General Communications Technician - Level 1 (GCT1)
Competency Requirements

The General Communications Technician Level 1 certification is a program modeled after general industry communication systems basics and the U.S. Department of Homeland Security (DHS) guidelines covering many of the fundamental disciplines in the COMT program. The purpose of the GCT1 is to provide basic communications electronics knowledge that covers all of the areas a new radio communications technician and/or engineer will encounter in the public safety communications or in the business / commercial radio fields. Please see the General Communication Technician Level 2 competencies for specific in-depth descriptions of communications theories which will involve more complex skills and troubleshooting. The GCT program certifications are maintainable for all Levels.

The following Level 1 Competency listing is an identification and description of basic individual electronics area subject topics in which an introductory technician is expected to have knowledge in order to prepare for the GCT1 certification examination.

1.0 Safety
1.1. List basic building / workplace safety protocols per industry standards
1.2. Describe general power safety guidelines, including:
   1.2.1. battery systems
   1.2.2. “Lock Out / Tag Out” rule
   1.2.3. grounding and lightning protection safety measures
1.3. Describe general tools and equipment safety
1.4. List personal protection equipment (PPE) used in the communication fields
1.5. Describe “Radio Frequency” (RF) safety
1.6. Describe communications safety requirements used near machinery
1.7. Describe safety measures used with towers and elevated surfaces
1.8. List fiber optic safety requirements
1.9. List laser use safety requirements

2.0 Electronic and Electrical Theory
2.1. Summarize Ohm’s law and formulas to include:
   2.1.1. voltage
   2.1.2. current
   2.1.3. resistance
2.2. List Watt’s law formula including power calculations
2.3. Define “Direct Current” (DC)
2.4. Define “Alternating Current” (AC)
2.5. Explain how and why series circuits are used
2.6. Explain how and why parallel circuits are used
2.7. Describe decibels (dB) and their use including:
   2.7.1. RF- (dBi, dDb, etc)
       2.7.1.1. sensitivity
       2.7.1.2. gain
   2.7.2. power- dBm
       2.7.2.1. “Rule of Three”
   2.7.3. audio
2.8. Describe harmonics applications in communications
2.9. Calculate power efficiency
2.10. Explain the use of the International System of Units (SI) to include:
    2.10.1. the metric system:
       2.10.1.1. prefixes and their acronyms
       2.10.1.2. scientific notation

3.0 Tools and Components
3.1. Describe hand tools used in communication fields
3.2. Describe power tools used in communication fields
3.3. Define components used in communications to include:
3.3.1. wire(s)
3.3.2. resistors
3.3.3. capacitors
3.3.4. inductors
3.3.5. relays
3.3.6. “Solid State Devices” to include:
   3.3.6.1. diodes
   3.3.6.2. transistors
      3.3.6.2.1. bipolar
      3.3.6.2.2. field effect (FET)
   3.3.6.3. operational amplifiers (op-amps)
   3.3.6.4. integrated circuits (IC’s)
   3.3.6.5. optical devices

4.0 Connectorization
4.1. Describe the requirements for the following types of connections to include:
   4.1.1. DC power
   4.1.2. AC power
   4.1.3. telecom
   4.1.4. RF
   4.1.5. signaling
4.2. List basic wiring fundamentals including:
   4.2.1. wire sizing (gauge, American Wire Gauge {AWG})
   4.2.2. color code
4.3. List standard connector types and functions
4.4. Describe standard connector terminations

5.0 Power Systems
5.1. Define “Voltage”
5.2. Define “Polarity”
5.3. Describe uninterruptible power supply (UPS) systems including AC UPS systems
5.4. Describe DC power systems
5.5. Describe AC power back-up generators to include:
   5.5.1. parameters
   5.5.2. uses
   5.5.3. operation
5.6. Define battery sizing in power systems
5.7. Describe renewable energy power systems including:
   5.7.1. solar
   5.7.2. wind
5.8. Describe power distribution
5.9. Explain the use of and operation of breakers including:
   5.9.1. fuse
   5.9.2. circuit
5.10. Describe load centers usage and operation
5.11. Define a “Cutoff switch”/low voltage disconnect (LVD) and its use
5.12. Describe an alarm unit and its use
5.13. Define transfer boxes

6.0 Radio Frequency (RF) Fundamentals
6.1. Explain basic RF fundamental operating principles and terminology
   6.1.1. duty cycle
6.2. Explain basic Federal Communications Commission (FCC) rules and regulations pertaining to two-way communications including:
   6.2.1. licensing
   6.2.2. spectrum usage
6.3. Define RF bandwidth
6.4. Define propagation to include:
6.4.1. “Line-of-Sight” (LOS)
6.4.2. groundwave
6.4.3. “Skywave”

