

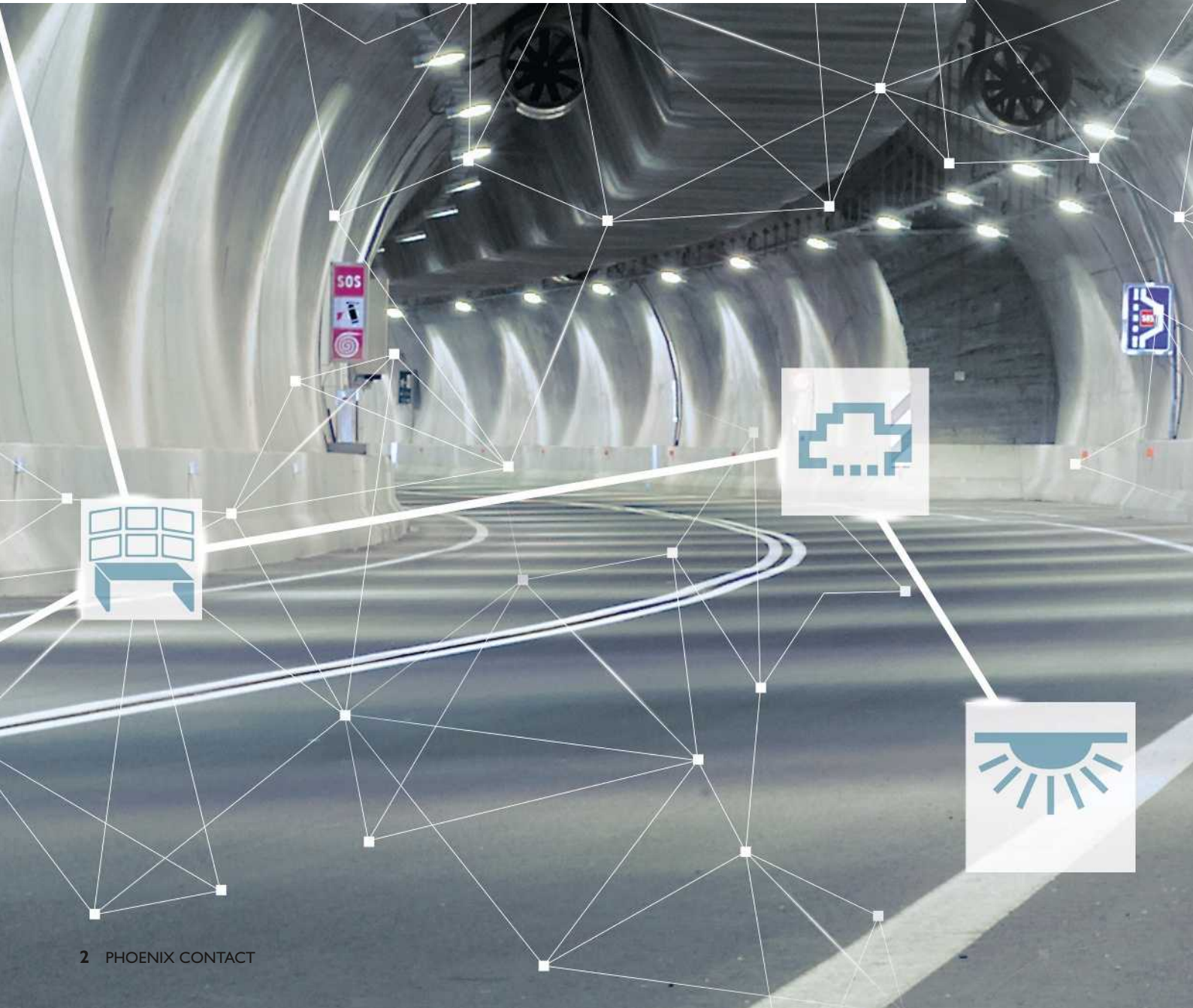


# Tunnel technology

Solutions for tunnel infrastructure

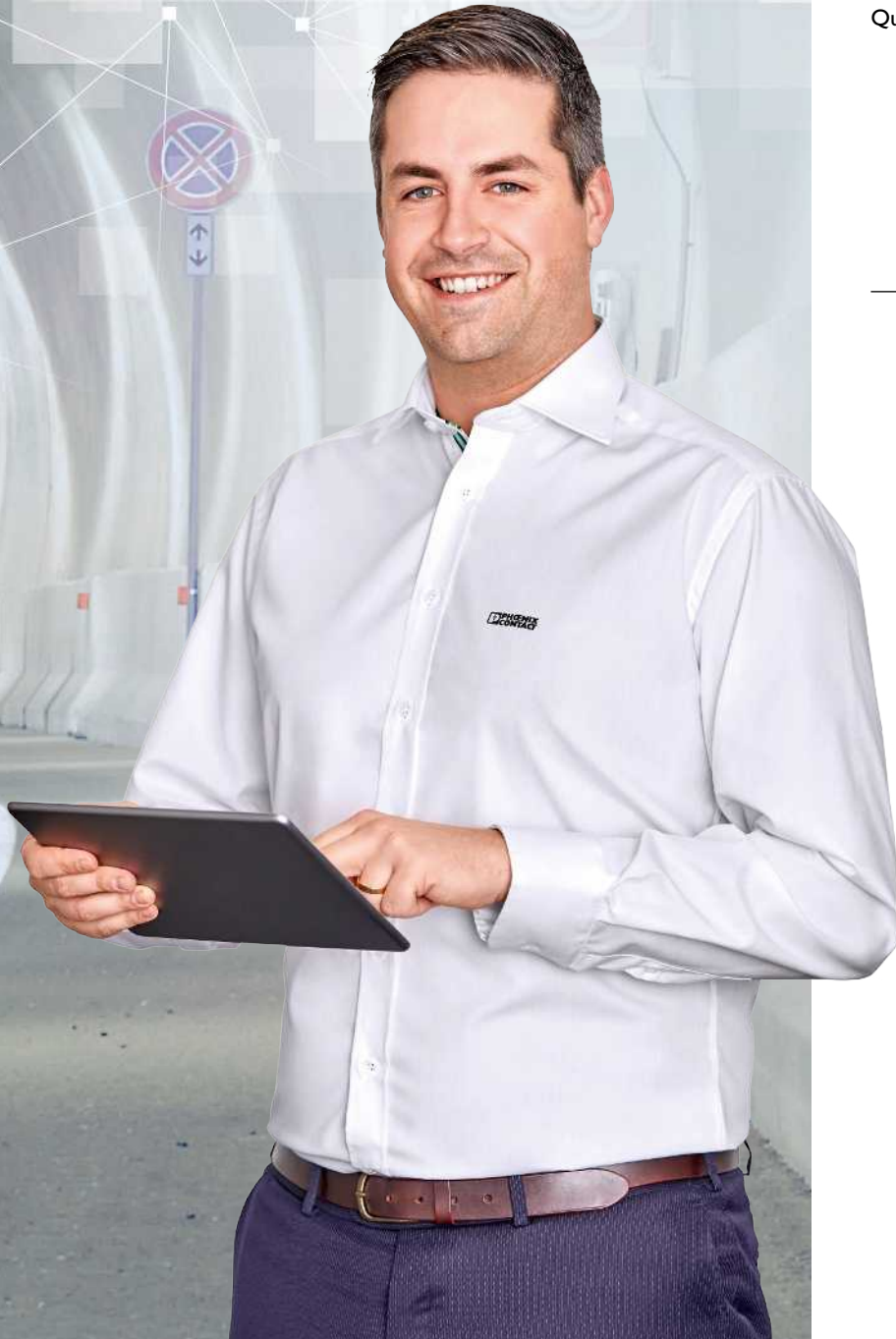
# Solutions for tunnel technology

Phoenix Contact, a global market leader in the field of electrical engineering, electronics, and automation, is your reliable partner for tunnel technology. To ensure the efficiency of your systems in the long-term, our experts use their years of technical expertise and passion to focus on the challenges you face. Excellent products which are intelligently combined to form innovative systems are at the heart of our solutions. Extended with industry-specific features, we develop solutions which are rounded out by engineering, servicing, and training services.



“Freeing towns and cities of traffic will be one of the key challenges of the future. Phoenix Contact is breaking new ground in the engineering of underground infrastructures such as roads, rail, subway, and utility tunnels. With the help of digitalization, we provide forward-looking solutions and systems that will remain robust, reliable, and easy to maintain throughout their entire life cycle.”

Christophe Steppe, Global Industry Manager



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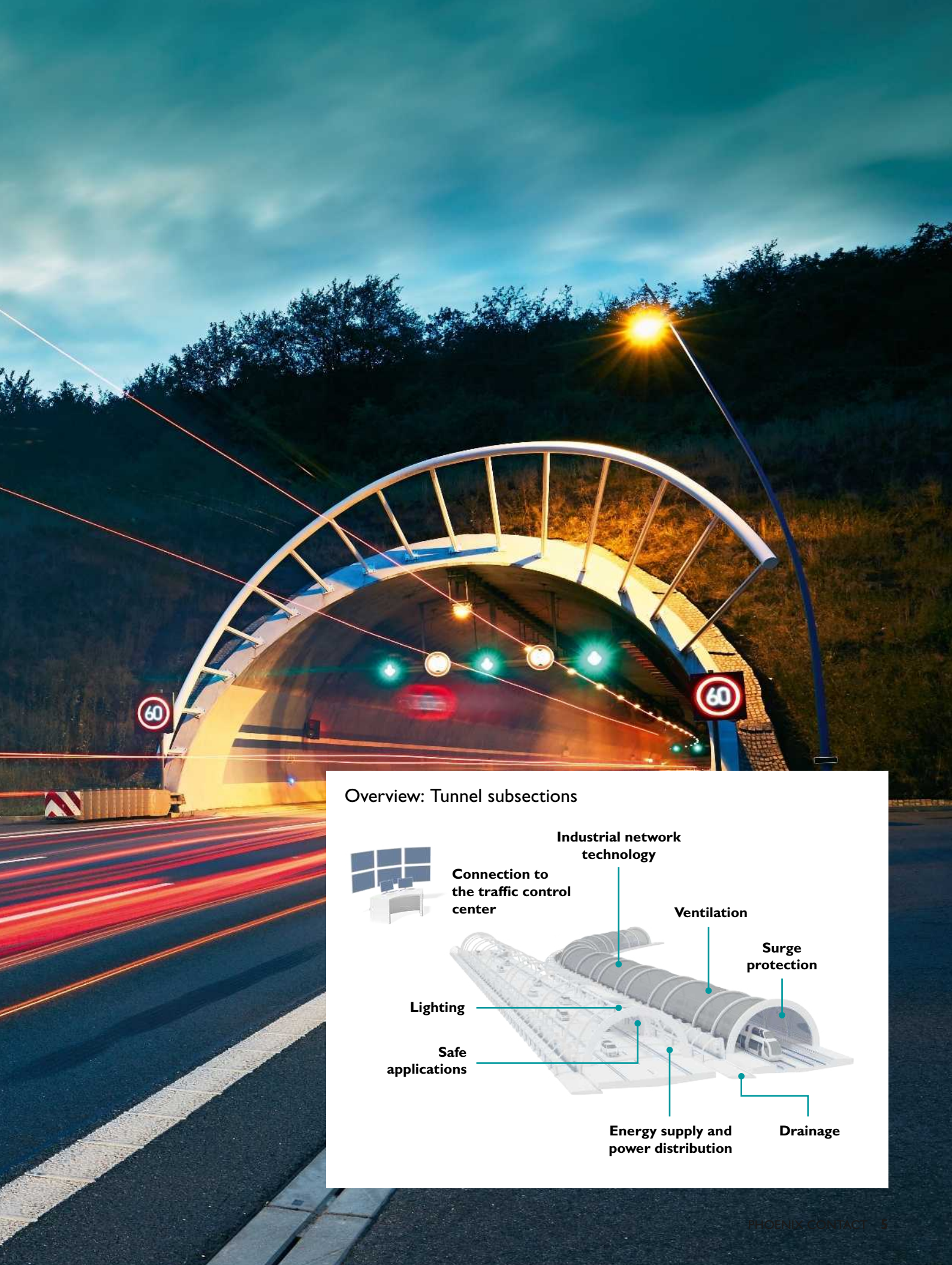
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# Solutions for tunnel technology

