Cytron Technologies

IFC-RS08
Interface Free Controller
RC Servo Card
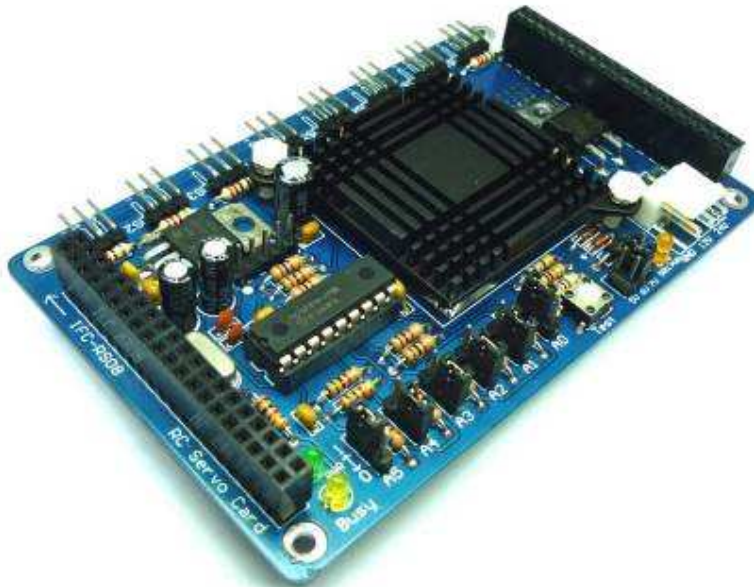
User's Manual

V1.0

March 2009

Index

1. INTRODUCTION AND OVERVIEW

1.1 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, play station 2 Controller card, analog input card, dual brush motor card and power card. This document will focus on the RC Servo Card, IFC-RS08. 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.
- **8 channels:** RC Servo driven independently
- **Extendable to more channels**
- **Optional Position Reporting:** User may request position of an individual servo.
- **Optional Servo Ramping:** Choose one of 255 ramp rate (speed rate) for each servo.
- **Resolution:** 5000 steps => 2ms/5000steps=0.4us
- **Servo pulse:** 0.5ms to 2.5ms.
- **RC servo power supply selection:** 5V, 6V and 7V or using external supply
- Template and sample source code is provided for MPLAB C18 compiler.
- **Dimension** 11.1cm x 6.9cm

1.2 How RC Servo Motor works

Radio Control (RC) hobby servos are small actuators designed for remotely operating model vehicles such as cars, airplanes, and boats. Nowadays, RC servos are become more popular in robotics, creating humanoid robot, biologically inspired robot, robotic arm and etc. This is because its' ability to rotate and maintain and certain location, position or angle according to control pulses from a single wire. Inside a typical RC servo contains a small motor and gearbox to do the work, a potentiometer to measure the position of the output gear, and an electronic circuit that controls the motor to make the output gear move to the desired position. Because all of these components are packaged into a compact, low-cost unit, RC servos are great actuators for robots.

Besides signal wire, a RC servo has other two leads: power and ground. The control signal is a continuous stream of pulses that are 1 to 2 milliseconds long, repeated approximately fifty times per second, as shown below.
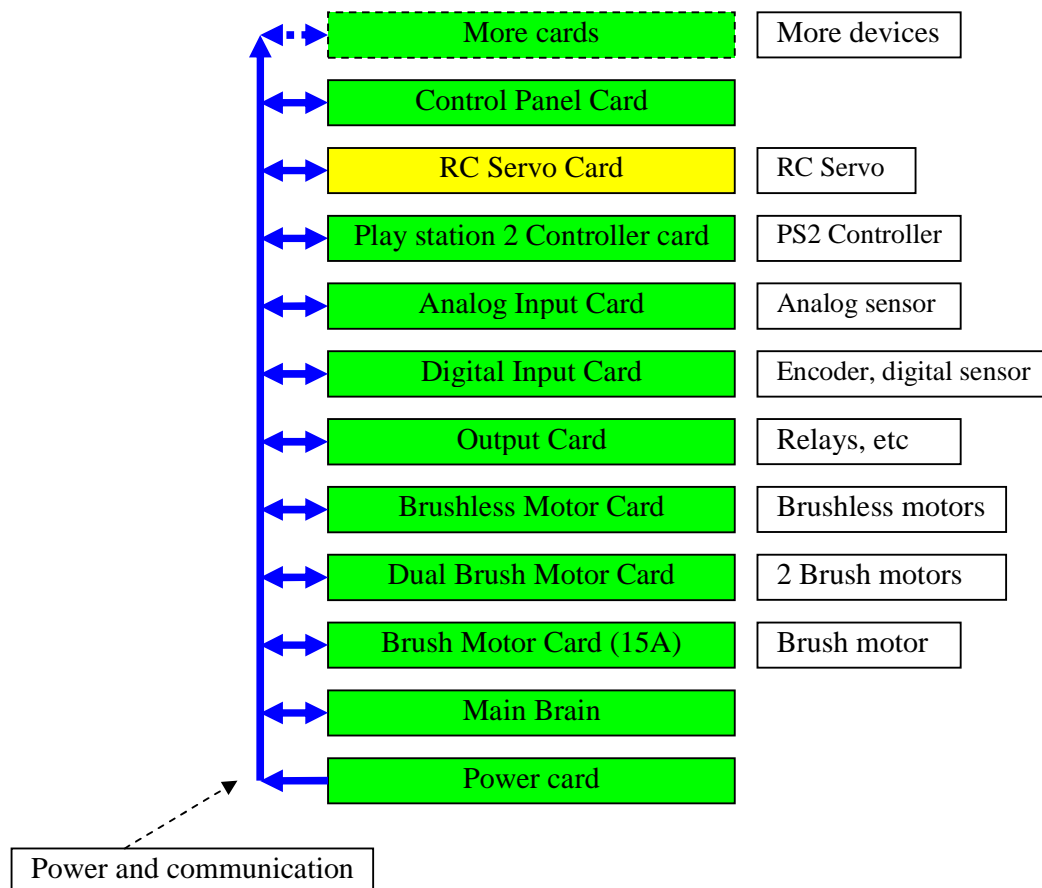
The width of the pulses determines the position to which the servo moves. The servo moves to its neutral, or middle, position when the signal pulse width is 1.5 ms. As the pulse gets wider, the servo turns one way; if the pulse gets shorter, the servo moves the other way. Typically, a servo will move approximately 90 degrees for a 1 ms change in pulse width. However, the **exact correspondence between pulse width and servo varies from one servo manufacturer to another**. **1.5ms is not necessarily neutral or middle position. When the pulse gets wider, the servo not necessarily turn to clockwise and when the pulse gets shorter it is not necessarily turn to counter clockwise position. It is depends on what types or brands RC servo user use.**
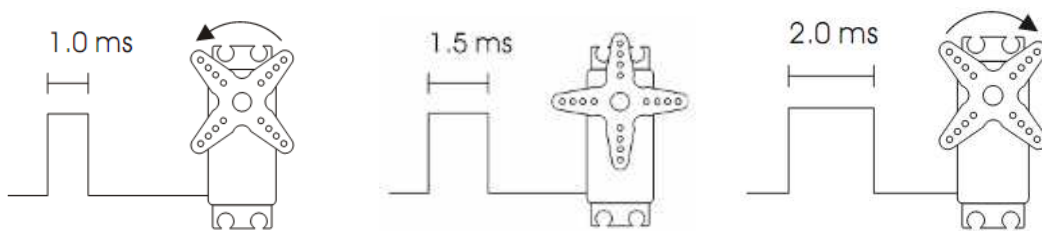
IFC-RS08 is designed to simultaneously generate 8 independent servo control signals. The servo controller can generate pulses from 0.5 ms to 2.5 ms, which is greater than the range of most servos, and which allows for a servo operating range of over 180 degrees.

