Electronic Devices on Discrete Components for Industrial and Power Engineering

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Vladimir Gurevich was born in Kharkov, Ukraine, in 1956. He received an M.S.E.E. degree (1978) at the Kharkov Technical University, named after P. Vasilenko, and a Ph.D. degree (1986) at Kharkov National Polytechnic University. His employment experience includes: teacher, assistant professor and associate professor at Kharkov Technical University, and chief engineer and director of Inventor, Ltd. In 1994, he arrived in Israel and works today at Israel Electric Corp. as a specialist of the Central Electric Laboratory. He is the author of more than 140 professional papers and 4 books and holder of nearly 120 patents in the field of electrical engineering and power electronics. In 2006 he was Honorable Professor with the Kharkov Technical University, and since 2007 he has served as an expert with the TC-94 Committee of International Electrotechnical Commission.

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Preface

Integral microchips and microprocessors have come into our lives so swiftly and completely that sometimes it seems that modern equipment simply cannot exist without them, which is true. However, dependence of modern equipment on microelectronics and microprocessors does not mean that there are no problems in this area. The integrity of many functions distributed earlier among separate devices of a complex system in a single microprocessor leads to the reduction of system reliability because damage to the microprocessor or to any number of peripheral elements serving the microprocessor leads to failure of the whole system but not of its separate functions as it was in pre-microprocessor time. Added to this is the extra sensitivity of microelectronic and microprocessor-based equipment to electromagnetic interferences (EMI) and the possibility of intentional remote actions breaking the normal operation of the microprocessor-based devices (electromagnetic weapons, electromagnetic terrorism). Intensive investigations into the electromagnetic weapons field are being carried out in Russia, the U.S., England, Germany, China, and India. Many world-leading companies work intensively in this sphere creating new devices of these weapon systems functioning at a distance of several dozens of meters to several kilometers, which while specialized in their use are still available to everybody (as they are freely sold on the market).

The need for specialized power supplies of microprocessors, different types of memory, special input and output circuits, special software – in short, all of the above-mentioned – has led to the situation where documentation and manufacturing of automation devices has become available only to serious companies having all the necessary resources for this. Development tendencies of this area of technique make it more and more unavailable to individual engineers and technicians wishing to apply their knowledge and ingenuity to improve production or technological processes to their companies. At the same time, lately in the market a number of new types of small-size, discrete electronic components with previously inaccessible parameters appeared. They are miniature transistors meant for currents of dozens of amperes and voltages of 1200 – 1600 V; miniature vacuum reed switches with operational speeds of milliseconds capable of sustaining voltages of 1,000 – 2,000 V; and other no less interesting elements. These new discrete components serve as the basis for creating industrial automation and control devices that are fed directly from networks of 220 – 250 V and work directly with input and output signals of the same voltage level. Hybrid devices combining advantages of semiconductor (transistors, thyristors) and electromechanical (reed switches) elements are of particular interest.

This book is concerned with the description of different functional units and automation devices for industry and electric power engineering implemented by modern discrete electronic elements without using microelectronics and microprocessor-based technologies. The devices described in this book turn out to be much simpler

and cheaper; they may be produced not only by large companies, but even by independent amateurs. This book presents for the readers' judgment dozens of unusual but very simple realizable devices, which may be easily created by any engineer or technician wishing to improve automation systems. Some of the technical decisions presented by the author may serve as the basis for the creation of new types of devices of relay protection and automation free from disadvantages of complex microelectronic systems.

The book consists of seven chapters and appendices containing reference data. The first three chapters are devoted to the theory and operating principles of modern discrete components designed for automation devices: transistors, thyristors, dinistors, reed switches, and high-voltage reed switch relays. The fourth chapter describes dozens of different functional modules of automation systems incorporating discrete elements with direct supply from 220 – 250 V networks: switching devices, generators and multivibrators, timers, logic elements, elements sensitive to overcurrents and overvoltages, voltage regulators and stabilizers, pulse expanders, etc. The fifth, sixth, and seventh chapters are devoted to the description of concrete examples of automation devices for industry and electric power engineering based on discrete electronic components and also hybrid ones: semiconductors and reed switches.

The book makes a smooth transition from theory and the properties of modern electronic elements by means of examination of operating principles and examples of realization of separate functional units of automation devices to the description of concrete examples of those that are finished and ready for use. The author thinks that this approach to the material will make it possible for the readers not only to repeat the constructions that are described, but to understand and master the general principles of automation devices on discrete elements and to apply them in the future for creation of new necessary constructions. As an aid to complete understanding, voluminous reference material has been included containing information about the most modern components specially selected by the author and classified in the appendices.