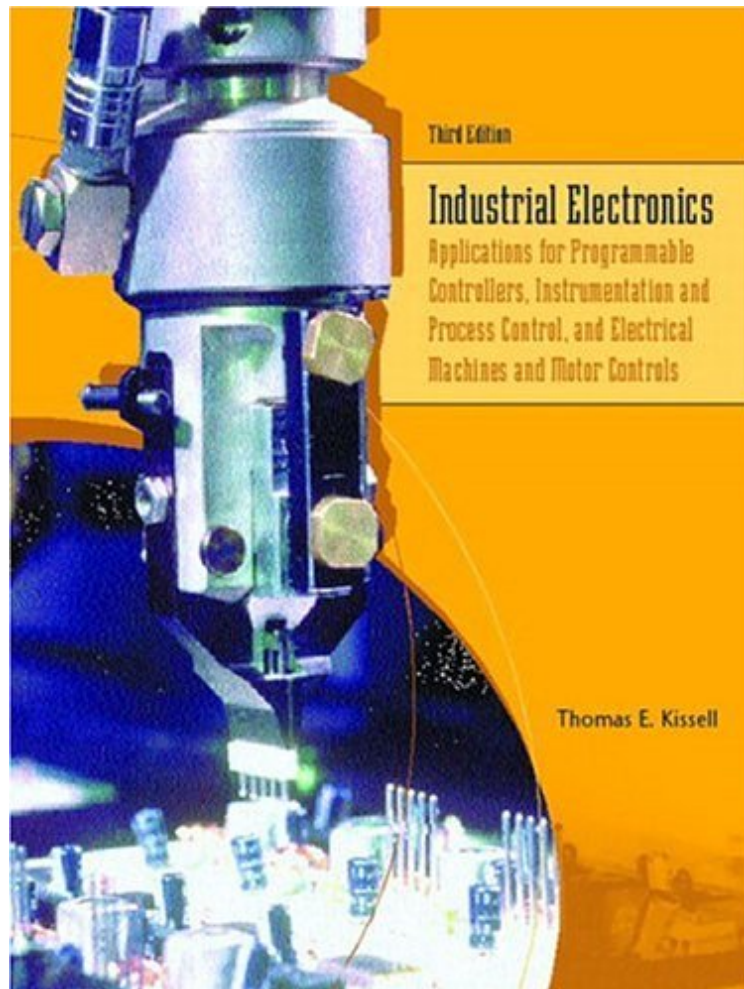


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# Industrial Electronics: Applications for Programmable Controllers, Instrumentation and Process Control, and Electrical Machines and Motor Controls (3rd Edition)

*Thomas E. Kissell*

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Based on the author's experience working with technicians directly on the factory floor in major industries, this handbook/reference covers all of the electronic technology found in modern industrial systems, going into the depth required to install, troubleshoot, and repair complex automation systems. Each stand-alone (but cross-referenced) chapter explores either an entire system or individual circuits and components that are used over and over in a large variety of complex systems. Features a large number of figures, diagrams, and pictures, and typical Job Assignments, with solutions. Advanced Solid State Logic: Flip-Flops, Shift Registers, Counters and Timers. Programmable Controllers. Solid-State Devices Used to Control Power: SCRs, TRIACs and Power Transistors. Solid-State Devices Used for Firing Circuits. Photoelectronics, Lasers and Fiber Optics. Industrial Power Supplies, Inverters and Converters. Operational Amplifiers. Open-Loop and Closed-Loop Feedback Systems. Input Devices: Sensors, Transducers, and Transmitters for Measurement. Output Devices: Amplifiers, Valves, Relays, Variable-Frequency Drives, Stepper Motors and Servomotor Drives. AC and DC Motors and Generators, Transformers, and Three-Phase Electricity. Case Studies of Four Industrial Applications. Robots and Other Motion Control Systems. Motor-Control Devices and Circuits. Data Communications for Industrial Electronics. For Instrumentation and Process Control Technicians, PLC and Motion Control Technicians.

