Amateur Radio

LEVEL 1 TECHNICIAN LICENSE SYLLABUS

For the 2014 to 2018 Question Pool

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About The Author

Education:
Electrical Engineering, Penn State University

Work Experience:
Jerrold Electronics: Technician in R&D Laboratory working on cable TV distribution equipment
American Electronics Laboratories: 9 years managing a Metrology (Calibration Standards) Laboratory responsible for maintaining company test instruments and their calibration traceability to the National Standards Laboratory (NSIT)

Hewlett Packard Test Sales: Ten Years as Staff Engineer and Field Sales Engineer in the Eastern Pennsylvania and southern New Jersey Area

Hewlett Packard Electronic Instrument Group RF products Division in Spokane WA.: Twenty four years filling various positions in Technical Support, Application Engineering, Military Sales Manager, World Wide Sales Management, Systems Development and Product Planning and Management. Retired in 2004

Hobbies
Å Amateur Radio Å Test Equipment Å Electronics in general Å Teaching others
Å Attending every hamfest I can, including Hamvention in Dayton Ohio most years

Amateur Radio Activities:
Teaching and mentoring
- Teaching Technician, General and Extra License Classes (with training materials written by author)
- Write and develop technical presentations for local ham radio clubs (over 20 so far) . Contact the Author if you want any of these to present to you club.
- I provide a radio and general purpose test equipment table every year at the Spokane Hamfest for folks to test their radios and other electronic hamfest treasures.
- I have my own UHF portable repeater (443.400 with 100Hz CTCSS tone).

ARRL Appointments:
- ARRL VE (Volunteer Examiner)
- ARRL Technical Specialist for Spokane area
- ARRL Technical Coordinator for EWA
- ARRL Registered Instructor

Other
- Inland Empire VHF Club Past Director, President , Vice President (2014 to present)
- Member of Spokane ARES/Races ï Past Assistant Emergency Coordinator (AEC).

Syllabus Overview

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The Syllabus is intended either for classroom study or for self-study in pursuit of the Amateur Radio Technician License and to assist instructors in teaching a class. It may be distributed freely as long as no charge for the material is made. Reproduction costs associated with delivering paper or electronic copies on CD-ROMôs may be charged and this note of copyright permission is not removed.

Any modified copies must contain a note that the original material by the author has been modified and contain the name contact information of the person making the changes. An MS word version is available from the Author ad7fo@arrl.org for those who want to customize it for their class.

Question numbers are shown in bold text this, **T1A03** so you can go to the ARRL Technician Class License Manual, or the question pool itself, to see the actual questions and other answer choices that will be in the exam. If there is an FCC (Federal Communications Commission) part 97 rule relating to the answer it is shown following the question number and the FCC regulation reference number like this, **T1A07 [97.3(a)(45)]**

All questions are shown with only the correct answer **in bold green text**, which in the authors view makes it easier when you see the other choices in your exam to identify the correct answer.

Additional information has been added by the author ***(in italicized blue text)*** for some of the questions to explain the answer or show calculations. In addition some graphics have also been added for additional clarification.

You are not required to have a copy of the ARRL Technician Class License Manual. Everything you need to study for your license exam is in this syllabus. The author recommends if you want more technical background that you acquire a copy of a recent (within the last 8 years) ARRL Handbook. The Handbook will cover your Technical needs for all three licenses and will be a great reference after you are licensed and at a cost of approx. $50 ($10 to $20 if you find a used one at a Hamfest). This will be less than the total cost of purchasing all three license manuals from ARRL and provide a lot more technical information.

While every effort was made to insure the accuracy of the material herein, this material was prepared by an ordinary human being (we all know ñengineers canôt spellò), and it is likely that a few typographical or other errors remain. Author welcomes corrections and can be contacted at ad7fo@arrl.net

Contact the author via e-mail at ad7f0@arrl.net to be sure you have the latest revision of this syllabus.

This page and the author information must be retained in any copies. A word document version is available for instructors who want to change the material for their own use. Contact the Author.

Student Requirements

1. You will need a printed copy of this syllabus to study from and to bring to class. The Class will be taught directly from the syllabus. All the possible questions in the exam are covered in this syllabus.

2. A copy of part 97 of the FCC rules that can be purchased from the ARRL website, ham radio dealers and can be downloaded for free from the FCC web site. The rules require you have access to a copy of the part 97 rules (printed copy or on line from your computer) after you receive your license.

3 A Basic Scientific Calculator that you are familiar with. A basic scientific calculator is available from office supply stores and Wal-Mart for around $10.

4. A desire to learn and to ask questions if you do not understand something that is being taught be sure you ask the instructor.

5. You must take and pass the Technician Class written exam (element 2)

- There are 35 questions on the exam, All questions are multiple choice (4 choices).
- Questions only come the published Question Pool (all possible questions are covered in this syllabus).
- The number of possible questions for each topic area is fixed and shown for each question group in the test.
- You must have 26 correct answers to pass the test (no more than 9 incorrect answers).
- There are online practice sites with the real test questions you can take for practice. Listed below are three sites where you can take practice exams: *http://aa9pw.com/radio/*, *http://www.eham.net/exams/*, *http://www.qrz.com/ham/* *http://www.radioexam.org*, *http://www.hamexam.org*

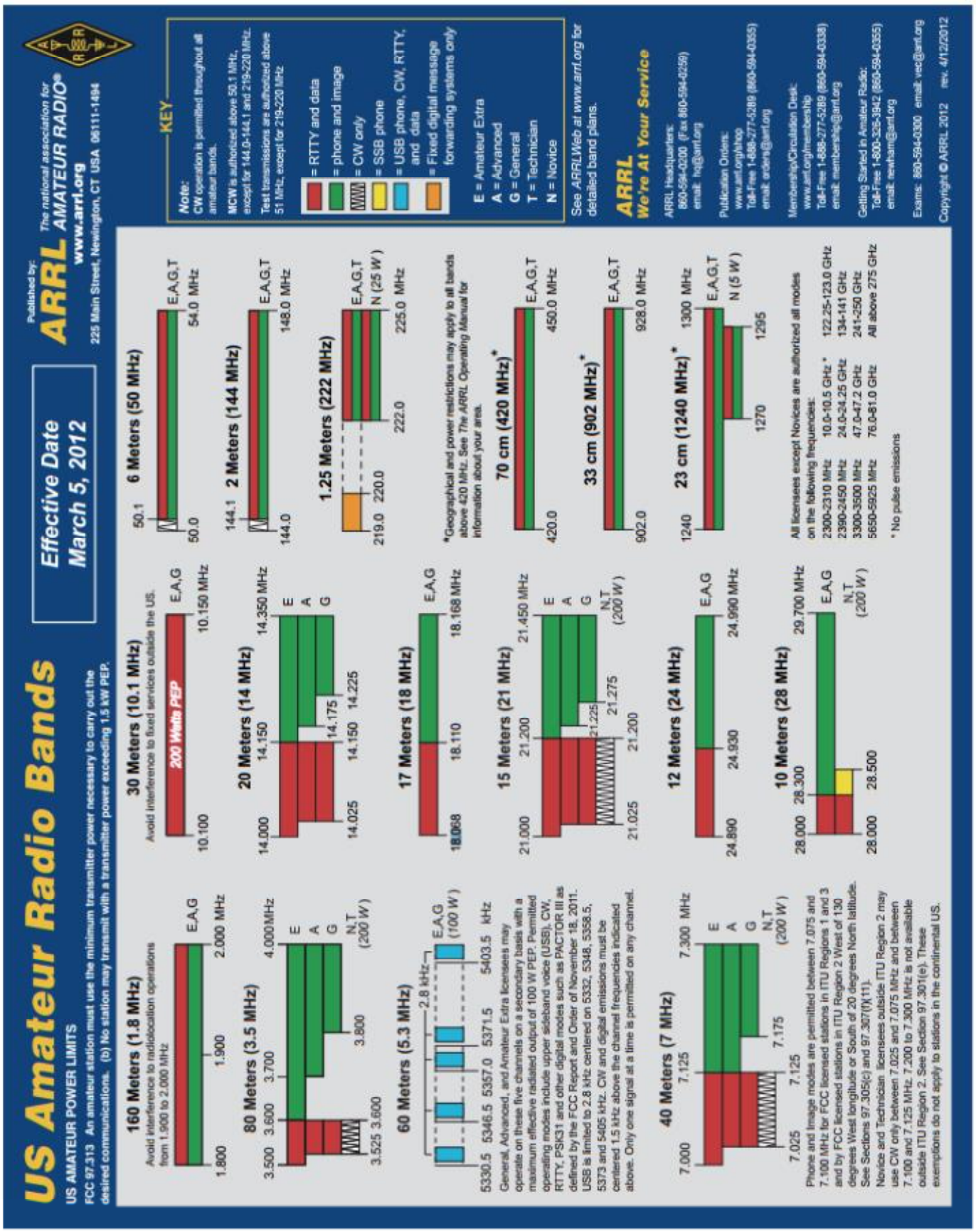
6. Please try to briefly read through the scheduled sections in the syllabus before each class. You are not expected to learn and understand what you read but by being familiar with what will be covered you can identify those areas where you may want focus on and/or bring up questions during the class.

Do not be intimidated. The material will be made easy to understand by your instructor and remember you can skip a whole section, study hard on the others and still pass the exam. The instructor will teach all the sections, but you can choose to focus on the topics you can or want to learn while skipping others and still pass your exam. You can then go back later and learn the areas where you had difficulty. There are many folks, ñElmerôsò, in the ham radio community ready to help you. Check in your region for local ARRL technical specialists if you donôt already know a local Ham that can help you.

It is not required that you have a copy of the current ARRL Technician Class License Manual. Everything you need to study for your license exam is in this syllabus.

The author recommends if you want more technical background that you acquire a copy of a recent (within the last 8 years) ARRL Handbook. The Handbook will cover your Technical needs for all three licenses and will be a great reference after you are licensed and at a cost of ~$50 ($10 to $20 if you find a used one) it will be less than the total cost of purchasing all three ARRL license manuals.

Additional information and resources to help you study for the Technician Class License can be found on the ARRL web site www.arrl.org This site has articles and resources for reference materials on all aspects of the exam questions.


US Amateur Radio Bands
US AMATEUR POWER LIMITS
FCC 97.313 An amateur station must use the minimum transmitter power necessary to carry out the desired communications. (b) No station may transmit with a transmitter power exceeding 1.5 kW PEP.
Effective Date March 5, 2012
Published by: ARRL The national association for AMATEUR RADIO® www.arrl.org
225 Main Street, Newington, CT USA 06111-1494
160 Meters (1.8 MHz)
Avoid interference to radiolocation operations from 1.900 to 2.000 MHz
E,A,G
1.800 1.900 2.000 MHz
80 Meters (3.5 MHz)
3.500 3.600 3.700 4.000MHz
E
A
G
3.525 3.600 3.800
N,T (200 W)
60 Meters (5.3 MHz)
2.8 kHz
E,A,G (100 W)
5330.5 5346.5 5357.0 5371.5 5403.5 kHz
General, Advanced, and Amateur Extra licensees may operate on these five channels on a secondary basis with a maximum effective radiated output of 100 W PEP. Permitted operating modes include upper sideband voice (USB), CW, RTTY, PSK31 and other digital modes such as PACTOR III as defined by the FCC Report and Order of November 18, 2011. USB is limited to 2.8 kHz centered on 5332, 5348, 5358.5, 5373 and 5405 kHz. CW and digital emissions must be centered 1.5 kHz above the channel frequencies indicated above. Only one signal at a time is permitted on any channel.
40 Meters (7 MHz)
7.000 7.125 7.300 MHz
E
A
G
N,T (200 W)
7.025 7.125 7.175
Phone and Image modes are permitted between 7.075 and 7.100 MHz for FCC licensed stations in ITU Regions 1 and 3 and by FCC licensed stations in ITU Region 2 West of 130 degrees West longitude or South of 20 degrees North latitude. See Sections 97.305(c) and 97.307(f)(11).
Novice and Technician licensees outside ITU Region 2 may use CW only between 7.025 and 7.075 MHz and between 7.100 and 7.125 MHz. 7.200 to 7.300 MHz is not available outside ITU Region 2. See Section 97.301(e). These exemptions do not apply to stations in the continental US.
30 Meters (10.1 MHz)
Avoid interference to fixed services outside the US.
200 Watts PEP
E,A,G
10.100 10.150 MHz
20 Meters (14 MHz)
14.000 14.150 14.350 MHz
E
A
G
14.025 14.150 14.175 14.225
17 Meters (18 MHz)
E,A,G
18.068 18.110 18.168 MHz
15 Meters (21 MHz)
21.000 21.200 21.450 MHz
E
A
G
21.025 21.200 21.225 21.275
N,T (200 W)
12 Meters (24 MHz)
E,A,G
24.890 24.930 24.990 MHz
10 Meters (28 MHz)
28.000 28.300 29.700 MHz
E,A,G
N,T (200 W)
28.000 28.500
6 Meters (50 MHz)
50.1
E,A,G,T
50.0 54.0 MHz
2 Meters (144 MHz)
144.1
E,A,G,T
144.0 148.0 MHz
1.25 Meters (222 MHz)
E,A,G,T
N (25 W)
219.0 220.0 222.0 225.0 MHz
*Geographical and power restrictions may apply to all bands above 420 MHz. See The ARRL Operating Manual for information about your area.
70 cm (420 MHz)*
E,A,G,T
420.0 450.0 MHz
33 cm (902 MHz)*
E,A,G,T
902.0 928.0 MHz
1240 23 cm (1240 MHz)* 1300 MHz
E,A,G,T
N (5 W)
1270 1295
All licensees except Novices are authorized all modes on the following frequencies:
2300-2310 MHz 10.0-10.5 GHz * 122.25-123.0 GHz
2390-2450 MHz 24.0-24.25 GHz 134-141 GHz
3300-3500 MHz 47.0-47.2 GHz 241-250 GHz
5650-5925 MHz 76.0-81.0 GHz All above 275 GHz
* No pulse emissions
KEY
Note:
CW operation is permitted throughout all amateur bands.
MCW is authorized above 50.1 MHz, except for 144.0-144.1 and 219-220 MHz.
Test transmissions are authorized above 51 MHz, except for 219-220 MHz
= RTTY and data
= phone and image
= CW only
= SSB phone
= USB phone, CW, RTTY, and data
= Fixed digital message forwarding systems only
E = Amateur Extra
A = Advanced
G = General
T = Technician
N = Novice
See ARRLWeb at www.arrl.org for detailed band plans.
ARRL
We're At Your Service
ARRL Headquarters:
860-594-0200 (Fax 860-594-0259)
email: hq@arrl.org
Publication Orders:
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Membership/Circulation Desk:
www.arrl.org/membership
Toll-Free 1-888-277-5289 (860-594-0338)
email: membership@arrl.org
Getting Started in Amateur Radio:
Toll-Free 1-800-326-3942 (860-594-0355)
email: newham@arrl.org
Exams: 860-594-0300 email: vec@arrl.org
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Question Pool Overview

SUBELEMENT T1 – FCC Rules, descriptions and definitions for the amateur radio service, operator and station license responsibilities *(6 exam Questions)*

- **T1A - Amateur Radio Service: purpose and permissible use of the Amateur Radio Service; operator/primary station license grant; where FCC rules are codified; basis and purpose of FCC rules; meanings of basic terms used in FCC rules; interference; spectrum management**
- **T1B - Authorized frequencies: frequency allocations; ITU regions; emission modes; restricted sub bands; spectrum sharing; transmissions near band edges**
- **T1C - Operator licensing: operator classes; sequential, special event, and vanity call sign systems; international communications; reciprocal operation; station license and licensee; places where the amateur service is regulated by the FCC; name and address on FCC license database; license term; renewal; grace period**
- **T1D - Authorized and prohibited transmission: communications with other countries; music; exchange of information with other services; indecent language; compensation for use of station; retransmission of other amateur signals; codes and ciphers; sale of equipment; unidentified transmissions; broadcasting**
- **T1E - Control operator and control types: control operator required; eligibility; designation of control operator; privileges and duties; control point; local, automatic and remote control; location of control operator**
- **T1F - Station identification; repeaters; third party communications; club stations; FCC inspection**

SUBELEMENT T2 - Operating Procedures *(3 exam Questions)*

- **T2A - Station operation: choosing an operating frequency; calling another station; test transmissions; procedural signs; use of minimum power; choosing an operating frequency; band plans; calling frequencies; repeater offsets**
- **T2B – VHF/UHF operating practices: SSB phone; FM repeater; simplex; splits and shifts; CTCSS; DTMF; tone squelch; carrier squelch; phonetics; operational problem resolution; Q signals**
- **T2C – Public service: emergency and non-emergency operations; applicability of FCC rules; RACES and ARES; net and traffic procedures; emergency restrictions**

SUBELEMENT T3 – Radio wave characteristics, radio and electromagnetic properties, propagation modes *(3 exam Questions)*

- **T3A - Radio wave characteristics: how a radio signal travels; fading; multipath; wavelength vs. penetration; antenna orientation**
- **T3B - Radio and electromagnetic wave properties: the electromagnetic spectrum; wavelength vs. frequency; velocity of electromagnetic waves; calculating wavelength**
- **T3C - Propagation modes: line of sight; sporadic E; meteor and auroral scatter and reflections; tropospheric ducting; F layer skip; radio horizon**

SUBELEMENT T4 - Amateur radio practices and station setup *(3 exam Questions)*

- **T4A – Station setup: connecting microphones; reducing unwanted emissions; power source; connecting a computer; RF grounding; connecting digital equipment; connecting an SWR meter**
- **T4B - Operating controls: tuning; use of filters; squelch function; AGC; repeater offset; memory channels**
- **T5C - Electronic principles: capacitance; inductance; current flow in circuits; alternating current; definition of RF; DC power calculations; impedance**

SUBELEMENT T5 – Electrical principles, math for electronics, electronic principles, Ohm's Law *(4 exam Questions)*

