

# PCI-TC03

## User Manual

Version 1.1



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# Contents

<b>1. Introduction</b>	-----	<b>3</b>
1-1 Product Features	-----	4
1-2 Product Applications	-----	5
 <b>2. PCI-TC03 Block Diagram</b>	-----	 <b>6</b>
 <b>3. PCI-TC03 Board Description</b>		
3-1 Board Layout	-----	7
3-2 Device Features	-----	8
3-3 Connector Pin Map		
3-3-1 External DSub-37Pin (J2)	-----	9
3-3-2 Internal BOX 40Pin (JP1)	-----	11
3-3-3 Output Power Jumper (J3, J6)	-----	13
3-3-4 SW1	-----	13
3-3-5 SW2	-----	14
3-4 Counter Input Circuit	-----	15
3-5 Timer Output Circuit	-----	16
3-6 Digital Input Circuit	-----	17
3-7 Digital Output Circuit	-----	18
 <b>4. Installation</b>		
4-1 Hardware Installation	-----	19
4-1-1 Product Contents	-----	19
4-1-2 Installation Process	-----	19
4-2 Driver Installation	-----	20

5. Sample Program

5-1	Program Interface	-----	24
5-2	Function Description	-----	25

Appendix

A-1	Repair Regulations	-----	26
-----	--------------------	-------	----

Reference

-----	27
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## 1. Introduction

PCI-TC03 is a board with 8 32-bit counter/timers (RS-485 or RS-422 Type) and 16-bit digital input/output (TTL Level) board that is perfectly compatible with industrial PCs and uses a PCI interface. All control of this board is designed with FPGA (Field Programmable Gate Array), so function enhancement or modification is free, and it can be easily upgraded according to the user's needs.

### ➤ DAQ System Digital I/O Products

Product	No. In/Out	Timer/Counter	Specification
cPCI-DIO6400	32/32		Isolated Input/Output
cPCI-DIO02	128 channels Software Configurable		Read/Write in 8 Groups in 16-bit Units
PCI(e)-DIO6400	32/32		Isolated Input/Output
PCI-DIO6401	64/None		Isolated Input
PCI-DIO6402	None/64		Isolated Output
PCI-DIO01	32/32 Software Configurable	1/1	TTL Level Input/Output 32bit Counter/Timer
PCI-DIO02	128 channels Software Configurable	1/1	Read/Write in 8 Groups in 16-bit Units
PCI-DIO12	16/16 or 32/32 Software Configurable		128Mbyte DDR SDRAM Data transfer rate up to 400Mb/s
PCI-MOT01	24/24 (Isolated)		1 Channel PWM, 2 Channel Encoder, 1 Channel ADC
PCI-PWM02	6/12(Isolated)		4 Channel Triggered PWM outputs
PCI(e)-TC03	16/16	8/8	32bit resolution Differential Counter/Timer
PCI-EK01	24(shared)	1/1(32bit)	12bit 8 Channel A/D Input 12bit 8 Channel D/A Output
PCIe-DIO05	32/32		TTL Level Input/Output
USB-AIO10	24/24(Isolated)		4-Ch Analog Input and Output RS-232 115,200bps Interface
USB-DIO12800	128 channels Software Configurable		Read/Write in 8 Groups in 16-bit Units
USB-DIO6400	32/32		Isolated Input/Output 12Mbps
USB-MULTI	2/None		Isolated Input/Output 16bit Counter In & Timer Out
USB-PWM10	6/8(Isolated)		4 Channel Triggered PWM outputs

## 1-1 Product Features

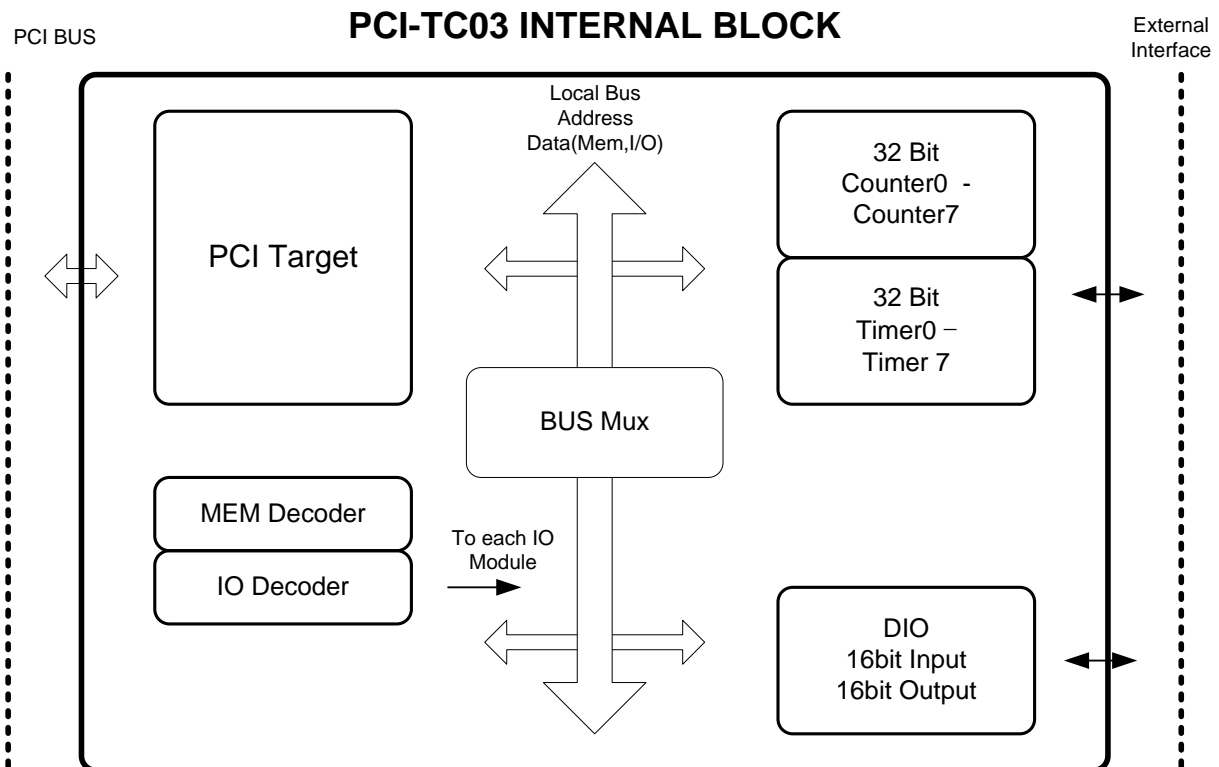
Items	Description	Remark
<b>Hardware</b>		
PC Interface	PCI 32bit/33Mhz	
Operation Power	+5VDC at 250mA typical	
I/O Port	D-Sub37	Plug Type
Feature	8Ch Counter/Timer, 16/16bit Digital I/O	
Isolated Digital Input	Number of Channels : 16 Number of Common Input : 2 Maximum Input Range(Non-polarity) : 12V Digital Logic Levels : Input High level 5 ~12V Input Low voltage 0 ~ 1.5V Input Resistance : 4.7Kohm@1.2W Isolation Voltage : 2500Vrms Isolated input voltage up to 12V Interrupt Sources : Programmed I/O	
Isolated Digital Output	Number of Channels : 16 Output type : Open collector Supply Voltage : 5V PCI or Isolated 5V(inside equipped) Isolation Voltage : 5000Vrms Data Transfer : Programmed I/O	
Counter/Timer	8 Independent 32bit Counters & 8-Ch Independent 32bit Timers Isolation Counter Input & Timer Output Base Timer Clock : 10MHz I/O Level : 12V(External)	
Simultaneous use of boards	Max. 4 (Currently, only one board is supported)	
Operating temperature range	0 ~ 60°C	
Storage temperature range	-20 ~ 80°C	
Humidity range	5 ~ 95%	Non-condensing
Board size	160mm X 100mm	PCB Board Size
<b>Software</b>		
OS	Windows 2000/XP/7/8/10 (32/64bit)	
API	Windows Client DLL API	
Development	Windows Application by User	
Support	Sample Program	VC++

