PCIM-DDA06/16

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 describes the Measurement Computing PCIM-DDA06/16 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 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 PCIM-DDA06/16 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.

If you need to program at the register level in your application, refer to the *Register Map for the PCIM-DDA06/16* on our website at www.mccdaq.com/registermaps/RegMapPCIM-DDA06-16.pdf.

Introducing the PCIM-DDA06/16

The PCIM-DDA06/16 has six channels of analog output and 24 bits of digital input/output. Analog outputs are from AD660 DACs, with each output buffered by an OP27. Digital I/O is performed with an 82C55.

Analog output ranges are either Bipolar or Unipolar. Bipolar ranges are ±10 V and ±5 V. Unipolar ranges are 0 to 10 V and 0 to 5 V. You set the analog output range for each DAC with an onboard switch. You set the analog outputs for simultaneous or individual transfer with an on-board jumper.

The PCIM-DDA06/16 digital I/O lines are a direct interface to an 82C55. The 82C55 is a CMOS chip with TTL level inputs and outputs. The 8255 can source or sink about 2.5 mA. This is enough to switch other TTL or similar inputs, but is inadequate to drive relays, LEDs or solid-state relays without additional buffering.

The 82C55 digital I/O chip initializes all ports as inputs on power-up and reset.

The PCIM-DDA06/16 digital I/O is controlled by programming the 8255's mode register. There are three possible modes. The most commonly used mode is Mode 0, simple input and output.

Functional block diagram

The PCIM-DDA06/16 board consists of two functional sections: analog output and digital I/O. The digital I/O section consists of a single 82C55, and a 24-line digital I/O chip. The analog output section consists of six identical circuits, each consisting of a DAC, an OP27 output buffer, and a gain range control switch. You can control each analog output individually or control all six outputs simultaneously.

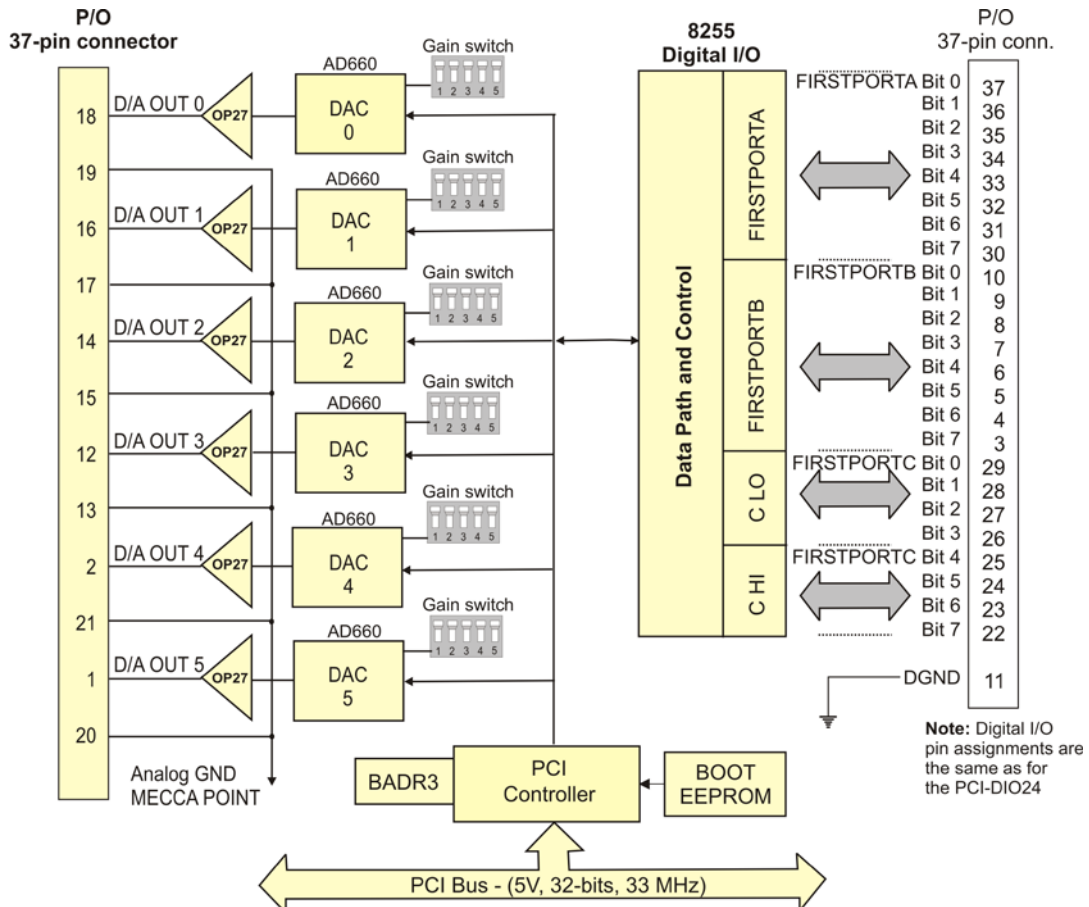PCIM-DDA06/16 functions are illustrated in the block diagram shown here.

