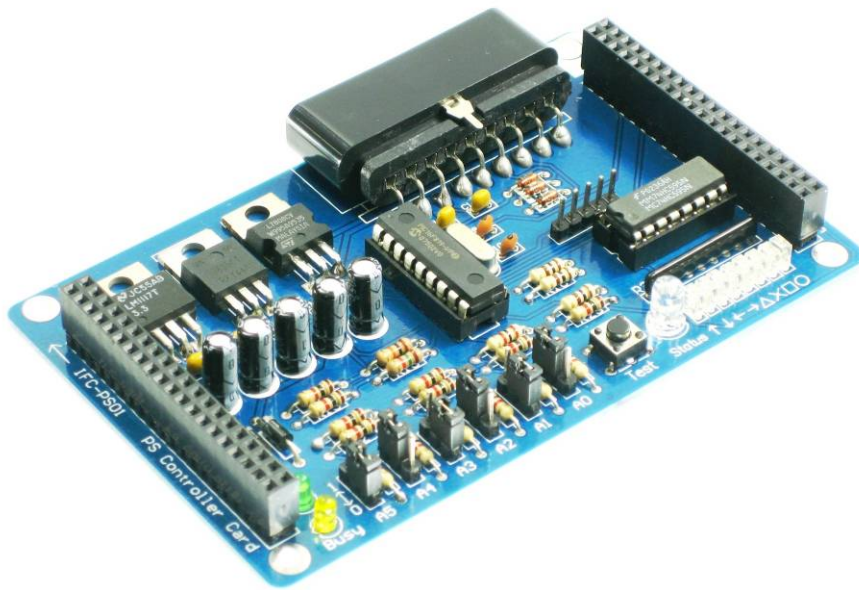




# **IFC-PS01**

## **Interface Free Controller**

## **PS Controller Card**



## **User's Manual**

**V1.0**

**Oct 2008**

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## 1. INTRODUCTION AND OVERVIEW

### 1.0 Introduction of Interface Free Controller

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

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

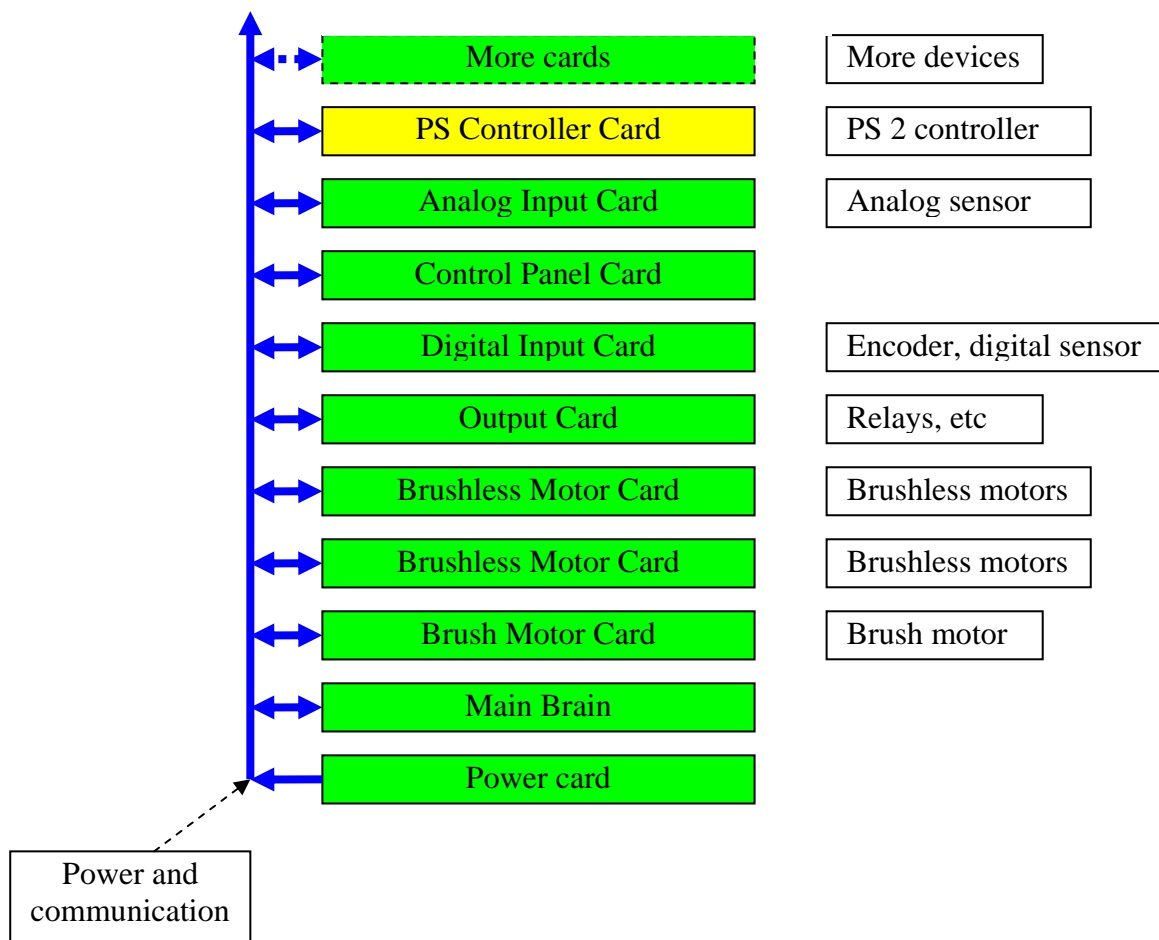
IFC come with a brain card (main controller) where the main program is loaded. There are several cards available for robotics development such as control panel, 15A brush motor driver, brushless motor controller, counter and digital input, output card, power card, analog input card and PS Controller card. This document will focus on PS Controller card, IFC-PS01. 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.
- 6 set of 1x3 headers to select communication address.
- 1 standard PS2 Controller adapter on each card.
- Software readable of each button on PS2 Controller.
- Single push button to test communication with PS2 Controller.
- Vibrator motor is controllable.
- Locked in analog mode for Joy-Stick.
- Fully compatible with wired or wireless PS2 Controller.
- **Dimension** 11.1cm x 6.9cm
- Come with sample code and template to start.

**Note:** IFC-PS01 does not come with PS2 controller, please purchase separately from Cytron Technologies website. It is advised to use PS2 controller from Cytron Technologies because all PS2 controller provided is tested before it is being shipped to costumer.

