RF Components and Basic Concepts
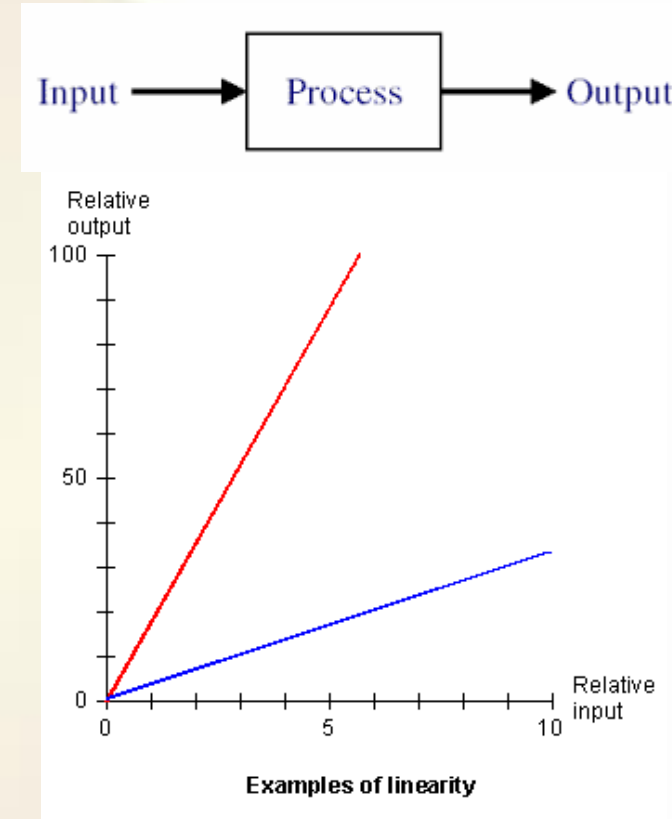# *1.14 - Linearity*

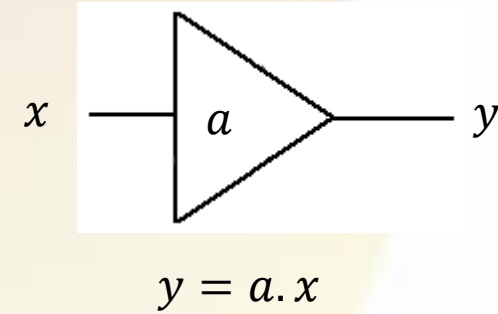# Linearity

Examples of linearity

- **Linearity** is the property of a mathematical
relationship or function in which means that
it can be graphically represented as a straight line.

- Examples are the relationship of voltage and current across a resistor (Ohm's law).
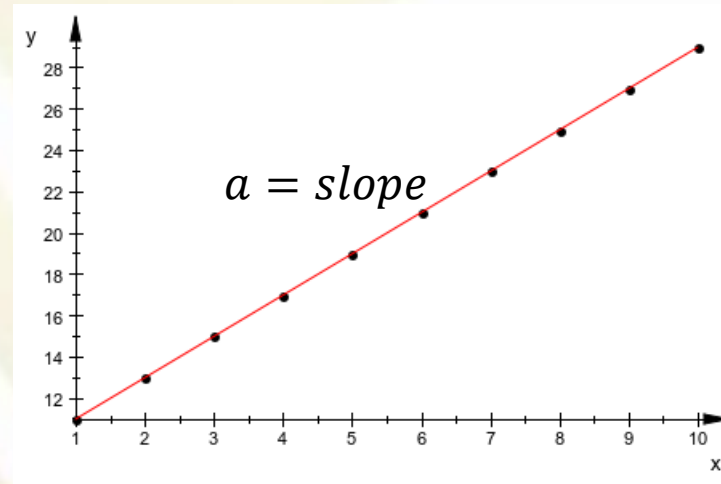
Linear Amplifier
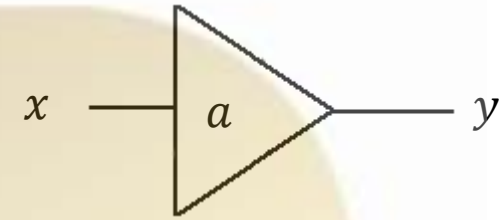
- x = input

