Amateur Radio Service Technician Class

Exam Preparation Class
March 2019
Session 4

Roland K. Smith K7OJL
Phone: (435) 849-1946 Email: rolandksmith@gmail.com

These slides are uploaded to my website

https://k7ojl.com/class-course-materials/technician-class-materials/

just before class each week.

Depending on how the class goes, they may get updated after the class.

Class Overview

- Questions?
- Volts, Ohms, Amperes, and Henries
- Electrical Components
- Decibels
- Scientific Notation
- Ohms Law
- Safety First
- The Exam

"You never heard of a ham operator before?"


Questions from Session 1 or 2 or 3?
Questions about Amateur Radio?

Volts, Ohms, Amperes, Henries, and Farads? Oh My!

Electromotive Force

- The force behind electron flow
- Symbol is ‘E’
- Measured in Volts, ‘v’
- Measured by a voltmeter
- Measurement is made in parallel with the circuit
- May also be called “electric potential’

Current … The Flow of Electrons

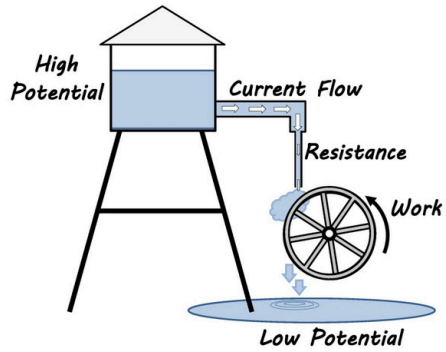
- The symbol for current is ‘I’
- The amount of current flowing is measured in ‘Amperes’, denoted by an ‘A’
- Current is measured by an ‘ammeter’
- Measurement is made in series with the circuit
- Current flowing in one direction is called “direct current”
- Current flowing in one direction and then the other is called “alternating current”

Resistors Oppose the Flow

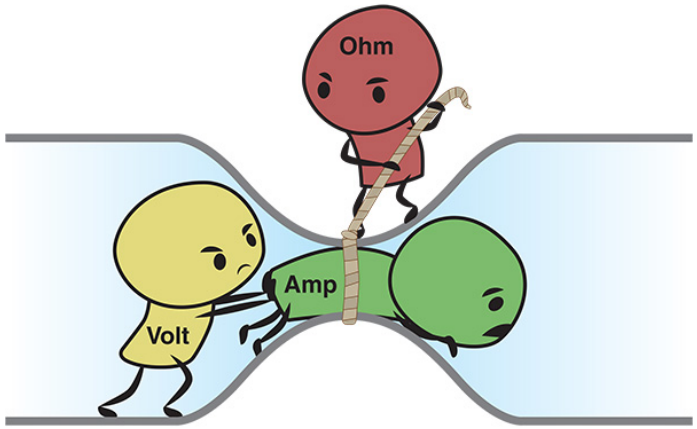
- Resistance is measured in ‘ohms’
- The symbol for ohms is the Greek letter ‘Ω’
- Resistance is measured by an ‘ohmmeter’
- The resistance in a circuit usually cannot be directly measured, but can be calculated
- The current that doesn’t pass is dissipated as heat

The Water Analogy

- Electromotive Force = water pressure
- Current = the water flow
- Resistance = the constraints in the plumbing

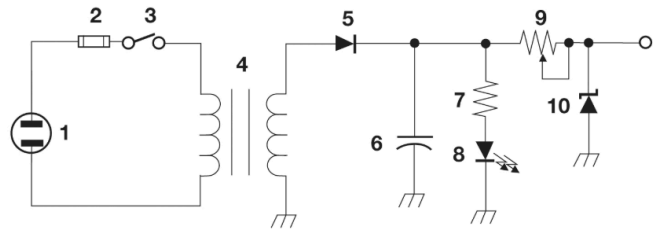


Volts, Amps, Ohms



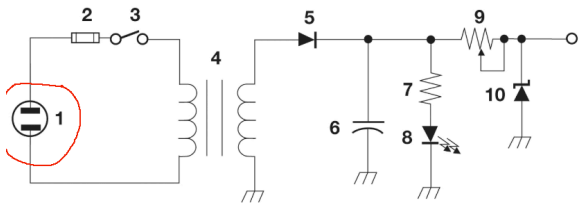
Electrical Components

Schematic Diagrams



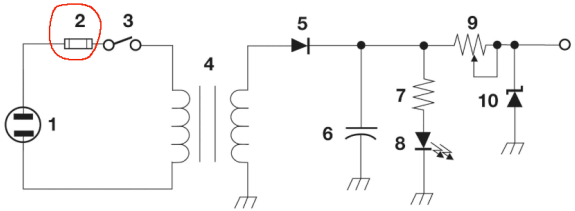
This is one of three possible schematic diagrams that may be on the test. The various components are numbered and the test question(s) will ask you to identify the component.

Power Source



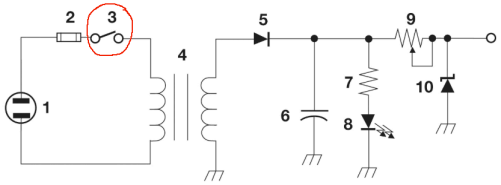
Either Alternating Current or Direct Current is used to provide voltage and current to an electronic device. In this particular diagram, the input is alternating current because it is feeding a transformer.

