

A high-speed train, likely a Shinkansen, is shown in motion on a track. The train is white with a red stripe and is moving towards the left. The background shows a clear sky and some infrastructure.

IMPULSE

SRPA "IMPULSE"

**AUTOMATICS SYSTEMS
FOR RAILWAYS**



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SIGNALLING SOFTWARE

ABOUT THE ENTERPRISE

SRPA “Impulse” is a designer, manufacturer, and supplier of highly reliable instrumentation and control systems (I&C systems), an I&C market leader for nuclear power engineering and railways of Ukraine. The I&C systems meet both Ukrainian and international quality and safety standards.

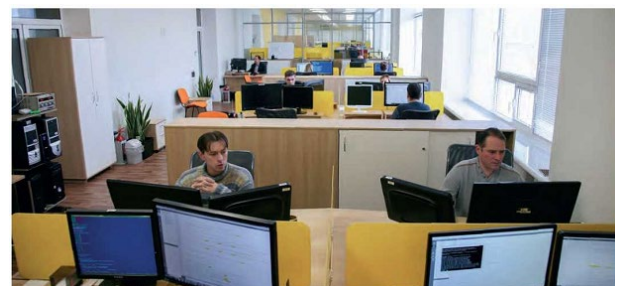
The company was established in 1956 as the basic enterprise for development of instrumentation and control systems for automation of technological processes. For sixty-five-year-long history, tens of thousands of instrumentation and control systems have been developed and commissioned for nuclear and thermal power engineering, railways, oil and gas, chemical, aerospace industries, mechanical engineering, geophysics, defence, etc.

The staff of SRPA “Impulse” is a team of professionals with experience and skills of operation in the branch of instrumentation and control systems for particularly important facilities. This experience includes all stages of the automation system life cycle - from inspection of a facility and design to author's support and technical support of operation.

One of the main activity areas of SRPA “Impulse” is design, manufacturing, and commissioning of microprocessor based signalling systems (signalling). Due to many years of unique experience, advanced design and manufacturing technologies, signalling by SRPA “Impulse” meets the best world standards and operates under the severest conditions of operation at sections of any length and any traffic intensity.

R&D DEPARTMENTS

Up-to-date design, programming, and debugging aids for software and hardware are used.
Equipped with modern laboratory devices



Products and services for railways

- Microprocessor based signalling systems:
 - MPC-U microprocessor based interlocking system;
 - MAB-U microprocessor based automatic blocking;
 - MRC-U microprocessor based track circuits;
 - MPAB-U microprocessor based semiautomatic blocking;
 - MDC-U microprocessor based centralized traffic control system;
 - MSSO-U microprocessor-based axle counting system MSSO-U.
- Highly reliable power supply devices and systems;
- Locomotive safety system;
- Hot axle box detection system;
- Service equipment;
- Construction-engineering design, construction, installation, commissioning work (there are corresponding licences and certificates available);
- Support of equipment operation in Ukraine and other countries.

PRODUCTION FACILITIES



The signalling hardware is manufactured at the own high-tech works. The area of the works and the grounds – over 30 thousand square metres.



The CNC equipment is used

EXPERIMENTAL AND RESEARCH FACILITIES

Include the following:

- a system ground for adjustment and technical support of signalling;
- testing equipment;
- field equipment simulators;
- test software.



Functional capabilities of signalling

The signalling based on unified highly reliable software and hardware manufactured by SRPA "Impulse" forms a modern integrated system for safe control of train movement.

The unique peculiarity of the signalling is compliance with both the requirements of the "area 1520" and the requirements of the European Union standards.



Cooperation when designing

Starting from the earliest stages of system development, SRPA "Impulse" cooperates actively with a customer, operating personnel, design, regulating, and research organizations.

Such approach assures generation of the most complete requirements for an automation system of a specific facility.



Support at commissioning

Specialists of SRPA "Impulse" carry out construction, installation, commissioning and commissioning of signalling, guaranteeing an economical, fast and safe launch of the system.



The following is done at the "EUTEST" testing laboratory certified at the National Certification Agency of Ukraine (for meeting ISO 17025):

- testing of devices and systems for meeting the series of standards IEC 61000-4, IEC 60068-2,3, GOST 25861, GOST 12.2.007.0, DSTU 2862, DSTU 2864, etc.;
- functional testing of signalling with real-time simulation of field equipment operation of a specific station layout and train running.

Support of operation

Author's support is assured during the whole life cycle of equipment and systems:

- engineering and technical support for operating organization personnel in "24/7" mode;
- system updating on customers' requests;
- warranty and post-warranty repairs.

CERTIFICATES

ACHIEVEMENT AWARD

Private Joint Stock Company «Severodonetsk Research and Production Association «Impulse»
Частное акционерное общество «Сверодонецкое научно-производственное объединение «Импульс»

2, Pobedy square, Severodonetsk, Luhansk Oblast, Ukraine
2, площа Перемоги, Сєвєродонецьк, Луганська область, Україна

has been awarded Intertek by conforming to the requirements of

Workplace Conditions Assessment

Intertek has assessed the condition of the above facility according to the scope of the Workplace Conditions Assessment, which resulted in issuing the performance certificate, recorded for the "Achievement Award".
The evaluation of the facility covered the following areas:

1. Labour
2. Working Hours
3. Health and Safety
4. Management System
5. Environment

Registration Number: **F_IAR_160999_WCA**
Issue Date: September 19, 2022
Expires Date: September 16, 2023

Signature: [Signature]
Name: [Name]
Title: [Title]

City: [City]

CERTIFICATE
Number 9_OCI/CCS/1603/EN/2016-01

Certifying Organisation	TINSA Ltd Product Certification Body „NB and OS” N99 OCI Accreditation of BDS EN ISO/IEC 17003:2012 by the order of BSA 16/376/03.07.2015. TINSA Notified Body number NB 2397 3A, Vasilko Hristov Street, 1112 Sofia Bulgaria
Certificate Holder	Private Joint Stock Company Severodonetsk Research and Production Association "Impulse", Sq. Pobedy, Building 2, Severodonetsk, Luhansk region, 93400, Ukraine
Assessed Product	Computer based Interlocking System „MPC-U"
Developer/Manufacturer	Private Joint Stock Company Severodonetsk Research and Production Association "Impulse", Sq. Pobedy, Building 2, Severodonetsk, Luhansk region, 93400, Ukraine
Legal base	BDS EN 50126-1:2006, BSC EN 50128-2011, BSC EN 50129-2004
Result of the Assessment	This certificate represents the final result of the application from certifying organization for the documented procedure for the assessment of the safety level of the product with general purpose for different independent applications "Computer based Interlocking System MPC-U". From the presented evidence for application of the purposes, methods and tools for ensuring safety at the stages of development/design, manufacturing, validation and operation of the base platform system MPC-U, as well as based on the assessment results presented in the report on the safety assessment 3_OCI/BSA/CCS/1603/BS/2016-01, the Certifying Organization certifies that the product is a general purpose product for independent applications „Computer based Interlocking System MPC-U" fulfills the quantitative and qualitative requirements for safety integrity level SIL1 in accordance with the BDS EN 50126-1:2006 BDS EN 50128-2011 and BDS EN 50129-2004.
Appendix	The Appendix on page 9 represents an integral part of the present Certificate.
Validity period	Is not limited. The certificate is valid for the product "Computer based Interlocking System MPC-U", whose production is performed in accordance with the documentation referred to in the Appendix.
Head of the Product Certification Body „NB and OS” TINSA Ltd	Ing. Yordan Kostadinov
Date and venue of issuance:	25.08.2016, Sofia

QuayAudit
REGISTRATION CERTIFICATE

This certificate confirms that the management systems of
PJSC "SRPA "Impulse"
93405, Ukraine, Luhansk region, Severodonetsk St. Pobedy 2

Have been audited and approved by
Quay Audit UK Ltd on the following management standard:
BS EN ISO 27001:2013

The approved management system apply to the following scope:
Development, production, supply and warranty services of hardware and software of automated technological process control systems including safety automation and telemechanics systems, power supply systems, transformers, electrical distributing and control equipment.

This certificate is restricted to those aspects of business activity described in the internationally recognized NACE Codes listed below:
2611, 2620, 2630, 6201

Original Approval: 20 December 2017
Current Certificate: 20 December 2017
Certificate Expiry: 20 December 2020
Registration Number: 4162936

On behalf of Quay Audit UK Limited: [Signature]

This certificate is subject to periodic surveillance audits by Quay Audit. Further information can be found on our website www.quayaudit.com or by contacting Quay Audit UK Limited, 100, The Quadrant, London W2 2BQ, UK. Quay Audit UK Limited is a member of the International Register of Certificated Auditors (IRCA).
Quay Audit UK Limited: 100, The Quadrant, London W2 2BQ, UK. Tel: +44 (0)20 7611 8177 | info@quayaudit.com | www.quayaudit.com

СЕРТИФІКАТ
IMPULSE

ISO 9001:2015
DSTU ISO 9001:2015

Орган з сертифікації систем менеджменту ТОВ «Глобал Сертифік» підтверджує, що компанія
Приватне акціонерне товариство «Сверодонецьке науково-виробниче об'єднання «Імпульс»

в наступній сфері діяльності:
Підприємство виробляє, експлуатує, встановлює, ремонтує та обслуговує машини та обладнання з функціональним призначенням для автоматизації технологічних процесів управління на технологічних підприємствах, у тому числі для систем захисту та автоматизації технологічних процесів на шахтах, транспортних засобах, обладнанні системної розподільної управління, постачає в роботу програмне забезпечення.

адреса:
вул. Перемоги, будинок 2А, м. Імпульс, 93400, Україна

в процесі та на вимогу системи управління якістю на основі даної інформації підприємство сертифіковане на підставі вимог стандарту ISO 9001:2015 та рівня вимог стандарту ІСО 9001:2015 Р.

Розширений номер сертифікату: 0401180530020 Сертифікат діє до: 25.10.2022
Для підприємств: 0411-2232 Сертифікат діє до: 04.11.2022

Кабінет служби з сертифікації систем менеджменту Рубальський С.С.

вул. Каліфорнія, 23, м. Київ, 01011, Україна | www.gococ.com

СЕРТИФІКАТ
IMPULSE

ISO 14001:2015
DSTU ISO 14001:2015

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Розробка, виробництво, постачання, монтаж, установка, обслуговування та ремонт машин, обладнання, систем управління технологічними процесами, в тому числі для систем захисту та автоматизації технологічних процесів управління на технологічних підприємствах, у тому числі для систем захисту та автоматизації технологічних процесів на шахтах, транспортних засобах, обладнанні системної розподільної управління, постачає в роботу програмне забезпечення.

адреса:
вул. Перемоги, будинок 17А, м. Київ, 01073, Україна

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Розширений номер сертифікату: 04A-0502/001/0222 Сертифікат діє до: 25.10.2022
Для підприємств: 0411-2232 Сертифікат діє до: 25.04.2022

Кабінет служби з сертифікації систем менеджменту Рубальський С.С.

