

2007

Avionics Electronics Technician - AVN CATEGORIES LIST

Avionics electronics technicians are expected to obtain knowledge of wired and wireless communications basic concepts which are then applicable to various types of avionics systems as they are used in the aeronautics field. It is also highly recommended that the Avionics technician have an FCC General Radio Telephone Operator license. Once the CET has acquired these skills, abilities and knowledge, he or she will be able to enter employment in any part of the avionics field. With minimal training in areas unique to specific products, the CET should become a profitable and efficient part of the aviation electronics-communications workforce.

Avionics Electronics Technicians must be knowledgeable and have functional abilities in the following technical areas:

- | | | | |
|-----|--------------------------------|------|--------------------------------------|
| 1.0 | AVIONICS SYSTEMS | 9.0 | NETWORK TOPOLOGIES & INFRASTRUCTURES |
| 2.0 | CABLES AND CABLING | 10.0 | PEOPLE RELATIONS |
| 3.0 | COMPUTERS AND DIGITAL CONCEPTS | 11.0 | OPTICAL CABLING |
| 4.0 | AMPLIFIERS | 12.0 | SAFETY |
| 5.0 | INTERFACING | 13.0 | TEST EQUIPMENT & TOOLS |
| 6.0 | ANTENNAS & TRANSMISSION LINES | 14.0 | SATELLITE COMMUNICATIONS |
| 7.0 | COMPONENTS | 15.0 | TROUBLESHOOTING |
| 8.0 | MATHEMATICS | | (END OF CATEGORIES LIST) |



Avionics Electronics Technician - AVN

ITEMS LIST - 2007

(A listing of the major areas required for courses, training or study in Telecommunications Electronics)

1.0 AVIONICS SYSTEMS

- 1.1 Avionics wireless communications systems
- 1.2 Wired voice communications (telephone systems)
- 1.3 Distance Measurement Equipment (DME)
- 1.4 Instrument Landing Systems block diagram (ILS)
- 1.5 Avionics electronic engine controls
- 1.6 Servo and synchros in avionics
- 1.7 Autopilot systems
- 1.8 IFF—Identification equipment
- 1.9 GPW—Ground Proximity Warning systems
- 1.10 APW—Aircraft Proximity Warning systems
- 1.11 Stall Warning systems
- 1.12 Inertial Reference system
- 1.13 Air Data Computers
- 1.14 Commercial RADAR systems frequencies
- 1.15 Marker Beacon systems
- 1.16 Fuel Indicator systems
- 1.17 Emergency locator systems for avionics (EPIRBs)
- 1.18 GPS and GLONASS

2.0 CABLES AND CABLING

- 2.1 UTP technology
- 2.2 RJ45/48 connectors and fittings
- 2.3 Wavelength calculation
- 2.4 Impedance in cabling
- 2.5 Fiber-Copper comparisons
- 2.6 Bandwidth comprehension
- 2.7 Coaxial cable comparisons
- 2.8 Heliac cable in avionics
- 2.9 Impedance factors
- 2.10 Stray capacitance—magnetic induction
- 2.11 Cable chaffing
- 2.12 Troubleshooting cables
- 2.13 Preparing and fabricating cables (FO, COAX, UTP)
- 2.14 Grounding and bonding
- 2.15 Wave guides

3.0 COMPUTERS AND DIGITAL CONCEPTS

- 3.1 Computer—communications interrelationships
- 3.2 Modems
- 3.3 Worldwide numbering systems
- 3.4 Common ICs used in avionics
- 3.5 Redundancy, parity, block-check, cyclical and forward error correction
- 3.6 Channel bandwidth vs. bps data rates
- 3.7 Computer components—truth tables
- 3.8 Bytes, packets and frames

4.0 AMPLIFIERS

- 4.1 Operating characteristics—A, AB, B, C, D, E
- 4.2 RF, IF, audio amplifier circuit definitions
- 4.3 Operational amplifier circuits
- 4.4 Power measurement open termination
- 4.5 Amplifier circuit bandwidth
- 4.6 Amplifiers as used in computers, receivers, transmitters

5.0 INTERFACING

- 5.1 Troubleshooting interconnected wiring
- 5.2 Signal types, frequencies, levels for interconnection
- 5.3 Data transfer busses: RS 232C, ARINC-429 and MIL-STD 1553b
- 5.4 Intercom systems block diagrams
- 5.5 Avionics power systems, fusing, backups
- 5.6 Noise interference

