PC-CARD-DAC08

Analog Outputs & Digital I/O

User's Manual

Revision 1

March, 2001

Notice

Measurement Computing Corporation does not authorize any Measurement Computing Corporation product for use in life support systems and/or devices without the written approval of the President of Measurement Computing Corporation Life support devices/systems are devices or systems which, a) are intended for surgical implantation into the body, or b) support or sustain life and whose failure to perform can be reasonably expected to result in injury. Measurement Computing Corp. products are not designed with the components required, and are not subject to the testing required to ensure a level of reliability suitable for the treatment and diagnosis of people.

TABLE OF CONTENTS

This page is blank.

1 INTRODUCTION

The PC-CARD-DAC08 is an eight-channel, analog output control board for IBM PC compatible computers having PCMCIA-type slots. The heart of the board is an octal, 13-bit digital-to-analog converter of which only 12 bits are used for each output. Analog voltage signals are generated by the D/A from registers. Control of I/O operations is done by the Field Programmable Gate Array (FPGA) on the board (Figure 1-1). Double-buffering of the output registers permit simultaneous output changes.

Range of the analog outputs is bipolar, ±5V.

In addition to the analog outputs, there are eight bi-directional digital I/O lines arranged in two, 4-bit ports. They provide the capability of sensing and controlling discrete events (via external signal-conditioning hardware). The ports can be programmed to be either eight inputs, eight outputs, or four inputs and four outputs.

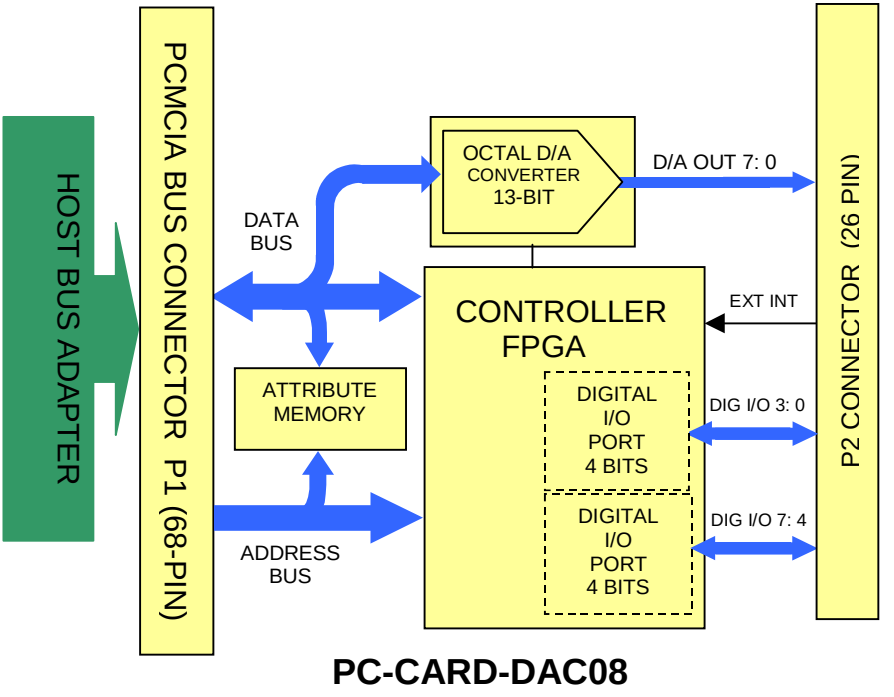

Figure 1-1. PC-CARD-DAC08 Block Diagram

2 INSTALLATION

2.1 SOFTWARE

Your PCM card is completely plug and play. There are no switches or jumpers to set prior to installation in your computer. *Insta*Cal is the installation, calibration and test software supplied with the board. Refer to the *Extended Software Installation Manual* to install *Insta*Cal.

2.2 INSTALL THE PC-CARD

Follow the steps below to install your PC-Card.

