8 INNOVATION TRENDS EFFECTING THE UK RAILWAY INDUSTRY

KEY STATISTICS

- **Public sector spending on railways £25.2bn 2021-2022 ([Statista](#))**

- **In Autumn 2021 there were 1,079,976 daily passenger arrivals into major cities (UK Government)**

- **In England (2021) 49% of all rail journeys are for commuting 32% for leisure (UK Government)**

- **Fatalities on the railways have increased in the latest year (April 2021 to March 2022), (Office of Rail & Road)**

- **Network Rail pledges to cut carbon dioxide emissions so that the railway is carbon neutral by 2045 in Scotland and by 2050 for the rest of Britain (Network Rail)**

- **Total freight moved was 3.95 billion net tonne kilometres in April to June 2022, a decrease of 8.8% compared with April to June 2021. (Office of Rail and Road)**

- **The UK rail industry employs more than 190,000 people, from train drivers and station staff, to those responsible for managing and maintaining the network's 20,000 miles of track.**

- **The UK rail network includes more than 2,500 stations and more than 40,000 bridges and tunnels. (Stagecoach)**

- **The average freight train travelling at 55mph will take approximately 1-1.5 miles to stop**

- **The fastest train in the UK is the Eurostar E320 with a recorded speed of over 219 mph (World Atlas)**

- **London Stratford has been named Britain's busiest station and London Waterloo has the most number of platforms 24 ([Statista](#))**

1. MODERNISATION:

To keep up with the ever-changing landscape of the transportation industry, railways must continuously update and modernise their infrastructure, equipment and integrate with other transport services. This includes everything from track upgrades, new locomotives, to modern real-time communication interfaces such as 5G on the train and passenger carriages.

The key trends for modern railways are electrification, automation, and digitalisation. Electrification is necessary to reduce emissions and increase efficiency. Automation can help to improve safety and efficiency, while digitalization can help manage large networks more effectively.

As infrastructure and carriages become increasingly electrified, the dependency on electrical power increases. Power supplies designed for railway applications must be designed to meet a range of standards, including but not limited to shock, vibration resistance, and fire protection. Excellent EMC performance becomes increasingly important as more electrical systems are integrated.

2. INCREASED EFFICIENCY

Railways are constantly looking for ways to increase efficiency and decrease costs. This could involve anything from new scheduling methods, management systems for efficient driving to using alternative fuels for locomotives.

Efficiency is being reviewed at railway stations due to the energy consumption of high-performance real-time passenger information systems and other systems that are becoming a standard feature across the country.

As the rail system becomes more reliant on electrical power, the energy consumption increases. Therefore, small incremental increases in efficiency can have huge impacts on running costs.

Autronic power solutions are designed to have efficiency levels of 90% or higher over the entire quoted temperature and input voltage

range. These highly efficient and fully filtered power supplies have been designed to have their power converter components passively cooled by dissipating heat to the mounting surface. This ensures that you'll minimise unnecessary power losses, across a variety of applications within the train including speed tracking, driver cab displays, data recorders, lubrication, tracking and air filters.

3. IMPROVED SAFETY

Safety is always a top priority for railways, and they are constantly working to improve safety standards and procedures. This includes new technologies like automated train control systems, as well as improved track maintenance and inspection procedures.

In the wake of several high-profile accidents, safety has become an even higher priority for railways around the world. Typically, a control centre controls sections of the track and informs the operator/system that the section is occupied. Even with this system in place over 700 accidents took place in Europe last year, therefore more autonomation on board the train itself (like the aviation

industry) has been put forward to reduce these occurrences. A reliable, EMC compliant power solution is required to supply these systems.