## 1-2 Product Applications

- ◆ Data acquisition
- ◆ Laboratory instrumentation
- ◆ Process control systems

## 2. PCI-TC03 Block Diagram

PCI-TC03 consists of 8 32-bit counters, 8 32-bit timers, 16-bit digital input circuit, and 16-bit digital output circuit as shown in [Figure 2-1].



[Figure 2-1. PCI-TC03 Internal Block Diagram]

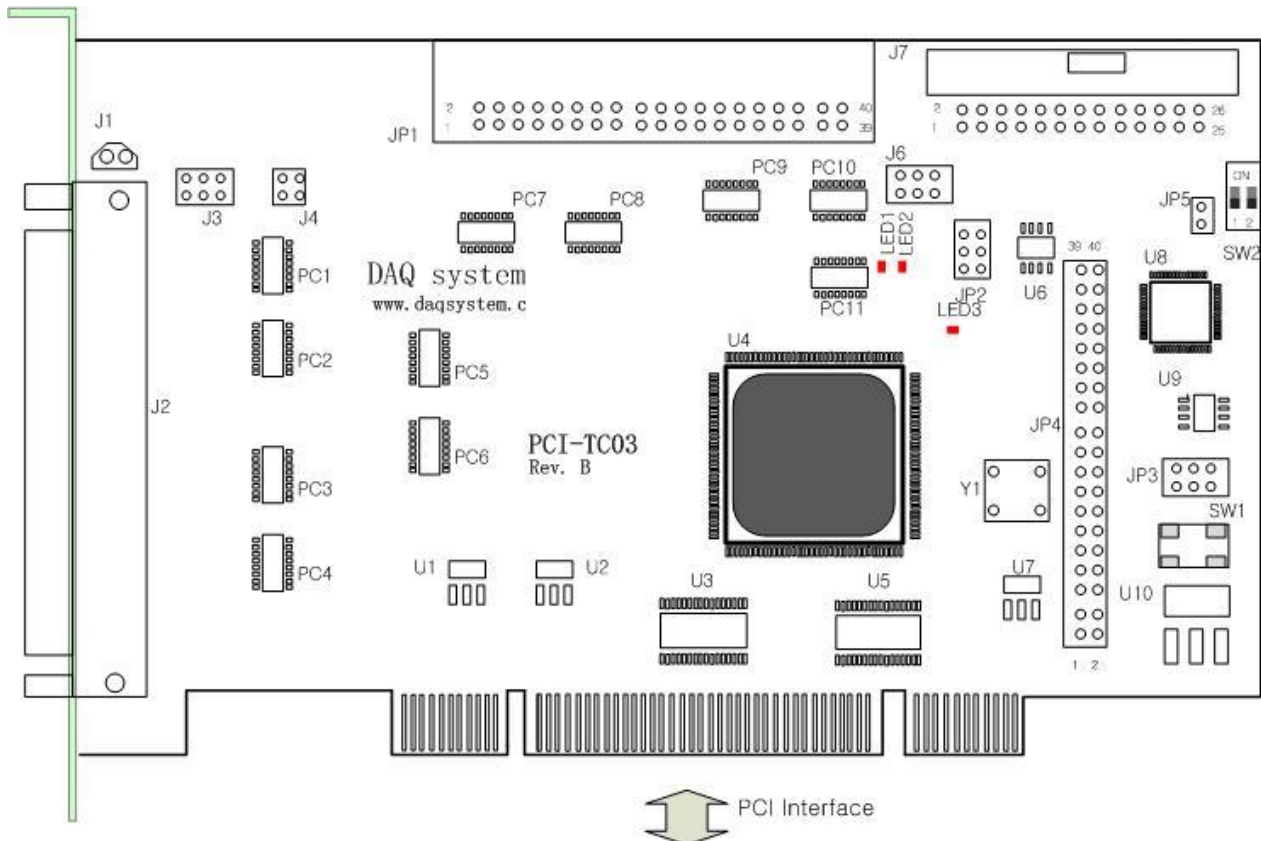
### GENERAL DESCRIPTION

- ◆ PCI 32-bit, 33MHz 5/3.3V compatible target board
- ◆ 16-bit digital input/output ports
- ◆ 8-port 32-bit Differential Timer
- ◆ 8-port 32-bit Differential Counter
- ◆ 3.3V CMOS and TTL logic input, 3.3V CMOS logic output level

### 3. PCI-TC03 Board Description

Each important board function is briefly described. For detailed function information, please refer to the parts specification.

#### 3-1 Board Layout



[Figure 3-1. PCI-TC03 Layout]

There are 3 LEDs on the board, and the description of each is as follows.

**LED1** : Blinks according to PCI Express clock change.

**LED2** : Blinks when there is a change in the COUNT0 or COUNT1 input signal.

**LED3** : Lights up when FPGA fusing is complete.



## 3-2 Device Features

(1) **FPGA : U4**

All functions of the board are controlled through this FPGA Logic.

(2) **Photo-coupler : PC1 ~ PC11**

Photo-coupler chipset.

(3) **Regulator : U1, U2, U7, U10**

It supplies the power used by the board.

(4) **PCI Chipset : U3, U5**

PCI Signal Control

(5) **CPLD : U8**

In-system programming for general purpose logic integration is provided.

