

Environmental Related Substances Management

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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” hereby guarantees that we conform to supply parts as per RoHS (DIRECTIVE 2011/65/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast)) including attachments, packages, and all the matters delivered with the materials that are delivered to your company or your subsidiary/associated companies directly or via third parties.

ROYALOHM 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

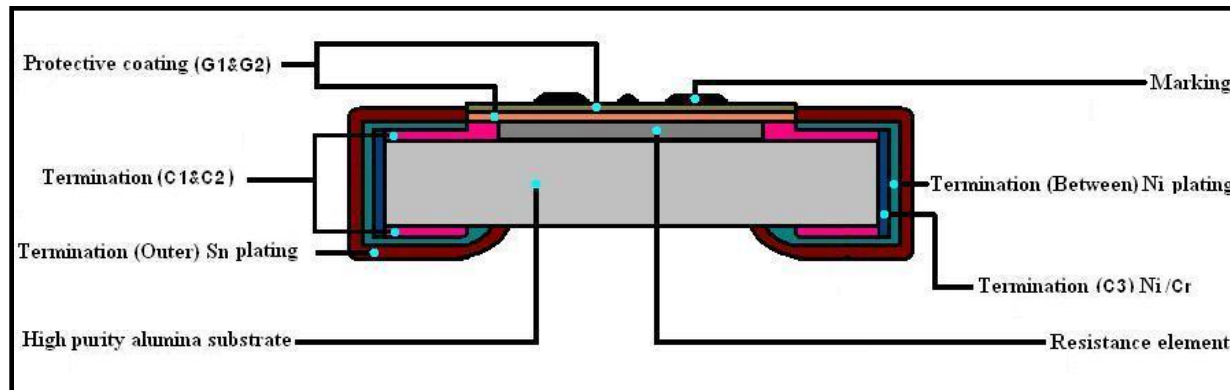
Step	Item	Detail	Due Date	Remark
Step 1	Prototype test	Send samples of overcoat Pb-free to SGS Thailand - third party laboratory.	May 14 th , 2005	Result : Chip Resistor is RoHS compliant but does not meet required specs.
Step 2	Continuously look for new Pb-free G2 & marking paste (5%) for chip resistor	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 th , 2005	Done (May 30, 2005)
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 st , 2005	

The development of Pb free chip resistor

Step	Item	Due Date	Remark
Step 4	Pre-launch for Overcoat Pb-free product	Jan.1 st , 2006	
Step 5	Mass production	April.1 st , 2006	Overcoat Pb free available now.
Step 6	Whole product Pb-free	Jan. 2014	

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

Overcoat Pb-free type

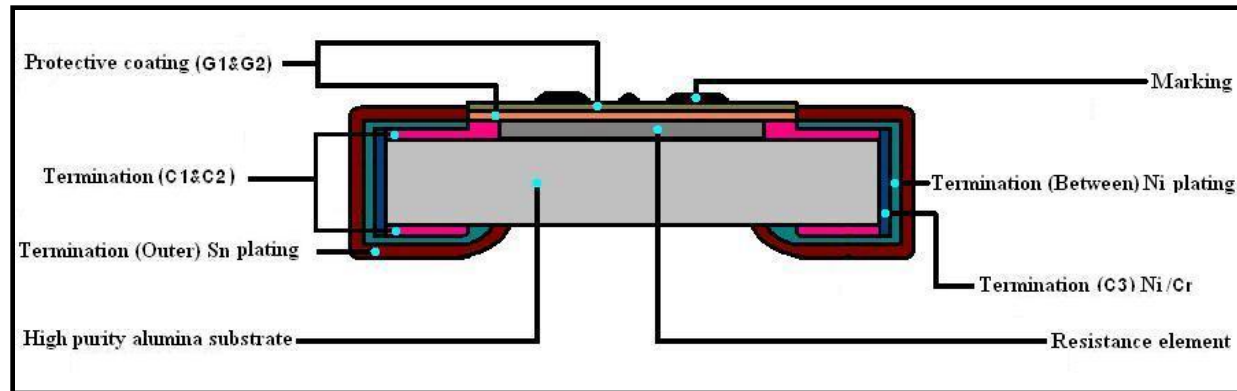


Overcoat Pb free :

- ◆ 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

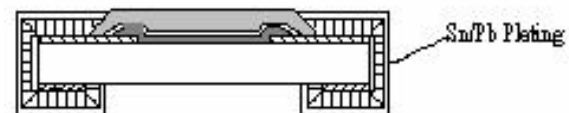
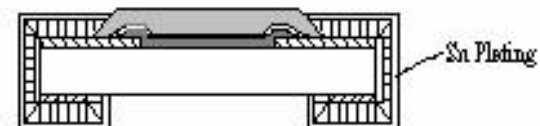
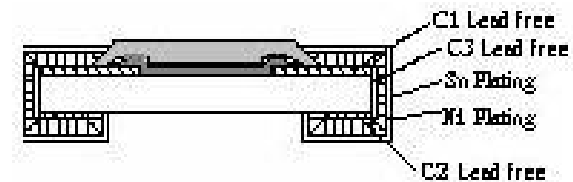
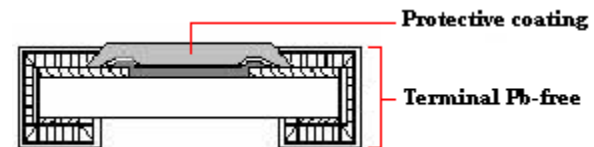
- * Terminal Pb-free for chip resistor
(included C1, C2, C3 and electroplating)

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 1st July 2006, new electrical and electronic equipment placed in the market shall not contain:

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

For now, our chip fixed resistor series and metal glaze resistor series (MGR.) are contained lead substance in their glass portion. However Pb in glass of electronic component is considered included in the exemption No. 7(c)-I of RoHS directive.

