UEI Application Notes:

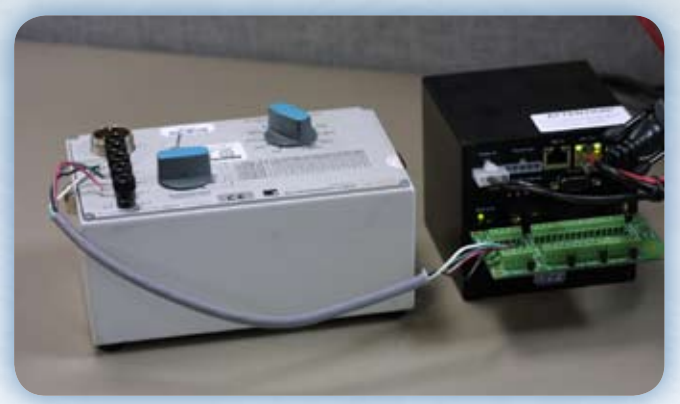
AI-208 Strain Gage Measurement

App Note #024

United Electronic Industries

Introduction

Purpose: This paper outlines how to use an AI-208 layer, STP-AI-208 terminal, and a four-wire full-bridge strain-gage simulator, for voltage-with-excitation measurements.



Test Setup Devices

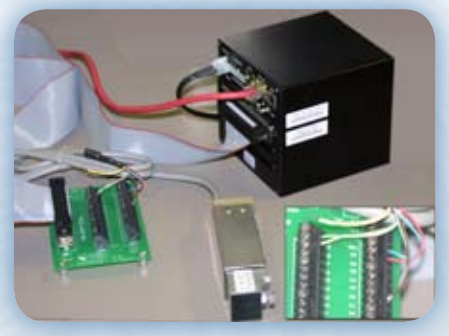
Our test setup consisted of

- (1) Four-wire full-bridge transducer simulator that can produce 0, 1, and 2 mV signals.
- (1) DNA-CM5 PowerDNA Cube, equipped with
  (1) DNA-AI-208 Analog Input layer, connected to
  (1) DNA-STP-AI-208 terminal panel
- (1) Host PC connected to the DNA-CM5 (via Ethernet cable)

Addendum: Other tested Load-Cells & Simulators (see right)

Our following transducers were also used to perform the same tests:

- *The high-precision HBM K3607 load-cell simulator (six-wire)*
- *The Load Cell Central PVS-10 simulator (four-wire)*
- *The HBM -3kg standard load cell (six-wire)*



Test Setup: This section presumes that the PowerDNA Cube is already configured to, and has been tested to, connect to a Host PC via Ethernet.

PowerDNA Cube — Host PC Connectivity

Connect the Ethernet line to your PC. Connect the DNA-STP-AI-208 terminal to the DNA-AI-208 layer via the DB37 connector on the cube. For multiple layers, you may want to use DNA-CBL-37 flat ribbon cables.

Supply power to the PowerDNA cube (we used a DNA-PSU-24 brick).

Run the PowerDNA Explorer application from:

Start Menu » Programs » UEI » PowerDNA » PowerDNA Explorer

Scan the network, and connect to your cube. Select the AI-208 layer. From the menu, go to:

Network » Read Input Data:

Values should display in the Input tab, indicating that the layer is functional. We incremented our precision voltage source between 0.0000V and 1.2500V, to double-check the input line for errors.

We knew that the layer was working correctly when PowerDNA Explorer reflected the values on the voltage source to within the datasheet's specification.

Note that although this layer is calibrated, it does not mean that the layer is calibrated for the strain gage. More on this in subsequent chapters.

