

# ISO-813

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## User's Manual

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## Tables of Contents

<b>1. INTRODUCTION</b> .....	<b>4</b>
1.1. GENERAL DESCRIPTION .....	4
1.2. FEATURES .....	4
1.3. SPECIFICATIONS .....	5
1.3.1. Power Consumption : .....	5
1.3.2. Analog Inputs .....	5
1.3.3. A/D Converter .....	5
1.3.4. Applications .....	6
1.4. PRODUCT CHECK LIST .....	6
<b>2. HARDWARE CONFIGURATION</b> .....	<b>7</b>
2.1. BOARD LAYOUT .....	7
2.2. I/O BASE ADDRESS SETTING .....	8
2.3. JUMPER SETTING .....	9
2.3.1. JP1 : Analog Input Range Selection .....	9
2.3.2. JP2 : Bipolar / Unipolar Selection .....	9
2.4. I/O REGISTER ADDRESS .....	10
2.4.1. A/D Input Buffer Register .....	11
2.4.2. A/D Gain Control Register .....	12
2.4.3. A/D Multiplex Control Register .....	13
2.4.4. A/D Software Trigger Control Register .....	14
2.4.5. A/D Conversion .....	15
<b>3. CN1 PIN ASSIGNMENT</b> .....	<b>16</b>
3.1. DAUGHTER BOARD ( OPTION ) .....	17
3.1.1. DB-8325 Screw Terminal Board .....	17
3.1.2. DB-37/ DN-37 general purpose screwing terminal board .....	17
<b>4. SOFTWARE</b> .....	<b>18</b>
4.1. COMPILER & LINK .....	19
4.1.1. using MSC .....	19
4.1.2. using TC .....	19
4.1.2. using BC .....	19
4.2. C LANGUAGE LIBRARY .....	20
4.3. LIBRARY FUNCTIONS .....	21
4.3.1. ISO813_Initialize .....	21
4.3.2. ISO813_ActiveBoard .....	22

4.4. ISO813_CHECK_ADDRESS .....	23
4.5. ISO813_AD_SETCHGAIN .....	24
4.6. ISO813_AD_POLLINGVAR.....	25
4.7. ISO813_AD_POLLINGARRAY .....	26
<b>5. CALIBRATION .....</b>	<b>27</b>
5.1. CALIBRATION VR DESCRIPTION.....	27
5.1.1. Calibration Step.....	28

# 1. Introduction

## 1.1. General Description

The ISO-813 is a bus type isolated 12-bit 32-channel analog input board for the PC/AT compatible computer. It's isolation range is increased to 3000V and extend the application field to real industry application . It is backward compatible to ACL-813 add X16 programmable gain control range.

## 1.2. Features

- 12-bit A/D resolution
- 3,000Vdc photo-isolation protection
- The maximum sample rate of A/D converter is about 10K sample/sec
- PC/AT compatible ISA bus
- A/D trigger mode : software trigger
- A/D data transfer mode : polling
- 32 single-ended analog inputs
- Software selectable input ranges  
Programmable gain : x1,x2,x4,x8,x16  
Input range(Bipolar mode) :  $\pm 10V$ ,  $\pm 5V$ ,  $\pm 2.5V$ ,  $\pm 1.25V$ ,  $\pm 0.625V$ ,  $\pm 0.3125V$   
Input range(Unipolar mode): 0~10V, 0~5V, 0~2.5V, 0~1.25V, 0~ 0.625V
- Bipolar / Unipolar input mode by jumper selection

## 1.3. Specifications

### 1.3.1. Power Consumption :

- single power +5V @300 mA maximum
- Operating temperature : 0°C ~50°C

### 1.3.2. Analog Inputs

- Channels : 32 single-ended , 12-bit resolution
- isolation 3000Vdc
- Input range : (software programmable)
  - Bipolar :  $\pm 10V$  ,  $\pm 5V$  ,  $\pm 2.5V$  ,  $\pm 1.25V$  ,  $\pm 0.625V$  ,  $\pm 0.3125V$
  - Unipolar : 0~10V, 0~5V, 0~2.5V, 0~1.25V, 0~0.625V
- Input current : 250 nA max (125 nA typical ) at 25 °C.
- On chip sample and hold
- Over voltage : continuous single channel to **70Vp-p**
- Input impedance : > 10M $\Omega$

### 1.3.3. A/D Converter

- Type : successive approximation , Burr Brown ADS-774 or equivalent
- Conversion time : 8 micro second.
- Accuracy : +/- 1 bit
- Resolution : 12 bits

### 1.3.4. Applications

- Signal analysis
- FFT & frequency analysis
- Transient analysis
- Production test
- Process control
- Vibration analysis
- Energy management
- Industrial and lab. measurement and control

## 1.4. Product Check List

In addition to this manual, the package includes the following items:

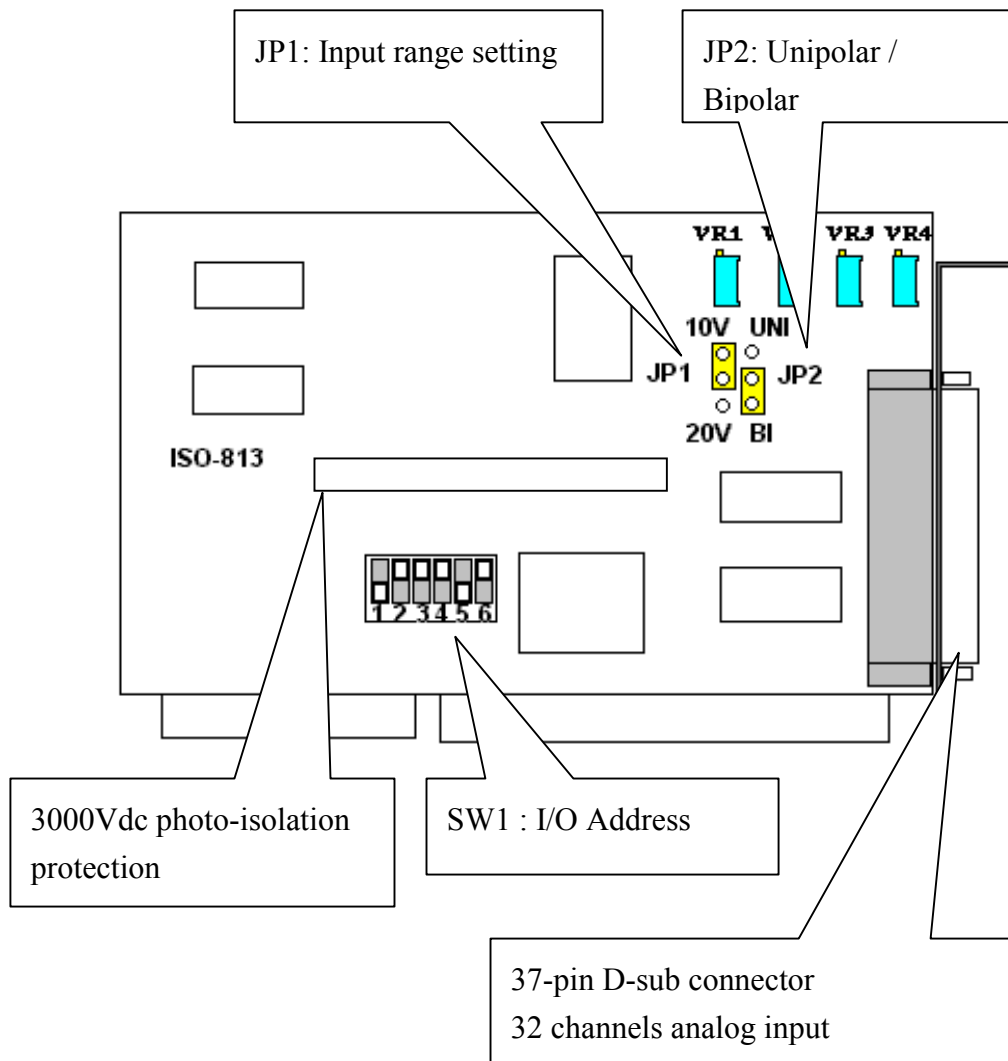
- ISO-813 multifunction card
- ISO-813 utility diskette

