Lesson 3

RESISTORS

ACMA Syllabus February 2024 Chapters 2.1 and 3.1

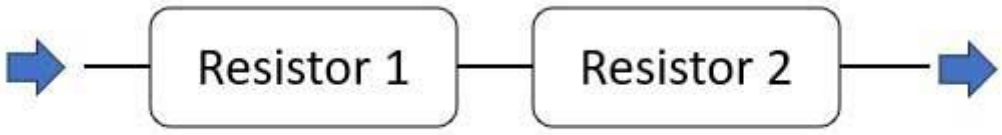
Contents

Resistors in Series and parallel

We looked at circuits with one resistor and now we look at combinations of resistors. These configurations will look familiar.

Hint: Series connection. Signal or electrons go through one device then the next.

Parallel connection. Signal or electrons split and go separate paths.



Series Connection

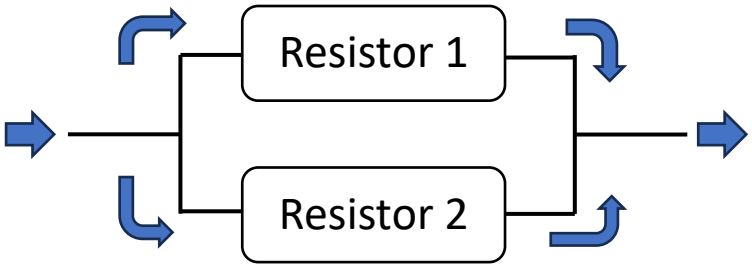
To calculate resistors in series, you add the resistances together.

Formula: Rt = R1 + R2 + R3 + R4…….n

Example: R1, R2, R3 and R4 are 1.5 kΩ and are connected in series. What is the total resistance?

R1 + R2 + R3 + R4 = 1.5 kΩ + 1.5 kΩ + 1.5 kΩ + 1.5 kΩ = 6 kΩ

The value of resistors in parallel will result in less than the smallest resistor value.



Parallel Connection

Formula: $\frac{1}{Rt} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3} \ldots n$

Example: R1, R2, R3 and R4 are 1.5 kΩ and are connected in parallel. What is total resistance?

1/Rt = 1/1500 + 1/ 1500 + 1/ 1500 + 1/ 1500

= 0.00066 + 0.00066 + 0.00066 + 0.00066

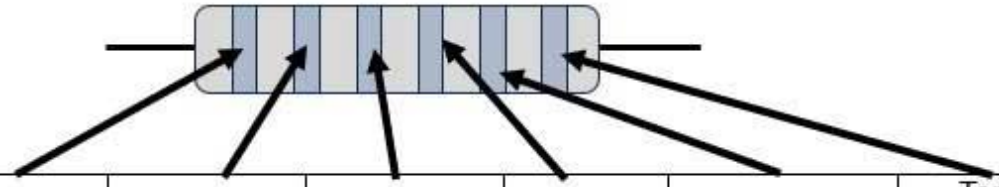
= 0.0026

R = 1/ 0.0026

= 384.61Ω

Resistor colour codes

Resistors can be very small, so the value of the resistor is painted in bands around the resistor. There can be 3, 4, 5, or 6 bands and each colour represents a specific value. Surface mounted resistors have a different numbering sequence due to their small size.



Colour	1st Digit	2nd Digit	3rd Digit	Multiplier	Tolerance	Temp Coefficient
Black	0	0	0	1Ω	N/A	N/A
Brown	1	1	1	10Ω	± 1% (F)	100
Red	2	2	2	100Ω	± 2% (G)	50
Orange	3	3	3	1kΩ	± 3%	15
Yellow	4	4	4	10kΩ	± 4%	25
Green	5	5	5	100kΩ	± 0.5% (D)	N/A
Blue	6	6	6	1MΩ	± 0.25% (C)	10
Violet	7	7	7	10MΩ	± 0.10% (B)	5
Grey	8	8	8	100MΩ	± 0.05% (A)	N/A
White	9	9	9	1GΩ	N/A	N/A
Gold				0.1Ω	± 5% (J)	N/A
Silver				0.01Ω	± 10% (K)	100

In a three-band resistor colour codes, there is no tolerance band, so 20% is assumed.

1. In four band resistor colour codes the tolerance band is used.
2. In the case of five band and six band resistor colour codes, the 5th band code is used for tolerance in percentages.
3. The temperature coefficient in parts per million/ Degrees Celsius(ppm/°C) tells the change in the resistance value with temperature.

A mnemonic to remember these numbers is,

Better Be Ready Or Your Great Big Venture Goes West.

Black Brown Red Orange Yellow Green Blue Violet Grey White Or

Big, Beautiful Roses Occupy Your Gardens, But Violets Grow Wild.

Black, Brown Red Orange Yellow Green Blue Violet Grey White

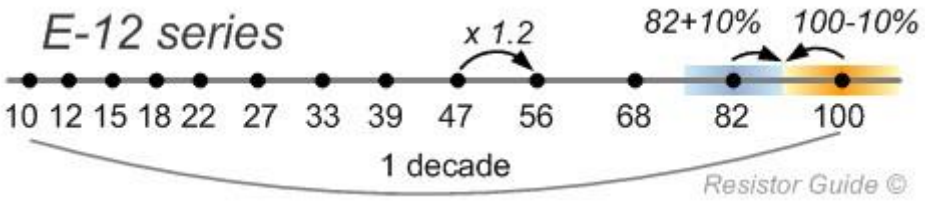
Resistor Sizes

Resistor sizes are not infinite by 1-ohm increments. They are divided into E-series sets of preferred values. E 12 is the most common series. E12 means that every decade (0.1-1.0, 1-10, 10-100, 10etc.) is divided into 12 steps on a logarithmic scale. The size of every step is equal to:

$$10^{(\frac{1}{12})} = 1.21$$

Based on this, every value is 21% or 1.21 times higher than the previous value in the series, rounded to whole numbers. All resistors with a tolerance of 10% overlap. The series looks as follows: 1– 1.2 – 1.5 – 1.8 – 2.2 – 2.7 – 3.3 – 3.9 – 4.7 – 5.6 – 6.8 – 8.2 – 10 etc.

One decade of the E12 series



Resistor Power Rating

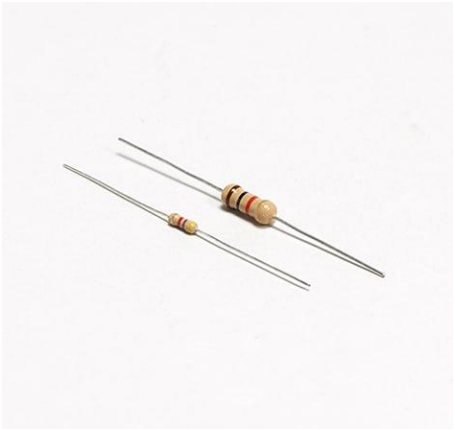
The power rating of a resistor is measured in watts, and it's usually between ⅛W (0.125W) and 1W. Resistors with power ratings of more than 1W are usually referred to as power resistors, resistors and specifically for their power dissipating abilities.

Resistor Types

Resistors come in various designs.

Fixed Resistors

Are resistors whose value is predetermined and marked with colour bands.



Variable Resistor (Sometimes called a Potentiometer or Pot)

Is a resistor whose value can be varied through a specified range.

Wire Wound Resistors

These are usually special resistors designed to dissipate a lot of heat.

Practical Exercise

A practical exercise is included for comprehension of the material. However, the answers to all the questions can be calculated without the aid of test equipment.

Next go to Lesson 3 questions.