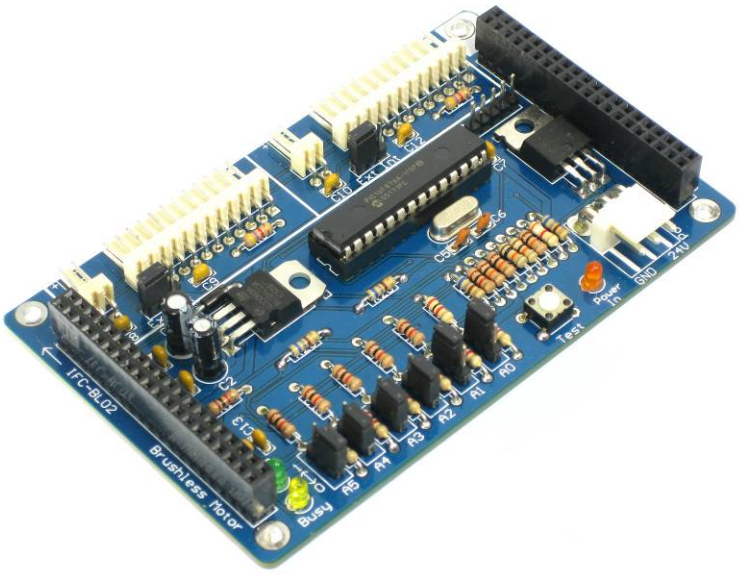
IFC-BL02
Interface Free Controller
Brushless Motor Card



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!

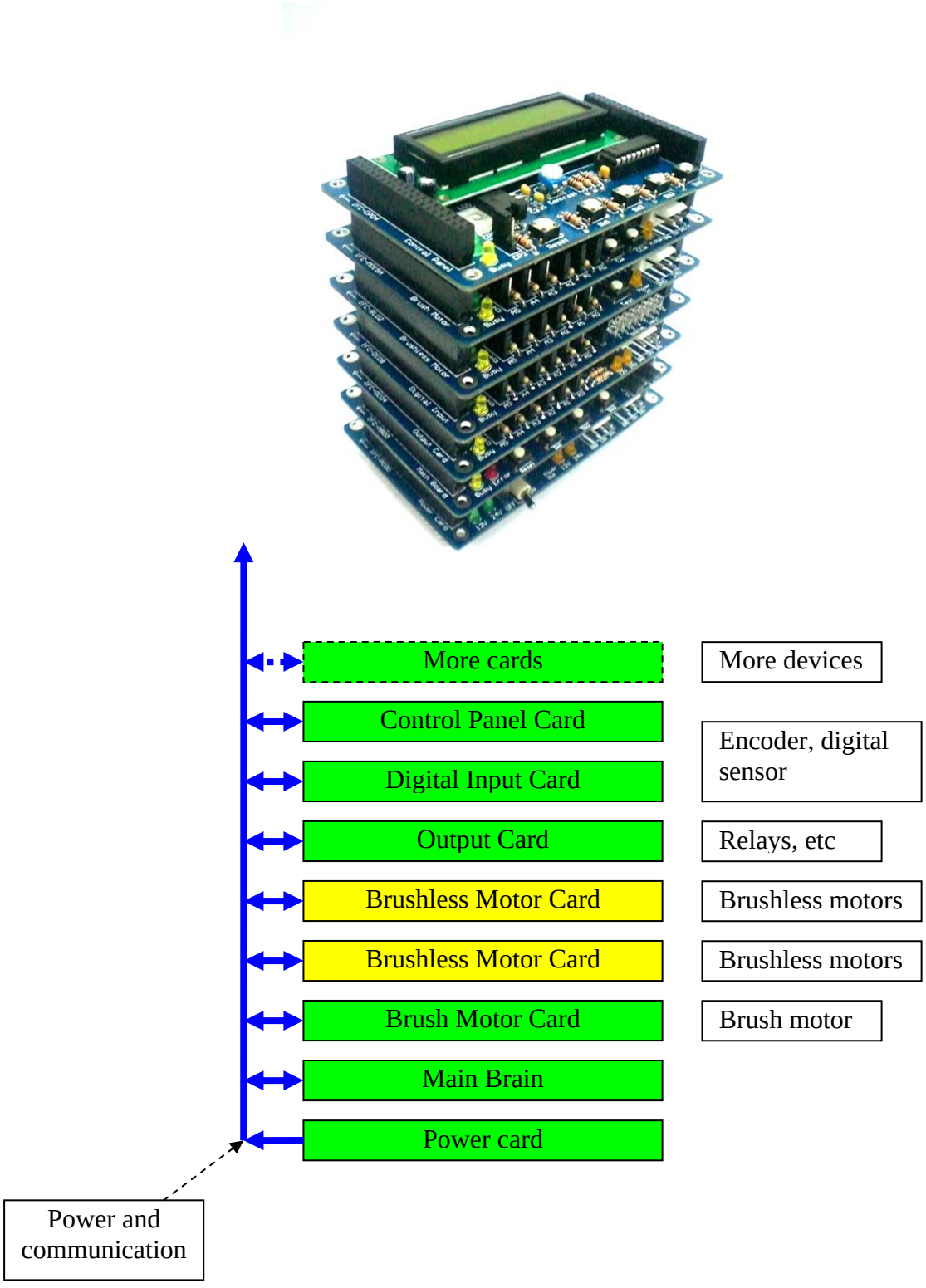
Furthermore, with functions based software library, user save valuable time during software development by concentrating on algorithm development. No more flipping or scrolling PIC data sheet looking for ADCON0, T1CON or even TRISA. With just a programming hand book, user may simply copy the header file, 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 Brushless Motor card, IFC-BL02. 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.
- 2 brushless motor ports.
- Selectable power source for brushless motor (External or Internal).
- 1 push button to test motor.
- A Motor External Power In status indicator LED.
- **Dimension** 11.1cm x 6.9cm
- Template and sample source code is provided for MPLAB C18 compiler.

1.1 System Overview

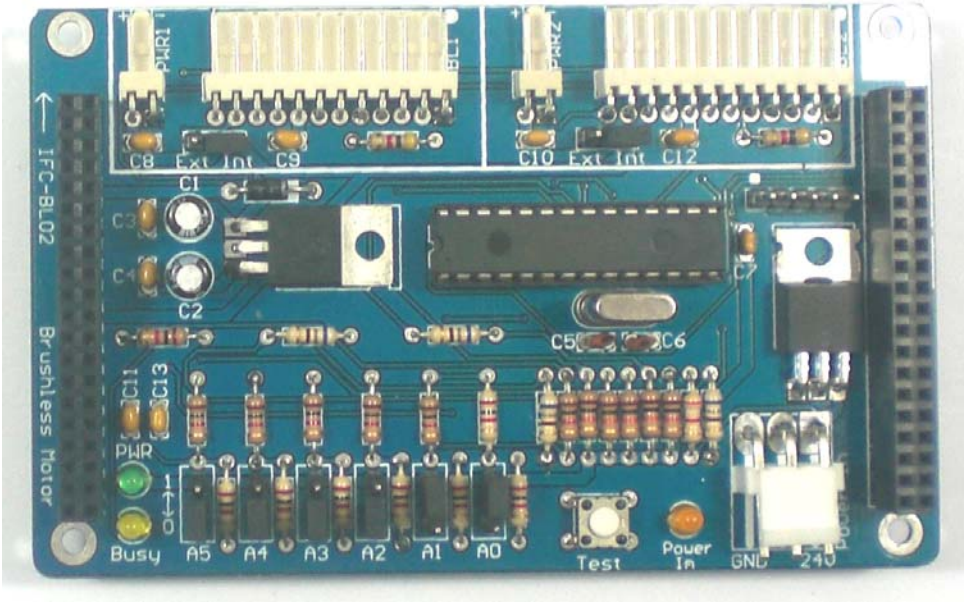
With serial communication perception, IFC offer million of possibilities to develop embedded system creatively and easily. In IFC, several cards are stacked to get a complete embedded system. The minimum card requires is Power card and Main Board.



This document explains the method to use IFC-BL02.

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 Brushless Motor Card, IFC-BL02 with:
   - 1 x 28 pin PIC microcontroller.
   - 8 x mini jumper.
   - 2 x brushless motor terminal.
   - 2 x brushless motor power terminal.
   - 1 x External motor Power In terminal.
   - 1 x push button to test motor.
   - 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-BL02 that can be selected. The 6 bits communication address is determine by selector A5 through A0 (6 set of 1x3 headers on IFC-BL02). User can 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 no need** to prepare programmer for IFC-BL02. IFC-BL02 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 BL02 are as below:

- 2 status indicator LED: Power and busy LED:
  - Power LED (PWR) will turn ON when power supplied to BL02.
  - Busy LED (Busy) will turn ON or blinking when BL02 is communicating with master card, IFC-MB00.
- External Motor Power In status indicator LED.
- 2 brushless motor ports to connect brushless motor. There are 2 brands of brushless motor can be connected to IFC-BL02, which are Linix brushless and Vexta brushless motor.

The input devices on BL02 are as below:

- 1 push button to test both the brushless motors in the direction of clockwise (depends on motor) with a medium speed.

