Trainguard
Trackside equipment
Ensuring mobility is one of the major challenges facing our society. In order to stay mobile in the future, we need internationally networked transportation and information systems. Only if all modes of transport are properly matched and optimally interoperate can our mobility requirements be mastered. With “Complete mobility”, Siemens is therefore creating integrated transportation and logistics solutions – for safe, economical and environmentally friendly passenger and cargo services.
Trainguard is the Siemens solution for the standardized European Train Control System (ETCS). ETCS is successively replacing the different national train protection and train control systems. Standardized interfaces between the vehicle and the line permit interoperability beyond national borders. As one of the pioneers for ETCS, Siemens offers mature ETCS systems and components with its Trainguard 100 and Trainguard 200 products. Key elements of the ETCS trackside equipment are the Trainguard Eurobalises S21 and S22 which have already proven themselves in countless cases.

**Range of applications**

Siemens’ Eurobalises enable data for position finding and train control to be transmitted to the train wherever required along the track. They are in use in mainline and regional traffic all over the world. Due to their compact size and lightweight design, the Trainguard Eurobalises S21 and S22 are simple to install. They are both immune to weather conditions and maintenance-free. Existing outdoor equipment can be easily expanded with the Eurobalises.

**Interoperability**

Siemens’ Eurobalises ensure smooth, reliable interaction with on-board equipment from different manufacturers. They have been developed, tested and certified in line with the European Union’s Technical Specifications for Interoperability (TSI).

**Optimum operating conditions**

With a height of only 4 cm, the Trainguard Eurobalise S21 is a reduced-size balise in line with the Class B balise defined by UNISIG specifications. The Trainguard Eurobalise S22 is also a reduced-size balise and has a height of 5.5 cm. It complies with the requirements for a Class A balise. Tried-and-tested foam embedding technology and a compact design make both Eurobalise types optimally suitable for use in the track bed.

The Trainguard Eurobalises S21 and S22 are available in two variants and are universally suitable. As fixed balises with a permanently stored telegram, they transmit the same data to the train whenever they are traversed. As transparent balises, they send variable data depending on the signal aspect involved. In this case, this balise variant is controlled by a lineside electronic unit (LEU) via a permanently attached cable without connector.

**Benefits**

- Cost-effective
- Compact
- Tried-and-tested
- Highly reliable data transmission for train speeds of up to 500 km/h
- Contactless programming
Principle of operation

Trainguard Eurobalises use a standardized transmission method. It is based on inductive coupling and data transmission with frequency shift keying and has, for many years, been successfully used by Siemens for train control.

When a train passes, the on-board balise antenna activates the Eurobalise by emitting a low-power signal. The Eurobalise uses this energy to send its information to the balise/loop antenna. It transmits the data required for train control to the train intermittently. This information is for train supervision by the EVC (European Vital Computer, on-board computer) and, at the same time, serves as a basis for display on the DMI (driver-machine interface) in the driver’s cab. Depending on the application involved, fixed or transparent balises of the type Eurobalise S/two.fitted/one.fitted or S/two.fitted/two.fitted are used.

Programming

Eurobalises are programmed without any cable. Programming is done via the air gap by means of a handheld computer and a test and programming unit (TPG). Using the TPG, line operators can conveniently read out and modify the balise programming at any time.

The Trainguard Euroloop S21 and S22 plus Trainguard Euroloop S21

The Trainguard Euroloop S21 increases line capacity and improves safety.

The Trainguard Euroloop S21, a member of the Trainguard 100 family, is a continuous option complementing the Trainguard Eurobalise, which permits semi-continuous data transmission to the train. The on-board balise/loop antenna used for the Eurobalises is also deployed for the Euroloop.

The Trainguard Euroloop S21, an up to 1000 meter-long leaky feeder, is laid at the base of the rail web between the distant and main signals. The advantage of data transfer is that the latest information is fed to the train continuously (infill), not merely at a defined point. With minimal modification to the vehicles, the Trainguard Euroloop S21 allows higher train speeds in the relevant sections with the same high level of safety.
**Two for the line**

*Trainguard Eurobalises S21 and S22 – for universal usage*

**S21 and S22 fixed balises**
As a fixed balise, the Eurobalise sends a track data telegram to the vehicle. The track data telegram is permanently stored in the fixed balise. The user can modify the data at any time if required.