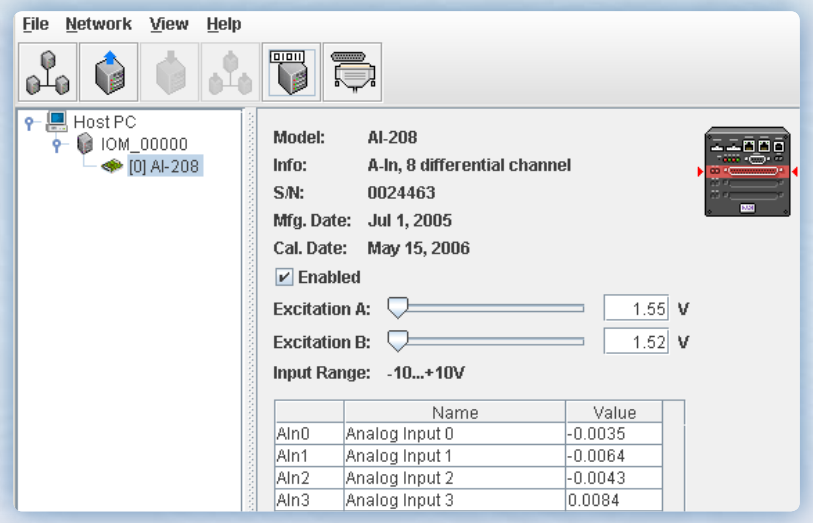


Figure: Floating values read when testing reading on the AI-208.

Terminal Setup for the DNA-STP-AI-208

The datasheet for the DNA-STP-AI-208 terminal and DNA-AI-208 layer contain block-level diagrams of the board and tables for configuration options. They are available online.

Notice the legend/key for wiring on the left side of the DB-37 connector:

- *PS..+* *Excitation Sense +*
- *P..+* *Excitation +*
- *S..+* *Signal +*
- *S..-* *Signal -*
- *AGND* *Excitation -*

For a four-wire, full-bridge simulator, the excitation sense line (PS..+) is not used, and therefore connected to the Excitation line (P..+) by setting the jumper J is ON. See the DNA-STP-AI-208 datasheet for jumper settings.

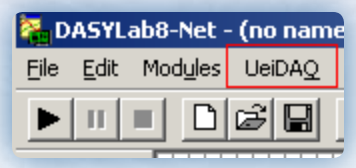
Screw the thermocouple leads into the terminal panel.

Connect DNA-STP-AI-208 terminal to the cube's DNA-AI-208 layer.

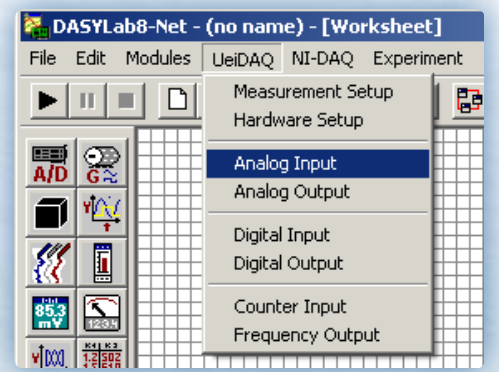
You are now ready to take measurements with the AI-208 and DNA-STP-AI-208 and your four-wire transducer.

Measuring with DASYLab

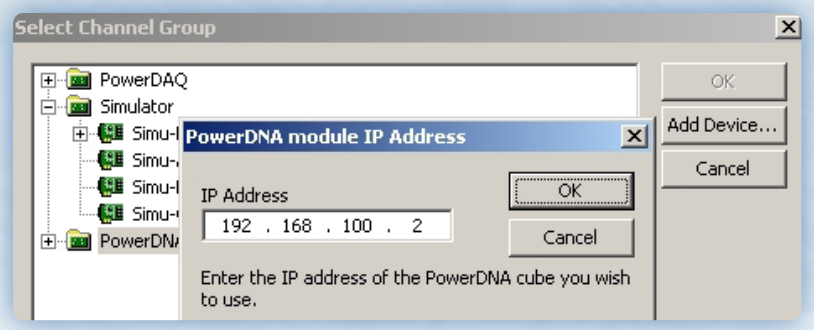
DASYLab Setup: You should have the PowerDNA and Framework drivers (both included in the PowerDNA Software Suite) installed; a menu "UeiDAQ" should be visible in the DASYLab menubar:



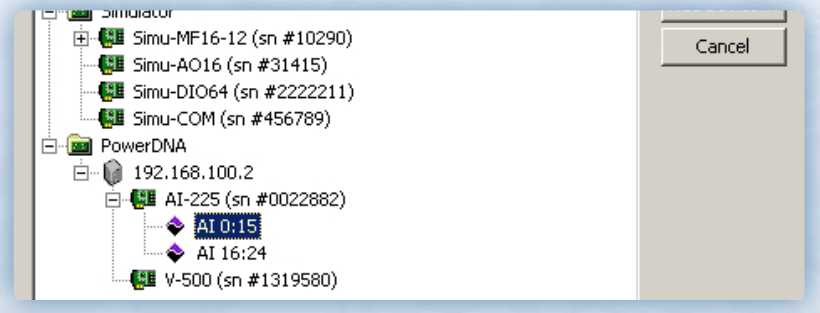
Select the "Analog Input" module from UeiDAQ menu:



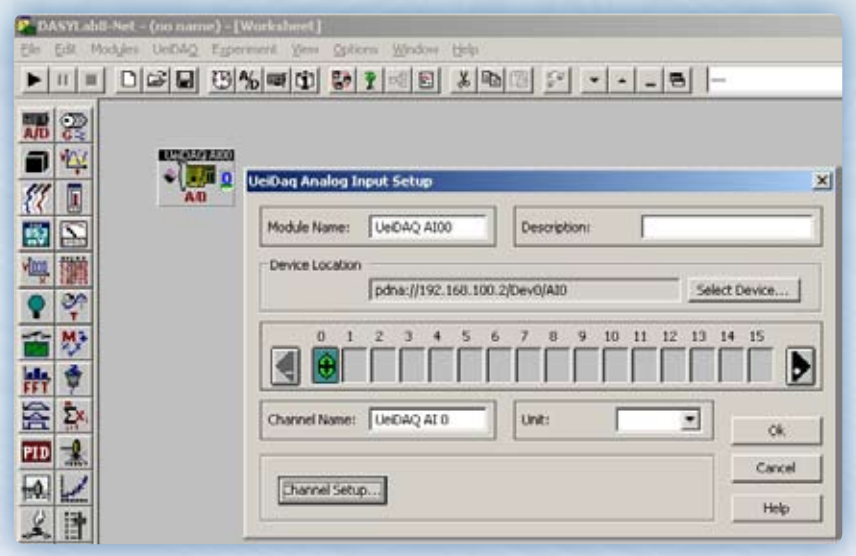
Click in an open space on the worksheet to drop the AI module.
Select PowerDNA > Add Device... and add your Cube's IP.



Browse the Cube devices to select the AI channels you want to use:



An Analog Input block is created.
Double click on this block to open the property page:



Notice the arrow on the right-hand side with a + sign.
This adds more channels; you may do this later—first set up this first channel.

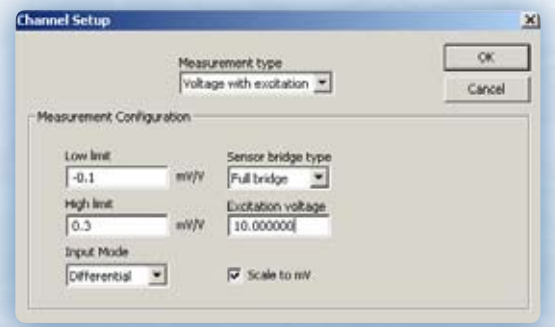
Press the Channel Setup button to adjust the Analog Input parameters
(changes are applied to the currently selected channel!)

Under Channel Setup, change the Measurement type to Voltage with Excitation.

In the Channel Setup's measurement configuration:

- *Select bridge type as Full Bridge from the drop-down list.*
- *Set the Input Mode to Differential*
- *Check the Scale to mV checkbox*
- *Set low and high measurement limits for the transducer. My transducer has a range of 0 to 2mv, so I will use –1 to 3 mV/V for my example. This automatically sets the gain.*
- *Set the excitation voltage for the bridge; take care, as setting an even channel's excitation voltage changes all even channels excitation voltage. The same applies to odd channels.*

Your final channel setup should resemble the following:



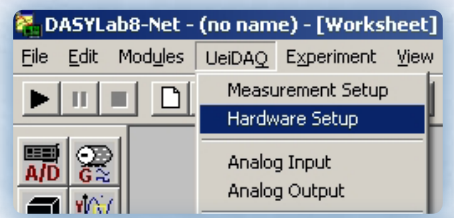
Note: *Changing the excitation voltage for a even layer changes the excitation voltage for all even layers; for odd the change applies to all odd layers.*