1.3 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	
RC Servo Card	RC Servo
Play station 2 Controller card	PS2 Controller
Analog Input Card	Analog sensor
Digital Input Card	Encoder, digital sensor
Output Card	Relays, etc
Brushless Motor Card	Brushless motors
Dual Brush Motor Card	2 Brush motors
Brush Motor Card (15A)	Brush motor
Main Brain	
Power card	

Power and communication

This document explains the method to use IFC-RS08.

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.
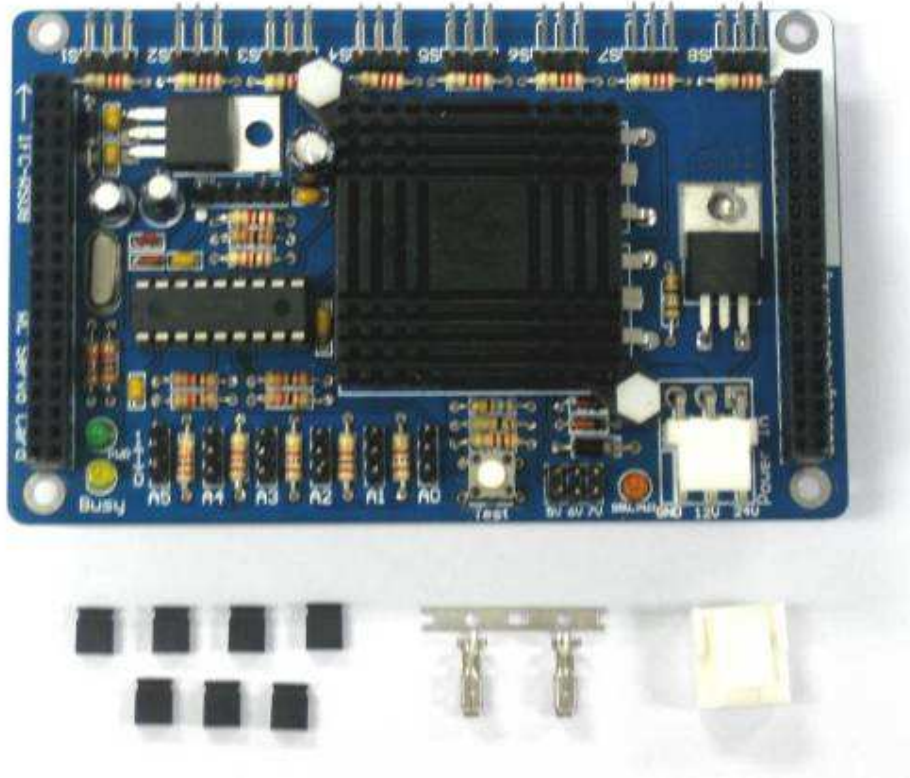
1. 1 x IFC RC Servo Card ,IFC-RS08 with:
    *   7 x mini jumper.
    *   1 x Female Connector (3961-03)
    *   2 x 3961 iron pin

3. PRODUCT SPECIFICATION

3.1 Communication Address

There are 64 (2^6) communication address of IFC-RS08 that can be selected. The 6 bits communication address is determine by selector A5 through A0 (6 set of 1x3 headers on IFC-RS08). 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 **not needs** to prepare programmer for IFC-RS08. IFC-RS08 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 RS08 are as below:
- 3 status indicator LED: Power and busy LED:
    - Power LED (PWR) will turn ON when power supplied to RC Servo Card.
    - Busy LED (Busy) will turn ON or blink when Control Panel is communicating with master card, IFC-MB00.
    - Servo LED (PWR) will turn ON when power is supplied either from external or internal power source.

- 8 channels for RC servo motor.
    - Selectable power source for RC servo (5V, 6V or 7V). User can select the RC servo power source by using the mini jumper.

3.4 Operating Voltage

- The operation voltage of IFC-RS08 controller is 12V. 2 x12V batteries are not required in IFC-RS08. User needs to stack a Power Card IFC-PC00, in order to get the power supply. Power LED (PWR) will turn ON when power is supplied to RC Servo Card.

- RC servos' voltage
  RC servo's operating voltage is 5V – 7V. They are 2 methods to supply voltage/power to RC servos.
    - ◆ 1st method is 12V power supply. This power supply is come from IFC-RS08 operating voltage. This 12V power supply will regulated to either 5V, 6V or 7V depends on the user's selection. Connect Power out connector from IFC-PC00 to Power In connector of IFC-RS08 using cable connector. Please refer to section **5.Installation (Hardware)** for external power source of RC servos. The Servo PWR LED will turn ON when power at Power In is connected.

Note: Operating voltage for IFC-RS08 is 12V. 2x12V batteries is not required in IFC-RS08

◆ 2nd method is external batteries. **User may also use their own +5V external power supply if they do not want to regulate the servo motors' power.** Then they have to unsolder the 3 way 3961 connector and replace with 2 way 3961 connector. In this method, please make sure the power supply is suitable with the servo motors (typically is between 5V to 6V). **Over voltage would damage the RC servo motors.**

Absolute Maximum Rating

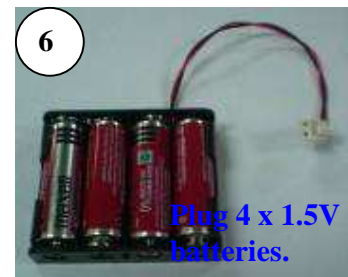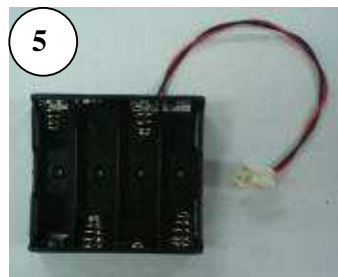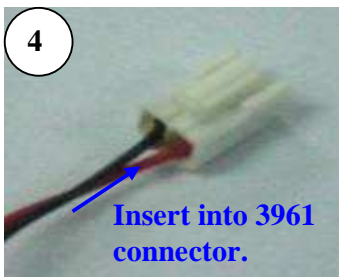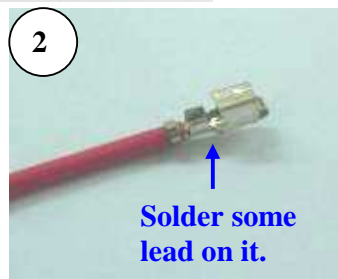| Symbol	Parameter	Min	Max	Unit
V_{IN}	Servo Motor supply voltage	5	7	V
V_{CC}	Operating voltage	-	12	V
I_{max}	Maximum input current	-	6	A

Method below is only for user who wants to use own 5V-7V power supply. The power is directly connected to RC servo's power without regulated. Therefore, please do not connect any power supply which is more than RC servo's voltage range. Skip this section if the power supply is 12V.

User may follow the steps below to build a cable connector for connecting the external power source from 4 x 1.5V batteries.
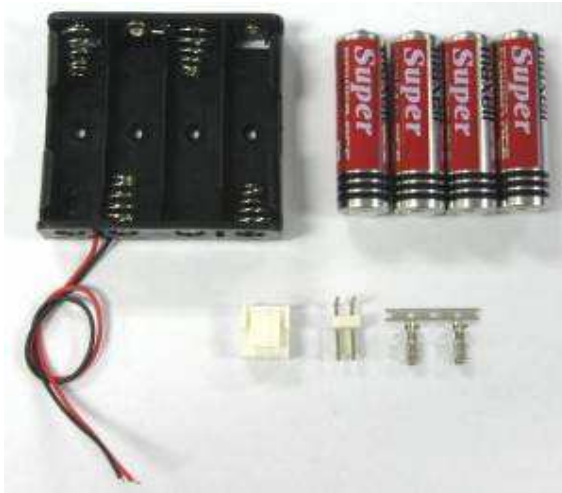

Materials needed:
a. 1 x battery holder
b. 4 x 1.5V battery AA
c. 1 x 3961-2 female connector
d. 2 x 3961 iron pins

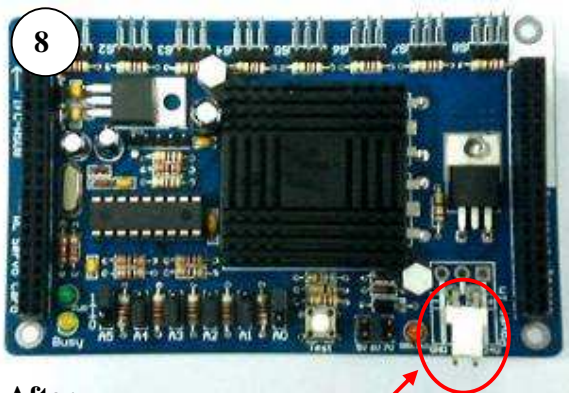|		
1	**2** Solder some lead on it.	**3** Solder some lead on it.
4 Insert into 3961 connector.	**5**	**6** Plug 4 x 1.5V batteries.

