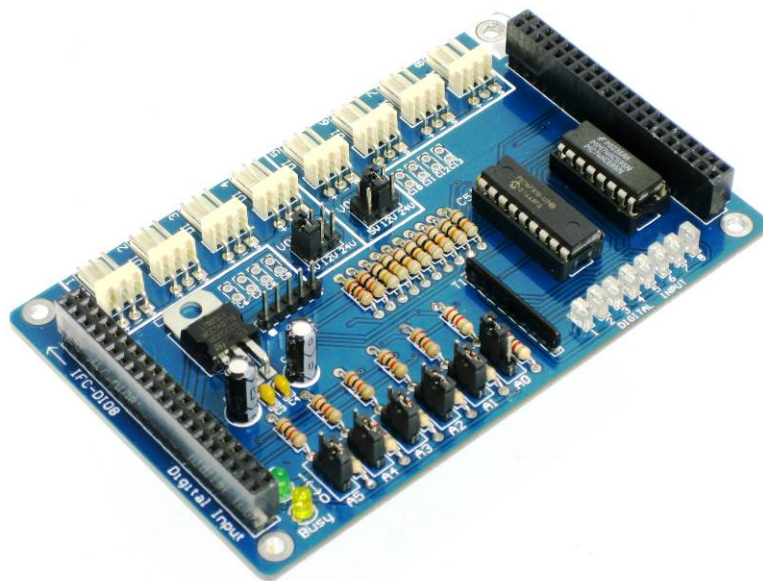




IFC-DI08

Interface Free Controller Digital Input Card



User's Manual

V1.1

Apr 2008

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1. INTRODUCTION AND OVERVIEW

1.0 Introduction of Interface Free Controller

IFC (Interface Free Controller) offer a new concept of developing microcontroller embedded system and also robotics system. With IFC, no more frustration in determine hardware interface and configuring peripheral in software. Checking few hundreds pages of data sheet can be waved. With the concept of interfacing card, user may stack as many as 64 cards in a system to get infinite combination of peripherals. The design aim is to offer 3 simple steps in microcontroller system development – Configure card's address, Stack IFC cards, Write Program and Run!

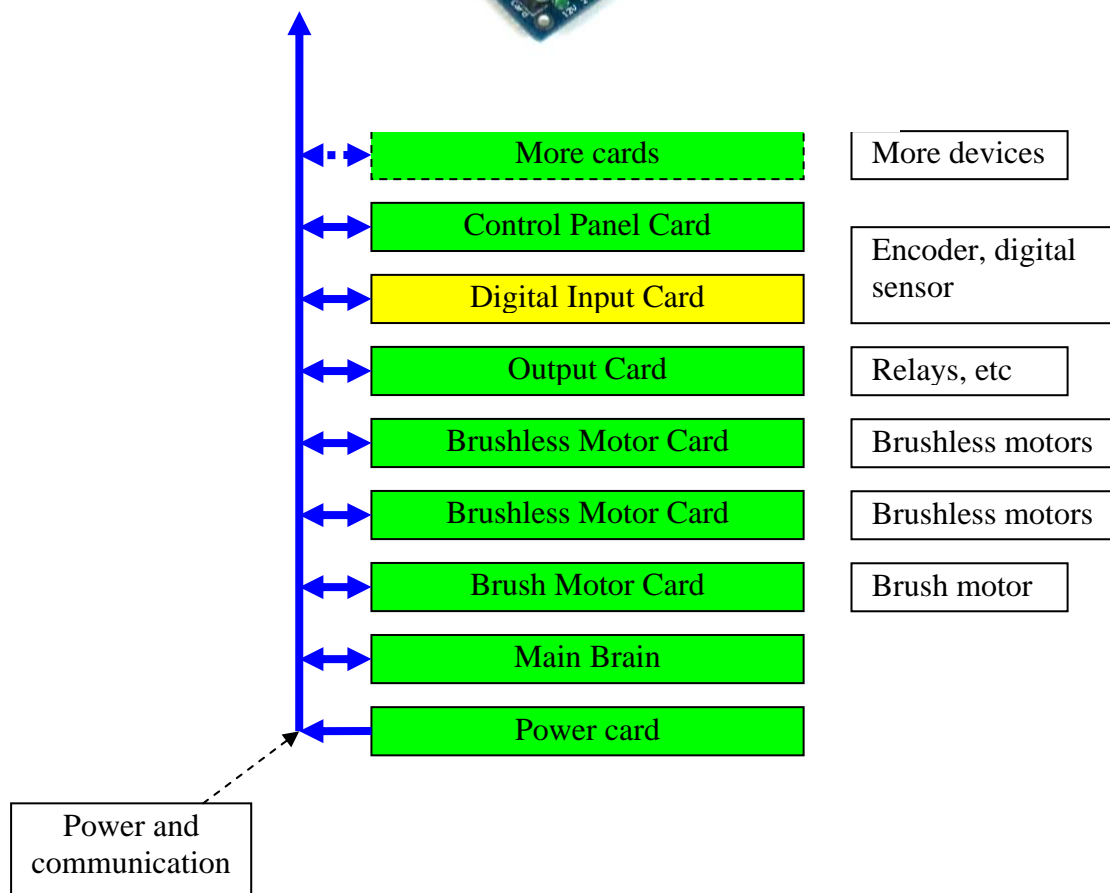
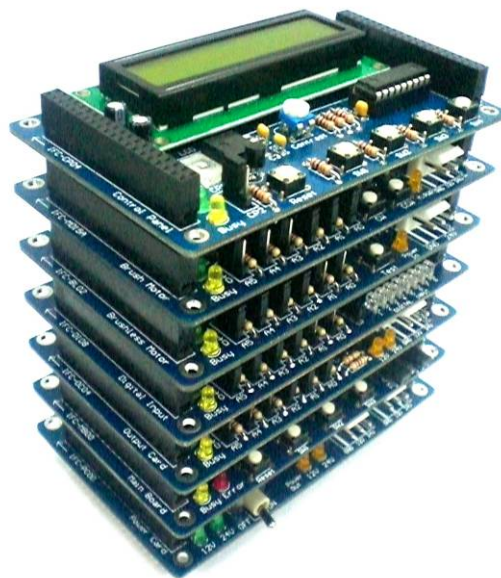
Furthermore, with functions based software library, user save valuable time during software development by concentrating on algorithm development. No more flipping or scrolling PIC data sheet looking for ADCON0, T1CON or even TRISA. With just a programming hand book, user may simply copy the header file, call comprehensive functions and it's ready to rock.

IFC come with a brain card (main controller) where the main program is loaded. There are several cards available for robotics development such as control panel, 15A brush motor driver, brushless motor controller, counter and digital input, output card and power card. This document will focus on the digital input card, IFC-DI08. This card has been designed with capabilities and features of:

- Industrial grade PCB.
- Every component is soldered properly and tested before board is shipped.
- Circuit power and busy indicator LED.
- 12V operation.
- 6 set of 1x3 headers to select communication address.
- 8 digital input ports which first 2 ports are changeable as counter input port.
- 5V TTL logic input
- Selectable power source for each digital input port (5V, 12V or 24V).
- A status indicator LED for each digital input port.
- **Dimension** 11.1cm x 6.9cm
- Template and sample source code is provided for MPLAB C18 compiler.

