IFC-OC04
Interface Free Controller
Output Card
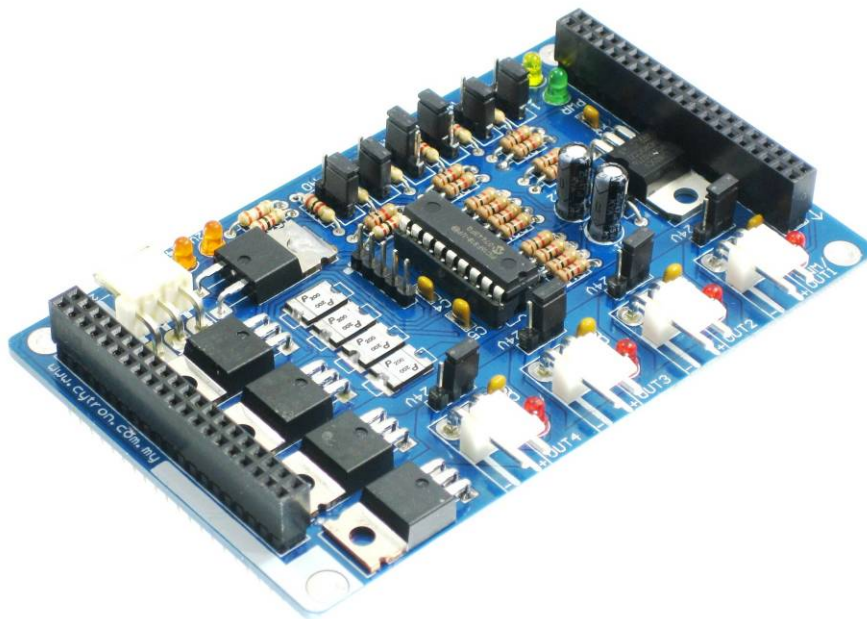
User's Manual

V1.1

Apr 2008

Index

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!
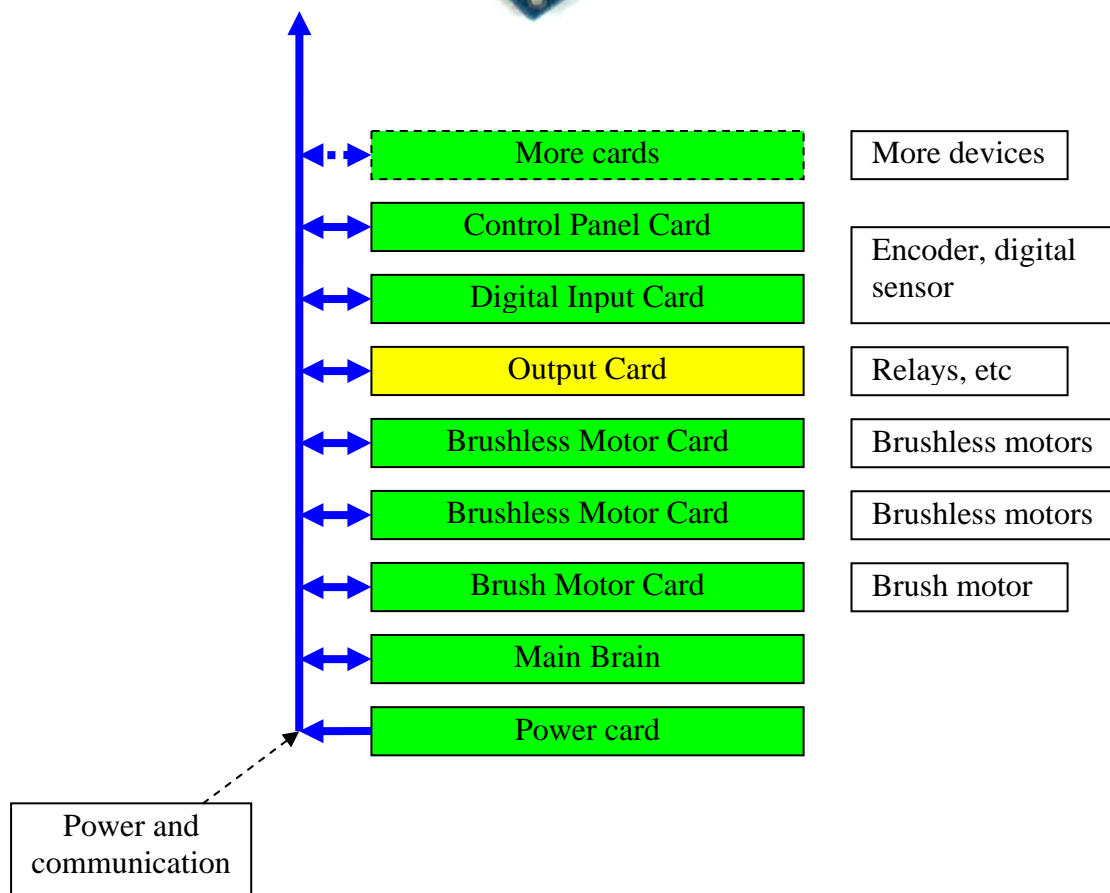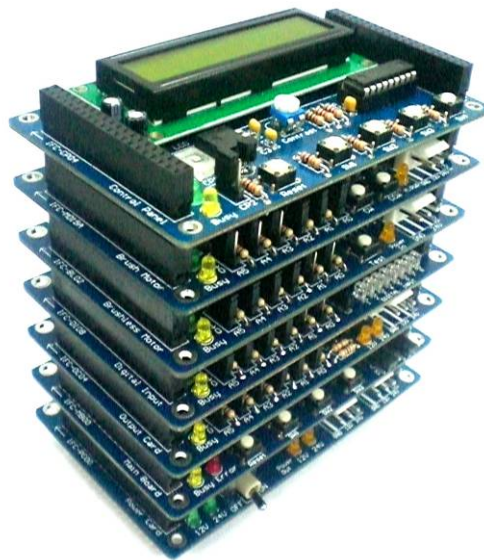
Furthermore, with functions based software library, user save valuable time during software development by concentrating on algorithm development. No more flipping or scrolling PIC data sheet looking for ADCON0, T1CON or even TRISA. With just a programming hand book, user may simply copy the header file, 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 output card, IFC-OC04. 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.
- 2 external power indicator LED, 12V and 24V
- 12V operation.
- 6 set of 1x3 headers to select communication address.
- 4 output ports with maximum 3A for each port.
- Selectable power source for each output port (12V or 24V).
- A status indicator LED for each output port.
- Reset able fuse protection for every output 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.

More cards		More devices
Control Panel Card		Encoder, digital sensor
Digital Input Card		
Output Card		Relays, etc
Brushless Motor Card		Brushless motors
Brushless Motor Card		Brushless motors
Brush Motor Card		Brush motor
Main Brain		
Power card		

Power and communication

This document explains the method to use IFC-OC04.

2. PACKAGING 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.
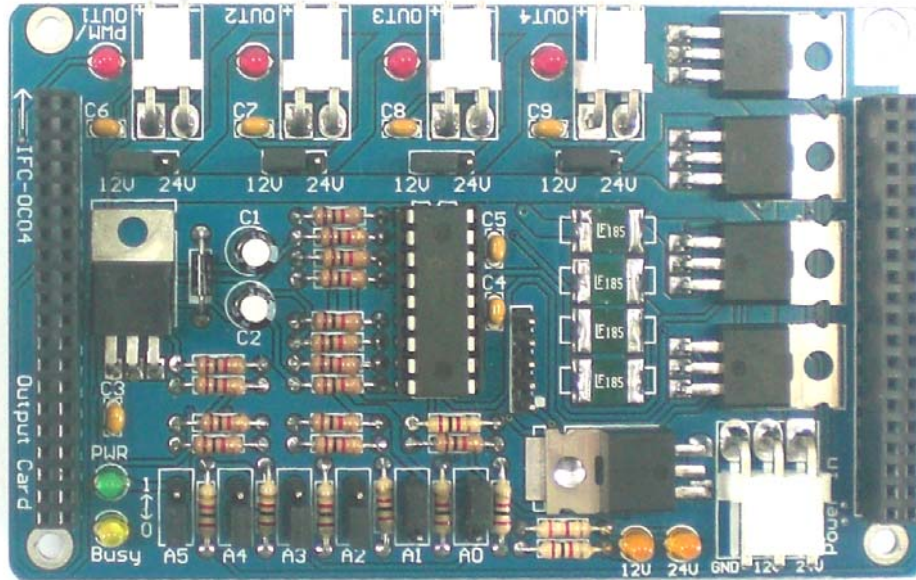
1. 1 x IFC Output Card ,IFC-OC04 with:
    - 1 x PIC microcontroller.
    - 10 x mini jumper.
    - 4 x output terminal.
    - 1 x power in terminal
    - Female connector for every terminal.
    - Other electronics components soldered on board.

3. PRODUCT SPECIFICATION

3.1 Communication Address

There are 64 (2^6) communication address of IFC-OC04 that can be selected. The 6 bits communication address is determine by selector A5 through A0 (6 set of 1x3 headers on IFC-OC04). User can set the card address by using the mini jumper. However, user needs to make sure the communication address chosen on board is compatible with program written in Main Board.

3.2 Programmer

User **does no need** to prepare programmer for IFC-OC04. IFC-OC04 is one of the slave cards of IFC system. The slave program is preloaded before it is shipped to customer. User will only need the Main Board of IFC system, IFC-MB00 to control this slave card.

3.3 Output device

The output devices on OC04 are as below:
- 2 status indicator LED: Power and busy LED:
    - Power LED (PWR) will turn ON when power supplied to Output Card.
    - Busy LED (Busy) will turn ON or blink when Control Panel is communicating with master card, IFC-MB00.

- 4 output ports with maximum 3A for each port.
    - Selectable power source for each output port (12V or 24V). User can select the output power source by using the mini jumper.
    - Each output port is protected by reset able fuse with holding current: 2.0A; tripping current:3.7A. For more information please refer to its datasheet at: http://production.littelfuse.com/data/en/Data_Sheets/Littelfuse_2920L.pdf
    - A status indicator LED for each output port. The LED will turn ON when its compatible output port is being activated.
    - The example outputs devices that can be connected to the port are solenoid, relays or a small power motor.

