IFC-XB01
Interface Free Controller
XBEE Wireless Card
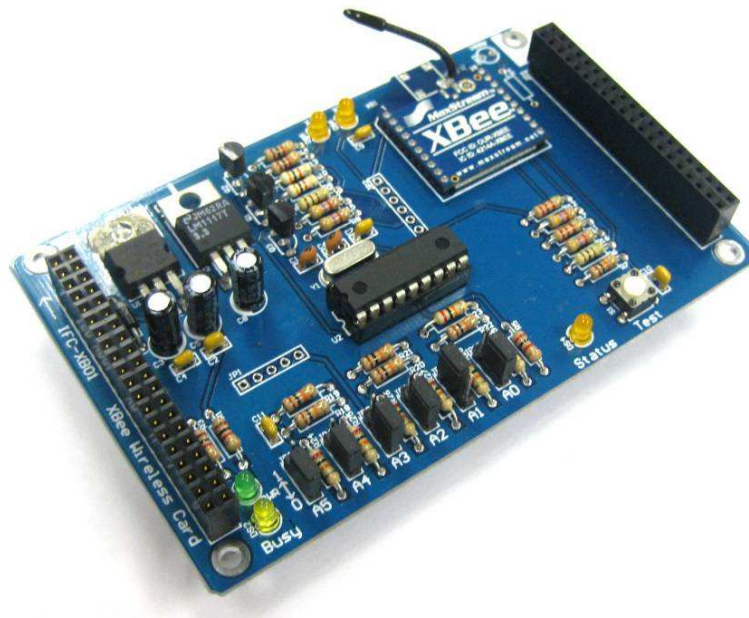
User's Manual

V1.0

Jan 2010

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 waived. 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!
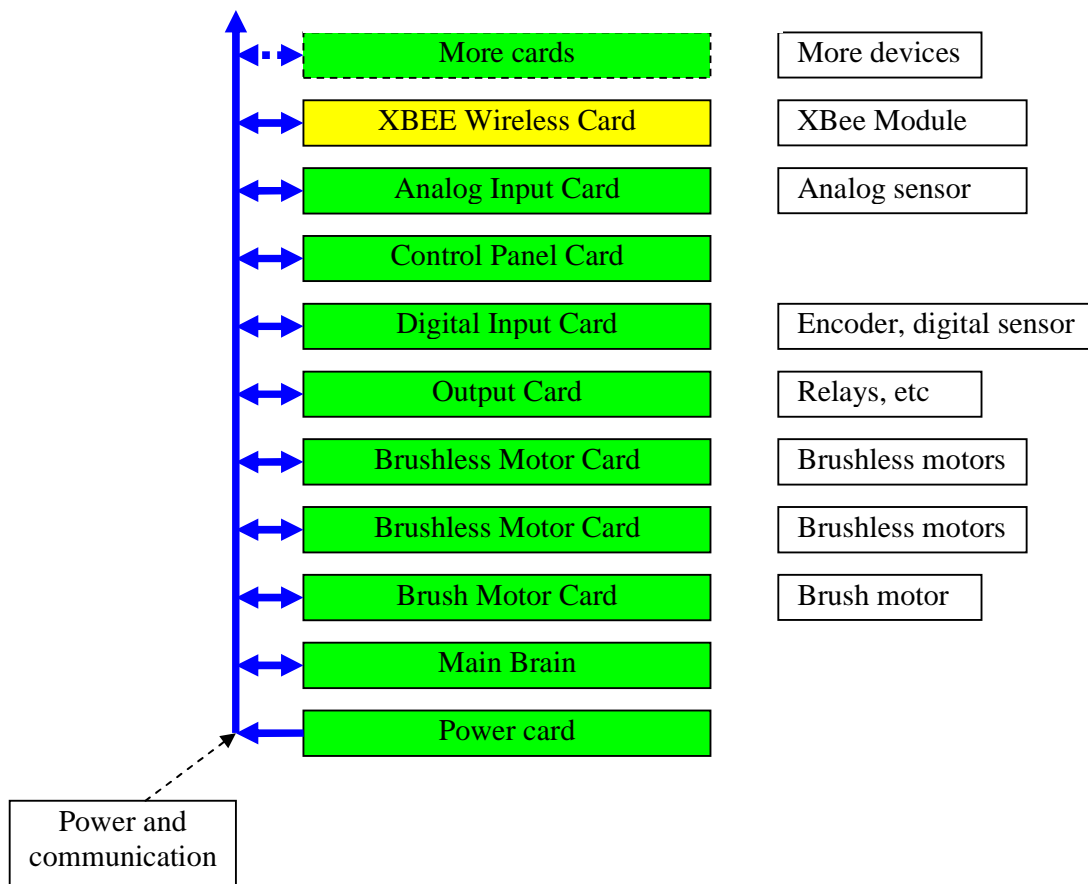
Furthermore, with functions based software library, user can save valuable time during software development by concentrating on algorithm development. No more flipping or scrolling PIC data sheet looking for ADCON0, T1CON or even TRISA. With just a programming hand book, user may simply copy the header 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, power card, analog input card and PS Controller card. This document will focus on XBEE Wireless card, IFC-XB01. 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 LEDs.
- 6 set of 1x3 headers to select communication address.
- **XBee** module onboard.
- **Indicator LEDs** for transmit and receive.
- **Test button** to test the communication between Xbee module and PIC.
- Dimension 11.1cm x 6.9cm
- Come with sample code and template to start.

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
XBEE Wireless Card	XBee Module
Analog Input Card	Analog sensor
Control Panel Card	
Digital Input Card	Encoder, digital sensor
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-XB01.

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.
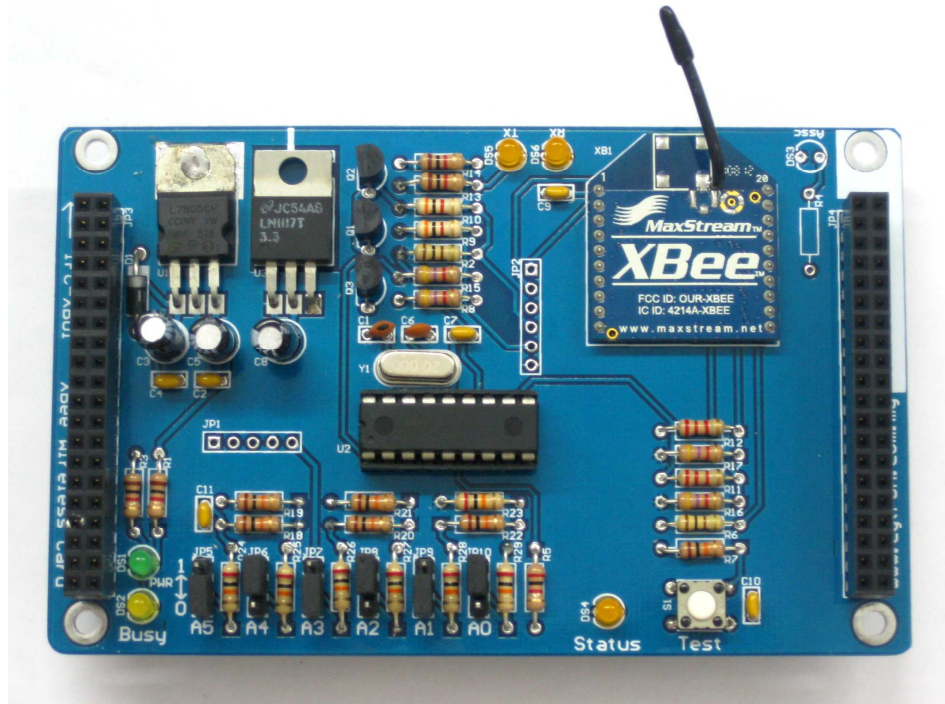
1. 1 x IFC XBEE Wireless card IFC-XB01 with:

   - 6 x mini jumper.
   - Industrial grade PCB with every component is soldered properly.

