# I-8090

# 3-axis encoder card

# User's Manual

## Version 1.0 06/2001 Edition

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# I-8090 3-axis encoder card

I-8090 is a 3-axis encoder counter board on I-8000 platform. I-8090 encoder card has internal digital filter, 16 bits counter and high counting rate 1Mpps. The application of I-8090 board is position/distance measurement, velocity measurement, feedback for motor control, handwheel input and so on.

A system including I-8000 (main system), I-8091 (2-axis stepping/servo control card), I-8090 (3-axis encoder card) can be implemented as a standalone motion controller system for low cost automatical machine.

## Features

- I-8000 series.
- 3-axis, 16 bits encoder counter.
- 32 bits encoder counter by software.
- Maximum counting rate : 1M pulse/sec.
- Differential input A+, A-, B+, B-, C+, C-.
- Quadrant counting mode, CW/CCW counting mode, Pulse/Dir counting mode.
- 2500V optical isolation

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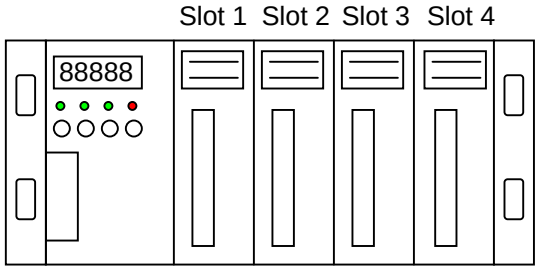
# 1. Hardware

## 1.1 I-8000 hardware address

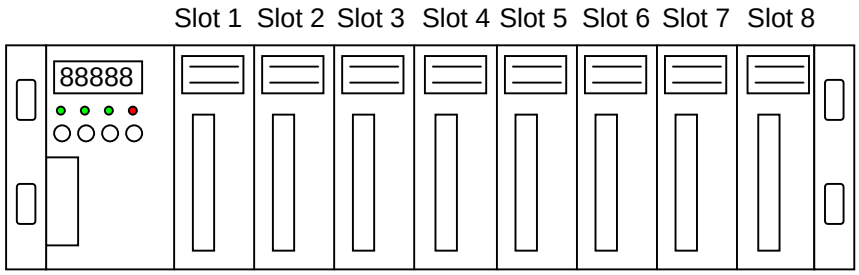
The hardware address of I-8000 main system is fixed as following table.
There are 4 slots I-8000 and 8 slots I-8000.

| | Slot 1 | Slot 2 | Slot 3 | Slot 4 | Slot 5 | Slot 6 | Slot 7 | Slot 8 |
|---|---|---|---|---|---|---|---|---|
| I-8000, 4 slot Address | 0x080 | 0x0A0 | 0x0C0 | 0x0E0 | --- | --- | --- | --- |
| I-8000, 8 slot Address | 0x080 | 0x0A0 | 0x0C0 | 0x0E0 | 0x140 | 0x160 | 0x180 | 0x1A0 |

**I-8000, 4 slots**




**I-8000, 8 slots**




Fig(1) I-8000 hardware address

## 1.2 Registers of I-8090 board

The **I-8090** card's registers table as following.

| Register | Add. | R/W | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|---|---|---|
| ID | 0x00 | R | 0x0D | | | | | | | |
| XDATA | 0x01 | R | X-axis encoder value | | | | | | | |
| YDATA | 0x02 | R | Y-axis encoder value | | | | | | | |
| ZDATA | 0x03 | R | Z-axis encoder value | | | | | | | |
| INDEX | 0x04 | R | | | | | | ZI | YI | XI |
| XCTRL | 0x00 | W | | | S1 | S0 | | /RST | /INH | /SEL |
| YCTRL | 0x01 | W | | | S1 | S0 | | /RST | /INH | /SEL |
| ZCTRL | 0x02 | W | | | S1 | S0 | | /RST | /INH | /SEL |

| Register | Add. | R/W | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|---|---|---|
| ID | 0x00 | R | 0x0D | | | | | | | |

The ID register is read only and its value is fixed as 0x0D. User can check this register to identify I-8090 card or not.

| Register | Add. | R/W | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|---|---|---|
| XDATA | 0x01 | R | X-axis encoder value | | | | | | | |

XDATA: the X-axis encoder counter value can be read out from this register. The low byte value of 16 bits encoder counter can be read out when set /SEL=0 (XCTRL register), the high byte can be read out when set /SEL=1 (XCTRL register).

| Register | Add. | R/W | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|---|---|---|
| YDATA | 0x02 | R | Y-axis encoder value | | | | | | | |

YDATA : the Y-axis encoder counter value can be read out from this register. The low byte value of 16 bits encoder counter can be read out when set /SEL=0 (YCTRL register), the high byte can be read out when set /SEL=1 (YCTRL register).

| Register | Add. | R/W | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|---|---|---|
| ZDATA | 0x03 | R | Z-axis encoder value | | | | | | | |

ZDATA : the Z-axis encoder counter value can be read out from this register. The low byte value of 16 bits encoder counter can be read out when set

/SEL=0 (ZCTRL register), the high byte can be read out when set /SEL=1 (ZCTRL register).

| Register | Add. | R/W | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|---|---|---|
| INDEX | 0x04 | R | | | | | | ZI | YI | XI |

The index input C+/C- can read out from this register. These bits are active high.

