ETA® International - Associate C.E.T. – ANALOG BASICS

BASIC ELECTRONICS CERTIFICATION COMPETENCIES—2009

(As suggested for segmenting the Associate CET Competencies into 5 BASIC areas: DC; AC; Analog; Digital; and Comprehensive)

1.0 Diodes

1.1 Describe the electrical characteristics of semiconductors.
1.2 Explain the difference between intrinsic and doped semiconductors.
1.3 Explain how current flows through intrinsic and doped semiconductors.
1.4 Describe the construction of a PN junction diode.
1.5 Explain the behavior of a forward and reverse biased diode.
1.6 Identify diodes with a proper front to back ratio.
1.7 Describe the forward and reverse current-voltage characteristics of a typical zener diode.
1.8 Describe how the zener diode is used to provide voltage regulation.
1.9 Identify a diagram for a zener voltage regulator and explain its operation.
1.10 Describe how capacitance is produced in a varactor diode and explain how it is affected by a change in operating voltage.
1.11 Explain the operational and electrical characteristics of the following types of diodes:
- 1.11.1 Pin
- 1.11.2 Gunn
- 1.11.3 Tunnel
- 1.11.4 Schottky
- 1.11.5 Laser Diodes
- 1.11.6 Light Emitting
- 1.11.7 Photodiodes
- 1.11.8 Super-Barrier

1.12 Identify the various types of diodes from their schematic symbols, alphanumerical designation, and color code.
1.13 Explain the proper procedure for both operational and acceptance testing of diodes.
1.14 List the safety precautions to be taken when working with diodes.

2.0 Transistors

2.1 Explain the operational and electrical characteristics of bipolar junction transistors.
2.1a Describe the construction of PNP and NPN bipolar junction transistors
2.2 Explain the proper biasing of bipolar junction transistors for normal operation.
2.3 Explain the relationship between emitter, base, and collector currents in bipolar junction transistors.
2.4 Identify the schematic diagram for and explain the function of the three basic bipolar junction transistor amplifier circuits.
2.5 Explain the differences between heterojunction bipolar transistors and bipolar junction transistors
2.6 Describe the operational and electrical characteristics of a unijunction transistor.
2.6a Explain the conditions necessary to turn on and off unijunction transistor.
2.7 Determine an amplifier gain using a transistor collector characteristic curve.
2.8 Determine input and output resistance of transistor amplifier circuit.
2.9 Explain the meaning of and calculate both alpha and beta cutoff frequency.
2.10 Explain the operational and electrical characteristics of JFETs (junction field effect transistors).
2.11 Explain the proper biasing of N-channel and P-channel JFETs for normal operation.
2.12 Determine the transconductance of the device using an FET's drain characteristic curve.

2.13 Explain the operational and electrical characteristics of a MOSFET (metal oxide semiconductor field effect transistor).
2.13a Identify enhancement mode and depletion mode MOSFET configurations
2.14 Identify the various types of transistors from their schematic symbols, alphanumerical designation, and color code.
2.15 Explain the proper procedure for both operational and acceptance testing of transistors.
2.16 List the safety precautions to be taken when working with transistors.

3.0 Thyristors

3.1 Describe the operational and electrical characteristics of a silicon-controlled rectifier.
3.2 Explain the conditions necessary to turn on and off a bidirectional triode thyristor.
3.3 Identify the various types of thyristors from their schematic symbols, alphanumerical designation, and color code.
3.4 Explain the proper procedure for both operational and acceptance testing of thyristors.
3.5 List the safety precautions to be taken when working with thyristors.

4.0 Integrated Circuits

4.1 Describe the operational and electrical characteristics of integrated circuits.
4.2 Explain the difference between linear and digital integrated circuits.
4.3 Given their schematic symbols, alphanumerical designation, and color code, identify various integrated circuits packages and explain their use.
4.4 Explain the proper procedure for both operational and acceptance testing of integrated circuits.
4.5 List the safety precautions to be taken when working with integrated circuits.

