



Freiburg and Glenrothes Locations

“Preserving what we value”

Preserving natural habitats – Part of our corporate philosophy

Editorial

I have been CEO of TDK-Micronas since January 2018, and am delighted to be part of a leading global semiconductor company. During my first few months in the many different sectors of our organization, I have seen time and again that environmental awareness is not just a short-term trend. The urgency of preserving our natural habitat has also manifested itself in our entrepreneurial principles – both for us and for our parent company TDK. We at TDK-Micronas are currently implementing environmental projects that will in future save around one million kilowatt-hours a year. We already have the necessary permits as regards immission control as well as approval from the water authorities. You can find an overview of all our environmental projects on page 4.

The most important factors at present as regards changes in the automotive industry are the ever stricter legal regulations, especially in the field of emissions. Car manufacturers must comply with customers' demands for increased driving comfort, optimal engine performance and greater driving enjoyment and, at the same time, must reduce not only fuel consumption but also carbon dioxide (CO₂) and nitrogen dioxide (NO₂) emissions. The electronics of modern automotive applications require sensors with ever higher integration density, and at the same time they must meet the increasing demands on robustness, reliability and energy efficiency. Sensor manufacturers like TDK have to satisfy this constantly increasing call for innovation and reduced costs by coming up with tailor-made sensor solutions for a variety of automotive applications.

As the competence center for magnetic field sensors within the TDK Group, we are not only responsible for marketing Hall sensors, we are also responsible for TMR sensors (based on the magneto-resistive tunnel effect). One

possible application for this type of sensor is in so-called „mild hybrids“. This means replacing conventional combustion engines with a relatively small electric motor (up to 15 kW) instead of the alternator. This motor can support the combustion engine with additional electric torque (boost), and can, while braking, feed electricity back into the energy storage system (energy recovery) and start the combustion engine. The fuel saving results from the mix of unpowered driving, electrical driving and energy recovery. Raw nitrogen oxide emissions can, during acceleration and when driving under high loads, be reduced by up to 20 %. With the energy recovery, it is the electric motor that slows down the vehicle instead of the brakes. Consumption can be reduced in this way by a further 4 %. To control the electric motor, the motor angle position must be calculated very precisely. Because of their long-term stability and high precision, TMR sensors are particularly suitable for these applications.

TDK is continuing to drive the expansion of its Sensor Systems Business Company, to which we also belong. In March 2017, TDK-Micronas took over the Belgian IC design company, ICSense. Its core business is the development and marketing of ASICs for the automotive, medical technology, industry and consumer segments. ASICs read out the recorded measurements of sensor products for example with pressure or temperature sensors and process the signals. ICSense has one of the largest development departments in Europe for such ASICs, with first-class know-how in analog, digital, mixed signal and high-voltage technology.

Because of the volume of certain hazardous materials, TDK-Micronas is classified as a „lower-category operating segment“ in the 12th Federal Immission Control Act (ger.: Bundesimmissionschutz-Verordnung (engl.: hazardous

incident ordinance). Through the amendment to this act at the beginning of 2017, we were given further obligations. As a result we declared the operating segment of TDK-Micronas in Freiburg as such an operating segment. We provided the supervising authority with information on the type of hazardous substances and the quantities involved, and made an information sheet available to the general public for download in line with § 8a on our Internet site www.micronas.com.

The continuing growth of the Freiburg population is leading to a considerable surplus in demand on the very tight housing market. The city of Freiburg is therefore planning a residential area near to the industrial area Nord on which the TDK-Micronas operating segment is situated. According to Germany's immission control act, any plans for building development in the vicinity of the plants must be subjected to an examination under the hazardous incident ordinance, and the risks of an incident must be estimated and evaluated. This takes the form of an expert report that is currently being drawn up.

