To ECHA:

Our company supports the objective of avoiding emissions of hazardous substances into the environment and an appropriate regulation of uncontrollable risks posed by individual substances.

But as a semiconductor/chip and power electronics manufacturer, we do need derogations and even total exemption from this PFAS ban.

Therefore, we present you this following information.

Electronic manufacturer	**PfAS use:** PFAS, including both polymeric and non-polymeric compounds, are used all throughout the electronics industry, at different points within the supply chain. PFAS offer a number of key properties, such as flame retardancy, chemical inertness, hydrophobicity, and dielectric strength, which make them desirable for applications in electronic products because these typically involve high temperatures and voltages. In some cases, they are only used in the manufacturing process of a given product, which is an issue primarily for potential environmental contamination. However, in many cases they are purposefully added to a final product that is delivered to consumers, which then also creates human health concerns. This section of the guide describes products and processes which use PFAS and offers potential alternatives when available. The listed alternatives have only been assessed for their technical feasibility in replacing PFAS compounds at a basic level; typically, they are other compounds or products that have been demonstrated to be used for the same function and may not be feasible based on the specific needs of the product in question. Additionally, any specific products that are listed as alternatives have not been independently verified to be PFAS-free; they are listed based on claims from the manufacturers and/or information presented in safety data sheets and technical documents. No hazard assessment has been performed on the alternatives. For all the above reasons these potential alternatives need further investigation before substitution is initiated.
Semiconductor/chip manufacturing	**PfAS use:** Semiconductors are small electronic components primarily constructed from a semiconductive material, such as silicon, which then have integrated circuits constructed upon the semiconductive substrate (wafer). PFAS chemicals are extensively used through the fabrication process of the semiconductors due to their unique physiochemical properties. **Photolithography** Photolithography is the process of creating circuits on the semiconductor wafers. The process involves placing a thin layer of photoresist material on the wafer, and then exposing the wafer to UV light through a mask. The photoresist is then washed off on the exposed or unexposed areas and etching can be done in specific patterns. PFAS chemicals are used in multiple stages of the photolithographic process and their roles are described below.

	Photoresist Photoresist is a light-sensitive polymer that is applied to the semiconductor to facilitate the etching process. Light is used to transfer a pattern from a photomask onto the photoresist of the wafer; the photoresist is removed from the light exposed regions and structures can then be built upon the wafer. PFAS are found in the photoresist polymer itself and typically require the presence of fluorine. Potential alternatives for PFAS in the photoresist are Fujifilm's KrF (248nm) (active ingredient not disclosed) and DOW™ company's photo-resist products which are marketed as PFOS-free; however, other species of PFAS are potentially used in its place. 55 The photoresist process also requires the presence of photoacid generators (PAGs) that are typically fluorinated and can include PFAS compounds. Historically, PFOS was largely used as the PAG for this process before being phased out and PFBS, another PFAS chemical, being used as an alternative. Fluorine-free alternatives required for this process would need to be able to form a strong acid: acceptor-substituted thiosulfonate anions and acceptor-substituted aromatic anions may be suitable substitutes; however, no substitutes in-use have been identified. 56 There seem to be alternatives for PAGs and photoacid generators 62 but according to industry experts there is a need for further research and development of these. **Antireflective coatings** PFAS can also be used in photoresist itself as an anti-reflective coating to reduce reflections. The photoresist is washed off and etched off during the photolithographic process, so no PFAS from Check Your Tech Semiconductors the photoresist specifically should be on the final chip. Generally, for this use, fluoropolymers with a short fluoroalkyl side chain less than C4 are used and have a low refractive index. 25 Non-PFOS alternatives are available, but they seem to contain other PFAS. **Developers** PFAS are actively used as additives to developer solutions that facilitate the control of the development process. PFOS has largely been phased out as a developer in favor of shorter-chain PFAS alternatives; however, no fluorine-free alternatives in use were identified. The availability of alternatives is uncertain, but a patent for a non-fluorinated surfactant for this process has been filed. **Rinsing Solutions** Rinsing solutions are used to remove the photoresist of the wafer after having undergone a change in solubility. PFAS are reported to be additives in these rinsing solutions as they have low surface tension;56 however, their presence in these solutions on the market or potential fluorinefree alternatives have not been determined. **Etching** Etching is the step of selectively removing substrate on top of the wafer in order to create a pattern designed by the photolithographically process. There are multiple etching methods including wet and dry etching; both of which are reported to involve PFAS either as an additive in the etching solutions or is captured in the waste of the etching process. PFOS was the primary PFAS in use for etching applications; however, it has largely been phased out in favour of short-chain PFAS surfactants, which are confirmed to be in use for etching applications and

