

Study Guide for Exam Questions



Element 4 — Extra Class Question Pool

Valid July 1, 2008 through June 30, 2012

This version of the Element 4 Question Pool has been rearranged to follow the topics as presented in the *ARRL Extra Class License Manual*, 9th Edition. See the printed book for a version of the Question Pool arranged by Subelement, as released by the NCVEC Question Pool Committee.

As you study, cover the answer key provided at the margin to test your knowledge. (Please note: Answer selections may be presented in a different order on the actual FCC exam.)

Chapter 2, Section 2.1

DXING

Why might a phone DX station state that he is 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 reduce interference, thereby improving operating efficiency
- D. All of these choices are correct

E2C10
(D)
Page 2-5

How should you generally sign your call when attempting to contact a DX station working a “pileup” or in a contest?

- 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

E2C11
(A)
Page 2-5

In North America during low sunspot activity, when signals from Europe become weak and fluttery across an entire HF band two to three hours after sunset, what might help to contact other European DX stations?

- A. Switch to a higher frequency HF band
- B. Switch to a lower frequency HF band
- C. Wait 90 minutes or so for the signal degradation to pass
- D. Wait 24 hours before attempting another communication on the band

E2C12
(B)
Page 2-6

CONTESTING

- E2C01
(A)
Page 2-9
- Which of the following is true about contest operating?
- A. Operators are permitted to make contacts even if they do not submit a log
 - B. Interference to other amateurs is unavoidable and therefore acceptable
 - C. It is mandatory to transmit the call sign of the station being worked as part of every transmission to that station
 - D. Every contest requires a signal report in the exchange
- E2C02
(A)
Page 2-10
- Which of the following best describes “self spotting” in regards to contest operating?
- A. The generally prohibited practice of posting one’s own call sign and frequency on a call sign spotting network
 - B. The acceptable practice of manually posting the call signs of stations on a call sign 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
(A)
Page 2-7
- From which of the following bands is amateur radio contesting generally excluded?
- A. 30 meters
 - B. 6 meters
 - C. 2 meters
 - D. 33 cm
- E2C04
(D)
Page 2-7
- On which of the following frequencies is an amateur radio contest contact generally discouraged?
- A. 3.525 MHz
 - B. 14.020 MHz
 - C. 28.330 MHz
 - D. 146.52 MHz
- E2C05
(B)
[97.301]
Page 2-7
- Which of the following frequencies would generally be acceptable for U.S. stations to work other U.S. stations in a phone contest?
- A. 5405 kHz
 - B. 14.310 MHz
 - C. 50.050 MHz
 - D. 146.52 MHz
- E2C06
(C)
Page 2-7
- During a VHF/UHF contest, in which band segment would you expect to find the highest level of 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
(A)
Page 2-9
- What is the Cabrillo format?
- A. A standard for organizing information in contest log files
 - 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

Chapter 2, Section 2.2

PACKET RADIO

What does “command mode” mean in packet operations?

- A. Your computer is ready to run packet communications software
- B. The TNC is ready to receive instructions via the keyboard
- C. Your TNC has received a command packet from a remote TNC
- D. The computer is ready to be set up to communicate with the TNC

E2D01
(B)
Page 2-12

What is the purpose of digital store-and-forward functions on an Amateur satellite?

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

E2D04
(C)
Page 2-13

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

E2D05
(B)
Page 2-13

AUTOMATIC POSITION REPORTING SYSTEM (APRS)

Which of the following is a commonly used 2-meter APRS frequency?

- A. 144.20 MHz
- B. 144.39 MHz
- C. 145.02 MHz
- D. 146.52 MHz

E2D06
(B)
Page 2-13

Which of the following digital protocols is used by APRS?

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

E2D07
(A)
Page 2-13

Which of the following types of packet frames is used to transmit APRS beacon data?

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

E2D08
(D)
Page 2-13

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 GPS unit can automatically transmit information to show a mobile station’s position during the event
- D. All of these choices are correct

E2D10
(C)
Page 2-14

E2D11
(D)
Page 2-14

- Which of the following data sources are needed to accurately transmit your geographical location over the APRS network?
- A. The NMEA-0183 formatted data from a Global Positioning System (GPS) satellite receiver
 - B. The latitude and longitude of your location, preferably in degrees, minutes and seconds, entered into the APRS computer software
 - C. The NMEA-0183 formatted data from a LORAN navigation system
 - D. Any of these choices is correct

Chapter 2, Section 2.3

UNDERSTANDING SATELLITE ORBITS

E2A01
(C)
Page 2-17

- 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
(A)
Page 2-17

- What is the direction of a descending pass for an amateur satellite?
- A. From north to south
 - B. From west to east
 - C. From east to west
 - D. From south to north

E2A03
(C)
Page 2-16

- What is the orbital period of a satellite?
- A. The point of maximum height of a satellite's orbit
 - B. The point of minimum height of a satellite's orbit
 - C. The time it takes for a satellite to complete one revolution around the Earth
 - D. The time it takes for a satellite to travel from perigee to apogee

E2A10
(A)
Page 2-18

- Why may the received signal from an amateur satellite exhibit a rapidly repeating fading effect?
- A. Because the satellite is rotating
 - B. Because of ionospheric absorption
 - C. Because of the satellite's low orbital altitude
 - D. Because of the Doppler effect

E2A11
(B)
Page 2-18

- 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
(D)
Page 2-16

- What is one way to predict the location of a satellite at a given time?
- A. By means of the Doppler data for the specified satellite
 - B. By subtracting the mean anomaly from the orbital inclination
 - C. By adding the mean anomaly to the orbital inclination
 - D. By calculations using the Keplerian elements for the specified satellite

E2A13
(B)
Page 2-16

- What type of satellite appears to stay in one position in the sky?
- A. HEO
 - B. Geosynchronous
 - C. Geomagnetic
 - D. LEO

- What happens to a satellite's transmitted signal due to the Doppler Effect?
- A. The signal strength is reduced as the satellite passes overhead
 - B. The signal frequency shifts lower as the satellite passes overhead
 - C. The signal frequency shifts higher as the satellite passes overhead
 - D. The polarization of the signal continually rotates
- E2A14
(B)
Page 2-18

SATELLITE COMMUNICATIONS

- What is meant by the term "mode" as applied to an amateur radio satellite?
- A. The type of signals that can be relayed through the satellite
 - 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
- E2A04
(B)
Page 2-20

- 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 frequencies
- E2A05
(D)
Page 2-20

- On what band would a satellite receive signals if it were operating in mode U/V?
- A. 432 MHz
 - B. 144 MHz
 - C. 50 MHz
 - D. 28 MHz
- E2A06
(A)
Page 2-20

- 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 answers are correct
- E2A07
(D)
Page 2-19

- What is the primary reason for satellite users to limit their transmit ERP?
- A. For RF exposure safety
 - B. Because the satellite transmitter output power is limited
 - C. To avoid limiting the signal of the other users
 - D. To avoid interfering with terrestrial QSOs
- E2A08
(B)
Page 2-19

- What do the terms L band and S band specify with regard to 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
- E2A09
(A)
Page 2-20

Chapter 3, Section 3.1

FREQUENCY AND EMISSION PRIVILEGES

- When using a transceiver that displays the carrier frequency of phone signals, which of the following displayed frequencies will result in a normal USB emission being within the band?
- A. The exact upper band edge
 - B. 300 Hz below the upper band edge
 - C. 1 kHz below the upper band edge
 - D. 3 kHz below the upper band edge
- E1A01
(D)
[97.301,
97.305]
Page 3-4

<p>E1A02 (D) [97.301, 97.305] Page 3-4</p>	<p>When using a transceiver that displays the carrier frequency of phone signals, which of the following displayed frequencies will result in a normal LSB emission being within the band?</p> <p>A. The exact lower band edge B. 300 Hz above the lower band edge C. 1 kHz above the lower band edge D. 3 kHz above the lower band edge</p>
<p>E1A03 (C) [97.301, 97.305] Page 3-4</p>	<p>With your transceiver displaying the carrier frequency of phone signals, you hear a DX station's CQ on 14.349 MHz USB. Is it legal to return the call using upper sideband on the same frequency?</p> <p>A. Yes, because the DX station initiated the contact B. Yes, because the displayed frequency is within the 20 meter band C. No, my sidebands will extend beyond the band edge D. No, USA stations are not permitted to use phone emissions above 14.340 MHz</p>
<p>E1A04 (C) [97.301, 97.305] Page 3-4</p>	<p>With your transceiver displaying the carrier frequency of phone signals, you hear a DX station's CQ on 3.601 MHz LSB. Is it legal to return the call using lower sideband on the same frequency?</p> <p>A. Yes, because the DX station initiated the contact B. Yes, because the displayed frequency is within the 75 meter phone band segment C. No, my sidebands will extend beyond the edge of the phone band segment D. No, USA stations are not permitted to use phone emissions below 3.610 MHz</p>
<p>E1A05 (C) [97.305] Page 3-4</p>	<p>Which is the only amateur band that does not permit the transmission of phone or image emissions?</p> <p>A. 160 meters B. 60 meters C. 30 meters D. 17 meters</p>
<p>E1A06 (B) [97.303] Page 3-4</p>	<p>What is the maximum power output permitted on the 60 meter band?</p> <p>A. 50 watts PEP effective radiated power relative to an isotropic radiator B. 50 watts PEP effective radiated power relative to a dipole C. 100 watts PEP effective radiated power relative to an isotropic radiator D. 100 watts PEP effective radiated power relative to a dipole</p>
<p>E1A07 (D) [97.303] Page 3-4</p>	<p>What is the only amateur band where transmission on specific channels rather than a range of frequencies is permitted?</p> <p>A. 12 meter band B. 17 meter band C. 30 meter band D. 60 meter band</p>
<p>E1A08 (C) [97.303] Page 3-4</p>	<p>What is the only emission type permitted to be transmitted on the 60 meter band by an amateur station?</p> <p>A. CW B. RTTY Frequency shift keying C. Single sideband, upper sideband only D. Single sideband, lower sideband only</p>
<p>E1A09 (A) [97.301] Page 3-2</p>	<p>Which frequency bands contain at least one segment authorized only to control operators holding an Amateur Extra Class operator license?</p> <p>A. 80/75, 40, 20 and 15 meters B. 80/75, 40, 20, and 10 meters C. 80/75, 40, 30 and 10 meters D. 160, 80/75, 40 and 20 meters</p>

AUTOMATIC MESSAGE FORWARDING

If a station in a message forwarding system inadvertently forwards a message that is in violation of FCC rules, who is primarily accountable for the rules violation?

- A. The control operator of the packet bulletin board station
- B. The control operator of the originating station
- C. The control operators of all the stations in the system
- D. The control operators of all the stations in the system not authenticating the source from which they accept communications

E1A10
(B)
[97.219]
Page 3-6

What is the first action you should take if your digital message forwarding station inadvertently forwards a communication that violates FCC rules?

- A. Discontinue forwarding the communication as soon as you become aware of it
- B. Notify the originating station that the communication does not comply with FCC rules
- C. Notify the nearest FCC Field Engineer's office
- D. Discontinue forwarding all messages

E1A11
(A)
[97.219]
Page 3-6

RACES OPERATION

What is the Radio Amateur Civil Emergency Service (RACES)?

- A. A radio service using amateur service frequencies on a regular basis for communications that can reasonably be furnished through other radio services
- B. A radio service of amateur stations for civil defense communications during periods of local, regional, or national civil emergencies
- C. A radio service using amateur service frequencies for broadcasting to the public during periods of local, regional or national civil emergencies
- D. A radio service using local government frequencies by Amateur Radio operators for civil emergency communications

E1B09
(B)
[97.3]
Page 3-6

Which amateur stations may be operated in RACES?

- A. Only those club stations licensed to Amateur Extra class operators
- B. Any FCC-licensed amateur station except a Technician class operator's station
- C. Any FCC-licensed amateur station certified by the responsible civil defense organization for the area served
- D. Any FCC-licensed amateur station participating in the Military Affiliate Radio System (MARS)

E1B10
(C)
[97.407]
Page 3-6

What frequencies are normally authorized to an amateur station participating in RACES?

- A. All amateur service frequencies otherwise authorized to the control operator
- B. Specific segments in the amateur service MF, HF, VHF and UHF bands
- C. Specific local government channels
- D. Military Affiliate Radio System (MARS) channels

E1B11
(A)
[97.407]
Page 3-6

What are the frequencies authorized to an amateur station participating in RACES during a period when the President's War Emergency Powers are in force?

- A. All frequencies in the amateur service authorized to the control operator
- B. Specific amateur service frequency segments authorized in FCC Part 214
- C. Specific local government channels
- D. Military Affiliate Radio System (MARS) channels

E1B12
(B)
[97.407]
Page 3-7

What communications are permissible in RACES?

- A. Any type of communications when there is no emergency
- B. Any Amateur Radio Emergency Service communications
- C. Authorized civil defense emergency communications affecting the immediate safety of life and property
- D. National defense and security communications authorized by the President

E1B13
(C)
[97.407]
Page 3-7

STATIONS ABOARD SHIPS OR AIRCRAFT

E1A12
(A)
[97.11]
Page 3-7

- If an amateur station is installed on board a ship or aircraft, what condition must be met before the station is operated?
- A. Its operation must be approved by the master of the ship or the pilot in command of the aircraft
 - B. The amateur station operator must agree to not transmit when the main ship or aircraft radios are in use
 - C. It must have a power supply that is completely independent of the main ship or aircraft power supply
 - D. Its operator must have an FCC Marine or Aircraft endorsement on his or her amateur license

E1A13
(B)
[97.5]
Page 3-7

- When a US-registered vessel is in international waters, what type of FCC-issued license or permit is required to transmit amateur communications from an on-board amateur transmitter?
- A. Any amateur license with an FCC Marine or Aircraft endorsement
 - B. Any amateur license or reciprocal permit for alien amateur licensee
 - C. Only General class or higher amateur licenses
 - D. An unrestricted Radiotelephone Operator Permit

Chapter 3, Section 3.2

OPERATING RESTRICTIONS

E1B01
(D)
[97.3]
Page 3-8

- Which of the following constitutes a spurious emission?
- A. An amateur station transmission made at random without the proper call sign identification
 - B. A signal transmitted in a way that prevents its detection by any station other than the intended recipient
 - C. Any transmitted bogus signal that interferes with another licensed radio station
 - D. An emission outside its necessary bandwidth that can be reduced or eliminated without affecting the information transmitted

E1B08
(D)
[97.121]
Page 3-8

- On what frequencies may the operation of an amateur station be restricted if its emissions cause interference to the reception of a domestic broadcast station on a receiver of good engineering design?
- A. On the frequency used by the domestic broadcast station
 - B. On all frequencies below 30 MHz
 - C. On all frequencies above 30 MHz
 - D. On the interfering amateur service transmitting frequencies

STATION LOCATION AND ANTENNA STRUCTURES

E1B02
(D)
[97.13]
Page 3-9

- Which of the following factors might cause the physical location of an amateur station apparatus or antenna structure to be restricted?
- A. The location is in or near an area of political conflict, military maneuvers or major construction
 - B. The location's geographical or horticultural importance
 - C. The location is in an ITU zone designated for coordination with one or more foreign governments
 - D. The location is significant to our environment, American history, architecture, or culture.

E1B03
(A)
[97.13]
Page 3-9

- Within what distance must an amateur station protect an FCC monitoring facility from harmful interference?
- A. 1 mile
 - B. 3 miles
 - C. 10 miles
 - D. 30 miles

What must be done before placing an amateur station within an officially designated wilderness area or wildlife preserve, or an area listed in the National Register of Historical Places?	E1B04 (C) [97.13, 1.1305-1.1319] Page 3-9
A. A proposal must be submitted to the National Park Service	
B. A letter of intent must be filed with the National Audubon Society	
C. An Environmental Assessment must be submitted to the FCC	
D. A form FSD-15 must be submitted to the Department of the Interior	
What height restrictions apply to an amateur station antenna structure not close to a public use airport unless the FAA is notified and it is registered with the FCC?	E1B05 (B) [97.15] Page 3-9
A. It must not extend more than 300 feet above average height of terrain surrounding the site	
B. It must be no higher than 200 feet above ground level at its site	
C. There are no height restrictions because the structure obviously would not be a hazard to aircraft in flight	
D. It must not extend more than 100 feet above sea level or the rim of the nearest valley or canyon	
Which of the following additional rules apply if you are installing an amateur station antenna at a site within 20,000 feet of a public use airport?	E1B06 (A) [97.15] Page 3-9
A. You may have to notify the Federal Aviation Administration and register it with the FCC	
B. No special rules apply if your antenna structure will be less than 300 feet in height	
C. You must file an Environmental Impact Statement with the EPA before construction begins	
D. You must obtain a construction permit from the airport zoning authority	
Whose approval is required before erecting an amateur station antenna located at or near a public use airport if the antenna would exceed a certain height depending upon the antenna's distance from the nearest active runway?	E1B07 (A) [97.15] Page 3-9
A. The FAA must be notified and it must be registered with the FCC	
B. Approval must be obtained from the airport manager	
C. Approval must be obtained from the local zoning authorities	
D. The FAA must approve any antenna structure that is higher than 20 feet	

Chapter 3, Section 3.3

LOCAL CONTROL

What is meant by local control?	E1C07 (C) [97.3] Page 3-10
A. Controlling a station through a local auxiliary link	
B. Automatically manipulating local station controls	
C. Direct manipulation of the transmitter by a control operator	
D. Controlling a repeater using a portable handheld transceiver	

REMOTE CONTROL

What is a remotely controlled station?	E1C01 (D) [97.3] Page 3-12
A. A station operated away from its regular home location	
B. A station controlled by someone other than the licensee	
C. A station operating under automatic control	
D. A station controlled indirectly through a control link	

Which of the following statements concerning remotely controlled amateur stations is true?	E1C06 (C) [97.109] Page 3-12
A. Only Extra Class operators may be the control operator of a remote station	
B. A control operator need not be present at the control point	
C. A control operator must be present at the control point	
D. Repeater and auxiliary stations may not be remotely controlled	

E1C08
(B)
[97.213]
Page 3-12

What is the maximum permissible duration of a remotely controlled station's transmissions if its control link malfunctions?

- A. 30 seconds
- B. 3 minutes
- C. 5 minutes
- D. 10 minutes

AUTOMATIC CONTROL

E1C02
(A)
[97.3, 97.109]
Page 3-12

What is meant by automatic control of a station?

- A. The use of devices and procedures for control so that the control operator does not have to be present at a control point
- B. A station operating with its output power controlled automatically
- C. Remotely controlling a station's antenna pattern through a directional control link
- D. The use of a control link between a control point and a locally controlled station

E1C03
(B)
[97.3, 97.109]
Page 3-12

How do the control operator responsibilities of a station under automatic control differ from one under local control?

- A. Under local control there is no control operator
- B. Under automatic control the control operator is not required to be present at the control point
- C. Under automatic control there is no control operator
- D. Under local control a control operator is not required to be present at a control point

E1C04
(B)
[97.109]
Page 3-13

When may an automatically controlled station retransmit third party communications?

- A. Never
- B. Only when transmitting RTTY or data emissions
- C. When specifically agreed upon by the sending and receiving stations
- D. When approved by the National Telecommunication and Information Administration

E1C05
(A)
[97.109]
Page 3-13

When may an automatically controlled station originate third party communications?

- A. Never
- B. Only when transmitting an RTTY or data emissions
- C. When specifically agreed upon by the sending and receiving stations
- D. When approved by the National Telecommunication and Information Administration

E1C09
(D)
[97.205]
Page 3-12

Which of these frequencies are available for automatically controlled ground-station repeater operation?

- A. 18.110 - 18.168 MHz
- B. 24.940 - 24.990 MHz
- C. 10.100 - 10.150 MHz
- D. 29.500 - 29.700 MHz

E1C10
(B)
[97.113]
Page 3-12

What types of amateur stations may automatically retransmit the radio signals of other amateur stations?

- A. Only beacon, repeater or space stations
- B. Only auxiliary, repeater or space stations
- C. Only earth stations, repeater stations or model crafts
- D. Only auxiliary, beacon or space stations

Chapter 3, Section 3.4

DEFINITIONS AND RESTRICTIONS

What is the amateur-satellite service?

- A. A radio navigation service using satellites for the purpose of self-training, intercommunication and technical studies carried out by amateurs
- B. A spacecraft launching service for amateur-built satellites
- C. A radio communications service using amateur stations on satellites
- D. A radio communications service using stations on Earth satellites for weather information gathering

E1D02
(C)
[97.3]
Page 3-13

What is an Earth station in the amateur satellite service?

- A. An amateur station within 50 km of the Earth's surface for communications with amateur stations by means of objects in space
- B. An amateur station that is not able to communicate using amateur satellites
- C. An amateur station that transmits telemetry consisting of measurement of upper atmosphere data from space
- D. Any amateur station on the surface of the Earth

E1D04
(A)
[97.3]
Page 3-13

TELECOMMAND AND TELEMETRY

What is the definition of the term telemetry?

- A. One-way transmission of measurements at a distance from the measuring instrument
- B. A two-way interactive transmission
- C. A two-way single channel transmission of data
- D. One-way transmission that initiates, modifies, or terminates the functions of a device at a distance

E1D01
(A)
[97.3]
Page 3-14

What is a telecommand station in the amateur satellite service?

- A. An amateur station located on the Earth's surface for communications with other Earth stations by means of Earth satellites
- B. An amateur station that transmits communications to initiate, modify or terminate certain functions of a space station
- C. An amateur station located more than 50 km above the Earth's surface
- D. An amateur station that transmits telemetry consisting of measurements of upper atmosphere data from space

E1D03
(B)
[97.3]
Page 3-14

SATELLITE LICENSING AND FREQUENCY PRIVILEGES

What class of licensee is authorized to be the control operator of a space station?

- A. Any except those of Technician Class operators
- B. Only those of General, Advanced or Amateur Extra Class operators
- C. A holder of any class of license
- D. Only those of Amateur Extra Class operators

E1D05
(C)
[97.207]
Page 3-14

Which of the following special provisions must a space station incorporate in order to comply with space station requirements?

- A. The space station must be capable of effecting a cessation of transmissions by telecommand when so ordered by the FCC
- B. The space station must cease all transmissions after 5 years
- C. The space station must be capable of changing its orbit whenever such a change is ordered by NASA
- D. The station call sign must appear on all sides of the spacecraft

E1D06
(A)
[97.207]
Page 3-15

- E1D07
(A)
[97.207]
Page 3-15
- Which amateur service HF bands have frequencies authorized to space stations?
A. Only 40m, 20m, 17m, 15m, 12m and 10m
B. Only 40m, 20m, 17m, 15m and 10m bands
C. 40m, 30m, 20m, 15m, 12m and 10m bands
D. All HF bands
- E1D08
(D)
[97.207]
Page 3-15
- Which VHF amateur service bands have frequencies available for space stations?
A. 6 meters and 2 meters
B. 6 meters, 2 meters, and 1.25 meters
C. 2 meters and 1.25 meters
D. 2 meters
- E1D09
(B)
[97.207]
Page 3-15
- Which amateur service UHF bands have frequencies available for a space station?
A. 70 cm
B. 70 cm, 23 cm, 13 cm
C. 70 cm and 33 cm
D. 33 cm and 13 cm
- E1D10
(B)
[97.211]
Page 3-15
- Which amateur stations are eligible to be telecommand stations?
A. Any amateur station designated by NASA
B. Any amateur station so designated by the space station licensee
C. Any amateur station so designated by the ITU
D. All of these choices are correct
- E1D11
(D)
[97.209]
Page 3-15
- Which amateur stations are eligible to operate as Earth stations?
A. Any amateur station whose licensee has filed a pre-space notification with the FCC's International Bureau
B. Only those of General, Advanced or Amateur Extra Class operators
C. Only those of Amateur Extra Class operators
D. Any amateur station, subject to the privileges of the class of operator license held by the control operator
- E1D12
(B)
[97.207]
Page 3-14
- Who must be notified before launching an amateur space station?
A. The National Aeronautics and Space Administration, Houston, TX
B. The FCC's International Bureau, Washington, DC
C. The Amateur Satellite Corp., Washington, DC
D. All of these answers are correct

Chapter 3, Section 3.5

THE VOLUNTEER EXAMINER COORDINATOR

- E1E04
(C)
[97.521]
Page 3-15
- What is a Volunteer Examiner Coordinator?
A. A person who has volunteered to administer amateur operator license examinations
B. A person who has volunteered to prepare amateur operator license examinations
C. An organization that has entered into an agreement with the FCC to coordinate amateur operator license examinations
D. The person that has entered into an agreement with the FCC to be the VE session manager

THE VOLUNTEER EXAMINER

What is a VE?

- A. An amateur operator who is approved by three or more fellow volunteer examiners to administer amateur license examinations
- B. An amateur operator who is approved by a VEC to administer amateur operator license examinations
- C. An amateur operator who administers amateur license examinations for a fee
- D. An amateur operator who is approved by an FCC staff member to administer amateur operator license examinations

E1E05
(B)
[97.525,
97.3]
Page 3-15

ACCREDITATION

Which of the following persons seeking to become VEs cannot be accredited?

- A. Persons holding less than an Advanced Class operator license
- B. Persons less than 21 years of age
- C. Persons who have ever had an amateur operator or amateur station license suspended or revoked
- D. Persons who are employees of the federal government

E1E07
(C)
[97.509]
Page 3-16

Which of the following best describes the Volunteer Examiner accreditation process?

- A. Each General, Advanced and Amateur Extra Class operator is automatically accredited as a VE when the license is granted
- B. The amateur operator applying must pass a VE examination administered by the FCC Enforcement Bureau
- C. The prospective VE obtains accreditation from a VE team
- D. The procedure by which a VEC confirms that the VE applicant meets FCC requirements to serve as an examiner

E1E08
(D)
[97.509,
97.525]
Page 3-16

What is the minimum age to be a volunteer examiner?

- A. 13 years old
- B. 16 years old
- C. 18 years old
- D. 21 years old

E1E20
(C)
[97.509]
Page 3-16

EXAM PREPARATION

Where are the questions for all written US amateur license examinations listed?

- A. In FCC Part 97
- B. In an FCC-maintained question pool
- C. In the VEC-maintained question pool
- D. In the appropriate FCC Report and Order

E1E02
(C)
[97.523]
Page 3-16

Who is responsible for maintaining the question pools from which all amateur license examination questions must be taken?

- A. All of the VECs
- B. The VE team
- C. The VE question pool team
- D. The FCC's Wireless Telecommunications Bureau

E1E03
(A)
[97.523]
Page 3-16

EXAM SESSION ADMINISTRATION

What is the minimum number of qualified VEs required to administer an Element 4 amateur operator license examination?

- A. 5
- B. 2
- C. 4
- D. 3

E1E01
(D)
[97.509]
Page 3-18

<p>E1E06 (A) [97.509] Page 3-18</p>	<p>What is a VE team?</p> <ul style="list-style-type: none"> A. A group of at least three VEs who administer examinations for an amateur operator license B. The VEC staff C. One or two VEs who administer examinations for an amateur operator license D. A group of FCC Volunteer Enforcers who investigate Amateur Rules violations
<p>E1E09 (A) [97.509] Page 3-18</p>	<p>Where must the VE team be while administering an examination?</p> <ul style="list-style-type: none"> A. All of the administering VEs must be present where they can observe the examinees throughout the entire examination B. The VEs must leave the room after handing out the exam(s) to allow the examinees to concentrate on the exam material C. The VEs may be elsewhere provided at least one VE is present and is observing the examinees throughout the entire examination D. The VEs may be anywhere as long as they each certify in writing that examination was administered properly
<p>E1E10 (C) [97.509] Page 3-18</p>	<p>Who is responsible for the proper conduct and necessary supervision during an amateur operator license examination session?</p> <ul style="list-style-type: none"> A. The VEC coordinating the session B. The FCC C. Each administering VE D. The VE session manager
<p>E1E11 (B) [97.509] Page 3-18</p>	<p>What should a VE do if a candidate fails to comply with the examiner's instructions during an amateur operator license examination?</p> <ul style="list-style-type: none"> A. Warn the candidate that continued failure to comply will result in termination of the examination B. Immediately terminate the candidate's examination C. Allow the candidate to complete the examination, but invalidate the results D. Immediately terminate everyone's examination and close the session
<p>E1E12 (C) [97.509] Page 3-18</p>	<p>To which of the following examinees may a VE not administer an examination?</p> <ul style="list-style-type: none"> A. Employees of the VE B. Friends of the VE C. The VE's close relatives as listed in the FCC rules D. All these answers are correct
<p>E1E14 (C) [97.509] Page 3-18</p>	<p>What must the VE team do with the examinee's test papers once they have finished the examination?</p> <ul style="list-style-type: none"> A. The VE team must collect and send them to the NCVEC B. The VE team must collect and send them to the coordinating VEC for grading C. The VE team must collect and grade them immediately D. The VE team must collect and send them to the FCC for grading
<p>E1E15 (B) [97.509] Page 3-18</p>	<p>What must the VE team do if an examinee scores a passing grade on all examination elements needed for an upgrade or new license?</p> <ul style="list-style-type: none"> A. Photocopy all examination documents and forwards them to the FCC for processing B. Three VEs must certify that the examinee is qualified for the license grant and that they have complied with the VE requirements C. Issue the examinee the new or upgrade license D. All these answers are correct
<p>E1E16 (A) [97.509] Page 3-18</p>	<p>What must the VE team do with the application form if the examinee does not pass the exam?</p> <ul style="list-style-type: none"> A. Return the application document to the examinee B. Maintain the application form with the VEC's records C. Send it to the FCC D. Destroy the application form

For which types of out-of-pocket expenses may VEs and VECs be reimbursed?

