

## Solution Information

### 1. LDR

Section 1: 3.6V at high light and 8V at low light; 5.5k and 66k

Section 2: 2.4V at high light and 7.5V at low light; 3k and 42k

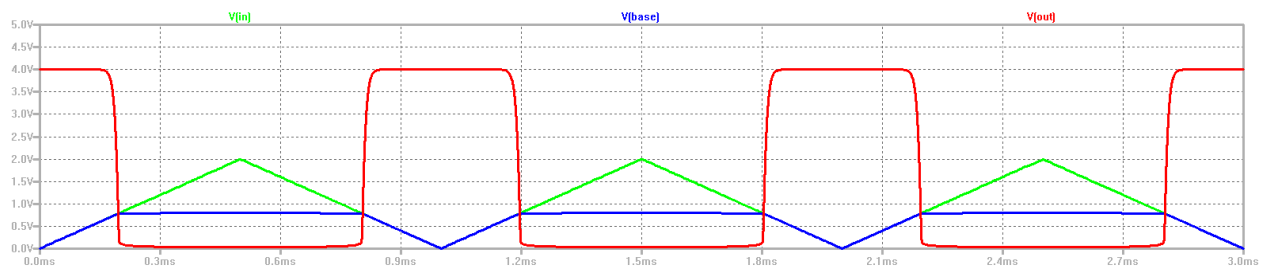
### 2. Phase

Section 1:  $f = 400\text{Hz}$ , Phase =  $180$  or  $\pi$  ( $\pm$ ), Ampl = 1.5, Phasor  $\tilde{U} = 1.5e^{j\pi} = -1.5$

Section 2:  $f = 250\text{Hz}$ , Phase =  $90$  or  $\pi/2$ , Ampl = 1, Phasor  $\tilde{U} = 1e^{j\pi/2}$

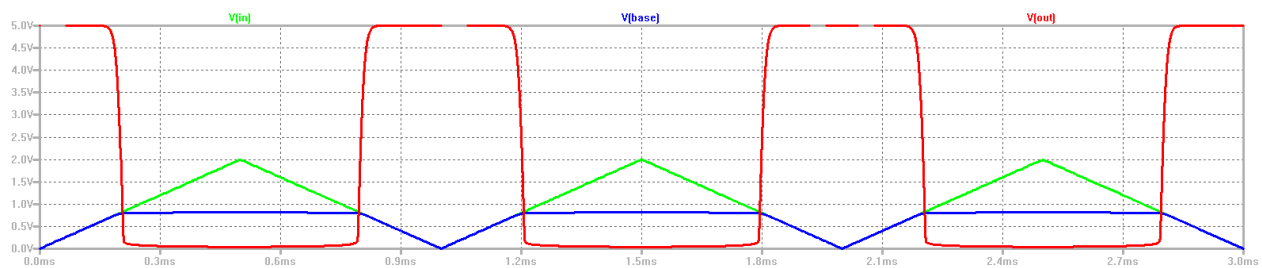
### 3. Transistor as switch:

Section 1:  $R_1 = 5\text{k}$ ,  $R_2 = 10\text{k}$



ON is 0V, OFF is  $4\text{V} = 6(10/15)$ , ON more than half of the time, Red is output across  $R_2$ , Blue is Base

Section 2:  $R_1 = 2\text{k}$ ,  $R_2 = 10\text{k}$



ON is 0V, OFF is  $5\text{V} = 6(10/12)$ , ON more than half of the time, Red is output across  $R_2$ , Blue is Base

#### 4. Filters

Section 1: High Pass, R and  $j\omega L$ ,  $V_{out} = V_{in} (Z_2 / (Z_1 + Z_2))$ ,  $H(j\omega) = \frac{\tilde{V}_{OUT}}{\tilde{V}_{IN}} = \frac{j\omega L}{R + j\omega L}$ ,  $\omega = 2\pi f =$

$$108.8k, \omega L = (108.8)(15.9) = 1730, H(j\omega) = \frac{\tilde{V}_{OUT}}{\tilde{V}_{IN}} = \frac{j\omega L}{R + j\omega L} = \frac{j1730}{1000 + j1730} = \frac{j1.73}{1 + j1.73},$$

$$H(j\omega) = \frac{j1.73}{1 + j1.73} \frac{1 - j1.73}{1 - j1.73} = .75 + j.43 = .86 \exp(j\pi/6), \text{ phase} = 30 \text{ degrees},$$

$$\tilde{V}_{IN} = 2, \tilde{V}_{OUT} = 1.72e^{j\pi/6}, V_{OUT}(t) = 1.72 \cos(34620\pi t + \pi/6)$$

Section 2: Low Pass, R and  $j\omega L$ ,  $V_{out} = V_{in} (Z_2 / (Z_1 + Z_2))$ ,  $H(j\omega) = \frac{\tilde{V}_{OUT}}{\tilde{V}_{IN}} = \frac{R}{R + j\omega L}$ ,  $\omega = 2\pi f =$

$$108.8k, \omega L = (108.8)(15.9) = 1730, H(j\omega) = \frac{\tilde{V}_{OUT}}{\tilde{V}_{IN}} = \frac{R}{R + j\omega L} = \frac{1000}{1000 + j1730} = \frac{1}{1 + j1.73},$$

$$H(j\omega) = \frac{1}{1 + j1.73} \frac{1 - j1.73}{1 - j1.73} = .25 - j.43 = .5 \exp(-j\pi/3), \text{ phase} = -60 \text{ degrees},$$

$$\tilde{V}_{IN} = 2, \tilde{V}_{OUT} = 1e^{-j\pi/3}, V_{OUT}(t) = 1 \cos(34620\pi t - \pi/3)$$

#### 5. Damped Harmonic Oscillator

Section 1:  $\alpha = 69.3$ ,  $f = 300\text{Hz}$ ,  $\omega = 1885$ ,  $A = 4$

Section 2:  $\alpha = 45.8$ ,  $f = 250\text{Hz}$ ,  $\omega = 1885$ ,  $A = 5$

#### 6. Diode

Section 1: ON, .6 or .7,  $(5-.7)/300 = 14.3\text{mA}$ , OFF, 5, 0mA

Section 2: ON, .6 or .7,  $(6-.7)/500 = 10.6\text{mA}$ , OFF, 6, 0mA