

Electronics Technicians Association - International

Competency Standard - 2007

Personal Communication Service - Cellular

The name of this technician certification program is: PCS-C (PCS-Cellular Certification).

This exam shall be for a stand alone certification. The title of the technician who successfully passes the exam and shows the minimum experience will be: **Certified PCS-Cellular Technician**.

Passing this exam also can qualify as the specialty option exam which, along with the ETA C.E.T. Associate Level core exam, results in a **Certified Electronics Technician with PCS-C Specialty**.

(Current PCS-C Competency standards:)

1.0 PCS-C concepts

- 1.1 Describe PCS/Cellular network structures using SS7 common channel signaling and IS-41 protocols.
- 1.2 Describe communications theory including antennas, transmitters and receivers.
- 1.3 Identify the common terms and acronyms used in the PCS-C field such as, but not limited to: MIN, ESN, SID, PSIC, RSID, TLDN identities. (GSM systems use IMSI, IMEI, PLMN, TMSI as similar acronyms, VSWR, return loss (RL) dBm, capture effect, frequency reuse, frequency planning and co-channel interference.
- 1.4 Describe common analog and digital modulation methods such as FM, PM, GMSK, BPSK, Pi/4DQPSK as well as multiple user access methods of FDMA, TDMA, GSM and CDMA modulation.
- 1.5 Describe vocoder, speech encoder and decoder operations.
- 1.6 Describe pre-emphasis and de-emphasis theory and compression/expansion companding theory.
- 1.7 Describe balanced and unbalanced modulators.
- 1.8 Describe the operation of the RF output section of base station systems and subscriber phones. State what RF components are used. Explain why duplexers, block filters, combiners, isolators and antenna multicouplers are used.
- 1.9 State the frequency ranges expected in 1900 MHz PCS and 800 MHz Cellular systems.
- 1.10 State the standard frequency duplex separation between transmit and receive channels of cellular and PCS operations.
- 1.11 Describe dual-conversion superheterodyne receivers and image rejection in UHF applications and why it is used in cellular/PCS transceivers.
- 1.12 Recognize co-channel and adjacent channel interference and their causes and other common forms of RF interference.
- 1.13 Calculate and list methods of eliminating image frequencies.
- 1.14 Describe MSC functions and basic systems components.
- 1.15 Describe Handoff operation between cells and how Intersystems Handoffs are coordinated. Determine the type of handoff that a system uses: (hard, soft, softer).
- 1.16 Describe the GPS system, Stratum clocks and explain where and why accurate timing information is needed.
- 1.17 Define TDMA, CDMA and GSM digital access methods.
- 1.18 Describe current wireless data transmission methods.

2.0 RF transmit, propagate and receive principles

- 2.1 Describe RF-signal propagation principles.
- 2.2 Explain the relationship between signal frequency and wavelength.
- 2.3 Explain how frequency selective fading and multipath signals can be improved with diversity receiver operation.
- 2.4 State the different characteristics of digital systems, such as TDMA and CDMA and how signal propagation is affected by these processes.
- 2.5 Describe the benefits of CDMA in call capacity and effective combining of multipaths to enhance signal quality.
- 2.6 Discuss packet burst transmission, the effects on voice signal quality, user handset battery life, transmitter on and off times and overall data bit rates possible.

3.0 Technical Procedures

- 3.1 Measure signal-to-noise ratio, quieting and sensitivity.
- 3.2 Measure transmitter frequency error in percent and FM deviation on a communications service monitor.
- 3.3 Calculate signal levels using volts, watts and decibels.
- 3.4 Calculate wavelength from frequency, and gain/loss in decibels.
- 3.5 Properly use RF wattmeter, standing wave meter, VOM and communications service monitors.
- 3.6 Determine maximum frequency variation in respect to listed tolerances.
- 3.7 Explain what superheterodyne involves in a receiver.
- 3.8 Interpret and explain equipment specifications.
- 3.9 Define multiplexing and demultiplexing.
- 3.10 Explain A/D conversion, digital modulation and VOCODER operations.

4.0 Technical capabilities

- 4.1 Explain Journeyman troubleshooting procedures.
- 4.2 Describe all special circuits used in UHF radio equipment.
- 4.3 Analyze 'dropped call' reports
- 4.4 Define:
 - Analog Control Channels (ACC)
 - Analog Voice Channels (AVC)
 - Digital Voice Channels (DVC)
 - Digital Control Channels (DCCH)
 - Slow Associated Control Channel (SACCH)
 - Fast Associated Control Channel (FACCH)
- 4.5 Explain how an analog handoff and digital Mobile Assisted Handoff (MAHO) are performed .
- 4.6 Explain troubleshooting procedures for 48V, 24V and 12V battery powered communications equipment.
- 4.7 Describe DC power supply elements: rectifiers, charging circuits, floating and equalize, backup supplies and UPS operation.
- 4.8 Calculate power dissipation in transmitter final amplifiers.
- 4.9 Recognize audio clipping and identify poor high or low frequency response in waveforms.
- 4.10 Explain common types of FM detector circuits and how they are used.
- 4.11 Properly tune receiver RF, receiver IF and transmitter output circuits using manufacturers' procedures
- 4.12 Explain how band pass and notch filters work
- 4.13 Discuss DS1/DS3 theory, terminology and troubleshooting. Interpret BER (bit error rates) and diagnose base station interface equipment connecting to the MSC
- 4.14 Describe digital data transmission, packet switching and data rates associated with twisted pair DSO channels on DS1, and fiber optic OC3 and larger capacity systems.
- 4.15 Define wireless data transmission methods: CDPD, GPRS, 802.11, "Bluetooth" unlicensed and other current licensed services standards

