# Research Migration Project

https://esim.fossee.in/research-migration-project

**The Research Migration Project is an initiative of FOSSEE, IIT Bombay that promotes the use of eSim for reproducing published research circuits originally implemented using proprietary simulation tools. The objective is to migrate these validated designs to eSim to build an open source resource database.**

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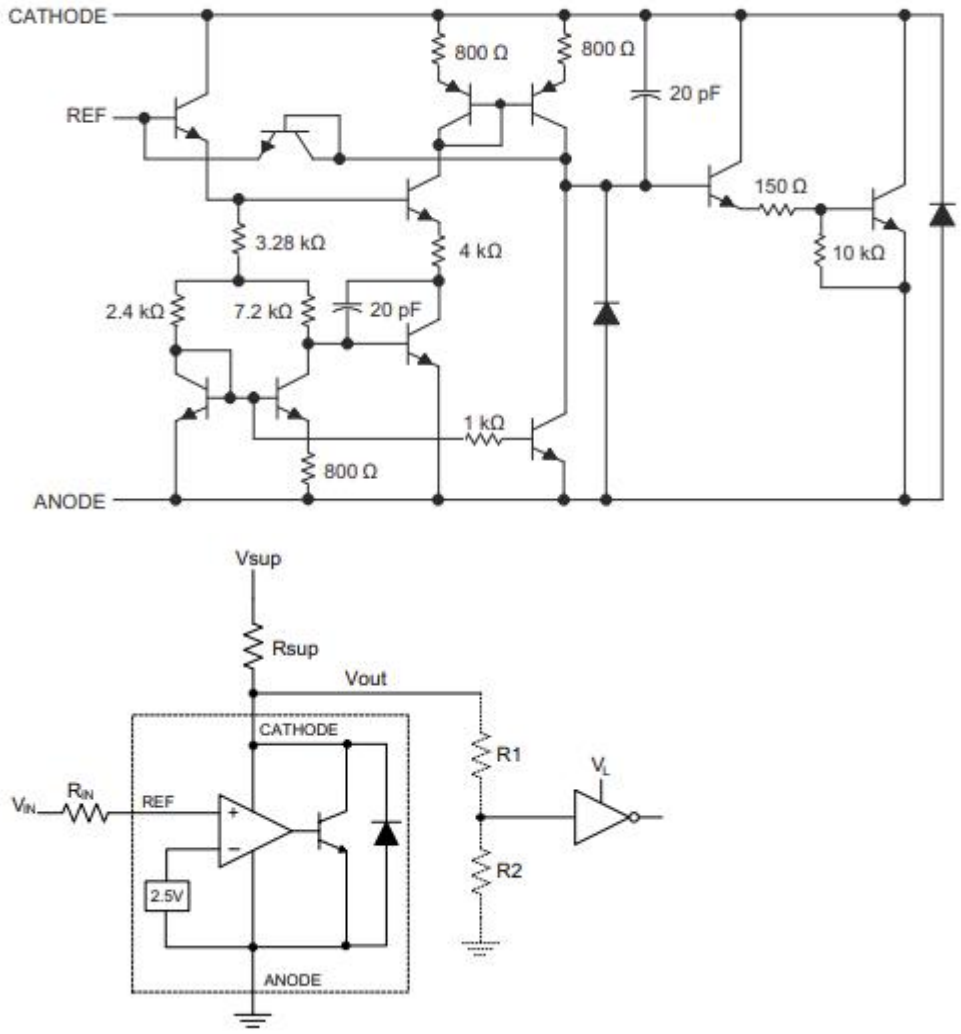
**Title of the circuit :**Precision Programmable Shunt Regulator-TL431

**Theory/Description :**The TL431 is a precision programmable shunt regulator that can also function as a voltage comparator. It contains an internal 2.5 V reference and an error amplifier, which compares the voltage at the reference pin with the internal reference. When the input voltage exceeds the programmed threshold, the TL431 conducts and sinks current, causing the output voltage at the cathode to drop. When the input voltage is below the threshold, the device turns off and the output voltage rises toward the supply voltage through an external resistor. Thus, the TL431 provides accurate voltage comparison and regulation, making it suitable for precision control and monitoring applications.

**Reason to reproduce with eSim :** The circuit is reproduced using eSim to verify the theoretical operation of the TL431 as a precision comparator through simulation. eSim allows accurate modeling of electronic components and provides time-domain analysis of circuit behavior without the need for physical hardware. By simulating the circuit, the voltage switching characteristics, threshold behavior, and transient response can be observed and validated. This helps in understanding the practical performance of the circuit, identifying design issues, and optimizing component values before hardware implementation. Therefore, eSim serves as an efficient and reliable tool for circuit analysis and validation.

**Expected Outcome**: The expected outcome of the simulation is to demonstrate the operation of the TL431 as a precision comparator. When the input voltage crosses the programmed threshold level, the output voltage at the cathode is expected to switch between high and low states. The transient analysis should show a clear change in output voltage corresponding to the input signal variations. The simulation results are expected to match the theoretical predictions, confirming the correct functioning of the circuit. This validates the use of TL431 for precise voltage comparison and regulation in electronic applications.

**Circuit Diagram:**




**Research Paper/Journal/etc. :**

TL431, TL432 Precision Programmable Reference

https://www.ti.com/lit/ds/symlink/tl431.pdf