**S21 and S22 transparent balises**
All the signal codes corresponding to the possible signal aspects and their associated telegrams are stored in a Trainguard LEU S21 (lineside electronic unit) installed at the trackside. In accordance with the signal aspect, the matching telegram is passed to the transparent balise and transmitted from there to the vehicle.

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### Technical data

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Speed range</strong></td>
<td>0 km/h to 500 km/h</td>
</tr>
<tr>
<td><strong>Power transmission frequency</strong></td>
<td>27.095 MHz</td>
</tr>
<tr>
<td><strong>Data transmission frequency</strong></td>
<td>4.234 MHz</td>
</tr>
<tr>
<td><strong>Data transmission rate</strong></td>
<td>565 kbits/s</td>
</tr>
<tr>
<td><strong>Type of modulation</strong></td>
<td>FSK (frequency shift keying)</td>
</tr>
<tr>
<td><strong>Telegram length</strong></td>
<td>341 bits or 1023 bits (selectable)</td>
</tr>
<tr>
<td><strong>Usable data length</strong></td>
<td>210 bits or 830 bits (selectable)</td>
</tr>
<tr>
<td><strong>Programming</strong></td>
<td>cableless across an air gap by means of the TPG test and programming unit</td>
</tr>
<tr>
<td><strong>LEU S21 – Eurobalise control distance</strong></td>
<td>max. 5000 m</td>
</tr>
<tr>
<td><strong>Reliability (MTBF values as per SN 29500)</strong></td>
<td>fixed balise &gt; 800 years</td>
</tr>
<tr>
<td></td>
<td>transparent balise &gt; 160 years</td>
</tr>
<tr>
<td><strong>Dimensions (l x w x h)</strong></td>
<td></td>
</tr>
<tr>
<td>Eurobalise S21</td>
<td>480 x 260 x 40 mm</td>
</tr>
<tr>
<td>Eurobalise S22</td>
<td>480 x 260 x 55 mm</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>4 kg without cable (fixed balise), 10 kg with 9.6 m cable (transparent balise)</td>
</tr>
<tr>
<td><strong>Ambient temperature</strong></td>
<td>-40 °C to +70 °C (without solar radiation)</td>
</tr>
<tr>
<td><strong>IP rating</strong></td>
<td>IP67</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>reduced-size balise</td>
</tr>
</tbody>
</table>

**Trainguard Eurobalise S21 class B**

**Trainguard Eurobalise S22 class A**

**Conformity**
The Eurobalises S21 and S22 fully comply with [TSI ZZS 2015] and UNISIG’s [Subset-036-BL2] and [Subset-036-BL3], Versions V2.4.1 and V3.0.0.
The TPG Eurobalise V2 Web test and programming unit is a logical refinement of the current version and enables Siemens’ Eurobalises S11, S21 and S22 to be tested and programmed via WLAN both easily and fast.

Using commercial off-the-shelf operator control units such as a tablet or notebook, the user communicates with the TPG at a distance of up to 50 m from the track area, wirelessly via 15 - 25m and outside the danger zone.

In environments where WLAN must not be used, a cable-bound USB connection between TPG and operator control unit is available as an alternative.

A positioning aid is located underneath the housing to enable the TPG to be safely placed on the balise.

A robust tablet suitable for outdoor applications under snowy, rainy and sunny conditions is available on request. The battery life of the tablet is sufficient for more than one shift. The tablet can also be operated when wearing gloves. A shoulder bag is available for transport along the track.

