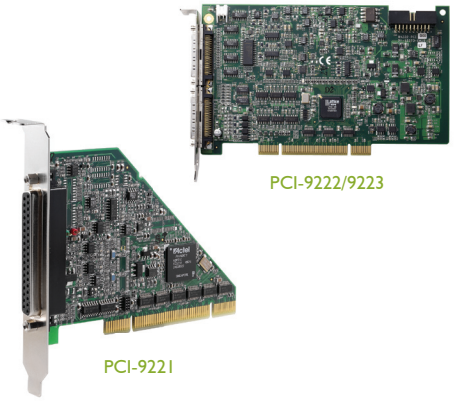
# PCI-9221/9222/9223

## 16/32-CH 16-Bit 250/500 kS/s Multi-Function DAQ Cards with Encoder Input




## Introduction

The PCI-9221/9222/9223 are ADLINK's next-generation high performance DAQ cards. PCI-9221/9222/9223 are 16-bit, 16/32-CH, 250/500 kS/s multi-function DAQ cards with 4/8 different input ranges. They also feature 2-CH 16-bit simultaneous analog outputs and programmable function I/O. The software-programmable function I/O supports a variety of applications, including TTL digital I/O, high-speed DIO (PCI-9222/9223 only), general-purpose timer/counter, pulse generation, encoder input, and PWM output. Analog input, analog output, and function I/O can operate at full speed simultaneously. For the PCI-9222/9223, multiple cards can be synchronized through the SSI (System Synchronization Interface) bus if more channels are needed. Ideal for mixed-signal tests, laboratory research, and factory automation, the PCI-9221/9222/9223 are the best single-board solutions on the market providing the best integration capability of multiple tasks with high performance and an affordable price.

## Features

- **Supports a 32-bit 3.3 V or 5 V PCI bus**
- **Programmable gains for analog input: 1, 2, 4, 5, 8, 10, 20, 40 (PCI-9222/9223) 1, 5, 10, 25 (PCI-9221)**
- **2-CH 16-bit simultaneous analog outputs, up to 1 MS/s analog output update rate (PCI-9222/9223)**
- **Programmable function I/O, supporting modes:**
  - **TTL DI and TTL DO**
  - **2 MHz High-Speed DIO (PCI-9222/9223 only)**
  - **General-purpose timer/counter**
  - **PWM outputs**
  - **Encoder inputs**
- **Dedicated 2-CH 4 MHz encoder inputs, supporting AB phase, and CW/CCW (PCI-9222/9223)**
- **Dedicated DMA channels for A/D, D/A, and high-speed DIO (PCI-9222/9223)**
- **External digital trigger for A/D, D/A, and high-speed DIO (PCI-9222/9223)**
- **Multiple card synchronization through SSI (System Synchronization Interface) bus (PCI-9222/9223)**
- **Auto-calibration**

### Operating Systems

- Windows Vista/XP/2000/2003
- Linux

### Recommended Software

- AD-Logger
- VB.NET/VC.NET/VB/VC++/BCB/Delphi
- DAQBench

### Driver Support

- DAQPilot for Windows
- DAQPilot for LabVIEW™
- DAQ-MTLB for MATLAB®
- D2K-DASK for Windows
- D2K-DASK/X for Linux

## Terminal Boards

### DIN-68S-01 (for PCI-9222/9223)

Terminal Board with One 68-pin SCSI-II Connector and DIN-Rail Mounting (Cables are not included. For more information on mating cables, refer to Section 14, Accessories.)

### TB-9221-01 (for PCI-9221)

General-purpose Terminal Board with One 37-pin D-Sub Connector. Supports Differential to Single-ended Encoder Signal Conversion of PCI-9221's Function I/O Through Jumper Switching. (Cables are not included.)

### DIN-37D-01 (for PCI-9221)

Terminal Board with One 37-pin D-sub Connector and DIN-Rail Mounting (Cables are not included.)

## SSI Bus Cables (for PCI-9222/9223) (for multiple cards synchronization)

### ACL-SSI-2

SSI Bus cable for two devices

### ACL-SSI-3

SSI Bus cable for three devices

### ACL-SSI-4

SSI Bus cable for four devices

## Ordering Information

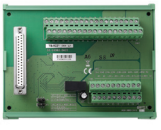
**PCI-9222**
16-CH 16-bit 250 kS/s Multi-Function DAQ Card with Encoder Input