1.1 System Overview

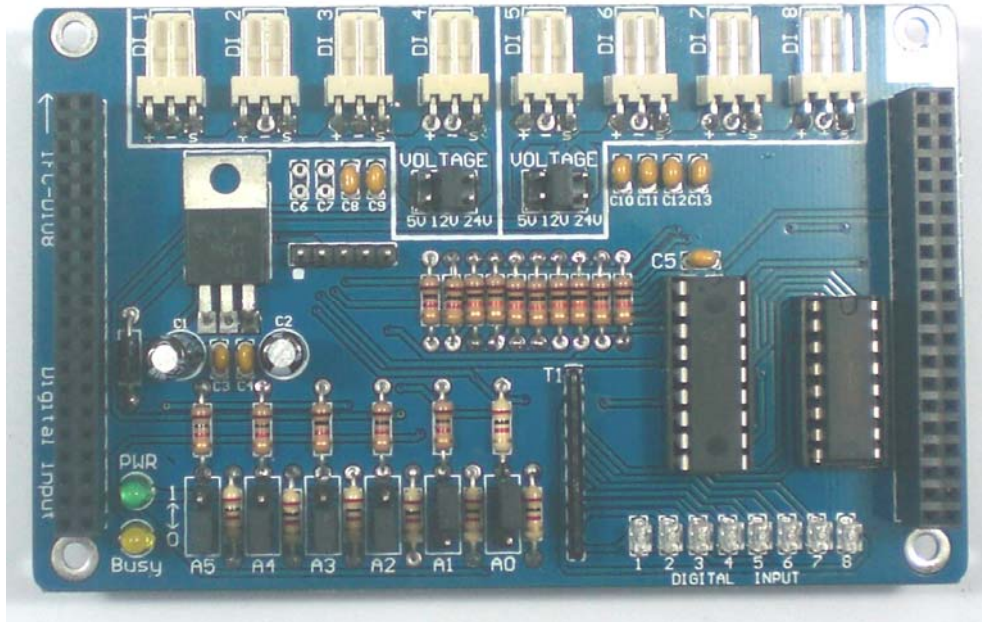
With serial communication perception, IFC offer million of possibilities to develop embedded system creatively and easily. In IFC, several cards are stacked to get a complete embedded system. The minimum card requires is Power card and Main Board.



This document explains the method to use IFC-DI08.

2. PACKING LIST

Please check the parts and components according to the packing list. If there are any parts missing, please contact us at sales@cytron.com.my immediately.



1. 1 x IFC Digital Input Card ,IFC-DI08 with:
 - 1 x PIC microcontroller.
 - 8 x mini jumper.
 - 8 x digital input terminal.
 - 8 x digital input status LED.
 - Female connector for every terminal.
 - Other electronics components soldered on board.

3. PRODUCT SPECIFICATION

3.1 Communication Address

There are 64 (2^6) communication address of IFC-DI08 that can be selected. The 6 bits communication address is determined by selector A5 through A0 (6 set of 1x3 headers on IFC-DI08). User may set the card address by using the mini jumper. However, user need to make sure the communication address chosen on board is compatible with program written in Main Board.

3.2 Programmer

User **does not need** to prepare programmer for IFC-DI08. IFC-DI08 is one of the slave cards of IFC system. The slave program is preloaded before shipped to customer. User will only need the Main Board of IFC system, IFC-MB00 to control this slave card.

3.3 Input and Output device

The output devices on DI08 are as below:

- 2 status indicator LED: Power and busy LED:
 - Power LED (PWR) will turn ON when power supplied to DI08.
 - Busy LED (Busy) will turn ON or blink when DI08 is communicating with master card, IFC-MB00.
 -
- 8 digital input status indicator LED:
 - A status indicator LED for each digital input port. The LED will turn ON when signal is detected (signal pin become 'LOW') on input device that connected to its compatible digital input port.

The input devices on DI08 are as below:

- 8 digital input ports ready with selectable power source and 2 changeable counter input ports:
 - Selectable power source for each digital input port (5V, 12V or 24V). User may select the input devices power source by using the mini jumper. If 24V is needed, please ensure that two 12V batteries are connected to PC00.
 - All digital input signal is pull high to 5V, thus it is 5V logic port.
 - The first 2 digital input ports are changeable to counter input port. User may set the input mode in programming. Please refer to sample source code and technical info for IFC-DI08 for more details.
 - Digital input devices that can be connected to the digital port are digital sensor and encoder.

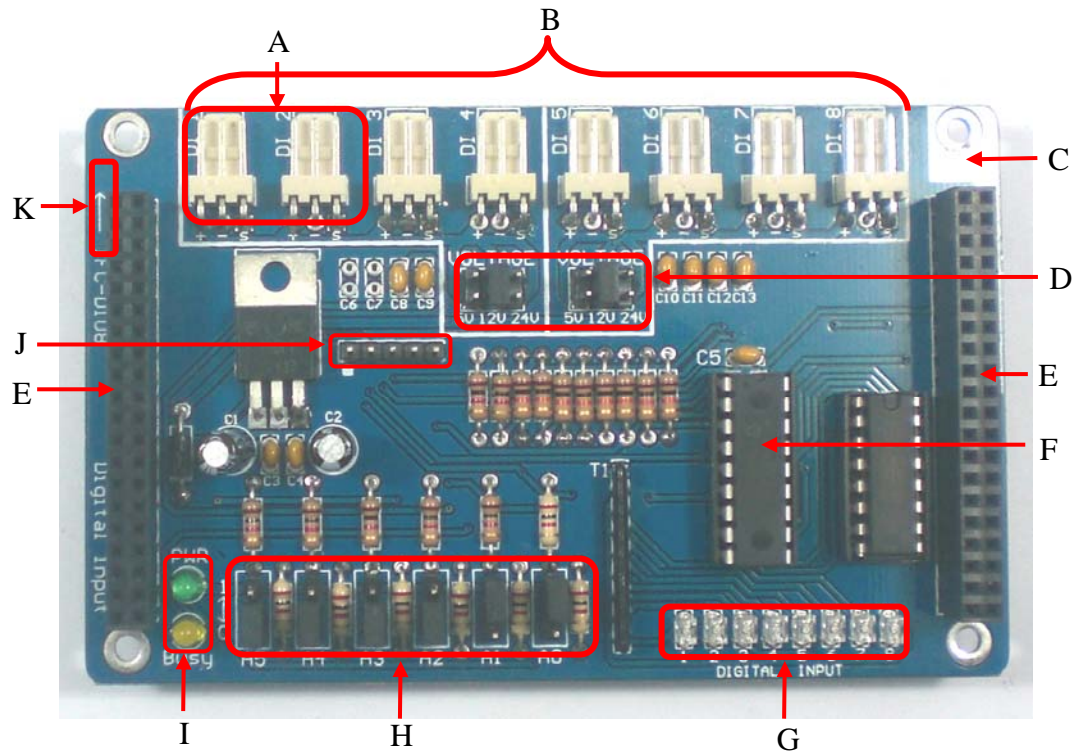
3.4 Operating Voltage

The operation voltage of IFC-DI08 is 12V. User needs to stack a Power Card, IFC-PC00, and connect a 12V battery on Power Card to supply 12V to the Digital Input Card. However, user needs to connect 2x12V batteries on IFC Power card to provide 24V to digital input port if it is necessary.

Absolute Maximum Rating

Symbol	Parameter	Min	Max	Unit
V _{CC}	Operating voltage	-	12	V
V _{IN}	Input Devices supply voltage	5	24	V

4. BOARD OR PRODUCT LAYOUT



Label	Function	Label	Function
A	Changeable counter input ports	G	Digital input status indicator LED
B	Digital Input port	H	Communication address selectors
C	Orientation marking	I	Status indicator LED
D	Input device voltage selector	J	Manufacturing Test Points
E	Side connector	K	Arrow
F	PIC Microcontroller		

A – 2 changeable 16 bits counter input port on DI08. User may enable or disable the encoder function in the program. Please refer sample source code for the example.

B – 8 output digital input ports ready with selectable power source and the first 2 digital input ports are changeable counter input ports. All 8 digital input ports is being pulled high to 5V through 4.7K Ohm resistor. User may connect NPN digital sensor such as photo electric, fiber optic sensor or limit switch to it.

C – The orientation marking on IFC-DI08. Every IFC card has this orientation marking, this is to help user in ensure the cards are stack correctly.

D – 2 input voltage selectors on IFC-DI08. The voltage selector on the left hand side is for DI1 to DI4, where the voltage selector on the right hand side is for DI5 to DI8. User may use mini jumper to select 5V, 12V or 24V for input voltage of each input port.

E – Side connector for stack card and communication between cards.

F – PIC microcontroller which used as controller for this slave card.

G – 8 status indicators LED for the digital input port. Each input port has its own status indicator LED. The LED are active high and will turn ON when signal is detected on corresponding input port.

H – 6 set of 1x3 headers use as communication address selector on IFC-DI08. User may set the card address by using the mini jumper.

