Online Instructor's Manual
for

Electronics Fundamentals
A Systems Approach

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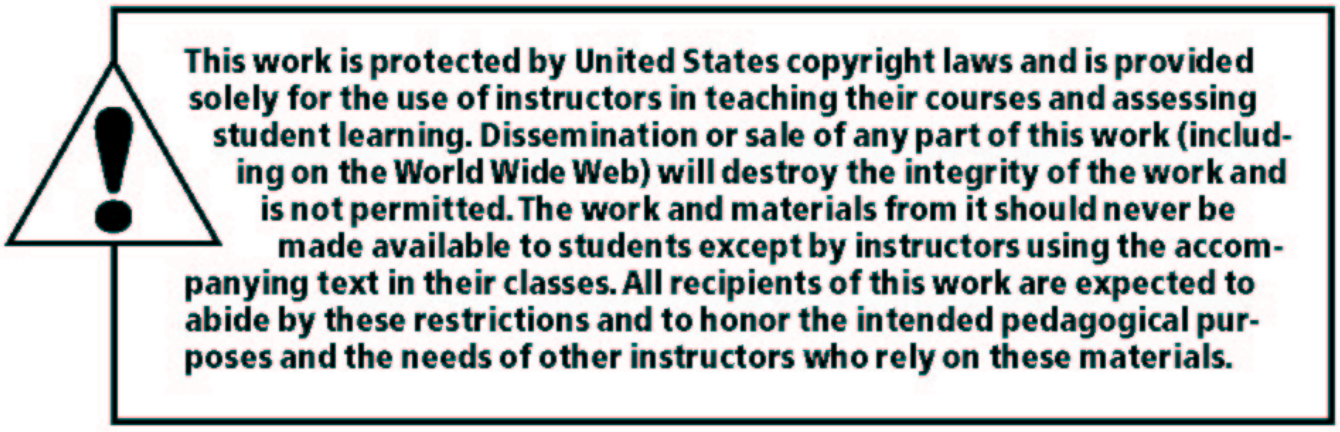

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PART ONE

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) $3000 = \mathbf{3 \times 10^3}$ (b) $75{,}000 = \mathbf{7.5 \times 10^4}$ (c) $2{,}000{,}000 = \mathbf{2 \times 10^6}$

12. (a) $\frac{1}{500} = 0.002 = \mathbf{2 \times 10^{-3}}$

(b) $\frac{1}{2000} = 0.0005 = \mathbf{5 \times 10^{-4}}$

(c) $\frac{1}{5{,}000{,}000} = 0.0000002 = \mathbf{2 \times 10^{-7}}$

13. (a) $8400 = \mathbf{8.4 \times 10^3}$ (b) $99{,}000 = \mathbf{9.9 \times 10^4}$ (c) $0.2 \times 10^6 = \mathbf{2 \times 10^5}$

14. (a) $0.0002 = \mathbf{2 \times 10^{-4}}$ (b) $0.6 = \mathbf{6 \times 10^{-1}}$

(c) $\mathbf{7.8 \times 10^{-2}}$ (already in scientific notation)

15. (a) $2.5 \times 10^{-6} = \mathbf{0.0000025}$ (b) $5.0 \times 10^2 = \mathbf{500}$ (c) $3.9 \times 10^{-1} = \mathbf{0.39}$

16. (a) $4.5 \times 10^{-6} = \mathbf{0.0000045}$

(b) $8 \times 10^{-9} = \mathbf{0.000000008}$

(c) $4.0 \times 10^{-12} = \mathbf{0.0000000000040}$

17. (a) $9.2 \times 10^6 + 3.4 \times 10^7 = 9.2 \times 10^6 + 34 \times 10^6 = \mathbf{4.32 \times 10^7}$

(b) $5 \times 10^3 + 8.5 \times 10^{-1} = 5 \times 10^3 + 0.00085 \times 10^3 = \mathbf{5.00085 \times 10^3}$

(c) $5.6 \times 10^{-8} + 4.6 \times 10^{-9} = 56 \times 10^{-9} + 4.6 \times 10^{-9} = \mathbf{6.06 \times 10^{-8}}$

18. (a) $3.2 \times 10^{12} - 1.1 \times 10^{12} = \mathbf{2.1 \times 10^{12}}$

(b) $2.6 \times 10^8 - 1.3 \times 10^7 = 26 \times 10^7 - 1.3 \times 10^7 = \mathbf{24.7 \times 10^7}$

