

Transportation

The next decade of transport will revolutionise the industry with technical advancements and new inventions.



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DISTRELEC

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Publitek



Foreword

Distrelec is proud to announce its second edition of its eBook series focusing on product solutions for the transportation industry.

Transportation plays a vital role in the global infrastructure. Moving goods, materials, people from one destination to another in a safe manor has always been a challenge for many nations. Moreover, transportation has been a key focal point to tackle climate change.

Technology plays a significant role in transforming the transportation industry from energy efficient components that are more reliable and robust that meet industry standards, to artificial intelligent systems that predict maintenance or traffic routes in the supply chain.

Distrelec invests in innovative solutions by working with our key suppliers to deliver a best-in-class product portfolio for our customers. In this eBook we look at some of the solutions in the Transportation category led by our key suppliers who are experts in their fields.

Technology innovations are driving change in the transportation industry. If we

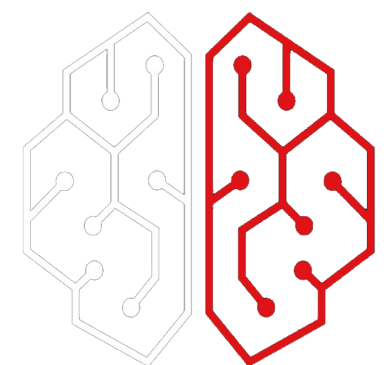
look at the railway industry for example, more trains are becoming electrified.

The demand for power supply systems for industrial applications that meet the highest quality and safety standards is exceedingly high. In addition to this the railway industry is one of the harshest environments for components and must operate reliably when exposed to the elements as well as constant shock and vibrations. Some of the articles in this eBook investigate some of those operational conditions, understanding further considerations why selecting suitable solutions is paramount.

Part of the safety and standards within the transportation industry is the essential testing and maintenance. As components and systems get more complex and transportation systems must meet safety standards, testing is an essential part of developing a system. In this eBook we highlight some of our supplier solutions within this sector.

Part of the future of transportation is the connectivity of vehicles and transport systems. The excitement around 5G has gone hand-

in-hand with the expectation around autonomous driving and advanced mobility. One of our in-house digital writers Julia Stollberg takes a deeper look into how 5G can impact the automotive industry, focusing on Autonomous driving, connectivity, electrification and shared mobility.



Selecting power supplies for railway and transportation applications

[Traco Power](#)



Power supply systems for industrial applications are subject to the highest quality standards. Therefore, our products comply with current international safety standards and are used primarily in control and automation technology and increasingly for IoT and IIoT applications - even in harsh and demanding environments.

Selecting power supplies for railway and transportation applications

Of all the sectors that power supplies need to operate reliably in, anything requiring exposure to the elements must be the most demanding. Take railway transportation, for example. Parts of the electrical installation of an engine, passenger carriages, and freight trucks may be mounted externally and subject to ingress of water, oil, and many different types of dust particles. Even if mounted inside a carriage, they can still experience shock and severe vibrations daily. Then there are the electrical conditions that frequently involve large voltage swings, momentary loss of power, and powerful transients.

This article investigates some of the operational challenges that railway applications experience and why understanding the technical considerations are a must before selecting suitable power supplies.

Provisioning reliable power in the challenging railway environment

From a passenger's perspective, most modern railway carriages are comfortable, well-lit, and equipped with modern technology. Seating typically offers mains power outlets and USB power. Information displays indicate progress along the journey and the likelihood of delays. Behind

the scenes, public Wi-Fi, carriage heating and ventilation systems, and online infotainment systems occupy passengers and make the trip enjoyable. Safety features such as smoke detectors and security CCTV are omnipresent. Door controls, door openers, and emergency lighting all are based around electronic systems today, and as everything else highlighted, they all require power. Moreover, electronics-based systems and associated power supplies are susceptible to voltage variations, interruptions, and environmental conditions.

Power is probably something we all take for granted in our homes and offices. Power outages are typically uncommon, and access to a reliable and stable main power supply becomes the norm. However, for railway and other transportation applications, the stability and reliability of the power supply is not as assured.

Understanding the electrical and environmental challenges of railway applications

The electricity available on a train comes from a generator attached to the main engine or via an overhead pantograph. Both are subject to voltage spikes, surges, and drop-outs—some of these result

from the myriad of electrical and electromechanical equipment used for rolling stock systems, such as braking. Momentary interruptions of supply also occur.

Another significant aspect of a railway application is the environmental operating conditions. Some systems are mounted externally, subject to weather extremes, rain, snow, ice, and the associated temperature swings. Dust, particularly with conductive elements, are a particular hazard. Even inside the passenger carriage, condensation occurs regularly. Then there are the many jolts, vibrations, and rapid motion forces we all experience.

When selecting a power supply for a railway application, let's investigate several vital considerations, starting with the supply voltage.

Railway Voltage Sources

Most railway supplies for electronics-based equipment are DC, emphasising the application using DC/DC converters. As already highlighted, the supply in electrical terminology is noisy. Over the evolution of railway electrical systems, standards have emerged that provide a relatively well-defined specification under

Selecting power supplies for railway and transportation applications

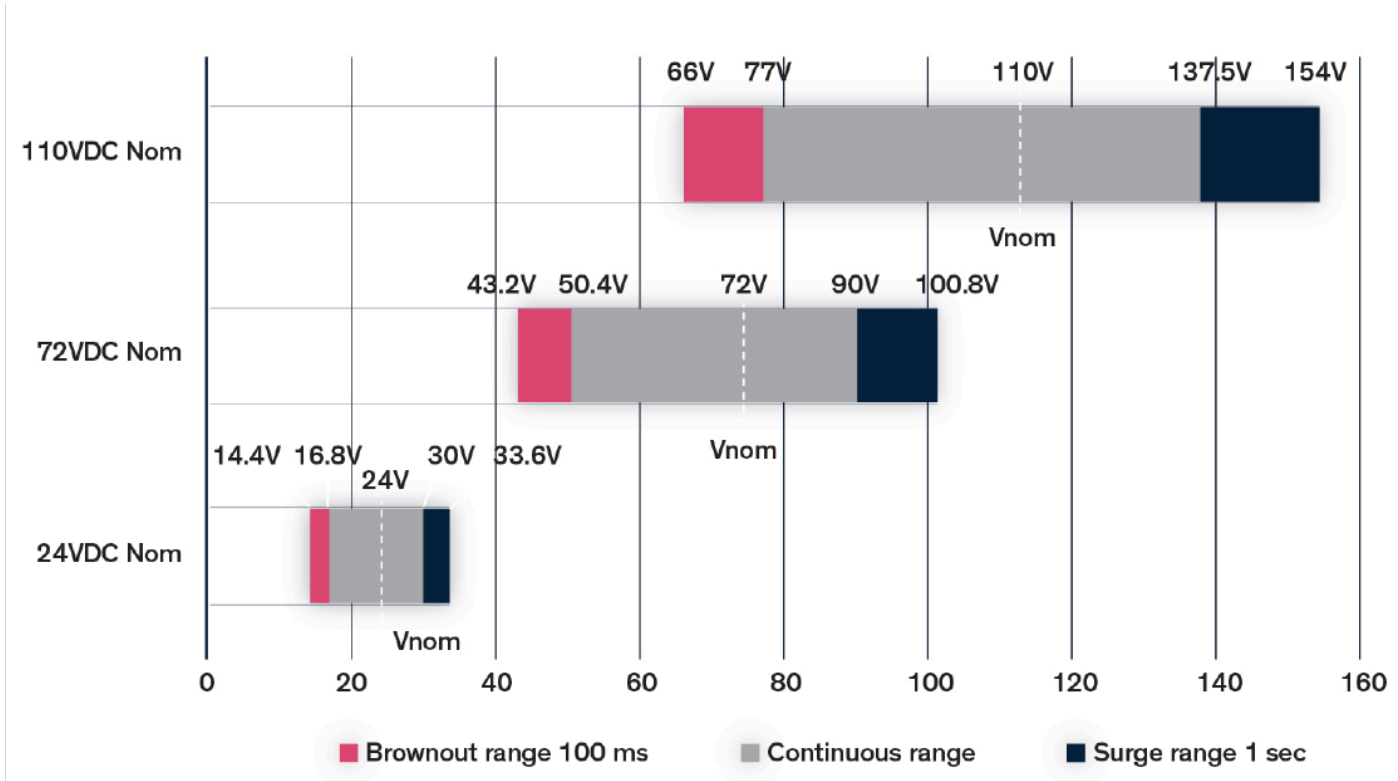


Figure 1 - Input voltage ranges for different nominal voltages as stipulated by EN 50155:2017 (source Traco Power)

which a power supply should operate. EN 50155:2017 is the principal standard covering most equipment for voltage, environmental and safety characteristics. The standard stipulates several nominal working voltages (Vnom), three of which are illustrated in Figure 1. The continuous operating voltage range is coloured grey, and the 'brown out' voltage, essentially a short-term sag or drop of the input voltage for 100 ms in red. The black bar defines a surge voltage range.

Any DC/DC converter selected

for a railway application must comply with EN 50155, and consequently, many suitable converters can accommodate an input voltage range of at least 4:1. For example, based on a 24 VDC nominal, the input voltage range is 9 VDC to 36 VDC. Outside these specifications, additional hold-up capacitors provide a brief period of continued operation and need to survive surges. To an extent, surge voltages can be suppressed with active clamps, although the energy involved can be substantial. Railway standard, RIA12, requires extended

immunity to surges of voltages up to 8.5 kV of 100 ns duration.

Electromagnetic Immunity (EMI), Electromagnetic Compatibility (EMC), and Electrostatic Discharge (ESD)

Short nanosecond duration, high voltage transients (high dV/dt) of thousands of volts can easily damage or disrupt the operation of sensitive electronic systems. Such transients can be radiated electromagnetically or conducted through power

Selecting power supplies for railway and transportation applications

supply rails. The function of a power supply should cause problems or interfere with other equipment. Likewise, a power supply must be immune to any emissions from other electromagnetic sources.

EMC relates to whether, for example, a DC/DC converter creates any electromagnetic emissions, and standards, EN 61000-4 (radiated) and EN 50121-3-2 (conducted) apply.

EN 61000-4 also covers electromagnetic immunity to radiated and conducted emissions, surges, fast high voltage transients, and electrostatic discharge.

