ADLINK TECHNOLOGY INC.

PCI-8136

General Purpose Multi-Function I/O Card

User's Manual

Manual Rev. 2.00

Revision Date: July 5, 2007

Part No: 50-11120-1010

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1 Introduction

The PCI-8136 is a multi function DAQ card with 6-CH AD for signal measurement, and 6-CH 16-bit DA for precise voltage output. It also has six-channels 32-bit differential encoder counters and six pulse train generators, both supporting three kinds of differential pulse types: Out/Dir, A/B phase, CW/CCW. The PCI-8136 has 17 NPN type digital input channels and 6 open collector type digital output. All digital I/O are photo coupler isolated. The PCI-8136 also has a 24-bit programmable timer for users to generate a constant timer interval.

The PCI-8136 provides Windows DLL for users to easily develop their own applications. It supports Windows 95/98/NT/2000/XP/Vista platform. The development environment for Windows is compatible with Visual Basic, Visual Basic .Net, Visual C++, Visual C++.Net, C++ Builder, and Delphi. Since this is a PCI 32-bit interface card, the PCI-8136 will only support Borland C++ 3.1 in a DOS environment.

1.1 Features

The PCI-8136 provides ADPIO functions for users. The ADPIO stands for Analog/Digital/Pulse Input/Output. The following list summarizes the main features of the PCI-8136.

- 32-bit PCI-bus, plug and play
- 6 channels 16-bit analog output
- 6 channels analog input
- 19 channels isolated digital input
- 7 channels open collector digital output
- Programmable interrupt sources
- 6 differential types 32-bit encoder counters
- 6 differential type pulse generators
- One 24-bit programmable timer
- Software supports maximum up to 4 cards
- Function library for DOS and Windows 95/98/NT/2000/XP/Vista
- Compact, half size PCB

1.2 Specifications

Analog Input

- 6 differential input channels
- Input range:
  - Voltage: ±10 V
  - Current: ±20 mA (manually soldering 124ohms resistor)
- Input impedance:
  - 10^{12} Ohms || 100pF (voltage mode)
  - 124Ohms (current mode)
- Sampling rate: 133 kHz multiplexing

Analog Output

- 6 output channels
- Output range: bipolar, ±10V
- 16-bit DAC resolution, 14-bit accuracy guaranteed
- Settling time: 2 µ second
- Voltage output drive: 5 mA max.

Digital Input

- 19 input channels for NPN type sensor
- Input impedance: 4.7 K Ohms
- Max. Current: 20 mA
- Isolated voltage: 2500 V_{RMS}
- Throughput: 10 kHz (0.1 ms)

Digital Output

- 7 Output channels
- Output type: Darlington transistor with open collector type (ULN2003A)
- Sink current:
  - 90 mA/Ch (typical)
  - 150 mA/Ch (max.)
  - 500 mA/total
- Isolated voltage 2500 V_{RMS}
- Throughput 10 kHz (0.1 ms)

Pulse Input (Encoder Counter)

- 6 differential input channels
- 32-bit counter for AB-phase, CW/CCW, Pulse/Direction modes
- 2500 V_{RMS} optical isolation
- Maximum pulse input frequency: 2 MHz
- 32-bit encoder counter comparison

Pulse Output (Pulse Generator)

- 6 output channels with differential line drivers
- Pulse command type: CW/CCW, Pulse/Direction, A/B Phase
- Maximum pulse rate: 500 kHz with 1µ second pulse width.

Timer

- One 24-bit programmable timer
- Base clock: 33 MHz from PCI bus

General Specifications

- Connectors:
  - 100-pin SCSI-type connector
  - DB25 female connector
  - DB9 male connector
- Operating Temperature: 0°C - 50°C
- Storage Temperature: -20°C - 80°C
- Humidity: 5 - 85%, non-condensing
- Power Consumption:
  - Slot power supply(input): +5V DC ±5%, 900mA max.
  - External power supply(input): +24V DC ±5%, 500mA max.
  - External power supply(output): +5V DC ±5%, 500mA, max.
- Dimension: 164mm(L) X 98.4mm(H)

1.3 Software Support

For the customers who are writing their own programs, we provide a programming library for Borland C/C++ 3.1 under DOS and DLL for Windows 95/98/NT/2000/XP/Vista. These function libraries are shipped with the board.

2 Installation

This chapter describes how to install the PCI-8136 hardware and software correctly. Please follow the following steps.

- Check what you have (section 2.1)
- Check the PCB (section 2.2)
- Install the hardware (section 2.3)
- Install the software driver (section 2.4)
- Understand the connectors' pin assignments (the rest of the sections) and wiring the connections

2.1 What You Have

In addition to this User's Guide, the package includes the following items:

- PCI-8136 General Purpose Multi-I/O Card
- DB9 and DB25 Bracket
- External power cable for CN1
- ADLINK All-in-one Compact Disc

If any item is missing or damaged, contact the dealer from whom you pur¬chased the product. Save the shipping materials and carton in case you want to ship or store the product in the future.

2.2 Outline Drawing

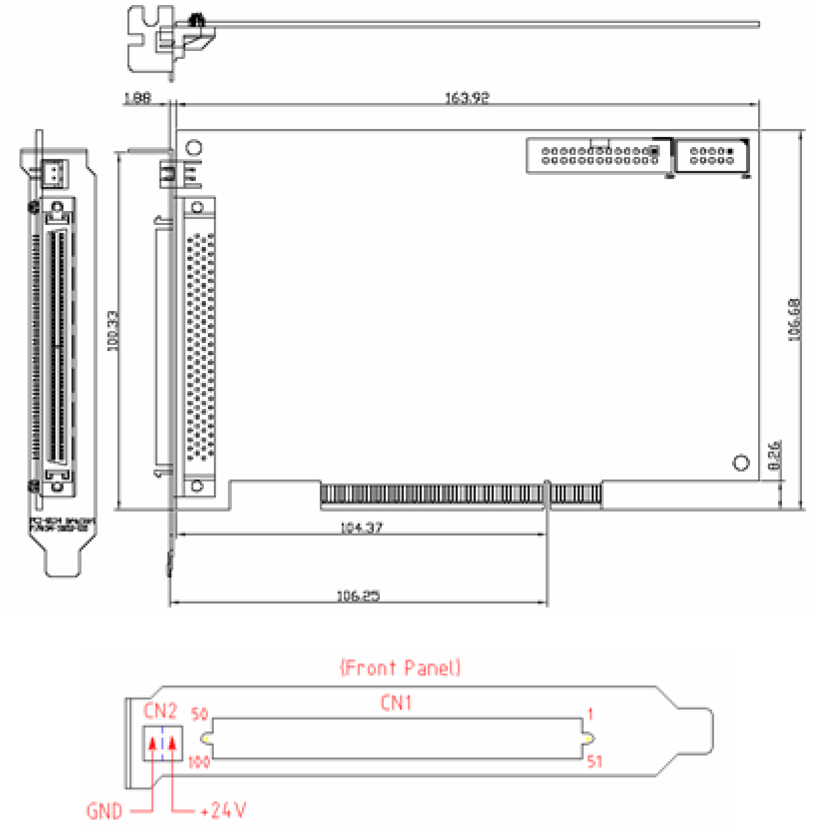


Figure 2-1: PCB Layout of the PCI-8136

CN1: Main Connector

CN2: External Power Input

CN3: DB25 Connector for analog input/output and remote I/O

CN4: DB9 Connector for remote I/O

Note: Remote I/O function is reserved for special requests

2.3 Hardware Installation

2.3.1 Hardware configuration

The PCI-8136 has a plug and play PCI controller on board. The memory usage (I/O port locations) of the PCI card is assigned by system BIOS. The address assignment is done on a board-by-board basis for all PCI cards in the system.

2.3.2 PCI slot selection

Your computer will probably have both PCI and ISA slots. Do not force the PCI card into a PC/AT slot. The PCI-8136 can be used in any PCI slot.

2.3.3 Installation Procedures

1. Read through this manual, and setup the jumper according to your application
2. Turn off your computer, Turn off all accessories (printer, modem, monitor, etc.) connected to computer.
3. Remove the cover from your computer.
4. Select a 32-bit PCI expansion slot. PCI slots are shorter than ISA or EISA slots and are usually white or ivory.
5. Before handling the PCI-8136, discharge any static buildup on your body by touching the metal case of the computer. Hold the edge and do not touch the components.
6. Position the board into the PCI slot you selected.
7. Secure the card in place at the rear panel of the system unit using screw removed from the slot.

2.3.4 Troubleshooting

If your system won't boot or if you experience erratic operation with your PCI board in place, it's likely caused by an interrupt conflict (perhaps because you incorrectly described the ISA setup). In general, the solution, once you determine it is not a simple oversight, is to consult the BIOS documentation that comes with your system.

2.4 Software Installation

Please refer to the Software Installation Guide.

2.5 CN1: Main Connector

The CN1 is the major connector for the Digital I/O, Pulse IO and Analog output signals.

No.	Name	I/O	Function	No	Name	I/O	Function
1	AGND	SG	Analog ground	51	AGND	SG	Analog ground
2	DAC0	O	Analog output, (0)	52	DAC3	O	Analog output, (2)
3	DAC1	O	Analog output, (1)	53	DAC4	O	Analog output, (3)
4	DAC2	O	Analog output, (2)	54	DAC5	O	Analog output, (4)
5	VCC+5V	O	+5V from 24V	55	COM-	PG	+24V Ground
6	COM+	P	+24V Input for Digital I/O	56	COM-	PG	+24V Ground
7	COM+	P	+24V Input for Digital I/O	57	DI18	I	Digital Input 18
8	COM+	P	+24V Input for Digital I/O	58	DO6	O	Digital Output 06
9	DI00	I	Digital Input 00	59	DI01	I	Digital Input 01
10	DI06	I	Digital Input 06	60	DI08	I	Digital Input 08
11	DI07	I	Digital Input 07	61	DI09	I	Digital Input 09
12	DO0	O	Digital Output 00	62	DO1	O	Digital Output 01
13	DI02	I	Digital Input 02	63	DI03	I	Digital Input 03
14	DI10	I	Digital Input 10	64	DI12	I	Digital Input 12
15	DI11	I	Digital Input 11	65	DI13	I	Digital Input 13
16	DO2	O	Digital Output 02	66	DO3	O	Digital Output 03
17	DI04	I	Digital Input 04	67	DI05	I	Digital Input 05
18	DI14	I	Digital Input 14	68	DI16	I	Digital Input 16
19	DI15	I	Digital Input 15	69	DI17	I	Digital Input 17
20	DO4	O	Digital Output 04	70	DO5	O	Digital Output 05
21	EA0+	I	Encoder A-phase (+), (0)	71	EA1+	I	Encoder A-phase (+), (1)
22	EA0-	I	Encoder A-phase (-), (0)	72	EA1-	I	Encoder A-phase (-), (1)
23	EB0+	I	Encoder B-phase (+), (0)	73	EB1+	I	Encoder B-phase (+), (1)
24	EB0-	I	Encoder B-phase (-), (0)	74	EB1-	I	Encoder B-phase (-), (1)
25	EZ0+	I	Encoder Z-phase (+), (0)	75	EZ1+	I	Encoder Z-phase (+), (1)
26	EZ0-	I	Encoder Z-phase (-), (0)	76	EZ1-	I	Encoder Z-phase (-), (1)

Table 2-1: CN1: Main Connector

No.	Name	I/O	Function	No	Name	I/O	Function
27	EA2+	I	Encoder A-phase (+), (2)	77	EA3+	I	Encoder A-phase (+), (3)
28	EA2-	I	Encoder A-phase (-),(2)	78	EA3-	I	Encoder A-phase (-), (3)
29	EB2+	I	Encoder B-phase (+),(2)	79	EB3+	I	Encoder B-phase (+), (3)
30	EB2-	I	Encoder B-phase (-),(2)	80	EB3-	I	Encoder B-phase (-), (3)
31	EZ2+	I	Encoder Z-phase (+),(2)	81	EZ3+	I	Encoder Z-phase (+), (3)
32	EZ2-	I	Encoder Z-phase (-),(2)	82	EZ3-	I	Encoder Z-phase (-), (3)
33	EA4+	I	Encoder A-phase (+),(4)	83	EA5+	I	Encoder A-phase (+),(5)
34	EA4-	I	Encoder A-phase (-),(4)	84	EA5-	I	Encoder A-phase (-),(5)
35	EB4+	I	Encoder B-phase (+),(4)	85	EB5+	I	Encoder B-phase (+),(5)
36	EB4-	I	Encoder B-phase (-),(4)	86	EB5-	I	Encoder B-phase (-),(5)
37	EZ4+	I	Encoder Z-phase (+),(4)	87	EZ5+	I	Encoder Z-phase (+),(5)
38	EZ4-	I	Encoder Z-phase (-),(4)	88	EZ5-	I	Encoder Z-phase (-),(5)
39	OUT0+	O	Pulse signal (+),(0)	89	OUT1+	O	Pulse signal (+), (1)
40	OUT0-	O	Pulse signal (-),(0)	90	OUT1-	O	Pulse signal (-), (1)
41	DIR0+	O	Dir. signal (+),(0)	91	DIR1+	O	Dir. Signal (+), (1)
42	DIR0-	O	Dir. Signal (-),(0)	92	DIR1-	O	Dir. Signal (-), (1)
43	OUT2+	O	Pulse signal (+), (2)	93	OUT3+	O	Pulse signal (+),(3)
44	OUT2-	O	Pulse signal (-),(2)	94	OUT3-	O	Pulse signal (-),(3)
45	DIR2+	O	Dir. signal (+), (2)	95	DIR3+	O	Dir. signal (+),(3)
46	DIR2-	O	Dir. signal (-), (2)	96	DIR3-	O	Dir. signal (-),(3)
47	OUT4+	O	Pulse signal (+),(4)	97	OUT5+	O	Pulse signal (+),5
48	OUT4-	O	Pulse signal (-),(4)	98	OUT5-	O	Pulse signal (-),(5)
49	DIR4+	O	Dir. signal (+),(4)	99	DIR5+	O	Dir. signal (+),(5)
50	DIR4-	O	Dir. Signal (-),(4)	100	DIR5-	O	Dir. Signal (-),(5)