вул. Каліфорнія, 23, м. Київ, 01011, Україна | www.gococ.com

СЕРТИФІКАТ
IMPULSE

ISO 45001:2018
DSTU ISO 45001:2019

Орган з сертифікації систем менеджменту ТОВ «Глобал Сертифік» підтверджує, що компанія
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вул. Каліфорнія, 23, м. Київ, 01011, Україна | www.gococ.com

We work in accordance with the international standards



MAIN IMPLEMENTED RAILWAY PROJECTS

- ✓ **2008 - 2017** – Commissioning of power supply systems of EC for small and medium stations (30 stations at JSC “Ukrainian Railways” and Departmental Railways).
- ✓ **2012** – Trial commissioning, and in 2013 constant commissioning of MPC-U at Pereiezdnaia Station.
- ✓ **2013** – Constant commissioning of MPC-U at Stanishevka Station.
- ✓ **2014** – Constant commissioning of MAB-U at Stanishevka-Zhytomyr Span.
- ✓ **2015** – Constant commissioning of MPC-U at Dubovo Station.
- ✓ **2016** – Constant commissioning of project-arranged power supply systems at Kryvyi Rig-Main Station (107 switches) and on objects “TIS”.
- ✓ **2017** – Trial commissioning of an MDC-U at Obkhodnaia – Perelety Section.
- ✓ **2017** – Trial commissioning of systems AKRO-B at Kozhanka-Popelnia Span and Nasvetevich-Rubezhnoie Span.
- ✓ **2017** – Trial commissioning of systems «ImproTRAIN-250» (locomotives attributed to Osnova, Podolsk and Kyiv-Passazhirskii Depots).
- ✓ **2017** – Constant commissioning of MPC-U at Beskid Station, Nizhnedneprovsk-Uzel Station, Blockhouse 194 km.
- ✓ **2018** – Constant commissioning of MPC-U at 327 km Crossroad of Zaporizhzhia – Kamysh-Zaria Section.
- ✓ **2018** – Extended trial commissioning of MRC-U at Dubovo Station.
- ✓ **2018** – SRPA “Impulse” within a consortium won the international tender for supply of the microprocessor interlocking system to Sindel Station (Bulgaria).
- ✓ **2019** – Constant commissioning of systems AKRO-B at Kozhanka-Popelnia Span and Nasvetevich-Rubezhnoie Span.
- ✓ **2019** – Commissioning of MPC-U with MRC-U at Kazatin Station (post EC-1).
- ✓ **2019 - 2020** – Supply of ImproTRAIN-250 locomotive safety systems for freight mainline locomotives; for shunting locomotives; for passenger mainline locomotives and trains; for special self-propelled rolling stock made in Ukraine, Siemens and Skoda to JSC “Ukrainian Railways” and JSC “Lithuanian Railways”.
- ✓ **2020** – Commissioning of MPC-U at Sindel Station (Bulgaria)
- ✓ **2021** – Start of work on the project “Upgrade of Priority Railway Lines of Ukrainian Railways. Installation of train control systems (centralized traffic control) on Priority Railway Lines of Trans-European Transport Network (TEN-T)”.
- ✓ **2021** – Commissioning of MPC-U with MRC-U at Kazatin Station (post EC-3).
- ✓ **2021** – Commissioning of MPC-U at Vasilkov-2 station.
- ✓ **2021** – Commissioning of MPAB-U at Vasilkov-1 - Vasilkov-2 Span.
- ✓ **2021** – Supply of ImproTRAIN-250 locomotive safety systems for passenger, shunting and freight mainline rolling stock JSC “Ukrainian Railways”; for rolling stock testing laboratory manufactured by «LTG INFRA» (joint project with TESMEC RAIL S.R.L., Italy), for special self-propelled rolling stock APV520 from SVI S.P.A. (Italy) to JSC “Lithuanian Railways”.
- ✓ **2022** – Commissioning of MDC-U at Pomichna – Chornoliska section.
- ✓ **2022** – Factory acceptance tests were carried out for the MRC-U, manufactured by order of Siemens Mobility for the Tartu-Koidula section of the Estonian Railways.
- ✓ **2023** – Commissioning of 20 complexes of equipment for remote control of moving units AKRO-B at 10 stations and adjacent spans of the South-Western and Odessa railways.
- ✓ **2023** – Commissioning of microprocessor-based axle counting system (MSSO-U) on the “Stepok-Stanishevka” and “Vasylkov-1 - Vasylkov-Center” spans.

MPC-U MICROPROCESSOR BASED INTERLOCKING SYSTEM

MPC-U – a microprocessor based interlocking system carrying out all functions of monitoring and safe control of train movement at stations and spans.

It implements route and individual control of field equipment of any kind, remote control of shunting zones and yards, coupling with the upper level's systems.

Functions of MAB-U and MPAB-U are integrated into MPC-U. To monitor vacancy of track sections, track circuits or axle counting systems can be used.

Structural principles of MPC-U allow to implement the following:

- division of large sections to control zones (both permanent and seasonal);
- selection of sectors with the function of temporary local control at a station with shunting operation;
- remote control of adjacent stations and track towers.

It can be used to construct MPC of stations with the following parameters:

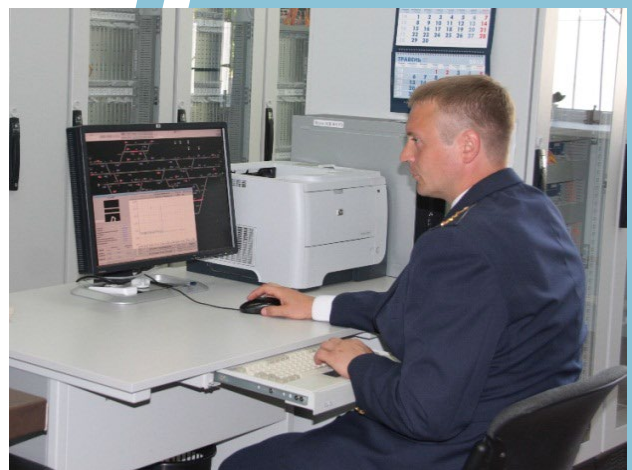
- number of switches up to.....256 pcs.;
- number of signals up to.....256 pcs.;
- number of track circuits up to...512 pcs.

Main functions of MPC-U

- monitoring and control of processes of train reception, departure, passing, overtaking, shunting operation at a station;
- train movement safety assurance on routes:
 - setting, release, and cancel of routes;
 - control of traffic light signals;
 - coding of train routes with signals of automatic locomotive signalling (ALS);
 - automatic unlocking of shunting routes during angle runs;
 - switching on of a call-on signal;
 - individual switching and automatic return of tongues;



MPC-U – the first Ukrainian interlocking system with an international certificate of meeting the highest safety integrity level SIL4 of the CENELEC standard



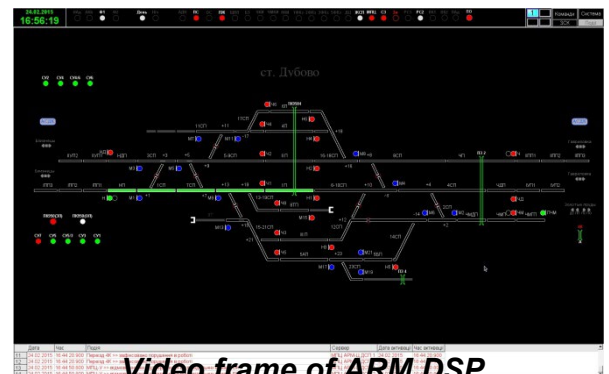
- artificial release of sections;
 - switching off of switches and isolated sections with preservation of use of signals;
 - setting of a route without opening of a signal;
 - coupling with level crossing, pedestrian, tunnel signalling with individual time lag for each signal being opened;
 - individual counting of time lag for each route cancelled and section released;
- display of reliable information concerning a train position and a state of signalling devices at ARM of an assistant station master (DSP) and ARM of a technician (ShN);
 - monitoring of a power supply system;
 - logging of actions of operating and maintenance personnel, archiving of all information received, and forming of logs and reports required;
 - check of awareness of operator actions when setting important control commands.



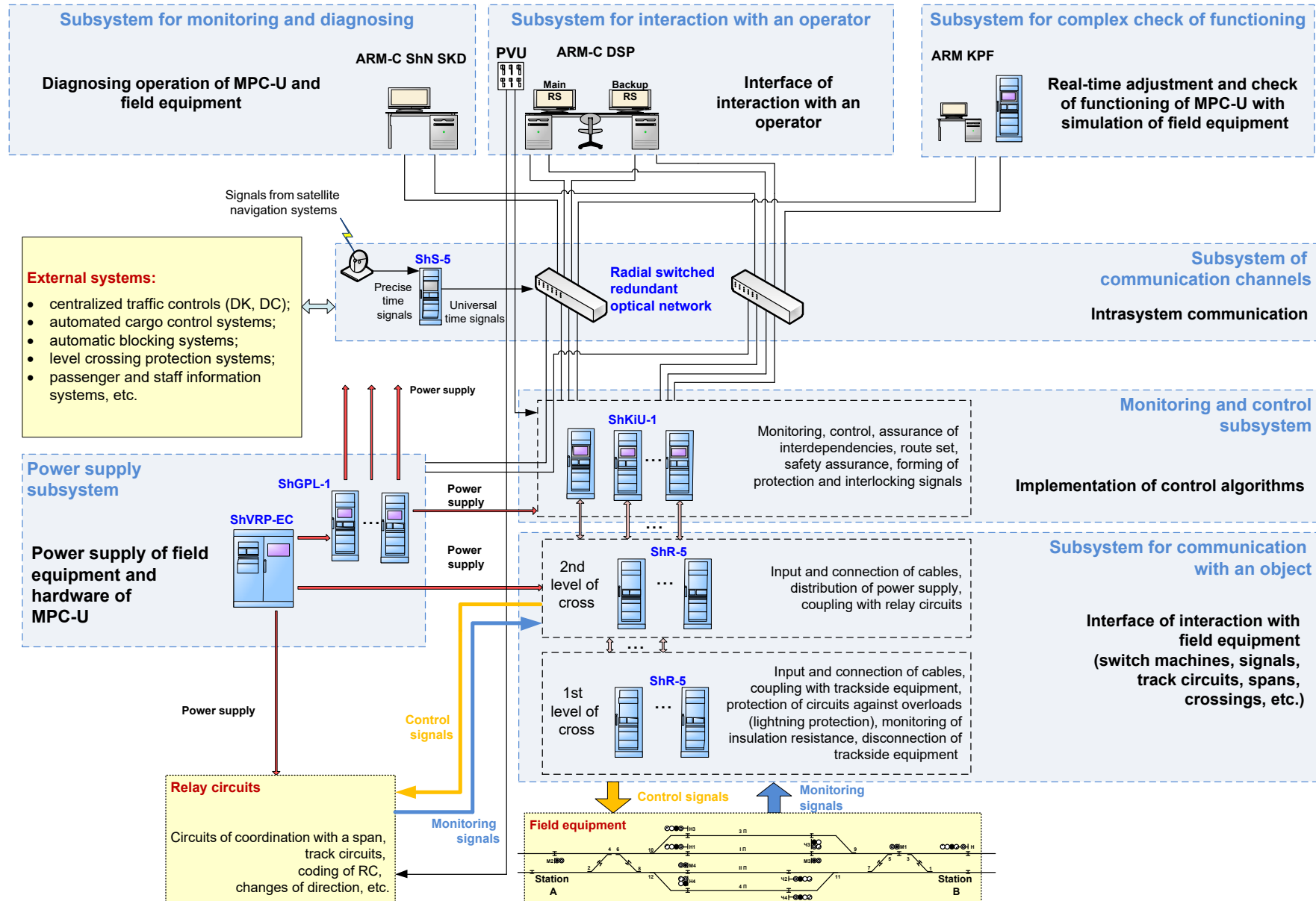
A reliable power supply system and defense-in-depth lightning protection assure operation of MPC-U under severe weather events and in case of operational disorders of electric networks

Structure of MPC-U

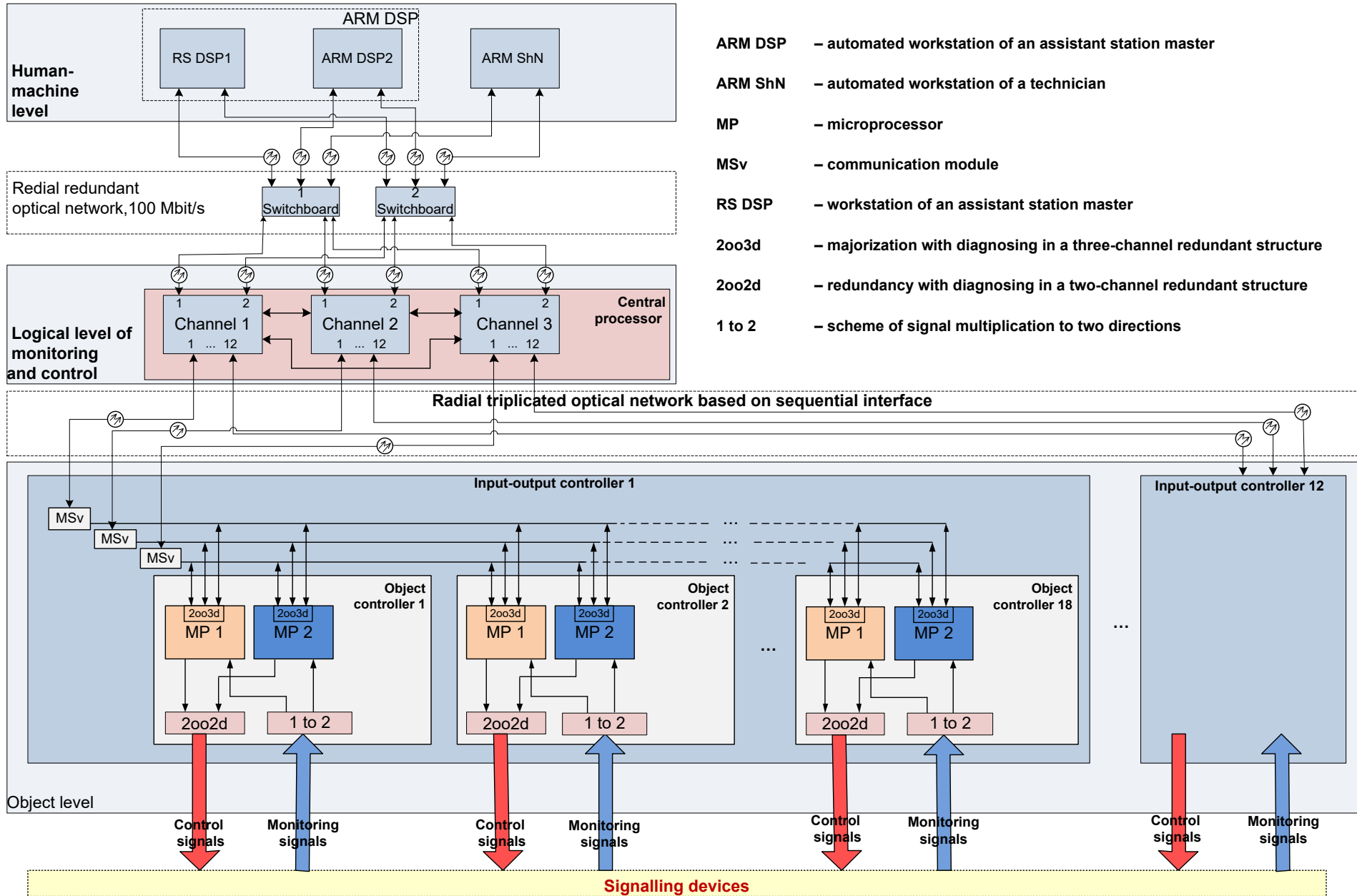
The modular structure of the hardware and the software assures use of MPC-U at large, medium, and small stations. The systems differ only in number of object controllers required to connect the signalling devices and configuration of the application software. The equipment of MPC-U can be located both in a centralized and in a decentralized manner.



