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Impact of the electromagnetic field on a measuring system of a light electric vehicle

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ABSTRACT: *In the paper, a laboratory test stand created especially for research of a light electric vehicle designed by students of the Silesian University of Technology and the impact of electromagnetic interference on a measuring system of a light electric vehicle are discussed. The laboratory test stand is used to test and measure the characteristics of vehicles. The article contains a description how the test stand works and shows its versatility in many areas. In the paper, sample results of conducted research is discussed. The investigations of electromagnetic interference showed the possibility of significant minimization of this interference.*

KEYWORDS: *electromagnetic field, interference electromagnetic, laboratory test, light electric vehicle, measurement system*

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I. INTRODUCTION

A light electric vehicle and a measurement system is designed and constructed by students the Silesian Greenpower. This project is students project realized at the Silesian University of Technology. The aim of the project is to build the light electric vehicle to start in annual racing series held in the UK. The main goal of the race is to go as many laps as possible in one hour. This light electric car is equipped with the same batteries and the same 240W DC motor in time the race. Therefore, for performance improvement of the vehicle and is associated with a personalized measuring system. One of the crucial elements of the light electric vehicle being studies is a DC motor. The research caused to excluding the worse motors from use [1].

The impact of the electromagnetic filed on electrical and electronic devices is increasingly becoming the subject of consideration of scientific circles [2], it is due to the development of the technology. Development has caused an increase in the level of electromagnetic field intensity. So there is a need to investigate of electromagnetic interference and to show ways to reduce them, because the increase in the level of the electromagnetic field intensity has a negative affects surroundings and devices electric and electronics.

The laboratory test stand created especially for research of the light electric vehicle designed by students of the Silesian University of Technology and the impact of electromagnetic interference on a measuring system of a light electric vehicle are discussed [3]. The attention was paid to the need of reducing electromagnetic interference.

Moreover, the possibility of reducing the electromagnetic interference of the tested torque sensor used in light electric vehicles designed by students of the Silesian University of Technology [3] within the Silesian Greenpower project is discussed. The results of investigations are presented in the paper as well. The investigations were performed on a stationary test stand designed by students of the Silesian University of Technology [4]. In the paper, results the analysis carried out on the laboratory test stand is presented [5].

The aim of the investigation is to increase the efficiency of measuring systems of designed light electric vehicles and to reduce the interference, that can negatively affect the measurement process (tests were carried out in the real time), while driving the light electric vehicle. The research was conducted on the laboratory test stand which was designed to keep conditions as close as possible to those on the race.

In the vehicle applies the measurement system, which was created by the team of Silesian Greenpower. The application of the measuring system allows the preview of the actual state of the vehicle and saving of the measurement data on a memory card. This can be used the analysis the course of the race, and then the results can be confronted with it was carried out the simulations.

II. MEASURING SYSTEM

The use of the measuring system in the light electric car has many benefits, because there are the possibilities of using of the measurement data of the light electric vehicle. This system processes the raw data from the sensors. Then it converts them into the appropriate values expressed in physical units, which these date can be used for analysis and simulation on the laboratory test stand.

Fig. 1 shows a schematic diagram of the laboratory testing stand. Engine 2 is of the same kind as the engine 1 but they are rotating in opposite directions.