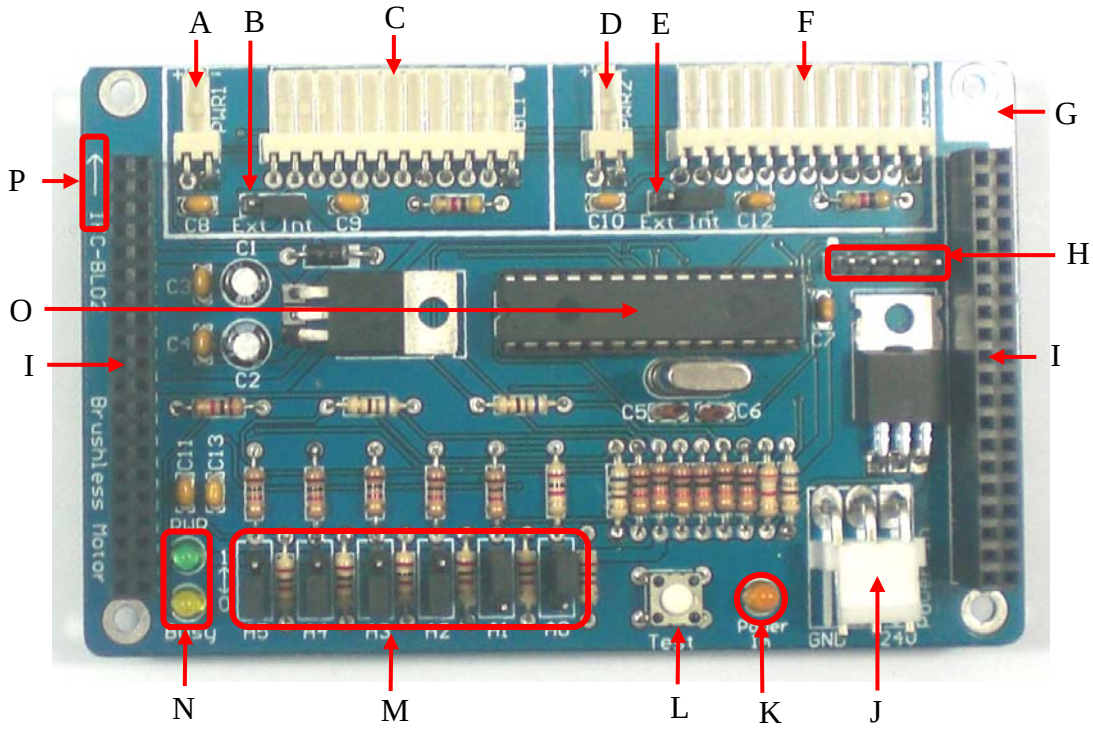
3.4 Operating Voltage

The operation voltage of IFC-BL02 is 12V. User needs to stack a Power Card, IFC-PC00, and connect a 12V battery on Power Card to supply 12V to the Brushless Motor Card. However, user needs to supply 24V either from External power source or internal power source to run both of the brushless motors. The External Motor Power In status indicator LED will turn ON when 24V external power is connected. User can connect external power source from IFC Power Card (IFC-PC00), IFC Extension Board (IFC-EB02) or external battery. Please refer hardware setup in chapter 5.0 Installation (hardware) for connecting power to Brushless Motor Card.

Absolute Maximum Rating

Symbol	Parameter	Min	Max	Unit
V_{IN}	Motor supply voltage	-	24	V
V_{CC}	Operating voltage	-	12	V
I_{max}	Maximum output current	-	3	A

4. BOARD OR PRODUCT LAYOUT



Label	Function	Label	Function
A	BL1's power terminal	**I**	Side connector
B	BL1's power source selector	**J**	External Motor Power In terminal
C	BL1's brushless motor terminal	**K**	External Motor Power In status indicator LED
D	BL2's power terminal	**L**	Motor's test button
E	BL2's power source selector	**M**	Communication address selectors
F	BL2's brushless motor terminal	**N**	Status indicator LED
G	Orientation marking	**O**	28 pin PIC Microcontroller
H	Manufacturing Test Points	**P**	Arrow

A – is BL1's power terminal to connect power connector from brushless motor.

B – is power source selector for BL1. User needs to use the mini jumper to select External (Ext.) power source or Internal (Int.) power source for voltage supplied to motor. The maximum current supported is 3A to each brushless motor.

C – is brushless motor terminal for BL1. User needs to connect the cable connector for brushless motor's driver to this terminal.

D – is BL2's power terminal to connect power connector from brushless motor.

E – is power source selector for BL2. User needs to use the mini jumper to select External (Ext.) power source or Internal (Int.) power source for voltage supplied to motor. The maximum current supported is 3A to each brushless motor.

F – is brushless motor terminal for BL2. User needs to connect the cable connector for brushless motor's driver to this terminal.

G – is the orientation marking on IFC-BL02. Every IFC card will have this orientation marking, this is to help user in ensuring the cards are stack correctly.

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

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

J – is External Motor Power In connector for user to connect external power source for motor. If External (Ext.) power source is selected, user needs to connect 24V either from IFC Power Card (IFC-PC00), IFC Extension Board (IFC-EB02) or external battery to the connector in order to run brushless motor.

K – is External Motor Power In status indicator LED. The Motor Power In status indicator LED will turn ON when 24V external power is connected.

L – is Motor's test button for motors. User can simply test the motors connected to BL02 by pressing this test button without any programming. The motors will run in the direction of clockwise.

M – are 6 set of 1x3 headers use as communication address selector on IFC-BL02. User can set the card address by using the mini jumper.

N – 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 supplied to the board. Busy LED will turn ON when the card is busy in communicate with master card, IFC-MB00.

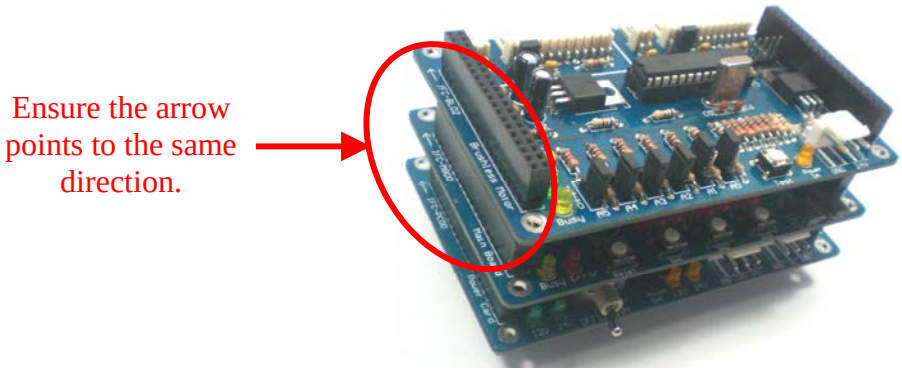
O – is 28 pin PIC microcontroller which used as controller for this slave card.

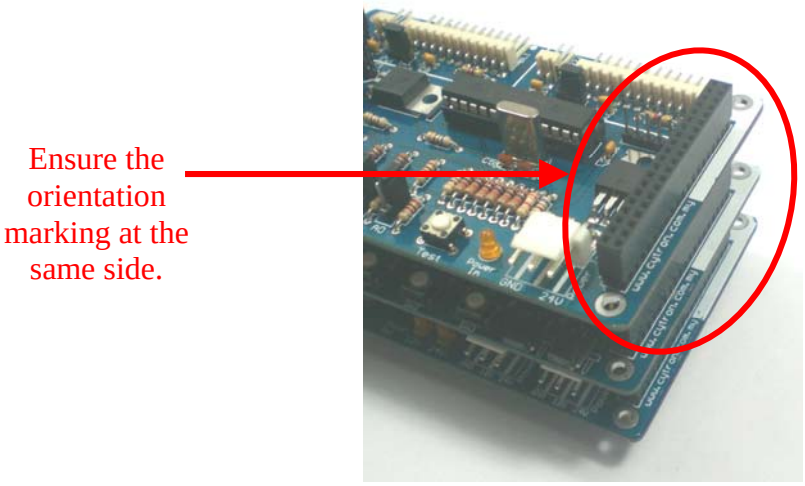
P – is a arrow mark to help user in ensuring the cards are stack correctly. Every IFC card will have this arrow mark; user needs to ensure that the arrow points to the same direction when IFC cards are stack together.

5. INSTALLATION (HARDWARE)

For hardware installation of IFC-BL02, user will first need the Main Board card (IFC-MB00) and Power Card (IFC-PC00) of IFC system. 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 user obtain IFC-BL02, user can stack it on IFC system as shown in Figure.

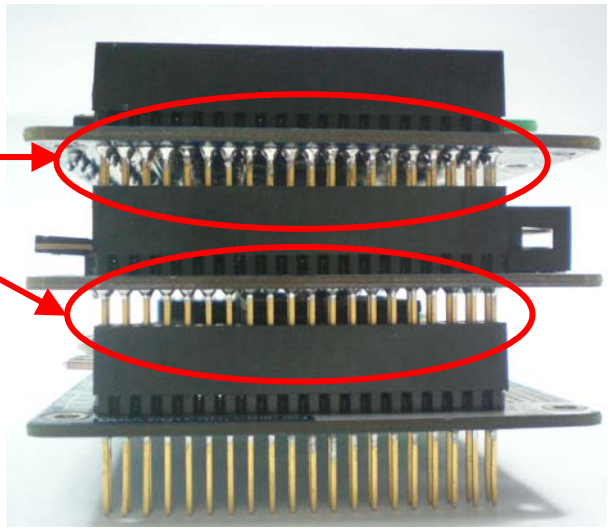




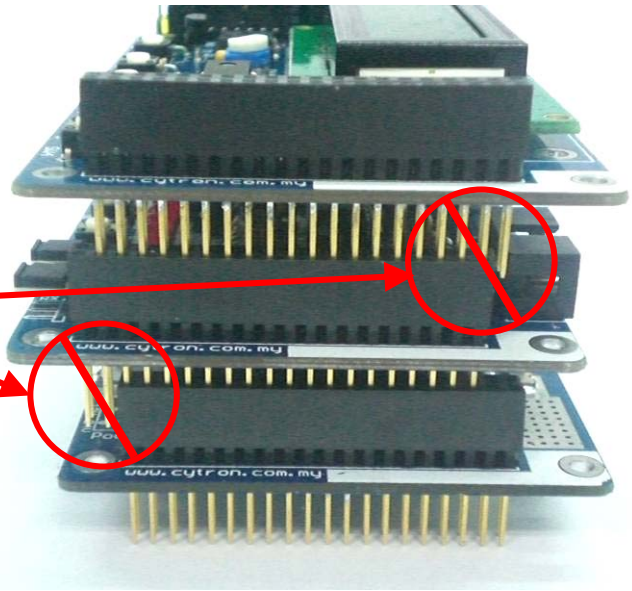
Cautions: Please ensure that every card is being stacked properly in correct orientation. Whole IFC system will be damaged if one of the cards is being stacked wrongly when it is powered up.

