



# Train Control and Management System

Smarter trains. Better future.





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# EKE-TRAINNET® TCMS PRODUCT FAMILY

**FOR NEARLY FOUR DECADES, EKE-ELECTRONICS HAS BEEN A TRUSTED SUPPLIER OF TRAIN CONTROL AND MANAGEMENT SYSTEM SOLUTIONS TO TRAIN MANUFACTURERS, OPERATORS, AND INTEGRATORS WORLDWIDE. USING OUR EKE-TRAINNET® MODULES, WE BUILD SOLUTIONS FOR SYSTEM INTEGRATION, TRAIN AUTOMATION, COMMUNICATIONS, DIAGNOSTICS, AND ENHANCED SAFETY.**

## PROVEN TRACK RECORD

EKE-Electronics work with some of the biggest train builders and operators earning the trust and loyalty of our returning customers. There are over 35,000 EKE-Trainnet® systems in operation around the world, serving our customers with unparalleled safety, performance and cost-effectiveness.

## WHY CHOOSE EKE-ELECTRONICS?

EKE-Electronics is a Finnish high-tech company based in Espoo, near Helsinki, specialising in Train Control and Management Systems (TCMS). Founded in 1986, we have nearly 40 years of experience in the railway industry. As a family-owned business with Mitsubishi Electric as a minority shareholder, we combine advanced electronics and software to enhance train operations worldwide.

### 01

#### BROAD PRODUCT FAMILY

EKE-Electronics offers a diverse portfolio spanning train control and management systems and SIL safety applications. Our expertise in these areas ensures robust, reliable performance across diverse railway environments, supporting enhanced safety, efficiency, and operational excellence.

### 02

#### FLEXIBLE BUSINESS MODEL

We understand that every project demands flexibility and customisation. That's why we offer a diverse range of project delivery options, including TCMS products, SIL Safety products, TCMS platform projects, TCMS turnkey projects, and solution projects. These allow you to choose the approach that aligns best with your capability and resource availability.

### 03

#### EXPERIENCED PEOPLE

Our team of experts brings a wealth of experience and unparalleled knowledge about both legacy and modern trains. This expertise enables us to build train control and management systems using our EKE-Trainnet® modules to the best meet the requirements for your vehicles.



# TRAIN CONTROL AND MANAGEMENT SYSTEM

**EKE-TRAINNET® TRAIN CONTROL AND MANAGEMENT SYSTEM EMBODIES DEPENDABILITY IN RAILWAY OPERATIONS. WITH A STEADFAST FOCUS ON SAFETY AND EFFICIENCY, OUR SOLUTIONS ENSURE ENDURING RELIABILITY FOR RAILWAY OPERATIONS WORLDWIDE.**

## WHAT IS A TRAIN CONTROL AND MANAGEMENT SYSTEM?

A Train Control and Management System (TCMS) oversees the supervision, control, and monitoring of onboard functions. Acting as the train's nerve centre, its primary goals are to enhance safety, optimise performance, and improve passenger experience by integrating various subsystems.



## WHY CHOOSE EKE-ELECTRONICS?

Our Train Control and Management System supports SIL 2 development, with some key modules already pre-certified. Its modular design allows you to select only the features you need, creating a cost-efficient, flexible, and versatile solution with a simplified architecture.

### 01

#### SIMPLIFIED ARCHITECTURE

By utilising a simplified Train Communication Network (TCN), the Train Control and Management System (TCMS) achieves a more efficient train architecture, significantly reducing development and maintenance costs. Our systems allow multiple applications to run on the same train computers, combining Gateway functionalities for a compact, cost-effective solution. Additionally, our TCMS offers comprehensive interfaces for seamless subsystem and TCN integration.

### 02

#### MODULAR APPROACH

Our modular approach allows seamless integration into our rack system, consolidating multiple products into one rack. This maximises space and efficiency, letting you create cost-effective systems. Designed for scalability, our systems can be easily upgraded with additional modules as your needs evolve.

### 03

#### FLEXIBLE OPEN-SOURCE SOFTWARE PLATFORM

Built on an open-source software platform (Linux), the TCMS is a powerful and highly flexible system. With our Software Development Environment Powered by CODESYS®, you have the freedom to develop your own applications and seamlessly integrate third-party hardware and software onto the platform.

In addition, we also support C/C++ and Matlab Simulink for development of SIL 2 software.



# WHAT DO WE OFFER?

EKE-Trainnet® Train Control and Management System offers a comprehensive suite of products.

## TRAIN CONTROL NETWORKS

Vehicle and train bus interfaces for train-wide information sharing that can interface with different types and generations of interfaces.

## TCN GATEWAYS

Train computers enabling translation between two protocols for efficient data flow from discrete networks.

## VEHICLE CONTROL UNITS

Train computers that manage the control of individual coaches or the entire train, ensuring efficient operation of all subsystems.

## REMOTE I/O SYSTEMS

Handle numerous signals and exchange data between different parts of the train and external systems.

## EVENT RECORDERS

Collect and store vital train borne information required for your specific needs or to meet regulatory compliance.

## SOFTWARE DEVELOPMENT

Develop your own software applications using our Software Development Environment, Powered by CODESYS®.

