ARRL The national association for AMATEUR RADIO®

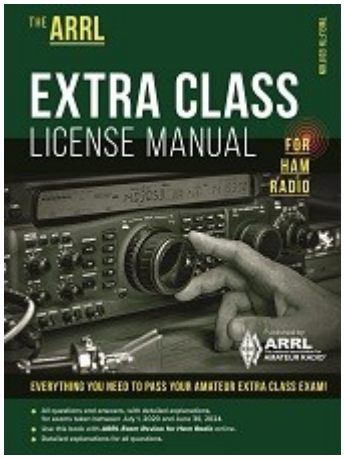
The ARRL Extra Class License Course

All You Need to Pass Your Extra Class Exam

LEVEL 3: Extra

For use with *The ARRL Extra Class License Manual*, 12th Edition

Extra License Manual and other resources



http://www.arrl.org/shop/Licensing-Education-and-Training/

In what application is gallium arsenide used as a semiconductor material?

A. In high-current rectifier circuits

B. In high-power audio circuits

C. In microwave circuits

D. In very low frequency RF circuits

E6A01 ECLM Page (5 - 13)

In what application is gallium arsenide used as a semiconductor material?

A. In high-current rectifier circuits

B. In high-power audio circuits

C. In microwave circuits

D. In very low frequency RF circuits

(C) E6A01 ECLM Page (5 - 13)

Which of the following semiconductor materials contains excess free electrons?

A. N-type

B. P-type

C. Bipolar

D. Insulated gate

E6A02 ECLM Page (5 - 2)

Which of the following semiconductor materials contains excess free electrons?

A. N-type

B. P-type

C. Bipolar

D. Insulated gate

(A) E6A02 ECLM Page (5 - 2)

Why does a PN-junction diode not conduct current when reverse biased?

A. Only P-type semiconductor material can conduct current

B. Only N-type semiconductor material can conduct current

C. Holes in P-type material and electrons in the N-type material are separated by the applied voltage, widening the depletion region

D. Excess holes in P-type material combine with the electrons in N-type material, converting the entire diode into an insulator

E6A03 ECLM Page (5 - 3)

Why does a PN-junction diode not conduct current when reverse biased?

A. Only P-type semiconductor material can conduct current

B. Only N-type semiconductor material can conduct current

C. Holes in P-type material and electrons in the N-type material are separated by the applied voltage, widening the depletion region

D. Excess holes in P-type material combine with the electrons in N-type material, converting the entire diode into an insulator

(C) E6A03 ECLM Page (5 - 3)

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

E6A04 ECLM Page (5 - 2)

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
(C) E6A04 ECLM Page (5 - 2)

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 are both low impedance

B. An FET has lower input impedance

C. An FET has higher input impedance

D. They are both high impedance

E6A05 ECLM Page (5 - 10)

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 are both low impedance

B. An FET has lower input impedance

C. An FET has higher input impedance

D. They are both high impedance

(C) E6A05 ECLM Page (5 - 10)

What is the beta of a bipolar junction transistor?

A. The frequency at which the current gain is reduced to 0.707

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

E6A06 ECLM Page (5 - 9)

What is the beta of a bipolar junction transistor?

A. The frequency at which the current gain is reduced to 0.707

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

(B) E6A06 ECLM Page (5 - 9)

Which of the following indicates that a silicon NPN junction transistor is biased on?

A. Base-to-emitter resistance of approximately 6 to 7 ohms

B. Base-to-emitter resistance of approximately 0.6 to 0.7 ohms

C. Base-to-emitter voltage of approximately 6 to 7 volts

D. Base-to-emitter voltage of approximately 0.6 to 0.7 volts

E6A07 ECLM Page (5 - 8)

Which of the following indicates that a silicon NPN junction transistor is biased on?

