# OHM's Law Help Sheet

## Definition

A potential difference of 1 Volt will force a current of 1 Ampere through a resistance of 1 Ohm, or

Voltage (V—Volts) = Current (I—Amps) x Resistance (R—Ohms)

or more simply:

V = I x R

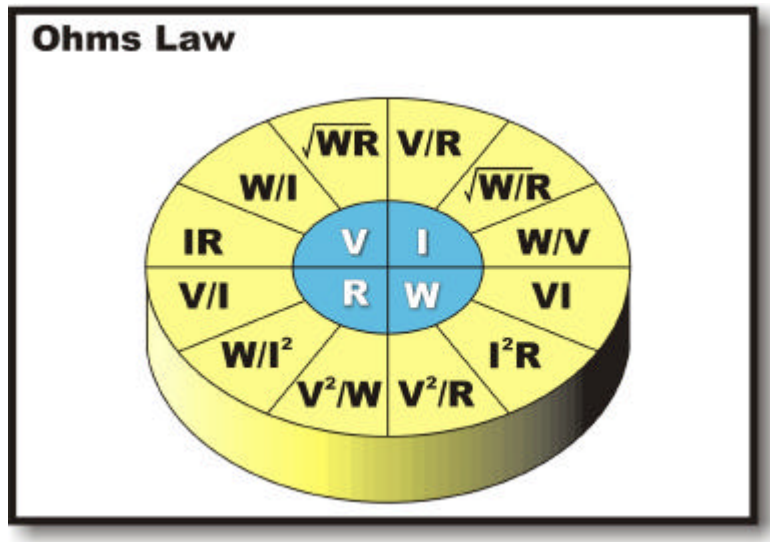Power (W-Watts) = Voltage (V—Volts) x Current (I—Amps)

or more simply:

W = V x I

The diagram below shows the variations on this formulae.



Examples:

A heater in a tool measures 20 Ohms. Assuming a voltage of 240V, what is the expected wattage of the heater?

W = V x V / R = 240 x 240 / 20 = 2880W.

A controller has a fused output of 15A on a voltage of 240V. What would be the expected maximum output wattage of the controller?

W = V x I = 240 x 15 = 3600W.

A 24V tip is rated at 250W. What would the expected current demand be?

W = V x I, or I = W / V = 250 / 24 = 10.42A

If the connecting cable to the 24V tip is rated at 0.1R per meter and is 3m long, how much heat will be dissipated by the cable?

