



ELMA
Your Solution Partner

Railway

PRODUCTS AND SERVICES FOR RAILWAY APPLICATIONS

SYSTEM SOLUTIONS
ENCLOSURES & COMPONENTS
ROTARY SWITCHES

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Who are we? **since 1960**

Elma Electronic is a globally operating manufacturer of electronic packaging products for the embedded systems market. Our portfolio includes components, backplanes, power supplies, storage solutions, rack platforms and fully integrated systems. Elma partners with leading technology providers from the industry to perfectly satisfy its customers' needs for integrated solutions. As a global company, we are close to our customers through our sales, engineering and manufacturing facilities on three continents.

Reliability and long-term support backed by many years of technical competence and precision engineering – that's what makes Elma Electronic.



Train of Jungfrau

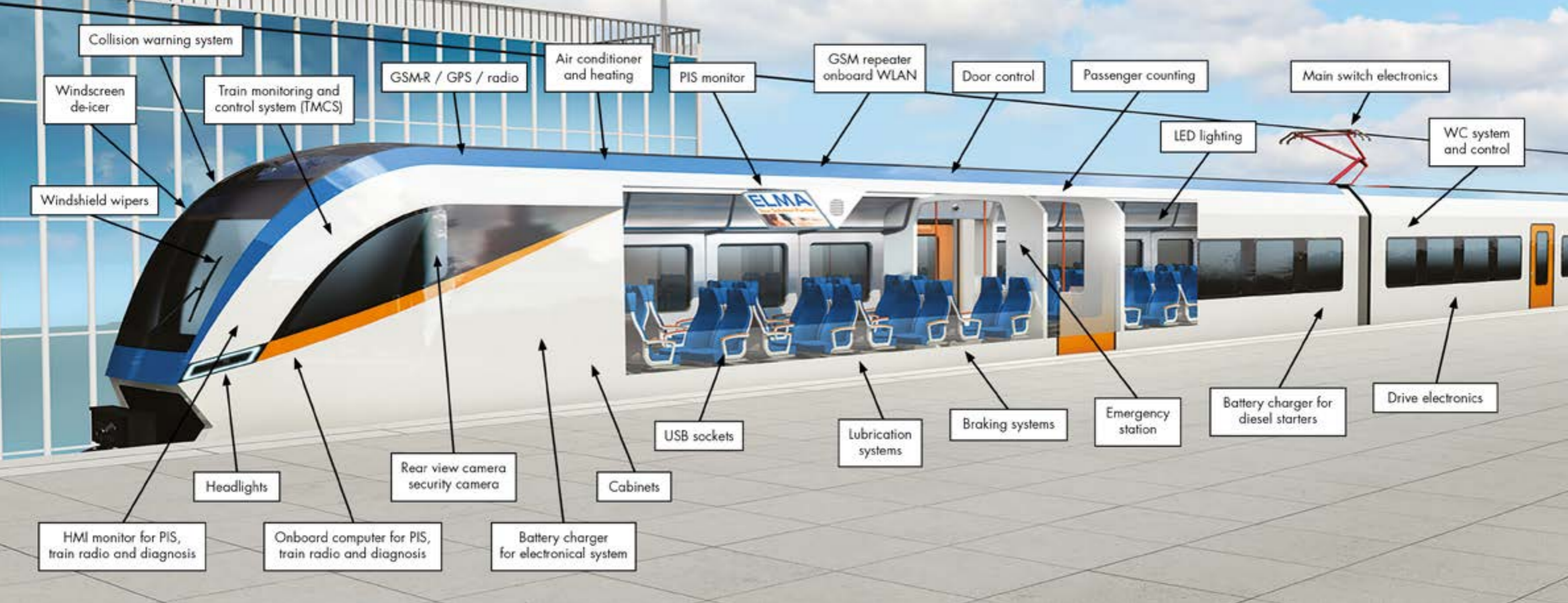
SHORT PROFILE

The close relationship between development, production and sales, in-depth knowledge of the railway market as well as the responsiveness to customer requirements and feedback have helped Elma to achieve steady market growth.

Product cycles in the railway industry differ significantly from those in the commercial sector. LCC (lifecycle costing) and RAMS (reliability, availability, maintainability and safety) are becoming increasingly important in the evaluation of equipment. Elma is your solution partner in helping to achieve these requirements.

Elma's electronic components, mechanical assemblies and systems can be found on the train, along the track and in the control centers. This includes enclosures for electronics, supply power, control and monitor systems or, in the form of input units and screens, provide interfaces to operators.

- › Over 25 years of experience in the railway industry
- › Global presence
- › Member of several industry trade associations
- › Long-standing supplier and customer relationships
- › Power supplies compliant to EN 50155
- › Railway computers and systems compliant to EN 50155
- › Railway cabinets compliant to EN 50155
- › 19" subrack compliant to EN 50155
- › Customized mechanical and electronic engineering
- › Engineering, thermal simulation, validation, certification
- › Production, assembly and testing



APPLICATIONS IN ROLLING STOCK

Elma's electronic components, systems and mechanical assemblies can be found in many rolling stock applications. Battery chargers and power supplies feed onboard electrical systems and components in rolling stock. System suppliers for brakes, train and toilet control systems, air conditioning, telecommunications and radio equipment, monitoring systems, drive and vehicle electronics as well as lighting rely on our products. DC/AC inverters feed battery-supported AC networks, such as those required for refrigerators and freezers on bistro cars. They are also used for upgrading vehicles with AC sockets. Elma's HMI solutions, monitors and onboard computers can be found in passenger information (PIS) and diagnostic systems.

Elma designs and manufactures 19" systems to accommodate electronic assemblies. You may rely on our rich experience gained from being a system manufacturer for ETCS (European train control system), TCMS (train monitoring and control system), radio and recording devices. Front panels are drilled, milled and printed from various materials in our in-house front panel center. Being the manufacturer of either your front panel or a completely mounted module, such as of emergency call stations in trains, we are prepared to meet your needs.