XI : indicate the index of X-axis (C+/C- input).

YI : indicate the index of Y-axis (C+/C- input).

ZI : indicate the index of Z-axis (C+/C- input).

| Register | Add. | R/W | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|---|---|---|
| XCTRL | 0x00 | W | | | S1 | S0 | | /RST | /INH | /SEL |
| YCTRL | 0x01 | W | | | S1 | S0 | | /RST | /INH | /SEL |
| ZCTRL | 0x02 | W | | | S1 | S0 | | /RST | /INH | /SEL |

The XCTRL,YCTRL and ZCTRL register are control registers for X-axis, Y-axis, Z-axis respectively.

**/RST** : reset counter to zero

**/INH** : inhibit the counter data latch. This bit must be set 0 before read out the counter value to inhibit the counter data latch to DATA registers.

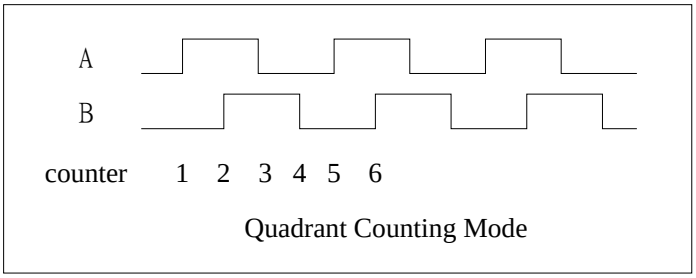
**/SEL** : to select low byte or high byte for reading the counter value.

0 : low byte

1 : high byte

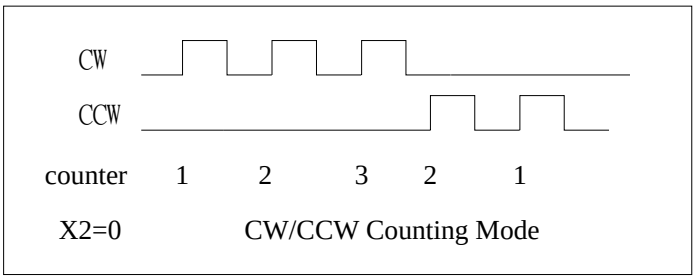
**S1, S0** : to select counting mode

**00** : quadrant counting mode



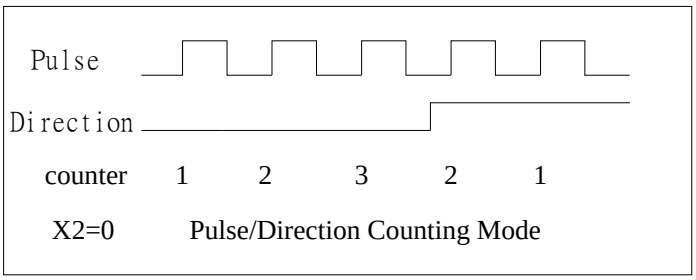

Fig(2) Quadrant counting mode

**01** : CW/CCW counting mode




Fig(3) CW/CCW counting mode

**10** : Pulse/Direction counting mode




Fig(4) Pulse/Direction counting mode

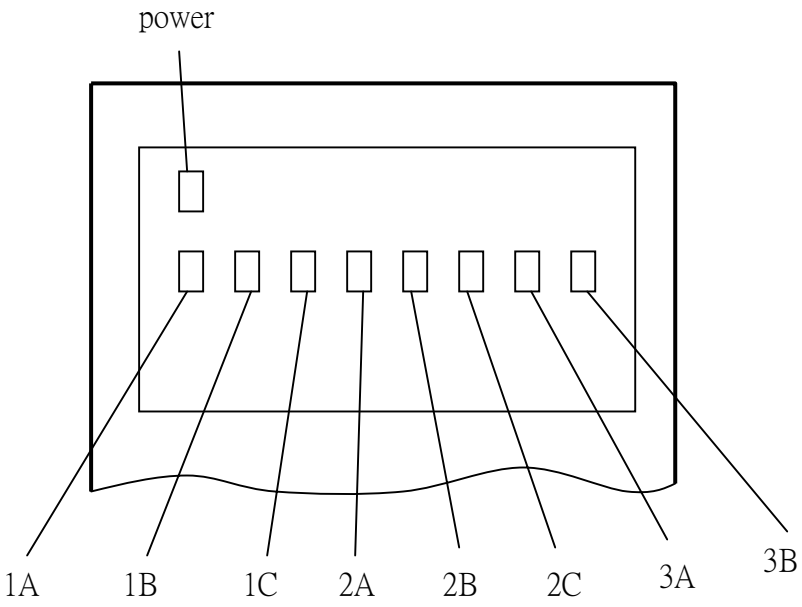
Example: assign counting mode

```
x_mode=y_mode=z_mode=0x00;
card[cardNo].ctrl1 = 0x07 | x_mode;
card[cardNo].ctrl2 = 0x07 | y_mode;
card[cardNo].ctrl3 = 0x07 | z_mode;
outportb(card[cardNo].base + WR1, card[cardNo].ctrl1);
outportb(card[cardNo].base + WR2, card[cardNo].ctrl2);
outportb(card[cardNo].base + WR3, card[cardNo].ctrl3);
```