# HOW DOES IT WORK?

All train subsystems are integrated via a common communication network. The Train Control and Management System (TCMS) provides a single point of control over all train subsystems in the coach/consist.

The TCMS enables control and monitoring over almost any subsystem and function, for instance doors, brakes, PIS/PA and video surveillance, to name a few. Using a unique control and management system allows for a simplified Train Communication Network.

The train architecture is simplified, and costs are reduced resulting in simpler design, installation and maintenance, less cabling and more efficient programming. In addition, the centralised TCMS is used to automate train operations and subsystem diagnostics, enabling increased reliability and quicker response times.

It is the application software that determines the functionality of the TCMS. Our Software Development Environment Powered by CODESYS® is used to build the application software for the TCMS product.



*Train Control and Management System in standard rack*



*Train Control and Management System in flat rack*

# TRAIN COMMUNICATION NETWORKS

**EKE-TRAINNET® TRAIN COMMUNICATION NETWORK IS A SINGLE, FULLY INTEGRATED SYSTEM DESIGNED TO SIMPLIFY TRAIN MANAGEMENT SYSTEM ARCHITECTURE LEADING TO SIGNIFICANT SAVINGS.**

## WHAT IS A TRAIN COMMUNICATION NETWORK?

A Train Communication Network (TCN) facilitates information exchange throughout the train, using a Vehicle Bus for intra-vehicle communication and a Train Bus for train-wide connectivity. The TCN typically consists of interconnected train computers, or Gateways, linked to various subsystems.



## WHY CHOOSE EKE-ELECTRONICS?

Introducing our globally trusted Train Communication Network, designed for unmatched reliability and seamless integration. With support for your existing protocols and multiple bus technologies, our system offers a flexible and straightforward solution for your communication needs.

### 01

#### COMPATIBLE WITH YOUR PROTOCOL

A versatile solution that supports Train Real-Time Data Protocol (TRDP) and Safe Data Transmission v2 (SDTv2) - with v2 being essential for SIL 2 safety applications - is provided by the Train Communication Network. It can also interface seamlessly with your proprietary protocols, ensuring adaptability to meet your specific needs. With dual-homing capabilities incorporated, it provides enhanced reliability and performance.

### 02

#### MULTIPLE BUS TECHNOLOGIES

Enabling the simultaneous use of multiple bus technologies—including Ethernet, WTB, MVB, CAN, and Serial Links—the Train Communication Network is ideal for both new and refurbished trains. This flexibility allows a customised, cost-effective system with a single integrated network or multiple independent networks, seamlessly connecting all train subsystems.

### 03

#### SIMPLIFIED INTEGRATION

Train subsystems often lack interoperability, using separate communication networks and technologies, leading to complex architecture and excess wiring. EKE-Trainnet® Train Communication Network allows for a single, fully integrated system compatible with customers' protocols, simplifying train management and reducing costs. Customers can freely develop their own applications using our Software Development Environment Powered by CODESYS®.



# WHAT DO WE OFFER?

At EKE-Electronics, we specialise in Train Communication Network solutions that optimise reliability, efficiency, and control, empowering you to achieve maximum performance and flexibility in rail operations.

## REDUNDANT TRAIN COMMUNICATION NETWORKS

Creating a redundant Train Communication Network guarantees uninterrupted operation by establishing alternative communication paths in case of network failures. This eliminates single points of failure, maintaining operations during malfunctions. It prevents train immobilisation, guaranteeing accessibility to functionalities at all times. Enhanced reliability, heightened safety, and long-term cost savings are among the primary benefits of redundancy. EKE-Electronics offers redundant network solutions for both fixed and dynamic train configurations, ensuring robust performance and peace of mind.

## AUTOMATIC TRAIN INAUGURATION

EKE-Trainnet® train bus technologies, including Wire Train Bus (WTB) and Ethernet Train Backbone (ETB), enable seamless automatic inauguration for efficient train operations. While the Multifunction Vehicle Bus (MVB) traditionally lacks automatic inauguration, EKE-Electronics has developed a solution to dynamically configure trains using the MVB as a backbone. For fully fixed train sets, the Train Communication Network offers a cost-effective solution that does not require a dynamic train bus, optimising both performance and budget.

## DECENTRALISED TRAIN MANAGEMENT

The EKE-Trainnet® Train Communication Network enables you to create a centralised system with complete control across the entire network, accessible from any location. Unlike traditional systems that rely on a single central computer for applications and event logs, the Train Communication Network distributes key information and instructions across the network. Each car can independently run its own applications, logging faults and alarms, ensuring that in the event of a computer failure, the functionality and logs of other coaches remain intact. This decentralised approach enhances system reliability and minimises downtime.

# HOW DOES IT WORK?

The Train Communication Network connects all the train subsystems together via a common network (or several when requested), enabling centralised control.

In practice, the TCN consists of train computers, commonly referred to as Gateways, connected to each other as well as to train subsystems.

When designing a Train Communication Network, the following should be considered.

1. **Type of redundancy required:** Dynamic and fixed train confirmation require different types of redundant network.
2. **Train bus technology required:** Traditionally, the highly standardised Wire Train Bus (WTB) technology is used as a train. Ethernet Train Backbone (ETB) provides larger bandwidth and more flexible networks. MVB or CAN can also be used to develop train-wide communication networks.
3. **Vehicle bus technology required:** EKE-Trainnet® Gateways support multiple interface technologies including WTB, MVB, CAN, Serial Links and Ethernet.



