PCI-DDA04/16

Analog Output and Digital I/O

User's Guide

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MEASUREMENT COMPUTING™

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Table of Contents

About this User's Guide

What you will learn from this user's guide

This user's guide describes the Measurement Computing PCI-DDA04/16 data acquisition device and lists device specifications.

Conventions in this user's guide

For more information

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.

bold text — **Bold** text is used for the names of objects on a screen, such as buttons, text boxes, and check boxes.

italic text — *Italic* text is used for the names of manuals and help topic titles, and to emphasize a word or phrase.

Where to find more information

Additional information about the PCI-DDA04/16 is available on our website at www.mccdaq.com. You can also contact Measurement Computing Corporation by phone, fax, or email with specific questions.

- 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 to control your board. Only experienced programmers should attempt register-level programming. If you need to program at the register level in your application, refer to the *Register Map for the PCI-DDA0x/16 Series* on our web site at www.mccdaq.com/registermaps/RegMapPCI-DDA0x-16.pdf.

Introducing the PCI-DDA04/16

This manual explains how to install and use the PCI-DDA04/16 board. The PCI-DDA04/16 provides four channels of 16-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-DDA04/16 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.

PCI-DDA04/16 block diagram

PCI-DDA04/16 functions are illustrated in the block diagram shown here.

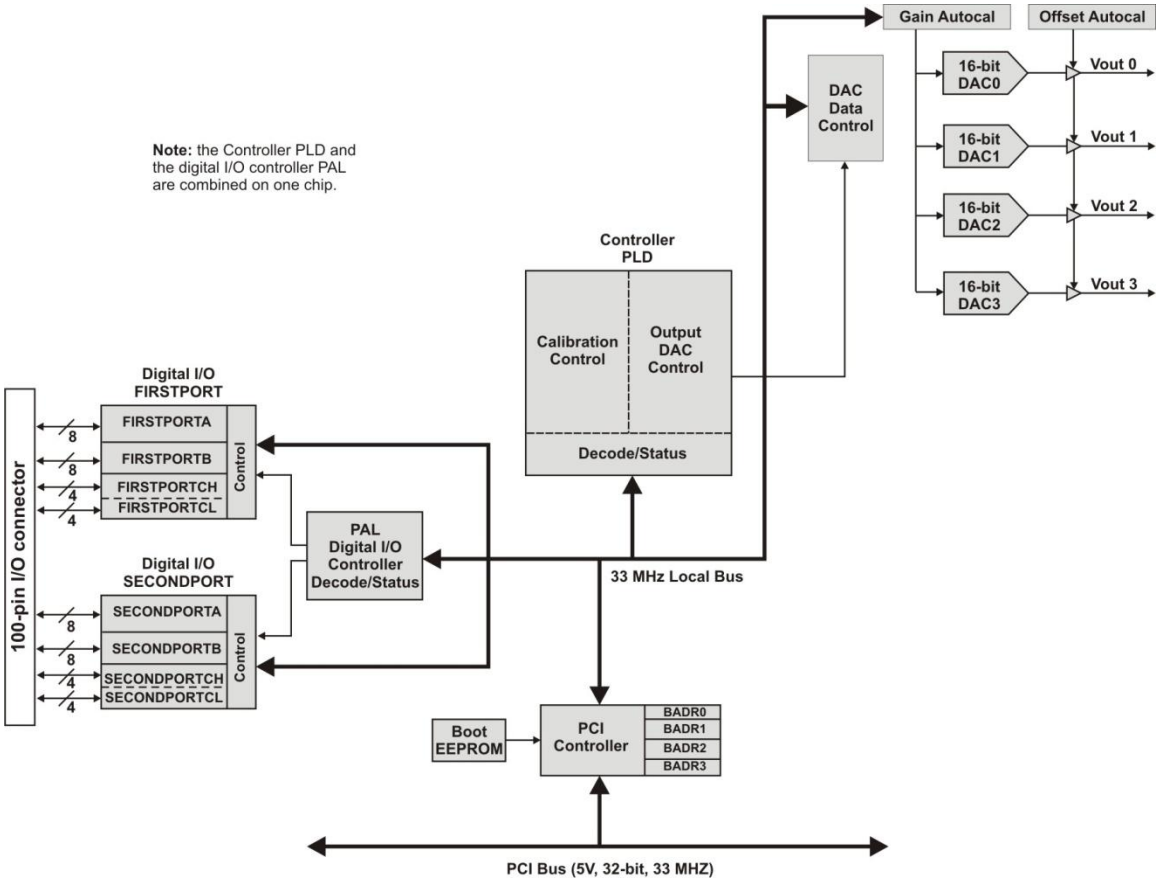

Figure 1. PCI-DDA04/16 functional block diagram

Installing the PCI-DDA04/16

What comes with your shipment?