- **T5A - Electrical principles, units, and terms: current and voltage; conductors and insulators; alternating and direct current**
- **T5B - Math for electronics: conversion of electrical units; decibels; the metric system**
- **T5C - Electronic principles: capacitance; inductance; current flow in circuits; alternating current; definition of RF; DC power calculations; impedance**
- **T5D – Ohm's Law: formulas and usage**

SUBELEMENT T6 – Electrical components, semiconductors, circuit diagrams, component functions *(4 exam Questions)*

- **T6A - Electrical components: fixed and variable resistors; capacitors and inductors; fuses; switches; batteries**
- **T6B – Semiconductors: basic principles and applications of solid state devices; diodes and transistors**
- **T6C - Circuit diagrams; schematic symbols**
- **T6D - Component functions: rectification; switches; indicators; power supply components; resonant circuit; shielding; power transformers; integrated circuits**

SUBELEMENT T7 – Station equipment, common transmitter and receiver problems, antenna measurements and troubleshooting, basic repair and testing *(4 exam Questions)*

- **T7A – Station equipment: receivers; transmitters; transceivers; modulation; transverters; low power and weak signal operation; transmit and receive amplifiers**
- **T7B – Common transmitter and receiver problems: symptoms of overload and overdrive; distortion; causes of interference; interference and consumer electronics; part 15 devices; over and under modulation; RF feedback; off frequency signals; fading and noise; problems with digital communications interfaces**
- **T7C – Antenna measurements and troubleshooting: measuring SWR; dummy loads; coaxial cables; feed line failure modes**

- **T7D – Basic repair and testing: soldering; using basic test instruments; connecting a voltmeter, ammeter, or ohmmeter**

SUBELEMENT T8 – Modulation modes, amateur satellite operation, operating activities, non-voice communications *(4 exam Questions)*

- **T8A – Modulation modes: bandwidth of various signals; choice of emission type**
- **T8B - Amateur satellite operation; Doppler shift, basic orbits, operating protocols; control operator, transmitter power considerations; satellite tracking; digital modes**
- **T8C – Operating activities: radio direction finding; radio control; contests; linking over the Internet; grid locators**
- **T8D – Non-voice communications: image signals; digital modes; CW; packet; PSK31; APRS; error detection and correction; NTSC**

SUBELEMENT T9 – Antennas, feed lines (*2 exam Questions)*

- **T9A – Antennas: vertical and horizontal polarization; concept of gain; common portable and mobile antennas; relationships between antenna length and frequency**
- **T9B – Feed lines: types of feed lines; attenuation vs. frequency; SWR concepts; matching; weather protection; choosing RF connectors and feed lines**

SUBELEMENT T0 – AC power circuits, antenna installation, RF hazards *(3 exam Questions)*

- **T0A – Power circuits and hazards: hazardous voltages; fuses and circuit breakers; grounding; lightning protection; battery safety; electrical code compliance**
- **T0B – Antenna safety: tower safety; erecting an antenna support; overhead power lines; installing an antenna**
- **T0C - RF hazards: radiation exposure; proximity to antennas; recognized safe power levels; exposure to others; radiation types; duty cycle**

SUBELEMENT T1 – FCC Rules, descriptions and definitions for the Amateur Radio Service, operator and station license responsibilities - [6 Exam Questions - 6 Groups]

T1A - Amateur Radio Service: purpose and permissible use of the Amateur Radio Service; operator/primary station license grant; where FCC rules are codified; basis and purpose of FCC rules; meanings of basic terms used in FCC rules; interference; spectrum management

T1A01 [97.1]
Which of the following is a purpose of the Amateur Radio Service as stated in the FCC rules and regulations? **Persons who are interested in radio technique solely with a personal aim and without pecuniary interest**
97.1 Basis and purpose.
The rules and regulations in this part are designed to provide an amateur radio service having a fundamental purpose as expressed in the following principles (note only the above answer will be in the exam):
(a) Recognition and enhancement of the value of the amateur service to the public as a voluntary noncommercial communication service, particularly with respect to providing emergency communications.
(b) Continuation and extension of the amateur's proven ability to contribute to the advancement of the radio art.
(c) Encouragement and improvement of the amateur service through rules which provide for advancing skills in both the communication and technical phases of the art.
(d) Expansion of the existing reservoir within the amateur radio service of trained operators, technicians, and electronics experts.
(e) Continuation and extension of the amateur's unique ability to enhance international goodwill."

T1A02 [97.1]
Which agency regulates and enforces the rules for the Amateur Radio Service in the United States? **The FCC**

T1A03
Which part of the FCC regulations contains the rules governing the Amateur Radio Service? **Part 97**

T1A04 [97.3(a)(23)]
Which of the following meets the FCC definition of harmful interference? **That which seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the Radio Regulations.**

T1A05 [97.1 (e)]
Which of the following is a purpose of the Amateur Radio Service rules and regulations as defined by the FCC? **Enhancing international goodwill.**

T1A06 [97.101 (d), 97.303 (o)(2)]
Which of the following services are protected from interference by amateur signals under all circumstances? **Land Radionavigation Service**
These systems used some form of directional radio antenna to determine the location of a broadcast station on the ground. Conventional navigation techniques are then used to take a radio fix. These were introduced prior to WWI, and remain in use today.

T1A07 [97.3(a)(46)]
What is the FCC Part 97 definition of telemetry? **A one-way transmission of measurements at a distance from the measuring instrument. .**
Example would be data from an amateur or commercial satellite giving on board conditions such as battery charge level, temperature, usage data, etc.

T1A08 [97.3(a)(22)]
Which of the following entities recommends transmit/receive channels and other parameters for auxiliary and repeater stations? **Frequency Coordinator**

T1A09 [97.3(a)(22)]
Who selects a Frequency Coordinator? **Amateur operators in a local or regional area whose stations are eligible to be auxiliary or repeater stations.**

An amateur radio repeater is an electronic device that receives a weak or low-level amateur radio signal and retransmits it at a higher level or higher power, so that the signal can cover longer distances without degradation. Many repeaters are located on hilltops or on tall buildings as the higher location increases their coverage area, sometimes referred to as the radio horizon, or "footprint." Amateur radio repeaters are similar in concept to those used by public safety entities (police, fire department, etc.), businesses, government, military,.

"Auxiliary" operation, at the very basic level, is inherently closed operation, which means that all auxiliary stations are part of a "system" of stations. All operators of the system must be authorized control operators. There are several forms of auxiliary operation, which encompass a number of different types of activities, such as:

1. Remote control of a station, where a radio link is used.
2 Voice links between two or more stations within a system of stations, such as;
a. Point-to-point links from a repeater's remote receiver(s) back to the main repeater site
b. Dedicated point-to-point links between different repeaters in a "system" of either full- time or part-time linked repeaters;
c. Combination remote-control and voice point-to-point links intended to control and carry the voice signals to the transmitter(s) of a remotely-controlled station
d. Point-to-point links from the receiver(s) of a remotely located station back to the control point

T1A10 [97.3(a)(5)]
What is the FCC Part 97 definition of an amateur station? **A station in the Amateur Radio Service consisting of the apparatus necessary for carrying on radio communications**
This can be anything from simple hand held or mobile transceiver to a fixed high power base station.

T1A11 [97.101 (d)]
When is willful interference to other amateur radio stations permitted? **At no time**

T1A12
Which of the following is a permissible use of the Amateur Radio Service?
Allowing a person to conduct radio experiments and to communicate with other licensed hams around the world

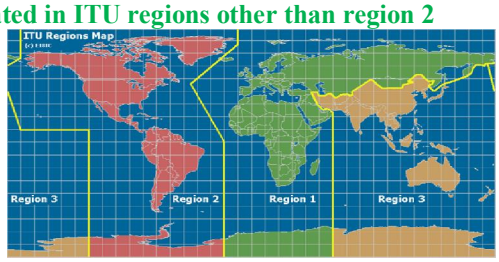
T1A13 [97.3(a)(45)]
What is the FCC Part 97 definition of telecommand? **A one-way transmission to initiate, modify or terminate functions of a device at a distance**
An example would be a transmission to an amateur radio satellite to initiate a function such as reducing transmit power, turning off a function or turning off the satellite repeater function.

T1A14 [97.303(d)]
What must you do if you are operating on the 23 cm band and learn that you are interfering with a radiolocation station outside the United States? **Stop operating or take steps to eliminate the harmful interference**

T1B - Authorized frequencies: frequency allocations; ITU regions; emission modes; restricted sub-bands; spectrum sharing; transmissions near band edges

T1B01
What is the ITU? **A United Nations agency for information and communication technology issues**
The ITU stands for the International Telecommunications Union.

T1B02 [97.301]
Why are the frequency assignments for some U.S. Territories different from those in the 50 U.S. States? **Some U. S. Territories are located in ITU regions other than region 2**



T1B03 [97.301(a)]
Which frequency is within the 6 meter band? **52.525 MHz**
Amateur radio operating frequencies are frequently referred to in meters. To determine the frequency band in meters, simply divide 300 by the frequency in MHz (Mega Hertz). In this question 300 divided by 52.525 which would be 5.711 (close to 6 meters) so the closest answer would be 6 meters)

T1B04 [97.301(a)]
Which amateur band are you using when your station is transmitting on 146.52 MHz? **2 meter band**
Amateur radio operating frequencies are frequently referred to in meters. To determine the frequency band in meters, simply divide 300 by the frequency in MHz (Mega Hertz). In this question 300 divided by 145.52 which would be 2.06 (close to 2 meters) so the closest answer would be 2 meters.

T1B05 [97.301(a)]
Which 70 cm frequency is authorized to a Technician Class license holder operating in ITU Region 2? **443.350 MHz**
See part 97 rules or the ARRL Band Plan on page 5 in this handout.

T1B06 [97.301(a)]
Which 23 cm frequency is authorized to a Technician Class licensee? **1296 MHz**
To determine the frequency of band simply divide 300 by the band, in meters. In this question 300/.23 would be1304.34 MHz therefore the closest answer would be 1296 MHz.

T1B07 [97.301(a)]
What amateur band are you using if you are transmitting on 223.50 MHz? **1.25 meter band**
To determine the band simply divide 300 by the frequency on MHz. In this question 300/223.50 would 1.34 meters, so the closest answer would be the 1.25 meter band.

T1B08 [97.303]
Which of the following is a result of the fact that the amateur service is secondary in some portions of the 70 cm band? **U.S. amateurs may find non-amateur stations in the bands, and must avoid interfering with them**

T1B09 [97.101(a), 97.301(a-e)]
Why should you not set your transmit frequency to be exactly at the edge of an amateur band or sub-band?

A. To allow for calibration error in the transmitter frequency display
B. So that modulation sidebands do not extend beyond the band edge
C. To allow for transmitter frequency drift
D. All of these choices are correct.

T1B10 [97.301(e), 97.305(c)]
Which of the bands above 30 MHz that are available to Technician Class operators have mode-restricted sub-bands?
The 6 meter, 2 meter, and 1.25 meter bands
See part 97 rules or the ARRL Band Plan on page 5 in this syllabus.

T1B11 [97.301(a), 97.305 (a)(c)]
What emission modes are permitted in the mode-restricted sub-bands at 50.0 to 50.1 MHz and 144.0 to 144.1 MHz?
CW only
See ARRL Band Plan on page 5 in this syllabus. CW is morse code

T1B12 [97.301]
Why are frequency assignments for U.S. stations operating maritime mobile not the same everywhere in the world?
Amateur frequency assignments can vary among the three ITU regions

T1B13 [97.305(c)]
Which emission may be used between 219 and 220 MHz? **Data**
See the ARRL Band Plan on page 5 in this syllabus.

T1C - Operator licensing: operator classes; sequential, special event, and vanity call sign systems; international communications; reciprocal operation; station license and licensee; places where the amateur service is regulated by the FCC; name and address on FCC license database; license term; renewal; grace period

T1C01 [97.3(a)(11)(iii)]
Which type of call sign has a single letter in both its prefix and suffix? **Special event**
Examples A1A, C7T, H1K, etc.

T1C02
Which of the following is a valid US amateur radio station call sign? **W3ABC**
All U.S. amateur radio call signs contain one or two prefix letters beginning with K, N, W, AA-AL, KA- KZ, NA-NZ or WA-WZ. By agreement, these prefix letters are allocated to the United States by the International Telecommunication Union (ITU.)

T1C03 [97.117]
What types of international communications are permitted by an FCC-licensed amateur station? **Communications incidental to the purposes of the amateur service and remarks of a personal character**

T1C04 [97.107]
When are you allowed to operate your amateur station in a foreign country? **When the foreign country authorizes it**

T1C05
Which of the following is a vanity call sign which a technician class amateur operator might select if available?
K1XXX
Technician class licenses must have a three letter suffix.

T1C06 [97.5(a)(2)]
From which of the following locations may an FCC-licensed amateur station transmit, in addition to places where the FCC regulates communications? **From any vessel or craft located in international waters and documented or registered in the United States**

T1C07 [97.23]
What may result when correspondence from the FCC is returned as undeliverable because the grantee failed to provide the correct mailing address? **Revocation of the station license or suspension of the operator license**

T1C08 [97.25]
What is the normal term for an FCC-issued primary station/operator amateur radio license grant? **Ten years**

T1C09 [97.21(a)(b)]
What is the grace period following the expiration of an amateur license within which the license may be renewed?
Two years

T1C10 [97.5a]
How soon after passing the examination for your first amateur radio license may you operate a transmitter on an amateur service frequency? **As soon as your operator/station license grant appears in the FCC's license database**

T1C11 [97.21(b)]
If your license has expired and is still within the allowable grace period, may you continue to operate a transmitter on amateur service frequencies? **No, transmitting is not allowed until the FCC license database shows that the license has been renewed**

T1C12 [97.19]
Who may select a desired call sign under the vanity call sign rules? **Any licensed amateur**

T1C13 [97.9(a), 97.17(a)]
For which licenses classes are new licenses currently available from the FCC? **Technician, General, Amateur Extra**
Existing licenses for Novice, Technician Plus and Amateur Advanced can still be renewed

T1C14 [97.21(a) (1)]
Who may select a vanity call sign for a club station? **Only the person named as trustee on the club station license grant**

T1D - Authorized and prohibited transmission: communications with other countries; music; exchange of information with other services; indecent language; compensation for use of station; retransmission of other amateur signals; codes and ciphers; sale of equipment; unidentified transmissions; broadcasting

T1D01 [97.111(a)(1)]
With which countries are FCC-licensed amateur stations prohibited from exchanging communications? **Any country whose administration has notified the ITU that it objects to such communications**

T1D02 [97.111(a)(5)]
On which of the following occasions may an FCC-licensed amateur station exchange messages with a U.S. military station? **During an Armed Forces Day Communications Test**

Split frequency operation is typical for the message exchange with each station transmitting within it own allocation.

T1D03 [97.211(b), 97.215(b)]
When is the transmission of codes or ciphers that hide the meaning of a message allowed by an amateur station? **Only when transmitting control commands to space stations or radio control craft**

T1D04 [97.113(a)(4), 97.113(c)]
What is the only time an amateur station is authorized to transmit music? **When incidental to an authorized retransmission of manned spacecraft communications**

T1D05 [97.113(a)(3)(ii)]
When may amateur radio operators use their stations to notify other amateurs of the availability of equipment for sale or trade? **When the equipment is normally used in an amateur station and such activity is not conducted on a regular basis**

T1D06 [97.113(a)(4)]
What, if any, are the restrictions concerning transmission of language that may be considered indecent or obscene? **Any such language is prohibited**

T1D07 [97.113(d)]
What types of amateur stations can automatically retransmit the signals of other amateur stations? **Auxiliary, repeater, or space stations**

T1D08 [97.113(a)(3)(iii)]
In which of the following circumstances may the control operator of an amateur station receive compensation for operating the station? **When the communication is incidental to classroom instruction at an educational institution**

T1D09 [97.113(5)(b)]
Under which of the following circumstances are amateur stations authorized to transmit signals related to broadcasting, program production, or news gathering, **assuming no other means is available**? **Only where such communications directly relate to the immediate safety of human life or protection of property**

T1D10 [97.3(a)(10)]
What is the meaning of the term ñbroadcastingò in the FCC rules for the amateur services? **Transmissions intended for reception by the general public**

T1D11 [97.119(a)]
When may an amateur station transmit without identifying? **When transmitting signals to control a model craft**

T1D12 [97.111(b)(4,5,6)
Under which of the following circumstances may an amateur radio station engage in broadcasting? **When transmitting code practice, information bulletins, or transmissions necessary to provide emergency communications**

T1E - Control operator and control types: control operator required; eligibility; designation of control operator; privileges and duties; control point; local, automatic and remote control; location of control operator

T1E01 [97.7(a)]
When is an amateur station permitted to transmit without a control operator? **Never**

T1E02 [97.7(a)]
Who may a station licensee designate to be the control operator of an amateur station? **Only a person for whom an amateur operator/primary station license grant appears in the FCC database or who is authorized for alien reciprocal operation**

T1E03 [97.103(b)]
Who must designate the station control operator? **The station licensee**
A station log book would be an appropriate way to designate a control operator it is not the station licensee.

T1E04 [97.103(b)]
What determines the transmitting privileges of an amateur station? **The class of operator license held by the control operator**

T1E05 [97.3(a)(14)]
What is an amateur station control point? **The location at which the control operator function is performed**

T1E06 [97.109(d)]
Under what type of control do APRS network digipeaters operate? **Automatic**
APRS Digipeaters are repeater stations that receive transmitted APRS information and forward it to another Digipeaters or to an internet gateway station.

