6208/6216-GL Series

Multi-channel Analog Output Cards

User's Manual

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Revision History

Revision	Release Date	Description of Change(s)
1.00	N/A	Document created (Legacy documentation revised/converted to new system)
3.22	2003/05/07	Document created (legacy documentation revised/converted to new system) Specification Revision Initial Release
4.00	2007/12/27	Major revision of document flow and placement of content. Renaming of PCI-6208V & PCI-6216V to PCI-6208V-GL & PCI-6216V-GL respectively Re-release
4.01	2008/4/8	Updated for CompactPCI versions
4.02	2008/5/28	Updated board diagrams
4.03	2009/7/8	Added PCI Express boards

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Preface

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Using this Manual

Audience and Scope

The PCI-6208/6216-GL Series User's Manual is intended for hardware technicians and systems operators with knowledge of installing, configuring and operating PCI analog output cards.

Manual Organization

This manual is organized as follows:

Preface: presents important copyright notifications, disclaimers, trademarks, and associated information on the proper understanding and usage of this document and its associated product(s).

Chapter 1, Introduction: gives an overview of 6208/6216-GL Series features, applications, specifications and supporting software environments for use with the product. The layout of the 6208/6216-GL Series as well as its connectors and termination boards are presented.

Chapter 2, Getting Started: describes how to install and configure the 6208/6216-GL Series.

Chapter 3, Supporting Software & Libraries: presents DOS and Windows 95 software libraries for programming 6208/ 6216-GL Series cards. This information is especially useful for programmers using high-level programming languages.

Chapter 4, Hardware Registers: provides detailed descriptions of the 6208/6216-GL Series registers, I/O address map and Voltage Output conversion information. This information is especially useful for programmers who want to control the hardware with low-level programming.

Chapter 5, Utilities & Calibration: describes how to run the 6208/6216-GL Series utility program included in the software CD. Also describes how to calibrate 6208/6216-GL Series cards for accurate measurements and operations.

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Important Safety Instructions: Presents safety instructions all users must follow for the proper setup, installation and usage of equipment and/or software.

Warranty Information: Presents important warranty information for users/manufacturers rights and responsibilities regarding ADLINK products and services.

Conventions

Take note of the following conventions used throughout this manual to make sure that users perform certain tasks and instructions properly.



Additional information, aids, and tips that help users perform tasks.



Information to prevent ***minor*** physical injury, component damage, data loss, and/or program corruption when trying to complete a task.



Information to prevent ***serious*** physical injury, component damage, data loss, and/or program corruption when trying to complete a specific task.

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Acronyms & Terminology

The following terms are used throughout this document. This list is prepared in alphabetical order for clarity.

µsec./µs - microsecond

A/mA - (Ampere/amp/milliampere) a unit of electric current, or amount of electric charge per second

ADE - Application Development Environment

API - Application Programming Interface

ATE - Automatic Test Equipment

BIOS - Basic Input/Output System

bit - Binary digit, the basic unit of information storage in computing

CD/CD-ROM - Compact Disk/Compact Disk Read Only Memory

ch/CH/Chn - Channel

DA - Digital-to-Analog Conversion

DAQ - Data Acquisition

DC - Continuous Current

DI - Digital Input

DLL (.dll) - Dynamic-link libraries, a library subroutine file type and common filename extension in Microsoft Windows.

DMA - Direct Memory Access

DMM - digital-multi-meters, an electronic measuring instrument that combines several functions in one unit

DO - Digital Output

driver - A software component used to interact with hardware devices

EXE (.exe) - A filename extension for executable files/programs

FAE - Field Application Engineer

HMI - Human-Machine Interface

I/**O** (IO) - Input / Output

IC - integrated circuit, a miniaturized electronic circuit

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IRQ/SERIRQ - Interrupt Request / Serial Interrupt Request

LabVIEW™ - Laboratory Virtual Instrumentation Engineering Workbench, a visual programming language for platforms and development environments

LCR - Local Configuration Registers

LSB - Least Significant Byte

MATLAB® - Matrix Laboratory, a numerical computing environment and programming language

MHz - Megahertz (one million hertz)

mm - millimeter

OEM - Original Equipment Manufacturer

OS - Operating System

PCI - Peripheral Component Interconnect

PCI Express (PCIe or PCI-E) - An I/O interconnect bus standard that expands on and doubles the data transfer rates of original PCI

PCR - PCI Configuration Registers

PnP - Plug and Play

PXI - PCI eXtensions for Instrumentation, a modular instrumentation platforms

SCADA - Supervisory Control And Data Acquisition

TTL - Transistor-Transistor Logic, digital circuits built from bipolar junction transistors and resistors.

V - Volt, a derived unit of electrical potential difference

VDC - Volts of Continuous Current

VEE™ - Visual Engineering Environment, a visual and dataflow programming language and development environment

X86 - A generic term that refers to the CISC (complex instruction set computer) architecture, the most commercially successful central processing unit (CPU) architecture in modern computing.

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Reference Documentation

The following list of documents may be used as reference materials to support installation, configuration and/or the operation of ADLINK PCI-6208/6216-GL Series Multi-channel Analog Output Cards. This list is prepared in alphabetical order (by vendor name, then by document title) for clarity.

Vendor(s)	Title	Rev.
ADLINK Technology, Inc.	ADLINK DAQ Software Installation User's Manual	2.00
ADLINK Technology, Inc.	DAQBench ActiveX Controls for Measurement and SCADA/HMI Vista support	2.43
ADLINK Technology, Inc.	DAQBench Simplified Chinese: ActiveX® Controls for Measurement and SCADA/HMI	2.42
ADLINK Technology, Inc.	DAQBench Traditional Chinese: ActiveX® Controls for Measurement and SCADA/HMI	2.42
ADLINK Technology, Inc.	DAQ-LVIEW PnP: LabVIEW™ Interface for all ADLINK PCI™/PCI Express®/cPCI Series Data Acquisition Cards	1.29
ADLINK Technology, Inc.	DAQ-MTLB: MATLAB® Data Acquisition Toolbox Adapter for ADLINK DAQ Cards	1.10
ADLINK Technology, Inc.	PCI-OCX: ActiveX® Controls for ADLINK PCI™/PCI Express®/cPCI Series Data Acquisition Cards	4.22
ADLINK Technology, Inc.	PCIS-DASK: Data Acquisition Software Development Kit for NuDAQ PCI™ bus cards	2.00
ADLINK Technology, Inc.	PCIS-VEE: VEE™ Interface for ADLINK PCI™/cPCI Series Data Acquisition Cards	3.21
PCI-SIG	Conventional PCI	3.0