3.4 Operating Voltage

The operation voltage of IFC-OC04 is 12V. User needs to stack a Power Card, IFC-PC00, and connect a 12V battery on Power Card to supply 12V to the Output Card. However, user needs to connect external power source through Power In connector on IFC-OC04 for the output voltage of output port. The 12V LED will turn ON when 12V external power is connected, and 24V LED will turn ON when 24V external power is connected. Both of the external power indicators LED will turn ON when 12V and 24V external power are connected. User can connect external power source from IFC Power Card, IFC-PC00 or external battery.

4. BOARD OR PRODUCT LAYOUT
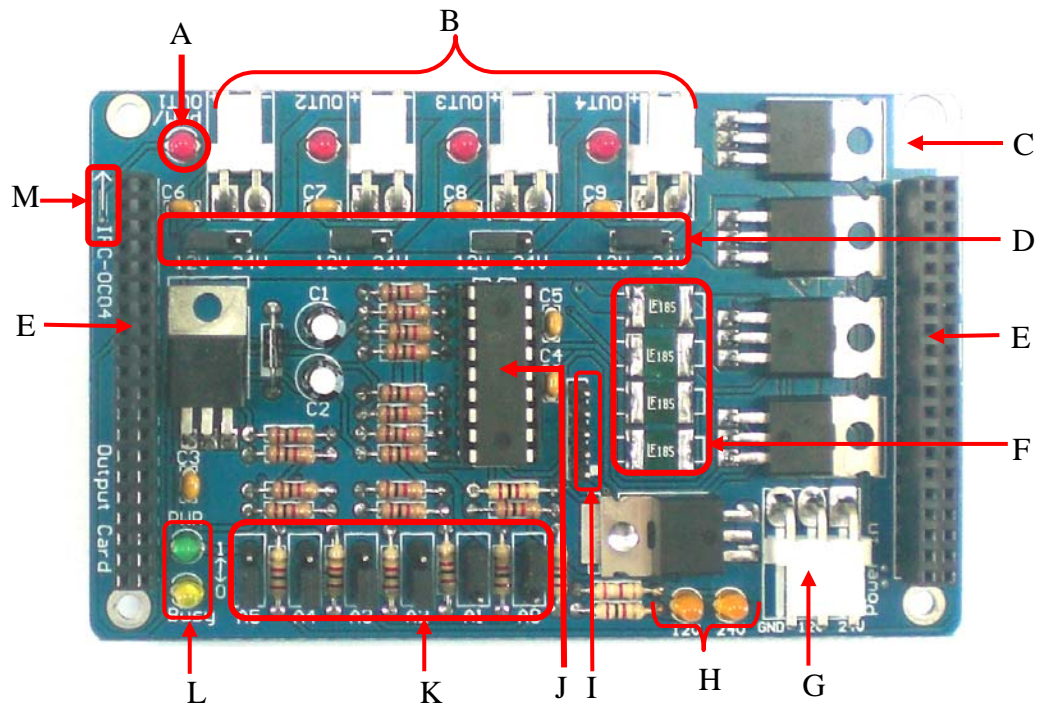
Label	Function	Label	Function
A	Output status indicator LED	**H**	External power indicator LED
B	Output port	**I**	Manufacturing Test Points
C	Orientation marking	**J**	PIC Microcontroller
D	Output voltage selector	**K**	Communication address selectors
E	Side connector	**L**	Status indicator LED
F	Reset able Fuse	**M**	Arrow
G	External Power In connector		

A – is a status indicator LED for each output port. The LED will turn ON when its compatible output port is being activated.

B – are 4 output ports with maximum 3A for each port on IFC-OC04. The voltage is selectable for each port, either 12V or 24V. Each port is NPN sinking type.

C – is the orientation marking on IFC-MB00. Every IFC card will have this orientation marking, this is to help user in ensuring the cards are stack correctly.

D – are 4 output voltage selectors on IFC-OC04. User can use mini jumper to select either 12V or 24V for output voltage of each output port.

E – are side connector for stack card and communication between cards.

F – are 4 reset able fuses on IFC-OC04. The reset able fuses provide protection for every output port.

G – is terminal for user to connect external power source for output port. The external power source **must** be provided to IFC-OC04 in order to run output device that is connected to output port. User can connect either 12V or 24V or both together to the terminal.

H – are 2 status indicator LED to indicator status for External Power In. The 12V LED will turn ON when 12V external power is connected, and 24V LED will turn ON when 24V external power is connected. Both external power indicators LED will turn ON when 12V and 24V external power are connected.

I – is reserved for Manufacturing Test Point. Please DO NOT short or connect wire to any of these pins.

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

K – are 6 set of 1x3 headers use as communication address selector on IFC-OC04. User can set the card address by using the mini jumper.

L – there are 2 status indicator LED to indicate status for power ON (PWR) and busy in 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.

M – is 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-OC04, 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-OC04, user may stack it on IFC system as shown in Figure.

Ensure the arrow points to the same direction.
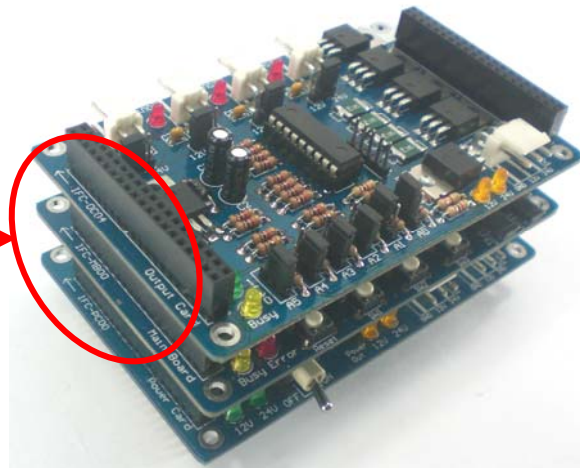
Ensure the orientation marking is at the same side.
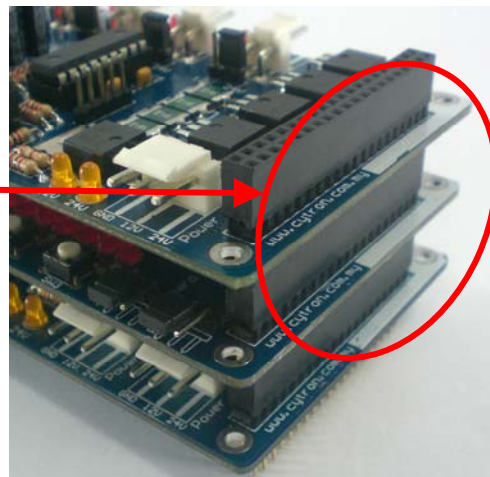
Cautions: Please ensure that every card is being stacked properly in correct orientation. Whole IFC system will be damaged if one of the cards is being stacked wrongly when it is powered up.

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.

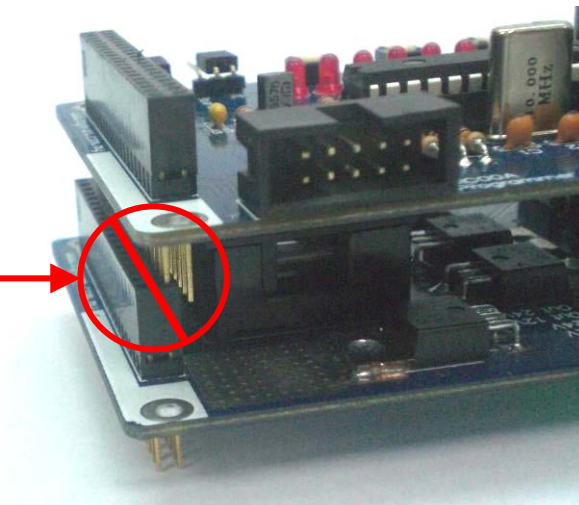Ensure that all card pins are not shifted when stacking.
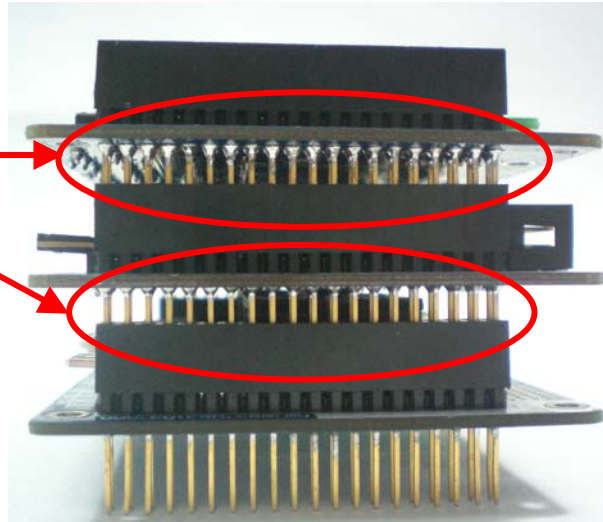
Examples of stacking cards with shifted pins. Please AVOID this!
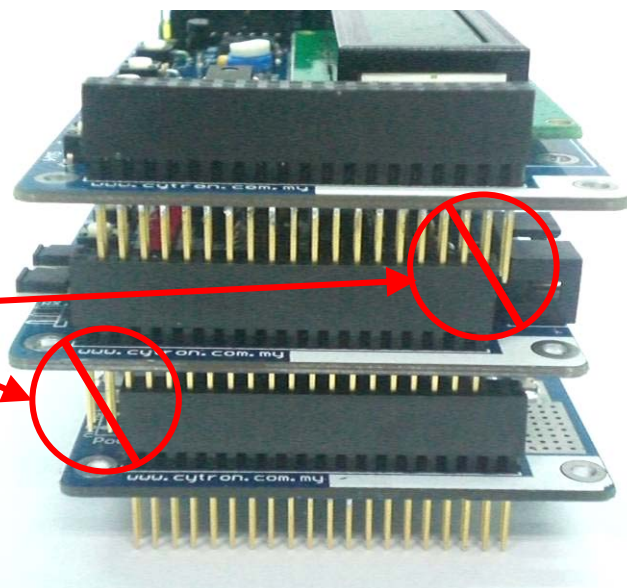
Ensure that all card pins are not shifted when stacking.