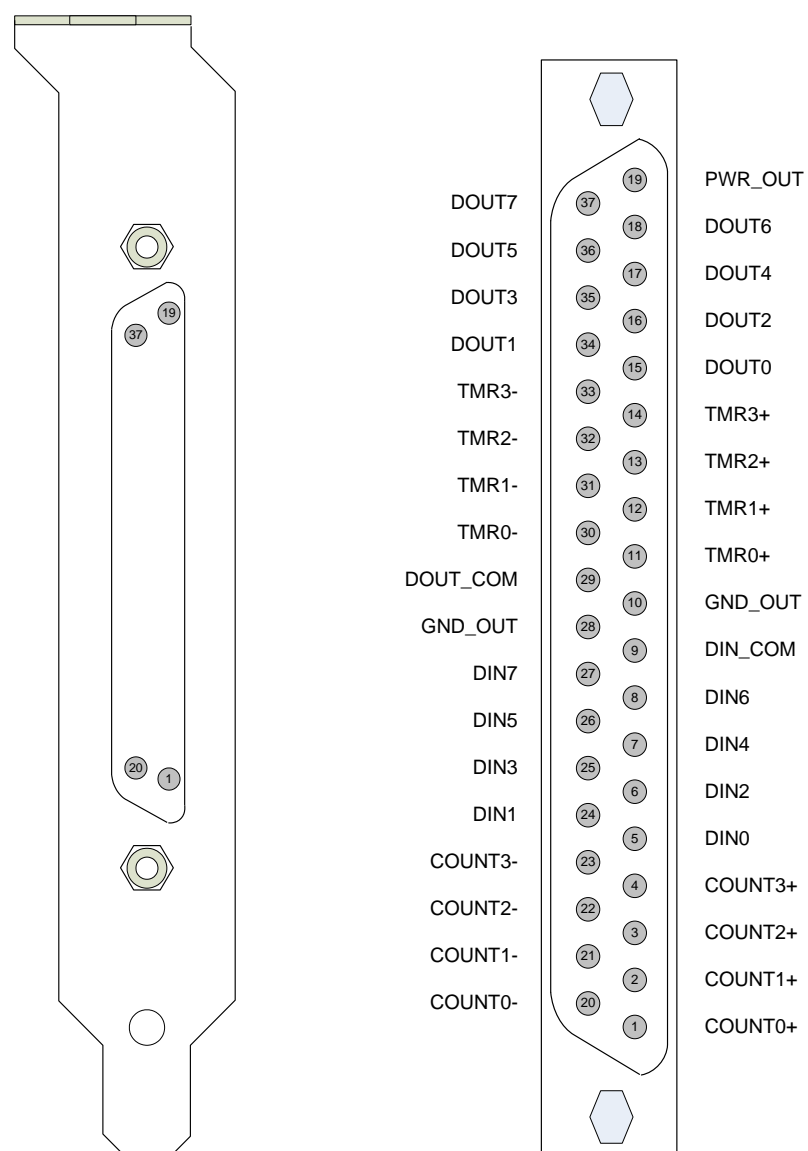
(6) **Oscillator : Y1**

It supplies 40MHz to the board.

### 3-3 Connector Pin Map

PCI-TC03 receives counter, timer and digital I/O in two parts: D-Sub37 Pin (external connector) J2 and BOX 40 Pin header (internal connector) JP1.

#### 3-3-1 External DSub-37Pin (J2)



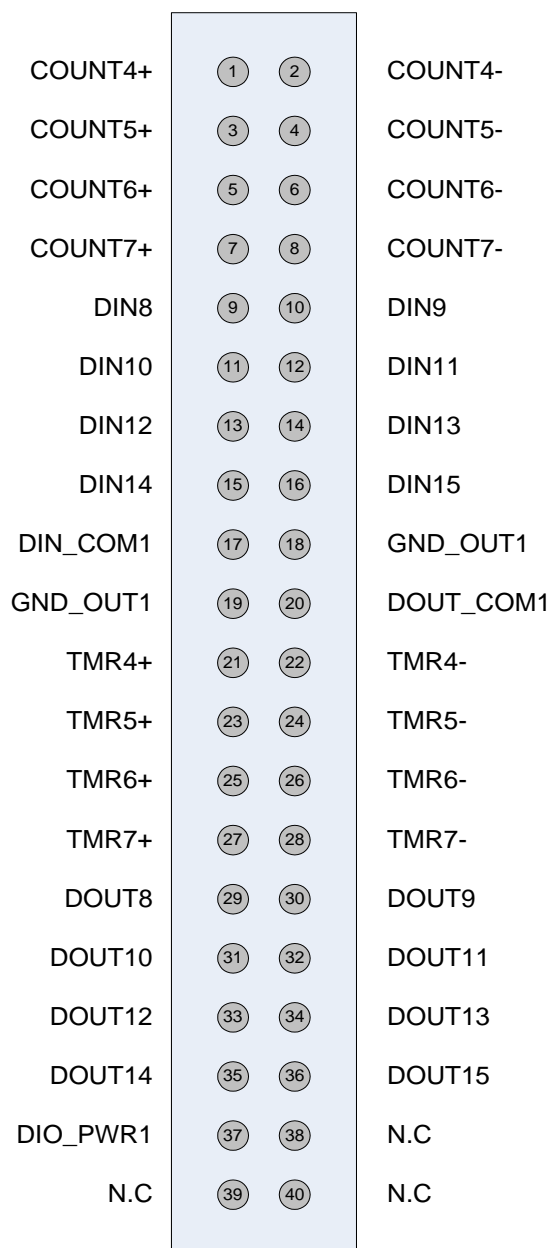
[Figure 3-1. J2 Connector]

[Table 1. PCI-TC03 J2 Connector]

Pin No.	Pin Name	Description	Remark
1	COUNT0+	Counter0 + Input	
2	COUNT1+	Counter1 + Input	

3	COUNT2+	Counter2 + Input	
4	COUNT3+	Counter3 + Input	
5	DIN0	Digital Input 0	
6	DIN2	Digital Input 2	
7	DIN4	Digital Input 4	
8	DIN6	Digital Input 6	
9	DIN_COM	Digital Input Common	DIN0~7 Common Input
10	GND OUT	Board Ground Output	
11	TMR0 +	Timer0 + Output	
12	TMR1 +	Timer1 + Output	
13	TMR2 +	Timer2 + Output	
14	TMR3 +	Timer3 + Output	
15	DOUT0	Digital Output 0	
16	DOUT2	Digital Output 2	
17	DOUT4	Digital Output 4	
18	DOUT6	Digital Output 6	
19	PWR_OUT	Board Power Output	
20	COUNT0-	Counter0 - Input	
21	COUNT1-	Counter1 - Input	
22	COUNT2-	Counter2 - Input	
23	COUNT3-	Counter3 - Input	
24	DIN1	Digital Input 1	
25	DIN3	Digital Input 3	
26	DIN5	Digital Input 5	
27	DIN7	Digital Input 7	
28	GND OUT	Board Ground Output	
29	DOUT_COM	Digital Output Common	DOUT0~7 Common Output
30	TMR0 -	Timer0 - Output	
31	TMR1 -	Timer1 - Output	
32	TMR2 -	Timer2 - Output	
33	TMR3 -	Timer3 - Output	
34	DOUT1	Digital Output 1	
35	DOUT3	Digital Output 3	
36	DOUT5	Digital Output 5	
37	DOUT7	Digital Output 7	