A. Base-to-emitter resistance of approximately 6 to 7 ohms

B. Base-to-emitter resistance of approximately 0.6 to 0.7 ohms

C. Base-to-emitter voltage of approximately 6 to 7 volts

D. Base-to-emitter voltage of approximately 0.6 to 0.7 volts

(D) E6A07 ECLM Page (5 - 8)

What term indicates the frequency at which the grounded-base current gain of a transistor 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

E6A08 ECLM Page (5 - 9)

What term indicates the frequency at which the grounded-base current gain of a transistor 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

(D) E6A08 ECLM Page (5 - 9)

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. Any FET without a channel

D. Any FET for which holes are the majority carriers

E6A09 ECLM Page (5 - 11)

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. Any FET without a channel

D. Any FET for which holes are the majority carriers

(A) E6A09 ECLM Page (5 - 11)

In Figure E6-1, what is the schematic symbol for an N-channel dual-gate MOSFET?

A. 2

B. 4

C. 5

D. 6

E6A10 ECLM Page (5 - 11)

In Figure E6-1, what is the schematic symbol for an N-channel dual-gate MOSFET?

A. 2

B. 4

C. 5

D. 6

(B) E6A10 ECLM Page (5 - 11)

In Figure E6-1, what is the schematic symbol for a P-channel junction FET?

A. 1

B. 2

C. 3

D. 6

E6A11 ECLM Page (5 - 10)

In Figure E6-1, what is the schematic symbol for a P-channel junction FET?

A. 1

B. 2

C. 3

D. 6

(A) E6A11 ECLM Page (5 - 10)

Why do many MOSFET devices have internally connected Zener diodes on the gates?

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 static damage to the gate

E6A12 ECLM Page (5 - 11)

Why do many MOSFET devices have internally connected Zener diodes on the gates?

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 static damage to the gate

(D) E6A12 ECLM Page (5 - 11)

What is the most useful characteristic of a Zener diode?

A. A constant current drop under conditions of varying voltage

B. A constant voltage drop under conditions of varying current

C. A negative resistance region

D. An internal capacitance that varies with the applied voltage

E6B01 ECLM Page (5 - 5)

What is the most useful characteristic of a Zener diode?

A. A constant current drop under conditions of varying voltage

B. A constant voltage drop under conditions of varying current

C. A negative resistance region

D. An internal capacitance that varies with the applied voltage

(B) E6B01 ECLM Page (5 - 5)

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

A. Much higher reverse voltage breakdown

B. More constant reverse avalanche voltage

C. Longer carrier retention time

D. Less forward voltage drop

E6B02 ECLM Page (5 - 4)

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

A. Much higher reverse voltage breakdown

B. More constant reverse avalanche voltage

C. Longer carrier retention time

D. Less forward voltage drop

(D) E6B02 ECLM Page (5 - 4)

What type of bias is required for an LED to emit light?

A. Reverse bias

B. Forward bias

C. Zero bias

D. Inductive bias

E6B03 ECLM Page (5 - 7)

What type of bias is required for an LED to emit light?

A. Reverse bias

B. Forward bias

C. Zero bias

D. Inductive bias

(B) E6B03 ECLM Page (5 - 7)

What type of semiconductor device is designed for use as a voltage-controlled capacitor?

A. Varactor diode

B. Tunnel diode

C. Silicon-controlled rectifier

D. Zener diode

E6B04 ECLM Page (5 - 6)

What type of semiconductor device is designed for use as a voltage-controlled capacitor?

A. Varactor diode

B. Tunnel diode

C. Silicon-controlled rectifier

D. Zener diode

(A) E6B04 ECLM Page (5 - 6)

What characteristic of a PIN diode makes it useful as an RF switch?

A. Extremely high reverse breakdown voltage

B. Ability to dissipate large amounts of power

C. Reverse bias controls its forward voltage drop

D. Low junction capacitance

E6B05 ECLM Page (5 - 7)

What characteristic of a PIN diode makes it useful as an RF switch?

