



# Student Electronics Technician (SET)

## Basic Electronics Competency Requirements

For use by high school and post-secondary programs that offer training in basic electronic applications. The SET may be used for program assessment and as student certification from the following topics in these competencies.

### 1.0 Safety

- 1.1 Describe electrical shock and its causes
- 1.2 List the effects of electric current on the human body
- 1.3 Explain shock hazards when working around power sources
- 1.4 Identify sources of static charges and its damage to sensitive components
  - 1.4.1 Describe static charge prevention straps, mats and grounding
- 1.5 List tools use hazards in the workplace and in the field
- 1.6 Describe lockout and tagging rules for unsafe electrical or mechanical hazards
- 1.7 Explain where eye and ear protection are needed
- 1.8 List safety concerns related to the National Electrical Code®
- 1.9 Describe the types and usage of fire extinguishers

### 2.0 Electron Theory

- 2.1 Describe atomic structure and parts of the atom with its electric charges
- 2.2 Describe the action of electrons, protons and neutrons
- 2.3 Explain static charges and *coulombs*
- 2.4 Explain current flow and units of measure
- 2.5 Explain potential difference, voltage drop and units of measure
- 2.6 List types of resistive materials and units
- 2.7 Describe voltage sources, batteries and electromagnetic force
- 2.8 Explain the creation of magnet poles and magnetic effects

### 3.0 DC Basics

- 3.1 State Ohm's law and Watt's power laws
- 3.2 List 12 common basic electronic formulas derived from Ohm's and Watt's laws
- 3.3 State Kirchhoff laws for current and voltage
- 3.4 Explain formulas used in series circuits
- 3.5 Explain formulas used for parallel circuits
- 3.6 Identify circuit configurations of series, parallel and combination circuits
- 3.7 Explain the purposes of grounding and common conventions
- 3.8 Calculate power consumption, dissipation and energy units
- 3.9 Describe capacitance and its units of measure including charging and discharging curves

### 4.0 AC Basics

- 4.1 List methods that produce alternating current
- 4.2 Describe sine wave shapes and RMS values
- 4.3 Describe capacitance and its units of measure
- 4.4 Describe magnetic flux and inductance and list its units of measure
- 4.5 Explain how series circuits with R, C and L values are used in electronics equipment
- 4.6 Explain how inductance relates to magnetism and describe coil construction, cores and usages
- 4.7 Compare reactance and resistance and describe current/voltage relationships
- 4.8 Compare impedance with reactance and resistance
  - 4.8.1 Explain the causes and effects of impedance

### 5.0 Wire and Cables

- 5.1 List wire types, purpose of insulation and construction
- 5.2 Explain the American Wire Gauge (AWG) sizes of conductors
- 5.3 List common uses for copper cables in electrical and telecommunications applications
- 5.4 Explain differences between copper, coaxial and fiber optic cables
- 5.5 Explain the effects of proper and improper termination
- 5.6 Describe types and testing of splices

## 6.0 Electronic Components

- 6.1 Identify common electronic symbols of components and connection points
- 6.2 Identify types of switches and use in circuits
- 6.3 Describe fuses and circuit breakers
- 6.4 Explain where passive components are used in circuits
- 6.5 Identify resistor values by color code and numerical markings
- 6.6 Identify capacitor types, ratings and use in circuits
- 6.7 Identify inductive components, core materials and how coil diameter and wire size affect values
- 6.8 Identify common types of transformers and explain step-up/step-down in relation to turns ratio

## 7.0 Semiconductors

- 7.1 Explain P-N junction theory
- 7.2 Describe types of diodes
- 7.3 Explain Zener diode ratings; describe their usage in regulator circuits
- 7.4 Identify PNP and NPN transistors as to type and usage
- 7.5 Describe FET, MOSFET and CMOS types of components
- 7.6 Identify other semiconductors and symbols and explain their uses
- 7.7 Compare thyristors with other semiconductors
- 7.8 Identify diacs, triacs and SCRs and explain their operation
- 7.9 Identify common types of Integrated Circuit packages and chip cases