Table 2-1: CN1: Main Connector

2.6 CN2: External Power Input

CN1 Pin No	Name	Description	Cable Color
1	EXGND	Grounds of the external power.	Black
2	EX+24V	External power supply of +24V DC ± 5%	Red

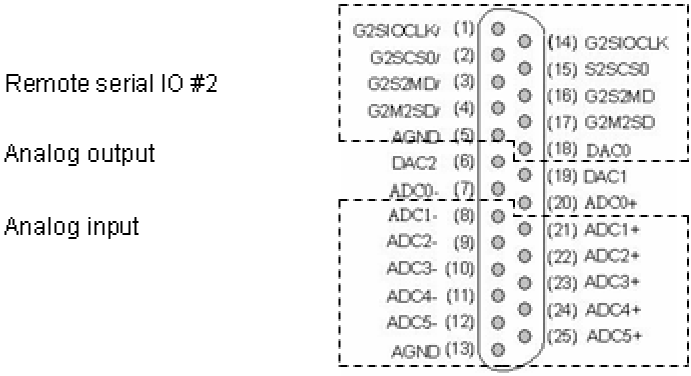
Table 2-2: CN2: External Power Input

Notes:

1. CN2 is a plug-in terminal connector with no screw.
2. Be sure to use the external power supply. The +24V DC is used by external input/output signal circuit.
3. Wires for connection to CN2
   - ▷ Solid wire: φ 0.32 mm to φ 0.65 mm (AWG28 to AWG22)
   - ▷ Twisted wire: 0.08 mm^2 to 0.32 mm^2 (AWG28 to AWG22)
   - ▷ Naked wire length: 10 mm standard
4. The EX+24V is shorted inside PCI-8136 with COM+ in CN1 (No. 6,7,8).
5. The EXGND is shorted inside PCI-8136 with COM- in CN1 (No. 55,56).

2.7 CN3 Pin Assignments: DB25 Connector

The signals on CN3 are for Analog input and remote serial IO.

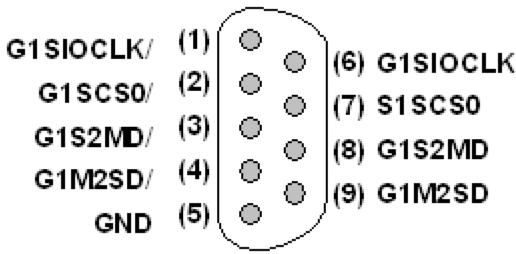


Note1: The DAC1-3 pins are the same with those on CN1

Note2: The Remote Serial IO #2 is reserved.

2.8 CN4 Pin Assignments: DB9 Connector

The signals on CN4 are for remote serial IO#1.



Note: The Remote Serial IO #1 is reserved.

3 Signal Connections

The signal connections of all the I/O signals are described in this chapter. Please refer to the contents of this chapter before wiring the cable between the PCI-8136 and IO Device.

This chapter contains the following sections:

Section 3.1 Analog Inputs

Section 3.2 Analog Outputs

Section 3.3 Digital Inputs

Section 3.4 Digital Outputs

Section 3.5 Pulse Inputs

Section 3.6 Pulse Outputs

Section 3.7 VCC Pin

3.1 Analog Input

The PCI-8136 provides 6 A/D converter channels. The analog source is selectable for each channel to be ±10V DC (Default) or ±20 mA automatically.

To avoid ground loops and get more accuracy measurement of A/D conversion, it is quite important to understand the signal source type. The PCI-8136 provides differential input modes that consist of two inputs per channel.

Signal	PIN	Connector	Function
ADC0+	20	CN3 (DB25)	ADC channel 0 (+)
ADC0-	7	CN3 (DB25)	ADC channel 0 (-)
ADC1+	21	CN3 (DB25)	ADC channel 1 (+)
ADC1-	8	CN3 (DB25)	ADC channel 1 (-)
ADC2+	22	CN3 (DB25)	ADC channel 2 (+)
ADC2-	9	CN3 (DB25)	ADC channel 2 (-)
ADC3+	23	CN3 (DB25)	ADC channel 3 (+)
ADC3-	10	CN3 (DB25)	ADC channel 3 (-)
ADC4+	24	CN3 (DB25)	ADC channel 4 (+)
ADC4-	11	CN3 (DB25)	ADC channel 4 (-)
ADC5+	25	CN3 (DB25)	ADC channel 5 (+)
ADC5-	12	CN3 (DB25)	ADC channel 5 (-)

A differential source means the ends of the signal are not grounded. To avoid the danger of high voltage between the local ground of signal and the ground of the PC system, a shorted ground path must be connected. Figure 3.1.2 shows the connection of differential analog input sources.

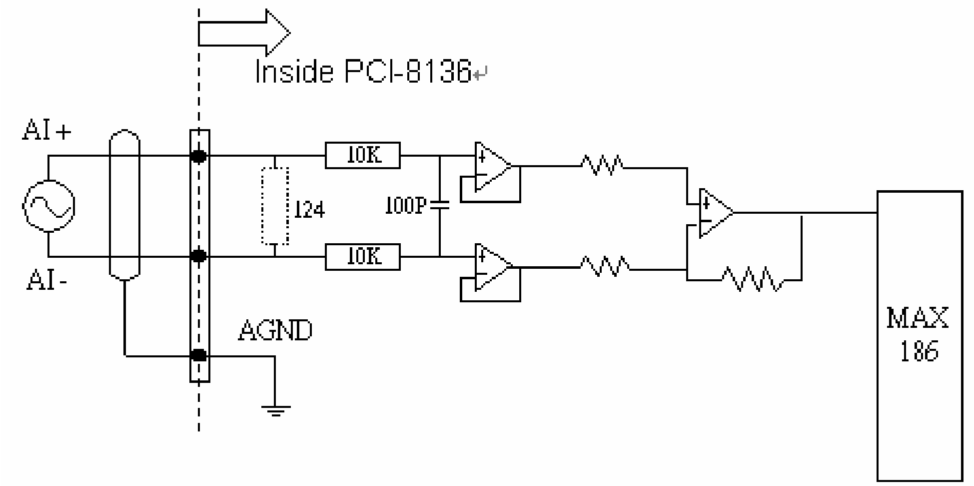


Figure 3-1: Analog input circuit

3.2 Analog Output

The PCI-8136 provides 6 16-bit Digital-to-Analog converter channels. The output voltage ranged from -10 V to +10V. To make correct connection, please refer to following figure:

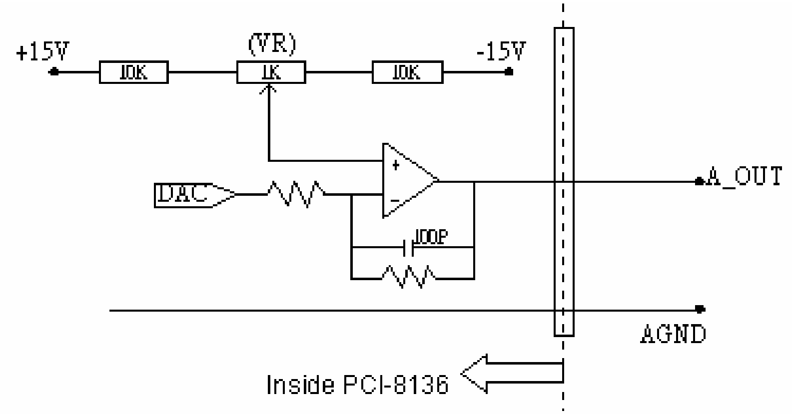


Figure 3-2: Analog output circuit

The Analog outputs are all single ended with common ground 'AGND'. The following is the pin assignment information for DAC.

Signal	PIN	Connector	Function
DAC0	2	CN1 (SCSI II – 100 Pin)	DAC Channel 0
DAC1	3	CN1 (SCSI II – 100 Pin)	DAC Channel 1
DAC2	4	CN1 (SCSI II – 100 Pin)	DAC Channel 2
DAC3	52	CN1 (SCSI II – 100 Pin)	DAC Channel 3
DAC4	53	CN1 (SCSI II – 100 Pin)	DAC Channel 4
DAC5	54	CN1 (SCSI II – 100 Pin)	DAC Channel 5
AGND	1	CN1 (SCSI II – 100 Pin)	Analog Ground
AGND	51	CN1 (SCSI II – 100 Pin)	Analog Ground
AGND	5	CN3 (DB25)	Analog Ground
AGND	13	CN3 (DB25)	Analog Ground
DAC0	18	CN3 (DB25)	DAC Channel 0
DAC1	19	CN3 (DB25)	DAC Channel 1
DAC2	6	CN3 (DB25)	DAC Channel 2

3.3 Digital Input

The PCI-8136 provides 19 digital inputs with 2500V rms isolation. The system recognizes a logical '1' when no current goes from COM+ to DIf, and, Logical '0' is returned when current goes from COM+ to DIf. The max current passing trough DIf must be less than 20mA.

Here is the input circuit of digital input channels.

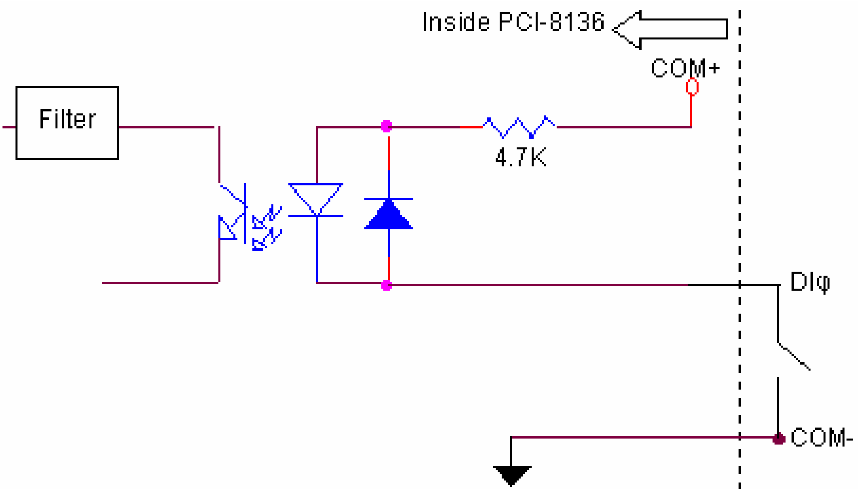
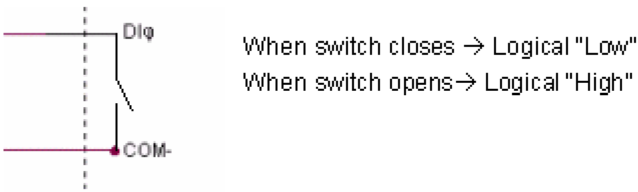


Figure 3-3: Digital input circuit

Example of input wiring:



The following is the pin assignment information for digital input.

Signal	PIN	Connector	Function
DI00	9	CN1 (SCSI II – 100 Pin)	Digital Input Ch. 00
DI01	59	CN1 (SCSI II – 100 Pin)	Digital Input Ch. 01
DI02	13	CN1 (SCSI II – 100 Pin)	Digital Input Ch. 02
DI03	63	CN1 (SCSI II – 100 Pin)	Digital Input Ch. 03
DI04	17	CN1 (SCSI II – 100 Pin)	Digital Input Ch. 04
DI05	67	CN1 (SCSI II – 100 Pin)	Digital Input Ch. 05
DI06	10	CN1 (SCSI II – 100 Pin)	Digital Input Ch. 06
DI07	11	CN1 (SCSI II – 100 Pin)	Digital Input Ch. 07
DI08	60	CN1 (SCSI II – 100 Pin)	Digital Input Ch. 08
DI09	61	CN1 (SCSI II – 100 Pin)	Digital Input Ch. 09
DI10	14	CN1 (SCSI II – 100 Pin)	Digital Input Ch. 10
DI11	15	CN1 (SCSI II – 100 Pin)	Digital Input Ch. 11
DI12	64	CN1 (SCSI II – 100 Pin)	Digital Input Ch. 12
DI13	65	CN1 (SCSI II – 100 Pin)	Digital Input Ch. 13
DI14	18	CN1 (SCSI II – 100 Pin)	Digital Input Ch. 14
DI15	19	CN1 (SCSI II – 100 Pin)	Digital Input Ch. 15
DI16	68	CN1 (SCSI II – 100 Pin)	Digital Input Ch. 16
DI17	69	CN1 (SCSI II – 100 Pin)	Digital Input Ch. 17
DI18	57	CN1 (SCSI II – 100 Pin)	Digital Input Ch. 18
COM-	55	CN1 (SCSI II – 100 Pin)	DIO Common Ground
COM-	56	CN1 (SCSI II – 100 Pin)	DIO Common Ground

3.4 Digital Output

The PCI-8136 provides 7 open collector outputs with 2500 V rms isolation. The maximum output switching frequency is 10 kHz, when the continuous output supply current is subject to 500mA/ total, 90mA/CH(typical), and 150mA/CH(max). In power-on state, the system issues a logical '0'.