Autronic has in-house expertise in railway power supply units (on board and on the tracks), which is also reflected in the wide and proven range of products. The units are used worldwide, a largely in the EU market, and are specifically designed for the stringent EMC requirements and other standards for railway/rolling stock.
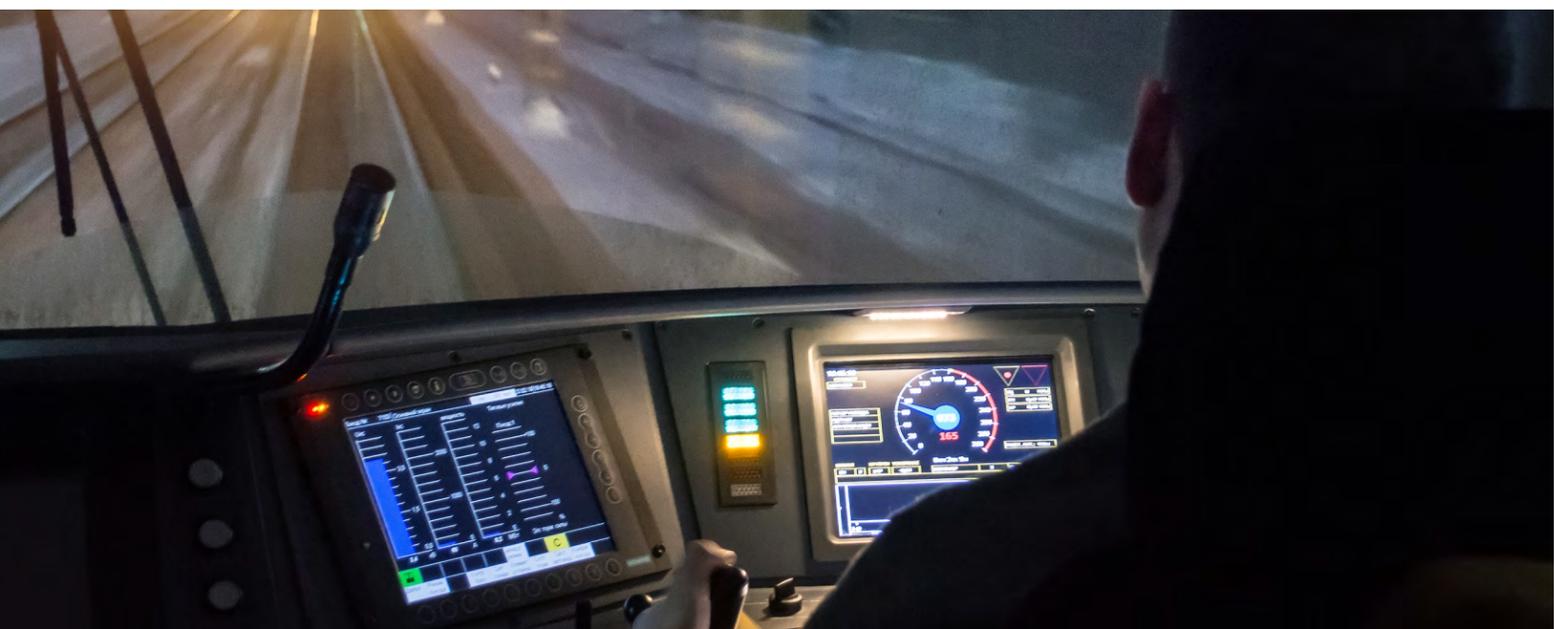

4. SUSTAINABILITY

As the transportation industry becomes more aware of its impact on the environment, sustainability is becoming a key concern for railways. This includes everything from using alternative fuels to investing in energy-efficient technologies.

Trains are focusing on sustainability through electrification which is the process of using electric power to run the railway. This can be done through overhead wires or third rail.

Electrification allows for less noise pollution and lower emissions of greenhouse gases. In fact, it has been shown that electrified railways can produce up to 90% less carbon dioxide than diesel-powered railways.

Railway systems require huge infrastructure investments, as a result it

is practical to future proof the systems to be resistant to climate change. Additionally the impact of the transportation system on the environment and wildlife has been increasingly evident, consequently it is important that the industry investigates the use of sustainable materials and technology.