Shock, Vibration and Environmental considerations

Shock and vibration are

perhaps the most significant mechanical forces to which a DC/DC converter is exposed. Standard EN 61373 stipulates various categories depending on the mounting location. The minor forces are experienced on or in the rolling stock body, whereas mounting on an axle assembly is the most severe.

Environmental standards such as temperature and humidity are detailed by EN 50155, categorised according to the mounting location, either in an internal cubicle or externally. The impact of sudden temperature shock between significantly different temperatures that can potentially result in condensation is another requirement of this standard.

For passenger safety reasons, DC/DC converters used in

railway applications must also comply with EN 45545-2. This standard defines the materials used for the construction of the converter, whether it might start a fire, and its usage.

Selecting suitable power supplies for railway applications

Traco Power manufactures a range of DC/DC converters certified for use in railway applications. Figure 2 highlights Traco's portfolio of DC/DC converters for a variety of use cases.



EXTERNAL DISPLAY
TEQ300WIR

CLIMATE CONTROL
THN15WIR

ON-BOARD COMMUNICATION
TEN20WIR

DOOR CONTROL
TMR3WIR

SWITCH/SIGNAL CONTROL
TEP100WIR

SURGE PROTECTION
TFI150

BRAKE CONTROL
TEP76WIR

Ruggedized Power Solutions
DC/DC from 3–300 Watt

- EN 50155: Isolation and EMC immunity
- EN 45545-2: Fire protection
- EN 61373: Shock and vibration immunity
- Input voltage range: 2:1/4:1/12:1
- 3-years warranty

For more information, datasheet and certifications please visit our website www.tracopower.com

Figure 2 - Traco Power offers a comprehensive line-up of DC/DC power supplies certified for railway applications (source Traco Power)

Selecting power supplies for railway and transportation applications

For example, the THN series of encapsulated metal cased 20 Watt DC/DC converters suit use in climate control systems and offer a high conversion efficiency, typically 91 %, and accommodate a 4:1 input voltage range. See Figure 3. This board mounted converter, measuring just 2.54 cm x 2.54 cm, has input to output isolation is 3 kV and conforms with EN 50155, EN 61373, and EN 45545-2 standards.

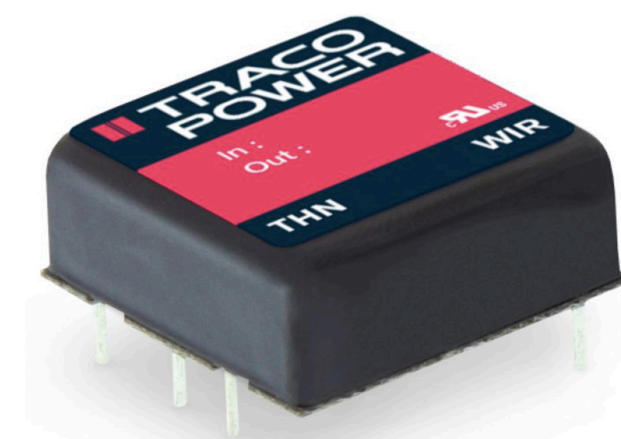


Figure 3 - The Traco Power THN series of 20 Watt DC/DC converters (source Traco Power)

Suiting the requirements of higher loads, such as external displays, the TEQ series, see Figure 4, provides up to 300 Watts and 900 Watts by combining three converters in a power-sharing arrangement. This high power density, convection cooled converter is packaged in a rugged sealed metal case with heatsinking fins.

With an exceptionally high, ultra-wide 12:1 input voltage range,

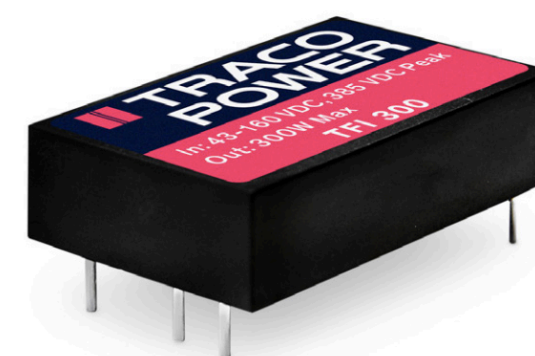


Figure 4 - The TEQ 300WIR series of 300 Watt DC/DC converters from Traco Power (source Traco Power)

the TEP 40UIR series of 40 Watt is housed in an industry-standard, quarter-brick metal package. Typical applications include brake control and switch/signal control applications. The TEP 40 UIR series comprises two input voltage variants based on 36 VDC or 110 VDC nominal inputs. Both versions offer the popular nominal output voltage of 5 VDC, 12 VDC, 15 VDC, 24 VDC, and 48 VDC.

For railway applications requiring compact, fully regulated, and isolated low power DC/DC converters, the TMR 6WIR series of 6 Watt provides an ideal solution. The board mounted series uses a SIP-8 metal case construction format to occupy minimal PCB area. A typical railway use case is for door control systems.

Another compact DC/DC converter in an industry-standard 1-inch x 2-inch form factor in a low-profile metal case is the 20 Watt TEN 20WIN series. On-board communication systems are typical applications for this series.

Providing compliance to the RIA12 surge standard is the TFI 300, a 300 Watt surge filter - see Figure 5. Placed in front of a DC/DC converter, the TFI protects the converter from damage by actively clamping its input voltage exceeding 168 VDC. The filter complies with the higher specification of RIA12 that allows transients

Recommended Products

of 20 ms at 385 VDC.

Railway applications demand reliable and rugged power supplies

When it comes to operating DC-powered equipment in demand environments, railway applications are high on the list. This article highlights some of the essential factors that engineers should carefully review when selecting suitable products. Compliance with specific railway standards covering voltage supply rails, EMC, EMC & ESD, and environmental operating conditions are

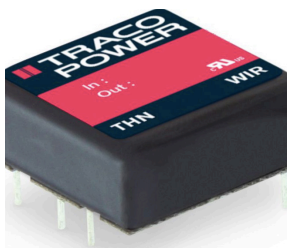


Figure 5 - The Traco Power TFI 300 RIA12-compliant surge filter (source Traco Power)

mandatory.

Distrelec is an authorised

distributor of railway approved DC/DC converter products from Traco Power.



DC/DC Converter, THN 20WIR

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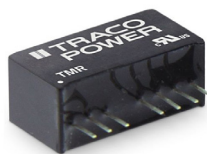
DC/DC Converter, TEQ 300

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DC/DC-Wandler 20W

[Shop now](#)



DC/DC Converter, TMR 4

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DC/DC Converters, TEP

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Surge Filters, TFI

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BUILD, REPAIR AND SAVE LIKE NEVER BEFORE WITH RND



Bulgin shaping the Automotive and Transport industry

By Chris Rush



There are hundreds of types of connectors used in general vehicles across many manufacturers. There are also hundreds of connectors used in a single vehicle with that number ever increasing as the digital age moves on.

As the increasing demand for safety, environmental protection, comfort and intelligence, the application

for electronics within vehicles increases, thus causing the number of automotive connectors to also show an increase.

The global automotive connectors market size was valued at USD 15.58 billion in 2017 and is expected to grow at a compound annual growth rate (CAGR) of 7.4% from 2018 to 2025.

Source: Grandview research

Bulgin shaping the Automotive and Transport industry



Automotive

An ever-growing population calls for more vehicles to fulfil transportation needs as well as the ever-increasing demand on the supply chain network. The rise of autonomous cars and increasingly connected vehicles also means that reliable and high-performance components have never been more important in the automotive industry.

There are four basic structural components that make up most automotive connectors:

- The contact
- The shell
- The insulator
- Accessories

These four essential components enable automotive connectors to act as bridges and operate more stable and secure in the harshest of environments.

Bulgin offer a full range of IP rated sealed circular power connectors designed to provide secure, robust and watertight connections in harsh environments such as the automotive industry.

One of Bulgin's most compact connectors within the Buccaneer range is the 400 series, which is ideal for designs requiring a small footprint such as in the Automotive industry. The range of key features

available to the much larger Buccaneer family have been condensed into a compact form factor in the 400 series. This gives engineers and manufacturers greater flexibility in the design and manufacturer processes whilst meeting the same specification requirements and standards.

Bulgin also provide solutions in a rectangular power connector. The standard rectangular range offers reliable, rugged solution for wire to wire applications like we see in many vehicles.

Wire to wire is the most significant connectivity type for automotive connectors, due to increasing vehicle electrification. Usage of wires and cables in automotive electronics has grown steadily over the last decade, with the introduction of new features and rise in vehicle sales.

The wire to wire connectors segment is expected to grow over the forecast period 2025 with rising implementation of convenience systems such as start-stop system, power steering, and park assist.

The 400 series has a male and female option, as well as modifications such as enhanced seal retention,

Bulgin shaping the Automotive and Transport industry

protective end caps, shrink boot adaptors, welded flange, terminating resistors and a Y-type connector (YTY) for industrial applications.

With a wide variety of products on offer including sealed connectors for power, signal and data, Bulgin can also produce bespoke custom solutions that combine switches, enclosures, PCB's and cable assemblies to meet the needs of demanding automotive applications. Some of the applications in the Automotive industry are:

- Automotive Manufacturing
- Illuminated Taxi Sign
- Glove Compartment Light
- RV Heating / Cooling Systems
- Lorry / Truck LED Lighting
- Quad Bike Control Panel
- Power Diagnostics
- Wheel Diagnostic Equipment
- Off Road Vehicles
- Snowmobile Controls
- Cherry Pickers
- Vehicle Tail Lift and Controls
- Agricultural Vehicles
- Military Vehicle Datacoms
- Pressure Washers
- Heated Car Seats

Transport & Infrastructure

With ambient and environmental conditions such as water, moisture and extreme temperatures



posing a constant threat to transport and infrastructure applications, reliable and robust solutions are vitally important in this sector, in-particular with refrigerated vehicles and temperature sensitive cargo during transit.

From outdoor lighting and industrial meters to HVAC systems and surveillance cameras, the industry leading solutions available are built for maximum reliability and performance to support the challenging needs of various indoor, outdoor and industrial applications.

