

**2020-2024 Amateur Extra Class  
FCC Element 4 Question Pool  
Effective 7/01/2020 – 6/30/2024**

**SUBELEMENT E2 - OPERATING PROCEDURES [5 Exam Questions - 5 Groups]**

E2A Amateur radio in space: amateur satellites; orbital mechanics; frequencies and modes; satellite hardware; satellite operations

E2A01

**What is the direction of an ascending pass for an amateur satellite?**

- A. From west to east
- B. From east to west
- C. From south to north
- D. From north to south

~~

E2A02

**Which of the following occurs when a satellite is using an inverting linear transponder?**

- A. Doppler shift is reduced because the uplink and downlink shifts are in opposite directions
- B. Signal position in the band is reversed
- C. Upper sideband on the uplink becomes lower sideband on the downlink, and vice versa
- D. All these choices are correct

~~

E2A03

**How is the signal inverted by an inverting linear transponder?**

- A. The signal is detected and remodulated on the reverse sideband
- B. The signal is passed through a non-linear filter
- C. The signal is reduced to I and Q components and the Q component is filtered out
- D. The signal is passed through a mixer and the difference rather than the sum is transmitted

~~

E2A04

**What is meant by the term "mode" as applied to an amateur radio satellite?**

- A. Whether the satellite is in a low earth or geostationary orbit
- B. The satellite's uplink and downlink frequency bands
- C. The satellite's orientation with respect to the Earth
- D. Whether the satellite is in a polar or equatorial orbit

~~

E2A05

**What do the letters in a satellite's mode designator specify?**

- A. Power limits for uplink and downlink transmissions
- B. The location of the ground control station
- C. The polarization of uplink and downlink signals
- D. The uplink and downlink frequency ranges

~~

E2A06

**What are Keplerian elements?**

- A. Parameters that define the orbit of a satellite
- B. Phase reversing elements in a Yagi antenna
- C. High-emission heater filaments used in magnetron tubes
- D. Encrypting codes used for spread spectrum modulation

~~

E2A07

**Which of the following types of signals can be relayed through a linear transponder?**

- A. FM and CW
- B. SSB and SSTV
- C. PSK and packet
- D. All these choices are correct

~~

E2A08

**Why should effective radiated power to a satellite that uses a linear transponder be limited?**

- A. To prevent creating errors in the satellite telemetry
- B. To avoid reducing the downlink power to all other users
- C. To prevent the satellite from emitting out-of-band signals
- D. To avoid interfering with terrestrial QSOs

~~

E2A09

**What do the terms "L band" and "S band" specify regarding satellite communications?**

- A. The 23 centimeter and 13 centimeter bands
- B. The 2 meter and 70 centimeter bands
- C. FM and Digital Store-and-Forward systems
- D. Which sideband to use

~~

E2A10

**What type of satellite appears to stay in one position in the sky?**

- A. HEO
- B. Geostationary
- C. Geomagnetic
- D. LEO

~~

E2A11

**What type of antenna can be used to minimize the effects of spin modulation and Faraday rotation?**

- A. A linearly polarized antenna
- B. A circularly polarized antenna
- C. An isotropic antenna
- D. A log-periodic dipole array

~~

E2A12

**What is the purpose of digital store-and-forward functions on an amateur radio satellite?**

- A. To upload operational software for the transponder
- B. To delay download of telemetry between satellites
- C. To store digital messages in the satellite for later download by other stations
- D. To relay messages between satellites

~~

E2A13

**Which of the following techniques is normally used by low Earth orbiting digital satellites to relay messages around the world?**

- A. Digipeating
- B. Store-and-forward
- C. Multi-satellite relaying
- D. Node hopping

~~

E2B Television practices: fast scan television standards and techniques; slow scan television standards and techniques

E2B01

**How many times per second is a new frame transmitted in a fast-scan (NTSC) television system?**

- A. 30
- B. 60
- C. 90
- D. 120

~~

E2B02

**How many horizontal lines make up a fast-scan (NTSC) television frame?**

- A. 30
- B. 60
- C. 525
- D. 1080

~~

E2B03

**How is an interlaced scanning pattern generated in a fast-scan (NTSC) television system?**

- A. By scanning two fields simultaneously
- B. By scanning each field from bottom to top
- C. By scanning lines from left to right in one field and right to left in the next
- D. By scanning odd numbered lines in one field and even numbered lines in the next

