Notes from the SmarterWorld RF Energy Summit

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The *SmarterWorld* RF Energy Summit was held on Oct. 17, 2017 in Erding (close to Munich), Germany. The meeting was organized by the RF Energy Alliance (RFEA). The following is a reflection of this meeting as presented by Mr. Heinz Arnold on behalf of the meeting's organizers.

How RF energy is changing the world?

Semiconductor lasers have changed the world as have low-cost mass storage devices. The fact that light can be controlled electronically has revolutionized lighting technology. And now, the generation of RF energy using solid-state RF energy technology is leading to a similar revolution:

"We are at a turning point. In many industries, we no longer have to explain what it is all about. Developers in some sectors have already become aware and they want to know exactly how they can use RF energy in their systems," said Dr. Klaus Werner, Executive Director of the RF Energy Alliance, at the *SmarterWorld* RF Energy Summit. Here, *SmarterWorld* brought together the tight-knit community of pioneers in the field of transistors and amplifiers with manufacturers of the other components needed to build RF energy subsystems. Since integrators and representatives of the supply chain as well as potential users from a wide variety of industrial sectors were also present, the participants were able to obtain comprehensive information about what the new technology is capable of and how it can be used efficiently and economically.

In his overview of the current technical and economic status of RF energy technology, Dr. Klaus Werner indicated one thing in particular: 2017 is the year of the breakthrough; very different products for various markets will already be appearing next year. And above all: "Prices are falling by 25 to 30 percent per year," says Klaus Werner. They have now reached a price level that allows them to demonstrate their advantages over previous systems, under practical conditions of use – and to penetrate into quantities that will further drive prices down. This in turn presents the opportunity to enter into an increasing number of markets – including consumer-like markets. This is also reflected in the experience of the component manufacturers. They are experiencing that the new technology is gaining momentum, the first products are already available on the market, and in 2018 many more products will follow according to the opinion of most of the participants. The markets where RF energy ensures that the cards will be reshuffled include microwave ovens, industrial heating and drying processes, cleaning and activation of sensitive surfaces, plasma lamps, engine ignition systems, medical technology and many other sectors, as shown in some presentations at the *SmarterWorld* RF Energy Summit.

The RF Energy Alliance is setting the course:

The RF Energy Alliance (RFEA) plays a major role in this. It was founded with the goal of building complete ecosystems, developing standards, and producing a roadmap. The members of the RFEA therefore cover the entire supply chain: Manufacturers of transistors and amplifiers are included together with manufacturers of electromechanical components such as connectors, cables, printed circuit boards, antennas, cooling systems and end users from different sectors.

The RFEA wants to contribute towards ensuring that all companies work together and be certain that they are going in the right direction. "It is equally important to inform all potential users about the opportunities offered by the technology and how it can be used correctly. Expanding this knowledge is

extremely important," explains Dr. Klaus Werner. "That's why an event like the *SmarterWolrd* RF Energy Summit gives a fresh impetus to the entire RF energy community because it provides a valuable means to inform and educate the participants."

Until now, the good old tube technology has been used, particularly magnetrons, which, however, cannot be controlled. This even had a certain advantage: Because it was hardly possible to regulate anything anyway, complex processes did not have to be developed for this. Magnetrons are relatively easy to use. With their disadvantages, such as the unavoidable mismatch, users simply had to live with them.

Fantastic opportunities – for those in the know…

Now, however, solid-state RF energy offers manufacturers the fantastic opportunity to control the process very precisely. However, they do not get this fantastic opportunity completely for nothing, as Klaus Werner emphasizes: "In order to be able to adapt the control loop precisely to the respective process, the process itself must be understood in detail and the users have to learn a lot and know exactly what they are doing. That means hard work!" This is exactly why he considers it important that the RF Energy Alliance conveys this knowledge.

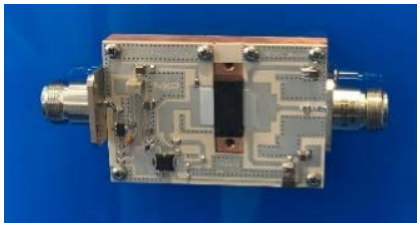
Those who successfully go through this learning phase are richly rewarded: for example, the energy can be adjusted reproducibly, in the range from microjoule (µJ) to megajoule (MJ) – this was nowhere near possible with the relatively easy to use magnetrons. One of the major advantages is that the energy can also be switched off within microseconds (µs). In addition, the devices work reliably over a long period of time and they are very robust. Due the fact that solid-state RF energy generation – in contrast to magnetrons – takes up little space, the hardware can be flexibly partitioned.

Because component manufacturers know that in most case end users are not, and do not want to become, experts in the development of RF systems, the first friendly development environments are already available thus making it unnecessary for the user to delve deeply into the details of the underlying RF technology. This is another sign that solid-state RF technology is now so mature that it will penetrate into the real world with all its economic implications. "This is exactly what the RF Energy Alliance has set out to do: to accelerate market acceptance and thus growth," says Klaus Werner.

All participants at the *SmarterWorld* RF Energy Summit were convinced that this time has now come, and demonstrated it with presentations. They showed how efficiency and flexibility can continue to increase, while costs decrease, and what interesting opportunities for completely new applications emerge, from cancer treatment and mass spectrometric analysis of substances with the help of portable devices within a matter of minutes and directly on-site, through to transportation of food over long distances using microwave preservation with no chemicals.

The manufacturers of components and sub-systems were surprised in the end at how RF energy technology opens up completely new opportunities in different applications and the potential it has to bring about sustainable change in entire market sectors. This is especially important because these systems can now also be networked in the Internet of Things (IoT) and thus also make it possible to develop new business models. Therefore, one thing is already clear today: the second *SmarterWorld* RF Energy Summit will take place in October 2018 in order to keep all involved parties updated on the current status and to show how the technology works, how it can be controlled and how it can be economically integrated into different devices.

(a)



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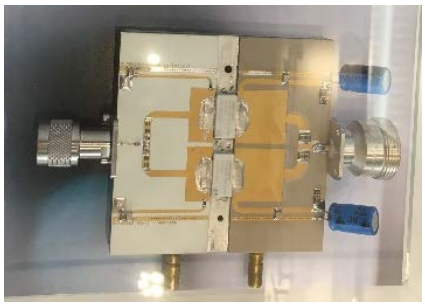

New amplifiers presented at the summit: (a) A 300-W, 32-V LDMOS amplifier at 2.4-2.5 GHz by NXP. (b) A compact 1.2-kW, 902-928 MHz demo board for industrial heating applications by Ampleon.