

Digital Power Supplies

Durable Film Capacitors Increase the Service Life of End Devices

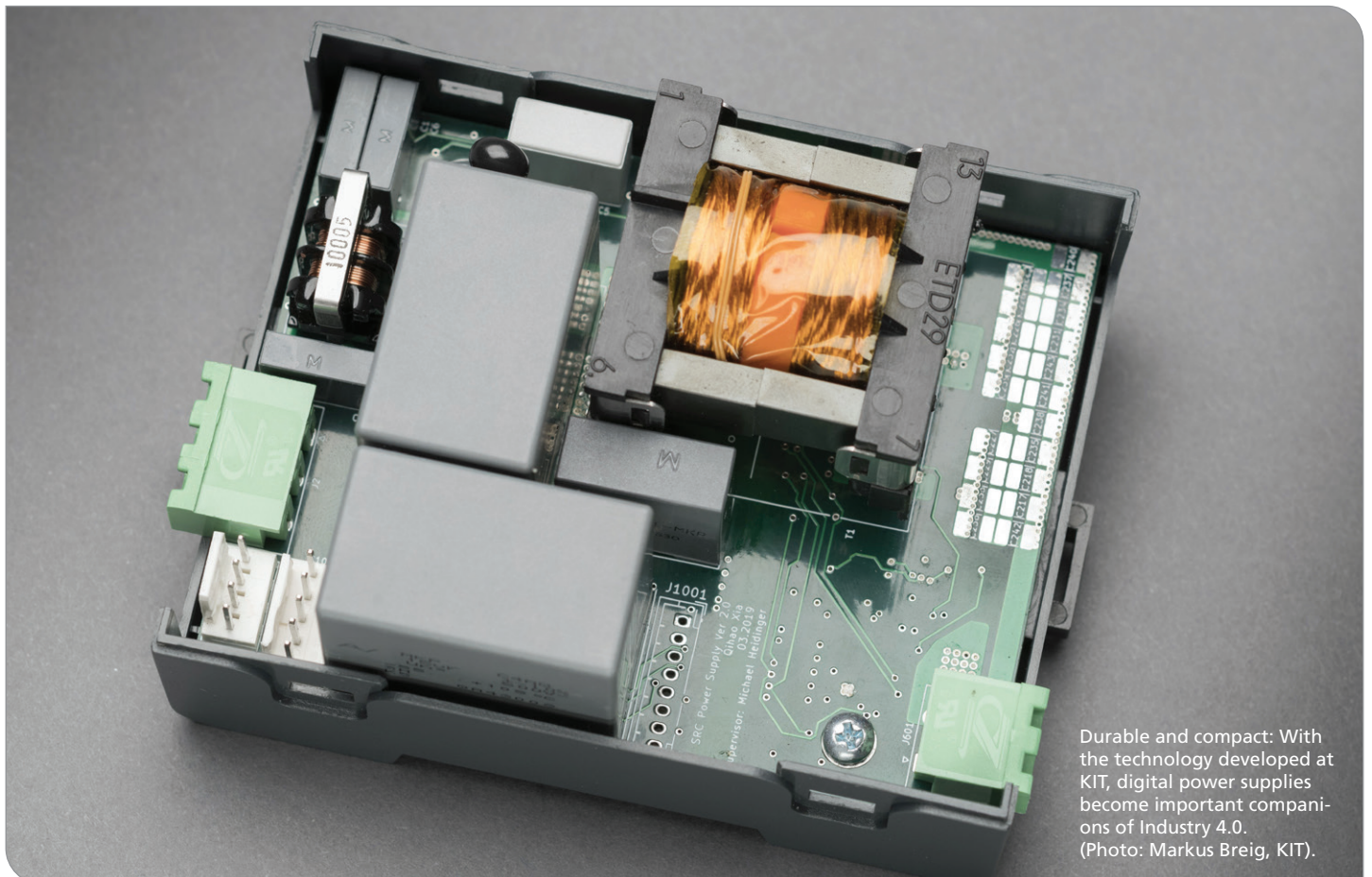
In the manufacturing industry, many tasks that were done by humans are now done by machines. Mostly, electricity is used as an energy source. Therefore, the number of power supplies in production halls continues to increase. Power supplies convert the alternating grid current into the direct current required by devices. Their applications are diverse and range from computers to LED lights through to laser welding machinery. Currently, power supplies achieve a maximum full-performance life of eight years. Often, technical devices fail due to breakdown of the integrated power supply units. These thus limit the devices' useful life or require short service intervals. A new technology for digital power supply units developed at KIT enables a service life of well over 30 years. The power supply units can be integrated into the Internet of Things (IoT) via an online monitor. Digital power supplies will thus become important companions of Industry 4.0.