## 8.0 Power Supplies

- 8.1 Describe types of batteries and common usage including primary, secondary and rechargeable cells
- 8.2 Describe how to safely work on and around power supplies
- 8.3 Describe the differences between half wave and full wave power supply types
- 8.4 Identify components that determine output voltage and power
- 8.5 Explain the need for power supply filtering, describe hum, and identify common filter types
- 8.6 Explain the reasons for regulation in an electronic power supply
- 8.7 Explain why and where fuses and circuit breakers are located in protection circuits

## 9.0 Amplifiers and Analog Circuits

- 9.1 List common amplifier devices
- 9.2 List common amplifier configurations
- 9.3 Describe the purpose of components in an amplifier circuit
- 9.4 List the usages and classes of amplifiers
- 9.5 Describe decibel (dB) measurements, voltage and power gain
- 9.6 Explain frequency response of an amplifier circuit and why it is important
- 9.7 Explain the uses of operational amplifiers and how they differ from discrete amplifiers
- 9.8 Identify causes of distortion in amplifiers and list ways to reduce or eliminate it
- 9.9 List types of feedback
- 9.10 Describe types of oscillator circuits

## 10.0 Interfacing of Electronics Products

- 10.1 List signal levels in electronics products
- 10.2 List anticipated signal or voltage levels for output circuits in audio and video equipment
- 10.3 Explain the importance of impedance matching and list causes of mismatches
- 10.4 Explain common types of connectors
- 10.5 Explain grounding methods
- 10.6 Describe power transfer between circuits, components used and problems of mismatch

## 11.0 Digital Concepts and Circuitry

- 11.1 Describe the use of binary numbers and math, converting between binary and decimal
- 11.2 Identify symbol and function of digital logic gates: (AND, OR, NOT, NAND, NOR, XOR and XNOR)
- 11.3 Explain truth tables for basic gates
- 11.4 Explain Boolean equations from a truth table for combinational logic circuit
  - 11.4.1 Simplify Boolean equations using Boolean Algebra or K-map
- 11.5 Simplify combinational logic circuits to the fewest number of chips using NAND or NOR gates
- 11.6 Explain the purpose of a latch and list common flip-flops
- 11.7 Explain the purpose of clocks in sequential circuits

- 11.8 List types and functions of shift registers
- 11.9 Explain how counters and timers operate

## **12.0 Computer Electronics**

- 12.1 Describe the major components of a computer
- 12.2 Describe how the computer block diagram and flow charts are utilized
- 12.3 Explain Operating System functions and common types
- 12.4 Explain the function of a bus and how it connects the CPU, peripherals, and/or memory devices
- 12.5 Describe different types of computer memory and how storage is accomplished
- 12.6 List various types of peripherals, USB and other connector usage
- 12.7 Describe how microprocessors function and identify internal sections

## **13.0 Computer Applications**

- 13.1 Explain basic computer operation
- 13.2 List ways to backup data and the importance of daily back-ups
- 13.3 Explain the causes of line surges and viruses and protection procedures against each
- 13.4 Explain major components and use of the Internet, browsers and IP addressing
- 13.5 List commonly used programming languages
- 13.6 List commonly used software application programs

## **14.0 Audio and Video Systems**

- 14.1 Explain major components of common entertainment, function and security products
- 14.2 Describe microphone types, construction and usage
- 14.3 Explain speaker construction, usage and precautions
- 14.4 List the types of cables and connectors used in audio and video applications
- 14.5 Describe distorted sound and electronic/acoustical causes of distortion
- 14.6 Explain how signals may conflict and the indications the conflict may produce, including interference and static
- 14.7 Explain how to isolate problems between discrete equipment

## **15.0 Optical Electronics**

- 15.1 Describe symbols for photo resistors, photodiodes and phototransistors
- 15.2 List materials that make up optical devices
- 15.3 List common display devices and describe how numbers and letters are activated
- 15.4 Explain where and how LCD displays are used
- 15.5 Describe how LED devices function
- 15.6 List applications of opto-isolators
- 15.7 Describe uses for light-activated controls and photosensitive devices
- 15.8 Explain where charge-coupled devices (CCD) are found
- 15.9 List products where lasers are used

## **16.0 Telecommunications Basics**

- 16.1 Describe major types of communications: landline, wireless and two-way
- 16.2 Explain half duplex and full duplex communications
- 16.3 Describe copper and fiber telephone local loop circuits
- 16.4 Explain the common connectors, plugs and jacks used in communications
- 16.5 List fiber optics types
- 16.6 List common RF (Radio Frequency) bands
- 16.7 Explain types and frequencies used in cellular communications
- 16.8 Describe common wireless schema, such as WiFi, Bluetooth, and Zigbee