Fuse



A fuse is used to protect a circuit from drawing too much current. Fuses are rated by how many amperes of current can pass before the fuse opens the circuit. Fuses are made of a resistive material that gets hot and melts when the rated current draw is exceeded.

Switch

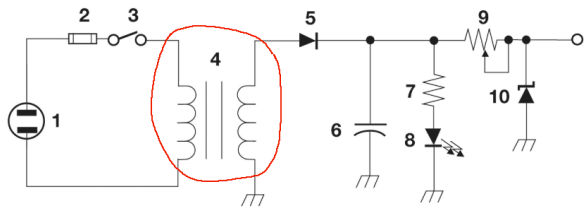


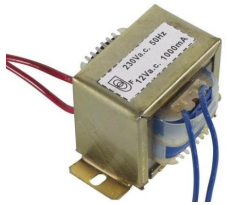
Switches come in a variety of configurations. The switch in this diagram is a “single pole, single throw” switch. It can be used to either complete or interrupt a single circuit.

Other configurations of this switch type include “single pole, double throw”,“double pole, single throw”, “double pole, double throw” and more.

There are also rotary switches, momentary switches, and gang switches.

Transformer





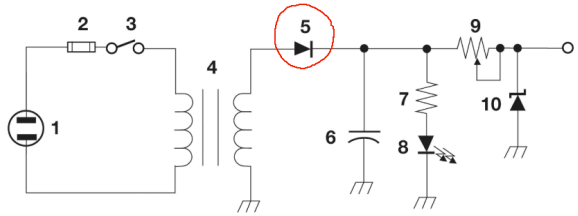
A transformer is a static electrical device that transfers electrical energy between two or more circuits through electromagnetic induction.

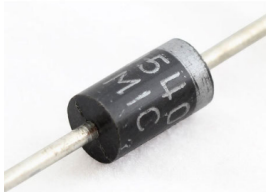
They are used to isolate one circuit from another and/or to increase or decrease the voltage from one side to the other.

The amount of increase (or decrease) depends on the ratio of the number of turns in the coil on each side of the transformer.

The transformer in this circuit has a iron core, signified by the two parallel lines in the middle of the transformer.

Diode





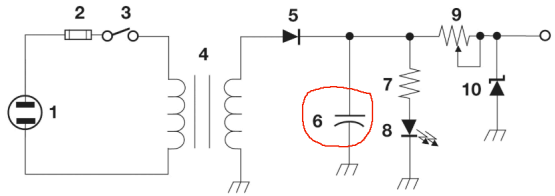
A diode is a two-terminal electronic component that conducts current primarily in one direction; it has low (ideally zero) resistance in one direction, and high (ideally infinite) resistance in the other.

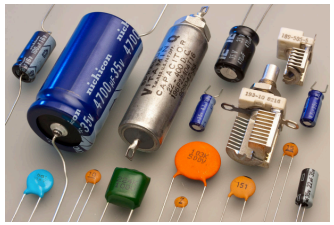
The two electrodes are the anode and cathode. The cathode side is marked with a stripe.

Current flows from the anode to the cathode. Diodes have a threshold voltage value and current will flow when the threshold is exceeded.

While they will normally only allow current to flow in one direction, a very high voltage applied to the cathode can cause the diode to break down and allow current to flow in the reverse direction.

Capacitor





A capacitor consists of two or more conductive surfaces separated by an insulator. The insulator can be air, a vacuum, or other solid material such as plastic or paper.

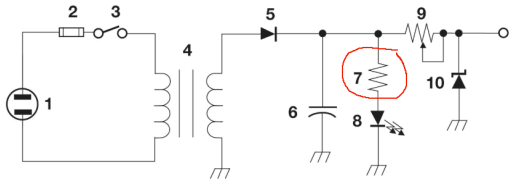
Applying voltage higher than the rated value can cause the capacitor to short circuit.

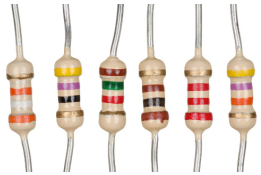
Capacitance is measured in Farads

One farad is a rather large amount of power stored in a capacitor. Capacitors capable of being charged to one or more farads are massive and found in places like the large Hadron collider in Cern, Switzerland.

The capacitors used in most electrical circuits have fractions of a farad capacity, usually measured in microfarads (1/1,000 of a farad), nanofarad (1/1,000,000 of a farad), and picofarads (1/1,000,000,000 of a farad).

Resistor



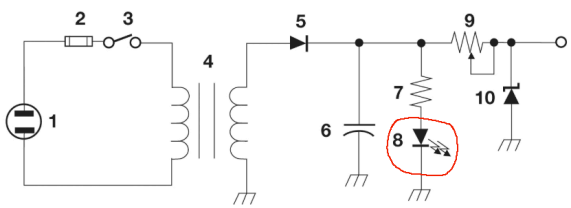


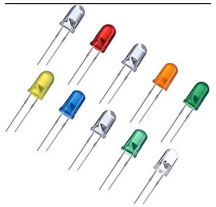
A resistor restricts, but doesn't inhibit, current flow in a circuit. Some of the current is converted into heat, the rest flows through the resistor.

Resistors come in various compositions and power ratings (the amount of current and voltage the resistor can accomodate).

