EKE

Solutions for smarter trains

INTEGRATION   **AUTOMATION**   **COMMUNICATION**   **SAFETY**

Meeting the challenges
of modern train
management systems

Modern trains are equipped with an increasing number of intelligent sub-systems to cope with the demands for improved performance, safety, energy efficiency and comfort. This evolution brings a number of challenges to train manufacturers, operators and system integrators. For instance, the lack of interoperability and integration between the different sub-systems may lead to a complicated system architecture and various technical challenges.

We can say that the higher the number of separate sub-systems on-board, the higher the costs for train design, manufacturing, operation, maintenance and refurbishment.

EKE developed Trainnet® to be a versatile and comprehensive answer to all these challenges. Trainnet® is what we would like to call a "Super TCMS", a Train Control and Management System that is fully capable of integrating all communication and safety enhancing systems such as PIS/PA, Event Recorders, HMI, GPS, 3G/WIFI and CCTV.

The Trainnet® TCMS can interact with other on-board sub-system and provide you with additional features such as centralized control and diagnostics. The idea behind Trainnet® is to provide a single platform for the integration and automation of all train-borne intelligent systems.

The Trainnet® concept enables us to offer an open, flexible, and cost-effective solution for any train. We provide you with turnkey integration services making your life easier.

Contents

Products

The product section presents EKE's technologies for train automation, system integration, onboard communication and increased safety. All the products are part of the Trainnet® family and use the same modular platform for maximum freedom and synergy.

Applications

The application section gives some examples of functions and developments possible with Trainnet® products. It covers safety applications as well as Software for improved train management and operations.
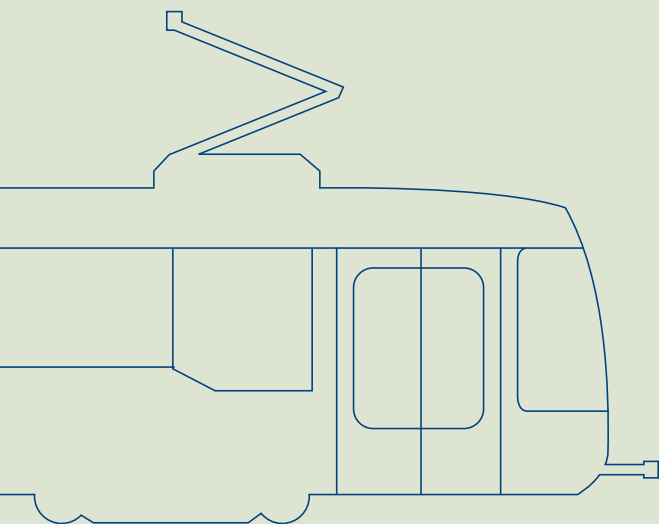
Modules

The module section provides advanced technical information about most commonly used Trainnet® modules: please contact us for further needs. Please note Trainnet® modules can only be used as part of Trainnet® Products.

Technology for smarter trains

EKE provides leading technologies to train manufacturers, operators and integrators for improved train manufacturing and operations.

We provide tailored solutions for system integration, train automation, train communications and improved safety. We have solutions for high speed trains, commuter trains, metros, trams, passenger coaches and locomotives.

We are the experts for Train Control and Management Systems (TCMS), Train Communication Networks (TCN), Vehicle Control Units (VCU), Gateways, Ethernet Train Backbones (ETB), Ethernet Switches and Event Recorders.

Our expertise ranges from developing complete turnkey solutions to providing specific Hardware and Software products. We can also provide training, tools and guidance to support your own developments.

EKE is IRIS certified and our products comply with the International Railway Industry Standards such as EN 50155.

INTEGRATION
Integrate on-board systems *via* an efficient and versatile Train Communication Network (TCN). Hybrid networks are also supported.

AUTOMATION
Automate operations and diagnostics by developing a powerful Train Control and Management System (TCMS).
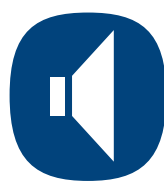
COMMUNICATION
Communicate with passengers and staff in the train and beyond *via* displays, audio announcements and wireless technologies.

SAFETY
Improve safety with our SIL technology, redundancies and safety enhancing systems such as Event Recorders and video surveillance.

Our promises

PERFORMANCE
→ Most advanced technology…
   … that works together with older technology!
→ Improved train operation reliability and safety
→ Improved comfort and services to passengers

FLEXIBILITY
→ Modular systems matching both your current and future needs
→ Open platform and open standards for easy and unrestricted developments
→ Integrate any system, even from third parties

COST EFFICIENCY
→ Lower costs of design, installation and operation
→ Faster diagnostics and maintenance to optimise train use
→ Reduced cabling and weight with a more compact solution

Our references

EKE has 30 years of experience in Railways, working with high speed trains, commuter trains, metros, trams, passenger coaches and locomotives.

We have already installed tens of thousands of systems around the world and we continue to serve our customers with the highest quality and reliability.

source: VR group

Contact us for more information on our experiences and capabilities:

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Fax. +358 9 6130 3300
sales@eke.com
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Talgo AVRIL High Speed Train
TCMS with Train Communication Networks. Includes WTB, MVB, CAN, Ethernet, I/O modules as well as SIL-2 functionalities.

London Underground
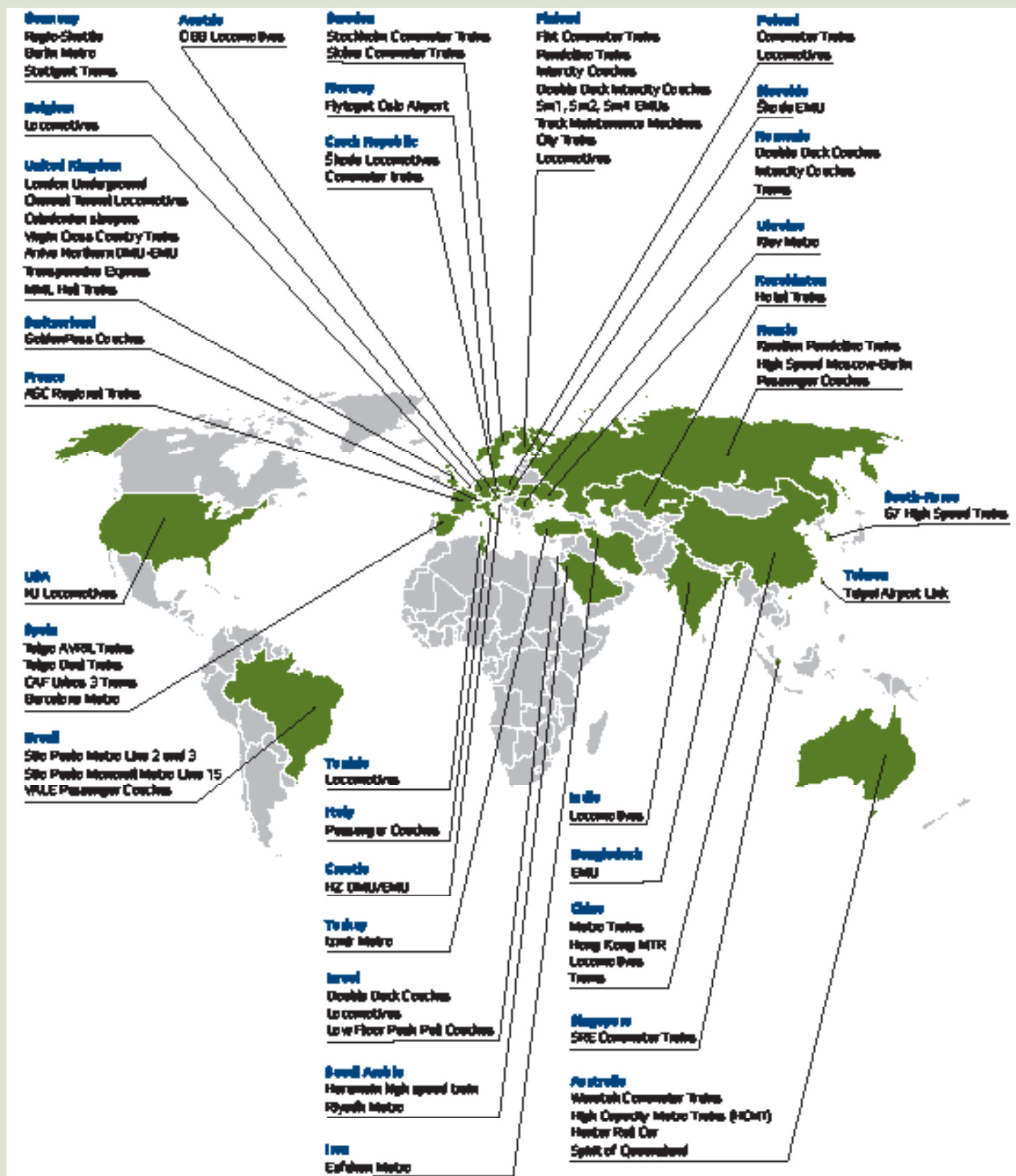*TCMS, Driver display modules, Serial links to ATO, ATP, Train radio and brake controllers.*

São Paulo Metro
Metro trains provided with TCMS, Train Communication Networks, PIS, CCTV, Video and Event Recorders (RMM).

Finnish Pendolino
Gateways, Brake diagnostics data transmission system, Speedometers, Displays and Event Recorders.

Germany
Regio-Shuttle
Berlin Metro
Stuttgart Trams

Belgium
Locomotives

United Kingdom
London Underground
Channel Tunnel Locomotives
Caledonian sleepers
Virgin Cross Country Trains
Arriva Northern DMU-EMU
Transpennine Express
Mk3, Mail Trains

Switzerland
GoldenPass Coaches

France
AGC Regional Trains

USA
KU Locomotives

Spain
Talgo AVRIL Trains
Talgo Oval Trains
CAF Urbos 3 Trams
Barcelona Metro

Brazil
São Paulo Metro Line 2 and 3
São Paulo Monorail Metro Line 15
VALE Passenger Coaches

Austria
ÖBB Locomotives

Sweden
Stockholm Commuter Trains
Skåne Commuter Trains

Norway
Flytoget Oslo Airport

Czech Republic
Škoda Locomotives
Commuter trains

Finland
Flirt Commuter Trains
Pendolino Trains
Intercity Coaches
Double Deck Intercity Coaches
Sm1, Sm2, Sm4 EMUs
Track Maintenance Machines
City Trains
Locomotives

Poland
Commuter Trains
Locomotives

Slovakia
Škoda EMU

Romania
Double Deck Coaches
Intercity Coaches
Trams

Ukraine
Kiev Metro

Kazakhstan
Hotel Trains

Russia
Russian Pendolino Trains
High Speed Moscow-Berlin
Passenger Coaches

South Korea
G7 High Speed Trains

Taiwan
Taipei Airport Link

Tunisia
Locomotives

Italy
Passenger Coaches

Croatia
HZ DMU/EMU

Turkey
Izmir Metro

Israel
Double Deck Coaches
Locomotives
Low Floor Push Pull Coaches

Saudi Arabia
Haramain high speed train
Riyadh Metro

Iran
Esfahan Metro

India
Locomotives

Bangladesh
EMU

China
Metro Trains
Hong Kong MTR
Locomotives
Trams

Singapore
SRE Commuter Trains

Australia
Waratah Commuter Trains
High Capacity Metro Trains (HCMT)
HunterRail Car
Spirit of Queensland

Some of our reference projects

*We have worked with our customers on both new trains
and refurbishment projects from the frosts of Finland
to the heat of Australia.*

Waratah Australia

We at EKE strive to push the boundaries of existing technologies in order to serve our customers with unparalleled safety, performance and cost-effectiveness. We designed the first Train Communication Network (TCN) fully based on Ethernet and industry standard IP-protocols for the Sydney Double-Deck Suburban Waratah Trains. 78 trains of 8 cars (624 cars) were equipped with Trainnet® systems between 2007 and 2012.

All sub-systems were integrated into the Trainnet® TCMS for comprehensive train control and diagnostics. Deliveries included TCMS, Driver Display Units (DDU), Guard Display Units (GDU), TCN (including Ethernet Switching Units with Power-over-Ethernet), Event Recorders with Rugged Memory Modules, an automated Passenger Information System and Radio link interfaces.

Products
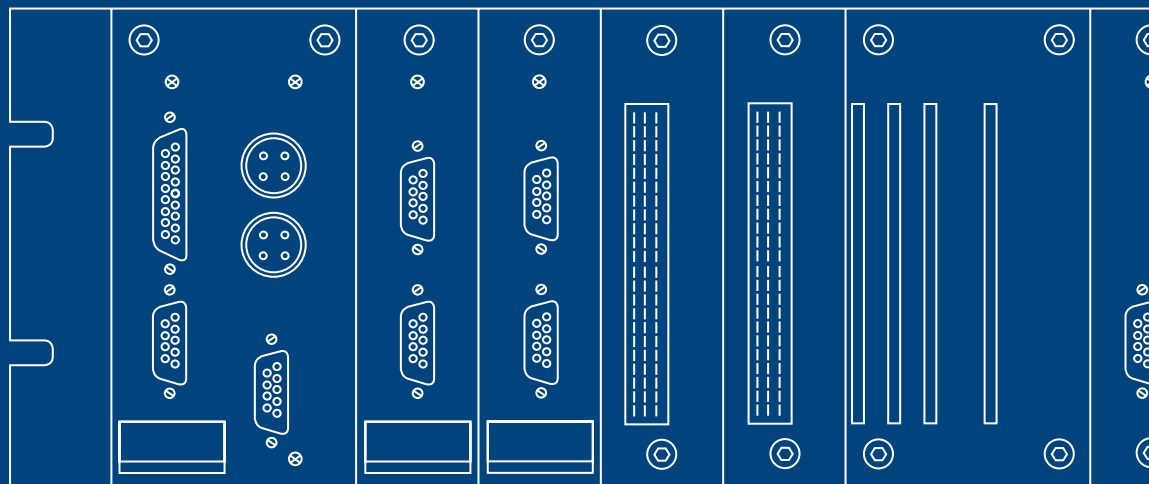
Train Control and Management System (TCMS)

The Trainnet® TCMS improves train performance and safety while decreasing maintenance and operating costs.

The Trainnet® Train Control and Management System (TCMS) provides a single point of control over all train sub-systems. The TCMS enables control and monitoring over virtually any sub-system 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 (TCN). The train architecture becomes more efficient, thus saving on development and maintenance costs. In addition, the centralized TCMS is used to automate train operations and sub-system diagnostics, enabling increased reliability and quicker response times.

EFFICIENT INTEGRATION
The core of the Trainnet® TCMS is the Trainnet® Train Communica-tion Network (TCN). The Trainnet® TCN is the infrastructure enabling the exchange of information throughout the train. It connects all the train sub-systems together *via* a common network (or several when requested), enabling centralized control.

In practice, the TCN consists of train computers, commonly referred to as Gateways, connected to each other as well as to train sub-systems. Trainnet® Gateways support multiple interface technologies including WTB, MVB, CAN, Serial Links and Ethernet. For more detailed information, please refer to the TCN and Gateway sections.

TRAIN AUTOMATION
The Trainnet® TCMS can be used to automate the train sub-systems. In most modern trains, on-board sub-systems generate a large quantity of data which is essential for safety (speed, braking, faults etc.) and operation purposes (system status, energy consumption, video recording etc.). The Trainnet® TCMS is able to gather this data, analyse it, and send logical commands and warnings. The information can be automatically exchanged between sub-systems and conveyed in real time to the train driver, the train captain, remotely located personnel and even passengers.

The Trainnet® TCMS is a versatile train computer which can be used in a number of applications such as:
→ Diagnostics
→ Automatic Train Inauguration
→ PIS/PA system management
→ Crew HMIs management
→ Brakes and traction monitoring
→ SIL and Safety Applications
→ Fleet Management
→ HVAC management

→ Door management
→ Lighting management
→ CCTV system management
→ Tank level monitoring
→ Battery charge monitoring
→ Train-to-wayside communication management

For more detailed descriptions of these applications, please refer to the Application Software section.

Trainnet® enables these applications to run on the same train computers that are used for Gateway functionalities, providing a more compact and cost-effective solution. Physically separated train computers can also be implemented, sometimes referred to as Vehicle Control Units (VCU).

Trainnet® systems provide all the necessary interfaces to connect with the sub-systems and the Train Communication Network.

Advantages

Versatility
Cover all your needs with a single system.
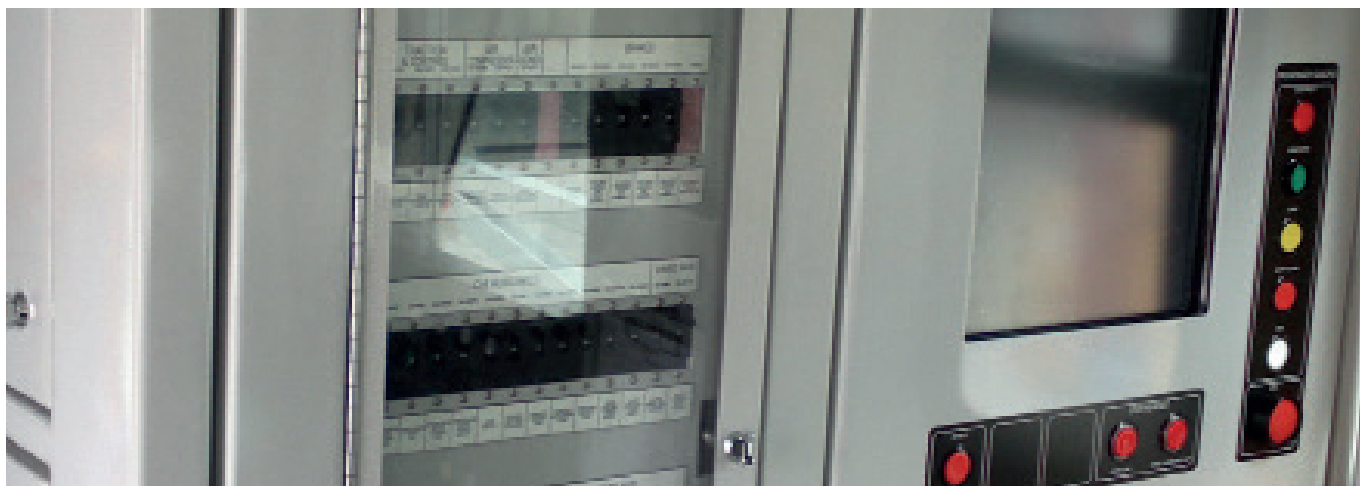
Modularity
Only pay for the features you need.

Open software
Keep control over your project at all times.

Long term support
Get support during the lifetime of your project.

Available technologies include a wide range of Bus Interface Modules (e.g. WTB, MVB, CAN, Serial Links and Ethernet) and Input/Output Interface Modules (Analogue Input, High Speed Analogue Input, Digital Input/Output, Digital Relay Output, Analogue Output, Pt-100 temperature Sensor Input). Remote Input/Output Modules (RIOM) are also available.

MORE CONTROL

The Trainnet® TCMS is a powerful and highly flexible system built on an open source software platform (Linux). You are free to develop your own applications as well as to integrate third party Hardware and Software onto the Trainnet® platform. With Trainnet®, you can develop your own applications using the CODESYS PLC Software. You can also develop applications as well make configuration modifications in C language, giving you full control. EKE 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. Finally, EKE can grant you the intellectual property rights (IPR) of the application Software in order to ensure you a safe, long-term investment.
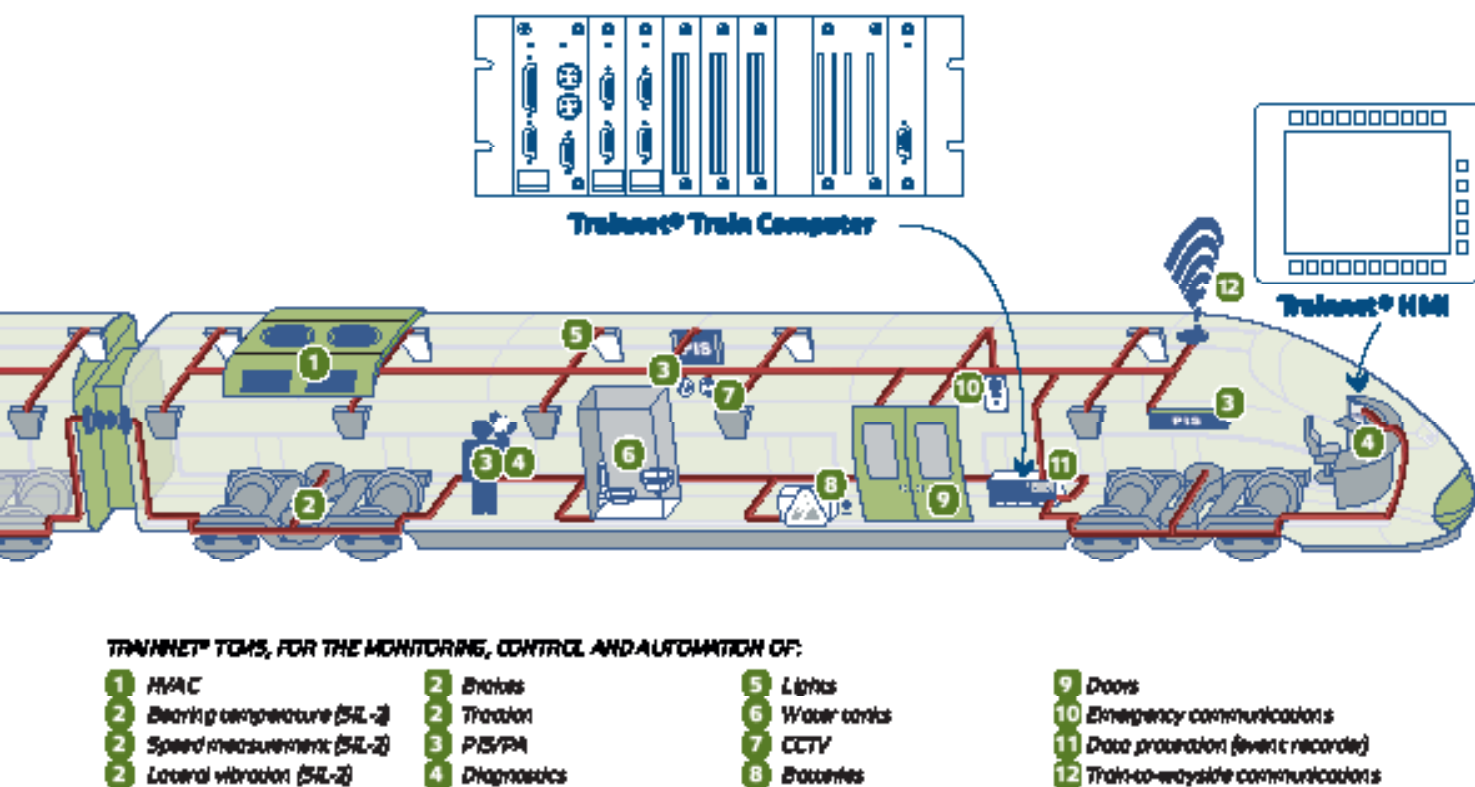
On the Hardware side, the Trainnet® TCMS is modular. This means you can develop tailored systems matching your needs perfectly. By simply selecting the interfaces you need, you make sure the system answers all your demands while being cost-efficient. Systems can be easily upgraded with additional modules as needs arise.

QUALITY AND RELIABILITY

The outstanding quality and the unique design of Trainnet® products guarantee unparalleled reliability. Trainnet® products minimize the need for maintenance while maximizing train availability, providing a long-term cost benefit for operators. We provide support for more than 30 years in order to ensure that our customers are satisfied during the entire life-time of their project.

EKE is IRIS certified and Trainnet® complies with the railway industry standards, including the IEC 61375 series, IEC 61131 and EN 50155.

Trainnet® Train Computer

Trainnet® HMI

TRAINNET® TCMS, FOR THE MONITORING, CONTROL AND AUTOMATION OF:

1	HVAC	2	Brakes	5	Lights	9	Doors
2	Bearing temperature (SIL-2)	2	Traction	6	Water tanks	10	Emergency communications
2	Speed measurement (SIL-2)	3	PIS/PA	7	CCTV	11	Data protection (event recorder)
2	Lateral vibration (SIL-2)	4	Diagnostics	8	Batteries	12	Train-to-wayside communications

Train Communication Network (TCN)

Trainnet® TCN is a highly reliable Train Communication Network used all around the world. It complies with the IEC 61375 standard for TCNs.

WHAT IS A TCN?

A Train Communication Network (TCN) is the infrastructure enabling the exchange of information throughout the train. It usually consists of a Vehicle Bus for intra-vehicle communications and a Train Bus for train-wide information exchange. Traditionally the highly standardized WTB (Wire Train Bus) technology is used as a train bus and MVB (Multifunction Vehicle Bus) as a vehicle bus. Other bus technologies such as CAN and Serial Links are also widely used as vehicle buses. MVB or CAN can also be used to develop train-wide communication networks. The Ethernet bus technology (e.g Ethernet Train Backbone, ETB) is a relative newcomer to be used as part of a TCN but has gained popularity in recent years, providing larger bandwidth and more flexible networks.

