

## INDUSTRIAL ENGINEERING NEWS

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### Industrializing the Production of Electrolyzers and Fuel Cells

The entire energy supply is being put under scrutiny. The trump card can be hydrogen.

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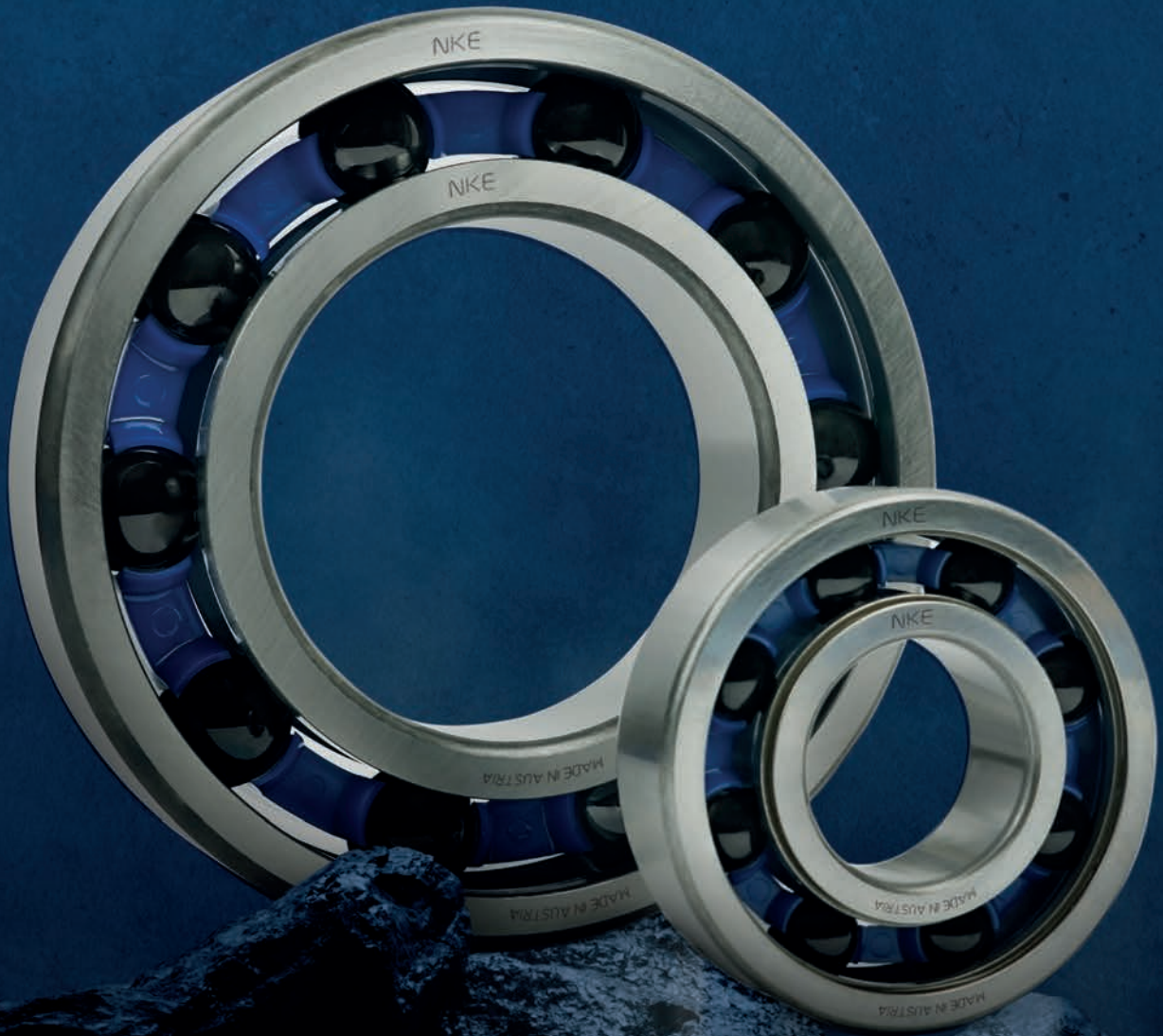
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A Legacy of Austrian  
Quality and Craftmanship  
for Wind, Railway and  
Industrial Applications

<b>Editorial Director:</b>	<b>Orhan Erenberk</b> o.erenberk@tim-europe.com
<b>Editor:</b>	<b>Anis Zenadji</b> a.zenadji@tim-europe.com
<b>Editorial Support</b> <b>Energy Efficiency:</b>	<b>Flavio Steinbach</b> f.steinbach@tim-europe.com
<b>Associate Publisher:</b>	<b>Marco Marangoni</b> m.marangoni@tim-europe.com
<b>Production &amp;</b> <b>Order Administration:</b>	<b>Francesca Lorini</b> f.lorini@tim-europe.com
<b>Website &amp;</b> <b>Newsletter:</b>	<b>Carlo Cucchi</b> c.cucchi@tim-europe.com
<b>Marketing Manager:</b>	<b>Marco Prinari</b> m.prinari@tim-europe.com
<b>President:</b>	<b>Orhan Erenberk</b> o.erenberk@tim-europe.com

**ADVERTISING SALES OFFICES****EUROPE**

AUSTRIA/SWITZERLAND  
Monika Ailinger  
Tel: +41 41 850 44 24  
m.ailinger@marcomedia.ch

BENELUX,  
NORWAY, SWEDEN  
Nadia Liefsoens  
Tel: +32-(0)11-224397  
Fax: +32-(0)11-224397  
n.liefsoens@tim-europe.com

FRANCE  
Roxanne Akbulut  
Tel: +33 06 52 31 41 56  
rakbulut@tim-europe.com

M'fumu Tiya Mindombe  
Tel: +32 465 443 530  
m.mindombe@tim-europe.com

GERMANY  
Simone Ciolek  
Tel: +49-09771-1779007  
s.ciolek@tim-europe.com

ITALY, SLOVENIA  
Andrea Rancati  
Tel: +39-02-7030 0088  
arancati@rancatinet.it

TURKEY  
Onur Dil  
Tel: +90 212 366 02 76  
Fax: +90 212 366 58 02  
E-mail: o.dil@tim-europe.com

UNITED KINGDOM/DENMARK/  
FINLAND  
Dave Harvett  
Tel: +44 (0)121 705 21 20  
daveharvett@btconnect.com

**NORTH AMERICA**

Hamilton-Murphy Global, LLC  
John Murphy  
Tel: +1 616 682 4790  
Fax: +1 616 682 4791  
john@hamiltonmurphy.com

**JAPAN**

Ichiro Suzuki  
Incom Co. Ltd.  
Tel: +81-(0)3-3260-7871  
Fax: +81-(0)3-3260-7833  
isuzuki@INCOM.co.jp

**OTHER COUNTRIES**

Cristian Son  
Tel: +39 027030631  
c.son@tim-europe.com

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Anis Zenadji  
a.zenadji@tim-europe.com

**Dear Readers,**

Hannover Messe is coming! This year is going to be the second in-person event in a row following the pandemic. This edition focuses on electro and digital Technology, plus IT, to pave road to Energy Efficiency. Industry faces the challenge of reducing consumption to counter rising energy prices, reduce its carbon footprint and at the same time, be prepared for various taxonomies dictated by capital providers and/or governments. This magazine further gives you elements on what not to miss during the show.

The April issue has a big Energy Efficiency section in it with two original pieces from Pepperl+Fuchs and Schaffner. Fossil fuels such as oil, gas, and coal have been the energy carriers of choice—until now. Contrary to past predictions, they are still widely available, inexpensive, and versatile. These fossil fuels have not just been used for energy generation—they are also used as raw materials for chemicals, pharmaceuticals, and many other products. Secondly, Schaffner's Dr. Guido Schlegelmilch highlights the top three tech trends that are driving product development EMI. Specifically, he looks at how e-mobility is leading to an increased demand for EMI protection equipment to avoid damage to both the vehicle and the grid.

Moreover, you will find out a great piece from Analog Devices on Power Over Ethernet 2. Despite an increase in remote work due to the coronavirus disease 2019, the number of powered Ethernet ports deployed each year continues to increase. Employers have been taking advantage of empty desks and upgrading IT infrastructure to future-proof workplaces with the hope that they will eventually return to full occupancy.

We wish you a pleasant and interesting reading.

Editor for IEN Europe

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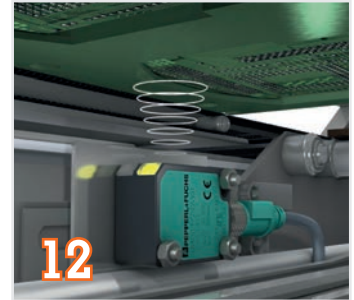




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## Emerson helps reduce maintenance and improves differential pressure measurement accuracy

Emerson introduced the Rosemount™ 319 Flushing Ring with valve-integrated design, ensuring accurate differential pressure measurement and lower maintenance suitable for a wide range of differential pressure applications. Available in Traditional and Compact options, the new Rosemount 319 Flushing Rings provide a process-to-seal connection and allow for faster diaphragm seal maintenance without disconnecting them from process flanges. Both versions of the Rosemount 319 Flushing Rings come pre-assembled including the flushing ring, matching valves and connections, allowing technicians to commission devices faster by eliminating the need to procure and assemble components on-site. Rosemount 319 Flushing Rings are factory leak-tested so users can mount products to vessels right out of the box. When installed, diaphragm seal maintenance is significantly faster without compromising safety while reducing stocked inventory and management of multiple vendor piece-parts.



## AIMPLAS will analyze the plastics regulatory context at the fourth edition of OKPLAST on 24-25 May

The plastics industry is currently facing challenges directly related to major threats to society, such as climate change, the circular economy, food waste, and protecting people's health and improving their quality of life. In this context, plastic materials will have the chance to showcase their versatility and functionality when it comes to offering solutions. At the same time, they will have to adapt and comply with all new national and international regulatory requirements. To analyse this situation, AIMPLAS, the Plastics Technology Centre, is organizing the 4th edition of the OKPLAST International Seminar on Plastics Legislation on 24-25 May. Organized in five thematic blocks, the two-day Seminar will review topics such as the legislative changes affecting products containing plastic, as provided for in the European Green Deal and the New Circular Economy Plan for a cleaner and more competitive Europe, new developments in the REACH Regulation and legislation on food contact materials.



## Raruk automation to offer new human-robot interface software from extend robotics

RARUK Automation, a leading distributor of collaborative robots and automation solutions, have announced a new partnership with Extend Robotics. As a result, RARUK Automation will now offer Extend Robotics' Advanced Mechanic Assistance System (AMAS) human-robot interface software in the UK. The software uses virtual reality technology to enable a human user to control a Universal Robots collaborative robot remotely. AMAS is an ideal solution for a wide range of industries, especially those that involve extreme, dangerous environments. Robots can safely access areas that humans cannot. Since the software enables remote robot operation, human operators can maintain complete control without compromising on their health and safety. The new technology is suited to applications like decommissioning nuclear facilities, inspection and maintenance of offshore energy facilities and handling toxic pharmaceutical material.



## ROHM Establishes Ultra-High-Speed Control IC Technology that Maximizes the Performance of GaN Devices

ROHM's ultra-high-speed Control IC technology maximizes the performance of GaN and other high-speed switching devices. While the adoption of GaN devices has expanded in recent years due to their superior high-speed switching characteristics, the speed of Control ICs, which are responsible for directing the driving of these devices, has become challenging. In response, ROHM has further evolved its ultra-high-speed pulse control technology Nano Pulse Control™. It is cultivated for power supply ICs, succeeding in significantly improving the control pulse width from the conventional 9ns to an industry-best\* 2ns. Leveraging this technology allowed ROHM to establish its ultra-high-speed Control IC technology that maximizes the performance of GaN devices. When pursuing miniaturization of the power supply circuit, it is necessary to reduce the size of the peripheral components through high-speed switching. Achieving this requires a Control IC that can take advantage of the drive performance of high-speed switching devices such as GaN devices.