**PCI-9223**
32-CH 16-bit 500 kS/s Multi-Function DAQ Card with Encoder Input

**PCI-9221**
16-Bit Multi-Function DAQ Card with 2-CH Encoder Input

SSI bus cable for multiple cards synchronization

Terminal board DIN-68S-01 & 68-Pin SCSI-VHDCI cable ACL-10568-1



TB-9221-01

## Pin Assignment

### CN1 pin assignment for PCI-9223

| | | | |
|---|---|---|---|
| AI0(AIH0) | 34 | 68 | AI16(AIL0) |
| AI1(AIH1) | 33 | 67 | AI17(AIL1) |
| AI2(AIH2) | 32 | 66 | AI18(AIL2) |
| AI3(AIH3) | 31 | 65 | AI19(AIL3) |
| AI4(AIH4) | 30 | 64 | AI20(AIL4) |
| AI5(AIH5) | 29 | 63 | AI21(AIL5) |
| AI6(AIH6) | 28 | 62 | AI22(AIL6) |
| AI7(AIH7) | 27 | 61 | AI23(AIL7) |
| AGND | 26 | 60 | AISENSE |
| AI8(AIH8) | 25 | 59 | AI24(AIL8) |
| AI9(AIH9) | 24 | 58 | AI25(AIL9) |
| AI10(AIH10) | 23 | 57 | AI26(AIL10) |
| AI11(AIH11) | 22 | 56 | AI27(AIL11) |
| AI12(AIH12) | 21 | 55 | AI28(AIL12) |
| AI13(AIH13) | 20 | 54 | AI29AIL13) |
| AI14(AIH14) | 19 | 53 | AI30(AIL14) |
| AI15(AIH15) | 18 | 52 | AI31(AIL15) |
| AGND | 17 | 51 | AGND |
| AO0 | 16 | 50 | AGND |
| AO1 | 15 | 49 | AGND |
| NC | 14 | 48 | NC |
| NC | 13 | 47 | NC |
| NC | 12 | 46 | NC |
| NC | 11 | 45 | NC |
| NC | 10 | 44 | NC |
| NC | 9 | 43 | NC |
| NC | 8 | 42 | NC |
| NC | 7 | 41 | NC |
| NC | 6 | 40 | NC |
| NC | 5 | 39 | NC |
| NC | 4 | 38 | NC |
| NC | 3 | 37 | NC |
| NC | 2 | 36 | NC |
| NC | 1 | 35 | NC |

### CN1 pin assignment for PCI-9222

| | | | |
|---|---|---|---|
| AI0(AIH0) | 34 | 68 | AI8(AIL0) |
| AI1(AIH1) | 33 | 67 | AI9(AIL1) |
| AI2(AIH2) | 32 | 66 | AI10(AIL2) |
| AI3(AIH3) | 31 | 65 | AI11(AIL3) |
| AI4(AIH4) | 30 | 64 | AI12(AIL4) |
| AI5(AIH5) | 29 | 63 | AI13(AIL5) |
| AI6(AIH6) | 28 | 62 | AI14(AIL6) |
| AI7(AIH7) | 27 | 61 | AI15(AIL7) |
| AGND | 26 | 60 | AISENSE |
| NC | 25 | 59 | NC |
| NC | 24 | 58 | NC |
| NC | 23 | 57 | NC |
| NC | 22 | 56 | NC |
| NC | 21 | 55 | NC |
| NC | 20 | 54 | NC |
| NC | 19 | 53 | NC |
| NC | 18 | 52 | NC |
| AGND | 17 | 51 | AGND |
| AO0 | 16 | 50 | AGND |
| AO1 | 15 | 49 | AGND |
| NC | 14 | 48 | NC |
| NC | 13 | 47 | NC |
| NC | 12 | 46 | NC |
| NC | 11 | 45 | NC |
| NC | 10 | 44 | NC |
| NC | 9 | 43 | NC |
| NC | 8 | 42 | NC |
| NC | 7 | 41 | NC |
| NC | 6 | 40 | NC |
| NC | 5 | 39 | NC |
| NC | 4 | 38 | NC |
| NC | 3 | 37 | NC |
| NC | 2 | 36 | NC |
| NC | 1 | 35 | NC |