6.0 ANTENNAS & TRANSMISSION LINES

- 6.1 Transmitter power, modulation, spurious tests
- 6.2 Improper line matching
- 6.3 Wavelength computation
- 6.4 Avionics antenna types
- 6.5 Calculating impedance
- 6.6 Radio wave characteristics
- 6.7 Ground, sky and space electromagnetic waves
- 6.8 Wave guides
- 6.9 Directional couplers, circulators, isolators, T-sections, cavity resonators, vacuum tubes
- 6.10 Microwave antenna types
- 6.11 Fiber cable benefits
- 6.12 Reasons for spectrum regulation of RF

7.0 COMPONENT

- 7.1 Schematic symbol identification
- 7.2 Signal filters
- 7.3 Crystals and crystal circuits
- 7.4 Power supply components
- 7.5 Circuit board substitution vs. component
- 7.6 Differences in displays including CRT, LED and LCD
- 7.7 Filters—Active vs. Passive

Avionics Electronics Technician - AVN - pg 2

ITEMS LIST - 2006

(A listing of the major areas required for courses, training or study in Telecommunications Electronics)

8.0 MATHEMATICS

- 8.1 Modulation index calculation for AM
- 8.2 PEP—peak envelope power calculation in transceivers
- 8.3 Voltage, current, gain calculations in decibels
- 8.4 Scientific calculations—ohms law-formulas-time constants—series/parallel resistances, capacitance and inductance
- 8.5 Scientific notation, binary, octal, decimal, hex conversion

9.0 NETWORK INFRASTRUCTURES & TOPOLOGIES

- 9.1 RS232 standard in avionics
- 9.2 Transmission protocols for avionics

10.0 PEOPLE RELATIONS

- 10.1 Human relations poor behavior examples
- 10.2 Hygiene—appearance standards
- 10.3 Telephone techniques—manners
- 10.4 Understanding CSS (Customer Service Specialist) certification program of ETA

11.0 OPTICAL CABLING

- 11.1 Eye Safety (Fiber Optic disposal)
- 11.2 Types and functions of fiber cables
- 11.3 Conversion of optical to copper signals
- 11.4 Definition of SONET
- 11.5 DWDM (Dense Wave Division Multiplexing)

12.0 SAFETY

- 12.1 Workplace safety procedures
- 12.2 Aircraft worker height special safety rules
- 12.3 Interfacing equipment safety rules
- 12.4 OSHA safety requirements
- 12.5 Safety wiring, anti-chaffing, rack mounting
- 12.6 Lead solder precautions—fumes
- 12.7 Static hazards
- 12.8 Kinescope voltage dangers
- 12.9 Flight surfaces, hydraulics special safety aspects
- 12.10 Special fueling static prevention
- 12.11 FCC rules for communications
- 12.12 MEL (minimum equipment list), fault tolerance and patching around faults

13.0 TEST EQUIPMENT & TOOLS

- 13.1 Certifying wired networks
- 13.2 BER (Bit Error Rates) test equipment, toners and OTDRs
- 13.3 SWR—standing wave ratios
- 13.4 Voltmeters, oscilloscopes, generators, spectrum analyzers, power meters, dummy loads, meggers, frequency counters, specialized avionics equipment 13.5
- Hand tools—riveting equipment
- 13.6 Solder types
- 13.7 Cable splicing rules

14.0 SATELLITE COMMUNICATIONS

- 14.1 Geosynchronous satellite system concepts
- 14.2 Satellites as used in avionics applications
- 14.3 Most common frequency bands for satellite
- 14.4 Terms definitions: geocenter, apogee, perigee, ascending, descending, period, angle of inclination, latitude, longitude and meridian
- 14.5 Satellite launching principles—maintaining orbit

15.0 TROUBLESHOOTING

- 15.1 Test equipment usage
- 15.2 Troubleshooting methods (last good, first bad)
- 15.3 Troubleshooting methods (divide and conquer)
- 15.4 Block diagrams and schematics points location
- 15.5 Repair logs—their importance
- 15.6 Procedures for ordering parts
- 15.7 Tagging of circuit breakers or power sources

(END OF ITEMS—SYLLABUS)

Electronics Technicians Association, International

Competency Requirements—2006



Avionics Electronics Technician - AVN

Avionics electronics technicians are expected to obtain knowledge of wired and wireless communications basic concepts which are then applicable to various types of avionics systems as they are used in the aeronautics field. It is also highly recommended that the Avionics technician have an FCC General Radio Telephone Operator license. Once the CET has acquired these skills, abilities and knowledge, he or she will be able to enter employment in any part of the avionics field. With minimal training in areas unique to specific products, the CET should become a profitable and efficient part of the aviation electronics-communications workforce.

