PCI-DAC6702 and PCI-DAC6703

Analog Output and Digital I/O

User's Guide

December 2020. Rev 4

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 explains how to install, configure, and use the PCI-DAC6702 and PCI-DAC6703 boards so that you get the most out of the voltage and current analog outputs 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

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 the 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 PCI-2511 hardware is available on our website at www.mccdaq.com. You can also contact Measurement Computing Corporation with specific questions.

- Knowledgebase: kb.mccdaq.com
- Tech support form: www.mccdaq.com/support/support_form.aspx
- Email: techsupport@mccdaq.com
- Phone: 508-946-5100 and follow the instructions for reaching Tech Support

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

Register-level programming

You should use the Universal Library 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-DAC6700 Series*. This document is available on our website at www.mccdaq.com/registermaps/RegMapPCI-DAC670x.pdf.

Introducing the PCI-DAC6702 and PCI-DAC6703

Overview

PCI-DAC6702 and PCI-DAC6703 boards are high-resolution analog output and digital I/O boards designed for PCI bus-compatible computers. You can use PCI-DAC6702 and PCI-DAC6703 boards for various digital I/O and DC setpoint applications.

The PCI-DAC6702 provides 8 analog outputs, and the PCI-DAC6703 provides 16 analog outputs. The voltage output range for each board is ±10.1V volts.

Each board has eight TTL-compatible digital I/O channels that are configured as one eight-bit port. You can configure each channel individually as either input or output. Digital channels are configured as inputs by default. Digital bits are pulled up to +5V with 47 kΩ resistors. Positions are available for pull-down resistors.

PCI-DAC6702 and PCI-DAC6703 boards have a 16-bit digital to analog converter (DAC) that may be periodically updated with new channel data. DAC channel data is stored in nonvolatile RAM (nvRAM). Each channel has a main circuit that maintains the channel value between DAC updates.

PCI-DAC6702 and PCI-DAC6703 boards are equipped with an onboard temperature sensor that measures the air temperature flowing over the board.

Each board features plug-and-play installation and on-board digital calibration. All I/O signals are transmitted through a 100-pin connector.

Functional block diagram

PCI-DAC6702 and PCI-DAC6703 board functions are illustrated in the block diagram shown here.