I – 2 status indicator LED to indicate status of power ON (PWR) and busy for communicate with Main Board card (Busy). PWR LED will turn ON when power is supplied to the board. Busy LED will turn ON when the card is busy communicating with master card, IFC-MB00.

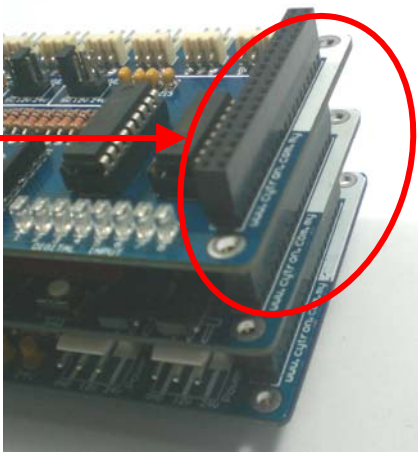
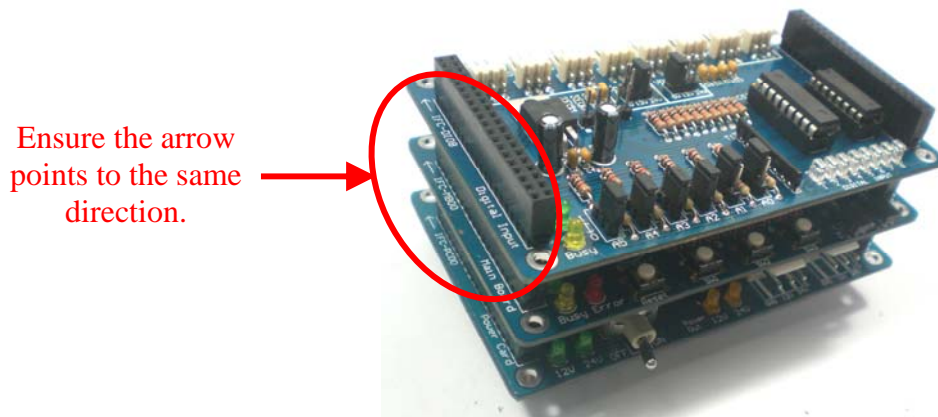
J – Reserved as Manufacturing Test Points. Please DO NOT shorted or connects wire to any pin.

K – A arrow to help user in ensuring the cards are stack correctly. Every IFC card has this arrow; user needs to ensure that the arrow points to the same direction when IFC cards are stack together.

5. INSTALLATION (HARDWARE)

For hardware installation of IFC-DI08, user will first need the Main Board card (IFC-MB00) and Power Card (IFC-PC00). IFC-MB00 is the main controller of IFC system while IFC-PC00 is the main power supply. For installation of IFC-MB00 and IFC-PC00 please refer to the user's manual of IFC-MB00.

After obtaining IFC-DI08, user may stack it on IFC system as shown in Figure.

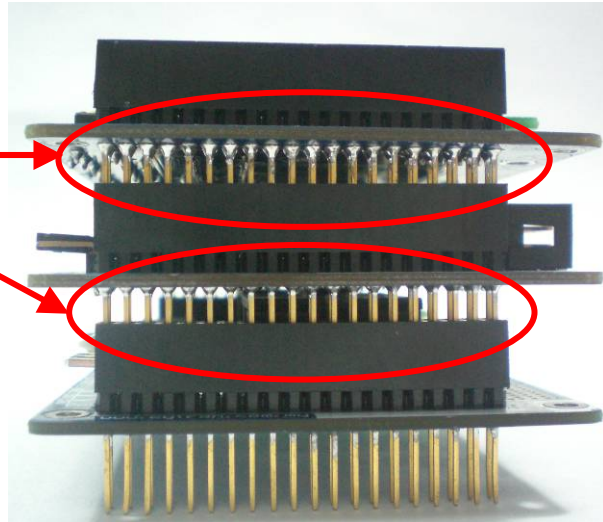


Ensure the orientation marking at the same side.

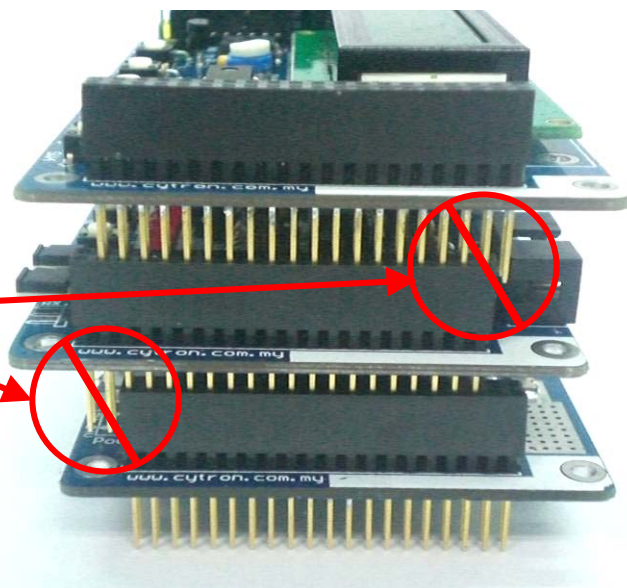
Cautions: Please ensure that every card is being stacked properly in correct orientation. Whole IFC system will be damaged if one of the cards is being stacked wrongly when it is powered up.

Besides stack every card in correct orientation, user must also require to ensure all card pins are not shifted when stacking. Figures show the example of stacking cards in proper location and example of stacking cards with shifted pins.

Ensure that all card pins are not shifted when stacking.



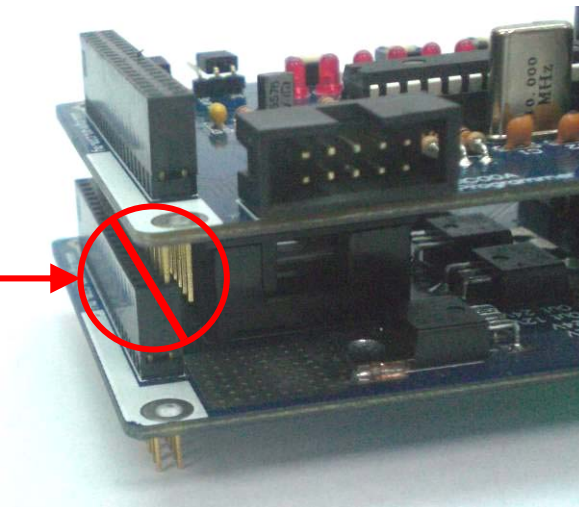
Examples of stacking cards with shifted pins. Please AVOID this!



Ensure that all card pins are not shifted when stacking.

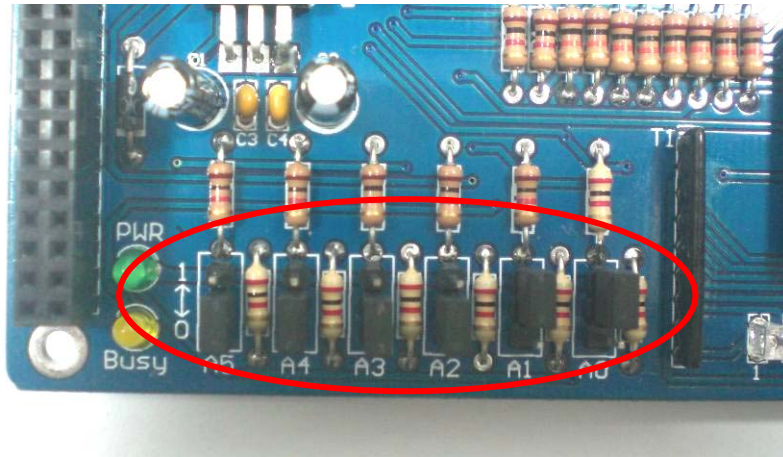


Examples of stacking cards with shifted pins. Please AVOID this!

