Centro Federal de Educação Tecnológica de Santa Catarina
Departamento Acadêmico de Eletrônica

Conversores Estáticos

Conversores CC-CC Não-Isolados

Estágio de Potência dos Conversores Boost e Buck-Boost

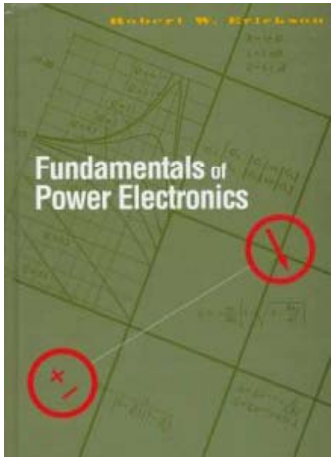
Prof. Clóvis Antônio Petry.

Florianópolis, maio de 2008.

Bibliografia para esta aula

Capítulo 9: Choppers DC

1. Conversores CC-CC não-isolados.



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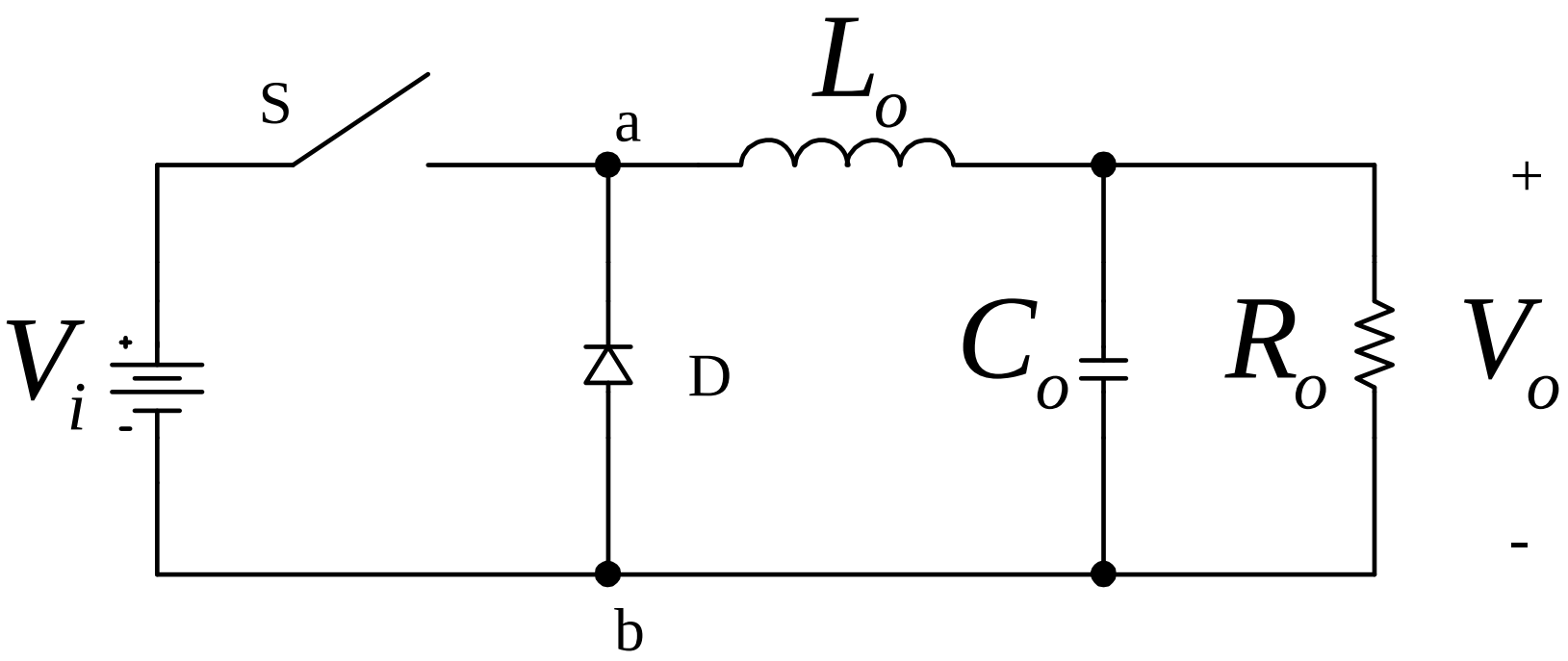
Nesta aula

Conversores CC-CC:

1. Revisão do conversor Buck;
2. Conversor Boost;
3. Conversor Buck-Boost;
4. Outros conversores básicos.

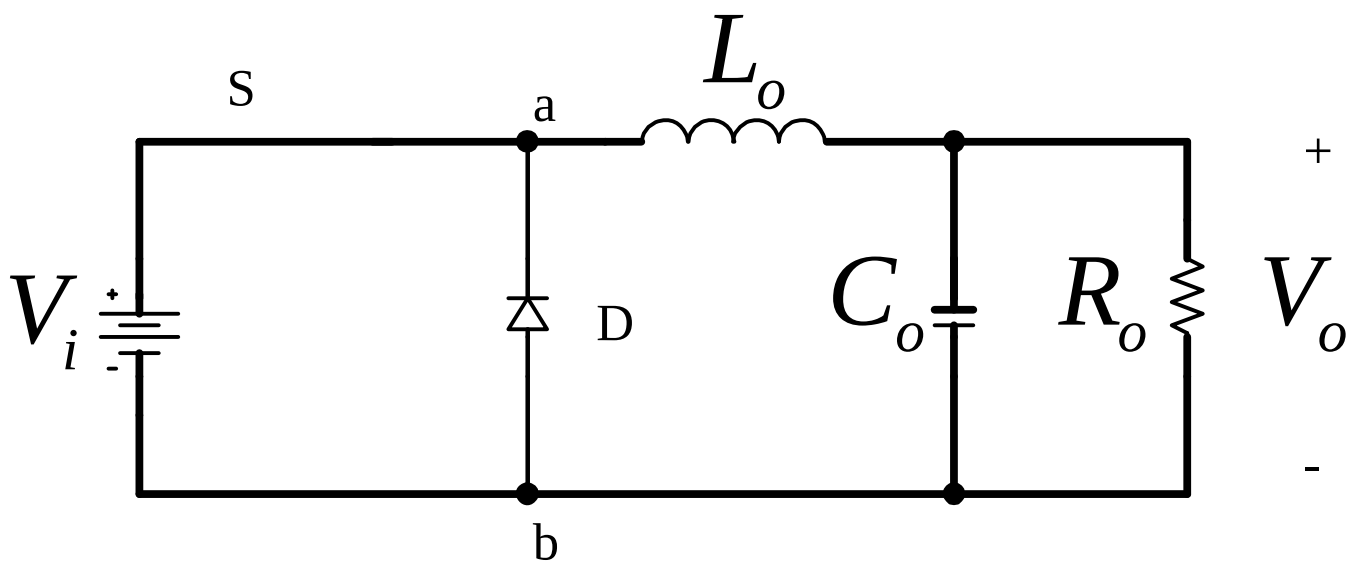
Conversor Buck



Conversor Buck

Primeira etapa de funcionamento:

- Interruptor conduzindo;
- Diodo bloqueado;
- Energia sendo armazenada no indutor.