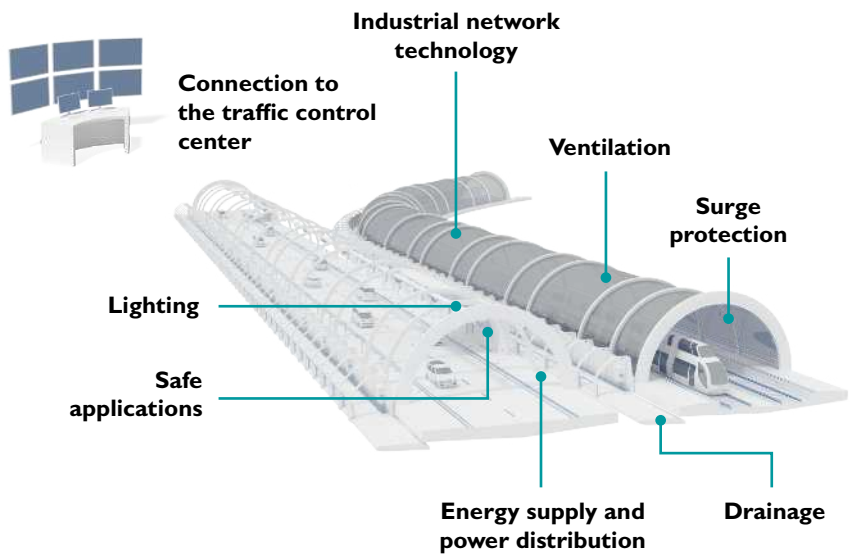
Road, rail, and subway tunnels have a crucial role to play in the development of an efficient and sustainable mobility system. Large-scale increases in transportation capacity in ever more complex structures call for intelligent automation solutions, whereby the focus is on urban mobility and the safety of transportation users.

Phoenix Contact is a reliable and experienced partner, who can work with you to turn even challenging tunnel automation projects into a reality – covering everything from the key element of control technology, including connection of the sensors and actuators, through surge protection, and beyond to a comprehensive safety concept.





### Overview: Tunnel subsections

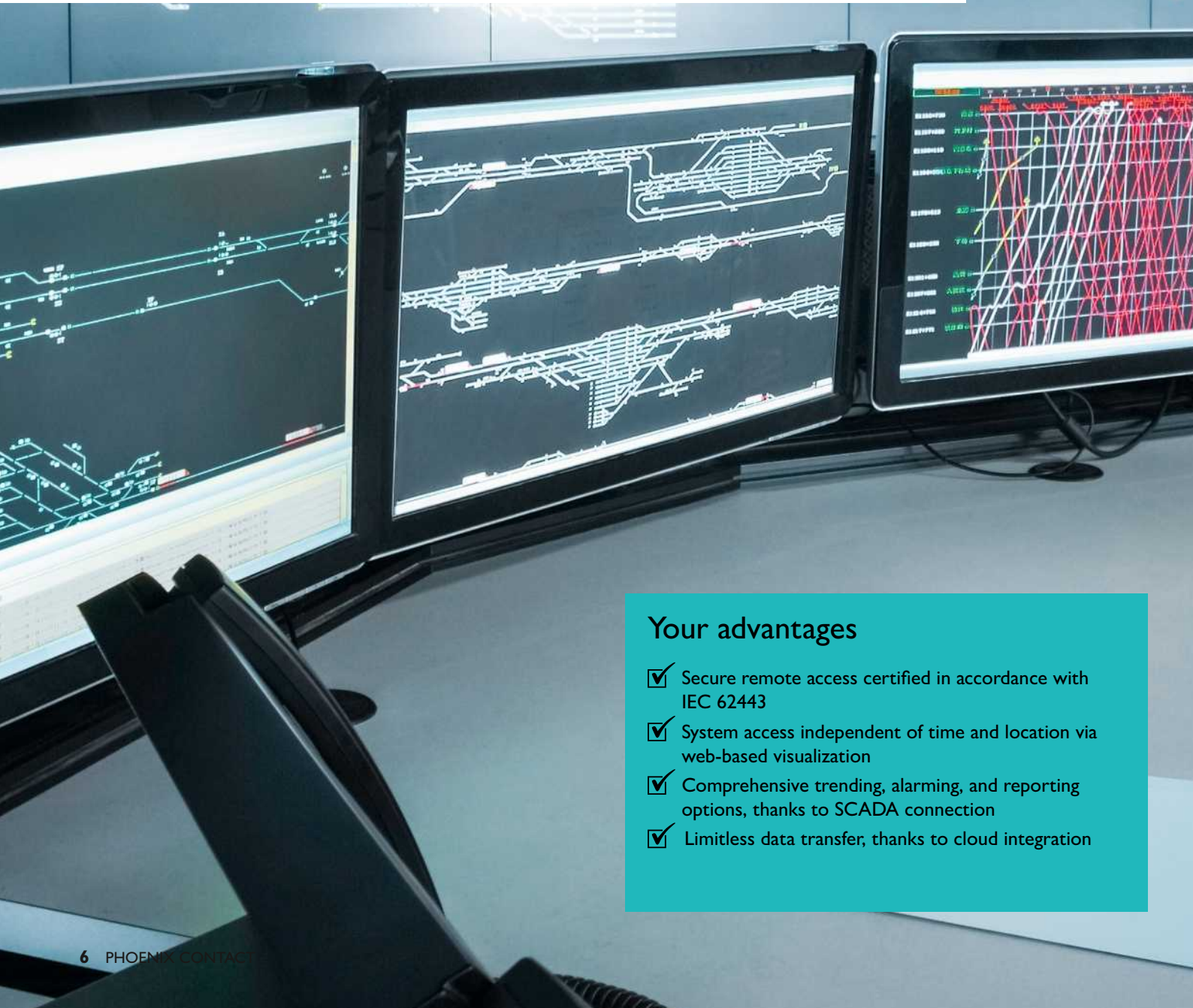


## Solutions for tunnel technology

# Connection to the traffic control center

Tunnels are a sensitive element of a transport system, with countless transportation users relying on them every day. Tunnels are monitored from central control centers to ensure they operate smoothly. Depending on their size and type, tunnels may be equipped with their own monitoring devices connected to overall control rooms.

Phoenix Contact enables you to securely connect and easily control your tunnel structures from traffic control centers.



### Your advantages

- ✓ Secure remote access certified in accordance with IEC 62443
- ✓ System access independent of time and location via web-based visualization
- ✓ Comprehensive trending, alarming, and reporting options, thanks to SCADA connection
- ✓ Limitless data transfer, thanks to cloud integration



### Secure remote access

It must be possible to access tunnel structures from traffic control centers in order to manage them centrally as part of a transport system; this requires a secure, reliable, and interference-free connection. Our components for secure remote access enable particularly secure data transfer via VPN tunnel. The very latest encryption standards combined with IEC 62443 certification ensure that your data remains secure.



### Comprehensive visualization

Phoenix Contact provides a comprehensive range of visualization options for controlling and monitoring complex technical processes. System visualization can be made available locally at the application, in the tunnel control room, or in the superordinate traffic control center. Our range extends from cost-effective web-based visualization right through to a versatile SCADA system with built-in alarming for the most demanding of tasks.

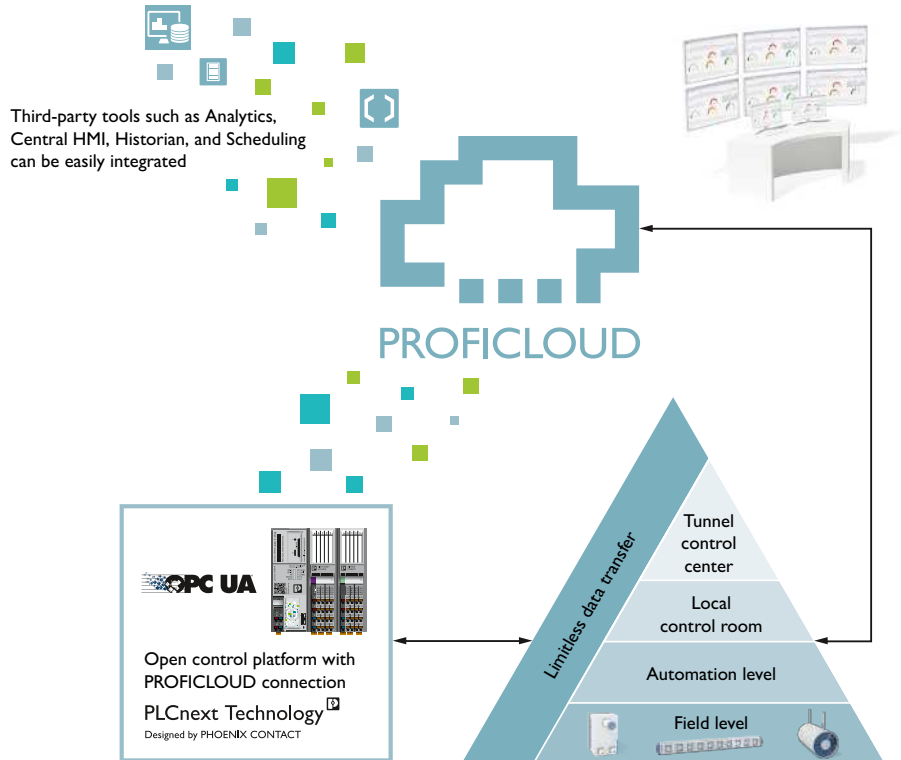


### Continuous data acquisition

In the future, tunnels will be part of an entire smart city concept, so it is vitally important to be able to continually record their operating data. Huge amounts of data have to be sent to cloud systems in order to incorporate that data into smart city applications. With Proficloud, Phoenix Contact provides you with a professional and secure solution for this.

