

NuIPC[®] / NuDAQ[®]
743X Series
64-CH Isolated Digital I/O Board
User' s Guide

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Questions			
Product Model			
Environment to Use	OS _____ Computer Brand _____ M/B : CPU : Chipset : Bios : Video Card : Network Interface Card : Other :		
Challenge Description			
Suggestions for ADLINK			

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How to Use This Guide

This manual is designed to help you use the 743X series products. It describes how to modify and control various functions on the 743X card to meet your requirements. It is divided into four chapters:

- **Chapter 1**, "Introduction", gives an overview of the product features, applications, and specifications.
- **Chapter 2**, "Installation", describes how to install the board. The layout of PCB is shown, the connectors specifications, and the notes for installation are described.
- **Chapter 3**, "Register Format and Operation", describes details on-board register format and the details about the operation of DIO. It is very useful to understand the lowest level of controlling the boards.
- **Chapter 4**, "C/C++ Library", describes the functions in the DOS C/C++ Library and Windows 95 DLL.

Introduction

The 743X series products are 64-CH high-density isolated digital input and/or output products. The 743X series products include the following cards which are in different form factor.

The following items are for PCI bus products:

- PCI-7432: Isolated 32-CH DI and 32-CH DO card
- PCI-7433: Isolated 64-CH DI card
- PCI-7434: Isolated 64-CH DO card

The following items are for 3U CompactPCI products:

- cPCI-7432 : Isolated 32-CH DI and 32-CH DO
- cPCI-7433 : Isolated 64-CH DI card
- cPCI-7434 : Isolated 64-CH DO card with common ground configuration
- cPCI-7434P: Isolated 64-CH DO card with common power configuration

The following items are for 3U CompactPCI with rear I/O:

- cPCI-7433R :Isolated 64-CH DI card
- cPCI-7434R :Isolated 64-CH DO card with common ground configuration
- cPCI-7434RP:Isolated 64-CH DO card with common power configuration

The above I/O cards are isolated up-to 5000 Vdc (excluding cables) for channel-to-computer isolation. It protects your computer against damage caused by accidental contact with high external voltage and eliminates troublesome ground loops.

The 743X series products use PCI-9050 PCI controller to interface the board to the PCI bus. The PCI-9050 fully implements the PCI local bus specification Rev 2.1. All bus relative configurations, such as base memory and interrupt assignment, are automatically controlled by BIOS software.

1.1 Features

The PCI-743X Isolated D/I cards provide the following advanced features:

PCI bus	PCI-7432	PCI-7433	PCI-7434
3U CompactPCI	cPCI-7432	cPCI-7433	cPCI-7434 cPCI-7434P
3U CompactPCI with Rear I/O	--	cPCI-7433R	cPCI-7434R cPCI-7434RP
32 Isolated Digital Input / Output Channels	√	--	--
64 Isolated Digital Input Channels	--	√	--
64 Isolated Digital Output Channels	--	--	√
High output driving capability	√	--	√
500mA sink current on isolated output channels	√	--	√
5000 Vrms high voltage isolation	√	√	√
Up to 24V voltage protection for isolated input	√	√	--
External interrupt signal on DI channels	√	√	--
Dual interrupt trigger	√	√	--
100-pin SCSI-II connector	√	√	√

1.2 Applications

- Laboratory and Industrial automation
- Watchdog timer
- Event counter
- Frequency counter and generator
- Low level pulse generator
- Time delay

1.3 Specifications

** Optical Isolated Input Channel

Numbers of Channel: 32 digital inputs for 7432
64 digital inputs for 7433

Input Voltage: 0 - 24V dc

- Logic H: 3~24V
- Logic L: 0~2.4V

Input resistance: 2.4K Ω @ 0.5W

Isolated voltage: 5000 Vrms

Throughput: 10K Hz (0.1 ms)

** Optical Isolated Output Channel

Numbers of Channel: 32 digital outputs for 7432
64 digital outputs for 7434

Output type: Darlington transistors with common ground
(7432, PCI/cPCI-7434, cPCI-7434R)

Output voltage: 5V_{DC} min, 35V_{DC} maximum

Output Device: TD62083(common ground)
TD62783(common power)

Sink Current:

- Max. 500mA/ch for only one of the TD62083 transistor is ON
- 347mA/ch for all of the TD62083 transistors are ON @ 10% duty

Power Dissipation: 1.47W per TD62083 device (8 channels)

Isolated voltage: 5000 V_{DC}

Throughput: 10K Hz(0.1 ms)

** Interrupt Sources (for 7432 and 7433)

Channel 0 and channel 1 of digital input channels

** General Specifications

- **Connector:** 100-pin SCSI-II connector
- **Operating temperature:** 0°C ~ 60°C
- **Storage temperature:** -20°C ~ 80°C
- **Humidity:** 5 ~ 95%, non-condensing
- **Power Consumption:**
 - PCI-7432: +5V @ 530 mA typical
 - PCI-7433: +5V @ 500 mA typical
 - PCI-7434: +5V @ 560 mA typical
 - cPCI-7432[R]: +5V @ 530 mA typical

- cPCI-7433[R]: +5V @ 500 mA typical
- cPCI-7434[R][P]: +5V @ 560 mA typical
- **Dimension:**
 - PCI-7432/33/34: Compact size only 98mm(H) X 173mm(L)
 - cPCI-7432/33/34: Standard 3U CompactPCI form factor
 - cPCI-7433R/34R: Standard 3U CompactPCI form factor with rear I/O

1.4 Software Supporting

ADLink provides versatile software drivers and packages for users' different approach to built-up a system. We not only provide programming library such as DLL for many Windows systems, but also provide drivers for many software package such as LabVIEW[®], HP VEE[™], DASLab[™], InTouch[™], InControl[™], ISaGRAF[™], and so on.

All the software options are included in the ADLink CD. The non-free software drivers are protected with serial licensed code. Without the software serial number, you can still install them and run the demo version for two hours for demonstration purpose. Please contact with your dealer to purchase the formal license serial code.

1.4.1 Programming Library

For customers who are writing their own programs, we provide function libraries for many different operating systems, including:

- ◆ DOS Library: Borland C/C++ and Microsoft C++, the functions descriptions are included in this user' s guide.
- ◆ Windows 95 DLL: For VB, VC++, Delphi, BC5, the functions descriptions are included in this user' s guide.
- ◆ PCIS-DASK: Include device drivers and DLL for Windows 98, Windows NT and Windows 2000. DLL is binary compatible across Windows 98, Windows NT and Windows 2000. That means all applications developed with PCIS-DASK are compatible across Windows 98, Windows NT and Windows 2000. The developing environment can be VB, VC++, Delphi, BC5, or any Windows programming language that allows calls to a DLL. The user' s guide and function reference manual of PCIS-DASK are in the CD. Please refer the PDF manual files under \\Manual_PDF\Software\PCIS-DASK

The above software drivers are shipped with the board. Please refer to the "Software Installation Guide" to install these drivers.