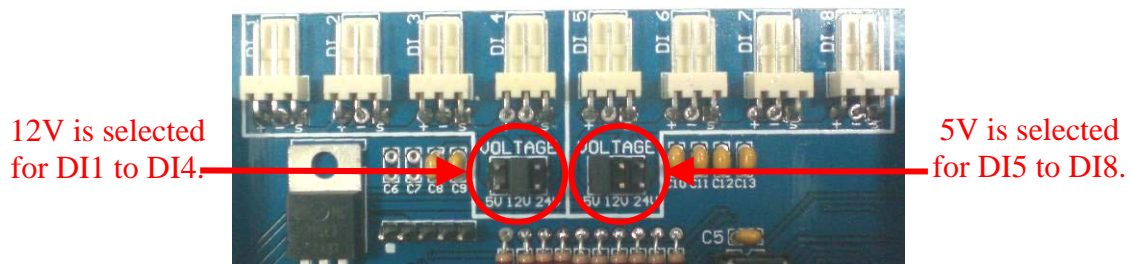


Cautions: Please ensure that all card pins are not shifted when stacking. IFC system will NOT function if the pins are shifted.

User may use the mini jumper provided on IFC-DI08 to select the communication address of IFC-DI08. For example, figure below shows the communication address, 000011 selected. Please make sure the address selected is compatible with the program. Each slave card must have unique address. Please refer chapter 7 for details of writing program for IFC-DI08.

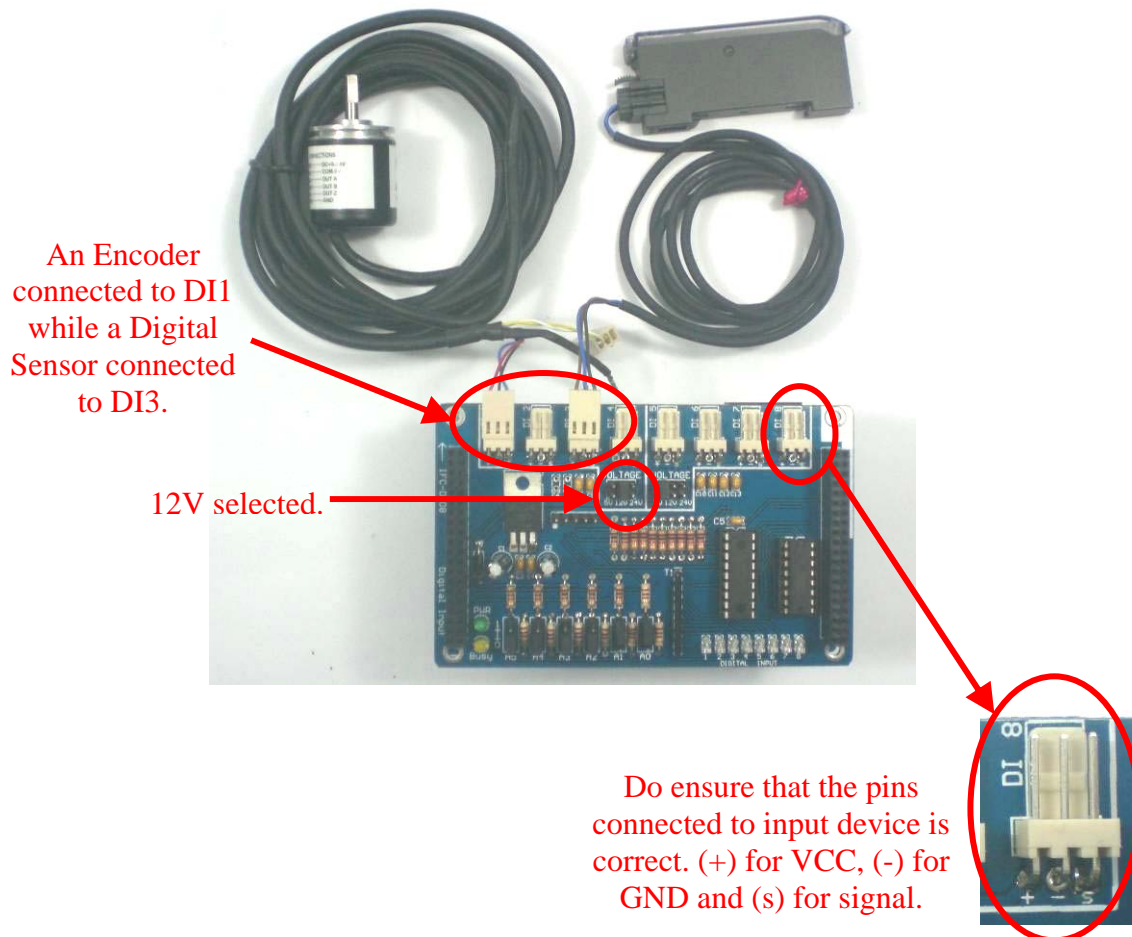


User also needs to select power source for the input device (sensor) which will be connected to DI08. There are 2 input voltage selectors on IFC-DI08; the voltage selector on left side is for DI1 to DI4, where the voltage selector on right side is for DI5 to DI8. Please refer User's Manual for IFC-MB00 for the connection of battery to Power Card. Figure below shows that 12V is selected for DI1 to DI4 while 5V is selected for DI5 to DI8.



Caution: Please ensure that only ONE input voltage range (5V, 12V or 24V) selected for each selector. If user need to supply 24V to input devices, 2 x 12V batteries must be connected to Power Card to provide 24V.

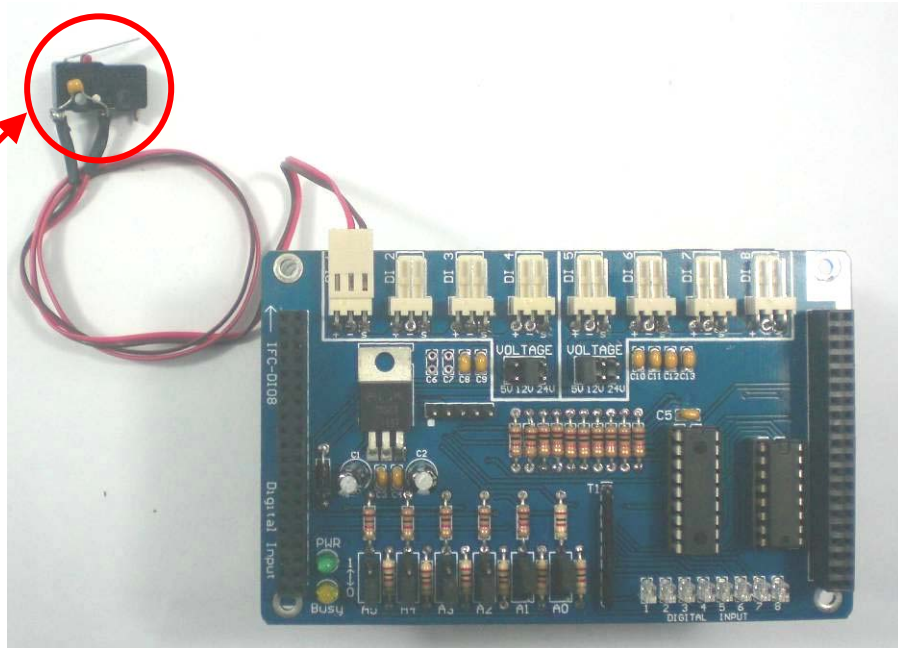
Figure below shows how to connect an Encoder to DI1 and a NPN Digital Sensor to DI3. The voltage selected is 12V. Please connect input devices that require same voltage to appropriate port. For example, 12V is selected on voltage selector on the left side where 5V is selected on voltage selector on the right side, thus user needs to connect all 12V input devices at DI1 to DI4 and connect 5V input devices at DI5 to DI8 only.



When connecting input device to input port, user needs to ensure the pin from input device is compatible to the pin of the input port. Besides, this Digital Input card is designed for **NPN** input device, which mean the input device should give signal '0' when signal detected. Hence, user needs to make sure the sensor or encoder connected to the card is **NPN configured**.

User may simply short the signal pin (s) to ground pin (-) to give signal '0' to the input port. By using switch or push button that connect between (-) and (s), user may use the switch or push button as an input device. For example, user may connect a limit switch as an input device. User needs to connect the (-) from DI08 input port to Normally Open (NO) pin of limit switch while (s) from DI08 input port to Common (COM) pin of limit switch. When the limit switch is pressed, signal '0' will be detected Figure shows the example to connect a limit switch as input device.