Note: This method only applicable when the 5V-7V power supply is used. Please skip this section if the power supply is 12V.
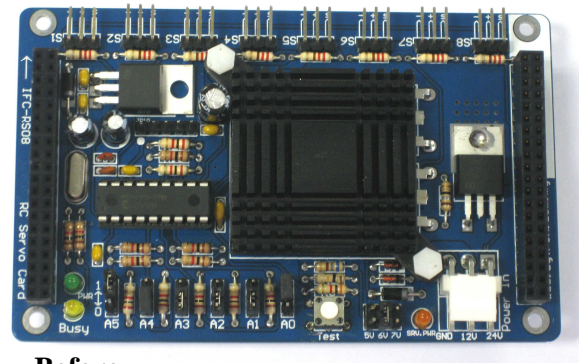
User may follow the steps below to connect 3961-02 female connector to supply 6V to external power supply.
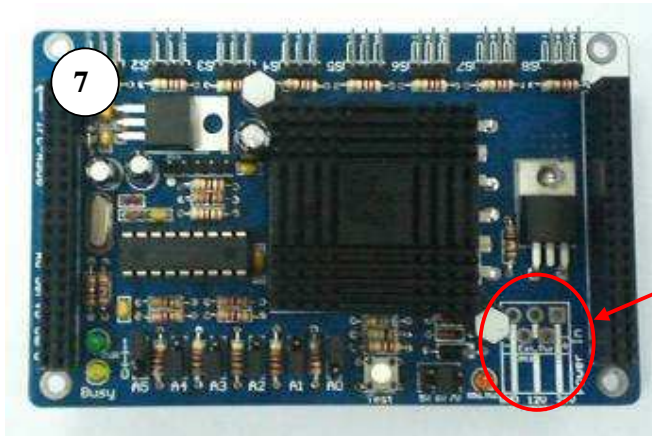
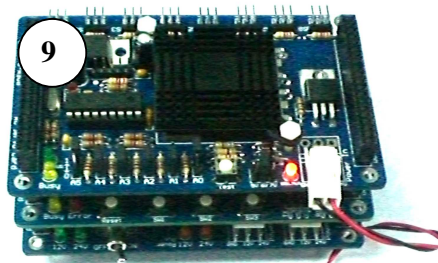**Desolder 3961-03 Female connector**

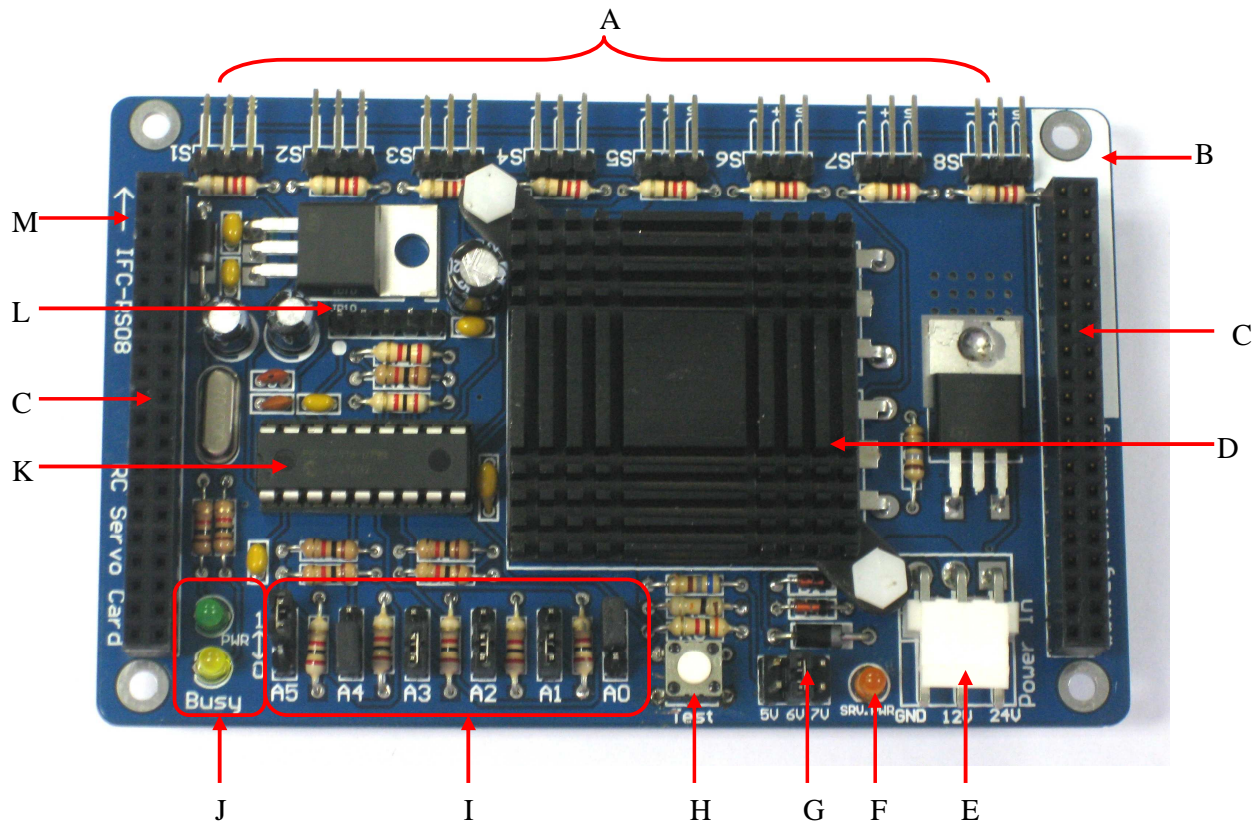**After**

Before

Solder 3961-02 Female connector

Connect 4 x 1.5V batteries

Note: This method only applicable when the 5V-7V power supply is used. Please skip this section if the power supply is 12V.

4. BOARD OR PRODUCT LAYOUT

Label	Function	Label	Function
A	8 RC Servo Channel	H	Test button
B	Orientation marking	I	Communication address selectors
C	Side connector	J	Status indicator LED
D	Heat sink	K	PIC Microcontroller
E	External Power In connector	L	Manufacturing Test Points
F	External servo power indicator LED	M	Arrow
G	Voltage selector		

A – 8 channel for RC servo on IFC-RS08. The voltage is selectable for RC servo, 5V, 6V or 7V.

B – 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.

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

D – A heat sink which helps to absorbs and dissipates heat from servo controller on RS08.

E – Terminal for user to connect external power source for RC servo. The external power source **must** be provided to IFC-RS08 in order to run RC servo that is connected to output channel. 12V connected to supply regulated voltage which is either 5V, 6V and 7V to RC

servos. However if user would like to use their own 5V-7V external power supply, the connector has to desolder, and replace with 2 way 3961 connector.

F – Status indicator LED to indicator status for External Power In. The 12V LED will turn ON when 12V external power is connected.

G – Voltage selectors on IFC-RS08 for RC servo. User can use mini jumper to select 5V, 6V or 7V.

