

Instituto Federal de Educação, Ciência e Tecnologia de Santa Catarina

Departamento Acadêmico de Eletrônica

Eletrônica de Potência



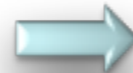
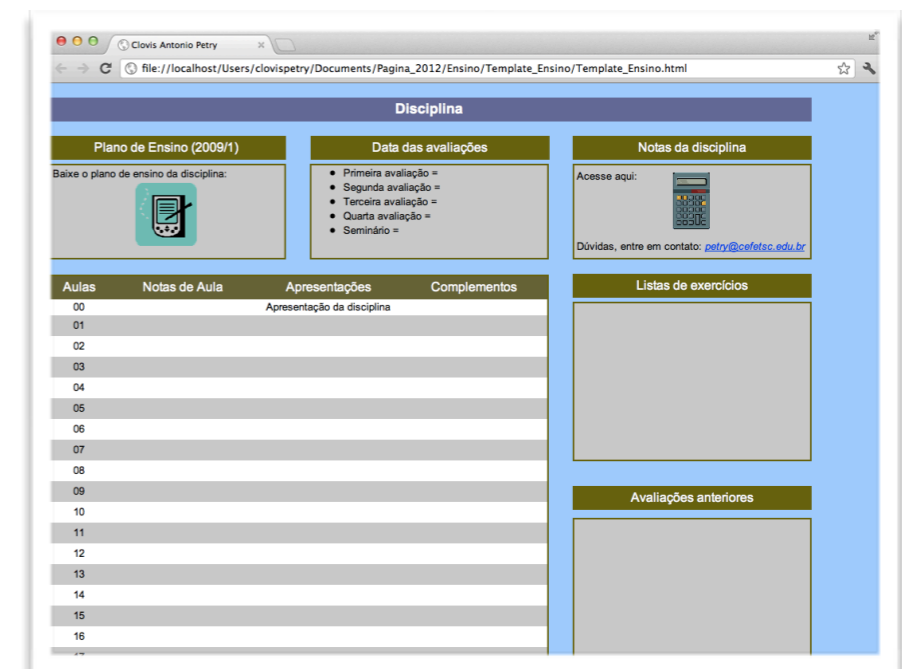
Modulação PWM Senoidal

Prof. Clovis Antonio Petry.

Florianópolis, maio de 2020.

Capítulo 9 - Conversores cc-cc:

- Modulação por largura de pulsos.



Nesta Aula

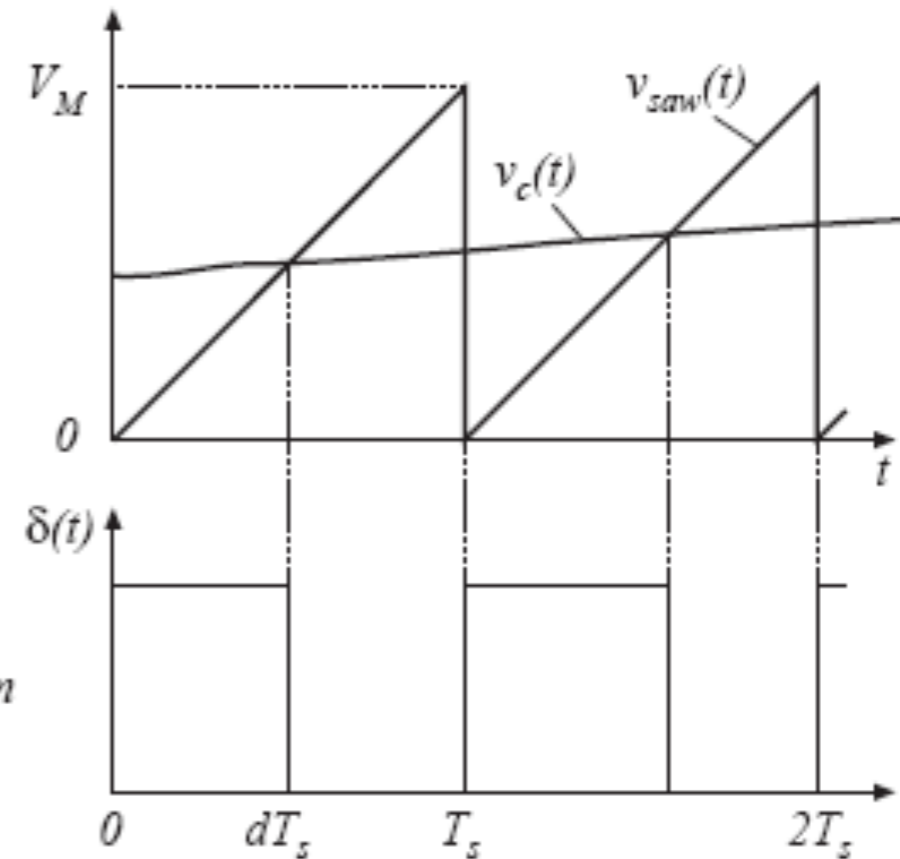
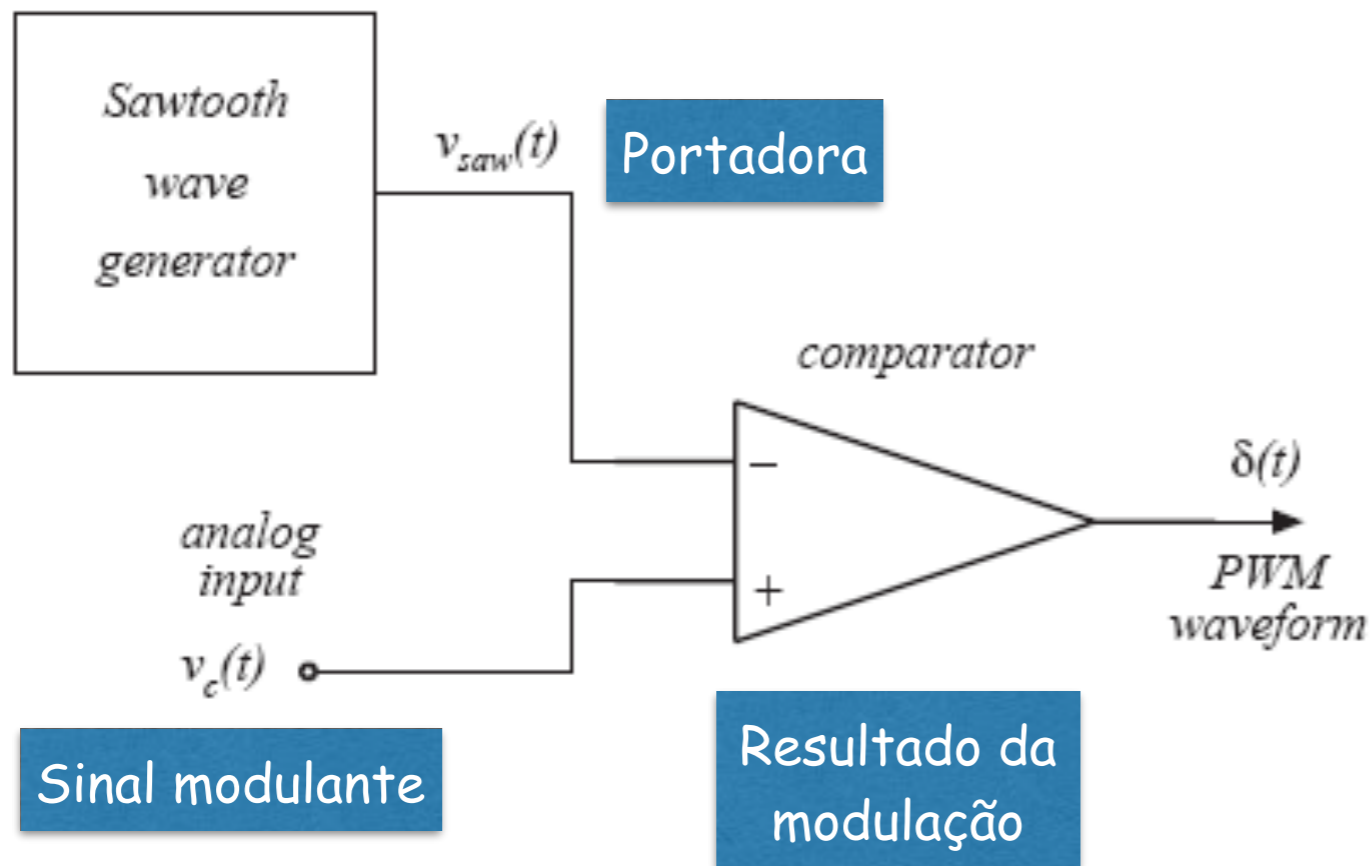
Conversores cc-cc: modulação por largura de pulsos:

- Princípio geral;
- Circuitos analógicos;
- Circuitos dedicados.

Conversores cc-ca: modulação por largura de pulsos senoidal:

- Simulação de conversores Buck;
- Simulação com modulação PWM senoidal.

Princípio Geral



Considerações:

1. A portadora define a frequência de comutação;
2. O sinal modulante deve ser aproximadamente contínuo durante um período da portadora;
3. O sinal modulante define a fundamental da grandeza de saída do conversor.