(c) $1.5 \times 10^{-12} - 8 \times 10^{-13} = 15 \times 10^{-13} - 8 \times 10^{-13} = \mathbf{7 \times 10^{-13}}$

19. (a) $(5 \times 10^3)(4 \times 10^5) = 5 \times 4 \times 10^{3+5} = 20 \times 10^8 = \mathbf{2 \times 10^9}$

(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) $\dfrac{50}{2.2 \times 10^{3}} = \mathbf{22.7 \times 10^{-3}}$

(b) $\dfrac{5 \times 10^{3}}{25 \times 10^{-6}} = 0.2 \times 10^{(3-(-6))} = 0.2 \times 10^{9} = \mathbf{200 \times 10^{6}}$

(c) $\dfrac{560 \times 10^{3}}{660 \times 10^{3}} = 0.848 \times 10^{(3-3)} = 0.848 \times 10^{0} = \mathbf{848 \times 10^{-3}}$

SECTION 1-5 Units and Metric Prefixes

28. (a) 89,000 Ω = 89×10^{3} = **89 kΩ**

(b) 450,000 Ω = 450×10^{3} = **450 kΩ**

(c) 12,040,000,000,000 Ω = 12.04×10^{12} = **12.04 TΩ**

29. (a) 0.000345 A = 345×10^{-6} A = **345 μA**

(b) 0.025 A = 25×10^{-3} A = **25 mA**

(c) 0.00000000129 A = 1.29×10^{-9} A = **1.29 nA**

30. (a) 31×10^{-3} A = **31 mA** (b) 5.5×10^{3} V = **5.5 kV** (c) 20×10^{-12} F = **20 pF**

31. (a) 3×10^{-6} F = **3 μF** (b) 3.3×10^{6} Ω = **3.3 MΩ** (c) 350×10^{-9} A = **350 nA**

32. (a) 5 μA = **5×10^{-6} A** (b) 43 mV = **43×10^{-3} V**

(c) 275 kΩ = **275×10^{3} Ω** (d) 10 MW = **10×10^{6} W**

SECTION 1-6 Metric Unit Conversions

33. (a) (5 mA) (1×10^{3} μA/mA) = 5×10^{3} μA = **5000 μA**

(b) (3200 μW)(1×10^{-3} W/μW) = **3.2 mW**

(c) (5000 kV)(1×10^{-3}) MV/kV = **5 MV**

(d) (10 MW)(1×10^{3} kW/MW) = 10×10^{3} kW = **10,000 kW**

34. (a) $\frac{1\,\text{mA}}{1\,\mu\text{A}} = \frac{1\times10^{-3}\,\text{A}}{1\times10^{-6}\,\text{A}} = 1 \times 10^{3} =$ **1000**

(b) $\frac{0.05\,\text{kV}}{1\,\text{mV}} = \frac{0.05\times10^{3}\ \text{V}}{1\times10^{-3}\ \text{V}} = 0.05 \times 10^{6} =$ **50,000**

(c) $\frac{0.02\,\text{k}\Omega}{1\,\text{M}\Omega} = \frac{0.02\times10^{3}\ \Omega}{1\times10^{6}\ \Omega} = 0.02 \times 10^{-3} =$ **2×10^{-5}**

(d) $\frac{155\,\text{mW}}{1\,\text{kW}} = \frac{155\times10^{-3}\ \text{W}}{1\times10^{3}\ \text{W}} = 155 \times 10^{-6} =$ **1.55×10^{-4}**

35. (a) 50 mA + 680 μA = 50 mA + 0.68 mA = **50.68 mA**

(b) 120 kΩ + 2.2 MΩ = 0.12 MΩ + 2.2 MΩ = **2.32 MΩ**

(c) 0.02 μF + 3300 pF = 0.02 μF + 0.0033 μF = **0.0233 μF**

36. (a) $\frac{10\,\text{k}\Omega}{2.2\,\text{k}\Omega + 10\,\text{k}\Omega} = \frac{10\,\text{k}\Omega}{12.2\,\text{k}\Omega} =$ **0.8197**

(b) $\frac{250\,\text{mV}}{50\,\mu\text{V}} = \frac{250\times10^{-3}}{50\times10^{-6}} =$ **5000**

(c) $\frac{1\,\text{MW}}{2\,\text{kW}} = \frac{1\times10^{6}}{2\times10^{3}} =$ **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 ≅ **50.5×10^{3}**
(b) 220.45 ≅ **220**
(c) 4646 ≅ **4.65×10^{3}**
(d) 10.99 ≅ **11.0**
(e) 1.005 ≅ **1.00**