

# Summary of Series and Parallel Circuits

## Series Circuit Characteristics:

i. **Voltage:** Kirchhoff's voltage law: The total source voltage applied to a series circuit is equal to the total number of individual voltage drops in the series circuit.  $V_T =$  sum of all voltage drops.

ii. **Current:** The current must be the same value at any point in the circuit.

### iii. Resistance:

$$R_T = R_1 + R_2 + R_3 + \dots + R_N$$

The large resistor dominates

### iv. Power:

$$P_T = V_T * I_T, \text{ and}$$

$$P_T = P_1 + P_2 + P_3 + \dots + P_N$$

v. **Open circuits** across a series resistor cause the current to go to zero everywhere in the circuit.

vi. **Short circuit** across one resistor in a series resistor network causes the current to increase, but the entire circuit is not shorted.

## Parallel Circuit Characteristics:

vii. **Voltage:** The voltage drop across each component is the same as the source voltage.

viii. **Current:** Kirchhoff's Current Law: The sum of the currents into a junction is equal to the sum of the currents leaving that junction.

### ix. Resistance:

Case 1: All resistors the same value:  $R_T = R/N$

Case 2: Two resistors with different values:  $R_T = R_1 R_2 / (R_1 + R_2)$

Case 3: More than two resistors with different values:

$$1/R_T = 1/R_1 + 1/R_2 + 1/R_3 + \dots + 1/R_N$$

The small resistor dominates

### x. Power:

$$P_T = V_T * I_T, \text{ and}$$

$$P_T = P_1 + P_2 + P_3 + \dots + P_N$$

xi. **Open circuits** across a parallel resistor cause no change in the good branches.

xii. **Short circuit** across one resistor in a parallel resistor network causes a dead short across the entire parallel resistor network.