1.4.2 PCIS-LVIEW: LabVIEW[®] Driver

PCIS-LVIEW contains the VIs, which are used to interface with NI's LabVIEW[®] software package. The PCIS-LVIEW supports Windows 95/98/NT/2000. The LabVIEW[®] drivers are free shipped with the board. You can install and use them without license. For detail information about PCIS-LVIEW, please refer to the user's guide in the CD. (\\Manual_PDF\Software\PCIS-LVIEW)

1.4.3 PCIS-VEE: HP-VEE Driver

The PCIS-VEE includes the user objects, which are used to interface with HP VEE software package. PCIS-VEE supports Windows 95/98/NT. The HP-VEE drivers are free shipped with the board. You can install and use them without license. For detail information about PCIS-VEE, please refer to the user's guide in the CD. (\\Manual_PDF\Software\PCIS-VEE)

1.4.4 DAQBench[™]: ActiveX Controls

We suggest the customers who are familiar with ActiveX controls and VB/VC++ programming use the DAQBench[™] ActiveX Control components library for developing applications. The DAQBench[™] is designed under Windows NT/98. For more detailed information about DAQBench, please refer to the user's guide in the CD. (\\Manual_PDF\Software\DAQBench\DAQBench Manual.PDF)

1.4.5 PCIS-DDE: DDE Server and InTouch[™]

DDE stands for Dynamic Data Exchange specifications. The PCIS-DDE includes the PCI cards' DDE server. The PCIS-DDE server is included in the ADLINK CD. It needs license. The DDE server can be used conjunction with any DDE client under Windows NT.

1.4.6 PCIS-ISG: ISaGRAF[™] driver

The ISaGRAF WorkBench is an IEC1131-3 SoftPLC control program development environment. The PCIS-ISG includes ADLink products' target drivers for ISaGRAF under Windows NT environment. The PCIS-ISG is included in the ADLINK CD. It needs license.

1.4.7 PCIS-ICL: InControl[™] Driver

PCIS-ICL is the InControl driver which support the Windows NT. The PCIS-ICL is included in the ADLINK CD. It needs license.

1.4.8 PCIS-OPC: OPC Server

PCIS-OPC is an OPC Server, which can link with the OPC clients. There are many software packages on the market can provide the OPC clients now. The PCIS-OPC supports the Windows NT. It needs license.

2

Installation

This chapter describes how to install the 743X products. Please follow the follow steps to install the PCI-6308 family products.

- ◆ Check what you have (section 2.1)
- ◆ Unpacking (section 2.2)
- ◆ Check the PCB (section 2.3)
- ◆ Install the hardware (section 2.4)
- ◆ Install the software drivers and run utility to test (section 2.5)
- ◆ Cabling with external devices (section 2.6)

2.1 What You Have

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

- 743X Board
- ADLINK CD
- Software Installation Guide
- Rear I/O transition board (DB-100RU) for cPCI-743XR rear I/O version only

If any of these items is missing or damaged, contact the dealer from whom you purchased the product. Save the shipping materials and carton in case you want to ship or store the product in the future.

2.2 Unpacking

Your PCI-7432/33/34 card contains sensitive electronic components that can be easily damaged by static electricity.

The card should be done on a grounded anti-static mat. The operator should be wearing an anti-static wristband, grounded at the same point as the anti-static mat.

Inspect the card module carton for obvious damage. Shipping and handling may cause damage to your module. Be sure there are no shipping and handling damages on the module before processing.

After opening the card module carton, extract the system module and place it only on a grounded anti-static surface component side up.

Again inspect the module for damage. Press down on all the socketed IC's to make sure that they are properly seated. Do this only with the module place on a firm flat surface.

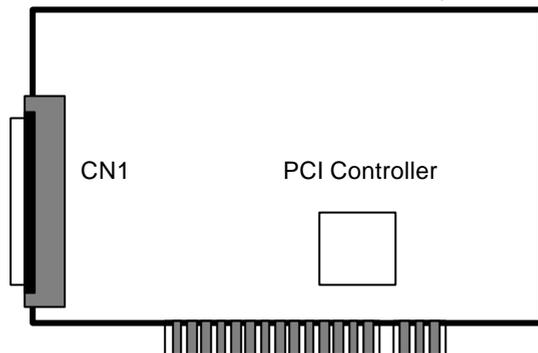
Note : DO NOT APPLY POWER TO THE CARD IF IT HAS BEEN DAMAGED.

Now you are ready to install your 743X card.

2.3 PCB Layout

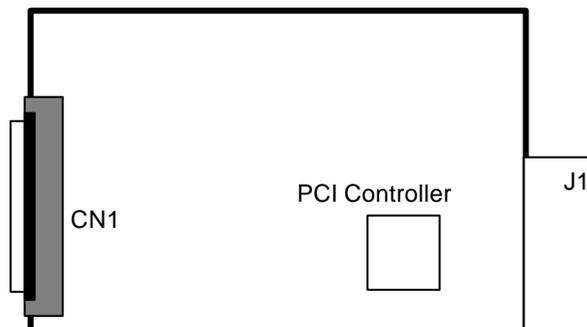
2.3.1 PCI-743X PCB Layout

The CN1 is for the I/O interface. It is a 100-pin SCSI-type connector.



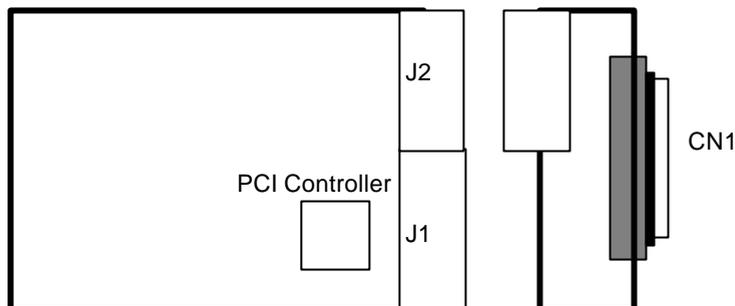
2.3.2 cPCI-743X PCB Layout

The CN1 is for the I/O interface. It is a 100-pin SCSI-type connector.



2.3.3 cPCI-743XR PCB Layout

The CN1 is for the I/O interface. It is a 100-pin SCSI-type connector. The J2 is for rear I/O signal. There is no connector on the main board.



2.4 Hardware Installation Outline

PCI configuration

The PCI cards (or CompactPCI cards) are equipped with plug and play PCI controller, it can request base addresses and interrupt according to PCI standard. The system BIOS will install the system resource based on the PCI cards' configuration registers and system parameters (which are set by system BIOS). Interrupt assignment and memory usage (I/O port locations) of the PCI cards can be assigned by system BIOS only. These system resource assignments are done on a board-by-board basis. It is not suggested to assign the system resource by any other methods.