Video frame of ARM DSP



Functional scheme of MPC-U



- ARM DSP** – automated workstation of an assistant station master
- ARM ShN** – automated workstation of a technician
- MP** – microprocessor
- MSv** – communication module
- RS DSP** – workstation of an assistant station master
- 2oo3d** – majorization with diagnosing in a three-channel redundant structure
- 2oo2d** – redundancy with diagnosing in a two-channel redundant structure
- 1 to 2** – scheme of signal multiplication to two directions

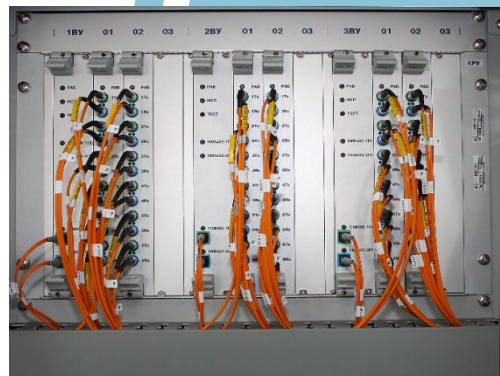
Structure of MPC-U



MPC-U at a station (relay room)

The main solutions to assure functional safety and reliability of MPC-U include as follows:

- the three-channel structure of the safe central processor working by the “2oo3d” scheme (voting with diagnosing) with diversification of the software. If one of the channels fails, operation continues by the “2oo2d” scheme (redundancy with diagnosing), and information on an error is recorded in the database. A faulty module can be replaced and put into operation without stopping the system;
- internal redundancy of object controllers, each having two diverse channels and operating by the “2oo2d” scheme, and control commands from three channels of the central processor are processed by the “2oo3d” scheme with reconfiguration if one of the channels fails (2oo3d → 2oo2d);
- single defects of the hardware and the software don’t cause dangerous failures and are detected by operating and testing impacts;



Safe central processor



Object controllers

- connection with the help of a redundant fibre-optic cable by the “dot-dot” scheme between each channel of the central processor and each input-output controller (failure of any connection doesn’t influence operation of other connections);
- redundant version of ARM DSP, possibility to add additional ARMs DSP;
- security of interaction of an operator and MPC-U:
 - impossibility to create a situation dangerous for train movement by incorrect operator’s actions during operation in the main control mode;
 - clear indication of operator’s actions, as well as check of consciousness of his actions in the auxiliary control mode (repeated request to an operator and reception from him of a corresponding answer confirmed by pressing of a special button);
- strategy of safe behavior in case of failures (failure resistance);
- continuous monitoring and diagnosing of states of the signalling devices and the MPC-U software and hardware with data acquisition, processing, storing, and display at ARM ShN.

System advantages

- high safety level meeting both European (CENELEC, SIL4) and national safety standards;
- possibility to construct interlocking systems in accordance with the standards of the “area 1520” and the European standards assuring safety of operation (ERTMS/ETCS);
- cyber security of MPC-U meeting the requirements of the corresponding ISO and IEC standards;
- contactless control of switches and signals eliminating relay components completely;
- the software and the hardware approved in MPC-U are the basis to construct other systems (MAB-U, MDC-U, MRC-U, etc.), assuring high characteristics of unification, reliability, and safety of signalling;
- availability of all required interfaces for coupling with different electric interlockings (EC), centralized traffic controls (DC), traffic control systems, etc.;
- use of the computer-aided design system when developing and modifying the application software with protection against unauthorized access;
- availability of the common-timing system receiving exact time signals from satellite navigation systems;
- reliable protection against atmospheric and switching overvoltages, short circuits, pulse overvoltages;
- absence of fans (as the most unreliable elements) to remove heat from electronic components;
- a version of the MPC-U equipment allowing placing it in transportable modules and operating in a wide range of climatic conditions.



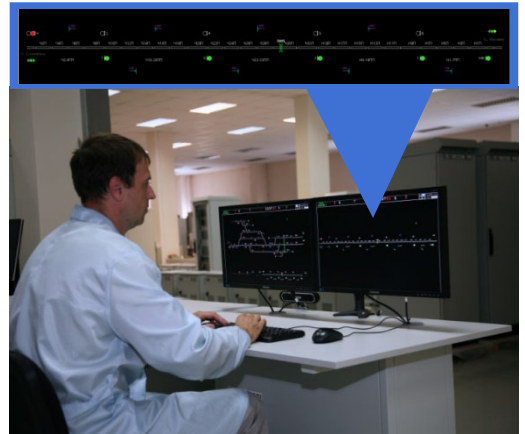
Ease in extending and changing configuration of MPC-U of a specific station is assured due to the modular structure of the hardware and the software, as well as automation of the process for preparation of the application software

Ease of maintenance is assured due to automatic detection of a faulty standard substitute element and possibility to replace it without shutdown of MPC-U

Before being supplied, MPC-U undergoes a full-scale check of operation with the help of the specialized software and hardware system allowing full real-time simulation of operation of all signalling devices (including electrical loads) for a concrete track of a station. This significantly reduces terms of MPC-U commissioning

MAB-U MICROPROCESSOR BASED AUTOMATIC BLOCKING

MAB-U – a system of train separation and assurance of train operation safety at single-track and multiple-track railway spans on a real-time basis. It can be used as an autonomous system (based on the components of MPC-U) or as a function integrated into MPC-U.



It assures remote control of facilities at a span (signals, a railway crossing, track circuits, coding of track circuits, etc.) and coordination between stations limiting this span.

It is implemented based on track circuits. The equipment is located at stations adjacent to the span or in transportable modules (TM) at the span.

Main functions of MAB-U

- monitoring integrity and vacancy of block sections of a span;
- monitoring sequence of occupying and vacating block sections with automatic blocking when there is a violation;
- controlling signals of intermediate traffic signals with observation of traffic safety conditions;
- controlling crossing, tunnel signalling;
- coding track circuits of block sections with signals of ALS;
- implementing an algorithm of three-digit or four-digit signalling (depending on customer's requirements);
- real-time displaying (at ARM DSP and ARM ShN) reliable information on train position and state of the signalling devices at a span.

MAB-U has the same advantages and high characteristics of reliability, functional safety (SIL4 level) as MPC-U



MAB-U equipment for Stanishevka-Zhytomyr Span

Technical characteristics of MAB-U

NAME	CHARACTERISTIC
Length of a span serviced	Up to 24 km (without installation of intermediate TM) Up to 48 km (with installation of intermediate TM)
Length of a track circuit	Is determined with a type of track circuit equipment
Quantity of crossings at a span	Up to 30
5 frequencies (with 2 modulations) of monitoring of track circuits in a range	From 420 to 780 Hz
Type of modulation of track circuit monitoring signals	Amplitude
Additional shunting zone	Not more than 40 m
Monitoring of levels of track circuit monitoring signals	Without use of additional instruments

MRC-U MICROPROCESSOR BASED TRACK CIRCUITS

The MRC-U tone-frequency microprocessor track circuits are designated to monitor occupancy/vacancy of track sections at stations and spans, to monitor integrity of track circuits, to transmit code signals of ALS from wayside devices to a locomotive.

A track circuit power supply module (MPRC) is a combined device containing the following:

- an RC power supply node (a tone-frequency signal generator);
- a two-channel RC monitoring node;
- an ALS code generator node.

In the “generator” mode, MPRC carries out design of tone-frequency signals and ALS code signals, generating a sum signal of power supply and ALS at the output. In the “receiver” mode, the module carries out simultaneous measurement of levels of two frequency signals and their comparison with a specified setpoint.

A track circuit control module (MKRC) is designated to monitor uncoded branches of track circuits. It contains three independent two-channel RC monitoring (voltage measurement) nodes.

In MPRC and MKRC the same solutions are used as in the object controllers of MPC-U (two diverse channels, operation according to the “2oo2d” scheme).

System advantages

- supplying power, monitoring, and coding track circuits without use of relay equipment;
- parameters of signals of TRC and ALS don't depend on changes of climatic conditions;
- high noise-immunity of receiving equipment, due to digital filtering;
- continuous diagnostics of receiving-transmitting nodes by means of measurement of parameters of signals being shaped;



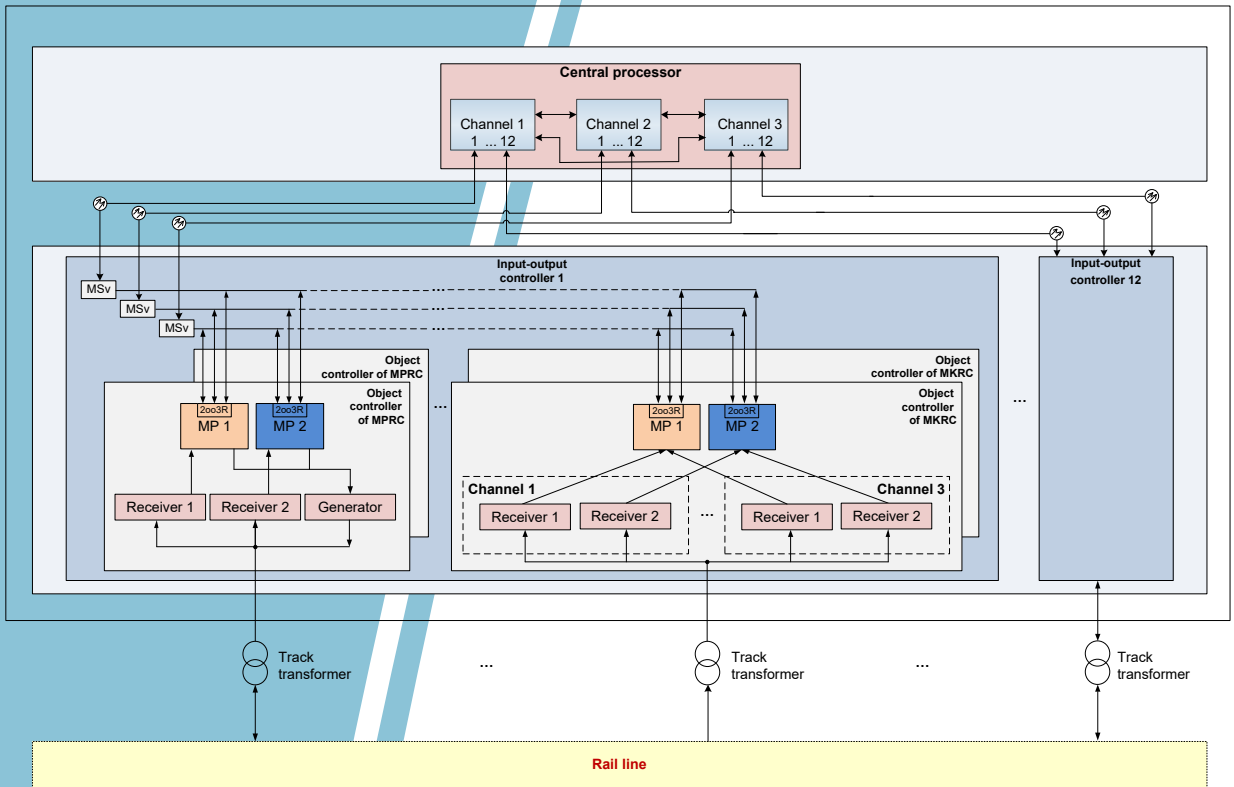
Control cabinet of MRC-U



- possibility of redundancy of MPRC and MKRC (“hot” redundancy);
- availability of interfaces for coupling with any type of EC;
- resistance to lightning and switching overvoltages;
- use of MRC-U based on digital signal processing assures the following:
 - continuous monitoring of cable parameters;
 - continuous monitoring of track circuit parameters (including assessment of residual voltage, track circuit integrity, insulation failure of an insulated joint, monitoring of occupancy of diverging branch lines) without additional equipment;
 - stable operation of track circuits in case of asymmetry of traction currents up to 50 A, which corresponds to real parameters of asymmetry at railways with the “1520” track;
 - absence of necessity of season regulation of track circuit parameters;
 - reduction of human factor influence onto rail traffic safety due to a safe function of automated adjustment of track circuit parameters.