**Benefits**

- Cableless testing, programming and ETCS-conformant telegram data read-out at a safe distance from Siemens’ Eurobalises (up to 50 m)
- Programming of more than 200 balises with one battery charge
- Operator control with commercial off-the-shelf WLAN operator control units such as a tablet or notebook
- Additional cable-bound USB connection option
- Positioning aid for placing the TPG on the balise
- No software installation required on the operator control unit
- Storage and transportation in an easy-to-carry backpack (overall weight approx. 7 kg)
WLAN-based test and programming unit for local maintenance

Technical data

<table>
<thead>
<tr>
<th>Specifications and application conditions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>approx. 6.5 kg</td>
</tr>
<tr>
<td>Dimensions (h x w x d)</td>
<td>157 x 488 x 346 mm</td>
</tr>
</tbody>
</table>
| Connection between an operator control unit and the TPG | – via WLAN (802.11 b.n): up to 50 m  
– USB 2.0 cable connection |
| Operating temperature range              | –20 ºC to +55 ºC |
| IP rating                                | IP54 (if the mains connection socket and other sockets are provided with covers) |
| Mains power supply                       | – external power pack: 110 V/230 V, 50 Hz/60 Hz  
– TPG base unit: 12 V to 15 V, 3 A |
| Operating life with one battery charge at 20 ºC | programming of at least 200 balises |
| Rechargeable battery                     | 12 V NiMH |
| Menu languages                           | German, English, French, Italian |
| Balise programming                       | cableless across an air gap |
| Radiation                                | 27.095 MHz, 9 MHz |
| Reception (data received from the balise) | 4.237 MHz ± 200 kHz |

Recommended mobile operator control units and requirements

<table>
<thead>
<tr>
<th>Tested and recommended operator control units</th>
<th>Important requirements</th>
</tr>
</thead>
</table>
| Toughpad FZ-G1 and Toughpad FZ-M1 tablets (from Panasonic) | – WLAN interface (802.11 b.n)  
– Display with 1024 x 600 pixels (min. 7” widescreen recommended)  
– File system for storage of programming files and logs  
– Tested browsers: Internet Explorer, Firefox (other browsers may function but have not been tested) |
| Algiz 7 (from handheld) | Notebook/laptop with Windows 7 and Internet Explorer 10 and 11 |
| Notebook/laptop with Windows 7 and Internet Explorer 10 and 11 | – |

Supported balises

– Trainguard Eurobalise S11  
– Trainguard Eurobalise S21  
– Trainguard Eurobalise S22

All necessary data is programmed in the memory of Siemens’ Eurobalise in the form of a telegram across the air gap.

The operator control unit which can be ordered as an option enables the TPG Eurobalise V2 Web test and programming unit to be operated. As an alternative, operator control is also possible via a different tablet (according to customer specifications) or a notebook/laptop.
Trainguard LEU S21 – unlimited safety with ETCS Level 1
The Trainguard LEU S21 (lineside electronic unit) is the link between existing fixed signals and trackside ETCS components, Eurobalises and Euroloops of the S21 type. The Trainguard LEU 21 has proved to be extremely reliable in more than 15,000 instances in different countries.

**Principle of operation**

An ETCS-equipped transmission point usually comprises one fixed balise and one transparent balise. The telegrams are transmitted intermittently by means of the Eurobalise and, if required, semi-continuously by the Trainguard Euroloop S21 F. The indicated signal aspect is extracted by the Trainguard LEU S21 and the associated telegram is selected and continuously transmitted as a serial data stream via a standardized interface to the transparent balise(s) or the Euroloop modem. If an ETCS-equipped train traverses the balise, the ETCS telegram is transmitted to the train and evaluated by the EVC (European Vital Computer, on-board computer). All configuration data, signal codes and telegrams belonging to the signal are stored in the Trainguard LEU S21. If the Trainguard LEU S21 detects an invalid signal aspect, a fault telegram is output.

<table>
<thead>
<tr>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compliance with all relevant European standards</td>
</tr>
<tr>
<td>Modular structure</td>
</tr>
<tr>
<td>Accommodation in concrete equipment houses, apparatus cabinets or relay rooms</td>
</tr>
<tr>
<td>High-reliability data transmission</td>
</tr>
<tr>
<td>No maintenance required</td>
</tr>
<tr>
<td>High level of availability</td>
</tr>
<tr>
<td>Low purchase and lifecycle costs</td>
</tr>
<tr>
<td>Low power consumption</td>
</tr>
</tbody>
</table>

**Programming and diagnostics**

A handheld computer is the central component for programming and diagnostics of the Trainguard LEU S21. The data generated during configuration is transmitted by the handheld computer and safely stored in the Trainguard LEU S21 memory. The displays on the Trainguard LEU 21 and the handheld computer also offer easy-to-use diagnostic options.