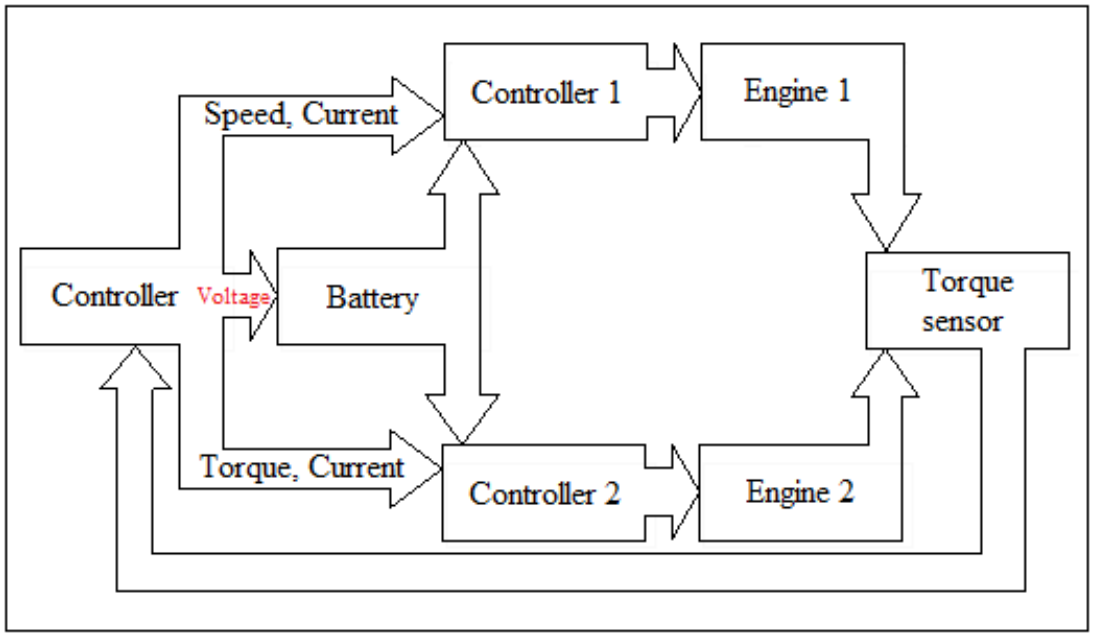

Figure 1. Schematic diagram of the laboratory testing stand

Fig. 2 shows the light electric vehicle designed by students of the Silesian University of Technology.

Figure 2. The light electric vehicle

III. REDUCING THE IMPACT OF THE ELECTROMAGNETIC INTERFERENCE

There are many possibilities to reduce the impact of the electromagnetic field interference. The research conducted on the laboratory test stand focused mainly on using: a protective housing (the protective housing is made of a conductive material) and ferrite beads (these elements are made of ferrite materials). These elements can to increase the functionality of the designed measuring system for the light electric car.

Main parameters i.e.:

- current,
- torque,
- energy consumption,
- speed.

Several parameters were always equal:

- initial battery
- voltage supply,
- ambient temperature,
- measurement time.

In order to maintain comparable conditions during tests.

The multitude of shielding materials is huge, there are many solutions to limit the impact of harmful interference electromagnetic field on devices. But the material was used for the construction of the protective housing is a copper (the protective housing has been grounded).

A shielding housing uses to the protect electrical circuit components and electronic devices against harmful interference. This element uses to eliminate unwanted interference on measurement results.

Ferrite bead prevents electromagnetic interference in two directions: from a device or to a device. These elements are used to filter electromagnetic interference. Beads are used as low pass filters to eliminate high frequency noise while allowing low frequency signals or DC current to pass through a circuit. A characteristic feature is a high electrical resistance and low saturation induction (it results from the construction this element). Ferrite beads are required for regulatory compliance, to reduce electromagnetic interference (a conductive cable acts as an antenna). These elements prevent the cable from acting as an antenna and receiving interference from these other devices (the particularly common on data cables).

IV. LABORATORY TEST ON A STATIONARY STAND

The main aim of the laboratory test stand is to provide racing conditions. Components tested on the laboratory test stand are particularly: 240W motor DC, two batteries, a high beam current, a motor controller, measurement system, many transducers and a protective housing. This protective housing is the element that it has reduce the impact of the electromagnetic field.

The components participating in the motion simulation of the vehicle include mechanical but also electronic components cooperating with the control and measurement software. These electronic components permit to simulate racing conditions properly, which is mainly to provide calculated load [3].

The measurement-control software works with controllers manufactured by the National Instruments. A multitude of analog and digital inputs and outputs allows to provide highly advanced test stand. Fig. 3 shows the measurement-control panel. This panel is allowing for visualization of tests on the laboratory testing stand.

An application used on the laboratory testing stand was written in the LabVIEW programming environment by the students Silesian Greenpower. The measurement environment permit creating measurement-control software for complex and fast-changing processes, which includes controlling of the laboratory test stand elements.

The impact of electromagnetic field is caused on the stationary testing stand. Fig. 4 shows the laboratory testing stand, which it is used in the time the investigation, where the torque sensor, used on the laboratory test stand is clearly visible.

