A V_{DD} Independent Temperature Sensor Circuit with Scaled CMOS Process

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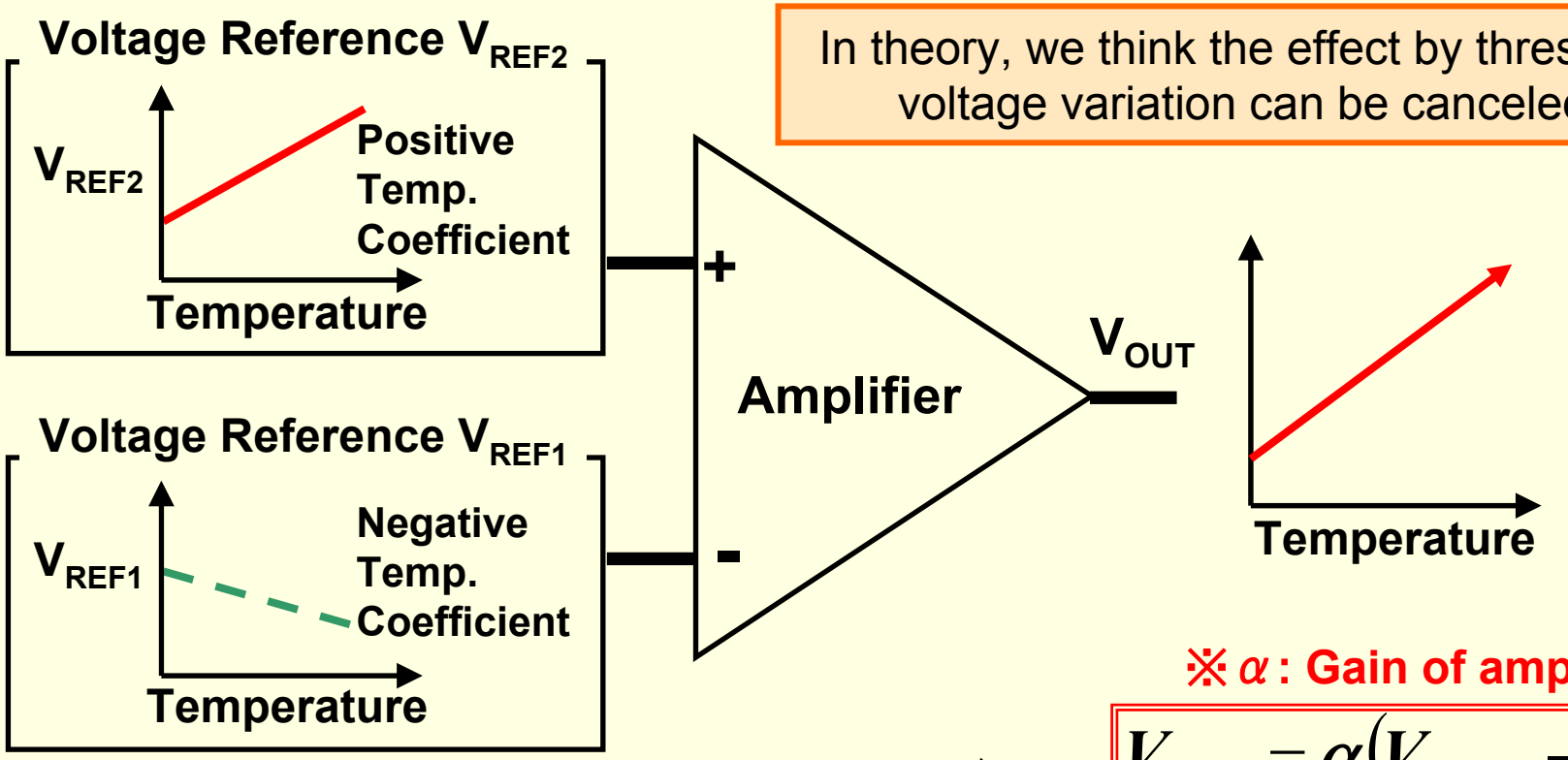
Motivation and Purpose

- A supply-voltage independent on-chip CMOS temperature sensor circuit is one of important analog sub-circuits for thermally sensitive integrated circuit systems
- We propose a V_{DD} independent temperature sensor circuit with a standard CMOS process
- We are aiming realization of on-chip high accuracy temperature sensor applying CMOS voltage reference with scaled CMOS process

