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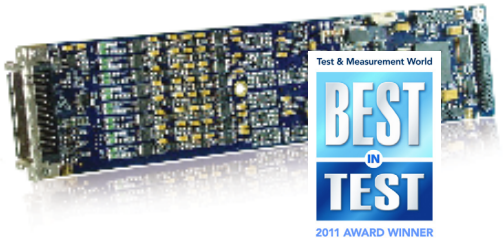
WHEN ACCURACY MATTERS

ProDAQ Data Acquisition Function Cards

ProDAQ 3416 16-Channel, 24-Bit, Sigma-Delta ADC Function Card



OVERVIEW

The ProDAQ 3416 16-channel, 24-bit, Sigma-Delta Analog-to-Digital Converter (ADC) function card is one of Bustec's range of high density analog input cards. Each of the card's sixteen channels has it's own independent ADC and, as channels are not multiplexed, this allows the user to perform true simultaneous sampling of multiple signal sources. Each differential input channel is equipped with its own filter and independently programmable gain stage. The gain is programmable from 1 to 2000, providing the user with voltage ranges from ±5 mV to ±10 V. Higher voltage versions of the ProDAQ 3416 are available on request. For example, the 3416-B4 provides a ±40 V input range with a sample rate of up to 10 kS/s per channel*. All versions have an additional 5 % voltage overhead to allow both for on-line calibration and out-of-range detection.

The 3416-AA effective sample rate may be set from 1 S/s to 1 kS/s per channel, the 3416-BA from 1 S/s to 10 kS/s per channel while the 3416-CA effective sample rate may be set from 5 kS/s to 52 kS/s per channel. The sample rate resolution for all versions is 0.01 S/s.

Multiple ProDAQ 3416 cards can be synchronized with each other or other ProDAQ function cards via VXIbus trigger lines, trigger lines on the front panel connector, IEEE 1588 Ethernet synchronization for LXI systems or the LXI LVDS Trigger Bus.

The voltage from the 3202-AA programmable voltage reference card can be switched directly to the input of the gain stage for "on-the-fly" calibration or self-test purposes. The ProDAQ 3416's DC accuracy is better than ±(20 + 600/gain) µV, or typically 0.0012 % FSR for a gain of 1, with typical offset error of just ±30 µV.

The ProDAQ 3416's AC specifications are also excellent with both SINAD and SNR better than 100 dB for a gain of 1 at 100 Hz. Even for a gain of 1000 the SNR of the ProDAQ 3416 is greater than 70 dB and the Total Harmonic Distortion is 0.0045 %.

All **ProDAQ function cards** can be used in both ProDAQ VXIbus motherboards and LXI function card carriers, providing users with the highest channel density and functionality available today.

*Please contact the factory for other input voltage ranges and sample rate options.

Features & Benefits

- **16 differential** analog inputs
- **Independent per-channel** 24-bit analog-to-digital converters (ADCs)
- **1 S/s to 52 kS/s** per channel simultaneous sampling rate
- **Programmable gain** from 1 to 2000 per channel
- **Accuracy** of up to 0.0012 % FSR
- **Synchronization** in large distributed systems

For more information, visit **www.bustec.com**.

Learn more about the **ProDAQ 3416** on our website by scanning the code below.

SPECIFICATIONS

SAMPLING

Resolution	24 bits
ADC Type	Sigma-Delta (individual ADC per channel)
Effective Sample Rates	1 S/s to 1 kS/s (model number 3416-AA) 1 S/s to 10 kS/s (model numbers 3416-BA, 3416-B4) 5 kS/s to 52 kS/s (model number 3416-CA)
Rate Selection Resolution	0.01 S/s
Oversampling	128 x
FIFO	10 kSamples (3416-AA, 3416-BA), 60 kSamples (3416-CA)