PCI slot selection

The PCI card can be inserted to any PCI slot without any configuration for system resource. Please note that the PCI system board and slot must provide bus-mastering capability to operate this board well.

Installation Procedures

1. Turn off your computer
2. Turn off all accessories (printer, modem, monitor, etc.) connected to your computer.
3. Remove the cover from your computer.
4. Setup jumpers on the PCI or CompactPCI card.
5. Select a 32-bit PCI slot. PCI slot are short than ISA or EISA slots, and are usually white or ivory.
6. Before handling the PCI cards, discharge any static buildup on your body by touching the metal case of the computer. Hold the edge and

- do not touch the components.
7. Position the board into the PCI slot you selected.
 8. Secure the card in place at the rear panel of the system.

For cPCI-743X (both with and without rear I/O) products,

1. Read through this manual, and setup the jumper according to your application.
2. Turn off your computer and turn off all accessories (printer, modem, monitor, etc.) connected to computer.
3. Remove the cover from the slot of your cPCI computer.
4. Select a 32-bit cPCI expansion slot on the back plane for cPCI-743X products.
5. Before handling the cPCI-743X products, 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 cPCI slot you selected.
7. Secure the card on the back plane by using screw removed from the slot.

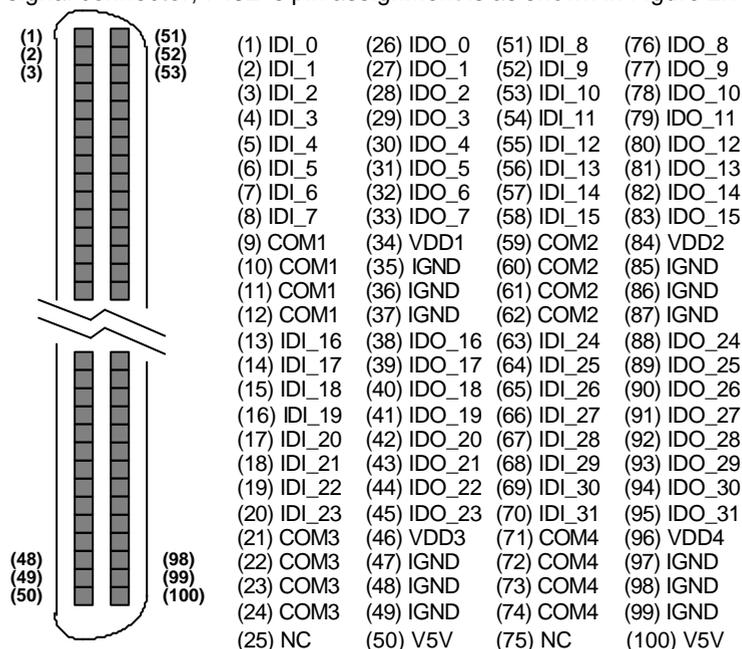
CAUTION!! Don't put cPCI-743XR (rear I/O) cards into the cPCI back plane of other manufacturers because the rear I/O definition might be different, and permanent damage could happen.

2.5 Device Installation for Windows Systems

Once Windows 95/98/2000 has started, the Plug and Play function of Windows system will find the new NuDAQ/NuIPC cards. If this is the first time to install NuDAQ/NuIPC cards in your Windows system, you will be informed to input the device information source. Please refer to the "**Software Installation Guide**" for the steps of installing the device.

2.6 Connector Pin Assignment of cPCI/PCI-7432

The pin assignment of the 100 pins SCSI-II connector is an isolated signal connector, 7432's pin assignment is as shown in Figure 2.7.



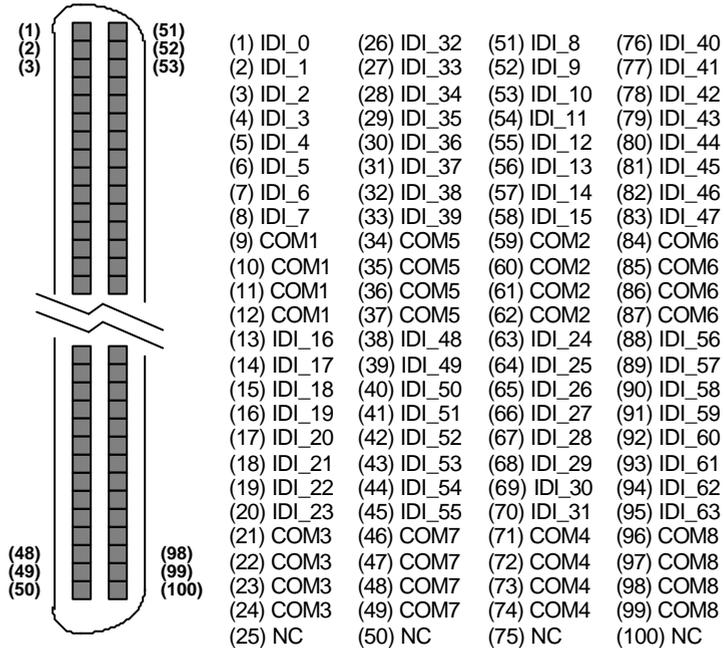
Legend:

- IDI_n** : Isolated digital input channel #n
- IDO_n** : Isolated digital output channel #n
- VDD_m** : Common pin of output channel group #m
(VDD1 is common pin of isolated output channel #0-7, VDD2 is common pin of isolated output channel #8-15, and so on.)
- IGND** : Ground return path of isolated output channels
- COM_m** : Common junction of isolated input channel group #m
(COM1 is common junction of input channel #0-7, COM2 is common junction of input channel #8-15, COM3 is common junction of input channel #16-23, and so on.)
- V5V** : Onboard un-regulated 5V power supply output

Figure 2.7. Pin Assignment of 7432 Connector CN1

2.7 Connector Pin Assignment of cPCI/PCI-7433

The pin assignment of the 100 pins SCSI-II connector is an isolated signal connector, 7433's pin assignment is as shown in Figure 2.8.



