Abstract
The application of state of the art track circuits is getting more and more popular on the Polish tramway infrastructure. The electromagnetic interference between traction return current and track circuits has become significant not only in the railways. The paper describes implementation of modern track circuits in the Polish tramway infrastructure and related electromagnetic issues. The on-site survey and proper measurements were performed to identify the electromagnetic interference problems. Authors conducted the analysis concerning the track circuit application in the tramway infrastructure, presenting its weaknesses that influence safety and reliability of the system.

Introduction
Electric traction vehicles are equipped with power electronics equipment for traction and non-traction purposes. Power electronics systems enable smooth determination of traction characteristics depending on a set duty-cycle of motion. Structure of modern converters consists of semiconductors, typically IGBT, which apart from many advantages, posses a range of drawbacks - there are sources of electromagnetic noise. The latter makes the requirement of the electromagnetic compatibility (EMC) provision.

In typical electric traction systems, running rails (RR) are operating as return conductors as well. As a result, the vehicle's input current flows not only in an overhead catenary (or 3rd rail) but also in the running rails. It could be expected though, that current harmonics flow in the RR, could be the reason of EMC issues.

Conclusions
Appropriate interpretation of the measurement results requires further attention. According to the enclosed diagrams (Fig. 2+6), it could be stated that the tram might be the source of interference causing the track circuits failures. The current flowing in the tram's electrical circuits contained the higher frequencies components overlapped with the frequencies utilized by the applied signaling systems. Furthermore, these could be also seen in the magnetic field emission in the vehicle’s surroundings.

However, the above mentioned results are not sufficient reasons to state that the tram is the source of EMI in the infrastructure. Fortunately, prolonged works and cooperation of the tram inverter and track circuits manufactures with infrastructure operator and ETD were successful and the disturbances were eliminated. The slight changes were applied in the tramway electronic circuit (filters and electrical bonding improvement) and in the area of disturbed infrastructure (earthing and bonding analysis).

The main aim of this paper was not to present how to solve the problem of track circuit failures in the tramway infrastructure, but to emphasize the issue of insufficient preparation of signaling system implementation at such infrastructure. Issues related to EMI are complex and have to be analysed not only by infrastructure operators and manufactures of traction power electronics systems or track circuits, but also by appropriate institutions that will be responsible for developing specifications, standards and guidelines. Only after complete and comprehensive preparation of the overall system, the interfaces of all of the traction subsystems will be electromagnetically compatible and safe.

References


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