- A. Preparing, processing, administering and coordinating an examination for an amateur radio license
- B. Teaching an amateur operator license examination preparation course
- C. No expenses are authorized for reimbursement
- D. Providing amateur operator license examination preparation training materials

E1E18
(A)
[97.527]
Page 3-18

How much reimbursement may the VE team and VEC accept for preparing, processing, administering and coordinating an examination?

- A. Actual out-of-pocket expenses
- B. The national minimum hourly wage for time spent providing examination services
- C. Up to the maximum fee per examinee announced by the FCC annually
- D. As much as the examinee is willing to donate

E1E19
(A)
[97.509,
97.527]
Page 3-18

READMINISTRATION OF EXAMINATIONS

What may be the penalty for a VE who fraudulently administers or certifies an examination?

- A. Revocation of the VE's amateur station license grant and the suspension of the VE's amateur operator license grant
- B. A fine of up to \$1000 per occurrence
- C. A sentence of up to one year in prison
- D. All of these choices are correct

E1E13
(A)
[97.509]
Page 3-20

What are the consequences of failing to appear for re-administration of an examination when so directed by the FCC?

- A. The licensee's license will be cancelled
- B. The person may be fined or imprisoned
- C. The licensee is disqualified from any future examination for an amateur operator license grant
- D. All of the above

E1E17
(A)
[97.519]
Page 3-19

Chapter 3, Section 3.6

AUXILIARY STATIONS

Who may be the control operator of an auxiliary station?

- A. Any licensed amateur operator
- B. Only Technician, General, Advanced or Amateur Extra Class operators
- C. Only General, Advanced or Amateur Extra Class operators
- D. Only Amateur Extra Class operators

E1F15
(B)
[97.201]
Page 3-20

EXTERNAL POWER AMPLIFIERS

What does it mean if an external RF amplifier is listed on the FCC database as certificated for use in the amateur service?

- A. The RF amplifier may be marketed for use in any radio service
- B. That particular RF amplifier may be marketed for use in the amateur service
- C. All similar RF amplifiers produced by other manufacturers may be marketed
- D. All RF amplifiers produced by that manufacturer may be marketed

E1F04
(B)
[97.315]
Page 3-20

E1F05
(A)
[97.315]
Page 3-20

Under what circumstances may a dealer sell an external RF power amplifier capable of operation below 144 MHz if it has not been granted FCC certification?

- A. It was purchased in used condition from an amateur operator and is sold to another amateur operator for use at that operator's station
- B. The equipment dealer assembled it from a kit
- C. It was imported from a manufacturer in a country that does not require certification of RF power amplifiers
- D. It was imported from a manufacturer in another country, and it was certificated by that country's government

E1F14
(D)
[97.317]
Page 3-20

Which of the following best describes one of the standards that must be met by an external RF power amplifier if it is to qualify for a grant of FCC certification?

- A. It must produce full legal output when driven by not more than 5 watts of mean RF input power
- B. It must be capable of external RF switching between its input and output networks
- C. It must exhibit a gain of 0 dB or less over its full output range
- D. It must satisfy the FCC's spurious emission standards when operated at its full output power

LINE A AND NATIONAL QUIET ZONES

E1F06
(A)
[97.3]
Page 3-21

Which of the following geographic descriptions approximately describes "Line A"?

- A. A line roughly parallel to and south of the US-Canadian border
- B. A line roughly parallel to and west of the US Atlantic coastline
- C. A line roughly parallel to and north of the US-Mexican border and Gulf coastline
- D. A line roughly parallel to and east of the US Pacific coastline

E1F07
(D)
[97.303]
Page 3-21

Amateur stations may not transmit in which of the following frequency segments if they are located north of Line A?

- A. 440 - 450 MHz.
- B. 53 - 54 MHz
- C. 222 - 223 MHz
- D. 420 - 430 MHz

E1F08
(C)
[97.3]
Page 3-21

What is the National Radio Quiet Zone?

- A. An area in Puerto Rico surrounding the Aricebo Radio Telescope
- B. An area in New Mexico surrounding the White Sands Test Area
- C. An area surrounding the National Radio Astronomy Observatory
- D. An area in Florida surrounding Cape Canaveral

BUSINESS AND PAYMENT

E1F09
(D)
[97.113]
Page 3-22

When may the control operator of a repeater accept payment for providing communication services to another party?

- A. When the repeater is operating under portable power
- B. When the repeater is operating under local control
- C. During Red Cross or other emergency service drills
- D. Under no circumstances

E1F10
(D)
[97.113]
Page 3-21

When may an amateur station send a message to a business?

- A. When the total money involved does not exceed \$25
- B. When the control operator is employed by the FCC or another government agency
- C. When transmitting international third-party communications
- D. When neither the amateur nor his or her employer has a pecuniary interest in the communications

Which of the following types of amateur-operator-to-amateur-operator communications are prohibited?

- A. Communications transmitted for hire or material compensation, except as otherwise provided in the rules
- B. Communications that have a political content, except as allowed by the Fairness Doctrine
- C. Communications that have a religious content
- D. Communications in a language other than English

E1F11
(A)
[97.113]
Page 3-22

What types of communications may be transmitted to amateur stations in foreign countries?

- A. Business-related messages
- B. Automatic retransmissions of any amateur communications
- C. Communications incidental to the purpose of the amateur service and remarks of a personal nature
- D. All of these choices are correct

E1F16
(C)
[97.117]
Page 3-22

SPREAD SPECTRUM OPERATION

On what frequencies are spread spectrum transmissions permitted?

- A. Only on amateur frequencies above 50 MHz
- B. Only on amateur frequencies above 222 MHz
- C. Only on amateur frequencies above 420 MHz
- D. Only on amateur frequencies above 144 MHz

E1F01
(B)
[97.305]
Page 3-22

FCC-licensed amateur stations may use spread spectrum (SS) emissions to communicate under which of the following conditions?

- A. When the other station is in an area regulated by the FCC
- B. When the other station is in a country permitting SS communications
- C. When the transmission is not used to obscure the meaning of any communication
- D. All of these choices are correct

E1F12
(D)
[97.311]
Page 3-22

What is the maximum transmitter power for an amateur station transmitting spread spectrum communications?

- A. 1 W
- B. 1.5 W
- C. 100 W
- D. 1.5 kW

E1F13
(C)
[97.311]
Page 3-22

NON-US OPERATING AGREEMENTS

Which of the following operating arrangements allows an FCC-licensed US citizen to operate in many European countries, and alien amateurs from many European countries to operate in the US?

- A. CEPT agreement
- B. IARP agreement
- C. ITU reciprocal license
- D. All of these choices are correct

E1F02
(A)
[97.5]
Page 3-22

Which of the following operating arrangements allow an FCC-licensed US citizen and many Central and South American amateur operators to operate in each other's countries?

- A. CEPT agreement
- B. IARP agreement
- C. ITU agreement
- D. All of these choices are correct

E1F03
(B)
[97.5]
Page 3-23

SPECIAL TEMPORARY AUTHORITY

E1F17
(A)
[1.931]
Page 3-23

- Under what circumstances might the FCC issue a “Special Temporary Authority” (STA) to an amateur station?
- A. To provide for experimental amateur communications
 - B. To allow regular operation on Land Mobile channels
 - C. To provide additional spectrum for personal use
 - D. To provide temporary operation while awaiting normal licensing

Chapter 4, Section 4.1

RECTANGULAR AND POLAR COORDINATES

E5C11
(C)
Page 4-2

- What do the two numbers represent that are used to define a point on a graph using rectangular coordinates?
- A. The magnitude and phase of the point
 - B. The sine and cosine values
 - C. The coordinate values along the horizontal and vertical axes
 - D. The tangent and cotangent values

Chapter 4, Section 4.2

ELECTRIC AND MAGNETIC FIELDS

E5D04
(B)
Page 4-4

- What unit measures electrical energy stored in an electrostatic field?
- A. Coulomb
 - B. Joule
 - C. Watt
 - D. Volt

E5D05
(B)
Page 4-4

- What is a magnetic field?
- A. Electric current through the space around a permanent magnet
 - B. The region surrounding a magnet through which a magnetic force acts
 - C. The space between the plates of a charged capacitor, through which a magnetic force acts
 - D. The force that drives current through a resistor

E5D08
(B)
Page 4-5

- What is the term for energy that is stored in an electromagnetic or electrostatic field?
- A. Amperes-joules
 - B. Potential energy
 - C. Joules-coulombs
 - D. Kinetic energy

RC AND RL TIME CONSTANTS

E5B01
(B)
Page 4-9

- What is the term for the time required for the capacitor in an RC circuit to be charged to 63.2% of the supply voltage?
- A. An exponential rate of one
 - B. One time constant
 - C. One exponential period
 - D. A time factor of one

<p>What is the term for the time it takes for a charged capacitor in an RC circuit to discharge to 36.8% of its initial value of stored charge?</p> <p>A. One discharge period B. An exponential discharge rate of one C. A discharge factor of one D. One time constant</p>	<p>E5B02 (D) Page 4-9</p>
<p>The capacitor in an RC circuit is discharged to what percentage of the starting voltage after two time constants?</p> <p>A. 86.5% B. 63.2% C. 36.8% D. 13.5%</p>	<p>E5B03 (D) Page 4-9</p>
<p>What is the time constant of a circuit having two 220-microfarad capacitors and two 1-megohm resistors all in parallel?</p> <p>A. 55 seconds B. 110 seconds C. 440 seconds D. 220 seconds</p>	<p>E5B04 (D) Page 4-10</p>
<p>How long does it take for an initial charge of 20 V DC to decrease to 7.36 V DC in a 0.01-microfarad capacitor when a 2-megohm resistor is connected across it?</p> <p>A. 0.02 seconds B. 0.04 seconds C. 20 seconds D. 40 seconds</p>	<p>E5B05 (A) Page 4-10</p>
<p>How long does it take for an initial charge of 800 V DC to decrease to 294 V DC in a 450-microfarad capacitor when a 1-megohm resistor is connected across it?</p> <p>A. 4.50 seconds B. 9 seconds C. 450 seconds D. 900 seconds</p>	<p>E5B06 (C) Page 4-11</p>
<p>What device is used to store electrical energy in an electrostatic field?</p> <p>A. A battery B. A transformer C. A capacitor D. An inductor</p>	<p>E5D03 (C) Page 4-6</p>
<p>In what direction is the magnetic field oriented about a conductor in relation to the direction of electron flow?</p> <p>A. In the same direction as the current B. In a direction opposite to the current C. In all directions; omnidirectional D. In a direction determined by the left-hand rule</p>	<p>E5D06 (D) Page 4-6</p>
<p>What determines the strength of a magnetic field around a conductor?</p> <p>A. The resistance divided by the current B. The ratio of the current to the resistance C. The diameter of the conductor D. The amount of current</p>	<p>E5D07 (D) Page 4-7</p>

PHASE ANGLE

E5B09
(D)
Page 4-13

What is the relationship between the current through and the voltage across a capacitor?

- A. Voltage and current are in phase
- B. Voltage and current are 180 degrees out of phase
- C. Voltage leads current by 90 degrees
- D. Current leads voltage by 90 degrees

E5B10
(A)
Page 4-14

What is the relationship between the current through an inductor and the voltage across an inductor?

- A. Voltage leads current by 90 degrees
- B. Current leads voltage by 90 degrees
- C. Voltage and current are 180 degrees out of phase
- D. Voltage and current are in phase

COMPLEX IMPEDANCE

E5B07
(C)
Page 4-24

What is the phase angle between the voltage across and the current through a series R-L-C circuit if XC is 500 ohms, R is 1 kilohm, and XL is 250 ohms?

- A. 68.2 degrees with the voltage leading the current
- B. 14.0 degrees with the voltage leading the current
- C. 14.0 degrees with the voltage lagging the current
- D. 68.2 degrees with the voltage lagging the current

E5B08
(A)
Page 4-24

What is the phase angle between the voltage across and the current through a series R-L-C circuit if XC is 100 ohms, R is 100 ohms, and XL is 75 ohms?

- A. 14 degrees with the voltage lagging the current
- B. 14 degrees with the voltage leading the current
- C. 76 degrees with the voltage leading the current
- D. 76 degrees with the voltage lagging the current

E5B11
(B)
Page 4-25

What is the phase angle between the voltage across and the current through a series RLC circuit if XC is 25 ohms, R is 100 ohms, and XL is 50 ohms?

- A. 14 degrees with the voltage lagging the current
- B. 14 degrees with the voltage leading the current
- C. 76 degrees with the voltage lagging the current
- D. 76 degrees with the voltage leading the current

E5B12
(C)
Page 4-25

What is the phase angle between the voltage across and the current through a series RLC circuit if XC is 75 ohms, R is 100 ohms, and XL is 50 ohms?

- A. 76 degrees with the voltage lagging the current
- B. 14 degrees with the voltage leading the current
- C. 14 degrees with the voltage lagging the current
- D. 76 degrees with the voltage leading the current

E5B13
(D)
Page 4-25

What is the phase angle between the voltage across and the current through a series RLC circuit if XC is 250 ohms, R is 1 kilohm, and XL is 500 ohms?

- A. 81.47 degrees with the voltage lagging the current
- B. 81.47 degrees with the voltage leading the current
- C. 14.04 degrees with the voltage lagging the current
- D. 14.04 degrees with the voltage leading the current

In polar coordinates, what is the impedance of a network consisting of a 100-ohm-reactance inductor in series with a 100-ohm resistor? A. 121 ohms at an angle of 35 degrees B. 141 ohms at an angle of 45 degrees C. 161 ohms at an angle of 55 degrees D. 181 ohms at an angle of 65 degrees	E5C01 (B) Page 4-19
In polar coordinates, what is the impedance of a network consisting of a 100-ohm-reactance inductor, a 100-ohm-reactance capacitor, and a 100-ohm resistor, all connected in series? A. 100 ohms at an angle of 90 degrees B. 10 ohms at an angle of 0 degrees C. 10 ohms at an angle of 90 degrees D. 100 ohms at an angle of 0 degrees	E5C02 (D) Page 4-22
In polar coordinates, what is the impedance of a network consisting of a 300-ohm-reactance capacitor, a 600-ohm-reactance inductor, and a 400-ohm resistor, all connected in series? A. 500 ohms at an angle of 37 degrees B. 900 ohms at an angle of 53 degrees C. 400 ohms at an angle of 0 degrees D. 1300 ohms at an angle of 180 degrees	E5C03 (A) Page 4-22
In polar coordinates, what is the impedance of a network consisting of a 400-ohm-reactance capacitor in series with a 300-ohm resistor? A. 240 ohms at an angle of 36.9 degrees B. 240 ohms at an angle of -36.9 degrees C. 500 ohms at an angle of 53.1 degrees D. 500 ohms at an angle of -53.1 degrees	E5C04 (D) Page 4-21
In polar coordinates, what is the impedance of a network consisting of a 400-ohm-reactance inductor in parallel with a 300-ohm resistor? A. 240 ohms at an angle of 36.9 degrees B. 240 ohms at an angle of -36.9 degrees C. 500 ohms at an angle of 53.1 degrees D. 500 ohms at an angle of -53.1 degrees	E5C05 (A) Page 4-23
In polar coordinates, what is the impedance of a network consisting of a 100-ohm-reactance capacitor in series with a 100-ohm resistor? A. 121 ohms at an angle of -25 degrees B. 191 ohms at an angle of -85 degrees C. 161 ohms at an angle of -65 degrees D. 141 ohms at an angle of -45 degrees	E5C06 (D) Page 4-19
In polar coordinates, what is the impedance of a network comprised of a 100-ohm-reactance capacitor in parallel with a 100-ohm resistor? A. 31 ohms at an angle of -15 degrees B. 51 ohms at an angle of -25 degrees C. 71 ohms at an angle of -45 degrees D. 91 ohms at an angle of -65 degrees	E5C07 (C) Page 4-22
In polar coordinates, what is the impedance of a network comprised of a 300-ohm-reactance inductor in series with a 400-ohm resistor? A. 400 ohms at an angle of 27 degrees B. 500 ohms at an angle of 37 degrees C. 500 ohms at an angle of 47 degrees D. 700 ohms at an angle of 57 degrees	E5C08 (B) Page 4-20

<p>E5C09 (A) Page 4-17</p>	<p>When using rectangular coordinates to graph the impedance of a circuit, what does the horizontal axis represent?</p> <p>A. The voltage or current associated with the resistive component B. The voltage or current associated with the reactive component C. The sum of the reactive and resistive components D. The difference between the resistive and reactive components</p>
<p>E5C10 (B) Page 4-17</p>	<p>When using rectangular coordinates to graph the impedance of a circuit, what does the vertical axis represent?</p> <p>A. The voltage or current associated with the resistive component B. The voltage or current associated with the reactive component C. The sum of the reactive and resistive components D. The difference between the resistive and reactive components</p>
<p>E5C12 (D) Page 4-18</p>	<p>If you plot the impedance of a circuit using the rectangular coordinate system and find the impedance point falls on the right side of the graph on the horizontal line, what do you know about the circuit?</p> <p>A. It has to be a direct current circuit B. It contains resistance and capacitive reactance C. It contains resistance and inductive reactance D. It is equivalent to a pure resistance</p>
<p>E5C13 (D) Page 4-17</p>	<p>What coordinate system is often used to display the resistive, inductive, and/or capacitive reactance components of an impedance?</p> <p>A. Maidenhead grid B. Faraday grid C. Elliptical coordinates D. Rectangular coordinates</p>
<p>E5C14 (D) Page 4-17</p>	<p>What coordinate system is often used to display the phase angle of a circuit containing resistance, inductive and/or capacitive reactance?</p> <p>A. Maidenhead grid B. Faraday grid C. Elliptical coordinates D. Polar coordinates</p>
<p>E5C15 (A) Page 4-18</p>	<p>In polar coordinates, what is the impedance of a circuit of 100 $-j100$ ohms impedance?</p> <p>A. 141 ohms at an angle of -45 degrees B. 100 ohms at an angle of 45 degrees C. 100 ohms at an angle of -45 degrees D. 141 ohms at an angle of 45 degrees</p>
<p>E5C16 (B) Page 4-18</p>	<p>In polar coordinates, what is the impedance of a circuit that has an admittance of 7.09 millisiemens at 45 degrees?</p> <p>A. 5.03×10^{-E05} ohms at an angle of 45 degrees B. 141 ohms at an angle of -45 degrees C. 19,900 ohms at an angle of -45 degrees D. 141 ohms at an angle of 45 degrees</p>
<p>E5C17 (C) Page 4-18</p>	<p>In rectangular coordinates, what is the impedance of a circuit that has an admittance of 5 millisiemens at -30 degrees?</p> <p>A. $173 - j100$ ohms B. $200 + j100$ ohms C. $173 + j100$ ohms D. $200 - j100$ ohms</p>

In polar coordinates, what is the impedance of a series circuit consisting of a resistance of 4 ohms, an inductive reactance of 4 ohms, and a capacitive reactance of 1 ohm?

- A. 6.4 ohms at an angle of 53 degrees
- B. 5 ohms at an angle of 37 degrees
- C. 5 ohms at an angle of 45 degrees
- D. 10 ohms at an angle of -51 degrees

E5C18
(B)
Page 4-21

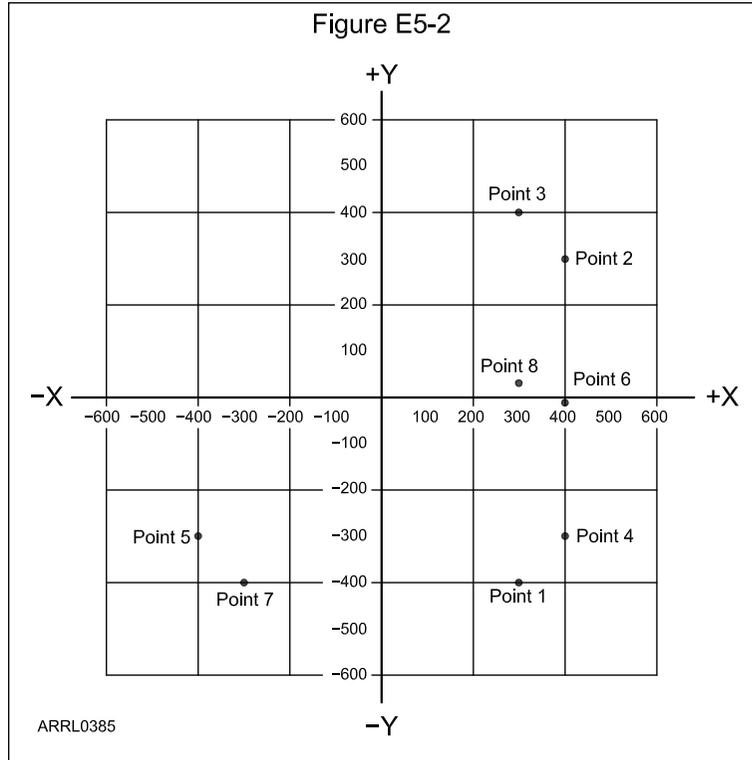


Figure E5-2 — Refer to this figure for questions E5C19 through E5C21 and E5C23.

Which point on Figure E5-2 best represents that impedance of a series circuit consisting of a 400 ohm resistor and a 38 picofarad capacitor at 14 MHz?

- A. Point 2
- B. Point 4
- C. Point 5
- D. Point 6

E5C19
(B)
Page 4-21

Which point in Figure E5-2 best represents the impedance of a series circuit consisting of a 300 ohm resistor and an 18 microhenry inductor at 3.505 MHz?

- A. Point 1
- B. Point 3
- C. Point 7
- D. Point 8

E5C20
(B)
Page 4-20

Which point on Figure E5-2 best represents the impedance of a series circuit consisting of a 300 ohm resistor and a 19 picofarad capacitor at 21.200 MHz?

- A. Point 1
- B. Point 3
- C. Point 7
- D. Point 8

E5C21
(A)
Page 4-21

- E5C22
(A)
Page 4-20
- In rectangular coordinates, what is the impedance of a network comprised of a 10-microhenry inductor in series with a 40-ohm resistor at 500 MHz?
- A. $40 + j31,400$
 - B. $40 - j31,400$
 - C. $31,400 + j40$
 - D. $31,400 - j40$
- E5C23
(D)
Page 4-23
- Which point on Figure E5-2 best represents the impedance of a series circuit consisting of a 300-ohm resistor, a 0.64-microhenry inductor and an 85-picofarad capacitor at 24.900 MHz?
- A. Point 1
 - B. Point 3
 - C. Point 5
 - D. Point 8
- REACTIVE POWER AND POWER FACTOR**
- E5D09
(D)
Page 4-27
- What is the term for an out-of-phase, nonproductive power associated with inductors and capacitors?
- A. Effective power
 - B. True power
 - C. Peak envelope power
 - D. Reactive power
- E5D10
(B)
Page 4-26
- In a circuit that has both inductors and capacitors, what happens to reactive power?
- A. It is dissipated as heat in the circuit
 - B. It is repeatedly exchanged between the associated magnetic and electric fields, but is not dissipated
 - C. It is dissipated as kinetic energy in the circuit
 - D. It is dissipated in the formation of inductive and capacitive fields
- E5D11
(A)
Page 4-28
- How can the true power be determined in an AC circuit where the voltage and current are out of phase?
- A. By multiplying the apparent power times the power factor
 - B. By dividing the reactive power by the power factor
 - C. By dividing the apparent power by the power factor
 - D. By multiplying the reactive power times the power factor
- E5D12
(C)
Page 4-28
- What is the power factor of an R-L circuit having a 60 degree phase angle between the voltage and the current?
- A. 1.414
 - B. 0.866
 - C. 0.5
 - D. 1.73
- E5D13
(B)
Page 4-28
- How many watts are consumed in a circuit having a power factor of 0.2 if the input is 100-V AC at 4 amperes?
- A. 400 watts
 - B. 80 watts
 - C. 2000 watts
 - D. 50 watts
- E5D14
(B)
Page 4-28
- How much power is consumed in a circuit consisting of a 100 ohm resistor in series with a 100 ohm inductive reactance drawing 1 ampere?
- A. 70.7 Watts
 - B. 100 Watts
 - C. 141.4 Watts
 - D. 200 Watts

<p>What is reactive power?</p> <p>A. Wattless, nonproductive power</p> <p>B. Power consumed in wire resistance in an inductor</p> <p>C. Power lost because of capacitor leakage</p> <p>D. Power consumed in circuit Q</p>	<p>E5D15 (A) Page 4-27</p>
<p>What is the power factor of an RL circuit having a 45 degree phase angle between the voltage and the current?</p> <p>A. 0.866</p> <p>B. 1.0</p> <p>C. 0.5</p> <p>D. 0.707</p>	<p>E5D16 (D) Page 4-28</p>
<p>What is the power factor of an RL circuit having a 30 degree phase angle between the voltage and the current?</p> <p>A. 1.73</p> <p>B. 0.5</p> <p>C. 0.866</p> <p>D. 0.577</p>	<p>E5D17 (C) Page 4-28</p>
<p>How many watts are consumed in a circuit having a power factor of 0.6 if the input is 200V AC at 5 amperes?</p> <p>A. 200 watts</p> <p>B. 1000 watts</p> <p>C. 1600 watts</p> <p>D. 600 watts</p>	<p>E5D18 (D) Page 4-29</p>
<p>How many watts are consumed in a circuit having a power factor of 0.71 if the apparent power is 500 watts?</p> <p>A. 704 W</p> <p>B. 355 W</p> <p>C. 252 W</p> <p>D. 1.42 mW</p>	<p>E5D19 (B) Page 4-29</p>
<p>RESONANT CIRCUITS</p>	
<p>What can cause the voltage across reactances in series to be larger than the voltage applied to them?</p> <p>A. Resonance</p> <p>B. Capacitance</p> <p>C. Conductance</p> <p>D. Resistance</p>	<p>E5A01 (A) Page 4-30</p>
<p>What is resonance in an electrical circuit?</p> <p>A. The highest frequency that will pass current</p> <p>B. The lowest frequency that will pass current</p> <p>C. The frequency at which the capacitive reactance equals the inductive reactance</p> <p>D. The frequency at which the reactive impedance equals the resistive impedance</p>	<p>E5A02 (C) Page 4-29</p>
<p>What is the magnitude of the impedance of a series R-L-C circuit at resonance?</p> <p>A. High, as compared to the circuit resistance</p> <p>B. Approximately equal to capacitive reactance</p> <p>C. Approximately equal to inductive reactance</p> <p>D. Approximately equal to circuit resistance</p>	<p>E5A03 (D) Page 4-31</p>

E5A04 (A) Page 4-32	<p>What is the magnitude of the impedance of a circuit with a resistor, an inductor and a capacitor all in parallel, at resonance?</p> <p>A. Approximately equal to circuit resistance B. Approximately equal to inductive reactance C. Low, as compared to the circuit resistance D. Approximately equal to capacitive reactance</p>
E5A05 (B) Page 4-31	<p>What is the magnitude of the current at the input of a series R-L-C circuit as the frequency goes through resonance?</p> <p>A. Minimum B. Maximum C. R/L D. L/R</p>
E5A06 (B) Page 4-32	<p>What is the magnitude of the circulating current within the components of a parallel L-C circuit at resonance?</p> <p>A. It is at a minimum B. It is at a maximum C. It equals 1 divided by the quantity [2 multiplied by Pi, multiplied by the square root of (inductance "L" multiplied by capacitance "C")] D. It equals 2 multiplied by Pi, multiplied by frequency "F", multiplied by inductance "L"</p>
E5A07 (A) Page 4-32	<p>What is the magnitude of the current at the input of a parallel R-L-C circuit at resonance?</p> <p>A. Minimum B. Maximum C. R/L D. L/R</p>
E5A08 (C) Page 4-29	<p>What is the phase relationship between the current through and the voltage across a series resonant circuit?</p> <p>A. The voltage leads the current by 90 degrees B. The current leads the voltage by 90 degrees C. The voltage and current are in phase D. The voltage and current are 180 degrees out of phase</p>
E5A09 (C) Page 4-29	<p>What is the phase relationship between the current through and the voltage across a parallel resonant circuit?</p> <p>A. The voltage leads the current by 90 degrees B. The current leads the voltage by 90 degrees C. The voltage and current are in phase D. The voltage and current are 180 degrees out of phase</p>
E5A14 (C) Page 4-31	<p>What is the resonant frequency of a series RLC circuit if R is 22 ohms, L is 50 microhenrys and C is 40 picofarads?</p> <p>A. 44.72 MHz B. 22.36 MHz C. 3.56 MHz D. 1.78 MHz</p>
E5A15 (B) Page 4-31	<p>What is the resonant frequency of a series RLC circuit if R is 56 ohms, L is 40 microhenrys and C is 200 picofarads?</p> <p>A. 3.76 MHz B. 1.78 MHz C. 11.18 MHz D. 22.36 MHz</p>

What is the resonant frequency of a parallel RLC circuit if R is 33 ohms, L is 50 microhenrys and C is 10 picofarads?
A. 23.5 MHz
B. 23.5 kHz
C. 7.12 kHz
D. 7.12 MHz

E5A16
(D)
Page 4-32

What is the resonant frequency of a parallel RLC circuit if R is 47 ohms, L is 25 microhenrys and C is 10 picofarads?
A. 10.1 MHz
B. 63.2 MHz
C. 10.1 kHz
D. 63.2 kHz

E5A17
(A)
Page 4-32

Q AND BANDWIDTH OF RESONANT CIRCUITS

Which of the following can be used as a relative measurement of the Q for a series-tuned circuit?
A. The inductance to capacitance ratio
B. The frequency shift
C. The bandwidth of the circuit's frequency response
D. The resonant frequency of the circuit

E4B17
(C)
Page 4-34

What is the half-power bandwidth of a parallel resonant circuit that has a resonant frequency of 1.8 MHz and a Q of 95?
A. 18.9 kHz
B. 1.89 kHz
C. 94.5 kHz
D. 9.45 kHz

E5A10
(A)
Page 4-34

What is the half-power bandwidth of a parallel resonant circuit that has a resonant frequency of 7.1 MHz and a Q of 150?
A. 157.8 Hz
B. 315.6 Hz
C. 47.3 kHz
D. 23.67 kHz

E5A11
(C)
Page 4-35

What is the half-power bandwidth of a parallel resonant circuit that has a resonant frequency of 3.7 MHz and a Q of 118?
A. 436.6 kHz
B. 218.3 kHz
C. 31.4 kHz
D. 15.7 kHz

E5A12
(C)
Page 4-35

What is the half-power bandwidth of a parallel resonant circuit that has a resonant frequency of 14.25 MHz and a Q of 187?
A. 38.1 kHz
B. 76.2 kHz
C. 1.332 kHz
D. 2.665 kHz

E5A13
(B)
Page 4-35

E5D01
(A)
Page 4-35

What is the result of skin effect?