Total R of cable = 3 x 0.1R = 0.3R. W = I$^2$ x R = 10.42 x 10.42 x 0.3 = 32.57W per cable.
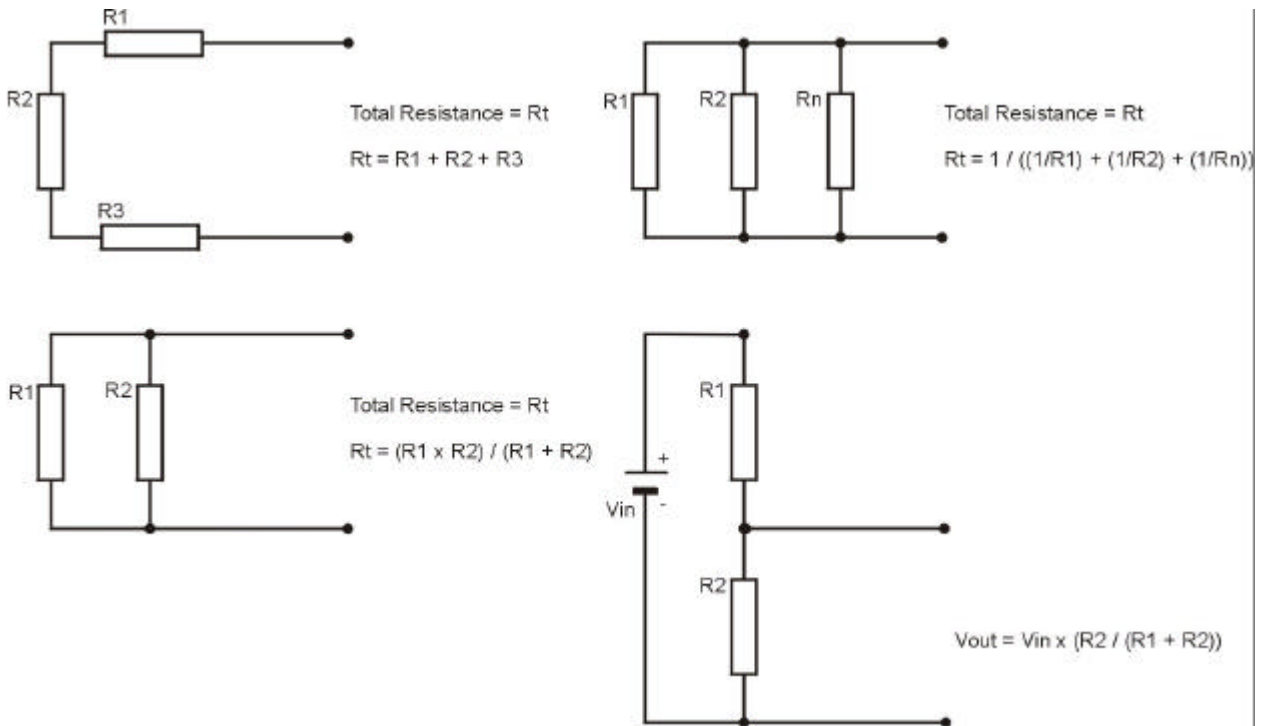
If the system is changed to a 240V tip, all other parameters remaining the same, what will be the current demand be and how much heat will be dissipated by the cable?
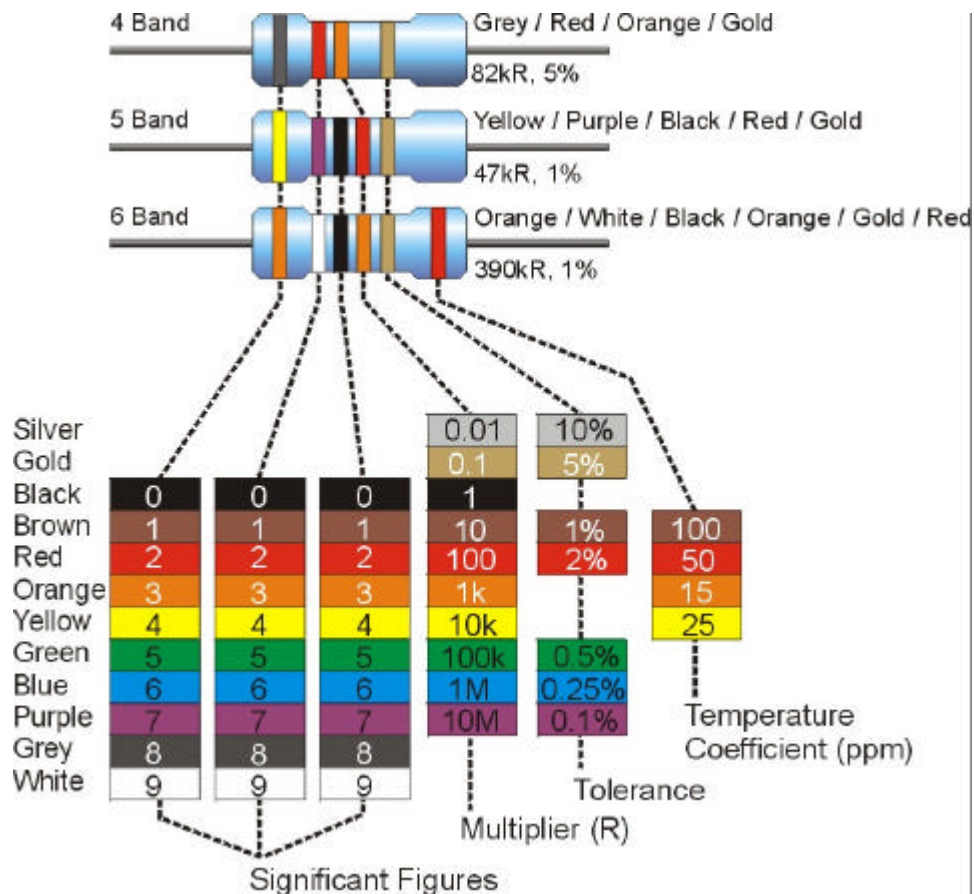
I = W / V = 250 / 240 = 1.042A

Total R of cable = 3 x 0.1R = 0.3R. W = I$^2$ x R = 1.042 x 1.042 x 0.3 = 0.323W per cable.

*fast heat*

## Resistor Networks

Total Resistance = Rt

Rt = R1 + R2 + R3

Total Resistance = Rt

Rt = 1 / ((1/R1) + (1/R2) + (1/Rn))

Total Resistance = Rt

Rt = (R1 x R2) / (R1 + R2)

Vin

Vout = Vin x (R2 / (R1 + R2))

## Resistor Colour Code

| | | |
|---|---|---|
| 4 Band | | Grey / Red / Orange / Gold |
| | | 82kR, 5% |
| 5 Band | | Yellow / Purple / Black / Red / Gold |
| | | 47kR, 1% |
| 6 Band | | Orange / White / Black / Orange / Gold / Red |
| | | 390kR, 1% |

| | | | | | Multiplier (R) | Tolerance | Temperature Coefficient (ppm) |
|---|---|---|---|---|---|---|---|
| Silver | | | | | 0.01 | 10% | |
| Gold | | | | | 0.1 | 5% | |
| Black | 0 | 0 | 0 | | 1 | | |
| Brown | 1 | 1 | 1 | | 10 | 1% | 100 |
| Red | 2 | 2 | 2 | | 100 | 2% | 50 |
| Orange | 3 | 3 | 3 | | 1k | | 15 |
| Yellow | 4 | 4 | 4 | | 10k | | 25 |
| Green | 5 | 5 | 5 | | 100k | 0.5% | |
| Blue | 6 | 6 | 6 | | 1M | 0.25% | |
| Purple | 7 | 7 | 7 | | 10M | 0.1% | |
| Grey | 8 | 8 | 8 | | | | |
| White | 9 | 9 | 9 | | | | |