EFFICIENT INTEGRATION

There is often a lack of interoperability and harmonization between the different train sub-systems. Consequently, it is common to have several sub-systems within the train that use their own separate communication network and technologies. This leads to a complicated architecture and Software as well as excess wiring. The development of a single, fully integrated system greatly simplifies train management system architecture and allows significant savings.

Trainnet® Train Communication Network enables the concurrent use of multiple bus technologies including Ethernet, WTB, MVB, CAN and Serial Links, making it suitable for both new trains and refurbishment projects. By selecting only the bus technologies that you need, you can develop a fully customized system and keep costs down. This versatility allows the deployment of a single integrated communication network across the train, connecting all the train sub-systems together. Multiple independent networks can of course be deployed if that is what your project requires

The Trainnet® TCN provides efficient and reliable communication and data-routing between systems and different networks throughout the train as well as to the wayside. The information conveyed by the Trainnet® TCN can be accessed from any point on the network and even remotely (e.g. from depot). Redundancy can be implemented for additional reliability, with the possibility to use a different technology for the redundant path if required. Finally, the Trainnet® open Software (Linux) enables you to develop your own applications freely and keep control over your project at all times. EKE also has the expertise to make all or a part of the Software for you, or alternatively provide training, tools and guidance to support your own developments. EKE can give you the intellectual property rights (IPR) of all applications Software to make sure you make a safe long-term investment.
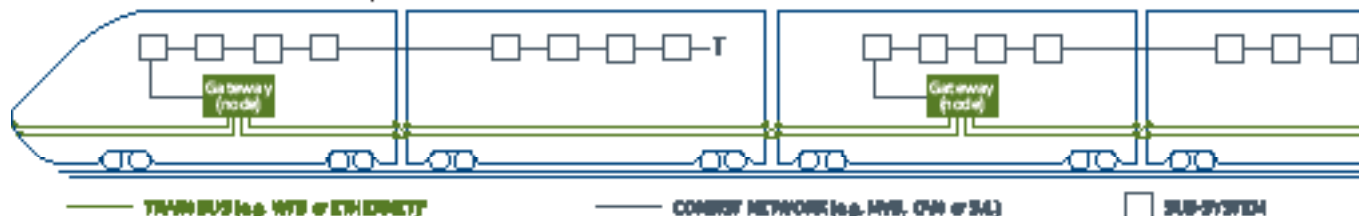
COMPARISON OF TRAIN BUS TECHNOLOGIES:

	WTB (Wire Train Bus)	ETB (Ethernet Train Backbone)
Bandwidth	1 Mbit/s	100 Mbit/s or 1Gbit/s*
Maximum network length	32 nodes and a maximum overall length of 860 meters	63 nodes and a maximum length of 100 m between nodes
Standard	IEC 61375-2-1	IEC 61375-2-5

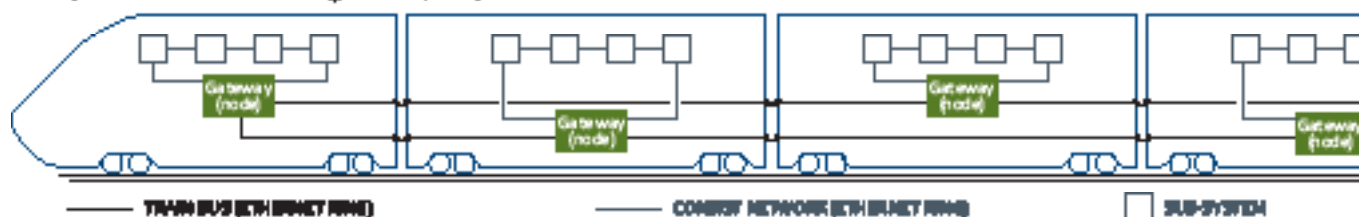** 1Gbit/s is not standardized but technically available*

Example 1: Dynamic train configuration, no redundancy

TRAIN BUS (e.g. WTB or ETHERNET) — CONSIST NETWORK (e.g. MVB, CAN, ETHERNET, SVL etc) □ SUB-SYSTEM

Example 2: Dynamic train configuration, redundant train bus

TRAIN BUS (e.g. WTB or ETHERNET) — CONSIST NETWORK (e.g. MVB, CAN or SVL) □ SUB-SYSTEM

Example 3: Fixed train configuration, fully redundant network

TRAIN BUS (ETHERNET RING) — CONSIST NETWORK (ETHERNET RING) □ SUB-SYSTEM

KEY APPLICATIONS

→ Redundancy

Building a redundant Train Communication Network (TCN) enables you to ensure continuous operations in case of a failure somewhere in the network. Where a single point of failure would disable the entire network (see Example 1), a redundant network provides alternative communication paths (see Example 3). Redundancy aims at eliminating single point of failures for flawless operations, even when malfunctions or breakdowns occur in the network. Implementing redundant networks helps preventing train immobilization and ensures availability of train functionalities at all time. Redundancy improves reliability and safety while saving costs in the long run.

→ Automatic Train Inauguration

Automatic Train Inauguration means that train consists can be connected, disconnected or switched without jeopardizing the train operations (Examples 1 and 2). Train configuration changes are automatically detected and the inauguration identify each car and its orientation thus enabling communications across the Train Communication Network. In the case of a fixed train set, the automatic inauguration may also be required in order to connect several trains together.

Trainnet® train bus technologies such as WTB and ETB (Ethernet Train Backbone) enable automatic inauguration. Even thought MVB does not allow automatic inauguration EKE has developed a solution to dynamically configure trains using MVB bus as backbone. When a completely fixed train set is used, a cost-effective train communication network can be built without a dynamic train bus (Example 3).

→ Decentralized Event Management

Trainnet® TCN technology enables you to build a centralized system with full control over the system from anywhere in the network. It is also able to keep key information and instructions spread over the network. Where in some systems, the applications and event logs are kept in a central computer, Trainnet® TCN allows for each car to run its own applications as well as logging its faults and alarms. It means that if one computer fails, the functionality and logs of the other coach computers are preserved.

COMPATIBILITY

For a compact and efficient system, Trainnet® TCN Gateways can be used as part of a broader Trainnet® solution, for instance as-sociated with an Event recorder, a Vehicle Control Unit (VCU) or as part of a complete TCMS. The Trainnet® TCN Gateways can also be used together with your own equipment or with sub-systems from other providers.

QUALITY AND RELIABILITY

The outstanding quality and the unique design of Trainnet® products guarantee unparalleled reliability. Trainnet® products minimize the need for maintenance while maximizing train availability, providing a long-term cost benefit to operators. We provide support for more than 30 years in order to ensure that our customers are satisfied during the entire life-time of their project.

EKE is IRIS certified and Trainnet® complies with the railway industry standards, including the IEC 61375 series, IEC 61131 and EN 50155.

Advantages

Versatility
Cover all your needs with a single system.

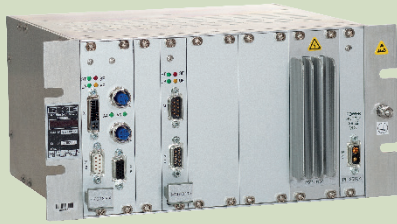**Modularity**
Only pay for the features you need.

Open software
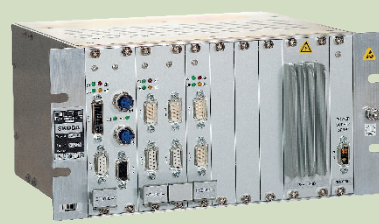Keep control over your project at all times.

Long term support
Get support during the lifetime of your project.

MVB-Ethernet-Serial Links
Gateway

WTB-Ethernet-CAN- Serial Links
Gateway

TCN
Gateways

The Trainnet® TCN Gateways are advanced train
computers used in the creation of efficient Train
Communication Networks (TCN).

MODULAR CONCEPT
The Trainnet® TCN Gateways are
modular, enabling you to precisely
select the train bus and vehicle
bus technologies you require.
Modules can be freely combined
for a very flexible and versatile so-
lution. The modular design enables
you to select only the features
you need for a cost-efficient solu-
tion. It also means that repairs
and upgrades are quick and easy.

A Trainnet® TCN Gateway usually
consists of a Central Processing
Unit (CPU), a power supply and at
least one Bus Interface module.
EKE has developed a comprehen-
sive range of CPUs, power sup-
plies and bus interface modules
to accommodate most technical
requirements and budgets. Please
find below an example of a Gate-
way made of a selection of com-
mon modules.

BUS INTERFACES
Trainnet® TCN Gateways can
combine some or all of the follow-
ing train and vehicle bus technolo-
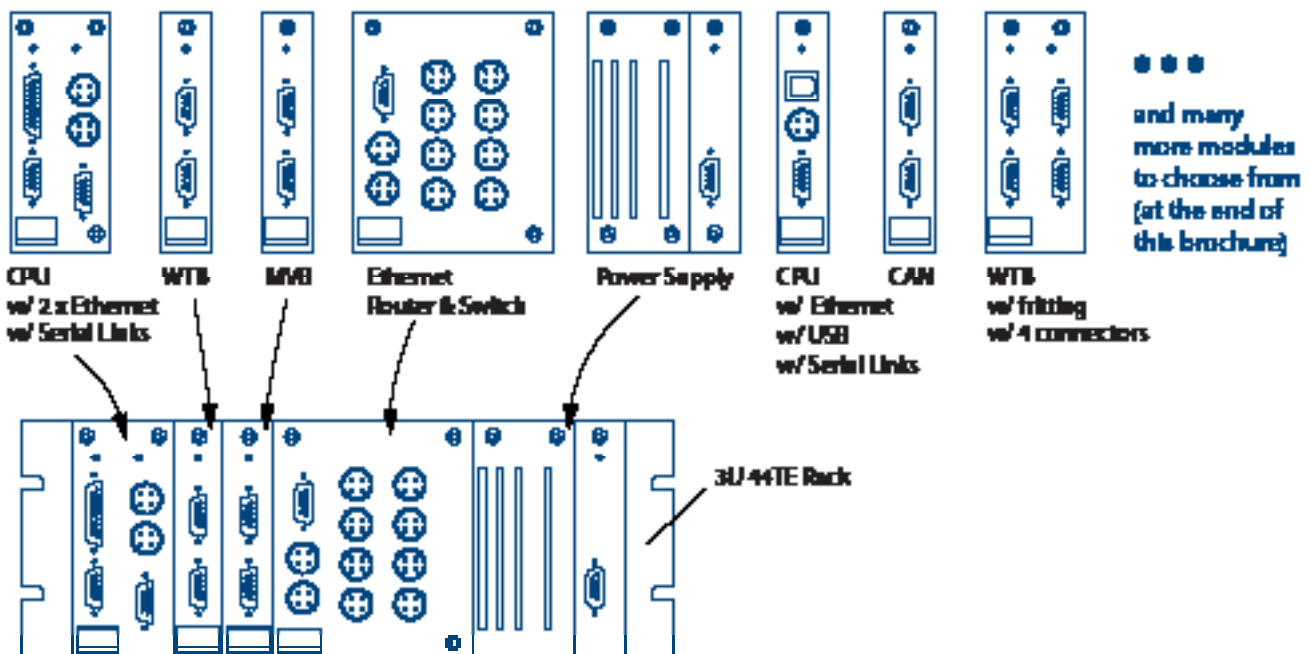gies, as your needs require:

→ Wire Train Bus (WTB)
The WTB interface usually has two
DE-9 connectors with redundant
lines integrated in each connector. A
version with 4 connectors and one
with fritting are available as options.

→ ETB (Ethernet Train Backbone)
The Ethernet Train Backbone is
implemented with the Trainnet®
ERU module. The ERU module is
an Ethernet Switch and Router
providing 10 Ethernet ports, 4 of
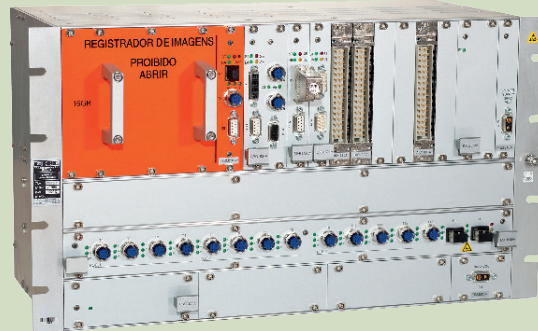which are dedicated to the ETB
(with redundant lines).

→ ECN (Ethernet Consist Network)
An ECN can be used as vehicle
bus but also as train bus in the

CPU
w/ 2 x Ethernet
w/ Serial Links

WTB

MVB

Ethernet
Router & Switch

Power Supply

CPU
w/ Ethernet
w/ USB
w/ Serial Links

CAN

WTB
w/ fritting
w/ 4 connectors

and many
more modules
to choose from
(at the end of
this brochure)

3U 44TE Rack

Redundant WTB-MVB Gateway

MVB - CAN - Ethernet Gateway with Power-over-Ethernet, plus integrated Event Recorder and I/O modules

EN 50155
EN 45545
IEC 61375 SERIES
IEC 61131

case of a fixed consist. Trainnet® Ethernet Switches (ERU, 3U ESU, 1U ESU) can be used to create ECNs. Power-over-Ethernet is available as an option with the 1U ESU modules to provide power to connected sub-systems via the Ethernet cables.

→ Multifunction Vehicle Bus (MVB)
The MVB physcial medium can be ESD+ or EMD. ESD+ and EMD have two DE-9 connectors with redundant lines integrated into each connector.

→ CAN Vehicle Bus (CVB)
The Trainnet® 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 (S/L)
Serial Links interfaces can be used to create Vehicle Buses even though they are commonly used for direct connection to sub-systems. The physical layers RS-485 and RS-422 are supported. Modbus and customized protocols can be used.

Please contact us to discuss which architecture and modules meet best your requirements.

Trainnet® TCN Gateways are designed with ease of use in mind. Most Trainnet® modules have interface connectors at the front and communicate with each other via the backplane (includes VME bus). Mechanical coding of DE-9 connectors is available as an option.

RACKS
The Trainnet® TCN Gateways are usually provided as fully integrated systems, fitting in either 44TE or 84TE wide rack. The rack height is typically 3U or 6U. Other rack sizes like 20TE are also available: please ask us.

MORE THAN A GATEWAY
Other modules such as Event Recorders and Discrete Input and Output modules can also be integrated into the same rack to build a compact and cost-efficient train computer or TCMS.

SUPPORT
EKE provides at least 30 years of support for all Trainnet® products.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
3U 44TE Rack
280 mm x 133 mm x 215 mm
(installation width 240 mm)
3U 84TE Rack
483mm x 133mm x 215 mm
(installation width 443 mm)
6U 84TE Rack
483 mm x 266 mm x 215 mm
(installation width 443 mm)
Weight
Depends on rack and installed modules
Input Voltage
24, 36, 48, 52, 72 or 110 V DC
Temperature Range (operational)
-40 ºC...+70 ºC
MTBF (40 ºC ambient temperature)
Depends on installed modules
Interface Options:
WTB, MVB, CAN, Ethernet, Serial Links
Read Module pages for more details.

Advantages

Versatility
Cover all your needs with a single system.

Modularity
Only pay for the features you need.

Open software
Keep control over your project at all times.

Long term support
Get support during the lifetime of your project.

VCU with CAN and Digital
Input/Output Interfaces

Redundant VCU with MVB and various
Digital Input/Output Interfaces

Vehicle Control Unit (vcu)

EN 50155
EN 45545

FUNCTIONS

The Trainnet® Vehicle Control Unit (VCU) is a powerful computer for train automation. The Trainnet® VCU can carry out advanced control and diagnostic functions.

The Trainnet® VCU can control any train sub-system such as brakes or doors. It can be used for both physical control (e.g. opening/closing/locking the doors, activate heating/cooling/ventilation etc.) and diagnostics (e.g. checking the proper closing of a door, monitoring brake temperature etc.) of train sub-systems. Please find below common applications:

➔ Diagnostics
➔ PIS/PA system management
➔ Crew HMIs management
➔ Brakes and traction monitoring
➔ SIL and Safety Applications
➔ Fleet Management
➔ HVAC management
➔ Door management
➔ Lighting management
➔ CCTV system management
➔ Tank level monitoring
➔ Battery charge monitoring
➔ Train-to-wayside communication management

For more details, please visit our Application Software pages.

Trainnet® enables these control and diagnostic applications to run on the same train computers that are used for Gateway functionalities, providing a more compact and cost-effective solution. Physically separated Gateways can also be implemented.

KEY FEATURES

The Trainnet® VCU can connect with sub-systems and the Train Communication Network. Available interfaces include a wide range of bus technologies (e.g. WTB, MVB, CAN, Serial Links and Ethernet) and Input/Output Interface Modules (Analogue Input, High Speed Analogue Input, Digital Input/Output, Digital Relay Output, Analogue Output, Pt-100 temperature Sensor Input). Remote Input/Output Modules (RIOM) are also available.

MORE CONTROL

The Trainnet® VCU is a powerful and highly flexible system built on an open source software platform (Linux). You are free to develop your own applications as well as to integrate third party Hardware and Software onto the Trainnet® platform. With Trainnet®, you can develop

your own applications using the CODESYS PLC Software. You can also develop applications and make configuration modifications in C language, giving you full control. EKE 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. Finally, EKE can grant you the intellectual property rights (IPR) of the application Software in order to ensure you a safe, long-term investment.

On the Hardware side, the Trainnet® VCU is modular. This means you can develop tailored systems matching your needs perfectly. By simply selecting the interfaces you need, you make sure the system answers all your demands while being cost-efficient. Systems can be easily upgraded with additional modules as needs arise.

SUPPORT

EKE provides support for at least 30 years for all Trainnet® products.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
3U 44TE Rack
280 mm x 133 mm x 215 mm
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6U 84TE Rack
483 mm x 266 mm x 215 mm
(installation width 443 mm)
Weight
Depends on installed modules
Input Voltage
24, 36, 48, 52, 72 or 110 V DC
Temperature Range (operational)
-40 ºC...+70 ºC
MTBF (40 ºC ambient temperature)
Depends on installed modules
Interface Options:
WTB, MVB, CAN, Ethernet, Serial Links, Analogue Input, High Speed Analogue Input, Digital Input/Output, Digital Relay Output, Analogue Output, Pt-100 temperature Sensor Input. Read Module pages for more details.

Trainnet® Ethernet RIOM

Trainnet® MVB RIOM

Remote Input/Output Module
(ETHERNET RIOM, MVB RIOM)

EN 50155
EN 45545

FUNCTIONS

The Trainnet® RIOM enables data input and output within the vicinity of the I/O sources. It is used as an alternative to connecting I/O sources directly to the train computer (e.g. VCU) and it can lead to reduced cabling and thus cost savings.

KEY FEATURES

The RIOM supports both analogue and digital inputs/outputs. Most Trainnet® I/O modules can be used, including AIM, AOM, DIO, DRO, PTI and TSI. You can find out more about these modules by reading the dedicated datasheets or by contacting a Sales representative at EKE.

The Trainnet® RIOM includes an interface module used for the communications with the train computer. It is also equipped with an independent power supply (Trainnet® PSR module).

OPTIONS

Interfaces:

➜ The Trainnet® Ethernet RIOM is equipped with one Ethernet interface for connectivity with the train computer (CPE module).
➜ The Trainnet® MVB RIOM

uses MVB interfaces to connect with the train computer. By default, the MVB physical interface is Electrical Medium Distance (EMD) with two sub D-9 connectors. Electrical Short Distance with optical isolation (ESD+) mediums are available upon request.

Number of modules:

➜ In its most compact version, RIOM can use up to 8 EKE Trainnet® I/O modules and be fitted into a 44TE rack.
➜ An 84TE rack version is also available as an option to fit up to 18 I/O modules.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
 3U 44TE Rack
  280 mm x 133 mm x 215 mm
  (installation width 240 mm)
 3U 84TE Rack
  483mm x 133mm x 215 mm
  (installation width 443 mm)
Weight
 44TE option
  2.6 Kg (+ I/O module weights)
 84TE option
  4 Kg (+ I/O module weights)
Input Power
 24...36 V DC -30/+25%
 or 48...110 V DC -30/+25%
Temperature Range (operational)
 -40 ⁰C...+70 ⁰C
MTBF (40 ⁰C ambient temperature)
 Depends on installed I/O modules
Interface options
 Ethernet RIOM:
  1 x 10/100 Mbit/s M12
 MVB RIOM:
  Electrical Medium Distance (EMD)
  with two sub D-9 connectors
  (Isolated Electrical Short Distance (ESD) physical interface)

Trainnet® Ethernet Switch and Router
(functions: run applications, router, switch)

Trainnet® Ethernet Switch
(functions: switch with PoE)

...

 # Ethernet Switches

EKE is a pioneer in Ethernet based Train Communication Networks (TCN). Trainnet® Switches and Software were used on board the first train with 100% IP-based TCN.

FUNCTIONS
Depending on the Ethernet modules that you select, the following functions can be achieved:

→ **Ethernet Train Backbone (ETB)**
The Ethernet Train Backbone (ETB) is a modern train bus technology enabling a cost-effective setup with a large bandwidth (up to 100Mbit/s Vs 1 Mbit/s for WTB). It can replace or be used together with WTB and other train buses. Like the WTB, it allows for dynamic train configuration.

→ **Ethernet Consist Network (ECN)**
The Ethernet Consist Network (ECN) technology can be used to create vehicle buses and also as train-wide communication network in the case of fixed consist (no dynamic train configuration).

→ **Ethernet Switch**
Ethernet Switches are used to connect devices to the Train Communication Network enabling networked devices to communicate with each other. The managed switches manage layer 3 protocols, such as DHCP and IGMP. It also allows for finer configuration of the switch.

→ **ETB Router**
The routing functionality allows the switch to be dynamically configured, thus redirecting messages to devices based on the latest information. A common application is dynamic train configuration: when changing the order of cars, the train communication network is automatically reconfigured. The position and orientation of each car is identified, enabling flawless communications throughout the train.

→ **Power-over-Ethernet (PoE)**
Power-over-Ethernet allows for the passing of electrical power in addition to data with Ethernet cabling. It means you can dramatically reduce setup costs and wiring as only one cable is required to each device. More and more devices

COMPARING TRAINNET® ETHERNET MODULES

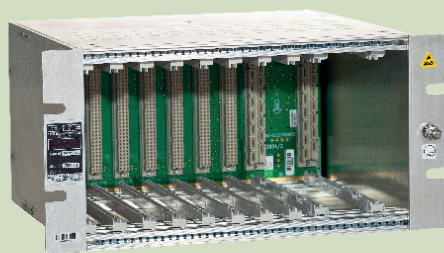| FUNCTIONS	3U ESU POE	ERU	3U ESU	1U ESU
Ethernet Train Backbone (ETB)	-	☯	-	-
Ethernet Consist network (ECN)	☯	☯	☯	☯
Managed Switch	☯	☯	☯	☯
Unmanaged Switch	☯	☯	☯	☯
Router	-	☯	☯	-
Power-over-Ethernet	☯	-	-	☯
Firewall	-	☯	☯	-

20

Trainnet®
Rack
(Here 3U 44 TE Rack)

Trainnet® Switch

Trainnet®
Power Supply
(PSV + PIU)

EN 50155
EN 45545
IEC 61375-3-4
IEC 61375-2-5

support PoE including surveillance cameras, displays, GSM antennas, emergency phones etc.

MODULARITY

The Trainnet® Systems are modular. You can build an Ethernet Switch with just the functionnalities you need, for cost-efficiency. As a general rule, a standalone Trainnet® Ethernet Switch includes a Trainnet® Rack, a Trainnet® power supply and at least one Trainnet® Ethernet Module.

Trainnet® Ethernet Switches can be easily integrated into a more comprehensive Trainnet® system. For instance, the Ethernet Switch can be used as part of a Gateway, a VCU or a full TCMS train computer. That way, you are able to save space and money with a very compact and efficient system.

RACKS

The Trainnet® Racks are available in different sizes: the most common are 20TE, 44TE and 84TE wide racks. The racks are usually 3U high but a 6U 84TE Rack is also available for larger systems as well as for the Trainnet® 1U ESU Switch with Power-over-Ethernet. Other rack sizes are also available: please ask us.

POWER SUPPLY

Most Trainnet® Systems can be powered using the Trainnet® PSV and Trainnet® PIU modules. When Power-over-Ethernet is needed, the Trainnet® PSE, Trainnet® ESS and optionally the Trainnet® PBU are used.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
 3U 44TE Rack
 280 mm x 133 mm x 215 mm
 (installation width 240 mm)
 3U 84TE Rack
 483mm x 133mm x 215 mm
 (installation width 443 mm)
 6U 84TE Rack
 483 mm x 266 mm x 215 mm
 (installation width 443 mm)
Weight
Depends on rack and installed modules
Input Voltage
PIU: 24, 36, 48, 52, 72 or 110 V DC
ESS (PoE): 36-52 or 110 V DC
Temperature Range (operational)
-40 ºC...+70 ºC
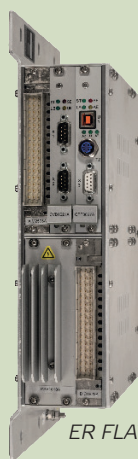**MTBF (40 ºC ambient temperature)**
Depends on installed modules
Ethernet Interfaces:
Depends on installed modules

Please read individual Ethernet Module datasheets for more detailed specifications.