1. Insert the card into a free PC Card/PCMCIA type II or III slot. You do not have to turn the computer off. The system is designed for power-on installation.
2. If the appropriate driver is already loaded on the PC, the card should be detected, recognized, and configured by Windows and you should hear an insertion beep. If the card is not detected by Windows, go to step 3. To verify the card has been recognized, go to Control Panel\System\Device Manager and the card should now appear under "DAS Component."
3. If the drivers are not already loaded on the PC, you will be prompted for a driver. If you are not prompted for a driver after inserting the card, go to Step 4. The appropriate driver is located on disk 1 of the installation disk set. Insert this disk. Windows should detect the driver file automatically, install it and then the card should be detected by Windows and you should hear an insertion beep. To verify the card has been recognized, go to Control Panel\System\Device Manager and the card should now appear under "DAS Component." If your card appears in the list you can now proceed to the "RUN *Insta*Cal" section of this manual.
4. If the card is not detected by Windows and you are not prompted for a driver after inserting the card, check that your computer's 32-bit PCMCIA drivers are enabled. If they are not, enable them and then restart your computer and try the above procedure again.

3 INTERFACING

The PC-CARD-DAC08 connector has eight, single-ended analog outputs, one interrupt input, eight, digital inputs/outputs and eight ground pins. A chassis ground is in the cable shield clips to either side of the 26 pins of the connector.

3.1 PC-CARD-DAC08 CONNECTOR

Figure 3-1 shows a PC-CARD-DAC08 case looking into the male mini-connector. The connector is mechanically keyed to insure that the cable is inserted correctly.

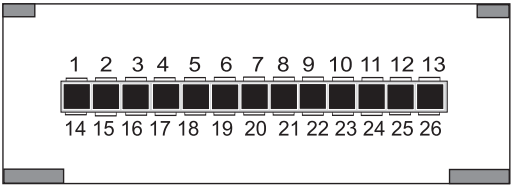

Figure 3-1. 26-Pin I/O Mini-Connector

Table 3-1. 26-Pin Connector Pinout

PIN	SIGNAL NAME	PIN	SIGNAL NAME
1	GND	14	EXT. INTERRUPT IN
2	DIGITAL I/O 0	15	DIGITAL I/O 1
3	DIGITAL I/O 2	16	DIGITAL I/O 3
4	DIGITAL I/O 4	17	DIGITAL I/O 5
5	DIGITAL I/O 6	18	DIGITAL I/O 7
6	PC +5V OUT	19	D/A OUT 0
7	GND	20	D/A OUT 1
8	GND	21	D/A OUT 2
9	GND	22	D/A OUT 3
10	GND	23	D/A OUT 4
11	GND	24	D/A OUT 5
12	GND	25	D/A OUT 6
13	GND	26	D/A OUT 7

Analog devices to be controlled should be connected with the high side to the numbered analog output and the low side to an adjacent ground.

Refer to Section 7, Specifications, for information on a mating cable, PC-CARD-C37F/26. This cable will permit attachment to a variety of screw terminal and signal conditioning boards. The PC-CARD-DAC08 used in conjunction with the

PC-CARD-C37F/26 cable is pin compatible with the PCM-DAC08 using the PCM-C37/33 cable.

3.2 CONNECTING DEVICES TO THE ANALOG OUTPUTS

The analog outputs are single-ended. You must avoid potentials between signal ground and chassis ground on your computer. If you are using a laptop and are on battery power, the computer is floating with respect to earth ground, but the laptop is on the charger unit or on wall power, the laptop may be grounded.

Whenever the computer is grounded, you must connect signals so there is no potential between PC ground and signal ground. If there is a potential, it will be added to the signal. For example, if your card is supplying 3.5 volts and there is a potential of -1.5V between the PC and the sensor ground, your device under control will be reading 2.0V instead of 3.5V

3.3 OUTPUT VOLTAGE RANGE

There is only one output voltage range, ±5VDC.

3.4 SIGNAL CONNECTION

Loads drawing higher currents than the maximum current specified in the electrical spec will cause the analog output to drop, meaning that a code of 4095 will not be able to generate a full scale voltage of 5V, but somewhat less.

3.5 EXTERNAL INTERRUPT INPUT

Pin 14 on the 26 pin I/O mini-connector is an external input which will generate an interrupt to the computer. The interrupt must be enabled through software. The interrupt is falling edge triggered using TTL level signals. The procedure initiated by an interrupt is wholly dependent on programming.

3.6 DIGITAL INPUTS & OUTPUTS

The PC-CARD-DAC08 has eight bi-directional digital I/O lines. The eight digital lines can be programmed as input or output in groups of: eight inputs, eight outputs or four inputs and four outputs. A register controls the direction of the digital I/O lines and must be set via software. At power-on or reset, the digital lines are set as inputs.

