

# HVAC Electrical – Wiring Diagrams / Ohm's Law / Sequence of Operation

RV 7.25.17

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### **Quiz 1**

1. An atom's nucleus, or center, is made up of \_\_\_\_\_.
  - neutrons and protons
  - neutrons and electrons
  - protons and electrons
2. The \_\_\_\_\_ orbit around the nucleus.
  - protons
  - neutrons
  - electrons
3. A proton is \_\_\_\_\_.
  - a positively charged particle
  - a negatively charged particle
  - neither positively or negatively charged
4. A neutron is \_\_\_\_\_.
  - a positively charged particle
  - a negatively charged particle
  - neither positively or negatively charged
5. An electron is \_\_\_\_\_.
  - a positively charged particle
  - a negatively charged particle
  - neither positively or negatively charged
6. A molecule of water has how many atoms of hydrogen and oxygen?
  - Two hydrogens and two oxygen
  - Two hydrogens and one oxygen
  - One hydrogen and two oxygen

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7. In a balanced charge \_\_\_\_\_.
  - the electrons weigh the same as the protons
  - the protons weigh the same as the neutrons
  - the protons and the neutrons weigh the same amount
  - the number of electrons equals the number of protons
8. A positive charge has \_\_\_\_\_.
  - more electrons than protons
  - more protons than neutrons
  - more protons than electrons
  - none of the answers provided
9. Conductors are used to carry electricity because they have \_\_\_\_\_.
  - loosely held electrons in the outer orbit
  - negative neutrons
  - positive protons
  - extra electrons
10. Current flow in a conductor can be accomplished using \_\_\_\_\_.
  - frictions
  - chemicals
  - magnetism
  - all of the answers provided
4. Typical residential voltages encountered are \_\_\_\_\_.
  - 120v
  - 208v
  - 240v
  - all of the answers provided
5. What is the equation when solving for "I" (intensity in amps)?
  - $I = E / R$
  - $I = R / E$
  - $I = E \times R$
6. What is the equation when solving for "R" (resistance in ohms)?
  - $R = E / I$
  - $R = I / E$
  - $R = I \times E$
7. What is the amperage of a circuit with 120v and 15-ohm strip heater?
  - 8 amps
  - 12 amps
  - 15 amps
  - 18 amps
8. What is the amperage of a circuit with 240v and 23-ohm strip heater?
  - 9.2 amps
  - 10.4 amps
  - 15 amps
  - 18.5 amps

## Quiz 2

1. In the Ohm's law equation, Electromotive Force – labeled "E" is also known as \_\_\_\_\_.
  - energy
  - volts
  - power
  - electricity
2. In the Ohm's law equation, Intensity – labeled "I" is also known as \_\_\_\_\_.
  - intelligence
  - illumination
  - interference
  - amps
3. In the Ohm's law equation, Resistance – labeled "R" is also known as \_\_\_\_\_.
  - ohms
  - reluctance
  - residual
  - reactance
9. What is the amperage of a circuit with 208v and 28-ohm strip heater?
  - 7.4 amps
  - 12.2 amps
  - 15.7 amps
  - 28 amps
10. What is the wattage of a circuit with 120v and 15-ohm strip heater? (2 steps are needed here to find the answer)
  - 960 watts
  - 1200 watts
  - 1550 watts
  - 1810 watts

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11. What is the wattage of a circuit with 240v and 23-ohm strip heater? (2 steps are needed here to find the answer)
    - 1920 watts
    - 2504 watts
    - 1550 watts
    - 1850 watts
  12. What is the wattage of a circuit with 208v and 28-ohm strip heater? (2 steps are needed to find the answer)
    - 1545 watts
    - 1220 watts
    - 1570 watts
    - 2810 watts
  13. A Btu is the amount of heat given off by a \_\_\_\_\_.
    - kitchen match
    - birthday candle
    - cup of sawdust
    - gallon of gasoline
    - cord of wood
  14. How many Btus are produced from a circuit with 120v and 15-ohm strip heater? (3 steps are needed here to find the answer)
    - 3264 Btus
    - 1200 Btus
    - 1550 Btus
    - 1810 Btus
  15. How many Btus are produced from a circuit with 240v and 23-ohm strip heater? (3 steps are needed here to find the answer)
    - 1920 Btus
    - 8514 Btus
    - 1550 Btus
    - 1850 Btus
  16. How many Btus are produced from a circuit with 208v and 28-ohm strip heater? (3 steps are needed here to find the answer)
    - 5253 Btus
    - 1220 Btus
    - 1570 Btus
    - 2810 Btus
  17. The higher the resistance in a circuit, the \_\_\_\_\_ its amperage draw.
    - higher
    - lower
    - it stays the same
- Quiz 3**
1. In a series circuit, the loads are wired one right after another.
    - True
    - False
  2. In a series circuit, if one of the loads “burns” out, the other loads \_\_\_\_\_.
    - continue to function
    - also “burn” out
    - receive more power and run better
    - discontinue to function
    - none of the answers provided
  3. In a series circuit, the total resistance is the \_\_\_\_\_ of the resistances in the circuit.
    - sum of all
    - average
    - highest
    - lowest
  4. Which statement is true? With more loads in a series circuit, \_\_\_\_\_.
    - the greater the total resistance
    - the lower the total amperage
    - the amperage will be the same everywhere in the circuit
    - all of the answers provided