	etching agents with ceramic filters.58 PFAS are favoured in this process in general due to their reduction of surface tension and reflection in the etching solution. An example of PFAS in etching compounds are Daikin's dry etching agents which reportedly contain perfluorinated carbons. After the etching process, the silicon wafer needs to be cleaned to remove photo resist and polymer residue left behind; this is done with a strong acid. Chemours'Vertrel™ and Opteon™ specialty fluids are marketed for etching and wafer cleaning/drying processes. Recently , functional alternatives have been identified and successfully implemented to replace semiconductor etchant solutions that use PFAS surfactants including the replacement of Novec 4200 as a surfactant for Buffered Oxide Etchants, FC95 as a surfactant for Chrome Etchants, Novec 4300 as a surfactant for Phosphoric/Acetic/Nitric Acid Etchants, and Novec 4200 for Tetramethyl ammonium hydroxide etchants.64 15 Check Your Tech Semiconductors 16 **Wafer thinning** Wafer thinning is the process by which material is removed from the backside of the wafer in order to meet the required thickness. It is unconfirmed if PFAS are actively in use in the wafer thinning process; however, the use of PFAS as a non-stick coating composition on the carrier wafer for wafer thinning has been patented (patent US20130201635). 3 A low surface tension for the chemical is required for this process. **Vacuum pumps** Perfluoroalkoxy alkanes (PFA) and fluoropolymers are used in the working fluids of vacuum pumps. Chemours'KrytoxTM line of products are used as vacuum pump oils and contain PFPE. Alternative chemicals for this use would need to be stable and non-reactive; 3 however, there do appear to be vacuum pumps for semiconductor applications that are oil-free, indicating that the use of PFAS-containing vacuum pump oil might be engineered out. **Vapor phase soldering** PFAS are used in vapor phase soldering and act as a heat transfer medium. This requires the additive compound to have good heat conductivity. PFPEs are primarily used for this process and is in products such as Solvay's Galden®LS/HS products line. 46 No alternatives to PFAS were identified for its use in vapor phase soldering. **Components** Certain micromechanical semiconductor components (MEMS) contain PFAS in the final product. Due to their ability to be formed in very thin layers, high temperature stability, and non-stick properties, they are used in MEMS accelerometers and image sensors. These are used in the electronic automotive safety systems of vehicles and some medical equipment, as well as consumer products such as smartphones, tablets, and wearables. 27 No alternatives were found for these applications of PFAS. **Inert equipment** There are many processes within the semiconductor manufacturing process which require components to be chemically inert and stable, such as moulds, piping, chemical containers, and reaction surfaces. 3 Depending on the specific product or process, there are a variety of

	potentially suitable alternatives. As mentioned in other sections, there are a variety of non-fluorinated polymer. **We need a permanent derogation/total exemption from PFAS ban for semiconductors/chip manufacturing.**
	Consequences of ban: **Absolut and catastrophic.** Without Power Electronics and semiconductors/chips production in Europe we will not be able to reach the goals of the Green Deal. We would get into an absolute dependency to other countries like China. This will also include sectors like Medical, Military, Science, CO2 reduction and Tech in general. And if Europe tries to buy chip and power electronics in other region of the world prices and availability of these product will be jeopardised. Consequences to SEMIKRON would be absolute and catastrophic as well. **We would have to lay off ca. 2200 people in Europe and lose up to 500 Mio. Euro per year.**
	Release of PFAS to environment: Is very low, because these means of production containing PFAS are mostly big stational machines, like sinks, tubes, tanks, and transportation trays for wafers/chips.
	Costs of ban: Extremely high. 500 Mio. Euro per year, and because it is a booming market, up to 1000 Mio. per year from next year onwards. It would be the end of our company.
Back-end soldering (Attaching chip to PCB)	**Pfas use:** **Semikron used PFAS in two processes.** 1. Sintering chip on PCB via mechanical pressure and heat. In this process we use a Teflon foil to protect the chip/PCB from the mechanical pressure needed to attach the chip to the PCB. Alternatives materials do not perform as good and are not practical. 2. Sintering chip on PCB via vapor phase soldering In this process we use Galden as vapor to transfer the needed heat to attach chip on PCB. During the manufacture of various electronic products there is a need for heat transfer fluids, typically to control temperatures during fabrication of various components. There are several different methods for doing this, each with their own selection of products marketed for the task, including evaporative cooling, brine cooling, direct contact cooling, and total immersion cooling. In each of these cases, some of the leading products on the market are fluoropolymers and other PFAS-containing