Please note: Digital lines in an input state present a high impedance to any device connected to them. The implication of this is that if you are using a digital line to control the input of a TTL chip, and that digital line changes from an output to an input, the TTL chip being controlled *may* detect the turned around line as a "1" or a "0". This could cause the TTL input being controlled to switch on or off, possibly causing bad consequences for the system you are controlling. To prevent random switching and force all digital lines into a known state on power up or reset, use pull -up or pull-down resistors to fix the state of the line as either high or low. A properly selected resistor will not interfere with TTL level output signals.

For more information on programming the digital I/O lines, please refer to the Universal library programmers manual.

4 PROGRAMMING & APPLICATIONS

4.1 PROGRAMMING LANGUAGES

Universal Library provides complete access to the PC-CARD-DAC08 functions from a range of programming languages; both DOS and Windows. If you are planning to write programs, or would like to run the example programs for Visual Basic or any other language, please turn now to the Universal library manual.

4.2 PACKAGED APPLICATIONS PROGRAMS

Many packaged application programs, such as SoftWIRE™, have drivers for the PC-CARD-DAC08. If the package you own does not appear to have drivers you need, please fax the package name and the revision number from the install disks. We will research the package for you and advise by return fax how to obtain necessary drivers.

5 I/O ADDRESS MAP & REGISTER FUNCTIONS

A base address register controls the beginning, or 'Base Address' of the I/O addresses occupied by the control registers of the PC-CARD-DAC08. Sixteen addresses are allocated to the PC-CARD, however, only 5 addresses are actually used. The base address assigned by CSS is stored in the CB.CBG file by InstaCal.

After CSS is installed and a base address has been established, the PC-CARD-DAC08 is controlled by writing to and reading from the control registers. While it is possible to write your own control routines, routines have been written and are available in Universal library for DOS and Windows programming languages. We support the use of the PC-CARD-DAC08 through high level languages using Universal Library.

All I/O access can be performed as bytes or words. Eight-bit addressing is controlled by the CSS, which is currently set for 8-bit addressing. The registers are presented in 8-bit format here.

BASE + 0 - DAC0 LSB Data Register

7	6	5	4	3	2	1	0
D/A7	D/A6	D/A5	D/A4	D/A3	D/A2	D/A1	D/A0

Any read to this register triggers an D/A conversion. This is a good method of starting conversions from software or time of day clock control.

WRITE: D/A Data can be written to this address and to Base + 1 to form a 12-bit D/A data word. All eight DAC's are updated using this register. The DAC being updated is set via the Select bits (S3 to S0) in the Base +2 register.

READ: Starts a D/A conversion. Updates the output of the selected DACs in Base + 2 Register.

BASE + 1 - DAC Value MSB (4 bits)

7	6	5	4	3	2	1	0
X	X	X	D/A12	D/A11	D/A10	D/A9	D/A8

WRITE: Send DAC data.

READ: Clear Interrupt Request bit at Base +4 bit D#3

BASE + 2 - DAC Select Register

7	6	5	4	3	2	1	0
X	X	X	CLR	S3	S2	S1	S0

WRITE: Select the DAC to update

READ: Read back Currently Selected DAC

S2: S0: The data entered to registers base +0 and base +1 will be latched to the DAC register defined by these bits (see table 5-1).

Table 5-1. DAC Selection and Update Mode

S3	S2	S1	S0	Function on Base + 0 Read	Function on Base + 0, Base + 1 Write
0	0	0	0	Update DAC0 & 1	Latch new D/A Value for DAC0
0	0	0	1	Update DAC0 & 1	Latch new D/A Value for DAC1
0	0	1	0	Update DAC2 & 3	Latch new D/A Value for DAC2
0	0	1	1	Update DAC2 & 3	Latch new D/A Value for DAC3
0	1	0	0	Update DAC4 & 5	Latch new D/A Value for DAC4
0	1	0	1	Update DAC4 & 5	Latch new D/A Value for DAC5
0	1	1	0	Update DAC6 & 7	Latch new D/A Value for DAC6
0	1	1	1	Update DAC6 & 7	Latch new D/A Value for DAC7
1	X	X	X	Update All DACs	No write function if S3 set

S3: Setting the S3 bit to 1 enables simultaneous update mode. Setting S3 to 0 updates the DACs in pairs.