A. Extremely high reverse breakdown voltage

B. Ability to dissipate large amounts of power

C. Reverse bias controls its forward voltage drop

D. Low junction capacitance

(D) E6B05 ECLM Page (5 - 7)

Removed from question pool

~~Which of the following is a common use of a Schottky diode?~~

~~A. As a rectifier in high current power supplies~~

~~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~~

~~E6B06 ECLM Page (5 - 5)~~

Removed from question pool

~~Which of the following is a common use of a Schottky diode?~~

~~A. As a rectifier in high current power supplies~~

~~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~~

~~(D) E6B06 ECLM Page (5 - 5)~~

What is the failure mechanism when a junction diode fails due to excessive current?

A. Excessive inverse voltage

B. Excessive junction temperature

C. Insufficient forward voltage

D. Charge carrier depletion

E6B07 ECLM Page (5 - 4)

What is the failure mechanism when a junction diode fails due to excessive current?

A. Excessive inverse voltage

B. Excessive junction temperature

C. Insufficient forward voltage

D. Charge carrier depletion

(B) E6B07 ECLM Page (5 - 4)

Which of the following is a Schottky barrier diode?

A. Metal-semiconductor junction

B. Electrolytic rectifier

C. PIN junction

D. Thermionic emission diode

E6B08 ECLM Page (5 - 4)

Which of the following is a Schottky barrier diode?

A. Metal-semiconductor junction

B. Electrolytic rectifier

C. PIN junction

D. Thermionic emission diode

(A) E6B08 ECLM Page (5 - 4)

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

E6B09 ECLM 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

(C) E6B09 ECLM Page (5 - 5)

In Figure E6-2, what is the schematic symbol for a light-emitting diode?

A. 1

B. 5

C. 6

D. 7

E6B10 ECLM Page (5 - 7)

In Figure E6-2, what is the schematic symbol for a light-emitting diode?

A. 1

B. 5

C. 6

D. 7

(B) E6B10 ECLM Page (5 - 7)

What is used to control the attenuation of RF signals by a PIN diode?

A. Forward DC bias current

B. A sub-harmonic pump signal

C. Reverse voltage larger than the RF signal

D. Capacitance of an RF coupling capacitor

E6B11 ECLM Page (5 - 7)

What is used to control the attenuation of RF signals by a PIN diode?

A. Forward DC bias current

B. A sub-harmonic pump signal

C. Reverse voltage larger than the RF signal

D. Capacitance of an RF coupling capacitor

(A) E6B11 ECLM Page (5 - 7)

What is the function of hysteresis in a comparator?

A. To prevent input noise from causing unstable output signals

B. To allow the comparator to be used with AC input signals

C. To cause the output to change states continually

D. To increase the sensitivity

E6C01 ECLM Page (6 - 10)

What is the function of hysteresis in a comparator?

A. To prevent input noise from causing unstable output signals

B. To allow the comparator to be used with AC input signals

C. To cause the output to change states continually

D. To increase the sensitivity

(A) E6C01 ECLM Page (6 - 10)

What happens when the level of a comparator's input signal crosses the threshold?

A. The IC input can be damaged

B. The comparator changes its output state

C. The comparator enters latch-up

D. The feedback loop becomes unstable

E6C02 ECLM Page (6 - 10)

What happens when the level of a comparator's input signal crosses the threshold?

A. The IC input can be damaged

B. The comparator changes its output state

C. The comparator enters latch-up

D. The feedback loop becomes unstable

(B) E6C02 ECLM Page (6 - 10)

What is tri-state logic?

A. Logic devices with 0, 1, and high impedance output states

B. Logic devices that utilize ternary math

C. Low power logic devices designed to operate at 3 volts

D. Proprietary logic devices manufactured by Tri-State Devices

E6C03 ECLM Page (5 - 21)

What is tri-state logic?

A. Logic devices with 0, 1, and high impedance output states

B. Logic devices that utilize ternary math

C. Low power logic devices designed to operate at 3 volts

D. Proprietary logic devices manufactured by Tri-State Devices

(A) E6C03 ECLM Page (5 - 21)

Which of the following is an advantage of BiCMOS logic?