Technical characteristics of MRC-U

NAME	CHARACTERISTICS
Length of a track circuit	From 25 m to 1500 m (depends on track line insulation resistance and track circuit configuration)
Additional shunting zone	From 0 to 40 m



Structure of MRC-U

MPAB-U MICROPROCESSOR BASED SEMIAUTOMATIC BLOCKING

MPAB-U – a system of train separation and assurance of train operation safety at single-track and multiple-track low-density railway spans with any traction type using a function of semiautomatic blocking.

Span occupancy/vacancy is monitored using the axle counting equipment.

Main functions of MPAB-U

- monitoring occupancy/vacancy of each track of a span;
- monitoring integrity of an arrived train automatically;
- exchanging information between adjacent stations to implement an algorithm of semiautomatic blocking;
- shaping signals for EC;
- coding track circuits of station approaching sections with signals of ALS.

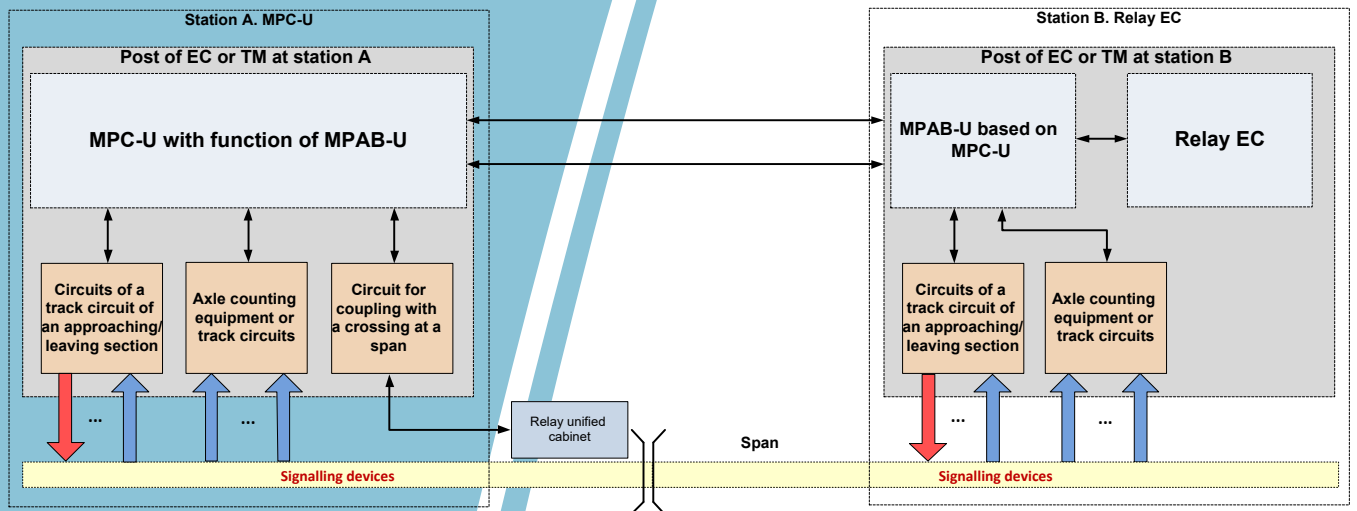
System advantages

- minimum quantity of station equipment when integrating into MPC-U;
- software implementation of logical dependencies in a safe central processor;
- possibility to arrange an automatic blockhouse at a span;
- availability of interfaces for coupling with any type of EC.



Control cabinet of MPAB-U





Structure of MPAB-U

MPAB-U has the same advantages and high characteristics of reliability, functional safety (SIL4 level) as MPC-U

MDC-U MICROPROCESSOR BASED CENTRALIZED TRAFFIC CONTROL SYSTEM

MDC-U – a hardware and software system designated to create systems of centralized traffic controls (DC) assuring monitoring and control of train movement at a specific railway section from a traffic management centre (CUP).



Main functions of MDC-U

- monitoring and controlling processes of train reception, dispatch, handling, overtaking at field stations of a subdivision by commands of a traffic controller;
- displaying reliable information on a train situation at a subdivision, state of the signalling and MDC-U devices at ARM of:
 - train dispatchers (ARM DNC);
 - signalling engineers (ARM ShD);
- keeping a traffic schedule (ARM GID);
- automating a control process in accordance with an expected train movement schedule (“automatic dispatcher” function);
- transferring field stations to station (local) control;
- monitoring power supply systems;
- logging actions of operating and servicing personnel, archiving all information received, and generating required records and reports.

Structure

MDC-U has a modular hierarchical structure.

Upper level – CUP with a redundant data server, ARM DNC, ARM ShD, ARM GID.

Lower level – field stations with equipment for coupling with EC, AB, PAB, a level crossing signalling system, feeding installations, signalling installations at spans.

Communication between the upper and lower levels is implemented via redundant channels of the railway communication system.

The field station equipment implementing control functions is built based on the hardware of MPC-U.

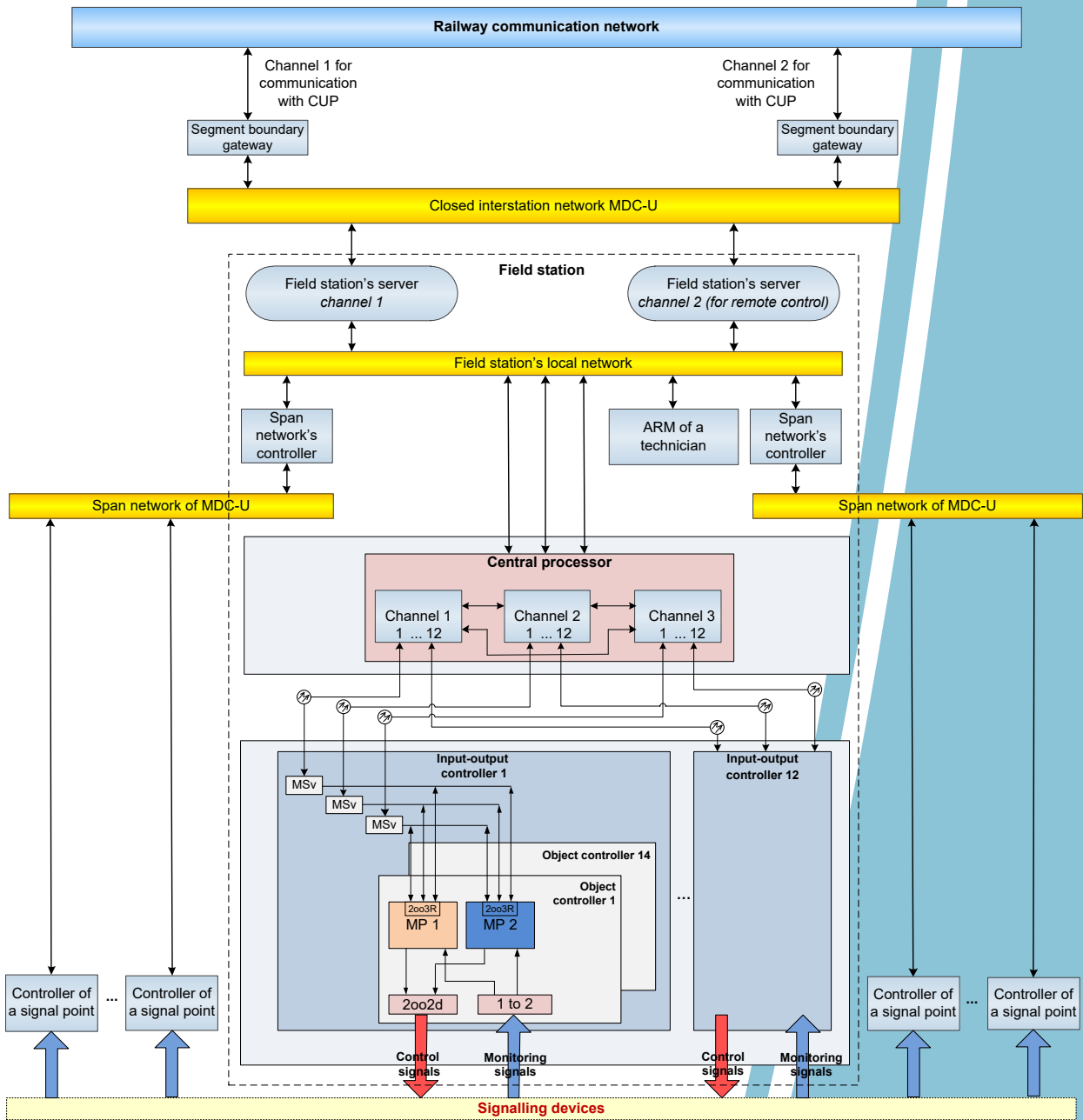


Data server

System advantages

- possibility of arrangement of additional remote ARMs for operating and maintenance personnel;
- remote monitoring of analog signals of different types and rates, allowing reducing time expenditures for servicing of the signalling devices;
- integration of field stations equipped with another type of DC;
- availability of a multiple-access indicator panel in CUP;
- long-term storage of archive information with the possibility of viewing in the “Movie” mode with the regulated speed of displaying.





Structure of a field station of MDC-U

“ImproTRAIN-250” LOCOMOTIVE SAFETY SYSTEM

A modern on-board system to increase safety, to automate control of safety functions for locomotives and multiple-unit rolling stock.

It can be used:

- at railways, including at speed and high-speed sections with autonomous and electric propulsion of direct and alternating current equipped with wayside devices of automatic locomotive signalling (ALSN), advanced automatic locomotive signalling (ALS-EN);
- at railway sections equipped with a train traffic coordinate control system based on a digital radio channel.

High safety level meeting both European (CENELEC, SIL4) and Ukrainian (DSTU 4178, level 4) safety standards

Main functions

- determining speed and coordinates of a locomotive based on information from satellite-based navigation devices and distance and speed sensors;
- shaping a value of allowable rate of movement using signals from ALSN, ALS-EN, a radio channel, data from an electronic card;
- indicating information required for an engine driver and his assistant;
- assuring braking when actual speed exceeds permitted speed;
- preventing passing lights with danger signals;
- preventing unauthorized movement of a locomotive (rolling);
- service brake application via a brake valve attachment by a command transmitted through a digital radio channel;
- monitoring vigilance of an engine driver;
- recording onto a removable cassette recording parameters of locomotive movement;
- interacting with other on-board systems of a locomotive with the help of digital interfaces (CAN, MVB, RS-485).



