

REPORT

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Schematic:

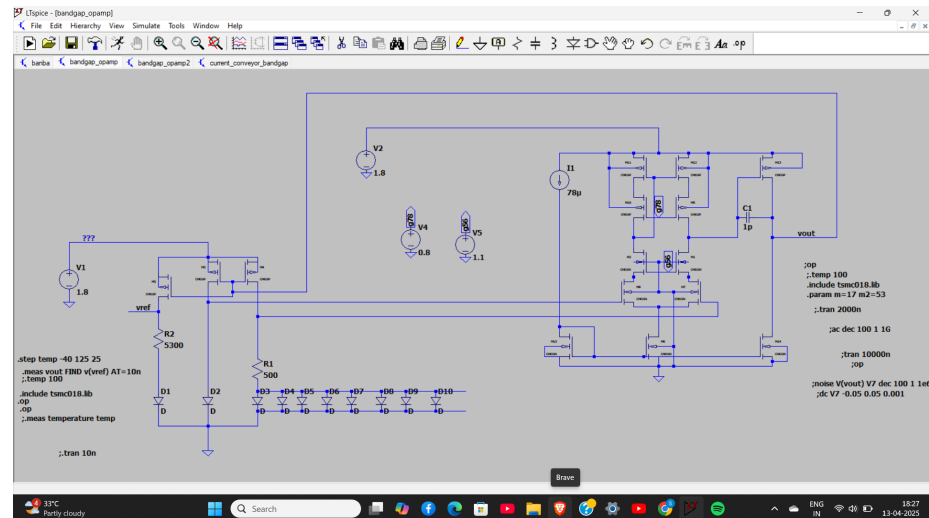


Figure 1:

Plots:

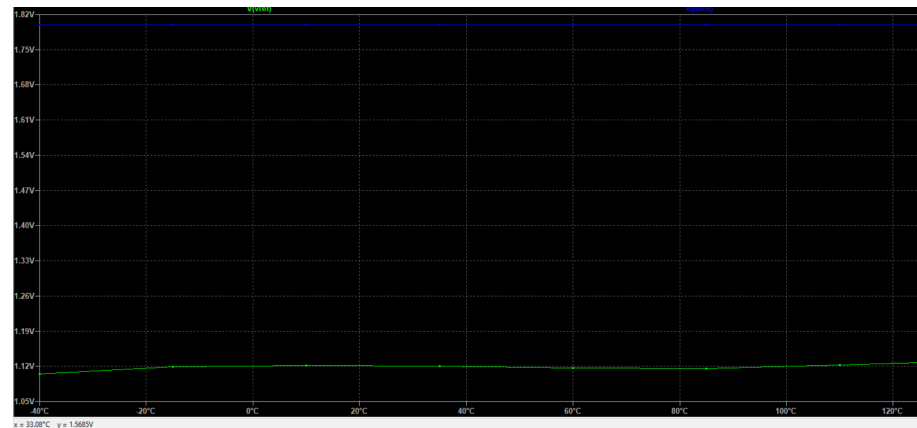


Figure 2:

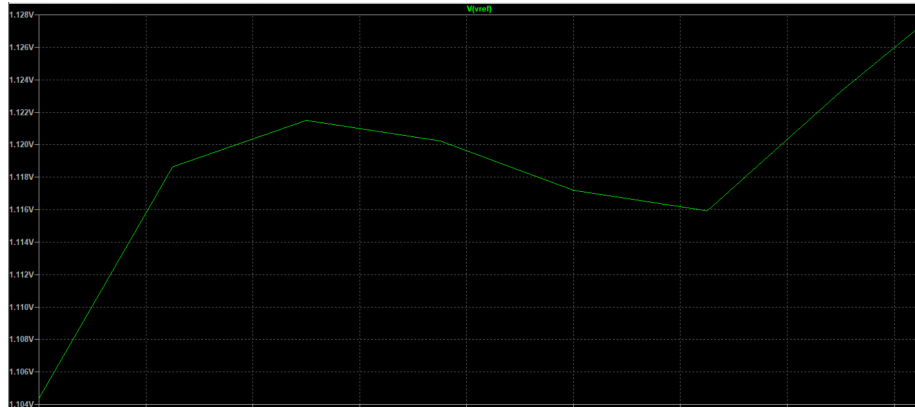


Figure 3: Reference voltage generated

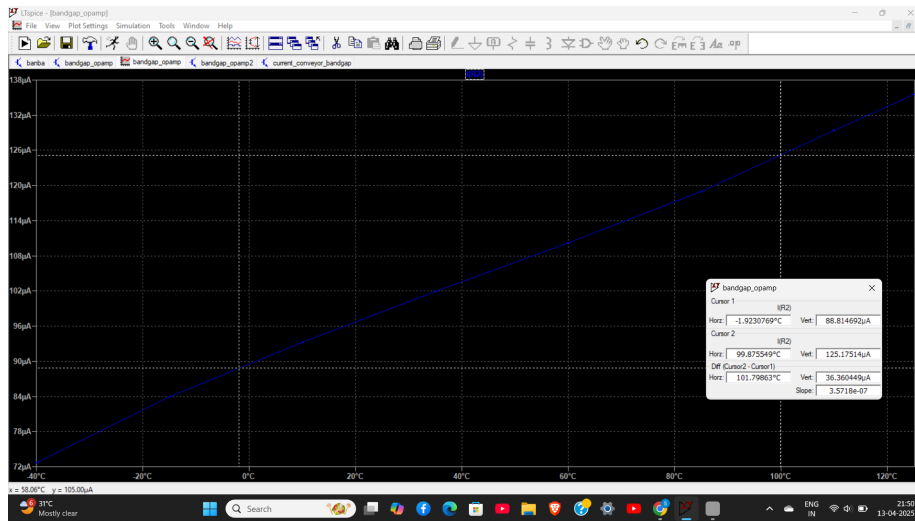


Figure 4: PTAT current:

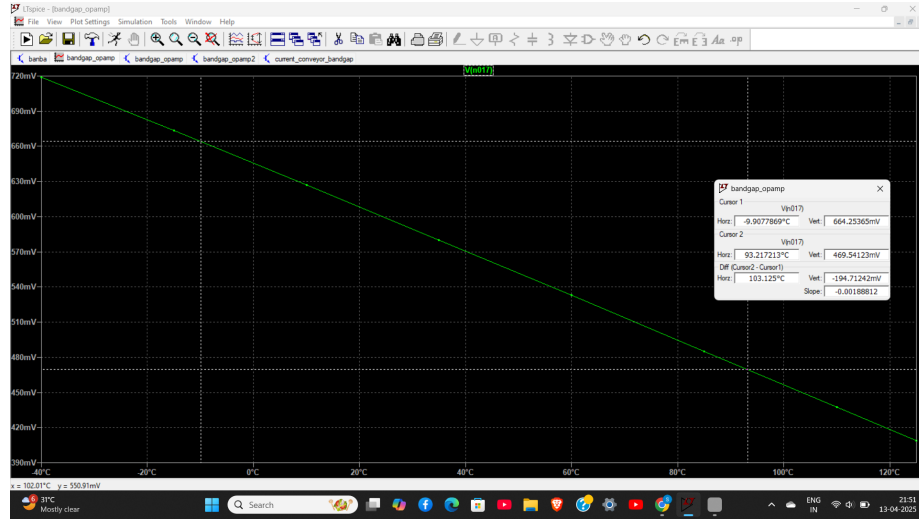


Figure 5: CTAT voltage across single diode:

Calculations:

$$\text{slope of PTAT voltage} = R_2 \cdot (\text{slope of PTAT current})$$

$$\Rightarrow |\text{slope of CTAT voltage}| = |\text{slope of PTAT voltage}|$$

$$R_2 = \frac{\text{slope of CTAT voltage}}{\text{slope of PTAT current}}$$

From plot:

$$R_2 \approx \frac{0.00188}{3.572 \times 10^{-7}}$$

$$R_2 \approx 5263.2$$

Observations:

- Slope of CTAT voltage = -1.888 mV/K.
- range of vref observed: 22 mV and Mean vref : 1.118 V

2. Bandgap reference voltage generator - modified

Schematic:

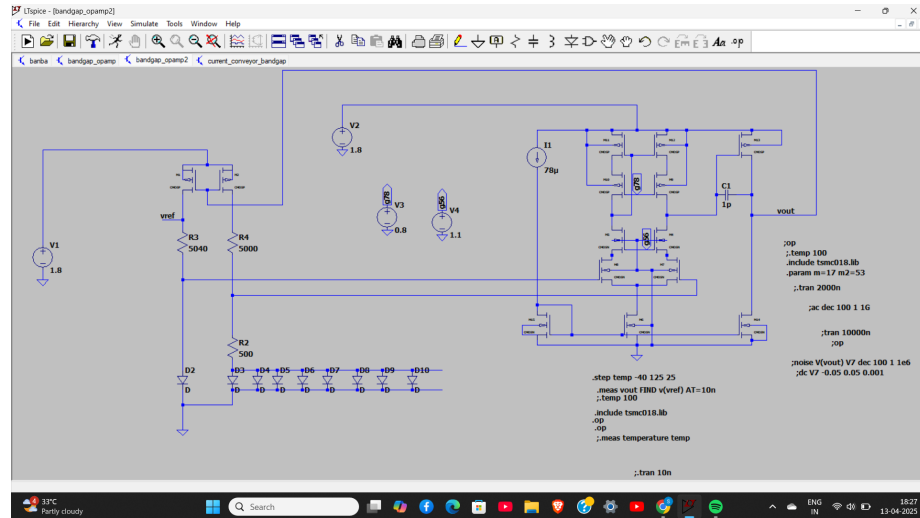


Figure 6:

Plots:

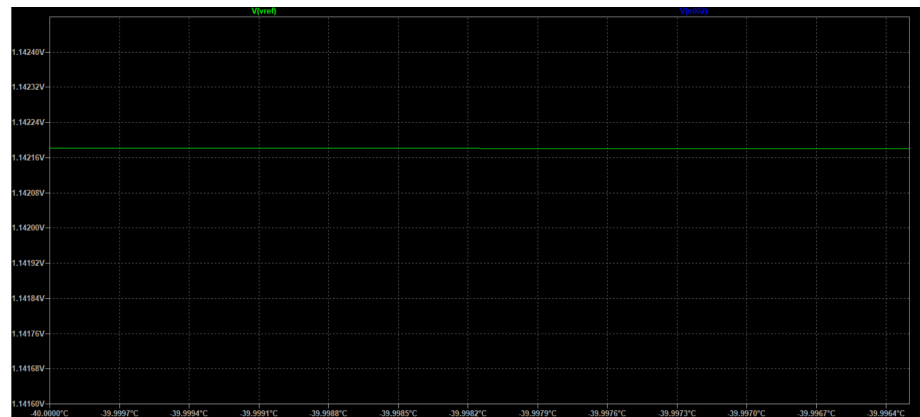


Figure 7:

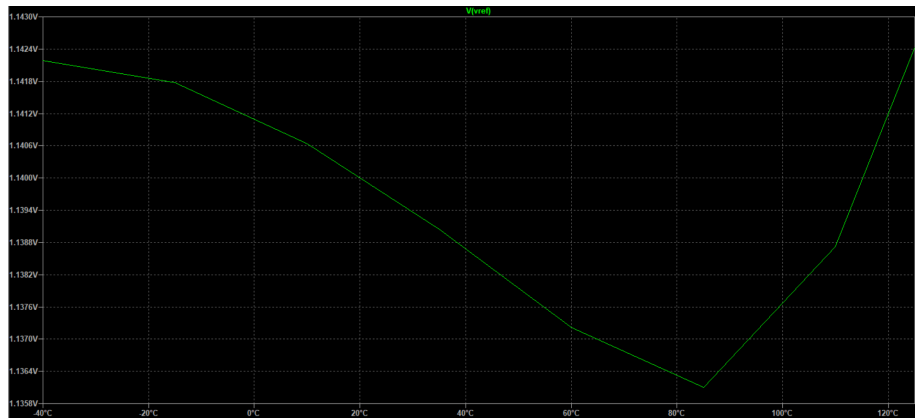


Figure 8: Reference voltage generated

Observations:

- range of v_{ref} observed: 64 mV and Mean v_{ref} : 1.139 V

3.Banba's Bandgap Voltage Reference generator:

Schematic:

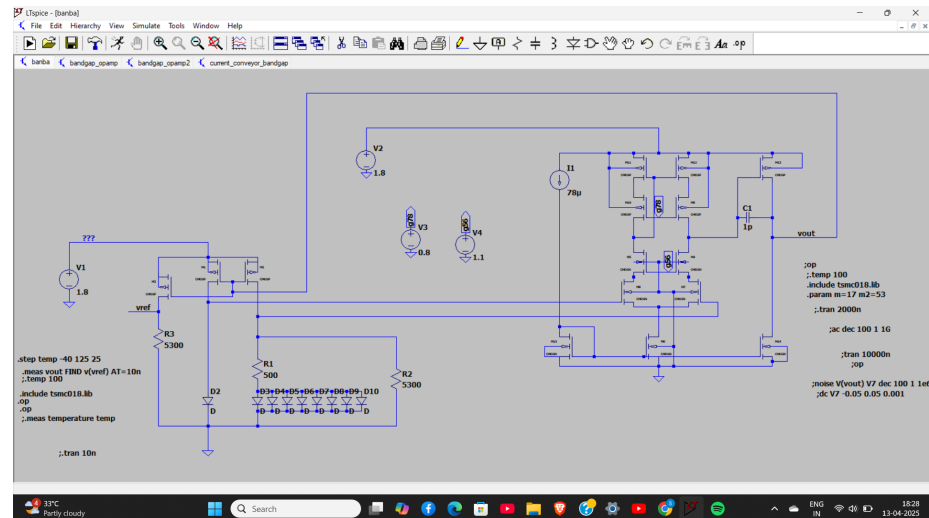


Figure 9:

Plots:

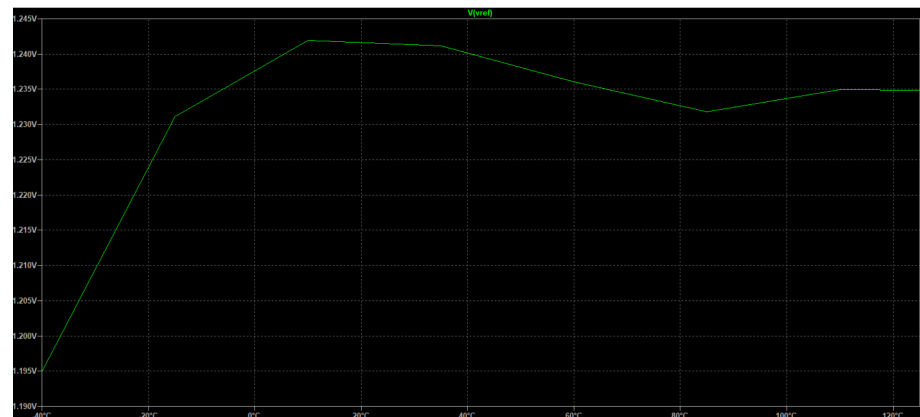


Figure 10:

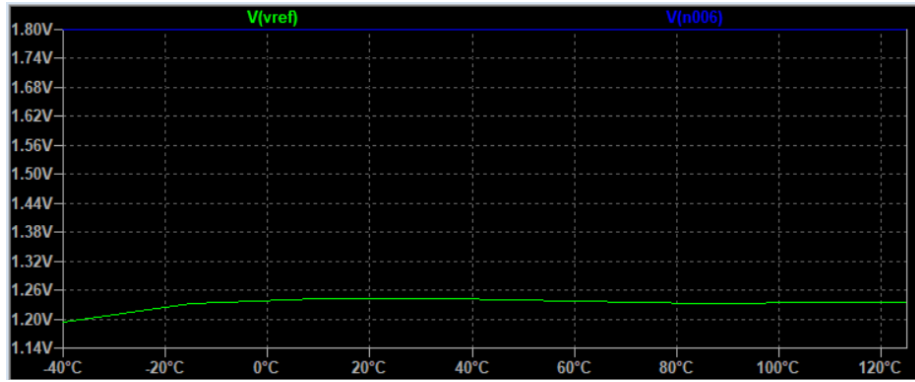


Figure 11: Reference voltage generated with ratio=1

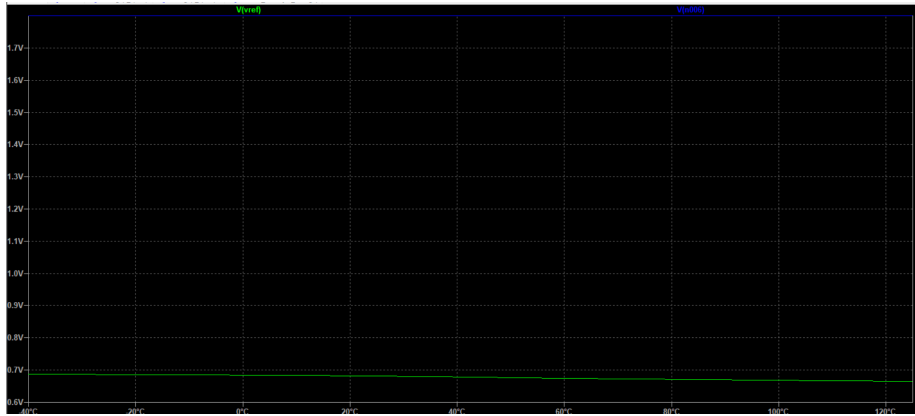


Figure 12: Reference voltage generated with ratio= 0.5

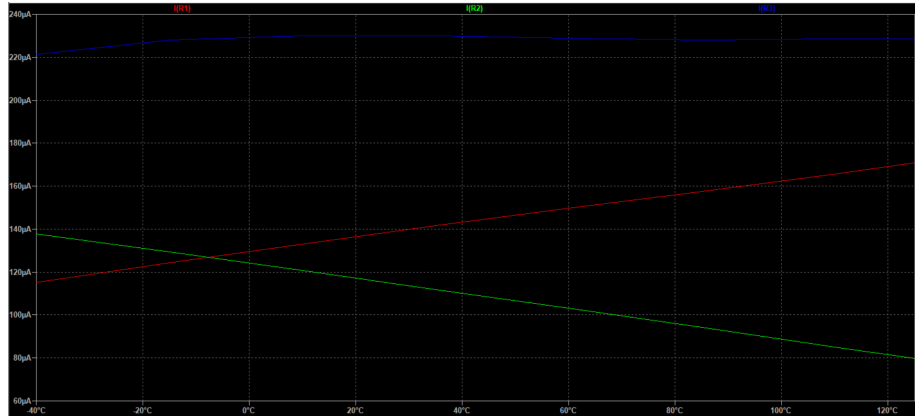


Figure 13: CTAT PTAT ZTAT currents

Calculations:

$$V_{ref} = \frac{R3}{R2} \times \text{Band gap voltage}$$

$$I_{ztat} = \frac{\text{Band gap voltage}}{R2}$$

$$I_{ztat} = \frac{1.2}{5400} = 226.42 \mu A$$

Observations:

- a constant(with Temperature) current is created and by varying the ratio of R3 and R2 different reference voltages can be generated.
- range of vref observed: 47 mV and Mean vref : 1.22 V.

4. Bandgap reference voltage generator - without opamp

Schematic:

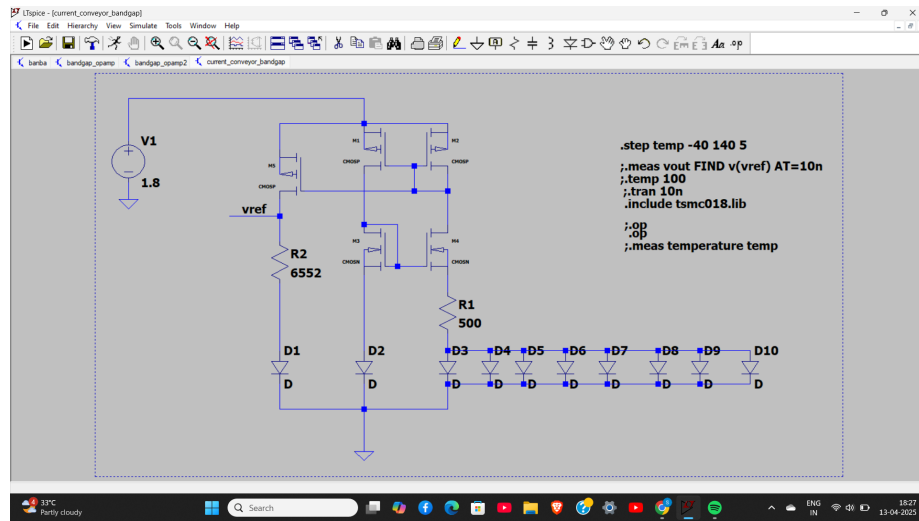


Figure 14:

Plots:

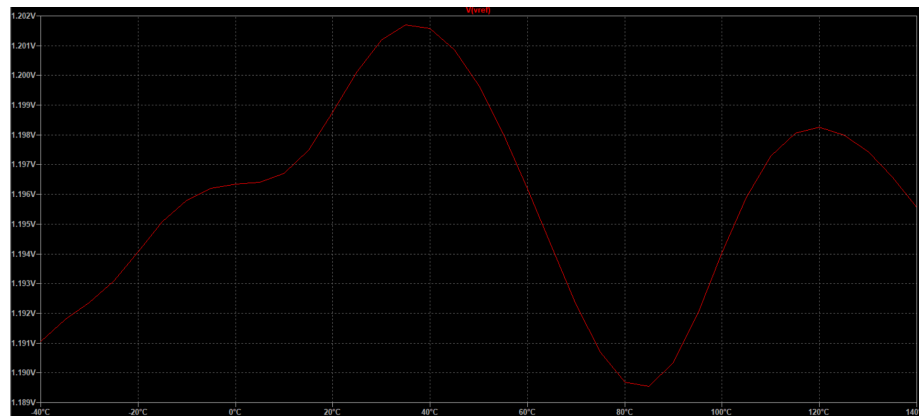


Figure 15:

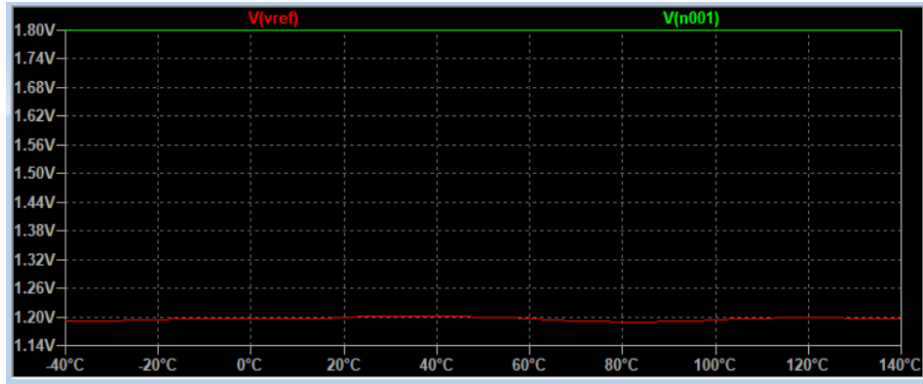


Figure 16: Reference voltage generated

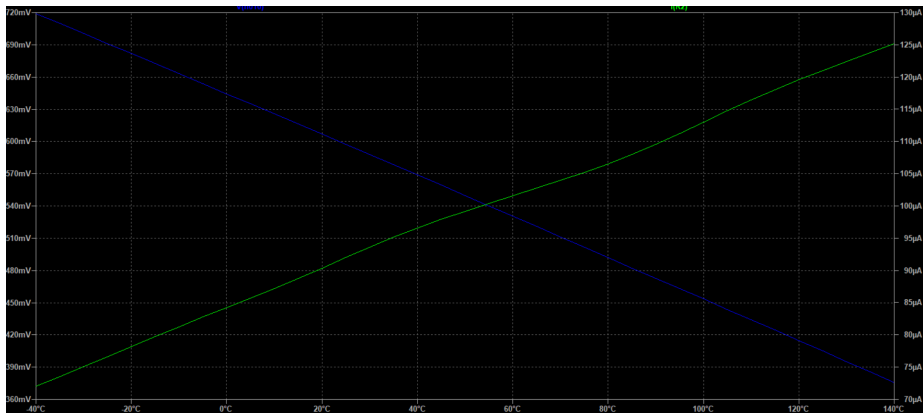


Figure 17: PTAT current and CTAT voltage

Observations:

- range of vref observed: 10 mV and Mean vref : 1.196 V