MIC-3758DIO

128-channel Isolated Digital I/O CompactPCI Card

User Manual

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5. Write the RMA number visibly on the outside of the package and ship it prepaid to your dealer.

CE

This product has passed the CE test for environmental specifications when shielded cables are used for external wiring. We recommend the use of shielded cables. This kind of cable is available from Advantech. Please contact your local supplier for ordering information.

Technical Support and Assistance

Step 1. Visit the Advantech web site at **www.advantech.com/support** where you can find the latest information about the product.

Step 2. Contact your distributor, sales representative, or Advantech's customer service center for technical support if you need additional assistance. Please have the following information ready before you call:
  - Product name and serial number
  - Description of your peripheral attachments
  - Description of your software (operating system, version, application software, etc.)
  - A complete description of the problem
  - The exact wording of any error messages

Packing List

Before setting up the system, check that the items listed below are included and in good condition. If any item does not accord with the table, please contact your dealer immediately.

• 1 x MIC-3758DIO card

• 1 x Companion CD-ROM (DLL driver included)

• 1 x User Manual (this manual)

Safety Precaution - Static Electricity

Follow these simple precautions to protect yourself from harm and the products from damage.

1. To avoid electrical shock, always disconnect the power from your PC chassis before you work on it. Don't touch any components on the CPU card or other cards while the PC is on.

2. Disconnect power before making any configuration changes. The sudden rush of power as you connect a jumper or install a card may damage sensitive electronic components.

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General Information

This chapter gives background information on MIC-3758DIO. It then shows how to configure the card to match your application and prepare it for installation on your system..

Sections include:

- Introduction
- Features
- Installation Guide
- Accessories

Chapter 1 General Information

1.1 Introduction

Thank you for buying the Advantech MIC-3758DIO DAS card. The Advantech MIC-3758DIO card is a powerful data acquisition (DAS) card for the CompactPCI bus. It features a unique circuit design and complete functions for data acquisition and control. The MIC-3758DIO card provide specific functions for different user requirements:

The following sections of this chapter will provide further information about features of the DAS cards.

1.2 Features

The Advantech MIC-3758DIO DAS card provides users with the most requested measurement and control functions as seen below:

Digital Output

- 64 isolated digital output channels
- High-voltage isolation on output channels (2,500 V_{DC})
- Wide output range (5 ~ 40 V_{DC})
- High-sink current for isolated output channels (90 mA max./Channel)
- Current protect for each port
- Output status read-back
- Digital output value retained after hot system reset
- Programmable Power-Up States
- Watchdog Timer

Digital Input

- 64 isolated digital input channels
- High-voltage isolation for input channels (2,500 V_{DC})
- Wide input range (5 ~ 25 V_{DC})
- High ESD protection (2,000 V_{DC})
- Digital Filter function
- Interrupt handling capability
- Robust Isolation
- BoardID switch

MIC-3758DIO features robust isolation protection for applications in industrial, lab and machinery automation. MIC-3758DIO can durably withstand a voltage up to 2,500 VDC, preventing your host system from any incidental harms. MIC-3758DIO, if connected to an external input source with surge-protection, can offer up to a maximum of 2,000 VDC ESD (Electrostatic Discharge) protections for input channels.

1.2.1 Wide Input/Output Range

MIC-3758DIO has a wide range of input voltage from 5 to 25 VDC, and it is suitable for most industrial applications with 12 VDC and 24 VDC input voltage. MIC-3758DIO also features a wide output voltage range from 5 to 40 VDC, suitable for most industrial applications with 12 VDC / 24 VDC output voltage. In the mean time, we are also ready to serve your special needs for specific input/output voltage ranges.

1.2.2 BoardID Switch

MIC-3758DIO has a built-in DIP switch that helps define each card's ID when multiple cards have been installed on the same PC chassis. The BoardID setting function is very useful when you build your system with multiple MIC-3758DIO cards. With correct BoardID settings, you can easily identify and access each card during hardware configuration and software programming.

1.2.3 Programmable Power-Up State Function

User-configurable power-up states are useful for ensuring that MIC-3758DIO powers up in a known state. Power-up states are programmed in the EEPROM through the driver.

1.2.4 Watchdog Timer Function

The watchdog timer is a software configurable feature used to set critical outputs to safe states in the event of a software failure. If there is loss of communication between the application and MIC-3758DIO, if the watch-dog timer is enabled and MIC-3758DIO does not receive a watchdog clear software command within the interval time specified for the watch-dog timer, the outputs go to a user-defined safe state and remain in that state until the watchdog timer is disabled and new values are written by the software. After the watchdog timer expires, MIC-3758DIO ignores any writes until the watchdog timer is disabled. You can set the watchdog timer timeout period through the WDT register to specify the amount of time that must elapse before the watchdog timer expires. The counter on the watchdog timer is configurable up to 2^{32}-1 x 100 ns (approximately seven minutes) before it expires.

1.2.5 Reset Protection

If the system has undergone a hot reset (i.e. system power was not turned off), MIC-3758DIO can either retain output values of each channel, or return to its default configuration as power up status, depending on its on-board jumper setting. This function protects the system from wrong oper-ations during unexpected system resets.

1.3 Installation Guide

Before you install your MIC-3758DIO card, please make sure you have the following necessary components:

- MIC-3758DIO isolated digital I/O card
- MIC-3758DIO User Manual (this manual)
- Driver software: Advantech DLL drivers (included in the companion CD-ROM)
- Wiring cable: 100-pin MINI-SCSI HDRA-E100 cable
- Wiring board: ADAM-39100
- Computer: CompactPCI computer system (running Windows 98/NT/2000/XP)

After you get the necessary components and maybe some accessories for enhanced operation for your DAS card, you can begin the installation procedure. Figure 1-1 provides a concise flow chart to give users a broad picture of the software and hardware installation procedures.

```
┌────────────────────────────────────────┐
│ Install Driver from CD-ROM and turn off computer │
└────────────────────────────────────────┘
                    │
                    ▼
┌────────────────────────────────────────┐
│    Install hardware and turn on computer    │
└────────────────────────────────────────┘
                    │
                    ▼
┌────────────────────────────────────────┐
│        Use driver utility to configure        │
│                  hardware                   │
└────────────────────────────────────────┘
                    │
                    ▼
┌────────────────────────────────────────┐
│           Use test utility to test           │
│                  hardware                   │
└────────────────────────────────────────┘
                    │
                    ▼
┌────────────────────────────────────────┐
│           Read examples & driver            │
│                   manual                    │
└────────────────────────────────────────┘
                    │
                    ▼
┌────────────────────────────────────────┐
│      Start to write your own application       │
└────────────────────────────────────────┘
```
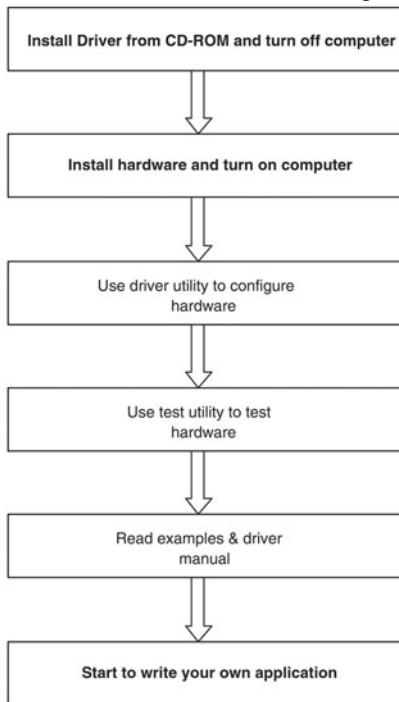
Figure 1.1: Installation flow chart

1.4 Accessories

Advantech offers a complete set of accessory products to support MIC-3758DIO cards. These accessories include:

1.4.1 Wiring Cables
• PCL-101100S-1 (1.5 m, 3 m, 5 m): The PCL-101100S-1 (1.5m, 3m, 5m) shielded cable is specially designed for MIC-3758DIO cards to provide high resistance to noise.