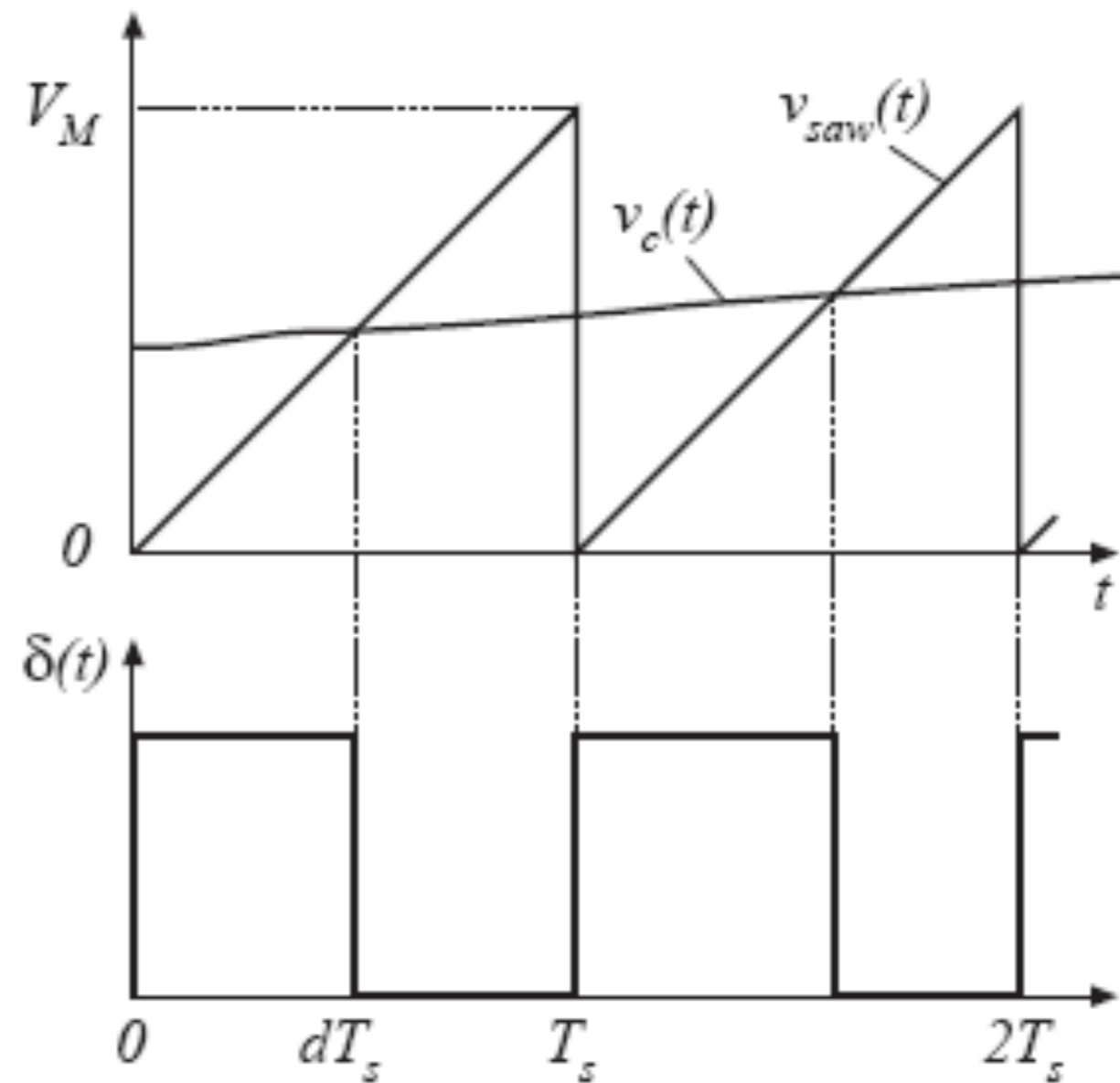
Princípio Geral

Considerando uma dente-de-serra linear:

$$d(t) = \frac{v_c(t)}{V_M}$$

Para:

$$0 \leq v_c(t) \leq V_M$$



Princípio Geral

Perturbando o sinal no tempo:

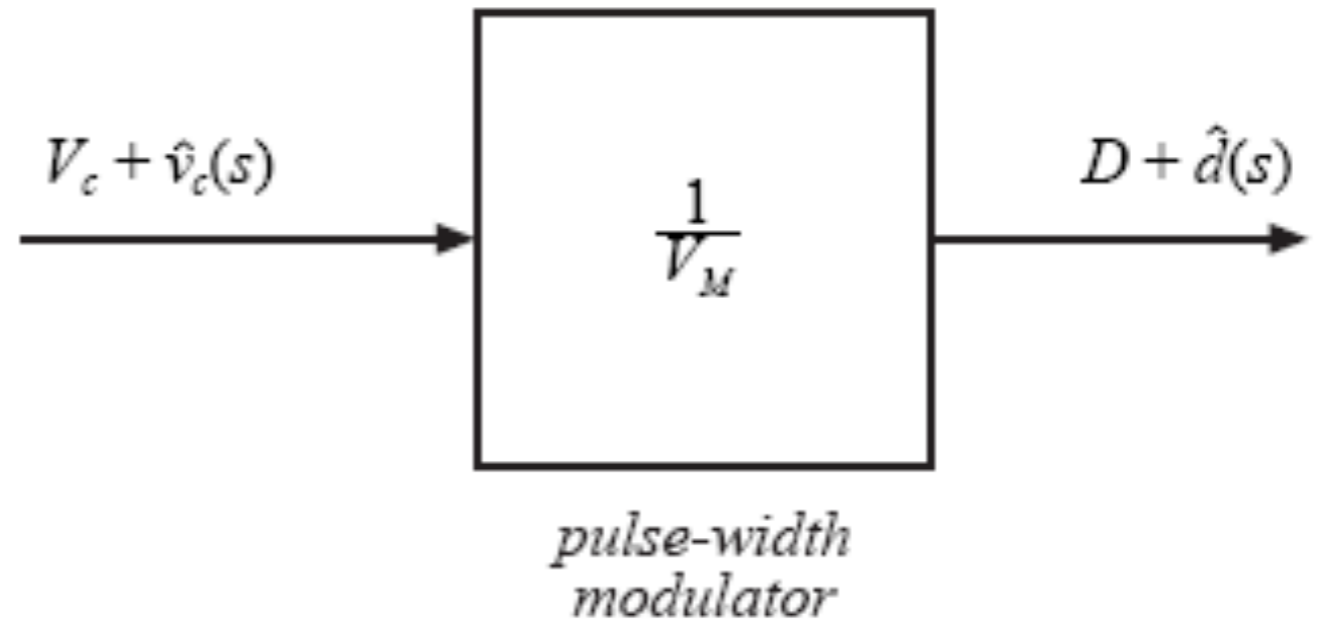
$$d(t) = D + \hat{d}(t)$$

$$v_c(t) = V_c + \hat{v}_c(t)$$

Resultado:

$$d(t) = \frac{v_c(t)}{V_M}$$

$$D + \hat{d}(t) = \frac{V_c + \hat{v}_c(t)}{V_M}$$

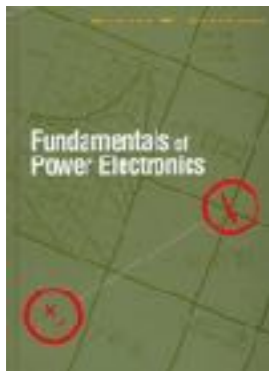


Relações CC:

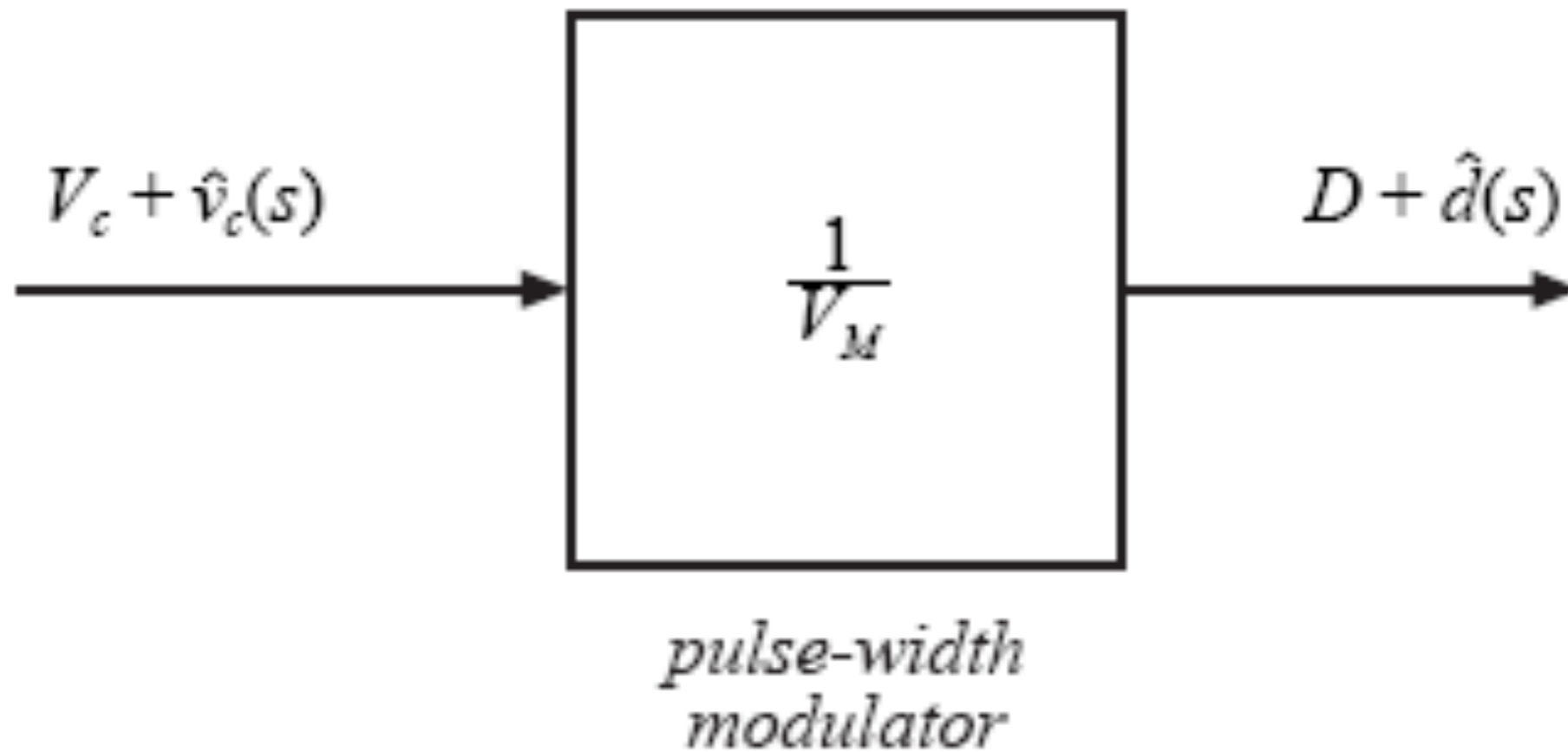
$$D = \frac{V_c}{V_M}$$

Relações CA:

$$\hat{d}(t) = \frac{\hat{v}_c(t)}{V_M}$$



Princípio Geral



$$D = \frac{V_c}{V_M}$$

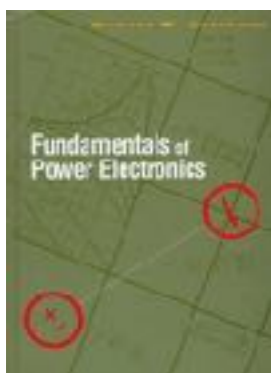
CC

$$\hat{d}(t) = \frac{\hat{v}_c(t)}{V_M}$$

No tempo

$$D(s) = \frac{V_c(s)}{V_M}$$

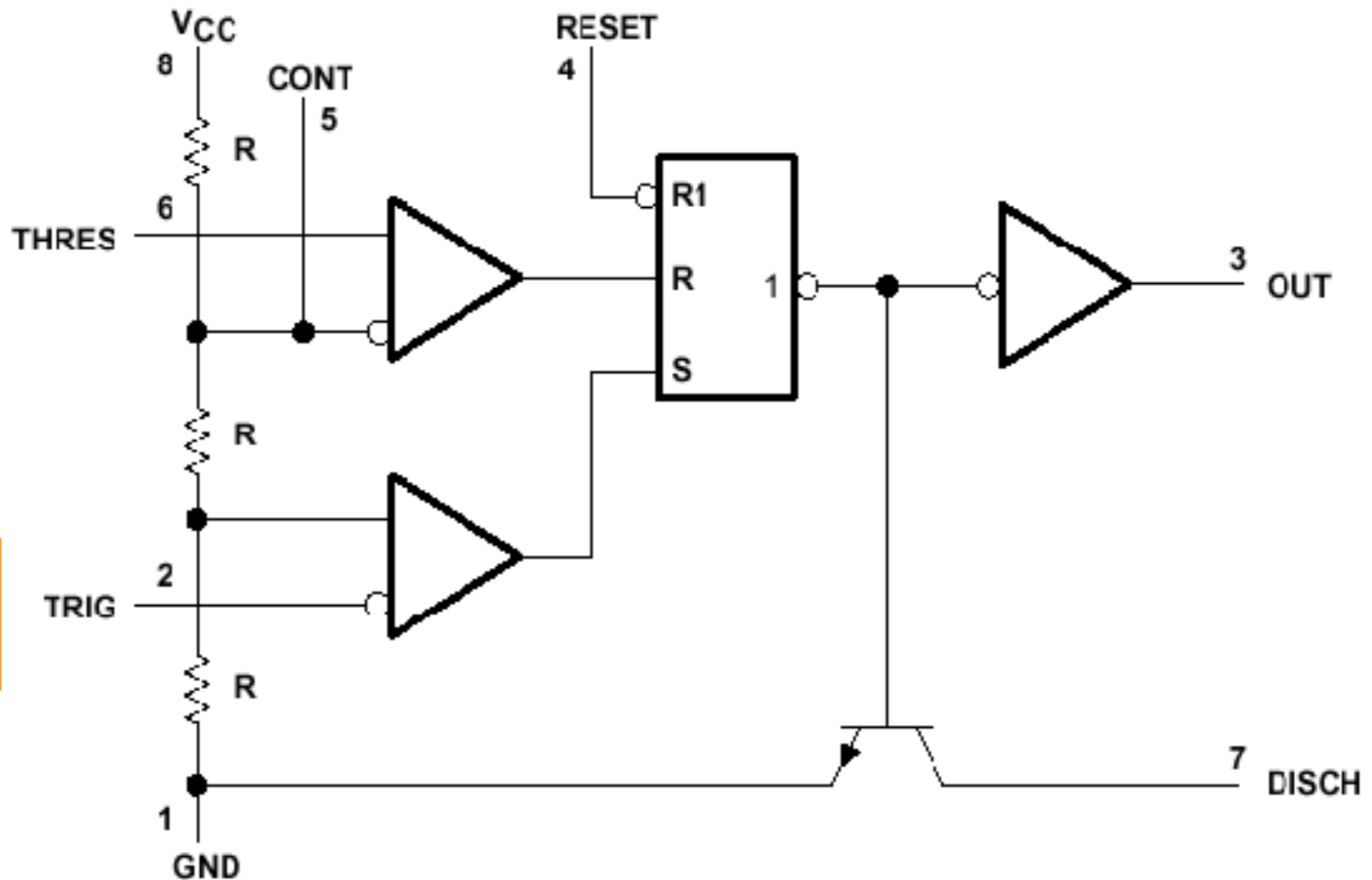
Na frequência



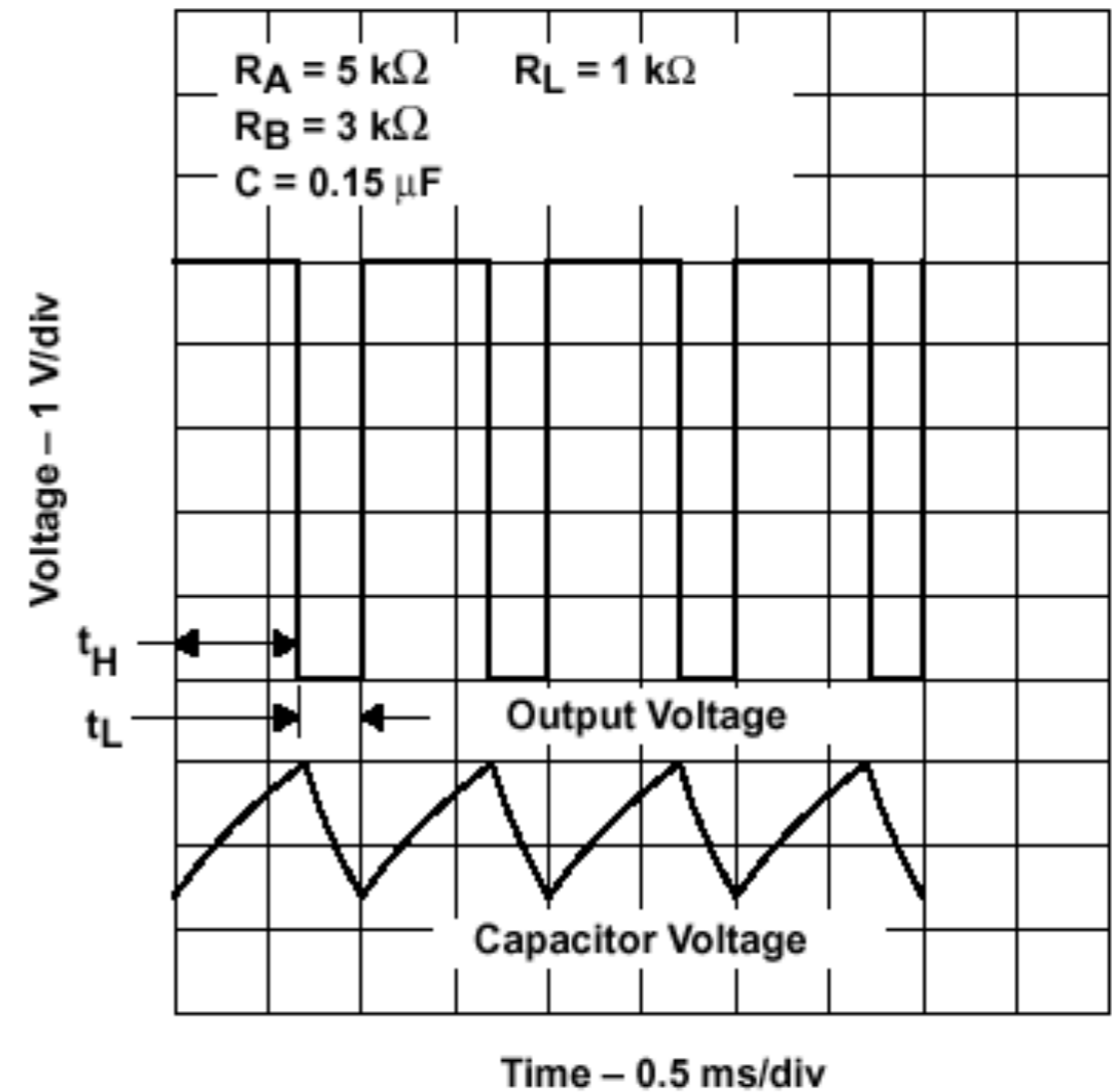
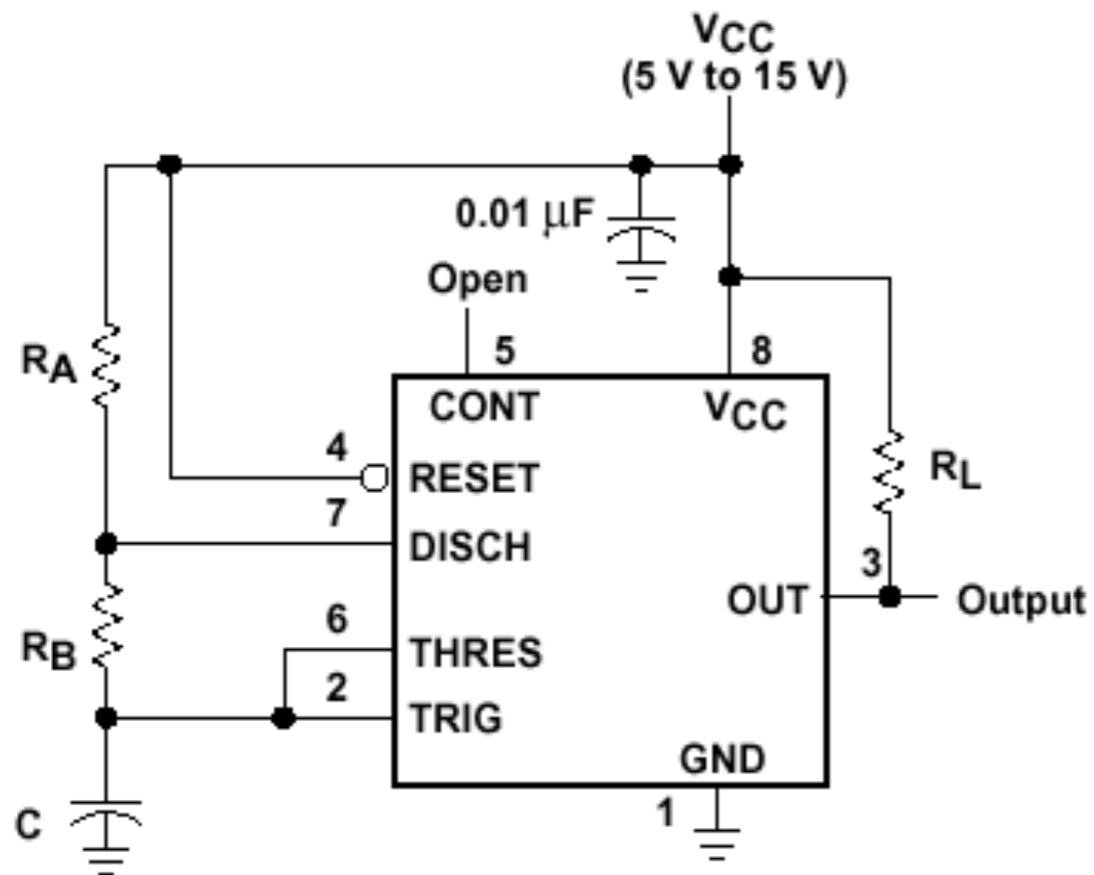
Modulador PWM usando temporizador 555:

$$V_6 > \frac{2}{3} V_{cc}$$

$$V_2 < \frac{1}{3} V_{cc}$$

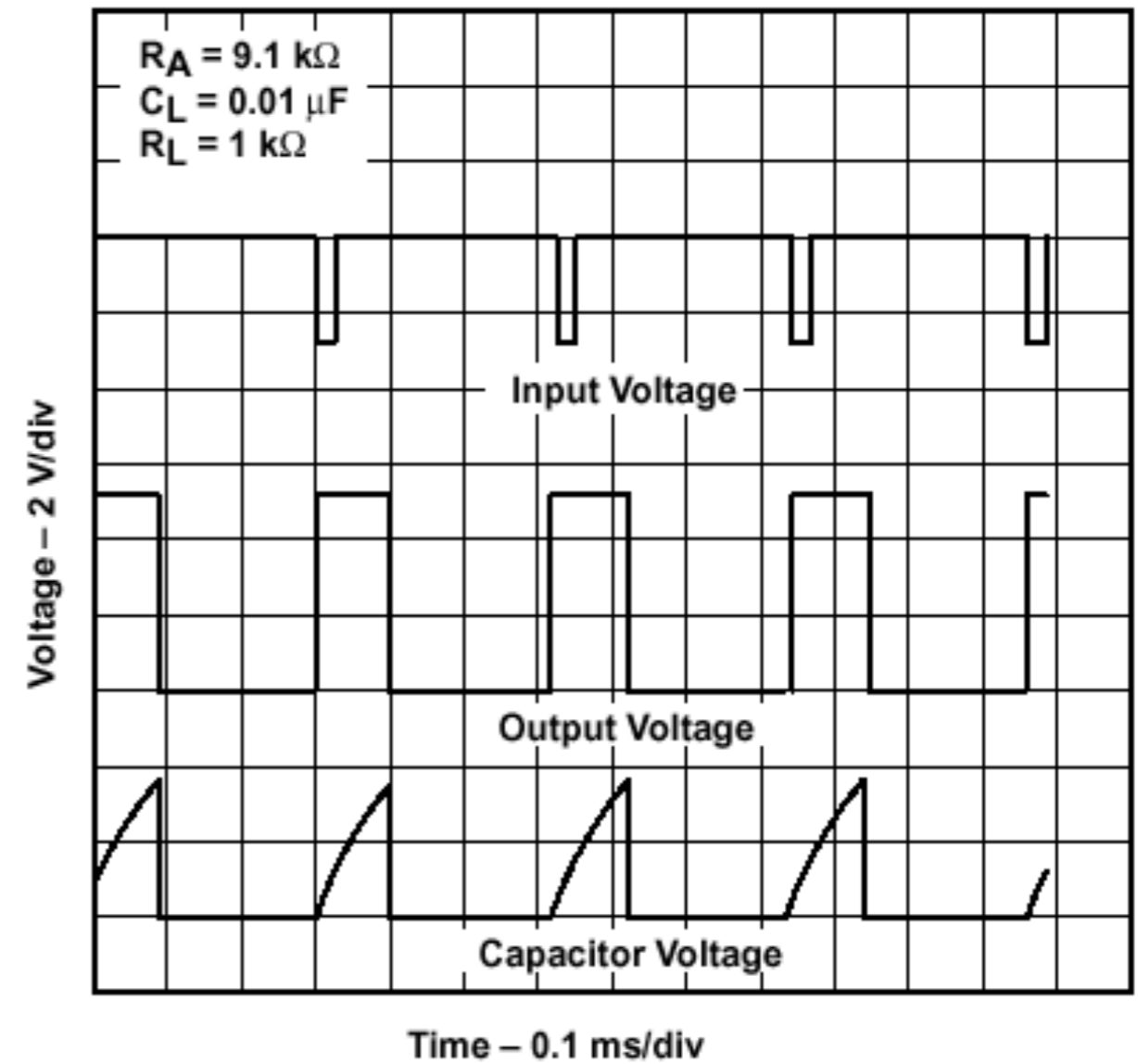
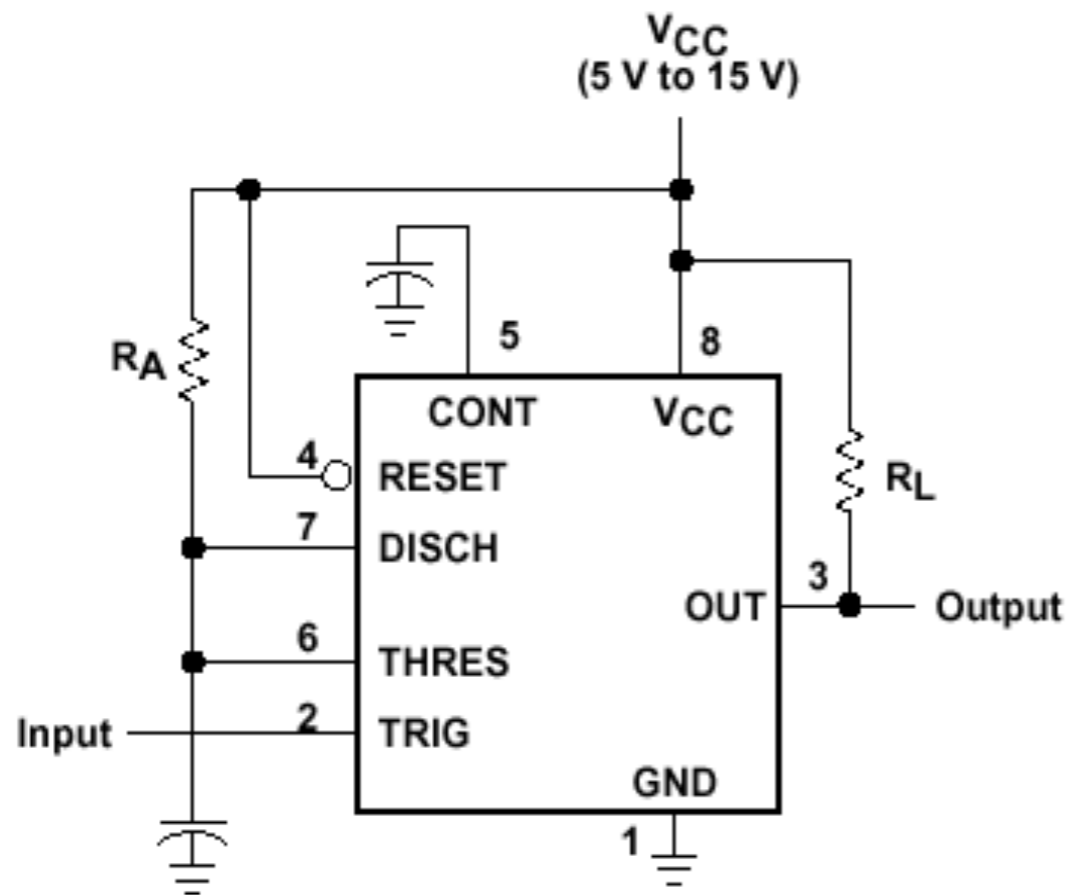


Modulador PWM usando temporizador 555:



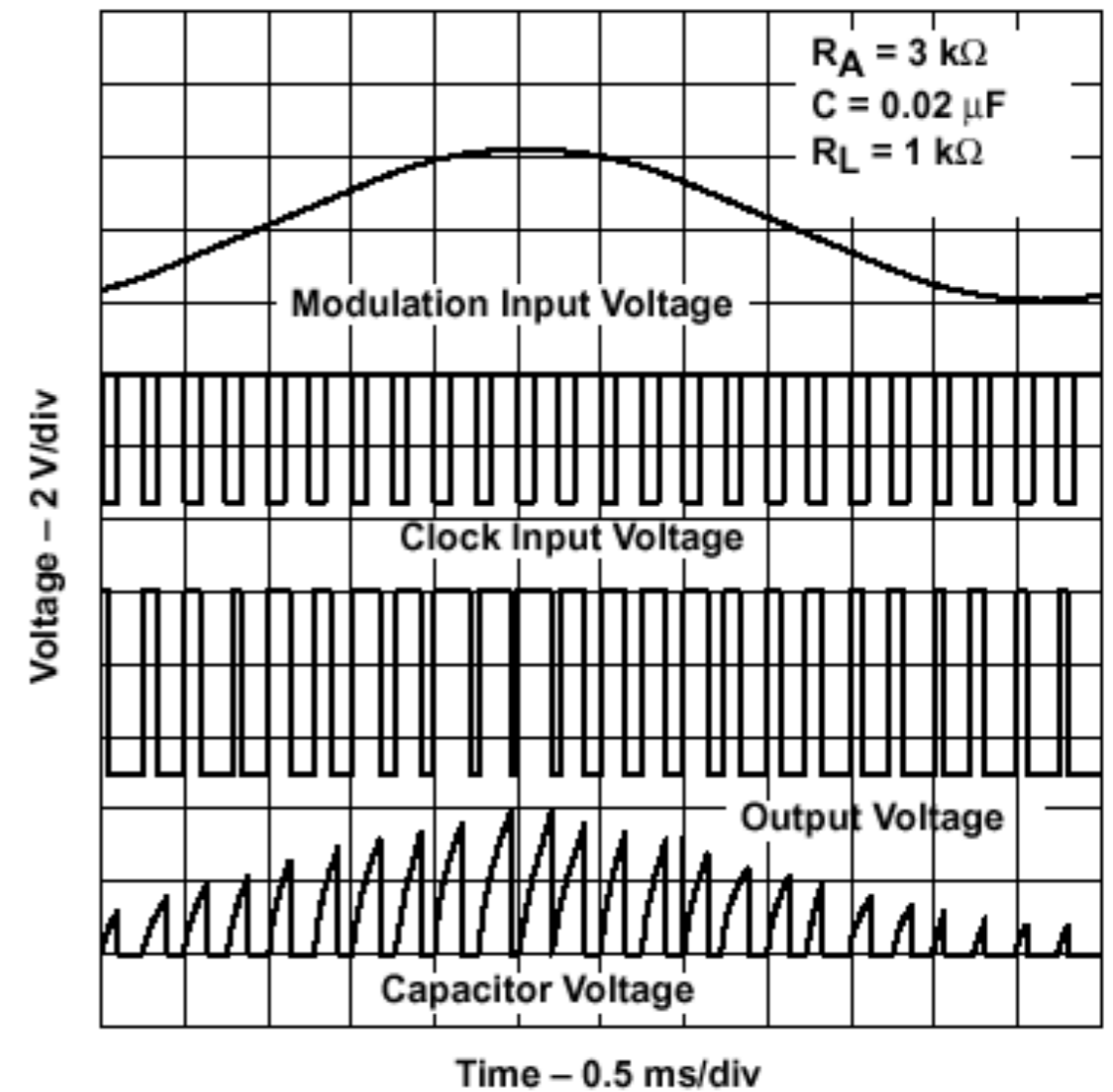
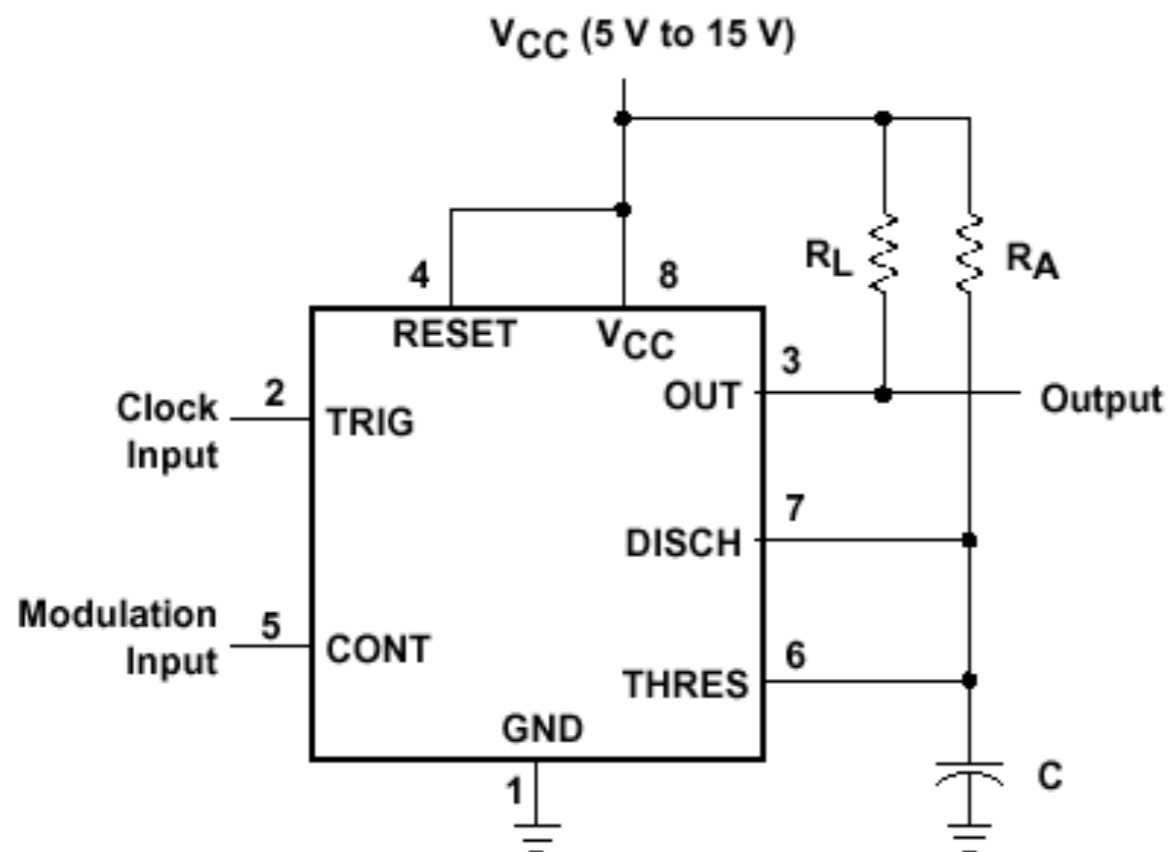
Multivibrador astável