5. INCREASED CAPACITY

With the world population expected to reach 9 billion by 2050, the demand for rail transportation will only continue to grow. This means that railways will need to find ways to increase capacity and handle larger numbers of passengers and freight.

One way to increase capacity is by increasing the length of trains. This can be done by adding more cars to a train, or by increasing the size of the cars themselves.

Another way to increase capacity is by running trains more frequently. This could involve running trains more often during peak times or adding additional routes to the network.

An increase in capacity would increase energy usage, not only for the traction aspect of the train but also auxiliary systems such as air conditioning, passenger charging outlets and a variety of other systems. Therefore, high efficiency power supplies will be a key aspect in reducing carbon emissions.

6. BETTER INFRASTRUCTURE

In order to accommodate the increasing demand for rail transportation, railways need to invest in better infrastructure. This includes everything from new tracks to larger and more modern stations.

Network rail has identified that passengers are interested in having more weather resistant stations, tracks and trains. Improved technology will play an important role in delivering this aspect.

Autronic has developed power supplies for use in specific systems that are in use on the train and used on the tracks. Some of the customer applications can be served with a COTS (Plug-and-Play)

product, so a solution is quickly at hand and helps to reduce the development time of the product.

For those cases where a plug-and-play solution would mean too many compromises or functional limitations for the customer, Autronic offers the service of developing tailor-made, customer-specific solutions to meet the requirements.

With a view to have very long availability (>20 years), long lifetime and close cooperation with the customer even after completion of the project.

7. IMPROVED CUSTOMER EXPERIENCE

As the competition for passengers increases, railways need to focus on providing a better customer experience. This could involve anything from more comfortable seats to better customer service and facilities.

To attract and retain passengers, railways need to focus on providing a top-notch customer experience. This means offering comfortable seats, plenty of legroom, and good customer service at an affordable price point. It also means providing amenities that make the journey more enjoyable, such as Wi-Fi, power outlets, food and beverage service.

Autronic supplies numerous applications in trains that are not visible at first sight. Powering active filtration systems in trains to always the air of bacteria, viruses, and fine particles (aerosols) safely. Seat reservation systems, ethernet, switches, USB charging terminals, customer information and emergency systems, fire protection systems, to name a few.

Although these applications are often taken for granted as they have become common place, AUTRONIC helps to ensure that these systems are fully operational to improve the customer experience.

8. ADVANCED TECHNOLOGIES

To stay ahead of the competition, railways need to invest in advanced technologies. This could involve anything from new train control systems to improved passenger information systems.

Advanced technologies can help railways to improve efficiency, reduce costs, and provide a better customer experience. Importantly they can also help to improve safety and prevent accidents. Some of the most promising technologies for railways include automated train control systems, which can help to improve efficiency and reduce costs. Other promising technologies include improved passenger information systems, new track maintenance and inspection procedures.

Autronic offers power supplies in a variety of packages to seamlessly integrate into your application. From DIN Rail, 19" racks, PCB mounted, custom-designed mounting and others. Important train control systems and computers must ensure the safety of passengers and crew. Here at AUTRONIC we offer numerous solutions to meet these requirements, including redundancy or parallel operation to maintain functionality.

The future of railways is predicted to be very exciting with many new technologies emerging to help improve the efficiency, capacity and the customer experience of rail travel.

What trends do you think will have the biggest impact on railways in the future?

FIONA WESTCOUGH
MEng(Hons) AMIMechE, National Chair 2022/23 , Young Rail Professionals

When it comes to providing better infrastructure, the key is in providing innovative solutions which connects the customer (passenger or freight) on the first and last mile of the journey. Other industries are making great strides in developing transport solutions, such as electric vehicles, and rail must stay on track in developing equivalent solutions. In doing so, we provide a better case for travelling by rail, which will further support our other value proposition such as being a sustainable method of travelling.

