

Questionnaire

Exemption request 2 under Directive 2002/95/EC

“Lead in PZT based dielectric ceramic materials of capacitors being part of integrated circuits or discrete semiconductors”

ESIA/Ramtron applied for an exemption from the ban of lead in the RoHS Directive with the following wording:

Lead in PZT based dielectric ceramic materials of capacitors being part of integrated circuits or discrete semiconductors

For details please see the documents [“ESIA General questionnaire 7c PZT Capacitors.pdf”](#) and [“ESIA Ramtron RoHS 7c Exemption Request.pdf”](#) of this stakeholder consultation.

Background

During the review of the Annex of the RoHS Directive in 2008 / 2009, it was recommended for the future exemption 7c to repeal the use of lead in dielectric ceramic materials of capacitors with rated voltages of less than 125 V AC or 250 V DC

(http://ec.europa.eu/environment/waste/weee/pdf/report_2009.pdf, page 113). During the ongoing review of Annex II of the ELV Directive, it was discussed to transfer this limitation to Annex II as well

(http://circa.europa.eu/Public/irc/env/elv_4/library?!=/consultation_2/stakeholder_contribution/elv_exemption_10&vm=detailed&sb=Title).

As described above exemption 7c of the Annex to the RoHS Directive would no longer cover the use of lead in low voltage applications if the Commission decides to adopt the recommended proposal from the last review. Against this background, the applicant requests an exemption since FRAMS and MIM capacitors using PZT-based dielectric ceramic materials may be operated in the low voltage area.

The applicant justifies his exemption request with the following arguments:

Lead-zirconium-titanate (PZT) material has the highest known dielectric constant ($\epsilon_r = 1000 - 1200$) and thus can be used as a planar metal/insulator/metal (MIM) capacitor with a breakdown voltage of more than 100 V. No alternative to PZT is currently known for thin film capacitors and ferroelectric RAM (F-RAM) memories that achieves the same combination of high dielectric constant, high breakdown field and temperature stability of 20% in a temperature range from -25 to +85 °C. This combination of properties is indispensable to realize capacitors as parts of integrated circuits and discrete semiconductors.

Alternatives to PZT based dielectric ceramic capacitors are not available. Trench capacitors have a breakdown of less than 30 V only, no MIM is possible. Other potential alternatives such as Barium-Strontium-Titanate (BST) have only half the dielectric constant, which results in much larger devices that do not meet the size dimensions of semiconductor applications. Performance characteristics with alternatives are severely degraded. These potential alternative techniques (trench- or BST-capacitors) are not able to fulfill the electric requirements that are needed for such applications, a high breakdown voltage and low internal resistance at low leakage currents and high capacitance values. New materials without Pb will have to be invented.

According to the applicant, FRAMS and MIM capacitors using PZT based dielectric ceramic materials offer unique properties, which cannot be replaced at the current state of science and technology. He states that neither lead-free ceramic materials are available, nor alternative technologies providing the same or similar functionalities.

In case you do not agree to the applicant's justification or should you wish to support the justification with additional arguments, please answer the following questions:

Questions

1. Can PZT-based dielectric ceramic materials be substituted in all or in specific RoHS-covered applications (please give examples of applications and substitute materials used)?
2. Which alternatives to PZT-based dielectric ceramic capacitors are available (please state a list as comprehensive as possible)
 - a. What are their properties?
 - b. How can they replace the PZT based dielectric ceramic capacitors?
 - c. How would the replacement affect the performance of ICs and discrete semiconductors?
3. Which alternative technologies can be used instead of the PZT based dielectric ceramic capacitors?
 - a. What are their properties?
 - b. How can they replace the PZT-based dielectric ceramic capacitors?
 - c. How would the replacement affect the performance of ICs and discrete semiconductors?
4. In case a substitution of lead or of the PZT-based capacitor technology is possible, please explain until when this could be achieved and in which RoHS-covered applications respectively.
5. Are there any other points in the applicants' justification to which you do not agree or that you would particularly want to support?

The applicant and stakeholders are invited to clarify the above questions as detailed as possible. In your contribution, please state which question number you are referring to. Before you answer the questions, please read the following background information: results of the former evaluation of exemption 7c of the RoHS Annex¹ under http://ec.europa.eu/environment/waste/weee/studies_rohs1_en.htm and <http://rohs.exemptions.oeko.info/index.php?id=21> for the corresponding consultation as well as the report containing the recommendation under http://ec.europa.eu/environment/waste/weee/pdf/report_2009.pdf.

Documentation provided by stakeholders including replies to the questions above should take the following points into consideration:

Please justify your contribution according to Article 5 (1) (b) RoHS Directive, i.e.

- Justification for exemption still given or not given anymore according to technical and scientific progress;
- Substitution of concerned hazardous substances via materials and components not containing these is technically or scientifically either practicable or impracticable;
- Elimination or substitution of concerned hazardous substances via design changes is technically or scientifically either practicable or impracticable.

¹ Cf. http://ec.europa.eu/environment/waste/weee/legis_en.htm