**Problems with cross-talk on the LabJack T7-PRO**

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In my Word document on November 11, 2022 I identified the following 3 issues which all involve channel cross-talk on the LabJack T7-PRO.

**Issue 8: There are very significant glitches in voltage readout immediately after reading TEMPERATURE\_DEVICE\_K.**

**Issue 9: There is significant cross-talk between analog inputs on the T7-Pro that cannot be reduced by increasing the settling time.**

**Issue 10: Initial scan values have large errors on T7-Pro when running high gain.**

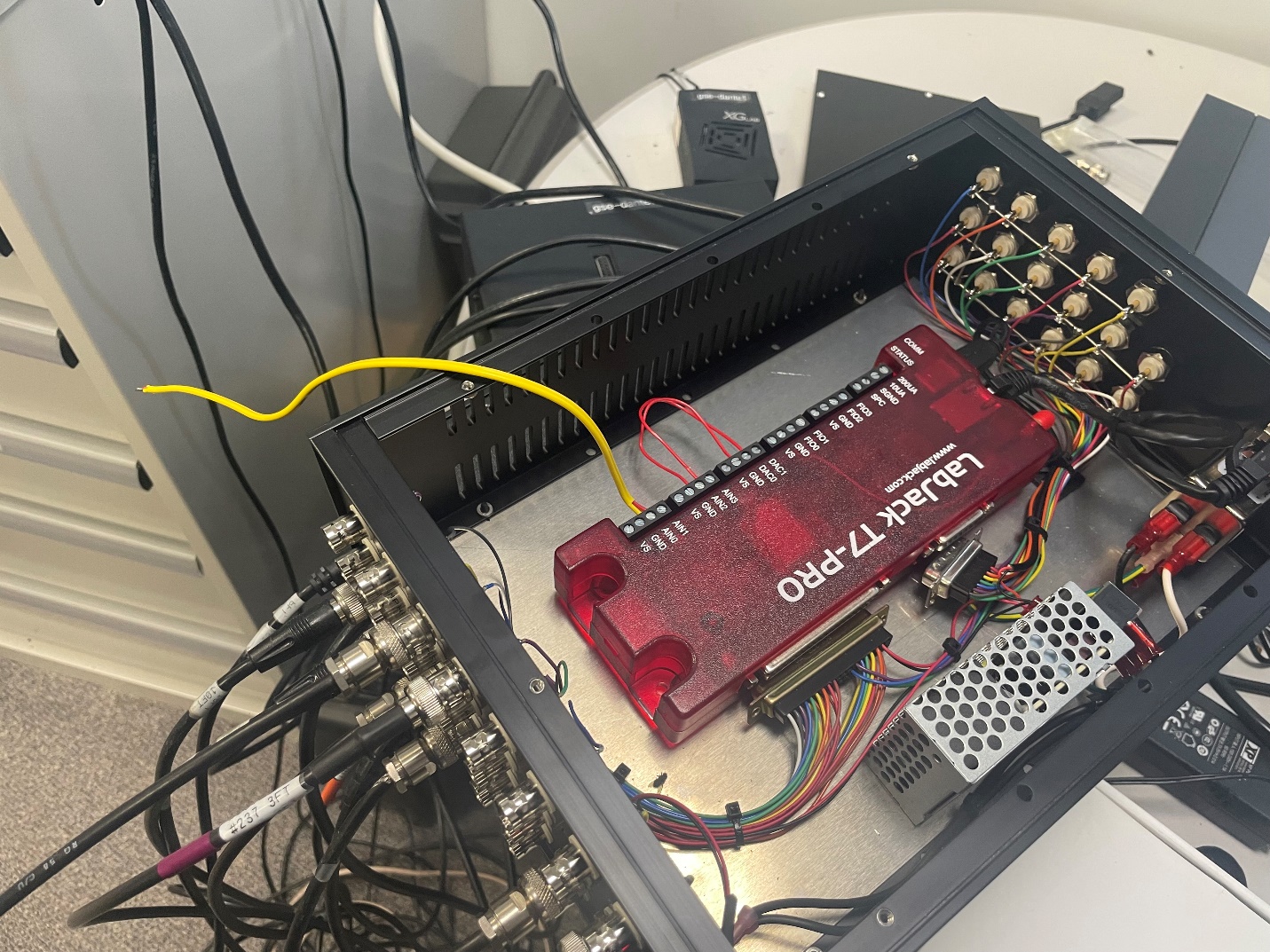
**Soloman replied to these issues as follows:**

#8, #9, #10: I tried a couple of quick tests and cannot seem to reproduce these behaviors. I suspect they could be something related to the thermocouple setup. How do you have the thermocouple connected to the device? Are you using an ungrounded probe? Please try reproducing the test with the thermocouple connection replaced by the AIN connected to GND with a short wire. If you still see the issue from there, I would ask that you provide a simple script to reproduce the error.

**Device Wiring**

The wiring to the T7-PRO is shown in the following photograph.

* The T7-PRO is mounted in a box with 41 BNC connectors.
* Normally these BNCs are connected to the T7-PRO via the 2 D connectors.
* However, for this test the D connector cables were removed and very simple wiring was used.
  + A short Type K thermocouple is connected to AIN0 and AIN1. This is effectively a short between these 2 inputs, except for the thermocouple EMF.
  + DAC0 is connected to AIN2.
  + DAC1 is connected to AIN3.