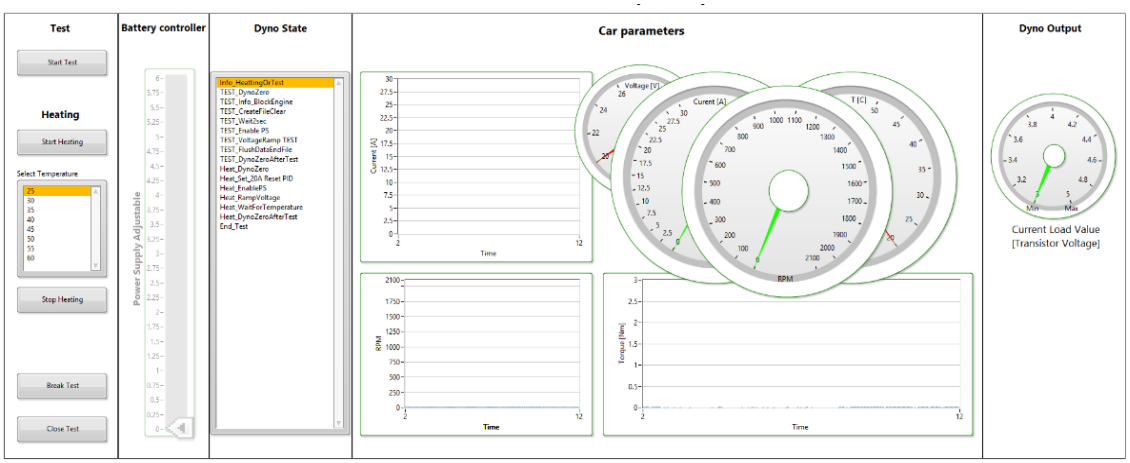

Figure 3. The measurement-control panel

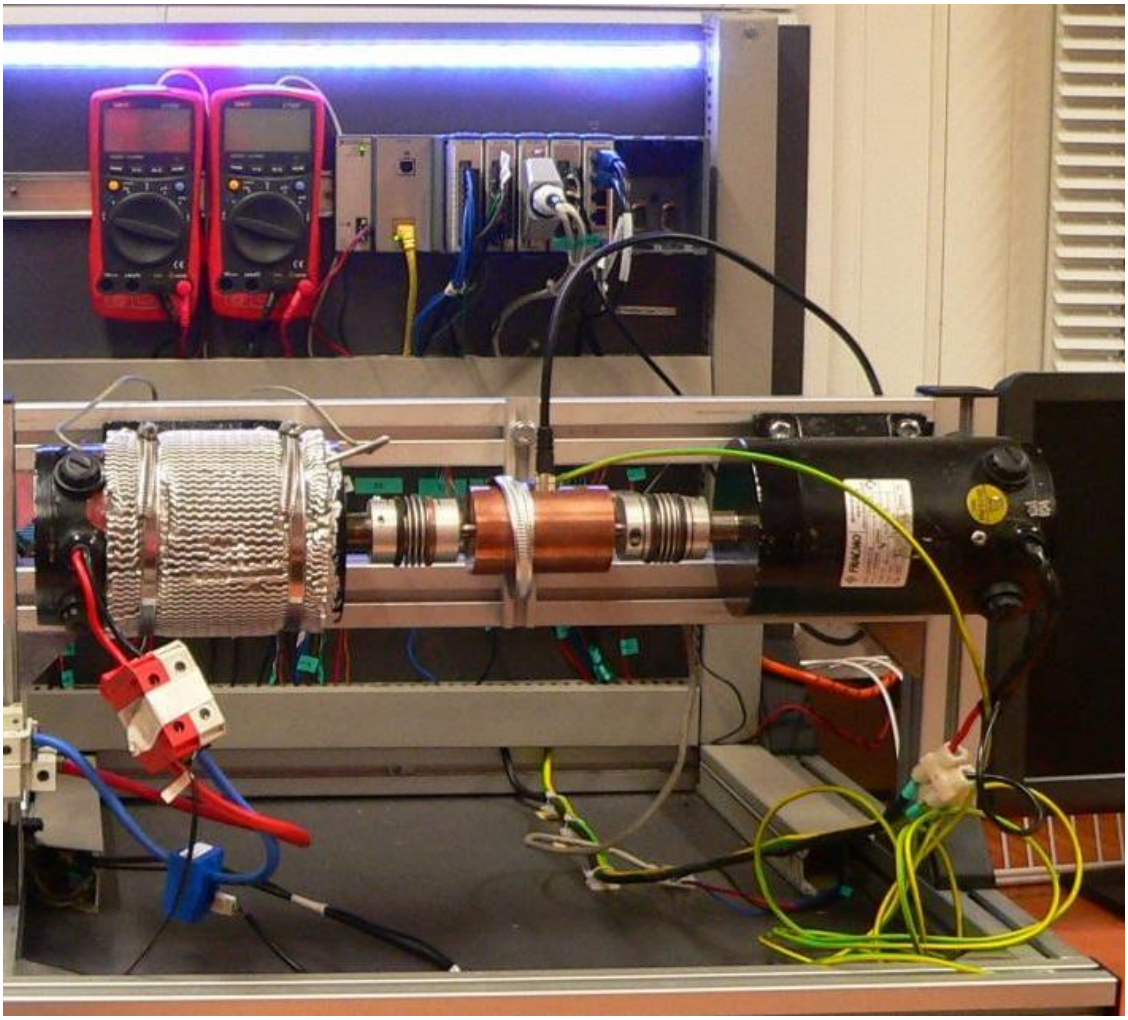

Figure 4. The stationary test stand

The laboratory tests on the testing stand were carried out in the accordance with the adopted test profile. The study was conducted in two configurations (a configuration 1 and a configuration 2). The configuration 1 is a basic configuration and the configuration 2 is a configuration with a protective hosting [3].

V. SIMULATION RESULTS

The reference characteristic allow to the analysis of the measurement data. On the laboratory test stand was performed the analysis of the influence of the basic configuration and basic