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 can use the mini jumper provided on IFC-OC04 to select the communication address of IFC-OC04. 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 of IFC-OC04.
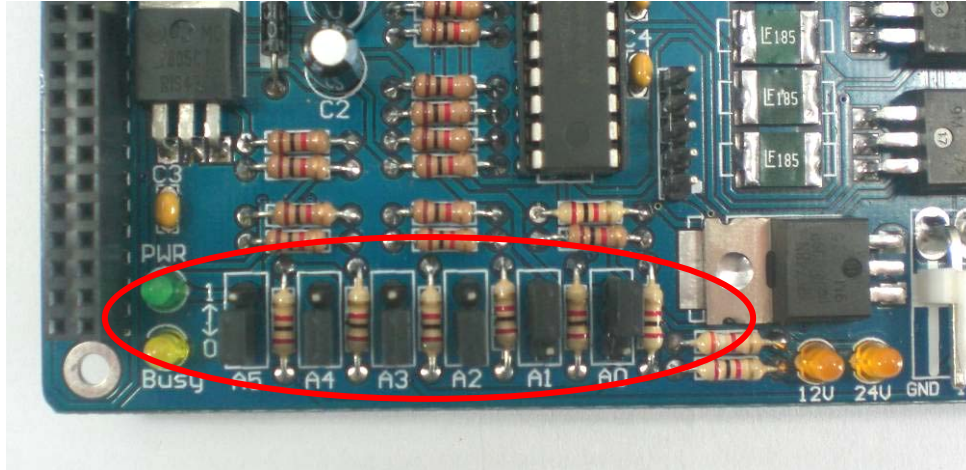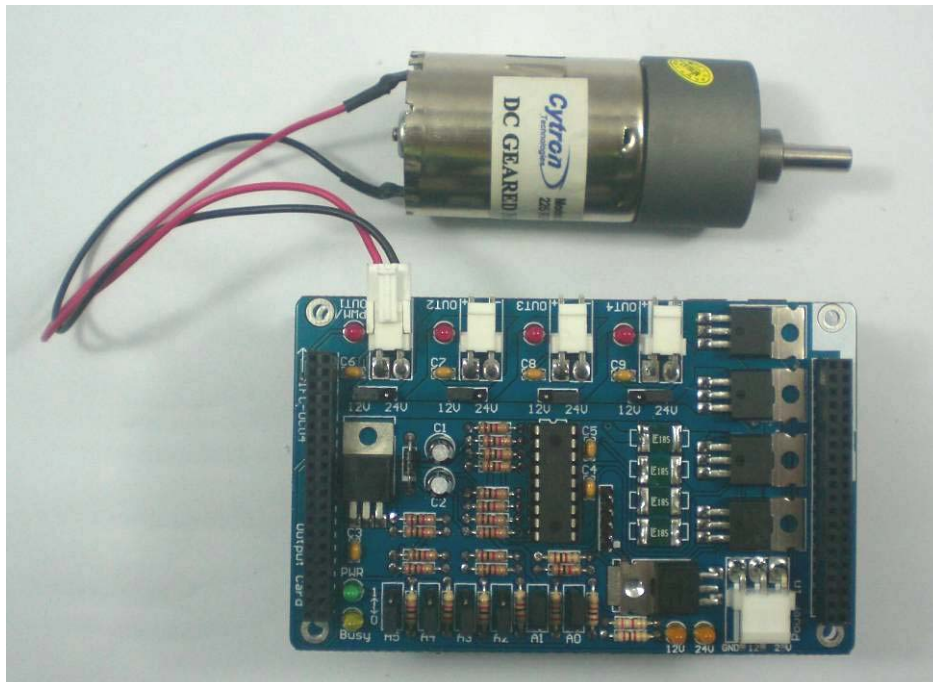

Figure below shows how to connect a DC motor to OUT1. The output voltage selected is 12V. User needs to make sure the output voltage selected on IFC-OC04 is compatible with the output device. For more examples, user may refer the schematics in Appendix A.

For power supply to output port, user can connect external power source from IFC Power Card, IFC-PC00, IFC Extension Board, IFC-EB02 or external battery. Figure below show the connection of external Power In from Power Card, Extension Board and external battery. **User needs to make sure the polarity is correct when connect external power source for Output Card.**

If user need to supply 24V to output port from Power Card, 2 x 12V batteries must be connected to provide 24V. Please refer User's Manual for IFC-MB00 for the connection of battery to Power Card.

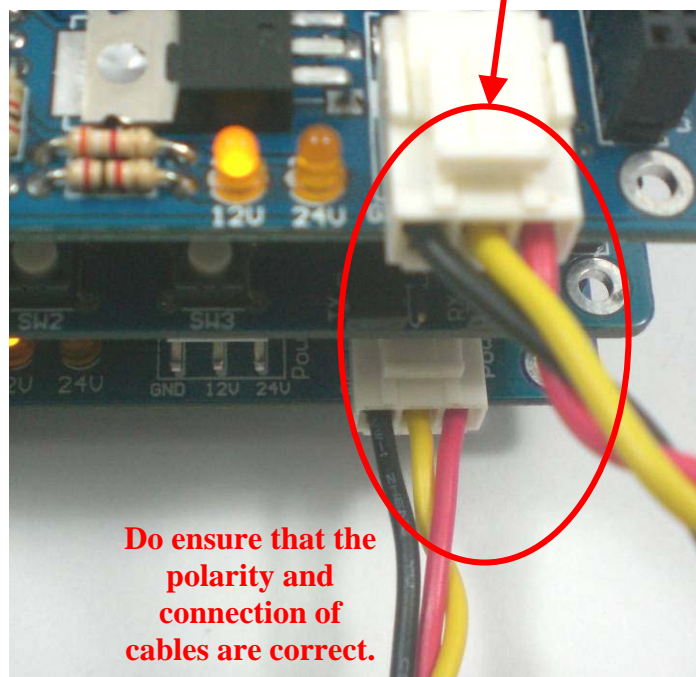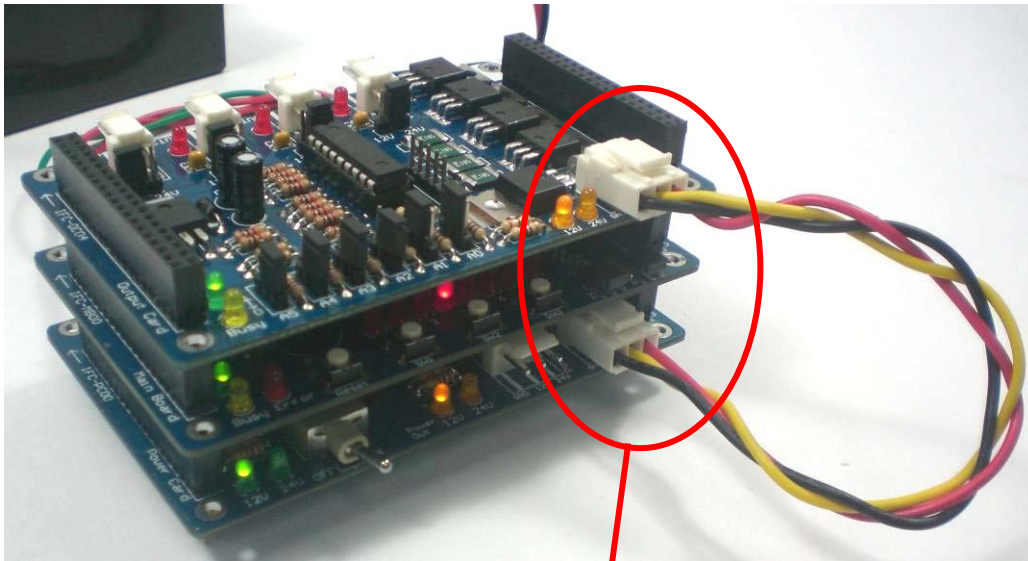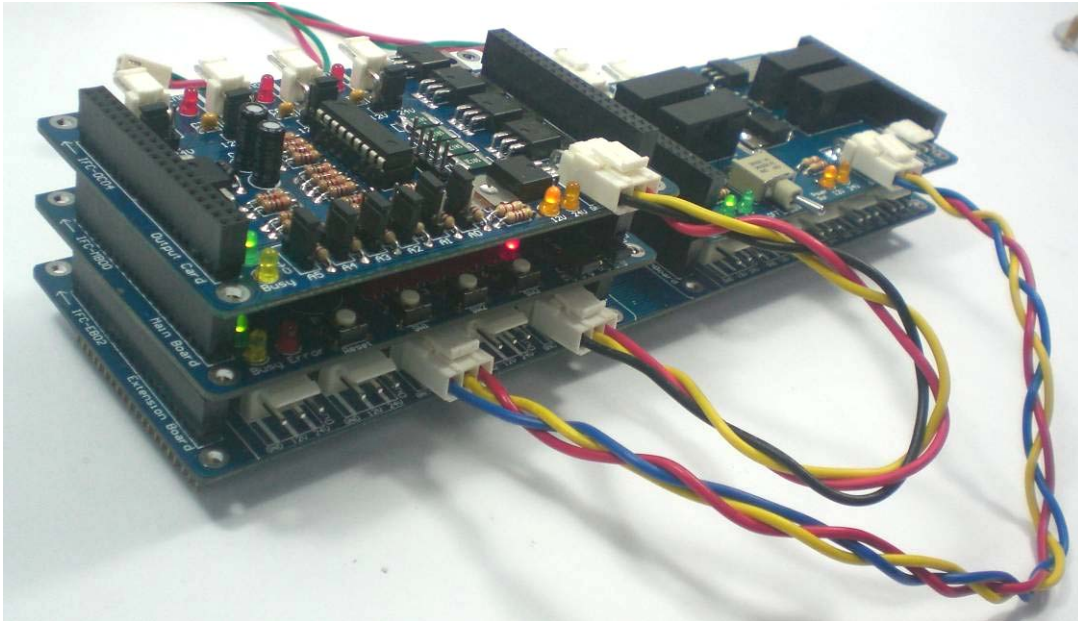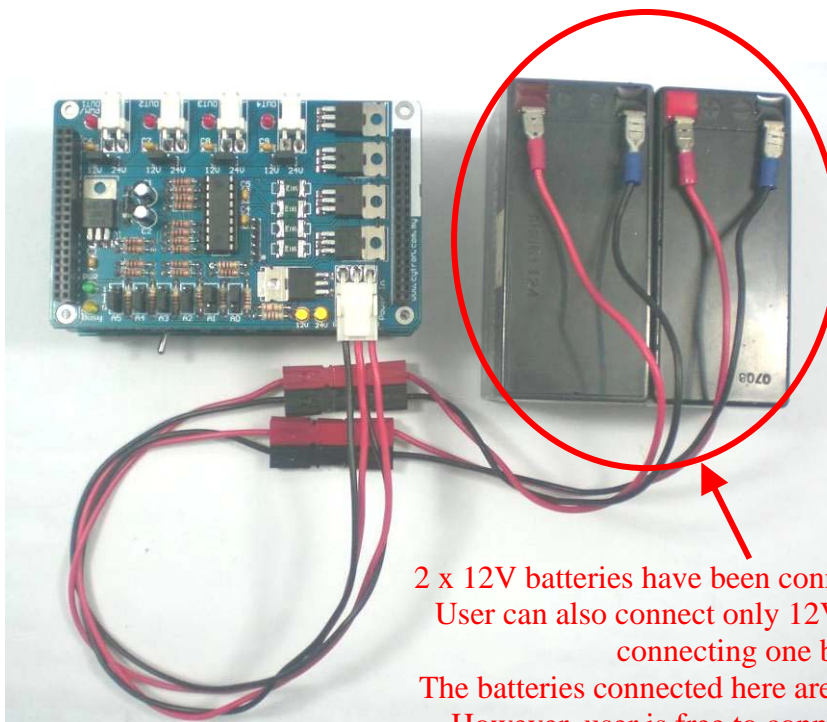**Do ensure that the polarity and connection of cables are correct.**