### **Attention !**

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

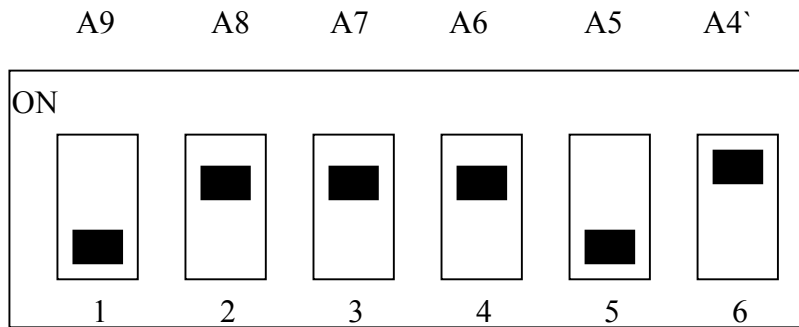
## 2. Hardware Configuration

### 2.1. Board Layout



## 2.2. I/O Base Address Setting

The ISO-813 occupies 16 consecutive locations in I/O address space. The base address is set by DIP switch SW1. The default address is 0x220.



SW1 : BASE ADDRESS

Base Adders	A9	A8	A7	A6	A5	A4
200-20F	OFF	ON	ON	ON	ON	ON
210-21F	OFF	ON	ON	ON	ON	OFF
220-22F(☑)	OFF	ON	ON	ON	OFF	ON
230-23F	OFF	ON	ON	ON	OFF	OFF
:	:	:	:	:	:	:
300-30F	OFF	OFF	ON	ON	ON	ON
:	:	:	:	:	:	:
3F0-3FF	OFF	OFF	OFF	OFF	OFF	

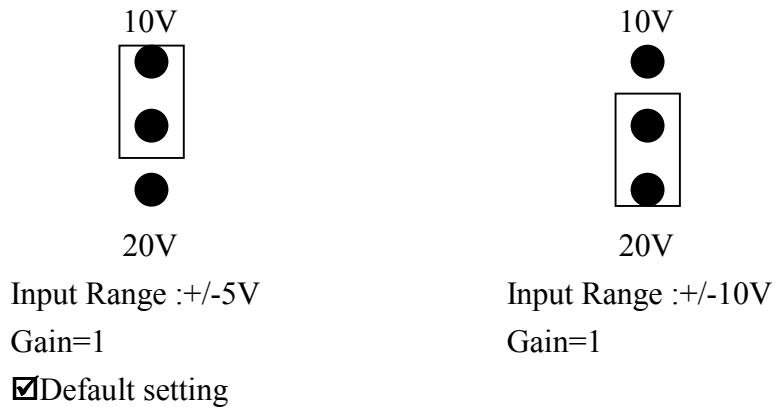
(☑) : default base address is 0x220

The PC I/O port mapping is given below.

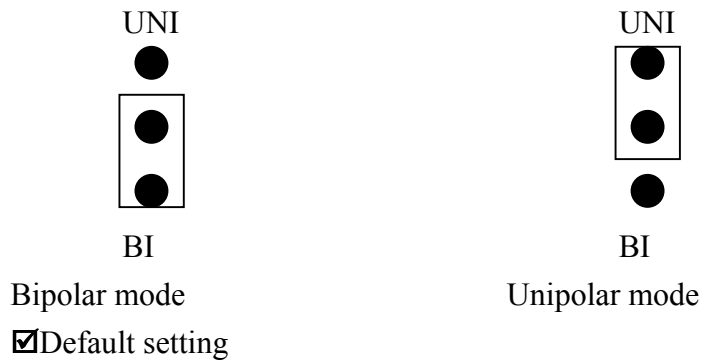
ADDRESS	Device	ADDRESS	DEVICE
000-1FF	PC reserved	320-32F	XT Hard Disk
200-20F	Game/control	378-37F	Parallel Printer
210-21F	XT Expansion Unit	380-38F	SDLC
238-23F	Bus Mouse/Alt. Bus Mouse	3A0-3AF	SDLC
278-27F	Parallel Printer	3B0-3BF	MDA/Parallel Printer
2B0-2DF	EGA	3C0-3CF	EGA
2E0-2E7	AT GPIB	3D0-3DF	CGA
2E8-2EF	Serial Port	3E8-3EF	Serial Port
2F8-2FF	Serial Port	3F0-3F7	Floppy Disk
300-31F	Prototype Card	3F8-3FF	Serial Port

## 2.3. Jumper Setting

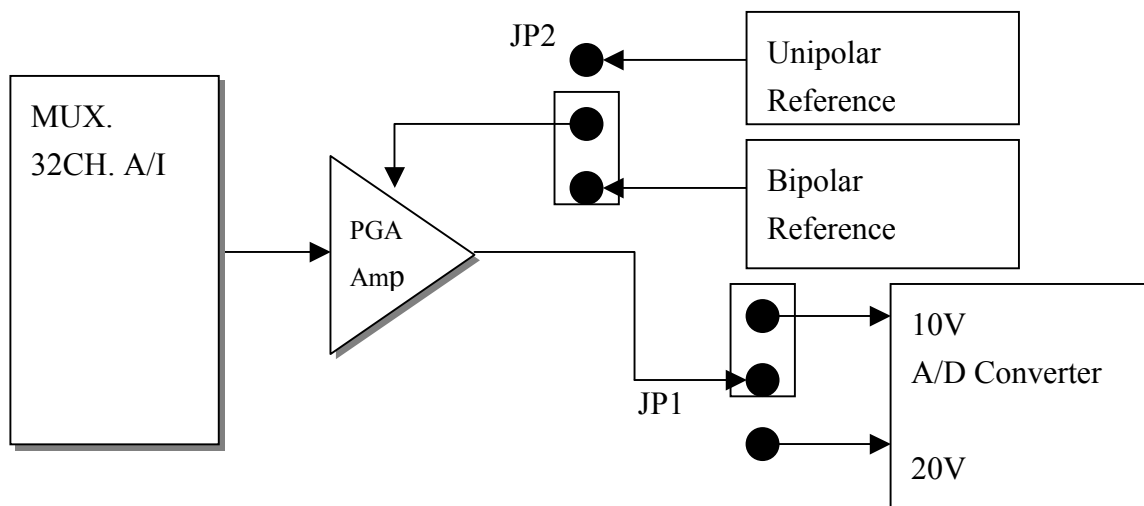
### 2.3.1. JP1 : Analog Input Range Selection



### 2.3.2. JP2 : Bipolar / Unipolar Selection



The input range will be change if the JP1 and JP2 in different position.



## 2.4. I/O Register Address

The ISO-813 occupies 16 consecutive PC I/O addresses. The following table lists the registers and their locations.