Global climate change is one of the big ecological, social and economic challenges of the 21st century. To master this challenge, everyone is called on to make a contribution. We at TDK-Micronas support these targets, not only with our products, but also through our day-to-day commitment to achieving our energy and climate protection targets in our production processes, as is described in the following article dealing with the example of successful copper reduction in the effluent.



Günter Weinberger
Chief Executive Officer TDK-Micronas





Preserving what we value – “End-of-Pipe” starts at the beginning

Environmental Projects

Things are the same today as they were fifty thousand years ago¹: Since man began shaping and creating objects with his hands according to his own ideas, traces of his work have been preserved for future generations, sometimes over thousands of years.

Modern Times

Nowadays, modern industry and the consumer society create a wide range of goods and products². To produce them, numerous raw materials and resources are used in a wide variety of different manufacturing processes, and a large number of substances are produced that harm our environment and impair our future. These harmful materials need to be eliminated according to ever stricter European and German legislation³, or at least be reduced to a level that is compatible with the environment. Not least for this reason, the measures that have become available for this purpose in environmental (protection) technology⁴ have, in the last few decades, developed at a rapid rate, and a social and ecological sense of responsibility has become established in our personal lives and, across countries and cultures, throughout the world^{5, 6, 7, 8}.

End-of-Pipe or process-integrated approach – either or?

Traditionally, a distinction is made between two fundamental types of environmental protection solutions for preventing or reducing effects on the environment through production processes:

1. *End-of-Pipe solutions* that take effect not at the place they originated (individual production process), but at the

end of a whole chain of production processes as so-called „downstream measures“. End-of-pipe solutions must, in a highly complex process, safely treat large volume flows of different mixtures of harmful substances from various production processes under changing operating conditions.

2. *Process or production-integrated solutions*, which reduce the effects on the environment at source under easily manageable operating conditions by treating harmful substances with tailor-made, material-specific measures integrated into the production process.

End-of-Pipe and process-integrated approach – not only but also!

In the manufacturing process used for our elements, the tinning of the copper contacts is performed in an electroplating process. In 2008, in electroplating, the chemical recipe in the copper surface treatment process was improved. In 2016, by revising and optimizing the electrochemical copper deposition inherent in the process, a significant stabilization of the copper concentration in the process was achieved, and the reproducibility in the process control was increased – which also led to consistently lower copper concentrations in the electroplating effluent to be treated.

With the modified bentonite used in the electroplating effluent treatment (end-of-pipe solution), it was possible even before 2016 to achieve low concentrations below the copper threshold, with which the now optimized copper deposition integrated into the electroplating production process (process-integrated

solution) has been further reduced. This means that 99% of all metal concentrations measured in the in-house control of the treated electroplating effluent are below the respective half threshold value, nearly three quarters are lower than 10% of the relevant threshold and as much as two thirds are lower than the respective analytical determination threshold.



Team Facilities (l. to r.): B. Bohnert, E. Stoeckl, M. Ratescu, J. Matuschek, C. Scholl, A. Borrozzino, (not shown: C. Hatsch) and Dr. C. Mueller

Responsibility and commitment

A general for and against one or other kind of environmental protection measure is simply not possible at TDK-Micronas in our demanding, complex semiconductor manufacture, as is shown by the example of the copper in the electroplating and effluent treatment processes. The overall production interrelationships, the environmental regulations and the environmental possibilities always have to be carefully weighed up against each other, as does our responsibility for ourselves, for our environment and for future generations^{9, 10}.

Dr. Christian Mueller
Head of Facilities

¹ T. Montenari, C. Brehm, discussion contributions.

² Schwerpunkte 2017 – Jahrespublikationen des Umweltbundesamt, Umweltbundesamt (ed.), Dessau-Roßlau 2018, www.umweltbundesamt.de/publikationen/schwerpunkte-2017.

³ Vorschriften, Gewerbeaufsicht Baden-Württemberg, Zentrale Stelle für die Vollzugsunterstützung (ZSV) beim Regierungspräsidium Tübingen, Tübingen 2018, www.gaa.badenwuerttemberg.de/servlet/is/16032/.

