Amateur Radio Technician Exam Preparation Course

ARRL
The National Association for Amateur Radio®

Amateur Radio Technician Exam Prep Course

Module 6

Communicating With Other Hams

6.1 Band Plans
6.2 Making Contacts
6.3 Using Repeaters
6.4 Nets
6.5 Communications for Public Service
6.6 Satellite Operating

Band Plans

- Band plans are *voluntary agreements* designed for normal conditions (not regulations)
- Amateur Radio is the only service that can tune freely and use multiple modes within their allocations
- Amateur Radio Band Plan:
  - www.arrl.org/band-plan
- See 2 meter band plan on following slide (Table 6.1)

Table 6.1: 2 meter (144-148 MHz) Band Plan

2 meter and 70 cm bands are where many Technician licensees begin operating

Note the variety of activity in just one band

144.00-144.05	EME (CW)
144.05-144.10	General CW and weak signals
144.10-144.20	EME and weak-signal SSB
144.200	SSB calling frequency
144.200-144.275	General SSB operation
144.275-144.300	Propagation beacons
144.30-144.50	OSCAR subband
144.50-144.60	Linear translator inputs
144.60-144.90	FM repeater inputs
144.90-145.10	Weak signal and FM simplex (145.01, 03, 05, 07,09 are widely used for packet radio)
145.10-145.20	Linear translator outputs
145.20-145.50	FM repeater outputs
145.50-145.80	Miscellaneous and experimental modes
145.80-146.00	OSCAR subband
146.01-146.37	Repeater inputs
146.40-146.58	Simplex
146.52	National Simplex Calling Frequency
146.61-147.39	Repeater outputs
147.42-147.57	Simplex
147.60-147.99	Repeater inputs

Band Plans (cont.)

- HF band plans tend to be simpler than VHF and UHF because there are no repeaters
- Other common uses listed in band plans …
  - Beacons — Automated transmissions for listeners to tell when the band is "open" to the beacon's location
  - Weak signal — Modes that work better at lower signal strengths (CW, SSB, and some digital modes). Every amateur band from 50 MHz on up has frequencies available for CW and SSB operation.
  - Satellite uplinks and downlinks —Segments of bands where signals are sent to (*uplink*) and received from (*downlink*) satellites
  - Simplex — Transmitting and receiving on the same frequency
  - Repeater inputs and outputs
  - Control links

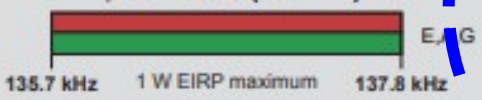
US Amateur Radio Bands

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.

ARRL The national association for AMATEUR RADIO

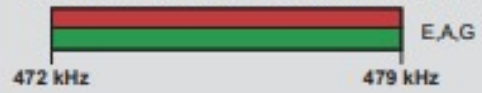
Amateurs wishing to operate on either 2,200 or 630 meters must first register with the Utilities Technology Council online at **https://utc.org/pic-database-amateur-notification-process/.** You need only register once for each band.

2,200 Meters (135 kHz)



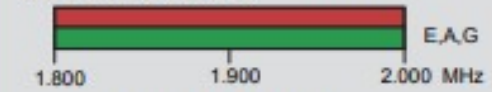
630 Meters (472 kHz)

5 W EIRP maximum, except in Alaska within 496 miles of Russia where the power limit is 1 W EIRP.



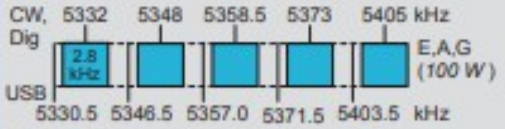
160 Meters (1.8 MHz)

Avoid interference to radiolocation operations from 1.900 to 2.000 MHz



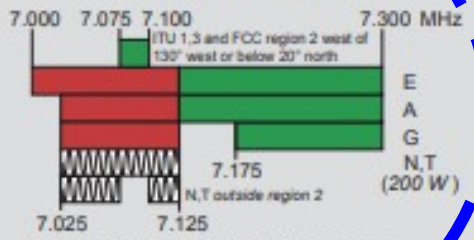
80 Meters (3.5 MHz)

60 Meters (5.3 MHz)



General, Advanced, and Amateur Extra licensees may operate on these five channels on a secondary basis with a maximum effective radiated power (ERP) of 100 W PEP relative to a half-wave dipole. Permitted operating modes include upper sideband voice (USB), CW, RTTY, PSK31 and other digital modes such as PACTOR III. Only one signal at a time is permitted on any channel.

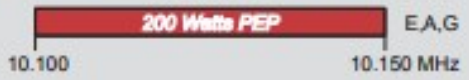
40 Meters (7 MHz)



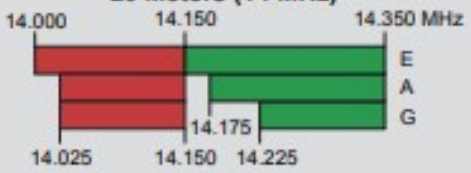
See Sections 97.305(c), 97.307(f)(11) and 97.301(e).These exemptions do not apply to stations in the continental US.

30 Meters (10.1 MHz)

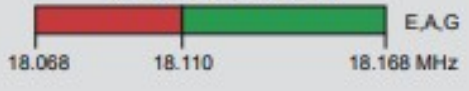
Avoid interference to fixed services outside the US.