**Installation**

The entire wiring and the connectors for the external connections are integrated into the mounting rack and accessible from the front. The Trainguard LEU S21 is normally housed in the signal cabinet of the signal to be equipped. It is directly connected via the cable feeder from the interlocking to the signal or via the lamp circuit.
Benefits of Trainguard LEU S21

Compact design
The Trainguard LEU S21 can be installed in almost all conventional apparatus cabinets. All connectors are accessible from the front, thus simplifying equipment replacement and cutting down on modification costs.

Safe current tapping
A low-resistance transformer enables the Trainguard LEU S21 to be looped into an existing signal circuit without affecting the control distance. Lamp tapping with a current transformer is fail-safe in line with SIL 4.

Absence of interaction
Due to the special characteristics of the current transformer, the absence of interaction can be easily demonstrated. This has already been done for various signaling systems.

Cascadability
A modular Trainguard LEU S21 with a signal tap provides up to three simplified cascaded LEUs with the signal aspect. This means that up to eight outputs are available for balises/loops.

Patented programming method
This method is patented and ensures data transmission between the handheld computer and the Trainguard LEU S21 in line with SIL 4.

Three-stage diagnostic concept
Rough diagnostics are possible in two stages without any tools:
• LEDs (operating state)
• seven-segment display (fault cause)

Detailed diagnostics with a handheld computer also permit records to be made over long periods of time (in the event of temporary faults).

Maximum availability
The Trainguard LEU S21 deactivates the outputs for Eurobalises/Euroloops in the event of faults and reactivates them as soon as the relevant fault has been rectified.

Monitoring functions
Smooth operation is ensured by monitoring functions, considerably boosting the availability of the trackside equipment and minimizing the deployment of maintenance staff.

Maintenance-free operation
The Trainguard LEU S21 is maintenance-free; no regular inspections need to be performed.

Driver-machine interface
Interlocking
Stop marker board with overrun light
MSTT
LEU
Track vacancy detection
Eurobalise (fixed)
Eurobalise (controlled)
Eurobalise antenna
Odometer pulse generator
Radar
Euroloop infill
Eurobalise (fixed)
Eurobalise (controlled)
Eurobalise (controlled)
### Technical data

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability (MTBF as per SN 29500)</td>
<td>&gt; 31.7 years</td>
</tr>
<tr>
<td>Dimensions (l x w x h)</td>
<td>185 x 190 x 286 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>3.8 kg</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-40 °C to +70 °C</td>
</tr>
<tr>
<td>IP rating</td>
<td>IP20 (installation in housing with min. IP54)</td>
</tr>
</tbody>
</table>

### Current inputs

- **Number of inputs**: up to 16 inputs configurable
- **Input range**: 30 mA to 4 A (15 Hz to 440 Hz)
- **Flashing detectors**: configurable at up to four inputs

### Voltage inputs

- **Number of inputs**: up to eight inputs configurable
- **Input ranges**: 0 V<sub>rms</sub> to 181 V<sub>rms</sub> AC (15 Hz to 66 Hz); 0 V to 181 V DC
- **Flashing detectors**: 2 inputs configurable

### Power supply

- **Input ranges**: 88 V<sub>rms</sub> to 264 V<sub>rms</sub> AC (15 Hz to 90 Hz); 34 V to 177 V DC

### Telegram generator/outputs

- **Outputs**: two transparent balises, two Trainguard Euroloops or combined
- **Extension**: with cascaded Trainguard LEU S21 extendable to eight outputs
- **Interface signal „C“**: in line with UNISIG Subset 036 FFFIS for Trainguard Eurobalise
- **Interface signal „CL“**: in line with UNISIG Subset 044 FFFIS for Trainguard Euroloop
- **Number of telegrams**: 1023 telegrams per output
- **Telegram length**: 341 bits or 1023 bits (selectable)
The Trainguard MiniLEU S15 is intended for use in mass transit and mainline services for ETCS Level 1 Limited Supervision (L1 LS). Comparable applications are possible (e.g. TBL1+, ZBS).