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## Formulas:

**Resistance in series**     $R_{\text{total}} = R_1 + R_2 + R_3 + \dots$

**Resistance in Parallel** =  $\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}$

**Power (watts) = I (amps) x E (volts)**

**Btus = watts x 3.4**

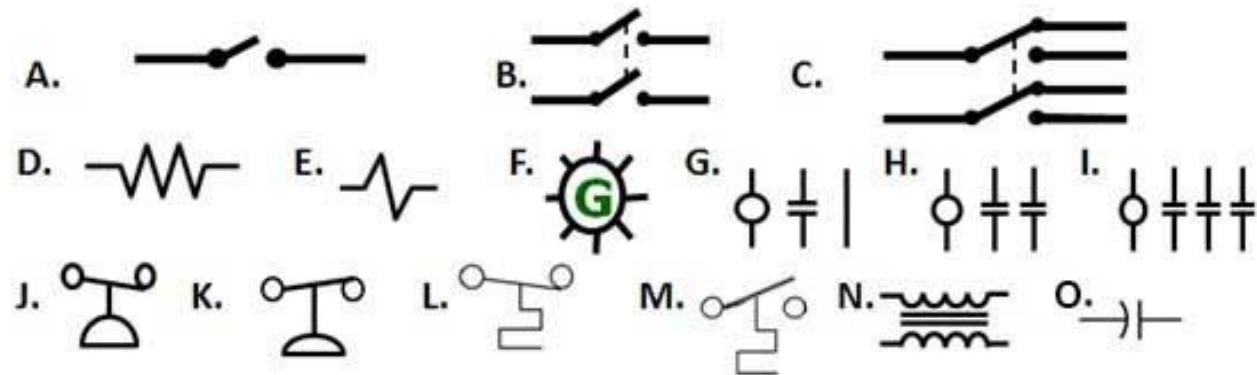


5. What is the total resistance of the circuit in a series? R1 = 12 ohms, R2 = 22 ohms – 120v
  - 12 ohms
  - 17 ohms
  - 22 ohms
  - 34 ohms
6. What is the amp draw of the circuit in a series? R1 = 12 ohms, R2 = 22 ohms – 120v
  - 10 amps
  - 7.1 amps
  - 5.5 amps
  - 3.5 amps
7. What is the wattage of the circuit in a series? R1 = 12 ohms, R2 = 22 ohms – 120v
  - 1200 watts
  - 852 watts
  - 660 watts
  - 423 watts
8. What are the Btus produced by the circuit in a series? R1 = 12 ohms, R2 = 22 ohms – 120v
  - 4080 Btus
  - 2896 Btus
  - 2244 Btus
  - 1440 Btus
9. What is the resulting resistance of a 25-ohm and a 15-ohm load when wired in parallel with each other?
  - 25 ohms
  - 15 ohms
  - 17 ½ ohms
  - 40 ohms
  - 9.4 ohms
10. What is the resulting resistance of a 20-ohm and a 10-ohm load when wired in parallel with each other?
  - 30 ohms
  - 20 ohms
  - 15 ohms
  - 10 ohms
  - 6.7 ohms
11. Given 3 resistors wired in parallel, 10 ohms, 20 ohms, and 30 ohms, determine the resulting total resistance.
  - 60 ohms
  - 30 ohms
  - 20 ohms
  - 5.5 ohms
  - none of the answers provided
12. Given 3 resistors wired in parallel, 10 ohms, 20 ohms, and 30 ohms, determine the amps draw in a 240v circuit.
  - 14.5 amps
  - 24.2 amps
  - 33.6 amps
  - 43.6 amps
  - 52.1 amps
13. Given 3 resistors wired in parallel, 10 ohms, 20 ohms, and 30 ohms, determine the Btus generated in a 240v circuit. Select the closest answer. (requires 3 steps)
  - 10,500 Btus
  - 7500 Btus
  - 15,000 Btus
  - 22,500 Btus
  - 35,600 Btus