**Test Program**

As requested I have written a short C program that demonstrates all 3 of the issues I reported, test\_temp\_t7pro.c. This program can be found on Github:

<https://github.com/epics-modules/LabJack/blob/master/LabJackApp/src/test_temp_t7pro.c>

The program is run with 4 arguments:

test\_temp\_t7.pro deviceID ain0Resolution channelsToRead readingsPerLoop

* deviceID is the IP address or serial number of the T7-PRO
* ain0Resolution is the value of AIN0\_RESOLUTION\_INDEX to use.
* channelsToRead is the number of AIN channels to read during the test. It must be between 1 and 14.
* readingsPerLoop is the number of readings of AINx to make after reading the cold junction temperature

The program configures the analog inputs as follows:

* AIN0 set to differential (AIN0\_NEGATIVE\_CH=1), RANGE=0.01 V, RESOLUTION\_INDEX=ain0Resolution specified on the command line.
* AIN2-AIN13 are set to single-ended (AINn\_NEGATIVE\_CH=199), RANGE=10V, RESOLUTION\_INDEX=0.
* AIN\_ALL\_SETTLING\_US is set to 2000 for 2 ms settling time on all channels.

The program then does the following sequence of operations 4 times:

* Sets DAC0 and DAC1 each to either 0 V or 5 V. The DAC0,DAC1 values are [0,0], [0,5], [5,0], and [5,5] on the 4 loops.
* Reads the DEVICE\_TEMPERATURE\_K to get the cold junction temperature.
* Does the following steps readingsPerLoop times
  + Reads AIN0 and converts from volts to temperature using the cold junction temperature
  + Optionally reads the other analog inputs (AIN2-AIN13) according to the user-specified value of numChannelsToRead if it is between 3 and 14.
  + Prints out the loop counter, elapsed time, AIN0 temperature and the other voltages

The program then does a stream burst input of AIN0 with the following settings:

* 256 scans
* 500 Hz scan rate
* STREAM\_RESOLUTION\_INDEX=8
* STREAM\_SETTLING\_US=0 (default)

At the end of the scan the AIN0 values are converted to temperature and printed out.

**Results of the test\_temp\_t7pro.c test program with ain0Resolution=11, channelsToRead=1, readingsPerLoop=10**

The following is the output of the program when ain0Resolution=11, channelsToRead=1 so it only reads AIN0 during the first phase of the program.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

>../../bin/linux-x86\_64/test\_temp\_t7pro 10.54.160.73 11 1 10

deviceType: LJM\_dtT7

connectionType: LJM\_ctETHERNET

serialNumber: 470028527

IP address: 10.54.160.73

port: 502

Maximum number of bytes per packet: 1040

Configuration:

ain0Resolution: 11

channelsToRead: 1

readingsPerLoop: 10

AIN0\_NEGATIVE\_CH : 1

AIN0\_RANGE : 0.010000

AIN0\_RESOLUTION\_INDEX : 11

AIN\_ALL\_SETTLING\_US : 2000

Cold junction temperature (C): 25.037012, DAC0: 0.000000, DAC1: 0.000000

Point: 0, Elapsed ms: 69, Temp (C): 21.790807

Point: 1, Elapsed ms: 137, Temp (C): 21.249519

Point: 2, Elapsed ms: 206, Temp (C): 20.950166

Point: 3, Elapsed ms: 275, Temp (C): 20.950013

Point: 4, Elapsed ms: 343, Temp (C): 20.950044

Point: 5, Elapsed ms: 411, Temp (C): 20.952983

Point: 6, Elapsed ms: 480, Temp (C): 20.949615

Point: 7, Elapsed ms: 549, Temp (C): 20.949707

Point: 8, Elapsed ms: 617, Temp (C): 20.953014

Point: 9, Elapsed ms: 686, Temp (C): 20.945635

Cold junction temperature (C): 25.037012, DAC0: 0.000000, DAC1: 5.000000

Point: 0, Elapsed ms: 69, Temp (C): 21.797386

Point: 1, Elapsed ms: 137, Temp (C): 21.261365

Point: 2, Elapsed ms: 206, Temp (C): 20.951911

Point: 3, Elapsed ms: 274, Temp (C): 20.950197

Point: 4, Elapsed ms: 342, Temp (C): 20.952677

Point: 5, Elapsed ms: 411, Temp (C): 20.950227

Point: 6, Elapsed ms: 480, Temp (C): 20.952064

Point: 7, Elapsed ms: 548, Temp (C): 20.956259

Point: 8, Elapsed ms: 616, Temp (C): 20.956137

Point: 9, Elapsed ms: 685, Temp (C): 20.956259

Cold junction temperature (C): 25.037012, DAC0: 5.000000, DAC1: 0.000000

Point: 0, Elapsed ms: 69, Temp (C): 21.810359

Point: 1, Elapsed ms: 137, Temp (C): 21.275324

Point: 2, Elapsed ms: 206, Temp (C): 20.960515

Point: 3, Elapsed ms: 274, Temp (C): 20.958647

Point: 4, Elapsed ms: 343, Temp (C): 20.959046

Point: 5, Elapsed ms: 411, Temp (C): 20.958923

Point: 6, Elapsed ms: 480, Temp (C): 20.961587

Point: 7, Elapsed ms: 548, Temp (C): 20.966670

Point: 8, Elapsed ms: 617, Temp (C): 20.963669

Point: 9, Elapsed ms: 685, Temp (C): 20.961771

Cold junction temperature (C): 25.037012, DAC0: 5.000000, DAC1: 5.000000

Point: 0, Elapsed ms: 68, Temp (C): 21.811521

Point: 1, Elapsed ms: 137, Temp (C): 21.278997

Point: 2, Elapsed ms: 205, Temp (C): 20.964128

Point: 3, Elapsed ms: 274, Temp (C): 20.966700

Point: 4, Elapsed ms: 342, Temp (C): 20.965445

Point: 5, Elapsed ms: 411, Temp (C): 20.963761

Point: 6, Elapsed ms: 479, Temp (C): 20.966486

Point: 7, Elapsed ms: 548, Temp (C): 20.967251

Point: 8, Elapsed ms: 616, Temp (C): 20.968537

Point: 9, Elapsed ms: 685, Temp (C): 20.969180

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I have highlighted in red the first 2 AIN0 values read after reading the cold junction temperature. Note that the last 8 values each time are very close to 20.96 degrees. However, the first value is about 21.80, which is about 0.84 degrees too high. The second reading in each case if is about 20.26, which is about 0.31 degrees too high.