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.

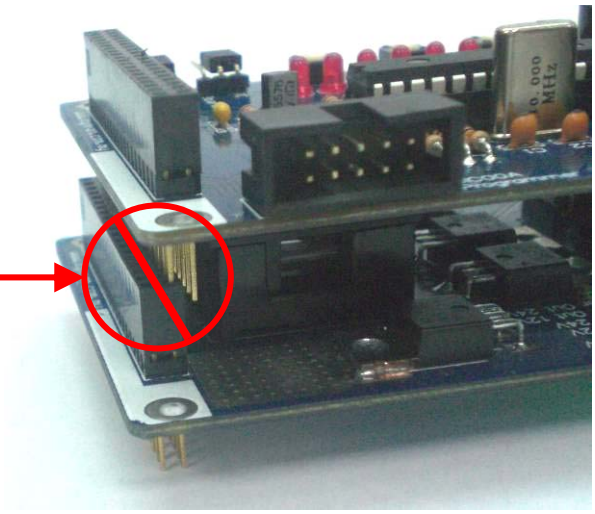


Examples of stacking cards with shifted pins. Please AVOID this!



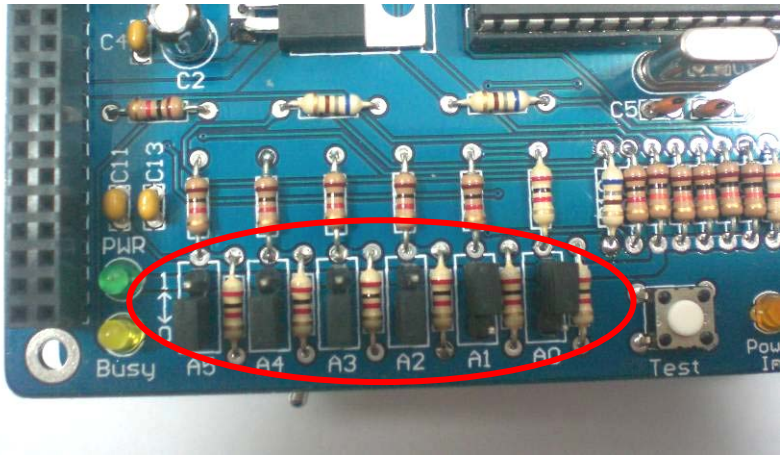
Ensure that all card pins are not shifted when stacking.

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



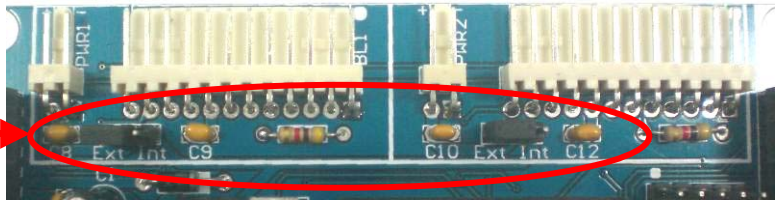
Cautions: Please ensure that all card pins are not shifted when stacking. IFC system will NOT function if the pins are shifted.

User can use the mini jumper provided on IFC-BL02 to select the communication address of IFC-BL02. For example, figure below shows the communication address, 000011 selected. Please make sure the address selected is compatible with the program. Please refer chapter 7 for details of writing program for IFC-BL02. Each slave card must have unique address.

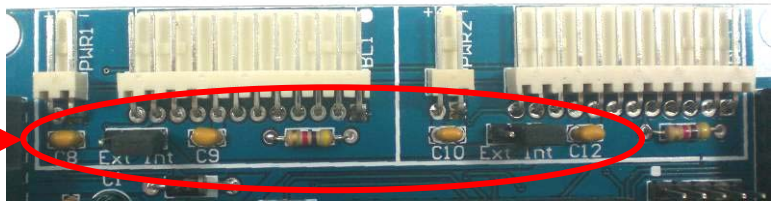


User also needs to select power source for the brushless motor. There is a power source selector for each brushless motor port. User can use the mini jumper to select External (Ext.) power source or Internal (Int.) power source for voltage supplied to motor. Each port can only support up to maximum of 3A. Please ensure 24V is connected to External Motor Power In if External (Ext.) power source is selected. Figure below shows the method to select power source for the brushless motor.

External (Ext.) Power Source was selected for BL1 and BL2. →



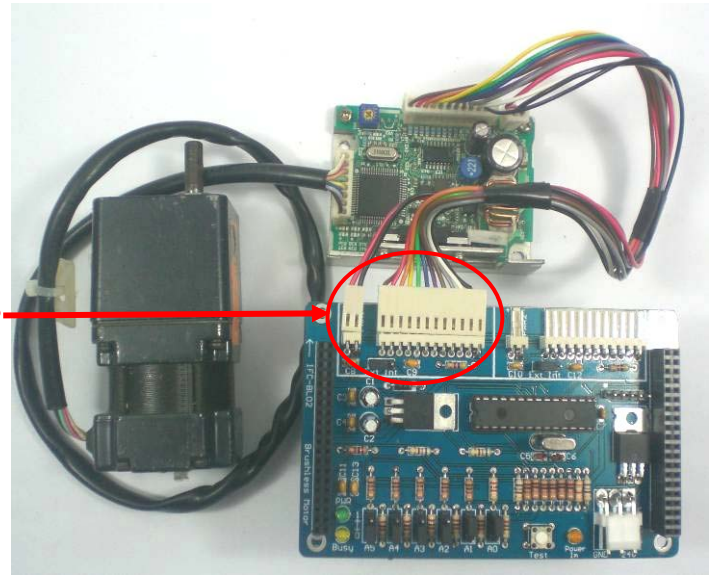
Internal (Int.) Power Source was selected for BL1 and BL2. →



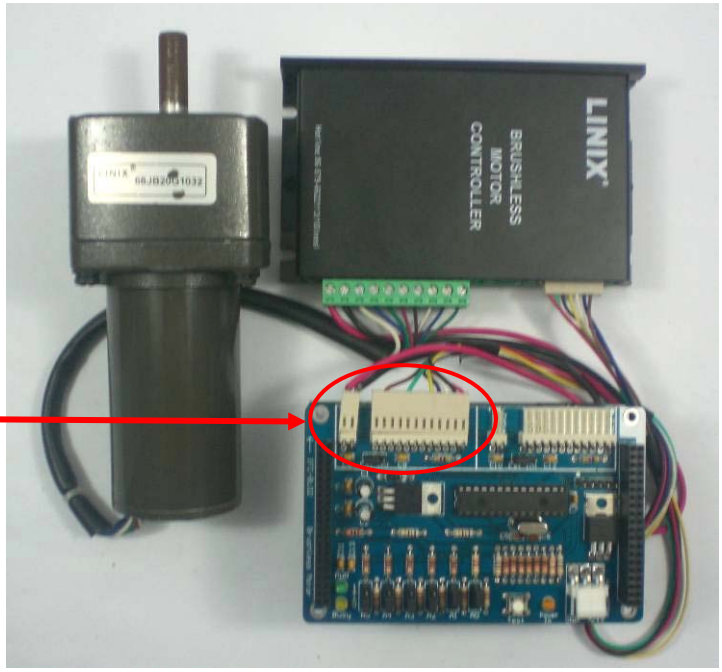
Caution: Please ensure that the power source for BL1 and BL2 were selected to supply 24V to the motors. **2 x 12V batteries** must be connected to Power Card if Internal (Int.) power source is selected whereas **24V** must be connected to External Motor Power In if External power source (Ext.) is selected. **User is advised to connect external power if more than one card is used, as the internal connector can only supply up to 20A.**

Figure below shows the method to connect a brushless motor to BL02. The Internal (Int.) power source is selected from both of the motors.

Cable from Vexta brushless motor's driver is connected to BL02.



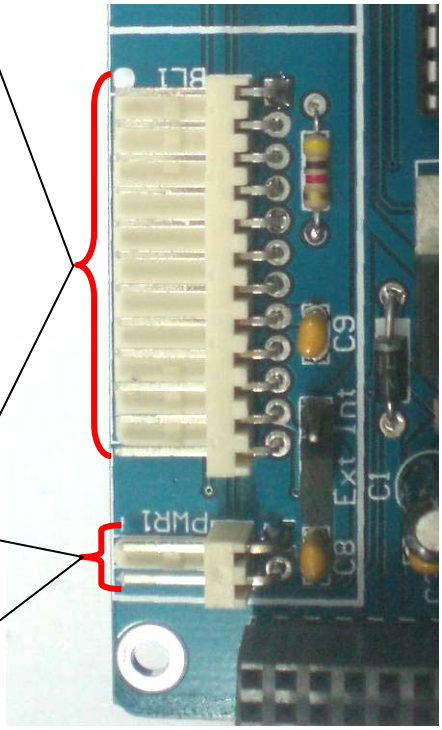
Cable from Linix brushless motor's driver is connected to BL02.