Resistance is measured in Ohms (Ω)

Light-Emitting Diode



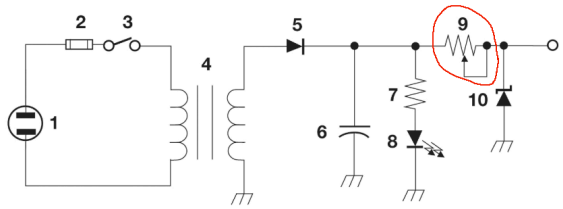


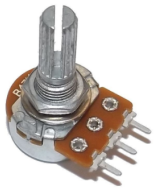
LED's are a special type of diode. They allow current to flow in one direction, but convert some of the energy into light.

The positive (anode) lead will be the longer lead and have a flat edge on the outer casing.

Diodes have very low resistance and will short a circuit if not coupled with a resistor to limit the current flow through the LED.

Variable Resistor





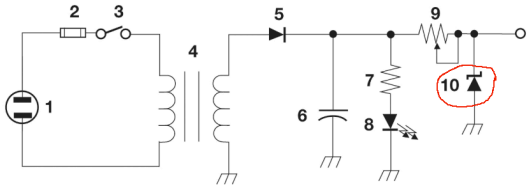
A variable resistor, aka potentiometer, is often used as a voltage divider (when all three pins are used) or as a variable resistor when two pins are used (as in this example).

A common use of a potentiometer is as a volume control in a radio.

The outer two pins have a fixed amount of resistance between them.

When a potentiometer is turned all the way to the left, the center conductor (also called the “wiper”) has zero resistance. Turned all the way to the right, the center conductor has the full resistance.

Schottky Diode



A schottky diode was the first semiconductor invented.It is a very fast diode compared to a “normal” diode. The amount of voltage needed to cause current to flow is very low, meaning the diode can switch on or off quickly.

The Schottky Diode is distinguished from “normal” diodes by the “curly” cathode indicator. Note that in a Schottky Diode, the current flows from the cathode to the anode whereas in normal
diodes, current flows from the anode to the cathode (compare #5 to #10)

Schematic 2

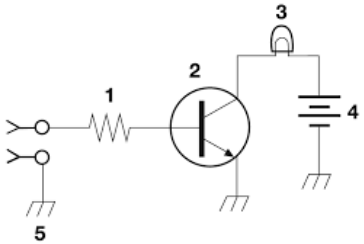


Figure T-1

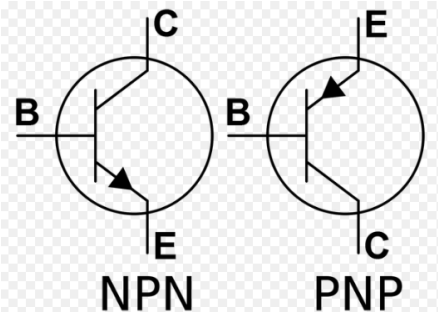
1. A Resistor
2. A Transistor
3. A lamp
4. A battery
5. Common or Ground

Common or ground is the return path for the current flowing in the circuit

The only thing this circuit does is turn on a lamp if some other part of the circuit (which isn't shown) draws current.

Transistors

- B: Base, C: Collector, E: Emitter
- Two flavors, distinguished by the emitter arrow
- Transistors are excellent amplifiers
  - A small modulated signal on one pair of pins will modulate a larger carrier on the other pair
- They are also excellent switches
  - Current won't flow on one pair if a signal is present on the other pair



A Field Effect Transistor (FET) is a transistor that amplifies or switches voltage (instead of current)

When input voltage applied to Base/Emitter, it changes the resistance between the Collector and Emitter. That then affects how much current can flow between the Collector and Emitter

Amplification is called "gain" and is measured in "dBm"

The 3rd Schematic

1. A connector to/from some other part of the schematic
2. A variable capacitor
3. A variable inductor
4. An antenna

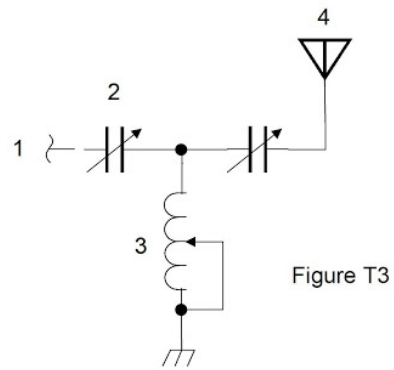
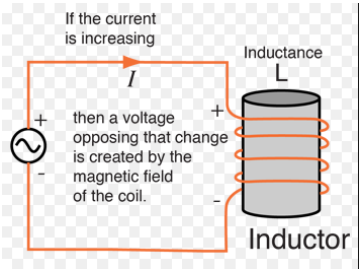


Figure T3

This circuit actually works, whereas the other two circuits are pretty much nonsense. This circuit is a trans match to make the transmitter think it's seeing a 50 ohm impedance.

Inductance

- An inductor is a coil of wire and may have an air core or some type of a metal core
- Inductors store electrical energy in a magnetic field
- Inductors oppose rising current until the magnetic field is full and then passes the current.
- As the incoming current falls, the inductor releases the magnetic field



Inductance is measured in “henries”

One henry is a very large amount of power. Most of the inductors in today’s electrical circuits are measured in milli henries and micro henries.

Inductance vs Capacitance

Inductors

- Stores energy in the form of a magnetic field
- A current can pass through an inductor but will create a magnetic field as it does so
- As a property of the magnetic field, when the current suddenly increases or decreases, the current within the magnetic field will change in the opposite direction. This resists, or impedes, the change in current across the circuit. The inductor inhibits the current from changing instantly.