The aluminium profile frame of Elma cabinets has been specifically adapted to the needs of our railway customers. They are configured and fabricated, modelled on flexible cabinet platforms for specific projects. The cabinets are used to accommodate the vehicle electronics.

Battery chargers for

- › Onboard powergrid
- › Diesel engine starter

Monitors and HMI for

- › HMI for radio and passenger information systems
- › Monitors for passenger information systems
- › Emergency call stations

Onboard computer for

- › Passenger information systems
- › Monitoring applications
- › Data analysis applications

19" systems and enclosures for

- › Passenger information systems
- › Radio
- › Train protection
- › Train monitoring and control system
- › Cabinets

DC/AC converter for the supply of

- › AC sockets
- › Onboard bistro (food supply, freezer, refrigerator)

DC/DC converter for the supply of

- › GSM-R / GPS / radio
- › Headlamps and windscreen wipers
- › Rearview mirror and surveillance camera
- › Windscreen de-icer
- › Event recorder and collision warning system
- › Lubrication and braking systems
- › Train monitoring and control system
- › GSM repeater
- › Air conditioning and heating
- › Onboard WiFi and USB sockets
- › LED lighting
- › Passenger information and counting systems
- › Onboard bistro, toilet system and control unit
- › Door control
- › Drive electronics
- › Main switch electronics



CRH380A CRRC

IN USE WORLDWIDE

MOBILITY AROUND THE GLOBE

Elma products and equipment from our suppliers are used worldwide. Whether in the Alps, climbing the Jungfrauoch or underground in the Minsk Metro or even on the highest tracks in the trains of the Tibet Rail operators rely on our products. Our products are installed in the strongest locomotives in the world – for example in the iron ore mines of Kiruna or in the cogwheel locomotives of mines in the Brazilian rainforest.

Products from Elma and our suppliers are used in the following worldwide projects.

Project	Application	Elma products
CRH380A CRRC	Power supply train control	DC/DC converter
Hollysys Beijing	Radio control center	Subrack CompactPCI with backplane
Jungfraubahn – Top of Europe	Power supply train control	DC/DC converter
Malmtrafik AB IORE – strongest locomotive in the world	Passenger information system	Monitors, repeater, passenger information system computer
Matterhorn Gotthard Bahn	Supply onboard powergrid	DC/DC converter
MRS Brazil – strongest gear locomotive in the world	Supply onboard powergrid	DC/DC converter BAP319R series
New Jersey Transit ALP DP45	Supply onboard powergrid	DC/DC converter
RhB / SBB / DB	Passenger information system	Subrack passenger information system, DC/DC converter
Siemens DB IC4	Power supply train radio	DC/DC converter
Siemens Mobility	Power supply ETCS	DC/DC converter
Stadler EC250	Supply onboard powergrid	DC/DC converter R series, DC/AC inverter, ODX series
Stadler FLIRT KISS GTW WINK	Supply onboard powergrid	Battery chargers, DC/DC converter
Tram Cochabamba	Passenger information system, power supply train radio	Monitors, passenger information system computer, emergency call stations, HMI
Subway Hangzhou Zhejiang	Traffic management system	Subrack with backplane
Subway Shanghai	Control center	Subrack CompactPCI with backplane
Talgo Medina Mekka	Power supply lighting	DC/DC converter
Talgo Renfe	Supply onboard powergrid	Battery chargers LBC series
TGV Alstom	Different applications	DC/DC converter
Tibet Rail	Power supply train control	DC/DC converter
Twindexx Bombardier	Power supply onboard kitchen	DC/AC inverter, ODX series

REFERENCES

Operator

- > DB
- > SBB, BLS, SOB (various private railways in Switzerland)
- > SNCF

Rolling stock manufacturers

- > Alstom
- > Ansaldo STS
- > CAF
- > CRRC
- > Matisa
- > Newag
- > Scheuchzer
- > Siemens
- > Stadler Rail
- > Vossloh

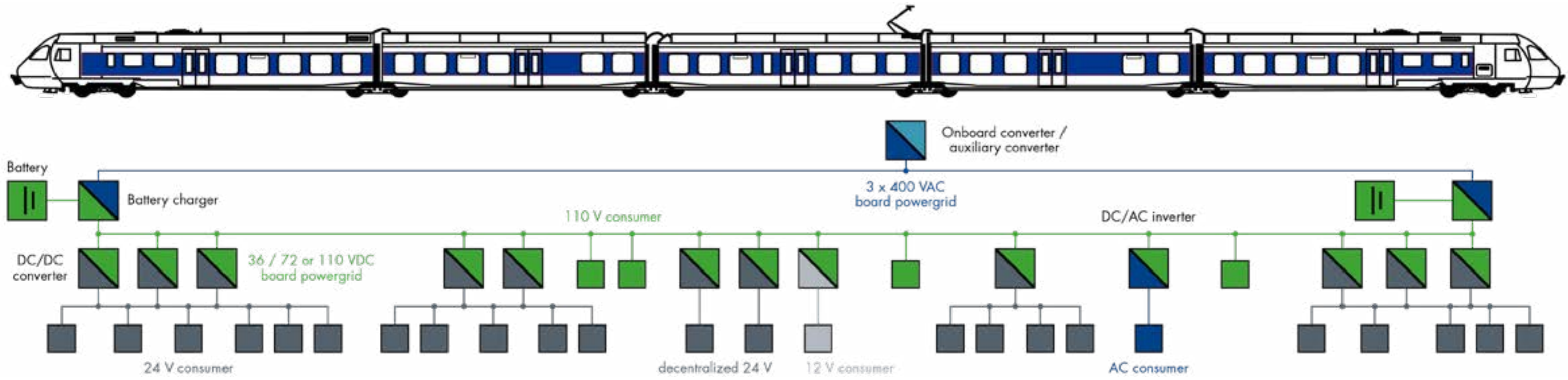
Subsystems

- > Annax
- > Casco
- > Comlab
- > Ervocom
- > Gilgen Door Systems
- > Hasler Rail
- > Hollysys
- > Insigma
- > Kiepe Electric
- > Knorr Bremse
- > MEN
- > Rhomberg Sersa
- > Siemens
- > Stadler Signaling
- > Strabag ISS
- > Systemtech Schneider
- > Thales Rail
- > Zhonghe Science & Technology