III. RoHS exemptions for materials and components

Revised RoHS Annex

Entered force September 24, 2010, corrected September 29, 2010

No.	Description	Expiry Date
Lead and lead compounds		
5(a)	Lead in glass of cathode ray tube	
5(b)	Lead in glass fluorescent tubes not exceeding 0.2% by weight	
6(a)	Lead as an alloying element in steel for machining purposes and in galvanized steel containing up to 0.35% lead by weight	
6(b)	Lead as alloying element in aluminium containing up to 0.4% lead by weight	
6(c)	Copper alloy containing up to 4% lead by weight	
7(a)	Lead in high melting temperature type solder	
7(b)	Lead in solders for servers, storage and storage array system, network infrastructure equipment and network management for telecommunications	
7(c)-I	Electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors or in a glass or ceramic matrix compound	
7(c)-II	Lead in dielectric ceramic in capacitors for a rated voltage of 125 V AC or 250 V DC or higher	
7(c)-III	Lead in dielectric ceramic in capacitors for a rate voltage of less than 125 V AC or 250 V DC	Expires on Jan. 1, 2013 and after that date may be used in spare parts for EEE placed on the market before Jan 1, 2013

IV. China RoHS

China RoHS MII (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

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

V. 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**

VI. Tested report number

Royal Ohm (Product)

A. Summary of tested report for chip fixed resistor and chip array fixed resistor series (over-coated Pb free)


No.	Product Type	SGS. Tested Report (ppm.)								Report Number
		Cd	Pb	Hg	Cr ⁺⁶	PBB	PBDE	Br	Cl	
1	Chip resistor and chip array resistor series	ND.	ND.	ND.	ND.	ND.	ND.	ND.	ND.	2899386 2899039

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 ⁺⁶	PBB	PBDE	Br	Cl	
1	Carbon film resistor	ND.	12	ND.	ND.	ND.	ND.	ND.	53	2896918 2898487
2	Metal film resistor	ND.	10	ND.	ND.	ND.	ND.	ND.	66	2897090 2898485
3	Metal oxide film resistor	ND.	ND.	ND.	ND.	ND.	ND.	ND.	81	2896902 2898484
4	Fusible resistor	ND.	13	ND.	ND.	ND.	ND.	ND.	ND.	2897087 2898481
5	Metal glaze film resistor	ND.	ND.	ND.	ND.	ND.	ND.	ND.	ND.	2896904 2898486
6	Wire wound resistor	ND.	26	ND.	ND.	ND.	ND.	ND.	104	2896885 2898480

Remark : 1. ND. = Not Detected

2. 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 ⁺⁶	PBB	PBDE		
Chip fixed resistor									
1	Alumina substrate	ND.	ND.	ND.	ND.	ND.	ND.	CTSSA/04547/15 CE/2015/A3268 CE/2014/42507	
2	Electrode paste C1	ND.	ND.	ND.	ND.	ND.	ND.	SHAEC1512636803	
3	Electrode paste C2	ND.	ND.	ND.	ND.	ND.	ND.	SCL01H088515005	Impurity
4	Electrode past C3	ND.	ND.	ND.	ND.	ND.	ND.	NGBEC1502338201 TSNEC1500213314	
5	Resistive paste R-2000 SRS-1 R-2000 SRS-2 R-2000 SRS-3	ND. ND. ND.	30,700 125,000 226,000	ND. ND. ND.	ND. ND. ND.	ND. ND. ND.	ND. ND. ND.	CE/2015/53516 CE/2015/53513 CE/2015/53510	Exemption : Lead in glass of electronic components
6	Protective paste G1	ND.	ND.	ND.	ND.	ND.	ND.	CANEC1518027401	
7	Protective paste G2	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/64996	
8	Nickel plating	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/A2654B	
9	Tin plating	ND.	18.6	ND.	NA.	ND.	ND.	CE/2015/A3402	
10	Marking	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/75405	



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 ⁺⁶	PBB	PBDE		
A. Carbon film fixed resistor (coated fixed resistor)									
1	CFR. ceramic rod	ND.	13	ND.	ND.	ND.	ND.	CANEC1600584917	
2	Cap	ND.	ND.	ND.	NA.	ND.	ND.	CANEC1600584901	
3	Tin plated copper wire	ND.	ND.	ND.	NA.	NA	NA	2976670	
4	Epoxy paint (Z-1874)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/A0202	
5	Color code (clear)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50440	
6	Color code (white)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50439	
7	Color code (gray)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50438	
8	Color code (violet)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50437	
9	Color code (blue)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50436	
10	Color code (green)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50435	
11	Color code (yellow)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50527	
12	Color code (orange)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50433	
13	Color code (red)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50432	
14	Color code (brown)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50431	
15	Color code (black)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50427	

No.	Raw Material Name	SGS. Tested Report (ppm.)						Report Number	Remark
		Cd	Pb	Hg	Cr ⁺⁶	PBB	PBDE		
B. Metal film fixed resistor (coated fixed resistor)									
1	MFR. capped ceramic rod	ND.	16	ND.	ND.	NA.	NA.	CANEC1420783601	
2	Tin plated copper wire	ND.	ND.	ND.	NA.	NA	NA	2976670	
3	Epoxy paint (Z-1992)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/A0204	
4	Color code (clear)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50440	
5	Color code (white)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50439	
6	Color code (grey)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50438	
7	Color code (violet)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50437	
8	Color code (blue)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50436	
9	Color code (green)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50435	
10	Color code (yellow)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50527	
11	Color code (orange)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50433	
12	Color code (red)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50432	
13	Color code (brown)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50431	
14	Color code (black)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50427	