Capacitors

- Stores energy in the form of an electrical field
- As a current is applied to the circuit, charges accumulate on the plates of the capacitor. Therefore, voltage cannot change instantly across a capacitor
- When the current decreases the capacitor will release the charge

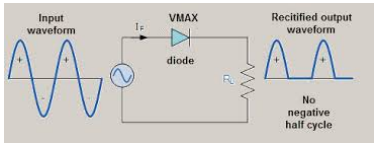
Some Add'l Component Info

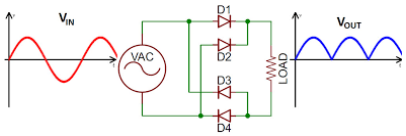
- A transistor is made up of three layers of semiconductor material
- A transistor is used to amplify signals
- The three pins on a transistor, whether it is an NPN or a PNP transistor are Emitter, Base, and Collector
- However, the three pins on a Field Effect Transistor are Source, Gate, and Drain
- A Rectifier is used to convert alternating current to direct current. A rectifier is a component of a Power Supply. A Regulator governs the amount voltage from a power supply

And Even More…

- A dummy load is non-inductive resistor (usually about 50 ohms) and a heat sink to dissipate the heat
- Dummy loads are used to prevent transmission of signals while testing the equipment
- Rosin core solder is used for electronic circuits. A good solder joint will be bright and shiny
- When measuring resistance with a ohmmeter which shows increasing resistance over time, there is a capacitor in the circuit being measured

A Rectifier for example…





Good Things to Know

- Some battery types are rechargeable. Carbon-zinc batteries are not
- Copper, gold, aluminum are a good conductors of electricity. Wood, glass, and rubber are good insulators
- Copper wire has some resistance, meaning that the voltage will drop as the length of the wire increases. Heavier wire has less resistance. Shorter lengths have less loss
- Opposition to the flow of AC current is called impedance and is also measured in ohms

If a battery is rechargeable, it will say so

Most power supplies (as well as the automotive charging system) deliver 13.7 volts which will draw down to 12.5 volts when transmitting

How Much Power Does a Transceiver Need?

- Modern transceivers require at least 12 volts of power
  - Most power supplies, as well as the automotive charging system, deliver 13.7 volts which will drop to about 12.5 volts when transmitting
- The amount of current needed is determined by:
  - The efficiency of the transmitter at full power
  - The receiver and control circuit requirements
  - The efficiency (regulation) of the power supply
  - The amount of heat dissipation
- A 100 watt transmitter will required about 20-25 watts on transmit and 1-5 watts on receive

Decibels

The decibel (dB) is used to measure sound level, but it is also widely used in electronics, signals and communication. The dB is a logarithmic way of describing a ratio. The ratio may be power, sound pressure, voltage, or intensity or several other things.

Decibel Table

dB	Power Change
3 dB	2x Power Change
6 dB	4x Power Change
9 dB	8x Power Change
10 dB	10x Power Change
20 dB	100x Power Change
30 dB	1000x Power Change
40 dB	10,000 x Power Change

Amount of change in dB of a power increase from 20 watts to 200 watts? 10 dB
Amount of change in dB of a power increase from 5 watts to 10 watts? 3 dB

Going the Other Way

dB	Power Change
-3 dB	1/2 Power Change
-6 dB	1/4 Power Change
-9 dB	1/8 Power Change
-10 dB	1/10 Power Change
-20 dB	1/100 Power Change
-30 dB	1/1000 Power Change
-40 dB	1/10,000 Power Change

Scientific Notation

Scientific Notation

Pfx	Symbol	Factor	Pfx	Symbol	Factor
giga	G	1,000,000,000	milli	m	0.001
mega	M	1,000,000	micro		0.000001
kilo	k	1,000	nano	n	0.000000001
unit		1	pico	p	0.000000000001

Each step either adds or subtracts 3 decimal positions.

Some Examples

- A frequency display of 2425 MHz would be 2.425 GHz
- A frequency of 28,400 kHz would be 28.4 MHz
- 500 milliwatts would be 0.5 watts
- 1.5 amperes is 1500 milliamperes
- One microvolt is on one-millionth of a volt
- If an ammeter calibrated in amperes measures a 3000-milliampere current would show a reading of 3 amperes

Your Turn!

- How many volts are equal to one microvolt?
- What is another way to specify a radio signal frequency of 1,500,000 hertz?
- If a frequency display calibrated in megahertz shows a reading of 3.525 MHz, what would it show if it were calibrated in kilohertz?
- How many microfarads are equal to 1,000,000 picofarads?

1 millionth of a volt

1.5 MHz

3525 kHz

1 microfarad

Random Definitions

Relay: an electrically controlled switch, usually using magnetism (inductance) to switch the relay

Integrated Circuit: a device that combines multiple transistors, capacitors, resistors, etc. into one package

LED's: commonly used as indicators (such as on/off)

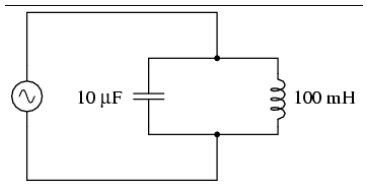
Solder: comes in many types. Rosin Core solder is used for electrical circuits. A good solder connection will have a bright, silvery surface. A dull and grainy surface indicates a faulty, or "cold" connection

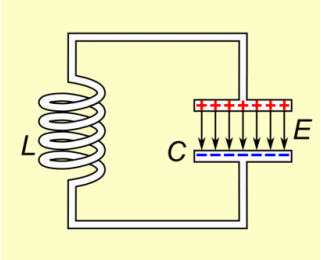
How to damage a meter? Measure voltages or currents beyond the instrument's rated capacity or measure volts in the resistance setting….