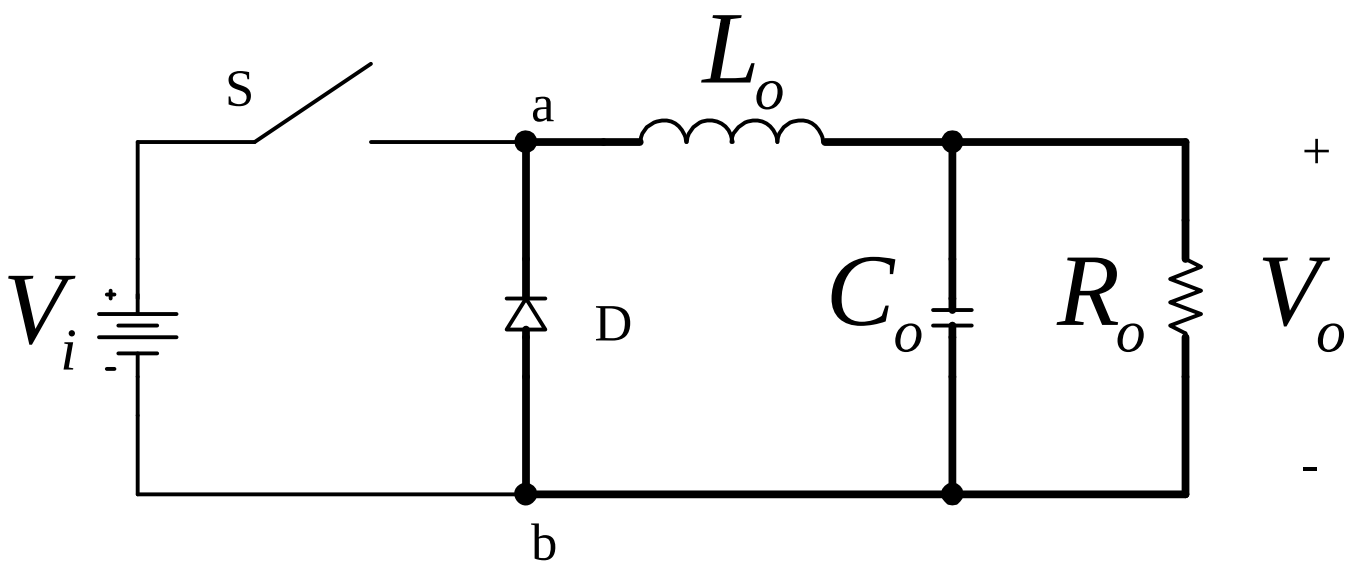


$$0 \leq t < D \cdot T_s$$

Conversor Buck

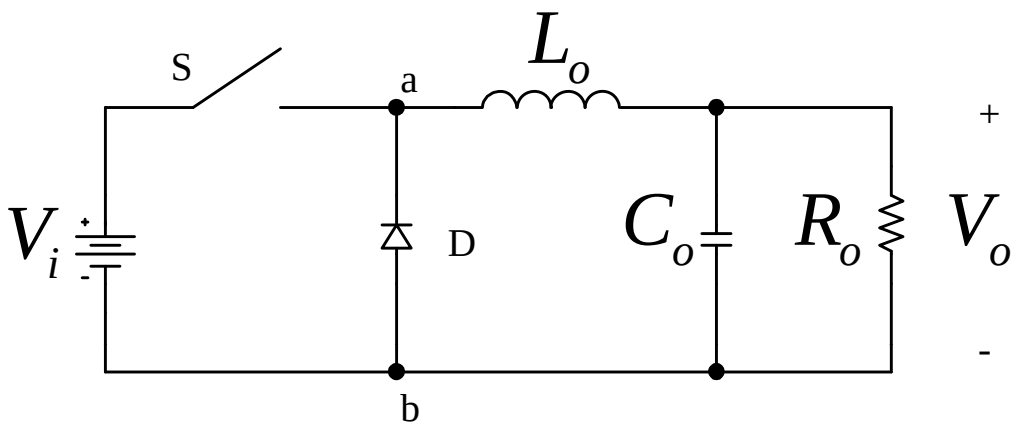
Segunda etapa de funcionamento:

- Interruptor bloqueado;
- Diodo conduzindo;
- Energia armazenada no indutor sendo transferida para saída.