- A. As frequency increases, RF current flows in a thinner layer of the conductor, closer to the surface
- B. As frequency decreases, RF current flows in a thinner layer of the conductor, closer to the surface
- C. Thermal effects on the surface of the conductor increase the impedance
- D. Thermal effects on the surface of the conductor decrease the impedance

E5D02
(C)
Page 4-35

Why is the resistance of a conductor different for RF currents than for direct currents?

- A. Because the insulation conducts current at high frequencies
- B. Because of the Heisenburg Effect
- C. Because of skin effect
- D. Because conductors are non-linear devices

MAGNETIC CORES

E6D08
(D)
Page 4-35

What material property determines the inductance of a toroidal inductor with a 10-turn winding?

- A. Core load current
- B. Core resistance
- C. Core reactivity
- D. Core permeability

E6D09
(B)
Page 4-36

What is the usable frequency range of inductors that use toroidal cores, assuming a correct selection of core material for the frequency being used?

- A. From a few kHz to no more than 30 MHz
- B. From less than 20 Hz to approximately 300 MHz
- C. From approximately 1000 Hz to no more than 3000 kHz
- D. From about 100 kHz to at least 1000 GHz

E6D10
(B)
Page 4-36

What is one important reason for using powdered-iron toroids rather than ferrite toroids in an inductor?

- A. Powdered-iron toroids generally have greater initial permeabilities
- B. Powdered-iron toroids generally have better temperature stability
- C. Powdered-iron toroids generally require fewer turns to produce a given inductance value
- D. Powdered-iron toroids have the highest power handling capacity

E6D11
(C)
Page 4-38

What devices are commonly used as VHF and UHF parasitic suppressors at the input and output terminals of transistorized HF amplifiers?

- A. Electrolytic capacitors
- B. Butterworth filters
- C. Ferrite beads
- D. Steel-core toroids

E6D12
(A)
Page 4-36

What is a primary advantage of using a toroidal core instead of a solenoidal core in an inductor?

- A. Toroidal cores contain most of the magnetic field within the core material
- B. Toroidal cores make it easier to couple the magnetic energy into other components
- C. Toroidal cores exhibit greater hysteresis
- D. Toroidal cores have lower Q characteristics

E6D13
(C)
Page 4-37

How many turns will be required to produce a 1-mH inductor using a ferrite toroidal core that has an inductance index (A L) value of 523 millihenrys/1000 turns?

- A. 2 turns
- B. 4 turns
- C. 43 turns
- D. 229 turns

- How many turns will be required to produce a 5-microhenry inductor using a powdered-iron toroidal core that has an inductance index (A L) value of 40 microhenrys/100 turns?
- A. 35 turns
 - B. 13 turns
 - C. 79 turns
 - D. 141 turns
- What is one reason for using ferrite toroids rather than powdered-iron toroids in an inductor?
- A. Ferrite toroids generally have lower initial permeabilities
 - B. Ferrite toroids generally have better temperature stability
 - C. Ferrite toroids generally require fewer turns to produce a given inductance value
 - D. Ferrite toroids are easier to use with surface mount technology

Chapter 5, Section 5.1

MATERIALS

- In what application is gallium arsenide used as a semiconductor material in preference to germanium or silicon?
- A. In high-current rectifier circuits
 - B. In high-power audio circuits
 - C. At microwave frequencies
 - D. At very low frequency RF circuits
- What type of semiconductor material contains more free electrons than pure germanium or silicon crystals?
- A. N-type
 - B. P-type
 - C. Bipolar
 - D. Insulated gate
- What are the majority charge carriers in P-type semiconductor material?
- A. Free neutrons
 - B. Free protons
 - C. Holes
 - D. Free electrons
- What is the name given to an impurity atom that adds holes to a semiconductor crystal structure?
- A. Insulator impurity
 - B. N-type impurity
 - C. Acceptor impurity
 - D. Donor impurity
- What two elements widely used in semiconductor devices exhibit both metallic and nonmetallic characteristics?
- A. Silicon and gold
 - B. Silicon and germanium
 - C. Galena and germanium
 - D. Galena and bismuth

E6A16
(B)
Page 5-2

What type of semiconductor material contains fewer free electrons than pure germanium or silicon crystals?

- A. N-type
- B. P-type
- C. Superconductor-type
- D. Bipolar-type

E6A17
(B)
Page 5-3

What are the majority charge carriers in N-type semiconductor material?

- A. Holes
- B. Free electrons
- C. Free protons
- D. Free neutrons

DIODES

E6B01
(B)
Page 5-6

What is the principal characteristic of a Zener diode?

- A. A constant current under conditions of varying voltage
- B. A constant voltage under conditions of varying current
- C. A negative resistance region
- D. An internal capacitance that varies with the applied voltage

E6B02
(C)
Page 5-7

What is the principal characteristic of a tunnel diode?

- A. A high forward resistance
- B. A very high PIV
- C. A negative resistance region
- D. A high forward current rating

E6B03
(D)
Page 5-6

What is an important characteristic of a Schottky Barrier diode as compared to an ordinary silicon diode when used as a power supply rectifier?

- A. Much higher reverse voltage breakdown
- B. Controlled reverse avalanche voltage
- C. Enhanced carrier retention time
- D. Less forward voltage drop

E6B04
(C)
Page 5-7

What special type of diode is capable of both amplification and oscillation?

- A. Point contact
- B. Zener
- C. Tunnel
- D. Junction

E6B05
(A)
Page 5-7

What type of semiconductor device varies its internal capacitance as the voltage applied to its terminals varies?

- A. Varactor diode
- B. Tunnel diode
- C. Silicon-controlled rectifier
- D. Zener diode

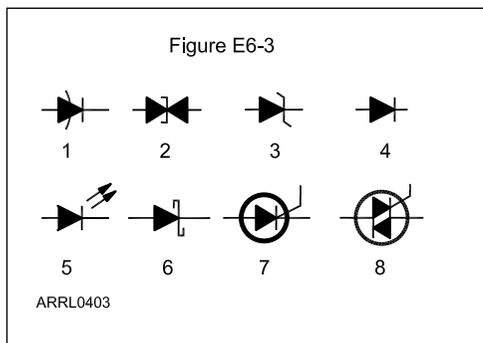


Figure E6-3 — Refer to this figure for questions E6B06 and E6B11.

In Figure E6-3, what is the schematic symbol for a varactor diode?

- A. 8
- B. 6
- C. 2
- D. 1

E6B06
(D)
Page 5-7

What is a common use of a hot-carrier diode?

- A. As balanced mixers in FM generation
- B. As a variable capacitance in an automatic frequency control circuit
- C. As a constant voltage reference in a power supply
- D. As a VHF / UHF mixer or detector

E6B07
(D)
Page 5-6

What limits the maximum forward current rating in a junction diode?

- A. Peak inverse voltage
- B. Junction temperature
- C. Forward voltage
- D. Back EMF

E6B08
(B)
Page 5-4

Which of the following describes a type of semiconductor diode?

- A. Metal-semiconductor junction
- B. Electrolytic rectifier
- C. CMOS-field effect
- D. Thermionic emission diode

E6B09
(A)
Page 5-5

What is a common use for point contact diodes?

- A. As a constant current source
- B. As a constant voltage source
- C. As an RF detector
- D. As a high voltage rectifier

E6B10
(C)
Page 5-5

How are junction diodes rated?

- A. Maximum forward current and capacitance
- B. Maximum reverse current and PIV
- C. Maximum reverse current and capacitance
- D. Maximum forward current and PIV

E6B12
(D)
Page 5-4

E6B13
(C)
Page 5-8

- What is one common use for PIN diodes?
- A. As a constant current source
 - B. As a constant voltage source
 - C. As an RF switch
 - D. As a high voltage rectifier

BIPOLAR TRANSISTORS

E6A05
(C)
Page 5-10

- What is the alpha of a bipolar junction transistor?
- A. The change of collector current with respect to base current
 - B. The change of base current with respect to collector current
 - C. The change of collector current with respect to emitter current
 - D. The change of collector current with respect to gate current
- What is meant by the beta of a bipolar junction transistor?

E6A06
(B)
Page 5-10

- A. The frequency at which the current gain is reduced to 1
- B. The change in collector current with respect to base current
- C. The breakdown voltage of the base to collector junction
- D. The switching speed of the transistor

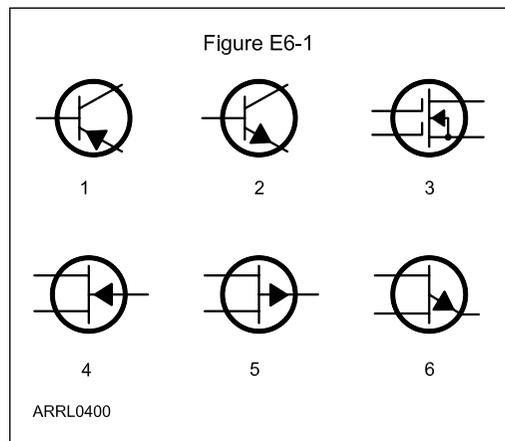


Figure E6-1 — Refer to this figure for question E6A07.

E6A07
(A)
Page 5-9

- In Figure E6-1, what is the schematic symbol for a PNP transistor?
- A. 1
 - B. 2
 - C. 4
 - D. 5

E6A08
(D)
Page 5-10

- What term indicates the frequency at which a transistor grounded base current gain has decreased to 0.7 of the gain obtainable at 1 kHz?
- A. Corner frequency
 - B. Alpha rejection frequency
 - C. Beta cutoff frequency
 - D. Alpha cutoff frequency

FIELD EFFECT TRANSISTORS

What is a depletion-mode FET?

- A. An FET that exhibits a current flow between source and drain when no gate voltage is applied
- B. An FET that has no current flow between source and drain when no gate voltage is applied
- C. An FET without a channel so no current flows with zero gate voltage
- D. An FET without a channel so maximum gate current flows

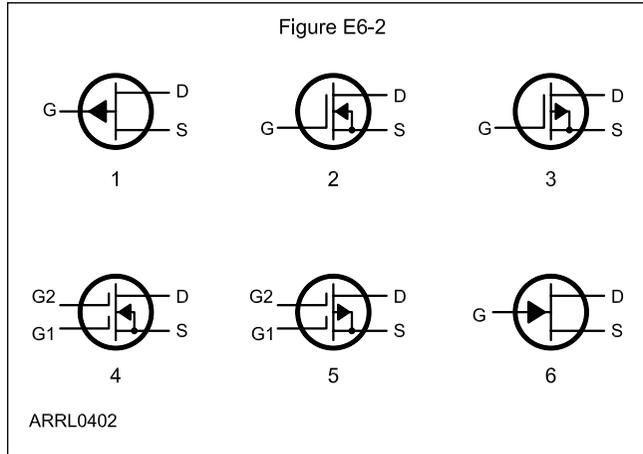


Figure E6-2 — Refer to this figure for questions E6A10 and E6A11.

E6A09
(A)
Page 5-12

In Figure E6-2, what is the schematic symbol for an N-channel dual-gate MOSFET?

- A. 2
- B. 4
- C. 5
- D. 6

E6A10
(B)
Page 5-11

In Figure E6-2, what is the schematic symbol for a P-channel junction FET?

- A. 1
- B. 2
- C. 3
- D. 6

E6A11
(A)
Page 5-11

Why do many MOSFET devices have built-in gate-protective Zener diodes?

- A. To provide a voltage reference for the correct amount of reverse-bias gate voltage
- B. To protect the substrate from excessive voltages
- C. To keep the gate voltage within specifications and prevent the device from overheating
- D. To reduce the chance of the gate insulation being punctured by static discharges or excessive voltages

E6A12
(D)
Page 5-11

How does DC input impedance at the gate of a field-effect transistor compare with the DC input impedance of a bipolar transistor?

- A. They cannot be compared without first knowing the supply voltage
- B. An FET has low input impedance; a bipolar transistor has high input impedance
- C. An FET has high input impedance; a bipolar transistor has low input impedance
- D. The input impedance of FETs and bipolar transistors is the same

E6A14
(C)
Page 5-11

E6A18 (D) Page 5-11
What are the names of the three terminals of a field-effect transistor?
A. Gate 1, gate 2, drain
B. Emitter, base, collector
C. Emitter, base 1, base 2
D. Gate, drain, source

RF INTEGRATED DEVICES

E6E07 (A) Page 5-13
What is the characteristic impedance of circuits in which almost all MMICs are designed to work?
A. 50 ohms
B. 300 ohms
C. 450 ohms
D. 10 ohms

E6E08 (B) Page 5-13
What is the typical noise figure of a monolithic microwave integrated circuit (MMIC) amplifier?
A. Less than 1 dB
B. Approximately 3.5 to 6 dB
C. Approximately 8 to 10 dB
D. More than 20 dB

E6E09 (D) Page 5-13
What type of amplifier device consists of a small pill-type package with an input lead, an output lead and 2 ground leads?
A. A junction field-effect transistor (JFET)
B. An operational amplifier integrated circuit (OAIC)
C. An indium arsenide integrated circuit (IAIC)
D. A monolithic microwave integrated circuit (MMIC)

E6E10 (B) Page 5-13
What typical construction technique is used when building an amplifier for the microwave bands containing a monolithic microwave integrated circuit (MMIC)?
A. Ground-plane “ugly” construction
B. Microstrip construction
C. Point-to-point construction
D. Wave-soldering construction

E6E11 (A) Page 5-13
How is the operating bias voltage normally supplied to the most common type of monolithic microwave integrated circuit (MMIC)?
A. Through a resistor and/or RF choke connected to the amplifier output lead
B. MMICs require no operating bias
C. Through a capacitor and RF choke connected to the amplifier input lead
D. Directly to the bias-voltage (VCC IN) lead

E6E12 (B) Page 5-13
What supply voltage do monolithic microwave integrated circuits (MMIC) amplifiers typically require?
A. 1 volt DC
B. 12 volts DC
C. 20 volts DC
D. 120 volts DC

E6E13 (C) Page 5-13
What is the most common package for inexpensive monolithic microwave integrated circuit (MMIC) amplifiers?
A. Beryllium oxide packages
B. Glass packages
C. Plastic packages
D. Ceramic packages

Chapter 5, Section 5.2

LIGHT-EMITTING DIODES

In Figure E6-3, what is the schematic symbol for a light-emitting diode?

- A. 1
- B. 5
- C. 6
- D. 7

E6B11
(B)
Page 5-14

What type of bias is required for an LED to produce luminescence?

- A. Reverse bias
- B. Forward bias
- C. Zero bias
- D. Inductive bias

E6B14
(B)
Page 5-14

LIQUID-CRYSTAL DISPLAYS

What is a liquid-crystal display (LCD)?

- A. A modern replacement for a quartz crystal oscillator which displays its fundamental frequency
- B. A display that uses a crystalline liquid to change the way light is refracted
- C. A frequency-determining unit for a transmitter or receiver
- D. A display that uses a glowing liquid to remain brightly lit in dim light

E6D07
(B)
Page 5-14

What is the principle advantage of liquid-crystal display (LCD) devices over other types of display devices?

- A. They consume less power
- B. They can display changes instantly
- C. They are visible in all light conditions
- D. They can be easily interchanged with other display devices

E6D17
(A)
Page 5-15

CATHODE-RAY TUBES

What is cathode ray tube (CRT) persistence?

- A. The time it takes for an image to appear after the electron beam is turned on
- B. The relative brightness of the display under varying conditions of ambient light
- C. The ability of the display to remain in focus under varying conditions
- D. The length of time the image remains on the screen after the beam is turned off

E6D02
(D)
Page 5-16

If a cathode ray tube (CRT) is designed to operate with an anode voltage of 25,000 volts, what will happen if the anode voltage is increased to 35,000 volts?

- A. The image size will decrease
- B. The image size will increase
- C. The image will become larger and brighter
- D. There will be no apparent change

E6D03
(A)
Page 5-17

Exceeding what design rating can cause a cathode ray tube (CRT) to generate X-rays?

- A. The heater voltage
- B. The anode voltage
- C. The operating temperature
- D. The operating frequency

E6D04
(B)
Page 5-17

- E6D15
(D)
Page 5-16
- What type of CRT deflection is better when high-frequency waves are to be displayed on the screen?
- A. Electromagnetic
 - B. Tubular
 - C. Radar
 - D. Electrostatic

VIDICONS

- E6D01
(D)
Page 5-17
- How is the electron beam deflected in a vidicon?
- A. By varying the beam voltage
 - B. By varying the bias voltage on the beam forming grids inside the tube
 - C. By varying the beam current
 - D. By varying electromagnetic fields

CHARGE-COUPLED DEVICES

- E6D05
(C)
Page 5-18
- Which of the following is true of a charge-coupled device (CCD)?
- A. Its phase shift changes rapidly with frequency
 - B. It is a CMOS analog-to-digital converter
 - C. It samples an analog signal and passes it in stages from the input to the output
 - D. It is used in a battery charger circuit

- E6D06
(A)
Page 5-18
- What function does a charge-coupled device (CCD) serve in a modern video camera?
- A. It stores photogenerated charges as signals corresponding to pixels
 - B. It generates the horizontal pulses needed for electron beam scanning
 - C. It focuses the light used to produce a pattern of electrical charges corresponding to the image
 - D. It combines audio and video information to produce a composite RF signal

- E6D16
(C)
Page 5-18
- Which is NOT true of a charge-coupled device (CCD)?
- A. It uses a combination of analog and digital circuitry
 - B. It can be used to make an audio delay line
 - C. It is commonly used as an analog-to-digital converter
 - D. It samples and stores analog signals

Chapter 5, Section 5.3

LOGIC BASICS

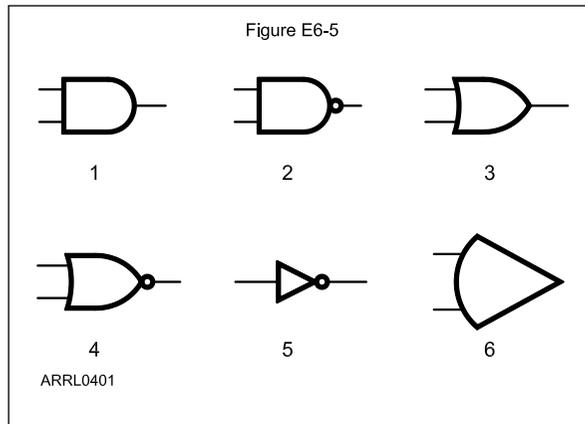


Figure E6-5 — Refer to this figure for questions E6C07 through E6C11.

In Figure E6-5, what is the schematic symbol for an AND gate?

- A. 1
- B. 2
- C. 3
- D. 4

E6C07
(A)
Page 5-20

In Figure E6-5, what is the schematic symbol for a NAND gate?

- A. 1
- B. 2
- C. 3
- D. 4

E6C08
(B)
Page 5-21

In Figure E6-5, what is the schematic symbol for an OR gate?

- A. 2
- B. 3
- C. 4
- D. 6

E6C09
(B)
Page 5-20

In Figure E6-5, what is the schematic symbol for a NOR gate?

- A. 1
- B. 2
- C. 3
- D. 4

E6C10
(D)
Page 5-21

In Figure E6-5, what is the schematic symbol for the NOT operation (inverter)?

- A. 2
- B. 4
- C. 5
- D. 6

E6C11
(C)
Page 5-20

- E7A07
(B)
Page 5-20
- What logical operation does an AND gate perform?
- A. It produces a logic “0” at its output only if all inputs are logic “1”
 - B. It produces a logic “1” at its output only if all inputs are logic “1”
 - C. It produces a logic “1” at its output if only one input is a logic “1”
 - D. It produces a logic “1” at its output if all inputs are logic “0”
- E7A08
(D)
Page 5-21
- What logical operation does a NAND gate perform?
- A. It produces a logic “0” at its output only when all inputs are logic “0”
 - B. It produces a logic “1” at its output only when all inputs are logic “1”
 - C. It produces a logic “0” at its output if some but not all of its inputs are logic “1”
 - D. It produces a logic “0” at its output only when all inputs are logic “1”
- E7A09
(A)
Page 5-20
- What logical operation does an OR gate perform?
- A. It produces a logic “1” at its output if any or all inputs are logic “1”
 - B. It produces a logic “0” at its output if all inputs are logic “1”
 - C. It only produces a logic “0” at its output when all inputs are logic “1”
 - D. It produces a logic “1” at its output if all inputs are logic “0”
- E7A10
(C)
Page 5-21
- What logical operation does a NOR gate perform?
- A. It produces a logic “0” at its output only if all inputs are logic “0”
 - B. It produces a logic “1” at its output only if all inputs are logic “1”
 - C. It produces a logic “0” at its output if any or all inputs are logic “1”
 - D. It produces a logic “1” at its output only when none of its inputs are logic “0”
- E7A11
(C)
Page 5-19
- What is a truth table?
- A. A table of logic symbols that indicate the high logic states of an op-amp
 - B. A diagram showing logic states when the digital device’s output is true
 - C. A list of inputs and corresponding outputs for a digital device
 - D. A table of logic symbols that indicates the low logic states of an op-amp
- E7A12
(D)
Page 5-21
- What is the name for logic which represents a logic “1” as a high voltage?
- A. Reverse Logic
 - B. Assertive Logic
 - C. Negative logic
 - D. Positive Logic
- E7A13
(C)
Page 5-21
- What is the name for logic which represents a logic “0” as a high voltage?
- A. Reverse Logic
 - B. Assertive Logic
 - C. Negative logic
 - D. Positive Logic
- SYNCHRONOUS LOGIC**
- E7A01
(C)
Page 5-22
- What is a bistable circuit?
- A. An “AND” gate
 - B. An “OR” gate
 - C. A flip-flop
 - D. A clock

How many output level changes are obtained for every two trigger pulses applied to the input of a “T” flip-flop circuit?
A. None
B. One
C. Two
D. Four

E7A02
(C)
Page 5-25

Which of the following can divide the frequency of pulse train by 2?
A. An XOR gate
B. A flip-flop
C. An OR gate
D. A multiplexer

E7A03
(B)
Page 5-25

How many flip-flops are required to divide a signal frequency by 4?
A. 1
B. 2
C. 4
D. 8

E7A04
(B)
Page 5-25

Which of the following is a circuit that continuously alternates between two unstable states without an external clock?
A. Monostable multivibrator
B. J-K Flip-Flop
C. T Flip-Flop
D. Astable Multivibrator

E7A05
(D)
Page 5-25

What is a characteristic of a monostable multivibrator?
A. It switches momentarily to the opposite binary state and then returns, after a set time, to its original state
B. It is a clock that produces a continuous square wave oscillating between 1 and 0
C. It stores one bit of data in either a 0 or 1 state
D. It maintains a constant output voltage, regardless of variations in the input voltage

E7A06
(A)
Page 5-25

FREQUENCY DIVIDERS AND COUNTERS

What is the purpose of a prescaler circuit?
A. It converts the output of a JK flip-flop to that of an RS flip-flop
B. It multiplies a higher frequency signal so a low-frequency counter can display the operating frequency
C. It prevents oscillation in a low-frequency counter circuit
D. It divides a higher frequency signal so a low-frequency counter can display the operating frequency

E7F01
(D)
Page 5-27

Which of the following would be used to reduce a signal’s frequency by a factor of ten?
A. A preamp
B. A prescaler
C. A marker generator
D. A flip-flop

E7F02
(B)
Page 5-27

What is the function of a decade counter digital IC?
A. It produces one output pulse for every ten input pulses
B. It decodes a decimal number for display on a seven-segment LED display
C. It produces ten output pulses for every input pulse
D. It adds two decimal numbers together

E7F03
(A)
Page 5-26

<p>E7F04 (C) Page 5-27</p>	<p>What additional circuitry must be added to a 100-kHz crystal-controlled marker generator so as to provide markers at 50 and 25 kHz?</p> <p>A. An emitter-follower B. Two frequency multipliers C. Two flip-flops D. A voltage divider</p>
<p>E7F05 (B) Page 5-27</p>	<p>Which of the following circuits can be combined to produce a 100 kHz fundamental signal with harmonics at 100 kHz intervals?</p> <p>A. A 10 MHz oscillator and a flip-flop B. A 1 MHz oscillator and a decade counter C. A 1 MHz oscillator and a flip-flop D. A 100 kHz oscillator and a phase detector</p>
<p>E7F06 (D) Page 5-27</p>	<p>Which of these choices best describes a crystal marker generator?</p> <p>A. A low-stability oscillator that sweeps through a band of frequencies B. An oscillator often used in aircraft to determine the craft's location relative to the inner and outer markers at airports C. A crystal-controlled oscillator with an output frequency and amplitude that can be varied over a wide range D. A crystal-controlled oscillator that generates a series of reference signals at known frequency intervals</p>
<p>E7F07 (D) Page 5-27</p>	<p>Which type of circuit would be a good choice for generating a series of harmonically related receiver calibration signals?</p> <p>A. A Wein-bridge oscillator followed by a class-A amplifier B. A Foster-Seeley discriminator C. A phase-shift oscillator D. A crystal oscillator followed by a frequency divider</p>
<p>E7F08 (C) Page 5-27</p>	<p>What is one purpose of a marker generator?</p> <p>A. To add audio markers to an oscilloscope B. To provide a frequency reference for a phase locked loop C. To provide a means of calibrating a receiver's frequency settings D. To add time signals to a transmitted signal</p>
<p>E7F09 (A) Page 5-27</p>	<p>What determines the accuracy of a frequency counter?</p> <p>A. The accuracy of the time base B. The speed of the logic devices used C. Accuracy of the AC input frequency to the power supply D. Proper balancing of the mixer diodes</p>
<p>E7F10 (C) Page 5-26</p>	<p>How does a conventional frequency counter determine the frequency of a signal?</p> <p>A. It counts the total number of pulses in a circuit B. It monitors a WWV reference signal for comparison with the measured signal C. It counts the number of input pulses occurring within a specific period of time D. It converts the phase of the measured signal to a voltage which is proportional to the frequency</p>
<p>E7F11 (A) Page 5-26</p>	<p>What is the purpose of a frequency counter?</p> <p>A. To provide a digital representation of the frequency of a signal B. To generate a series of reference signals at known frequency intervals C. To display all frequency components of a transmitted signal D. To provide a signal source at a very accurate frequency</p>