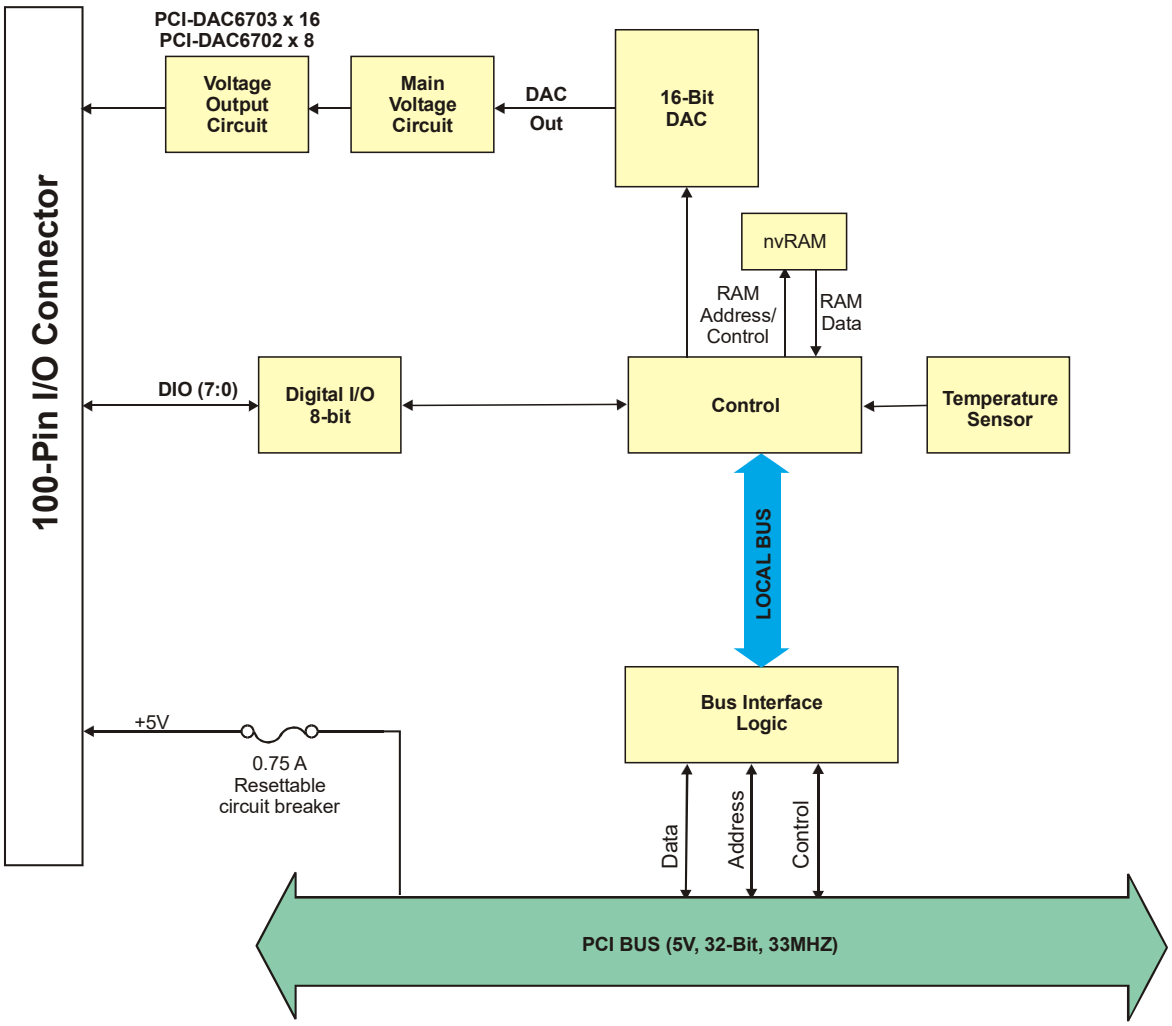


Figure 1. PCI-DAC6702 and PCI-DAC6703 functional block diagram

Installing the PCI-DAC6702 and PCI-DAC6703

Unpacking

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

Contact us immediately if any components are missing or damaged.

Installing the software

Refer to the *MCC DAQ Quick Start* and the PCI-DAC6702 and PCI-DAC6703 product page on our website for information about the software that supports the device.

Install the software before you install your device

The driver needed to run the PCI-2511 is installed with the software. Therefore, you need to install the software package you plan to use before you install the hardware.

Installing the hardware

PCI-DAC6702 and PCI-DAC6703 boards are completely plug-and-play, with 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.

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 connected for the first time, a **Found New Hardware** dialog opens when the operating system detects the device. When the dialog closes, the installation is complete. If you have not installed the MCC DAQ software, cancel the dialog and install it now.
3. To test your installation and configure your board, run the InstaCal utility installed in the previous section. Refer to the *Quick Start Guide* that came with your board for information on how to initially set up and load InstaCal.

If your board has been powered-off for more than 10 minutes, allow your computer to warm up for at least 15 minutes before acquiring data. This warm-up period is required in order for the board to achieve its rated accuracy. The high-speed components used on the board generate heat, and it takes this amount of time for a board to reach steady state if it has been powered off for a significant amount of time.

Signal connections

The table below lists the board connectors, applicable cables, and compatible accessory products for the PCI-DAC6702 and PCI-DAC6703.

