# Low Halogen / Halogen Free Position Statement - Policy

Interlink Electronics overall success as an enterprise is impacted by our ethical values and conducting our business in the right way. Doing it right extends to the environmental impact of the materials we use as well as our expectations of how our supply chain partners are aligned with our broader environmental and sustainability objectives. We have separate policies regarding the EU directives on ROHS[1] (Restriction of Certain Hazardous Substances), REACH[2] (Registration, Evaluation, Authorisation and Restriction of Chemicals) and Conflict Minerals[3] sourcing. The following support our position as it relates to "Low Halogen" or "Halogen Free" requirements.

## Summary of Interlink Low Halogen / Halogen Free Position Statement

All printed circuit boards (PCBAs)

- 900 PPM maximum chlorine
- 900 PPM maximum bromine
- 1500 PPM maximum total

For components other than printed board and substrate laminates, each plastic within the component must contain:

- < 1000 PPM (0.1%) of bromine if the Br source is from BFRs and
- < 1000 PPM (0.1%) of chlorine if the Cl source is from CFRs or PVC or PVC copolymers

## Background

There has been an industry led drive for the supply chain to comply with "low halogen" or "halogen free" requirements. A few leading companies are working to ensure certain products including consumer electronics like laptops and cell phones, comply with these goals. It is likely that at some time in the future enforceable regulations will be introduced. The initial rationale for these standards was driven by the known dangers of Persistent Organic Pollutants (POPs) banned under Annex A of the Stockholm

[1] *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*

[2] *European Parliament and Council Regulation (EC) No 1907/2006 (Corrigendum 29 May 2007) and Directive 2006/121/EC (Corrigendum 29 May 2007).*

[3] *Dodd-Frank, Section 1502(a)- SEC final Ruling:* https://www.sec.gov/rules/final/2012/34-67716.pdf

Convention. In addition, concerns about the production and ingestion of highly toxic compounds during low-temperature combustion in non-professional recycling operations was also a driving factor. In certain countries where large scale electronic recycling is carried out cables/boards/etc. were/are burned in open fires to enable easier access to the more valuable metals like copper and gold. There is emerging evidence about the environmental and human health safety issues surrounding materials that contain these halogenated compounds. It is known that halogenated polymers produce more toxic by-products than non-halogenated polymers.

The halogen containing compounds of most concern include:

- Chlorinated flame retardants (CFRs)
- Brominated flame retardants (BFRs)
- Polyvinyl chloride (PVC) used as insulation material in electrical wiring and cables

The above concerns and drive toward low-halogen materials in electronic products has created a need for electronics supply chain alignment on the maximum levels of bromine (Br) and chlorine (Cl) allowed in electronic materials and systems that are identified as "low halogen" (or "halogen-free" and/or "BFR/CFR/PVC-free").

iNEMI[4] (the International Electronics Manufacturing Initiative) has released a position statement regarding "Low Halogen" in an attempt to provide some guidance to the broader electronics supply chain. They have based this position statement on two standards; IEC 61249-2-21:2003[5] and JEDEC JS709C[6].

The two standards that are cited in the iNEMI position statement and commonly referenced in specification documents by manufacturers when products must comply with "low halogen" requirements are detailed below:

1. IEC 61249-2-21:2003 - Materials for printed boards and other interconnecting structures - Part 2-21: Reinforced base materials, clad and unclad - Non-halogenated epoxide woven E-glass reinforced laminated sheets of defined flammability (vertical burning test), copper-clad

   The definition in this standard is:

   "Halogen-free board": Printed board resins plus reinforcement matrix that contain maximum total halogens of 1500 ppm with less than 900 ppm bromine and less than 900 ppm chlorine.

[4] http://thor.inemi.org/webdownload/projects/ese/HFR-Free/Low-Halogen_Def.pdf

[5] *IEC 61249-2-21:2003 - Materials for printed boards and other interconnecting structures - Part 2-21: Reinforced base materials, clad and unclad - Non-halogenated epoxide woven E-glass reinforced laminated sheets of defined flammability (vertical burning test), copper-clad*

[6] *JS709C - JOINT JEDEC/ECA STANDARD, DEFINITION OF "LOW-HALOGEN" FOR ELECTRONIC PRODUCTS*

2. JS709C - JOINT JEDEC/ECA STANDARD, DEFINITION OF "LOW-HALOGEN" FOR ELECTRONIC PRODUCTS

   The definition in this standard is:

   Each material within an electronic product, (excluding printed board laminates) shall contain <1000 ppm (0.1%) by weight of bromine if the bromine source is from BFRs and <1000 ppm (0.1%) by weight of chlorine if the chlorine source is from CFRs, PVC, PVC congeners, PVC block polymers, PVC copolymers, or polymer alloys containing PVC. Higher concentrations of bromine and chlorine are allowed in plastics contained within electronic products (other than printed board laminates contained within those devices) as long as their sources are not flame retardants, PVC, PVC congeners, PVC block polymers, PVC copolymers, or polymer alloys containing PVC.