⁴ GreenTech made in Germany 2018, Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit (ed.), Berlin 2018, www.bmu.de/fileadmin/Daten_BMU/Pool/Broschueren/greentech_2018_bf.pdf.

⁵ Healthy environments for healthier people, WHO regional office for Europe, DK-2100 Copenhagen 2018, www.euro.who.int/en/about-us/organization/office-locations/who-european-centre-for-environment-and-health-eceh-bonn-germany/healthy-environments-for-healthier-people-2018.

⁶ United Nations Framework Convention on Climate Change (UNFCCC), United Nations, New York, <https://unfccc.int/>.

⁷ World climate conferences: from COP 1 (Berlin 1995) to COP 23 (Bonn 2017), www.cop23.de/.

⁸ WHO – Public Health, Environmental and Social Determinants of Health, World Health Organisation, Genf, www.who.int/phe/en/.

⁹ CSR Activities – Environment, TDK Corporation, Tokyo 2018, www.global.tdk.com/corp/en/csr/environmental_responsibility/index.htm.

¹⁰ Environment at TDK-Micronas, TDK-Micronas GmbH, Freiburg 2018, www.micronas.com/en/company/environment.



Overview of current and planned projects

Freiburg and Glenrothes locations

Environmental Projects

Subject	Goal	Measure	Dept. responsible	2017	2018
Waste management	Reduction in the spent acids for disposal by 450 kg / day, of which spent hydrofluoric acid by 270 kg / day	Elimination of spent acids during production stoppages	Waferfab	●	
Energy management	Electricity savings of approx. 10,000 kWh / year (2 t CO ₂ / year)	Electricity saving by relocation of hazardous substances in the warehouse and optimization of the fan efficiency	Plant Engineering and Facilities	○	○
	Electricity savings of approx. 10,000 kWh / year (2 t CO ₂ / year)	Switch to LED technology in buildings		●	●
	Natural gas and electricity savings of approx. 400,000 kWh / year (76 t CO ₂ / year)	Renovation of office buildings 9, 12		●	
	Natural gas and electricity savings of approx. 36,000 kWh / year (7 t CO ₂ / year)	Roof renovation office building 3a, part of building 7 (both rented areas)			●
	Electricity savings of approx. 33,000 kWh / year (10 t CO ₂ / year)	Electricity savings through new generation of end-testers and 8-fold test	Backend Test in Freiburg and Glenrothes	●	●
	Electricity savings of approx. 147,000 kWh / year (72 t CO ₂ / year)	Conversion to LED technology	Testcenter Glenrothes	●	●
Resource management	Savings of approx. 25,000 m ³ / year of municipal water and 85,000 kWh / year electricity (17 t CO ₂ / year)	Utilization of groundwater for cooling purposes with the continued use of installed sections of the groundwater remediation facility	Plant Engineering and Facilities	●	●
	Annual savings of approx. 42 t chemicals, 2,600 m ³ water and 315,000 kWh electricity (53 t CO ₂ / year)	Optimized wafer cleaning	Waferfab	●	●
Immission control	Cutting CO ₂ emissions by 1 t / year	10 E-bike and 2 E-car charging stations installed	Plant Engineering and Facilities	●	
Health protection	Encourage health care among the workforce	Health campaigns: - Industry bikes in Industriegebiet Nord - Course for successfully losing weight - Tips on mindfulness topics	Working group on health protection	●	
		New offers: Conflict mediation		●	
		Health campaigns: - Offer of a medical check-up (B2Run check-up) and running training to take part in the Business Run - Support of the TDK-Micronas team for the soccer tournament in Industriegebiet Nord			●

Legend:

● Implementation

○ Extension

● Completed, goal achieved



TDK-Micronas within the MSBG of TDK

Facts and Figures

FACTS AND FIGURES

TDK in T122

- ◆ Sales of around USD 12 billion
- ◆ 103,000 employees worldwide

TDK-Micronas in T122

- ◆ Part of the Magnetic Sensors Business Group and the Competence Center for magnetic sensors of the TDK Group
- ◆ Operational management and production in Freiburg, Germany
- ◆ Design center in Haar (Germany)
- ◆ Test center in Glenrothes (Scotland)
- ◆ Take-over of the IC design company ICsense in Leuven (Belgium)
- ◆ 1050 employees worldwide, of which 874 in Freiburg
- ◆ Investment and ongoing expenditures in corporate environmental protection in Freiburg:

Magnetic Sensors Business Group Vision:
"Be a World No. 1 Magnetic Sensor Supplier."

Investment and ongoing expenditures in operational environmental protection (waste management, water protection, soil decontamination, noise reduction, air pollution control, climate protection, nature protection, landscape conservation, energy generation and control) in Freiburg

	Mio. Euro
2014	5.8
2015	1.6
2016	1.7
2017	1.8

Test center in Glenrothes

- ◆ 85 employees
- ◆ Energy consumption 2.8 GWh, equivalent to 1,361 t CO₂
- ◆ The important environmental aspect is the electricity consumption and the CO₂ emissions connected with it
- ◆ Most important waste fractions: 3.2 t paper and board, 2.2 t plastics and 11.8 t metals into recycling; 2.8 t of waste similar to domestic-like waste for disposal
- ◆ No notifiable accidents

Certificates

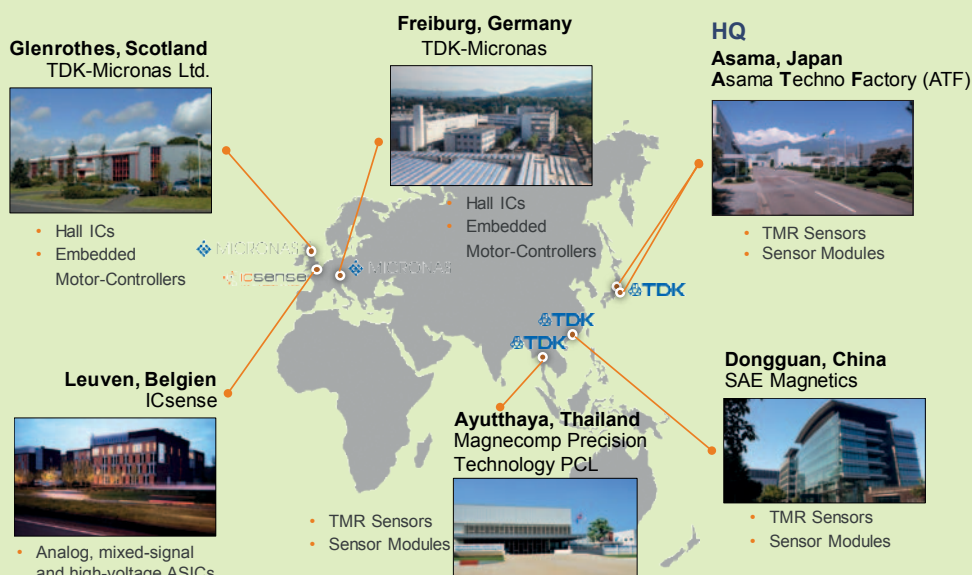


ISO 14001 Freiburg



ISO 14001 Glenrothes

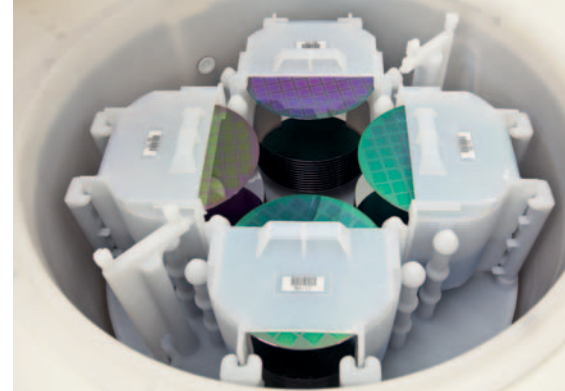
Magnetic Sensors Business Group Locations