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Getting Service

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ADLINK Technology Inc.
Address: 9F, No.166 Jian Yi Road, Chungho City,
Taipei County 235, Taiwan
台北縣中和市建一路 166 號 9 樓
Tel: +886-2-8226-5877
Fax: +886-2-8226-5717
Email: service@adlinktech.com

Ampro ADLINK Technology Inc.
Address: 5215 Hellyer Avenue, #110, San Jose, CA 95138, USA
Tel: +1-408-360-0200
Toll Free: +1-800-966-5200 (USA only)
Fax: +1-408-360-0222
Email: info@adlinktech.com

ADLINK Technology Beijing
Address: 北京市海淀区上地东路 1 号盈创动力大厦 E 座 801 室
(100085)
Rm. 801, Power Creative E, No. 1, B/D
Shang Di East Rd., Beijing 100085, China
Tel: +86-10-5885-8666
Fax: +86-10-5885-8625
Email: market@adlinktech.com

ADLINK Technology Shanghai
Address: 上海市漕河泾高科技开发区钦江路 333 号 39 幢 4 层
(200233)
Tel: +86-21-6495-5210
Fax: +86-21-5450-0414
Email: market@adlinktech.com

ADLINK Technology Shenzhen
Address: 深圳市南山区科技园南区高新南七道 数字技术园
A1 栋 2 楼 C 区 (518057)
2F, C Block, Bld. A1, Cyber-Tech Zone,
Gao Xin Ave. Sec 7, High-Tech Industrial Park S.,
Shenzhen, 518054 China
Tel: +86-755-2643-4858
Fax: +86-755-2664-6353
Email: market@adlinktech.com

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ADLINK Technology Inc. (German Liaison Office)
Address: Nord Carree 3, 40477 Duesseldorf, Germany
Tel: +49-211-495-5552
Fax: +49-211-495-5557
Email: emea@adlinktech.com

ADLINK (French Liaison Office)
Address: 15 rue Emile Baudot, 91300 MASSY Cedex, France
Tel: +33 (0) 1 60 12 35 66
Fax: +33 (0) 1 60 12 35 66
Email: france@adlinktech.com

ADLINK Technology Japan Corporation
Address: 151-0072 東京都渋谷区幡ヶ谷
1-1-2 朝日生命幡ヶ谷ビル 8F
Asahiseimei Hatagaya Bldg. 8F
1-1-2 Hatagaya, Shibuya-ku, Tokyo 151-0072, Japan
Tel: +81-3-4455-3722
Fax: +81-3-5333-6040
Email: japan@adlinktech.com

ADLINK Technology Inc. (Korean Liaison Office)
Address: 서울시 강남구 논현동 60-12 동성빌딩 4 층 402 호
No.402, Dongsung B/D, 60-12, Nonhyeon-Dong
Gangnam-gu, Seoul, 135-010, Korea.
Tel: +82-2-2057-0565
Fax: +82-2-2057-0563
Email: korea@adlinktech.com

ADLINK Technology Singapore Pte Ltd.
Address: 84 Genting Lane #07-02A, Cityneon Design Centre,
Singapore 349584
Tel: +65-6844-2261
Fax: +65-6844-2263
Email: singapore@adlinktech.com

ADLINK Technology Singapore Pte Ltd. (Indian Liaison Office)
Address: No. 1357, "Anupama", Sri Aurobindo Marg, 9th Cross,
JP Nagar Phase I, Bangalore - 560078, India
Tel: +91-80-65605817
Fax: +91-80-22443548
Email: india@adlinktech.com

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1 Introduction

1.1 Overview

ADLINK 6208/6216-GL Series are 8-ch or 16-ch, 16-bit analog output cards. They each offer ±10 V output ranges and 25 V/µs slew rates. Each channel is equipped with a dedicated digital to analog converter, and the output value of each channel can be updated individually. These devices provide high resolution, high density analog output functionalities and are suitable for automation test equipment, signal generation, industrial process control, servo control, and several other industrial control applications.

The specific models described in this manual are the PCI/PCIe/cPCI-6208V-GL and PCI/PCIe/cPCI-6216V-GL which are direct replacements of the previously released PCI-6208V and PCI-6216V cards (register map, hardware, and software are all fully compatible). Likewise, the cPCI-6208V-GL, cPCI-6216V-GL, cPCI-6208V/R-GL and cPCI-6216V/R-GL are also direct replacements of the previously released cPCI-6208V, cPCI-6216V, cPCI-6208V/R and cPCI-6216V/R cards, respectively.

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1.2 Features

- PCI-6208V-GL and PCI-6216V-GL are fully compatible with PCI-6208V and PCI-6216V, respectively.
- cPCI-6208V-GL, cPCI-6216V-GL, cPCI-6208V/R-GL and cPCI-6216V/R-GL are fully compatible with cPCI-6208V, cPCI-6216V, cPCI-6208VR and cPCI-6216VR, respectively.
- Supports a 32-bit 3.3 V or 5 V PCI bus, Plug and Play (PCI-6208V/6216V-GL)
- x1 lane PCI Express interface (PCIe-6208V/6216V-GL)
- 3U Eurocard form factor, CompactPCI compliant PICMG 2.9 R2.1 (cPCI-6208V/6216V-GL)
- 16-bit high resolution voltage outputs
- Output Range: ±10V (15-bit resolution guarantee)
- Differential Linearity Error: ±1.5 LSB typical
- 4-CH TTL digital inputs and 4-CH TTL digital outputs
- Rear I/O available on the cPCI-6208VR6216VR-GL