### 3-3-2 Internal BOX 40Pin (JP1)



[Figure 3-2. PCI-TC03 BOX 40 Pin JP1 Connector]

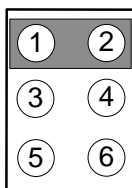
[Table 2. PCI-TC03 BOX40 PIN JP1 Connector(HIROSE HIF3F-40PA-2.54DS)]

Pin No.	Pin Name	Description	Remark
1	COUNT4+	Counter4 + Input	
2	COUNT4-	Counter4 - Input	
3	COUNT5+	Counter5 + Input	
4	COUNT5-	Counter5 - Input	
5	COUNT6+	Counter6 + Input	

6	COUNT6-	Counter6 - Input	
7	COUNT7+	Counter7 + Input	
8	COUNT7-	Counter7 - Input	
9	DIN8	Digital Input 8	
10	DIN9	Digital Input 9	
11	DIN10	Digital Input 10	
12	DIN11	Digital Input 11	
13	DIN12	Digital Input 12	
14	DIN13	Digital Input 13	
15	DIN14	Digital Input 14	
16	DIN15	Digital Input 15	
17	DIN_COM1	Digital Input Common 1	DIN8~15 Common Input
18	GND OUT1	Board Ground Output	
19	GND OUT1	Board Ground Output	
20	DOUT_COM1	Digital Output Common 1	DOUT8~15 Common Output
21	TMR4 +	Timer4 + Output	
22	TMR4 -	Timer4 - Output	
23	TMR5 +	Timer5 + Output	
24	TMR5 -	Timer5 - Output	
25	TMR6 +	Timer6 + Output	
26	TMR6 -	Timer6 - Output	
27	TMR7 +	Timer7 + Output	
28	TMR7 -	Timer7 - Output	
29	DOUT8	Digital Output 8	
30	DOUT9	Digital Output 9	
31	DOUT10	Digital Output 10	
32	DOUT11	Digital Output 11	
33	DOUT12	Digital Output 12	
34	DOUT13	Digital Output 13	
35	DOUT14	Digital Output 14	
36	DOUT15	Digital Output 15	
37	DIO_PWR1	Board Power Output	
38	N.C	NO CONNECTION	
39	N.C	NO CONNECTION	
40	N.C	NO CONNECTION	

### 3-3-3 Output Power Jumper (J3, J6)

It is used as an external device power source of In/Out connector.



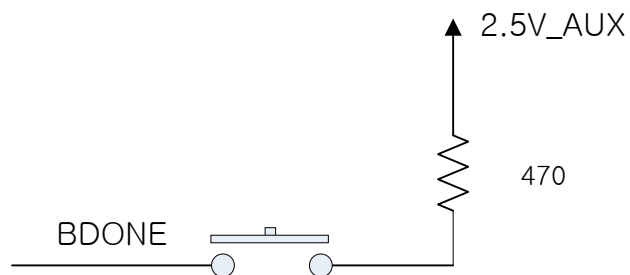
[Figure 3-3. J3, J6 Jumper (Top View)]

[Table 3. J3, J6 Power Connector]

Pin No.	Pin Name	Description	Remark
1	+5VPCI	+5V	
2	DIO_PWR		
3	+12VPCI	+12V	
4	DIO_PWR		
5	ISO_PWR	+5V or +12V	
6	DIO_PWR		

### 3-4-4 SW1

It is a U8 CPLD Reset Switch that is High Active (2.5V).

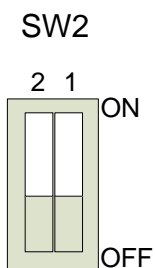


[Figure 3-4. SW1 Switch]

### 3-4-5 SW2

In a system that requires many I/O ports, if several PCI-TC03 series boards are installed in one system, each board address must be used separately. At this time, each board is classified using the dip switch (SW2) on the board.

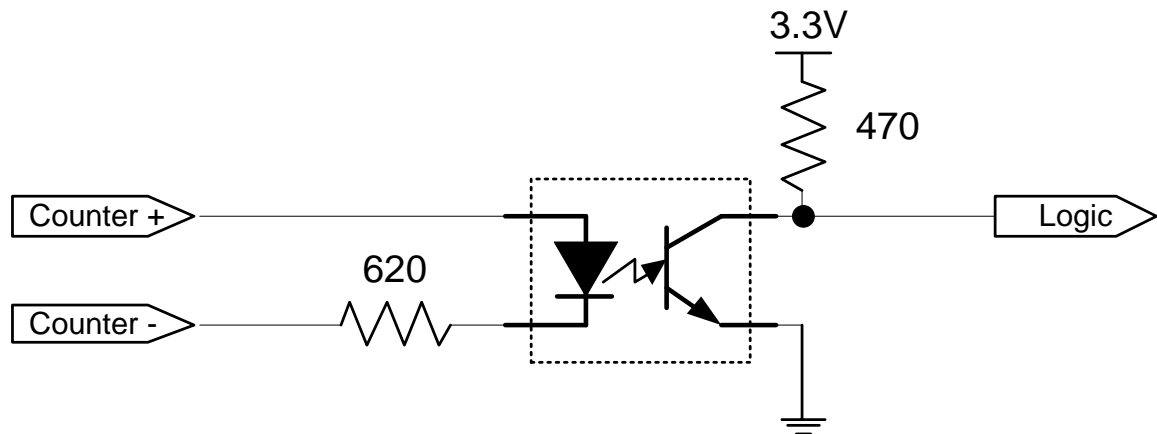
The total number of boards installed in one system is up to four.  
Currently, only one board is supported.



1	2	Board No.
OFF	OFF	0
ON	OFF	1
OFF	ON	2
ON	ON	3

[Figure 3-5. Board Address Setup]

### 3-5 Counter Input Circuit



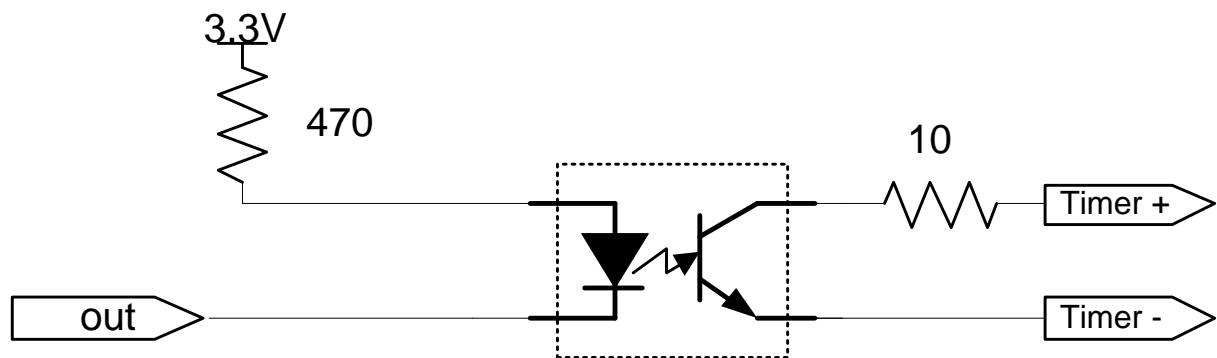
[Figure 3-6. Counter Input Circuit]

The counter signal receives a differential signal, which is +/- two signal lines, as an input, such as RS-485 or RS-422. In the figure, the counter input circuit is insulated by a port coupler that is strong against circuit protection and noise.