## Delta to Demonstrate How to Transition Towards Sustainability with its IoT-based Smart Green Solutions at Hannover Messe 2023

Delta Electronics announced it will participate in Hannover Messe 2023 to demonstrate how its IoT-based Smart Green Solutions help industries transition towards sustainability through lower carbon emissions, in line with the net zero by 2050 goal. The showcase will include Smart Manufacturing, Energy Infrastructure, as well as Building Automation Solutions, all capable of fostering smart factories, smart microgrid-supported e-mobility and smart green buildings. Key highlights of Delta showcase include the new VP3000 Open-Loop Variable-Torque Standard Drive, and the EV charging infrastructure and energy storage solutions. Delta will also host a press conference at its own exhibition site (Hall 11, stand C20) on April 18 (Tue), from 13:30-14:30 CET.



### Delta Electronics Logo

Commenting on its presence at Hannover Messe 2023, Dalip Sharma, President and General Manager, Delta Electronics EMEA region, said: "Environmental challenges are driving industry-wide and far reaching transformation across all organisations globally. At Hannover Messe 2023, Delta demonstrates its solutions suited to EMEA's rapidly expanding IIoT market and those that meet the growing demand for EV charging solutions. As its solutions demonstrate, Delta is committed to responding to local market requirements, and it will continue to invest in the development of energy efficient and sustainable solutions that meet EMEA's requirements."

### Smart Manufacturing

Delta will be launching its new open-loop variable-torque standard drive - the VP3000 Series. It has a high power rating of up to 630kW. It enhances productivity and lowers harmonic distortion (THDi) down to 35% in industrial motors used in HVAC, pumps, compressors, and water supply applications. Delta will also demonstrate the compact modular CODESYS motion controller AX-3 series, which increases the scalability of its motion control and PLC product portfolio. Another highlight is Delta's MOOVair Wireless Charging System (1kW), with point-to-point contactless power transmission efficiency of up to 93%. The 1 kW Wireless Charging System is ideal for charging batteries in industrial electric vehicles and AGVs.

### EV Charging Infrastructure and Energy Storage Solutions

Delta will showcase its EV charging infrastructure solutions and smart energy storage solutions. The full range of EV charging infrastructure ranges from residential, commercial to destination charging, fulfilling the various requirements and needs in the market. The highlight will be the UFC200 Ultra Fast EV Charger, a 200kW single charging station with the flexibility to charge up to four vehicles simultaneously. For the infrastructure, Delta offers its Energy Storage Skid Solution, an integrated energy storage system for industrial and commercial sites with limited space and construction times with its faster deployment in a smaller footprint.

### Building Automation solutions

Delta's Building Automation Solutions is committed to lead building automation into a sustainable future, including the industrial applications. The integrated solutions ensure the design and operation of green, safe, energy-efficient, comfortable and healthier industrial and manufacturing environments. Showcased in the exhibition are versatile industrial LED high-bay and linear lighting. The excellent efficiency, extreme long lifetime, tri proof, and high operating temperature features of our products tolerate the harsh and intense environmental and operational conditions of the manufacturing processes. Also shown during the exhibition is the multi-protocol building automation system from its subsidiary LOYTEC, and advanced video surveillance solutions from its other subsidiary VIVOTEK.



## ABB unveils Unstoppable film series to underline the lives of women in industry and advocate for diversity

ABB announces the launch of its new film series: Unstoppable. This series aims to promote diversity and profile three remarkable female leaders in the mining, pulp and paper, and metals industries.

Unstoppable highlights the inspiring stories of three women who have broken down barriers and made significant contributions to their respective industries. Through this series, ABB aims to raise awareness of the importance of diversity and inclusion; and encourage more women to pursue careers in STEM fields.

The first film in the series features Marjorie Boles, Chief Information Officer at Sappi, a visionary in the pulp and paper industry who has transformed her company with her passion for digitalization.

The second film profiles Tove Thelin Täckdal, Concentrating Plant Manager at Copperstone Resources, a trailblazer in the mining industry who has dedicated her career to promoting sustainability and innovation in the sector.

The final film highlights Chithra Sharma, Chief Commercial, Engineering and Projects for Capital Procurement at Tata Steel, a pioneering leader in the metals industry who has pushed boundaries and challenged the status quo to drive growth and competitiveness.

By shining a spotlight on strong female role models in industries where the greatest disparities exist, ABB aims to influence others to come forward and play a part in Unstoppable. The directors of the series hope to make a positive difference and bridge known gender gaps. According to the World Economic Forum, women make up only 22 percent of the global mining and metals workforce, underscoring the urgency to foster diversity and inclusion in this and many other traditionally male-dominated sectors.

"We're not doing well enough to ensure diversity in our industries and know there are many dynamic career paths open to women," said Joanne Woo, Global Head of Communications, Process Industries, ABB. "This is why we're proud to launch the Unstoppable film series, which showcases the incredible achievements of women in industry."

"The adage holds true: if you can see it, you can be it. Raising the visibility of women in industry is vital in breaking down gender stereotypes and showcasing role models. Through our series we aim to ignite a spark that will encourage others to join the movement towards a more diverse and inclusive workplace."

"At ABB, we believe that diversity is a key driver of innovation and progress, and we are committed to promoting equal opportunities for all," said Joachim Braun, President of Process Industries, ABB. "Our target is to double the representation of women in senior management positions at ABB by 2030."

"Leadership must take responsibility for driving change in diversity and inclusion. It is not only a moral imperative but a business necessity. Leaders must actively work to hire, advance and support women in the workplace, and create a culture that empowers them to succeed."

"I am honored to be part of the Unstoppable film series and to share my story. It is my hope that through this series, we can inspire and empower more women to pursue careers in the mining industry and drive sustainable innovation. I believe that diversity is key to unlocking the potential of any industry, and I am proud to be part of a company that values and promotes inclusion," said Tove Thelin Täckdal, Concentrating Plant Manager at Copperstone Resources.

"Unstoppable is designed to be more than a film series. It is a call to action to drive greater diversity and inclusion in the workplace and an encouragement to others to follow in the footsteps of these incredible women. ABB invites everyone to join in the conversation and help create a more inclusive and diverse world," said Joanne Woo.





# ACE Vibration Dampers: Tugger Trains Protected Against Vibrations Step by Step

Schiller Automatisierungstechnik GmbH offers independent conversion kits to turn conventional electric tow tractors into autonomous transport systems. ACE's rubber-metal isolators are used to protect the electronics required for the autonomous trains from shocks and vibrations

Autonomous driving, which is still being perfected for road traffic, is already commonplace for material transport from the warehouse to the assembly line. Independent special conversion kits for converting conventional electric tow tractors into autonomous transport systems are an innovation offered by Schiller Automatisierungstechnik GmbH. The electronics required for autonomous trains are protected from shocks and vibrations by ACE's rubber-metal isolators.

For long-distance trucking, a truck that is 99.986% available, drives autonomously, and chooses the fastest route is still a thing of the future. However, it is a reality for the autonomous transport vehicles developed by Schiller Automatisierungstechnik GmbH. The company, headquartered in Osterhofen, located in the Lower Bavarian district of Deggendorf, recently completed a project involving 22 autonomous tugger trains successfully for a major Bavarian automaker. The fleet transports over 500 tons of ma-



"ACE initially convinced us with their wide selection of suitable components and the fact that we could configure and calculate the vibration dampers on the ACE website," said Peter Stoiber, Head of Mobile Robotics at Schiller Automatisierungstechnik GmbH.



The autonomous transport of 500 tons of material from the warehouse to the assembly line is realized daily thanks to digitization and automation of logistics tasks with the driverless train fleet from Schiller Automatisierungstechnik GmbH.

terial from the warehouse to the assembly line every working day, covering a distance of over 300 kilometers daily. During the test over 10 shifts, more than 1,550 kilometers were autonomously completed with the highest availability.

**Convert electric tow tractors into autonomous driving systems**

Founded in 1985 by Ewald Schiller, Schiller





*The basis for these components are commercially available electric tow tractors, which are converted into driverless tugging trains by Schiller using standard components, including vibration dampers from ACE.*

Automatisierungstechnik GmbH has grown into a company with more than 240 employees in Osterhofen, Metten, Grafenau, and Shenyang, China. The company's core competencies include electrical engineering, mechanics, and IT for automation, logistics, cleanroom technology, and electrical planning. In 2018, Schiller laid the foundation for the development of solutions for autonomous tugging trains. "It quickly became clear to us that safety technology would be a central issue for our driverless transport systems because, as with trailers in general, the trailer's deviation from its intended course is an important challenge to solve," explains Peter Stoiber, head of mobile robotics at Schiller, during the development work. To comply with the strict regulations of the machinery directives, the engineer and his team had to calculate the probability of failure of all components and ensure the highest availability. The development work led to the perfection of an indoor GPS system that enables



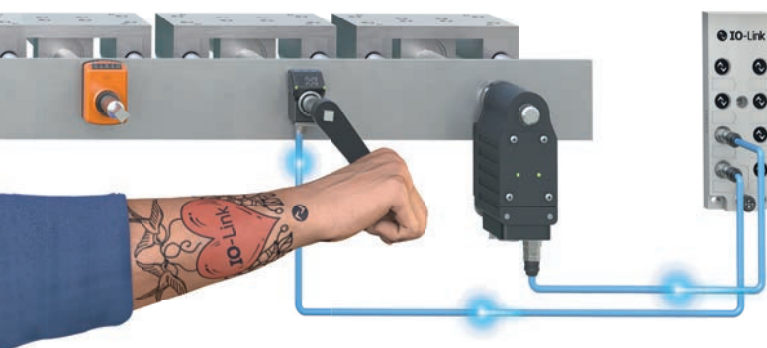
the tugging train to always know its location, eliminating the need for structural changes for orientation during transport. Each Schiller tugging train can also be easily adapted to changing situations in the manufacturing process and can be used at other locations. The biggest advantage of the solution is that conventional electric tow tractors can be retrofitted with Schiller technology to become autonomous driving systems.

**The task: Ensuring the electronics' reliability**  
Even though the tugging trains could still be operated by drivers after having been equipped with upgrade kits, the autopilot

demonstrates its strengths in everyday use. For example, when the routing train arrives near the next workstation, a smartwatch on the wrist of the responsible employee vibrates to signal the status. The employee can then load or unload the wagons and give the signal "all actions completed, send the train ahead" to continue the route without delay. Unnecessary travel time for personnel is eliminated. As smart as the Schiller routing train is, it cannot yet fly. Of course, flying was not really one of the problems that Peter Stoiber, Mobile Robotics department head, and his team had to address in the development process. It was much more the task of

## POSITIONING SYSTEMS FOR PRODUCTION MACHINES

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INTERPACK 2023, Hall 12, Booth A46

the trains having to travel on uneven terrain and the occasional crossing of building corridors on the many different paths through the car factory. These are potential hazard areas that could endanger the reliability of the electronics. Therefore, it was essential to prevent the control cabinet from being subjected to vibrations. The tigger train should be equipped with vibration dampers at the critical locations to achieve this.

### The solution: Rubber-metal isolators protect the control cabinet

As with all electronic and mechanical components of the system, potential solutions were thoroughly analyzed and tested by Schiller Automation Technology GmbH. The design department identified ACE Stossdämpfer GmbH, part of the Stabilus Group, as the ideal solution partner. "ACE initially impressed us with the wide range of components that could be considered and because we were able to configure and calculate the vibration dampers on the ACE website," Peter Stoiber looks back on the design process on this website:

<https://www.ace-ace.de/de/berechnungen/schwingungsdampfung.html>

"ACE sales then responded very quickly to our request and convinced us with a sample. This created additional trust in the quality and durability of the proposed solutions." Based on the parameters of a maximum speed of 10 km/h and a control cabinet weight of 50 kg, four rubber-metal isolators of type AAM-52205 were selected. This family of maintenance-free and ready-to-install vibration dampers is designed to absorb loads between 0.5 kg and 22.7 kg. Thus, the



Further development: the autonomous route train as an outdoor solution.

small shock- and vibration-isolating connecting elements effectively help protect lighter components. They isolate in all directions and can be mounted in any desired spatial axis and used for loads in shear, com-

pression, and tension. Made of galvanized metal and Neoprene rubber components, by standard, they can also be ordered with highly dampening silicone for special applications at ACE to protect against heavy shocks. Although this case is a premiere for the standard version in an application for driverless transport systems in the logistics industry, vehicle technology has long been a familiar terrain for these machine elements. ACE's customers worldwide use them to protect against shocks and vibrations in lighter electronic equipment and other constructions, including off-road vehicles and trucks that still are being operated by humans.