The Trainguard MiniLEU S15 can be used to upgrade a line already equipped with a national train protection system to L1 LS. The existing train protection systems (e.g. track magnets) can remain on the track and are supplemented by a cost-optimized ETCS solution (Trainguard MiniLEU S15 and Trainguard Eurobalise S21).

The Trainguard MiniLEU S15 connects the Trainguard Eurobalise S21 to the lineside signals. The indicated signal aspect is read in by the Trainguard MiniLEU S15 via the PZB contacts and generates a pointer which, in turn, activates one of the configured telegrams per balise output and transmits it to the transparent balise(s), thus ensuring a minimum need for modification.

The Trainguard MiniLEU S15 offers the fast, cost-optimized conversion of transmission points and considerably reduces installation and cabling costs due to an integrated contact multiplier for the control of PZB magnets and earth-leakage monitoring of the PZB cables.

**Benefits**

- Compliance with European standards
- Simplification of signal-interlocking configuration
- Reduction of the scope of equipment along the track
- Migration of the existing national systems to ETCS
- Further usage of existing outdoor equipment
- Very low power consumption
- Possibility of autonomous solar power supply
- Low life-cycle costs
- Reusability after alterations
- Simple evidence of absence of any interaction
The Trainguard MiniLEU S15 complies with European railway standards (EN 50129 ff) in adherence to the specifications of Subsets 036, 085 and 091. Adherence to the requirements stipulated by UNISIG ensures that the group of constituents (Trainguard MiniLEU S15 and Trainguard Eurobalise S21) interacts with the components of other vehicle manufacturers.

**Applications**

**Signal-guided L1 LS**

The PZB 90 system operated in Germany is used for this purpose. Track magnets are available along the line which are directly connected to the different signaling systems via a standard interface.

The contact information of the national PZB 90 train protection system is read into the Trainguard MiniLEU S15 and provided again via a contact multiplier to control the relevant track magnets. At the same time, the telegram is sent via the Trainguard Eurobalise S21 to the ETCS on-board units.

**TBL1+ train control system**

On the Aachen–Belgian border line, the MiniLEU S15 with TBL1+ function has been implemented in addition to the existing PZB intermittent train control system. In the TBL1+ upgrading phase, signals continue to be used for train operation. The train control function is performed by the Belgian TBL1+ system and in parallel by German Railways’ PZB system. Hence, both trains with PZB on-board equipment and trains with TBL1+ on-board equipment can run on the line.

The information for the TBL1+ system is obtained from the existing PZB infrastructure and forwarded to the MiniLEU S15 as input information. However, Eurobalises are used as in the ETCS for information transmission from the track to the train. This enables mass transit trains coming from Belgium to run with their TBL1+ train control system as far as Aachen Central Station. The section from the Belgian border to the Hammerbrücke junction on the Belgian side is equipped with ETCS Level 1 and TBL1+.

### Technical data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of telegrams</td>
<td>10 telegrams per output</td>
</tr>
<tr>
<td>Number of outputs</td>
<td>3 Trainguard Eurobalises S21</td>
</tr>
<tr>
<td>Number of inputs</td>
<td>5</td>
</tr>
<tr>
<td>Power consumption</td>
<td>&lt; 2000 mW</td>
</tr>
<tr>
<td>Operating voltage</td>
<td>4 V to 60 V DC</td>
</tr>
<tr>
<td></td>
<td>110 V to 230 V AC</td>
</tr>
</tbody>
</table>
ETCS-safe and sustainable throughout:
Siemens is supplying 5000 solar-powered
MiniLEUs for Swiss Federal Railways’ network
The Trainguard MiniLEU S11 has been developed for rail customers who wish to upgrade their existing systems with ETCS fast, cost-effectively and ecologically, whether for enhanced safety or for interoperability. In combination with the new ETCS Level 1 Limited Supervision mode, roll-out is possible without causing performance to be diminished or making extensive adjustments to the operating rules.

ETCS installation both fast and uncomplicated
Development of the MiniLEU S11 focused on full-coverage installation with ETCS within the shortest possible time and with minimum investment. With this in mind, we have minimized the costs involved, from configuration and installation through to commissioning.

