

*Act on the Resource Recycling of Electrical and Electronic Equipment and Vehicles.  
Enforcement: January 1, 2008*

### *A. Product groups to be controlled*

*Electronic products operated by electricity and magnetic field and automotives*

### *B. Scope*

*Design and Recycle*

### *C. Korea RoHS*

*1. Restricts materials, like EU RoHS.*

- Details not defined – expect consistency with EU.*
- Exemption process will be defined.*
- Self-declaration, like EU.*

*2. Manufacturers must maintain records of material composition and “announce” in a centralized database that they are compliant.*

*3. Requires extended producer responsibility for recycling.*

*4. Requires that products are designed with environmental considerations.*

5. *Will require a mark...expressed interest in using pre-existing marks.*
6. *Only for new products “put on the market” as of July 1, 2007.*
  - *Existing product will not have to comply.*
7. *Scope not defined in the legislation*
  - *Initially limited to TVs, refrigerators, air conditioners, laundry machines, personal computers, audio devices, cellular phones, printers, copy machines, and fax machines.*
  - *Plan to eventually expand to mirror EU scope.*
  - *No obvious impact yet to most Semiconductor Equipment and Materials International (SEMI) member companies.*
8. *Recycling regimen already in-force for this scope.*
  - *In an earlier act; will be subsumed in to this.*
  - *Manage it yourself or join a collective.*

# Royal Electronic Factory (Thailand)

## Co., Ltd.

### The Summary of Global RoHS

There are some aspects of RoHS which are not harmonized well at a global level such as scope, but the fundamentals such as the ban substances, the limits applied and how they are applied are harmonized.

Item	EU	China	California	Japan	Korea
Scope	10 product categories, exclusions	11 product categories,	1 product categories	7 product categories	10 products
The restricted substances	Lead Cadmium Mercury Chromium VI PBBs PBDEs	Lead Cadmium Mercury Chromium VI PBBs PBDEs Other toxic substance	Lead Cadmium Mercury Chromium VI PBBs PBDEs	Lead Cadmium Mercury Chromium VI PBBs PBDEs	Lead Cadmium Mercury Chromium VI PBBs PBDEs
Restriction or Disclosure	Restriction	Disclosure only	Restriction	Disclosure only	Disclosure only
Maximum Concentration Values	0.1% for all except cadmium at 0.01%	0.1% for all except cadmium at 0.01%	0.1% for all except cadmium at 0.01%	0.1% for all except cadmium at 0.01%	0.1% for all except cadmium at 0.01%
Level at which restriction is applied	Homogeneous material	Homogeneous material	Homogeneous material	Homogeneous material	Homogeneous material
Exemptions	Allowed	Expected to follow EU	EU follows	EU follows	Expected to follow EU
ROYALOHM status	Compliance	Compliance	Compliance	Compliance	Compliance

## VI. Comparison between RoHS and ROYALOHM

### A. Chip fixed resistor & Network fixed resistor

No.	RoHS Standard (EU)		Tested report for Royal Ohm's product		Tested report for Royal Ohm's raw materials
	Chemical name	Limit (ppm)	Chip type	Network type	
1	Cadmium	100	Pass	Pass	Pass
2	Lead	1000	Pass*	Pass*	Pass*
3	Mercury	1000	Pass	Pass	Pass
4	Chromium VI	1000	Pass	Pass	Pass
5	PBB	1000	Pass	Pass	Pass
6	PBDE	1000	Pass	Pass	Pass

\* There are still some our raw materials which cannot meet the Pb content required due to technical problems (this is the same for all of chip resistor manufacturers). However, Lead in glass of electronic component is considered included in the exemption by RoHS directive.

(Each exemption listed in the Annex must be subjected to a review, at least every 4 years)

## B. Coated fixed resistor & Cement fixed resistor

No.	RoHS Standard (EU)		Tested report for Royal Ohm's product		Tested report for Royal Ohm's raw materials	
	Chemical name	Limit (ppm)	Coated type	Cement type	Coated type	Cement type
1	Cadmium	100	Pass	Pass	Pass	Pass
2	Lead	1000	Pass**	Pass	Pass**	Pass
3	Mercury	1000	Pass	Pass	Pass	Pass
4	Chromium VI	1000	Pass	Pass	Pass	Pass
5	PBB	1000	Pass	Pass	Pass	Pass
6	PBDE	1000	Pass	Pass	Pass	Pass

**\*\* All of coated fixed resistors have pass the RoHS standard without any stipulated except metal glaze film resistor that can pass this standard by the exempted in RoHS directive, lead in glass of electronic components same chip fixed resistor and network resistor**

## VII. Tested report number

### Royal Ohm (Product)

#### A. Summary of tested report for chip fixed resistor (terminal Pb-free) & network fixed resistor

No.	Product Type	SGS. Tested Report (ppm.)								Report Number
		Cd	Pb	Hg	Cr <sup>+6</sup>	PBB	PBDE	Br	Cl	
1	Chip resistor (SMD 0402)	ND.	22	ND.	ND.	ND.	ND.	ND.	ND.	BKKH09019378
2	Chip resistor (SMD 0603)	ND.	22	ND.	ND.	ND.	ND.	ND.	ND.	BKKH09019378
3	Chip resistor (SMD 0805)	ND.	22	ND.	ND.	ND.	ND.	ND.	ND.	BKKH09019378
4	Chip resistor (SMD 1206)	ND.	22	ND.	ND.	ND.	ND.	ND.	ND.	BKKH09019378

Remark : Terminal Pb-free (included C1, C2, C3 and electroplating)