In terms of improved customer experience, innovation can often lead us

"There could be must less expensive solutions, such as flexile ticketing."

into the trap of thinking about new technology or products. However, it can be more effective when implementing innovative methods and processes. For example, decreasing journey time could mean implementing better infrastructure, which could cost billions of pounds. Instead, there could be much less expensive solutions, such as flexile ticketing. By implementing flexible ticketing, a passenger could travel on an earlier service, decreasing their journey time. This method still provides a solution to the passenger's problem, but in a different way. We must keep sight of the end user.

remove carbon out of the atmosphere through freight transport. In the long term we would like to make more use of electric haulage. There are places where there are gaps in the electrified network and we are campaigning in government for those gaps to be filled. There are other things we can do for example if you are waiting in a yard or terminal making sure the engine automatically turns off like a car does and we are trialling alternative fuels such as HVO. There is more work being done on remote monitoring and making fuel more efficient and we can still do better on biodiversity.

On safety there is a lot of work and collaboration required, for example training staff in passenger railheads who are not used to rail safety standards.

There are parts of the network which are already quite tight in capacity but we still have to be more productive as an industry rather than turning away demand. Squeezing the assets hard as we can, for example is a freight train as long as it could be, a loop for something that isn't long enough or sometimes the terminal isn't big enough. What would the impact be of an extra wagon on every train. There are pressures from extreme weather and the need for the railways to be more resilient, but we also need to balance the need for extra time for engineering works with the demands of customers to grow freight. Having greater understanding of extreme weather conditions whether engineering works are proportionate response and maybe it was not in others. How can we manage the tracks to be more resilient to these demands.

I'd love to see the completion of the Transpennine route and more upgrading of the core systems of the railway. Better timetable management and fuel use is what I like to see more of us investing our time in.

We are seeing innovation in freight terminals more and more customers are looking to decarbonise their supply chains. I've seen really good progress in the customer operator relationship, and how they do things. I think where it's more challenging is where they interface back to the railways, after all freight is still a small percentage of the overall network just 10% but if you pick tonnage its closer to 20%. Up until 2015 probably about a third of all goods carried by rail was coal going into power stations, things have changed now, although construction materials still remain a significant part of trade. The big growth has come from intermodal transport ie ship

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to train to warehouse. A typical freight train might have 50-60 containers on it, with something completely different in each one. What has changed over the last decade is historically we would have gone into a rail terminal, a container would come off the train and onto a lorry and out to a factory. Those terminals still exist but the new ones have got on-site warehousing so the loads come off the train and into the warehouse and that's very efficient. One of the challenges that makes freight unproductive is where there is too much time waiting, passenger trains will always take priority in terms of sustainability. The rail freight industry is always trying to get to net zero. Modal shift off road onto rail is the thing we can do right now to help

MARTIN FENNER
Engineering consultant Tilt Consulting

Martin works in train control and traffic management - in other words getting trains closer together and making things generally more efficient. How do we get more and up to date information to the customer? We need our railways to remain relevant in a changing world, and keeping them a part of the transport system in the country is really key. Train journeys as a part of peoples' day, it might involve a meeting, an interview, visiting a friend. But when you are right up against it and a delay means you are going to be late, it can have such an impact and it's a horrible feeling. So I think we need to ask ourselves can we trust the railway to get us there on time and safely. There is a lot of innovation in the information space. I use apps like citymapper and google maps to plan my journeys. The amount that has come on in the last 10 years has been incredible, but that's a result of third parties using data that's accessible, but it could

become a lot more powerful in the future if we can use data from these apps to inform how we run the railway - responsive supply of trains to demand is key. You can achieve better responsive supply in a metro than mainline, particularly when it comes to automation. We are now seeing trials to use metro levels of automation within mainline railways, for example using automatic train operation in trials in Germany. Once you have control of the driving style automatically you can send a message to the train to say you are 30 seconds behind timetable, please speed up now. You can't get the same level of responsiveness with a human train operator driver because it's too much information and they would have too many information sources. The same is true the other way of course, if the driver is ahead of time and gets to a station two minutes early after using too much acceleration and braking, you can use less

