**NPN and PNP Overvoltage Protection**

* *NPN Overvoltage Protection:*

The circuit provides overvoltage protection for the load connected to R3. If the voltage across R3 exceeds a certain threshold, Q2 will turn on, effectively shorting the load and limiting the voltage.

Voltage Source (V1): This source generates a pulse waveform with a peak voltage of 15V and a pulse width of 300ms.

Resistors (R1, R2, R3): These resistors form a voltage divider network, dividing the voltage from V1 across the circuit elements.

NPN Transistors (Q1, Q2): These transistors act as switches, turning on or off depending on the base voltage.

***How it works:***

Under normal conditions, the voltage from the pulse source is divided across the resistors, and Q1 is turned on. This allows a controlled amount of current to flow through the circuit.

A screenshot of a computer

Description automatically generatedIf the input voltage exceeds a predetermined threshold ( overvoltage ), the voltage across R3 becomes sufficiently high to turn on Q2, so when Q2 turns on, it effectively shorts the load connected to R3. This essentially bypasses the excess voltage, preventing it from reaching and damaging the sensitive components.

* *PNP Overvoltage Protection:*

The PNP overvoltage protection circuit works similarly to the NPN circuit but is configured for different voltage conditions.

Voltage Source (V1): This source generates a pulse waveform with a peak voltage of 15V and a pulse width of 300ms.

Resistors (R1, R2): These resistors form a voltage divider network, dividing the voltage from V1 across the circuit elements.

Diode (D): The diode acts as a rectifier, allowing current to flow only in one direction.

PNP Transistors (Q1, Q2): These transistors act as switches, turning on or off depending on the base voltage.

***How it works:***

A screenshot of a computer screen

Description automatically generatedThe input voltage (V1) increases over time according to the PWL function, as the input voltage reaches a certain threshold, Q2 turns on. This happens when the voltage at Q2's base is sufficiently low compared to its emitter. When Q2 turns on, it pulls the base of Q1 lower, turning off Q1, as Q1 turns off, the load is disconnected from the circuit, preventing damage from the overvoltage.

* ***Comparison of NPN and PNP Circuits***

*Response to Overvoltage*: Both circuits effectively protect against overvoltage by disconnecting the load when the input voltage exceeds a certain level. The NPN circuit is better suited for circuits with positive voltage rails, while the PNP circuit is more appropriate for negative rails or situations where the load needs to be disconnected at higher potentials.

*Component Selection:* The main difference lies in the type of transistors used—NPN versus PNP. The PNP circuit typically requires a higher base-emitter voltage drop to activate, which may affect the threshold voltage.

*Sensitivity and Threshold:* Both circuits are sensitive to the resistor values that set the threshold voltage. By adjusting R3 and R4, you can fine-tune the overvoltage protection level.

*Simplicity and Cost:* Both circuits are simple and cost-effective, making them suitable for various applications. However, the choice between NPN and PNP may depend on the specific requirements of the voltage rails in the system.