

Exemption Request Form

Date of submission: 22.12.14

1. Name and contact details

1) Name and contact details of applicant:

Company: IXYS Semiconductor GmbH Tel.: 49 6206 503300
Name: Markus Bickel E-Mail: m.bickel@ixys.de
Function: Quality Officer Address: Edisonstr. 15, D-68623
Lampertheim

2) Name and contact details of responsible person for this application (if different from above):

Company: _____ Tel.: 49 6202 572923
Name: Dr. Arno Neidig E-Mail: contepla@t-online.de
Function: Consultant Address: Bruehler Weg 42,
D-68723 Plankstadt

2. Reason for application:

Please indicate where relevant:

- Request for new exemption in:
 Request for amendment of existing exemption in
 Request for extension of existing exemption 7a in annex III
 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: **lead in soft solder alloys used in power semiconductor devices containing more than 90% lead**

Duration where applicable: **no expiry date**

Other: _____

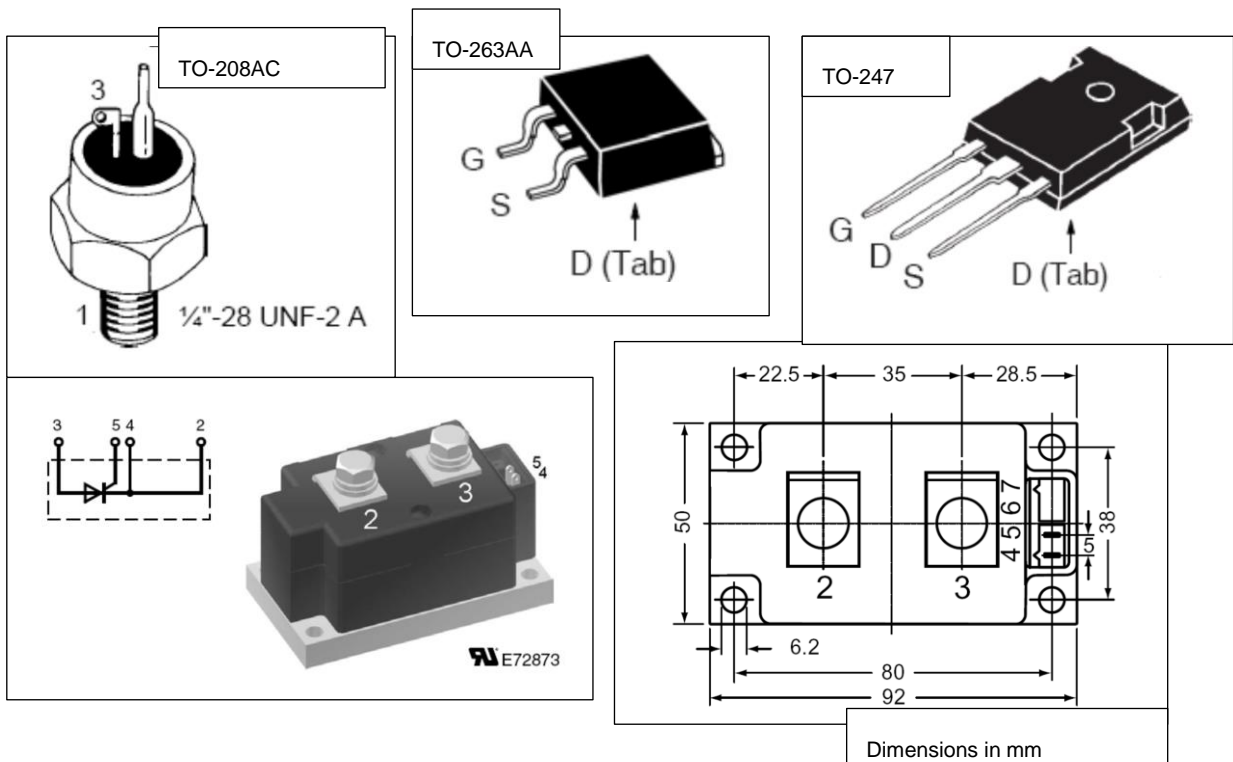
3. Summary of the exemption extension request / revocation request

This exemption renewal request is for the use of lead in high reliability semiconductor power device contacting and packaging. Lead based solder alloys are used because they have unique combinations and characteristics that cannot be achieved by other

materials or methods. High lead content soft solder alloys still 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. Semiconductor power devices are increasingly used to effectively manage electric power in EEEs. Therefore, they represent an important contribution to electric energy savings and reduction of energy consumption. Also by the use of modern power devices like epitaxial diodes, MOSFETs and IGBTs a considerable reduction of material and size is achieved in EEEs (e. g. compare modern “SMPS” switch mode power supplies today with supplies 30 years ago).