*EKE-Trainnet® System*



*EKE-Trainnet® Redundant System*

# TCN GATEWAYS

## COMPLIANCE

IEC 61375 Series  
IEC 61131  
EN 50155  
EN 45545

**OUR TCN GATEWAYS EMPOWER YOU WITH UNPARALLELED FLEXIBILITY. WITH THE ABILITY TO COMBINE MODULES FOR A VERY FLEXIBLE AND VERSATILE SOLUTION. CHOOSE THE INTERFACES AND FUNCTIONS REQUIRED FOR YOUR SPECIFIC NEEDS.**

## WHAT IS A TCN GATEWAY?

A TCN (Train Communication Network) Gateway is a critical component of a train system. It is a train computer that acts as a convertor, between two protocols, allowing data to flow from various subsystems using different bus protocols to ensure that they work together seamlessly.



## WHY CHOOSE EKE-ELECTRONICS?

EKE-Electronics' commitment to reliability and quality ensures that our TCN Gateways deliver superior performance and integration options.

### 01

#### MODULAR CONCEPT

With a variety of CPUs, power supplies, and bus interface modules, our TCN Gateways offer versatility and efficiency through a modular design. Our module concept allows for the precise selection of train and vehicle bus technologies, ensuring cost-effectiveness and customisation.

### 02

#### ADAPTABILITY

EKE-Trainnet® TCN Gateways are renowned for its adaptability, enabling seamless integration of subsystems with different communication protocols. These gateways allow application software to control subsystem functions, running on the same train computers for a compact, cost-effective solution. Additionally, with the right modules, TCN Gateways can serve as a multifunctional vehicle control unit, enhancing operational efficiency.

### 03

#### EASE OF USE

Ease of use is a key factor when choosing the right TCN Gateway for your vehicle and EKE-Trainnet® TCN Gateways are designed to prioritise user-friendly operation. They have interface connectors at the front and communicate with each other via the backplane, which includes a VME bus. Mechanical coding of DE-9 connectors is available as an option.



# WHAT DO WE OFFER?

EKE-Trainnet® TCN Gateways can combine some or all of the following bus technologies, as your needs require.

## TRAIN BUS TECHNOLOGIES

### Wire Train Bus Interface Module (WTB)

The WTB interface usually has two DE-9 connectors with redundant lines integrated in each connector. A version with 4 connectors is available as an option.

## VEHICLE BUS TECHNOLOGIES

### Multifunction Vehicle Bus Interface Module (MVB)

The MVB physical medium can be ESD+ or EMD. ESD+ and EMD have two DE-9 connectors with redundant lines integrated into each connector. The MVB can also be used as a train bus.

### CAN Vehicle Bus Interface Module (CVB)

The CAN module has two DE-9 connectors and is used to create up to two CAN buses. The 2 CAN ports can be independently configured as CAN 2.0 A/B or CANopen®.

### Serial Links Interface Unit (SIU)

Serial Links interfaces can be used to create Vehicle Buses even though they are commonly used for direct connection to sub-systems. The RS-485 and RS-422 physical layers are supported. Modbus and customised protocols can be used.

## ETHERNET TECHNOLOGIES

### Ethernet Consist Network (ECN)

An ECN can function as both a vehicle bus and a train bus for fixed consists. Ethernet Switches, such as the ERU, 3U ESU, and 1U ESU models, can be used to create ECNs if needed. Additionally, the 1U ESU modules offer Power-over-Ethernet (PoE) as an option, allowing power to be supplied to connected subsystems via Ethernet cables.

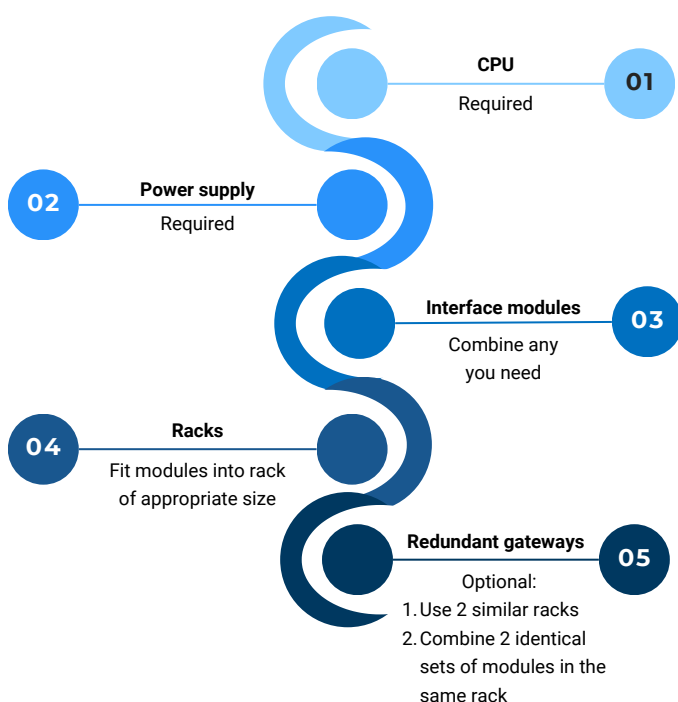
### Ethernet Train Backbone (ETB)

The ETB is implemented using the ERU module, which functions as both an Ethernet switch and router. The ERU module provides 10 Ethernet ports, with 4 ports dedicated to the ETB, featuring redundant lines for enhanced reliability.