There is thus a voltage/temperature glitch after reading the cold junction temperature. When using AIN0\_RESOLUTION\_INDEX=11 the glitch is removed by reading the AIN0 voltage 2 times right after reading the device temperature.

Note that the final 8 temperatures in each test above are all very similar, and do not depend on the values of DAC0 and DAC1. This makes sense, because AIN2 and AIN3 are not being read in this case, so the DAC values do not matter.

I have omitted the stream output in the output shown above, because it does not show a problem when only reading AIN0 before the stream begins.

**Results of the test\_temp\_t7pro.c test program with ain0Resolution=8, channelsToRead=1, readingsPerLoop=50**

The following is the output of the program when ain0Resolution=8, channelsToRead=1 so it only reads AIN0 during the first phase of the program.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

>../../bin/linux-x86\_64/test\_temp\_t7pro 10.54.160.73 8 1 50

deviceType: LJM\_dtT7

connectionType: LJM\_ctETHERNET

serialNumber: 470028527

IP address: 10.54.160.73

port: 502

Maximum number of bytes per packet: 1040

Configuration:

ain0Resolution: 8

channelsToRead: 1

readingsPerLoop: 50

AIN0\_NEGATIVE\_CH : 1

AIN0\_RANGE : 0.010000

AIN0\_RESOLUTION\_INDEX : 8

AIN\_ALL\_SETTLING\_US : 2000

Cold junction temperature (C): 25.029688, DAC0: 0.000000, DAC1: 0.000000

Point: 0, Elapsed ms: 4, Temp (C): 21.893421

Point: 1, Elapsed ms: 7, Temp (C): 21.875787

Point: 2, Elapsed ms: 10, Temp (C): 21.850315

Point: 3, Elapsed ms: 14, Temp (C): 21.828762

Point: 4, Elapsed ms: 17, Temp (C): 21.801329

Point: 5, Elapsed ms: 21, Temp (C): 21.768017

Point: 6, Elapsed ms: 24, Temp (C): 21.769977

Point: 7, Elapsed ms: 28, Temp (C): 21.730785

Point: 8, Elapsed ms: 31, Temp (C): 21.703350

Point: 9, Elapsed ms: 35, Temp (C): 21.689633

Point: 10, Elapsed ms: 38, Temp (C): 21.666117

Point: 11, Elapsed ms: 42, Temp (C): 21.644560

Point: 12, Elapsed ms: 45, Temp (C): 21.609283

Point: 13, Elapsed ms: 49, Temp (C): 21.587725

Point: 14, Elapsed ms: 52, Temp (C): 21.550487

Point: 15, Elapsed ms: 56, Temp (C): 21.542648

Point: 16, Elapsed ms: 59, Temp (C): 21.519128

Point: 17, Elapsed ms: 63, Temp (C): 21.493648

Point: 18, Elapsed ms: 66, Temp (C): 21.458368

Point: 19, Elapsed ms: 69, Temp (C): 21.432886

Point: 20, Elapsed ms: 73, Temp (C): 21.391723

Point: 21, Elapsed ms: 76, Temp (C): 21.385843

Point: 22, Elapsed ms: 80, Temp (C): 21.330956

Point: 23, Elapsed ms: 83, Temp (C): 21.309393

Point: 24, Elapsed ms: 87, Temp (C): 21.299591

Point: 25, Elapsed ms: 90, Temp (C): 21.266264

Point: 26, Elapsed ms: 94, Temp (C): 21.229017

Point: 27, Elapsed ms: 97, Temp (C): 21.221174

Point: 28, Elapsed ms: 101, Temp (C): 21.170201

Point: 29, Elapsed ms: 104, Temp (C): 21.152556

Point: 30, Elapsed ms: 108, Temp (C): 21.109422

Point: 31, Elapsed ms: 111, Temp (C): 21.076090

Point: 32, Elapsed ms: 115, Temp (C): 21.056483

Point: 33, Elapsed ms: 118, Temp (C): 21.001581

Point: 34, Elapsed ms: 122, Temp (C): 20.987854

Point: 35, Elapsed ms: 125, Temp (C): 20.972167

Point: 36, Elapsed ms: 129, Temp (C): 20.940793

Point: 37, Elapsed ms: 132, Temp (C): 20.885885

Point: 38, Elapsed ms: 135, Temp (C): 20.880002

Point: 39, Elapsed ms: 139, Temp (C): 20.846663

Point: 40, Elapsed ms: 142, Temp (C): 20.832935

Point: 41, Elapsed ms: 146, Temp (C): 20.803518

Point: 42, Elapsed ms: 149, Temp (C): 20.799596

Point: 43, Elapsed ms: 153, Temp (C): 20.825091

Point: 44, Elapsed ms: 156, Temp (C): 20.805480

Point: 45, Elapsed ms: 160, Temp (C): 20.805480

Point: 46, Elapsed ms: 163, Temp (C): 20.811363

Point: 47, Elapsed ms: 167, Temp (C): 20.815285

Point: 48, Elapsed ms: 170, Temp (C): 20.813324

Point: 49, Elapsed ms: 174, Temp (C): 20.789790

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I have highlighted in red the first 41 AIN0 values read after reading the cold junction temperature. Note that points 41-49 values are very close 20.80 degrees. However, the first value is about 21.89, which is about 1.09 degrees too high. Readings 1 to 40 are monotonically decreasing over a time period of 142 ms.