Minimum lifecycle costs
The following measures have reduced the lifecycle costs to a minimum:
• automatic indication of faults or low battery charge levels, obviating the need for preventive maintenance
• extremely high mean time between failures (MTBF), reducing intervention costs which would be incurred in the event of a failure
• status LEDs on the front panel of each board, enabling diagnostics without auxiliary tools; necessary measures can be initiated and implemented within a very short period of time
• due to local configuration, no reprogramming required if boards are replaced

<table>
<thead>
<tr>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar power supply for self-sufficient operation of the MiniLEU S11</td>
</tr>
<tr>
<td>No need for cabling, adjustments to circuits, installation of fuses, UPS, etc.</td>
</tr>
<tr>
<td>Due to the plastic housing, no complex cabinet installation and the otherwise usual earthing measures</td>
</tr>
<tr>
<td>Programming less than two minutes</td>
</tr>
</tbody>
</table>

Smart combination for the ETCS safety standard: Trainguard MiniLEU S11 and Trainguard Eurobalise S11
ETCS Level 1 Limited Supervision
This is a modified version of ETCS Level 1 (L1). Limited Supervision (LS) entails simplified background monitoring without cab signaling. The driver continues to observe trackside signals and thus largely drives the train in line with the current operating processes.

ETCS L1 LS monitors in the background and only as many parameters as required at any particular location. ETCS L1 LS has been adopted into Baseline 3 of the ETCS specifications.

The MiniLEU S11 allows ETCS L1 LS to be implemented in existing signaling and safety systems without any major modifications, thus enabling cost-effective migration to the ETCS standard.
Market data

Technical data

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight of MiniLEU S11</td>
<td>6.8 kg (incl. housing)</td>
</tr>
<tr>
<td>Dimensions</td>
<td>300 x 300 x 300 mm</td>
</tr>
</tbody>
</table>

Ambient conditions

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature</td>
<td>-40 °C to + 70 °C</td>
</tr>
<tr>
<td>Cooling</td>
<td>not required</td>
</tr>
<tr>
<td>Storage classes</td>
<td>1K2, 1Z2, 1B1, 1C2, 1S2, 1M2</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-25 °C to + 70 °C</td>
</tr>
<tr>
<td>IP rating</td>
<td>IP54 in housing</td>
</tr>
<tr>
<td>Humidity</td>
<td>in line with EN 50125-3, climate class T1</td>
</tr>
<tr>
<td>Vibrations</td>
<td>in line with EN 50125-3, application 1 to 3 m next to the track edge</td>
</tr>
<tr>
<td>Pollution degree</td>
<td>4C3, 4B1, 4S3 (applicable outside on the housing)</td>
</tr>
<tr>
<td>EMC</td>
<td>EN 50121-4, EN 61000-6-2, EN 61000-6-4</td>
</tr>
<tr>
<td>Insulation coordination</td>
<td>EN 50124-1</td>
</tr>
<tr>
<td>Service life</td>
<td>25 years</td>
</tr>
<tr>
<td>Safety integrity level</td>
<td>SIL 2 as per EN 50129</td>
</tr>
</tbody>
</table>

Referenzen

More than 2,500 installed and in operation in Swiss Federal Railways’ network

Zulassung

Operation in Switzerland

Installed ETCS systems ensure cross-border interoperability.
The Trainguard 200 RBC (radio block center) transmits all the information required for safe train operation within a particular line section by radio from the interlocking to the train. This information is indicated on the cab display. For data transmission, the digital Global System for Mobile Communications – Railways (GSM-R) is used. For position finding, Eurobalises serve as reference points.

The Trainguard 200 RBC supports the parallel connection of two mobile services switching centers (MSC) to the RBC. If a connection to one of the MSCs fails, undisrupted operation can be maintained via the second MSC.

<table>
<thead>
<tr>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-availability, fail-safe computer system</td>
</tr>
<tr>
<td>Compact design with a proven platform</td>
</tr>
<tr>
<td>Reduction of the scope of configuration and preventive maintenance work when used in Simis interlockings</td>
</tr>
<tr>
<td>Optimal integration of relay interlockings or other manufacturers’ interlockings</td>
</tr>
<tr>
<td>Control of ETCS Level 1 balises</td>
</tr>
<tr>
<td>Modular extension</td>
</tr>
<tr>
<td>Upgradability to Baseline 3</td>
</tr>
<tr>
<td>Low power consumption</td>
</tr>
<tr>
<td>Use in a wide temperature range; less need for air-conditioning</td>
</tr>
</tbody>
</table>
Principle of operation
The ETCS trains moving in the line area controlled by the Trainguard 200 RBC locate themselves independently and cyclically transmit their positions to the Trainguard 200 RBC. The Trainguard 200 RBC is continuously supplied with the current process image from the connected interlockings and sends movement authorities to the trains by radio data transmission.