T1E07 [97.103(a)]
When the control operator is not the station licensee, who is responsible for the proper operation of the station? **The control operator and the station licensee are equally responsible**

T1E08 [97.3(a)(6), 97.205(d)]
Which of the following is an example of automatic control? **Repeater operation**

T1E09 [97.109(b)]
What type of control is being used when the control operator is at the control point? **Local control**

T1E10 [97.3(a)(39)]
Which of the following is an example of remote control as defined in Part 97? **Operating the station over the Internet**

T1E11 [97.103(a)]
Who does the FCC presume to be the control operator of an amateur station, unless documentation to the contrary is in the station records? **The station licensee**

T1E12 [97.119(e)]
When, under normal circumstances, may a Technician Class licensee be the control operator of a station operating in an exclusive Extra Class operator segment of the amateur bands? **At no time**

T1F - Station identification; repeaters; third party communications; club stations; FCC inspection

T1F01
What type of identification is being used when identifying a station on the air as Race Headquarters? **Tactical call sign**

T1F02 [97.119 (a)]
When using tactical identifiers such as ñRace Headquarterso during a community service net operation, how often must your station transmit the stationôs FCC-assigned call sign? **At the end of each communication and every ten minutes during a communication**

T1F03 [97.119(a)]
When is an amateur station required to transmit its assigned call sign?
At least every 10 minutes during and at the end of a communication

T1F04 [97.119(b)(2)]
Which of the following is an acceptable language to use for station identification when operating in a phone sub-band?
The English language

T1F05 [97.119(b)(2)]
What method of call sign identification is required for a station transmitting phone signals? **Send the call sign using CW or phone emission**

T1F06 [97.119(c)]
Which of the following formats of a self-assigned indicator is acceptable when identifying using a phone transmission?
A. KL7CC stroke W3
B. KL7CC slant W3
C. KL7CC slash W3
D. All of these choices are correct.
Only for the holder of the call sign KL7CC (who is James B. Wiley in this case)

T1F07 [97.115(a)(2)]
The following restriction applies when a non-licensed person is allowed to speak to a foreign station using a station under the control of a Technician Class control operator: **The foreign station must be one with which the U.S. has a third party agreement.**

T1F08 [97.119(f)]
Which indicator is required by the FCC to be transmitted after a station call sign?
KT, /AE or /AG when using new license privileges earned by CSCE while waiting for an upgrade to a previously issued license to appear in the FCC license database

T1F09 [97.3(a)(40)]
What type of amateur station simultaneously retransmits the signal of another amateur station on a different channel or channels? **Repeater station**

T1F10 [97.205(g)]
Who is accountable should a repeater inadvertently retransmit communications that violate the FCC rules? **The control operator of the originating station**

T1F11 [97.115(a)]
To which foreign stations do the FCC rules authorize the transmission of non-emergency third party communications?
Any station whose government permits such communications

T1F12 [97.5(b)(2)]
How many persons are required to be members of a club for a club station license to be issued by the FCC? **At least 4**

T1F13 [97.103(c)]
When must the station licensee make the station and its records available for FCC inspection? **At any time upon request by an FCC representative**

SUBELEMENT T2 - Operating Procedures [3 Exam Questions - 3 Groups

T2A - Station operation: choosing an operating frequency; calling another station; test transmissions; procedural signs; use of minimum power; choosing an operating frequency; band plans; calling frequencies; repeater offsets

T2A01
What is the most common repeater frequency offset in the 2 meter band? **Plus or minus 600 kHz**

T2A02
What is the national calling frequency for FM simplex operations in the 70 cm band? **446.000 MHz**
On the 2 meter band the national calling frequency is 146.52 MHz.

T2A03
What is a common repeater frequency offset in the 70 cm band? **Plus or minus 5 MHz**

T2A04
What is an appropriate way to call another station on a repeater if you know the other station's call sign? **Say the station's call sign then identify with your call sign**
Example: W3JIN AD7FO or W3JIN this is AD7FO

T2A05
How should you respond to a station calling CQ? **Transmit the other station's call sign followed by your call sign**
Example: W1AW AD7FO or W1AW this is AD7FO

T2A06
What must an amateur operator do when making on-air transmissions to test equipment or antennas? **Properly identify the transmitting station**

T2A07
Which of the following is true when making a test transmission? **Station identification is required at least every ten minutes during the test and at the end of the test**

T2A08
What is the meaning of the procedural signal ñCQò? **Calling any station**
A list of common procedural signals is in the appendix at the back of this syllabus on page 65.

T2A09
What brief statement is often transmitted in place of ñCQò to indicate that you are listening on a repeater? **Your call sign**

T2A10
What is a band plan, beyond the privileges established by the FCC? **A voluntary guideline for using different modes or activities within an amateur band**
See ARRL Band Plan on page 5 in this syllabus

T2A11 [97.313(a)]
Which of the following is an FCC rule regarding power levels used in the amateur bands, under normal, non-distress circumstances? **While not exceeding the maximum power permitted on a given band, use the minimum power necessary to carry out the desired communication**

T2A12
Which of the following is a guideline to use when choosing an operating frequency for calling CQ?
A. Listen first to be sure that no one else is using the frequency
B. Ask if the frequency is in use
C. Make sure you are in your assigned band
D. All of these choices are correct

T2B – VHF/UHF operating practices: SSB phone; FM repeater; simplex; splits and shifts; CTCSS; DTMF; tone squelch; carrier squelch; phonetics; operational problem resolution; Q signals

T2B01
What is the term used to describe an amateur station that is transmitting and receiving on the same frequency? **Simplex communication**

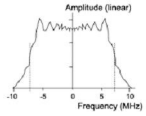
T2B02
What is the term used to describe the use of a sub-audible tone transmitted with normal voice audio to open the squelch of a receiver? **CTCSS**
CTCSS is an abbreviation for Continuous Tone Coded Squelch System.

T2B03
Which of the following describes the muting of receiver audio controlled solely by the presence or absence of an RF signal? **Carrier squelch**

T2B04
Which of the following common problems might cause you to be able to hear but not access a repeater even when transmitting with the proper offset?
A. The repeater receiver may require an audio tone burst for access
B. The repeater receiver may require a CTCSS tone for access
C. The repeater receiver may require a DCS tone sequence for access
D. All of these choices are correct

T2B05
What determines the amount of deviation of an FM (as opposed to PM) signal? **The amplitude of the modulating signal**
FM modulation is Frequency Modulation, PM is Phase Modulation. Modulation is the information applied to a RF carrier such as Voice or Data. The louder your voice the more deviation and more bandwidth your signal will occupy.

T2B06
What happens when the deviation of an FM transmitter is increased? **Its signal occupies more bandwidth**



T2B07
What could cause your FM signal to interfere with stations on nearby frequencies? **Microphone gain too high, causing over-deviation**

T2B08
Which of the following applies when two stations transmitting on the same frequency interfere with each other?
Common courtesy should prevail, but no one has absolute right to an amateur frequency

T2B09 [97.119(b)(2)]
Which of the following methods is encouraged by the FCC when identifying your station when using phone? **Use of a phonetic alphabet**

A - Alfa	N - November
B - Bravo	O - Oscar
C - Charlie	P - Papa
D - Delta	Q - Quebec
E - Echo	R - Romeo
F - Foxtrot	S - Sierra
G - Golf	T - Tango
H - Hotel	U - Uniform
I - India	V - Victor
J - Juliet	W - Whiskey
K - Kilo	X - X-Ray
L - Lima	Y - Yankee
M - Mike	Z - Zulu

T2B10
Which Q signal indicates that you are receiving interference from other stations? **QRM**
***A list of common procedural (Q) signals isin the back of the syllabus in the appendix*.**

T2B11
Which Q signal indicates that you are changing frequency? **QSY**
***A list of common procedural (Q) signals isin the back of the syllabus in the appendix*.**

T2B12
Under what circumstances should you consider communicating via simplex rather than a repeater? **When the stations can communicate directly without using a repeater**

T2B13
Which of the following is true of the use of SSB phone in amateur bands above 50 MHz? **It is permitted in at least some portion of all the amateur bands above 50 MHz**
***See ARRL Band Plan on page 5 in this syllabus*.**

T2C – Public service: emergency and non-emergency operations; applicability of FCC rules; RACES and ARES; net and traffic procedures; emergency restrictions

T2C01 [97.103(a)]
When do the FCC rules NOT apply to the operation of an amateur station? **Never, FCC rules always apply.**

T2C02
What is one way to recharge a 12-volt lead-acid station battery if the commercial power is out? **Connect the battery in parallel with a vehicle's battery and run the engine**

T2C03
To insure that voice message traffic containing proper names and unusual words are copied correctly by the receiving station **Such words and terms should be spelled out using a standard phonetic alphabet**

T2C04
What do RACES and ARES have in common? **Both organizations may provide communications during emergencies.**

T2C05 [97.3(a)(38), 97.407]
Which of the following describes the Radio Amateur Civil Emergency Service (RACES)?

A. A radio service using amateur frequencies for emergency management or civil defense communications
B. A radio service using amateur stations for emergency management or civil defense communications
C. An emergency service using amateur operators certified by a civil defense organization as being enrolled in that organization
D. All of these choices are correct

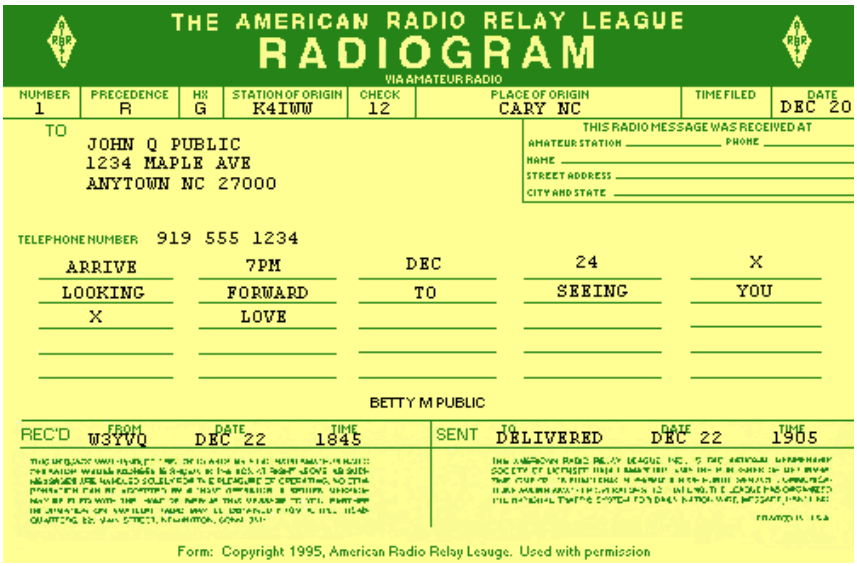
T2C06
Which of the following is an accepted practice to get the immediate attention of a net control station when reporting an emergency? **Begin your transmission by saying "Priority" or "Emergency" followed by your call sign.**

T2C07
Which of the following is an accepted practice for an amateur operator who has checked into an emergency traffic net? **Remain on frequency without transmitting until asked to do so by the net control station.**

T2C08
Which of the following is a characteristic of good emergency traffic handling? **Passing messages exactly as received.**

T2C09
Are amateur station control operators ever permitted to operate outside the frequency privileges of their license class? **Yes, but only if necessary in situations involving the immediate safety of human life or protection of property.**

T2C10
What is the preamble in a formal traffic message? **The information needed to track the message as it passes through the amateur radio traffic handling system.**


THE AMERICAN RADIO RELAY LEAGUE
RADIOGRAM
VIA AMATEUR RADIO

NUMBER	PRECEDENCE	HX	STATION OF ORIGIN	CHECK	PLACE OF ORIGIN	TIME FILED	DATE
1	R	G	K4IWW	12	CARY NC		DEC 20

TO
JOHN Q PUBLIC
1234 MAPLE AVE
ANYTOWN NC 27000

THIS RADIO MESSAGE WAS RECEIVED AT
AMATEUR STATION _____ PHONE _____
NAME _____
STREET ADDRESS _____
CITY AND STATE _____

TELEPHONE NUMBER 919 555 1234

ARRIVE	7PM	DEC	24	X
LOOKING	FORWARD	TO	SEEING	YOU
X	LOVE			

BETTY M PUBLIC

REC'D FROM	DATE	TIME	SENT TO	DATE	TIME
W3YVQ	DEC 22	1845	DELIVERED	DEC 22	1905

Form: Copyright 1995, American Radio Relay League. Used with permission

T2C11
What is meant by the term ñcheckò in reference to a formal traffic message? **The check is a count of the number of words or word equivalents in the text portion of the message.**

T2C12
What is the Amateur Radio Emergency Service (ARES)? **Licensed amateurs who have voluntarily registered their qualifications and equipment for communications duty in the public service.**

SUBELEMENT T3 – Radio wave characteristics: properties of radio waves; propagation modes – [3 Exam Questions - 3 Groups]

T3A - Radio wave characteristics: how a radio signal travels; fading; multipath; wavelength vs. penetration; antenna orientation

T3A01
What should you do if another operator reports that your stationôs 2 meter signals were strong just a moment ago, but now they are weak or distorted? **Try moving a few feet or changing the direction of your antenna if possible, as reflections may be causing multi-path distortion**

T3A02
Why are UHF signals often more effective from inside buildings than VHF signals? **The shorter wavelength allows them to more easily penetrate the structure of buildings**

T3A03
What antenna polarization is normally used for long-distance weak-signal CW and SSB contacts using the VHF and UHF bands? **Horizontal**

T3A04
What can happen if the antennas at opposite ends of a VHF or UHF line of sight radio link are not using the same polarization? **Signals could be significantly weaker**

T3A05
When using a directional antenna, how might your station be able to access a distant repeater if buildings or obstructions are blocking the direct line of sight path? **Try to find a path that reflects signals to the repeater**

T3A06
What term is commonly used to describe the rapid fluttering sound sometimes heard from mobile stations that are moving while transmitting? **Picket fencing**

T3A07
What type of wave carries radio signals between transmitting and receiving stations? **Electromagnetic**

T3A08
Which of the following is a likely cause of irregular fading of signals received by ionospheric reflection? **Random combining of signals arriving via different paths**

T3A09
Which of the following results from the fact that skip signals refracted from the ionosphere are elliptically polarized? **Either vertically or horizontally polarized antennas may be used for transmission or reception**

T3A10
What may occur if data signals propagate over multiple paths? **Error rates are likely to increase**

T3A11
Which part of the atmosphere enables the propagation of radio signals around the world? **The ionosphere**

T3B - Radio and electromagnetic wave properties: the electromagnetic spectrum; wavelength vs. frequency; velocity of electromagnetic waves; calculating wavelength

T3B01
What is the name for the distance a radio wave travels during one complete cycle? **Wavelength**

T3B02
What property of a radio wave is used to describe its polarization? **The orientation of the electric field**

T3B03
What are the two components of a radio wave? **Electric and magnetic fields**

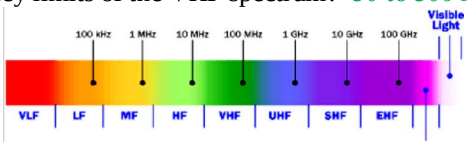
T3B04
How fast does a radio wave travel through free space? **At the speed of light**
The speed of light is approximately 300,000,000 meters a second
(Actually 299,792,458 meters per second)

T3B05
How does the wavelength of a radio wave relate to its frequency? **The wavelength gets shorter as the frequency increases**
At 1 MHz the wave length would be 300/1 or 300 meters
At 10 MHz the wave length would be 300/10 or 30 meters
At 100 MHz the wave length would be 300/100 or 3 meters

T3B06
What is the formula for converting frequency to approximate wavelength in meters? **Wavelength in meters equals 300 divided by frequency in megahertz**

T3B07
What property of radio waves is often used to identify the different frequency bands? **The approximate wavelength**
At 3.75 MHz the wave length would be 300/3.75 or 80 meters
At 7.5 MHz the wave length would be 300/7.5 or 40 meters
At 148 MHz the wave length would be 300/148 or 2.02 meters

T3B08
What are the frequency limits of the VHF spectrum? **30 to 300 MHz**



T3B09
What are the frequency limits of the UHF spectrum? **300 to 3000 MHz**

T3B10
What frequency range is referred to as HF? **3 to 30 MHz**

T3B11
What is the approximate velocity of a radio wave as it travels through free space? **300,000,000 meters per second**
Radio waves travel at the speed of light

T3C - Propagation modes: line of sight; sporadic E; meteor and auroral scatter and reflections; tropospheric ducting; F layer skip; radio horizon

T3C01
Why are direct (not via a repeater) UHF signals rarely heard from stations outside your local coverage area? **UHF signals are usually not reflected by the ionosphere**

T3C02
Which of the following might be happening when VHF signals are being received from long distances? **Signals are being refracted from a sporadic E layer**

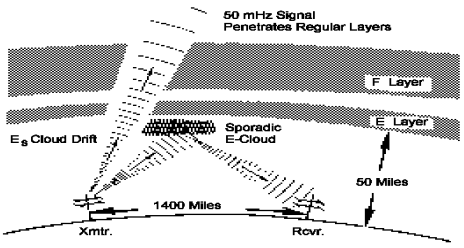
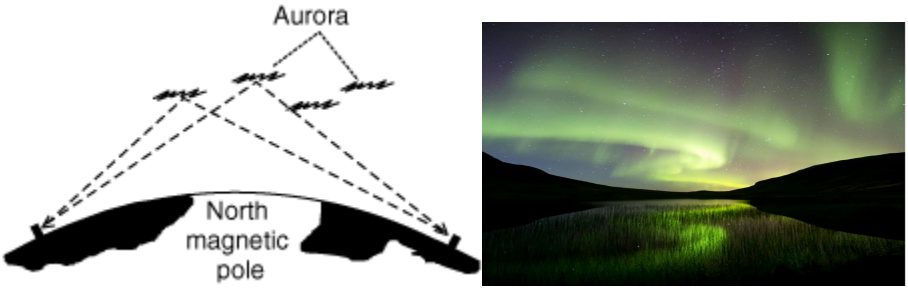


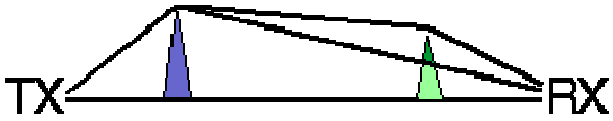
Fig. 1 - 50 mHz short-skip propagation by means of sporadic-E reflection.