Fields of Application

Durable power supplies are advantageous when maintenance or failure are significantly more expensive than the purchase price of the device. This may be the case in process technology applications. Durable power supplies, for example, reduce the costs of wind energy by achieving longer maintenance intervals and help LED lights to achieve an extended service life of 20 years.

State of the Art

Electrolytic capacitors used in power supplies are particularly prone to errors. They buffer electrical energy and smooth out voltage fluctuations over a grid period. Electrolytic capacitors offer a high energy density. Film capacitors are much more durable. However, due to their lower energy density, they require ten times the installation space for the same capacity.



Durable and compact: With the technology developed at KIT, digital power supplies become important companions of Industry 4.0. (Photo: Markus Breig, KIT).

The New Technology

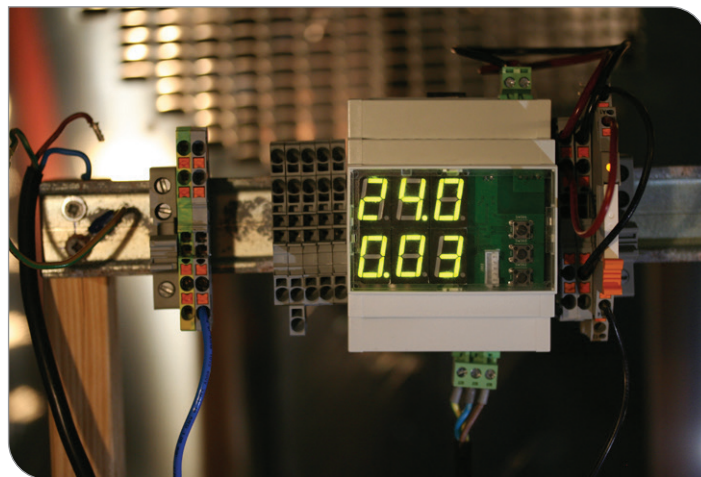
Researchers at KIT's Light Technology Institute (LTI) have developed a new modulation method for the digital and highly dynamic control of power supply units that allows the use of film capacitors with only slightly increased installation space. The method allows the control of the output current under consideration of the DC link and output voltage, with frequency and pulse duty factor being possible control variables. By including these variables, the control becomes more robust, safer, and faster. In addition, control inaccuracies are reduced by taking into account input and output voltages. The control procedure, which runs on a microprocessor built into the power supply unit, detects disturbing environmental influences, so that, for example, higher voltage fluctuations can be compensated. Storage capacitors with lower capacity are therefore sufficient.

Advantages

The durability of the installed film capacitors reduces the failure rate of the switching power supplies and thus increases the service life of the end devices many times over. In addition, there is a lower maintenance effort, which is particularly advantageous in places that are difficult to access. Applications also benefit from the new power supplies. Thanks to the accuracy and flexibility of the highly dynamic control, power supplies of this type are particularly suitable for applications where maximum reliability is essential, such as in aviation, electric cars, or industrial applications. Easy Internet-of-Things integration for remote diagnosis or remote maintenance is another important advantage.

Options for Companies

A functional prototype was built at KIT's Light Technology Institute. Measurement results, including dynamic and lifetime measurements, are already available. The LTI team is currently looking for industrial partners for the development of application-specific power supplies in the premium segment.



The durable industrial DIN rail power supplies are thoroughly tested in a climate chamber (Photo: KIT).

Technology Transfer

Industrialization is implemented by the KIT spin-off Digital Power Systems whose expertise can be used optionally. This allows partners to benefit from existing know-how and thus achieve a faster market entry.

Karlsruhe Institute of Technology (KIT)
Light Technology Institute
Dr. Michael Heindinger
Engesserstr. 13
76131 Karlsruhe, Germany
Phone: +49 721 608 47852
Email: michael.heindinger@kit.edu
<https://digitalpowersystems.eu>

Karlsruhe Institute of Technology (KIT) · President Professor Dr.-Ing. Holger Hanselka · Kaiserstraße 12 · 76131 Karlsruhe, Germany · www.kit.edu

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