User needs to follow the figure below to connect the pin from brushless motor to IFC-BL02. **Please ensure the connection is correct.**

Pin	Connection
1	NC
2	Start/Stop
3	Run/Brake
4	CW/CCW
5	INT/EXT
6	Alarm reset
7	VRH
8	VRM
9	VRL
10	GND
11	Speed Out
12	Alarm out

Pin	Connection
1	GND
2	VCC



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

If user need to supply 24V to IFC-BL02 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.

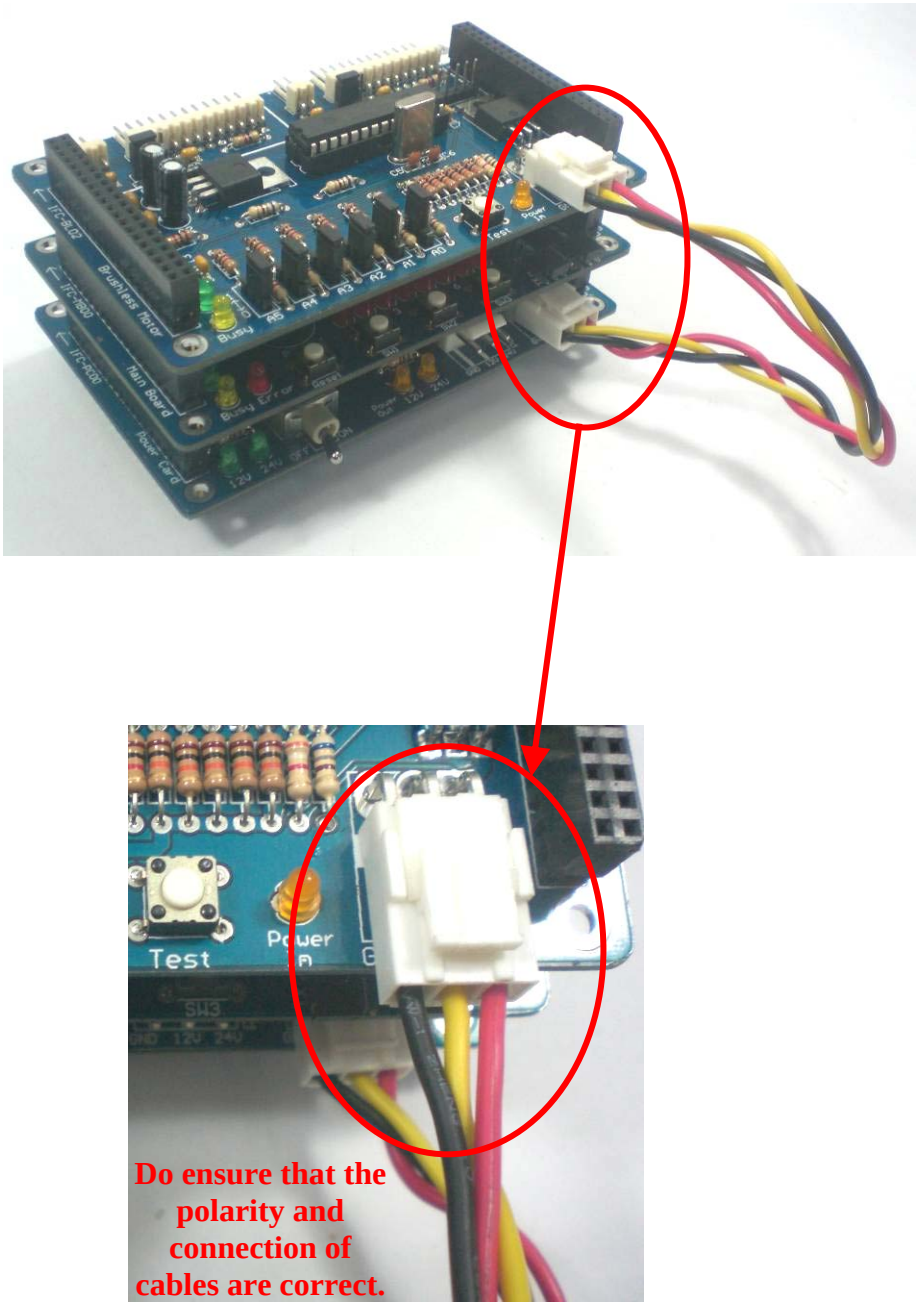
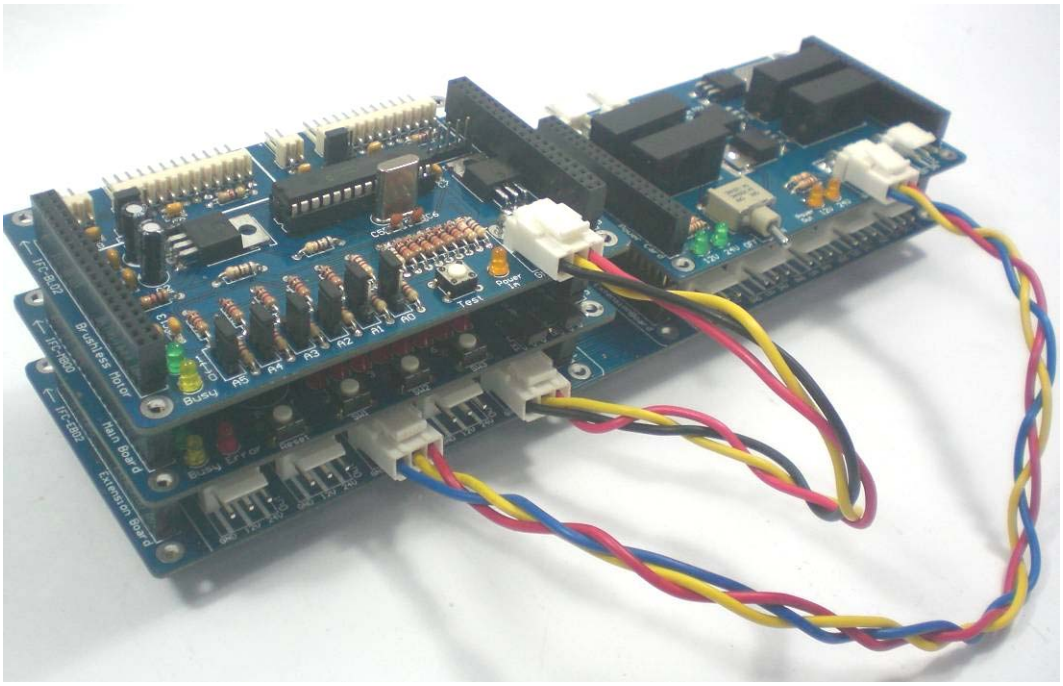
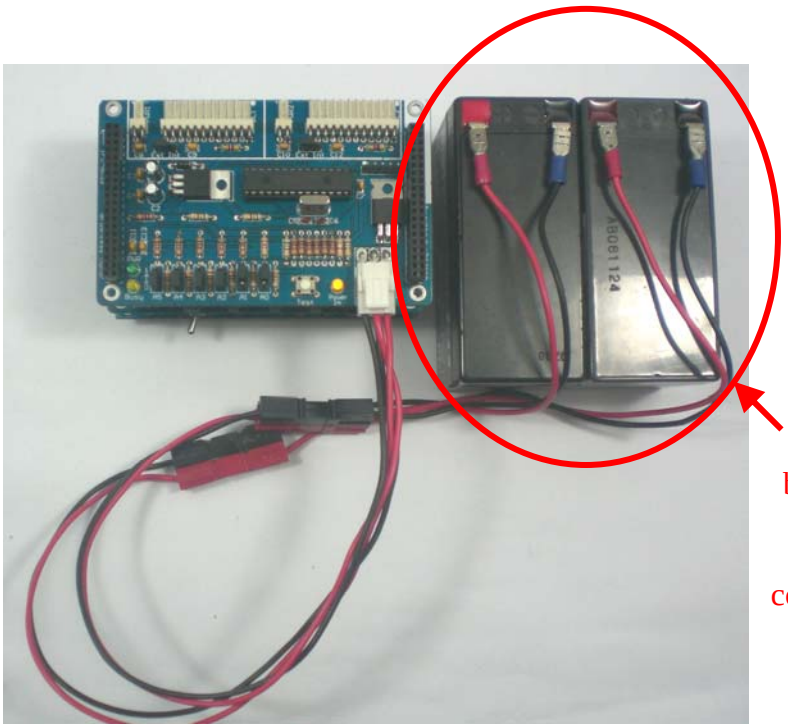


Figure shows the example of connect external power source from IFC Extension Board. Please refer User's Manual for IFC-EB02 for the more details.