## *B. Summary of tested report for coated fixed resistor & cement fixed resistor*

No.	Product Type	SGS. Tested Report (ppm.)								Report Number
		Cd	Pb	Hg	Cr <sup>+6</sup>	PBB	PBDE	Br	Cl	
1	Carbon film resistor	ND.	ND.	ND.	ND.	ND.	ND.	ND.	ND.	BKKH09019373
2	Metal film resistor	ND.	ND.	ND.	ND.	ND.	ND.	ND.	ND.	BKKH09019376
3	Metal oxide film resistor	ND.	ND.	ND.	ND.	ND.	ND.	ND.	ND.	BKKH09019374
4	Fusible resistor	ND.	ND.	ND.	ND.	ND.	ND.	ND.	ND.	BKKH09019377
5	Metal glaze film resistor	ND.	ND.	ND.	ND.	ND.	ND.	ND.	ND.	BKKH09019375
6	Wire wound resistor	ND.	ND.	ND.	ND.	ND.	ND.	ND.	ND.	BKKH09019372

**Remark : 1. ND. = Not Detected**

**2. NA. = Not Applicable**


**3. The resistive paste (R) of metal glaze film resistor consist of lead oxide (PbO) substance contained in glass. As we know lead in glass of electronic components obtained the exempted in RoHS directive.**

## ☘ Vendors (raw materials)

### A. Summary of tested report of raw materials of chip fixed resistor & chip array fixed resistor

No.	Raw Material Name	SGS. Tested Report (ppm.)						Report Number	Remark
		Cd	Pb	Hg	Cr <sup>+6</sup>	PBB	PBDE		
<b>Chip fixed resistor</b>									
1	Alumina substrate	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/52068, CE/2008/45844	
2	Electrode paste C1	ND.	10	ND.	ND.	ND.	ND.	SHAH0005208601, SHAH0005208602	Impurity
3	Electrode paste C2	ND.	ND.	ND.	ND.	NA.	NA.	CANEC0805669502	
4	Electrode past C3	ND.	ND.	ND.	ND.	ND.	ND.	KA/2008/C0700	
5	Resistive paste -R -2001, R -2010, R-2040, R -2210, R -2140 - R-2210, R -2310, R -2410 - R-2510, R-2610, R-2710	ND.	30,300	ND.	ND.	ND.	ND.	CE/2008/54959	Exemption : Lead in glass of electronic component
		ND.	116,000	ND.	ND.	ND.	ND.	CE/2008/54962	
		ND.	232,000	ND.	ND.	ND.	ND.	CE/2008/54965	



 **Vendors (raw materials)**

**A. Summary of tested report of raw materials of chip fixed resistor & chip array fixed resistor**

No.	Raw Material Name	SGS. Tested Report (ppm.)						Report Number	Remark
		Cd	Pb	Hg	Cr <sup>+6</sup>	PBB	PBDE		
<b>Chip fixed resistor</b>									
6	Protective paste G2	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/67902	
7	Nickel plating	ND.	ND.	ND.	ND.	ND.	ND.	CE/2009/26411	
8	Tin plating	ND.	190	ND.	ND.	ND.	ND.	CE/2009/11820	impurity
9	Marking	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/96022	

## Vendors (raw materials)

### B. Summary of tested report for coated fixed resistor & cement fixed resistor

No.	Raw Material Name	SGS. Tested Report (ppm.)						Report Number	Remark
		Cd	Pb	Hg	Cr <sup>+6</sup>	PBB	PBDE		
A. Carbon film fixed resistor (coated fixed resistor)									
1	Capped ceramic rod	ND.	12	ND.	ND.	ND.	ND.	SHR08050830711006, CE/2008/65235A	impurity
2	Tin plated copper wire	ND.	ND.	ND.	ND.	NA	NA	1568376	
3	Under coating (H-800)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1460	
4	Epoxy paint (Z-1874)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C7783	
5	PC-2	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/72789	
6	Color code (clear)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1448	
7	Color code (white)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1447	
8	Color code (grey)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1473	
9	Color code (violet)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1472	
10	Color code (blue)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1471	
11	Color code (green)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1470	
12	Color code (yellow)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1469	
13	Color code (orange)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1468	
14	Color code (red)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1467	
15	Color code (brown)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1466	
16	Color code (black)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1465	

No.	Raw Material Name	SGS. Tested Report (ppm.)						Report Number	Remark
		Cd	Pb	Hg	Cr <sup>+6</sup>	PBB	PBDE		
<b>B. Metal film fixed resistor (coated fixed resistor)</b>									
1	Capped ceramic rod	ND.	ND.	ND.	ND.	ND.	ND.	SHR0903043030B002	
2	Tin plated copper wire	ND.	ND.	ND.	ND.	NA.	NA.	1568376	
3	Epoxy paint (10312 LBN, Z-1992)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1452, CE/2008/C7774	
4	Silicon paint (SPC-660)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2009/26096	
5	PC-2	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/72789	
6	Color code (clear)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1448	
7	Color code (white)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1447	
8	Color code (grey)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1473	
9	Color code (violet)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1472	
10	Color code (blue)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1471	
11	Color code (green)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1470	
12	Color code (yellow)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1469	
13	Color code (orange)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1468	
14	Color code (red)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1467	
15	Color code (brown)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1466	
16	Color code (black)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1465	