### Limitless data communication

Solutions for predictive maintenance, transport concepts offering a high level of integration, and energy-efficient tunnel operation rely on data communication with no system limits. The tunnel authorities also actively promote connecting the field level, automation units, decentral SCADA systems, and central application hosting. Phoenix Contact is an expert in communication, able to provide you with seamless data transfer from the sensor through to the cloud.

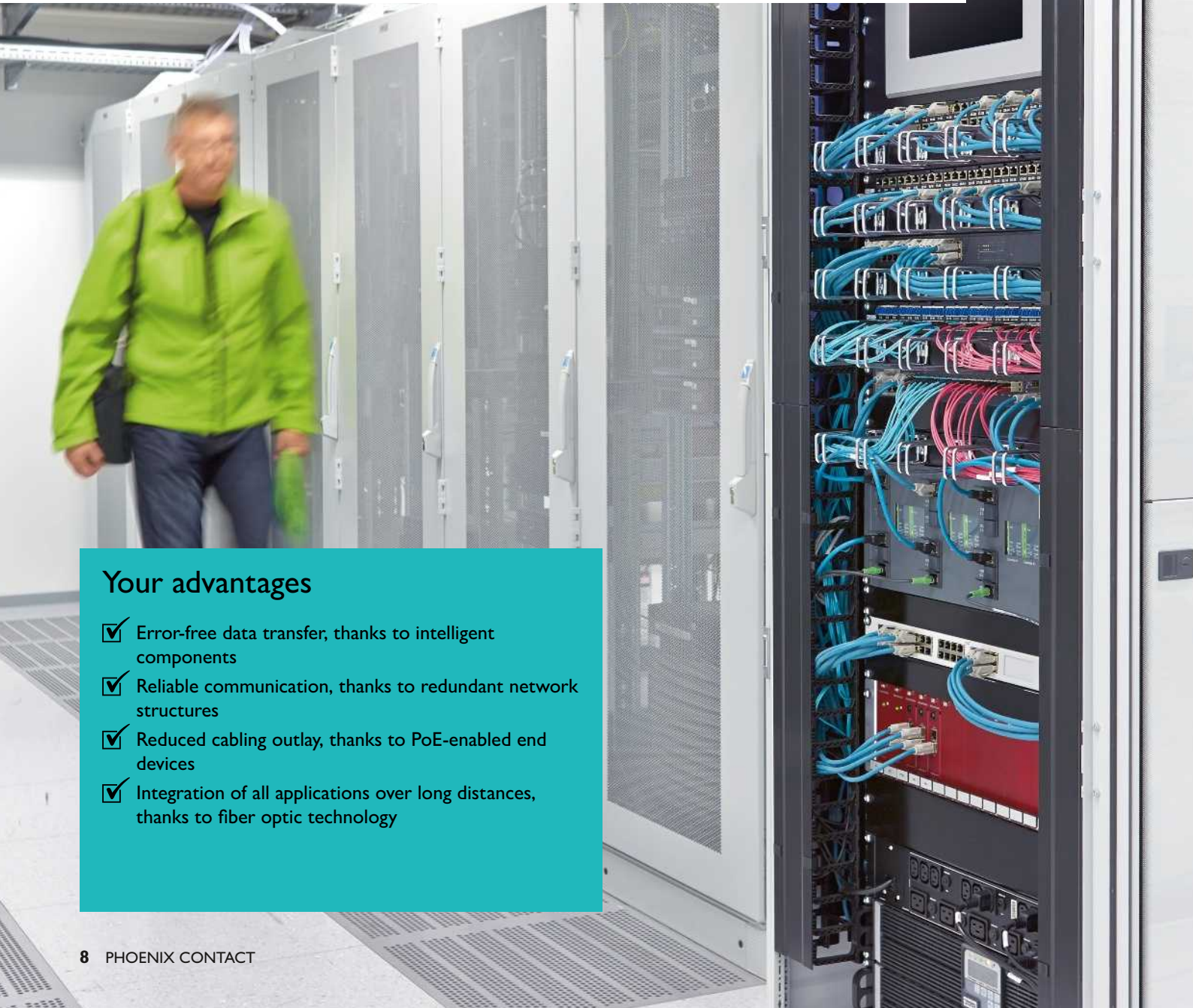


Solutions for tunnel technology

## Industrial network technology

Tunnels can only run smoothly and be continuously monitored if they are based on a reliable network. It is absolutely essential in critical infrastructure such as tunnels for data from all applications, such as those relating to ventilation, communication, or energy supply, to be transferred securely.

Phoenix Contact provides a wide selection of powerful network components, which you can use to create a high-availability Ethernet network for your application.



### Your advantages

- ✓ Error-free data transfer, thanks to intelligent components
- ✓ Reliable communication, thanks to redundant network structures
- ✓ Reduced cabling outlay, thanks to PoE-enabled end devices
- ✓ Integration of all applications over long distances, thanks to fiber optic technology



## Seamless communication

The transitions between classic information technology and operational communication technology also have to be smooth in tunnels. Seamless communication, the real-time forwarding of all relevant protocols, and meaningful diagnostics, which can be integrated into the visualization, are crucial to this. Network components from Phoenix Contact provide connections for all media, such as fiber optics, copper, and wireless.

## Redundant connections

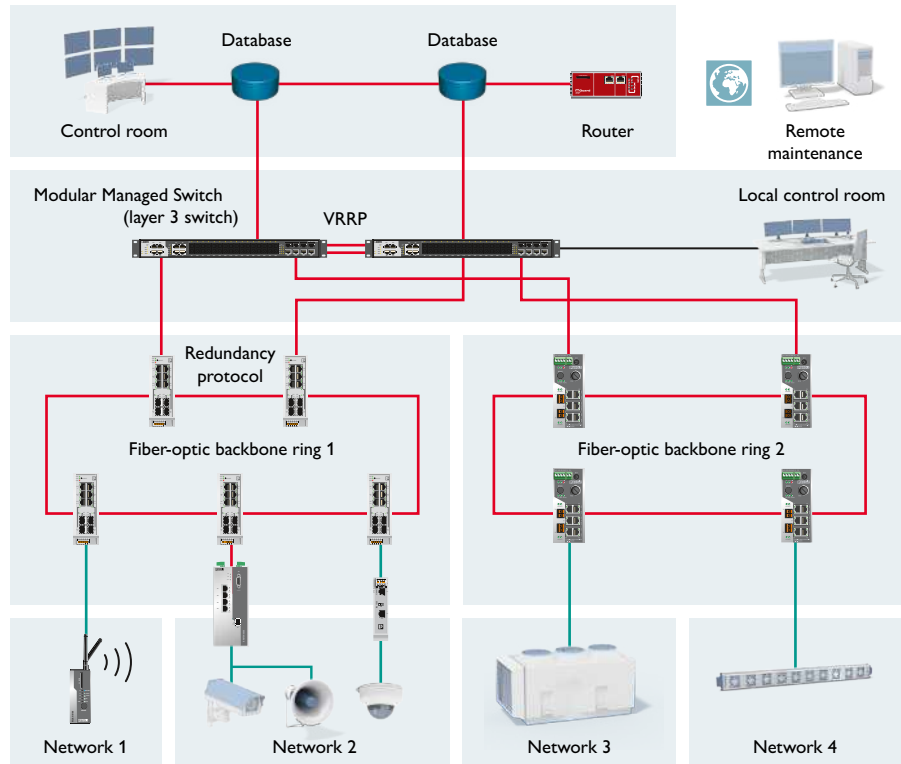
Redundancy is necessary to ensure that data will continue to be transferred even if there are partial system failures. Single points of failure are avoided when planning and installing infrastructure components in high-availability systems. Intelligent switches from Phoenix Contact provide options for automatic fault detection and rectification. Redundancy mechanisms enable stable communication, even if loops are formed inadvertently or if devices fail.

## Communication in the field

Alongside the high-performance main communication arteries, there is also a wide range of components available for local applications. Connected components such as telephones and cameras are supplied with operating voltage through the same cable. These Power-over-Ethernet (PoE) components are also available with a built-in protective function on request. We also provide a huge range of different switches for distributing data packets.

## Fully redundant tunnel network

The tunnel network needs to have several redundancy levels in order to reliably connect all tunnel applications. At the switch level, Phoenix Contact enables the seamless integration of all end applications via a redundant fiber-optic backbone with redundancy protocols such as RSTP or MRP. At the router level, we use VRRP for setting up redundant layer 3 switches. The switches combine the communication algorithms of the IT level, such as OSPF or PIM, with the specific demands of industrial communication.



## Solutions for tunnel technology

# Energy supply and power distribution

Tunnels are home to a variety of applications, which need to be supplied with energy in a high-availability configuration. Particularly critical subsections, such as ventilation and lighting, must continue to work in the event of an emergency.

With Phoenix Contact you always have a reliable partner by your side who can deliver a secure power supply and consistent power distribution. The Phoenix Contact Group also includes a grid monitoring and protection controller specialist, our Swiss subsidiary NSE.

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### Your advantages

- ✓ Time savings of up to 80% when installing the power distribution system, thanks to fast, simple assembly
- ✓ Extensive investment security, thanks to compatible products in accordance with IEC 61850 and IEEE network standards
- ✓ Long product life even in harsh ambient conditions, thanks to robust designs



### Reliable energy supply

Tunnel structures are home to a variety of electrical systems which need to be supplied with energy in a high-availability configuration. At the same time, the tunnels themselves are large-scale consumers in the distribution network. Phoenix Contact provides special network switches for power plants which enable gigabit data transfer to the control rooms of the energy providers in accordance with IEC 61850 and IEEE 1613.