ER FLAT
3U x 12 TE

ER 20TE

ER 44TE

ER FLAT 6U x 12TE

Event Recorders

FUNCTIONS

A Trainnet® Event Recorder (ER) is an on-board data recorder for collecting and storing vital train-borne information. The Trainnet® Event Recorder can record all kinds of data including audio and video streams.

KEY FEATURES

Trainnet® Event Recorders are able to record virtually any available signals, analogue or digital. The Event Recorder can be programmed to record safety critical information like train speed, train position or brake temperature.

The Event Recorder can also record video streams from onboard digital video recorders (DVR) or directly from the cameras. For easy data retrieval, the stream format can be made compatible with your CCTV Software or any other video analysis Software that you are using.

Alternatively, we can develop customized video analysis tools to fit your needs.

Trainnet® Event Recorders have an Ethernet port, a USB port and an RS-485 port at the front for easy access. The Ethernet port

COMPARING TRAINNET® EVENT RECORDERS

	ER FLAT 3U X 12TE	ER 20TE	ER FLAT 6U X 12TE	ER 44TE	ER 84TE	RMM 84TE (e.g. JRU)
External Dimensions (W x H x D)	87 x 229 x 215	158 x 133 x 215	87 x 363 x 215	280 x 133 x 215	280 x 133 x 215	280 x 133 x 215
Rugged Memory Module (RMM)	-	-	-	-	-	↻
Storage Memory	500MB or 4GB	500MB or 4GB	500MB or 4GB	500MB or 4GB	500MB or 4GB	2GB or 16GB
Connectivity *Included interfaces:*	1 x Ethernet M12 1 x USB 3 x RS-485	1 x Ethernet M12 1 x USB 3 x RS-485	1 x Ethernet M12 1 x USB 3 x RS-485	1 x Ethernet M12 1 x USB 3 x RS-485	1 x Ethernet M12 1 x USB 3 x RS-485	1 x Ethernet M12 1 x USB 3 x RS-485
Optional interfaces:	no free slot	2 free slots for:	3 free slots for:	7 free slots for:	17 free slots for:	10 free slots for:
. Bus interfaces		MVB, CAN, SIU	MVB, CAN, SIU	MVB, CAN, SIU, 3U ESU	MVB, CAN, SIU, 3U ESU	MVB, CAN, SIU, 3U ESU
. I/O Interfaces		AIM, HSA, DIO, DRO, AOM, PTI	AIM, HSA, DIO, DRO, AOM, PTI	AIM, HSA, DIO, DRO, AOM, PTI	AIM, HSA, DIO, DRO, AOM, PTI	AIM, HSA, DIO, DRO, AOM, PTI
. Remarks		*Note: Max 1 underlined module*	*Note: Max 1 underlined module*	*Note: Max 5 underlined modules. 3U ESU = 3 slots*	*Note: Max 15 underlined, Max 9 not underlined modules. 3U ESU = 3 slots*	*Note: Max 6 underlined modules. 3U ESU = 3 slots*
Power Supply Input Voltage	24, 36, 48, 52, 72 or 110 V DC	24, 36, 48, 52, 72 or 110 V DC	24, 36, 48, 52, 72 or 110 V DC	24, 36, 48, 52, 72 or 110 V DC	24, 36, 48, 52, 72 or 110 V DC	24, 36, 48, 52, 72 or 110 V DC
Power Supply Cabling	Back	Back	Back	Front	Front	Front
Option for side mounting	side mounted	↻	side mounted	-	-	-
Included Software	Trainnet® TIP	Trainnet® TIP	Trainnet® TIP	Trainnet® TIP	Trainnet® TIP	Trainnet® TIP
Optional Software	CODESYS, PST	CODESYS, PST	CODESYS, PST	CODESYS, PST	CODESYS, PST	CODESYS, PST

ER 84TE

RMM 84TE

EN 50155, EN 45545
IEEE 1482-1.1999
IEC 62625-1
GM/RT2472-1.2002
EEIG 97E461-3.1998

and the USB port can be used to download the data stored in the recorder. Alternatively, the Ethernet port can be used to connect to a sub-system or an Ethernet Switch. The RS-485 port can also be connecting sub-systems.

All the Trainnet® Event Recorders are protected against shocks, vibration, humidity, temperature variations, excessive emissions and excessive voltages (follows the EN50155 standard). Front-panel imprints are available upon request.

MODULARITY

Additional interfaces can be easily added to the Event Recorder, as the system is modular. You can add bus interfaces such as MVB, CAN, S/L or Ethernet to connect with train sub-systems or Train Communication Network (TCN) in order to acquire data. You can also add Input/Ouput Interfaces to record various signals. Available I/O Interface Modules include Analogue Input, High Speed Analogue Input, Digital Input/Output, Digital Relay Output, Analogue Output and Pt-100 temperature Sensor Input.

For a compact and efficient system, Trainnet® Event Recorder can be used as part of a broader Trainnet® system, for instance integrated to a Gateway, a VCU or a TCMS.

DATA RETRIEVAL AND ANALYSIS

Data can be retrieved at any time *via* the Event Recorder Ethernet port using the Trainnet® TIP Software (Train Inspection Program). The TIP Software enables the download and the analysis of the train data. Alternatively, the data can be transferred to a USB stick, for convenient transport or storage. The data is easily imported from the USB stick to the TIP Software.

The Trainnet® Event Recorder proves useful beyond traditional use following an incident. The retrieved data can be visualized with the TIP Software in order to perform regular system performance analysis and train operational optimization.

Illustration: TIP Software

RUGGED MEMORY MODULE

The Trainnet® Rugged Memory Module (RMM) is available as an option whenever a high level of data protection is needed. This crash-proof construction guaran-

tees 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.

The design of the Trainnet® Rugged Memory Module fulfils the British (GM/RT2472-1.2002) and European (EEIG 97E461-3.1998) crashworthiness as well as the IEEE (1482.-1.1999) standards. This makes the Trainnet® Event Recorder suitable for trains worldwide.

JURIDICAL RECORDING UNIT

The Trainnet® Juridical Recording Unit (JRU) is a train event recorder complying with the ERTMS/ETCS standard. The Trainnet® JRU has all the features of other Trainnet® Event Recorder and is equipped with the Trainnet® Rugged Memory Module for data protection.

The Trainnet® JRU 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). The ETCS architecture illustration highlights the two standard setup options.

Illustration: ETCS architecture
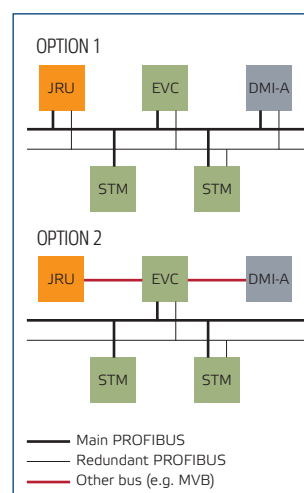
GPS/GNSS

As an option, a GNSS (Global Navigation Satellite System) receiver can be integrated into the Event Recorder. Versions with GPS+GLONASS and GPS+BeiDou are available. This option requires 4TE of additional space in the rack (one free bus interface slot).

RACKS AND SIZES

The modularity of the Trainnet® Event Recorders means you can choose a rack size based on your needs: the more additional interfaces or features you need, the larger is the rack that you need to select. The table on the previous page presents some of the possible alternatives.

12.1" Full Touch (FT)

12.1"   6.5"

Human Machine
Interface (HMI)

EN 50155
EN 45545

FUNCTIONS

The Trainnet® Human Machine Interfaces (HMI) are interactive displays. They can be used to display information to train drivers or crew members with interactive displays. They can also be used as CCTV monitor as well as for any Trainnet® applications.

KEY FEATURES

The Trainnet® HMIs are flexible devices providing ease of use and robustness for all Trainnet® applications.

The touch control buttons positioned around the display area provide great durability with no mechanical part to wear out. The layout of the keys is designed according to the international UIC 557 standard. You can easily configure the keys to match any of your requirements.

The flat displays, including the touch control buttons, are protected behind an anti-reflective vandal proof safety glass (IK 07, IP 65 tightness) for durability.

As the displays are very compact, they can be fitted virtually anywhere in the train and

are easy to mount (rear fixing for protection). Two sizes are available for flexibility: 6.5" and 12.1" with respectively 640 x 480 and 1024 x 768 pixel resolutions.

As part of a Trainnet® System, the HMI is usually configured and controlled by the Train Computer's CPU (Trainnet® CPG, Central Processing unit with Graphics controller). There is a DVI-I interface and a touch screen interface integrated into the same cable.

The Trainnet® HMI also sends self-diagnostics data to the Train Computer, such as module temperature and the count of lamp's operating hours. The display does not include any moving parts and the lamp is the only replaceable component. The absence of components that are subject to any wear out guarantees a long unit lifetime.

OPTION

The Trainnet® HMI 12.1" is available as a full touch screen as an option (12.1" FT). The 12.1" FT display does not have touch control buttons around the display area.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
6.5": 220 x 170 x 125 mm
12.1": 340 x 270 x 106 mm
12.1" FT: 320 x 260 x7 5 mm

Weight
6.5": 3.7 kg
12.1" and 12.1" FT: 6 kg

Input Power
6.5": 24 V DC or 110 V DC
12.1": 24 V DC, 72 V DC or 110 V DC
12.1" FT: 110 V

Power Consumption, Typical
6.5": Standby 3.5 W (no image), Full brightness 11 W
12.1": Standby 4 W (no image), Full brightness 15 W
12.1" FT: Standby 5 W (no image), Full brightness 15 W

Temperature Range (operational)
-25 ºC...+70 ºC

MTBF (40 ºC ambient temperature)
50 000 h

Display Resolution
6.5": 640 x 480 (VGA)
12.1" and 12.1" FT: 1024 x 768 (XGA)

Active Display Area
6.5": 133 x 99 mm
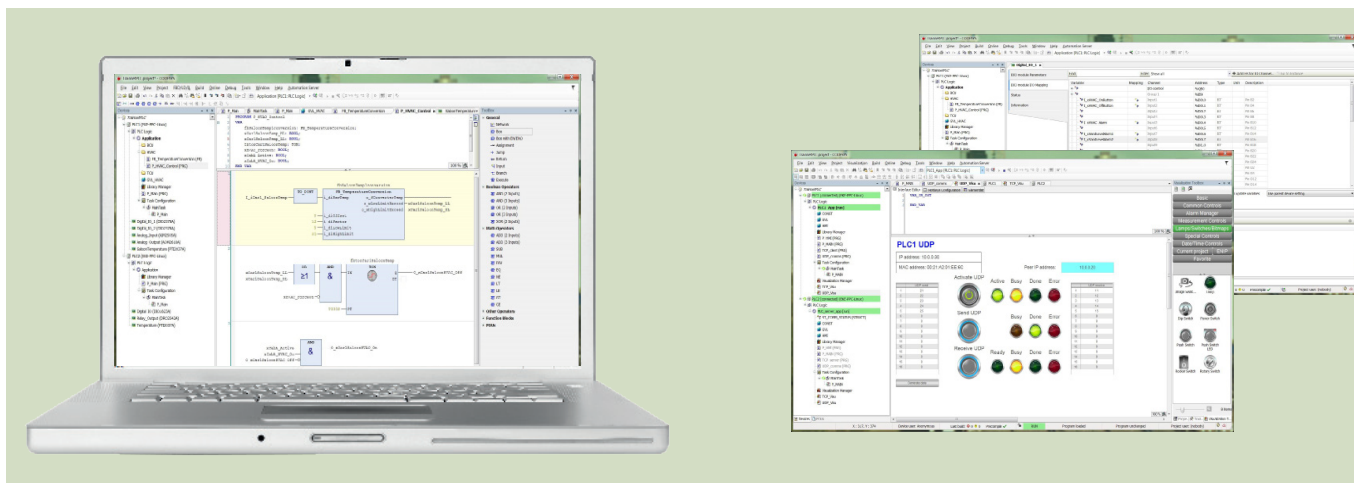12.1": 246 x 184 mm
12.1" FT: 245 x 184 mm

Colour Depth
262 144

Viewing Angle (Cr≥10)
6.5": -50~50(H) -60~30(V)
12.1": -65~65(H) -75~45(V)

Luminance
6.5": 440 cd/m2 typ.
12.1" and 12.1" FT: 320 cd/m2 typ.

CODESYS
PLC Software

IEC 61131
IEC 61375
UIC 556

FUNCTIONS

The CODESYS® Software is designed for efficient programming of PLC applications of Trainnet® Systems. It is also used for simulation, commissioning and debugging. It complies with the IEC 61131standard.

KEY FEATURES

CODESYS is 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.

The CODESYS Workbench supports all of the standard IEC 61131 control program languages extended with the Continuous Function Chart (CFC). You may use any or all of the control languages in your application as it best suits your needs.

The supported languages are:
→ Function Block Diagram (FBD)
→ Structured Text (ST)
→ Continuous Function Chart (CFC)
→ Ladder Logic Diagram (LD)
→ Sequential Function Chart (SFC)
→ Instruction List (IL)

EFFICIENT AND SECURE DEVELOPMENT

CODESYS Application is compiled to binary which means small Application size and fast execution time. CODESYS supports multitasking with individual execution cycle times. Comprehensive information security features are natively built-in in CODESYS, e.g. communication and project file encryption and user management. CODESYS can be run on most Trainnet® CPUs, e.g. CPG, CPS and RMM. CODESYS Configuration Tool developed by EKE-Electronics makes it easy to administer large PLC applications.

The CODESYS series of toolkits give you the ability to write your own I/O drivers and supports "C" user programs. Functions and function blocks written in C can be called directly from any of the supported languages.

We have already developed number of functions and function blocks that are designed for rail applications. For instance for communication over various train networks such as TRDP and other most typically used Ethernet protocols, WTB with UIC 556 and MVB.

We can develop custom functions and function blocks that match your needs. We can provide tools and training to help you develop your own train application. We can also help you to build more advanced capabilities to integrate your own I/O devices and C Functions.

ADVANCED FEATURES

CODESYS can perform unprecedented functions such as database and file operations. It also supports object-oriented programming for advanced application development. CODESYS Visualization helps in creating easy-to-adopt views for commissioning and debugging. CODESYS online store offers vast selection of ready-made add-ons such as development tools and drivers for databuses and 3rd party devices.

TECHNICAL REQUIREMENTS

Programming System
CODESYS Development System V3.5

Operating System
Windows 8 / 10 (32/64 Bit)

Recommended System Properties
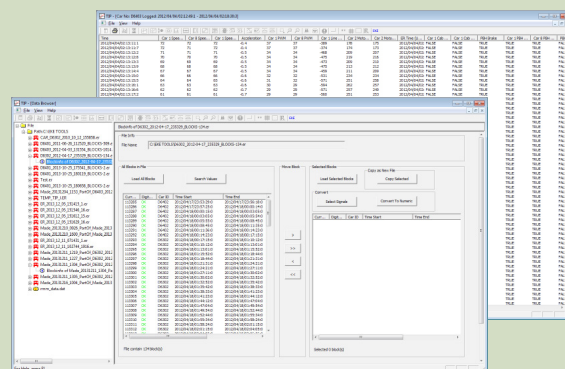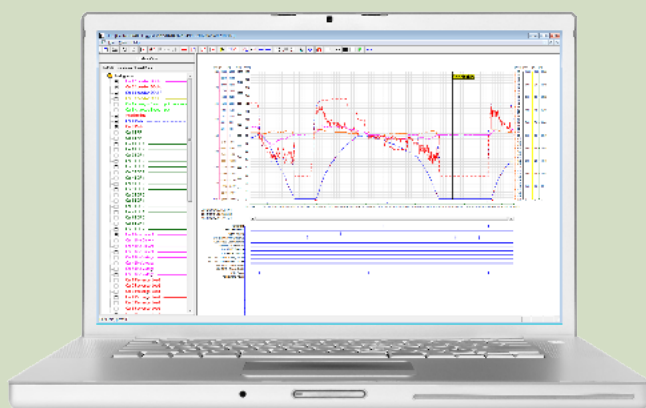2.5 GHz Processor
8 GB RAM
4 GB available HD space

Hard Drive
20 GB

Ports
Ethernet

25

Train Inspection Program (TIP)

FUNCTIONS

The Trainnet® Train Inspection Program (TIP) is a Software tool used for the transfer and analysis of the data recorded in the Trainnet® Event Recorders. The tool allows for the visualization, analysis and printing of the records, as well as real-time train monitoring.

KEY FEATURES

The Software is compatible with Windows 8, Windows 7, Windows XP and Windows Vista operating systems. The Data can be downloaded with the TIP Software by connecting a PC or a USB memory stick to the Trainnet® Event Recorder.

The TIP has been designed with the ease of use and customization in mind. The Software is able to display the data in several ways such as graphically and numerically or with signal states and comprehensive reports. The Trainnet® TIP can also be configured to show exactly the information needed for a specific task. The user can instantly locate points of interest in a large data log, or archived registrations for later use. The data views can be customized to

suit your specific needs, with everything from colors to line types.

TIP enables you to select exactly the information you require for your analysis. You can for example analyze any numbers or combination of signals displayed along with a scale and a time-period of your choosing. The TIP also enables you to locate an incident or a particular piece of information by using the built-in search and statistical functions.

The Event Recorder data can be archived on a computer, where each registered individual data file can be retrieved for later analysis with the Software. The TIP also allows the saving of a selected portion of recorded data to a new file, without modifying the original data in any way.

TIP has a feature that enables you to display several data files simultaneously. This feature enables you to easily compare different types of data from the same track sections. The feature can also be used for driver comparison and to reveal slow changes in signals (trends).

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

The TIP Tool also provides an on-line monitoring feature that allows you to monitor any selection of signals in the car in real-time, without interfering with the Trainnet® Event Recorder's normal operations. Under all conditions, the TIP Software tool ensures that your data is kept confidently with the highest levels of integrity.

TECHNICAL REQUIREMENTS

Operating System
Windows 8, 7, XP or Vista

RAM Memory
2 to 4 GB

Hard Drive
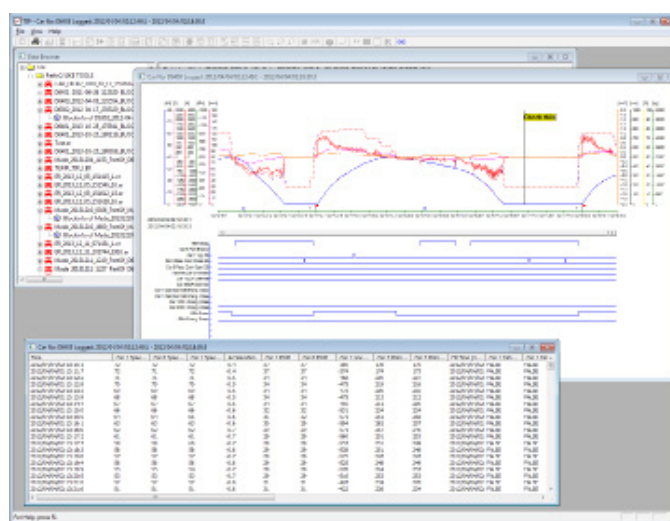120 GB or more (if large ER files)

Processor
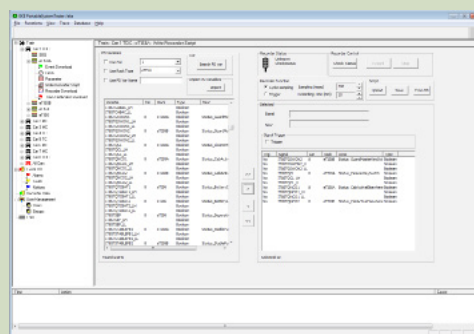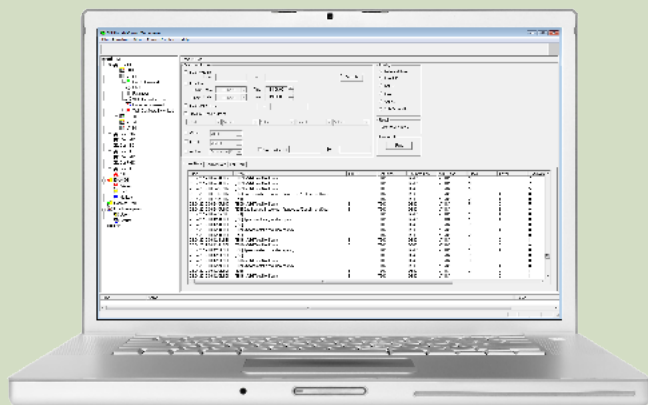Dual core processor

Ports
Ethernet

Display
If laptop is used, external HD display would be preferred to ease the analysis of Event Recorder data.

Trainnet® TIP Software Multiple View

Portable System Tester (PST)

FUNCTIONS

The Trainnet® Portable System Tester (PST) is a Software tool used to perform diagnostics and configurations of Gateways and train computers. A computer equipped with the PST, can be connected to any gateway or train computer using either serial or Ethernet connection, providing a single point of access to all coaches within the train set.

KEY FEATURES

The Trainnet® Portable System Tester (PST) is compatible with Windows 8, Windows 7, Windows XP and Windows Vista Operating Systems.

The Trainnet® PST is a tool for downloading event history data (e.g. faults and alarms) and provides built-in features for examining the data. Additionally, it is a tool for settings the system time and other operational parameters.

The tool features are largely based upon customer requirements and are project-dependant. However, some of the possible functionalities include:

→ Set up operational parameters to the Train Computer, such as time, coach number and type or wheel diameter.
→ View I/O channels statuses as well as TCMS link status and signals.
→ Download system faults and event logs.
→ Keep track of the diagnostic data (faults) already retrieved, and when performing successive retrievals, it downloads only the new, un-retrieved, portion of the data.
→ Access to system data, including the train bus process and message data, binary tree (Modbus data), etc.
→ Allows modifying off-line parameter files to edit start-up or functional parameters.
→ Allows incorporation of any HTML files into the tool, which typically is used to integrate User and Maintenance documentation.
→ Customize functions in order to create special reports for selected events, such as Test and Trend Reports, Maintenance Alerts, etc.
→ Integrate the Electronic Serial Number (ESN) Programming Tool.

The PST tool is protected against unauthorised use with usernames and passwords. 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).

TECHNICAL REQUIREMENTS

Operating System
Windows 8, 7, XP or Vista

RAM Memory
2 to 4 GB

Hard Drive
40 GB

Processor
Dual core processor

Ports
Ethernet

Our
Services

EKE provides services to support you from
the early stages of your project to its very end.

CONSULTING

We can help you to define specifi-
cations and to design your system
in the most efficient way. We can
also advice you on sourcing and
recommend suitable technologies
and products for the best results.
We can help with all technical as-
pect of your project.

TRAINING

We provide all the necessary
training to help you master our
technologies, including both Hard-
ware and Software. We can also
share with you our experience
and know-how to make sure you
use our products and tools as ef-
ficiently as possible.

SUPPORT

We support you during the entire
lifetime of your project. We can
help you to develop your own sys-
tem or alternatively develop it for
you. We can also assist you at the
installation, testing and commis-
sioning stages, to the extend your
require.

MAINTENANCE AND REPAIRS

We guarantee at least 30-years
of support for all our products. It
shows the faith we have in their
quality. We provide fast product
repairs, spare parts, Hardware
and Software upgrades, support
contracts and on-site technical as-
sistance.