No.	Raw Material Name	SGS. Tested Report (ppm.)						Report Number	Remark
		Cd	Pb	Hg	Cr <sup>+6</sup>	PBB	PBDE		
<b>C. Metal oxide film fixed resistor (coated fixed resistor)</b>									
1	Capped ceramic rod	ND.	ND.	ND.	ND.	NA.	NA.	SHR0903043030B001	
2	Tin plated copper wire	ND.	ND.	ND.	ND.	NA.	NA.	1568376	
3	Silicon paint (SPC P-660)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2009/26099, CE/2009/26097	
4	Color code (clear)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1448	
5	Color code (white)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1447	
6	Color code (grey)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1473	
7	Color code (violet)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1472	
8	Color code (blue)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1471	
9	Color code (green)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1470	
10	Color code (yellow)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1469	
11	Color code (orange)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1468	
12	Color code (red)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1467	
13	Color code (brown)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1466	
14	Color code (black)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1465	

No.	Raw Material Name	SGS. Tested Report (ppm.)						Report Number	Remark
		Cd	Pb	Hg	Cr <sup>+6</sup>	PBB	PBDE		
<b>D. Fusible film fixed resistor (coated fixed resistor)</b>									
1	Capped ceramic rod	ND.	ND.	ND.	ND.	ND.	ND.	SHR0903043030B002	
2	Tin plated copper wire	ND.	ND.	ND.	ND.	NA.	NA.	1568376	
3	Silicon paint (SPC P-660)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2009/26098	
4	Color code (clear)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1448	
5	Color code (white)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1447	
6	Color code (grey)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1473	
7	Color code (violet)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1472	
8	Color code (blue)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1471	
9	Color code (green)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1470	
10	Color code (yellow)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1469	
11	Color code (orange)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1468	
12	Color code (red)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1467	
13	Color code (brown)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1466	
14	Color code (black)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1465	

No.	Raw Material Name	SGS. Tested Report (ppm.)						Report Number	Remark
		Cd	Pb	Hg	Cr <sup>+6</sup>	PBB	PBDE		
E. Metal glaze film fixed resistor (coated fixed resistor)									
1	Capped ceramic rod	ND	2,088	ND.	ND.	ND.	ND.	SHR08050830711005	Exemption : Lead in glass of electronic component
2	Tin plated copper wire	ND.	ND.	ND.	ND.	NA.	NA.	1568376	
3	Epoxy paint (Z-2213)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C7774	
4	Color code (clear)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1448	
5	Color code (white)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1447	
6	Color code (grey)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1473	
7	Color code (violet)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1472	
8	Color code (blue)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1471	
9	Color code (green)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1470	
10	Color code (yellow)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1469	
11	Color code (orange)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1468	
12	Color code (red)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1467	
13	Color code (brown)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1466	
14	Color code (black)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1465	

No.	Raw Material Name	SGS. Tested Report (ppm.)						Report Number	Remark
		Cd	Pb	Hg	Cr <sup>+6</sup>	PBB	PBDE		
<b>F. Cement fixed resistor : PRM, PRW type</b>									
1	Ceramic case	ND.	92	ND.	ND.	NA.	NA.	SHR08050830711001, CE/2008/B2802	impurity
2	Tin plated copper wire	ND.	ND.	ND.	ND.	NA.	NA.	1568376	
3	Resistance wire (CN49)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/44186	
4	Resistance wire (Ni80)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/44185	
5	Silicone cement	ND.	ND.	ND.	ND.	ND.	ND.	CE/2009/11532	
6	Capped ceramic rod	ND.	27	ND.	ND.	ND.	ND.	SH8050547/CHEM	impurity
<b>G. Cement fixed resistor : PRV, PRZA type</b>									
1	Ceramic case	ND.	92	ND.	ND.	ND.	ND.	SHR08050830711001, CE/2008/B2802	impurity
2	Terminal	ND.	104	ND.	ND.	NA.	NA.	CE/2009/21814	impurity
3	Resistance wire (CN49)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/44186	
4	Resistance wire (Ni80)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/44185	
5	Silicone cement	ND.	ND.	ND.	ND.	ND.	ND.	CE/2009/11532	
6	Capped ceramic rod	ND.	27	ND.	ND.	NA.	NA.	SH8050547/CHEM	impurity

No.	Raw Material Name	SGS. Tested Report (ppm.)						Report Number	Remark
		Cd	Pb	Hg	Cr <sup>+6</sup>	PBB	PBDE		
<b>H. Cement fixed resistor : wire wound type</b>									
1	Capped ceramic rod	ND.	27	ND.	ND.	NA.	NA.	SH8050547/CHEM	Impurity
2	Tin plated copper wire	ND.	ND.	ND.	ND.	NA.	NA.	1568376	
3	Silicon paint (Silox CE-77 )	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/57801	
4	Resistance wire (CN49)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/44186	
5	Resistance wire (Ni80)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/44185	
6	Color code (clear)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1448	
7	Color code (white)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1447	
8	Color code (grey)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1473	
9	Color code (violet)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1472	
10	Color code (blue)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1471	
11	Color code (green)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1470	
12	Color code (yellow)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1469	
13	Color code (orange)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1468	
14	Color code (red)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1467	
15	Color code (brown)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1466	
16	Color code (black)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/C1465	