A limit switch is connected to DI1 as input device. Remember to put a capacitor (0.1uF) if the limit switch is use as counter. It is to filter the switch bouncing.

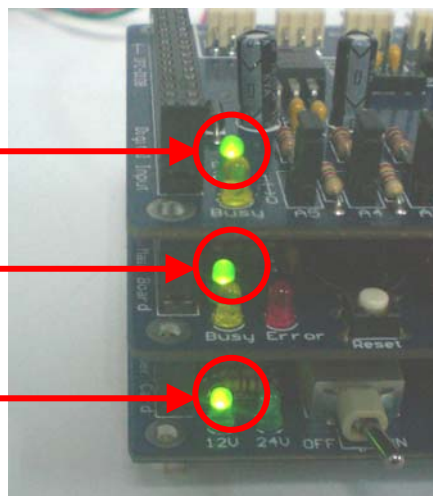


Next, please turn ON the power on Power Card; the PWR LED of IFC-DI08 will turn ON as shown in following figure. Initially, if there are no functions related to IFC-DI08 being called in Main Board's program, the busy LED will not turn ON or blink.

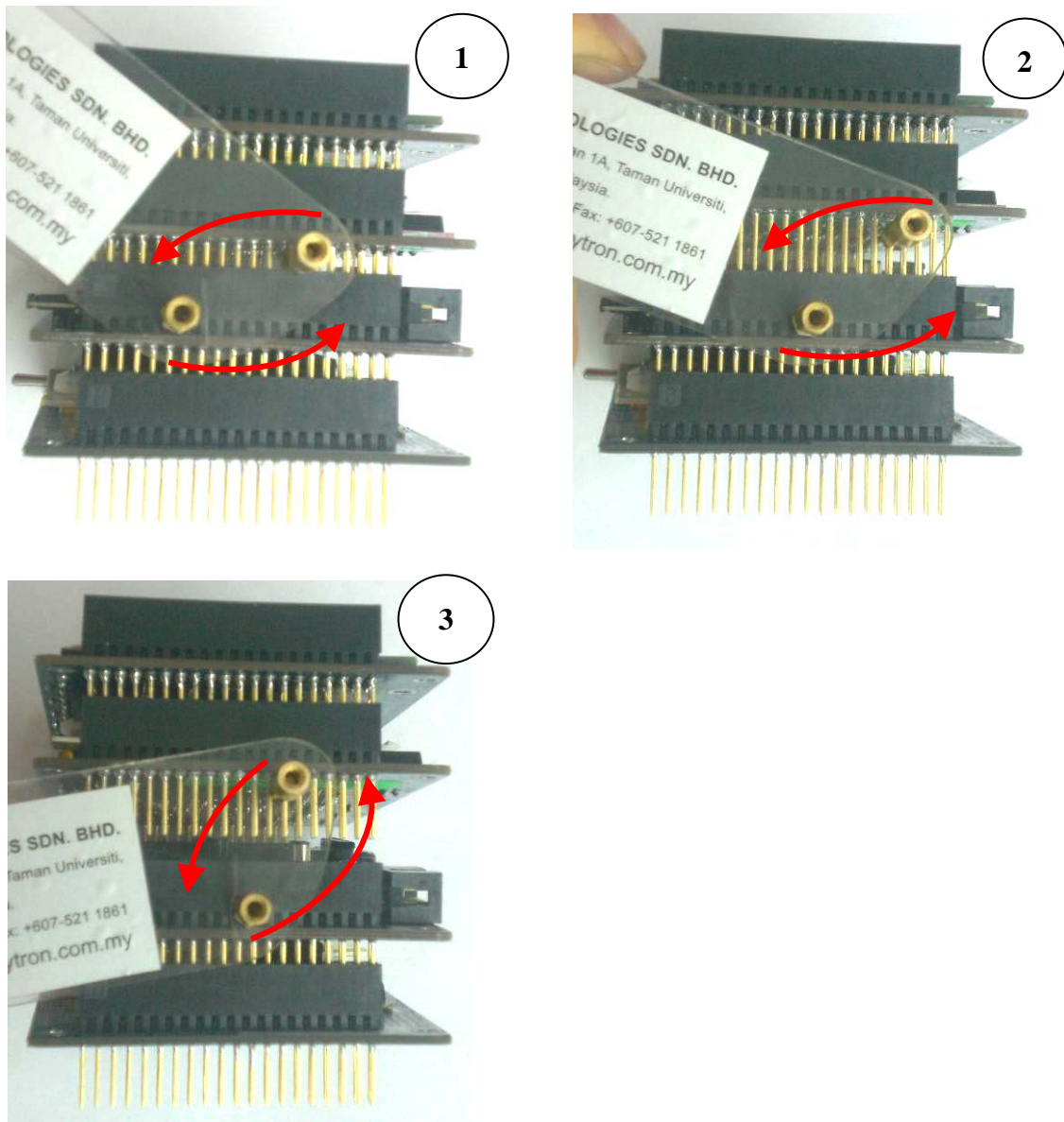
PWR LED on
IFC – DI08

PWR LED on
IFC - MB00

12V LED on
IFC - PC00



To open the cards, user should use the IFC card's opener to open the stacked cards. Figure shows the method to open cards with the opener.



Caution: Please use the opener to open IFC cards to avoid damage of the pins or cards.

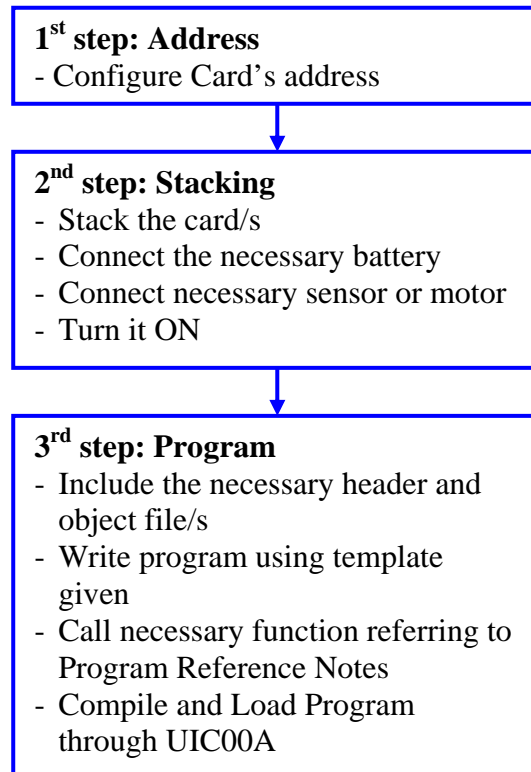
6. INSTALLATION (SOFTWARE)

User only needs to write program in IFC-MB00 in order to send data and communicate with IFC-DI08. A program editor, C compiler and UIC00A software is required to be installed in order for user to write program, compile it and further loading program to IFC main board. User is recommended to use MPLAB IDE as source code editor and MPLAB C18 as C compiler. Both this software is from Microchip and it is provided freely to download. Please refer user's manual of IFC-MB00 for the installation of MPLAB IDE and MPLAB C18. As for the installation of UIC00A software, please refer to UIC00A User's Manual.

Please refer to MB00 User's Manual, Chapter 6 for details step to install MPLAB IDE and C18 compiler.

7. GETTING STARTED

IFC is being design with the aim of 3 simple steps to use it. Configure card address, Stack it, Load program and run. There must be at least power card (IFC-PC00) and main board (IFC-MB00) for this system to function. This section will show the example to operate it with Digital Input Card, IFC-DI08.



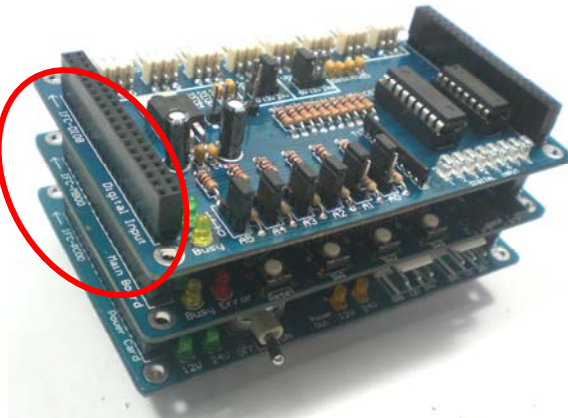
There are 2 basic setups in this chapter for IFC-DI08, the first one includes 3 cards, IFC-PC00, IFC-MB00 and IFC-DI08, and second one includes one extra card, which is IFC-CP04. Please refer following part of this chapter for setup details.

