

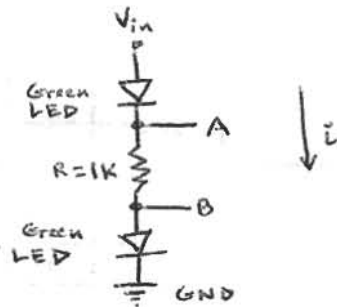
Assumptions

- (1) Red LED —  $V_F = 1.5\text{ V}$
- Green LED —  $V_F = 2.0\text{ V}$  } Ideal
- (2) Kirchhoff's Laws
- (3) No current flow (or open circuit) below  $V_F$  for each LED
- (4) Positive current flow from high to low voltage

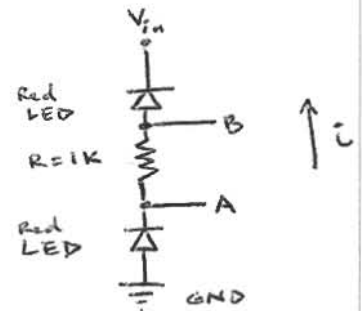
Analysis

Given assumptions above, treat given circuit as two independent circuits:

For  $V_{in} > 0$



For  $V_{in} < 0$



Write Kirchhoff's Voltage Law in direction of current flow

$$V_{in} - V_A = 2\text{ V}$$

$$V_B - \text{GND} = 2\text{ V}$$

$$\rightarrow V_B = 2\text{ V}$$

$$V_A = V_{in} - 2\text{ V}$$

$$\boxed{V_A - V_B = V_{in} - 4\text{ V}}$$

$$\text{GND} - V_A = 1.5\text{ V}$$

$$V_B - V_{in} = 1.5\text{ V}$$

$$\rightarrow V_A = -1.5\text{ V}$$

$$V_B = 1.5\text{ V} + V_{in}$$

$$\boxed{V_A - V_B = -V_{in} - 3\text{ V}}$$

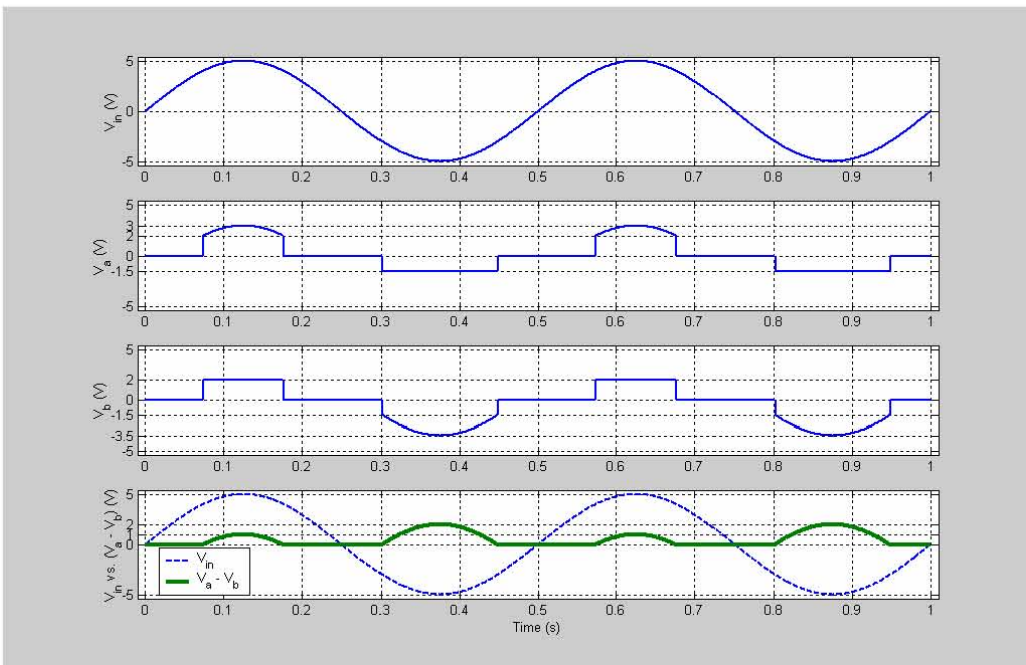
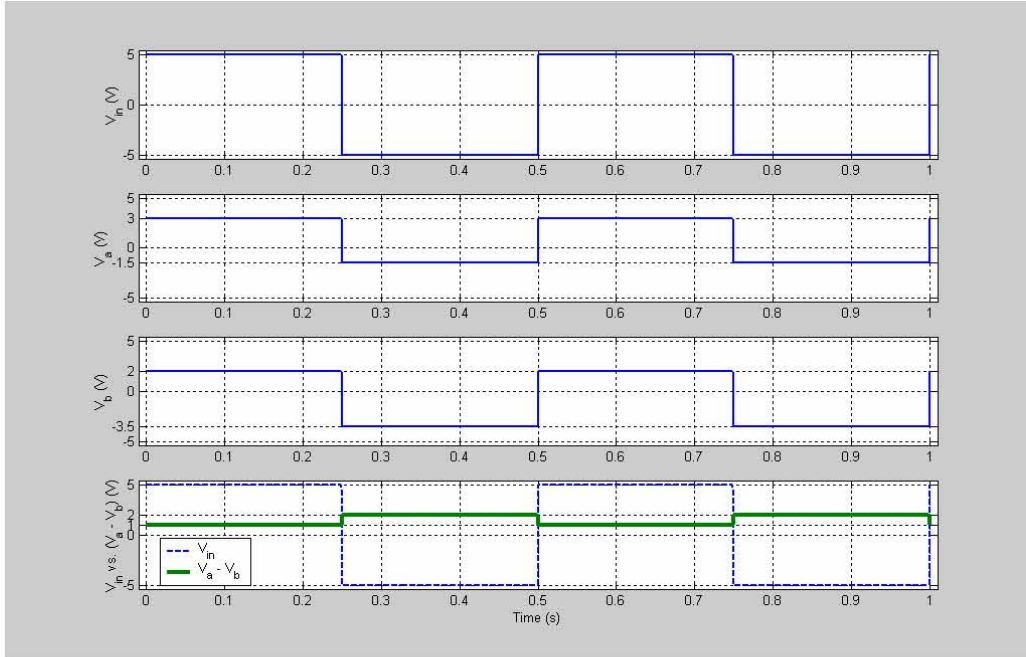
These equations are valid only when the supply voltage  $V_{in}$  is greater than the minimum voltage drop across the LEDs

$$\underline{|V_{in}| \geq 2V_F} \text{ independently for the Green \& Red LEDs}$$

with respect to a common ground reference, or else the circuit behaves like an open circuit.

\* See reverse for sketches 1-5

**Sketches of 2 cycles +/- 5 V square and sine wave forms applied to a simple bridge rectifier with green LEDs ( $V_F = 2.0\text{ V}$ ) and red LEDs ( $V_F = 1.5\text{ V}$ ) and measuring voltages at end points (A and B) of the resistor bridge.**



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