energy if the train coasts in, and still arrive on time. When it comes to safety, we are seeing innovative use of technology, for example sensors across the network cost far less than they did than 10 years ago, and they could be checking all sorts of things at much lower cost - for example asset condition and detecting failures before they happen. This offers huge safety benefits, and the potential to learn much more about the health of the assets we use. The threat to the railway however is around skills and competence, there's a lot of knowledge around the industry but that's always moving, people leave the industry or retire and therefore knowledge and experience is lost. It takes a lot of effort to replace someone with 40 years worth of experience, so the challenge is to continually develop the next generation. As the industry becomes increasingly automated, we inevitably need different skills too, for example software engineers, however we are not alone in wanting software engineers, every industry is trying to attract this skill.

In my area, technology and systems are constantly evolving. The availability of Automatic Train Protection (ATP) is becoming easier and cheaper to roll out. There are big improvements in this area, to move from simple systems that can't account for different train types for example, to much more complex systems where the train has a bigger role

to play. These systems are improving in maturity and complexity, giving much greater confidence on the safety benefits they bring. The biggest threat I see remains on bringing new talent into the industry. How do we develop these engineers to learn quickly without having to learn from mistakes.

In terms of improvements in the railways, I'd like to see a greater level of balanced service/investment across the UK, outside of the South East and London. When you have a reliable transport link the benefits to the community are incredible, so investment in cheaper rural schemes eg what we've seen at Oakhampton, where the community want a railway and they invest time and energy in these community led schemes - that's where I would put my effort.

> "When it comes to safety, we are seeing more use of technology, for example sensors across the network are at far less cost than 10 years ago."

GARETH DENNIS
Railway design engineer, writer and broadcaster

There is a lot good stuff coming with updating and aligning worker contracts in terms and conditions to make it easier to work in a modern railways environment but there is also pressure from government to reduce some of those terms and conditions or reducing the quality of working conditions for staff so there is a bit of challenge.

The word modernisation, well there is an elephant in the room that we cant ignore when we are talking about happy things like innovation. We forget how some of these words can be

> **"We can learn a lot from our European neighbours but actually the UK is at the forefront of working practices."**

harnessed, its important to frame it the right way

However modernisation is what the industry has been doing for a very longtime whether it's infrastructure or handing back the railway after engineering work has been completed. So whether it's on-board monitoring in trains to spot errors or potential failures allowing for preventive maintenance.

Often when we think of innovation we think of a fancy whizz product like an app. When it isn't it's taking engineering learnings for example, operational learning and applying it differently or adapt-

ing it ie those small gains can add up to a significant impact. We can learn a lot from our European neighbours but actually the UK is at the forefront of working practices and certainly when it comes from an infrastructure perspective we are ahead of the charge for example Network Rail's yellow fleet as it's often called have high definition cameras to monitor the track. Now a lot of people talk about machine learning being the answer but they don't have enough data to make machine learning work effectively yet with PLPR (Plain Line Patent Recognition) this creates about 9 terrabytes of data per shift which is a huge amount of data to analyse and its being used to de-risk some of the inspection practices we have but there is a real opportunity for us to do more predictive work. You can see every sleeper in immense detail.

In terms of other forms of modernisation its important to understand how the workforce is going to look in the future. Even if some people disagree with union action, some of the practices have been hard won by collective bargaining so we need to be making sure when it comes to modernisation we are bringing every one along with us. We actually have an enormous skills shortage.

Automation can be a tool for bad but in the railways we are almost at the forefront of testing what sort of automation and technology can be good. Technolo-

gy enables us to be efficient with a very small pool of skilled people resulting in a safer system because if you are taking boots off the tracks generally that's a good thing for safety.

