

S.E.T. Student Electronics Technician
BASIC ELECTRONICS COMPETENCIES FOR S.E.T.
March 2004 STUDENT ELECTRONICS TECHNICIAN

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Greencastle, IN 46135

Training electronics workers as entry level, apprenticed, installer personnel should include the following 19 Categories and 145 Item subject matter headings:

- 1.0 Electrical Theory**
 - 1.1 Describe atomic structure, the components of the atom, their charges and importance to electronics technology
 - 1.2 List ten uses for magnetism in electronics technology
 - 1.3 Explain basic uses for electricity
 - 1.4 Describe the basic methods of using electricity to operate a motor and how mechanical motion causes a generator to produce electrical current
 - 1.5 Explain the differences between current, voltage and resistance
 - 1.6 List different types of resistive materials and how resistors are used in electronics
 - 1.7 Show the different purposes for capacitors and list common types and construction
 - 1.8 Explain how inductance relates to magnetism and describe coil construction, cores and usages
 - 1.9 Show a comparison between reactance and resistance and describe current/voltage relationships
 - 1.10 Compare impedance with reactance and resistance and explain the causes and effects of impedance
 - 1.11 List voltage sources, AC and DC, batteries and natural generation
 - 1.12 List ohms law formulas for current, voltage, resistance and power. Solve math problems utilizing each
 - 1.13 Calculate power consumption and requirements

- 2.0 Electronic Components**
 - 2.1 Identify resistor values from color code or other marks and list composition and reasons for different usages
 - 2.2 Identify capacitor types; list common usages; methods of varying capacitance and explain the terms *charge* and *coulomb*
 - 2.3 Identify inductor types and reasons for various core materials; how diameter and wire size affects the values
 - 2.4 Identify common types of transformers and list uses for each; explain step up/down voltage methods; explain why laminations are used
 - 2.5 Identify transistors as to type and usage, such as unijunction, FETs and MOSFETS; explain beta and alpha and provide common DC and bias voltage ranges; list common usage
 - 2.6 Identify other semiconductors and explain their uses: Darlington pairs; unijunction transistors and Gunn diodes

- 2.7 Compare thyristors with other semiconductors; Identify diacs, triacs and SCRs and explain their operation.
- 2.8 Explain zeners diode ratings; describe usage in regulator circuits
- 2.9 List common optical devices (LEDs, LCDs, etc.) and describe how photovoltaic cells are activated. Draw symbols for photo resistors, photodiodes and phototransistors; list materials from which these devices are made
- 2.10 Describe MOS, CMOS, FET applications

3.0 Soldering-Desoldering and Tools

- 3.1 Describe solder safety as it pertains to burns and potential fires or damage to facilities or customer products
- 3.2 Explain the cause of solder fumes and the effects of lead poisoning
- 3.3 List causes and precautions to prevent or reduce solder splatter
- 3.4 Explain the reasons for flux usage and describe types
- 3.5 List types of solder and reasons for choosing each
- 3.6 Explain heat shunts, why and how they are used
- 3.7 Identify cold solder joints and explain causes
- 3.8 Describe the differences between good and bad mechanical and electrical solder connections
- 3.9 Demonstrate proper care of solder-desolder equipment and aids
- 3.10 Explain desoldering principles
- 3.11 Describe various types of desoldering equipment and how it is used
- 3.12 Demonstrate the use of braid-wick solder removers

4.0 Block Diagrams—Schematics-Wiring Diagrams

- 4.1 Draw common electrical/electronic symbols
- 4.2 Explain how block diagrams are used for trouble shooting and maintenance of electronics products
- 4.3 Explain the differences between wiring prints, schematics and block diagrams
- 4.4 Describe the purpose and use of test points. Indicate their likely placement on schematics
- 4.5 Explain how schematics are used to locate component and wiring failures in electronics products
- 4.6 Explain the methods of using flow diagrams/charts

5.0 Cabling

- 5.1 List wire types and construction
- 5.2 List wire gauges used for various purposes
- 5.3 Explain construction of coaxial cable and the impedance characteristics
- 5.4 List common identifications for copper cables, such as #18 and #24, and UTP telephone cable
- 5.5 Explain major differences between copper, coaxial and fiber optic cables
- 5.6 Describe impedance and its causes; explain reasons for maintaining a cable's characteristics
- 5.7 Explain the effects of proper and improper termination

