Owners of the first edition of this classic handbook know that no other book covers the functions and inner workings of electronic instruments as completely as the Electronic Instrument Handbook. Used by both experienced practitioners and newcomers alike, it provides authoritative and easy access to all aspects of measurement tools and technologies. Thoroughly updated, this edition covers not only all the newer types of instruments but also the major changes in instrument technology.

With contributions from leaders in both industry and academia, the Electronic Instrument Handbook starts with the building blocks of instruments and progresses through stand-alone instruments, instrument systems, and virtual instruments. It includes in-depth information on analog-to-digital conversion ... microprocessors in instruments ... lightwave technology ... VXI and other busses ... controllers ... user interfaces ... software in instruments ... and transducers.

This handbook is the only book that explains what each instrument is used for, how it works, how to choose the correct one for an application, and how to get the most out of it in use.

CONTENTS IN BRIEF

Contributors xix
Foreword by Dr. Frederick E. Terman xxi
Preface xxiii

Part 1 Introduction to Electronic Instruments
Chapter 1. Measurements and Instruments Tim Healy 1.1
Chapter 2. Calibration, Traceability, and Standards David R. Workman 2.1
Chapter 3. Basic Electronic Standards David R. Workman 3.1

Part 2 Basics of Electronic Instrumentation
Chapter 4. Introduction to Electronic Instruments Randy Coverstone 4.1
Chapter 5. Transducers J. Fleming Dias 5.1
Chapter 6. Analog-to-Digital Converters John J. Corcoran 6.1
Chapter 7. Signal Sources Charles Kingsford-Smith 7.1
Chapter 8. Microwave Signal Sources William Heinz 8.1
Chapter 9. Signal Processing Howard Hilton 9.1
Chapter 10. Microprocessors in Electronic Instruments Joseph E. Mueller 10.1
Chapter 11. Power Supplies James S. Gallo 11.1
Chapter 12. Instrument-User Interfaces Janice S. Bradford 12.1

Part 3 Current and Voltage Measurement Instruments
Chapter 13. Voltage, Current, and Resistance Measuring Instruments Scott Stever 13.1
Chapter 14. Oscilloscopes Alan J. De Vilbiss 14.1
Chapter 15. Power Measurements Ronald E. Pratt 15.1

Part 4 Signal and Waveform Generation Instruments
Chapter 16. Oscillators, Function Generators, Frequency and Waveform Synthesizers Charles Kingsford-Smith 16.1
Chapter 17. Pulse Generators Andreas Pfaff 17.1
Chapter 18. Microwave Signal Generators William Heinz 18.1

Part 5 Frequency and Time Measurement Instruments
Chapter 19. Electronic Counters and Frequency and Time Interval Analyzers Gary D. Sasaki 19.1
Chapter 20. Precision Time and Frequency Sources John A. Kusters 20.1
Chapter 22. Phase Noise Instruments Dieter Scherer 22.1
# Chapter 3. Basic Electronic Standards

3.1. International System of Measurement Units  
3.2. Traceability of Standards  
3.3. Standards Maintained by NIST  

## References

3.10 Bibliography

---

# Part 2 Basics of Electronic Instrumentation

## Chapter 4. Introduction to Electronic Instruments

### Randy Coverstone

4.1. Introduction

4.2. Instruments

4.3. The Signal Flow of Electronic Instruments

4.4. The Instrument Block Diagram

4.5. Measurement Systems

4.6. Summary

## Chapter 5. Transducers

### J. Fleming Dias

5.1. Introduction

5.2. Transduction Mechanisms and Measurands

5.3. Classification of Transducers

5.4. Selection of Transducers

5.5. Capacitive Transducers

5.6. Inductive Transducers

5.7. Electromagnetic Transducers

5.8. Resistive Transducers

5.9. Hall-Effect Transducers

5.10. ChemFET Transducers

5.11. Piezoelectric Wave-Propagation Transducers

5.12. Tunneling Displacement Transducers

5.13. Thermodynamic Transducers

5.14. Ionization Transducers

5.15. Photonic Transducers

5.16. Fiber-Optic Transducers

## References

5.46

---

# Chapter 6. Analog-to-Digital Converters

### John J. Corcoran

6.1. Introduction

6.2. What Is an Analog-to-Digital Converter?

6.3. Types of Analog-to-Digital Converters

6.4. Integrating Analog-to-Digital Converters

6.5. Parallel Analog-to-Digital Converters

6.6. Multistep Analog-to-Digital Converters

6.7. Static ADC Errors and Testing Techniques

6.8. Dynamic ADC Errors and Testing Techniques

## References

6.30

---

# Chapter 7. Signal Sources

### Charles Kingsford-Smith

7.1. Introduction

7.2. Kinds of Signal Waveforms

7.3. How Periodic Signals Are Generated

7.4. Signal Quality Problems

## References

7.14

---

# Chapter 8. Microwave Signal Sources

### William Heinz

8.1. Introduction

8.2. Solid-State Sources of Microwave Signals

8.3. Control and Modulation of Signal Sources

8.4. Frequency Synthesis

## References

8.9

---

# Chapter 9. Signal Processing

### Howard Hilton

9.1. Introduction

9.2. Signal-Processing Functions

9.3. Signal-Processing Hardware

## References

9.34

---

# Chapter 10. Microprocessors in Electronic Instruments

### Joseph E. Mueller

10.1. Introduction

10.2. What a Microprocessor Is

10.3. Hardware Components of a Microprocessor System

10.4. Firmware Components of a Microprocessor System

10.5. Microcontrollers

10.6. Multiple Processors

10.7. An Example Application of a Microprocessor in an ADC

10.8. Calibration and Correction

10.9. Human Interface
### 43.1. Introduction

### 43.2. Computer Selection

### 43.3. Software Architecture

### 43.4. Operating System

### 43.5. Instrument Interconnect Bus Drivers

### 43.6. Instrument Control Drivers

### 43.7. Test Programs and Diagnostic Tests

### 43.8. Test Executives

### 43.9. System Test

### References

---

**Part 12**  
**Software in Instruments and Virtual Instruments**

**Chapter 44. Virtual Instruments and the Role of Software**  
Larry DesJardin

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>44.1. Introduction</td>
<td>44.1</td>
</tr>
<tr>
<td>44.2. Virtual Instrument Classes</td>
<td>44.2</td>
</tr>
<tr>
<td>44.3. Basic Components of Virtual Instruments</td>
<td>44.4</td>
</tr>
<tr>
<td>44.4. Using Virtual Instruments</td>
<td>44.8</td>
</tr>
<tr>
<td>44.5. Summary</td>
<td>44.14</td>
</tr>
</tbody>
</table>

**Acronyms and Abbreviations**  
A.1

**Index**  
1.1
This chapter provides an overview of both the software and hardware components of instruments and instrument systems. It introduces the principles of electronic instrumentation, the basic building blocks of instruments, and the way that software ties these blocks together to create a solution.