This shows that the voltage/temperature glitch after reading the cold junction temperature depends on the value of AIN0\_RESOLUTION\_INDEX. It appears that perhaps it always takes about 140 ms to recover after reading the cold junction temperature This is only 2 readings when AIN0\_RESOLUTION\_INDEX=11 but it is 40 readings when AIN0\_RESOLUTION\_INDEX=8.

**Results of the test\_temp\_t7pro.c test program with ain0Resolution=11, channelsToRead=4**

The following is the output of the program when numChannelsToRead=4 so it reads AIN0, AIN2, and AIN3 during the first phase of the program.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

>../../bin/linux-x86\_64/test\_temp\_t7pro 10.54.160.73 11 4 10

deviceType: LJM\_dtT7

connectionType: LJM\_ctETHERNET

serialNumber: 470028527

IP address: 10.54.160.73

port: 502

Maximum number of bytes per packet: 1040

Configuration:

ain0Resolution: 11

channelsToRead: 4

readingsPerLoop: 10

AIN0\_NEGATIVE\_CH : 1

AIN2\_NEGATIVE\_CH : 199

AIN3\_NEGATIVE\_CH : 199

AIN0\_RANGE : 0.010000

AIN2\_NEGATIVE\_CH : 10.000000

AIN3\_NEGATIVE\_CH : 10.000000

AIN0\_RESOLUTION\_INDEX : 11

AIN2\_RESOLUTION\_INDEX: 0

AIN3\_RESOLUTION\_INDEX: 0

AIN\_ALL\_SETTLING\_US : 2000

Cold junction temperature (C): 25.022363, DAC0: 0.000000, DAC1: 0.000000

Point: 0, Elapsed ms: 85, Temp (C): 21.786958, 0.001492, 0.002379

Point: 1, Elapsed ms: 169, Temp (C): 22.138000, 0.001473, 0.002346

Point: 2, Elapsed ms: 254, Temp (C): 22.249149, 0.001464, 0.002366

Point: 3, Elapsed ms: 339, Temp (C): 22.276582, 0.001475, 0.002360

Point: 4, Elapsed ms: 424, Temp (C): 22.288448, 0.001510, 0.002360

Point: 5, Elapsed ms: 509, Temp (C): 22.283953, 0.001430, 0.002381

Point: 6, Elapsed ms: 594, Temp (C): 22.284197, 0.001433, 0.002345

Point: 7, Elapsed ms: 679, Temp (C): 22.284106, 0.001502, 0.002329

Point: 8, Elapsed ms: 764, Temp (C): 22.292210, 0.001471, 0.002325

Point: 9, Elapsed ms: 849, Temp (C): 22.283953, 0.001455, 0.002355

Cold junction temperature (C): 25.022363, DAC0: 0.000000, DAC1: 5.000000

Point: 0, Elapsed ms: 85, Temp (C): 22.048529, 0.001475, 4.976861

Point: 1, Elapsed ms: 170, Temp (C): 21.784571, 0.001453, 4.977045

Point: 2, Elapsed ms: 255, Temp (C): 21.780471, 0.001479, 4.977045

Point: 3, Elapsed ms: 340, Temp (C): 21.781420, 0.001476, 4.979049

Point: 4, Elapsed ms: 425, Temp (C): 21.786407, 0.001457, 4.979655

Point: 5, Elapsed ms: 510, Temp (C): 21.784020, 0.001484, 4.979133

Point: 6, Elapsed ms: 595, Temp (C): 21.780961, 0.001453, 4.977036

Point: 7, Elapsed ms: 680, Temp (C): 21.772577, 0.001449, 4.977009

Point: 8, Elapsed ms: 765, Temp (C): 21.772516, 0.001507, 4.976675

Point: 9, Elapsed ms: 850, Temp (C): 21.769120, 0.001491, 4.977067

Cold junction temperature (C): 25.029688, DAC0: 5.000000, DAC1: 0.000000

Point: 0, Elapsed ms: 85, Temp (C): 21.900187, 4.975275, 0.002372

Point: 1, Elapsed ms: 170, Temp (C): 22.006832, 4.975226, 0.002406

Point: 2, Elapsed ms: 254, Temp (C): 22.035189, 4.975229, 0.002384

Point: 3, Elapsed ms: 339, Temp (C): 22.041032, 4.975167, 0.002372

Point: 4, Elapsed ms: 424, Temp (C): 22.039625, 4.975097, 0.002387

Point: 5, Elapsed ms: 509, Temp (C): 22.042561, 4.975207, 0.002351

Point: 6, Elapsed ms: 594, Temp (C): 22.044305, 4.975301, 0.002435

Point: 7, Elapsed ms: 679, Temp (C): 22.044121, 4.975230, 0.002392

Point: 8, Elapsed ms: 764, Temp (C): 22.043326, 4.975250, 0.002366

Point: 9, Elapsed ms: 849, Temp (C): 22.045376, 4.975190, 0.002383

Cold junction temperature (C): 25.022363, DAC0: 5.000000, DAC1: 5.000000

Point: 0, Elapsed ms: 85, Temp (C): 21.901781, 4.975060, 4.978411

Point: 1, Elapsed ms: 170, Temp (C): 21.662331, 4.975169, 4.978533

Point: 2, Elapsed ms: 255, Temp (C): 21.654252, 4.975253, 4.977935

Point: 3, Elapsed ms: 340, Temp (C): 21.657741, 4.975225, 4.981040

Point: 4, Elapsed ms: 425, Temp (C): 21.655966, 4.975281, 4.980724

Point: 5, Elapsed ms: 510, Temp (C): 21.660495, 4.975218, 4.980614

Point: 6, Elapsed ms: 594, Temp (C): 21.660923, 4.975247, 4.981161

Point: 7, Elapsed ms: 679, Temp (C): 21.661994, 4.975245, 4.977890

Point: 8, Elapsed ms: 764, Temp (C): 21.660984, 4.975256, 4.978516

Point: 9, Elapsed ms: 849, Temp (C): 21.659883, 4.975251, 4.978158

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The output above demonstrates that there is cross-talk about AIN0, and AIN2/AIN3.