The world is constantly changing and bulgin helps to keep it moving with their innovative solutions. With more transport links

and vehicles needed than ever before to meet the challenging needs of a growing population and demand, bulging solutions help future proof your investment by providing cost effective and high-performance solutions that last. As experts in manufacturing sealed electrical connectors, bulgin provides connectivity solutions to transport and infrastructure applications for years.

Particularly suited to provide power, signal and data connections in harsh environments, the reliable connector range makes sure that people and goods successfully get to their destination by land, sea or air.

Bulgin shaping the Automotive and Transport industry



Some of the application in the Transport & Infrastructure industry are:

- Lorry / Truck LED Lighting
- Road Management Maintenance
- Speed Check Signage
- Illuminated Taxi Sign
- Transport Refrigeration
- Noise Monitoring Terminal
- Container Cooling Units
- Surface Friction Test Equipment

- Noise Monitoring Terminal
- Traffic Light

The future of transport

As we know already the world is heading into an age of electric vehicles. It is estimated that by 2035 in Europe, there will be no further ICE cars being sold to the general public.

With the increase in the production of electric vehicles and new government regulations, the use of Vehicle

Charge Ports is on the rise. These ports are usually installed in public parking spaces, private parking lots, houses and offices – but as demand and usage for electric cars increases, so too will the continued infrastructure development required for their accommodated use.

Currently, a range of charging port options include; three-pin plugs, Socketed and Tethered – offering charging times ranging from 8-10 hours, 3-4 hours and even

Bulgin shaping the Automotive and Transport industry

30-60 minutes with some Socketed or Tethered connection ports. To ensure a secure and sealed connection whilst charging, the 900 Series Buccaneer is used on charging ports providing renewable power to both hybrid and electric cars.

Now more than ever there is an increase demand for reliable, robust connectors in the transport industry. Connectors that also must meet the high safety standards and pass rigorous testing throughout its lifecycle.

It is evident that that sourcing the right connector is not just considering in the design phase of a vehicle but also throughout the entire lifecycle from manufacturing, general vehicle use in harsh environments and vehicle maintenance such as servicing.

Europe is the second largest market, driven by rising inclusion of advanced driver assistant systems (ADAS) in commercial vehicles. The European Union has made the inclusion of ADAS features such as lane departure warning

signal and autonomous breaking mandatory in heavy commercial vehicles.

Distrelec is delighted to offer our customer a range of Bulgin connectors specifically for this market, as they are considered one of the industry leaders through their wide range of product solutions.



Buccaneer® 900, IP 68

[Shop now](#)



Buccaneer® 400, IP 68

[Shop now](#)



Ethernet Buccaneer®, IP 68

[Shop now](#)



USB, Buccaneer®, IP 68

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MOXA®

NPort 5100

Serial device servers designed to get your network up and running in an instant.

The small form factor, standard TCP/IP interface and versatile operation modes make these serial devices ideal in many space confined applications.

SHOP NOW



An engineer's guide to automotive test and measurement equipment

Keysight empowers automotive industry designers and manufacturers with the latest innovations in design and test solutions to help create high-quality and high-performance products while mitigating safety risks.



An engineer's guide to automotive test and measurement equipment

Our modern cars are brimming with electronics. From sleek infotainment systems to advanced driver assistance systems (ADAS), today's vehicles rely on high-performance computing, fast in-vehicle networking, high-resolution sensors, and resilient wireless connectivity. Hybrid and fully electric cars add battery management systems, high power electric motor drive trains, and energy optimisation capabilities. Fully autonomous vehicles further add to the complexity of systems deployed.

As the complexity of in-vehicle electronics increases, so does the need to adhere to many international and regional standards for EMI/EMC, ESD,

wireless type approval, and functional safety. Throughout the design, testing, and production cycles, engineers require access to a broad range of test and measurement equipment to check and validate system operation and behaviour.

This article investigates some critical test and measurement challenges automotive engineers face and showcases suitable equipment from Distrelec partner, Keysight.

Automotive electronics; a complex world
Today's vehicles could be considered a data centre on wheels due to the

number of computing resources installed. Further illustrating that point is the degree of networking used to interconnect electronic control units (ECUs), sensors, and actuators together. Figure 1 showcases the extent of this networking challenge and how the growing trend of implementing a zonal architecture is becoming the norm. Zonal ECUs and gateways manage downstream connectivity using legacy bus protocols, and upstream connectivity uses multi-gigabit Ethernet.

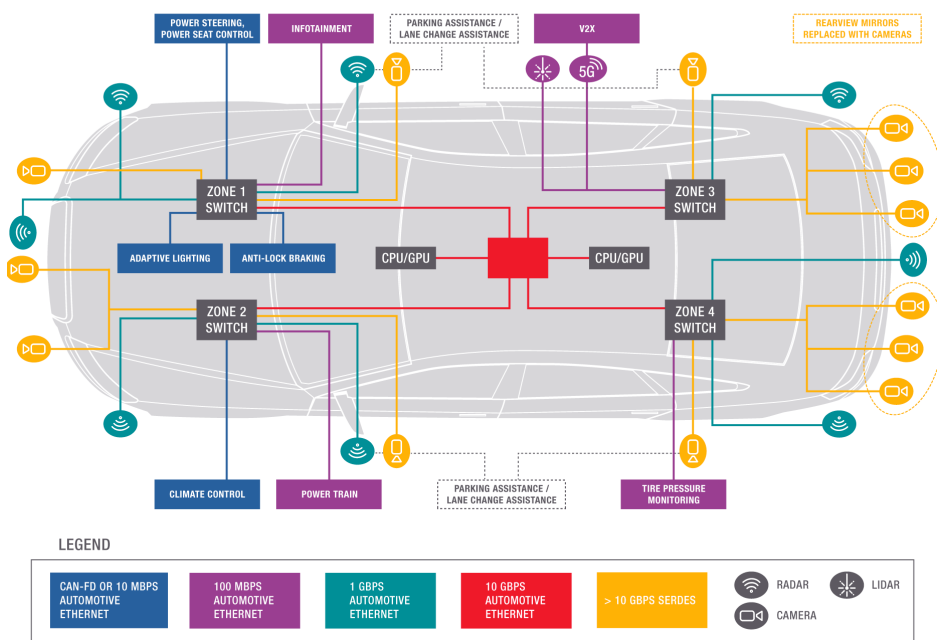


Figure 1 - The network architecture of a modern vehicle (source Keysight)

An engineer's guide to automotive test and measurement equipment

What Figure 1 does not show are the additional electronics used for an electric vehicle, such as battery management, onboard charger, isolation systems, and the motor drive train. Wireless communication, both within and external to the car, is also not illustrated. Wireless connectivity is growing in popularity for syncing up to the vehicle's infotainment system and providing an in-vehicle Wi-Fi capability for passengers. Also, wireless is essential to provisioning new vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2X) services, particularly for fully autonomous vehicles.

Manufacturers and consumers task automotive electronics engineers to make automotive electronic systems function and ensure that they work reliably and comply with the many automotive safety and regulatory standards.

Taking all the above considerations together, one can easily see the immense challenges engineering teams face. Access to accurate and calibrated test and measurement equipment throughout the design to the production process is paramount.

Automotive test and measurement requirements

The automotive domain is challenging. Different electronic sensors, actuators, and control systems are squeezed together in small spaces. Many face frequent exposure to the worst of environmental elements, water, dust, heat, and vibration.

From the perspective of electrical and electronic systems, the regulatory and test requirements broadly fall into the following categories: electromagnetic conformance and immunity (EMC, EMI), electrostatic discharge (ESD), networking protocols, wireless communication, and power management.

With so many complex systems, many interacting with each other at gigabit speeds, the requirement to capture data during test cycles for analysis is essential. Data acquisition is an integral part of automotive test and measurement.

Electromagnetic conformance, immunity, and electrostatic discharge:

These topics are perhaps among the most important aspects of regulatory compliance. The basic tenets are that the operation of any electronic system does not interfere with or cause other electronic systems to fail or operate unreliably. Likewise, the same electronic system must be immune to unwanted and spurious electromagnetic interference from other systems. There are two ways in which electromagnetic interference propagates between electronic systems; radiated or conducted. For example, a conducted emissions transfer by wire along with power cables or through the vehicle's chassis. Radiated emissions occur through electromagnetic transfer, just as a wireless signal does. Conducted and radiated radio frequency (RF) immunity and conformance can present many technical challenges for automotive engineers. Both conducted and radiated emissions can come from any number of sources, including microprocessors, switching power supplies, and networking cabling. In particular, electric vehicles' power conversion and motor drive chains can create high voltage spikes and transients that can interfere with and

An engineer's guide to automotive test and measurement equipment

potentially damage sensitive electronic systems.

Relevant international automotive standards for EMC and EMI are those from the Society of Automotive Engineers (SAE), the International Standards Organisation (ISO), and many regional and national standards bodies.

Electrostatic discharge

(ESD): We've all probably experienced a mild electric shock exiting or entering a vehicle. Such electrostatic discharge can, in extreme cases, involve many thousands of volts and result from the friction of moving surfaces. A car's rubber tyres insulate it from the ground, resulting in a significant build-up of electric charge driving down the road. Electronic systems are susceptible to permanent damage from this level of electrical discharge and need to be well protected. Safety is also of prime concern for drivers and passengers, so any onboard systems capable of generating high voltages should have adequate protection to the relevant standards.

Networking and protocols:

automotive systems communicating and receiving constant data streams from sensors, including radar and vision cameras, diagnosing faults occurring across the networked domains is paramount. Seeing into communication protocols such as CAN and Ethernet in real-time allows the engineering fault to isolate defects and problems. Likewise, during the initial system design, the ability to view what is happening on embedded microcontroller interfaces such as I2C, USART, and SPI saves considerable engineering time.

Wireless communication: Just like any device equipped with a radio transceiver for data transmission, they all need to conform to regulatory type approvals. Compliance ensures that wireless devices do not interfere with other equipment and that the method of communication, Wi-Fi, Bluetooth etc. meets the interoperability standards of the various networking bodes.



Selecting the proper test equipment for automotive applications

Data Acquisition

One aspect of automotive test and measurement highlighted above is that of data acquisition. An excellent example of a modular, expandable, and configurable data acquisition system is the Keysight DAQ970A - see Figure 2.

