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Online Instructor's Manual
for

Electronics Fundamentals

A Systems Approach

Thomas L. Floyd

David M. Buchla

PEARSON

Boston Columbus Indianapolis New York San Francisco Upper Saddle River

Amsterdam Cape Town Dubai London Madrid Milan Munich Paris Montreal Toronto

Delhi Mexico City Sao Paulo Sydney Hong Kong Seoul Singapore Taipei Tokyo



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PART ONE

Solutions to End-of-Chapter Problems

CHAPTER 1

SYSTEMS, QUANTITIES AND UNITS

SECTION 1-1 The Electronics Industry

1. The circuit is first tested with a computer design and simulation program, which can simulate the performance and look for potential problems. When the simulation is satisfactory, a prototype circuit is constructed, tested, and modified as needed before putting it into production.
2. Semiconductor and component manufacturers as well as printed circuit board manufacturers.
3. Electronic assemblies have become more complex but also more reliable, so there is less need for repair. It is generally cheaper for manufacturers to replace a board than troubleshoot it to the component level. Skills needed by technicians tend to be broader skills than in the past.

SECTION 1-2 Introduction to Electronic Systems

4. Electrical systems deal primarily with power; electronic systems involve signals and a logical sequence of processes.
5. Advantages are that the digital signal can be processed and stored easily; it is also less subject to noise.
6. A block diagram shows signal flow in a system; a flowchart shows a logical process.

SECTION 1-3 Types of Circuits

7. (a) An electronic oscillator generates a repetitive electronic signal
(b) An oscillator does not have a signal input.
8. (a) High Voltage Direct Current

- (b) HVDC is used for long distance and underwater power transmission.
9. A carrier is a high frequency radio wave that can be modulated (changed) by a lower frequency signal.
10. A stair-step output; each step represents a different digital value.

SECTION 1-4 Scientific and Engineering Notation

11. (a) $3000 = 3 \times 10^3$ (b) $75,000 = 7.5 \times 10^4$ (c) $2,000,000 = 2 \times 10^6$
12. (a) $\frac{1}{500} = 0.002 = 2 \times 10^{-3}$
- (b) $\frac{1}{2000} = 0.0005 = 5 \times 10^{-4}$
- (c) $\frac{1}{5,000,000} = 0.0000002 = 2 \times 10^{-7}$
13. (a) $8400 = 8.4 \times 10^3$ (b) $99,000 = 9.9 \times 10^4$ (c) $0.2 \times 10^6 = 2 \times 10^5$
14. (a) $0.0002 = 2 \times 10^{-4}$ (b) $0.6 = 6 \times 10^{-1}$
- (c) 7.8×10^{-2} (already in scientific notation)
15. (a) $2.5 \times 10^{-6} = 0.0000025$ (b) $5.0 \times 10^2 = 500$ (c) $3.9 \times 10^{-1} = 0.39$
16. (a) $4.5 \times 10^{-6} = 0.0000045$
- (b) $8 \times 10^{-9} = 0.000000008$
- (c) $4.0 \times 10^{-12} = 0.0000000000040$
17. (a) $9.2 \times 10^6 + 3.4 \times 10^7 = 9.2 \times 10^6 + 34 \times 10^6 = 4.32 \times 10^7$
- (b) $5 \times 10^3 + 8.5 \times 10^{-1} = 5 \times 10^3 + 0.00085 \times 10^3 = 5.00085 \times 10^3$
- (c) $5.6 \times 10^{-8} + 4.6 \times 10^{-9} = 56 \times 10^{-9} + 4.6 \times 10^{-9} = 6.06 \times 10^{-8}$
18. (a) $3.2 \times 10^{12} - 1.1 \times 10^{12} = 2.1 \times 10^{12}$
- (b) $2.6 \times 10^8 - 1.3 \times 10^7 = 26 \times 10^7 - 1.3 \times 10^7 = 24.7 \times 10^7$
- (c) $1.5 \times 10^{-12} - 8 \times 10^{-13} = 15 \times 10^{-13} - 8 \times 10^{-13} = 7 \times 10^{-13}$
19. (a) $(5 \times 10^3)(4 \times 10^5) = 5 \times 4 \times 10^{3+5} = 20 \times 10^8 = 2 \times 10^9$