~~

E2B04

**How is color information sent in analog SSTV?**

- A. Color lines are sent sequentially
- B. Color information is sent on a 2.8 kHz subcarrier
- C. Color is sent in a color burst at the end of each line
- D. Color is amplitude modulated on the frequency modulated intensity signal

E2B05

**Which of the following describes the use of vestigial sideband in analog fast-scan TV transmissions?**

- A. The vestigial sideband carries the audio information
- B. The vestigial sideband contains chroma information
- C. Vestigial sideband reduces bandwidth while allowing for simple video detector circuitry
- D. Vestigial sideband provides high frequency emphasis to sharpen the picture

~~

E2B06

**What is vestigial sideband modulation?**

- A. Amplitude modulation in which one complete sideband and a portion of the other are transmitted
- B. A type of modulation in which one sideband is inverted
- C. Narrow-band FM modulation achieved by filtering one sideband from the audio before frequency modulating the carrier
- D. Spread spectrum modulation achieved by applying FM modulation following single sideband amplitude modulation

~~

E2B07

**What is the name of the signal component that carries color information in NTSC video?**

- A. Luminance
- B. Chroma
- C. Hue
- D. Spectral intensity

~~

E2B08

**What technique allows commercial analog TV receivers to be used for fast-scan TV operations on the 70 cm band?**

- A. Transmitting on channels shared with cable TV
- B. Using converted satellite TV dishes
- C. Transmitting on the abandoned TV channel 2
- D. Using USB and demodulating the signal with a computer sound card

~~

E2B09

**What hardware, other than a receiver with SSB capability and a suitable computer, is needed to decode SSTV using Digital Radio Mondiale (DRM)?**

- A. A special IF converter
- B. A special front end limiter
- C. A special notch filter to remove synchronization pulses
- D. No other hardware is needed

~~

E2B10

**What aspect of an analog slow-scan television signal encodes the brightness of the picture?**

- A. Tone frequency
- B. Tone amplitude
- C. Sync amplitude
- D. Sync frequency

~~

E2B11

**What is the function of the Vertical Interval Signaling (VIS) code sent as part of an SSTV transmission?**

- A. To lock the color burst oscillator in color SSTV images
- B. To identify the SSTV mode being used
- C. To provide vertical synchronization
- D. To identify the call sign of the station transmitting

~~

E2B12

**What signals SSTV receiving software to begin a new picture line?**

- A. Specific tone frequencies
- B. Elapsed time
- C. Specific tone amplitudes
- D. A two-tone signal

~~

E2C Operating methods: contest and DX operating; remote operation techniques; Cabrillo format; QSLing; RF network connected systems

E2C01

**What indicator is required to be used by U.S.-licensed operators when operating a station via remote control and the remote transmitter is located in the U.S.?**

- A. / followed by the USPS two-letter abbreviation for the state in which the remote station is located
- B. /R# where # is the district of the remote station
- C. / followed by the ARRL Section of the remote station
- D. No additional indicator is required

~~

E2C02

**Which of the following best describes the term "self-spotting" in connection with HF contest operating?**

- A. The often-prohibited practice of posting one's own call sign and frequency on a spotting network
- B. The acceptable practice of manually posting the call signs of stations on a spotting network
- C. A manual technique for rapidly zero beating or tuning to a station's frequency before calling that station
- D. An automatic method for rapidly zero beating or tuning to a station's frequency before calling that station

~~

E2C03

**From which of the following bands is amateur radio contesting generally excluded?**

- A. 30 meters
- B. 6 meters
- C. 2 meters
- D. 33 centimeters

~~

E2C04

**Which of the following frequencies are sometimes used for amateur radio mesh networks?**

- A. HF frequencies where digital communications are permitted
- B. Frequencies shared with various unlicensed wireless data services
- C. Cable TV channels 41 through 43
- D. The 60 meter band channel centered on 5373 kHz