An engineer's guide to automotive test and measurement equipment



Figure 2 - The Keysight DAQ970A data acquisition system (source Keysight)

The base unit features a 3-slot mainframe for expansion modules and a built-in 6-1/2 digit DMM with a 0.003 % DCV accuracy. Engineers can opt to select nine different plug-in modules, including control units, a 1 GHz bandwidth radio frequency multiplexer, multi-channel sensor switching multiplexers, and a 4-channel 24-bit 800 ks/s sampling digitiser. The DAQ970A can accommodate up to 120 channels per system and scan at the rate of 450 channels per second. Internal memory is sufficient for one million data points.

Up to 14 different input system types can be acquired and stored by the DAQ970A, including resistance temperature detectors (RTDs), AC/DC voltages, 2- and 4-wire resistance, frequency, period, AC/DC amps, capacitance, and two types of strain gauges.

The BenchVue DAQ software offers the ability to further analyse signals on a desktop computer or laptop.

Oscilloscopes

The bench oscilloscope is the 'go-to' tool for most engineers. Analog oscilloscopes provide

the capability to see a wide variety of analog voltages, complex waveforms, periods, transients, and frequencies. Most units offer a minimum of two input channels, and four is the norm. Digital mixed-signal oscilloscopes add the capability to view multiple digital logic inputs alongside analog signals. An example of an analog oscilloscope is the Keysight DSOX3014T - see Figure 3. This unit features four analog input channels and a 100 MHz input bandwidth. A mixed-signal version, the Keysight MSOX3014T, additionally offers 16 digital logic channels. Other models in the series include those with a bandwidth up to 1 GHz and optionally incorporate an arbitrary wave generator (AWG) option.



Figure 3 - The Keysight MSOX3014T mixed-signal oscilloscope (source Keysight)

An essential addition to any mixed-signal oscilloscope is the ability to decode automotive network

An engineer's guide to automotive test and measurement equipment

protocols such as CAN and FlexRay and embedded serial protocols such as I2C and SPI. These software capabilities are optional yet valuable additions to any oscilloscope.

RF Spectrum Analyser

For dealing with RF signals, a spectrum analyser is an essential item of test equipment. Unlike an oscilloscope that operates in the time domain, a spectrum analyser uses in the frequency domain. A spectrum analyser can measure the amplitude and frequency spread of fundamental (primary) RF signals and their harmonics.

An ideal entry-level product for automotive use is the Keysight N9322C - see Figure 4. This analyser operates from 7 kHz to 7 GHz, and a -152 dBm displayed average noise level (DANL).

Power Supplies and Power Measurement

Programmable power



Figure 4 - The Keysight N9322C 7 kHz to 7 GHz entry-level spectrum analyser (source Keysight)

supplies are another key item of test and measurement equipment. Power supplies are much in demand, whether providing power for automotive electronic control units under test or powering automatic test equipment racks. Keysight offers the N6700 series of bench and rack-mounted power supplies. In addition to supplying power, there is often the requirement to analyse its characteristics. The Keysight N6705C achieves both in a single desktop unit. Capable of delivering four different voltage outputs and a total power delivery capability of up to 1,200 Watts, the N6705C combines an oscilloscope, an arbitrary waveform generator, a digital multimeter, and a data logger in a single unit.

Portable test and measurement equipment

Engineers still need access to reliable and accurate test and measurement equipment for

use away from a bench or lab environment. Keysight offers a range of compact, battery-powered equipment that satisfies engineers working in the remote test or production environment. Portable units include the U1272A 4-1/2 digit handheld digital multimeter, the U5856A thermal infrared camera, the 200 MHz two-channel analog oscilloscope, and the U1194A clamp meter.

Reliable and accurate test and measurement paramount for automotive design

Today's vehicles rely on a



Figure 6 - A collection of Keysight handheld test and measurement equipment (source Keysight)

dazzling array of electronic systems. Ensuring these systems operate as designed and comply with all relevant specifications requires a rigorous approach to test and measurement. In this article, we've highlighted just some of the many test and measurement options available to automotive engineers from Keysight.



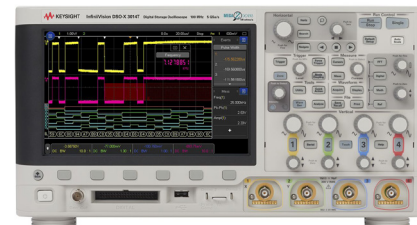
DAQ970A - Data Acquisition System

The DAQ970A combines precision measurement capability with flexible signal connections for your production and development test systems. Three module slots are built into the rear of the instrument to accept any combination of data acquisition or switching modules.

[Shop now](#)

MSOX3014T - Oscilloscope, 4x 100MHz, 5GSPS

The InfiniiVision 3000A X-Series redefined oscilloscopes. It saw the most signal detail, provided more functionality than any other oscilloscope, and gave you maximum investment protection.



[Shop now](#)



N9322C - Spectrum Analyser, 7GHz, 50Ohm

The Keysight N9322C basic spectrum analyser defines a new generation of value-priced, general purpose instruments. Features like proven testing efficiency, best-in-class usability, and the flexibility to adapt to new requirements are just a few of the reasons. Using the N9322C means you can rely on results.

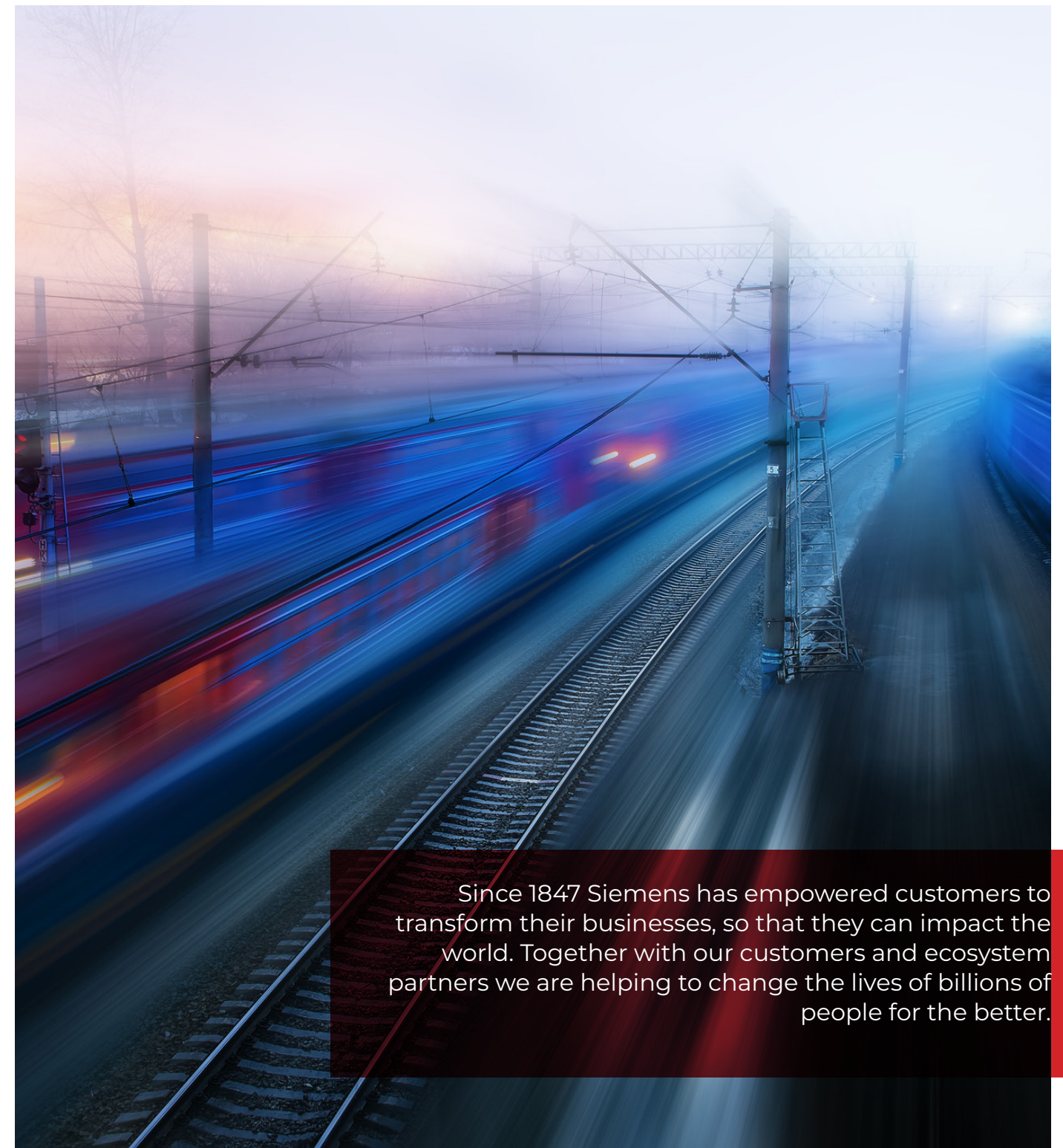
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N6705C - Modular DC Power Analyser

The Keysight N6705 DC power analyser is a modular system that can be tailored to meet specific test needs. At the heart of the DC power analyser is the DC power module. The Keysight N6705 DC power analyser is a mainframe that has four slots to accept one to four DC power modules.



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Since 1847 Siemens has empowered customers to transform their businesses, so that they can impact the world. Together with our customers and ecosystem partners we are helping to change the lives of billions of people for the better.

Electrical components for the railway industry

Large temperature fluctuations, condensation, shock, vibration, electromagnetic interference, and more: Electrical and mechanical components for the railway industry must provide safe and reliable operation even under extreme application conditions – at all times. Therefore, Siemens leaves nothing to chance when developing these components. Right from the start, sound technology, application, and service knowhow go hand in hand with the highest quality standards.

As a global technology and innovation leader, Siemens continuously pushes progress and helps customers overcome challenges – e.g., by using the so-called digital twin. This cross-domain digital model integrates all data of a physical asset (product, plant, or infrastructure systems) – from the early design phase to engineering, commissioning, and service.

The digital twin offers real value throughout the entire asset lifecycle, reducing over-engineering as well as improving component

reliability with predictive engineering system simulation. It also reduces the costs for design, dimensioning and commissioning, which accelerates your engineering and project execution.

Siemens has been a reliable partner in the railway industry for decades. Their comprehensive experience in the fields of rolling stock and infrastructure is directly incorporated in the development of components – as is the knowledge gained from close cooperation with international standards committees. Therefore, you can rely on Siemens components' guaranteed compliance with railway-specific requirements and standards.