- 5.8 Explain the purposes of grounding and common conventions used in electrical and electronics
- 5.9 Demonstrate splicing knowledge and ability for coaxial and copper cable; explain two types of fiber splices
- 5.10 Demonstrate testing methods for all three types of cables and compare dB loss measurements and techniques
- 5.11 Compare the fittings and connectors used in cabling and list potential defects a technician may encounter
- 5.12 Describe proper crimping of communications wiring connectors
- 5.13 Explain how cable prep tools are used and demonstrate proper and improper crimping

6.0 Power Supplies

- 6.1 Explain shock hazards when servicing power supplies in electronic equipment
- 6.2 Describe the differences between transformer powered supplies and line connected supplies
- 6.3 Describe battery supplies and list common usages; also explain recharging principles
- 6.4 Explain the reasons for filtering, describe hum, identify common filter types (π , t, l, etc.)
- 6.5 Explain the reasons for power supply regulation and list common components used in regulated supplies
- 6.6 Explain where fuses and circuit breakers are commonly and electrically located in circuits; approximate sizes for common circuits; house service box common fuses and circuit breaker configuration and precautions for replacement

7.0 Test Equipment & Measurements

- 7.1 Describe how volt-ohm-current meters operate
- 7.2 Identify meter protection, safety and usage
- 7.3 Explain care of equipment and test leads
- 7.4 List the purposes and types of signal generators
- 7.5 Describe meter loading and precautions
- 7.5 Explain what R-C-L substitution equipment is and its purposes; explain ESR Capacitance-measurement equipment
- 7.7 List the uses and precautions for logic test probes
- 7.8 Explain how logic pulsers are used
- 7.9 Describe oscilloscope usage; explain the purposes of each front panel control
- 7.10 List the uses for pattern generators
- 7.11 Define dummy load; show where and why used
- 7.12 Explain reasons for using rheostats, isolation transformers and variacs and why size matters

8.0 Safety Precautions

- 8.1 Describe the physiological reactions electrical shock causes; list various degrees of current the human body can tolerate

- 8.2 Explain the concept of First Aid and its particular importance to workers in electric and electronics fields; explain precautions for untrained people
- 8.3 Explain what the National Electric Code is and describe various rules technicians must abide by
- 8.4 Explain NFPA rules and describe how technicians comply and may violate them
- 8.5 Describe fusing and circuit breaker rules and reasons for different type of fuses
- 8.6 Explain static causes and CMOS damage prevention straps, mats and grounding
- 8.7 List tools hazards that are associated with technician activities in the workplace and in the field.
- 8.8 Describe lockout and tagging rules for potentially unsafe electrical or mechanical hazards
- 8.9 Explain eye and ear protection needed by technicians
- 8.10 List ladder handling and usage and OSHA heights safety rules
- 8.11 List service vehicle safety concerns such as ladder or transporting security and flying objects, driver screens inside the vehicle
- 8.12 Describe the types and usage of fire extinguishers

9.0 Mathematics and Formulas

- 9.1 Quote Ohms law power, voltage, current and resistance formulas and solve for circuit values
- 9.2 List other common basic electronic formulas

10.0 Electronic Circuits: Series and Parallel

- 10.1 Identify and describe the operation of common DC circuits
- 10.2 Identify and describe the operation of common AC circuits
- 10.3 Explain how series circuits, R, L, C are used in electronics equipment
- 10.4 Explain the purpose of oscillators
- 10.5 Show how oscillators and multivibrators are similar and how they differ
- 10.6 Describe filter circuits, why and how they are used

11.0 Amplifiers

- 11.1 List common amplifier devices
- 11.2 Describe the purpose of each component in an amplifier circuit
- 11.3 List the usages and classes of amplifiers
- 11.4 Describe biasing and gain characteristics
- 11.5 Explain frequency response of an amplifier circuit and why it is important
- 11.6 Explain the uses of operational amplifiers and how they differ from other amplifiers
- 11.7 Show causes of distortion in amplifiers and list ways to reduce or eliminate it
- 11.8 Explain how inaccurate measurements can be experienced due to meter or scope loading. List ways to overcome loading problems

12.0 Interfacing of Electronics Products

- 12.1 List input circuit signal levels that may be expected for various common electronics products or test equipment