<p>What alternate method of determining frequency, other than by directly counting input pulses, is used by some frequency counters?</p> <p>A. GPS averaging B. Period measurement C. Prescaling D. D/A conversion</p>	<p>E7F12 (B) Page 5-27</p>
<p>What is an advantage of a period-measuring frequency counter over a direct-count type?</p> <p>A. It can run on battery power for remote measurements B. It does not require an expensive high-precision time base C. It provides improved resolution of signals within a comparable time period D. It can directly measure the modulation index of an FM transmitter</p>	<p>E7F13 (C) Page 5-27</p>
<p>LOGIC FAMILIES</p>	
<p>What do the initials CMOS stand for?</p> <p>A. Common mode oscillating system B. Complementary mica-oxide silicon C. Complementary metal-oxide semiconductor D. Complementary metal-oxide substrate</p>	<p>E6A13 (C) Page 5-29</p>
<p>What is the recommended power supply voltage for TTL series integrated circuits?</p> <p>A. 12 volts B. 1.5 volts C. 5 volts D. 13.6 volts</p>	<p>E6C01 (C) Page 5-28</p>
<p>What logic state do the inputs of a TTL device assume if they are left open?</p> <p>A. A logic-high state B. A logic-low state C. The device becomes randomized and will not provide consistent high or low-logic states D. Open inputs on a TTL device are ignored</p>	<p>E6C02 (A) Page 5-29</p>
<p>What level of input voltage is a logic “high” in a TTL device operating with a positive 5-volt power supply?</p> <p>A. 2.0 to 5.5 volts B. 1.5 to 3.0 volts C. 1.0 to 1.5 volts D. -5.0 to -2.0 volts</p>	<p>E6C03 (A) Page 5-28</p>
<p>What level of input voltage is a logic “low” in a TTL device operating with a positive 5-volt power-supply?</p> <p>A. -2.0 to -5.5 volts B. 2.0 to 5.5 volts C. 0.0 to 0.8 volts D. -0.8 to 0.4 volts</p>	<p>E6C04 (C) Page 5-28</p>
<p>Which of the following is an advantage of CMOS logic devices over TTL devices?</p> <p>A. Differential output capability B. Lower distortion C. Immune to damage from static discharge D. Lower power consumption</p>	<p>E6C05 (D) Page 5-29</p>

- E6C06
(C)
Page 5-29
- Why do CMOS digital integrated circuits have high immunity to noise on the input signal or power supply?
- A. Larger bypass capacitors are used in CMOS circuit design
 - B. The input switching threshold is about two times the power supply voltage
 - C. The input switching threshold is about one-half the power supply voltage
 - D. Input signals are stronger

Chapter 5, Section 5.4

PHOTOCONDUCTIVITY

- E6F01
(B)
Page 5-32
- What is photoconductivity?
- A. The conversion of photon energy to electromotive energy
 - B. The increased conductivity of an illuminated semiconductor
 - C. The conversion of electromotive energy to photon energy
 - D. The decreased conductivity of an illuminated semiconductor
- E6F02
(A)
Page 5-32
- What happens to the conductivity of a photoconductive material when light shines on it?
- A. It increases
 - B. It decreases
 - C. It stays the same
 - D. It becomes unstable
- E6F06
(D)
Page 5-32
- What characteristic of a crystalline solid will photoconductivity change?
- A. The capacitance
 - B. The inductance
 - C. The specific gravity
 - D. The resistance
- E6F07
(C)
Page 5-32
- Which material will exhibit the greatest photoconductive effect when illuminated by visible light?
- A. Potassium nitrate
 - B. Lead sulfide
 - C. Cadmium sulfide
 - D. Sodium chloride
- E6F08
(B)
Page 5-32
- Which material will exhibit the greatest photoconductive effect when illuminated by infrared light?
- A. Potassium nitrate
 - B. Lead sulfide
 - C. Cadmium sulfide
 - D. Sodium chloride
- E6F09
(A)
Page 5-32
- Which of the following materials is affected the most by photoconductivity?
- A. A crystalline semiconductor
 - B. An ordinary metal
 - C. A heavy metal
 - D. A liquid semiconductor

OPTOELECTRONIC COMPONENTS

- E6F03
(D)
Page 5-32
- What is the most common configuration for an optocoupler?
- A. A lens and a photomultiplier
 - B. A frequency modulated helium-neon laser
 - C. An amplitude modulated helium-neon laser
 - D. An LED and a phototransistor

Which of the following is an optoisolator?
A. An LED and a phototransistor
B. A P-N junction that develops an excess positive charge when exposed to light
C. An LED and a capacitor
D. A P-N junction that develops an excess negative charge when exposed to light

E6F04
(A)
Page 5-32

What is an optical shaft encoder?
A. An array of neon or LED indicators whose light transmission path is controlled by a rotating wheel
B. An array of optocouplers whose light transmission path is controlled by a rotating wheel
C. An array of neon or LED indicators mounted on a rotating wheel in a coded pattern
D. An array of optocouplers mounted on a rotating wheel in a coded pattern

E6F05
(B)
Page 5-33

What characteristic of optoisolators is often used in power supplies?
A. They have low impedance between the light source and the phototransistor
B. They have very high impedance between the light source and the phototransistor
C. They have low impedance between the light source and the LED
D. They have very high impedance between the light source and the LED

E6F10
(B)
Page 5-33

What characteristic of optoisolators makes them suitable for use with a triac to form the solid-state equivalent of a mechanical relay for a 120 V AC household circuit?
A. Optoisolators provide a low impedance link between a control circuit and a power circuit
B. Optoisolators provide impedance matching between the control circuit and power circuit
C. Optoisolators provide a very high degree of electrical isolation between a control circuit and a power circuit
D. Optoisolators eliminate (isolate) the effects of reflected light in the control circuit

E6F11
(C)
Page 5-33

PHOTOVOLTAIC CELLS

Which of the following types of photovoltaic cell has the highest efficiency?
A. Silicon
B. Silver iodide
C. Selenium
D. Gallium arsenide

E6F12
(D)
Page 5-34

What is the most common type of photovoltaic cell used for electrical power generation?
A. Selenium
B. Silicon
C. Cadmium Sulfide
D. Copper oxide

E6F13
(B)
Page 5-34

Which of the following is the approximate open-circuit voltage produced by a fully-illuminated silicon photovoltaic cell?
A. 0.1 V
B. 0.5 V
C. 1.5 V
D. 12 V

E6F14
(B)
Page 5-34

What absorbs the energy from light falling on a photovoltaic cell?
A. Protons
B. Photons
C. Electrons
D. Holes

E6F15
(C)
Page 5-34

Chapter 6, Section 6.1

DISCRETE DEVICE AMPLIFIERS

E7B09
(B)
Page 6-3

In Figure E7-1, what is the purpose of R1 and R2?
A. Load resistors
B. Fixed bias
C. Self bias
D. Feedback

E7B10
(D)
Page 6-3

In Figure E7-1, what is the purpose of R3?
A. Fixed bias
B. Emitter bypass
C. Output load resistor
D. Self bias

E7B11
(C)
Page 6-3

What type of circuit is shown in Figure E7-1?
A. Switching voltage regulator
B. Linear voltage regulator
C. Common emitter amplifier
D. Emitter follower amplifier

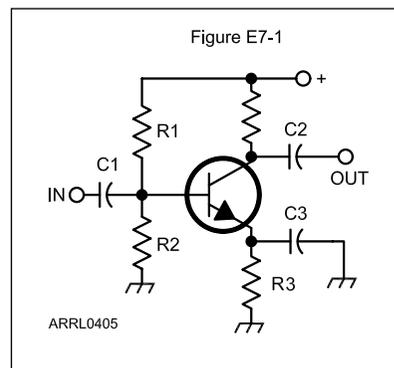


Figure E7-1 — Refer to this figure for questions E7B09 through E7B11.

E7B12
(A)
Page 6-5

In Figure E7-2, what is the purpose of R?
A. Emitter load
B. Fixed bias
C. Collector load
D. Voltage regulation

E7B13
(A)
Page 6-5

In Figure E7-2, what is the purpose of C2?
A. Output coupling
B. Emitter bypass
C. Input coupling
D. Hum filtering

E7B14
(C)
Page 6-3

What is one way to prevent thermal runaway in a transistor amplifier?
A. Neutralization
B. Select transistors with high beta
C. Use degenerative emitter feedback
D. All of the above

E7B17
(C)
Page 6-6

Which of the following is a characteristic of a grounded-grid amplifier?
A. High power gain
B. High filament voltage
C. Low input impedance
D. Low bandwidth

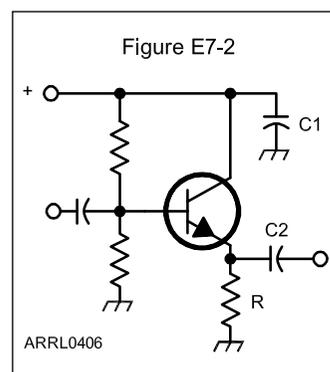


Figure E7-2 — Refer to this figure for questions E7B12 and E7B13.

OP-AMP AMPLIFIERS

What voltage gain can be expected from the circuit in Figure E7-4 when R_1 is 10 ohms and R_F is 470 ohms?

- A. 0.21
- B. 94
- C. 47
- D. 24

How does the gain of a theoretically ideal operational amplifier vary with frequency?

- A. It increases linearly with increasing frequency
- B. It decreases linearly with increasing frequency
- C. It decreases logarithmically with increasing frequency
- D. It does not vary with frequency

What will be the output voltage of the circuit shown in Figure E7-4 if R_1 is 1000 ohms, R_F is 10,000 ohms, and 0.23 volts is applied to the input?

- A. 0.23 volts
- B. 2.3 volts
- C. -0.23 volts
- D. -2.3 volts

What voltage gain can be expected from the circuit in Figure E7-4 when R_1 is 1800 ohms and R_F is 68 kilohms?

- A. 1
- B. 0.03
- C. 38
- D. 76

What voltage gain can be expected from the circuit in Figure E7-4 when R_1 is 3300 ohms and R_F is 47 kilohms?

- A. 28
- B. 14
- C. 7
- D. 0.07

What is an operational amplifier?

- A. A high-gain, direct-coupled differential amplifier whose characteristics are determined by components external to the amplifier
- B. A high-gain, direct-coupled audio amplifier whose characteristics are determined by components external to the amplifier
- C. An amplifier used to increase the average output of frequency modulated amateur signals to the legal limit
- D. A program subroutine that calculates the gain of an RF amplifier

What is meant by the term “op-amp input-offset voltage”?

- A. The output voltage of the op-amp minus its input voltage
- B. The difference between the output voltage of the op-amp and the input voltage required in the immediately following stage
- C. The potential between the amplifier input terminals of the op-amp in a closed-loop condition
- D. The potential between the amplifier input terminals of the op-amp in an open-loop condition

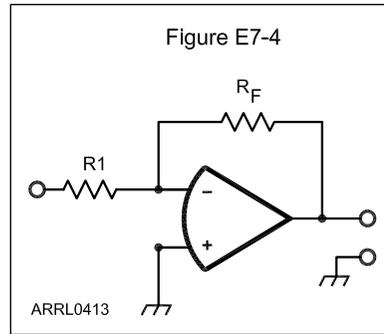


Figure E7-4 — Refer to this figure for questions E7G09 and E7G11 through E7G13.

E7G09
(C)
Page 6-9

E7G10
(D)
Page 6-7

E7G11
(D)
Page 6-9

E7G12
(C)
Page 6-9

E7G13
(B)
Page 6-9

E7G14
(A)
Page 6-7

E7G15
(C)
Page 6-8

E7G16
(D)
Page 6-7

What is the typical input impedance of an integrated circuit op-amp?

- A. 100 ohms
- B. 1000 ohms
- C. Very low
- D. Very high

E7G17
(A)
Page 6-7

What is the typical output impedance of an integrated circuit op-amp?

- A. Very low
- B. Very high
- C. 100 ohms
- D. 1000 ohms

CLASSES OF OPERATION

E7B01
(A)
Page 6-11

For what portion of a signal cycle does a Class AB amplifier operate?

- A. More than 180 degrees but less than 360 degrees
- B. Exactly 180 degrees
- C. The entire cycle
- D. Less than 180 degrees

E7B02
(C)
Page 6-12

Which class of amplifier, of the types shown, provides the highest efficiency?

- A. Class A
- B. Class B
- C. Class C
- D. Class AB

E7B03
(A)
Page 6-11

Where on the load line of a Class A common emitter amplifier would bias normally be set?

- A. Approximately half-way between saturation and cutoff
- B. Where the load line intersects the voltage axis
- C. At a point where the bias resistor equals the load resistor
- D. At a point where the load line intersects the zero bias current curve

DISTORTION AND INTERMODULATION

E7B05
(B)
Page 6-13

Which of the following amplifier types reduces or eliminates even-order harmonics?

- A. Push-push
- B. Push-pull
- C. Class C
- D. Class AB

E7B06
(D)
Page 6-13

Which of the following is a likely result when a Class C rather than a class AB amplifier is used to amplify a single-sideband phone signal?

- A. Intermodulation products will be greatly reduced
- B. Overall intelligibility will increase
- C. Part of the transmitted signal will be inverted
- D. The signal may become distorted and occupy excessive bandwidth

E7B15
(A)
Page 6-12

What is the effect of intermodulation products in a linear power amplifier?

- A. Transmission of spurious signals
- B. Creation of parasitic oscillations
- C. Low efficiency
- D. All of the above

Why are third-order intermodulation distortion products of particular concern in linear power amplifiers?

- A. Because they are relatively close in frequency to the desired signal
- B. Because they are relatively far in frequency from the desired signal
- C. Because they invert the sidebands causing distortion
- D. Because they maintain the sidebands, thus causing multiple duplicate signals

E7B16
(A)
Page 6-12

INSTABILITY AND PARASITIC OSCILLATION

What can be done to prevent unwanted oscillations in a power amplifier?

- A. Tune the stage for maximum SWR
- B. Tune both the input and output for maximum power
- C. Install parasitic suppressors and/or neutralize the stage
- D. Use a phase inverter in the output filter

E7B04
(C)
Page 6-15

How can a vacuum-tube power amplifier be neutralized?

- A. By increasing the grid drive
- B. By reducing the grid drive
- C. By feeding back an out-of-phase component of the output to the input
- D. By feeding back an in-phase component of the output to the input

E7B07
(C)
Page 6-14

VHF, UHF AND MICROWAVE AMPLIFIERS

What is a klystron?

- A. A high speed multivibrator
- B. An electron-coupled oscillator utilizing a pentode vacuum tube
- C. An oscillator utilizing ceramic elements to achieve stability
- D. A VHF, UHF, or microwave vacuum tube that uses velocity modulation

E7B18
(D)
Page 6-15

What is a parametric amplifier?

- A. A type of bipolar operational amplifier with excellent linearity derived from use of very high voltage on the collector
- B. A low-noise VHF or UHF amplifier relying on varying reactance for amplification
- C. A high power amplifier for HF application utilizing the Miller effect to increase gain
- D. An audio push-pull amplifier using silicon carbide transistors for extremely low noise

E7B19
(B)
Page 6-16

Which of the following devices is generally best suited for UHF or microwave power amplifier applications?

- A. FET
- B. Nuvistor
- C. Silicon Controlled Rectifier
- D. Triac

E7B20
(A)
Page 6-16

Chapter 6, Section 6.2

OSCILLATOR CIRCUITS AND CHARACTERISTICS

What is one aspect of the piezoelectric effect?

- A. Physical deformation of a crystal by the application of a voltage
- B. Mechanical deformation of a crystal by the application of a magnetic field
- C. The generation of electrical energy by the application of light
- D. Reversed conduction states when a P-N junction is exposed to light

E6E06
(A)
Page 6-19

<p>E7H01 (D) Page 6-18</p>	<p>What are three major oscillator circuits often used in Amateur Radio equipment? A. Taft, Pierce and negative feedback B. Pierce, Fenner and Beane C. Taft, Hartley and Pierce D. Colpitts, Hartley and Pierce</p>
<p>E7H02 (C) Page 6-17</p>	<p>What condition must exist for a circuit to oscillate? A. It must have at least two stages B. It must be neutralized C. It must have a positive feedback loop with a gain greater than 1 D. It must have negative feedback sufficient to cancel the input signal</p>
<p>E7H03 (A) Page 6-18</p>	<p>How is positive feedback supplied in a Hartley oscillator? A. Through a tapped coil B. Through a capacitive divider C. Through link coupling D. Through a neutralizing capacitor</p>
<p>E7H04 (C) Page 6-18</p>	<p>How is positive feedback supplied in a Colpitts oscillator? A. Through a tapped coil B. Through link coupling C. Through a capacitive divider D. Through a neutralizing capacitor</p>
<p>E7H05 (D) Page 6-18</p>	<p>How is positive feedback supplied in a Pierce oscillator? A. Through a tapped coil B. Through link coupling C. Through a neutralizing capacitor D. Through a quartz crystal</p>
<p>E7H06 (B) Page 6-20</p>	<p>Which type of oscillator circuits are commonly used in VFOs? A. Pierce and Zener B. Colpitts and Hartley C. Armstrong and deForest D. Negative feedback and Balanced feedback</p>
<p>E7H07 (C) Page 6-20</p>	<p>What is a magnetron oscillator? A. An oscillator in which the output is fed back to the input by the magnetic field of a transformer B. An crystal oscillator in which variable frequency is obtained by placing the crystal in a strong magnetic field C. A UHF or microwave oscillator consisting of a diode vacuum tube with a specially shaped anode, surrounded by an external magnet D. A reference standard oscillator in which the oscillations are synchronized by magnetic coupling to a rubidium gas tube</p>
<p>E7H08 (A) Page 6-20</p>	<p>What is a Gunn diode oscillator? A. An oscillator based on the negative resistance properties of properly-doped semiconductors B. An oscillator based on the argon gas diode C. A highly stable reference oscillator based on the tee-notch principle D. A highly stable reference oscillator based on the hot-carrier effect</p>

DIGITAL SIGNAL PROCESSING (DSP)

Which of these methods is commonly used to convert analog signals to digital signals?

- A. Sequential sampling
- B. Harmonic regeneration
- C. Level shifting
- D. Phase reversal

E8A14
(A)
Page 6-21

MIXERS

What is one result of the process of mixing two signals?

- A. The elimination of noise in a wideband receiver by phase comparison
- B. The elimination of noise in a wideband receiver by phase differentiation
- C. The recovery of the intelligence from a modulated RF signal
- D. The creation of new signals at the sum and difference frequencies

E7E07
(D)
Page 6-25

What are the principal frequencies that appear at the output of a mixer circuit?

- A. Two and four times the original frequency
- B. The sum, difference and square root of the input frequencies
- C. The original frequencies, and the sum and difference frequencies
- D. 1.414 and 0.707 times the input frequency

E7E08
(C)
Page 6-25

What occurs when an excessive amount of signal energy reaches a mixer circuit?

- A. Spurious mixer products are generated
- B. Mixer blanking occurs
- C. Automatic limiting occurs
- D. A beat frequency is generated

E7E09
(A)
Page 6-25

MODULATORS

What type of digital signal processing filter might be used in generating an SSB signal?

- A. An adaptive filter
- B. A notch filter
- C. A Hilbert-transform filter
- D. An elliptical filter

E7C09
(C)
Page 6-29

Which of the following can be used to generate FM-phone emissions?

- A. A balanced modulator on the audio amplifier
- B. A reactance modulator on the oscillator
- C. A reactance modulator on the final amplifier
- D. A balanced modulator on the oscillator

E7E01
(B)
Page 6-29

What is the function of a reactance modulator?

- A. To produce PM signals by using an electrically variable resistance
- B. To produce AM signals by using an electrically variable inductance or capacitance
- C. To produce AM signals by using an electrically variable resistance
- D. To produce PM signals by using an electrically variable inductance or capacitance

E7E02
(D)
Page 6-30

What is the fundamental principle of a phase modulator?

- A. It varies the tuning of a microphone preamplifier to produce PM signals
- B. It varies the tuning of an amplifier tank circuit to produce AM signals
- C. It varies the tuning of an amplifier tank circuit to produce PM signals
- D. It varies the tuning of a microphone preamplifier to produce AM signals

E7E03
(C)
Page 6-30

- E7E04
(A)
Page 6-28
- What is one way a single-sideband phone signal can be generated?
- A. By using a balanced modulator followed by a filter
 - B. By using a reactance modulator followed by a mixer
 - C. By using a loop modulator followed by a mixer
 - D. By driving a product detector with a DSB signal
- E7E05
(D)
Page 6-31
- What circuit is added to an FM transmitter to proportionally attenuate the lower audio frequencies?
- A. A de-emphasis network
 - B. A heterodyne suppressor
 - C. An audio prescaler
 - D. A pre-emphasis network
- E7E06
(A)
Page 6-31
- What circuit is added to an FM receiver to restore attenuated lower audio frequencies?
- A. A de-emphasis network
 - B. A heterodyne suppressor
 - C. An audio prescaler
 - D. A pre-emphasis network
- E7E14
(D)
Page 6-29
- Which of the following describes a common means of generating a SSB signal when using digital signal processing?
- A. Mixing products are converted to voltages and subtracted by adder circuits
 - B. A frequency synthesizer removes the unwanted sidebands
 - C. Emulation of quartz crystal filter characteristics
 - D. The phasing or quadrature method

DETECTORS AND DEMODULATORS

- E7E10
(B)
Page 6-31
- What is the process of detection?
- A. The extraction of weak signals from noise
 - B. The recovery of information from a modulated RF signal
 - C. The modulation of a carrier
 - D. The mixing of noise with a received signal
- E7E11
(A)
Page 6-31
- How does a diode detector function?
- A. By rectification and filtering of RF signals
 - B. By breakdown of the Zener voltage
 - C. By mixing signals with noise in the transition region of the diode
 - D. By sensing the change of reactance in the diode with respect to frequency
- E7E12
(C)
Page 6-31
- Which of the following types of detector is well suited for demodulating SSB signals?
- A. Discriminator
 - B. Phase detector
 - C. Product detector
 - D. Phase comparator
- E7E13
(D)
Page 6-32
- What is a frequency discriminator?
- A. An FM generator circuit
 - B. A circuit for filtering two closely adjacent signals
 - C. An automatic band-switching circuit
 - D. A circuit for detecting FM signals

- What is meant by “direct conversion” when referring to a software defined receiver?
- A. Software is converted from source code to object code during operation of the receiver
 - B. Incoming RF is converted to the IF frequency by rectification to generate the control voltage for a voltage controlled oscillator
 - C. Incoming RF is mixed to “baseband” for analog-to-digital conversion and subsequent processing
 - D. Software is generated in machine language, avoiding the need for compilers

E7E15
(C)
Page 6-32

FREQUENCY SYNTHESIS

What type of frequency synthesizer circuit uses a stable voltage-controlled oscillator, programmable divider, phase detector, loop filter and a reference frequency source?

E7H09
(C)
Page 6-34

- A. A direct digital synthesizer
- B. A hybrid synthesizer
- C. A phase locked loop synthesizer
- D. A diode-switching matrix synthesizer

What type of frequency synthesizer circuit uses a phase accumulator, lookup table, digital to analog converter and a low-pass anti-alias filter?

E7H10
(A)
Page 6-35

- A. A direct digital synthesizer
- B. A hybrid synthesizer
- C. A phase locked loop synthesizer
- D. A diode-switching matrix synthesizer

What information is contained in the lookup table of a direct digital frequency synthesizer?

E7H11
(B)
Page 6-35

- A. The phase relationship between a reference oscillator and the output waveform
- B. The amplitude values that represent a sine-wave output
- C. The phase relationship between a voltage-controlled oscillator and the output waveform
- D. The synthesizer frequency limits and frequency values stored in the radio memories

What are the major spectral impurity components of direct digital synthesizers?

E7H12
(C)
Page 6-35

- A. Broadband noise
- B. Digital conversion noise
- C. Spurs at discrete frequencies
- D. Nyquist limit noise

Which of these circuits would be classified as a principal component of a direct digital synthesizer (DDS)?

E7H13
(D)
Page 6-35

- A. Phase splitter
- B. Hex inverter
- C. Chroma demodulator
- D. Phase accumulator

What circuit is often used in conjunction with a direct digital synthesizer (DDS) to expand the available tuning range?

E7H14
(C)
Page 6-33

- A. Binary expander
- B. J-K flip-flop
- C. Phase locked loop
- D. Compander

What is the capture range of a phase-locked loop circuit?