## 1.1 System Overview

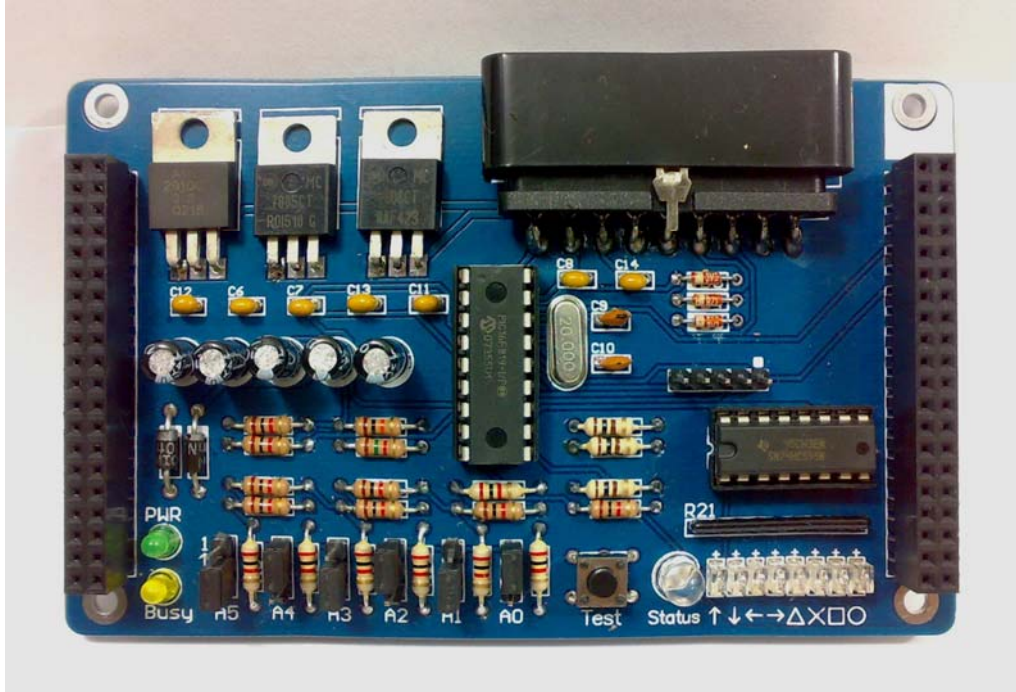
With serial communication perception, IFC offer million of possibilities to develop embedded system creatively and easily. In IFC, several cards are stacked to get a complete embedded system. The minimum card requires is Power card and Main Board.



This document explains the method to use IFC-PS01.

## 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](mailto:sales@cytron.com.my) immediately.



1. 1 x IFC PS Controller card IFC-PS01 with:

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

**Note:** IFC-PS01 does not come with PS2 controller, please purchase separately from Cytron Technologies website. It is advised to use PS2 controller from Cytron Technologies because all PS2 controller provided is tested before it is being shipped to customer.

### 3. PRODUCT SPECIFICATION

#### 3.1 Communication Address

There are 64 ( $2^6$ ) communication address of IFC-PS01 that can be selected. The 6 bits communication address is determined by selector A5 through A0 (6 set of 1x3 headers on IFC-PS01). 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-PS01. IFC-PS01 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 on PS01 are as below:

- 2 status indicator LED: Power and busy LED.
  - Power LED (PWR) will turn ON when power supplied to PS01.
  - Busy LED (Busy) will turn ON or blinking when PS01 is communicating with master card, IFC-MB00.
- 8 status indicator LED:
  - This status indicator LED is for 8 buttons on PS2 controller. The LED will turn ON when the buttons on PS2 controller is pressed. The 8 buttons on PS2 controller that has status indicator LED are circle, triangle, square, cross, up, down, left and right buttons.
- 1 status indicator LED: Blue LED
  - This LED blink when PS2 controller is not detected, ON with 50% of brightness when PS2 controller is detected, and ON with 100% of brightness when a button is pressed on the PS2 controller.

The input devices on PS01 are as below:

- 1 push button to test PS2 controller vibration.

#### 3.4 Operating Voltage

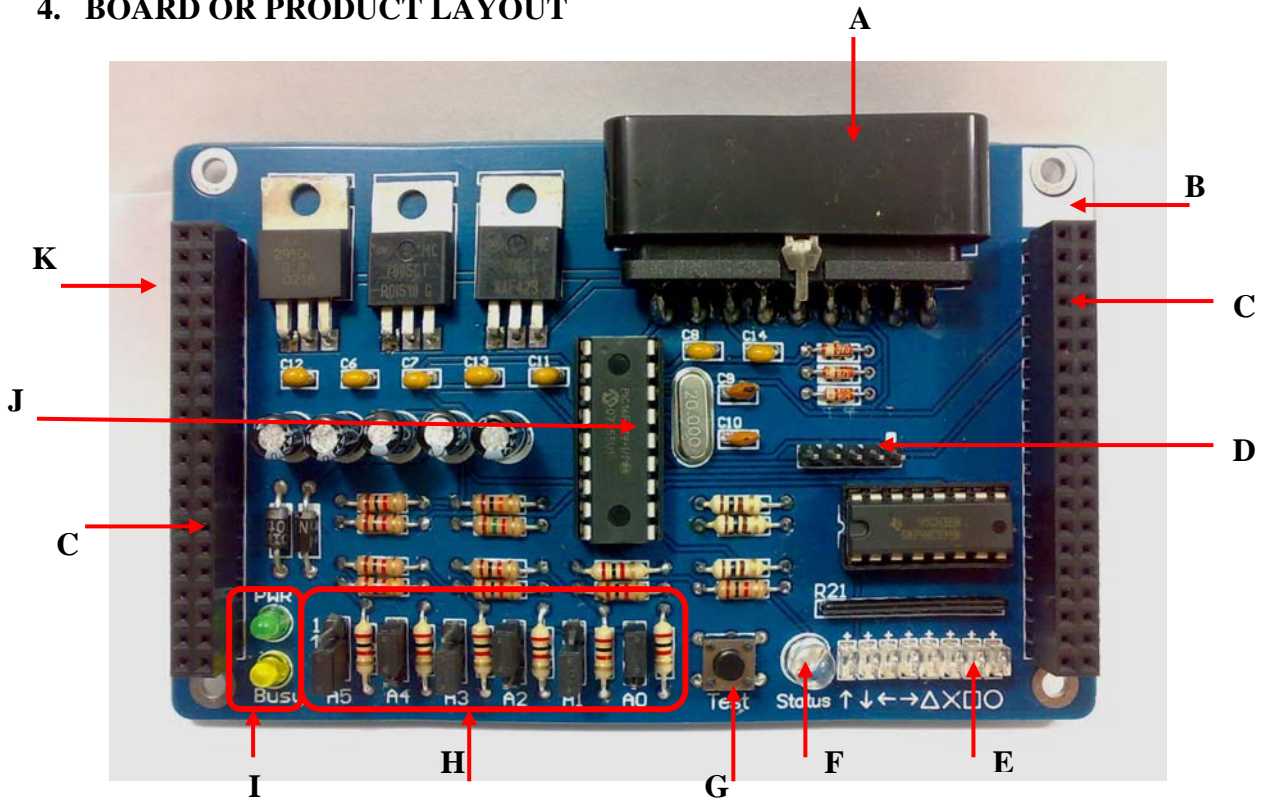
The operation voltage of IFC-PS01 is 12V. User needs to stack a Power Card, IFC-PC00, and connect a 12V battery on Power Card to supply 12V to the PS Controller Card. Please refer hardware setup in chapter 5.0 Installation (hardware) for connecting power to PS Controller Card.

