

SIGNALLING & CONTROL

Company for engineering "Signalling & Control" Ltd.
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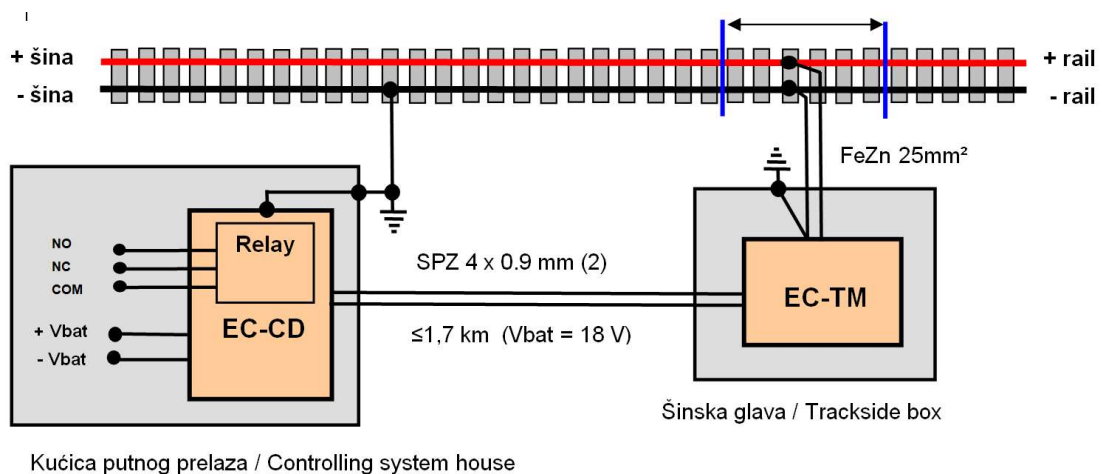
ERC - ELEKTRONIC RAIL CONTACT

ERC – Electronic Rail Contact represents an electronic device, which allows punctual detection of railway vehicles on the controlled portion of tracks. ERC consists of two separate electronic functional modules: **Track module (EC-TM)**, which places into the trackside box next to the rails and **Detector (EC-CD)**, which places into the equipment house of the controlling system. Track module is realised in two basic types, which differ by the nominal working frequency: **Type 1 – 40 kHz** and **Type 2 – 58 kHz**. Other types of track modules, with nominal frequency in the range from 5 kHz to 100 kHz, can be realised on request.

Mainly, it is dedicated for the replacement of the MRC – Magnetic Rail Contact, which is used in the relay-based interlocking systems SpDrS-XX (Siemens) or similar. It can be used as 80-ty meters contact, switch-on contact for level crossings, switch-off contact for level crossings, as well as, for the other applications where punctual, i.e. short distance detection of railway vehicle is required (audiofrequency track circuit).

As an electronic device, in the aim of use in 2 out of 2 configuration (duplication for safety) the ERC is realized in two types, which differ by the working frequency. The ERC, in 2 out of 2 configuration, can be used for the replacement of a pair of switch-on or switch-off MRCs inside the level crossing systems.

Minimalan opseg detekcije / Minimum detection range $\leq 20\text{m}$



Block diagram of the ERC with the layout of typical cabling and connections to the track.

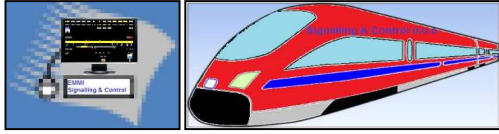


Layout of the Detector.



Layout of the Rail Module and the Trackside Box.





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COMMON TECHNICAL CHARACTERISTICS OF THE ERC

1. Nominal power supply voltage: 18 V DC.
2. Power supply voltage tolerances: $\pm 15\%$.
3. Temperature working range from: $-40\text{ }^{\circ}\text{C}$ to $85\text{ }^{\circ}\text{C}$.
4. Maximum line resistance (cable): 100 Ω .
5. Connection cable between rail module and detector:
 - SPZ 4 x 0.9 (2 wires are used);
 - SPZ 4 x 1.4 (2 wires are used).