1.4.2 Wiring Terminal Boards
• ADAM-39100: The ADAM-39100 is a 100-pin SCSI wiring terminal module for DIN-rail mounting. This terminal module can be readily connected to the Advantech PC-Lab cards and allow easy yet reliable access to individual pin connections for the MIC-3758DIO card.

Hardware Configuration

This chapter provides a package item checklist, proper instructions about unpacking and step-by-step procedures for card installation..

Sections include:

- Unpacking
- Hardware Installation
- Board Layout

Chapter 2 Hardware Configuration

2.1 Unpacking

After receiving your MIC-3758DIO package, please inspect its contents first. The package should contain the following items:

- MIC-3758DIO card
- Companion CD-ROM (DLL driver included)
- User Manual

The MIC-3758DIO card harbors certain electronic components that are vulnerable to electrostatic discharge (ESD). ESD could easily damage the integrated circuits and certain components if preventive measures are not carefully paid attention to.

Before removing the card from the antistatic plastic bag, you should take following precautions to ward off possible ESD damage:

- Touch the metal part of your computer chassis with your hand to discharge static electricity accumulated on your body. Or one can also use a grounding strap.
- Touch the antistatic bag to a metal part of your computer chassis before opening the bag.
- Take hold of the card only by the metal bracket when removing it out of the bag.

After taking out the card, first you should:

- Inspect the card for any possible signs of external damage (loose or damaged components, etc.). If the card is visibly damaged, please notify our service department or our local sales representative immediately. Avoid installing a damaged card into your system.

Also pay extra caution to the following aspects to ensure proper installation:

Avoid physical contact with materials that could hold static electricity such as plastic, vinyl and Styrofoam. Whenever you handle the card, grasp it only by its edges. DO NOT TOUCH the exposed metal pins of the connector or the electronic components.

Note: *Keep the antistatic bag for future use. You might need the original bag to store the card if you have to remove the card from PC or transport it elsewhere.*

2.2 Hardware Installation

Note: *Make sure you first install the driver before installing the card. We strongly recommend that you install the software driver before installing the hardware into your system, since this will guarantee a smooth and trouble-free installation process. For more information about the driver installation, configuration and removal procedures for Windows 9X, Windows NT, Windows 2000 and Windows XP, please see the Device Driver Manual.*

When installing the MIC-3758DIO card, Please make sure the DLL driver of MIC-3758DIO installation is completed. You can then go on to install the MIC-3758DIO card in your CompactPCI system. If you have any doubts, please consult the user manual or related documentation. Please follow the below steps to install the card in your system.

2.2.1 Installing a CompactPCI Card:

Step 1: Remove one cover on the unused slot of your CompactPCI computer slot.

Step 2: Hold the card vertically. Be sure that the card is pointing in the correct direction. The components of the card should be pointing to the right-hand side and the black handle of the card should be pointing to the lower edge of the backplane.

Step 3: Hold the lower handle and pull the handle down to unlock it.

Step 4: Insert the MIC-3758DIO card into the CompactPCI chassis carefully by sliding the lower edges of the card into the card guides.

Step 5: Push the card into the slot gently by sliding the card along the card guide until J1 meets the long needle on the backplane, then the **Blue LED** on the front panel of the card will be lit.

Note: *If your card is correctly positioned and has been slid all the way into the chassis, the handle should match the rectangular holes. If not, remove the card from the card guide and repeat step 3 again. Do not try to install a card by forcing it into the chassis.*

Step 6: Now push the card into the right place, and the **Blue LED** will turn off.

Step 7: After the **Blue LED** is off, push the handle to secure the card and lock it into place.

.

Note: *Before the hot-swap function can be used, the card must first be installed normally.*

Note: *If your card is properly installed, you should see the device name of your card listed on the Device Manager tab.*

2.2.2 Removing a CompactPCI Card
Step 1: Push the handle down to unlock the card, and the CompactPCI system will automatically uninstall the card configuration.

Step 2: Once the system completes the configuration, the **Blue LED** will be lit. Now you can slide the card out.

2.3 Board Layout
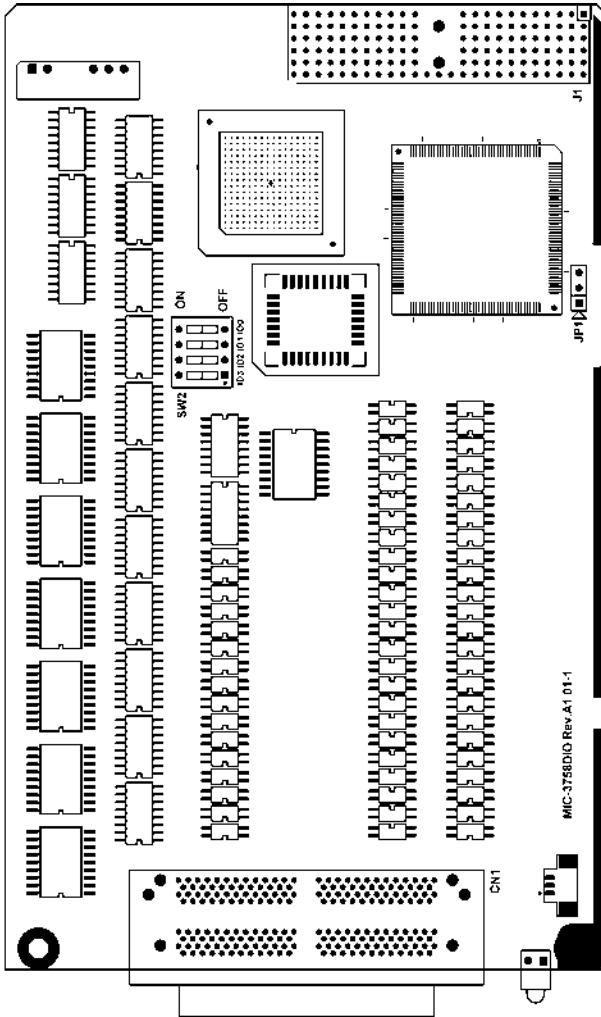
Figure 2.1: MIC-3758DIO Board Layout

2.3.1 Connector

MIC-3758DIO has one HDRA-E100W1LFDT1EC-SL Equivalent female connector. For more details about jumper, switch and connector, please see Chapter 3 Pin Assignment & Jumper Setting and Chapter 4 Operation.

Pin Assignments & Jumper Settings

Maintaining signal connections is one of the most important factors in ensuring that your application system is sending and receiving data correctly. A good signal connection can avoid unnecessary and costly damage to your system and other hardware devices. This chapter provides useful information about how to connect input and output signals to the MIC-3758DIO via the I/O connector..

Sections include:

- Pin Assignments
- Location of Jumper and DIP Switch
- Isolated Digital Input Connections
- Isolated Digital Output Connections
- Field Wiring Considerations

Chapter 3 Pin Assignments & Jumper Settings

3.1 Pin Assignments

The I/O connector on MIC-3758DIO is one MINI-SCSI HDRA-E100 female connector. Figure 3.1 shows a description of the connector, while Figure 3.2 shows the pin assignments for the MINI-SCSI HDRA-E100 female connector on MIC-3758DIO, and Table 3.1 describes the functionality of each pin on the connector.