   All printed board laminates contained within electronic and electrical products, including those within a passive or solid-state device shall meet the "halogen-free" requirements for Br and Cl as defined in the most current version of one of the following specifications: IEC 61249-2, IPC-4101, JPCA-ES-01.

The iNEMI positions statement declares that a component[7] must meet all the following requirements to be Low Halogen ("BFR/CFR/PVC-Free"):

1. All printed board (PB) and substrate laminates shall meet Br and Cl requirements for low halogen as defined in IEC 61249-2-21 and IPC-4101B[8] per 1(a) below (refer to IEC and IPC standards for actual requirements).
   a. Non-halogenated epoxide with a glass transition temperature of 120°C minimum. The maximum total halogens contained in the resin plus reinforcement matrix is 1500 ppm with a maximum chlorine of 900 ppm and maximum bromine being 900 ppm. 2) For components other than printed board and substrate laminates: Each plastic within the component contains < 1000 ppm (0.1%) of bromine [if the Br source is from BFRs] and < 1000 ppm (0.1%) of chlorine [if the Cl source is from CFRs or PVC or PVC copolymers].

2. For components other than printed board and substrate laminates:
   Each plastic within the component contains < 1000 ppm (0.1%) of bromine [if the Br source is from BFRs] and < 1000 ppm (0.1%) of chlorine [if the Cl source is from CFRs or PVC or PVC copolymers].

[7] *Definition of terms "component," is in accordance with IPC -T-50 and/or JESD88*

[8] *IPC 4101B-2006 Specification For Base Materials For Rigid And Multilayer Printed Boards*

While no specific test methods are defined IPC - TM-650[9] is a good method for measuring halogens. Another alternative is EN 14582:2016[10].

It should be noted that the halogen family of elements also includes fluorine, iodine and astatine. These are not included in either standard's definitions. Fluorine-based substances, while far less common than Br and Cl, are starting to be increasingly used in electronic components and materials, including in flame retardants for polycarbonates. Iodine has very limited uses and astatine is not used.

## Interlink Low Halogen/Halogen Free Policy

Interlinks Low Halogen Policy is based on the iNEMI position statement and also uses the definition as outlined in both of the standards referenced above. We follow the guidelines that the halogens; Bromine and Chlorine must originate from Flame Retardant materials or PVC.

Therefore, our policy is that an Interlink product must meet all of the following requirements to be considered Low Halogen or Halogen Free:

All printed circuit boards (PCBAs)

- 900 PPM maximum chlorine
- 900 PPM maximum bromine
- 1500 PPM maximum total

For components other than printed board and substrate laminates, each plastic within the component must contain:

- < 1000 PPM (0.1%) of bromine if the Br source is from BFRs and
- < 1000 PPM (0.1%) of chlorine if the Cl source is from CFRs or PVC or PVC copolymers.

Plastic is defined as any of a group of synthetic or natural organic compounds produced by polymerization, optionally combined with additives (organic or inorganic fillers, modifiers, etc.) into a homogeneous material capable of being molded, extruded, coated, printed, or cast into various shapes and films.
PVC copolymer: Copolymers are polymers derived from two or more monomers. Highly chlorinated PVC copolymers, block polymers, and congeners are not considered acceptable alternatives to PVC for low-halogen components.

[9] *IPC - TM-650 2.3.41 Test Method for Total Halogen Content in Base Materials*

[10] *EN 14582:2016 Characterization of waste. Halogen and sulfur content. Oxygen combustion in closed systems and determination methods*

Interlink is committed to meeting our customers' expectations in terms of Low Halogen products and we will work closely with our supply chain to achieve this. In most cases the requirement for Low Halogen products requires the use of more expensive materials and as such the costs of providing this type of product is typically higher than our standard products. This will be reflected in our pricing to customers if a Low Halogen requirement is specified at the time of quotation.

It is also important that customers apply the Standards in the correct manner and do not overly burden the supply chain with requirements that are not clearly within the scope of the specifications.

As standards and regulations evolve Interlink will adjust is position accordingly but until such time as these updates are disseminated and implemented then the above policy is the one we will apply to meet the customer requirements for "Low Halogen" or "Halogen Free".

Sincerely,

Ellen Zhao

Quality & Compliance Manager Interlink Electronics, Inc