based on steady solid-state technology with high power efficiency and total parametric control. All the modules are powered by low-voltage DC supply, tested for CW and pulsed power modes and enclosed in shielded metal cases, ready for forced-air or liquid cooling with minimum assembling effort.

LEANFA also offers user-friendly evaluation kits for a quick *plug&play* assessment of the new solid-state technology and compact benchtop generators for a trouble-free laboratory use, perfect for universities and research centres that need flexible and reliable tools for their experimentation programs.

The most recent and valuable developments are mainly focused on the medical world, where LEANFA has recently completed the development of complete medical-grade equipment based on radiofrequency, microwaves and laser technologies, combining high-quality hardware construction with sophisticated software design, in line with the relevant international standards.

About the author

Marco Fiore received his M. Sc. degree in electronics engineering at Politecnico di Bari, Italy. He has worked for more than 15 years in the field of digital telecommunications and broadcasting, from design tasks to operational management, always dedicated to implement deep interaction between high-frequency power electronics and programmable digital devices. He is co-founder of LEANFA in 2014, fully devoted to foster new business opportunities in Industrial, Scientific and Medical fields by means of innovative solid-state generators powered by distributed software applications.

The Muegge Group

Markus Dingeldein

Muegge GmbH, Hochstraße 4 – 6, 64385 Reichelsheim, Germany
Contact E-mail: Markus.Dingeldein@muegge.de

The MUEGGE Group is a leading manufacturer and supplier of function-critical industrial microwave components, systems and plasma sources with a strong global presence.

Founded in 1979 and headquartered in Reichelsheim, Germany, the MUEGGE Group employs approximately 170 people and provides solutions for a wide range of industrial applications, such as growth of lab-grown diamonds, processing of food and semiconductor components, drying processes, molecular extraction in chemistry, and hydrogen production for customers in more than 40 countries.

To serve our global customer base close to their requirements, we rely on a network of partners and operate successfully in the American market with our subsidiary MUEGGE Gerling (formerly GERLING APPLIED ENGINEERING, INC). At present, about 25 employees work at the location in California including a production facility for customized magnetrons, isolators and waveguides. Our customers can also rely on a network of competent, specialized partners in Asia.

As a strong employer in our region, it is important for us to show responsibility for the environment. To reduce our CO_2 footprint, we installed a photovoltaic system on all three building roofs in 2022, with a total output of 200 kWp. MUEGGE is a founding member of the "Unternehmensnetzwerk Klimaschutz - Eine IHK-Plattform" (Network - Corporate Network Climate Protection (klima-plattform.de)) and a participant in the UN Global Compact in Germany (MUEGGE GmbH | UN Global Compact).

Thanks to its advanced and sustainable technologies, MUEGGE is a sought-after partner in a wide range of industries and is already contributing to solutions for future topics such as

Power-to-X or lab-grown diamonds for technical applications. A special role is played by MUEGGE Food Solutions, whose solutions raise food to a new level in terms of quality, shelf life, safety and resource conservation. For example, MUEGGE technology reduces food waste and creates new possibilities for packaging high-quality food sustainably (reduction of plastic).

With our new member of the MUEGGE Group LEANFA, we are now also working to have the right energy in the right place at the right time with solid-state technology. Once again, a warm welcome to the great LEANFA team!

Spotlight R&D

The CiMPAS Air pasteurization tool for ready meals with its specific antenna technology is a result of our strong R&D and engineering team. Beside modeling and design of antenna systems to optimize homogenous and efficient distribution of microwave into certain processes, we are taking the generators to the next level of I4.0 to push digitalization and optimize smart processes.

To support climate-sensitive and energy related demand for new, emerging technologies, the team is working on a variety of high-power microwave driven plasma sources. The existing sources are optimized to the maximum power level with optimized conversation rate and plasma stability. In addition to the internal further development of plasma sources, individual optimizations for the customer process take place in a large number of projects. Process ranges from 0.1 bar - 5 bar, flows from 10 l/min - several 1000 l/min, power levels from 0.5 kW -100 kW, many different process gas mixtures and flow characteristics are reached.