A total of 8 photo coupler circuits are configured on the PCI-TC03 board.



### 3-6 Timer Output Circuit

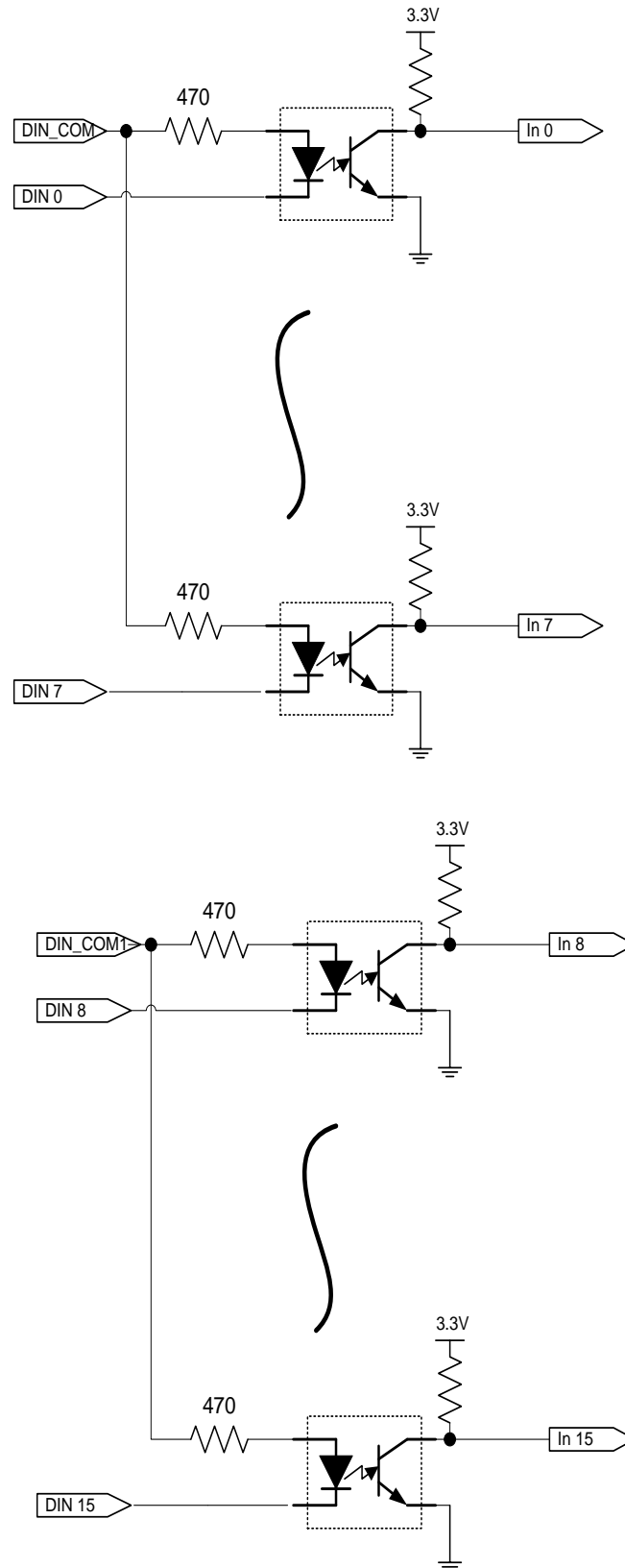


[Figure 3-7. Timer Output Circuit]

The timer signal is output as a differential signal, which is +/- two signal lines, like RS-485 or RS-422. In the figure above, the timer output circuit is insulated by a port coupler. And a current limiting resistor 10Ω (Ohm) is connected in series to the output for protection.

A total of 8 photo coupler circuits are configured on the PCI-TC03 board.

