DNA/DNR-AI-224

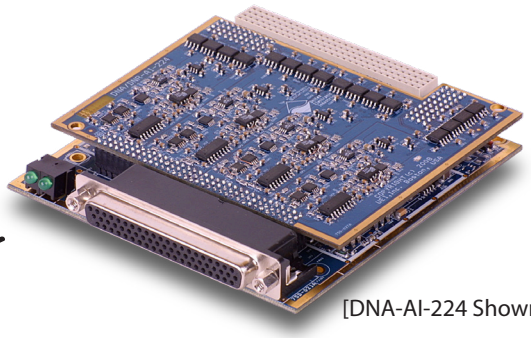
4-Channel High Speed Strain Gage Input Board

- DNA-AI-224 for use with "Cube" chassis
- DNR-AI-224 for use with RACKtangle™ I/O chassis
- 4 Strain Gage input channels
- 18-bit resolution, 100 kS/sec, per channel
- Simultaneous sampling on all channels
- Built-in anti-aliasing filters
- Full, Half and Quarter Bridge inputs
- 120, 350 and 1000 ohm bridge completion
- Built-in tension/compression shunt calibration resistors

10 YEAR AVAILABILITY GUARANTEE

STANDARD WARRANTY 3 YEAR

100% TEST VERIFIED



[DNA-AI-224 Shown]

General Description

The DNA-AI-224 and DNR-AI-224 are high speed, four channel strain gage input boards for UEI's data acquisition and control Cubes and RACKtangle I/O racks respectively. The boards provide an ideal combination of high speed, accuracy and connection flexibility and are suitable for use in a wide variety of applications.

The analog inputs offer 18-bit resolution at sample rates up to 100 kilosamples per second. Each channel has an A/D converter and all four channels are sampled simultaneously. The combination of the 18-bit resolution with the board's automatic offset zeroing and automatic gain calibration ensure the measurements are extremely accurate. Each channel also includes an anti-aliasing filter that automatically is configured to match the sample rate *(*Please see the note on the following page for details)*

The DNx-AI-224 accepts inputs from full, half or quarter bridge gages and load cells. Bridge completion resistors are built in for use with 120, 350 and 1000 ohm gages. Of course full bridge gages of any resistance value may also be measured. Each channel offers an independent excitation output, programmable from 0 to ±10 Vdc, in 65535 steps. The excitation outputs can drive up to 50 mA each, allowing 1k bridges to be driven at ±10 Vdc, 350 ohm bridges at ±8.75 V and 120 ohm bridges at up to ± 3 Vdc.

The board provides on-board compression and tension shunt calibration with shunt-calibration values selectable between 6.7 k and 170 kOhm, in 1.1 kOhm steps** (please see the note on next page for more details). Connections for external, user supplied shunt resistors are also provided. An automatic input nulling/balancing capability has also been built in allowing most bridges to be quickly and easily balanced before testing actually begins.

The DNx-AI-224 offers 350 Vrms of isolation between the I/O connections and the Cube or RACKtangle. Like all UEI "Cube" and RACKtangle I/O boards, the DNA offers operation in harsh environments. Cube systems have been tested to 5g vibration, 50g shock, -40 to +85 °C and altitudes up to 70,000 feet.

Software is included, providing a comprehensive, yet easy-to-use API that supports all popular operating systems, including Windows, Linux, and most real-time operating systems—such as QNX, Intime, VXworks, and more. Additionally, the UEIDAQ Framework—an even higher level Windows driver—supplies complete support for those creating applications in many popular Windows programming languages, as well as data acquisition software packages such as LabVIEW and MATLAB/Simulink.

Technical Specifications:

Inputs	
Number of channels	4, simultaneously sampling
Configuration	Full, Half, or Quarter bridge
Resolution	18-bit
Input ranges	*†See table below.*
Sample rate	100 kSamples/sec (max board rate 400 kS/s)
Accuracy	
Integral non-linearity	±0.0015%
Offset error @ 25 °C, G=2	0.0005% typical
Gain error @ 25 °C, G=2	0.003% typical
Offset drift per °C	2ppm typical / 10ppm max
Gain drift per °Cz	2ppm typical / 10ppm max
Overall error	< 250 µV
Bridge resistance	120, 350 or 1000 Ohm
Anti-aliasing filter*	Automatic, 72 dB minimum rejection
Input impedance	10 MegOhm, min
Excitation Outputs	
Number of channels	Two (P+, P-) per channel, independently programmable
Output voltage	0 to ±10 Vdc (each output); 20Vdc diff span
Resolution	16-bit
Output drive current	50 mA, max
Output error	± 5 mV, max, measured to the same accuracy as the analog input
Shunt Calibration **(see note next page)	
Shunt range	6.7 k to 170k Ohm (tension or compression) internal. Also provides two connections for user supplied shunt resistors.
Shunt resolution	~1.1 kOhm
Shunt read-back accuracy**	±0.02% of reading returned
Automatic Bridge Nulling / Balancing	
Null/balance range	19-bit resolution @ ±10V (auto-null 1 mV max)
General Specifications	
Electrical isolation	350 Vrms, chan-chan and chan-chassis
Operating temperature	Tested -40 °C to +85 °C
Vibration *IEC 60068-2-6* *IEC 60068-2-64*	5 g, 10-500 Hz, sinusoidal 5 g (rms), 10-500 Hz, broad-band random
Shock *IEC 60068-2-27*	100 g, 3 ms half sine, 18 shocks @ 6 orientations 30 g, 11 ms half sine, 18 shocks @ 6 orientations
Humidity	0 to 95%, non-condensing
Altitude	120,000 ft
Power consumption	6.0 Watts + 1.5 X excitation power supplied
MTBF	260,000 hours

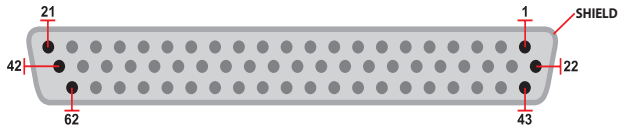
** / ** Please see the notes on the following page for details*

†Input Ranges:

Input	Range (Vdc)	±20*	±10	±5	±2.5	±1.25	±0.625	±0.3125	±0.15625	±0.078125
	Gain	1	2	4	8	16	32	64	128	256

*Full differential span, both S + & S- should be within common mode range of ±12V; Input voltage should not exceed +12V or -12V relative to AGND.