Composition

NAME	PLACE OF INSTALLATION
DL-1 (DL-2, DL-3) locomotive display	Cabin
InL-PV (InL-P) locomotive indicator of driver's assistant	Cabin
BRL-1 registration unit	Cabin
KR-1 removable contactless registration cassette	Cabin
RB, RBS, RBP vigilance handle	Cabin
UPO-1 (UPO-2) secured redundant controller	Body
Electropneumatic valve (EPK), Electropneumatic valve (EPV)	Body
BPt power supply unit (three versions)	Body
DD pressure sensor	Body
DPS distance-and-speed sensor	Box
KP-I receiver coil	Under a body
SNS + antenna (a radio channel as an option)	Deck

Equipment that can be supplied additionally:

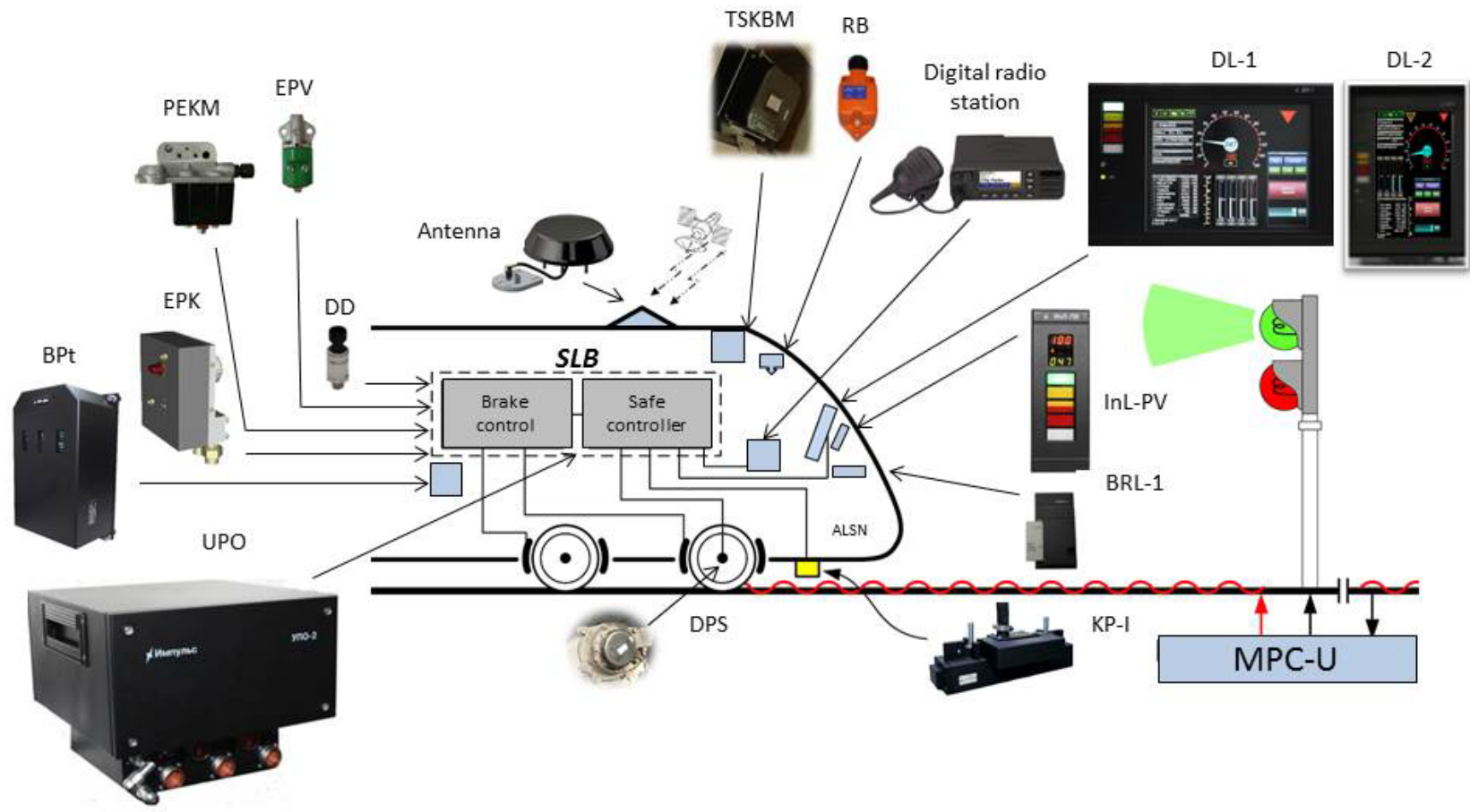
- a digital radio station;
- a radio channel brake control unit (PEKM).

Service equipment:

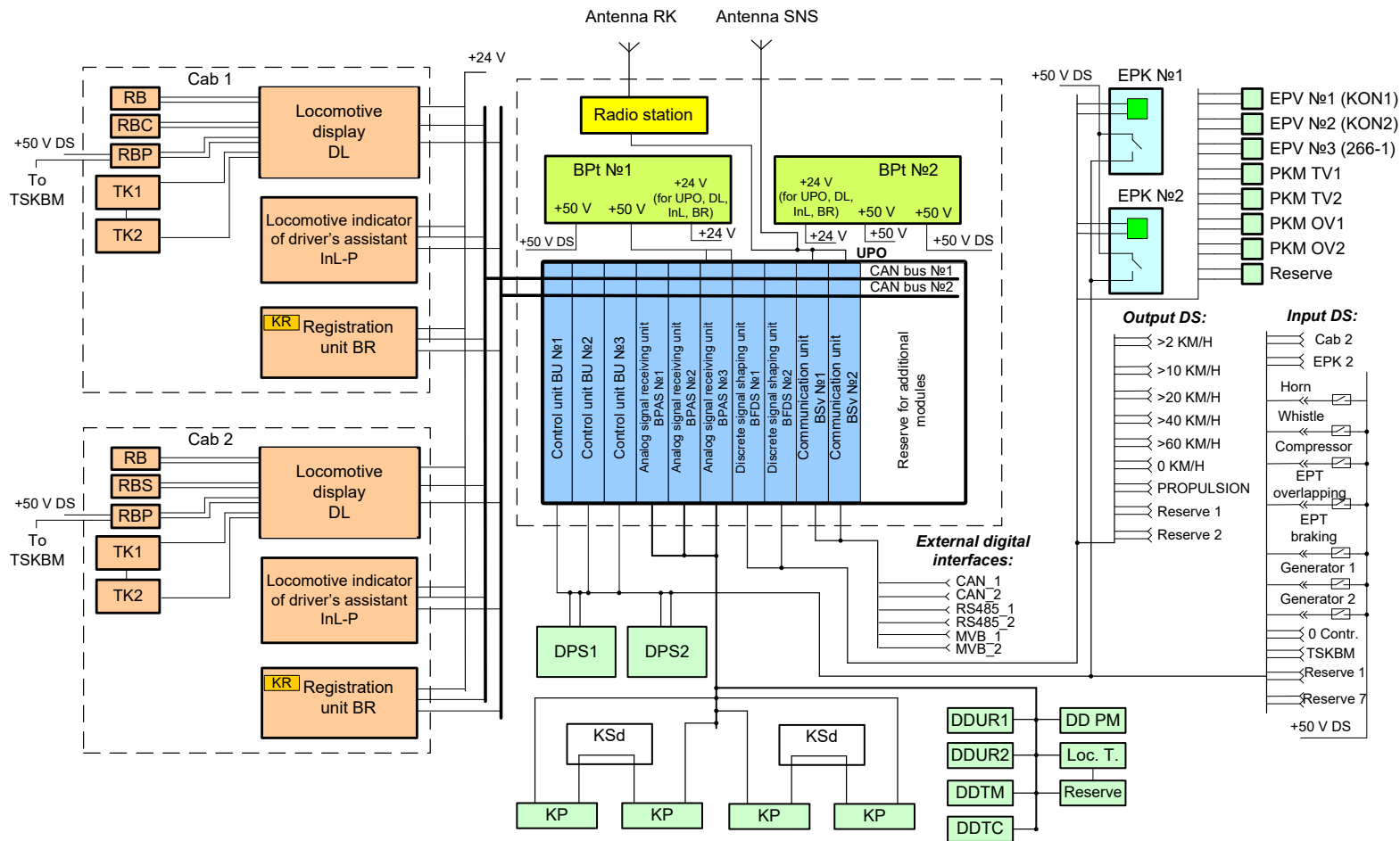
- an equipment for decoding recording cassettes;
- a device for shaping electronic cards;
- a console for deep check and diagnostics.

Structure

A modular structure allows composing the system with the configuration required for the customer. Interaction with the automatic braking control system (SAUT), driver's vigilance telemetric control system (TSKBM), the automatic train operation system, etc. is carried out via an on-board local network.



Composition of the locomotive safety system



List of abbreviations:

- BPt – power supply unit;
- DD PM – supply line pressure sensor;
- DDTM – brake line pressure sensor;
- DDTC – brake cylinder pressure sensor;
- DDUR – equalizing tanks pressure sensor;
- DPS – distance-and-speed sensor;
- DS – discrete signals;
- KP – ALSN receiver coil;
- KSd – connecting box;
- PKM OV – release valve;
- PKM TV – brake valve;
- TSKBM – driver's vigilance telemetric control system;
- UPO – data converting and processing device;
- EPV – electropneumatic valve;
- EPK – electropneumatic valve;
- EPT – electropneumatic braking valve.

Structural scheme of "ImproTRAIN-250"

Reliability and functional safety of SLB are assured with the following:

- three-channel processing of input information by the “2oo3d” scheme with reconfiguring if one of channels fails (2oo3d → 2oo2d);
- generating output control signals in two diverse channels by the “2oo2d” principle;
- implementing multilevel safety:
 - 1 level – monitoring permitted speed of a train based on the data recorded into an electronic card;
 - 2 level – monitoring permitted speed specified with signals of ALSN, ALS-EN;
 - 3 level – centralized control with the possibility to receive commands for immediate stop of a train via a radio channel;
 - 4 level – monitoring based on internal algorithms and online data (state of an engine driver, mode of operation of PS, etc.);
- self-diagnosing using built-in simulators of model signals allowing diagnostic procedures without equipment dismantling from a locomotive.

System advantages

- 100% resistance to a "single failure" due to reconfiguration, which allows continuing movement in the safe mode without stopping;
- minimization of equipment (all functions as to receiving, processing, generating signals, including gateway functions, are implemented in one UPO construct);
- cyber security of the system meets the requirements of the corresponding ISO and IEC standards;
- possibility of departure diagnostics of the system and channels of communication with adjacent devices with the accuracy up to a module;
- use of permitted speed smooth change methods based on calculations taking into account movement dynamics and characteristics of a train composition (a locomotive type, a train weight, a brake type, a track plan, speed limitations, etc.);
- use of a removable contactless registration cassette protected against external impacts (including against deliberate distortion), assuring recording of the following during 72 hours:

Meets
SOU 45.020-00034045-002 and series of
EN 50121, EN 50125
as to resistance to external
exposure factors

- movement parameters, actions of an engine driver, and results of system diagnostics;
- frequency signals of ALSN with binding to coordinates for further analysis and diagnostics of field equipment;
- availability of a backup archive in a registration unit, which can be read if the main archive (cassette) is “unavailable”;
- availability of a set of service equipment for maintenance of operated devices;
- displaying extended diagnostic information on state of units and modules of the system on a screen of a locomotive display;
- possibility to increase quantity of input-output channels for analog and discrete signals, to configure a system in accordance with the Customer's requirements;
- availability of several versions of locomotive displays differing in overall dimensions and installation methods.



AKRO-B HOT AXLE BOX DETECTION SYSTEM

AKRO-B – a modern monitoring and diagnostics system designated for remote state monitoring for running gears of rolling stock, transmission and registration of information on their characteristics at the nearest car service point (PTO).

Main functions of AKRO-B

- automatically determining alarm levels – “Alarm 0”, “Alarm 1”, “Alarm 2” depending on ambient temperature;
- automatically assessing state of an axle box not only by its case temperature, but also by each axle box’s case temperature exceeding the average temperature value of axle boxes’ cases of a carriage of a corresponding train side;
- determining a movable unit type at a train passage rate and assessing state of axle boxes of a locomotive and carriages by threshold values established for corresponding movable units;
- continuously diagnostically monitoring AKRO-B equipment with transmission and display of all diagnostic information to an automated workstation (ARM) of an operator of the nearest car service point (PTO);
- determining instantaneous speed for each axle of a passing train;
- remotely controlling (from ARM PTO) span equipment (switching on heating of input windows of trackside chambers, changing threshold levels – “Alarm 0”, “Alarm 1”, “Alarm 2”, calibrating measuring chambers, etc.);
- accumulating and storing information on trains having passed a monitoring zone in case of a communication channel failure with transmitting information after its restoration;
- dialogue testing and adjusting AKRO-B using an indicator and control console with a graphic liquid-crystal display, the console is built into a span equipment controlling rack;
- monitoring power supply feeders, automatically switching a system to an operable backup power supply feeder, switching to power supply from accumulator batteries in case both power supply feeders fail;
- possibility to connect security and fire alarm.

A solid-state detector based on lead selenide used in the system, ease of operation, and high reliability make AKRO-B competitive with the leading world analogues

Composition of AKRO-B basic system

- The basic AKRO-B system includes span (trackside and tower) equipment of a line control station (LPK) and station equipment.
- The field equipment includes four infrared measuring chambers for remote measurement of temperature of axle boxes' cases and detection of braked wheel pairs. For each measuring chamber, an own wheel detection sensor is stipulated for time synchronization of measurements. Additionally, two wheel detection sensors are used at the starting and ending boundaries of the monitoring zone.
- The tower equipment is an accumulation and processing device in a cabinet construction located at a distance up to 30 m from measuring chambers of the field equipment.
- The station equipment is a PS5150 workstation combining functions of a server and ARM PTO. It is located in a room of PTO or assistant station master.