<b>Address</b>	<b>Read</b>	<b>Write</b>
<b>Base+0</b>	Reserved	Reserved
<b>Base+1</b>	Reserved	Reserved
<b>Base+2</b>	Reserved	Reserved
<b>Base+3</b>	Reserved	Reserved
<b>Base+4</b>	<b>A/D Low Byte</b>	Reserved
<b>Base+5</b>	<b>A/D High Byte</b>	Reserved
<b>Base+6</b>	Reserved	Reserved
<b>Base+7</b>	Reserved	Reserved
<b>Base+8</b>	Reserved	Reserved
<b>Base+9</b>	Reserved	<b>A/D Gain Control</b>
<b>Base+A</b>	Reserved	<b>A/D Multiplexer Control</b>
<b>Base+B</b>	Reserved	Reserved
<b>Base+C</b>	Reserved	<b>A/D Software Trigger</b>
<b>Base+D</b>	Reserved	Reserved
<b>Base+E</b>	Reserved	Reserved
<b>Base+F</b>	Reserved	Reserved

## 2.4.1. A/D Input Buffer Register

(READ) Base+4 : A/D Low Byte Data Format

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
D7	D6	D5	D4	D3	D2	D1	D0

(READ) Base+5 : A/D High Byte Data Format

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	X	READY	D11	D10	D9	D8

X: Don't Care

A/D 12 bits data : D11.....D0, D11=MSB, D0=LSB

READY =1 : A/D 12 bits data not ready

=0 : A/D 12 bits data is ready

The low 8 bits A/D data are stored in address BASE+4 and the high 4 bits data are stored in address BASE+5. The READY bit is used as a indicator for A/D conversion. **When a A/D conversion is completed, the READY bit will be clear to zero.**

## 2.4.2. A/D Gain Control Register

(WRITE) Base+9 : A/D Gain Control Register Format

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	X	X	X	GAIN2	GAIN1	GAIN0

X : Don't Care

The gain control register control the gain of A/D input signal. Bipolar/Unipolar will effect the gain factor.

It is important to select the correct gain-control-code according to Bipolar/Unipolar input

### ISO-813 Bipolar mode GAIN CONTROL CODE TABLE

- JP2 : Bipolar

	JP1 : 10V	JP1 : 20V				
GAIN	Input Range	Input Range	GAIN2	GAIN1	GAIN0	Hex
1	± 5V	± 10V	0	0	0	0x0
2	± 2.5V	± 5V	0	0	1	0x1
4	± 1.25V	± 2.5V	0	1	0	0x2
8	± 0.625V	± 1.25V	0	1	1	0x3
16	±0.3125	± 0.625	1	0	0	0x4

### ISO-813 Unipolar mode GAIN CONTROL CODE TABLE

- JP2 : Unipolar

	JP1 : 10V	JP1 : 20V				
GAIN	Input Range	Input Range	GAIN2	GAIN1	GAIN0	Hex
1	0~10V	Not use	0	0	0	0x0
2	0~5V	0~10V	0	0	1	0x1
4	0~2.5V	0~5V	0	1	0	0x2
8	0~1.25V	0~2.5V	0	1	1	0x3
16	0~0.625V	0~1.25V	1	0	0	0x4

### 2.4.3. A/D Multiplex Control Register

This function is change analog input channels.

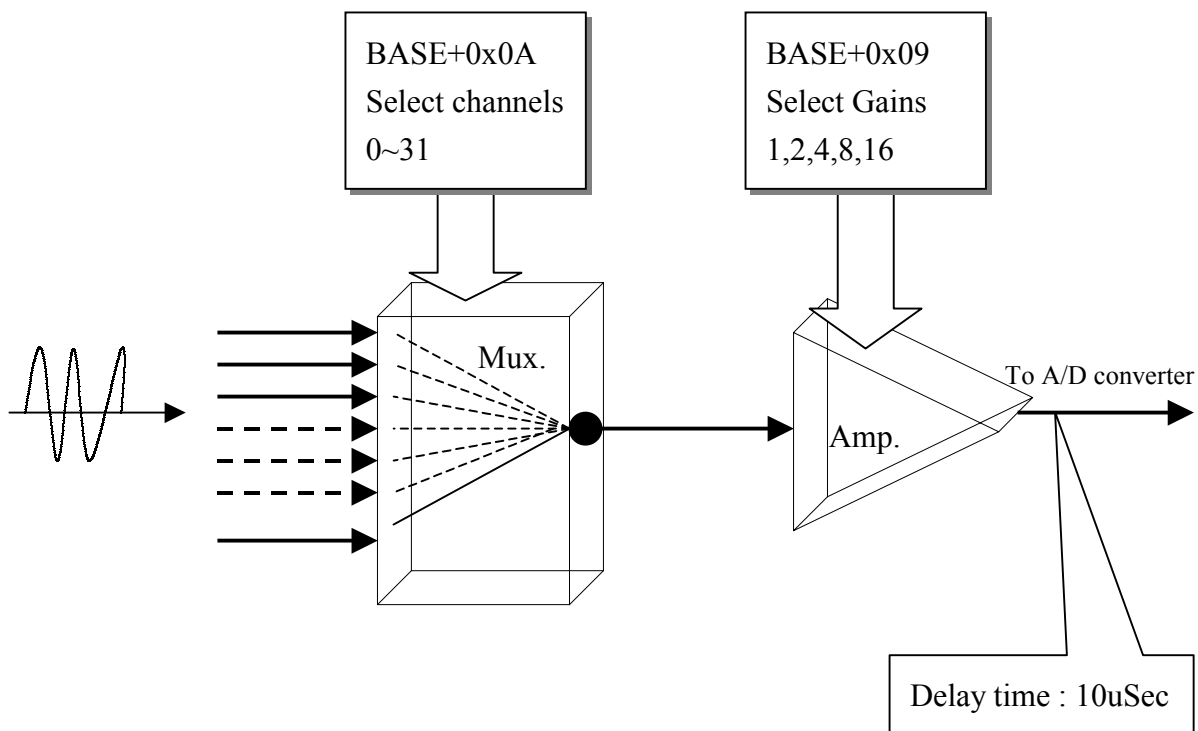
(WRITE) Base+A : A/D Multiplexer Control Register Format

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	X	D4	D3	D2	D1	D0

A/D input channel selection data = 5 bits : D4..D0, D4=MSB, D0=LSB, X=don't care

Channels	MUX. data	Channels	MUX. Data	Channels	MUX. data	Channels	MUX. Data
0	0x00	8	0x08	16	0x10	24	0x18
1	0x01	9	0x09	17	0x11	25	0x19
2	0x02	10	0x0A	18	0x12	26	0x1A
3	0x03	11	0x0B	19	0x13	27	0x1B
4	0x04	12	0x0C	20	0x14	28	0x1C
5	0x05	13	0x0D	21	0x15	29	0x1D
6	0x06	14	0x0E	22	0x16	30	0x1E
7	0x07	15	0x0F	23	0x17	31	0x1F

Note: The ISO-813 change A/I channel and gain must be delay 10u sec.