Schematic: An electrical circuit diagram showing electrical components as standard symbols & how the various components are connected. It does not show actual placement, sizes, or wire lengths.

Capacitors & Inductors

- Capacitors and Inductors operate opposite each other
- If a pulsing / alternating current is introduced, oscillation will occur
- Often a crystal or a rapidly switching current source is used to drive the circuit
- The value of the capacitor and the inductor are selected based on the desired oscillation frequency
- A capacitor and inductor, either in parallel or series, forms a <u>resonant</u> or <u>tuned</u> circuit





One last thought about a circuit that includes a capacitor: when measuring the resistance with an ohmmeter, the circuit will first show little or no resistance after which the resistance will climb sharply as the capacitor charges and reaches capacity

Ohms Law

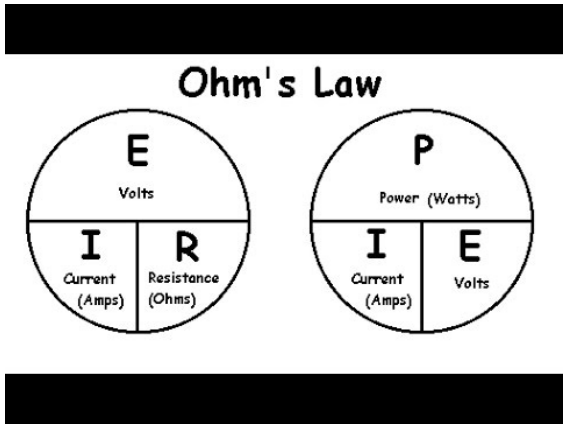
Ohms Law Defined

- Ohms Law defines the relationship among Electromotive Force (measured in Volts and depicted as ‘E’), Resistance (measured in ohms and depicted as ‘R’) and Current (measured in amperes and depicted as ‘I’)
- It further defines the relationship among Power (measured in Watts and depicted as ‘P’), Resistance (measured in ohms and depicted as ‘R’) and Current (measured in amperes and depicted as ‘I’)

The Magic Circles

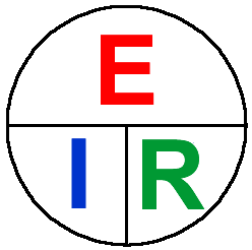
E (volts) = I (amperes) * R (ohms)

P (watts) = I (amperes) * E (volts)

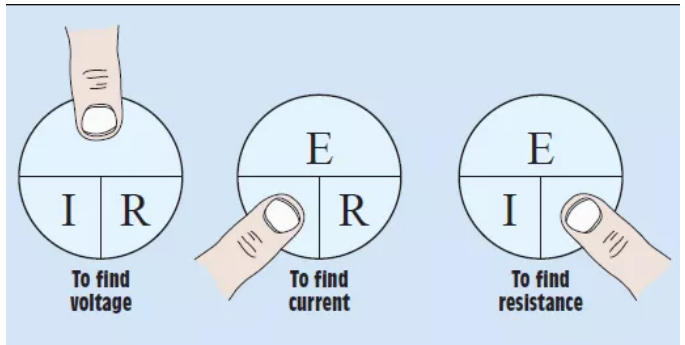


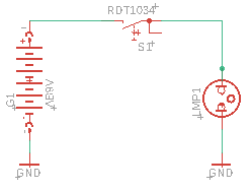
How To Use the Magic Circle for Volts, Ohms, Amperes

- There are three elements in the equation, volts, amps, ohms
  - Two are known, one is the unknown
- Cover the unknown and then solve the equation



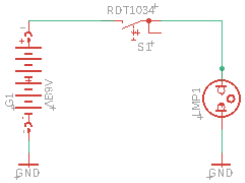
For Example

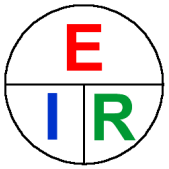




What is the voltage in this circuit where the current is 0.5 amperes and the resistance is 2 ohms?

What is the resistance in this circuit where the voltage is 2 volts and the current is 4 amperes?





1st Example: Volts = Amperes * Ohms = 0.5 * 2 = 1 Volt

2nd Example: Resistance = Volts / Amperes = 2 / 4 = 0.5 ohms

Your Turn!

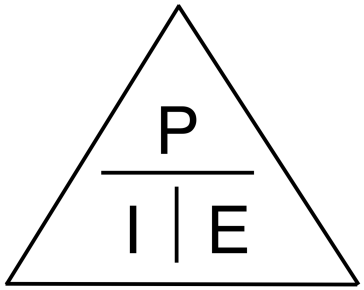
- What is the resistance of a circuit in which a current of 3 amperes flows through a resistor connected to 90 volts?
- What is the current through a 100-ohm resistor connected across 200 volts?

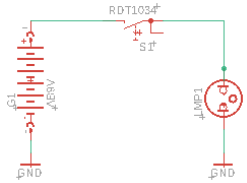
30 ohms

2 amps

Calculating Power (Watts)

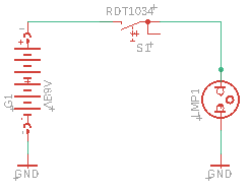
- Power is the rate at which electrical energy is used
- Power is measured in Watts and is often described in watt-hours
- The magic triangle works the same way as the ohms law circle

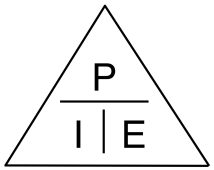




If the voltage in this circuit is 13.8 volts DC and the current is 10 amperes, how much power is being consumed?