3. PRODUCT SPECIFICATION

3.1 Communication Address

There are 64 (2^6) communication address of IFC-XB01 that can be selected. The 6 bits communication address is determine by selector A5 through A0 (6 set of 1x3 headers on IFC-XB01). 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-XB01. IFC-XB01 is one of the slave cards of IFC system and user don't have to program this card. The slave program is preloaded with firmware 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 or indicators on IFC-XB01 are as below:
- Power and busy LED.
    - Power LED (PWR) will turn ON when power supplied to IFC-XB01.
    - Busy LED (Busy) will turn ON or blinking when IFC-XB01 is communicating with master card, IFC-MB00.

- 3 status indicator LED:
    - 2 x status indicator LEDs indicate the data transfer i.e. transmit and receive between microcontroller and Xbee module.
    - 1 x test status indicator LED. This status LED will turn ON when for a while if test button is pressed to show microcontroller and XBEE module connection is successful.

The input device on IFC-XB01 is as below:
- 1 push button to test connection between microcontroller and XBEE module. Microcontroller will send a test signal to Xbee module and Xbee will response if the connection is fine. At the same time Xbee module will send out a wireless message of "IFC-XB01 Cytron Technologies". User is able to receive this message and verify the functionality of on board Xbee module if user have SKXbee and XCTU software.

3.4 Operating Voltage

The operation voltage of IFC-XB01 is 12V. User needs to stack a Power Card, IFC-PC00, and connect a 12V battery on Power Card to supply 12V to the XBEE Wireless Card. However, Xbee module is operating with 3.3V. LM1117 on board is used to provide regulated 3.3V for XBEE module. Please refer hardware setup in chapter 5.0 Installation (hardware) for connecting power to XBEE Wireless Card.

Absolute Maximum Rating

Symbol	Parameter	Min	Max	Unit
V_{CC}	Operating voltage	-	12	V
V_{Xbee}	Operating voltage for XBEE Module	-	3.3	V

4. BOARD OR PRODUCT LAYOUT
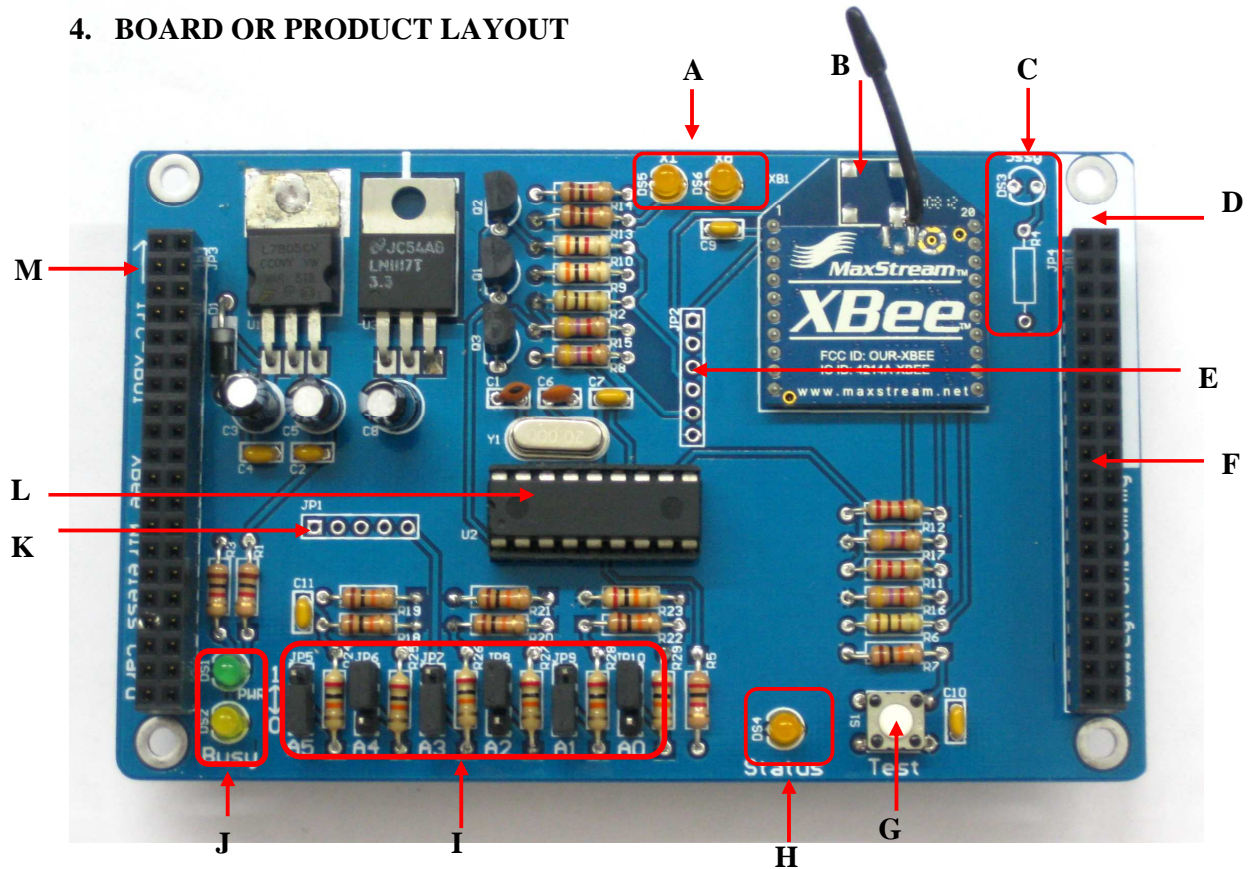
Label	Function	Label	Function
A	Transmit-Receive Status LED	H	Test Status LED
B	XbeeModule	I	Communication address selectors
C	Reserved	J	Status indicator LED (power & busy LEDs)
D	Orientation marking	K	Manufacturing test point
E	Manufacturing test point	L	18 pin PIC Microcontroller
F	Side Connector	M	Arrow (orientation mark)
G	Test button		

A – 2 x Status Indicator LED for transmit and receive data indication.

B – Xbee Module

C – This is reserved for future development.

D – The orientation marking on IFC-XB01. Every IFC card have this orientation marking, this is to help user in ensuring the cards are stack correctly.

E – Manufacturing test and maintenance point. Please DO NOT short or connect wires to these points.

F – Side connector for stacking cards and communication between cards.

G – Test button to check connection between microcontroller and Xbee Module.