	compounds. These include the product lines GaldenTM, by Solvay Solexis, FluorinertTM, by 3M, and VertrelTM, by Chemours, among others. Perfluorinated compounds are used for this purpose because of their large liquid temperature range, high dielectric strengths, and chemical inertness. While these products seem to be marketed as the best performing fluids on the market, there are non-fluorinated alternatives. Eastman Therminol® heat transfer fluids are hydrocarbon based, with a variety of temperature ranges and other properties available. 34 After use, they are considered nonpetroleum waste oil. Caldera Heat Transfer Fluids claim to be environmentally friendly, and that they can be disposed of using mineral oil recycling services. The company Engineered Fluids calls out PFAS as harmful to human health and the environment, and makes products based on ester chemistry, with the claim that they are biodegradable. 36 MIVOLT® products are specifically marketed as dielectric fluids for liquid immersion cooling and are listed as halogen free and readily biodegradable.
	Consequences of ban: Both above mentioned processes would have to be replaced. This will lead to high costs. **We need at least a 6,5-year derogation period for this.**
	Impact on enviroment: Medium, because the used PFAS could be put into a recycling process.
	Costs of ban: **High**
Cables and connectors	**Pfas use in:** Insulation of cables and connectors.
	Consequences of ban: We would have to find suppliers, that do provide PFASs free cables and connectors. First market analysis has shown that this will be very difficult, because up to now we have not spotted alternative suppliers**.** Another ubiquitous electronic product category is wiring and cables. The insulating layer around the outside of each wire or cable can be made from a variety of plastic or rubber materials and are often made from fluoropolymers due to their resistance to heat and fire, corrosion, moisture, and cracking. 3, 22,23, 24 Teflon and other fluoropolymer cables and wires are widely available and used in many applications across industries. The best alternative will depend on the specific function needed, but there are many options available, including PVC, PP, PE, neoprene, silicone, and others. **We need at least a 13,5-year derogation period for this.**
	Impact on enviroment:

	Costs of ban: **High**
MRO **M**aintanance **R**epair **O**verhaul **A:** from us to costumer **B:** from supplier to us	**Pfas use because of:** **A:** We use PFAS in a various number of cables and connectors and in some polymeric housings. Because the data from our suppliers is weak regarding PFAS, we do not know how many parts are containing PFAS. Still, we are bound by contracts to provide spare parts to our costumers for long periods of time (sometimes 10years). **B:** We are using some PFAS substances in our means of production. Although we put a lot of effort of find PFAS in our machinery, but data is weak. We simply don't know where PFAS are in our machinery, because we bought them in the past. It is not possible to get this kind of information from our suppliers. **We need a permanent derogation/total exemption from PFAS ban for spare parts and MRO.**
	Consequences of ban: A: With a ban we will not be able to fulfil our contract duties regarding spare parts, which will lead to massive financial consequences. B: It will be very expensive and not sustainable to buy new machinery every time a machine manufacturer can't support spare parts, because they are containing PFAS.
	Impact on enviroment: A: It will be not sustainable if our customers have to renew their machinery, if we can't provide PFAS containing spare parts. B: It will be not sustainable if we would have to renew our machinery if the manufacturer can't provide PFAS containing spare parts to us.
	Costs of ban: A: Very high B: Very high

General Points	**Essential use concept:** We as a company find it very disturbing, that ECHA is not defining a essential use concept for this PFAS ban. We also do recommend to use the "normal REACH" procedure to handle this PFAS topic. This would give the industries the needed time to look for and qualify alternatives.

	Polymers of low concern: We do need the use of the “Polymers of low concern” as defined by the OECD. These substances do not harm environment or animals or people but are essential to power electronic and semiconductor/chip production.
	Legal consequenses: Semikron as a chip manufacturer has received government founding to produce semiconductors/chips in Germany. This would not be possible with a ban of PFAS. Therefore, **We need a permanent derogation/total exemption from PFAS ban for semiconductors/chip manufacturing.**
	The Unknown Unknown: There are still many data gaps regarding the use of PFAS in the electronics industry. The specifics of most manufacturing processes and formulations of final products are not disclosed to the public, and therefore the true extent of PFAS use is not fully understood. While PFOS and PFOA have been restricted under the Stockholm Convention since 2009 and 2019, respectively, and therefore have largely been phased out, in many cases they have been replaced by other, shorter chain, PFAS. Additionally, the various manufacturers in the industry that were spoken to as part of the development of this guide indicated that they were all in early stages of the process to identify PFAS within their supply chain and identify potential alternatives. This suggests that more information on the use of PFAS within the electronics industry is constantly generated and will hopefully add to the currently available resources as time goes bon. Provided examples of alternatives will not work in all scenarios, based upon the specific physical and chemical properties needed to fulfil the function currently performed by PFAS. Industry has noted that in many cases, finding an exact ‘drop in’ replacement for PFAS is not always feasible. For example, substituting a new product or compound in place of one that contains PFAS may also require other changes to the product to accommodate any changes in size, resistance, or other differences between the alternative and the PFAS compound. In some cases, suggested alternatives could turn out to contain PFAS themselves (either intentionally added but not disclosed, or as impurities).