20 Meters (14 MHz)

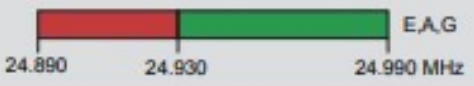


17 Meters (18 MHz)

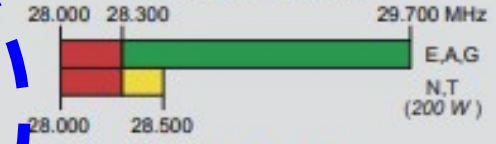


15 Meters (21 MHz)

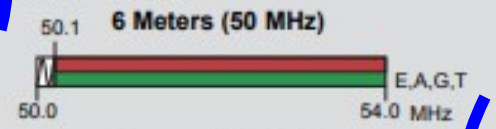
12 Meters (24 MHz)



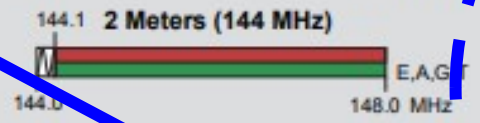
10 Meters (28 MHz)



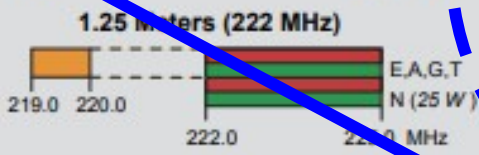
6 Meters (50 MHz)



2 Meters (144 MHz)



1.25 Meters (222 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)*

33 cm (902 MHz)*

23 cm (1240 MHz)*

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.

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ARRL Headquarters:
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email: hq@arrl.org

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email: newham@arrl.org

Exams: 860-594-0300 email: vec@arrl.org

 rev. 9/22/2017

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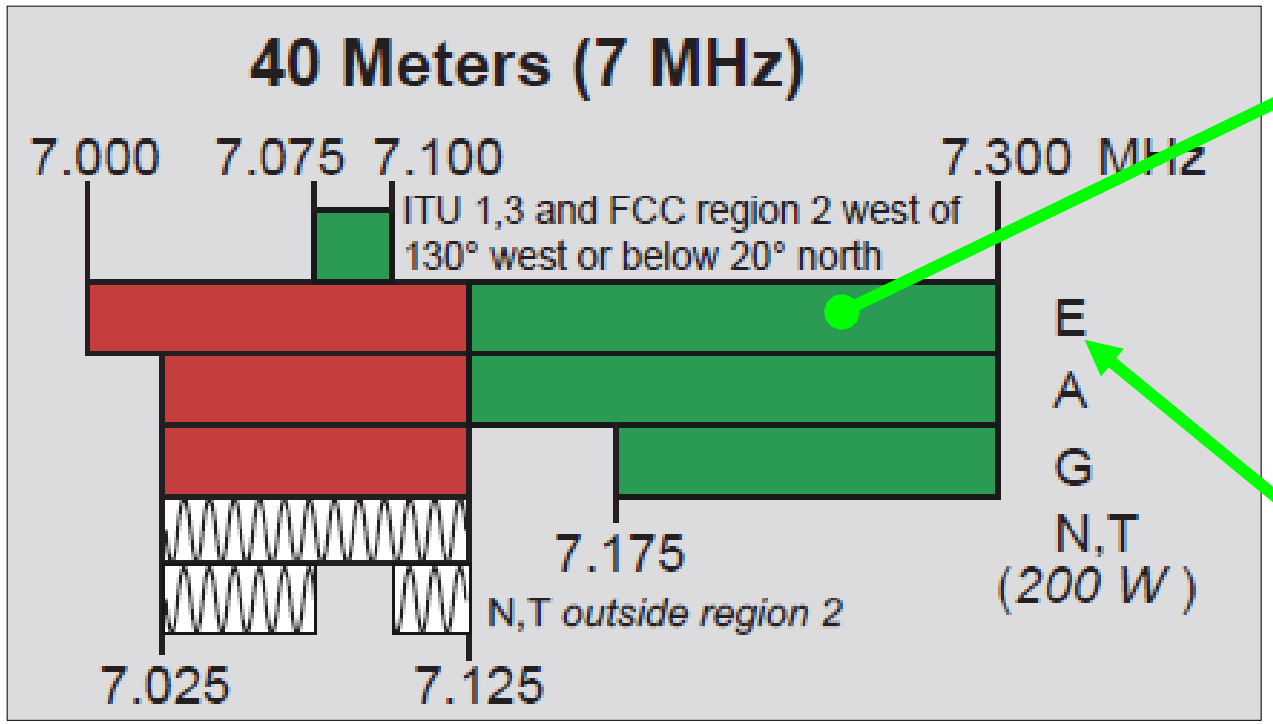
Frequency Bands Chart from arrl.org

See slide **INTERPRETING THE BAND PLAN**

Interpreting the Band Plan

Band (frequency)



= RTTY and data
= phone and image
= CW *only*
= SSB phone
= USB phone, CW, RTTY, and data
= Fixed digital message forwarding systems *only*

Use(s)

E = Amateur Extra
A = Advanced
G = General
T = Technician
N = Novice

License privilege(s)

An EXTRA may use the 40 meter band for phone or image from 7.100 to 7.300 MHz.