No.	Raw Material Name	SGS. Tested Report (ppm.)						Report Number	Remark
		Cd	Pb	Hg	Cr ⁺⁶	PBB	PBDE		
C. Metal oxide film fixed resistor (coated fixed resistor)									
1	MOR. capped ceramic rod	ND.	ND	ND.	ND.	NA.	NA.	ECL01H010882004	
2	Tin plated copper wire	ND.	ND.	ND.	NA.	NA	NA	2976670	
3	Silicon paint (SPC P-660)	ND.	8.23	ND.	ND.	ND.	ND.	CE/2015/73747	
4	Color code (clear)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50440	
5	Color code (white)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50439	
6	Color code (grey)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50438	
7	Color code (violet)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50437	
8	Color code (blue)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50436	
9	Color code (green)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50435	
10	Color code (yellow)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50527	
11	Color code (orange)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50433	
12	Color code (red)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50432	
13	Color code (brown)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50431	
14	Color code (black)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50427	

No.	Raw Material Name	SGS. Tested Report (ppm.)						Report Number	Remark
		Cd	Pb	Hg	Cr ⁺⁶	PBB	PBDE		
D. Fusible film fixed resistor (coated fixed resistor)									
1	Capped ceramic rod	ND.	ND.	ND.	ND.	ND.	ND.	ECL01H010882001	
2	Tin plated copper wire	ND.	ND.	ND.	NA.	NA	NA	2976670	
3	Silicon paint (SPC P-660)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/73746	
4	Color code (clear)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50440	
5	Color code (white)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50439	
6	Color code (grey)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50438	
7	Color code (violet)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50437	
8	Color code (blue)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50436	
9	Color code (green)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50435	
10	Color code (yellow)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50527	
11	Color code (orange)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50433	
12	Color code (red)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50432	
13	Color code (brown)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50431	
14	Color code (black)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50427	

No.	Raw Material Name	SGS. Tested Report (ppm.)						Report Number	Remark
		Cd	Pb	Hg	Cr ⁺⁶	PBB	PBDE		
E. Metal glaze film fixed resistor (coated fixed resistor)									
1	MGR. capped ceramic rod	ND	930	ND.	ND.	NA.	NA.	ECL01H010882003	Exemption : Lead in glass of electronic component
2	Tin plated copper wire	ND.	ND.	ND.	NA.	NA	NA	2976670	
3	Epoxy paint (Z-2213)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/A0204	
4	Color code (clear)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50440	
5	Color code (white)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50439	
6	Color code (grey)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50438	
7	Color code (violet)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50437	
8	Color code (blue)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50436	
9	Color code (green)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50435	
10	Color code (yellow)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50527	
11	Color code (orange)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50433	
12	Color code (red)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50432	
13	Color code (brown)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50431	
14	Color code (black)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50427	

No.	Raw Material Name	SGS. Tested Report (ppm.)						Report Number	Remark
		Cd	Pb	Hg	Cr ⁺ ₆	PBB	PBDE		
F. Cement fixed resistor : PRM, PRW type									
1	Ceramic case	ND.	ND	ND.	ND.	ND.	ND.	ECL01H010882008	impurity
2	Ceramic core	ND.	13	ND.	ND.	ND.	ND.	ECL01H032715001	
3	End cap	ND.	ND.	ND.	NA.	NA.	NA.	ECL01H010882009	
4	Tin plated copper wire	ND.	ND.	ND.	NA.	NA.	NA.	CRSSA/00006-1/16	
5	Resistance wire (CN49)	ND.	ND.	ND.	NA.	ND.	ND.	SHAEC1505632801	
6	Resistance wire (Ni80)	ND.	ND.	ND.	NA.	ND.	ND.	SHAEC1502632803	
7	Silicone cement	ND.	ND.	ND.	ND.	ND.	ND.	CE/2014/C1602	
G. Cement fixed resistor : PRV, PRZA type									
1	Ceramic case	ND.	ND.	ND.	ND.	ND.	ND.	ECL01H010882008	
2	Ceramic core	ND.	13	ND.	ND.	ND.	ND.	ECL01H032715001	
3	End cap	ND.	ND.	ND.	NA.	NA.	NA.	SHAEC1404269510	
4	Terminal	ND.	ND.	ND.	NA.	NA.	NA.	ECL01H010882010	
5	Resistance wire (CN49)	ND.	ND.	ND.	NA.	ND.	ND.	SHAEC1505632801	
6	Resistance wire (Ni80)	ND.	ND.	ND.	NA.	ND.	ND.	SHAEC1502632803	
7	Silicone cement	ND.	ND.	ND.	ND.	ND.	ND.	CE/2014/C1602	

No.	Raw Material Name	SGS. Tested Report (ppm.)						Report Number	Remark
		Cd	Pb	Hg	Cr ⁺⁶	PBB	PBDE		
H. Cement fixed resistor : wire wound type									
1	Ceramic core	ND.	13	ND.	ND.	ND.	ND.	ECL01H032715001	
2	End cap	ND.	ND.	ND.	NA.	NA.	NA.	ECL01H010882009	
3	Tin plated copper wire	ND.	ND.	ND.	NA.	NA.	NA.	CTSSA/00006-1/15	
4	Silicon paint (Silox CE-77, SPC-P660)	ND. ND.	ND. ND.	ND. ND.	ND. ND.	ND. ND.	ND. ND.	CE/2015/80920 CE/2015/73744	
5	Resistance wire (CN49)	ND.	ND.	ND.	NA.	ND.	ND.	SHAEC1505632801	
6	Resistance wire (Ni80)	ND.	ND.	ND.	NA.	ND.	ND.	SHAEC1502632803	
7	Color code (clear)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50440	
8	Color code (white)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50439	
9	Color code (grey)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50438	
10	Color code (violet)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50437	
11	Color code (blue)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50436	
12	Color code (green)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50435	
13	Color code (yellow)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50527	
14	Color code (orange)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50433	
15	Color code (red)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50432	
16	Color code (brown)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50431	
17	Color code (black)	ND.	ND.	ND.	ND.	ND.	ND.	CE/2015/50427	



Royal Electronic Factory (Thailand) Co., Ltd.