Absolute Maximum Rating

Symbol	Parameter	Min	Max	Unit
V <sub>CC</sub>	Operating voltage	-	12	V



#### 4. BOARD OR PRODUCT LAYOUT



Label	Function	Label	Function
A	PS2 controller adapter	G	Test button
B	Orientation marking	H	Communication address selectors
C	Side Connector	I	Status indicator LED
D	Manufacturing test point	J	28 pin PIC Microcontroller
E	Digital input status indicator LED	K	Arrow
F	Status LED		

**A** – PS2 controller adaptor. User can simply connect wired or wireless PS2 controller to this adaptor.

**B** – The orientation marking on IFC-PS01. Every IFC card have this orientation marking, this is to help user in ensuring the cards are stack correctly.

**C** – Side connector for stack card and communication between cards.

**D** – Reserved for Manufacturing Test Point. Please DO NOT short or connect wire to any of these pins.

**E** - 8 indicators LED for the PS2 controller button. The 8 buttons on PS2 Controller that has indicator LED are circle, triangle, square, cross, up, down, left and right buttons. The LED is active high and will turn ON when corresponding buttons on PS2 controller is pressed.



**F** – Communication and button press status LED for the PS2 controller. This LED will blink if PS2 Controller is not detected on the PS2 socket. It can either be the PS2 is not connected properly or the communication between PS2 and IFC-PS01 card failed. If PS2 controller is detected and communication is stable, the LED will illuminate with 50% brightness. It will light up with 100% if any button on PS2 controller is pressed.

**G** – Vibrate test button for PS2 controller. User can simply test the vibrator motors on PS2 controller by pressing this test button without any programming on MB00. This further verify the communication between IFC-PS01 with the PS2 controller attached, wired or wireless.

**H** – 6 sets of 1x3 headers use as communication address selector on IFC-PS01. User can set the card address by using the mini jumper.

**I** - 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.

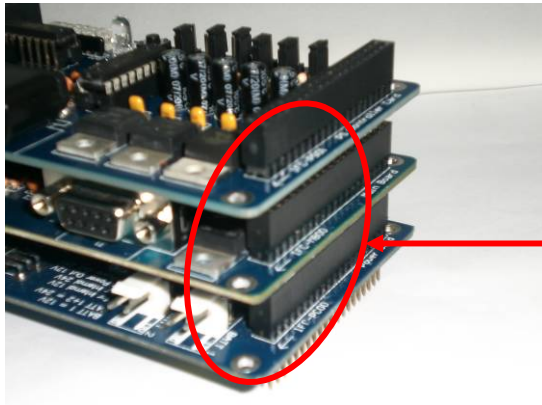
**J** – 18 pin PIC microcontroller which used as controller for this slave card.

**K** – An 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.

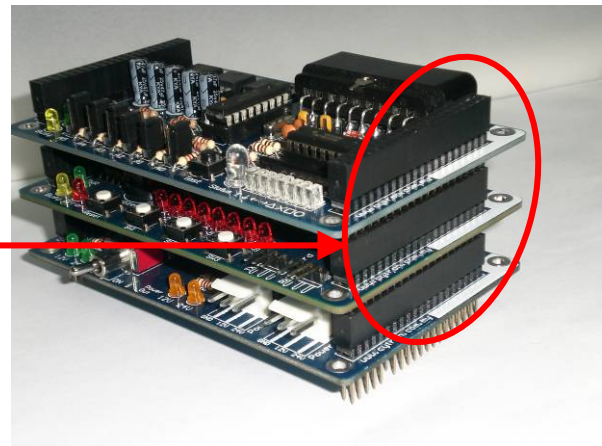
## 5. INSTALLATION (HARDWARE)

For hardware installation of IFC-PS01, 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-PS01, user can stack it on IFC system as shown in following figures.



Ensure the arrow points to the same direction.

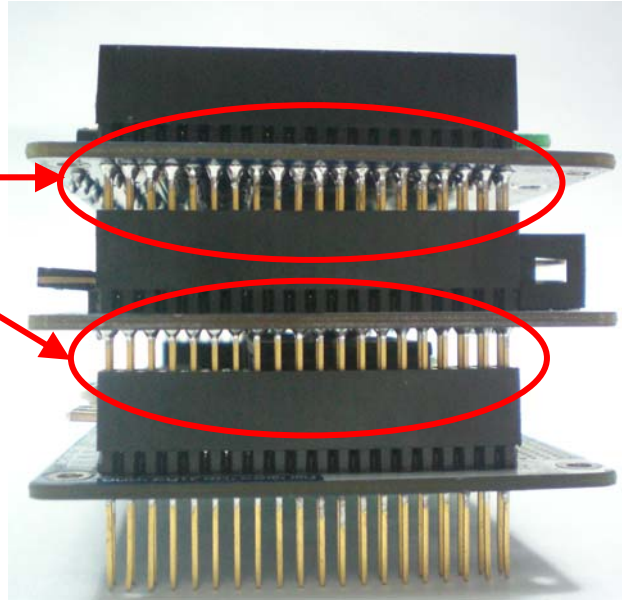


Ensure the orientation marking at the same side.

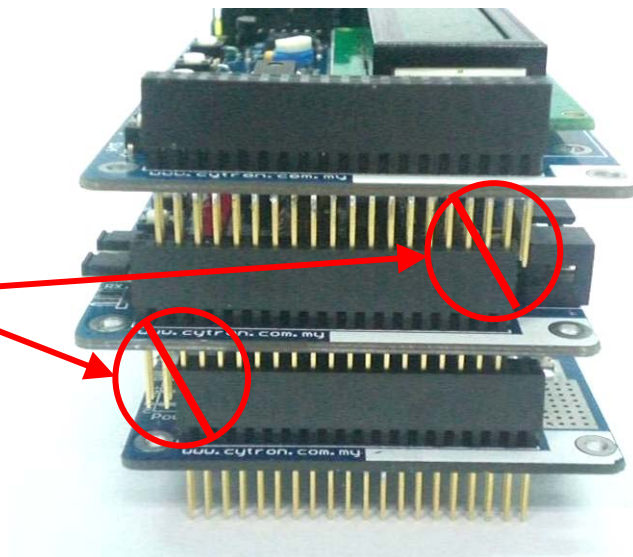
**Cautions:** Please ensure that every card is being stacked properly in correct orientation. Whole IFC system will be damaged if one of the cards is being stacked wrongly when it is powered up.

Besides 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.

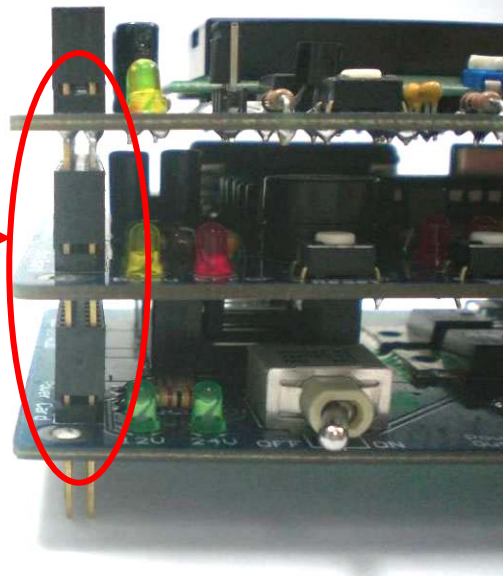
Ensure that all card pins are not shifted when stacking.