Robert Timmerberg M. A., plus2 GmbH, Düsseldorf, for ACE Stoßdämpfer GmbH

►► 63596 at [www.ien.eu](http://www.ien.eu)

*The rubber-metal isolators type AAM-52205 provide effective vibration isolation in all directions for this application, with a natural frequency ranging from 16 Hz to 46 Hz.*



## DRIVE CONTROLLERS

Communicate via PROFI-safe



Consistent and safe communication facilitates the commissioning as well as the operation of machines and systems. The drive controllers COMBIVERT F6 and Servo Drives S6 from **KEB Automation** offer integrated

safety functions directly in the drive. In the device variant "APPLICATION" Ethernet-based bus systems are switchable via software and thus enable a flexible fieldbus connection to the superimposed control level, for example via PROFINET. Communication via the safe fieldbus protocol PROFI-safe has now been integrated and certified in the units. This reduces the amount of wiring required in the application. The integration of drives with integrated safety into the Siemens TiA-Portal PROFINET network is done with the help of GSD files that have been checked for conformity in advance. Based on this, the safe fieldbus communication between different F-Devices (safety devices) is realised. With the COMBIVERT F6 and S6 APPLICATION drive controllers (with type 3 safety module), the corresponding encoder-related safety functions can be selected and used via the configuration. The device series cover a wide power range from 0.75 kW to 450 kW and can be used for the operation of different motor technologies.

▶▶ 63568 at [www.iem.eu](http://www.iem.eu)

## 5121 IEC C14 APPLIANCE INLET FILTER

Available as standard or medical technology version



**SCHURTER** launches a new very compact filter series with the 5121 appliance inlet filter. An IEC C14 inlet is surrounded by a closed metal housing and thus effectively shields the mains input. The new filter series is available as a standard or medical technology version for a rated current up to

10 A / 15 A with wire connections. The mains input is often a critical opening in the housing. Interference via the power cables and interference radiated through the opening gets into, or out of the housing. The new 5121 appliance inlet filter series offers a very compact solution to prevent interference. The new filter family is especially suitable for applications with very small installation depths that require high-frequency filtering of the mains input at the same time. The 5121 appliance inlet filter reliably shields high-frequency interference conducted through cables or radiated thanks to a completely closed metal shield and capacitors. Interference in the lower frequency range can be reliably attenuated with additional capacitors and chokes on the PCB. Especially the interferences in the low frequency range < 10 MHz are mainly conducted through the cables, which means that the filter components do not necessarily have to be located at the mains input and can simply be placed on the printed circuit board. SCHURTER offers a wide range of current-compensated and linear chokes for this purpose.

▶▶ 63597 at [www.iem.eu](http://www.iem.eu)



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## 700W POWER SUPPLIES

For demanding medical and industrial applications



**COSEL Co, Ltd** announced the introduction of its new open-frame high power density power supply. Based on the robust platform with optimized thermal conduction, the GHA700F delivers 700W

within a 3"x5" industry footprint. With a power density of 31.1W per cubic inch it's one of the highest power density power supplies in its category for powering medical and industrial applications. The GHA700F is designed in accordance with safety standard IEC 60601-1, making it suitable for Body Floating medical applications but its high isolation and creepage distance make it eminently suitable for demanding industrial applications, complying with EN61558-2-16 (OVC III) and simplifying design to conform to EN60335. To power a large range of systems-bus-voltages the GHA700F is available in four output voltages, 24, 30, 48 and 56VDC and has a universal input voltage of 85 to 264VAC. Using the latest power switching topology and components, the GHA700F boasts an excellent efficiency figure of up to 96%. The Cosel Group includes the European power specialist Powerbox International AB, which has been acquired June 25, 2018 by COSEL.

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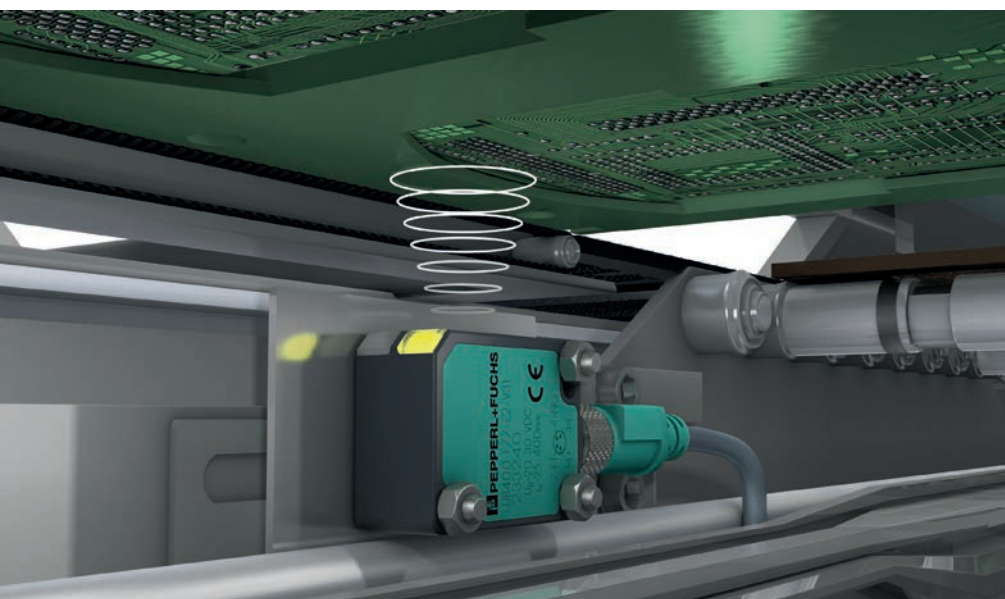
# Industrializing the Production of Electrolyzers and Fuel Cells

The world is facing a fundamental change to its entire energy supply with all current methods of generating energy being under scrutiny. The trump card in this game can be hydrogen

Nuclear energy—a technology that promised limitless availability in the 1960s and 1970s—has fallen into disrepute for a number of reasons and is now being considered as an option in only a handful of countries. Meanwhile, hydropower has its own limitations in terms of scope, albeit for entirely different reasons, one of which is its immense impact on the landscape and the associated consequences for flora and fauna. Biomass is another option, but it competes with food production and is also a limited resource. For these reasons, fossil fuels such as oil, gas, and coal have been the energy carriers of choice—until now. Contrary to past predictions, they are still widely available, inexpensive, and versatile. These fossil fuels have not

just been used for energy generation—they are also used as raw materials for chemicals, pharmaceuticals, and many other products. Over the past 20 years, two “renewable energies” have become the forerunners in terms of generating electrical energy. Disregarding the fact that energy is not technically “renewable,” wind and solar energy are the first candidates to come to mind here—as energy carriers that appear to be free of charge. In fact, there have been astonishing developments in this area over the past two decades, both in terms of scale and cost. The fact that wind turbines of up to 18 MW per unit are installed at sea today was unimaginable even in the 1980s. The fact that photovoltaic systems in sunny areas now

generate electricity at a cost of less than 1 cent per kWh was at best a utopian dream. Have all problems with these technologies now been solved? Not at all: There are still fundamental problems that have unfortunately been negligently underestimated over a long period of time. Germany is one country in the world with a reliable supply of electrical energy at all times. This is not necessarily a matter of course, even in highly developed countries. The supply system was designed to always cover absolute maximum demand, even if this is only incurred for one hour a year. Energy generation therefore depends on demand—not only in terms of time, but also space. That is why it made sense to build large power plants near large energy consumers. These may be highly populous cities or heavy industry facilities, for example. Using solar and wind power as energy sources does not meet these requirements. The position of wind turbines depends on the available space and the “wind supply.” In turn, installing PV modules depends heavily on the willingness of private individuals to invest. The supply of energy from these systems also depends on weather conditions. Germany has been afforded the luxury of having two energy supplies for years to compensate for the problems described above. Even though current figures indicate that we are generating 46 % of our electricity from renewable sources, on certain days of the year it is barely more than 20 %. The fewer conventional power plants we have, the more likely it is that we are heading toward an uncontrollable situation. We therefore need to find a balance between supply and demand, not only in the short



An F77 series ultrasonic sensor for measuring distances precisely.

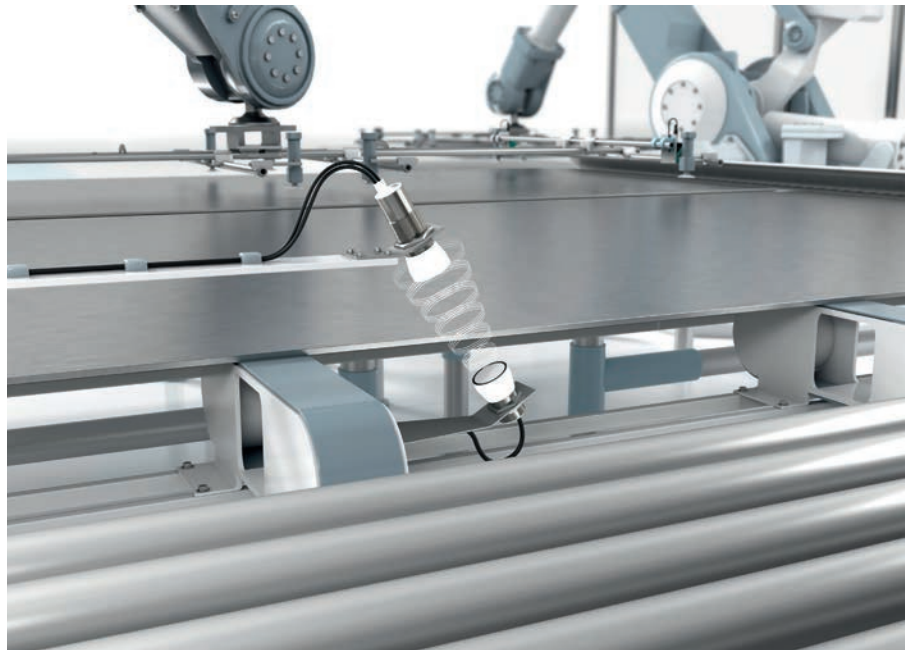




term, but also seasonally. It goes without saying that more energy is needed in winter than in summer. This means that a medium is required that can store energy over any period of time, is easily transportable, and can be used for various applications, including for reversion.

If we look at Germany as an example, however, only around 20 % of the country's total energy requirements are met by electricity: The far greater share is therefore actually supplied using oil, gas, and coal. This includes the entire transport sector, heating market, and industry, especially sectors such as steel, chemicals, cement, and glass. It's easy to sit and philosophize about the extent to which these industries can be "electrified," but only time will tell—it will very much depend on cost and availability.

The trump card in this game is hydrogen. There is currently unanimous agreement about this across the world. As a storage



A UDC ultrasonic sensor for detecting double layers.



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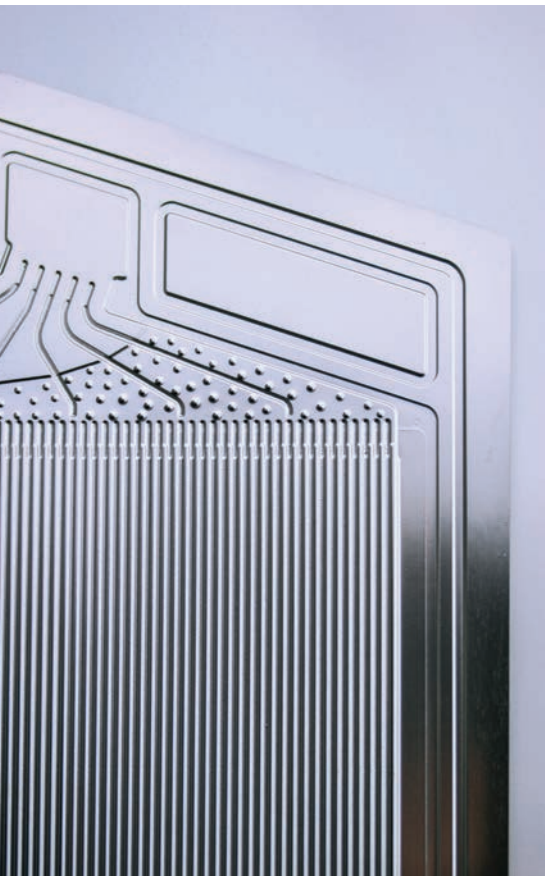
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*Bipolar plate (Fraunhofer IWU) embossed in stainless steel.*

medium, it can compensate for the erratic fluctuations in wind and solar energy, and its known derivatives can replace fossil fuels in all applications as a raw material. How exactly this can be implemented in practice goes beyond the scope of this article. However, the fact is that gigantic amounts of "green" hydrogen are now required. "Green" hydrogen is produced by electrolysis, which involves running an electric current through water. The water is split into hydrogen and oxygen. This process takes place in an electrolyzer: It can then be reversed in a fuel cell. In this case, the hydrogen serves as the fuel and combines with oxygen to generate energy. The "waste product" is water.