If you are building a new Metro system like Crossrail, they are already built with certain grades of automation but for a mixed traffic system there are very few material benefits to having a driverless system. On a high density mass transit system where you have very short headways and where you have a closed off system then absolutely this has advantages for capacity and throughput. But for a mixed traffic railway where tolerances are a little bit wider there is a little bit more wiggle room in the time table. If you have mixed traffic, and passengers with a lot of luggage and you've got freight trains in amongst it all the advantages of automation are hugely minimal.

You will never match the complexity of the decision making that a car driver has. That said train driver support systems such as optimising acceleration and deceleration, optimising how trains sit amongst each other, so automation might not be a driverless train but other aspects of the process can be effective.

This is not new but we have been working with automatic route setting to navigate a train through a complicated junction or

sending trains through junctions to avoid each other.

We are harnessing that with new signalling systems. Current innovations are around the European Train Control System which is a standardised set of rules and an accepted way of working and whilst not new there are lots of benefits to working in this way. There are challenges of course like the heatwave in July 2022 that affected the track and servers with all the signalling equipment within them.

This can be real challenge, because if they were to overheat a load of hardrives within the signalling equipment can take months to re-install.

The best forms of innovation are incremental tech, you don't want to move fast and break things, like it needs to be worn in because if we make a fundamental alteration we don't know the impact of that in other parts of the network. The railway is an immensely complicated integrated system and we don't know what emerging properties might have down the line. A good example of that is crash worthiness for rail vehicles so many new vehicles have many more features for crash resistance.

Another form of innovation has been around accessibility and for so long we have built rail vehicles that exclude a huge proportion of the population whether wheel chair users who can't use them without a ramp, whether we are excluding families for being difficult to travel with. We have generally been better with people who are blind because we

have more braille appearing. But people with monochromatism we are not doing enough for.

In terms of safety, we are doing all we can to remove red zone working for the railways, that's people out on a track while trains are running and you have a look out person waving a flag but we kill or injure too many staff that way. There is some push back in the industry on this from a shift planning perspective. But now it has to be planned in with signallers with a blockade. It's just not acceptable to be putting employees at risk. This requires staff and cultural innovation to move away from a type of working we have had for years.

When it comes to sustainability the obvious solution is decarbonise the railways but Network Rail have an enormous amount of vehicles on the road too so making them all electric over time is a plan. Station emissions is another one and Network Rail has a policy of sourcing all of its power through Nuclear power so that helps with energy efficiency.

And if we can get solar panels on stations too that's ideal. We are working on a new station at Cambridge South which will be one of the first net zero stations in the country and essentially it will be

self sustaining and will generate all the electricity it needs from the PVs on the roof. Skills are critical but also having a diverse workforce is essential for having a sustainable industry.   Network Rail is one of the leaders in this area at self-auditing and driving a diverse workforce but its also very tricky, as a company as large as Network Rail which is mostly an engineering organisation largely attracts a typical white male workforce and this gets worse the higher up the chain you go. Diversity in the younger employees is far better but retaining a diverse workforce is as important.

In addition we must be building trains and infrastructure projects that are going to be resilient to climate change. We therefore have to take a reactive **and** proactive approach. We want to reduce our emissions and when I say rail I mean even a diesel railway is far more efficient than moving stuff by road. Government still tends to be reactive to some of these problems rather than proactive The extreme impact of climate change is happening now. The July heatwave is a proof in point. Excess flooding and landslides are all having an impact too. More leaves on the line are a result of high winds and rainfall together If they all fall at once like what happened at Salisbury, the train we have scheduled to remove those leaves isn't going around regularly enough to remove them.

On capacity in order for Government to reach its own net targets, 25% of GHG emissions come from road transport road transport accounts for 89% of mode share of people and things moving around the country. Rail accounts for 10%

and even with Electric vehicles they only solve one thing which is tailpipe emissions, just to build these would be the equivalent of 40 high Speed 2 in terms of construction emissions so EVs are not the solution longterm. We need to have 50-100 percent more Rail capacity in the UK by the middle of this century and that's an enormous ask. We are already at 90% of pre-Covid passenger levels so are already back to where we were in 2019 and things have been crowded on our railways since 2010 so we need more rail capacity. There are two approaches to that and they both need to happen simultaneously. One is we upgrade our existing network like the Trans Pennine route, station remodelling and the other is to simplify the timetables and that also means building new lines and high speed lines like HS2.