Verify that the following components are included in the shipment:

Hardware

- PCI-DDA04/16

Software

- MCC DAQ CD

Documentation

In addition to this hardware user's guide, you should also receive the *Quick Start Guide*. This booklet provides an overview of the MCC DAQ software you received with the device, and includes information about installing the software. Please read this booklet completely before installing any software or hardware.

Optional components

- Cables – C100HD50-x or C100HDS-x
- Signal termination boards

  Measurement Computing provides signal termination boards for use with the PCI-DDA04/16. Refer to Signal termination on page 9 for more information.

Unpacking

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the PCI-DDA04/16 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

For international customers, contact your local distributor. Refer to the International Distributors section on our web site at www.mccdaq.com/International.

Installing the software

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

Installing the hardware

The PCI-DDA04/16 board is completely plug-and-play. There are no switches or jumpers to set. Configuration is controlled by your system's BIOS.

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.

Complete the following steps to install the board:

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.

   When you connect the device for the first time to a computer running Windows, a **Found New Hardware** dialog opens when the operating system detects the device. 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 InstaCal 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 InstaCal.

Signal connections

The table below lists the board connectors, applicable cables and compatible accessory boards.

Board connectors, cables, accessory equipment

Connector type	100-pin, high density "D" connector
Compatible cables	C100HDS-x (x = 3 or 6 feet) C100HD50-x (x = 3 or 6 feet)
Compatible accessory products with the C100HDS-x cable	SCB-100
Compatible accessory products with the C100HD50-x cable	SCB-50 CIO-TERM100 CIO-MINI50 (two required)

The PCI-DDA04/16 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.

I/O connector pinout

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	NC
SECONDPORTB Bit 2	64	14	Analog Ground
SECONDPORTB Bit 3	63	13	NC
SECONDPORTB Bit 4	62	12	Analog Ground
SECONDPORTB Bit 5	61	11	NC
SECONDPORTB Bit 6	60	10	Analog Ground
SECONDPORTB Bit 7	59	9	NC
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 ↓