# HOW DOES IT WORK?

EKE-Trainnet® Gateways are the most versatile on the market. You can freely combine modules to obtain exactly the interfaces and functions that you need.

EKE-Trainnet® modules can be easily combined for a compact and efficient gateway.



TCN Gateway with CAN Interfaces



TCN Gateway with Ethernet Switches



TCN Gateway with Ethernet Switches

# VEHICLE CONTROL UNITS

**BACKED BY DECADES OF EKE-ELECTRONICS SUPPORT AND A PROVEN TRACK RECORD OF RELIABILITY, OUR VEHICLE CONTROL UNIT IS THE TOP CHOICE FOR SEAMLESS OPERATION IN EVOLVING RAIL NETWORKS, OFFERING ADVANCED CONTROL AND DIAGNOSTICS ACROSS VARIOUS SUBSYSTEMS.**

## WHAT IS A VEHICLE CONTROL UNIT?

A Vehicle Control Unit (VCU) is a programmable device crucial for smooth train operations, managing and interfacing with various train functions. It interacts with subsystems, performs automatic system functions, executes programmable control applications, interfaces with the Train Communication Network (TCN), monitors and controls train operations, and responds to driver inputs.



## WHY CHOOSE EKE-ELECTRONICS?

Transform your rail operations with the EKE-Trainnet® Vehicle Control Unit, which supports SIL 2 development. Our modular approach builds solutions selected from our range of EKE-Trainnet® modules, while our integration expertise and advanced diagnostics ensure exceptional performance and reliability.

### 01

#### MODULAR DESIGN AND CUSTOMISATION

EKE-Trainnet® Vehicle Control Units are built using a selection of EKE-Trainnet® modules to best meet your requirements. The open platform, supported by our Software Development Environment powered by CODESYS®, enables you to build and manage your own applications.

### 02

#### INTEGRATION KNOW-HOW

With nearly four decades of expertise, EKE-Electronics excels in integrating vehicle control units. This deep experience ensures EKE-Electronics understands the complexities of integrating control units across diverse vehicles, delivering superior solutions that meet our customers' needs and challenges. Customers can trust our proven track record and comprehensive understanding to provide efficient, effective, and reliable solutions.

### 03

#### ADVANCED CONTROL AND DIAGNOSTICS

Controlling various train subsystems such as brakes and doors, the EKE-Trainnet® Vehicle Control Unit manages both physical functions (like door operations and HVAC activation) and diagnostics (such as door status and brake temperature). These applications can run on the same train computers used for TCN Gateway functions, providing a compact and cost-effective solution. Alternatively, separate TCN Gateways can be deployed if needed.



# WHAT DO WE OFFER?

At EKE-Electronics, we provide customised Vehicle Control Units for modern rail systems, ensuring seamless integration and optimal performance to keep operations smooth and reliable.

## COMPREHENSIVE CONNECTIVITY OPTIONS

Seamlessly integrating with subsystems and the Train Communication Network, the Vehicle Control Unit supports a range of bus technologies, including WTB, MVB, CAN, Serial Links, and Ethernet.

Flexible connectivity options are enhanced by a wide array of Remote Input/Output Modules, such as

- o Analogue Input
- o High-Speed Analogue Input
- o Digital Input/Output
- o Digital Relay Output
- o Analogue Output
- o Pt-100 Temperature Sensor Input.

## FLEXIBLE SYSTEM

The EKE-Trainnet® Vehicle Control Unit is a robust and highly adaptable system based on an open-source Linux platform. It offers unparalleled flexibility, allowing you to develop custom applications and seamlessly integrate third-party hardware and software.

Utilising our Software Development Environment Powered by CODESYS®, you have the capability to create and customise applications. For more advanced control, applications can be developed and configured using the C language, ensuring comprehensive oversight.

## EXTENSIVE SOFTWARE APPLICATION EXPERTISE

At EKE-Electronics, we specialise in delivering application software solutions that align with your unique business needs. Whether you're looking to outsource the entire development process or require assistance with specific components, our expert team is here to help.

Prefer to keep development in-house? We offer tailored training programs and expert guidance to empower your team to achieve their goals with confidence.

Moreover, EKE-Electronics provides the option to secure full intellectual property rights (IPR) for the software we develop, ensuring your investment is protected for the long term.

# HOW DOES IT WORK?

The EKE-Trainnet® Vehicle Control Unit functions as a central control point and ensures that all components of the train work in harmony, enabling safe and efficient operation.

Train borne data is collected and analysed from onboard sensors, actuators and other train data i.e. from apparatus, equipment, instrument, etc..

Based on the analysis, the Vehicle Control Unit connects to the Train Communication Network and performs train controlling and diagnostic functions.