Here is the output circuit of digital output channels.

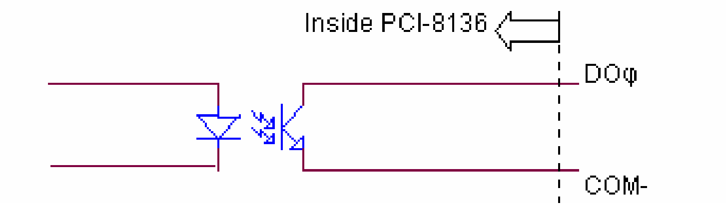


Figure 3-4: Digital output circuit

Example of output wiring:

When output is set to “HIGH”, current goes from COM+ to COM-

When output is set to “LOW”, the resistance value between DOφ and COM- becomes extremely large, so that no current was drawn from COM+.

The following is the pin assignment information for Digital Output.

Signal	PIN	Connector	Function
COM+	6	CN1 (SCSI II – 100 Pin)	EXT +24V for Digital Output
COM+	7	CN1 (SCSI II – 100 Pin)	EXT +24V for Digital Output
COM+	8	CN1 (SCSI II – 100 Pin)	EXT +24V for Digital Output
DO0	12	CN1 (SCSI II – 100 Pin)	Digital Output CH.0
DO1	62	CN1 (SCSI II – 100 Pin)	Digital Output CH.1
DO2	16	CN1 (SCSI II – 100 Pin)	Digital Output CH.2
DO3	66	CN1 (SCSI II – 100 Pin)	Digital Output CH.3
DO4	20	CN1 (SCSI II – 100 Pin)	Digital Output CH.4
DO5	70	CN1 (SCSI II – 100 Pin)	Digital Output CH.5
DO6	58	CN1 (SCSI II – 100 Pin)	Digital Output CH.6

Signal	PIN	Connector	Function
COM-	55	CN1 (SCSI II – 100 Pin)	DIO Common Ground
COM-	56	CN1 (SCSI II – 100 Pin)	DIO Common Ground

3.5 Pulse Input (Encoder Counter)

The PCI-8136 provides 6 differential pulse inputs with 2500V rms isolation. The pulse mode is software programmable to be AB-phase, CW/CCW, or Pulse/Direction, and the counter speed goes up to 2 MHz. The relative signal names, and pin numbers are shown in the following tables.

Signal	PIN	Connector	Function
EA0+	21	CN1 (SCSI II – 100 Pin)	Encoder CH.0 A-Phase (+)
EA0-	22	CN1 (SCSI II – 100 Pin)	Encoder CH.0 A-Phase (-)
EB0+	23	CN1 (SCSI II – 100 Pin)	Encoder CH.0 B-Phase (+)
EB0-	24	CN1 (SCSI II – 100 Pin)	Encoder CH.0 B-Phase (-)
EZ0+	25	CN1 (SCSI II – 100 Pin)	Encoder CH.0 Z-Phase (+)
EZ0-	26	CN1 (SCSI II – 100 Pin)	Encoder CH.0 Z-Phase (-)
EA1+	71	CN1 (SCSI II – 100 Pin)	Encoder CH.1 A-Phase (+)
EA1-	72	CN1 (SCSI II – 100 Pin)	Encoder CH.1 A-Phase (-)
EB1+	73	CN1 (SCSI II – 100 Pin)	Encoder CH.1 B-Phase (+)
EB1-	74	CN1 (SCSI II – 100 Pin)	Encoder CH.1 B-Phase (-)
EZ1+	75	CN1 (SCSI II – 100 Pin)	Encoder CH.1 Z-Phase (+)
EZ1-	76	CN1 (SCSI II – 100 Pin)	Encoder CH.1 Z-Phase (-)
EA2+	27	CN1 (SCSI II – 100 Pin)	Encoder CH.2 A-Phase (+)
EA2-	28	CN1 (SCSI II – 100 Pin)	Encoder CH.2 A-Phase (-)
EB2+	29	CN1 (SCSI II – 100 Pin)	Encoder CH.2 B-Phase (+)
EB2-	30	CN1 (SCSI II – 100 Pin)	Encoder CH.2 B-Phase (-)
EZ2+	31	CN1 (SCSI II – 100 Pin)	Encoder CH.2 Z-Phase (+)
EZ2-	32	CN1 (SCSI II – 100 Pin)	Encoder CH.2 Z-Phase (-)
EA3+	77	CN1 (SCSI II – 100 Pin)	Encoder CH.3 A-Phase (+)
EA3-	78	CN1 (SCSI II – 100 Pin)	Encoder CH.3 A-Phase (-)
EB3+	79	CN1 (SCSI II – 100 Pin)	Encoder CH.3 B-Phase (+)
EB3-	80	CN1 (SCSI II – 100 Pin)	Encoder CH.3 B-Phase (-)
EZ3+	81	CN1 (SCSI II – 100 Pin)	Encoder CH.3 Z-Phase (+)
EZ3-	82	CN1 (SCSI II – 100 Pin)	Encoder CH.3 Z-Phase (-)
EA4+	33	CN1 (SCSI II – 100 Pin)	Encoder CH.4 A-Phase (+)
EA4-	34	CN1 (SCSI II – 100 Pin)	Encoder CH.4 A-Phase (-)

Signal	PIN	Connector	Function
EB4+	35	CN1 (SCSI II – 100 Pin)	Encoder CH.4 B-Phase (+)
EB4-	36	CN1 (SCSI II – 100 Pin)	Encoder CH.4 B-Phase (-)
EZ4+	37	CN1 (SCSI II – 100 Pin)	Encoder CH.4 Z-Phase (+)
EZ4-	38	CN1 (SCSI II – 100 Pin)	Encoder CH.4 Z-Phase (-)
EA5+	83	CN1 (SCSI II – 100 Pin)	Encoder CH.5 A-Phase (+)
EA5-	84	CN1 (SCSI II – 100 Pin)	Encoder CH.5 A-Phase (-)
EB5+	85	CN1 (SCSI II – 100 Pin)	Encoder CH.5 B-Phase (+)
EB5-	86	CN1 (SCSI II – 100 Pin)	Encoder CH.5 B-Phase (-)
EZ5+	87	CN1 (SCSI II – 100 Pin)	Encoder CH.5 Z-Phase (+)
EZ5-	88	CN1 (SCSI II – 100 Pin)	Encoder CH.5 Z-Phase (-)

The input circuits of the EA, EB, EZ signals are shown as follows.

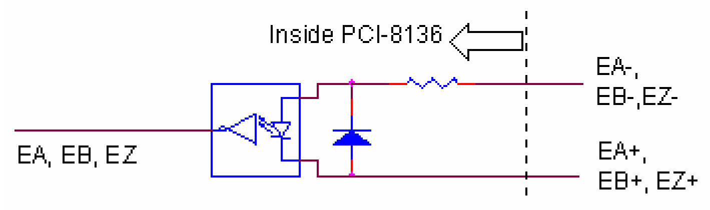


Figure 3-5: Pulse input (encoder counter) circuit

Note: The voltage across every differential pair of encoder input signals (EA+, EA-), (EB+, EB-) and (EZ+, EZ-) should be at least 3.5V or higher. Therefore, you have to take care of the driving capability when connecting with the encoder feedback or motor driver feedback.

Here are two examples of connecting the input signals with the external circuits. The input circuits can connect to the encoder or motor driver, which are equipped with: (1) a differential line driver or (2) open collector output.

Connection to Line Driver Output

To drive the PCI-8136 encoder input, the driver output must provide at least 3.5V across the differential pairs with at least 6 mA driving capability. The ground level of the two sides must be tight together too.

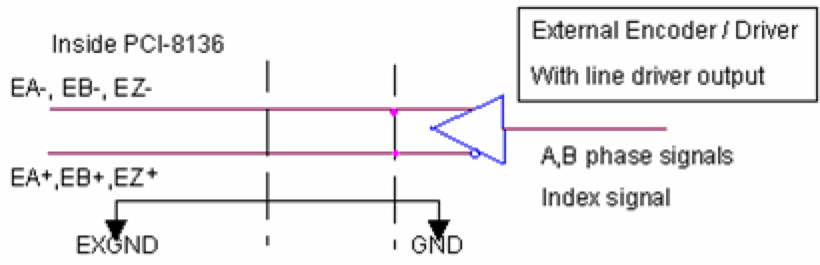


Figure 3-6: Connection to line driver output

Connection to Open Collector Output

To connect with open collector output, an external power supply is necessary. Some motor drivers also provide the power source. The connection between PCI-8136, encoder, and the power supply is shown in the following diagram. Please note that the external current limit resistor R is necessary to protect the PCI-8136 input circuit. The following table lists the suggested resistor value according to the encoder power supply.

Encoder Power(VDD)	External Resistor R
+5V	0 Ω (None)
+12V	1.8kΩ
+24V	4.3kΩ

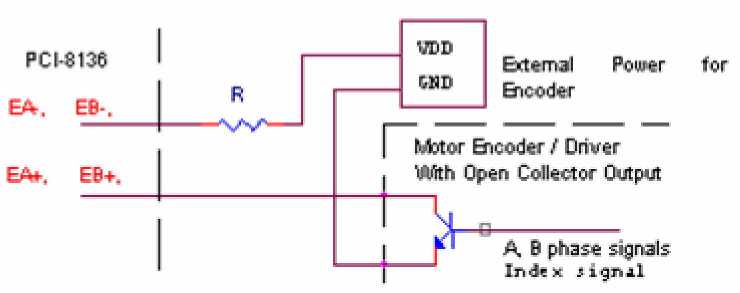


Figure 3-7: Connect to open collector output

3.6 Pulse Output (Pulse Generator)

The PCI-8136 provides 6 differential pulse output channels. The pulse mode is software programmable to be Pulse/Direction, CW/CCW, or AB-phase, and the output frequency goes up to 500 KHz. The operations of pulse output channels are quite straightforward. Call library functions to set pulse mode, send pulse at constant frequency, and stop pulse. Please refer to chapter 5 for detail function descriptions.

The relative signal names, and pin numbers are shown in the following tables.

Signal	PIN	Connector	Function
OUT1+	39	CN1 (SCSI II – 100 Pin)	CH.1 Pulse Signal (+)
OUT1-	40	CN1 (SCSI II – 100 Pin)	CH.1 Pulse Signal (-)
DIR1+	41	CN1 (SCSI II – 100 Pin)	CH.1 Direction Signal (+)
DIR1-	42	CN1 (SCSI II – 100 Pin)	CH.1 Direction Signal (-)
OUT2+	89	CN1 (SCSI II – 100 Pin)	CH.2 Pulse Signal (+)
OUT2-	90	CN1 (SCSI II – 100 Pin)	CH.2 Pulse Signal (-)
DIR2+	91	CN1 (SCSI II – 100 Pin)	CH.2 Direction Signal (+)
DIR2-	92	CN1 (SCSI II – 100 Pin)	CH.2 Direction Signal (-)
OUT3+	43	CN1 (SCSI II – 100 Pin)	CH.3 Pulse Signal (+)
OUT3-	44	CN1 (SCSI II – 100 Pin)	CH.3 Pulse Signal (-)
DIR3+	45	CN1 (SCSI II – 100 Pin)	CH.3 Direction Signal (+)
DIR3-	46	CN1 (SCSI II – 100 Pin)	CH.3 Direction Signal (-)
OUT4+	83	CN1 (SCSI II – 100 Pin)	CH.4 Pulse Signal (+)
OUT4-	84	CN1 (SCSI II – 100 Pin)	CH.4 Pulse Signal (-)
DIR4+	85	CN1 (SCSI II – 100 Pin)	CH.4 Direction Signal (+)
DIR4-	86	CN1 (SCSI II – 100 Pin)	CH.4 Direction Signal (-)
OUT5+	47	CN1 (SCSI II – 100 Pin)	CH.5 Pulse Signal (+)
OUT5-	48	CN1 (SCSI II – 100 Pin)	CH.5 Pulse Signal (-)
DIR5+	49	CN1 (SCSI II – 100 Pin)	CH.5 Direction Signal (+)
DIR5-	50	CN1 (SCSI II – 100 Pin)	CH.5 Direction Signal (-)
OUT6+	97	CN1 (SCSI II – 100 Pin)	CH.6 Pulse Signal (+)
OUT6-	98	CN1 (SCSI II – 100 Pin)	CH.6 Pulse Signal (-)
DIR6+	99	CN1 (SCSI II – 100 Pin)	CH.6 Direction Signal (+)
DIR6-	100	CN1 (SCSI II – 100 Pin)	CH.6 Direction Signal (-)

Here is the circuit of PCI-8136 pulse output (pulse generator) channels.