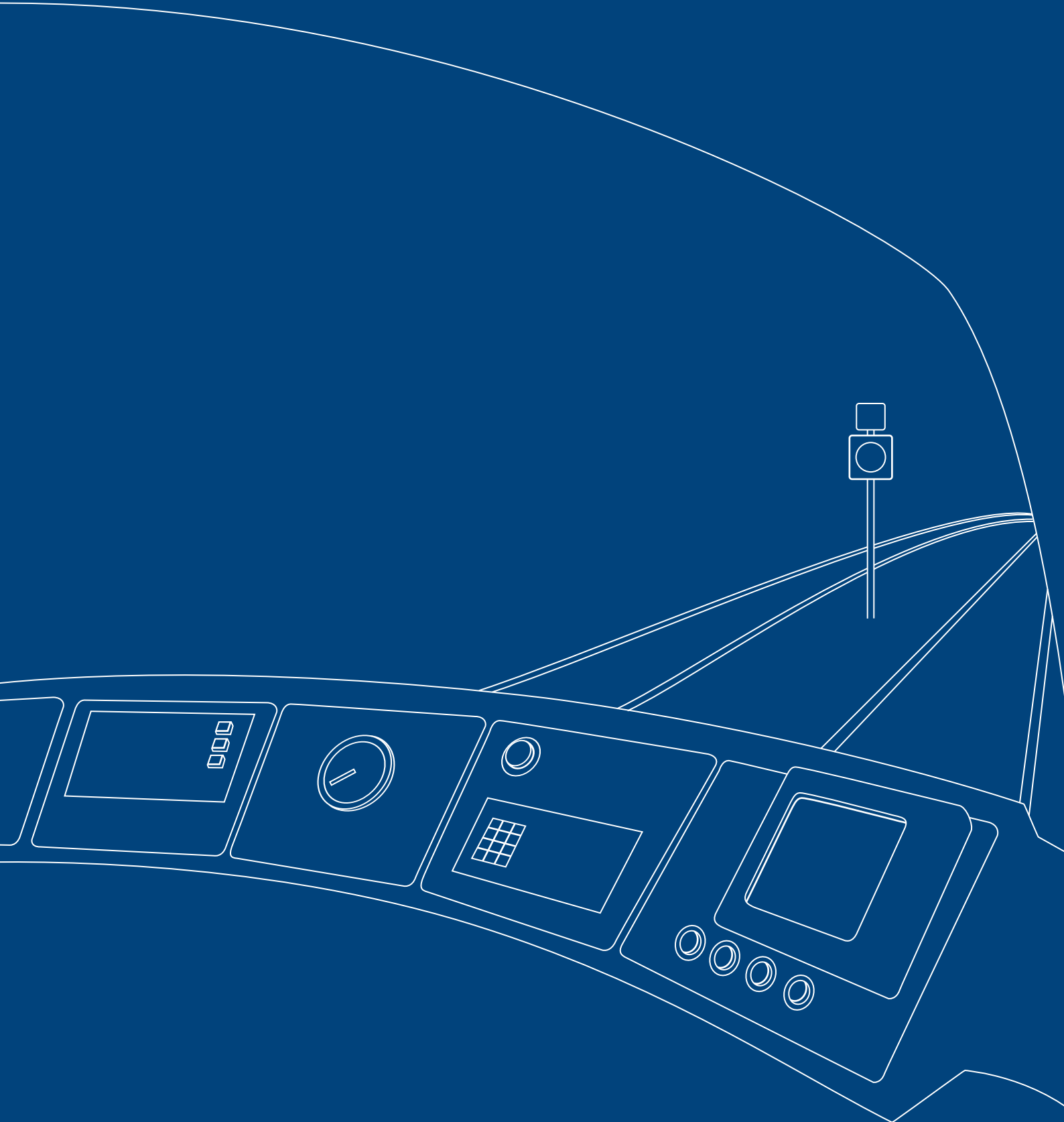SPECIFICATIONS   SOURCING   DEVELOPMENT   INSTALLATION   COMMISSIONING   MAINTENANCE

Applications

Automation Applications

Trainnet® onboard computers can be used to automate the entire trains. Applications can be developed with the ISaGRAF PLC Software or in C-language. You can freely develop your own applications or let EKE do it for you.
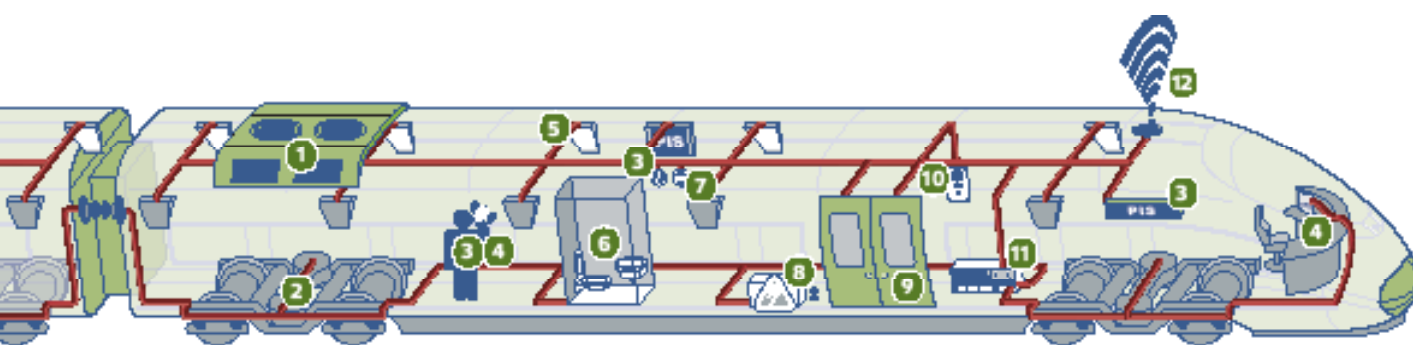
CONTROL AND MONITORING

Trainnet® TCMS and VCU can run applications used for the control and monitoring of train sub-systems. For diagnostics, applications can be designed to issue warnings when preset limits are crossed or in case of technical error. The applications can even be programmed to give instructions or take corrective actions automatically. Such applications reduce response times and increase train availability. Controlled sub-systems and functions may include:

→ **HVAC** (heating, cooling, air flow monitoring, fresh air intake management, condensation and evaporation monitoring etc.)
→ **Doors** (opening, closing, locking, jammed door detection etc.)
→ **Lights** (on/off, dimming, day/night setup implementation etc.)
→ **CCTV** (camera status, automatic display relelant screen to the driver in case of incident etc.)
→ **Water tanks** (levels of fresh water and used water etc.)
→ **Batteries** (charge / discharge monitoring etc.)
→ **Brakes and traction** (status, brake temperature, traction effort etc.)
→ **PIS/PA**

AUTOMATIC INAUGURATION

With an automatic train inauguration, consists can be connected, disconnected or switched without jeopardizing the train operations. The train configuration changes are automatically detected and the Train Communication Network (TCN) continue to work flawlessly. WTB and Ethernet Train Backbone technology supports such dynamic configuration. EKE has also developed an application Software enabling automatic train inauguration when using MVB as a train backbone for communicattion.

TRAINNET® TRAIN APPLICATIONS, FOR THE MONITORING, CONTROL AND/OR AUTOMATION OF:

1. HVAC
2. Bearing temperature (SIL-2)
2. Speed measurement (SIL-2)
2. Lateral vibration (SIL-2)
2. Brakes
2. Traction
3. PIS/PA
4. Diagnostics
5. Lights
6. Water tanks
7. CCTV
8. Batteries
9. Doors
10. Emergency communications
11. Data procedion (event recorder)
12. Train-to-wayside communications

Safety Integrity Level (SIL)

SIL	EN 50126
	EN 50128
	EN 50129

SIL is an indicator of the relative risk-reduction provided by a safety function. We help you develop SIL functions to make your trains safer and more reliable.

EKE-Electronics has expertise in designing and manufacturing systems with Safety Integrity Level (SIL) functions. We have developed systems up to SIL-2 for various safety functions, including speed measurement, temperature measurement and door operation.

STANDARDS

The SIL notion results directly from the IEC 61508 standard which is not railway specific. For the rail industry, CENELEC has developed the EN 50126, EN 50128 and EN 50129 standards which were derived from the IEC 61508 to meet railway specific requirements. Following the CENELEC standards ensures compliance with the IEC 61508.

WHY IMPLEMENTING SIL

The development of Safety Integrity Levels fulfils the need for more approachable and systematic safety management. The SIL probabilistic approach helps to determine the risks associated with a safety function, system or component and to set an acceptable risk level for it.
Four Safety Integrity Levels are defined, ranging from SIL-1 to

SIL-4:

	TFFR**
SIL-1	10^{-5}-10^{-6}
SIL-2	10^{-6}-10^{-7}
SIL-3	10^{-7}-10^{-8}
SIL-4	10^{-8}-10^{-9}

*TFFR: Tolerable functional failure rate per hour

As described in the table above, SIL-4 provides the lowest functional failure rate and is reserved for highly critical safety functions that may cause severe casualties and must be prevented at all costs. For most safety functions in a train, SIL-1 or SIL-2 will provide acceptable risk levels. No matter the level, SIL functions contribute to make your trains safer.

WORKING WITH EKE

We can develop SIL applications for you, or alternatively, provide training and guidance to help you develop your own applications.

APPLICATIONS

Safety Integrity Levels can be assigned to virtually any function presenting a safety risk in your train. For example, we have developed the following SIL applications:

SIL-1 | Speed monitoring and display

Analysis of several speed measurements and display of the value to the train crew.

SIL-2 | Monitoring of axle box bearing temperature

Measurement of the axle bearing grease box temperature. Safe Contact Digital Output. Redundant measurement.

SIL-2 | Train speed measurement

Measurement of train speed in bogie and rodal. Safe Contact (CS) Digital Output. Redundant system.

SIL-2 | Lateral acceleration monitoring

Measurement of acceleration peaks in bogie and rodal. Safe Contact (CS) Digital Output. Redundant system.

SIL-2 | Fire detection system monitoring

Reading fire detection signals and SIL-2 data transfer via MVB. Redundant system.

SIL-2 | Safety communication management

Receive, handle and send safety communication data such as temperature pattern, speed data. Validate train configuration information. Redundant system.

### SIL-2 | ASDO (Automatic Selective Door Operation)

Bringing flexibility by enabling customized door opening based on platform and safety requirements.

SIL-2 | Brake pipe pressure monitoring

Monitoring of the status of the main brake pipe pressure of the brake system.

SIL-2 | Supervision of traction enabling

Supervision and decision of enabling the traction based on the received status of the traction manipulation devices.
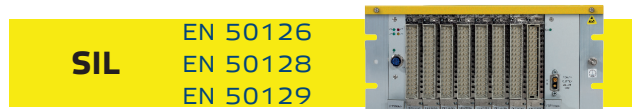
Monitoring of axle box bearing temperature

FUNCTIONS

Failed bearings on rolling stocks present important safety risks, potentially leading to catastrophic events such as derailment or fire. A rise in the heat generated by a bearing is found to be a good predictive diagnostic of a bearing about to fail.

Thus, monitoring the hot axle box bearing temperature with Train-net® improves train safety by detecting wheelset bearings presenting a risk of failure.

ONBOARD MONITORING OF AXLE BOX BEARING TEMPERATURE

The European standard EN 15437 defines methods for axle box condition monitoring. The method of monitoring hot axle box bearing temperature by on-board systems is illustrated at the bottom of the page.

On-board monitoring was developed to overcome number of limitations of the HABD trackside systems. Firstly, the temperature monitoring is continuous whereas track equipment only measure at one point in time, when the train passes by. Also, the track equipment is used for all trains with no possibility to develop specific solution depending on the train type, bogie design, bearing property, and so on while the on-board system can be tailored to match the train characteristics.

The rolling bearing temperature can be monitored directly. However, the most common setup up is to monitor the hot axle box temperature, or more precisely, the grease temperature.

The Trainnet® system monitors the bearing temperature at all times *via* temperature sensors. Acceptable temperatures and temperature variations are set in the system: any value deviating from the norms will trigger alarms and, potentially, actions to guarantee safety.

SAFETY INTEGRITY LEVEL (SIL)

The Trainnet® system for on-board monitoring of axle box bearing temperature can be certified up to SIL-2.

AXLEBOX BEARING TEMPERATURE MONITORING
BY ONBOARD EQUIPMENT
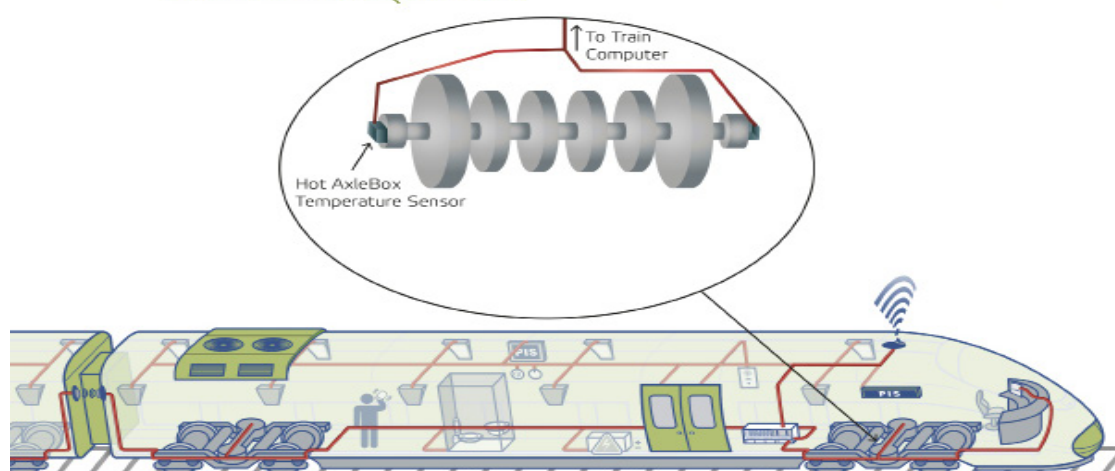
Lateral Acceleration Monitoring (LAM)

The Trainnet® Lateral Acceleration Monitoring (LAM) system contributes to improve safety and passenger comfort.

FUNCTIONS

The Trainnet® Lateral Acceleration Monitoring (LAM) onboard system measures lateral vibrations. Vibrations can have multiple sources, including engines, suspensions, wheelsets, tracks etc. Sensors can be placed in the bogie or on the car body.

KEY FEATURES

The vibrations measured by the acceleration sensors are converted into lateral accelerations values. The data from sensors can be processed in various ways, for example by following methods defined in the industry standard UIC 518:2009. Criteria for acceptable lateral accelerations are defined by setting up threshold values which can be obtained from standards or by performing online testing.

Several levels of alarms can be set, either to notify maintenance teams about abnormalities or even to automatically stop the train in case of immediate danger. In most cases, abnormalities can be detected before the issue represents a safety risk. The Trainnet® LAM is then used as a predictive maintenance tool, allowing for better maintenance planning. To increase reliability further, the system can be redundant.

IMPROVING SAFETY & COMFORT

Excessive train lateral vibration undermines passenger comfort. Some passenger may even tumble and injure themselves. When sensors are placed on the car body, the Trainnet® Lateral Acceleration Monitoring (LAM) system enables control over train stability, thus improving passenger comfort and safety.

PREVENTING DERAILMENT

With sensors placed in the bogies, wheelset stability on the tracks can be monitored by the Trainnet® Lateral Acceleration Monitoring (LAM) system. Preventing excessive lateral movements of wheels contributes to prevent damages to the train and possible derailment. The measured lateral acceleration can provide information on wheelset conditions, enabling improved maintenance planning. It may also provide insight to identify track damages when equipped with a GPS or other positioning system.
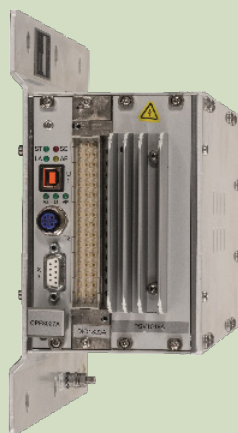
SAFETY INTEGRITY LEVEL (SIL)

Lateral Acceleration Monitoring is a safety critical function commonly developed as SIL-2.

SIL stands for Safety Integrity Level and is a concept defined in the IEC 61508 standard. For the rail industry, the CENELEC has developed the EN 50126, EN 50128 and EN 50129 standards.

Version with CAN interface module and extra logging memory

Vigilance Control System (vcs)

FUNCTIONS

The Trainnet® Vigilance Control System (VCS) can also be referred to as Dead Man's Switch or Driver Safety Device (DSD). The Trainnet® Vigilance Control System (VCS) increases train safety by checking the train driver vigilance at all times. When the driver experiences a loss of consciousness, death or any physical issues preventing him to react, the train is automatically stopped.

KEY FEATURES

In practice, the train driver notify his vigilance by pressing onto a pedal or a dedicated momentary push button, thus sending a signal to the Trainnet® Vigilance Control System (VCS). The VCS can also monitor other actions, based on your needs.

In case the VCS stops receiving signals, alarms are activated according to a predefined schedule. The first alarm is a blinking light (T1). Should the driver fail to respond within the allowed time frame, a bell ring will be heard (T2). Finally, if still no action is detected from the driver, the Trainnet® VCS will automatically send command for train emergency braking to ensure passengers' safety (T3). Automatic braking is also triggered if the Trainnet® VCS is powered off.

The Trainnet® Vigilance Control System can be easily customized, should you need different alarms or a modified setup. For instance, the times T1, T2 and T3 can be configured based on your requirements. It is also possible to set a minimum speed under which the system is not activate (e.g. 10 km/hour). The system can be used standalone or used as part of a more comprehensive Trainnet® system.

The modularity of the system allows you to add as many input and output channels as you wish, by simply adding new modules and/or choosing a larger rack. The VCS can also store the status of vigilance, events and signals, acting as an event recorder. Messages can also be sent to the wayside if the train is equipped with the appropriate system.

SIL CERTIFICATION

The Trainnet® VCS can be certified up to SIL-2.

Schematic view of the Trainnet® Vigilance Control System (VCS). Please note direct cabling to sub-systems like brakes are just for illustration purposes.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
107 x 229 x 215 mm

Weight:
2.3 Kg

Input Voltage
24, 36, 48, 52,72 or 110 V DC

Temperature Range (operational)
-40 ºC...+70 ºC

MTBF (40 ºC ambient temperature)
290 316 h

Ingress Protection (IP) rating:
20 (up to IP 67 as an option)

Input/Output Module:
See Trainnet® DIO module datasheet

Central Processing Unit (CPU):
See Trainnet® CPS module datasheet

Power Supply:
See Trainnet® PSV and Trainnet® PIU module datasheets

Logging memory:
512 MB (4 GB as an option)

EKE can provide suitable push-buttons, pedals, buzzers and alarm lights on request.

Automatic Selective Door Operating system (ASDO)

FUNCTIONS

ASDO stands for Automatic Selective Door Operation or Operating system. ASDO was primarily developed to improve passenger operation at stations where the platforms are shorter than the trains.

Without ASDO, trainsets with one or several doors not facing the platform would commonly remain shut, forcing passengers to board or leave the trains through other trainsets. In addition, the selection of the doors to be opened is usually done manually, with a risk to open the wrong doors.

ASDO enables an automatic check of the train position and the platform configuration: only doors safe to be opened are released, thus enhancing passenger comfort and safety while allowing for shorter stops at stations.

SAFE DOOR OPENING

The ASDO system first checks the platform configuration to ensure doors will only be opened at the right places.

Beacons are usually positioned on the tracks to inform the train about its position and about the platform configurations. Other source of information such as odometry or GPS positioning can be used to identify the stations and to determine how many doors shall be opened and on what side(s) of the train.

SAFETY INTEGRITY LEVEL (SIL)

The Trainnet® ASDO can be certified up to SIL-2.
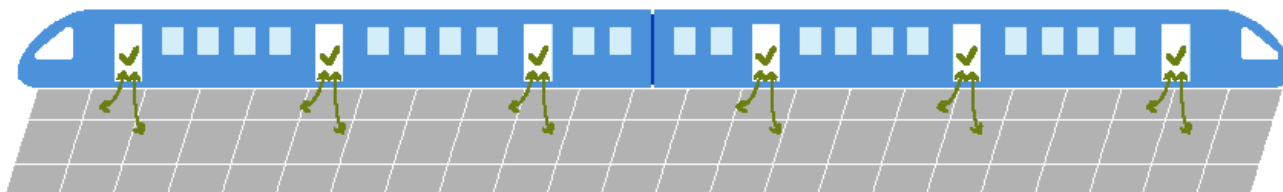
(A) Train calling at a station with long enough platform

(B) Train calling at a station with shorter platform, without ASDO

(C) Train calling at a station with shorter platform, with ASDO

SmartVision™: Condition based maintenance for trains, trams, metros and track infrastructure

SmartVision™ is is an advanced system for remotely monitoring the health of trains, their subsystems and track infrastructure. It provides a complete condition monitoring solution enabling the implementation of condition-based maintenance.

TRAIN CONDITION MONITORING
Collect diagnostics data from onboard systems and add sensors to critical components to enable condition-based and predictive maintenance.

TRACK CONDITION MONITORING
Monitor continuously the condition of track infrastructure from in-service trains to apply the correct maintenance actions at the right time.

MONITORED SYSTEMS

SmartVision™ comprehensively monitors and analyses many elements of the rolling stock and track infrastructure: bogies, wheel bearings, track, door, HVAC, engines etc, with the objective of generating diagnostic and remaining useful life forecasts based on asset health.

**Bogies**   **Wheel bearings**   **Track**   **Doors**   **HVAC**   **Engines**   **Other**

Customised Applications
The SmartVision™ software suite together with the onboard EKE-Trainnet® solutions have been applied in customer projects to provide additional functionalities. Examples include remote software version control and downloading, passenger information system announcement creation, downloading a remote view of the train driver's display and remote inspection of event recorder data.

# SmartVision™ train condition monitoring

SmartVision™ collects data from management and diagnostic systems of trains, metros, trams and/or from additional sensors installed to monitor such assets where condition monitoring brings added value in the form of reduced maintenance costs or improved operations. Based on the collected data, SmartVision™ helps operators or maintainers to understand the status of their fleets and thus make the right decisions regarding operations and maintenance on a daily basis as well as identify developing failures at an early stage to be able to manage the maintenance process based on the condition of the assets.
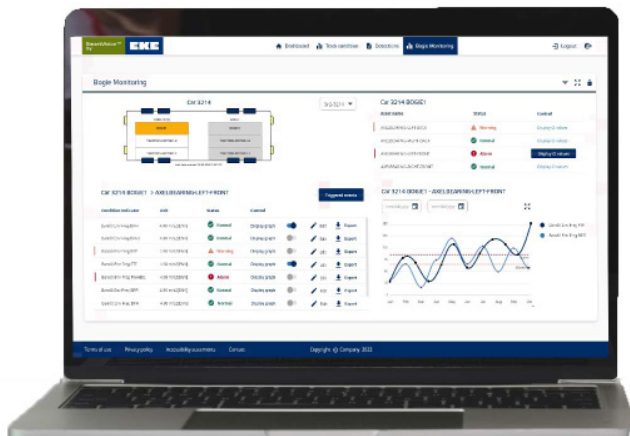

SmartVision™ track condition monitoring

SmartVision™ Track Condition Monitoring measures the smoothness of ride experienced by a normal in-service train passing in full load and with full speed over the track. These frequent measurements complement less frequently produced track geometry measurements from measurement trains. Sudden and quickly developing problems, such as broken rails or damage caused by wheel slip are detected. Early detection can result in a cheaper cost of repair and reduces the risk of secondary damage.

A key enabler for the condition monitoring of track assets is the SmartVision™ Rail Asset Database. This records the type and location of track assets so that the degradation of the asset's condition can be followed. The user receives notifications of critical changes so that the correct action can be taken in the correct location at the correct time.
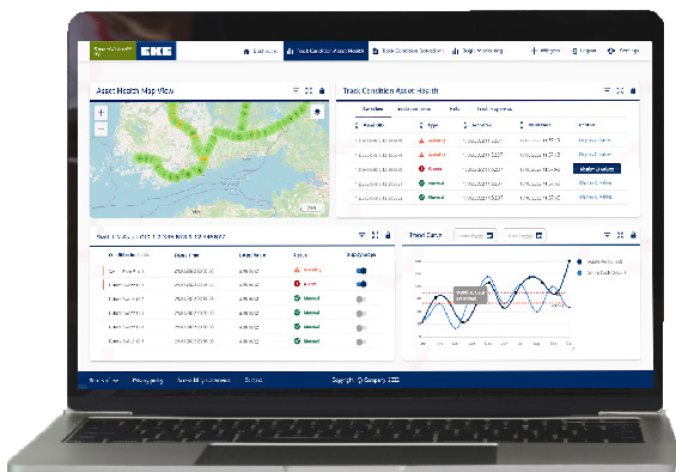
Modules
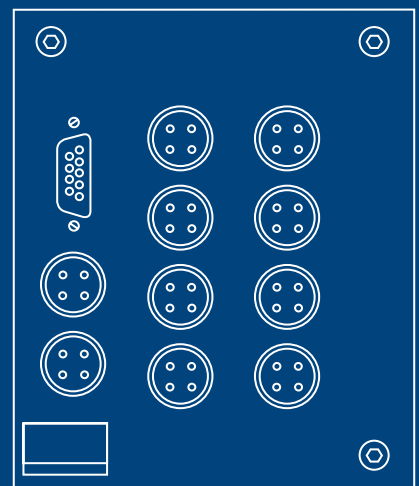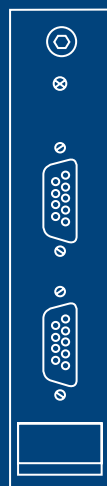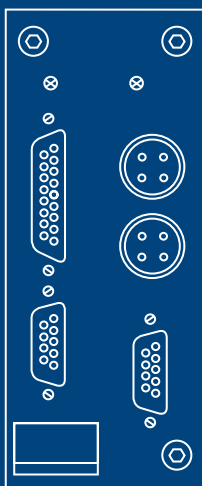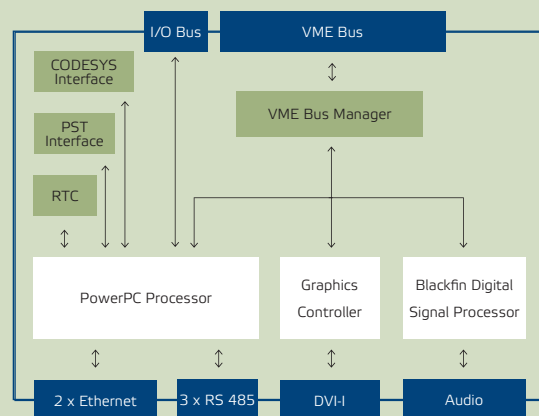
Central Processing Unit with Graphical Display Controller (CPG)

EN 50155
EN 45545
IEC 61131

MODULE FUNCTIONS

Trainnet® CPG can be used as a processor to manage train computers and sub-systems connected to them. It integrates a graphical display controller that supports both analogue and digital displays. It can also be used to manage the display of video surveillance recordings. The Trainnet® CPG module is also capable of storing digital media content such as audio announcements in a compressed format for on-board use.