Note:　　　　　*The PCL-101100S (1m, 2m) shielded cable is especially designed for MIC-3758DIO to reduce noise in the analog signal lines. Please refer to section 1.3 Accessories.*

Figure 3.1: Connector for MIC-3758DIO

CNB

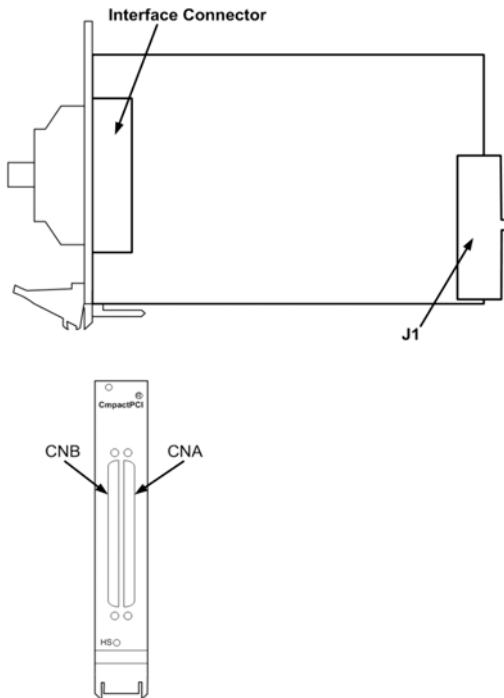| Signal	Pin	Pin	Signal
P67_COMP	100	50	P23_COMP
P67_COMP	99	49	P23_COMP
P7_IDO07	98	48	P3_IDO07
P7_IDO06	97	47	P3_IDO06
P7_IDO05	96	46	P3_IDO05
P7_IDO04	95	45	P3_IDO04
P7_IDO03	94	44	P3_IDO03
P7_IDO02	93	43	P3_IDO02
P7_IDO01	92	42	P3_IDO01
P7_IDO00	91	41	P3_IDO00
P6_IDO07	90	40	P2_IDO07
P6_IDO06	89	39	P2_IDO06
P6_IDO05	88	38	P2_IDO05
P6_IDO04	87	37	P2_IDO04
P6_IDO03	86	36	P2_IDO03
P6_IDO02	85	35	P2_IDO02
P6_IDO01	84	34	P2_IDO01
P6_IDO00	83	33	P2_IDO00
P67_COMM	82	32	P23_COMM
P67_COMM	81	31	P23_COMM
P67_COMM	80	30	P23_COMM
P67_COMM	79	29	P23_COMM
P67_COMM	78	28	P23_COMM
P67_COMM	77	27	P23_COMM
NC	76	26	NC
NC	75	25	NC
P45_COMP	74	24	P01_COMP
P45_COMP	73	23	P01_COMP
P5_IDO07	72	22	P1_IDO07
P5_IDO06	71	21	P1_IDO06
P5_IDO05	70	20	P1_IDO05
P5_IDO04	69	19	P1_IDO04
P5_IDO03	68	18	P1_IDO03
P5_IDO02	67	17	P1_IDO02
P5_IDO01	66	16	P1_IDO01
P5_IDO00	65	15	P1_IDO00
P4_IDO07	64	14	P0_IDO07
P4_IDO06	63	13	P0_IDO06
P4_IDO05	62	12	P0_IDO05
P4_IDO04	61	11	P0_IDO04
P4_IDO03	60	10	P0_IDO03
P4_IDO02	59	9	P0_IDO02
P4_IDO01	58	8	P0_IDO01
P4_IDO00	57	7	P0_IDO00
P45_COMM	56	6	P01_COMM
P45_COMM	55	5	P01_COMM
P45_COMM	54	4	P01_COMM
P45_COMM	53	3	P01_COMM
P45_COMM	52	2	P01_COMM
P45_COMM	51	1	P01_COMM

CNA

Signal	Pin	Pin	Signal
NC	1	51	NC
NC	2	52	NC
NC	3	53	NC
NC	4	54	NC
NC	5	55	NC
NC	6	56	NC
P0_IDI00	7	57	P4_IDI00
P0_IDI01	8	58	P4_IDI01
P0_IDI02	9	59	P4_IDI02
P0_IDI03	10	60	P4_IDI03
P0_IDI04	11	61	P4_IDI04
P0_IDI05	12	62	P4_IDI05
P0_IDI06	13	63	P4_IDI06
P0_IDI07	14	64	P4_IDI07
P1_IDI00	15	65	P5_IDI00
P1_IDI01	16	66	P5_IDI01
P1_IDI02	17	67	P5_IDI02
P1_IDI03	18	68	P5_IDI03
P1_IDI04	19	69	P5_IDI04
P1_IDI05	20	70	P5_IDI05
P1_IDI06	21	71	P5_IDI06
P1_IDI07	22	72	P5_IDI07
P01_COM	23	73	P45_COM
P01_COM	24	74	P45_COM
NC	25	75	NC
NC	26	76	NC
NC	27	77	NC
NC	28	78	NC
NC	29	79	NC
NC	30	80	NC
NC	31	81	NC
NC	32	82	NC
P2_IDI00	33	83	P6_IDI00
P2_IDI01	34	84	P6_IDI01
P2_IDI02	35	85	P6_IDI02
P2_IDI03	36	86	P6_IDI03
P2_IDI04	37	87	P6_IDI04
P2_IDI05	38	88	P6_IDI05
P2_IDI06	39	89	P6_IDI06
P2_IDI07	40	90	P6_IDI07
P3_IDI00	41	91	P7_IDI00
P3_IDI01	42	92	P7_IDI01
P3_IDI02	43	93	P7_IDI02
P3_IDI03	44	94	P7_IDI03
P3_IDI04	45	95	P7_IDI04
P3_IDI05	46	96	P7_IDI05
P3_IDI06	47	97	P7_IDI06
P3_IDI07	48	98	P7_IDI07
P23_COM	49	99	P67_COM
P23_COM	50	100	P67_COM

Figure 3.2: I/O Connector Pin Assignments for MIC-3758DIO

Table 3.1: MIC-3758DIO I/O connector Signal Description			
Signal Name	**Reference**	**Direction**	**Description**
P0_IDI00~ 07	DI COM0	Input	Isolated Digital Input of port 0
P1_IDI00~ 07	DI COM1	Input	Isolated Digital Input of port 1
P2_IDI00~ 07	DI COM2	Input	Isolated Digital Input of port 2
P3_IDI00~ 07	DI COM3	Input	Isolated Digital Input of port 3
P4_IDI00~ 07	DI COM4	Input	Isolated Digital Input of port 4
P5_IDI00~ 07	DI COM5	Input	Isolated Digital Input of port 5
P6_IDI00~ 07	DI COM6	Input	Isolated Digital Input of port 6
P7_IDI00~ 07	DI COM7	Input	Isolated Digital Input of port 7
P01_COM	-		Common port of Digital Input port 0 and port 1
P23_COM	-		Common port of Digital Input port 0 and port 1
P45_COM	-		Common port of Digital Input port 0 and port 1
P67_COM	-		Common port of Digital Input port 0 and port 1
P0_IDO00~ 07	P01_COMM	Output	Isolated Digital Output of port 0
P1_IDO00~ 07	P01_COMM	Output	Isolated Digital Output of port 1
P2_IDO00~ 07	P23_COMM	Output	Isolated Digital Output of port 2
P3_IDO00~ 07	P23_COMM	Output	Isolated Digital Output of port 3
P4_IDO00~ 07	P45_COMM	Output	Isolated Digital Output of port 4
P5_IDO00~ 07	P45_COMM	Output	Isolated Digital Output of port 5
P6_IDO00~ 07	P67_COMM	Output	Isolated Digital Output of port 6
P7_IDO00~ 07	P67_COMM	Output	Isolated Digital Output of port 7
P01_COMM	-		Negative external power supply
P23_COMM	-		Negative external power supply
P45_COMM	-		Negative external power supply
P67_COMM	-		Negative external power supply
P01_COMP	-		Positive external power supply
P23_COMP	-		Positive external power supply
P45_COMP	-		Positive external power supply
P67_COMP	-		Positive external power supply

