

Table I: Hazardous substances in EEE – high priority - Qualcomm Comments

ID	Substance name	CAS-Nr.	Hazard	Main use in EEE	Stakeholder Input		
					Specification of use: component(s) in which substance is contained	Quantity	General comments
1	Antimony trioxide	1309-64-4	Carc Cat. 3 R40	Synergist brominated flame retardants;	Synergist for the brominated flame retardants	Trace quantity, < 1% in integrated circuit (IC) package mold compound materials	Sb203 used in this type of brominated flame retardant system amounts to <1%, which is only a trace quantity to cause adverse environmental affects. The restriction should not cause substitution or conversion of materials in our existing product designs. The restriction should apply only to new product designs. Alternates are available.
2	Antimony compounds	-	Xn; R20/22 N; R51-53	Flame retardant; melting agent in CRT glass; solder material (antimony-tin) Melting agent in CRT glass	1. Pb-free Antimony-tin solder in IC packages; 2. Antimony as a dopant in silicon-based semiconductor	1. 5% of SnSb solder; 2. Trace amount of Sb dopant in the Si wafer	1. Sb contributes to the high melting temperature characteristic of SnSb solder. Alternatives lack the critical technical performance & reliability data; 2. Antimony is one of the critical elements used in the manufacturing of silicon-based semiconductors.
3	Arsenic/arsenic compounds	7440-38-2	T; R23/25 N; R50-53	III-V group semiconductor substrate (GaAs) Flame retardant	1. Arsenic as a dopant in all our semiconductors; 2. In GaAs semiconductors;	1. Trace amount As dopant present in the wafer die in all IC packages; 2. In GaAs semiconductor die in some IC	1. Arsenic is one of the critical elements used in the manufacturing of silicon-based semiconductors. Because of the unique characteristics of arsenic

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						packages	doping chemistry, no replacement elements are available.; 1. See #14 GaAs below.
4	Beryllium metal	7440-41-7	Carc. Cat. 2; R49 T+; R26 T; R25-48/23 Xi; R36/37/38 R43	In alloys; copper-beryllium alloy; Connectors: contact springs, improves elasticity of copper alloy; Finger clips PCs: maintains electrical conductivity in metal housing; Monitors Relays: improves properties of copper contact springs Switches: high strength, high conductivity Laser printers: Rotating mirror, lightweight rigidity for precision instrumentation			
5	Beryllium oxide BeO	1304-56-9	Carc. Cat. 2; R49 T+; R26 T; R25-48/23 Xi; R36/37/38 R43	In ceramics, as cooling device; Thermally conductive electrical insulator			
6	Tetrabromo bisphenol A and related compounds (see Table II)	79-94-7	Dangerous to the environment N; R50/53	Flame retardant	TBBPA is in most printed wiring boards (PWB) that Qualcomm and Qualcomm's OEM customers use.	< 2% in PWBs	EU authority agreed that it is not a PBT substance. Final report on human health RA published in 2006 indicated no risk identified, and, hence, no need for risk reduction measures. It

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							would be cost prohibitive to replace with materials that are not yet well proven on environmental impacts as well as product performance & reliability.
7	Bisphenol A (4,4'-Isopropylidendiphenol)	80-05-7	Repr. Cat. 3; R62 Xi; R37-41 R43	Polycarbonate plastic in electronic devices, medical equipment; in PVC as hardener, catalyst, binding agents, stabiliser; epoxy resin production			
8	Diethylhexylphthalate (DEHP)	117-81-7	Repr. Cat. 2; R60-61	Plasticizer in PVC cables			
9	Butylbenzylphthalate (BBP)	85-68-7	Repr. Cat.2; R61 Repr. Cat.3; R62 N; R50-53	Plasticizer in PVC cables			
10	Dibutylphthalate (DBP)	84-74-2	Repr. Cat. 2; R61 Repr. Cat. 3; R62 N; R50	Plasticizer in PVC cables			
11	Diocetylphthalate (DOP)	117-84-0	Dangerous to the Environment	Plasticizer in PVC cables			
12	Dimethylformamide (DMF)	68-12-2	Repr. Cat. 2; R61 Xn; R20/21 Xi; R36	Electrolyte capacitors			
13	Formaldehyde	50-00-0	Carc. Cat. 3; R40 T; R23/24/25 C; R34 R43	Preservatives, monomer (e.g. phenol resin and melamine resin)			
14	Gallium arsenide	1303-00-0	Human	Power amplifiers,	Semiconductors used in wireless equipment	The entire semiconductor die	GaAs offers many outstanding technical