### Safe and secure power grids

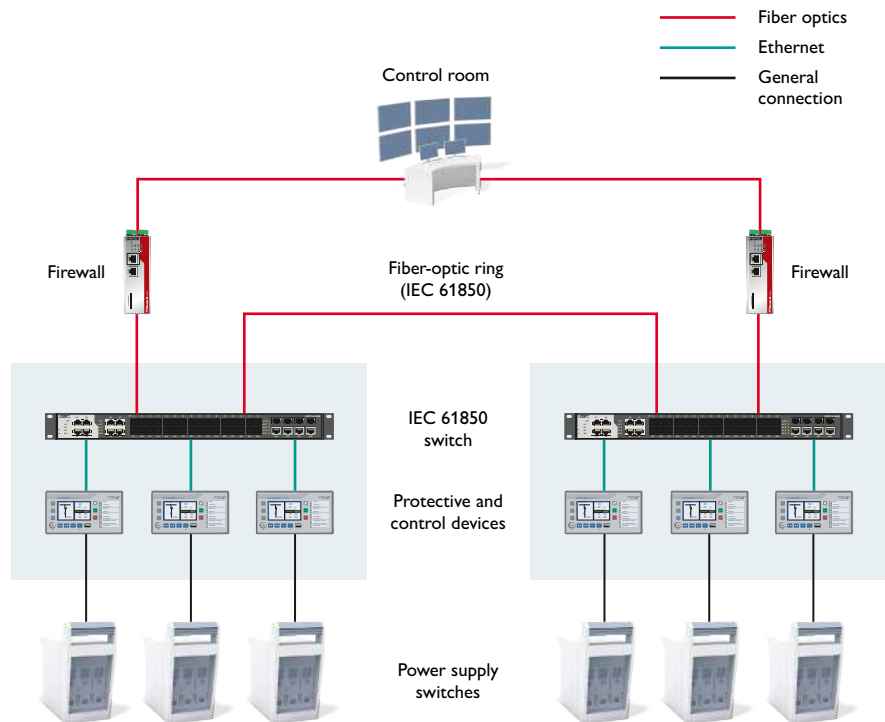
Power failures in tunnels can lead to considerable damage and danger. Our protective and control devices enable you to protect your systems inside tunnels. The compact designs pack a huge number of features into a small space: from protective functions through to power circuit control, electrical parameter measurements, and incident and grid fault logging. We support you every step of the way, from grid analysis through device installation, right through to training and maintenance.

### Consistent power distribution

Rapidboxes from Phoenix Contact have been specially developed to enable safe and simple power distribution in tunnels. Starting from the main distribution, a reduced number of connections branch off to the individual consumers, such as those involved in lighting and ventilation. This protects the main distribution from short circuits. Extremely high functional integrity means ongoing availability is guaranteed even in emergencies.

### High-availability networks

Ensure a consistently high level of availability for your system and avoid unplanned failures. In particular, the harsh environment in high-voltage applications poses special requirements in terms of communication network availability. Robust components and redundant network structures ensure high availability. Phoenix Contact provides you with comprehensive protection across all levels of your energy control centers: IT security and encrypted data transfer to the overall control room, reinforced connections to the power distribution network, and comprehensive protection for the field level. Communication in accordance with IEC 60870-5-101/103/104 or IEC 61850 and the redundant Ethernet connections via RSTP/HSR/PRP enable fault-free parallel operation.



## Solutions for tunnel technology

# Surge protection

Transient overvoltages caused by lightning or by switching operations can damage devices and installations or cause them to fail completely. Although they run underground, tunnels are not automatically protected from the consequences of such events, which would require them to be closed for repair.

With an effective surge protection concept from Phoenix Contact, these risks can be reduced to an absolute minimum.

### Your advantages

- ✓ Identification of surge protective devices (SPD) that are subject to high loads and replacement at an early stage, thanks to intelligent accessories
- ✓ The right protection for any requirement, thanks to the comprehensive portfolio
- ✓ Tunnel infrastructure failures caused by bad weather are reduced to a minimum
- ✓ Tunnel availability is increased sustainably



### Comprehensive protection

Each interface needs the right protection. Our broad range of products has the perfect solution for every application: rapid data communication, extremely slimline surge protection for MCR technology, narrowband or broadband antenna signals, and high-performance devices for energy supply systems.

### Intelligent monitoring

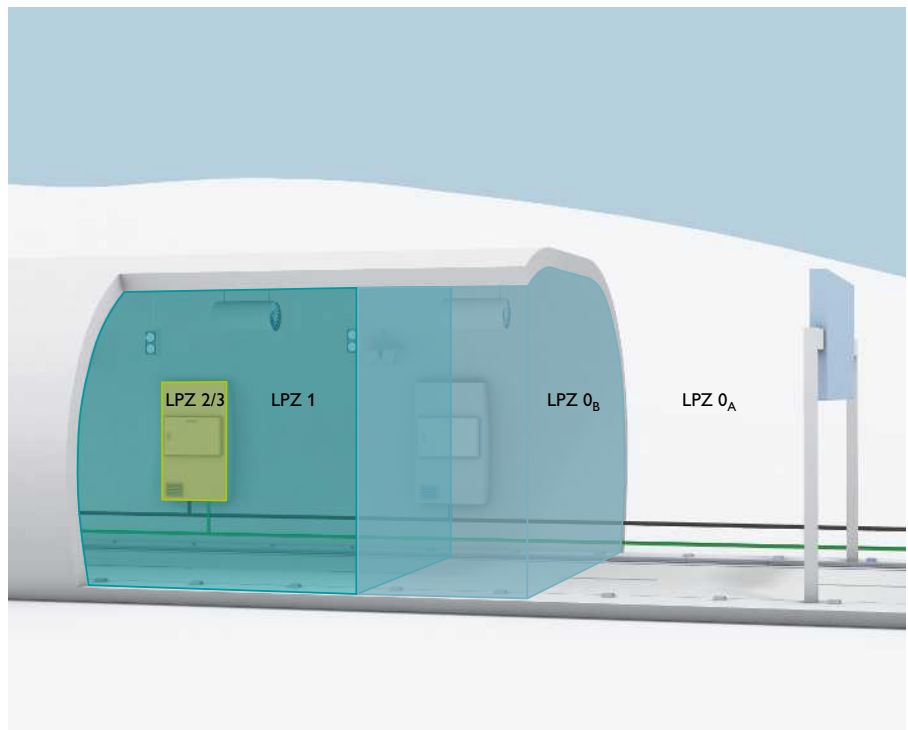
If an SPD is overloaded, the tunnel electricians are no longer protected. In order to guarantee uninterrupted protection for the tunnel, intelligent components send out a notification as soon as a power limit is reached. This enables you to replace an SPD even before it fails, meaning that the tunnel continues to operate unimpeded.

### Compact protection

Along with surge voltages, overloads and short circuits also pose a hazard for tunnel operation. Multichannel device circuit breakers minimize this risk. Is there just one channel to be protected? In this case, device circuit breakers with a width of just 6 mm in a terminal block design are the perfect choice.

### Surge protection exactly where it is needed in tunnels

Tunnel tubes can be divided into various lightning protection zones, with surge protective devices installed at the transitions between zones. Having a type 1 SPD in the first control cabinet in each tube makes that section a zone 1. All subsequent control cabinets become zone 2 by virtue of type 2 SPDs. The established lightning protection regulations (IEC 62305) are used for external structures (including the control room and variable traffic signs).



Lightning protection zones (LPZ) in a tunnel

## Solutions for tunnel technology

# Lighting

Lighting is a key element of tunnel safety. Right from the entrance, the lighting conditions need to be delicately adjusted to counteract the increasing levels of darkness inside the tunnel. Different lighting scenarios may be required, depending on the volume of traffic and any emergencies that may arise; individual luminaire groups will need to be activated flexibly and reliably in response.

Phoenix Contact has a comprehensive range of options for controlling your tunnel lighting.



### Your advantages

- ✓ Flexible response to different traffic and daylight situations
- ✓ Easy installation and startup, thanks to Plug and Play
- ✓ Efficient maintenance, thanks to enhanced diagnostic state and operating lifetimes
- ✓ Compensation of losses due to aging and dirt, thanks to constant light output



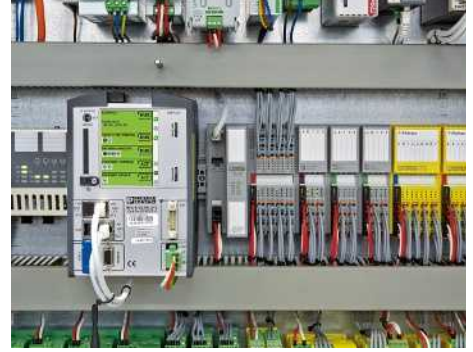
### Flexible cabling

The reliable operation of lighting and the emergency control system in tunnels is essential. It must therefore be possible to carry out maintenance work quickly and easily. The versatile and robust QPD installation system with tried-and-tested QUICKON fast connection technology allows you to distribute power over long distances effortlessly. The simple connection principle in conjunction with the optional pre-assembly reduces installation times by 60%.



### Efficient lighting

Intelligent activation electronics are a fast and easy way to implement LED-based lighting solutions in tunnels. Data regarding ambient conditions in the tunnel is gathered in order to attain an ideal illumination level for the complete tunnel. In this way, only as much light is generated as is required at any particular time. This cuts energy costs and increases the life cycle of the LED lights. Integrated surge protection also increases the availability of the lighting system.



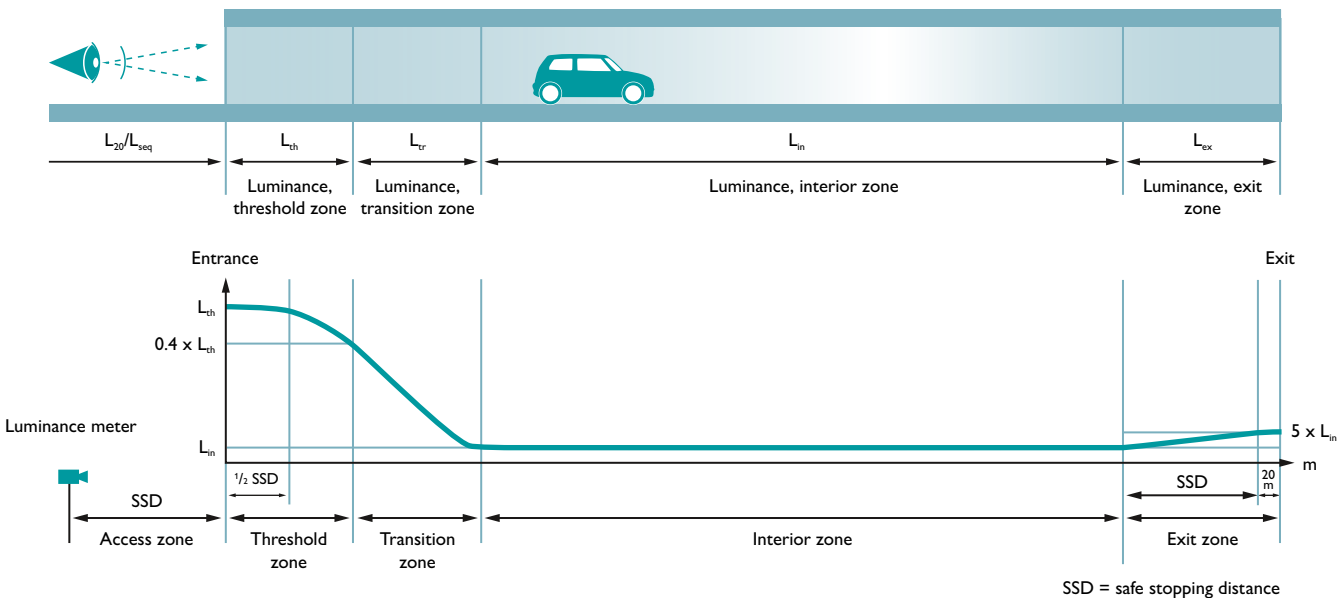
### Installation-ready solutions

Our installation-ready control cabinet solutions (BTS, ATS, or TCS) allow you to configure your entire lighting system quickly and easily, without any programming work. The pre-programmed solutions can be flexibly integrated into your existing automation systems, reducing your programming efforts by up to 75%.

