

Lab 06

Thermocouple Measurements

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CSE 4355- Section 001

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Fall 2025

TM4C Code

Lookup Tables

```
static const float tc_k_temps[] =  
{  
    -80, -70, -60, -50, -40, -30, -20, -10,  
     0,  10,  20,  30,  40,  50,  60,  70,  
    80,  90, 100, 110, 120, 130, 140, 150,  
   160, 170, 180, 190, 200, 210, 220, 230,  
   240, 250, 260, 270, 280, 290, 300  
};
```

```
static const float tc_k_millivolts[] =
{
    -2.920, // -80°C
    -2.587, // -70°C
    -2.243, // -60°C
    -1.889, // -50°C
    -1.527, // -40°C
    -1.156, // -30°C
    -0.778, // -20°C
    -0.392, // -10°C
    0.000, // 0°C
    0.397, // 10°C
    0.798, // 20°C
    1.203, // 30°C
    1.612, // 40°C
    2.023, // 50°C
    2.436, // 60°C
    2.851, // 70°C
    3.267, // 80°C
    3.682, // 90°C
    4.096, // 100°C
    4.509, // 110°C
    4.920, // 120°C
    5.328, // 130°C
    5.735, // 140°C
    6.138, // 150°C
    6.540, // 160°C
    6.941, // 170°C
    7.340, // 180°C
    7.739, // 190°C
    8.138, // 200°C
    8.539, // 210°C
    8.940, // 220°C
    9.343, // 230°C
    9.747, // 240°C
    10.153, // 250°C
    10.561, // 260°C
    10.971, // 270°C
    11.382, // 280°C
    11.795, // 290°C
    12.209 // 300°C
};
```

Interpolation

```
// Linear interpolation. For x outside range, clamps to endpoints.

static float linear_interp(const float *x, const float *y, size_t n, float xq)
{
    if (n == 0 || x == NULL || y == NULL)
    {
        return 0.0;
    }

    if (xq <= x[0])
    {
        return y[0];
    }

    if (xq >= x[n - 1])
    {
        return y[n - 1];
    }

    /* linear scan (table small) */
    int i;
    for (i = 0; i < n - 1; i++)
    {
        if (xq >= x[i] && xq <= x[i + 1])
        {
            float t = (xq - x[i]) / (x[i + 1] - x[i]);
            return y[i] + t * (y[i + 1] - y[i]);
        }
    }

    return y[n - 1];
}
```

mV to Temperature

```
// Convert temperature (°C) -> Type K thermocouple voltage (mV)
float typeK_temp_to_mV(float T_C)
{
    return linear_interp(tc_k_temps, tc_k_millivolts, ARR_SIZE, T_C);

    // if (T_C < -80)
    // {
    //     return -2.920;
    // }
    // else if (T_C > 300)
    // {
    //     return 12.209;
    // }
    // else
    // {
    //     int i = 0;
    //     while(T_C > tc_k_temps[i]) i++;
    //     return tc_k_millivolts[i];
    // }
}
```

Temperature to mV

```
// Convert Type K thermocouple voltage (mV) -> temperature (°C)
float typeK_mV_to_temp(float mV)
{
    /* swap arrays for inverse interpolation */
    return linear_interp(tc_k_millivolts, tc_k_temps, ARR_SIZE, mV);

    // if (mV < -2.920)
    // {
    //     return -80;
    // }
    // else if (mV > 12.209)
    // {
    //     return 300;
    // }
    // else
    // {
    //     int i = 0;
    //     while(mV > tc_k_millivolts[i]) i++;
    //     return tc_k_temps[i];
    // }
}
```

