

## BASIC ELECTRICAL UNDERSTANDING



**MCC** *Equipment & Service Center*

Your Sales, Service and Solutions Team

## SAFETY FIRST

- **Always use extreme caution when working around electricity**
- **A electrical shock can kill you!**
- **The purpose of this module is to:**
  - Develop basic understanding of equipment used to test circuits
  - Diagnose correctly
  - Diagnose safely
- **Know and understand you and your co-workers competence level before opening a live panel to diagnose**

## SAFETY FIRST

- Many times you will be required to check components & circuits while they are “Live”
- Never perform “repair” work while circuits are “Live”
- Always disconnect power, lock out as required before accessing with tools or hands.
- Always be aware of surrounding components inside of an electrical panel when diagnosing with meters


## TERMS TO KNOW

- **Voltage: also known as Electromotive force**
  - The force, or pressure, which causes electrons to flow thru a conductor.
- **Classes of Voltage:**
  - AC ~ Alternating Current, sign associated with
    - $\sim$  VAC
  - DC – Direct Current, sign associated with,
    - VDC
- **Alternating current**
  - 120VAC utilizes 1 hot leg and 1 Neutral leg, ground
  - 220VAC – 1  $\emptyset$ , 2 hot legs, ground, (3 wire)
  - 220VAC – 3  $\emptyset$ , 3 hot legs, ground, (4 wire)
    - Some Components will utilize a Neutral leg in cabinet, rare in our equipment

## TERMS TO KNOW

- **Ampere: also known as Amperage or Intensity, is a measurement of Current**
  - Technically it is measuring 1 coulomb, or 6,280,000,000 electrons movement
  - Current is measuring the flow of the Voltage, very similar to how fluid flow would be measured in Gallon per Minute

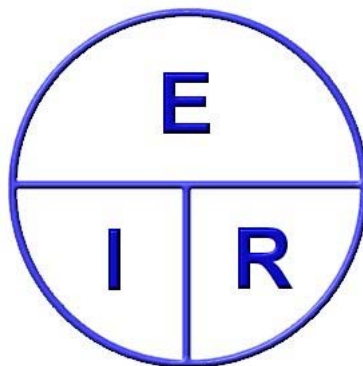
## TERMS TO KNOW

- **Resistance : also known as electrical friction**
  - Measured in Ohms  $\Omega$
  - Some meters may also have Diode symbol 
- **Ohms is used to measure the amount of resistance a circuit possesses to flow of amperage & voltage**
- **Example of this: The gate valve for your water hose – as you close it off, water flow is reduced, you are increasing the resistance of that circuit.**
- **This can commonly relate to corroded, dirty, or loose electrical connections.**

## UNDERSTANDING THESE TERMS

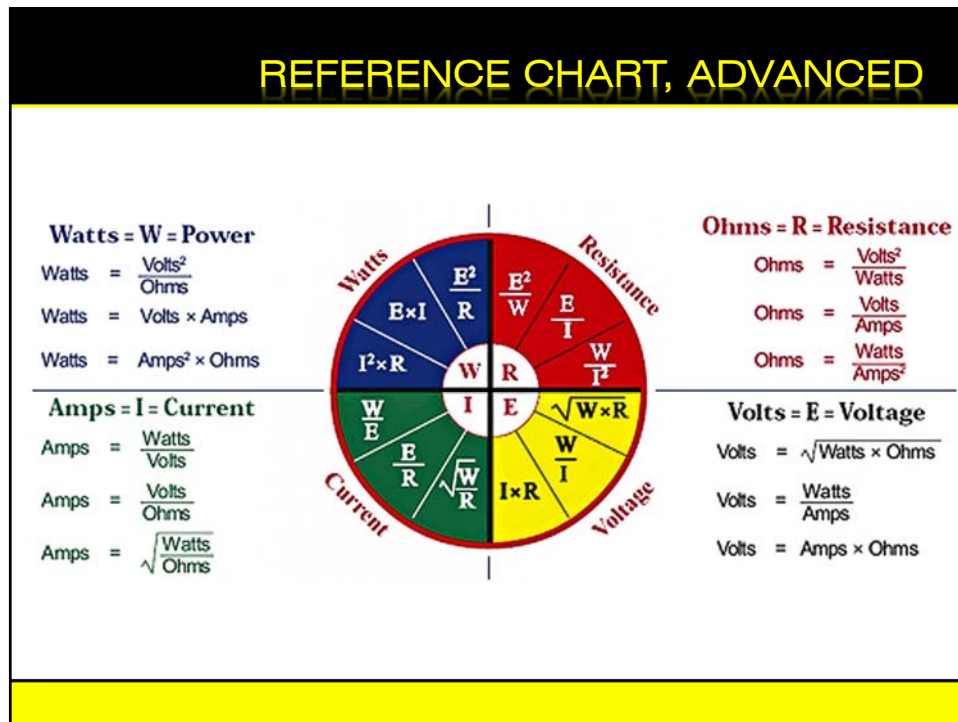
- **Best example is to state –**
  - One Volt will push One Ampere thru One ohm.
  - **Example**
    - 230 volts
    - 23 ohms
    - 10 Amps
  - **Relationship**
    - 10 gallon vat of water @ 100 psi
    - 1 valve with ¼" opening
    - Low flow, high power stream