Range of applications
The Trainguard 200 RBC can be integrated into existing infrastructures without any complex adaptation since interlockings are connected via standard interfaces. This means that different interlocking types are supported. In the migration phase, the Trainguard 200 RBC also offers mixed operation in combination with other ETCS levels.

The Trainguard 200 RBC can also assume the tasks of a central lineside electronic unit (LEU), enabling mixed Level 1 and Level 2 solutions. Level 1 and Level 2 are configured in the same way, which means that the level can be simply changed over. This also enables temporary speed restrictions to be entered for Level 1 vehicles via the operator console and movement authorities to be issued for several sections even in Level 1. Standardized interfaces allow the Trainguard 200 RBC to communicate with other Trainguard 200 RBCs or other manufacturers’ RBCs.

Optimum integration into existing Simis interlockings
The Trainguard 200 RBC is based on the proven Simis® platform and can be easily integrated into existing Simis interlockings. By using the same hardware platform, benefits result for preventive and corrective maintenance, e.g. due to the fewer spare parts stocked, reducing the lifecycle costs.

Both systems use the same diagnostic system, thus reducing the complexity of maintenance. Due to the joint configuration of both the interlocking and the Trainguard 200 RBC, optimum project durations are achieved.

Integration into relay interlockings and other manufacturers’ interlockings
The use of standardized interfaces means that the Trainguard 200 RBC can be connected to other manufacturers’ interlockings. Furthermore, relay interlockings can communicate with the Trainguard 200 RBC via interface computers.

Operator console for Trainguard 200 RBC
Temporary speed restriction, for example, are entered via the Trainguard 200 RBC operator console. The operator console can be installed locally or integrated into a higher-level operator and operations control system.

Flexible migration
The Trainguard 200 RBC supports migration from national train control systems to ETCS. Migration can involve mixed operation with the relevant national systems or different ETCS levels.
CENELEC and safety
The Trainguard 200 RBC complies with the CENELEC standards and meets safety integrity level SIL 4. The Trainguard 200 RBC works on the basis of the well-known, reliable Simis principle and features a high level of availability.

Compact design
The Trainguard 200 RBC has a compact, modular design. Depending on the number of vehicles to be monitored or connected interlockings, the Trainguard 200 RBC can be modularly extended. The Trainguard 200 RBC can also assume the tasks of a central LEU and control ETCS Level 1 balises.

Ready for Baseline 3
The UNISIG functionality of the Trainguard 200 RBC corresponds to SRS 2.3.0d. The future Baseline 3 has been taken into account in the design of the Trainguard 200 RBC. Hence, a software update to Baseline 3 is straightforward.

Low power consumption
The Trainguard 200 RBC has a power consumption of less than 600 W. If trackside signals are not used, considerable energy is additionally saved. This means that the Trainguard 200 RBC contributes to environmentally friendly railway operations.

### Technical data

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of monitored vehicles</td>
<td>scalable from 30 to 60</td>
</tr>
<tr>
<td>Power consumption</td>
<td>&lt; 200 W</td>
</tr>
<tr>
<td>Number of interlockings per RBC</td>
<td>8 (standard), optionally extendable</td>
</tr>
<tr>
<td>Number of interfaces to adjacent RBCs as per UNISIG Subset 039</td>
<td>4</td>
</tr>
</tbody>
</table>
Trainguard Futur 2500 RBC
As part of Siemens’ Trainguard train control system family, the Trainguard Futur 2500 RBC is the ERTMS Level 2 solution for railway operators throughout the world who attach importance to high-level performance and maintainability.

Harmonized traffic concepts are decisive in the European Union. An interoperable train control system is of essential significance for cross-border traffic between the EU’s member states.