As a raw material, water is available on our planet in almost limitless amounts in the oceans. However, electricity must be generated. If this process can be completed in a climate-neutral manner, it will be possible to

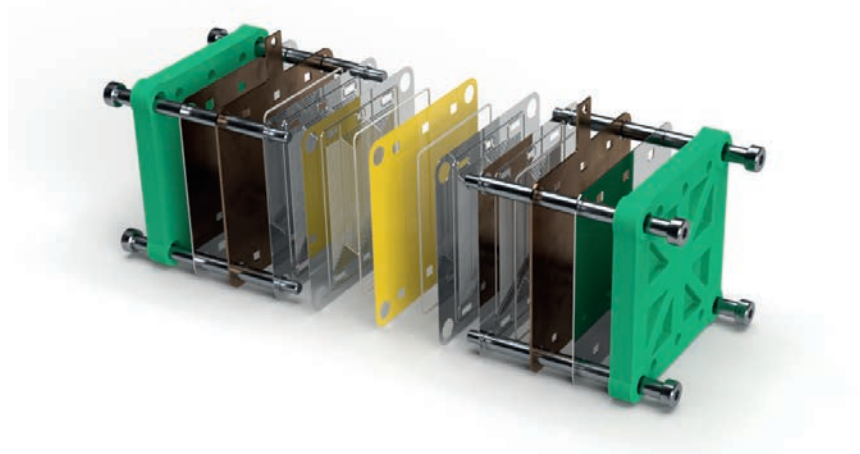
convert our energy supply so that CO<sub>2</sub> generation and absorption is brought back into balance, preventing the continual warming of the atmosphere.

The use of hydrogen and its derivatives will therefore depend on availability and price in the near future. There are two major factors influencing the production process: the price of electricity and the cost of purchasing plants. Although they use very similar technology, electrolyzers and fuel cells play in different leagues. Electrolyzers have a unique selling point in the production of green hydrogen, while fuel cells compete with other processes. In heavy goods transport, for example, hydrogen drives compete with battery-powered electric motors.

Nevertheless, the aim in both cases is to significantly increase the number of production units to meet massively growing demand and sustainably reduce costs. A key factor here is therefore industrializing production process, i.e., using automation. The core components are the bipolar plates (BPP) and the membrane electrode assembly (MEA). In terms of the latter, a distinction is made between 3-, 5-, and 7-layer MEAs. In this case, catalyst layers are applied that are required for the electrolytic processes.

The Fraunhofer Institute for Machine Tools and Forming Technology IWU in Chemnitz is currently launching the "Reference-Factory. H<sub>2</sub>" project, the aim of which is to optimize the production of these components. The project will test, investigate, and optimize all

*Complete stack in a fuel cell (Fraunhofer IWU)*



processes, from the production of bipolar plates and the functionality of seals through to the assembly of the complete stack.

Initial practical applications have shown that checking for potential double layers may be a criterion. Ultrasonic sensor technology has proven itself as effective in this application. In principle, these sensors can accurately measure distances to a tenth of a millimeter and detect multiple layers or even cracks. One particular benefit of ultrasonic technology is that it works irrespective of the object's material composition; therefore, properties like color, luster, and transparency will have no effect. This offers great advantages, especially for metallic and translucent materials.

Sensors of the F77 series can deliver height measurements that are accurate within 0.2 mm. UDC double sheet controls can detect multiple layers by detecting boundary layers, i.e., the last layer before an air gap. Last but not least, the supplied components can simply be checked for their presence or position. These modern sensors have a standardized IO-Link interface that can be used to adjust settings and query status data. The interface modules (masters) that are also available transfer the data via OPC UA to other units of the IT infrastructure. This means that all the prerequisites for an architecture in accordance with Industry 4.0 are met.

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# Global Mega-trends that Accelerate Technology Innovation in Electromagnetic Interference

Schaffner's Dr. Guido Schlegelmilch highlights the top three tech trends that are driving product development EMI. Specifically, he looks at how e-mobility is leading to an increased demand for EMI protection equipment to avoid damage to both the vehicle and the grid.

Our world is becoming increasingly digitalised and electrified. One of the major trends is the drive towards greater adoption of electrified transport solutions, which now encompass many private and commercial vehicles, from cars, to vans, lorries and busses – even military vehicles are being investigated for the potential to power them electrically. There are already 20 million electric vehicles (EVs) on the road, while the network of electric vehicle charging stations (EVCSs) to serve them is also growing at pace.

Electrification is also making inroads in numerous other fields and applications, with many former mechanical, combustion or analogue systems being replaced by electric motors. Many of these will run on renewable energy and be controlled by automated, digitalized systems. Political, economic and environmental factors are accelerating the uptake in energy derived from renewables.

There are three main trends in this new electrified world that will drive technology innovation in 2023 and beyond – the success of all of them depends on the critical need to reduce electromagnetic interference (EMI) and filter out noise.

## The growth in e-mobility

The number of EVs is growing rapidly in developed markets such as the UK, France and Germany with a corresponding need to develop and expand the network of EVCSs to support them. An extensive and easy to use network of chargers is essential to allow continued expansion in the EV market.

Drivers are demanding that these charging stations charge their vehicles rapidly while also delivering the power they need to offer maximum range between charges. Current EVCSs provide a single phase or three phase supply with a mains voltage at 230 V or 400 V.

A major issue with EVCSs is protection against EMI. With the extremely high energy levels common in rapid-charging EV systems, EMC/EMI products and solutions are required that can protect all the varied systems of the EV – the power electronics, onboard chargers, batteries and keyless authentication systems. They also need to offer protection for the power grid.

To protect users, the EV and the power grid, standards such as IEC/EN 61851-23 for EV conductive charging systems and the UL 2202 standard for EV charging system equipment have been introduced.

It is also important for manufacturers to source a filter that also satis-

fies the safety standards essential to ensure EMC compliant currents – this can significantly reduce development time for companies developing EVCSs. A filter that can 'clean' the power that feeds into the car ensures a safe charging experience with industry-specific charging voltages up to 1000 VDC.

## Energy management and the transition to renewables

As the world seeks to mitigate the effects of climate change and en-

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sure access to reliable and affordable energy sources, the electrification of many other machines and energy using process is growing. With recognition of the need for energy security and the move away from reliance on fossil fuels, many countries are looking to diversify their energy base and considering new forms of power generation.

Renewable sources help meet a number of environmental, economic and geopolitical challenges, while also meeting the expectations of a growing number of environmentally aware consumers.

Although the move to renewable energy generation has been gradual so far, this is set to ramp up dramatically in the next few years as countries seek to make a greater commitment to protect the planet, cut costs and boost their energy security. There are great benefits in this, but there are also major challenges for design engineers seeking to harness tomorrow's energy efficiently, effectively, economically and also safely.

It is well known that the major renewable energy sources - wind and solar - can be challenging to both harness and manage. This can be a particular issue in countries with limited renewable resources such as wind or sunlight. Countries are asking themselves what can be done to make the most of these renewable resources, with the aim of producing energy that is both reliable and affordable.

Again, as with EVs, dealing with EMI is a major challenge for renewable energy management. To ensure efficient and reliable operation of electronic systems, EMI must be reduced and electrical noise must be filtered out, requiring a range of electromagnetic solutions.

Tools include pre-compliance testing and expert advice that allows engineers to meet the requirements of international standards. This testing helps diagnose the EMI challenges of the system and specifies an appropriate electromagnetic compatibility (EMC) product that will eliminate electromagnetic interference. These products protect systems from any distortions experienced by the grid, preventing disturbances and maintaining a reliable electrical supply.

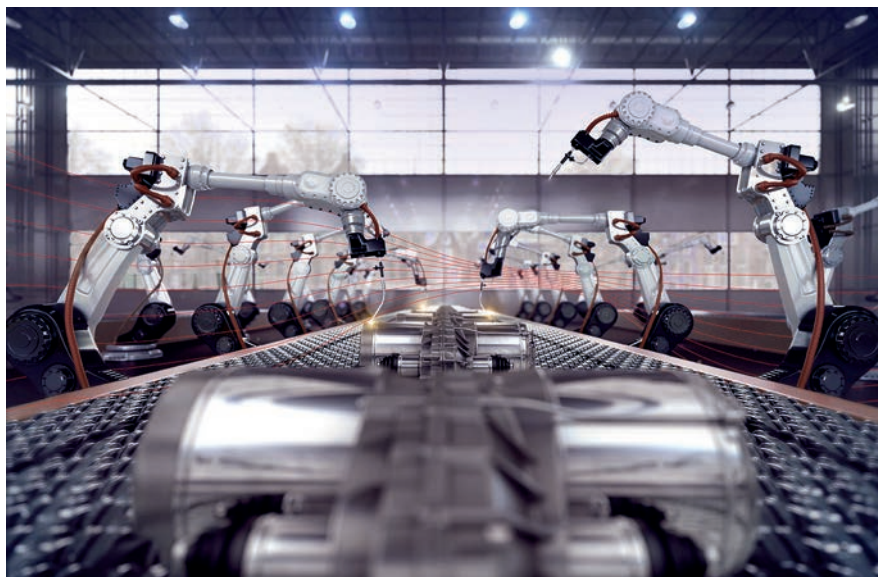
Solar panels are increasingly used in many applications, from large scale commercial farms to domestic power and to powering devices



*Dr. Guido Schlegelmilch, Head of Products & Technologies, Schaffner*

such as illuminated road signs and mobile phone base stations. However, they also present their own challenges, most notably the need to manage high levels of direct current. There are also space constraints with solar installations that restrict the size of EMI suppressing equipment that can be used.

A small high-current DC filter for a solar inverter can greatly reduce the potential for high frequency (HF) interference in the panel. Another benefit is preventing premature panel ageing, which is often caused by HF stray and leakage currents.



### **The growth in automation**

As industry faces growing challenges, many companies are increasingly turning to automation to help solve them. Faced by the demand for customized products, the need to increase energy and cost efficiencies, the demand for more flexible production, higher quality and meeting the shortage of skilled labour, many companies are looking at what automation can bring to their processes.

To ensure success, automation requires a reliable source of energy to keep disruptions to production processes to a minimum. Modern industrial systems are at risk here, as computerised and digital control and monitoring systems are more susceptible to EMI than previous, less advanced generations of control equipment. Wireless systems or radio-frequency identification (RFID) tags







can be especially sensitive to EMI.

Although EMC standards for consumer goods are higher than those set for industry, the growing use of digital communications in industrial facilities has highlighted the need for industrial EMI filters to meet the requirements of the IEC standards for audio/video, information and communication technology equipment. Characteristics of filters for industrial automation include robustness, high-performance, the ability to function at high voltages and also remain operational at high temperatures.

The immunity of an entire installation can be boosted by using mains input filters for all three phases and the neutral line. Although there is often limited space in industrial applications to fit EMI filters, compact solutions are available that deliver excellent saturation resistance and can give good attenuation performance from 150 kHz to 30 MHz.

Meeting these challenges is made easier through using expert advice.

Although trends such as wider adoption of e-mobility through electric vehicles, more widespread use of automated systems, or greater reliance on renewable energy are welcome, electromagnetic interference will always be an issue. It will need to be solved if these technologies are to fulfil their promise while also providing maximum efficiency and safety.

If the innovations promised in these sectors are to come to fruition, industry needs to be fully aware of developments in EMI mitigation and keep on top of, and even ahead of, these technological advances. Schaffner is a global leader in electromagnetic solutions that ensure the efficient and reliable operation of electrical and electronic systems by reducing electromagnetic interference (EMI) and filtering out noise.