H – Servo's test button for RC servos. User can simply test the RC servo connected to RS08 by pressing this test button without any programming on MB00. The RC servo will move to 4500 steps from initial position when test button is pressed. Press test button once again and RC servo will turn to 500 steps. Test button will not function when MB00 communicate with RS08.

I – 6 set of 1x3 headers use as communication address selector on IFC-RS08. User can set the card address by using the mini jumper.

J – 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.

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

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

M – An 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-RS08, 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-RS08, 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.
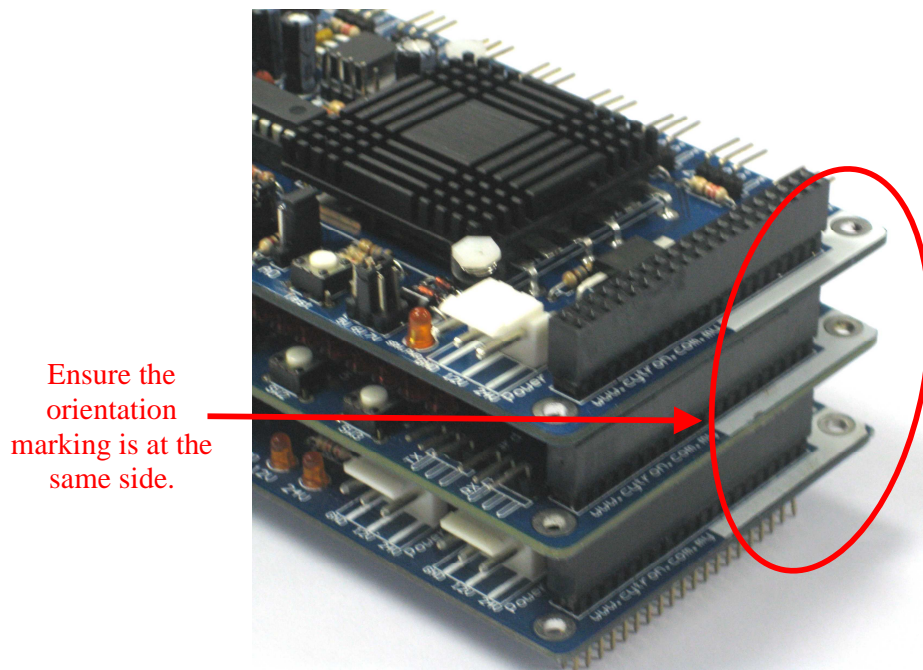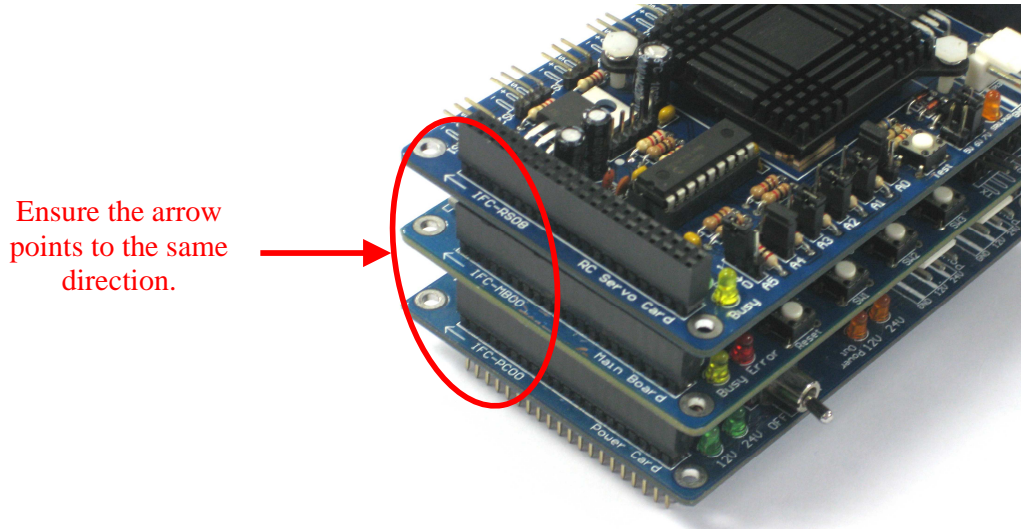
Cautions: Please ensure that every card is being stacked properly in correct orientation. Whole IFC system will be damaged if one of the cards is being stacked wrongly when it is powered up.

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.

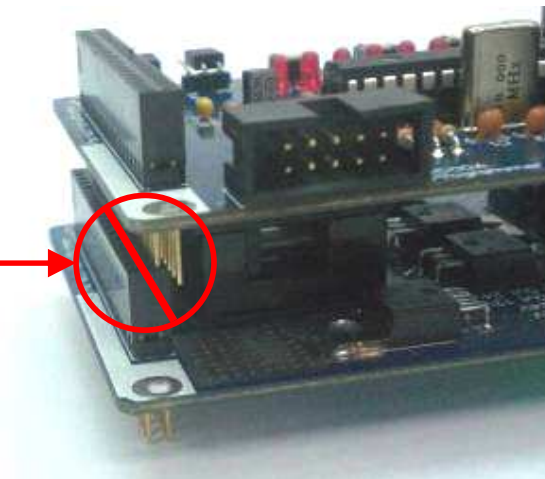Ensure that all card pins are not shifted when stacking.
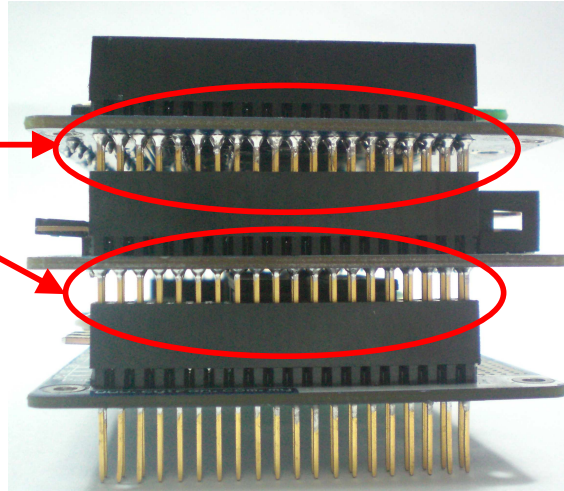
Examples of stacking cards with shifted pins. Please AVOID this!
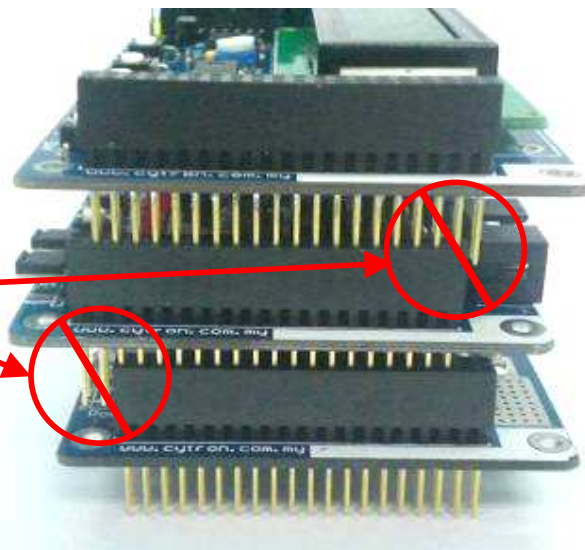
Ensure that all card pins are not shifted when stacking.