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			carcinogen*	semiconductors	and mobile devices	in some IC packages	advantages. The restriction could result in a whole range of wireless products no longer made available in EU
15	Hexabromocyclododecane (HBCDD) and further brominated flame retardants (see table II)	3194-55-6	not (yet) classified in the Annex I of Directive 67/548/EEC; proposal: R33, R64, N R50-53; PBT	Flame retardant			
16	Liquid crystals e.g. MBBA (4-methoxybenzylidene-4-butylaniline); 5CB (4-pentyl-4-cyanobiphenyl)			Electroactive layer in liquid crystal displays of cellular phones, notebooks, PC monitors			
17	Medium-chained chlorinated paraffins (MCCP) (Alkanes, C14-17, chloro)	85535-85-9		secondary plasticisers in PVC (cable) flame retardant plasticisers in rubbers			
18	Nickel ¹	7440-02-0	Carc. Cat. 3; R40 R43	Stainless steel, plating; Decorative metal finishes, barrier layers	1. Pb-free interconnect layer in IC packages; 2. various hardware plating.	1. The layer has a micron-level thickness and poses no direct contact with human skin or environment.	1 & 2. Alternatives are available for some applications but generally are not drop-in replacement. Alternatives' health and environmental impacts

¹ Only in those applications where nickel is likely to result in direct and prolonged skin exposure

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							are not always proven.
19	Nonylphenol Nonylphenolpolyglycol ethers (Nonylphenoethoxylates)	25154-52-3 9016-45-9	Repr.Cat.3; R62 Repr.Cat.3; R63 Xn; R22 C; R34 N; R50-53	Surfactants, antioxidant in plastics			
20	Perfluorooctane sulfonates ²	1763-23-1	-				
21	PVC	9002-86-2	Dependent on the additives (stabilizers and plasticizer) used; Dioxin formation during incineration; Source of organic bound chlorine	Sleeve material (of capacitors), cables, tubing films labels and gaskets, insulator, chemical resistance, transparency, sheath material			
22	PCBs Polychlorinated Biphenyls	1336-36-3 and various others	R33 N; R50-53 Dioxin/furan formation during incineration	Flame retardant in PVC plastic cable; capacitors			
23	PCT Polychlorinated Terphenyls	61788-33-8 and various others		Electrical insulation medium, Plasticizers, fire retardants, coatings for electrical wire and cable, dielectric sealants			

² iRestriction does not apply to the following applications or processes: 1) photoresists or antireflective coatings for photolithography processes; 2) photographic coatings applied to films, papers, or printing plates; 3) mist suppressants for non-decorative hard chromium (VI) plating; 4) wetting agents for use in controlled electroplating systems

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24	Polychlorinated Naphthalenes	70776-03-3		lubricant, paint, stabilizer (electric characteristic, flame-resistant, water-resistant) insulator, flame retardant			
25	Selenium	7782-49-2	T; R23/25 R33 R53 Toxic/ Danger of cumulative effects / Environment**	Rectifiers and detector instruments, photoreceptor, semiconductor material, light receiving element, photocell			
26	Short-chained chlorinated paraffins (SCCP) (Alkanes, C10-13, chloro)	85535-84-8	Carc. Cat. 3; R40 N; R50-53	plasticisers in PVC (cable) flame retardant plasticisers			
27	Synthetic vitreous fibres -glass fibres - mineral wool - refractory ceramic fibre (RCFs)	142844-00-6	RCF: Carc. Cat. 2;	Thermal insulation materials in domestic electrical appliances			
28	Tributyl Tin (TBT) compounds Triphenyl Tin (TPT) compounds	various	T; R25-48/23/25 Xn; R21 Xi; R36/38 N; R50-53; T; R23/24/25 N; R50-53	Stabilizer, antioxidant, antibacterial and antifungal agents, antifoulant, antiseptic, anti-fungal agent, paint, pigment, antistaining			
29	Tributyl Tin Oxide (TBTO)	56-35-9	No classification according to 67/548	antiseptic, antifungal agent, paint, pigment, antistaining, refrigerant, foaming agent, extinguishant,			
30	dinickel trioxide	1314-06-3	Carc. Cat. 1; R49 R43	May be used as an electrolyte			