Modulador PWM usando temporizador 555:



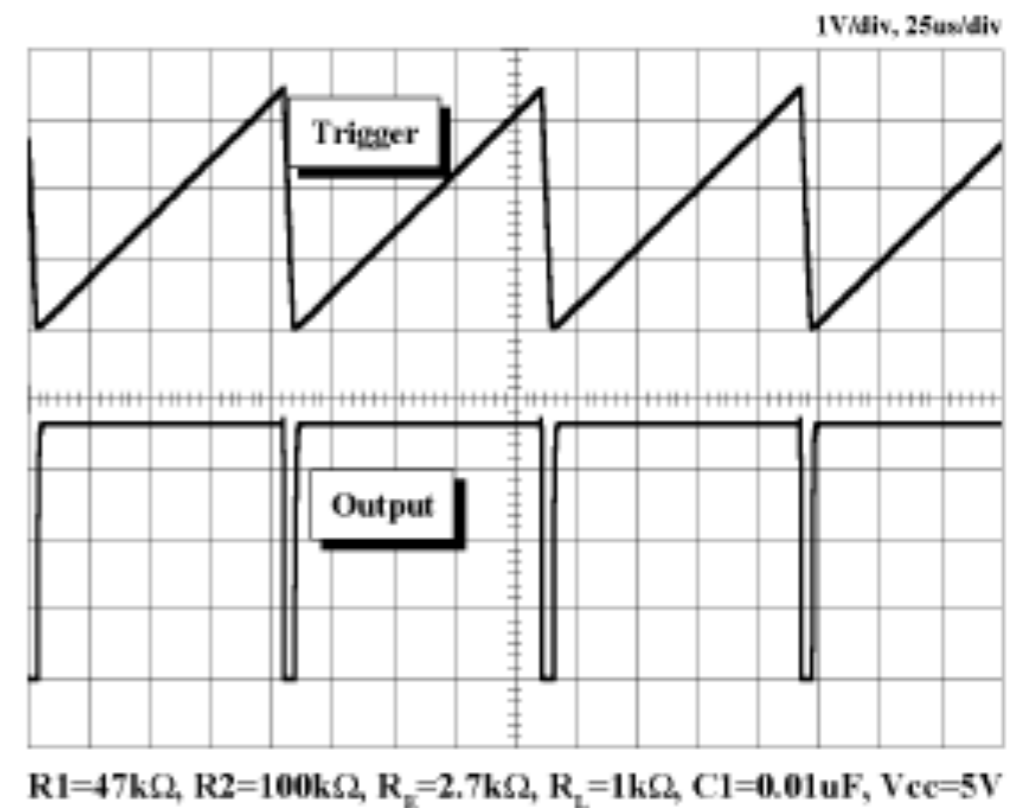
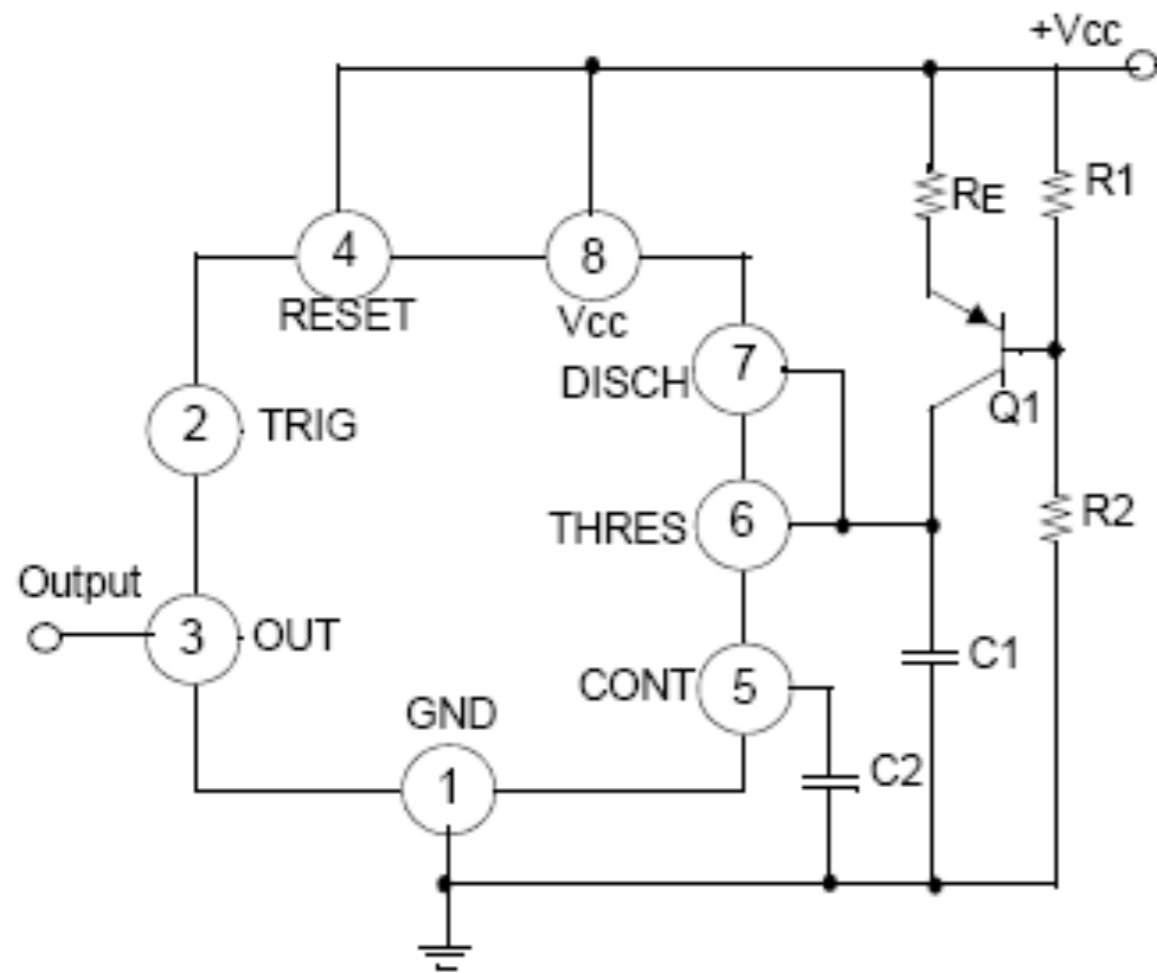
Multivibrador monoestável

Modulador PWM usando temporizador 555:

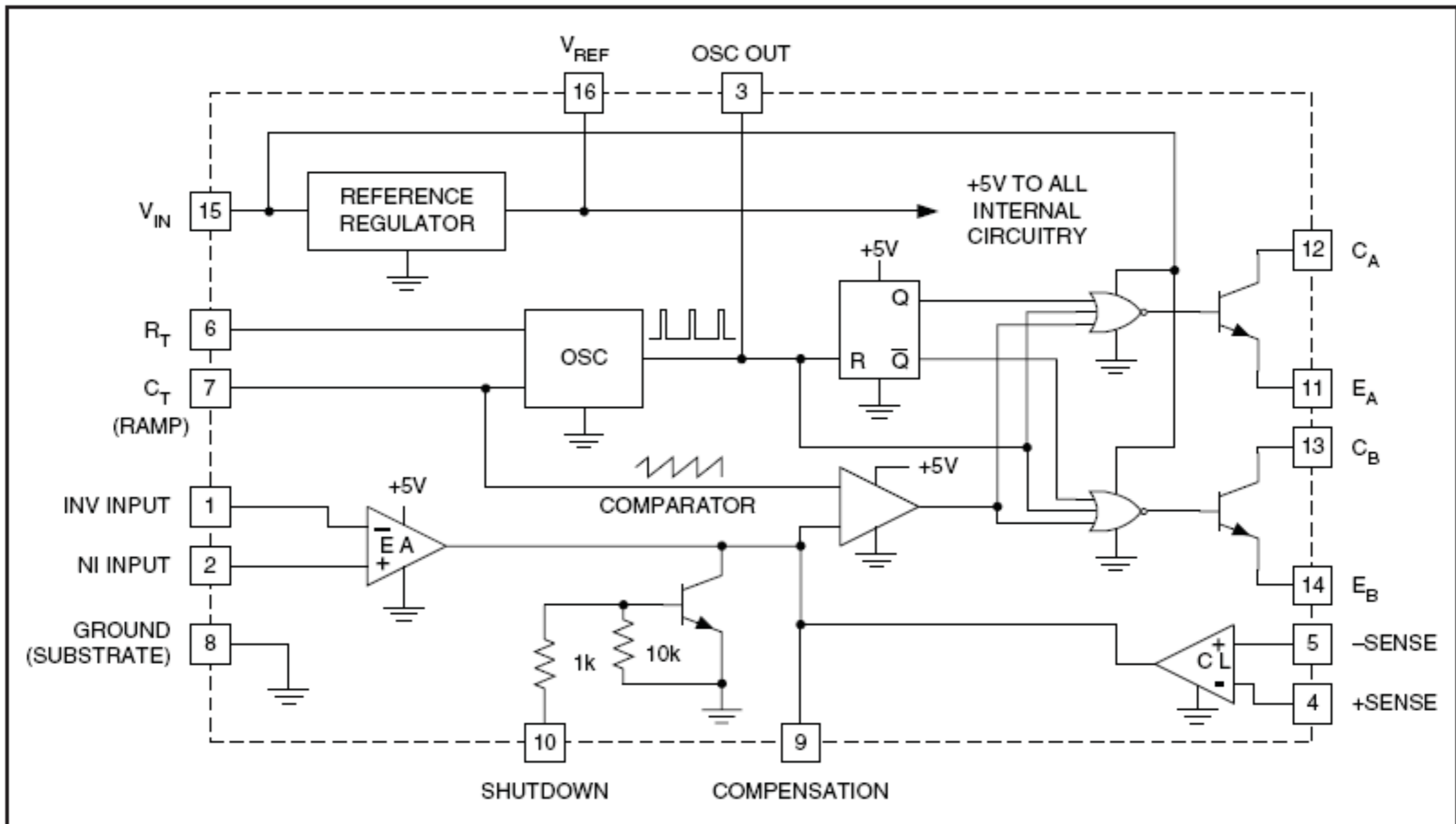


Modulador PWM

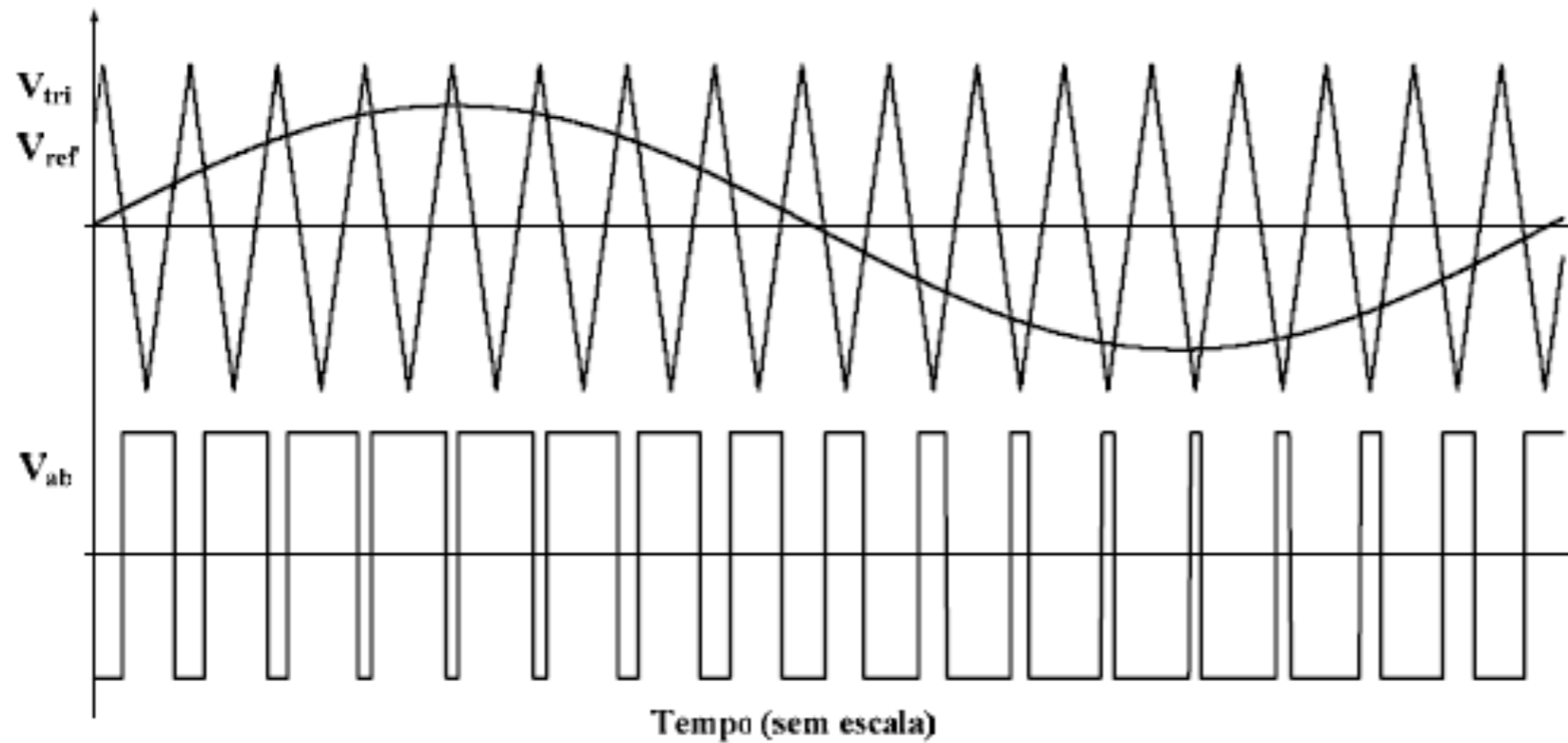
Gerador de rampa usando o temporizador 555:



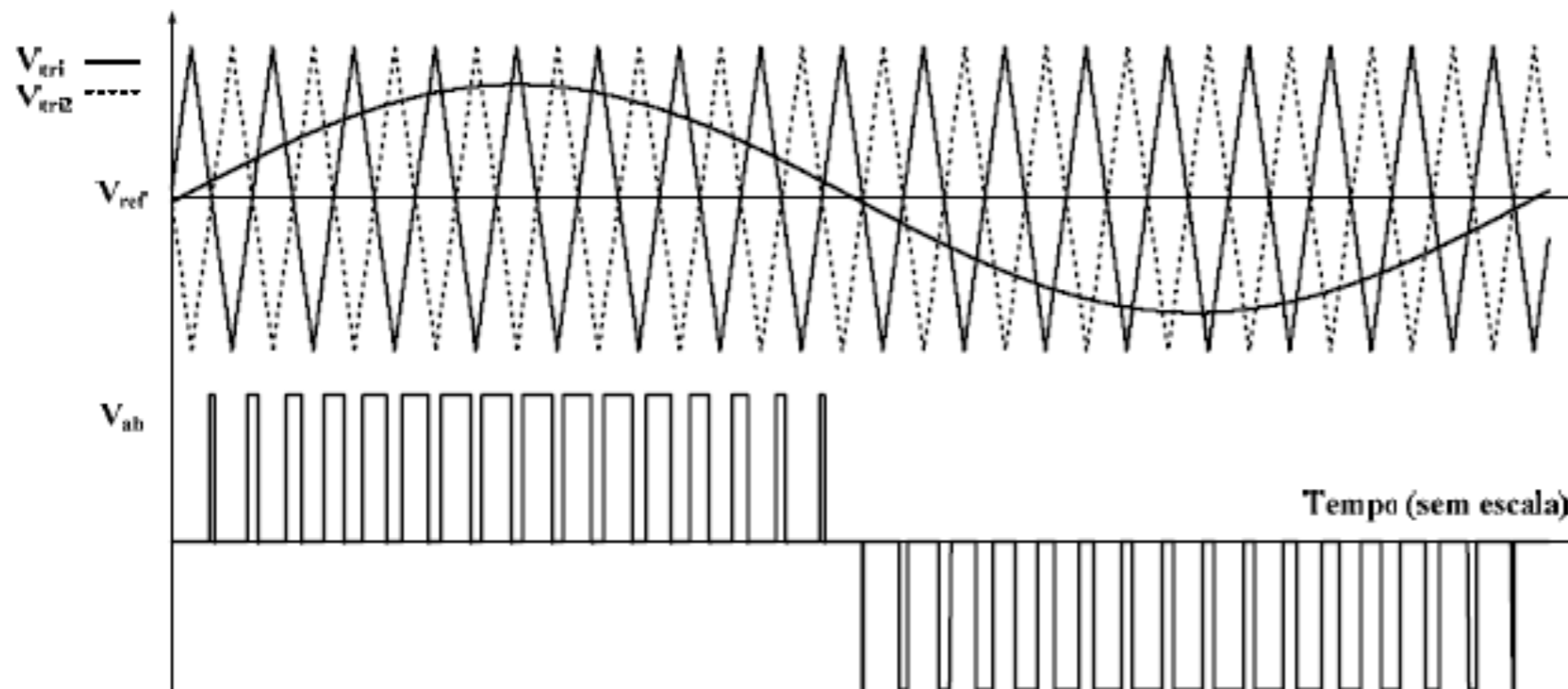
UC3524N:



Modulação PWM Senoidal

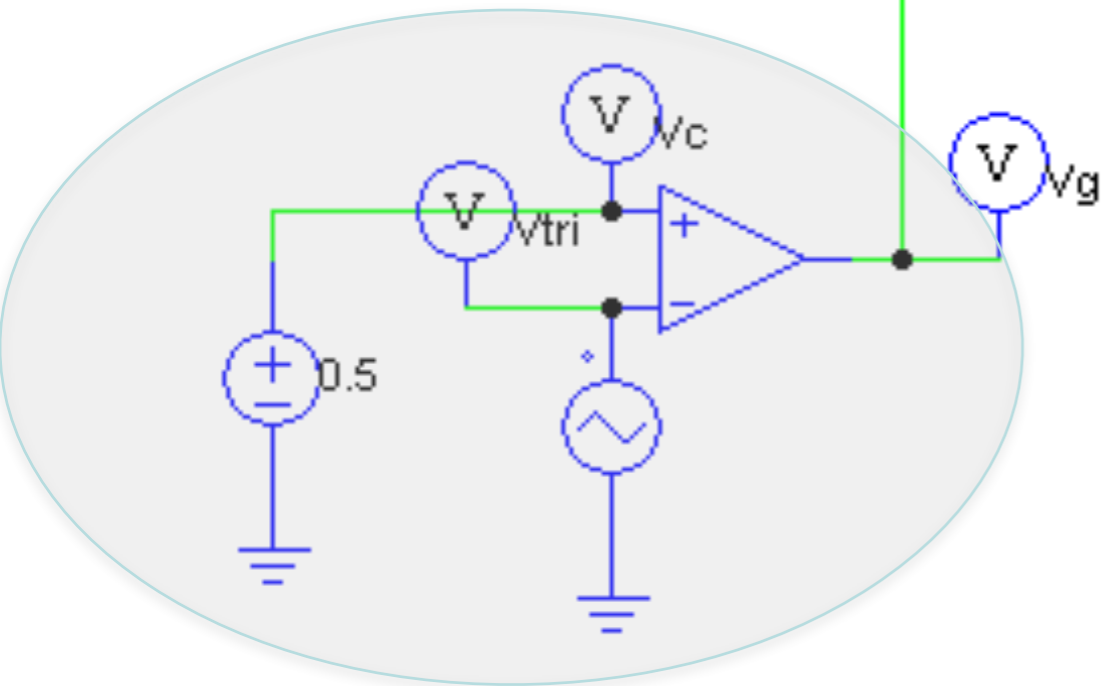
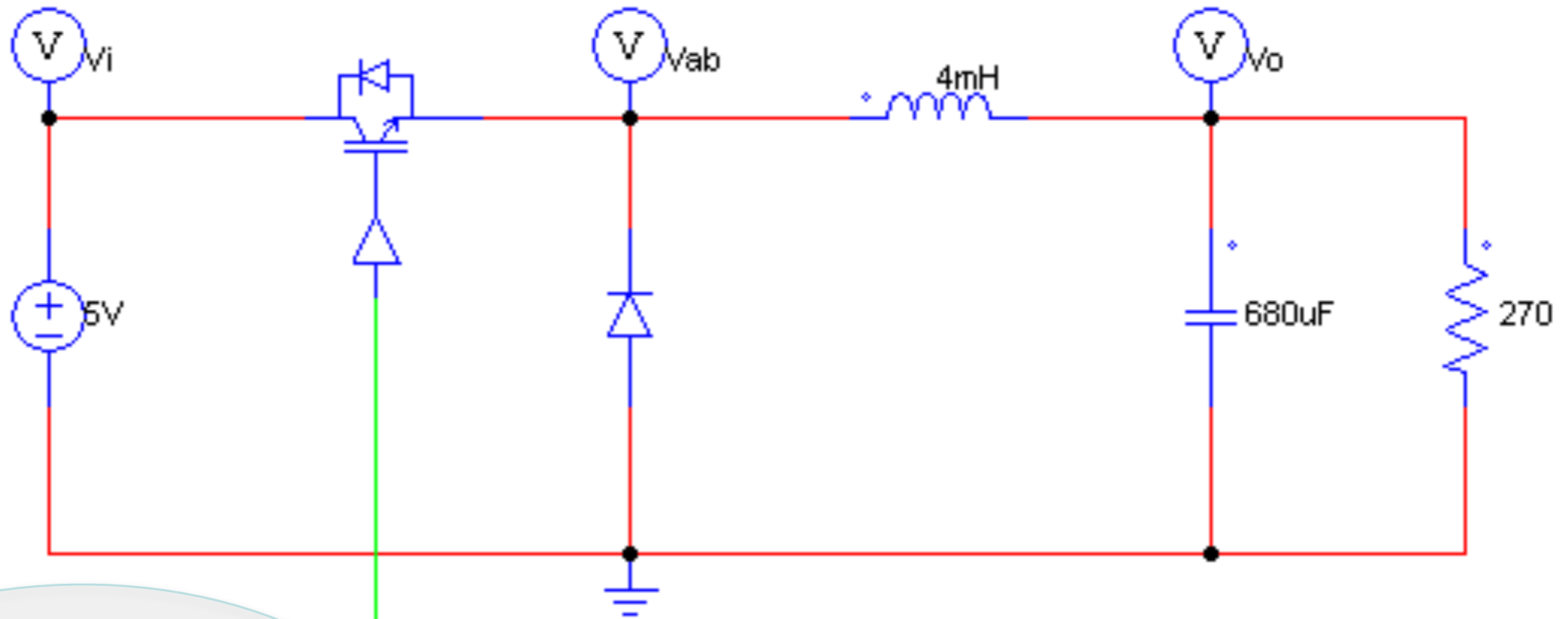