~~

E2C05

**What is the function of a DX QSL Manager?**

- A. To allocate frequencies for DXpeditions
- B. To handle the receiving and sending of confirmation cards for a DX station
- C. To run a net to allow many stations to contact a rare DX station
- D. To relay calls to and from a DX station

~~

E2C06

**During a VHF/UHF contest, in which band segment would you expect to find the highest level of SSB or CW activity?**

- A. At the top of each band, usually in a segment reserved for contests
- B. In the middle of each band, usually on the national calling frequency
- C. In the weak signal segment of the band, with most of the activity near the calling frequency
- D. In the middle of the band, usually 25 kHz above the national calling frequency

~~

E2C07

**What is the Cabrillo format?**

- A. A standard for submission of electronic contest logs
- B. A method of exchanging information during a contest QSO
- C. The most common set of contest rules
- D. The rules of order for meetings between contest sponsors

~~

E2C08

**Which of the following contacts may be confirmed through the U.S. QSL bureau system?**

- A. Special event contacts between stations in the U.S.
- B. Contacts between a U.S. station and a non-U.S. station
- C. Repeater contacts between U.S. club members
- D. Contacts using tactical call signs

~~

E2C09

**What type of equipment is commonly used to implement an amateur radio mesh network?**

- A. A 2 meter VHF transceiver with a 1200 baud modem
- B. An optical cable connection between the USB ports of 2 separate computers
- C. A wireless router running custom firmware
- D. A 440 MHz transceiver with a 9600 baud modem

~~

E2C10

**Why might a DX station state that they are listening on another frequency?**

- A. Because the DX station may be transmitting on a frequency that is prohibited to some responding stations
- B. To separate the calling stations from the DX station
- C. To improve operating efficiency by reducing interference
- D. All these choices are correct

~~

E2C11

**How should you generally identify your station when attempting to contact a DX station during a contest or in a pileup?**

- A. Send your full call sign once or twice
- B. Send only the last two letters of your call sign until you make contact
- C. Send your full call sign and grid square
- D. Send the call sign of the DX station three times, the words "this is," then your call sign three times

~~

E2C12

**What technique do individual nodes use to form a mesh network?**

- A. Forward error correction and Viterbi codes
- B. Acting as store-and-forward digipeaters
- C. Discovery and link establishment protocols
- D. Custom code plugs for the local trunking systems

~~

E2D Operating methods: VHF and UHF digital modes and procedures; APRS; EME procedures; meteor scatter procedures

E2D01

**Which of the following digital modes is designed for meteor scatter communications?**

- A. WSPR
- B. MSK144
- C. Hellschreiber
- D. APRS

~~

E2D02

**Which of the following is a good technique for making meteor scatter contacts?**

- A. 15-second timed transmission sequences with stations alternating based on location
- B. Use of special digital modes
- C. Short transmissions with rapidly repeated call signs and signal reports
- D. All these choices are correct

~~

E2D03

**Which of the following digital modes is especially useful for EME communications?**

- A. MSK144
- B. PACTOR III
- C. Olivia
- D. JT65

E2D04

**What technology is used to track, in real time, balloons carrying amateur radio transmitters?**

- A. Ultrasonics
- B. Bandwidth compressed LORAN
- C. APRS
- D. Doppler shift of beacon signals

~~

E2D05

**What is one advantage of the JT65 mode?**

- A. Uses only a 65 Hz bandwidth
- B. The ability to decode signals which have a very low signal-to-noise ratio
- C. Easily copied by ear if necessary
- D. Permits fast-scan TV transmissions over narrow bandwidth

~~

E2D06

**Which of the following describes a method of establishing EME contacts?**

- A. Time synchronous transmissions alternately from each station
- B. Storing and forwarding digital messages
- C. Judging optimum transmission times by monitoring beacons reflected from the moon
- D. High-speed CW identification to avoid fading