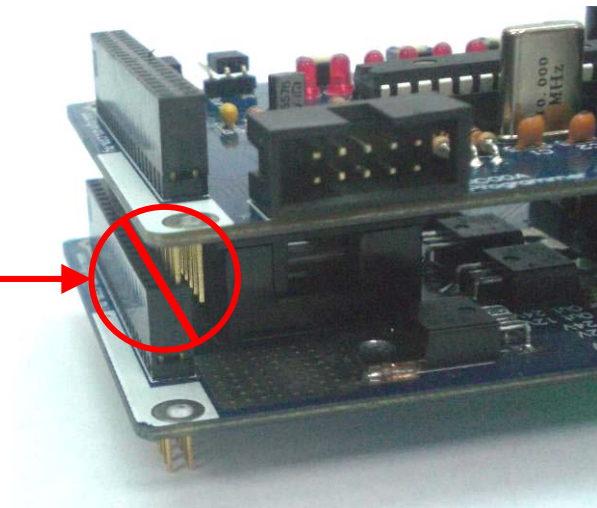
Examples of stacking cards with shifted pins. Please AVOID this!



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.

2<sup>nd</sup> step is to configure the card address. User may use the mini jumper provided on IFC-PS01 to select the communication address of IFC-PS01. 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-PS01. Each slave card must have unique address.

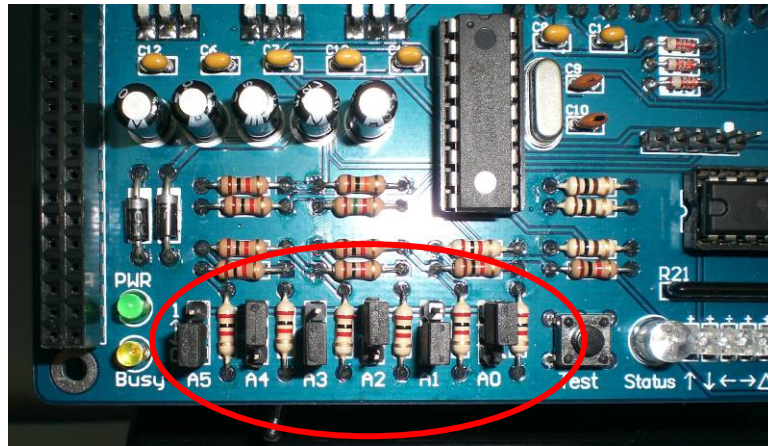


Figure below shows the method to connect PS2 controller to IFC PS controller card. User may choose either wired or wireless PS2 Controller.



**(a) Wired PS2 Controller**





**(b) Wireless PS2 Controller**

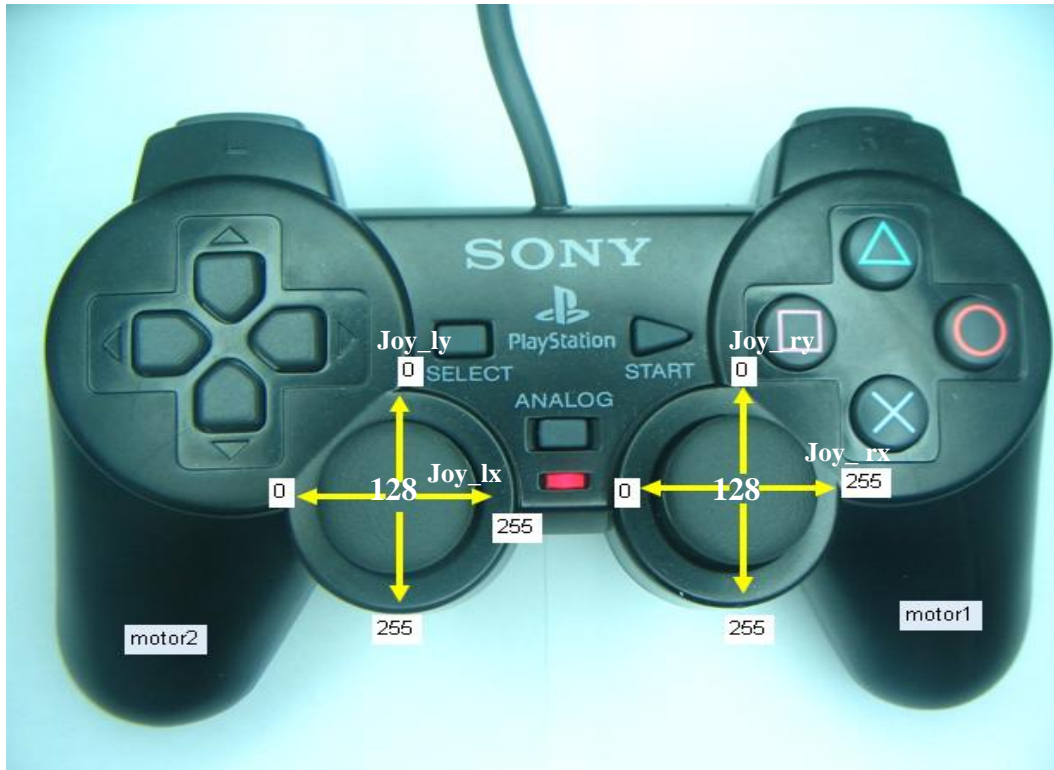
Figure (a) above shows connection of wired PS2 controller to IFC-PS01 card while figure (b) shows connection of wireless PS2 controller to IFC-PS01 card. They are many type of PS2 controller in the market; the sensitivity and compatibility for each controller are different. User is advised to use PS2 controller from Cytron Technologies. All PS2 controller provided by Cytron is being tested before being shipped to customer. Cytron Technologies does not guarantee the compatibility of other PS2 controller from other source.

Figure below shows an example of PS2 controller which can be used for IFC-PS01 card. There are 16 buttons that can be used as input button on PS2 controller.





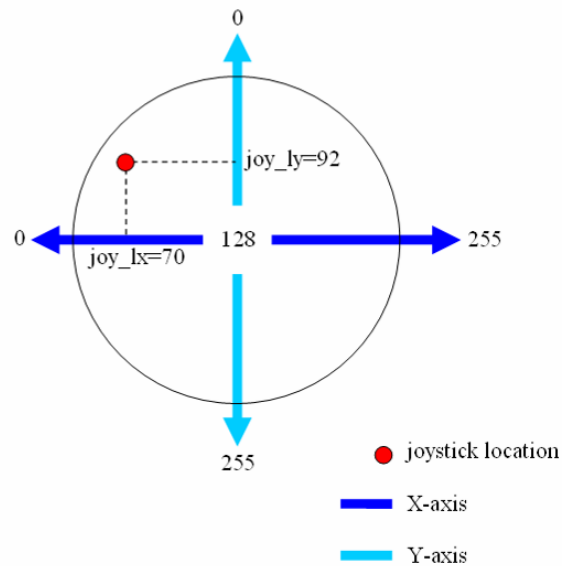
Referring to figure above, left and right joystick is used to change and further provide analog value of PS2 controller. Each analog joystick is read in axis. For IFC-PS01 card, they are 2 types of axis that can be read. User can use either type 1 or type 2. Figure below shows joystick axis, type 1 and type 2.



