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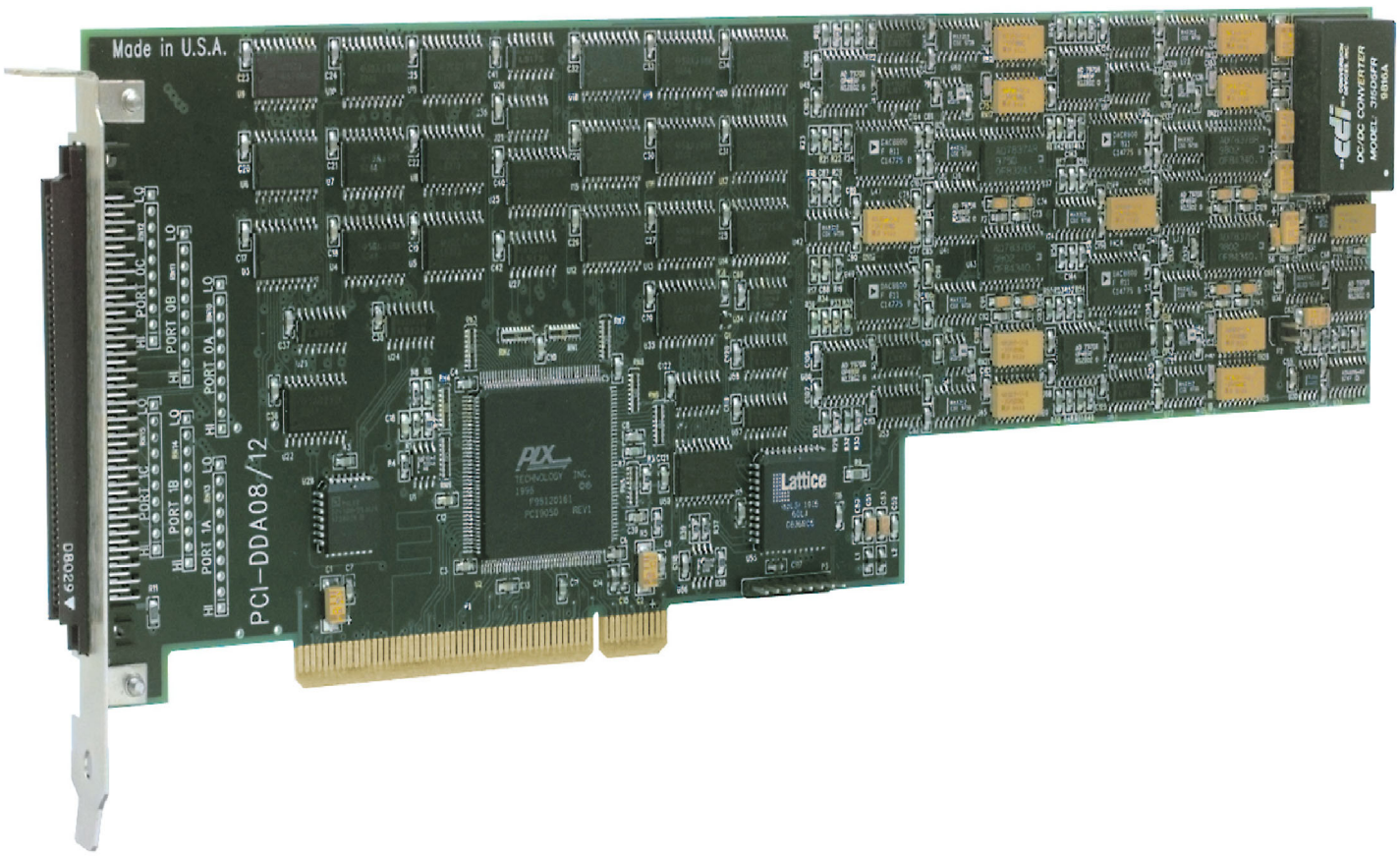
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PCI-DDA08/12

Analog Output and Digital I/O Board

User's Guide



MEASUREMENT COMPUTING

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PCI-DDA08/12

Analog Output and Digital I/O

User's Guide



MEASUREMENT COMPUTING™

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About this User's Guide

What you will learn from this user's guide

This user's guide explains how to install, configure, and use the PCI-DDA08/12 so that you get the most out of its analog output and digital I/O features.

This user's guide also refers you to related documents available on our web site, and to technical support resources.

Conventions in this user's guide

For more information on …

Text presented in a box signifies additional information and helpful hints related to the subject matter you are reading.

Caution! Shaded caution statements present information to help you avoid injuring yourself and others, damaging your hardware, or losing your data.

<#:#> Angle brackets that enclose numbers separated by a colon signify a range of numbers, such as those assigned to registers, bit settings, etc.

bold text **Bold** text is used for the names of objects on the screen, such as buttons, text boxes, and check boxes. For example:
1. Insert the disk or CD and click the **OK** button.

italic text *Italic* text is used for the names of manuals and help topic titles, and to emphasize a word or phrase. For example:
The *Insta*Cal installation procedure is explained in the *Quick Start Guide*.
Never touch the exposed pins or circuit connections on the board.