5.0 Test equipment

- 5.1 Properly operate test equipment necessary for use in PCS-C applications.
- 5.2 Analyze malfunctions of RF circuits and interpret transmission line and antenna sweep return loss measurements on a typical communications service monitor.
- 5.3 Measure transmit power output in dBm and Watts.
- 5.4 Measure receiver power sensitivity, squelch threshold and handoff points in dBm.
- 5.5 Analyze system performance with drive testing and monitoring equipment.

6.0 Knowledge of Components

- 6.1 Explain common types of electronic signal filters.
- 6.2 List coax cable types and comparative loss factors for each
- 6.3 Identify transistors used in specific applications such as transmitter output, receiver output and RF receive circuits.
- 6.4 Explain how the components affect system optimization and performance.

7.0 Antennas

- 7.1 Recognize and name common antenna types
- 7.2 Explain how antenna polarization patterns are constructed and explain their use
- 7.3 Describe the factors which affect the bandwidth and gain of an antenna.
- 7.4 Explain Return Loss, VSWR and list the procedures in using a tracking generator with a spectrum analyzer in a communications service monitor to perform a sweep of an antenna system.

8.0 Frequency bands

- 8.1 List the current frequencies, channels and block assignments used for Cellular and PCS systems.
- 8.2 List where interference could be generated in other service bands such as UHF TV, pagers and others
- 8.3 Locate adjacent service bands such as SMR, ESMR and show their locations with respect to the 800 and 1900 MHz spectrums
- 8.4 List the pertinent FCC rules and regulations governing Personal Communications Services and Cellular operations.

9.0 Customer Relations

- 9.1 List ten customer needs or relationships with the service facility
- 9.2 Describe the need to communicate and explain to the public what your job is and how it relates to their phone operation.

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- 9.3 List competitive PCS or cellular systems and describe how and why the technician should treat these with respect.

10.0 Safety and Regulations

- 10.1 Describe safety precautions involved in cellular and PCS base stations.
10.2 Understand the dangers of working around high-current battery and backup power supply systems and charging systems.
10.3 Understand the potential health effects of long exposure to UHF and microwave radiation.

(end of PCS-C Competency Listing - 72 items)

Study Guide Suggestion #1: **CELLULAR and PCS/PCN TELEPHONE SYSTEMS**, APDG
Lawrence Harte & Steve Prokup, ISBN 0-9650658-1-2 (800 227 9681)

Study Guide Suggestion #2: **GWEC Curriculum Modules**, 2002 www.gwec.org

Study Guide Suggestion #3: **WIRELESS TECHNICIAN'S HANDBOOK**, Andrew Miceli, Artech House
Publisher, ISBN-158053-005-2 order at barnes&noble.com

**Course Outlines for PCS-C and Advanced Communications
Training are available from ETA-I**

Texts and References

Basic Wireless Telephony Course Notes, Kerr, AT&T Wireless
Services Tech. Ed. Group, 1998
Cellular and PCS - The Big Picture, Harte, Prokup and Levine,
McGraw-Hill, 1997
Wireless Technician's Handbook; Andrew Miceli; Artech House
Publisher; ISBN1-58053-005-2

2007 PCS-C Committee Chairman
is John Baldwin, CETsr
Communications Div. Chair at
South Central Technical College
(SCTC),
Mankato, MN
jbaldwin@myclearwave.net

800 288 3824 eta@tds.net

PCS-C Committee Members—2007:

John Baldwin, CETsr, Mankato, MN
James Arcaro, CETsr, Wickliffe, OH
David Caldwell, CETsr, Brownsville, PA
Robert Ing, Ph.D., CES, Toronto, Ont. Canada
Cully Phillips, CET, Fairless Hills, PA
Kirby L. Wallace, Wonder Lake, IL
Tom Janca, CETsr, Pueblo, CO
Paul Menz, Beloit, WI
Paul Muse, Clute, TX

Course length suggestion: 8 weeks, 32 contact hours

PCS-C Certification examinations may be taken at any of ETA-I's 635 permanent test sites in the U.S. and elsewhere and at most U.S. Military installations.

E-addresses for PCS-C Committee members:

jgarcaro@juno.com
jbaldwin@myclearwave.net
phantom@usaor.net
ring549@aol.com
n3htz@fast.net
electro@doitnow.com
kwallace@charlesindustries.com