

## MAX31855 Linearized Thermocouple Temperature

Thermocouple Type

Select the thermocouple type and version of MAX31855 being evaluated. The EV Kit hardware comes with a K type device preinstalled. K (41.276  $\mu\text{V}/^\circ\text{C}$ )

Other thermocouple types can be evaluated by populating/soldering Channel 2 and moving the jumper (J4) to Channel 2.

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Read from MAX31855

Linearized Thermocouple Temperature:   $^\circ\text{C}$

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Raw Thermocouple Temperature B[31:18]   $^\circ\text{C}$

Cold Junction Temperature B[15:4]   $^\circ\text{C}$

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Raw B[31:0]  (binary)

Raw B[31:0]  (hex)

1. Subtract the **Cold Junction Temperature** from the **Raw Thermocouple Temperature** data.

$$-84.75^\circ\text{C} - 22.9375^\circ\text{C} = -107.6875^\circ\text{C}$$

2. Calculate the thermocouple voltage based on the MAX31855's  $\mu\text{V}/^\circ\text{C}$  for that thermocouple type (See Table 1 in MAX31855 Datasheet).

$$-107.6875^\circ\text{C} * 0.041276\text{mV}/^\circ\text{C} = -4.44490925\text{mV}$$

3. Calculate the cold junction equivalent thermocouple voltage using the formula below with the NIST temperature-to-voltage coefficients A0, A1, A2... and exponential constants C0, C1 and C2.

$$mV = A0 + A1 * Temp + A2 * Temp^2 + A3 * Temp^3 + \dots + C0 * e^{C1*(Temp-C2)^2}$$

**NOTE:** C0, C1 and C2 only have values for the K-Type thermocouple in the  $0^\circ\text{C}$  to  $1372^\circ\text{C}$  temperature range.

$$-1.76 * 10^{-2} + (3.89 * 10^{-2} * 22.9375) + (1.86 * 10^{-5} * 22.9375^2) + (-9.95 * 10^{-8} * 22.9375^3) + \dots + 1.19 * 10^{-1} * e^{-1.18*10^{-4}*(22.9375-1.27*10^2)^2} = 0.916753\text{mV}$$

4. Add the cold junction equivalent thermocouple voltage calculated in step 3 to the thermocouple voltage calculated in step 2.

$$-4.44490925\text{mV} + 0.916753\text{mV} = -3.528157\text{mV}$$

5. Use the result of step 4 and the NIST voltage-to-temperature (inverse) coefficients B0, B1, B2... to calculate the cold-junction-compensated, linearized temperature value.

$$Temp = B0 + B1 * mV + B2 * mV^2 + B3 * mV^3 + \dots$$

$$0 + (2.52 * 10^1 * -3.528157) + (-1.17 * -3.528157^2) + (-1.08 * -3.528157^3) + \dots = -99.16^\circ\text{C}$$