Where to find more information

The following electronic documents provide information relevant to the operation of the PCI-DDA08/12.

- MCC's *Specifications: PCI-DDA08/12* (the PDF version of the *Specifications* chapter in this guide) is available on our web site at www.mccdaq.com/pdfs/PCI-DDA08-12.pdf.
- MCC's *Quick Start Guide* is available on our web site at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.
- MCC's *Guide to Signal Connections* is available on our web site at www.mccdaq.com/signals/signals.pdf.
- MCC's *Universal Library User's Guide* is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-user-guide.pdf.
- MCC's *Universal Library Function Reference* is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-functions.pdf.
- MCC's *Universal Library for LabVIEW™ User's Guide* is available on our web site at www.mccdaq.com/PDFmanuals/SM-UL-LabVIEW.pdf.

PCI-DDA08/12 User's Guide (this document) is also available on our web site at www.mccdaq.com/PDFmanuals/PCI-DDA08-12.pdf.

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Introducing the PCI-DDA08/12

Overview: PCI-DDA08/12 features

This manual explains how to install and use the PCI-DDA08/12 board. The PCI-DDA08/12 provides eight channels of 12-bit analog output and 48-bits of digital I/O.

The D/A converters can be independently configured for either Bipolar or Unipolar. Bipolar ranges are ±10 V, ±5 V, and ±2.5 V. Unipolar ranges are 0 to 10 V, 0 to 5 V, and 0 to 2.5 V. The outputs may be updated individually or simultaneously. The range settings are software-selectable.

The digital I/O ports are configured as two 82C55 mode 0 emulations. Each group is divided into three 8-bit ports — Port A, Port B, and Port C. Port C can be split into two four-bit ports — Port C-HI and Port C-LO. Each of these ports may be individually programmed as input or output. The digital outputs are capable of sinking 64 mA and sourcing 15 mA utilizing standard "S" logic.

The PCI interface uses the PLX 9052 chip, which is a slave-only device. The PCI interface for the analog output is configured in a 16-bit, multiplexed address/data bus, I/O access mode. The PCI interface for the digital I/O is configured in an 8-bit, multiplexed address/data bus, I/O access mode to be register-compatible with the PCI-DIO48H and PCI-DIO96H boards.

The PCI-DDA08/12 board is completely plug-and-play, with no jumpers or switches to set. All board addresses are set by the board's plug-and-play software. Board configuration is controlled by your system's BIOS.

Software features

For information on the features of *Insta*Cal and the other software included with your PCI-DDA08/12, refer to the *Quick Start Guide* that shipped with your device. The *Quick Start Guide* is also available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.

Check www.mccdaq.com/download.htm for the latest software version or versions of the software supported under less commonly used operating systems.

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PCI-DDA08/12 block diagram

PCI-DDA08/12 functions are illustrated in the block diagram shown here.