If the voltage in this circuit is 12 volts DC and the load is 120 watts, how many amperes are flowing?





1st Example: Watts = 10 amperes x 13.8 volts = 138 watts

2nd Example: Amperes = 120 watts / 12 volts = 10 amperes

Your Turn!

How much power is being used in a circuit when the applied voltage is 12 volts DC and the current is 2.5 amperes?

30 watts

The Four Equations

Converting between Wavelength in Meters and Frequency in MHz:
Wavelength in meters = 300 / frequency MHz
Frequency MHz = 300 / Wavelength in meters

Calculating the length of a dipole in feet:
Length in Feet = 468 / Frequency in MHz

Ohms Law:
E = I x R (where E=volts, I=amperes, and R=ohms). Draw the circle

Ohms Power Law:
P = I x E (where P=watts, I=amperes, and E=volts). Draw the circle

Kirchoff's Laws

- Voltage Law: the sum of the voltages in a series circuit adds up to zero
  - Sources add voltages, components use (subtract) voltages
  - The voltage across two components in series depends on the value and type of components
- Current Law: the sum of currents entering a node must equal the sum of the currents leaving a node
  - In a series circuit the current is the same across all components
  - In a parallel circuit, the current divides proportionately at each junction
  - In all cases, the amount of current injected must equal the amount of current returned to the injection point

What happens to current at the junction of two components in series? It is the same in both components (or, in other words, a series loop has only one path, so the same current goes through each component)

In a parallel circuit, the current will divide at the junction point depending on the value of the components in each leg of the circuit

Safety First!!

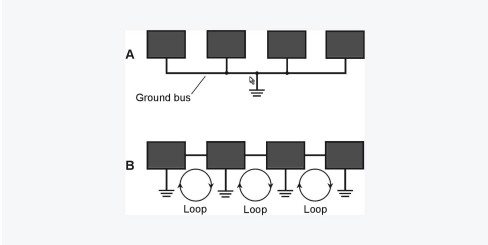
Important Grounding Info

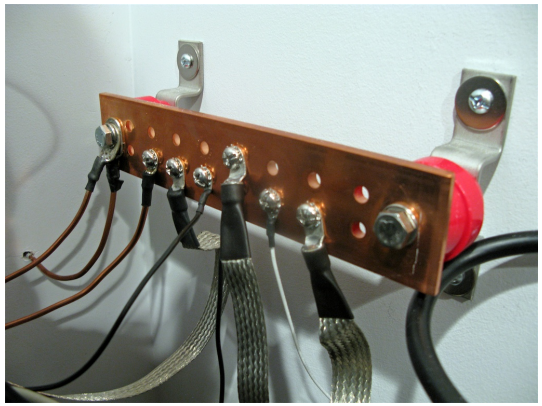
- Grounding protects against electrical shock!!
  - Use 3-way cords and plugs on all AC powered equipment
  - Use a circuit protected by a ground-fault interrupter
  - Connect all AC powered station equipment to a common safety ground
    - Prevents different equipment from having “floating grounds”
- The GREEN WIRE in a 3-wire AC plug is always connected to the equipment ground

The proper grounding procedure for a tower is an 8 foot ground rod for each leg of the tower, bonded to the tower and to each other.

Local electrical codes establish the grounding requirements for towers.

Avoid sharp bends with the grounding straps for lightning protection.





Connect all grounds to a common point. No “daisy chains”! Will cause ground loops instead of having all equipment at the same ground

Ground bus bars are a good choice. One side is connected to the house ground (where the green wire is attached) and the other side goes to a good earth ground (wire as short as possible)

Fuses

- A fuse of the proper value will protect you and your equipment in case of an overload
- A fuse should always be included in home-built equipment
- Never replace a blown fuse with one of a higher amperage value
- Electrical current flowing through the human body may
  - Cause injury by heating tissue
  - Disrupt electrical function of cells
  - Cause involuntary muscle contractions

Battery Safety

If a lead-acid battery is discharged too quickly (as in a short circuit) the battery could overheat, discharge flammable hydrogen gas, or explode

Tower Safety

- Keep towers a safe distance from a power line!!!!
  - Far enough so that if the tower falls, no part of it can come closer than 10 feet to the power lines
- Never attach to a utility pole (they carry high-voltage power lines)
- When climbing, always use a climbing harness (fall arrester) and safety glasses
- Never, ever climb without a helper or observer
- Everyone around the tower should wear a hard hat
- Crank-up towers should not be climbed unless safety-locking devices are installed

More on Towers

- A “gin pole” is used to lift tower sections or antennas safely
- Use safety wires on turnbuckles to prevent them from loosening from vibration
- Local electrical codes govern tower grounding requirements
  - Generally separate eight-foot long ground rods for each tower leg, bonded to the tower and each other
  - Use copper strap (lowest impedance to RF) for bonding
  - Keep connections short and direct (no sharp corners)

So, What Is A Gin Pole (You Might Ask)

RF Exposure

- The amount of RF energy the human body will absorb varies with the frequency
  - The body is most susceptible at 50 MHz (6 meters)
  - This is the frequency with the lowest “maximum permissible exposure”
- RF Exposure Evaluation is required when the maximum power output is 50 watts or more
  - The evaluation is done based on the FCC OET Bulletin 65 using computer models and actual field measurements

- Relocate antennas if necessary to avoid excessive RF exposure (particularly mobile antennas)
- Whenever station equipment changes you must re-evaluate for RF exposure limits

Touching an antenna while transmitting can cause a serious RF burn!

