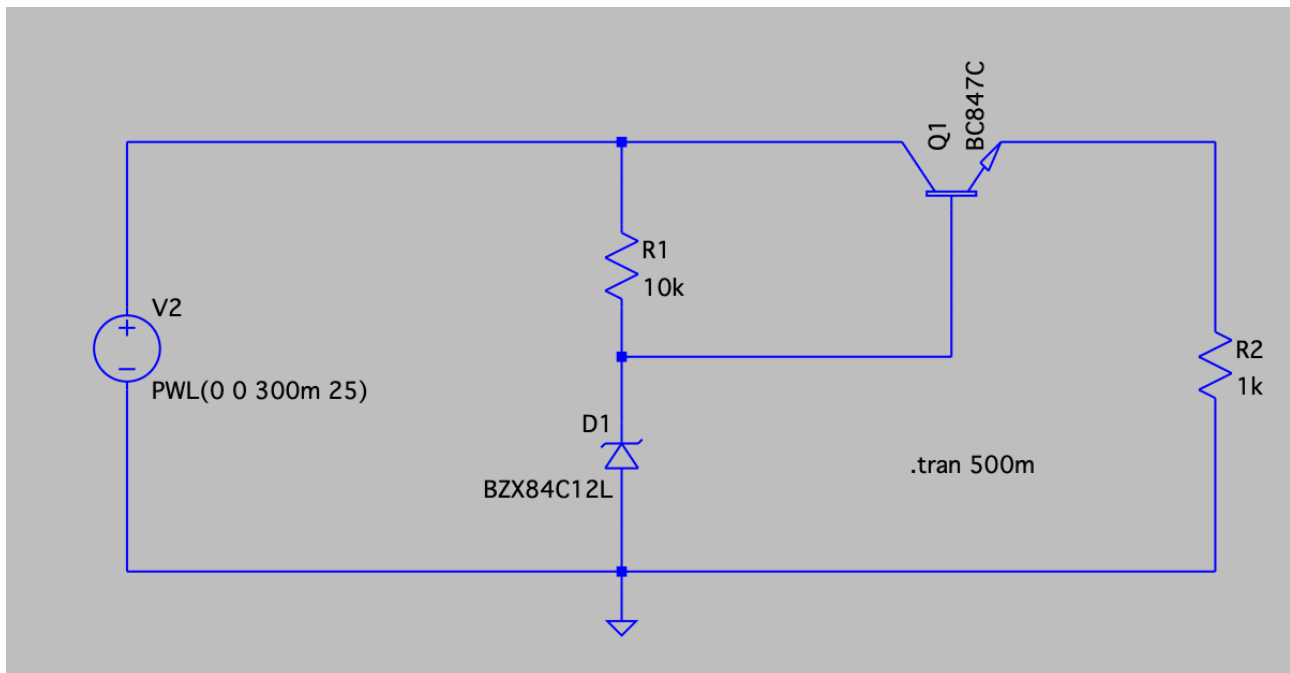# NPN Over-Voltage Protection Circuit

Overview

This circuit consists of:

- A piecewise linear (PWL) voltage source that increases gradually through time until it reaches 25V.
- A zener-diode (D1) with a breakdown voltage equal to 12V. This is considered as the threshold voltage of our circuit.
- Two $1k\Omega$ resistors (R1 & R2). R2 will be considered as the load that needs to be protected.
- A npn transistor (Q1)
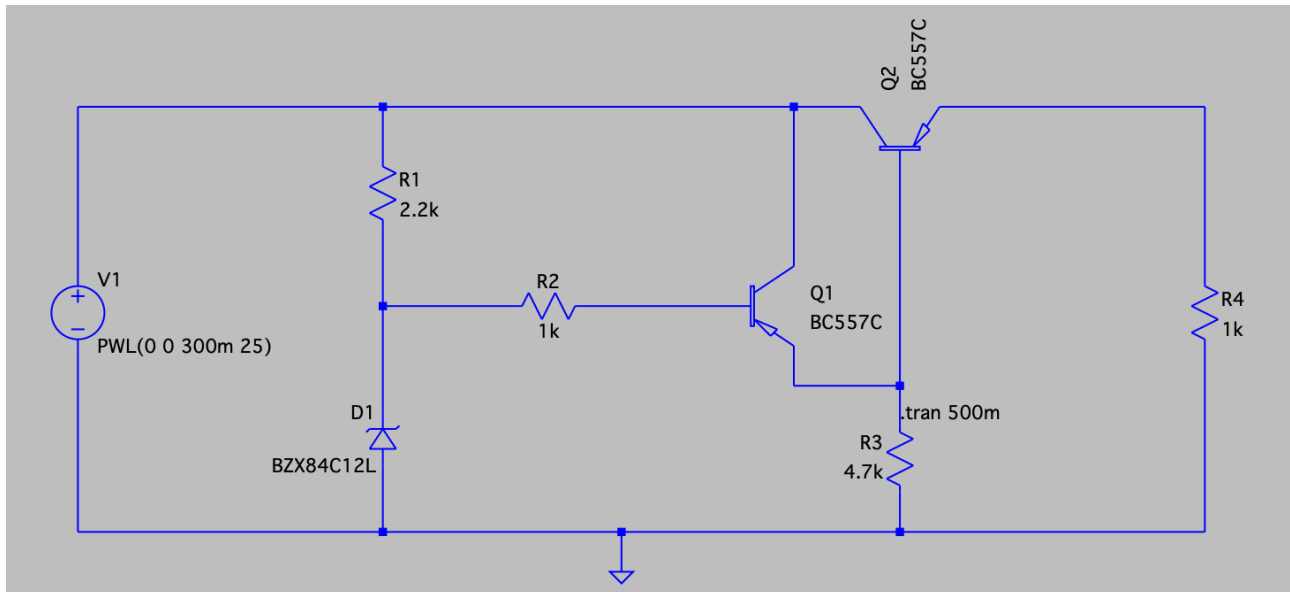
Circuit Operation
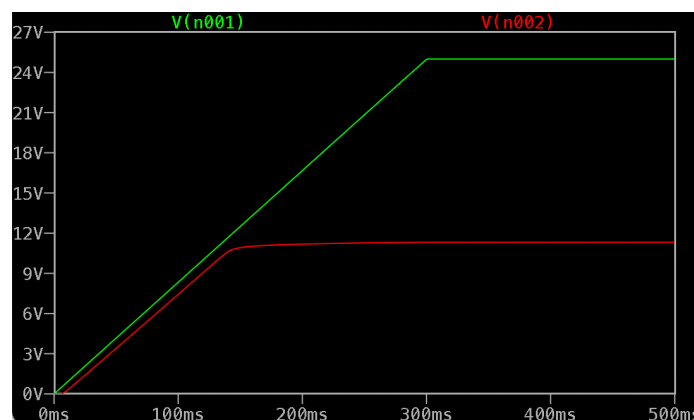
When the input voltage is below 12V (threshold voltage), the zener diode will be reverse-biased but not in its breakdown region yet. This will result in a low voltage at the transistor's base, rendering the transistor as an open switch. Therefore, R2 (load) remains in the circuit and the current flows through it normally.

Once the input voltage rises above 12V, the zener diode will enter its breakdown region. Consecutively, the transistor will act as a closed switch, creating a path between its collector and emitter. This will result in limiting the voltage across R2 (load).

Video Explanation

https://drive.google.com/file/d/1v9cXom2qtfPr3R-yqBvmX-RBusKUxZMI/view?usp=sharing

# PNP Over-Voltage Protection Circuit

Overview

This circuit consists of:

- A piecewise linear (PWL) voltage source that increases gradually through time until it reaches 25V.
- A zener-diode (D1) with a breakdown voltage equal to 12V. This is considered as the threshold voltage of our circuit.
- One $2.2k\,\Omega$ resistor (R1), Two $1k\,\Omega$ resistors (R2 & R4), and One $4.7k\,\Omega$ resistor (R3)
- Two pnp transistors (Q1 & Q2)

Circuit Operation
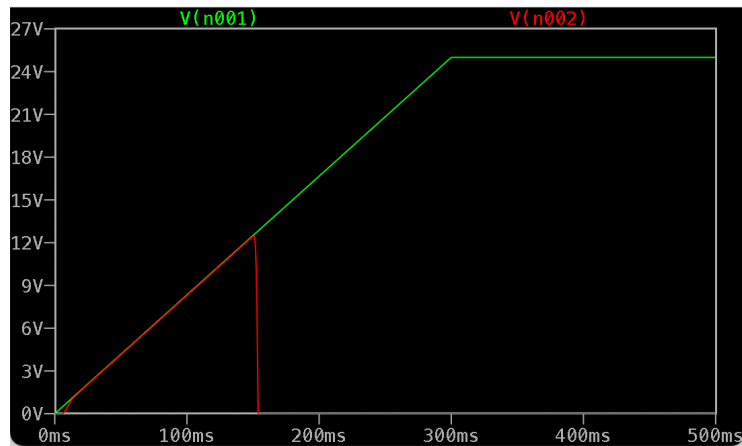
When the input voltage is below 12V (threshold voltage), the zener diode will be reverse-biased but not in its breakdown region yet. This will make the Q1 transistor act as a closed switch, allowing current to flow normally through R4 (load).

Once the input voltage rises above 12V, the zener diode will enter its breakdown region. Therefore, the voltage will drop across R2 forcing Q1 to act as an open switch. This will result in cutting off the current passing through R4 (load)

Video Explanation

https://drive.google.com/file/d/11mIzCPW3-tVmSPE8sTFfyMfjdwgH9m_5/view?usp=sharing