REVIEW

from Prof. Eng. Marin Hristov Hristov, PhD, Technical University of Sofia,
Faculty of Electrical Engineering and Technologies
of the materials submitted for participation in the competition
for obtaining the academic position of "Associate Professor" in
the field of higher education Technical sciences,
in professional field 5.2 Electrical engineering, electronics and automation,
specialty "Industrial Electronics" (Reliability of electronic systems, Design and technology of electronic equipment, Design of communication equipment).

In the competition for Associate Professor, publicised in the State Gazette, issue 68 of 31.07.2020 and on the website of TU-Gabrovo for the needs of the Department of Electronics at the Faculty of Electrical Engineering and Electronics, as a candidate participates Assistant Professor PhD Prodan Ivanov Prodanov.

1. Brief biographical data

Assist. Prof. Eng. Prodan Ivanov Prodanov was born on December 17, 1981 in the town of Gabrovo. In 2004 he obtained Bachelor's degree from the Technical University - Gabrovo, specialty Electronics, and in 2005 Master's degree. In 2010 he defended his PhD thesis in the scientific specialty 02.20.09 "Industrial Electronics" on the topic: "Theoretical and experimental research on the reliability of power supplies for induction technologies" in the field of competition.

In 2010 he became an assistant in the Department of Electronics at the Technical University - Gabrovo, later became an assistant professor.

2. General description of the presented materials

The candidate for Associate Professor, Assist. Prof. Eng. Prodan Prodanov, PhD participated in the competition with a total of 42 works. Of these, 11 publications in specialized scientific journals, referenced in the world database SCOPUS, equivalent to a monograph (B4), 2 of which are independent. Of these, 2 publications were presented at prestigious scientific conferences abroad - Serbia. The other 9 publications were presented at

international scientific conferences in Bulgaria. Four scientific publications are in publications that are referenced and indexed in world-famous databases of scientific information (G7) (one abroad and 3 in Bulgaria). Twenty-three publications have been published in non-refereed journals with scientific review (G8), 21 of which have been presented at international scientific conferences and symposia in Bulgaria, and 2 have been published in Notices of the Technical University of Gabrovo. Four of the works are study books (2 independent), of which one is a textbook.

3. Reflection of the candidate's research publications in the research community

Five publications of the candidate are cited 14 times which is an objective evidence of the importance of contributions to science and practice. All citations are published in international conferences and symposia in Bulgaria in specialized scientific journals, referenced in the world database SCOPUS.

4. **Overview of the content and results in the presented works**

The candidate has summarized the presented works in four thematic areas.

The works on reliability of electronic elements (first thematic area) are grouped in two main directions: development of a methodology for forecasting the failure rate of electronic elements and analysis of the influence of electrical and thermal regimes of the elements on their reliability. When developing a methodology, its applicability to a given category of electronic elements is analysed, as well as the possibility for its adaptation and development with adequate models for calculations of the failure rate, when in the relevant methodology a group of elements is missing.

In the second thematic area - analysis and modelling of the reliability of electronic systems, the modelling of the reliability of electronic systems is studied and used to create probabilistic models of electronic systems and assess their readiness, determine the functional relationships of reliability, probabilistic states and time for prevention, definition of the elements and blocks, leading to failure of an electronic system and analysis of the influence of the operating conditions. The following four types of analyses can be summarized in this section: probabilistic analysis, probabilistic analysis and time for

prevention, analysis of the influence of operating conditions on the reliability of electronic systems and analysis of the reliability of different classes of electronic systems.

Materials in the field of "Modelling and research of circuits and processes in power converters" are related to modelling of the system "inductor-piece" in the processes of induction heating of cylindrical steel parts and flat parts in a magnetic circuit, modelling and simulation of power circuits of electricity converters and construction of prototypes and reconstruction of existing technical solutions.

The publications in the last field "Modelling, design and research of Positioning Drive Systems" are dedicated to modelling, design, implementation and research of electric drive systems with stepper motors and servo motors. Research in this area is related to the modelling of the mechanical characteristics of stepper motors and the possibilities for improving their driver circuits. The analysis of servo drive systems is related to the modelling, development and research of digital PID controllers, improving the dynamic properties of the system.

5. General characteristics of the candidate's activity

5.1. Educational and pedagogical activity (work with students and PhD students)

Assist. Prof. Prodan I. Prodanov, PhD has 10 years of teaching experience since 2010. During this period he is the supervisor of the disciplines included in the curriculum of the Bachelor's degree for full-time and part-time forms of education: "Design and technology of electronic equipment" for the specialties "Electronics"; "Design of communication equipment" for the specialty "Communication equipment and technologies" "Electric drive" for the specialties "Mechatronics" and "Equipment and technologies for environmental protection", "Training practice" for the specialty "Industrial and automotive electronics". Bachelor's degree for full-time and part-time forms of education: "Reliability of electronic systems" for the specialty "Electronics" and "Industrial electronic devices and systems - II".

He participated in the construction of the following new training laboratories: "Design and technology of electronic equipment", "Training practice", laboratory of the company "Schneider Electric Bulgaria" Ltd. on "Electric drive systems".

Under the supervision of Dr. Prodan Prodanov for that period, 53 graduates from the specialty "Electronics", Bachelor's degree and "Master's" degree were defended.

