

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

**SUBELEMENT E7 - PRACTICAL CIRCUITS [8 Exam Questions - 8 Groups]**

E7A Digital circuits: digital circuit principles and logic circuits; classes of logic elements; positive and negative logic; frequency dividers; truth tables

E7A01

**Which circuit is bistable?**

- A. An AND gate
- B. An OR gate
- C. A flip-flop
- D. A bipolar amplifier

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E7A02

**What is the function of a decade counter?**

- A. It produces one output pulse for every 10 input pulses
- B. It decodes a decimal number for display on a seven-segment LED display
- C. It produces 10 output pulses for every input pulse
- D. It decodes a binary number for display on a seven-segment LED display

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E7A03

**Which of the following can divide the frequency of a pulse train by 2?**

- A. An XOR gate
- B. A flip-flop
- C. An OR gate
- D. A multiplexer

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E7A04

**How many flip-flops are required to divide a signal frequency by 4?**

- A. 1
- B. 2
- C. 4
- D. 8

~~

E7A05

**Which of the following is a circuit that continuously alternates between two states without an external clock?**

- A. Monostable multivibrator
- B. J-K flip-flop
- C. T flip-flop
- D. Astable multivibrator

~~

E7A06

**What is a characteristic of a monostable multivibrator?**

- A. It switches momentarily to the opposite binary state and then returns to its original state after a set time
- B. It 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

~~

E7A07

**What logical operation does a NAND gate perform?**

- A. It produces logic 0 at its output only when all inputs are logic 0
- B. It produces logic 1 at its output only when all inputs are logic 1
- C. It produces logic 0 at its output if some but not all inputs are logic 1
- D. It produces logic 0 at its output only when all inputs are logic 1

~~

E7A08

**What logical operation does an OR gate perform?**

- A. It produces logic 1 at its output if any or all inputs are logic 1
- B. It produces logic 0 at its output if all inputs are logic 1
- C. It only produces logic 0 at its output when all inputs are logic 1
- D. It produces logic 1 at its output if all inputs are logic 0

~~

E7A09

**What logical operation is performed by an exclusive NOR gate?**

- A. It produces logic 0 at its output only if all inputs are logic 0
- B. It produces logic 1 at its output only if all inputs are logic 1
- C. It produces logic 0 at its output if only one input is logic 1
- D. It produces logic 1 at its output if only one input is logic 1

~~

E7A10

**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 output is true
- C. A list of inputs and corresponding outputs for a digital device
- D. A table of logic symbols that indicate the logic states of an op-amp

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E7A11

**What type of logic defines "1" as a high voltage?**

- A. Reverse Logic
- B. Assertive Logic
- C. Negative logic
- D. Positive Logic

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E7B Amplifiers: Class of operation; vacuum tube and solid-state circuits; distortion and intermodulation; spurious and parasitic suppression; microwave amplifiers; switching-type amplifiers

E7B01

**For what portion of the signal cycle does each active element in a push-pull Class AB amplifier conduct?**

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

~~

E7B02

**What is a Class D amplifier?**

- A. A type of amplifier that uses switching technology to achieve high efficiency
- B. A low power amplifier that uses a differential amplifier for improved linearity
- C. An amplifier that uses drift-mode FETs for high efficiency
- D. A frequency doubling amplifier

~~

E7B03

**Which of the following components form the output of a class D amplifier circuit?**

- A. A low-pass filter to remove switching signal components
- B. A high-pass filter to compensate for low gain at low frequencies
- C. A matched load resistor to prevent damage by switching transients
- D. A temperature compensating load resistor to improve linearity

~~

E7B04

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

- A. Approximately halfway 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

~~

E7B05

**What can be done to prevent unwanted oscillations in an RF 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

~~

E7B06

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

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

~~

E7B07

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

- A. Reduced intermodulation products
- B. Increased overall intelligibility
- C. Signal inversion
- D. Signal distortion and excessive bandwidth

~~

E7B08

How can an RF power amplifier be neutralized?

- A. By increasing the driving power
- B. By reducing the driving power
- C. By feeding a 180-degree out-of-phase portion of the output back to the input
- D. By feeding an in-phase component of the output back to the input

~~

E7B09

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, and the loading capacitor is adjusted for maximum permissible plate current

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E7B10

In Figure E7-1, what is the purpose of R1 and R2?

- A. Load resistors
- B. Voltage divider bias
- C. Self bias
- D. Feedback

~~

E7B11

In Figure E7-1, what is the purpose of R3?