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			R53				
31	diarsenic trioxide; arsenic trioxide	1327-53-3	Carc. Cat. 1; R45 T+; R28 C; 34 N; R50-53	May be used in certain glass-materials, less than 5000ppm			
32	4,4'-methylenedi-o-toluidine	838-88-0	Carc. Cat. 2; R45 Xn; R22 R43 N; R50-53	Potential use as a dye			
33	Petrolatum; Petrolatum	8009-03-8	Carc. Cat. 2; R45	Used in solder fluxes/pastes			
34	nickel dihydroxide	12054-48-7	Carc. Cat. 3; R40 Xn; R20/22 R43 N; R50-53	May be present in certain plastics, metallic- or ceramic materials			
35	tributyl phosphate	126-73-8	Carc.Cat.3; R40 Xn; R22 Xi; R38	May be present in certain plastics, metallic- or ceramic materials			
36	divanadium pentaoxide; vanadium pentoxide	1314-62-1	Muta. Cat. 3; R68 Repr. Cat. 3; R63 T; R48/23 Xn; R20/22 Xi; R37 N; R51-53	May be present in certain plastics, metallic- or ceramic materials			
37	nickel sulphate	7786-81-4	Carc. Cat. 3; R40 Xn; R22 R42/43 N; R50-53	May be present in certain plastics, metallic- or ceramic materials			
38	cobalt oxide	1307-96-6	Xn; R22 R43 N; R50-53	May be present in certain plastics, metallic- or ceramic materials			
39	cobalt	7440-48-4	R42/43 R53	May be present in certain plastics, metallic- or ceramic			

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				materials			
40	2-ethylhexyl acrylate	103-11-7	Xi; R37/38 R43	2-Ethylhexyl acrylate is used as a monomer in the chemical industry for the production of polymers and copolymers, which are mainly processed further to aqueous polymer dispersions. The polymers and polymer dispersions are used in adhesives and as binders for paints. Other applications include coatings raw materials and uses in the plastics and textiles industries.			
41	Naphthenic acids, copper salts; copper naphthenate	1338-02-9	R10 Xn; R22 N; R50-53	May be present in certain plastics, metallic- or ceramic materials			
42	phenyl bis(2,4,6-trimethylbenzoyl)-phosphine oxide	162881-26-7	R43 R53	May be present in certain plastics, metallic- or ceramic materials			
43	thallium	7440-28-0	T+; R26/28 R33 R53	May be present in certain plastics, metallic- or ceramic materials			
44	bromobenzylbromotoluene, mixture of isomers	99688-47-8	Xn; R48/22 R43 N; R50-53	May be present in certain plastics, metallic- or ceramic materials			
45	2,2'-(ethylenedioxy)diethyl diacrylate; triethylene glycol diacrylate	1680-21-3	Xi; R36/38 R43	May be used in carton materials			
46	Rosin; colophony [1]	8050-09-7 [1] 8052-10-6 [2] 73138-82-6	R43	Used in solder fluxes/pastes	Solder fluxes used in hand soldering and reflow processes		No alternatives that meet Qualcomm soldering requirements

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		[3]					are currently available

Table II: Brominated flame retardants (other than PBBs or PBDEs) (JIG, 2007)