*Vehicle Control Unit with CAN and Digital Input/Output Interfaces*



*Redundant Vehicle Control Unit with MVB and various Digital Input/Output Interfaces*

# REMOTE INPUT/ OUTPUT SYSTEM

**EFFICIENT DATA INPUT AND OUTPUT MANAGEMENT WITH SUPPORT FOR ANALOGUE AND DIGITAL INPUTS/OUTPUTS, MINIMISES CABLING COMPLEXITIES WHILE ENSURING FLEXIBILITY AND OPTIMISED SYSTEM PERFORMANCE.**

## WHAT IS A REMOTE/INPUT OUTPUT SYSTEM?

A Remote Input/Output System is a component of the train's control and management system (TCMS) that extends the number of available I/O channels of the TCMS. It connects and manage various sensors and controls throughout a train and allows these components to communicate with the train's main computer without needing a lot of wiring.



## WHY CHOOSE EKE-ELECTRONICS?

EKE-Trainnet® Remote Input/Output System is engineered for excellence in rail technology, supporting SIL 2 development. Our system is designed to seamlessly integrate into your operations, providing the reliability and advanced capabilities needed for efficient and effective control.

### 01

#### VERY HIGH I/O DENSITY

Designed with a very high I/O density, the EKE-Trainnet® Remote Input/Output System accommodates numerous signals within a compact space. In a standard 3U, 84TE rack, it can include up to 576 digital input/output channels (18x32ch). This high density is crucial for high-speed trains and Electric Multiple Units (EMUs), offering space-saving benefits, a decentralized network architecture, and simplified I/O cabling, which ultimately reduces costs.

### 02

#### SUPPORT FOR SEVERAL VEHICLE BUSES

Supporting multiple vehicle buses, the EKE-Trainnet® Remote Input/Output System excels by managing several identical or different buses simultaneously. This capability simplifies the train design process, allowing for a more streamlined and efficient system architecture. By integrating various buses into a single solution, our system enhances flexibility and reduces complexity, making it an ideal choice for modern rail applications.

### 03

#### DUAL HOMING WITH TRDP

EKE-Trainnet® Remote Input/Output System features dual-homing with Train Real-Time Data Protocol (TRDP), ensuring unparalleled reliability and continuity. This dual-homing capability provides redundant pathways for data communication, safeguarding against potential failures and enhancing system stability. Ideal for high-speed and critical applications, this feature ensures uninterrupted performance and dependable operation for your train systems.



# WHAT DO WE OFFER?

EKE-Trainnet® Remote Input/Output Systems offers a wide range of I/O modules.

## DIGITAL INPUT/OUTPUT MODULES

### Digital Input/Output Module (DIO)

- 24 Input channels
- 8 input/output channels

### Digital Relay Output Module (DRO)

- up to 8 relay outputs

### Digital Solid State Outputs (DSO)

- 8 solid state outputs (only available by request)

## ANALOGUE INPUT/OUTPUT MODULES

### Analogue Input Module (AIM)

- 10 voltage channels
- 10 current channels

### Analogue Input Module (AIO)

- up to 16 voltage channels

### Analogue Output Module (AOM)

- 16 output channels (in 4 groups of 4 isolated channels)

### High Speed Analogue Input Module (HSA)

- 4 voltage channels
- 4 current channels

## TEMPERATURE SENSOR INPUT MODULES

### Pt100/Pt1000 Temperature Sensor Input Module (PTI)

- up to 6 measurement channels

### Temperature Sensor Input Module (TSI)

- up to 6 measurement channels

# HOW DOES IT WORK?

The Remote Input/Output system on a train is designed to extend the reach of the train control and management system by extending the number of available physical (or hard-wired) I/O-channels of the (TCMS) system to allow the integration of various sensors and actuators distributed throughout the train.

The train is equipped with multiple Remote Input/Output Systems placed in different locations, resulting in a decentralised network architecture design.

1. **Signal processing:** The Remote I/O modules convert the analogue signals from various sensors and devices into digital data. They can also handle digital inputs directly from other subsystems.
2. **Communication with controller unit:** The processed data from the Remote I/O modules is transmitted to the controller unit over MVB or Ethernet bus interface. There is no need for a dedicated processor module.
3. **Redundancy and Reliability:** Redundancy is often built in with the Remote Input/Output System ensuring that if one module fails, others can take over.



*Ethernet Remote Input/ Output System*



*MVB Remote Input/ Output System*

# EVENT RECORDERS

**A RANGE OF EVENT RECORDERS DESIGNED TO CAPTURE AND STORE CRITICAL ON-BOARD DATA, ENSURING COMPREHENSIVE MONITORING OF SAFETY-CRITICAL INFORMATION.**

## WHAT IS AN EVENT RECORDER?

An Event Recorder, often referred to as a “train black box” is an on-board data recorder for collecting and storing a wide array of operational data related to the train's performance and activities. The primary purpose of the event recorder is to capture and store critical information that can be used for accident investigation, safety analysis, and operational reviews.



## WHY CHOOSE EKE-ELECTRONICS?

Capture a wide range of analogue and digital signals with EKE-Trainnet®'s Event Recorders. Customisable to record only the signals you need, they help you avoid unnecessary data capture and storage costs. Additionally, they are designed to support SIL 2 development.