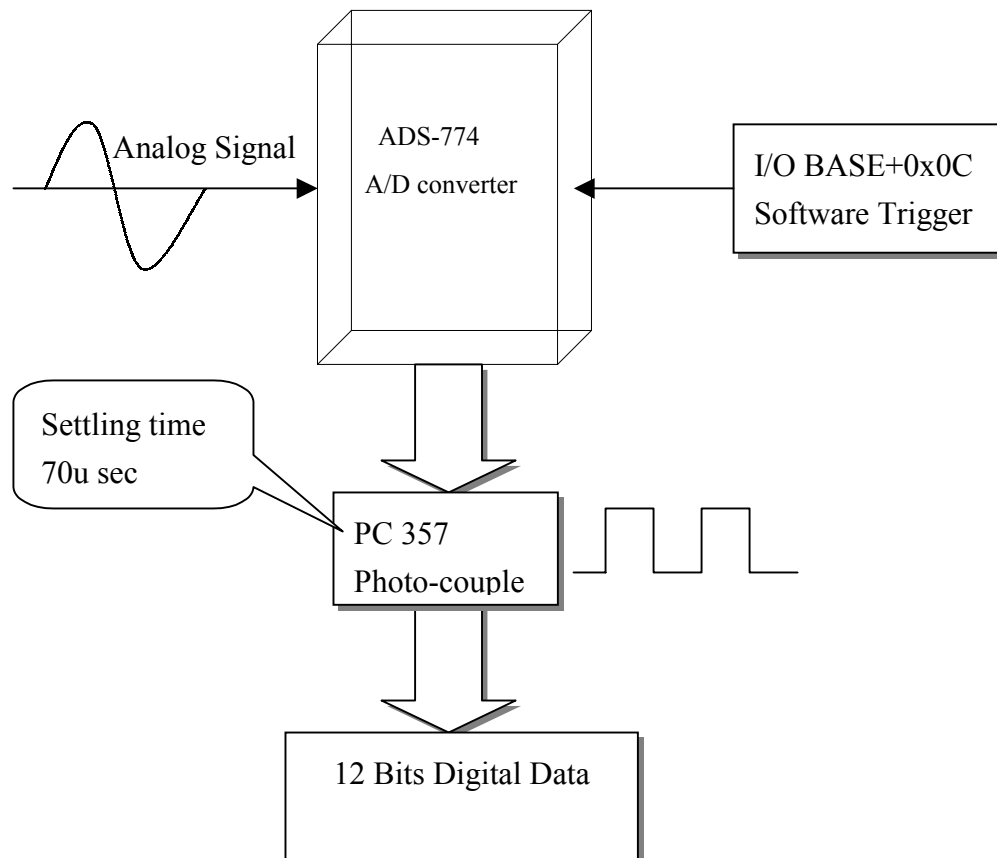
### 2.4.4. A/D Software Trigger Control Register

(WRITE) Base+C : A/D Software Trigger Control Register Format

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	X	X	X	X	X	X

X=dont care, XXXXXXXX=any 8 bits data is validate

The ISO-813 A/D conversion is polling mode, The A/D converter must be trigger when you reading each data.

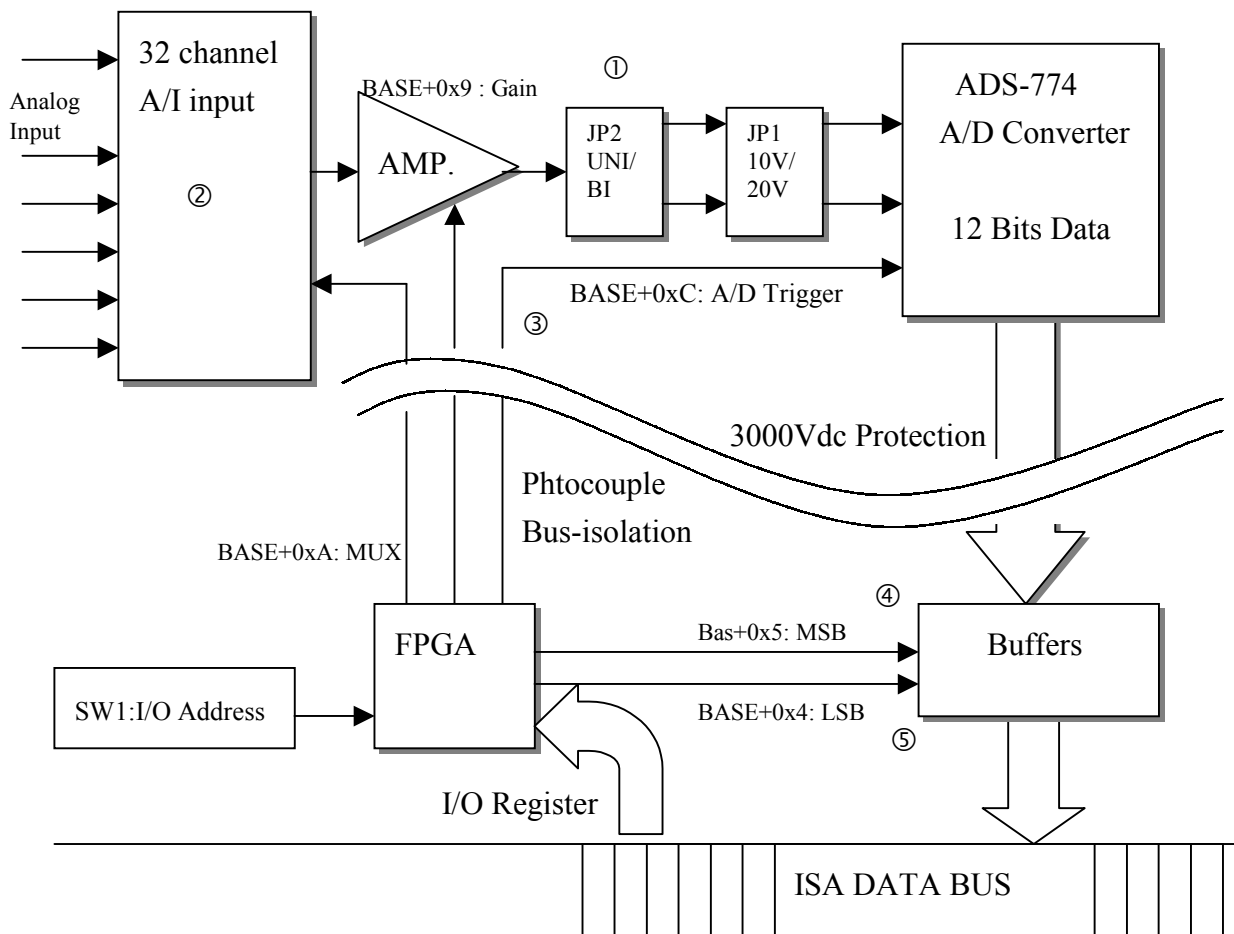


## 2.4.5. A/D Conversion

This section explains how to get data from the A/D conversions and using I/O register. Before use the A/D conversion function, user should notice the following issue:

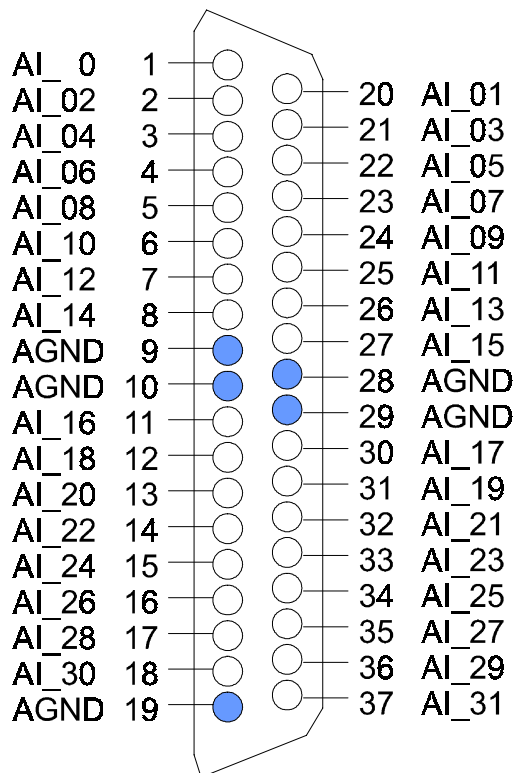
1. Make sure input range : Unipolar / Bipolar by JP2 , 10V / 20V by JP1 and gain value by software setting from I/O BASE ADDRESS + 0x9
2. Select input channels : I/O BASE ADDRESS + 0xA (Channel 0~Channel 31)  
Delay 10u sec
3. Trigger A/D Converter : I/O BASE ADDRESS + 0xC  
Delay 70u sec
4. Get A/D MSB Data : I/O BASE ADDRESS + 0x5 and make sure A/D conversion ready bit is logic low (Bits 4). ( Reading again if bit 4 is logic high )
5. Get A/D LSB Data : I/O BASE ADDRESS + 0x4
6. Conversion A/D data value :  $Ad\_data = LSB \times 256 + MSB$

The block diagram is given below:



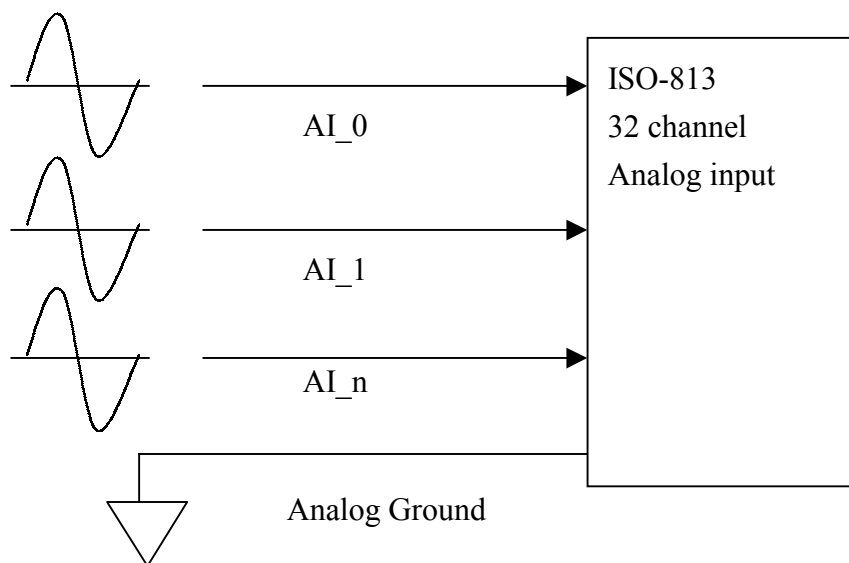
### 3. CN1 Pin Assignment

The ISO-813 provides three connectors. Connector 1,



Note:

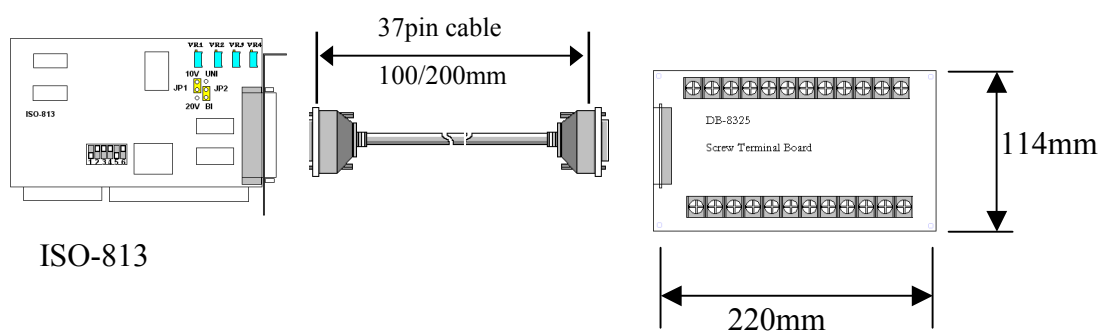
1. AI\_n: Analog input channel n
2. AGND : Analog Ground



## 3.1. Daughter Board ( Option )

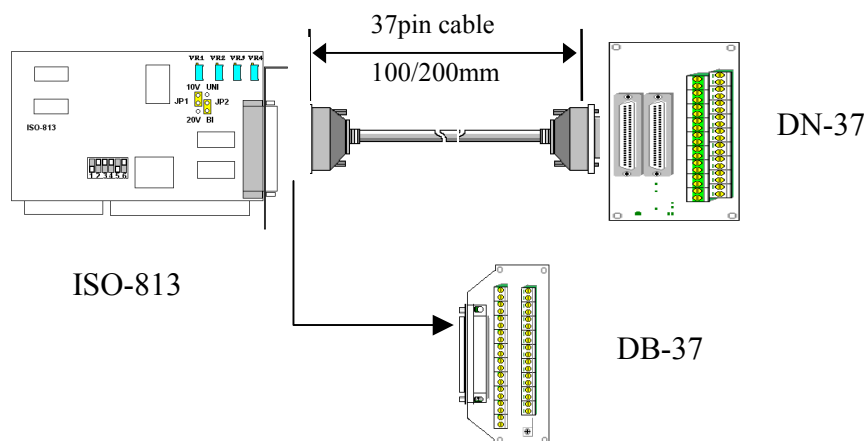
The ISO-813 can be connected with many different daughter boards. The function of these daughter boards are described as follows.

### 3.1.1. DB-8325 Screw Terminal Board



### 3.1.2. DB-37/ DN-37 general purpose screwing terminal board

The DB-37 / DN-37 is a **general purpose** 37-pin connector. The DB-37 is direct connect to a 37-pin D-sub connector, the DN-37 via 37-pin d-sub cable connection. It is suitable for easy signal connection and measurement.



## 4. Software

The ISO813.lib is a collection of data acquisition subroutines for ISO-813. These subroutines are written with C language and perform a variety of data acquisition operations. These subroutines can be classified as follow:

It is recommended to install the ISO-813 application software to your hard disk to get the best performance. Before beginning, to make a backup copy of the ISO-813 application software. Store the original diskette in a safe place. The ISO-813 application disk includes the following files:

- DIAG\SETUP.EXE : Diagnostic program for MS-WINDOWS 95  
MS-WINDOWS 98  
MS-WINDOWS NT 4.0  
MS-WINDOWS 2000
- ISO813\lib\ISO813S.lib : The small mode library for MSC/TC.
- ISO813\lib\ISO813M.lib : The medium mode library for MSC/TC.
- ISO813\lib\ISO813C.lib : The compact mode library for MSC/TC.
- ISO813\lib\ISO813L.lib : The large mode library for MSC/TC.
- ISO813\lib\ISO813H.lib : The huge mode library for MSC/TC.
  