Making Contacts on Repeaters

- Before you transmit, be sure you are authorized to use that frequency and mode
- Typical repeater "manners" …
  - Listen so that you are aware of someone using the repeater
  - Keep transmissions short
  - Identify your station legally
- Easiest way to attract listeners … *give your call sign followed by "monitoring" … KØILP monitoring*
- Responding to a station looking for a contact … *say the other station's call sign once, followed by "this is" or "from," then give your call sign … KX4IU this is KØILP*

Making Contacts on Repeaters (cont.)

- If you accidentally interrupt someone … *just say "Sorry, KØILP clear" and wait for their contact to end or tune to a different repeater*
- What if you receive a report that your signal's audio is strong, but distorted?
  - You're slightly off-frequency (radio control knob got bumped)
  - Speaking too loudly into the microphone
  - Transmitting from a bad location
  - Weak or low batteries
- Repeaters often add a short *courtesy beep* to the retransmitted signal when the transmitting station's signal disappears
  - Becomes the "over" cue to other stations to start speaking (although saying *OVER* is common and acceptable)

Making Contacts on Simplex Channels

- Simplex channels are conveniently located between bands of repeater input and output channels
- It's often quite easy to make contact directly, without use of a repeater … avoids occupying or "tying up" a repeater
- Many radios have a *reverse* split function that swaps transmit and receive frequencies, enabling you to listen for the other station on the repeater's input frequency
- The *national simplex calling frequency* on 2 meters is 146.52 MHz
  - 70 cm it is 446.00 MHz
  - Most amateur bands have a calling frequency (www.arrl.org/band-plan)

Making Contacts: SSB, CW, and DIGITAL

- Starting contacts is different on these modes than on repeaters that use fixed channels … *call must be long enough to attract attention*
- Done by calling *CQ* (means "I am calling any station.")
  - The station calling CQ sends or says "CQ" several times followed by their call sign … *CQ CQ CQ, this is KØILP Kilo Zero India Lima Papa calling CQ and standing by*
  - On CW or Digital: *CQ CQ CQ DE KØILP KØILP KØILP K*
- Before you call CQ you should do three things …
  1. Be sure the frequency is one your license privileges authorize you to use
  2. Listen to be sure the frequency is not already in use
  3. Make a short transmission asking if the frequency is in use
- Responding to a station calling CQ …
  - Give the CQing station's call sign (KX4IU) once then yours (KØILP) once (using phonetics) … *KX4IU this is Kilo Zero India Lima Papa*

Q-Signals

- Q-signals are a system of radio shorthand (abbreviations for common information) developed from old telegraphy codes
- Although developed for use by Morse operators, their use is also common on phone/voice
- Table 6.2 lists the most common Q-signals

Table 6.2: Q-Signals

Take the form of a question only when followed by a question mark.

QRG	Your exact frequency (or that of _____) is _____kHz. Will you tell me my exact frequency (or that of _____)?
QRL	I am busy (or I am busy with _____). Are you busy? Usually used to see if a frequency is busy.
QRM	Your transmission is being interfered with _____ (1. Nil; 2. Slightly; 3. Moderately; 4. Severely; 5. Extremely.) Is my transmission being interfered with?
QRN	I am troubled by static _____. (1 to 5 as under QRM.) Are you troubled by static?
QRO	Increase power. Shall I increase power?
QRP	Decrease power. Shall I decrease power?
QRQ	Send faster (_____wpm). Shall I send faster?
QRS	Send more slowly (_____wpm). Shall I send more slowly?
QRT	Stop sending. Shall I stop sending?
QRU	I have nothing for you. Have you anything for me?
QRV	I am ready. Are you ready?
QRX	I will call you again at _____hours (on _____kHz). When will you call me again? Minutes are usually implied rather than hours.
QRZ	You are being called by _____ (on _____kHz). Who is calling me?
QSB	Your signals are fading. Are my signals fading?
QSK	I can hear you between signals; break in on my transmission. Can you hear me between your signals and if so can I break in on your transmission?
QSL	I am acknowledging receipt. Can you acknowledge receipt (of a message or transmission)?
QSO	I can communicate with _____ direct (or relay through _____). Can you communicate with _____ direct or by relay?
QSP	I will relay to _____. Will you relay to _____?
QST	General call preceding a message addressed to all amateurs and ARRL members. This is in effect "CQ ARRL."
QSX	I am listening to _____ on _____kHz. Will you listen to _____on _____kHz?
QSY	Change to transmission on another frequency (or on _____kHz). Shall I change to transmission on another frequency (or on _____kHz)?
QTC	I have _____messages for you (or for _____). How many messages have you to send?
QTH	My location is _____. What is your location?
QTR	The time is _____. What is the correct time?

DXing and Contesting

- DX stands for *distant station*
  - Means thousands of miles on HF (and occasionally 6 meters)
  - Beyond the radio horizon on VHF/UHF
- Best done on SSB or CW because of the efficiency of those modes
- Radio contests are held in which the competitors try to make as many short contacts as possible in a fixed period of time
- During contesting send only the minimum information needed to identify your station and complete the exchange
- Contesting info available at:
  - http://www.arrl.org/contest-calendar

Popular DXing Event

ARRL Field Day — The Biggest Amateur Event of All!