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 mini jumper provided on IFC-RS08 to select the communication address of IFC-RS08. For example, figure below shows the communication address, 100001 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-RS08.
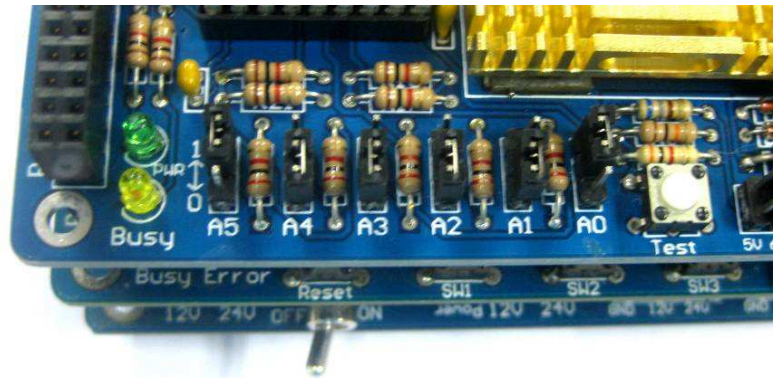
For RC servo's power supply, user can connect external power source from IFC Power Card, IFC-PC00, IFC Extension Board, IFC-EB02 or external battery. This 12V external power supply will regulated to either 5V, 6V or 7V depends on the user's selection.

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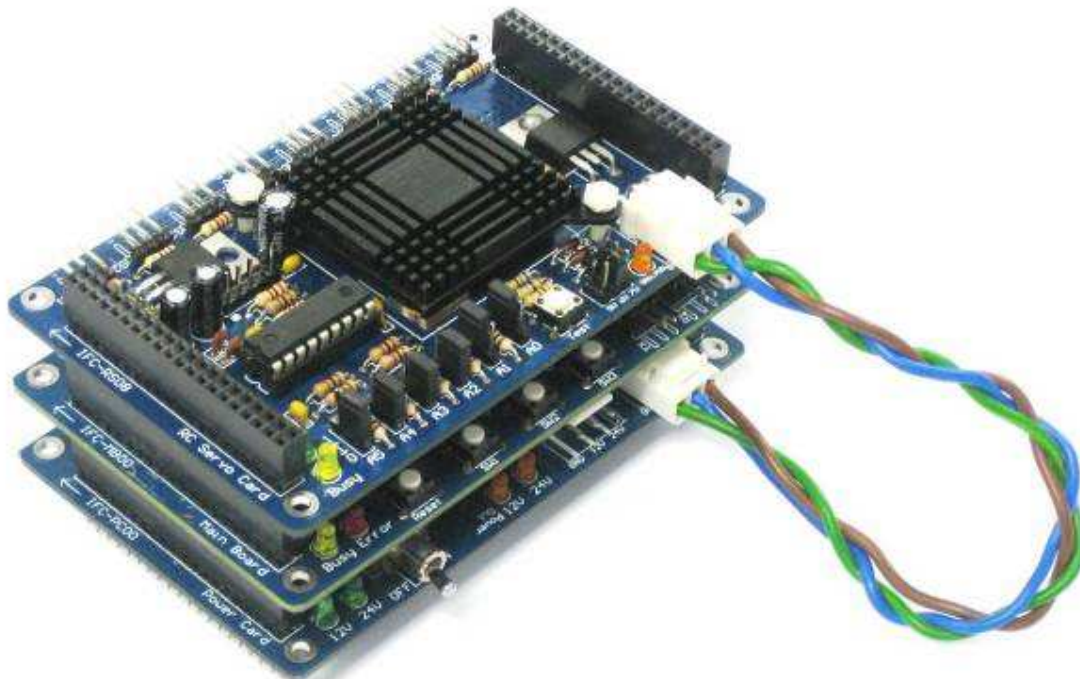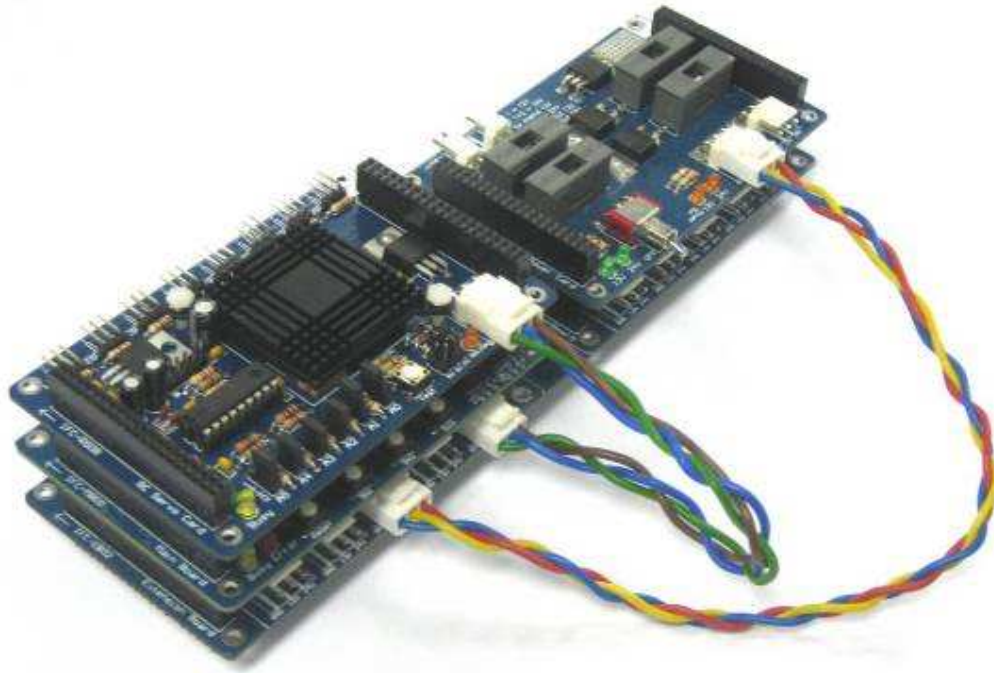
Figure shows the example connection of external power source from IFC Extension Board. Please refer User's Manual for IFC-EB02 for the more details.

User may also connect the external power source from extra battery as shown in figure below. Before that, users need to desolder 3961-03 female connector and solder 3961-02 female connector. User may refer **Operating voltage** on chapter 3.4 for connect the external power source from extra battery. Please skip this section if the battery used is 12V.
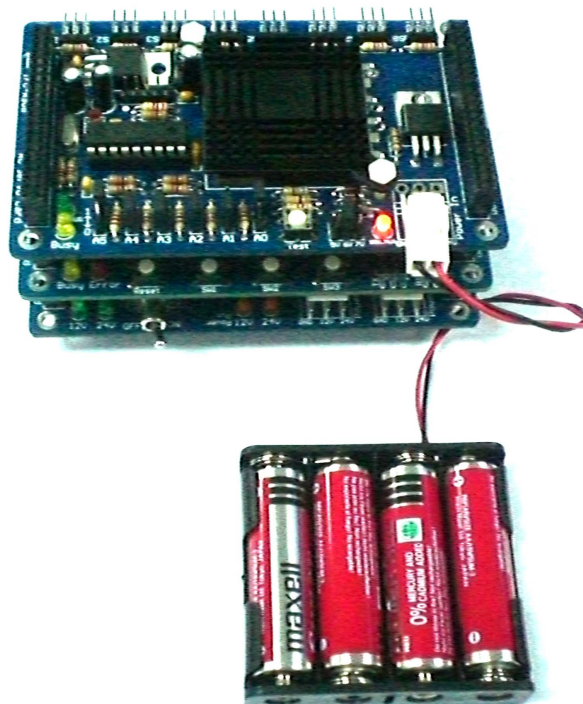
Figure below shows how to connect RC servos to IFC-RS08 servo channel. The RC servos are controlled by three wires: ground (usually black/orange), power (red) and control (white). When connecting servos, be careful because it is possible to plug in servos backwards. Make sure to connect servos correctly, or they maybe destroyed.

The selection for RC servo's voltage is 5V, 6V or 7V. User may choose the RC servo's voltage using mini jumper. User needs to make sure the servo voltage selected on IFC-RS08 is compatible with the RC servo.