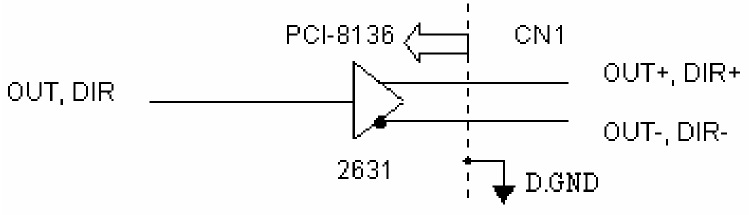


Figure 3-8: Pulse output (pulse generator) circuit

3.7 VCC Pin

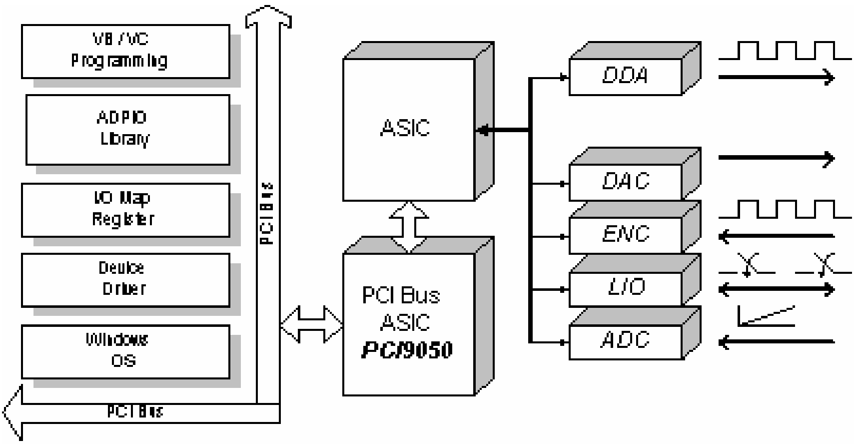
There is one pin named VCC+5V on Pin5 of CN1. This voltage source is from external 24V. Please don't use this voltage source on any device which is connected to PCI-8136's isolation I/Os. If not, the grounds will be connected at both of the isolative sides and the noise will be introduced from this loop. So the isolation will be meaningless. The VCC's ground is the same with AGND inside the board.

4 Operation Theory

This chapter describes the detail operation of the PCI-8136 card. Contents of the following sections are as following.

- Section 4.1: AD Conversion and Preloaded Trigger
- Section 4.2: DA Conversion
- Section 4.3: DIO
- Section 4.4: Pulse Input and Position Compare
- Section 4.5: Pulse Output
- Section 4.6:Interrupt Control

Please refer to the following architecture diagram of PCI-8136



ADC: Please refer to Section 4.1: AD Conversion and Preloaded Trigger.

DAC: Please refer to Section 4.2: DA Conversion.

DIO: Please refer to Section 4.3: DIO.

ENC: Please refer to Section 4.4: Pulse Input and Position Compare.

4.1 AD Conversion and Preloaded Trigger

4.1.1 ADC

The PCI-8136 provides 6 differential ADC channels. Each channel consists of two inputs. One for a (+) signal and the other for a (-) signal. The input signal may have a voltage range from –10 ~ +10V or current range from –20mA ~ 20mA. The following figure show the A (voltage or current) to D (value read) converting table. The zero voltage or current is at value 2000.

Related functions:

_8136_A_Initial(): please refer to section 5.5

_8136_A_Read_Value(), **_8136_A_Read_Volt**(): please refer to section 5.5

4.1.2 Voltage Compare

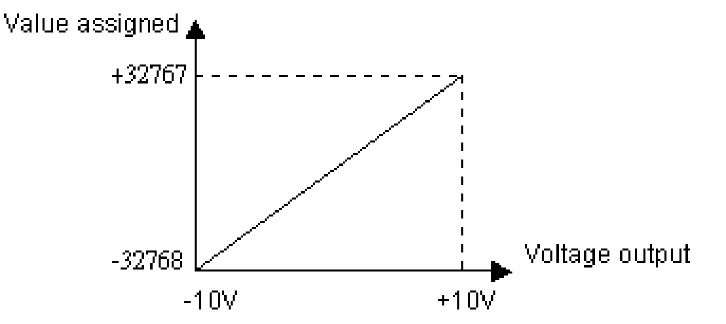
The voltage compare function allows users to set a compare value by software function. When one ADC signal reaches the pre-set value, an interrupt will be generated for corresponding channel.

Relative functions:

_8136_A_Set_Compare_Value(),
_8136_A_Set_Compare_Volt(),
_8136_S_Set_Int_Factor() : please refer to section 5,7

4.2 DA Conversion

The PCI-8136 has a 6 channel 16-bit, bipolar (±10V DC) digital to analog converter. The D (value assigned) to A (voltage output) converting chart is showed bellow.



4.2.1 DA Output by Trigger Source

PCI-8136 allows users to set a pre-load value for each DAC channel. The value will be sent once any trigger condition for this channel occurs. The trigger source could be from encoder counter comparators or ADCs by setting the trigger map in the software functions. Users can set every channel's trigger sources independently. The compare method could be set in Set_Int_Factor() function.

Related functions:

_8136_A_Initial() : please refer to section 5.5

_8136_A_Write_Value(), **_8136_A_Write_Volt**(), **_8136_A_Output_Control**(): please refer to section 5.5

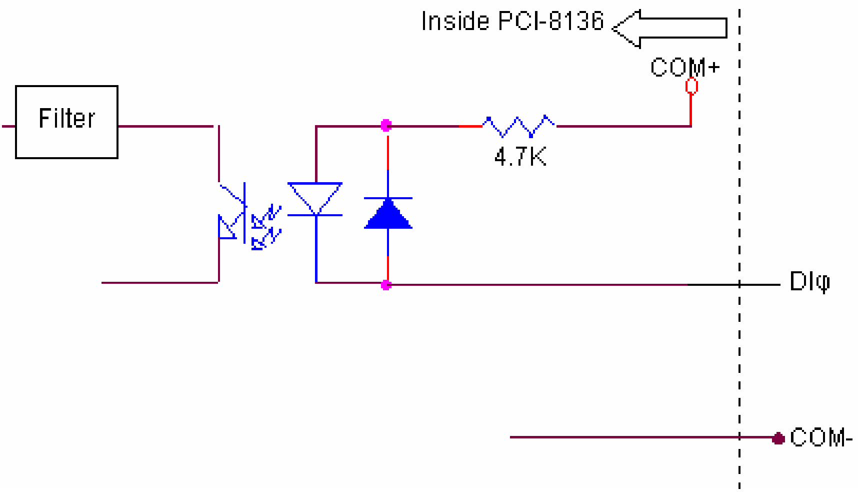
_8136_A_Set_Preload_Volt(), **_8136_A_Set_Trigger**(), **_8136_A_Set_Trigger_Map**(): please refer to section 5.5

_8136_S_Set_Int_Factor(): please refer to section 5,7

4.3 DIO

4.3.1 Digital Input

The PCI-8136 provides 19 digital input channels with 2500Vrms isolation. The DI channel is logically "HIGH" when no current goes from COM+ to DIf, and, Logically "LOW" when current goes from COM+ to DIf. The max current passing through DIf must be less than 20mA.

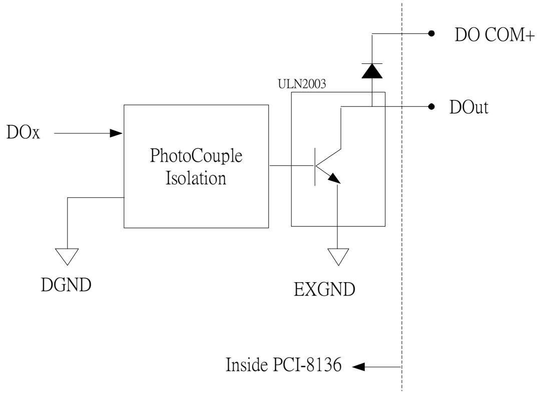


Related functions:

_8136_D_Input(), **_8136_D_InputA**(): please refer to section 5.4

4.3.2 Digital Output

The PCI-8136 provides 7 open collector output channels with 2500Vrms isolation. Please carefully refer to section 3.4 for the circuit wiring.



Related functions:

_8136_D_Output(), **_8136_D_OutputA**(): please refer to section 5.4

4.4 Pulse Input and Position Compare

4.4.1 Pulse Input

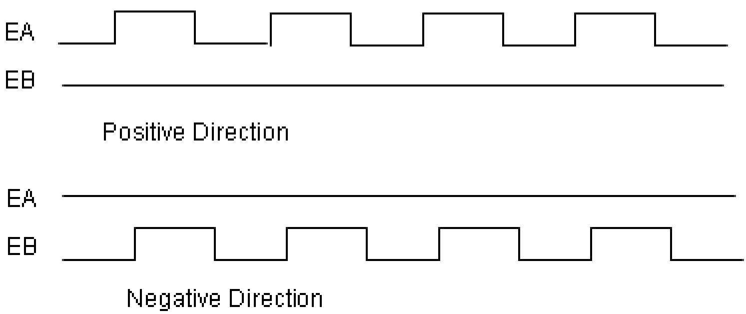
The PCI-8136 has 6 32-bit pulse input channels for encoder counter. It can accept 3 kinds of pulse signal:

1. Plus and minus pulse inputs (CW/CCW mode)
2. 90°phase difference signals(AB phase mode)
3. Pulse and direction inputs (Pulse/DIR).

90° phase difference signals may be selected to be multiplied by a factor of 1, 2, or 4x AB phase mode is the most commonly used for incremental encoder input. For example, if a rotary encoder has 2000 pulses per phase (A or B phase), then the value read from the counter will be 8000 pulses per turn These input modes can be selected by software function calls.

Plus and minus pulses input mode(CW/CCW Mode)

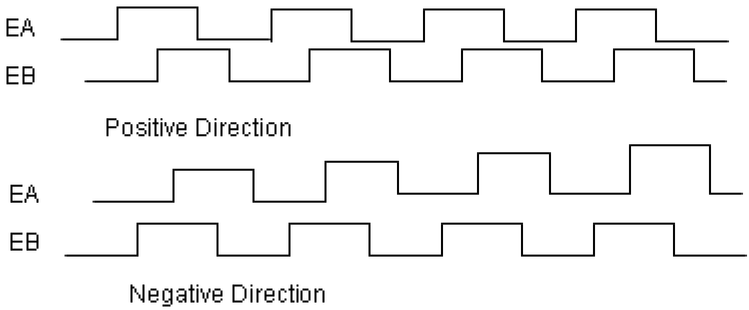
In this mode, pulse from EA causes the counter to count up, whereas EB causes the counter to count down.



90° phase difference signals Input Mode(AB phase Mode)

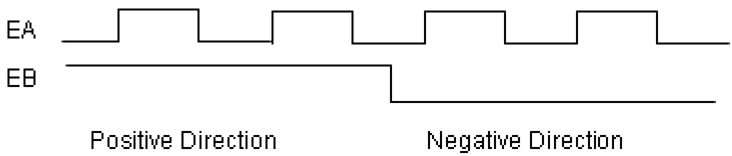
In this mode, the EA signal is 90° phase leading or lagging in comparison to the EB signal. Where "lead" or "lag' of phase difference between two signals is caused by the turning direction of motors. The up/down counter counts up when the phase of EA signal leads the phase of EB signal.

The following diagram shows the waveform.



Pulse and direction input (Pulse/DIR)

In this mode, the high / low status of EB will cause the counter value to increase or decrease (Direction), whereas the high/low status of EA will cause the count number to increase or decrease (Pulse).



4.4.2 Encoder Counter Value Capture (latch)

The EZ (index signal) of each pulse input channel doesn't affect counter value. It can capture (latch) the current counter value by proper setting, and generate an interrupt signal when receiving a rising edge. The counter value capture function is very useful to sensing the position of a moving object.

Related functions:

_8136_P_Initial(): please refer to section 5.6

_8136_P_Set_Input_Type(), **_8136_P_Read**(), **_8136_P_Clear**(), **_8136_P_Set_Index_Latch**(), **_8136_P_Read_Index**(), **_8136_P_Read_Latch_Value**(): please refer to section 5.6

4.4.3 Encoder Counter Value Compare

The PCI-8136 provides a position compare function for all six pulse input channels. Once the counter value is reached the preset compare value, an interrupt signal will be generated immediately. This function can effectively reduce the overhead of CPU's polling for current position.

Related functions:

_8136_S_Set_Int_Factor(): please refer to section 5,7
_8136_P_Set_Compare_Value(): please refer to section 5.6

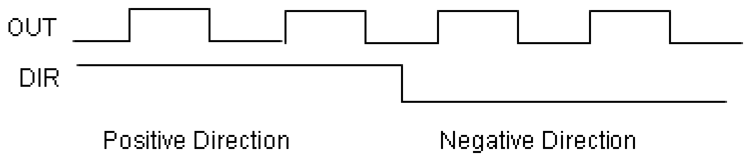
4.5 Pulse Output

The PCI-8136 provides 6 pulse output channels. They are used to send out constant-frequency pulse trains. When changing the output frequency of any channel, there is at most 265ms time delay.