### 01

#### CHOOSE ONLY THE SIGNALS YOU NEED

With a modular design, EKE-Trainnet® Event Recorders provide the flexibility to select and record only the signals you need. This approach ensures that you capture precisely the data required for your specific needs and regulatory compliance, avoiding unnecessary data capture and storage. By focusing only on essential signals, you not only streamline your data management but also potentially reduce costs associated with excess storage and processing.

### 02

#### FUTURE PROOFING

Designed with future-proofing in mind, EKE-Trainnet® Event Recorders allow you to invest in a core system and easily add modules as new technologies or data points become relevant. This modular approach ensures that your recording system evolves with advancements in technology, keeping you ahead of the curve. By expanding your system as needed, you protect your investment and ensure long-term relevance and adaptability to emerging requirements.

### 03

#### OPEN DATA POLICY

EKE-Electronics maintains an open data policy, facilitating effortless data retrieval via Ethernet and USB connection, enabling seamless import and export into other systems. Our Train Inspection Program analyses train data, enabling visualisation and interpretation. Perform routine system performance analysis and optimise train operations, as well as in-depth analysis following any incidents.



# WHAT DO WE OFFER?

EKE-Electronics offers three types of event recorders which can be built to capture precisely the data required for your specific needs and regulatory compliance, avoiding unnecessary data capture and storage.

## NON-RUGGED EVENT RECORDER

The EKE-Trainnet® Non-rugged Event Recorder uses our standard input/output modules and is programmed to record safety critical information like train speed, train position or brake temperature.

The Non-rugged Event Recorder can also record video streams from onboard digital video recorders or directly from the cameras.

## RUGGED EVENT RECORDER

The EKE-Trainnet® Rugged Event Recorder contains the EKE-Trainnet® Rugged Memory Module. This crash-proof construction guarantees that the memory board is protected against fire, magnetic fields and any liquids, as well as against any mechanical stress during an impact or continued pressure.

In practice, the memory board is embedded in a protected fire insulation block, surrounded by a special steel case that is hermetically sealed.

## JURIDICAL RECORDING UNIT

The EKE-Trainnet® Juridical Recording Unit has all the features of other EKE-Trainnet® Event Recorders and complies with the ERTMS/ETCS standard.

The Juridical Recording Unit can record data from the ETCS (i.e. European Vital Computer, EVC) and/or from nation-specific control systems (i.e. Specific Transmission Module, STM).

# HOW DOES IT WORK?

Train event recorders on trains function in a similar way to the "Black Box" on aircraft. They are critical for safety and operational analysis, recording key data about the train's operation.

1. **Continuous data recording:** Continuous on-time data recording ensures data integrity and ease of analysis. The logging interval can be selected for each signal and/or at the time of state change.
2. **Data protection:** The Rugged Event Recorder and the Juridical Recording Unit include the Rugged Memory Module which enables data to be stored in a secure, fire insulated block. Its crash-proof construction guarantees that the memory board is protected against fire, magnetic fields, liquids and mechanical stress during an impact or continued pressure.
3. **Data storage:** The recorded data is typically stored in a cyclic manner, meaning the oldest data is overwritten by the newest data after a certain period unless a significant event (like an accident) triggers the system to lock the data to prevent overwriting. With flexible memory capacity options and optimised memory allocation, the system ensures sufficient event data storage for several months, depending on the number of recorded signals.
4. **Data retrieval:** In the event of an incident, data can be downloaded via Ethernet or USB connection. The Train Inspection Program can then assist in analysing the retrieved data.



*Non-Rugged Event Recorder with digital and analogue I/O, tachometer input, temperature sensor input and interfaces for CAN and MVB bus*



*Rugged Event Recorder with digital and analogue I/O, tachometer input, temperature sensor input and interfaces for CAN and MVB bus*



*Juridical Recording Unit with MVB interfaces*

# REMOTE DIAGNOSTICS

**COLLECT AND ANALYSE DATA FROM THE EKE-TRAINNET® TRAIN CONTROL AND MANAGEMENT SYSTEM TO UNDERSTAND FLEET STATUS AND MAKE DATA-DRIVEN DECISIONS REGARDING OPERATIONS AND MAINTENANCE BASED ON ACTIONABLE INFORMATION.**

## WHAT IS REMOTE DIAGNOSTICS?

Remote Diagnostics is the process of monitoring various components and systems of a train to assess their health, performance, and potential for failure. The goal is to ensure safe, efficient, and reliable operation by detecting potential issues before they lead to failures or disruptions.



## WHY CHOOSE EKE?

For EKE-Trainnet® Train Control and Management System (TCMS) customers, we offer SmartVision™ Remote Diagnostics, enabling quick and easy extraction of event and time-series data to monitor the health of the train and its subsystems.

### 01

#### REMOTE DIAGNOSTICS BASED ON TCMS DATA

With real-time access to performance metrics and system health reports, SmartVision™ Remote Diagnostics empowers you to proactively identify and address potential issues before they escalate into critical problems. This capability minimises downtime and maximises efficiency, ensuring your fleet run smoothly and reliably. With in-depth insights into your fleet's operations, you can make more informed and strategic decision-making helping you to optimise resource allocation and improve overall fleet management.