This table shows the temperature measured by AIN0 as a function of the voltages applied to AIN2 and AIN3.

|  |  |  |
| --- | --- | --- |
| **AIN2** | **AIN3** | **AIN0 temperature** |
| 0 | 0 | 22.28 |
| 0 | 5 | 21.78 |
| 5 | 0 | 22.04 |
| 5 | 5 | 21.66 |

So the temperature measured on AIN0 differs by 0.62 degrees when the AIN2/AIN3 voltages are changed from [0,0] to [5,5].

When channelsToRead is 4 there is also a problem with the stream input. This is the output of that part of the program. For brevity I have only showed the first 100 values captured in the stream, out of 256 total.

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Configuring stream:

Setting STREAM\_TRIGGER\_INDEX to 0

Setting STREAM\_CLOCK\_SOURCE to 0

Setting STREAM\_RESOLUTION\_INDEX to 8

Setting STREAM\_SETTLING\_US to 0.000000

Starting stream:

scan rate: 500.00 Hz (500.00 sample rate)

number of scans : 256

number of samples: 256

Stream burst complete:

Actual scanRate was: 500.000000

256 scans over approximately 608 milliseconds

Stream data:

Point 0: Temp (C): 21.856660

Point 1: Temp (C): 21.856660

Point 2: Temp (C): 21.848822

Point 3: Temp (C): 21.833147

Point 4: Temp (C): 21.786120

Point 5: Temp (C): 21.801796

Point 6: Temp (C): 21.770444

Point 7: Temp (C): 21.778282

Point 8: Temp (C): 21.762606

Point 9: Temp (C): 21.739091

Point 10: Temp (C): 21.746929

Point 11: Temp (C): 21.715575

Point 12: Temp (C): 21.707737

Point 13: Temp (C): 21.684221

Point 14: Temp (C): 21.660704

Point 15: Temp (C): 21.645026

Point 16: Temp (C): 21.613670

Point 17: Temp (C): 21.629348

Point 18: Temp (C): 21.613670

Point 19: Temp (C): 21.613670

Point 20: Temp (C): 21.590152

Point 21: Temp (C): 21.574473

Point 22: Temp (C): 21.535275

Point 23: Temp (C): 21.535275

Point 24: Temp (C): 21.519595

Point 25: Temp (C): 21.503916

Point 26: Temp (C): 21.488236

Point 27: Temp (C): 21.480395

Point 28: Temp (C): 21.441194

Point 29: Temp (C): 21.417672

Point 30: Temp (C): 21.409832

Point 31: Temp (C): 21.394151

Point 32: Temp (C): 21.378469

Point 33: Temp (C): 21.362787

Point 34: Temp (C): 21.339264

Point 35: Temp (C): 21.339264

Point 36: Temp (C): 21.323582

Point 37: Temp (C): 21.323582

Point 38: Temp (C): 21.276534

Point 39: Temp (C): 21.268692

Point 40: Temp (C): 21.237325

Point 41: Temp (C): 21.229484

Point 42: Temp (C): 21.221642

Point 43: Temp (C): 21.213800

Point 44: Temp (C): 21.166747

Point 45: Temp (C): 21.158905

Point 46: Temp (C): 21.135378

Point 47: Temp (C): 21.143220

Point 48: Temp (C): 21.111850

Point 49: Temp (C): 21.111850

Point 50: Temp (C): 21.072636

Point 51: Temp (C): 21.072636

Point 52: Temp (C): 21.041264

Point 53: Temp (C): 21.025578

Point 54: Temp (C): 21.009891

Point 55: Temp (C): 20.986361

Point 56: Temp (C): 20.954986

Point 57: Temp (C): 20.962830

Point 58: Temp (C): 20.954986

Point 59: Temp (C): 20.923611

Point 60: Temp (C): 20.915767

Point 61: Temp (C): 20.900079

Point 62: Temp (C): 20.884391

Point 63: Temp (C): 20.876547

Point 64: Temp (C): 20.892235

Point 65: Temp (C): 20.884391

Point 66: Temp (C): 20.900079

Point 67: Temp (C): 20.892235

Point 68: Temp (C): 20.892235

Point 69: Temp (C): 20.907923

Point 70: Temp (C): 20.907923

Point 71: Temp (C): 20.884391

Point 72: Temp (C): 20.907923

Point 73: Temp (C): 20.892235

Point 74: Temp (C): 20.876547

Point 75: Temp (C): 20.876547

Point 76: Temp (C): 20.884391

Point 77: Temp (C): 20.892235

Point 78: Temp (C): 20.907923

Point 79: Temp (C): 20.923611

Point 80: Temp (C): 20.884391

Point 81: Temp (C): 20.900079

Point 82: Temp (C): 20.892235

Point 83: Temp (C): 20.923611

Point 84: Temp (C): 20.884391

Point 85: Temp (C): 20.907923

Point 86: Temp (C): 20.884391

Point 87: Temp (C): 20.907923

Point 88: Temp (C): 20.900079

Point 89: Temp (C): 20.884391

Point 90: Temp (C): 20.900079

Point 91: Temp (C): 20.907923

Point 92: Temp (C): 20.900079

Point 93: Temp (C): 20.900079

Point 94: Temp (C): 20.907923

Point 95: Temp (C): 20.915767

Point 96: Temp (C): 20.900079

Point 97: Temp (C): 20.907923

Point 98: Temp (C): 20.915767

Point 99: Temp (C): 20.907923

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Note that the first temperature value in the scan is 21.86 degrees. The values then continuously decrease to about point 62 where the temperature is 20.88. The values after that are quite constant. So the temperature drops by 0.98 degrees in the first 62 points = 124 ms.