1.3 Applications

- Industrial Process Control
- Servo control
- Reference voltage generator

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1.4 Specifications

- **Voltage Output:**
  - Channels:
    - 8 channels for the 6208V-GL
    - 16 channels for the 6216V-GL
  - Resolution: 16-bit (15-bit guaranteed)
  - Voltage output range: ±10 V
  - Voltage output driving capability: ±5 mA max.
  - Settling time: 130 µs (-10 V to +10 V)
  - Slew rate: 25 V/µs
  - Gain error: 0.0025% Full Scale Range (at 25°C)
  - Offset error: 0.0005% Full Scale Range (at 25°C)
  - Differential Nonlinearity Error: ±1.5 LSB typical
  - Integral Nonlinearity Error: ±2.5 LSB
  - Output initial status: 0 V (after RESET or POWER-ON)
  - Data Transfer: Programmed I/O
- **Digital I/O**
  - Channel: Four TTL compatible inputs and outputs
  - Input Voltage:
    - Low: Min. 0 V, Max. +0.8 V
    - High: Min. +2.0 V, Max. +5.5 V
  - Input Load:
    - Low: +0.8 V at -0.2 mA max.
    - High: +2.7 V at +20 mA max.
  - Output Voltage:
    - Low: Min. 0 V, Max. +0.4 V
    - High: Min. +2.4 V, Max. +5.5 V
  - Driving Capacity:
    - Low: Max. +0.5 V at +8.0 mA (Sink)
    - High: Min. +2.7 V at +0.4 mA (Source)

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- **General Specifications:**
  - Operating temperature: 0°C to +50°C
  - Storage temperature: -20°C to +80°C
  - Humidity: 5% to 95% non-condensing
  - Connector: 37-pin D-sub connector (female)
  - Bus interface: 32-bit slave PCI bus
- **Power Consumption:**
  - PCI-6208V-GL:
    - +5 VDC at 580 mA typical
    - +12 VDC at 70 mA typical
  - PCI-6216V-GL:
    - +5 VDC at 1 A typical
    - +12 VDC at 280 mA typical
  - cPCI-6208V-GL:
    - +5 VDC at 500 mA typical
    - +12 VDC at 200 mA typical
  - cPCI-6216V-GL:
    - +5 VDC at 1 A typical
    - +12 VDC at 300 mA typical
  - cPCI-6208V/R-GL
    - +5 VDC at 500 mA typical
    - +12 VDC at 200 mA typical

  cPCI-6216V/R-GL
    - +5 VDC at 1 A typical
    - +12 VDC at 300 mA typical
- **PCB Dimensions:**
  - PCI-6208V/6216V-GL: 175 mm x 105 mm
  - PCIe-6208V/6216V-GL: 168 mm x 112 mm
  - cPCI-6208V(R)/6216V(R)-GL: 160 mm x 100 mm

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1.5 PCI-6208/6216-GL Series Card Layout

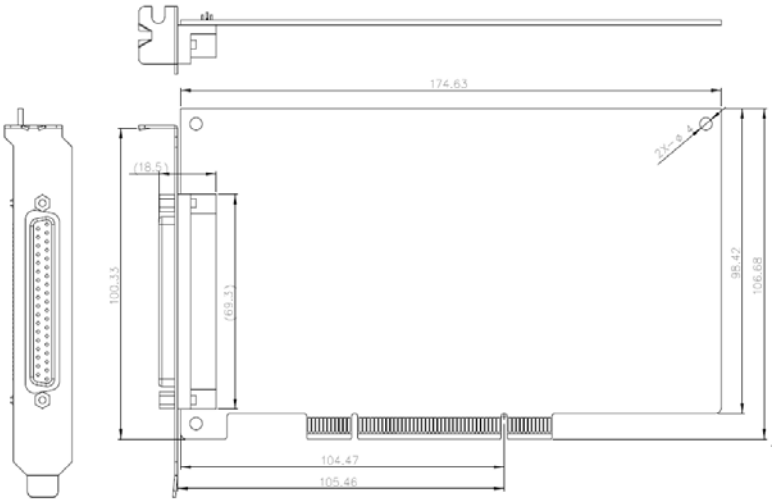


Figure 1-1: PCI-6208V-GL/6216V-GL Rev. C2 Layout

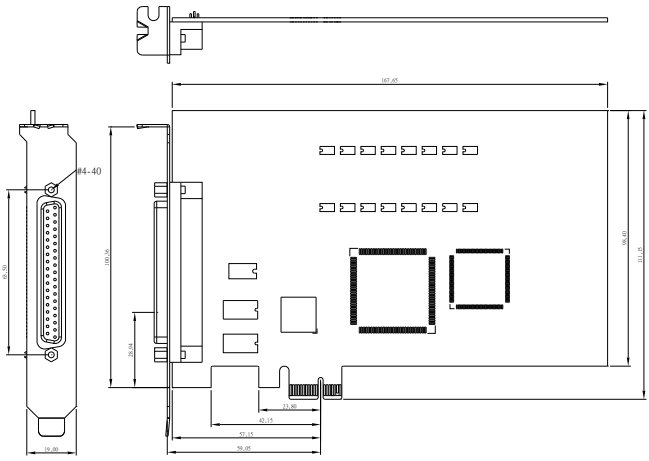


Figure 1-2: PCIe-6208V/6216V-GL Layout

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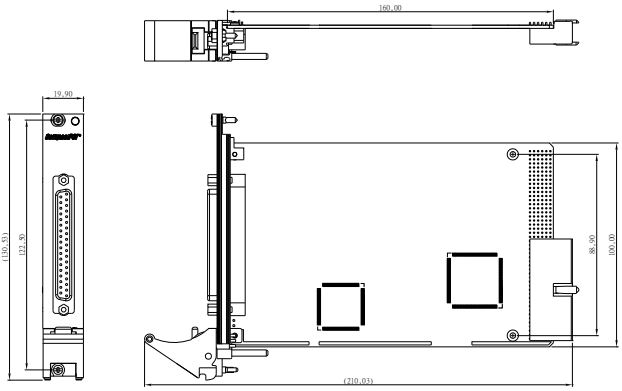


Figure 1-3: cPCI-6208V-GL and cPCI-6216V-GL Layou

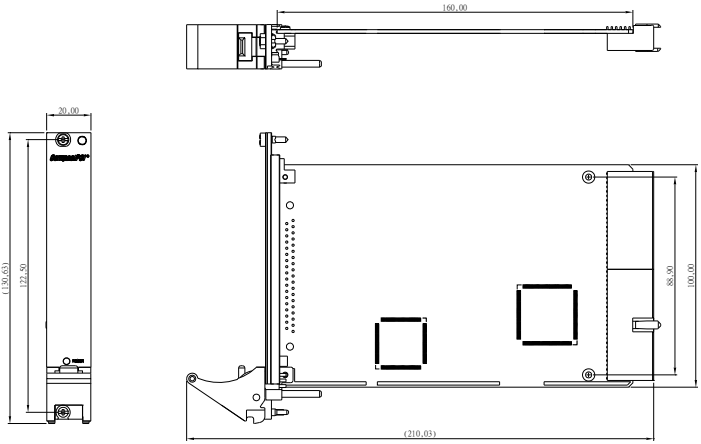


Figure 1-4: cPCI-6208V/R-GL and cPCI-6216V/R-GL Layout

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1.6 6208/6216-GL Series Pin Assignments