- y = output

- a = gain

$$y = a.x$$

Constant

$$y = a.x$$

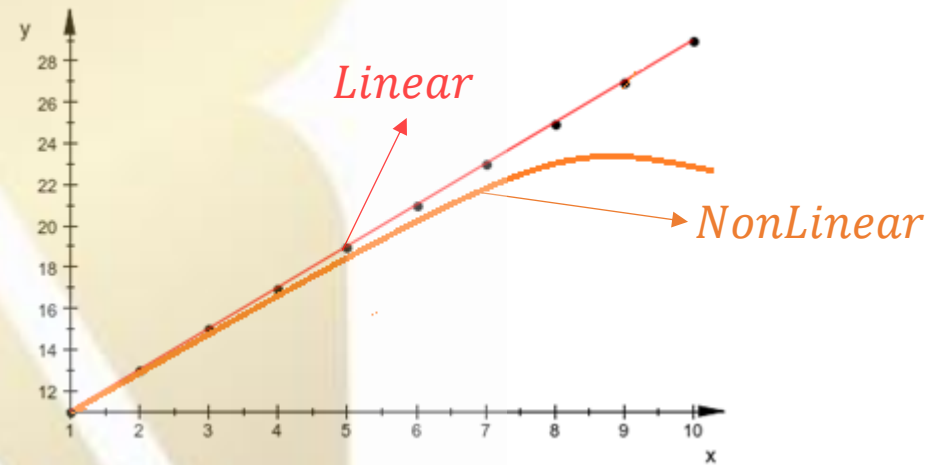$a = slope$

Non-Linear Amplifier

- x = input
- y = output

$$y = a.x + b.x^2 + c.x^3 + \ldots$$

- Generally c<0
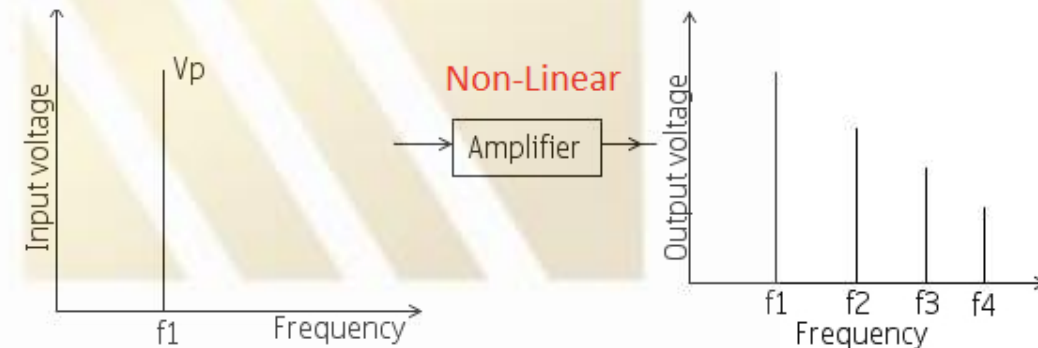
x ——[a]—— y

$$y = a.x + b.x^2 + c.x^3 + \ldots$$

Linear

NonLinear

Linear vs. Non-Linear in Frequency Domain

$$y = a.x$$
$$x = \cos(w_1 t)$$
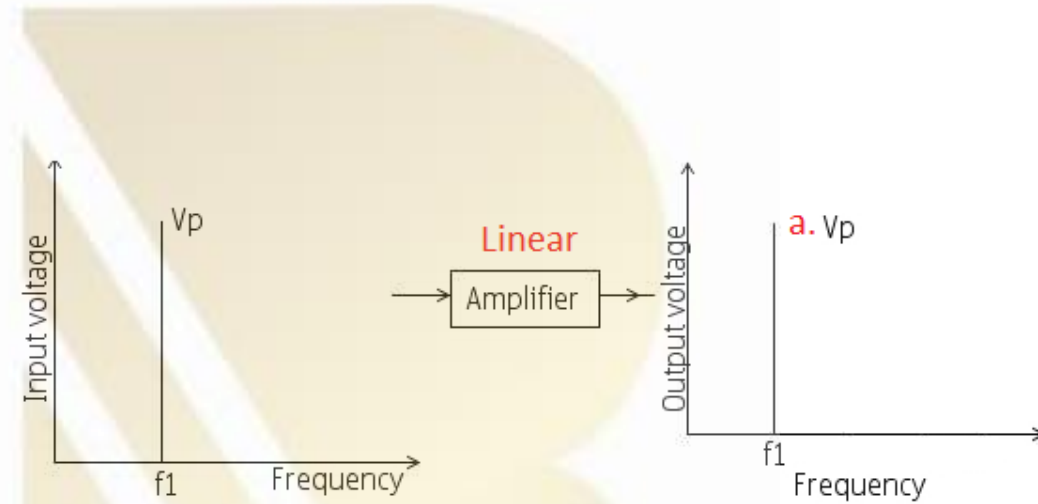
$$y = a.x + b.x^2 + c.x^3 + \ ...$$
$$x = \cos(w_1 t)$$

Nonlinearity problems

Gain Compression

Intermodulation

Desensitization

$y = 5x$

Compression

$y = 5x + 0.5x^2 - 0.25x^3$