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## Quiz 4



- Which of the above diagrams represents a DPDT switch?
  - A
  - B
  - C
  - D
  - E
- Which of the above diagrams represents a SPST switch?
  - A
  - B
  - C
  - D
  - E
- Which of the above diagrams represents a DPST switch?
  - A
  - B
  - C
  - D
  - E
- Which of the above symbols represents a resistance heater?
  - D
  - E
  - F
  - N
  - M
- Which of the above symbols represents a solenoid coil?
  - D
  - E
  - F
  - N
  - M
- Which of the above symbols represents a signal light?
  - D
  - E
  - F
  - N
  - M
- In the symbol shown for the signal light, the color of the light would be \_\_\_\_\_.
  - red
  - green
  - blue
  - yellow
  - orange
- The voltage for a contactor coil could be \_\_\_\_\_.
  - 24v
  - 120v
  - 208/240v
  - all of the answers provided
- Which of the above symbols represents a triple pole contactor?
  - A
  - B
  - G
  - H
  - I
- Which of the above symbols represents a single pole contactor?
  - A
  - B
  - G
  - H
  - I

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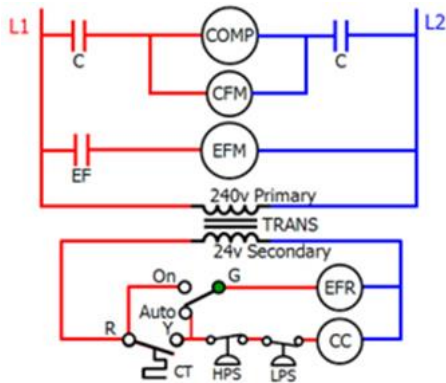
11. Which of the above symbols represents a double pole contactor?
- A
  - B
  - G
  - H
  - I
12. Typically, the maximum amps on a relay contact are \_\_\_\_\_ amps.
- 10
  - 15
  - 20
  - 50
  - 100
13. The voltage for a relay coil can be \_\_\_\_\_.
- 24v
  - 120v
  - 208/240v
  - all of the answers provided
14. When a relay coil is energized with the correctly rated voltage, \_\_\_\_\_.
- the "NC" contacts open and the "NO" contacts close
  - the "NC" contacts open and the "NO" contacts remain open
  - the "NC" contacts remain closed and the "NO" contacts close
  - the "NC" contacts remain closed and the "NO" contacts remain open
  - none of the answers provided
15. A typical safety device would be a \_\_\_\_\_.
- fuse
  - bimetal overload
  - thermal overload
  - magnetic overload
  - all of the answers provided
16. Which of the above symbols represents a low-pressure control?
- J
  - K
  - L
  - M
17. Which of the above symbols represents a high-pressure control?
- J
  - K
  - L
  - M
18. A bi-metal switch has \_\_\_\_\_ pieces of metal with different expansion rates.
- 1
  - 2
  - 3
  - 4
  - none of the answers provided
19. A cooling thermostat close on temperature rise is illustrated by symbol \_\_\_\_\_.
- J
  - K
  - L
  - M
20. A heating thermostat open on temperature rise is illustrated by symbol \_\_\_\_\_.
- J
  - K
  - L
  - M
- Quiz 5**
1. There are several components to a complete circuit. These include \_\_\_\_\_.
- a load
  - a switch
  - a complete electrical path
  - a power source
  - all of the answers provided
2. A schematic drawing shows \_\_\_\_\_ of the components.
- photographs
  - symbols
  - "as built" placement
  - installation requirements
  - the manufacturer
3. A schematic is sometimes called a \_\_\_\_\_.
- ladder diagram
  - controls sequence diagram
  - pictorial
  - roadmap
  - none of the answers provided

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4. The \_\_\_\_\_ diagram is most useful when troubleshooting for service technicians.
- schematic or ladder
  - pictorial
  - "as built"
  - picture
  - step stool
5. Typically, electrical systems that have more than one load have \_\_\_\_\_.
- the loads wired in series with each other
  - the loads wired in parallel with each other
  - a switch located after the load
  - the sequence of operation in order of the components' appearance
  - all of the answers provided

