**Edit TS-V3.1(ard)**

**Arduino potentiostat calibration Procedures**

1. Change the Arduino code to scan voltage range from 0 to 5 V, digital 0 to 255

for(int n = 1; n <= count; n++){

for(int val = 0; val < 255; val++){

analogWrite(a,val);

Troubleshoot the board power problem

2. Connect the board to Arduino nano. Load the Arduino code. Then, measure the voltage value at the output (reference and counter electrode shorted, and ground terminal of voltmeter connect to Arduino nano ground terminal). This is also used to measure voltage at other resistor components and negative voltage regulator supply.

Grounding: Gnd on breadboard -> connect to crocodile clip -> connect to black (machine)

Disconnect WE wire

RE/CE wire crocodile clip to red (machine)/ red(machine) used to check voltage at components

|  |  |  |
| --- | --- | --- |
|  | When (a,0) /V | When (a,1) /V |
| @R1 | 0 | 4.5 |
| @R2 | 0 | 1.9 |
| @R3 | -3.3 | -3.3 |
| @R4 | 1.3 | -0.5 |
| @R5 | -3.3 | -3.3 |
| @R6 | 0 | 0.8 |
| @C5 | -4.2 | -3.5 |
| **@C6** | **-3.3** | **-3.3** |
| @CE/RE | +1.34 | -0.64 |

|  |  |  |
| --- | --- | --- |
| Terminal | On (1)/off (0) | On (1)/off (0) |
| an | 1 | 1 |
| ap | 1 | 1 |
| a1 | 1 | 1 |
| A (d9) | 0 | 1 |
| Vout | +1.34 | -0.64 |

3. Run the MIT-app, take note the voltage reading from voltmeter and val.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Digital (val) | 1Voltage (v) | 2Voltage (v) | 3Voltage (v) | Ave Voltage (v) |
| 0 | 1.34 | 1.34 | 1.34 | 1.34 |
| 10 | 1.13 | 1.13 | 1.13 | 1.13 |
| 20 | 0.96 | 0.96 | 0.96 | 0.96 |
| 30 | 0.78 | 0.78 | 0.78 | 0.78 |
| 40 | 0.60 | 0.60 | 0.60 | 0.60 |
| 50 | 0.42 | 0.40 | 0.42 | 0.41 |
| 60 | 0.23 | 0.23 | 0.23 | 0.23 |
| 70(@69) | 0 | 0 | 0 | 0 |
| 80 | -0.12 | -0.13 | -0.13 | -0.13 |
| 90 | -0.31 | -0.31 | -0.31 | -0.31 |
| 100 | -0.52 | -0.52 | -0.52 | -0.52 |
| 110 | -0.64 | -0.64 | -0.64 | -0.64 |
| 120 | -0.64 | -0.64 | -0.64 | -0.64 |
| 200 | -0.64 | -0.64 | -0.64 | -0.64 |
| 255 | -0.64 | -0.64 | -0.64 | -0.64 |

Note: The results can tell use the DAC range and DAC resolution. It can calculate the Estep1 parameter value.

voltage value is from +1.34 to -0.64,

voltage range: 1.34 + 0.64 = 1.98

digital range: 0 to 110

so, 1.98v/110=0.0127

Estep1 = Estep1+0.0127 <- change in arduino

4. Plot voltage vs Digital (val). Fit the curve to find the linear equation.

Chart, line chart

Description automatically generated

Fitting equation is Vout=-0.0182x+1.3218

Use this equation to find x, which is translated into Arduino voltage

5. Calculate current limit, Vcvc = iin x R6 ; where Vcvc = 5 V and R6 = 250 ohm,

The limit is iin = 5/250 = 20 mA. Due to voltage converter is only -3.3 V, so, the maximum current is

Imax= 3.3V/R5 = 275 micronA, where R5 is 12k.

Form the truth table

|  |  |  |
| --- | --- | --- |
| Input | Output (V) | ADC |
| + 275 micronA | 0 (where I1 = 0) | 0 |
| 0 | 0.06 | 12 |
| -275 micronA | 0.12 | 25 |

Connect 1Kohm resistor to WE-CE/RE

6. The ct (c=analog(ct) is an integer of ADC value. We need to convert it to voltage, Since ADC is 1024 resolution, 5V/1024 = 4.88V/DAC. Then, the measured current value, cc= 275-(c\*19.53); (c=ADC value)

Note: // in micronA, resolution DAC is (5V/1024)/R6=0.01953; R6=250 ohm

7. Calibrate with 1 kOhm resistor.

Chart, scatter chart

Description automatically generated

Fitting equation is current= y = 1028x – 38.335

So, the percentage error is err = (1000- 1/1028 \*106)/1000 = 2.7%

To find the upper and lower limit

Set ei = -1400mV, ef= 1000mV

Diagram

Description automatically generatedDiagram

Description automatically generatedDiagram

Description automatically generated

Narrow down to range: -700mV to 400mV

Diagram

Description automatically generated with medium confidence