T3C03
What is a characteristic of VHF signals received via auroral reflection? **The signals exhibit rapid fluctuations of strength and often sound distorted**



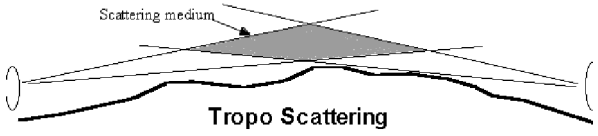
T3C04
Which of the following propagation types is most commonly associated with occasional strong over-the-horizon signals on the 10, 6, and 2 meter bands? **Sporadic E**

T3C05 Which of the following effects might cause radio signals to be heard despite obstructions between the transmitting and receiving stations**? Knife-edge diffraction**



T3C06
What mode is responsible for allowing over-the-horizon VHF and UHF communications to ranges of approximately 300 miles on a regular basis? **Tropospheric scatter**

*The **troposphere** is the lowest portion of Earth's atmosphere. It contains approximately 80% of the atmosphere's mass and 99% of its water vapor. The average depth of the troposphere is approximately 17 km (11 mi) in the middle latitudes. It is deeper in the tropics, up to 20 km (12 mi), and shallower near the polar regions, approximately 7 km (4.3 mi) in winter. The lowest part of the troposphere, where friction with the Earth's surface influences air flow, is the planetary boundary layer. This layer is typically a few hundred meters to 2 km (1.2 mi) deep depending on the landform and time of day. The border between the troposphere and stratosphere, called the tropopause, is a temperature inversion.*



T3C07
What band is best suited for communicating via meteor scatter? **6 meters**

T3C08
What causes tropospheric ducting? **Temperature inversions in the atmosphere**

T3C09
What is generally the best time for long-distance 10 meter band propagation via the F layer? From dawn to shortly after sunset during periods of high sunspot activity

T3C10
What is the radio horizon? **The distance over which two stations can communicate by direct path**

T3C11
Why do VHF and UHF radio signals usually travel somewhat farther than the visual line of sight distance between two stations? **The Earth seems less curved to radio waves than to light**

T3C12
Which of the following bands may provide long distance communications during the peak of the sunspot cycle? **Six or ten meters**

SUBELEMENT T4 - Amateur radio practices and station set up – [2 Exam Questions - 2 Groups]

T4A – Station setup: connecting microphones; reducing unwanted emissions; power source; connecting a computer; RF grounding; connecting digital equipment; connecting an SWR meter

T4A01
Which of the following is true concerning the microphone connectors on amateur transceivers? **Some connectors include push-to-talk and voltages for powering the microphone**

Since many microphones may have identical plugs do not assume they are compatible with your radio the wrong microphone may damage your radio or the microphone.

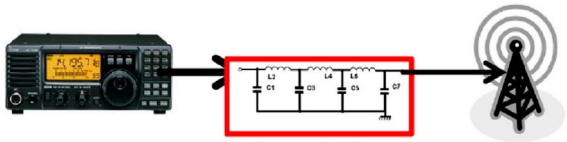
T4A02
How might a computer be used as part of an amateur radio station?

A. For logging contacts and contact information
B. For sending and/or receiving CW
C. For generating and decoding digital signals
D. All of these choices are correct

T4A03
Which is a good reason to use a regulated power supply for communications equipment?
It prevents voltage fluctuations from reaching sensitive circuits

Unregulated power supply output voltage will change with load and may cause too high a voltage under minimum load conditions and too low a voltage in the full load condition

T4A04
Where must a filter be installed to reduce harmonic emissions from your station? **Between the transmitter and the antenna**


Harmonic Filter

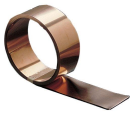
T4A05
Where should an in-line SWR meter be connected to monitor the standing wave ratio of the station antenna system?
In series with the feed line, between the transmitter and antenna


In Line SWR Meter

T4A06
Which of the following would be connected between a transceiver and computer in a packet radio station? **Terminal node controller**

T4A07
How is a computerôs sound card used when conducting digital communications using a computer? **The sound card provides audio to the microphone input and converts received audio to digital form**

T4A08
Which type of conductor is best to use for RF grounding? **Flat strap**



T4A09
Which of the following could you use to cure distorted audio caused by RF current flowing on the shield of a microphone cable? Ferrite choke

T4A10
What is the source of a high-pitched whine that varies with engine speed in a mobile transceiverôs receive audio?
The alternator

T4A11
Where should the negative return connection of a mobile transceiver's power cable be connected?
At the battery or engine block ground strap

T4A12
What could be happening if another operator reports a variable high-pitched whine on the audio from your mobile transmitter? **Noise on the vehicle's electrical system is being transmitted along with your speech audio**

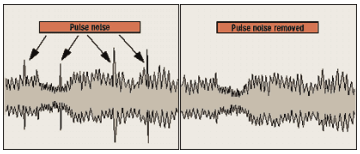
T4B - Operating controls: tuning; use of filters; squelch function; AGC; repeater offset; memory channels

T4B01
What may happen if a transmitter is operated with the microphone gain set too high? **The output signal might become distorted**

T4B02
Which of the following can be used to enter the operating frequency on a modern transceiver? **The keypad or VFO knob**
q
T4B03
What is the purpose of the squelch control on a transceiver? **To mute receiver output noise when no signal is being received**

T4B04
What is a way to enable quick access to a favorite frequency on your transceiver? **Store the frequency in a memory channel**

T4B05
Which of the following would reduce ignition interference to a receiver? **Turn on the noise blanker**



A noise blanker circuit clips or removes impulse noise caused in ignition systems when the spark plug is fired.

T4B06
Which of the following controls could be used if the voice pitch of a single-sideband signal seems too high or low?
The receiver RIT or clarifier
RIT is an abbreviation for Receiver Incremental Tuning and is a fine tuning for the receive function without changing the transmit frequency.

T4B07
What does the term ñRITò mean? **Receiver Incremental Tuning**

T4B08
What is the advantage of having multiple receive bandwidth choices on a multimode transceiver? **Permits noise or interference reduction by selecting a bandwidth matching the mode**

T4B09
Which of the following is an appropriate receive filter bandwidth to select in order to minimize noise and interference for SSB reception? **2400 Hz**

T4B10
Which of the following is an appropriate receive filter bandwidth to select in order to minimize noise and interference for CW reception? **500 Hz**

T4B11
Which of the following describes the common meaning of the term "repeater offset"? **The difference between the repeater's transmit and receive frequencies**

T4B12
What is the function of automatic gain control or AGC? **To keep received audio relatively constant**

SUBELEMENT T5 – Electrical principles: math for electronics; electronic principles; Ohm's Law – [4 Exam Questions - 4 Groups]

T5A - Electrical principles, units, and terms: current and voltage; conductors and insulators; alternating and direct current

T5A01
Electrical current is measured in which of the following units? **Amperes**

T5A02
Electrical power is measured in which of the following units? **Watts**

T5A03
What is the name for the flow of electrons in an electric circuit? **Current**

T5A04
What is the name for a current that flows only in one direction? **Direct current**

T5A05
What is the electrical term for the electromotive force (EMF) that causes electron flow? **Voltage**

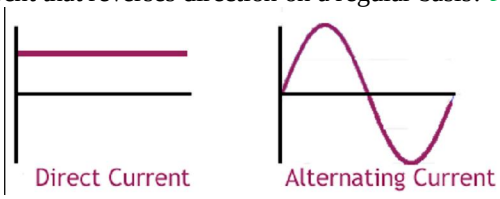
T5A06
How much voltage does a mobile transceiver usually require? **About 12 volts**

Most modern radios are specified at 13.8 volts DC which is the normal battery voltage in a vehicle when the engine is running and the alternator is charging the battery. Most radios will not function below about 11.8 volts.

T5A07
Which of the following is a good electrical conductor? **Copper**

T5A08
Which of the following is a good electrical insulator? **Glass**

T5A09
What is the name for a current that reverses direction on a regular basis? **Alternating current**



T5A10
Which term describes the rate at which electrical energy is used? **Power**

T5A11
What is the basic unit of electromotive force? **The volt**

T5A12
What term describes the number of times per second that an alternating current reverses direction? **Frequency**

T5B - Math for electronics: conversion of electrical units; decibels; the metric system

T5B01
How many milliamperes is 1.5 amperes? **1,500 milliamperes**

T5B02
What is another way to specify a radio signal frequency of 1,500,000 hertz? **1500 kHz**

T5B03
How many volts are equal to one kilovolt? **One thousand volts**

T5B04
How many volts are equal to one microvolt? **One one-millionth of a volt**

T5B05
Which of the following is equivalent to 500 milliwatts? **0.5 watts**

T5B06
If an ammeter calibrated in amperes is used to measure a 3000-milliampere current, what reading would it show?
3 amperes

T5B07
If a frequency readout calibrated in megahertz shows a reading of 3.525 MHz, what would it show if it were calibrated in kilohertz? **3525 kHz**

T5B08
How many microfarads are 1,000,000 picofarads? **1 microfarad**

T5B09
What is the approximate amount of change, measured in decibels (dB), of a power increase from 5 watts to 10 watts?
3 dB

For dB - dB = 10 * LOG (P1/P2) P1 andP2 must be the same i.e.: µWatts. Milliwatts or Watts

$dB=10 * LOG\left(\frac{P1}{P2}\right)$ or **dB= 10 (Log (10 / 5)) or dB=10 (Log(2)) or dB= 10 (-.3010) or dB= +3.01**

The following table will allow you to quickly estimate power dB gain or loss. The one and two dB values are close enough to get you to the correct answer in the test.

Gain (+)	*dB*	*Loss (-)*
x 1.2	*1*	*x 0.8*
x 1.6	*2*	*x 0.63*
x 2	*3*	*x 0.50%*
x 4	*6*	*x 0.25%*
x 10	*10*	*x 0. 10%*

T5B10
What is the approximate amount of change, measured in decibels (dB), of a power decrease from 12 watts to 3 watts?
-6 dB

Using the above chart if the power decreased by 50 %to 6 watts we would have a loss of -3dB. If the 6 watts decreased another 50 percent to 3 watts we would have another -3 dB of loss for a total of -6 dB loss.
Or by calculation dB=10(log(3/12)) or dB=10(log(.25) or dB=10(-.602) or dB= -6.02

T5B11
What is the approximate amount of change, measured in decibels (dB), of a power increase from 20 watts to 200 watts?
10 dB
From the table above this is a change of 10 times and would be a change of +10 dB

Or by calculation dB=10(log(200/20)) or dB=10(log(10) or dB=10(1) or dB= +10

T5B12
Which of the following frequencies is equal to 28,400 kHz? **28.400 MHz**

T5B13
If a frequency readout shows a reading of 2425 MHz, what frequency is that in GHz? **2.425 GHz**
2425 MHz would be between channel 3 (2422 MHz) and 4 (2427 MHz) used by part 15 WIFI devices.

T5C - Electronic principles: capacitance; inductance; current flow in circuits; alternating current; definition of RF; DC power calculations; impedance

T5C01
What is the ability to store energy in an electric field called? **Capacitance**

T5C02
What is the basic unit of capacitance? **The farad**

T5C03
What is the ability to store energy in a magnetic field called? **Inductance**

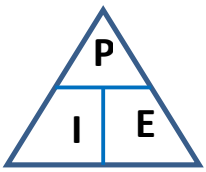
T5C04
What is the basic unit of inductance? **The henry**

T5C05
What is the unit of frequency? **Hertz**

T5C06
What does the abbreviation ñRFò refer to? **Radio Frequency signals of all types**

T5C07
What is a usual name for electromagnetic waves that travel through space? **Radio waves**

T5C08
What is the formula used to calculate electrical power in a DC circuit? **Power (P) equals voltage (E) multiplied by current (I)**



T5C09
How much power is being used in a circuit when the applied voltage is 13.8 volts DC and the current is 10 amperes?
138 watts
P=E (voltage) x I (current) or P=13.8 x 10 or P= 138 watts

T5C10
How much power is being used in a circuit when the applied voltage is 12 volts DC and the current is 2.5 amperes?
30 watts
P=E (voltage) x I (current) or P=12 x 2.5 or P= 30 watts

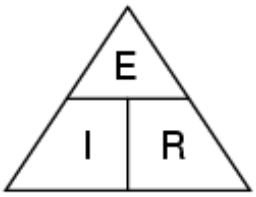
T5C11
How many amperes are flowing in a circuit when the applied voltage is 12 volts DC and the load is 120 watts? **10 amperes**

I=P (power) / E (Voltage) or I =120 /12 or I= 10 amps

T5C12
What is meant by the term impedance? **It is a measure of the opposition to AC current flow in a circuit**

T5C13
What are the units of impedance? **Ohms**

T5D – Ohm's Law: formulas and usage



T5D01
What formula is used to calculate current in a circuit?
Current (I) equals voltage (E) divided by resistance (R)

T5D02
What formula is used to calculate voltage in a circuit?
Voltage (E) equals current (I) multiplied by resistance (R)

T5D03
What formula is used to calculate resistance in a circuit? **Resistance (R) equals voltage (E) divided by current (I)**

T5D04
What is the resistance of a circuit in which a current of 3 amperes flows through a resistor connected to 90 volts?
30 ohms
R=E/I or R= 90/3 or R=30 Ohms

T5D05
What is the resistance in a circuit for which the applied voltage is 12 volts and the current flow is 1.5 amperes?
8 ohms
R=E/I or R= 12/1.5 or R=8 Ohms

T5D06
What is the resistance of a circuit that draws 4 amperes from a 12-volt source?
3 ohms
R=E/I or R= 12/4 or R=3 Ohms

T5D07
What is the current flow in a circuit with an applied voltage of 120 volts and a resistance of 80 ohms? **1.5 amperes**
I=E/R or I= 120/80 or I=1.5 Amperes

T5D08
What is the current flowing through a 100-ohm resistor connected across 200 volts? **2 amperes**
I=E/R or I= 200/100or I=2 Amperes

T5D09
What is the current flowing through a 24-ohm resistor connected across 240 volts? **10 amperes**
I=E/R or I= 240/24 or I=10 Amperes

T5D10
What is the voltage across a 2-ohm resistor if a current of 0.5 amperes flows through it? **1 volt**
E =R x I or E=2 x .5 or E = 1 volt

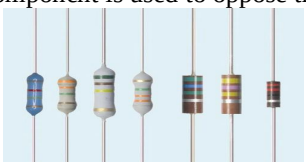
T5D11
What is the voltage across a 10-ohm resistor if a current of 1 ampere flows through it? **10 volts**
E =R x I or E=10 x 1 or E = 10 volts

T5D12
What is the voltage across a 10-ohm resistor if a current of 2 amperes flows through it? **20 volts**
E =R x I or E=10 x 2 or E = 20 volts

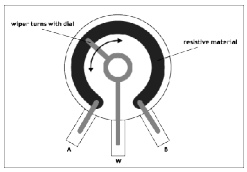
SUBELEMENT T6 – Electrical components: semiconductors; circuit diagrams; component functions – [4 Exam Questions - 4 Groups]

T6A - Electrical components: fixed and variable resistors; capacitors and inductors; fuses; switches; batteries

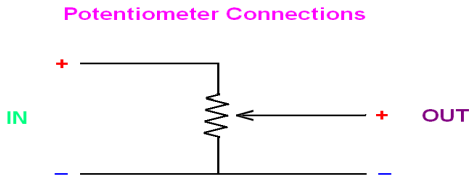
T6A01
What electrical component is used to oppose the flow of current in a DC circuit? **Resistor**



T6A02
What type of component is often used as an adjustable volume control? **Potentiometer**

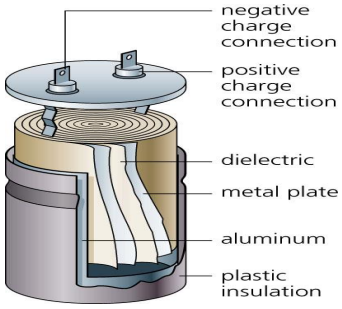


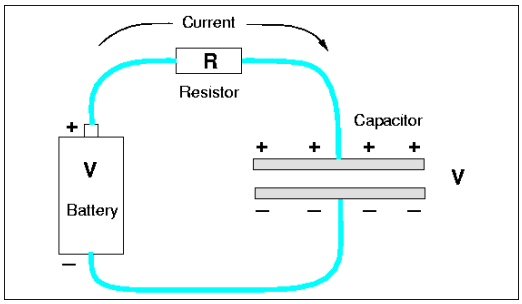
T6A03
What electrical parameter is controlled by a potentiometer? **Resistance**



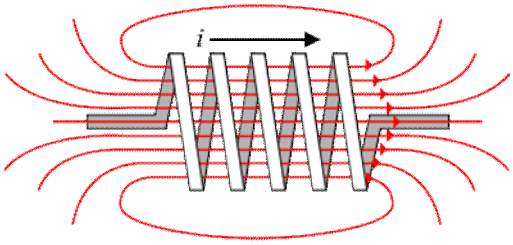
T6A04
What electrical component stores energy in an electric field? **Capacitor**

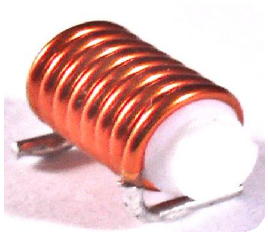
T6A05
What type of electrical component consists of two or more conductive surfaces separated by an insulator? **Capacitor**





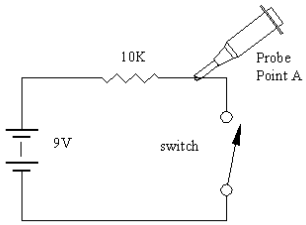
T6A06
What type of electrical component stores energy in a magnetic field? **Inductor**

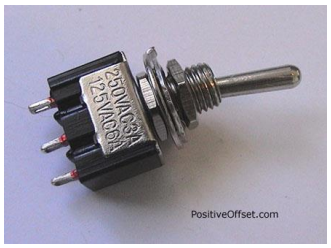




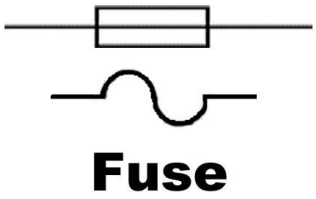
T6A07
What electrical component is usually composed of a coil of wire? **Inductor**

T6A08
What electrical component is used to connect or disconnect electrical circuits? **Switch**