- (b) $(1.2 \times 10^{12})(3 \times 10^2) = 1.2 \times 3 \times 10^{12+2} = \mathbf{3.6 \times 10^{14}}$
- (c) $(2.2 \times 10^{-9})(7 \times 10^{-6}) = 2.2 \times 7 \times 10^{-9-6} = 15.4 \times 10^{-15} = \mathbf{1.54 \times 10^{-14}}$
20. (a) $\frac{1.0 \times 10^3}{2.5 \times 10^2} = 0.4 \times 10^{3-2} = 0.4 \times 10^1 = \mathbf{4}$
- (b) $\frac{2.5 \times 10^{-6}}{5.0 \times 10^{-8}} = 0.5 \times 10^{-6-(-8)} = 0.5 \times 10^2 = \mathbf{50}$
- (c) $\frac{4.2 \times 10^8}{2 \times 10^{-5}} = 2.1 \times 10^{8-(-5)} = \mathbf{2.1 \times 10^{13}}$
21. (a) $89,000 = \mathbf{89 \times 10^3}$
- (b) $450,000 = \mathbf{450 \times 10^3}$
- (c) $12,040,000,000,000 = \mathbf{12.04 \times 10^{12}}$
22. (a) $2.35 \times 10^5 = \mathbf{235 \times 10^3}$
- (b) $7.32 \times 10^7 = \mathbf{73.2 \times 10^6}$
- (c) $\mathbf{1.333 \times 10^9}$ (already in engineering notation)
23. (a) $0.000345 = \mathbf{345 \times 10^{-6}}$
- (b) $0.025 = \mathbf{25 \times 10^{-3}}$
- (c) $0.00000000129 = \mathbf{1.29 \times 10^{-9}}$
24. (a) $9.81 \times 10^{-3} = \mathbf{9.81 \times 10^{-3}}$
- (b) $4.82 \times 10^{-4} = \mathbf{482 \times 10^{-6}}$
- (c) $4.38 \times 10^{-7} = \mathbf{438 \times 10^{-9}}$
25. (a) $2.5 \times 10^{-3} + 4.6 \times 10^{-3} = (2.5 + 4.6) \times 10^{-3} = \mathbf{7.1 \times 10^{-3}}$
- (b) $68 \times 10^6 + 33 \times 10^6 = (68 + 33) \times 10^6 = \mathbf{101 \times 10^6}$
- (c) $1.25 \times 10^6 + 250 \times 10^3 = 1.25 \times 10^6 + 0.25 \times 10^6 = (1.25 + 0.25) \times 10^6 = \mathbf{1.50 \times 10^6}$
26. (a) $(32 \times 10^{-3})(56 \times 10^3) = 1792 \times 10^{(-3+3)} = 1792 \times 10^0 = \mathbf{1.792 \times 10^3}$
- (b) $(1.2 \times 10^{-6})(1.2 \times 10^{-6}) = 1.44 \times 10^{(-6-6)} = \mathbf{1.44 \times 10^{-12}}$

- (c) $(100)(55 \times 10^{-3}) = 5500 \times 10^{-3} = \mathbf{5.5}$
27. (a) $\frac{50}{2.2 \times 10^3} = \mathbf{22.7 \times 10^{-3}}$
- (b) $\frac{5 \times 10^3}{25 \times 10^{-6}} = 0.2 \times 10^{(3-(-6))} = 0.2 \times 10^9 = \mathbf{200 \times 10^6}$
- (c) $\frac{560 \times 10^3}{660 \times 10^3} = 0.848 \times 10^{(3-3)} = 0.848 \times 10^0 = \mathbf{848 \times 10^{-3}}$

SECTION 1-5 Units and Metric Prefixes

28. (a) $89,000 \Omega = 89 \times 10^3 = \mathbf{89 \text{ k}\Omega}$
- (b) $450,000 \Omega = 450 \times 10^3 = \mathbf{450 \text{ k}\Omega}$
- (c) $12,040,000,000,000 \Omega = 12.04 \times 10^{12} = \mathbf{12.04 \text{ T}\Omega}$
29. (a) $0.000345 \text{ A} = 345 \times 10^{-6} \text{ A} = \mathbf{345 \mu\text{A}}$
- (b) $0.025 \text{ A} = 25 \times 10^{-3} \text{ A} = \mathbf{25 \text{ mA}}$
- (c) $0.00000000129 \text{ A} = 1.29 \times 10^{-9} \text{ A} = \mathbf{1.29 \text{ nA}}$
30. (a) $31 \times 10^{-3} \text{ A} = \mathbf{31 \text{ mA}}$ (b) $5.5 \times 10^3 \text{ V} = \mathbf{5.5 \text{ kV}}$ (c) $20 \times 10^{-12} \text{ F} = \mathbf{20 \text{ pF}}$
31. (a) $3 \times 10^{-6} \text{ F} = \mathbf{3 \mu\text{F}}$ (b) $3.3 \times 10^6 \Omega = \mathbf{3.3 \text{ M}\Omega}$ (c) $350 \times 10^{-9} \text{ A} = \mathbf{350 \text{ nA}}$
32. (a) $5 \mu\text{A} = \mathbf{5 \times 10^{-6} \text{ A}}$ (b) $43 \text{ mV} = \mathbf{43 \times 10^{-3} \text{ V}}$
- (c) $275 \text{ k}\Omega = \mathbf{275 \times 10^3 \Omega}$ (d) $10 \text{ MW} = \mathbf{10 \times 10^6 \text{ W}}$