Figure shows the example of connection of external power source from IFC Extension Board. Please refer User's Manual for IFC-EB02 for the more details.

User may also connect the external power source from extra battery as shown in figure below.

2 x 12V batteries have been connected serially to offer 24V. User can also connect only 12V as the external power by connecting one battery only.
The batteries connected here are Sealed Lead Acid Battery. However, user is free to connect the other type of 12V battery as external power source.
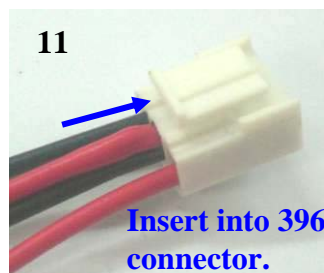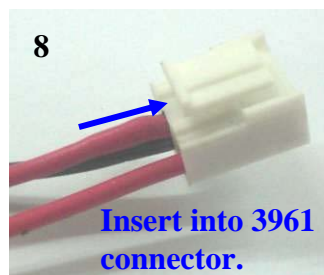
User may follow the steps below to build a cable connector for connecting the external power source from 2 extra batteries.

Materials needed:
a. 4 x cable
b. 1 x 3961-3 female connector
c. 3 x 3961 iron pins

1	2	3
	Solder some lead on it.	**Insert into 3961 connector.**
4	5	6
		Solder some lead on it.
7	8	9
Solder another cable on it.	**Insert into 3961 connector.**	
10	11	12
Solder some lead on it.	**Insert into 3961 connector.**	
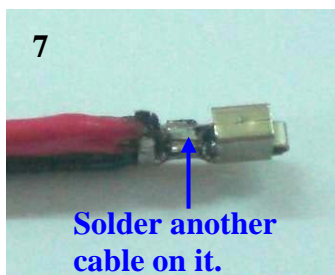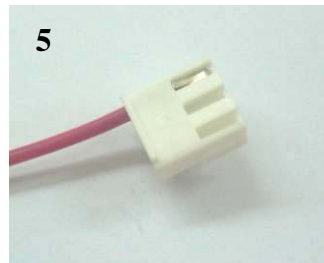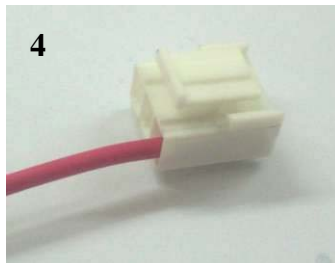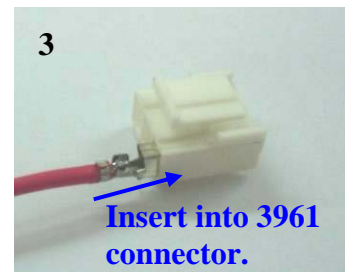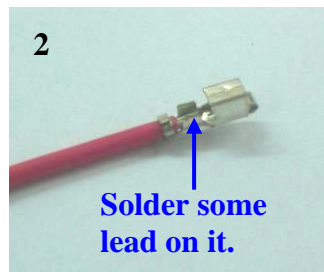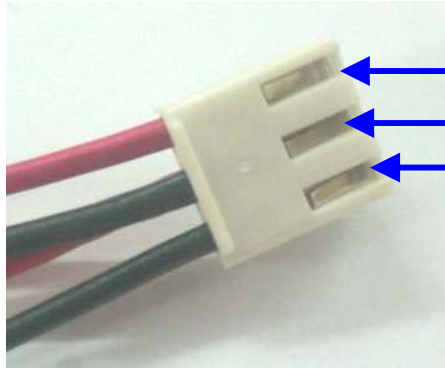
Ensure the iron pins are fully inserted to the connector
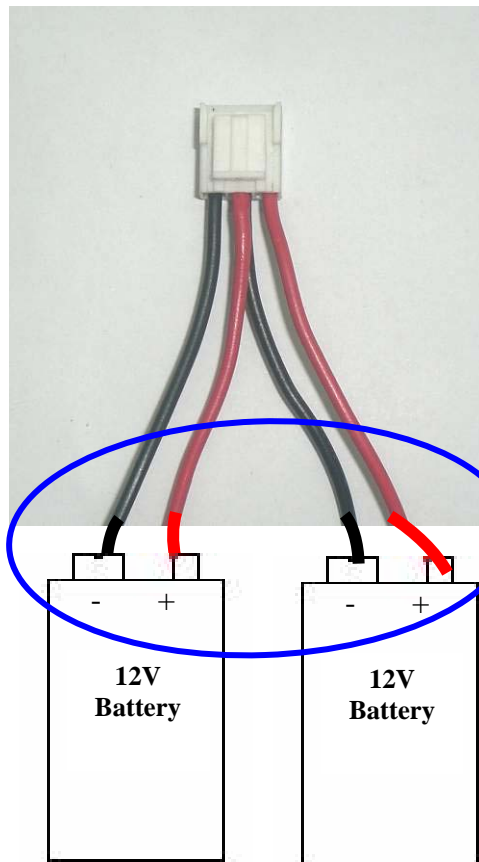
Connect the cable to batteries. **Please ensure the polarity is correct.** Red for positive (+) while black for negative (-).

12V Battery

12V Battery

After the external Power In is connected for OC04, user may select the output voltage for each output port. **Do ensure the voltage selected is compatible with the output device**. Figure below shows the output voltage for OUT1 and OUT2 are selected as 12V, while for OUT3 and OUT4 are 24V.
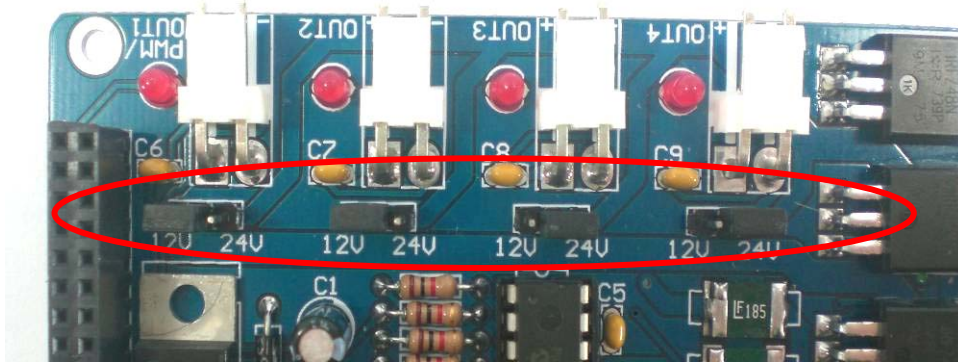
Please switch ON the power on Power Card, the PWR LED of IFC-OC04 will turn ON as shown in following figure. Initially, if there are no functions related to IFC-OC04 being called in Main Board's program, the busy LED will not ON or blink.

PWR LED on
IFC – OC04

PWR LED on
IFC - MB00

12V LED on
IFC - PC00
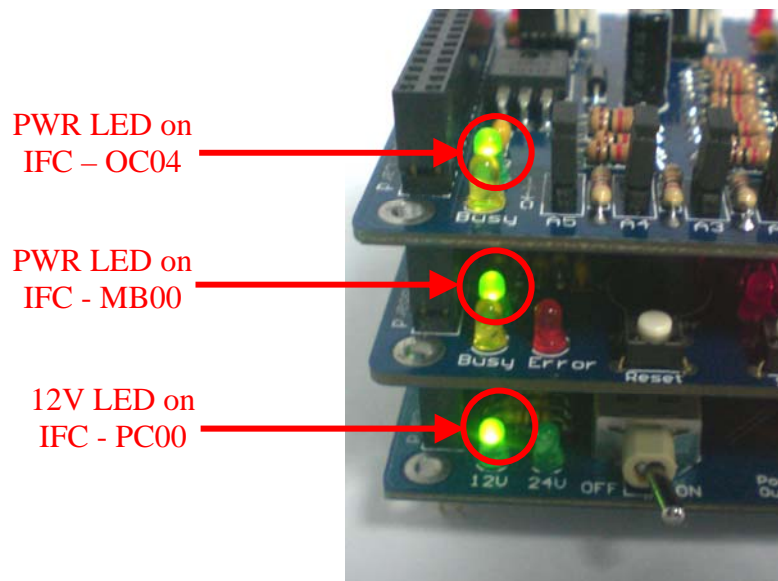
Note: If user need to supply 24V to output port from Power Card, 2 x 12V batteries must be connected to Power Card to provide 24V.

