

Lab 4: Wave-shaping Circuits

1 Pre Lab

1.1 P1

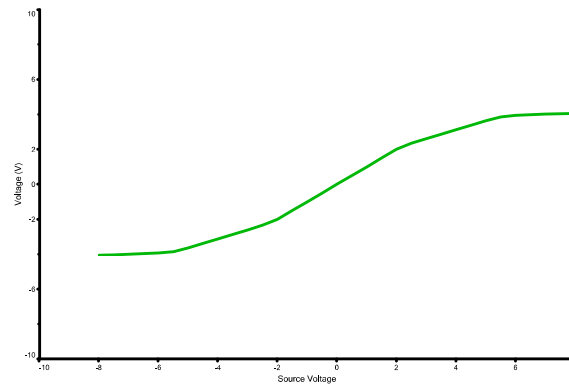


Figure 1: Graph P1. Input-output transfer characteristic of Wave Shaping Circuit

1.2 P2

$$\begin{array}{l}
 \begin{array}{c}
 V_{in}=8 \\
 \text{---} R_1 \text{---} \\
 \downarrow I \\
 \begin{array}{cc}
 \downarrow I_1 & \downarrow I_2 \\
 \cdot 7 & \cdot 7 \\
 \downarrow D_1 & \downarrow D_2 \\
 \downarrow & \downarrow \\
 3.3 & 1.67 \\
 \Omega & \Omega
 \end{array}
 \end{array}
 \quad V_o=4
 \end{array}$$

$$\begin{array}{l}
 4 = 0.7 + I_2 R_2 + 1.67 \\
 R_2 = \frac{4 - 0.7 - 1.67}{I_2} \\
 I_2 \geq 0.5 \text{ mA} \\
 \Rightarrow R_2 \leq 3.3 \text{ K}\Omega \\
 \text{From P}_1 \\
 \frac{R_2}{R_1 + R_2} = 0.5 \\
 \Rightarrow R_1 = R_2 \\
 \text{Selecting both equal} \\
 \text{to } 3.3 \text{ K}\Omega
 \end{array}$$

$$\begin{array}{l}
 I = \frac{8 - 4}{R_1} \\
 = \frac{4}{3.3 \text{ K}} \\
 = 1.2 \text{ mA} \\
 I_1 = I - I_2 \\
 = 0.7 \text{ mA} \\
 > 0.5 \text{ mA} \\
 \text{Meet all the} \\
 \text{requirements}
 \end{array}$$

1.3 P3

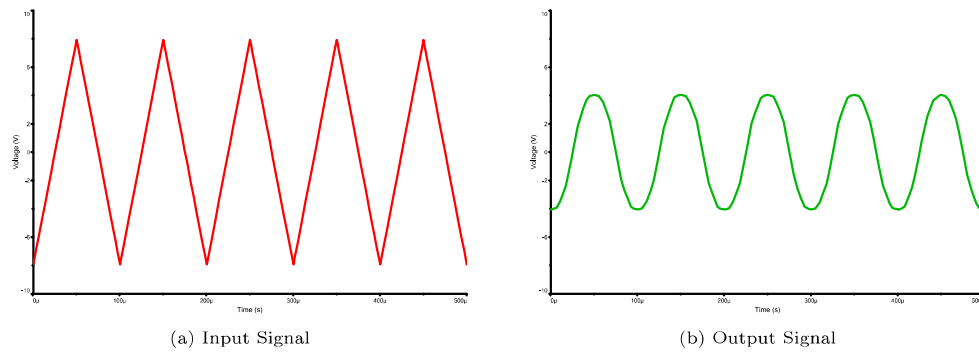


Figure 2: Graph P3(a). Input and output voltage waveforms.