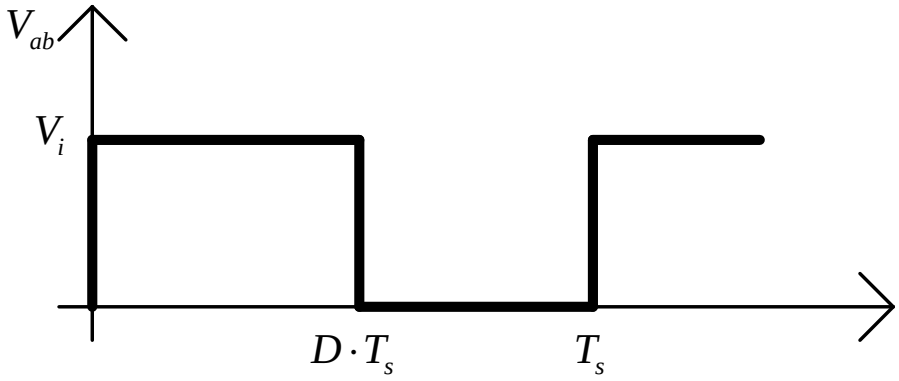
$$D \cdot T_s \leq t < T_s$$

Conversor Buck

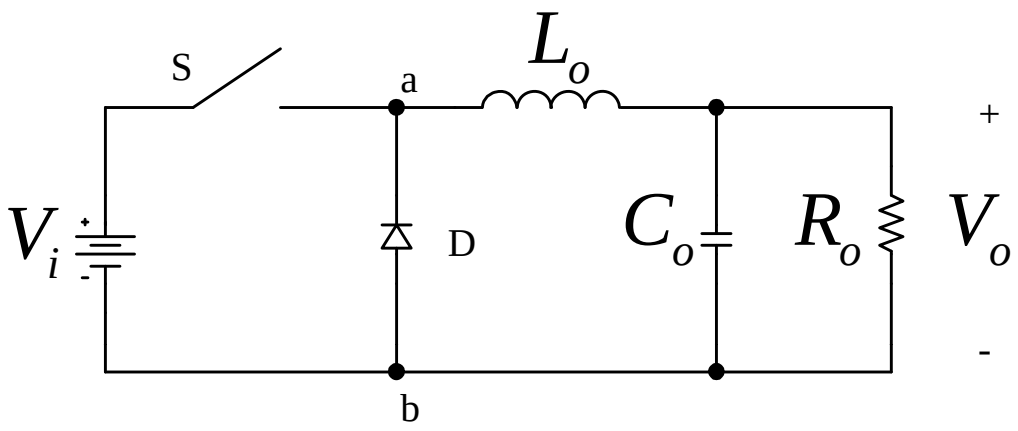


$$V_{ab} = \frac{1}{T_s}\int_0^{T_{on}} V_i \cdot dt = V_i \frac{T_{on}}{T_s}$$

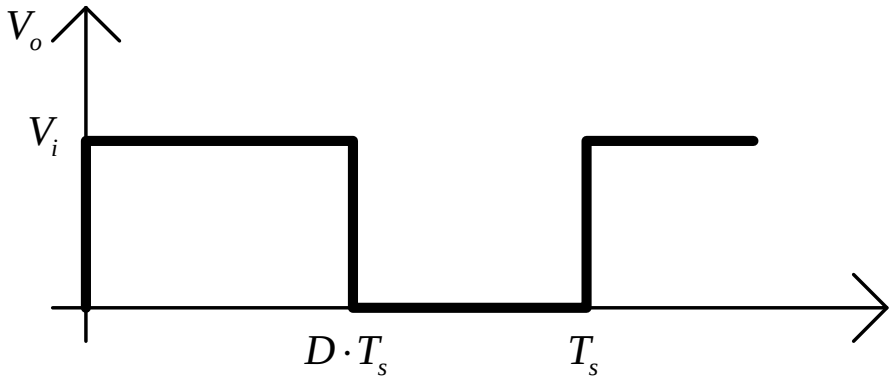
$$V_{ab} = D \cdot V_i$$



Conversor Buck



$$V_{ab} = \frac{1}{T_s}\int_0^{T_{on}} V_i \cdot dt = V_i \frac{T_{on}}{T_s}$$

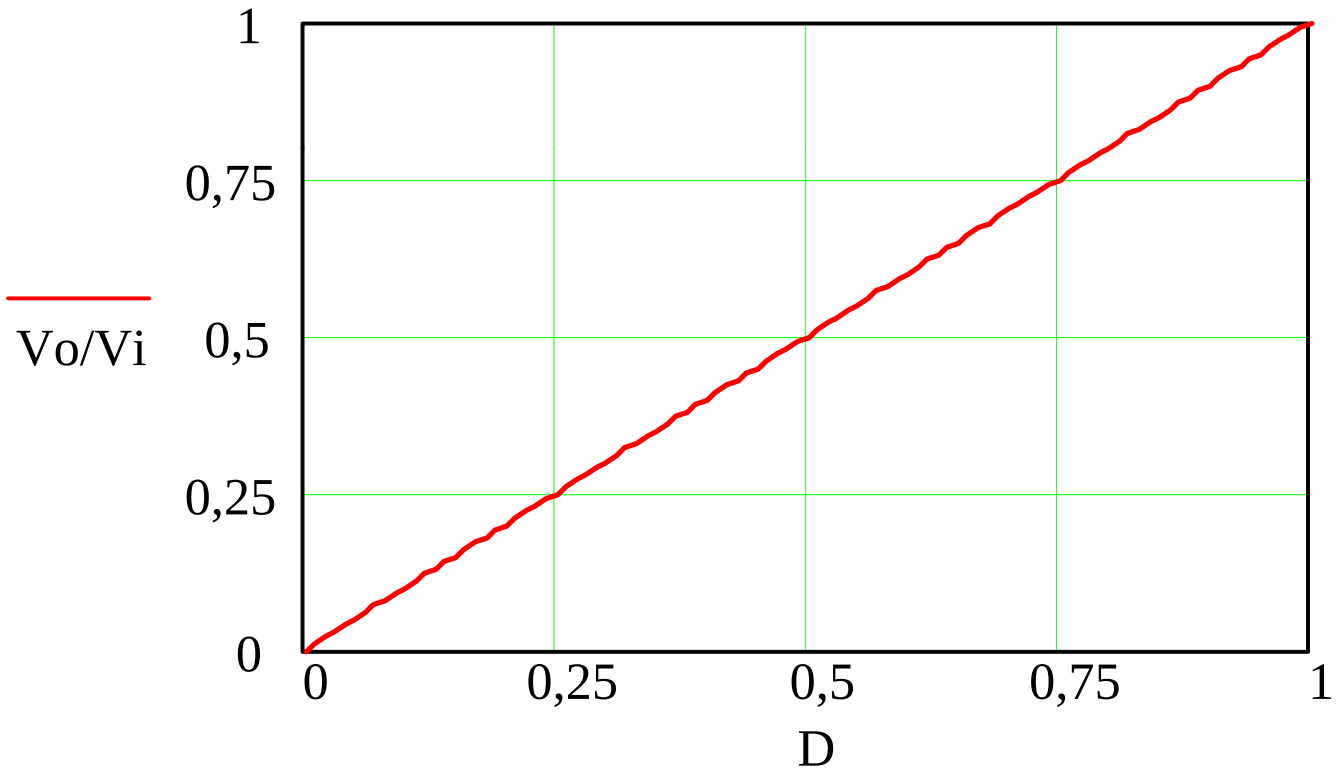


$$V_{ab} = D \cdot V_i$$

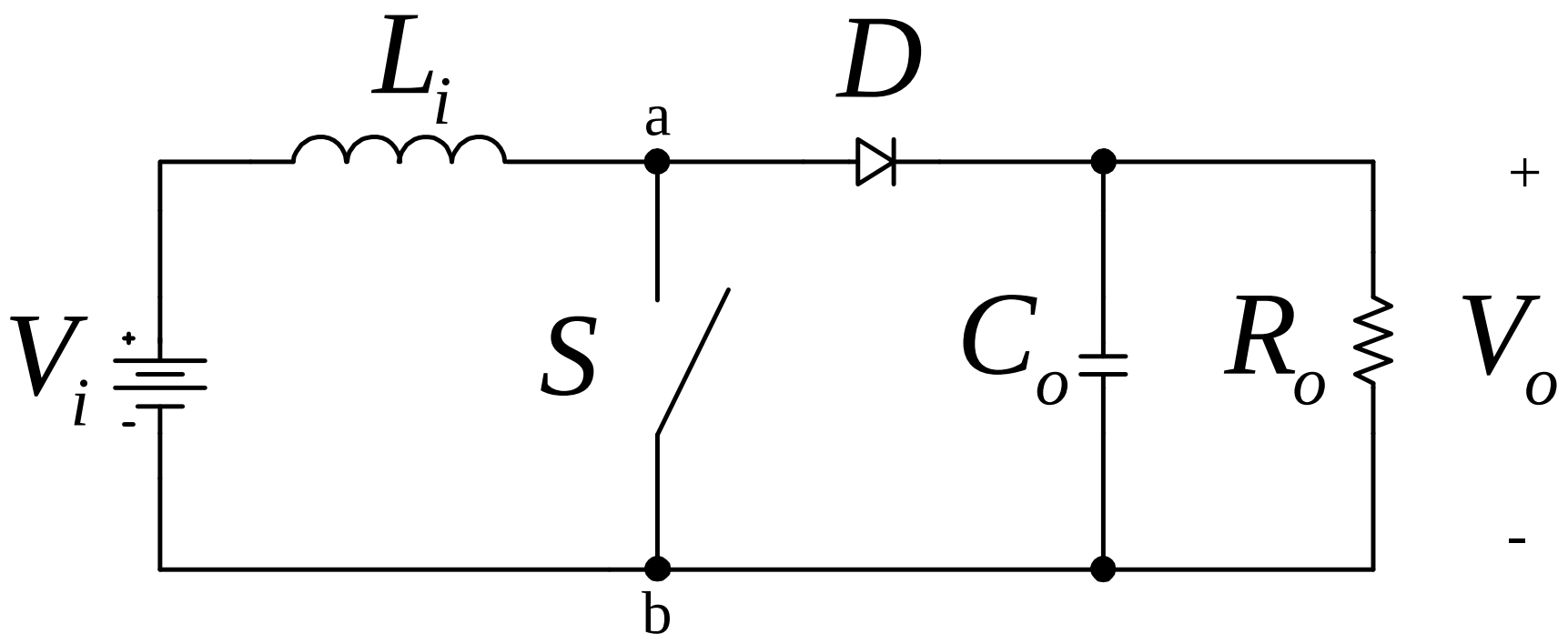
$$V_o = V_{ab} \qquad V_o = D \cdot V_i \qquad D = \frac{V_o}{V_i}$$

Conversor Buck

Ganho estático em função da razão cíclica:



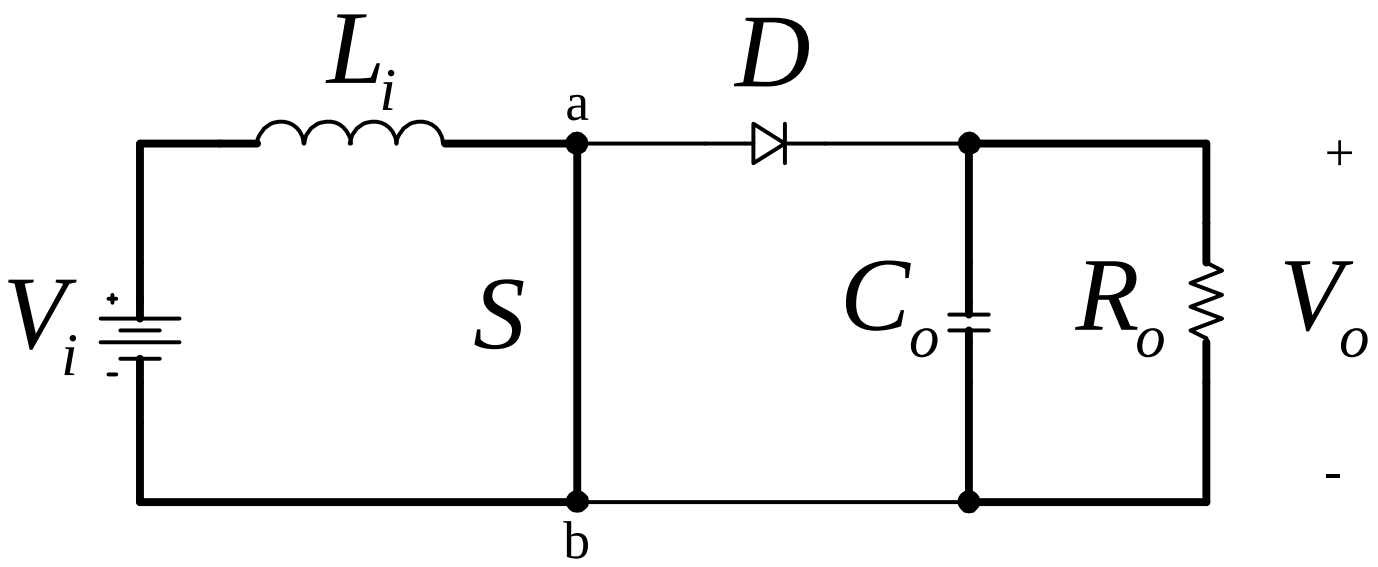
Conversor Boost



Conversor Boost

Primeira etapa de funcionamento:

- Interruptor conduzindo;
- Diodo bloqueado;
- Energia sendo armazenada no indutor.