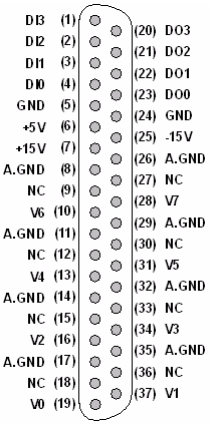


Figure 1-5: 6208V-GL CN1 Connector Pin Assignments

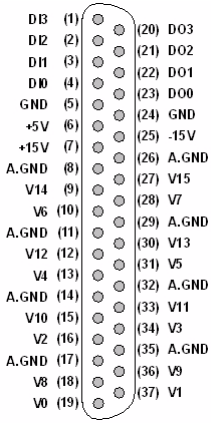


Figure 1-6: 6216V-GL CN1 Connector Pin Assignments

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The analog output pin are specified as Vn and A.GND, where:

Vn: The voltage output of channel number n.

- For 6208V-GL, n - 0 to 7
- For 6216V-GL, n = 0 to 15

A.GND: The ground pin of analog output. All ground pins are tied together.

The digital input and output pin names are specified as **DIn** and **DOn** respectively, where n = 0 to 3.

1.7 Termination Boards and Cables

6208/6216-GL Series cards are equipped with a 37-pin D-sub connector and compatible with the following termination boards..

- **DIN-37D-01:** A general purposed 37-pin screw terminal with a DIN-socket (cables are not included).
- **ACLD-9137-01**: General-Purpose termination board with a 37-pin D-sub male connector.
- **ACLD-9138-01**: General-Purpose termination board with a 37-pin D-sub connector.
- **ACL-10137:** 37-pin D-Sub male-male cable.

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2 Getting Started

This chapter describes how to install and setup 6208/6216-GL Series cards.



For illustration/reference purposes, we will specifically describe the **PCI-6208V-GL** card in all instances from this point forward unless otherwise noted.

2.1 Installation Environment

Whenever unpacking and preparing to install any equipment described in this manual, please refer to the ***Important Safety Instructions*** chapter of this manual.

Only install equipment in well lit areas on flat, sturdy surfaces with access to basic tools such as flat and cross head screwdrivers.

ADLINK 6208/6216-GL Series cards are electro-static sensitive components that can be easily damaged by static electricity. The card must be handled on a grounded anti-static mat. The operator must wear an anti-static wristband, grounded at the same point as the anti-static mat.

Inspect the carton and packaging for damage. Shipping and handling could cause damage to the equipment inside. Make sure that the card has no damage before installing.



The cards must be protected from static discharge and physical shock. Never remove any of the socketed parts except at a static-free workstation. Use the anti-static bag shipped with the product to handle the card and wear a grounded wrist strap when servicing.

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2.2 Package Contents

Before continuing, check the package contents for any damage. If the contents are damaged, inform your dealer immediately. Retain the shipping carton and packing materials for inspection. Obtain authorization from your dealer before returning any product to ADLINK.

Check if the following items are included in the packaging.

- 6208V-GL, or-6216-GL card.
- ADLINK All-in-One CD
- User's Manual
- cPCI-R6216DB rear I/O backplane (only available with cPCI-6208V/R-GL and cPCI-6216V/R-GL)



DO NOT install or apply power to equipment that is damaged or if there is missing/incomplete equipment. Please contact your ADLINK dealer/vendor immediately for assistance.



The packaging of OEM versions with non-standard configurations, functionality, or package contents may vary according to different configuration requests.

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2.3 Installation

After opening the packaging, remove the card and place it on a grounded anti-static surface with component side up. Locate the ADLINK All-in-one CD also packaged in the carton and have this user's manual and any associated documentation ready for reference.

Installing Software

- Insert the ADLINK All-in-one CD in your target system and follow the graphical user interface.
- Install Drivers depending on your system/card requirements:
  - Choose either DAQPilot: ADLINK's Next-Generation Driver accessible at (www.adlinktech.com/TM/DAQPilot.html), or;
  - Legacy Drivers for older operating systems or proprietary software systems (included on the ADLINK All-in-one CD).
- Install the system manager, DAQManager, included on the All-in-one CD and accessible using the graphical user interface.
- Locate your 6208/6216-GL Series card and continue device installation.


NOTE:

Also see Chapter 3 for Supporting Software details.

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Installing Hardware

PCI Configuration

The PCI cards (or CompactPCI cards) are equipped with Plug and Play PCI controller, it can request base addresses and interrupt according to PCI standard. The system BIOS will install the system resources based on the PCI cards' configuration registers and system parameters (which are set by system BIOS). Interrupt assignment and memory usage (I/O port locations) of the PCI cards can be assigned by system BIOS only. These system resource assignments are done on an individual board basis. It is not recommended to assign the system resource by any other methods.

PCI slot selection

The PCI card can be inserted into any PCI slot without any configuration for system resource. Please note that the PCI system board and slot must provide bus-mastering capability to operate this board well.

PCI Installation Procedures

1. Turn off your computer.
2. Turn off all peripherals (printer, modem, monitor, etc.) connected to your computer.
3. Remove the cover from your computer.
4. Set up jumpers on the PCI or CompactPCI card.
5. Select the 32-bit PCI slot. PCI slots are shorter than the ISA or EISA slots and are usually white or ivory.
6. Before handling the PCI cards, discharge any static buildup on your body by touching the metal case of the computer. Hold the edge and do not touch the components.
7. Position the board into the PCI slot you have selected.
8. Secure the card in place at the rear panel of the system.

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CompactPCI Installation Procedures

1. Read through this manual, and set the jumpers according to your application.
2. Turn off your computer and turn off all accessories connected to computer.
3. Remove the slot cover from the CompactPCI.
4. Select a 32-bit CompactPCI slot on the back plane for cPCI-7248 board. Select a 32-bit CompactPCI slot with rear I/O extension for cPCI-7249R.
5. Before handling the boards, discharge any static buildup on your body by touching the metal case of the computer. Hold the edge and do not touch the components.
6. Position the board into the slot you selected.
7. Secure the card on the back plane by using the screw removed from the slot.
8. Install the rear I/O transition board for cPCI-7249R.