Dois níveis

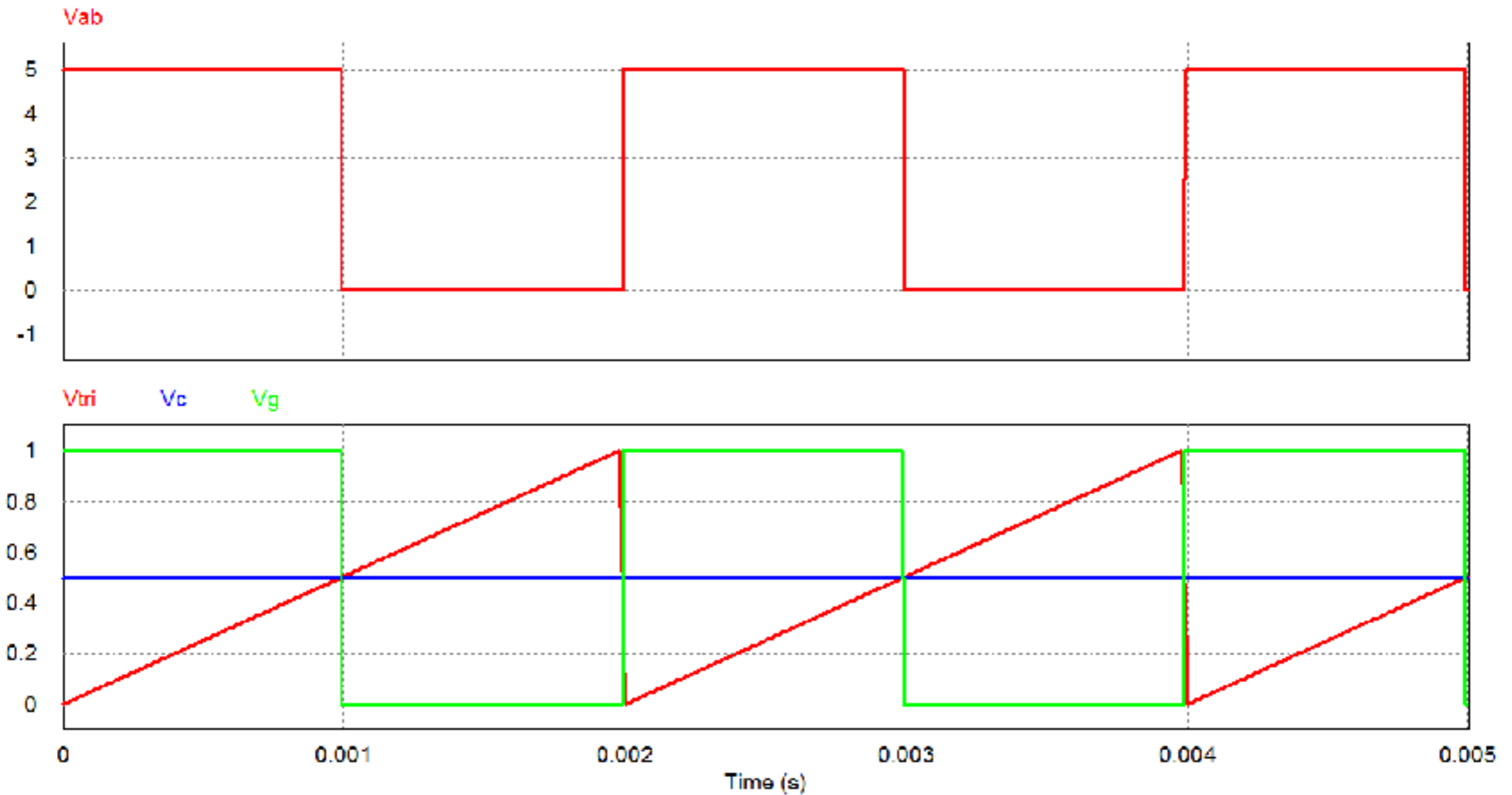


Três níveis

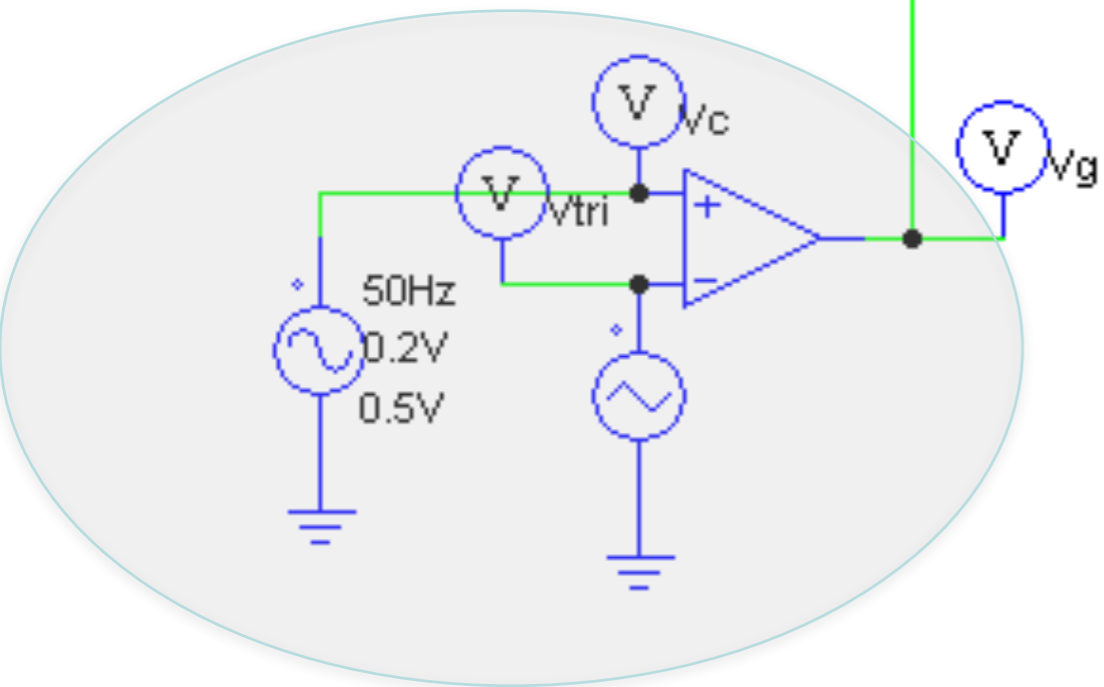
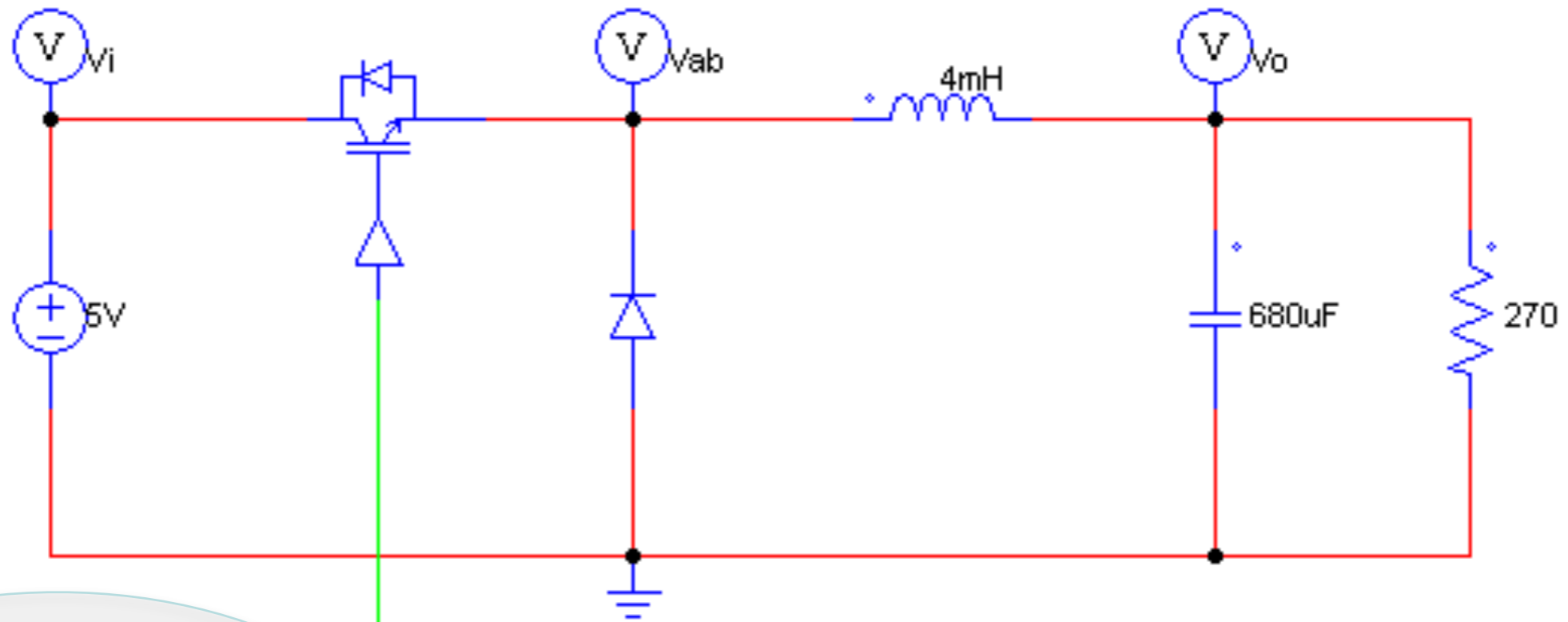
Simulação de um Conversor CC-CC