### CN2 pin assignment for PCI-9222/9223

| | | | |
|---|---|---|---|
| GPI0/GPTC_CLK0 | 34 | 68 | GPB/GPTC_CLK2 |
| GPI1/GPTC_UD0 | 33 | 67 | GPB/GPTC_UD2 |
| GPI2/GPTC_GATE0 | 32 | 66 | GPI10/GPTC_GATE2 |
| GPI3/GPTC_AUX0 | 31 | 65 | GPI11/GPTC_AUX2 |
| GPI4/GPTC_CLK1 | 30 | 64 | GPI12/GPTC_CLK3 |
| GPI5/GPTC_UD1 | 29 | 63 | GPI13/GPTC_UD3 |
| GPI6/GPTC_GATE1 | 28 | 62 | GPI14/GPTC_GATE3 |
| GPI7/GPTC_AUX1 | 27 | 61 | GPI15/GPTC_AUX3 |
| DGND | 26 | 60 | DGND |
| GPO0/GPTC_OUT0 | 25 | 59 | GPO8 |
| GPO1/GPTC_OUT1 | 24 | 58 | GPO9 |
| GPO2/GPTC_OUT2 | 23 | 57 | GPO10 |
| GPO3/GPTC_OUT3 | 22 | 56 | GPO11 |
| GPO4 | 21 | 55 | GPO12 |
| GPO5 | 20 | 54 | GPO13 |
| GPO6 | 19 | 53 | GPO14 |
| GPO7 | 18 | 52 | GPO15 |
| DGND | 17 | 51 | DGND |
| DGND | 16 | 50 | DGND |
| DGND | 15 | 49 | DGND |
| +5Vout | 14 | 48 | DGND |
| NC | 13 | 47 | NC |
| NC | 12 | 46 | NC |
| NC | 11 | 45 | NC |
| NC | 10 | 44 | NC |
| E24V | 9 | 43 | NC |
| EGND | 8 | 42 | NC |
| IEA0+ | 7 | 41 | IEA1+ |
| IEA0- | 6 | 40 | IEA1- |
| IEB0+ | 5 | 39 | IEB1+ |
| IEB0- | 4 | 38 | IEB1- |
| IEZ0+ | 3 | 37 | IEZ1+ |
| IEZ0- | 2 | 36 | IEZ1- |
| IORG0 | 1 | 35 | IORG1 |

### CN1 pin assignment For PCI-9221

| | | | |
|---|---|---|---|
| GPO2 | 1 | 20 | GPO3 |
| DGND | 2 | 21 | GPO1/GPTC_OUT1 |
| GPO0/GPTC_OUT0 | 3 | 22 | GPI1/ORG1/GPTC_AUX1 |
| GPI6/EZ1/GPTC_GATE1 | 4 | 23 | DGND |
| GPI5/EB1/GPTC_UD1 | 5 | 24 | GPI4/EA1/GPTC_CLK1 |
| GPI3/ORG0/GPTC_AUX0 | 6 | 25 | GPI2/EZ0/GPTC_GATE0 |
| DGND | 7 | 26 | GPI1/EB0/GPTC_UD0 |
| GPI0/EA0/GPTC_CLK0 | 8 | 27 | AO1 |
| AOGND | 9 | 28 | AO0 |
| AIGND | 10 | 29 | AI15(AIL7) |
| AI7(AIH7) | 11 | 30 | AI14(AIL6) |
| AI6(AIH6) | 12 | 31 | AI13(AIL5) |
| AI5(AIH5) | 13 | 32 | AI12(AIL4) |
| AI4(AIH4) | 14 | 33 | AISENSE |
| AIGND | 15 | 34 | AI11(AIL3) |
| AI3(AIH3) | 16 | 35 | AI10(AIL2) |
| AI2(AIH2) | 17 | 36 | AI9(AIL1) |
| AI1(AIH1) | 18 | 37 | AI8(AIL0) |
| AI0(AIH0) | 19 | | |