3.2 Location of Jumper and DIP switch

Figure 3.3 show the names and locations of the jumper and DIP switch on MIC-3758DIO. There is one DIP switch SW2 and one jumper JP1.
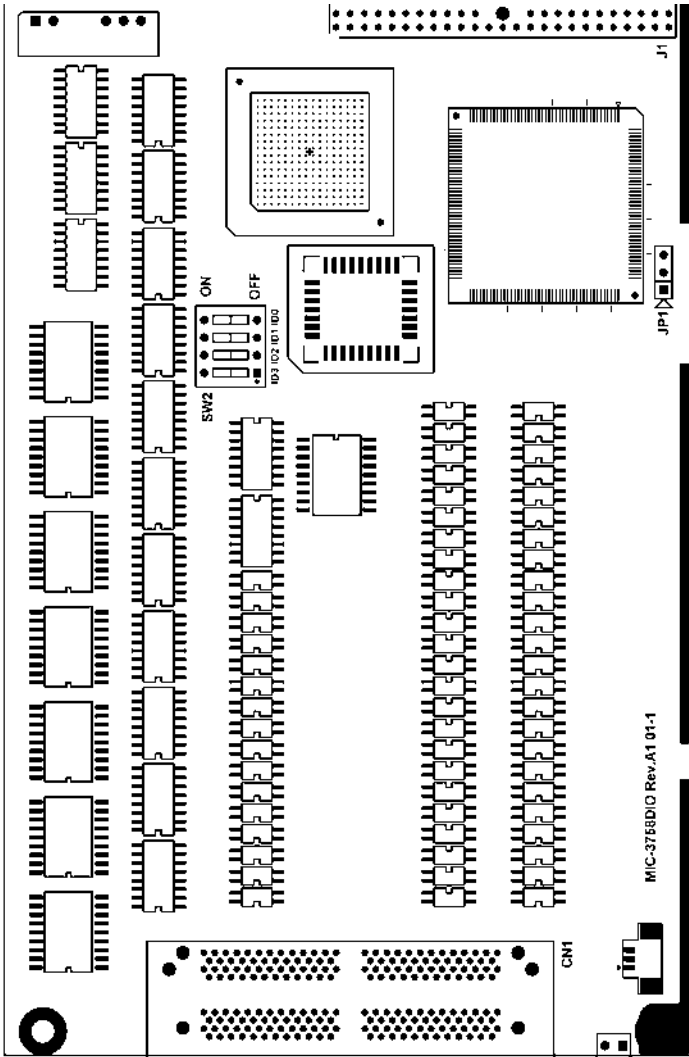
Figure 3.3: Location of Jumper and DIP Switch on MIC-3758DIO

3.3 Isolated Digital Input Connections

MIC-3758DIO has 64 isolated digital input channels designated
P0_IDI00~07, P1_IDI00~07, P2_IDI00~07, P3_IDI00~07,
P4_IDI00~07, P5_IDI00~07, P6_IDI00~07, P7_IDI00~07.

3.3.1 Interrupt Function of the DI Signals

All 64 channels in MIC-3758DIO can be used to generate hardware inter-
rupts. You can setup the configuration of interrupts by programming the
interrupt control register. For more detailed information, please refer to
Section 5.1 Interrupt Function.

3.3.2 Isolated Inputs

Each isolated digital input channel accepts 5~30 VDC inputs, and also
accept bi-directional input. It means that you can apply positive or nega-
tive voltage to an isolated input pin. Every one of the 16 input channels
share one common pin. Figure 3.4 shows how to connect an external
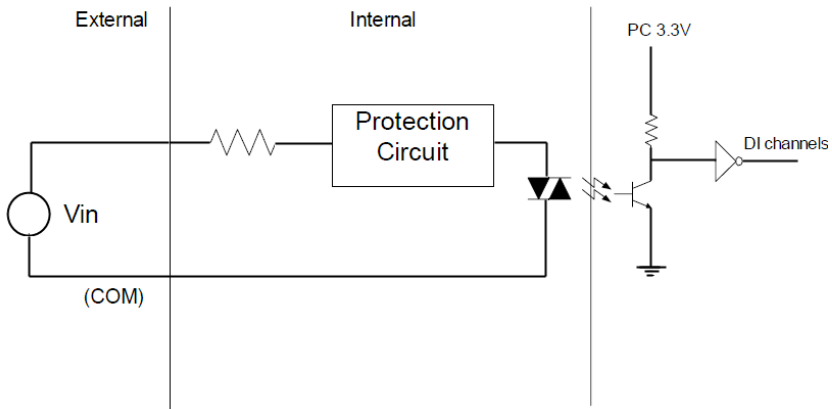input source to one of the card's isolated input channels.

Figure 3.4: Isolated Digital Input Connection

3.4 Isolated Digital Output Connections

MIC-3758DIO has 64 isolated digital output channels designated
P0_IDO00~7, P1_IDO00~7, P2_IDO00~7, P3_IDO00~7,
P4_IDO00~7, P5_IDO00~7, P6_IDO00~7, P7_IDO00~7.

3.4.1 Power-Up Configuration

Default configuration will be set after the power is on. The hardware reset
is to set all the isolated output channels to "off" status (The current of the
load can not be sink mode). So, you do not need to worry about damaging
external devices during system startup or reset. When the system is hot
reset, the status of isolated digital output channels can be selected by
jumper JP1. Table 3.2 shows the configuration of jumper JP1.

Table 3.2: JP1 Power on Configuration after Hot Reset	
MIC-3758DIO JP1	**Power on configuration after hot reset**
	Keep last status after reset
	Load default configuration after reset (Default)

3.4.2 Isolated Outputs

Each of the isolated output channels is equipped with a Darlington tran-
sistor. Every 16 output channel shares common collectors and integral
suppression diodes for induction loads.

Note: *If an external voltage (5 ~ 40 VDC) is applied*
                to an isolated output channel while it is being
                used as an output channel, the current will flow
                from the external voltage source to the card.
                Please be cautious as the current flowing
                through each IDO pin can not exceed 90 mA.

Figure 3-5 shows how to connect an external output load to the card's iso-
lated outputs.
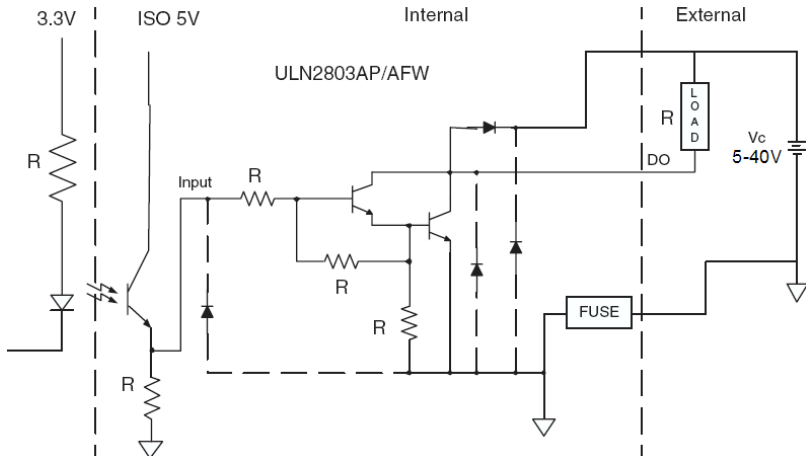
Figure 3.5: Isolated Digital Output Connection

3.5 Field Wiring Considerations

When you use MIC-3758DIO to acquire data from outside, noises in the environment might significantly affect the accuracy of your measurements if due cautions are not taken. The following measures will be helpful to reduce possible interference running signal wires between signal sources and MIC-3758DIO.