- ISO813\demo\\*.\* : The demo program

## 4.1. Compiler & link

### 4.1.1. using MSC

- The including file is ISO813.H
  - There are 5 different mode library files : ISO813S/C/M/L/H.LIB
  - Support MSC 6.x compiler
  - **SMALL** mode compiler & link command : CL /AS program.c ISO813S.LIB
  - **COMPACT** mode compiler & link command : CL /AC program.c ISO813C.LIB
  - **MEDIUM** mode compiler & link command : CL /AM program.c ISO813M.LIB
  - **LARGE** mode compiler & link command : CL /AL program.c ISO813L.LIB
  - **HUGE** mode compiler & link command : CL /AH program.c ISO813H.LIB
  - A:\ISO813\demo\msc\\*.bat give some examples for compiler&link batch file
- 

### 4.1.2. using TC

- The including file is **ISO813.H**
  - There are 5 different model library files : **ISO813**S/C/M/L/H.LIB
  - Support TC 2.x compiler
  - Use text editor to create a project file include : program.c ISO813?.lib
  - Use TC integrated environment to **select the correct compiler model**
  - A:\ISO813\demo\\*.prj give some examples for compiler&link project file
- 

### 4.1.3. using BC

- The including file is **ISO813.H**
  - There are 5 different model library files : **ISO813**S/C/M/L/H.LIB
  - Support BC 3.x compiler
  - Use BC integrated environment to create a project file include : program.c ISO813?.lib
  - Use BC integrated environment to **select the correct compiler model**
  - A:\ISO813\demo\\*.prj give some examples for compiler&link project file
-

## 4.2. C Language Library

- ISO813.H

```
/** ***** Declare ISO813 Board Interface ***** */
int ISO813_ActiveBoard(int BoardNo);
int ISO813_Check_Address(int BaseAddr);
int ISO813_Initialize(int CardNo, int BaseAddr);
void ISO813_AD_SetChGain(int Channel , int Gain);
unsigned int ISO813_AD_PollingVar(void);
void ISO813_AD_PollingArray(unsigned int *Buffer, unsigned int Length);

/** ***** define ISO813 relative address ***** */
#define AD_LO      0x04    //Analog to Digital, Low Byte
#define AD_HI      0x05    //Analog to Digital, Hiht Byte
#define SET_GAIN0x09
#define SET_CH      0x0A
#define SOFT_TRIG   0x0C

/** ***** define the gain mode ***** */
#define ISO813_BI_1 0x00
#define ISO813_BI_2 0x01
#define ISO813_BI_4 0x02
#define ISO813_BI_8 0x03
#define ISO813_BI_160x04

#define ISO813_UNI_10x00
#define ISO813_UNI_20x01
#define ISO813_UNI_40x02
#define ISO813_UNI_80x03
#define ISO813_UNI_16 0x04

/** ***** define the error number ***** */
#define NoError 0
#define CheckBoardError 1
#define TimeOutError0xffff
#define CardNumError4
```

## 4.3. Library Functions

### 4.3.1. ISO813\_Initialize

- **Description :**

ISO813\_Initialize initialize the ISO813 board. This function should be called before using the other ISO813.lib subroutines. This function will detect automatically ISO813 board according to I/O base address. Auto detection failure will occur if I/O base address not match with hardware DIP switch. The others can perform A/D operation via polling. After this subroutine is executed, **the board which CardNo specified will be active**. If more than one board in a system, the ISO813\_ActiveBoard(int CardNo, int BaseAddr) must use to switch to the active board.

- **Syntax :**

```
int ISO813_Initialize(int CradNo, int BaseAddr );
```

- **Input Parameter :**

CardNo : The validate card number is from 0 to 7.

IOBase : I/O base address. (must match with hardware DIP switch)

- **Return Value :**

CheckBoardError : IO base address detection error

CardNumError : error in card number input (validate numbers are from 0 to 7)

CheckIrqError : error in IRQ channel number

NoError

- **Example 1 :**

```
#include "ISO813.h"
main()
{
int CradNo=0; /* only one card */
int IOBase=0x220; /* The IO base address for ISO813 */
ISO813_Initialize(CardNo,IOBase); /* board_0 is active */
/* only one card in this system, so no need to call ISO813_ActiveBoard(0) */
```

## 4.3.2. ISO813\_ActiveBoard

- **Description :**

This driver support 8 different cards in one system max. The ISO813\_Initialize(...) will initialize the separate boards. But only one board can be active at one time. So the software should active the selected card before perform specific function. The ISO813\_ActiveCrad(?) is used to active the desired card in the system. If only one card in the system, there is no need to use this subroutine.

- **Syntax :**

int ISO813\_ActiveBoard(int BoardNo);

- **Input Parameter :**

BoardNo : The validate board number is from 0 to 7. This number is equal to CardNo in ISO813\_Initial(CardNo,.....);

- **Return Value :**

CardNumError : error in card number input (validate numbersare from 0 to 7)  
NoError

## 4.4. ISO813\_Check\_Address

### ● Description :

This subroutine check if the I/O base address is match with the board. This subroutine send a software trigger signal to the A/D converter and check the ready bit of A/D conversion. If the **ready bit can not be clear to zero in a fixed time, this subroutine will return CheckBoardError.**

### ● Syntax :

```
int ISO813_Check_Address(int BaseAddr);
```

### ● Input Parameter :

BaseAddr : base address of the board

### ● Return Value :

CheckBoardError : The BaseAddr does not match with the hardware setting  
NoError

### ● Example 1 :

```
#include "ISO813.h"
main()
{
if (ISO813_Check_Address(0x220)==NoError)
    {
    printf("\n0x220 find a card");
    }
else
    {
    printf("\n0x220 cannot find any card");
    }
}
```

## 4.5. ISO813\_AD\_SetChGain

- **Description :**

This function is used to set the A/D channel number, gain and operation mode.

- **Syntax :**

```
void ISO813_AD_SetChGain(int Channel, int Gain)
```

- **Input Parameter :**

Channel : A/D channel number, 0 ~ 31

Gain : A/D gain control code, 0 ~ 4

- **Return Value :**

None

- **Example 1 :**

```
#include "ISO813.h"
main()
{
int Gain,Mode;

ISO813_Initialize(0,0x220);

/* user must define Gain, Mode here */

for (channel=0; channel<32; channel++)
{
ISO813_AD_SetChGainMode(channel,Gain);
/* delay settling time if needed */.
}
}
```

## 4.6. ISO813\_AD\_PollingVar

- **Description :**

This function performs the A/D conversion by polling .

- **Syntax :**

unsigned ISO813\_AD\_PollingVar(void)

- **Input Parameter :**

None.

- **Return Value :**

The result of A/D conversion. \_

**If there is a timeout occurred, the data will be set to 0xffff.**

- **Example 1 :**

```
#include "ISO813.h"
#include "stdio.h"
main()
{
int channel,gain,mode;
unsigned PollData;
float volt;
ISO813_Initialize(0,0x220);
channel=0; /* channel 0 */
gain=0; /* bipolar, gain=1, range=-5V ~ +5V , JP1: 10V , JP2: BI */
ISO813_AD_SetChGainMode(channel,gain);

PollData=ISO813_AD_PollingVar();
volt=((float)PollData-2048.0)/2048.0*5.0;
printf("\ndata = %xH = %5.3fV\n",PollData,volt);

}
```

## 4.7. ISO813\_AD\_PollingArray

- **Description :**

This function performs the A/D conversion by polling method.

- **Syntax :**

void ISO813\_AD\_PollingArray(unsigned \*Buffer, unsigned Count)

- **Input Parameter :**

Buffer : address of buffer.

Count : number of A/D conversions .

- **Return Value :**

None.