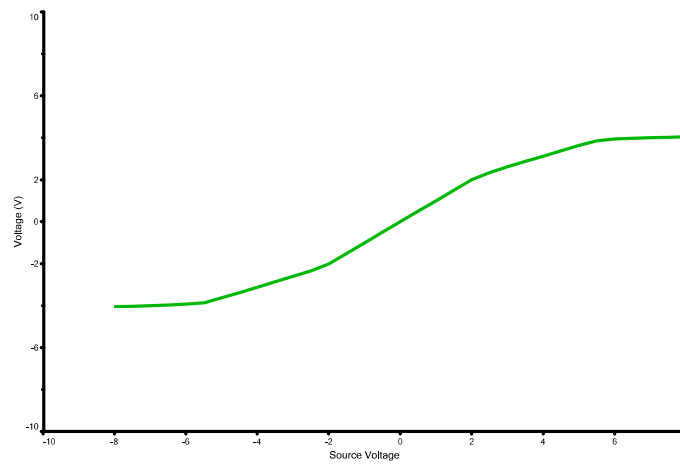


Figure 3: Graph P3(b). Input-output transfer characteristic.

1.4 P4

Let $I = 20\text{mA}$ (Midpoint of 15mA & 25mA)

$$R_3 = \frac{12 - 3.3}{I} = 435\Omega$$

Closest Value in Lab Kit is $\boxed{470\Omega}$

$$R_4 = R_5 = \frac{1.67}{I} = 83.5\Omega$$

Closest Value in Lab Kit is $\boxed{91\Omega}$

1.5 P5

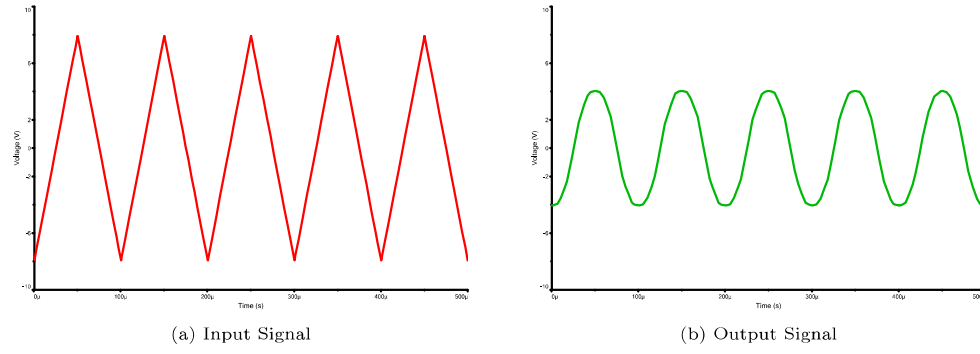


Figure 4: Graph P5(a). Input and output voltage waveforms.

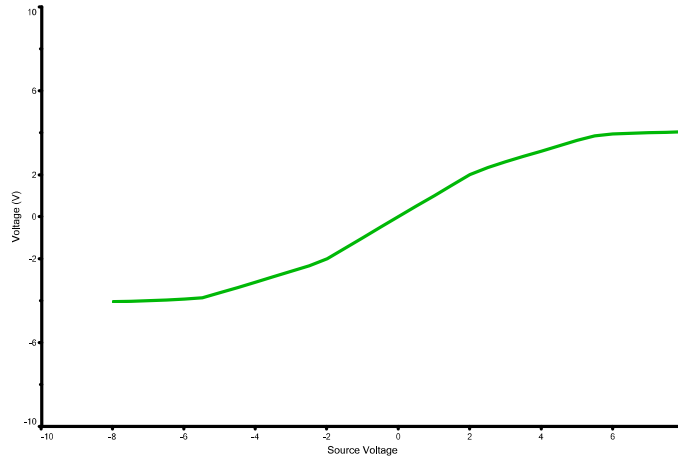


Figure 5: Graph P5(b). Input-output transfer characteristic.

1.6 P6

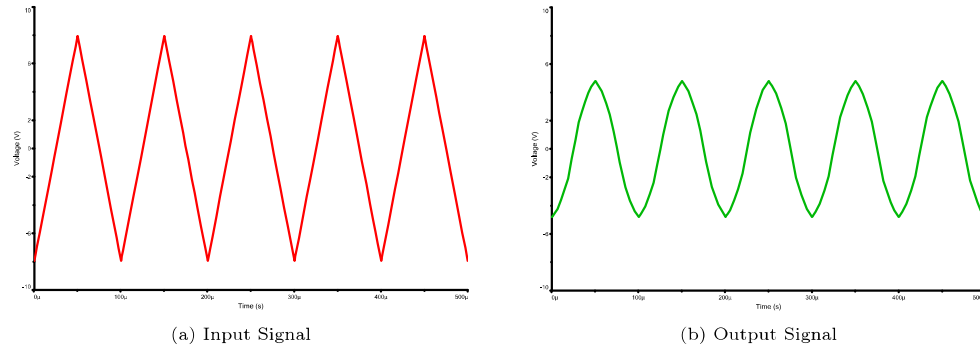


Figure 6: Graph P6(a). Input and output voltage waveforms.