5.0 Optoelectronic Devices

5.1 Describe the characteristics of light.
5.2 Given a light frequency, determine its wavelength.
5.3 Explain the operational and electrical characteristics of both light emitting and light sensitive devices.
5.4 Explain the proper biasing of light sensitive and light emitting devices.
5.5 Explain the operational and physical characteristics of light transmission media.
5.6 Explain the operation of optoelectronic couplers and isolators.
5.7 Explain the operation of light amplifiers.
5.8 Explain the proper procedure for both operational and acceptance testing of optoelectronic devices.
5.9 List the safety precautions to be taken when working with optoelectronic devices.

6.0 Power Supplies

6.1 Describe the configuration of various rectifier circuits.
6.2 Describe the electrical and operational characteristics of rectifier circuits.
6.3 Describe the configuration of various power supply filters.
6.4 Describe the configuration of various voltage multipliers.
6.5 Describe the electrical and operational characteristics of various voltage multipliers.
6.6 Describe the configuration of various voltage regulators.
6.7 Describe the electrical and operational characteristics of various voltage regulators.
6.8 Describe the configuration of switching power supplies.
6.9 Describe the electrical and operational characteristics of switching power supplies.
6.10 Describe the configuration of series, shunt and biased clippers.
6.11 Describe the electrical and operational characteristics of series, shunt, and biased clippers.
6.12 Describe the configuration of clampers.

6.13 Describe the electrical and operational characteristics clampers.
6.14 Explain the proper procedure for both operational and acceptance testing of power supplies.
6.15 List the shock hazards and safety precautions to be taken when working with power supplies.

7.0 Test Equipment & Measurements

7.1 Describe “meter loading” and precautions.
7.2 Explain the purposes of frequency counters and list their limitations.
7.3 Explain proper use of the oscilloscope.
7.4 Explain fundamental block diagram of oscilloscope and function/purpose of each block
7.5 Describe oscilloscope usage; explain the purposes of each front panel control.
7.6 List the uses for pattern generators.
7.7 Define dummy load; show where and why used.

8.0 Mathematics and Formulas

8.1 Calculate wavelength, frequency and power values
8.2 Explain decibels and show reasons for using dBs in signal level, voltage, and power level calculations:
- 8.2.1 dBm
- 8.2.2 dBW
- 8.2.3 dBV
- 8.2.4 dB (SPL)
- 8.2.5 dB (SIL)
- 8.2.6 sB (SWL)

8.3 Demonstrate how graphs are used to demonstrate electronics functions
8.4 Calculate PRF/PRR (pulse recurring frequency/pulse recurring rate)
8.5 Calculate duty cycle

9.0 Amplifiers

9.1 Describe basic amplifier configuration, biasing, coupling, and operation.
9.2 Describe the electrical and operational characteristics of the following types of amplifiers:
- 9.2.1 Direct current
- 9.2.2 Audio
- 9.2.3 Video
- 9.2.4 IF
- 9.2.5 RF

9.3 Explain the proper procedure for both operational and acceptance testing of amplifiers.
9.4 List the safety precautions to be taken when working with amplifiers.

10.0 Operational Amplifiers

10.1 Describe operational amplifier configurations, biasing, coupling, and operation.
- 10.1.2 Inverting amplifier
- 10.1.3 Non-inverting amplifier
- 10.1.4 Voltage follower
- 10.1.5 Summing amplifier
- 10.1.6 Integrator
- 10.1.7 Differentiator
- 10.1.8 Comparator

10.2 Describe the input and output impedance characteristics of various operational amplifiers.
10.3 Describe the input and output phase relationship and gain of various operational amplifiers.

10.4 Explain the proper procedure for both operational and acceptance testing of operational amplifiers.
10.5 List the safety precautions to be taken when working with operational amplifiers.

11.0 Oscillators

11.1 Describe the fundamentals of oscillation.
11.2 Describe the configuration of an Armstrong oscillator circuit.
11.3 Describe the electrical and operational characteristics of an Armstrong oscillator circuit.
11.4 Describe the configuration of a Hartley oscillator circuit.
11.5 Describe the electrical and operational characteristics of a Hartley oscillator circuit.
11.6 Describe the configuration of a Colpitts oscillator circuit.
11.7 Describe the electrical and operational characteristics of a Colpitts oscillator circuit.
11.8 Describe the configuration of a crystal controlled oscillator circuit.
11.9 Describe the electrical and operational characteristics of a crystal controlled oscillator circuit.
11.10 Describe the configuration of a resistive-capacitive oscillator circuit.
11.11 Describe the electrical and operational characteristics of a resistive-capacitive oscillator circuit.
11.12 Describe the configuration of a transformer oscillator circuit.
11.13 Describe the electrical and operational characteristics of a transformer oscillator circuit.
11.14 Explain the piezoelectric effect.
11.15 Explain regenerative feedback.
11.16 Explain frequency multiplication.
11.17 Explain the Barkhausen Criterion
11.18 Explain the proper procedure for both operational and acceptance testing of oscillators.
11.19 List the safety precautions to be taken when working with oscillators.