Developed, tested, and certified in accordance with current standards and directives

Siemens is a founding member of the IRIS Initiative, and consistently implements its requirements. The railway components comply with all the relevant standards, for example: DIN, EN, IEC, IEEE, ISO, EAC/GOST and ANSI (American National Standards Institute), as well

as the current fire protection standard EN 45545. With certified components, Siemens actively supports the worldwide vehicle approval process.

For the railway industry, Siemens offers a wide-ranging portfolio of reliable, high-quality components for all types of railway transportation, as well as for infrastructure applications. For example, the products from SIRIUS and SENTRON ranges are employed around the clock in countless railway vehicles all over the world. They control, switch, and protect air-conditioning systems, windshield heaters, underfloor containers, hygiene cubicles, and many other components.

Siemens also offers components and services for the complete propulsion system. From the pantograph through the surge arrester, transformer and traction converter to the motor and gear unit, including the coupling. Auxiliary power supply system and battery converters provide the energy for all the passenger-comfort and auxiliary loads.

The SIPLUS extreme product

Electrical components for the railway industry



range includes refined controls for use under extreme conditions. And SIDOOR, Siemens automatic control system, is the ideal solution for controlling and driving interior train doors, platform screen doors and new gap fillers also known as movable steps. Including, well-proven vacuum interrupters fulfil, in the railway industry, all requirements on medium-voltage components. They are installed, for example, in circuit breakers on the rooftop of the rolling stock to provide electrical power to the

electrical drives. Furthermore, they are utilized in load break switches, contactors, and railway breakers.

In the field of infrastructure, components ensure the fault free operation of barriers, signals, sets of points, and platform doors. In addition, SIPLUS RIC facilitates communication via internationally standardized transfer protocols for telecontrol. Selected network components from SCALANCE and RUGGEDCOM product lines ensure reliable and

secure wired and wireless communication – on the train as well as trackside. These components are specifically designed to operate reliably in harsh and critical environments. Electrical components for the railway industry: Siemens stand for proven technology and industry expertise you can rely on.

Electrical components for the railway industry

SIRIUS range of electrical components for the railway industry

Whether for rolling stock or infrastructure applications, Siemens offers a comprehensive portfolio of electrical components for countless applications. One of our portfolio highlights is SIRIUS, the complete range for industrial controls. SIRIUS offers everything required for the switching, protection, or starting of loads, as well as for their monitoring, control, detection, commanding, signalling, or supply. Our portfolio is rounded out by numerous products specifically developed and tested for the railway industry.



SENTRON protection and switching devices

Tested protection and switching devices from the SENTRON portfolio ensure reliable low-voltage power distribution in infrastructure and railway applications. The perfectly coordinated components offer outstanding flexibility, convenience, and safety for the railway industry.

**Siemens surge arresters
for railway applications –
reliable, stable, and safe
overvoltage protection**

Siemens has been designing and manufacturing surge arresters for all kinds of applications since 1925. For more than 80 years, have been manufacturing surge arresters for rail systems. Continuous research and development, the wealth of Siemens expertise, and comprehensive worldwide experience give Siemen's surge arresters a leading edge in overvoltage



protection. Their uncompromising quality ensures a long service life and the highest reliability in any application.

Siemens surge arresters are an indispensable aid to insulation coordination in electrical power systems. Valuable equipment, such as traction vehicles, is optimally protected against lightning and switching over voltages. Siemens surge arresters have been designed to meet the requirements of a wide range of common installation environments, from arctic cold to the heat of the desert and the dampness of tropical climates. All Siemens surge arresters feature a superior sealing system that reliably

Electrical components for the railway industry

prevents moisture ingress to ensure the highest possible degree of overvoltage protection and decades of trouble-free service.

SIPLUS extreme RAIL – automation with railway approvals

Thanks to their extensive approvals and conformity to railway standards, the new SIPLUS extreme RAIL products are the perfect choice for a wide range of rolling stock and trackside applications. Based on SIMATIC industrial controllers, common features such as integrated system diagnostics and security and safety are already included. Whether simple, complex, or distributed – SIPLUS extreme RAIL offers a durable and robust solution for your automation tasks.





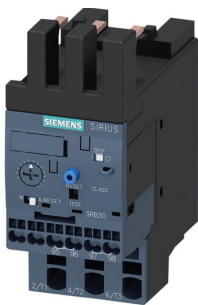
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Overload relay 14-20 A Thermal For motor protection Size S2, Class 10 Contactor mounting Main circuit: Screw Auxiliary circuit: Screw Manual-Automatic-Reset

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Our SENTRON portfolio of residual current protective devices (RCDs) includes basic residual current operated circuit breakers (RCCBs) with no integrated overvoltage protection, combined RCBO with residual current detection and overvoltage protection in a single device, and, as an alternative, RC unit that can be fitted to miniature circuit breakers (MCBs).



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The modular design allows the ET 200 system to be scaled up and expanded in small, easy steps: digital and analog inputs outputs, intelligent modules with CPU functionality, safety engineering, motor starters, pneumatic systems, frequency converters, and diverse technology modules.

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The Technology and Market Leader in Industrial Networking. Hirschmann™ develops innovative solutions, which are geared towards its customers' requirements in terms of performance, efficiency and investment reliability.

Valve Connectors in road construction

The harsh conditions of road construction

Road construction is a notoriously harsh environment for mechanical and electrical components of heavy machinery. These machines are exposed to dust, vibration, high temperatures, wind, and rain. In addition, road construction uses products like melted bitumen that are challenging to handle. Other applications have similar challenges in terms of the operating environment, like garbage trucks, dump trucks, and construction machinery.

All these machines must also function with the highest level of reliability. Road construction causes inconvenience to the community. It is, therefore, critical to avoid delays and to complete the job as quickly as possible. Component failures on road construction machinery must be kept to a minimum and when they occur, the repair should be quick and simple. The same principles apply to garbage trucks and other high impact industries.

Valve connectors are small components in a large road construction machine. However, their role is critical to

the machine's operation. They control the flow of hydraulic fluid that allows the large mechanical parts to do their work. When valve connectors fail, the entire machine becomes inoperable. Some valve connectors are also used for injection of materials into the mixture for the road surface. This function is also critical to machine operation due to the precise metering required to create the correct mixture of additives for the road surface.

Common valve connector failure modes

Valve connectors fit to the directional control valves of hydraulic systems on road construction machines. They open or close the valve to allow movement in an actuator so that the hydraulic cylinder can move forward or backward.

There are three common root causes of failure for valve connectors:

1. Vibration

A typical example of road construction machinery using valve connectors is a cold recycling machine. This machine removes asphalt layers up to 35mm by milling and mixing while

adding bonding agents to apply the new surface. The constant milling action causes vibration throughout the machine. Any weakness in a plastic or metal part is exposed by vibration, causing the component to break and stop functioning or even resulting in a hydraulic leak.

2. Dust and moisture

Milling an existing road surface generates large amounts of dust. While much of this dust is contained in the milling and mixing room of the machine, some dust will escape and spread out into any open spaces. At the same time, moisture from rain or water addition also migrates to all parts of a road construction machine. Dust and water are both highly detrimental to the functioning of electrical and mechanical components. Dust creates friction and prevents valves from moving, while moisture can short circuit electrical signals and contaminate hydraulic fluid.

3. High temperature

Road construction machines operate at high temperature to allow the road surfacing material to flow before solidifying on the road. This means that any component used on the machine must be rated for high temperature

Valve Connectors in road construction



use. Using unrated parts can lead to the casing melting or the internal components of a valve connector to fail due to high temperature exposure.

The challenges of working on road construction machines

One of the challenges of working on road construction machinery is the lack of space. Engine compartments are small and access to components is sometimes limited. Any component used in the system - whether it be

for hydraulics or injection - must be easy to access and remove for replacement. Simple ergonomic features can make a big difference in the time taken to perform a maintenance task.

Valve connectors are controlled by electrical signals that switch the position of the device. Cable connectors can be challenging to work on if the design of the device does not take ergonomics into account. Making space for easy connection and disconnection is essential for

effective maintenance.

Selecting suitable valve connectors

There are several factors to consider when selecting valve connectors for a road construction machine, garbage truck or any other similar application. Some factors are related to the standards that the valve connector complies with, while others are related to the quality of construction and design features:

Valve Connectors in road construction

- The ideal valve connector has strength and security against failure in harsh conditions. It is resistant to the effects of vibration and high temperature that are often present in road construction.
- Valve connectors should be safe and durable. They should conform to the standard IEC 60529 at a high level of ingress protection. The IP67 rating under this standard means that the device is completely sealed against dust particles even smaller than 1mm. It can also resist the ingress of water when submerged at a depth of 1cm to 1m for 30 minutes.
- The best valve connectors are easy to assemble and work on in the confined spaces of a road construction machine. They have a large cable connector space that makes connection and disconnection easy.

Hirschmann GL and GS valve connectors from Distrelec have all these features, which make them an ideal choice for road construction machines. The wide range of available models cover all the necessary options. This includes input voltage

ratings from 12V up to 400V and current rating from 2A to 16A. The maximum temperature rating is 125°C, which is more than sufficient for the road construction industry. Hirschmann valve connectors come in a straight or right-angle body orientation, giving maximum flexibility for different installation ergonomics.

Conclusion

The road construction industry and other similar applications like garbage trucks, dumpsters and construction vehicles experience harsh environments that can cause damage to valve connectors. High vibrations, heat, dust, and moisture can cause components to fail leading to the machine becoming inoperable until it is repaired. At the same time, the design of valve connectors can make them challenging to work with. Lack of space makes maintenance tasks difficult, which makes maintenance tasks more time-consuming.



However, Hirschmann GL and GS valve connectors, available from Distrelec, overcome these challenges with excellent design and practical features. These devices are safe and durable and have an IP67 rating. Their cable connector space is large, making it easy to assemble and disassemble the device. GL and GS valve connectors also offer excellent strength and security.

More information about Distrelec's range of Hirschmann GL and GS valve connectors can be found here.

Hirschmann

When it comes to selecting the right valve connectors, reliable and durable performance are just as important as choosing the right design, protection circuitry and accessory. Thanks to a protection circuit and function indicator, as well as an extremely robust design, Lumberg Automation Valve Connectors reliably connect solenoid valves, pressure sensors, temperature sensors and flow monitors to voltage supplies or a data network.