### 02

#### OPEN DATA POLICY

EKE's open data policy is designed to provide seamless access to measured data via the SmartVision™ user interface. This approach allows users to effortlessly view and interact with data, enhancing their ability to make informed decisions. For those who require more detailed analysis, SmartVision™ also offers the option to download raw signal data. This data can be exported and examined using your preferred analytical tools, giving you greater flexibility and control over your data analysis process.

### 03

#### SECURE UPDATE MANAGEMENT

Our Train Software Management System offers a secure way to manage, transfer and activate updates to your the EKE-Trainnet® equipment. The packages are automatically transferred to the entire fleet while the train is at the depot, with users notified when the transfers are complete, allowing them to focus on other tasks. The Train Software Management System provides a high level of granularity both for user and package (version) management.



# WHAT DO WE OFFER?

SmartVision™ Remote Diagnostics provides a set of tools designed to support improved operational efficiency.

## FLEET & TRAIN OVERVIEW

Our fleet overview provides real-time insights into the health and status of your entire fleet, enabling quick reactions when problems occur.

The Train Overview provides insights into active events, event history logs, and quantitative information about alarms, warnings, and indicators. Users can also view real-time situational data, such as speed and destination, when the train is online.

## ACTIONABLE INFORMATION

The system is able to provide actionable information, giving operational and maintenance teams additional information about the next steps to take based on the event identified. These actions are set by the customer according to their internal process.

Advanced event analysis tools allow users to filter, chart, and visualise event data, including heatmaps and interactive charts. Export functionality supports further analysis.

## DRIVER'S DISPLAY

A driver's display feature that provides real-time information for train operators can be incorporated into SmartVision™.

When the train is connected to SmartVision™, the driver's display mirrors the Human-Machine Interface (HMI) used by the driver's display, offering a view of the train's status and operations. This feature allows operators to monitor various aspects of the train, including speed, destination, and module health indicators, without affecting the state of the train.

# HOW DOES IT WORK?

The SmartVision™ Data Acquisition Gateway collects data from the EKE-Trainnet® Train Control and Management System. Such data typically includes process and message data giving an overview of the status of the train.

1. **Collect data:** Diagnostics data is collected from the EKE-Trainnet® Train Control and Management System.
2. **Transmit data:** The measurement data is then sent to the cloud for processing via cellular/Wi-Fi.
3. **Analyse data:** Advanced diagnostics takes place on the cloud.
4. **Present results:** The user is notified of alerts and warnings via a browser-based interface.



Example of SmartVision™ Remote Diagnostics user interface showing train status



Example of SmartVision™ Remote Diagnostics with driver's display

# BUILD YOUR OWN APPLICATIONS

WHETHER YOU PREFER TO DEVELOP IN-HOUSE OR RELY ON OUR EXPERTISE, EKE-ELECTRONICS OFFERS THE TOOLS AND SUPPORT TO HELP YOU SUCCEED. WITH POWERFUL TOOLS FOR CUSTOM APPLICATION DESIGN AND SEAMLESS THIRD-PARTY INTEGRATION, YOU RETAIN FULL CONTROL OVER YOUR TRAIN CONTROL SYSTEMS.

## WHAT IS A SOFTWARE DEVELOPMENT ENVIRONMENT?

A software development environment is designed to facilitate the development of software applications. It provides programmers with the necessary tools, features, and resources needed to write, test, debug, and deploy software efficiently.



## WHY CHOOSE EKE-ELECTRONICS?

EKE-Electronics offers a flexible TCMS development platform that supports both in-house and supported approaches. We can train your engineers to build and manage software applications independently or deliver a complete, ready-to-use solution. With powerful tools for custom application design and seamless third-party integration, you retain full control over your train control systems.

### 01

#### POWERED BY CODESYS®

Our Software Development Environment is powered by CODESYS® - the state-of-the-art, software-based Programmable Logic Controller (PLC) that enables you to create advanced train control applications and distributed control systems. It offers a combination of a highly efficient and robust runtime environment as well as an intuitive and productive application development environment (Workbench). The Workbench has extensive monitoring and debugging features and supports simulation and online changes for rapid development.

### 02

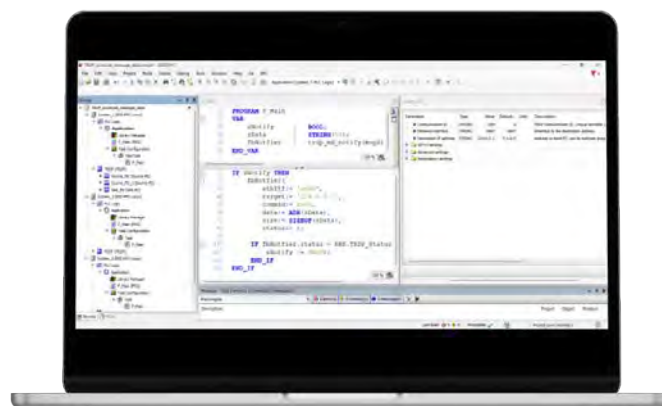
#### SUPPORTED LANGUAGES

Featuring robust language support, the Software Development Environment Powered by CODESYS® accommodates a wide range of programming needs with options like Function Block Diagram, Structured Text, Continuous Function Chart, Ladder Logic Diagram, Sequential Function Chart, and Instruction List. For even greater control, it also allows development and configuration in C language. This comprehensive flexibility ensures you can develop and customise applications precisely to your requirements, enhancing both efficiency and adaptability.