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# New developments for safety and automation

## Innovative solutions for machine safety – advantages for productivity

The Schmersal Group will be attending Hannover Messe 2023 in Hall 09, Stand D09. The company has put the focus on automation, safety solutions for intralogistics and for packaging.

### Intelligent solenoid interlocks

A robot carrying out palletisation operations is safeguarded on the Schmersal stand with solenoid interlocks that keep guard doors locked until hazardous movements have come to a halt. The AZM201 solenoid interlock with integrated AS-i-SaW interface, help to minimise downtime thanks to comprehensive diagnosis functions.

### New Time-of-Flight procedure

Schmersal will be demonstrating a brand-new technology at Hannover Messe for the first

time – a technology in which the position and stacking height of boxes/crates palletised by robots is monitored by a TOF camera. The Time-of-Flight (ToF) procedure can be used to create a 3D image of the scene that is available as a point cloud. Software that can be used to define and monitor three-dimensional zones in space opens up a wide range of automation solutions in logistics and production-line production.

### New magnet track sensor box

Schmersal will be showcasing a solution for Electric monorail conveyors at Hannover Messe: the SSB-R sensor box is used to define route sections for speed regulation for electric monorail conveyors in a manner that is cost efficient and maintenance free.



### New command and signalling devices in hygienic design

Also new: The H series from Schmersal will be showcased at Hannover Messe as a full range of command and signalling devices for hygiene-sensitive applications.

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# The new Flender One: Drivetrain Questions are a Thing of the Past

After establishing the Flender Standard Gearbox (FSG) as the industry standard for industrial gearboxes around 30 years ago, Flender is now introducing its successor at Hannover Messe: Flender One.

Flender One is a gearbox produced exactly according to the individual customer requirements. However, it needs less time from order to commissioning thanks to its fully digitalized engineering process. It maximizes efficiency, saves valuable energy and sets new standards in sustainability. Customers can configure Flender One without support and gearbox know-how. Fully integrated sensor technology and onboard analytics make it smart, simplify maintenance and prevent failures. It is the next level of the Flender One platform for industrial gearboxes with further developments to follow.



### Digital drive intelligence ensures maximum availability and reduces costs

The Flender One platform also includes Flender's new drive intelligence AIQ®. With integrated sensor technology and analytic functions AIQ® provides all relevant information about the drivetrain while operating. The detailed condition monitoring of each component detects deviations from normal operation at an early stage and enables for detection of potentially harmful conditions. Service jobs can thus be carried out in good time, quickly and proactively, tailored to the customer's needs. This con-

serves resources and increases the availability of the plant.

Moreover, the Flender couplings portfolio is digital thanks to AIQ®. With AIQ® Detect operators have a close eye on their production plants and prevent a porous elastomer from bringing the entire production process to a standstill.

### Drive technology that protects the climate

Last but not least, at the end of 2022 Flender has been awarded the gold medal in the EcoVadis sustainability rating and ranks in the top five percent of the most sustainable companies globally.

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# Digital I/O Remote Module with Integrated Output Relays for EtherCAT Networks

32 digital optocoupler inputs and 32 dry contact relay outputs offer easy integration with Delta and third-party EtherCAT masters

Delta announces the launch of its R2-EC0902D0 32 digital input/output remote module. Featuring 32 integrated relays on the output, supporting 2 A at 30 VDC/ 250 VAC per channel, and 32 24 VDC digital inputs, the unit greatly simplifies the implementation of digital I/O on EtherCAT networks. The high level of integration reduces system costs by eliminating the need for a separate coupler, digital input/output modules, and external relays.

## High level of integration for EtherCAT applications

EtherCAT is predicted to grow above 7% CAGR1 in the coming years, supporting the view that continued innovation around this technology is needed. While advanced automation capabilities are well covered, more straightforward capabilities, such as hardware integrating EtherCAT for digital I/O, are not as refined. Instead, system integrators have relied on couplers, digital input and output modules, and external relays. The R2-EC0902D0 DI/DO mixed remote module removes this complexity and associated cost, integrating digital I/O into a single, EtherCAT-capable unit.

The R2-EC0902D0 features an input and out-

put EtherCAT port, allowing for daisy-chaining. At the front of the 120 mm wide DIN-rail unit, power, communication, and alarm indicators are set into the housing for good visibility. Indicators for each of the 32 inputs and outputs are located in the center of the face plate. All the optical coupler inputs are grouped on one side, with the digital outputs placed on the other. The 32 digital outputs are implemented using normally-open dry contact relays. These operate at up to 1 Hz and have an off/on response time of 10 ms, and on/off response time of 5 ms. On the input side, PNP/NPN configurable sink/source signals of up to 1 kHz can be acquired with a response time of 300  $\mu$ s.

"The R2-EC0902D0 DI/DO mixed remote module supports the EtherCAT protocol to enable a fast I/O response. The large number of integrated digital inputs and relay-type outputs makes it suitable for a wide range of applications, from the packaging industry and wood-working to assembly lines," said Simone Orlandi, Product Manager - Motion Control, Delta Electronics EMEA region.

## Third-party support for EtherCAT masters

The R2-EC0902D0 is ideal for industrial automation engineers looking for a digital I/O solution with a large number of channels that also supports EtherCAT. Compliant with EN 60068-2-6 for vibration and EN60068-2-27/29 for shock resistance, this IP 20-rated unit can operate over 0°C to 50°C (32°F to 122°F). It requires a 24 V/1 A external power supply and is compatible with all Delta and third-party EtherCAT controllers.

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# Returning to the Office with Power Over Ethernet 2

IEEE's latest Power over Ethernet (PoE) standard, also known as PoE 2 or 802.3bt, just turned 3 years old but its application is still growing stronger than ever

Despite an increase in remote work due to the coronavirus disease 2019 (COVID-19), the number of powered Ethernet ports deployed each year continues to increase. Employers have been taking advantage of empty desks and upgrading IT infrastructure to future-proof workplaces with the hope that they will eventually return to full occupancy. Creating a smart office involves equipping the office space with multiple IoT devices that are connected to the internet, including meeting room signage, teleconferencing equipment, and various sensors.

The benefits of a smart office include energy savings, streamlined business operations, and, perhaps most importantly, increased workplace safety for employees. COVID-19 has only accelerated the need for well-controlled building heating, ventilation, and air conditioning (HVAC) systems and numerous contactless communal items, forcing facility and IT managers to collaborate and deploy PoE-enabled systems. According to the 650 Group market research company, the number of switch/PoE ports shipped in the world is expected to exceed 150 million in 2025.

When PoE 2 was ratified in 2018, it delivered up to 71.3 W to the powered device (PD), nearly tripling the previous standard's 25.5 W.

PoE 2 allows power to be sent over the same cabling with gigabit Ethernet, laying the groundwork for many of yesterday's, today's and tomorrow's power and data-hungry applications, including the remote temperature monitoring systems and thermal cameras that are used to screen personnel for COVID-19 at entrances before they enter the work site.

Figure 1 shows a basic PoE block diagram, with a single PD connected to power sourcing equipment (PSE). In past generations of PoE, a single power channel was sufficient to power each PoE port. Fast forward to 802.3bt now, where two power channels per port are required for medium and high power levels, with higher power density per channel to also consider. The global Ethernet market has seen an ever-increasing penetration of PoE-enabled ports. All of these factors have led to a need for IT departments to deploy vast numbers of high power density, high port count systems, all while demanding five nines uptime (99.999%) and reliability. A truly scalable PoE subsystem to ease deployment of high port count, PoE enabled switches has been long overdue.

As the pioneer of PoE, a member of the IEEE 802.3bt Task Force, and an active participant of the Ethernet Alliance, Analog Devices has a

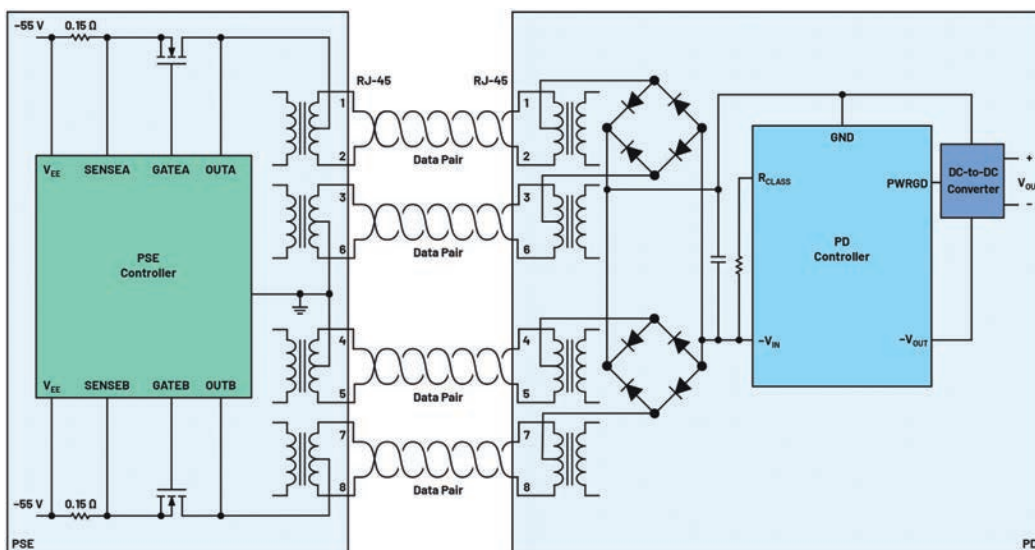


Figure 1. Power over Ethernet block diagram.





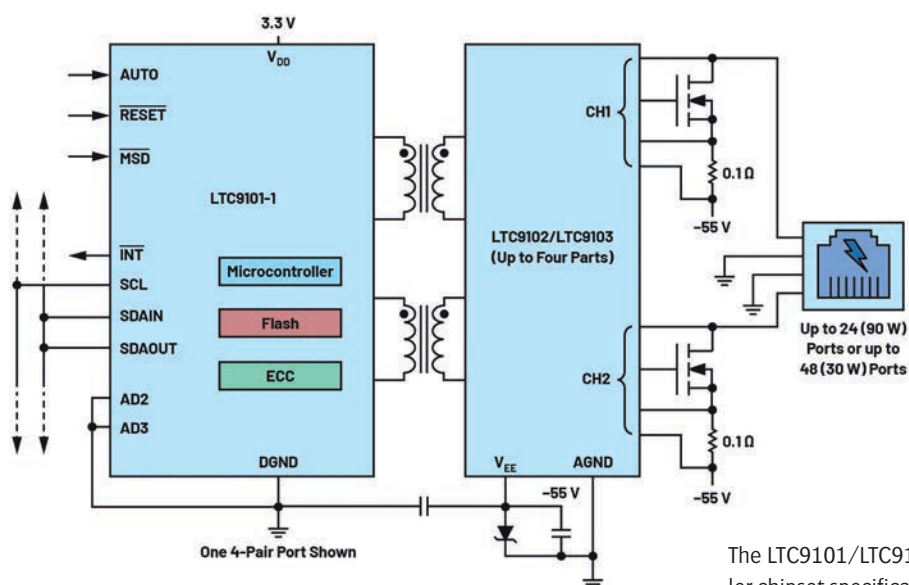


Figure 2. Simplified schematic of the LTC9101/LTC9102/LTC9103 PoE 2 24-port PSE chipset.

long history of being the premier PSE and PD controller supplier in the industry, contributing to the hundreds of millions of ports deployed in the field today. The just-released ADI LTC9101, LTC9102, and LTC9103 high port count PSE chipset and any of ADI's PoE 2 PD controllers enable developers to offer a complete end-to-end PoE 2 system. Let's take a closer look at what makes this new platform special in today's market.

#### A Platform-Based Approach to PSE Design

Modern switches are highly complex systems that are commonly exposed to harsh environmental conditions, including surge and cable discharge events, and must deliver high system reliability and uptime. Past approaches to PSE architecture have viewed PSE subsystem design at the component level, focusing on incremental component improvements that did not necessarily optimize collective system performance. Viewing the PSE subsystem at a higher level forced design teams at ADI to rethink the PSE paradigm and to deliver system-level solutions. The LTC9101/LTC9102/LTC9103 and future derivatives will take this system-level approach, combining digital and analog components holistically to solve the PSE challenges facing system integrators, including those listed in Table 1.