Select voltage for RC servos. 5V, 6V or 7V.
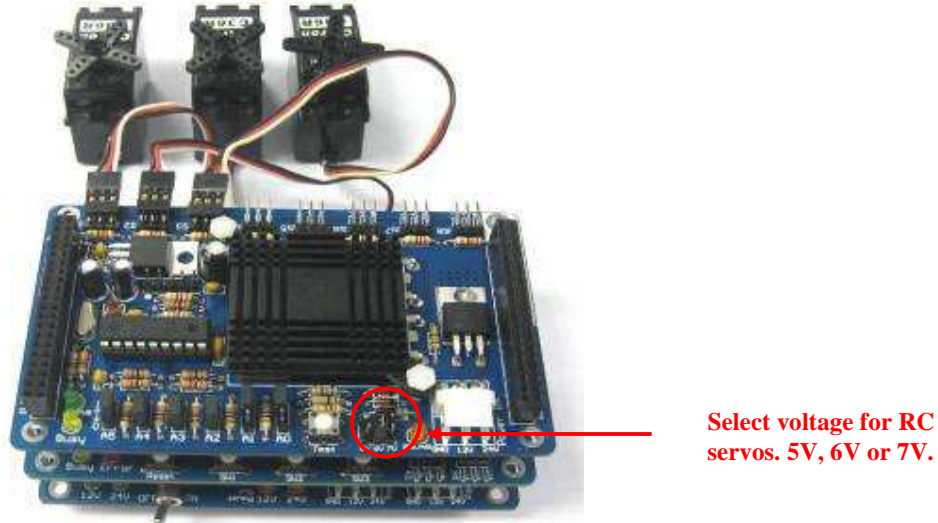
Do ensure that the pins connected to RC servo are correct. (+) for VCC, (-) for GND and (s) for signal.
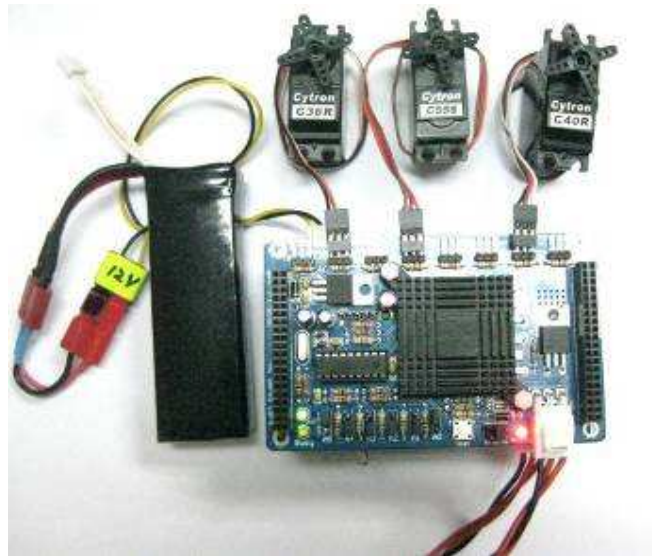
The photo shows the complete connection. From the photo, RC servo got the power source from 12V power supply. This 12V power supply will regulated to either 5V, 6V or 7V depends on the user's selection.

Please switch ON the power on Power Card, the PWR LED of IFC-RS08 will turn ON as shown in following figure. Initially, if there are no functions related to IFC-RS08 being called in Main Board's program, the busy LED will not ON or blink.

PWR LED on
IFC – RS08

PWR LED on
IFC - MB00

12V LED on
IFC - PC00
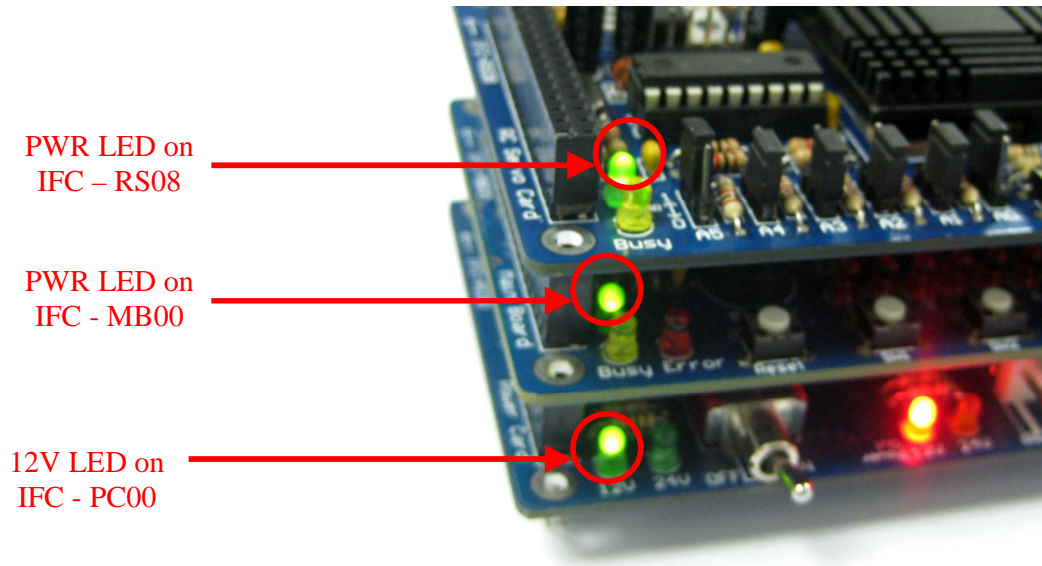
To open the cards, user can use the IFC card's opener to open the stacked cards. Figure shows the method to open cards with the opener.
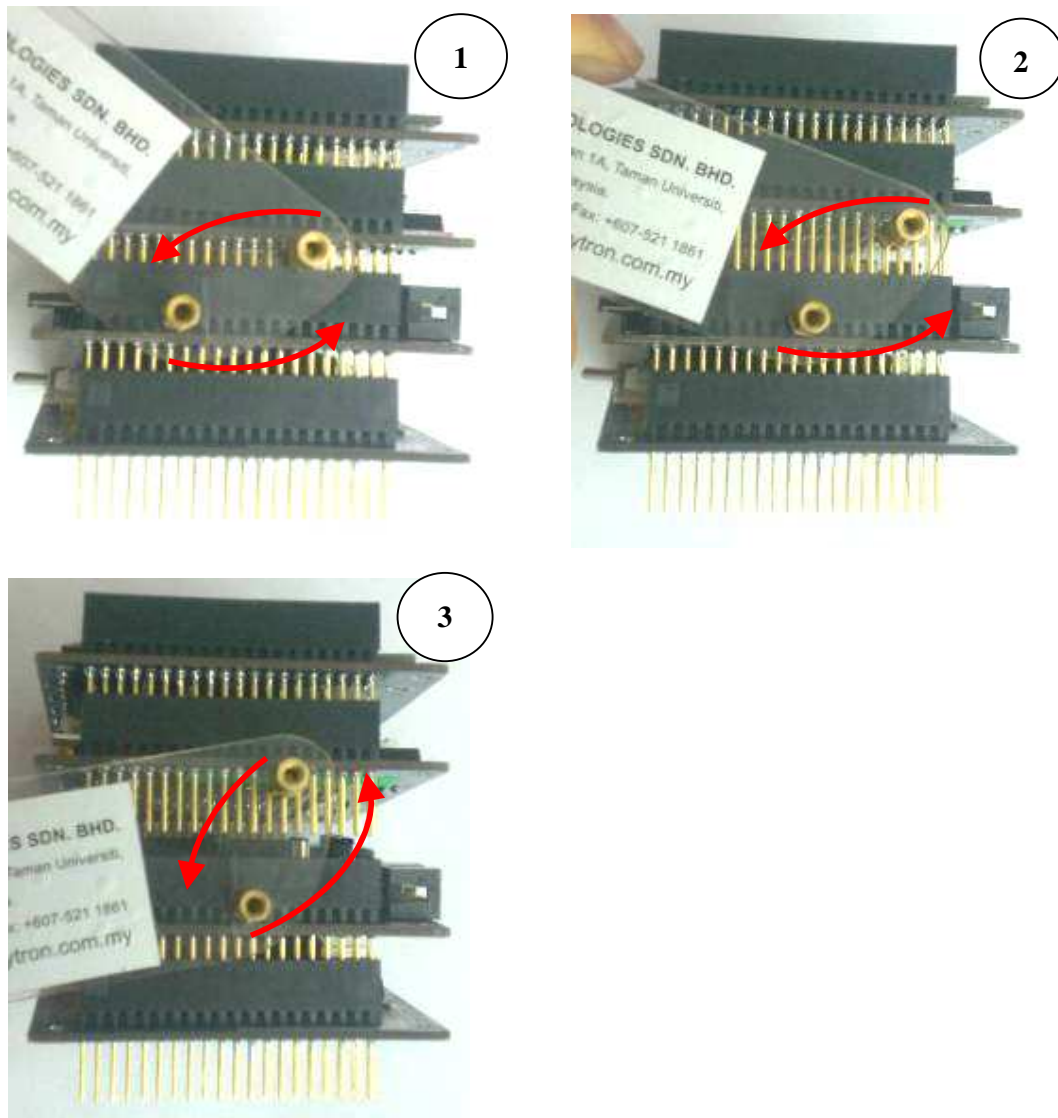
Caution: Please use the opener to open IFC cards to avoid damage of the pins or cards.
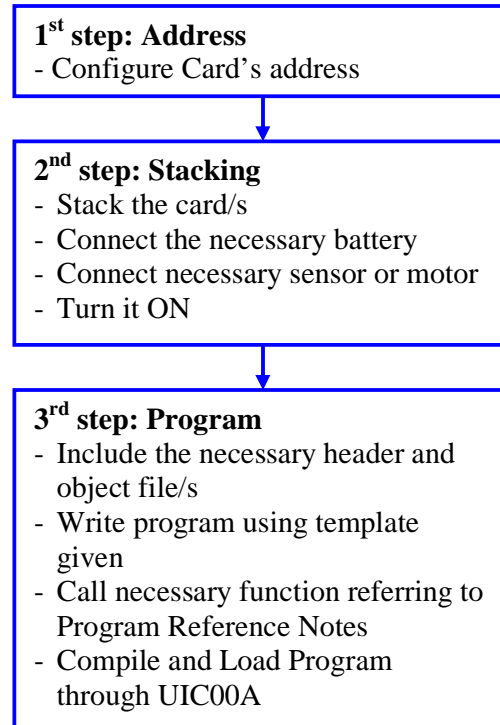
6. INSTALLATION (SOFTWARE)