There are also 3 kinds of pulse outputs: (1). plus and minus pulse inputs (CW/CCW mode); (2) pulse and direction input(Pulse/DIR); (3). 90° phase difference signals(AB phase mode);

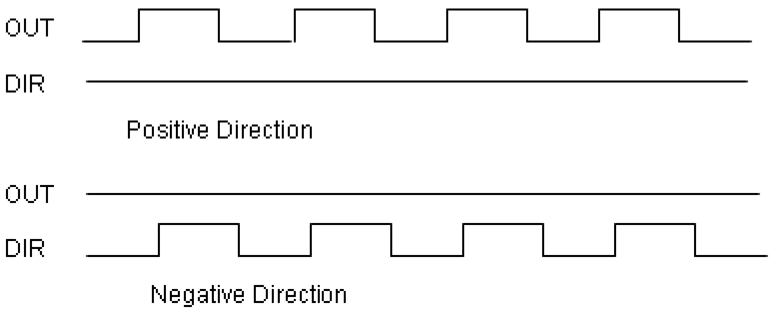
Pulse and direction input(Pulse/DIR)

In this mode, the high / low status of DIR defines the plus / negative direction, whereas OUT generates the pulse train.



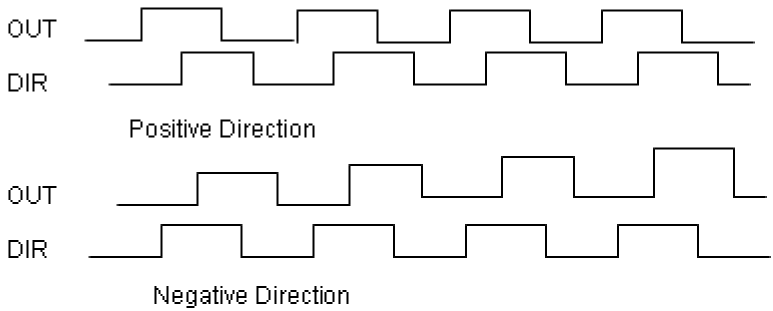
Plus and minus pulses input mode(CW/CCW Mode)

In this mode, plus frequency (plus direction) goes on OUT, whereas negative frequency (negative direction) is generated from DIR.



90° phase difference signals input mode(AB phase Mode)

In this mode, the OUT signal is 90° phase leading or lagging in comparison with DIR signal. Where “lead” or “lag' of phase difference between two signals is caused by the direction of pulse train.



Related functions:

_8136_P_Initial(): please refer to section 5.6

_8136_P_Set_Output_Type(), **_8136_P_Send**(), **_8136_P_Stop**(), **_8136_P_Change_Speed**(): please refer to section 5.6

4.6 Interrupt Control

The PCI-8136 can generate an INT signal to the host PC according to 7 of factors, refer to **`_8136_S_Set_Int_factor`**() function for more details. Type 0 to type 2 are local digital Input interrupts. The following table represents the interrupt setting for local digital Input:

`_8136_S_Set_Int_factor(Cardno, ChannelNo, Int_Factor)`

Channel

	Channel	0	1	2	3	4	5
Int. factor bit(type)							
0		DI 6/7	DI 8/9	DI 10/11	DI 12/13	DI 14/15	DI 16/17
1		DI 18	-	-	-	-	-
2		DI 00	DI 01	DI 02	DI 03	DI 04	DI 05
3		EZ1	EZ2	EZ3	EZ4	EZ5	EZ6
4		CMP1	CMP2	CMP3	CMP4	CMP5	CMP6
5		Timer	-	-	-	-	-
6		ADC1	ADC2	ADC3	ADC4	ADC5	ADC6

Note: Once the first row of interrupt factor is set, both of the digit channels' interrupt are enabled. The interrupt comes when any one of the two digital channels' are triggered.

EZ is index signal , CMP is position compare true, Timer is card's internal timer, ADC is analog compare true.

For each channel number, the interrupt can be set according to above table.

Since interruptions can not be handled with a Windows System, the PCI-8136 has a Windows message system to handle interruptions. This card uses events to notice the user's program if an interruption is coming. Users can create a thread to retreive the interrupt events and then use **`_8136_S_Get_Int_Status`**() to get the interrupt status. The status bits for each axis is in the following table:

`_8136_S_Get_Int_Status(Cardno, AxisNo, Status)`

Bits	Description
0	Digital Input pin 6/8/10/12/14/16 interrupt
1	Digital Input pin 7/9/11/13/15/17 interrupt
2	Digital Input pin 18 interrupt
3	Digital Input pin 0~5 interrupt
4	Index signal interrupt
5	Position counter compare interrupt
6	Internal timer interrupt
7	Analog compared interrupt

Table 4-1: _8136_S_Get_Int_Status

Use Thread to deal with Interrupt under Windows NT/95

In order to detect the interrupt signal from PCI-8136 under Windows NT/95, users must create a thread routine first. Then use APIs provided by PCI-8136 to get the interrupt signal. Each card has 7 events for these interrupts. Event 0 ~ 5 stands for channel 0~5 and event 6 stands for timer interrupt and alarm interrupt. The sample program is as follows:

Situation: Assume that we have one card and want to receive Timer interrupt.

Steps:

1. Define a Global Value to deal with interrupt event

```
HANDLE hEvent[7];
volatile bool ThreadOn;
```

2. In Initializing Section (you must Initialize PCI-8136 properly first), set interrupt types and enable an event for each axis.

```
_8136_S_Set_Int_Factor(0,0, 0x40);
_8136_S_INT_Control(0,1);
_8136_INT_Enable(0,&hEvent[0]);
```

Note: For each card, you must assign a 7-events-array in **`_8136_INT_Enable`** function.

3. Define a Global Function (Thread Body). Use WaitForSingleObject() or WaitForMultipleObjects() to wait events. Remember to reset this event after you get the event.

```
UINT IntThreadProc(LPVOID pParam)
{
U32 IntSts;
while(ThreadOn==TRUE)
{
::WaitForSingleObject(hEvent[6],INFINITE);
_8136_S_Get_Int_status(0,0,&IntSts);
::ResetEvent(hEvent[6]);
}
return 0;
}
```

4. Start the thread(Use a boolean value to control the thread's life)

```
ThreadOn=TRUE;
AfxBeginThread(IntThreadProc,GetSafeHwnd(),THREA
     D_PRIORITY_NORMAL);
```

5. Before exiting the program, remember to let the thread go to end naturally.

```
ThreadOn=FALSE;
```

Note: If users need to deal interrupt under VB6.0. Please refer to section 5.7 for details.

We suggest user creates a thread and uses **WaitForSingleObject**() for each event in order to guarantee proper performance.

5 Function Library

This chapter describes the supporting software for PCI-8136 cards. User can use these functions to develop application programs in Visual Basic, Visual Basic .Net, Visual C++, Visual C++.Net, C++ Builder, and Delphi language.

The function prototypes and some common data types are decelerated in PCI-8136.H. These data types are used by PCI-8136 library. We suggest you to use these data types in your application programs. The following table shows the data type names and their range.

Type Name	Description	Range
U8	8-bit ASCII character	0 to 255
I16	16-bit signed integer	-32768 to 32767
U16	16-bit unsigned integer	0 to 65535
I32	32-bit signed long integer	-2147483648 to 2147483647
U32	32-bit unsigned long integer	0 to 4294967295
F32	32-bit single-precision floating-point	-3.402823E38 to 3.402823E38
F64	64-bit double-precision floating-point	-1.797683134862315E308 to 1.797683134862315E309
Boolean	Boolean logic value	TRUE, FALSE

The functions of PCI-8136's software drivers use full-names to represent the functions' real meaning. The naming convention rules are:

In a C Environment:

_{hardware_model}_{action_name}. e.g. **`_8136_Initial`**().

In order to recognize the difference between C/C++ library and Visual Basic library, A capital "B" is put on the head of each function name of the Visual Basic function. e.g. **`B_8136_Initial`**()

5.1 List of Functions

Initialization		Section 5.2
_8136_Initial	Interface card initialization	
_8136_S_Close	Interface card close	
_8136_S_Get_IRQ_Channel	Get card's IRQ	
_8136_S_Get_Base_Addr	Get card's base address	
System Parameters		Section 5.3
_8136_S_Set_Timer_Value	Set Timer click count	
Digital I/O		Section 5.4
_8136_D_Output	Digital output for one bit	
_8136_D_Input	Digital input for one bit	
_8136_D_OutputA	Digital Output for all bits once	
_8136_D_InputA	Digital Input for all bits once	
Analog I/O		Section 5.5
_8136_A_Initial	Analog I/O initialization	
_8136_A_Set_Source		
_8136_A_Write_Value		
_8136_A_Write_Volt	Output DAC in voltage	
_8136_A_Read_Value	Input from ADC in value	
_8136_A_Read_Volt	Input from ADC in voltage	
_8136_A_Output_Control	Start or stop DAC output	
_8136_A_Set_Trigger	Set DAC output by trigger	
_8136_A_Set_Trigger_Map	Select DAC trigger source	
_8136_A_Set_Preload_Volt	Set DAC trigger output voltage	
_8136_A_Set_Compare_Value	Set ADC compare value	
_8136_A_Set_Compare_Volt	Set ADC compare voltage	
_8136_A_Output_Control		
Pulse I/O		Section 5.6
_8136_P_Initial		
_8136_P_Set_Output_Type	Pulse I/O initialization	
Set pulse output mode		
_8136_P_Set_Input_Type	Set pulse input mode	
_8136_P_Read	Read encoder counter	

_8136_P_Clear	Clear encoder counter	
_8136_P_Send	Send a constant pulse train	
_8136_P_Stop	Stop pulse train	
_8136_P_Change_Speed	Change pulse train frequency	
_8136_P_Read_Index	Read index value	
_8136_P_Set_Index_Latch	Set index latch type	
_8136_P_Read_Latch_Value	Read a latched encoder data	
_8136_P_Set_Compare_Value	Set a encoder compare data	
_8136_P_Get_Stock_Count		
_8136_P_Set_Input_Logic		
Interrupt		Section 5.7
_8136_INT_Enable	Set interrupt event handler	
_8136_INT_Disable	Remove int. event handler	
_8136_S_Set_Int_Factor	Set interrupt factor	
_8136_S_INT_Control	Enable/disable interrupt	
_8136_S_Get_Int_Status	Get Int. status	

5.2 Initialization

@ Name

```
_8136_Initial – Software Initialize for PCI-8136
_8136_S_Close – Software release for PCI-8136
_8136_S_Get_IRQ_Channel - Get card's IRQ
_8136_S_Get_Base_Addr - Get card's base address
```

@ Description

`_8136_Initial`:

This function is used to initialize PCI-8136 card. User must use this function before any operation in the program. This function will tell the number of cards it finds.

`_8136_S_Close`:

This function is used to close PCI-8136 card. It releases the resources declared by the driver. User must use this function before the program ends.

`_8136_S_Get_IRQ_Channel`:

Although PCI-8136 is a PCI interface card, this function can be used to get the IRQ channel which is assigned by PCI BIOS. This value has no meaning when operating this card. It is only a part of PCI-8136's information

`_8136_S_Get_Base_Addr`

Although PCI-8136 is a PCI interface card, user can use this function to get the I/O Base Address which is assigned by PCI BIOS. This value has no meaning when operating this card. It is only a part of PCI-8136's information

@ Syntax

C/C++ (DOS, Windows 95/98/NT/2000)

```
I16 _8136_Initial(I16 *existCards);
I16 _8136_S_Close(I16 CardNo);
void _8136_S_Get_IRQ_Channel(I16 cardNo, U16
     *irq_no )
void _8136_S_Get_Base_Addr(I16 cardNo, U16
     *base_addr )
```

Visual Basic 5.0 or higher

```
B_8136_Initial (existCards As Integer) As Integer
B_8136_S_Close (ByVal CardNo As Integer) As
      Integer
B_8136_S_Get_IRQ_Channel(ByVal cardNo As Integer,
      irq_no As Integer)
B_8136_S_Get_Base_Addr(ByVal cardNo As Integer,
      base_addr As Integer )
```

@ Arguments

CardNo: card number designated to set (Range 0 - 3)

***existCards**: a return value to indicate how many cards are found

Irq_no: IRQ channel for this card, return value

Base_addr: Base Address for this card, return value

@ Return Code

```
ERR_RangeError
ERR_PCIBiosNotExist
ERR_NoError
```

5.3 System Parameters

@ Name

```
_8136_A_Set_DAC_Clk - Set DAC clock divider
_8136_A_Set_ADC_Clk -Set ADC clock divider
_8136_S_Set_Timer_Value - Set Timer click count
_8136_P_Set_Enc_Filter - Set encoder filter clock
```

@ Description

_8136_A_Set_DAC_Clk

There are 6 serial type DA channels in PCI-8136. This function is for settles the DAC transmission clock. Assign a clock divider number to change the DAC transmission rate. The maximum transmission clock is about 8.33 Mhz and the minimum is about 65Khz.

_8136_A_Set_ADC_Clk

There are 6 serial type AD channels in PCI-8136. This function settles the ADC transmission clock. Assign a clock divider number to change the DAC transmission rate. The maximum transmission clock is about 8.33 Mhz and the minimum is about 65 Khz.

_8136_S_Set_Timer_Value

There is a 24-bits counter in PCI-8136. This function settles the counter value and receives a fixed interrupt interval from this timer when the counting is finished. The timer clock rate is 33.3 Mhz. If user set the timer value to be 333000 then the interrupt interval will be 10ms.