7.1 Basic Setup (IFC-PC00 + IFC-MB00 + IFC-DI08)

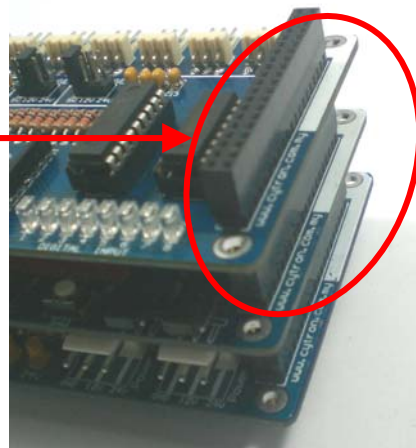
This is the basic and minimum setup for IFC-DI08 which comes with 8 digital input ports. Though without other card, this basic setup may still perform some task such as turn ON LED and buzzer on MB00 when a signal detected on Digital Sensor. Following steps show the installation of this system and method to operate it.

- a. 1st step, configure the address of card. Digital Input Card has 6 mini jumpers to configure communication address (A5-A0). It should be set to 000011 if sample source code is being used.
- b. 2nd step is to stack all 3 cards together. Power card (IFC-PC00) should be at the bottom, while Main board (IFC-MB00) at 2nd layer and Digital Input Card (IFC-DI08) at top layer as shown in following figure.

Ensure the arrow points to the same direction.

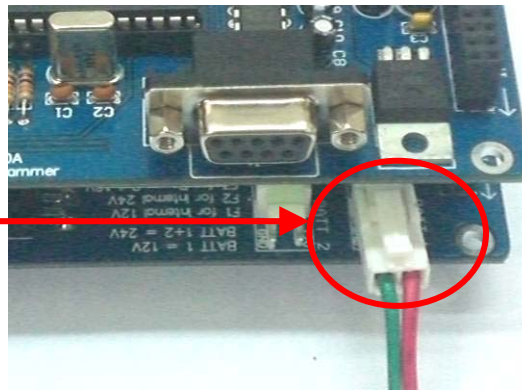


Ensure the orientation marking at the same side.

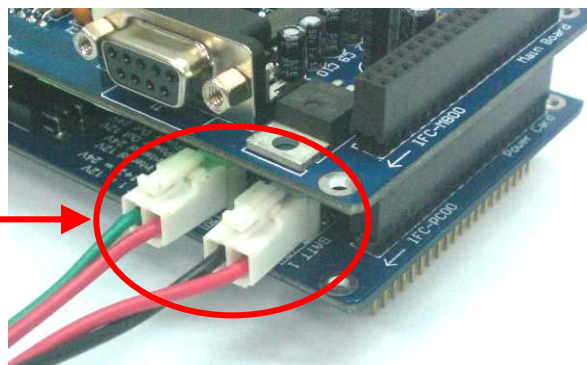


- c. Connect digital input device such as digital sensor and encoder to input ports. Please refer hardware setup for connecting input devices to Digital Input Card.
- d. Connect the battery to Power card as shown; please ensure the **polarity is correct**.

Connect 1 x 12V battery to supply operating voltage to IFC. **Ensure the polarity is correct.**



If 24V is needed in the system, connect 2 x 12V batteries to PC00. **Ensure the polarity is correct.**

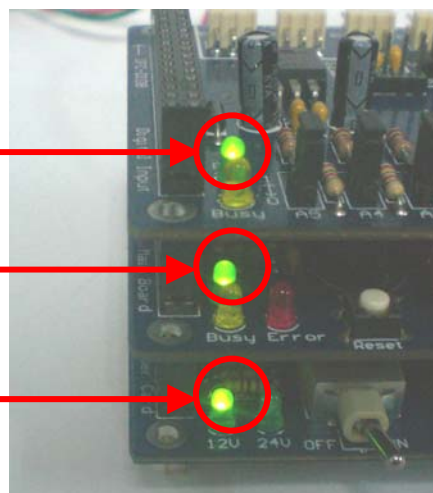


- e. Turn ON the IFC power by pushing the toggle switch to “ON”. There should be at least 3 LED (12V LED on Power Card, PWR LED on Main Brain and PWR LED on Digital Input Card) light up as show.