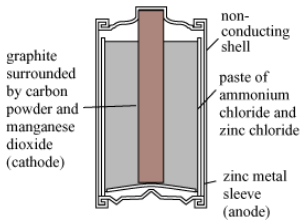


T6A09
What electrical component is used to protect other circuit components from current overloads? **Fuse**



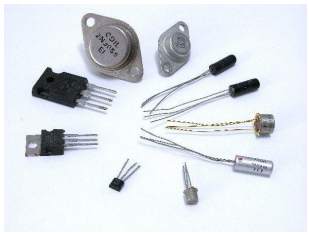
T6A10
Which of the following battery types is rechargeable?
A. Nickel-metal hydride
B. Lithium-ion
C. Lead-acid gel-cell
D. All of these choices are correct

T6A11
Which of the following battery types is not rechargeable? **Carbon-zinc**

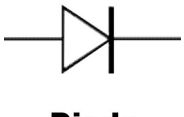


T6B – Semiconductors: basic principles and applications of solid state devices; diodes and transistors

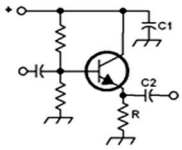
T6B01
What class of electronic components is capable of using a voltage or current signal to control current flow? **Transistors**



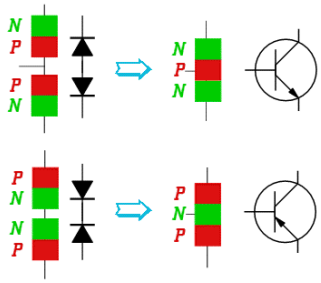
T6B02
What electronic component allows current to flow in only one direction? **Diode**



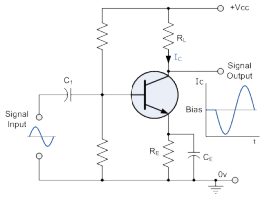
T6B03
Which of these components can be used as an electronic switch or amplifier? **Transistor**



T6B04
Which of the following components can be made of three layers of semiconductor material? **Transistor**

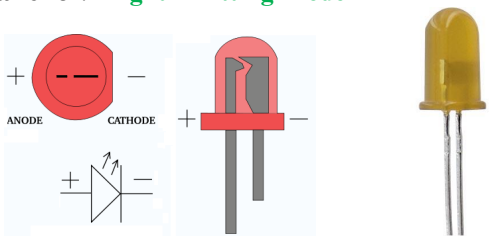


T6B05
Which of the following electronic components can amplify signals? **Transistor**

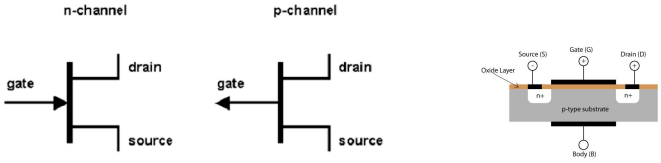


T6B06
How is the cathode lead of a semiconductor diode usually identified? **With** a stripe

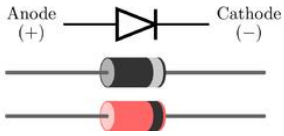
T6B07
What does the abbreviation LED stand for? **Light Emitting Diode**



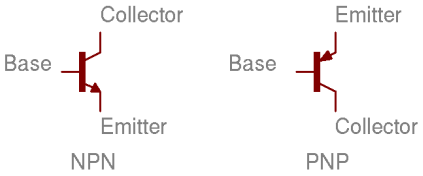
T6B08
What does the abbreviation FET stand for? **Field Effect Transistor**



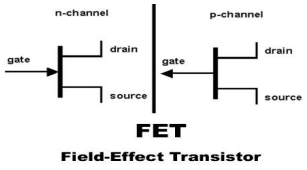
T6B09
What are the names of the two electrodes of a diode? **Anode and cathode**



T6B10
What are the three electrodes of a PNP or NPN transistor? **Emitter, base, and collector**



T6B11
What at are the three electrodes of a field effect transistor? **Source, gate, and drain**



T6B12
What is the term that describes a transistor's ability to amplify a signal? **Gain**

T6C - Circuit diagrams; schematic symbols

T6C01
What is the name for standardized representations of components in an electrical wiring diagram? **Schematic symbols**

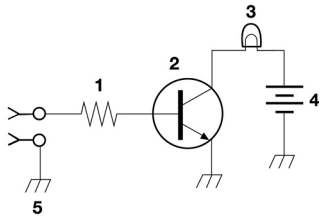


Figure T-1

T6C02
What is component 1 in figure T1? **Resistor**

T6C03
What is component 2 in figure T1? **Transistor**

T6C04
What is component 3 in figure T1? **Lamp**

T6C05
What is component 4 in figure T1? **Battery**

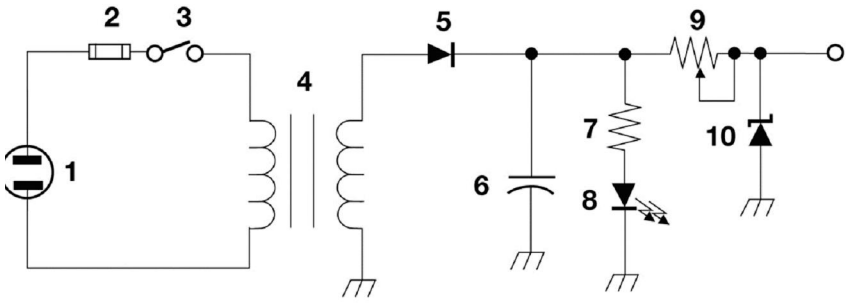


Figure T-2

T6C06
What is component 6 in figure T2? **Capacitor**

T6C07
What is component 8 in figure T2? **Light emitting diode**

T6C08
What is component 9 in figure T2? **Variable resistor**

T6C09
What is component 4 in figure T2? **Transformer**

T6C10
What is component 3 in figure T3? **Variable inductor**

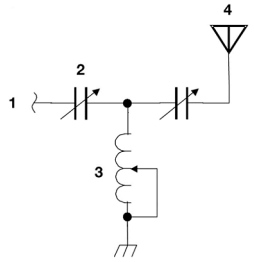


Figure T-3

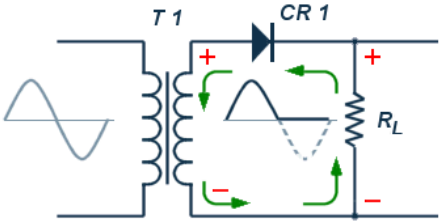
T6C11
What is component 4 in figure T3? **Antenna**

T6C12
What do the symbols on an electrical circuit schematic diagram represent? **Electrical components**

T6C13
Which of the following is accurately represented in electrical circuit schematic diagrams? **The way components are interconnected**

T6D - Component functions: rectification; switches; indicators; power supply components; resonant circuit; shielding; power transformers; integrated circuits

T6D01
Which of the following devices or circuits changes an alternating current into a varying direct current signal? **Rectifier**



T6D02 (A)
What best describes a relay? **A switch controlled by an electromagnet**

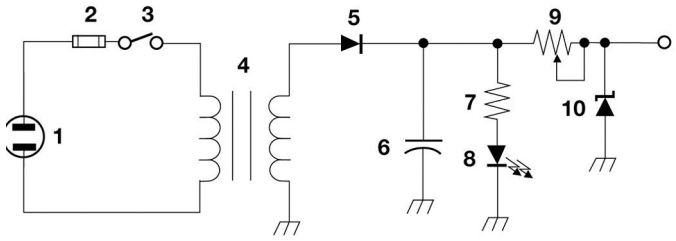
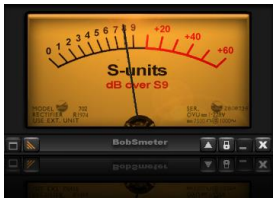


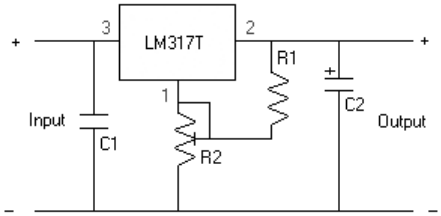
Figure T-2

T6D03
What type of switch is represented by component 3 in figure T2? **Single-pole single-throw**

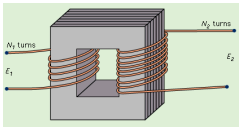
T6D04
Which of the following can be used to display signal strength on a numeric scale? **Meter**



T6D05
What type of circuit controls the amount of voltage from a power supply? **Regulator**

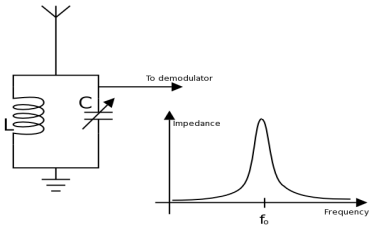


T6D06
What component is commonly used to change 120V AC house current to a lower AC voltage for other uses?
Transformer

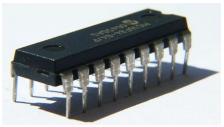
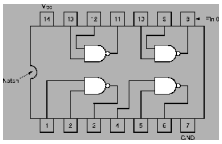


T6D07
Which of the following is commonly used as a visual indicator? **LED**

T6D08
Which of the following is used together with an inductor to make a tuned circuit? **Capacitor**



T6D09
What is the name of a device that combines several semiconductors and other components into one package?
Integrated circuit


T6D10
What is the function of component 2 in Figure T1? **Control the flow of current**

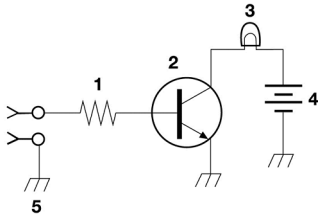
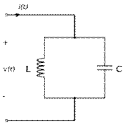
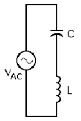
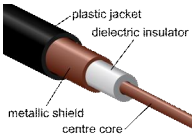


Figure T-1

T6D11
What is a simple resonant or tuned circuit? **An inductor and a capacitor connected in series or parallel to form a filter**

T6D12
Which of the following is a common reason to use shielded wire? **To prevent coupling of unwanted signals to or from the wire**



SUBELEMENT T7 – Station equipment: common transmitter and receiver problems; antenna measurements; troubleshooting; basic repair and testing – [4 Exam Questions - 4 Groups]

T7A – Station equipment: receivers; transmitters; transceivers; modulation; transverters; low power and weak signal operation; transmit and receive amplifiers

T7A01
Which term describes the ability of a receiver to detect the presence of a signal? **Sensitivity**

T7A02
What is a transceiver? **A unit combining the functions of a transmitter and a receiver**

T7A03
Which of the following is used to convert a radio signal from one frequency to another? **Mixer**

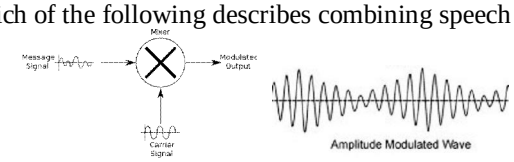
T7A04
Which term describes the ability of a receiver to discriminate between multiple signals? **Selectivity**

T7A05
What is the name of a circuit that generates a signal of a desired frequency? **Oscillator**

T7A06
What device takes the output of a low-powered 28 MHz SSB exciter and produces a 222 MHz output signal? **Transverter**

T7A07
What is meant by term ñPTTò? **The push to talk function which switches between receive and transmit**

T7A08
Which of the following describes combining speech with an RF carrier signal?- **Modulation**



T7A09
Which of the following devices is most useful for VHF weak-signal communication? **A multi-mode VHF transceiver**

A multimode VHF Transceiver can generate FM, CW and SSB signals. For weak signal communication both the CW and SSB modes occupy less bandwidth (2.8 KHz for SSB and 500Hz for CW) compared to FM (15 KHz). The narrower bandwidth means less noise in the received signal which is important when working weak signals.

T7A10
What device increases the low-power output from a handheld transceiver? **An RF power amplifier**

T7A11
Where is an RF preamplifier installed? **Between the antenna and receiver**

T7B – Common transmitter and receiver problems: symptoms of overload and overdrive; distortion; causes of interference; interference and consumer electronics; part 15 devices; over and under modulation; RF feedback; off frequency signals; fading and noise; problems with digital communications interfaces

T7B01
What can you do if you are told your FM handheld or mobile transceiver is over-deviating? **Talk farther away from the microphone**
Transmitter deviation increases in direct proportion to the audio input level (loudness of your voice)

T7B02
What would cause a broadcast AM or FM radio to receive an amateur radio transmission unintentionally?
The receiver is unable to reject strong signals outside the AM or FM band

T7B03
Which of the following may be a cause of radio frequency interference?
A. Fundamental overload
B. Harmonics
C. Spurious emissions
D. All of these choices are correct

T7B04
Which of the following is a way to reduce or eliminate interference by an amateur transmitter to a nearby telephone?
Put a RF filter on the telephone

T7B05
How can overload of a non-amateur radio or TV receiver by an amateur signal be reduced or eliminated? **Block the amateur signal with a filter at the antenna input of the affected receiver**

T7B06
Which of the following actions should you take if a neighbor tells you that your stationôs transmissions are interfering with their radio or TV reception? **Make sure that your station is functioning properly and that it does not cause interference to your own radio or television when it is tuned to the same channel**

T7B07
Which of the following may be useful in correcting a radio frequency interference problem?
~~ **A. Snap-on ferrite chokes**
B. Low-pass and high-pass filters
C. Band-reject and band-pass filters
D. All of these choices are correct

T7B08
What should you do if something in a neighborôs home is causing harmful interference to your amateur station?
A. Work with your neighbor to identify the offending device
B. Politely inform your neighbor about the rules that prohibit the use of devices which cause interference
C. Check your station and make sure it meets the standards of good amateur practice
D. All of these choices are correct

T7B09
What is a Part 15 device? **An unlicensed device that may emit low powered radio signals on frequencies used by a licensed service**

T7B10
What might be the problem if you receive a report that your audio signal through the repeater is distorted or unintelligible?

A. Your transmitter may be slightly off frequency
B. Your batteries may be running low
C. You could be in a bad location
D. All of these choices are correct

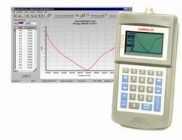
T7B11
What is a symptom of RF feedback in a transmitter or transceiver? **Reports of garbled, distorted, or unintelligible transmissions**

T7B12
What might be the first step to resolve cable TV interference from your ham radio transmission? **Be sure all TV coaxial connectors are installed properly**

T7C – Antenna measurements and troubleshooting: measuring SWR; dummy loads; coaxial cables; feed line failure modes

T7C01
What is the primary purpose of a dummy load? **To prevent the radiation of signals when making tests**

T7C02
Which of the following instruments can be used to determine if an antenna is resonant at the desired operating frequency? **An antenna analyzer**



T7C03
What, in general terms, is standing wave ratio (SWR)? **A measure of how well a load is matched to a transmission line**

T7C04
What reading on an SWR meter indicates a perfect impedance match between the antenna and the feed line? **1 to 1**

T7C05
What is the approximate SWR value above which the protection circuits in most solid-state transmitters begin to reduce transmitter power? **2 to 1**

T7C06
What does an SWR reading of 4:1 indicate? **Impedance mismatch**

T7C07
What happens to power lost in a feed line? **It is converted into heat**

T7C08
What instrument other than an SWR meter could you use to determine if a feed line and antenna are properly matched?
Directional wattmeter


T7C09
Which of the following is the most common cause for failure of coaxial cables? **Moisture contamination**

T7C10
Why should the outer jacket of coaxial cable be resistant to ultraviolet light?
Ultraviolet light can damage the jacket and allow water to enter the cable

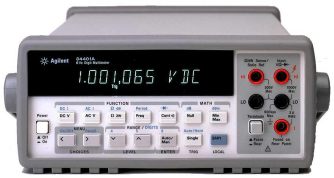
T7C11
What is a disadvantage of air core coaxial cable when compared to foam or solid dielectric types? **It requires special** techniques to prevent water absorption

T7C12
Which of the following is a common use of coaxial cable? **Carrying RF signals between a radio and antenna**

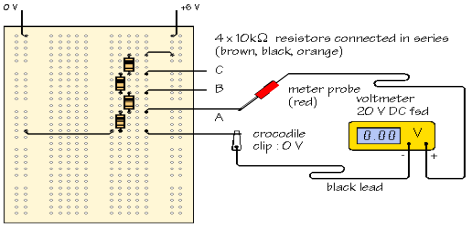
T7C13
What does a dummy load consist of? **A non-inductive resistor and a heat sink**

T7D – Basic repair and testing: soldering; using basic test instruments; connecting a voltmeter, ammeter, or ohmmeter

T7D01
Which instrument would you use to measure electric potential or electromotive force? **A voltmeter**

T7D02
What is the correct way to connect a voltmeter to a circuit? **In parallel with the circuit**



T7D03
How is an ammeter usually connected to a circuit? **In series with the circuit**

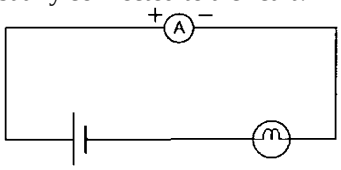


Fig. 5.13 Ammeter in a circuit

T7D04
Which instrument is used to measure electric current? **An ammeter**

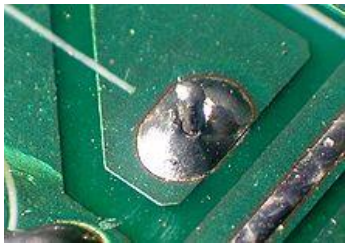
T7D05
What instrument is used to measure resistance? **An ohmmeter**

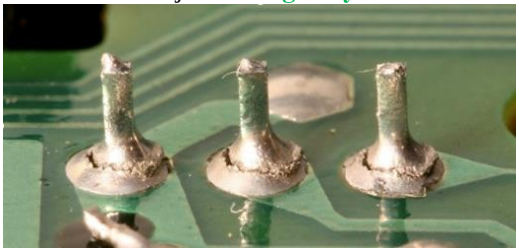
T7D06
Which of the following might damage a multimeter? **Attempting to measure voltage when using the resistance setting**

T7D07
Which of the following measurements are commonly made using a multimeter? **Voltage and resistance**

T7D08
Which of the following types of solder is best for radio and electronic use? **Rosin-core solder**
Never use acid core solder on electronic circuits, the connection will eventually fail as the acid corrodes the connection.