Field equipment



UNO-5 tower equipment



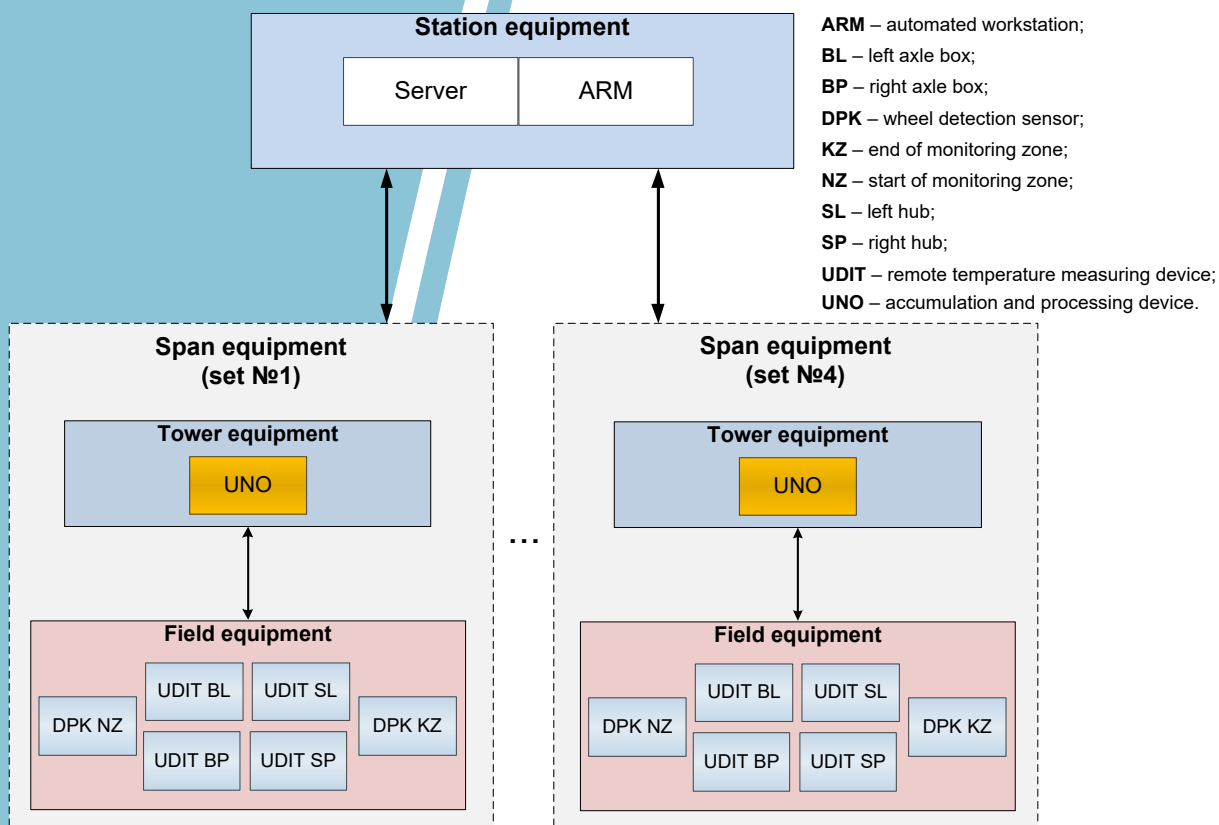
ARM of an operator

System advantages

- Cost and labour saving during equipment installation due to:
 - fastening the field equipment to a rail base on clamps without drilling, welding, or foundation laying;
 - excluding the chamber positioning procedure;
 - installing the tower equipment into existing structures or into a transportable module;
- Cost and labour saving during equipment operation due to:
 - automating the calibration process for temperature measuring channels;
 - automatically keeping the optimum temperature of a sensitive layer of infrared radiation receivers;
- Life increase for a measuring chamber due to minimization of active operation time of mechanical elements;
- It is not required to reduce and maintain constant train speed;
- Possibility to be included into a centralized system for automatic remote monitoring of technical state of movable units (within a certain railway or the whole railway network).

Additionally, on customer's request, equipment with the following functions is supplied within AKRO-B:

- detecting tread wheel defects;
- monitoring dimensions of movable units and availability of dragged objects;
- automatically individually identifying each movable unit using RF-marks;
- dynamically weighting, fixing load distribution to axles (wheels), etc.



Structure of AKRO-B

Key technical characteristics

NAME	CHARACTERISTIC
Speed range of monitored trains	from 1 to 160 (freight ones) and up to 350 km/h (passenger)
Quantity of movable units in a train	not more than 200 pcs.
Quantity of axles in a train	not more than 1600 pcs.
Minimum time interval between two trains passing the monitoring zone	2 min
Maximum quantity of trains passing the monitoring zone per 24 hours	250 pcs.
Operation readiness time after supplying power voltage	not more than 10 min
Information transmission range	not more than 30 km
Monitored temperature range for axle boxes' cases from the ambient temperature to +120 °C, error	not more than 2 °C
Monitored temperature range for wheel disks from +150 to +550 °C, error	not more than 12 °C
Error of ambient temperature monitoring	not more than 1 °C
Detection probability for overheated axle boxes	not less than 98 %
Detection reliability for overheated axle boxes	not less than 96 %
Average lifetime	not less than 10 years

HIGHLY RELIABLE POWER SUPPLY SYSTEMS

PROJECT-ARRANGED POWER SUPPLY SYSTEM OF MEDIUM AND LARGE STATIONS (PKSEP)

PKSEP is designated for power supply of relay or microprocessor based interlocking devices of medium and large stations, at railway sections with any traction type.

Main functions

- supplying power from :
 - two feeders of three-phase AC voltage 230/400 V with a dead-earthed neutral;
 - a diesel-generator set (DGA);
 - an accumulator battery (AB) with voltage 24 V;
 - from AB with voltage 240 V;
- distributing, converting, and recording electric power;
- three-level protection of power supply lines against atmospheric and switching overvoltages, short circuits, pulse overvoltages;
- quality monitoring for electric power;
- automatically switching a load;
- monitoring malfunction of contactors of both feeders and monitoring availability of voltage on a guaranteed three-phase current power supply bus.

Composition

PKSEP includes the following devices:

- an input panel;
- an ShchOAB battery disconnection panel;
- an ShVpR rectifying distribution cabinet;



Meets the branch standard
SOU45.020-0034045-002:2006
and the requirements of
OSZhD (Railway Cooperation
Organization) R 801 and R 852



ShGPL
guaranteed power supply cabinet

- an ShVR input distribution cabinet;
- an ShGPL guaranteed logic power supply cabinet;
- an ShTr transformer cabinet without battery backup;
- an ShTr transformer cabinet with battery backup;
- an ShSt points cabinet without battery backup;
- an ShSt points cabinet with battery backup;
- an ShD diagnostic cabinet;
- an accumulator battery;
- an automatic transfer switch panel.



ShSt with battery backup



ShSt without battery backup

It is possible to compose two main types of power supply systems:

- with backup of loads from AB with voltage 240 V;
- with backup of loads with voltage 24 V and voltage 230 V from AB with voltage 24 V.

Power supply backup time, depending on AB capacity, is from 10 minutes to 8 hours.

Rated load capacity of the system is:

- 25 – 40 kW;
- 40 – 55 kW;
- 55 – 80 kW.



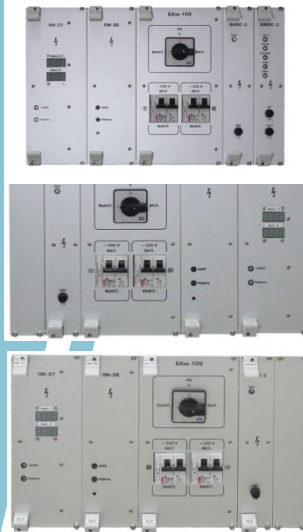
Input panel



ShD diagnostic cabinet



ShVpR rectifying distribution cabinet



ShTr transformer cabinet

System advantages

- design arrangement and scalability – allow designing a power supply system with the parameters required for a specific station;
- has been developed in accordance with the requirements of area “1520”;
- high “survivability” due to redundancy of main nodes;
- possibility of remote switching-off of input feeders, DGA, and AB with a “single button” when emergency situations or a fire emerge;
- possibility of manual selective switching-on/switching-off of feeders;
- a built-in microprocessor based system monitors and diagnoses power supply parameters and PKSEP hardware state recording the following parameters:
 - resistance of insulation as related to “ground” in circuits of power supply for signals, track circuits, relay racks, panels, electric switch machines, heating of electric switch machines;
 - voltage and current in each phase of input feeders;
 - voltage in output circuits of cabinets forming a part of PKSEP;
 - operability of units and devices, automatic switches, protective varistors, etc.;
- possibility to monitor quality and periodicity of maintenance based on archive data:
 - DGA start on load with specifying its operation duration and recording feeder parameters;
 - service of station’s AB with switching-off a charger, operation of main and additional chargers;

- diagnostics results and archive data allow the following at any time: to monitor equipment state, to determine pre-failure conditions, failure mode of power supply devices;
- archives contain information on incidents in a power supply system, in particularly:
 - voltage absence on a supply feeder;
 - switching from one feeder to the other specifying a reason (voltage reduction, voltage increase by each of three phases of a power supply source, disturbance of phase sequence, etc.);
 - on switches, where there is current increase by normal transfer and operation on friction (based on curves of switch machine currents);
 - on modes of sparking on engine manifolds due to brush wear, brush assembly weakness, manifold contamination, etc.



POWER SUPPLY SYSTEM FOR EC FOR SMALL AND MEDIUM STATIONS

Power supply system for EC based on ShVRP-EC

It is designated for power supply of electric interlocking devices of small and medium stations equipped with audio or phase-sensitive track circuits, DC or AC point electric machines.

System advantages

- combination of functions of inputting, distributing, and converting panels;
- three-level protection of power supply lines against atmospheric and switching overvoltages, short circuits, pulse overvoltages;
- automated remote and local monitoring of power supply circuit state using a built-in microprocessor based system;
- maintenance of a deep archive of power supply parameters (archive data for one year);
- N+1 redundancy scheme with the hot swap function;
- determination of equipment pre-failure conditions for “maintenance on condition”;
- easy rearrangement for power supply of AC or DC switch machines;
- is a turnkey device – installation and commissioning don’t require involvement of specialists from the manufacturing plant.



Meets the branch standard
SOU45.020-0034045-002:2006
and the requirements of OSZhD
R 801 and R 852



Power supply system for MPC-U for small stations based on ShP-8

- Designated for power supply of microprocessor based interlocking systems (MAB-U, MPAB-U) of railway stations with the quantity of switches up to 15.
- Combines functions of inputting, distributing, and converting panels.
- Has the same advantages as the power supply system for EC based on ShVRP-EC.



SINGLE DELIVERY DEVICES

All devices described in this section meet the branch standard SOU 45.020-0034045-002:2006, as well as the standards DSTU IEC 61000-4-2:2008, DSTU IEC 61000-4-3:2007, DSTU IEC 61000-4-4:2008, DSTU IEC 61000-4-9:2009

Power supply panels

ShchV-1 – a modern input cabinet designated to connect up to three power supply feeders (including from DGA). A built-in consumed power recording node and reliable protection against atmospheric and switching overvoltages, short circuits, pulse overvoltages are implemented in ShchV-1.

Key characteristics

- protection against atmospheric and switching overvoltages, pulse overvoltages, short circuits;
- remote switching-off of an external alternating current source from a DSP post;
- manual switching-off of an external alternating current source with a circuit breaker with a “visible break”;
- a built-in power recording node;
- monitoring of panel’s equipment state and unauthorized access;
- a case of high quality with corrosion-resistant coating, meant for thirty years of life;
- possibility to separate input and output cables (upper and lower inputs).



ShchOAB-1 – a backup power connection panel designated to control and protect backup power sources, such as an accumulator battery or a diesel-generator.

Key characteristics

- remote switching-off of an external direct current source from a DSP post;
- manual switching-off of an external direct current source;
- installation variants available – mounted or rack version;
- possibility to install devices for protection against atmospheric overvoltages;
- small dimensions and weight;
- a case of high quality preventing moisture penetration, with corrosion-resistant coating, meant for thirty years of life;
- monitoring of panel's equipment state and unauthorized access.



Signalling transformers and filters

Signalling transformers are designated for power supply of signalling devices.

Key characteristics

- double insulation (withstand voltage up to 3000 V);
- low power consumption in an idling mode (from 30 to 50% lower than the one of analogs);
- life is 20 years;
- brass connecting elements (electric contact of high quality).

FR-50 resonant filter is designated to protect track circuit equipment against impact of reverse traction current with frequency 50 Hz on sections with AC electric traction.

Key characteristics

- FR-50 is a series connection of inductance and capacity being a resonant circuit adjusted to traction current frequency 50 Hz. At ALS current frequency 25 Hz, the filter is capacitive in effect, which partially compensates inductive current of magnetization of a feeding transformer;
- FR-50 is not an additional load for track circuit modules, as it has high resistance at information frequencies;
- use of the filter is especially topical for high-speed or heavy-freight lines, as well as lines with bad traction current plumbing.



Power supply sources for rolling stock and signalling

SRPA “Impulse” develops and manufactures power supply sources for any industry branches, including according to customer’s technical requirements. On-board power supply sources and power supply sources of signalling devices are manufactured for railways.