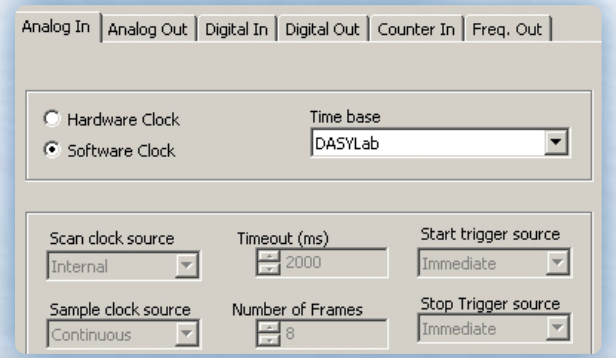
Click OK to commit the changes to the Channel Setup.
Click OK again to accept the Analog Input setup.

Next, adjust the timing type from the menu:

UeiDaq»Hardware Setup

A selection page will allow tuning data acquisition settings:

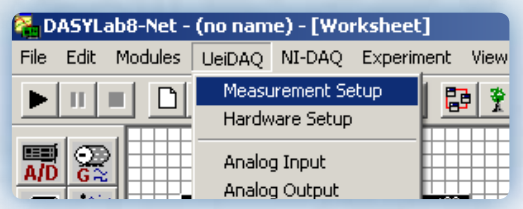




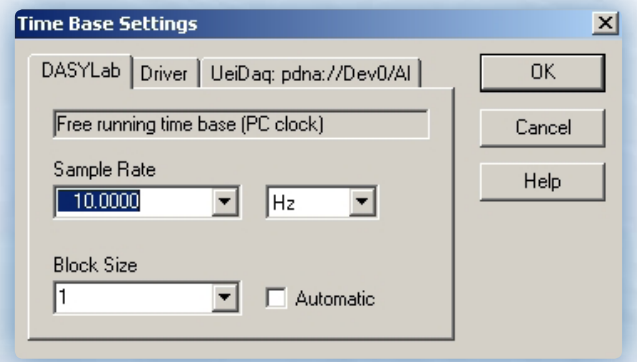
Note: *Strain gage measurements are a slow process. Select the more flexible Software Clock, and let DASYLab determine the time base. We can set up a hardware clock later, if necessary.*

To adjust the time base (sampling rate), from the menu:

UeiDAQ»Measurement Setup

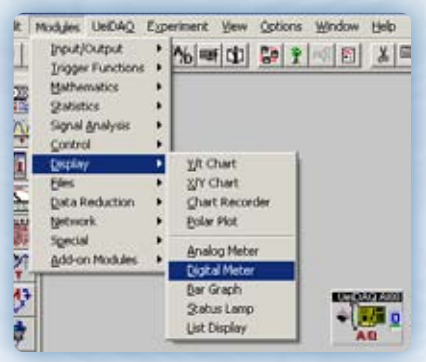


Select the "DASYLab" tab, and adjust your sample rate. The setting for our measurement is 10 Hz; as there is less hardware noise at lower sampling rates, and thermocouples do not require a high sampling rate

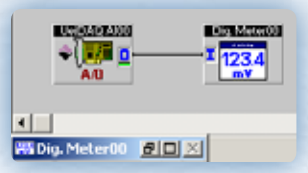


Choose a digital meter for output – select from the menu:

Module»Display»Digital Meter



When the Digital Meter block is created, connect the output of the Analog Input Block to the input of the Digital Meter with a wire (click on O, drag to I):



In the lower-left corner of the screen, a small child window labeled Dig.Meter00 will be minimized. You may select this window and restore it. Creating a Digital Meter will help debug channels when they do not display on the graph. This digital meter may also be set up to display microstrain.

Bring the main DASYLab window into focus.

*Alternatively, a Chart Recorder graph works equally well:
Modules » Display » Chart Recorder
Connect the Chart Recorder to the line connecting the Digital Meter module to the UeiDaq AI module.

The experiment is now ready to be run!