6. The typical meaning of COMP on a ladder diagram is \_\_\_\_\_.
- compensation
  - component
  - condenser
  - compressor
  - constituent



7. From the above illustration, "CC" is an abbreviation for \_\_\_\_\_.
- compressor control
  - contractor coil
  - controlled component
  - any of the answers provided
  - none of the answers provided
8. From the above illustration, "TS" is an abbreviation for \_\_\_\_\_.
- terminal switch
  - temperature switch
  - thermostat
  - any of the answers provided
  - none of the answers provided

9. From the above illustration, "TRANS" is an abbreviation for \_\_\_\_\_.
- transmuted
  - trans-gender
  - transistor
  - transformer
  - none of the answers provided

10. From the above illustration, "HPS" is an abbreviation for \_\_\_\_\_.
- high pressure switch
  - hot primary surface
  - high power segment
  - heating potential surface
  - none of the answers provided

11. From the above illustration, the "HPS" is \_\_\_\_\_.
- normally closed
  - normally opened

12. From the above illustration, "LPS" is an abbreviation for \_\_\_\_\_.
- low power system
  - lost power safety
  - last preventative safety
  - low pressure switch
  - none of the answers provided

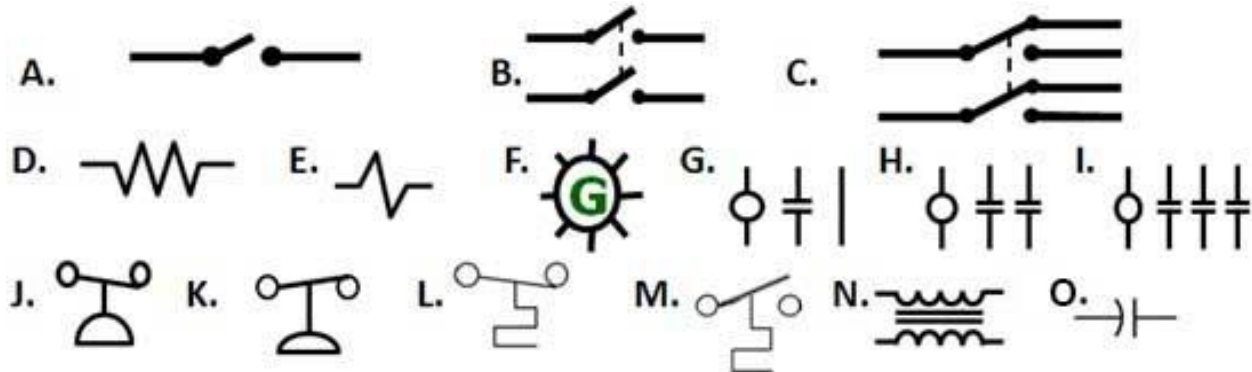
13. From the above illustration, the "LPS" is \_\_\_\_\_.
- normally closed
  - normally opened

## Quiz 6

1. A layout diagram includes \_\_\_\_\_.
- a schematic diagram
  - a pictorial diagram
  - a component legend
  - wire color codes
  - all of the answers provided
2. Many schematic diagrams have a marking "T1." This means \_\_\_\_\_.
- test 1
  - terminal 1
  - temperature 1
  - template 1
  - none of the answers provided

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3. Which of the above symbols represent a run capacitor?
  - A
  - D
  - G
  - J
  - O
4. A run capacitor is made up of thin sheets of aluminum separated by an electrolyte in a metal container.
  - True
  - False
5. A run capacitor is located between the \_\_\_\_\_ and \_\_\_\_\_ windings.
  - run – common
  - start – common
  - start – run
  - run – continuous
  - none of the answers provided
6. A run capacitor has a similar function as a \_\_\_\_\_.
  - fuel pump
  - side view mirror
  - carburetor
  - spark plug
  - shock absorber
7. The "HERM" marking on a dual run capacitor means \_\_\_\_\_.
  - common
  - fan
  - Herman
  - Hermetically sealed compressor
  - none of the answers provided
8. The primary function of a crankcase heater is to keep the \_\_\_\_\_.
  - refrigerant warm so that it can readily travel in the system
  - copper tubing warm to prevent "case hardening"
  - electrical components warm to prevent condensation from occurring
  - compressor 's oil warm to prevent the absorption of refrigerant
  - all of the answers provided
9. A crankcase heater control (CHC) \_\_\_\_\_.
  - modulates the crankcase
  - controls the refrigerant temperature
  - turns off the electric heater when the temperature is achieved
  - all of the answers provided
  - none of the answers provided
10. The crankcase heater is connected to \_\_\_\_\_ voltage.
  - line
  - control
  - 12 DC
  - 480 AC
  - none of the answers provided
11. The "LPC" \_\_\_\_\_.
  - is a safety device
  - opens on low pressure
  - means Low Pressure Control
  - is wired in series before the compressor's contactor coil
  - all of the answers provided



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12. Low pressure in an AC system may result from \_\_\_\_\_.