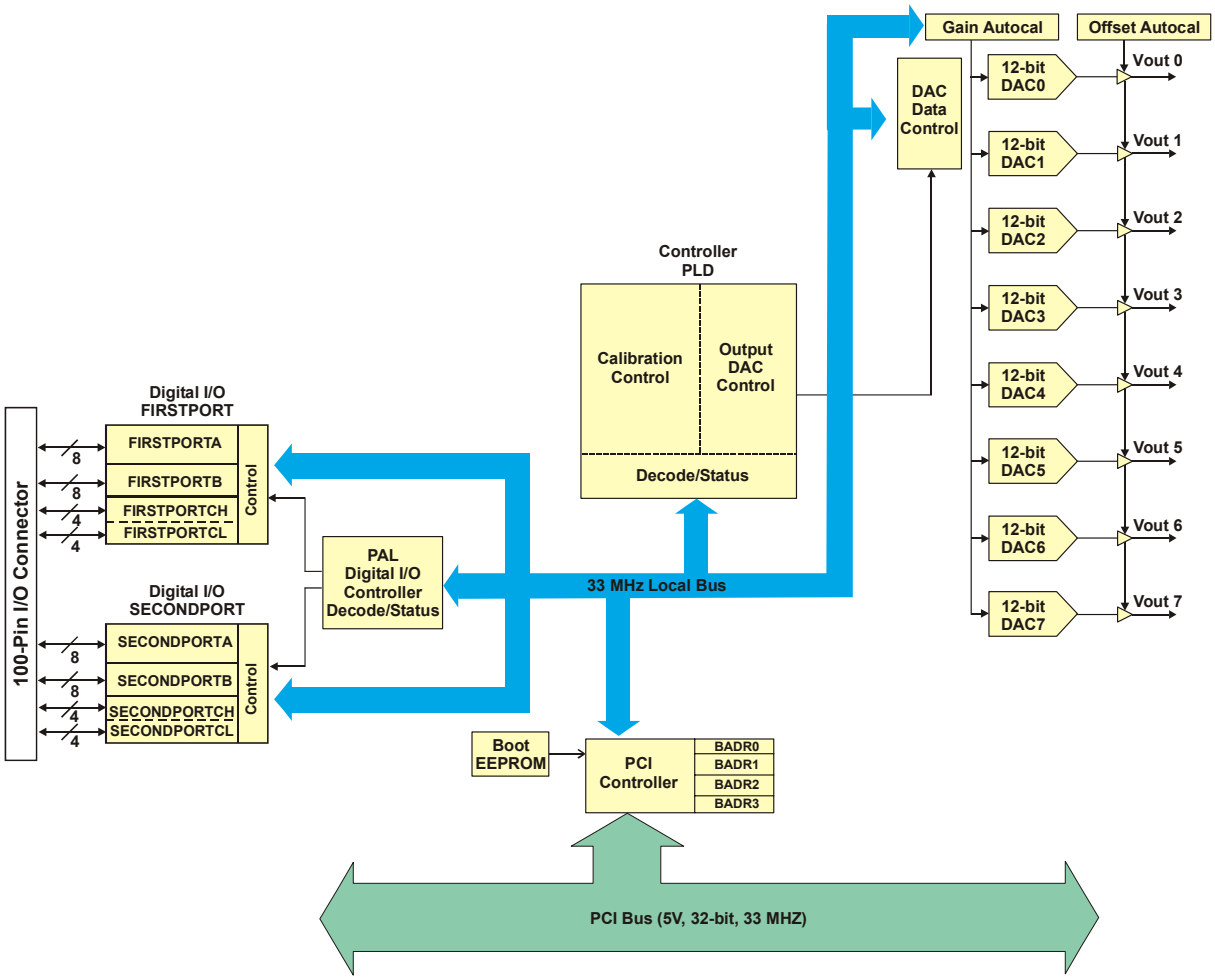


Figure 1-1. PCI-DDA08/12 functional block diagram

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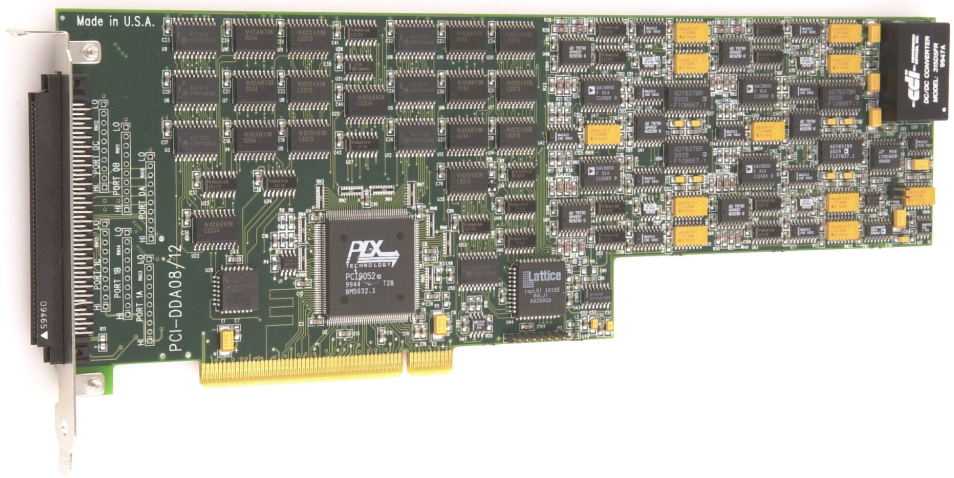
Installing the PCI-DDA08/12

What comes with your PCI-DDA08/12 shipment?

The following items are shipped with the PCI-DDA08/12.

Hardware

- PCI-DDA08/12

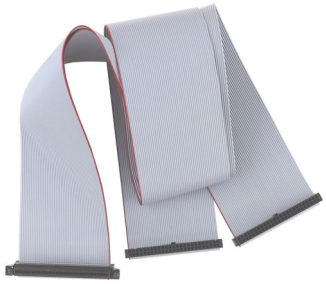


Additional documentation

In addition to this hardware user's guide, you should also receive the *Quick Start Guide* (available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf). This booklet supplies a brief description of the software you received with your PCI-DDA08/12 and information regarding installation of that software. Please read this booklet completely before installing any software or hardware.

Optional components

- C100FF-x cable



- Signal termination and conditioning accessories

  MCC provides signal termination products for use with the PCI-DDA08/12. Refer to Field wiring, signal termination and conditioning on page 2-4 for a complete list of compatible accessory products.

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Unpacking the PCI-DDA08/12

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the PCI-DDA08/12 from its packaging, ground yourself using a wrist strap or by simply touching the computer chassis or other grounded object to eliminate any stored static charge.

If any components are missing or damaged, notify Measurement Computing Corporation immediately by phone, fax, or e-mail:

- Phone: 508-946-5100 and follow the instructions for reaching Tech Support.
- Fax: 508-946-9500 to the attention of Tech Support
- Email: techsupport@mccdaq.com

Installing the software

Refer to the *Quick Start Guide* for instructions on installing the software on the *Measurement Computing Data Acquisition Software CD*. This booklet is available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.

Installing the PCI-DDA08/12

The PCI-DDA08/12 board is completely plug-and-play. There are no switches or jumpers to set. Configuration is controlled by your system's BIOS. To install your board, follow the steps below.