Board connectors, cables, and accessory equipment

Connector type	Shielded, SCSI 100-pin D-type
Compatible cables	C100HD50-x unshielded round cable. x = 3 or 6 feet. (Figure 2) C100MMS-x shielded round cable. x = 1, 2, or 3 meters. (Figure 3)
Compatible accessory products with the C100HD50-x cable	BNC-16SE BNC-16DI CIO-MINI50 CIO-TERM100 SCB-50
Compatible accessory products with the C100MMS-x cable	SCB-100 BNC-DI-FE

More information on signal connections

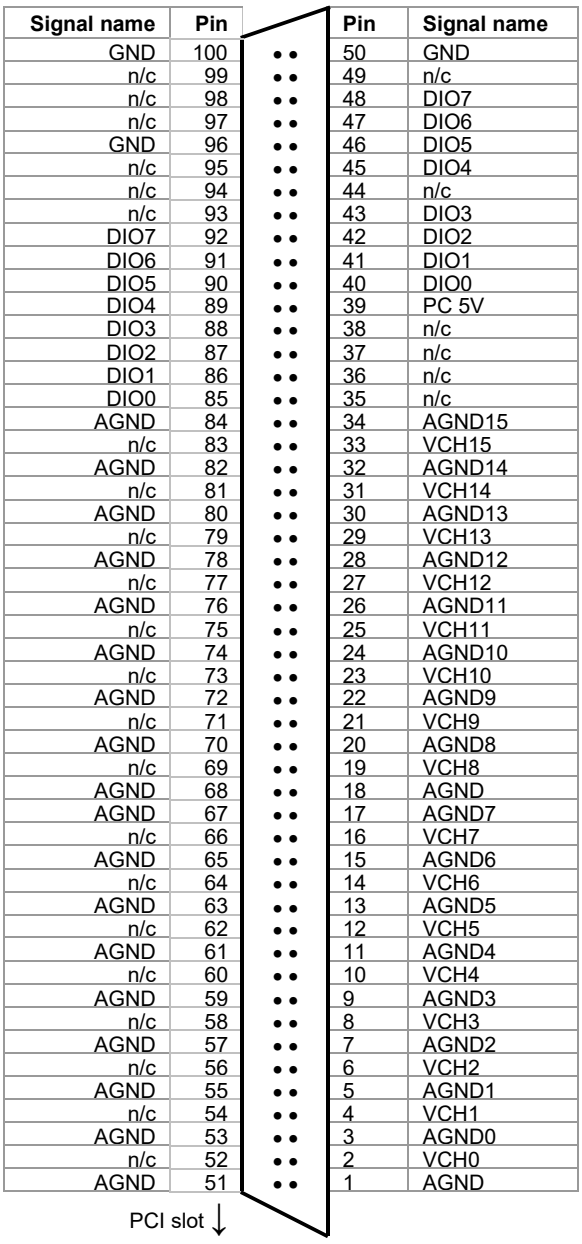
For general information regarding signal connection and configuration, refer to the *Guide to Signal Connections* (available on our website at www.mccdaq.com/support/DAQ-Signal-Connections.aspx).

Connector pinout

The main I/O connector pinouts for each board are shown in the following tables. Note that the DIO[7:0] signals are provided in two locations in order to provide flexibility for applications which use the C100HD50-x ribbon cable.

PCI-DAC6703 connector pin out

Signal name	Pin	Pin	Signal name
GND	100	50	GND
n/c	99	49	n/c
n/c	98	48	DIO7
n/c	97	47	DIO6
GND	96	46	DIO5
n/c	95	45	DIO4
n/c	94	44	n/c
n/c	93	43	DIO3
DIO7	92	42	DIO2
DIO6	91	41	DIO1
DIO5	90	40	DIO0
DIO4	89	39	PC 5V
DIO3	88	38	n/c
DIO2	87	37	n/c
DIO1	86	36	n/c
DIO0	85	35	n/c
AGND	84	34	AGND15
n/c	83	33	VCH15
AGND	82	32	AGND14
n/c	81	31	VCH14
AGND	80	30	AGND13
n/c	79	29	VCH13
AGND	78	28	AGND12
n/c	77	27	VCH12
AGND	76	26	AGND11
n/c	75	25	VCH11
AGND	74	24	AGND10
n/c	73	23	VCH10
AGND	72	22	AGND9
n/c	71	21	VCH9
AGND	70	20	AGND8
n/c	69	19	VCH8
AGND	68	18	AGND
AGND	67	17	AGND7
n/c	66	16	VCH7
AGND	65	15	AGND6
n/c	64	14	VCH6
AGND	63	13	AGND5
n/c	62	12	VCH5
AGND	61	11	AGND4
n/c	60	10	VCH4
AGND	59	9	AGND3
n/c	58	8	VCH3
AGND	57	7	AGND2
n/c	56	6	VCH2
AGND	55	5	AGND1
n/c	54	4	VCH1
AGND	53	3	AGND0
n/c	52	2	VCH0
AGND	51	1	AGND