E7H15
(A)
Page 6-34

- A. The frequency range over which the circuit can lock
- B. The voltage range over which the circuit can lock
- C. The input impedance range over which the circuit can lock
- D. The range of time it takes the circuit to lock

- E7H16
(C)
Page 6-34
- What is a phase-locked loop circuit?
- A. An electronic servo loop consisting of a ratio detector, reactance modulator, and voltage-controlled oscillator
 - B. An electronic circuit also known as a monostable multivibrator
 - C. An electronic servo loop consisting of a phase detector, a low-pass filter and voltage-controlled oscillator
 - D. An electronic circuit consisting of a precision push-pull amplifier with a differential input
- E7H17
(D)
Page 6-34
- Which of these functions can be performed by a phase-locked loop?
- A. Wide-band AF and RF power amplification
 - B. Comparison of two digital input signals, digital pulse counter
 - C. Photovoltaic conversion, optical coupling
 - D. Frequency synthesis, FM demodulation
- E7H18
(B)
Page 6-34
- Why is a stable reference oscillator normally used as part of a phase locked loop (PLL) frequency synthesizer?
- A. Any amplitude variations in the reference oscillator signal will prevent the loop from locking to the desired signal
 - B. Any phase variations in the reference oscillator signal will produce phase noise in the synthesizer output
 - C. Any phase variations in the reference oscillator signal will produce harmonic distortion in the modulating signal
 - D. Any amplitude variations in the reference oscillator signal will prevent the loop from changing frequency
- E7H19
(C)
Page 6-34
- Why is a phase-locked loop often used as part of a variable frequency synthesizer for receivers and transmitters?
- A. It generates FM sidebands
 - B. It eliminates the need for a voltage controlled oscillator
 - C. It makes it possible for a VFO to have the same degree of stability as a crystal oscillator
 - D. It can be used to generate or demodulate SSB signals by quadrature phase synchronization
- E7H20
(A)
Page 6-34
- What are the major spectral impurity components of phase-locked loop synthesizers?
- A. Broadband noise
 - B. Digital conversion noise
 - C. Spurs at discrete frequencies
 - D. Nyquist limit noise

Chapter 6, Section 6.3

FILTER FAMILIES AND RESPONSE TYPES

- E7C05
(D)
Page 6-37
- Which filter type is described as having ripple in the passband and a sharp cutoff?
- A. A Butterworth filter
 - B. An active LC filter
 - C. A passive op-amp filter
 - D. A Chebyshev filter
- E7C06
(C)
Page 6-37
- What are the distinguishing features of an elliptical filter?
- A. Gradual passband rolloff with minimal stop-band ripple
 - B. Extremely flat response over its passband, with gradually rounded stop-band corners
 - C. Extremely sharp cutoff, with one or more infinitely deep notches in the stop band
 - D. Gradual passband rolloff with extreme stop-band ripple

<p>What kind of audio filter would you use to attenuate an interfering carrier signal while receiving an SSB transmission?</p> <p>A. A band-pass filter B. A notch filter C. A Pi-network filter D. An all-pass filter</p>	<p>E7C07 (B) Page 6-38</p>
<p>Which of the following filters would be the best choice for use in a 2-meter repeater duplexer?</p> <p>A. A crystal filter B. A cavity filter C. A DSP filter D. An L-C filter</p>	<p>E7C10 (B) Page 6-36</p>
<p>Which of these modes is most affected by non-linear phase response in a receiver IF filter?</p> <p>A. Meteor Scatter B. Single-Sideband Voice C. Digital D. Video</p>	<p>E7C14 (C) Page 6-37</p>
<p>What causes ringing in a filter?</p> <p>A. The slew rate of the filter B. The bandwidth of the filter C. The frequency and phase response of the filter D. The gain of the filter</p>	<p>E7G02 (C) Page 6-37</p>
<p>CRYSTAL FILTERS</p>	
<p>Which of these filter bandwidths would be a good choice for use in a SSB radiotelephone transmitter?</p> <p>A. 6 kHz at -6 dB B. 2.4 kHz at -6 dB C. 500 Hz at -6 dB D. 15 kHz at -6 dB</p>	<p>E6E01 (B) Page 6-38</p>
<p>Which of these filter bandwidths would be a good choice for use with standard double-sideband AM transmissions?</p> <p>A. 1 kHz at -6 dB B. 500 Hz at -6 dB C. 6 kHz at -6 dB D. 15 kHz at -6 dB</p>	<p>E6E02 (C) Page 6-38</p>
<p>What is a crystal lattice filter?</p> <p>A. A power supply filter made with interlaced quartz crystals B. An audio filter made with four quartz crystals that resonate at 1-kHz intervals C. A filter with wide bandwidth and shallow skirts made using quartz crystals D. A filter with narrow bandwidth and steep skirts made using quartz crystals</p>	<p>E6E03 (D) Page 6-38</p>
<p>What technique is used to construct low-cost, high-performance crystal ladder filters?</p> <p>A. Obtain a small quantity of custom-made crystals B. Choose a crystal with the desired bandwidth and operating frequency to match a desired center frequency C. Measure crystal bandwidth to ensure at least 20% coupling D. Measure crystal frequencies and carefully select units with a frequency variation of less than 10% of the desired filter bandwidth</p>	<p>E6E04 (D) Page 6-39</p>

- E6E05
(A)
Page 6-39
- Which of the following factors has the greatest effect in helping determine the bandwidth and response shape of a crystal ladder filter?
- A. The relative frequencies of the individual crystals
 - B. The DC voltage applied to the quartz crystal
 - C. The gain of the RF stage preceding the filter
 - D. The amplitude of the signals passing through the filter

ACTIVE FILTERS

- E7G01
(B)
Page 6-39
- What determines the gain and frequency characteristics of an op-amp RC active filter?
- A. The values of capacitors and resistors built into the op-amp
 - B. The values of capacitors and resistors external to the op-amp
 - C. The input voltage and frequency of the op-amp's DC power supply
 - D. The output voltage and smoothness of the op-amp's DC power supply
- E7G03
(D)
Page 6-39
- What are the advantages of using an op-amp instead of LC elements in an audio filter?
- A. Op-amps are more rugged and can withstand more abuse than can LC elements
 - B. Op-amps are fixed at one frequency
 - C. Op-amps are available in more varieties than are LC elements
 - D. Op-amps exhibit gain rather than insertion loss
- E7G04
(C)
Page 6-40
- Which of the following capacitor types is best suited for use in high-stability op-amp RC active filter circuits?
- A. Electrolytic
 - B. Disc ceramic
 - C. Polystyrene
 - D. Paper dielectric
- E7G05
(A)
Page 6-40
- How can unwanted ringing and audio instability be prevented in a multi-section op-amp RC audio filter circuit?
- A. Restrict both gain and Q
 - B. Restrict gain, but increase Q
 - C. Restrict Q, but increase gain
 - D. Increase both gain and Q
- E7G06
(A)
Page 6-40
- What steps are typically followed when selecting the external components for an op-amp RC active filter?
- A. Standard capacitor values are chosen first, the resistances are calculated, and resistors of the nearest standard value are used
 - B. Standard resistor values are chosen first, the capacitances are calculated, and capacitors of the nearest standard value are used
 - C. Standard resistor and capacitor values are used, the circuit is tested, and additional resistors are added to make any needed adjustments
 - D. Standard resistor and capacitor values are used, the circuit is tested, and additional capacitors are added to make any needed adjustments
- E7G07
(D)
Page 6-39
- Which of the following is the most appropriate use of an op-amp RC active filter?
- A. As a high-pass filter used to block RFI at the input to receivers
 - B. As a low-pass filter used between a transmitter and a transmission line
 - C. For smoothing power-supply output
 - D. As an audio receiving filter

Which of the following is a type of active op-amp filter circuit?

- A. Regenerative feedback resonator
- B. Helical resonator
- C. Gilbert cell
- D. Sallen-Key

E7G08
(D)
Page 6-40

DIGITAL SIGNAL PROCESSING (DSP) FILTERS

What kind of digital signal processing audio filter might be used to remove unwanted noise from a received SSB signal?

- A. An adaptive filter
- B. A crystal-lattice filter
- C. A Hilbert-transform filter
- D. A phase-inverting filter

E7C08
(A)
Page 6-41

IMPEDANCE MATCHING

Which of the following describes how the loading and tuning capacitors are to be adjusted when tuning a vacuum tube RF power amplifier that employs a pi-network output circuit?

- A. The loading capacitor is set to maximum capacitance and the tuning capacitor is adjusted for minimum allowable plate current
- B. The tuning capacitor is set to maximum capacitance and the loading capacitor is adjusted for minimum plate permissible current
- C. The loading capacitor is adjusted to minimum plate current while alternately adjusting the tuning capacitor for maximum allowable plate current
- D. The tuning capacitor is adjusted for minimum plate current, while the loading capacitor is adjusted for maximum permissible plate current

E7B08
(D)
Page 6-42

How are the capacitors and inductors of a low-pass filter Pi-network arranged between the network's input and output?

- A. Two inductors are in series between the input and output and a capacitor is connected between the two inductors and ground
- B. Two capacitors are in series between the input and output and an inductor is connected between the two capacitors and ground
- C. An inductor is in parallel with the input, another inductor is in parallel with the output, and a capacitor is in series between the two
- D. A capacitor is in parallel with the input, another capacitor is in parallel with the output, and an inductor is in series between the two

E7C01
(D)
Page 6-42

A T-network with series capacitors and a parallel (shunt) inductor has which of the following properties?

- A. It transforms impedance and is a low-pass filter
- B. It transforms reactance and is a low-pass filter
- C. It transforms impedance and is a high-pass filter
- D. It transforms reactance and is a narrow bandwidth notch filter

E7C02
(C)
Page 6-43

What advantage does a Pi-L-network have over a Pi-network for impedance matching between the final amplifier of a vacuum-tube type transmitter and an antenna?

- A. Greater harmonic suppression
- B. Higher efficiency
- C. Lower losses
- D. Greater transformation range

E7C03
(A)
Page 6-43

- E7C04
(C)
Page 6-41
- How does a network transform a complex impedance to a resistive impedance?
- A. It introduces negative resistance to cancel the resistive part of an impedance
 - B. It introduces transconductance to cancel the reactive part of an impedance
 - C. It cancels the reactive part of an impedance and transforms the resistive part to the desired value
 - D. Network resistances are substituted for load resistances
- E7C11
(D)
Page 6-42
- Which of the following is the common name for a filter network which is equivalent to two L networks back-to-back?
- A. Pi-L
 - B. Cascode
 - C. Omega
 - D. Pi
- E7C12
(B)
Page 6-43
- What is a Pi-L network, as used when matching a vacuum-tube final amplifier to a 50-ohm unbalanced output?
- A. A Phase Inverter Load network
 - B. A network consisting of two series inductors and two shunt capacitors
 - C. A network with only three discrete parts
 - D. A matching network in which all components are isolated from ground
- E7C13
(A)
Page 6-43
- What is one advantage of a Pi matching network over an L matching network?
- A. Q of Pi networks can be varied depending on the component values chosen
 - B. L networks can not perform impedance transformation
 - C. Pi networks have fewer components
 - D. Pi networks are designed for balanced input and output

Chapter 6, Section 6.4

LINEAR VOLTAGE REGULATORS

- E7D01
(D)
Page 6-44
- What is one characteristic of a linear electronic voltage regulator?
- A. It has a ramp voltage as its output
 - B. It eliminates the need for a pass transistor
 - C. The control element duty cycle is proportional to the line or load conditions
 - D. The conduction of a control element is varied to maintain a constant output voltage
- E7D03
(A)
Page 6-45
- What device is typically used as a stable reference voltage in a linear voltage regulator?
- A. A Zener diode
 - B. A tunnel diode
 - C. An SCR
 - D. A varactor diode
- E7D04
(B)
Page 6-45
- Which of the following types of linear regulator makes the most efficient use of the primary power source?
- A. A constant current source
 - B. A series regulator
 - C. A shunt regulator
 - D. A shunt current source

Which of the following types of linear voltage regulator places a constant load on the unregulated voltage source?

- A. A constant current source
- B. A series regulator
- C. A shunt current source
- D. A shunt regulator

What is the purpose of Q1 in the circuit shown in Figure E7-3?

- A. It provides negative feedback to improve regulation
- B. It provides a constant load for the voltage source
- C. It increases the current-handling capability of the regulator
- D. It provides D1 with current

What is the purpose of C2 in the circuit shown in Figure E7-3?

- A. It bypasses hum around D1
- B. It is a brute force filter for the output
- C. To self-resonate at the hum frequency
- D. To provide fixed DC bias for Q1

What type of circuit is shown in Figure E7-3?

- A. Switching voltage regulator
- B. Grounded emitter amplifier
- C. Linear voltage regulator
- D. Emitter follower

What is the purpose of C1 in the circuit shown in Figure E7-3?

- A. It resonates at the ripple frequency
- B. It provides fixed bias for Q1
- C. It decouples the output
- D. It filters the supply voltage

What is the purpose of C3 in the circuit shown in Figure E7-3?

- A. It prevents self-oscillation
- B. It provides brute force filtering of the output
- C. It provides fixed bias for Q1
- D. It clips the peaks of the ripple

What is the purpose of R1 in the circuit shown in Figure E7-3?

- A. It provides a constant load to the voltage source
- B. It couples hum to D1
- C. It supplies current to D1
- D. It bypasses hum around D1

What is the purpose of R2 in the circuit shown in Figure E7-3?

- A. It provides fixed bias for Q1
- B. It provides fixed bias for D1
- C. It decouples hum from D1
- D. It provides a constant minimum load for Q1

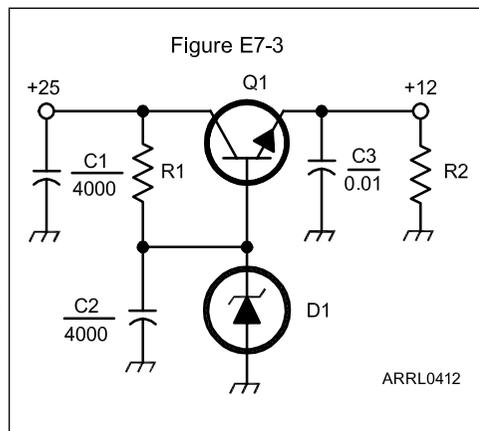


Figure E7-3 — Refer to this figure for questions E7D06 through E7D13.

E7D05
(D)
Page 6-44

E7D06
(C)
Page 6-45

E7D07
(A)
Page 6-45

E7D08
(C)
Page 6-44

E7D09
(D)
Page 6-45

E7D10
(A)
Page 6-45

E7D11
(C)
Page 6-45

E7D12
(D)
Page 6-44

E7D13
(B)
Page 6-45

- What is the purpose of D1 in the circuit shown in Figure E7-3?
- A. To provide line voltage stabilization
 - B. To provide a voltage reference
 - C. Peak clipping
 - D. Hum filtering

SWITCHING REGULATORS

E7D02
(C)
Page 6-45

- What is one characteristic of a switching electronic voltage regulator?
- A. The resistance of a control element is varied in direct proportion to the line voltage or load current
 - B. It is generally less efficient than a linear regulator
 - C. The control device's duty cycle is controlled to produce a constant average output voltage
 - D. It gives a ramp voltage at its output

E7D17
(C)
Page 6-45

- What is the primary reason that a high-frequency inverter type high-voltage power supply can be both less expensive and lighter in weight than a conventional power supply?
- A. The inverter design does not require any output filtering
 - B. It uses a diode bridge rectifier for increased output
 - C. The high frequency inverter design uses much smaller transformers and filter components for an equivalent power output
 - D. It uses a large power-factor compensation capacitor to create "free" power from the unused portion of the AC cycle

HIGH VOLTAGE TECHNIQUES

E7D14
(C)
Page 6-46

- What is one purpose of a "bleeder" resistor in a conventional (unregulated) power supply?
- A. To cut down on waste heat generated by the power supply
 - B. To balance the low-voltage filament windings
 - C. To improve output voltage regulation
 - D. To boost the amount of output current

E7D15
(D)
Page 6-46

- What is the purpose of a "step-start" circuit in a high-voltage power supply?
- A. To provide a dual-voltage output for reduced power applications
 - B. To compensate for variations of the incoming line voltage
 - C. To allow for remote control of the power supply
 - D. To allow the filter capacitors to charge gradually

E7D16
(D)
Page 6-46

- When several electrolytic filter capacitors are connected in series to increase the operating voltage of a power supply filter circuit, why should resistors be connected across each capacitor?
- A. To equalize, as much as possible, the voltage drop across each capacitor
 - B. To provide a safety bleeder to discharge the capacitors when the supply is off
 - C. To provide a minimum load current to reduce voltage excursions at light loads
 - D. All of these answers are correct

Chapter 7, Section 7.1

TYPES OF WAVEFORMS

E8A01
(A)
Page 7-4

- What type of wave is made up of a sine wave plus all of its odd harmonics?
- A. A square wave
 - B. A sine wave
 - C. A cosine wave
 - D. A tangent wave

What type of wave has a rise time significantly faster than its fall time (or vice versa)?

- A. A cosine wave
- B. A square wave
- C. A sawtooth wave
- D. A sine wave

E8A02
(C)
Page 7-3

What type of wave is made up of sine waves of a given fundamental frequency plus all its harmonics?

- A. A sawtooth wave
- B. A square wave
- C. A sine wave
- D. A cosine wave

E8A03
(A)
Page 7-3

What is the period of a wave?

- A. The time required to complete one cycle
- B. The number of degrees in one cycle
- C. The number of zero crossings in one cycle
- D. The amplitude of the wave

E8A08
(A)
Page 7-2

What type of waveform is produced by human speech?

- A. Sinusoidal
- B. Logarithmic
- C. Irregular
- D. Trapezoidal

E8A09
(C)
Page 7-3

Which of the following is a distinguishing characteristic of a pulse waveform?

- A. Regular sinusoidal oscillations
- B. Narrow bursts of energy separated by periods of no signal
- C. A series of tones that vary between two frequencies
- D. A signal that contains three or more discrete tones

E8A10
(B)
Page 7-4

AC MEASUREMENTS

What is the equivalent to the root-mean-square value of an AC voltage?

- A. The AC voltage found by taking the square of the average value of the peak AC voltage
- B. The DC voltage causing the same amount of heating in a given resistor as the corresponding peak AC voltage
- C. The DC voltage causing the same amount of heating in a resistor as the corresponding RMS AC voltage
- D. The AC voltage found by taking the square root of the average AC value

E8A04
(C)
Page 7-5

What would be the most accurate way of measuring the RMS voltage of a complex waveform?

- A. By using a grid dip meter
- B. By measuring the voltage with a D'Arsonval meter
- C. By using an absorption wavemeter
- D. By measuring the heating effect in a known resistor

E8A05
(D)
Page 7-5

What is the relationship between the peak-to-peak voltage and the peak voltage amplitude of a symmetrical waveform?

- A. 0.707:1
- B. 2:1
- C. 1.414:1
- D. 4:1

E8D02
(B)
Page 7-5

E8D03
(A)
Page 7-5

What input-amplitude parameter is valuable in evaluating the signal-handling capability of a Class A amplifier?

- A. Peak voltage
- B. RMS voltage
- C. Average power
- D. Resting voltage

E8D05
(D)
Page 7-6

If an RMS-reading AC voltmeter reads 65 volts on a sinusoidal waveform, what is the peak-to-peak voltage?

- A. 46 volts
- B. 92 volts
- C. 130 volts
- D. 184 volts

E8D15
(D)
Page 7-6

If an RMS reading voltmeter reads 34 volts on a sinusoidal waveform, what is the peak voltage?

- A. 123 volts
- B. 96 volts
- C. 55 volts
- D. 48 volts

E8D16
(B)
Page 7-6

Which of the following is a typical value for the peak voltage at a common household electrical outlet?

- A. 240 volts
- B. 170 volts
- C. 120 volts
- D. 340 volts

E8D17
(C)
Page 7-6

Which of the following is a typical value for the peak-to-peak voltage at a common household electrical outlet?

- A. 240 volts
- B. 120 volts
- C. 340 volts
- D. 170 volts

E8D18
(A)
Page 7-6

Which of the following is a typical value for the RMS voltage at a common household electrical power outlet?

- A. 120-V AC
- B. 340-V AC
- C. 85-V AC
- D. 170-V AC

E8D19
(A)
Page 7-6

What is the RMS value of a 340-volt peak-to-peak pure sine wave?

- A. 120-V AC
- B. 170-V AC
- C. 240-V AC
- D. 300-V AC

POWER OF MODULATED RF SIGNALS

E8A06
(A)
Page 7-8

What is the approximate ratio of PEP-to-average power in a typical voice-modulated single-sideband phone signal?

- A. 2.5 to 1
- B. 25 to 1
- C. 1 to 1
- D. 100 to 1

What determines the PEP-to-average power ratio of a single-sideband phone signal?

- A. The frequency of the modulating signal
- B. The characteristics of the modulating signal
- C. The degree of carrier suppression
- D. The amplifier gain

E8A07
(B)
Page 7-8

What is the PEP output of a transmitter that has a maximum peak of 30 volts to a 50-ohm load as observed on an oscilloscope?

- A. 4.5 watts
- B. 9 watts
- C. 16 watts
- D. 18 watts

E8D04
(B)
Page 7-8

What is the advantage of using a peak-reading wattmeter to monitor the output of a SSB phone transmitter?

- A. It is easier to determine the correct tuning of the output circuit
- B. It gives a more accurate display of the PEP output when modulation is present
- C. It makes it easier to detect high SWR on the feed-line
- D. It can determine if any “flat-topping” is present during modulation peaks

E8D06
(B)
Page 7-8

What type of meter should be used to monitor the output signal of a voice-modulated single-sideband transmitter to ensure you do not exceed the maximum allowable power?

- A. An SWR meter reading in the forward direction
- B. A modulation meter
- C. An average reading wattmeter
- D. A peak-reading wattmeter

E8D13
(D)
Page 7-8

What is the average power dissipated by a 50-ohm resistive load during one complete RF cycle having a peak voltage of 35 volts?

- A. 12.2 watts
- B. 9.9 watts
- C. 24.5 watts
- D. 16 watts

E8D14
(A)
Page 7-7

ELECTROMAGNETIC FIELDS

What is an electromagnetic wave?

- A. Alternating currents in the core of an electromagnet
- B. A wave consisting of two electric fields at right angles to each other
- C. A wave consisting of an electric field and a magnetic field oscillating at right angles to each other
- D. A wave consisting of two magnetic fields at right angles to each other

E8D07
(C)
Page 7-9

Which of the following best describes electromagnetic waves traveling in free space?

- A. Electric and magnetic fields become aligned as they travel
- B. The energy propagates through a medium with a high refractive index
- C. The waves are reflected by the ionosphere and return to their source
- D. Changing electric and magnetic fields propagate the energy

E8D08
(D)
Page 7-9

What is meant by circularly polarized electromagnetic waves?

- A. Waves with an electric field bent into a circular shape
- B. Waves with a rotating electric field
- C. Waves that circle the Earth
- D. Waves produced by a loop antenna

E8D09
(B)
Page 7-11

E8D10
(D)
Page 7-10

What is the polarization of an electromagnetic wave if its magnetic field is parallel to the surface of the Earth?

- A. Circular
- B. Horizontal
- C. Elliptical
- D. Vertical

E8D11
(A)
Page 7-10

What is the polarization of an electromagnetic wave if its magnetic field is perpendicular to the surface of the Earth?

- A. Horizontal
- B. Circular
- C. Elliptical
- D. Vertical

E8D12
(A)
Page 7-10

At approximately what speed do electromagnetic waves travel in free space?

- A. 300 million meters per second
- B. 186,300 meters per second
- C. 186,300 feet per second
- D. 300 million miles per second

Chapter 7, Section 7.2

INSTRUMENTS AND ACCURACY

E4A11
(A)
Page 7-15

Which of the following test instruments can be used to indicate pulse conditions in a digital logic circuit?

- A. A logic probe
- B. An ohmmeter
- C. An electroscopes
- D. A Wheatstone bridge

E4B01
(B)
Page 7-12

Which of the following is a characteristic of a good harmonic frequency marker?

- A. Wide tuning range
- B. Frequency stability
- C. Linear output amplifier
- D. All of the above

E4B02
(B)
Page 7-15

Which of the following factors most affects the accuracy of a frequency counter?

- A. Input attenuator accuracy
- B. Time base accuracy
- C. Decade divider accuracy
- D. Temperature coefficient of the logic

E4B03
(C)
Page 7-14

What is an advantage of using a bridge circuit to measure impedance?

- A. It provides an excellent match under all conditions
- B. It is relatively immune to drift in the signal generator source
- C. The measurement is based on obtaining a null in voltage, which can be done very precisely
- D. It can display results directly in Smith chart format

<p>If a frequency counter with a specified accuracy of +/- 1.0 ppm reads 146,520,000 Hz, what is the most the actual frequency being measured could differ from the reading?</p> <p>A. 165.2 Hz B. 14.652 kHz C. 146.52 Hz D. 1.4652 MHz</p>	<p>E4B04 (C) Page 7-16</p>
<p>If a frequency counter with a specified accuracy of +/- 0.1 ppm reads 146,520,000 Hz, what is the most the actual frequency being measured could differ from the reading?</p> <p>A. 14.652 Hz B. 0.1 MHz C. 1.4652 Hz D. 1.4652 kHz</p>	<p>E4B05 (A) Page 7-16</p>
<p>If a frequency counter with a specified accuracy of +/- 10 ppm reads 146,520,000 Hz, what is the most the actual frequency being measured could differ from the reading?</p> <p>A. 146.52 Hz B. 10 Hz C. 146.52 kHz D. 1465.20 Hz</p>	<p>E4B06 (D) Page 7-16</p>
<p>Which of the following is a characteristic of a good DC voltmeter?</p> <p>A. High reluctance input B. Low reluctance input C. High impedance input D. Low impedance input</p>	<p>E4B09 (C) Page 7-12</p>
<p>What is the significance of voltmeter sensitivity expressed in ohms per volt?</p> <p>A. The full scale reading of the voltmeter multiplied by its ohms per volt rating will provide the input impedance of the voltmeter B. When used as a galvanometer, the reading in volts multiplied by the ohms/volt will determine the power drawn by the device under test C. When used as an ohmmeter, the reading in ohms divided by the ohms/volt will determine the voltage applied to the circuit D. When used as an ammeter, the full scale reading in amps divided by ohms/volt will determine the size of shunt needed</p>	<p>E4B13 (A) Page 7-12</p>
<p>What happens if a dip-meter is too tightly coupled to a tuned circuit being checked?</p> <p>A. Harmonics are generated B. A less accurate reading results C. Cross modulation occurs D. Intermodulation distortion occurs</p>	<p>E4B15 (B) Page 7-14</p>
<p>Which of these factors limits the accuracy of a D'Arsonval-type meter?</p> <p>A. Its magnetic flux density B. Coil impedance C. Deflection rate D. Electromagnet current</p>	<p>E4B16 (B) Page 7-12</p>
<p>THE OSCILLOSCOPE</p>	
<p>Which of the following is good practice when using an oscilloscope probe?</p> <p>A. Keep the ground connection of the probe as short as possible B. Never use a high impedance probe to measure a low impedance circuit C. Never use a DC-coupled probe to measure an AC circuit D. All of these choices are correct</p>	<p>E4B08 (A) Page 7-18</p>

- E4B14
(A)
Page 7-18
- How is the compensation of an oscilloscope probe typically adjusted?
- A. A square wave is observed and the probe is adjusted until the horizontal portions of the displayed wave is as nearly flat as possible
 - B. A high frequency sine wave is observed, and the probe is adjusted for maximum amplitude
 - C. A frequency standard is observed, and the probe is adjusted until the deflection time is accurate
 - D. A DC voltage standard is observed, and the probe is adjusted until the displayed voltage is accurate
- E8D01
(A)
Page 7-18
- What is the easiest voltage amplitude parameter to measure when viewing a pure sine wave signal on an oscilloscope?
- A. Peak-to-peak voltage
 - B. RMS voltage
 - C. Average voltage
 - D. DC voltage
- THE SPECTRUM ANALYZER**
- E4A01
(C)
Page 7-18
- How does a spectrum analyzer differ from a conventional oscilloscope?
- A. A spectrum analyzer measures ionospheric reflection; an oscilloscope displays electrical signals
 - B. A spectrum analyzer displays the peak amplitude of signals; an oscilloscope displays the average amplitude of signals
 - C. A spectrum analyzer displays signals in the frequency domain; an oscilloscope displays signals in the time domain
 - D. A spectrum analyzer displays radio frequencies; an oscilloscope displays audio frequencies
- E4A02
(D)
Page 7-19
- Which of the following parameters would a typical spectrum analyzer display on the horizontal axis?
- A. SWR
 - B. Q
 - C. Time
 - D. Frequency
- E4A03
(A)
Page 7-19
- Which of the following parameters would a typical spectrum analyzer display on the vertical axis?
- A. Amplitude
 - B. Duration
 - C. SWR
 - D. Q
- E4A04
(A)
Page 7-19
- Which of the following test instruments is used to display spurious signals from a radio transmitter?
- A. A spectrum analyzer
 - B. A wattmeter
 - C. A logic analyzer
 - D. A time-domain reflectometer
- E4A05
(B)
Page 7-20
- Which of the following test instruments is used to display intermodulation distortion products in an SSB transmission?
- A. A wattmeter
 - B. A spectrum analyzer
 - C. A logic analyzer
 - D. A time-domain reflectometer
- E4A06
(D)
Page 7-21
- Which of the following could be determined with a spectrum analyzer?
- A. The degree of isolation between the input and output ports of a 2 meter duplexer
 - B. Whether a crystal is operating on its fundamental or overtone frequency
 - C. The spectral output of a transmitter
 - D. All of these choices are correct

Which of the following procedures is an important precaution to follow when connecting a spectrum analyzer to a transmitter output?

- A. Use high quality double shielded coaxial cables to reduce signal losses
- B. Attenuate the transmitter output going to the spectrum analyzer
- C. Match the antenna to the load
- D. All of these choices are correct

E4A12
(B)
Page 7-20

Which of the following describes a method to measure intermodulation distortion in an SSB transmitter?

- A. Modulate the transmitter with two non-harmonically related radio frequencies and observe the RF output with a spectrum analyzer
- B. Modulate the transmitter with two non-harmonically related audio frequencies and observe the RF output with a spectrum analyzer
- C. Modulate the transmitter with two harmonically related audio frequencies and observe the RF output with a peak reading wattmeter
- D. Modulate the transmitter with two harmonically related audio frequencies and observe the RF output with a logic analyzer

E4B11
(B)
Page 7-20

TRANSISTOR CIRCUIT PARAMETERS

Which of the following is a useful test for a functioning NPN transistor in an active circuit where the transistor should be biased “on” ?

- A. Measure base-to-emitter resistance with an ohmmeter; it should be approximately 6 to 7 ohms
- B. Measure base-to-emitter resistance with an ohmmeter; it should be approximately 0.6 to 0.7 ohms
- C. Measure base-to-emitter voltage with a voltmeter; it should be approximately 6 to 7 volts
- D. Measure base-to-emitter voltage with a voltmeter; it should be approximately 0.6 to 0.7 volts

E4A10
(D)
Page 7-21

Chapter 7, Section 7.3

FM/PM MODULATION AND MODULATORS

What is the term for the ratio between the frequency deviation of an RF carrier wave, and the modulating frequency of its corresponding FM-phone signal?

- A. FM compressibility
- B. Quieting index
- C. Percentage of modulation
- D. Modulation index

E8B01
(D)
Page 7-25

How does the modulation index of a phase-modulated emission vary with RF carrier frequency (the modulated frequency)?