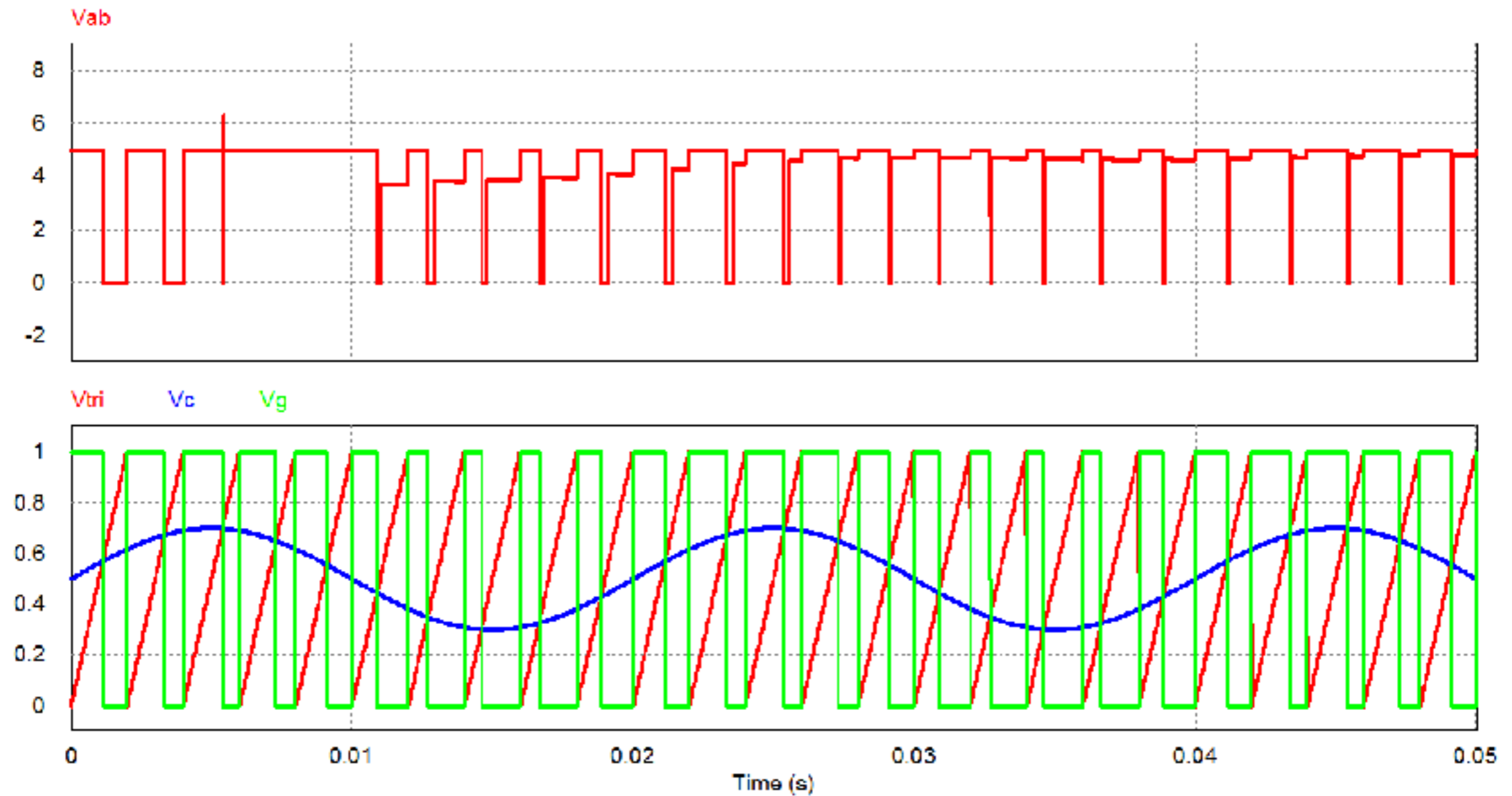
Simulação de um Conversor CC-CC



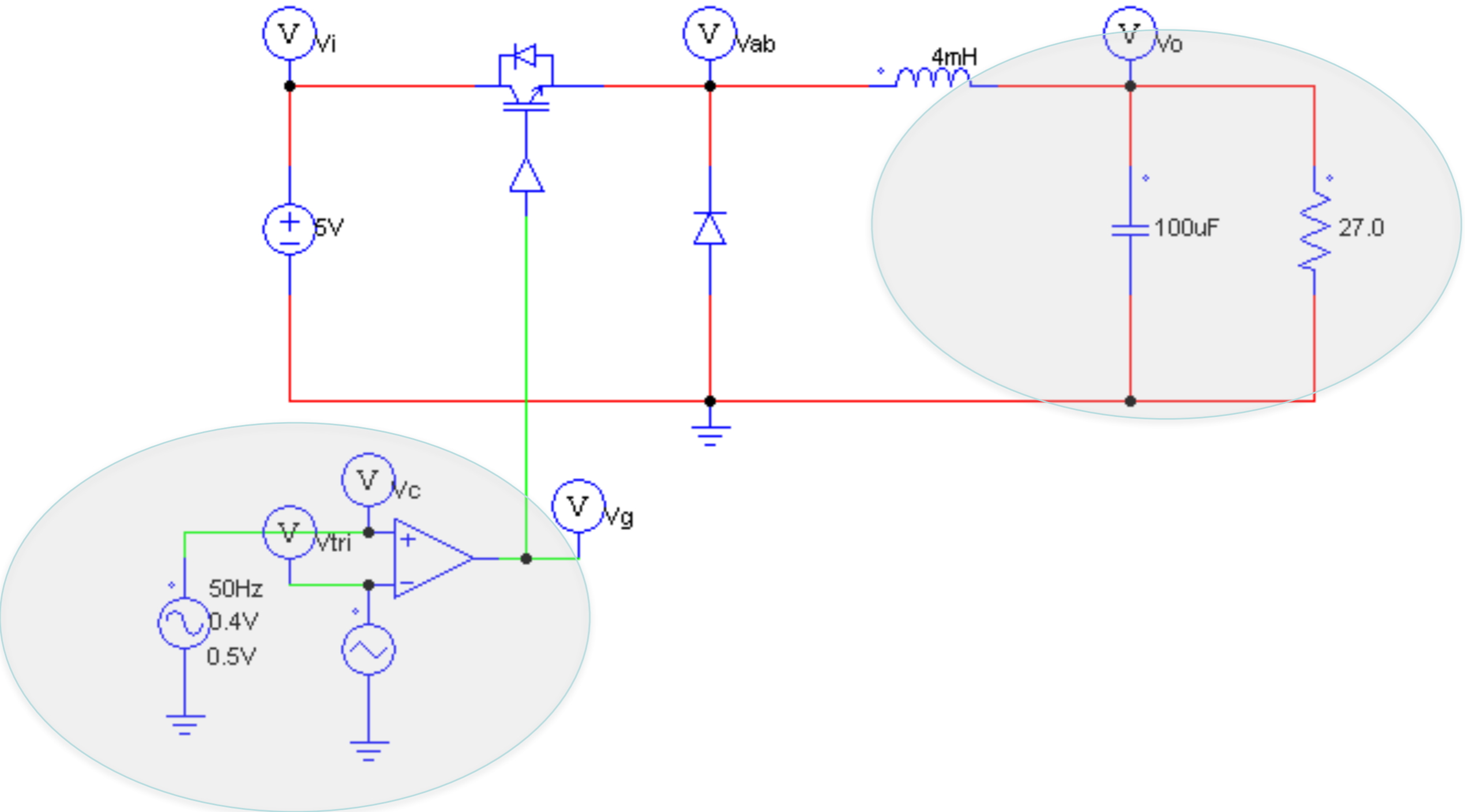
Simulação de um Conversor CC-CA



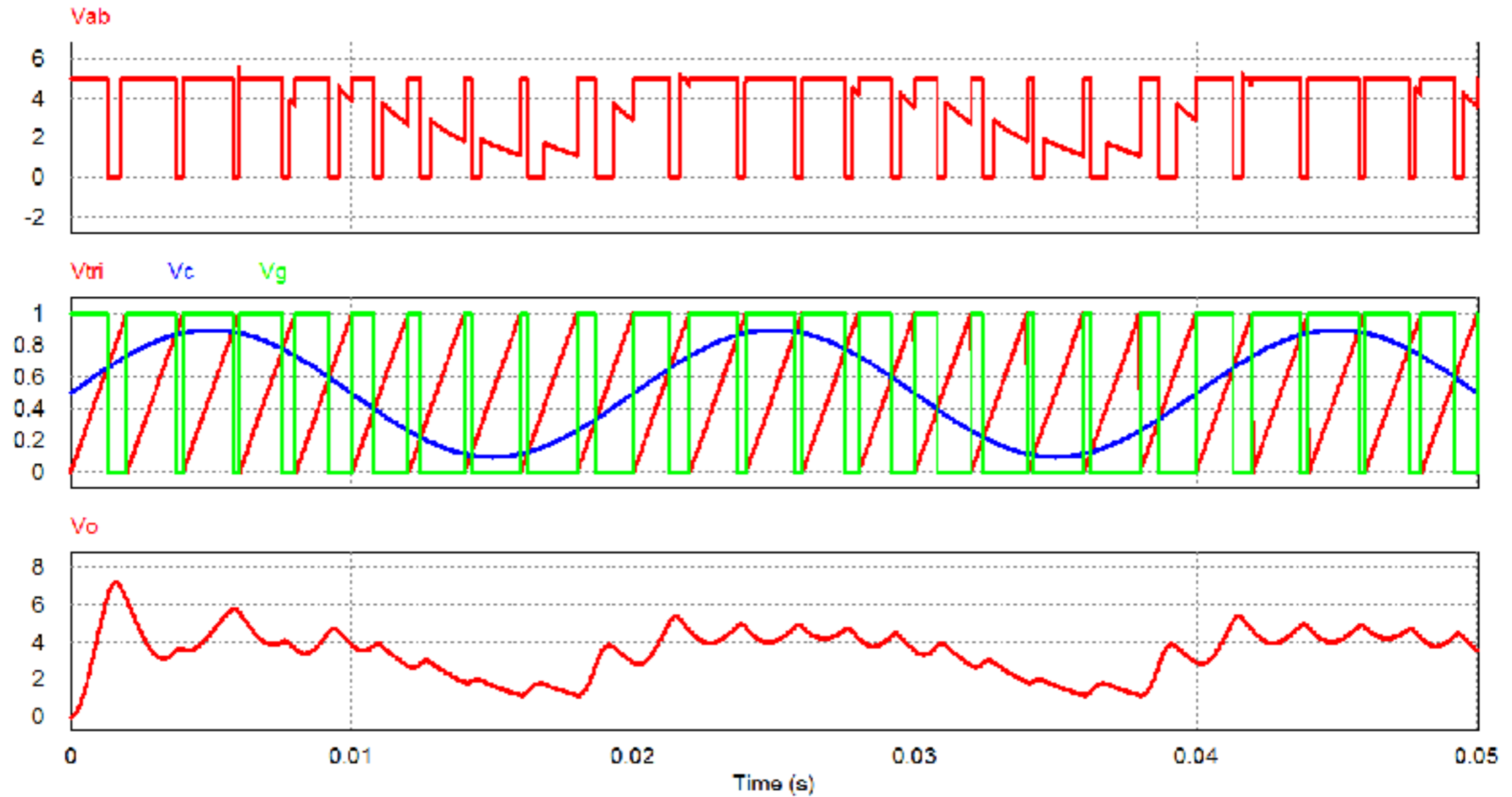
Simulação de um Conversor CC-CA



Simulação de um Conversor CC-CA



Simulação de um Conversor CC-CA



Conversores cc-ca:

- Conversor meia-ponte.