H – Status Indicator LED for test button. This LED will turn on for a while and off if microcontroller and Xbee module's connectivity is fine.

I – 6 sets of 1x3 headers use as communication address selector on IFC-XB01. User can set the card address by using the mini jumper.

J – 2 status indicator LEDs to indicate status for power ON (PWR) and busy communication 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 in communicating with master card, IFC-MB00.

K – Reserved as Manufacturing Test point. Please DO NOT short or connect wire to these points.

L – 18 pin PIC microcontroller which used as controller for this slave card.

M – An arrow mark to help user to ensure the cards are stacked correctly. Every IFC cards will have this arrow mark; user needs to make sure that the arrows point to the same direction when IFC cards are stacked together.

5. INSTALLATION (HARDWARE)

For hardware installation of IFC-XB01, 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.

User can refer to the following figures to stack IFC-XB01 on IFC system.
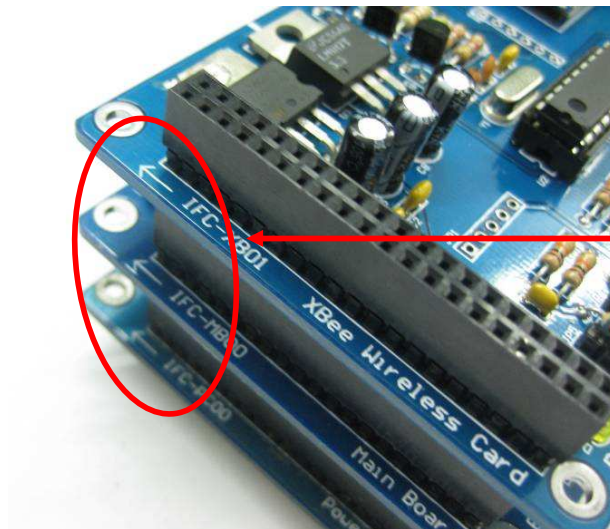

Ensure the arrow points to the same direction.
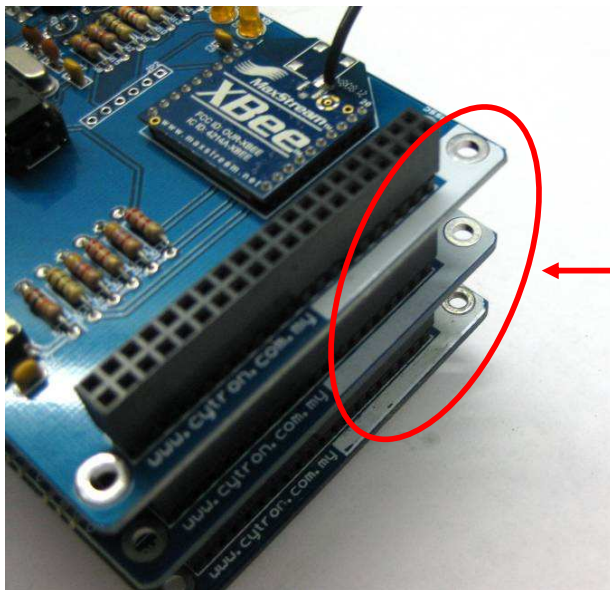
Ensure the orientation marking at the same side.

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 stacking every cards in correct orientation, user is required to make sure 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 which need to be avoided.
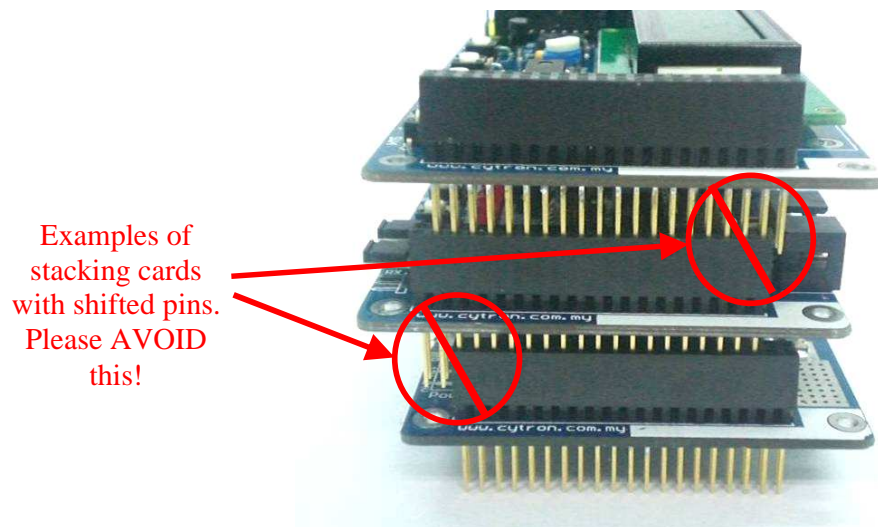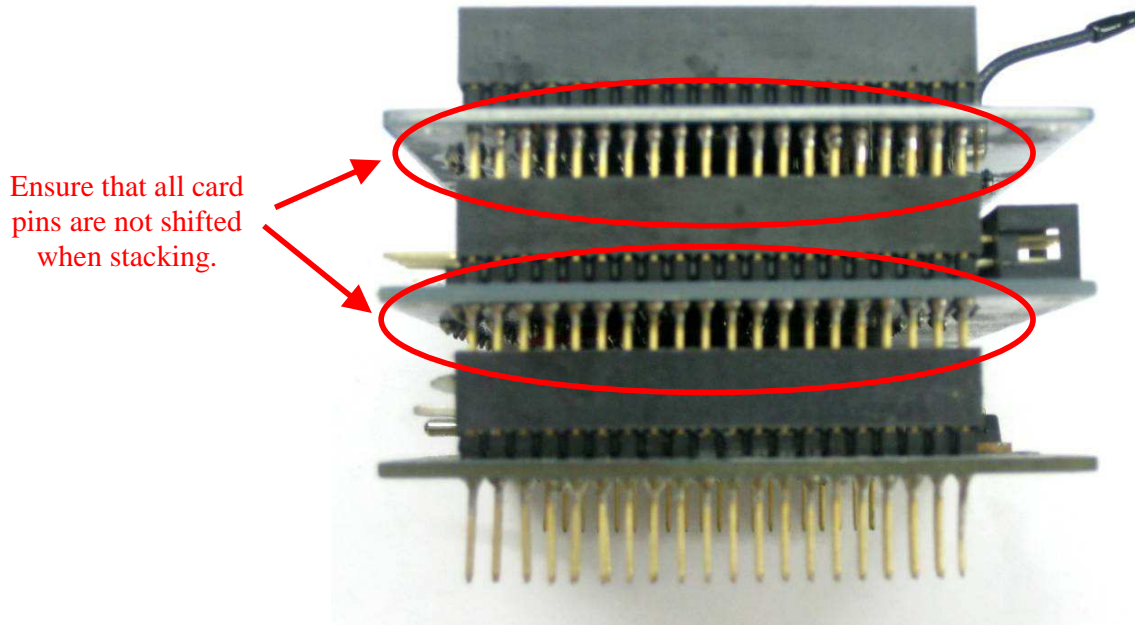
Ensure that all card pins are not shifted when stacking.