No.	Raw Material Name	SGS. Tested Report (ppm.)						Report Number	Remark
		Cd	Pb	Hg	Cr ⁺⁶	PBB	PBDE		
I. Cement fixed resistor : PRS type									
1	Ceramic case	ND.	ND.	ND.	ND.	ND.	ND.	ECL01H010882008	Impurity
2	Tin plated copper wire	ND.	ND.	ND.	NA.	NA.	NA.	CTSSA/00006-1/15	
3	Resistance wire (CN49)	ND.	ND.	ND.	NA.	ND.	ND.	SHAEC1505632801	
4	Resistance wire (Ni80)	ND.	ND.	ND.	NA.	ND.	ND.	SHAEC1502632803	
5	Silicone cement	ND.	ND.	ND.	ND.	ND.	ND.	CE/2014/C1602	
6	Ceramic core	ND.	13	ND.	ND.	ND.	ND.	ECL01H032715001	
7	End cap	ND.	ND.	ND.	NA.	ND.	ND.	ECL01H010882009	
8	Bracket	ND. ND.	9.69 199	ND. ND.	NA. NA.	NA. NA.	NA. NA.	CE/2015/C6282 CE/2015/C6281	Impurity
J. Cement fixed resistor : PRT type									
1	Ceramic case	ND.	ND.	ND.	ND.	ND.	ND.	ECL01H010882008	Impurity
2	Terminal	ND.	ND.	ND.	NA.	NA.	NA.	ECL01H010882010	
3	Resistance wire (CN49)	ND.	ND.	ND.	NA.	ND.	ND.	SHAEC1505632801	
4	Resistance wire (Ni80)	ND.	ND.	ND.	NA.	ND.	ND.	SHAEC1502632803	
5	Silicone cement	ND.	ND.	ND.	ND.	ND.	ND.	CE/2014/C1602	
6	Ceramic core	ND.	13	ND.	ND.	ND.	ND.	ECL01H032715001	
7	End cap	ND.	ND.	ND.	NA.	ND.	ND.	ECL01H010882009	
8	Bracket	ND. ND.	9.69 199	ND. ND.	NA. NA.	NA. NA.	NA. NA.	CE/2015/C6282 CE/2015/C6281	Impurity

No.	Raw Material Name	SGS. Tested Report (ppm.)						Report Number	Remark
		Cd	Pb	Hg	Cr ⁺⁶	PBB	PBDE		
K. Cement fixed resistor : FTR type									
1	Ceramic case	ND.	16	ND.	ND.	NA.	NA.	ECL01H010882008	Impurity
2	Tin plated copper wire	ND.	ND	ND.	NA.	NA.	NA.	CTSSA/00006-1/15	
3	Resistance wire (CN49)	ND.	ND.	ND.	NA.	ND.	ND.	SHAEC1505632801	
4	Resistance wire (Ni80)	ND.	ND.	ND.	NA.	ND.	ND.	SHAEC1502632803	
5	Silicone cement	ND.	ND.	ND.	ND.	ND.	ND.	CE/2014/C1602	
6	Ceramic core	ND.	13	ND.	ND.	ND.	ND.	ECL01H032715001	
7	End cap	ND.	ND.	ND.	NA.	ND.	ND.	ECL01H010882009	
L. Cement fixed resistor : TMOR type									
1	MOR. capped ceramic rod	ND.	ND.	ND.	ND.	NA.	NA.	ECL01H010882004	
2	Terminal	ND.	ND.	ND.	NA.	NA.	NA.	ECL01H010882010	
3	Silicon paint (SPC P-660)	ND.	13	ND.	ND.	ND.	ND.	CE/2014/82345	

VII. 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 Free Implement Program

A. Finished Good Implement Program

Step	Item	Detail	Due Date	Remark
Step 1	Finished goods -Chip Resistor -Carbon Film Resistor -Metal Film Resistor -Metal Oxide Film Resistor -Fusible Film Resistor -Metal Glaze Film Resistor -Wire Wound Resistor	Send all of finished goods to test halogen at 3 rd party organization	March 2008	Result: All of finished goods not detected halogen

Halogen Free Implement Program

B. Chip Resistor's Raw Materials Implement Program





Step	Item	Detail	Due Date	Remark
Step 1	- Resistive paste - Protective paste G2 - Marking paste	Request halogen tested report from vendor	April 2008	
	- Primary Protective Coating (G1)	Request halogen tested report from vendor	August 2008	
Step 2	- Resistive paste	Received and reviewed tested report	June 2008	Result: Not detected halogen
	- Protective paste G2 - Marking	Received and reviewed tested report	May 2008	
	- Primary Protective Coating (G1)	Received and reviewed tested report	August 2008	Result: Not detected halogen

Halogen Free Implement Program

C. Coated Resistor's Raw Materials Implement Program

Step	Item	Detail	Due Date	Remark
Step 1	- Base paint - Color code paint	Request halogen tested report from vendor	April 2008	
Step 2	- Base paint - Color code paint	Received and reviewed tested report	May 2008	Result: Maximum allowable concentration not exceed the standard of -IPC 4101 -IEC 61249-2-21 -JPCA-ES01 2003

Halogen Free Schedule

Step	2008.03	2008.04	2008.05	2008.06	2008.07	2008.08	2008.09
Finished good halogen free							
Raw material							
- Color code halogen free							
-Base paint halogen free							
-Protective paste (G2)							
-Marking							
Resistive paste							
Protective paste (G1)							

Halogen Free Plan Conclude

No.	Item	Status
1.	Halogen free plan due date are September 2008	Completed (August 29, 2008)
2.	Chip resistors and their all of raw materials	Halogen free
3.	Coated resistors and their all of raw materials	Halogen free
4.	Cement resistors and their all of raw materials	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.	2647926
2	Metal Film Fixed Resistor	900	ND.	900	ND.	2647925
3	Metal Oxide Film Fixed Resistor	900	ND.	900	ND.	2647924
4	Metal Glaze Film Fixed Resistor	900	ND.	900	ND.	2647119
5	Fusible Film Fixed Resistor	900	ND.	900	ND.	2647118
6	Wire Wound Fixed Resistor	900	ND.	900	ND.	2647117
7	Chip Fixed Resistor	900	ND.	900	ND.	2647927