Every year on the fourth full weekend of June, North American hams head for the hills…and the fields and the parks and the backyards. It's Field Day! This is the annual emergency preparedness exercise in which more hams participate than any other. The basic idea — set up a portable station (or several) and try to make as many contacts with other ham groups as possible on as many amateur bands as possible. If you think the bands are busy on weekends, wait until you hear them during ARRL Field Day!

Some groups focus on the emergency preparedness aspect, others get into the competitive aspect trying for the most points, and some just treat it as the annual club picnic plus radio operating. Whatever your organization prefers, Field Day is a great way to see a lot of ham radio all in one spot and all at the same time. For more information, browse to ARRL Field Day web page, read the Field Day announcement in the May issue of *QST* magazine, or enjoy the Field Day summary and results that usually appear in the December issue. CQ, Field Day!

www.arrl.org/field-day

Fox Hunting & Direction Finding

- A different and more physical type of contest is known as *foxhunting*
- Involves hiding and finding hidden transmitters
- Trains hams to find downed aircraft, lost hikers, and sources of interference or jamming
- You can get started with a portable radio with a signal strength indicator and a handheld or portable directional antenna (*Yagi*)
- A similar event is *radio direction finding*
  - A hybrid of the radio fox hunt using orienteering skills to navigate outdoors with map and compass

Video

- Two primary means of exchanging pictures or video in real-time
  - Amateur television (ATV) on the UHF bands at 430 MHz and higher
  - Fast-scan color television signals (NTSC … National Television System Committee)
    - Slow-scan television (SSTV) sends *still* signals
- More info on amateur radio imaging at:
  - www.arrl.org/atv-fast-scan-amateur-television
  - www.hamuniverse.com/atvfastscantv.html

PRACTICE QUESTIONS

Where may SSB phone be used in amateur bands above 50 MHz?

A. Only in sub-bands allocated to General class or higher licensees
B. Only on repeaters
C. In at least some segment of all these bands
D. On any band if the power is limited to 25 watts

T1B10 C 97.305(c) 6-1

What is a band plan, beyond the privileges established by the FCC?

A. A voluntary guideline for using different modes or activities within an amateur band
B. A list of operating schedules
C. A list of available net frequencies
D. A plan devised by a club to indicate frequency band usage

T2A10 A 6-1

What term describes an amateur station that is transmitting and receiving on the same frequency?

A. Full duplex
B. Diplex
C. Simplex
D. Multiplex

T2A11 C 6-1

What is an appropriate way to call another station on a repeater if you know the other station's call sign?

A. Say "break, break," then say the station's call sign
B. Say the station's call sign, then identify with your call sign
C. Say "CQ" three times, then the other station's call sign
D. Wait for the station to call CQ, then answer

T2A04 B 6-4

Which of the following indicates that a station is listening on a repeater and looking for a contact?

A. “CQ CQ” followed by the repeater’s call sign
B. The station’s call sign followed by the word “monitoring”
C. The repeater call sign followed by the station’s call sign
D. “QSY” followed by your call sign

T2A09 B 6-4

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

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

T7B10 D 6-4

What is the national calling frequency for FM simplex operations in the 2 meter band?

A. 146.520 MHz

B. 145.000 MHz

C. 432.100 MHz

D. 446.000 MHz

T2A02 A 6-6

How is a VHF/UHF transceiver's "reverse" function used?

A. To reduce power output
B. To increase power output
C. To listen on a repeater's input frequency
D. To listen on a repeater's output frequency

T2B01 C 6-6

Why are simplex channels designated in the VHF/UHF band plans?

A. So stations within range of each other can communicate without tying up a repeater
B. For contest operation
C. For working DX only
D. So stations with simple transmitters can access the repeater without automated offset

T2B09 A 6-6

How should you respond to a station calling CQ?

A. Transmit “CQ” followed by the other station’s call sign
B. Transmit your call sign followed by the other station’s call sign
C. Transmit the other station’s call sign followed by your call sign
D. Transmit a signal report followed by your call sign

T2A05 C 6-6

What is the meaning of the procedural signal “CQ”?

A. Call on the quarter hour
B. Test transmission, no reply expected
C. Only the called station should transmit
D. Calling any station

T2A08 D 6-6

What should you do before 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 authorized to use that frequency
D. All these choices are correct

T2A12 D 6-6

Which Q signal indicates that you are receiving interference from other stations?

A. QRM
B. QRN
C. QTH
D. QSB

T2B10 A 6-7

Which Q signal indicates that you are changing frequency?

A. QRU
B. QSY
C. QSL
D. QRZ

T2B11 B 6-7

What operating activity involves contacting as many stations as possible during a specified period?

A. Simulated emergency exercises
B. Net operations
C. Public service events
D. Contesting

T8C03 D 6-7

Which of the following is good procedure when contacting another station in a contest?

A. Sign only the last two letters of your call if there are many other stations calling
B. Contact the station twice to be sure that you are in his log
C. Send only the minimum information needed for proper identification and the contest exchange
D. All these choices are correct

T8C04 C 6-7

What is a grid locator?

A. A letter-number designator assigned to a geographic location
B. A letter-number designator assigned to an azimuth and elevation
C. An instrument for neutralizing a final amplifier
D. An instrument for radio direction finding

T8C05 A 6-8

What type of transmission is indicated by the term “NTSC?”

