UDC 62-83: 681.51

LABORATORY STAND WITH WIRELESS INTERFACE FOR STUDY OF AUTOMATIC CONTROL SYSTEMS OF DC ELECTRIC DRIVE

KULYNYCH E.M., NAZAROVA O.S., GONCHAROV D.V., CHERNYSHEV S.G.
(kuliniched@gmail.com, nazarova16@gmail.com, nicksonszp@gmail.com, flashboy811@gmail.com).
ZAPORIZHZHIA POLYTECHNIC NATIONAL UNIVERSITY (UKRAINE)

Abstract. *DC motors are used in many industries, are studied in most educational programs in the field of "Electrical Engineering", as well as specialties "Automation and computer-integrated technologies", so there is the need to develop a laboratory bench for studying and research of automatic control systems (ACS) of DC electric drive, taking into account modern IT-technologies of data transmission and processing.*

The rapid development of modern computer technology, digital communications, robotics and information technology promotes the introduction of microprocessor technology, digital devices with a discrete form of signaling in various electromechanical systems [1-3], which improves their technical characteristics, reduces power consumption, size, reliability data processing and transmission speed. This, in turn, opens new ways and approaches to solving problems of improving the quality of student training.

Therefore, the aim of the work is to develop a laboratory stand with a wireless interface for the study and research of automatic control systems of DC electric drive.

During the study, the advantages and disadvantages of existing developments on this topic were considered and analyzed, taking into account the cost-effectiveness, mobility, reliability and ease of implementation, as well as the possibility of use as a training stand.

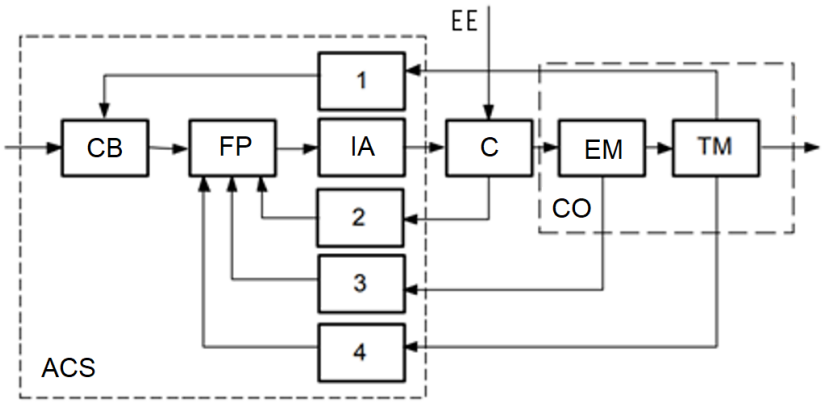

Figure 1. Scheme of electromechanical control system.

Since the DC motor can operate in generator mode, and the EMF of the motor in generator mode is directly proportional to the torque on the motor shaft, it is possible to control the motor without a physical feedback sensor [4, 5]. In Figure 1: ACS – automatic control system, CB - command body; FP - functional part; IA - intermediate amplifier; EM - electric machine; C - converter; TM - technological mechanism; 1 - the main hard feedback; 2-4 auxiliary flexible feedback; EE - electrical energy; CO - control object. A model of the control circuit of a DC motor with reversible rotation has been developed (Fig. 2). A laboratory stand with a wireless interface has been developed to study the operation of the DC motor and conduct research on a closed automatic control systems of DC motor with feedback on the EMF and PID controller [6, 7].

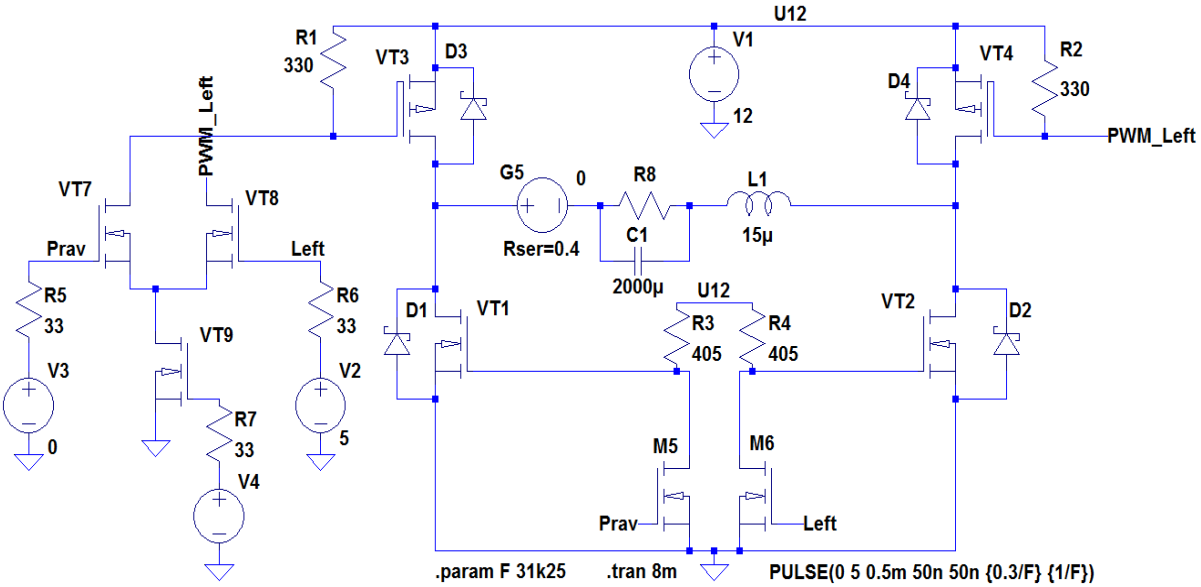

Figure 2. Model of the control circuit of a DC motor with reversible rotation.

