

Power Electronics Reference

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Introduction

Just throwing together some concepts and examples for later reference

1 General Equations

1.1 Power and Energy

1.1.1 Instantaneous Power

This value is a positive real number if the element is supplying power, or is a negative real number if the element is consuming power.

$$p(t) = v(t)i(t) \quad (W)$$

- $p(t) :=$ Instantaneous Power (W)
- $v(t) :=$ Instantaneous Voltage (V)
- $i(t) :=$ Instantaneous Current (A)

1.1.2 Average Power

$$P = \frac{1}{T} \int_{t_o}^{t_o+T} p(t) dt \quad (W)$$

$$P = \frac{1}{T} \int_{t_o}^{t_o+T} v(t)i(t) dt \quad (W)$$

$$P = \frac{W}{T} \quad (W)$$

- $P :=$ Average Power (W)
- $p(t) :=$ Instantaneous Power (W)
- $v(t) :=$ Instantaneous Voltage (V)
- $i(t) :=$ Instantaneous Current (A)
- $T :=$ Time Period (Δs)
- $t_o :=$ Initial Time (s)
- $W :=$ Work (J)

1.1.3 Energy

$$W = \int_{t_1}^{t_2} p(t) dt \quad (J)$$

- $W :=$ Work (J)
- $p(t) :=$ Instantaneous Power (W)

1.2 Inductors

1.2.1 Current/Voltage Relationship

$$i(t_o + T) = \frac{1}{L} \int_{t_o}^{t_o+T} v_L(t) dt + i(t_o)$$

- $i(t_o)$:= Initial Current at Time t_o (A)
- $i_L(t)$:= Current Through an Inductor (A)
- $v_L(t)$:= Voltage Across an Inductor (V)
- L := Inductance (H)
- t_o := Initial Time (s)
- T := Time Period (Δ s)

$$i(t_o + T) = \frac{1}{L} \int_{t_o}^{t_o+T} v_L(t) dt + i(t_o)$$

1.3 RMS Values

$$V_{RMS} = \sqrt{\frac{1}{T} \int_{t_o}^{t_o+T} v^2(t) dt}$$

$$I_{RMS} = \sqrt{\frac{1}{T} \int_{t_o}^{t_o+T} i^2(t) dt}$$

- V_{RMS} := RMS Voltage (V)
- I_{RMS} := RMS Current (A)

Variables

C Capacitance (F).
 I Average Current (A).
 I_C Average Current Through a Capacitor (A).
 I_L Average Current Through an Inductor (A).
 I_{RMS} RMS Current (A).
 L Inductance (H).
 P Average Power (W).
 T Time Period (Δs).
 V Average Voltage (V).
 V_C Average Voltage Across a Capacitor (V).
 V_L Average Voltage Across and Inductor (V).
 V_{RMS} RMS Voltage (V).
 W Work (J).
 $i(t)$ Instantaneous Current (A).
 $i(t_o)$ Initial Current at Time t_o (A).
 $i_C(t)$ Current Through a Capacitor (A).
 $i_L(t)$ Current Through an Inductor (A).
 $p(t)$ Instantaneous Power (W).
 t Instantaneous Time (s).
 t_o Initial Time (s).
 $v(t)$ Instantaneous Voltage (V).
 $v(t_o)$ Initial Voltage at Time t_o (V).
 $v_C(t)$ Voltage Across a Capacitor (V).
 $v_L(t)$ Voltage Across an Inductor (V).

Glossary

Average Current The average current going through a reference point throughout a period of time T .

Average Power The average power an element is consuming or producing throughout a period of time T .

Average Voltage The average voltage across two reference points throughout a period of time T .

Capacitance A measurement of the phenomenon that change in voltage is resisted in a capacitor due to the establishment of an electric field.

Inductance A measurement of the phenomenon that change in current is resisted in an inductor due to the establishment of a magnetic field.

Initial Time Describes the initial time that a period in time is taken.

Instantaneous Current The current going through a reference point at time t .

Instantaneous Power The power an element is consuming or producing at time t .

Instantaneous Time An instant in time.

Instantaneous Voltage The voltage across two reference points at time t .

Time Period A period between two points in time. Usually describes a full period in a sinusoidal wave.

Work The power a system is able to output over a period in time.

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