

To whom it may concern

BUSINESS AREA Semiconductors
FROM Marco Renggli
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REFERENCE RoHS 2011/65/EC
DATE 2021-03-02

RoHS Pack 22 - Exemption Annex III, 7(a) Request Evaluation under Directive 2011/65/EU

Dear Sir or Madam

Please find our request to renew exemption Annex III, 7(a) for high melting solder (> 85% lead).

[REDACTED]

Yours faithfully,

Marco Renggli
Product Environmental Compliance Specialist

Exemption Request Form

Date of submission: 02.03.2021

1. Name and contact details

1) Name and contact details of applicant:

Company: ABB Power Grids Switzerland Ltd., A Hitachi ABB Joint Venture
Name: Marco Renggli
Function: Product Environmental Compliance Expert
Tel. : +41 79 439 26 38
E-Mail : marco.renggli@hitachi-powergrids.com
Address: Fabrikstrasse 3
5600 Lenzburg
Schweiz

2) Name and contact details of responsible person for this application (if different from above): same as defined in 1. 1)

2. Reason for application:

Please indicate where relevant:

- Request for new exemption in:
 Request for amendment of existing exemption
 Request for extension of existing exemption in
 Request for deletion of existing exemption in:
 Provision of information referring to an existing specific exemption in:
 Annex III Annex IV

No. of exemption in Annex III or IV where applicable: 7a

Proposed or existing wording:

Existing wording: "Lead in high melting temperature type solders (i.e. lead-based alloys containing 85 % by weight or more lead)"

Duration where applicable: Standard extension at minimum

Other: _____

3. Summary of the exemption request / revocation request

ABB Power Grids Switzerland Ltd., requests to extend the current exemption 7(a), lead in high melting temperature (LHMP) type solders.

Even though our high-power semiconductors are out of the scope by the definition in article 3 (1), we need the exemption 7 (a) to prove the conformity with the directive for our end customers. When our products become components in OEM equipment and installations, product specific RoHS compliance declarations are issued at the customer's request.

We have high quality and reliability requirements for our high-power semiconductors which are used and installed in rush environments. Our customers are in the Railway-, Energy Distribution-, and with new designs in the Medical Industry. We rely on over 10 years of experience in Engineering and expertise given from the field, where our high-power semiconductors are installed in.

With the given high quality and reliability requirements, so far, no lead-free solution has been identified and any potential alternatives require material development, evaluation, internal process and product qualification and reliability testing in close cooperation with our end customer / OEM.

Using high-melting-Pb-soldering with only little amount of leaded solder in our products combined with the fact that our customer's applications have an expected life-cycle of 25-40 years, we strongly assume that extending this exemption 7(a) will better support the aim of the RoHS directive to protect human and environment rather than to risk early module failure in the field where people might be at risk or failure-returns of the application will become more waste than needed.

ABB Power Grids Switzerland monitors potential alternatives to the lead-containing high melting temperature solders, but more time is needed to understand lead-free solders or other alternatives and their reliability especially in our customers critical safety applications.

4. Technical description of the exemption request / revocation request

(A) Description of the concerned application:

1. To which EEE is the exemption request/information relevant?

Name of applications or products:

High Power Semiconductor Technology, HiPak, LinPak, StakPak components. These modules are not defined as EEE, as they are specified for high-power applications exempted per definition in Article 3 (1).

- a. List of relevant categories: The list of our customer's categories.

- | | |
|----------------------------|---------------------------------------|
| <input type="checkbox"/> 1 | <input type="checkbox"/> 7 |
| <input type="checkbox"/> 2 | <input checked="" type="checkbox"/> 8 |
| <input type="checkbox"/> 3 | <input checked="" type="checkbox"/> 9 |
| <input type="checkbox"/> 4 | <input type="checkbox"/> 10 |
| <input type="checkbox"/> 5 | <input type="checkbox"/> 11 |
| <input type="checkbox"/> 6 | |

- b. Please specify if application is in use in other categories to which the exemption request does not refer: n/a

- c. Please specify for equipment of category 8 and 9:

The requested exemption will be applied in

- monitoring and control instruments
- in industry in-vitro diagnostics
- other medical devices or other monitoring and control instruments than those in industry

2. Which of the six substances is in use in the application/product? (Indicate more than one where applicable)

- Pb Cd Hg Cr-VI PBB PBDE

3. Function of the substance:

Lead based solder alloys are used because they have unique combinations and characteristics that cannot be achieved by other 2 materials or methods. High lead content soft solder alloys remain the most effective material to avoid excess mechanical stress when combining brittle materials like monocrystalline silicon, silicon carbide or III-V semiconductor dies with highly conductive metals like copper.

The unique properties such as the high melting point and thermal conductivity of the high-lead alloys are necessary for the level of reliability required. Potential substitute reliability issues include voiding/cracking/disruption after stress, growth of brittle intermetallic at high temperature and disruption during temperature cycling. Some alternative solders such as zinc, bismuth or tin/ antimony-based solder have limited experience on reliability and are affected by potential whisker problem (bismuth).

4. Content of substance in homogeneous material (%weight):
In average 20 g (< 0,5 %-w/w of the semiconductor)

5. Amount of substance entering the EU market annually through application for which the exemption is requested: ██████████

6. Name of material/component: High temperature solder > 85% lead in tin

7. Environmental Assessment: _____
LCA: Yes
 No

The complete document, executive summary and various sections can be found at the EPA's website:

https://www.epa.gov/sites/production/files/2013-12/documents/lead_free_solder_lca_full.pdf

(B) In which material and/or component is the RoHS-regulated substance used, for which you request the exemption or its revocation? What is the function of this material or

component?