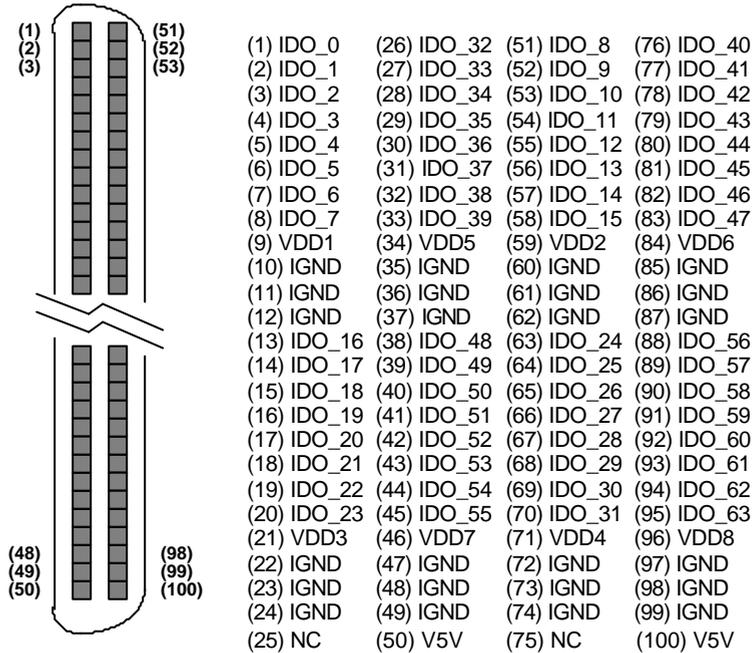
Legend:

- IDL_n** : Isolated digital input channel #n
COM_m : Common junction of isolated input channel group #m
 (COM1 is common junction of input channel #0~7, COM2 is common junction of input channel #8~15, COM3 is common junction of input channel #16~23, and so on.)

Figure 2.8. Pin Assignment of 7433 Connector CN1

2.8 Connector Pin Assignment of PCI-7434

The pin assignment of the 100 pins SCSI-II connector is an isolated signal connector, PCI-7434's pin assignment is as shown in Figure 2.9.



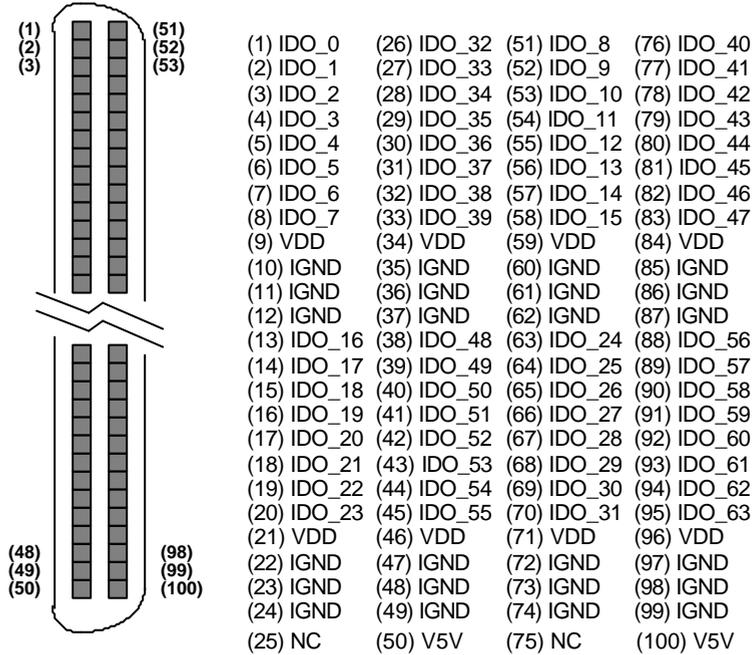
Legend:

- IDO_n** : Isolated digital output channel #n
- IGND** : Ground return path of isolated output channels
- VDD_m** : Common pin of isolated output channel group #m
(VDD1 is the common pin of isolated output channel #0~7, VDD2 is for channel #8~15, VDD3 is for channel #16~23, VDD4 is for channel #24~31, VDD5 is for channel #32~39, VDD6 is for channel #40~47, VDD7 is for channel #48~55, VDD8 is for channel #56~63)
- V5V** : Onboard un-regulated 5V power supply output

Figure 2.9. Pin Assignment of PCI-7434 Connector CN1

2.9 Connector Pin Assignment of cPCI-7434[R]

Since cPCI-7434[R]'s pin assignment is as shown in Figure 2.10.



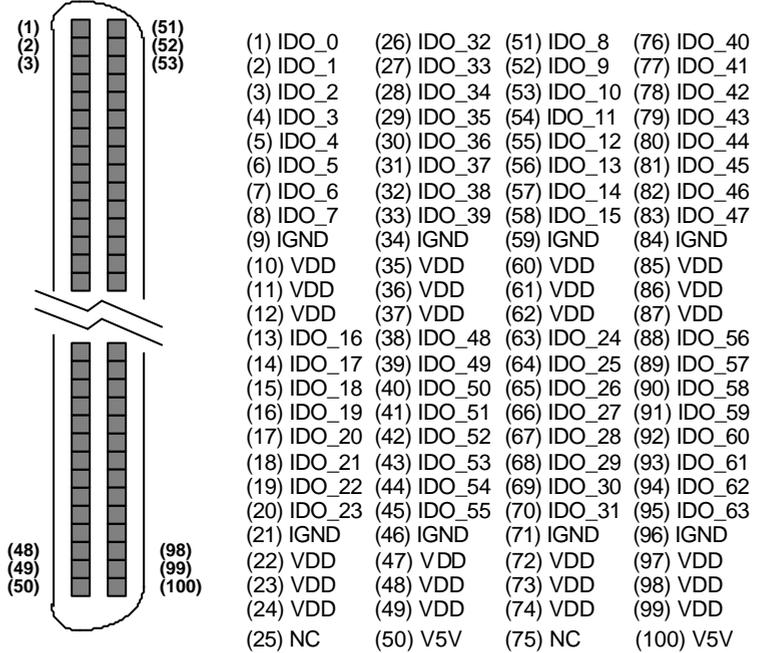
Legend:

- IDO_n** : Isolated digital output channel #n
- IGND** : Ground return path of isolated output channels
- VDD** : Common pin of isolated output channel group #m
(Note: All outputs share the same power supply)
- V5V** : Onboard un-regulated 5V power supply output

Figure 2.10. Pin Assignment of cPCI-7434[R] Connector CN1

2.10 Connector Pin Assignment of cPCI-7434[R]P

Since cPCI-7434[R]P' s pin assignment is as shown in Figure 2.11.



Legend:

- IDO_n** : Isolated digital output channel #n
- IGND** : Ground return path of isolated output channels
- VDD** : Common pin of isolated output channel group #m
(Note: All outputs share the same power supply)
- V5V** : Onboard un-regulated 5V power supply output

Figure 2.11. Pin Assignment of cPCI-7434[R]P Connector CN1

Registers Format

The detailed descriptions of the registers format are specified in this chapter. This information is quite useful for the programmers who wish to handle the card by low-level programming. However, we suggest user have to understand more about the PCI interface then start any low-level programming. In addition, the contents of this chapter can help users understand how to use software driver to manipulate this card.

3.1 PCI PnP Registers

This PCI card functions as a 32-bit PCI target device to any master on the PCI bus. There are three types of registers: PCI Configuration Registers (PCR), Local Configuration Registers (LCR) and PCI-6308 registers.