Table 1. PSE SYSTEM-LEVEL CHALLENGES AND SOLUTIONS

Systems Integrator Challenge	ADI Solution
Surge and cable discharge	Robust port facing pins
System-level isolation requirements	Integrated isolation comms channel
LED lighting support	Dedicated, per-port detect/class resources
802.3bt complexity and standards changes	Custom digital controller with flash memory
Mixed port designs	Software configurable architecture
Diversity of register interfaces	Platform flexibility (coming soon)
Thermal efficiency	Industry lowest power path resistance
Power delivery efficiency	802.3bt-compliant Autoclass

The LTC9101/LTC9102/LTC9103 are part of a self-isolating PSE controller chipset specifically designed from the substrate up for PoE 2 systems. Figure 2 shows a simplified schematic and how one of up to 48 Ethernet ports is powered. The most novel feature of the chipset is its integrated isolation. Hence the chipset architecture, where the LTC9101 provides an isolated digital interface to the PSE host, while multiple LTC9102s and/or LTC9103s provide the high voltage analog Ethernet interface. 802.3 Ethernet specifications require that network segments, including PoE circuitry, be electrically isolated from the chassis ground and the PHY. By placing the LTC9101 on the nonisolated side and the LTC9102 or LTC9103 on the isolated side, up to six expensive optocouplers and an isolated supply are replaced with a single cheaper and more reliable 10/100 Ethernet transformer. This topology results not only in cost savings, but also in a more robust and manufacturable PSE design. This scalable solution enables the flexible implementation of large PSE systems, anywhere from 4 to 48 ports, depending on how much power is needed for each port. Each design requires at least one LTC9101 digital controller and one or more LTC9102/LTC9103 analog controllers. The LTC9102 offers 12 power channels, where each channel energizes two of four pairs of wires in the Ethernet cable, to power anything from twelve 30 W ports (using one power channel per port) to six 90 W ports (using two power channels per port).

Similarly, the LTC9103 offers eight power channels that can be used to power anything from eight 30 W ports to four 90 W ports.

A single LTC9101 can manage up to four LTC9102s and/or LTC9103s that can be mixed and matched. For example, one LTC9101, one LTC9102s, and two LTC9103s could be used to implement a 24-port PSE with four 90 W ports and twenty 30 W ports, as shown in Figure 3.

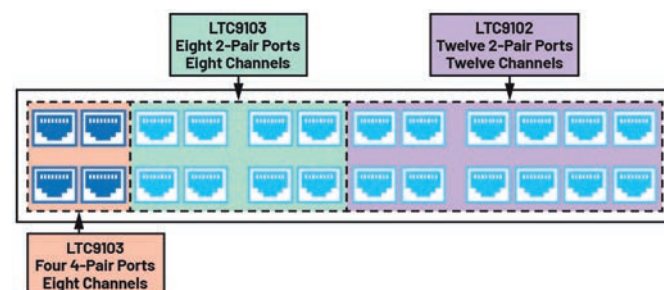


Figure 3. An LTC9102/LTC9103 mix-and-match implementation example: 24-port PSE with four 90 W ports and twenty 30 W ports.



IT and facility managers alike will appreciate the sixth-generation digital features of the LTC9101, including internal eFlash for storage of firmware updates and custom user configuration packages, backward-compatibility with the LTC4291 4-port PoE 2 PSE drivers, and an I2C serial interface. The LTC9101's field-upgradeable firmware images are stored in a dedicated flash partition, where a fully compliant IEEE 802.3at/bt firmware image is preconfigured. Two complete copies of the firmware image are maintained under separate ECC and CRC protections for maximum data protection. After successfully booting up the chipset, users can configure and communicate with the chipset through the LTC9101's I2C interface, where each port can be independently configured to one of four PSE operating modes (auto, semi-auto, manual, or shutdown) and telemetry readings of port current, PoE supply voltage, and port power can be used to manage system power. While the LTC9101 is the brains of the chipset, the LTC9102/LTC9103 are the brawn that offers high efficiency and ruggedness to the high voltage power path in multiple ways. Each LTC9102/LTC9103 power channel is implemented with dedicated detection and classification hardware. This allows all ports to detect, classify, and power on simultaneously, which drastically reduces the power-on latency across a switch. Other less advanced PSEs are subject to visible delays as PDs; for example, LED lights power on a serial port-by-port basis. The LTC9102/LTC9103 control each power channel using an external MOSFET, allowing users to select low RDS(ON) components, reduce power dissipation, and decouple channel failures. The use of 0.1  $\Omega$  sense resistors further helps to reduce power dissipation. During overcurrent faults or when ports short circuit, the LTC9102/LTC9103 quickly remove power in  $\sim 1 \mu\text{s}$  to protect the PSE, MOSFET, and downstream circuitry. In addition, all port-facing pins can tolerate voltage transient events up to +80 V or down to -20 V without damage. Perhaps most impressive is the chipset's ability to operate through over  $\pm 6.5 \text{ kV}$  of surge with minimal external components as tested per

the IEC 61000-4-5 surge immunity specification (the DC3160 demo board showcases this feature). After any fault, the LTC9102/LTC9103 quickly turn the MOSFET back on in a safe, current-limited manner while minimizing disruption to the PD, which is critical for maximizing network uptime.

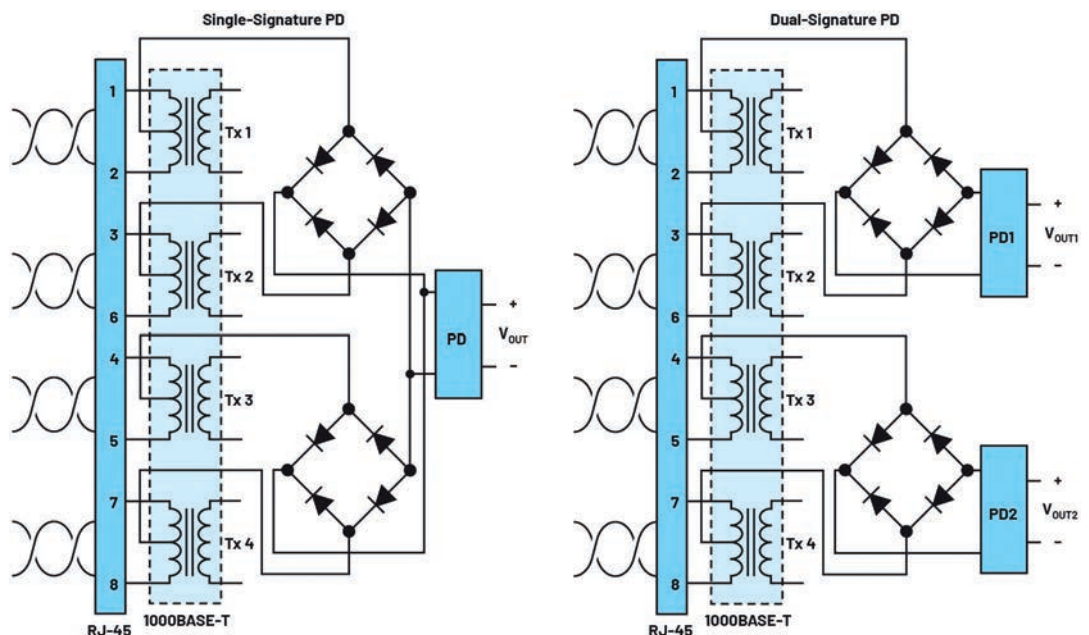
### PoE 2 Topologies, Detection Schemes, and Power Classes

PoE 2 introduced two different PD signature configurations, single- and dual-signature PDs. A single-signature PD (Figure 4) is a PoE 2 PD that shares the same detection signature and classification signature between both pairsets. A dual-signature PD is a PoE 2 PD with an independent signature on each pairset, allowing each pairset to have fully independent classification and power allocations. Dual-signature PDs are complex solutions costing twice as much as a single-signature PD. It is worth noting that 802.3bt dual-signature PDs are not equivalent to prestandard UPoE devices, despite sharing a common architecture. The LTC9101/LTC9102/LTC9103 support a robust PoE 2 PD detection process that incorporates the new connection check subprocedure to determine which PD signature configuration is attached to the PSE.

In addition to performing a connection check, devices also verify the connected PD is a legal IEEE-compliant PD. While IEEE requires PSEs to detect valid PD signatures (25 k $\Omega$ ) using either a 2-point voltage or 2-point current detection scheme, the LTC9101/LTC9102/LTC9103 implement a more robust scheme by employing both types of detection schemes. This multipoint (multiple voltages and multiple currents) detection scheme is used to eliminate false positives and avoid damaging network devices that were not designed to tolerate PoE DC voltages.

PoE 2 energizes two pairs of conductors (four wires) to deliver power up to 25.5 W and four pairs of conductors (eight wires) to deliver power up to 71.3 W. Not only are higher power levels enabled, but the use of more conductors provides better efficiency for the older, lower power

Figure 4. Single-signature vs. dual-signature PD topologies.



levels because, with all conductors powered, the power loss in the cable is cut in half. Take, for example, a PoE 1 (PoE+) PSE supplying 30 W to ensure a PoE 1 PD will receive 25.5 W, where 4.5 W is lost over 100 m of CAT5e cable. Four-pair powering the same 25.5 W PD with PoE 2 would reduce the loss to less than 2.25 W, increasing the power delivery efficiency from 85% to 92.5%. When you consider the number of PoE PDs in the world, this translates to a very large reduction in power and, in many use cases, up to a 7.5% lower carbon footprint.

PoE 2 introduced four new high power PD classes, bringing the total number of single-signature classes to nine as shown in Table 2. Classes 5 through 8 are new to PoE 2 and translate to PD power levels ranging from 40 W to 71.3 W. PSEs still have their choice of using the physical layer (that is, 5-event classification for 71.3 W) or data link layer (that is, link layer discovery protocol, LLDP) to classify PDs, and PDs still must be able to support both classification schemes to be compliant. Remember, because each pairset operates independently in a dual-signature PD, each pairset can be a different class. For example, a Class 1 (3.84 W) on the first pairset and a Class 2 (6.49 W) on the second pairset would make for a dual-signature Class 1 and Class 2 (10.3 W) PD.

**Table 2. POE 2 PD CLASSES AND POWER LEVELS**

Single-Signature PDs		Dual-Signature PDs	
Class	PD Power Available	Class	Pairset PD Power Available
0	13 W		
1	3.84 W	1	3.84 W
2	6.49 W	2	6.49 W
3	13 W	3	13 W
4	25.5 W	4	25.5 W
5	40 W	5	35.5 W
6	51 W		
7	62 W		
8	71 W		

PoE 2 PDs may also implement an optional extension of physical layer classification, known as Autoclass, where a PoE 2 PSE like the LTC9101/LTC9102/LTC9103 chipset measures the actual maximum power draw of a connected PD. By doing so, this handy power management feature allows for the allocation of “leftover” power to other light bulbs if they measure a particular bulb, due to lower brightness settings or a shorter cable, drawing less than its class power. It goes without saying that PoE 2 is backward compatible with the older 25.5 W and 13 W PoE 1 standards. A lower power PoE 1 PD can connect to a higher power PoE 2 PSE without any issues. And, when

the tables are turned and a higher power PoE 2 PD is connected to a lower power PoE 1 PSE, the PD can operate in the negotiated lower power state—this is referred to as demotion. If a PD ignores demotion and operates at its highest power state, the power-hungry PD will cause the PSE to repeatedly turn on, hit its overcurrent, then turn off—in effect, motor boating the PSE. For this reason, demotion is required by both PoE 1 and PoE 2 PDs, but is unfortunately overlooked in some implementations.