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

Ensure that all card pins are not shifted when stacking.
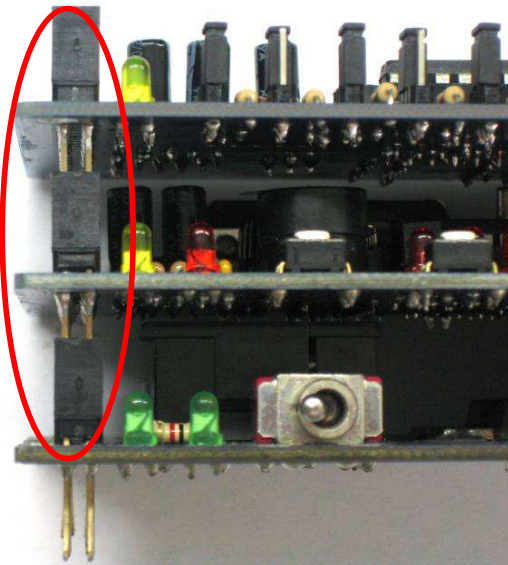
Examples of stacking cards with shifted pins. Please AVOID this!
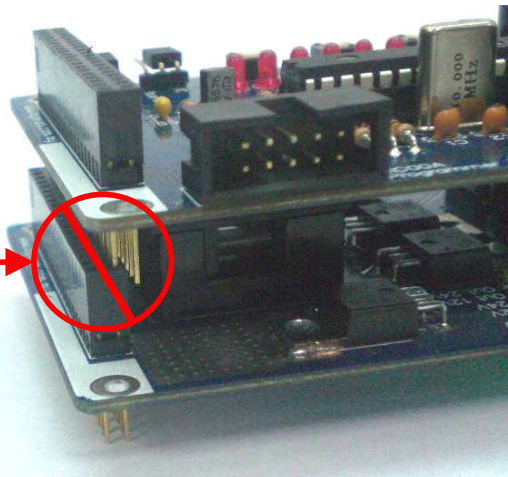
Cautions: Please ensure that all card pins are not shifted when stacking. IFC system will NOT function if the pins are shifted.

2nd step is to configure the card address. User will need to use the mini jumpers provided with IFC-XB01 to select the communication address of IFC-XB01. For example, figure below shows the communication address, 010101 selected. Please make sure the address selected is compatible (same) with the program. Please refer chapter 7 for details of writing program for IFC-XB01. Each slave card must have unique address.
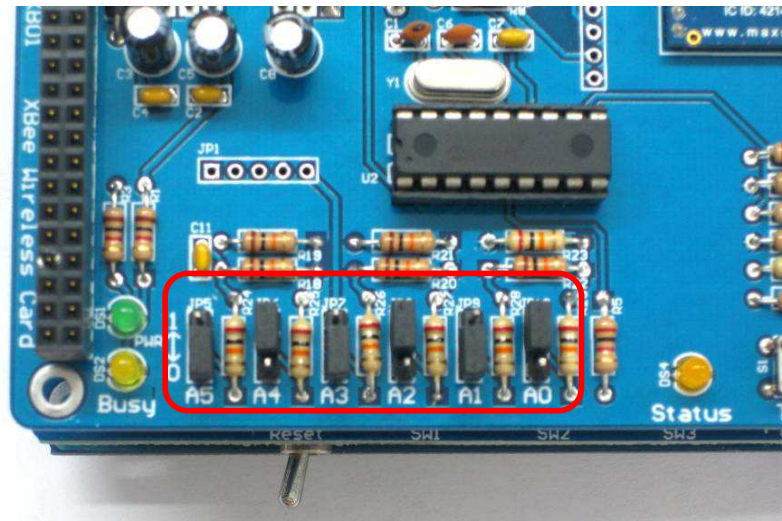
Connect the battery or power source to Power card as shown; please ensure the **polarity is correct**. (wrong polarity might cause damage to IFC cards)

Connect 1 x 12V battery to supply operating voltage to IFC**. Ensure the polarity is correct**.
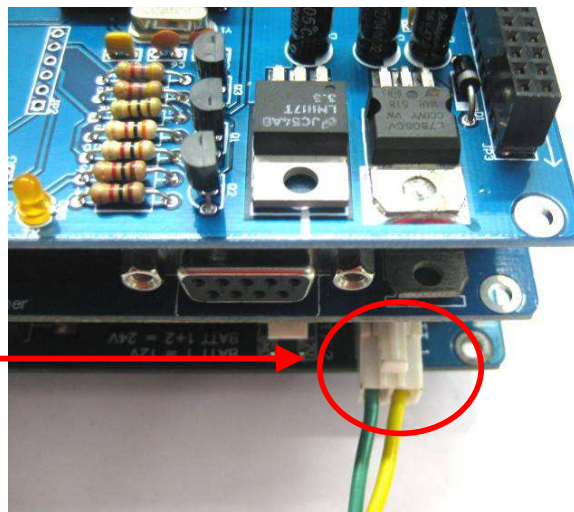
Next, please turn ON the switch on Power Card; the PWR LED of IFC-XB01 will turn ON as shown in following figure. Initially, if there are no functions related to IFC-XB01 being called in Main Board's program, the busy LED will not ON or blink.
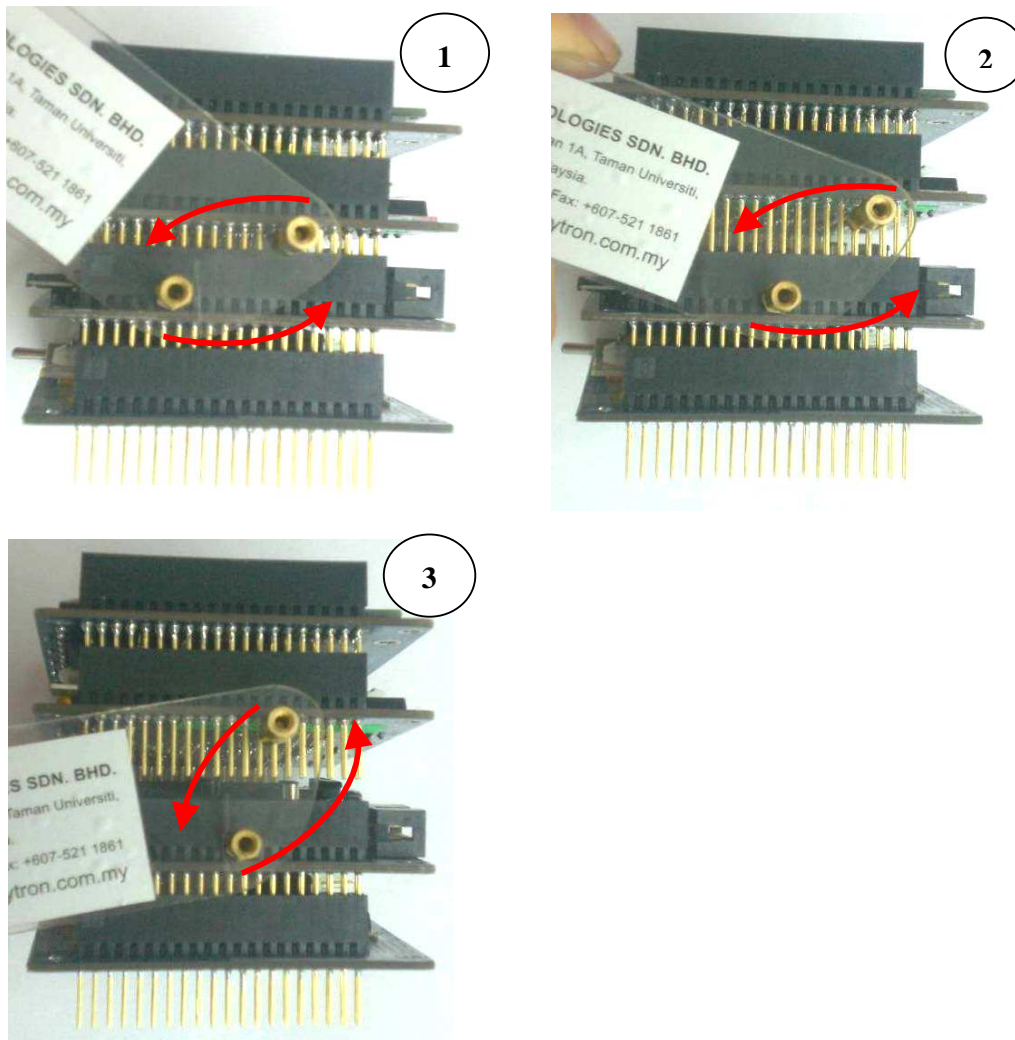
PWR LED on
IFC –XB01