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2.4 PCI Device Configuration

Overview

As plug and play component, a PCI card automatically requests an interrupt number through its PCI controller. The system BIOS responds with an interrupt assignment based on the card information and any known system parameters. These system parameters are determined by the installed drivers and the hardware load detected by the system.

Configuration

Board configuration is done on a board-by-board basis for all PCI boards on your system. Because configuration is controlled by the system and the software, there are no jumper settings required for base addresses, DMAs, and/or interrupt IRQs.

Configuration is subject to change with every boot of the system as new boards are added or removed.

Troubleshooting

If your system fails to boot or if you experience erratic operation with your PCI board installed, this is likely caused by an interrupt conflict (i.e. the BIOS Setup is incorrectly configured). Refer to the BIOS documentation that came with the system for details.

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3 Supporting Software

3.1 Supporting Software

ADLINK Technology Inc., a leading provider of high-performance, high-quality data acquisition cards and platforms, delivers robust software support for its comprehensive line of DAQ cards with varying form factors including PCI Express, PCI, CompactPCI, and PXI. ADLINK offers support not only for mainstream Windows and Linux OS, but also for third-party applications including Lab-VIEW™ and MATLAB®. In addition, ADLINK also provides ActiveX component ware for measurement, SCADA/HMI, and breakthrough proprietary software applications.

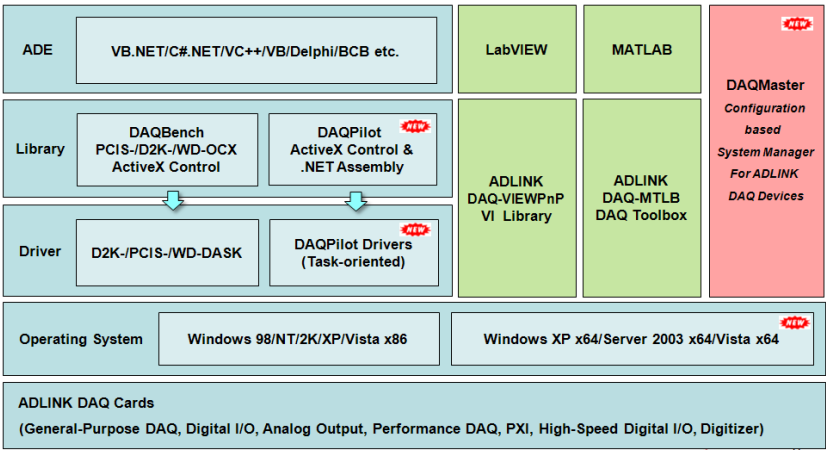


Figure 3-1: ADLINK Software Support Overview

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3.1.1 Windows OS Support & Drivers

DAQPilot

DAQPilot is a driver and SDK with a graphics-driven interface for various ADEs. DAQPilot comes as ADLINK's commitment to provide full support to its comprehensive line of data acquisition products. DAQPilot is designed for the novice, to the most experienced programmer.

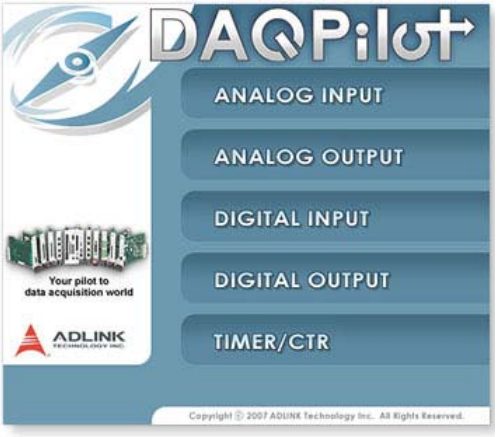


Figure 3-2: DAQPilot Main Screen

The ADLINK Task-oriented DAQ Driver/SDK and Wizard for Windows, DAQPilot helps users:

- Save development time
- Shorten the learning curve

Users may download and install DAQPilot via its product page:

`http://www.adlinktech.com/TM/DAQPilot.html`

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DAQMaster

The ADLINK DAQMaster is a smart device manager that opens up access to ADLINK data acquisition and test and measurement products. DAQMaster delivers an all-in-one interface which allows users to access a full support matrix to configure ADLINK Test and Measurement products.

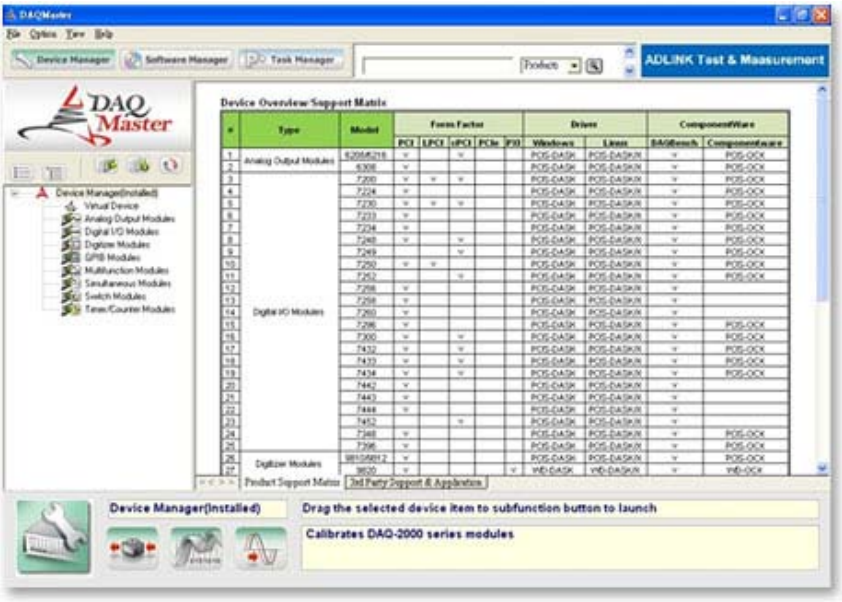


Figure 3-3: DAQMaster Device Manager Screen Shot

The ADLINK Configuration-Based Device Manager for ADLINK DAQ Cards, DAQMaster, enables users to:

- Manage ADLINK devices and interfaces
- Manage ADLINK installed software
- Manage ADLINK DAQPilot tasks

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3.1.2 PCIS-DASK (Legacy Drivers & Support)

ADLINK's DASK are advanced 32-bit kernel drivers for customized DAQ application development. DASK enables users to perform detailed operations and achieve superior performance and reliability from their data acquisition system. DASK kernel drivers now support the revolutionary Windows Vista OS.