_8136_P_Set_Enc_Filter

The encoder counter base clock is 33.3 Mhz. This function settles the encoder counter filter to fit the pulse rate from users. The maximum value for this filter is 127 and it means user's input pulse rate is smaller than 260 Khz.

@ Syntax

C/C++ (DOS, Windows 95/98/NT/2000)

```
I16 _8136_A_Set_DAC_Clk(I16 CardNo, I16
     Clk_Divider)
I16 _8136_A_Set_ADC_Clk(I16 CardNo, I16
     Clk_Divider)
I16 _8136_S_Set_Timer_Value(I16 CardNo,U32
     TimerValue)
I16 _8136_P_Set_Enc_Filter(I16 CardNo,I16 Filter)
```

Visual Basic 5.0 or higher

```
B_8136_A_Set_DAC_Clk(ByVal CardNo As Integer,
     ByVal  Clk_Divider As Integer) As Integer
B_8136_A_Set_ADC_Clk(ByVal CardNo As Integer,
     ByVal Clk_Divider As Integer ) As Integer
B_8136_S_Set_Timer_Value(ByVal CardNo As Integer
     , ByVal TimerValue As Long ) As Integer
B_8136_P_Set_Enc_Filter(ByVal CardNo As Integer,
     ByVal Filter As Integer) As Integer
```

@ Arguments

CardNo: card number designated to set (Range 0-3)

Clk_Divider: Set transmission clock divider (Range 0-127)

TimerValue: Set timer value (Range: 28 bits)

Filter: Set Filter sample clock divider (Range 0-127)

@ Return Code

```
ERR_RangeError
ERR_NoError
```

5.4 Digital I/O

@ Name

```
_8136_D_Output - Digital output for one bit
_8136_D_Input - Digital input for one bit
_8136_D_OutputA - Digital Output for all bits
     once
_8136_D_InputA - Digital Input for all bits once
```

@ Description

`_8136_D_Output`:

There are 7 open collector output channels in PCI-8136. This function controls these output bits by setting them on or off. This function can set each channel individually. Please refer to the pin assignment for bit numbers.

`_8136_D_Input`

There are 19 open isolated digital input channels in PCI-8136. This function retrieves these input bits by setting them on or off. This function can get each channel individually. Please refer to the pin assignment for bit numbers.

`_8136_D_OutputA`

There are 7 open collector output channels in PCI-8136. This function controls these output bits by setting them on or off. This function can set all output channels on/off by a value once. Each bit of this value represents the actual output bit. Please refer to the pin assignment for bit numbers.

`_8136_D_InputA`

There are 19 open isolated digital input channels in PCI-8136. This function retrieves these input bits by setting them on or off. This function can retrieve all input channels' status once. Each bit of this value represents the actual input channel. Please refer to the pin assignment for bit numbers.

@ Syntax

C/C++ (DOS, Windows 95/98/NT/2000)

```
U16 _8136_D_Output( I16 CardNo , I16 Channel ,
     I16 Control );
U16 _8136_D_Input( I16 CardNo , I16 Channel ,
     I16* Control );
U16 _8136_D_OutputA( I16 CardNo , I16 Value );
U16 _8136_D_InputA( I16 CardNo , I32 *Value );
```

Visual Basic 5.0 or higher

```
B_8136_D_Output(ByVal CardNo As Integer, ByVal
     Channe As Integer, ByVal Control As Integer)
     As Integer
B_8136_D_Input(ByVal CardNo As Integer, ByVal
     Channel As Integer, Control As Integer) As
     Integer
B_8136_D_OutputA (ByVal CardNo As Integer, ByVal
     Value As Integer) As Integer
B_8136_D_InputA(ByVal CardNo As Integer, Value As
     Long) As Integer
```

@ Argument

CardNo: card number designated to set (Range 0 - 3)

Channel: channel number designated to set (Range 0 - 6)

Control: control value for the designated channel (Range 0 - 1)

Value: control value for all digital output (Range 0 - 0x7f)

Control: return value for designated channel (Range 0 - 1)

Value: return value for all digital input (Range 0 - 0x7ffff)

@ Return Code

```
ERR_RangeError
ERR_NoError
```

5.5 Analog I/O

@ Name

```
_8136_A_Initial – Initialize ADC/DAC functions
     for PCI-8136
_8136_A_Write_Value - Output DAC in value
_8136_A_Write_Volt - Output DAC in voltage
_8136_A_Read_Value - Input from ADC in value
_8136_A_Read_Volt - Input from ADC in voltage
_8136_A_Output_Control - Start or stop DAC output
_8136_A_Set_Trigger - Set DAC output by trigger
_8136_A_Set_Trigger_Map - Select DAC trigger
     source
_8136_A_Set_Preload_Volt - Set DAC trigger output
     voltage
_8136_A_Set_Compare_Value - Set ADC compare value
_8136_A_Set_Compare_Volt - Set ADC compare
     voltage
```

@ Description

_8136_A_Initial:

This function enables serial ADC and DAC functions and sets the transmission clock divider. Tthis function must be used before using Analog IO.

_8136_A_Write_Value

This function generates a DC value from DAC channel. The DA converter resolution is 16-bits. The mapping value for 0 volt is 0x0000 , +10 volt is 0x7fff and –10 volt is 0x8000. There are six channels in one card. All channels are free to run individually.

_8136_A_Write_Volt

This function is for generating a DC value from DAC channel. The DA converter resolution is 16-bits. A voltage value can be assigned to this function directly. The voltage value range is–10.0 to +10.0. There are six channels in one card. All channels are free to run individually.

_8136_A_Read_Value

This function reads a digital value from ADC channel. . A word can be read from this function. The mapping value for 0V is 2000, +10V is 4000 and –10V is 0. There are six channels in one card. All channels are free to run individually.

_8136_A_Read_Volt

This function reads a voltage value from ADC channel. A voltage value can be read from this function directly. The range of the read-back voltage value is for –10.0V to +10.0V. There are six channels in one card. All channels are free to run individually.

_8136_A_Output_Control

This function will stop the outputting of any voltage from DA channel, and will immediately close DA channel. It can be open again by this function too.

_8136_A_Set_Trigger

This function enables/disables DA channel output by trigger source. The trigger source would be ADC comparator interrupt or encoder counter comparator interrupt.

_8136_A_Set_Trigger_Map

This function assigns each channel's trigger source. The trigger source is selected by one parameter. Each bit of this parameter represents one kind of trigger source. Bit 0-5 means trigger source is from encoder counter channel 0-5 and bit 8-13 means trigger source is from ADC channel 0-5. Set 1 is for enabling and 0 is for disabling.

_8136_A_Set_Preload_Volt

Once user set the DAC trigger function, the preload voltage must be set . When the trigger is active, the DAC channel will output this preload value.

_8136_A_Set_Compare_Value

This function is for DAC trigger output or simply for generating ADC comparator interrupt. When user wants to output a preload voltage which is triggered by ADC level, the trigger level must be set by this function. The range is from 0 to 4000.

_8136_A_Set_Compare_Volt

This function is for DAC trigger output or simply for generating ADC comparator interrupt. When user wants to output a preload voltage which is triggered by ADC level, the trigger level must be set by this function. The trigger level is set by ADC voltage with a range from –10.0 to 10.0.

@ Syntax

C/C++ (DOS, Windows 95/98/NT/2000)

```
I16 _8136_A_Initial(I16 CardNo)
I16 _8136_A_Write_Value(I16 CardNo, I16 Channel,
     I16 Value)
I16 _8136_A_Write_Volt(I16 CardNo, I16 Channel,
     F64 Volt)
I16 _8136_A_Read_Value(I16 CardNo, I16 Channel,
     I16 *Value)
I16 _8136_A_Read_Volt(I16 CardNo, I16 Channel,
     F32 *Volt)
I16 _8136_A_Output_Control(I16 CardNo, I16
     Channel, I16 Control)
I16 _8136_A_Set_Compare_Value(I16 CardNo, I16
     Channel, I16 Value)
I16 _8136_A_Set_Compare_Volt(I16 CardNo, I16
     Channel, F64 Volt)
I16 _8136_A_Set_Trigger_Map(I16 CardNo, I16
     Channel, I16 Source)
I16  _8136_A_Set_Trigger(I16 CardNo, I16 Channel,
     I16 Control)
I16 _8136_A_Set_Preload_Volt(I16 CardNo, I16
     Channel, F64 Volt)
```

Visual Basic 5.0 or higher

```
B_8136_A_Initial (ByVal CardNo As Integer) As
     Integer
B_8136_A_Write_Value (ByVal CardNo As Integer,
     ByVal Channel As Integer, ByVal Value As
     Integer) As Integer
B_8136_A_Write_Volt (ByVal CardNo As Integer,
     ByVal Channel As Integer, ByVal Volt As
     Single) As Integer
```

```
B_8136_A_Read_Value Lib (ByVal CardNo As Integer,
      ByVal Channel As Integer, Value As Integer)
      As Integer
B_8136_A_Read_Volt (ByVal CardNo As Integer,
      ByVal Channel As Integer, Volt As Double) As
      Integer
B_8136_A_Output_Control (ByVal CardNo As Integer,
      ByVal Channel As Integer, ByVal Control As
      Integer) As Integer
B_8136_A_Set_Compare_Value(ByVal CardNo As
      Integer, ByVal Channel As Integer, ByVal
      Value As Integer) As Integer
B_8136_A_Set_Compare_Volt (ByVal CardNo As
      Integer, ByVal Channel As Integer, ByVal
      Volt As Double) As Integer
B_8136_A_Output_Control (ByVal CardNo As Integer,
      ByVal Channel As Integer, ByVal Control As
      Integer) As Integer
B_8136_A_Set_Trigger_Map(ByVal CardNo As
      Integer,ByVal Channel As Integer, ByVal
      Source As Integer) As Integer
B_8136_A_Set_Trigger(ByVal CardNo As Integer,
      ByVal Channel As Integer, ByVal Control As
      Integer) As Integer
B_8136_A_Set_Preload_Volt(ByVal CardNo As
      Integer, ByVal Channel As Integer, ByVal
      Volt As Double) As Integer
```

@ Argument

CardNo: card number designated to set (Range 0 - 3)

Channel: channel number designated to set (Range 0 - 5)

Value: the output value for DAC channel (Range –32768 to +32767)

Volt: the output voltage for DAC channel (Range –10.0 - +10.0)

Value: the input value for ADC channel (Range 0 - 4000)

Volt: the input voltage for ADC channel (Range –10.0 - +10.0)

Control: enable or disable trigger (1 for enable/0 for disable)

Source: Set DAC trigger source

Value 0-5 is for encoder 0-5

Value 8-13 is for ADC channel 0-5

@ Return Code

```
ERR_RangeError
ERR_NoError
```

5.6 Pulse I/O

@ Name

```
_8136_P_Initial – Initialize pulse output engine
     and encoder counter
_8136_P_Set_Output_Type - Set pulse output mode
_8136_P_Set_Input_Type - Set pulse input mode
_8136_P_Read - Read encoder counter
_8136_P_Clear - Clear encoder counter
_8136_P_Send - Send a constant pulse train
_8136_P_Stop - Stop pulse train
_8136_P_Change_Speed - Change pulse train
     frequency
_8136_P_Read_Index - Read index value
_8136_P_Set_Index_Latch - Set index latch type
_8136_P_Read_Latch_Value - Read a latched encoder
     data
_8136_P_Set_Compare_Value - Set a encoder compare
     data
```

@ Description

_8136_P_Initial:

This function is for setting the encoder counter's clockand enabling pulse output functions. Tthis function must be used to enable pulse input and output.

_8136_P_Set_Output_Type:

There are 3 pulse output types in PCI-8136. This function is for configuring pulse output type by a value. Write a value 0 for pulse/ direction type. Write a value 1 for CW/CCW type. Write a value 2 for A/B phase type.

_8136_P_Set_Input_Type

There are 3 encoder counter input types in PCI-8136. This function is for configuring encoder counter input type. Write a value 0 for A/B phase type. Write a value 1 for CW/CCW type. Write a value 2 for pulse/direction type. When setting A/B phase type, the multiplier value must be assigned by this function.

_8136_P_Read

This function reads the 32-bits encoder counter value immediately. There are six encoder counters in one card. Assign the channel value 0-5 to read the encoder counter individually. There are three internal counters for receiving pulse output commands. When pulse output channel 0-2 is working, their output value will send to both CN1 and the internal feedback counter. These three command feedback counters are at channel 6-8. If the channel parameter of this function is assigned as the above three channels, it will read the command value at the same time.

_8136_P_Clear

This function clears the encoder counter value to zero immediately.

_8136_P_Send

This function sends a fixed frequency pulse train of each channel. It will output a pre-configured pulse format which is set by **P_Set_Output_Type**().

_8136_P_Stop

This function stops the output pulse for each channel.

_8136_P_Change_Speed

This function changes the output pulse frequency on line.

_8136_P_Read_Index

There are 6 index signal inputs in one PCI-8136. This function is for checking the index status on or off. Each bit of this status value represents an index status.

_8136_P_Set_Index_Latch

The index signal is also a trigger source for latching the respective encoder counter value. There are two modes for this latch. Set 0 to be first trigger latch and set 1 to be last trigger latch. First trigger latch means only trigger once and last trigger latch means latch every time if index signal comes.

`_8136_P_Read_Latch_Value`:

Once the encoder counter is latched, this function can retrieve the counter value at latched moment. It will not be clear until next index latched signal is coming.