Example: read X-axis encoder value

```
card[cardNo].ctrl1 &= 0xFC;  //1111 1100 low byte
outportb(card[cardNo].base + WR1, card[cardNo].ctrl1);
value = inportb(card[cardNo].base + RD1);
card[cardNo].ctrl1 |= 0x01;  //0000 0001 high byte
outportb(card[cardNo].base + WR1, card[cardNo].ctrl1);
value += inportb(card[cardNo].base + RD1)*256;
card[cardNo].ctrl1 |= 0x03;  //0000 0011
outportb(card[cardNo].base + WR1, card[cardNo].ctrl1);
```

## 1.3 LED Indicator




Fig(5) I-8090 LED indicator

Where

1A, 1B, 1C indicate X-axis's 1A+/1A-, 1B+/1B-, 1C+/1C- signal input.

2A, 2B, 2C indicate Y-axis's 2A+/2A-, 2B+/2B-, 2C+/2C- signal input.

3A, 3B, indicate Z-axis's 3A+/3A-, 3B+/3B- signal input.

## 1.4 Connection

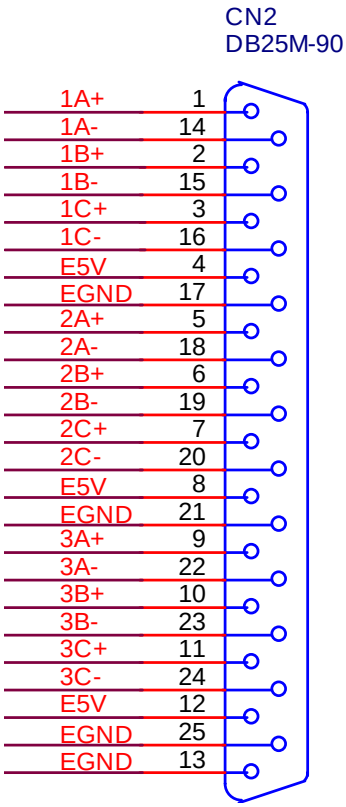



Fig (6) Pin out of CN2 connector

Table of CN2 connector

| Pin name | Pin number | description |
|---|---|---|
| 1A+ | 1 | A+ input of X-axis encoder |
| 1A- | 14 | A- input of X-axis encoder |
| 1B+ | 2 | B+ input of X-axis encoder |
| 1B- | 15 | B- input of X-axis encoder |
| 1C+ | 3 | C+ input of X-axis encoder |
| 1C- | 16 | C- input of X-axis encoder |
| E5V | 4 | Isolated 5V supply, max. 50mA (sum of pin 4,8,12) |
| EGND | 17 | Signal ground |
| 2A+ | 5 | A+ input of Y-axis encoder |
| 2A- | 18 | A- input of Y-axis encoder |
| 2B+ | 6 | B+ input of Y-axis encoder |
| 2B- | 19 | B- input of Y-axis encoder |
| 2C+ | 7 | C+ input of Y-axis encoder |
| 2C- | 20 | C- input of Y-axis encoder |

| | | |
|---|---|---|
| E5V | 8 | Isolated 5V supply, max. 50mA (sum of pin 4,8,12) |
| EGND | 21 | Signal ground |
| 3A+ | 9 | A+ input of Z-axis encoder |
| 3A- | 22 | A- input of Z-axis encoder |
| 3B+ | 10 | B+ input of Z-axis encoder |
| 3B- | 23 | B- input of Z-axis encoder |
| 3C+ | 11 | C+ input of Z-axis encoder |
| 3C- | 24 | C- input of Z-axis encoder |
| E5V | 12 | Isolated 5V supply, max. 50mA (sum of pin 4,8,12) |
| EGND | 25 | Signal ground |
| EGND | 13 | Signal ground |