Install the MCC DAQ software before you install your board

The driver needed to run your board is installed with the MCC DAQ software. Therefore, you need to install the MCC DAQ software before you install your board. Refer to the *Quick Start Guide* for instructions on installing the software.

1. Turn your computer off, open it up, and insert your board into an available PCI slot.
2. Close your computer and turn it on.

   If you are using an operating system with support for plug-and-play (such as Windows 2000 or Windows XP), a dialog box pops up as the system loads indicating that new hardware has been detected. If the information file for this board is not already loaded onto your PC, you will be prompted for the disk containing this file. The MCC DAQ software contains this file. If required, insert the *Measurement Computing Data Acquisition Software* CD and click **OK**.
3. To test your installation and configure your board, run the *Insta*Cal utility you installed in the previous section. Refer to the *Quick Start Guide* that came with your board www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf for information on how to initially set up and load *Insta*Cal.

Connecting the board for I/O operations

Connectors, cables – main I/O connector

Table 2-1 lists the board connectors, applicable cables and compatible accessory boards.

Table 2-1. Board connectors, cables, accessory equipment

Connector type	100-pin, high density connector
Compatible cables	C100FF-x unshielded ribbon cable (x = length in feet)

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Compatible accessory products with the C100FF-x cable	SCB-50 CIO-TERM100 CIO-MINI50 (two required)

The PCI-DDA08/12 uses a single 100-pin high density connector on the back plate of the board to bring out all required digital and analog lines and grounds.

Pin out – main I/O connector

Table 2-2. I/O connector pin out

Signal name	Pin		Pin	Signal name
Digital Ground	100	••	50	Digital Ground
+5V	99	••	49	NC
FIRSTPORTC Bit 0	98	••	48	NC
FIRSTPORTC Bit 1	97	••	47	NC
FIRSTPORTC Bit 2	96	••	46	NC
FIRSTPORTC Bit 3	95	••	45	NC
FIRSTPORTC Bit 4	94	••	44	NC
FIRSTPORTC Bit 5	93	••	43	NC
FIRSTPORTC Bit 6	92	••	42	NC
FIRSTPORTC Bit 7	91	••	41	NC
FIRSTPORTB Bit 0	90	••	40	NC
FIRSTPORTB Bit 1	89	••	39	NC
FIRSTPORTB Bit 2	88	••	38	NC
FIRSTPORTB Bit 3	87	••	37	NC
FIRSTPORTB Bit 4	86	••	36	NC
FIRSTPORTB Bit 5	85	••	35	NC
FIRSTPORTB Bit 6	84	••	34	NC
FIRSTPORTB Bit 7	83	••	33	NC
FIRSTPORTA Bit 0	82	••	32	NC
FIRSTPORTA Bit 1	81	••	31	NC
FIRSTPORTA Bit 2	80	••	30	NC
FIRSTPORTA Bit 3	79	••	29	NC
FIRSTPORTA Bit 4	78	••	28	NC
FIRSTPORTA Bit 5	77	••	27	NC
FIRSTPORTA Bit 6	76	••	26	NC
FIRSTPORTA Bit 7	75	••	25	NC
SECONDPORTC Bit 0	74	••	24	NC
SECONDPORTC Bit 1	73	••	23	NC
SECONDPORTC Bit 2	72	••	22	NC
SECONDPORTC Bit 3	71	••	21	NC
SECONDPORTC Bit 4	70	••	20	NC
SECONDPORTC Bit 5	69	••	19	NC
SECONDPORTC Bit 6	68	••	18	NC
SECONDPORTC Bit 7	67	••	17	NC
SECONDPORTB Bit 0	66	••	16	Analog Ground
SECONDPORTB Bit 1	65	••	15	Vout 7
SECONDPORTB Bit 2	64	••	14	Analog Ground
SECONDPORTB Bit 3	63	••	13	Vout 6
SECONDPORTB Bit 4	62	••	12	Analog Ground
SECONDPORTB Bit 5	61	••	11	Vout 5
SECONDPORTB Bit 6	60	••	10	Analog Ground
SECONDPORTB Bit 7	59	••	9	Vout 4
SECONDPORTA Bit 0	58	••	8	Analog Ground
SECONDPORTA Bit 1	57	••	7	Vout 3
SECONDPORTA Bit 2	56	••	6	Analog Ground
SECONDPORTA Bit 3	55	••	5	Vout 2
SECONDPORTA Bit 4	54	••	4	Analog Ground
SECONDPORTA Bit 5	53	••	3	Vout 1
SECONDPORTA Bit 6	52	••	2	Analog Ground
SECONDPORTA Bit 7	51	••	1	Vout 0