This drop does not occur if numSamplesPerRead=1, so it is clearly caused by the 5 V values read immediately before the scan from AIN2 and AIN3.

**Results of the test\_temp\_t7pro.c test program with numChannelsToRead=14**

The following is the output of the program when numChannelsToRead=4 so it reads AIN0, and AIN2-AIN13 during the first phase of the program. AIN4-AIN13 have no connection, so they are open inputs.

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corvette:labjack/iocBoot/iocLabJack\_T7Pro>../../bin/linux-x86\_64/test\_temp\_t7pro 10.54.160.73 11 14 10

deviceType: LJM\_dtT7

connectionType: LJM\_ctETHERNET

serialNumber: 470028527

IP address: 10.54.160.73

port: 502

Maximum number of bytes per packet: 1040

Configuration:

ain0Resolution: 11

channelsToRead: 14

readingsPerLoop: 10

AIN0\_NEGATIVE\_CH : 1

AIN2\_NEGATIVE\_CH : 199

AIN3\_NEGATIVE\_CH : 199

AIN4\_NEGATIVE\_CH : 199

AIN5\_NEGATIVE\_CH : 199

AIN6\_NEGATIVE\_CH : 199

AIN7\_NEGATIVE\_CH : 199

AIN8\_NEGATIVE\_CH : 199

AIN9\_NEGATIVE\_CH : 199

AIN10\_NEGATIVE\_CH : 199

AIN11\_NEGATIVE\_CH : 199

AIN12\_NEGATIVE\_CH : 199

AIN13\_NEGATIVE\_CH : 199

AIN0\_RANGE : 0.010000

AIN2\_NEGATIVE\_CH : 10.000000

AIN3\_NEGATIVE\_CH : 10.000000

AIN4\_NEGATIVE\_CH : 10.000000

AIN5\_NEGATIVE\_CH : 10.000000

AIN6\_NEGATIVE\_CH : 10.000000

AIN7\_NEGATIVE\_CH : 10.000000

AIN8\_NEGATIVE\_CH : 10.000000

AIN9\_NEGATIVE\_CH : 10.000000

AIN10\_NEGATIVE\_CH : 10.000000

AIN11\_NEGATIVE\_CH : 10.000000

AIN12\_NEGATIVE\_CH : 10.000000

AIN13\_NEGATIVE\_CH : 10.000000

AIN0\_RESOLUTION\_INDEX : 11

AIN2\_RESOLUTION\_INDEX: 0

AIN3\_RESOLUTION\_INDEX: 0

AIN4\_RESOLUTION\_INDEX: 0

AIN5\_RESOLUTION\_INDEX: 0

AIN6\_RESOLUTION\_INDEX: 0

AIN7\_RESOLUTION\_INDEX: 0

AIN8\_RESOLUTION\_INDEX: 0

AIN9\_RESOLUTION\_INDEX: 0

AIN10\_RESOLUTION\_INDEX: 0

AIN11\_RESOLUTION\_INDEX: 0

AIN12\_RESOLUTION\_INDEX: 0

AIN13\_RESOLUTION\_INDEX: 0

AIN\_ALL\_SETTLING\_US : 2000

Cold junction temperature (C): 25.000452, DAC0: 0.000000, DAC1: 0.000000

Point: 0, Elapsed ms: 140, Temp (C): 21.759245, 0.001538, 0.002367, -0.896480, -1.512641, -2.065677, -2.764777, -3.309640, -3.755492, -4.313461, -4.818801, -5.564435, -5.873859

Point: 1, Elapsed ms: 280, Temp (C): 22.700520, 0.001501, 0.002346, -1.609704, -2.549555, -3.777394, -4.857583, -6.108878, -7.185974, -8.569942, -9.710835, -10.588195, -10.588212

Point: 2, Elapsed ms: 420, Temp (C): 25.317262, 0.001418, 0.002310, -1.645367, -2.596976, -3.929456, -5.072390, -6.476028, -7.670351, -9.362840, -10.496775, -10.588230, -10.588200

Point: 3, Elapsed ms: 560, Temp (C): 25.342600, 0.001386, 0.002367, -1.639167, -2.581766, -3.917800, -5.059043, -6.469589, -7.673324, -9.406198, -10.524380, -10.588243, -10.588255

Point: 4, Elapsed ms: 699, Temp (C): 25.343456, 0.001418, 0.002315, -1.639845, -2.583468, -3.921590, -5.062274, -6.478061, -7.681709, -9.425128, -10.535548, -10.588213, -10.588166

Point: 5, Elapsed ms: 839, Temp (C): 25.343242, 0.001416, 0.002345, -1.641580, -2.586631, -3.926709, -5.066639, -6.477593, -7.682079, -9.422934, -10.531590, -10.588225, -10.588263