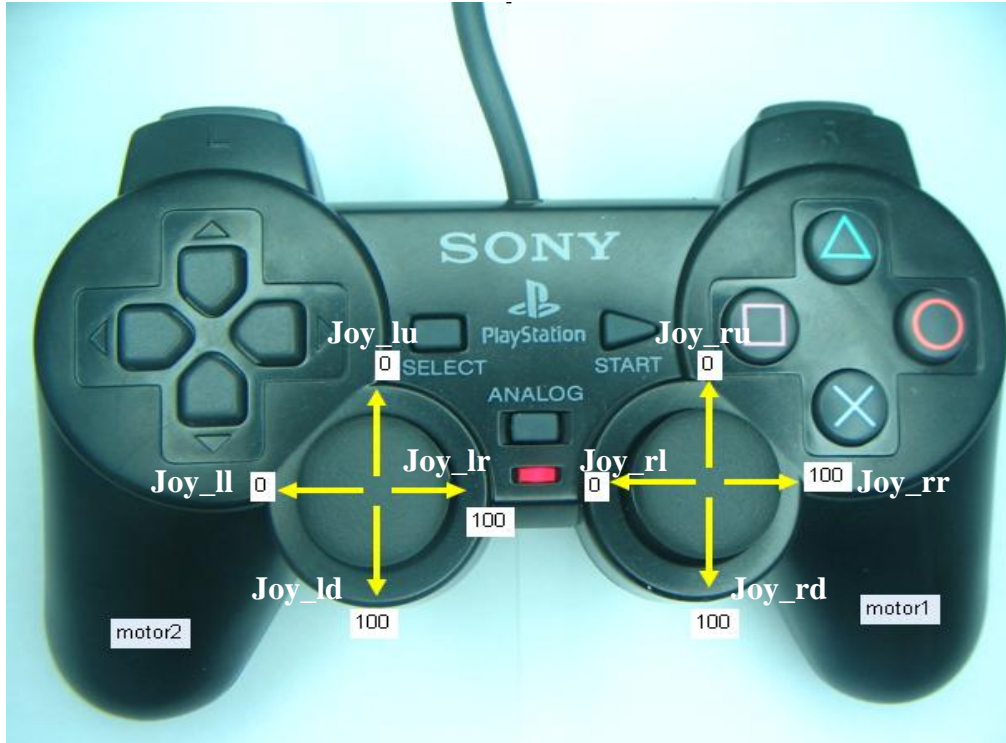
**Type 1**

User can use either type 1 or type 2 for joystick axis. For type 1, there are 2 variables for each joystick which is axis X and axis Y. For example user can move the joystick up, down for Y axis and left, right for X axis. For Y axis, when users move the joystick up, the value will change from 128 to 0; when user move the joystick down, the value will change from 128 to 255. For X axis, when users move the joystick right, the value will change from 128 to 255; when user move the joystick left, the value will change from 128 to 0. This axis is same for left joystick and right joystick on PS2 controller.

Let's take an example on left joystick. Referring to the figure below (red dot), the left joystick is moved a bit to the left and a bit to the up direction. So, the value of joy\_lx and joy\_ly will changed, as in the figure joy\_lx=70 and joy\_ly=92.

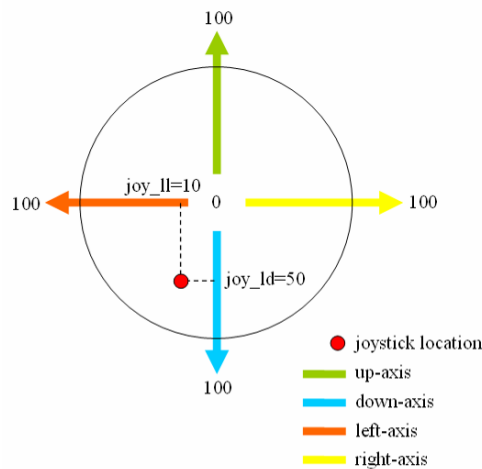


For type 2, they are 4 variables for each joystick. The 4 variables are up, down, left and right. When users move the joystick up, down, left or right the value is at range 0-100. This axis is same for left joystick and right joystick on PS2 controller.

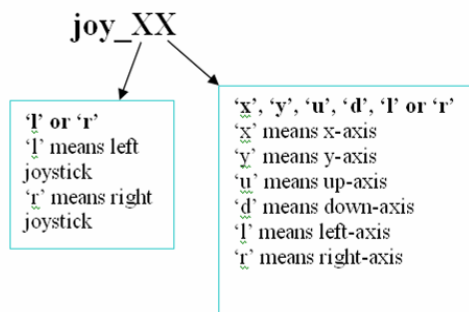


**Type 2**

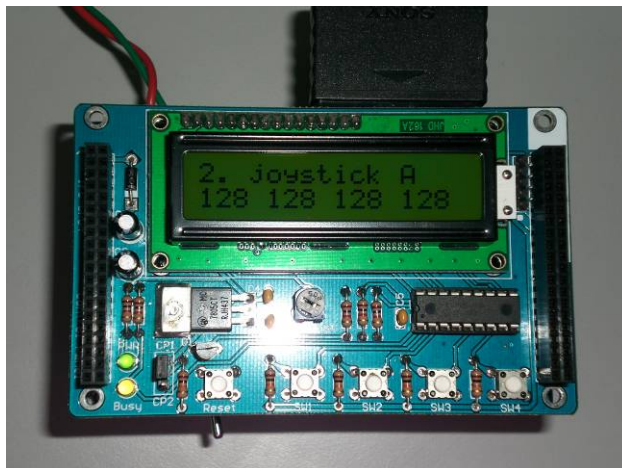
For example, when left joystick is being move 10% to left and 50% to down position, the value of joy\_ll and joy\_ld will change, as in figure below, joy\_ll=10 and joy\_ld=50. However the value of joy\_lu=0 and joy\_lr=0.



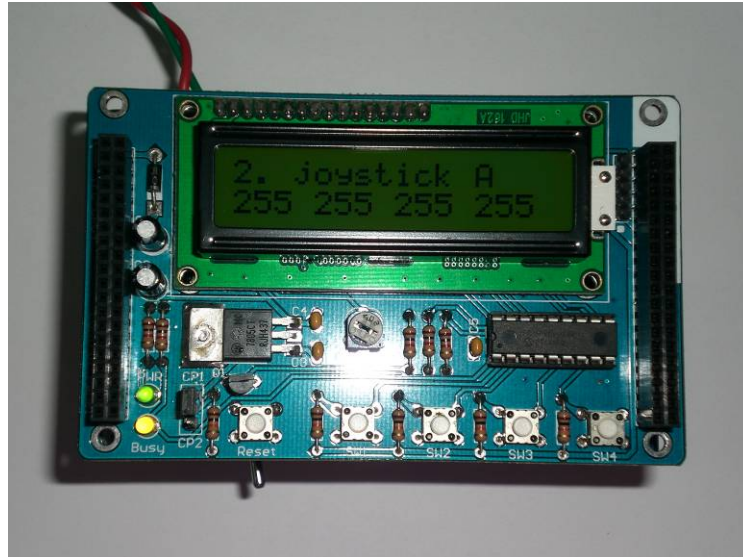
Please take note that the joy\_lx, joy\_ly, joy\_rx and joy\_ry is for type 1 axis; joy\_lu, joy\_ld, joy\_ll, joy\_lr, joy\_ru, joy\_rd, joy\_rl and joy\_rr is for type 2 axis. These variables are being named according to a standard format of:



Please take note when user unplugs the PS2 Controller and read joystick button on both axis, the value user will gets is 255. Figure below show different value return on LCD when user unplug and plug the PS2 controller.