Source: Stadler Rail AG, KISS



POWER SUPPLIES IN RAIL VEHICLES



Source: Stadler Rail AG, FLIRT



- 110 VDC battery-supported onboard electrical system
- 3 x 400 VAC onboard electrical system
- Track power
- Other consumer voltages
- 24 V on-board supply

Elma's portfolio includes battery chargers and converters for the onboard electrical system on the rolling stock. A battery charger converts AC voltage from the auxiliary onboard converter into DC voltage, charges the battery and simultaneously feeds various consumers directly or via onboard DC/DC converters.

Many customers use 24 V and they usually have not direct connection to the onboard electrical system. DC/DC converters are then applied to convert the onboard voltage into the required low voltages. DC/DC converters are also used in sub-systems attached directly to the onboard electrical system.

RAILWAY INFRASTRUCTURE

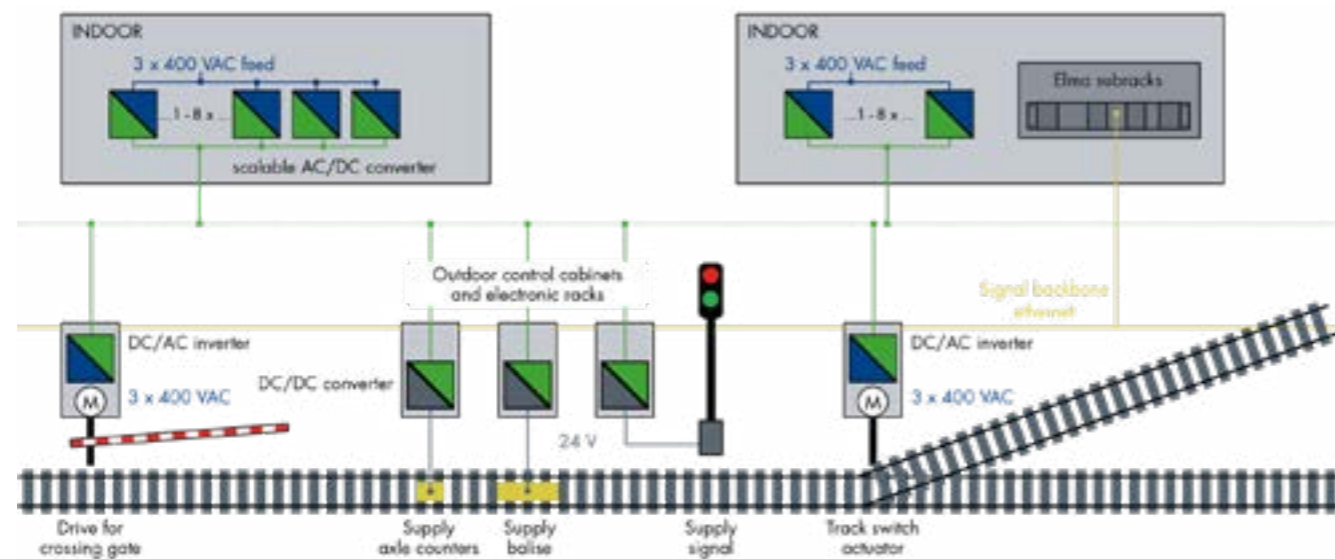
750 VDC

Power supply for the railway track side

Field elements such as signals, balises, switches and barriers along railway tracks require power supply. Up to now, available power connections have been used. Balises have been powered by currents induced when passing over. New technologies and increased safety measures, however, demand higher power consumption. Future power supply designs envisage a voltage of 750 VDC in order to keep power losses over long distances to a minimum.

Elma provides scalable feeds and a large number of DC/DC converters for operating the loads along the tracks and in the control stations. Since switch and barrier motors are AC-powered, DC/AC inverters are used. Power supplies can be monitored and controlled via Ethernet.

Our subracks and electronic racks are used in the control stations of the railway operators as well as in track side cabinets. Both the backplanes and the mechanics for track side control units are made by Elma.



PRODUCT OVERVIEW

MANUFACTURER

Elma provides power supplies of the leading producers in the railway industry for both rolling stock and track side. In addition, Elma develops proprietary products for customized requirements when standard products are inadequate.

Services include distribution, lifecycle management such as development and qualification as well as the construction of appropriate power supplies pursuant to directives and standards applicable in the railway industry. Elma is an official and certified partner of the manufacturers Premium, Power Control Systems, Absopulse, Recom, Cincon Delta, Hitron and TDK providing end-to-end solutions for all requirements of power supply systems in the railway industry.

AC/DC BATTERY CHARGERS

Battery chargers are used wherever loads have to be operated despite failure of the regular supply. Battery chargers are usually used in rolling stock to supply power to small consumers attached to the onboard electrical system while keeping the battery buffered. Batteries provide power for the onboard key loads once the track power supply fails, the pantograph is shut down or the train is intentionally disconnected from track power.

The high density and efficiency of Absopulse and Premium AC/DC power supplies enable high availability and easy maintenance. Its modular design supports versions of 4, 8 and 12 kW units. In addition, several units can be connected in parallel to the same onboard electrical system. CANOpen or Ethernet can be optionally selected as communication interface.