- A. Fixed bias
- B. Emitter bypass
- C. Output load resistor
- D. Self bias

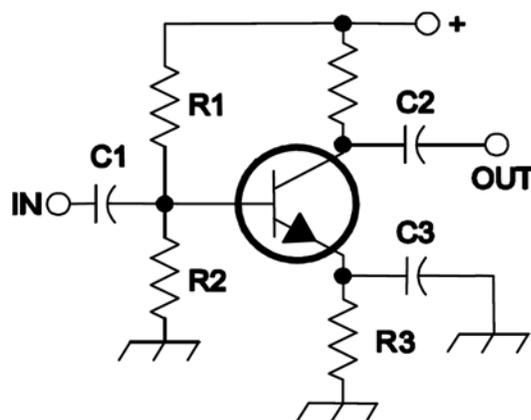
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E7B12

What type of amplifier circuit is shown in Figure E7-1?

- A. Common base
- B. Common collector
- C. Common emitter
- D. Emitter follower

Figure E7-1



E7B13

**Which of the following describes an emitter follower (or common collector) amplifier?**

- A. A two-transistor amplifier with the emitters sharing a common bias resistor
- B. A differential amplifier with both inputs fed to the emitter of the input transistor
- C. An OR circuit with only one emitter used for output
- D. An amplifier with a low impedance output that follows the base input voltage

~~

E7B14

**Why are switching amplifiers more efficient than linear amplifiers?**

- A. Switching amplifiers operate at higher voltages
- B. The power transistor is at saturation or cutoff most of the time
- C. Linear amplifiers have high gain resulting in higher harmonic content
- D. Switching amplifiers use push-pull circuits

~~

E7B15

**What is one way to prevent thermal runaway in a bipolar transistor amplifier?**

- A. Neutralization
- B. Select transistors with high beta
- C. Use a resistor in series with the emitter
- D. All these choices are correct

~~

E7B16

**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 these choices are correct

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E7B17

**Why are odd-order rather than even-order intermodulation distortion products of 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

~~

E7B18

**What is a characteristic of a grounded-grid amplifier?**

- A. High power gain
- B. High filament voltage
- C. Low input impedance
- D. Low bandwidth

~~

E7C Filters and matching networks: types of networks; types of filters; filter applications; filter characteristics; impedance matching; DSP filtering

E7C01

**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 connected between the input and ground, another inductor is connected between the output and ground, and a capacitor is connected between the input and output
- D. A capacitor is connected between the input and ground, another capacitor is connected between the output and ground, and an inductor is connected between input and output

~~

E7C02

**Which of the following is a property of a T-network with series capacitors and a parallel shunt inductor?**

- A. It is a low-pass filter
- B. It is a band-pass filter
- C. It is a high-pass filter
- D. It is a notch filter

~~

E7C03

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

- A. Greater harmonic suppression
- B. Higher efficiency
- C. Does not require a capacitor
- D. Greater transformation range

~~

E7C04

**How does an impedance-matching circuit transform a complex impedance to a resistive impedance?**

- A. It introduces negative resistance to cancel the resistive part of impedance
- B. It introduces transconductance to cancel the reactive part of impedance
- C. It cancels the reactive part of the impedance and changes the resistive part to a desired value
- D. Reactive currents are dissipated in matched resistances

~~

E7C05

**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

**What are the distinguishing features of an elliptical filter?**

- A. Gradual passband rolloff with minimal stop band ripple
- B. Extremely flat response over its pass band with gradually rounded stop band corners
- C. Extremely sharp cutoff with one or more notches in the stop band
- D. Gradual passband rolloff with extreme stop band ripple

~~

E7C07

**Which describes a Pi-L-network used for matching a vacuum tube final amplifier to a 50-ohm unbalanced output?**

- A. A Phase Inverter Load network
- B. A Pi-network with an additional series inductor on the output
- C. A network with only three discrete parts
- D. A matching network in which all components are isolated from ground

~~

E7C08

**Which of the following factors has the greatest effect on 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

~~

E7C09

**What is a crystal lattice filter?**

- 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 using lattice-shaped quartz crystals for high-Q performance
- D. A filter with narrow bandwidth and steep skirts made using quartz crystals

~~

E7C10

**Which of the following filters would be the best choice for use in a 2 meter band repeater duplexer?**

- A. A crystal filter
- B. A cavity filter
- C. A DSP filter
- D. An L-C filter

~~

E7C11

**Which of the following describes a receiving filter's ability to reject signals occupying an adjacent channel?**

- A. Passband ripple
- B. Phase response
- C. Shape factor
- D. Noise factor

~~

E7C12

**What is one advantage of a Pi-matching network over an L-matching network consisting of a single inductor and a single capacitor?**