• The signal cables must be kept away from strong electromagnetic sources such as power lines, large electric motors, circuit breakers or welding machines, since they may cause strong electromagnetic interference. Keep the analog signal cables away from any video monitor, since it can significantly affect a data acquisition system.

• If the cable travels through an area with significant electromagnetic interference, you should adopt individually shielded, twisted-pair wires as the analog input cable. This type of cable has its signal wires twisted together and shielded with a metal mesh. The metal mesh should only be connected to one point at the signal source ground.

• Avoid running the signal cables through any conduit that might have power lines in it.

• If you have to place your signal cable parallel to a power line that has a high voltage or high current running through it, try to keep a safe distance between them. Or place the signal cable at a right angle of the power line to minimize the effect.

Operation

This chapter describes the operation of the MIC-3758DIO. The software driver provided allows access to all of the card's functions without register level programming. For those who prefer to implement their own bit-level programming, please refer to the following information in this chapter..

Sections include:

- Interrupt Function
- Digital Filter Function
- Power-Up States Function
- Watchdog Timer Register Function
- BoardID Switch

Chapter 4 Operation

4.1 Interrupt Function

MIC-3758DIO provides an interrupt function for every digital input channel. All the isolated digital input channels are connected to the interrupt circuitry. You can disable/enable interrupt function, select trigger type by setting the Rising Edge Interrupt Registers and Falling Edge Interrupt Registers of the MIC-3758DIO. When the interrupt request signals occur, the software will service these interrupt requests by ISR. The multiple interrupt sources provide the card with more capability and flexibility.

4.1.1 IRQ Level

The IRQ level is set automatically by the CompactPCI Plug & Play BIOS and is saved in the CompactPCI controller. There is no need to set the IRQ level. Only one IRQ level is used by this card, although it has two or four interrupt sources.

4.1.2 Interrupt Modes for Digital Input

There are four registers that control the function and status of each digital input interrupt signal source. They give you the ability to select different modes to match different applications. The four registers are: Interrupt State Register, Rising Edge Interrupt Register, Falling Edge Interrupt Register and Port Identify Register. The detailed functions of these registers are described in Appendix C.
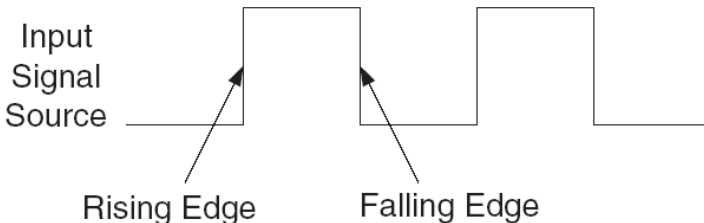
Figure 4.1: Digital Input Interrupt Mode

4.2 Digital Filter Function

The digital filter function is used to eliminate glitches on input data and reduce the number of changes to examine and process. The filter blocks pulses that are shorter than the specified timing interval and passes pulses that are twice as long as the specified interval. Intermediate-length pulses, i.e. pulses longer than half of the interval but less than the interval, may or may not pass the filter.

The following table lists the pulse widths guaranteed to be passed or blocked.

Table 4.1: Pulse Widths Guaranteed				
Filter Interval	Pulse Width Passed		Pulse Width Blocked	
	Low Pulse	High Pulse	Low Pulse	High Pulse
Tinterval	$T_{interval}$	$T_{interval}$	$(T_{interval}/2)$	$(T_{interval}/2)$

You can enable or disable filtering on every input channel as required for your application. All filtered channels share the same timing interval, which range from 200 ns to 400 sec.

There are two clocks: the sample clock and the filter clock, in the filter. The sample clock has a period of 100 ns. The filter clock is generated by a counter and has a period equal to one half of the specified timing interval. The input signal is sampled on each rising edge of the sample clock. However, a change in the input signal is recognized only if it maintains its new state for at least two consecutive rising edges of the filter clock.

The filter clock is programmable and allows you to control how long a pulse must last to be recognized by writing a value to the a 32-bit Filter Interval Time Preset Register. (high 16-bit register and low 16-bit register).

4.2.1 Digital Filtering Example

The following figure shows a filter configuration with an 800 ns filter interval (400 ns filter clock).
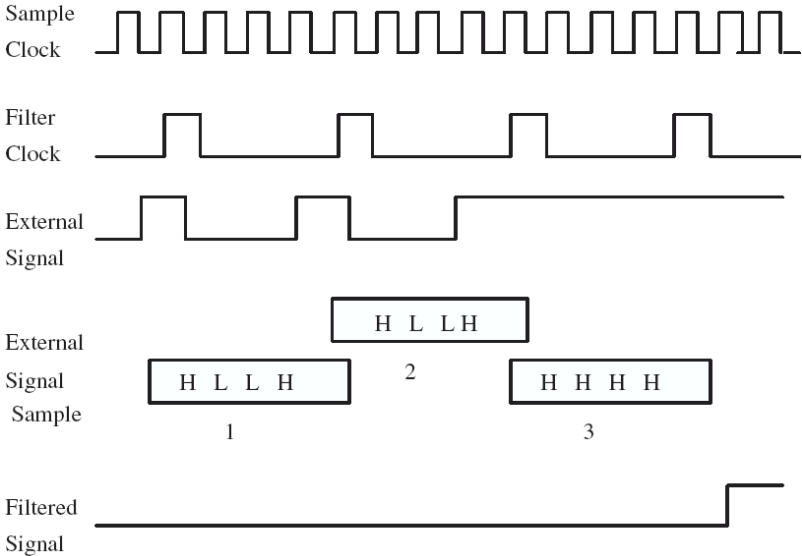
Figure 4.2: Digital Filter Example

In periods 1 and 2, the filter blocks the glitches because the external signal does not remain steadily high from one filter clock to the next. In period 3, the filter passes the transition because the external signal remains steadily high. Depending on when the transition occurs, the filter may require up to two filter clocks—one full filter interval—to pass a transition. The figure shows a rising (0 to 1) transition. The same filtering applies to falling (1 to 0) transitions.

4.2.2 Digital Filter Function Control Register

There are two registers that control the digital filter function and status of each channel: the Digital Filter Function Control Register and the Filter Interval Time Preset Register. For details about their functions, please refer to Appendix C.

4.3 Power-up States Function

User-configurable power-up states are useful for ensuring that the MIC-3758DIO powers up in a known state. When the system is powered-up, all output Darlington arrays of MIC-3758DIO are user-configurable for output. So you can predefine the outputs. This function ensures the card's output state can be defined at any time. Power-up states are programmed in EEPROM with a driver. In the EEPROM Control Register you can write the predefined output data to EEPROM. The default value from the factory is all set to 0. For more details about register operations, please refer to Appendix C.

4.4 Watchdog Timer Register Operation

This feature is used to set critical outputs to safe states in the event of a software failure. When the watchdog timer is enabled, MIC-3758DIO has to receive a watchdog clear software command within the specified interval time. If it doesn't, this is considered a loss of communication between the application and MIC-3758DIO, and the outputs go to a user-defined safe state and remain in that state until the watchdog timer is disabled and new values are written by software.

After the watchdog timer expires, MIC-3758DIO will ignore any writes until the watchdog timer is disabled. You can set the watchdog timer timeout period through the WDT register to specify the amount of time that must elapse before the watchdog timer expires. The counter on the watchdog timer is configurable up to 2^{32}-1 x 100 ns (approximately seven minutes) before it expires. For more details about the watchdog timer register operation, please refer to Appendix C.

4.5 BoardID Switch

MIC-3758DIO has a built-in BoardID DIP switch (SW2), which is used to define each card's unique identity. You can determine the BoardID setting in the register as shown in Table 4.2. When there are multiple cards on the same chassis, the BoardID setting function is useful for identifying each card's device number. MIC-3758DIO's BoardID setting is set to 0 at the factory. If you need to adjust it to another number, set SW2 by referring to Table 4.3.