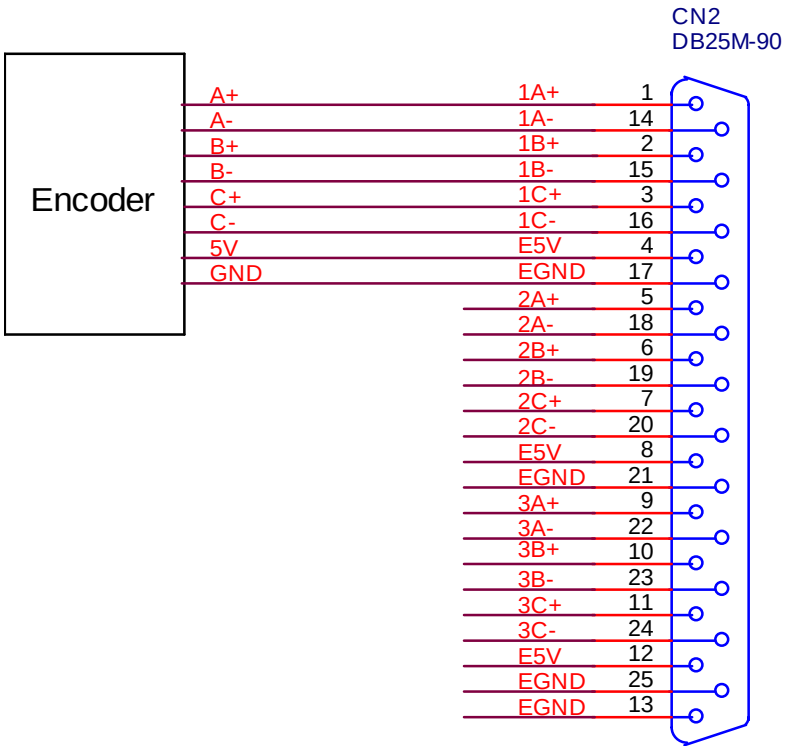



Fig (7) Connection between encoder and I-8090 card

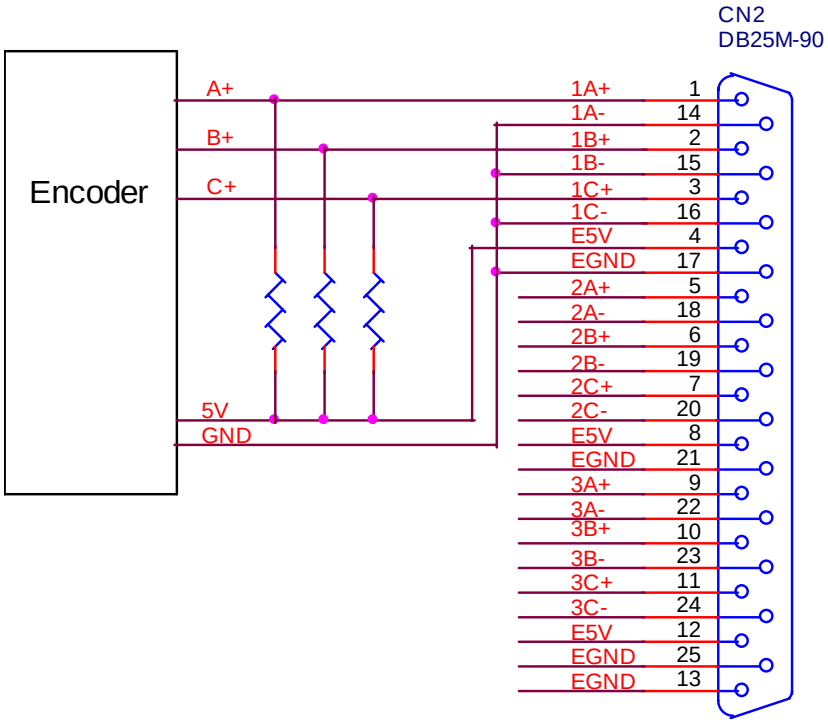



Fig (8) Connection between open collecter type encoder and I-8090 card

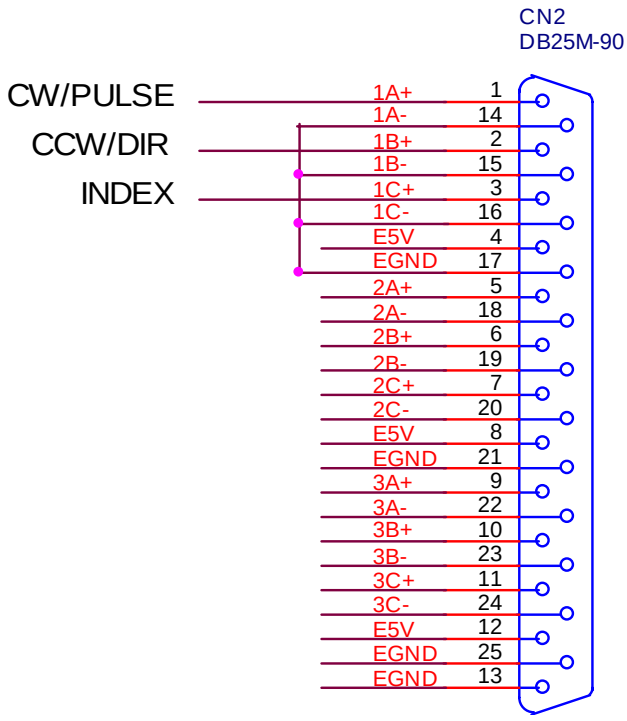



Fig (9) The connection for CW/CCW or Pulse/Direction counting mode

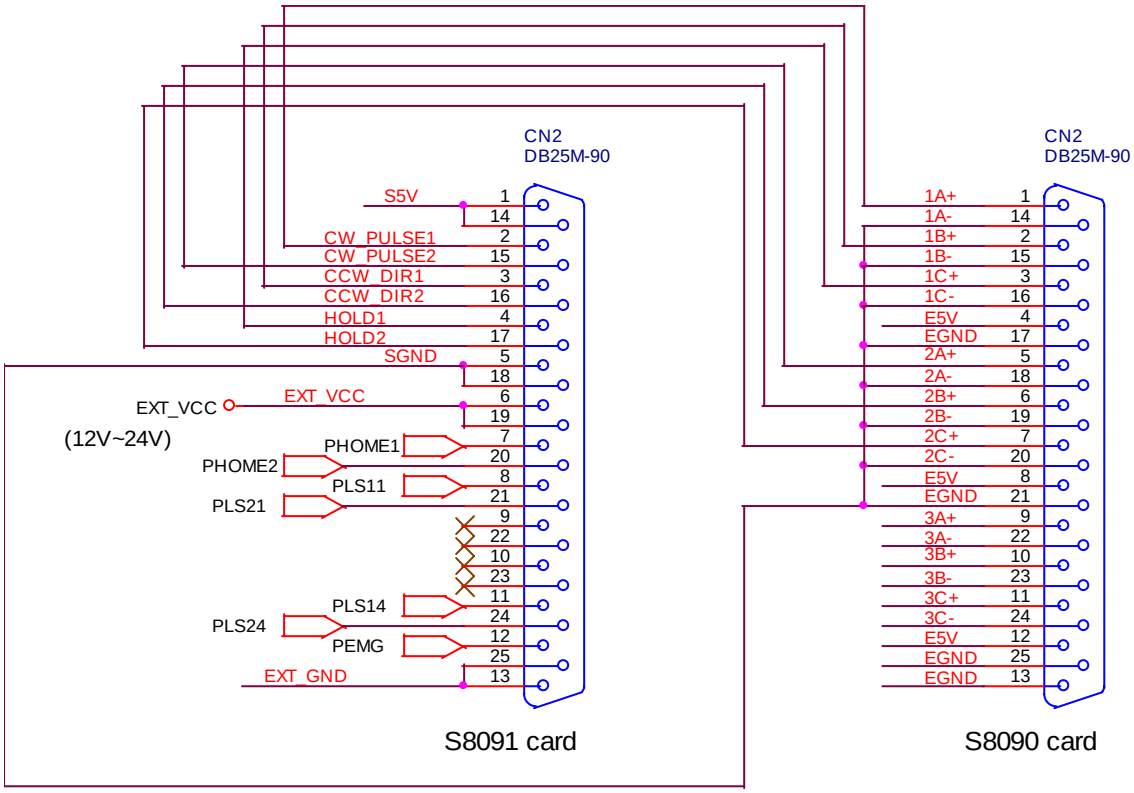



Fig (10) The connection between I-8090 and I-8091 for function testing or pulse feedback by I-8090 encoder card.

# 2. Software

User's applications could be compiled under DOS Turbo/Borland C/C++ environment. It should be include i8090.h and i8090.LIB to compile the target execution file. The execution files can be downloaded under I-8000 main system (execute 7188x.exe), and then run the target execution file as under PC system. About the I-8000's resource or environment, please refer to the manual of I-8000 system or its software programming guide.

The following section will introduce the I-8090's functions and examples.

## 2.1 constants and functions

**Constants**

```
#define YES    1
#define NO     0
#define ON     1
#define OFF    0

#define X_axis         1
#define Y_axis         2
#define Z_axis         3

#define ENC_QUADRANT    0x00
#define ENC_CW_CCW      0x10
#define ENC_PULSE_DIR   0x20
```

**Functions**

**(1) unsigned char i8090_REGISTRATION(unsigned char cardNo, unsigned int address)**

In order to distinguish more than one I-8090 card in I-8000 platform, the I-8090 cards should be registrated before using it. This command will assign a card number="cardNo" to I-8090 card address="address" . If there is not I-8090 at the given address, this command will return "NO".

cardNo: 0~19, assign the address as which card.

address: hardware address which defined at chapter 1.1

Return: "YES" : registration successful

"NO" : registration failure.