No.	Raw Material Name	SGS. Tested Report (ppm.)						Report Number	Remark
		Cd	Pb	Hg	Cr <sup>+6</sup>	PBB	PBDE		
<b>I. Cement fixed resistor : PRS type</b>									
1	Ceramic case	ND.	92	ND.	ND.	NA.	NA.	SHR08050830711001, CE/2008/B2802	
2	Tin plated copper wire	ND.	ND.	ND.	ND.	NA.	NA.	1568376	
3	Resistance wire (CN49)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/44186	
4	Resistance wire (Ni80)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/44185	
5	Silicone cement	ND.	ND.	ND.	ND.	ND.	ND.	CE/2009/11532	
6	Capped ceramic rod	ND.	27	ND.	ND.	NA.	NA.	SH8050547/CHEM	Impurity
7	Bracket	ND.	104	ND.	ND.	NA.	NA.	CE/2009/21814	Impurity
<b>J. Cement fixed resistor : PRT type</b>									
1	Ceramic case	ND.	92	ND.	ND.	NA.	NA.	SHR08050830711001, CE/2008/B2802	
2	Terminal	ND.	ND.	ND.	ND.	NA.	NA.	CE/2009/21813	
3	Resistance wire (CN49)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/44186	
4	Resistance wire (Ni80)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2008/44185	
5	Silicone cement	ND.	ND.	ND.	ND.	ND.	ND.	CE/2009/11532	
6	Capped ceramic rod	ND.	27	ND.	ND.	ND.	ND.	SH8050547/CHEM	Impurity
7	Bracket	ND.	104	ND.	ND.	NA.	NA.	CE/2009/21814	Impurity

No.	Raw Material Name	SGS. Tested Report (ppm.)						Report Number	Remark
		Cd	Pb	Hg	Cr <sup>+6</sup>	PBB	PBDE		
<b>K. Cement fixed resistor : FTR type</b>									
1	Ceramic case	ND.	92	ND.	ND.	NA.	NA.	SHR08050830711001, CE/2008/B2802	
2	Tin plated copper wire	ND.	ND.	ND.	ND.	NA.	NA.	1568376	
3	Resistance wire (CN49)	ND.	ND.	ND.	ND.	NA.	NA.	CE/2008/44186	
4	Resistance wire (Ni80)	ND.	ND.	ND.	ND.	NA.	NA.	CE/2008/44185	
5	Silicone cement	ND.	ND.	ND.	ND.	ND.	ND.	CE/2009/11532	
6	Capped ceramic rod	ND.	27	ND.	ND.	ND.	ND.	SH8050547/CHEM	Impurity
7	Thermal fuse	ND.	ND.	ND.	ND.	ND.	ND.	EC409006101-EC409006110	
<b>L. Cement fixed resistor : TMOR type</b>									
1	Capped ceramic rod	ND.	27	ND.	ND.	ND.	ND.	SH8050547/CHEM	Impurity
2	Terminal	ND.	104	ND.	ND.	NA.	NA.	CE/2009/21814	
3	Silicon paint (SPC P-660)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2009/26099	

## VIII. Halogen

### Specifications and Standards:

Several standards bodies that have worked to define “halogen-free” are listed below:

- **JPCA** (Japan Electronics Packaging and Circuits Association) JPCA-ES-01-1999 defines criteria and method for “halogen-free”
  - Br < 0.09wt% (900ppm)
  - Cl < 0.09wt% (900ppm)
- **IEC** (International Electrotechnical Commission) Finalized requirements of IEC 61249-2-21:
  - Br < 0.09wt% (900 ppm.)
  - Cl < 0.09wt% (900 ppm.)
  - Total halogens (Br and Cl) <0.15 wt% (1,500 ppm.)
- **IPC - 4101B** has adopted the IEC definition of halogen-free
  - Br < 0.09wt% (900 ppm.)
  - Cl < 0.09wt% (900 ppm.)
  - Total halogens (Br and Cl) <0.15 wt% (1,500 ppm.)

**Note:** fluorine, iodine, and astatine (other Group VIIA halogens) are not restricted in the industry definition of “halogen-free.”

## Halogen Analysis Result

No.	Product Name	Chlorine (Cl)		Bromine (Br)		Report Number
		Limit (ppm.)	Result (ppm.)	Limit (ppm.)	Result (ppm.)	
1	Carbon Film Fixed Resistor	900	ND.	900	ND.	TH-123743
2	Metal Film Fixed Resistor	900	ND.	900	ND.	TH-123744
3	Metal Oxide Film Fixed Resistor	900	ND.	900	ND.	TH-123742
4	Metal Glaze Film Fixed Resistor	900	ND.	900	ND.	TH-124231
5	Fusible Film Fixed Resistor	900	ND.	900	ND.	TH-123232
6	Wire Wound Fixed Resistor	900	ND.	900	ND.	TH-123253
7	Chip Fixed Resistor	900	ND.	900	ND.	TH-122160

## Halogen free of raw material

### A. Chip fixed resistor

No.	Raw Material Name	Chlorine (Cl)		Bromine (Br)		Report Number
		Limit (ppm.)	Result (ppm.)	Limit (ppm.)	Result (ppm.)	
1	Alumina substrate	900	ND.	900	ND.	CE/2008/52068
2	Tin plating	900	ND.	900	ND.	CE/2008/17987
3	Resistive paste	900	ND.	900	ND.	CE/2008/54960A
4	Dielectric paste (G1)	900	ND.	900	ND.	CE/2008/82448
5	Dielectric paste (G2)	900	ND.	900	ND.	CE/2008/91719
6	Nickel plating	900	ND.	900	ND.	CE/2008/30989
7	Marking	900	ND.	900	ND.	CE/2007/73523