Table 4.2: BoardID Register of MIC-3758DIO				
	BoardID register of MIC-3758DIO			
Base Addr.+ 3Eh	3	2	1	0
Abbreviation	ID3	ID2	ID1	ID0

ID0: the least significant bit (LSB) of BoardID setting

ID3: the most significant bit (MSB) of BoardID setting

Table 4.3: BoardID Setting (SW2)				
BoardID (DEC)	Switch Position			
	ID3	ID2	ID1	ID0
0*	ON	ON	ON	ON
1	ON	ON	ON	OFF
2	ON	ON	OFF	ON
3	ON	ON	OFF	OFF
4	ON	OFF	ON	ON
5	ON	OFF	ON	OFF
6	ON	OFF	OFF	ON
7	ON	OFF	OFF	OFF
8	OFF	ON	ON	ON
9	OFF	ON	ON	OFF
10	OFF	ON	OFF	ON
11	OFF	ON	OFF	OFF
12	OFF	OFF	ON	ON
13	OFF	OFF	ON	OFF
14	OFF	OFF	OFF	ON
15	OFF	OFF	OFF	OFF
* Default				

Specifications

Appendix A Specifications

A.1 Specifications

A.1.1 Isolated Digital Inputs

Number of Input Channels		64
Interrupt Inputs		64
Optical Isolation		2500 VDC
Opto-isolator response time		20 µs
ESD		2000 VDC
Input Voltage	VIH(max)	25 V
	VIH(min)	5 V
	VIL(max)	2.5 V
Input Current	5 V	1.30 mA(typical)
	10 V	2.90 mA(typical)
	12 V	3.60 mA(typical)
	24 V	7.90 mA(typical)

A.1.2 Isolated Digital Output

Number of Input Channels	64
Optical Isolation	2500 VDC
Opto-isolator response time	20 µs
Supply Voltage	5-40 V
Sink Current	90 mA max./channel

A.1.3 General

I/O connector Type		MINI-SCSI HDRA-E100 Female
Dimensions		160 x 100 mm (6.3" x 3.9")
Power Consumption	Typical	+5V@800mA, +3.3V@600mA
	Max.	+5V@1A, +3.3V@1A
Temperature	Operating	0~60° C (32~140° F) (refer to IEC 68-2-1,2)
	Storage	-20~70° C (-4~158° F)
Relative Humidity		5~95 % RH non-condensing (refer to IEC 68-2-3)

Function Block Diagram

Appendix B Function Block Diagram

B.1 MIC-3758DIO Block Diagram
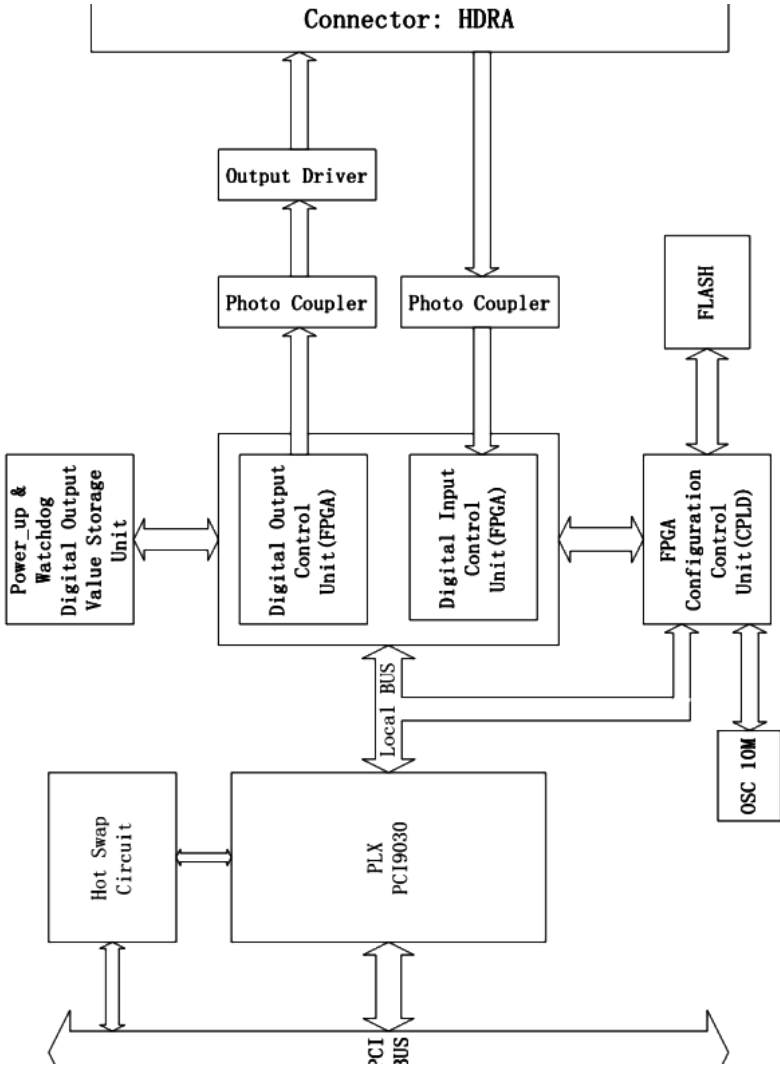
Register & Structure Format

Appendix C Register & Structure Format

C.1 Register Structure

MIC-3758DIO is delivered with an easy-to-use 32-bit DLL driver for user programming under the Windows 98/NT/2000/XP operating systems. We advise users to program the MIC-3758DIO using the 32-bit DLL driver provided by Advantech to avoid the complexity of low-level programming by register.

The most important consideration in programming the MIC-3758DIO at the register level is to understand the function of the card's registers. The information in the following sections is provided only for those who would like to do their own low-level programming.

MIC-3758DIO requires 64 consecutive addresses in the PC's I/O space. The address of each register is specified as an offset from the card's base address. For example, BASE+0 is the card's base address and BASE+8 is the base address plus eight bytes.

Note: *All registers only support 16-bit data access.*

Base Address (Hex)	Register Description	
	Write	Read
0H	--	Digital Input Port0 and Port1
2H	--	Digital Input Port2 and Port3
4H	--	Digital Input Port4 and Port5
6H	--	Digital Input Port6 and Port7
8H	Digital Output Port0 and Port1	Digital Output Port0 and Port1 Read Back
AH	Digital Output Port2 and Port3	Digital Output Port2 and Port3 Read Back
CH	Digital Output Port4 and Port5	Digital Output Port4 and Port5 Read Back
EH	Digital Output Port6 and Port7	Digital Output Port6 and Port7 Read Back
10H	DI Port0 and Port1 Rising Edge Interrupt Register	DI Port0 and Port1 Rising Edge Interrupt Register
12H	DI Port0 and Port1 Falling Edge Interrupt Register	DI Port0 and Port1 Falling Edge Interrupt Register
14H	DI Port2 and Port3 Rising Edge Interrupt Register	DI Port2 and Port3 Rising Edge Interrupt Register
16H	DI Port2 and Port3 Falling Edge Interrupt Register	DI Port2 and Port3 Falling Edge Interrupt Register
18H	DI Port4 and Port5 Rising Edge Interrupt Register	DI Port4 and Port5 Rising Edge Interrupt Register
1AH	DI Port4 and Port5 Falling Edge Interrupt Register	DI Port4 and Port5 Falling Edge Interrupt Register
1CH	DI Port6 and Port7 Rising Edge Interrupt Register	DI Port6 and Port7 Rising Edge Interrupt Register
1EH	DI Port6 and Port7 Falling Edge Interrupt Register	DI Port6 and Port7 Falling Edge Interrupt Register
20H	DI Port 0 and Port 1 Interrupt State Register	DI Port 0 and Port 1 Interrupt State Register
22H	DI Port 2, Port 3 Interrupt State Reg.	DI Port 2 and Port 3 Interrupt State Register
24H	DI Port 4, Port 5 Interrupt State Reg.	DI Port 4 and Port 5 Interrupt State Register
26H	DI Port 6, Port 7 Interrupt State Reg.	DI Port 6 and Port 7 Interrupt State Register
28H	DI Port 0 and Port 1 Digital filter Enable Register	DI Port 0 and Port 1 Digital filter Enable Register
2AH	DI Port 2 and Port 3 Digital filter Enable Register	DI Port 2 and Port 3 Digital filter Enable Register
2CH	DI Port 4 and Port 5 Digital filter Enable Register	DI Port 4 and Port 5 Digital filter Enable Register
2EH	DI Port 6 and Port 7 Digital filter Enable Register	DI Port 6 and Port 7 Digital filter Enable Register
30H	Digital Filter interval time preset low 16 bits	Digital Filter interval time preset low 16 bits
32H	Digital Filter interval time preset high 16 bits	Digital Filter interval time preset high 16 bits
34H	Watchdog counter values low 16 bits	Watchdog counter values low 16 bits
36H	Watchdog counter values high 16 bits	Watchdog counter values high 16 bits
38H	Watchdog timer Control Register	Watchdog timer State Register
3AH	Watchdog Timer Clear Register	--
3CH	EEPROM Control Register	EEPROM DO Status
3EH	--	BoardID
40H	--	INT of Port Identify Register