The PCR, which is compliant to the PCI-bus specifications, is initialized and controlled by the plug & play (PnP) PCI BIOS. User' s can study the PCI BIOS specification to understand the operation of the PCR. Please contact with PCISIG to acquire the specifications of the PCI interface.

The PCI bus controller PCI-9050 is provided by PLX technology Inc. (www.plxtech.com). For more detailed information of LCR, please visit PLX technology' s web site to download relative information. It is not necessary for users to understand the details of the LCR if you use the software library. The PCI PnP BIOS assigns the base address of the LCR. The assigned address is located at offset 14h of PCR.

The PCI-6308 registers are shown in the next section. The base address, which is also assigned by the PCI PnP BIOS, is located at offset 18h of PCR. Therefore, users can read the 18h of PCR to know the base address by using the BIOS function call.

Please do not try to modify the base address and interrupt which assigned by the PCI PnP BIOS, it may cause resource confliction in your system.

3.2 I/O Address Map

The 743X board registers are in 32-bit width. The users can access these registers by only 32-bit I/O instructions. The following tables show the address map, including descriptions and their offset addresses relative to the base address.

	Address	Write	Read
PCI-7432 cPCI-7432	Base + 0x00	32-bit Isolated DO	32-bit Isolated DI
	Base + 0x40	Clear IRQ	--

	Address	Write	Read
PCI-7433 cPCI-7433 cPCI-7433R	Base + 0x00	--	Isolated DI
	Base + 0x04	--	Isolated DI
	Base + 0x08	Clear IRQ	--
cPCI-7433R	Base + 0x50	LED Control	Slot Number

	Address	Write	Read
PCI-7434 cPCI-7434[P] cPCI-7434R[P]	Base + 0x00	Isolated DO	--
	Base + 0x04	Isolated DO	--
cPCI-7434R[P]	Base + 0x50	LED Control	Slot Number

Table 3.1. I/O Address Map of c/PCI-7432/33/34

DO -- Digital Output
DI -- Digital Input

Caution:

1. I/O port is 32-bit width
2. 8-bit or 16-bit I/O access is not allowed.

3.3 Digital Input Register

There are 32 isolated digital input channels on PCI-7432 and 64 isolated digital input channels on the PCI-7433, each bit of based address is corresponding to a signal on the digital input channel.

Address :

BASE + 0 ~ BASE + 3 for 7432

BASE + 0 ~ BASE + 7 for 7433

Attribute : read only

Data Format :

7432

	7	6	5	4	3	2	1	0
Base + 0	IDI_7	IDI_6	IDI_5	IDI_4	IDI_3	IDI_2	IDI_1	IDI_0
Base + 1	IDI_15	IDI_14	IDI_13	IDI_12	IDI_11	IDI_10	IDI_9	IDI_8
Base + 2	IDI_23	IDI_22	IDI_21	IDI_20	IDI_19	IDI_18	IDI_17	IDI_16
Base + 3	IDI_31	IDI_30	IDI_29	IDI_28	IDI_27	IDI_26	IDI_25	IDI_24

7433

	7	6	5	4	3	2	1	0
Base + 0	IDI_7	IDI_6	IDI_5	IDI_4	IDI_3	IDI_2	IDI_1	IDI_0
Base + 1	IDI_15	IDI_14	IDI_13	IDI_12	IDI_11	IDI_10	IDI_9	IDI_8
Base + 2	IDI_23	IDI_22	IDI_21	IDI_20	IDI_19	IDI_18	IDI_17	IDI_16
Base + 3	IDI_31	IDI_30	IDI_29	IDI_28	IDI_27	IDI_26	IDI_25	IDI_24
Base + 4	IDI_39	IDI_38	IDI_37	IDI_36	IDI_35	IDI_34	IDI_33	IDI_32
Base + 5	IDI_47	IDI_46	IDI_45	IDI_44	IDI_43	IDI_42	IDI_41	IDI_40
Base + 6	IDI_55	IDI_54	IDI_53	IDI_52	IDI_51	IDI_50	IDI_49	IDI_48
Base + 7	IDI_63	IDI_62	IDI_61	IDI_60	IDI_59	IDI_58	IDI_57	IDI_56

IDI_N : Isolated Digital Input CH N

3.4 Digital Output Register

There are total 32 digital output channels on the PCI-7432 and 64 isolated digital input channels on the PCI-7434, each bit of based address is corresponding to a signal on the digital output channel.

Address: **BASE + 0 ~ BASE + 3 for 7432**
BASE + 0 ~ BASE + 7 for 7434

Attribute : write only

Data Format :

7432

	7	6	5	4	3	2	1	0
Base + 0	<i>IDO_7</i>	<i>IDO_6</i>	<i>IDO_5</i>	<i>IDO_4</i>	<i>IDO_3</i>	<i>IDO_2</i>	<i>IDO_1</i>	<i>IDO_0</i>
Base + 1	<i>IDO_15</i>	<i>IDO_14</i>	<i>IDO_13</i>	<i>IDO_12</i>	<i>IDO_11</i>	<i>IDO_10</i>	<i>IDO_9</i>	<i>IDO_8</i>
Base + 2	<i>IDO_23</i>	<i>IDO_22</i>	<i>IDO_21</i>	<i>IDO_20</i>	<i>IDO_19</i>	<i>IDO_18</i>	<i>IDO_17</i>	<i>IDO_16</i>
Base + 3	<i>IDO_31</i>	<i>IDO_30</i>	<i>IDO_29</i>	<i>IDO_28</i>	<i>IDO_27</i>	<i>IDO_26</i>	<i>IDO_25</i>	<i>IDO_24</i>

7434

	7	6	5	4	3	2	1	0
Base + 0	<i>IDO_7</i>	<i>IDO_6</i>	<i>IDO_5</i>	<i>IDO_4</i>	<i>IDO_3</i>	<i>IDO_2</i>	<i>IDO_1</i>	<i>IDO_0</i>
Base + 1	<i>IDO_15</i>	<i>IDO_14</i>	<i>IDO_13</i>	<i>IDO_12</i>	<i>IDO_11</i>	<i>IDO_10</i>	<i>IDO_9</i>	<i>IDO_8</i>
Base + 2	<i>IDO_23</i>	<i>IDO_22</i>	<i>IDO_21</i>	<i>IDO_20</i>	<i>IDO_19</i>	<i>IDO_18</i>	<i>IDO_17</i>	<i>IDO_16</i>
Base + 3	<i>IDO_31</i>	<i>IDO_30</i>	<i>IDO_29</i>	<i>IDO_28</i>	<i>IDO_27</i>	<i>IDO_26</i>	<i>IDO_25</i>	<i>IDO_24</i>
Base + 4	<i>IDO_39</i>	<i>IDO_38</i>	<i>IDO_37</i>	<i>IDO_36</i>	<i>IDO_35</i>	<i>IDO_34</i>	<i>IDO_33</i>	<i>IDO_32</i>
Base + 5	<i>IDO_47</i>	<i>IDO_46</i>	<i>IDO_45</i>	<i>IDO_44</i>	<i>IDO_43</i>	<i>IDO_42</i>	<i>IDO_41</i>	<i>IDO_40</i>
Base + 6	<i>IDO_55</i>	<i>IDO_54</i>	<i>IDO_53</i>	<i>IDO_52</i>	<i>IDO_51</i>	<i>IDO_50</i>	<i>IDO_49</i>	<i>IDO_48</i>
Base + 7	<i>IDO_63</i>	<i>IDO_62</i>	<i>IDO_61</i>	<i>IDO_60</i>	<i>IDO_59</i>	<i>IDO_58</i>	<i>IDO_57</i>	<i>IDO_56</i>