When antennas are where people may accidentally touch them (such as at a shelter or an outdoor activity), they need to be guarded and well marked

RF energy is <u>non-ionizing</u> radiation (as opposed to nuclear radiation). RF energy doesn’t have sufficient energy to cause genetic damage.

Managing RF Exposure

- The “Duty Cycle” of the RF emitter is an important component of RF exposure
  - Duty Cycle is the percentage of the time that the transmitter is transmitting vs the time it is not
- “Power Density” is the average amount of RF power exposure over a period of time
  - Duty Cycle directly affects power density
  - 3 minutes on and 3 minutes off vs 6 minutes on would double the power density allowed over a 6 minute period

BE SAFE!

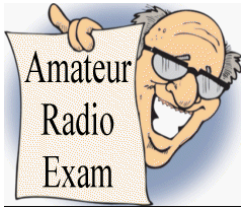
Some Final Things

- VHF Packet Radio: uses FM emissions, even the ISS uses FM packet
- Weak signal work on VHF or UHF? You will ned a multi-mode transceiver operating SSB
- Most repeaters use FM emissions and have a bandwidth of 10-15 kHz
- When controlling a radio controlled device, you must affix a label to the transmitter stating the licensee's name, call sign, and address

The Exam

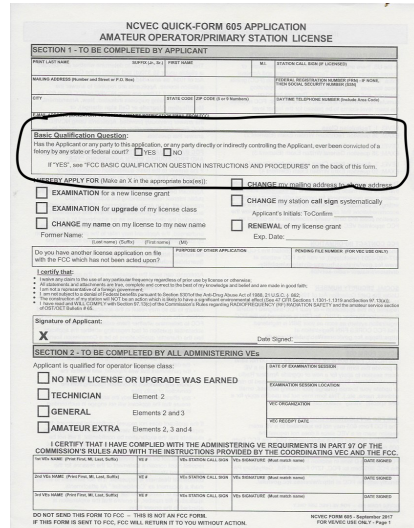
The Exam Session

- Please bring:
  - Your social security number
  - 2 forms of ID, one of which must have your picture
  - A calculator (special rules for a smart phone!)
  - $15 in cash or check. If needed, we can accept a credit card
- The first action will be to fill out a form 605



Form 605 Paperwork

- Applicant fills out the top section down to the signature
- Upon completion of the exam, the exam coordinator will fill out the bottom section
  - If you have ever been convicted of a felony, a written statement as to why you should be granted a license must be submitted



NCVEC QUICK-FORM 605 APPLICATION
AMATEUR OPERATOR/PRIMARY STATION LICENSE

SECTION 1 - TO BE COMPLETED BY APPLICANT

PRINT LAST NAME | SUFFIX (jr., Sr.) | FIRST NAME | MI. | STATION CALL SIGN (IF LICENSED)

MAILING ADDRESS (Number and Street or P.O. Box) | FEDERAL REGISTRATION NUMBER (FRN) - IF NONE, THEN SOCIAL SECURITY NUMBER (SSN)

CITY | STATE CODE | ZIP CODE (5 or 9 Numbers) | DAYTIME TELEPHONE NUMBER (Include Area Code)

Basic Qualification Question:
Has the Applicant or any party to this application, or any party directly or indirectly controlling the Applicant, ever been convicted of a felony by any state or federal court? ☐ YES ☐ NO
If 'YES', see 'FCC BASIC QUALIFICATION QUESTION INSTRUCTIONS AND PROCEDURES' on the back of this form.

I HEREBY APPLY FOR (Make an X in the appropriate box(es)):
☐ EXAMINATION for a new license grant
☐ EXAMINATION for upgrade of my license class
☐ CHANGE my name on my license to my new name
Former Name: (Last name) (Suffix) (First name) (MI)
☐ CHANGE my mailing address to above address
☐ CHANGE my station call sign systematically
Applicant's Initials: To Confirm
☐ RENEWAL of my license grant
Exp. Date:

Do you have another license application on file with the FCC which has not been acted upon? | PURPOSE OF OTHER APPLICATION | PENDING FILE NUMBER (FOR VEC USE ONLY)

I certify that:
- I waive any claim to the use of any particular frequency regardless of prior use by license or otherwise;
- All statements and attachments are true, complete and correct to the best of my knowledge and belief and are made in good faith;
- I am not a representative of a foreign government;
- I am not subject to a denial of Federal benefits pursuant to Section 5301of the Anti-Drug Abuse Act of 1988, 21 U.S.C. § 862;
- The installation of my station will NOT be an action which is likely to have a significant environmental effect (See 47 CFR Sections 1.1301-1.1319 and Section 97.13(a));
- I have read and WILL COMPLY with Section 97.100(d) of the Commission's Rules regarding RADIOFREQUENCY (RF) RADIATION SAFETY and the amateur service section of 47CFR OET Bulletin #65.