C.2 Digital Input Register

MIC-3758DIO can sense DC signals from 5 to 25 V.

Applying a DC voltage of at least 5 V across the two input terminals registers a logic high for that input. If no voltage is present (a voltage of 3 V or less), MIC-3758DIO registers a logic low for that input. DC voltages between 3 and 5 V are invalid and register an unreliable value.

Base+0x00/02/04/06: Digital Input Value

Base+0x00 - 0x06(Read)															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
P1 IDI7	P1 IDI6	P1 IDI5	P1 IDI4	P1 IDI3	P1 IDI2	P1 IDI1	P1 IDI0	P0 IDI7	P0 IDI6	P0 IDI5	P0 IDI4	P0 IDI3	P0 IDI2	P0 IDI1	P0 IDI0

Base+0x00 - 0x06(Write)															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
N/A															

Bit 15 - Bit 0(Read):

• 0: The Pn-IDIm input: no voltage is present or a voltage below 3 V

• 1: The Pn-IDIm input: a voltage over 5 V is present

(n : 0 to 7 is for Port 0 to Port 7, m : 0 to 7 is for IDI0 to IDI7)

Base+0x00 for Port 1 and Port 0

Base+0x02 for Port 3 and Port 2

Base+0x04 for Port 5 and Port 4

Base+0x06 for Port 7 and Port 6

C.3 Digital Output Register

The outputs on MIC-3758DIO are optically isolated photocouplers with Darlington arrays. You can configure the outputs as follows:

Writing a 1 (logic high) to an output line switches **on** one channel of the Darlington array and allows current to pass through the output line.

Writing a 0 (logic low) to an output line switches **off** one channel of the Darlington array and prohibits current from passing through the output line.

Base+0x08/0A/0C/0E: Digital Output Register.

Base+0x08 - 0x0E(Read/Write)															
Bit15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
P1 IDO7	P1 IDO6	P1 IDO5	P1 IDO4	P1 IDO3	P1 IDO2	P1 IDO1	P1 IDO0	P0 IDO7	P0 IDO6	P0 IDO5	P0 IDO4	P0 IDO3	P0 IDO2	P0 IDO1	P0 IDO0

Bit 15 - Bit 0 (Write):

• 0: The Pn-IDOm output Darlington switch OFF

• 1: The Pn-IDOm output Darlington switch ON

Bit 15 - Bit 0 (Read back):

0: The Pn-IDOm output Darlington state is OFF

1: The Pn-IDOm output Darlington state is ON

(n : 0 to 7 for Port 0 to Port 7, m : 0 to 7 for IDO0 to IDO7)

Base+0x08 for Port 1 and Port 0

Base+0x0A for Port 3 and Port 2

Base+0x0C for Port 5 and Port 4

Base+0x0E for Port 7 and Port 6

C.4 Digital Input Rising Edge Interrupt Register

When the digital input Rising Edge Interrupt is enabled, a 0 to 1 transaction on input channel will generate a interrupt to PC. Each digital input channel has a independent interrupt enable control bit.

Base+0x10/14/18/1C: Digital Input Rising Edge Interrupt setting.

Base+0x10 - 0x1C(Read/Write)															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
P1 IDI7	P1 IDI6	P1 IDI5	P1 IDI4	P1 IDI3	P1 IDI2	P1 IDI1	P1 IDI0	P0 IDI7	P0 IDI6	P0 IDI5	P0 IDI4	P0 IDI3	P0 IDI2	P0 IDI1	P0 IDI0

Bit 15 - Bit 0(Write):

- 0: Disable the Pn-IDIm Rising Edge interrupt function
- 1: Enable the Pn-IDIm Rising Edge interrupt function

(n : 0 to 7 is for Port 0 to Port 7, m : 0 to 7 is for IDI0 to IDI7)

Bit 15 - Bit 0(Read): Read back the setting value.

Base+0x10 for Digital Input Port 1 and Digital Input Port 0

Base+0x14 for Digital Input Port 3 and Digital Input Port 2

Base+0x18 for Digital Input Port 5 and Digital Input Port 4

Base+0x1C for Digital Input Port 7 and Digital Input Port 6

C.5 Digital Input Falling Edge Interrupt Register

When the digital input Falling Edge Interrupt is enabled, a 1 to 0 transaction on the input channel will generate a interrupt to the PC. Each digital input channel has a independent interrupt enable control bit.

Base+0x12/16/1A/1E: Digital Input Falling Edge Interrupt setting

Base+0x12 - 0x1E(Read/Write)															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
P1 IDI7	P1 IDI6	P1 IDI5	P1 IDI4	P1 IDI3	P1 IDI2	P1 IDI1	P1 IDI0	P0 IDI7	P0 IDI6	P0 IDI5	P0 IDI4	P0 IDI3	P0 IDI2	P0 IDI1	P0 IDI0

Bit 15 - Bit 0(Write):

• 0: Disable the Pn-IDIm Falling Edge interrupt function

• 1: Enable the Pn-IDIm Falling Edge interrupt function

(n : 0 to 7 for Port 0 to Port 7, m : 0 to 7 for IDI0 to IDI7)

Bit 15 - Bit 0(Read): Read back the setting value.

Base+0x12 for Port 1 and Port 0

Base+0x16 for Port 3 and Port 2

Base+0x1A for Port 5 and Port 4

Base+0x1E for Port 7 and Port 6

C.6 Interrupt State Register

Base+0x20/22/24/26: Interrupt state setting.

Base+0x20 - 0x26(Read/Write)															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
P1 IDI7	P1 IDI6	P1 IDI5	P1 IDI4	P1 IDI3	P1 IDI2	P1 IDI1	P1 IDI0	P0 IDI7	P0 IDI6	P0 IDI5	P0 IDI4	P0 IDI3	P0 IDI2	P0 IDI1	P0 IDI0

This register can read and clear the status of the interrupt flag. If an interrupt occurs, you can check the status of 0x40 (refer to C.7) to identify in which port the interrupt occurred. Then you can read the identified port to know in which bit an interrupt occurs. If you want to clear the interrupt flag, just identify in which bit the interrupt occurs and then write "1" into that bit directly.