PWR LED on
IFC - MB00

12V LED on
IFC - PC00
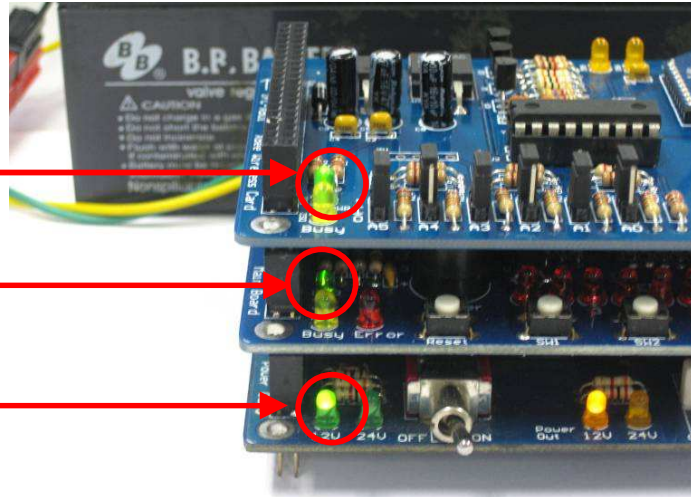
To open the IFC cards, user should use the IFC card's opener. Following figures show the method to open cards with the opener.

Caution: Please use the opener to open IFC cards to avoid damage of the pins or cards.
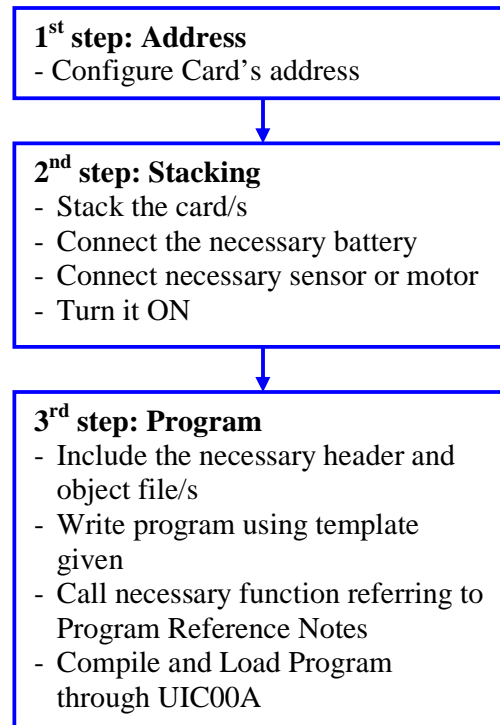
6. INSTALLATION (SOFTWARE)

User only needs to write program for IFC-MB00 in order to send data and communicate with IFC-XB01. A program editor, C compiler and UIC00A software are required to be installed in order for user to write program, compile it and further load the program into 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 free to be downloaded. 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 system is being designed with the aim of 3 simple steps in using 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 the system to function. This section will show the example to operate it with XBEE Wireless Card, IFC-XB01.

<div style="border:1px solid blue">

1st step: Address
- Configure Card's address

</div>

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

A basic setup for IFC-XB01 will be illustrated in this chapter. Please ensure the power is **OFF** before inserting or removing IFC card. The example includes 4 cards, IFC-PC00, IFC-MB00, IFC-XB01 and one extra card which is IFC-CP04. Please refer following section of this chapter for setup details.

7.1 Basic Setup with Control Panel (IFC-PC00 + IFC-MB00 + 2xIFC-XB01)

This is the basic and minimum setup for IFC-XB01. This basic setup required 2 x IFC-XB01, one as transmitter and one as receiver. Following steps show the installation of this system and method to operate it.

    a. 1st step, configure the address of card. XBEE Wireless Card has 6 mini jumpers to configure communication address (A5-A0). XBEE Wireless Card 1 and XBEE Wireless Card 2 with different address. The addresses should be set to 000001 for XBEE Wireless Card 1 and 000010 for XBEE Wireless Card 2 if sample source code is being used.

    b. 2nd step is to stack all 4 cards together. Power card (IFC-PC00) should be at the bottom, while Main board (IFC-MB00) at 2nd layer and XBEE Wireless Card (IFC-XB01) at top layer as shown in following figure.
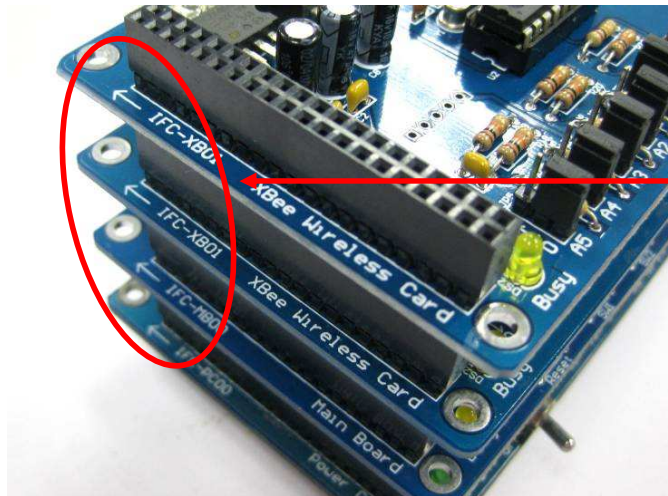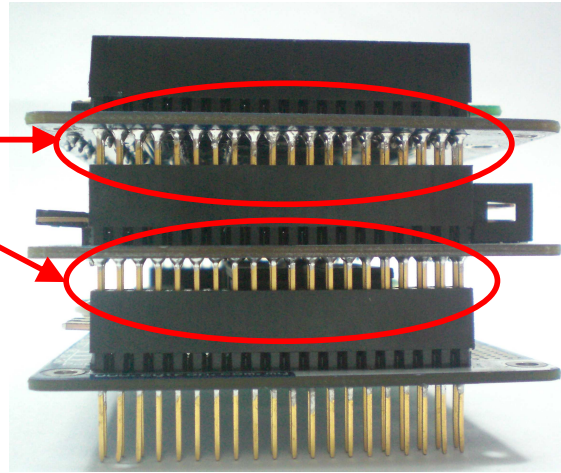