Cable Plugs

GDS Series DIN standard receptacle. The Hirschmann G series is at home where the installation space for other connectors may be too tight.

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Cable Sockets

With hydraulic, pneumatic and electromagnetic actuators and sensors, the GDM and GAN series stands ready for any harsh environment. Rugged, highly impermeable design guarantees uncompromising reliability in the most demanding applications.



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R&S® RTM3000

Oscilloscope Power of Ten

An oscilloscope is a perfect test and measurement tool for the development and verification of components and modules for variety of automotive applications. Designed as a versatile instrument able to analyze signals in the time and frequency domain, the R&S®RTM3000 oscilloscope can be used for testing a wide range of components of a modern vehicle, including optimization of wireless battery management, LED development and numerous infotainment applications such as touch screen testing. The RTM3000 has dedicated options for specific protocols such as RTM-K3 which enable trigger and decode of CAN and LIN buses, including CAN DBC file import.

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Make ideas real



Watch out: 5G Connectivity is impacting the automotive industry

By Julia Stollberg Distrelec



2020 is the year of 5G. With network providers rolling out coverage, the first mainstream 5G phones being released and infrastructure being built, the new network is becoming a reality for consumers and industrial actors alike. Across industries, innovators are already hard at work setting themselves up for success and preparing for the widespread transition to 5G as well as the opportunities

that come with it. A prime example of immense progression potential with 5G is the automotive industry, and it will be the cradle of some of the most notable advancements stemming from the new technology that will affect society as a whole.

But what exactly is it that 5G will enable the automotive industry to achieve?

Let's take a short look at the 5G basics.

The 5G basics

The 5G network makes use of a much higher frequency to send its signals than that available to the 4G network. At 5G frequencies between 24 and 100GHz, also called millimetre wave, 4G, which uses frequencies between 2 and 8GHz, can barely

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**AUTONOMOUS
DRIVING**



CONNECTIVITY



ELECTRIFICATION



**SHARED
MOBILITY**

compare. In this case, higher frequencies mean higher speeds – one of the key advantages of 5G.

Additionally, users will benefit from much lower latency. This means that lag will be almost nonexistent – a feature that is crucial for many professional purposes, for example in remote surgery or autonomous driving applications.

5G is also much more reliable than its predecessors, reaching nearly 100% reliability. This is again significant when it comes to industrial applications that can be responsible for human lives and need to drive down risk factors as low as possible.

With higher speeds, minimal lag and incredible reliability, 5G sets the stage for innovative automotive developments.

Focus: Cars

The excitement around 5G has, from the very beginning, gone hand in hand with high expectations around autonomous driving and advanced mobility. And for good reason: High uplink and downlink data rates up to 10 Mbps per device in a vehicle, very low latency of 1 ms and high network density up to 10,000 devices/km² are just some of the enablers relating to 5G that will progress this technology.

Cars as we know them are bound to change as technologies progress, and McKinsey have identified four trends related to 5G that will ultimately drive a significant change in what we think of as cars. They are collectively known as “ACES”:

Arguably the biggest out of these is autonomous driving. Though we have seen test projects with varying success,

5G's high network reliability and low latency represent a step towards increased safety when we think of the car of the future and the way it senses and connects to its environment. This will also lead automakers further down the path of an increased focus on software and hardware that make up a vehicle's operating system, and less focus on conventional machinery.

Another development that will rely on 5G and this further focus on software is connectivity inside the cars of tomorrow. This will enable a wide range of use cases, among them vehicular infotainment and cooperative Advanced Driver Assistance Systems (ADAS), which hugely benefit from 5G advancements of average data rates between 0.5 Mbps and 15 Mbps (depending on media), dense urban mobility up to 200 km/hr as well as

Watch out: 5G Connectivity is impacting the automotive industry

network density of 2,000 devices/km².

Shared mobility, or cars routinely being used by a large amount of different users, ties in with autonomous driving. Once autonomous driving has become established, taxi companies can deploy fleets of autonomous cars that make use of all the benefits of autonomous and connected driving experiences, like route-optimisation solutions and real-time data on traffic conditions. Plus, consumers will be able to monetise their idle cars.

Lastly, electrification as the final trend will increase the amount of electric powertrains available. These aren't just better for the environment, they also mean that cars – with the help of 5G – can perform remote operations and connect digitally.

These ACES trends don't each exist on their own but are connected. As we've already begun to outline, their interplay is crucial to cars' technological advancement. This requires large amounts of data to be processed almost instantaneously – and that's where 5G can truly shine. As an enabler for

revolutionary developments led by the ACES trends, industrial players can see its potential. For example, in Europe, the 5GCAR project is helping to develop an overall 5G system architecture, and has identified use cases that need 5G to unlock the future of transportation. These range from lane merge coordination to long range sensor sharing and increased protection for pedestrians.

Focus: Roads and Infrastructure

The automotive sector cannot exist without roads and infrastructure, and similarly all developments based on the ACES trends and enabled by 5G would be obsolete if significant innovation in this area was not achieved. Luckily, this is well underway.

Interconnected infrastructure including cameras to monitor traffic conditions, sensors that can gauge temperature and driving conditions as well as temporary road work signs will be a part of the future driving experience. With 5G, this infrastructure along with its interconnected cars can rely on average end user data rates up to 100 Mbps, latency of less than 200 ms, and dense urban mobility up to

100 km/h.

With these devices as well as advanced new cars, it will also be necessary to rely on a central intelligent traffic-management system. And again, this can be accessed through 5G.

Focus: Automotive Manufacturing

Within the manufacturing sector, it is known that 5G provides an opportunity to increase productivity, speed and efficiency. As a singular standard that the industry can adopt, projects are already in progress to be the first to benefit. Ericsson and Telefónica Germany, for instance, have teamed up to enable a private 5G network for Mercedes-Benz at the company's Sindelfingen plant in southern Germany.

With the installation of a local 5G network, the networking of all production systems and machines in the Mercedes-Benz

Watch out: 5G Connectivity is impacting the automotive industry



Cars factories will become even smarter and more efficient in the future. This opens up completely new production opportunities.

Jörg Burzer, Member of the Divisional Board of Management of Mercedes-Benz Cars, Production and Supply Chain

Scaled up opportunities

With 5G, it is possible to enable network-based communication that provides high reliability, low latency and higher speeds in order to move large amounts of data. This means that, in 5G, the industry has a unique opportunity to facilitate autonomy, shared mobility, connectivity and

electrification at scale. With a network fit for all the innovative ideas regarding connected cars, infrastructure and automotive factories, industry players have a blank canvas they can use to start making the automotive industry of the future a reality. And we can't wait to see what they come up with.

EA Elektro-Automatik supports advances in climate neutral-energy with automotive fuel cell testing and simulation solutions

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EA Elektro-Automatik (EA) is a Europe's leading supplier of power electronics in many industries. EA develops and manufactures innovative power supplies in their German labs.

EA Elektro-Automatik supports advances in climate neutral-energy with automotive fuel cell testing and simulation solutions

EA Elektro-Automatik (EA) is a Europe's leading supplier of power electronics in many industries. EA develops and manufactures innovative power supplies in their German labs. EA now offers its ELR range of regenerative electronic loads designed specifically to facilitate the testing of automotive fuel cells.

Fuel cells have been around for many years but with recent technological advancements and global initiatives for climate neutrality there has been a significant investment with automobile companies such as Honda, Toyota, Hyundai, and Mercedes.

Designing and manufacturing quality fuel cells requires characterizing the device and testing device performance. For standby power stations and automotive vehicles, fuel cells are assembled in stacks to meet the necessary power requirements for the application. These stacks can generate high power; thus, high wattage power supplies and electronic loads are needed for fuel cell characterization and testing.

Fuel cell stacks can deliver well over 10 kW of power. EA Elektro-Automatik not only manufactures high-power DC supplies and loads, but these products have several features that simplify the task of simulating, characterizing, and testing fuel cells and make the testing more efficient.

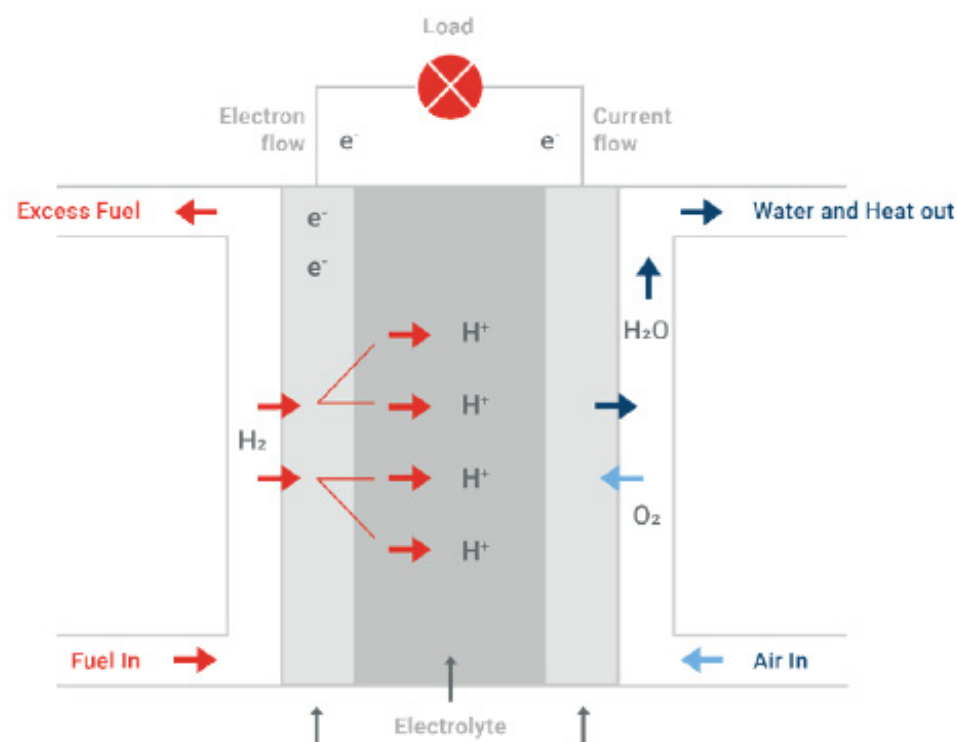
What is a fuel cell?