Avionics Electronics Technicians must be knowledgeable and have functional abilities in the following technical and human relations areas:

1.0 Avionics Systems

- 1.1 Describe the major wireless communications systems used in avionics
- 1.2 Describe the basics of wired voice communications-explain how basic telephone systems work
- 1.3 Explain the principles used in Distance Measuring Equipment
- 1.4 Draw a block diagram showing how basic instrument landing systems operate
- 1.5 Explain how electronic engine controls are used in today's aircraft
- 1.6 List where servo motors and syncros are used in aircraft
- 1.7 Describe how autopilots control aircraft functions
- 1.8 Define IFF (explain how and where it is used)
- 1.9 Explain the operation of Ground Proximity Warning systems
- 1.10 Explain the operation of Aircraft Proximity Warning systems
- 1.11 Explain the differences between Stall Warning systems and Angle of Attack sensors
- 1.12 Describe an Inertial Reference system
- 1.13 Draw a block diagram showing how Air Data Computers are connected within the aircraft
- 1.14 List the frequency ranges of common RADAR systems used on commercial aircraft
- 1.15 List the major components of the Marker Beacon system
- 1.16 List the components of a Fuel Indicating system
- 1.17 Discuss how Emergency Locator Transmitters (EPIRBs) are used in aviation
- 1.18 Draw a diagram which visually describes how GPS-Global Positioning Systems operate. Define "GLONASS"

2.0 Cables and Cabling

- 2.1 Define unshielded twisted pair (UTP)-show understanding and where it is used
- 2.2 Demonstrate ability to install and troubleshoot RJ45/48 telephone connectors and fittings
- 2.3 Calculate wavelength for several different aircraft communications frequencies
- 2.4 Discuss Impedance and explain its importance in aircraft cabling
- 2.5 Compare fiber optic cabling with coaxial or copper utilized in aircraft systems
- 2.6 Explain bandwidth as used in aircraft cabling systems
- 2.7 Explain the differences between coax types RG 58, RG 59, RG 11 and RG 6
- 2.8 Describe Heliac cable and indicate where it is used in avionics applications
- 2.9 List the impedance factors which affect signals in coaxial, twisted pair and fiber cables
- 2.10 Define stray capacitance and magnetic induction
- 2.11 List possible effects of cable chaffing
- 2.12 Describe how to locate a short or an open in an aircraft cable
- 2.13 Properly prepare and fabricate cable connectors for twisted pair, coaxial cables and fiber
- 2.14 Properly ground and bond aircraft cabling
- 2.15 Discuss wave guide signal (transmission / reception) and show where wave guides are used in aircraft

3.0 Computers and Digital Concepts

- 3.1 Discuss the interrelationship between computers and communications technology-show usage
- 3.2 Explain how a Modem interfaces with the computer and show differences in Modems
- 3.3 Describe worldwide numbering systems
- 3.4 List 10 common types of IC circuits used in aircraft communications
- 3.5 Compare and contrast— redundancy, parity, block-check sequences, cyclical redundancy checks and forward error correction
- 3.6 State the relationship between channel bandwidth and data rates in bits per second
- 3.7 Identify computer components and show an understanding of truth tables and gates

- 3.8 Describe the differences between bytes, packets and frames

4.0 Amplifiers

- 4.1 Compare and contrast the operating characteristics of class A, AB, B, C, D, and E amplifiers
- 4.2 Explain differences between RF, IF and audio amplifiers circuits
- 4.3 Draw a diagram of an operational amplifier circuit and show where similar op-amp circuits are used in avionics
- 4.4 State the effect of open termination of audio power measurements
- 4.5 Describe bandwidth as related to amplifier circuits and explain bandwidth requirements for various circuits
- 4.6 Discuss ten types of amplifiers and where they are used in receivers, transmitters and computer equipment