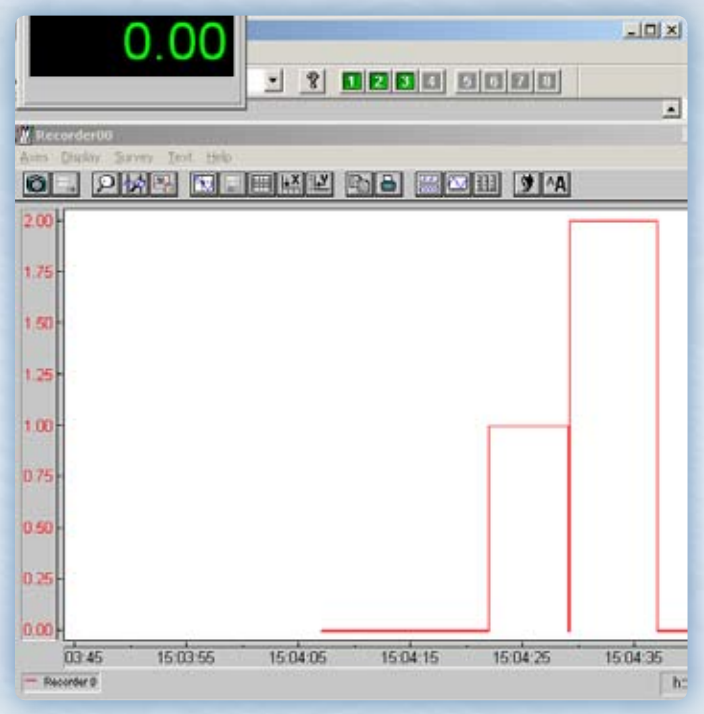
Running the experiment under DASYLab

Run the program by pressing the Start Button. This is the very first button in the toolbar. This action begins the experiment.

The digital meter or recorder set up earlier should display the information as soon as the button is pressed, as should the digital meter.

Here are the results for the following setup:

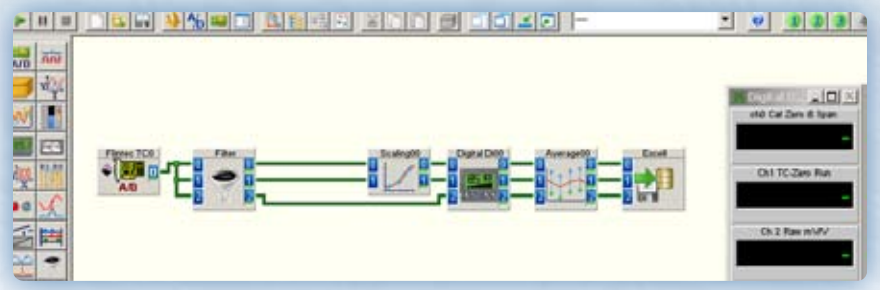
- (1) Four-wire full-bridge transducer simulator that can produce 0, 1, and 2 mV/V signals.
- (1) DNA-CM5 PowerDNA Cube, equipped with
  (1) DNA-AI-208 Analog Input layer, connected to
  (1) DNA-STP-AI-208 terminal panel
- (1) Host PC connected to the DNA-CM5 (via Ethernet cable) running DASYLab with parameters:
  - 10 Hz Sample Rate in Software Mode
  - Channel 0 Setup: Differential, Full-Bridge, Scale to mV



This completes the DASYLab how-to.

More controlled results with DASYLab

The following setup provides accurate, corrected results:



The setup consists of a filter, scaler, display, average, write data module:

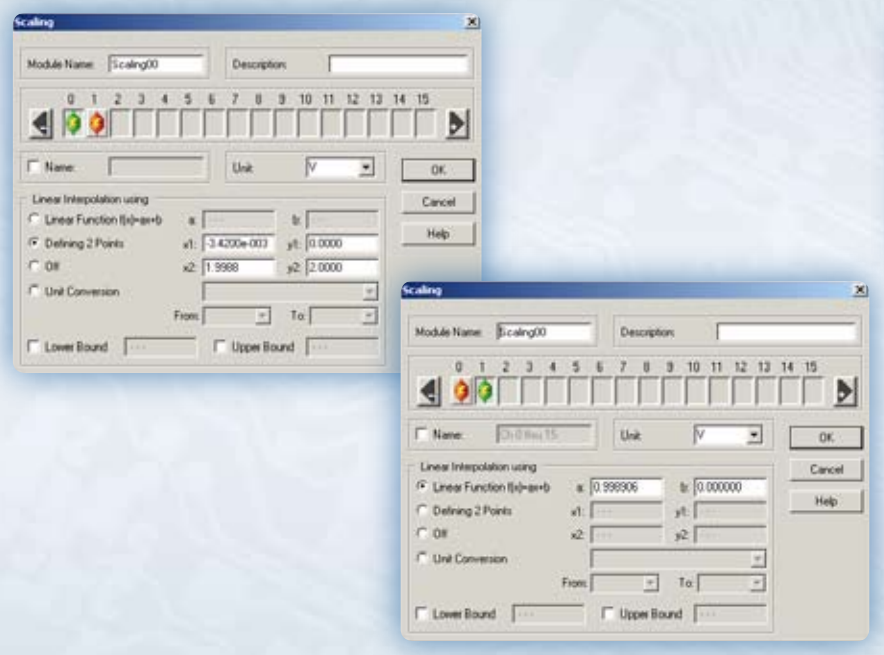
- The 10th order Butterworth low-pass (100Hz) Filter smoothes out the signal
- The Scaling module uses Linear Interpolation to zero/slope the line; the first channel corrects both slope and zero, the second only zeroes the line
- Digital Display to output the two corrected and raw analog input values
- The average module averages one minute of data, and sends it to the
- write module, which in turn saves the data to an ASCII file (for excel)