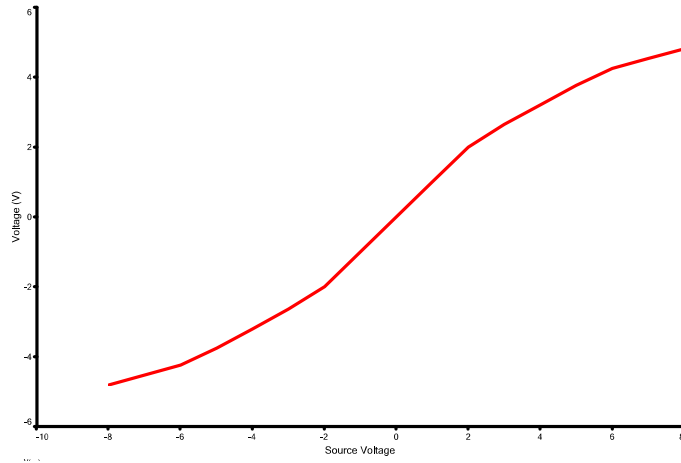


Figure 7: Graph P6(b). Input-output transfer characteristic.

1.7 P7

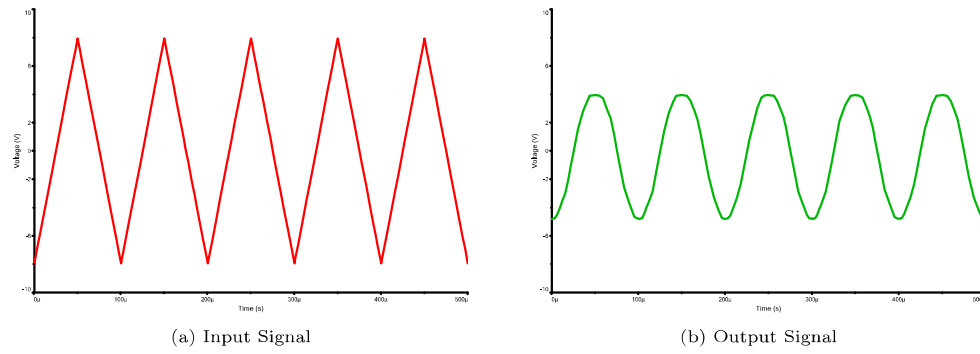


Figure 8: Graph P7(a). Input and output voltage waveforms.

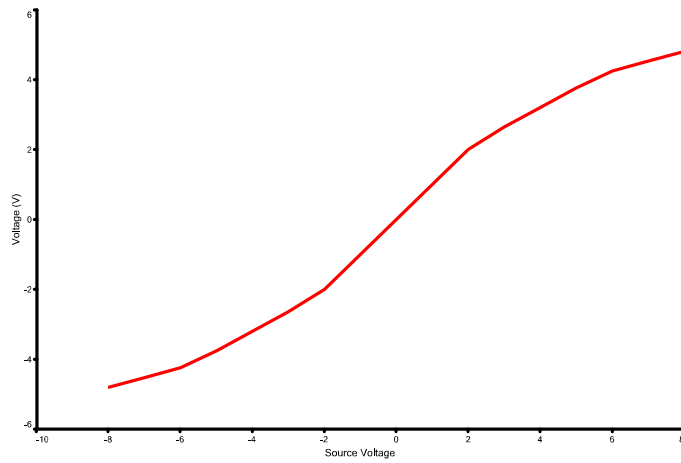


Figure 9: Graph P7(b). Input-output transfer characteristic.