Temperature Sensor Scheme



In theory, we think the effect by threshold voltage variation can be canceled

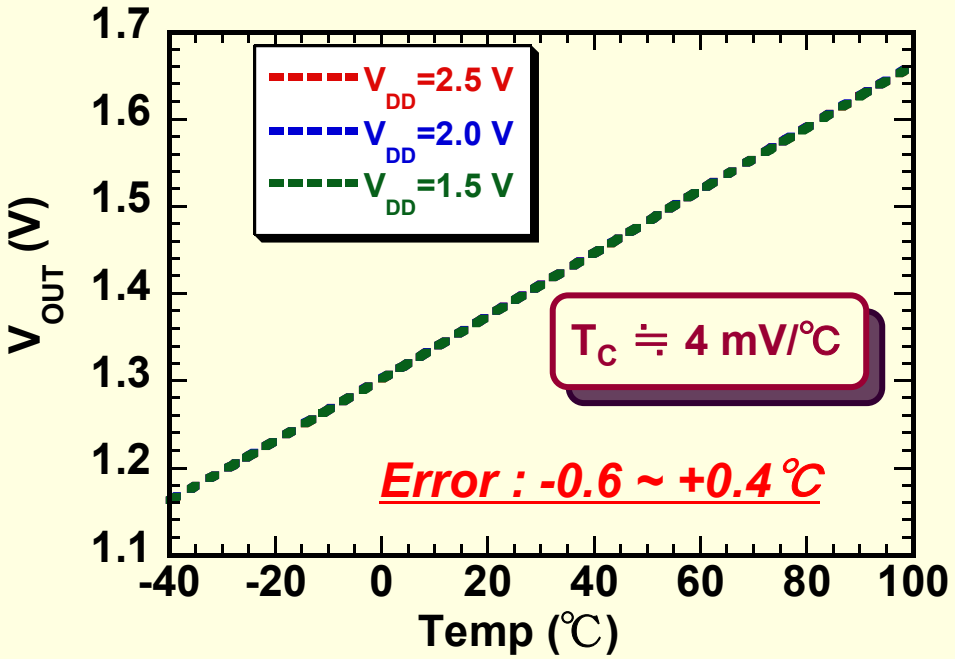
$$\begin{cases} V_{REF2} = V_{TH0} + T_{C_2} T \\ V_{REF1} = V_{TH0} + T_{C_1} T \end{cases}$$

※ α : Gain of amplifier

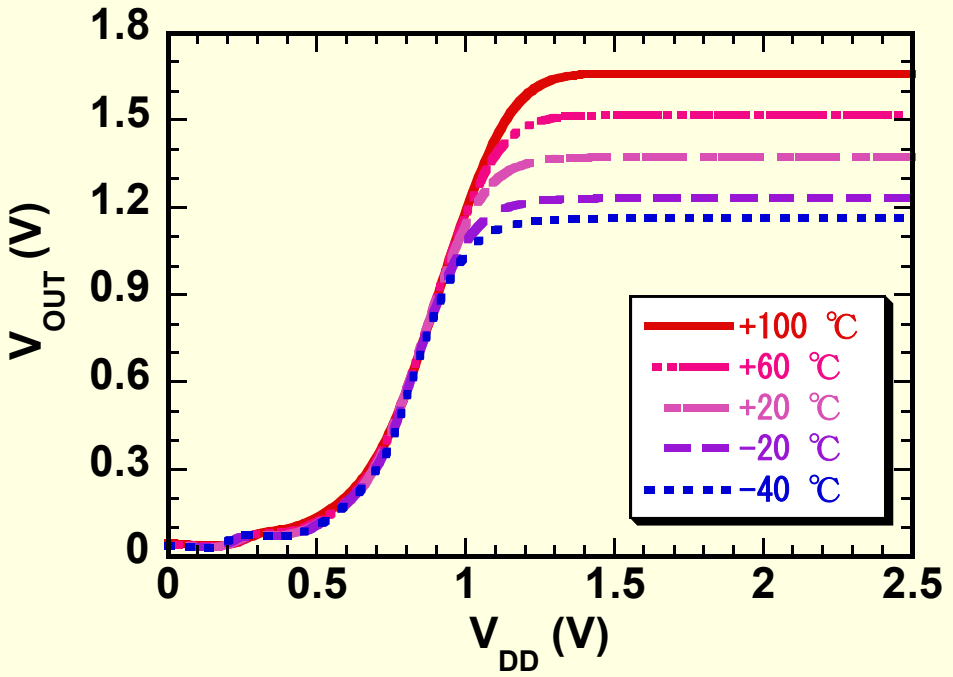
$$\begin{aligned} V_{OUT} &= \alpha\left(V_{REF2} - V_{REF1}\right) \\ &= \alpha\left(T_{C_2} T - T_{C_1} T\right) \\ &= \alpha\left(T_{C_2} - T_{C_1}\right) T \end{aligned}$$

