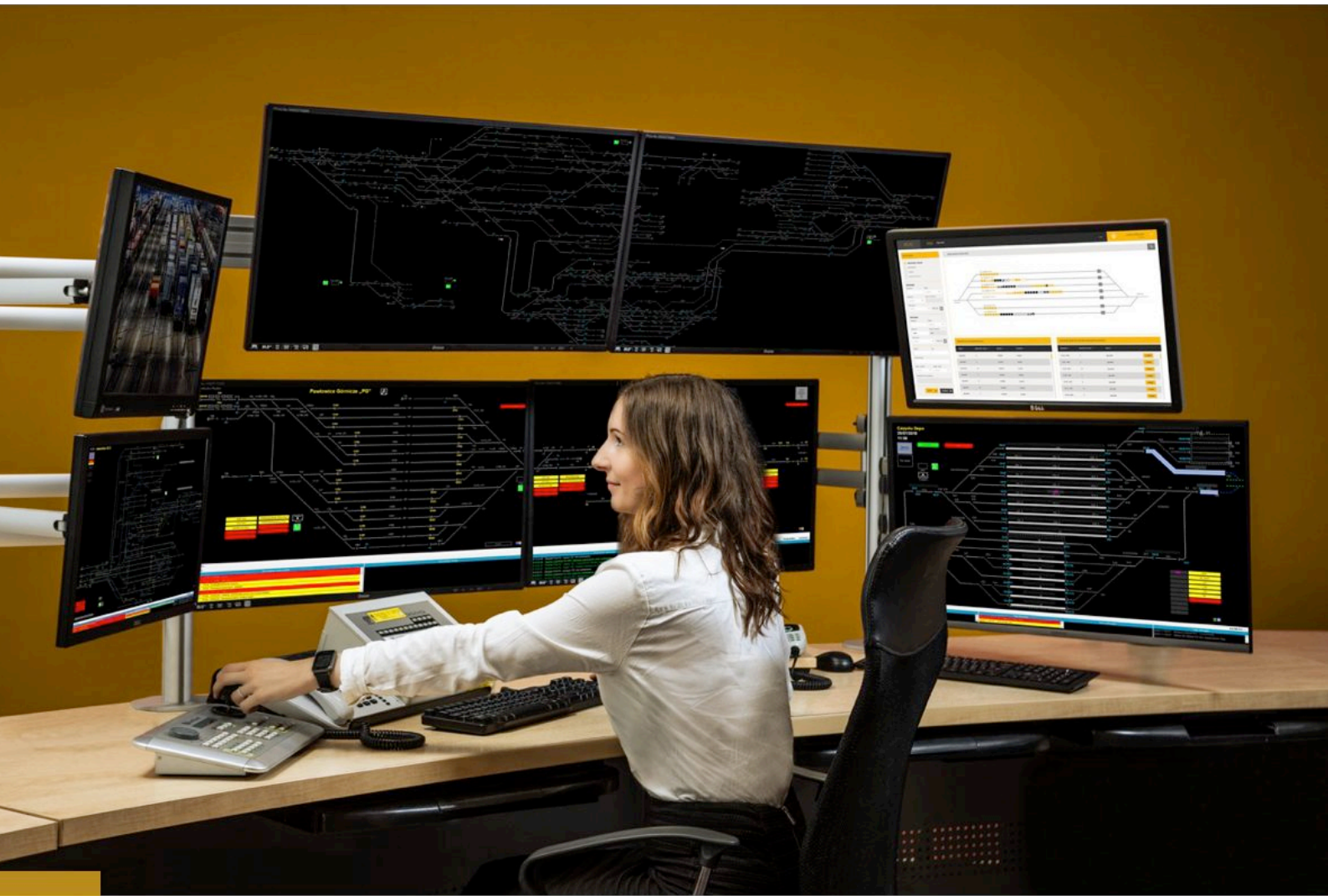


Digital Railways

Electronic Interlocking

MODEST-GEMINI



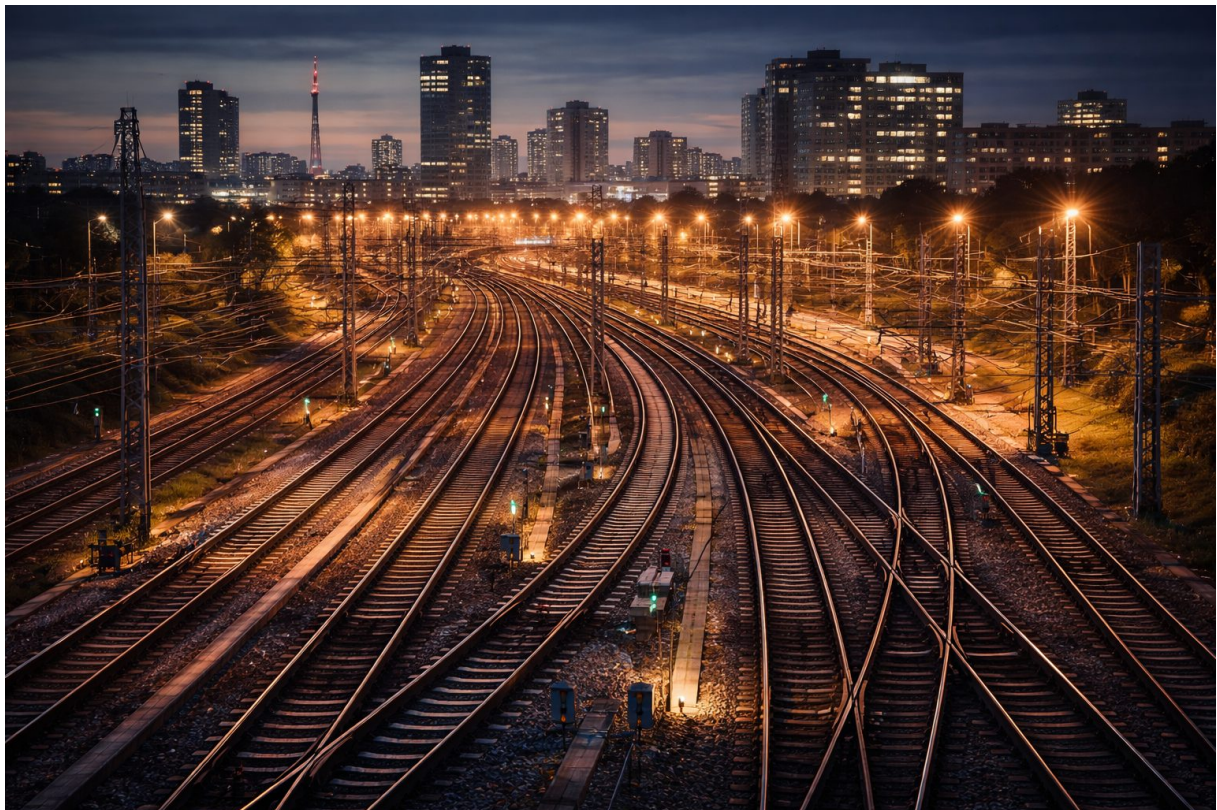
První**Signální**



Intelligent Control of Railway Operations

Modern railway infrastructure requires the highest levels of safety, availability, and operational flexibility. The increasing demands on capacity, interoperability, and digitalisation call for signalling systems that are both powerful and adaptable.

MODEST-GEMINI is a state-of-the-art electronic interlocking system designed to ensure safe and efficient railway operation across a wide range of applications – from local stations to large-scale centralised traffic control systems.



- Fully electronic interlocking system suitable for mainline, regional, industrial and urban railways
- Integrated functionality reducing system complexity and lifecycle costs
- Highest safety level compliant with SIL4 (CENELEC EN 50126 / 50128 / 50129)
- High availability ensuring uninterrupted railway operation
- Modular and scalable architecture
- Seamless integration with modern railway technologies including ETCS
- Advanced diagnostics and maintenance support

Proven Quality

Based on more than 40 years of experience in railway signalling technology, MODEST-GEMINI delivers proven quality under real operating conditions.

The system sets a benchmark in the market for computer-based interlocking systems. With installations across Europe, Asia, and Africa, the flexibility, competence, and long-standing experience of První Signální in interlocking technology have been demonstrated repeatedly.

Through the consistent use of digital components, modern diagnostics and control via intelligent communication networks have become standard.

Intelligent object controllers enable the distribution of control and monitoring functions. This allows a larger volume of information to be processed and recorded in a decentralised manner and made available for more efficient overall system control. The collected data forms the basis for advanced system diagnostics.