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

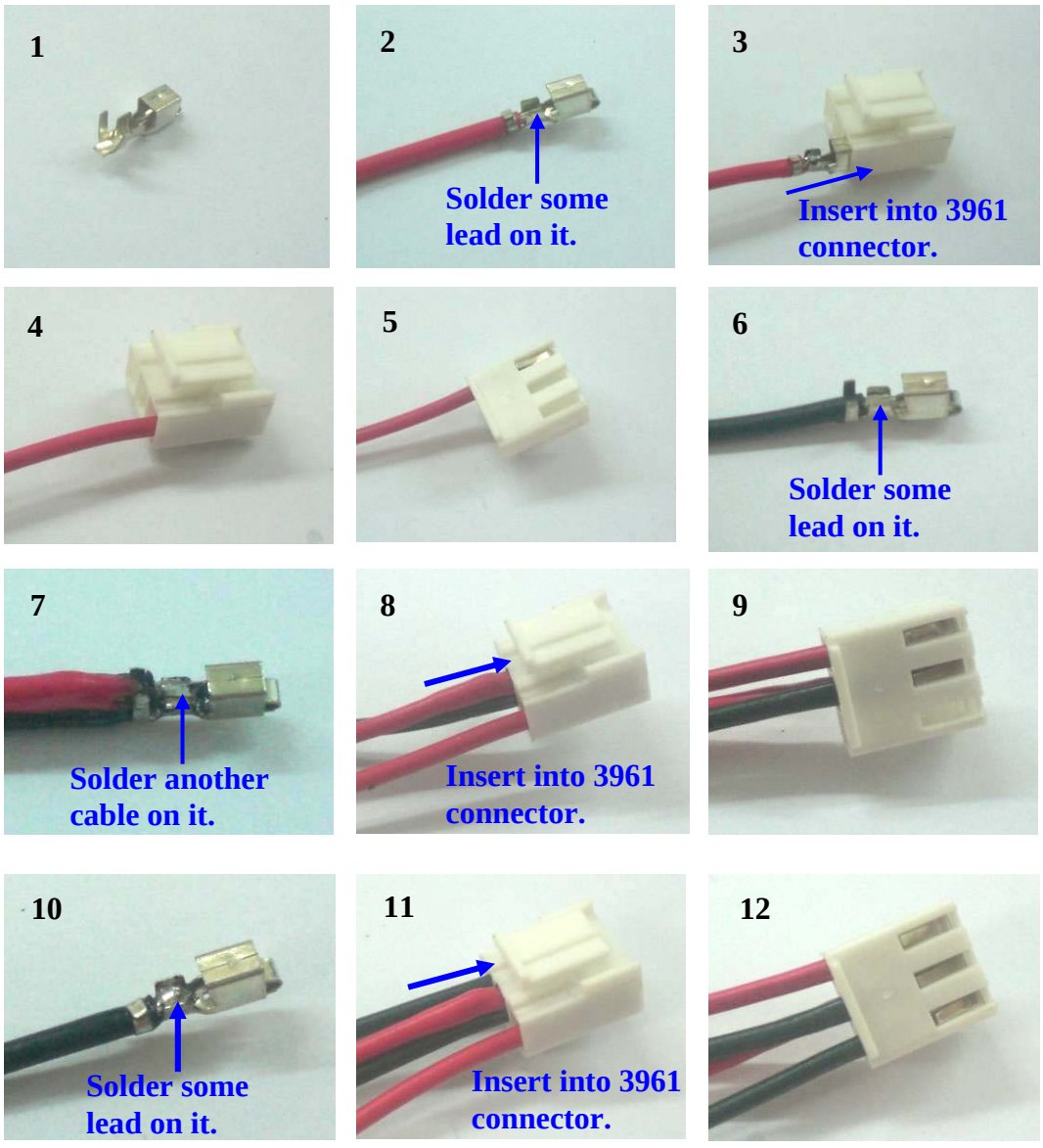


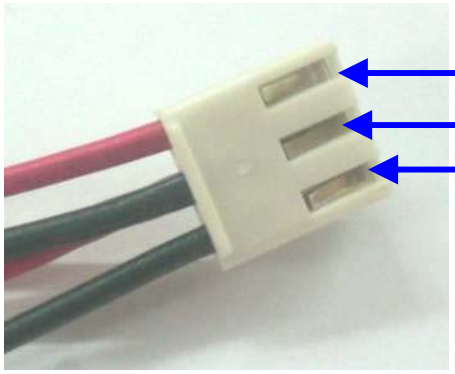
There are 24V (2 x 12V Batteries) connected. The batteries connected here are Sealed Lead Acid Battery. However, user is free to connect the other type of 12V battery as external power source.

User may follow the steps below to build a cable connector for connecting the external power source from 2 extra batteries.

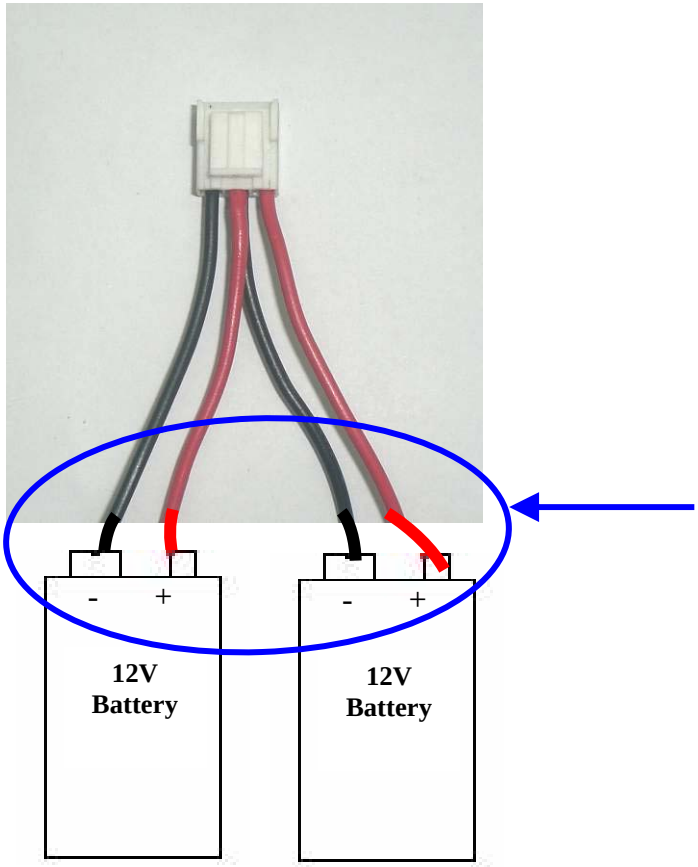
Materials needed:

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





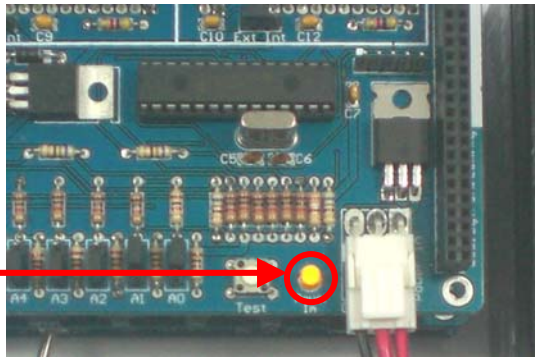
Ensure the iron pins are fully inserted to the connector



Connect the cable to batteries. **Please ensure the polarity is correct.** Red for positive (+) while black for negative (-).

After Motor Power in is connected, the External Motor Power In status indicator LED will turn ON. The External Motor Power In status indicator LED will turn ON when 24V external power is connected.

The External Motor Power In status indicator LED will turn ON when 24V external power is connected.

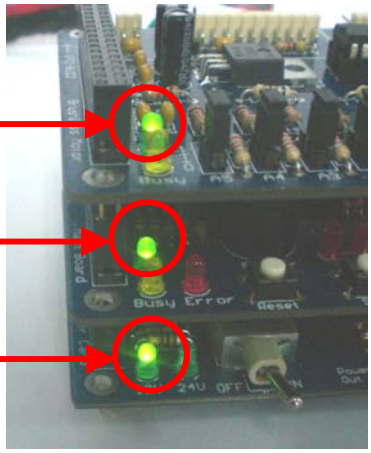


Next, please turn ON the power on Power Card, the PWR LED of IFC-BL02 will turn ON as shown in Figure. Initially, if there are no functions related to IFC-BL02 being called in Main Board's program, the busy LED will not ON or blink.

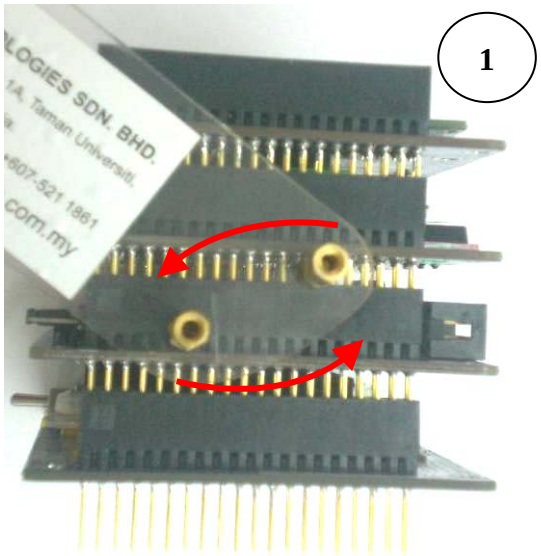
PWR LED on IFC – BL02

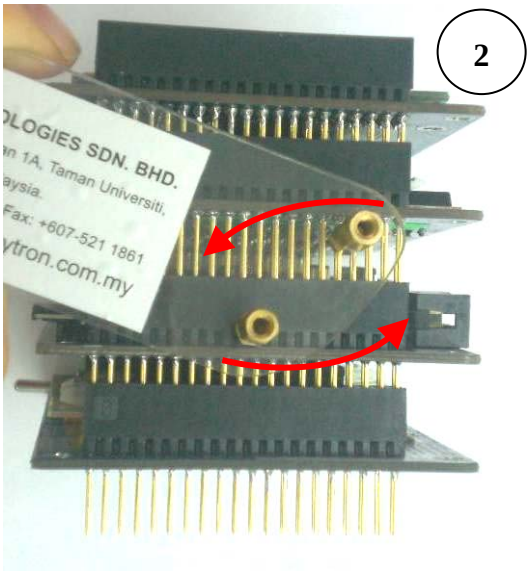
PWR LED on IFC - MB00

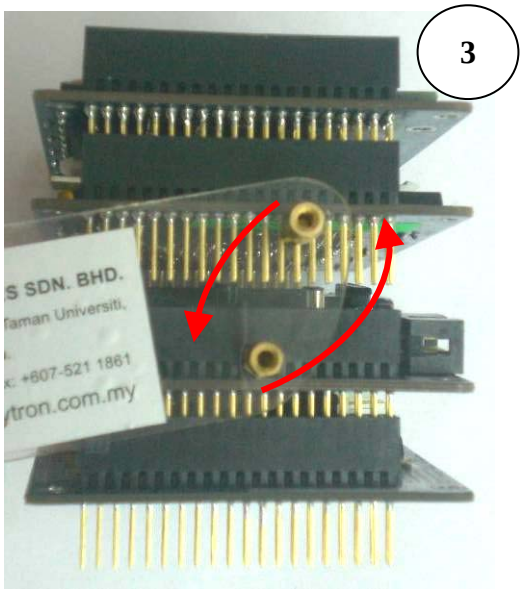
12V LED on IFC - PC00



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.