To open the cards, user can use the IFC card's opener to open the stacked cards. Figure shows the method to open cards with the opener.
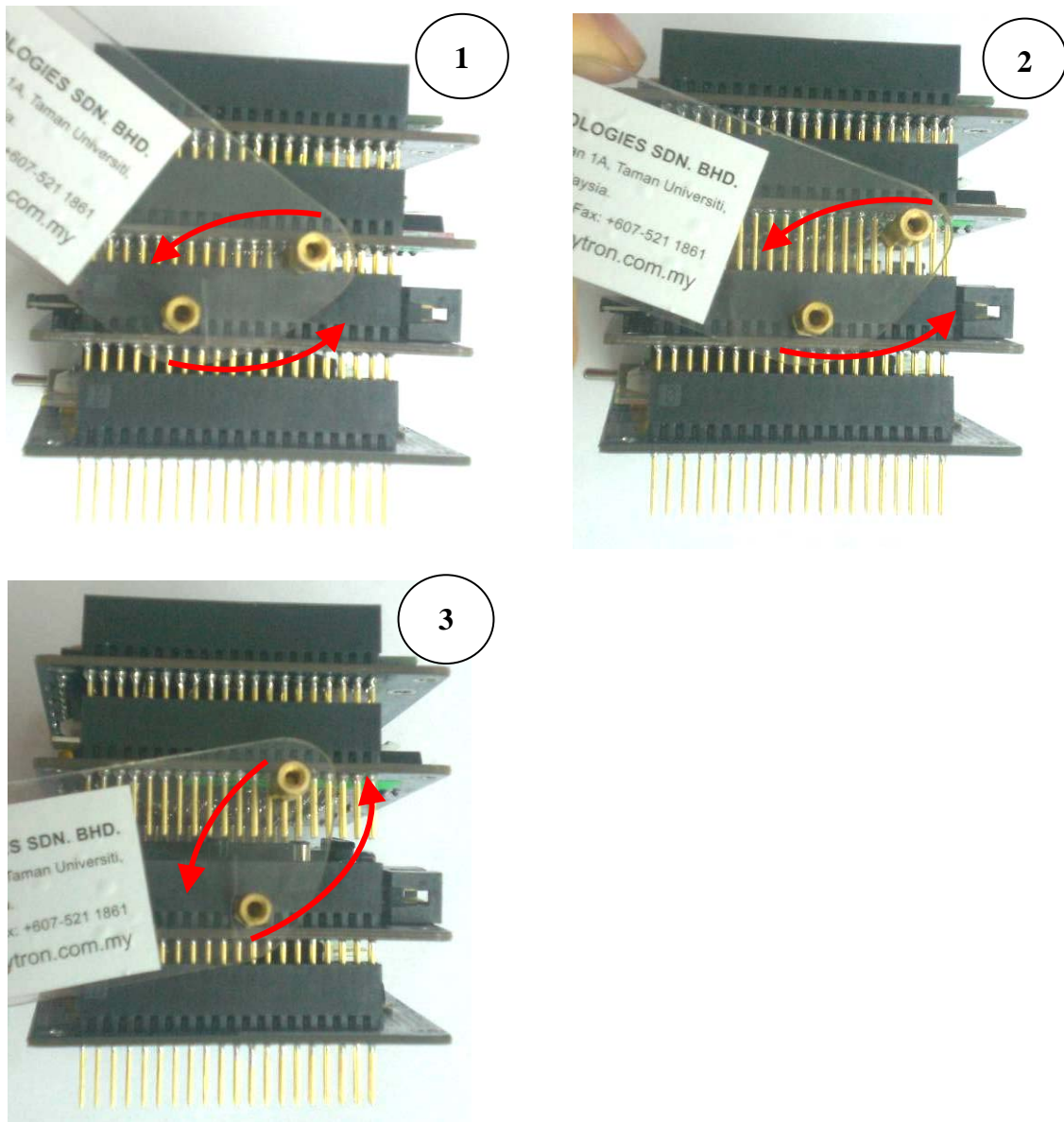
Caution: Please use the opener to open IFC cards to avoid damage of the pins or cards.

6. INSTALLATION (SOFTWARE)

User only needs to write program for IFC-MB00 in order to send data and communicate with IFC-OC04. 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 Output Card, IFC-OC04.

```
┌─────────────────────────────────────┐
│ 1st step: Address                    │
│ - Configure Card's address           │
└─────────────────────────────────────┘
                  │
                  ▼
┌─────────────────────────────────────┐
│ 2nd step: Stacking                   │
│ - Stack the card/s                   │
│ - Connect the necessary battery      │
│ - Connect necessary sensor or motor  │
│ - Turn it ON                         │
└─────────────────────────────────────┘
                  │
                  ▼
┌─────────────────────────────────────┐
│ 3rd step: Program                    │
│ - Include the necessary header and   │
│   object file/s                      │
│ - Write program using template       │
│   given                              │
│ - Call necessary function referring to│
│   Program Reference Notes            │
│ - Compile and Load Program           │
│   through UIC00A                     │
└─────────────────────────────────────┘
```
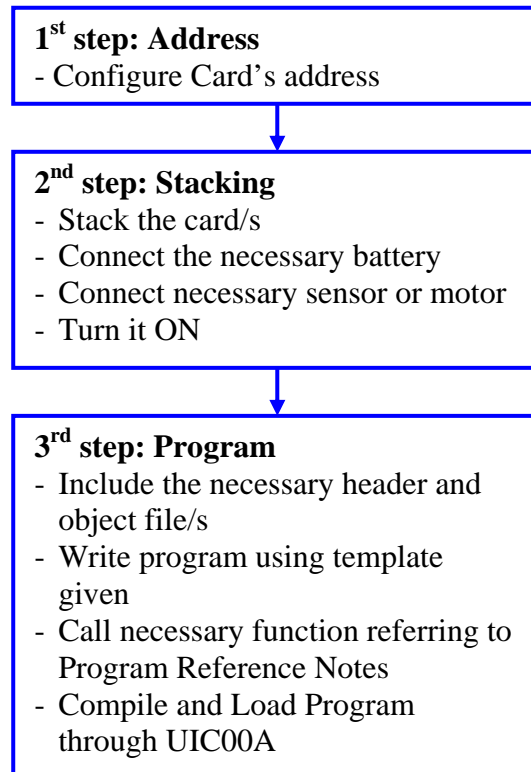
There are 2 basic setups in this chapter for IFC-OC04, the first one includes 3 cards, IFC-PC00, IFC-MB00 and IFC-OC04, and second one includes one extra card, which is IFC-CP04. Please refer to the following part of this chapter for setup details.

**7.1 Basic Setup (IFC-PC00 + IFC-MB00 + IFC-OC04)**

This is the basic and minimum setup for IFC-OC04 which comes with 4 output ports. Though without other card, this basic setup can still perform some task such as drive a DC motor and controlling relay. Following steps show the installation of this system and method to operate it.

a. 1st step, configure the address of card. Output 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 Output Card (IFC-OC04) at top layer as shown in following figure.
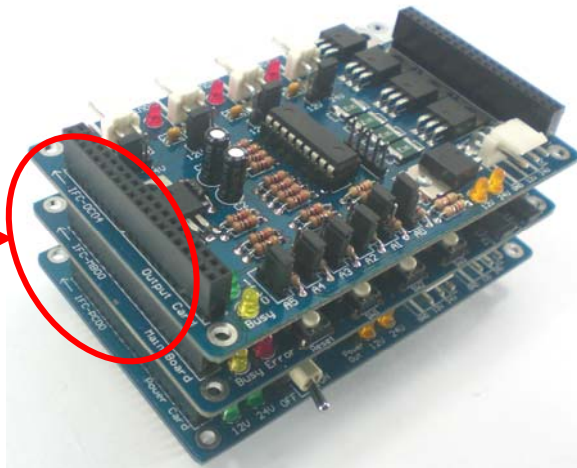
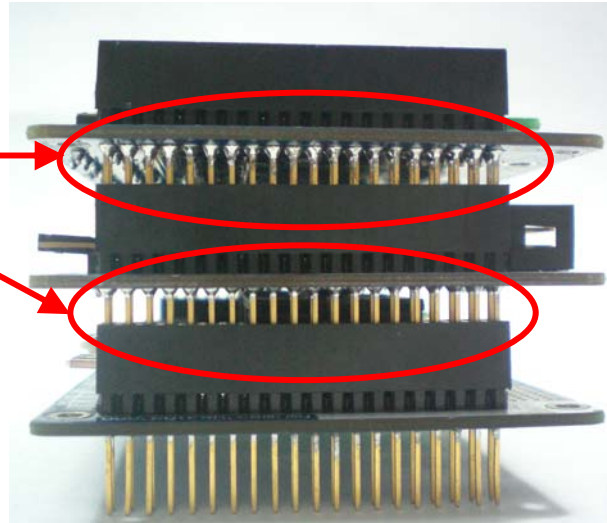Ensure the arrow points to the same direction.

Ensure the orientation marking is at the same side.