PCI-DAC6702 connector pin out

Signal name	Pin		Pin	Signal name
GND	100	••	50	GND
n/c	99	••	49	n/c
n/c	98	••	48	DIO7
n/c	97	••	47	DIO6
GND	96	••	46	DIO5
n/c	95	••	45	DIO4
n/c	94	••	44	n/c
n/c	93	••	43	DIO3
DIO7	92	••	42	DIO2
DIO6	91	••	41	DIO1
DIO5	90	••	40	DIO0
DIO4	89	••	39	PC 5V
DIO3	88	••	38	n/c
DIO2	87	••	37	n/c
DIO1	86	••	36	n/c
DIO0	85	••	35	n/c
AGND	84	••	34	AGND
n/c	83	••	33	n/c
AGND	82	••	32	AGND
n/c	81	••	31	n/c
AGND	80	••	30	AGND
n/c	79	••	29	n/c
AGND	78	••	28	AGND
n/c	77	••	27	n/c
AGND	76	••	26	AGND
n/c	75	••	25	n/c
AGND	74	••	24	AGND
n/c	73	••	23	n/c
AGND	72	••	22	AGND
n/c	71	••	21	n/c
AGND	70	••	20	AGND
n/c	69	••	19	n/c
AGND	68	••	18	AGND
AGND	67	••	17	AGND7
n/c	66	••	16	VCH7
AGND	65	••	15	AGND6
n/c	64	••	14	VCH6
AGND	63	••	13	AGND5
n/c	62	••	12	VCH5
AGND	61	••	11	AGND4
n/c	60	••	10	VCH4
AGND	59	••	9	AGND3
n/c	58	••	8	VCH3
AGND	57	••	7	AGND2
n/c	56	••	6	VCH2
AGND	55	••	5	AGND1
n/c	54	••	4	VCH1
AGND	53	••	3	AGND0
n/c	52	••	2	VCH0
AGND	51	••	1	AGND