## Halogen free of raw material

### B. Carbon film resistor

No.	Raw Material Name	Chlorine (Cl)		Bromine (Br)		Report Number
		Limit (ppm.)	Result (ppm.)	Limit (ppm.)	Result (ppm.)	
1	Base paint	900	522	900	N.D.	CE/2008/37699
2	Base paint	900	N.D.	900	N.D.	CE/2007/B3795
3	Color code (white & clear)	900	166	900	N.D.	CE/2008/14462
4	Color code (violet)	900	N.D.	900	N.D.	CE/2008/14460
5	Color code (blue)	900	631	900	N.D.	CE/2008/47021
6	Color code (green)	900	262	900	N.D.	CE/2008/37701
7	Color code (yellow)	900	268	900	N.D.	CE/2008/43438
8	Color code (orange)	900	174	900	N.D.	CE/2008/47020
9	Color code (red)	900	254	900	N.D.	CE/2008/43440
10	Color code (brown)	900	522	900	N.D.	CE/2008/37699
11	Color code (black)	900	382	900	N.D.	CE/2008/14452
12						

## Halogen free of raw material

### C. Metal film resistor

No.	Raw Material Name	Chlorine (Cl)		Bromine (Br)		Report Number
		Limit (ppm.)	Result (ppm.)	Limit (ppm.)	Result (ppm.)	
1	Base paint	900	631	900	N.D.	CE/2008/47021
2	Color code (white & clear)	900	166	900	N.D.	CE/2008/14462
3	Color code (violet)	900	N.D.	900	N.D.	CE/2008/14460
4	Color code (blue)	900	631	900	N.D.	CE/2008/47021
5	Color code (green)	900	262	900	N.D.	CE/2008/37701
6	Color code (yellow)	900	268	900	N.D.	CE/2008/43438
7	Color code (orange)	900	174	900	N.D.	CE/2008/47020
8	Color code (red)	900	254	900	N.D.	CE/2008/43440
9	Color code (brown)	900	522	900	N.D.	CE/2008/37699
10	Color code (black)	900	382	900	N.D.	CE/2008/14452
11						
12						

## Halogen free of raw material

### D. Metal oxide film resistor

No.	Raw Material Name	Chlorine (Cl)		Bromine (Br)		Report Number
		Limit (ppm.)	Result (ppm.)	Limit (ppm.)	Result (ppm.)	
1	Base paint	900	N.D.	900	N.D.	CE/2007/B3795
2	Color code (white & clear)	900	166	900	N.D.	CE/2008/14462
3	Color code (violet)	900	N.D.	900	N.D.	CE/2008/14460
4	Color code (blue)	900	631	900	N.D.	CE/2008/47021
5	Color code (green)	900	262	900	N.D.	CE/2008/37701
6	Color code (yellow)	900	268	900	N.D.	CE/2008/43438
7	Color code (orange)	900	174	900	N.D.	CE/2008/47020
8	Color code (red)	900	254	900	N.D.	CE/2008/43440
9	Color code (brown)	900	522	900	N.D.	CE/2008/37699
10	Color code (black)	900	382	900	N.D.	CE/2008/14452
11						
12						



## Halogen free of raw material

### E. Metal glaze film resistor

No.	Raw Material Name	Chlorine (Cl)		Bromine (Br)		Report Number
		Limit (ppm.)	Result (ppm.)	Limit (ppm.)	Result (ppm.)	
1	Base paint	900	N.D.	900	N.D.	CE/2007/B3795
2	Base paint	900	631	900	N.D.	CE/2008/47021
3	Resistive layer	900	634	900	N.D.	SH8028085/CHEM
4	Color code (white & clear)	900	166	900	N.D.	CE/2008/14462
5	Color code (violet)	900	N.D.	900	N.D.	CE/2008/14460
6	Color code (blue)	900	631	900	N.D.	CE/2008/47021
7	Color code (green)	900	262	900	N.D.	CE/2008/37701
8	Color code (yellow)	900	268	900	N.D.	CE/2008/43438
9	Color code (orange)	900	174	900	N.D.	CE/2008/47020
10	Color code (red)	900	254	900	N.D.	CE/2008/43440
11	Color code (brown)	900	522	900	N.D.	CE/2008/37699
12	Color code (black)	900	382	900	N.D.	CE/2008/14452

## Halogen free of raw material

### F. Fusible film resistor

No.	Raw Material Name	Chlorine (Cl)		Bromine (Br)		Report Number
		Limit (ppm.)	Result (ppm.)	Limit (ppm.)	Result (ppm.)	
1	Base paint	900	N.D.	900	N.D.	CE/2007/B3795
2	Color code (white & clear)	900	166	900	N.D.	CE/2008/14462
3	Color code (violet)	900	N.D.	900	N.D.	CE/2008/14460
4	Color code (blue)	900	631	900	N.D.	CE/2008/47021
5	Color code (green)	900	262	900	N.D.	CE/2008/37701
6	Color code (yellow)	900	268	900	N.D.	CE/2008/43438
7	Color code (orange)	900	174	900	N.D.	CE/2008/47020
8	Color code (red)	900	254	900	N.D.	CE/2008/43440
9	Color code (brown)	900	522	900	N.D.	CE/2008/37699
10	Color code (black)	900	382	900	N.D.	CE/2008/14452
11						
12						