5.0 Interfacing

- 5.1 Demonstrate ability to install and troubleshoot interconnecting wiring of aircraft
- 5.2 List the signal types, frequencies and levels required for interconnecting aircraft communications equipment
- 5.3 Explain how data transfer busses are used, including RS 232C, ARINC-429 and MIL-STD 1553b
- 5.4 Draw a block diagram of an aircraft intercom system and explain its operation
- 5.5 Describe the power system used for communications equipment, fusing and backup units
- 5.6 Explain common noise interference causes and methods of reduction

6.0 Antennas and Transmission Lines

- 6.1 Describe common communications equipment tests on transmitters including frequency measurements, power measurements, modulation measurements and spurious output measurements
- 6.2 Describe the conditions that produce an improperly matched line
- 6.3 Compute the length of a quarter-wavelength, given the frequency of operation
- 6.4 State the basic types of antennas used in avionics
- 6.5 Define characteristic impedance and show how it is calculated
- 6.6 Describe the characteristics of a radio wave
- 6.7 Describe the characteristics of ground waves, sky waves and space waves
- 6.8 Define the term "wave guide" and explain how it works
- 6.9 Explain the purpose and operation of directional couplers, circulators, isolators, T-sections, cavity resonators and microwave vacuum tubes
- 6.10 Name five common types of microwave antennas
- 6.11 State five benefits of fiber optics cabling over electrical cables for communications
- 6.12 Explain why it is necessary to regulate the electromagnetic spectrum

7.0 Components

- 7.1 Identify various electronic and electrical component schematic symbols
- 7.2 Describe the use of signal filters and list several types
- 7.3 Explain the use of crystals and show various circuits they may be used in
- 7.4 Identify the components used in the power supply section of communications equipment
- 7.5 Explain the practicality of circuit board substitution versus component level parts replacement
- 7.6 Describe the differences between display components such as CRTs, LEDs and LCDs
- 7.7 Contrast active filters used in avionics equipment and passive filters

8.0 Mathematics

- 8.1 Calculate the modulation index and percentage of modulation on an AM signal, given the amplitudes of the carrier and modulating signal
- 8.2 Calculate the peak envelope power (PEP) given signal voltages and load impedances of an avionics transceiver
- 8.3 Perform calculations for voltage, current, gain and attenuation in decibels
- 8.4 Utilize scientific calculators to solve ohm's law and other electronic formulas; to figure time constants, series and parallel resistances, capacitances and inductances
- 8.5 Demonstrate ability to utilize scientific notation and to convert binary, octal, decimal and hex numbers

9.0 Network Infrastructures and Topologies

- 9.1 Explain RS232 and show how this standard is used in avionics equipment
- 9.2 Describe the transmission protocols used in avionics communications equipment

10.0 People Relations

- 10.1 Identify ten human relations situations which would be classified as poor behavior examples for working with fellow employees
- 10.2 Explain the benefits of maintaining excellent personal hygiene and appearance standards
- 10.3 Contrast examples of proper and improper telephone or two-way communications manners
- 10.4 Explain the concepts of the CSS—Customer Service Specialist certification program by ETA-I

11.0 Optical Wiring

- 11.1 Demonstrate the rules for disposal and eye safety pertaining to fiber optics
- 11.2 Describe the two basic types of optical cables and show knowledge of different parameters and reasons for choosing each
- 11.3 Describe the conversion process from copper to fiber optic signals
- 11.4 Define and explain the term SONET
- 11.5 Explain DWDM, Dense Wave Division Multiplexing

12.0 Safety

- 12.1 Demonstrate and practice general safety procedures in the workplace
- 12.2 Demonstrate and practice safety procedures in working with aircraft worker equipment at heights
- 12.3 Demonstrate special safety procedures required for avionics equipment mechanical and electrical interfacing with other equipment and structure
- 12.4 Explain OSHA requirements for distribution system workers, including working at heights
- 12.5 Demonstrate abilities required for distribution and installation technicians such as safety wiring, anti-chaffing of cables and security of rack mounted communications equipment
- 12.6 Explain hazards of leaded solder and associated fumes
- 12.7 Describe static hazards when working with sensitive electronics products and components
- 12.8 Explain the voltage potentials while working with kinescope displays and methods of discharging
- 12.9 Describe safety aspects of working with hydraulic controlled flight surfaces and equipment
- 12.10 Discuss static prevention as regards fueling of aircraft or in-flight build up of static potentials
- 12.11 Describe basic FCC rules for broadcasting on communications frequencies
- 12.12 Describe MEL (minimum equipment list), fault tolerance and 'patching' around faults