### 03

#### INTELLECTUAL PROPERTY RIGHTS AVAILABLE

EKE-Electronics can grant you the intellectual property rights (IPR) of the application software in order to ensure you a safe, long-term investment. In addition, EKE-Electronics has the expertise to develop all or a part of the software for you, or alternatively provide training, tools and guidance to support your own developments.



Example user interface from Software Development Environment  
Powered by CODESYS®

# PORTABLE SYSTEM TESTER

**A SINGLE ACCESS POINT TO ALL COACHES WITHIN A TRAIN SET, ALLOWING USERS TO PERFORM TASKS SUCH AS DOWNLOADING EVENT HISTORY DATA, SETTING OPERATIONAL PARAMETERS, AND ACCESSING SYSTEM DIAGNOSTICS WITH EASE.**

## WHAT IS A PORTABLE SYSTEM TESTER?

A Portable System Tester is a software tool used to download event history data to perform diagnostics. It also enables configuration setting of TCN Gateways and train computers.



## WHY CHOOSE EKE-ELECTRONICS?

Choose versatility with the Portable System Tester. A versatile software tool designed for the diagnostics and configuration of train gateways and computers, providing a single access point for comprehensive management across all coaches.

### 01

#### CUSTOMISABLE EXPERIENCE

Offering a highly customisable experience, the Portable System Tester is designed to meet the unique requirements of each project. With features driven by customer needs, users have the flexibility to configure operational parameters for the Train Computer, including time, coach number, and wheel diameter. They can easily monitor the status of I/O channels and TCMS links, as well as access system faults and event logs for diagnostic purposes.

### 02

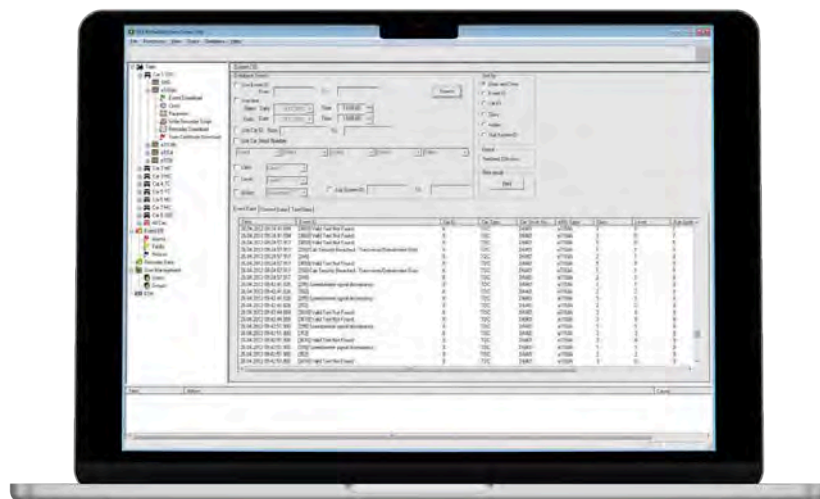
#### PEACE OF MIND

Protected against unauthorised use, the Portable System Tester employs usernames and passwords for secure access. Users can be arranged in groups that have different permissions to access the data. Selected functionalities can be granted to staff members according to their role (e.g. administration rights or different level of maintainer roles with read/write rights or read only possibility).

### 03

#### BUILT-IN FEATURES

Built-in features for examining data are provided by the Portable System Tester. The tool also supports the integration of HTML files for user and maintenance documentation and offers options to create specialised reports for events like test results and maintenance alerts.



*Example user interface from Portable System Tester*

# TRAIN INSPECTION PROGRAM

TRANSFER AND ANALYSE DATA FROM EKE-ELECTRONICS EVENT RECORDERS, ENABLING REAL-TIME MONITORING, CUSTOMISABLE VISUALISATION, AND COMPREHENSIVE REPORTING.

## WHAT IS A TRAIN INSPECTION PROGRAM?

A Train Inspection Program is a software tool used for the transfer and analysis of data recorded in the EKE-Trainnet® Event Recorder.



## WHY CHOOSE EKE-ELECTRONICS?

Transfer and analyse data recorded in the EKE-Trainnet® Event Recorder easily with the Train Inspection Program. The tool allows for the visualisation, analysis and printing of the records, as well as real-time train monitoring.

### 01

#### EASE OF USE

Versatile data displays, including graphical, numerical, and signal views, are offered by the Train Inspection Program, tailored to your needs. Quickly locate key points in data logs, customise views, and archive Event Recorder data for later analysis. The Train Inspection Program can display multiple data files simultaneously, aiding in comparisons and trend identification, ensuring you have the insights to improve train operations and safety.

### 02

#### ONLINE MONITORING

An online monitoring feature allows the Train Inspection Program to monitor any selection real-time tracking of selected signals in the car without interfering with the Event Recorder's normal operations. Under all conditions, the Train Inspection Program ensures that your data is kept confidently with the highest levels of integrity.

E

### 03

#### THIRD PARTY APPLICATIONS

The data can also be exported to a third-party application as the data can be converted to an open format (CSV file).



Example user interface from Train Inspection Program

# NOTES

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