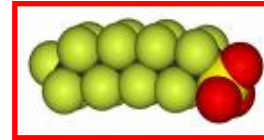
## Halogen free of raw material

### G. Wire wound resistor

No.	Raw Material Name	Chlorine (Cl)		Bromine (Br)		Report Number
		Limit (ppm.)	Result (ppm.)	Limit (ppm.)	Result (ppm.)	
1	Base paint	900	N.D.	900	N.D.	CE/2007/B3795
2	Color code (white & clear)	900	166	900	N.D.	CE/2008/14462
3	Color code (violet)	900	N.D.	900	N.D.	CE/2008/14460
4	Color code (blue)	900	631	900	N.D.	CE/2008/47021
5	Color code (green)	900	262	900	N.D.	CE/2008/37701
6	Color code (yellow)	900	268	900	N.D.	CE/2008/43438
7	Color code (orange)	900	174	900	N.D.	CE/2008/47020
8	Color code (red)	900	254	900	N.D.	CE/2008/43440
9	Color code (brown)	900	522	900	N.D.	CE/2008/37699
10	Color code (black)	900	382	900	N.D.	CE/2008/14452
11						
12						

*IX. Perfluorooctane sulphonate (PFOS)*

**PFOS: Perfluorooctane sulfonate (C<sub>8</sub>F<sub>17</sub>SO<sub>3</sub><sup>-</sup>)**



**EU's Regulation: Directive 2006/122/EC**

**Allowable concentration:**

- PFOS in substance or preparation ≤ 50 ppm.
- PFOS in semi-article or article or part ≤ 1,000 ppm.

**PFOS compounds can be found in some impregnation agents for**

No.	PFOS Application	ROYALOHM status
1.	Textiles, paper, carpets, and leather	Not Applicable
2.	Wax, polishes, paints	Need to test the paints and polymeric materials
3.	Metal surfaces	Not Applicable
4.	Foam Extinguisher	Not Applicable
5.	Electroplating process	Not Applicable

## PFOS Analysis Result

No.	Product Name	PFOS Concentration Value		Report Number
		Limit (ppm.)	Result (ppm.)	
1	Carbon Film Fixed Resistor	1,000	ND.	BKKH08004984S1
2	Metal Film Fixed Resistor	1,000	ND.	BKKH08004983S1
3	Metal Oxide Film Fixed Resistor	1,000	ND.	BKKH08004986S1
4	Metal Glaze Film Fixed Resistor	1,000	ND.	BKKH08004985S1
5	Fusible Film Fixed Resistor	1,000	ND.	BKKH08004982S1
6	Wire Wound Fixed Resistor	1,000	ND.	BKKH08004132S1
7	Chip Fixed Resistor	1,000	ND.	BKKH08004131S1

## *X. REACH*

**REACH** 2006/121/EC

**R** Registration

**E** Evaluation

**A** Authorization and Restriction

**CH** Chemicals

European Union's Chemical Directive enforces Manufacturers or Importers who reside in Europe to be registered to European Union's agency

## REACH'S Objective

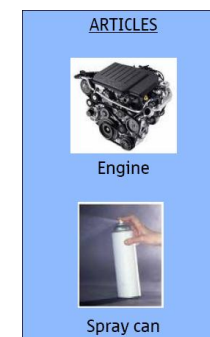
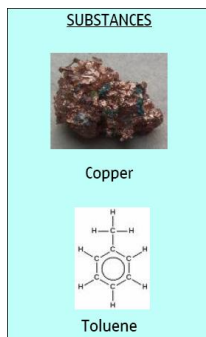
1. To reduce the risk from chemicals to humans and the Environment and to reduce animal testing
2. To encourage substitution of unsafe substances
3. To require authorization for use or restriction of substances of very high concern

## Registration

1. EU.: Effective Date: 2007.06.01 (27 countries in EU except  
Manufacturers and Importers

2. Pre-Registration: Manufacturers and Importers shall be  
pre-registered from June 1, 2008 to December 1, 2008  
Enforcement to Manufacturing distribution of

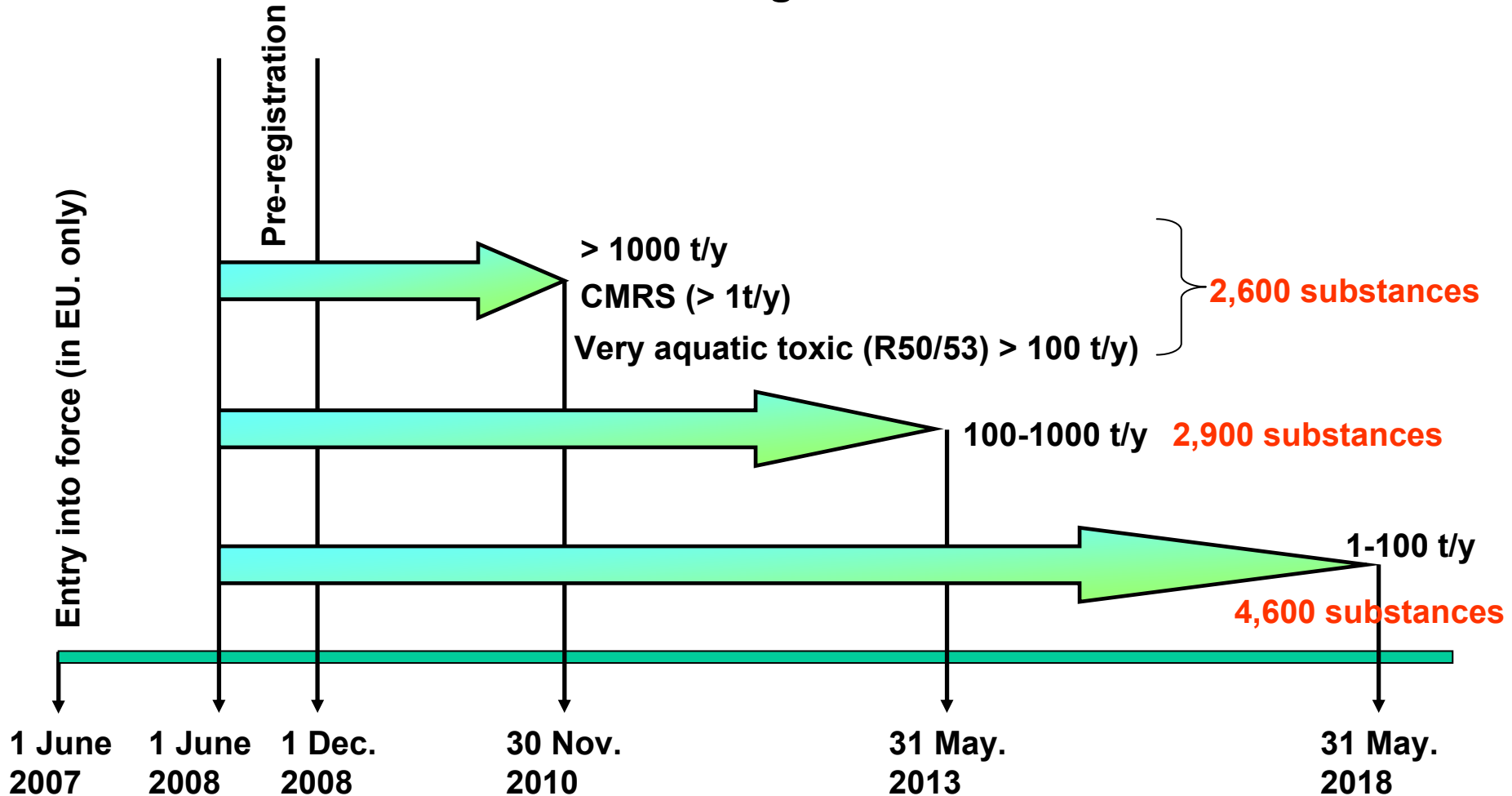
- **Substance** follow to REACH (Annex 11-17)
- **Substance** in Preparation
- **Substance** in Article