6.5. List frequency spectrum band allocations to include:
   6.5.1. VLF
   6.5.2. LF
   6.5.3. MF
   6.5.4. VHF:
   6.5.4.1. Low band
   6.5.4.2. Mid-band
   6.5.4.3. High band
   6.5.4.4. 220MHz (Ham, Commercial, Positive Train Control {PTC})
   6.5.5. UHF:
   6.5.5.1. 380-470 MHz (Military, Federal, Ham, Commercial)
   6.5.5.2. 470-512 MHZ (T-band)
   6.5.5.3. 700 MHz (Long Term Evolution {LTE}, Commercial and Public Safety)
   6.5.5.4. 800 MHz (Public Safety-Emergency Responders, Cellular, Specialized Mobile Radio {SMR or Trunking})
   6.5.5.5. 900 MHz
   6.5.5.6. 1.8-1.9 GHz (Broadband Personal Communications Service {PCS})
   6.5.5.7. 2.1 GHz (Universal Mobile Telecommunications System {UMTS}, 3G)
   6.5.5.8. 2.4 GHz (Industrial, Scientific and Medical)
   6.5.6. other frequencies

6.6. Explain RF modulation and demodulation to include:
   6.6.1. transmitter modulation
   6.6.2. receiver demodulation
   6.6.3. receiver bandwidth must match the transmitter modulation scheme
   6.6.4. non-linear modulation, such as C4FM (Continuous 4-level FM) used in P-25
   6.6.4.1. H-CPM (Harmonized Continuous Phase Modulation)

7.0 Radio Types and Systems

7.1. Describe the following radio types:
   7.1.1. base
   7.1.2. mobile
   7.1.3. portable 2-way
   7.1.4. paging
      7.1.4.1. tone only
      7.1.4.2. voice
      7.1.4.3. display
   7.1.5. repeater
   7.1.6. microwave
   7.1.7. satellite

7.2. Describe the following systems types:
   7.2.1. simplex
   7.2.2. duplex/half-duplex
   7.2.3. conventional
   7.2.4. microwave
   7.2.5. repeater
   7.2.6. internet protocol (IP)
   7.2.7. wireless network technology (Wi-Fi®), 2.4 GHz

7.3. Describe basic radio components to include:
   7.3.1. transmitter(s)
   7.3.2. receiver(s)
   7.3.3. power supplies
   7.3.4. audio and control
   7.3.5. user programmable parameters
8.0 Antennas
8.1. Define polarization
8.2. Describe antenna wavelength and how it is used
8.3. Define resonance
8.4. Define bandwidth
8.5. Define beamwidth
8.6. Explain 3dB points
8.7. Describe gain
8.8. Describe “YAGI”
   8.8.1. Identify elements
   8.8.2. Identify front-to-back ratio
8.9. Describe antenna match to include defining standing wave ratio (SWR)
8.10. Describe measurements including:
   8.10.1. power
   8.10.2. return loss
   8.10.3. “Distance-to-Fault”
8.11. Describe antenna downtilt
8.12. Explain the importance of using drain holes
8.13. Describe a “Balun” antenna
8.14. List antenna types and azimuth to include:
   8.14.1. omnidirectional
   8.14.2. uni-directional
   8.14.3. specialized

9.0 Transmission Lines
9.1. Describe transmission line power
9.2. Explain characteristic impedance
9.3. Describe transmission line frequency
9.4. Explain line length
9.5. Describe line weight
9.6. Describe cable size/diameter (gauge)
9.7. Describe line outer covering material
9.8. Define the importance of shielding percentage
9.9. Describe the importance of line bend radius rules
9.10. Explain line RF signal loss
9.11. List cable types used in communications

10.0 Interference
10.1. Define RF interference including:
   10.1.1. natural
   10.1.2. man-made
10.2. Describe co-channel interference
10.3. Describe adjacent channel interference
10.4. List interference protective devices
10.5. Describe common mitigation steps to help resolve interference

11.0 Data Networks
11.1. Define the “Open Systems Interconnect” (OSI) model
11.2. Define serial data to include:
   11.2.1. RS232 standard pin out
   11.2.2. Universal Serial Bus (USB) standard devices
   11.2.3. data communication environment (DCE)
   11.2.4. data terminal equipment (DTE)
11.3. Describe internet protocol (IP) to include:
   11.3.1. wireless
   11.3.2. protocols
   11.3.3. cables
12.0 Fiber Optic Systems
12.1. Describe basic fiber optic cable fundamentals and terminology
12.2. Define fiber optic modes including:
   12.2.1. Single-mode (9 µm /125) (µm = micron)
   12.2.2. Multimode (50 or 62.5 µm /125)
12.3. Describe fiber optic wavelengths including:
   12.3.1. 850 nanometers (nm)
   12.3.2. 1310 nm
   12.3.3. 1550 nm
12.4. List common fiber optic connectors

13.0 Test Equipment and Methods
13.1. Describe the use and operation of the following meters:
   13.1.1. volt meter(s)
   13.1.2. ammeter(s)
   13.1.3. wattmeter(s)
   13.1.4. optical power meter(s)
13.2. Define dummy load; show where and why used
13.3. Describe the value of “Communication Service Monitors” (CSM)
13.4. Describe the use and operation of system analyzers including:
   13.4.1. oscilloscope
   13.4.2. spectrum analyzer
   13.4.3. “Frequency Domain Reflectometer” (FDR)
   13.4.4. “Time Domain Reflectometer” (TDR)
13.5. Describe the use and operation of audio transmission test sets to include:
   13.5.1. “Transmission Impairment Measurement Sets” (TIMS)
13.6. Explain the use and operation of a lineman’s handset (“Butt-Sets”)
13.7. Explain the use of a ground resistance tester
13.8. Explain “Equipment Testing” best practices to include:
   13.8.1. calibration
   13.8.2. stabilization
   13.8.3. warm-up procedures
   13.8.4. test lead loss compensation
   13.8.5. pass/fail limits for tolerances
13.9. Describe appropriate “Lock Out / Tag Out” procedures to be applied before testing and troubleshooting

