

Student Study Guide

Part A: Analog Electronics

Chapter 1: Diodes, Rectifiers and Regulators

- **Electron Flow & P-N Junctions:** Understand how electrons flow in forward and reverse-biased conditions, and the definition of a P-N junction (**Pages 1-6 to 1-8**). *Note: The Erratum corrects Q1 and Q5 regarding the precise phrasing of electron flow from negative to positive terminals.*
- **Rectifiers:** Know the differences between Half-Wave, Full-Wave Centre-Tapped, and Full-Wave Bridge rectifiers, including their life safety applications like trace heating (**Pages 1-12 to 1-14**).
- **Zener Diodes:** Review how Single and Dual Zener Diode Regulators operate, including the role of the resistor in limiting current, and how to calculate combined voltages (**Pages 1-17 to 1-18**). *Note: The Erratum corrects Q15 regarding a 10-volt peak rectified half wave.*

Chapter 2: Bipolar Transistors

- **Transistor Basics:** Identify the three terminals (Base, Emitter, Collector), the layers of semiconductor materials, and the two types of Bipolar Transistors (NPN and PNP) (**Pages 2-3 to 2-5**).
- **Common-Base Amplifiers:** Review the purpose of resistors (limiting current) and capacitors (permitting AC voltage to pass), as well as the function of -Vee (**Pages 2-9 to 2-10**).
- **Common-Emitter & Common-Collector Amplifiers:** Understand how current flows through the base resistor and emitter resistor in a Common-Emitter circuit (**Page 2-10**). Know that a Common-Collector circuit is also called an Emitter Follower and how its output synchronizes with the input signal (**Page 2-11**).

Chapter 3: Field Effect Transistors

- **JFETs:** Identify the three terminals (Drain, Gate, Source), the two required materials (N-type and P-type), and the "water faucet" analogy for how a JFET operates (**Pages 3-4 to 3-5**).
- **MOSFETs:** Know what MOSFET stands for, the differences between Depletion and Enhancement types, and why its higher input impedance is an advantage over JFETs (**Pages 3-9 to 3-11**).

- **UJTs & SCRs:** Identify the Unijunction Transistor terminals and its two states (**Pages 3-12 to 3-13**). Review the function of an SCR in battery chargers and what TRIAC stands for (**Pages 3-14 to 3-16**).

Chapter 4: Power Supplies

- **AC to DC Conversion:** Understand why and how power is converted for electronic systems (**Page 4-3**).
- **Unregulated vs. Regulated:** Know the three main components of an unregulated supply (transformer, rectifier, filter) and how output fluctuates with the load (**Pages 4-3 to 4-4**). Differentiate between Linear and Switching regulated supplies (**Pages 4-4 to 4-5**).
- **Integrated Linear Regulators:** Understand the role of the Control Element, Feedback Control circuit, and dual-voltage chips like the LM317 (**Pages 4-5 to 4-6**).
- **Switching Power Supplies:** Review the advantages (clean output, cost-effective components) and practical DC/DC circuits like Buck, Boost, and Buck-Boost converters (**Pages 4-8, 4-11**).

Chapter 5: Operational Amplifiers

- **Ideal Op-Amp Characteristics:** Review why Op-Amps are the most commonly used Linear Integrated Circuits. Know that they provide infinite (or very high) input impedance, zero (or very low) output impedance, and unlimited open-loop gain (**Pages 5-4 to 5-5**).
- **Output Parameters:** Understand that output depends on the values of the supply voltages (+V and -V), polarity relationships, and load resistance (**Page 5-6**).

Chapter 6: Analog Electronics Applications

- **Supervisory & Alarm Conditions:** Understand how the blocking diode in an alarm bell enables electrical supervision (**Page 6-3**). Review how the Control Unit reverses polarity to initiate an alarm, passing current through the diode (**Page 6-4**). *Note: The Erratum modifies Q2 to state that the End of Line resistor acts as a "biasing resistor for a transistor located in the control panel".*
 - **Signals & Power:** Identify the 3-3-3 Temporal Alarm Signal pattern (**Page 6-5**) and the requirement for an independently-fused 115-volt 60-hertz power supply (**Page 6-4**).
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Part B: Digital Electronics

Chapter 7: Numbering Systems

- **Analog vs. Digital:** Differentiate between continuous analog signals and discrete digital steps (**Pages 7-3 to 7-4**).
- **Numbering Formats:** Be able to identify the Base-10 (Decimal), Base-2 (Binary), Base-8 (Octal), Base-16 (Hexadecimal), and Binary Coded Decimal (BCD) systems (**Pages 7-4 to 7-8**).

Chapter 8: Logic Gates

- **Logic Families:** Understand TTL (Transistor-Transistor Logic built with bipolar junction transistors) and CMOS (Complementary Metal-Oxide-Semiconductor) (**Pages 8-3 to 8-6**). Review the 7400 IC series (**Page 8-4**) and sub-class designations like LS (Low-Power Schottky) and ALS (Advanced Low-Power Schottky) (**Page 8-5**).
- **Flip-Flops:** Identify flip-flops as circuits that store state information (**Page 8-9**). Differentiate between the four types: RS (Non-Synchronous), JK (Synchronous), D, and T (**Pages 8-9 to 8-22**). Know that SET, RESET, PRESET, and CLEAR are "Toggle Inputs" (**Page 8-22**).

