



# General Communication 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 all of the disciplines in the COMT program. The purpose of the GCT1 is to provide basic certification testing that covers all of the areas a new radio communications technician and/or engineer will encounter in the public safety communications or business / commercial radio field.

Please see the General Communication Technician Level 2 and Level 3 competencies for more specific in depth descriptions of communications theories which will involve more complex skills and troubleshooting. The GCT program will require re-testing to renew every four years to keep current in the newest technology, for all Levels.

The following **Level 1** Competency listing is an identification and description of basic individual subject topics in electronics areas in which introductory General Communications Technicians (GCT1) are expected to obtain 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
- 1.3. 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. Describe grounding and lightning protection safety measures
- 1.9. List fiber optic safety requirements
- 1.10. 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
- 2.4. Define Alternating Current
- 2.5. Explain how and why series circuits are used
- 2.6. Explain how and why parallel circuits are used
- 2.7. Describe decibels and their use including:
  - 2.7.1. RF
  - 2.7.2. Power
  - 2.7.3. Audio
- 2.8. Describe harmonics applications in communications
- 2.9. Calculate power efficiency
- 2.10. Explain the use of the metric system including:
  - 2.10.1. prefixes and their acronyms

### **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
  - 3.3.2. Resistors
  - 3.3.3. Capacitors
  - 3.3.4. Inductors
  - 3.3.5. Solid State 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)
  - 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 generators and their uses
- 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" 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
- 6.2. Explain basic FCC (Federal Communications Commission) 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. Lowband
- 6.5.4.2. Mid-band
- 6.5.4.3. Highband
- 6.5.4.4. 220MHz (Ham, Commercial, Positive Train Control)
- 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

## 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

## 8.0 Antennas

- 8.1. Define polarization
- 8.2. Describe antenna wavelength and how it is used
- 8.3. Define resonance
- 8.4. Define antenna bandwidth
- 8.5. Define beamwidth
- 8.6. Explain 3dB Points (Rule of Three)
- 8.7. Describe gain
- 8.8. 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 physical weight
- 9.6. Describe cable physical 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
  - 10.1.3. mitigation
- 10.2. Describe co-channel interference
- 10.3. Describe adjacent channel interference
- 10.4. List interference protective devices

## 11.0 Data Networks

- 11.1. Define serial data to include:
  - 11.1.1. RS232 standard pin out
  - 11.1.2. Universal Serial Bus (USB)
  - 11.1.3. Data Communication Environment (DCE)
  - 11.1.4. Data Terminal Equipment (DTE)
- 11.2. Describe Internet Protocol (IP) to include:
  - 11.2.1. Wireless
  - 11.2.2. Protocols
  - 11.2.3. 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  $\mu\text{m}$  /125) ( $\mu\text{m}$  = micron)
  - 12.2.2. Multimode (50 or 62.5  $\mu\text{m}$  /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 Meters
  - 13.1.2. Ammeters

- 13.1.3. Watt Meters
- 13.1.4. Optical Power meters
- 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. Frequency Domain Reflectometer (FDR)
  - 13.4.3. Time Domain Reflectometer (TDR)
  - 13.4.4. Voltage Standing Wave Ratio (VSWR)
- 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. Describe appropriate Lock Out / Tag Out procedures

#### **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 telephone networks (PTN)
- 14.4. Identify telephone circuit types
  - 14.4.1. 2-wire
  - 14.4.2. 4-wire
- 14.5. Define Loopback or Channel Service Unit (CSU)

#### **15.0 Satellite Communications**

- 15.1. Define Low Earth Orbit (LEO) satellites
- 15.2. Describe why SMART was formed (Satellite Mutual Aid Radio Talk groups)
- 15.3. Define Broadband Global Area Network (BGAN)
- 15.4. Explain Global Positioning System (GPS)
- 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 / Headend 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 (with 17 major Categories)**

Find an ETA® Test Site

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**Additional Suggested Study Materials and Resources for General Communications Technician Certification:**

**General Communications Technician, Level 1;** 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@eta-i.org](mailto:eta@eta-i.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@eta-i.org](mailto:eta@eta-i.org)

<http://www.dhs.gov/communications-technician-training>

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