PCI slot ↓

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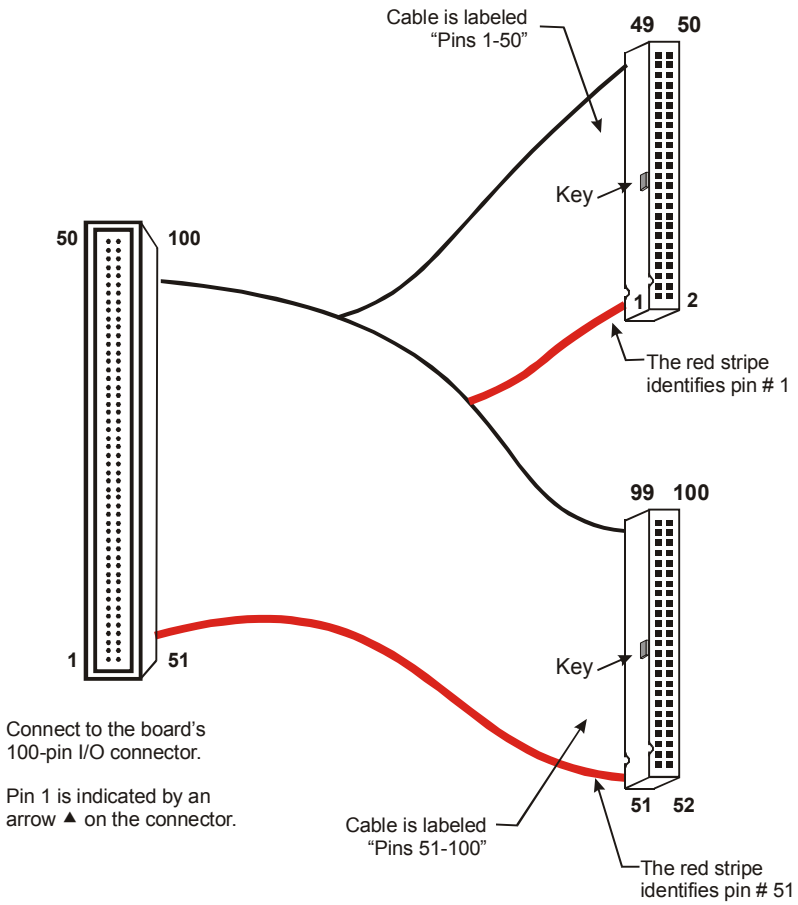


Figure 2-1. C100FF-x cable

Details on the C100FF-x cable are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=104&pf_id=21.

Information on signal connections

General information regarding signal connection and configuration is available in the *Guide to Signal Connections*. This document is available on our web site at www.mccdaq.com/signals/signals.pdf.

Field wiring, signal termination and conditioning

You can use the following screw terminal boards to terminate field signals and route them into the PCI-DDA08/12 using the C100FF-x cable:

- SCB-50 – 50 conductor, shielded signal connection/screw terminal box provides two independent 50-pin connections. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=196&pf_id=1168.
- CIO-TERM100 – 100-pin screw terminal board (daisy-chained 50-pin IDC connectors). Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=102&pf_id=281.
- CIO-MINI50 – 50-pin screw terminal board. Two boards are required. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=102&pf_id=258.

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Programming and Developing Applications

After following the installation instructions in Chapter 2, your board should now be installed and ready for use.

Programming languages

Measurement Computing's Universal Library™ provides access to board functions from a variety of Windows programming languages. If you are planning to write programs, or would like to run the example programs for Visual Basic® or any other language, please refer to the *Universal Library User's Guide* (available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-user-guide.pdf).

Packaged applications programs

Many packaged application programs, such as SoftWIRE® and HP-VEE™, now have drivers for your board. If the package you own does not have drivers for your board, please fax or e-mail the package name and the revision number from the install disks. We will research the package for you and advise how to obtain drivers.

Some application drivers are included with the Universal Library package, but not with the application package. If you have purchased an application package directly from the software vendor, you may need to purchase our Universal Library and drivers. Please contact us by phone, fax or e-mail:

- Phone: 508-946-5100 and follow the instructions for reaching Tech Support.
- Fax: 508-946-9500 to the attention of Tech Support
- Email: techsupport@mccdaq.com

Register-level programming

You should use the Universal Library or one of the packaged application programs mentioned above to control your board. Only experienced programmers should try register-level programming.

If you need to program at the register level in your application, refer to the *Register Map for the PCI-DDA0x/12 Series.* This document is available at on our web site at www.mccdaq.com/registermaps/RegMapPCI-DDA0x-12.pdf.

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Functional Details

Analog connections

The analog output connections on the PCI-DDA08/12 series are two-wire hookups. One wire connects to the signal labeled **Vout #**, where # is the channel number from 0 to 7. The other wire connects to the associated analog ground. The I/O connector pin out is shown in Table 2-2 on page 2-3.

Analog ranges are software-selectable for ±10 V, ±5 V, ±2.5 V, 0 to 10 V, 0 to 5 V, and 0 to 2.5 V. Each port may be reconfigured easily and quickly.

Digital connections

The PCI-DDA08/12 emulates two 82C55 chips, but offers much higher drive capability than the 82C55. The board emulates only Mode 0 of the 82C55 (no strobed I/O or bi-directional I/O bits). The PCI-DDA08/12 is completely plug-and-play, without any onboard user configurable switches or jumpers. The 48 CMOS/TTL compatible digital I/O lines are configured in four banks of eight and four banks of four. You can configure each bank for input or output.