NOTE:

ADLINK strongly recommends all users install DAQPilot and not use legacy DASK drivers. For users currently using legacy ADLINK DASK Drivers or whom do not have internet access, we offer an all-in-on CD. Contact your ADLINK vendor for details

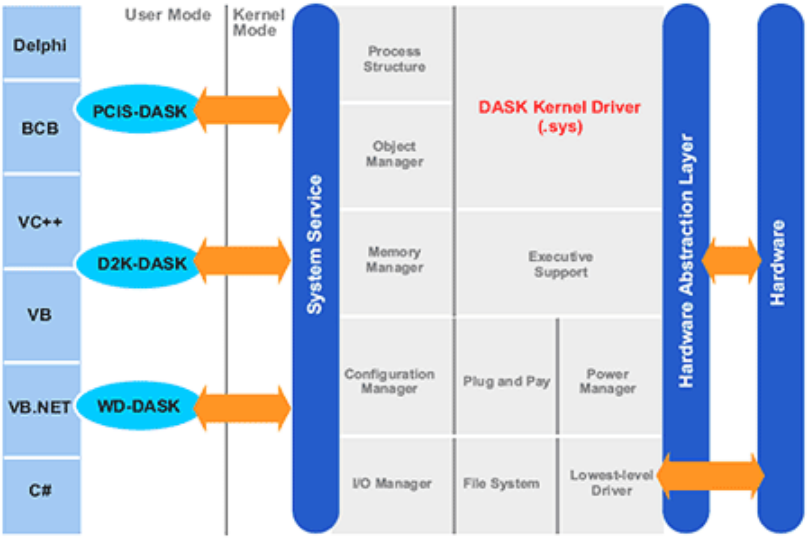


Figure 3-4: PCIS-DASK Legacy Software Support Overview

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PCIS-DASK readies legacy users for Windows Vista and Other Windows 64-bit Editions:

- Supports Windows Vista 32 or 64-bit Editions
- Supports AMD64 and Intel x86-64 architectures
- Digitally-signed for Windows Vista 64-bit Edition
- Utilizes WOW64 subsystem to ensure that 32-bit applications run normally on 64-bit Editions of Windows XP, Windows 2003 Server, and Windows Vista without modification

For more information about Windows Vista Support, please visit:

`http://www.adlinktech.com/TM/VistaSupport.html`

or

View the file on the ADLINK All-in-one CD

`//Manual/Software Package/PCIS-DASK/PSDASK User's Guide.pdf`

3.1.3 Linux OS Support & Drivers

ADLINK's DASK/X drivers are intended for developing customized data acquisition applications under Linux environments. The DASK/X drivers provide common APIs for ADLINK's extensive family of PCI, CompactPCI, and PXI plug-in data acquisition cards, and utilize the full capabilities of these cards under the Linux environment.



For more information about Linux drivers, please visit:

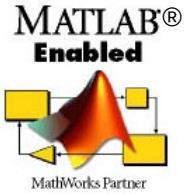
`http://www.adlinktech.com/TM/linux_daq.html`

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3.1.4 Third-party Software Support

MATLAB® Data Acquisition Toolbox Adapter

The ADLINK DAQ-MTLB for MATLAB® integrates ADLINK components with the MATLAB® Data Acquisition Toolbox and enables users to control a wide range of ADLINK DAQ cards directly within the advanced MATLAB® environment.



- Directly control scores of ADLINK DAQ cards including PCI Express, PCI, cPCI, and PXI Compliant form factors with MATLAB® DAQ Toolbox 2.2 or higher (now R2007a)
- Critical updates and support are available as ADLINK is now a MathWorks Connections Program partner
- ADLINK offers the only MATLAB® adapter for high-speed digitizers on the market with up to 65 MHz sampling rate and 14-bit resolution

For more information, please visit:

```
http://www.adlinktech.com/TM/DAQ-MTLB.html
```

or

View the file on the ADLINK All-in-one CD

```
//Manual/Software Package/DAQ-MTLB/DAQ-MTLB
     Manual.pdf
```

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LabVIEW™ Data Acquisition VI Set

The DAQ-LVIEW PnP is a set of LabVIEW™ Virtual Instruments (VIs) that is fully-compatible with National Instrument's DAQ VIs. Based on the virtual instruments concept, DAQ-LVIEW PnP provides four additional tool panels in LabVIEW™, including analog input, analog output, digital I/O, and timer/counter.

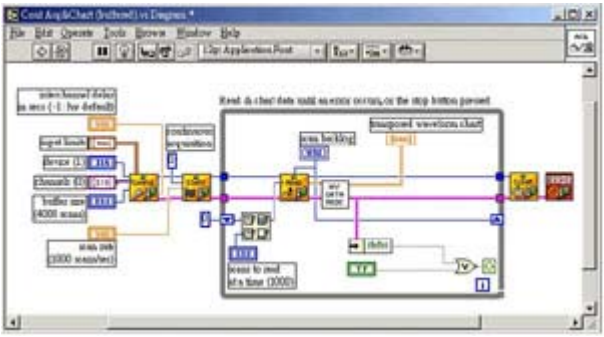


Figure 3-5: LabVIEW™ Screen Shot

The DAQ-LVIEW PnP is designed and verified for LabVIEW™ 7.0, and is compatible with LabVIEW™ 6.5, 7.1, 8.0, 8.2, and 8.5.

For more information, please visit:

`http://www.adlinktech.com/TM/labview-pnp.html`

or

View the file on the ADLINK All-in-one CD

`//Manual/Software Package/DAQ-LVIEW PnP/DAQ-LVIEW PnP User's Guide.pdf`

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VEE™ Interface for ADLINK DAQ Cards

Agilent VEE™ is a popular visual programming environment for data acquisition that includes data analysis and control. VEE™ provides a visual programming interface that allows users to create programs by connecting objects such as acquisition routines, buttons and displays in a flow diagram. The ADLINK PCIS-VEE drivers are designed and verified for the Agilent VEE™ 4.5 environment. For users that are familiar with Agilent VEE™, ADLINK has released the PCIS-VEE and D2K-VEE for seamless integration of the ADLINK DAQ cards to the VEE™ environment.