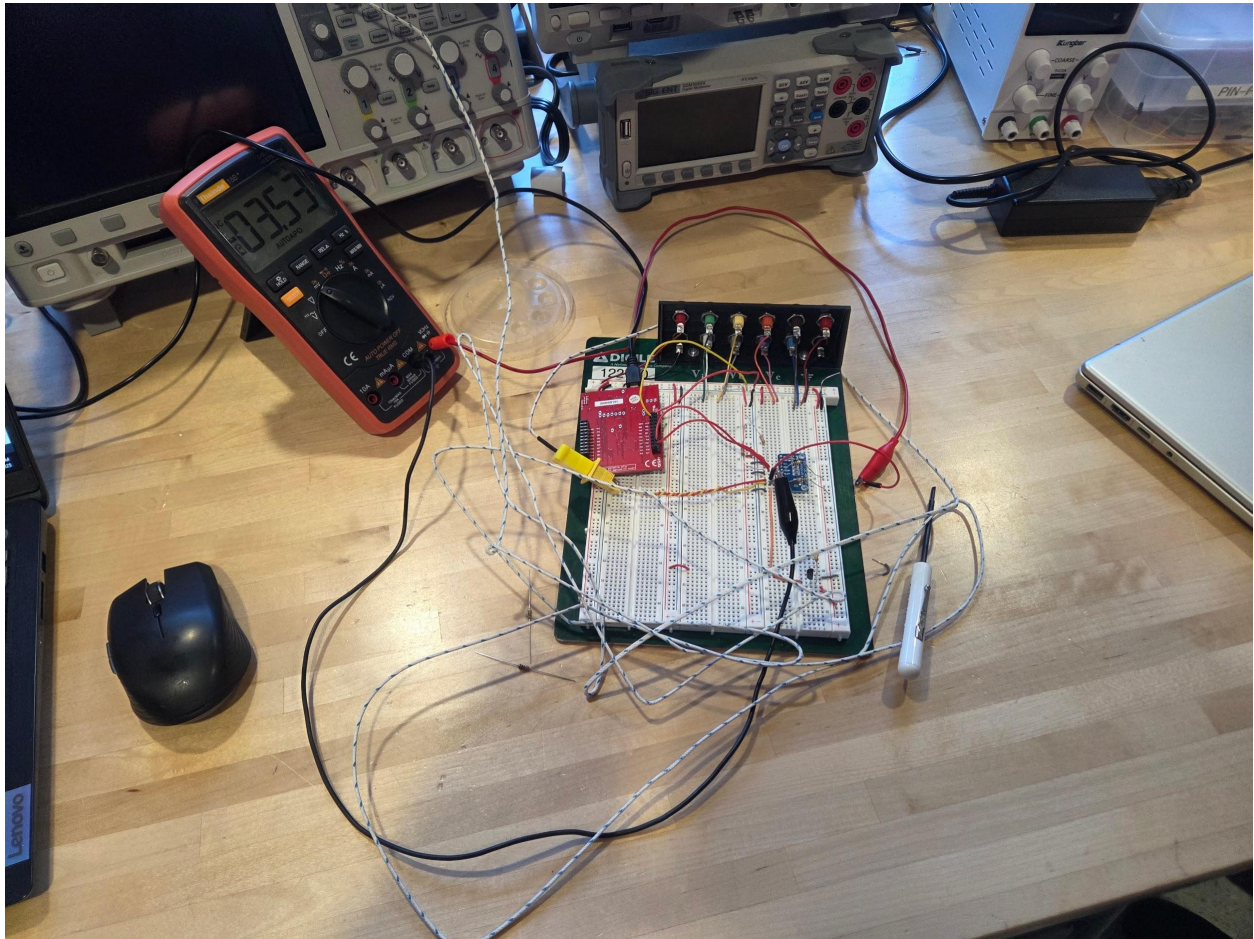
Temperature Measurements

Ambient Room Temperature - 123
Ice Water - 123
Dry Ice - 123
Soldering Iron - 123

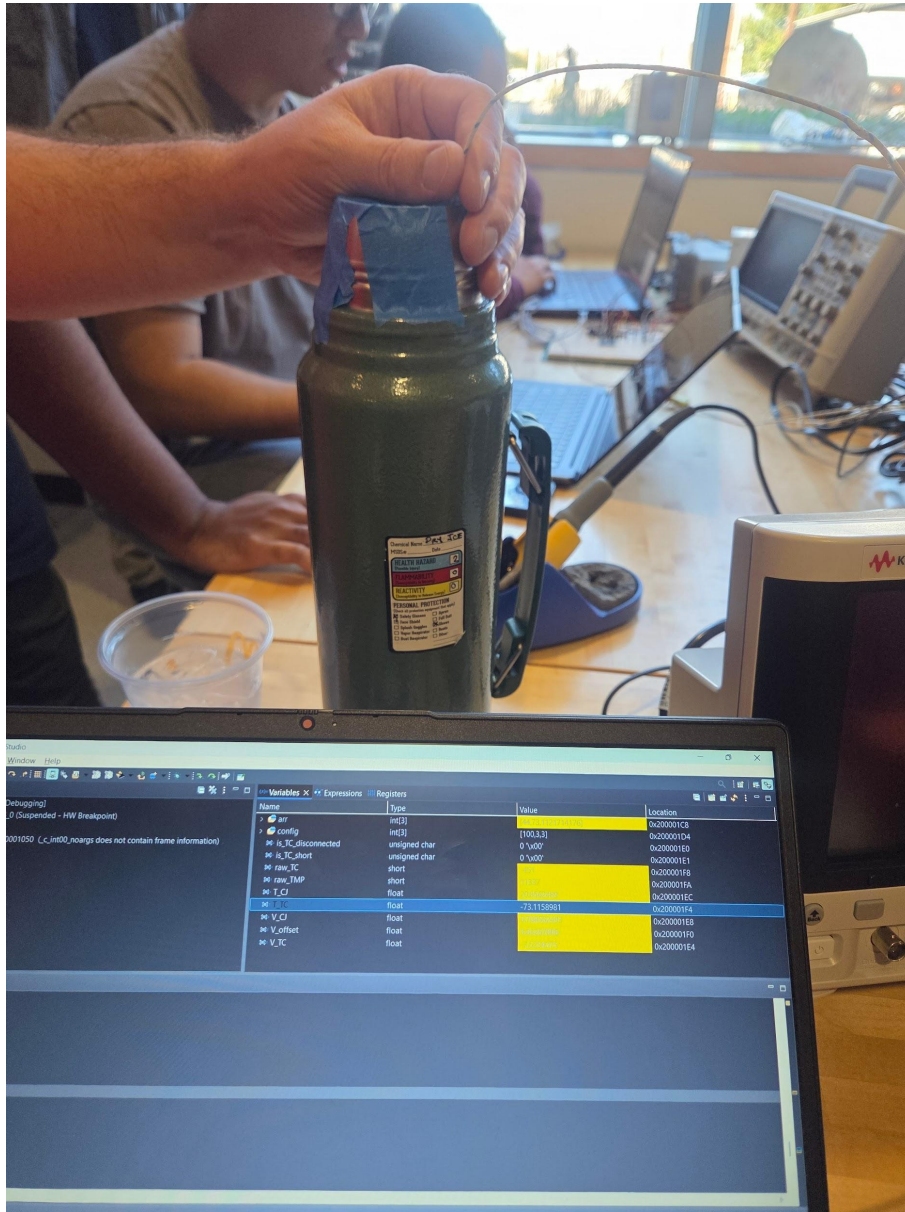
Item	Temperature (C)
Dry Ice	-73.1
Ice Water	1.5
Ambient	20.5
Soldering Iron	101.1