PCI slot ↓

Cabling

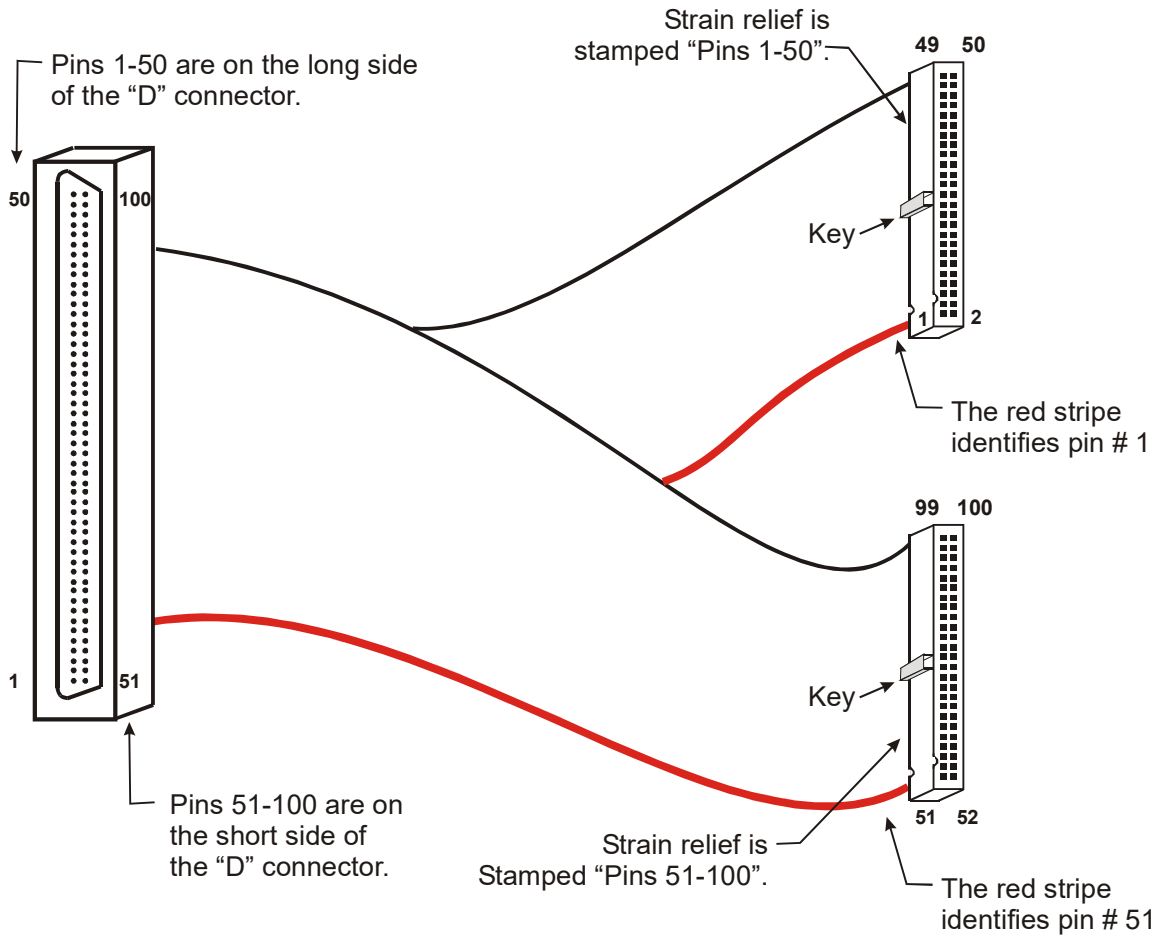


Figure 2. C100HD50-x cable

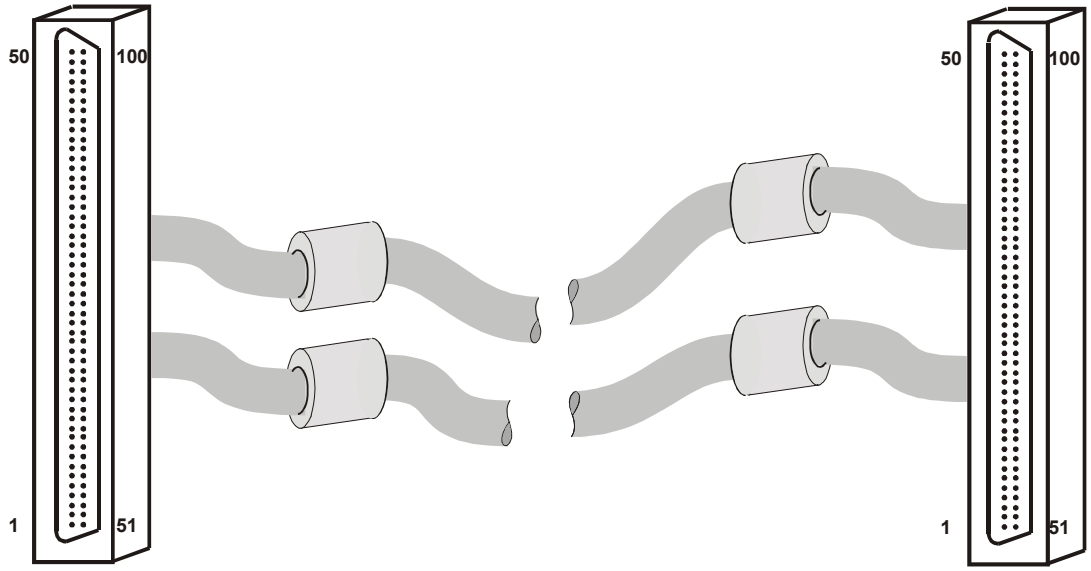


Figure 3. C100MMS-x cable

Field wiring and signal termination accessories

You can use the following BNC and screw terminal boards to terminate field signals and route them into the PCI-DAC6702 and PCI-DAC6703 boards using the C100HD50-x cable:

- BNC-16SE: Brings analog signals to standard BNC connectors. Designed for boards operating in single-ended mode.
- BNC-16DI: Brings analog signals to standard BNC connectors. Designed for boards operating in differential mode.
- CIO-MINI50: 50-pin screw terminal board. Two boards are required.
- CIO-TERM100: 100-pin screw terminal board (daisy-chained 50-pin IDC connectors).
- SCB-50: 50-conductor, shielded signal connection/screw terminal box provides two independent 50-pin connections.

You can use the following screw terminal box and BNC connector box to terminate field signals and route them into the PCI-DAC6702 and PCI-DAC6703 board using the C100MMS-x cable:

- SCB-100: 100-conductor, shielded signal connection/screw terminal box provides two independent 50-pin connections.
- BNC-16DI-FE – Brings analog signals to standard BNC connectors. Designed to be compatible with the 100-pin shielded C100MMS-x cable.

Details on these products are available on our website.

Calibrating the PCI-DAC6702 and PCI-DAC6703

You should calibrate the board using the InstaCal utility software after the board has fully warmed up. The recommended warm-up time is 15 minutes. For best results, calibrate the board immediately before use. The high-resolution analog components on the board are temperature-sensitive, so calibrating the board before use ensures that your board is operating with the optimum calibration values. All calibration values are saved in nvRAM.

Calibration theory

InstaCal calibrates the board's analog outputs for offset and gain (see Figure 4). A trim DAC is used to adjust the gain of the DAC. A separate DAC is used to adjust offset on the final output amplifier.

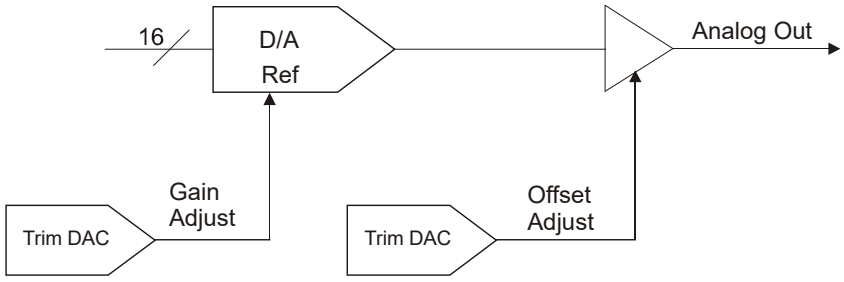


Figure 4. Analog output calibration

Calibration schedule

You should calibrate your PCI-DAC6702 and PCI-DAC6703 board once per year using the InstaCal calibration procedures.

Specifications

Typical for 25 °C unless otherwise specified.
Specifications in *italic text* are guaranteed by design

Analog output

Table 1. Analog output specifications

D/A converter type	Enhanced R-2R
Resolution	16-bits, 1 in 65536
Number of channels	PCI-DAC6703: 16 voltage PCI-DAC6702: 8 voltage
DNL	*±1 LSB max*
Monotonicity	*16-bits, guaranteed after calibration*
Update rate, max	PCI-DAC6703: 1111 S/s per channel, 3.5 kS/s for all channels PCI-DAC6702: 1111 S/s per channel, 3.5 kS/s for all channels
Update modes	Software selectable per channel for update immediate (default), or update from NVRAM on command
Output short-circuit duration	*Indefinite @ 25 mA*
Power-on state	Independent, user-defined power-on states.