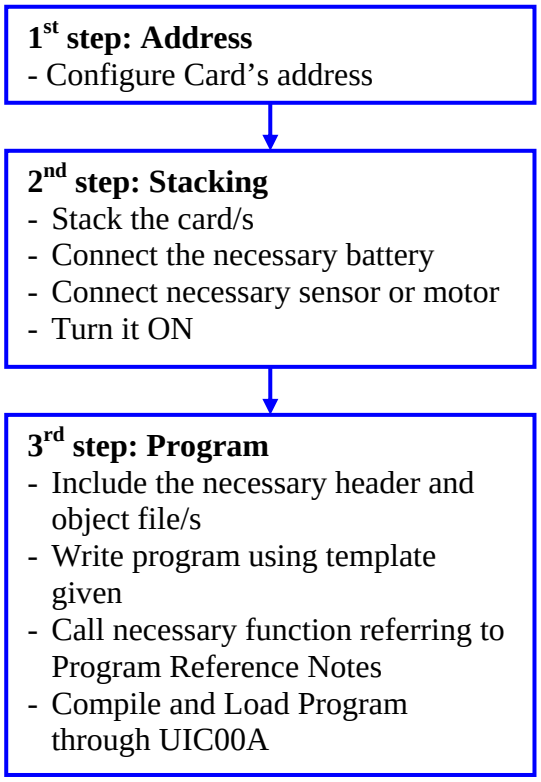
6. INSTALLATION (SOFTWARE)

User only needs to write program in IFC-MB00 in order to send data and communicate with IFC-BL02. A program editor, C compiler and UIC00A software are 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 Brushless Motor Card, IFC-BL02.



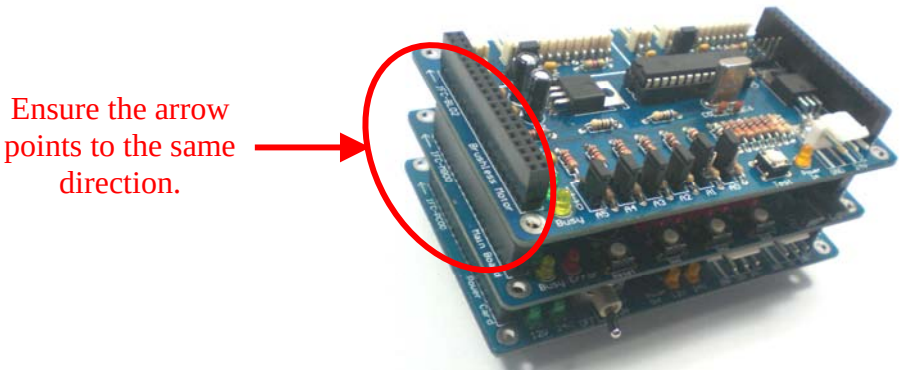
There are 2 basic setups in this chapter for IFC-BL02, the 1st example includes 3 cards, IFC-PC00, IFC-MB00 and IFC-BL02, while 2nd example includes one extra card, which is IFC-CP04. Please refer to the following section of this chapter for setup details.

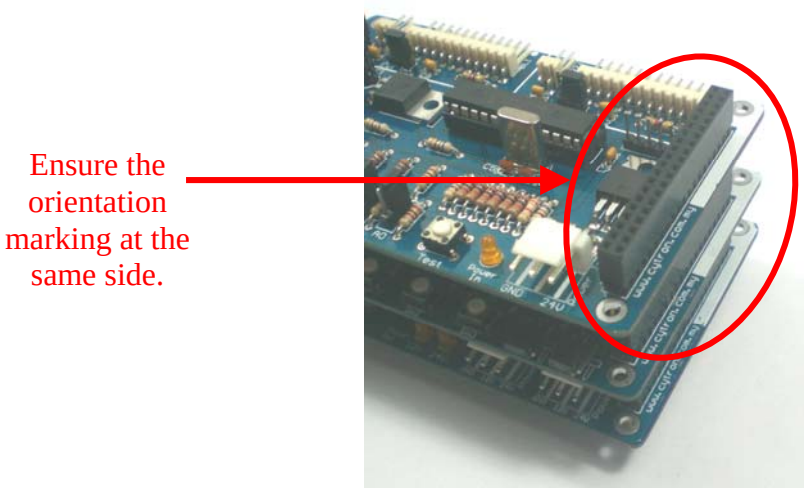
7.1 Basic Setup (IFC-PC00 + IFC-MB00 + IFC-BL02)

This is the basic and minimum setup for IFC-BL02 which comes with 2 brushless motor terminals. Though without other card, this basic setup can still perform some task such as drive brushless motor or controlling the motor based on value counted in encoder. Following steps show the installation of this system and method to operate it.

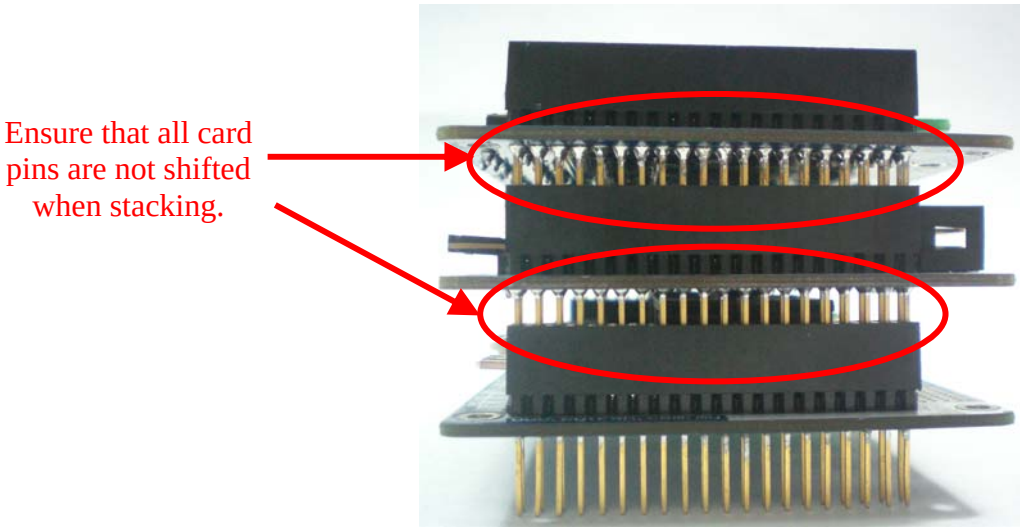
a. 1st step, configure the address of card. Brushless Motor Card has 6 mini jumpers to configure communication address (A5-A0). It should be set to 000011 if sample source code is being used.

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 Brushless Motor Card (IFC-BL02) at top layer as shown in following figure.



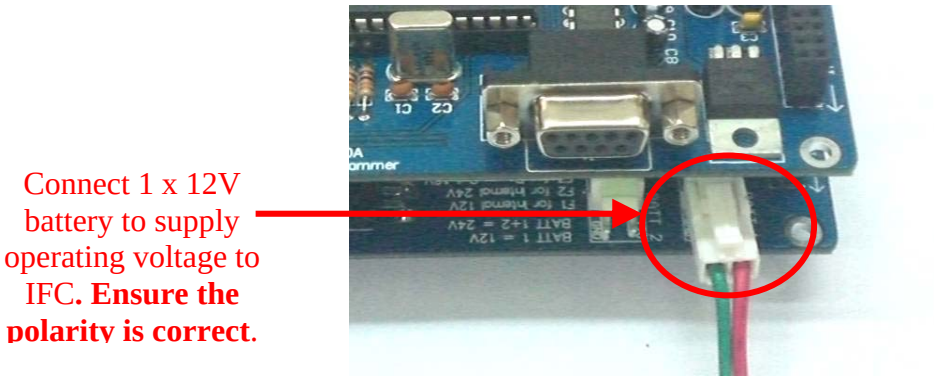


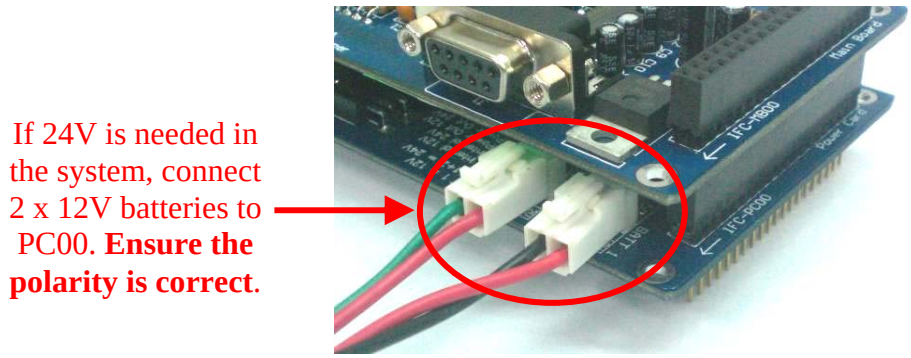
c. Besides stacking every card in correct orientation, user must also require to ensure all card pins are not shifted when stacking.



d. Connect the brushless motor to Brushless Motor Card. Please refer hardware setup for connecting motor to Brushless Motor Card.