## Demand-oriented and energy-efficient tunnel lighting control

Tunnel lighting solutions such as the ATS (Advanced Tunnel Solution) enable energy-saving tunnel lighting based on LEDs. In addition to the key parameter of luminance, parameters such as speed and traffic density

can also be integrated. Combined with the versatile and robust QPD installation system, ATS, as a pre-defined control cabinet solution, ensures fast installation and maintenance procedures.



## Solutions for tunnel technology

# Ventilation

Traffic conditions in automobile tunnels mean it is crucial to continuously monitor the oxygen supply, visibility, and the concentration of pollutants in the tunnel. Ventilation systems work closely with traffic control systems to maintain the air quality in regular operation. It is particularly important to ensure ventilation remains available in the event of a fire, so that rescue operations can be conducted.

Phoenix Contact provides reliable automation solutions for the energy-efficient and cost-effective operation of your tunnel ventilation system.

### Your advantages

- ✓ Quick and easy connection of your sensors via pre-programmed software and app solutions
- ✓ Reduced costs, thanks to low programming efforts
- ✓ Failsafe ventilation, thanks to redundant controllers



### Integrated sensors

Phoenix Contact enables you to connect your sensors in tunnels quickly and easily. Make the most of efficient engineering, thanks to pre-programmed software function blocks. You will find sub-functions for monitoring NO<sub>x</sub>, CO, or CO<sub>2</sub> concentrations, for example, in our PLCnext Store. Simply load your solution straight onto your PLCnext Control, with no programming efforts whatsoever.

### Increased efficiency

Ventilation systems are one of the biggest consumers of power in tunnels for motor vehicles. It is therefore important that fan drives start up and operate in a way that is energy-efficient. Integrating the drives into the tunnel control system enables any anomalies to be identified at an early stage. Benefit from increased efficiency, thanks to continuous monitoring and status-based maintenance.

### Reliable availability

Ventilation devices are a key element of tunnel safety. Fresh air is brought in to ensure pre-defined levels of carbon monoxide and diesel emissions are complied with, not only in the event of a fire, but also when the volume of traffic is particularly high. The controller has a redundant configuration to prevent the ventilation system from failing. Phoenix Contact provides tailored solutions for safeguarding the availability and the redundant design of the ventilation system.

### Removing smoke and heat in the event of a fire

In order to conduct rescue operations, appropriate ventilation control is used to manage smoke and heat in the tunnel tube. The ventilation runs in extraction or injection mode, depending on the specific fire scenario. Smoke and heat must be kept

away from the rescue service personnel and the other road users remaining in the tunnel. The way in which ventilation is controlled in the event of a fire depends in large part on the source of the fire being pinpointed within the tunnel tube. Excess

pressure is generated to prevent smoke from entering the evacuation shaft.



## Solutions for tunnel technology

# Drainage

Extreme weather events, plus the proximity to the water table, call for complex drainage systems in tunnels. Not only must flooding be prevented, but flammable liquids such as fuel and contaminated extinguishing water also need to be transported out of the tunnel safely.

Phoenix Contact supports you in controlling your tunnel pumping stations in a cost-effective way based on need.

### Your advantages

- ✓ Minimization of maintenance and repair work, thanks to predictive maintenance
- ✓ Reduced energy consumption, thanks to optimum pump operation
- ✓ Detailed recording of operating data, such as operating hours, temperature, and water levels



### Reliable regular operation

Rain and groundwater can easily cause flooding in tunnels. An intelligent drainage system will prevent this. The water that enters the tunnel is first collected there, before being routed into the sewerage system. High-availability pumps are needed to move these water masses. The CONTACTRON 4-in-1 hybrid motor starter from Phoenix Contact enables the uninterrupted operation of your pump motors.

### Dangerous chemicals

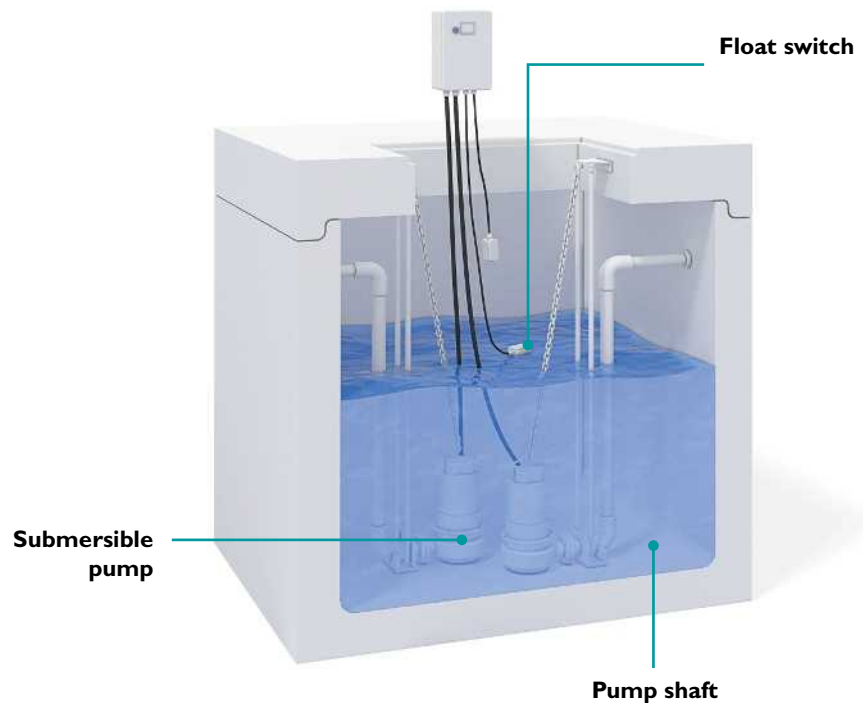
Toxic or explosive fluids can enter the drainage system either through normal traffic or when there is an accident or fire. The water is therefore continuously monitored for dangerous chemicals before it enters the pumping station. If the situation is hazardous, protective measures are introduced or the pump system is shut down completely.

### Predictive maintenance

An increasing number of pumps are being monitored to ensure their energy-efficient and long-term operation. Incorporating relevant variables such as vibrations, temperatures, and power enables predictive maintenance and ensures the optimum operation of your pumps. Phoenix Contact provides you with a comprehensive solution for continuously monitoring your pumps and reliably draining your structure.

### Automatic pump control

You can combine our flexible pump control solution with any PLCnext Control device. The modular I/O design means it can be easily adapted to any hardware configuration. Based on the changing water level, the PLC controls several pumps according to their operating hours or number of motor starts. Together with detailed diagnostics, monitoring, and data logging features, the system guarantees that pumps will offer many years of reliable operation. Every anomaly is transmitted to the control room for predictive maintenance.

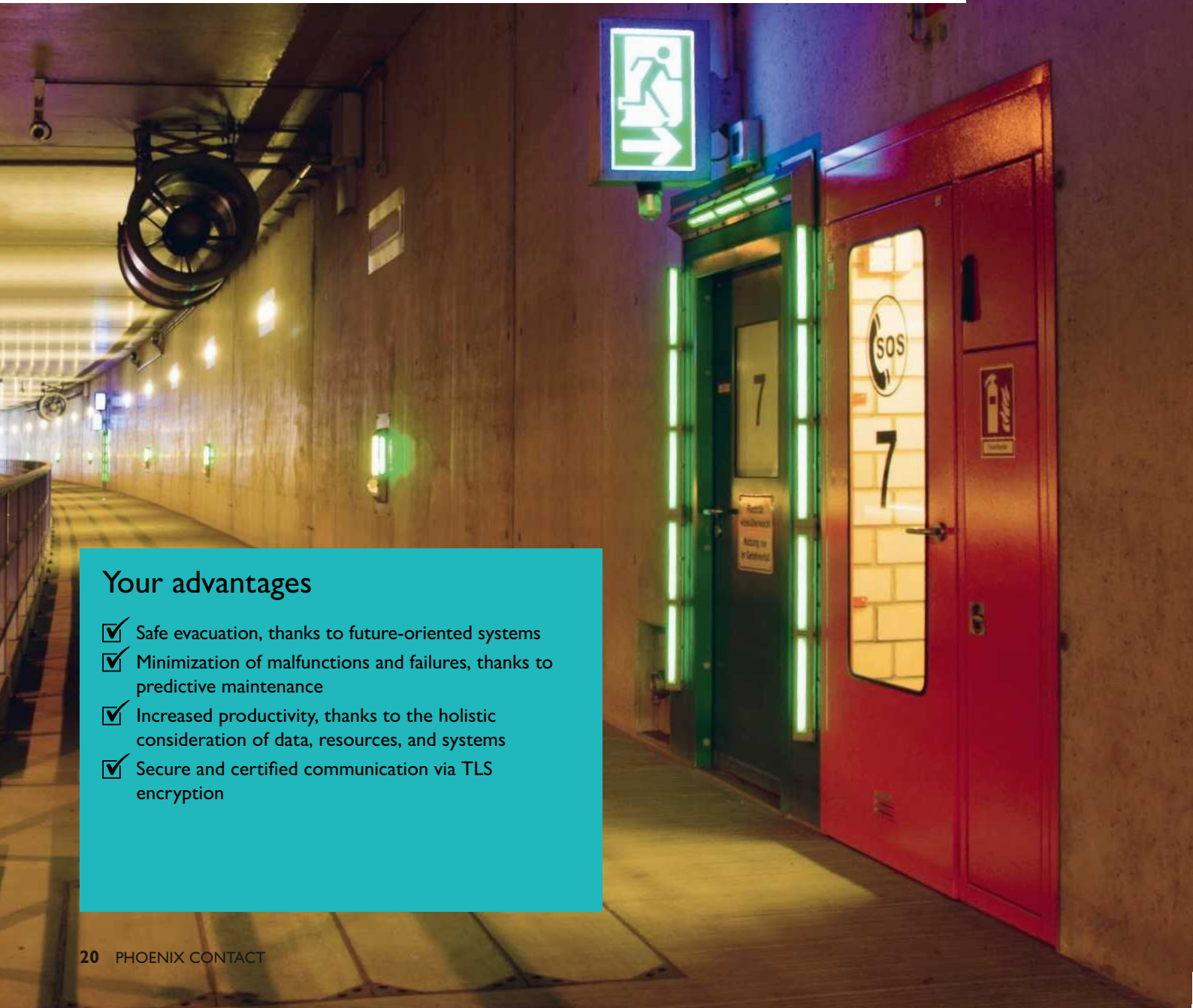


## Solutions for tunnel technology

### Safe applications

The safety of road users in tunnels is the top priority and this safety must be guaranteed at all times. There are directives specifying minimum safety requirements for tunnels. Alongside safety features such as emergency bays, tunnels must always be reliably supplied with power, light, fresh air, and extinguishing water.