The main benefit is not the fast new trains (that's a side benefit), it's the fact they are simplifying the timetable on the existing network so you get many more trains that can run on the existing network. Even the double decker trains you see in Europe don't add much more to the capacity because the trains have to wait at the stations for longer for passengers to get on and off. We don't have the station capacity for such trains.

I'd be keen to support relief lines in the south west. Another thing I would love to do is initiate rolling programs on electrification but also accessibility work on platforms across the country so that new trains can be procured to allow for people in wheelchairs so they don't need a ramp.

Article transcribed from an interview.

AUTRONIC
A FORTEC GROUP MEMBER

GIOVANNI RODIO
Sales Manager AUTRONIC

Things that are matter of course! That's the innovation for the passenger these days.

Anyone who boards a modern train these days assumes that everything works automatically and conveniently and that you don't notice you're travelling from A to B at high speed.

But this convenience is preceded by years of development, qualification, and persuasion. Years ago, it was unthinkable to install ticket machines on a moving train, or to be able to travel with paperless tickets, To provide real-time passenger safety

(cameras), to offer wireless access to the internet, to use dynamic information systems, to clean the air in trains to near-germ-free levels, to develop multiple redundant driver safety systems, to use highly efficient fire protection systems and optical speed measurements, etc..

The above-mentioned innovative systems are almost standard nowadays, but is it perceived as such?

We at AUTRONIC can only be as innovative as our customers or system suppliers are. Far-reaching innovations are rather

rare in the field of power supplies, compared to the field of visualisation systems, for example. A power supply must function highly reliably in the background, be maintenance-free, pose no danger to users, should not be visible and should not cause any problems.

If you look at power supply units that were built 10 to 15 years ago, it is possible today to achieve almost twice

"If you look at power supply units that were built 10 to 15 years ago, it is possible today to achieve almost twice the performance on the same size of these PSUs without going to the physical limits."

the performance on the same size of these PSUs without going to the physical limits. Nowadays, active protection elements can be implemented with the support of programmable components and adapted more quickly to customer requirements. Higher efficiency helps to reduce energy consumption. Therefore, at AUTRONIC we speak of an evolution that is progressing steadily and faster, but rarely of innovations.