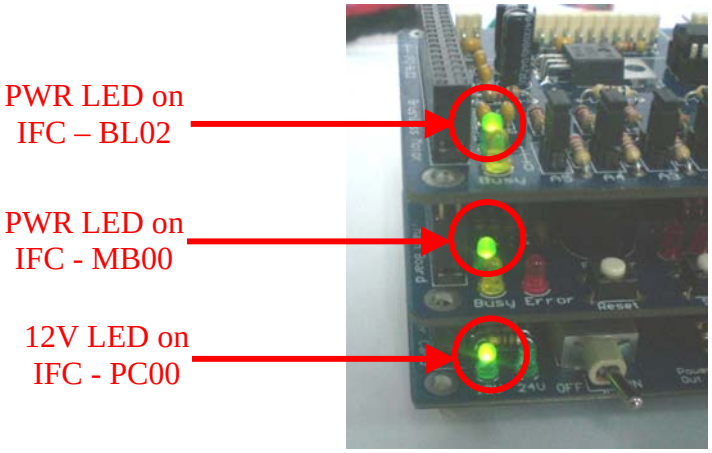
e. Connect the battery to Power card as shown; please ensure the **polarity is correct**.





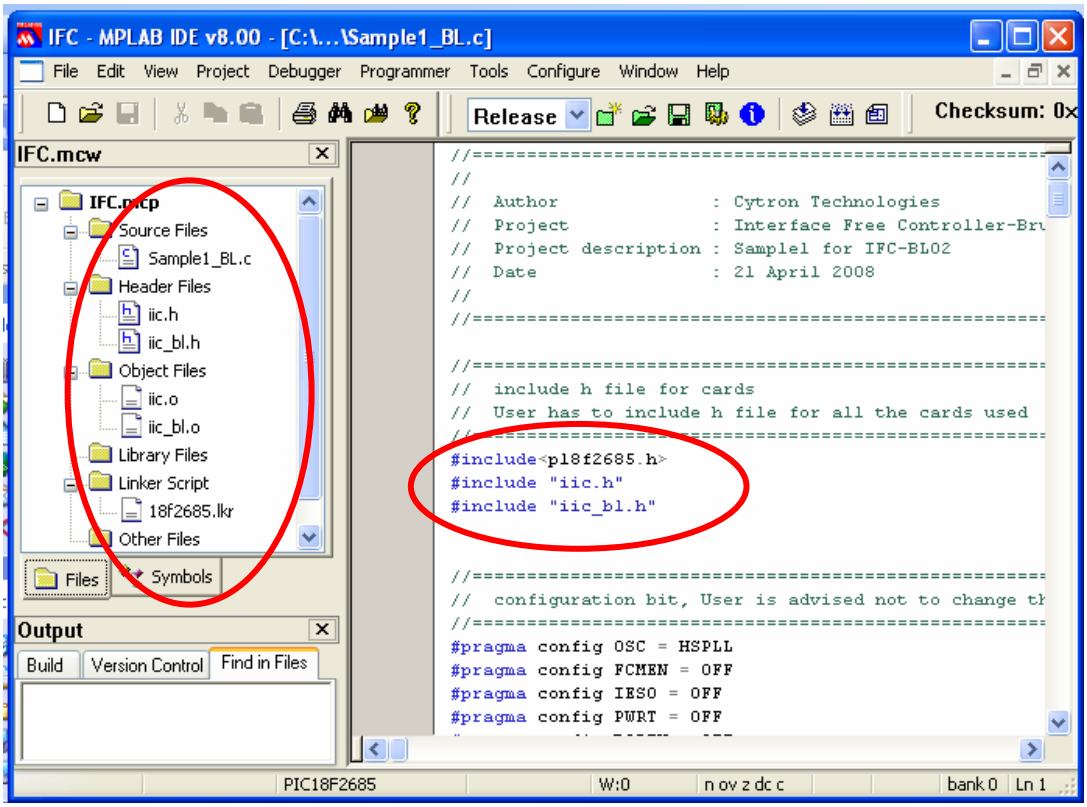
f. Connect the **24V** External power source for Brushless Motor Card if External power source is selected or connect **2 x 12V batteries** to Power Card if Internal (Int.) power source is selected. Please refer hardware setup in chapter 5.0 Installation (hardware) for connecting power to Brush Motor 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 Brushless Motor Card) light up as shown.



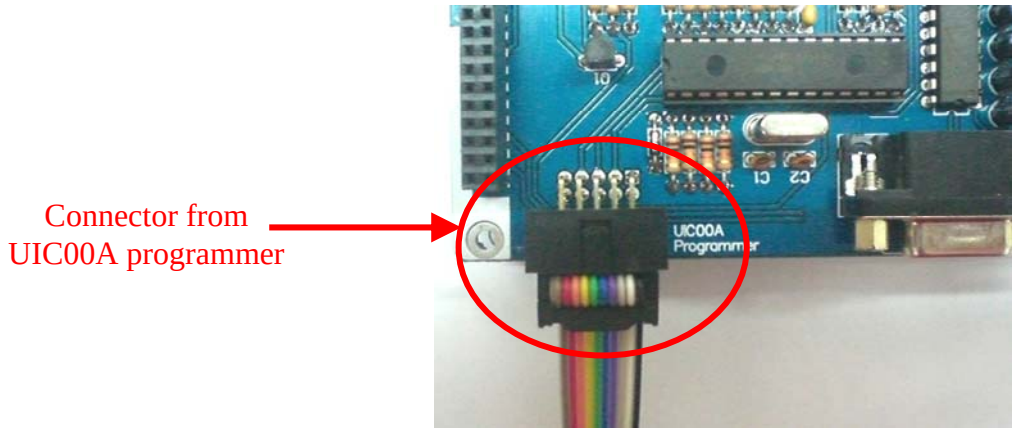
h. 3rd step is to write program and load it. IFC comes with comprehensive function to save program development time. Functions library will come with the interfacing card in the form of header file (*.h) and object file (*.o). In order to call these functions, particular header file and object file must 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_BL" for IFC Brushless Motor Card. Please note that the header file (iic.h and iic_bl.h) and object file (iic.o and iic_bl.o) for IFC-MB00 and IFC-BL02 have to be included in the project. If user did not use the provided sample source code, "Sample1_BL.c", user also needs to include card's header file at the beginning of the program. Figure shows the example to include header file, object file and card's header file.



j. For those wanted to understand the program, please refer to c file named "Sample1_BL.c" which is 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_BL.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.



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_BL.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. 2 Brushless Motors are activated and run based on program.
2	SW2	Buzzer on IFC-MB00 'beeps' for 2 times. 2 Brushless Motors are activated. The motors will change the running direction and speed based on the encoder.
3	SW3	Buzzer on IFC-MB00 'beeps' for 3 times. 2 Brushless Motors are activated. The motors' speed will increase gradually.

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.

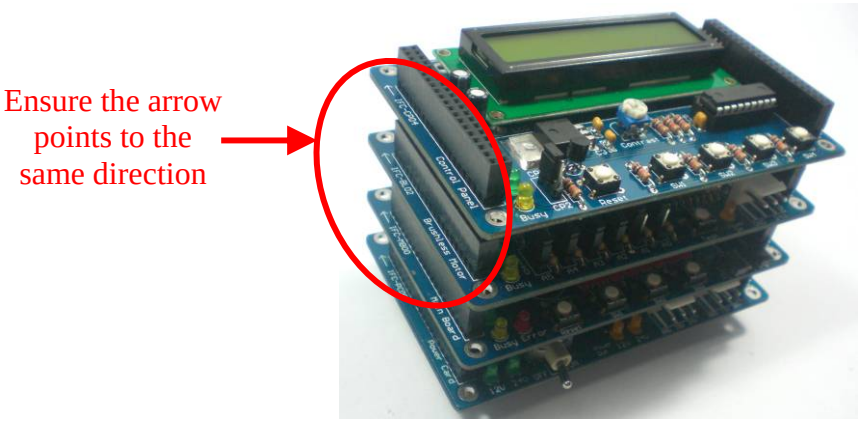
p. Please use proper tool to remove the card. User may refer last section in chapter 5.0 Installation (hardware) for the method to open card with provided IFC card opener.

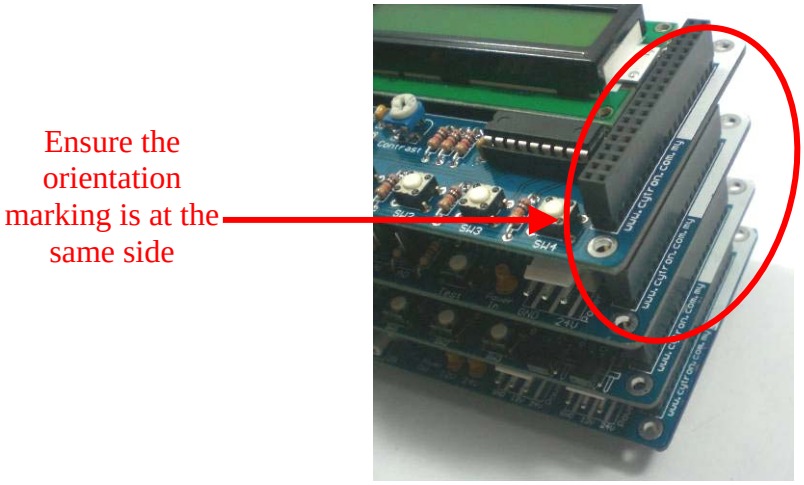
7.2 Basic Setup with Control Panel (IFC-PC00 + IFC-MB00 + IFC-BL02 + IFC-CP04)

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-BL02 and IFC-CP04. Brushless Motor 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).