Table 2. Voltage output specifications

Range	±10.1 V
Output coupling	*DC*
Output impedance	0.1 Ω max.
Current drive	±10 mA max
Load capacitance	10,000 pF
Slew rate	0.5 V/µs typ.
Settling time (full scale step)	7.2 ms max to ±0.5 LSB
Noise	100 μV_{rms}, DC to 1 MHz BW
Offset temperature coefficient	*±5 µV/ºC*
Gain temperature coefficient	*±1 ppm/ºC*
Protection	Short circuit to ground
Data transfer	Programmed I/O

Table 3. Absolute accuracy components - all values are (±)

Range[1]	% of Reading	Offset	Temp Drift[2] (%/ºC)	Absolute Accuracy at FS
±10 V	0.0019	±710 µV	0.0001	±1 mV

Note 1: Temp drift applies only if the ambient temperature changes by more than ±10ºC since the last calibration.

Note 2: Each PCI-DAC670x board is tested at the factory to assure that the overall error does not exceed the values specified in Table 3.

Table 4. Relative accuracy

Range	Relative Accuracy
±10 V	±1.0 LSB, max

Relative accuracy is defined as the measured deviation from a straight line drawn between measured endpoints of the transfer function.

Analog output calibration

Table 5. Analog I/O calibration

Recommended warm-up time	15 minutes
Calibration	Auto-calibration, calibration factors for each range stored on board in non-volatile RAM.
Onboard calibration reference	*DC Level: 10.000 V± 1 mV. Actual measured values stored in EEPROM.*
	Tempco: 0.6 ppm/°C max
	Long-term stability: ±6 ppm/sqrt(1000 hrs)
Calibration interval	1 year

Digital input / output

Table 6. Digital I/O

Digital type	Discrete, 5 V/TTL compatible
Number of I/O	8
Configuration	8 bits, independently programmable for input or output. Position available for pull-up/pull-down resistor network (not populated).
Input high voltage	2.0 V min, 7.0 V absolute max
Input low voltage	0.8 V max, –0.5 V absolute min
Output high voltage (IOH = –32 mA)	3.80 V min, 4.20 V typ
Output low voltage (IOL = 32 mA)	0.55 V max, 0.22 V typ
Data transfer	Programmed I/O
Power-up / reset state	Input mode (high impedance)

Power consumption

Table 7. Power consumption specifications

+5 V	PCI-DAC6703: 1.1 A max PCI-DAC6702: 1.0 A max
+5 V available at I/O connector	0.75A max, protected with a resettable fuse

Environmental

Table 8. Environmental specifications

Operating temperature range	0 to 55 °C
Storage temperature range	-20 to 70 °C
Humidity	0 to 90% non-condensing

Mechanical

Table 9. Mechanical specifications

Card dimensions	PCI half card: 174.4 mm (L) x 106.9 mm (W) x18.4 mm (H)
Form factor	Universal PCI keying. Compatible with either 3.3 V or 5 V PCI signaling environments.

Main connector and pin out

Table 10. Main connector specifications

Connector type	Shielded SCSI 100 D-Type
Compatible cables	C100HD50-x, unshielded ribbon cable. x = 3 or 6 feet
	C100MMS-x, shielded round cable. x = 1, 2, or 3 meters
Compatible accessory products (with C100HD50-x cable)	BNC-16SE BNC-16DI CIO-MINI50 CIO-TERM100 SCB-50
Compatible accessory products (with C100MMS-x cable)	SCB-100 BNC-16DI-FE