Example: This example will assign I-8090 card address=0x080 as CARD1 (1). Then initial the I-8090 card and reset X,Y,Z axis encoder counter value to 0.

```
#define CARD1  1
…
i8090_REGISTRATION(CARD1,  0x080);
i8090_INIT_CARD(CARD1, ENC_QUADRANT, ENC_QUADRANT,
                       ENC_QUADRANT);
i8090_RESET_ENCODER(CARD1, X_axis);
i8090_RESET_ENCODER(CARD1, Y_axis);
i8090_RESET_ENCODER(CARD1, Z_axis);
```

**(2) void i8090_INIT_CARD(unsigned char cardNo,**
**unsigned char x_mode,**
**unsigned char y_mode,**
**unsigned char z_mode)**

This command will reset all three axis's counter value of "cardNo" card, and assign its counting mode. The counting mode (S1,S0) has been explained in registers XCTRL, YCTRL, ZCTRL.

cardNo: 0~19, select which card.

x_mode, y_mode, z_mode: select the counting mode.

0x00 : quadrant counting mode

0x10 : CW/CCW counting mode

0x20 : Pulse/Direction counting mode

Example:

```
#define ENC_QUADRANT    0x00
#define ENC_CW_CCW      0x10
#define ENC_PULSE_DIR   0x20
```

i8090_INIT_CARD(CARD1, ENC_QUADRANT, ENC_QUADRANT, ENC_QUADRANT);

**(3) unsigned int i8090_GET_ENCODER(unsigned char cardNo, unsigned char axis)**

This command will return the counter value of the selected "axis" and "cardNo".

cardNo: 0~19, select which card.

axis : select which axis.

1 : X-axis

2 : Y-axis

3 : Z-axis

return : a 16 bits unsigned integer value.

**(4) void i8090_RESET_ENCODER(unsigned char cardNo, unsigned char axis)**

This command will reset the counter value of the selected "axis" and "cardNo".

cardNo: 0~19, select which card.

axis : select which axis.

1 : X-axis

2 : Y-axis

3 : Z-axis

**(5) unsigned char i8090_GET_INDEX(unsigned char cardNo)**

It will return the "INDEX" register's value of the selected "cardNo" card.

cardNo: 0~19, select which card.

| Register | Add. | R/W | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|---|---|---|
| INDEX | 0x04 | R | | | | | | ZI | YI | XI |

The index input C+/C- can read out from this register. These bits are active high.

XI : indicate the index of X-axis.

YI : indicate the index of Y-axis.

ZI : indicate the index of Z-axis.

**32 bits encoder counts command sets**

**(6) void i8090_ENCODER32_ISR(unsigned char cardNo)**

**(7) void i8090_RESET_ENCODER32(unsigned char cardNo, unsigned char axis)**

**(8) long i8090_GET_ENCODER32(unsigned char cardNo, unsigned char axis)**

cardNo: 0~19, select which card.

axis : select which axis.

1 : X-axis

2 : Y-axis

3 : Z-axis

The above three commands provided a software method to get 32 bits encoder counts.

The **i8090_ENCODER32_ISR(unsigned char cardNo)** command calculates the difference pulse between present and last time, and then add this difference into a *"long type"* variable. According to this idea, so, the **i8090_ENCODER32_ISR()** command should be executed periodically in 2~10ms by timer interrupt or manually call it.

The **i8090_RESET_ENCODER32((unsigned char cardNo, unsigned char axis)** command can reset the *"long type"* variable to zero.

The **long i8090_GET_ENCODER32(unsigned char cardNo, unsigned char axis)** command can return the value of the *"long type"* variable.

## 2.2 examples

### 2.2.1 Detect I-8090 card

```
//---------------------------------------------------
// detect i8090,i8091,i8092 card
//---------------------------------------------------
#include "8000.h"
#include "i8090.h"

#define i8090  0x0d
#define i8091  0x0e
#define i8092  0x0f
#define NOCARD 0x00
#define MAX_SLOT_NO  8
unsigned int PortAddress[8]={0x080, 0x0a0, 0x0c0, 0x0e0, 0x140, 0x160,
0x180, 0x1a0};
//---------------------------------------------------
void main ()
{
unsigned char slot,temp;

 for (slot=0; slot<MAX_SLOT_NO; slot++)
 {
  temp=inportb(PortAddress[slot]);
  switch (temp)
  {
    case i8090: //i8090 3-axis encoder card
          Print("Slot %d = i8090\r\n",SlotNum);
          return i8090;
    case i8091: //i8091 2-axis stepping card
          Print("Slot %d = i8091\r\n",SlotNum);
          return i8091;
    case i8092: //i8092
          Print("Slot %d = i8092\r\n",SlotNum);
```

```
            return i8092;
        default:
            Print("Slot %d = No Card\r\n",SlotNum);
            return NOCARD;
       };
       Delay(500);
     };
   }
```