**If there is a timeout occurred, the data will be set to 0xffff.**

- **Example 1 :**

```
#include "ISO813.h"
#include "stdio.h"
main()
{
int channel,gain,mode;
unsigned int i,Buffer[1000],DesireCount=1000;
ISO813_Initialize(0,0x220);
channel=0; /* channel 0 */
gain=0; /* bipolar, gain=1, range=-5V ~ +5V , JP1: 10V , JP2: BI*/

ISO813_AD_SetChGain(channel,gain);

ISO813_AD_PollingArray(Buffer, DesireCount);

for (i=0; i<10; i++) printf("\nBuffer[%d]=%x",i,Buffer[i]);

}
```

## 5. Calibration

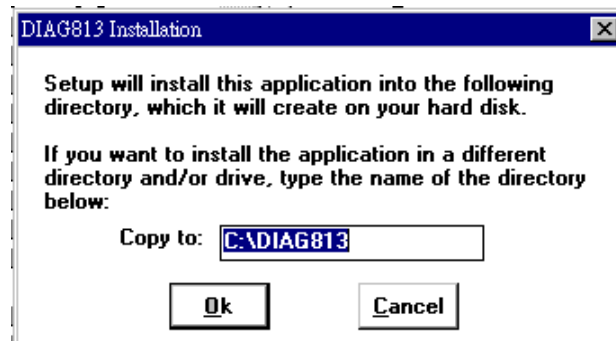
The ISO-813 is calibrated to its best state of operation. For environment with large vibration, recalibration is recommended. Before calibrating the ISO-813, user should take care the following issue:

- One stable voltage source (4.9988V)
- Diagnostic program :  
DIAG813 for MS-WINDOWS 95  
MS-WINDOWS 98  
MS-WINDOWS NT 4.0  
MS-WINDOWS 2000

this program included in the delivered package will guide the user to proceed the calibration.

Insert disk to 3.5" 1.44MB floppy disk driver then

RUN A:\DIAG\SETUP.EXE



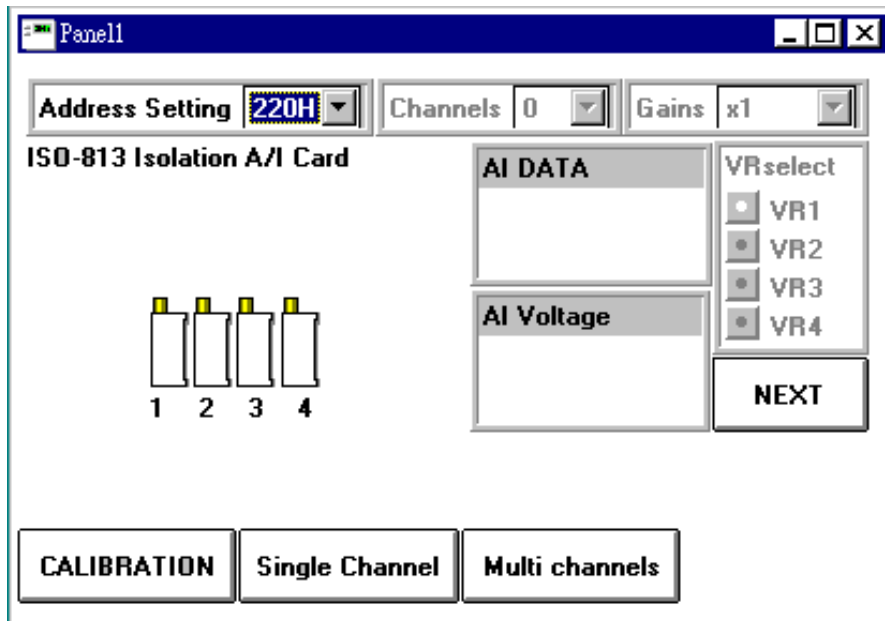
### 5.1. Calibration VR Description

There are four VRs on the ISO-813.

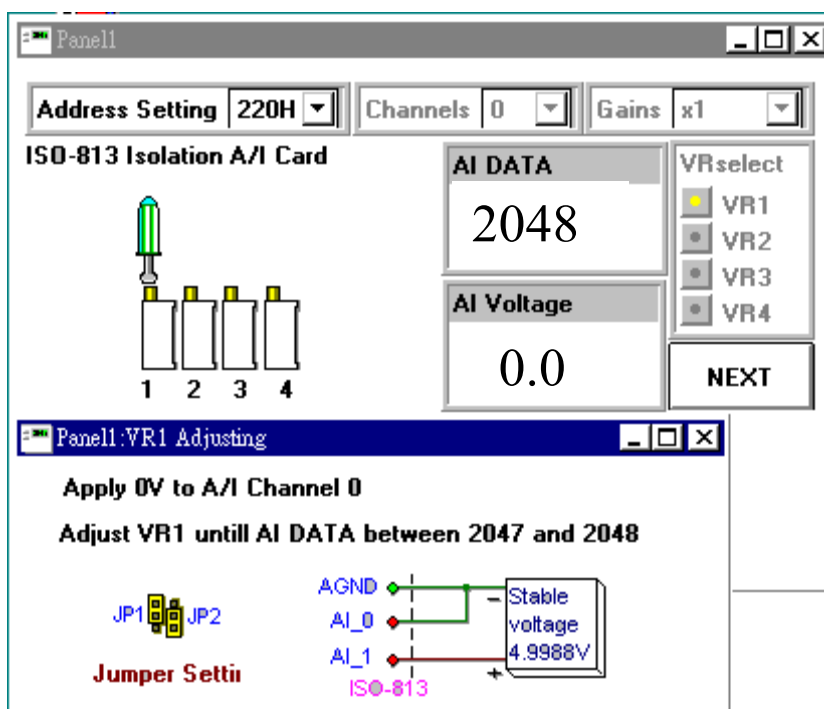
VR Num.	Description
VR1	A/D Full Scale
VR2	A/D Offset
VR3	A/D Unipolar Offset
VR4	PGA Offset

### 5.1.1. Calibration Step

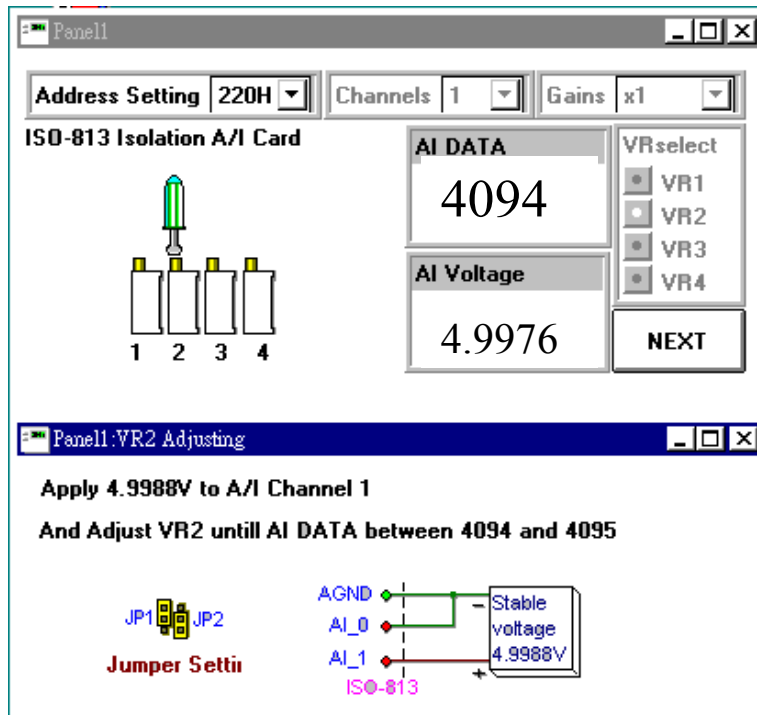
1. RUN “DIAG813”
2. Apply 0V to AI channel 0 and 4.9988V to AI channel 1
3. Press “CALIBRATION” push bottom