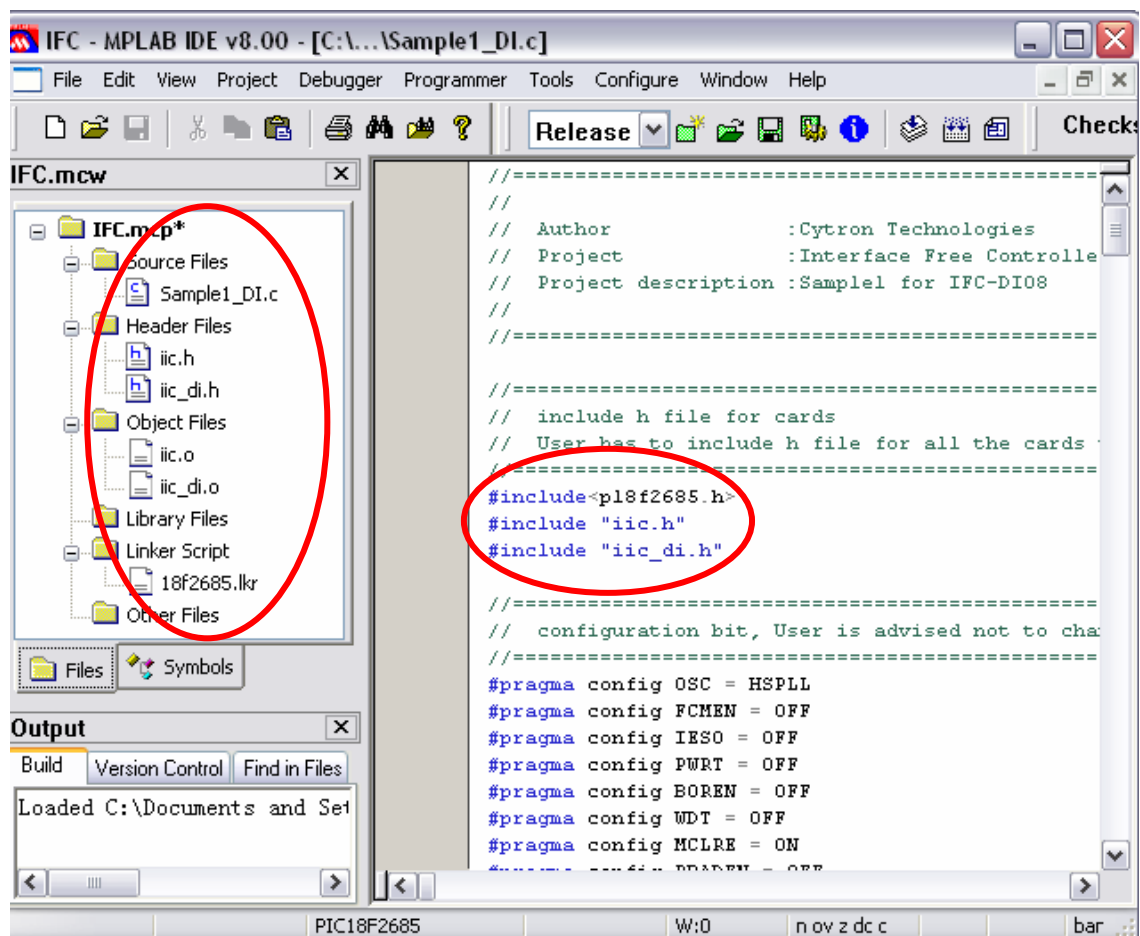
PWR LED on IFC – DI08

PWR LED on IFC - MB00

12V LED on IFC - PC00

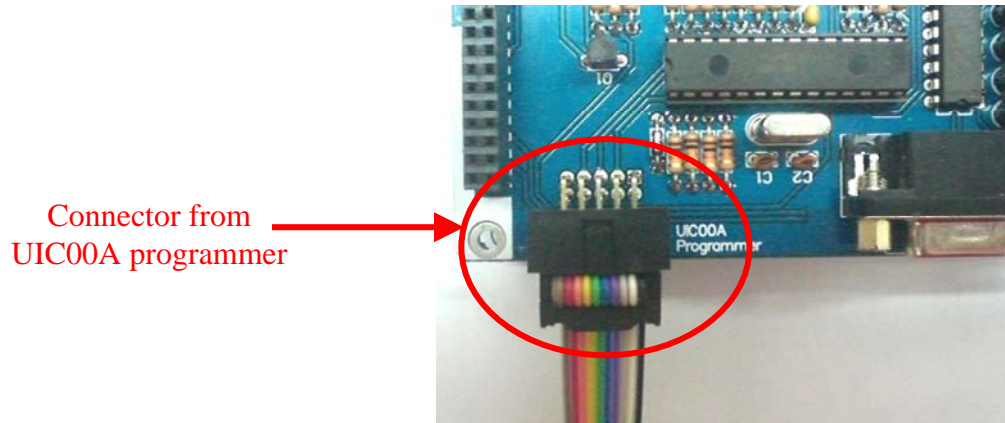


- f. 3rd step is to write program and load it. IFC comes with comprehensive function to save program development time. Functions library will come with the interfacing card in the form of header file (*.h) and object file (*.o). In order to call these functions, particular header file and object file must be included under a project.
- g. Open MPLAB IDE (please ensure, MPLAB C18 is being installed). User may follow the step in chapter 6.2 of user's manual for IFC-MB00 to open project named "IFC_DI" for IFC Digital Input Card. Please note that the header file (iic.h and iic_di.h) and object file (iic.o and iic_di.o) for IFC-MB00 and IFC-DI08 have to be included in the project. If user did not use the provided sample source code, "Sample1_DI.c", user also needs to include card h file at the beginning of the program. Figure shown the example to include header file, object file and card h file.



- h. For those wanted to understand the program, please refer to c file named "Sample1_DI.c" which is provided with this card.

- i. Compile this project to generate hex file. Connect UIC00A IDC connector to IFC-MB00 as show. The hex file generated is named “IFC_DI.hex”. Please note that Hex file generated from MPLAB IDE will be named according to project name, not C file name or header file name.



- j. Load the hex file generated to UIC00A using PICKIT2 window (refer to UIC00A User's Manual for details). Power up IFC system if it is OFF.
- k. There are also 3 modes for user to select in program “Sample1_DI.c”. User may select mode by pressing push button on IFC-MB00. Each time after selecting the mode, user needs to press reset to exit if other mode is require to be tested. The modes are:

Mode	Push Button	Function
1	SW1	Buzzer on IFC-MB00 ‘beeps’ for 1 time. LED and Buzzer on MB00 will give respond if signal detected on input devices connected to DI1, DI2 or DI3 and DI4.
2	SW2	Buzzer on IFC-MB00 ‘beeps’ for 2 times. DI1 and DI2 enable as Counter, LED on MB00 will give respond based on the condition written in sample program.
3	SW3	Buzzer on IFC-MB00 ‘beeps’ for 3 times. ALL LED on MB00 will blink if signal detected on ALL input devices.

- l. Please refer the comment in source code for the details of mode.
- m. To remove a card from IFC system, the power should be switched OFF.
- n. Please use proper tool to remove the card. User may refer last section in chapter 5.0 Installation (hardware) for the method to open card with provided IFC card opener.

7.2 Basic Setup with Control Panel (IFC-PC00 + IFC-MB00 + IFC-DI08 + IFC-CP04)

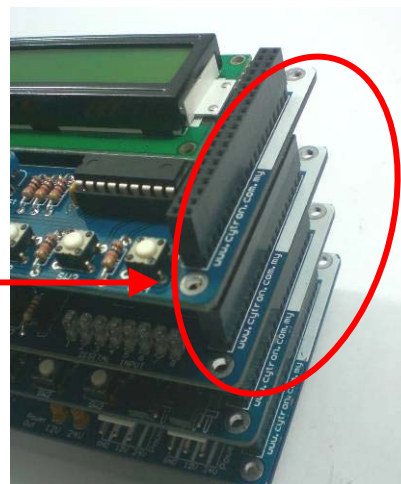
Adding a control panel which comes with a 2 x16 character LCD and 4 programmable push buttons will offer more interesting demonstration. Following steps show the installation of this system and method to operate it.

- a. 1st step, configure the address of cards, IFC-DI08 and IFC-CP04. Digital Input Card has 6 mini jumpers to configure communication address (A5-A0). It should be set to 000011 if sample source code is being used. As for Control Panel, it should be set to “CP1” (Upper side).
- b. 2nd step is to stack all 4 cards together. Power card (IFC-PC00) should be at the bottom, Main board (IFC-MB00) at 2nd layer, Digital Input Card (IFC-DI08) at 3rd layer and Control Panel at the top layer as shown in following figure.

Ensure the arrow
points to the
same direction

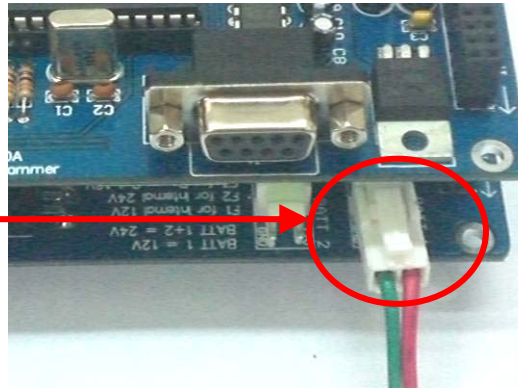


Ensure the
orientation
marking is at the
same side

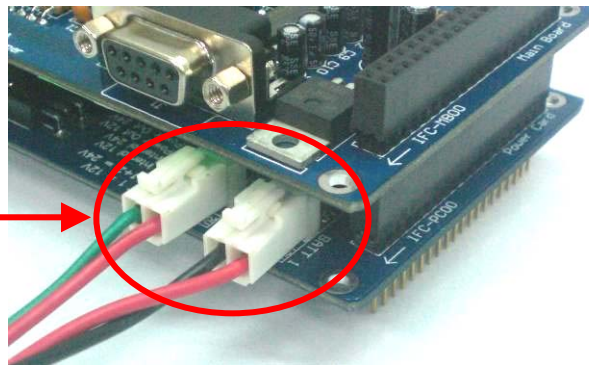


- c. Connect input device such as sensor and encoder to input ports. Please refer hardware setup for connecting output devices to Digital Input Card.
- d. Connect the battery to Power card as shown; please ensure the **polarity is correct**.

Connect 1 x 12V battery to supply operating voltage to IFC. **Ensure the polarity is correct.**



If 24V is needed in the system, connect 2 x 12V batteries to PC00. **Ensure the polarity is correct.**



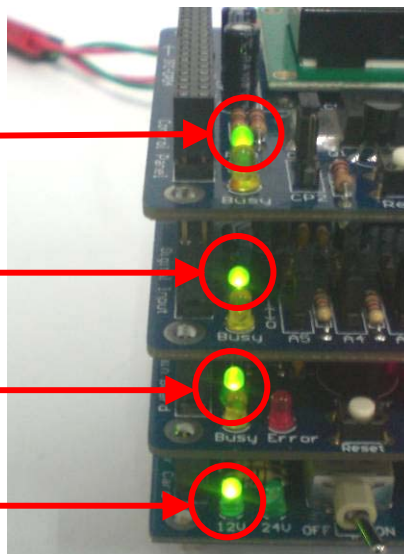
- e. Turn ON the IFC power by pushing the toggle switch to “ON”. There should be at least 4 LED (12V LED on Power Card, PWR LED on Main Brain, PWR LED on Digital Input Card and PWR LED on Control Panel) light up as show.