T7D09
What is the characteristic appearance of a cold solder joint? **A grainy or dull surface**





T7D10
What is probably happening when an ohmmeter, connected across an unpowered circuit, initially indicates a low resistance and then shows increasing resistance with time? **The circuit contains a large capacitor**

T7D11

Which of the following precautions should be taken when measuring circuit resistance with an ohmmeter? **Ensure that the circuit is not powered**

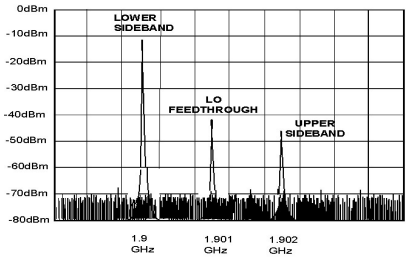
Also ensure that there are no charged capacitor's in the circuit after the power is disconnected from the circuit you are measuring

T7D12

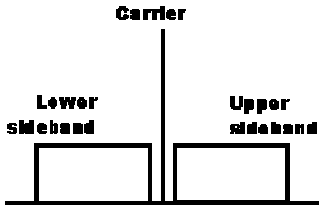
Which of the following precautions should be taken when measuring high voltages with a voltmeter? **Ensure that the voltmeter and leads are rated for use at the voltages to be measured**

SUBELEMENT T8 – Modulation modes: amateur satellite operation; operating activities; non-voice communications – [4 Exam Questions - 4 Groups]

T8A – Modulation modes: bandwidth of various signals; choice of emission type



T8A01
Which of the following is a form of amplitude modulation? **Single sideband**



T8A02
What type of modulation is most commonly used for VHF packet radio transmissions? **FM**

T8A03
Which type of voice mode is most often used for long-distance (weak signal) contacts on the VHF and UHF bands? **SSB**

T8A04
Which type of modulation is most commonly used for VHF and UHF voice repeaters? **FM**

T8A05
Which of the following types of emission has the narrowest bandwidth? **CW**

T8A06
Which sideband is normally used for 10 meter HF, VHF and UHF single-sideband communications? **Upper sideband**

*As a **general rule and practice** lower sideband (LSB) is used for frequencies below 10 MHz and upper sideband (USB) is used for frequencies above 10 MHz. The exception is 60 meters where LSB Is not permitted.*

T8A07
What is the primary advantage of single sideband over FM for voice transmissions? **SSB signals have narrower bandwidth**

T8A08
What is the approximate bandwidth of a single sideband voice signal? **3 kHz**

T8A09
What is the approximate bandwidth of a VHF repeater FM phone signal? **Between 10 and 15 kHz**

With a deviation of 5 KHz there would be a frequency spread from -5 KHz to + 5 KHz, adding the maximum audio frequency of 2.8 KHz to each side we would -7.8 KHz to + 7.8 KHz for a total occupied bandwidth of 15.6 KHz. This maximum would occur when speaking very loudly into the microphone. Speaking softly you would have much less occupied bandwidth.

T8A10
What is the typical bandwidth of analog fast-scan TV transmissions on the 70 cm band? **About 6 MHz**

T8A11
What is the approximate maximum bandwidth required to transmit a CW signal? **150 Hz**

T8B - Amateur satellite operation; Doppler shift, basic orbits, operating protocols; control operator, transmitter power considerations; satellite tracking; digital modes

T8B01 [97.301, 97.207(c)]
Who may be the control operator of a station communicating through an amateur satellite or space station?
Any amateur whose license privileges allow them to transmit on the satellite uplink frequency

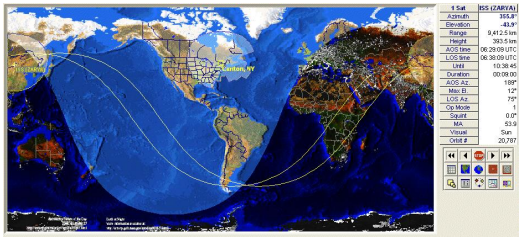
T8B02 [97.313]
How much transmitter power should be used on the uplink frequency of an amateur satellite or space station?
The minimum amount of power needed to complete the contact

T8B03
Which of the following are provided by satellite tracking programs?
A. Maps showing the real-time position of the satellite track over the earth
B. The time, azimuth, and elevation of the start, maximum altitude, and end of a pass
C. The apparent frequency of the satellite transmission, including effects of Doppler shift
D. All of these answers are correct

T8B04 [97.301, 97.207(c)]
Which amateur stations may make contact with an amateur station on the International Space Station using 2 meter and 70 cm band amateur radio frequencies? **Any amateur holding a Technician or higher class license**

T8B05
What is a satellite beacon? **A transmission from a space station that contains information about a satellite**

T8B06
Which of the following are inputs to a satellite tracking program? **The Keplerian elements**



T8B07
With regard to satellite communications, what is Doppler shift? **An observed change in signal frequency caused by relative motion between the satellite and the earth station**

T8B08
What is meant by the statement that a satellite is operating in mode U/V? **The satellite uplink is in the 70 cm *(UHF)* band and the downlink is in the 2 meter *(VHF)* band**

T8B09
What causes spin fading when referring to satellite signals? **Rotation of the satellite and its antennas**

This is because the antenna polarization is continuously changing due to the rotation.

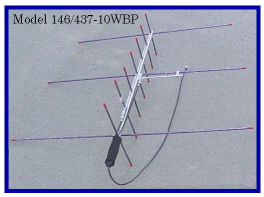
T8B10
What do the initials LEO tell you about an amateur satellite? **The satellite is in a Low Earth Orbit**
Low Earth Orbiting Satellites are between 160 kilometers to 2000 kilometers (99-1242 Miles) above the earth's surface.

T8B11
What is a commonly used method of sending signals to and from a digital satellite? **FM Packet**

T8C – Operating activities: radio direction finding; radio control; contests; linking over the Internet; grid locators

T8C01
Which of the following methods is used to locate sources of noise interference or jamming? **Radio direction finding**

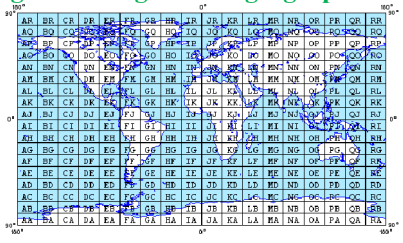
T8C02
Which of these items would be useful for a hidden transmitter hunt? **A directional antenna**



T8C03
What popular operating activity involves contacting as many stations as possible during a specified period of time?
Contesting

T8C04
Which of the following is good procedure when contacting another station in a radio contest? **Send only the minimum information needed for proper identification and the contest exchange**

T8C05
What is a grid locator? **A letter-number designator assigned to a geographic location**



T8C06
How is access to an IRLP node accomplished? **By using DTMF signals**

IRLP (Internet Radio Linking Project) is a method of linking the Internet with Amateur Radio. Usually the link is made through a local repeater so you can connect to someone with a handheld. Basically you sign on to the local repeater and enter a code to connect you to the Internet link. From there you are connected to other repeaters who are also on the Internet. So with your handheld you can be talking to hams many thousands of miles away with the signal quality of a local contact. With your basic Technician license new radio amateurs are able to use an HT to communicate worldwide.

T8C07 [97.215(c)]
What is the maximum power allowed when transmitting telecommand signals to radio controlled models? **1 watt**

T8C08 [97.215(a)]
What is required in place of on-air station identification when sending signals to a radio control model using amateur frequencies? **A label indicating the licensee's name, call sign and address must be affixed to the transmitter**

T8C09
How might you obtain a list of active nodes that use VoIP? **From a repeater directory**

T8C10
How do you select a specific IRLP node when using a portable transceiver? **Use the keypad to transmit the IRLP node ID**

T8C11
What name is given to an amateur radio station that is used to connect other amateur stations to the Internet?
A gateway

T8C12
What is meant by Voice Over Internet Protocol (VoIP) as used in amateur radio? **A method of delivering voice communications over the Internet using digital techniques**

T8C13
What is the Internet Radio Linking Project (IRLP)? **A technique to connect amateur radio systems, such as repeaters, via the Internet using Voice Over Internet Protocol**

T8D – Non-voice communications: image signals; digital modes; CW; packet; PSK31; APRS; error detection and correction; NTSC

T8D01
Which of the following is an example of a digital communications method?

A. Packet
B. PSK31
C. MFSK
D. All of these choices are correct

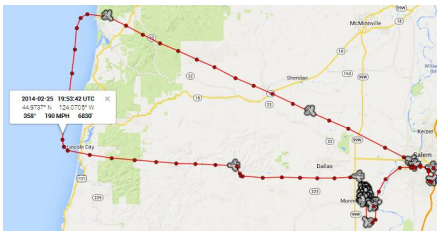
Packet radio *is a particular digital mode of Amateur Radio ("Ham" Radio) communications which corresponds to computer telecommunications. The telephone modem is replaced by a "magic" box called a terminal node controller (TNC); the telephone is replaced by an amateur radio transceiver, and the phone system is replaced by the "free" amateur radio waves. Packet radio takes any data stream sent from a*

computer and sends that via radio to another amateur radio station similarly equipped. Packet radio is so named because it sends the data in small bursts, or packets.

***PSK31** uses a single sideband transceiver connected to the sound card of the a PC. When the operator enters a message for transmission, the software produces an audio tone which sounds, to the human ear, like a continuous whistle with a slight warble. This is then fed through either a microphone or an auxiliary connection into the transceiver, where it is transmitted.*

***MFSK** is an amateur radio teletype protocol designed to work in difficult low signal to noise ratio plus multipath propagation conditions on shortwave bands. The signal can still be properly copied when it is buried 10 dB below the noise floor (i.e. when the amplitude of the noise is just over 3 times that of the signal). It is commonly used by amateur radio operators to reliably transmit ASCII characters over noisy channels using the high frequency (3-30MHz) spectrum.*

T8D02
What does the term ñAPRSò mean? **Automatic Packet Reporting System**



T8D03
Which of the following devices provides data to the transmitter when sending automatic position reports from a mobile amateur radio station? **Global Positioning System receiver**

T8D04 (C)
What type of transmission is indicated by the term NTSC? **An analog fast scan color TV signal**
NTSC is an abbreviation for National Television System Committee

T8D05
Which of the following is an application of APRS (Automatic Packet Reporting System)? **Providing real time tactical digital communications in conjunction with a map showing the locations of stations**

T8D06
What does the abbreviation PSK mean? **Phase Shift Keying**

T8D07
What is PSK31? **Low-rate data transmission mode**

A 31 baud BPSK modulation system is used in PSK31. PSK31 was enthusiastically received, and its usage grew like wildfire worldwide, lending a new popularity to digital communications. Due to the efficiency of the mode, it became, and still remains, especially popular with operators whose circumstances do not permit the erection of large antenna systems, the use of high power, or both.

T8D08
Which of the following may be included in packet transmissions?

A. A check sum which permits error detection
B. A header which contains the call sign of the station to which the information is being sent
C. Automatic repeat request in case of error
D. All of these choices are correct

T8D09
What code is used when sending CW in the amateur bands? **International Morse *(code)***

T8D10
Which of the following can be used to transmit CW in the amateur bands?

A. Straight Key
B. Electronic Keyer
C. Computer Keyboard
D. All of these choices are correct

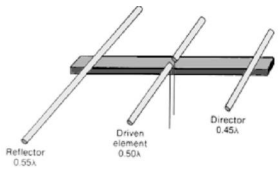
T8D11
What is an ARQ transmission system? **A digital scheme whereby the receiving station detects errors and sends a request to the sending station to retransmit the information**

Automatic Repeat-reQuest is an error control mechanism for data transmission

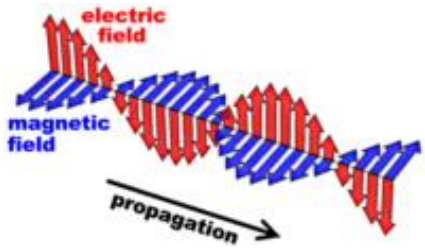
SUBELEMENT T9 ï Antennas and feed lines - [2 Exam Questions - 2 Groups]

T9A – Antennas: vertical and horizontal polarization; concept of gain; common portable and mobile antennas; relationships between antenna length and frequency

T9A01
What is a beam antenna? **An antenna that concentrates signals in one direction**



T9A02
Which of the following is true regarding vertical antennas? **The electric field is perpendicular to the Earth**

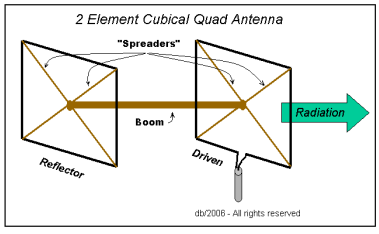


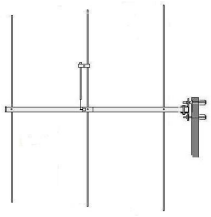
T9A03
Which of the following describes a simple dipole mounted so the conductor is parallel to the Earth's surface?
A horizontally polarized antenna

T9A04
What is a disadvantage of the ñrubber duckò antenna supplied with most handheld radio transceivers?
It does not transmit or receive as effectively as a full-sized antenna

T9A05
How would you change a dipole antenna to make it resonant on a higher frequency? **Shorten it**

T9A06
What type of antennas are the quad, Yagi, and dish? **Directional antennas**





T9A07
What is a good reason not to use a ñrubber duckò antenna inside your car? **Signals can be significantly weaker than when it is outside of the vehicle**

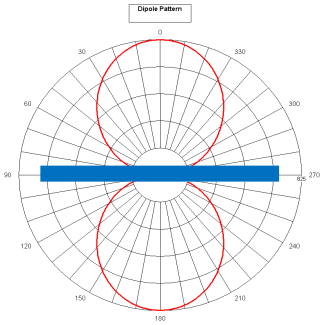
T9A08
What is the approximate length, in inches, of a quarter-wavelength vertical antenna for 146 MHz? **19**

1/4 λ =(300 / 146)/4 or λ = (2.0548) / 4 or .5137 Meters
Dividing by .0254 to convert to inches = 5137/.0254 or 20.22 inches
The closest answer choice is 19inches.
Note Wavelength is represented by the Greek letter Lambda λ

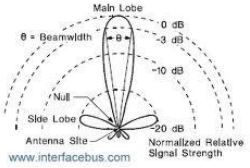
T9A09
What is the approximate length, in inches, of a 6 meter 1/2-wavelength wire dipole antenna? **112**

λ = 300 / 52MHz or wavelength = 5.7692 Meters
A dipole is ½ λ or 2.8846 meters
1 inch = 0.0254 meters
2.8846 / 0.0254 = ***113.567 Inches***
The closest answer in the choices is 112 inches

T9A10
In which direction is the radiation strongest from a half-wave dipole antenna in free space? **Broadside to the antenna**



T9A11
What is meant by the gain of an antenna? **The increase in signal strength in a specified direction when compared to a reference antenna**



T9A12
What is a reason to use a properly mounted 5/8 wavelength antenna for VHF or UHF mobile service?
It offers a lower angle of radiation and more gain than a 1/4 wavelength antenna and usually provides improved coverage

T9A13
Why are VHF or UHF mobile antennas often mounted in the center of the vehicle roof? **A roof mounted antenna normally provides the most uniform radiation pattern**

T9A14
Which of the following terms describes a type of loading when referring to an antenna? **Inserting an inductor in the radiating portion of the antenna to make it electrically longer**

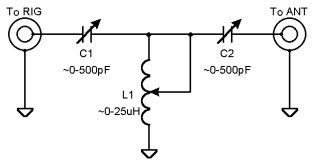
T9B – Feed lines: types of feed lines; attenuation vs. frequency; SWR concepts; matching; weather protection; choosing RF connectors and feed lines

T9B01
Why is it important to have a low SWR in an antenna system that uses coaxial cable feed line?
To allow the efficient transfer of power and reduce losses

T9B02
What is the impedance of the most commonly used coaxial cable in typical amateur radio installations?
50 ohms

T9B03
Why is coaxial cable used more often than any other feed line for amateur radio antenna systems?
It is easy to use and requires few special installation considerations

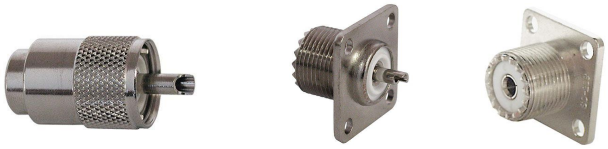
T9B04
What does an antenna tuner do? **It matches the antenna system impedance to the transceiver's output impedance**



T9B05
What generally happens as the frequency of a signal passing through coaxial cable is increased? **The loss increases**

T9B06
Which of the following connectors is most suitable for frequencies above 400 MHz? **A Type N connector**

T9B07 (C)
Which of the following is true of PL-259 type coax connectors? **They are commonly used at HF frequencies**



T9B08
Why should coax connectors exposed to the weather be sealed against water intrusion? **To prevent an increase in feed line loss**

T9B09
What might cause erratic changes in SWR readings? **A loose connection in an antenna or a feed line**

T9B10
What electrical difference exists between the smaller RG-58 and larger RG-8 coaxial cables? **RG-8 cable has less loss at a given frequency**

T9B11
Which of the following types of feed line has the lowest loss at VHF and UHF? **Air-insulated hard line**

SUBELEMENT T0 – Electrical safety: AC and DC power circuits; antenna installation; RF hazards – [3 Exam Questions - 3 Groups]

T0A – Power circuits and hazards: hazardous voltages; fuses and circuit breakers; grounding; lightning protection; battery safety; electrical code compliance

T0A01
Which of the following is a safety hazard of a 12-volt storage battery? **Shorting the terminals can cause burns, fire, or an explosion**

T0A02
How does current flowing through the body cause a health hazard?

