NTC thermistor with Linearization for temperature sensing

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Design Set-Up:

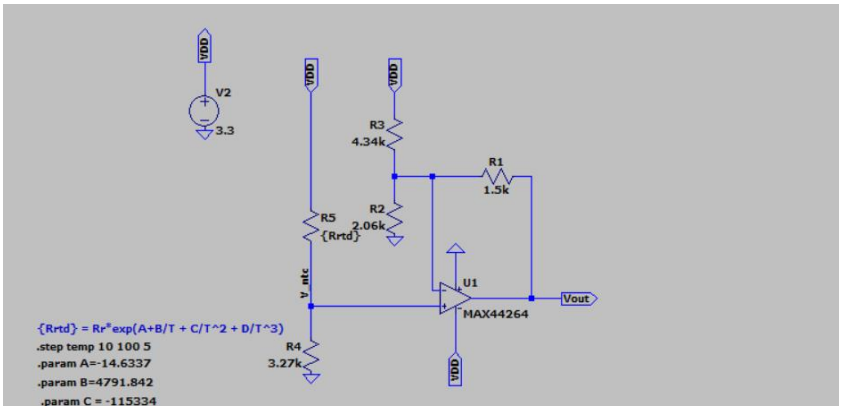

Figure 1: LTSpice for testing purposed

Temp		***Output Vol***		***Supply***	
min	*max*	*min*	*max*	*Vdd*	*Vee*
25	*85*	*0.5*	*3.25*	*3.5V*	*0*

Design Idea based on Circuit

$$Vout = V_{dd} \cdot \frac{R_4}{R_{ntc} + R_4} \cdot \frac{(R_2 R_3 parallel) + R_1}{(R_2 R_3 parallel)} - \left(\frac{R_4}{R_3} \cdot V_{dd}\right)$$

1. Calculate the value of R1 to produce a linear output voltage. Use the minimum and maximum values of the NTC to obtain a range of values for R1.
   a. $R_{ntc}\max = R_{ntc}@_{25} = 10k$
   b. $R_{ntc}\min = R_{ntc}@_{85} = 1070$
   c. $R_4 = sqrt(R_{ntc}@_{25} \cdot R_{ntc}@_{85}) = 3271$
2. . Calculate the input voltage range.
   a. $V_{inMin} = V_{dd} \cdot \frac{R_4}{R_{ntc}\max + R_4} = 0.86(V)$
   b. $V_{inMax} = V_{dd} \cdot \frac{R_4}{R_{ntc}\min + R_4} = 2.64(V)$
3. Calculate the gain required to produce the maximum output swing.
   a. $G = \frac{V_{out}Max - V_{out}Min}{V_{in}Max - V_{in}Min} = 1.8\ \frac{V}{V}$
4. Solve for the parallel combination of R2 and R3 using the ideal gain. Select R1= 1.5 kΩ (Standard Value)
   a. $(R_2 R_3) = \frac{R_1}{G-1} = 1875$
   b. $R_3 = \frac{R_1 \cdot V_{dd}}{V_{in}Max \cdot G - V_{out}Max} = 4369$
   c. $R_2 = \frac{R_2 R_3 \cdot R_3}{R_3 - R_2 R_3} = 3284$
5. Calculate the actual gain with the standard values of R2 (4.34 kΩ) and R3 (2.06 kΩ)
   a. $G = \frac{R_2 R_3 + R_1}{R_2 R_3} = 1.8\ \frac{V}{V}$

[NTC Datasheet]

[OpAmp Datasheet]

LTSpice Results:

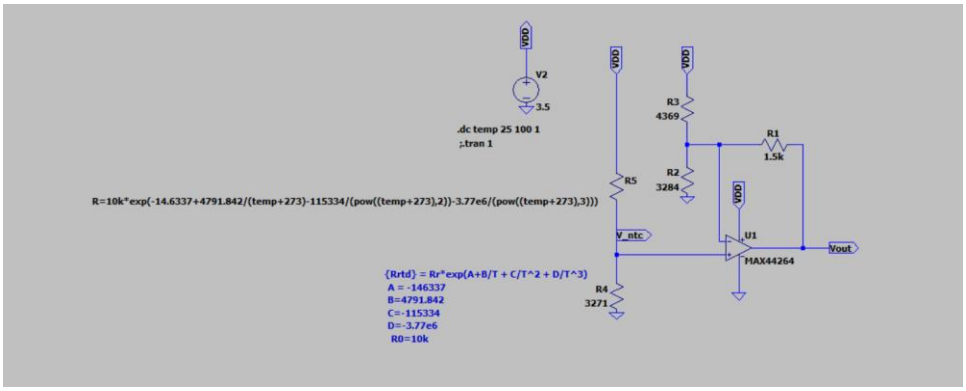

Figure 2: LTSpice Sketch

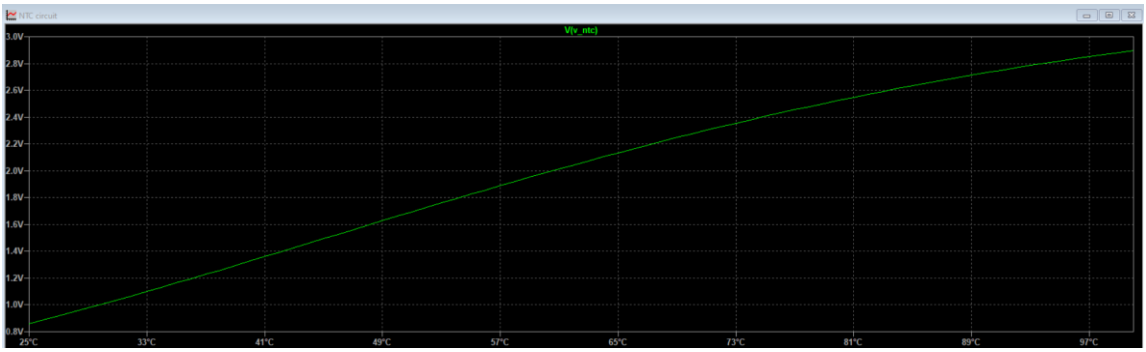

Figure 3: NTC output voltage

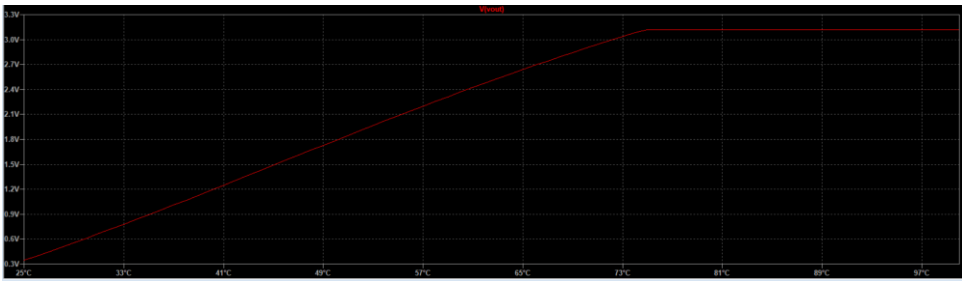

Figure 3: Temperature sensing output voltage