

BASIC ELECTRONICS *THEORY AND PRACTICE*

SECOND EDITION



SEAN WESTCOTT / JEAN RIESCHER WESTCOTT

BASIC ELECTRONICS

Second Edition

LICENSE, DISCLAIMER OF LIABILITY, AND LIMITED WARRANTY

By purchasing or using this book and disc (the “Work”), you agree that this license grants permission to use the contents contained herein, but does not give you the right of ownership to any of the textual content in the book or ownership to any of the information or products contained in it. *This license does not permit uploading of the Work onto the Internet or on a network (of any kind) without the written consent of the Publisher.* Duplication or dissemination of any text, code, simulations, images, etc. contained herein is limited to and subject to licensing terms for the respective products, and permission must be obtained from the Publisher or the owner of the content, etc., in order to reproduce or network any portion of the textual material (in any media) that is contained in the Work.

MERCURY LEARNING AND INFORMATION (“MLI” or “the Publisher”) and anyone involved in the creation, writing, or production of the companion disc, accompanying algorithms, code, or computer programs (“the software”), and any accompanying Web site or software of the Work, cannot and do not warrant the performance or results that might be obtained by using the contents of the Work. The author, developers, and the Publisher have used their best efforts to insure the accuracy and functionality of the textual material and/or programs contained in this package; we, however, make no warranty of any kind, express or implied, regarding the performance of these contents or programs. The Work is sold “as is” without warranty (except for defective materials used in manufacturing the book or due to faulty workmanship).

The author, developers, and the publisher of any accompanying content, and anyone involved in the composition, production, and manufacturing of this work will not be liable for damages of any kind arising out of the use of (or the inability to use) the algorithms, source code, computer programs, or textual material contained in this publication. This includes, but is not limited to, loss of revenue or profit, or other incidental, physical, or consequential damages arising out of the use of this Work.

The sole remedy in the event of a claim of any kind is expressly limited to replacement of the book and disc, and only at the discretion of the Publisher. The use of “implied warranty” and certain “exclusions” vary from state to state, and might not apply to the purchaser of this product.

Companion files may also be obtained by writing to the publisher at info@merclearning.com.

BASIC ELECTRONICS

Theory and Practice

Second Edition

Sean Westcott

Jean Riescher Westcott



MERCURY LEARNING AND INFORMATION

Dulles, Virginia

Boston, Massachusetts

New Delhi

Copyright ©2018 by MERCURY LEARNING AND INFORMATION LLC. All rights reserved.

This publication, portions of it, or any accompanying software may not be reproduced in any way, stored in a retrieval system of any type, or transmitted by any means, media, electronic display or mechanical display, including, but not limited to, photocopy, recording, Internet postings, or scanning, without prior permission in writing from the publisher.

Publisher: David Pallai
MERCURY LEARNING AND INFORMATION
22841 Quicksilver Drive
Dulles, VA 20166
info@merclearning.com
www.mericlearning.com
(800) 232-0223

S. Westcott and J. R. Westcott. *Basic Electronics: Theory and Practice. Second Edition.*
ISBN: 978-1-683920-33-5

The publisher recognizes and respects all marks used by companies, manufacturers, and developers as a means to distinguish their products. All brand names and product names mentioned in this book are trademarks or service marks of their respective companies. Any omission or misuse (of any kind) of service marks or trademarks, etc. is not an attempt to infringe on the property of others.

Library of Congress Control Number: 2017934666
171819 3 2 1 This book is printed on acid-free paper.
Printed in the United States of America

Our titles are available for adoption, license, or bulk purchase by institutions, corporations, etc.
For additional information, please contact the Customer Service Dept. at (800)232-0223(toll free).

All of our titles are available in digital format at authorcloudware.com and other digital vendors. *Companion disc files for this title are available by contacting info@merclearning.com.* The sole obligation of MERCURY LEARNING AND INFORMATION to the purchaser is to replace the disc, based on defective materials or faulty workmanship, but not based on the operation or functionality of the product.

