

Electronic Test Instruments: Analog and Digital Measurements (2nd Edition)

By Robert A. Witte

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Electronic Test Instruments: Analog and Digital Measurements, Second Edition offers a thorough, unified, up-to-date survey of electronics instrumentation, digital and analog. Start with basic measurement theory, then master all mainstream forms of electronic test equipment through real-world application examples. This new edition is now fully updated for the latest technologies, with extensive new coverage of digital oscilloscopes, power supplies, and more.

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Editorial Review

From the Back Cover

Electronic instruments: theory, applications, and real-world practice.

- The practical guide to electronic test and measurement: instruments and techniques, digital and analog
- Measurement techniques for maximizing accuracy
- Meters, signal sources, oscilloscopes, frequency counters, power supplies, spectrum analyzers, network analyzers, logic analyzers, and more
- Includes many circuit models and conceptual block diagrams

Electronic Test Instruments: Analog and Digital Measurements, Second Edition offers a thorough, unified, up-to-date survey of the entire field of electronic instrumentation: instruments and techniques, digital and analog.

Robert A. Witte first introduces basic measurement theory, then covers each type of commonly used electronic test equipment. Using detailed examples, Witte shows how these systems are applied in real-world applications, introducing core functionality and showing how to choose the right instrument for each task. This new second edition has been updated throughout, reflecting the latest technologies and presenting extensive new coverage of digital oscilloscopes and power supplies.

- Introduces essential measurement theory and explains its relationship to practical measurements
- Covers all mainstream test instruments, including meters, signal sources, oscilloscopes, frequency counters, power supplies, spectrum analyzers, network analyzers, logic probes, and logic analyzers
- Presents circuit models and conceptual block diagrams that clarify the behavior of complex circuits and instruments
- Explains key commonalities and differences between digital and analog instrumentation from the user's standpoint
- Introduces advanced circuit concepts and techniques that help users achieve higher quality measurements
- Illuminates important concepts such as loading effect, grounding, and bandwidth

About the Author

ROBERT A. WITTE is an Engineering Manager with Agilent Technologies (formerly Hewlett-Packard), where he is responsible for the design and development of electronic test and measurement equipment. He has taught electrical engineering courses as an adjunct professor at two universities and has written two books and numerous magazine articles about test and measurement instrumentation.

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Preface

This book is for the electrical engineer, technician, or student who understands basic electronics and wants to learn more about electronic measurements and test instruments. To use electronic instruments effectively, it is necessary to understand basic measurement theory and how it relates to practical measurements. Basic

measurement theory includes such things as how a voltage waveform relates to its frequency and how an instrument can affect the voltage that it is measuring. In an ideal world, we would not have to know anything about the internal operation of an instrument to use it effectively. Although this ideal situation can be approached, it cannot be obtained completely. (One does not have to know how a gasoline engine works to drive an automobile. However, a driver does need to understand the function of the accelerator and brake pedals.)

To minimize dealing with the internal workings of an instrument, circuit models and conceptual block diagrams are used extensively. Circuit models take a "black box" approach to describing a circuit. In other words, the behavior of a complex circuit or instrument can be described adequately by conceptually replacing it with a much simpler circuit. This circuit model approach reduces the amount of detail that must be remembered and understood. Conceptual block diagrams show just enough of the inner workings of an instrument so that the reader can understand what the instrument is doing, without worrying about the details of how this is accomplished.

In all instrument categories, the traditional analog technologies have been overtaken by digital technology. More precisely, the old analog approach has been replaced by precision analog circuitry that is enhanced by the power of analog-to-digital converters, digital logic, digital signal processing, and measurement algorithms implemented via software. However, a voltage measurement is still a voltage measurement, whether an analog meter or a digital meter is used. Since the measurement is fundamentally the same, this book treats both technologies in a unified manner, emphasizing digital instruments and highlighting the differences between the analog and digital approaches when appropriate.

This book does not attempt to be (nor can it be) a substitute for a well-written instrument operating manual. The reader is not well served by a book that says "push this button, turn this knob" because the definition of the buttons and knobs will undoubtedly change with time. Instead, this book is a reference, which provides the reader with a background in electronic instruments. Variations and improvements in instrument design cause each meter, oscilloscope, or function generator to be somewhat unique. However, they all have in common the fundamental measurement principles covered in this book.

This second edition of the book includes updates to all of the chapters, incorporating recent developments in technology while still remaining focused on the concepts and principles that last over time. The oscilloscope chapters were expanded, with an increased emphasis on digital oscilloscopes. The section on power supplies was expanded into its own chapter.

Chapter 1 covers the basic measurement theory and fundamentals. Chapters 2 through 7 cover the mainstream instruments and applications that the typical user will encounter (meters, signal sources, oscilloscopes, frequency counters, and power supplies). Chapter 8 introduces spectrum analyzer, network analyzers, and RF power meters while Chapter 9 covers logic probes and logic analyzers. Chapter 10 rounds out the book with some important circuit concepts and techniques that enable quality measurements.

My original motivation to write this book was my experience in teaching electrical engineering circuit theory courses. Even students with a good background in electrical theory seem to have trouble relating the textbook concepts to what is observed in the laboratory. The concepts of the loading effect, grounding, and bandwidth are particularly troublesome, so they are emphasized throughout the book.

Users Review

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Joshua Arwood:

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