Another typical feature is the use of battery chargers for the batteries of the diesel starter. In order to secure availability, this circuit is not connected to the rest of the onboard electrical system but powered by an autonomous battery.



3000W, Rugged, Railway Quality AC-DC Power Supply with PFC-Input (Absopulse)

AC/DC POWER SUPPLIES

AC/DC power supplies are rare in rolling stock, but more common in infrastructure. Devices differ mainly in the way they are installed and used.

Cassette design

This design is widely used by manufacturers of vehicle control systems in particular. Modular 19" systems can be adapted to the requirements of the infrastructure to be expanded. Reliability and availability of the systems are imperative. Several AC/DC converters can be easily connected in parallel to create redundancy. Since the DC/DC converter is identical in design, additional redundancy via battery is also available. These usually fanless devices are hard to beat in terms of robustness and longevity.



Premium CTS-240 with front panel and H15 connector

AC/DC POWER SUPPLIES

Designed for DIN rails

The benefits of these devices are their scalability, easy integration and high availability of DIN rail system components. Available systems can be upgraded to higher performance with minimum effort. A huge range of additional devices such as redundancy, buffer and UPS modules complete the full range of secure power supply for railway infrastructure.

Delta CliQ M DIN rail power supplies guarantee highest power density with an efficiency of more than 95 %. They provide the full power range even along railway tracks climbing to above 5'000 meters above sea level.



Delta CliQ M DIN rail power supply unit

DC/AC POWER SUPPLIES (INVERTERS)

If rolling stock vehicles in the depot or at the siding are disconnected from the grid, a reduced number of consumers will continue to be supplied via the battery buffered powergrid. This may include AC consumers, for example refrigerators or freezers in bistro wagons. By using inverters, these devices can be operated overnight, without external power supply, via the battery-supported onboard electrical system.

The devices of our partner Premium Power comprise a comprehensive range of inverters for railway applications, available from Elma. The power range of the ODS and ODX series includes devices from 260 to 6'000 W.



Premium Power Inverter ODX-3000

DC/DC POWER SUPPLIES

There is no alternative to Elma's DC/DC converters for rolling stock applications. Our product range covers the power classes from 1 W to 15 kW. The devices have been designed specifically for the railway market and meet all requirements of EN 50155.

Cassette design

Manufacturers of 19" subsystems need the fanless 19" cassette designs. Their use in 19" racks offers high modularity and fast interchangeability. In addition, the robustness and lifespan of these devices is enormously high.

The HDRC300S series for the CompactPCI Serial Standard impresses with a wide input range of 16.6 to 160 VDC.



Hitron DC/DC-Wandler

DC/DC POWER SUPPLIES

Panel mounting

Railway manufacturers prefer parallel converters of 500 W or 1'000 W to realize competitive, reliable and redundant onboard electrical systems. Where once fans or large heat sinks used to dominate the visual appearance of converters, improved designs now ensure that heat is dissipated onto the base plate and the metal panel on the customer's side. The devices of the latest generations excel with high-performance efficiencies of over 95 % and thermal resilience thanks to technologies such as silicon carbide.



The RMD500 series DC/DC converter for chassis mounting was developed for rail vehicles and transportation applications.



Individual input voltage ranges and freely selectable output voltages distinguish the CRS series from Premium Power.

HIGH VOLTAGE DC/DC CONVERTERS AND DC/DC BATTERY CHARGERS

The operation voltages of subways and trams are usually ranging from 600 to 900 VDC. Elma provides products for converting power to low-voltage loads. Our portfolio includes devices for charging onboard batteries as well as for supplying consumers.

Absopulse high voltage DC/DC converters are used in countless railway applications around the globe. Their key feature is their proven durability, with some of these devices having been in daily use for more than 30 years.



Absopulse high current and high voltage devices are available with power ratings of up to 5 kW and innumerable input and output configurations.

CUSTOMIZED POWER SUPPLIES

Flexible, modular converter series enable a multitude of configurations, whether in low or medium voltage. When standard devices reach their limits, Elma will design customized solutions exactly tailored to the needs of your application. We draw on our extensive experience and long-standing partnerships with producers of DC/DC converter modules.



ELOS Open System

The Elma ELOS DC/DC converter 50 W with a wide input voltage range of 14.4 to 154 VDC is used in our systems. We use a modular system of our own converter topologies. Thus, there are no limits to the number of available configurations and designs. The proven topologies can also be used for customized designs and voltages.