configuration with the protective housing on the sensor allowed determining the dependence of the current characteristics on time [3]. Fig. 5 and 6 show current flowing a circuit on the stationary test stand. The time-current characteristics (I=f(t)) show the effectiveness of the applied solution.

Fig. 5 shows the comparison of the reference characteristic with that for the basic configuration. Fig. 6 shows he comparison of the reference characteristic with that for the basic configuration with the protective housing.

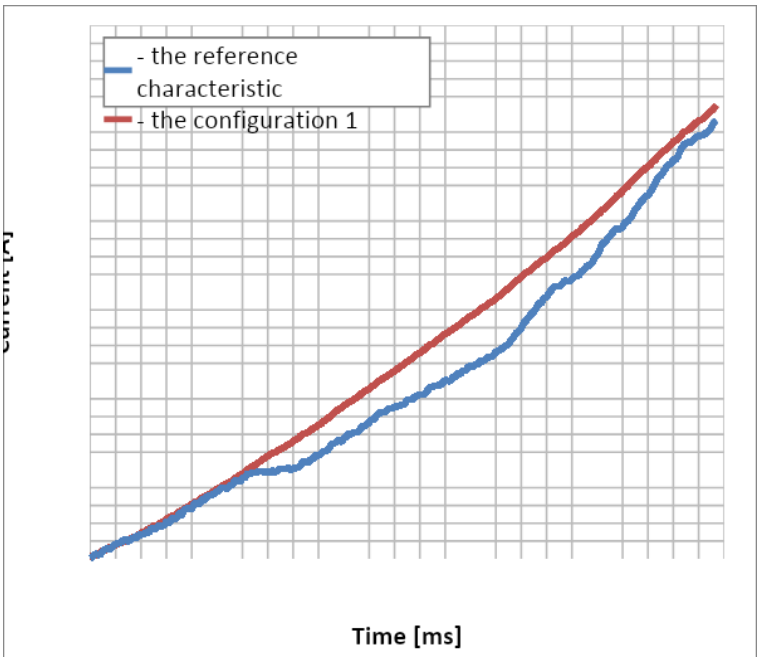

Figure 5. Comparison of the characteristic in the basic configuration (red color) and the reference characteristic (green color)

