

CIRCUIT: Hysteresis is defined as a situation where there is a lag between an action and its effect [1]. Here, we interpret hysteresis to mean that it is easier to trip a comparator to a new state than to trip it back to its old state. That is, once tripped it is harder to un-trip and vice versa.

An example of hysteresis in everyday life is a thermostat. Once the temperature gets low enough, the thermostat trips and turns on the heat. The thermostat could trip back as soon as the heat comes on, but the heater stays on for a minimum time in order to avoid this outcome. Alternatively, the thermostat could change the trip point for turning off the heat to some higher target value. The latter approach is what our comparator circuit will do here.

Fig. 1 shows a comparator with hysteresis implemented via positive feedback. The circuit monitors a sensor value that changes the voltage, v_n , out of the v -divider formed by R_1 and R_{sensor} . The other input of the comparator, v_p , comes from a potentiometer-based v -divider (R_a and R_b). Hysteresis is provided by the feedback resistor R_f .

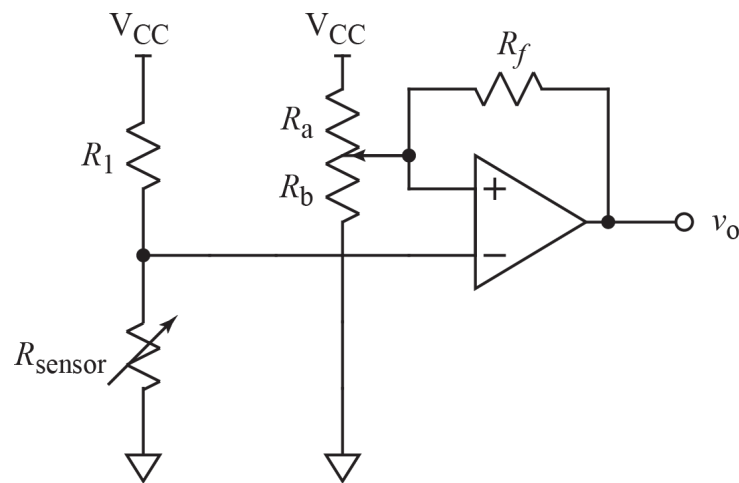


Fig. 1. Comparator with sensor input and hysteresis.

The hysteresis moves the setpoint-voltage at v_p when the comparator output changes from low to high or vice versa. The setpoint always moves in such a way that it becomes more difficult to change the output of the comparator back to its previous state. This prevents the comparator output from rapidly flipping from low to high and back.

To calculate the setpoint at v_p we consider two different cases: the comparator output is high (v_{+rail}) as in Fig. 2, or the comparator output is low (v_{-rail}) as in Fig. 3. We treat the comparator (op-amp) output as a voltage source, and we may use node-voltage or superposition to calculate v_p .

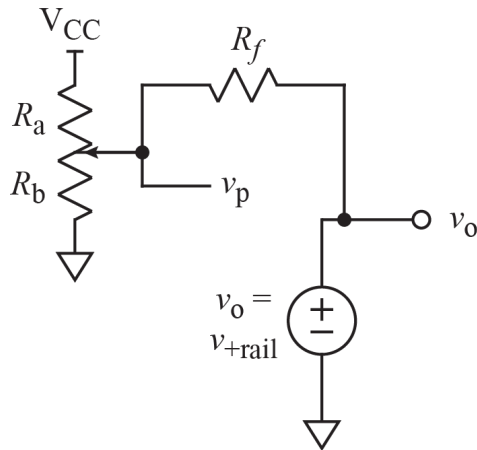


Fig. 2. Comparator model with output high.

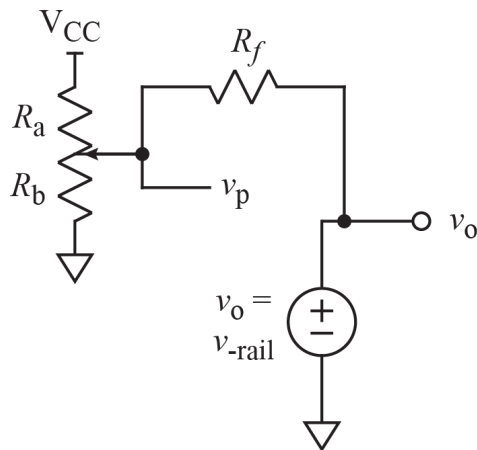


Fig. 3. Comparator model with output low.

REF: [1] <https://www.google.com/search?q=hysteresis&oq=hysteresis> (accessed 18 July 2020)