Point: 6, Elapsed ms: 979, Temp (C): 25.342783, 0.001415, 0.002346, -1.639825, -2.585303, -3.924371, -5.066374, -6.479215, -7.684926, -9.425642, -10.534734, -10.588242, -10.588224

Point: 7, Elapsed ms: 1119, Temp (C): 25.343272, 0.001405, 0.002340, -1.642548, -2.586915, -3.925676, -5.070730, -6.484157, -7.689532, -9.433020, -10.537790, -10.588247, -10.588268

Point: 8, Elapsed ms: 1259, Temp (C): 25.342814, 0.001428, 0.002372, -1.640529, -2.583771, -3.921003, -5.063105, -6.477538, -7.685652, -9.428562, -10.535193, -10.588209, -10.588239

Point: 9, Elapsed ms: 1399, Temp (C): 25.342997, 0.001484, 0.002297, -1.640570, -2.584728, -3.920371, -5.060566, -6.473810, -7.676403, -9.413683, -10.527908, -10.588239, -10.588180

Cold junction temperature (C): 25.015070, DAC0: 0.000000, DAC1: 5.000000

Point: 0, Elapsed ms: 140, Temp (C): 22.239211, 0.001426, 4.977061, 1.343378, 1.214878, -0.534578, -1.575369, -3.120018, -4.378692, -5.911762, -7.256826, -8.951974, -10.224951

Point: 1, Elapsed ms: 280, Temp (C): 24.226354, 0.001439, 4.979449, 1.649323, 1.567946, 0.004812, -0.921355, -2.303649, -3.435951, -4.813317, -6.043005, -7.607060, -8.686831

Point: 2, Elapsed ms: 419, Temp (C): 24.559293, 0.001446, 4.977990, 1.661294, 1.578073, 0.047894, -0.864933, -2.187686, -3.292996, -4.627322, -5.812408, -7.317461, -8.342025

Point: 3, Elapsed ms: 559, Temp (C): 24.428870, 0.001416, 4.979685, 1.656567, 1.571978, 0.043333, -0.870710, -2.184582, -3.288164, -4.612872, -5.791844, -7.279310, -8.293591

Point: 4, Elapsed ms: 699, Temp (C): 24.431984, 0.001420, 4.976598, 1.656882, 1.572388, 0.044173, -0.869402, -2.181919, -3.285944, -4.607094, -5.788176, -7.275204, -8.293027

Point: 5, Elapsed ms: 839, Temp (C): 24.414493, 0.001378, 4.978474, 1.656858, 1.571782, 0.042434, -0.871593, -2.186803, -3.286453, -4.609796, -5.786361, -7.274036, -8.288240

Point: 6, Elapsed ms: 979, Temp (C): 24.412112, 0.001470, 4.979568, 1.656591, 1.568751, 0.038298, -0.877246, -2.191239, -3.293251, -4.615905, -5.794734, -7.282416, -8.297605

Point: 7, Elapsed ms: 1118, Temp (C): 24.423315, 0.001476, 4.976527, 1.655909, 1.572738, 0.044152, -0.869380, -2.182207, -3.284377, -4.607819, -5.786895, -7.272815, -8.288288

Point: 8, Elapsed ms: 1258, Temp (C): 24.418004, 0.001395, 4.981185, 1.657184, 1.569313, 0.038354, -0.875385, -2.189469, -3.292570, -4.617141, -5.795462, -7.284399, -8.301249

Point: 9, Elapsed ms: 1398, Temp (C): 24.429420, 0.001415, 4.979105, 1.657436, 1.569603, 0.040721, -0.876708, -2.192527, -3.294270, -4.620968, -5.801531, -7.291837, -8.307774

Cold junction temperature (C): 25.015070, DAC0: 5.000000, DAC1: 0.000000

Point: 0, Elapsed ms: 140, Temp (C): 22.220035, 4.975267, 0.002321, 0.325755, -1.243373, -2.110239, -3.211923, -4.352496, -5.449403, -6.789399, -7.908349, -9.610177, -10.587397

Point: 1, Elapsed ms: 280, Temp (C): 24.370628, 4.975202, 0.002335, 0.193792, -1.483375, -2.457861, -3.676946, -4.937409, -6.123203, -7.592715, -8.774628, -10.475363, -10.588250

Point: 2, Elapsed ms: 420, Temp (C): 25.358059, 4.975224, 0.002350, 0.197750, -1.484072, -2.482815, -3.723579, -5.014190, -6.228453, -7.750977, -8.972870, -10.574829, -10.588245

Point: 3, Elapsed ms: 559, Temp (C): 25.357661, 4.975209, 0.002352, 0.198618, -1.481009, -2.479793, -3.716272, -5.005458, -6.220713, -7.750852, -8.978873, -10.575027, -10.588242

Point: 4, Elapsed ms: 699, Temp (C): 25.357661, 4.975220, 0.002329, 0.198817, -1.481629, -2.480306, -3.718268, -5.009841, -6.222784, -7.752504, -8.982069, -10.576529, -10.588230

Point: 5, Elapsed ms: 839, Temp (C): 25.357936, 4.975218, 0.002305, 0.199304, -1.480219, -2.480232, -3.717814, -5.007952, -6.221581, -7.753005, -8.979568, -10.575300, -10.588223

Point: 6, Elapsed ms: 979, Temp (C): 25.357111, 4.975160, 0.002282, 0.199902, -1.479519, -2.479757, -3.717415, -5.007581, -6.222113, -7.752057, -8.980761, -10.575808, -10.588184

Point: 7, Elapsed ms: 1119, Temp (C): 25.357753, 4.975194, 0.002350, 0.198512, -1.481717, -2.480147, -3.719014, -5.011081, -6.225216, -7.754557, -8.981090, -10.575600, -10.588203