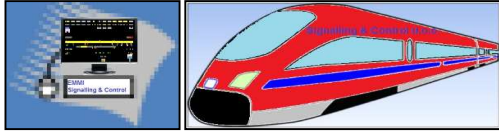
Comment: it is possible to use other types of cables, retaining the appropriate characteristics.
6. Maximum distance between rail module and detector:
 - over 2 wires of cable SPZ 4 x 0.9 (loop) 1,7 km;
 - over 2 wires of cable SPZ 4 x 1.4 (loop) 3,8 km.
7. Application possibilities:
 - single – type 1 or type 2 are used separately;
 - 2 out of 2 – both types are used together at the same place (duplication for safety).
8. Minimum railway vehicle detection range up to ± 10 m (adjustable, depends on the adjustment of the detection level on the sight, and practically is not influenced by the characteristics of the ballast and environmental conditions-wetness due to the application of the low voltage and the high frequency signal. Comment: it is assumed that both quality of the track impedance and resistances of the axles are in compliances with the railway rules).
9. Maximum speed of the railway vehicle:
 - due to the adjustable minimum detection range, ERC is suitable for all speeds of the railway vehicles.
10. Protection:
 - overvoltage protection (varistor + gas arrestor) is integrated inside the module;
 - current and voltage protection from the overload are integrated inside the module (fuse, diode and zener diode).

RAIL MODULE

ERC works on principle of detecting changes of the track impedance, which is caused by the axles of the train approaching to the connection point of the track module to the rails.

Track module is an electronic module, which is placed on the appropriate printed circuits board (EC-TM). It is placed in the metal made housing (aluminium or still sheet) of typical size of 120 mm x 103 mm x 53 mm. When an application requires 2 out of 2 configuration, both track modules (type 1 and type 2) are placed in the same housing. Layout of the track module in the typical housing is presented in Figure 2. Housing protects the track module from the environmental influences, as well as from the electromagnetic and electrostatic fields. The external connections are available by 4 wire cable via cable entry hole (2 wires for power supply and 2 wires for rail connections). The wires are clearly marked to allow proper connections to the trackside box terminals.





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Track module is placed in the trackside box, which is partly buried in the ballast, on the appropriate distance from the track centre. Trackside box is earthed for the minus rail (return current for the catenaries). Every track module connects to the rails by a pair of the FeZn connection robes ($2 \times 25 \text{ mm}^2$). They are fastened to the sleepers and connections to the rail are made by welding to the rail foot or by drilling the rail neck.

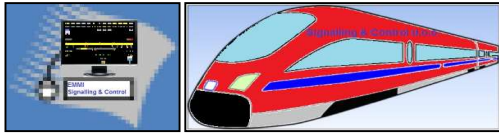
Signal of low voltage and high frequency goes to the rails (40 kHz and/or 58 kHz). Transmission of the signal along the rails is therefore limited. As a result, the detection range is narrow, i.e. practically punctual (minimum detection range up to 20 m). Also, the influences of the track impedance quality and whether conditions to the resistance of the connection point of track module are reduced. Hence, the stability of the detection for all whether conditions and bed track conditions is increased.

Track module directly detects change of the track connection point impedance and transmits it to the detector via change of the DC current which supplies the track module. Detector makes decision whether the railway vehicle is present in the vicinity of the track module or not, based on the current change. The decision is possible by the preset borders. The borders are used for the detection of the approaching train and also for the case when the track module is not connected to the rails (disconnection from the rails). Detector contains power free changeable relay contact to give the information free/occupied for the monitored portion of the track.