A. Its simplicity results in much less expensive devices than standard CMOS

B. It is immune to electrostatic damage

C. It has the high input impedance of CMOS and the low output impedance of bipolar transistors

D. All these choices are correct

E6C04 ECLM Page (5 - 26)

Which of the following is an advantage of BiCMOS logic?

A. Its simplicity results in much less expensive devices than standard CMOS

B. It is immune to electrostatic damage

C. It has the high input impedance of CMOS and the low output impedance of bipolar transistors

D. All these choices are correct

(C) E6C04 ECLM Page (5 - 26)

What is an advantage of CMOS logic devices over TTL devices?

A. Differential output capability

B. Lower distortion

C. Immune to damage from static discharge

D. Lower power consumption

E6C05 ECLM Page (5 - 26)

What is an advantage of CMOS logic devices over TTL devices?

A. Differential output capability

B. Lower distortion

C. Immune to damage from static discharge

D. Lower power consumption

(D) E6C05 ECLM Page (5 - 26)

Why do CMOS digital integrated circuits have high immunity to noise on the input signal or power supply?

A. Large bypass capacitance is inherent

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. Bandwidth is very limited

E6C06 ECLM Page (5 - 26)

Why do CMOS digital integrated circuits have high immunity to noise on the input signal or power supply?

A. Large bypass capacitance is inherent

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. Bandwidth is very limited

(C) E6C06 ECLM Page (5 - 26)

What best describes a pull up or pull down resistor?

A. A resistor in a keying circuit used to reduce key clicks

B. A resistor connected to the positive or negative supply line used to establish a voltage when an input or output is an open circuit

C. A resistor that ensures that an oscillator frequency does not drift

D. A resistor connected to an op-amp output that prevents signals from exceeding the power supply voltage

E6C07 ECLM Page (5 - 25)

What best describes a pull up or pull down resistor?

A. A resistor in a keying circuit used to reduce key clicks

B. A resistor connected to the positive or negative supply line used to establish a voltage when an input or output is an open circuit

C. A resistor that ensures that an oscillator frequency does not drift

D. A resistor connected to an op-amp output that prevents signals from exceeding the power supply voltage

(B) E6C07 ECLM Page (5 - 25)

In Figure E6-3, what is the schematic symbol for a NAND gate?

A. 1

B. 2

C. 3

D. 4

E6C08 ECLM Page (5 - 20)

In Figure E6-3, what is the schematic symbol for a NAND gate?

A. 1

B. 2

C. 3

D. 4

(B) E6C08 ECLM Page (5 - 20)

What is a Programmable Logic Device (PLD)?

A. A logic circuit that can be modified during use

B. A programmable collection of logic gates and circuits in a single integrated circuit

C. Programmable equipment used for testing digital logic integrated circuits

D. A type of transistor whose gain can be changed by digital logic circuits

E6C09 ECLM Page (5 - 26)

What is a Programmable Logic Device (PLD)?

A. A logic circuit that can be modified during use

B. A programmable collection of logic gates and circuits in a single integrated circuit

C. Programmable equipment used for testing digital logic integrated circuits

D. A type of transistor whose gain can be changed by digital logic circuits

(B) E6C09 ECLM Page (5 - 26)

In Figure E6-3, what is the schematic symbol for a NOR gate?

A. 1

B. 2

C. 3

D. 4

E6C10 ECLM Page (5 - 20)

In Figure E6-3, what is the schematic symbol for a NOR gate?

A. 1

B. 2

C. 3

D. 4

(D) E6C10 ECLM Page (5 - 20)

In Figure E6-3, what is the schematic symbol for the NOT operation (inverter)?

A. 2

B. 4

C. 5

D. 6

E6C11 ECLM Page (5 - 19)

In Figure E6-3, what is the schematic symbol for the NOT operation (inverter)?

A. 2

B. 4

C. 5

D. 6

(C) E6C11 ECLM Page (5 - 19)