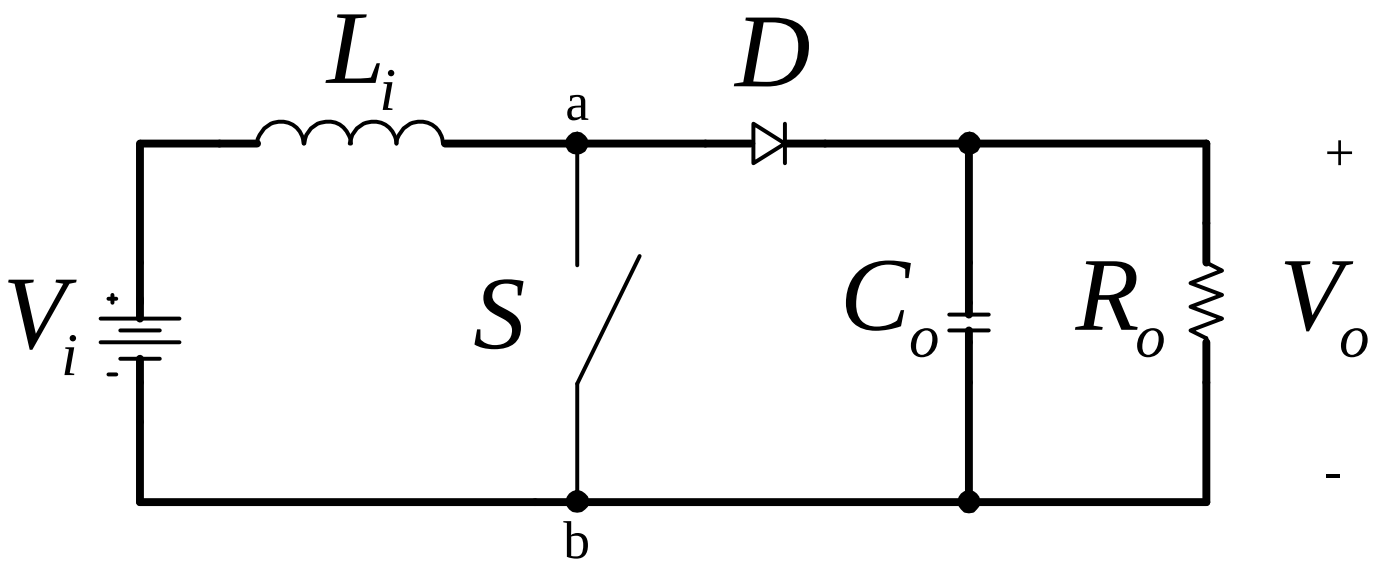


$$0 \leq t < D \cdot T_s$$

Conversor Boost

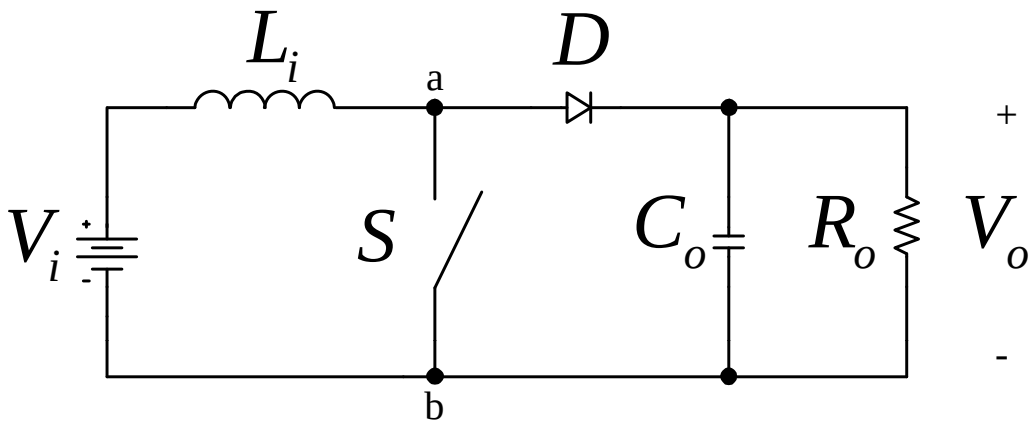
Segunda etapa de funcionamento:

- Interruptor bloqueado;
- Diodo conduzindo;
- Energia armazenada no indutor sendo transferida para saída.



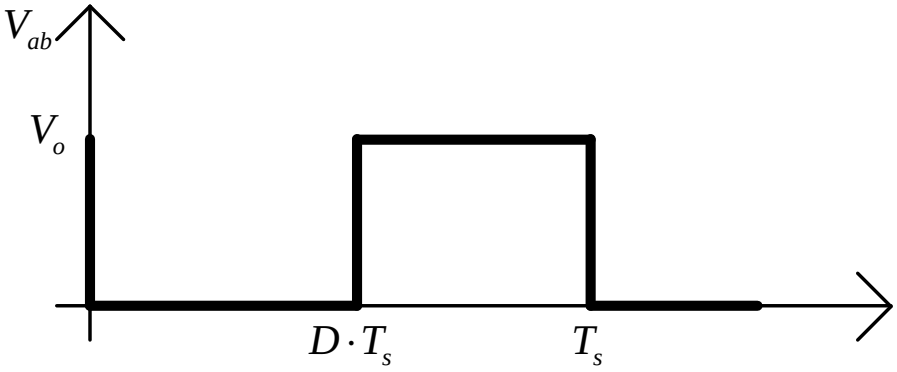
$$D \cdot T_s \leq t < T_s$$

Conversor Boost

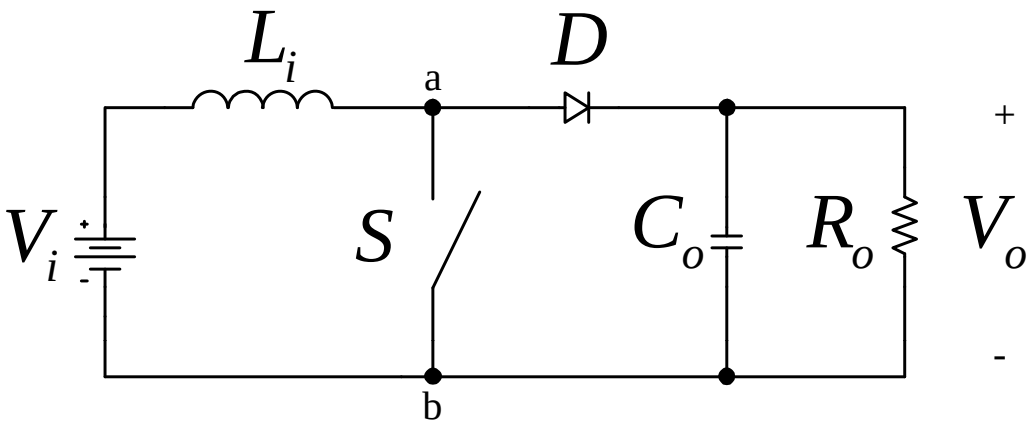


$$V_{ab} = \frac{1}{T_s}\int_{D\cdot T_s}^{T_s} V_o \cdot dt = V_o \frac{\left(T_s - D\cdot T_s\right)}{T_s}$$

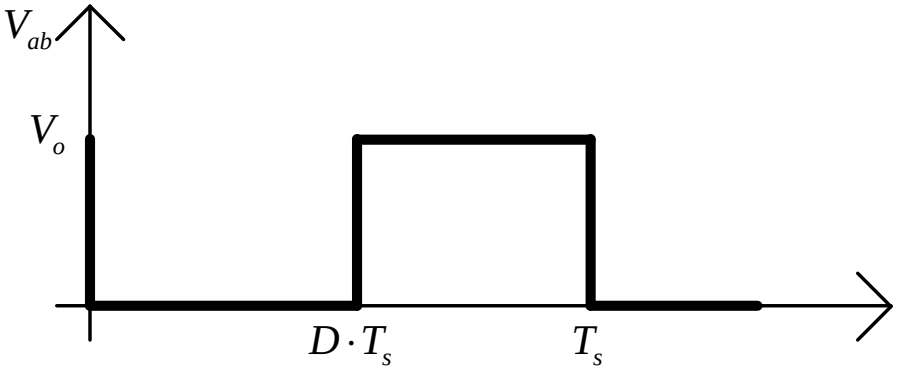
$$V_{ab} = V_o\left(1 - D\right)$$



Conversor Boost



$$V_{ab} = \frac{1}{T_s}\int_{D\cdot T_s}^{T_s} V_o \cdot dt = V_o \frac{\left(T_s - D\cdot T_s\right)}{T_s}$$



