UEI Application Notes:

Al-208 Strain Gage Measurement

App Note #024



© 2007 United Electronic Industries, Inc. All Rights Reserved.

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 loadcell 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 Al-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.

File Network View Help	
P	Model: AI-208 Info: A-In, 8 differential channel SN: 0024463 Mfg. Date: Jul 1, 2005 Cal. Date: May 15, 2006 ✓ Enabled Excitation A: 1.55 V Input Range: -10+10V
	Name Value
	AINU Analog Input U -0.0035
	Aint Analog Input 1 -0.0064
	Ainz Analog Input 2 -0.0043
	Ain3 Analog input 3 0.0084

Figure: Floating values read when testing reading on the Al-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:

🔁 D	🌺 DASYLab8-Net - (no name				
<u>F</u> ile	<u>E</u> dit	Mod <u>u</u> les	UeiDA <u>Q</u>		
►	Ш		Ê 🔒		

Select the "Analog Input" module from UeiDAQ menu:

CASYLal	58-Net -	(no nam	e) - [Wo	rksheet	
File Edit I	Modules	UeiDAQ	NI-DAQ	Experim	ent
		Measu Hardw	irement Se Jare Setup	etup	
		Analog Analog	g Input g Output		
		Digital Digital	Input Output		
		Count Frequ	er Input ency Outp	ut	



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:

P DANK and Net (our manual)	Wordeshared 1	
File Edit Modules UeDAO Expe	rement Wess Options Window Help	
Mulat Dicipi m		1-
		4
TH 22		
a with matternance		
······································	UeiDag Analog Input Setup	×
]
	Luogne vaue: Toened atto	
傳讀	Device Location	
0 20	pdna://192.168.100.2/Dev0/AI0	Select Device
M	0 1 2 3 4 5 6 7 8 9 10 11 12	13 14 15
FFT 9		
좀 화	Channel Name: UelDAQ AI 0 Unit:	
PTD - 4		
	Chungel Caters	Cancel
271 Pat	Line ren berghan	Help
X II		

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:



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:

UeiDag»Hardware Setup

A selection page will allow tuning data acquisition settings:



Analog In	Analog Out Di	igital In 🛛 Digita	l Out 🛛 Cour	nter In	Freq. O	ut
C Hard	lware Clock ware Clock	Tir	ne base ASYLab			•
Scan cl	ock source	Timeout (ms))	Start t	rigger so liate	ource
Sample Contine	clock source	Number of Fr	ames	Stop T	rigger so liate	ource

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):

	1234
45 Dig. Meter00	eo×

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 Al 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

Scaling Module Name

Name:
 Linear Integra
 C Linear Fur
 Detring 2
 OI
 Unit Conv

Lower Box

Modules » Mathematics » Scaling

	×
Scaling00 Description	
	<u>4 15</u>
Unit V I	ОК.
Idea a b: clion (b)=ax+0 a b: 0 Points a1: 2.4200e-003 y2: 0.0000	Cancel Help
rean From T Upper Bound	Generation Description Module Name Scaling00 Description 0 1 2 3 4 5 6 7 0 10 11 12 13 14 Image: Contract of the state of
	□ Name [0:0100;15] Unik [V
	Linesr Interpolation using F IF Linesr Function (tyl-ser-b) a: 0.999306 b: 0.000000 IF Defining 2 Points e1. yit: - IF OIL yit: - -
	Lower Bound

3. Adding a Digital Display

Modules » Display » Digital Meter

Hoble Name: []	DigialD00	Decogfore	
4 6		3 8 8 16 H 12 13 1	× 15 •
Phere [thiCa Zenii 1pa	Line IW/V	0
Sating		Mode	Centr
Tierd.		Evaluation views	
LiverLink		Depta Jecna +	Nelp -

38)

15 OK Carcel Help

Hodele Name (Digital DOD	Devalorian	
	7 8 9 13 11 12 13	
Phene Dilliconfun	DNE JWW.V	
Satrap	Mode	Carual
E Love Led	Endedto Prese	. Help
12 () () () () () () () () () (and the second second	

Module Name: Digita D-00	Denniprion	
	· · · · · · · · · · · · · · · · · · ·	<u>M 15</u>
Phere Dr2Rev.NVV	Line WW	Bi
Seting	Mode .	Centel
E trend	Evaluation interve	- Her
F Abarden	Coper Decrae	



4. Reducing data in a file with a Averaging Module

Modules » Data Reduction » Average

Arthough and Quality's House	*	
Arthurch and Shada da Nasa Mada than Parnyall Innapte. I	A 12 B Const	There is a second secon
		Optime Thereforehows Item Memory Despine Thereforehows Item Item Provide reaction of the transmit of the t

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)

rite Data		×	DdaTama	
Module Name: Excel	Description: Export to Ex	cel	Second First C be C Carra P Vindore	Cent
0 1 2 3 4 5 6	7 8 9 10 11 12 13	14 15	Decemb Overset	Halp
			Transformer Date TomObine tol	
Mane: 100 Cd 2ms 8.5ps	Unit: #0	OK.	Decentificent # Windows C Dot C Larens IP Tare has intelline C PC ine	
File Fornat	Options	Cancel	Ablencification 17 Heads 17 Dansilitanis 17 Tex Danvel	
ASCII Options	Elsolution de centre File Appendito existing File	Help	Notes Security // Security / Secu	
File Name > Global string	Vite Protection		Rate Longito II Gales Vacde No: T	
Test C Nove (ch. C With solt)	Books	Comment_,	Type at least Data	
Element		Mult-File	Mind Saraka	
Combi C:VProgram Fil	es/DASYLab 9.0%/oksheets/The	Fieldant	Owenthem	
File: C.VProgram Files\DASYLab 9.0%	voksheets\Them-LC1-TODest1_x	Copy Inputs	to Dared 0 +	



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 μ V).

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:





AI-208 and the Strain Gage

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/

No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form by any means, electronic, mechanical, by photocopying, recording, or otherwise without prior written permission.

Information furnished in this manual is believed to be accurate and reliable. However, no responsibility is assumed for its use, or for any infringements of patents or other rights of third parties that may result from its use.

All product names listed are trademarks or trade names of their respective companies.

See UEI's website for complete terms and conditions of sale:

http://www.ueidaq.com/company/terms.aspx

Contacting United Electronic Industries Mailing Address: 27 Renmar Avenue Walpole, MA 02081 U.S.A.

For a list of our distributors and partners in the US and around the world, please see

http://www.ueidaq.com/partners/

Support:

Telephone:	(508) 921-4600
Fax:	(508) 668-2350

Also see the FAQs and online "Live Help" feature on our web site.

Internet Support:

Support	support@ueidaq.com
Veb-Site	www.ueidaq.com
TP Site	ftp://ftp.ueidaq.com





About UEI:

Founded in 1990, UEI is a leader in the computer based data acquisition and control industry. Serving customers world-wide, UEI products based upon PCI, PXI, ISA and Ethernet interfaces offer unequaled performance as well as flexibility. We are committed to providing the highest quality hardware, software and services, enabling engineers and scientists to interface data-acquisition and control hardware to the real world. Through our state-of-the-art technologies we serve the needs of individual researchers and developers as well as OEMs.



United Electronic Industries

27 Renmar Avenue Walpole, MA 02081 Local: (781) 821-2890 Toll Free: (800) 829-4632 Fax: (781) 821-2891 www.UEIDAQ.com