Novel plasma source and microwave antenna concepts are discussed, designed and tested in the team in order to promote innovation through new ideas in the application of microwaves and microwave plasmas to best serve future markets.

In addition to the further development of the plasma sources and microwave components themselves, the microwave generators at MUEGGE are also continuously developed in order to offer customers the latest technological possibilities, e.g.: Optimized process stability, controllability, operability, efficiency, digital integrability and uptime. Here, a strong software and a future-oriented power electronic department ensures the successful development.

MUEGGE and its R&D team maintain close relationships to several European universities and research institutions to jointly develop in future-oriented, promising technologies. Together with the partners, more efficient photovoltaic cells are developed in the German project PlasCon. In a second project called NexPlas, funded by the German Federal Ministry of Education and Research, CO_2 and H_2 are converted into CH_3OH and O using microwave plasma processes. The use of microwave energy in industrial chemical processes is being investigated in the European project SIMPLI-DEMO. MUEGGE also participates in various projects in an advisory capacity and picks up new impulses by participating in workshops, meetings, congresses and conferences and realizes the step from the idea in the laboratory to the commercially usable innovation with academic and industrial partners.

AMPERE is a great platform to bring academia and industry closer together, which is important to combine knowledge and demand from both sides. Spoken in microwave, a great power-combiner!

Moreover, AMPERE is a great network between European and Overseas countries, which is so important in today's world.

LEANFA's R&D team in Ruvo di Puglia is working on various medical devices such as medical multi-probe applications, in addition to solid-state modules. Promising developments enabled by the extreme flexibility of parametric control of solid-state generators include advanced volumetric control of multi-probe applications and self-regulated treatments driven by real-time feedback from thermal and electromagnetic sensors. Other applications include the treatment of bone-metastases with radiofrequency, pain therapy

and lung-cancer treatment with microwave ablation.

About the author

Markus Dingeldein, pioneer and expert in microwave technology, looks back on many years of experience in the company. Over the past 27 years, the electrical engineering graduate has held various management positions in operations and sales, most recently heading the global sales organization. In the future, he will drive further internationalization.

Ricky's Afterthought:

Processing of plastic waste revisited

A.C. (Ricky) Metaxas

Life Fellow St John's College Cambridge UK
Email: acm33@cam.ac.uk

We use plastics at an accelerated rate. It is everywhere, packaging in shops and in industry, in hospitals and at home. The simple fact is that we cannot do without it and searching for alternative materials can be counter-productive because of the obvious benefits of plastics. However, the numbers are staggering. A recent report quotes that 400 Mt (million metric tonnes) of plastics are produced annually with Americans having generated some 220 kg per person in 2019 while the equivalent figure in Europe was 121kg. So it is evident that we have to manage this amount of plastic and after use not to damp it in landfills or in the sea which has adverse effect in marine life and its ecosystem.

By far the most used plastics are high density and low density polyethylene followed by polypropylene and polyvinyl chloride. Other plastics include polystyrene and polyethylene terephthalate are used to a lesser extent.

Back in the early 1980's when the "Yellow Bible" was published I wrote in Chapter 11 on Industrial Applications that pyrolysis using microwaves had been studied and specifically on page 312 microwave pyrolysis of coal in a discharge.

This Newsletter has on numerous occasions highlighted the work that emanated from the Chemical Engineering Dept at Cambridge University using high power microwaves for pyrolysis of a variety of plastic waste. This work has culminated in the company Enval which currently specialises in the processing of aluminium/plastic laminates in an applicator in the presence of carbon which acts as a catalyst absorbing the microwaves and imparting the energy to the laminates. Plastic laminate is lightweight and is preferred to other designs as it is flexible and protects the contents from oxygen, water and light. The amount of laminates that have to be processed in the UK is a staggering 160000 tonnes used in packaging of fruit juices, cosmetics and toothpaste.

The latest information is that SAIREM is supplying the magnetrons to power the propriety system. A typical Enval plant operates at a feed rate of up to 350 kg per hour, which roughly means it can process up to 2000 tonnes per annum. They collaborate with Kraft Heinz and Sonoko in the USA to investigate methods of plastic recycling and processing of the huge waste discussed above.