All of the digital outputs/inputs on the PCI-DDA08/12 connector are TTL-compatible. TTL is an electronics industry term, short for Transistor Transistor Logic, a standard for digital signals which are either at near 0V or near 5V. The outputs are capable of sinking 64 mA or sourcing 15 mA. All I/O is brought out to the 100-pin connector, which also allows connection to the computer's +5 volt and ground.

Unconnected inputs float

Unconnected inputs typically float high, but not reliably. If you are using a PCI-DDA08/12 board for input and have unconnected inputs, ignore the data from those lines. You do not have to terminate input lines. Unconnected lines will not affect the performance of connected lines. Ensure that you mask out any unconnected bits in software.

Pull up and pull down resistors

Whenever the board is powered-on or reset, all ports are set to input mode. To drive all outputs to a known state after power on or reset, pull all pins either high or low through a 2.2 KΩ resistor.

- The pull-up resistor pulls the input to a high state (+5V). Its resistance of 2200 ohms draws only 2 mA of the 64 mA available from the output.
- A 2200 ohm pull-down resistor does the same task, except that the line is pulled low when the board is in the input mode, and uses only 2 mA of the 15 mA available output provided by the board.

The PCI-DDA08/12 board has open positions for up to six Single Inline Package (SIPs) resistors. The locations are marked Port 0A, 0B, and 0C, and Port 1A, 1B, and 1C, and are adjacent to the I/O connector. Port 0*n* corresponds to FIRSTPORT*n*, and Port 1*n* corresponds to SECONDPORT*n*.

The SIP resistors provide either pull-up or pull-down action for each eight-line port, depending on their orientation in the port positions on the board.

The SIP is made up of eight 2.2 KΩ resistors. One side of each resistor is connected to a single common point and brought out to a pin. The common line is marked with a dot or line at one end of the SIP. The remaining resistor ends are brought out to the other eight pins (refer to Figure 4-1).

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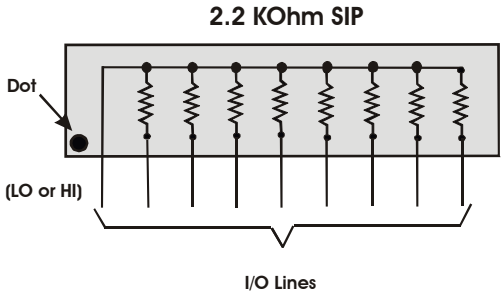


Figure 4-1. Eight-Resistor SIP Schematic

You can install the SIP as either pull-up or pull-down. At each location there are 10 holes in a line. One end of the line is +5V, the other end is GND. They are marked **HI** and **LO** respectively. The eight holes in the middle are connected to the eight lines of a port.

- For a pull-up function per port, mount the SIP with the common pin (marked with a dot or line) in the **HI** position.
- For a pull-down function per port, mount the SIP with the common pin in the **LO** position.

When installing pull-up and pull-down resistor SIP packs, we recommend using a 2.2 K, eight-resistor SIP (MCC part number SP-K2.29C). You can substitute individual 2.2 kΩ resistors for the resistor SIPs, if required.

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Calibrating the PCI-DDA08/12

Self-calibrating

The PCI-DDA08/12 is shipped fully-calibrated from the factory. Calibration coefficients are stored in nonvolatile RAM. When using the Universal Library, the calibration factors are read from nonvolatile RAM and are automatically written to the calibration DACs each time you select a different DAC range.

You can recalibrate with respect to the factory-measured voltage standards by selecting the "Calibrate" option in *Insta*Cal. *Insta*Cal calibrates each channel at all six ranges. Each channel takes less than a minute to calibrate.

Calibration configuration

The PCI-DDA08/12 provides self-calibration of the analog source and measure systems. This eliminates the need for external equipment and user adjustments. The analog output circuits are calibrated for both gain and offset. Gain calibration of the analog output is performed via DAC reference adjustments. Offset adjustments for the analog output is made in the output buffer section.

PCI-DDA08/12 calibration circuitry is shown in Figure 5-1.