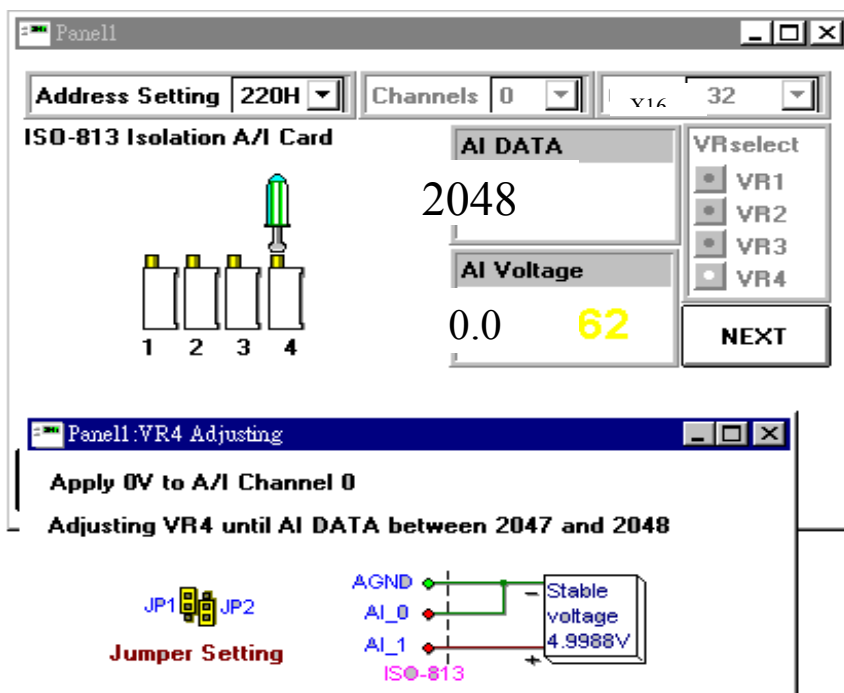
4. Adjusting VR1 until AI DATA between 2047 and 2048
5. Press “NEXT” push bottom



6. Adjusting VR2 until AI DATA between 4094 and 4095
7. Press “NEXT” push bottom



8. Adjusting VR4 until AI DATA between 2047 and 2048
9. Press “NEXT” push bottom

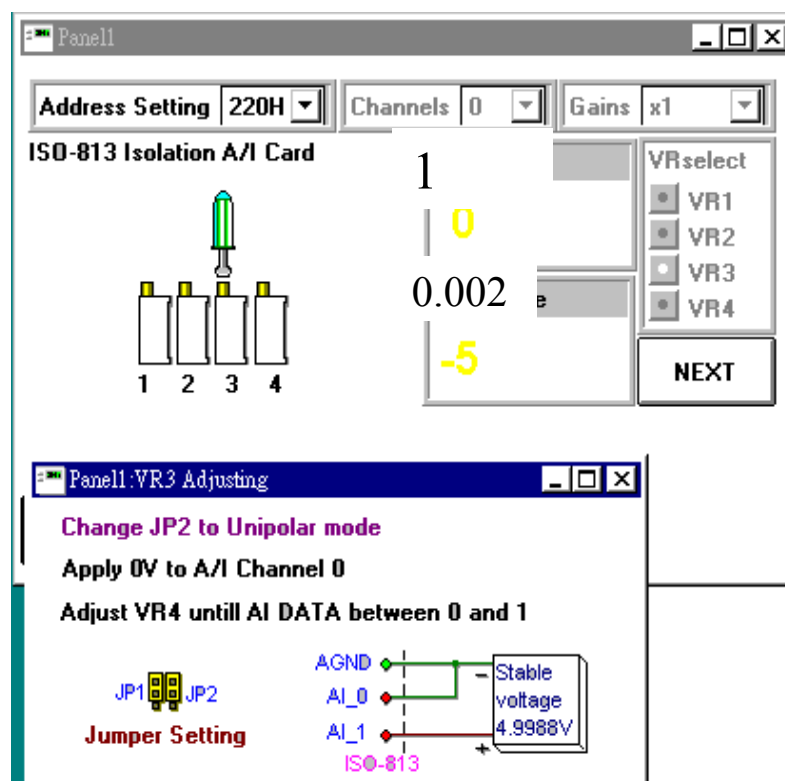


## ISO813 32-channels isolated analog input card

10. The VR3 adjusting is unipolar offset, you can by pass this step if using bipolar input range of your application.

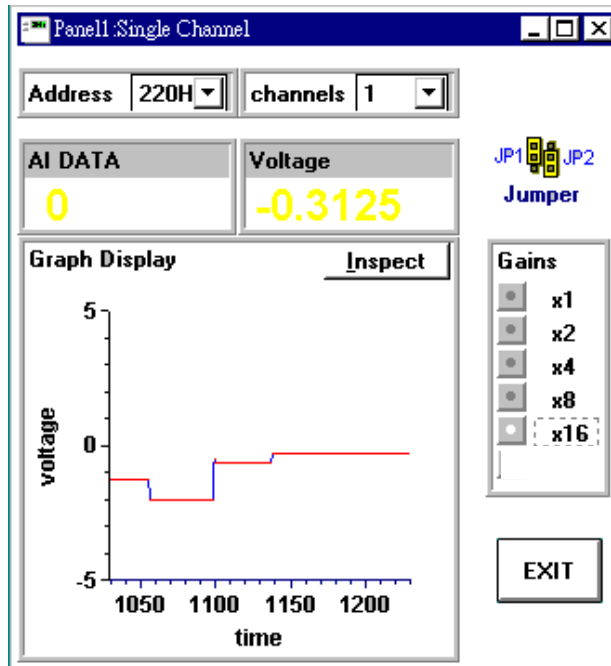
If you are using unipolar mode , shut down windows and turn off PC then take out the ISO-813 interface card and change JP2 to unipolar mode. Then insert ISO-813 to isa bus slot then turn on your PC , RUN “DIAG813” diagnostic program .

Apply 0V to AI channel 0, By pass VR1 , VR2 , VR4 calibration step if there are ready. Adjust VR3 until AI DATA between 0 and 1.



Diagnostic single channels

This function can show one channel value.



Diagnostic multi channels

This function can show 32 channels data.

The screenshot shows the 'Panel1: Multi Channels' window. At the top, 'Address' is set to '220H'. Below this is a 'Channels Scan' table with 8 rows and 4 columns (A, B, C, D). To the right of the table, there are 'Gains' options: 1, 2, 4, 8, and 16. An 'EXIT' button is located at the bottom right of the window.

	A	B	C	D
0	-2.866	-2.8	-2.863	-2.873
1	-2.89	-2.817	-2.893	-2.846
2	-2.878	-2.832	-2.885	-2.81
3	-2.871	-2.822	-2.858	-2.802
4	-2.849	-2.846	-2.9	-2.802
5	-2.839	-2.849	-2.927	-2.729
6	-2.829	-2.849	-2.88	-2.77
7	-2.836	-2.868	-2.917	-2.844