Brominated Flame Retardants (other than PBBs or PBDEs)	CAS Numbers
Brominated flame retardant which comes under notation of ISO 1043-4 code number FR(14) [Aliphatic/alicyclic brominated compounds]	-
Brominated flame retardant which comes under notation of ISO 1043-4 code number FR(15) [Aliphatic/alicyclic brominated compounds in combination with antimony compounds]	-
Brominated flame retardant which comes under notation of ISO 1043-4 code number FR(16) [Aromatic brominated compounds excluding brominated diphenyl ether and biphenyls]	-
Brominated flame retardant which comes under notation of ISO 1043-4 code number FR(17) [Aromatic brominated compounds excluding brominated diphenyl ether and biphenyls] in combination with antimony compounds]	-
Brominated flame retardant which comes under notation of ISO 1043-4 code number FR(22) [Aliphatic/alicyclic chlorinated and brominated compounds]	-
Brominated flame retardant which comes under notation of ISO 1043-4 code number FR(42) [Brominated organic phosphorus compounds]	-
Poly(2,6-dibromo-phenylene oxide)	69882-11-7
Tetra-decabromo-diphenoxy-benzene	58965-66-5
1,2-Bis(2,4,6-tribromo-phenoxy) ethane	37853-59-1
3,5,3',5'-Tetrabromo-bisphenol A (TBBA)	79-94-7
TBBA, unspecified	30496-13-0
TBBA-epichlorhydrin oligomer	40039-93-8
TBBA-TBBA-diglycidyl-ether oligomer	70682-74-5
TBBA carbonate oligomer	28906-13-0
TBBA carbonate oligomer, phenoxy end capped	94334-64-2
TBBA carbonate oligomer, 2,4,6-tribromo-phenol terminated	71342-77-3
TBBA-bisphenol A-phosgene polymer	32844-27-2
Brominated epoxy resin end-capped with tribromophenol	139638-58-7
Brominated epoxy resin end-capped with tribromophenol	135229-48-0
TBBA-(2,3-dibromo-propyl-ether)	21850-44-2
TBBA bis-(2-hydroxy-ethyl-ether)	4162-45-2
TBBA-bis-(allyl-ether)	25327-89-3
TBBA-dimethyl-ether	37853-61-5
Tetrabromo-bisphenol S	39635-79-5
TBBS-bis-(2,3-dibromo-propyl-ether)	42757-55-1
2,4-Dibromo-phenol	615-58-7
2,4,6-tribromo-phenol	118-79-6
Pentabromo-phenol	608-71-9
2,4,6-Tribromo-phenyl-allyl-ether	3278-89-5
Tribromo-phenyl-allyl-ether, unspecified	26762-91-4
Bis(methyl)tetrabromo-phtalate	55481-60-2
Bis(2-ethylhexyl)tetrabromo-phtalate	26040-51-7
2-Hydroxy-propyl-2-(2-hydroxy-ethoxy)-ethyl-TBP	20566-35-2
TBPA, glycol-and propylene-oxide esters	75790-69-1
N,N'-Ethylene -bis-(tetrabromo-phthalimide)	32588-76-4
Ethylene-bis(5,6-dibromo-norbornane-2,3-dicarboximide)	52907-07-0
2,3-Dibromo-2-butene-1,4-diol	3234-02-4
Dibromo-neopentyl-glycol	3296-90-0
Dibromo-propanol	96-13-9
Tribromo-neopentyl-alcohol	36483-57-5
Poly tribromo-styrene	57137-10-7
Tribromo-styrene	61368-34-1

Table III: Hazardous substances in EEE already regulated by existing legislation

Substance name	CAS-Nr.	Main use in EEE	Hazard	Key Legal and Regulatory Information
Asbestos	12001-28-4 132207-32-0 12172-73-5 77536-66-4 77536-68-6 77536-67-5 12001-29-5	Brake lining pad, insulator, filler, abrasive, insulator, filler, pigment, paint, talc, adiabatic material	Carc. Cat. 1; R45 T; R48/23	76/769/EEC, Marketing and Use of Dangerous Substances and amendments: (83/478/EEC; 85/610/EEC; 87/217/EEC; 91/659/EEC; 99/77/EEC)
Specific Azocolourants and azodyes (which form certain aromatic amines)	Various	Pigment, dyes, colorants		76/769/EEC, Marketing and Use of Dangerous Substances and amendments: (2002/61/EC; 2003/03/EEC).
Ozone Depleting Substances and Hydrochlorofluorocarbons	Various	Refrigerant, foaming agent, insulation extinguishant		Regulation (EC) No. 2037/2000 on substances that deplete the ozone layer