### 2.2.2 Start to use I-8090 card

```
#define CARD1   1
if (i8090_REGISTRATION(CARD1, PortAddress[0])==YES)
{
    i8090_INIT_CARD(CARD1, ENC_QUADRANT, ENC_QUADRANT,
                          ENC_QUADRANT);
    i8090_RESET_ENCODER(CARD1, X_axis);
    i8090_RESET_ENCODER(CARD1, Y_axis);
    i8090_RESET_ENCODER(CARD1, Z_axis);
}
else
{
    Print(" Not found I-8090 card in slot 0!");
    return;
}
```

### 2.2.3 Get X, Y, Z-axis encoder counter's value

```
unsigned int i8090_GET_ENCODER(unsigned char cardNo, unsigned char
axis)
{
unsigned int value;

  switch (axis)
  {
    case X_axis:
```

```
        card[cardNo].ctrl1 &= 0xFC;  //1111 1100 low byte
        outportb(card[cardNo].base + WR1, card[cardNo].ctrl1);
        value = inportb(card[cardNo].base + RD1);

        card[cardNo].ctrl1 |= 0x01;  //0000 0001 high byte
        outportb(card[cardNo].base + WR1, card[cardNo].ctrl1);
        value += inportb(card[cardNo].base + RD1)*256;

        card[cardNo].ctrl1 |= 0x03;  //0000 0011
        outportb(card[cardNo].base + WR1, card[cardNo].ctrl1);
        break;
    case Y_axis:
        card[cardNo].ctrl2 &= 0xFC;  //1111 1100 low byte
        outportb(card[cardNo].base + WR2, card[cardNo].ctrl2);
        value = inportb(card[cardNo].base + RD2);

        card[cardNo].ctrl2 |= 0x01;  //0000 0001 high byte
        outportb(card[cardNo].base + WR2, card[cardNo].ctrl2);
        value += inportb(card[cardNo].base + RD2)*256;

        card[cardNo].ctrl2 |= 0x03;  //0000 0011
        outportb(card[cardNo].base + WR2, card[cardNo].ctrl2);
        break;
    case Z_axis:
        card[cardNo].ctrl3 &= 0xFC;  //1111 1100 low byte
        outportb(card[cardNo].base + WR3, card[cardNo].ctrl3);
        value = inportb(card[cardNo].base + RD3);

        card[cardNo].ctrl3 |= 0x01;  //0000 0001 high byte
        outportb(card[cardNo].base + WR3, card[cardNo].ctrl3);
        value += inportb(card[cardNo].base + RD3)*256;

        card[cardNo].ctrl3 |= 0x03;  //0000 0011
        outportb(card[cardNo].base + WR3, card[cardNo].ctrl3);
```

```
            break;
        default : break;
      }

    return value;
  }
```