Figure 1. Functional block diagram

Installing the PCIM-DDA06/16

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 PCIM-DDA06/16 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 PCIM-DDA06/16 is installed with the software. Therefore, you need to install the software package you plan to use before you install the hardware.

Configuring the hardware

The PCIM-DDA06/16 board has six banks of five switches for setting the gain for each DAC, and one simultaneous transfer jumper to set the DAC update mode. Each analog channel also has an associated gain and offset potentiometer for calibrating the channel, if necessary.

The PCIM-DDA06/16 is shipped with the following factory-default settings:

Switch/jumper factory-configured defaults

Board label	Switch/jumper description	Default setting
XFER or **UPDATE**	Simultaneous or individual DAC update jumper	UPDATE position (single channel update)
CH0 through **CH5** (**S1** through **S6**)	Analog output range DIP switches	±5V

Before installing the PCIM-DDA06/16 in the computer, verify that the board is configured with the settings that you want. Review the following information to change the default configuration of a jumper or switch on the PCIM-DDA06/16 board.

Simultaneous transfer jumper

The simultaneous transfer jumper controls whether to update DAC channels individually (default) or as a group. This jumper is shown in Figure 2 configured in its default **UPDATE** position.
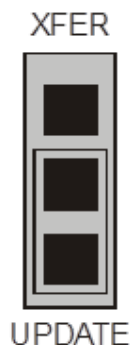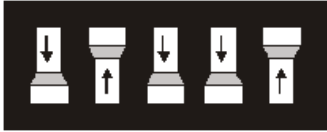

Figure 2. Simultaneous transfer jumper

▪ Set the jumper to **XFER** to update the DAC voltage outputs as a group.

New output data is held until all DACs are loaded with their new digital data.

The data for each DAC is simultaneously transferred and the DAC voltage outputs are updated as a group when any of the addresses BADR3 + 0 to BADR3 + B are read. Writing new digital values to the DAC control register does not cause an update of the DAC's voltage output. Update of the output occurs only after the DAC control register address (any of the addresses BADR3 + 0 to BADR3 + B) is read

In this way, the PCIM-DDA06/16 can be set to hold new values until all channels are loaded, then update all six channels simultaneously. This is a very useful feature for multi-axis motor control.

▪ Set the jumper to **UPDATE** to update the DAC voltage outputs individually.

The analog outputs are controlled by writing a digital control word as two bytes to the DAC's control register. The control register is double-buffered, so the DAC output is not updated until both bytes (first low byte, then high byte) are written to the DAC control register when the simultaneous transfer jumper is in the default **UPDATE** position.

Analog output range switch

You set the analog output voltage range of each with a five-position DIP switch. The switches are located on the board directly above the DACs and are labeled **CH5** through **CH0** (**S6** through **S1**). Bipolar ranges are ±10 V and ±5 V. Unipolar ranges are 0 to 10 V and 0 to 5 V.

Figure 3 lists the range value and associated settings for each switch.

Range	1	2	3	4	5
± 10	D	U	D	U	D
± 5.0	D	U	D	D	U (shown)
0-10	U	D	U	U	D
0-5	U	D	U	D	U

Figure 3. Analog output range switch—one per DAC

To set a channel to a particular range, read the switch positions as **U** (up) or **D** (down) from left to right in the row beside the range you want to set.

Installing the hardware

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.

After you configure the board's switches and jumpers, install the PCIM-DDA06/16 into your computer. Perform 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 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 outputting analog data with this board. This warm-up period is required 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 more than 10 minutes.

Signal connections

The table below lists the board connector, applicable cables, and compatible accessory products.

Board connector, cables, and accessory equipment

Connector type	37-pin male D connector
Compatibility	Pinout identical to CIO-DDA06/16
Compatible cables	C37FF-x C37FFS-x DFCON-37 (D-connector, D-shell, and termination pins to construct your own cable)
Compatible accessory products with the C37FF-x cable or C37FFS-x cable	CIO-MINI37 CIO-TERMINAL SCB-37 SSR-RACK24 ENC-MINI37

Information on signal connections

General information regarding signal connection and configuration is available in the *Guide to DAQ Signal Connections* (available for download from www.mccdaq.com/support/DAQ-Signal-Connections.aspx.)