1. Adding Filtering:

Modules » Signal Analysis » Filter

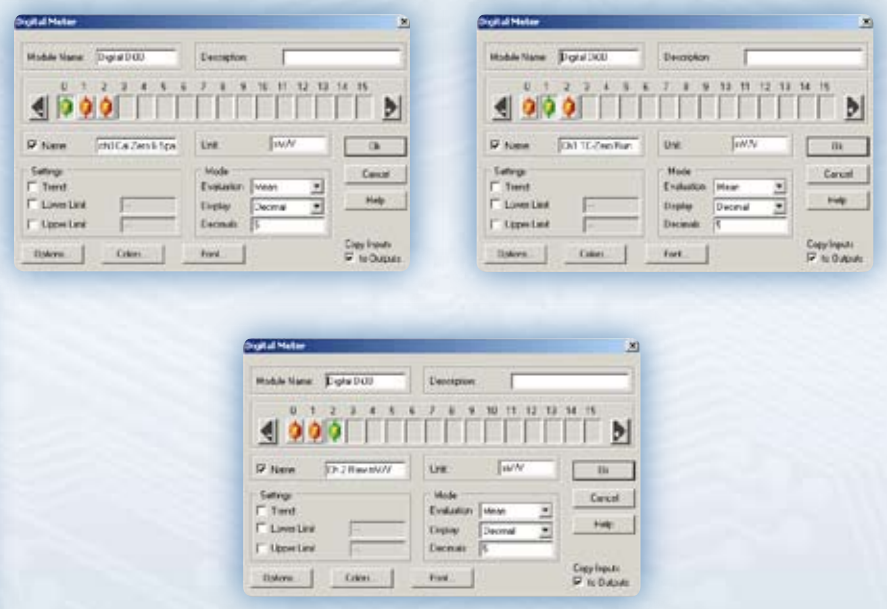
2. Adding Scaling

Modules » Mathematics » Scaling



3. Adding a Digital Display

Modules » Display » Digital Meter



4. Reducing data in a file with a Averaging Module

Modules » Data Reduction » Average

5. Sending the results to a text file (or Excel)

Modules » Files » Write Data

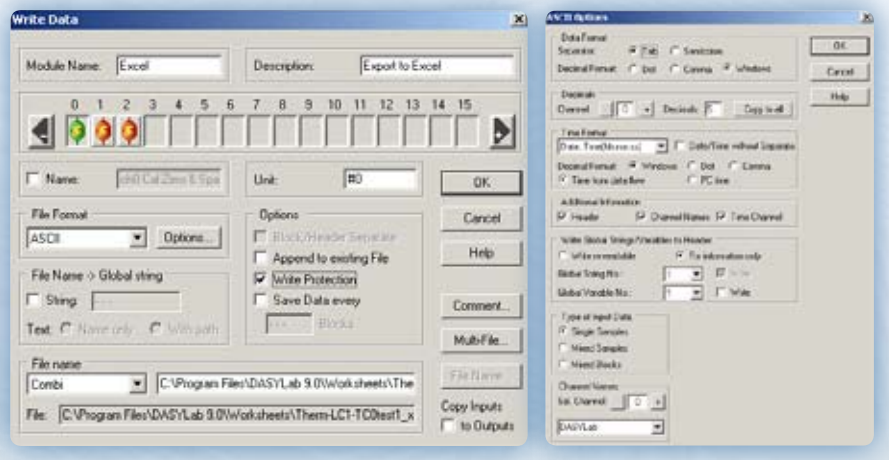
File Format: ASCII

Write Protection: Enabled

Multi-File... » Write As Multi File: Enabled » OK

File Name... » Desktop\thermo.txt

(it will be autosplit)



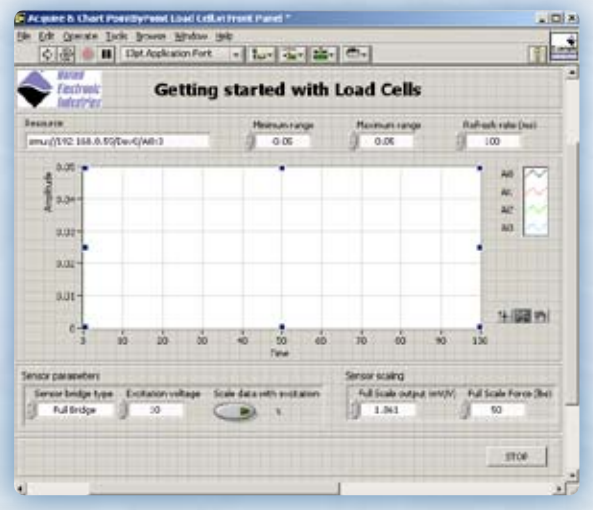
Measuring with LabVIEW

LabVIEW Setup

The UeiDaq Framework comes bundled with a variety of examples for test environments. The examples are accessible via the Start Menu:

Start Menu » Programs » UEI » Framework » Examples

(From the LabVIEW Examples, select Acquire & Chart PointByPoint Load Cell.VI)



Here is how to set up a strain-gage measurement in LabVIEW:

Use PowerDNA Explorer to determine the target cube's IP and device number,

for example: pdna://192.168.100.2/Dev0/Ai3. This resource string indicates that the IP address of the cube is 192.168.100.2, the AI-208 layer appears as [0] 208 in PowerDNA Explorer, and my strain gage is on Analog Input channel 3.

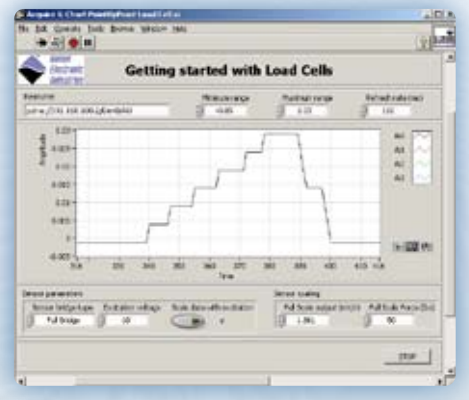
Next, choose the usable voltage range for the load cell. The gain will be set transparently by the Framework. The max input range is –10 to 10V (gain = 1), up to a gain of 800 (+/-12.5mV) with a resolution of 18 bits (3.81 µV).

Finally, set the refresh rate in milliseconds; strain-gage measurements are usually taken slowly, so a acquisition rate of 10Hz (100ms) is usually adequate.

Modify the other settings in accordance with your sensor type. When the experiment is set up:

Operate > Run

Begins the experiment:



For a Glossary of terms used in this document as well as our other Application Notes and stories, Please refer to our online glossary at:

http://www.ueidaq.com/data-acquisition-glossary/

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