A. By heating tissue
B. It disrupts the electrical functions of cells
C. It causes involuntary muscle contractions
D. All of these choices are correct

T0A03
What is connected to the green wire in a three-wire electrical AC plug? **Safety ground**
When operating in a foreign country this color code may not apply

T0A04
What is the purpose of a fuse in an electrical circuit? **To interrupt power in case of overload**

T0A05
Why is it unwise to install a 20-ampere fuse in the place of a 5-ampere fuse? **Excessive current could cause a fire**

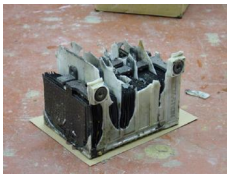
T0A06
What is a good way to guard against electrical shock at your station?

A. Use three-wire cords and plugs for all AC powered equipment
B. Connect all AC powered station equipment to a common safety ground
C. Use a circuit protected by a ground-fault interrupter
D. All of these choices are correct

T0A07
Which of these precautions should be taken when installing devices for lightning protection in a coaxial cable feed line? **Ground all of the protectors to a common plate which is in turn connected to an external ground**

T0A08
What safety equipment should always be included in home-built equipment that is powered from 120V AC power circuits? **A fuse or circuit breaker in series with the AC hot conductor**

T0A09
What kind of hazard is presented by a conventional 12-volt storage battery? **Explosive gas *(Hydrogen)* can collect if not properly vented**



T0A10
What can happen if a lead-acid storage battery is charged or discharged too quickly? **The battery could overheat and give off flammable gas or explode**

T0A11
What kind of hazard might exist in a power supply when it is turned off and disconnected? **You might receive an electric shock from the charged stored in large capacitors**

T0B – Antenna safety: tower safety; erecting an antenna support; overhead power lines; installing an antenna

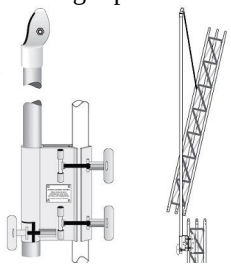
T0B01
When should members of a tower work team wear a hard hat and safety glasses? **At all times when any work is being done on the tower**

T0B02
What is a good precaution to observe before climbing an antenna tower? **Put on a climbing harness and safety glasses**

T0B03
Under what circumstances is it safe to climb a tower without a helper or observer? **Never**

T0B04
Which of the following is an important safety precaution to observe when putting up an antenna tower? **Look for and stay clear of any overhead electrical wires**

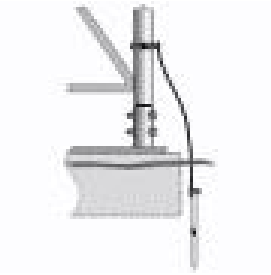
T0B05
What is the purpose of a gin pole? **To lift tower sections or antennas**



T0B06
What is the minimum safe distance from a power line to allow when installing an antenna? **So that if the antenna falls unexpectedly, no part of it can come closer than 10 feet to the power wires**

T0B07
Which of the following is an important safety rule to remember when using a crank-up tower? **This type of tower must never be climbed unless it is in the fully retracted position**

T0B08
What is considered to be a proper grounding method for a tower? **Separate eight-foot long ground rods for each tower leg, bonded to the tower and each other**



T0B09
Why should you avoid attaching an antenna to a utility pole? **The antenna could contact high-voltage power wires**
And it is illegal. The power company may remove your antenna or supports and charge you for their service.

T0B10
Which of the following is true concerning grounding conductors used for lightning protection? **Sharp bends must be avoided**

T0B11
Which of the following establishes grounding requirements for an amateur radio tower or antenna?
Local electrical codes

T0B12
Which of the following is good practice when installing ground wires on a tower for lightning protection?
Ensure that connections are short and direct

T0C - RF hazards: radiation exposure; proximity to antennas; recognized safe power levels; exposure to others; radiation types; duty cycle

T0C01
What type of radiation are VHF and UHF radio signals? **Non-ionizing radiation**
Ionizing radiation is radiation with enough energy so that during an interaction with an atom, it can remove tightly bound electrons from the orbit of an atom, causing the atom to become charged or ionized.

T0C02
Which of the following frequencies has the lowest value for Maximum Permissible Exposure limit? **50 MHz**
The Maximum Permissible Exposure limit defines the point after which you must take preventative measures to insure you or others near your station are not exposed to RF radiation that may cause health issues.

The FCC updated its RF safety regulations in 1997. These regulations require that all transmitting sites in the United States must meet all aspects of these regulations as of September 1, 2000. The FCC Regulations are based on setting limits for human exposure. The FCC limits are similar to, but not identical, to the limits of several other major standards. There are two sets of exposure limits.

You are required to do an MPE evaluation of your station and include a note of this evaluation and any actions taken in you station records.

See the RF Exposure and You by Ed Hare W1RFI available from the ARRL for a very detailed discussion of MPE requirements (ISBN: 087259-662-1). This detailed evaluation is not necessary for most stations.

An easy way to do this by using the MPE Evaluation decision chart on Page 61

of this syllabus.

T0C03
What is the maximum power level that an amateur radio station may use at VHF frequencies before an RF exposure evaluation is required? **50 watts PEP at the antenna**

See the MPE Evaluation decision chart on Page 61 of this syllabus.

T0C04
What factors affect the RF exposure of people near an amateur station antenna?

A. Frequency and power level of the RF field
B. Distance from the antenna to a person
C. Radiation pattern of the antenna
D. All of these choices are correct

T0C05
Why do exposure limits vary with frequency? **The human body absorbs more RF energy at some frequencies than at others**

T0C06
Which of the following is an acceptable method to determine that your station complies with FCC RF exposure regulations?

A. By calculation based on FCC OET Bulletin 65
B. By calculation based on computer modeling
C. By measurement of field strength using calibrated equipment
D. All of these choices are correct

T0C07 (B)
What could happen if a person accidentally touched your antenna while you were transmitting? **They might receive a painful RF burn**

T0C08
Which of the following actions might amateur operators take to prevent exposure to RF radiation in excess of FCC-supplied limits? **Relocate antennas**

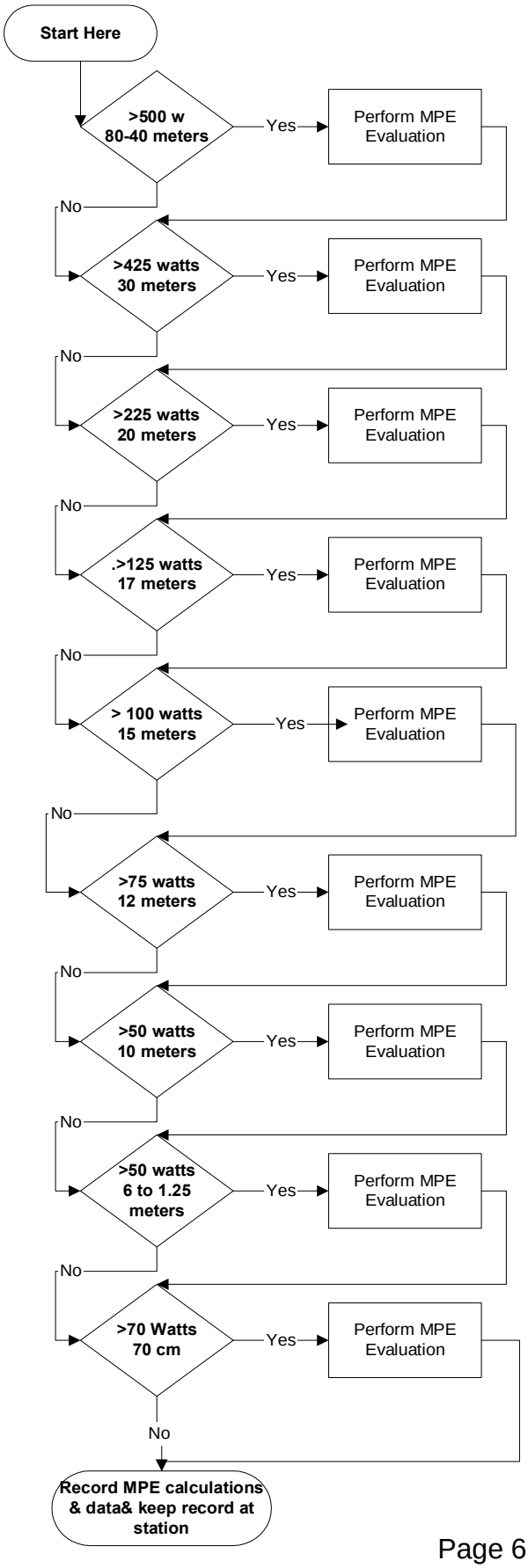
T0C09
How can you make sure your station stays in compliance with RF safety regulations? **By re-evaluating the station whenever an item of equipment is changed**

T0C10
Why is duty cycle one of the factors used to determine safe RF radiation exposure levels? **It affects the average exposure of people to radiation**

T0C11
What is the definition of duty cycle during the averaging time for RF exposure? **The percentage of time that a transmitter is transmitting**

T0C12
How does RF radiation differ from ionizing radiation (radioactivity)? **RF radiation does not have sufficient energy to cause genetic damage**

T0C13
If the averaging time for exposure is 6 minutes, how much power density is permitted if the signal is present for 3 minutes and absent for 3 minutes rather than being present for the entire 6 minutes? **2 times as much**

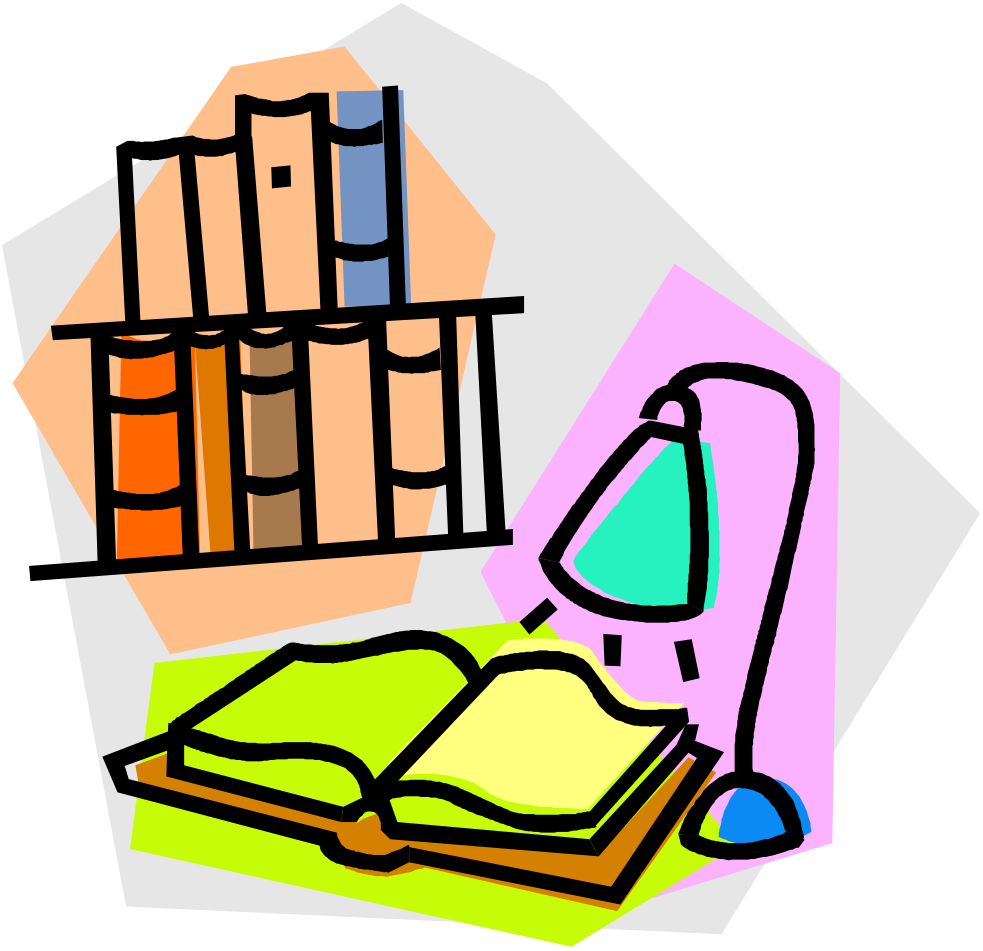


Note- Decision for running MPE at any specific frequency is determined by the ERP which is the transmiter output power plus antenna gain minus any feed line losses, filter or other losses

Example: The ERP for a 200 watt transmitter on 80 meters with an antenna gain of 9dB, feedline loss of 1.5 db and a band pass filter wit a loss of 1.5 dB would hava an ERP of 800 watts and would requires an MPE evaluation

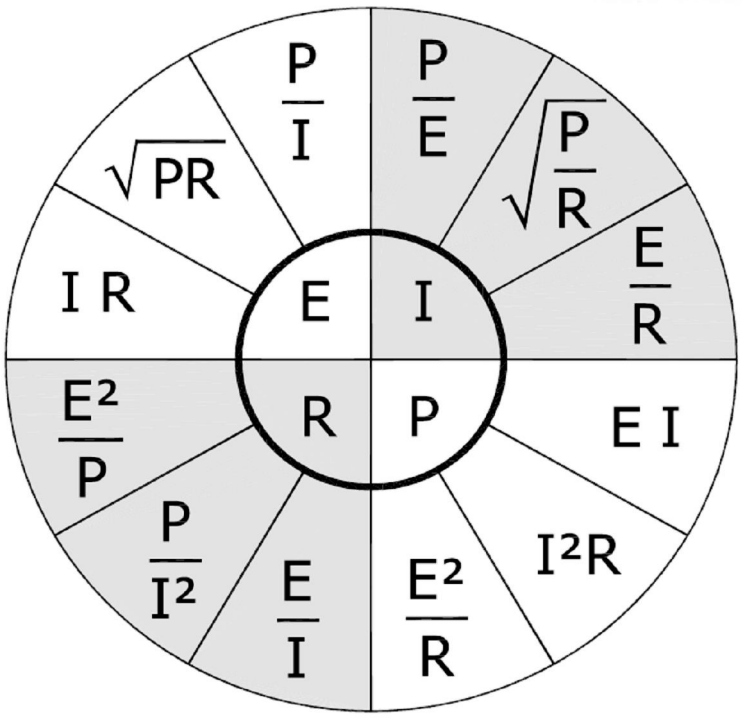
MPE = 200 watts +9dB -1.5 dB -1.5 dB or 200 watts with + 6db of gain. #db would be 2 times the power and an additional 3db to make 6 db would be times 2 again for a total of times 4. Withe the 200 watt input the ERP would be 4 x 200 or 800 watts. An MPE evaluation would be required

Appendix



International System of Units (SI)—Metric Units

Prefix	Symbol	Multiplication Factor	
exe	E	10+18	1,000,000 000,000,000,000
peta	P	10+15	1,000 000,000,000,000
tera	T	10+12	1,000,000,000,000
giga	G	10+9	1,000,000,000
mega	M	10+6	1,000,000
kilo	k	10+3	1,000
hecto	h	10+2	100
deca	da	10+1	10
(unit)		10+0	1
deci	d	10-1	0.1
centi	c	10-2	0.01
milli	m	10-3	0.001
micro	ε	10-6	0.000001
nano	n	10-9	0.000000001
pico	p	10-12	0.000000000001
femto	f	10-15	0.000000000000001
atto	a	10-18	0.000000000000000001



Ohms Law Circle

Scientific Notation to component values

Milli	m= .001 or	1x 10^-3
Micro	µ = .000,001 or	1x 10^-6
Nano	n= .000,000,001 or	1 x 10^-9
Pico	p= .000,000,000,001 or	1 x 10^-12
Fempto	f= .000,000,000,000,001 or	1 x 10^-15

Ohms Law

I=E/R R=E/I E=I * R (Amperes ï Volts-Ohms)

P=E * I P= E² /R I= P/E (amperes-volts-ohms-watts)

Series connected Resistors

$R = R1 + R2 + R3 + Rx$

Parallel connected Resistors

$$R = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \text{é} .. \frac{1}{R_x}}$$

Series inductors

Total Inductance = $L_1 + L_2 + L_3 + L_x$

Parallel inductors

$$L = \frac{1}{\frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} + \text{é} .. \frac{1}{L_x}}$$

Capicators in parallel

$C = C_1 + C_2 + C_3 + C_x$

Capacitors in series

$$C = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \text{é} .. \frac{1}{C_x}}$$

Effective Radiated Power

Lets take an example with the following characteristics:

Power output from radio = **50 watts**
Feed line loss = **- 4dB**
Duplexer loss = **-2 dB**
Circulator loss = **- 1dB**
Antenna Gain =**+ 4 dB**

We calculate the overall ERP as follows:

ERP=Transmitter Power Out = +((-4)+(-2)+(- 1)+(+4)) = 50 - 3 dB or 25 watts

Transmitter Power Measurements

The PEP power output for a transmitter with an observed 30 volt peak envelope voltage (as seen on an oscilloscope) would be 9 watts. To determent the PEP power we take the peak voltage and multiply it by

>707 to get the Peak RMS voltage then using the Peak RMS voltage we calculate power using the equation P(watts) = V(RMS)² / R (load)

PEP (watts) = [V(peak) x .707]² / Load Resistance

PEP (watts) = [V(peak) x .707]² / 50 = (21.2)²/ 50 = 449 / 50 = 9

Amplifier efficiency
Amplifier efficiency is the ratio of power divided by power input times 100%.

Efficiency = P(out) / P(input) x 100

A typical 1500 Watt PEP class B amplifier will require 2500 watts of DC input power (assume 60% efficiency). A typical class A amplifier will be typically 25 to 35% efficient.