The Trainnet® CPG can be used to develop, store and run applications for the control and diagnostics of on-board systems, making it suitable to develop Train Control and Management Systems (TCMS) or VCU. It can also implement Gateway functionnalities by providing the necessary interfaces and routing capabilities.

KEY FEATURES

The Digital Signal Processor of the Trainnet® CPG is dedicated for video and audio processing. The Digital Visual Interface (DVI-I) combines both analogue and digital signals and can be directly connected to DVI displays with resolutions up to 1024 x 768

pixels. Touch screens can be connected either through an isolated RS 485 interface or a DVI-cable when using Trainnet® Human Machine Interface (HMI). The audio interface line output can be used to drive audio announcement systems. The interface is isolated on the digital side in order to provide the best audio quality.

Three programmable isolated asynchronous or bit-synchronous SCC channels are available (RS 485) for the connection to compatible devices in the train.

Two 10/100 Mbit/s Full Duplex Ethernet interfaces can be used to connect to any Ethernet Communication Network, typically connecting the CPG with switches or other electronic racks. The Ethernet interfaces can also be directly connected to any Ethernet enabled devices (e.g. network cameras). A bridge between two channels is also supported. The number of Ethernet interfaces can be increased with one of the Trainnet® Ethernet Switches.

The CODESYS® PLC kernel embedded in the CPU acts as the CPU's operating Software.

Train management applications can be developed with the CODESYS® PLC Software in order to create the desired control and diagnostic functions of the train. The open platform runs on the Linux Operating Software and supports further Software development in C language, either as an CODESYS® extension or on top of the module's Linux kernel. The PowerPC processor provides enough processing power for demanding applications with 400 MHz core speed and 64 megabytes of 64-bit wide 100 MHz SDRAM.

A PST interface (usually serial link or Ethernet) enables the use of the Trainnet® Portable System tester (PST) as well as other tools for event log operations, maintenance, debugging, downloading and application development purposes.

The Trainnet® CPG real-time clock is powered by a back-up capacitor and will run for a minimum of 30 days from the time power is no longer applied.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
8 TE x 3 U x 160 mm
Weight: 300 g
Input Power: 5 V DC ± 5 % (1.5 A max., 1 A typ.)
Temperature Range (operational)
-40 ºC...+70 ºC
MTBF (40 ºC ambient temperature)
770 000 h (CPG1824A)
Video Interface
DVI-I; Single TMDS digital output and analogue RGB
Resolution up to 1024 x 768
Audio Interface
Isolated stereo audio line output
0 – 700 mVRMS to 10 kΩ load
Touch Screen Interface
Integrated RS 485 on DVI interface
Serial Interfaces
2 isolated RS 485 on front
(3 if not using the Touch Screen Interface)
1 RS 232 on front
(for maintenance, configuration or ESN dongle)
1 RS 485 on back for I/Obus connectivity
Ethernet Interfaces
2 x 10/100 Mbit, M12 connectors
Boot Flash Memory: 8 MB
File System Flash Memory
512 MB (On request up to 2 GB)
Processor RAM
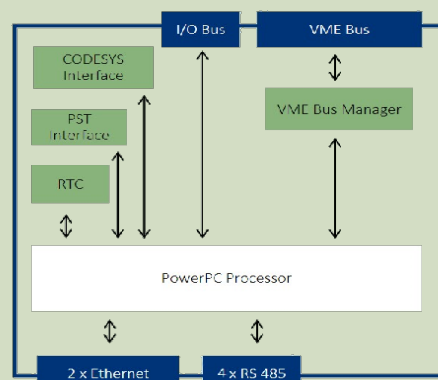64 MB
Graphics Controller RAM
32 MB
Digital Signal Processor RAM
16 MB
VME Bus (IEC 821) Interface
A24/D16 Master or Slave

Central Processing Unit with Dual Homing (CPD)

MODULE FUNCTIONS

The Trainnet® CPD can be used as a processor to manage train computers and sub-systems connected to them. The Trainnet® CPD module is also capable of storing digital media content.

The Trainnet® CPD can be used to develop, store and run applications for the control and diagnostics of on-board systems, making it suitable to develop Train Control and Management Systems (TCMS) or VCU. It can also implement Gateway functionalities by providing the necessary interfaces and routing capabilities.

KEY FEATURES

The Dual Homing feature of CPD is realised by two 10/100 Mbit/s Full Duplex Ethernet Interfaces that can be used to connect to any Ethernet Communication Network, typically connecting the CPD with switches or other electronic equipment. The Ethernet interfaces can also be directly connected to any Ethernet enabled devices (e.g. network cameras). A bridge between two channels is also supported. The number of Ethernet interfaces can be increased with one of the Trainnet® Ethernet Switches.

Four programmable isolated asynchronous or bit-synchronous SCC channels are available (RS 485) for the connection to compatible devices in the train.

The CODESYS® PLC kernel embedded in the CPU acts as the CPU's operating Software. Train management applications can be developed with the CODESYS® PLC Software in order to create the desired control and diagnostic functions of the train. The open platform runs on the Linux Operating Software and supports further Software development in C language, either as a CODESYS® extension or on top of the Linux kernel of the module. The PowerPC processor provides enough processing power for demanding applications with 400 MHz core speed and 64 megabytes of 64-bit wide 100 MHz SDRAM.

The Trainnet® Portable System Tester (PST) interface (usually serial link or Ethernet) enables the use of the PST as well as other tools for event log operations, maintenance, debugging, downloading and application development purposes.

The Trainnet® CPD real-time clock is powered by a back-up capacitor and will run for a minimum of 30 days from the time power is no longer applied.

The Trainnet CPD has extended event logging flash memory with 4 GB capacity. The Trainnet CPD can act as a low cost event recorder when limited protection is required.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
8 TE x 3 U x 160 mm
Weight: 300 g
Input Power: 5 V DC ± 5 % (1.5 A max., 1 A typ.)
Temperature Range (operational)
-40 ºC...+70 ºC
MTBF (40 ºC ambient temperature)
1 320 000 h (CPD5594A)
Serial Interfaces
An isolated group of 4 RS 485 on front
1 RS 232 on front
(for maintenance, configuration or ESN dongle)
1 RS 485 on back for I/Obus connectivity
Ethernet Interfaces
2 x 10/100 Mbit, M12 connectors
Boot Flash Memory
8 MB
File System Flash Memory
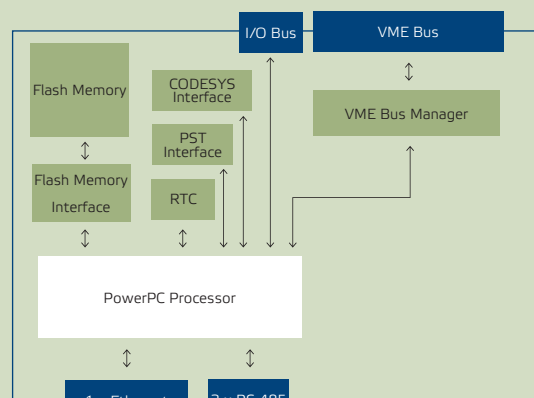512 MB
Event Logging Flash Memory
4 GB
Processor RAM
64 MB
VME Bus (IEC 821) Interface
A24/D16 Master or Slave

Central Processing Unit
with Serial Links (CPS, CPF)

EN 50155
EN 45545
IEC 61131

MODULE FUNCTIONS

The Trainnet® CPS can be used as a processor to manage train computers and sub-systems connected to them.

The Trainnet® CPS can be used to develop, store and run applications for the control and diagnostics of on-board systems, making it suitable to develop Train Control and Management Systems (TCMS) or Vehicle Control Units (VCU). It can also implement Gateway functionnalities by providing the necessary interfaces and routing capabilities.

KEY FEATURES

The Trainnet® CPS Module is a processing unit providing serial communication interfaces. Three (four as an option) programmable isolated asynchronous or bit-synchronous SCC channels are available (RS 485) for connection to compatible devices in the train.

A 10/100 Mbit/s Full Duplex Ethernet interface can be used to connect to any Ethernet Communication Network, typically connecting the CPS with switches or other electronic

racks. The Ethernet interface can alternatively be directly connected to any Ethernet enabled devices (e.g. network cameras). The number of Ethernet interfaces can be increased with one of the Trainnet® Ethernet Switches.

The CODESYS® PLC embedded in the CPU acts as the CPU's operating Software. Train management applications can be developed with the state-of-the-art CODESYS® PLC Software in order to create the desired control and diagnostic functions of the train. CODESYS execution is fast supporting low cycle times. It supports the IEC 61131-3 languages to best suit the use-case.

The platform runs on the Linux Operating System and supports further Software development in C language, either as a CODESYS extension or on top of the module's Linux kernel. The PowerPC processor provides enough processing power for demanding applications with 400 MHz core speed and 64 megabytes of 64-bit wide 100 MHz SDRAM.

A PST interface (usually serial link or Ethernet) enables the use of the Trainnet® Portable System tester (PST) as well as other tools for event log operations, maintenance, debugging, downloading and application development purposes.

The Trainnet® CPS real-time clock is powered by a back-up capacitor and will run for a minimum of 30 days from the time power is no longer applied.

OPTIONS

Event logging memory:
the Trainnet® CPF are similar to Trainnet® CPS with an extended event logging flash memory capacities (16 GB or 4 GB vs 512 MB). Trainnet® CPF can act as low cost event recorders when limited memory and protection are required. The Trainnet® CPF modules have all the features of the Trainnet® CPS.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
4 TE x 3 U x 160 mm

Weight
255 g

Input Power
5 V DC ± 5 % (1.5 A max., 1 A typ.)

Temperature Range (operational)
-40 ºC...+70 ºC

MTBF (40 ºC ambient temperature)
1 340 000 h

Ethernet Interface
1 x 10/100 Mbit M12 connector

Serial Interfaces
3 isolated RS 485 on front
1 RS 485 on back for I/Obus connectivity

Boot Flash Memory
8 MB

File System Flash Memory
512 MB

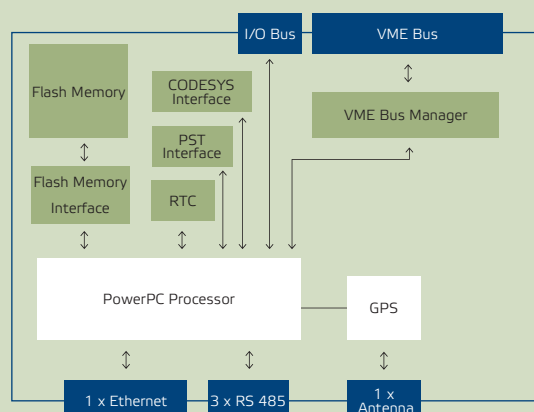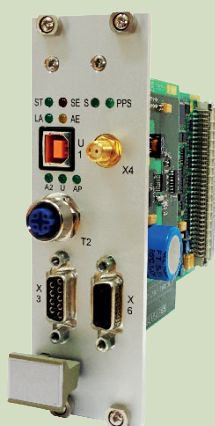**Event Logging Flash Memory**
512 MB (CPS2258B)
4 GB (CPF3027B)
16 GB (CPF357B)

Processor RAM
64 MB

VME Bus (IEC 821) Interface
A24/D16 Master or Slave

CPU with Serial Links and GPS
(CPS-GPS, CPF-GPS)

EN 50155
EN 45545
IEC 61131

MODULE FUNCTIONS

The Trainnet® CPS-GPS can be used as a processor to manage train computers and sub-systems connected to them. It integrates a GNSS receiver to provide location and time information for synchronisation with the processed data.

The Trainnet® CPS-GPS can be used to develop, store and run applications for the control and diagnostics of on-board systems, making it suitable to develop Train Control and Management Systems (TCMS) or Vehicle Control Units (VCU). It can also implement Gateway functionalities by providing the necessary interfaces and routing capabilities.

KEY FEATURES

The Trainnet® CPS-GPS Module provides serial communication interfaces. Three (four as an option) programmable isolated asynchronous or bit-synchronous SCC channels are available (RS 485) for connection to compatible devices in the train.

A 10/100 Mbit/s Full Duplex Ethernet interfaces can be used to connect to any Ethernet Communication Network, typi-cally connecting the CPS-GPS with switches or other electronic racks. The Ethernet interface can alternatively be directly connected to any Ethernet enabled devices (e.g. network cameras). The number of Ethernet interfaces can be increased with one of the Trainnet® Ethernet Switches.

A USB Host Interface is provided to connect memory sticks or other devices for maintenance purposes. B-type connector is used to protect unattended usage (special tools required).

The CODESYS® PLC kernel embedded in the CPU acts as the CPU's operating Software. Train management applications can be developed with the CODESYS® PLC Software in order to create the desired control and diagnostic functions of the train. The open platform runs on the Linux Operating Software and supports further Software development in C language, either as an COD-ESYS® extension or on top of the module's Linux kernel. The Pow-erPC processor provides enough processing power for demanding applications with 400 MHz core speed and 64 megabytes of 64-bit wide 100 MHz SDRAM.

A PST interface (usually serial link or Ethernet) enables the use of the Trainnet® Portable System tester (PST) as well as other tools for event log operations, maintenance, debugging, downloading and application development purposes.

The Trainnet® CPS-GPS real-time clock is powered by a back-up capacitor and will run for a minimum of 30 days from the time power is no longer applied.

The GNSS function is available for simultaneous GPS and GLONASS or, optionally, GPS and BeiDou. CPS-GPS supports active and passive antennas.

OPTIONS

Event logging memory: the Trainnet® CPF-GPS is simply a Trainnet® CPS-GPS with an extended event logging flash memory (4 GB vs 512 MB). Trainnet® CPF-GPS can act as a low cost event recorder when limited memory and protection are required. The Trainnet® CPF-GPS has all the features of the Trainnet® CPS-GPS.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
8 TE x 3 U x 160 mm

Weight
265 g

Input Power
5 V DC ± 5 % (1.5 A max., 1 A typ.)

Temperature Range (operational)
-40 ºC…+70 ºC

MTBF (40 ºC ambient temperature)
850 000 h

Ethernet Interface
1 x 10/100 Mbit M12 connector

USB Interface
One 2.0 High Speed host, Type B connector

Serial Interfaces
3 isolated RS 485 on front
1 RS 485 on back for I/Obus connectivity

GNSS Antenna Interface
SMA

Supported GNSS
GPS+GLONASS, GPS+BeiDou

Boot Flash Memory
8 MB

File System Flash Memory
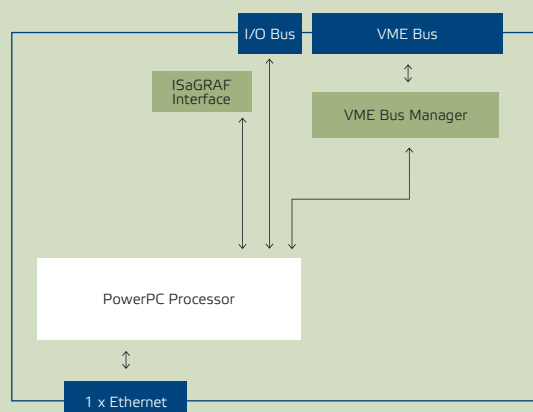512 MB

Event Logging Flash Memory
512 MB or 4 GB

Processor RAM
64 MB

VME Bus (IEC 821) Interface
A24/D16 Master or Slave

Central Processing Unit with Ethernet Bus (CPE)

EN 50155
EN 45545
IEC 61131

MODULE FUNCTIONS

The Trainnet® CPE is a straight-forward processing unit designed exclusively for Ethernet bus connectivity. It is used exclusively as a part of the Trainnet® Remote Input/Output Module (RIOM) to redirect I/O signals between the train computer (e.g. VCU) and the RIOM.

KEY FEATURES

The Trainnet® CPE comes with a 10/100 Mbit/s Full Duplex Ethernet interface that is used to connect to the Trainnet® train computer.

The Trainnet® CPE simply reads and writes I/O signals. It is able to redirect input signals from the RIOM to the train computer. The CPE can also get information from the train computer and pass it on to the RIOM I/O modules that generate output signals.

Please note that the CPE does not have a real-time clock or flash memory: it cannot be used to run train applications. It works only when it is connected to a Trainnet® train computer, typically a Gateway, VCU or TCMS.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
4 TE x 3 U x 160 mm
Weight
140 g
Input Power
5 V DC ± 5 % (1 A max., 0.5 A typ.)
Temperature Range (operational)
-40 ºC...+70 ºC
MTBF (40 ºC ambient temperature)
1 630 000 h
Ethernet Interface
1 x 10/100 Mbit M12 connector
Serial Interfaces
1 RS 485 on back for I/Obus connectivity
Boot Flash Memory
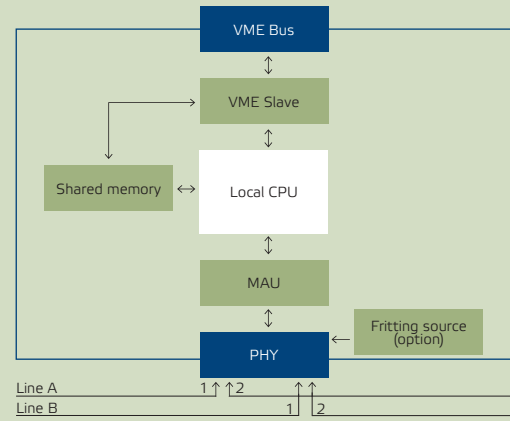8 MB
File System Flash Memory
512 MB
Processor RAM
64 MB
VME Bus (IEC 821) Interface
A24/D16 Master or Slave

Wire Train Bus
Interface Module (WTB, WTF)

EN 50155
EN 45545
IEC 61375-2-1

MODULE FUNCTIONS

Trainnet® Wire Train Bus (WTB) modules are used to create train-wide communication networks. The WTB module implements the WTB link layer functions of the IEC 61375-2-1 Train Communications Network standard. The TCN's real-time protocols, the UIC leaflet 556 specifications and the routing between the WTB and other buses are implemented by the gateway CPU Module.

KEY FEATURES

The WTB MAU supports physical cable redundancy as specified in the IEC 61375-2-1 standard. It uses TCN standard's Sub D-9 type connectors located on the front panel of the module. Communication to the gateway is done through a shared memory over the IEC 821 VME back plane bus. The WTB link layer functions are implemented by the WTB module's local processor.

The Trainnet® WTB module has a static shared RAM memory accessible from both the local CPU and the VME Bus interface. The TCN standard's source and sink port handling for WTB process data is supported. A separate memory area is reserved for message data and maintenance messages as well as for Remote Procedure Call type access to the Link Layer primitives. The WTB module is able to provide applications with timing synchronization when a Macro Period finishes.

The WTB module is realised through the highly efficient combination of a dedicated microprocessor and FPGA logic. In addition to strict compliance with the IEC 61375-1 standard, the WTB module has the capability of carrying out enhanced diagnostics functions, like monitoring the bit error ratios between individual train coaches in order to identify communication issues.

In order to handle incompatible cabling or extremely harsh operating conditions, the WTB module is able to act as a bus repeater by completely regenerating the data streams towards both extremities. Intelligent repeater management is included in the WTB module's system Software. It supports the selection of an optimal number of concurrently enabled repeaters on the train bus, thus allowing the network timing to retain undegraded specifications.

OPTIONS

Fritting voltage: The WTB bus interface sustains fritting voltage. Fritting voltage source is available as an option: see Trainnet® WTF 2259B and WTF 2376B modules.

Redundant connectors: In the basic module, the bus redundancy is integrated into a single bus connector. Separated connectors for the redundant bus are available as an option: see Trainnet® WTB 1912B and WTF 2376B modules.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
4 TE x 3 U x 160 mm (WTB1822B, first picture)
8 TE x 3 U x 160 mm (WTB1912B, second picture)
8 TE x 3 U x 160 mm (WTF1765B, third picture)
4 TE x 3 U x 160 mm (WTF2259B, fourth picture)
8 TE x 3 U x 160 mm (WTF2376B, fifth picture)

Weight
166 g (WTB1822B)
214 g (WTB1912B)
226 g (WTF1765B)
177 g (WTF2259B)
225 g (WTF2376B)

Input Power
5 V DC ± 5 % (1 A max., 0.5 A typ.)

Temperature Range (operational)
-40 ºC...+70 ºC

MTBF (40 ºC ambient temperature)
1 370 000 h (WTB1822B)
1 330 000 h (WTB1912B)
1 010 000 h (WTF1765B)
1 030 000 h (WTF2259B)
1 010 000 h (WTF2376B)

Train Bus
IEC 61375-1: WTB

Data Rate
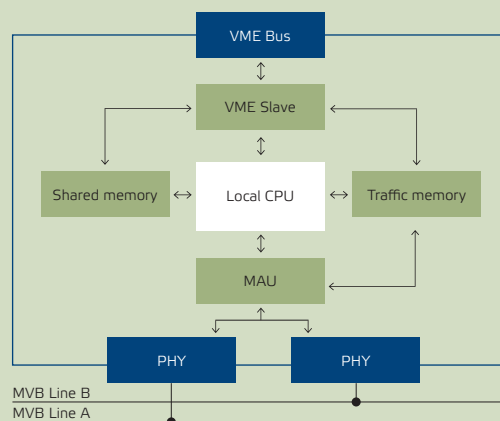1 Mbit/s (Half speed 500 kbit/s on request)

MAU
Transformer isolation
Combined or individual bus connectors

VME Bus (IEC 821) Interface
A24 Slave with D08(EO)/D16
256 kB DP RAM for process and message data

Multifunction Vehicle Bus Interface Module (MVB)

EN 50155
EN 45545
IEC 61375-3-1

MODULE FUNCTIONS

Trainnet® Multifunction Vehicle Bus (MVB) modules are used to create vehicle buses or more comprehensive train communication networks. The Multifunction Vehicle Bus Module implements the MVB link layer functions of the IEC 61375-3-1 Train Communications Network standard. The TCN's real-time protocols and the routing between the MVB and other buses are implemented by the gateway CPU Module.

KEY FEATURES

The Trainnet® Multifunction Vehicle Bus module supports physical cable redundancy and full bus master functionality as specified in the IEC 61375-3-1 standard. Bus administrator redundancy is supported on the Software level.

TCN standard's D-9 type connectors are located on the front panel of the module. Communication to the gateway is conducted through shared memory over the IEC 821 VME back plane bus. The MVB link layer functions are implemented by the MVB module's local processor. Multiple Trainnet® MVB

modules can be controlled by a single Trainnet® CPU to implement physically separated MVB networks.

The Trainnet® MVB module has static shared RAM memory accessible from both the local CPU and the VME Bus interface. A separate memory area is reserved for message data and maintenance messages as well as for Remote Procedure Call type access to the Link Layer primitives.

The MVB module is realised through a highly efficient combination of local microprocessor and FPGA logic. In addition to strict compliance with the IEC 61375-3-1 standard, the MVB module has the capability of carrying out some diagnostic functions.

OPTIONS

Physical interface. The following MVB module physical interfaces are available: Electrical Short Distance with isolation (ESD+) and Electrical Medium Distance (EMD). ESD+ and EMD come with two sub D-9 connectors.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
4 TE x 3 U x 160 mm

Weight
ESD: 160 g / EMD: 220 g

Input Power
5 V DC ± 5 % (1 A max., 0.5 A typ.)

Temperature Range (operational)
-40 ºC...+70 ºC

MTBF (40 ºC ambient temperature)
1 650 000 h (EMD, MVB1820B, left picture)
1 580 000 h (ESD, MVB2791B, right picture)

Physical Medium
Electrical Medium Distance (EMD, MVB1820B)
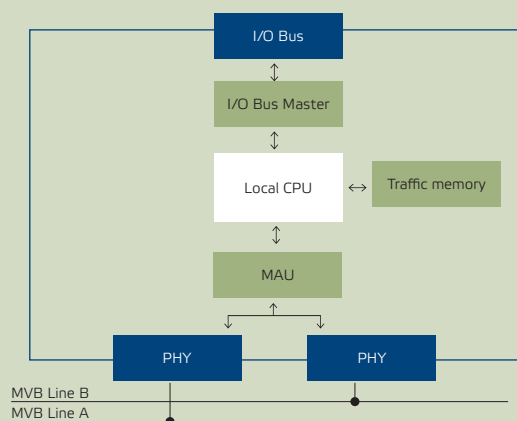Isolated Electrical Short Distance (ESD, MVB2791B)

Data Rate
1.5 Mbit/s; Manchester encoding

VME Bus (IEC 821) Interface
A24 Slave with D08(EO)/D16
246 kB SRAM and 512 kB traffic memory
for process and message data

Multifunction Vehicle Bus Remote I/O Master Module (MVR)

EN 50155
EN 45545
IEC 61375-3-1

MODULE FUNCTIONS

Trainnet® Multifunction Vehicle Bus Remote I/O Master Module (MVR) operates as a gateway between MVB and the modules connected to the EKE I/O bus. The MVR module is designed to ensure reliable data transmission on board a train. The MVR module provides a redundant MVB interface, fully compliant with the IEC 61375-3-1 Train Communication Network (TCN).