### 2.2.4 Software 32 bits encoder counter programming

```
  //---------------------------------------------------------------------
  // demo1.cpp for I-8090 card
  // This program demostrates the software 32 bits encoder method by
  //   void i8090_ENCODER32_ISR(unsigned char cardNo);
  //   void i8090_RESET_ENCODER32(unsigned char cardNo, unsigned char
  axis);
  //    long i8090_GET_ENCODER32(unsigned char cardNo, unsigned char
  axis);
  //---------------------------------------------------------------------
  // v1.0  4/7/2001
  //
  //---------------------------------------------------------------------
  #include <dos.h>
  #include <math.h>
  #include "8000.h"
  #include "i8090.h"

  #define i8090  0x0d
  #define i8091  0x0e
  #define i8092  0x0f
  #define NOCARD 0x00

  #define Insert         0x0000
  #define BasePort       0x0080
  #define SlotOffset     0x0020
  #define IDPort         0x0000
```

```
#define CARD1  1
#define CARD2  2
#define MAX_SLOT_NO  8
unsigned int PortAddress[8]={0x080, 0x0a0, 0x0c0, 0x0e0, 0x140, 0x160,
0x180, 0x1a0};
//---------------------------------------------------------------------
long        x_value;
long        y_value;
long        z_value;
unsigned char index;
unsigned char x_index;
unsigned char y_index;
unsigned char z_index;

unsigned char i8090Slot;
//---------------------------------------------------------------------

//---------------------------------------------------------------------
void ShowLedValue(long value,unsigned char axis)
{
long j;
unsigned char negative_value;

  if (value<0) negative_value=1;
  else        negative_value=0;
  value=labs(value);

  j=value-10*(value/10);
  if (negative_value) Show5DigitLedWithDot(0x05, j);
  else                Show5DigitLed(0x05, j);

  value=value/10;
  j=value-10*(value/10);
```

```
  Show5DigitLed(0x04, j);
  value=value/10;
  j=value-10*(value/10);
  if (axis==Z_axis) Show5DigitLedWithDot(0x03, j);
  else          Show5DigitLed(0x03, j);
  value=value/10;
  j=value-10*(value/10);
  if (axis==Y_axis) Show5DigitLedWithDot(0x02, j);
  else          Show5DigitLed(0x02, j);
  value=value/10;
  j=value-10*(value/10);
  if (axis==X_axis) Show5DigitLedWithDot(0x01, j);
  else          Show5DigitLed(0x01, j);
}
//---------------------------------------------------
void ShowCardName(unsigned char SlotNum)
{
unsigned char temp;

  Show5DigitLed(0x05, SlotNum);
  temp=inportb(PortAddress[SlotNum]);
  switch (temp)
  {
    case i8090: //i8090 3-axis encoder card
          Show5DigitLedSeg (0x01, 0x7F);
          Show5DigitLedSeg (0x02, 0x7E);
          Show5DigitLedSeg (0x03, 0x7B);
          Show5DigitLedSeg (0x04, 0x7E);
          break;
    case i8091: //i8091 2-axis stepping card
          Show5DigitLedSeg (0x01, 0x7F);
          Show5DigitLedSeg (0x02, 0x7E);
          Show5DigitLedSeg (0x03, 0x7B);
          Show5DigitLedSeg (0x04, 0x30);
```

```
                break;
        default:
                Show5DigitLedSeg (0x01, 0x01);
                Show5DigitLedSeg (0x02, 0x01);
                Show5DigitLedSeg (0x03, 0x01);
                Show5DigitLedSeg (0x04, 0x01);
                break;
    };
}
//-------------------------------------------------
unsigned char CardSearch(unsigned char SlotNum)
{
unsigned char temp;

    temp=inportb(PortAddress[SlotNum]);
    ShowCardName(SlotNum);
    switch (temp)
    {
      case i8090: //i8090 3-axis encoder card
                Print("Slot %d = i8090\r\n",SlotNum);
                return i8090;
      case i8091: //i8091 2-axis stepping card
                Print("Slot %d = i8091\r\n",SlotNum);
                return i8091;
      default:
           Print("Slot %d = No Card\r\n",SlotNum);
                return NOCARD;
    };
}

//-----------------------------------------------------------------------------
void main ()
{
unsigned char j;
```

```
int          key,ShowAxis;

  i8090Slot=99;
  for (j=0; j<MAX_SLOT_NO; j++)
  {
    if (CardSearch(j)==i8090) i8090Slot=j;
    Delay(500);
  };

  if (i8090Slot==99)
  {
     Print("Not found i8090 card in 8 slot!\r\n");
     return;
  }

  i8090_REGISTRATION(CARD1, PortAddress[i8090Slot]);
  i8090_INIT_CARD(CARD1,      ENC_QUADRANT,      ENC_QUADRANT,
ENC_QUADRANT);
  i8090_RESET_ENCODER(CARD1, X_axis);
  i8090_RESET_ENCODER(CARD1, Y_axis);
  i8090_RESET_ENCODER(CARD1, Z_axis);
  i8090_RESET_ENCODER32(CARD1, X_axis);
  i8090_RESET_ENCODER32(CARD1, Y_axis);
  i8090_RESET_ENCODER32(CARD1, Z_axis);

  Print("-------------------------------------------------------------------\r\n");
  Print(" i8090 DEMO1 program      demo1.PRJ, demo1.cpp, i8090.lib
\r\n");
  Print(" 32 bits encoder demostration                              \r\n");
  Print("-------------------------------------------------------------------\r\n");
  Print("Press any key to stop...\r\n");
  ClearSystemKey();
  ShowAxis=0;
  do
```

```
{
   Delay(5);   //delay 5ms
   //-----------------------------------------------------
   // i8090_ENCODER32_ISR(CARD1) should be called in 2~10ms
   // or call it by a timer interrupt service routine by 2~10ms
   //-----------------------------------------------------
   i8090_ENCODER32_ISR(CARD1);

   //-----------------------------------------------------
   x_value = i8090_GET_ENCODER32(CARD1, X_axis);
   y_value = i8090_GET_ENCODER32(CARD1, Y_axis);
   z_value = i8090_GET_ENCODER32(CARD1, Z_axis);
   index   = i8090_GET_INDEX(CARD1);
   x_index = index & 0x01;
   y_index = (index & 0x02) >> 1;
   z_index = (index & 0x04) >> 2;

   if (IsSystemKey())
   {
  key=GetSystemKey();
     ClearSystemKey();
     switch (key)
     {
       case SKEY_DOWN:
                 ShowAxis++;
                 if (ShowAxis>2) ShowAxis=0;
                 break;
       case SKEY_UP:
                 ShowAxis--;
            if (ShowAxis<0) ShowAxis=2;
                 break;
     };
   }
```

```
        switch (ShowAxis)
        {
          case 0: ShowLedValue(x_value,X_axis); break;
          case 1: ShowLedValue(y_value,Y_axis); break;
          case 2: ShowLedValue(z_value,Z_axis); break;
        };
        if (x_index) LedRunOff();  else LedRunOn();
        if (y_index) LedCommOff(); else LedCommOn();
        if (z_index) LedBattOff(); else LedBattOn();
    } while (!Kbhit());
}
```