**PS2 controller is plug**



**PS2 controller is unplug**

Next, please turn ON the power on Power Card; the PWR LED of IFC-PS01 will turn ON as shown in following figure. Initially, if there are no functions related to IFC-PS01 being called in Main Board's program, the busy LED will not ON or blink.

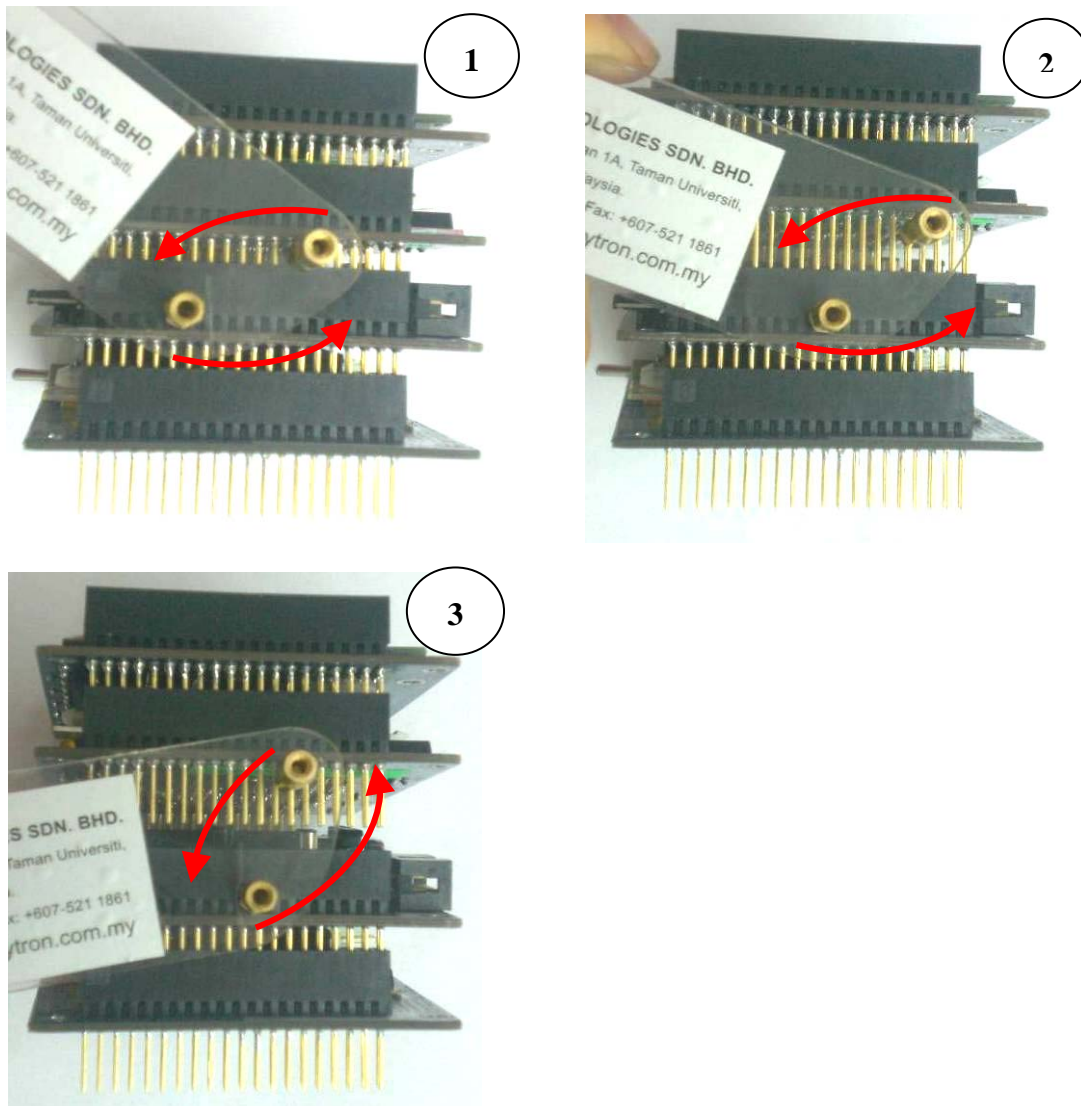
PWR LED on  
IFC -PS01

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)**

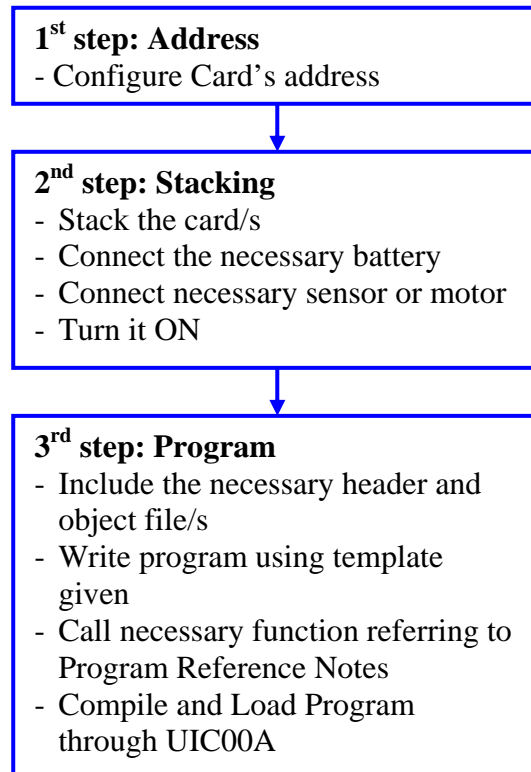
User only needs to write program for IFC-MB00 in order to send data and communicate with IFC-PS01. A program editor, C compiler and UIC00A software are required to be installed in order for user to write program, compile it and further load the program into IFC main board. User is recommended to use 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 is being design 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 this system to function. This section will show the example to operate it with PS2 controller Card, IFC-PS01.

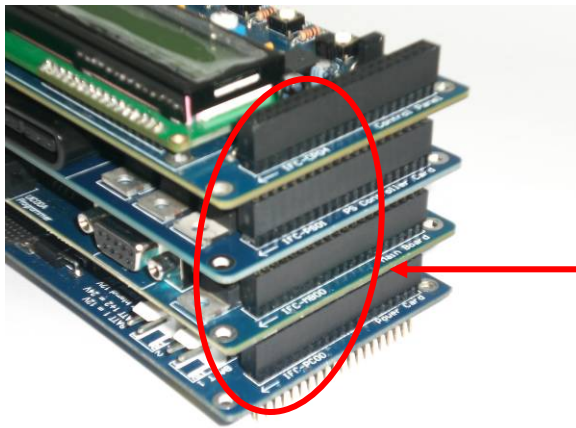


A basic setup for IFC-PS01 will be illustrated in this chapter. Please ensure the power is **OFF** before inserting or removing IFC card. The example includes 4 cards, IFC-PC00, IFC-MB00, IFC-PS01 and one extra card which is IFC-CP04. Please refer following section of this chapter for setup details.

