This initial feedback is submitted on behalf of participants in the Umbrella Project ("UP")´s Exemption #15 and 15a technical Working Group ("WG") (hereafter referred to as "UP Exemption #15-15a WG Participants")

Questionnaire 1 (Clarification) Exemptions 15 and 15(a) of RoHS Annex III

Current wording of the requested exemption:

15 Lead in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit flip chip packages

15(a) Lead in solders to complete a viable electrical connection between the semiconductor die and carrier within integrated circuit flip chip packages where at least one of the following criteria applies:
— a semiconductor technology node of 90 nm or larger;
— a single die of 300 mm2or larger in any semiconductor technology node;
— stacked die packages with die of 300 mm^2or larger, or silicon interposers of 300 mm^2 or larger.

Requested validity periods: Maximum, i.e. 5 or 7 years respectively

1. Acronyms and Definitions

FCP flip chip package

IVD in-vitro diagnostic

2. Background

Bio Innovation Service, UNITAR and Fraunhofer IZM have been appointed[1] by the European Commission through for the evaluation of applications for the review of requests for new exemptions and the renewal of exemptions currently listed in Annexes III and IV of the RoHS Directive 2011/65/EU.

Texas Instruments et al. submitted a request for the renewal of the above-mentioned exemptions, which was subject to a first review. As a result we identified that some information is missing. Against this background, the questions below are intended to clarify aspects concerning the request at hand.

We ask you to kindly answer the below questions until 29 January 2021 latest.

[1] It is implemented through the specific contract 070201/2020/832829/ENV.B.3 under the Framework contract ENV.B.3/FRA/2019/0017

3. Questions

Table 1: Requested wording of the renewed exemptions 15 and 15(a)

Exemption		Scope (for dates of applicability see "Duration where applicable" further below)
15	Lead in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit flip chip packages for bonding to cadmium zinc telluride (CZT)	Does not apply to applications covered by point 15(a) of this Annex. Applies to category 8, other than in vitro diagnostc medical devices
15(a)	Lead in solders to complete a viable electrical connection between the semiconductor die and carrier within integrated circuit flip chip packages where at least one of the following criteria applies: - a semiconductor technology node of 90 nm or larger; - a single die of 300 mm_2 or larger in any semiconductor technology node; - stacked die packages with die of 300 mm_2 or larger, or silicon interposers of 300 mm_2 or larger.	Does not apply to applications covered by point 15 of this Annex Applies to Categories 1 to 7, 8 including in vitro diagnostic medical devices, 9 including industrial monitoring and control instruments and 10

1. You request the renewal of exemption 15 for category 8 other than in-vitro diagnostic (IVD) medical devices.

    a. In your renewal request, you mention cadmium zinc telluride (CZT) X-ray detectors used for medical imaging as the only application in the scope of the renewed exemption. We would therefore like to restrict the scope to this application so that exemption 15 would read:
    "… for bonding to cadmium zinc telluride (CZT) X-ray detectors." "Applies to category 8 other than in-vitro diagnostic medical devices".

    Would you agree to this rewording?

Response:

Exemption 15 is specifically for FCPs bonding to CZT for Category 8 use in X-ray detectors, other than IVD medical devices; and

b. How is this exemption technically related to RoHS exemption 28-IV, which expired in 2017 already?

Response:

RoHS Exemption 28 relates to Lead in solders for mounting cadmium telluride and cadmium zinc telluride (CZT) digital array detectors to printed circuit boards. This exemption was required to make electrical connections to CZT detectors that were used in PET and SPECT imaging applications. Manufacturers of PET and SPECT have now been able to replace lead solder bonds to CZT array detectors by using anisotropic conducting adhesives and so exemption 28 has expired. However, the use of CZT detectors in CT imaging is relatively new and research has shown that anisotropic conducting adhesives cannot be used as the polymeric material is destroyed by the intense exposure to X-radiation (the radiation detected by PET and SPECT has a very low intensity as it is from radioisotopes that are inside the patient and so must be at levels that are very low to avoid radiation damage to the patient). It is the new use of CZT for CT imaging that now requires the use of exemption 15.

2. From the last review of this exemption in 2015/2016, we assessed that the more modern lead-free flip chip packages (FCPs) with technology nodes smaller than 90 nm can provide all electrical/electronic functionalities. This implies that their use may require a redesign of the EEE in which they are used, e.g. the surrounding circuitries and an adaptation to different geometries of these lead-free FCPs. We also understood that redesigning older FCPs to substitute or to eliminate lead does not make sense.

   Are there any new developments since 2016 which would falsify the above insights?

Response:

The above insights are still appropriate today.

3. You argue that legacy products require the renewal of those parts of exemption 15(a) where lead-free FCPs are available already. Even without exemption 15(a), RoHS Art. 4 would allow you to use lead-containing FCPs in products placed on the market prior to the expiry of this exemption. Since this part of the legacy problem does not exist, we assume that

   a. these leaded FCPs shall be used in products placed on the market with old designs which cannot accommodate the lead-free FCPs. The lead-FCPs shall be used until these products' model life comes to its end so that they will be replaced by new models which could then use lead-free FCPs.

   b. you are afraid that, should the proceeding described above have to end in 2021, the production of the lead-FCPs would be stopped so that the supplies for repair, upgrade etc. according to RoHS Art. 4 would become impossible or would require last time buys or other countermeasures.

Did we correctly understand your arguments and intentions?

Response:

It is correctly understood that EEE with older designs will need to be supported until products in these models reach end of life.

4. As to part ii) of exemption 15(a), you mention that new products introduced into the market in the last several years are assembled with Pb-free bumps even though the die size is greater than 300 mm^2.

    a. Up to which die size are these FCPs manufactured without using lead as in the scope of the exemption?

    Response:

    It is difficult to define a cut-off die size where the technology transitions from Pb based to Pb-free. UP Exemption #15-15a WG Participants agree to adhere to the 300 mm^2 die size for this category as warpage issues occur beyond current industry acceptance levels due to larger die sizes.

    b. If those FCPs have been introduced into the market "in the last several years" already. Can the die size limit in part ii) of the exemption be increased to reflect the state of science and technology in the exemption scope?

    Response:

    Based on the response to 4a, UP Exemption #15-15a WG Participants would like to maintain the part ii) of the exemption 15(a) to "single die of 300mm^2 or larger in any semiconductor technology node"

5. You request the renewal of part iii) of exemption 15(a) with the current scope.

    a. Could the die sizes which still enable lead-free manufacturing without relying on exemption 15(a) be increased for the stacked die packages as well like for the dies in part ii) of the exemption?

    Response:

    As per the response provided in 4a, UP Exemption #15-15a WG Participants would like to maintain the part iii) of exemption 15(a) to "stacked die packages with die of 300mm^2 or larger"

    b. If other than silicon interposers are used, the stacked die FCPs can be RoHS-compliant without exemption 15(a). Can silicon interposers be replaced by other interposer materials, e.g. plastics? Plastics might also have a smaller environmental impact (global warming, etc.) than silicon.

Response:

At this point UP Exemption #15-15a WG Participants have no evidence that other technologies will be a drop-in replacement to silicon interposers for this application. Silicon interposers provide the best CTE match to interconnect die as well as signal integrity needs to connect multiple dies.

Please note that answers to these questions will be published as part of the evaluation of this request. If your answers contain confidential information, please provide a version that can be made public along with a confidential version, in which proprietary information is clearly marked.

It would be helpful if you could kindly provide the information in formats that allow copying text, figures and tables to be included into the review report.