INPUT CHARACTERISTICS

Number of Channels	16
Input Type	Differential
Coupling	DC
Full Scale Signal Ranges	±5 mV, ±10 mV, ±20 mV, ±50 mV, ±100 mV, ±200 mV, ±500 mV, ±1 V, ±2 V, ±5 V and ±10 V ±40 V (3416-B4 only) (plus 5 % headroom for calibration and out-of-range detection)
Gain Settings	1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000
Analog Input Filter	2-pole Butterworth
Input Impedance	>10 MΩ, 25 pF
Input Protection	±25 V (3416-xA versions only)
Input Offset Voltage	±30 µV typical (gain 1) ±6 µV typical (gain 2000) ±80 µV typical (3416-CA, sample rates > 25kS/s, gain 1) ±200 µV typical (3416-B4, 10 kS/s, gain 1)
Gain Error	±0.002 % typical (gain 1) ±0.05 % typical (gain 2000) ±0.004 % typical (3416-CA, sample rates > 25 kS/s, gain 1) ±0.1 % typical (3416-CA, sample rates > 25 kS/s, gain 2000) ±0.02 % typical (3416-B4, 10 kS/s, gain 1)
INL (Best Fit Method)	±0.0003 % FSR typical ±0.0012 % FSR max.
DC Accuracy	±(8 + 225/gain) µV typical, ±(20 + 600/gain) µV max. in % FSR (typical): ±0.0012 % (gain 1) ±0.0015 % (gain 10) ±0.005 % (gain 100) ±0.04 % (gain 1000) ±(25 + 850/gain) µV max.(3416-CA, sample rates > 25kS/s) ±10 mV typical (3416-B4, 10 kS/s, gain 1, V_{IN} = 36 V) ±20 mV max (3416-B4, 10 kS/s, gain 1 , V_{IN} = 36 V)
Common-mode Rejection Ratio	87 dB typical (gain 1) 106 dB typical (gain 2000) 85 dB typical (3416-B4, 10 kS/s, gain 1)
0.1dB Analog Passband	DC to 450 Hz (3416-AA) DC to 4.5 kHz (3416-BA, 3416-B4) DC to 23.7 kHz (3416-CA)
3dB Analog Bandwidth	DC to 490 Hz (3416-AA) DC to 4.9 kHz (3416-BA , 3416-B4) DC to 25.8 kHz (3416-CA)
Pass Band Ripple	±0.005 dB
Stop Band Attenuation	95 dB minimum
Signal-to-Noise Ratio	105 dB typical (Sine, gain 1, 97.7 Hz, -1 dB_{FS}) 97 dB typical (3416-B4, Sine, gain 1, 97.7 Hz, 80 V_{PP})
Signal-to-Noise and Distortion (SINAD)	100 dB typical (Sine, gain 1, 97.7 Hz, -1 dB_{FS}) 90 dB typical (3416-B4, Sine, gain 1, 97.7 Hz, 80 V_{PP})
Total Harmonic Distortion (THD)	-102 dB typical (Sine, gain 1, 1 kHz, -1 dB_{FS}) -90 dB typical (3416-B4, Sine, gain 1, 97.7 Hz, 80 V_{PP})
Spurious-free Dynamic Range	103 dB typical (Sine, gain 1, 1 kHz, 0 dB_{FS}) 95 dB typical (3416-B4, Sine, gain 1, 97.7 Hz, 80 V_{PP})
Noise	35 µV RMS typical (1 kS/s, gain 1) 0.3 µV RMS typical (1 kS/s, gain 2000) 200 µV RMS typical (3416-B4, 10 kS/s, gain 1)
Crosstalk	-116 dB typical (any channel with 0 dB_{FS} 1 kHz Sine all other channels, gain 1)

Did You Know?

- **The Sigma-Delta** ADC architecture has become increasingly popular in the processing of low and moderate frequency signals. The architecture has several advantages over the more traditional SAR type ADCs. These include:

  A built-in Digital Filter which has a very flat passband, a sharp transition region and excellent stopband attenuation. This filter scales with sample rate and, combined with a fixed analog input filter in each channel, rejects all out-of-band signals to guarantee alias-free measurements.

  A wide Dynamic Range with very low noise, partly achieved by noise shaping within the ADC passband.

  Excellent Linearity over the entire ADC range.

About VXI and LXI

- **The VXIbus** (VME EXtensions for Instrumentation) provides a time-tested bus you can trust to support your automated test and measurement needs. Established in 1987, it is a well conceived, established and proven platform for data acquisition and test, based on the industry standard VMEbus. For more details visit **www.vxibus.org**.

- **LXI** (LAN EXtensions for Instrumentation) combines the advantage of Ethernet with the simplicity of GPIB. LXI combines features of GPIB instruments with modular instrumentation by providing high performance test and measurement solutions based on a LAN interface. By utilizing the IEEE1588 Standard for A Precision Clock Synchronization Protocol, LXI Instruments allow you to build scaleable distributed and fully synchronized networked measurement and control systems. For more details visit **www.lxistandard.org**.

SPECIFICATIONS (CONT.)

PHYSICAL CHARACTERISTICS

Dimensions	230 x 52.6 mm
Weight	110 g

POWER REQUIREMENTS

Current Consumption	Voltage (V)	Current (mA)
	+1.2	250
	+3.3	114
	+5	236
	-5.2	4
	+12	166
	-12	160
	+15	82
	-15	78
Power Consumption	7 W typical, 9.7 W maximum	

ENVIRONMENTAL

Temperature	0 °C to +50 °C	(operational)
	-40 °C to +70 °C	(storage only)
Humidity	10 % - 90 %	(non-condensing)

SOFTWARE SUPPORT

Driver support for Microsoft Windows, VxWorks, and Linux
(Contact Bustec Ltd. for more information)

WARRANTY PERIOD

12 months (extended periods available at additional cost)

INTERFACING TO SIGNAL CONDITIONING UNITS

The ProDAQ 3416 is complimented by Bustec's range of signal conditioning products. The ProDAQ 5720 19" Signal Conditioning Unit (SCU) can house up to two signal conditioning cards from the ProDAQ 5800 series. These cards provide an easy to use interface to various sensor types (bridge, thermocouple, RTD etc.) for the ProDAQ 3416. Contact the Sales office for further details.

A ProDAQ 3416 mounted on a 6100 and connected to a ProDAQ 5821 SCU

Ordering Information

- **3416-AA** 16-ch, 24-bit, Sigma-Delta ADC analog input function card (1 kS/s maximum sampling rate)
- **3416-BA** 16-ch, 24-bit, Sigma-Delta ADC analog input function card (10 kS/s maximum sampling rate)
- **3416-CA** 16-ch, 24-bit, Sigma-Delta ADC analog input function card (52 kS/s maximum sampling rate)
- **3416-xn** Versions with high voltage input ranges up to +/-60V are available. Please contact the factory for further information

Related Products

- **ProDAQ 6100** LXI function card carrier
- **ProDAQ 3180** Ultra-performance motherboard module
- **ProDAQ 3202** Programmable voltage reference plug-in
- **ProDAQ 5720** SCC
- **ProDAQ 5800** series of signal conditioning cards
- **ProDAQ 8010** series of data I/O cables

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