Bit 15 - Bit 0 (Read): Read the Interrupt Flag Status

• 1: means an interrupt flag occurs in Pn-IDIm

• 0: means no interrupt flag occurs in Pn-IDIm

(n : 0 to 7 for Port 0 to Port 7, m : 0 to 7 for IDI0 to IDI7)

To identify in which port an interrupt occurs, please refer to C.7

Bit 15 - Bit 0 (Write): Clear the Interrupt Flag.

• 1: Clear the interrupt flag in Pn-IDIm

• 0: Keep the interrupt flag status in Pn-IDIm

Base+0x20 for Port 1 and Port 0

Base+0x22 for Port 3 and Port 2

Base+0x24 for Port 5 and Port 4

Base+0x26 for Port 7 and Port 6

C.7 Interrupt Of Port Identify Register

Base+0x40: Interrupt Port Identify Register.

Base+0x40(Read)															
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
--	--	--	--	--	--	--	--	P7	P6	P5	P4	P3	P2	P1	P0

Bit0~Bit7 (Read): Identify in which port an interrupt occurs from Digital Input port 0 to Digital Input port 7.

1: means an interrupt occurs in this port.

0: means no interrupt occurs in this port.

There are two registers which control the digital filter function and status of each channel: **Digital Filter Enable Register** and **Filter Interval Time Preset Register**.

C.8 Digital Filter Function Control Register

Base+0x28/2A/2C/2E: Digital Filter Function Control Register

Base+0x28 - 0x2E(Read/Write)															
Bit15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
P1 IDI7	P1 IDI6	P1 IDI5	P1 IDI4	P1 IDI3	P1 IDI2	P1 IDI1	P1 IDI0	P0 IDI7	P0 IDI6	P0 IDI5	P0 IDI4	P0 IDI3	P0 IDI2	P0 IDI1	P0 IDI0

Bit 15 - Bit 0(Write):

- 0: Disable the Pn-IDIm digital filter function
- 1: Enable the Pn-IDIm digital filter function

Bit 15 - Bit 0(Read back):

- 0: Disable the Pn-IDIm digital filter function
- 1: Enable the Pn-IDIm digital filter function

(n: 0 to 7 for Port 0 to Port 7, m : 0 to 7 for IDI0 to IDI7)

Base+0x28 for Port 1 and Port 0

Base+0x2A for Port 3 and Port 2

Base+0x2C for Port 5 and Port 4

Base+0x2E for Port 7 and Port 6

C.9 Filter Interval Time Preset Register

Base+0x30(Read/Write)

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Filter interval time preset register Low 16 bits															

Base+0x32(Read/Write)

Bit15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Filter interval time preset register High 16 bits															

The filter interval time is preset by writing a 32-bit value to the two registers. The high 16 bits should be written to Filter Interval Time Preset register high 16 bits and the low 16 bits should be written to Filter Interval Time Preset register low 16 bits. The value written to the two registers is calculated by the following formula:

$T_{interval}$ = Value x 200 ns

For example:

- Filter Interval Time Preset register high 16 bits =0x0001;
- Filter Interval Time Preset register low 16 bits =0x0000;
- Value = 0x00010000;
- $T_{interval}$ = Value x 200ns=13107200ns;

C.10 Watchdog Counter Value Register

Base+0x34/36: Watchdog Counter Value Register.

Base+0x34 (Read/Write)

Bit15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Watchdog counter values low 16 bits															

Base+0x36 (Read/Write)

Bit15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Watchdog counter values high 16 bits															

Watchdog timer Interval = WDT x 100 ns

For example:

- Watchdog timer values high 16 bits Register=0x0001;
- Watchdog timer values low 16 bits Register=0x0000;
- WDT=0x00010000;
- Watchdog timer Interval = WDT x 100ns=6553600ns;

C.11 Watchdog State/Control Register

Base+0x38: WDT function setting

Base+0x38 (Write)

Bit 15-Bit 2	Bit1	Bit0
N/A	WDT INT EN	WDT En

Bit 0: watchdog timer enable control bit

- 0 : Disable WDT function

- 1 : Enable WDT function

(When the WDT is enabled the watch dog timer (WDT) in MIC-3758DIO start counting down from the value set in Base+0x34h and Base+0x36h)

Bit 1: watchdog timer interrupt enable control bit

- 0: Disable WDT interrupt

- 1: Enable WDT interrupt

(When the WDT interrupt is enabled, a interrupt will generate while the WDT counting down to 0; otherwise it won't generate a interrupt even when the WDT count down to 0)

Base+0x38 (Read)

Bit 15-Bit 3	Bit2	Bit1	Bit0
N/A	WDT Timeout flag	WDT INT EN	WDT En

Bit 0: Read the status of WDT En

Bit 1: Read the status of WDT INT EN

Bit 2: Read the status of WDT

- 0: WDT current value is not 0

- 1: WDT current value is 0

C.12 Watchdog Time Clear Register

Base+0x3A: Watchdog timer reset Register

Base+0x3A (Write)	
Bit 15 - Bit 1	Bit0
N/A	Clear_WDT

Bit 0: Watchdog timer reset bit

- 0: Reset the Watchdog Timer to pre-set value
- 1: Keep the Watchdog Timer current state

(Writing a 0 to this bit will reload the preset value to the watchdog timer and the WDT will count down from that value)

C.13 EEPROM Control/DO State Register

Base+0x3C: EEPROM DO state Register

Base+0x3C (Read)	
Bit 15 - Bit 1	Bit0
N/A	DO

Bit 0: EEPROM DO state

Base+0x3C (Write)				
Bit 15 - Bit 4	Bit3	Bit2	Bit1	Bit0
	CS	CLK	DI	DO

Through this register you can set the power up status and watchdog timer overflow states in the EEPROM.

- CS: EEPROM select
- CLK: EEPROM clock
- DI: EEPROM data in
- DO: EEPROM data out

The data format of EEPROM:

Address	Stored data description	Stored data class
0x00	P1_IDO & P0_IDO	Digital output power up values
0x01	P3_IDO & P2_IDO	
0x02	P5_IDO & P4_IDO	
0x03	P7_IDO & P6_IDO	
0x04	--	
0x05	--	
0x06	--	
0x07	--	
0x10	P1_IDO & P0_IDO	Digital output WDT overflow values
0x11	P3_IDO & P2_IDO	
0x12	P5_IDO & P4_IDO	
0x13	P7_IDO & P6_IDO	
0x14	--	
0x15	--	
0x16	--	
0x17	--	

Note: *It is recommended that you implement the function in base+0x3C through the driver instead of through this register directly.*

C.14 BoardID Register

You can determine the BoardID setting in the register as shown on table below. When there are multiple cards on the same chassis, this BoardID setting function is useful for identifying each card's device number. We set the MIC-3758DIO BoardID setting to 0 at the factory. If you need to adjust it to another number, set SW2 by referring to the table.

BoardID register of MIC-3758DIO				
Base Add.+ 3Eh	Bit3	Bit2	Bit1	Bit0
Abbreviation	ID3	ID2	ID1	ID0

ID0: the least significant bit (LSB) of BoardID

ID3: the most significant bit (MSB) of BoardID

BoardID Setting (SW2)				
BoardID (DEC)	Switch Position			
	ID3	ID2	ID1	ID0
0*	ON	ON	ON	ON
1	ON	ON	ON	OFF
2	ON	ON	OFF	ON
3	ON	ON	OFF	OFF
4	ON	OFF	ON	ON
5	ON	OFF	ON	OFF
6	ON	OFF	OFF	ON
7	ON	OFF	OFF	OFF
8	OFF	ON	ON	ON
9	OFF	ON	ON	OFF
10	OFF	ON	OFF	ON
11	OFF	ON	OFF	OFF
12	OFF	OFF	ON	ON
13	OFF	OFF	ON	OFF
14	OFF	OFF	OFF	ON
15	OFF	OFF	OFF	OFF
* : Default				