TECHNICAL CHARACTERISTICS OF THE RAIL MODULE

- Working frequency:
 - type 1 – 40 kHz;
 - type 2 – 58 kHz.
- Accuracy of the working frequency on 25°C : $\pm 0,5 \%$.
- Working frequency temperature stability: 3 % (in the all temperature range).
- Maximum power consumption: 1,2 W.
- Fuse for the power supply: 63 mA (middle).
- Maximum power supply current of rail module (short connection on the track): 50 mA.
- Output voltage of rail module to the rails: 0V AC – 4,5V AC (0 do 50 Ω).
- Maximum output power to the rails: 0,5 VA (0 do 50 Ω).
- Equipment box:
 - aluminium or still sheet thickness: 1,5 mm – 2 mm;
 - size: length 120 mm; with 103 mm; height 53 mm.
- The installation:
 - trackside: ERC delivers typically with the standard trackside box (IP65), which is made from the still sheets and places into the ballast at the prescribed distance from the rails;
 - equipment room, option: on standard DIN rail inside the metal enclosure of the controlling equipment, which is placed at the level crossing hut. Comment: in this case connection to the rails is done via standard trackside cable/track box;
 - trackside box, or the metal enclosure, at the same time protects from the electromagnetic influences and the radiation.
- Connection of the trackside head/box to the rails:
 - Standard FeZn multiwires robes $2 \times 25 \text{ mm}^2$ for connection on + rail and – rail.
 - Comment: on electrified lines trackside had/box has to be connected to the grounding, i.e. – rail by the standard means with the FeZn multiwire robe of prescribed thickness.





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DETECTOR MODULE

ERC detector works on the principle of detecting changes of the direct current, which is used for the power supply of the track module. It has two detection levels, up and down, forming the detection "window". Detected signal, when the track is free (no presence of the railway vehicle) has to be between the up and down level, means free track in the nominal working regime. If the detected signal rises over the up level, it means that the train presence is detected (occupancy), and that information is available via changeable contact of the detector relay. If the detected signal lowers below the down level, it means that one of the connection robes is disconnected, i.e. the rail module is disconnected from the rails. This has the same meaning as the presence of the railway vehicle on the track (occupancy) and it is also indicated via changeable relay contact of the detector.

TECHNICAL CHARACTERISTICS OF THE DETECTOR MODULE

1. Maximum power supply: 1,2 W.
2. Fuse for power supply: 63 mA (middle).
3. Box:
 - plastic box for placement on standard DIN rail;
 - typical size: length 86 mm; with 35 mm; high 57 mm.
4. The installation:
 - equipment room: on standard DIN rail in the house for the controlling systems or in the equipment boxes (special applications);
 - trackside: in standard trackside box (IP65), placed into the ballast at the prescribed distance from the rails.
5. Connections on the box:
 - two disconnectable 5 pins connectors (PCB + cable side).
6. Diagnostic:
 - LED red 5 mm – alighted when detection relay of ERC is energized (placed on the front side of the detector equipment box).
7. Characteristics of the detector's relay:
 - number of switching: 10^9 (mechanical); 5×10^7 (12 V, 10 mA);
 - maximum switching current: 1 A;
 - maximum pick up time: 2 ms;
 - maximum drop away time: 2 ms;
 - maximum number of switching (load free): 200 in second;
 - relay contact are of high quality, made from mixture of palladium and nickel and covered by mixture of gold and rhodium;
 - Insulation is realised in accordance with IEC / EN 60 950.
8. Protection of the electromagnetic interferences and radiation:
 - detectors are placed into the protective metal box made from the still sheets (typically one box for six – two double switch-on and one double switch-off ERC). The detectors are connected with the level crossing equipment by the shielded cables, which passing through the cable entry hols. The box is earthed to the earthling of the level crossing hut.

ADVANTAGES OF THE ERC

ERC offers advantages against MRC and the other types of the detection equipment, which are fastened to the rails (for example, inductive based sensors), due to the trackside installation into the ballast (standard trackside rail box). Hence, no need for its removal from the rails during the maintenance activities. ERC has a small size and its installation, handling and maintenance are very simple. Practically, it does not require any adjustments on the sight, except the detection range, as all parameters are already adjusted in factory.