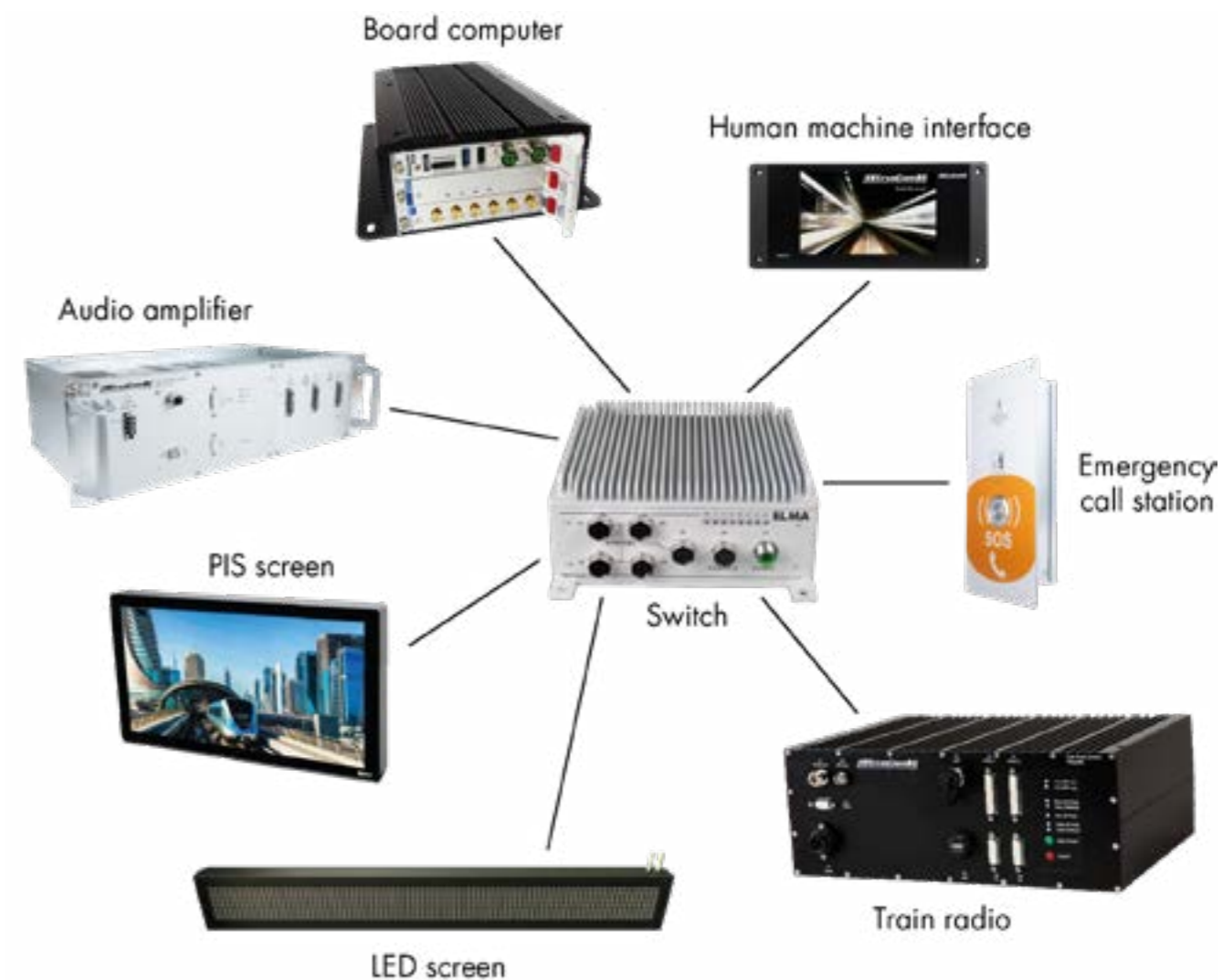


TRAIN RADIO | PASSENGER INFORMATION | COMMUNICATION

Elma modules for railway communication

In rolling stocks, Ethernet is increasingly replacing the CAN, MVB and other proprietary bus systems commonly used to date. Ethernet is gaining ground in the field of TCMS (train control and monitoring system), as well as in modern passenger information systems (PIS) where displays, voice announcement devices, PIS computers, emergency call stations, train radio and timetable computers communicate via Ethernet.

The RailSys-5401 onboard computer is the heart of passenger information systems. Our touch panels with enclosure are used as operating units for the passenger information system and train radio in the cockpit. Elma manufactures and assembles enclosures and fronts for train emergency call stations and deliver them turnkey to our customers. External displays as well as customised PIS monitors are also part of our product portfolio. Elma further produces 19" racks for train radio or ETCS applications, which can be installed in our railway-compatible cabinets. With our ELOS system, we also have a platform in our range that can be adapted to customer requirements.



EMBEDDED COMPUTING

RAILWAY COMMUNICATION

Systems in modern rolling stock are controlled via networked computer systems. The computers communicate via field buses (CAN-Bus, MVB/WTB, ProfiNet) or increasingly via secure Ethernet networks. Elma's portfolio of system solutions includes producers of COM modules, mainboards, industrial PCs, box PCs, panel PCs, monitors and displays as well as integrated systems. Supplementing and supporting the portfolio is the dedication of our engineering team that designs or adapts systems to meet specific customer requirements. The design of subracks, 19" racks, backplanes and the integration of embedded computing systems are among the core competencies of our company. Mechanical, operational and safety requirements for such systems are stringent. This systems have to be rugged and impervious to environmental influences in the rolling stock. Compliance to EN 50155 and EN 45445 standards is compulsory.

RailSys-5401

RailSys-5401 is a modular computer platform featuring optional extensions for memory and communication interfaces.

Elma's building block concept enables rapid computer configuration to meet your application's requirements. This system is based on an extruded profile enclosure able to be equipped with up to 3 standard eurocards (100 x 160 mm). With a computer card, a backplane behind and up to 2 optional interface cards, customer-specific systems with off-the-shelf products can be implemented very easily. In addition, the Elma Wide-Input DC/DC converter can be used at the rear of the enclosure. It enables connection to standard onboard voltages from 14.4 to 154 VDC.

This design is particularly suitable for CompactPCI Serial cards, which is widely used in railway computers. A large selection of CPU cards from Atom to Xeon, as well as a large number of available peripheral cards, make this standard ideal for applications in PIS, data transmission and diagnostics on trains.

- › 3 eurocards (100 x 160 mm) can be accommodated
- › Optional 3-slot or 2-slot backplanes
- › Optional power supply for railway or automotive applications
- › 3 enclosure variants for passive or active cooling
- › CompactPCI Serial peripheral cards for mass storage, interface expansion or ethernet switch
- › CompactPCI Serial carrier boards for PMC, XMC and PCIe modules enable fast integration of Wi-Fi, GPS, GSM-R, CAN, I/Os or customized interfaces



NetSys-5304 railway router

The NetSys-5304 is a fanless rugged embedded router suitable for railway or transportation applications. This Cisco 5915 Embedded Services Router (ESR) based system is designed to meet EN 50155 and delivers secure IP based data, to mobile applications in the rail transportation industry as well as others. The system facilitates seamless and secure communication in rolling stock applications.