Before we talk about the testing of fuel cells, let us get a quick overview of what fuel cells are. Fuel cells are a chemical fuel. When a chemical reaction occurs it typically generates energy with a by-product such as

heat. Most fuel cells are often hydrogen based mixed with an oxidising agent such as oxygen which then creates electrolytes.

The advantage of using hydrogen is that the by-product of the chemical reaction is just heat and water vapour making it a clean energy to use. Hydrogen used in the fuel cells can be harvested by several ways, steam methane reforming of fossil gas, biomass gasification, electrolysis of water or solar thermochemistry.

There are several diverse types of fuel cell designs,



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but they all consist of the same elements; an anode, a cathode and an electrolyte that allows ions that move between two sides of the fuel cell as shown in Figure 1.

How do you test for corrosion resistance?

The most important parameter of a fuel cell is its resistive component. The electrolyte resistance is the main contributor to the total resistance of the fuel cell. The polarization resistance models the reaction equivalent resistance, and the double layer capacitance models the anode-electrolyte-cathode interfaces. The lower the total resistance of the fuel cell is, the lower is its power loss and its efficiency is higher.

With power generation of kW to MW, an excessively high total resistance can prevent a fuel cell stack from outputting its maximum rated power.

The difficulty with measuring the resistance of the fuel cell is due to the fact that the cell voltage source cannot be isolated from the resistive components as the circuit model might suggest. Rather than employing a conventional DC resistance measurement, the measurement of fuel cell resistance requires an AC measurement.

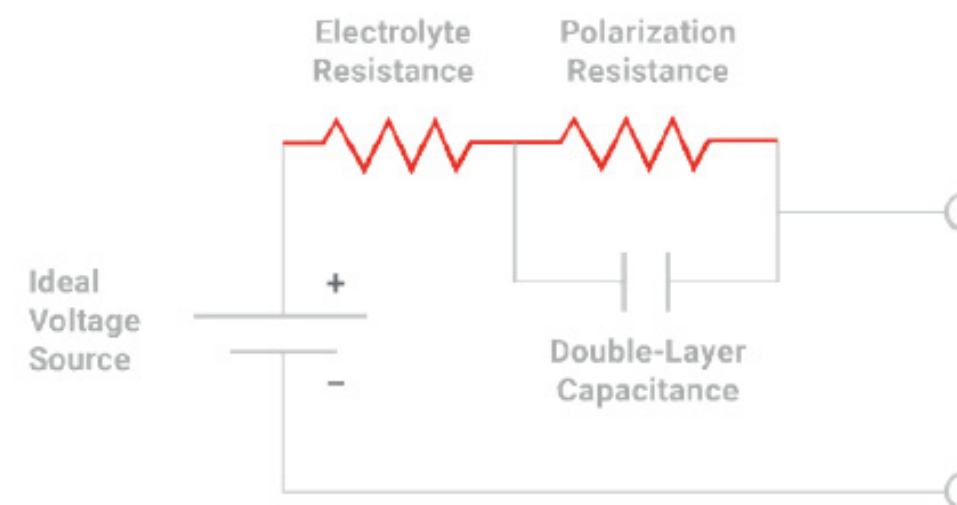
The pseudo-AC measurement is known as the current interrupt method. This method, as the name describes, creates a

current by instantaneously switching the load current from a steady state value to 0 A. The fuel cell voltage rises to its open circuit voltage from the voltage reduced by the product of the load current and the fuel cell resistance.

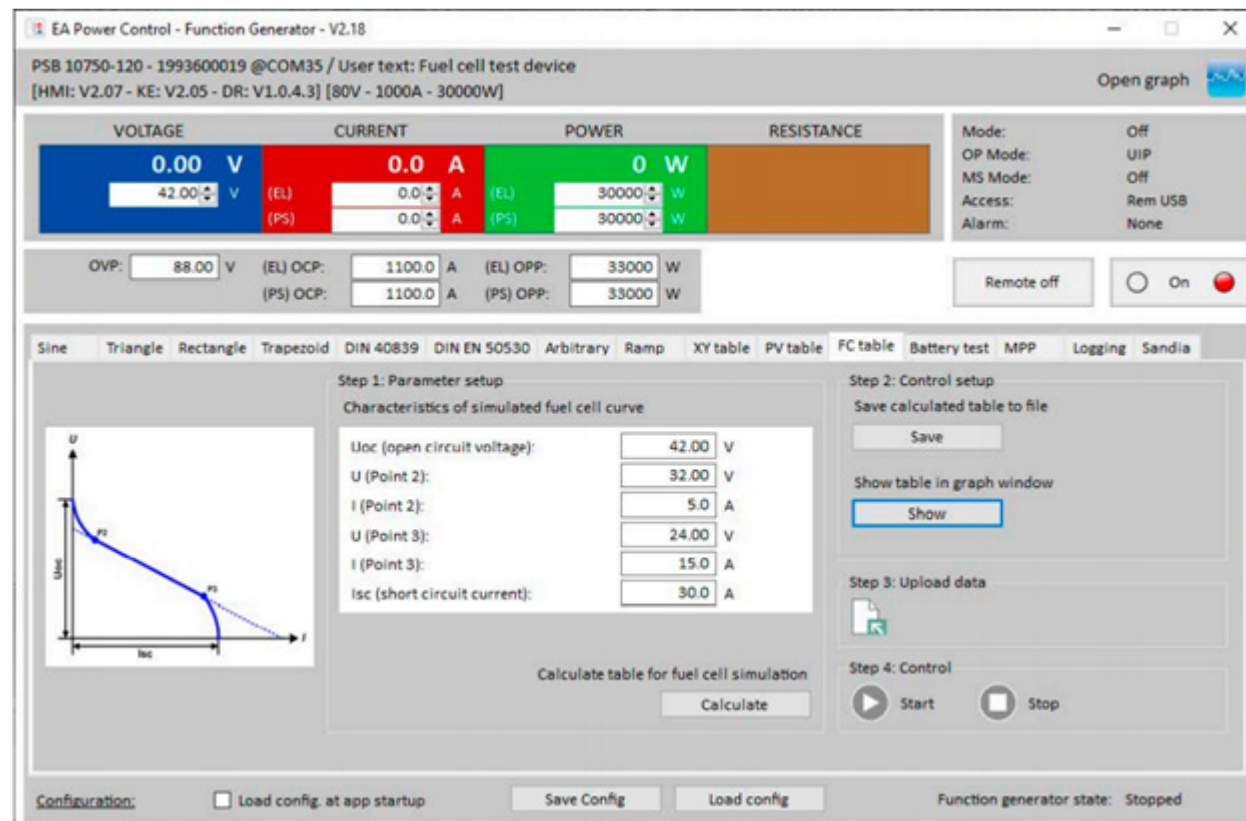
So how do you create the current needed to characterize the fuel cell?

You need an electronic load and the ability to vary its constant current output with an AC signal of varying frequency. You could connect the load and a waveform generator together. Waveform generators are low power devices, so you would have a problem testing a fuel cell stack containing several fuel cells. You could connect the waveform generator through a bias-T to the electronic load; but bias-Ts are low power components used primarily for RF applications. Connecting a low power waveform generator to a high-power electronic load is a challenge.

EA solves that challenge with their ELR electronic loads by integrating the waveform generator into the load. You do not have to worry about external



EA Elektro-Automatik supports advances in climate neutral-energy with automotive fuel cell testing and simulation solutions



connections and protecting a waveform generator from damaging high power. The waveform generator outputs sine waves, triangle waves, square waves, trapezoidal waves, ramps, and arbitrary waveforms. With the ELR load, you can create any type of dynamic load including a sinusoidal perturbation on a DC current sink for fuel cell resistance characterization.

In addition, the ELR load, with its internal waveform generator can subject the fuel-cell-under-test to a wide range of dynamic

load variations for both performance and durability testing. The load can stress a fuel cell with large step load changes at varying duty cycles.

Simulating a Fuel Cell for Realistic Inverter or DC-DC Converter Testing

Now that the fuel cell is characterized, the PSB-series power supplies, which also have a built-in waveform function generator, can simulate the output of a fuel cell. Using the simulated fuel cell, an inverter for a device such as a standby

power source or a DC-DC converter for an automotive vehicle can be tested under the most realistic conditions. Just use the Function Generator Application in the EA Elektro-Automatik Power Control Software. Enter the key voltage and current parameters, and the Function Generator App enables the PSB power supply to emulate the output of your fuel cell stack.

Figure 3 shows the window for the Fuel Cell table which shows the fuel cell characteristic V-I curve and

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defines the fuel cell output. At maximum voltage, fuel cell output is dominated by electro-kinetic effects. In the central part of the curve, the linear, ohmic resistance of the fuel cell determines the output characteristics. At the high current-low voltage portion of the curve, the exponential characteristic is defined by energy being consumed at a faster rate than hydrogen and oxygen can diffuse to the anode and cathode to supply energy.

The simulated fuel cell output can test inverter or DC-DC performance as these loads draw both low current and high current. The results indicate how well the loads can maintain their output under the varying voltage of the fuel cell. Fortunately, you do not need a complex test setup with an external variable resistance for testing inverters and DC-DC converters. All you need is a PSB-series power supply.

Save energy and run cooler

Both the ELR series electronic loads and the PSB series bidirectional (source and sink) power supplies can absorb power and deliver it back to the power grid

with an outstanding 96% efficiency. When you use the ELR loads or the sinking function of the PSB supplies, efficient inverters in the two instruments provide the regenerative energy recovery to reduce your electric utility costs. Returning the absorbed energy to the grid saves on cooling requirements for these instruments which can output and sink up to 30 kW. The instruments need lower capacity fans which run more quietly and less cooling infrastructure to maintain them at a safe operating temperature. Benefit from lower utility costs and the knowledge that you are helping the environment.

Work in any automated test environment

The EA Elektro-Automatik PSB power supplies and ELR loads offer several interfaces to allow easy communication and control in a few test environments. The PSB Series supplies and the ELR loads have USB and ethernet as standard interfaces for simplified connection to a PC. With optional ModBus and Profibus interfaces, the instruments conveniently allow control by a programmable logic

controller (PLC). With the CAN interface, the instruments can interface to an automotive control system. That is more flexibility than you get from other power supply and electronic load manufacturers.