Safety-related solutions and technologies from Phoenix Contact allow you to create a reliable monitoring and safety system for your tunnel.



#### Your advantages

- ✓ Safe evacuation, thanks to future-oriented systems
- ✓ Minimization of malfunctions and failures, thanks to predictive maintenance
- ✓ Increased productivity, thanks to the holistic consideration of data, resources, and systems
- ✓ Secure and certified communication via TLS encryption



### Safe components

SafetyBridge Technology from Phoenix Contact offers a network- and controller-independent safety solution. You can transmit and evaluate safety-related signals via standard automation networks with this technology. This can be done without the use of a safety controller. The technology can be used on various bus systems, thanks to the SafetyBridge protocol. It is certified for all common networks.

### Continuous monitoring

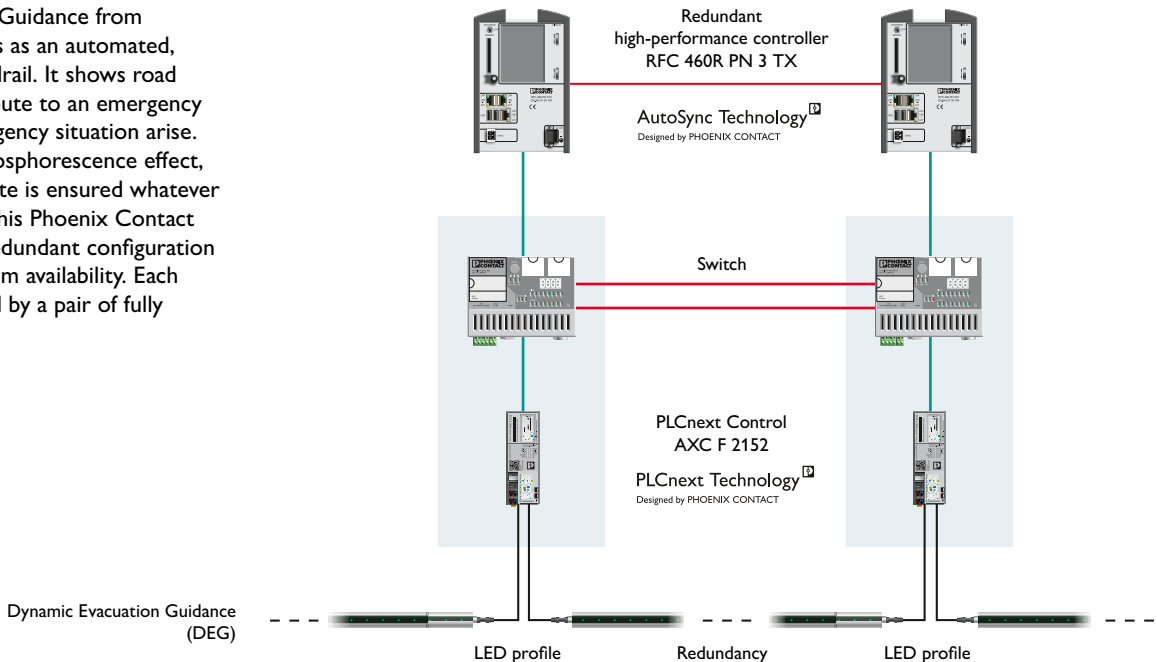
With the PROFINET-based cloud solution from Phoenix Contact, you can transmit safety-related data to the cloud over the Internet. Safety data can be accessed via the Internet in real time and converted into meaningful information. Improve your operational sequences, for example by analyzing user behavior. Furthermore, real-time data analysis enables predictive maintenance of components susceptible to wear.

### Future-oriented systems

Phoenix Contact develops future-oriented evacuation systems, such as Dynamic Evacuation Guidance based on laser technology. This new solutions drastically reduces installation costs. It also guarantees visibility even when there is smoke due to a fire. Automatic license plate recognition has been integrated into the traffic control systems, allowing information to be presented to road users in their national language.

### Dynamic Evacuation Guidance

Dynamic Evacuation Guidance from Phoenix Contact acts as an automated, illuminated LED handrail. It shows road users the shortest route to an emergency exit, should an emergency situation arise. With a two-hour phosphorescence effect, a safe evacuation route is ensured whatever the circumstances. This Phoenix Contact solution has a fully redundant configuration to guarantee maximum availability. Each handrail is monitored by a pair of fully redundant PLCs.



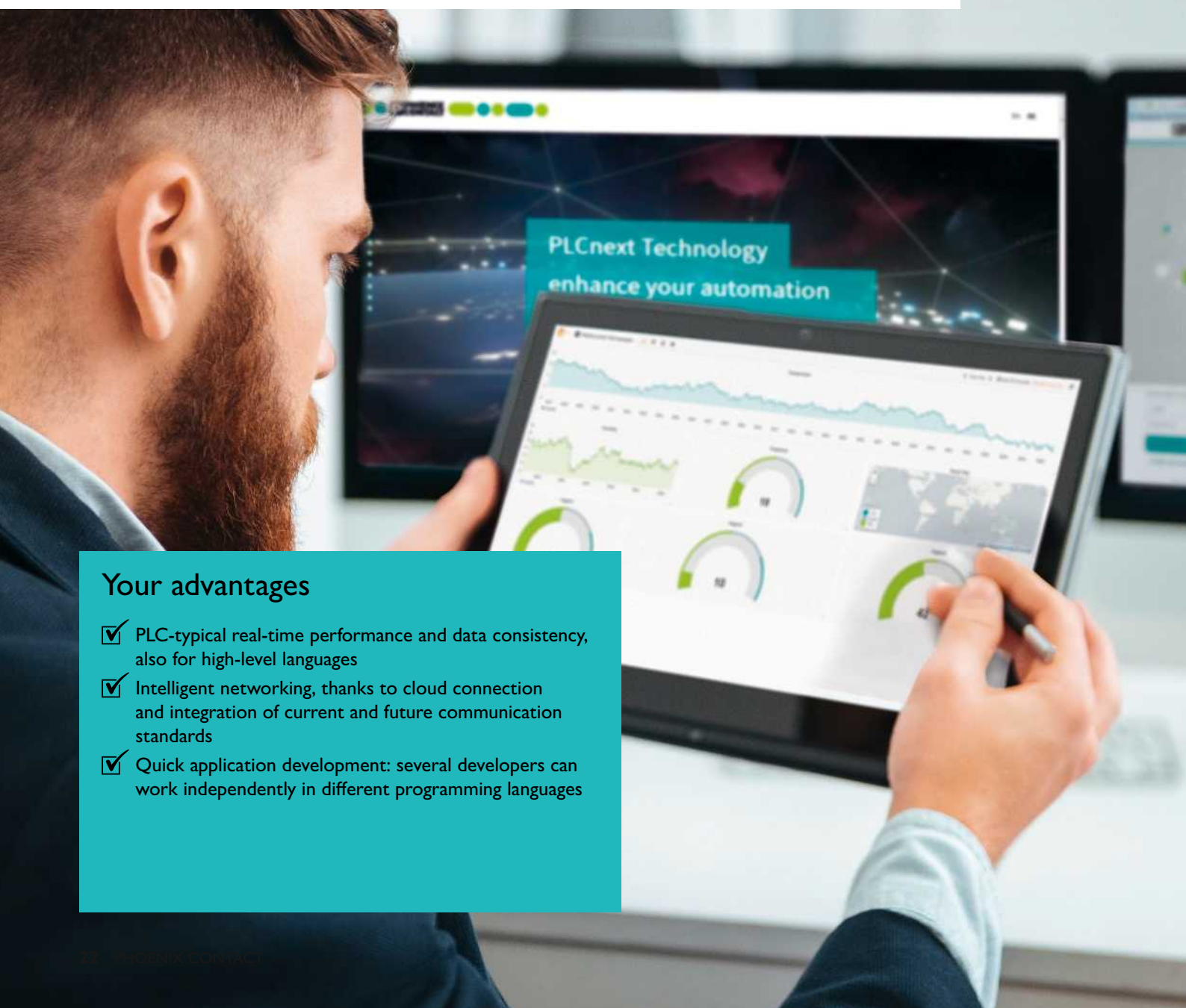
- Fiber optics
- Ethernet
- General connection

## Solutions for tunnel technology

# Future-oriented system automation

We provide intelligent solutions that you can use to efficiently automate sub-applications or your entire tunnel. Our control and software solutions allow you to stay competitive and respond flexibly to dynamically changing circumstances.

With its PLCnext Technology, Phoenix Contact offers a unique ecosystem that gives you a whole new level of freedom when it comes to creating tunnel solutions.



### Your advantages

- ✓ PLC-typical real-time performance and data consistency, also for high-level languages
- ✓ Intelligent networking, thanks to cloud connection and integration of current and future communication standards
- ✓ Quick application development: several developers can work independently in different programming languages

## PLCnext Technology: The ecosystem for limitless automation

Safety, availability, and cost-effectiveness are the decisive characteristics of tunnel automation. PLCnext Technology offers a comprehensive, coordinated portfolio for tunnel technology, thus enabling quick and reliable engineering. The combination of open control platform (PLCnext Control), modular engineering software (PLCnext Engineer), and systemic cloud integration allows for simple

adaptation to changing demands and the efficient utilization of existing and future software services. With the PLCnext Store, Phoenix Contact provides the PLCnext Community with an open exchange platform for its software functions. By upgrading automation systems to include cloud computing, new digital business models can be realized. Proficloud, the open and scalable IoT platform from

Phoenix Contact, is a key factor for future success and a possible extension of the PLCnext Technology ecosystem.



## Tunnel applications in the PLCnext Store

The PLCnext Store provides software applications (apps) that enable you to expand the functions of PLCnext Control directly and easily. Here are a few examples:

### Basic light control

Optimize your energy consumption and lower costs by adjusting your lighting to the ambient conditions.

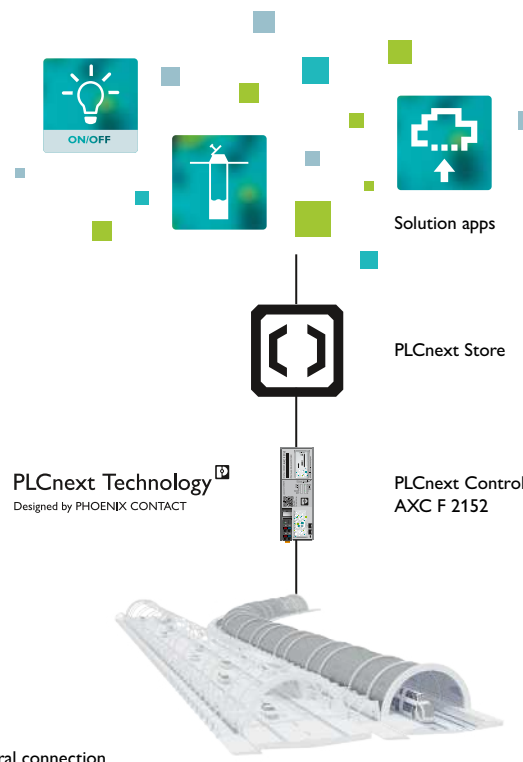
### Pump station control

Easily transform your PLCnext Control into a ready-to-use pumping station.