KEY FEATURES

The purpose of MVB RIOM system is to provide I/O interfaces to remote locations, utilizing MVB. The system consists of an MVR module, power module, backplane and I/O modules, such as AIO, AIM, AOM, DIO, DRO, PTI and TSI. The central system, which connects to MVB RIOM is called the Vehicle Control Unit (VCU). The VCU is a system with at least one CPU Module and an MVB module. The configuration of MVR RIOM is fully automated; it automatically detects the I/O modules, and configures itself as an MVB slave, with MVB Port Data interfaces of all connected I/O modules.

The MVB module configuration is done through the Gateway CPU, and the MVB reads it through its shared memory at the start-up of the system. For the MVB module, the configuration is read-only and it is managed by the CPU software. If any changes are made through the debug terminal, the original configuration is retained when the module is reset. The module has a Medium Attachment Unit (MAU) with an MVB FPGA which internally supports the EMD (MVR3297B) or ESD (MVR4570B) interface.

To ensure uninterrupted functionality of the Multifunction Vehicle Bus, the bus is duplicated: there are two lines through which the devices transmit data. If one line is temporarily out of order, the other line can take over and full redundancy is ensured. In this way, the flow of important data can continue without interruption even in the case of potential problems.

OPTIONS

Physical interface. There are MVR module versions available with two physical interface options: one for MVB

Electrical Short Distance RIOM (MVR4570B) up to 20 m and one for MVB Electrical Medium Distance RIOM (MVR3297B) up to 200 m cable lengths.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
4 TE x 3 U x 179 mm

Weight
155 g

Input Power
5 V DC ± 5 % (1 A max., 0.5 A typ.)

Temperature Range (operational)
-40 ºC...+70 ºC

MTBF (40 ºC ambient temperature)
1 620 000 h (MVR3297B, left picture)
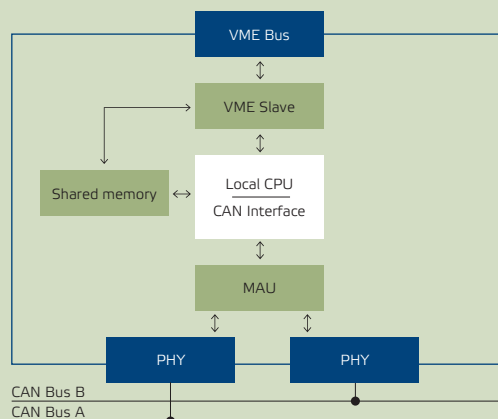1 550 000 h (MVR4570B, right picture)

Physical Medium
Electrical Medium Distance (EMD, MVR32907B)
Electrical Short Distance (ESD, MVR4570B)

Data Rate
1.5 Mbit/s; Manchester encoding

CAN Vehicle Bus
Interface Module (CVB)

EN 50155
EN 45545
IEC 61375-3-3

MODULE FUNCTIONS

The Trainnet® CAN Vehicle Bus Interface module (CVB) is used to create up to two CAN Buses in the train. The 2 CAN ports can be independently configured as CAN 2.0 A/B or CANopen®. The Trainnet® CVB module implements the CAN link layer functions. The routing between the CAN bus and other buses are implemented by the gateway CPU Module.

KEY FEATURES

The module has two CAN network connectors on the front-panel, one 9-pin sub-miniature D-type connector for each independent interface. Communication to the gateway is done through shared memory over the IEC 821 VME back plane bus. The CAN link layer functions and CAN network access are implemented with the local CPU of the CAN module. Multiple Trainnet® CVB modules can be controlled by a single Trainnet® CPU to implement physically separated CAN networks.

The Trainnet® CVB module has static shared RAM memory accessible from both the local CPU and the VME Bus interface. The CVB module is realized

through a highly efficient combination of local microprocessor and FPGA logic. The Trainnet® CAN Vehicle Bus Interface Module has the capability of carrying out some specific diagnostics functions. Interfaces are Dual CAN 2.0 B and ISO 11898 compatible with a CiA DS-102 standard pin.

OPTIONS

Bus interfaces: The Trainnet® CVB module is available as an option with integrated bus termination resistors.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
4 TE x 3 U x 160 mm
Weight
149 g
Input Power
5 V DC ± 5 % (500 mA nominal)
Temperature Range (operational)
-40 ºC...+70 ºC
MTBF (40 ºC ambient temperature)
1 880 000 h (CVB1621B CAN terminated)
1 880 000 h (CVB2456B CAN not terminated)
CAN Network Interface
Two CAN interfaces
Data Rate
Up to 1 Mbit/s
Protocol
CAN 2.0 compatible
Electrical
24 V compliant, optically isolated
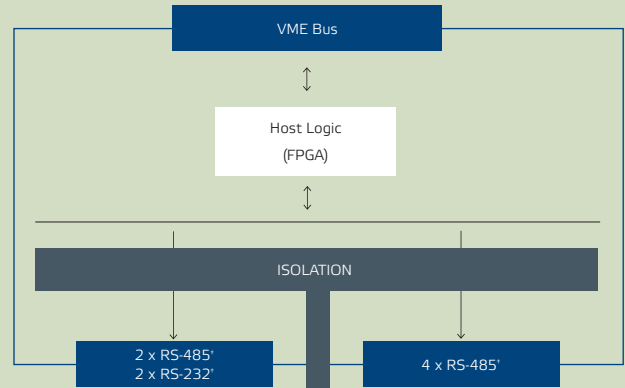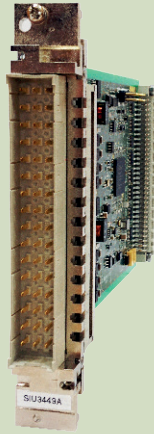**Connector**
9-pin sub-miniature D-type connector
AWG 20 STP cable recommended
Bus Termination
On board 120 Ohm termination on request
VME Bus (IEC 821) Interface
A24 Slave with D08(EO)/D16

† version SIU3449A. See table below for all options.

Serial Links
Interface Unit (SIU)

EN 50155
EN 45545

MODULE FUNCTIONS

The Trainnet® Serial Links Interface Unit (SIU) is used to implements up to eight serial links. The physical layer level and parts of data link layer are implemented within SIU and higher protocol layers are implemented on the system CPU.

For gateway applications, the routing between the Serial Link buses and other buses are implemented by the train computer CPU module.

KEY FEATURES

The module has one DIN41612-F48 connector on the front-panel where Serial Links can be connected. Serial links are split in two identical groups which are isolated from the FPGA and from each other. In each group there are four Serial Links that can be configured in different ways according to the table below.

Communication between the module and the train computer/system is done through shared memory over the IEC 821 VME back plane bus.

The Trainnet® SIU module provides 2 kByte long RX and TX double buffers for each serial link. The system CPU can access these buffers through the VME shared memory. A dedicated FPGA controls precise timing for all eight channels in parallel and provides convenient double buffering for the system CPU. This guarantee high performance in demanding safety critical applications.

OPTIONS

The Trainnet® SIU comes in 2 different versions offering different Serial Interface combinations. Please consult the table below for specifications. Other configurations are available upon request.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
4 TE x 3 U x 160 mm

Weight
140 g

Input Power
5 V DC ± 5 % (250 mA typ., 400 mA max.)

Temperature Range (operational)
-40 ºC...+70 ºC

MTBF (40 ºC ambient temperature)
2 600 000 h

Connector
DIN41612-F48 (at front)

Serial Link Interfaces
2 isolated groups
See table for all options

FPGA Shared Memory
TX buffers: 8 x 2 x 2 kB
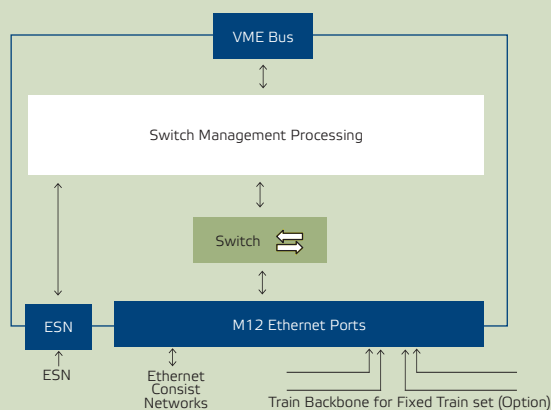RX buffers: 8 x 2 x 2 kB

VME Bus (IEC 821) Interface
A24 Slave with D08(EO)/D16

STANDARD SIU MODULES:

MODULE REFERENCE	RS-485 HALF OR FULL DUPLEX*	RS-232**
SIU3448A	8	0
SIU3449A	6	2

* The RS-485 Full Duplex can be used for RS-422 applications
** Optional handshake signals

Compact Ethernet Switching Unit (3U ESU)

EN 50155
EN 45545
IEC 61375-3-4

MODULE FUNCTIONS

The Trainnet® Compact Ethernet Switching Unit (3U ESU) is a versatile Ethernet switch module suitable for building cost effective Ethernet Consist Networks (ECN). It can also be used to create an Ethernet train bus in the case of a fixed train set when there is no need for automatic inauguration.

The Trainnet® 3U ESU module implements the ECN link layer function of the IEC 61375-3-4 Train Communications Network Standards. The Ethernet technology's large bandwidth (typically 100 Mb/s) is particularly suitable for data intensive systems like video surveillance or Passenger Information Systems.

KEY FEATURES

The Trainnet® 3U ESU non-blocking (QoS Layer 2) switching architecture provides large bandwidth: it has 10 Ethernet ports which are 10/100BASE-TX Mbit/s Full Duplex Ethernet with auto MDI/MDIX M12 connectors. The Ethernet ports are located on the front panel of the module and communication to the gateway is done *via* one of the Ethernet ports. An Electronic Serial Number (ESN) port

is available for device identification and configuration.

The car can be equipped with two redundant Trainnet® 3U ESU modules in order to increase system reliability. If the principal module fails, the secondary module takes over the functionality.

The Trainnet® 3U ESU provides connectivity to the consist network switches in a ring configuration (allows redundancy), or by connecting ports directly to end devices. The switch provides services such as Dynamic Host Configuration Protocol (DHCP) in order to assign IP addresses automatically to end devices. The management processor also provides VLAN configurations and Layer 3 switching. It enables diagnostic functions such as the identification of faulty cables.

The 10 ports of the 3U ESU can be partitioned to create distinct ECN subnets using a virtual router. The device also supports dynamic routing protocols. The possibility of using link aggregation provides an opportunity to increase data transfer capabilities as well to create

redundancies.

Port mirroring can be used to copy packet data seen on a switch port to another port for diagnostic and monitoring purposes.

FEATURE SUMMARY

The features of the 3U ESU module also include: Firewall, Rapid Spanning Tree Protocol (RSTP), Virtual LANs, routing multicasts in ECN and ETB networks (IGMP based multicast forwarding), Train Topology Discovery Protocol (TTDP), TCN domain name service, Port based VLAN configuration, routing between Virtual LANs, Network Address Translation (NAT) between ETB and ECN, rate limiting, port monitoring, port RMON statistics counters, PHY configuration and process data export.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
16 TE x 3 U x 160 mm

Weight
520 g

Input Power
5 V DC ± 5 % (1.5 A typ. 3 A max.)

Temperature Range (operational)
-40 ºC...+70 ºC

MTBF (40 ºC ambient temperature)
690 000 h

Ethernet Interfaces
10 x 10/100 Mbit/s M12

Serial Interface
1 RS 232 on front
(for maintenance, configuration or ESN dongle)
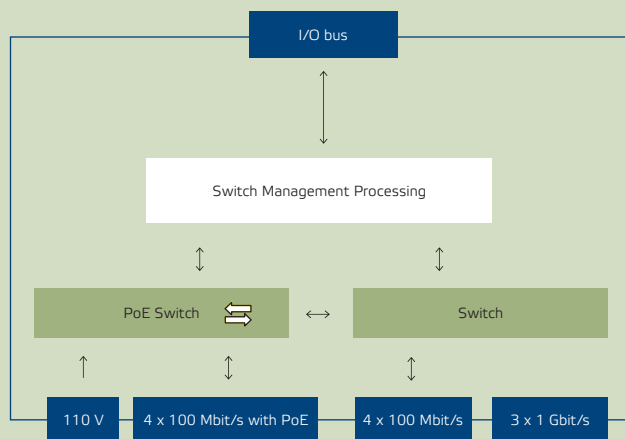
Switching Buffer Memory
2 Mbits

Management CPU
PowerPC 667 MHz

Flash Memory
512 MB

RAM
256 MB

Ethernet Switching Unit with PoE (3U ESU POE)

EN 50155
EN 45545
IEC 61375-3-4

MODULE FUNCTIONS

The Trainnet® Ethernet Switching Unit with PoE (3U ESU POE) is an Ethernet switch used to build Ethernet Consist Networks (ECN). It can also be used to create an Ethernet train bus in the case of a fixed trainset with no need for automatic inauguration.

The Trainnet® 3U ESU POE module implements the ECN link layer function of the IEC 61375-3-4 Train Communications Network Standard. The Ethernet technology's large bandwidth (typically 100 Mb/s) is particularly suitable for data intensive systems like video surveillance or Passenger Information Systems.

KEY FEATURES

The Trainnet® 3U ESU POE has 11 Ethernet ports which can have different properties. The 3 categories are:

➜ 4 x 100 Mbit/s Full Duplex Ethernet port with auto MDI/MDIX M12 connectors and Power-over-Ethernet (PoE).
➜ 4 x 100 Mbit/s Full Duplex Ethernet port with auto MDI/MDIX M12 connectors.

➜ 3 x 1 Gbit/s Full Duplex Ethernet port with auto MDI/MDIX M12 connectors

The PoE functionality provides power to cameras, intercoms and other low-power equipment *via* the Ethernet cable, thus simplifying and reducing train cabling.

The Ethernet ports are located on module's front panel. Port mirroring can be used to copy packet data seen on a switch port to another port for diagnostics and monitoring purposes.

The car can also be equipped with two redundant Trainnet® 3U ESU POE modules to increase system reliability. If the principal module fails, the secondary module takes over the functionality.

The 3U ESU POE provides connectivity to the consist network switches in a ring configuration (allows redundancy), or by connecting ports directly to end devices. The 3U ESU POE supports the Ethernet Ring Protection Switching (ERPS) protocol. The switch provides services

such as Dynamic Host Configuration Protocol (DHCP) in order to assign IP addresses to end devices automatically.
The management processor provides also VLAN configurations Layer 3 switching. It enables diagnostic functions such as the identification of faulty cables and PoE monitoring.
It features a non-blocking (QoS Layer 2) switching architecture.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
20 TE x 3 U x 160 mm
Weight
1 Kg
Input Power
5 V DC ± 5 % (4 A max., 1.5 to 2.5 A typ.)
Nominal PoE voltage
110 V DC
Temperature Range (operational)
-40 ºC...+70 ºC
MTBF (40 ºC ambient temperature)
880 000 h (ESU3712A)
Ethernet Interfaces
4 x 10/100 Mbit/s with PoE, M12
4 x 10/100 Mbit/s, M12
3 x 1 Gbit/s, M12
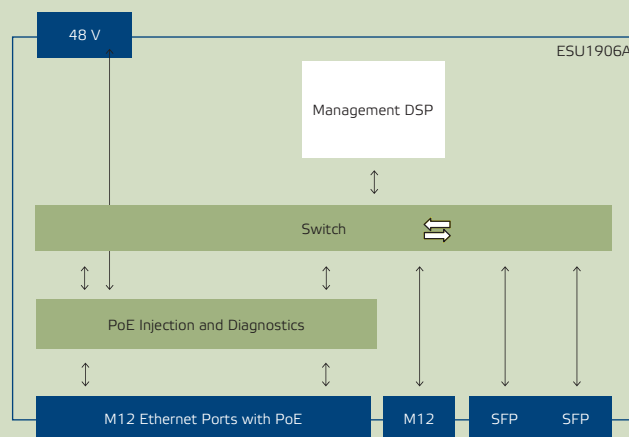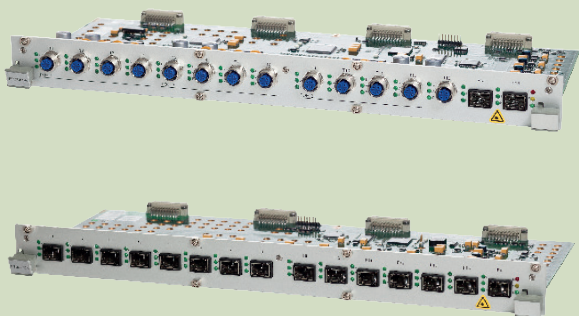**Switching Buffer Memory**
2 x 2 Mbits
PoE Classification
IEEE802.3af/at with two-event classification
Total power for PoE
75 W
Management CPU
Cortex M4 MCU 168 MHz, 512kB Flash

Ethernet Switching Unit (1U ESU)

EN 50155
EN 45545
IEC 61375-3-4

MODULE FUNCTIONS

The Trainnet® Ethernet Switching Unit (1U ESU) is an Ethernet switch used to build Ethernet Consist Networks (ECN). It can also be used to create an Ethernet train bus in the case of a fixed trainset with no need for automatic inauguration.

The Trainnet® 1U ESU module implements the ECN link layer function of the IEC 61375-3-4 Train Communications Network Standard. The Ethernet technology's large bandwidth (typically 100 Mb/s) is particularly suitable for data intensive systems like video surveillance or Passenger Information Systems.

KEY FEATURES

The Trainnet® 1U ESU has 15 Ethernet ports which can have different properties. Three port technologies are available:
➔ 10/100 Mbit/s Full Duplex Ethernet port with auto MDI/ MDIX M12 connectors
➔ 10/100 Mbit/s Full Duplex Ethernet port with auto MDI/ MDIX M12 connectors and Power-over-Ethernet (PoE).
➔ 1 Gbit/s optical fiber SFP port for larger bandwidth (single fibre, multimode fibre or copper cables) The PoE functionality provides power to cameras, intercoms and other low-power equipment *via*

the Ethernet cable, thus simplifying and reducing train cabling. The PoE power supply module (PSE) is used to provide 48 V DC from different train battery voltages to 1U ESU modules. Up to three power supplies (PSE) can be used together with two ESU modules in one 3U 19" rack to provide a standalone switch with a total of up to 30 ports including 24 ports with PoE.

The Ethernet ports are located on module's front panel and communication to the gateway is done *via* one of the Ethernet ports. The device also supports link aggregation to provide redundancy and increased data transfer capabilities. Port mirroring can be used to copy packet data seen on a switch port to another port for diagnostics and monitoring purposes. The car can also be equipped with two redundant Trainnet® 1U ESU modules to increase system reliability. If the principal module fails, the secondary module takes over the functionality.

The 1U ESU provides connectivity to the consist network switches in a ring configuration (allows redundancy), or by connecting ports directly to end devices. The switch provides services such as Dynamic Host

Configuration Protocol (DHCP) in order to assign IP addresses to end devices automatically. The management processor provides also VLAN configurations Layer 3 switching. It enables diagnostic functions such as the identification of faulty cables and PoE monitoring.
It features a non-blocking (QoS Layer 2) switching architecture.

OPTIONS

Port combinations (2 options available to meet different technical requirements)**:**
➔ 12 x 10/100 with PoE + 1 x 10/100 + 2 x SFP (ESU1906A)
➔ 15 x SFP (ESU2250A)

FEATURE SUMMARY

The features of the 1U ESU module also include: Configuration from ESN through CPG/CPS and backplane serial link, single configuration database for the whole train (LLDP based switch identity), Link Layer Discovery Protocol (LLDP), Rapid Spanning Tree Protocol (RSTP), Link Aggregation Control Protocol, Virtual LANs, Internet Groupe Management Protocol (IGMP), rate limiting, port monitoring, port RMON statistics counters, PHY configuration port enable/disable, PoE control and statistics, and process data export.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
84 TE x 1 U x 160 mm

Weight
550 g

Input Power
5 V DC ± 5 % (4 A max., 1.5 to 2.5 A typ.)

Temperature Range (operational)
-40 ºC...+70 ºC

MTBF (40 ºC ambient temperature)
550 000 h (ESU1906A)
640 000 h (ESU2250A)

Ethernet Interfaces
  ESU1906A
    12 x 10/100 Mbit/s with PoE, M12
    1 x 10/100 Mbit/s, M12
    2 x 1 Gbit/s available in SFP module slot
  ESU2250A
    15 x 1 Gbit/s available in SFP module slot

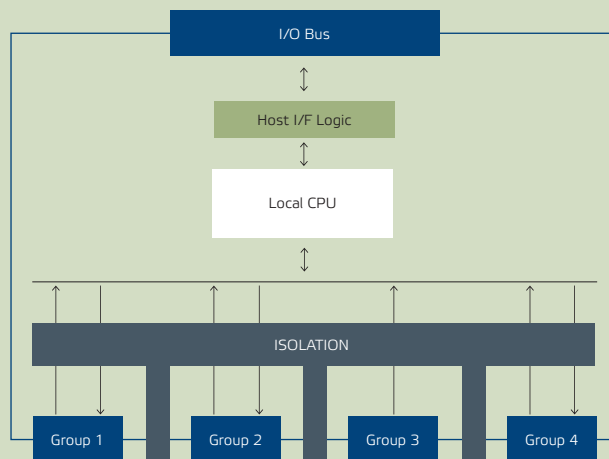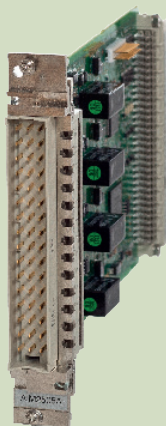**Switching Buffer Memory**
2 Mbits

Management CPU
Blackfin DSP, 500 MHz, 100 Mbit/s Ethernet

Flash Memory
8 MB

RAM
16 MB

Analogue Input Module (AIM)

MODULE FUNCTIONS

The Trainnet® Analogue Input Module (AIM) provides a standard interface for analogue input signals. Signals can be current (-20…+20mA) and voltage (-10…10V). Separate channels are provided for frequency signal measurements with the capability to measure pulse-width ratio (PWM). The Trainnet® AIM converts the analogue signals and makes them available to the train computer's CPU Module.

The Trainnet® Analogue Input Module can be used as a part of a Trainnet® TCMS, VCU or Event Recorder. Alternatively, the Trainnet® AIM can be fitted into the Trainnet® Remote I/O Module (RIOM).

KEY FEATURES

The Trainnet® AIM2505A has 10 current channels and 10 voltage channels divided in three isolated groups. 4 frequency channels are also available.

The Trainnet®AIM5250A has 6 current channels, and 6 voltage channels, and 4 frequency input channels in two groups: two for the low-voltage tachometer measurements and two for the

high-voltage pulse width modulation measurements.

The current measurement channels can measure currents between -20 and +20 mA. The module has the capability to supply voltage to external sensors or to supply loop voltage to the current loops. The module's voltage measurement channels can measure voltages between -10 and +10 V. The resolution of the input A/D conversion is sign+12 bits, and the cut-off frequency of the hardware low pass filter is 10 Hz. Both current and voltage channels are capable of giving over range indications which can be used for diagnostic purposes.

The frequency input channels can measure frequencies up to 16 kHz, period, pulse width, pulse count and rotary decoding with direction indication (compatible with most industry standard tachometers).

The module has its own 32-bit embedded processor that uses factory calibration values to convert the measurement value to mV or µA with great accuracy. The embedded processor also implements diagnostics

functions and reports to the system CPU module if it suspects that the input values cannot be trusted.

SIL 2 CERTIFIED

The module development is based on the railway standards EN 50126, EN 50128 and EN 50129 in accordance with safety integrity level SIL 2. A non-SIL version of the module is also available.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
4 TE x 3 U x 160 mm

Weight
160 g

Input Power
5 V DC ± 5 % (700 mA typ. 3 A max.)