User only needs to write program for IFC-MB00 in order to send data and communicate with IFC-RS08. 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 RC Servo card, IFC-RS08.

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
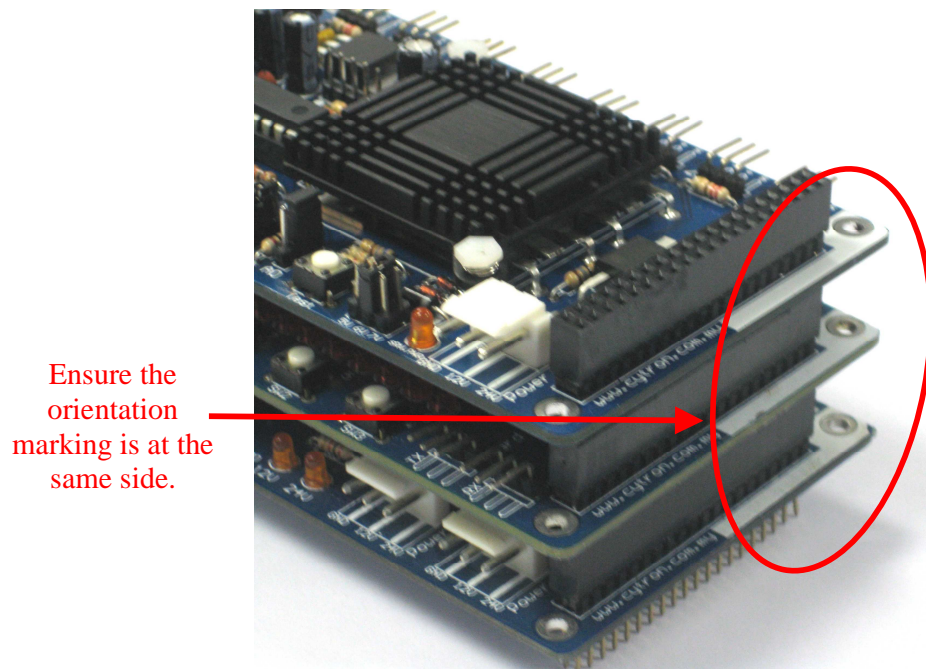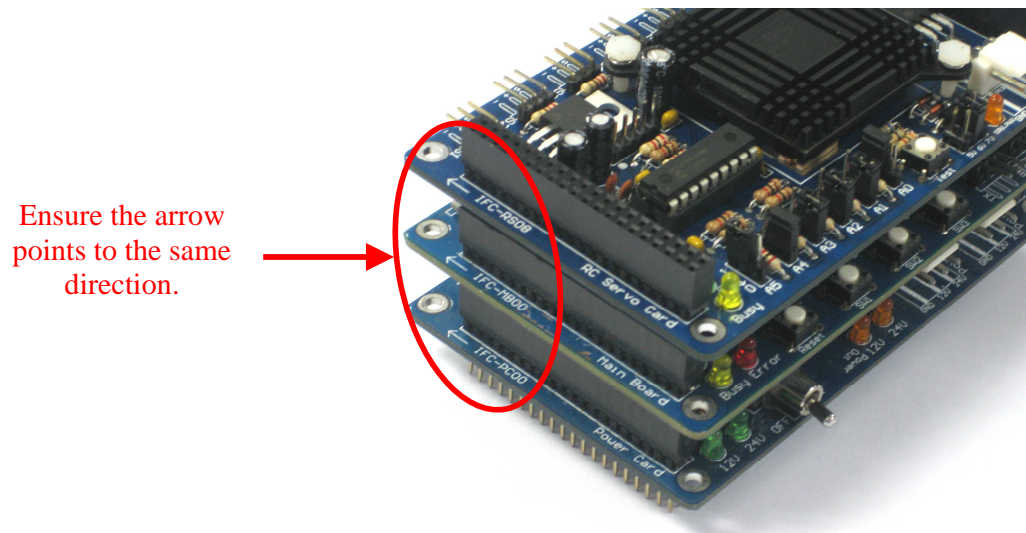- Compile and Load Program through UIC00A

There are a basic setups in this chapter for IFC-RS08, they are includes 3 cards, IFC-PC00, IFC-MB00 and IFC-RS08. Please refer to the following part of this chapter for setup details.

**7.1 Basic Setup (IFC-PC00 + IFC-MB00 + IFC-RS08)**

This is the basic and minimum setup for IFC-RS08 which comes with 8 Channels of RC servos. Though without other card, this basic setup can still perform some task such as drive servo motors. Following steps show the installation of this system and method to operate it.

   a. 1st step, configure the address of card. RC Servo Card has 6 mini jumpers to configure communication address (A5-A0). It should be set to 100001 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 RC Servo card (IFC-RS08) 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.

