PLECS

DEMO MODEL

H-Bridge Inverter Circuit

Last updated in PLECS 4.3.1

1 Overview

This demonstration shows a voltage source inverter (VSI) realized with generic switches. The three available output voltage levels are cyclically applied to an RL load.
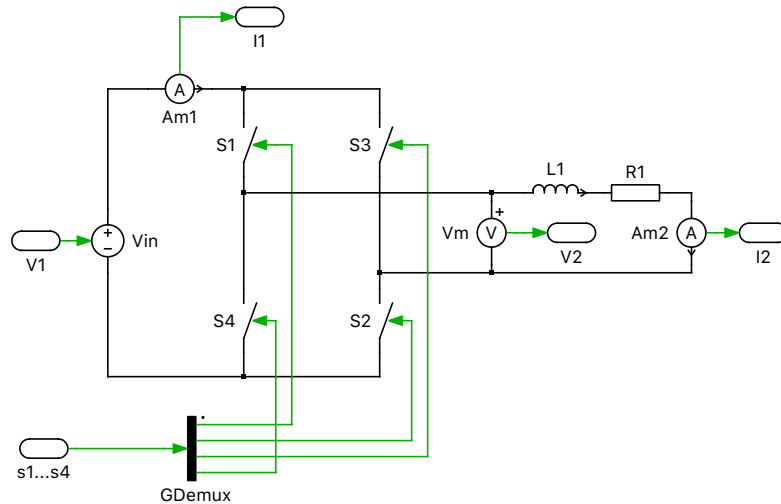

Figure 1: H-bridge inverter

2 Model

One typical use of H-bridge circuits is to convert DC to AC in power supply applications. The control strategy of the H-bridge's two parallel legs with two switches determines how it is used. The input to an H-bridge is a DC voltage source and the output is also a DC voltage, but whose magnitude and polarity can be controlled.

The converter can be used to create a square wave output voltage simply by closing switches S1 and S2 at the same time while keeping S3 and S4 open, and then opening S1 and S2 while closing S3 and S4. If the duty cycle of these switch pairs is both 50% and the pairs are switched at the same time, the pulsed voltage waveform will be a perfect square wave of positive and negative polarity of the input DC voltage. Maintaining the same duty cycle for each switch pair but using a value other than 50% will create a pulse train whose value is not $+V_{\text{dc}}$ for half of the cycle and $-V_{\text{dc}}$ for the other half.

Changing the duty cycle of one or both pairs of switches will create various three-level output waveforms where the output voltage is 0 V for part of a cycle. This can also be achieved by switching S1 and S3 as a pair and S2 and S4 a pair. Typically the switches in the same leg (S1/S4, S2/S3) are not turned on and off at the same time in practice, to avoid a potentially damaging short circuit of the input, also known as "shoot-through". To prevent this from happening, a small waiting period known as "dead time" is used to delay the turn-on of the opposing switches.
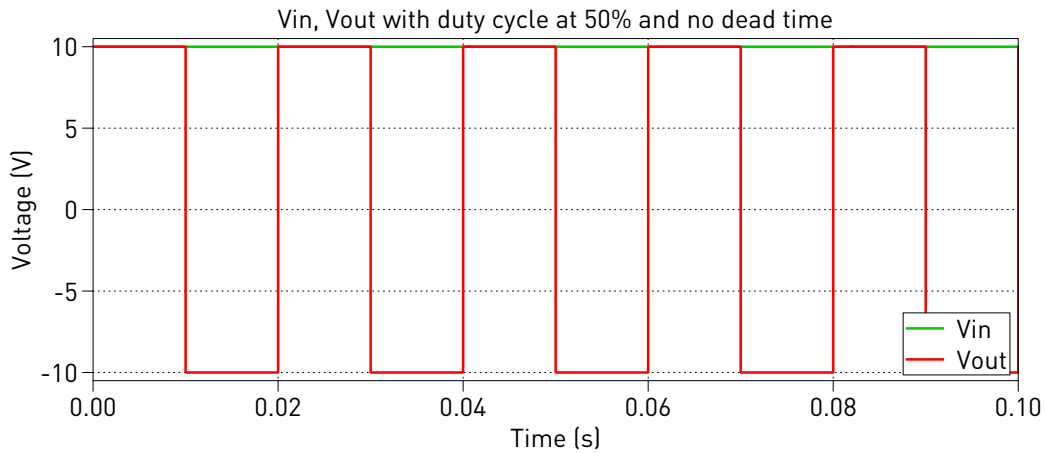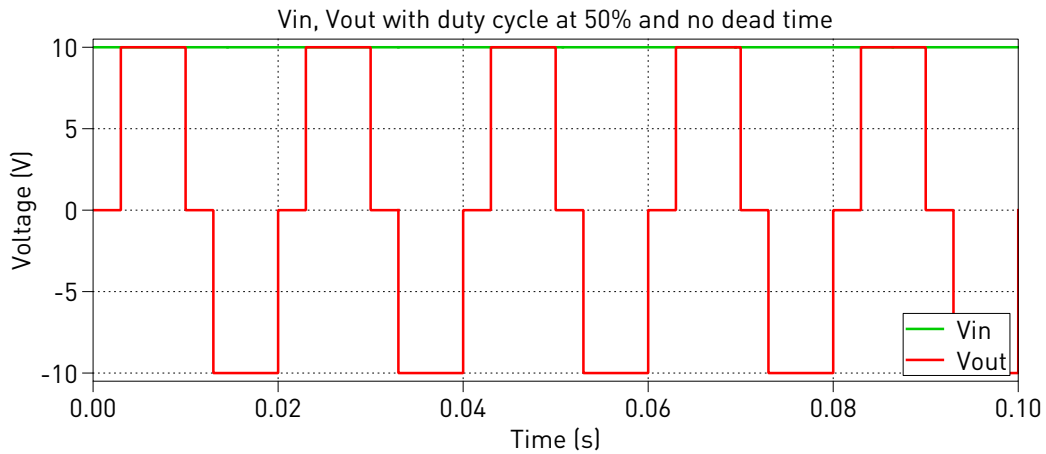
Figure 2: No dead time

Figure 3: Dead time

3 Simulation

Run the simulation with the model as provided to view the signals and verify that the load voltage waveform is a three-level square wave, with 0 V for part of the cycle. Notice that the second Pulse Generator is configured with a phase delay. Removing this creates a perfect square wave output voltage. Change the duty cycle of one or both of the Pulse Generator blocks and observe the output waveforms. Also try removing the resistor and see that the output current waveform is triangular since the voltage is applied to a purely inductive load. Output filtering can also be added to create a sinusoidal AC output voltage from a square wave pulse train.

Revision History:

PLECS 4.3.1   First release

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