Significant Figures

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# Resistance / Wattage / Amperage Chart

For any given resistance measurement, the table below shows the expected wattage and current load based on a 240V ac system. Please note that this table is provided as a 'rule of thumb' and the values shown are rounded for simplicity. It will also be necessary to take into consideration the resistance of the cables when measuring loads with a high wattage.

| Ohms | Watts | Amps | Ohms | Watts | Amps | Ohms | Watts | Amps |
|------|-------|------|------|-------|------|------|-------|------|
| 1 | 57,600 | 240 | 11 | 5,236 | 22 | 21 | 2,743 | 11.4 |
| 2 | 28,800 | 120 | 12 | 4,800 | 20 | 22 | 2,618 | 10.9 |
| 3 | 19,200 | 80 | 13 | 4,430 | 19 | 23 | 2,504 | 10.4 |
| 4 | 14,400 | 60 | 14 | 4,114 | 17 | 24 | 2,400 | 10.0 |
| 5 | 11,520 | 48 | 15 | 3,840 | 16 | 25 | 2,303 | 9.6 |
| 6 | 9,600 | 40 | 16 | 3,600 | 15 | 26 | 2,215 | 9.2 |
| 7 | 8,230 | 34 | 17 | 3,388 | 14 | 27 | 2,133 | 8.9 |
| 8 | 7,200 | 30 | 18 | 3,200 | 13.3 | 28 | 2,057 | 8.6 |
| 9 | 6,400 | 27 | 19 | 3,030 | 12.6 | 29 | 1,986 | 8.3 |
| 10 | 5,760 | 24 | 20 | 2,880 | 12 | 30 | 1,920 | 8.0 |

| Ohms | Watts | Amps | Ohms | Watts | Amps | Ohms | Watts | Amps |
|------|-------|------|------|-------|------|------|-------|------|
| 31 | 1,858 | 7.7 | 41 | 1,405 | 5.85 | 55 | 1,047 | 4.4 |
| 32 | 1,800 | 7.5 | 42 | 1,371 | 5.71 | 60 | 960 | 4.0 |
| 33 | 1,745 | 7.3 | 43 | 1,340 | 5.58 | 65 | 886 | 3.7 |
| 34 | 1,694 | 7.0 | 44 | 1,309 | 5.45 | 70 | 823 | 3.4 |
| 35 | 1,646 | 6.9 | 45 | 1,280 | 5.33 | 75 | 768 | 3.2 |
| 36 | 1,600 | 6.7 | 46 | 1,252 | 5.22 | 80 | 720 | 3.0 |
| 37 | 1,557 | 6.5 | 47 | 1,225 | 5.11 | 85 | 678 | 2.8 |
| 38 | 1,516 | 6.3 | 48 | 1,200 | 5.00 | 90 | 640 | 2.7 |
| 39 | 1,477 | 6.1 | 49 | 1,175 | 4.90 | 95 | 606 | 2.5 |
| 40 | 1,440 | 6.0 | 50 | 1,152 | 4.80 | 100 | 576 | 2.4 |

| Ohms | Watts | Amps | Ohms | Watts | Amps | Ohms | Watts | Amps |
|------|-------|------|------|-------|------|------|-------|------|
| 110 | 524 | 2.2 | 220 | 262 | 1.1 | 231 | 250 | 1.04 |
| 120 | 480 | 2.0 | 240 | 240 | 1.0 | 144 | 400 | 1.67 |
| 130 | 443 | 1.8 | 260 | 221 | 0.9 | 115 | 500 | 2.08 |
| 140 | 411 | 1.7 | 280 | 206 | 0.85 | 58 | 1000 | 4.17 |
| 150 | 384 | 1.6 | 300 | 192 | 0.8 | 38 | 1500 | 6.25 |
| 160 | 360 | 1.5 | 320 | 180 | 0.75 | 29 | 2000 | 8.33 |
| 170 | 339 | 1.4 | 340 | 169 | 0.7 | 23 | 2500 | 10.4 |
| 180 | 320 | 1.3 | 360 | 160 | 0.67 | 19 | 3000 | 12.5 |
| 190 | 303 | 1.3 | 380 | 152 | 0.63 | 14 | 4000 | 16.7 |
| 200 | 288 | 1.2 | 400 | 144 | 0.6 | 11.5 | 5000 | 20.8 |

**fast heat**