Ensure the arrow points to the same direction.
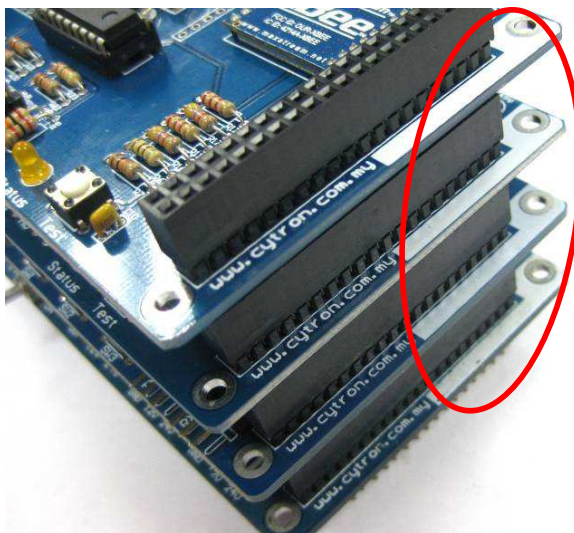
Ensure the orientation marking at the same side.

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

Ensure that all the pins when stacking are not shifted and inserted to correct location.

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**.
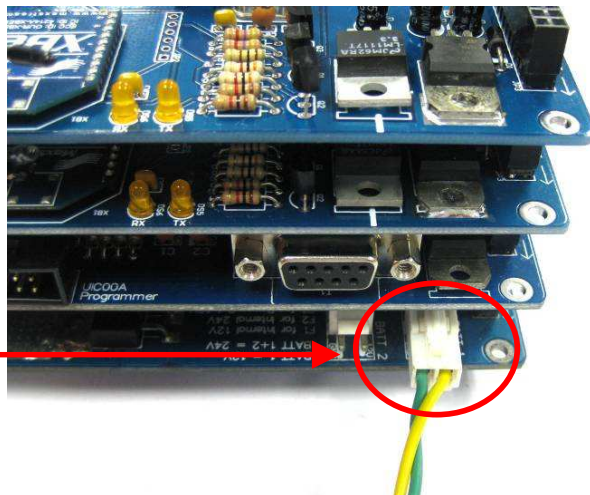
e. Turn ON the IFC power by pushing the toggle switch to "ON". There should be at least 3 LED (12V LED on Power Card, PWR LED on Main Brain, and PWR LED on XBEE Wireless card) light up as show.
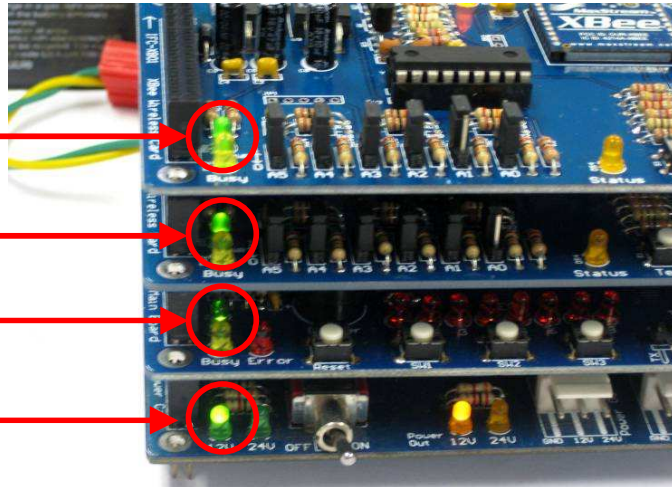
PWR LED on
IFC –XB01 (2)

PWR LED on
IFC –XB01 (1)

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 can follow the step in chapter 6.2 of user's manual for IFC-MB00 to open project named "IFC_XB01" for IFC XBEE Wireless. Please note that the header file (iic.h and iic_xb.h) and object file (iic.o and iic_xb.o) for IFC-MB00 and IFC-XB01 have to be included in the project. If user did not use the provided sample source code, "Sample1_XB.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.
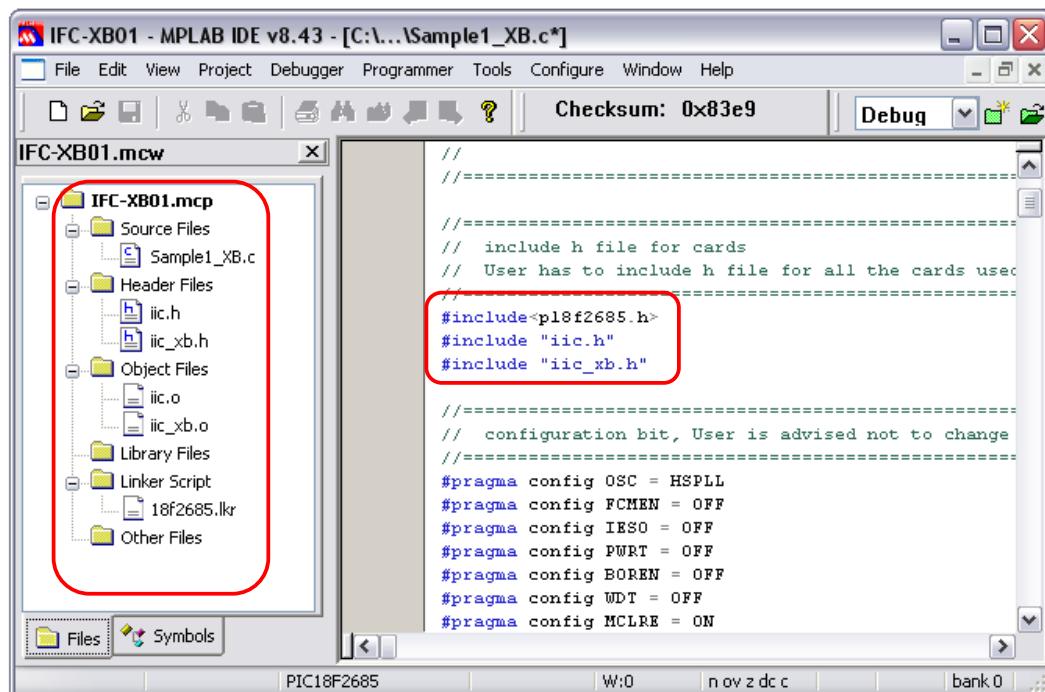
h. For those wanted to understand the program, please refer to c file named "Sample1_XB.c" which is provided with this card.

i. Compile this project to generate hex file. Connect UIC00A IDC connector to IFC-MB00 as show. The hex file generated is named "IFC_XB01.hex".

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.