~~

E2D07

**What digital protocol is used by APRS?**

- A. PACTOR
- B. 802.11
- C. AX.25
- D. AMTOR

~~

E2D08

**What type of packet frame is used to transmit APRS beacon data?**

- A. Unnumbered Information
- B. Disconnect
- C. Acknowledgement
- D. Connect

~~

E2D09

**What type of modulation is used for JT65 contacts?**

- A. Multi-tone AFSK
- B. PSK
- C. RTTY
- D. IEEE 802.11

~~

E2D10

**How can an APRS station be used to help support a public service communications activity?**

- A. An APRS station with an emergency medical technician can automatically transmit medical data to the nearest hospital
- B. APRS stations with General Personnel Scanners can automatically relay the participant numbers and time as they pass the check points
- C. An APRS station with a Global Positioning System unit can automatically transmit information to show a mobile station's position during the event
- D. All these choices are correct

~~

E2D11

**Which of the following data are used by the APRS network to communicate station location?**

- A. Polar coordinates
- B. Time and frequency
- C. Radio direction finding spectrum analysis
- D. Latitude and longitude

~~

E2E Operating methods: operating HF digital modes

E2E01

**Which of the following types of modulation is common for data emissions below 30 MHz?**

- A. DTMF tones modulating an FM signal
- B. FSK
- C. Pulse modulation
- D. Spread spectrum

~~

E2E02

**What do the letters FEC mean as they relate to digital operation?**

- A. Forward Error Correction
- B. First Error Correction
- C. Fatal Error Correction
- D. Final Error Correction

~~

E2E03

**How is the timing of FT4 contacts organized?**

- A. By exchanging ACK/NAK packets
- B. Stations take turns on alternate days
- C. Alternating transmissions at 7.5 second intervals
- D. It depends on the lunar phase

~~

E2E04

**What is indicated when one of the ellipses in an FSK crossed-ellipse display suddenly disappears?**

- A. Selective fading has occurred
- B. One of the signal filters is saturated
- C. The receiver has drifted 5 kHz from the desired receive frequency
- D. The mark and space signal have been inverted

~~

E2E05

**Which of these digital modes does not support keyboard-to-keyboard operation?**

- A. PACTOR
- B. RTTY
- C. PSK31
- D. MFSK

~~

E2E06

**What is the most common data rate used for HF packet?**

- A. 48 baud
- B. 110 baud
- C. 300 baud
- D. 1200 baud

~~

E2E07

**Which of the following is a possible reason that attempts to initiate contact with a digital station on a clear frequency are unsuccessful?**

- A. Your transmit frequency is incorrect
- B. The protocol version you are using is not supported by the digital station
- C. Another station you are unable to hear is using the frequency
- D. All these choices are correct

~~

E2E08

**Which of the following HF digital modes can be used to transfer binary files?**

- A. Hellschreiber
- B. PACTOR
- C. RTTY
- D. AMTOR

~~

E2E09

**Which of the following HF digital modes uses variable-length coding for bandwidth efficiency?**

- A. RTTY
- B. PACTOR
- C. MT63
- D. PSK31

~~

E2E10

**Which of these digital modes has the narrowest bandwidth?**

- A. MFSK16
- B. 170 Hz shift, 45-baud RTTY
- C. PSK31
- D. 300-baud packet

~~

E2E11

**What is the difference between direct FSK and audio FSK?**

- A. Direct FSK applies the data signal to the transmitter VFO, while AFSK transmits tones via phone
- B. Direct FSK occupies less bandwidth
- C. Direct FSK can transmit faster baud rates
- D. Only direct FSK can be decoded by computer

E2E12

**How do ALE stations establish contact?**

- A. ALE constantly scans a list of frequencies, activating the radio when the designated call sign is received
  - B. ALE radios monitor an internet site for the frequency they are being paged on
  - C. ALE radios send a constant tone code to establish a frequency for future use
  - D. ALE radios activate when they hear their signal echoed by back scatter
- ~~

E2E13

**Which of these digital modes has the fastest data throughput under clear communication conditions?**

- A. AMTOR
  - B. 170 Hz shift, 45 baud RTTY
  - C. PSK31
  - D. 300 baud packet
- ~~