Temperature Range (operational)
-40 ºC…+70 ºC

MTBF (40 ºC ambient temperature)
500 000 h (AIM2505A)
1 600 000 h (AIM5250A)

I/O Connector
DIN41612-F48 (at front)

Host Interface
RS 485 serial

Input Channels, Analogue
10 voltage channels, -10…10 V (Vin) (AIM2505A)
10 current channels, -20…20 mA (Iin) (AIM2505A)
6 voltage channels, -10…10 V (Vin) (AIM5250A)
6 current channels, -20…20 mA (Iin) (AIM5250A)

Input Channels, Frequency
4 input channels (AIM2505A)
4 input channels in 2 groups: 2 low-voltage tachometer, 2 high-voltage PWM (AIM5250A)

Frequency Input Voltage Range
0…36 V DC

Frequency Input Threshold level
Each channel has its own software configurable threshold level, fixed hysteresis
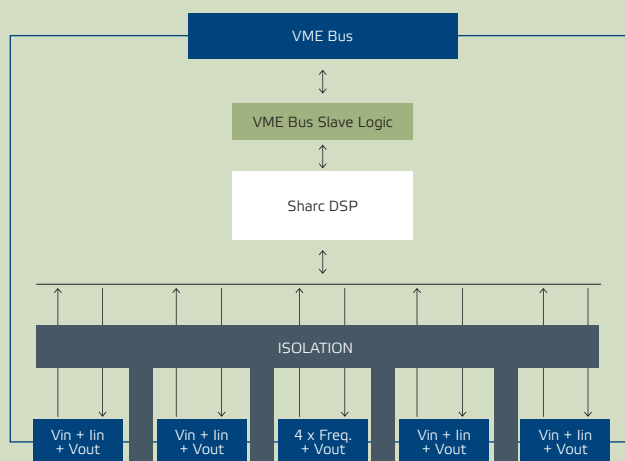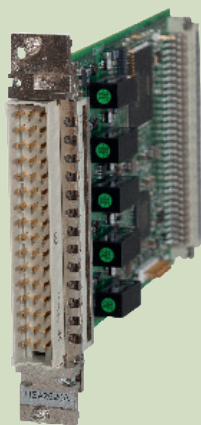
Frequency Input Range
DC to 16 kHz, 0.25 Hz resolution

Frequency Input Pulse Width Measurement
0.1% resolution

Tachometer Supply Outputs (Vout)
15 VDC, max. 100 mA

High Speed Analogue Input Module (HSA)

SIL-2

EN 50126
EN 50128
EN 50129
EN 50155
EN 45545

MODULE FUNCTIONS

The Trainnet® High Speed Analogue Input Module (HSA) provides a standard interface for analogue input signals. Signals can be current (-20…+20mA) and voltage (-10…10V). Separate channels are provided for frequency signal measurements with the capability to measure pulse-width ratio (PWM). The Trainnet® HSA converts the analogue signals and makes them available to the train computer's CPU Module.

The Trainnet® High Speed Analogue Input Module can be used as a part of a Trainnet® TCMS, VCU or Event Recorder.

KEY FEATURES

The Trainnet® HSA has 4 current channels and 4 voltage channels divided in four isolated groups. 4 frequency channels are also available.

The 4 current measurement channels can measure currents between -20 and +20 mA. The module has the capability to supply voltage to external sensors or to supply loop voltage to the current loops. The module 4 voltage measurement channels can

measure voltages between -10 and +10 V. The resolution of the input A/D conversion is sign+12 bits, and the cut-off frequency of the hardware low pass filter is 150 Hz. Both current and voltage channels are capable of giving over range indications which can be used for diagnostic purposes.

The 4 frequency input channels can measure frequencies up to 16 kHz, period, pulse width, pulse count and rotary decoding with direction indication (compatible with most industry standard tachometers).

The module has its own 32-bit Floating point Digital Signal Processor for a high signal processing capability and uses factory calibration values to convert the measurement value to mV or μA with great accuracy. The embedded DSP processor can be used to perform signal processing tasks like filtering. It also implements diagnostics functions and reports to the system CPU module if it suspects that the input values cannot be trusted.
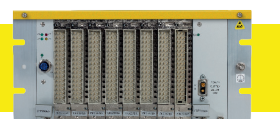
SIL-2 CERTIFIED

The module development is based on the railway standards EN 50126, EN 50128 and EN 50129 that are in accordance with safety integrity level SIL 2. A non-SIL version of the module is also available.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
4 TE x 3 U x 160 mm

Weight
170 g

Input Power
5 V DC ± 5 % (1 A typ. 3 A max.)

Temperature Range (operational)
-40 ºC…+70 ºC

MTBF (40 ºC ambient temperature)
410 000 h (HSA2620A)

I/O Connector
DIN41612-F48 (at front)

Host Interface
VME Bus A24/D08/D16 Slave

Input Channels, Analogue
4 voltage channels, -10…10 V (Vin)
4 current channels,-20…20 mA (Iin)

Input Channels, Frequency
4 input channels

Frequency Input Voltage Range
0…36 V DC (HSA2620A)

Frequeny Input Current Range
0…24 mA (HSA2620B)

Frequency Input Threshold level
Each channel has its own software configurable threshold level, fixed hysteresis
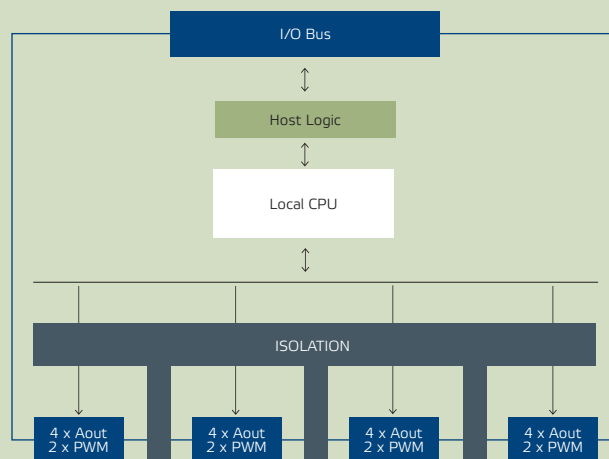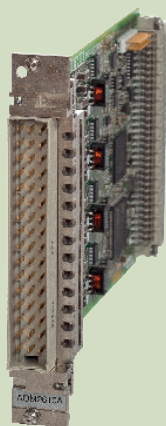
Frequency Input Range
DC to 16 kHz, 0.25 Hz resolution

Frequency Input Pulse Width Measurement
0.1% resolution

Tachometer Supply Outputs
15 VDC, max. 70 mA each

Analogue Output Module (AOM)

SIL-2

EN 50126
EN 50128
EN 50129
EN 50155
EN 45545

MODULE FUNCTIONS

The Trainnet® Analogue Output Module (AOM) provides standard interface for analogue output signals. The Trainnet® AOM receives instructions from the train computer's CPU Module and sends analogue signals to sub-systems accordingly.

The Trainnet® AOM can be used as a part of a Trainnet® TCMS, VCU or Event Recorder. Alternatively, the Trainnet® AOM can be fitted into the Trainnet® Remote I/O Module (RIOM).

KEY FEATURES

The module has 4 individually isolated analogue output groups. All groups are identical and have 4 analogue output channels. Each group has two PWM outputs.

By default, 2 channels are configured as current loop transmitters with integrated loop supply (current mode) and 2 channels as bipolar voltage output and two digital pulse width modulation outputs (voltage mode). The channel configurations can easily be changed from current mode to voltage mode and vice-versa, depending on your needs. The Trainnet®

AOM is able to provide current loop supply voltage internally: there is no need for an external power supply. Configurable ranges are from 4 to 20 mA for current and from -10 to +10 V for voltage.

Each output channel has parameters for calibration (factory set), and diagnostics to detect short or open in current loop and short in voltage output. Outputs are factory calibrated. The module has its own 32-bit embedded processor to manage serial communication with the train computer's CPU module. The embedded processor also implements diagnostic functions and reports to the train computer's CPU module if it suspects that the output values cannot be trusted.

The module has an RS-485 serial bus interface for connecting to the train computer.
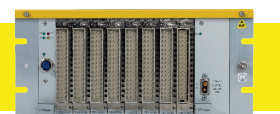
FUNCTIONAL SAFETY

The development of module AOM3371A is based on railway standards EN 50126, EN 50128 and EN 50129 that are in accordance with safety integrity level SIL 2.

A non-SIL module version AOM2610A is also available. For SIL 2, please contact EKE-Sales.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
4 TE x 3 U x 160 mm

Weight
165 g

Input Power
5 V DC ± 5 % (1 A typ., 3A max.)

Temperature Range (operational)
-40 ºC...+70 ºC

MTBF (40 ºC ambient temperature)
910 000 h (AOM2610A)

I/O Connector
DIN41612-F48 (at front)

Host Interface
RS-485

Current Output Mode
4...20 mA
1 µA resolution

Voltage Output Mode
-10...+10 V
1 mV resolution

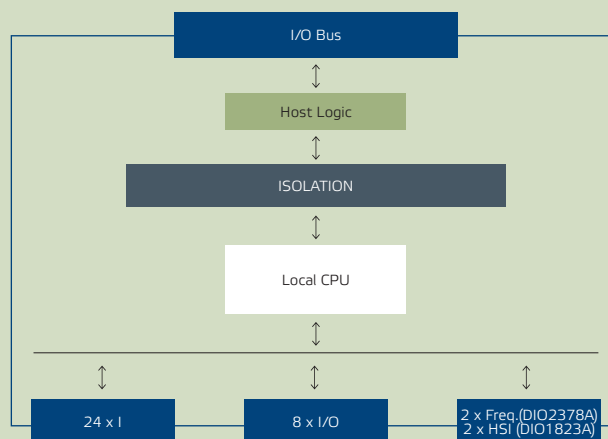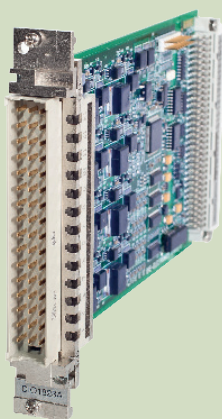**Analogue Output Channels**
16 (in 4 groups of 4 isolated channels)

PWM Outputs
8 (2 in each of the 4 groups)
Selectable base frequency 10 Hz to 10 kHz
Pulse width adjustable with 0.1% resolution
Output level 15 V

Digital Input/Output Module (DIO)

MODULE FUNCTIONS

The Trainnet® Digital Input/ Output Module (DIO) provides a standard interface for digital input and output signals. The Trainnet® DIO receives the digital signals via its input channels and makes them available to the train computer's CPU Module. The Trainnet® DIO receives instructions from the train computer's CPU Module and sends digital signals to the sub-systems accordingly via its output channels. Separate channels are provided for frequency measurements (can be used for tachometer inputs).

The Trainnet® Digital Input/Output Module can be used as a part of a Trainnet® TCMS, VCU or Event Recorder. Alternatively, the Trainnet® DIO can be fitted in the Trainnet® Remote I/O Module (RIOM).

KEY FEATURES

The Trainnet® DIO has 24 input channels and 8 channels which can be used either as input channels or output channels. With DIO2908B and DIO2378A up to four outputs can be connected in parallel to increase output current. Additionally, DIO2378A has 2 frequency input channels, whereas DIO1823A has 2 high speed input channels.

One special feature of the DIO module is to supports the UIC-556 sleep mode. The DIO can remain active with WTB modules, and provide local inauguration and battery voltage monitoring.

The module also provides emergency output short circuit protection: if the output current exceeds its maximum value, the short circuit protection shuts down the output. The status of the short circuit protection is available to the train computer's CPU module. If the communication between the train computer's CPU and the module fails, the module's output channel goes to a state defined in the application software (emergency output), which can be individually set for each single channel.

The module's own 32-bit embedded processor implements diagnostics functions and reports to the train computer's CPU module if it suspects that the input values cannot be trusted. Each input channel has a common test circuit, which is used for real-time diagnostics of the channel. This test is carried out during power-on and repeated during normal operation. The input and output states, and their configuration parameters (wetting current, threshold levels) are accessible by the train computer's CPU module.

Two separate group voltages with common ground allow split behind two circuit breakers, or having a mixed voltage system. Input and Input/Output channels are split evenly between group voltage 1 and 2. Please note that the groups are not isolated from each other.

SIL-2 CERTIFIED

The module development is based on the railway standards EN 50126, EN 50128 and EN 50129 that are in accordance with safety integrity level SIL 2. A non-SIL version of the module is also available.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D): 4 TE x 3 U x 160 mm

Weight: 140 g (DIO1823A: 179 g)

Input Power: 5 V DC ± 5 % (500 mA max., 200 mA typ.)

Temperature Range (operational)
-40 ºC...+70 ºC

MTBF (40 ºC ambient temperature)
2 520 000 h (DIO1823A)
2 360 000 h (DIO2378A)
1 350 000 h (DIO2908B) (SIL 2)

I/O Connector: DIN41612-F48 (at front)

Host Interface: RS 485

Input-only Channels: 24

Input/Ouput Channels: 8

Frequency Input Channels: 2 (DIO2378A)

High Speed Input Channels: 2 (DIO1823A)

Frequency/High Speed Input Range: 0...32 kHz, resolution 1 Hz

Battery Voltage Monitor: Yes, one or two (UIC-556)

Temperature Measurement: Yes, local CPU

Input type: Current sink

Output Type: High side (FET) from battery voltage

Voltage Drop: Max. 2 V

Input/Output Voltage Range
16.8...137.5 V DC (1 sec 14...154 V DC)

Threshold levels: Software selectable (both, positive and negative) (either V or % V_{in})
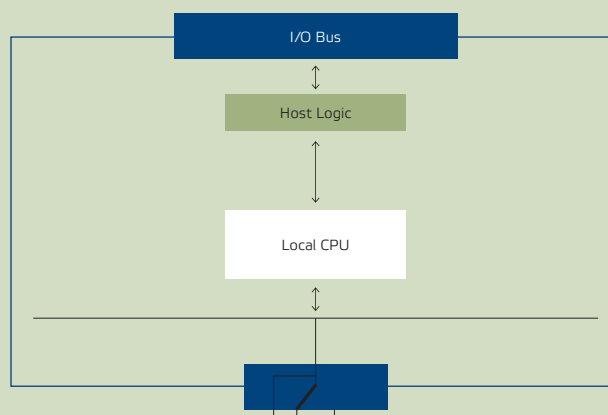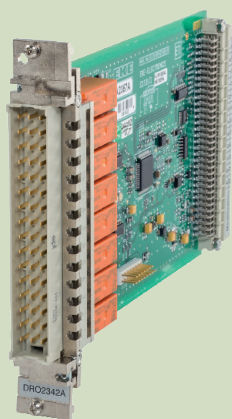
Wetting Current
0 ... 20 mA, Software selectable (DIO1823A)
0 ... 23 mA, Programmable (DIO2378A)
20 mA (DIO2908B)

Output Current: 1.0 A Continuous

Digital Relay Output Module (DRO)

MODULE FUNCTIONS

The Trainnet® Digital Relay Output Module (DRO) provides standard relay contacts. The Trainnet® DRO receives instructions from the train computer's CPU Module and controls output relays accordingly.

The Trainnet® DRO can be used as a part of a Trainnet® TCMS, VCU or Event Recorder. Alternatively, the Trainnet® DRO can be fitted in the Trainnet® Remote I/O Module (RIOM).

OPTIONS

The Trainnet® DRO2342A has 8 relay output channels located on the module's front side. DRO5141A version has 4 relay output channels. The relays are of type SPDT (Single Pole Double Throw). The relay contacts are available from the DIN41612F connector at the front of the module.

The DRO modules are able to take up pre-set output states in case of emergency. If the communication between the train computer's CPU module and the DRO fails, the relays go to emergency states that you can define in the application Software. When the Trainnet® DRO is unpowered, all relays are in Normally Closed state. Emergency states should be defined to match the wiring to Normally Open (NO)/ Normally Closed (NC) contacts.

FUNCTIONAL SAFETY

The DRO5141A module development is based on the railway standards EN 50126, EN 50128 and EN 50129 that are in accordance with safety integrity level SIL 2. The non-SIL version DRO2342A is also available. For SIL 2, please contact EKE-Sales.
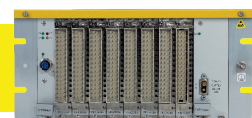
TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
4 TE x 3 U x 160 mm

Weight
190 g

Input Power
5 V DC ± 5 % (500 mA max., 200 mA typ.)

Temperature Range (operational)
-40 ºC...+70 ºC

MTBF (40 ºC ambient temperature)
1 000 000 h (DRO2342A)
3 250 000 h (DRO5141A)

Relay electrical endurance
500 000 operations (at 24 V DC 3.0 A resistive load)

I/O Connector
DIN41612-F48 (at front)

Host Interface
RS 485

Number of Channels
8 (DRO2342A)
4 (DRO5141A)

Relay Type
Change over (SPDT) AgNi 0.15 Contacts (DRO2342A)
Change over (SPDT) AgCuNi + Au 0.15 Contacts (DRO5141A)

Maximum Switching Current vs Voltage
24 V DC   3,5 A (DRO2342A)
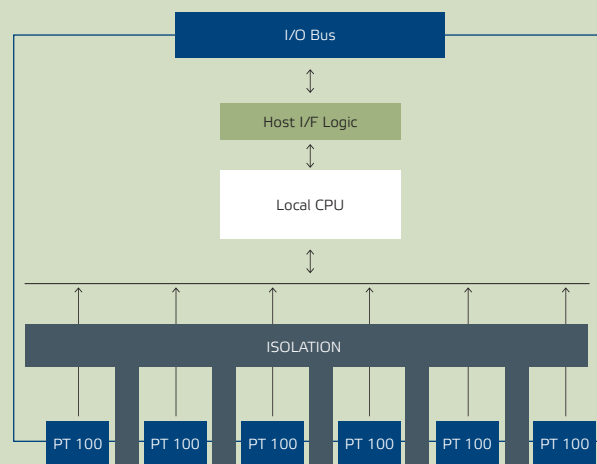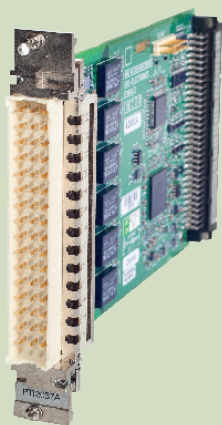48 V DC   1,4 A (DRO2342A)
110 V DC   0.5 A (DRO2342A)

24 V DC   3.0 A (DRO5141A)
48 V DC   1.0 A (DRO5141A)
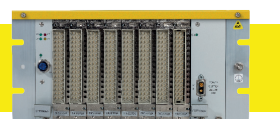110 V DC   0.3 A (DRO5141A)

Temperature Measurement
Yes, local CPU

Pt100/Pt1000 Temperature Sensor Input Module (PTI)

SIL-2

EN 50126
EN 50128
EN 50129
EN 50155
EN 45545

MODULE FUNCTIONS

The Trainnet® PTI modules are temperature sensor input modules. They acquire the signals from the PT-100 (PTI2037A) or PT-1000 (PTI3593A) temperature sensors (resistance measurement) and convert them into temperature values expressed in degrees Celsius. The PTI modules make the measured temperature values available to the train computer's CPU.

The Trainnet® PTI can be used as a part of a Trainnet® TCMS, VCU or Event Recorder. Alternatively, the Trainnet® PTI can be fitted in the Trainnet® Remote I/O Module (RIOM).

KEY FEATURES

The Trainnet® PTI has six measurement channels which can measure temperature within the -110 to +325 ºC range with over range indication. Each channel is isolated from each other, thus a fault in one channel will not affect the others. The temperature sensors can be connected using 2-wire, 3-wire or 4-wire schemes providing flexibility.

The measurement resolution is 0.01 ºC, with accuracy better than ±1 ºC within the measurement range.

The module has its own 32-bit embedded processor that uses factory calibration values to convert measurement values to degrees Celsius with the best possible accuracy. The embedded processor also implements diagnostic functions and reports to the train computer's CPU module if it suspects that the input values cannot be trusted. The Trainnet® PTI detects the temperature sensor as well as cable faults and input channel faults.

FUNCTIONAL SAFETY

The module development is based on the railway standards EN 50126, EN 50128 and EN 50129 in accordance with safety integrity level SIL 2. Non-SIL versions of the modules are also available.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
4 TE x 3 U x 160 mm

Weight
160 g

Input Power
5 V DC ± 5 % (310 mA typ., 400 mA max.)

Temperature Range (operational)
-40 ºC...+70 ºC

MTBF (40 ºC ambient temperature)
2 490 000 h

I/O Connector
DIN41612-F48 (at front)

Host Interface
RS 485

Input Channels
6 Pt100 sensor

Connection Type
2-wire, 3-wire or 4-wire

Measurement Range
-110 ºC to + 325 ºC

Resolution
0.01 ºC

Accuracy
Better than ± 1 ºC (3- or 4-wire)
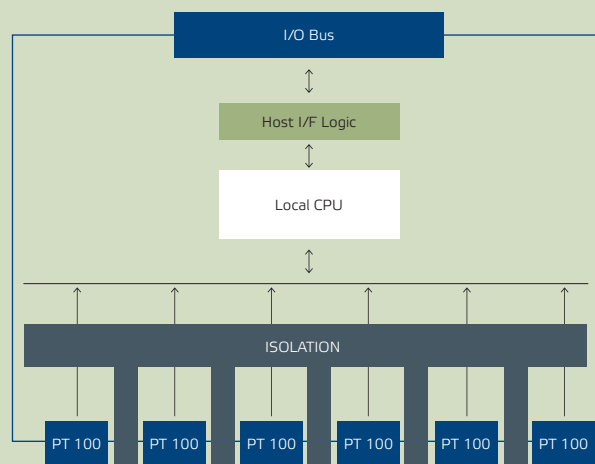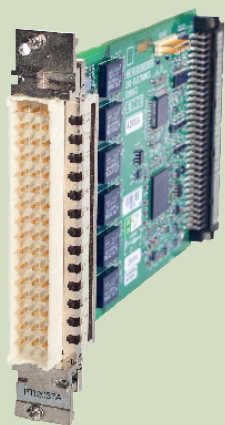
Temperature Sensor Input Module (TSI)

SIL-2

EN 50155
EN 45545

MODULE FUNCTIONS

The Trainnet® TSI5226A is a temperature sensor input module. It acquires the signals from the PT-100, or PT-1000 or NTC temperature sensors (resistance measurement) and converts them into temperature values expressed in degrees Celsius. The used sensor type can be configured by software. The TSI module makes the measured temperature values available to the train computer's CPU.

The Trainnet® TSI can be used as a part of a Trainnet® TCMS, VCU or Event Recorder. Alternatively, the Trainnet® TSI can be fitted in the Trainnet® Remote I/O Module (RIOM).

KEY FEATURES

The Trainnet® TSI has six measurement channels which can measure temperature within the -110 to +325 ºC range with over range indication. Each channel is isolated from each other, thus a fault in one channel will not affect the others. The temperature sensors can be connected using 2-wire, 3-wire or 4-wire schemes providing flexibility.

The measurement resolution is 0.01 ºC, with accuracy better than ±1 ºC within the measurement range.

The module has its own 32-bit embedded processor that uses factory calibration values to convert measurement values to degrees Celsius with the best possible accuracy. The embedded processor also implements diagnostic functions and reports to the train computer's CPU module if it suspects that the input values cannot be trusted. The Trainnet® TSI detects the temperature sensor as well as cable faults and input channel faults.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
4 TE x 3 U x 160 mm

Weight
160 g

Input Power
5 V DC ± 5 % (310 mA typ., 400 mA max.)

Temperature Range (operational)
-40 ºC...+70 ºC

MTBF (40 ºC ambient temperature)
2 490 000 h

I/O Connector
DIN41612-F48 (at front)

Host Interface
RS 485

Input Channels
6 Pt100 sensor

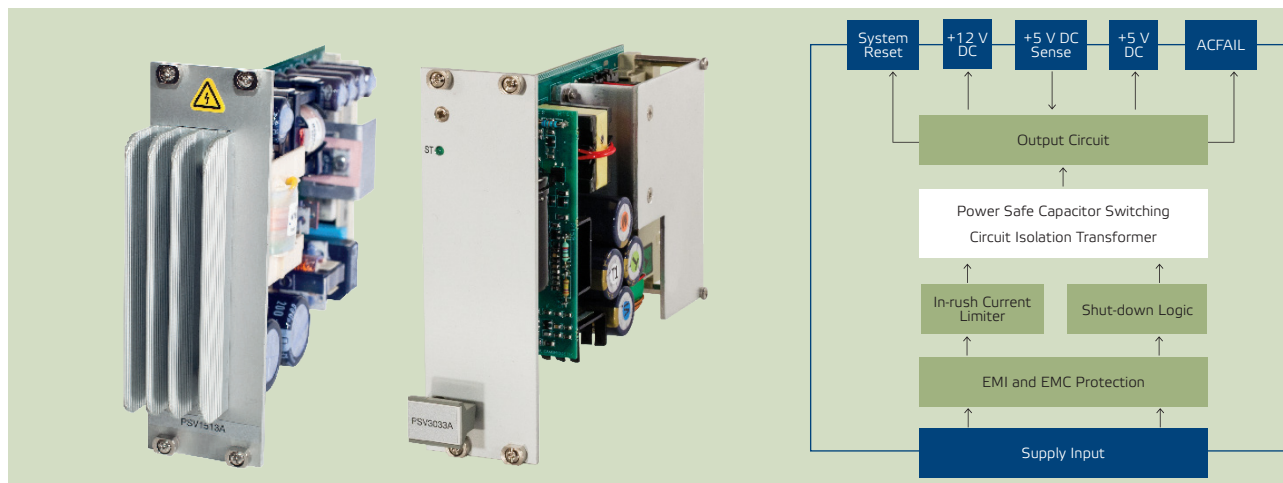**Connection Type**
2-wire, 3-wire or 4-wire

Measurement Range
-110 ºC to + 325 ºC

Resolution
0.01 ºC

Accuracy
Better than ± 1 ºC (3- or 4-wire)

Power Supply Unit for VME (PSV)

EN 50155
EN 45545

MODULE FUNCTIONS

The Trainnet® Power Supply Unit for VME (PSV) is a highly reliable switching mode power supply module. It works only together with the Trainnet® PIU module which takes power from the train batteries and transfers it to the Trainnet® PSV module. The Trainnet® PSV module is specially designed for VMEbus systems.