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.	CTSSA/04547/15 CE/2014/A5669 CE/2014/B0585A
2	Tin plating	900	ND.	900	ND.	CE/2014/B0182
3	Resistive paste	900	ND.	900	ND.	CE/2015/53517 CE/2015/53514
4	Dielectric paste (G1)	900	ND.	900	ND.	SCL01G060613003E
5	Dielectric paste (G2)	900	239	900	ND.	ECL01G003499001
6	Nickel plating	900	ND.	900	ND.	CE/2014/B1560
7	Marking	900	661	900	ND.	CE/2014/60347A

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	231	900	N.D.	CE/2014/A1478
2	Color code (white)	900	359	900	N.D.	CE/2015/50439
3	Color code (violet)	900	391	900	N.D.	CE/2015/50437
4	Color code (blue)	900	377	900	N.D.	CE/2015/50436
5	Color code (green)	900	328	900	N.D.	CE/2015/50435
6	Color code (yellow)	900	545	900	N.D.	CE/2015/50527
7	Color code (orange)	900	360	900	N.D.	CE/2015/50433
8	Color code (red)	900	374	900	N.D.	CE/2015/50432
9	Color code (brown)	900	350	900	N.D.	CE/2015/50431
10	Color code (black)	900	409	900	N.D.	CE/2015/50427

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	270	900	N.D.	CE/2014/A1476
2	Color code (white)	900	359	900	N.D.	CE/2015/50439
3	Color code (violet)	900	391	900	N.D.	CE/2015/50437
4	Color code (blue)	900	377	900	N.D.	CE/2015/50436
5	Color code (green)	900	328	900	N.D.	CE/2015/50435
6	Color code (yellow)	900	545	900	N.D.	CE/2015/50527
7	Color code (orange)	900	360	900	N.D.	CE/2015/50433
8	Color code (red)	900	374	900	N.D.	CE/2015/50432
9	Color code (brown)	900	350	900	N.D.	CE/2015/50431
10	Color code (black)	900	409	900	N.D.	CE/2015/50427

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/2014/82345
2	Color code (white)	900	359	900	N.D.	CE/2015/50439
3	Color code (violet)	900	391	900	N.D.	CE/2015/50437
4	Color code (blue)	900	377	900	N.D.	CE/2015/50436
5	Color code (green)	900	328	900	N.D.	CE/2015/50435
6	Color code (yellow)	900	545	900	N.D.	CE/2015/50527
7	Color code (orange)	900	360	900	N.D.	CE/2015/50433
8	Color code (red)	900	374	900	N.D.	CE/2015/50432
9	Color code (brown)	900	350	900	N.D.	CE/2015/50431
10	Color code (black)	900	409	900	N.D.	CE/2015/50427

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	270	900	N.D.	CE/2014/A1476
2	Base paint	900	N.D.	900	N.D.	CE/2014/82345
3	Color code (white)	900	359	900	N.D.	CE/2015/50439
4	Color code (violet)	900	391	900	N.D.	CE/2015/50437
5	Color code (blue)	900	377	900	N.D.	CE/2015/50436
6	Color code (green)	900	328	900	N.D.	CE/2015/50435
7	Color code (yellow)	900	545	900	N.D.	CE/2015/50527
8	Color code (orange)	900	360	900	N.D.	CE/2015/50433
9	Color code (red)	900	374	900	N.D.	CE/2015/50432
10	Color code (brown)	900	350	900	N.D.	CE/2015/50431
11	Color code (black)	900	409	900	N.D.	CE/2015/50427

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/2014/82344
2	Color code (white)	900	359	900	N.D.	CE/2015/50439
3	Color code (violet)	900	391	900	N.D.	CE/2015/50437
4	Color code (blue)	900	377	900	N.D.	CE/2015/50436
5	Color code (green)	900	328	900	N.D.	CE/2015/50435
6	Color code (yellow)	900	545	900	N.D.	CE/2015/50527
7	Color code (orange)	900	360	900	N.D.	CE/2015/50433
8	Color code (red)	900	374	900	N.D.	CE/2015/50432
9	Color code (brown)	900	350	900	N.D.	CE/2015/50431
10	Color code (black)	900	409	900	N.D.	CE/2015/50427

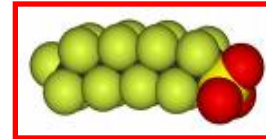
Halogen free of raw material

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/2014/82342
2	Color code (white)	900	359	900	N.D.	CE/2015/50439
3	Color code (violet)	900	391	900	N.D.	CE/2015/50437
4	Color code (blue)	900	377	900	N.D.	CE/2015/50436
5	Color code (green)	900	328	900	N.D.	CE/2015/50435
6	Color code (yellow)	900	545	900	N.D.	CE/2015/50527
7	Color code (orange)	900	360	900	N.D.	CE/2015/50433
8	Color code (red)	900	374	900	N.D.	CE/2015/50432
9	Color code (brown)	900	350	900	N.D.	CE/2015/50431
10	Color code (black)	900	409	900	N.D.	CE/2015/50427

VIII. Perfluorooctane sulphonate (PFOS)

PFOS: Perfluorooctane sulfonate ($C_8F_{17}SO_3^-$)



EU's Regulation: Directive 2006/122/EC

Allowable concentration:

- PFOS in substance or preparation ≤ 50 ppm.
- PFOS in semi-article or article or part $\leq 1,000$ 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 Free Implement Program