Table 11. PCI-DAC6703 pin out

Pin	Signal Name	Pin	Signal Name
1	AGND	51	AGND
2	VCH0	52	n/c
3	AGND0	53	AGND
4	VCH1	54	n/c
5	AGND1	55	AGND
6	VCH2	56	n/c
7	AGND2	57	AGND
8	VCH3	58	n/c
9	AGND3	59	AGND
10	VCH4	60	n/c
11	AGND4	61	AGND
12	VCH5	62	n/c
13	AGND5	63	AGND
14	VCH6	64	n/c
15	AGND6	65	AGND
16	VCH7	66	n/c
17	AGND7	67	AGND
18	AGND	68	AGND
19	VCH8	69	n/c
20	AGND8	70	AGND
21	VCH9	71	n/c
22	AGND9	72	AGND
23	VCH10	73	n/c
24	AGND10	74	AGND
25	VCH11	75	n/c
26	AGND11	76	AGND
27	VCH12	77	n/c
28	AGND12	78	AGND
29	VCH13	79	n/c
30	AGND13	80	AGND
31	VCH14	81	n/c
32	AGND14	82	AGND
33	VCH15	83	n/c
34	AGND15	84	AGND
35	n/c	85	DIO0
36	n/c	86	DIO1
37	n/c	87	DIO2
38	n/c	88	DIO3
39	PC 5V	89	DIO4
40	DIO0	90	DIO5
41	DIO1	91	DIO6
42	DIO2	92	DIO7
43	DIO3	93	n/c
44	n/c	94	n/c
45	DIO4	95	n/c
46	DIO5	96	GND
47	DIO6	97	n/c
48	DIO7	98	n/c
49	n/c	99	n/c
50	GND	100	GND

Note: DIO[7:0] signals are provided in two locations in order to provide flexibility for applications which use the C100HD50-x ribbon cable.

Table 12. PCI-DAC6702 pin out

Pin	Signal Name	Pin	Signal Name
1	AGND	51	AGND
2	VCH0	52	n/c
3	AGND0	53	AGND
4	VCH1	54	n/c
5	AGND1	55	AGND
6	VCH2	56	n/c
7	AGND2	57	AGND
8	VCH3	58	n/c
9	AGND3	59	AGND
10	VCH4	60	n/c
11	AGND4	61	AGND
12	VCH5	62	n/c
13	AGND5	63	AGND
14	VCH6	64	n/c
15	AGND6	65	AGND
16	VCH7	66	n/c
17	AGND7	67	AGND
18	AGND	68	AGND
19	n/c	69	n/c
20	AGND	70	AGND
21	n/c	71	n/c
22	AGND	72	AGND
23	n/c	73	n/c
24	AGND	74	AGND
25	n/c	75	n/c
26	AGND	76	AGND
27	n/c	77	n/c
28	AGND	78	AGND
29	n/c	79	n/c
30	AGND	80	AGND
31	n/c	81	n/c
32	AGND	82	AGND
33	n/c	83	n/c
34	AGND	84	AGND
35	n/c	85	DIO0
36	n/c	86	DIO1
37	n/c	87	DIO2
38	n/c	88	DIO3
39	PC 5V	89	DIO4
40	DIO0	90	DIO5
41	DIO1	91	DIO6
42	DIO2	92	DIO7
43	DIO3	93	n/c
44	n/c	94	n/c
45	DIO4	95	n/c
46	DIO5	96	GND
47	DIO6	97	n/c
48	DIO7	98	n/c
49	n/c	99	n/c
50	GND	100	GND

Note 3: DIO[7:0] signals are provided in two locations in order to provide flexibility for applications which use the C100HD50-x ribbon cable.

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-DAC6702 and PCI-DAC6703

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

EC EMC Directive 2004/108/EC: Electromagnetic Compatibility, EN 61326-1:2006 (IEC 61326-1:2005)

Emissions: Group 1, Class B

- EN 55011(1990)/CISPR 11: Radiated and Conducted emissions.

Immunity: EN61326-1:2006, (IEC 61326-1:2005)

- EN61000-4-2 (2001): Electrostatic Discharge immunity.
- EN61000-4-3 (2002): Radiated Electromagnetic Field immunity.
- EN61000-4-4 (2004): Electric Fast Transient Burst immunity.
- EN61000-4-5 (2001): Surge immunity.
- EN61000-4-6 (2003): Radio Frequency Common Mode immunity.
- EN61000-4-11 (2004): Voltage Dip and Interrupt immunity.

Declaration of Conformity based on tests conducted by Chomerics Test Services, Woburn, MA 01801, USA in May, 2004. Test records are outlined in Chomerics Test Report #EMI3887.04. Further testing was conducted by Chomerics Test Services, Woburn, MA. 01801, USA in December, 2008. Test records are outlined in Chomerics Test report #EMI5241.08.

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

Carl Haapaoja, Director of Quality Assurance

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