The development of a standard automatic train control system for the optimization of rail traffic is important not only on the European level but also for countries outside the EU, e.g. Saudi Arabia or Kazakhstan, which want to introduce this standard as a basis for their rail operations.

For such a system, common standards for vehicle systems and connection and communication interfaces between the modules have to be set up and joint processes defined. In order to comply with these requirements, the now globally used ERTMS has been developed.

Siemens has developed a complete range of fail-safe, interoperable ERTMS products which are in successful operation. The Trainguard Futur 2500 RBC is the ERTMS Level 2 train control solution from Siemens.
Performance features
The Trainguard Futur 2500 ERTMS Level 2 system has the following prime features:

Functionality
The entire range of functions of the Trainguard Futur 2500 RBC has been tested in various projects with different operating concepts. The Trainguard Futur 2500 RBC has been certified in line with UNISIG 2.3.0d and is upgradable to UNISIG Baseline 3.

Modularity
The Trainguard Futur 2500 RBC is modular in design, each subsystem having a specific function. This boosts reliability by using specific hardware for the different functions, simplifies maintenance and enables each subsystem to be upgraded independently.

Communication standards
Serial interfaces ensure straightforward communications with other systems via the TCP/IP protocol, enabling access to different networks used in railway environments (e.g. GSM-R, TETRA).

Reliability
The components used for the Trainguard Futur 2500 RBC meet maximum reliability requirements. As far as possible, standard industrial components are used to ensure availability throughout the system’s entire service life and enable it to be upgraded to new versions.

Availability
All safety-related subsystems of the Trainguard Futur 2500 RBC are designed as 2-out-of-3 systems. The communication equipment can be operated in hot stand-by mode and thus provides a high level of availability.

Maintainability
Maintenance and diagnostics can be performed either locally or centrally, with real-time access to all system parameters.

Safety
The Trainguard Futur 2500 RBC has been developed in line with the European CENELEC standards EN 50126, EN 50128 and EN 50129.

Performance
The system uses tried-and-tested technology to cut down on costs, reduce the space required for hardware and increase processing speed. The platform used enables later adjustment of the system to higher-level requirements in terms of functionality and response time.
Temporary speed restrictions
The Trainguard Futur 2500 RBC features a forward-looking system for the management of temporary speed restrictions along the line. Temporary speed restrictions can be established and canceled by the operator both simply and safely. They can be entered in 5 km/h increments for speeds of between 0 and 350 km/h on the basis of either track kilometrage or track circuits.

Both in ERTMS Level 1 and Level 2, temporary speed restrictions can be entered at the ERTMS center, on site or at an operations control center. This ensures a high degree of flexibility for the operator and maintenance engineer and efficient, coordinated operations management.

Selected projects
Siemens has already successfully implemented its ERTMS solution in various projects with different operating concepts:
- high-speed lines (e.g. Córdoba–Málaga, Madrid–Levante, Mecca–Medina, Ankara–Konya)
- mass transit (e.g. suburban lines in the Madrid area, Marmaray project)
- mass transit with ATO (e.g. Thameslink project)

The Trainguard Futur 2500 RBC has been installed and commissioned for the purpose of upgrading the line to ETCS Level 2 in accordance with the UNISIG 2.3.0.d specifications. In addition to the usual control and monitoring tasks for the respective areas, the two installed Trainguard Futur 2500 RBCs execute the complex train handover function.

Technische Daten

| Maximum number of temporary speed restrictions (TSR) | 10 per movement authority |
| Number of speed restriction section managers for all connected RBCs | 1 centrally |

Principle of operation
The Trainguard Futur 2500 RBC is a complete train control system which is based on continuous bidirectional data transmission with the train via GSM-R Euroradio.

Depending on the condition of the infrastructure and the position of the trains along the line, the RBC calculates the movement authority and sends it together with the track data to each train. This is based on the train position transmitted by the interlocking via GSM-R/TETRA or a track vacancy detection system.

The on-board unit continuously monitors the train speed and thus ensures that it is not exceeded.

The Trainguard Futur 2500 RBC ERTMS Level 2 system is suitable for various applications, from high-speed lines with trains operating at up to 500 km/h down to mass transit lines with short headways, and for rail operators’ very different requirements.
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