### Proficloud writer

Write your data directly to Proficloud and make use of the associated data storage and analysis options.

All the apps are available to download from our store: [plcnextstore.com](http://plcnextstore.com)



— General connection

# Excellent project management

We will be with you every step of the way with excellent project management services – from tender preparation, through planning and engineering, right through to managing your intelligent, futureproof tunnel system. Our agile project management approach helps us to achieve this. We explore new horizons together with you to develop the best possible solution for your application.

With Phoenix Contact you always have an expert project partner by your side. Our very own Center of Competence Tunnel Infrastructure is always busy ensuring we can meet your demands and create tailored solutions.



## Your advantages

- ✓ Continual exchange and flexible project adjustments, thanks to an agile project management approach
- ✓ Clear and comprehensive information processing
- ✓ Minimum lifecycle costs, thanks to continuous further development of our customized solutions



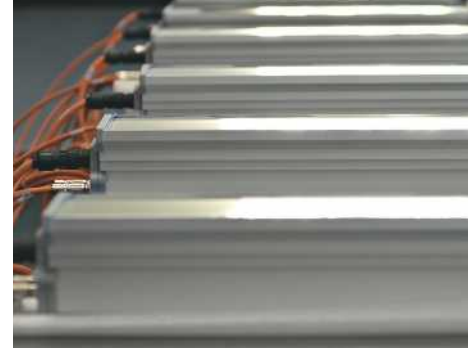
### Agile project management

Our cooperation with customers is based on a continual exchange of ideas. We will keep you involved throughout every stage of the project and provide you with results on a regular basis. For us, if we are to achieve the best possible outcome, this means we must respond to changes flexibly as they arise. We understand agile project management to be about continually incorporating these modifications, without interrupting the flow of the project.



### Comprehensive documentation

We will provide you not only with a precise project drawing, but also a comprehensive functional description. A detailed list of materials will enable you to see the scope of the project at a glance. We will also support you during the tendering phase, providing you with relevant information and documents.



### Training and tests

Our systems are subjected to comprehensive testing prior to use. Once the solution has passed the factory acceptance test (FAT), a team of our highly qualified tunnel engineers will test it in-situ in your application environment (SAT). Following installation, the entire system will be tested on site, before being started up. Phoenix Contact also offers you a complete range of training courses on system installation and maintenance.

## Our Center of Competence Tunnel Infrastructure in Belgium

The Phoenix Contact Center of Competence Tunnel Infrastructure is located in our subsidiary in Belgium. From this Center of Competence, which was founded in 2015, we offer our customers advice and work together with them to develop complete solutions for tunnel automation. The requirements analysis is

particularly important to us, as is the ability to offer exactly the right solution. We make sure our solutions are ready to use right out of the box. Installation, startup, and maintenance time and effort are reduced to an absolute minimum.

In 2019, a demo tunnel built specifically for test purposes will be completed in Belgium.

Here we will test components from third-party providers and make our solutions ready for your exact application.



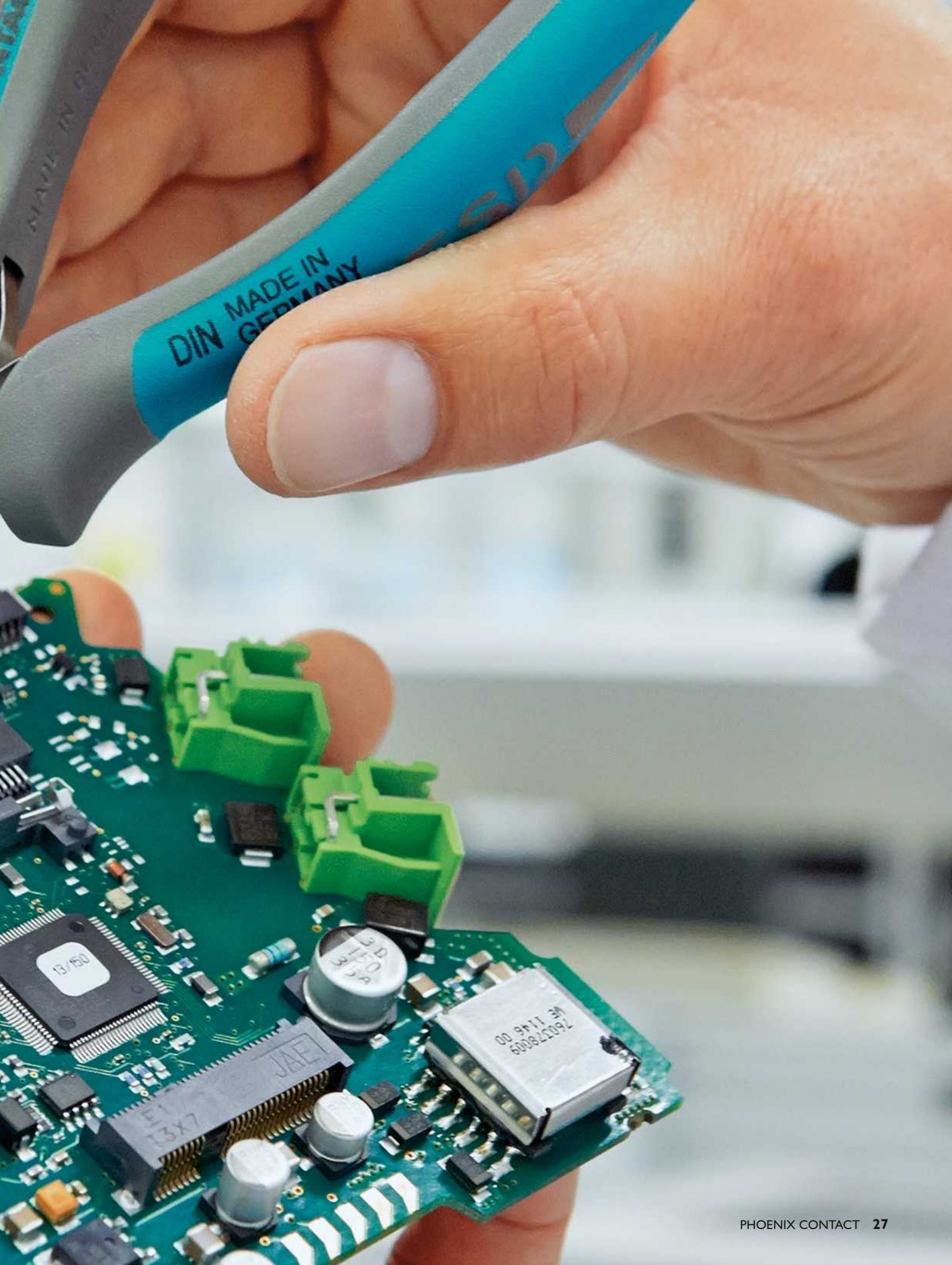
Demo tunnel in front of the Phoenix Contact subsidiary in Belgium

## Quality is no coincidence

It is only when you keep sight of every little detail that you can be sure of the quality of the entire product. For this reason, we not only manufacture our screws ourselves, but also develop tailor-made software and offer engineering services from industry professionals.

This allows us to secure our commercial and technological independence and gives us the freedom to develop new industrial solutions. You benefit from this because, for example, we are able to offer you pre-assembled control cabinet solutions. These are specifically tailored to your industry and have all the necessary certifications and approvals. For us, “Made by Phoenix Contact” means the best quality in every product, in every discussion, for the entire solution.



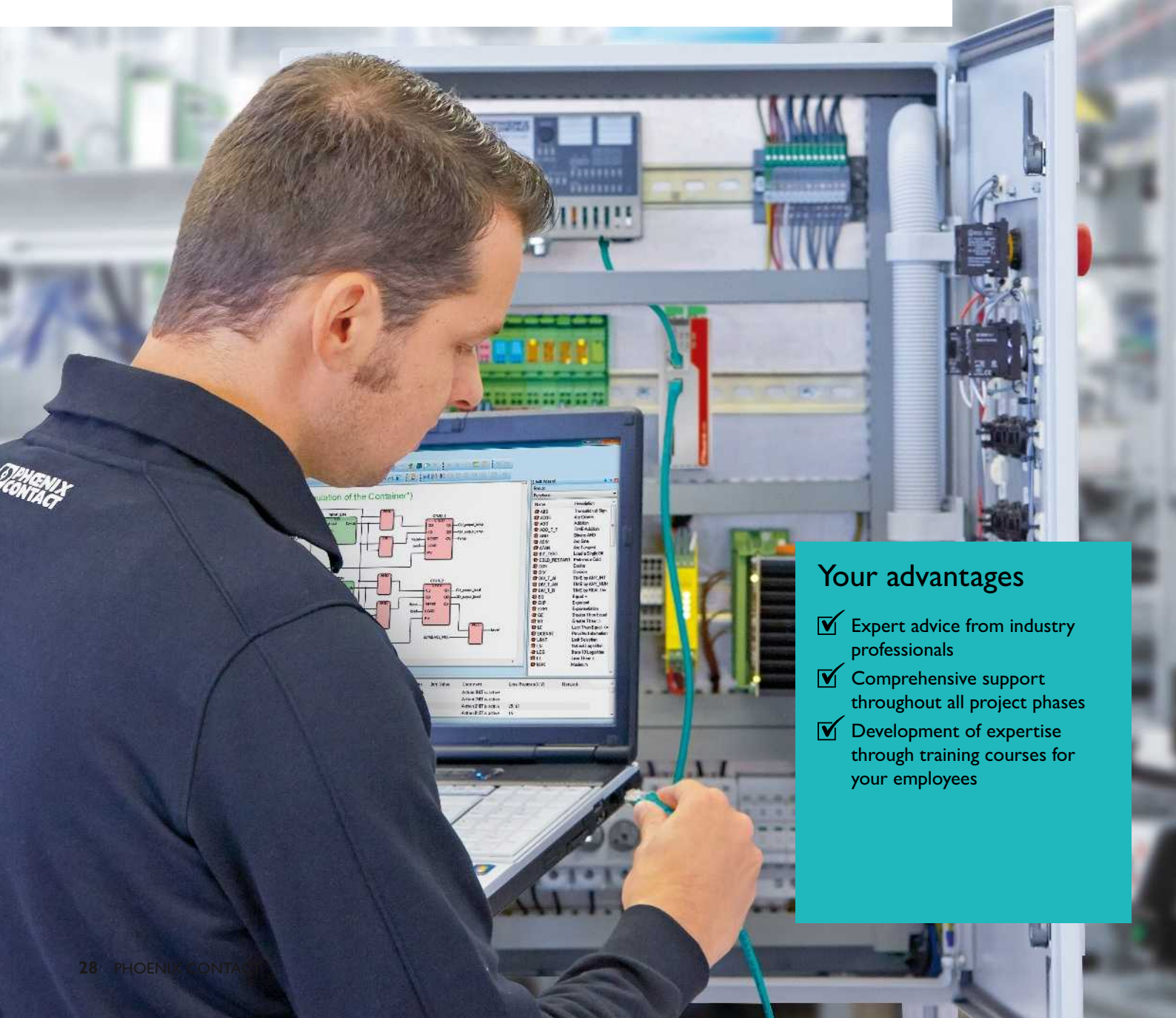


Quality is no coincidence

## Engineering and control cabinet solutions

We set the highest standards for your industry solution: everything is tested and certified, from the pre-wired and pre-programmed control cabinet solution to the engineering service. Our industry experts advise you during every phase of your project cycle and, if required, handle the engineering of your system.