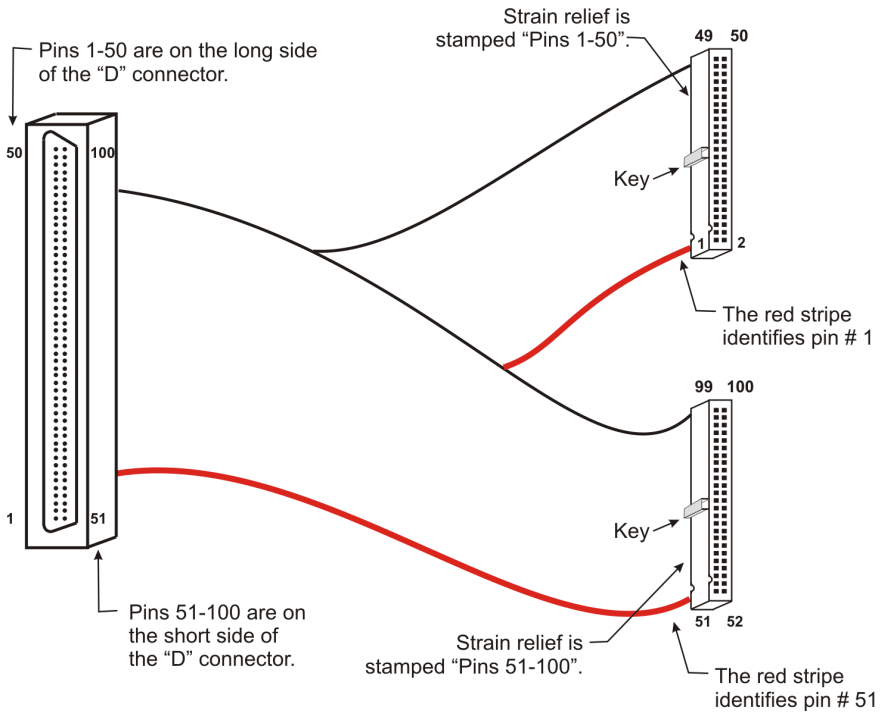

Figure 2. C100HD50-x cable

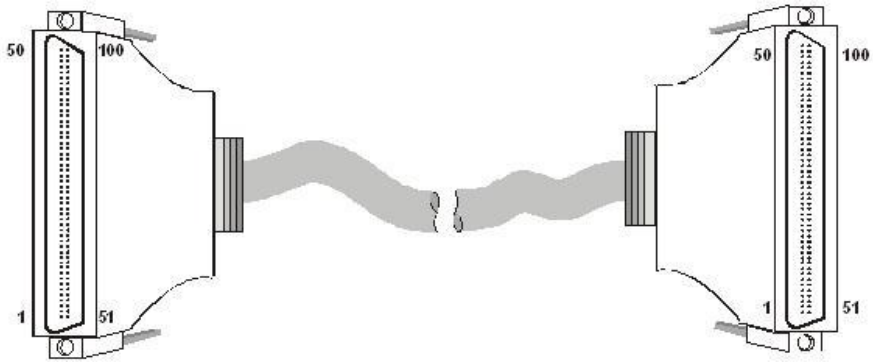

Figure 3. C100HDS-x cable

Details on these cable are available on our web site at www.mccdaq.com/products/accessories.aspx.

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.

Signal termination

You can use the following screw terminal board with the C100HDS-x cable:

- SCB-100 – 100 conductor, shielded signal connection/screw terminal box.

You can use the following screw terminal boards with the C100HD50-x cable:

- SCB-50: 50 conductor, shielded signal connection/screw terminal box; provides two independent 50-pin connections, with each connected one-to-one to a 50-pin header for ribbon cable mating.
- CIO-TERM100: 100-pin screw terminal board with daisy-chained 50-pin IDC connectors.
- CIO-MINI50: 50-pin screw terminal board.

Details on these products are available on our web site at www.mccdaq.com/products/screw_terminal_bnc.aspx.

Functional Details

Analog connections

The analog output connections on the PCI-DDA04/16 series are two-wire hookups. One wire connects to the signal labeled **Vout #**, where # is the channel number from 0 to 3. The other wire connects to the associated analog ground. The I/O connector pinout is shown on page 8.

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-DDA04/16 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-DDA04/16 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-DDA04/16 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-DDA04/16 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 k Ω resistor.

- The pull-up resistor pulls the input to a high state (+5V). Its resistance of 2200 Ω draws only 2 mA of the 64 mA available from the output.
- A 2200 Ω 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-DDA04/16 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 k Ω 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).

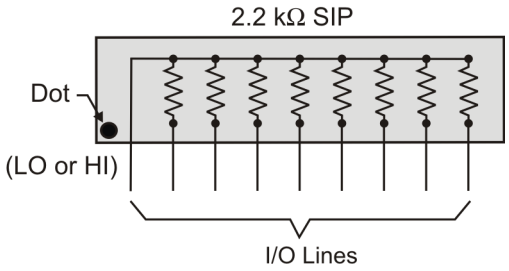

Figure 4. Eight-Resistor SIP Schematic

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 kΩ, eight-resistor SIP (MCC part number SP-K2.29C). You can substitute individual 2.2 kΩ resistors for the resistor SIPs, if required.

Calibrating the PCI-DDA04/16

Self-calibrating

The PCI-DDA04/16 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.

Use InstaCal to recalibrate with respect to the factory-measured voltage standards. InstaCal calibrates each channel at all six ranges. Each channel takes less than a minute to calibrate.

Calibration configuration

The PCI-DDA04/16 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-DDA04/16 calibration circuitry is shown in Figure 5.