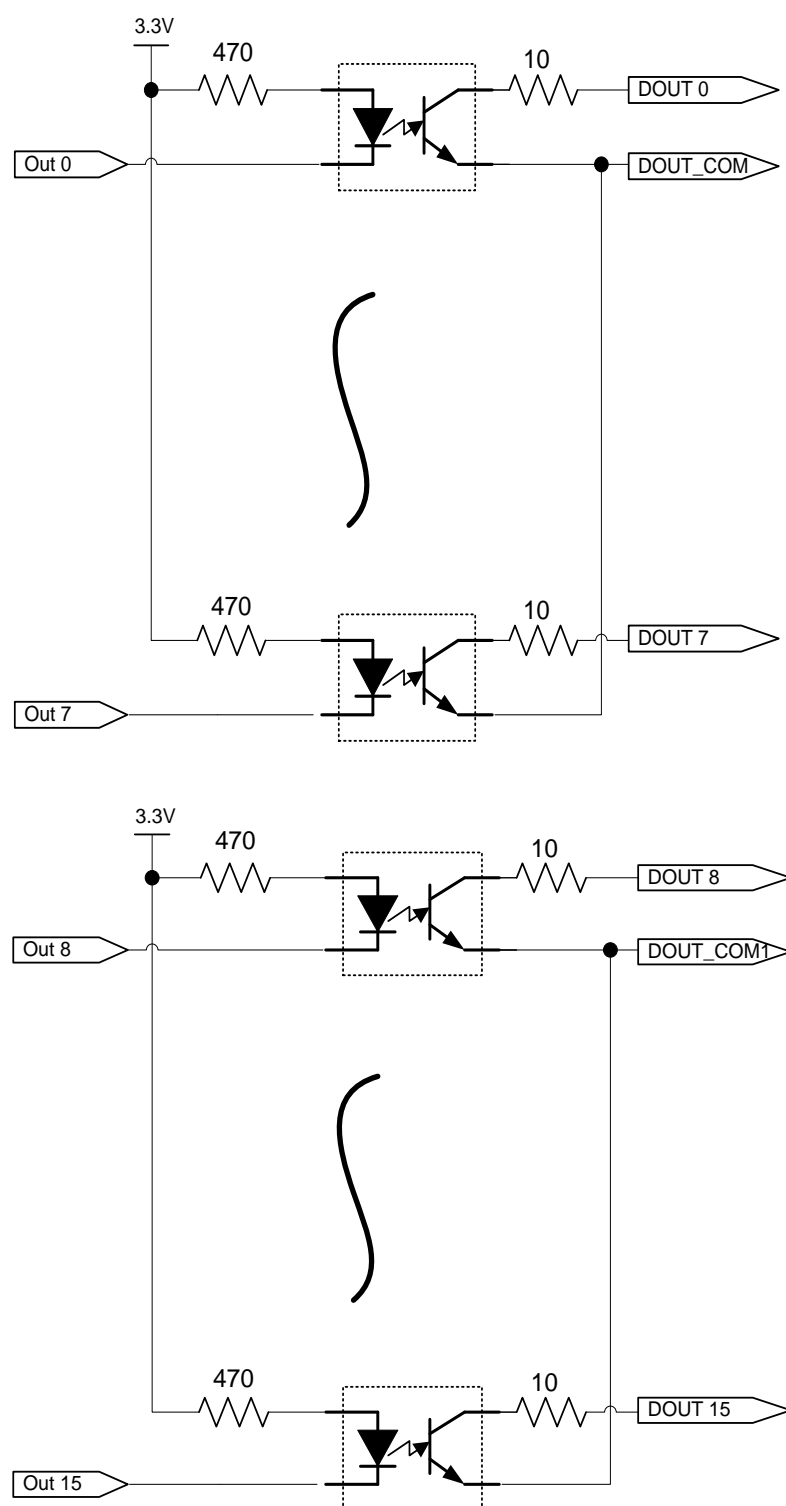
### 3-7 Digital Input Circuit



[Figure 3-8. Digital Input Circuit]

As shown in the figure above, the 16-bit digital input circuit is insulated by a port coupler, and is divided by 8 bits to use DIN\_COM and DIN\_COM1 in common.

### 3-7 Digital Output Circuit



[Figure 3-9. Digital Output Circuit]

As shown in the figure above, the output circuit is insulated by a port coupler, and it is divided by 8 channels to use DOUT\_COM and DOUT\_COM1 in common. And each output is connected in series with a current limiting resistor of 10Ω (Ohm) for protection.

## 4. Installation

Before installing the board, check that the contents of the package are intact.

### 4-1 Hardware Installation

#### 4-1-1 Product Contents

1. PCI-TC03 Board
2. CD (Driver/Manual/API/Sample Source etc.)

#### 4-1-2 Installation Process

- ① Turn off the computer.
- ② Remove the computer cover according to the computer manual.
- ③ Insert the product into an empty PCI slot. If possible, insert the boards in the order closest to the CPU.
- ④ Remove the blocked part at the back of the computer case of the slot where the board is inserted. Tighten the screws between the bracket of the board and the connection part of the case.
- ⑤ In case of multi-board, repeat from step 3.

Connect the PCI-TC03 board in the PC to an empty PCI slot.

When you turn on the power, a new hardware search window will appear.

## 4-2 Driver Installation

After mounting the board, install the driver and sample application program to run the board on the PC by referring to the contents of the provided CD.

The PCI-TC03 and PCIe-TC03 use the same driver and API, so they can share data.

The installation procedure is described based on Windows XP for PCIe-TC03 board.

The board environment must be Windows 2000 SP4 or higher and Windows XP SP1 or higher. First, turn off the PC's power, plug the PCIe-TC03 board into the PCI Slot, and turn on the PC's power. When the "Start New Hardware Wizard" window opens as shown below, select it as shown below and click the Next button.

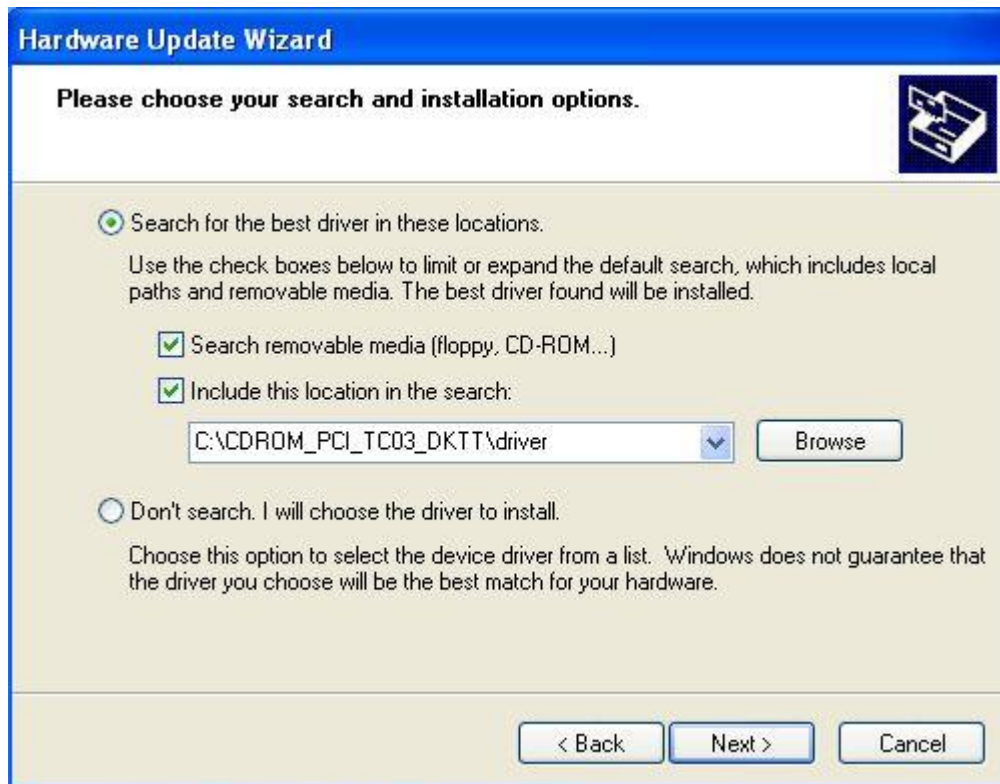
- (1) If new hardware is found, Wizard will ask you to install the corresponding driver. For installation of the driver, select the item "Install from a list or specific location (Advanced)" and click "Next" as in the below figure.