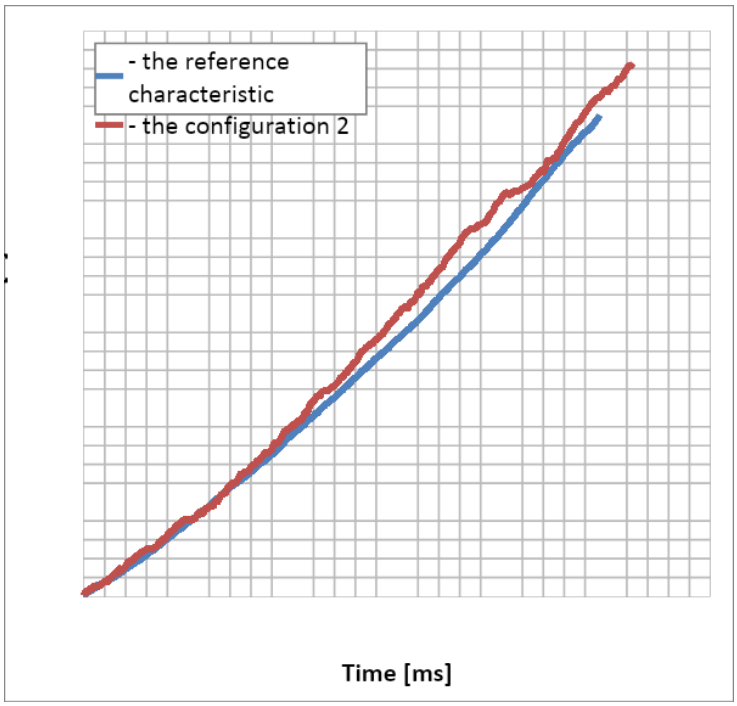

Figure 6. Comparison of the characteristic in the basic configuration with the protective housing (blue color) and the reference characteristic (green color).

The characteristic for the basic configuration (the blue one), the characteristic for the basic configuration with the protection housing (the green) and the reference characteristic (the red one) are shown in Fig. 7.

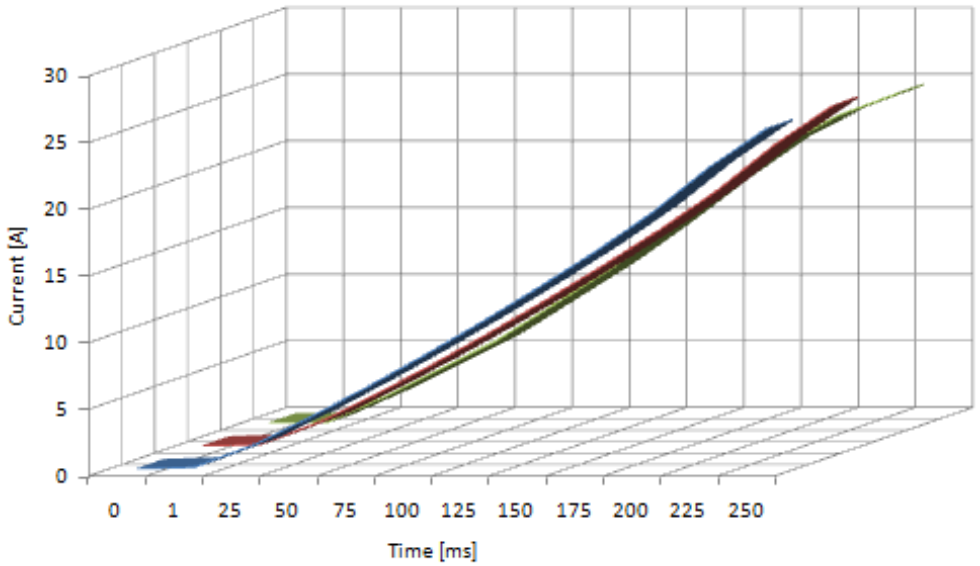

Figure 7. Comparison of the characteristics in the basic configuration (red color) and the basic configuration with the protection housing (blue color) with the reference characteristic (green color)

Fig. 8 shows the example the waveform of the current while the driving the light electric vehicle. The use of the protective housing with good shielding properties could effectively eliminate the interference environmental. The waveforms the waveforms of the current intensity were taken from measurements during the race, where the current waveform shows:

- the measuring system with the protective housing (the blue one),
- the measuring system without the protective housing (the red one).