The SPN-33 power supply source is designated for power supply with voltage 24 V of not critical loads on a rolling stock with an on-board network 110 V.

It can be used on the following rolling stock types: 2TE116U, 2TE116UD, 3TE116U, EPL2T, EPL9T, DEL-02, etc.

The BPt-224, BPt-225, BPt-226 power supply sources of critical users are designated for power supply of on-board safety systems, rolling stock control systems with any voltage value of a standard-line on-board network (24/50/75/110).

Output voltage of the sources is galvanically isolated and stabilized, with rated values 26 V, 48 V, and 50 V.

The SPN-42 power supply source is designated to assure power supply of signalling devices with rated DC voltage 15 V and load current 5 A.



Digital equipment for cable network monitoring

Application areas:

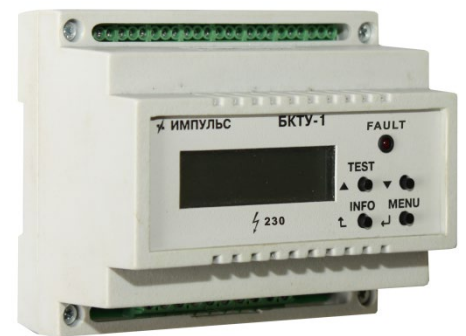
- railways;
- metal working and processing machines;
- equipment to produce foodstuff;
- construction machinery and construction materials;
- industrial equipment and printing machines, paper and cardboard production;
- climatic equipment;
- testing and measuring equipment;
- mining and quarry equipment;
- lifting and carrying equipment;
- control systems.

The BKTU-1 leak current monitoring unit is designated to increase operating safety and life of electric facilities, sudden outage of which can cause negative consequences and unreasonable material costs. According to the international classification it belongs to RCM-devices (Residual Current Monitor), which detect leak current and warn on this without power-off (as opposed to classic protective cutout devices).

BKTU-1 assures monitoring of up to 12 circuits and has two adjustable thresholds of leak current monitoring. When achieving the first threshold, it doesn't stop operation, but generates a warning, allowing personnel to end a technological process correctly.

BKTU-1 is connected with the BKSI-2 insulation resistance monitoring unit via two-wired bidirectional RS-485 interface, which assures the possibility to transmit diagnostic information on monitored circuits.

See details in our site www.imp.lg.ua.



Insulation resistance monitoring units

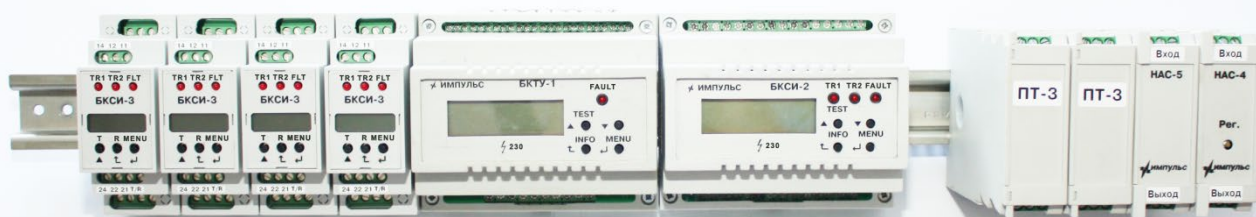
Use of insulation monitoring devices is regulated with Electrical Installation Regulations (PUE).

The **BKSI-2, BKSI-3 insulation resistance monitoring units** are designated for automatic monitoring and online indication of electric insulation resistance in AC and DC electric networks with leak capacities of a measured circuit:

- BKSI-2 – up to 500 μF (divided circuits);
- BKSI-3 – up to 20 μF (linear circuits).

They have two adjustable resistance thresholds. As a control point for each threshold is achieved, independent discrete signals of “dry” contact type are generated, the signals are accompanied with a light signal. BKSI-2 has output to an RS-485 interface.

See details in our site www.imp.lg.ua.



Normalizers of analog signals

The normalizers of analog signals are devices to convert voltage signals into a proportional normalized current signal (4-20 mA).



Microprocessor converters for phase-sensitive track circuits

The PChT-2 and PChT-3 frequency converters are designated to power track circuits with phase-sensitive receivers with current 25 Hz. PChT-2 is designated to power circuits 110 (115) V, PChT-3 – to power circuits 220 (230) V. The converters have been developed to replace obsolete PCh-50/25 ferroresonant converters.

Key characteristics

- mass-dimensional parameters of devices have been reduced more than twice;
- phasers have been excluded from the power supply scheme of RC;
- a built-in function of synchronization of a group of devices (master/slave mode);
- a phase-shift angle is changed with one button pressing, possible phase-shift angles are 0, 90, 180, and 270 °;
- online indication of supply voltage and a phase-shift angle on each converter;

Based on these converters a modern panel of converters is composed (a functional analog of PP25.1) exceeding analogs by several main characteristics:

- coefficient of efficiency – 90 % (coefficient of efficiency of an analog is less than 50 %);
- one panel assures power supply of phase-sensitive track circuits of a large station up to 120 conventional switches;
- self-diagnostics and continuous monitoring of state of insulation of cable networks indicating a problem section.



SIGNALLING SOFTWARE AND HARDWARE

PS5150 industrial workstations

The PS5150 project-arranged industrial computers – serial products by SRPA “Impulse” used in railway automation systems and other critical facilities.

The PS5150 workstations are used as ARM-C DSP, ARM-C ShN SKD, ARM KPF, operator equipment, servers, gateways, etc.

Composition of PS5150

- processor modules (based on compact computers) with different versions:
 - Intel Atom/Core i5/i7 processors;
 - random-access memory – up to 16 GB DDR3;
 - read-only memory – SSD not less than 120 GB;
 - Ethernet controllers – not less than two 100/1000Base-TX;
 - video interfaces – HDMI, Display Port, DVI, VGA (up to three independent video outputs);
 - USB 3.0 and USB 2.0 ports, COM-ports, audio output;
- power supply equipment:
 - uninterruptible power supply devices with the possibility to be installed onto a panel or into a structural element 19”;
 - network filters;
 - an emergency backup actuation device;
- display devices:
 - a video wall;
 - wide-format monitors;
 - operator consoles;



- network equipment:
 - switchboards (with the possibility to be installed onto a din rail or into a structural element 19");
 - "copper"- "optics" media converters;
 - SHDSL modems;
 - Ethernet/SHDSL network protection filters;
 - fibre optic crosses;
- operator equipment:
 - keyboards to be located on a table or to be installed in a rack 19";
 - a "mouse" manipulator;
 - column speakers;
- structural elements:
 - a table;
 - a pedestal and a corner pedestal;
 - a pedestal cabinet.



Key characteristics

- built based on fanless compact computers and highly reliable industry-standard components;
- highly resistant to:
 - electromagnetic effects;
 - power supply network parameter changes;
 - environmental factors;
 - mechanical effects;
 - corrosion;
 - dust;
- designated for continuous operation (24×7);
- possibility of universal use in signalling.

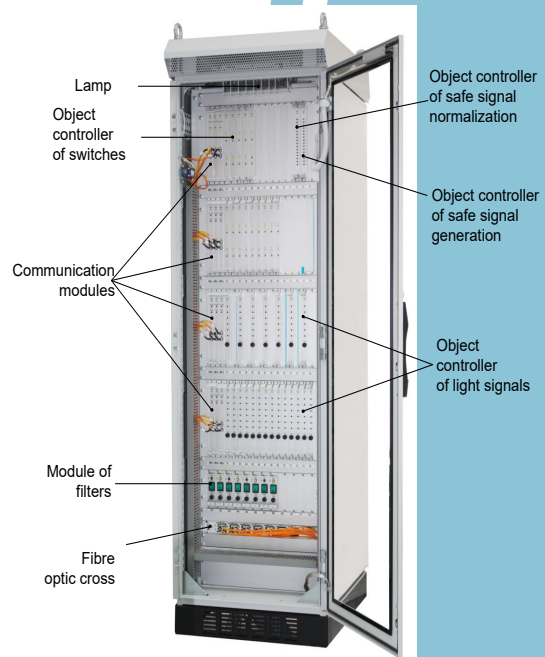
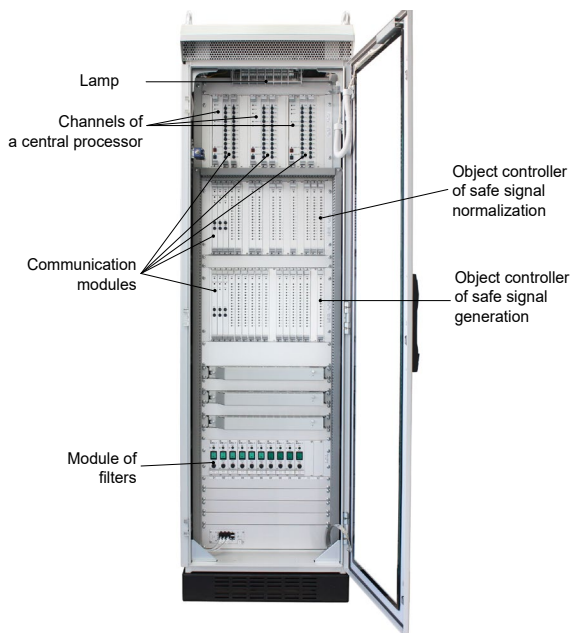
ShKiU monitoring and control cabinets

Are the basic component of signalling.

Have modular structure, assure the possibility to develop signalling systems (MPC-U, MAB-U, MPAB-U, etc.) as technically completed items (cabinets).

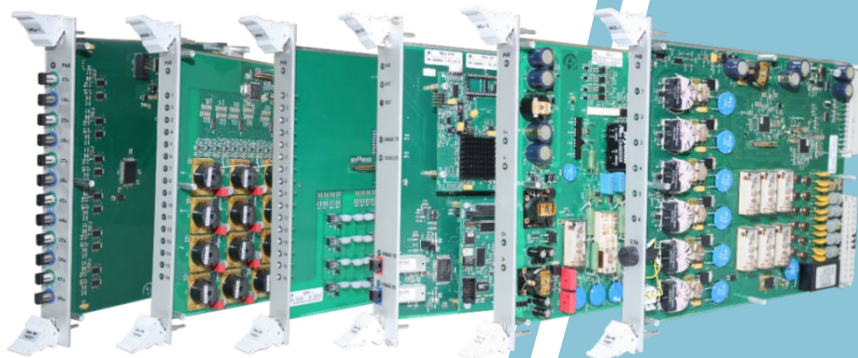
There two versions of ShKiU:

- with a safe central processor operating by the “2oo3d” scheme (majorizing with diagnosing) and object controllers operating by the “2oo2d” principle (redundancy with diagnosing);
- without a central processor, with object controllers.



ShKiU with a central processor

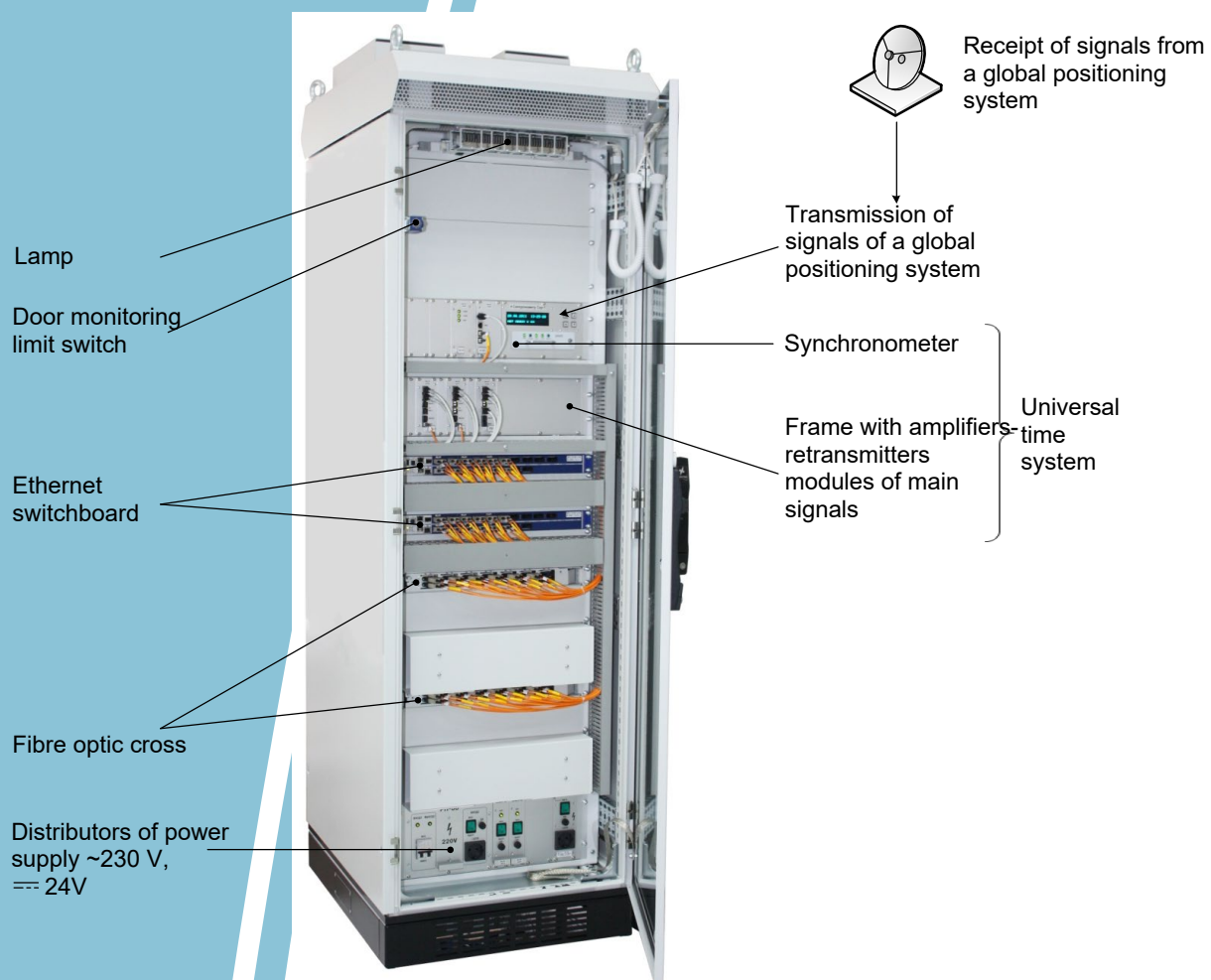
ShKiU without a central processor



ShS-5 coupling cabinet

Functions:

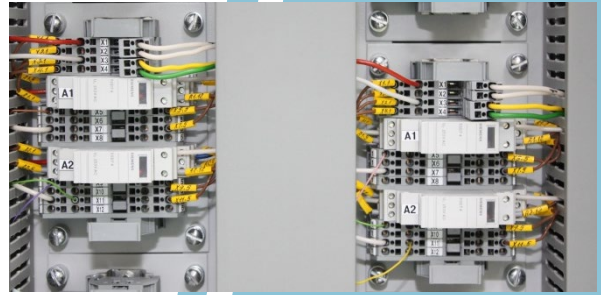
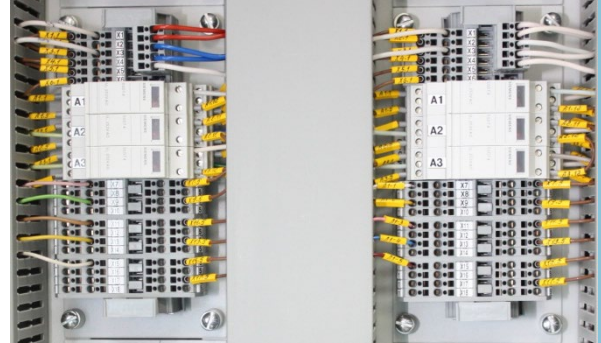
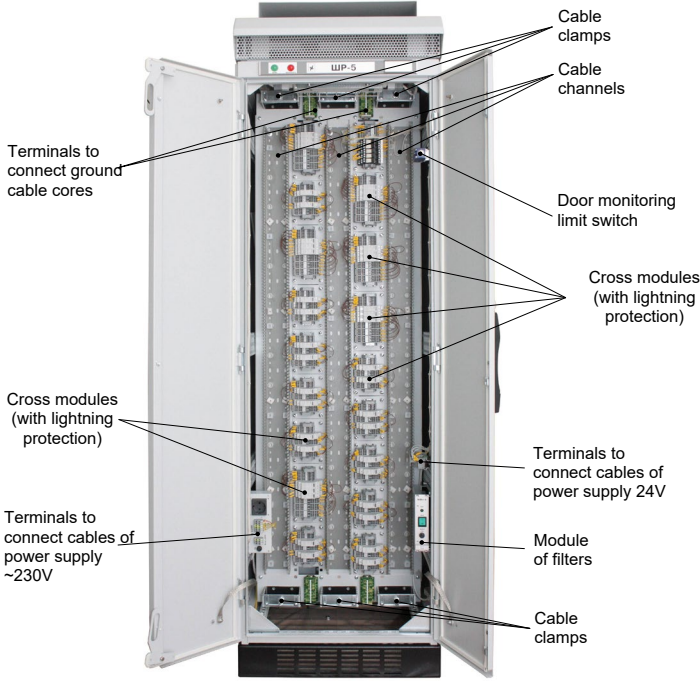
- assuring communication between signalling subsystems;
- implementing communication of signalling with external systems;
- receiving standard time signals and transmitting them to signalling subsystems.



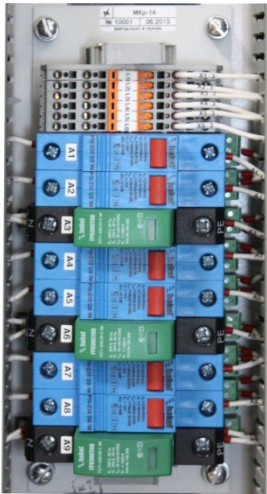
ShS-5 coupling cabinet

ShR-5 distribution cabinet

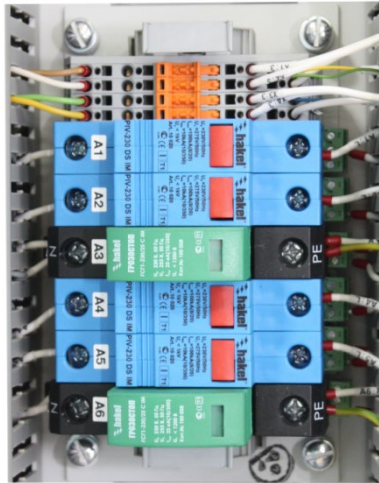
The distribution cabinet ShR-5 assures connection of signalling to the field equipment using cross modules.



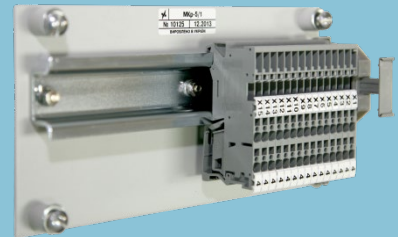
ShR-5 distribution cabinet



MKr-14 cross module
(lightning protection module for three channels, the first class of protection)



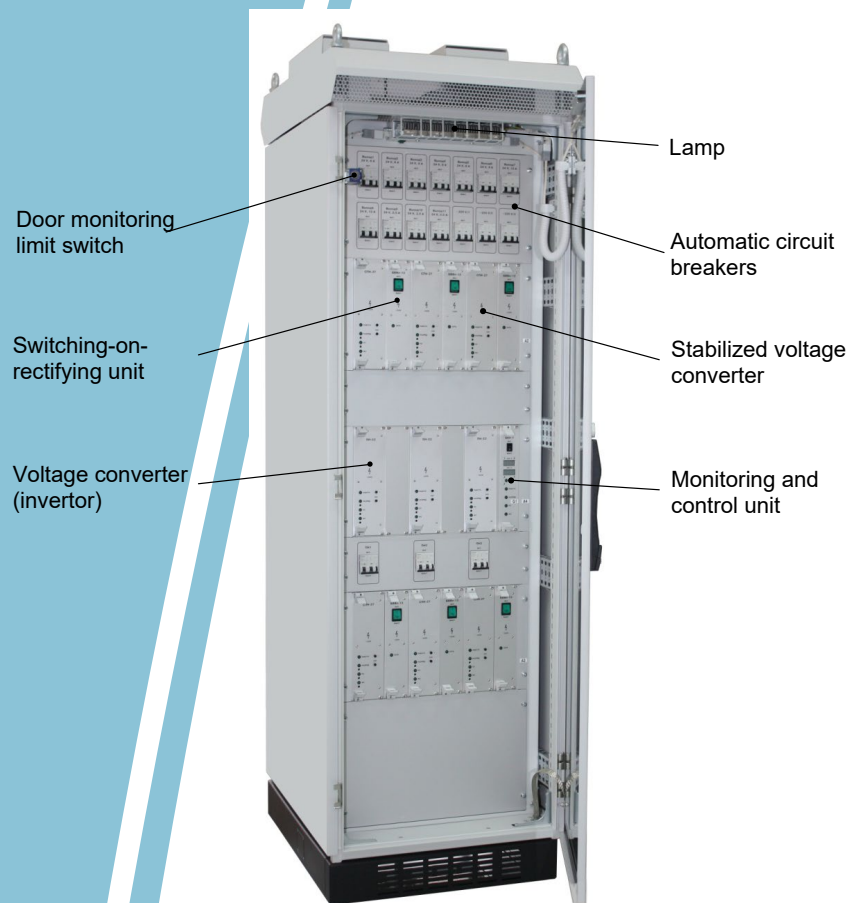
MKr-13 cross module
(lightning protection module for two channels, the first class of protection)



Location of MKr
on a DIN rail

ShGPL-1 guaranteed power supply cabinet

Provides signalling components (cabinets, workstations, etc.) with guaranteed power supply with single-phase alternating voltage ~ 220 V and direct voltage 24 V (from an accumulator battery). Contains three voltage converters 380/220 V with output guaranteed power supply ~ 220 V.



ShGPL-1 guaranteed power supply cabinet

SIGNALLING SOFTWARE

Basic software (SW)

Basic functional SW

Basic functional SW is a library of standard program modules (algorithmic blocks), each of which implementing one safety instrumentation and control function for one specific type of track equipment (switch control, control of signal lamp filaments, relay control, etc.).

Standard program modules have been developed with a specialized technological programming language based on structured and protective programming principles in accordance with the IEC 61131 standard. The library can be supplemented with new modules.

Basic SW of human-machine interface (HMI)

Basic SW of HMI is a set of completed groups of standard program modules. Each of the groups implements one function assuring operation of an operator or a technician.

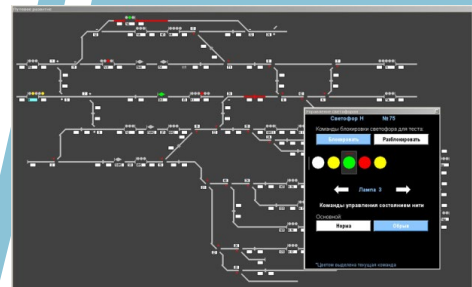
Basic SW of HMI includes development programs to prepare configuration files of application SW of HMI, to create new standard visual components of track equipment, to prepare installation of application SW of HMI. Basic SW of HMI can be supplemented with standard program modules with new functions.



Program interface between an object level and a logical instrumentation and control level

The safe program interface executes the following:

- automatic adjustment to a specific configuration of object controllers;
- message exchange between object controllers and channels of a safe central processor;
- monitoring of reliability of received messages and their acceptability according to settings;
- diagnostics of interface hardware.



Data transmission reliability is assured due to: checksumming, identifying data sources and receivers, identifying data types.

Program interface between a logical instrumentation and control level and a human-machine level

The program interface is implemented using a specially developed information exchange network protocol (TCP/IP is not used).

The program interface carries out the following:

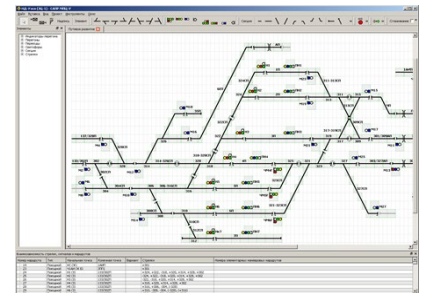
- automatic adjustment of network configuration;
- message exchange between network abonents;
- monitoring of reliability of received messages and their acceptability according to settings;
- diagnostics of interface hardware.

The program interface assures data transmission reliability due to: checksumming, identifying data sources and receivers, identifying data types, transmitting simultaneously via two delivery routes.

Development of application SW

Application functional SW and application SW of HMI are developed for each specific signalling application according to the principle “configuring basic SW based on application specific data and algorithms” (EN 50128).

Application SW is developed using graphic computer-aided design tools.



Safety of SW

Safety of SW is assured with the following factors:

- own-developed BIOS is used for basic functional SW;
- an own LINUX-similar operating system is used for basic SW of HMI;
- all peripheral ports are closed (“incidental” contamination hazard is eliminated);
- a closed corporate protocol (without TCP/IP) is used;
- absence of sporadic exchanges (only deterministic arrivals);
- communications with external systems are implemented via autonomous gateways with a firewall function;
- two diverse application SW sets developed with different technological programming languages:
 - with the YARUS language;
 - with the CoDeSys language.

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