- A. The Q of Pi-networks can be controlled
- B. L-networks cannot perform impedance transformation
- C. Pi-networks are more stable
- D. Pi-networks provide balanced input and output

~~

E7D Power supplies and voltage regulators; Solar array charge controllers

E7D01

**How does a linear electronic voltage regulator work?**

- 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

~~

E7D02

**What is a 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 controlled device's duty cycle is changed to produce a constant average output voltage
- D. It gives a ramp voltage at its output

~~

E7D03

**What device is typically used as a stable voltage reference in a linear voltage regulator?**

- A. A Zener diode
- B. A tunnel diode
- C. An SCR
- D. A varactor diode

~~

E7D04

**Which of the following types of linear voltage regulator usually make the most efficient use of the primary power source?**

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

~~

E7D05

**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

E7D06

**What is the purpose of Q1 in the circuit shown in Figure E7-2?**

- A. It provides negative feedback to improve regulation
- B. It provides a constant load for the voltage source
- C. It controls the current supplied to the load
- D. It provides D1 with current

~~

E7D07

**What is the purpose of C2 in the circuit shown in Figure E7-2?**

- A. It bypasses rectifier output ripple 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

~~

E7D08

**What type of circuit is shown in Figure E7-2?**

- A. Switching voltage regulator
- B. Grounded emitter amplifier
- C. Linear voltage regulator
- D. Monostable multivibrator

~~

E7D09

**What is the main reason to use a charge controller with a solar power system?**

- A. Prevention of battery undercharge
- B. Control of electrolyte levels during battery discharge
- C. Prevention of battery damage due to overcharge
- D. Matching of day and night charge rates

~~

E7D10

**What is the primary reason that a high-frequency switching 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 recover power from the unused portion of the AC cycle

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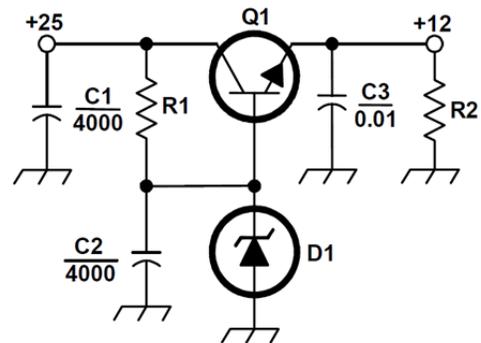
E7D11

**What is the function of the pass transistor in a linear voltage regulator circuit?**

- A. Permits a wide range of output voltage settings
- B. Provides a stable input impedance over a wide range of source voltage
- C. Maintains nearly constant output impedance over a wide range of load current
- D. Maintains nearly constant output voltage over a wide range of load current

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Figure E7-2



E7D12

**What is the dropout voltage of an analog voltage regulator?**

- A. Minimum input voltage for rated power dissipation
- B. Maximum output voltage drops when the input voltage is varied over its specified range
- C. Minimum input-to-output voltage required to maintain regulation
- D. Maximum that the output voltage may decrease at rated load

~~

E7D13

**What is the equation for calculating power dissipated by a series linear voltage regulator?**

- A. Input voltage multiplied by input current
- B. Input voltage divided by output current
- C. Voltage difference from input to output multiplied by output current
- D. Output voltage multiplied by output current

~~

E7D14

**What is the purpose of connecting equal-value resistors across power supply filter capacitors connected in series?**

- A. Equalize the voltage across each capacitor
- B. Discharge the capacitors when voltage is removed
- C. Provide a minimum load on the supply
- D. All these choices are correct

~~

E7D15

**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

~~

E7E Modulation and demodulation: reactance, phase and balanced modulators; detectors; mixer stages

E7E01

**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

~~

E7E02

**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 or FM signals by using an electrically variable inductance or capacitance

~~

E7E03

**What is a frequency discriminator stage in a FM receiver?**

- 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

~~

E7E04

**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

**What circuit is added to an FM transmitter to boost the higher audio frequencies?**

- A. A de-emphasis network
- B. A heterodyne suppressor
- C. A heterodyne enhancer
- D. A pre-emphasis network

~~

E7E06

**Why is de-emphasis commonly used in FM communications receivers?**

- A. For compatibility with transmitters using phase modulation
- B. To reduce impulse noise reception
- C. For higher efficiency
- D. To remove third-order distortion products