Signature of Applicant:
X _____ Date Signed: _____

SECTION 2 - TO BE COMPLETED BY ALL ADMINISTERING VEs

Applicant is qualified for operator license class:
☐ NO NEW LICENSE OR UPGRADE WAS EARNED
☐ TECHNICIAN Element 2
☐ GENERAL Elements 2 and 3
☐ AMATEUR EXTRA Elements 2, 3 and 4

DATE OF EXAMINATION SESSION
EXAMINATION SESSION LOCATION
VEC ORGANIZATION
VEC RECEIPT DATE

I CERTIFY THAT I HAVE COMPLIED WITH THE ADMINISTERING VE REQUIRMENTS IN PART 97 OF THE COMMISSION'S RULES AND WITH THE INSTRUCTIONS PROVIDED BY THE COORDINATING VEC AND THE FCC.

1st VEs NAME (Print First, MI, Last, Suffix)	VE #	VEs STATION CALL SIGN	VEs SIGNATURE (Must match name)	DATE SIGNED
2nd VEs NAME (Print First, MI, Last, Suffix)	VE #	VEs STATION CALL SIGN	VEs SIGNATURE (Must match name)	DATE SIGNED
3rd VEs NAME (Print First, MI, Last, Suffix)	VE #	VEs STATION CALL SIGN	VEs SIGNATURE (Must match name)	DATE SIGNED

DO NOT SEND THIS FORM TO FCC — THIS IS NOT AN FCC FORM.
IF THIS FORM IS SENT TO FCC, FCC WILL RETURN IT TO YOU WITHOUT ACTION.

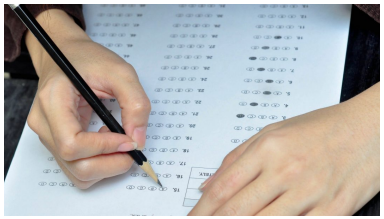
NCVEC FORM 605 - September 2017
FOR VE/VEC USE ONLY - Page 1

If you've been convicted of a felony, see me after the class for explanation of what the statement must include and how to submit the statement.

Note that a felony conviction does not disqualify an applicant. Further, the VE team has no involvement in the statement submission or review process.

Taking the Exam

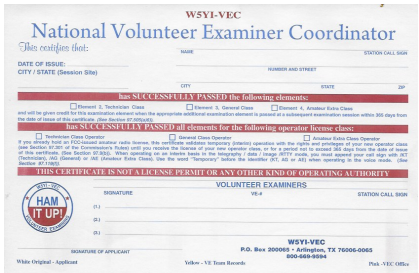
- You'll be given an exam booklet with the 35 questions you are to answer along with an answer sheet
- You'll also be given two blank pieces of paper to use as scratch paper. You must turn in the two sheets of paper, even if they weren't used when you turn in the answer sheet
- If you don't have a pen or pencil, one will be provided
- Make no marks on the exam books. They are reusable
- Mark your answers on the answer sheet. Double / triple check
- There is no time limit. It's easy to misread a question. Take your time!



- Your test will be different than your neighbors
- Three VE's will supervise the test session and each will independently grade your exam

Upon Successful Completion

- You will be issued a form indicating successful completion
- The white (top) copy of the form is given to the successful applicant, the yellow is kept in our local files, and the pink is sent to W5YI-VEC as part of your application for a license
- Keep the form at least until your license appears in the FCC database


W5YI-VEC

National Volunteer Examiner Coordinator

This certifies that:

NAME STATION CALL SIGN

DATE OF ISSUE:

CITY / STATE (Session Site)

NUMBER AND STREET

CITY STATE ZIP

has SUCCESSFULLY PASSED the following elements:

☐ Element 2, Technician Class ☐ Element 3, General Class ☐ Element 4, Amateur Extra Class

and will be given credit for this examination element when the appropriate additional examination element is passed at a subsequent examination session within 365 days from the date of issue of this certificate. (See Section 97.505(a)(4))

has SUCCESSFULLY PASSED all elements for the following operator license class:

☐ Technician Class Operator ☐ General Class Operator ☐ Amateur Extra Class Operator

If you already hold an FCC-issued amateur radio license, this certificate validates temporary (interim) operation with the higher amateur radio operator class (see Section 97.301 of the Commission's Rules) until you receive the license of your new operator class, or for a period not to exceed 365 days from the date of issue of this certificate. (See Section 97.9(b)). When operating on an interim basis in the telegraphy / data / image (RTTY mode, you must append your call sign with .RT (Telegraphy (General) or .NE (Amateur Extra Class). Use the word "temporary" before the identifier (VT, AG or AU) when operating in the voice mode. (See Section 97.119(f))

THIS CERTIFICATE IS NOT A LICENSE PERMIT OR ANY OTHER KIND OF OPERATING AUTHORITY

HAM IT UP!

VOLUNTEER EXAMINERS

SIGNATURE VE-# STATION CALL SIGN

(1-)

(2-)

(3-)

SIGNATURE OF APPLICANT

W5YI-VEC

P.O. Box 200065 • Arlington, TX 76006-0065

800-669-9594

White Original - Applicant Yellow - VE Team Records Pink - VEC Office

- Your call sign will appear in the FCC call sign database 10-12 days after the test session

http://wireless2.fcc.gov/UlsApp/UlsSearch/searchAmateur.jsp

No login is required as call signs are part of the public record

https://hamstudy.org/

Become “Radio Active”

GET ON THE AIR!

Check into the WDARC net on Thursday evenings at 9pm


That's All for Today!
Thank you for participating in the class
And for your interest in Amateur Radio!
REMEMBER
Exam on Monday, March 11th at 7pm here