The I/O connector is a standard 37-pin male connector that is accessible through the PC/AT expansion bracket.

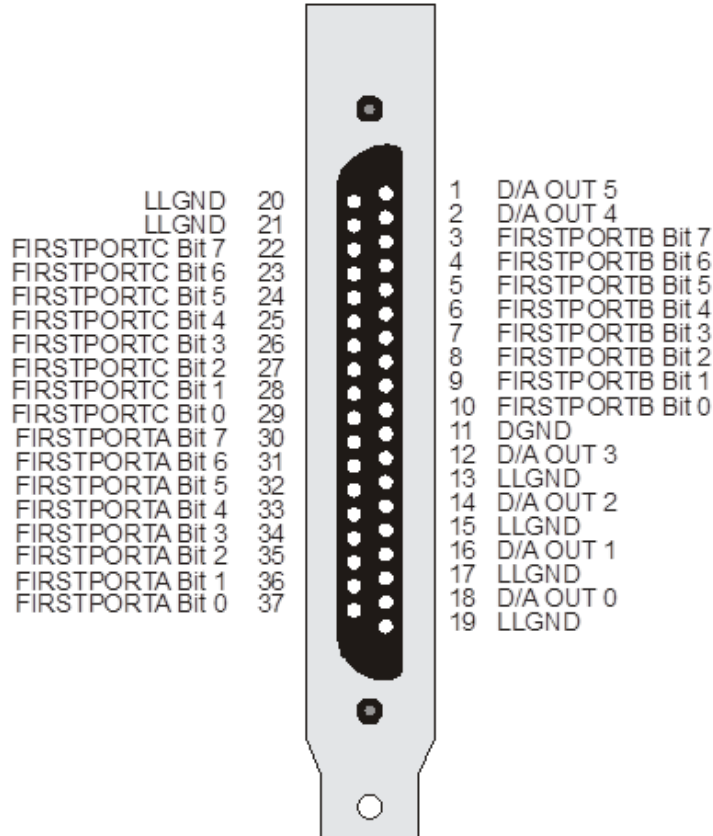|				
LLGND	20		1	D/A OUT 5
LLGND	21		2	D/A OUT 4
FIRSTPORTC Bit 7	22		3	FIRSTPORTB Bit 7
FIRSTPORTC Bit 6	23		4	FIRSTPORTB Bit 6
FIRSTPORTC Bit 5	24		5	FIRSTPORTB Bit 5
FIRSTPORTC Bit 4	25		6	FIRSTPORTB Bit 4
FIRSTPORTC Bit 3	26		7	FIRSTPORTB Bit 3
FIRSTPORTC Bit 2	27		8	FIRSTPORTB Bit 2
FIRSTPORTC Bit 1	28		9	FIRSTPORTB Bit 1
FIRSTPORTC Bit 0	29		10	FIRSTPORTB Bit 0
FIRSTPORTA Bit 7	30		11	DGND
FIRSTPORTA Bit 6	31		12	D/A OUT 3
FIRSTPORTA Bit 5	32		13	LLGND
FIRSTPORTA Bit 4	33		14	D/A OUT 2
FIRSTPORTA Bit 3	34		15	LLGND
FIRSTPORTA Bit 2	35		16	D/A OUT 1
FIRSTPORTA Bit 1	36		17	LLGND
FIRSTPORTA Bit 0	37		18	D/A OUT 0
			19	LLGND