A. A Normal Transmission mode in Static Circuit
B. A special mode for satellite uplink
C. An analog fast-scan color TV signal
D. A frame compression scheme for TV signals

T8D04 C 6-9

Which of the following methods is used to locate sources of noise interference or jamming?

A. Echolocation
B. Doppler radar
C. Radio direction finding
D. Phase locking

T8C01 C 6-10

Which of these items would be useful for a hidden transmitter hunt?

A. Calibrated SWR meter
B. A directional antenna
C. A calibrated noise bridge
D. All these choices are correct

T8C02 B 6-10

Using Repeaters

- Technicians commonly make contacts through *repeaters*
- To find repeaters in your area, you'll need a listing sorted by area …
  - ARRL Repeater Directory (www.arrl.org)
  - Repeater Book (www.repeaterbook.com)
- You can use the *scanning function* of your radio to listen for activity on repeater or simplex channels
- To access a repeater you will need to know three things …
  1. Repeater transmitter's *output* or *transmit frequency*
  2. Repeater receiver's *input* or *receive frequency*
  3. Frequency of any *access control tones*

Repeater Offset (Shift)

- To *listen* to a repeater, tune to its *output* frequency
- To *send* a signal through the repeater, you must transmit on the repeater's *input* frequency
- The *difference* between repeater input and output frequencies is called the repeater's *offset* or *shift*
  - For 2 meters, usually ±600 kHz
  - For 70 centimeters, usually ±5 MHz

Linked Repeater Systems & Access Tones

- To extend their range, repeaters sometimes use remote receivers
- Repeaters can also be *linked* to other repeaters (by sharing the signals each receives and retransmitting them)
- Most repeaters won't pass a signal from the receiver to the transmitter for retransmission unless it contains an *access tone*
  - Also called *Continuous Tone Coded Squelch System* (CTCSS), *PL* (for Private Line, the Motorola trade name) or *sub-audible*
  - Your radio's operating manual will explain how to select and activate the tone
    - There may be several tone options, such as tone squelch and digital code squelch (DCS)
- Troubleshooting repeaters … *If you can hear a repeater's signal, but it can't hear you …*
  - Make you're sure you are using the right offset
  - Make sure you have your radio set up to use the right type or frequency of access tone (CTCSS)
  - Make sure your radio's digital code squelch settings are correct (DCS)

PRACTICE QUESTIONS

What does the scanning function of an FM transceiver do?

A. Checks incoming signal deviation
B. Prevents interference to nearby repeaters
C. Tunes through a range of frequencies to check for activity
D. Checks for messages left on a digital bulletin board

T4B05 C 6-10

What is a common repeater frequency offset in the 2 meter band?

A. Plus or minus 5 MHz
B. Plus or minus 600 kHz
C. Plus or minus 500 kHz
D. Plus or minus 1 MHz

T2A01 B 6-11

What is a common repeater frequency offset in the 70 cm band?

A. Plus or minus 5 MHz
B. Plus or minus 600 kHz
C. Plus or minus 500 kHz
D. Plus or minus 1 MHz

T2A03 A 6-11

What is meant by “repeater offset”?

A. The difference between a repeater’s transmit and receive frequencies
B. The repeater has a time delay to prevent interference
C. The repeater station identification is done on a separate frequency
D. The number of simultaneous transmit frequencies used by a repeater

T2A07 A 6-11

Which of the following describes a linked repeater network?

A. A network of repeaters in which signals received by one repeater are transmitted by all the repeaters in the network
B. A single repeater with more than one receiver
C. Multiple repeaters with the same control operator
D. A system of repeaters linked by APRS

T2B03 A 6-12

What term describes the use of a sub-audible tone transmitted along with normal voice audio to open the squelch of a receiver?

A. Carrier squelch
B. Tone burst
C. DTMF
D. CTCSS

T2B02 D 6-12

Which of the following could be the reason you are unable to access a repeater whose output you can hear?

A. Improper transceiver offset
B. You are using the wrong CTCSS tone
C. You are using the wrong DCS code
D. All these choices are correct

T2B04 D 6-12

Digital Repeater Systems

- Ham radio and the Internet can link repeaters and communicate nearly anywhere on Earth … some of these systems include:
  - IRLP (Internet Radio Linking Project)
  - EchoLink
  - WIRES II — a proprietary system of the Yaesu company
  - D-STAR — a system based on the public D-STAR standard
  - DMR — Digital Mobile Radio
- IRLP and EchoLink use VoIP (*Voice over Internet Protocol*) technology
- EchoLink uses VoIP to enable stations to transmit through an internet-connected repeater **without** using a radio to initiate the transmission (a call sign & proof of license are required)

Digital Repeater Systems (cont.)

- IRLP and EchoLink contacts differ from a regular repeater contacts … *initiating station must know the repeater control code to request an IRLP connection* … a sequence of DTMF or *Dual-tone Multi-Frequency* tones
- WIRES II uses voice-only standard developed by radio manufacturer Yaesu
- D-STAR combines digital voice and data communications
- DMR is a technique for time-multiplexing two digital voice signals on a single 12.5 kHz repeater channel … digital codes called color codes are used to access a specific repeater, similar to CTCSS or PL access tones on an analog FM repeater
  - By programming your radio with those IDs and codes, you can join the group and your audio will be shared with all other members of the group
  - Talk groups allow groups of users to share a channel at different times without being heard by other users on the channel … data are contained in a code plug computer file

Digital Repeater Systems (cont.)