EMAS Freiburg



Fire Prevention Certificate (SISTA) Freiburg



Environmental Data

Freiburg Site

Environmental Data in T122

The following charts show the core indicators for the Freiburg operating segment. By publishing these figures, we comply with the requirements of Regulation (EC) No. 1221/2009, the so-called EMAS regulation. The bar charts show the absolute consumption figures, while the linear diagrams show the consumption normalized to the total gross value added – the so-called „core indicators“. The core indicators themselves are related to the reporting period of this issue of EnvironmentalNews. Whereas in previous years, the reporting period was always the calendar year, we have now adjusted the reporting period to the fiscal year of TDK. The fiscal year of 2017 began on April 1, 2017 and ended on March 31, 2018.

The consumption figures for the missing quarter from January 1, 2017 to March 31, 2017 are shown in the bar charts as Q1/2017. Normalization to the total gross value added over the last four years ensures the required comparability of the consumption data.

Primary energy factors, CO₂ emission factors, data on renewable energies of the power supplier and accident figures from the employers' liability insurance association are only available for the calendar year. Investment and ongoing expenditures also relate to the calendar year as do data that are sent recurrently to the statistical office or federal office.

Energy consumption

The total direct energy consumption from electricity and energy sources and the proportion of consumed renewable energy are shown in the following table. The energy consumption taking into account the relevant primary energy factors (PEF) are shown in the bar charts below. The line shows the energy consumption normalized to the total gross value added.

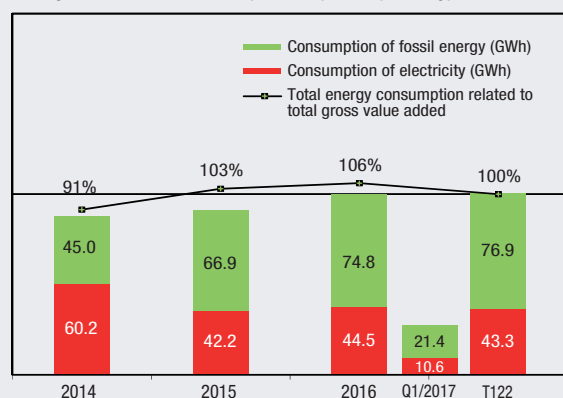
The photovoltaic unit generated around 233,000 kWh in the reporting period T122 which was fed into the public grid.

TDK-MICRONAS GMBH FREIBURG

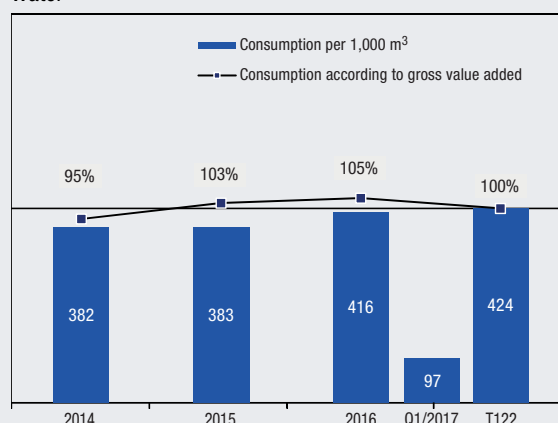
— Absolute consumption

— Consumption related to the total annual gross value added in %, normalized to the fiscal year T122