KEY FEATURES

The Trainnet® PSV has built-in circuitry to detect and control the input current in the event of a power-up. Controlling the in-rush current prevents component damages.

The Trainnet® PSV grace supply function enables the module to continue working for a short period of time when the power is cut off. The PSV module withstands 10 ms input power breaks without disrupting any of the normal operations (Voltage Supply Interruption as per EN50155 Class S2 and Supply change over as per EN50155 Class C1). If the break lasts longer, the power supply is capable of supplying a +5 V DC output during a minimum of 100 ms after the input power is lost, 80 ms for PSV1133C.

TECHNICAL SPECIFICATIONS

Reference	PSV1133C	PSV2513A	PSV3034C	PSV1513A	PSV1018A
Dimensions (W x H x D)	-----------------------	8 TE x 3 U x 160 mm		-----------------------	
Weight	500 g	500 g	470 g	500 g	500 g
Temperature Range (operational)	-------------------	40 ºC...+70 ºC	-----	------------------------------	
MTBF (40 ºC ambient temperature)	700 000 h	690 000 h	700 000 h	690 000 h	690 000 h
Input Voltage	24 V DC	36 ... 52 V DC	48 ... 110 V DC	72 V DC	110 V DC
Input Voltage Range (V DC)	16.8 ... 30.0	25.2 ... 65.0	33.6 ... 143	50.4 ... 90.0	77 ... 138
Input Fluctuation (1s) (V DC)	14.4 ... 33.6	21.6 ... 72.8	31.2 ... 154	43.2 ... 100.8	66 ... 154
Input Current (<0.1 s/1 s)	5 A max.	4 A max.	3 A max.	3 A max.	2 A max.
Input Power	80 W max.	75 W max.	100 W max.	100 W max.	100 W max.
Supported Supply Interruption (S2)	10 ms	10 ms	10 ms	10 ms	10 ms
Efficiency	-----------------------------	> 78%	--------------------------------		
Output Power	60 W	54 W	80 W	80 W	80 W

Output Voltage 5 V DC

	PSV1133C	PSV2513A	PSV3034C	PSV1513A	PSV1018A
Maximum Output Current	8.5 A	8.5 A *	13 A	12 A	13 A
Minimum Output Current	0.5 A	0.5 A	0.1 A	0.5 A	0.5 A
Ripple/noise p-p	-----------------------	50 mVpp (<20 MHz)	--------------------------------		
Output Voltage Hold-on at nom. load	100 ms	100 ms	100 ms	100 ms	100 ms
Output Voltage	-----------------	5.15 V DC ± 2 % (at nominal line, nominal load)	--------------		
	-------------------	5.00 V DC min. (at line range, load range)	---------------------		

Output Voltage 12 V DC

	PSV1133C	PSV2513A	PSV3034C	PSV1513A	PSV1018A
Maximum Output Current	1.25 A	2.0 A *	1.25 A	1.25 A	1.25 A
Ripple/noise p-p	----------------------	50 mVpp (<20 MHz)	----------------------------		
Output Voltage	-----------------	12.15 V DC ± 2 % (at nominal line, nominal load)	---------------		
	-----------------	11.80 V DC min. (at line range, load range)	-------------------		

Total output loading must not exceed Output power

The ACFAIL and SYSRESET signals are activated to ensure proper shutdown of the systems. This feature allows the system to record sub-system and module states during the shutdown, thus enabling event diagnostics.

When the input supply voltage is below the set minimum value, Trainnet® PSV minimizes current consumption in order to prevent the deep discharge of train batteries.

For various versions and specifications, please revert to the table above.
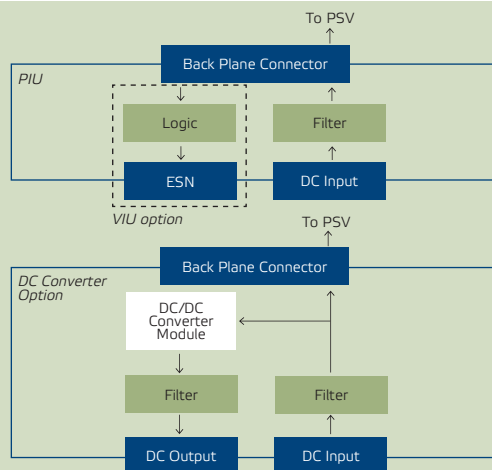
Power Input Unit (PIU, VIU)

EN 50155
EN 45545

MODULE FUNCTIONS

The Trainnet® Power Input Unit (PIU) is used to pass train battery voltage to the Trainnet® PSV module, thus powering the entire Trainnet® systems.

KEY FEATURES

The Trainnet® PIU input voltages can be 24 V DC (PIU2056A), 24 to 36 V DC (PIU4233A), 36 to 52 V DC (PIU2510A), 48 to 110 V DC (PIU4234A), 72 V DC (PIU2280A) or 110 V DC (PIU2219A). A Trainnet® PSV with a similar input voltage must be selected.

OPTIONS

Isolated DC Converter Output:
An isolated DC/ DC converter may be installed as an option to provide power to any external equipment. If required, the out-put voltage may be switched off during the system reset in order to force hard-resets of external equipment. Currently available PIU modules with DC Converter Ouput are listed in the table below. We can also provide you with another versions upon request.

Vehicle Identification Unit (VIU):
The Trainnet® VIU (Vehicle Identification Unit) has the functionalities of the Trainnet® PIU, and in addition, provides an interface for Electronic Serial Number (ESN). An Electronic Serial Number (ESN) dongle can be connected to VIU for device identification and configuration. There are VIU versions for 24 V DC (VIU3688B) and 110 V DC (VIU2336B) input voltages.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
4 TE x 3 U x 160 mm
Weight
100 - 150 g
Input Voltage
24, 24-36, 36-52, 48-110, 72 or 110 V DC available
Others on request
Temperature Range (operational)
-40 ºC…+70 ºC
MTBF (40 ºC ambient temperature)
38 570 000 h
Output Voltage (optional)
12 V DC (from PSV)

Technical Data DC Converter option
Weight
350 g
Input Voltage
24 or 110 V DC available
Others on request
MTBF (40 ºC ambient temperature)
2 400 000 h
Output Voltage and Power
See table

Vehicle Identification Unit (VIU)
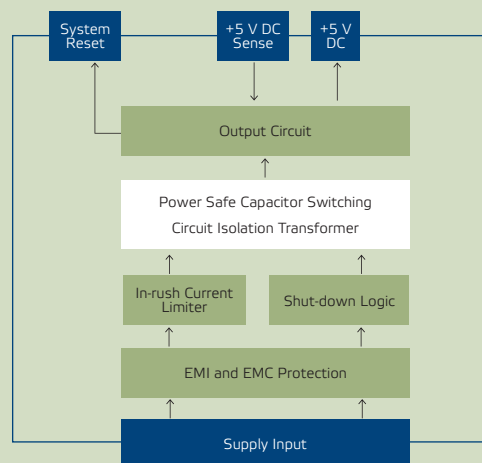**Weight**
155 g
Input Voltage
110 V DC
MTBF (40 ºC ambient temperature)
5 290 000 h

AVAILABLE PIU MODULES WITH DC CONVERTER OUTPUT:

MODULE REFERENCE	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT POWER
PIU2034A	24 V DC	16 V DC	17 W
PIU2023A	110 V DC	16 V DC	17 W
PIU3394A	110 V DC	24 V DC	25 W

Compact Power Supply Unit (PSR)

EN 50155
EN 45545

MODULE FUNCTIONS

The Trainnet® Compact Power Supply Unit (PSR) is a highly reliable switching mode power supply module. It takes power directly from the train batteries. The Trainnet® PSR module is primarily designed to power the Trainnet® RIOM but can also be used for some simple VMEbus systems.

KEY FEATURES

The Trainnet® PSR can be operated with either 24 to 36 V DC (PSR3031A) or 48 to 110 V DC (PSR3032A) coach supply voltage and provide 5 V DC output power. The input supply is provided directly from the train battery to the PSR module through a 2W2C D-Sub connector.

The Trainnet® PSR has built-in circuitry to detect and control the input current in the event of a power-up. Controlling the in-rush current prevents component damages.

When input supply voltage is below the minimum value, Trainnet® PSR minimizes current consumption in order to prevent the deep discharge of train batteries.

The Trainnet® PSR module withstands 10 ms input power breaks without disrupting any of the normal operations (Voltage Supply Interruption as per EN50155 Class S2 and Supply change over as per EN50155 Class C1). In case of a longer break in the power supply, the SYSRESET signal is activated to ensure proper shutdown of the systems.

TECHNICAL SPECIFICATIONS

Reference	PSR3031A	PSR3032A
Dimensions (W x H x D)	8 TE x 3 U x 160 mm	8 TE x 3 U x 160 mm
Weight	410 g	410 g
Temperature Range (operational)	-40 ºC...+70 ºC	-40 ºC...+70 ºC
MTBF (40 ºC ambient temperature)	800 000 h	800 000 h
Input Voltage	24 to 36 V DC	42 to 110 V DC
Input Voltage Range (V DC)	16.8 ... 47.8	33.6 ... 143
Input Fluctuation (1s) (V DC)	14.4 ... 50.4	28.8 ... 154
Input Current (<0.1 s/1 s)	7.5 A max.	4 A max.
Supported Supply Interruption (S2)	10 ms	10 ms
Efficiency	> 80% (typically 85%)	> 80% (typically 85%)
Output Power	80 W	80 W
Output Voltage 5 V DC		
Maximum Output Current	16 A max.	16 A max.
Minimum Output Current	0.1 A min.	0.1 A min.
Ripple/noise p-p	50 mVpp (<20 MHz)	50 mVpp (<20 MHz)
Output Voltage		
At nominal line, nominal load	5.15 V DC ± 2 %	5.15 V DC ± 2 %
At line range, load range	5.05 V DC min.	5.05 V DC min.
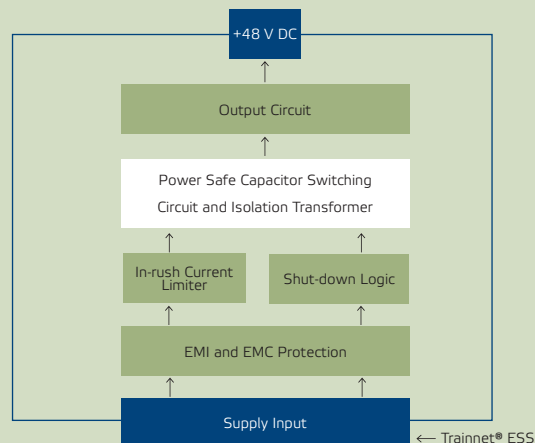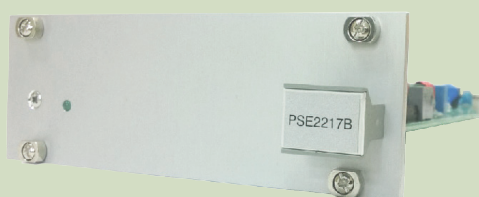
Power Supply Over Ethernet Module (PSE)

EN 50155
EN 45545

MODULE FUNCTIONS

The Trainnet® Power Supply Over Ethernet (PSE) module provides 48 V DC output power to the Trainnet® Ethernet Switching Unit (1U ESU). The Trainnet® PSE enables the Power-over-Ethernet (PoE) functionality of the Trainnet® 1U ESU.

KEY FEATURES

The Trainnet® PSE is used to power up the PoE output on the Trainnet® 1U ESU. In practice, one PSE provides power to 4 Ethernet ports on the 1U ESU. When using two Trainnet® 1U ESU simultaneously, the Trainnet® PSE can provide power to both of them, and provide a total of 8 ports.

The output voltage of the Trainnet® PSE is 48 V DC. The input voltage can be 36-52 V DC (PSE2524A) or 110 V DC (PSE2217B). The Trainnet® PSE can provide a maximum power output of 62 W to be split between the powered ports: for example, 15.4 W for 4 ports or 7 W for 8 ports.

The Trainnet® PSE has built-in circuitry to detect and control the input current in the event of a power-up. Controlling the in-rush current prevents component damages.

When input supply voltage is below the set minimum value, Trainnet® PSE minimizes current consumption in order to prevent the deep discharge of train batteries.

The Trainnet® PSE grace supply function enables the module to continue working for a short period of time when the power is cut off. The PSE module withstands 10 ms input power breaks without disrupting any of the normal operations (Voltage Supply Interruption as per EN50155 Class S2 and Supply change over as per EN50155 Class C1).

The PSE module works only together with the Trainnet® Ethernet Switch Supply (ESS) module which takes power from the train batteries and transfers it to the Trainnet® PSE.

OPTION

Bypass Unit Module

When the external devices requiring PoE consume little power (Class 1, 0.44 - 3.54 W), the Trainnet® PSE Bypass Unit Module (PBU) can be used. The Trainnet® PBU takes power from the PSE module and distributes it to another set of 4 ports (8 if using two 1U ESU modules). Two PBU modules can be used with one PSE module, sharing the PSE's 62 W between 12 ports of the 1U ESU (up to 24 ports if using a second 1U ESU module).

Trainnet® ESS Module

Trainnet® PBU Module

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D)
24 TE x 1 U x 160 mm

Weight :
280 g

Temperature Range (operational)
-40 ºC...+70 ºC

MTBF (40 ºC ambient temperature)
800 000 h

Input Voltage
36-52 V DC (PSE2524A)
110 V DC (PSE2217B)

Input Voltage Range
25.2 ... 65.0 V DC (PSE2524A)
77.0 ... 137.5 V DC (PSE2217B)

Input Power
80 W max.

Output Voltage
48 V DC ± 2 % (at nominal line, nominal load)
46 V DC min. (at line range, load range)

Output Voltage Hold-on
10 ms (at nominal load)

Trainnet® Ethernet Switch Supply (ESS)

Dimensions (W x H x D)
12 TE x 1 U x 160 mm

Weight: 60 g

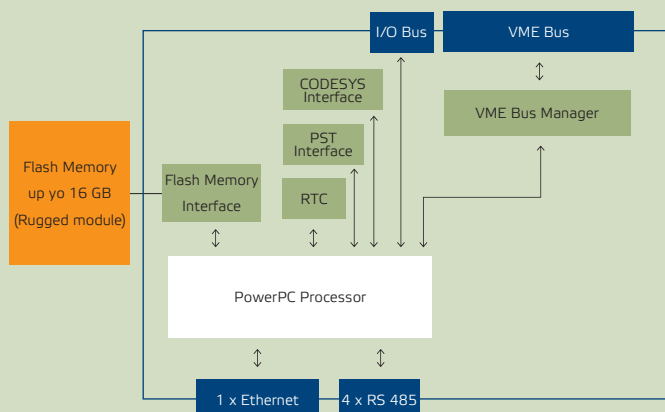**Temperature Range (operational)**
-40 ºC...+70 ºC

MTBF (40 ºC ambient temperature)
5 000 000 h

Input Voltage
36-52 V DC (ESS2525A) or 110 V DC (ESS2184A)

Rugged Memory Module (RMM)

EN 50155, EN 45545
IEEE 1482.1-1999
IEC 62625-1:2013
GM/RT2472:2014
EEIG 97E461-3.1998

MODULE FUNCTIONS

The Trainnet® Rugged Memory Module (RMM) is a highly protected memory module to be used as part of a Trainnet® Event Recorder. As the essential part of the Train Event Recorder, it collects and stores vital train-borne information. Depending on your needs, it can record all kinds of data including audio and video recordings.

KEY FEATURES

The Trainnet® Rugged Memory Module is used together with a Trainnet® 3U 84TE Rack and a power supply (usually Trainnet® PSV and Trainnet® PIU modules) to build a fully functional and standalone Event Recorder. The Trainnet® RMM can also be integrated to a larger Trainnet® System, for instance in a 6U 84TE Rack, as an addition to a Gateway, VCU or TCMS.

The Trainnet® Rugged Memory Module (RMM) is meant to be used whenever a high level of data protection is needed. Its crash-proof construction guarantees that the memory board is protected against fire, magnetic fields and any liquids, as well as any mechanical stress during an impact or a contin-

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

The design of the Trainnet® Rugged Memory Module fulfils the British (GM/RT2472-1.2002) and European (EEIG 97E461-3.1998) crashworthiness as well as the IEEE (1482.-1.1999) standards.

The Trainnet® RMM can store both analogue and digital signal data. The desired train information can be stored for a predetermined period of time. Data can be retrieved at any time using the Trainnet® TIP Software (Train Inspection Program) which enables system performance analysis and optimization. Data can be copied from the RMM to a USB stick for convenient transport and storage.

The Ethernet and USB ports located on the front of the module can be used to retrieve data from the memory module. The Trainnet® RMM can acquire data from the Ethernet port but also via the VME back plane (thus from added interface modules) and the RS 485 port

located on the front panel. The module gets power from the VME back plane.

The RMM can record video streams from onboard digital video recorders (DVR) or directly from cameras. For easy data retrieval, the stream format can be made compatible with your CCTV Software or any other video analysis Software that you use. Alternatively, we can develop customized video analysis tools to fit your needs.

OPTIONS

Memory:
Memory can be 2GB or 16 GB.

Front-panel Inprints:
Front-panel imprints are available on request in English or any other language of your choice.

GPS/GNSS:
A GNSS (Global Navigation Satellite System) receiver can be integrated to the RMM to provide location and time information. One version with GPS+GLONASS and one version with GPS+BeiDou are available. Please note this option will increase the module's width by 4TE.

TECHNICAL SPECIFICATIONS

Dimensions (W x H x D): 32 TE x 3 U x 160 mm
Weight: 7 Kg
Input Power: 5 V DC ± 5 % (1 A max., 0.5 A typ.)
Temperature Range (operational): -40 ºC...+70 ºC
MTBF (40 ºC ambient temperature)
890 000 h (2 GB) and 870 000 h (16 GB)
Interfaces
3 or 4 Isolated RS-485
1 x 10/100 Mbit/s Ethernet, M12 connector
1 x USB 2.0 Host for retrieval
Memory: 2 GB or 16 GB

Protection Levels (Rugged Memory Module)
Ingress Protection (IP) rating: 68
Shock: Up to 100 g / 10 ms and 55 g / 100 ms
Crush: Up to 110 kN for 5 minutes in all axes
Penetration
Up to 23 kg drop from a height of 1,5 m focussed on an area of 30 mm2
Temperature
Up to 700 ºC for 5 minutes and 650 ºC for 30 minutes followed by 300 ºC for 1 hour followed by 100 ºC for 5 hours
Chemical Immersion
Winter Diesel (*), Summer Diesel (*), Regular Water (*), Salt Water (*), Lubricating Oil (*), Transformer Oil (**), Hydraulic Oil (**), Anti Fire Fighting Foam (*), Refrigerant R134A (**), Alcohol (**), Anti Freeze (**), Battery Acid (**)
(*) minimum for 48 hours   (**) minimum for 60 min
Magnetic Field
Current flow of 64 kA at rising rate of 107 A/s
Hydrostatic pressure
Immersion in salt water at a depth of 15 meter for 48 hours

Trainnet® 3U 20TE Rack

Trainnet® 3U 44TE Rack

Trainnet® 3U 84TE - Dual Rack

Trainnet® 6U 84TE - RMM Rack

Standard Racks

EN 50155
EN 45545

FUNCTIONS

Trainnet® Racks are required with every Trainnet® System. Trainnet® modules only work when integrated into a Trainnet® Rack. The Racks enable communication between modules *via* an integrated IEC 821 VME back plane bus. All modules also take power from the power supply *via* the back plane.

KEY FEATURES

Trainnet® Racks come in different sizes to fit all needs. While 44TE and 84TE wide racks are commonly used, a 20TE wide rack is also available for smaller

systems. When working with a high number of modules or when requiring the 1U ESU module (Power-over-Ethernet), the 6U 84TE can be used. Other racks sizes are also available upon request.

The 3U 44TE and 3U 84TE Racks have different back plane options. Please read the table below for an overview of the possible rack-backplane combinations. The number of free slots for both VME modules (CPUs, bus interface modules and HSA module) and I/O modules (all I/O but HSA) are

mentioned. The space required for the power supply is already taken into account.

OPTIONS

Side mounting for 20TE Racks:
The 3U 20TE Racks can be sided mounted as an option, instead of the usual front mounting. Dimensions are then W127 x H133 x D306 mm.

TECHNICAL SPECIFICATIONS

External Dimensions (W x H x D):
 3U 20TE Rack
  158 x 133 mm x 215 mm
  (installation width 117 mm)
 3U 44TE Rack
  280 mm x 133 mm x 215 mm
  (installation width 240 mm)
 3U 84TE Rack
  483mm x 133mm x 215 mm
  (installation width 443 mm)
 6U 84TE Rack
  483 mm x 266 mm x 215 mm
  (installation width 443 mm)
Weight:
 3U 20TE Rack: 1.3 Kg
 3U 44TE Rack: 2.3 Kg
 3U 84TE Rack: 4 Kg
 6U 84TE Rack: 7.3 Kg
Ingress Protection (IP) rating:
20

AVAILABLE VME AND I/O SLOTS IN TRAINNET® RACKS

RACKS		VME ONLY SLOTS	VME OR I/O SLOTS	I/O ONLY SLOTS	MTBF	COMMENTS
3U 20 TE		2	1	0	3 480 000 h	-
3U 44TE		3	5	0	1 830 000 h	-
3U 44TE RIOM		1	0	8	2 330 000 h	-
3U 84TE		3	7	8	980 000 h	-
3U 84TE - Dual	*Left*	1	6	0	970 000 h	The right back plane has an extra VME slot that usually remain unused
	Right	2	6	0		
3U 84TE - RMM		4*	7	0	1 440 000 h	28TE* reserved for RMM or third party equipment
3U 84TE RIOM		1	0	18	1 130 000 h	
6U 84TE		Select a 3U 84TE rack version			850 000 h (RMM)	The other 3U fits 2 x 1U ESU

* If using RMM, please note it uses 1 VME slot (leaving 3 out of 4 free)

*Trainnet® 6U Flat Racks
(left 12TE, right 16TE)*

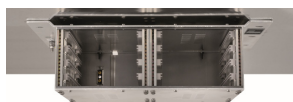*Trainnet® 3U Flat Rack
(left 12TE, right 16TE)*
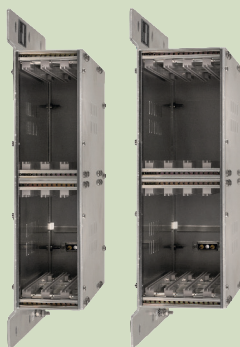
Flat
Racks

EN 50155
EN 45545

FUNCTIONS

Trainnet® Racks are required with every Trainnet® System as Trainnet® modules only work when integrated into a Trainnet® Rack. The Racks enable communication between modules *via* an integrated IEC 821 VME back plane bus. All modules also take power from the power supply *via* the back plane.

The Trainnet® Flat Racks are designed to be used in trains where space is limited, for instance trams and light rail vehicles. They are also providing an alternative to Standard Racks dimensions and mounting mechanisms.

KEY FEATURES

Trainnet® Flat Racks come in 3U and 6U format, either as a 12TE or 16TE wide rack. Thanks to their small sizes, Flat Racks can be used in the vicinity of train systems, thus allowing savings by reducing cabling. The Flat Racks have a power supply connector integrated at the back.

The number of free slots for both VME modules (CPUs, bus interface modules and HSA module) and I/O modules (all I/O modules except HSA) are mentioned in the table below. The space required for the power supply is already taken into account. Please note that in the 6U versions, there is no VME bus communication between the two rows of modules.
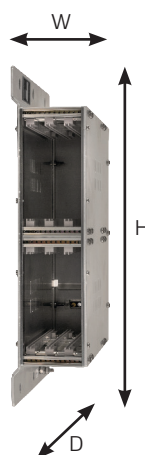
TECHNICAL SPECIFICATIONS

External Dimensions (W x H x D):
3U 12TE Flat Rack
87 x 229 mm x 215 mm
3U 16 TE Flat Rack
107 mm x 229 mm x 215 mm
6U 12TE Flat Rack
87 x 363 mm x 215 mm
6U 16 TE Flat Rack
107 mm x 363 mm x 215 mm
Weight:
3U 12TE Rack: 1.21 Kg
3U 16TE Rack: 1.32 Kg
6U 12TE Rack: 2.15 Kg
6U 16TE Rack: 2.33 Kg
Ingress Protection (IP) rating:
20

AVAILABLE VME AND I/O SLOTS IN TRAINNET® RACKS

RACKS	VME ONLY SLOTS	VME OR I/O SLOTS	I/O ONLY SLOTS	MTBF
3U 12 TE	0	1	0	8 150 000 h
3U 16 TE	0	2	0	5 680 000 h
6U 12 TE	0	4	0	3 140 000 h
6U 16 TE	0	5	1	2 440 000 h

NOTES

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