A. Finished Good Implement Program

Step	Item	Detail	Due Date	Remark
Step 1	Finished goods -Chip Resistor -Carbon Film Resistor -Metal Film Resistor -Metal Oxide Film Resistor -Fusible Film Resistor -Metal Glaze Film Resistor -Wire Wound Resistor	Send all of finished goods to test PFOS at 3 rd party organization	Jun. 2008	
Step 2	-Finished goods -Chip Resistor -Carbon Film Resistor -Metal Film Resistor -Metal Oxide Film Resistor -Fusible Film Resistor -Metal Glaze Film Resistor -Wire Wound Resistor	Received and reviewed tested report	Jul. 2008	Result: All of finished goods not detected PFOS

PFOS Free Implement Program

B. Chip Resistor's Raw Materials Implement Program

Step	Item	Detail	Due Date	Remark
Step 1	<ul style="list-style-type: none"> a. Resistive paste (R) b. Dielectric paste (G1) c. Dielectric paste (G2) d. Marking 	Request PFOS tested report from vendors	Aug. 2008	
Step 2	<ul style="list-style-type: none"> a. Resistive paste (R) b. Dielectric paste (G1) c. Dielectric paste (G2) d. Marking 	Received and reviewed tested report	Sept. 2008	

PFOS Free Implement Program

C. Coated Resistor's Raw Materials Implement Program

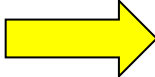
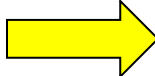
Step	Item	Detail	Due Date	Remark
Step 1	a. Base paint b. Color code paint	Request PFOS tested report from vendors	Aug. 2008	
Step 2	a. Base paint b. Color code paint	Received and reviewed tested report	Sept. 2008	

PFOS Free Implement Program

D. Cement Resistor's Raw Materials Implement Program

Step	Item	Detail	Due Date	Remark
Step 1	<ul style="list-style-type: none"> a. Marking ink b. Plastic Base of ALU c. Plastic of CAR wire 	Request PFOS tested report from vendors	Aug. 2008	
Step 2	<ul style="list-style-type: none"> a. Marking ink b. Plastic Base of ALU c. Plastic of CAR wire 	Received and reviewed tested report	Sept. 2008	

PFOS Free Schedule

Step	Year 2008						
	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Finished good PFOS free							
Raw material							
a. Resistive paste (R)							
b. Dielectric paste (G1)							
c. Dielectric paste (G2)							
d. Marking							
e. Base paint							
f. Color code paint							
g. Marking ink							
h. Plastic Base of ALU							
i. Plastic of CAR wire							

PFOS Free Plan Conclude

No.	Item	Status
1.	PFOS free plan due date are September 2008	Completed
2.	Chip resistors and their all of raw materials	PFOS free
3.	Coated resistors and their all of raw materials	PFOS free
4.	Cement resistors and their all of raw materials	PFOS free

PFOS Analysis Result

No.	Product Name	PFOS Concentration Value		Report Number
		Limit (ppm.)	Result (ppm.)	
1	Carbon Film Fixed Resistor	1,000	ND.	2751856
2	Metal Film Fixed Resistor	1,000	ND.	2751855
3	Metal Oxide Film Fixed Resistor	1,000	ND.	2751852
4	Metal Glaze Film Fixed Resistor	1,000	ND.	2751853
5	Fusible Film Fixed Resistor	1,000	ND.	2751854
6	Wire Wound Fixed Resistor	1,000	ND.	2751851
7	Chip Fixed Resistor	1,000	ND.	2751857

IX. 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

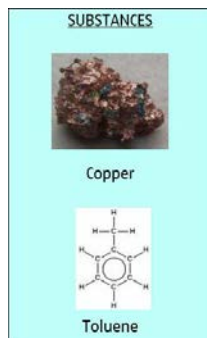
- 1. To reduce the risk from chemicals to humans and the Environment and to reduce animal testing**
- 2. To encourage substitution of unsafe substances**
- 3. To require authorization for use or restriction of substances of very high concern**