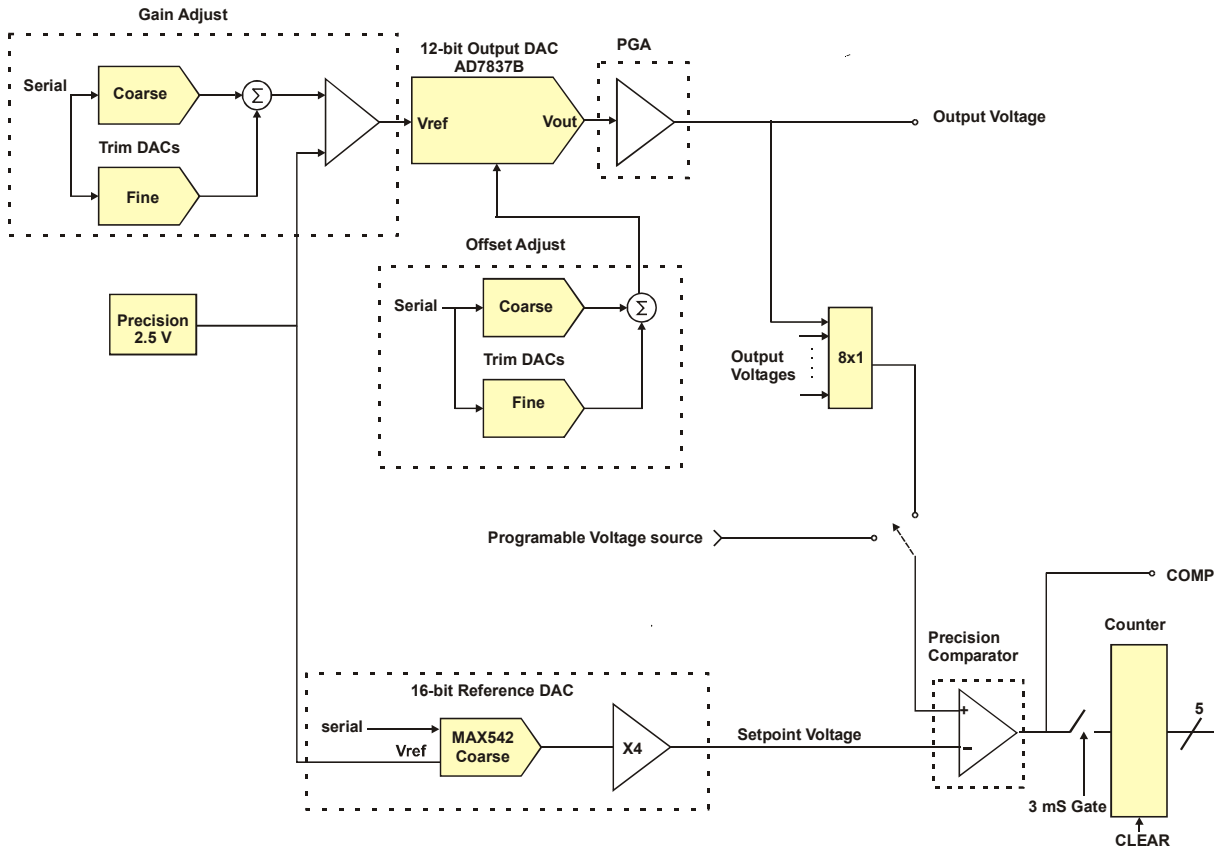


Figure 5-1. Calibration block diagram

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"In-system" calibration

The PCI-DDA08/12 is calibrated at the factory for the correct voltages at the I/O connector. For more precise application of voltages at the "system end", we can provide a version of *Insta*Cal that allows you to calibrate the board within your system for correct voltages at your field connection. This calibration lets you remove the effects of voltage drops caused by IR loss in the cable and connector for resistances up to 1 Ω. This calibration also allows you to zero out errors in any external signal conditioning up to approximately ±10 mV.

In most applications, the version of *Insta*Cal that ships with the board provides the accuracy specified. If your application has unusual requirements, such as long cables, etc., you may need the "in-system version" to achieve this accuracy.

Contact technical support by phone, fax, or e-mail for details regarding the "in-system" calibration feature. For international customers, contact your local distributor where you purchased the board.

- Phone: 508-946-5100 and follow the instructions for reaching Tech Support.
- Fax: 508-946-9500 to the attention of Tech Support
- Email: techsupport@mccdaq.com

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Specifications

Typical for 25 °C unless otherwise specified.

Specifications in *italic text* are guaranteed by design.

Power consumption

Table 1. Power consumption specifications

+5 V operating	1.6 A typical, 2.6 A max
+12 V	24 mA typical, 48 mA max
-12 V	16 mA typical, 25 mA max

Analog output

Table 2. Analog output specifications

D/A converter type	AD7837B
Resolution	12-bits
Number of channels	8
Output ranges	±10 V, ±5 V, ±2.5 V, 0 to 10 V, 0 to 5 V, 0 to 2.5 V. Each channel independently programmable.
Data transfer	Programmed I/O
Offset error (calibrated)	±(300 µV + ¼ LSB)
Gain error (calibrated)	±(300 µV + ¼ LSB)
Differential nonlinearity	±1 LSB max
Integral nonlinearity	±1 LSB max
Monotonicity	12-bits
D/A gain drift	±2 ppm/°C
D/A offset drift	±5 µV/°C
Throughput	PC dependent
Settling time (20V step to ±½LSB)	6 µs typ, 10µs max
Slew rate	5 V/µs
Current drive	±5 mA
Output short-circuit duration	25 mA indefinite
Output coupling	DC
Output impedance	0.1 Ohms max
Miscellaneous	▪ Double buffered output latches ▪ Update DACs individually or simultaneously (software selectable) ▪ Power up and reset, all DAC's cleared to 0 volts, ±210 mV

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Digital input / output

Table 3. Digital I/O specifications

Digital type (main connector)	82C55 mode 0 emulation
	Output: 74S244
	Input: 74LS373
Configuration	4 banks of 8, 4 banks of 4, programmable by bank as input or output
Number of channels	48 I/O
Output high	2.4 volts min @ -15 mA
Output low	0.5 volts max @ 64 mA
Input high	2.0 volts min, 7 volts absolute max
Input low	0.8 volts max, -0.5 volts absolute min
Power-up / reset state	Input mode (high impedance)

