

SIGNALLING & CONTROL

Company for engineering "Signalling & Control" Ltd.
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ELECTRONIC MMI SYSTEM

EMMI – Electronic Man Machine Interface system represents the system which enables interactive communication between man (operator) and system which is under control and monitoring.

EMMI system is mainly dedicated to the control and monitoring of the relay-based railway interlocking systems (Siemens, Westinghouse, etc.).

EMMI system can, also, be used for the control and monitoring of similar systems in other industrial fields (energetic, tele-communications, water supply, mining, etc.).

EMMI system consists of two main subsystems:

- Operator's System and
- Interface System.

OPERATER'S SYSTEM

Operator's System completely replaces conventional control-indication panel and it has additional functions supporting registration of events, service and diagnostic (Figure 1).

Operator's System places at operator's room (signalman room). It is used by the operator for issuing controls to the system and getting visual indications about system's state in the real time. Operator's System, besides visual indications, provides also appropriate acoustic signals to the operator.

Operator's System memorises on the hard disc all commands and indications (regular events, disruptions and faults) in the chronological order. Stats of the counters are also recorded and memorised. All records are available to the authorised personnel for the analyses and printing.



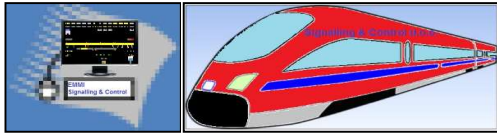
Figure 1: Operator's part of EMMI system.

Operator's System consists of hardware and software. Hardware of the Operator's System contains following parts:

- Personal computer – PC with keyboard, optical mouse and speakers, as well as, with PROFIBUS card that enables communication with Interface System. UPS can be additionally used (on request).
- Two (up to maximum four) TFT monitors.
- Laser printer.

Hardware of the Operator's System contains standardised computer components, produced by known manufacturers. Technical characteristics of the components are conformed to relevant European standards. The components are commercially available on the local market and therefore, supply of spare parts and maintenance are easier.

Operator's System, in essence, represents standard professional PC computer, which is equipped with standard PROFIBUS PC card in the aim to make communication on the industrial PROFIBUS standard possible.



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Software of the Operator's System consists of the following main parts:

- Standard operating system for PC computer – Microsoft Windows XP, SP2.
- Standard system software SCADA, for receiving controls, generating indications and making communication with the Interface System - Siemens WinCC.
- Common application software for generation of graphical symbols for the screen layout (library of symbols), connection of the symbols to the input-output data from Interface System and realisation of the control-monitoring functions. (Remark: This software is practically unchangeable for territory of one railway administration).
- Common application software for memorising of regular events (controls and changes of the states of the elements), disruptions and faults, with permanent display on the maintenance monitor's screen, with possibility for authorised personnel to do searches, printing and recording of selected events to appropriate medium (USB flash disc, with the password protected access to the PC). Complete event library is also available to the authorised personnel on the hard disc of PC. (**Remark:** This software is practically unchangeable for territory of one railway administration).
- Application software for generating concrete screen layout for one application (signalling arrangements of the railway. In the range of the available functions within WinCC SCADA software, the symbols get named and distributed along the screen in the aim to form appropriate picture.

Operator's System is designed in accordance with the customer requirements. User defines procedure and way of command, list of the symbols to be displayed on the screen, as well as, requirements for the recording of the events. On these bases, common application software gets developed (within the range of the available functions in the WinCC SCADA software) and tested in the aim to be accepted by the customer for the first application. After initial acceptance, this software becomes, by the rule, generally applicable for all other applications on the territory of that particular customer. On this manner, high level of standardisation is achieved, contributing to the significant reduction of design and testing efforts for consecutive applications.

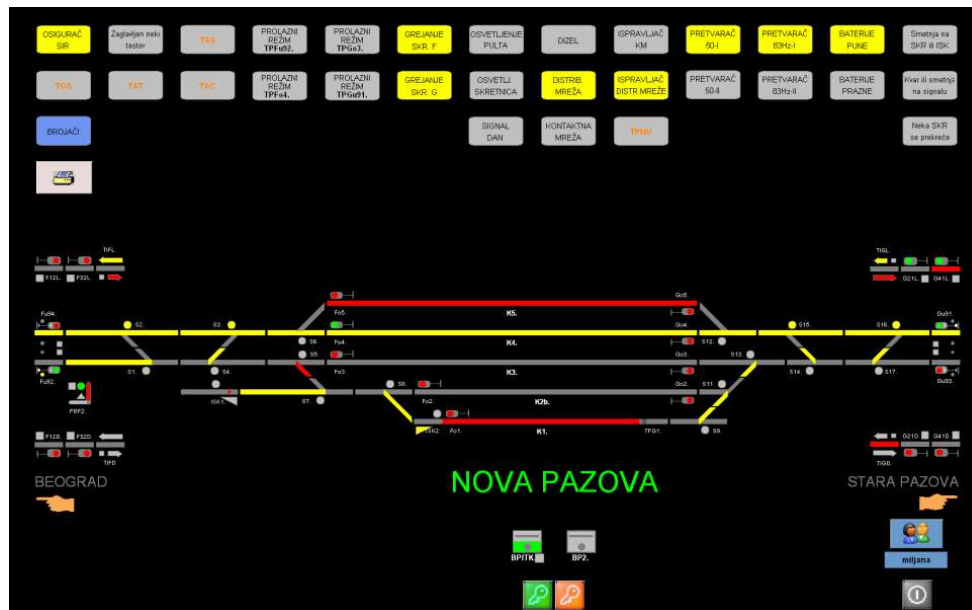
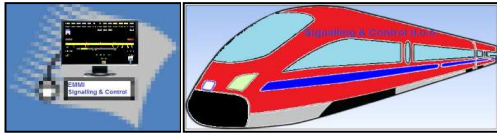