R Registration

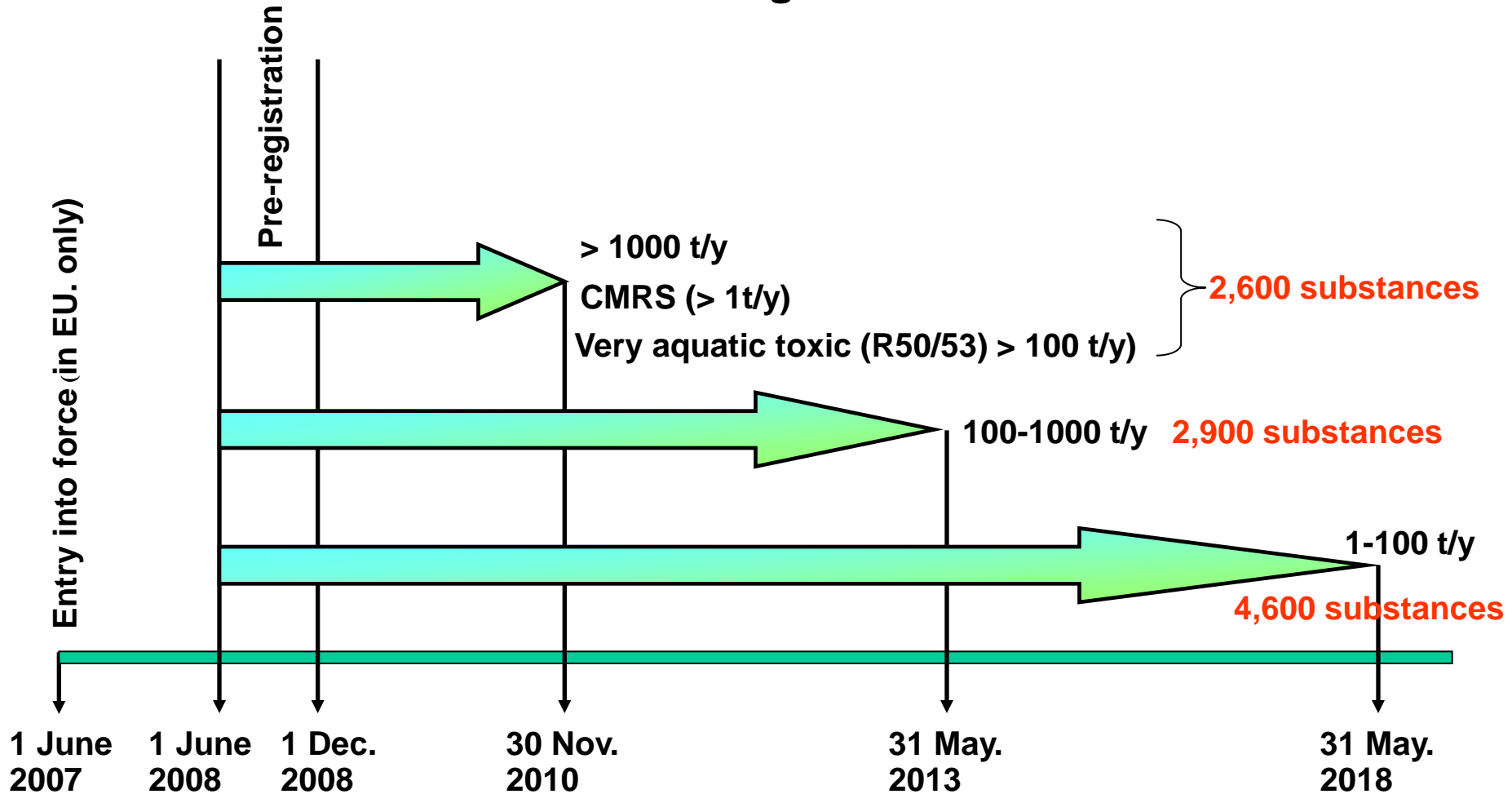
1. EU.: Effective Date: 2007.06.01 (27 countries in EU except Manufacturers and Importers)

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**



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

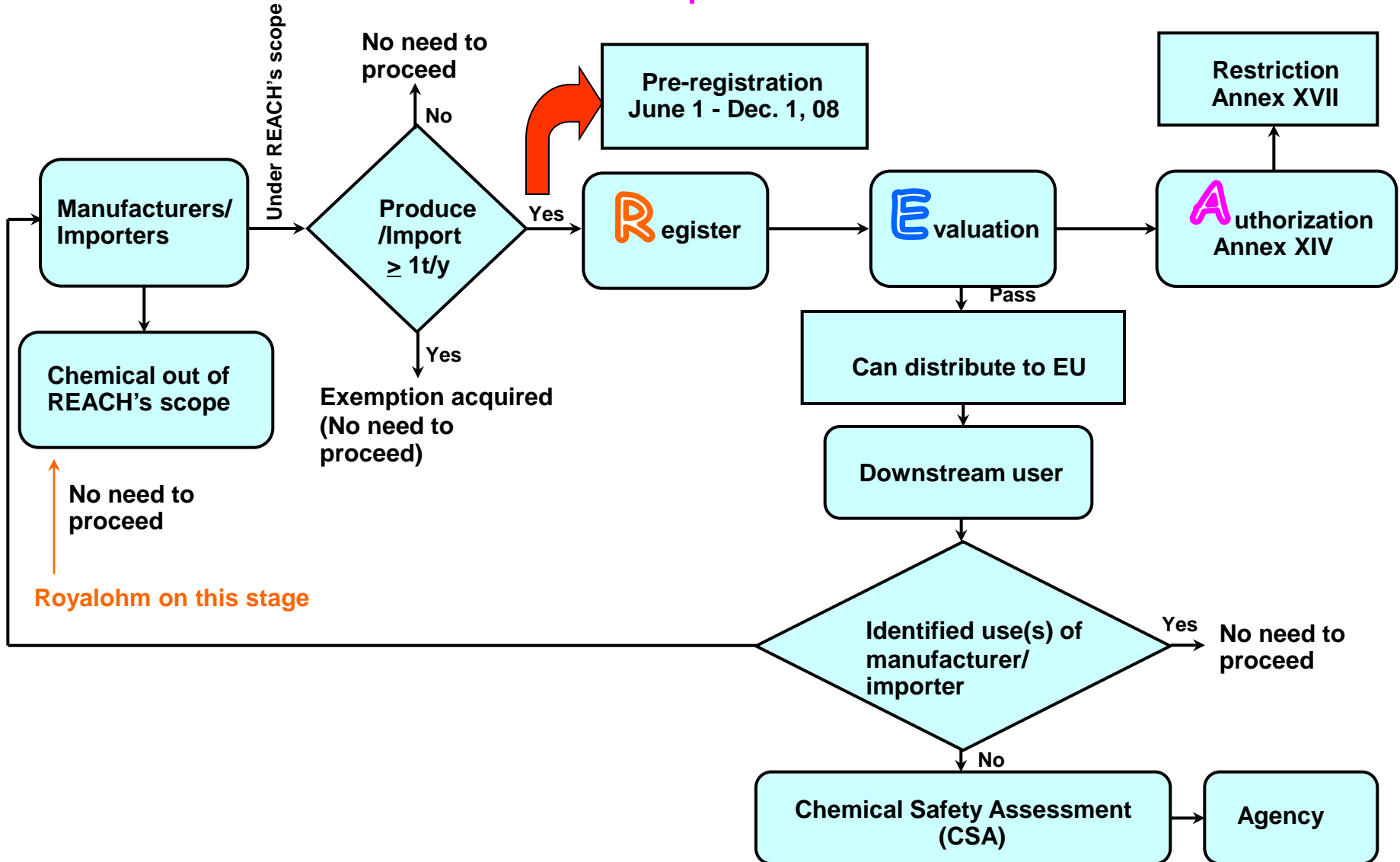
EU. Agency suspects that articles are:

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

Manufacture and Import the substance



sVHCs (Substance of very High Concern)

In 2008 to December 2014, The European Chemicals Agency (ECHA) issued the list of substances of very high concern (sVHCs) 161 substances because of their potential negative impacts on Human Health or to the Environment.