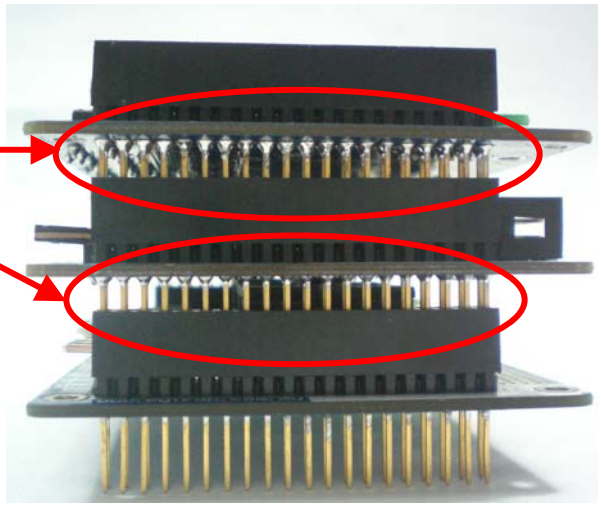
b. 2nd step is to stack all 4 cards together. Power card (IFC-PC00) should be at the bottom, Main board (IFC-MB00) at 2nd layer, Brushless Motor Card (IFC-BL02) at 3rd layer and Control Panel at the top layer as shown in following figure.





c. Besides stacking every card in correct orientation, user also needs 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.

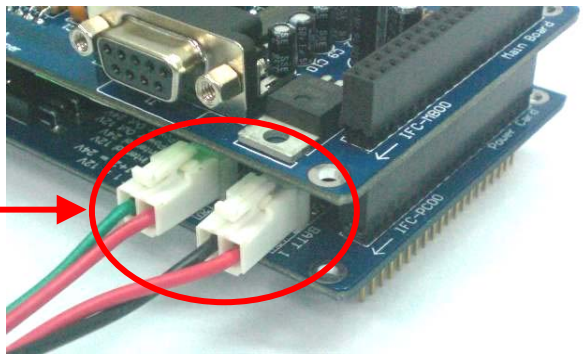


d. Connect the brushless motor to Brushless Motor Card. Please refer hardware setup for connecting motors to Brushless Motor Card.

e. Connect the battery to Power card as shown; please ensure the **polarity is correct**.

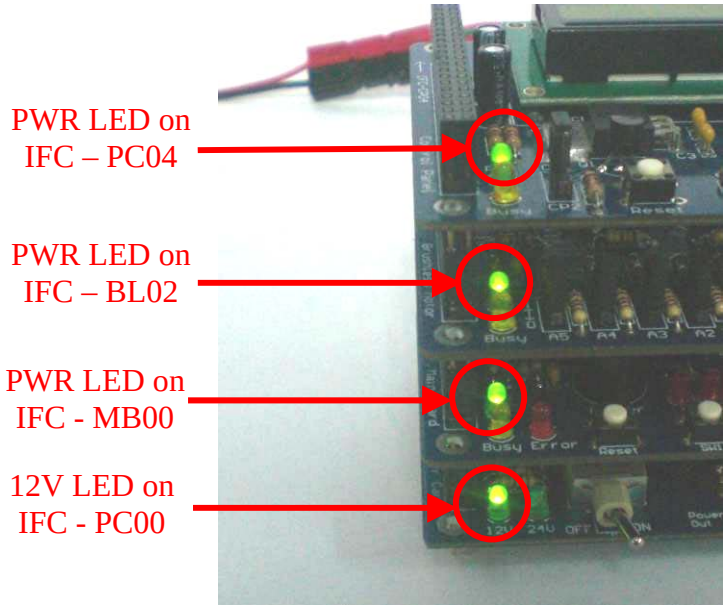
Connect 1 x 12V battery to supply operating voltage to IFC**. Ensure the polarity is correct**.

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



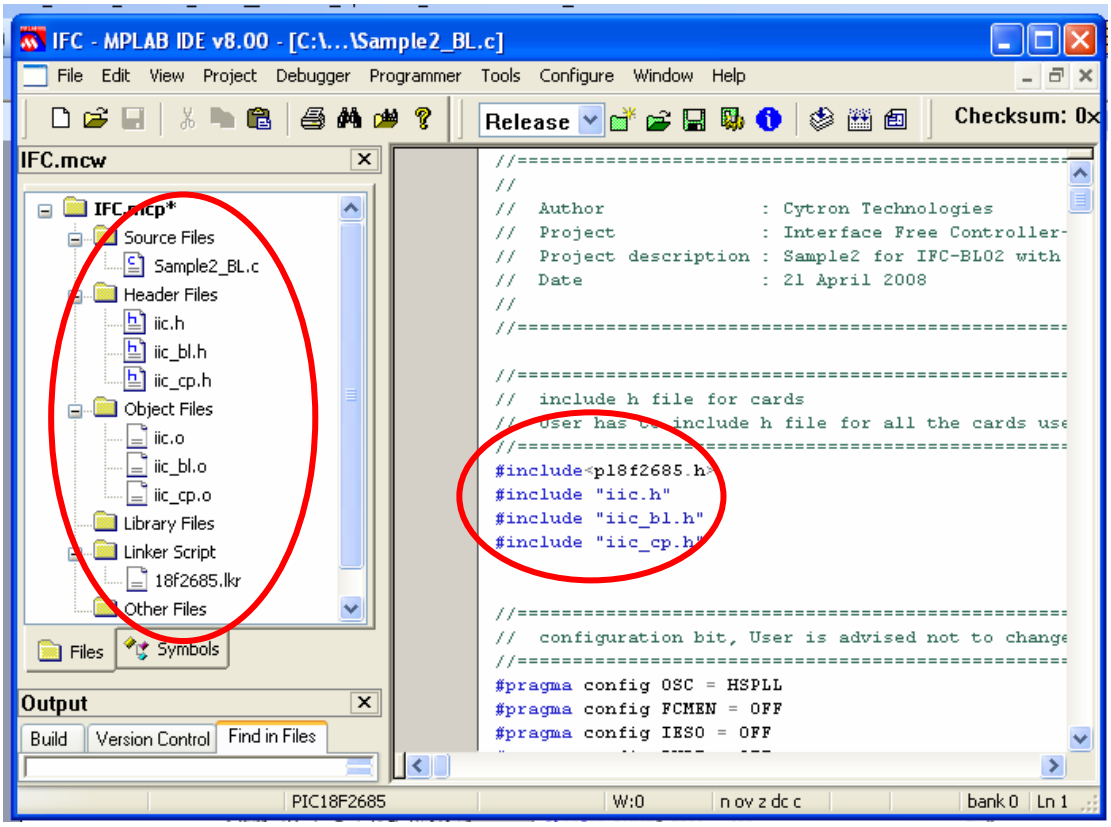
f. Connect the **24V** External power source for Brushless Motor Card if External power source is selected or connect **2 x 12V batteries** to Power Card if Internal (Int.) power source is selected. Please refer hardware setup in chapter 5.0 Installation (hardware) for connecting power to Brush Motor 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 Brushless Motor Card and PWR LED on Control Panel) light up as show.



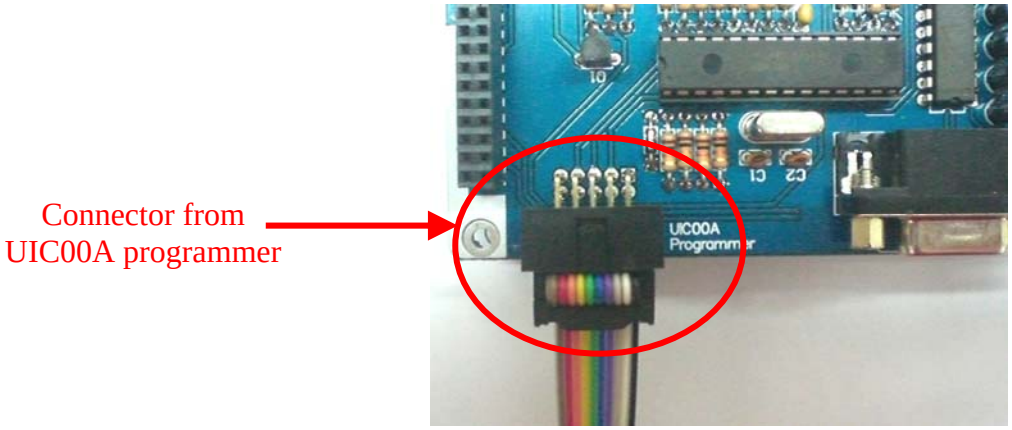
h. 3rd step is to write program and load it. IFC comes with comprehensive function to save program development time. Functions library will come with the interfacing card in the form of header file (*.h) and object file (*.o). In order to call these functions, particular header file and object file must 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_BL2" for IFC Brushless Motor Card. Please note that the header file (iic.h, iic_bl.h and iic_cp.h) and object file (iic.o, iic_bl.o and iic_cp.o) for IFC-MB00, IFC-BL02 and IFC-CP04 have to be included in the project. If user did not use the provided sample source code, "Sample2_BL.c", user also needs to include card's header file at the beginning of the program. Figure shows the example to include header file, object file and card's header file.



j. For those wanted to understand the program, please refer to c file named "Sample2_BL.c" which is 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_BL2.hex".



l. However, user can also add the "iic_cp.h" and "iic_cp.o" in project opened in chapter 7.1, remove the C file, "Sample1_BL.c", in the project and replace it with "Sample2_BL.c" 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 3 modes for user to select in program "Sample2_BL.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. 2 Brushless Motor are activated and run based on program. The motor's status will be display on Control Panel.
2	SW2	Buzzer on IFC-MB00 'beeps' for 2 times. The motors will change the status based on program. The motors' status will be display on Control Panel.
3	SW3	Buzzer on IFC-MB00 'beeps' for 3 times. Brushless Motor are activated. The motors' speed will increase gradually. The motors' status will be display on Control Panel.

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-BL02 Card Technical Info for the program function list. It will help user in writing program for IFC-BL02.

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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