All Phoenix Contact components undergo intensive testing in the independent and accredited Phoenix Testlab. Control cabinet solutions are designed and engineered in accordance with the required standards and directives. You can therefore be sure that our finished solution products satisfy the most stringent requirements.



### Your advantages

- ✓ Expert advice from industry professionals
- ✓ Comprehensive support throughout all project phases
- ✓ Development of expertise through training courses for your employees



## Engineering

Based on the typical phases of a tunnel project, we provide support by working with you at each stage. Simply provide us with an outline of the application you would like to implement. We will then provide you with a technical concept that includes suitable hardware and software:

- Configuration
- Programming
- Visualization
- Coaching

## Control cabinet solutions

Working together with our customers, we develop control cabinet solutions which, depending on the requirements, are ready to use or already pre-wired so that you can carry out final installation.

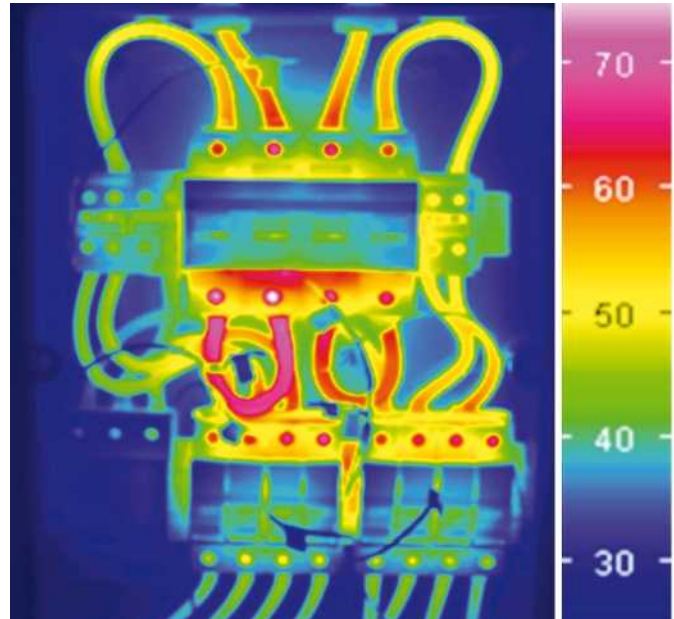
With a network of partners made up of proven control cabinet manufacturers, we can create specific industry solutions that satisfy the most stringent requirements.

This means that high quality is ensured in every step of the development process. A process-oriented, integrated management system based on international standards DIN EN ISO 9001 and 14001 ensures that legislation and standards such as EC directives 2002/96/EC (WEEE) and 2002/95/EC (RoHS) as well as customer specifications are taken into consideration during product manufacturing.

## Quality from planning through to production

During preliminary development clarification, all departments work closely with the customer. Following preliminary clarification and the design phase, a prototype undergoes specific tests. The knowledge gained is integrated into product optimization.

As a part of the project process, we provide support for the development of solutions: from initial planning and configuration, through the layout and design, right through to assessing and verifying the specified standards, as well as providing documentation and EPLAN-based circuit diagrams. Production planning and control then follow and, where appropriate, series production.



Quality is no coincidence

## Our expertise for your safety and security

Phoenix Contact offers a comprehensive portfolio of services in the area of functional safety, ICS security, and industrial communication technology. We know and understand the expectations and demands placed on automation and network technology in your tunnel projects. We will therefore provide you with advice, evaluate and plan on the basis of your application, and implement the necessary measures.



### Learn more about our services

We will provide you with flexible support so that you can concentrate on your core expertise. Feel free to call us or send us a message with your inquiry.

Hotline: +49 5281 946-5555

E-mail: [services@phoenixcontact.com](mailto:services@phoenixcontact.com)

# Our range of services

## Functional safety

### Consultation

We provide advice regarding the planning and implementation of your system.

- Design of the safety lifecycle: standards and their implementation
- Machinery Directive
- Changes to machinery and systems

### Engineering

To assess the safety integrity, we determine the SIL of the safety functions with the help of your technical documentation. These must be sufficiently robust to withstand random errors. In the case of Machinery Directive requirements, we implement the entire safety lifecycle process.

### Seminars

Functional safety in the process industry in accordance with EN 61511:

- Risk analysis
- Safety lifecycle
- Creation of PLT safety functions



We will accompany you through the entire safety lifecycle for your applications

### Safety application software:

- Requirements for safety-related software
- Specification of safety requirements and software
- Implementation of safety functions
- Development of function blocks



Our experts are on hand to assist you and share their extensive technological expertise

### Product support

We provide support in the event of any questions you may have regarding Phoenix Contact safety hardware and software. You can contact our support team about anything – from preliminary technical clarification, through planning and implementation, right through to operation.

24-hour safety hotline: +49 5271 946-2777  
E-mail: [safety-service@phoenixcontact.com](mailto:safety-service@phoenixcontact.com)

## ICS security and industrial communication technology

### Evaluation and planning

We offer you more than just a one-size-fits-all solution. To achieve your protection objectives, we analyze your requirements and adapt them in accordance with relevant standards and directives. We will analyze your network and present optimization options to ensure high availability.

### Implementation

We expose weak areas in your security and your network to ensure more transparency for your tunnel. We will support and advise you with regard to technical restructuring or new requirements for your system – from field level to company level.

### Maintenance and support

Stable and reliable processes are essential for productivity, quality, and delivery reliability. With our support in the areas of security and Industrial Ethernet, we safeguard your production and thus minimize downtimes.

### Seminars

Due to attack dynamics, awareness is becoming increasingly important. With our Cyber Security Center of Expertise in Berlin, we also have in-depth expertise in the area of industrial cyber security. We would be happy to share this knowledge with you in our seminars:

- Ethernet basics
- Security principles and awareness
- Product training
- Customized workshops



We will support you in the creation of your customized protection level



Quality is no coincidence

## Service and support

Implement your tunnel projects even more quickly and efficiently. Whether you operate, plan, produce, or maintain systems – Phoenix Contact provides support via its telephone and online service, as well as through industry experts on site. Numerous seminars are available for training your employees, either at Phoenix Contact headquarters or on site at your company. As part of our after sales service, we provide expert advice regarding any aspect of your products and solutions.



### Your advantages

- ✓ Expert advice from industry professionals
- ✓ Comprehensive support throughout all project phases
- ✓ Development of expertise through training courses for your employees



## Customer-specific solutions

From a small customization to a completely new product development – the Phoenix Contact service team will focus on your specific requirements. With many years of experience in tunnel technologies, we will support you step-by-step in creating an individual solution.

## Knowledge and information

Phoenix Contact provides the training programs that you need, including short evening seminars, expert seminars over several days, webinars, and e-learning courses. Classification into Basic, Advanced, and Individual simplifies assignment to a course.

## After sales service

Our service network will assist you at any time during installation, startup, and operation. Contact us on the free hotline for 24-hour product support. In the event of an emergency, we can provide you with replacement parts outside of office hours.

Hotline: +49 5281 946-2888

## Local expertise

Phoenix Contact supports you worldwide with professional service and support for all aspects of products, services, and solutions. Depending on requirements, we ensure the fast replacement of products or support you in the event of problems by patching into your system. Our experts are familiar with the regional conditions and specific challenges of your industry. We will be happy to provide support all over the world with our tight-knit network of automation experts. Contact us for more information.



Quality is no coincidence

## Inspiring industry solutions, thanks to excellent products

Phoenix Contact offers you innovative solutions for your tunnel applications. The basis for these solutions is our broad range of connection and automation technology. Intelligently combined, these products become systems for a variety of functions such as control, remote monitoring, or measurement recording. Inspiring industry solutions are created, thanks to industry expertise, longstanding experience, and consideration of special requirements.



Excellent products

Innovative systems

# Excellent products



## Installation-ready solutions

Utilize our installation-ready control cabinet solutions, including pre-programmed application software, to easily switch your tunnel lighting on/off and dim it continuously.



## Surge protection

Increase your tunnel availability with intelligent surge protection for all applications, from the power supply to measurement, control, and communication technology.



## PLCnext Technology

PLCnext Technology from Phoenix Contact is a unique, open ecosystem for modern automation capable of meeting all the challenges of the IoT world.



## Installation systems

The flexible and robust QPD installation system allows you to distribute power over long distances effortlessly. You can reduce cabling time by up to 80%, thanks to fast connection technology.



## Cloud solutions

Proficloud from Phoenix Contact provides you with professional, comprehensive cloud solutions for your automation – from infrastructure and platforms, right through to software.



## Network infrastructure

We offer you powerful network components for connecting your field devices and communication backbone, and integrating them into the power grid and distributed control rooms.



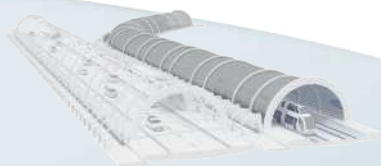
## Cyber security

Protect your applications against unauthorized access by people or malware. Our mGuard series uses a strong, flexible, rapid firewall to protect your system.



## Terminal blocks

Save time and space: our range of terminal blocks provides quick and easy-to-operate connection technology that is tailored for use in your tunnel application.



Inspiring  
industry solutions

## In dialog with customers and partners worldwide

Phoenix Contact is a globally present, Germany-based market leader. Our group is synonym for future-oriented components, systems, and solutions in the fields of electrical engineering, electronics, and automation. A global network across more than 100 countries, and 17,400 employees ensure a close proximity to our customers, which we believe is particularly important.

The wide variety of our innovative products makes it easy for our customers to find future-oriented solutions for different applications and industries. We especially focus on the fields of energy, infrastructure, process and factory automation.



You will find our complete product range at:  
[phoenixcontact.com](http://phoenixcontact.com)

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