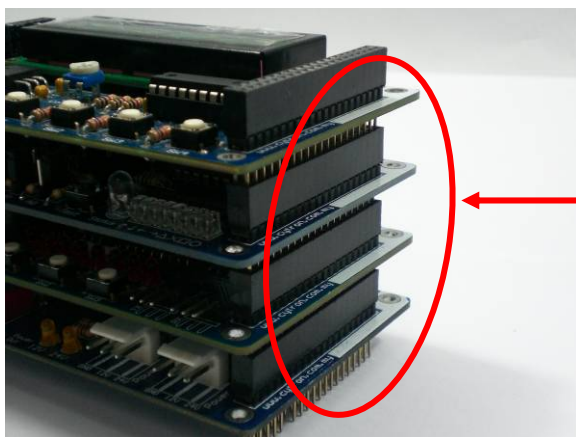
## 7.1 Basic Setup with Control Panel (IFC-PC00 + IFC-MB00 + IFC-PS01 + IFC-CP04)

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. 1<sup>st</sup> step, configure the address of cards, IFC-PS01 and IFC-CP04. PS Controller Card has 6 mini jumpers to configure communication address (A5-A0). It should be set to 010101 if sample source code is being used. As for Control Panel, it should be set to "CP1" (Upper side).
- b. 2<sup>nd</sup> step is to stack all 4 cards together. Power card (IFC-PC00) should be at the bottom, Main board (IFC-MB00) at 2<sup>nd</sup> layer, PS Controller Card (IFC-PS01) at 3<sup>rd</sup> layer and Control Panel at the top layer as shown in following figure.



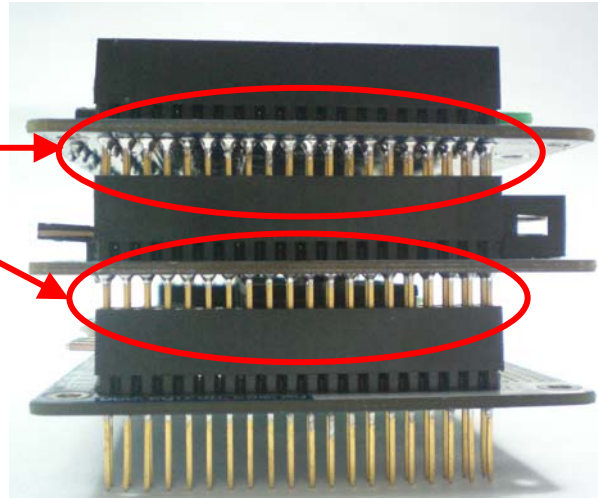
Ensure the arrow  
points to the  
same direction



Ensure the  
orientation  
marking is at the  
same side

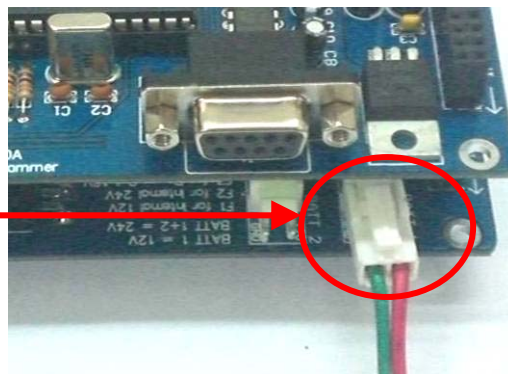
- c. Besides stacking every card in correct orientation, user also needs to ensure that all the pins when stacking are not shifted and inserted to correct location.

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

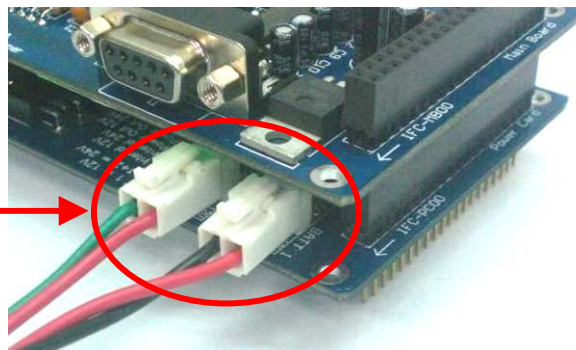


- d. Connect the PS2 controller to IFC-PS01 Card. Please refer hardware setup for the method to make the connection.
- e. Connect the battery or power source to Power card as shown; please ensure the **polarity is correct**.

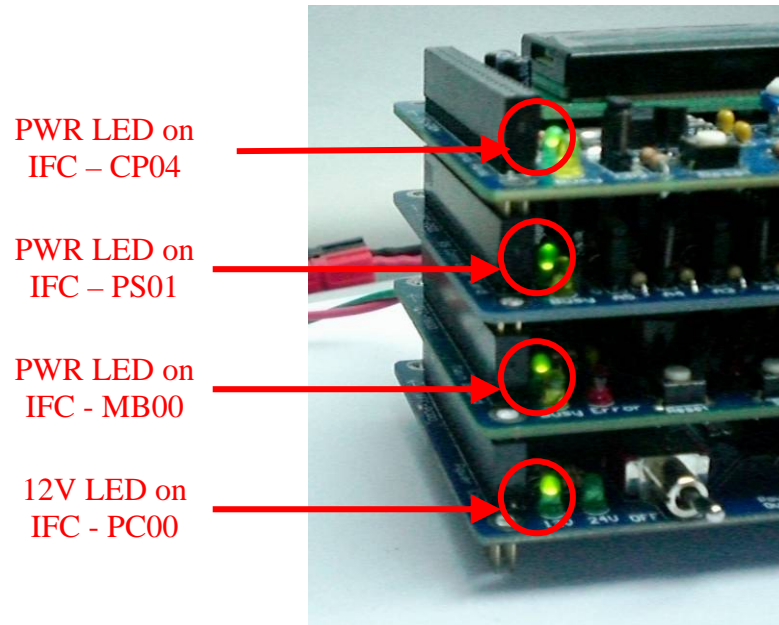
Connect 1 x 12V battery to supply operating voltage to IFC. **Ensure the polarity is correct.**