## REFERENCE CHART



$$E=I/R$$

E=volts I=amps R=ohms



## UNDERSTAND A CIRCUIT

- **Hose circuit**
  - Typical givens...
    - Most hose circuits are low VAC circuits with typical wattage range of 12-15 watts per foot
    - The output of the step-down transformer is proportional to the input value
      - I.E. – A Transformer has output of: 15, 30, 45, 60, 75 VAC, based on an input of 220VAC
      - Therefore a machine connected to 208 VAC may have outputs of: 14, 28, 43, 57, 71 VAC – adversely affecting power of the hose.

## EXAMPLE OF USING THE FORMULA

- 50' Hose resistance =  $.3 \Omega$
- Measured voltage from machine = 15 VAC
- Theoretical amperage = 50 Amps
- Theoretical wattage =  $750 (/50) = 15$  watts per foot with above calculation

## EXAMPLE OF USING THE FORMULA

- **Malfunctioning Hose circuit**
  - Unable to reach desired set point, however is heating above ambient
  - Output voltage from Control Cabinet (Secondary Side of Hose Transformer) = 14.5 VAC
  - Resistance of 60' hose =  $.48 \Omega$
  - Theoretical amperage = 30.2 I
  - Theoretical wattage = 438 watts or 7.3 watt/ft
  - First pass – check electrical connections to identify and potentially reduce resistance value.

## UNDERSTANDING TEST EQUIPMENT

- **Volt Ohm Meters**

- Typical hand held meters available on market

Analog



Digital with Auto range / without



## UNDERSTANDING TEST EQUIPMENT

- **Meters without Auto range** (examples as shown)

- **VAC** ~
  - 200 - used to test output of Hose transformer
  - 500 - used to test input voltage to machine
- **Ohms  $\Omega$** 
  - 2000K
  - 200K
  - 20K
  - 2000 – most common used for our application
- **VDC** ==
  - 500
  - 200
  - 20 – most common used for certain applications
  - 2000m

## UNDERSTANDING TEST EQUIPMENT

- **Clamp meters**

- Used to measure amperage, can also be used to measure voltage and basic resistance values.
- Clamp one wire in circuit to measure current of circuit



## TYPICAL APPLICATION

- **Check voltage**

- Back probe of main power across 2 legs to find power (“leg to leg”)
- Can also check leg to ground to verify each leg (“leg to ground”)





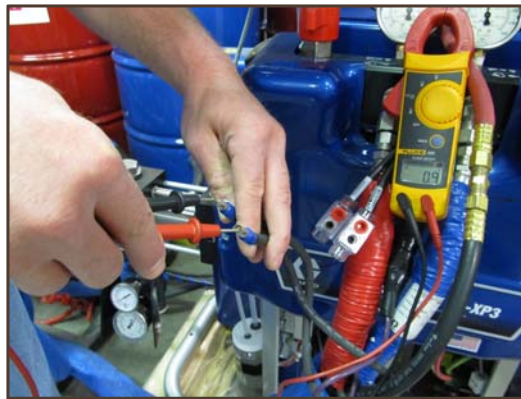
## TYPICAL APPLICATION

- **Check voltage**
  - Check output to Hose circuit, secondary side, while controller calls for heat



## TYPICAL APPLICATION

- **Check resistance**
  - In this example – notice the hose is disconnected from the base of the machine – this is required to prevent “back feed” of other components, thus giving a false reading.



## TYPICAL APPLICATION

- **Check amperage**
  - Clamp meter on One leg to read the Amperage of the circuit



## BASIC ELECTRICAL UNDERSTANDING



**MCC** *Equipment & Service Center*

Your Sales, Service and Solutions Team

317-209-1111

[www.mccind.com](http://www.mccind.com)