Simulation Results

Temp dependences of V_{OUT}



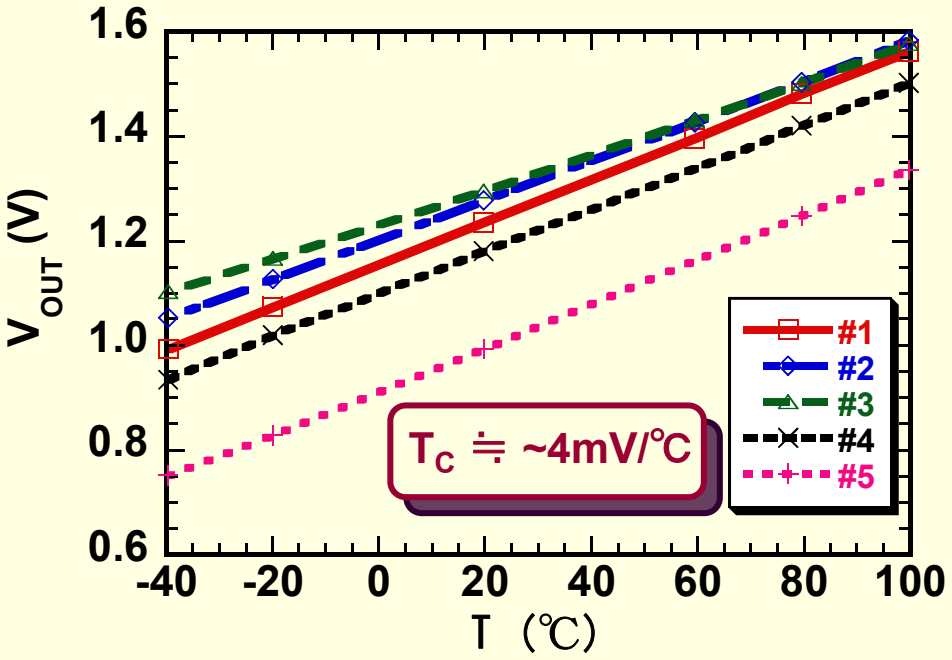
V_{DD} dependences of V_{OUT}



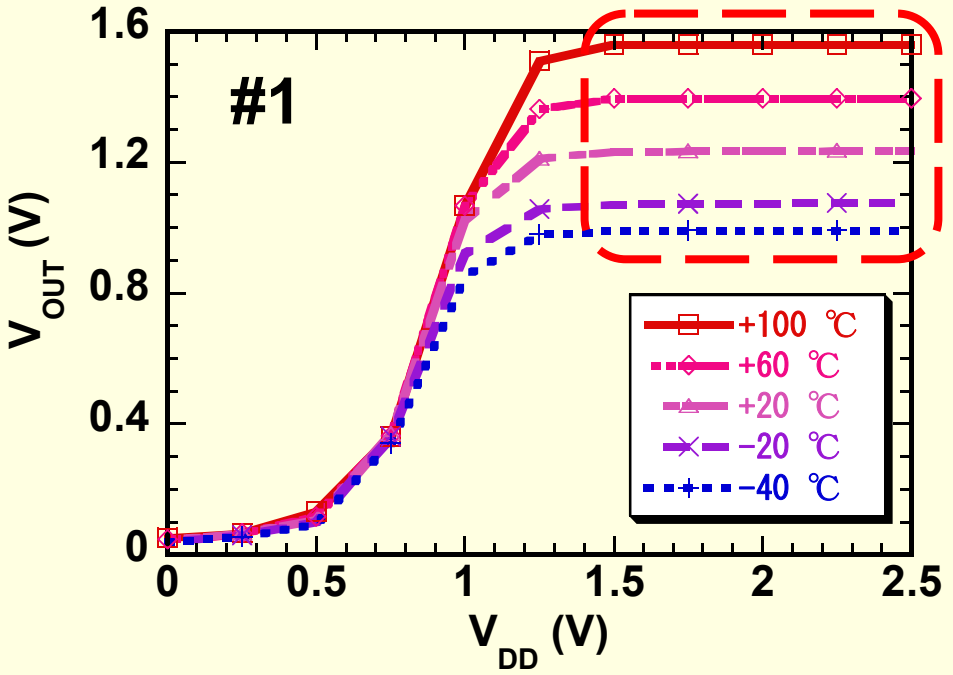
$$Error = \frac{V_{OUT} - (\text{Regression Line})}{T_C}$$

Measurement Results

Temp dependences of V_{OUT}



V_{DD} dependences of V_{OUT}



Calibration Error : -1 ~ 2 ℃ (-20 ~ +100 ℃)
: -0.6 ~ 0 ℃ (+20 ~ +80 ℃)

V_{DD} variation ΔV_{OUT} : ~ 0.9 ℃
(converting to temp)