- You don't need different radios for each digital voice system … *hot spots* are used that link your digital transceiver to the internet, and software in the hot spot makes the connection
- WIRES II/System Fusion, D-STAR, DMR, P25, and NXDN all use talk groups in one form or another
  - To join a talk group, you'll need to know the group's identification code or number
  - You'll also have to enter your own identification code (and call sign for D-STAR) into the transceiver so the system knows who you are

Nets

- In the early days of radio, *nets* helped stations meet on the air to share news and messages
- Today's nets include support for emergency communications and public service activities
- Nets usually have two purposes:
  1. Pass emergency messages
  2. Coordinate reporting and response activities
- Net messages are called *traffic*, which often have built-in routing information to get the message to the right place
- Exchanging messages is called *traffic handling*
- Between activations, emergency nets are activated for practice and to conduct training exercises

Net Structure and Participation

- A *Net Control Station* (NCS) directs the net by calling it to order and directing communications between stations checking into the net
- A station with *emergency traffic* should break in at any time
- Do not transmit unless you are specifically requested or authorized to do so or a request is made for capabilities or info that you can provide

Exchanging Messages on the Net

- The most important job during emergency and disaster net operation is the ability to accurately relay or *pass* messages
- Messages are often formatted as *radiograms*
- The *preamble* or *header* contains bits of information about the message so that it can be handled and tracked appropriately (see following slide for header details)
- Following the preamble is the text of the radiogram … to ensure accuracy, names are spelled out using standard phonetics

Message Headers Contain …

- Number —number assigned by the station that creates the radiogram
- Precedence — a description of the nature of the radiogram
- Handling Instructions
- Station of Origin — the sending station's call sign
- Check — the number of words and word equivalents in the radiogram
- Place of Origin — the name of the town from which the radiogram started
- Time and Date
- Address — the complete name, street and number, city and state to whom the radiogram is going

PRACTICE QUESTIONS

What type of signaling uses pairs of audio tones?

A. DTMF
B. CTCSS
C. GPRS
D. D-STAR

T2B06 A 6-13

How can you join a digital repeater's "talkgroup"?

A. Register your radio with the local FCC office
B. Join the repeater owner's club
C. Program your radio with the group's ID or code
D. Sign your call after the courtesy tone

T2B07 C 6-13

What is the purpose of the color code used on DMR repeater systems?

A. Must match the repeater color code for access
B. Defines the frequency pair to use
C. Identifies the codec used
D. Defines the minimum signal level required for access

T2B12 A 6-13

What function is performed with a transceiver and a digital mode hot spot?

A. Communication using digital voice or data systems via the internet
B. FT8 digital communications via AFSK
C. RTTY encoding and decoding without a computer
D. High-speed digital communications for meteor scatter

T4A10 A 6-13

What does a DMR “code plug” contain?

A. Your call sign in CW for automatic identification
B. Access information for repeaters and talkgroups
C. The codec for digitizing audio
D. The DMR software version

T4B07 B 6-13

How is a specific group of stations selected on a digital voice transceiver?

A. By retrieving the frequencies from transceiver memory
B. By enabling the group's CTCSS tone
C. By entering the group's identification code
D. By activating automatic identification

T4B09 C 6-13

Which of the following must be programmed into a D-STAR digital transceiver before transmitting?

A. Your call sign
B. Your output power
C. The codec type being used
D. All these choices are correct

T4B11 A 6-13

How is over the air access to IRLP nodes accomplished?

A. By obtaining a password that is sent via voice to the node
B. By using DTMF signals
C. By entering the proper internet password
D. By using CTCSS tone codes

T8C06 B 6-13

What is Voice Over Internet Protocol (VoIP)?

A. A set of rules specifying how to identify your station when linked over the internet to another station

B. A technique employed to “spot” DX stations via the internet

C. A technique for measuring the modulation quality of a transmitter using remote sites monitored via the internet

D. A method of delivering voice communications over the internet using digital techniques

T8C07 D 6-13

What is the Internet Radio Linking Project (IRLP)?

A. A technique to connect amateur radio systems, such as repeaters, via the internet using Voice Over Internet Protocol (VoIP)

B. A system for providing access to websites via amateur radio

C. A system for informing amateurs in real time of the frequency of active DX stations

D. A technique for measuring signal strength of an amateur transmitter via the internet

T8C08 A 6-13

Which of the following protocols enables an amateur station to transmit through a repeater without using a radio to initiate the transmission?

A. IRLP
B. D-STAR
C. DMR
D. EchoLink

T8C09 D 6-13

What is required before using the EchoLink system?

A. Complete the required EchoLink training
B. Purchase a license to use the EchoLink software
C. Register your call sign and provide proof of license
D. All these choices are correct

T8C10 C 6-13

What is a Talkgroup on a DMR repeater?

A. A group of operators sharing common interests

B. A way for groups of users to share a channel at different times without hearing other users on the channel

C. A protocol that increases the signal-to-noise ratio when multiple repeaters are linked together

D. A net that meets at a specified time

T8D02 B 6-14

Which of the following describes DMR?