IDO_N : Isolated Digital Output CH N

Operation Theorem

4.1 Isolated Digital Input Channels

The isolated digital input is open collector transistor structure. The input voltage range form 0V to 24V and input resistor is 2.4K Ω . The connection between outside signal and 7432/33 is shown in Fig 4.1. Please note that the input common junction could be common ground or common power, they are dependent on the user's environment. Therefore, the digital input could be either current source or current sink.

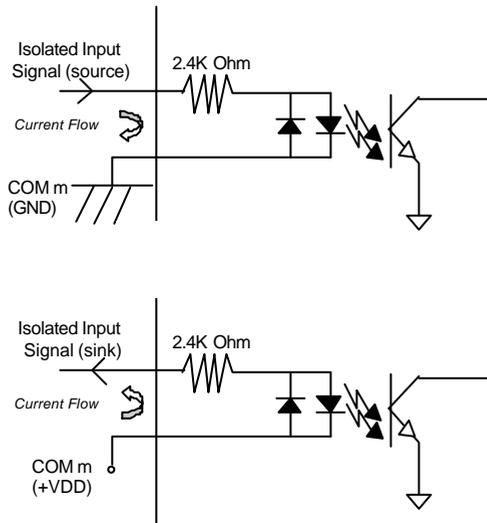


Figure 4.1 Isolated input connection

4.2 Isolated Digital Output Channels

The common ground connection of isolated digital output is shown as figure 4.2, while common power connection of isolated digital output as figure 4.3. When the isolated digital output goes “ON”, the sink current will be conducted through the transistors. When the isolated digital output goes “OFF”, no current could flow through the transistor. Please note that when the loading is as “inductance type loading” such as relay, coil or motor, the VDD pin must be connected to the external power source. The extra connection is to utilize the ‘fly-wheel diode’ to form a current-release closed loop, so that the transistor won’t be destroyed by the reverse high voltage which is generated by the inductance load when the output switches from “ON” to “OFF”.

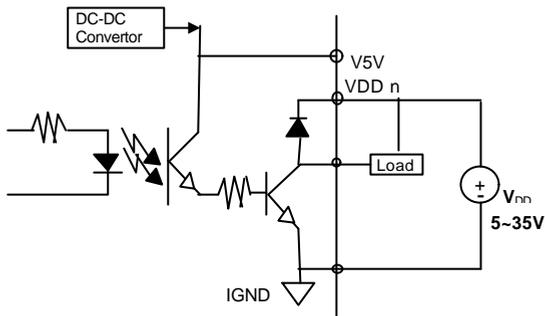


Figure 4.2 common ground connection in cPCI-7434[R]

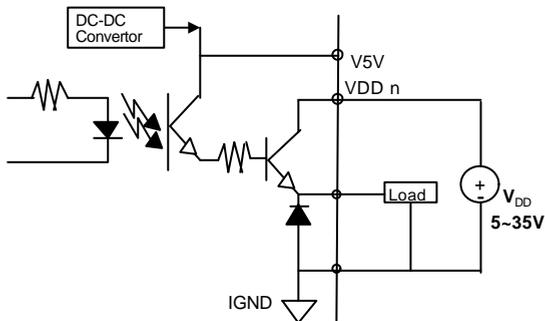


Figure 4.3 common power connection in cPCI-7434[R]P

C/C++ Libraries

This chapter describes the software library for operating this card. Only the functions in DOS library and Windows 95 DLL are described. Please refer to the PCIS-DASK function reference manual, which included in ADLINK CD, for the descriptions of the Windows 98/NT/2000 DLL functions.

The function prototypes and some useful constants are defined in the header files LIB directory (DOS) and INCLUDE directory (Windows 95). For Windows 95 DLL, the developing environment can be Visual Basic 4.0 or above, Visual C/C++ 4.0 or above, Borland C++ 5.0 or above, Borland Delphi 2.x (32-bit) or above, or any Windows programming language that allows calls to a DLL. It provides the C/C++, VB, and Delphi include files.

5.1 Libraries Installation

Please refer to the “**Software Installation Guide**” for the detail information about how to install the software libraries for DOS, or Windows 95 DLL, or PCIS-DASK for Windows 98/NT/2000.

The device drivers and DLL functions of Windows 98/NT/2000 are included in the PCIS-DASK. Please refer the PCIS-DASK user' s guide and function reference, which included in the ADLINK CD, for detailed programming information.

5.2 Programming Guide

5.2.1 Naming Convention

The functions of the NuDAQ PCI cards or NuIPC CompactPCI cards' software driver are using full-names to represent the functions' real meaning. The naming convention rules are:

In DOS Environment :

`_{hardware_model}_{action_name}. e.g. _7432_Initial()`.

All functions in PCI-7432 driver are with 7432 as {hardware_model}. But they can be used by PCI-7432 and cPCI-7432. All functions in PCI-7433 driver are with 7433 as {hardware_model}. But they can be used by PCI-7433, cPCI-7433 and cPCI-7433R. All functions in PCI-7434 driver are with 7434 as {hardware_model}. But they can be used by PCI-7434, cPCI-7434 and cPCI-7434R.

In order to recognize the difference between DOS library and Windows 95 library, a capital "W" is put on the head of each function name of the Windows 95 DLL driver. e.g. `W_7432_Initial()`.

5.2.2 Data Types

We defined some data type in `Pci_743X.h` (DOS) and `Acl_pci.h` (Windows 95). These data types are used by NuDAQ Cards' 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 integer	-2147483648 to 2147483647
U32	32-bit single-precision floating-point	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

5.3 Running Testing Utility

After finishing the installation, you can execute the DOS utility by typing as follows:

```
C> cd \7432\DOS\UTIL
```

```
C> 7432UTIL
```

(If your PCI card is PCI-7433 or 7434, please execute 7433UTIL.EXE or 7434UTIL.EXE)

5.4 Initial

@ Description

The 743X cards are initialized by this function. The software library could be used to control multiple 743X cards. Because PCI-743X is in PCI bus architecture and meets the plug and play specifications, the **IRQ** and **I/O address** are assigned by system BIOS directly.