CONTENTS

Introduction

About the Authors

Part 1: The Fundamentals

Chapter 1: The Theory Behind Electricity

Atoms and Their Structure

Electrons

Valence Shell

Conductors, Insulators, and Semiconductors

Conductors

Insulators

Semiconductors

Electron Flow Versus Hole Flow

The Least You Need to Know

Chapter Review Questions

Chapter 2: How Electricity Works

Circuits

Electromotive Force or Voltage

Current

Resistance

Ohm's Law

Power

Joule's Law

Putting It All Together

The Least You Need to Know

Chapter Review Questions

Lab 2.1: Constructing a Simple Circuit

Chapter 3: Currents and Circuits

Direct Current

Alternating Current

The War of Currents

Waveforms

Sine Wave

Other Waveforms

Phase

Using Waves to Measure AC Voltage

Direct Current Waveforms

More About Circuits

Circuit Diagrams

Short Circuits

Fuses and Circuit Breakers

Serial and Parallel Circuits

Learning the Language of Electronics

The Least You Need to Know

Chapter Review Questions

Part 2: Your Workspace and Tools

Chapter 4: Tools of the Trade

Essential Hand Tools

Essential Instruments

Lab 4-1: Taking a DC Voltage Reading

Lab 4-2: Taking an AC Voltage Reading

Lab 4-3: Measuring Resistance

Lab 4-4: Measuring Current

Electronics Specialty Items

Essential Safety Items

The Least You Need to Know

Chapter Review Questions

Chapter 5: Shop Setup and Safety

A Clean, Well-Lit Workshop

Claim Your Space

Your Workbench

Adequate Power

Lighting

Ventilation

Storage

Safety Equipment

Good Work Habits Are Good Safety Habits

Come Ready to Work

Dress for the Job

Be Neat and Work Deliberately

Know How Electricity Flows

First Aid for Electrical Shock

The Least You Need to Know

Chapter Review Questions

Part 3: Electronic Components

Chapter 6: Switches

Switch Symbols

Mechanical Switches

Poles and Throws

Lab 6-1: SPDT Switch

Push-button Switches

Knife Switches

Bi-metal Switches

Mercury Switches

Other Mechanical Switches

DIP Switches
Electromagnetic Switches or Relays
The Least You Need to Know
Chapter Review Questions

Chapter 7: Resistors

The Mighty Resistor
Fixed-Value Resistors
Resistor Color Codes and Power Ratings
Reading the Code
Power Ratings
Surface Mount Resistors
Single in Line Resistors
Variable Resistors
Kirchhoff's Laws
Calculating Resistance
Lab 7-1: Using Ohm's & Kirchhoff's Laws to Determine the Proper Resistor
Resistors in Series Circuits
Lab 7-2: Resistors in a Series Circuit
Resistors in Parallel Circuits
Lab 7-3: Resistors in a Parallel Circuit
Voltage Division Circuits
Lab 7-4: Voltage Division Using Fixed Value Resistors
Lab 7-5: Voltage Division Using a Variable Resistor
The Least You Need to Know
Chapter Review Questions

Chapter 8: Capacitors

How a Capacitor Works
Farads
Relative Permittivity
Capacitor Ratings
Nominal Value and Tolerance

- Temperature Coefficients
- Breakdown Voltage or DC Working Voltage
- Polarized Capacitor Types
- Electrolytic Capacitors
- Tantalum Capacitors
- Non-polarized Capacitor Types
- Variable Capacitors
- Capacitors in a Circuit
- Transient Time of Capacitors in a DC RC Circuit
- Lab 8-1: Charging Capacitance
- The Least You Need to Know
- Chapter Review Questions

Chapter 9: Diodes

- How Diodes Work
- Types of Semiconductor Diodes
- Common Silicon Diodes
- Zener Diodes
- Schottky Diodes
- Power Rectifiers
- Light-Emitting Diodes (LEDs)
- Photodiodes
- Handling Diodes
- The Least You Need to Know
- Chapter Review Questions

Chapter 10: Transistors

- Bipolar Junction Transistors (BJTs)
- How Amplifiers Work
- BJTs Under Varying Voltages
- Gain
- Darlington Pairs
- Field Effect Transistors