19" systems

The type 12K enclosure, consisting of standard components, is the basis of various standardized 19" systems (including VME, CompactPCI, CompactPCI Serial or customized). In our own facilities we develop and produce customized and standard backplanes compliant with all applicable standards (VME, VPX, CompactPCI, CompactPCI Serial, MicroTCA or ATCA). Elma's 19" rack type 12K, consisting of subrack, CompactPCI Serial backplane, computer and slave cards, has been tested by an independent laboratory to meet all requirements pertaining to the railway standard EN 50155.

The tests were carried out according to the following criteria:

- › Operating temperature range of the assembly with cards: -40 to +70 °C (OT4)
- › Installation location: Category 1 Class B, shock and vibration test



The tested Elma board with backplane provides the full performance of the CompactPCI Serial architecture:

- › Increased EMC requirements
- › CompactPCI Serial Segment 1: RAID with 1 x CPU card and 2 x SSD carrier card (EKF)
- › CompactPCI Serial Segment 2: Passenger information system with 1 x CPU card, 1 x SSD Carrier card and 1 x GbE Interface switch (EKF)
- › Cooled by convection (top and bottom ventilation)



EMBEDDED COMPUTING PLATFORMS

RAILWAY COMMUNICATION

CompactPCI Serial computer and peripheral cards

CompactPCI Serial and EN 45445 is a well-established system platform for embedded computing systems in the railway industry. CompactPCI Serial is based on the CompactPCI architecture but integrating high-speed serial connectivity. This provides higher speeds and data rates as well as support for high-speed interfaces such as Ethernet, SATA and USB.

The extremely robust mechanical characteristics of CompactPCI and CompactPCI Serial are identical. CompactPCI Serial technology is mainly used when long-term availability and robustness are essential. Many cards are therefore available for higher temperatures and with protective coating against external factors.

Our portfolio includes processor boards as well as a large selection of peripheral cards. Since CompactPCI systems are modular, the interfaces of the processor board can be extended as required using conventional peripheral cards. Peripheral cards for memory modules, XMC and PMC boards provide unlimited expansion options. Support and development of customized boards are part of the services performed by Elma's engineering team.



EKF CompactPCI Serial computer for railway applications and EKF CompactPCI Serial SSD module carrier card



Emergency call station

Personal safety is an essential part of public transport. For this reason, most passenger coaches are now equipped with emergency call stations for passengers to contact the operator in an emergency. Elma builds emergency call stations pursuant to individual customer requirements, to be seamlessly integrated into the design of modern trains. Elma provides everything under one roof from the printed and milled front panel and enclosure via the installation of lights, buttons and loudspeakers to the wiring and testing of integrated assemblies.

Display and HMI

Modern LCD and LED displays are omnipresent in modern rolling stocks. Applications are manifold, ranging from passenger information systems, parts of the cockpit or active advertising medium. The selection of the suitable display or touch screen is essential. In rolling stocks, they must have a long-term life cycle and meet higher environmental requirements. As a system integrator, Elma provides matching HMI components for screen width of at least 3.5", to be integrated into customized front panels or enclosures or to be combined with matching computer systems.

You can count on Elma's support for:

- › Choosing suitable displays and touch screens
- › Decentralized computer systems for display control
- › Integration in front panels and enclosure
- › Combination with print and buttons
- › Assembly and testing



ENCLOSURES

FOR RAILWAY

Connected systems are in use in modern rolling stocks. For example, computer systems for train control and monitoring, passenger information systems, Wi-Fi connections or communication systems are required. The use of 19" enclosures for standardized board sizes allow a modular design. This ensures that electronic modules can be exchanged quickly and easily. Elma offers the type 12K, designed for these modules. Tested for shock, vibration, humidity and temperature, the subrack secures the electronics in the rolling stock.

Benefits of the subrack type 12K

- › VME, VME64x or CompactPCI application (IEEE 1101, IEC 60297)
- › Rear I/O mounting option
- › Scalable EMC protection
- › All common heights and depths available as standard configurations
- › Recessed card mounting possible
- › Tested (vibration EN 60068-2-6, shock EN 60068-2-27, heat EN 60068-2-2, haze EN 60068-2-30, cold EN 60068-2-1, salt spray test DIN 50021)
- › Wide range of accessories and front panels



FRONT PANELS

FRONT PANEL CENTER

The control unit is the face of your device. The HMI (human machine interface) establishes the link between device, control or electronics and the operator. This is the most important interface to characterise a device. Besides aesthetics, a front panel needs to fulfil technical and user-specific requirements in its role as a control unit. Operation must be intuitive and the front panel must be abrasion- and scratch-proof. It has to meet EMC requirements and to support a variety of control elements.

Front panel design

Individually designed front panels are used in many applications:

- › Device front panels
- › Control panels
- › Call stations
- › Part of a cockpit
- › Systems diagrams
- › Labels