14.0 Telephony Communications
14.1. Describe telephony basics to include:
   14.1.1. incumbent local exchange carrier (ILEC)
   14.1.2. plain old telephone service – voice (POTS)
14.2. Describe public switched telephone networks (PSTN)
14.3. Describe private line telephone networks (PL)
14.4. Identify telephone circuit types
   14.4.1. 2-wire
   14.4.2. 4-wire
14.5. Define “Loopback” and loopback testing
14.6. Describe a “Channel Service Unit” (CSU)
   14.6.1. Explain CSU/Data Service Unit (DSU) functions

15.0 Satellite Communications
15.1. Define “Low Earth Orbit” (LEO) satellites
15.2. Describe why “Satellite Mutual Aid Radio Talk” groups (SMART) was formed
15.3. Define Broadband Global Area Network (BGAN)
15.4. Explain Global Positioning System (GPS)
   15.4.1. Define Position, Navigation and Timing (PNT)
15.5. Identify a satellite antenna alignment set-up
16.0 Environmental Systems
16.1. Describe fire suppression systems
16.2. Describe "Heating, Ventilation, Air Conditioning" (HVAC) systems affecting communications
16.3. List how lighting systems affect communications sites
16.4. Describe how vermin affect communication environments

17.0 Physical Plant / Head End and Security Systems
17.1. Describe the function of access systems / locks for a communications site
17.2. List cybersecurity systems awareness
17.3. Describe battery usage to include:
   17.3.1. types
   17.3.2. recharging
   17.3.3. Proper Sizing
   17.3.4. configuration
      17.3.4.1. series
      17.3.4.2. parallel

End of General Communications Technician - Level 1 Competencies Listing

Find an ETA® Test Site  
https://www.etai.org/test_sites.html

Additional Suggested Study Materials and Resources:

General Communications Technician, Level 1, 2Ed.; Ira Wiesenfeld, P.E., CETsr, Rob Walker, LAS, PIM, Jay Thompson, CETsr, A.J. Wiesenfeld, BSEE, LAS; ISBN 978-0-915913-5-0; Self Published; 2015; softcover. Contact ETA® International at 800-288-3824 or eta@etai.org


Wiring for Wireless Sites; Ira Wiesenfeld, P.E., CETsr, ISBN 978-1-40181037-5; Prompt; 2002; softcover. Contact ETA® International at 800-288-3824 or eta@etai.org


New HAM Radio License? Now What?; James Sanders, AG6IF; Kindle Edition; Amazon; 2014

https://www.dhs.gov/keywords/communications & Emergency Communications & Office of Emergency Communications & SAFECOM & Project 25 Resources and Information | Homeland Security


https://www.dovertrainingsolutions.com;
GCT - Certification Program Subject Matter Advisory Board:

Ira M. Wiesenfeld, P.E., CETms(RF)  IWA Technical Services.; (TX)  iwiesenfel@aol.com
A.J. Wiesenfeld, B.S.E.E., CETsr  AJW & Assoc., IWATSI; (TX)  ajwandassociates@aol.com
Jay Thompson, CETsr  TACTicalRF.; (IN, AZ)  jay@tacticalrf.com
Chris L. Dalton, LAS  RSA, Inc.; (VA)
John D. MacLean, CET  DHS; (TN)
Mark D. Pallans  Pallans & Assoc.; (NV)
Robert Walker, CET, LAS, PIM, RFIM  Walker & Assoc.; (TX)  rob@wa-rep.com
Tom Dover  DTS, Inc.; (UT)  tom@doverts.com
Merle Taylor, RFIM  Rockinmesquite; (TX)
Dr. Ron Milione, CETma  PSEG; (NY)
Daniel Newman, CET  BCSR; (CA)
Don Root, Jr  SDS; (CA)
Larry Schaeffer  USCP; (DC)
Paul Gilbert, CET  TX DOT; (TX)  ke5zw@wt.net
Michael Green, CET  ESPN; (CT)
James D. Bough, GCT1  DOI,BoR; (MT)
Mike S. Hare, CET, RFIM  CoFB; (TX)
Aaron J. Brandt, CET  CoFR; (CA)
Steven A. Powell, CET  CoFR; (CA)
Michael Olson, GCT1  USA; (TX)
D. Marty Burnham  ECTC; (OH)
Dane Brockmiller, LAS, PIM, DAS  dBc; (MO)
Bill Dow  Westell; (NY)
Bryan S. Detro, CETsr  Motorola Solutions; (FL)  bryan.detro@motorolasolutions.com
Joseph Delio, CETma, CETms(RF)  IWATSI; (OH)