Connector from
UIC00A programmer
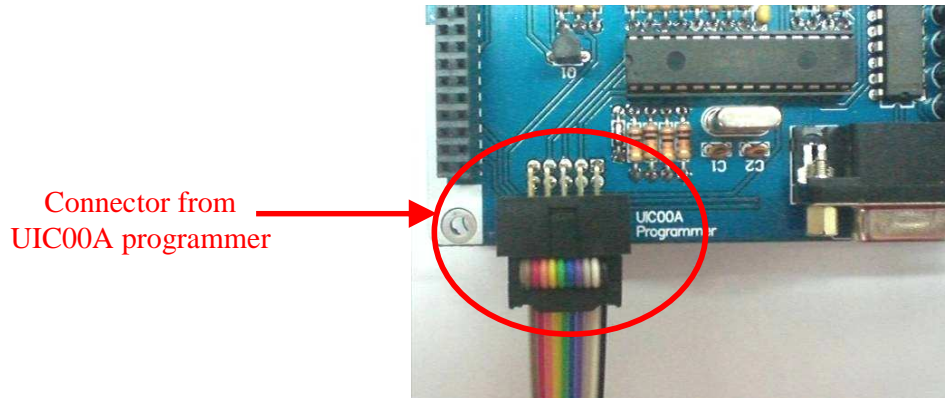
k. There are also 3 modes for user to select in program "Sample1_XB.c". User can select mode by pressing push button on IFC-MB00. Each time after selecting the mode, user needs to press reset to exit if other mode is require to be tested. The modes are:

Mode	Push Button	Function
1	SW1	Press SW1 for Unicast address setting
2	SW2	Press SW2 for Broadcast address setting
3	SW3	Sent out data. LED on IFC-MB00 will turn ON if data received is correct.

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 + 2 x IFC-XB01 + 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-XB01 and IFC-CP04. XBEE Wireless Card 1 and XBEE Wireless Card 2 with different address. It should be set to 000001 for XBEE Wireless Card 1 and 000010 for XBEE Wireless Card 2 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, XBEE Wireless Card (IFC-XB01) at 3rd layer and Control Panel at the top layer as shown in following figure.
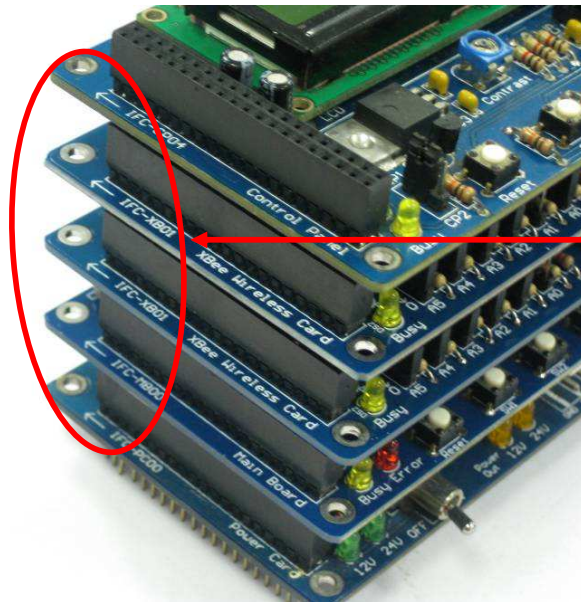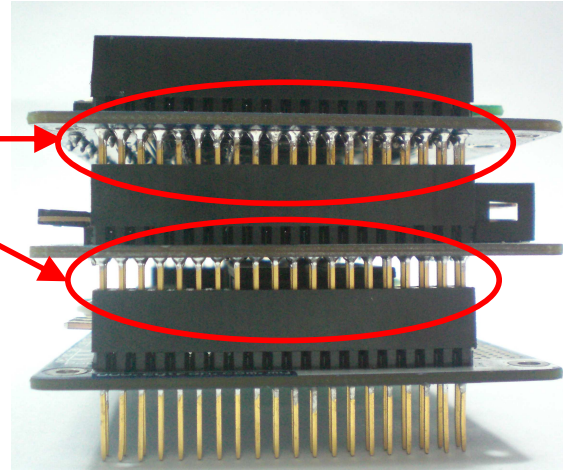

Ensure the arrow points to the same direction
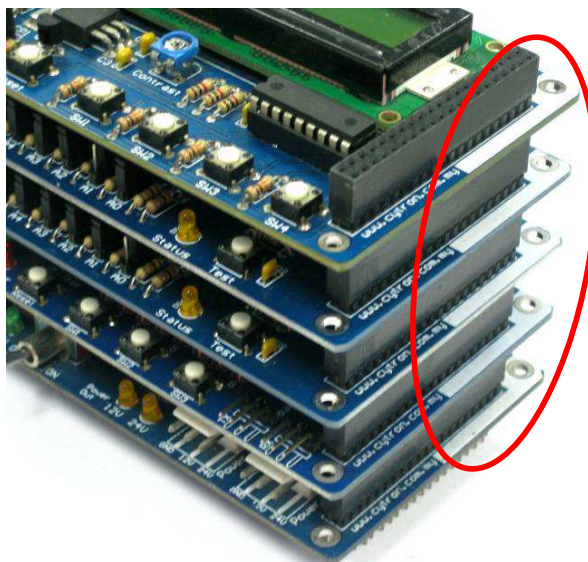
Ensure the orientation marking is at the same side

c. Besides 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 battery or power source 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**.
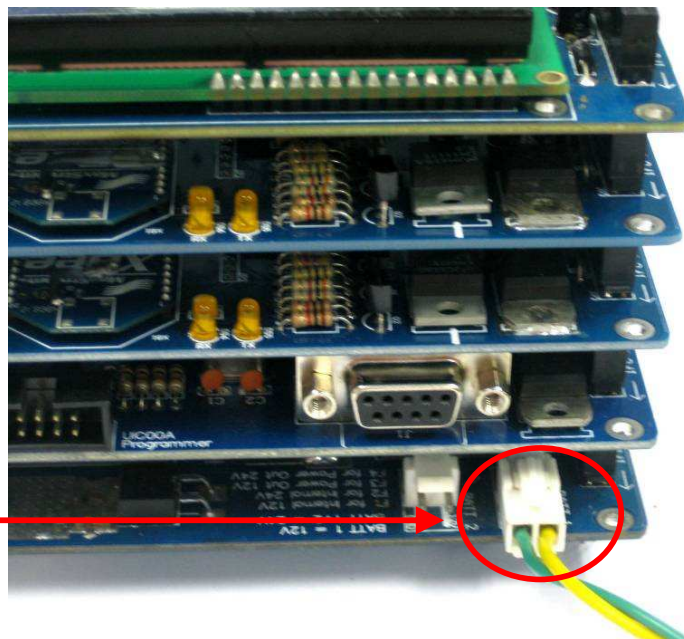
e. Turn ON the IFC power by pushing the toggle switch to "ON". There should be at least 4 LED (12V LED on Power Card, PWR LED on Main Brain, PWR LED on XBEE Wireless Card and PWR LED on Control Panel) light up as show.
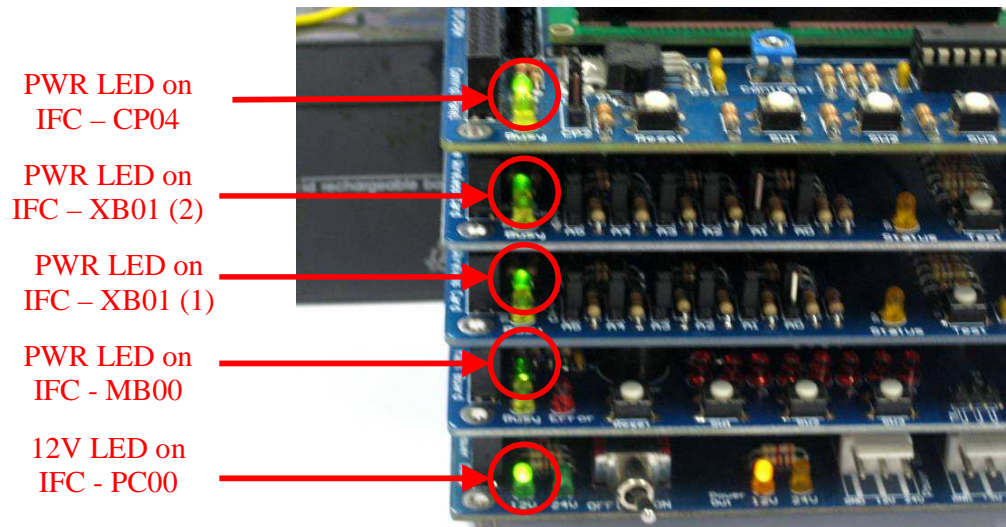