A. A technique for time-multiplexing two digital voice signals on a single 12.5 kHz repeater channel

B. An automatic position tracking mode for FM mobiles communicating through repeaters

C. An automatic computer logging technique for hands-off logging when communicating while operating a vehicle

D. A digital technique for transmitting on two repeater inputs simultaneously for automatic error correction

T8D07 A 6-14

What does the term “traffic” refer to in net operation?

A. Messages exchanged by net stations
B. The number of stations checking in and out of a net
C. Operation by mobile or portable stations
D. Requests to activate the net by a served agency

T2C05 A 6-16

Which of the following is standard practice when you participate in a net?

A. When first responding to the net control station, transmit your call sign, name, and address as in the FCC database

B. Record the time of each of your transmissions

C. Unless you are reporting an emergency, transmit only when directed by the net control station

D. All these choices are correct

T2C07 C 6-16

Which of the following are typical duties of a Net Control Station?

A. Choose the regular net meeting time and frequency
B. Ensure that all stations checking into the net are properly licensed for operation on the net frequency
C. Call the net to order and direct communications between stations checking in
D. All these choices are correct

T2C02 C 6-16

What technique is used to ensure that voice messages containing unusual words are received correctly?

A. Send the words by voice and Morse code
B. Speak very loudly into the microphone
C. Spell the words using a standard phonetic alphabet
D. All these choices are correct

T2C03 C 6-17

Which of the following is a characteristic of good traffic handling?

A. Passing messages exactly as received
B. Making decisions as to whether messages are worthy of relay or delivery
C. Ensuring that any newsworthy messages are relayed to the news media
D. All these choices are correct

T2C08 A 6-17

What information is contained in the preamble of a formal traffic message?

A. The email address of the originating station
B. The address of the intended recipient
C. The telephone number of the addressee
D. Information needed to track the message

T2C10 D 6-17

What is meant by “check” in a radiogram header?

A. The number of words or word equivalents in the text portion of the message
B. The call sign of the originating station
C. A list of stations that have relayed the message
D. A box on the message form that indicates that the message was received and/or relayed

T2C11 A 6-17

Communications for Public Service

ARES & RACES

- The two largest Amateur Radio emergency response organizations are ARES (*Amateur Radio Emergency Service*) and RACES (*Radio Amateur Civil Emergency Service*)
- ARES consists of licensed amateurs who have registered their qualifications and equipment for duty in the public service
  - Sponsored by ARRL
- RACES is a special part of the FCC Part 97 Amateur service to provide civil defense communications during national emergencies

Threats to Life and Property

FCC Part 97.403 states …

"No provision of these rules prevents the use by an amateur station of any means of radiocommunication at its disposal to provide essential communication needs in connection with the immediate safety of human life and immediate protection of property when normal communication systems are not available."

In an emergency, you may use any means possible to address that risk, including operating outside the frequency privileges of your license.

You are bound by FCC rules at all times, even if using your radio in support of a public safety agency.

Satellite Operating

- International Space Station
  - Most astronauts hold an amateur radio license
  - Any amateur licensed to use 2 meter and 70 cm bands can communicate with ISS (this means Technician)
  - To call the space station, call sign NA1SS, transmit on 145.990 MHz and listen on 145.800 MHz
- Amateurs have built more than 50 satellites since 1961
- Amateur satellites are nicknamed OSCAR for Orbiting Satellite Carrying Amateur Radio
- A Technician can communicate through a satellite listening for *uplink* signals on 2 meters and transmitting on a 10 meter *downlink* frequency even though a Technician is not permitted to transmit on 10 meters

Satellite Definitions

- Apogee — The point of a satellite's orbit that is farthest from Earth
- Beacon — A signal from the satellite containing information about a satellite
- Doppler shift — An observed change in signal frequency caused by relative motion between the satellite and the Earth station
- Elliptical orbit — An orbit with a large difference between apogee and perigee
- LEO — A satellite in low-Earth orbit
- Perigee — The point of a satellite's orbit that is nearest the Earth
- Space station — Defined by the FCC as an amateur station located more than 50 km above the Earth's surface
- Spin fading — Signal fading caused by rotation of the satellite and its antennas

Tracking a Satellite

- A *satellite tracking program* is used to determine satellite schedules
- The tracking program needs certain bits of data about the satellite's orbit called the *Keplerian elements*
- The software can provide real-time maps of the satellite's location, the trajectory the satellite will follow across the sky, and the amount of *Doppler shift* the signals will experience

Operating via Satellites

- Most satellites only have one operational *mode*
  - Specified as two letters separated by a slash
  - The uplink for a satellite in U/V mode is in the UHF band (70 cm) and a downlink is in the VHF band (2 meters)
  - Satellites can use any amateur mode … most common are SSB, FM, CW, and data
- You can tell when the satellite is within range by listening for the *beacon* (transmitted via CW or RTTY)
- This *telemetry data* from the satellite contains information on the health and status of the satellite
- Anyone can receive satellite telemetry!
- Use the minimum amount of transmitter power to contact satellites, since their relay transmitter power is limited by their solar panels and batteries (your signal on the satellite downlink should be about the same strength as that of the satellite's beacon)

PRACTICE QUESTIONS

What is 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 these choices are correct

T1A10 D 97.3(a)(38),97.407 6-18

What is RACES?