Point: 8, Elapsed ms: 1259, Temp (C): 25.357325, 4.975016, 0.002314, 0.201411, -1.478975, -2.477393, -3.715668, -5.008770, -6.224863, -7.756947, -8.986816, -10.577479, -10.588217

Point: 9, Elapsed ms: 1399, Temp (C): 25.357478, 4.975132, 0.002356, 0.199629, -1.477884, -2.475364, -3.714940, -5.006880, -6.224989, -7.755636, -8.985093, -10.576838, -10.588215

Cold junction temperature (C): 25.015070, DAC0: 5.000000, DAC1: 5.000000

Point: 0, Elapsed ms: 140, Temp (C): 22.246001, 4.975229, 4.981076, 2.827709, 1.978243, 0.514803, -0.612523, -2.070345, -3.312071, -4.748562, -6.076624, -7.667850, -8.989873

Point: 1, Elapsed ms: 280, Temp (C): 23.171926, 4.974715, 4.976590, 3.061273, 2.248126, 0.984186, -0.064931, -1.322004, -2.474290, -3.801643, -5.010243, -6.483092, -7.554023

Point: 2, Elapsed ms: 419, Temp (C): 24.291747, 4.975230, 4.979346, 3.070092, 2.253170, 1.022293, -0.024132, -1.219930, -2.347093, -3.631652, -4.806972, -6.216955, -7.265284

Point: 3, Elapsed ms: 559, Temp (C): 24.267355, 4.975208, 4.980194, 3.067344, 2.250754, 1.019105, -0.028547, -1.216407, -2.338698, -3.615974, -4.783222, -6.180718, -7.226846

Point: 4, Elapsed ms: 699, Temp (C): 24.269705, 4.975201, 4.978005, 3.068215, 2.250830, 1.019462, -0.029504, -1.221649, -2.346501, -3.621501, -4.792151, -6.189700, -7.232816

Point: 5, Elapsed ms: 839, Temp (C): 24.269553, 4.975204, 4.979425, 3.067230, 2.249512, 1.016665, -0.033779, -1.222061, -2.345509, -3.621453, -4.787698, -6.183477, -7.226748

Point: 6, Elapsed ms: 979, Temp (C): 24.269034, 4.975070, 4.977649, 3.066576, 2.248946, 1.017740, -0.028607, -1.216403, -2.340098, -3.616514, -4.786355, -6.183091, -7.229941

Point: 7, Elapsed ms: 1118, Temp (C): 24.265584, 4.975177, 4.980429, 3.067428, 2.249852, 1.017868, -0.031420, -1.219412, -2.343406, -3.620365, -4.789671, -6.189280, -7.233389

Point: 8, Elapsed ms: 1258, Temp (C): 24.263752, 4.975150, 4.978453, 3.068332, 2.249475, 1.015502, -0.033996, -1.224533, -2.349557, -3.626755, -4.794822, -6.192195, -7.237401

Point: 9, Elapsed ms: 1398, Temp (C): 24.262623, 4.974801, 4.976472, 3.069151, 2.251743, 1.020213, -0.030246, -1.222087, -2.347721, -3.625799, -4.793406, -6.190526, -7.234382 \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

In this case the glitch after reading the cold junction temperature is much larger. For clarity here are just the first 6 temperature measurements for the first cycle above when the DAC voltages are both 0.

Point: 0, Elapsed ms: 140, Temp (C): 21.759245

Point: 1, Elapsed ms: 280, Temp (C): 22.700520

Point: 2, Elapsed ms: 420, Temp (C): 25.317262

Point: 3, Elapsed ms: 560, Temp (C): 25.342600

Point: 4, Elapsed ms: 699, Temp (C): 25.343456

Point: 5, Elapsed ms: 839, Temp (C): 25.343242

So the first point has a temperature that is 3.6 degrees lower than the values of points 3 and later.

The stream output also shows a large change at the beginning:

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Configuring stream:

Setting STREAM\_TRIGGER\_INDEX to 0

Setting STREAM\_CLOCK\_SOURCE to 0

Setting STREAM\_RESOLUTION\_INDEX to 8

Setting STREAM\_SETTLING\_US to 0.000000

Starting stream:

scan rate: 500.00 Hz (500.00 sample rate)

number of scans : 256

number of samples: 256

Stream burst complete:

Actual scanRate was: 500.000000

256 scans over approximately 609 milliseconds

Stream data:

Point 0: Temp (C): 23.000863

Point 1: Temp (C): 23.040010

Point 2: Temp (C): 23.040010

Point 3: Temp (C): 23.055669

Point 4: Temp (C): 23.079156

Point 5: Temp (C): 23.094814

Point 6: Temp (C): 23.133958

Point 7: Temp (C): 23.157444

Point 8: Temp (C): 23.188758

Point 9: Temp (C): 23.196586

Point 10: Temp (C): 23.196586

Point 11: Temp (C): 23.298349

Point 12: Temp (C): 23.360967

Point 13: Temp (C): 25.253957

Point 14: Temp (C): 25.355719

Point 15: Temp (C): 25.355719

Point 16: Temp (C): 25.355719

Point 17: Temp (C): 25.355719

Point 18: Temp (C): 25.355719

Point 19: Temp (C): 25.355719

Point 20: Temp (C): 25.355719

Point 21: Temp (C): 25.355719

Point 22: Temp (C): 25.355719

Point 23: Temp (C): 25.355719

Point 24: Temp (C): 25.355719

Point 25: Temp (C): 25.355719\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Note that the first 12 points have temperatures of 23.00-23.36. Then at point 13 the temperature jumps by 2.06 degrees from point 12. This behavior is completely reproducible.