# Royal Electronic Factory (Thailand) Co., Ltd.

## When to register ?



Remark: CMRS = Carcinogens Mutagens Reprotoxics

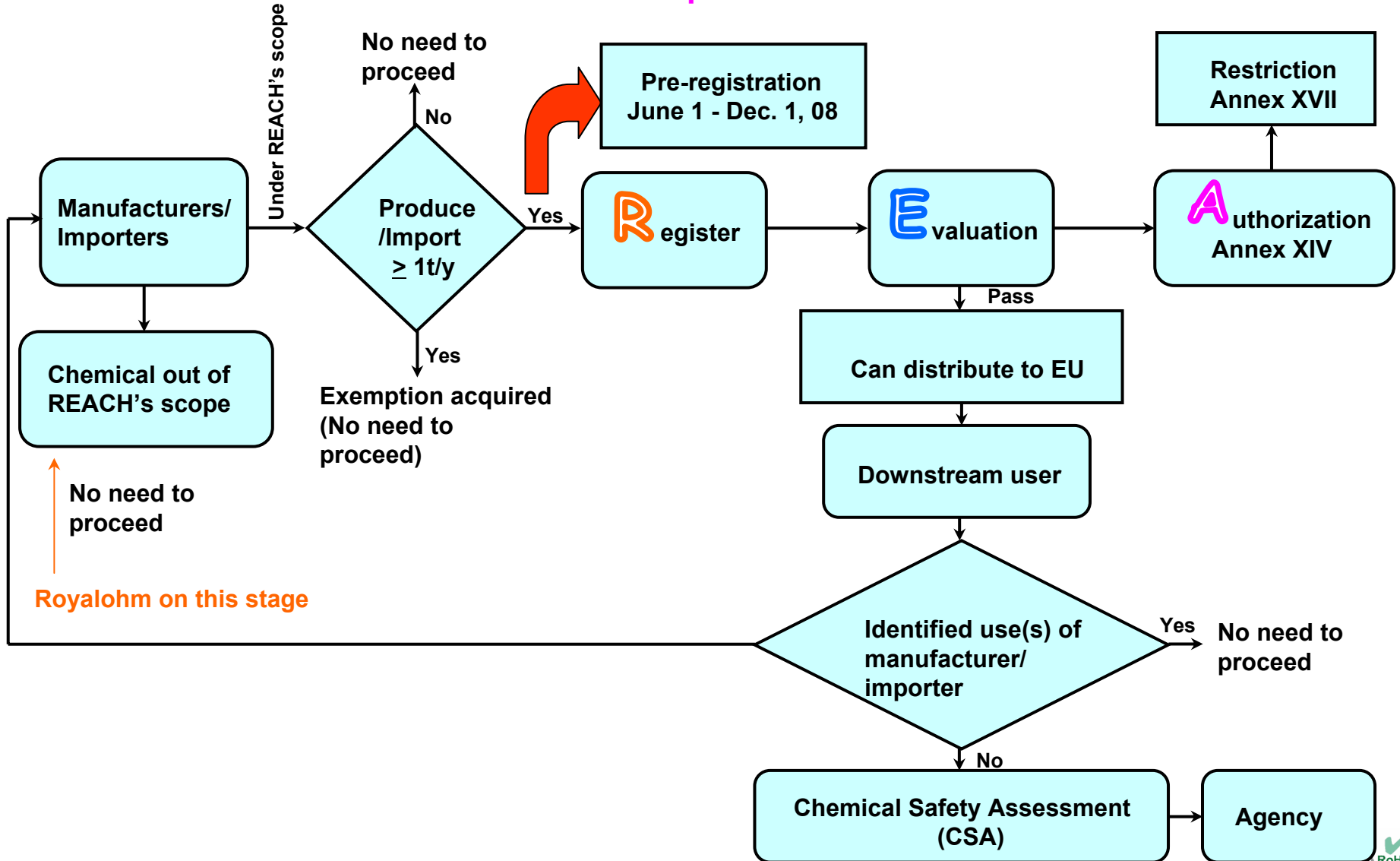
## Condition of Registration for Substance in Article

