# LAB 4

## CIRCUIT TECHNOLOGY

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## 1. Harmonic Shapers

Diode-based harmonic shaper circuit is used to convert a triangular input wave into a sine wave. A triangular wave can be obtained by integrating a rectangular (square) multi-vibrator signal

## 2. Optimal Oscilloscope Settings (Question 3)

The goal was to visually find optimal setting for potentiometers R10 and R11 using an oscilloscope. The function generator was set up to output a triangular wave with a frequency of 1000 Hz and an amplitude of 3V. By monitoring the signal on the oscilloscope, the potentiometers were adjusted simultaneously to shape the sharp triangular wave into a smooth sine wave. The optimal setting for both R10 and R11 was found to be **80%**.

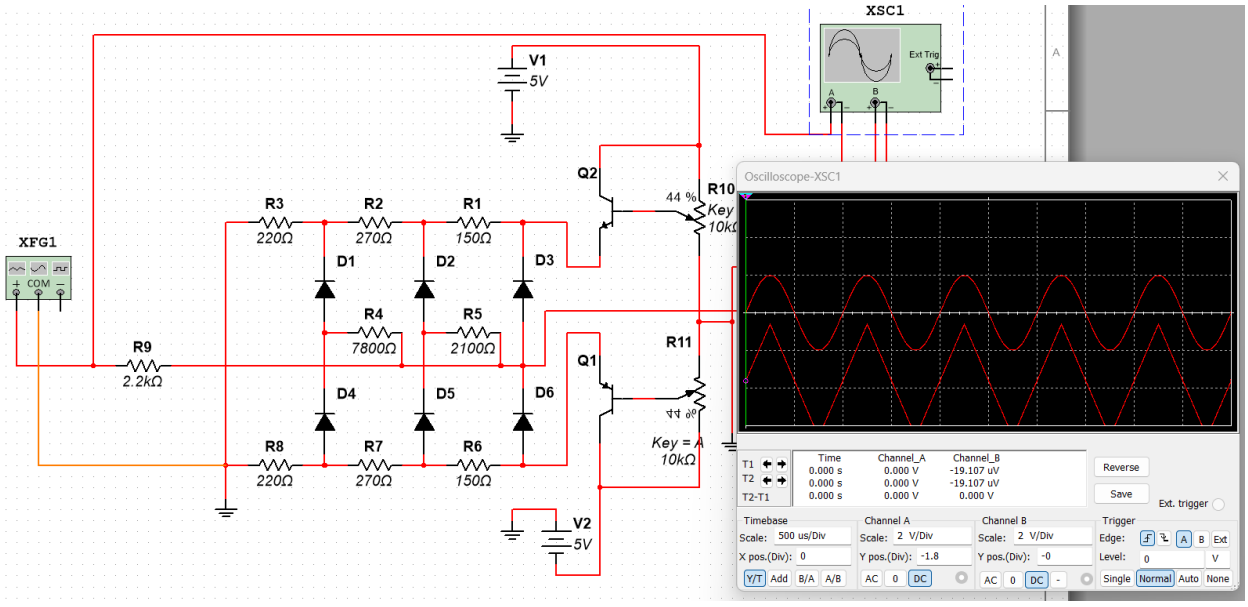


**Figure 1.** Schematic of the circuit, Oscilloscope, and Spectrum Analyzer

## 3. Total Harmonic Distortion (THD) Analysis (Question 4)

The objective was to tune R10 and R11 to obtain the minimum amount of higher harmonic components using a spectrum analyzer, and calculate the THD up to a maximum of 15 kHz.

| Frequency (kHz) | Amplitude (V) |
|---|---|
| **1 (primary f)** | **2.138** |
| 2 | 0.000120468 |
| 3 | 0.000003331 |
| 4 | 0.000043112 |
| 5 | 0.006852 |
| 6 | 0.000028497 |
| 7 | 0.000171837 |
| 8 | 0.000020224 |
| 9 | 0.002704 |
| 10 | 0.000016592 |
| 11 | 0.000743588 |
| 12 | 0.000016045 |
| 13 | 0.0024 |
| 14 | 0.000009085 |
| 15 | 0.003315 |

**Table 1.** Measured Amplitude V for frequencies (2kHz – 15kHz) at optimal 80% setting

The THD was calculated using the formula:

$$THD = \frac{\sqrt{\sum_{i=2}^{\infty} U_i^2}}{U_1}$$

$$\sum U_i^2 \approx 7.25 \times 10^{-5} V^2$$

$$\sqrt{7.25 \times 10^{-5}} \approx 0.00398\, V$$

$$THD = \frac{0.00398}{2.138} = 0.004 = \mathbf{0.4}\%$$