All this shows the great and successful educational activity of Assist. Prof. P. Prodanov.

5.2. Research and Research and Applied Activity

The scientific problems that PhD Prodan Prodanov deals with are in the profile of the announced competition. Studies are presented and an analysis of the applicability of various methodologies for calculating the failure rate of electronic components is made. Studies on the influence of electrical and thermal parameters of power semiconductor elements - MOSFET, SiC MOSFET and IGBT transistors, as well as high-power diodes and thyristors are presented. Simulation models of the following types of converters are proposed: Two switch forward converter; LED lamp driver; capacitive power transmission system; switching power supply unit based on a specialized circuit Viper100A. Circuits for control of SiC MOSFET transistors based on a specialized driver type ACPL-339J and resonant driver have been developed, as well as low-power circuits for induction heating of steel parts. A mathematical apparatus has been developed, on the basis of which a file with macros has been proposed, which make it possible to study and simulate the characteristics of stepper motors. This mathematical apparatus is applicable in two aspects: obtaining the characteristics of the stepper motor in the absence of catalogue data and obtaining a family of mechanical characteristics when setting different voltages and current limitation of the driver used. A servo controller for control of a DC servomotor, which can be used in machines with digital-program control, as well as in different types of position electric drive, has been realized and researched.

5.3. Implementation activities

Assist. Prof. Prodan Prodanov has been working on a lot of research projects:

- Coordinator of one university research project;

- Participant in 3 projects under operational programs; one project funded by the National Research Fund; 6 university research projects;

- Supervisor of 15 students who participated in student research sessions, numerous awards and certificates for participation in conferences and courses.

6. Contribution (research, research-applied, applied)

In principle, I accept the formulated research, research-applied and applied contributions from the candidate. I will summarize them briefly according to other criteria as follows:

A. Contributions to publications equivalent to a monograph

- A classification of the methods for analysis of the failure rate of the electronic elements is proposed. A new approach has been developed for determining the limit values of the thermal regimes of a class of power semiconductor elements. A method for analysis of the reliability of supercapacitors, taking into account the aging processes in them, has been described and verified.

- Probabilistic models have been created taking into account the time for prevention and the functional connections according to reliability.

- Probabilistic models for determining the efficiency of the embedded protection circuits in a series of thyristor converters for induction heating of steel parts have been synthesized and simulated.

- A mathematical apparatus has been developed and a three-dimensional model has been proposed for studying the field of reliable operation of electronic energy converters as a function of the operating conditions.

B. Contributions to publications beyond the equivalent of a monograph

- A new approach for analysis of reliability indicators of power MOSFET transistors based on a model taking into account the thermal resistance of the cooling system is proposed.

- Various electronic systems have been tested for reliability, according to the operating conditions and operating modes. The characteristics in terms of reliability and the warranty period have been established, and recommendations for increasing the reliability have been given.

- A new approach for analysis of the electromagnetic processes of the "inductor-piece" system with differentiated domains of the magnetic field has been developed.

- Compact models have been proposed and simulation studies have been performed in the P-SPICE environment of the operating modes of a wide class of electronic circuits of power converters.

- Devices with improved functionality, building blocks and control methods have been developed, studied and implemented.

- A modified model of a digital PID controller and a DC servo motor with the software product MATLAB was developed and studied, on the basis of which a software digital PID controller in the Attiny2313 microcontroller was implemented.

7. Assessment of the candidate's personal contribution

The results of the research and development of PhD Prodan Prodanov have been implemented in the activities of a number of Bulgarian and international companies, such as the companies MADARA, ET INGEGORG DEMIROVA - PETAR KARABADZHAKOV, IMG Union Ltd.

7 of the publications are independent and in 29 of them he is the first author. His professional and scientific authority is beyond doubt.

I am convinced that the contributions of Assist. Prof. Prodan Prodanov are his personal work.

8. Critical remarks and recommendations

I have no serious remarks and recommendations to the presented materials. I note only the following:

- I propose, with the consent of the candidate, the research contributions № 3 and 4 formulated by him to be reclassified from research as research-applied.

- There are no official documents for the actual teaching activity - number of hours of lectures, exercises, work with students, PhD students, etc.

- When summarizing the points for the national and university requirements for the scientific title of Associate Professor, I believe that the points from PhD should not be summed with the others. However, the results shown far exceed the minimum requirements.

9. Personal impressions

I know Assist. Prof. Prodan Ivanov Prodanov, PhD, from various scientific forums in Bulgaria. I have no common publications, common projects and contracts with him. I want to note that he is a person who can be relied on and trusted.

10. Conclusion

The availability of educational and scientific degree "PhD", of sufficient publications equivalent to a monograph on the topic of the competition, the large number of independent publications, significant research and research-applied contributions of the candidate, published in prestigious journals and conferences, sufficient citation of results, successful teaching activities, give me reason to confidently propose Assist. Prof. Prodan Ivanov Prodanov, PhD, to take the academic position of "Associate Professor" in the scientific field 5.2. Electrical Engineering, Electronics and Automation, scientific specialty "Industrial Electronics" (Reliability of electronic systems, Design and technology of electronic equipment, Design of communication equipment), for the needs of the Department of Electronics at TU - Gabrovo.

05.12.2020 Reviewer: /signature/

Sofia (Prof. Marin Hristov, PhD)