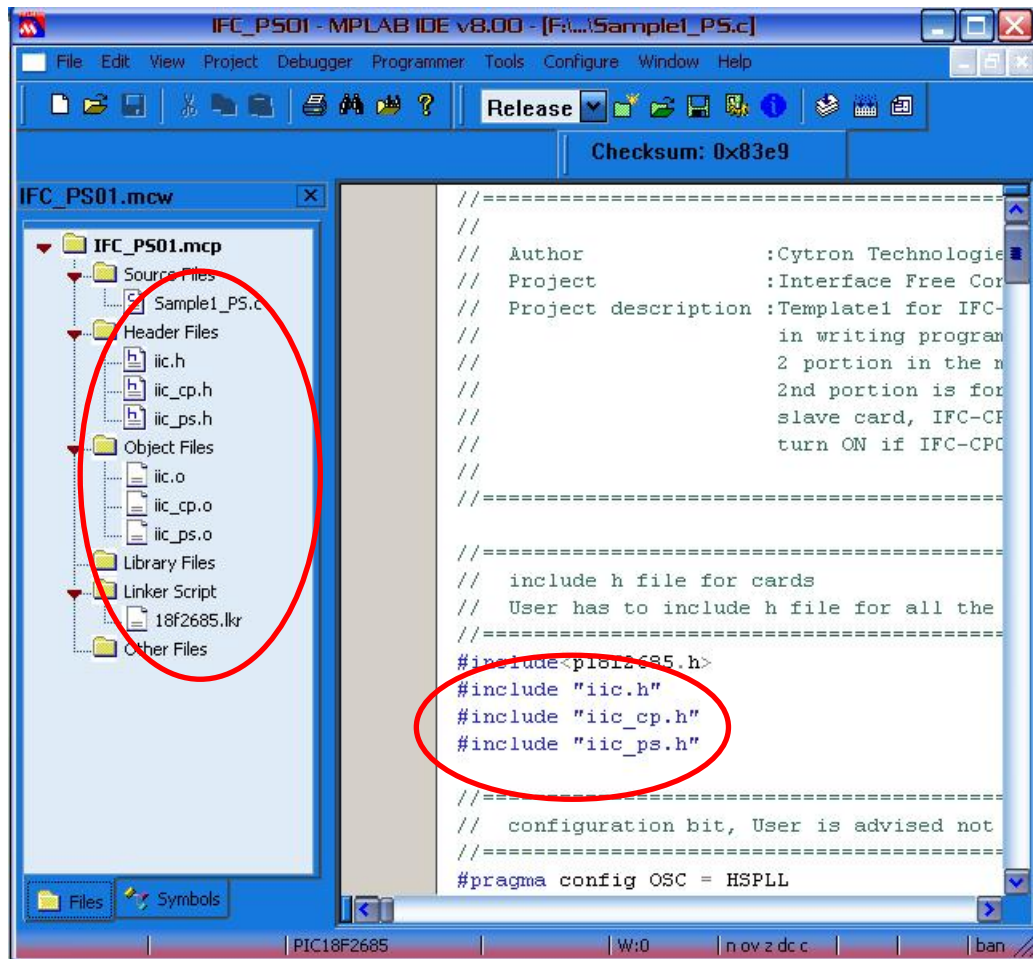
If 24V is needed in the system, connect 2 x 12V batteries to PC00. **Ensure the polarity is correct.**



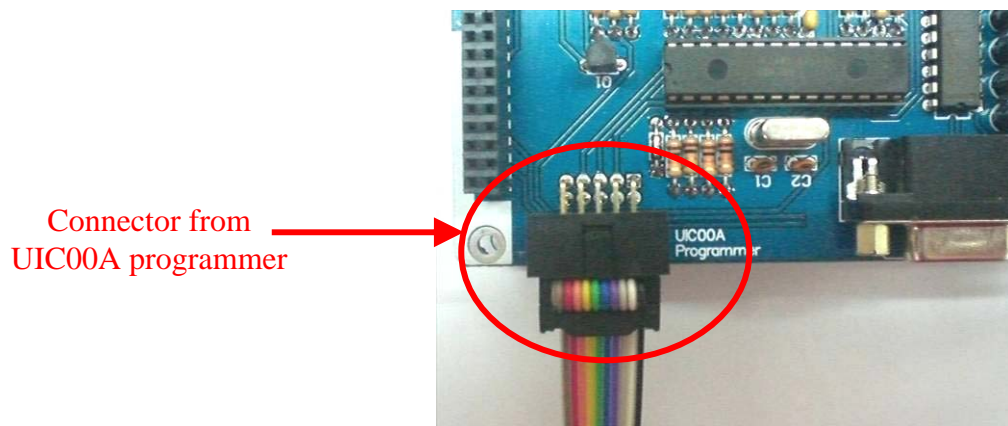
- f. Turn ON the IFC power by pushing the toggle switch to “ON”. There should be at least 4 LED (12V LED on Power Card, PWR LED on Main Brain, PWR LED on PS Controller Card and PWR LED on Control Panel) light up as show.



- g. 3<sup>rd</sup> 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.
- h. 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\_PS01” for IFC PS Controller Card. Please note that the header file (iic.h, iic\_ps.h and iic\_cp.h) and object file (iic.o, iic\_ps.o and iic\_cp.o) for IFC-MB00, IFC-PS01 and IFC-CP04 have to be included in the project. If user did not use the provided sample source code, “Sample1\_PS.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.



- i. For those wanted to understand the program, please refer to c file named “Sample1\_PS.c” which can be downloaded in the product page of this card in Cytron website: [www.cytron.com.my](http://www.cytron.com.my).
- j. Compile this project to generate hex file. Connect UIC00A IDC connector to IFC-MB00 as show. The hex file generated is named “IFC\_PS01.hex”.





- k. Load the hex file generated to UIC00A using PICKit2 window (refer to UIC00A User's Manual for details).
- l. Power up IFC-PS01 with power card without plug in the PS2 controller. Status LED is blink. Busy LED for IFC-MB00, IFC-PS01 and IFC-CP04 also blinking.



- m. This sample project will print message at LCD on Control panel. The message print are:

set PS01  
add to 010101





- n. There are 3 modes for user to select in program “Sample1\_PS”. User can switch between modes by pressing SW1 on IFC-CP04. The modes are:

Mode	Enter modes	Enter sub-modes	Function
1	SW1	No sub-modes	Test all switch on the PS2 controller. The pressed switch will be display on the LCD at IFC-CP04. Indicator LED on board will on when the corresponding button is pressed. The brightness of status LED for button without indicator will change to brighter.
2	SW1	There are 3 sub-modes in this mode, joystick A, joystick B, and joystick C. Press SW2 to switch between sub-mode.	<p><b><u>Sub-mode joystick A</u></b> Display the value of joy_lx, joy_ly, joy_rx and joy_ry.</p> <p><b><u>Sub-mode joystick B</u></b> Display the value of joy_lu, joy_ld, joy_ll, and joy_lr.</p> <p><b><u>Sub-mode joystick C</u></b> Display the value of joy_ru, joy_rd, joy_rl, and joy_rr.</p>
3	SW1	There are 3 sub-modes in this mode. Press SW2, SW3 and SW4 to enter sub-modes.	Please take note that some of the PS2 controller doesn't have small motor installed. So, those PS2 controllers will not respond when small motor is activated.
		SW2	Activate small motor
		SW3	Activate big motor with 150 speed
		SW4	Activate big motor with 255 speed.

- o. Please refer the comment in source code for the details of mode.
- p. To remove a card from IFC system, the power should be switched OFF.
- q. 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-PS01 Card Technical Info for the program function list. It will help user in writing program for IFC-PS01.

**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.

## **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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