@ Syntax

PCI-7432 / cPCI-7432

C/C++ (DOS)

```
U16 _7432_Initial (U16 *existCards, PCI_INFO *pciInfo)
```

C/C++ (Windows 95)

```
U16 W_7432_Initial (U16 *existCards, PCI_INFO *pciInfo)
```

Visual Basic (Windows 95)

```
W_7432_Initial (existCards As Integer, info As PCI_INFO) As Integer
```

PCI-7433 / cPCI-7433 / cPCI-7433R

C/C++ (DOS)

```
U16 _7433_Initial (U16 *existCards, PCI_INFO *pciInfo)
```

C/C++ (Windows 95)

```
U16 W_7433_Initial (U16 *existCards, PCI_INFO *pciInfo)
```

Visual Basic (Windows 95)

```
W_7433_Initial (existCards As Integer, info As PCI_INFO) As Integer
```

PCI-7434 / cPCI-7434 / cPCI-7434R

C/C++ (DOS)

```
U16 _7434_Initial (U16 *existCards, PCI_INFO *pciInfo)  
C/C++ (Windows 95)
```

```
U16 W_7434_Initial (U16 *existCards, PCI_INFO *pciInfo)
```

Visual Basic (Windows 95)

```
W_7434_Initial (existCards As Integer, info As PCI_INFO) As Integer
```

@ Argument

existCards : The numbers of installed 7432/33/34 cards. The returned value shows how many 7432/33/34 cards are installed in your system.

pciinfo: It is a structure to memorize the PCI bus plug and play initialization information which is decided by p&p BIOS. The PCI_INFO structure is defined in ACL_PCI.H. The base I/O address and the interrupt channel number are stored in pciinfo which is for reference.

@ Return Code

```
ERR_NoError  
ERR_PCIBiosNotExist
```

5.5 Digital Input Relative Functions

@ Description

These functions are used to read 32-bit digital inputs data from digital input port. You can get 32 bits data from 7432 by using function “_7432_DI”, get 32 bits data (MSB double word) from 7433 by using “_7433_DI_HiDW”, get 32 bits data (LSB double word) from PCI-7433 by using “_7433_DI_LoDW”.

@ Syntax

PCI-7432 / cPCI-7432

C/C++ (DOS)

```
U16 _7432_DI (U16 cardNo, U32 *di_data)
```

C/C++ (Windows 95)

```
U16 W_7432_DI (U16 cardNo, U32 *di_data)
```

Visual Basic (Windows 95)

```
W_7432_DI (ByVal cardNo As Integer, di_data As Long) As Integer
```

PCI-7433 / cPCI-7433 / cPCI-7433R

C/C++ (DOS)

```
U16 _7433_DI_HiDW (U16 cardNo, U32 *di_data)
```

```
U16 _7433_DI_LoDW (U16 cardNo, U32 *di_data)
```

C/C++ (Windows 95)

```
U16 W_7433_DI_HiDW (U16 cardNo, U32 *di_data)
```

```
U16 W_7433_DI_LoDW (U16 cardNo, U32 *di_data)
```

Visual Basic (Windows 95)

```
W_7433_DI_HiDW ( ByVal cardNo As Integer, di_data As Long) As Integer
```

```
W_7433_DI_LoDW (ByVal cardNo As Integer, di_data As Long) As Integer
```

@ Argument

cardNo: card number to select board

di_data: return 32-bit value from digital port.

@ Return Code

ERR_NoError

ERR_BoardNoInit

5.6 Digital Output Relative Functions

@ Description

These functions are used to write data to digital output ports. You can write 32 bits data to 7432 by using function “_7432_DO”; write 32 bits data (MSB double word) to 7434 by using “7434_DO_HiDW”; or write 32 bits data (LSB double word) to 7434 by using “7434_DO_LoDW”.

@ Syntax

PCI-7432 / cPCI-7432

C/C++ (DOS)

```
U16 _7432_DO (U16 cardNo, U32 do_data)
```

C/C++ (Windows 95)

```
U16 W_7432_DO (U16 cardNo, U32 do_data)
```

Visual Basic (Windows 95)

```
W_7432_DO (ByVal cardNo As Integer, ByVal do_data As Long)  
As Integer
```

PCI-7434 / cPCI-7434 / cPCI-7434R

C/C++ (DOS)

```
U16 _7434_DO_HiDW (U16 cardNo, U32 do_data)
```

```
U16 _7434_DO_LoDW (U16 cardNo, U32 do_data)
```

C/C++ (Windows 95)

```
U16 W_7434_DO_HiDW (U16 cardNo, U32 do_data)
```

```
U16 W_7434_DO_LoDW (U16 cardNo, U32 do_data)
```

Visual Basic (Windows 95)

```
W_7434_DO_HiDW (ByVal cardNo As Integer, ByVal do_data As  
Long) As Integer
```

```
W_7434_DO_LoDW (ByVal cardNo As Integer, ByVal do_data As  
Long) As Integer
```

@ Argument

cardNo : card number to select board

do_data : value will be written to digital output port

@ Return Code

ERR_NoError

ERR_BoardNoInit

5.7 Interrupt Source Control

@ Description

The 7432 or 7433 has dual interrupts system, two interrupt sources can be generated and be checked by the software. This function is used to select and control 7432/33 interrupt sources by writing data to interrupt control register. The interrupt source can be set as from Channel 0 (INT1) and/or channel 1 (INT2) of digital input channels.

@ Syntax

PCI-7432 / cPCI-7432

C/C++ (DOS)

```
void _7432_Set_INT_Control (U16 cardNo, U16 int1Flag, U16  
int2Flag)
```

C/C++ (Windows 95)

```
void W_7432_Set_INT_Control (U16 cardNo, U16 int1Flag, U16  
int2Flag)
```

Visual Basic (Windows 95)

```
W_7432_Set_INT_Control (ByVal cardNo As Integer, ByVal  
int1Flag As Integer, ByVal int2Flag As Integer)
```

PCI-7433 / cPCI-7433 / cPCI-7433R

C/C++ (DOS)

```
void _7433_Set_INT_Control (U16 cardNo, U16 int1Flag, U16  
int2Flag)
```

C/C++ (Windows 95)

```
void W_7433_Set_INT_Control (U16 cardNo, U16 int1Flag, U16  
int2Flag)
```

Visual Basic (Windows 95)

```
W_7433_Set_INT_Control (ByVal cardNo As Integer, ByVal  
int1Flag As Integer, ByVal int2Flag As Integer)
```

@ Argument

cardNo: card number to select board
int1Flag: INT1 setting; 0: disable, 1: enable
int2Flag: INT2 setting; 0: disable, 1: enable

5.8 Get Interrupt Status

@ Description

The PCI-7432 or PCI-7433 has dual interrupts system. Two interrupt sources can be generated and be checked by the software. This function is used to distinguish which interrupt is inserted if both INT1 and INT2 interrupts are used.