`_8136_P_Set_Compare_Value`

There are 6 encoder counters in PCI-8136. Each encoder can set a compare value individually. This compare value is also a 32-bits value.

@ Syntax

C/C++ (DOS, Windows 95/98/NT/2000)

```
I16 _8136_P_Initial(I16 CardNo);
I16 _8136_P_Set_Output_Type(I16 CardNo, I16
     ChannelNo, I16 PulseFmt);
I16 _8136_P_Set_Input_Type(I16 CardNo, I16 EncNo,
     I16 EncFmt, I16 Mul);
I16 _8136_P_Read(I16 CardNo, I16 EncNo, I32
     *EncData);
I16 _8136_P_Send(I16 CardNo,I16 ChannelNo,F64
     FrqL);
I16 _8136_P_Stop(I16 CardNo,I16 ChannelNo);
I16 _8136_P_Clear(I16 CardNo, I16 EncNo);
I16 _8136_P_Set_Compare_Value(I16 CardNo,I16
     EncNo, I32 CompValue);
I16 _8136_P_Read_Latch_Value(I16 CardNo, I16
     EncNo, I32 *Value)
I16 _8136_P_Set_Index_Latch(I16 CardNo, I16
     WhichIndex, I16 Type);
I16 _8136_P_Read_Index(I16 CardNo, I16 AxisNo,
     I16 *Index);
I16 _8136_P_Change_Speed(I16 CardNo,I16
     AxisNo,F32 Frq);
```

Visual Basic 5.0 or higher

```
B_8136_P_Initial (ByVal CardNo As Integer) As
     Integer
B_8136_P_Initial (ByVal CardNo As Integer) As
     Integer
```

```
B_8136_P_Set_Output_Type (ByVal CardNo As
      Integer, ByVal AxisNo As Integer, ByVal
      PulseFmt As Integer) As Integer
B_8136_P_Set_Input_Type (ByVal CardNo As Integer,
      ByVal EncNo As Integer, ByVal EncFmt As
      Integer, ByVal Mul As Integer) As Integer
B_8136_P_Read (ByVal CardNo As Integer, ByVal
      EncNo As Integer, EncData As Long) As
      Integer
B_8136_P_Send (ByVal CardNo As Integer, ByVal
      AxisNo As Integer, ByVal FrqL As Double) As
      Integer
B_8136_P_Stop (ByVal CardNo As Integer, ByVal
      AxisNo As Integer) As Integer
B_8136_P_Clear (ByVal CardNo As Integer, ByVal
      EncNo As Integer) As Integer
B_8136_P_Set_Compare_Value (ByVal CardNo As
      Integer, ByVal EncNo As Integer, ByVal
      CompValue As Long) As Integer
B_8136_P_Read_Latch_Value(ByVal CardNo As
      Integer, ByVal EncNo As Integer, Value As
      Long) As Integer
B_8136_P_Set_Index_Latch (ByVal CardNo As
      Integer, ByVal WhichIndex As Integer, ByVal
      LatchType As Integer) As Integer
B_8136_P_Read_Index (ByVal CardNo As Integer,
      ByVal AxisNo As Integer, Index As Integer)
      As Integer
B_8136_P_Change_Speed (ByVal CardNo As Integer,
      ByVal AxisNo As Integer, ByVal Frq As
      Single) As Integer
```

@ Argument

CardNo: card number designated to set (Range 0 - 3)

ChannelNo: channel number designated to set (Range 0 - 5)

EncNo: encoder channel number designated to set (Range 0 - 5)

PulseFmt: Output pulse format

0 = Pulse/Direction

1 = CW/CCW

2 = A/B Phase

EncFmt: Input pulse format:

0 = A/B Phase

1 = CW/CCW

2 = Pulse/Direction

Mul: for A_B type's mutiplier

0 = 0X A_B Phase

1 = 1X A_B Phase

2 = 2X A_B Phase

3 = 4X A_B Phase

EncData: read back encoder data

FrqL: Pulse output frequency (Range 0-500k Hz)

CompValue: Encoder Compare Value

***Index**: Index Status (0 or 1)

Type: two trigger latch mode: 0 for first trigger, 1 for last trigger

WhichIndex: select index no. (0-5)

Frq: Pulse output frequency for change (Range 0-500kHz)

@ Return Code

```
ERR_RangeError
ERR_PCIBiosNotExist
ERR_NoError
```

5.7 Interrupt

@ Name

```
_8136_INT_Enable - Set interrupt event
     handler(WINDOWS ONLY)
_8136_INT_Disable - Remove int. event
     handler(WINDOWS ONLY)
_8136_S_Set_Int_Factor - Set interrupt factor
_8136_S_INT_Control - Enable/disable interrupt
_8136_S_Get_Int_Status - Get Int. status
_8136_Callback_Function - Set a call back
     function for int
```

@ Description

_8136_INT_Enable

This function is only for Windows system. It allocates interrupt events in Windows system for passing message to application from kernel.

_8136_INT_Disable

This function is only for Windows system. It clear event resources which is allocated by INT_Enable() function.

_8136_S_Set_Int_Factor

This function settles the interrupt source for each channel. Every channel has 6 types of interrupt that can be set. It includes four digital input interrupt, index interrupt, encoder compare interrupt, timer interrupt, and voltage compare interrupt.

_8136_S_INT_Control

This function controls the hardware interrupt pin. The interrupt won't come if this function hasn't been used.

_8136_S_Get_Int_Status

This function must be used to check the interrupt types. There are 6 types of interrupt at one interrupt event. Sometimes two inpter-rupts will come at once, it is important that each interrupt is checked individually in order to prevent the loss of any interrupt events.

_8136_Callback_Function

This function can set a user-defined function to be an ISR. When one interrupt comes, this user-defined function will wake up. This function should be dealt with carefully, and not too much time should be spent on it.

@ Syntax

C/C++ (DOS, Windows 95/98/NT/2000)

```
U16_8136_INT_Enable(I16 CardNo, HANDLE *phEvent);
     (Windows Only)
U16 _8136_INT_Disable(I16 CardNo);  (Windows
     Only)
void _8136_S_INT_Control(I16 CardNo, U16 intFlag
     )
U16 _8136_S_Set_Int_Factor(I16 CardNo, I16
     ChannelNo, U16 IntFactor,OptionType)
U16 _S_Get_Int_Status(I16 CardNo,I16 AxisNo,U16
     *IntStatus)
void _8136_Callback_Function(I16 CardNo,void
     *callbackAddr(I16 AxisNo, U16 IntSts))
```

Visual Basic 5.0 or higher

```
B_8136_INT_Enable (ByVal card_number As Integer,
     phEvent As Long) As Integer
B_8136_INT_Disable (ByVal card_number As Integer)
     As Integer
B_8136_S_INT_Control (ByVal CardNo As Integer,
     ByVal intFlag As Integer)
B_8136_S_Set_Int_Factor (ByVal CardNo As Integer,
     ByVal AxisNo As Integer, ByVal IntFactor As
     Integer, ByVal OptionType As Integer) As
     Integer
B_8136_S_Get_Int_Status (ByVal CardNo As Integer,
     ByVal AxisNo As Integer, IntStatus As Long)
     As Integer
B_8136_Callback_Function (ByVal CardNo As
     Integer, ByVal lpCallBackProc As Long) As
     Integer
```

@ Arguments

`CardNo`: card number designated to set (Range 0 - 3)

`ChannelNo`: channel number designated to set (Range 0 - 5)

`*phEvent`: event handler array contains 7 handler for each card in Windows interrupt system

`*existCards`: a return value to indicate how many cards are found

`intFlag`: enable or disable interrupt signal (Range 0-1)

`intFactor`: enable or disable interrupt for each type in each bit:

bit0: Limit switch on

bit1: Emergency stop on

bit2: Home switch on

bit3: Index signal on

bit4: Encoder value compared

bit5: Timer interrupt

bit6: ADC pre-load value reached

`*IntStatus`: Read the interrupt status of one axis. To adjudge which interrupt is coming.

bit0: Positive Limit switch on

bit1: Minus Limit switch on

bit2: Emergency stop on

bit3: Home switch on

bit4: Index signal on

bit5: Encoder value compared

bit6: Timer interrupt

bit7: ADC pre-load value reached

`OptionType`: Set ADC compare direction

1 = Rising Direction

2 = Falling Driection

3 = Both Direction

`*callbackAddr(I16 AxisNo, U16 IntSts)`: function pointer type

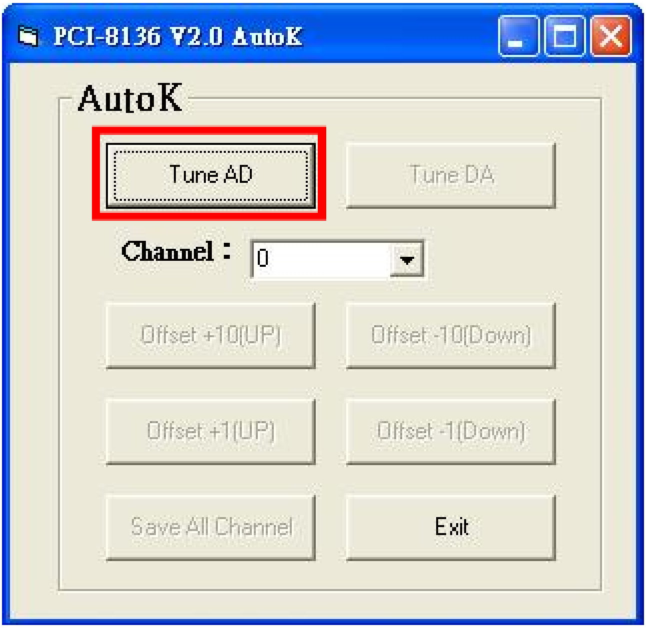
@ Return Code

```
ERR_RangeError
ERR_NoError
```

6 Appendix

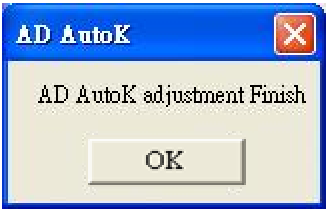
6.1 Auto Calibration Utility

1. Execute the utility under c:\program file\adlink\pci-8136\utility.
2. Connect all AD channel to ground.

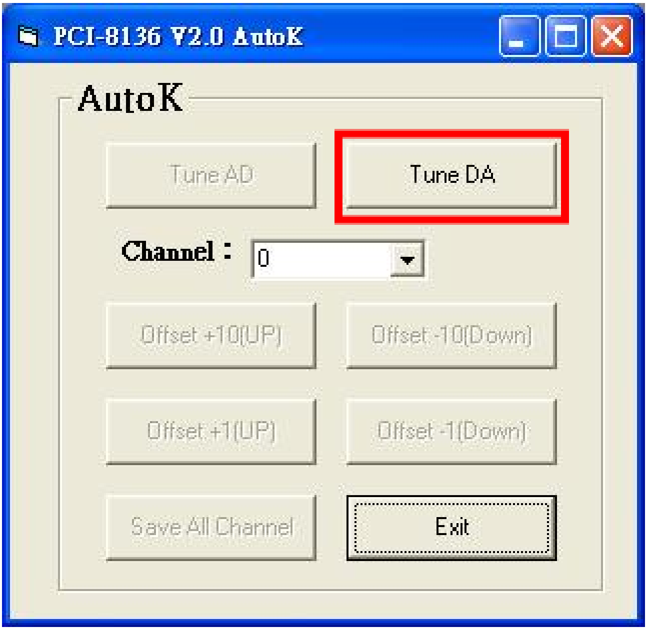


3. It will remind you when you press “Tune AD” button.

4. After a minute a message will show that the adjustment is complete.



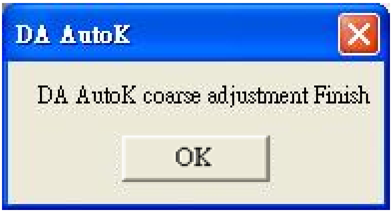
5. Connect all DA channels to AD channels one by one then press “Tune DA” button.



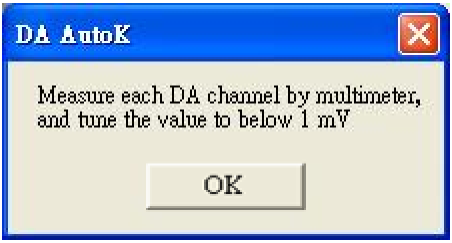
6. It will remind you to connect the AD channel to DA chan-

nel one by one.

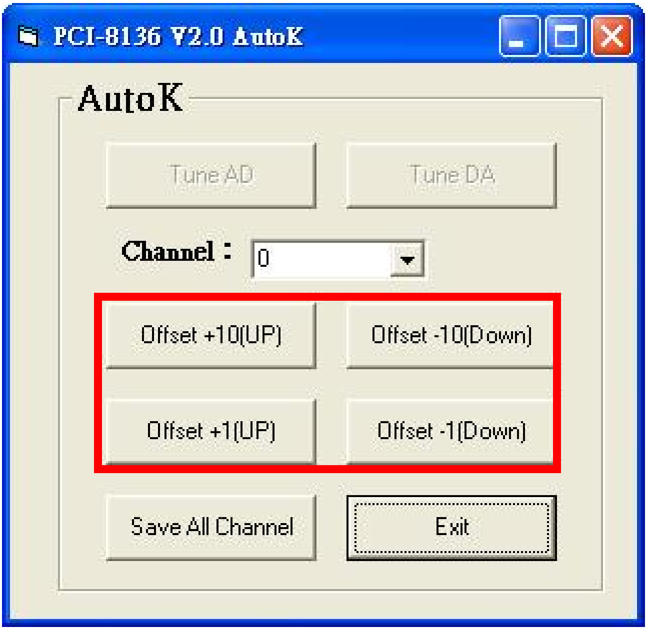
7. After a minute a messge will show that the adjustment is complete.