Maintenance and diagnostic activities can be centralised using public or private communication networks.

Furthermore, digital data connections such as EULYNX SCI interfaces (Standard Communication Interfaces) can be easily implemented using RaSTA (Rail Safe Transport Application) over IP-based networks. This enables secure and flexible integration with various signalling systems and external equipment.

Modern communication methods also enable data exchange with neighboring interlockings, level crossing protection systems or even with onboard systems. All relevant information can be made available where needed, without limitations on data processing capacity. The system therefore provides a solid foundation for integration of MODEST-GEMINI into ETCS environments.



INSPECTION CERTIFICATE

registration number **05.319.163 rev. 1**

issued according to ČSN EN ISO/IEC 17020 for the organisation:

**První Signální, a.s.,
Bohumínská 368/172
712 00 Ostrava-Muglinov**

Amazing Flexibility

Since the beginning of the development of digitalised control and safety technology, První Signální has pursued a modern and flexible platform strategy.

The První Signální platform NEXUS has been continuously developed since then and forms the basis for our MODEST-GEMINI interlocking and the LEXIS level crossing.

It follows the concept of distributed intelligence and allows functions and hardware to be decoupled from each other and thus to react individually to even the most varied customer requirements.



The NEXUS platform consists of:

- The hardware modules
- The associated firmware
- The operating systems
- The generic basic software components

The components are always identical and used for both the LEXIS level crossing technology and the MODEST-GEMINI digital interlocking.

This common platform results in cost-optimising synergy effects, helping to simplify development, approval, production and the supply of spare parts.

The same spare parts can be kept in stock for maintaining both the MODEST-GEMINI digital

interlocking and the LEXIS level crossing technology, thus minimizing parts storage and the maintenance staff can easily be trained for two very similar technologies.

The necessary and often very different functions and requirements of the markets are met by planning the software on a project-related basis.

The platform strategy makes us optimally equipped to implement a broad range of market-specific requirements.

The use of NEXUS technology in various countries in Europe, Asia, Africa and America without needing to generate customised hardware proves the success of this strategy.

Modular Structure

The concept of the MODEST-GEMINI works according to the principle of distributed intelligence. Information is transmitted from digital field components to a safe system core. From that point, the information is processed and the appropriate commands are transmitted to the field components.

The portfolio of input/output modules of the NEXUS safe control platform includes fully electronic modules for the implementation of interfaces to wayside equipment and neighboring systems:

- NX_SI16 16 safe binary inputs with common ground
- NX_SI8 8 safe binary inputs with separate ground
- NX_SO8 8 safe binary outputs
- NX_SR5 5 safe binary outputs (dry contacts)
- NX_EP a portfolio of control cards for various types of switch machines
- NX_SIG1 safe control of 6 lamps of monitoring signals
- NX_AXC integrated axle counter card sensing up to 3 wheel detectors



Control Technology

The control technology of MODEST-GEMINI interlocking system consists of

- Core controller
- Diagnostic servers
- Area / Object controllers
- Communication subsystem
- Power supply subsystem
- Operator interfaces (local and remote)

The indoor control technology is rack mounted and can be allocated in

- Outdoor cabinets
- Containers / Cabins
- (Concrete / Prefabricated) Houses



System Architecture

The MODEST-GEMINI interlocking system features a highly flexible architecture designed to meet the requirements of a wide range of applications.

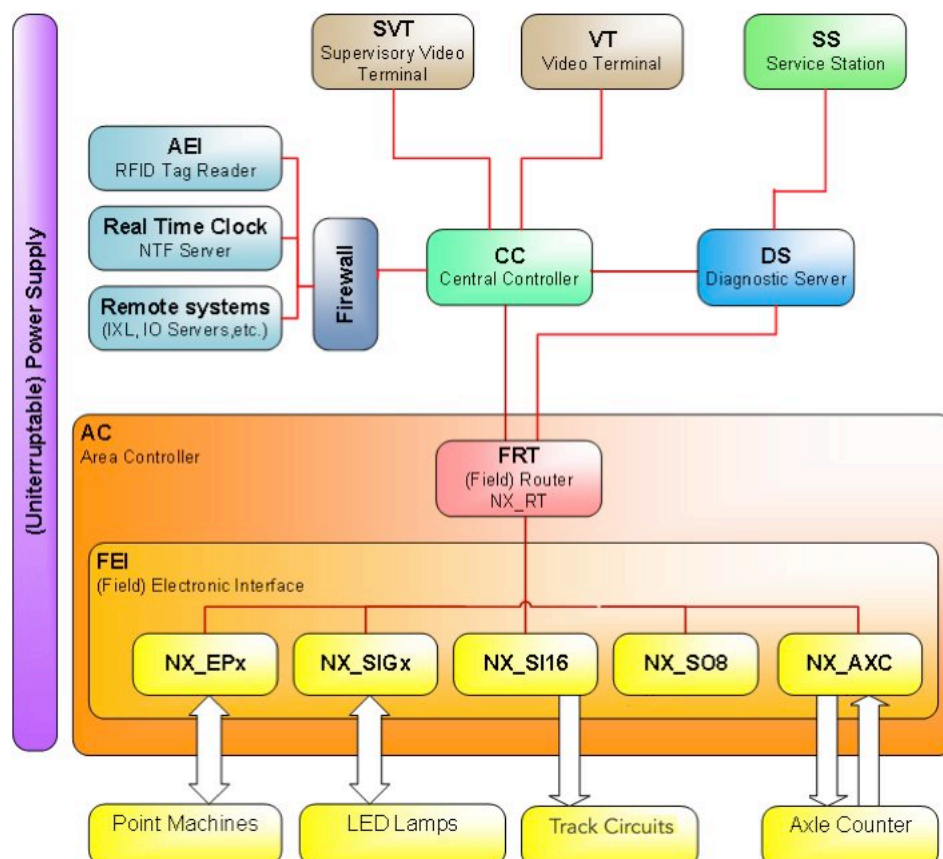
It supports any combination of local and remote control, including operation of a single station, multiple adjacent stations, or entire railway lines. Operator workstations can be configured as single-operator or multi-operator solutions, depending on operational needs.

The control system can be implemented as fully centralised, partially decentralised, or fully distributed, allowing optimal adaptation to infrastructure and operational concepts.

The architecture is designed to achieve high system availability. The central controller is implemented with 2oo3 redundancy, while all communication components, networks, and buses are consistently designed as redundant. The power supply system can also be configured with redundancy, combining dual mains supply, UPS systems, and backup diesel generators.

An integral part of the system is the integrated diagnostic subsystem, which continuously monitors the health status of the hardware and provides early fault detection. Detected faults are automatically identified and localised, and maintenance personnel are supported with clear guidance for troubleshooting.

The system provides detailed measurement data of key parameters (such as currents, voltages, and timing values). Based on continuous monitoring of system states and trends, the system generates comprehensive operational and diagnostic reports, supporting efficient maintenance and system management.



Integrated Functions

MODEST-GEMINI integrates multiple signalling subsystems into a single platform:

- Axle Counter System

Fully integrated axle counting functionality eliminates the need for external evaluation units and reduces system complexity.

- Line Block

Integrated multiple section line block functionality ensures safe train separation between stations and supports efficient line operation.

- Level Crossing Control

Direct integration of level crossing protection enables seamless coordination between interlocking and crossing systems.

- Electronic Consents

Secure electronic consent functionality provides safe interfaces to neighbouring interlockings and stations.

Functional Processing and Execution Cycle

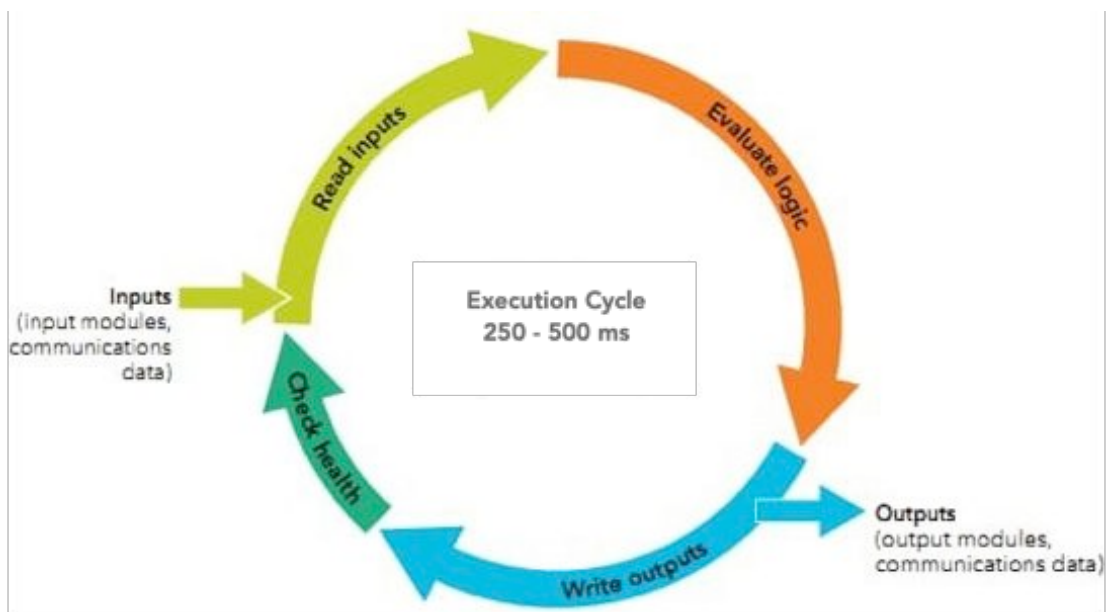
Input signals are acquired by the object controllers and subsequently processed by the Core Controller. In accordance with the defined interlocking functional principles, input data is evaluated and transformed into corresponding output commands.

Signal processing is performed cyclically. During each cycle, inputs are read, evaluated based on the application logic, and appropriate outputs are generated. This is followed by a cyclic hardware health check to ensure system integrity.

This repeating sequence is referred to as the Execution Cycle (EC). Typical cycle times are in the range of 30–70 ms for object controllers and 250–500 ms for the Core Controller, resulting in an overall system response time of less than one second.

Each MODEST-GEMINI installation is configured using standardised functional modules tailored to the specific application. Dedicated modules are available for handling input and output functions, while the processor module performs higher-level tasks such as control logic execution, communication with control centres, and interfacing with external systems.

The system operates on a cyclic principle, where each cycle consists of input acquisition, logical evaluation, output generation, and system supervision phases. The total cycle time is defined by the combined duration of these phases.



Operator Interfaces

The operator level of the MODEST-GEMINI interlocking is formed by an advanced Operator Interface, designed for intuitive control and clear visualisation of the railway infrastructure.

The system provides a comprehensive graphical overview of the track layout, enabling operators to monitor the current operational state and issue commands efficiently. It utilises context-based control, menu-driven navigation, and a highly user-friendly interface, ensuring fast and error-resistant operation even in complex situations.

High-resolution, large-format displays offer excellent visibility and situational awareness. MODEST-GEMINI supports flexible implementation of various national control and visualisation standards, allowing seamless adaptation to specific operational environments.

The system also enables the execution of safety-critical commands, which are protected by dedicated safety procedures. These include multi-step confirmation sequences and verification of correct display representation, ensuring protection against potential failures of display systems.



Centralized Traffic Control

For the control of multiple stations or large railway nodes, MODEST-GEMINI supports the implementation of Centralised Traffic Control (CTC) centres equipped with advanced traffic management functions.

In addition to standard operator workstations used for local control, the system provides dispatcher overview workstations offering different levels of abstraction:

- Simplified overview diagrams for network-wide supervision
- Detailed “zoom-in” views with full operational detail at the dispatcher level

A shared large-scale video wall can be used to display the status of the entire controlled area or railway line, enhancing coordination and situational awareness.

The system supports multi-operator environments, allowing operators to dynamically share and transfer control areas. Control handover can be performed locally within a control centre or between remote and local control locations.

MODEST-GEMINI also enables the implementation of multiple remote control centres, providing maximum flexibility in operational organisation and redundancy of traffic management.



Wayside equipment

MODEST-GEMINI offers exceptional flexibility and supports a wide range of wayside elements, ensuring safe, reliable, and efficient operation under all conditions.

Signals

MODEST-GEMINI provides full control of railway signalling devices, supporting both LED and incandescent signal lamps.

The system enables precise and reliable control of signal aspects in accordance with operational and safety requirements. Thanks to its modular architecture, it can be easily adapted to various national signalling standards and project-specific configurations.



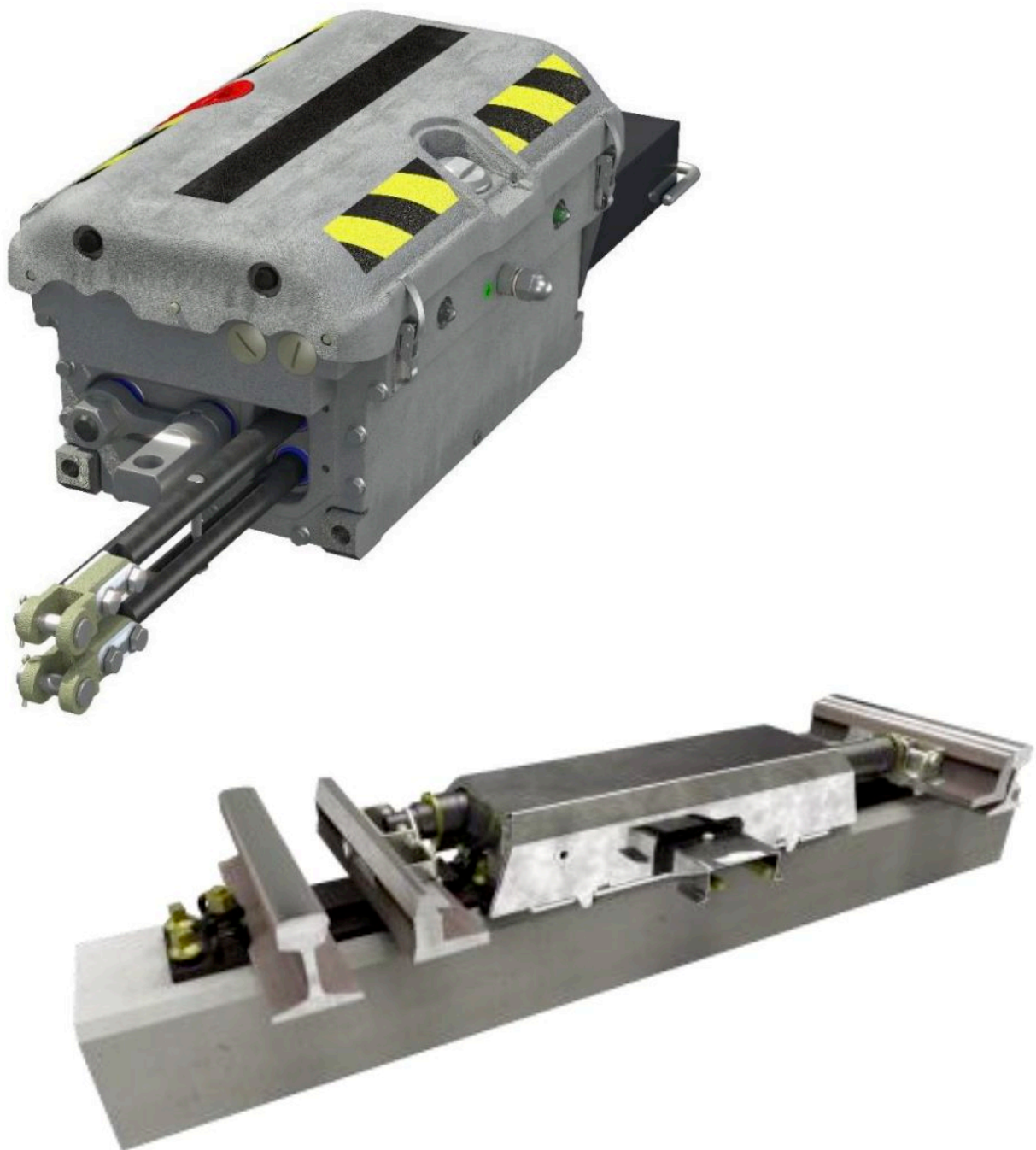
Switch machines & End position detectors

MODEST-GEMINI supports a wide range of switch machine types, including:

- 3-phase and single-phase switch machines
- Normal-speed and high-speed (fast-throw) operation
- Single or multiple switch machines per turnout

The system ensures safe and accurate control and monitoring of turnout positions, contributing to reliable route setting and overall operational safety.

A wide portfolio of end position detectors can be integrated, enabling safe and reliable detection of the final positions of switch blades. This ensures precise position verification and enhances overall system safety.



Train detection

MODEST-GEMINI offers a wide range of train detection functionality. Either track circuits or, increasingly, wheel detectors with optional directional outputs are used.



Track to Train communication

MODEST-GEMINI is fully prepared to support the implementation of ERTMS/ETCS functions, enabling seamless integration into modern digital railway environments.

The system provides a dedicated interface to the Radio Block Centre (RBC), ensuring secure and bidirectional data exchange between the interlocking and onboard train equipment. This interface enables the transmission of movement authorities and operational data, forming the basis for ETCS Level 2 applications.

In addition, MODEST-GEMINI is ready for integration with Lineside Electronic Units (LEU) for ETCS Level 1. Through this interface, telegrams are transmitted via balises to the onboard unit of the train, ensuring reliable communication between trackside and train systems.



High Availability and Safety

MODEST-GEMINI is designed for:

- Fail-safe operation
- Redundant system configurations
- Continuous system monitoring
- Optimised lifecycle costs

The system complies with:

- EN 50126
- EN 50128
- EN 50129



Scalability and Flexibility

The system can be applied in:

- Small and medium stations
- Large railway nodes
- Industrial railways
- Cross-border and interoperable networks

Modern service concept

Each MODEST-GEMINI interlocking is equipped with diagnostic modules that are connected to central diagnostic servers via a communication interface. The diagnostic data received via this interface can be displayed either graphically or in a text-based format. The information can also be made available for remote access.

Diagnostic servers

The diagnostic software installed on the redundant diagnostic servers is based on a high-availability database, which guarantees no data loss in the event of a failure.

A web-based backend is built on top of the database, making diagnostic data available to service and maintenance staff.

Diagnostic interface

For maintenance personnel, the graphical user interface of the diagnostic system provides a comprehensive overview of the states of all subsystems of the interlocking on a single screen.

In addition to displaying active status changes – such as the position of turnouts, signal aspects, track section occupancy, and route status – faulty elements are also clearly visualised in real time.

Further diagnostic information can be accessed via the menu and analysed using online help or additional evaluation tools. All diagnostic information can be accessed via a web browser without the need for any proprietary software.

Data Exchange

In today's networked world, it is essential that data is available wherever it is needed. The diagnostic system of MODEST-GEMINI provides the foundation for this availability.

The diagnostic servers can forward collected diagnostic data via a wide range of transmission paths. In addition to leased-line transmission via copper or fibre-optic connections, various digital communication channels such as the internet, telephone, and mobile networks can also be used.

The transmitted diagnostic data can be made available as a web service, regardless of location.

Diagnostic centre

In a diagnostic centre, all connected interlockings (and level crossings) can be monitored simultaneously. Diagnostic data is consolidated in one place, enabling efficient planning and coordination of maintenance and service activities.

The diagnostic centre software is specifically designed for service and maintenance requirements. It offers intuitive operation and does not require specialised training.





Summary

- Fully electronic, modern interlocking system
 - Integrated axle counter, line block, level crossing and interlocking links
 - Supports local and centralised control (CTC)
 - Ready for ETCS Level 1 and Level 2
 - Based on proven NEXUS platform
 - Modular, scalable and future-proof
-
- Covers applications from the very simple to the most complex configurations
 - Meets **SIL4** of CENELEC safety standards EN 50 126, EN 50 128, EN 50 129 and EN 50 159
 - Offers easy configuration and testing prior to delivery, as well as simple and quick on-site setup
 - MODEST-GEMINI can control signal lamps, both incandescent and LED
 - All switch machines, end point detectors and derailleurs
 - Track circuits, axle counters and wheel detectors can be interfaced
 - Capable to interface other vital logic via signal or vital communication lines
 - Communication links are fully redundant and use industry standard protocols (RS485/RS232/Ethernet/TCP/IP)
 - Copper or fiber optic cabling or wireless communication
 - Supports fail-safe data transmission using safe and secure protocols
 - Diagnostics places maximum emphasis on fault prevention with early detection of faults
 - Offers Web-based diagnostics

MODEST - GEMINI

Safety First

První**Signální**



První Signální, a.s.

Bohumínská 368/172, 712 00 Ostrava–Muglinov

Headquarters:

Žižkova 712/4, 711 00 Slezská Ostrava

+420 607 014 330