Figure 4. I/O connector pinout

The analog outputs of the PCIM-DDA06/16 are two-wire hook-ups. Always use analog ground (LLGND) as the ground reference for all analog hook-ups.
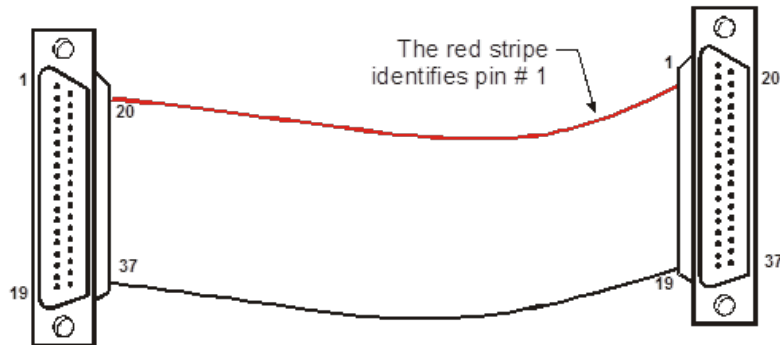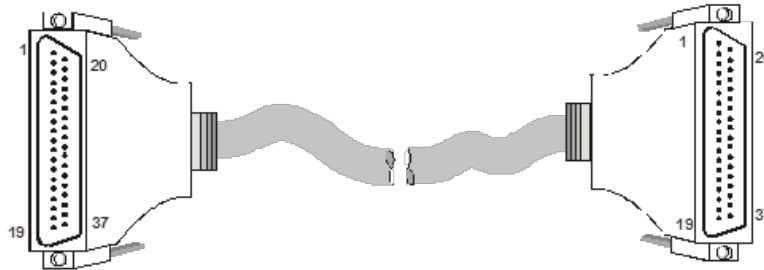
Cabling

Figure 5. C37FF-x cable

Figure 6. C37FFS-x cable

Field wiring, signal termination, and conditioning

You can use the following cabling, screw termination, and signal conditioning products with the PCIM-DDA06/16.

- CIO-MINI37 – 37-pin screw terminal board.
- CIO-TERMINAL – 37-pin screw terminal board with on-board prototyping area.
- SCB-37 – 37 conductor, shielded signal connection/screw terminal box that provides two independent 50-pin connections.
- SSR-RACK24 – 24-channel, solid-state relay mounting and interface board for digital signal conditioning.
- ENC-MINI37 – Enclosure for the MINI37.
- DFCON37 – Connector kit that includes a 37-pin female D-connector, D-shell, 37 crimp pins, and cable termination kit to construct your own cable.

Details on these products are available on our website.

Specifications

All specifications are subject to change without notice.
Typical for 25 °C unless otherwise specified.
Specifications in *italic* text are guaranteed by design.

Analog output

Table 1. Analog output specifications

Parameter	Specification
D/A converter type	AD660BR
Resolution	16 bits
Number of channels	6
Voltage ranges	±10 V, ±5, 0 to 10 V, 0 to 5 V. Ranges are switch selectable
D/A pacing	Software paced
Throughput	System-dependent. Using the Universal Library programmed output function (cbAOut()) in a loop, in Visual Basic, a typical update rate of 150 kHz (± 70 nS jitter) can be expected. The rate was measured on a 500 MHz Pentium III based PC.
Data transfer	Programmed I/O
Monotonicity	*15 bits guaranteed over temperature*
Slew rate	1.7 V/µs min, 2.4 V/µS typ
Current drive	±5 mA min
Output short-circuit duration	*Indefinite*
Power-on reset voltage	0 V ±15 mV
Miscellaneous	Double buffered output latches Update DACs individually or simultaneously (jumper selectable)

Accuracy

Table 2. Analog output accuracy specifications

Parameter	Specification
Absolute accuracy	±2.0 LSB max
Typical accuracy	±1.0 LSB max
Gain error	Trimmable by potentiometer to 0
Offset error	Trimmable by potentiometer to 0
Integral linearity error	±1.0 LSB max, ±0.5 LSB typ
Differential linearity error	*±1.0 LSB max, ±0.5 LSB typ*

Each PCIM-DDA06/16 is tested at the factory to assure the board's overall error does not exceed ±2.0 LSB.

Total board error is a combination of gain, offset, integral linearity and differential linearity error. The theoretical worst-case error of the board may be calculated by summing these component errors. Worst case error is realized only in the unlikely event that each of the component errors are at their maximum level and causing error in the same direction.

Typical accuracy is derived directly from the various component typical errors. This typical, maximum error calculation for the PCIM-DDA06/16 yields ±1.0 LSB.

Analog output drift

Table 3. Worst case analog output drift specifications

Range	Gain Drift (LSB/°C)	Offset Drift (LSB/°C)	Overall Drift (LSB/°C)
±10.0 V	1.0	0.3	1.3
±5.00 V	4.0	0.3	4.3
0 V to 10.0 V	1.9	0.3	2.2
0 V to 5.0 V	6.0	0.3	6.3

Digital I/O

Table 4. DIO specifications

Parameter	Specification
Digital type	One 82C55
Number of I/O	24
Configuration	2 banks of 8 and 2 banks of 4, or 3 banks of 8, or 2 banks of 8 with handshake
Output high	*3.0 volts min @ –2.5mA*
Output low	*0.4 volts max @ 2.5mA*
Input high	*2.0 volts min, 5.5 volts absolute max*
Input low	*0.8 volts max, –0.5 volts absolute min*
Power-up / reset state	Input mode (high impedance)