- A. It increases as the RF carrier frequency increases
- B. It decreases as the RF carrier frequency increases
- C. It varies with the square root of the RF carrier frequency
- D. It does not depend on the RF carrier frequency

E8B02
(D)
Page 7-26

What is the modulation index of an FM-phone signal having a maximum frequency deviation of 3000 Hz either side of the carrier frequency, when the modulating frequency is 1000 Hz?

- A. 3
- B. 0.3
- C. 3000
- D. 1000

E8B03
(A)
Page 7-26

E8B04
(B)
Page 7-26

What is the modulation index of an FM-phone signal having a maximum carrier deviation of plus or minus 6 kHz when modulated with a 2-kHz modulating frequency?

- A. 6000
- B. 3
- C. 2000
- D. 1/3

E8B05
(D)
Page 7-25

What is the deviation ratio of an FM-phone signal having a maximum frequency swing of plus-or-minus 5 kHz and accepting a maximum modulation rate of 3 kHz?

- A. 60
- B. 0.167
- C. 0.6
- D. 1.67

E8B06
(A)
Page 7-25

What is the deviation ratio of an FM-phone signal having a maximum frequency swing of plus or minus 7.5 kHz and accepting a maximum modulation frequency of 3.5 kHz?

- A. 2.14
- B. 0.214
- C. 0.47
- D. 47

E8B10
(B)
Page 7-25

What is meant by deviation ratio?

- A. The ratio of the audio modulating frequency to the center carrier frequency
- B. The ratio of the maximum carrier frequency deviation to the highest audio modulating frequency
- C. The ratio of the carrier center frequency to the audio modulating frequency
- D. The ratio of the highest audio modulating frequency to the average audio modulating frequency

PULSE MODULATION SYSTEMS

E8A11
(D)
Page 7-27

What is one use for a pulse modulated signal?

- A. Linear amplification
- B. PSK31 data transmission
- C. Multiphase power transmission
- D. Digital data transmission

E8B07
(A)
Page 7-27

When using a pulse-width modulation system, why is the transmitter's peak power greater than its average power?

- A. The signal duty cycle is less than 100%
- B. The signal reaches peak amplitude only when voice modulated
- C. The signal reaches peak amplitude only when voltage spikes are generated within the modulator
- D. The signal reaches peak amplitude only when the pulses are also amplitude modulated

E8B08
(D)
Page 7-27

What parameter does the modulating signal vary in a pulse-position modulation system?

- A. The number of pulses per second
- B. The amplitude of the pulses
- C. The duration of the pulses
- D. The time at which each pulse occurs

E8B09
(A)
Page 7-27

How are the pulses of a pulse-modulated signal usually transmitted?

- A. A pulse of relatively short duration is sent; a relatively long period of time separates each pulse
- B. A pulse of relatively long duration is sent; a relatively short period of time separates each pulse
- C. A group of short pulses are sent in a relatively short period of time; a relatively long period of time separates each group
- D. A group of short pulses are sent in a relatively long period of time; a relatively short period of time separates each group

MULTIPLEXING

Which of these methods can be used to combine several separate analog information streams into a single analog radio frequency signal?

- A. Frequency shift keying
- B. A diversity combiner
- C. Frequency division multiplexing
- D. Pulse compression

E8B11
(C)
Page 7-28

Which of the following describes frequency division multiplexing?

- A. The transmitted signal jumps from band to band at a predetermined rate
- B. Two or more information streams are merged into a “baseband”, which then modulates the transmitter
- C. The transmitted signal is divided into packets of information
- D. Two or more information streams are merged into a digital combiner, which then pulse position modulates the transmitter

E8B12
(B)
Page 7-28

What is time division multiplexing?

- A. Two or more data streams are assigned to discrete sub-carriers on an FM transmitter
- B. Two or more signals are arranged to share discrete time slots of a digital data transmission
- C. Two or more data streams share the same channel by transmitting time of transmission as the sub-carrier
- D. Two or more signals are quadrature modulated to increase bandwidth efficiency

E8B13
(B)
Page 7-28

Chapter 7, Section 7.4

TRANSMITTER INTERMODULATION

How can intermodulation interference between two repeaters occur?

- A. When the repeaters are in close proximity and the signals cause feedback in one or both transmitter final amplifiers
- B. When the repeaters are in close proximity and the signals mix in one or both transmitter final amplifiers
- C. When the signals from the transmitters are reflected out of phase from airplanes passing overhead
- D. When the signals from the transmitters are reflected in phase from airplanes passing overhead

E4D03
(B)
Page 7-29

What is an effective way to reduce or eliminate intermodulation interference between two repeater transmitters operating in close proximity to one another?

- A. By installing a band-pass filter in the feed line between the transmitter and receiver
- B. By installing a properly terminated circulator at the output of the transmitter
- C. By using a Class C final amplifier
- D. By using a Class D final amplifier

E4D04
(B)
Page 7-29

If the signals of two transmitters mix together in one or both of their final amplifiers, and unwanted signals at the sum and difference frequencies of the original signals are generated, what is this called?

- A. Amplifier desensitization
- B. Neutralization
- C. Adjacent channel interference
- D. Intermodulation interference

E4D06
(D)
Page 7-29

E4D07
(D)
Page 7-29

Which of the following describes the most significant effect of an off-frequency signal when it is causing cross-modulation interference to a desired signal?

- A. A large increase in background noise
- B. A reduction in apparent signal strength
- C. The desired signal can no longer be heard
- D. The off-frequency unwanted signal is heard in addition to the desired signal

E4E11
(B)
Page 7-30

What is the most likely cause if you are hearing combinations of local AM broadcast signals inside one or more of the MF or HF ham bands?

- A. The broadcast station is transmitting an over-modulated signal
- B. Nearby corroded metal joints are mixing and re-radiating the BC signals
- C. You are receiving sky-wave signals from a distant station
- D. Your station receiver IF amplifier stage is defective

ATMOSPHERIC STATIC

E4E06
(B)
Page 7-30

What is a major cause of atmospheric static?

- A. Solar radio frequency emissions
- B. Thunderstorms
- C. Geomagnetic storms
- D. Meteor showers

AC LINE NOISE

E4E05
(B)
Page 7-31

How can noise from an electric motor be suppressed?

- A. By installing a ferrite bead on the AC line used to power the motor
- B. By installing a brute-force AC-line filter in series with the motor leads
- C. By installing a bypass capacitor in series with the motor leads
- D. By using a ground-fault current interrupter in the circuit used to power the motor

E4E13
(D)
Page 7-31

What might be the cause of a loud “roaring” or “buzzing” AC line type of interference that comes and goes at intervals?

- A. Arcing contacts in a thermostatically controlled device
- B. A defective doorbell or doorbell transformer inside a nearby residence
- C. A malfunctioning illuminated advertising display
- D. All of these answers are correct

LOCATING NOISE AND INTERFERENCE SOURCES

E4E07
(C)
Page 7-32

How can you determine if line-noise interference is being generated within your home?

- A. By checking the power-line voltage with a time-domain reflectometer
- B. By observing the AC power line waveform with an oscilloscope
- C. By turning off the AC power line main circuit breaker and listening on a battery-operated radio
- D. By observing the AC power line voltage with a spectrum analyzer

E4E08
(A)
Page 7-33

What type of signal is picked up by electrical wiring near a radio transmitter?

- A. A common-mode signal at the frequency of the radio transmitter
- B. An electrical-sparking signal
- C. A differential-mode signal at the AC power line frequency
- D. Harmonics of the AC power line frequency

What is a common characteristic of interference caused by a “touch controlled” electrical device?

- A. The interfering signal sounds like AC hum on an AM receiver or a carrier modulated by 60 Hz FM on a SSB or CW receiver
- B. The interfering signal may drift slowly across the HF spectrum
- C. The interfering signal can be several kHz in width and usually repeats at regular intervals across a HF band
- D. All of these answers are correct

E4E10
(D)
Page 7-33

What is one type of electrical interference that might be caused by the operation of a nearby personal computer?

- A. A loud AC hum in the audio output of your station receiver
- B. A clicking noise at intervals of a few seconds
- C. The appearance of unstable modulated or unmodulated signals at specific frequencies
- D. A whining type noise that continually pulses off and on

E4E14
(C)
Page 7-33

AUTOMOTIVE NOISE

How can conducted and radiated noise caused by an automobile alternator be suppressed?

- A. By installing filter capacitors in series with the DC power lead and by installing a blocking capacitor in the field lead
- B. By connecting the radio to the battery by the longest possible path and installing a blocking capacitor in both leads
- C. By installing a high-pass filter in series with the radio’s power lead and a low-pass filter in parallel with the field lead
- D. By connecting the radio’s power leads directly to the battery and by installing coaxial capacitors in line with the alternator leads

E4E04
(D)
Page 7-34

NOISE REDUCTION

Which of the following types of receiver noise can often be reduced by use of a receiver noise blanker?

- A. Ignition Noise
- B. Broadband “white” noise
- C. Heterodyne interference
- D. All of these choices are correct

E4E01
(A)
Page 7-35

Which of the following types of receiver noise can often be reduced with a DSP noise filter?

- A. Broadband “white” noise
- B. Ignition noise
- C. Power line noise
- D. All of these choices are correct

E4E02
(D)
Page 7-35

Which of the following signals might a receiver noise blanker be able to remove from desired signals?

- A. Signals which are constant at all IF levels
- B. Signals which appear correlated across a wide bandwidth
- C. Signals which appear at one IF but not another
- D. Signals which have a sharply peaked frequency distribution

E4E03
(B)
Page 7-35

What undesirable effect can occur when using an IF type noise blanker?

- A. Received audio in the speech range might have an echo effect
- B. The audio frequency bandwidth of the received signal might be compressed
- C. Nearby signals may appear to be excessively wide even if they meet emission standards
- D. FM signals can no longer be demodulated

E4E09
(C)
Page 7-35

E4E12
(A)
Page 7-35

- What is one disadvantage of using some automatic DSP notch-filters when attempting to copy CW signals?
- A. The DSP filter can remove the desired signal at the same time as it removes interfering signals
 - B. Any nearby signal passing through the DSP system will always overwhelm the desired signal
 - C. Received CW signals will appear to be modulated at the DSP clock frequency
 - D. Ringing in the DSP filter will completely remove the spaces between the CW characters

Chapter 8, Section 8.1

SYMBOL RATE, DATA RATE AND BANDWIDTH

E2D02
(A)
Page 8-2

- What is the definition of “baud”?
- A. The number of data symbols transmitted per second
 - B. The number of characters transmitted per second
 - C. The number of characters transmitted per minute
 - D. The number of words transmitted per minute

E8A15
(B)
Page 8-2

- What would the waveform of a digital data stream signal look like on a conventional oscilloscope?
- A. A series of sine waves with evenly spaced gaps
 - B. A series of pulses with varying patterns
 - C. A running display of alpha-numeric characters
 - D. None of the above; this type of signal cannot be seen on a conventional oscilloscope

PROTOCOLS AND CODES

E2E11
(D)
Page 8-4

- What is the Baudot code?
- A. A code used to transmit data only in modern computer-based data systems using seven data bits
 - B. A binary code consisting of eight data bits
 - C. An alternate name for Morse code
 - D. The International Telegraph Alphabet Number 2 (ITA2) which uses five data bits

E8C01
(D)
Page 8-3

- Which one of the following digital codes consists of elements having unequal length?
- A. ASCII
 - B. AX.25
 - C. Baudot
 - D. Morse code

E8C02
(B)
Page 8-4

- What are some of the differences between the Baudot digital code and ASCII?
- A. Baudot uses four data bits per character, ASCII uses seven; Baudot uses one character as a shift code, ASCII has no shift code
 - B. Baudot uses five data bits per character, ASCII uses seven; Baudot uses two characters as shift codes, ASCII has no shift code
 - C. Baudot uses six data bits per character, ASCII uses seven; Baudot has no shift code, ASCII uses two characters as shift codes
 - D. Baudot uses seven data bits per character, ASCII uses eight; Baudot has no shift code, ASCII uses two characters as shift codes

E8C03
(C)
Page 8-4

- What is one advantage of using the ASCII code for data communications?
- A. It includes built-in error-correction features
 - B. It contains fewer information bits per character than any other code
 - C. It is possible to transmit both upper and lower case text
 - D. It uses one character as a shift code to send numeric and special characters

DIGITAL MODES

Which of the follow is true when comparing HF and 2-meter packet operations?

- A. HF packet typically uses FSK with a data rate of 300 baud; 2-meter packet uses AFSK with a datarate of 1200 baud
- B. HF packet and 2-meter packet operations use different codes for information exchange
- C. HF packet is limited to Amateur Extra class amateur licensees; 2-meter packet is open to all but Novice Class amateur licensees
- D. HF and 2-meter packet operations are both limited to CW/Data-only band segments

E2D03
(A)
Page 8-7

Under clear communications conditions, which of these digital communications modes has the fastest data throughput?

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

E2D09
(D)
Page 8-7

What is a common method of transmitting data emissions below 30 MHz?

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

E2E01
(B)
Page 8-6

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 has saturated
- C. The receiver has drifted 5 kHz from the desired receive frequency
- D. The mark and space signal have been inverted

E2E04
(A)
Page 8-6

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

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

E2E06
(C)
Page 8-7

What is the typical bandwidth of a properly modulated MFSK16 signal?

- A. 31 Hz
- B. 316 Hz
- C. 550 Hz
- D. 2 kHz

E2E07
(B)
Page 8-8

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

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

E2E08
(B)
Page 8-7

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

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

E2E09
(D)
Page 8-7

- E2E12
(C)
Page 8-7
- Which of these digital communications modes has the narrowest bandwidth?
- A. MFSK16
 - B. 170-Hz shift, 45 baud RTTY
 - C. PSK31
 - D. 300-baud packet
- E4A09
(C)
Page 8-7
- Which of the following is most important when adjusting PSK31 transmitting levels?
- A. Power output
 - B. PA current
 - C. ALC level
 - D. SWR
- E8A12
(D)
Page 8-5
- What type of information can be conveyed using digital waveforms?
- A. Human speech
 - B. Video signals
 - C. Data
 - D. All of these answers are correct
- E8A13
(C)
Page 8-5
- What is an advantage of using digital signals instead of analog signals to convey the same information?
- A. Less complex circuitry is required for digital signal generation and detection
 - B. Digital signals always occupy a narrower bandwidth
 - C. Digital signals can be regenerated multiple times without error
 - D. All of these answers are correct
- E8C05
(C)
Page 8-7
- What technique is used to minimize the bandwidth requirements of a PSK-31 signal?
- A. Zero-sum character encoding
 - B. Reed-Solomon character encoding
 - C. Use of sinusoidal data pulses
 - D. Use of trapezoidal data pulses
- E8C06
(C)
Page 8-6
- What is the necessary bandwidth of a 13-WPM international Morse code transmission?
- A. Approximately 13 Hz
 - B. Approximately 26 Hz
 - C. Approximately 52 Hz
 - D. Approximately 104 Hz
- E8C07
(C)
Page 8-6
- What is the necessary bandwidth of a 170-hertz shift, 300-baud ASCII transmission?
- A. 0.1 Hz
 - B. 0.3 kHz
 - C. 0.5 kHz
 - D. 1.0 kHz
- E8C08
(A)
Page 8-6
- What is the necessary bandwidth of a 4800-Hz frequency shift, 9600-baud ASCII FM transmission?
- A. 15.36 kHz
 - B. 9.6 kHz
 - C. 4.8 kHz
 - D. 5.76 kHz
- E8C15
(B)
Page 8-8
- What is one advantage of using JT-65 coding?
- A. Uses only a 65 Hz bandwidth
 - B. Virtually perfect decoding of signals well below the noise
 - C. Easily copied by ear if necessary
 - D. Permits fast-scan TV transmissions over narrow bandwidth

SPREAD SPECTRUM TECHNIQUES

Why are received spread-spectrum signals resistant to interference?

- A. Signals not using the spectrum-spreading algorithm are suppressed in the receiver
- B. The high power used by a spread-spectrum transmitter keeps its signal from being easily overpowered
- C. The receiver is always equipped with a digital blanker circuit
- D. If interference is detected by the receiver it will signal the transmitter to change frequencies

E2C08
(A)
Page 8-9

How does the spread-spectrum technique of frequency hopping (FH) work?

- A. If interference is detected by the receiver it will signal the transmitter to change frequencies
- B. If interference is detected by the receiver it will signal the transmitter to wait until the frequency is clear
- C. A pseudo-random binary bit stream is used to shift the phase of an RF carrier very rapidly in a particular sequence
- D. The frequency of the transmitted signal is changed very rapidly according to a particular sequence also used by the receiving station

E2C09
(D)
Page 8-10

What term describes a wide-bandwidth communications system in which the transmitted carrier frequency varies according to some predetermined sequence?

- A. Amplitude companded single sideband
- B. AMTOR
- C. Time-domain frequency modulation
- D. Spread-spectrum communication

E8C09
(D)
Page 8-8

Which of these techniques causes a digital signal to appear as wide-band noise to a conventional receiver?

- A. Spread-spectrum
- B. Independent sideband
- C. Regenerative detection
- D. Exponential addition

E8C10
(A)
Page 8-9

What spread-spectrum communications technique alters the center frequency of a conventional carrier many times per second in accordance with a pseudo-random list of channels?

- A. Frequency hopping
- B. Direct sequence
- C. Time-domain frequency modulation
- D. Frequency companded spread-spectrum

E8C11
(A)
Page 8-9

What spread-spectrum communications technique uses a high speed binary bit stream to shift the phase of an RF carrier?

- A. Frequency hopping
- B. Direct sequence
- C. Binary phase-shift keying
- D. Phase companded spread-spectrum

E8C12
(B)
Page 8-10

What makes spread-spectrum communications resistant to interference?

- A. Interfering signals are removed by a frequency-agile crystal filter
- B. Spread-spectrum transmitters use much higher power than conventional carrier-frequency transmitters
- C. Spread-spectrum transmitters can hunt for the best carrier frequency to use within a given RF spectrum
- D. Only signals using the correct spreading sequence are received

E8C13
(D)
Page 8-9

ERROR DETECTION AND CORRECTION

- E2E02
(A)
Page 8-11
- 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
(C)
Page 8-11
- How is Forward Error Correction implemented?
A. By the receiving station repeating each block of three data characters
B. By transmitting a special algorithm to the receiving station along with the data characters
C. By transmitting extra data that may be used to detect and correct transmission errors
D. By varying the frequency shift of the transmitted signal according to a predefined algorithm
- E2E05
(D)
Page 8-11
- How does ARQ accomplish error correction?
A. Special binary codes provide automatic correction
B. Special polynomial codes provide automatic correction
C. If errors are detected, redundant data is substituted
D. If errors are detected, a retransmission is requested
- E8C14
(D)
Page 8-10
- What is the advantage of including a parity bit with an ASCII character stream?
A. Faster transmission rate
B. The signal can overpower interfering signals
C. Foreign language characters can be sent
D. Some types of errors can be detected

Chapter 8, Section 8.2

FAST-SCAN TELEVISION

- E2B01
(A)
Page 8-13
- 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
(C)
Page 8-13
- How many horizontal lines make up a fast-scan (NTSC) television frame?
A. 30
B. 60
C. 525
D. 1080
- E2B03
(D)
Page 8-13
- How is an interlace 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 ones in the next
- E2B04
(B)
Page 8-14
- What is blanking in a video signal?
A. Synchronization of the horizontal and vertical sync pulses
B. Turning off the scanning beam while it is traveling from right to left or from bottom to top
C. Turning off the scanning beam at the conclusion of a transmission
D. Transmitting a black and white test pattern

Which of the following is an advantage of using vestigial sideband for standard fast scan TV transmissions?	E2B05 (C) Page 8-15
<ul style="list-style-type: none"> 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 	
What is vestigial sideband modulation?	E2B06 (A) Page 8-15
<ul style="list-style-type: none"> A. Amplitude modulation in which one complete sideband and a portion of the other sideband is transmitted B. A type of modulation in which one sideband is inverted C. Narrow-band FM transmission 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 	
What is the name of the video signal component that carries color information?	E2B07 (B) Page 8-15
<ul style="list-style-type: none"> A. Luminance B. Chroma C. Hue D. Spectral Intensity 	
Which of the following is a common method of transmitting accompanying audio with amateur fast-scan television?	E2B08 (D) Page 8-16
<ul style="list-style-type: none"> A. Frequency-modulated sub-carrier B. A separate VHF or UHF audio link C. Frequency modulation of the video carrier D. All of these choices are correct 	
Which of the following is the video standard used by North American Fast Scan ATV stations?	E2B16 (D) Page 8-12
<ul style="list-style-type: none"> A. PAL B. DRM C. Scottie D. NTSC 	
Which of the following is NOT a characteristic of FMTV (Frequency-Modulated Amateur Television) as compared to vestigial sideband AM television?	E2B17 (A) Page 8-16
<ul style="list-style-type: none"> A. Immunity from fading due to limiting B. Poor weak signal performance C. Greater signal bandwidth D. Greater complexity of receiving equipment 	
On which of the following frequencies is one likely to find FMTV transmissions?	E2B19 (D) Page 8-16
<ul style="list-style-type: none"> A. 14.230 MHz B. 29.6 MHz C. 52.525 MHz D. 1255 MHz 	
If 100 IRE units correspond to the most-white level in the NTSC standard video format, what is the level of the most-black signal?	E2B21 (B) Page 8-14
<ul style="list-style-type: none"> A. 140 IRE units B. 7.5 IRE units C. 0 IRE units D. -40 IRE units 	

SLOW-SCAN TELEVISION

- E2B09
(D)
Page 8-18
- What hardware, other than a transceiver with SSB capability and a suitable computer, is needed to decode SSTV based on 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
(A)
Page 8-18
- Which of the following is an acceptable bandwidth for Digital Radio Mondiale (DRM) based voice or SSTV digital transmissions made on the HF amateur bands?
- A. 3 KHz
 - B. 10 KHz
 - C. 15 KHz
 - D. 20 KHz
- E2B11
(B)
Page 8-18
- What is the function of the Vertical Interval Signaling (VIS) code transmitted 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 callsign of the station transmitting
- E2B12
(D)
Page 8-17
- How are analog slow-scan television images typically transmitted on the HF bands?
- A. Video is converted to equivalent Baudot representation
 - B. Video is converted to equivalent ASCII representation
 - C. Varying tone frequencies representing the video are transmitted using FM
 - D. Varying tone frequencies representing the video are transmitted using single sideband
- E2B13
(C)
Page 8-18
- How many lines are commonly used in each frame on an amateur slow-scan color television picture?
- A. 30 to 60
 - B. 60 or 100
 - C. 128 or 256
 - D. 180 or 360
- E2B14
(A)
Page 8-17
- What aspect of an amateur slow-scan television signal encodes the brightness of the picture?
- A. Tone frequency
 - B. Tone amplitude
 - C. Sync amplitude
 - D. Sync frequency
- E2B15
(A)
Page 8-17
- What signals SSTV receiving equipment to begin a new picture line?
- A. Specific tone frequencies
 - B. Elapsed time
 - C. Specific tone amplitudes
 - D. A two-tone signal
- E2B18
(B)
Page 8-18
- What is the approximate bandwidth of a slow-scan TV signal?
- A. 600 Hz
 - B. 3 kHz
 - C. 2 MHz
 - D. 6 MHz

- What special operating frequency restrictions are imposed on slow scan TV transmissions?
- A. None; they are allowed on all amateur frequencies
 - B. They are restricted to 7.245 MHz, 14.245 MHz, 21.345 MHz, and 28.945 MHz
 - C. They are restricted to phone band segments and their bandwidth can be no greater than that of a voice signal of the same modulation type
 - D. They are not permitted above 54 MHz

E2B20
(C)
Page 8-20

Chapter 8, Section 8.3

SENSITIVITY AND NOISE

What is meant by the noise floor of a receiver?

- A. The minimum level of noise at the audio output when the RF gain is turned all the way down
- B. The equivalent phase noise power generated by the local oscillator
- C. The minimum level of noise that will overload the RF amplifier stage
- D. The equivalent input noise power when the antenna is replaced with a matched dummy load

E4C04
(D)
Page 8-19

What does a value of -174 dBm/Hz represent with regard to the noise floor of a receiver?

- A. The minimum detectable signal as a function of receive frequency
- B. The theoretical noise at the input of a perfect receiver at room temperature
- C. The noise figure of a 1 Hz bandwidth receiver
- D. The galactic noise contribution to minimum detectable signal

E4C05
(B)
Page 8-19

The thermal noise value of a receiver is -174 dBm/Hz. What is the theoretically best minimum detectable signal for a 400 Hz bandwidth receiver?

- A. 174 dBm
- B. -164 dBm
- C. -155 dBm
- D. -148 dBm

E4C06
(D)
Page 8-20

What does the MDS of a receiver represent?

- A. The meter display sensitivity
- B. The minimum discernible signal
- C. The multiplex distortion stability
- D. The maximum detectable spectrum

E4C07
(B)
Page 8-19

How might lowering the noise figure affect receiver performance?

- A. It would reduce the signal to noise ratio
- B. It would increase signal to noise ratio
- C. It would reduce bandwidth
- D. It would increase bandwidth

E4C08
(B)
Page 8-20

Which of the following is most likely to be the limiting condition for sensitivity in a modern communications receiver operating at 14 MHz?

- A. The noise figure of the RF amplifier
- B. Mixer noise
- C. Conversion noise
- D. Atmospheric noise

E4C09
(D)
Page 8-20

E4C15
(D)
Page 8-20

What is the primary source of noise that can be heard from an HF-band receiver with an antenna connected?

- A. Detector noise
- B. Induction motor noise
- C. Receiver front-end noise
- D. Atmospheric noise

SELECTIVITY

E4C10
(B)
Page 8-22

Which of the following is a desirable amount of selectivity for an amateur RTTY HF receiver?

- A. 100 Hz
- B. 300 Hz
- C. 6000 Hz
- D. 2400 Hz

E4C11
(B)
Page 8-22

Which of the following is a desirable amount of selectivity for an amateur single-sideband phone receiver?

- A. 1 kHz
- B. 2.4 kHz
- C. 4.2 kHz
- D. 4.8 kHz

E4C12
(D)
Page 8-21

What is an undesirable effect of using too wide a filter bandwidth in the IF section of a receiver?

- A. Output-offset overshoot
- B. Filter ringing
- C. Thermal-noise distortion
- D. Undesired signals may be heard

E4C14
(D)
Page 8-22

Which of these choices is a desirable amount of selectivity for an amateur VHF FM receiver?

- A. 1 kHz
- B. 2.4 kHz
- C. 4.2 kHz
- D. 15 kHz

E4D09
(C)
Page 8-21

What is the purpose of the preselector in a communications receiver?

- A. To store often-used frequencies
- B. To provide a range of AGC time constants
- C. To improve rejection of unwanted signals
- D. To allow selection of the optimum RF amplifier device

DYNAMIC RANGE

E4C13
(C)
Page 8-23

How does a narrow band roofing filter affect receiver performance?