RAILWAY CABINETS

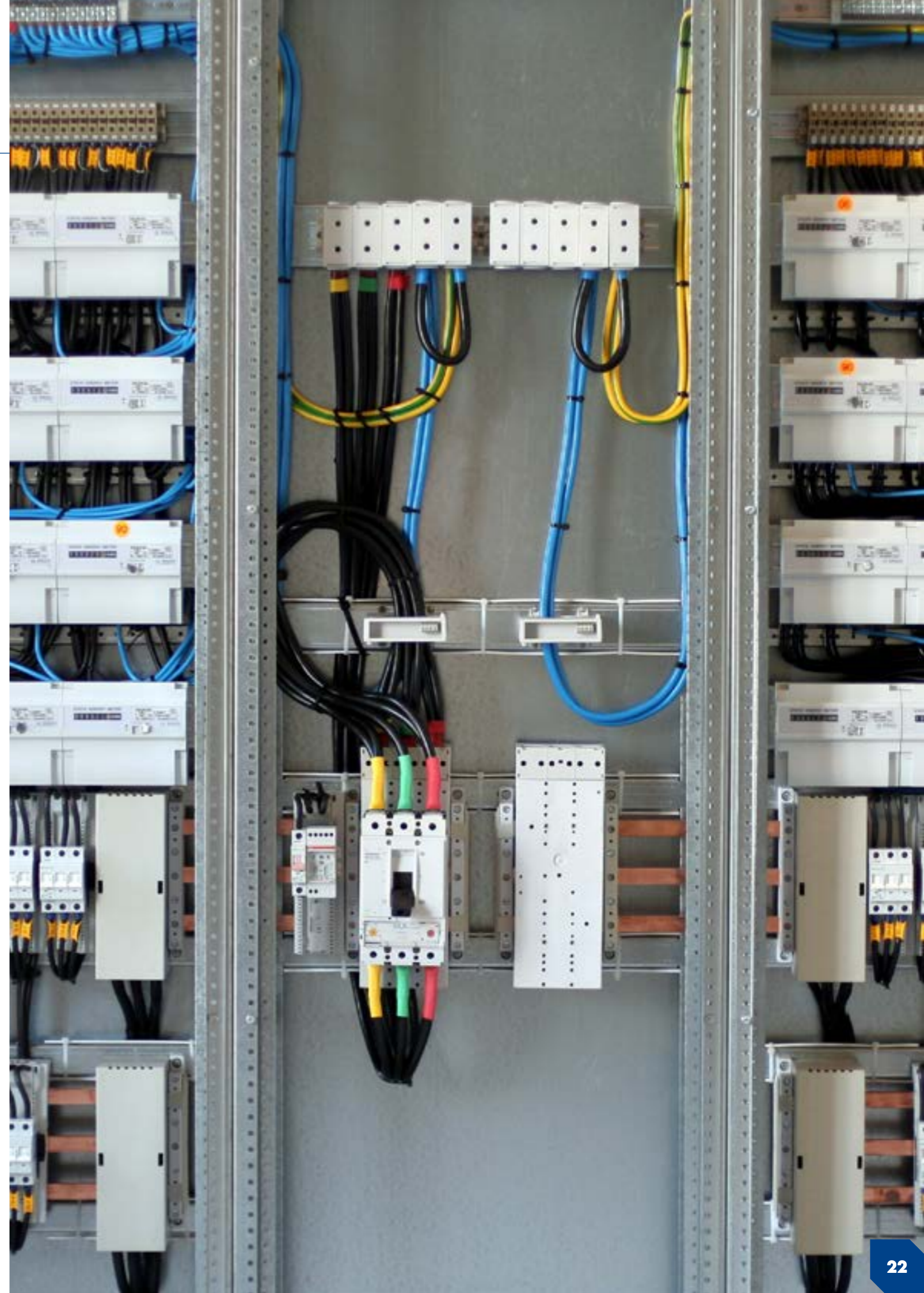
CABINET SOLUTIONS WITH THE TECHFRAME 40

The aluminium cabinet frame designed for railway applications does not require welding thanks to its clever corner connection. This allows us to build it directly to customer-specific dimensions and guarantees maximum flexibility even for small quantities. The enclosure frame was developed to meet the requirements of the railroad sector with regard to shock, vibration and corrosion in accordance with EN 50155.

Not only the enclosure frame is built to customer specifications. We also design and build the interior fittings and side panels according to the customer's requirements. Doors and hinged frames are available for ideal positioning of operating elements. This allows the cabinet to be optimally adapted to the individual vehicle equipment. Installation dimensions, fixing points, side panels and other specific features are defined on a project-specific basis and developed by our experienced design team. The interior fittings are specified by you or designed by our developers. This creates a 3D model that can be transferred to your environment. On request, we can calculate the load simulations with the appropriate finishing weight.

Production, assembly and interior fittings are executed in our own global production sites.

- › Perfect adaptation to the individual conditions of the vehicle
- › Vibration and shock resistance in accordance with EN 50155
- › Aluminum construction with low weight and high corrosion resistance
- › Individual, customer-specific dimensions with maximum precision



SERVICE IS A TOP PRIORITY

QUALITY CONTROL

Transforming customer requirements into a comprehensive product requires a high level of know-how and experience, commitment and pro-active contribution. Our interdisciplinary team of engineers, developers and designers create customized products up to series production. As our customer you will benefit from our rich experience gained in many projects.

Electronic development

Electronic and electrical engineers at all Elma locations are working on customized developments. We develop designs, create schematics, layouts, cable and circuit diagrams, package electronics in rugged enclosures and provide reliable heat dissipation.

We focus on our core competencies in power supplies, embedded boards, high voltage design, backplane and system engineering. When developing electronics, we observe all requirements of standards relating to EMC, ESD, safety, shock, vibration and ambient temperature right from the design stage. Our know-how is also evident from the fact, that many customers from the railway industry rely on our development competence and use devices designed by Elma in their applications.

Mechanical design

Thanks to compatible software, electronic and mechanical components can be virtually integrated with each other at will – even when designing cabinets, 19" racks, enclosure parts or front panels, or when integrating displays in fronts. Drawing on a variety of established designs, our design department will find the perfect solution for you. In collaboration with partner companies, we perform strength analyses and reliably assess shock and vibration behaviour in advance.

Thermal simulation

Electronic components are increasingly smaller and more powerful. Microprocessors with 100 W power loss are no longer uncommon. Without sufficient cooling, the service life of such components is dramatically reduced. Moreover, components in enclosures, racks or cabinets can heat each other up.

Using thermal analysis, critical configurations can be identified already in the design phase, before prototypes are built. This way enclosures may be perfectly adapted to actual environmental conditions of the kind prevailing in rolling stock.

Simulation software is used to visualize air flows based on CAD data and to identify critical hot spots. This reduces the risk of later thermal inconveniences and saves on development costs.