From the Back Cover Based on the author's experience working with technicians directly on the factory floor in major industries, this handbook/reference covers all of the electronic technology found in modern industrial systems, going into the depth required to install, troubleshoot, and repair complex automation systems. Each stand-alone (but cross-referenced) chapter explores either an entire system or individual circuits and components that are used over and over in a large variety of complex systems. Features a large number of figures, diagrams, and pictures, and typical Job Assignments, with solutions. Advanced Solid State Logic: Flip-Flops, Shift Registers, Counters and Timers. Programmable Controllers. Solid-State Devices Used to Control Power: SCRs, TRIACs and Power Transistors. Solid-State Devices Used for Firing Circuits. Photoelectronics, Lasers and Fiber Optics. Industrial Power Supplies, Inverters and Converters. Operational Amplifiers. Open-Loop and Closed-Loop Feedback Systems. Input Devices: Sensors, Transducers, and Transmitters for Measurement. Output Devices: Amplifiers, Valves, Relays, Variable-Frequency Drives, Stepper Motors and Servomotor Drives. AC and DC Motors and Generators, Transformers, and Three-Phase Electricity. Case Studies of Four Industrial Applications. Robots and Other Motion Control Systems. Motor-Control Devices and Circuits. Data Communications for Industrial Electronics. For Instrumentation and Process Control Technicians, PLC and Motion Control Technicians. Excerpt. Reprinted by permission. All rights reserved. Students who enter the job market and become electronics technicians must be prepared to work on industrial electronics in many forms. The job responsibilities for these fields are rapidly changing because electronic devices and circuits have become thoroughly integrated into all aspects of modern industrial control systems during the past ten years. As industries have learned to compete in the global marketplace, the role of technicians has changed to the point where they are expected to work on every aspect of an industrial system from the simplest electrical components, such as fuses and motors, to the most complex, such as electronic boards, motor drives, and programmable controllers. This book is designed for students in two-year technical and community colleges and for students in engineering technology programs and engineering programs at four-year universities. It can be used in courses that cover one semester or one quarter or in a series of courses covering one year or more. The book also provides sufficient depth to be a useful resource after students finish school and are working on the job. Chapters do not have to be read sequentially. Rather, each chapter is self-contained so instructors can select specific chapters that provide material for a specific course. ORGANIZATION OF THE TEXT Individual components and smaller circuits are introduced in the early chapters and larger circuits and complete systems are added along the way, specifically in later chapters. Each chapter is also written to stand alone. This allows teachers to change the order of the sequence of chapters to match their course syllabus. Often chapters in books are linked so that they only make sense when they are read in the order they are presented. With this text the teacher can feel free to change the order of the chapters and the student will still understand everything in each chapter. The first two chapters introduce solid-state devices and logic devices used in industrial electronic circuits. In the third edition, Chapter 3 has been enhanced to provide additional programming applications for programmable controllers. This chapter starts by explaining the basic parts of all programmable controllers and then provides numerous applications that show how instructions are used. It also provides much more information and applications than merely reviewing the instruction set from a typical programmable controller. The Allen-Bradley MicroLogix 1000, SLC500 family, PLC2, and PLC5 are used as examples. Additional PLC material that explains how PLCs are used in process control and the operation of PID instructions has been added to Chapter 9. Chapter 4 provides an in-depth study of power devices such as thyristors and power transistors and the types of circuit applications where they are commonly used in industrial electronic circuits. Chapter 5 introduces the triggering

devices used to control the power electronic devices, and Chapter 6 provides in-depth coverage of optoelectronic devices and industrial lasers. To supplement the information in these chapters, a complete set of manufacturer's data sheets for each major device discussed in these three chapters is provided in the appendix. Chapter 7 provides an in-depth study of power supplies, inverters, and converters that are found in all types of industrial electronic circuits, such as AC and DC motor drives, stepper motor and servomotor drives, and other power control circuits. It explains switch-mode power supplies and electronic boards. Chapter 8 provides detailed information about operational amplifiers. Chapter 9 has been enhanced in this new edition to include additional information about PID loops that are found in PLCs. This material provides an in-depth study of how PLCs use PID loops for process control. This chapter also provides a PID simulation program that can be operated in a PLC or SLC500 controller without any hardware or complex process system. Chapter 10 provides a comprehensive study of all types of input sensors and instruments. It provides details about the theory of operation and troubleshooting information for all the major sensors and instruments used in the manufacturing and process industry today. Chapter 11 covers output devices such as solenoids, valves, relays, AC and DC motor drives, stepper motors, and servomotors. This chapter has perhaps the most information provided in any text today on variable-frequency AC motor drives and industrial DC motor drives, including stepper and servo amplifiers. Chapter 12 discusses information about traditional industrial DC motors and single-phase and three-phase AC motors. In-depth case studies of four industrial systems in Chapter 13 show how all the devices and components studied to this point operate together in a typical industrial system. Chapter 14 is devoted to robots and other motion control systems, such as CNC machines. It helps students understand how servo and stepper motors must be integrated into complete multiple-axis systems. Chapter 15 provides an in-depth study of traditional motor control devices and circuits. The final chapter in the book provides a study of data communications used in modern industrial applications such as linking programmable controllers, robots, and other automated systems to computer networks to pass data. Today students are expected to have experience with networks and understand how different electronic boards and systems, such as programmable controllers, robots, and servo and stepper systems, can be interconnected through networks. This chapter helps students to understand all the parts of data communications systems and how they are integrated with modern industrial systems. Examples of the most widely used industrial networks are provided, along with a complete explanation of network standards and protocols. Each chapter begins with a job assignment that each student is expected to solve after reading the chapter. The assignments are actual jobs that technicians perform today. Each chapter also has a comprehensive list of objectives outlining what the student is expected to learn from the chapter. At the end of each chapter a variety of true or false, multiple-choice, and open-ended questions and problems are provided for the student to complete. The solution to the job assignment is given at the end of each chapter, and the answers to the questions and problems are provided in the instructor's manual. This text uses only applied mathematics, and each formula is accompanied by worked-out example problems. Additional problems are provided at the point in the chapter where the topic is discussed, and solutions to these problems are worked out on a separate page. This allows the student to practice working a problem and immediately receive feedback about the solution. Problems that the teacher can assign to test each student's comprehension are also provided at the end of each chapter. The answers to these problems are available in the instructor's manual. A Laboratory Manual to accompany Industrial Electronics (ISBN: 0-13-047427-4) is available to enhance learning and instruction.