P(input) = P(output) / Efficiently = 1500 Watts/.60 = 2500Watts

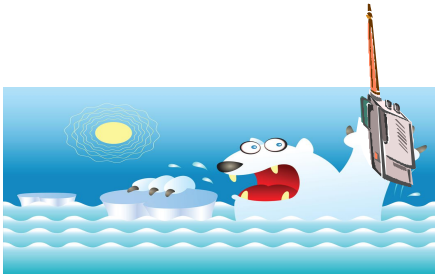
Common Q signals

QRB	***How far are you from my station?***
QRK	***What is the readability of my signal?***
QRL	***are you busy? / Is this frequency in use?***
QRM	***Are you being interfered with?***
QRP	***Shall I decrease power?***
QRV	***Are you ready?***
QTH	***What is you location?***
QTR	***What is the correct time?***
QSK	***Full break in telegraphy***
QRQ	***Send Faster***
QRS	***Send slower***
QRV	***I am ready to receive***
QRZ	***Who is calling me?***
QSL	***Can you acknowledge receipt?***
QSY	***Shall I change to another frequency?***

A complete list of Q signals can be found at
http://bclingan.org/mainpage_000012.htm

There is more to Ham Radio than Emergency Communication

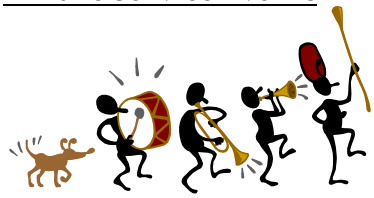
Author: Jack Tiley AD7FO
EWA ARRL Technical Specialist/Technical coordinator
ARRL Registered Instructor



Many folks obtain their Technician license with the sole intention of having a capability of personal communication in an emergency or to be part of an emergency communications group by being a member of ARES/RACES, Red Cross, or their church emergency communications network and for checking into nets. This certainly is a good reason to obtain the license and is in fact the reason we are allocated the valuable spectrum by the FCC that we enjoy, but there is a lot more to the Hobby of Amateur radio than emergency communication.

Here are some VHF and UHF activities for a Technician license holder with a hand held, mobile or base station radio

Public Service Events

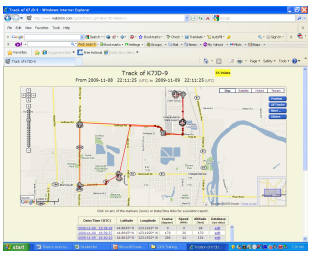


There are a number of public service event organizers that ask for amateur radio communications (Usually but not always through ARES/RACES). These events can be fun and give you a front row seat to the event. Examples in running events like marathons, Parades, Bike Races and many more. Attend your local ARES/RACES meetings or go to the the ARRL Web Site arrl.org for more information about ARES/RACES.

Hidden Transmitter Hunting

On VHF and UHF there are activities like hidden transmitter hunts, sometimes called fox hunts or ñbunny huntsò where the ñbunnyò is the hidden transmitter. This activity allows us to test our skill should we need to find an interfering signal. Hidden transmitter hunts provide friendly competition and the winner usually becomes the ñbunnyò for the next hunt. Many local clubs run monthly ñbunnyò hunts during the good weather months.

APRS Location - Tracking

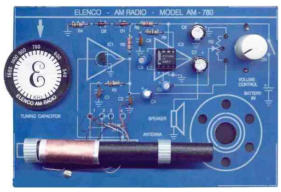


APRS (Automatic Position Reporting System) is a fun aspect of the hobby that allows you to be tracked as you drive around. With an APRS transmitter in your vehicle or carried on your person folks can track your progress or location. Place an APRS system in your vehicle as you travel about or as you drive to hamfests like Hamvention in Dayton Ohio. An old hand held or mobile and about $125 worth of additional new hardware from Byonics and you can be on the air. If you have an old GPS with an output you can put together for less. Check the Byonics web site at http://www.byonics.com for more information.

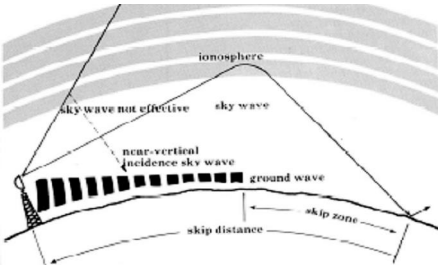
Building equipment and accessories from kits or from scratch

A fun portion of the hobby for some is experimentation and building things. Because the wave length is short it is easy to experiment with and build antennas for the two meter or 70 cm bands. Whether it is a simple ground plane antenna or a beam there is a lot of information on how to build them from readily available materials such as wire, copper pipe, and PVC pipe with old tape measure elements. There is a lot of information on building antennas in the ARRL antenna handbook and on the web.

In addition to building antennas there are a number other electronic kits available if you want to try you hand at building something. One source of kits for the hobbyist is Ramsey Electronics (http://www.ramseyelectronics.com).



HF (High Frequency) Skip and other long distance communication



As a Technician class license holder you have the 6 meter band available (50-54MHz). The 6 meter band frequently opens up and allows communication beyond line of site. You also have limited SSB privileges in the 10 meter (28.300 to 28.500) with a maximum power of 200 watts. In addition if you want to try your hand at Morse code there are HF band segments available for CW to the Technician license holder.

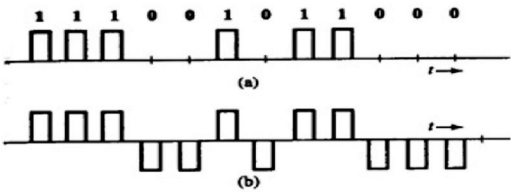
Many of todayôs HF radios (like the ICOM 706 and 7000, and Yaesu FT857and FT897) offer FM/AM/SSB/and CW on the 6 meter, 2meter and 70 cm bands and full HF band coverage from 180 to 10 meters in a single radio. If you plan to

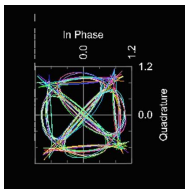
upgrade to General or Extra these could be a good first radio with the VHF/UHF bands for your Technician class license and ready for HF when you get your General License.

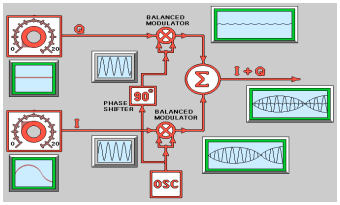
Adding a computer adds more VHF/UHF fun

If you have a computer you can do more with your radio. First is the difficult job of entering 50 to 100 frequencies with offsets, tones and power levels that can be made easy with software and a programming cable that is available for most radios.

Digital Communications







There are a number of ways to tie your computer to the radio to do digital communications. Digital communication modes allow you to type and exchange messages between other amateur stations by typing your message or reply into your computer and reading the other stations reply on screen. This is a great mode for those who have ñMike Frightò.

Packet Radio

Packet radio where you can send written communication to another radio, like sending a wireless e-mail anywhere in the world through an internet back bone, or local peer to peer (direct radio to radio) communication with another station. There are lots of references on the web for packet radio and how to build your own interface from the computer to the radio. There is some excellent Packet software that can be downloaded for free on the web (WinPack and Packet engine and more, search on Packet Radio)

WinLink 2000 Global radio link email system

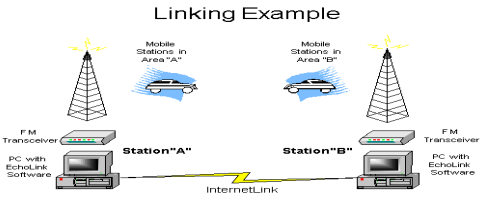
WinLink *2000 (WL2K)* is a worldwide system of volunteer resources supporting e-mail by radio, with non-commercial links to internet e-mail. These resources come from Amateur Radio, the Military Affiliate Radio Systems (MARS), and other volunteer organizations. The system provides valuable service to emergency communicators, and to licensed radio operators without access to the internet. The all-volunteer Winlink Development Team (WDT) is committed to continuous improvement using modern computer and networking technology with the most efficient and effective radio mode *Winlink* s and digital protocols for local, regional and long-distance applications.
To use the WinLink 2000 system, you must hold an Amateur Radio license or be a member of a supported organization or agency. Use of the system and all software is free of charge for those who qualify. A simple modem is all that is required to operate Winlink 2000 log onto http://www.winlink.org/ for more information.

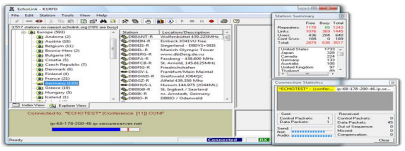
Amateur TV

You can send live full motion TV on the 70 cm and higher frequencies. It takes an old Camcorder as the camera, an ATV transmitter that is available from PC electronics for about $500, and an old cable ready TV as the receiving station. There are lower cost cameras and transmitter boards available to mount in your model airplane, car or boat. These small lightweight transmitters have been attached to balloons and have sent back images from near space altitudes. Fast scan TV is only allowed on the 70 cm and above bands because it takes 6MHz of bandwidth to transmit.

You can also send slow scan TV (single frames) on VHF and HF in the same bandwidth you send SSB voice transmission. Your normal HF or VHF multiband transceiver and a computer along with a camera and simple interface is all that is required.

ECHO Link

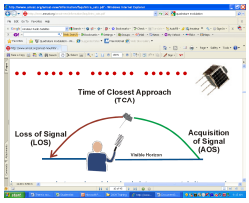


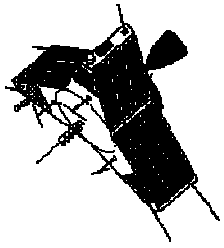


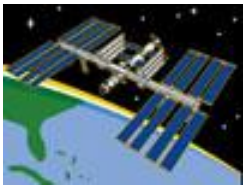
EchoLink® software allows licensed Amateur Radio stations to communicate with one another over the Internet, using voice-over-IP (VoIP) technology. The program allows worldwide voice connections to be made between radio stations, or from computer to a radio station, greatly enhancing Amateur Radio's communications capabilities. There are more than 200,000 validated users worldwide in 162 of the world's 193 nations ð with about 4,000 online at any given time. Go to http://www.echolink.org/ for more information.

With your hand held transceiver and operating through an Echo link station you can communicate around the world from a local repeater to another repeater on the other side of the world. No additional equipment required.

Satellite and Space Stationcommunication







Amateur radio satellites contain transponders or repeaters that can relay voice communications. Digital satellites are capable of transmitting, receiving, or relaying digital information. Information on amateur satellite communication can be found at http://www.amsat.org/amsat-new/index.php

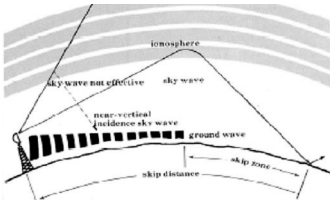
The International Space station has a licensed amateur radio operator and a VHF amateur radio transceiver for scheduled contacts with schools and for random contacts with amateur radio operators when onboard schedules allow.

To listen to amateur radio conversations on satellites or communicate with the International Space Station a hand held transceiver and a directional antenna are all that are required. To communicate over an amateur radio satellite a separate transceiver and dual band directional antenna may be required.

HF activities with a General or extra license and an HF radio

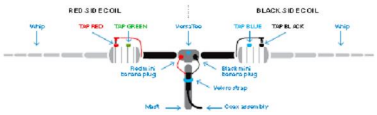
You do not need a 50 foot tower, beam antenna and 1500 watt transmitter to operate on HF and make many contacts. If you are a serious contest operator you may want a tower, antenna and a high power linear amplifier, but for most of us this is not needed. Simple wire dipoles and a 100 watt transceiver are very effective for the HF bands.

Direct contact with someone thousands of miles away



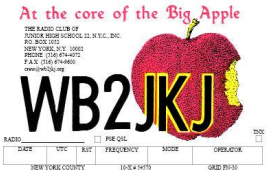
HF communication with skip propagation allows your signal to be reflected from the ionosphere one or more times allowing communication around the world without any intervening infrastructure. Propagation conditions are continually changing throughout the day and are also affected by solar activity, meteor showers and many more factors. HF operators understand these changes and how to use them to make long distance contacts.

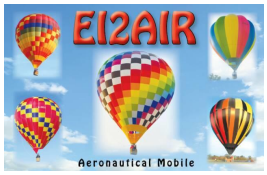
QRP Operation



One activity on HF is QRP, or Low power operation, where your station is transmitting 5 watts or less. You will be amazed what you can do with a simple Dipole or Budipole antenna and a small battery operated CW or SSB radio. There are many kits available for QRP transceivers if you want to try your hand at home brewing (building) a radio. Visit http://www.ac6v.com/qrp.htm for more information on QRP Operation.

DX





DX stands for long distance communication and communication with as many different countries or locations as possible. DX Operators collect QSL cards to confirm their contact with that station. This activity usually requires directional antennas and 100 watts or more of power. There is a local club in Spokane that focuses on the art of DX communication. Their web site is http://www.sdxa.org/ .

Contesting

Contesting (also known as *radiosport*) is a competitive activity pursued by amateur radio operators. In a contest, an amateur radio station, which may be operated by an individual or a team that seeks to contact as many other amateur radio stations as possible in a given period of time and exchange information. Rules for each competition define the amateur radio bands, the mode of communication that may be used, and the kind of information that must be exchanged. The contacts made during the contest contribute to a score by which stations are ranked. Contest sponsors publish the results in magazines and on web sites.

There are contests to see how many contacts by grid square we can contact on VHF/UHF with directional antennas and a high location, like driving to the top of mountain or high spot to operate. These are usually a 24 to 48 hour events and are competitive. Anyone can participate regardless of their contesting experience. Even if your only make a few contacts folks will be glad to talk with you because they are looking to add more contacts to their score. These are a great way to get over ñmike frightò. These contests are listed in the ARRL magazine, QST, and on the ARRL web site. www.arrl.org .

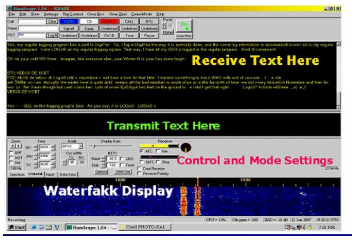
Pactor

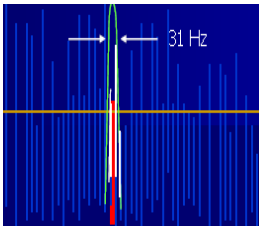
PACTOR is a radio transmission protocol used by amateur radio operators, marine radio stations, and radio stations in isolated areas to send and receive digital information via radio. PACTOR is one of the fastest, most accurate, and most efficient ways to send digital data by radio. A robust network of stations that use PACTOR has been established to relay data by radio to and from the Internet, extending Internet access to sea based and other isolated users.[

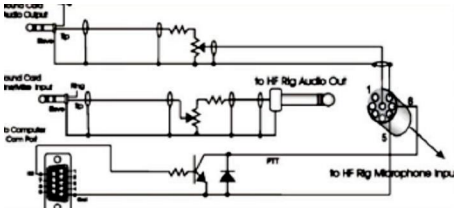
PACTOR can provide one on one worldwide communication, without any intervening infrastructure. You donôt need a tower and beam to experience PACTOR.

PACTOR was developed by a German company, Special Communications Systems GmbH (SCS), which has only released code for PACTOR I into the public domain. PACTOR II, III, and IV are all proprietary, and there is controversy as to whether this falls under the definition of encryption (and thus is prohibited under amateur regulations). Being a single vendor product the cost of the proprietary gear to work PACTOR II, III, and IV can be very expensive. For Pactor IV the modem currently sells for $1,850, well out of the reach of most amateurs. Many other digital modes are available with little hardware cost and free software.

PSK31







Another digital mode is PSK31 (more commonly used on HF bands but can be used on any band) which allows typed message communication between stations using extremely small bandwidths of approx 100 Hz. Again free software is available on the web and modems can be purchased or can be built to work with the directly with the computer or its sound card. PSK31 is easy to do and a great way to make contacts even when Voice transmission can't get through because of high noise levels.

Slow Scan TV

The best way to understand slow scan TV is to imagine it as color fax pictures but sent over the radio rather than the phone. The pictures are transmitted via tones (1200-2300 HRZ) over the air. There are several simple ways to get setup for slow scan TV, the simplest of which use your computer and software with a hardware interface. There are interface circuits which work well and cost less than $20 to build or less if from your parts junk box.

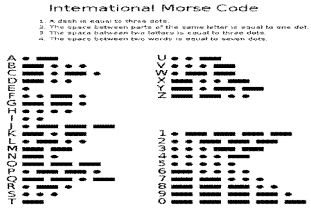
Slow scan has been great fun. You can exchange pictures, picture QSLs with different people in many different countries throughout the world. The quality of the pictures is somewhat dependent upon the computer, (monitor & graphics card), and somewhat on the software, hardware. The better systems support Hicolour which gives typical picture resolutions of 320 x 240 in 32 thousand colors. These pictures are almost photographic quality and are very impressive to say the least.

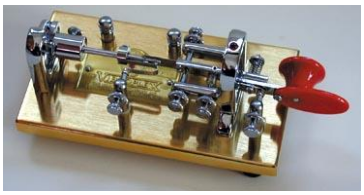
Once you've tried it you will be hooked. Imagine being able to swap photos with other Amateurs allowing you to see who you're talking to. You can also send diagrams and schematics over the air. It's great. Tune in to 14.230 MHz and 14.233 MHz on the HF band almost anytime to hear the action. Don't be afraid to break in for info. The SSTV hams are usually very willing to help other interested parties or help you get started in slow scan. Go for it and we'll see you on the air. Go to http://www.kent.net/ve3rdn/ for more information.

RTTY – Radio Teletype

RTTY is a keyboard to keyboard communication means over HF using FSK (frequency shift keying) to send characters using BAUDET code instead of ASCII. It was originally implemented with mechanical radio teletype machines but today is implemented with a transceiver, simple interface and a computer. There are many dedicated RTTY operators and there are national and international RTTY contests.

Morse Code - CW





Morse code operation is still viable today even though you no longer need to demonstrate your ability to send or receive it. There are many who enjoy QSOôs in code. Today experienced CW operators copy received text without the need to write as they receive, and when transmitting, can easily converse at 20 to 30 words per minute (there are 5wpm nets if you want to try your had at CW). Morse Code will always remain a viable means of providing reliable communications during difficult communications conditions.

Getting involved

Want to try a new activity but donôt know where to start? You can join in on one of the many nets and ask if someone can help you. Many of the nets are listed on the ARRL web site.

There are many knowledgeable operators dedicated to helping others in the hobby. They are referred to as Elmerôs, ask on the air or at a meeting and you will likely find someone who can help and answer your questions or get you started with a new mode.

The ARRL organization has folks appointed as Technical Specialists (TSôs) who are available to answer questions via e-mail. Again check the ARRL Web site for your section managerôs page for local information.