~~

E7E07

**What is meant by the term "baseband" in radio communications?**

- A. The lowest frequency band that the transmitter or receiver covers
- B. The frequency range occupied by a message signal prior to modulation
- C. The unmodulated bandwidth of the transmitted signal
- D. The basic oscillator frequency in an FM transmitter that is multiplied to increase the deviation and carrier frequency

~~

E7E08

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

- A. Two and four times the original frequency
- B. The square root of the product of input frequencies
- C. The two input frequencies along with their sum and difference frequencies
- D. 1.414 and 0.707 times the input frequency

~~

E7E09

**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

~~

E7E10

**How does a diode envelope 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

~~

E7E11

**Which type of detector circuit is used for demodulating SSB signals?**

- A. Discriminator
- B. Phase detector
- C. Product detector
- D. Phase comparator

~~

E7F DSP filtering and other operations; software defined radio fundamentals; DSP modulation and demodulation

E7F01

**What is meant by direct digital conversion as applied to software defined radios?**

- A. Software is converted from source code to object code during operation of the receiver
- B. Incoming RF is converted to a control voltage for a voltage controlled oscillator
- C. Incoming RF is digitized by an analog-to-digital converter without being mixed with a local oscillator signal
- D. A switching mixer is used to generate I and Q signals directly from the RF input

~~

E7F02

**What kind of digital signal processing audio filter is 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

~~

E7F03

**What type of digital signal processing filter is used to generate an SSB signal?**

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

~~

E7F04

**What is a common method of generating an SSB signal 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. Varying quartz crystal characteristics emulated in digital form
- D. Signals are combined in quadrature phase relationship

~~

E7F05

**How frequently must an analog signal be sampled by an analog-to-digital converter so that the signal can be accurately reproduced?**

- A. At least half the rate of the highest frequency component of the signal
- B. At least twice the rate of the highest frequency component of the signal
- C. At the same rate as the highest frequency component of the signal
- D. At four times the rate of the highest frequency component of the signal

~~

E7F06

**What is the minimum number of bits required for an analog-to-digital converter to sample a signal with a range of 1 volt at a resolution of 1 millivolt?**

- A. 4 bits
- B. 6 bits
- C. 8 bits
- D. 10 bits

~~

E7F07

**What function is performed by a Fast Fourier Transform?**

- A. Converting analog signals to digital form
- B. Converting digital signals to analog form
- C. Converting digital signals from the time domain to the frequency domain
- D. Converting 8-bit data to 16-bit data

~~

E7F08

**What is the function of decimation?**

- A. Converting data to binary code decimal form
- B. Reducing the effective sample rate by removing samples
- C. Attenuating the signal
- D. Removing unnecessary significant digits

~~

E7F09

**Why is an anti-aliasing digital filter required in a digital decimator?**

- A. It removes high-frequency signal components that would otherwise be reproduced as lower frequency components
- B. It peaks the response of the decimator, improving bandwidth
- C. It removes low-frequency signal components to eliminate the need for DC restoration
- D. It notches out the sampling frequency to avoid sampling errors

~~

E7F10

**What aspect of receiver analog-to-digital conversion determines the maximum receive bandwidth of a Direct Digital Conversion SDR?**

- A. Sample rate
- B. Sample width in bits
- C. Sample clock phase noise
- D. Processor latency

~~

E7F11

**What sets the minimum detectable signal level for a direct-sampling SDR receiver in the absence of atmospheric or thermal noise?**

- A. Sample clock phase noise
- B. Reference voltage level and sample width in bits
- C. Data storage transfer rate
- D. Missing codes and jitter

~~

E7F12

**Which of the following is an advantage of a Finite Impulse Response (FIR) filter vs an Infinite Impulse Response (IIR) digital filter?**

- A. FIR filters can delay all frequency components of the signal by the same amount
- B. FIR filters are easier to implement for a given set of passband rolloff requirements
- C. FIR filters can respond faster to impulses
- D. All these choices are correct

~~

E7F13

**What is the function of taps in a digital signal processing filter?**

- A. To reduce excess signal pressure levels
- B. Provide access for debugging software
- C. Select the point at which baseband signals are generated
- D. Provide incremental signal delays for filter algorithms

~~

E7F14

**Which of the following would allow a digital signal processing filter to create a sharper filter response?**

- A. Higher data rate
- B. More taps
- C. Complex phasor representations
- D. Double-precision math routines

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E7G Active filters and op-amp circuits: active audio filters; characteristics; basic circuit design; operational amplifiers

E7G01

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

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

~~

E7G02

**What is ringing in a filter?**

- A. An echo caused by a long time delay
- B. A reduction in high frequency response
- C. Partial cancellation of the signal over a range of frequencies
- D. Undesired oscillations added to the desired signal