More information can also be viewed on the ADLINK All-in-one CD

```
//Manual/Software Package/PCIS-VEE/PSVEE User's
     Guide.pdf
```

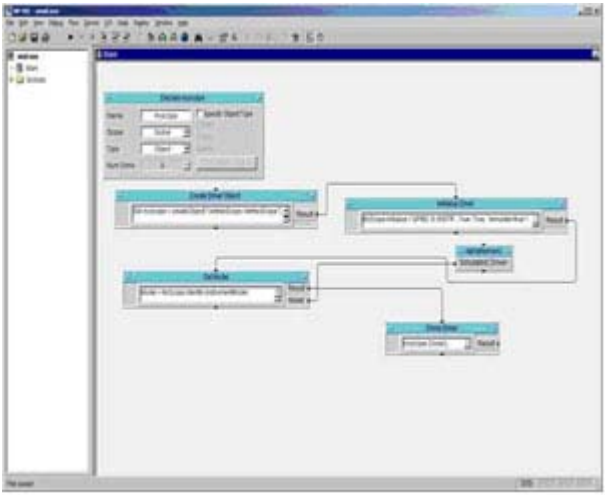


Figure 3-6: VEE™ Screen Shot

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ActiveX Controls for ADLINK DAQ Cards

ADLINK provides comprehensive ActiveX controls for DAQ devices. These ActiveX controls are designed to hide all hardware manipulation details so data acquisition operations can be achieved with only a few lines of codes. Furthermore, hardware configurations may be set with easy-to-use property pages while acquired data is returned in an event-driven manner.

More information can also be viewed on the ADLINK All-in-one CD

```
//Manual/Software Package/PCIS-OCX/PS-OCX
     Programmer's Guide.pdf
```

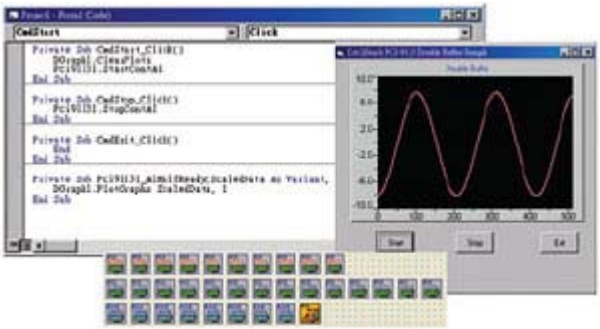


Figure 3-7: ActiveX Screen Shot

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4 Hardware Registers

This chapter presents a detailed description of the 6208/6216-GL registers. This information is quite useful for the programmers who wish to handle the card using low-level programming. However, we suggest users have extended knowledge and experience using the PCI interface when performing machine level programming. In addition, the contents of this chapter assist users to understand how to manipulate PCI card drivers.

4.1 PCI PnP Registers

PCI cards function as 32-bit PCI target devices to any master on the PCI bus. There are three types of registers: PCI Configuration Registers (PCR), Local Configuration Registers (LCR) and 6208/6216-GL registers.

The PCR, which is PCI-bus specification compliant, is initialized and controlled by the plug & play (PnP) PCI BIOS. Users may obtain more information on the PCI BIOS specification to better understand the operation of the PCR. Please contact PCISIG to acquire specifications of the PCI interface.

The PCI bus controller PCI-9052 is provided by PLX technology Inc. (www.plxtech.com). For more information about LCR, please visit PLX technology's web site to download relative information. It is not necessary for users to fully understand the details of the LCR if the software library provided is used. The PCI PnP BIOS assigns the base address of the LCR. The assigned address is located at an offset of 14h from the PCR.

The PCI-6208/6216-GL registers are discussed in the next section. The base address, which is also assigned by the PCI PnP BIOS, is located at an offset of 18h from the PCR. Therefore, users can read address 18h from the PCR to obtain its base address by using the BIOS function call. Do not attempt to modify the base address and interrupt that have been assigned by the PCI PnP BIOS, it may cause resource conflicts in your system.

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4.2 Analog Output Control Register

The 6208/6216-GL Series registers are all 16-bit. Users can access these registers with 16-bit I/O instructions. The following table shows the address of every analog output port relative to the base address. Note that the base address is assigned by the PCI BIOS.

Offset Address	6208V	6216V
0x00	V0	V0
0x02	V1	V1
0x04	V2	V2
0x06	V3	V3
0x08	V4	V4
0x0A	V5	V5
0x0C	V6	V6
0x0E	V7	V7
0x10	--	V8
0x12	--	V9
0x14	--	V10
0x16	--	V11
0x18	--	V12
0x1A	--	V13
0x1C	--	V14
0x1E	--	V15

Table 4-1: 6208/6216-GL Series I/O Address Map

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4.3 Analog Output Status Register

The 6208/6216-GL Series cards use series bus architecture to communicate with digital-to-analog converters, hence there is a delay for digital values to be output. The data transfer rate for every DA data write is 2.2 µs, therefore the software driver must wait 2.2 µs before sending any other data to any analog output port. While the DA value is being sent, the Data_Send bit is set to 'H'. The software driver should check this bit before writing any data to the output port. Writing any value to the analog output control register prior to this status bit is being "L" is not allowed. This register is read only.

Offset Address	D15~D1	D0
0x00	X	Data_Send

Table 4-2: Analog Output Status Register

4.4 Digital Output Register

Signals D0 through D3 are digital output signals written to each output channel. Signals D4 to D7 are reserved.

Offset Address	D7	D6	D5	D4	D3	D2	D1	D0
0x40	X	X	X	X	DO3	DO2	DO1	DO0

Table 4-3: Digital Output Register

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4.5 Digital Input Register

Signals D4 through D7 are digital input signals from the CN1 connector.

D4 - D7: digital input signal status.

D0 - D3: read back signal from digital output channel.

Offset Address	D7	D6	D5	D4	D3	D2	D1	D0
0x40	DI3	DI2	DI1	DI0	DO3	DO2	DO1	DO0

Table 4-4: Digital Input Register

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4.6 Voltage Output DA Conversion

The DA converter used in PCI-6208/6216-GL Series cards are 16-bit resolution with ±10 V bi-polar output ranges. Therefore, the data registers are all 16-bit sign values. The digital value ranges from -32768 (0X8000) to +32767 (0x7FFF) correspond to -10 V to +10 V respectively. The table displays the digital value and its corresponding hex value and analog output voltage.