- A. It improves sensitivity by reducing front end noise
- B. It improves intelligibility by using low Q circuitry to reduce ringing
- C. It improves dynamic range by keeping strong signals near the receive frequency out of the IF stages
- D. All of these choice are correct

<p>What is meant by the blocking dynamic range of a receiver?</p> <p>A. The difference in dB between the level of an incoming signal which will cause 1 dB of gain compression, and the level of the noise floor</p> <p>B. The minimum difference in dB between the levels of two FM signals which will cause one signal to block the other</p> <p>C. The difference in dB between the noise floor and the third order intercept point</p> <p>D. The minimum difference in dB between two signals which produce third order intermodulation products greater than the noise floor</p>	<p>E4D01 (A) Page 8-23</p>
<p>Which of the following describes two types of problems caused by poor dynamic range in a communications receiver?</p> <p>A. Cross modulation of the desired signal and desensitization from strong adjacent signals</p> <p>B. Oscillator instability requiring frequent retuning, and loss of ability to recover the opposite sideband, should it be transmitted</p> <p>C. Cross modulation of the desired signal and insufficient audio power to operate the speaker</p> <p>D. Oscillator instability and severe audio distortion of all but the strongest received signals</p>	<p>E4D02 (A) Page 8-23</p>
<p>If a receiver tuned to 146.70 MHz receives an intermodulation-product signal whenever a nearby transmitter transmits on 146.52 MHz, what are the two most likely frequencies for the other interfering signal?</p> <p>A. 146.34 MHz and 146.61 MHz</p> <p>B. 146.88 MHz and 146.34 MHz</p> <p>C. 146.10 MHz and 147.30 MHz</p> <p>D. 73.35 MHz and 239.40 MHz</p>	<p>E4D05 (A) Page 8-23</p>
<p>What causes intermodulation in an electronic circuit?</p> <p>A. Too little gain</p> <p>B. Lack of neutralization</p> <p>C. Nonlinear circuits or devices</p> <p>D. Positive feedback</p>	<p>E4D08 (C) Page 8-22</p>
<p>What does a third-order intercept level of 40 dBm mean with respect to receiver performance?</p> <p>A. Signals less than 40 dBm will not generate audible third-order intermodulation products</p> <p>B. The receiver can tolerate signals up to 40 dB above the noise floor without producing third-order intermodulation products</p> <p>C. A pair of 40 dBm signals will theoretically generate the same output on the third order intermodulation frequency as on the input frequency</p> <p>D. A pair of 1 mW input signals will produce a third-order intermodulation product which is 40 dB stronger than the input signal</p>	<p>E4D10 (C) Page 8-24</p>
<p>Why are third-order intermodulation products within a receiver of particular interest compared to other products?</p> <p>A. The third-order product of two signals which are in the band is itself likely to be within the band</p> <p>B. The third-order intercept is much higher than other orders</p> <p>C. Third-order products are an indication of poor image rejection</p> <p>D. Third-order intermodulation produces three products for every input signal</p>	<p>E4D11 (A) Page 8-23</p>
<p>What is the term for the reduction in receiver sensitivity caused by a strong signal near the received frequency?</p> <p>A. Desensitization</p> <p>B. Quieting</p> <p>C. Cross-modulation interference</p> <p>D. Squelch gain rollback</p>	<p>E4D12 (A) Page 8-23</p>

E4D13
(B)
Page 8-23

Which of the following can cause receiver desensitization?

- A. Audio gain adjusted too low
- B. Strong adjacent-channel signals
- C. Audio bias adjusted too high
- D. Squelch gain adjusted too low

E4D14
(A)
Page 8-23

Which of the following is a way to reduce the likelihood of receiver desensitization?

- A. Decrease the RF bandwidth of the receiver
- B. Raise the receiver IF frequency
- C. Increase the receiver front end gain
- D. Switch from fast AGC to slow AGC

PHASE NOISE

E4C01
(D)
Page 8-25

What is the effect of excessive phase noise in the local oscillator section of a receiver?

- A. It limits the receiver ability to receive strong signals
- B. It reduces the receiver sensitivity
- C. It decreases the receiver third-order intermodulation distortion dynamic range
- D. It can cause strong signals on nearby frequencies to interfere with reception of weak signals

CAPTURE EFFECT

E4C02
(C)
Page 8-26

Which of the following is the result of the capture effect in an FM receiver?

- A. All signals on a frequency are demodulated
- B. None of the signals could be heard
- C. The strongest signal received is the only demodulated signal
- D. The weakest signal received is the only demodulated signal

E4C03
(C)
Page 8-26

What is the term for the blocking of one FM phone signal by another, stronger FM phone signal?

- A. Desensitization
- B. Cross-modulation interference
- C. Capture effect
- D. Frequency discrimination

Chapter 9, Section 9.1

ANTENNA GAIN

E9A01
(C)
Page 9-2

Which of the following describes an isotropic Antenna?

- A. A grounded antenna used to measure earth conductivity
- B. A horizontal antenna used to compare Yagi antennas
- C. A theoretical antenna used as a reference for antenna gain
- D. A spacecraft antenna used to direct signals toward the earth

E9A02
(B)
Page 9-3

How much gain does a $\frac{1}{2}$ -wavelength dipole have compared to an isotropic antenna?

- A. 1.55 dB
- B. 2.15 dB
- C. 3.05 dB
- D. 4.30 dB

Which of the following antennas has no gain in any direction?

- A. Quarter-wave vertical
- B. Yagi
- C. Half-wave dipole
- D. Isotropic antenna

E9A03
(D)
Page 9-3

What is meant by antenna gain?

- A. The numerical ratio relating the radiated signal strength of an antenna in the direction of maximum radiation to that of a reference antenna
- B. The numerical ratio of the signal in the forward direction to that in the opposite direction
- C. The ratio of the amount of power radiated by an antenna compared to the transmitter output power
- D. The final amplifier gain minus the transmission-line losses (including any phasing lines present)

E9A09
(A)
Page 9-3

How much gain does an antenna have over a $\frac{1}{2}$ -wavelength dipole when it has 6 dB gain over an isotropic antenna?

- A. 3.85 dB
- B. 6.0 dB
- C. 8.15 dB
- D. 2.79 dB

E9A14
(A)
Page 9-3

How much gain does an antenna have over a $\frac{1}{2}$ -wavelength dipole when it has 12 dB gain over an isotropic antenna?

- A. 6.17 dB
- B. 9.85 dB
- C. 12.5 dB
- D. 14.15 dB

E9A15
(B)
Page 9-4

How does the total amount of radiation emitted by a directional (gain) antenna compare with the total amount of radiation emitted from an isotropic antenna, assuming each is driven by the same amount of power?

- A. The total amount of radiation from the directional antenna is increased by the gain of the antenna
- B. The total amount of radiation from the directional antenna is stronger by its front to back ratio
- C. There is no difference between the two antennas
- D. The radiation from the isotropic antenna is 2.15 dB stronger than that from the directional antenna

E9B08
(C)
Page 9-3

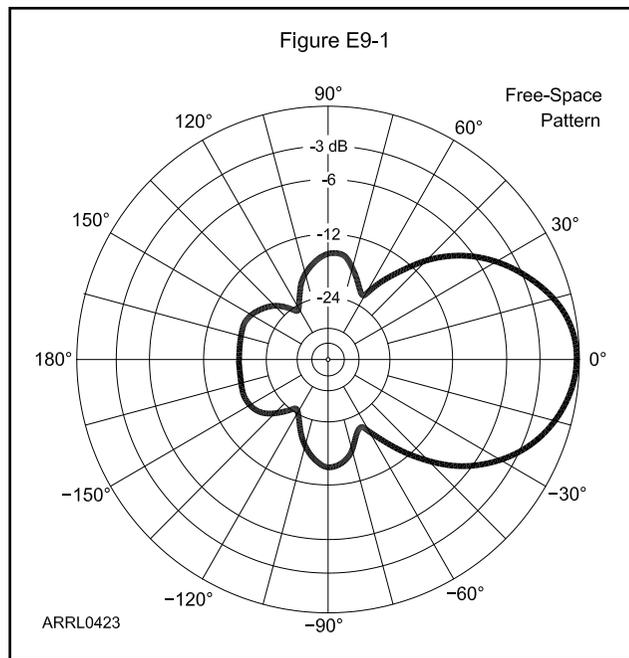


Figure E9-1 — Refer to this figure for questions E9B02 through E9B04.

BEAMWIDTH AND PATTERN RATIOS

E9B02
(B)
Page 9-4

- In the antenna radiation pattern shown in Figure E9-1, what is the 3-dB beamwidth?
- A. 75 degrees
 - B. 50 degrees
 - C. 25 degrees
 - D. 30 degrees

E9B03
(B)
Page 9-4

- In the antenna radiation pattern shown in Figure E9-1, what is the front-to-back ratio?
- A. 36 dB
 - B. 18 dB
 - C. 24 dB
 - D. 14 dB

E9B04
(B)
Page 9-4

- In the antenna radiation pattern shown in Figure E9-1, what is the front-to-side ratio?
- A. 12 dB
 - B. 14 dB
 - C. 18 dB
 - D. 24 dB

E9B09
(A)
Page 9-4

- How can the approximate beamwidth of a directional antenna be determined?
- A. Note the two points where the signal strength of the antenna is 3 dB less than maximum and compute the angular difference
 - B. Measure the ratio of the signal strengths of the radiated power lobes from the front and rear of the antenna
 - C. Draw two imaginary lines through the ends of the elements and measure the angle between the lines
 - D. Measure the ratio of the signal strengths of the radiated power lobes from the front and side of the antenna

What is the front-to-back ratio of the radiation pattern shown in Figure E9-2?

- A. 15 dB
- B. 28 dB
- C. 3 dB
- D. 24 dB

E9C10
(B)
Page 9-4

How does the beamwidth of an antenna vary as the gain is increased?

- A. It increases geometrically
- B. It increases arithmetically
- C. It is essentially unaffected
- D. It decreases

E9D03
(D)
Page 9-4

RADIATION RESISTANCE AND EFFICIENCY

Which of the following factors determine the radiation resistance of an antenna?

- A. Transmission-line length and antenna height
- B. Antenna height and conductor length/diameter ratio, and location of nearby conductive objects
- C. It is a physical constant and is the same for all antennas
- D. Sunspot activity and time of day

E9A05
(B)
Page 9-5

What is the term for the ratio of the radiation resistance of an antenna to the total resistance of the system?

- A. Effective radiated power
- B. Radiation conversion loss
- C. Antenna efficiency
- D. Beamwidth

E9A06
(C)
Page 9-6

What is included in the total resistance of an antenna system?

- A. Radiation resistance plus space impedance
- B. Radiation resistance plus transmission resistance
- C. Transmission-line resistance plus radiation resistance
- D. Radiation resistance plus ohmic resistance

E9A07
(D)
Page 9-5

How is antenna efficiency calculated?

- A. $(\text{radiation resistance} / \text{transmission resistance}) \times 100\%$
- B. $(\text{radiation resistance} / \text{total resistance}) \times 100\%$
- C. $(\text{total resistance} / \text{radiation resistance}) \times 100\%$
- D. $(\text{effective radiated power} / \text{transmitter output}) \times 100\%$

E9A11
(B)
Page 9-6

How can the efficiency of an HF quarter-wave grounded vertical antenna be improved?

- A. By installing a good radial system
- B. By isolating the coax shield from ground
- C. By shortening the vertical
- D. By reducing the diameter of the radiating element

E9A12
(A)
Page 9-6

What is meant by the radiation resistance of an antenna?

- A. The combined losses of the antenna elements and feed line
- B. The specific impedance of the antenna
- C. The value of a resistance that would dissipate the same amount of power as that radiated from an antenna
- D. The resistance in the atmosphere that an antenna must overcome to be able to radiate a signal

E9A16
(C)
Page 9-5

ANTENNA POLARIZATION

E9B01
(C)
Page 9-7

What determines the free-space polarization of an antenna?

- A. The orientation of its magnetic field (H Field)
- B. The orientation of its free-space characteristic impedance
- C. The orientation of its electric field (E Field)
- D. Its elevation pattern

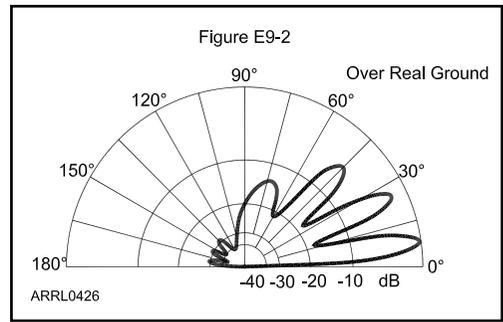


Figure E9-2 — Refer to this figure for questions E9C08 through E9C11.

E9C08
(A)
Page 9-7

What type of antenna pattern over real ground is shown in Figure E9-2?

- A. Elevation
- B. Azimuth
- C. Radiation resistance
- D. Polarization

E9C09
(C)
Page 9-7

What is the elevation angle of peak response in the antenna radiation pattern shown in Figure E9-2?

- A. 45 degrees
- B. 75 degrees
- C. 7.5 degrees
- D. 25 degrees

E9C11
(A)
Page 9-7

How many elevation lobes appear in the forward direction of the antenna radiation pattern shown in Figure E9-2?

- A. 4
- B. 3
- C. 1
- D. 7

E9C14
(B)
Page 9-7

How would the electric field be oriented for a Yagi with three elements mounted parallel to the ground?

- A. Vertically
- B. Horizontally
- C. Right-hand elliptically
- D. Left-hand elliptically

BANDWIDTH

E9A10
(B)
Page 9-7

What is meant by antenna bandwidth?

- A. Antenna length divided by the number of elements
- B. The frequency range over which an antenna satisfies a performance requirement
- C. The angle between the half-power radiation points
- D. The angle formed between two imaginary lines drawn through the element ends

Chapter 9, Section 9.2

EFFECTS OF GROUND AND GROUND SYSTEMS

How does the radiation pattern of a 3-element, horizontally polarized beam antenna vary with height above ground?

- A. The main lobe takeoff angle increases with increasing height
- B. The main lobe takeoff angle decreases with increasing height
- C. The horizontal beam width increases with height
- D. The horizontal beam width decreases with height

E3C07
(B)
Page 9-9

How does the performance of a horizontally polarized antenna mounted on the side of a hill compare with the same antenna mounted on flat ground?

- A. The main lobe takeoff angle increases in the downhill direction
- B. The main lobe takeoff angle decreases in the downhill direction
- C. The horizontal beam width decreases in the downhill direction
- D. The horizontal beam width increases in the uphill direction

E3C10
(B)
Page 9-9

Which is the most important factor that determines ground losses for a ground-mounted vertical antenna operating in the 3-30 MHz range?

- A. The standing-wave ratio
- B. Base current
- C. Soil conductivity
- D. Base impedance

E9A13
(C)
Page 9-8

How is the far-field elevation pattern of a vertically polarized antenna affected by being mounted over seawater versus rocky ground?

- A. The low-angle radiation decreases
- B. The high-angle radiation increases
- C. Both the high- and low-angle radiation decrease
- D. The low-angle radiation increases

E9C12
(D)
Page 9-8

What strongly affects the shape of the far-field, low-angle elevation pattern of a vertically polarized antenna?

- A. The conductivity and dielectric constant of the soil in the area of the antenna
- B. The radiation resistance of the antenna and matching network
- C. The SWR on the transmission line
- D. The transmitter output power

E9C15
(A)
Page 9-8

What is the main effect of placing a vertical antenna over an imperfect ground?

- A. It causes increased SWR
- B. It changes the impedance angle of the matching network
- C. It reduces low-angle radiation
- D. It reduces losses in the radiating portion of the antenna

E9C17
(C)
Page 9-8

Which of the following types of conductor would be best for minimizing losses in a station's RF ground system?

- A. A resistive wire, such as a spark-plug wire
- B. A thin, flat copper strap several inches wide
- C. A cable with 6 or 7 18-gauge conductors in parallel
- D. A single 12 or 10 gauge stainless steel wire

E9D14
(B)
Page 9-9

- E9D15
(C)
Page 9-9
- Which of these choices would provide the best RF ground for your station?
- A. A 50-ohm resistor connected to ground
 - B. A connection to a metal water pipe
 - C. A connection to 3 or 4 interconnected ground rods driven into the Earth
 - D. A connection to 3 or 4 interconnected ground rods via a series RF choke

SHORTENED AND MULTIBAND ANTENNAS

- E9D05
(A)
Page 9-11
- For a shortened vertical antenna, where should a loading coil be placed to minimize losses and produce the most effective performance?
- A. Near the center of the vertical radiator
 - B. As low as possible on the vertical radiator
 - C. As close to the transmitter as possible
 - D. At a voltage node
- E9D06
(C)
Page 9-11
- Why should an HF mobile antenna loading coil have a high ratio of reactance to resistance?
- A. To swamp out harmonics
 - B. To maximize losses
 - C. To minimize losses
 - D. To minimize the Q
- E9D07
(A)
Page 9-13
- What is a disadvantage of using a multiband trapped antenna?
- A. It might radiate harmonics
 - B. It can only be used for single-band operation
 - C. It is too sharply directional at lower frequencies
 - D. It must be neutralized
- E9D08
(B)
Page 9-11
- What happens to the bandwidth of an antenna as it is shortened through the use of loading coils?
- A. It is increased
 - B. It is decreased
 - C. No change occurs
 - D. It becomes flat
- E9D09
(D)
Page 9-12
- What is an advantage of using top loading in a shortened HF vertical antenna?
- A. Lower Q
 - B. Greater structural strength
 - C. Higher losses
 - D. Improved radiation efficiency
- E9D11
(D)
Page 9-10
- Why is a loading coil often used with an HF mobile antenna?
- A. To improve reception
 - B. To lower the losses
 - C. To lower the Q
 - D. To cancel capacitive reactance
- E9D12
(D)
Page 9-12
- What is an advantage of using a trapped antenna?
- A. It has high directivity in the higher-frequency bands
 - B. It has high gain
 - C. It minimizes harmonic radiation
 - D. It may be used for multi-band operation

What happens at the base feed-point of a fixed-length HF mobile antenna as the frequency of operation is lowered?

- A. The resistance decreases and the capacitive reactance decreases
- B. The resistance decreases and the capacitive reactance increases
- C. The resistance increases and the capacitive reactance decreases
- D. The resistance increases and the capacitive reactance increases

E9D13
(B)
Page 9-10

FOLDED DIPOLE

What is a folded dipole antenna?

- A. A dipole one-quarter wavelength long
- B. A type of ground-plane antenna
- C. A dipole constructed from one wavelength of wire forming a very thin loop
- D. A hypothetical antenna used in theoretical discussions to replace the radiation resistance

E9A08
(C)
Page 9-13

What is the approximate feed-point impedance at the center of a folded dipole antenna?

- A. 300 ohms
- B. 72 ohms
- C. 50 ohms
- D. 450 ohms

E9D10
(A)
Page 9-14

TRAVELING WAVE ANTENNAS

Which of the following describes a basic rhombic antenna?

- A. Unidirectional; four-sided, each side one quarter-wavelength long; terminated in a resistance equal to its characteristic impedance
- B. Bidirectional; four-sided, each side one or more wavelengths long; open at the end opposite the transmission line connection
- C. Four-sided; an LC network at each corner except for the transmission connection;
- D. Four-sided, each side of a different physical length

E9C04
(B)
Page 9-15

What are the main advantages of a terminated rhombic antenna?

- A. Wide frequency range, high gain and high front-to-back ratio
- B. High front-to-back ratio, compact size and high gain
- C. Unidirectional radiation pattern, high gain and compact size
- D. Bidirectional radiation pattern, high gain and wide frequency range

E9C05
(A)
Page 9-16

What are the disadvantages of a terminated rhombic antenna for the HF bands?

- A. The antenna has a very narrow operating bandwidth
- B. The antenna produces a circularly polarized signal
- C. The antenna requires a large physical area and 4 separate supports
- D. The antenna is more sensitive to man-made static than any other type

E9C06
(C)
Page 9-16

What is the effect of a terminating resistor on a rhombic antenna?

- A. It reflects the standing waves on the antenna elements back to the transmitter
- B. It changes the radiation pattern from bidirectional to unidirectional
- C. It changes the radiation pattern from horizontal to vertical polarization
- D. It decreases the ground loss

E9C07
(B)
Page 9-15

When constructing a Beverage antenna, which of the following factors should be included in the design to achieve good performance at the desired frequency?

- A. Its overall length must not exceed $\frac{1}{4}$ wavelength
- B. It must be mounted more than 1 wavelength above ground
- C. It should be configured as a four-sided loop
- D. It should be one or more wavelengths long

E9C13
(D)
Page 9-16

PHASED ARRAYS

- E9C01
(D)
Page 9-19
- What is the radiation pattern of two $\frac{1}{4}$ -wavelength vertical antennas spaced $\frac{1}{2}$ -wavelength apart and fed 180 degrees out of phase?
- A. A cardioid
 - B. Omnidirectional
 - C. A figure-8 broadside to the axis of the array
 - D. A figure-8 oriented along the axis of the array
- E9C02
(A)
Page 9-19
- What is the radiation pattern of two $\frac{1}{4}$ -wavelength vertical antennas spaced $\frac{1}{4}$ -wavelength apart and fed 90 degrees out of phase?
- A. A cardioid
 - B. A figure-8 end-fire along the axis of the array
 - C. A figure-8 broadside to the axis of the array
 - D. Omnidirectional
- E9C03
(C)
Page 9-17
- What is the radiation pattern of two $\frac{1}{4}$ -wavelength vertical antennas spaced $\frac{1}{2}$ -wavelength apart and fed in phase?
- A. Omnidirectional
 - B. A cardioid
 - C. A Figure-8 broadside to the axis of the array
 - D. A Figure-8 end-fire along the axis of the array
- E9E12
(A)
Page 9-19
- What is the primary purpose of a “phasing line” when used with an antenna having multiple driven elements?
- A. It ensures that each driven element operates in concert with the others to create the desired antenna pattern
 - B. It prevents reflected power from traveling back down the feed-line and causing harmonic radiation from the transmitter
 - C. It allows single-band antennas to operate on other bands
 - D. It makes sure the antenna has a low-angle radiation pattern
- E9E13
(C)
Page 9-19
- What is the purpose of a “Wilkinson divider”?
- A. It divides the operating frequency of a transmitter signal so it can be used on a lower frequency band
 - B. It is used to feed high-impedance antennas from a low-impedance source
 - C. It divides power equally among multiple loads while preventing changes in one load from disturbing power flow to the others
 - D. It is used to feed low-impedance loads from a high-impedance source

EFFECTIVE RADIATED POWER

- E9H01
(D)
Page 9-20
- What is the effective radiated power of a repeater station with 150 watts transmitter power output, 2-dB feed line loss, 2.2-dB duplexer loss and 7-dBd antenna gain?
- A. 1977 watts
 - B. 78.7 watts
 - C. 420 watts
 - D. 286 watts
- E9H02
(A)
Page 9-20
- What is the effective radiated power of a repeater station with 200 watts transmitter power output, 4-dB feed line loss, 3.2-dB duplexer loss, 0.8-dB circulator loss and 10-dBd antenna gain?
- A. 317 watts
 - B. 2000 watts
 - C. 126 watts
 - D. 300 watts

What is the effective radiated power of a repeater station with 200 watts transmitter power output, 2-dB feed line loss, 2.8-dB duplexer loss, 1.2-dB circulator loss and 7-dBd antenna gain?

- A. 159 watts
- B. 252 watts
- C. 632 watts
- D. 63.2 watts

E9H03
(B)
Page 9-21

What term describes station output (including the transmitter, antenna and everything in between), when considering transmitter power and system gains and losses?

- A. Power factor
- B. Half-power bandwidth
- C. Effective radiated power
- D. Apparent power

E9H04
(C)
Page 9-19

SATELLITE ANTENNA SYSTEMS

How does the gain of a parabolic dish antenna change when the operating frequency is doubled?

- A. Gain does not change
- B. Gain is multiplied by 0.707
- C. Gain increases 6 dB
- D. Gain increases 3 dB

E9D01
(C)
Page 9-22

What is one way to produce circular polarization when using linearly polarized antennas?

- A. Stack two Yagis, fed 90 degrees out of phase, to form an array with the respective elements in parallel planes
- B. Stack two Yagis, fed in phase, to form an array with the respective elements in parallel planes
- C. Arrange two Yagis perpendicular to each other with the driven elements at the same point on the boom and fed 90 degrees out of phase
- D. Arrange two Yagis collinear to each other, with the driven elements fed 180 degrees out of phase

E9D02
(C)
Page 9-22

Why is it desirable for a ground-mounted satellite communications antenna system to be able to move in both azimuth and elevation?

- A. In order to track the satellite as it orbits the earth
- B. So the antenna can be pointed away from interfering signals
- C. So the antenna can be positioned to cancel the effects of Faraday rotation
- D. To rotate antenna polarization to match that of the satellite

E9D04
(A)
Page 9-22

RECEIVING LOOP ANTENNAS

What is a receiving loop antenna?

- A. A large circularly-polarized antenna
- B. A small coil of wire tightly wound around a toroidal ferrite core
- C. One or more turns of wire wound in the shape of a large open coil
- D. Any antenna coupled to a feed line through an inductive loop of wire

E9H09
(C)
Page 9-23

How can the output voltage of a receiving loop antenna be increased?

- A. By reducing the permeability of the loop shield
- B. By increasing the number of wire turns in the loop and reducing the area of the loop structure
- C. By reducing either the number of wire turns in the loop or the area of the loop structure
- D. By increasing either the number of wire turns in the loop or the area of the loop structure

E9H10
(D)
Page 9-24

DIRECTION-FINDING AND DF ANTENNAS

E9H05
(A)
Page 9-24

- What is the main drawback of a wire-loop antenna for direction finding?
- A. It has a bidirectional pattern
 - B. It is non-rotatable
 - C. It receives equally well in all directions
 - D. It is practical for use only on VHF bands

E9H06
(C)
Page 9-25

- What is the triangulation method of direction finding?
- A. The geometric angle of sky waves from the source are used to determine its position
 - B. A fixed receiving station plots three headings from the signal source on a map
 - C. Antenna headings from several different receiving stations are used to locate the signal source
 - D. A fixed receiving station uses three different antennas to plot the location of the signal source

E9H07
(D)
Page 9-24

- Why is an RF attenuator desirable in a receiver used for direction finding?
- A. It narrows the bandwidth of the received signal
 - B. It eliminates the effects of isotropic radiation
 - C. It reduces loss of received signals caused by antenna pattern nulls
 - D. It prevents receiver overload from extremely strong signals

E9H08
(A)
Page 9-25

- What is the function of a sense antenna?
- A. It modifies the pattern of a DF antenna array to provide a null in one direction
 - B. It increases the sensitivity of a DF antenna array
 - C. It allows DF antennas to receive signals at different vertical angles
 - D. It provides diversity reception that cancels multipath signals

E9H11
(B)
Page 9-25

- Why is an antenna with a cardioid pattern desirable for a direction-finding system?
- A. The broad-side responses of the cardioid pattern can be aimed at the desired station
 - B. The response characteristics of the cardioid pattern can assist in determining the direction of the desired station
 - C. The extra side lobes in the cardioid pattern can pinpoint the direction of the desired station
 - D. The high-radiation angle of the cardioid pattern is useful for short-distance direction finding

E9H12
(B)
Page 9-24

- What is an advantage of using a shielded loop antenna for direction finding?
- A. It automatically cancels ignition noise pickup in mobile installations
 - B. It is electro-statically balanced against ground, giving better nulls
 - C. It eliminates tracking errors caused by strong out-of-band signals
 - D. It allows stations to communicate without giving away their position

Chapter 9, Section 9.3

IMPEDANCE MATCHING

E9A04
(A)
Page 9-27

- Why would one need to know the feed point impedance of an antenna?
- A. To match impedances for maximum power transfer from a feed line
 - B. To measure the near-field radiation density from a transmitting antenna
 - C. To calculate the front-to-side ratio of the antenna
 - D. To calculate the front-to-back ratio of the antenna

<p>What system matches a high-impedance transmission line to a lower impedance antenna by connecting the line to the driven element in two places spaced a fraction of a wavelength each side of element center?</p> <p>A. The gamma matching system B. The delta matching system C. The omega matching system D. The stub matching system</p>	<p>E9E01 (B) Page 9-27</p>
<p>What is the name of an antenna matching system that matches an unbalanced feed line to an antenna by feeding the driven element both at the center of the element and at a fraction of a wavelength to one side of center?</p> <p>A. The gamma match B. The delta match C. The omega match D. The stub match</p>	<p>E9E02 (A) Page 9-28</p>
<p>What is the name of the matching system that uses a short perpendicular section of transmission line connected to the feed line near the antenna?</p> <p>A. The gamma match B. The delta match C. The omega match D. The stub match</p>	<p>E9E03 (D) Page 9-29</p>
<p>What is the purpose of the series capacitor in a gamma-type antenna matching network?</p> <p>A. To provide DC isolation between the feed-line and the antenna B. To compensate for the inductive reactance of the matching network C. To provide a rejection notch to prevent the radiation of harmonics D. To transform the antenna impedance to a higher value</p>	<p>E9E04 (B) Page 9-28</p>
<p>How must the driven element in a 3-element Yagi be tuned to use a hairpin matching system?</p> <p>A. The driven element reactance must be capacitive B. The driven element reactance must be inductive C. The driven element resonance must be lower than the operating frequency D. The driven element radiation resistance must be higher than the characteristic impedance of the transmission line</p>	<p>E9E05 (A) Page 9-28</p>
<p>What is the equivalent lumped-constant network for a hairpin matching system on a 3-element Yagi?</p> <p>A. Pi network B. Pi-L network C. L network D. Parallel-resonant tank</p>	<p>E9E06 (C) Page 9-28</p>
<p>Which of these matching systems is an effective method of connecting a 50-ohm coaxial cable feed-line to a grounded tower so it can be used as a vertical antenna?</p> <p>A. Double-bazooka match B. Hairpin match C. Gamma match D. All of these answers are correct</p>	<p>E9E09 (C) Page 9-28</p>
<p>What is an effective way of matching a feed-line to a VHF or UHF antenna when the impedances of both the antenna and feed-line are unknown?</p> <p>A. Use a 50-ohm 1:1 balun between the antenna and feed-line B. Use the "universal stub" matching technique C. Connect a series-resonant LC network across the antenna feed terminals D. Connect a parallel-resonant LC network across the antenna feed terminals</p>	<p>E9E11 (B) Page 9-29</p>