Environmental

Table 4. Environmental specifications

Operating temperature range	0 to 70 °C
Storage temperature range	-40 to 100 °C
Humidity	0 to 90% non-condensing

Main connector and pin out

Table 5. Board connectors, cables, accessory equipment

Connector type	100-pin, high density connector
Compatible cables	C100FF-x unshielded ribbon cable (x = length in feet)
Compatible accessory products with the C100FF-x cable	CIO-TERM100 CIO-MINI50 (two required)

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Table 6. I/O connector pin out

Pin	Signal Name	Pin	Signal Name
1	Vout 0	51	SECONDPORTA Bit 7
2	Analog Ground	52	SECONDPORTA Bit 6
3	Vout 1	53	SECONDPORTA Bit 5
4	Analog Ground	54	SECONDPORTA Bit 4
5	Vout 2	55	SECONDPORTA Bit 3
6	Analog Ground	56	SECONDPORTA Bit 2
7	Vout 3	57	SECONDPORTA Bit 1
8	Analog Ground	58	SECONDPORTA Bit 0
9	Vout 4	59	SECONDPORTB Bit 7
10	Analog Ground	60	SECONDPORTB Bit 6
11	Vout 5	61	SECONDPORTB Bit 5
12	Analog Ground	62	SECONDPORTB Bit 4
13	Vout 6	63	SECONDPORTB Bit 3
14	Analog Ground	64	SECONDPORTB Bit 2
15	Vout 7	65	SECONDPORTB Bit 1
16	Analog Ground	66	SECONDPORTB Bit 0
17	NC	67	SECONDPORTC Bit 7
18	NC	68	SECONDPORTC Bit 6
19	NC	69	SECONDPORTC Bit 5
20	NC	70	SECONDPORTC Bit 4
21	NC	71	SECONDPORTC Bit 3
22	NC	72	SECONDPORTC Bit 2
23	NC	73	SECONDPORTC Bit 1
24	NC	74	SECONDPORTC Bit 0
25	NC	75	FIRSTPORTA Bit 7
26	NC	76	FIRSTPORTA Bit 6
27	NC	77	FIRSTPORTA Bit 5
28	NC	78	FIRSTPORTA Bit 4
29	NC	79	FIRSTPORTA Bit 3
30	NC	80	FIRSTPORTA Bit 2
31	NC	81	FIRSTPORTA Bit 1
32	NC	82	FIRSTPORTA Bit 0
33	NC	83	FIRSTPORTB Bit 7
34	NC	84	FIRSTPORTB Bit 6
35	NC	85	FIRSTPORTB Bit 5
36	NC	86	FIRSTPORTB Bit 4
37	NC	87	FIRSTPORTB Bit 3
38	NC	88	FIRSTPORTB Bit 2
39	NC	89	FIRSTPORTB Bit 1
40	NC	90	FIRSTPORTB Bit 0
41	NC	91	FIRSTPORTC Bit 7
42	NC	92	FIRSTPORTC Bit 6
43	NC	93	FIRSTPORTC Bit 5
44	NC	94	FIRSTPORTC Bit 4
45	NC	95	FIRSTPORTC Bit 3
46	NC	96	FIRSTPORTC Bit 2
47	NC	97	FIRSTPORTC Bit 1
48	NC	98	FIRSTPORTC Bit 0
49	NC	99	+5V
50	Digital Ground	100	Digital Ground

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CE Declaration of Conformity

Manufacturer: Measurement Computing Corporation
Address: 10 Commerce Way
Suite 1008
Norton, MA 02766
USA

Category: Electrical equipment for measurement, control and laboratory use.

Measurement Computing Corporation declares under sole responsibility that the product

PCI-DDA08/12

to which this declaration relates is in conformity with the relevant provisions of the following standards or other documents:

EU EMC Directive 89/336/EEC: Electromagnetic Compatibility, EN55022 (1995), EN55024 (1998)

Emissions: Group 1, Class B

- EN55022 (1995): Radiated and Conducted emissions.

Immunity: EN55024

- EN61000-4-2 (1995): Electrostatic Discharge immunity, Criteria A.
- EN61000-4-3 (1997): Radiated Electromagnetic Field immunity Criteria A.
- EN61000-4-4 (1995): Electric Fast Transient Burst immunity Criteria A.
- EN61000-4-5 (1995): Surge immunity Criteria A.
- EN61000-4-6 (1996): Radio Frequency Common Mode immunity Criteria A.
- EN61000-4-8 (1994): Power Frequency Magnetic Field immunity Criteria A.
- EN61000-4-11 (1994): Voltage Dip and Interrupt immunity Criteria A.

Declaration of Conformity based on tests conducted by Chomerics Test Services, Woburn, MA 01801, USA in September, 2001. Test records are outlined in Chomerics Test Report #EMI3053.01.

We hereby declare that the equipment specified conforms to the above Directives and Standards.



Carl Haapaoja, Director of Quality Assurance

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