$$V_{ab} = V_o\left(1-D\right)$$

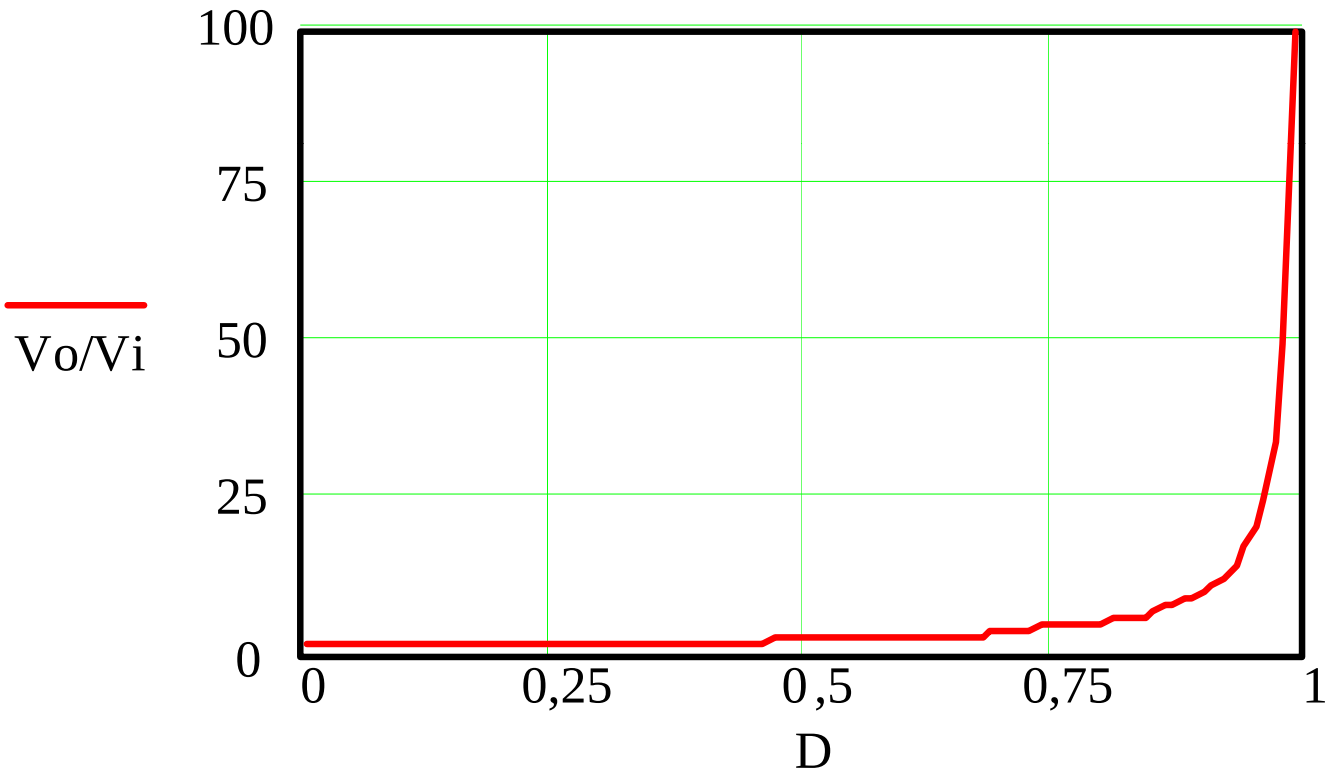
$$V_{ab} = V_i$$

$$V_o = \frac{V_i}{1-D}$$

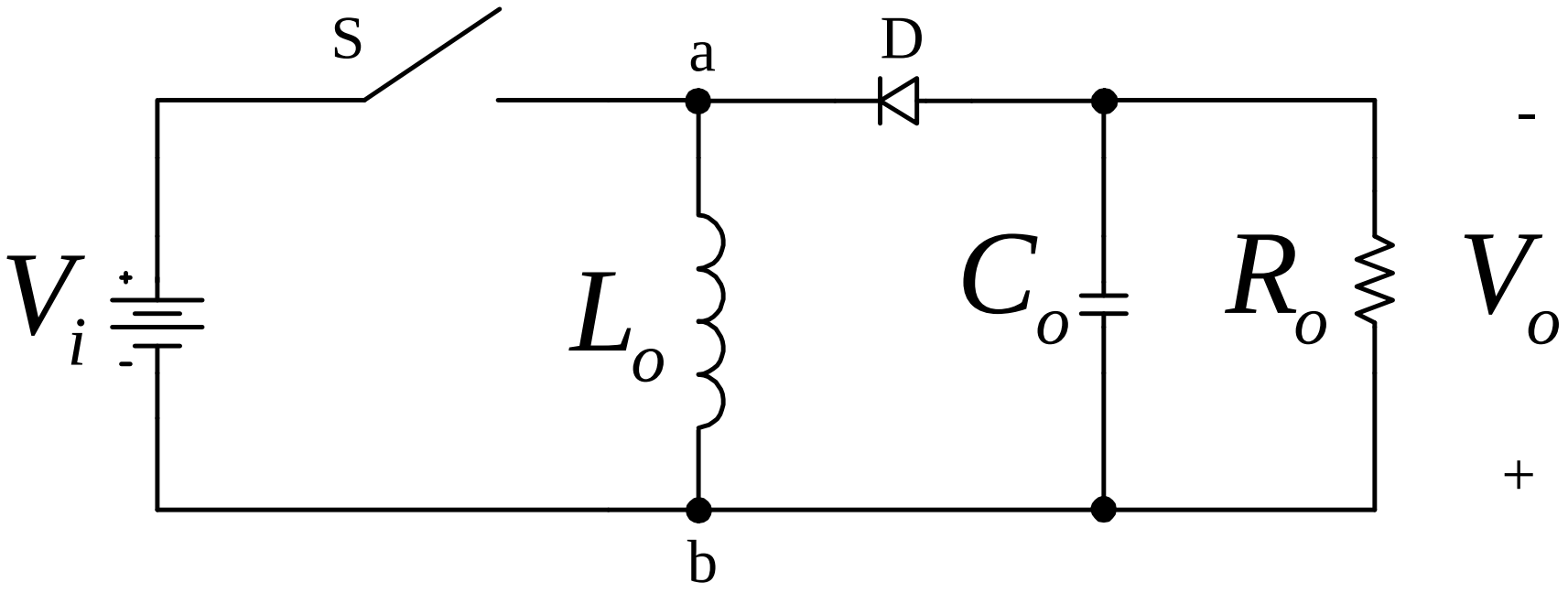
$$D = 1 - \frac{V_i}{V_o}$$

Conversor Boost

Ganho estático em função da razão cíclica:



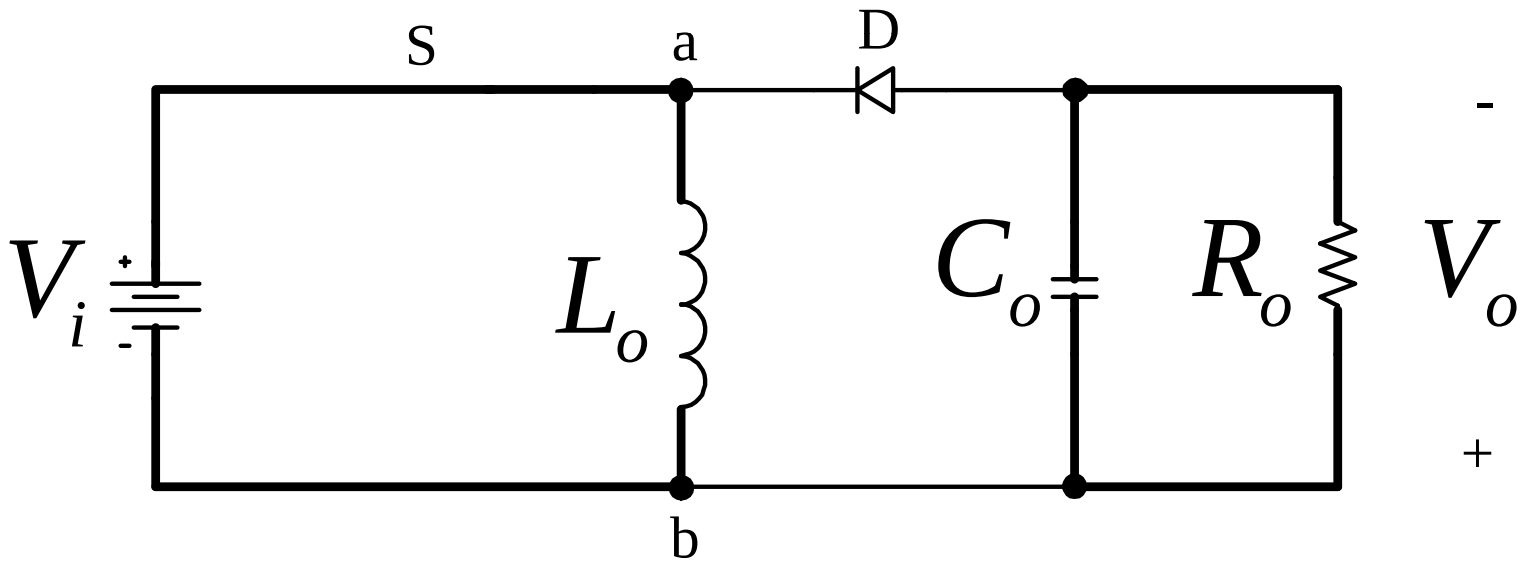
Conversor Buck-Boost



Conversor Buck-Boost

Primeira etapa de funcionamento:

- Interruptor conduzindo;
- Diodo bloqueado;
- Energia sendo armazenada no indutor.