TRANSMISSION LINE MECHANICS

- E4B07
(D)
Page 9-34
- How much power is being absorbed by the load when a directional power meter connected between a transmitter and a terminating load reads 100 watts forward power and 25 watts reflected power?
- A. 100 watts
 - B. 125 watts
 - C. 25 watts
 - D. 75 watts
- E4B10
(D)
Page 9-34
- What is indicated if the current reading on an RF ammeter placed in series with the antenna feedline of a transmitter increases as the transmitter is tuned to resonance?
- A. There is possibly a short to ground in the feedline
 - B. The transmitter is not properly neutralized
 - C. There is an impedance mismatch between the antenna and feedline
 - D. There is more power going into the antenna
- E9E07
(B)
Page 9-33
- What parameter best describes the interactions at the load end of a mismatched transmission line?
- A. Characteristic impedance
 - B. Reflection coefficient
 - C. Velocity factor
 - D. Dielectric Constant
- E9E08
(D)
Page 9-33
- Which of the following measurements describes a mismatched transmission line?
- A. An SWR less than 1:1
 - B. A reflection coefficient greater than 1
 - C. A dielectric constant greater than 1
 - D. An SWR greater than 1:1
- E9F01
(D)
Page 9-30
- What is the velocity factor of a transmission line?
- A. The ratio of the characteristic impedance of the line to the terminating impedance
 - B. The index of shielding for coaxial cable
 - C. The velocity of the wave in the transmission line multiplied by the velocity of light in a vacuum
 - D. The velocity of the wave in the transmission line divided by the velocity of light in a vacuum
- E9F02
(C)
Page 9-30
- What determines the velocity factor in a transmission line?
- A. The termination impedance
 - B. The line length
 - C. Dielectric materials used in the line
 - D. The center conductor resistivity
- E9F03
(D)
Page 9-31
- Why is the physical length of a coaxial cable transmission line shorter than its electrical length?
- A. Skin effect is less pronounced in the coaxial cable
 - B. The characteristic impedance is higher in a parallel feed line
 - C. The surge impedance is higher in a parallel feed line
 - D. Electrical signals move more slowly in a coaxial cable than in air
- E9F04
(B)
Page 9-30
- What is the typical velocity factor for a coaxial cable with solid polyethylene dielectric?
- A. 2.70
 - B. 0.66
 - C. 0.30
 - D. 0.10

<p>What is the physical length of a coaxial transmission line that is electrically one-quarter wavelength long at 14.1 MHz? (Assume a velocity factor of 0.66.)</p> <p>A. 20 meters B. 2.3 meters C. 3.5 meters D. 0.2 meters</p>	<p>E9F05 (C) Page 9-31</p>
<p>What is the physical length of a parallel conductor feed line that is electrically one-half wavelength long at 14.10 MHz? (Assume a velocity factor of 0.95.)</p> <p>A. 15 meters B. 20 meters C. 10 meters D. 71 meters</p>	<p>E9F06 (C) Page 9-32</p>
<p>What characteristic will 450-ohm ladder line have at 50 MHz, as compared to 0.195-inch-diameter coaxial cable (such as RG-58)?</p> <p>A. Lower loss B. Higher SWR C. Smaller reflection coefficient D. Lower velocity factor</p>	<p>E9F07 (A) Page 9-32</p>
<p>What is the term for the ratio of the actual speed at which a signal travels through a transmission line to the speed of light in a vacuum?</p> <p>A. Velocity factor B. Characteristic impedance C. Surge impedance D. Standing wave ratio</p>	<p>E9F08 (A) Page 9-30</p>
<p>What would be the physical length of a typical coaxial transmission line that is electrically one-quarter wavelength long at 7.2 MHz? (Assume a velocity factor of 0.66)</p> <p>A. 10 meters B. 6.9 meters C. 24 meters D. 50 meters</p>	<p>E9F09 (B) Page 9-31</p>
<p>What is the primary difference between foam-dielectric coaxial cable as opposed to solid-dielectric cable, assuming all other parameters are the same?</p> <p>A. Reduced safe operating voltage limits B. Reduced losses per unit of length C. Higher velocity factor D. All of these answers are correct</p>	<p>E9F16 (D) Page 9-32</p>
<p>SMITH CHART</p>	
<p>Which of the following can be calculated using a Smith chart?</p> <p>A. Impedance along transmission lines B. Radiation resistance C. Antenna radiation pattern D. Radio propagation</p>	<p>E9G01 (A) Page 9-35</p>
<p>What type of coordinate system is used in a Smith chart?</p> <p>A. Voltage circles and current arcs B. Resistance circles and reactance arcs C. Voltage lines and current chords D. Resistance lines and reactance chords</p>	<p>E9G02 (B) Page 9-35</p>

E9G03
(C)
Page 9-37

- Which of the following is often determined using a Smith chart?
- A. Beam headings and radiation patterns
 - B. Satellite azimuth and elevation bearings
 - C. Impedance and SWR values in transmission lines
 - D. Trigonometric functions

E9G04
(C)
Page 9-35

- What are the two families of circles and arcs that make up a Smith chart?
- A. Resistance and voltage
 - B. Reactance and voltage
 - C. Resistance and reactance
 - D. Voltage and impedance

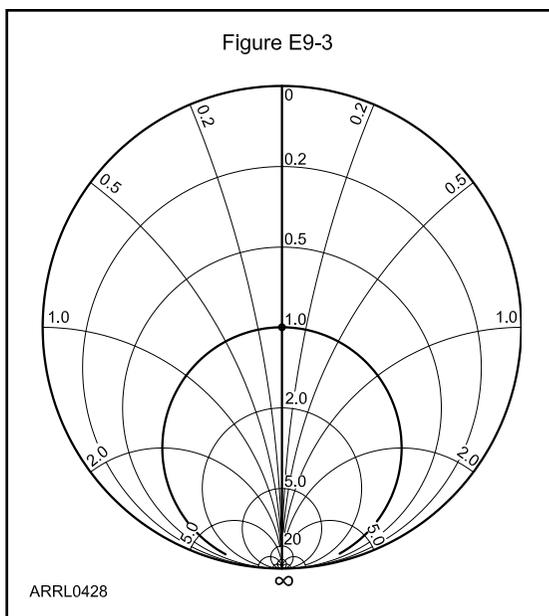


Figure E9-3 — Refer to this figure for questions E9G05 through E9G07.

E9G05
(A)
Page 9-35

- What type of chart is shown in Figure E9-3?
- A. Smith chart
 - B. Free-space radiation directivity chart
 - C. Elevation angle radiation pattern chart
 - D. Azimuth angle radiation pattern chart

E9G06
(B)
Page 9-35

- On the Smith chart shown in Figure E9-3, what is the name for the large outer circle on which the reactance arcs terminate?
- A. Prime axis
 - B. Reactance axis
 - C. Impedance axis
 - D. Polar axis

E9G07
(D)
Page 9-35

- On the Smith chart shown in Figure E9-3, what is the only straight line shown?
- A. The reactance axis
 - B. The current axis
 - C. The voltage axis
 - D. The resistance axis

<p>What is the process of normalization with regard to a Smith chart?</p> <p>A. Reassigning resistance values with regard to the reactance axis</p> <p>B. Reassigning reactance values with regard to the resistance axis</p> <p>C. Reassigning impedance values with regard to the prime center</p> <p>D. Reassigning prime center with regard to the reactance axis</p>	<p>E9G08 (C) Page 9-37</p>
<p>What third family of circles is often added to a Smith chart during the process of solving problems?</p> <p>A. Standing-wave ratio circles</p> <p>B. Antenna-length circles</p> <p>C. Coaxial-length circles</p> <p>D. Radiation-pattern circles</p>	<p>E9G09 (A) Page 9-37</p>
<p>What do the arcs on a Smith chart represent?</p> <p>A. Frequency</p> <p>B. SWR</p> <p>C. Points with constant resistance</p> <p>D. Points with constant reactance</p>	<p>E9G10 (D) Page 9-35</p>
<p>How are the wavelength scales on a Smith chart calibrated?</p> <p>A. In fractions of transmission line electrical frequency</p> <p>B. In fractions of transmission line electrical wavelength</p> <p>C. In fractions of antenna electrical wavelength</p> <p>D. In fractions of antenna electrical frequency</p>	<p>E9G11 (B) Page 9-37</p>
<p>TRANSMISSION LINE STUBS AND TRANSFORMERS</p>	
<p>Which of these choices is an effective way to match an antenna with a 100-ohm terminal impedance to a 50-ohm coaxial cable feed-line?</p> <p>A. Connect a $\frac{1}{4}$-wavelength open stub of 300-ohm twin-lead in parallel with the coaxial feed-line where it connects to the antenna</p> <p>B. Insert a $\frac{1}{2}$ wavelength piece of 300-ohm twin-lead in series between the antenna terminals and the 50-ohm feed cable</p> <p>C. Insert a $\frac{1}{4}$-wavelength piece of 75-ohm coaxial cable transmission line in series between the antenna terminals and the 50-ohm feed cable</p> <p>D. Connect $\frac{1}{2}$ wavelength shorted stub of 75-ohm cable in parallel with the 50-ohm cable where it attaches to the antenna</p>	<p>E9E10 (C) Page 9-40</p>
<p>What kind of impedance does a $\frac{1}{8}$-wavelength transmission line present to a generator when the line is shorted at the far end?</p> <p>A. A capacitive reactance</p> <p>B. The same as the characteristic impedance of the line</p> <p>C. An inductive reactance</p> <p>D. The same as the input impedance to the final generator stage</p>	<p>E9F10 (C) Page 9-39</p>
<p>What kind of impedance does a $\frac{1}{8}$-wavelength transmission line present to a generator when the line is open at the far end?</p> <p>A. The same as the characteristic impedance of the line</p> <p>B. An inductive reactance</p> <p>C. A capacitive reactance</p> <p>D. The same as the input impedance of the final generator stage</p>	<p>E9F11 (C) Page 9-39</p>

E9F12
(B)
Page 9-38

What kind of impedance does a $\frac{1}{4}$ -wavelength transmission line present to a generator when the line is open at the far end?

- A. A very high impedance
- B. A very low impedance
- C. The same as the characteristic impedance of the line
- D. The same as the input impedance to the final generator stage

E9F13
(A)
Page 9-38

What kind of impedance does a $\frac{1}{4}$ -wavelength transmission line present to a generator when the line is shorted at the far end?

- A. A very high impedance
- B. A very low impedance
- C. The same as the characteristic impedance of the transmission line
- D. The same as the generator output impedance

E9F14
(B)
Page 9-38

What kind of impedance does a $\frac{1}{2}$ -wavelength transmission line present to a generator when the line is shorted at the far end?

- A. A very high impedance
- B. A very low impedance
- C. The same as the characteristic impedance of the line
- D. The same as the output impedance of the generator

E9F15
(A)
Page 9-38

What kind of impedance does a $\frac{1}{2}$ -wavelength transmission line present to a generator when the line is open at the far end?

- A. A very high impedance
- B. A very low impedance
- C. The same as the characteristic impedance of the line
- D. The same as the output impedance of the generator

ANTENNA ANALYZERS

E4A07
(B)
Page 9-40

Which of the following is an advantage of using an antenna analyzer vs. a SWR bridge to measure antenna SWR?

- A. Antenna analyzers automatically tune your antenna for resonance
- B. Antenna analyzers typically do not need an external RF source
- C. Antenna analyzers typically display a time-varying representation of the modulation envelope
- D. All of these answers are correct

E4A08
(D)
Page 9-40

Which of the following instruments would be best for measuring the SWR of a beam antenna?

- A. A spectrum analyzer
- B. A Q meter
- C. An ohmmeter
- D. An antenna analyzer

E4B12
(D)
Page 9-40

How should a portable SWR analyzer be connected when measuring antenna resonance and feedpoint impedance?

- A. Loosely couple the analyzer near the antenna base
- B. Connect the analyzer via a high-impedance transformer to the antenna
- C. Connect the antenna and a dummy load to the analyzer
- D. Connect the antenna feed line directly to the analyzer's connector

Chapter 9, Section 9.4

ANTENNA MODELING AND DESIGN

What type of computer program technique is commonly used for modeling antennas?

- A. Graphical analysis
- B. Method of Moments
- C. Mutual impedance analysis
- D. Calculus differentiation with respect to physical properties

E9B10
(B)
Page 9-41

What is the principle of a Method of Moments analysis?

- A. A wire is modeled as a series of segments, each having a distinct value of current
- B. A wire is modeled as a single sine-wave current generator
- C. A wire is modeled as a series of points, each having a distinct location in space
- D. A wire is modeled as a series of segments, each having a distinct value of voltage across it

E9B11
(A)
Page 9-41

What is a disadvantage of decreasing the number of wire segments in an antenna model below the guideline of 10 segments per half-wavelength?

- A. Ground conductivity will not be accurately modeled
- B. The resulting design will favor radiation of harmonic energy
- C. The computed feed-point impedance may be incorrect
- D. The antenna will become mechanically unstable

E9B12
(C)
Page 9-41

Which of the following is a disadvantage of NEC-based antenna modeling programs?

- A. They can only be used for simple wire antennas
- B. They are not capable of generating both vertical and horizontal polarization patterns
- C. Computing time increases as the number of wire segments is increased
- D. All of these answers are correct

E9B13
(C)
Page 9-41

What does the abbreviation NEC stand for when applied to antenna modeling programs?

- A. Next Element Comparison
- B. Numerical Electromagnetics Code
- C. National Electrical Code
- D. Numeric Electrical Computation

E9B14
(B)
Page 9-41

What type of information can be obtained by submitting the details of a proposed new antenna to a modeling program?

- A. SWR vs. frequency charts
- B. Polar plots of the far-field elevation and azimuth patterns
- C. Antenna gain
- D. All of these answers are correct

E9B15
(D)
Page 9-41

DESIGN TRADEOFFS

What may occur when a directional antenna is operated at different frequencies within the band for which it was designed?

- A. Feed-point impedance may become negative
- B. The E-field and H-field patterns may reverse
- C. Element spacing limits could be exceeded
- D. The gain may exhibit significant variations

E9B05
(D)
Page 9-42

E9B06
(B)
Page 9-42

What usually occurs if a Yagi antenna is designed solely for maximum forward gain?

- A. The front-to-back ratio increases
- B. The front-to-back ratio decreases
- C. The frequency response is widened over the whole frequency band
- D. The SWR is reduced

E9B07
(A)
Page 9-42

If the boom of a Yagi antenna is lengthened and the elements are properly retuned, what usually occurs?

- A. The gain increases
- B. The SWR decreases
- C. The front-to-back ratio increases
- D. The gain bandwidth decreases rapidly

Chapter 10, Section 10.1

GROUND WAVE

E3C12
(B)
Page 10-2

As the frequency of a signal is increased, how does its ground wave propagation change?

- A. It increases
- B. It decreases
- C. It stays the same
- D. Radio waves don't propagate along the Earth's surface

E3C13
(A)
Page 10-1

What type of polarization does most ground-wave propagation have?

- A. Vertical
- B. Horizontal
- C. Circular
- D. Elliptical

SKY WAVE

E3C08
(B)
Page 10-2

What is the name of the high-angle wave in HF propagation that travels for some distance within the F2 region?

- A. Oblique-angle ray
- B. Pedersen ray
- C. Ordinary ray
- D. Heaviside ray

LONG PATH AND GRAY LINE

E3B04
(A)
Page 10-3

What type of propagation is probably occurring if an HF beam antenna must be pointed in a direction 180 degrees away from a station to receive the strongest signals?

- A. Long-path
- B. Sporadic-E
- C. Transequatorial
- D. Auroral

E3B05
(C)
Page 10-4

Which amateur bands typically support long-path propagation?

- A. 160 to 40 meters
- B. 30 to 10 meters
- C. 160 to 10 meters
- D. 6 meters to 2 meters

Which of the following amateur bands most frequently provides long-path propagation? A. 80 meters B. 20 meters C. 10 meters D. 6 meters	E3B06 (B) Page 10-4
Which of the following could account for hearing an echo on the received signal of a distant station? A. High D layer absorption B. Meteor scatter C. Transmit frequency is higher than the MUF D. Receipt of a signal by more than one path	E3B07 (D) Page 10-4
What type of propagation is probably occurring if radio signals travel along the terminator between daylight and darkness? A. Transequatorial B. Sporadic-E C. Long-path D. Gray-line	E3B08 (D) Page 10-4
At what time of day is gray-line propagation most prevalent? A. At sunrise and sunset B. When the sun is directly above the location of the transmitting station C. When the sun is directly overhead at the middle of the communications path between the two stations D. When the sun is directly above the location of the receiving station	E3B09 (A) Page 10-4
What is the cause of gray-line propagation? A. At midday, the sun, being directly overhead, superheats the ionosphere causing increased refraction of radio waves B. At twilight, solar absorption drops greatly, while atmospheric ionization is not weakened enough to reduce the MUF C. At darkness, solar absorption drops greatly, while atmospheric ionization remains steady D. At mid afternoon, the sun heats the ionosphere, increasing radio wave refraction and the MUF	E3B10 (B) Page 10-4
What communications are possible during gray-line propagation? A. Contacts up to 2,000 miles only on the 10-meter band B. Contacts up to 750 miles on the 6- and 2-meter bands C. Contacts up to 8,000 to 10,000 miles on three or four HF bands D. Contacts up to 12,000 to 15,000 miles on the 2 meter and 70 centimeter bands	E3B11 (C) Page 10-4
FADING	
What causes selective fading? A. Small changes in beam heading at the receiving station B. Phase differences in the received signal caused by different paths C. Large changes in the height of the ionosphere D. Time differences between the receiving and transmitting stations	E3C05 (B) Page 10-5

Chapter 10, Section 10.2

RADIO HORIZON

- E3C06
(A)
Page 10-6
- How much farther does the VHF/UHF radio-path horizon distance exceed the geometric horizon?
- A. By approximately 15% of the distance
 - B. By approximately twice the distance
 - C. By approximately one-half the distance
 - D. By approximately four times the distance
- E3C14
(D)
Page 10-6
- Why does the radio-path horizon distance exceed the geometric horizon?
- A. E-region skip
 - B. D-region skip
 - C. Auroral skip
 - D. Radio waves may be bent

TROPOSPHERIC PROPAGATION

- E3C09
(C)
Page 10-7
- What effect is usually responsible for propagating a VHF signal over 500 miles?
- A. D-region absorption
 - B. Faraday rotation
 - C. Tropospheric ducting
 - D. Moonbounce

TRANSEQUATORIAL PROPAGATION

- E3B01
(A)
Page 10-8
- What is transequatorial propagation?
- A. Propagation between two points at approximately the same distance north and south of the magnetic equator
 - B. Propagation between any two points located on the magnetic equator
 - C. Propagation between two continents by way of ducts along the magnetic equator
 - D. Propagation between two stations at the same latitude
- E3B02
(C)
Page 10-8
- What is the approximate maximum range for signals using transequatorial propagation?
- A. 1000 miles
 - B. 2500 miles
 - C. 5000 miles
 - D. 7500 miles
- E3B03
(C)
Page 10-8
- What is the best time of day for transequatorial propagation?
- A. Morning
 - B. Noon
 - C. Afternoon or early evening
 - D. Late at night

AURORAL PROPAGATION

- E3C01
(D)
Page 10-10
- What effect does auroral activity have on radio communications?
- A. Signals experience long-delay echo
 - B. FM communications are clearer
 - C. CW signals have a clearer tone
 - D. CW signals have a fluttery tone

<p>What is the cause of auroral activity?</p> <p>A. Reflections in the solar wind B. A low sunspot level C. The emission of charged particles from the sun D. Meteor showers concentrated in the northern latitudes</p>	<p>E3C02 (C) Page 10-9</p>
<p>Where in the ionosphere does auroral activity occur?</p> <p>A. At F-region height B. In the equatorial band C. At D-region height D. At E-region height</p>	<p>E3C03 (D) Page 10-9</p>
<p>Which emission mode is best for auroral propagation?</p> <p>A. CW B. SSB C. FM D. RTTY</p>	<p>E3C04 (A) Page 10-10</p>
<p>From the contiguous 48 states, in which approximate direction should an antenna be pointed to take maximum advantage of auroral propagation?</p> <p>A. South B. North C. East D. West</p>	<p>E3C11 (B) Page 10-10</p>
<p>METEOR SCATTER COMMUNICATIONS</p>	
<p>When a meteor strikes the Earth's atmosphere, a cylindrical region of free electrons is formed at what layer of the ionosphere?</p> <p>A. The E layer B. The F1 layer C. The F2 layer D. The D layer</p>	<p>E3A09 (A) Page 10-11</p>
<p>Which range of frequencies is well suited for meteor-scatter communications?</p> <p>A. 1.8 - 1.9 MHz B. 10 - 14 MHz C. 28 - 148 MHz D. 220 - 450 MHz</p>	<p>E3A10 (C) Page 10-11</p>
<p>What transmit and receive time sequencing is normally used on 144 MHz when attempting a meteor-scatter contact?</p> <p>A. Two-minute sequences, where one station transmits for a full two minutes and then receives for the following two minutes B. One-minute sequences, where one station transmits for one minute and then receives for the following one minute C. 15-second sequences, where one station transmits for 15 seconds and then receives for the following 15 seconds D. 30-second sequences, where one station transmits for 30 seconds and then receives for the following 30 seconds</p>	<p>E3A11 (C) Page 10-12</p>

<p>E3A01 (D) Page 10-13</p>	<p>EME</p> <p>What is the approximate maximum separation along the surface of the Earth between two stations communicating by moonbounce?</p> <p>A. 500 miles if the moon is at perigee B. 2000 miles, if the moon is at apogee C. 5000 miles, if the moon is at perigee D. 12,000 miles, as long as both can “see” the moon</p>
<p>E3A02 (B) Page 10-13</p>	<p>What characterizes libration fading of an earth-moon-earth signal?</p> <p>A. A slow change in the pitch of the CW signal B. A fluttery irregular fading C. A gradual loss of signal as the sun rises D. The returning echo is several Hertz lower in frequency than the transmitted signal</p>
<p>E3A03 (A) Page 10-13</p>	<p>When scheduling EME contacts, which of these conditions will generally result in the least path loss?</p> <p>A. When the moon is at perigee B. When the moon is full C. When the moon is at apogee D. When the MUF is above 30 MHz</p>
<p>E3A04 (D) Page 10-13</p>	<p>What type of receiving system is desirable for EME communications?</p> <p>A. Equipment with very wide bandwidth B. Equipment with very low dynamic range C. Equipment with very low gain D. Equipment with very low noise figures</p>
<p>E3A05 (A) Page 10-14</p>	<p>What transmit and receive time sequencing is normally used on 144 MHz when attempting an EME contact?</p> <p>A. Two-minute sequences, where one station transmits for a full two minutes and then receives for the following two minutes B. One-minute sequences, where one station transmits for one minute and then receives for the following one minute C. Two-and-one-half minute sequences, where one station transmits for a full 2.5 minutes and then receives for the following 2.5 minutes D. Five-minute sequences, where one station transmits for five minutes and then receives for the following five minutes</p>
<p>E3A06 (C) Page 10-14</p>	<p>What transmit and receive time sequencing is normally used on 432 MHz when attempting an EME contact?</p> <p>A. Two-minute sequences, where one station transmits for a full two minutes and then receives for the following two minutes B. One-minute sequences, where one station transmits for one minute and then receives for the following one minute C. Two-and-one-half minute sequences, where one station transmits for a full 2.5 minutes and then receives for the following 2.5 minutes D. Five-minute sequences, where one station transmits for five minutes and then receives for the following five minutes</p>
<p>E3A07 (B) Page 10-14</p>	<p>What frequency range would you normally tune to find EME stations in the 2 meter band?</p> <p>A. 144.000 - 144.001 MHz B. 144.000 - 144.100 MHz C. 144.100 - 144.300 MHz D. 145.000 - 145.100 MHz</p>

What frequency range would you normally tune to find EME stations in the 70 cm band?

- A. 430.000 - 430.150 MHz
- B. 430.100 - 431.100 MHz
- C. 431.100 - 431.200 MHz
- D. 432.000 - 432.100 MHz

E3A08
(D)
Page 10-14

Chapter 11, Section 11.1

PCBs

What material found in some electronic components such as high-voltage capacitors and transformers is considered toxic?

- A. Polychlorinated biphenyls
- B. Polyethylene
- C. Polytetrafluoroethylene
- D. Polymorphic silicon

E0A10
(A)
Page 11-1

BERYLLIUM AND BERYLLIUM OXIDE

Which insulating material commonly used as a thermal conductor for some types of electronic devices is extremely toxic if broken or crushed and the particles are accidentally inhaled?

- A. Mica
- B. Zinc oxide
- C. Beryllium Oxide
- D. Uranium Hexafluoride

E0A09
(C)
Page 11-2

Chapter 11, Section 11.2

POWER DENSITY, ABSORPTION AND LIMITS, AVERAGING AND DUTY CYCLE

What, if any, are the differences between the radiation produced by radioactive materials and the electromagnetic energy radiated by an antenna?

- A. There is no significant difference between the two types of radiation
- B. Only radiation produced by radioactivity can injure human beings
- C. RF radiation does not have sufficient energy to break apart atoms and molecules; radiation from radioactive sources does
- D. Radiation from an antenna will damage unexposed photographic film, ordinary radioactive materials do not cause this problem

E0A01
(C)
Page 11-3

When evaluating exposure levels from your station at a neighbor's home, what must you do?

- A. Make sure signals from your station are less than the controlled MPE limits
- B. Make sure signals from your station are less than the uncontrolled MPE limits
- C. Nothing; you need only evaluate exposure levels on your own property
- D. Advise your neighbors of the results of your tests

E0A02
(B)
Page 11-5

Why are there separate electric (E) and magnetic (H) field MPE limits?

- A. The body reacts to electromagnetic radiation from both the E and H fields
- B. Ground reflections and scattering make the field impedance vary with location
- C. E field and H field radiation intensity peaks can occur at different locations
- D. All of these answers are correct

E0A06
(D)
Page 11-3

E0A08
(C)
Page 11-3

What does SAR measure?

- A. Synthetic Aperture Ratio of the human body
- B. Signal Amplification Rating
- C. The rate at which RF energy is absorbed by the body
- D. The rate of RF energy reflected from stationary terrain

E0A11
(C)
Page 11-4

Which of these items might be a significant hazard when operating a klystron or cavity magnetron transmitter?

- A. Hearing loss caused by high voltage corona discharge
- B. Blood clotting from the intense magnetic field
- C. Injury from radiation leaks that exceed the MPE limits
- D. Ingestion of ozone gas from the cooling system

ANTENNA SYSTEM, ESTIMATING EXPOSURE AND STATION EVALUATION, EXPOSURE SAFETY MEASURES

E0A03
(D)
Page 11-6

Which of the following would be a practical way to estimate whether the RF fields produced by an amateur radio station are within permissible MPE limits?

- A. Use a calibrated antenna analyzer
- B. Use a hand calculator plus Smith-chart equations to calculate the fields
- C. Walk around under the antennas with a neon-lamp probe to find the strongest fields
- D. Use a computer-based antenna modeling program to calculate field strength at accessible locations

E0A04
(C)
Page 11-7

When evaluating a site with multiple transmitters operating at the same time, the operators and licensees of which transmitters are responsible for mitigating over-exposure situations?

- A. Only the most powerful transmitter
- B. Only commercial transmitters
- C. Each transmitter that produces 5% or more of its maximum permissible exposure limit at accessible locations
- D. Each transmitter operating with a duty-cycle greater than 50%

E0A05
(B)
Page 11-7

What is one of the potential hazards of using microwaves in the amateur radio bands?

- A. Microwaves are ionizing radiation
- B. The high gain antennas commonly used can result in high exposure levels
- C. Microwaves often travel long distances by ionospheric reflection
- D. The extremely high frequency energy can damage the joints of antenna structures

E0A07
(D)
Page 11-6

What is the “far-field” zone of an antenna?

- A. The area of the ionosphere where radiated power is not refracted
- B. The area where radiated power dissipates over a specified time period
- C. The area where radiated field strengths are obstructed by objects of reflection
- D. The area where the shape of the antenna pattern is independent of distance