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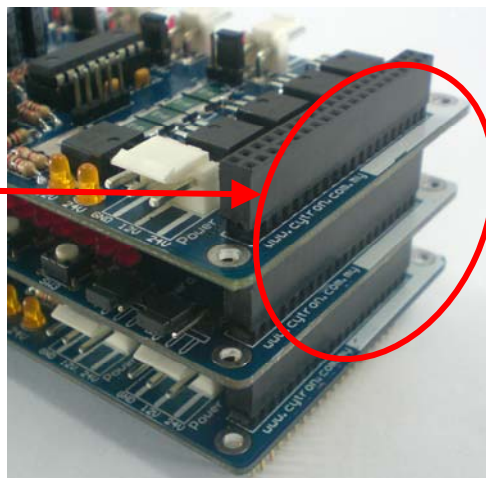
c. Besides stack every card in correct orientation, user also need to ensure that all the pins are not shifted when stacking IFC cards.

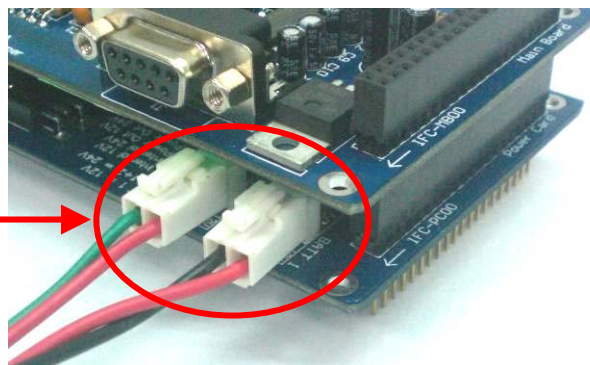Ensure that all card pins are not shifted when stacking.

d. Connect output device such as DC motor, solenoid and relays to output ports. Please refer hardware setup for connecting output devices to Output Card.

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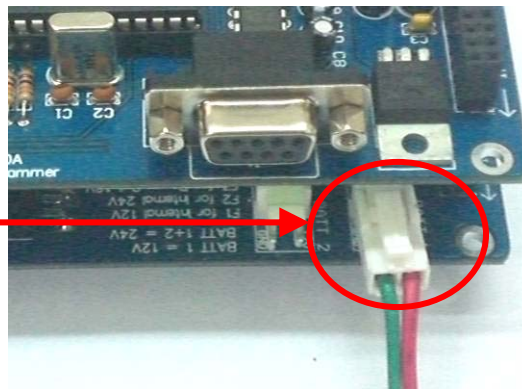
If 24V is needed in the system, connect 2 x 12V batteries to PC00. **Ensure the polarity is correct**.

f. Connect the External power source for Output Card. Please refer hardware setup for connecting power to Output Card.

g. 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 Output Card) light up as show.
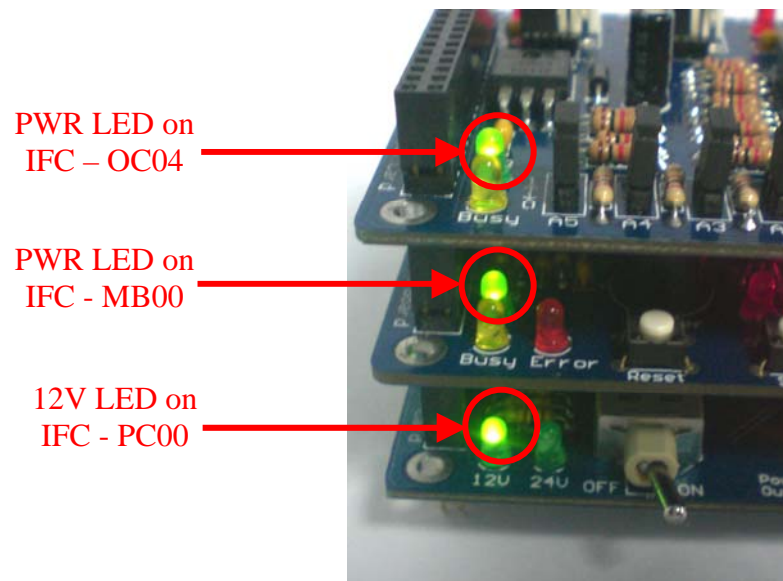
PWR LED on
IFC – OC04

PWR LED on
IFC - MB00

12V LED on
IFC - PC00

h. 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.

i. Open MPLAB IDE (please ensure, MPLAB C18 is being installed). User can follow the step in chapter 6.2 of user's manual for IFC-MB00 to open project named "IFC_OC" for IFC Output Card. Please note that the header file (iic.h and iic_oc.h) and object file (iic.o and iic_oc.o) for IFC-MB00 and IFC-OC04 have to be included in the project. If user did not use the provided sample source code, "Sample1_OC.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.
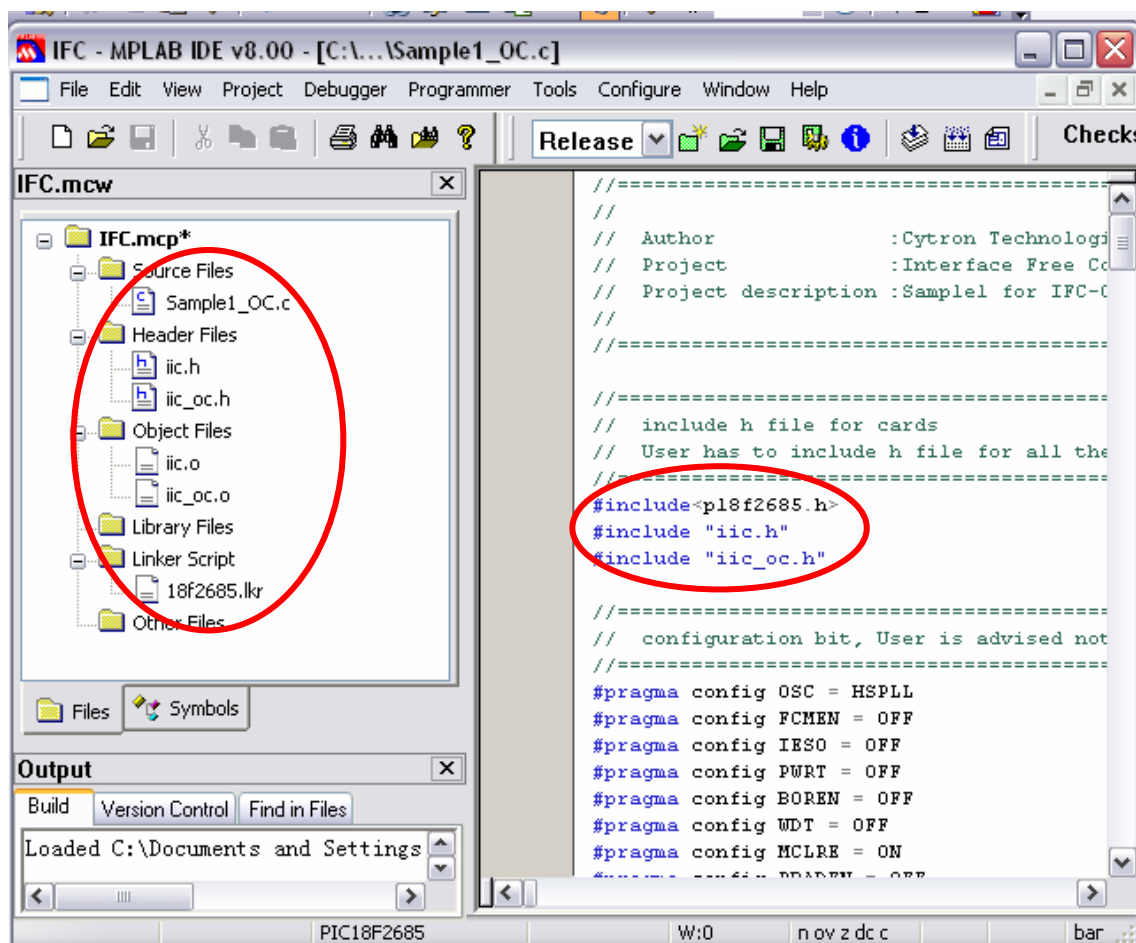
j. For those who want to understand the program, please refer to c file named "Sample1_OC.c" which is provided with this card.

k. Compile this project to generate hex file. Connect UIC00A IDC connector to IFC-MB00 as shown. The hex file generated is named "IFC_OC.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.

Connector from UIC00A programmer
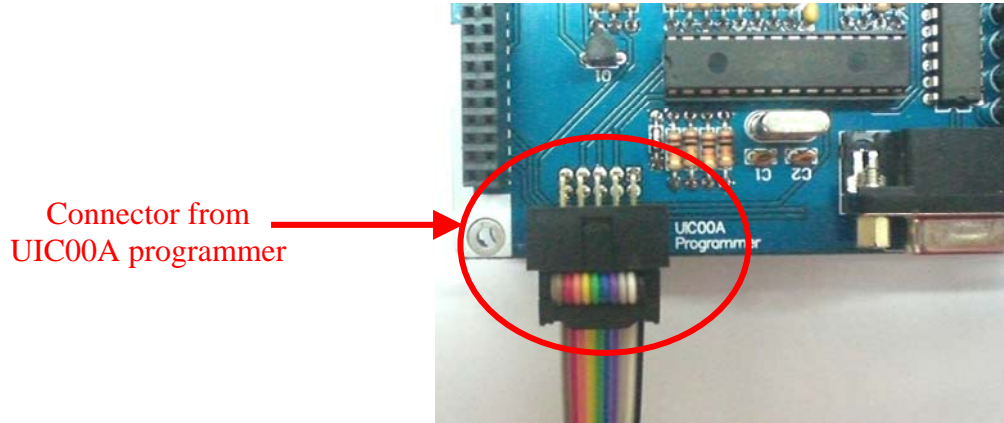
l. Load the hex file generated to UIC00A using PICkit2 window (refer to UIC00A User's Manual for details). Power up IFC system if it is OFF.

m. There are also 3 modes for user to select in program "Sample1_OC.c". User can 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. OUT1 and OUT2 are activated.
2	SW2	Buzzer on IFC-MB00 'beeps' for 2 times. All Output ports are activated.
3	SW3	Buzzer on IFC-MB00 'beeps' for 3 times. OUT1 is activated in PWM mode.

