

Design of Band- gap Reference

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Band-Gap Reference Circuit

- Voltage Reference circuits provide constant, stable voltage irrespective of variations in temperature, supply voltage and process parameters.
- It is a vital analog building block used in many applications like Low Dropout voltage regulators, Analog to digital converter, Digital to analog converter, Buck converters etc. Compared to a voltage regulator, reference circuit lack current driving capability.
- As per industry standards, range of variation in temperature is considered as from -400°C to 1250°C . Range of supply variation depends on applications, typically 10% to 20% from the typical value of voltage supply.
- To design a reference circuit, first the temperature dependency behaviour of electronic devices has to be Analyzed.

Device response to temperature variations

- All electronic devices are sensitive to temperature variations.
- If voltage across a device increases with the increase in temperature, then such devices are called PTAT [Proportional to Absolute Temperature].
- If voltage decreases with the increase in temperature then such devices are called CTAT [Complementary to Absolute Temperature].
- Consider Fig. 1 (a), where typical response of PTAT and CTAT voltages are given. If we add PTAT and CTAT voltages we get the response as shown in Fig. 1 (b). Though the Response is not that of a voltage reference, we can achieve it by multiplying PTAT and CTAT voltages with suitable constants. Fig. 2 forms the basic idea behind the band-gap reference.

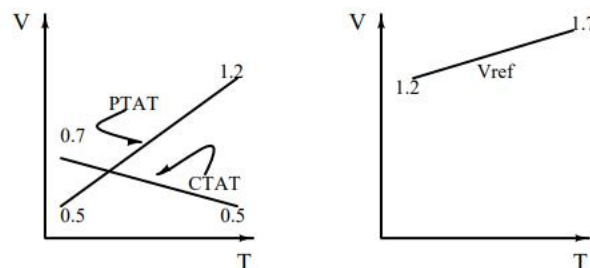


Fig. 1: (a) PTAT and CTAT responses (b) Response of voltage reference

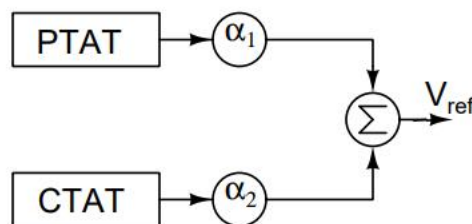
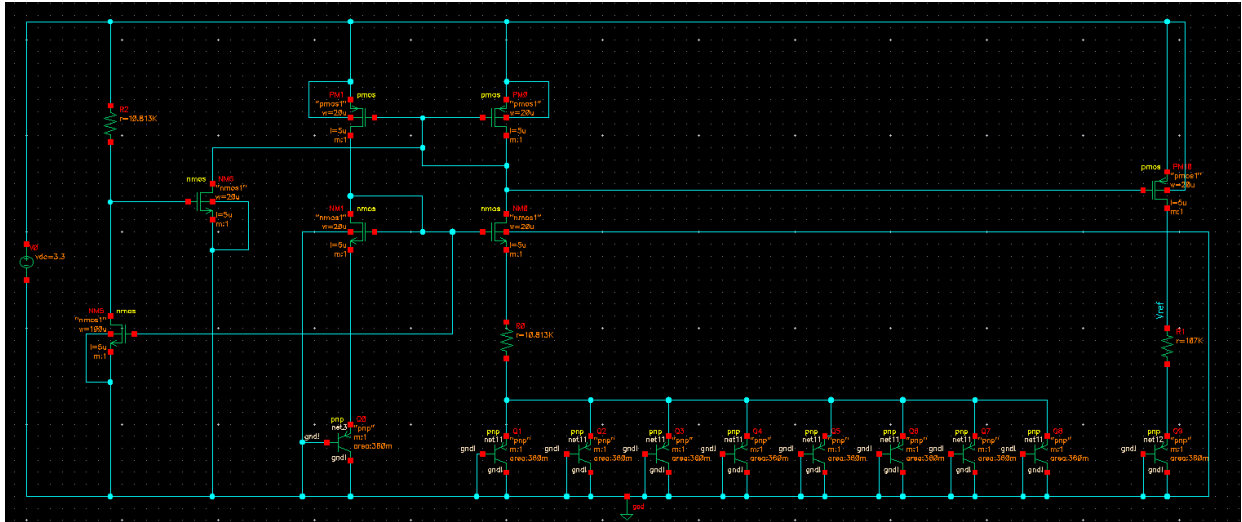


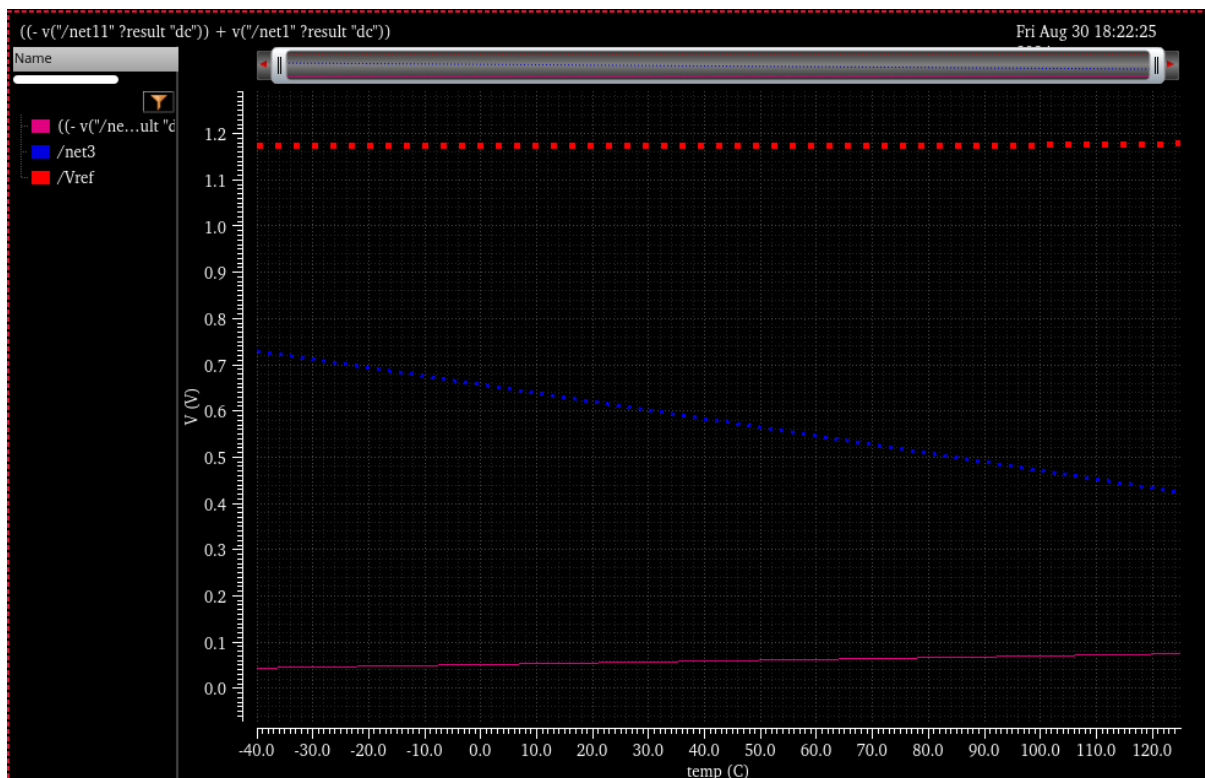
Fig. 2: Generation of V_{ref} voltage

Circuit



Result

Temperature variation



Voltage variation