SECTION 1-6 Metric Unit Conversions

33. (a) $(5 \text{ mA})(1 \times 10^3 \mu\text{A/mA}) = 5 \times 10^3 \mu\text{A} = \mathbf{5000 \mu\text{A}}$
- (b) $(3200 \mu\text{W})(1 \times 10^{-3} \text{ W}/\mu\text{W}) = \mathbf{3.2 \text{ mW}}$
- (c) $(5000 \text{ kV})(1 \times 10^{-3}) \text{ MV/kV} = \mathbf{5 \text{ MV}}$
- (d) $(10 \text{ MW})(1 \times 10^3 \text{ kW/MW}) = 10 \times 10^3 \text{ kW} = \mathbf{10,000 \text{ kW}}$

34. (a) $\frac{1 \text{ mA}}{1 \mu\text{A}} = \frac{1 \times 10^{-3} \text{ A}}{1 \times 10^{-6} \text{ A}} = 1 \times 10^3 = \mathbf{1000}$
- (b) $\frac{0.05 \text{ kV}}{1 \text{ mV}} = \frac{0.05 \times 10^3 \text{ V}}{1 \times 10^{-3} \text{ V}} = 0.05 \times 10^6 = \mathbf{50,000}$
- (c) $\frac{0.02 \text{ k}\Omega}{1 \text{ M}\Omega} = \frac{0.02 \times 10^3 \Omega}{1 \times 10^6 \Omega} = 0.02 \times 10^{-3} = \mathbf{2 \times 10^{-5}}$
- (d) $\frac{155 \text{ mW}}{1 \text{ kW}} = \frac{155 \times 10^{-3} \text{ W}}{1 \times 10^3 \text{ W}} = 155 \times 10^{-6} = \mathbf{1.55 \times 10^{-4}}$
35. (a) $50 \text{ mA} + 680 \mu\text{A} = 50 \text{ mA} + 0.68 \text{ mA} = \mathbf{50.68 \text{ mA}}$
- (b) $120 \text{ k}\Omega + 2.2 \text{ M}\Omega = 0.12 \text{ M}\Omega + 2.2 \text{ M}\Omega = \mathbf{2.32 \text{ M}\Omega}$
- (c) $0.02 \mu\text{F} + 3300 \text{ pF} = 0.02 \mu\text{F} + 0.0033 \mu\text{F} = \mathbf{0.0233 \mu\text{F}}$
36. (a) $\frac{10 \text{ k}\Omega}{2.2 \text{ k}\Omega + 10 \text{ k}\Omega} = \frac{10 \text{ k}\Omega}{12.2 \text{ k}\Omega} = \mathbf{0.8197}$
- (b) $\frac{250 \text{ mV}}{50 \mu\text{V}} = \frac{250 \times 10^{-3}}{50 \times 10^{-6}} = \mathbf{5000}$
- (c) $\frac{1 \text{ MW}}{2 \text{ kW}} = \frac{1 \times 10^6}{2 \times 10^3} = \mathbf{500}$

SECTION 1-7 Measured Numbers

37. (a) 1.00×10^3 has 3 significant digits. (b) 0.0057 has 2 significant digits.
- (c) 1502.0 has 5 significant digits. (d) 0.000036 has 2 significant digits.
- (e) 0.105 has 3 significant digits. (f) 2.6×10^2 has 2 significant digits.
38. (a) $50,505 \cong \mathbf{50.5 \times 10^3}$ (b) $220.45 \cong \mathbf{220}$
- (c) $4646 \cong \mathbf{4.65 \times 10^3}$ (d) $10.99 \cong \mathbf{11.0}$
- (e) $1.005 \cong \mathbf{1.00}$