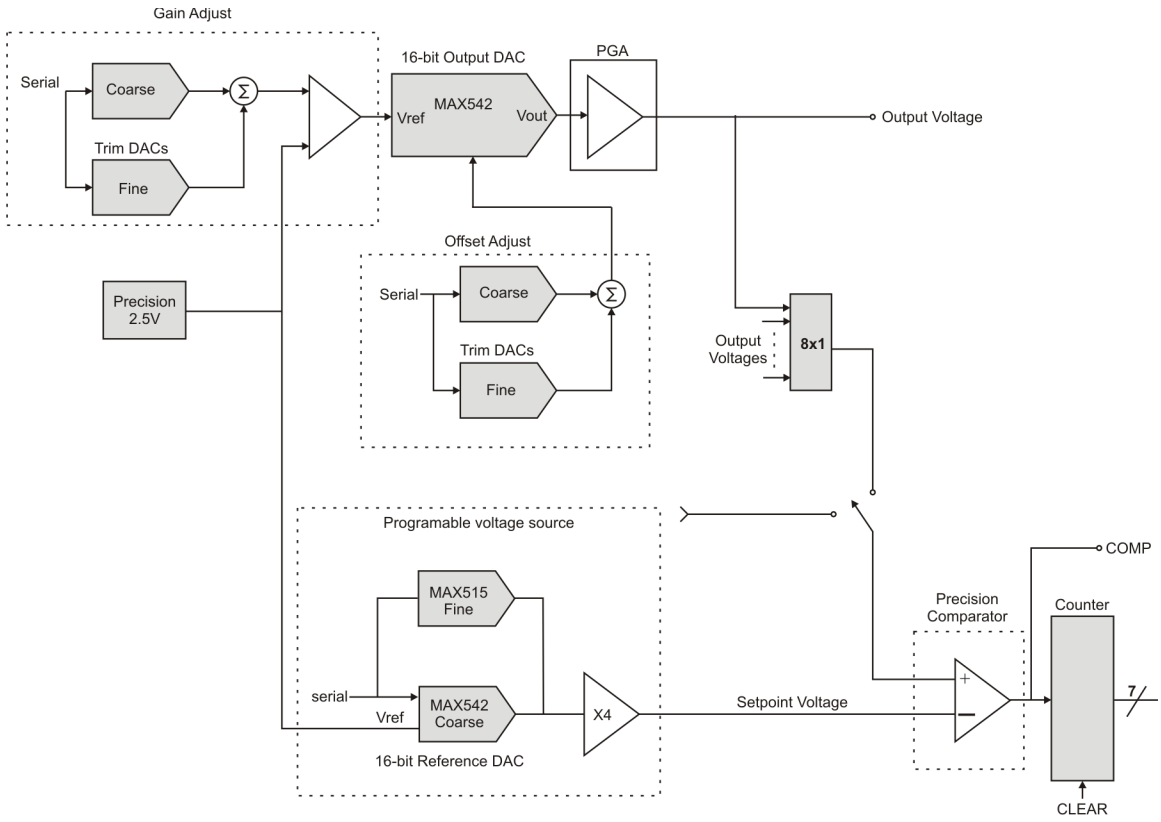

Figure 5. Calibration block diagram

"In-system" calibration

The PCI-DDA04/16 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 InstaCal 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 InstaCal that ships with the board provides the accuracy specified. If your application has unusual requirements, such as long cables, 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.

- 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

For international customers, contact your local distributor. Refer to the International Distributors section on our web site at www.mccdaq.com/International.

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	1.65 A

Analog output

Table 2. Analog output specifications

D/A converter type	MAX542A
Resolution	16 bits
Number of channels	4
Output ranges	±10 V, ±5 V, ±2.5 V, 0 – 10 V, 0 – 5 V, 0 - 2.5 V. Each channel independently programmable.
Data transfer	Programmed I/O
Absolute accuracy (calibrated)	±10 V range: ±1.18 mV maximum ±5 V, 0 to 10 V ranges: ±0.63 mV maximum ±2.5 V, 0 to 5 V ranges: ±0.37 mV maximum 0 to 2.5 V ranges: ±0.23 mV maximum
Offset error (calibrated)	±(1 LSB + 50 µV)
Gain error (calibrated)	±(1.5 LSBs + 50 µV)
Differential nonlinearity	±0.5 LSBs typical, ±1LSB maximum over temperature
Integral nonlinearity	±0.5 LSBs typical, ±1 LSBs maximum over temperature
Monotonicity	16 bits
D/A gain drift	±0.1 ppm/°C
D/A unipolar offset drift	±0.1 ppm/°C
D/A bipolar offset drift	±0.5 ppm/°C
Throughput	PC dependent, 200 kHz maximum
Settling time (20 V step to ±1.5 LSBs)	12 µs typical, 20 µs maximum
Slew rate	2.5 V/µs
Current drive	±5 mA
Output short-circuit duration	25 mA indefinite
Output coupling	DC
Output impedance	0.1 Ω maximum
Miscellaneous	▪ Double buffered output latches ▪ Update DACs individually or simultaneously (software selectable) ▪ Power up and reset, all DAC outputs pulled to 0 V (±3 mV maximum).

Digital input / output

Table 3. Digital I/O specifications

Digital type (main connector)	8255 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 V minimum @ -15 mA
Output low	0.5 V maximum @ 64 mA
Input high	2.0 V minimum, 7 V absolute maximum
Input low	0.8 V maximum, -0.5 V absolute minimum
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 pinout

Table 5. Board connectors, cables, accessory equipment

Connector type	100-pin, high density "D" connector
Compatible cable	C100HD50-x (x = 3 or 6 feet)
Compatible accessory products	SCB-50 CIO-TERM100 CIO-MINI50 (two required)

Table 6. I/O connector pinout

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	NC	59	SECONDPORTB Bit 7
10	Analog Ground	60	SECONDPORTB Bit 6
11	NC	61	SECONDPORTB Bit 5
12	Analog Ground	62	SECONDPORTB Bit 4
13	NC	63	SECONDPORTB Bit 3
14	Analog Ground	64	SECONDPORTB Bit 2
15	NC	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

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-DDA04/16

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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