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.

7.2 Basic Setup with Control Panel (IFC-PC00 + IFC-MB00 + IFC-OC04 + 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-OC04 and IFC-CP04. Output 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, Output Card (IFC-OC04) at 3rd layer and Control Panel at the top layer as shown in following figure.
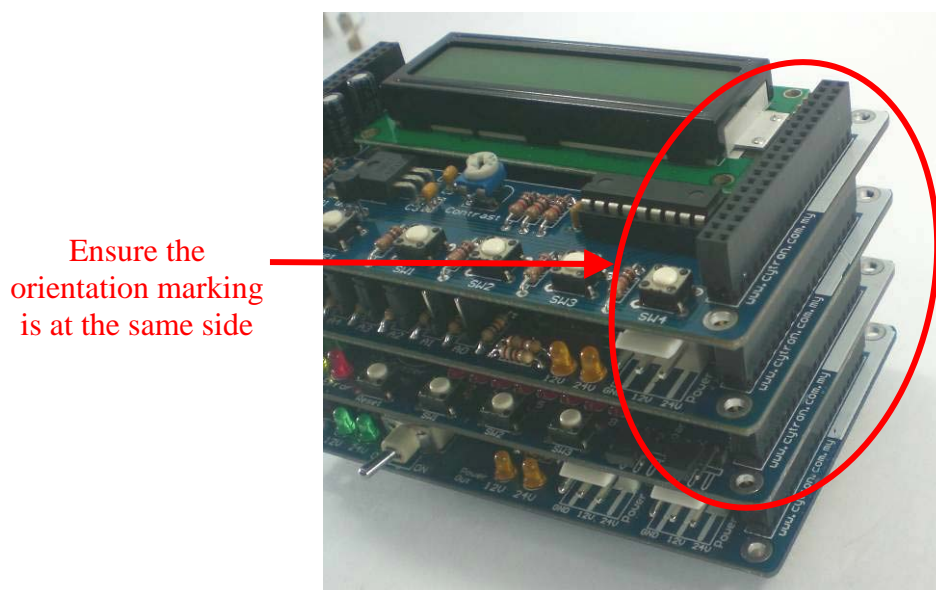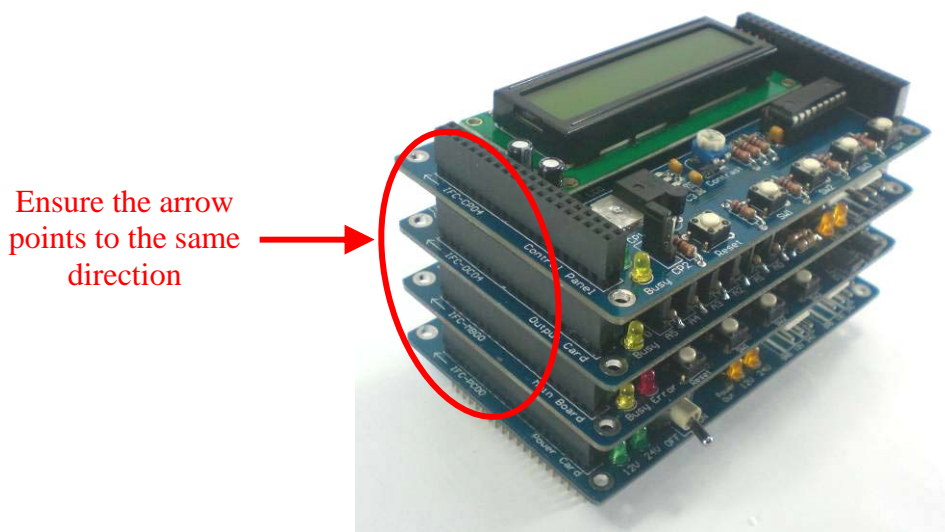
Ensure the arrow points to the same direction


Ensure the orientation marking is at the same side

c. Besides stack every card in correct orientation, user also need to ensure that all the pins when stacking are not shifted and inserted to correct location.

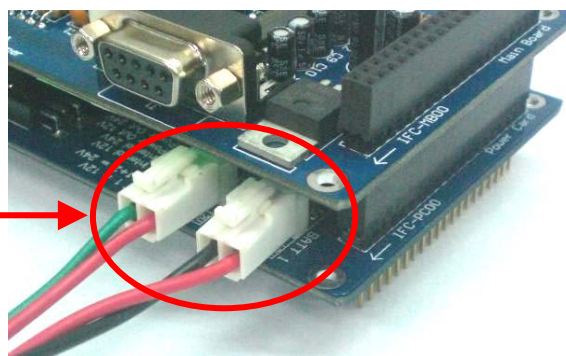Ensure that all the pins when stacking are not shifted and inserted to correct location.
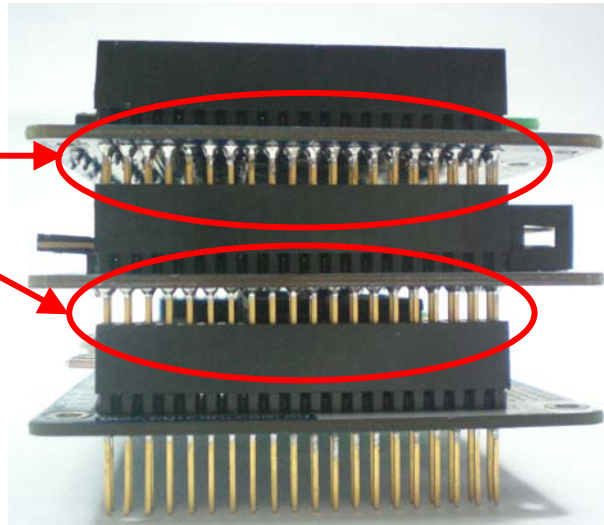
d. Connect output device such as DC motor, solenoid and relays to output ports. Please refer hardware setup for connecting output devices to Output Card.

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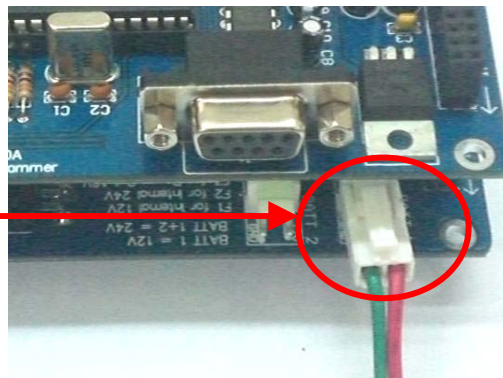
If 24V is needed in the system, connect 2 x 12V batteries to PC00. **Ensure the polarity is correct**.

f. Connect the External power source for Output Card. Please refer hardware setup for connecting power to Output Card.

g. 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 Output Card and PWR LED on Control Panel) light up as show.
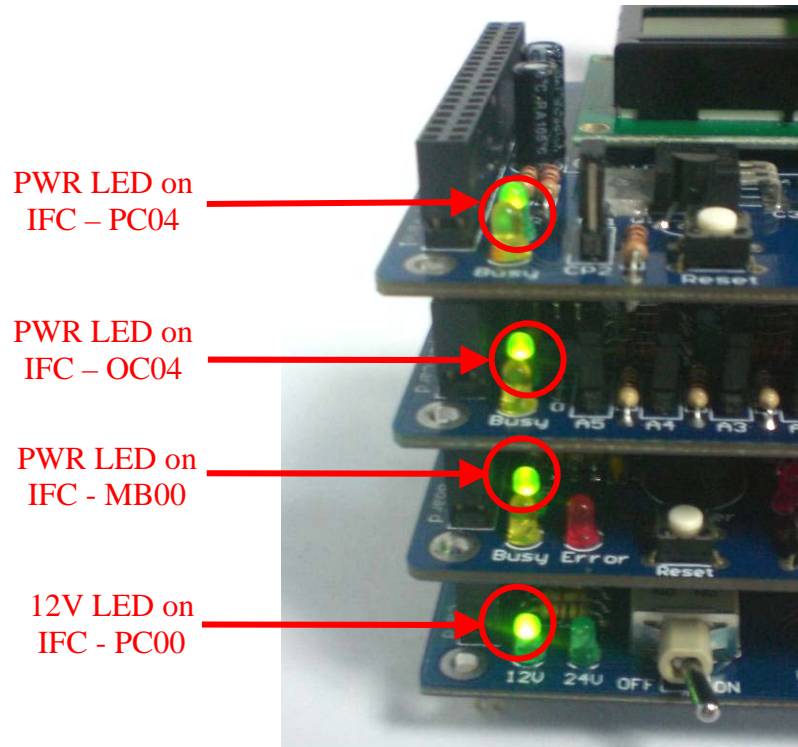
h. 3rd step is to write program and load it. IFC comes with comprehensive function to save program development time. Functions library will come with the interfacing card in the form of header file (*.h) and object file (*.o). In order to call these functions, particular header file and object file must be included under a project.