13.0 Test Equipment and Tools

- 13.1 Define the job of certifying wired communications networks
- 13.2 Describe Bit Error Rate test equipment, (TBERD, etc.) toners and OTDRs
- 13.3 Measure SWR (Standing Wave Ratio) and explain its significance in aircraft communications
- 13.4 Demonstrate ability to efficiently use volt, ohm and current meters, oscilloscopes, signal generators, RF spectrum analyzers, power meters, dummy loads, meggers, frequency counters and specialized avionics testing instruments
- 13.5 Demonstrate ability to properly use common hand tools, including riveting equipment
- 13.6 List the different types of solder used in electronics service work. Explain how solder containing lead is in the process of being replaced by countries around the world and for what reasons
- 13.7 State the standard procedures and rules for splicing cables in aircraft

14.0 Satellite Communications

- 14.1 Describe the basic concept of the geosynchronous satellite communications systems
- 14.2 Discuss satellite communications particular to aircraft or aircraft communications centers
- 14.3 List the most important frequency bands utilized for satellite communications
- 14.4 Define these terms: geocenter, apogee, perigee, ascending, descending, period, angle of inclination, latitude, longitude and meridian
- 14.5 State the operative physical principles of launching a satellite and maintaining its orbit

15.0 Troubleshooting

- 15.1 Demonstrate proper usage of avionics test equipment as well as other common equipment as listed above in #13.4
- 15.2 Describe "Last Good, First Bad" troubleshooting methods and loop testing
- 15.3 Explain the 'divide and conquer' troubleshooting method
- 15.4 Locate test points indicated on block diagrams and schematics and describe expected voltages or signals
- 15.5 Describe requirements for repair logs and their importance to the avionics industry
- 15.6 Show procedures for ordering parts or repair services for non-electronic work that may be required in order for the avionics technician to complete his/her job
- 15.7 Describe 'tagging' of circuit breakers or power sources that may be required while working on live equipment that may affect other worker procedures in or near the same work site

- end -

Suggested Study Material:

Principles of Avionics; Albert Helfrick; 2000; 340 pp; 8 1/2 X 11"; 1-800-288-3824
GROL; Fred Maia & Gordon West; Master Publishing, Inc; 496 pps; available from ETA-I, 800-288-3824
Technician's Guide to Fiber Optics; 2000; Donald Sterling, Jr.; Delmar publishing; available from ETA-I 800 288 3824
Avionics Installation Handbook, 430 pgs. Robt Horan, \$69; www.avionics.com
Aircraft Electricity and Electronics; Thomas K. Eismen; 1994; 417 pp; Glencoe Publishing; ISBN: 0028018591 available through
www.barnesandnoble.com

Avionics AVN Committee Chairman: William Gremler, CETma

Belliston, Ward, Logan, UT, ward@cc.usu.edu
Burnham, Samuel Lee, Tallahassee, FL, samres@hotmail.com,
Caldwell, David, CETsr, Brownsville, PA, phantom@usaor.net
Collins, Lee, Miami, FL, avionicstchr@yahoo.com
Csondor, Dennis E., Aviation, Lansing, MI, dennis@csondor.com
Dean, Marshall, MD, El Paso, TX, marshall@elp.rr.com
DelliCarpini, Michael, Flushing, NY,
Glass, Dick, CETsr, Greencastle, IN, eta@tds.net
Gremler, William, CETma, Broken Arrow, OK
Hinds, Edwin, CETsr, Jamaica, NY, ehinds6062@aol.com
Krempin, Bob, FO, Vacaville, CA, lighthouse training@earthlink.net
Miller, Stephen W., CETsr, Brandon, MS
Neal, James, Dunnellon, FL
Paschen, Steve, CSI, Walkerton, IN, spaschen@starband.net
Pendergrass, Frank, Tulsa, OK, james_pendergras@msn.com
Roehm, Mark, Virginia Beach, VA, mroehm@cox.net
Shields, William "Skip", Salt Lake City, UT, William.Shields@slcc.edu
Siegert, Christopher, CET, Piedmont, CA, siegertcet@yahoo.com