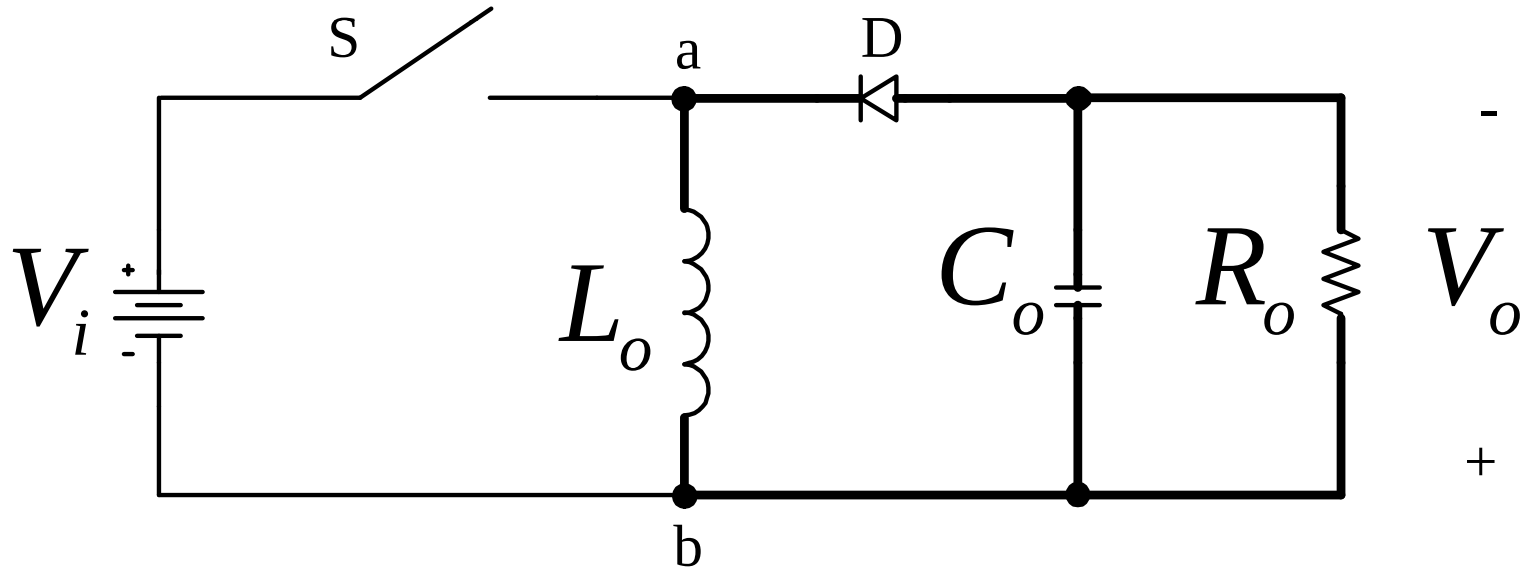


$$0 \leq t < D \cdot T_s$$

Conversor Buck-Boost

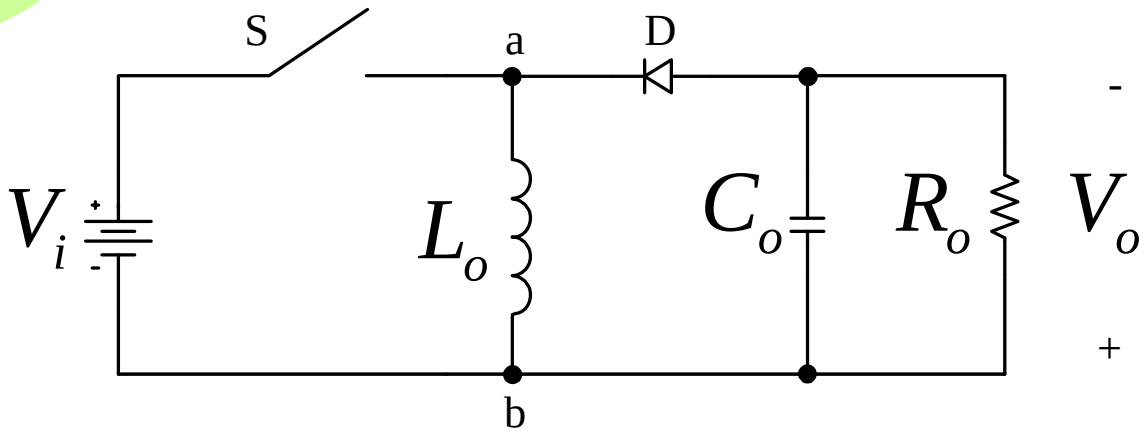
Segunda etapa de funcionamento:

- Interruptor bloqueado;
- Diodo conduzindo;
- Energia armazenada no indutor sendo transferida para saída.



$$D \cdot T_s \leq t < T_s$$

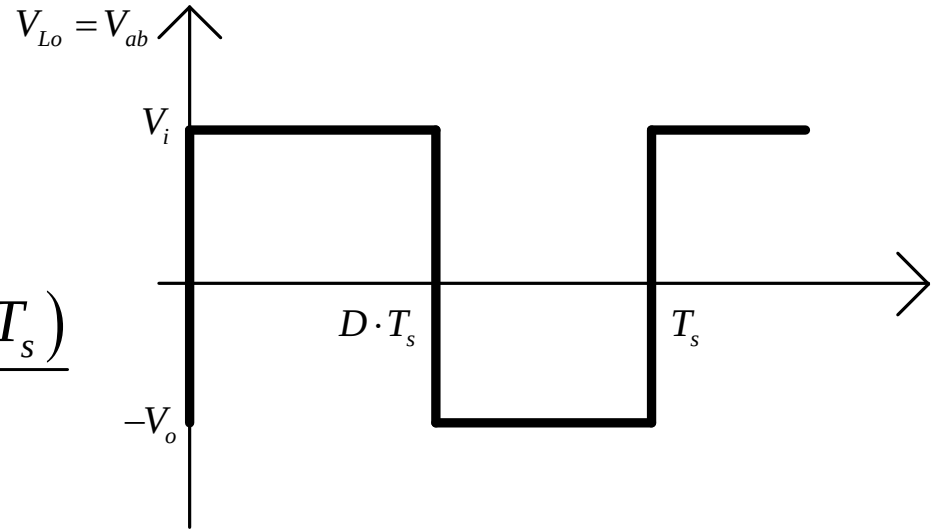
Conversor Buck-Boost



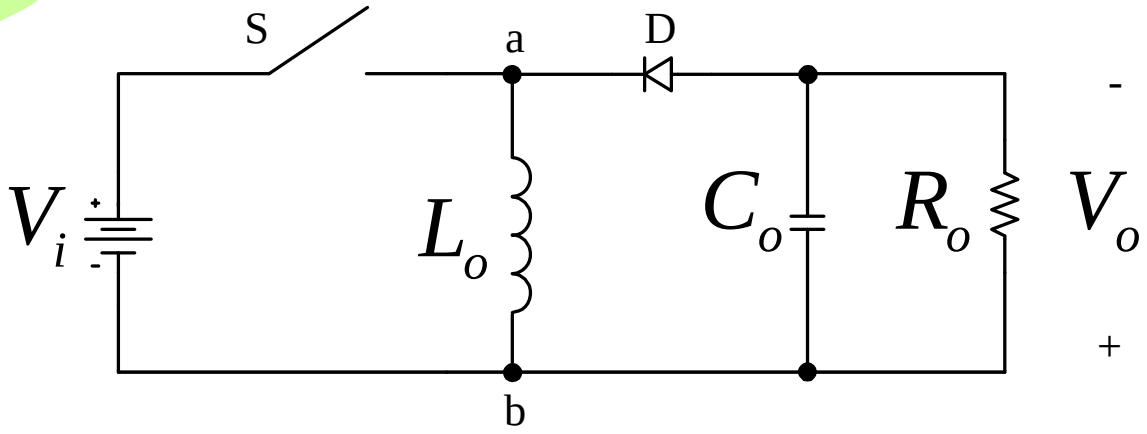
$$V_{ab} = \frac{1}{T_s}\int_{0}^{D\cdot T_s} V_i \cdot dt + \frac{1}{T_s}\int_{D\cdot T_s}^{T_s} \left(-V_o\right)\cdot dt$$