4. Technical description of the exemption request / revocation request

Because of the highly ductile (“soft”) properties of high lead soft solders the build-up of excess mechanical stress is avoided after establishing the electrical contact to the outer connectors of the device. This scenario is especially important when combining large power dies with copper base plates (headers). High lead containing soft solders have melting temperatures near 300°C and subsequently possess higher recrystallization temperatures ($\sim T_{abs}/2$). The latter property additionally helps to delay the wear out of the solder alloy after extended power and temperature cycling since operation temperatures normally range from -55°C to +180°C. This property also helps to extend the life of the devices. Furthermore the melting point of this kind of solders is higher than the reflow temperature of lead free solder (SAC) that is used for board assembly. No other soft solder material has this property. Examples of devices below (housing standard shown as TO-xxx).



(A) Description of the concerned application:

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

Name of applications or products: all kind of **EEEs**

a. List of relevant categories: (mark more than one where applicable)

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

b. Please specify if application is in use in other categories to which the exemption request does not refer: **transportation, automotive, high power equipment in the industry.**

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: providing electric and thermal contact of semiconductor dies

4. Content of substance in homogeneous material (%weight): >90% of solder material

5. Amount of substance entering the EU market annually through application for which the exemption is requested: ~ 50 000 kg
Please supply information and calculations to support stated figure.

6. Name of material/component: soft solder

7. Environmental Assessment: as part of EEEs

LCA: Yes
 No

(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?

Die attach material for power semiconductor devices

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

Ductility and good electric and thermal conductivity

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.)

2) Please indicate where relevant:

- 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

3) Please provide information concerning the amount (weight) of RoHS substance present in EEE waste accumulates per annum:

- In articles which are refurbished _____
- In articles which are recycled _____
- In articles which are sent for energy return _____
- In articles which are 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

For very high power semiconductor devices so-called compression bonded contact systems are in use. Packaging is mostly realized as voluminous ceramic cases:



(B) Please provide information and data to establish reliability of possible substitutes of application and of RoHS materials in application

The power cycling reliability problem mostly arises when semiconductor dies are directly mounted onto copper headers having electric potential. For more expensive electrically isolated package versions in so-called DCB technology (with metal bonded alumina or AlN ceramic isolator substrates) with better fit of CTEs more and more SAC type solders are used. But many customers still require cheaper non-isolated versions, however.

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.

IXYS is a pioneer in bringing DCB technology power devices into market since the early 80ies. This technology allows integration of more than one semiconductor die into one package.

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

Customers in the EEE industry should be motivated to use DCB modules instead of discrete devices (at least in the low and medium power range) accepting some higher costs for the isolation feature.

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

Restriction

Annex XVII

Registry of intentions

Registration

2) Provide REACH-relevant information received through the supply chain.

Name of document: _____

(B) Elimination/substitution:

1. Can the substance named under 4.(A)1 be eliminated?

Yes. Consequences? _____

No. Justification: _____

2. Can the substance named under 4.(A)1 be substituted?

Yes.

Design changes:

Other materials:

Other substance:

No.

Justification: _____

3. Give details on the reliability of substitutes (technical data + information): _____
 4. Describe environmental assessment of substance from 4.(A)1 and possible substitutes with regard to
 - 1) Environmental impacts: _____
 - 2) Health impacts: _____
 - 3) Consumer safety impacts: _____
- ⇒ Do impacts of substitution outweigh benefits thereof?
Please provide third-party verified assessment on this: _____

(C) Availability of substitutes:

- 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:

- ⇒ 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: _____

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:
