

# RAILWAY PORTFOLIO

Signalling & Telecommunications

## SIGNALLING

Safe. Reliable. Advanced.

## TELECOMMUNICATIONS

Connected. Integrated. Secure.

BERLIN

# INNOTRANS 2026

HALL 27 · STAND 840

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# RAILWAY PORTFOLIO

Solutions at a Glance

## 01 SIGNALLING

Safe. Reliable. Advanced.



**LED  
LED INDICATORS**



**BROS AXLE COUNTER  
UTD**



**CTC-ST  
MMI  
MUMZ  
GS20**



## 02 TELECOMMUNICATIONS

Connected. Integrated. Secure



**SPDC**



**DRDC**



**UPT**



**REGISTROPHONE**



**SIL 4**  
Certified  
Solutions



**Integrated**  
End-to-end  
Systems



**Developed**  
& Manufactured  
In Serbia



**Trusted**  
Railway Operators  
Worldwide

# RAILWAY TECHNOLOGY SOLUTIONS



01

# **SIGNALLING**

Railway Signalling Solutions

# RAILWAY LED SIGNALS

## Device features and capabilities

- Developed specifically as a replacement for incandescent light bulbs on Siemens SpDrS-64 relay interlocking
- Compatible for use with Domino 55 relay interlocking and various electronic interlocking
- LL-000-m can be adopted according to customer requirements for different interlocking systems
- Modular and flexible design capable of supporting a wide range of operating conditions
- No changes are needed in the interlocking system
- Day and Night mode of operation with different lighting level
- Possibility to adjust the lighting level according to user requirements
- Blinking operation with frequency of 1Hz
- Operating with various input voltages both AC and DC
- Provides two-lamp operation, including auxiliary lamp test on red aspect
- Supplied in own housing or as an LED module
- Use of high quality Cree or Osram LEDs in the device
- Completely galvanically isolated device from interlocking system
- Different levels of protection in the device (over-voltage, over-current and temperature protection for electronics)
- Safe at fault and long service life
- Behavior of the device as a light bulb substitute (voltage and current are in phase)
- Fulfills SIL4 requirements according to CENELEC standards



## Basic description

LL-000-m is an LED light source used for main railway signals, designed as a replacement for two-lamp light bulbs on relay interlocking (SpDrS-64 or Domino55). LL-000-m provides full compatibility with the light bulb interface, i.e. day-time, night-time and blinking operation as well as continuous auxiliary lamp test on the red aspect. Due to the complex operating requirements of a relay interlocking, LL-000-m implements a modular and flexible design capable of supporting wide range of operating conditions, applicable on different types of interlocking systems. When used on the SpDrS-64, LL-000-m doesn't require any modifications on the interlocking system, other than replacing light bulb housing with LL-000-m or replacing just light bulb with LED module.

The main advantage of the LED signal over the incandescent light bulb signal (for SpDrS-64, Domino 55 or any other relay based interlocking systems) is considerably longer life time and availability which greatly reduces maintenance cost.

LL-000-m can also satisfy different electronic interlocking requirements. This use case proves the advantage of the modular design as it reduces costs of adapting LL-000-m to different kind of interlockings.

Light source of LL-000-m consists of several individually controlled and monitored high current LEDs. LL-000-m proves that bulk glass lens and light bulbs are not necessary. Due to the fact that LL-000-m uses color LEDs, color filters are also not necessary. This also means that color phantom signals are not possible. This use case was successfully proven on railway infrastructure where around 3000 pcs of LED signals of the Institute Mihajlo Pupin were installed and commissioned on Railway corridor sections.

## Technical characteristics for LED modules

|                              |                                                                                       |
|------------------------------|---------------------------------------------------------------------------------------|
| Input voltage range AC:      | from 10VAC to 50VAC (transformers are used to make voltages suitable for LED modules) |
| Input voltage range DC:      | from 10VDC to 50VDC                                                                   |
| Current consumption:         | up to 1.6A                                                                            |
| Rated power:                 | from 15VA to 30VA (normal working range)                                              |
| Operating temperature range: | from -40°C to +85°C (ambient temperature)                                             |

## Technical characteristics for LED signals

|                              |                                                                                             |
|------------------------------|---------------------------------------------------------------------------------------------|
| Input voltage range AC:      | from 50VAC to 240VAC                                                                        |
| Input voltage range DC:      | from 10VDC to 50VDC                                                                         |
| Current consumption:         | up to 1.6A                                                                                  |
| Rated power:                 | from 15VA to 30VA (normal working range)                                                    |
| Operating temperature range: | from -40°C to +85°C (ambient temperature)                                                   |
| Distance from the station:   | up to 5km with railway cable 0.9mm (loop resistance 56.6Ω/k m)                              |
| Housing material:            | aluminum alloy housing                                                                      |
| Housing protection:          | IP54 level for standard use, can be upgraded to IP68                                        |
| Signal diameter:             | 70mm, 100mm, 136mm, 160mm, 200mm, 210mm                                                     |
| Available colors:            | Red, Yellow, Green, White and Blue                                                          |
| Electrical protection:       | Galvanic isolation, integrated thermal, over-current, over-voltage and transient protection |
| Mode of operation:           | Day and Night mode of operation with different lighting level                               |
| States of operation:         | Three different states of operation so that interlocking can detect device state            |



Module can operate in interlocking system with one (only main) or two laments (main and auxiliary).

If used with one lument (only main, with for example electronic interlocking system) there are three different states of operation:

1. Normal state Works properly, both LEDs work, the device returns the rated nominal current to interlocking system
2. Alarm state Device detected that one of the LEDs stopped working, the device returns the alarm current to interlocking system
3. Error state Device detected that both LEDs stopped working, the device returns the fault current to interlocking system

If used with two laments (main and auxiliary, with for example relay interlocking system) device can imitate light bulb, there are three different states of operation:

1. Normal state Works properly, both LEDs work, the device returns the rated nominal current to interlocking system for main lument, auxiliary lument test on red aspect
2. Alarm state Device detected that one of the LEDs stopped working, the device turns of current consumption on main lument and starts working on auxiliary lument with nominal current to interlocking system
3. Error state Device detected that both LEDs stopped working, the device returns the fault current to both laments of interlocking system (no current draw)

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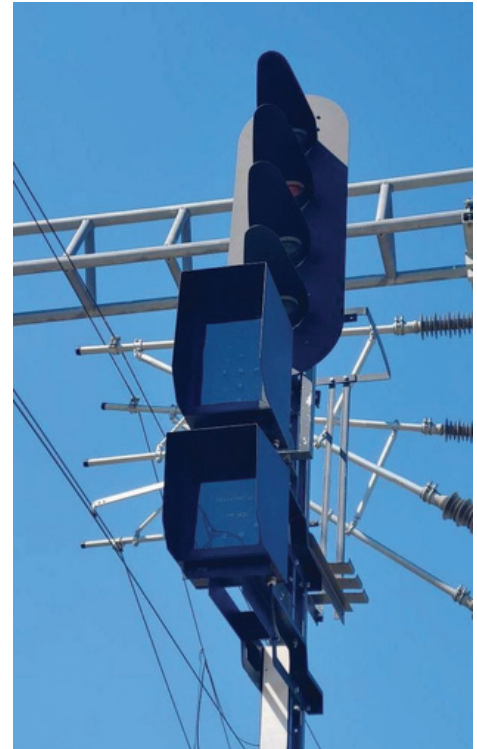


# RAILWAY LED INDICATOR SIGNALS

## Device features and capabilities

Developed specially to provide alphanumeric characters and symbolic drawings, as supplement to the main railway signal:

- IND-01 for route indications and speed limit,
- IND-02 - for allowance of train departure
- Displaying any possible symbol by means of 7x5 LED matrix (IND-01)
- Ability to use two symbols in one housing (IND-01)
- Same device consumption regardless of the symbol it displays
- For every symbol device contains two independent LED arrays
- Use of high quality Cree LEDs in the device
- Completely galvanically isolated device from interlocking system
- Different levels of protection in the device (over-voltage, over-current and temperature protection for electronic circuits)
- Day and Night mode of operation with different lighting level
- Possibility to adjust the lighting level according to user requirements
- Modular and flexible design capable of supporting a wide range of operating conditions
- IND-01 and IND-02 version can be adopted according to customer requirements, for different interlocking systems
- Behavior of the device as a light bulb substitute (voltage and current are in phase)
- The device contains a power factor correction system (PFC)
- Safe at fault and long service life
- For different applications: railway, metro, tram
- 



## Basic description

Due to the complex operating requirements of a railway relay interlocking, IND-00 implements a modular and flexible design capable of supporting wide range of operating conditions, applicable on different types of relay interlocking systems, too. LED indicators IND1 and IND2 reduces cost of adapting railway indicators to different kind of interlockings.



### Technical characteristics (per symbol)

|                              |                                                                                                             |
|------------------------------|-------------------------------------------------------------------------------------------------------------|
| Input voltage range:         | from 165VAC to 240VAC (can be lowered for specific application)                                             |
| Current consumption:         | from 70mA to 120mA (normal working range)                                                                   |
| Rated power:                 | from 10VA to 30VA (normal working range)                                                                    |
| Operating temperature range: | from -35°C to +70°C (ambient temperature)                                                                   |
| Distance from the station:   | up to 5km with railway cable 0.9mm (loop resistance 56.6Ω/km)                                               |
| IND1 – LED matrix:           | standard railway 7x5 matrix for representation of any symbol and capable of using various LED colors        |
| IND2 – LED circle:           | for signal of train (with Green LEDs)                                                                       |
| Housing material:            | steel housing                                                                                               |
| Housing protection:          | IP54 level for standard use, can be upgraded to IP68                                                        |
| Electrical protection:       | Galvanic isolation for each symbol, integrated thermal, over-current, over-voltage and transient protection |
| Mode of operation:           | Day and Night mode of operation with different lighting level                                               |
| States of operation:         | Three different states of operation so that interlocking can detect                                         |

### Different states of operation

- |                 |                                                                                                                         |
|-----------------|-------------------------------------------------------------------------------------------------------------------------|
| 1. Normal state | Works properly, both LED chains work, the device returns the rated nominal current to interlocking system               |
| 2. Alarm state  | Device detected that one of the LED chains stopped working, the device returns the alarm current to interlocking system |
| 3. Error state  | Device detected that both LED chains stopped working, the device returns the fault current to interlocking system       |

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# TRAIN AXLE COUNTER - BROS

- Control of up to 8 railway sections
- Up to 12 sensor pairs can be connected directly to the BROS
- Adjustable power supply AC/DC
- Reliable detection for train speed up to 350 km/h
- Device fulfills SIL 4 requirements according to CENELEC standards EN 50126, EN50128 and EN50129
- Data communication is in accordance with EN 50159
- Device is in accordance with the European directives
- Device can be connected with Computer based Interlocking system via Safe Ethernet protocol or similar.



Axle Counter BROS is used to control occupancy of the railway sections. The device is placed into a standard 19-inch 3U height rack and it is mounted inside the relay room of the railway station, automatic block system, or level crossing.

Axle Counter BROS uses sensor pairs (SP) at the end of each section and

it counts in axles that have entered the section, and counts out axles that

have left the section. Sensor pair consists of two sensors (wheel detectors) which are placed opposite to each other on the rails.

In addition to the basic function of detecting the presence or the arrival of the train wheel, sensor pair also provides detection of the direction and speed of rail vehicles.

## Key features

Providing outputs for 8 sections and having up to 12 directly connected sensor pairs, BROS device is perfectly suitable for usage within station interlocking system, as a relatively small number of devices can control all sections of the small, medium or large railway stations.

In the case using BROS for controlling occupancy within automatic signaling block (ABS), only two wires are enough for communication with adjacent axle counters, alternatively optical fiber communication can be used for communication between two BROS devices.

BROS has two modems, which enable communication with maximum two neighboring axle counters, which is important for usage within ABS.

BROS supports all section topologies. Configuration stored in non-volatile memory provides all possible combinations between sensor pairs and relay outputs.

## Technical characteristics

- Dimensions:
  - 19" standard board rack
  - 3 U height
  - 84 pitch units width
- BROS device uses external power supply:
  - [+11, +28] VDC,
  - [+48, +72] VDC,
  - 220 VAC, or
  - any other AC/DC on demand.
- Maximum power consumption is 60W.
- Operating temperature range is [-25, +70] °C.
- Reliable detection for train speed up to 350 km/h.
- Maximum number of axles per section is 9999.
- Possibility of the accommodation in the standard relay frame of the system SpDrS-64.
- One BROS device controls up to 8 railway sections.
- Each section can be configured as normal, automatic signaling block or train announcing section.
- Up to 12 sensor pairs (detection points) can be connected directly to one BROS device. Four wires are required for connection of detection point to BROS device.
- BROS device can communicate with up to two remote axle counters using modem communication. Two wires are required for modem communication between two BROS devices.
- Maximum distance between BROS device and detection point is 5 km using 0.9mm diameter wire when detection point is supplied from BROS device directly.
- Maximum communication distance between two BROS devices is up to 5 km using 0.9mm diameter copper wire and 20km using optical fiber cable (on request, it is possible to deliver a solution with greater maximum distance)



## Additional features

- Possibility of importing and exporting sensor signals from nearby BROS devices enables continuous control of theoretically unlimited number of railway sections and detection points.
- Relay outputs for each section consist of two normally opened (N.O.) and two normally closed (N.C.) relay contacts. At least one N.O and one N.C. contact shall be used for safe operation. Double number of contacts for various applications (like relay automatic block section implementation) can be reached by using two output modules per section. In that case device has four normally opened (N.O.) and four normally closed (N.C.) relay contacts for one section.
- Every section can be reset locally using buttons of the front panel of the device, or remotely using opto-coupler inputs of the device. Section reset type can be either unconditional (immediate) or conditional (preparatory) reset. Section reset type can be configured separately for each section.
- BROS device stores all section reset events and changes of each section state in non-volatile memory.
- Possibility of remote section reset using modem communication (in case of automatic signaling block section).
- BROS device can provide remote supervision of current device state.

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# UNIVERSAL TRAIN-WHEEL SENSOR - UTD

**UTD is EN 50617-2 compatible detector device used for reliable and accurate train wheel detection, designed for simple installation and maintenance.**

## **Safety Orientated Design:**

- Programmable Logic Design
- Internal monitoring of system integrity and functions
- Power Line Carrier (PLC) Design enables the use of just one pair of wires for both power and communication for

total cable/infrastructure monitoring

- 1 of 1, 1 of 2, 2 of 2 and up to 4 units in con guration on short rail sections

## **Accurate and Robust Sensing Technology:**

- Electromagnetic eld Amplitude sensing
- Electromagnetic eld Phase sensing
- Robust Signal Processing
- Very high resistance to accidental or deliberate false act ivation

## **Simple and Fast Installation:**

- Clamped on the rail without the need for special tools, drills or welding machines
- Simple setup procedure
- Self calibrating upon start-up
- Directly replaces mechanical, magnetic, or other cable/ electronic detectors, using the existing infrastructure
- No need for any construction of specialised foundations and equipment cabinets
- "Ready To Run" in cca. 10 minutes

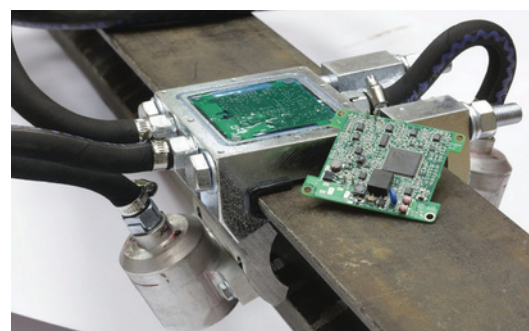


## **Virtually Maintenance Free:**

- No mechanical adjustment needed throughout the lifetime of the device
- Visual inspection and manual system reset recommended every 12 to 24 months depending on the working conditions and rail usage

## **Added Value:**

- Can operate in parallel with any other rail devices
- Can operate in parallel with any other rail devices enabling infrastructure modernisation through regular maintenance (e.g. UTD can operate in parallel with Magnetic or any other wheel detector at the same detection point)
- It can be installed as a single or double wheel detector, and used in axle counting system, safe closing and opening of level crossings, direction detector, speed detector or used in any other railway application requiring accurate wheel detection.





## Technical characteristics

|                                                                            |                                                             |
|----------------------------------------------------------------------------|-------------------------------------------------------------|
| Operation frequency                                                        | 50kHz to 80kHz (CCS TSI Index 77)                           |
| Maximum wheel detection speed                                              | 350km/h                                                     |
| Detection of any known wheel diameters and types                           |                                                             |
| Maximum power consumption                                                  | 1,5 W                                                       |
| Nominal supply voltage                                                     | 30VDC                                                       |
| Protection                                                                 | IP 68 (EN 60529)                                            |
| Operational temperature range                                              | -40 °C to 80 °C (EN 60068-2-1, EN 60068-2-2, EN 60068-2-30) |
| Up to 250g impact resistance Up to 28g vibration resistance EMC compatible | EN 50125-3                                                  |
| Voltage and current protection                                             | EN 50121-4, EN61000                                         |
| Voltage and current protection                                             | EN 50124-2                                                  |
| Voltage and current protection                                             | integrated                                                  |



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# CENTRALIZED TRAFFIC CONTROL SYSTEM CTC - ST

Centralized railway traffic control system enables the management and planning of railway traffic, as well the display of information on the movement of trains and the state of station and trackside signaling and interlocking devices from one remote and centralized place. CTC-ST system increases railway traffic safety, railway line throughput, work productivity and enable economic and rational traffic management.

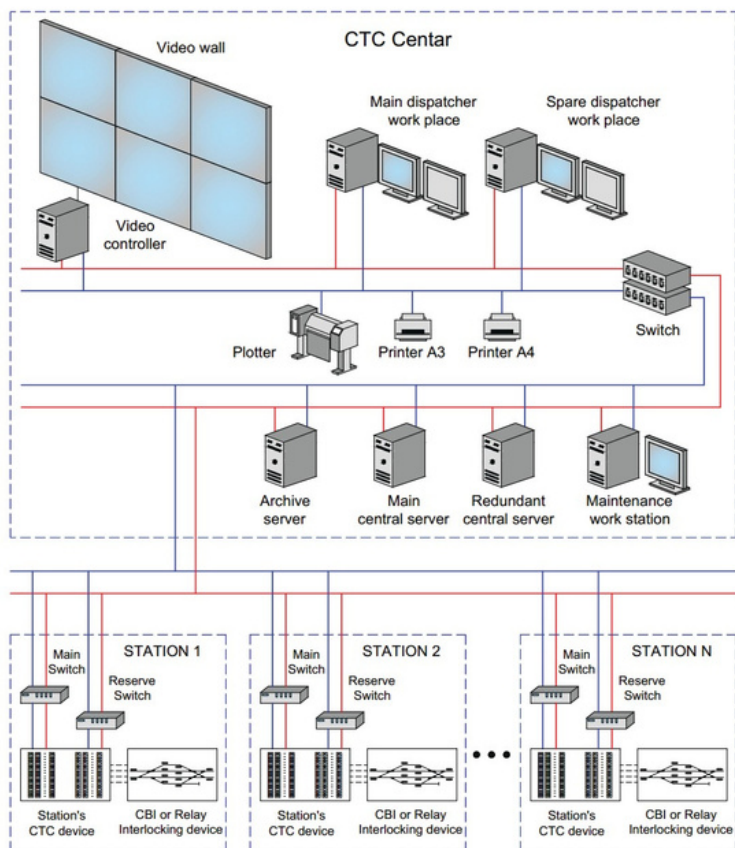
The core of CTC system equipment is redundant and as a data transmission channel in the system, the main and spare dedicated digital channel are adopted. Connecting of station CTC devices with central server equipment is possible via optical and copper cables, redundant or single lines. The possibility of managing a practically unlimited number of railway stations.

CTC-ST system automatically describes the actual line of train movement in order to generate the actual diagram according to the information received from station and trackside devices. The system keeps in archive the actual diagram of movement of trains as well list of set commands, station can check and print archive on a plotter or printer if needed.



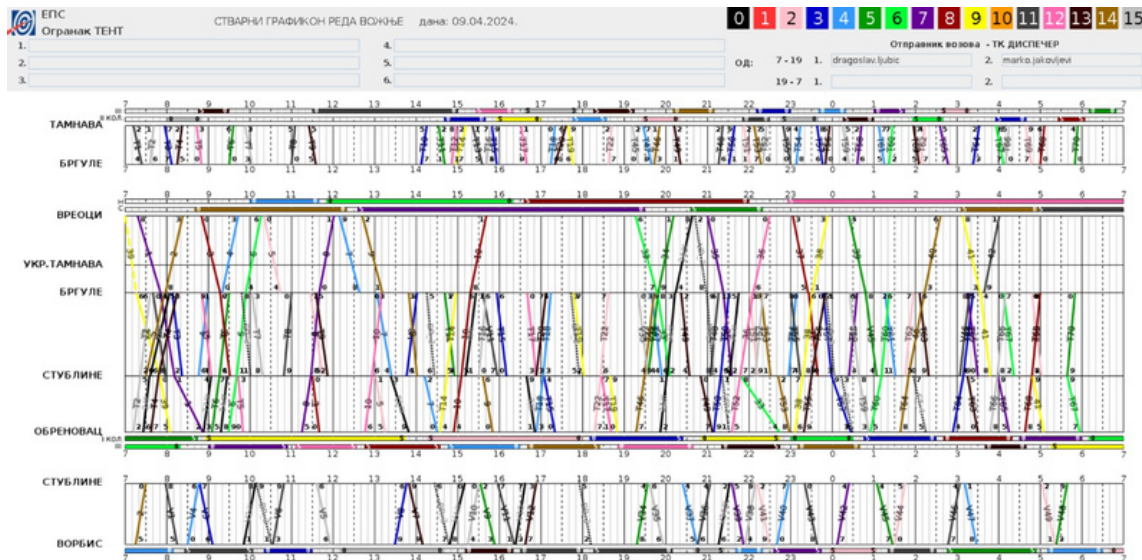
## General characteristics of CTC-ST system

- Mean Time Between Failures (MTBF): greater than 50,000 hours;
- Mean Time to Repair (MTTR): less than 48 hours;
- Mean Time Between Maintenance Actions (MTBMA): greater than 50 hours;
- High-performance computers and servers with standard operating system (Linux) and workstations with high graphic performance;
- Standard communication architecture and standard support for LAN and WAN networks through IEEE 802, TCP/IP, CCITT protocols;
- Open and Modular architecture and communication exible application software;
- High availability achieved by doubling the system of vital hardware and software modules, as well as communication paths;
- The possibility of connection to computer-based (CBI) and relay interlocking systems in stations.
- Possibility of integration with other systems (timetable, information systems, systems for remote control of electric traction...);
- Architecture and can be adapted to any design requirement and any topology. This system can be centralized, decentralized, autonomous or integrated into a centralized monitoring and control system.



## CTC-ST Dispatcher work place

The system provides three control modes. The centralized dispatching control is the base mode, in that mode the CTC center terminal has full control of signal equipments, the CTC center dispatcher has right to operate train routes and the shunting routes, while the station dispatcher does not. Station shunting operation mode: the CTC center dispatcher has right to operate train routes but the shunting routes, and the station dispatcher has no right to operate train routes but the shunting routes. Station operation mode: The station terminal has full control of the signal equipment, the station dispatcher has right to operate train routes and the shunting routes, while the center dispatcher does not.



CTC-ST system automatically describes the actual line of train movement in order to generate the actual diagram according to the information received from station and trackside devices. The system keeps the actual diagram of movement as well list of setted commands. Manager sta can check previous diagrams of actual movement of trains or list of setted command and print them on a plotter or printer as needed.



## Equipment in the stations

Station's CTC equipment consists of redundant industrial multifunction process computers for monitoring and controlling station's Signalling & Interlocking devices.

A modular structure that allows connecting the required specific number of inputs and outputs for the corresponding station. Collecting information about statuses of signalling equipment in station and sending commands to Interlocking devices is done through the I/O module.

The connection of the station equipment and the equipment in the CTC Center is achieved through two switches with standard telecommunication protocols. In case of failure of one switch, the other one remains in operation.



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# STATION POINT HEATING SYSTEM - GS20

## General description

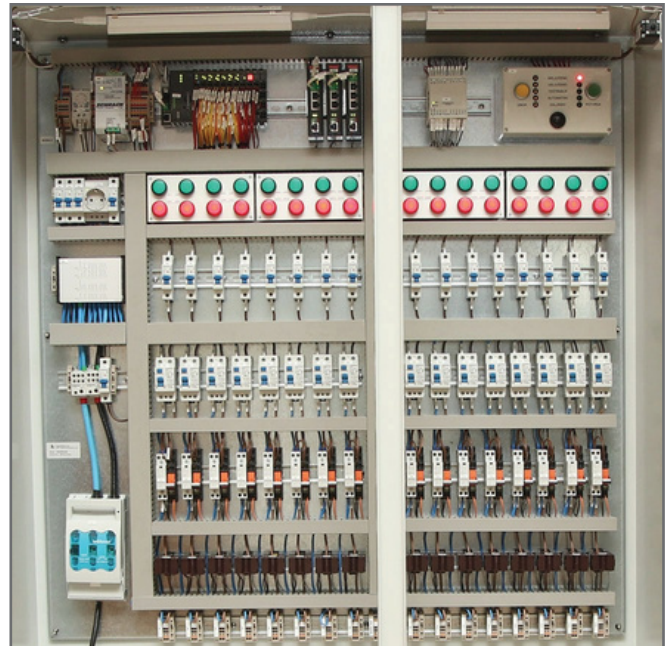
The GS20 point heating system is based on a flexible architecture and can be adapted to any design requirement and any topology. This system can be centralized, decentralized, autonomous or integrated into a centralized monitoring and control system.

GS20 System is powered from Overhead contact line by pole-mounted substations or some other alternative power source. The system itself includes HMI workstation,

SCADA subsystem, distribution cabinets, connection cabinets, electric heaters and electrical cables for connection, control and signaling. It is designed for easy handling and easy fault detection.

The system is designed so that tests can be performed to check and determine the failures of individual heaters.

The heaters are switched on, in normal operation, sequentially one after the other with a predetermined delay, in order to reduce the load on the electrical network.

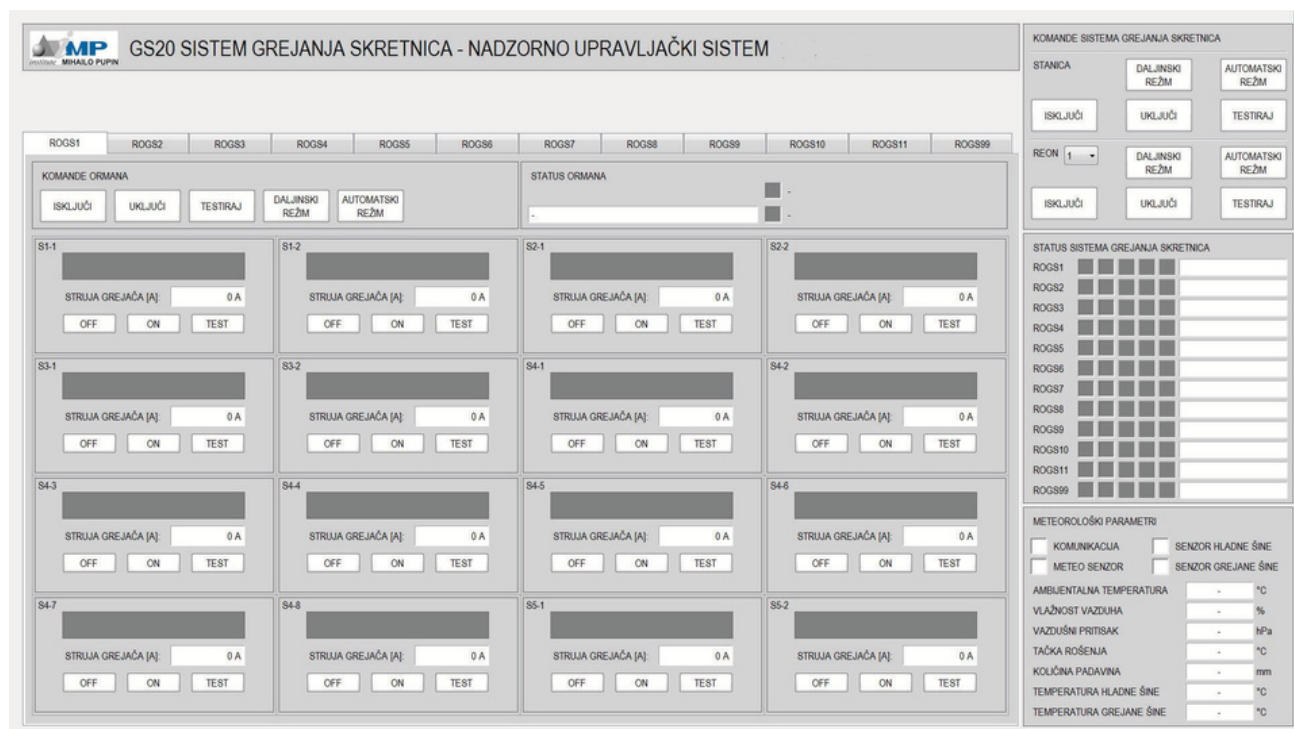


## Basic function

Point heaters are automatically activated based on pre-set parameters on the HMI workstation. These parameters are a function of current weather conditions. Measurements are performed at a weather station set up at the appropriate location. Temperature, humidity and precipitation detectors send information to the monitoring and control system. It is realized in the form of a SCADA system that controls the operation of the device - regulates the activation of each switch and monitors potential failures of individual heaters, sensor damage, unauthorized intervention on devices, etc. The current state of the system can be monitored at the HMI workstation in the trace of the train dispatcher, and any irregularities are further highlighted. PLC controllers installed in each distribution cabinet communicate with the control system. The heater is switched on according to the relay command principle in order to reduce electric shocks and network load.

## Technical characteristics

- Power supply:
  - o main power supply – 230V AC
  - o internal logic power supply – 24V DC
- Heater length, power and number of heaters are defined by the project task individually for each point
- The temperature range of the equipment is from -40 °C to 70 °C
- EN60870-2-1 - resistance to impulse overvoltages up to 5 kV
- EN60068-2-6 – vibration resistance up to 5 g
- IP54 EN60529 – degree of the box protection
- IP65 EN60529 – degree of external equipment protection
- CENELEC EN 50121-4 – immunity to electromagnetic influences of communication and SCADA system



## Subsystem description

### Point heater distribution cabinet (PHDC)

The PHDC contains PLC controllers that control and monitor the associated parts of the point heating system. They can be hierarchically organized, depending on the station topology and project requirements. The control is based on the possibility of individually switching on the heater for each point.

Switching on is done successively. Control consists of detecting possible interruptions or failures of the heater, access to the main cabinet and measuring the intensity of current at the entrance to the cabinet. In addition to the PLC controller, the main cabinet also contains switches for switching on the heater, earth fault protection, as well as overcurrent protection.

### Heaters

The heaters are placed next to the point and are activated manually or automatically under certain weather conditions. The system is designed so that it can work with different types of heaters, power from 200W to 2000 W, regardless of the point configuration. The heaters are mounted on points by simply mounting and fastening them with elastic clamping elements that enable easy assembly and disassembly.

### HMI workstation

Work station allows the operator to access to the system monitoring, control and testing over the user interface.

### Connection cabinet

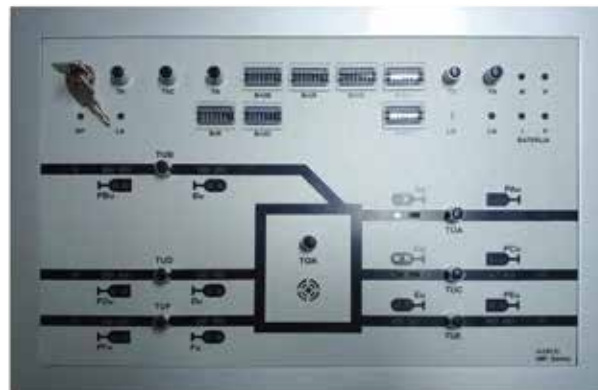
The connection cabinet is located next to the point and a heater is connected with the main cabinet in it. All cabinets must be resistant to shocks, vibrations and damage.



## m2SCD

### Mobile Signal Control Device

- **Interlocking (impossible to set another entrance route until the one already set is cleared)**
- **Implementation of tra c control with multiple entrance routes**
- **Providing power supply for announcing signals**
- **Signaling and control from independent control panel**
- **Symbols on control panel are in accordance with regulations of Serbian Railway<sup>1</sup>**
- **Counter of entrances, independent counter for each entrance route**
- **Switch for forceful clearing of set entrance route**
- **Independent counter for forceful clearing of set entrance route**
- **Battery powered autonomy**



### Brief technical description

Primary function of m2SCD device is implementation of temporary railway signal interlocking on four or more routes.

Basic con guration of the device supports control and driving of four signal lights and four announcing signals.

Device can be con gured to control lower number of entrance routes or expansion for greater number of routes. In that case all descriptions can be expanded on additional entrance routes.

Complete equipment is placed in standard 19" industrial rack enclosure.

Complete device consists of: batteries, battery charger, inverter for signal power supply, axle sensors and logic for signal interlocking and entrance route enabling and clearing.

Control panel is used to set and clear entrance route and to display

signal,

sensor and system state. Control panel is freely movable and can be placed in the cabinet or on the appropriate tra c control desk independently from the rack enclosure (this has to be de ned in project documentation).

### Primary application

Implementation of temporary railway signal interlocking in case where primary safety and signaling equipment is disabled or lacking eg. during modernization of primary safety and signaling equipment.

<sup>1</sup>Device can be con gured in accordance with different regulation or according to project

## Technical characteristics

|                                      |                     |
|--------------------------------------|---------------------|
| • Power supply:                      | 230VAC <sup>2</sup> |
| • Working voltages:                  | 230VAC              |
|                                      | 175VAC              |
|                                      | 24VDC               |
|                                      | 12VDC               |
|                                      | 5VDC                |
| • Number of signals:                 | 43                  |
| • Number of announcing signals:      | 43                  |
| • No of workplaces:                  | 1                   |
| • Power consumption:                 | <500VA <sup>4</sup> |
| • Autonomy:                          | >8h <sup>5</sup>    |
| • Connection for external equipment: | terminal block      |

<sup>2</sup> Implementation for different power supply or redundant power supply possible

<sup>3</sup> Possible control of more than (or less than) four entrance routes preset in default implementation

<sup>4</sup> Basic configuration without railroad switch lighting

<sup>5</sup> Greater autonomy possible on demand



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# RAILWAY SAFETY HMI - MMI 10

MMI 10 is a safety HMI (Human Machine Interface) system for administrating, monitoring and controlling one or more railroad interlocking devices. It provides a graphics-based visualization that makes railroad standards compliant with user interface, safe and easy to use at the same time. It's highly customizable and available in different languages.

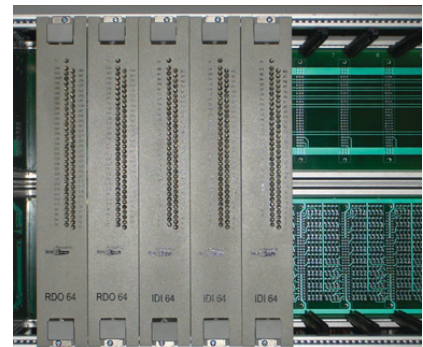


## Data acquisition & distribution unit

MMI 10 includes data acquisition & distribution unit for handling both relay and electronic interlocking devices. This unit is based on Cortex M3 MCU and it's been made in a way that guarantees safety and reliability. It's simple and robust, virtually maintenance free. Up to 2560 digital I/O are provided for monitoring and controlling relay-based interlocking devices.

## Data communication

The MMI 10 exchanges data with a data acquisition & distribution unit by a LAN or RS485 communication channel. A sophisticated communication protocol ensures high safety and integrity of both acquired and sent data.



## Information reliability

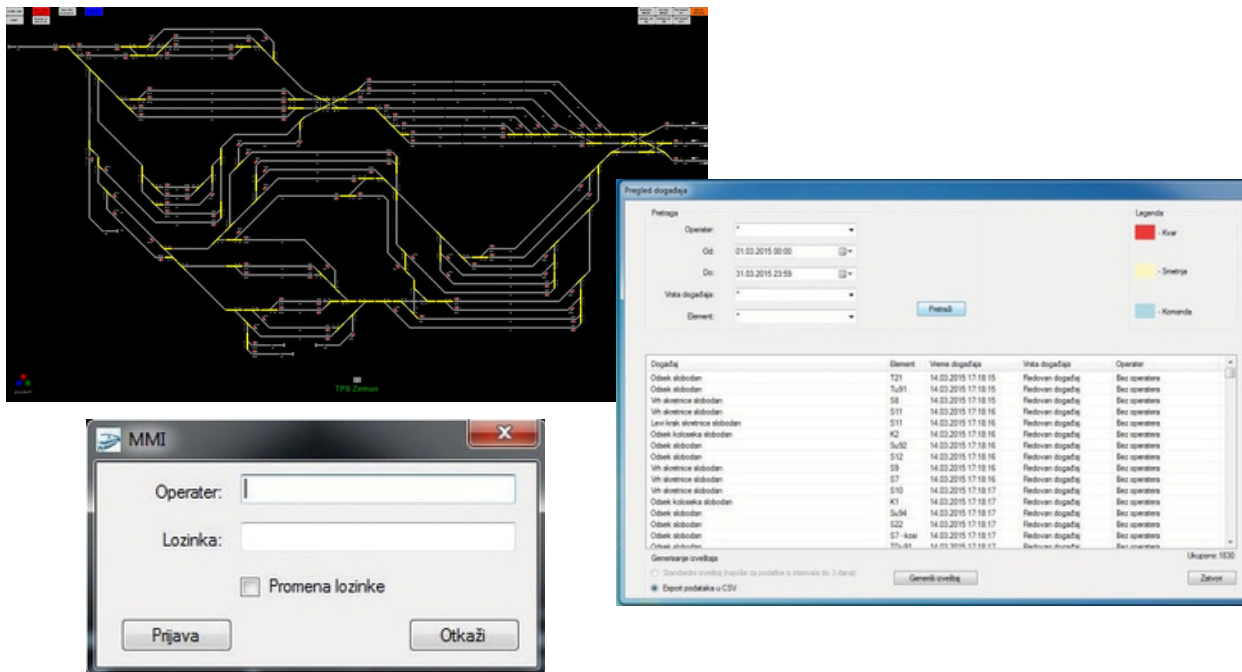
Several control mechanisms are applied to make sure that all displayed information is fresh and correctly represented. Possible faults, like monitor malfunctioning, dead or frozen pixels, etc., cannot jeopardize the system safety.

## Operators

Only an authorized operator can handle the system, and only up to a certain level, according to his privileges. Each operator's action is being audited and logged permanently. A complete and powerful operator maintenance module is included in the system.

## Data logging & reporting

Every event, command, fault or a failure is being shown as it occurs in a separate textual screen as well. An operator can browse through their history, as deep as needed, because all of them are permanently archived in the database. Based on the archived data and the applied user's criteria, number of data views and reports can be generated.



MMI 10 system provides:

- high comfort for the operators
- integration of relay and electronic signal-safety devices into modern Centralized Traffic Control systems
- effective diagnostic and reporting of all events, commands, failures and data archiving



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02

# TELECOMMUNICATIONS

Railway Communication Solutions

# RAILWAY DISPATCHING CENTRAL SYSTEM - SPDC

- Used for communication between tra c dispatchers, tra c and other personnel in all stations at exit signals, entry signals, pre-signals and spatial signals
- Selective calling (automatic) of each connection on the railway, i.e. station, in the direction dispatcher - railway and vice versa
- All the devices of this telephony are powered in the stations from a common battery that powers all the telecommunication devices of the station



The railway dispatching central system (hereinafter referred to as SPDC) is a modern system, developed in digital technology, and is intended to replace the existing railway dispatching centers in stations and CTC.

The SPDC system enables voice communication between dispatchers in stations, tra c dispatchers in CTC, as well as all railway dispatching telephones on one railway section: TIS, TUS, TAPB, TPP, PT and TCB, as well as LB and CB telephones in facilities on the railway.

The system enables operation via copper cables or via optical ber, which enables mutual communication between all o cial stations on the railway in pre-de ned lines, in accordance with regulations.

The system is manufactured to be compatible with the B14 protocol manufactured by Siemens or newer devices that use the same type of protocol.

All equipment on the railway is connected to a common LAN network, through which it is possible to add an unlimited number of peripheral devices, work consoles and railway dispatching telephones.



## Key features

Depending on the purpose, SPDC can be configured for the following operation:

- As a railway dispatching telephony central system, for the needs of the central traffic dispatcher CTC dispatcher, to which all stations on the associated section of the railway are connected with the associated railway dispatching telephones, as well as with all APB telephones
- As a railway central dispatching telephony central system, for the needs of the electric traction central dispatcher -ETCD, to which all stations on the railway are connected with the associated railway dispatching telephones and telephones in the facilities. As an additional option, SPDC offers the display of the calling user's identification from any railway dispatching telephone
- As a railway station dispatching telephony station system, for the needs of the dispatcher, to which all necessary railway connections are connected, all railway dispatching telephones in the area of one station, as well as all associated APB telephones
- As a railway temporary station dispatching telephony temporary station system for the purpose of securing connections during works or the similar needs

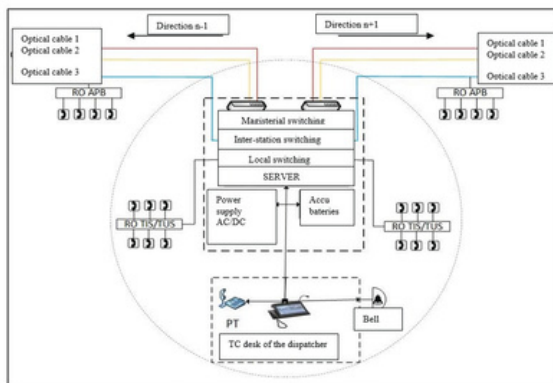


Figure 1: Block diagram of "SPDC"



In addition to the above mentioned basic devices, the SPDC system allows connection to the various additional devices that expand the set of the functionalities and applications of the system as a analogue telephone connection, RDV and GSMR.

## Technical characteristics

- System is placed in 19" standard rack
- System supports inbound and outbound voice calls
- Various calling groups and rules are supported
  - Call forwarding (back-up phone definition)
  - Conference rooms
  - Ring groups
  - Logical groups and restriction zones
- Voice server redundancy is supported
- All inbound and outbound calls are recorded and stored in central storage
- System can be connected with various external systems (e.g. PSTN, private PBX)
- System autonomy is designed according to user requirements (up to several hours)

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# TELECOMMUNICATION DIGITAL RADIO-DISPATCH CENTER - D-RDC

## General description

The railway radio dispatch system is used for the transmission of speech and commands between the rail vehicle and the radio dispatch center. The system consists of a dispatch center, fixed railway radio base stations deployed along the rail, a modulation line and mobile radio stations located in rail vehicles.

In the existing analog system, the connection between the dispatch center and the fixed radio stations is wired, while the connection between the fixed and mobile radio stations is wireless, realized by radio waves. The modulation line can be with optical fiber or may be a four-wire connection, where one pair is used to send information in the direction from the dispatch center to the rail vehicles, while the other pair is used to send information in the direction from the rail vehicle to the dispatch center.

The digital radio dispatch center (D-RDC) is designed to be fully compatible with the existing analog dispatch center by supporting the all currently used services with the possibility to easily add new ones. This enables easy replacement of existing analog dispatch center with the new D-RDC systems, without any modifications done on modulation lines, fixed railway radio stations and mobile radio stations in rail vehicles.



D-RDC consists of several elements, all of which are interconnected. The main elements are:

- dispatch control panel - control panel through which dispatcher can initiate calls and send commands, and also receive notifications and calls from rail vehicle,
- server - the central part of the D-RDC system which performs logical connection of all devices, manages calls and data by forwarding them to the appropriate system entities,
- media converter - a device supports communication according to the UIC 751-3 standard, on one side has an analog interface for connection with the four-wire modulation line, while on the other side has a LAN interface for connection with the server.



In addition to the above mentioned basic devices, the D-RDC system allows connection to various additional devices that expand the set of functionalities and applications of the system. One such device is the analogue telephone connection, which enables the connection of the D-RDC system to the analogue telephone network, which is useful in the case when there is a need to connect the dispatch center to the railway telephone network. Also, the D-RDC system supports optical fiber interface for connection with the fixed radio stations.

D-RDC can incorporate large number of elements. The system always has only one server, while the number of other entities is variable. The number of dispatch control panels is arbitrary, it is possible to set one control panel for several tracks, but also it is possible to set several control panels for control of one track. One media converter controls the operation of one track. Therefore, the number of media converters is defined by the number of tracks that the observed dispatch center should control.

The entire manipulation of the D-RDC system is performed through the dispatch control panel. The control panel allows you to view the history of sent commands, the history of received notifications, to send commands to the rail vehicle, to receive notifications from the rail vehicle, to initiate calls to the rail vehicle and receive calls from the rail vehicle, as well as to test fixed radio base stations.

| 22-08-2022 14:13:17 |                     |        |                       | TRACK "INNOTRANS 2022" |                     |        |                                |
|---------------------|---------------------|--------|-----------------------|------------------------|---------------------|--------|--------------------------------|
| SENT TELEGRAMS      |                     |        |                       | RECEIVED TELEGRAMS     |                     |        |                                |
| ID                  | Date and time       | Train  | Telegram type         | ID                     | Date and time       | Train  | Telegram type                  |
| 1                   | 22-08-2022 14:13:08 | 606220 | Announcement to train | 1                      | 22-08-2022 14:11:56 | 465662 | Report to the center           |
| 2                   | 22-08-2022 14:12:46 | 606220 | Selective call        | 2                      | 22-08-2022 14:11:55 | 79825  | Acknowledgement of order       |
| 3                   | 22-08-2022 14:12:43 | 465662 | Emergency stop        | 3                      | 22-08-2022 14:11:54 | 386580 | External telephone line wanted |
| 4                   | 22-08-2022 14:12:40 | 27811  | Expect junction       | 4                      | 22-08-2022 14:11:52 | 663561 | Stop all trains                |
| 5                   | 22-08-2022 14:12:29 | 79825  | Release the breaks    | 5                      | 22-08-2022 14:11:50 | 757797 | Danger                         |
| 6                   | 22-08-2022 14:12:24 | 249494 | Report your position  | 6                      | 22-08-2022 14:11:48 | 78184  | Monitoring required            |
| 7                   | 22-08-2022 14:12:19 | 465662 | Run slower            | 7                      | 22-08-2022 14:11:47 | 606220 | Traction difficulties          |
| 8                   | 22-08-2022 14:12:14 | 271528 | Run faster            | 8                      | 22-08-2022 14:11:46 | 27811  | Standing in front of a signal  |
| 9                   | 22-08-2022 14:12:11 | 386580 | Test                  | 9                      | 22-08-2022 14:11:45 | 271528 | Communication wanted           |
| 10                  | 22-08-2022 14:12:08 | 78184  | Await a written order | 10                     | 22-08-2022 14:11:43 | 249494 | Test                           |

| TRAIN NUMBER |   |   |    | TELEGRAM COMMAND |             |  |  | GROUP TEST COMMAND                             |    |     |
|--------------|---|---|----|------------------|-------------|--|--|------------------------------------------------|----|-----|
| 1            | 2 | 3 | <  |                  | CALL TO ANY |  |  | I                                              | II | III |
| 4            | 5 | 6 | << |                  |             |  |  | Active group: 1<br>Last test: 22-08-2022 14:13 |    |     |
| 7            | 8 | 9 | 0  |                  |             |  |  |                                                |    |     |

The D-RDC system is installed inside the railway facility, usually in the same room where other telecommunication and signaling devices are located. The only exception is the dispatch control panel, which is installed at the workplace of the railway traffic dispatcher, which enables easy manipulation and access.

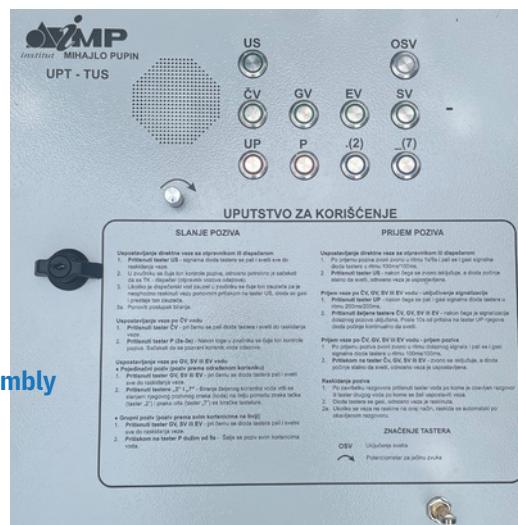
- Basic functions of the system:
  - Inbound and outbound voice calls
  - Sending commands and receiving notifications
  - Testing of fixed radio stations
- All sent commands and received notifications are stored in system database
- All inbound and outbound calls are recorded and stored in systems storage
- System can be connected with various external systems (e.g. PSTN, private PBX)
- Easy replacement of an old analog radio dispatch central station
- Compatible with UIC 751-3 standard
- System is adaptable to different markets and rulebooks
- Supports operation along optical fiber modulation line
- Operational voltage: 230VAC
- System autonomy is designed according to user requirements (up to several hours)

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# UNIVERSAL RAILWAY TELEPHONE (UPT)

- Universal UPT device for all purposes, that is connections used in railway infrastructure
- Telephone at exit signals (TIS)
- Telephone at entry signals (TUS)
- Telephone for the needs of APB and spatial signals (TAPB)
- Telephone on railway sections (PT)
- Telephone on platforms and shunting stations - (CB)
- Adjustable power supply AC/DC
- Small dimensions of the device, which facilitates assembly and disassembly
- Extremely low energy consumption
- Possibility of operation via optical and copper cable
- Upgradeable for use in GSMR, TETRA, RDV, etc.



All versions of the “UPT” are in a unique cabinet that is made in an anti-vandal version and the design corresponds to the existing appearance and dimensions that have been in use on the railway tracks.

The speaking part is realized through combinations of microphones and speakers for work with manual adjustment of the the volume of the speakers on the front panel and through circuits that have the functionality of a standard analog telephone.

## Key features

The UPT is connected to di erent LB and CB lines via a translator for galvanic isolation, and the connection to the access cables is made via key terminals.

Power supply is possible via direct voltage DC (20V - 72V) or in special cases even UPT can use input voltage or AC (220V).

Switches with built-in light indicators are used for connection establishment and line management instaed of physical switches.

A switch is installed on the door, which has the function of automatically switching on all lines when the door is closed.

The manipulative part is made in the hands-free version, but for the appropriate needs, the variant with the handset can be easily used.



## Technical and mechanical characteristics

### Mechanical

- Dimensions: 470mm x 541mm x 345mm
- Weight: 32kg
- Level of protection: IP54 even if with open cabinet door
- Maximum number of introductions: 6
- Type of electrical connection: PG13.5 and PG19

### Technical

- UPT device uses external power supply:
  - [+20, +72] VDC,
  - [+9, +150] VDC in special case,
  - 220 VAC in special case.
- Maximum power consumption is 5W.
- Power consumption in idle state is 2.5W.
- Operating temperature range is [-40, +85] °C.
- Electrical protection:
  - Galvanic isolation, integrated thermal, overcurrent, overvoltage protection
- Grounding: Through the housing and mounting screws.
- Communication interface: Optical, duplex, single mode, 1310nm, connector SC UPC
- Range from the station: Maximum 20km
- End optical box (ZOK): Grommets for 3 cables, 8 positions for splicing and output for 8 bers.



## Other characteristics

- The design of the UPT is such that it can be installed in the place where the existing ones were phones that are already in use without any structural changes.
- Increased reliability and longevity by using components of newer technology.
- The UPT is a compact device, usable for several types of phones, so handling is a breeze assembly, and/or during maintenance is simple and does not require major works or application.
- During assembly, only basic tools are used (set keys and screwdrivers), as well as a minimum amount of consumables.

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# Telecommunication Voice Recording System ATIS VC-MDx

## General description

The Registrophone (digital voice recorder) Pupin-Atis VC-MDx is used for recording and archiving conversations between participants on telephone and radio links. It consists of a computer with an associated peripherals (keyboard, mouse, monitor, external speakers) and an alarm (external) unit. In the computer itself, there are interface boards in the form of PCI cards whose basic function is to detect and record traffic on telephone and radio lines. Dedicated software installed on the computer processes recordings that interface boards collect from telephone and radio lines and archive them as such on internal hard drives. This software allows you to listen to conversations that are in progress, those that have already been archived, and transfer archived recordings to some permanent memory.



The alarm unit is located at the dispatcher's desk and its role is to monitor the operation of the registrophone and in the event of any irregularity in the operation of the registrophone audibly and visually inform the dispatcher about the malfunction.

The registrophone computer is in the form of a standard desktop housing with an associated peripherals (keyboard, mouse, monitor, external speakers), and is mounted within the railway station room where telephone and radio connections used by the dispatcher in daily work are located.

The registrophone can record and archive up to 256 telephone or radio channels. Telephone and radio connections that are recorded are routed from the terminal block with the cable to the 50-pin connector on the registrophone interface boards. The recordings on the registrophone can be accessed locally and remotely (provided there is a LAN connection between the registrophone and the client computer with the appropriate software).

## Hardware requirements

The computer needs to be of some standard configuration with a 500W power supply module and the following hardware features:

- industrial motherboard with Intel chipset
- intel i3 processor or higher
- RAM minimum 8 GB
- minimum 2 hard drives, each with 1TB capacity in RAID1 configuration (mirror mode)
- LAN connection (to access recordings from a remote location)
- minimum 1 free USB port (for USB dongle)
- PCI port (as many as there are interface boards)

## Software

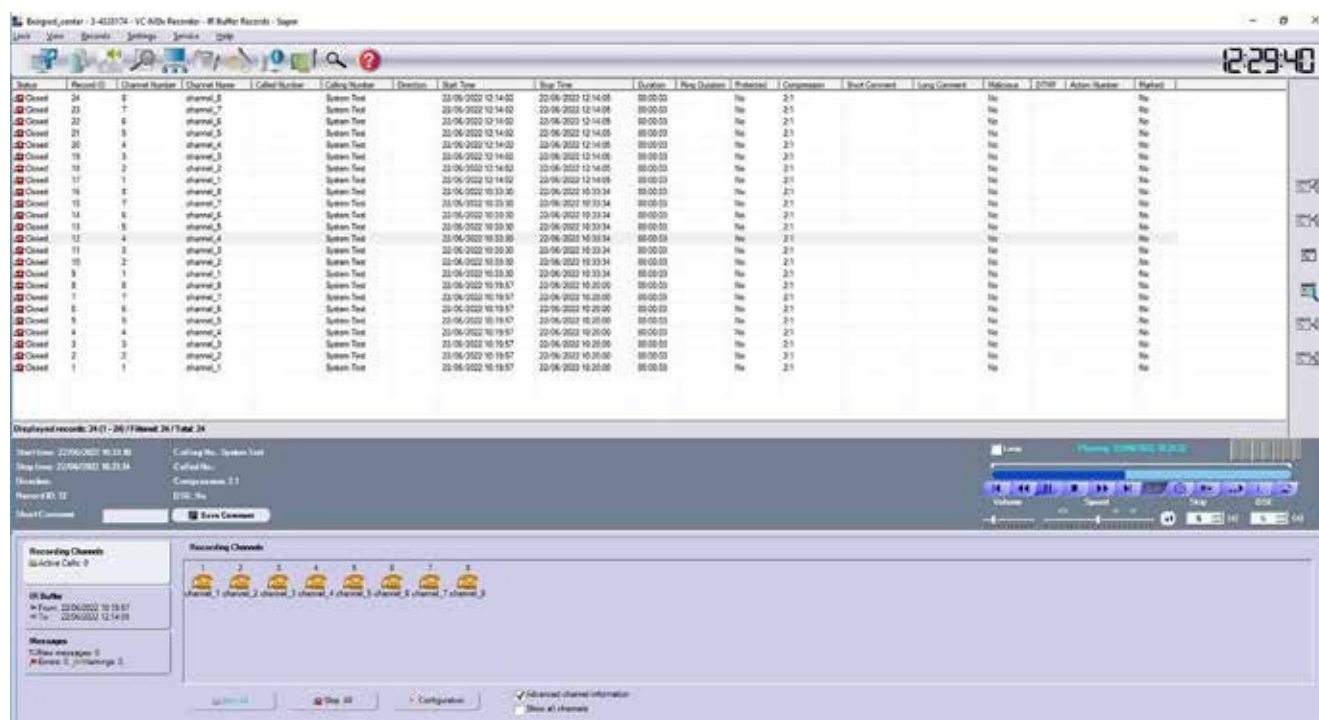
The following software can be installed on the computer:

- Windows 10 Professional or later
- Microsoft NET Framework 3.5
- SQL Server (for database storage)
- drivers for interface boards
- application Configurator (for working with system users and recordings databases)
- application Recorder for use of regisraphone (system setup and working with recordings themselves)

## Alarm unit

The alarm unit is realized in the form box with visual (in the form of 3 LEDs) and sound signaling (piezo buzzer with several sound frequency). Inside the regisraphone (on one of the interface boards) there is a piece of hardware with 3 relays that transmits information through the 15-pin connector (on the back of the computer case) to the alarm unit in the event of any irregularities in the operation of the regisraphone itself.

The errors that this hardware (together with the software) detects and forwards to the alarm board refer to software, hardware errors and global (critical) errors.



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