i. Open MPLAB IDE (please ensure, MPLAB C18 is being installed). User can follow the step in chapter 6.2 of user's manual for IFC-MB00 to open project named "IFC_OC2" for IFC Output Card. Please note that the header file (iic.h and iic_oc.h) and object file (iic.o and iic_oc.o) for IFC-MB00 and IFC-OC04 have to be included in the project. If user did not use the provided sample source code, "Sample2_OC.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.
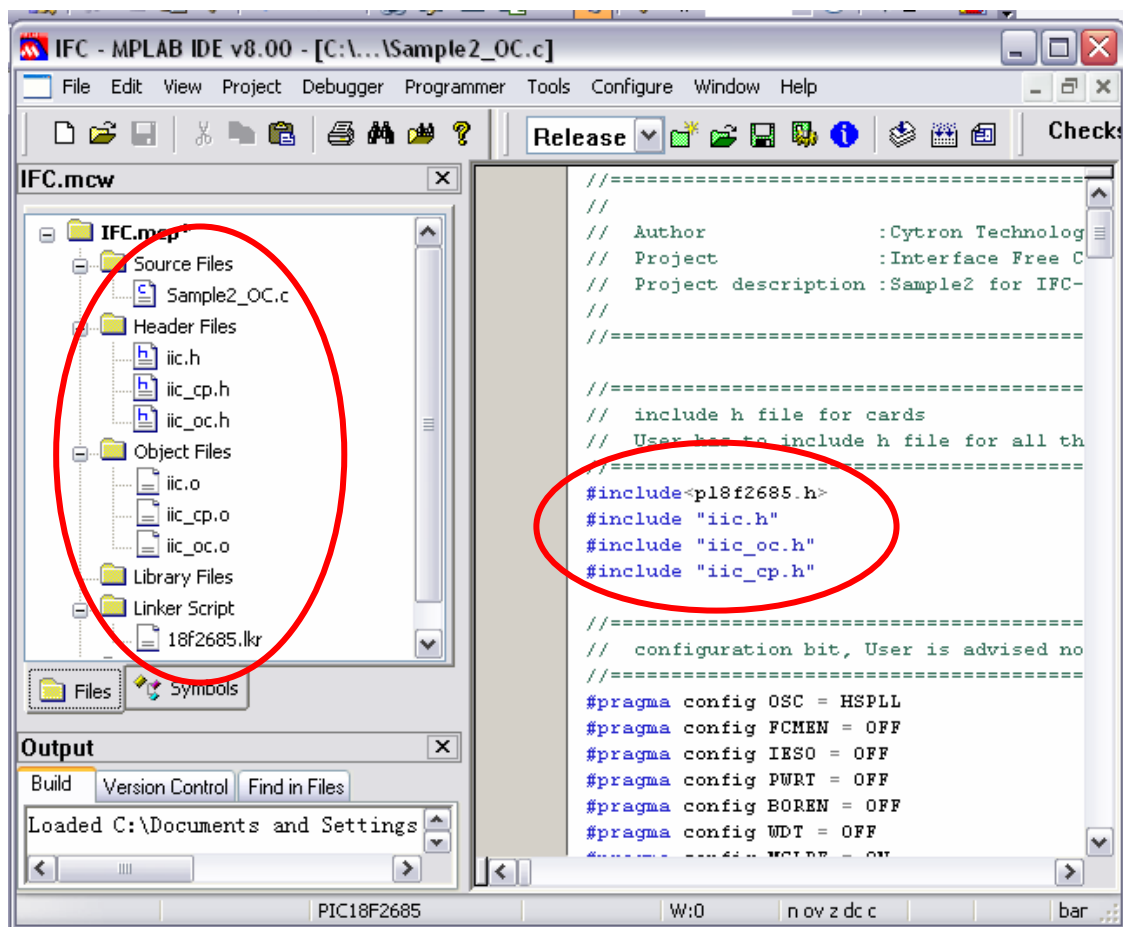
j. For those who want to understand the program, please refer to c file named "Sample2_OC.c" which provided with this card.

k. Compile this project to generate hex file. Connect UIC00A IDC connector to IFC-MB00 as show. The hex file generated is named "IFC_OC2.hex".

Connector from
UIC00A programmer
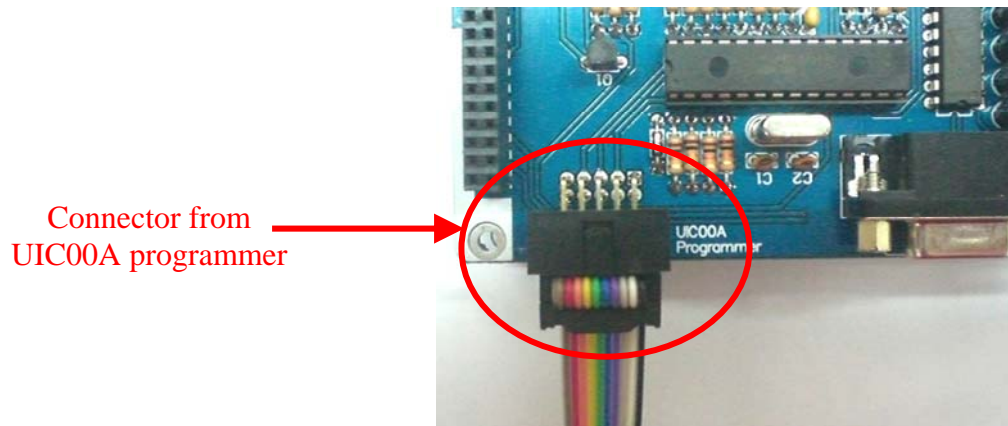
l. However, user can also add the "Sample2_OC.c", "iic_cp.h" and "iic_cp.o" to project opened in chapter 7.1 without creating a new project for Control Panel.

m. 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.

n. This sample project will print message at LCD on Control panel after reset. The message print after reset are:

Welcome!
IFC User

o. There are also 3 modes for user to select in program "Sample2_OC.c". User can 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. OUT1 and OUT2 are activated. Display output status on CP04.
2	SW2	Buzzer on IFC-MB00 'beeps' for 2 times. All Output ports are activated. Display output status on CP04.
3	SW3	Buzzer on IFC-MB00 'beeps' for 3 times. OUT1 is activated in PWM mode. Display output status on CP04.

p. Please refer the comment in source code for the details of mode.

q. To remove a card from IFC system, the power should be switched OFF.

r. 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 may refer to IFC-OC04 Card Technical Info for the program function list. It will help user in writing program for IFC-OC04.
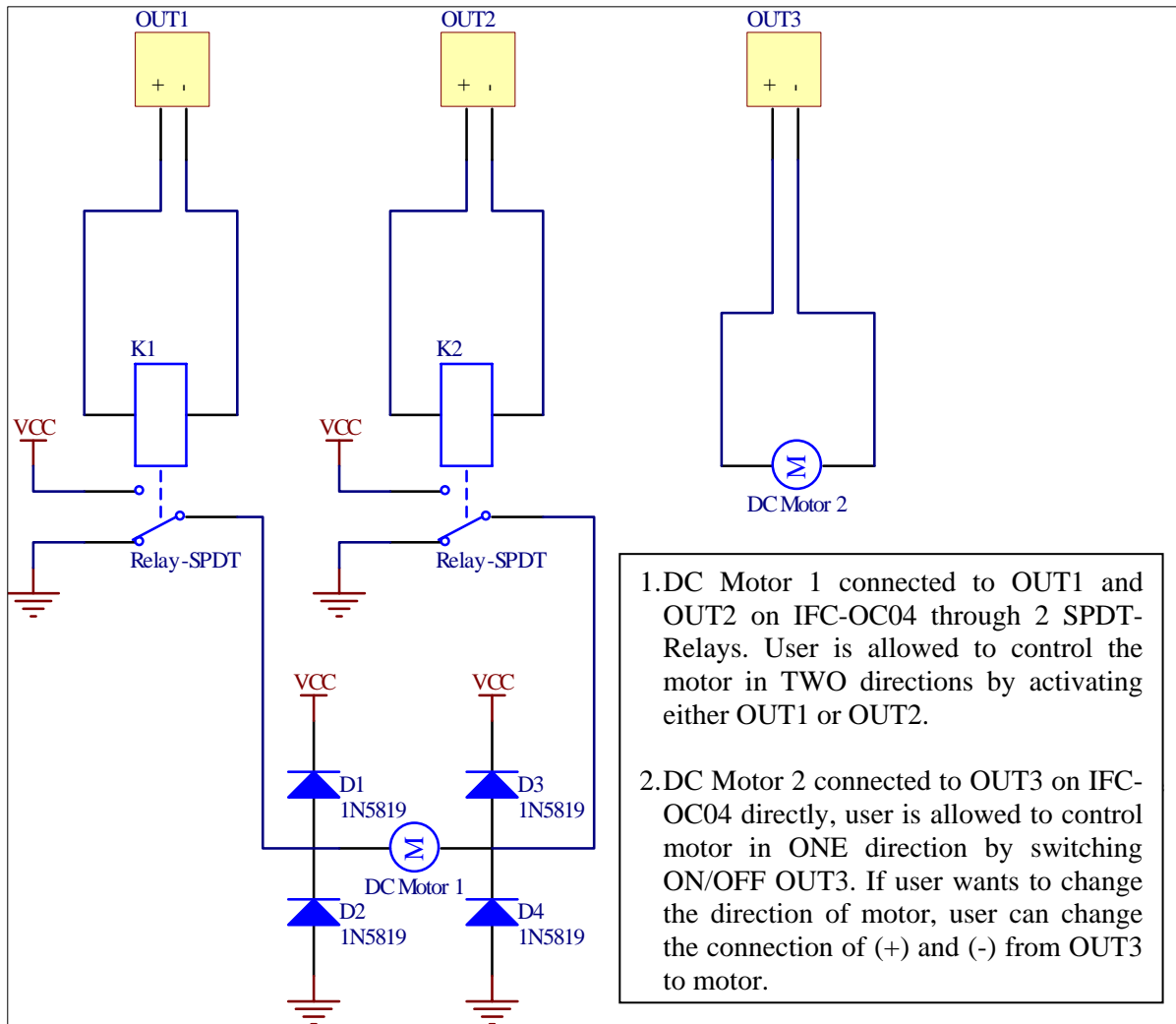
Note2: Each time open a new project for IFC, user need to add **ALL** header files and object files for all related IFC cards used. User also need to include **ALL** card h file at the beginning of the program. Please refer sample source code for the example to include card h file.

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.

Appendix A

1. DC Motor 1 connected to OUT1 and OUT2 on IFC-OC04 through 2 SPDT-Relays. User is allowed to control the motor in TWO directions by activating either OUT1 or OUT2.

2. DC Motor 2 connected to OUT3 on IFC-OC04 directly, user is allowed to control motor in ONE direction by switching ON/OFF OUT3. If user wants to change the direction of motor, user can change the connection of (+) and (-) from OUT3 to motor.