[Redacted]

Referencing Heraeus Products which are soldered during our production steps:

https://www.heraeus.com/media/media/het/doc_het/products_and_solutions_het_documents/adhesives_docs/FirstSpirit_1461048855943Brochure_Power_and_Discrete.pdf

(C) What are the particular characteristics and functions of the RoHS-regulated substance that require its use in this material or component?

[Redacted]

5. Information on Possible preparation for reuse or recycling of waste from EEE and on provisions for appropriate treatment of waste

1) Please indicate if a closed loop system exist for EEE waste of application exists and provide information of its characteristics (method of collection to ensure closed loop, method of treatment, etc.)

Our high-power semiconductor modules are not classified as EEE, nevertheless we started with a supplier to evaluate the recyclability of our modules. This project is currently ongoing.

2) Please indicate where relevant: (Presumed handling of our components)

- Article is collected and sent without dismantling for recycling
- Article is collected and completely refurbished for reuse
- Article is collected and dismantled:
 - The following parts are refurbished for use as spare parts: ____
 - The following parts are subsequently recycled: _____
- Article cannot be recycled and is therefore: Sent for
 - energy return
 - Landfilled

6. Analysis of possible alternative substances

- (A) Please provide information if possible alternative applications or alternatives for use of RoHS substances in application exist. Please elaborate analysis on a life-cycle basis, including where available information about independent research, peer-review studies development activities undertaken
- (B) Please provide information and data to establish reliability of possible substitutes of application and of RoHS materials in application

The discussion of reliability of lead-free solder is discussed controversial. So far and for our understanding, the field experience is missing to prove evidence that the lead-free solder should be used in critical safety applications.

High Lead Solder (> 85%) Solder in the Electronics Industry, RoHS Exemptions and Alternatives:

https://www.researchgate.net/publication/276534201_High_lead_solder_over_85_solder_in_the_electronics_industry_RoHS_exemptions_and_alternatives

We have already converted the possible product portfolio (e.g. LinPak modules) the lead soldering process (2nd step module soldering) to lead free solder process and we continuously push this transfer forward.

7. Proposed actions to develop possible substitutes

- (A) Please provide information if actions have been taken to develop further possible alternatives for the application or alternatives for RoHS substances in the application.

We have already performed a product portfolio cleaning and with R&D investments developed most of our product portfolio without lead. Our newest module conforms to the RoHS directive as well as there are no REACH SVHC substances over the threshold.

Nevertheless, for the existing high-runner modules we need still the high melting solder to rely on the quality and reliability. Please take into consideration, we estimate a life-cycle of our modules of 25-40 years in the field.

- (B) Please elaborate what stages are necessary for establishment of possible substitute and respective timeframe needed for completion of such stages.

Some of the product portfolio containing high lead solder (> 85%) will be phased out over time and the new product technologies will be introduced, where the process step is not required (advanced packaging technology, press-pack modules etc.)

8. Justification according to Article 5(1)(a):

- (A) Links to REACH: (substance + substitute)

- 1) Do any of the following provisions apply to the application described under (A) and (C)?

- Authorisation
 - SVHC
 - Candidate list
 - Proposal inclusion Annex XIV Annex XIV
 - Annex XIV
- Restriction
 - Annex XVII
 - Registry of intrusions
- Registration

2) Provide REACH-relevant information received through the supply chain. Name of document:

Example of our declaration:

██
██

(B) Elimination/substitution:

1. Can the substance named under 0(A)1 be eliminated?
 - Yes. Consequences? _____
 - No. Justification: see section 7.
 2. Can the substance named under 0(A)1 be substituted?
 - Yes.
 - Design changes: Other
 - materials: Other substance:
 - stance:
 - No. Justification: see section 7.
 3. Give details on the reliability of substitutes (technical data + information): n/a
 4. Describe environmental assessment of substance from 4(A)1 and possible substitutes with regard to
 - 1) Environmental impacts: n/a
 - 2) Health impacts: n/a
 - 3) Consumer safety impacts: as mentioned, critical safety application in Energy Distribution, Medical Device and other industrial applications
- ⇒ Do impacts of substitution outweigh benefits thereof?
Please provide third-party verified assessment on this: n/a

(C) Availability of substitutes: n/a

- a) Describe supply sources for substitutes: _____
- b) Have you encountered problems with the availability? Describe: _____
- c) Do you consider the price of the substitute to be a problem for the availability?
 Yes No
- d) What conditions need to be fulfilled to ensure the availability? _____

(D) Socio-economic impact of substitution: n/a

- ⇒ What kind of economic effects do you consider related to substitution?
 - Increase in direct production costs
 - Increase in fixed costs
 - Increase in overhead
 - Possible social impacts within the EU
 - Possible social impacts external to the EU
 - Other: _____
- ⇒ Provide sufficient evidence (third-party verified) to support your statement: n/a

9. Other relevant information

Please provide additional relevant information to further establish the necessity of your request:

10. Information that should be regarded as proprietary

Please state clearly whether any of the above information should be regarded to as proprietary information. If so, please provide verifiable justification: n/a