## Specifications

| Model Name | PCI-9221 | PCI-9222 | PCI-9223 |
|---|---|---|---|
| **Analog Input** | | | |
| Resolution | 16 bits | | |
| Number of channels | 16 SE/ 8 DIFF | 16 SE/ 8 DIFF | 32 SE/ 16 DIFF |
| Maximum sampling rate (single channel) | 250 kS/s | 250 kS/s | 500 kS/s |
| Programmable gain | 1, 5,10, 25 | 1, 2, 4, 5, 8, 10, 20, 40 | 1, 2, 4, 5, 8, 10, 20, 40 |
| Input range | ±5 V, ±1 V, ±500 mV, ±200 mV | ±10 V, ±5 V, ±2.5 V, ±2 V, ±1.25 V, ±1 V, ±500 mV, ±250 mV | ±10 V, ±5 V, ±2.5 V, ±2 V, ±1.25 V, ±1 V, ±500 mV, ±250 mV |
| Offset error | ±2.6 mV typical, before calibration, ±0.5 mV typical, after calibration | | |
| Gain error | ±0.2% of FSR, before calibration, ±0.015% of FSR, after calibration | | |
| -3 dB small signal bandwidth (gain=1) | 1.8 MHz | 1.5 MHz | 1.5 MHz |
| System noise (gain=1) | 0.1 $mV_{RMS}$ | 0.5 $mV_{RMS}$ | 0.5 $mV_{RMS}$ |
| CMRR (gain=1) | 71 dB | 93.5 dB | 93.5 dB |
| SFDR (Spurious-free dynamic range, gain=1) | 95 dB | 95 dB | 88 dB |
| SINAD (Signal-to-noise and distortion ratio, gain=1) | 85 dB | 86 dB | 84 dB |
| THD (Total harmonic distortion, gain=1) | -93 dB | -94 dB | -90 dB |
| SNR (Signal-to-noise ratio, gain=1) | 86 dB | 87 dB | 86 dB |
| ENOB (gain=1) | 13.5 bits | 13.9 bits | 13.5 bits |
| FIFO buffer size | 1 k samples | | |
| Trigger sources | Software, external digital | Software, external digital, SSI | Software, external digital, SSI |
| Trigger mode | Post trigger | Post trigger, retrigger, gate trigger | Post trigger, retrigger, gate trigger |
| External conversion source | Yes (up to 250 kS/s) | Yes (up to 250 kS/s) | Yes (up to 500 kS/s) |
| Input coupling | DC | | |
| Overvoltage protection | ±10 V | Continuous ±30 V | Continuous ±30 V |
| Input impedance | High impedance > 1 GΩ | | |
| Data Transfer | Programmed I/O, Interrupt, Bus Mastering DMA | | |
| **Analog Output** | | | |
| Number of channels | 2 voltage outputs | | |
| Resolution | 16-bit | | |
| Maximum update rate | 1.25 kS/s (static) | 1 MHz (simultaneous update) | 1 MHz (simultaneous update) |
| FIFO | - | 512 | 512 |
| Output range | ±5 V | ±10 V | ±10 V |
| Output driving capacity | ±5 mA | | |
| Slew rate | 0.014 V/μs | 20 V/μs | 20 V/μs |
| Setting time (0.1% of full scale) | 1396 μs | 2.6 μs | 2.6 μs |
| Offset error | ±1 mV | ±0.1 mV | ±0.1 mV |
| Gain error | ±2 mV | ±0.1 mV | ±0.1 mV |
| Rising time | 390 μs | 0.67 μs | 0.67 μs |
| Falling time | 395 μs | 0.705 μs | 0.705 μs |
| **Function I/O** | | | |
| Mode | Digital I/O(1) , General Timer/Counter(1), Pulse Generation(1) | Digital I/O, General Timer/Counter, Pulse Generation | Digital I/O, General Timer/Counter, Pulse Generation |
| Digital I/O | 8DI/4DI (5 V TTL level) | 16 DO (3.3 V TTL Level) / 16 DI (3.3 V or 5 V TTL Level) | 16 DO (3.3 V TTL Level) 16 DI (3.3 V or 5 V TTL Level) |
| General Timer/Counter | Two 32-bit, Base clock: 40 MHz, external to 10 MHz | Four 32-bit, Base clock: 80 MHz, external to 10 MHz | Four 32-bit, Base clock: 80 MHz, external to 10 MHz |
| Pulse generation | Two PWM outputs (Modulation frequency: 0.005 Hz to 5 MHz; Duty cycle: 1%-99%) | Four PWM outputs (Modulation frequency: 0.01 Hz to 5 MHz; Duty cycle: 1%-99%) | Four PWM outputs (Modulation frequency: 0.01 Hz to 5 MHz; Duty cycle: 1%-99%) |
| **Encoder Input** | | | |
| Number of channels | 2(2) | | |
| Encoder type | CW/CCW encoder, x 1 AB phase encoder, x 2 AB phase encoder, x 4 AB phase encoder | | |
| **General specs.** | | | |
| PCI Bus | 5 V and 3.3 V universal PCI bus | | |
| Auto-calibration | | Yes | |
| I/O Connector | One 37-pin D-Sub connector | Two 68-pin SCSI-VHDCI female | Two 68-pin SCSI-VHDCI female |
| Operation temperature | 0 to 45˚C | 0 to 55˚C | 0 to 55˚C |
| Storage temperature | -20 to 80˚C | -20 to 70˚C | -20 to 70˚C |
| Humidity | | 5 to 95% non-condensing | |
| Power requirements | +5 V 1A typical, +12 V 100mA typical, -12 V 100mA typical | +5 V 1.2 A typical +12 V 760 mA typical -12 V 50 mA typical | +5 V 1.2 A typical +12 V 760 mA typical -12 V 50 mA typical |
| Dimensions | 120 mm x 87 mm | 175 mm x 107 mm (not including connectors) | 175 mm x 107 mm (not including connectors) |

Note:
(1) The function I/O and encoder inputs share the same I/O pins of the PCI-9221. Only one of these modes can be selected.
(2) Dedicated