Efficiency vs. input @85 °C
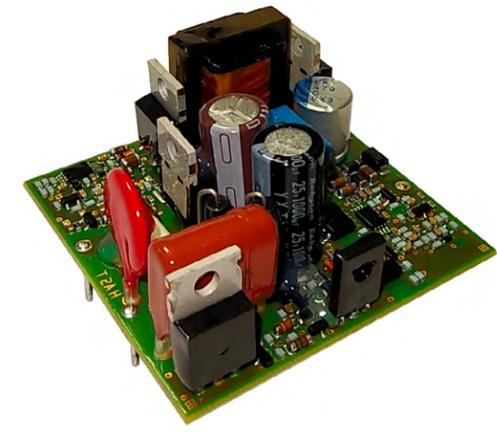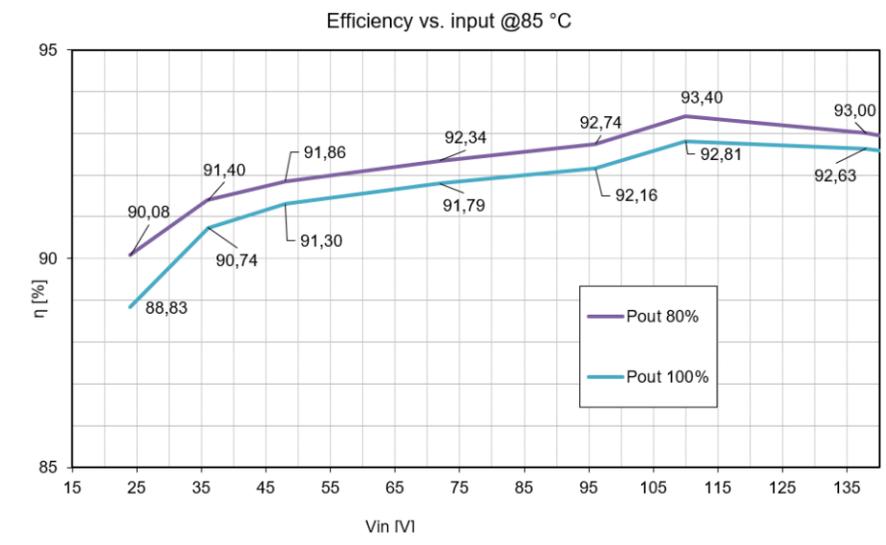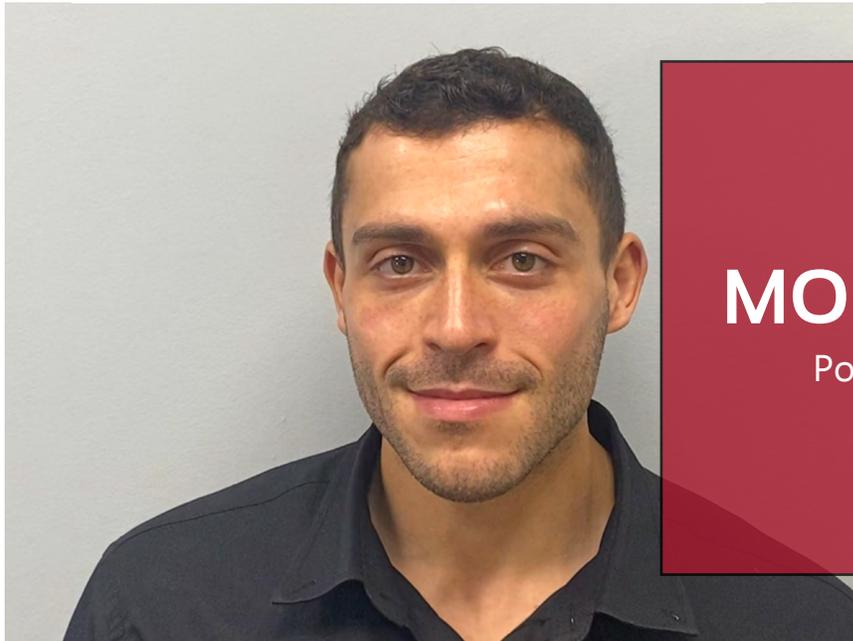
MO AL-AKAYSHEE
Power Applications Engineer

Here at Display Technology we have partnered with Autronic to provide power solutions to the rail industry. We work with system developers and engineers to select power converters that are ideal for specific applications within rolling stock, when required we design or modify power supplies to meet bespoke requirements.

With the changing climate thereby changing the operating conditions of many onboard systems, we design for the future and implement converters with a wide operating temperature range that will remain reliable even in the most extreme of weather conditions.

While we work on developing converters with high efficiency and find application in innovative solutions to achieve net zero targets. We also endeavor to view the transport industry's overall carbon footprint and try to make rail travel as inviting as possible for passengers, through reliable and modernised systems such as USB ports, WiFi and air conditioning to name a few. Rail transport is more efficient than traditional modes of transport such as personal vehicles and is even more efficient when utilised by more passengers.

Advances in manufacturing technology and semiconductor devices allow us to deliver a highly reliable power supply, that can be customised around the system both in terms of power and mechanical requirements.

We strive to get it right the first time through a rigorous testing and design phase, to deliver an ideal solution. Our technical support starts from the design phase and remains throughout the products life in the field.