- 12.2 List anticipated signal or voltage levels for output circuits in audio and video equipment
- 12.3 Explain the importance of impedance matching; list causes of mismatches
- 12.4 Explain the purposes of plugs and connectors and why it is necessary to use the proper ones
- 12.5 Explain grounding, proper and improper methods, and the results of power source mismatch

13.0 Digital Concepts and Circuitry

- 13.1 Describe ASCII code
- 13.2 Identify each basic digital gate
- 13.3 Construct truth tables for common gates
- 13.4 Explain how counters operate
- 13.5 Explain the purpose of flip-flops and list common types
- 13.6 Explain the purpose of a digital bus and show how it is connected to various sections of a product
- 13.7 List types of display circuitry and describe how numbers and letters are activated digitally
- 13.8 Explain the purpose of computer clocks
- 13.9 Show how pulsers are used for digital signal tracing and how logic probes are used to verify states in digital equipment
- 13.10 Describe digital clock usage and circuitry
- 13.11 Describe how microprocessors function and identify the basic components and pinouts

14.0 Computer Electronics

- 14.1 Describe the major sections of a computer
- 15.2 Demonstrate how the computer block diagram and flow charts are utilized
- 15.3 Describe different types of computer memory and how storage is accomplished
- 15.4 Define the word peripheral and list various types

15.0 Computer Applications

- 15.1 Demonstrate knowledge of basic computer operation
- 15.2 List ways to backup data and the importance of doing so
- 15.3 Explain the causes of line surges and viruses and protection procedures against each
- 15.4 Explain major components of the Internet, how it is accessed and common applications
- 15.5 Demonstrate how to download a service or application, data or programs
- 15.6 Explain how to use the Internet to locate parts and service literature

16.0 Audio & Video Systems

- 16.1 Explain major components of the most common home entertainment products
- 16.2 Describe microphone technology and usage
- 16.3 Explain speaker construction and precautions

- 16.4 Describe the differences between good quality and distorted sound and electronic/acoustical reasons for each
- 16.5 Explain how signals may conflict and the symptoms the conflict may produce
- 16.6 Explain how to isolate troubles between discrete equipment units

17.0 Optical Electronics

- 17.1 List common electronics display devices
- 17.2 Explain the operation of a kinescope
- 17.3 Explain how LCD displays operate, their advantages and disadvantages
- 17.4 Describe how LED remote hand units work
- 17.5 Explain why and list some locations or circuits in which opto isolators are used
- 17.6 List uses for light activated controls and how photo devices are incorporated

18.0 Telecommunications Basics

- 18.1 Describe major types of two-way radio communications (avionics, land mobile, and maritime, etc.)

19.0 Technician Work Procedures

- 19.1 Explain major invoice and billing concepts for service businesses
- 19.2 Describe ways to procure service literature
- 19.3 Demonstrate location/cross referencing of parts and product in catalogs
- 19.4 Explain the purposes and requirements for proper record keeping
- 19.5 Explain estimate concepts for service work
- 19.6 Describe field technician work procedures that may differ from in-shop routines

End of Basic Electronics Competencies Listing (with 19 major Categories, 145 ITEMS and Competencies)

Notes:

The purpose in distributing the above Competencies list is to provide a detailed syllabus for electronics educational institutions and instructors. Also to go further and explain what the student should be able to do with each of the items included in the Categories and Competencies listings.

The NCEE (National Coalition for Electronics Education) and allied associations encourage the nation's school systems to adopt these competencies for their basic electronics High School courses.

Suggested study texts:

The Associate CET Certification Study Guide 2003—Available through ETA-I, 800-288-3824, \$60

Electronics; Principles and Applications 2002 6th ed., by Schuler; Glencoe/McGraw Hill Publications ISBN—0078288932, \$76.75 order at www.barnesandnoble.com

The *CEA Study Guide* by CEA (EIA), Anatonakos; (Available from ISCET)

Electronics Theory, Delton Horn;

Electronic Communications 6th ed., by Robert Shrader; McGraw-Hill ISBN—0070571570, \$106 order at www.barnesandnoble.com

Soldering Handbook—3rd Edition, Paul T. Vianco, Published by American Welding Society; www.SMTnet.com

Mastering Technical Mathematics, 2nd ed; McGraw-Hill; 592 p.; \$34.95; 1-800-2-MCGRAW

How to Test Almost Everything Electronic; Delton Horn, McGraw-Hill #030406-8; \$19.95; 1-800-2-MCGRAW

Check online for NEETS module content: www.tpub.com/neets/index.htm