



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, dBd, 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:

General Communications Technician Level 1 Knowledge Competencies

- 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

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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 978-0-9915913-5-0; Self Published; 2015; softcover. Contact ETA® International at 800-288-3824 or eta@etai.org

Modern Electronic Communication, 9E; Jeff Beasley, Gary Miller, ISBN 978-0-13225113-6; Prentice Hall; 2007; hardcover.

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

ARRL Handbook, 2021 (Annual); Numerous Authors; ISBN 978-1-62595-139-7; The American Radio Relay League, Inc.; 2021

Practical Antenna Handbook, 5E; Carr, Hippisley; ISBN 978-0071639583; McGraw-Hill; 2011

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.iwatsi.com/> & <https://www.iwa-radio.com/>; <https://www.electronics-notes.com/articles/radio/>;

<https://www.fcc.gov/commercial-radio-operator-license-program>; <https://us-cert.cisa.gov/ncas/tips/ST04-001>;

<https://www.tacticalrf.com/>; [APCO Project 25](#); <https://www.iwceexpo.com/> & <http://urgentcomm.com/>;

[RadioReference.com Wiki Reference](#); <http://www.rcrwireless.com/>; <http://www.radioresourcemag.com/>;

<https://www.dovertrainingsolutions.com/>;

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