Source: Stadler Rail AG, KISS



Testing and validation

Every design, whether electronic or mechanical, passes through different project phases: Preliminary study, concept, design, realization, series introduction and completion.

We place great emphasis on regularly defined auditing as to whether the stage of development meets the originally set of requirements. State-of-the-art measuring equipment is available at all Elma locations to perform related tests. Where inadequate, we also collaborate with independent testing laboratories.

TRADE ASSOCIATIONS

KEY ASSOCIATIONS

Elma Electronic is a member of the UNIFE, SWISSRAIL, Rail Alliance, RSSI and APTA railway associations.



UNIFE is representing the interests of the European railway industry in Brussels since 1992. This association represents more than 100 major European companies and SMEs in the fields of development, production, maintenance and renewal of railway systems, sub-components and associated equipment.



Railway Systems Suppliers Inc. (RSSI) is a trade association serving the communication and signal segment of the rail transportation industry. RSSI continues to grow with over 280 member companies.



SWISSRAIL Industry Association is the association of the Swiss railway industry, with more than 140 members. They produce rolling stock and components and provide services for all forms of rail-bound transport.



American Public Transportation Association (APTA) plays a critical role in the management and development of national public transportation standards related to rail, bus, security and urban design. APTA has 27 working groups developing standards and best practice documents and several sub-working groups.



Rail Alliance is the English B2B network organization comprising large and small companies from the railway industry.

RAILWAY STANDARDS

KEY STANDARDS

There are a wide variety of worldwide standards that apply to railway systems. Elma works with their customers to ensure that products meet or exceed the required criteria. A few of the key European and U.S. standards are listed below.

Railway standards	
EN 50155	European standard for railway applications, rolling stock and electronic equipment
AREMA	American railway engineering and maintenance association
CENELEC	European Committee for Electrotechnical Standardization.
EN 45545	European standard for fire & safety on rolling stock
NFF 16-101	French fire test to railway components
NFPA130	Standard for fixed guideway transit and passenger rail systems (USA)

EN 50155

The European standard EN 50155 covers various railway-related requirements for electronic equipment on rolling stock. Relevant requirements for Elma products are listed below.

Onboard voltage (battery voltage)

The EN 50155 standard permits voltage fluctuations in the range from 0.6 to 1.4 Un on battery-powered onboard electrical DC systems.

Nominal 24 V	14.4 to 33.6 V
Nominal 28 V	16.8 to 39.2 V
Nominal 36 V	21.6 to 50.4 V
Nominal 48 V	28.8 to 67.2 V
Nominal 72 V	43.2 to 100.8 V
Nominal 96 V	57.6 to 134.4 V
Nominal 110 V	66.0 to 154.0 V

Surrounding temperature classes

The standard defines different temperature classes based on applications and environmental conditions to which the equipment is exposed.

OT1	(-25 to +55 °C)
OT2	(-40 to +55 °C)
OT3	(-25 to +70 °C)
OT4	(-40 to +70 °C)
OT5	(-25 to +85 °C)
OT6	(-40 to +85 °C)

Power interruptions

Short-circuits may cause short power outages on the on-board electrical DC system. The standard describes the requirements for onboard components as follows:

S1	No outage of the onboard power
S2	10 ms outage of the onboard power
S3	20 ms outage of the onboard power

Shock and vibration

The standard EN 50155 refers to EN 61373. Depending on location, the standard distinguishes three different categories.

Category 1 Class A	Components mounted right beneath the wagon body
Category 1 Class B	Components mounted inside an enclosure on or beneath the wagon body
Category 2	Components mounted on the bogie
Category 3	Components mounted on the axle

Protective coating of the printed circuit boards

PC1	PCB without protective coating
PC2	PCB with protective coating on both sides
PCX	According to separate requirements

RAILWAY STANDARDS

KEY STANDARDS

Electromagnetic compatibility

The standard EN 50155 refers to EN 50121-3-2.

Surge, ESD, transient and EMC requirements are listed in EN 50121-3-2:2016 (railway applications, electromagnetic compatibility, rolling stock and apparatus). Limit values for conducted radiation and immunity to interference are listed in the two tables below.

Emission	Test specifications	
Wired	150 kHz to 500 kHz	99 dBµV quasi-peak
	500 kHz to 30 MHz	93 dBµV quasi-peak
Broadcast	30 MHz to 230 MHz	40 dBµV quasi-peak
	20 MHz to 1 GHz	47 dBµV quasi-peak

Immunity	Test specifications		Performance criterion
Electrostatic discharge	Contact / air	6 kV / 8 kV	B
Electromagnetic field	80 MHz to 800 MHz	20 V/m	A
	800 MHz to 1'000 MHz	20 V/m	A
	1400 MHz to 2'000 MHz	10 V/m	A
	2000 MHz to 2'700 MHz	5 V/m	A
	5100 MHz to 6'000 MHz	3 V/m	A
Burst	5/50 ns 5 kHz	± 2 kVp	A
Surge	Cable to ground	± 2 kVp	B
	Line to line	± 1 kVp	B
Wired interference	150 kHz to 80 MHz	10 VAC	A

Criterion A stipulates that the equipment shall perform its function without restriction during and after the test. Criterion B indicates that the device must return to its normal function after completion of the test but may suffer performance degradation during the test.

EN 45545

The EN 45545 standard defines the requirements for fire testing of railway equipment. While EN 45545-1 specifies the operating and design categories of rolling stock products, EN 45545-2 specifies the requirements and tests for the individual products with reference to the operating conditions.

Function	Design category			
	N	A	D	S
	Standard train	Automatic train	Double-deck train	Sleeping coaches
1 trains on open track	HL1	HL1	HL1	HL2
2 tunnels up to 5 km	HL2	HL2	HL2	HL2
3 tunnels longer than 5 km	HL2	HL2	HL2	HL3
4 no lateral evacuation	HL3	HL3	HL3	HL3



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