Chapter 9: Digital System Components

- **Registers & Counters:** Understand how registers transfer data based on clock pulses (**Page 9-3**) and the function of Shift Registers (**Pages 9-5 to 9-6**). Review the three types of counters: Asynchronous (Ripple), Synchronous, and Pre-settable (**Pages 9-12 to 9-14**).
- **Multiplexers & Decoders:** Know that a multiplexer combines several input signals into a single output, while a decoder is a de-multiplexer without an input line (**Pages 9-15 to 9-21**).
- **A/D and D/A Converters:** Review how analog signals are conditioned, multiplexed, and converted (**Pages 9-22 to 9-24, 9-29**). Study the AD7520 Chip's 10-bit resolution (**Page 9-27**).

Chapter 10: Digital System Components

- **The Development Board:** Review the components (CPU, Memory, Interface) and the "Memory Mapping" process required to set up the board (**Pages 10-3 to 10-7**).

- **CPU Architecture:** Understand the roles of the Arithmetic Logic Unit (ALU) decodes, the Internal Register Files (Stack Point, Segment, Instruction Pointer), and the Control Unit's interrupt 'Handler' (**Pages 10-3 to 10-6**).
 - **Processors & Chips:** Differentiate between Microprocessors, Microcontrollers (a computer on a one-chip solution), and Digital Signal Processors (DSPs) (**Pages 10-11 to 10-14**). Review Programmable Logic Devices (PLDs) and Field Programmable Gate Arrays (FPGAs) programmed with VHDL (**Pages 10-16 to 10-17**).
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Part C: Life Safety Applications

Chapter 11: Analog Applications

- **System Components & Codes:** Review the primary components of a fire alarm system (Control Unit, Initiating Devices, Signalling Devices) (**Page 11-4**). Understand how the *Building Code* dictates system requirements and how *CAN/ULC-S561* governs off-site monitoring connections (**Pages 11-7, 11-10**).
- **Ancillary Devices:** Review the operation of Mag-locks, annunciators, and Hospital Proportional Integral Regulators for smoke control (**Pages 11-5 to 11-9**).
- **Fire Detectors:** Differentiate the sensing methods of Fixed-Temperature and Rate-of-Rise heat detectors (**Pages 11-11 to 11-12**), optical flame detectors (**Pages 11-12 to 11-13**), and Ionization vs. Photoelectric smoke detectors (**Pages 11-13 to 11-16**).

Chapter 12: Signalling Applications

- **Alert vs. Alarm Signals:** Distinguish between a first-stage Alert signal and a second-stage Evacuation Alarm signal (**Page 12-4**).
- **Principles of Sound:** Review the human hearing range (20 Hz to 18,000 Hz) and the Inverse Square Law (a change of 3 dB represents a 50% change in power, while +3 dB requires twice the sound power) (**Pages 12-5 to 12-6**).
- **Signalling Devices:** Compare vibrating bells (which use an interrupting contact) to single-stroke bells, electronic horns, and chimes (**Pages 12-6 to 12-8**). Know that the "Temporal Pattern" refers to a specific timing sequence applied to sound (**Page 12-9**).
- **Speaker Circuits:** Understand how line matching transformers operate, how amplifiers are loaded and zoned, and the critical requirement that voice messages be "intelligible" (**Pages 12-11 to 12-14**).

Chapter 13: Digital Applications

- **Data Transfer:** Understand the differences between Simplex, Half-Duplex, and Full-Duplex communication (simultaneous two-way transfer) (**Pages 13-4 to 13-5**).
- **Addressable Devices:** Review how addressable active field devices provide unique identifiers to the CPU, reducing wiring and installation costs (**Pages 13-7 to 13-8**). Understand how to identify the Most Significant Bit (MSB) and Least Significant Bit (LSB) in Binary Coded Decimal (BCD) (**Page 13-7**).
- **Fault Isolator Modules:** Know that Fault Isolators prevent a single short circuit from disabling an entire Data Communication Link (DCL) (**Page 13-9**). Remember that they define fire zones, must not exceed specific area limits, and are always installed in pairs (**Pages 13-9 to 13-10**).

Chapter 14: Network Applications

- **Protective Signalling Systems:** Differentiate between Local, Auxiliary, Remote Station, Central Station, and Proprietary systems (**Pages 14-6 to 14-7**). Review the use of DVAC Modems and CAN/ULC-S561 compliance (**Pages 14-4 to 14-5**).
- **System Operations:** Understand the 5-minute Auto-Evacuation fail-safe countdown timer in Two-Stage systems (**Pages 14-7 to 14-8**).
- **Network Architectures:** Review the survivability differences between Master-Slave and Peer-to-Peer transponder networks (**Pages 14-10 to 14-12**). Understand how DCL-C wiring provides two alternate communication paths for high survivability (**Page 14-12**), and how this plays into modern IP-based "Intelligent Buildings" (**Page 14-13**).