Summary

Fuel testing is a complex process which can be made easy with the right tools. EA Elektro-Automatik are industry leaders in power electronics and offer several solutions for the testing of fuel cells within the automotive market. Specifically, hydrogen fuel cells are considered as one of the cleanest fuels you can use with little to no carbon emissions. It is essential to ensure their longevity and efficiency during operation and storage by regular testing of the fuel cells across a number of industries, including automotive.

EA Elektro-Automatik

Electronic Loads EL 9000 B



The new series of compact electronic DC loads, called EA-EL 9000 B, replaces the former series AE-EL 9000 and offers new voltage, current and power ratings for a multitude of applications.

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Electronic Load EL 3000 & EL 9000 Series

Compact electronic DC loads extends EL series in a Desktop enclosure to round up the portfolio of electronic loads. It offers new voltage, current and power ratings for a multitude of applications.



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Electronic Load ELR 9000

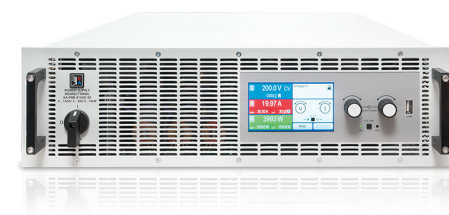


These devices incorporate the four common regulation modes constant voltage, constant current, constant power and constant resistance.

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Bidirectional DC Power Supplies, EA-PSB 9000

The microprocessor-controlled, bidirectional power supplies of series EA-PSB 9000 incorporate two devices in one; a power supply (source) and an electronic load (sink) with energy recovery.



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Top 5 futuristic modes of transport

By Justyna Matuszak



The futuristic modes of transport do not only exist in science-fiction movies; they already take place in our world and will soon shape how people commute, work and live.

Since 1886, when Karl Benz created a 'vehicle powered by a gas engine', the car industry changed drastically. From vehicles powered by

gas, petrol to finally hybrid and electric cars. Thanks to technology, the driving sector is transforming travelling and improves people's lives. New modes of transport make commuting quicker, safer and more comfortable. However, the future of transportation is not just about safety but also about upgrading and launching a new era.

Hyperloop trains, flying or walking cars, self-driving scooters or vehicles transforming into different forms – are they a new generation of transport? So far, futuristic vehicles have been seen in sci-fi, but the recent development in emerging technologies, like IoT, AI and LiDAR, as well as Cloud computing, is

Top 5 futuristic modes of transport

turning traditional vehicles into autonomous cars and making fiction a new reality.

What types of transportation are we likely to use in the future?

Many people wonder what transport will look like in 2050, but the new innovative forms might begin even earlier. The upcoming types of transport will require new and better sources of energy as well as physical and technological infrastructure. Advanced technology and electrification will form the future of transportation.

1. Autonomous helicopter

The autonomous industry will be a danger for the current automobile, resulting in the largest and most dramatic transformation since its creation in the 20th century. Autonomous aircraft is the future of mass transportation. Flying taxis are definitely a dream of everyone rushing in big cities and wanting to avoid traffic jams.

Uber and several Chinese businesses are investing in this rapidly developing transportation technology. The reality of flying cars called 'Spinner' will be a scene from a Blade Runner film and everyday life. The Uber

Elevate startup is planned for 2023.

identification, autonomous thanks to technology.



In 2017, Aurora Flight Sciences, a company focused on aviation research, demonstrated a completely autonomous military helicopter that can also be controlled remotely. Year later, Airbus accomplished a test flight of Vahana, a self-piloted, electric vertical take-off and landing (eVTOL) demonstrator that is an all-electric, single-seat, and tilt-wing vehicle.

Whereas in April, this year, Airbus did not stop and announced a Flightlab through a Vertex. Flightlab is full of vision-based sensors and algorithms for situational awareness and obstacle

Besides that, it has a fly-by-wire for enhanced auto-pilot and an advanced human-machine interface for inflight monitoring and control. These technologies are designed to reduce helicopter pilot workload, improve safety and make mission planning and management easier.

The advanced camera sensors help avoid any obstacles and select the most appropriate route to the destination independently. OMRON is a leading brand in industrial automation, offering sensors that analyse images to perform a character, positioning and appearance inspections.

Top 5 futuristic modes of transport

On-board LiDAR is another technique helpful in the new aircraft technology. LiDAR is a survey method that involves lighting an item with pulsed laser light and detecting the reflected pulses using a sensor.

2. Hyperloop

Elon Musk, in 2012 introduced a 700 MPH Hyperloop concept. His idea was to create a mode of transport that would be cheap, like road transport, but fast like air. In cooperation with Tesla and SpaceX, it began a new era of high-speed innovation. The hyperloop can reduce waiting times by departing every couple of minutes,

On November 8, 2020, the first passengers travelled safely on a hyperloop – making transportation history

Virgin Hyperloop

more regularly than other high-speed rail networks. Through Musk's focusing on developing electric cars and space rockets, he decided to allow others to continue working on Hyperloop. This led companies dedicated to advanced technology,



like Virgin Hyperloop, to successfully design a prototype in 2017, headed by Richard Branson. Branson hoped to establish a fully operational system in 3 years, which he has done. Virgin Hyperloop is currently working with Hyperloop Transportation Technologies to bring the hyperloop to life by 2030.

3. Drone Bus

Along with flying taxis and autonomous helicopters that can transport only a few people, a flying bus can commute a group of forty.

Apart from a higher number of passengers, travel on a drone bus from Los Angeles to San Francisco or London to Paris takes only an hour, similarly to an aeroplane flight. The difference, however, is that the drone bus will be able to land and take off closer to city centres.

As an Uber Taxi competitor, Kelekona trucks would transport 10,000 pounds of freight for the cost of one Amtrak ticket.

To begin, there is a planned 30-minute flight from Manhattan to the Hamptons, which will cost 85 dollars. The aircraft body might be built of 3D printed composite and aluminium.

The company also confirmed that they have the enormous battery power required to keep such flights going. This amount of energy would be sufficient to power hundreds, if not thousands, of homes. Kelekona compares the battery capacity to that of Tesla's Model S and Model 3 batteries. The aerospace company expects their Airbus

Top 5 futuristic modes of transport

to go to the skies in 2022 for freight and 2024 for human passengers if the aircraft passes the necessary FAA certification process.

4. Electric Scooter

Electric scooters have become very popular lately as a quick and cost-efficient way of transport to reach destinations. However, many companies are already thinking about improving this transportation mode. Layer and Nio designed a stylish scooter that uses artificial intelligence to get people to their favourite destinations. It connects to smartphones via an app and allows riders to ask and receive voice commands about location or how much battery is left.

One of the most popular motorcycle brands, Harley Davidson, created a futuristic electric scooter that still looks like a motorcycle but in a very modern edition. Moreover, a leading motorcycle company decided to stay on electricity and created two more electric vehicles LiveWire. But the scooter is much more manageable than the large LiveWire motorcycle—an eco-friendly, easy to ride



and is an ideal new attraction for Harley Davidson fans.

5. Walking Car

Hyundai, a popular car maker, designed a car that looks straight out of a Star Wars movie. This walking vehicle differs significantly from traditional vehicles. It looks like it has almost legs and knees and the capability of climbing up steep inclines and driving on different ground, terrains and rocky surfaces makes it the perfect futuristic mode of transport. It was primarily designed as



a vehicle for the Armed Forces.

Besides walking cars, the future will also bring automobiles with the ability to transform into different things. Toyota

has already created the e-Palette concept vehicle, which can be converted from a regular cab to a store selling any type of products or a delivery van. It will improve cars' basic functionality as well as their versatility.

The technology that could end traffic jams

Considering that a little over half a century ago there were barely any cars on the streets (not many people could afford them), now almost everyone has a vehicle. There is an increased number of queues and traffic jams, especially in cities. That harms the environment and safety. Over a million people each year are killed or injured as a result of road

Top 5 futuristic modes of transport

traffic accidents. Technology can reduce accidents by launching IoT-enabled road sensors that instantaneously communicate with smart automobiles on the best way to avoid hazards or unfavourable road conditions. The rise of smart roads linked to the internet of things (IoT) has the potential to drastically reduce road fatalities.

Vans or buses will have adjusted seats to make them more convertible in the near future. Thanks to technology, soon people will be able to use personalized routes based on user data. Also, wireless battery chargers

will be installed beneath highways, helping to cut air pollution and virtually eliminating the use of fossil fuels to power automobiles. Recently, Sweden completed a trial project. Two kilometres of road were converted into an electrified track that recharges vehicles such as electric automobiles and trucks while they are in motion.

Technology will make the most significant difference in the new era of modes of transport, will it be for the better? We will find out soon because the futurism of vehicles is already the near

future. It will vastly change the world and the way of commuting.



Industrial LiDAR Sensor, Sick

Shop now



Industrial Wireless Charger, Alfatronix

Shop now



Thermal Sensor, Omron

Shop now



HMI Panel, Siemens

Shop now

Recommended transportation solutions from FLUKE



Battery Analyser

Best suited for:

- Maintenance, troubleshooting and individual stationary batteries and battery banks used in critical battery back-up applications
- Designed for measurements on stationary batteries of all types



Digital Multimeter

Best suited for:

- Electrical system installation and troubleshooting
- Quick voltage detection
- Environments with both AC and DC (autoVolt or Ghost Voltages)



Thermal Imagers

Best suited for:

- Detection of 'hot spots' in motors, pumps, VPDs, bearings and wheels
- Rail axle inspection through corrosion fatigue tests
- Monitoring of switching heaters



Infrared Thermometers

Best suited for:

- Quickly capturing spot measurements from a distance
- Accurately measuring up to 800



Earth Ground Testers

Best suited for:

- Ensuring safety of personnel and proper operation of electrical equipment
- Diagnosing intermittent electrical problems related to poor earth grounding
- Earth resistance loop and soil resistivity testing



Power Quality Analysers

Best suited for:

- Troubleshooting and preventing problems in power generation, transmission and distribution systems
- Conducting load studies to reduce energy usage
- Use with motors, pumps, generators, transformers, compressors and electrical panels



Insulation Meters

Best suited for:

- Wide range of tests including simple spot checks to time tests and breakdown tests
- Insulation resistance testing up to 10 KW
- Use with switchgear, motors, generators and cables



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