12.0 Filters

12.1 Describe the electrical and operational characteristics of the following filters:
- 12.1.1 RC high pass
- 12.1.2 RC low pass
- 12.1.3 RL high pass
- 12.1.4 RL low pass
- 12.1.5 Series LC band pass
- 12.1.6 Series LC band stop
- 12.1.7 LC tank band pass
- 12.1.8 LC tank band stop
- 12.1.9 PI-type RC
- 12.1.10 PI-type RL
- 12.1.11 PI-type LC
- 12.1.12 T-type RC
- 12.1.13 T-type RL
- 12.1.14 T-type LC

12.2 Describe the configuration of various active filters.
- 12.2.1 Butterworth
- 12.2.2 Chebyshev
- 12.2.3 Bessel
- 12.2.4 Multiple-Feedback Bandpass
- 12.2.5 Phase-locked loop

12.3 Describe the relationship between bandwidth and Q of a circuit.

13.0 Wave-shaping Circuits

13.1 Describe the configuration of a square wave generating circuit.
13.2 Describe the electrical and operational characteristics of a square wave generating circuit.
13.3 Describe the configuration of a sawtooth wave generating circuit.
13.4 Describe the electrical and operational characteristics of a sawtooth wave generating circuit.
13.5 Describe the configuration of a trapezoidal wave generating circuit.
13.6 Describe the electrical and operational characteristics of a trapezoidal wave generating circuit.
13.7 Describe the configurations of various differentiator and integrator circuits.
13.8 Describe the electrical and operational characteristics of various differentiator and integrator circuits.
13.9 Describe the configuration of a ramp generator circuit.
13.10 Describe the electrical and operational characteristics of a ramp generator circuit.
13.11 Explain the proper procedure for both operational and acceptance testing of wave-shaping circuits.
13.12 List the safety precautions to be taken when working with wave-shaping circuits.

End of ANALOG BASICS Electronics Competencies Listing
(with 13 major Categories)

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 Competencies listings.

Find An ETA Test Site:

http://www.eta-i.org/testing.html

Suggested study texts:

The 2010 Associate CET Study Guide; ISBN 1-891749-03X; ETA International; 2010; — Available through ETA at 800-288-3824, $60
Electronics; Principles and Applications,6E; ISBN 978-0078288937; Schuler; Glencoe/McGraw Hill, 2002
Introduction to Electricity, Electronics, and Electromagnetics, 5E; ISBN 978-0130105738; Boylestad, Nashelsky; Prentice Hall; 2001
Mastering Technical Mathematics, 3E; ISBN 978-0071494489; Gibilisco, Crowhurst; McGraw-Hill / TAB Electronics; 2007
Electronics Principles, 7E; ISBN 978-0072975277; Malvino, Bates; McGraw-Hill Higher Education; 2007
Electronic Communications, 6E; ISBN 978-0070571570; Shrader ; McGraw-Hill Co; 1990
How to Test Almost Everything Electronic; ISBN 978-0830641277; Horn; McGraw-Hill/TAB Elec. 1993
Basic Electronics Theory With Projects & Experiments, 4E; ISBN 978-0830642007; Horn; McGraw-Hill/TAB Elec. 1993
The Soldering Handbook, 3E; ISBN 978-0871716187; Vianco; American Welding Society; 2000
Introductory DC / AC Electronics, 5E; ISBN 978-0130310859; Cook; Prentice Hall; 2002
Introduction to Electronics; ISBN 978-0534012434; Crozier; Breton Pub.; 1983
There Are No Electrons: Electronics for Earthlings; ISBN 978-0962781599; Amdahl; Clearwater Pub.; 1991
Becoming An Electronics Technician, 4E; ISBN 978-0130932198; Reis; Prentice Hall; 2001