$$V_{ab} = \frac{V_i \cdot \left(D\cdot T_s - 0\right) - V_o \cdot \left(T_s - D\cdot T_s\right)}{T_s}$$

$$V_{ab} = V_i \cdot D - V_o \cdot \left(1 - D\right)$$



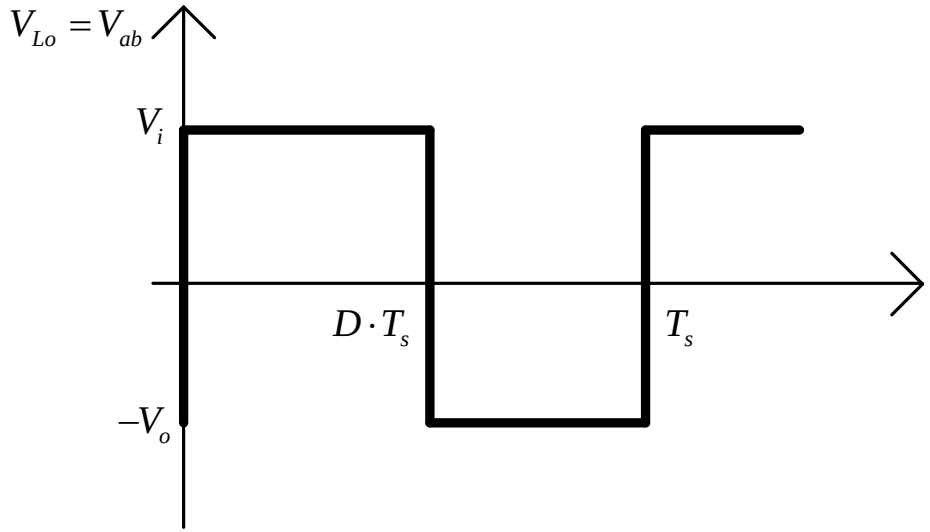
Conversor Buck-Boost



$$V_{ab} = \frac{1}{T_s}\int_{0}^{D\cdot T_s} V_i \cdot dt + \frac{1}{T_s}\int_{D\cdot T_s}^{T_s} \left(-V_o\right)\cdot dt$$

$$V_{ab} = V_i \cdot D - V_o \cdot \left(1-D\right) = 0$$

$$V_i \cdot D = V_o \cdot \left(1-D\right)$$

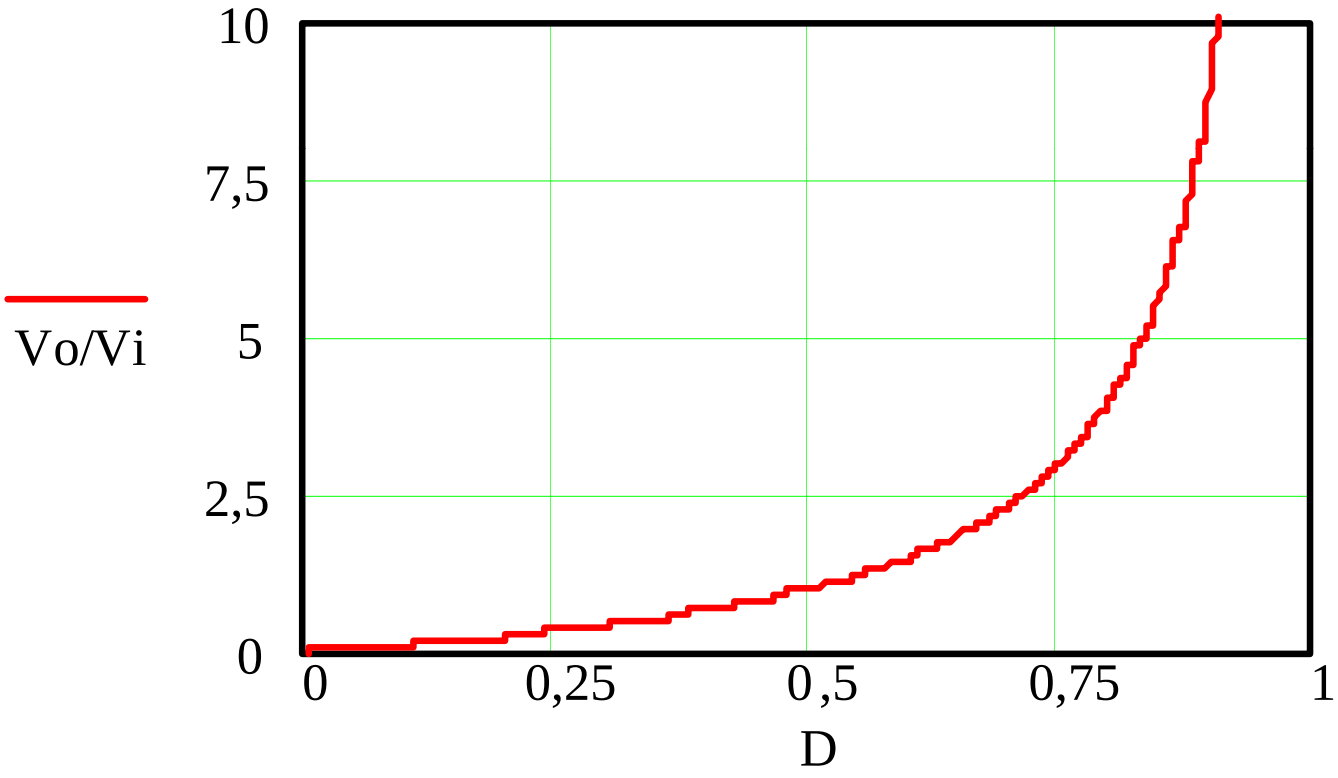


$$V_o = V_i \cdot \frac{D}{1-D}$$

$$D = 1 + \frac{V_o}{V_i}$$

Conversor Buck-Boost

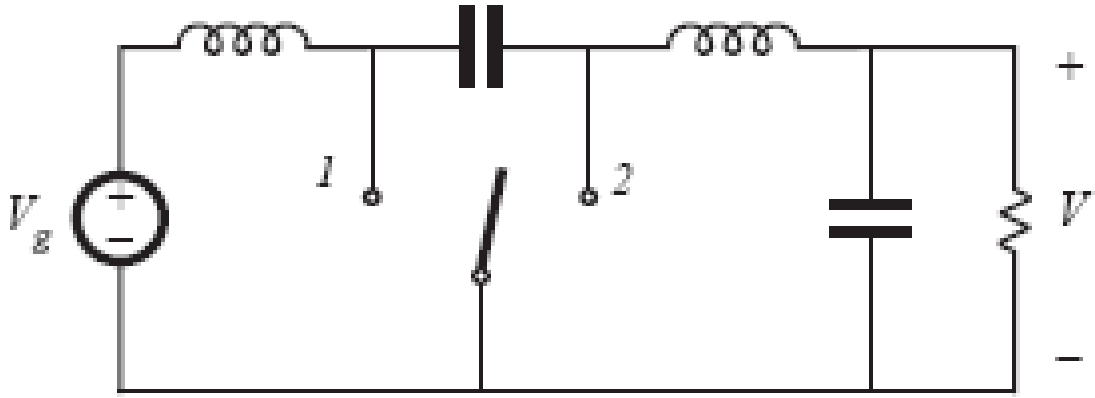
Ganho estático em função da razão cíclica:

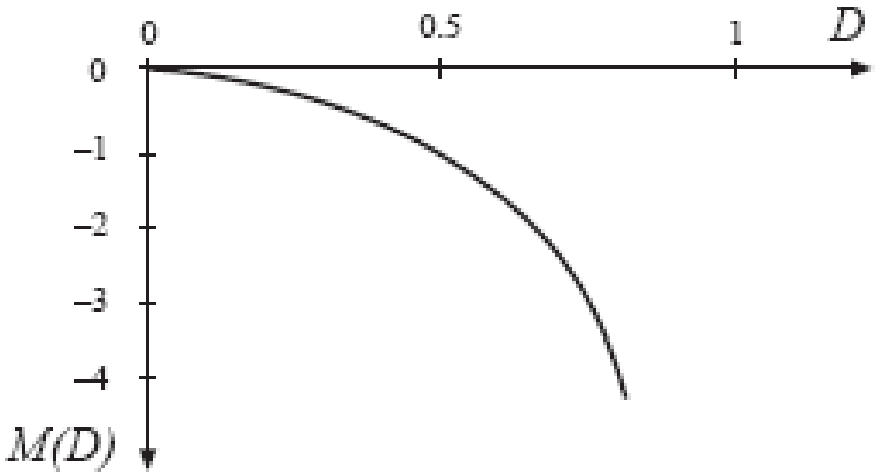


Outros conversores básicos - Cuk

1. *Cuk*

$$M(D) = -\frac{D}{1-D}$$

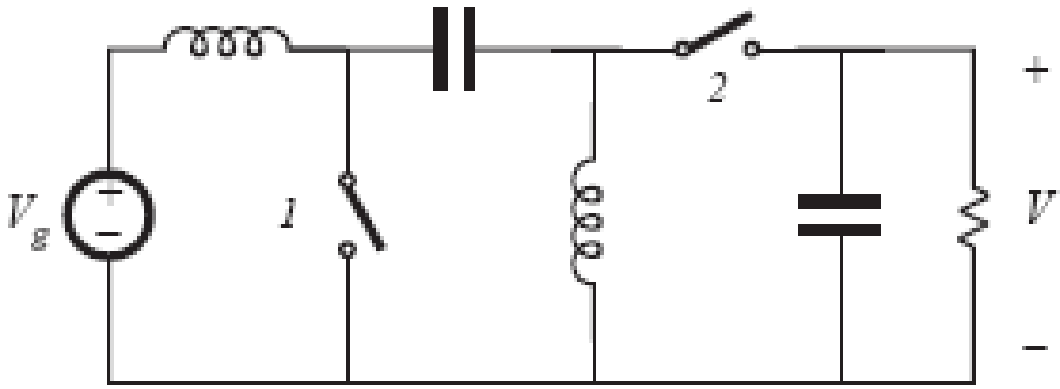


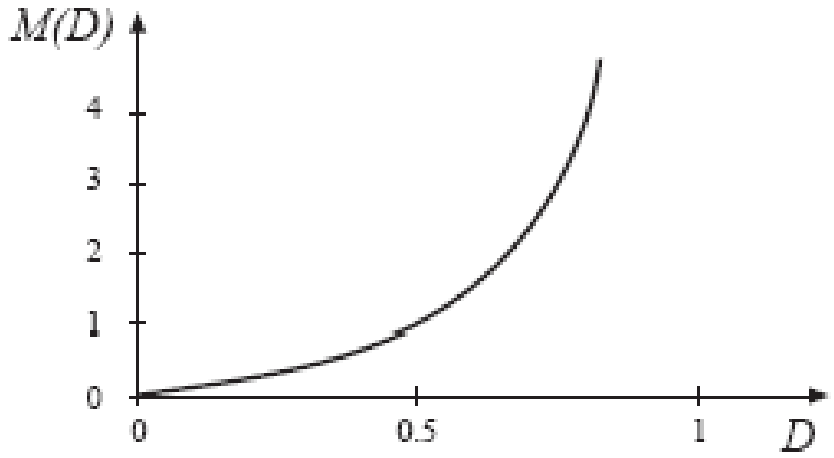


Outros conversores básicos - Sepic

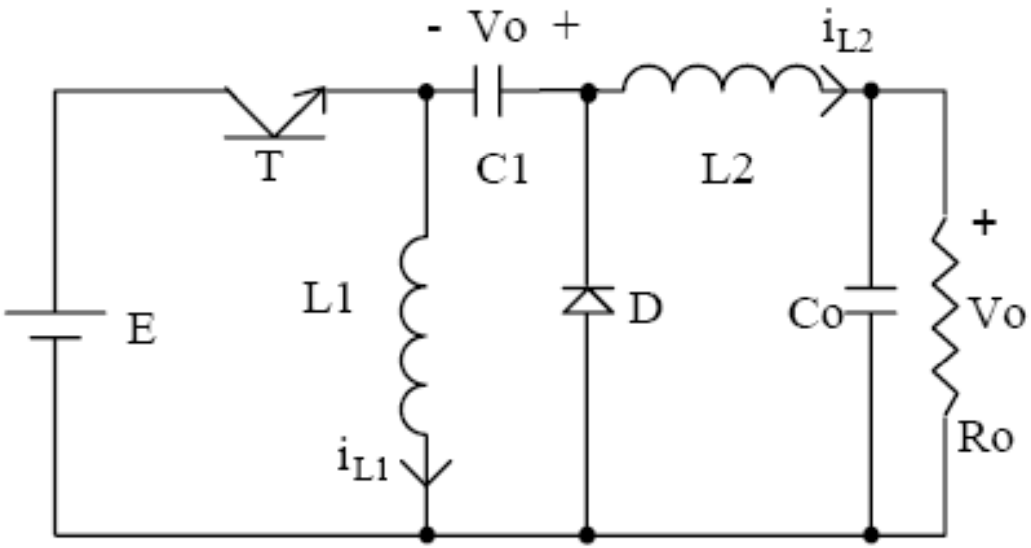
2. *SEPIC*

$$M(D) = \frac{D}{1-D}$$





Outros conversores básicos - Zeta



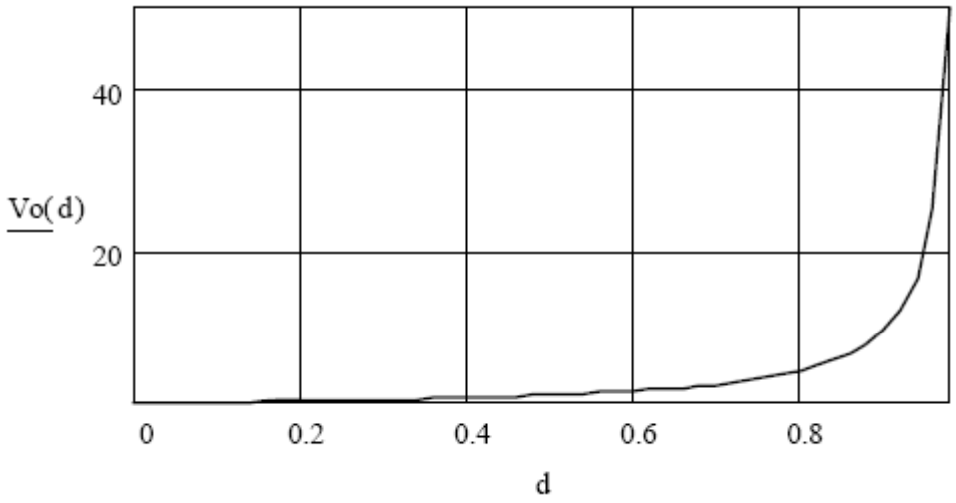


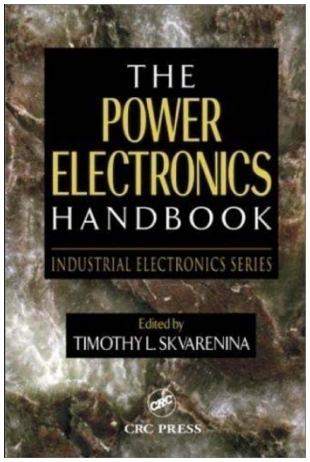
Tabela comparativa dos conversores CC-CC

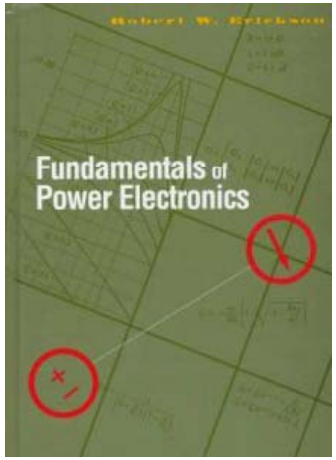
Conversor	Ganho estático	Característica
Buck	$\frac{V_o}{V_i} = D$	Abaixador
Boost	$\frac{V_o}{V_i} = \frac{1}{1-D}$	Elevador
Buck-Boost	$\frac{V_o}{V_i} = \frac{D}{1-D}$	Abaixador/Elevador
Cuk	$\frac{V_o}{V_i} = -\frac{D}{1-D}$	Abaixador/Elevador
Sepic	$\frac{V_o}{V_i} = \frac{D}{1-D}$	Abaixador/Elevador
Zeta	$\frac{V_o}{V_i} = \frac{D}{1-D}$	Abaixador/Elevador

Próxima aula

Capítulo 9: Choppers DC

1. Conversores CC-CC isolados.





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