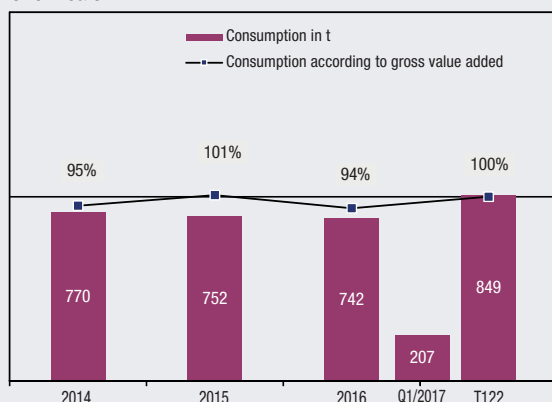
Consumption of electricity and fossil energy sources, taking into account the respective primary energy factor.



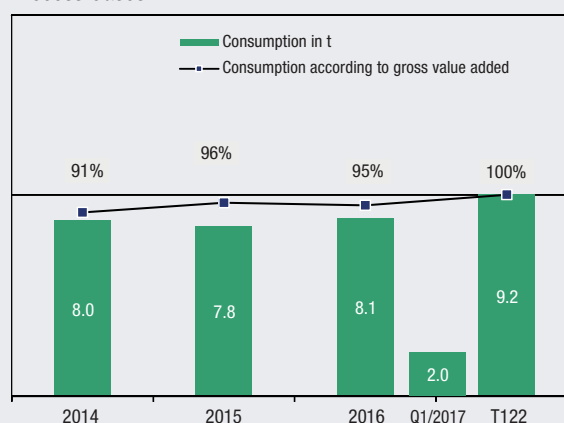
Water



Chemicals



Process Gases





Environmental Data in T122

Year	Total energy consumption in GWh	of which from renewable energy sources in GWh (proportion of total energy consumption)
2014	90.6	36.3 (40%)
2015	95.6	25.4 (27%)
2016	103.7	24.7 (24%)
T122	103.9	22.5 (22%)

Other environmental data

- The natural gas consumption (for heating and for electricity and heat generation in the co-generation unit) of just under 70 GWh according to GEMIS* corresponds to equivalent emissions of 102 kg SO₂, 5,600 kg NO_x, and 70 kg of dust, which are regarded as insignificant environmental aspects

- The sealed area (core indicator biological diversity) is 39,200 m², the unsealed area is 12,300 m². Both figures have remained unchanged for many years.

- The recycling quota for the entire waste produced is very high at 99.5%.

Occupational safety and health protection

At TDK-Micronas in Freiburg, the accident figures are well below the comparative index of the employers' liability insurance association. In the 2017 calendar year, there were three minor notifiable accidents at work.

Emergency management

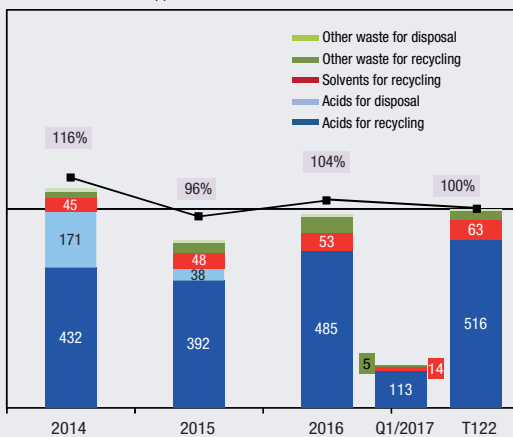
The operational capability of the emergency task force was tested in 25 exercise drills with the 24 members of the force, including two exercise drills at the respiratory protection facility of the Freiburg professional fire department. The safety officers on duty who have responsibility in the production areas in the event of an alarm were given routine training.