Digital Value	HEX value	Output Voltage
32767	0x7FFF	+9.99969V
16384	0x4000	+5.00000V
8192	0x2000	+2.50000V
1	0x0001	0.00031V
0	0x0000	0.00000V
-1	0xFFFF	-0.00031V
-8192	0xE000	-2.50000V
-16384	0xC000	-5.00000V
-32767	0x8001	-9.99969V
-32768	0x8000	-10.00000V

Table 4-5: Voltage DA Conversion Table

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5 Utilities & Calibration

The ADLINK All-in-One CD provides a utility program located at:

```
\\Driver Installation\NuDAQ
     PCI_cPCI\6208\Dos_bc\UTIL\6208util.exe
```

or

```
\\Driver Installation\NuDAQ
     PCI_cPCI\6208\dos_msc\UTIL\6208util.exe
```

for function testing of the 6208/6216-GL cards. The utility is a menu-driven graphical interface and operates under MS-DOS.

There are text based messages for operating guidance, with graphics to indicate correct hardware configurations and locations. The utility is further described in the following sections.

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5.1 Running the Utility

After installing/initializing DOS, you may execute the utility by typing the following command (assuming your utility is located in the `\ADLINK\DOS\6208\Util` directory) at the DOS prompt.

```
C> cd \ADLINK\DOS\6208\Util
C> 6208UTIL
```

The following diagram will be displayed on your screen. The message at the bottom of each window guides you through the selected item.



Figure 5-1: 6208/6216-GL Utility Main Menu

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5.1.1 Function Testing

From the main menu, when you choose < `Function Testing` > the function test menu will display. Select the device you have installed and would like to test by moving the cursor and pressing < `Enter` >. You will then be offered several options to select the channel you want to test. After you have selected a channel from the channel selection menu, a testing window appears with the results of your test. Please see figures below for details.

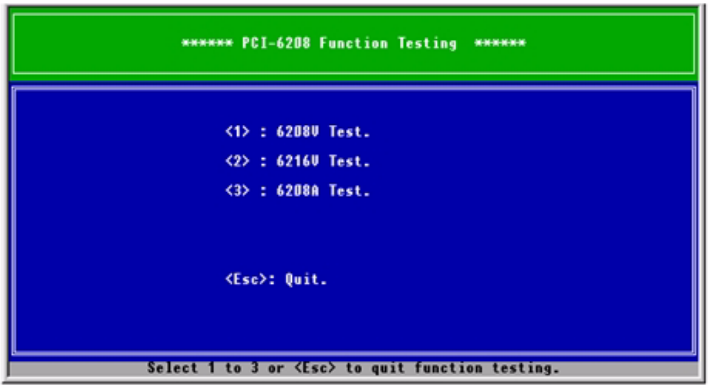


Figure 5-2: PCI-6208/6216-GL Function Test Menu

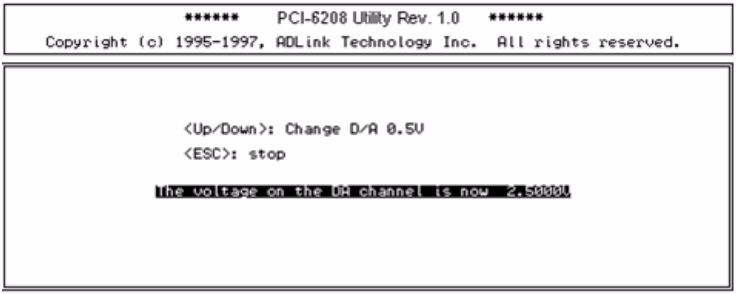


Figure 5-3: PCI-6208/6216-GL Function Test Screen Shot

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5.1.2 Calibration

ADLINK has adopted a new calibration method to optimize linearity and minimize gains and offset errors for 6208/6216-GL Series cards. We utilize a precision 6½ digital multi-meter (DMM) for in-house calibration.

During the calibration process, the calibration program will trigger the DMM to measure the actual output of every digital code (-32768 to +32767) generated by a 6208/6216-GL Series card. Then it creates a mapping table and records these data on a Flash memory chip.

After calibration, when the 6208/6216-GL Series cards perform their DA conversion, each cards firmware converts the output code automatically to the closest code which then corresponds to the actual output value closest to the ideal value based on the mapping table to minimize gain and offset errors for better linearity.



A one year re-calibration interval is recommended. Please contact your vendor or ADLINK directly to have your card re-calibrated.

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Important Safety Instructions

For user safety, please read and follow all **instructions**, **WARNINGS**, **CAUTIONS,** and **NOTES** marked in this manual and on the associated equipment before handling/operating the equipment.

- Read these safety instructions carefully.
- Keep this user's manual for future reference.
- Read the specifications section of this manual for detailed information on the operating environment of this equipment.
- When installing/mounting or uninstalling/removing equipment:
  - Turn off power and unplug any power cords/cables.
- To avoid electrical shock and/or damage to equipment:
  - Keep equipment away from water or liquid sources;
  - Keep equipment away from high heat or high humidity;
  - Keep equipment properly ventilated (do not block or cover ventilation openings);
  - Make sure to use recommended voltage and power source settings;
  - Always install and operate equipment near an easily accessible electrical socket-outlet;
  - Secure the power cord (do not place any object on/over the power cord);
  - Only install/attach and operate equipment on stable surfaces and/or recommended mountings; and,
  - If the equipment will not be used for long periods of time, turn off and unplug the equipment from its power source.

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- Never attempt to fix the equipment. Equipment should only be serviced by qualified personnel.
- A Lithium-type battery may be provided for uninterrupted, backup or emergency power.



RISK OF EXPLOSION IF BATTERY IS REPLACED BY AN INCORECT TYPE. DISPOSE OF USED BATTERIES ACCORDING TO THEIR INSTRUCTIONS.

- Equipment must be serviced by authorized technicians when:
  - The power cord or plug is damaged;
  - Liquid has penetrated the equipment;
  - It has been exposed to high humidity/moisture;
  - It is not functioning or does not function according to the user's manual;
  - It has been dropped and/or damaged; and/or,
  - It has an obvious sign of breakage.

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