Power consumption

Table 5. Power consumption specifications

Parameter	Specification
+5V supply	965 mA typ, 1206 mA max

Environmental

Table 6. Environmental specifications

Parameter	Specification
Operating temperature range	*0 °C to 70 °C*
Storage temperature range	*–40 °C to 100 °C*
Humidity	*0 to 95% non-condensing*

Mechanical

Table 7. Mechanical specifications

Parameter	Specification
Card dimensions (L× W × H)	PCI half card: 174.4 × 100.6 × 11.65 mm (6.87 × 3.96 × 0.46 in.)

Signal connector

Table 8. Signal connector specifications

Parameter	Specification
Connector type	37-pin male D connector
Compatibility	Pinout identical to CIO-DDA06/16
Compatible cables	C37FF-x C37FFS-x DFCON-37 (D-connector, D-shell, and termination pins to construct your own cable)
Compatible accessory products with the C37FF-x cable or C37FFS-x cable	CIO-MINI37 CIO-TERMINAL SCB-37 SSR-RACK24 ENC-MINI37

Table 9. Signal connector pinout

Pin	Signal Name	Pin	Signal Name
1	D/A Out 5	20	LLGND
2	D/A Out 4	21	LLGND
3	FIRSTPORTB Bit 7	22	FIRSTPORTC Bit 7
4	FIRSTPORTB Bit 6	23	FIRSTPORTC Bit 6
5	FIRSTPORTB Bit 5	24	FIRSTPORTC Bit 5
6	FIRSTPORTB Bit 4	25	FIRSTPORTC Bit 4
7	FIRSTPORTB Bit 3	26	FIRSTPORTC Bit 3
8	FIRSTPORTB Bit 2	27	FIRSTPORTC Bit 2
9	FIRSTPORTB Bit 1	28	FIRSTPORTC Bit 1
10	FIRSTPORTB Bit 0	29	FIRSTPORTC Bit 0
11	DGND	30	FIRSTPORTA Bit 7
12	D/A Out 3	31	FIRSTPORTA Bit 6
13	LLGND	32	FIRSTPORTA Bit 5
14	D/A Out 2	33	FIRSTPORTA Bit 4
15	LLGND	34	FIRSTPORTA Bit 3
16	D/A Out 1	35	FIRSTPORTA Bit 2
17	LLGND	36	FIRSTPORTA Bit 1
18	D/A Out 0	37	FIRSTPORTA Bit 0
19	LLGND		

$C \in$ EU Declaration of Conformity
According to ISO/IEC 17050-1:2010

Manufacturer:	Measurement Computing Corporation
Address:	10 Commerce Way
	Norton, MA 02766
	USA
Product Category:	Electrical equipment for measurement, control and laboratory use.
Date and Place of Issue:	December 4, 2017, Norton, Massachusetts USA
Test Report Number:	EMI5259.09

Measurement Computing Corporation declares under sole responsibility that the product

PCIM-DDA06/16

is in conformity with the relevant Union Harmonization Legislation and complies with the essential requirements of the following applicable European Directives:

Electromagnetic Compatibility (EMC) Directive 2014/30/EU

Low Voltage Directive 2014/35/EU

RoHS Directive 2011/65/EU

Conformity is assessed in accordance to the following standards:

EMC:

Emissions:

- EN 61326-1:2013 (IEC 61326-1:2012), Class A
- EN 55011: 2009 + A1:2010 (IEC CISPR 11:2009 + A1:2010), Group 1, Class A

Immunity:

- EN 61326-1:2013 (IEC 61326-1:2012), Controlled EM Environments
- EN 61000-4-2:2008 (IEC 61000-4-2:2008)
- EN 61000-4-3 :2010 (IEC61000-4-3:2010)
- EN 61000-4-4 :2012 (IEC61000-4-4:2012)
- EN 61000-4-5 :2014 (IEC61000-4-5:2014)
- EN 61000-4-6 :2013 (IEC61000-4-6:2013)
- EN 61000-4-11:2004 (IEC61000-4-11:2004)

Safety:

- EN 61010-1:2010 (IEC 61010-1:2010)

Environmental Affairs:

Articles manufactured on or after the Date of Issue of this Declaration of Conformity do not contain any of the restricted substances in concentrations/applications not permitted by the RoHS Directive.

Carl Haapaoja, Director of Quality Assurance