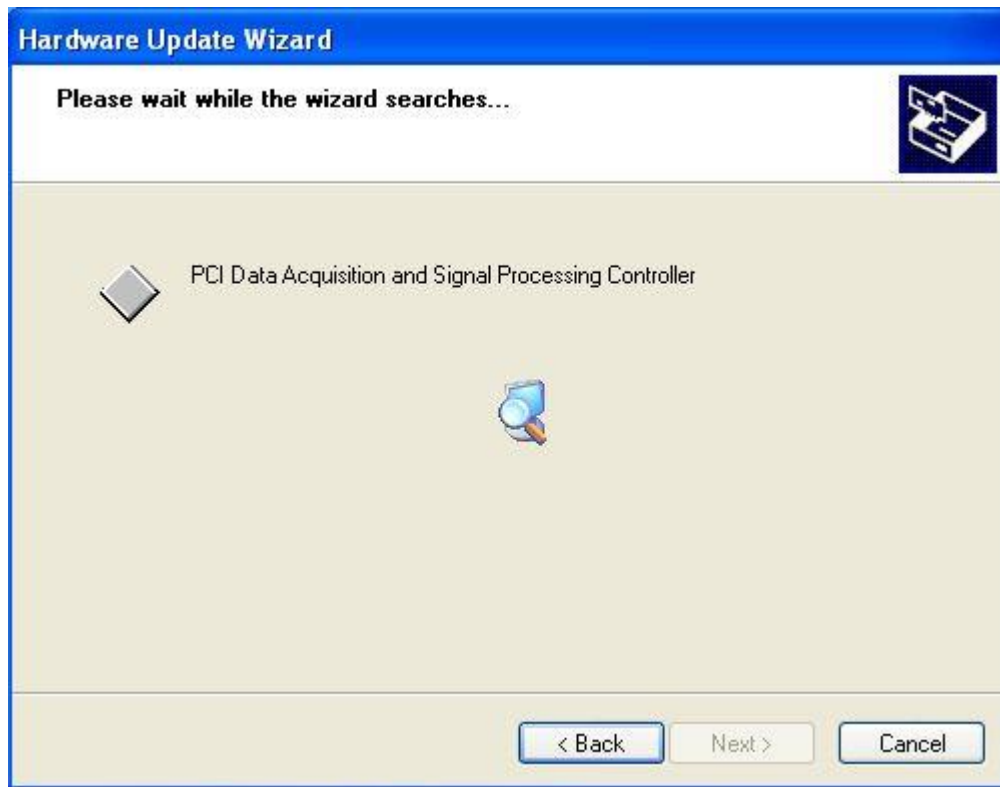
(2) After find a driver folder of the CD, press "next" button.

ex F:\CDROM\_PCI\_TC03\Driver

The driver folder includes a file of "**pci\_tc03.inf**" and "**pci\_tc03.sys**" that it is necessary for driver installation.



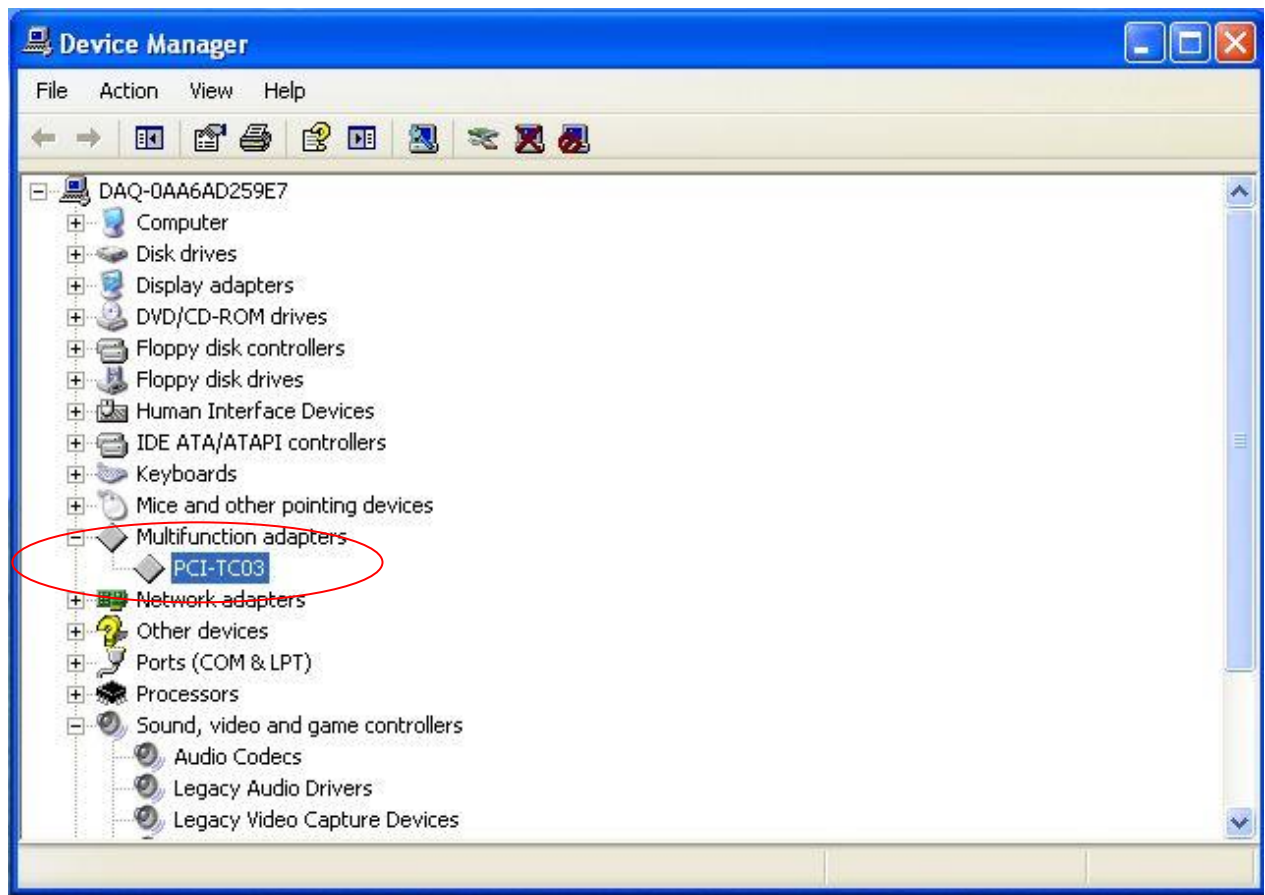
(3) A warning message appears during installation here, press "Continue Anyway" button. You can show below message window. The process progress as follows.



(4) If the installation is completely finished, you can show below message window.