~~

E7G03

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

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

~~

E7G04

**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 differential input voltage needed to bring the open loop output voltage to zero
- D. The potential between the amplifier input terminals of the op-amp in an open loop condition

~~

E7G05

**How can unwanted ringing and audio instability be prevented in an 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

**What is the gain-bandwidth of an operational amplifier?**

- A. The maximum frequency for a filter circuit using that type of amplifier
- B. The frequency at which the open-loop gain of the amplifier equals one
- C. The gain of the amplifier at a filter's cutoff frequency
- D. The frequency at which the amplifier's offset voltage is zero

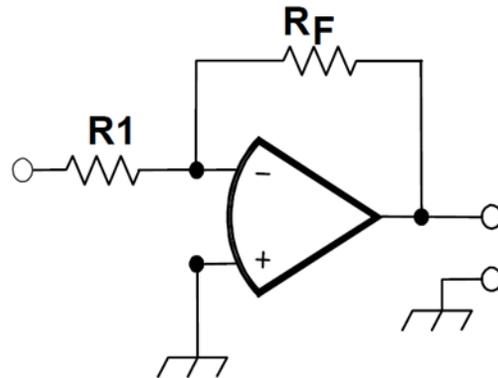
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E7G07

What magnitude of voltage gain can be expected from the circuit in Figure E7-3 when  $R_1$  is 10 ohms and  $R_F$  is 470 ohms?

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

Figure E7-3



E7G08

How does the gain of an 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
- ~~

E7G09

What will be the output voltage of the circuit shown in Figure E7-3 if  $R_1$  is 1000 ohms,  $R_F$  is 10,000 ohms, and 0.23 volts DC is applied to the input?

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

E7G10

What absolute voltage gain can be expected from the circuit in Figure E7-3 when  $R_1$  is 1800 ohms and  $R_F$  is 68 kilohms?

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

E7G11

What absolute voltage gain can be expected from the circuit in Figure E7-3 when  $R_1$  is 3300 ohms and  $R_F$  is 47 kilohms?

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

E7G12

**What is an operational amplifier?**

- A. A high-gain, direct-coupled differential amplifier with very high input impedance and very low output impedance
- B. A digital 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 RF amplifier used in the UHF and microwave regions

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E7H Oscillators and signal sources: types of oscillators; synthesizers and phase-locked loops; direct digital synthesizers; stabilizing thermal drift; microphonics; high-accuracy oscillators

E7H01

**What are three oscillator circuits 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

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E7H02

**What is a microphonic?**

- A. An IC used for amplifying microphone signals
- B. Distortion caused by RF pickup on the microphone cable
- C. Changes in oscillator frequency due to mechanical vibration
- D. Excess loading of the microphone by an oscillator

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E7H03

**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

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E7H04

**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

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E7H05

**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

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E7H06

**Which of the following 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

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E7H07

**How can an oscillator's microphonic responses be reduced?**

- A. Use NP0 capacitors
- B. Reduce noise on the oscillator's power supply
- C. Increase the bias voltage
- D. Mechanically isolate the oscillator circuitry from its enclosure

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E7H08

**Which of the following components can be used to reduce thermal drift in crystal oscillators?**

- A. NP0 capacitors
- B. Toroidal inductors
- C. Wirewound resistors
- D. Non-inductive resistors

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E7H09

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

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

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E7H10

**What information is contained in the lookup table of a direct digital synthesizer (DDS)?**

- A. The phase relationship between a reference oscillator and the output waveform
- B. Amplitude values that represent the desired waveform
- C. The phase relationship between a voltage-controlled oscillator and the output waveform
- D. Frequently used receiver and transmitter frequencies

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E7H11

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

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

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E7H12

**Which of the following must be done to ensure that a crystal oscillator provides the frequency specified by the crystal manufacturer?**

- A. Provide the crystal with a specified parallel inductance
- B. Provide the crystal with a specified parallel capacitance
- C. Bias the crystal at a specified voltage
- D. Bias the crystal at a specified current

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E7H13

**Which of the following is a technique for providing highly accurate and stable oscillators needed for microwave transmission and reception?**

- A. Use a GPS signal reference
- B. Use a rubidium stabilized reference oscillator
- C. Use a temperature-controlled high Q dielectric resonator
- D. All these choices are correct

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E7H14

**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, a voltage-controlled oscillator, and a stable reference oscillator
- D. An electronic circuit consisting of a precision push-pull amplifier with a differential input

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E7H15

**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

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