Note that DACs are always updated in pairs if S3 is set to 0. For example, if you latch new data to DAC1, then update the DAC0 and DAC1 pair, DAC1 updates with the new value and DAC0 updates with the same value as before since the latch (data for output) has not changed.

If S3 is set to 1, a read from the base +0 register will simultaneously update all eight DACs with the data previously latched to the DAC registers.

CLR: Setting the CLR bit to 1 resets all eight DAC outputs to 0V. Default and normal operation is CLR = 0, which has no effect on the DAC outputs.

BASE + 3 - Digital I/O (8 bits)

7	6	5	4	3	2	1	0
DIO7	DIO6	DIO5	DIO4	DIO3	DIO2	DIO1	DIO0

WRITE: Updates output of DIO bits set for output.

READ: Reads current status of DIO bits for input. Reads back output state of DIO bits set for output.

BASE + 4 - Interrupt Control & Digital I/O Direction Control

7	6	5	4	3	2	1	0
X	X	X	X	INTREQ	INT_EN	UDIR	LDIR

WRITE: Set control bits.

READ: Read status of control bits.

INTREQ Default is no interrupt has occurred = 0. When set to 1 an interrupt has occurred.

External interrupts, when enabled, occur at TTL falling edge.

A read of base + 1 clears this bit.

Interrupt status routines may want to read and verify this bit then clear it with a read of Base +1.

INT_EN Enable external interrupt. Enable = 1. Disable = 0.

6 SPECIFICATIONS

Typical for 25°C unless otherwise specified.

Power Consumption

+5V quiescent

Normal Operation	42 mA typical, 110 mA maximum
CIS Read	57 mA typical, 135 mA maximum

Analog Output Section

D/A converter type	MAX547 13-bit Octal MDAC
Resolution	12 bits. LSB of converter not used.
Number of channels	8 Voltage Output, Single-ended
Output Range	±5V. 1 LSB = 2.44mV
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 50 kHz (±3kHz) can be expected. This rate was measured on a 500 MHz Pentium III based PC running under Windows 98.
Data transfer	Programmed I/O
D/A trigger modes	Software

Accuracy

Absolute Accuracy (SW calibrated)	±4.0 LSB
Typical Accuracy (SW calibrated)	±1.8 LSB

Accuracy Components (Uncalibrated)

Gain Error	Offset Error	DLE	ILE
±40 max, ±20.0 typ	±12.0 max, ±3.0 typ	±0.5 max, ±0.3 typ	±2 max, 0.5 typ

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. Each PC-CARD-DAC08 is tested at the factory to ensure the board's overall SW calibrated error does not exceed ±4.0 LSB.

Typical accuracy is derived directly from the various component typical errors. This typical error calculation for a SW calibrated PC-CARD-DAC08 yields ±1.8 LSB.

However, this again assumes that each of the errors contributes in the same direction and the ±1.8 LSB specification is quite conservative.

Slew Rate	± 1.6 V/µs min
Settling Time (to ½ LSB of FSR)	8.0 µs typ
Current Drive	±1 mA min
Output short-circuit duration	Indefinite @15 mA
Output coupling	DC
Output impedance	0.1 ohms max

Miscellaneous:

Double-buffered output latches
Update in DAC pairs (i.e., DAC 0/1, 2/3...) or all DACs simultaneously
Coding: Offset Binary (0 code = -FS, 4095 code = +FS)
Power-up and reset, all DAC's cleared to 0 volts, ± 10.2mV typ
'CLEAR' command to reset all DAC's to 0 volts, ± 10.2mV typ in software

Digital Input / Output

Digital type	FPGA
Configuration	Two ports, four bits each. Programmable as 8 input , 8 output or 4 input / 4 output
Input low voltage	0.8V max
Input high voltage	2.0V min
Output low voltage (IOL = 4 mA)	0.23V max
Output high voltage (IOH =–4mA)	3.86V min
Absolute maximum input voltage	–0.5V , +5.5V
Power-up / reset state	Input mode (high impedance)
Interrupt enable	Programmable
Interrupt source	External Interrupt triggered

Environmental

Operating Temperature Range	0 to 70°C
Storage Temperature Range	–40 to 100°C
Humidity	0 to 95% non-condensing

Mechanical

Card dimensions	PCMCIA type II: 85.6mm L x 54.0mm W x 5.0mm H

Connector and Pin Out

Connector Type:	Honda 26-Pin mini D-type
Connector Compatibility:	Translates to 37D pinout using PC-CARD-C37F/26 cable.