PWR LED on IFC – PC04

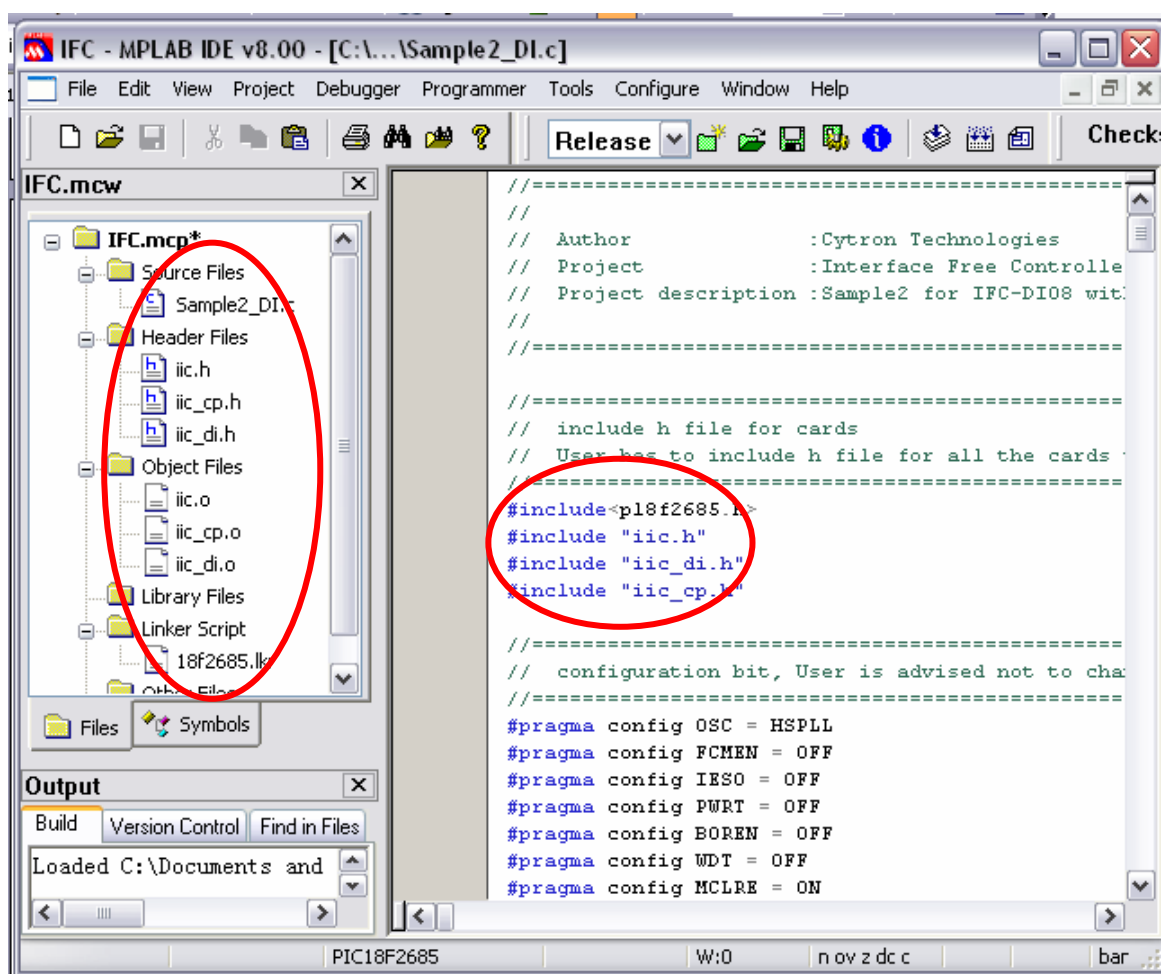
PWR LED on IFC – DI08

PWR LED on IFC - MB00

12V LED on IFC - PC00

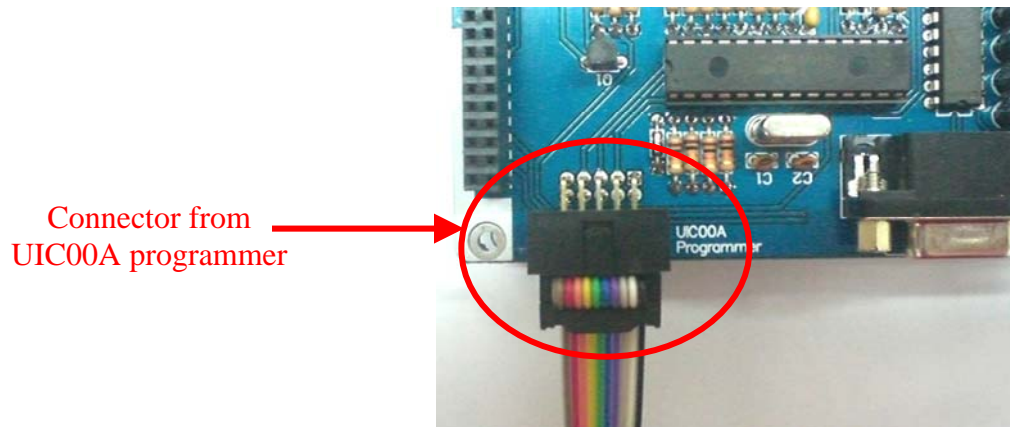


- f. 3rd step is to write program and load it. IFC comes with comprehensive function to save program development time. Functions library will come with the interfacing card in the form of header file (*.h) and object file (*.o). In order to call these functions, particular header file and object file must be included under a project.
- g. Open MPLAB IDE (please ensure, MPLAB C18 is being installed). User may follow the step in chapter 6.2 of user's manual for IFC-MB00 to open project named "IFC_DI2" for IFC Digital Input Card. Please note that the header file (iic.h, iic_di.h and iic_cp.h) and object file (iic.o, iic_di.o and iic_cp.o) for IFC-MB00, IFC-DI08 and IFC-CP04 have to be included in the project. If user did not use the provided sample source code, "Sample2_DI.c", user also needs to include card's header file at the beginning of the program. Figure shown the example to include header file, object file and card's header file.



- h. For those who want to understand the program, please refer to c file named "Sample2_DI.c" which is provided with this card.

- i. Compile this project to generate hex file. Connect UIC00A IDC connector to IFC-MB00 as show. The hex file generated is named “IFC_DI2.hex”.



- j. However, user may also add the “Sample2_DI.c”, “iic_cp.h” and “iic_cp.o” to project opened in chapter 7.1 without creating a new project for Control Panel.
- k. Load the hex file generated to UIC00A using PICKIT2 window (refer to UIC00A User's Manual for details). Power up IFC system if it is OFF.
- l. This sample project will print message at LCD on Control panel after reset. The message print after reset are:

Welcome!
IFC User

- m. There are 4 modes for user to select in program “Sample2_DI.c”. User may select mode by pressing push button on IFC-CP04. Each time after selecting the mode, user needs to press reset to exit if other mode is require to be tested. The modes are:

Mode	Push Button	Function
1	SW1	Buzzer on IFC-MB00 ‘beeps’ for 1 time. Mode ‘Demo1’ will run based on the condition written in sample program.
2	SW2	Buzzer on IFC-MB00 ‘beeps’ for 2 times. Mode ‘Demo2’ will run based on the condition written in sample program.
3	SW3	Buzzer on IFC-MB00 ‘beeps’ for 3 times. Mode ‘Demo3’ will run based on the condition written in sample program.
4	SW4	Buzzer on IFC-MB00 ‘beeps’ for 4 times. Mode ‘Demo4’ will run based on the condition written in sample program.

- n. Please refer the comment in source code for the details of mode.
- o. To remove a card from IFC system, the power should be switched OFF.
- p. Please use proper tool to remove the card. User may refer last section in chapter 5.0 Installation (hardware) for the method to open card with provided IFC card opener.

Note1: User can refer to IFC-DI08 Card Technical Info for the program function list. It will help user in writing program for IFC-DI08.

Note2: Each time open a new project for IFC, user need to add **ALL** header files and object files for all related IFC cards used. User also needs to include **ALL** cards' header file at the beginning of the program. Please refer sample source code for the example to include card h file.

8. WARRANTY

- Product warranty is valid for 6 months.
- Warranty only applies to manufacturing defect.
- Damage caused by miss-use is not covered under warranty.
- Warranty does not cover freight cost for both ways.

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