f. 3rd step is to write program and load it. IFC comes with comprehensive function to save program development time. Functions library will come with the interfacing card in the form of header file (*.h) and object file (*.o). In order to call these functions, particular header file and object file must be included under a project.

g. Open MPLAB IDE (please ensure MPLAB C18 is being installed). User can follow the step in chapter 6.3 of user's manual for IFC-MB00 to open project named "IFC_XB01" for IFC XBEE Wireless Card. Please note that the header file (iic.h, iic_xb.h and iic_cp.h) and object file (iic.o, iic_xb.o and iic_cp.o) for IFC-MB00, IFC-XB01 and IFC-CP04 have to be included in the project. If user did not use the provided sample source code, "Sample2_XB.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.
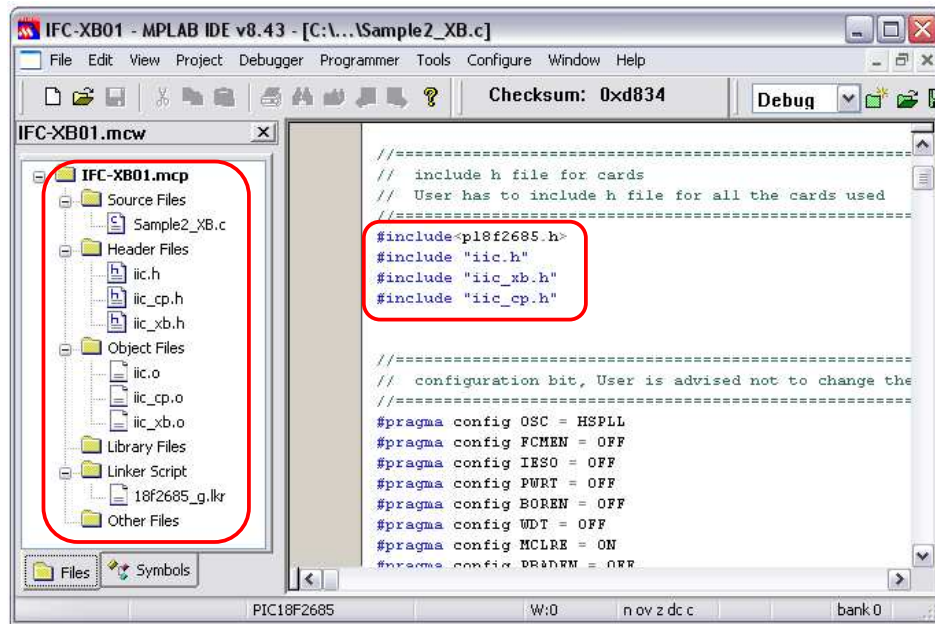
h. For those wanted to understand the program, please refer to c file named "Sample2_XB.c" which can be downloaded in the product page of this card in Cytron website: www.cytron.com.my.

i. Compile this project to generate hex file. Connect UIC00A IDC connector to IFC-MB00 as show. The hex file generated is named "IFC_XB01.hex".

j. Load the hex file generated to UIC00A using PICkit2 window (refer to UIC00A User's Manual for details).

Connector from
UIC00A programmer
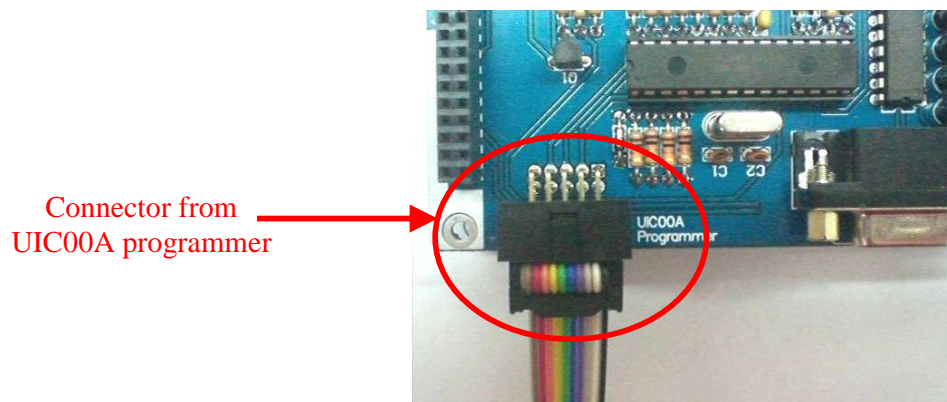
k. There are 3 modes for user to select in program "Sample2_XB". User can switch between modes by pressing SW1 on IFC-CP04. The modes are:

Mode	Push Button	Function
1	SW1	Press SW1 on IFC-CP04 for Broadcast address setting. LED2 will turn ON.
2	SW2	Press SW1 on IFC-CP04 for Broadcast address setting. LED2 will turn ON.
3	SW3	Press SW3 to send out data "IFC-XB01" and display received data on LCD. LED3 will turn ON.
4	SW4	Press SW4 to send out data "12345678" and display received data on LCD.

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.

Note1: User may refer to IFC-XB01 Card Technical Info for the program function list. It will help user in writing program for IFC-XB01.

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 (C file). Please refer sample source code for the example to include card h file.

Note3: Test button can only be used before user calls any function from main board.

Note4: IFC-Xb01 card will initialize for a few seconds on every power up. During initialization period, please make sure there is no continuous wireless signal which might cause the initialization of the IFC-XB01 card to fail. The transmitter should only send data after the receiver initialization is completed.

Note5: User is advised to do extra filtering of noise and also feedback in software for the data transmission and reception. 8 bytes of data is sent out on every transmission packets. User can utilized some bytes to do the filtering, and remaining bytes as the actual data.

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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