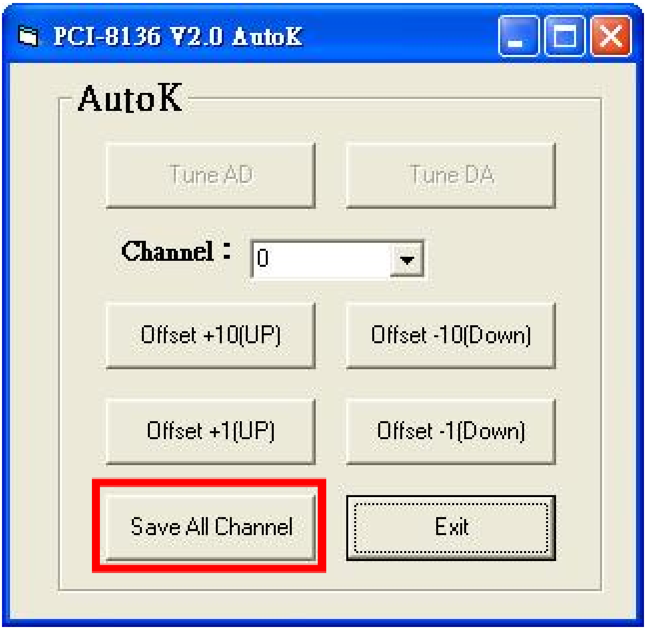
8. Please use multimeter to do measure and adjust.



9. Use the 4 buttons outlined below to do fine adjustments. Please use “Channel” item box to change DA channel.



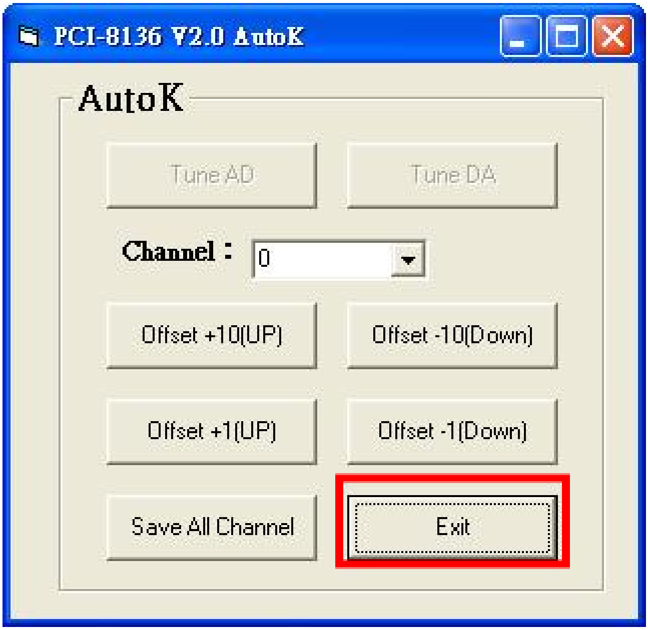
10.Please press “Save All Channel” to save parameter.



11. You will be asked if you would like to save the adjustment value. 11.

12.A save finish window will appear.

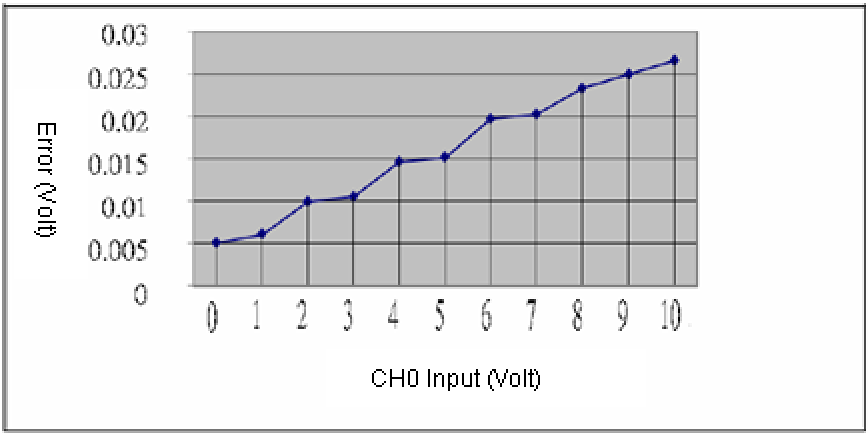
13.Press “Exit” button to exit utility.



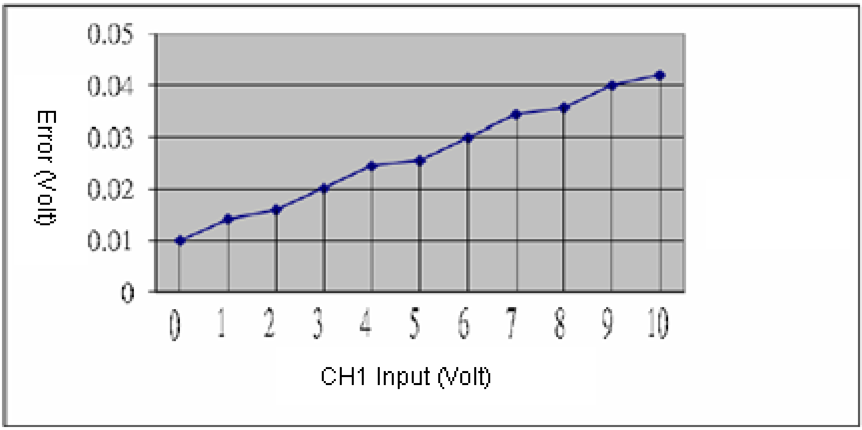
6.2 Analog Output Error Test

This appendix is a reference for error values and their analog output. The error value depends on your card.

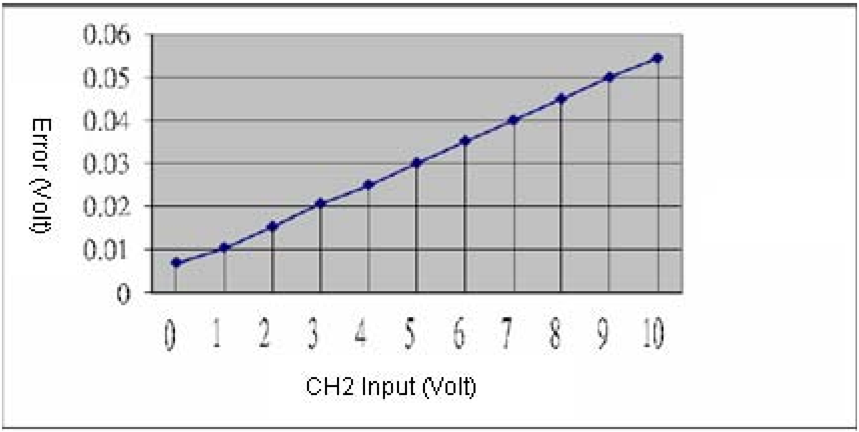
Channel 0



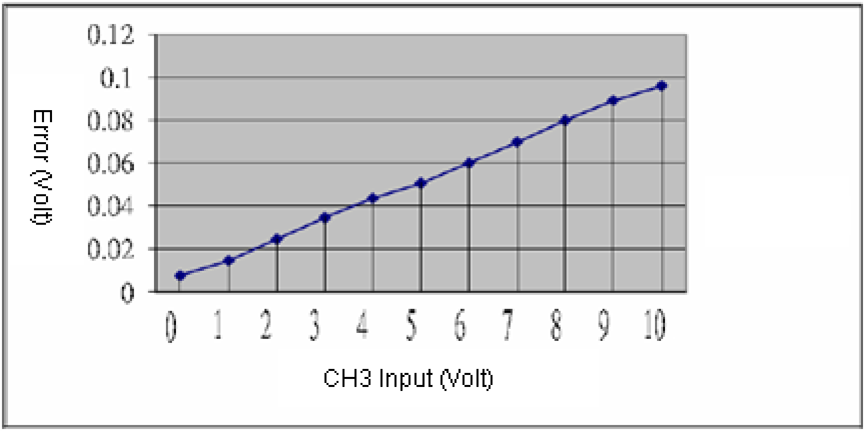
Channel 1



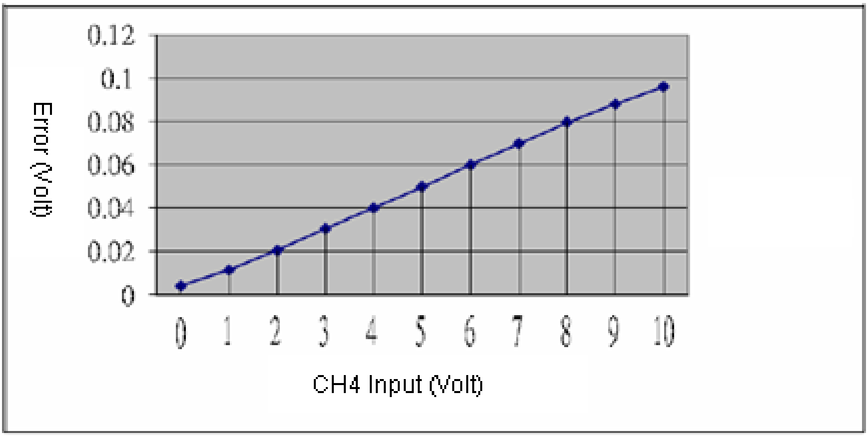
Channel 2



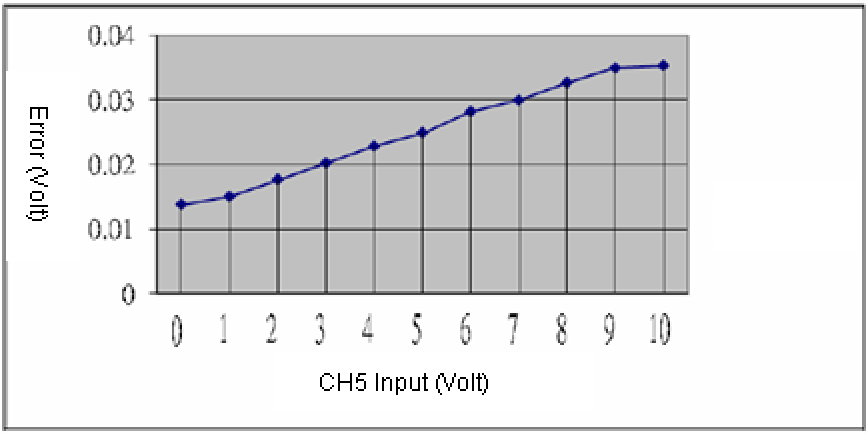
Channel 3



Channel 4



Channel 5



Warranty Policy

Thank you for choosing ADLINK. To understand your rights and enjoy all the after-sales services we offer, please read the following carefully.

1. Before using ADLINK's products please read the user manual and follow the instructions exactly. When sending in damaged products for repair, please attach an RMA application form which can be downloaded from: http://rma.adlinktech.com/policy/.
2. All ADLINK products come with a limited two-year warranty, one year for products bought in China:
   - The warranty period starts on the day the product is shipped from ADLINK's factory.
   - Peripherals and third-party products not manufactured by ADLINK will be covered by the original manufacturers' warranty.
   - For products containing storage devices (hard drives, flash cards, etc.), please back up your data before sending them for repair. ADLINK is not responsible for any loss of data.
   - Please ensure the use of properly licensed software with our systems. ADLINK does not condone the use of pirated software and will not service systems using such software. ADLINK will not be held legally responsible for products shipped with unlicensed software installed by the user.
   - For general repairs, please do not include peripheral accessories. If peripherals need to be included, be certain to specify which items you sent on the RMA Request & Confirmation Form. ADLINK is not responsible for items not listed on the RMA Request & Confirmation Form.

3. Our repair service is not covered by ADLINK's guarantee in the following situations:
   - Damage caused by not following instructions in the User's Manual.
   - Damage caused by carelessness on the user's part during product transportation.
   - Damage caused by fire, earthquakes, floods, lightening, pollution, other acts of God, and/or incorrect usage of voltage transformers.
   - Damage caused by unsuitable storage environments (i.e. high temperatures, high humidity, or volatile chemicals).
   - Damage caused by leakage of battery fluid during or after change of batteries by customer/user.
   - Damage from improper repair by unauthorized ADLINK technicians.
   - Products with altered and/or damaged serial numbers are not entitled to our service.
   - This warranty is not transferable or extendible.
   - Other categories not protected under our warranty.
4. Customers are responsible for shipping costs to transport damaged products to our company or sales office.
5. To ensure the speed and quality of product repair, please download an RMA application form from our company website: http://rma.adlinktech.com/policy. Damaged products with attached RMA forms receive priority.

If you have any further questions, please email our FAE staff: service@adlinktech.com.