Present, ECHA has announced the addition of 2 sVHCs to the existing candidate list of 161 sVHCs, bringing the candidate list to a total 163 sVHCs. The addition is effective from June 15, 2015.

ROYALOHM has reviewed and is guaranteeing that all of our materials do not contain 163 candidates of sVHCs. Our resistors do not release any substance at their normal function which could affect the Human Health or the Environment. Therefore, there is no need to pre-register to European Chemicals Agency and that ROYALOHM can be distributed freely to Europe.

X. Dimethyl Fumarate (DMF)

DMF: Dimethyl Fumarate (C₆H₈O₄)

DMF Cas No.: 624-49-7

EU Regulation Directive: 2009/251/EC

Allowable Concentration: 1,000 ppm. (0.1 mg/kg)



European Directive (2009/251/EC) was published on the March 17, 2009 and requires that products containing DMF are not placed on the market: this means the presence of DMF in one or more pouches or in a concentration greater than 0.1 mg/kg of the weight of the product or part of the product. The directive also requires any product containing DMF that has already been placed on the market be withdrawn by May 1, 2009 and consumers to be made aware of the potential risks.

No.	DMF Application	ROYALOHM status
1.	Desiccant substance in - Raw materials - Products. - Packaging materials.	Not Applicable

We declare that all of materials/products does not contain Dimethylfumarate (DMF) including the package does not contain desiccant bags (like silica gel products)

It is meeting *EU Regulation Directive: 2009/251/EC*. If there is DMF substance supplied in the products, the maximum allowable limit is 0.1mg/kg.

XI. Conflict Minerals

There has been increased awareness of violence and human rights violations in the mining of certain minerals from a location described as the “Conflict Region”, which is situated in the eastern portion of the Democratic Republic of the Congo (DRC) and surrounding counties.

In 2010, the United States Congress issued the Dodd-Frank wall street reform and consumer protection Act and the U.S. Securities and Exchange Commission (the “SEC”) issued rules requiring certain reporting companies to make disclosures under specific circumstances concerning the use of Conflict Minerals.

- Tantalum (Ta)
- Tungsten (W)
- Tin (Sn)
- Gold (Au)

We “Royal Electronic Factory (Thailand) Co., Ltd.” guarantee that all of metal type raw materials are not derived from the Conflict Region.

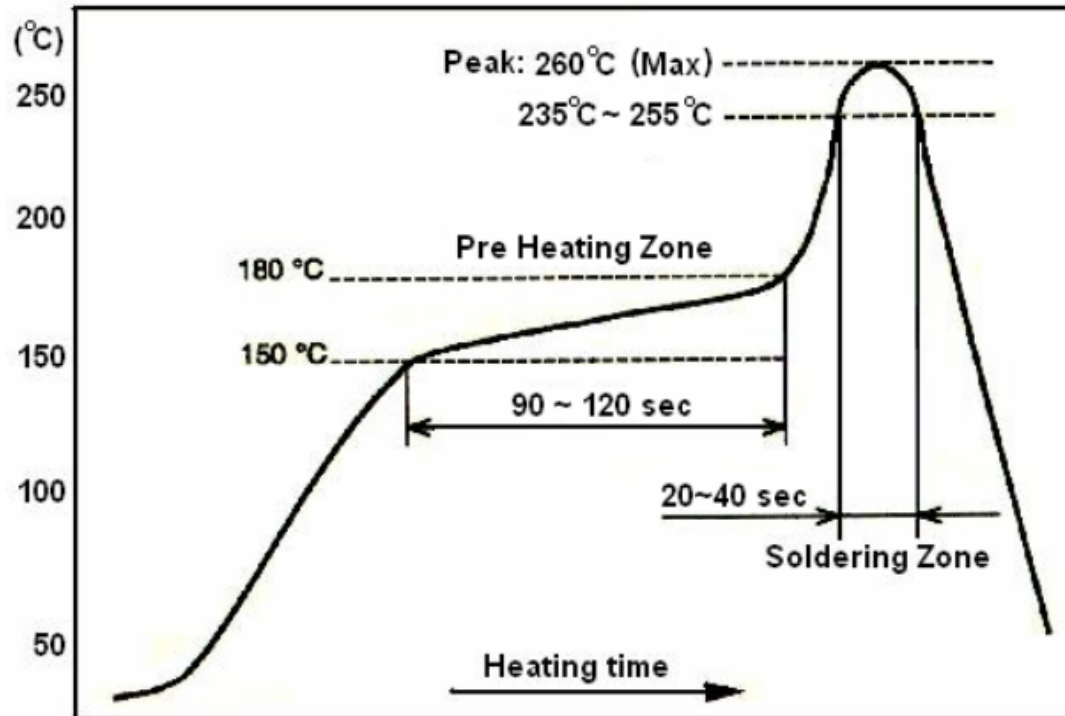
Solderability Profile

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, 10 sec. (Max.)</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, 10 sec. (Max.) Maximum Soldering Time: 2 times</p> <p><u>Hand soldering condition:</u> Hand soldering temperature: 350 +/-5 °C Dwell time in solder: Less than 3 sec. Soldering Wattage: Less than 40 W. Maximum Soldering Time: 1 time</p>
Solderability	95 % coverage Min.	Test temperature of solder : 245+/-3°C Dwell time in solder : 3 ~ 5 seconds

A. Recommended Reflow Soldering Curve:

CHIP:



Max Soldering Time: 2 times

Temperature profile for evaluation

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>