*Global Emissions Model for Integrated Systems

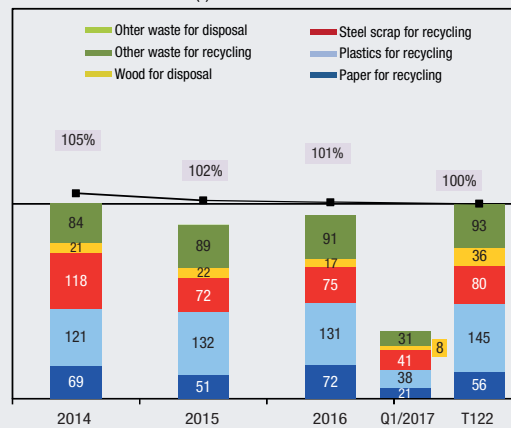
WASTE

- Waste in t
- Waste referring to gross value added in %, normalized to the year T122

Hazardous waste (t)

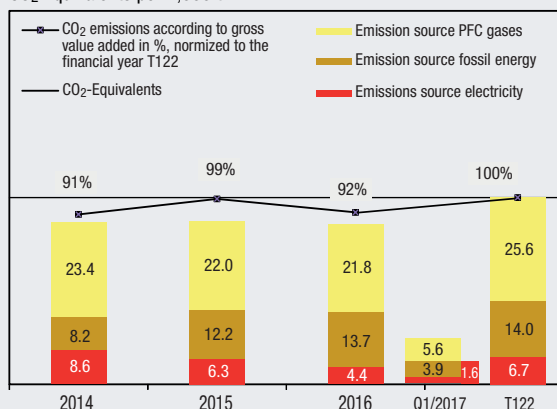


Non-hazardous waste (t)



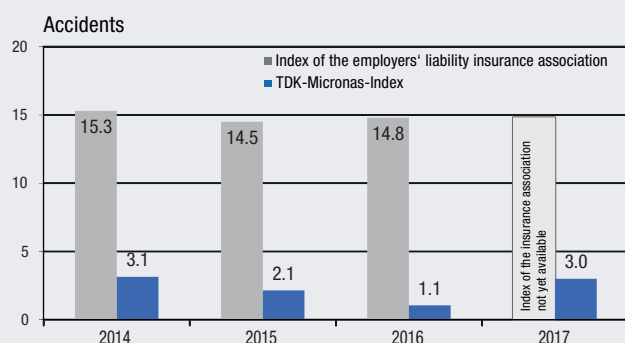
CO₂ EQUIVALENTS

CO₂ Equivalents per 1,000 t



ACCIDENTS

Notifiable accidents per 1,000 employees in the last four calendar years





Environmental statement

The next consolidated Environmental Statement will be submitted for validation at the latest in July 2020. The next updated Environmental News will be submitted for validation in July 2019.

Environmental Verifier / Environmental Verifier Organization

The authorized environmental verifier / environmental verifier organization are as follows:

Dr.-Ing. R. Beer (Permit No. DE-V-0007)
Intechnica Cert GmbH (Permit No. DE-V-0279)
Ostendstr. 181
90482 Nuernberg

Validation

Dr. Reiner Beer, with EMAS environmental verifier registration number DE-V-0007, accredited or licensed for the scope 26.1 (NACE Code Rev. 2), Manufacture of electronic components and boards, declares to have verified whether the site as indicated in the consolidated environmental statement with registration number D-126-00053 meets all requirements of Regulation (EC) No 1221/2009 of the European Parliament and of the Council of 25 November 2009 on the voluntary participation by organizations in a community eco-management and audit scheme (EMAS), supplemented by Regulation (EU) No 2017/1505 amending Annexes I, II and III to Regulation (EC) No 1221/2009.

By signing this declaration, I declare that

- the verification and validation has been carried out in full compliance with the requirements of Regulation (EC) No 1221/2009,
- the outcome of the verification and validation confirms that there is no evidence of non-compliance with applicable legal requirements relating to the environment,
- the data and information of the updated environmental statement of the site reflect a reliable, credible and correct image of the site activities, within the scope mentioned in the environmental statement.



Nuremberg, July 2018

Dr. Reiner Beer, Environmental Expert

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