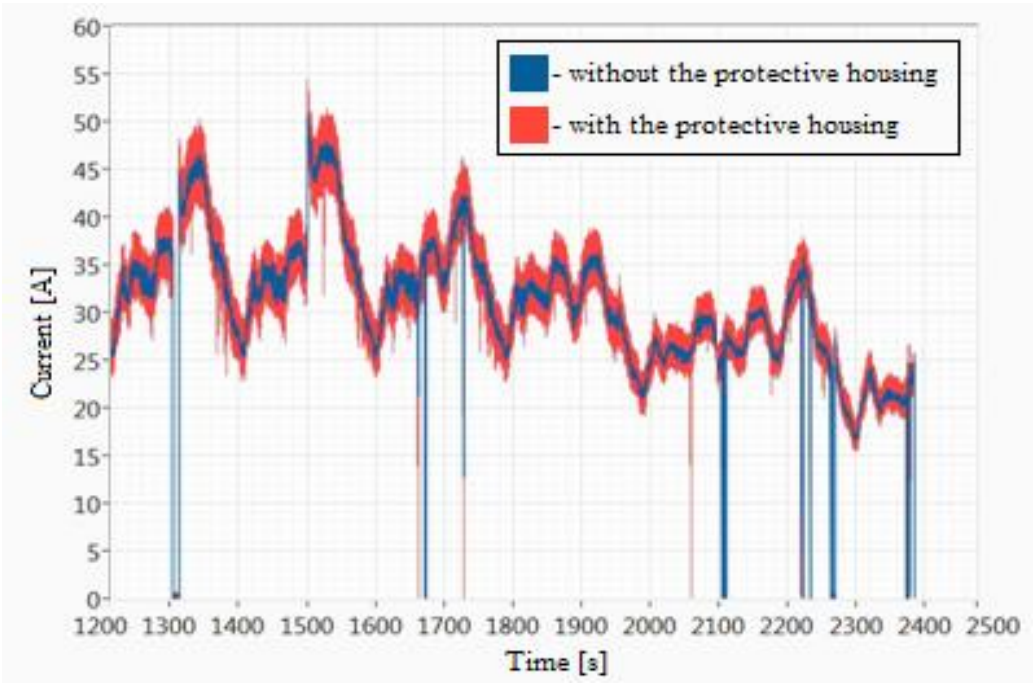

Figure 8. Current waveform obtained while driving the light electric vehicle

The presented characteristics were the simulation results for the current the measuring system. This system consists of a large number of sensors. The results show that the impact of the electromagnetic field is small at the beginning. he impact of the electromagnetic field increases with the time. It is necessary to the introduce the protection for the measuring system in a light electric vehicle (Fig. 7). The protective housing allows for more efficient operation of measuring devices (Fig. 6), because the reliability of the results increases.

VI. CONCLUSIONS

The data recorded by the measuring system are processed in software, which involves the processing of the collected data together with interfering noise. An appropriate shielding makes it possible to reduce the influence of external interference. Shielding gives the possibility to separate the measurement system from the influence of external factors. if desired.

The protective housing, ferrite beads and the introduction of the data filtering are the factors reducing measurement noise. The introduction of filtration of collected data will allow for the omission of random single thick errors, which may result from:

- the operation of an electric vehicle,
- weather conditions,
- the driving path of the tested electric vehicle.

It is possible to limit the influence of interference and noise by the stability of the mounting and shielding of sensors from the influence of external factors.

Vibrations during the driving of the light electric vehicle, causing difficulties in the operation of sensors. From Fig. 8 is evident to see that placing of the measuring system in a protective housing affect the operation of the sensors.

The investigations show that the use of the protective housing can significantly improve the performance of the sensors. On the laboratory test stand, it is not possible to accurately simulate the real conditions on a track. So it is necessary to check the effectiveness of a protective housing in real conditions (Fig. 8).

REFERENCES

[1]. A.Baier, M. Baier, M. Sobek, Ł.Grabowski, D.Dusik, and P. Papaj, Computer aided process of designing the mechatronic Silesian Greenpower electric car, *Advanced Materials Research, 1036*, 2014, 112-116.

[2]. T. Więckowski, *Badania kompatybilności elektromagnetycznej urządzeń elektrycznych i elektronicznych* (Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 2001)

[3]. D. Macha, Redukcja wpływu zakłóceń pola elektromagnetycznego na system pomiarowy lekkiego pojazdu elektrycznego, master diss., Silesian Unniversity of Technology, Gliwice, MA, 1978. (8)

[4]. http://www.sg.polsl.pl/ [access online]

[5]. M. Baier, J. Franiasz and D. Wylenżek, Hamownia do testów elektrycznych pojazdów wyścigowych, *Projektowanie i konstrukcje inżynierskie*, nr 4 (91), April 2015

[6]. D. Macha, P. Sowa, Reducing interference of the electromagnetic field on the torque sensor of the light electric vehicle, *Przegląd Elektrotechniczny*, 2019 R. 95 nr 9, 28-31

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