### The Most Efficient PD


ADI offers a number of unique ICs, including those designed by Maxim Integrated (now part of ADI), to maximize PoE 2 PD performance. Figure 3 shows a simplified block diagram of a high efficiency single-signature PoE 2 PD interface with an auxiliary input. This solution provides an end-to-end (RJ-45 input to PD load) efficiency of greater than 94% and operates within the  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  temperature range. The LT4321, shown at the RJ-45 interface in Figure 5, is an active diode bridge controller that replaces the required diode bridge rectifiers. The LT4321 uses low loss N-channel MOSFET bridges to simultaneously increase the PD’s available power and reduce heat dissipation. PoE 2 requires PDs to accept DC supply voltages of any polarity over their

## Level Switches

High Quality

**RFS-9**

- Maximum Operating Pressure : 4MPa
- Specific Gravity : 0.6
- Materials : SUS 316

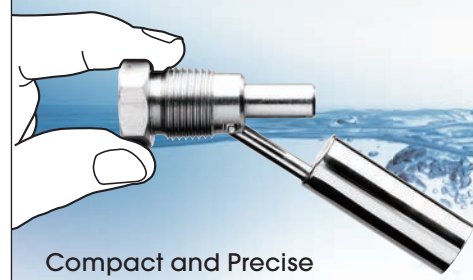


Compact and Precise


all 304 Stainless steel mode

**RFS-12**

- Maximum Operating Pressure : 0.5MPa
- Specific Gravity : 0.7
- Operating Temperature :  $-40^{\circ}\text{C}$  ~  $+120^{\circ}\text{C}$
- External Mount Type



Riko's Level Switches are compact and simple in design. They have proven their high reliabilities in the wide range of applications. Many more types are available. OEM designs are widely welcome. Please check with our website below.



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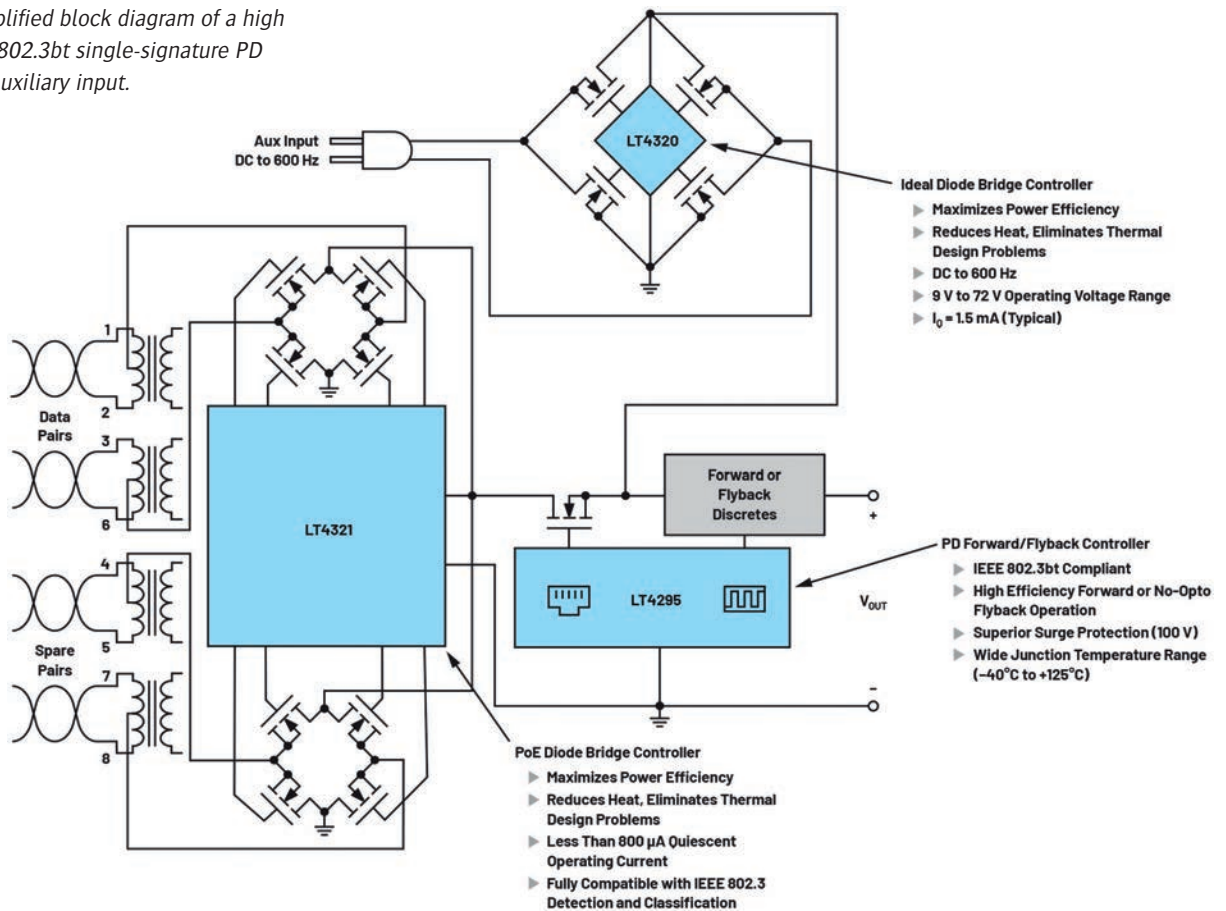
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Figure 5. A simplified block diagram of a high efficiency IEEE 802.3bt single-signature PD interface with auxiliary input.



Ethernet inputs, so the LT4321 smoothly rectifies and combines power from both data pairs into a single, polarity-correct supply output. Overall circuit size and cost are reduced as the enhanced power efficiency practically eliminates heat sinking requirements, and power savings of 10× or more enable PDs to stay within classification power budgets or add additional functionality.

The ideal diode bridge controller shown in Figure 5 is the brains of the PD interface—the LT4295 is a PoE 2 PD interface controller that integrates a high efficiency forward or no-opto flyback controller. The LT4295 supports all nine IEEE PD classes with an integrated 25 k $\Omega$  signature resistor, up to 5-event classification, and a single-signature topology. Aside from providing more PD power, what gives the LT4295 an edge over traditional PD controllers is its use of an external power MOSFET to, again, drastically reduce overall PD heat dissipation and maximize power efficiency, which becomes more important at PoE 2's higher power levels.

For those PoE 2 PD designs that need to be able to support an auxiliary supply, where the PD can be optionally powered by a power adapter, the LT4320, shown at the top of Figure 3, is a 9 V to 72 V active diode bridge controller that replaces each of the four diodes in a full-wave bridge rectifier with a low loss N-channel MOSFET to significantly reduce the power dissipation and increase available voltage. Power

supply and wall wart sizes can be reduced as the enhanced power efficiency eliminates bulky and costly heat sinks. Low voltage applications can also benefit from the extra margin afforded by saving almost two full diode drops (~1.2 V, which is 10% at 12 V) inherent in hot-running diode bridges, increasing the application headroom.

## Conclusion

PoE 2 continues to be very relevant in today's growing global Ethernet market, even amidst the ongoing preponderance of remote work. Small, medium, and large businesses that are retrofitting buildings with PoE-enabled scanners, cameras, and other systems to safeguard employees need high port count PSEs more than ever before. ADI's LTC9101/LTC9102/LTC9103 PoE 2 PSE chipset answers the call by enabling switch vendors to efficiently and reliably power up to 48 Ethernet ports, while equipping facility and IT managers with advanced power management capabilities. Meanwhile, at the other end of the cable, PD developers continue to have multiple ADI ICs at their disposal to increase integration, reduce heat, and increase power efficiency.

*Christopher Gobok, Product Marketing Director at Analog Devices*

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## NSF-APPROVED TURBINE FLOW METERS

For pharmaceutical and medical industry



Precision flow measurement is a critical tool for the Pharmaceutical and Medical industries, where processes require the precise control of liquid flow rates. Titan's NSF-approved 800-series turbine flow meters are ideally suited for applications where both food-grade

hygiene and precision flow measurement are required, such as those seen in dispensing and accurate batch delivery systems for ingestible pharmaceutical products and additives. Titan's NSF-approved 800-series flowmeters, certified under NSF/ANSI 169 as equipment for food products, are designed for precise metering of low viscosity liquids - water, water-soluble chemicals, drug coatings for example. These mini turbine sensors provide a low-cost dispensing solution giving reliable, high performance over 6 flow ranges from 0.05 to 15 L/min. The 800-series flow measuring devices have totally non-metallic NSF-approved wetted components that ensure safe dispensing of ingestible materials. The flow device's body and turbine are moulded from inert PVDF to ensure there is no contamination to any liquid passing through it. The bearings within the Titan mini turbine flow sensors are made of sapphire giving long life and reliability. As an experienced OEM supplier, Titan develop customised flow meters for specific applications within the pharmaceutical and medical industries.

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delivery system, the FlowLab Plus™ can be configured to run both manual and automated flow chemistry reactions. This versatile system may be configured with any combination of up to 4 individual reactor modules. By selecting from the HotCoil™ and HotChip™ heated reactor modules, and the Polar Bear Plus Flow™ or Polar Bear Plus GSM™ cryogenic modules, an operating range from -40 °C to 300 °C is possible. The addition of FlowControl II software allows you to integrate your FlowLab Plus™ with a fraction collector enabling you to automate reactions from either reagent bottles or automated sample loops for reaction optimization studies. The computer, pumps, and heating / cooling modules in a FlowLab Plus™ are connected over a LAN using an Ethernet hub enabling the system to be controlled remotely by Wi-Fi, allowing the control computer to be conveniently operated outside your fume hood.

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## APPLICATION OPTIMISED UV LENSES

High performance measurements in the UV waveband

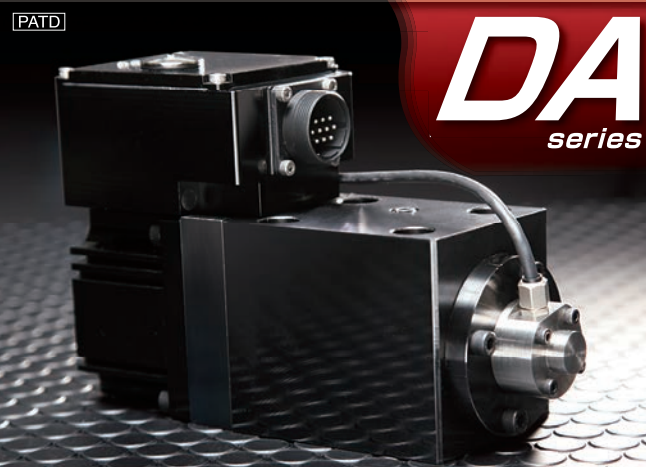


To provide inspectors with an effective tool for non-intrusive verification of spent nuclear fuel, a global leader in nuclear safeguards technology asked **Resolve Optics** to design a wavelength corrected UV Zoom lens to enable its Digital Cerenkov Viewing Device to view a

nuclear fuel assembly situated 13 metres away from the lens and through 10 metres of water. Spent nuclear fuel emits a faint UV (Cerenkov) light when gamma rays from fuel assemblies interact with electrons in the cooling pond water. To meet the challenges of this demanding application - Resolve Optics designed the UV zoom lens to optimally operate from 10 to 55°C. By incorporating a telescopic focus in the design, the novel lens can image objects from 3m to infinity. Miniature motors on the lens allow accurate remote setting of both zoom and focus functions. A filter slide was also incorporated in the design enabling the lens to be switched between UV (270 to 350 nm) and visible (400 to 700 nm) without the need for refocusing. The lens achieves high image resolution with low distortion throughout the zoom range without refocusing. A lockable C mount ensures the lens cannot come loose during operation. The Digital Cerenkov Viewing Device equipped with UV Zoom lens provides a highly effective system that captures the Cerenkov image of spent nuclear fuel for analysis and comparison.

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## Direct Acting High-Speed Servo Valve



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- high speed response of spool by non-contact detecting system of displacement and velocity

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Supply Pressure : 35 MPa, Rated Flow : 60LPM at ΔP 7MPa, Rated spool displacement : ±1.0mm

(1) Frequency Response (with oil bath) 800HZ : GAIN-3db, phase delay 90° (Spool amplitude : ±10%)

(2) Step Response (dry type) settling time 1.5 msec for 0-100% spool displacement



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## Driving an Extraction Fan with Dyneo+ Energy-saving Motor

**NOVENCO called on Nidec Leroy-Somer for driving their largest axial fan, that is designed for the extraction of carbon dioxide in a German backfill mine. The objective was to supply the most climate-neutral solution**

The Danish manufacturer of highly efficient ventilation fans and systems NOVENCO called on the specialist in electrical motors Nidec Leroy-Somer for driving the largest fan in their ZerAx range of axial fans. Thanks to its IE5 highly efficient synchro-reluctant Dyneo+ motor, Nidec Leroy-Somer has brilliantly met the challenge.