@ Syntax

PCI-7432 / cPCI-7432

C/C++ (DOS)

```
void _7432_Get_IRQ_Status (U16 cardNo, U16 *int1Status, U16 *int2Status)
```

C/C++ (Windows 95)

```
void W_7432_Get_IRQ_Status (U16 cardNo, U16 *int1Status, U16 *int2Status)
```

Visual Basic (Windows 95)

```
W_7432_Get_IRQ_Status (ByVal cardNo As Integer, int1Status As Integer, int2Status As Integer)
```

PCI-7433 / cPCI-7433 / cPCI-7433R

C/C++ (DOS)

```
void _7433_Get_IRQ_Status (U16 cardNo, U16 *int1Status, U16 *int2Status)
```

C/C++ (Windows 95)

```
void W_7433_Get_IRQ_Status (U16 cardNo, U16 *int1Status, U16 *int2Status)
```

Visual Basic (Windows 95)

```
W_7433_Get_IRQ_Status (ByVal cardNo As Integer, int1Status As Integer, int2Status As Integer)
```

@ Argument

```
cardNo:    card number to select board  
int1Status: 0: interrupt is not from INT1,  
              1: interrupt is from INT1  
int2Status: 0: interrupt is not from INT2,  
              1: interrupt is from INT2
```

5.9 Interrupt Enable

@ Description

This function is only available in Windows 95 driver. This function is used to start up the interrupt control. After calling this function, every time an interrupt request is generated, a software event is signaled. So that in your program, you can use wait operation to wait for the event. When the event is signaled, it means an interrupt is generated. Please refer to the sample program 7432int.c or 7433int.c.

@ Syntax

PCI-7432 / cPCI-7432

C/C++ (Windows 95)

```
U16 W_7432_INT_Enable (U16 cardNo, HANDLE *hEvent)
```

Visual Basic (Windows 95)

```
W_7432_INT_Enable (ByVal cardNo As Integer, hEvent As Long)  
As Integer
```

PCI-7433 / cPCI-7433 / cPCI-7433R

C/C++ (Windows 95)

```
U16 W_7433_INT_Enable (U16 cardNo, HANDLE *hEvent)
```

Visual Basic (Windows 95)

```
W_7433_INT_Enable (ByVal cardNo As Integer, hEvent As Long)  
As Integer
```

@ Argument

cardNo : card number to select board
hEvent : the address of an array of two handles. hEvent[0] and hEvent[1] are the events for interrupt signals INT1 and INT2 respectively.

@ Return Code

```
ERR_NoError  
ERR_BoardNoInit
```

5.10 Interrupt Disable

@ Description

This function is only available in Windows 95 driver. This function is used to disable the interrupt signal generation.

@ Syntax

PCI-7432 / cPCI-7432

C/C++ (Windows 95)

```
U16 W_7432_INT_Disable (U16 cardNo)
```

Visual Basic (Windows 95)

```
W_7432_INT_Disable (ByVal cardNo As Integer) As Integer
```

PCI-7433 / cPCI-7433 / cPCI-7433R

C/C++ (Windows 95)

```
U16 W_7433_INT_Disable (U16 cardNo)
```

Visual Basic (Windows 95)

```
W_7433_INT_Disable (ByVal cardNo As Integer) As Integer
```

@ Argument

cardNo : card number to select board

@ Return Code

ERR_NoError

ERR_BoardNoInit

5.11 LED Control Function

@ Description

The LED control function is only available on the CompactPCI rear I/O version. The cPCI-7433R/34R has four user defined LED lights. This function is used to control the LED lights.

@ Syntax

cPCI-7433R / cPCI-7434R

C/C++ (DOS)

```
void _7433R_LED (U16 cardNo, U32 LED_Data)
void _7434R_LED (U16 cardNo, U32 LED_Data)
```

C/C++ (Windows 95)

```
void W_7433R_LED (U16 cardNo, U32 LED_Data)
void W_7434R_LED (U16 cardNo, U32 LED_Data)
```

Visual Basic (Windows 95)

```
W_7433R_LED (ByVal cardNo As Integer , ByVal
              LED_Data As Long) As Integer
W_7434R_LED (ByVal cardNo As Integer , ByVal
              LED_Data As Long) As Integer
```

@ Argument

cardNo: card number to select board
LED_Data: control LED data (only use finally byte)

5.12 Get Slot Number

@ Description

The Get slot number function is only available on the CompactPCI rear I/O version. The slot number is read back from the Geographic address which defined on the backplane.

@ Syntax

cPCI-7433R / cPCI-7434R

C/C++ (DOS)

```
void _7433R_SlotNo (U16 cardNo, U32 *slot_No)  
void _7434R_SlotNo (U16 cardNo, U32 *slot_No)
```

C/C++ (Windows 95)

```
void W_7433R_SlotNo (U16 cardNo, U32 *slot_No)  
void W_7434R_SlotNo (U16 cardNo, U32 *slot_No)
```

Visual Basic (Windows 95)

```
W_7433R_SlotNo (ByVal cardNo As Integer , slot_No  
As Long) As Integer  
W_7434R_SlotNo (ByVal cardNo As Integer , slot_No  
As Long) As Integer
```

@ Argument

cardNo: card number to select board
slot_No: the slot number of the cPCI card (only use LSB byte)

Product Warranty/Service

Seller warrants that equipment furnished will be free from defects in material and workmanship for a period of one year from the confirmed date of purchase of the original buyer and that upon written notice of any such defect, Seller will, at its option, repair or replace the defective item under the terms of this warranty, subject to the provisions and specific exclusions listed herein.

This warranty shall not apply to equipment that has been previously repaired or altered outside our plant in any way as to, in the judgment of the manufacturer, affect its reliability. Nor will it apply if the equipment has been used in a manner exceeding its specifications or if the serial number has been removed.

Seller does not assume any liability for consequential damages as a result from our products uses, and in any event our liability shall not exceed the original selling price of the equipment.

The equipment warranty shall constitute the sole and exclusive remedy of any Buyer of Seller equipment and the sole and exclusive liability of the Seller, its successors or assigns, in connection with equipment purchased and in lieu of all other warranties expressed implied or statutory, including, but not limited to, any implied warranty of merchant ability or fitness and all other obligations or liabilities of seller, its successors or assigns.

The equipment must be returned postage-prepaid. Package it securely and insure it. You will be charged for parts and labor if you lack proof of date of purchase, or if the warranty period is expired.