Main Connector:

PIN	SIGNAL NAME	PIN	SIGNAL NAME
1	GND	14	EXT. INTERRUPT IN
2	DIGITAL I/O 0	15	DIGITAL I/O 1
3	DIGITAL I/O 2	16	DIGITAL I/O 3
4	DIGITAL I/O 4	17	DIGITAL I/O 5
5	DIGITAL I/O 6	18	DIGITAL I/O 7
6	PC +5V OUT	19	D/A OUT 0
7	GND	20	D/A OUT 1
8	GND	21	D/A OUT 2
9	GND	22	D/A OUT 3
10	GND	23	D/A OUT 4
11	GND	24	D/A OUT 5
12	GND	25	D/A OUT 6
13	GND	26	D/A OUT 7

PC-CARD-C37F/26 User Connections on 37D:

PIN	SIGNAL NAME	PIN	SIGNAL NAME
1	GND	20	D/A OUT 1
2	EXTERNAL INTERRUPT IN	21	GND
3	GND	22	D/A OUT 2
4	DIGITAL I/O 0	23	GND
5	DIGITAL I/O 1	24	D/A OUT 3
6	DIGITAL I/O 2	25	GND
7	DIGITAL I/O 3	26	D/A OUT 4
8	DIGITAL I/O 4	27	GND
9	DIGITAL I/O 5	28	D/A OUT 5
10	DIGITAL I/O 6	29	GND
11	DIGITAL I/O 7	30	D/A OUT 6
12	GND	31	GND
13	GND	32	D/A OUT 7
14	PC +5V OUT	33	GND
15	GND	34	N/C
16	GND	35	N/C
17	GND	36	N/C
18	D/A OUT 0	37	N/C
19	GND		

NOTE: Pins 19, 21, 23, 25, 27, 31, and 33 connected to pin 1 inside 37D housing.

NOTE:

If the 37-pin connector (P2) is removed from the C37F/26 cable assembly and is to be replaced by a different user's connector, wiring of the replacement connector must adhere to the twisted-pair pairings listed in the following table.

Wire Run List C3726 - P1 (Honda) to P2 (37D)

P1 Honda	**Twisted Pair**	**P2 37D**
1 20	BLK BLU	1 20
2 8	RED BLU	4 3
3 16	BLK GRN	6 7
4 5	WHT BLK	8 10
6 25	GRN RED	14 30
7 26	BLK ORN	12 32
9 10	BLK BRN	13 15
11 17	BLK RED	16 9
12 15	YEL RED	29 5
13 22	BLK YEL	17 24
14 21	ORN RED	2 22
23 18	RED WHT	26 11
19 24	RED BRN	18 28
_	SHIELD	33

For Your Notes

For Your Notes

EC Declaration of Conformity

We, Measurement Computing Corporation, declare under sole responsibility that the product:

Part Number	Description
PC-CARD-DAC08	PCMCIA Eight-Channel Analog Output Board with eight DIO channels.

to which this declaration relates, meets the essential requirements, is in conformity with, and CE marking has been applied according to the relevant EC Directives listed below using the relevant section of the following EC standards and other normative documents:

EU EMC Directive 89/336/EEC: Essential requirements relating to electromagnetic compatibility.

EU 55022 Class B: Limits and methods of measurements of radio interference characteristics of information technology equipment.

EN 50082-1: EC generic immunity requirements.

IEC 801-2: Electrostatic discharge requirements for industrial process measurement and control equipment.

IEC 801-3: Radiated electromagnetic field requirements for industrial process measurements and control equipment.

IEC 801-4: Electrically fast transients for industrial process measurement and control equipment.

Carl Haapaoja, Director of Quality Assurance

Measurement Computing Corporation

16 Commerce Boulevard,

Middleboro, Massachusetts 02346

(508) 946-5100

Fax: (508) 946-9500

E-mail: info@measurementcomputing.com

www.measurementcomputing.com