Figure 2: An example of the track layout on the monitor of the EMMI system

For every consecutive application user shall define only the screen layout (signaling arrangements of the railway station). Design is then reduced to the arrangement of the elements from the library to form required layout and configuration of the inputs and outputs of the Interface System. Accuracy of the screen layout and correspondence of the inputs and outputs from the Interface System to the indications fields of elements gets proved by testing. This way provides fast and efficient realization of the system for every concrete application.





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Second monitor serves for display of registries events and support of its search and printing. It is divided in four parts (commands, disruptions, faults and regular events.).

INTERFACE SYSTEM

Interface System (Figure 3.) serves to connect controlled system (interlocking system of railway station) to the Operator's System, i.e. operator. Interface System collects information about the state of the controlled system and transmits it to the Operator's System. Also, the Interface System receives controls from the Operator's System and using miniature interface relays transmits the commands to the controlled system.

Interface System consists of hardware and software. Hardware of the Interface System contains following main parts:

- Processor is from Simatic S7-300 (Siemens) family with PROFIBUS communication interface.
- Appropriate number of input – output modules of Simatic S7-300 (Siemens) type.
- Miniature relays for realisation of the command interface.
- Disconnectable terminals for connection of the indications.
- Power supply with battery.
- Enclosure for the placement of the equipment of the Interface System.

Hardware of the Interface System contains standardised components of the known manufacturers. Technical characteristics of the components are conformed to relevant European standards. The components are commercially available on the local market and therefore, supply of spare parts and maintenance are easier.

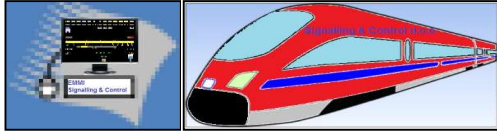
Manufacturing of the Interface System consists of arrangement, assembling and wiring of the standardized modules and components in accordance with the installation project for each particular application. Installation project is also, in big extend, standardised due to similar architecture of the designed systems and standardised components and modules, which number depends on the track layout of the particular application.

Software of the Interface System is based on the standardised software package Simatic S7 (Siemens), which is standardised for the industrial application.

Software of the Interface System contains the following parts:

- System software SIMATIC S7 (Siemens).
- System software for communication with WinCC SCADA system of Operator's System.
- Common application software for collection of the input data from the interlocking system, selection by the element types and transfer to the Operator's System in the aim of generating: indication on the screen, acoustic signals and records. (**Remark:** This software is practically unchangeable for territory of one railway administration.).
- Common application software for processing of the command received from Operator's System, selection of the appropriate element and activation of the appropriate miniature interface relay. (**Remark:** This software is practically unchangeable for territory of one railway administration.).
- Application software for configuration of the concrete application, which anticipates determination of the number of elements and order of their connections to the inputs and outputs of the Interface System in the aim to provide appropriate indications on the screen of the Operator's System.

Common application software gets tested and accepted by the customer for first application and afterwards becomes common for that railway administration. This software is based on the typical arrangement of the signals for every type of the element and practically ensures that all signals of one type of element get processed and transmitted within the Interface System on the same way. Also, by physical connection of the element to the Interface System, it is directly defined its connection with the appropriate symbol on the screen of the Operator's System. Testing of the EMMI for concrete application is, therefore, reduced to checking of the accurate connections of the signals to the Interface System, i.e. to the correspondence between elements of the interlocking and element on the screen. This provides high level of standardisation, which contributes to the significant reduction of the efforts on the design and testing of the concrete applications.



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Border between Interface System and controlled equipment (relay interlocking system) is existing main termination rack with terminals, which are used for connection with the conventional control-indication panel.

Appropriate terminals from main termination rack of the relay interlocking system get connected to the disconnection terminals of the Interface System of the EMMI via cables or individual conductors, as appropriate. Detailed design of the connections (indications and commands) is defined in the Installation project for every concrete application.



Figure 3. Layout of the Interface System with the arrangement of the equipment.

ADDITIONAL POSSIBILITIES

Additional TFT monitor can be used at the relay room, next to the Interface System, to provide screen layout of the signalling arrangements (the same as for the signalman) for the maintenance personnel.

Additional Operator's System with complete functionality (as a reserve working place) can be provided if required. This would allow for the fast change from the failed Operator's System to the reserve one for the application with the high availability demands.