A. An emergency organization combining amateur radio and citizens band operators and frequencies
B. An international radio experimentation society
C. A radio contest held in a short period, sometimes called a “sprint”
D. An FCC part 97 amateur radio service for civil defense communications during national emergencies

T2C04 D 6-18

What is the Amateur Radio Emergency Service (ARES)?

A. A group of licensed amateurs who have voluntarily registered their qualifications and equipment for communications duty in the public service

B. A group of licensed amateurs who are members of the military and who voluntarily agreed to provide message handling services in the case of an emergency

C. A training program that provides licensing courses for those interested in obtaining an amateur license to use during emergencies

D. A training program that certifies amateur operators for membership in the Radio Amateur Civil Emergency Service

T2C06 A 6-18

When do FCC rules NOT apply to the operation of an amateur station?

A. When operating a RACES station
B. When operating under special FEMA rules
C. When operating under special ARES rules
D. FCC rules always apply

T2C01 D 97.103(a) 6-19

Are amateur station control operators ever permitted to operate outside the frequency privileges of their license class?

A. No
B. Yes, but only when part of a FEMA emergency plan
C. Yes, but only when part of a RACES emergency plan
D. Yes, but only in situations involving the immediate safety of human life or protection of property

T2C09 D 6-19

Which amateurs may contact the International Space Station (ISS) on VHF bands?

A. Any amateur holding a General class or higher license
B. Any amateur holding a Technician class or higher license
C. Any amateur holding a General class or higher license who has applied for and received approval from NASA
D. Any amateur holding a Technician class or higher license who has applied for and received approval from NASA

T1B02 B 97.301,97.207(c) 6-22

Who may be the control operator of a station communicating through an amateur satellite or space station?

A. Only an Amateur Extra Class operator
B. A General class or higher licensee with a satellite operator certification
C. Only an Amateur Extra Class operator who is also an AMSAT member
D. Any amateur allowed to transmit on the satellite uplink frequency

T1E02 D 97.301,97.207(c) 6-23

What is the FCC Part 97 definition of a space station?

A. Any satellite orbiting Earth
B. A manned satellite orbiting Earth
C. An amateur station located more than 50 km above Earth's surface
D. An amateur station using amateur radio satellites for relay of signals

T1A07 C 97.3(a)(41) 6-23

What is a satellite beacon?

A. The primary transmit antenna on the satellite
B. An indicator light that shows where to point your antenna
C. A reflective surface on the satellite
D. A transmission from a satellite that contains status information

T8B05 D 6-23

What is Doppler shift in reference to satellite communications?

A. A change in the satellite orbit
B. A mode where the satellite receives signals on one band and transmits on another
C. An observed change in signal frequency caused by relative motion between the satellite and Earth station
D. A special digital communications mode for some satellites

T8B07 C 6-23

What causes spin fading of satellite signals?

A. Circular polarized noise interference radiated from the sun
B. Rotation of the satellite and its antennas
C. Doppler shift of the received signal
D. Interfering signals within the satellite uplink band

T8B09 B 6-23

What is a LEO satellite?

A. A sun synchronous satellite
B. A highly elliptical orbit satellite
C. A satellite in low energy operation mode
D. A satellite in low earth orbit

T8B10 D 6-23

Which of the following are provided by satellite tracking programs?

A. Maps showing the real-time position of the satellite track over 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 these choices are correct

T8B03 D 6-24

Which of the following are inputs to a satellite tracking program?

A. The satellite transmitted power
B. The Keplerian elements
C. The last observed time of zero Doppler shift
D. All these choices are correct

T8B06 B 6-24

What telemetry information is typically transmitted by satellite beacons?

A. The signal strength of received signals
B. Time of day accurate to plus or minus 1/10 second
C. Health and status of the satellite
D. All these choices are correct

T8B01 C 6-24

What is the impact of using excessive effective radiated power on a satellite uplink?

A. Possibility of commanding the satellite to an improper mode
B. Blocking access by other users
C. Overloading the satellite batteries
D. Possibility of rebooting the satellite control computer

T8B02 B 6-24

What mode of transmission is commonly used by amateur radio satellites?

A. SSB
B. FM
C. CW/data
D. All these choices are correct

T8B04 D 6-24

What is meant by the statement that a satellite is operating in U/V mode?

A. The satellite uplink is in the 15 meter band and the downlink is in the 10 meter band

B. The satellite uplink is in the 70 centimeter band and the downlink is in the 2 meter band

C. The satellite operates using ultraviolet frequencies

D. The satellite frequencies are usually variable

T8B08 B 6-24

Who may receive telemetry from a space station?

A. Anyone
B. A licensed radio amateur with a transmitter equipped for interrogating the satellite
C. A licensed radio amateur who has been certified by the protocol developer
D. A licensed radio amateur who has registered for an access code from AMSAT

T8B11 A 6-24

Which of the following is a way to determine whether your satellite uplink power is neither too low nor too high?

A. Check your signal strength report in the telemetry data
B. Listen for distortion on your downlink signal
C. Your signal strength on the downlink should be about the same as the beacon
D. All these choices are correct

T8B12 C 6-24

END OF MODULE 6

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