Pictures

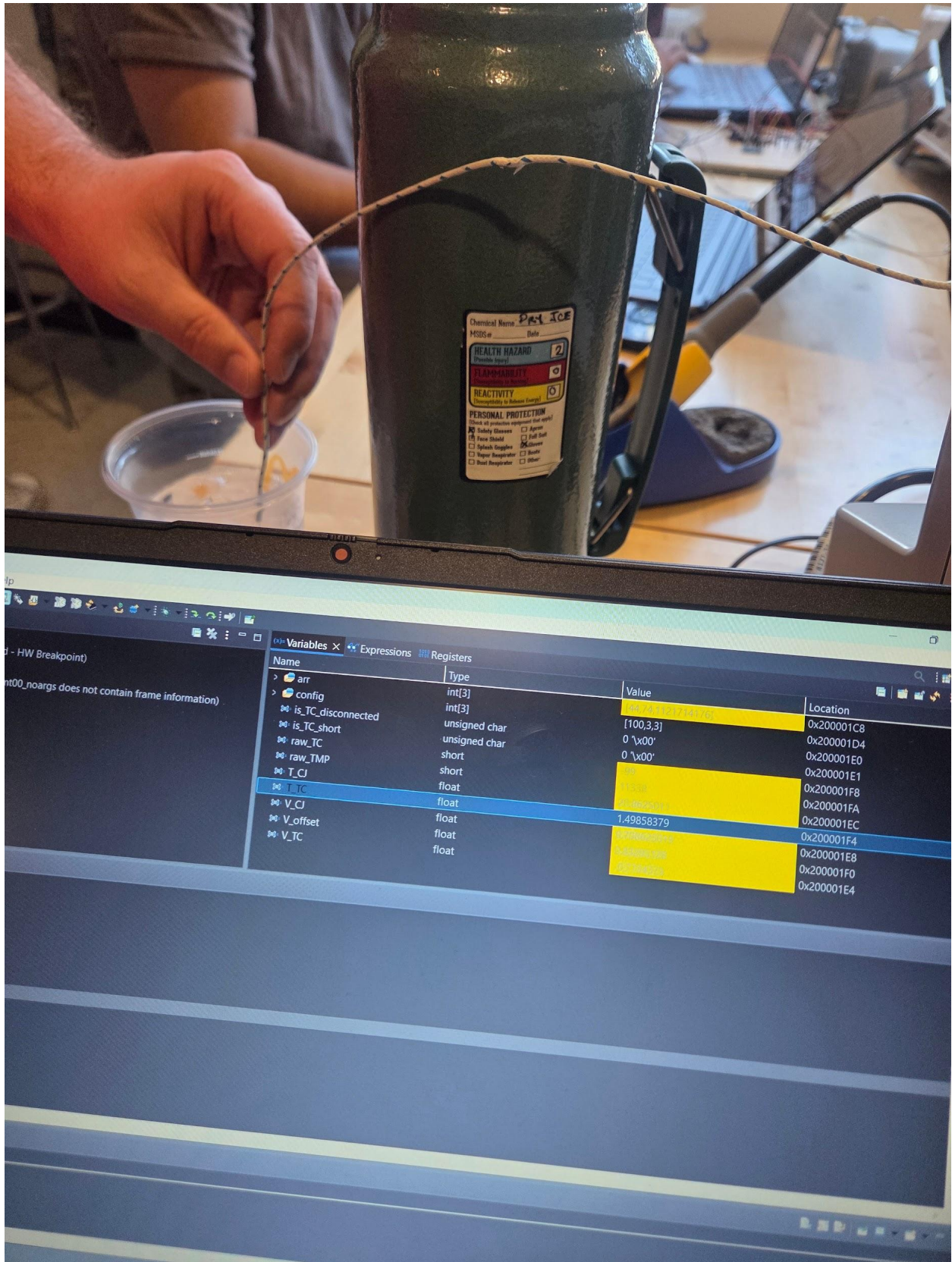
Set up



Dry ice read reading



Ice water reading



Soldering Iron reading

