River Publishers

Basic DC Circuit Simulations: Theory, Verification, and Data Analysis

From Virtual Breadboards to Graphical Analysis

Author: Massimo Mitolo, PhD, PE, FIEEE, FIET



Basic DC Circuit Simulations: Theory, Verification, and Data Analysis provides a practical, hands-on introduction to direct current (DC) circuits, combining fundamental electrical theory with virtual experimentation and engineering data analysis. Designed as an introductory laboratory manual, the book helps students develop essential skills in circuit design, simulation, measurement, and technical reporting using accessible digital tools.

Through structured, step-by-step exercises, readers learn to construct and simulate DC circuits using Tinkercad Circuits, exploring component behavior, breadboard configurations, current limitations, and switching operations in a safe virtual environment. Mathematical analysis is integrated with simulation-based experimentation to reinforce fundamental circuit principles, including Ohm's Law and the Superposition Theorem.

The book also emphasizes accuracy in engineering calculations and measurements, providing practical guidance on significant figures, rounding, precision, and interpreting multimeter readings. Dedicated exercises introduce Microsoft Excel for organizing experimental data, generating scatter plots, applying linear regression, evaluating goodness of fit (R^2), and determining resistance from graphical analysis.

By connecting theoretical concepts with practical simulation and data interpretation, this manual builds a foundation for further study in electrical and electronic engineering. It is an ideal resource for undergraduate engineering and technology students, aspiring technicians, independent learners, and instructors seeking an accessible framework for virtual DC circuit laboratories.

TABLE OF CONTENTS

- Preface
- Lab Zero Introduction to Tinkercad Circuits
- Lab 1 Using solderless breadboard
- Lab 2 Measuring Voltage, Current, and Resistance with Digital Multimeters (DMMs)
- Lab 3 DC Variable Power Supplies
- Lab 4 Ohm’s law and linear Voltage-Current relationship
- Lab 5 Characterizing Light Dependent Resistors (LDRs)
- Lab 6 Analog Temperature Sensors (TMP36) and Signal Calibration
- Lab 7 Force-Sensing Resistors and Piezoresistive Force Measurement
- Lab 8 Rheostat dimmer for illumination control
- Lab 9 LED circuit with potentiometer and current-limiting resistor
- Lab 10 Measuring Power in DC Circuits
- Lab 11 Series Resistors in DC Circuits
- Lab 12 Kirchhoff’s Voltage Law (KVL)
- Lab 13 Voltage Divider
- Lab 14 Parallel Resistors in DC Circuits
- Lab 15 Kirchhoff’s Current Law (KCL)
- Lab 16 Current Divider
- Lab 17 Series-Parallel Circuit
- Lab 18 Ladder Network
- Lab 19 Verification of Superposition Theorem
- Appendix 1 Creating Engineering Charts in Excel
- Appendix 2 Significant Figures, Rounding, and Precision in circuit calculations



River Publishers Series in Electronic Materials, Circuits and Devices

ISBN: 9788743817390
e-ISBN: 9788743817406
Available From: January 2027
Price: € 133.13

KEYWORDS:
Absolute maximum rating (LED), Addition and subtraction rule, Anode, Battery / DC Power Source, Breadboard Architecture, Center divider, Internal connections, Power rails, Terminal strips, Calculation vs. display precision, Cathode, Coefficient of determination (R^2), Current-limiting resistor, Data Analysis (Excel), Dependent variable, Digital Multimeter (DMM), Exact values, Experimental resistance, False precision, Forward voltage drop (LED), Independent variable, Intermediate results, I-V Scatter Plot, Light Emitting Diode (LED), Measured values, Multiplication and division rule, Nominal resistor rating, Ohm's Law, Open circuit, Percent error, Power dissipation, Premature rounding, Resistor, Rounding rules, Short circuit, Single pole single t… …nificant Figures, Counting rules, De… …esence, Slope, Tinkercad Circuits … Canvas area, Components panel, … …rols, Wire color conventions, Trendli… …iable placement (Excel), XY (Scatter) Chart, y-intercept (b)

www.riverpublishers.com
marketing@riverpublishers.com