Connector Pinout
(DB-62, female)



	Pin	Signal	Pin	Signal	Pin	Signal
Chan 0	1	QB1K 0	22	Gnd 0	43	P- 0
	2	PS+ 0	23	PS- 0	44	P+ 0
	3	S- 0	24	QB120 0	45	QB350 0
	4	S+ 0	25	S- 0	46	SHA+ CH 0 (P+ CH 0)
	5	SHB- CH 0 (P - CH 0)	26	SHA- CH 0 (S- CH 0)	47	n/c
Chan 1	6	Gnd 1	27	n/c	48	QB1K 1
	7	P+ 1	28	P- 1	49	QB120 1
	8	PS+ 1	29	PS- 1	50	S- 1
	9	S+ 1	30	S- 1	51	QB350 1
	10	SHA+ CH 1 (P+ CH 1)	31	SHA- CH 1 (S- CH 1)	52	SHB- CH 1 (P- CH 1)
Chan 2	11	QB1K 2	32	n/c	53	P- 2
	12	PS+ 2	33	PS- 2	54	P+ 2
	13	QB350 2	34	Gnd 2	55	QB120 2
	14	S+ 2	35	S- 2	56	S- 2
	15	SHA+ CH 2 (P+ CH 2)	36	SHA- CH 2 (S- CH 2)	57	n/c
Chan 3	16	Gnd 3	37	SHB- CH 2 (P- CH 2)	58	QB1K 3
	17	P+ 3	38	P- 3	59	QB120 3
	18	PS+ 3	39	PS- 3	60	S- 3
	19	n/c	40	QB350 3	61	S- 3
	20	SHA+ CH 3 (P+ CH 3)	41	SHA- CH 3 (S- CH 3)	62	S+ 3
	21	SHB- CH 3 (P- CH 3)	42	n/c		

Dashed Line represents the isolation barrier between channels

Note: On signals available at multiple pins, it is not necessary to connect to more than one. They are connected internally on the board itself.

***Note on Shunt Calibration accuracy*

Shunt calibration of a strain gauge bridge is performed by placing a known resistor across one leg of the measurement Wheatstone bridge. The purpose of this technique is to simulate the effect of applying a specific physical load to the bridge sensor without actually doing so.

The DNx-AI-224 provides built-in shunt calibration resistors that can be set in tension or compression in the range from 6.7 kOhm to 170 kOhm. Terminals are also provided to allow the connection of external shunt calibration resistors if desired.

The resolution of the internal shunt calibration resistors is approximately 1.1 KOhm in the 6.7k to 170k resistance range. Building a shunt calibration system accurate over the full temperature range of the Cube/RACKtangle family is a challenging task. Finding actual resistor networks that would provide this functionality and maintain the required accuracy over this wide temperature range within the space available on the DNx-AI-224 is not possible. However it is relatively straightforward to fit a resistance measurement system that performs resistance measurements at a level suitable for high accuracy shunt calibration.. The DNx-AI-224 takes advantage of this fact in its shunt calibration operations.

To perform shunt calibration with the DNx-AI-224, the user selects the shunt resistance desired as well as whether compression or tension simulation is desired. The DNx-AI-224 driver/software then selects the shunt resistor to the setting closest to the desired value. Note that the resolution of this resistor selection is approximately 1.1 kOhm. The DNx-AI-224 software then performs an automatic measurement of the selected shunt resistor and returns the measured resistance within 0.02% of the reading. This measured value is then used by the application's calibration routine as the shunt resistance "switched in".

**Note on filtering*

The DNx-AI-224 provides automatic anti-aliasing filtering. The filter response is automatically set to match the selected sample rate. Though these filters are not programmable analog filters, their performance will exceed the capabilities of an analog filter implementation. The following provides the details on how the filtering is done.

Though each channels maximum sample rate is specified at 100 kHz, the actual A/D converters (one per channel) in the DNx-AI-224 sample at up to 300 kHz. The data is then "filtered" and averaged by two programmable FIR filter in the board's FPGA. This is done in real time. This configuration has a number of advantages relative to more standard programmable analog filters. These include:

1. VERY sharp (512-tap) filters, with much more "drop" off than would be possible using analog filters
2. Perfectly uniform group delay / phase shift between channels.
3. Automatic signal averaging, thus reducing effective noise
4. Higher overall DC and gain accuracy as there is no gain/offset error induced by changing analog filter frequencies on the fly.

There is one question left to answer. How do we keep Aliases from 50 kHz and above from impacting the input waveform, as there is no way to remove alias errors in post A/D converter digital filtering? The answer is a fixed analog filter in front of the A/D converter, set at 70 kHz. which is less than half the minimum actual A/D sampling rate of 150 kHz.

Ordering Guide

Part Number	Description
DNx-AI-224	High Speed Four Channel Strain Gate Input board (order DNA-AI-224 for Cube chassis, DNR-AI-224 for RACKtangle chassis)
DNA-STP-62	62 conductor screw terminal panel
DNA-CBL-62	62 conductor shielded cable