During the study, the advantages and disadvantages of existing developments on this topic were considered and analyzed, taking into account the cost-effectiveness, mobility, reliability and ease of implementation, as well as the possibility of use as a training stand. As a result, a motor was selected, which has a reducer and a torque regulator (rattle, as in screwdrivers), with a power of 9 W - 300 W. Alternative options for connecting the stand have been developed: USB and Wi-Fi. An ATmega8A-AU (Figure 3) microcontroller was used for the power switch and the automatic control system, and a power board and a motor control board using PWM were developed.

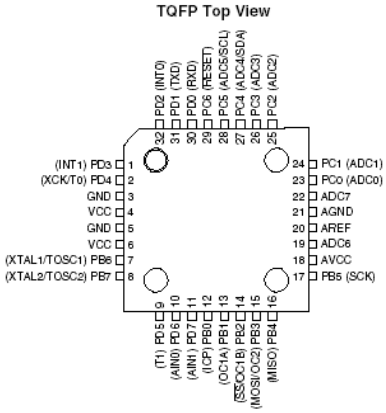

Figure 3. Location of the pins of the microcontroller ATmega8A-AU.

The UART - USB interface is used for information transfer and programming of the stand. The appearance of the module is shown in the Figure 4.

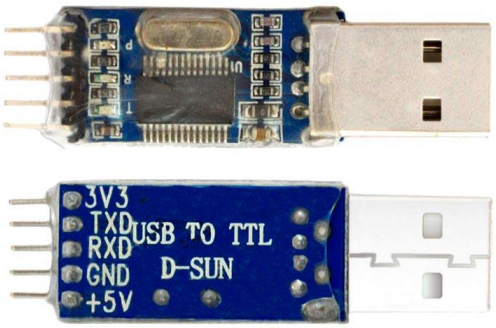

Figure 4. UART - USB interface adapter.

It is possible to currently transfer information about the modes and parameters of the engine to a computer with a browser output by installing the Wi-Fi module ESP8266MOD, which is shown in the Figure 5.

Figure 5. Wi-Fi module.

The information coming from the laboratory stand is pre-stored by the microcontroller in the microSD-card module in real time.

CONCLUSIONS

A laboratory stand with a wireless interface has been developed to study the operation of the DC motor and conduct research on a closed system of automatic DC motor control with feedback on the EMF and PID controller. The software of the stand allows to display them in the form of graphs on various gadgets (smartphone, tablet, laptop, personal computer) via Wi-Fi on the basis of data taken from the DC motor. The use of this laboratory stand in the educational process will expand the possibilities of studying the DC electric drive and will allow students to gain skills in data transmission and processing through a wireless interface.

REFERENCES

1. Osadchiy V. V., Nazarova Ye. S., Brilistii V. V., Savilov R. I. (2016), “Laboratory stand for researching of microprocessor control systems of dual-mass electric drive”, Elektromekhanichni i computerni systemy, no. 22(98), pp. 33-38. http://dx.doi.org/10.15276/eltecs.22.98.2016.05

2. Osadchiy, V.V., Nazarova, Ye. S., Tobolkin, S.U. (2014), “Laboratorniy stend dlya issledovsniya algoritmov mikroprotsessornikh system upravleniya shagovimi dvigatelyami” [Laboratory bench for the research of algorithms microprocessor control systems of stepper motors], Elektromekhanichni i energozberigauchi sistemi, no. 2(26), pp. 102-108.

3. Nazarova O., Osadchyy V., Shulzhenko S. (2019), “Accuracy improving of the two-speed elevator positioning by the identification of loading degree”, International Conference «Modern Electrical and Energy Systems» (MEES-2019), September 23-25, Kremenchuk Mykhailo Ostrohradskyi National University, Ukraine, pp. 50 – 53. DOI: 10.1109/MEES.2019.8896414

4. Frir G. (1990), “Construction of computing systems based on advanced microprocessors”, Moskow, 413 p.

5. Konstantinov K.V. (2004), “DC electric drive control systems”, Khabarovsk, 92p.

6. Diskretnyj PID regulyator [Discrete PID Controller]. Available at: http://robot-develop.org/archives/2833.

7. Nastrojka PID regulyatora [PID Control Setting]. Available at: http://www.asutp.org/index.php?option=com_content&task=view&id=142&Itemid=68.