1. If substance in Article > 1 ton / manufacturer or importer / year and that substance in article can release to environment in normal function
2. Substance in Article > 1 ton / manufacturer or importer / year and  
EU. Agency suspects that articles are:
  - 2.1 substance in article can release and
  - 2.2 released substance may affect humans and the Environment

Remark: In normal function, ROYALOHM resistors don't release any substance to the Environment so there's no need to register in REACH's Directive

# Royal Electronic Factory (Thailand) Co., Ltd.

## Manufacture and Import the substance



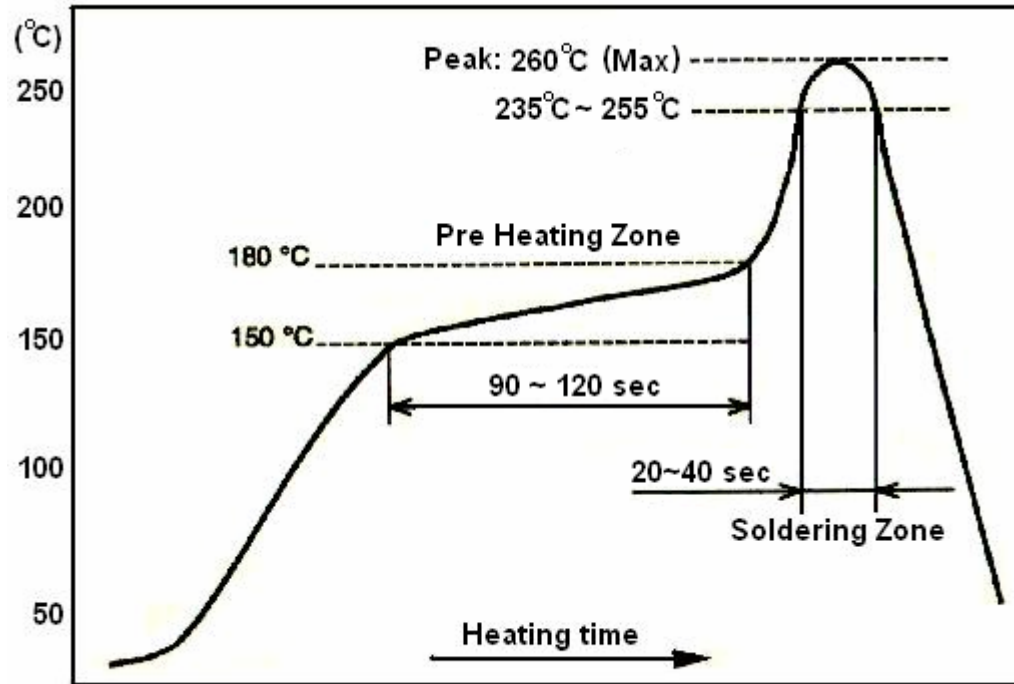
Royalohm on this stage

## XI. Solderability Profile

### Chip fixed resistor (SMD)

Characteristics	Limits	Soldering Condition
Soldering Temp. reference	Electrical characteristics shall be satisfied. Without distinct deformation in appearance. (95 % coverage Min.)	<p><u>A. Wave soldering condition:</u>            Pre-heat: 100 to 120 °C, 30 ± 5 sec.            Suggestion Soldering Temp.: 235 ~ 255 °C            Suggestion Soldering Time: 10 sec. (Max.)            Peak Temperature: 260 °C</p> <p><u>Reflow soldering condition:</u>            Pre-heat: 150 to 180 °C, 90 ~ 120 sec.            Suggestion Soldering Temp.: 235 ~ 255 °C            Suggestion Soldering Time: 20 ~ 40 sec.            Peak Temperature: 260 °C</p> <p><u>Hand soldering condition:</u>            Hand soldering Bit temperature: 300 °C            Dwell time in solder: 5 sec.</p>
Solderability	95 % coverage Min.	Test temperature of solder : 245+/-3°C Dwell time in solder : 3 ~ 5 seconds

## A. Recommended Reflow Soldering Curve:



Temperature profile for avaluation

## B. Recommended Wave Soldering Curve:

Pre-heat: 100 to 120 °C, 30 ± 5 sec.

Temperature: 235 - 255 °C, 10 sec. (Max)

## *Coated Resistors / Cement Resistors (Lead Free) TMD*

Characteristics	Limits	Soldering Condition
Soldering Temp. reference	Electrical characteristics shall be satisfied. Without distinct deformation in appearance. (95 % coverage Min.)	<p>The leads immersed into solder bath to 3.2 to 4.8 mm. from the body. Permanent resistance change shall be checked.</p> <p><u>Wave soldering condition:</u> Pre-heat: 100 to 105 °C, 30 ± 5 sec. Temperature: 245 +10/-0°C, 5 +1/-0sec.</p> <p><u>Hand soldering condition:</u> Hand soldering Bit temperature: 380 ± 10°C Dwell time in solder: 3 +1/-0sec.</p>
Solderability	95 % coverage Min.	<p>Test temperature of solder: 235~260 °C Dwell time in solder: 3 ~ 5 seconds</p>