- low refrigerant charge
- a leak in the tubing
- a dirty air filter
- a malfunctioning blower motor
- all of the answers provided

13. A pictorial diagram shows \_\_\_\_\_.







- field wiring required by the installer
- factory wiring
- the placement of components
- the wiring between components
- all of the answers provided

14. To determine the name of the abbreviation used, such as "CC" = Compressor Contactor, one would look at the \_\_\_\_\_ section of the layout diagram.

- high voltage schematic
- low voltage schematic
- pictorial diagram
- component codes
- none of the answers provided

15. Notes on the layout diagram would include electrical installation instructions.

- True
- False

- a. 
- b. 
- c. 
- d. 
- e. 
- f. 

16. Which wiring symbol above indicates a low voltage – factory standard wiring?

- A
- B
- C
- D
- E

17. Which wiring symbol above indicates a line voltage – factory standard wiring?

- A
- B
- C
- D
- E

18. Which wiring symbol above indicates a line voltage – field installed wiring?

- A
- B
- C
- D
- E

19. Which wiring symbol above indicates a low voltage – field installed wiring?

- B
- C
- D
- E
- F

20. Which wiring symbol above indicates a line voltage – factory option wiring?

- A
- B
- C
- D
- E

21. Which wiring symbol above indicates a low voltage – factory option wiring?

- B
- C
- D
- E
- F

22. On the layout diagram, "BR" indicates a \_\_\_\_\_ colored wire.

- black
- brown
- orange
- purple

23. On the layout diagram, "O" indicates a \_\_\_\_\_ colored wire.

- black
- brown
- orange
- purple

24. On the layout diagram, "BK" indicates a \_\_\_\_\_ colored wire.

- black
- brown
- orange
- purple

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25. Schematics may have a series of numbers on the left side of the diagram which identifies the \_\_\_\_\_.
    - line or circuit
    - sequence of operation
    - wire size
    - wire type
    - none of the answers provided
  26. Positions of the contacts are shown \_\_\_\_\_.
    - neutral
    - energized
    - de-energized
    - powered up
    - with 24 volts
  27. Numbers on the upper right side of the control device coil show the line where the contacts are located.
    - True
    - False
  28. Near the control coil symbols, the underline numbers indicate which contacts are \_\_\_\_\_.
    - NO
    - NC
    - energized
    - de-energized
    - none of the answers provided
  29. Labeling of the components \_\_\_\_\_.
    - is mandatory
    - is not required
    - may or may not be shown
    - none of the answers provided
- Quiz 7 – Sequence of Operation**
1. Sequence of operation typically means \_\_\_\_\_.
    - one thing after another
    - the order in which activities or processes proceed
    - one action precedes the following action
    - all of the answers provided
    - none of the answers provided
  2. Sequence of operation is most easily understood with a layout diagram when using the \_\_\_\_\_.
    - pictorial diagram
    - schematic or ladder diagram
    - equipment description
    - wire codes
    - wiring information
  3. The transformer on a schematic diagram \_\_\_\_\_.
    - divides the line voltage and low voltage portions of the illustration
    - has the line voltage portion at the top of the diagram
    - has the control voltage portion at the bottom of the diagram
    - indicates the primary and secondary sides
    - all of the answers provided
  4. On a fan call, \_\_\_\_\_ in the thermostat.
    - R makes to C
    - R makes to G
    - R makes to Y
    - R makes to O
    - R makes to W
  5. On a cooling call, \_\_\_\_\_ in the thermostat.
    - R makes to C & G
    - R makes to G & W
    - R makes to Y & G
    - R makes to O & Y
    - R makes to W & G
  6. The cooling thermostat closes on \_\_\_\_\_.
    - temperature rise
    - temperature fall
    - humidity rises
    - humidity fall
    - none of the answers provided
  7. The “EFM” is energized on a cooling call which moves air across the evaporator coil \_\_\_\_\_.
    - to prevent coil icing
    - to boil the refrigerant in the indoor coil
    - to prevent low pressure from occurring
    - all of the answers provided
    - none of the answers provided