## **17.0 Industrial and Manufacturing Automation**

- 17.1 Identify types of DC motors
- 17.2 Describe the common uses of AC motors
- 17.3 Identify types of alternator and generator power sources
- 17.4 Describe use and types of sensors
- 17.5 Explain the use of ladder logic and control devices
- 17.6 Explain how microcontrollers and PLCs function
- 17.7 Describe the use and programming of major types of control panels

## 18.0 Test Equipment and Measurements

- 18.1 Describe how a Digital Multimeter (DMM) and related meters operate
- 18.2 Identify meter protection, safety and usage
- 18.3 Explain care of equipment and test leads
- 18.4 List the purposes and types of signal generators
- 18.5 Describe meter loading and precautions observed
- 18.6 List the uses and precautions for logic tracer test probes
- 18.7 Explain how logic pulsers are used
- 18.8 Describe oscilloscope usage and explain the purposes of front panel controls

## 19.0 Soldering - Desoldering Tools

- 19.1 Describe soldering safety
- 19.2 Explain hazards of solder fumes and solder spatter
- 19.3 Explain solder flux usage and describe types
- 19.4 List types of solder and reasons for choosing each
- 19.5 Identify cold solder joints and explain causes
- 19.6 Describe the differences between good and bad mechanical and electrical solder connections
- 19.7 Describe various types of desoldering equipment and how it is used
- 19.8 Describe how to use of braid-wick solder removers

## 20.0 Troubleshooting and Repair Procedures

- 20.1 Explain the order of the troubleshooting process and techniques to find problems
- 20.2 Describe how to locate/cross reference parts and products in catalogs and online
  - 20.2.1 Explain how to safely download service and technical information
- 20.3 Explain the purposes and requirements for proper documentation
- 20.4 Explain how block diagrams are used for troubleshooting and maintenance of electronics products
- 20.5 Explain the differences between wiring prints, circuit board views, schematics and block diagrams
- 20.6 Describe the purpose and use of test points including their likely placement on schematics
- 20.7 Explain how schematics are used to locate component and wiring failures in electronics products
- 20.8 Explain the methods of using flow diagrams/charts

### End of Basic Student Electronics Competencies Listing (with 20 major Categories, 160 Items)

**Find An ETA Test Site:** [http://www.eta-i.org/test\\_sites.html](http://www.eta-i.org/test_sites.html)

#### **Suggested additional study texts and resources:**

**The Associate CET Study Guide, 6E;** ETA International; ISBN 1-891749-07-2; 2012; Available through ETA at 800-288-3824 or [www.eta-i.org](http://www.eta-i.org); \$60

**EM Study Guide series;** Karl Eilers; download through ETA at 800-288-3824 or [www.eta-i.org](http://www.eta-i.org)

**Electronic Principles, 8E;** Malvino, Bates; ISBN 978- 0073373881; McGraw Hill; 2015

**Electricity & Electronics, 10E;** Gerrish, Dugger & Roberts; ISBN 978-159070-883-5, Goodheart-Wilcox; 2008

**Electronics: Principles and Applications, 8E;** Schuler; ISBN 978-0077567705; McGraw Hill; 2012

**Electricity: Principles and Applications, 8E;** Fowler; ISBN 978-0077567620; McGraw Hill, 2012

**Digital Electronics: Principles and Applications, 8E;** Tokheim; ISBN 978-00733733775; McGraw Hill, 2013

**Cabling: The Complete Guide to Copper and Fiber-Optic Networking, 5E;** Oliviero & Woodward; ISBN 978-1-118-80732-3; Sybex, Inc.; 2014; Available through ETA at 800-288-3824 or [www.eta-i.org](http://www.eta-i.org)

Review **MasteringElectronicsDesign.com** website; RMS material; Adrian S. Nastase; 2013

Check online for NEETS module content: [www.tpub.com/neets/index.htm](http://www.tpub.com/neets/index.htm)

ETA certification programs are accredited through the ICAC,  
complying with the ISO/IEC 17024 standard.