- (5) If the installation is completely finished, you confirm it in the following ways. Do the following steps to show up the "Device Manager" window. [My Computer -> properties -> Hardware -> Device Manager -> **Multifunction Adaptors** -> **PCI-TC03**]



If you can see the "PCI-TC03" at Multifunction Adaptors, the driver installation is to have been over. (Check the red circle)

**Notice : After installation, you should re-boot the system for the proper operation.**

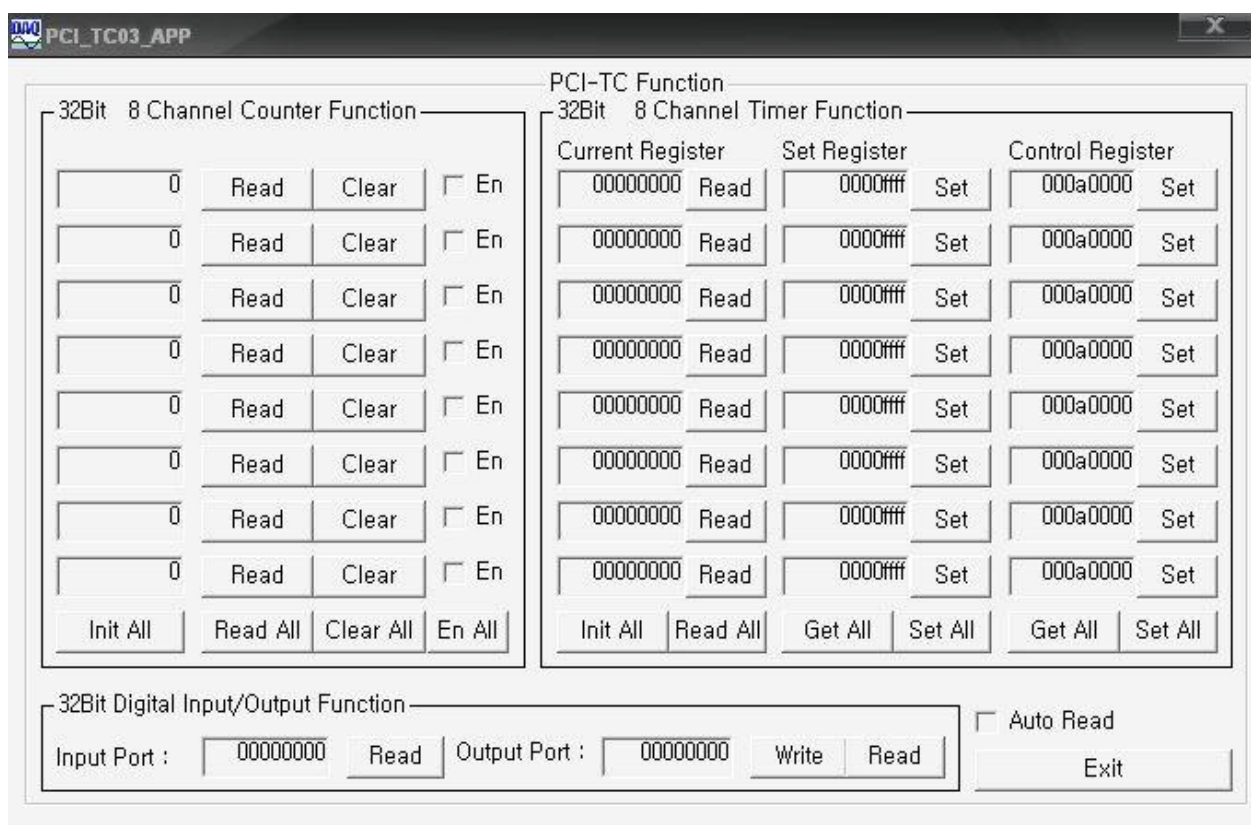


## 5. Sample Program

### 5-1 Program Interface

In the APP folder of the CDROM provided with the board, a sample program “**PCI\_TC03\_APP.exe**” is provided for easy use of the board. In order to test the sample program, the driver of the board must be installed first.

The sample program is provided in source form so that the API provided to use the board can be tested simply, so the user can modify it and use it.



[Figure 5-1. Sample Program “PCI\_TC03\_APP.exe”]

API (Application Programming Interface) is required to use the above sample program. API is provided in the form of “DLL”, and import library and header file are required for compilation. In order to run the sample program normally, the API DLL (**PCI\_TC03.DLL**) must be in the executable folder or in the Windows system folder or the folder specified by the Path environment variable.

## 5-2 Function Description

### (1) 32Bit 8 Channel Counter Function

Enable the 8 channels Counter, and read the current Counter value.

**Init (All)** : (All) Counter initialize.

**Read (All)** : (All) Counter read the current value.

**Clear (All)** : (All) Counter value clear.

**En (All)** : (All) Counter enable.

### (2) 32Bit 8 Channel Timer Function

Enable the 8 channels Timer, and control the Timer register.

#### Current Register

**Read** : Read the value of current Timer

**Init (All)** : (All) Timer initialize.

**Read (All)** : (All) Read the current value of Timer.

#### Set Register

**Get (All)** : (All) Get the value of Timer register. The default value is '0000ffff'.

**Set (All)** : (All) Set the value of wanted Timer. The default value is '000a0000'.

Ex.) In case of the value is '0000100', the Timer counts from '0' to 'ff'.

#### Control Register

**Get (All)** : (All) Get the value of Timer register.

**Set (All)** : (All) Enable the Timer. Ex.) Timer operation as '00000005'

Bit	Name	Description	Default
0	Enable	If it is '1', a timer operates. (Up-Counter)	'0'
1	Clear	If it is '1', it initialize current (TMR_CUR) value to "0x00000000"	'0'
2	Auto	If it is '1', it will occur time-out. It operates automatically as reload the timer value of "TMR_SET"	'0'

### (3) 32bit Digital Input/Output Function

**Input port "Read"** : It reads the Digital value of the Input port.

**Output Port "Read"** : It reads the Digital Input value of the Output port.

**Output Port "Write"** : It outputs the Digital value of the Output port.

## Appendix

### A-1 Repair Regulations

Thank you for purchasing DAQ SYSTEM's product. Please refer to the following regarding Customer Service stipulated by DAQ SYSTEM.

- (1) Please read the user's manual and follow the instructions before using the DAQ SYSTEM product.
- (2) When returning the product to be repaired, please send it to the head office with the symptoms of the malfunction as well.
- (3) All DAQ SYSTEM products have a one-year warranty.
  - The warranty period is counted from the date the product is shipped from DAQ SYSTEM.
  - Peripherals and third-party products not manufactured by DAQ SYSTEM are covered by the manufacturer's warranty.
  - If repair is required, please contact the contact points below.
- (4) Even during the free repair warranty period, paid repairs are made in the following cases.
  - ① Failure or damage caused by not following the user's manual
  - ② Failure or damage caused by customer negligence during product transportation after purchase
  - ③ Natural phenomena such as fire, earthquake, flood, lightning, pollution, etc. or power supply exceeding the recommended range malfunction or damage
  - ④ Failures caused by inappropriate storage environment (eg, high temperature, high humidity, volatile chemicals, etc.) damaged
  - ⑤ Failure or damage due to unreasonable repair or modification
  - ⑥ Products whose serial number has been changed or intentionally removed
  - ⑦ In the event that DAQ SYSTEM determines that it is the customer's negligence for other reasons
- (5) The customer must bear the shipping cost of returning the repaired product to DAQ SYSTEM.
- (6) The manufacturer is not responsible for any problems caused by incorrect use regardless of our Warranty provisions.

## References

1. PCI System Architecture  
-- MindShare Inc.
2. PCI Local Bus Specification  
-- PCI-SIG
3. AN201 How to build application using APIs  
-- DAQ system
4. AN242 PCI-TC03 API Programming  
--DAQ system

# MEMO

## Contact Point

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