With more than 70 years of experience, NOVENCO Building & Industry, a member of the SCHAKO Group, ranks among the world leaders in design, development and manufacture of ventilation products and systems on the technological forefront of performance and durability. The company provides a vast choice of energy-efficient and life safety ventilation systems worldwide, which are well-known for uncompromising quality and the highest standards within a wide range of industries.

With focus on a sustainable green solution for the latest renovation

project of the Teutschenthal backfill mine in Germany, operated by GTS (Grube Teutschenthal Sicherungs GmbH & Co. KG), in the Geiger Group, the NOVENCO ZerAx® axial flow fan was approved as an obvious choice.

Since the mining of potash and rock salt was stopped in 1982, the mine is used to store every year more than 200,000 tons of mineral waste materials produced by municipal and industrial plants. By using the cavities for the environmentally friendly and long-term safe disposal of mineral waste at a depth of approx. 700 metres, the backfill mine makes a significant and sustainable contribution to environmental protection.

To improve ventilation systems under the ground intended for removing CO2 from stored mineral waste, the main contractor Jeremias® Chimney Systems delivered a specially designed 36 m tall chimney.

*Nidec Leroy-Somer  
Dyneo+ motor  
combined with the  
Novenco® ZerAx® fan*







*Dyneo+ permanent magnet-assisted synchronous reluctance motor from Nidec Leroy-Somer Dyneo+*

fewer raw materials used and lower CO2 emissions. Combined with the ZerAx® fan efficiency of up to 92%, 98% recyclability rate and 20+ years of lifetime, this solution is of great benefit to the environment for many years to come. Compared with an IE3 induction motor, the frame size would be 315 mm and even 355 mm instead of 280 mm with the Dyneo+ motor. As for the weight, it would total 1300 kg in frame size 315, instead of 820 kg, i.e. half a ton lower, and the efficiency level of the motor powered by drive less than 96.5%.

By combining an efficient extraction fan to a Dyneo+ energy-saving motor controlled by a frequency inverter, NOVENCO provides the greenest solution for the earth's surface. This unique configuration offers the highest possible system efficiency that goes beyond the requirements of current regulations.

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*Teutschenthal backfill mine in Germany*

To support this, NOVENCO delivered a 2-meter diameter giant ZerAx® fan with efficiency up to 92%, driven by a Nidec Leroy-Somer's Dyneo+ eco-efficient permanent magnet motor delivering a power output of 220 kW.

Compact, robust and easy to commission, the Dyneo+ permanent magnet-assisted synchronous reluctance motors offer IE5 Ultra Premium efficiency level. With the lowest TCO (Total Cost of Ownership) on the market, a very short ROI (Return On Investment) and low maintenance, Dyneo+ provides a cost-effective, efficient and environmentally-friendly drive solution.

Implementing the Dyneo+ technology means less kWh consumed,

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# Increasing Threat to Product Characteristics due to Particulate Matter

Spetec shows how a laminar flow box such as its FBS series uses high-performance class H14 filters to allow 99.995 % of all particulate matter to be efficiently filtered out

Particulate matter consists of a complex mixture of solid and liquid particles and is divided into different fractions according to the particle size. A distinction is made between PM10 and PM2.5 (PM = particulate matter) with a maximum diameter of 10 and 2.5 micrometers ( $\mu\text{m}$ ) respectively, and ultra-fine particles with a diameter of less than 0.1  $\mu\text{m}$ .

Particulate matter is released from a variety of sources. These include domestic heating and power generation plants, business operations, industrial plants and especially road traffic (diesel soot, abrasion from tires and brakes). Mean annual PM10 values between 15 and 20  $\mu\text{g}/\text{m}^3$  are common today, with a trend towards decreasing concentrations being observed. However, the number of particles is increasing dramatically. In enclosed spaces, smoke from tobacco products, emissions from laser printers (up to 2 billion particles per printed page) and humans themselves are sources of particulate matter pollution. The deleterious effects on health of particulate matter vary depending on the size and penetration depth of the particles. They range from mucous membrane irritation and local inflammation in the trachea or bronchi to increased plaque formation in the blood vessels. In order to protect human health, strict annual average limits of 25  $\mu\text{g}/\text{m}^3$  therefore apply to PM2.5 particles. As of 2015, adherence to this limit has been mandatory, with the exception that the daily mean PM10 value of 50  $\mu\text{g}/\text{m}^3$  may be exceeded up to 35 times per calendar year.

Particulate matter is also posing an increasing threat to many technical processes. In production and packaging, it can alter or impair the properties of products and even destroy optical and electronic components! This is the reason why certain products must be protected from particulate matter under clean room conditions. However, extracting particulate matter is a major technical challenge. Particulate matter can only be removed from the air by properly cleaning the air in the room.

In this context, filter technologies in particular have proven to be a



*Spetec FBS series laminar flow box*

cost-effective alternative. They can be easily retrofitted as needed. This applies equally to complex clean rooms and to smaller filter units, known as laminar flow boxes, because both systems are based on the same filter technology.

A laminar flow box, for example, such as the FBS series from Spetec GmbH, a filter technology manufacturer with decades of experience, uses high-performance class H14 filters. This allows 99.995 % of all particulate matter to be efficiently filtered out (based on a particle size of 0.12  $\mu\text{m}$ ). In this way, the air quality in the interior can be improved by at least 10,000 times compared with the ambient air in the production area. The use of a laminar flow box is an effective measure in the fight against the increasing number of particles. In other words, the most effective way of ensuring the quality and correct operation of products is to use a clean-room workspace.

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# Waterford Crystal Realises Significant Energy Savings with the ELGi EG Series

The world-renowned luxury crystal glassware manufacturer from Waterford in Ireland selected the ELGi EG Series oil-lubricated screw air compressor to modernize its high-precision engraving operations.

Waterford Crystal, the Irish manufacturer of fine luxury crystal, chose the EG Series EG22V from ELGi Compressors Europe to modernise the compressed air system at its plant in Waterford, Ireland.

Waterford Crystal needed to replace its existing compressor and commissioned Airtec Compressors Ltd., ELGi's Channel Partner in Ireland, for a solution. Waterford Crystal required reliability and energy efficiency from its new lead compressor providing 24/7 operations for a large proportion of their industrial machinery and high-precision engraving tools that highlight the skilled craftsmanship that goes into every piece of Waterford Crystal.

Airtec Compressors, air service partners for Waterford Crystal for over ten years, conducted a detailed site study and recommended installing a new ELGi EG22V (variable speed), which was installed in April 2021.

"The main reasons for purchasing the ELGi machine were its market-leading 10-year airend warranty and the efficiency improvements it offered," said Tony Elsted, Engineering and Maintenance Manager at Waterford Crystal. "The ELGi EG22V is our new lead compressor and has been operating seamlessly at our factory for over a year. Since installing the EG22V we have seen a large reduction in our energy consumption versus our older compressor, and despite the increased cost of electricity, the compressor has given us a payback in less than two years."

Waterford Crystal is a manufacturer of lead glass or "crystal", specialising in fine/luxury cut glass. Named after the city of Waterford in Ireland, crystal manufacturing in the city dates back to 1783 when George and William Penrose founded Waterford Crystal. The company's offerings go beyond traditional stemware and classic interior pieces to embrace and complete the luxury lifestyle experience, including stemware and barware, fine china & flatware, vases, bowls & centerpieces, collectibles, lighting, chandeliers, paperweights, holiday ornaments, and gifts.

"We are proud that an ELGi unit is at the heart of operations of Waterford Crystal – a world-renowned luxury crystal producer – supporting the creation of beautiful crystal pieces through its reliability and energy efficiency," said Terry McGuire, Regional Manager UK & Ireland, at ELGi. "At ELGi, our vision is to be 'Always Better,' and our EG Series embodies this approach with innovative technology options that help our customers be more efficient, lower life cycle costs and



reduce the environmental footprint. The EG Series stands out for its patented technologies, high efficiency, and ten-year market-leading warranty on the airend."

The sturdy design of the EG Series compressor range enables operations at extreme temperatures – from cold to hot and from dry to extremely humid conditions, leading to improved reliability of the compressed air system. ELGi's high-efficient airends are equipped with in-house developed -V profile rotors, with the 4/5 lobe combination, designed to run at low rotor speeds. This unique design reduces pressure losses and, together with the OSBIC (Oil separation by impact and centrifugal action), 3-stage separation provides best-in-class energy efficiency.

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18 – 20

#### Maintenance Next

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25 – 27

#### LogiMAT

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#### Ifat Eurasia

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### MAY

4 – 10

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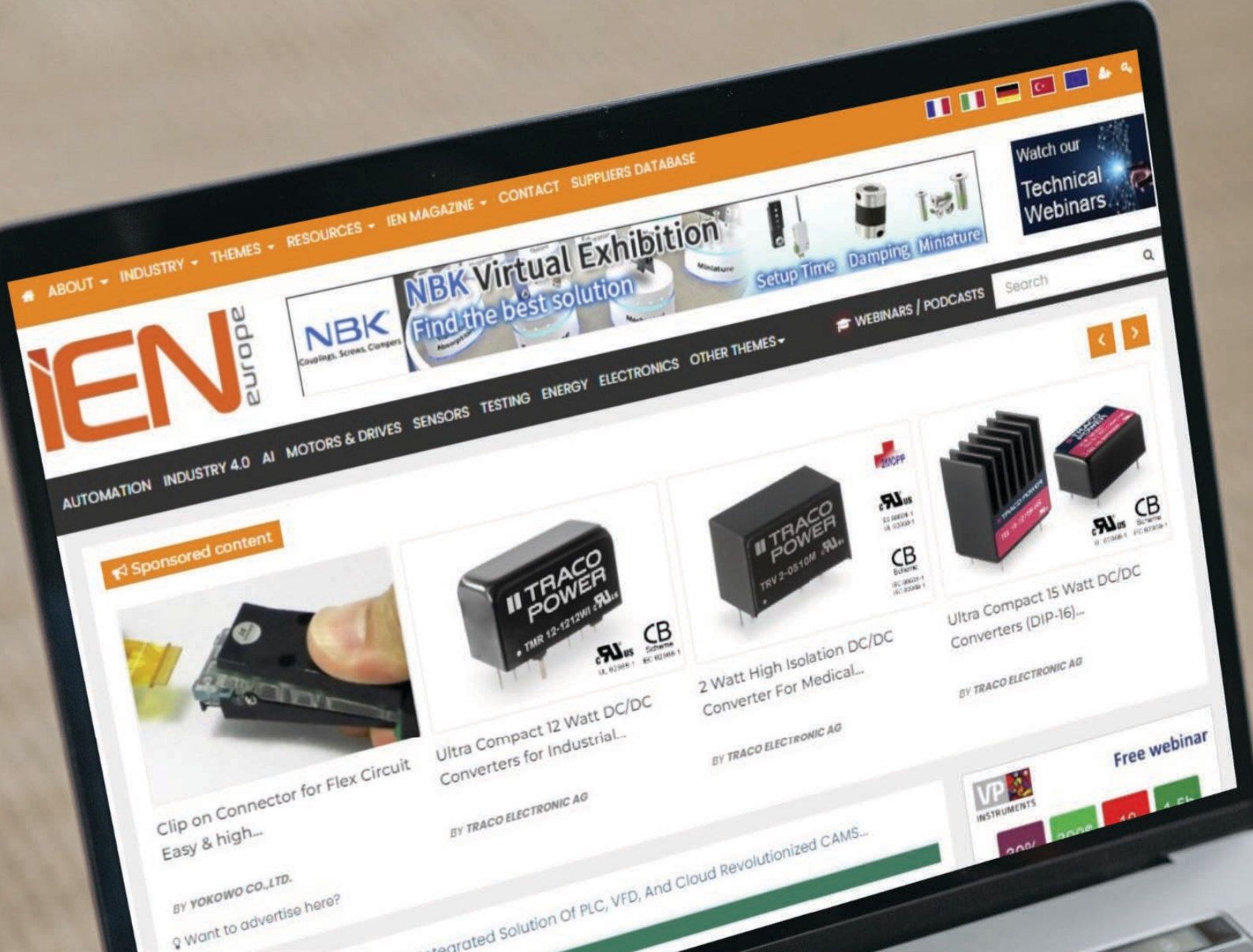
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9 – 11

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