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.
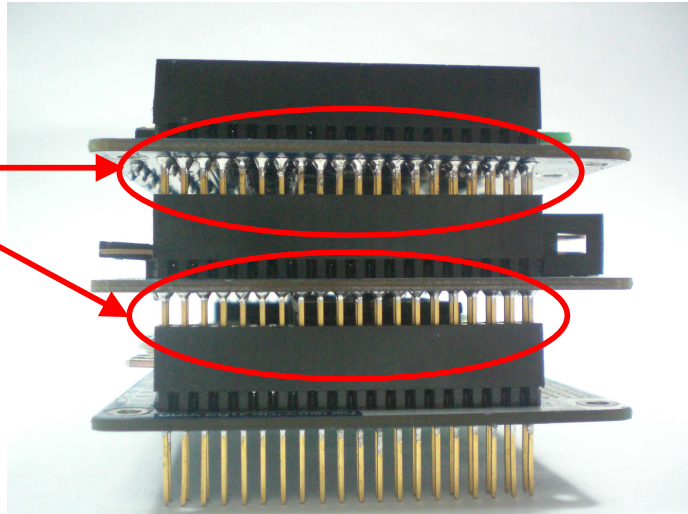
d. Connect RC servo to output channels. Please refer hardware setup for connecting RC servo to RC Servo channel.

e. Connect the battery to Power card as shown; please ensure the **polarity is correct**. 2 x 12V batteries is not required.

Connect 1 x 12V battery to supply operating voltage to IFC**. Ensure the polarity is correct**.
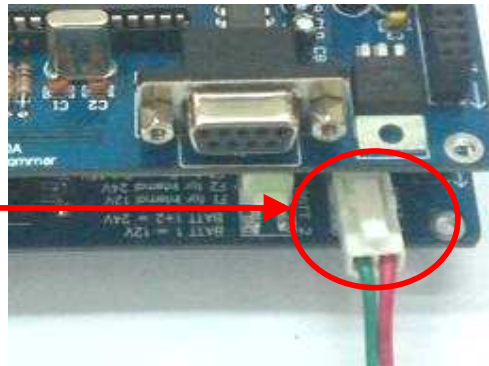
f. Connect the External power source for RC Servo Card. Please refer hardware setup for connecting power to RC Servo Card.

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 RC Servo Card) light up as show.

PWR LED on
IFC – RS08

PWR LED on
IFC - MB00

12V LED on
IFC - PC00
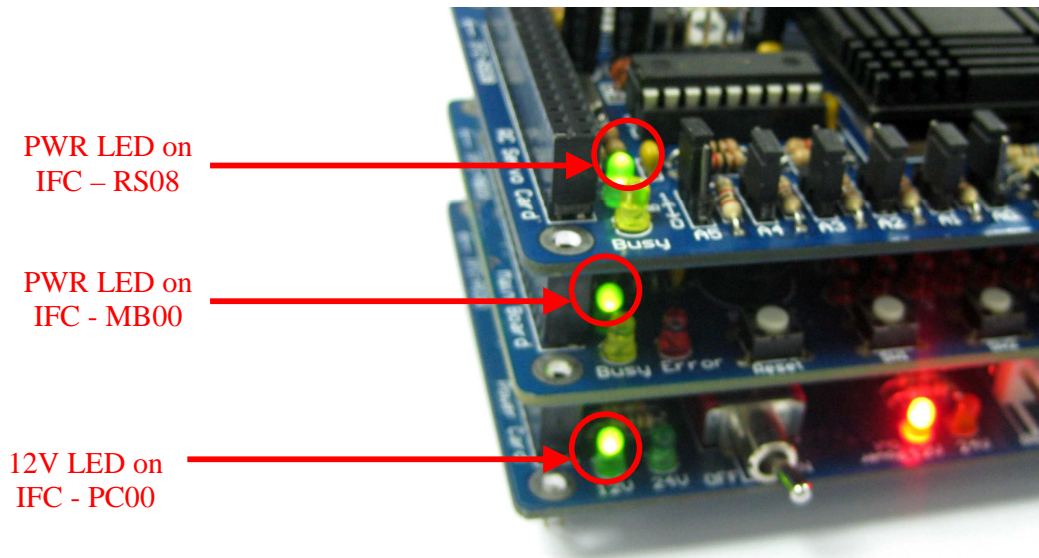
h. 3rd step is to write program and load it. IFC comes with comprehensive function to save program development time. Functions library will come with the interfacing card in the form of header file (*.h) and object file (*.o). In order to call these functions, particular header file and object file must 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_RS" for IFC RC Servo Card. Please note that the header file (iic.h and iic_rs.h) and object file (iic.o and iic_rs.o) for IFC-MB00 and IFC-RS08 have to be included in the project. If user did not use the provided sample source code, "sample1_RS.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.
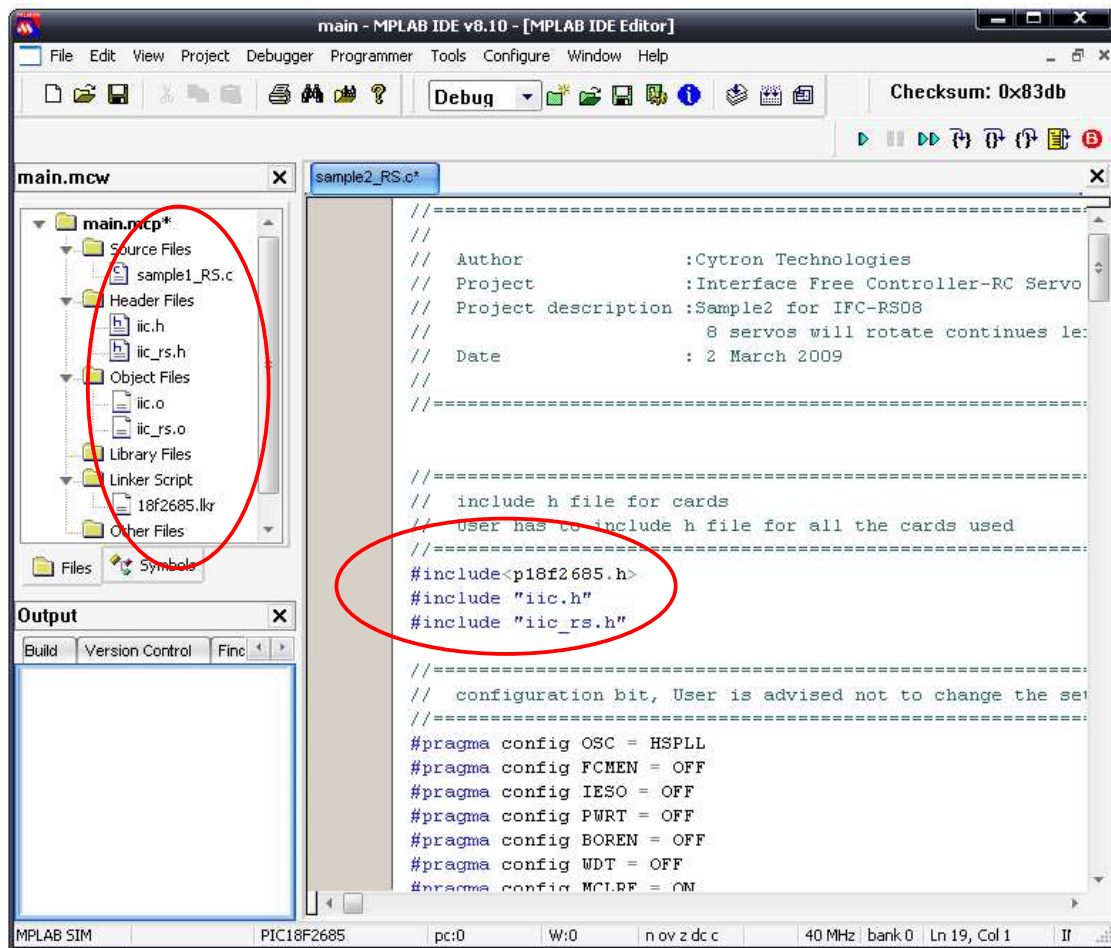
j.   For those who want to understand the program, please refer to c file named "sample1_RS.c and sample2_RS" which is provided with this card. The different for these two c file is sample1_RS use position reporting function and sample2_RS use delay routine to wait for servo motor reach their position.

k.   Compile this project to generate hex file. Connect UIC00A IDC connector to IFC-MB00 as shown. The hex file generated is named "IFC_RS.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
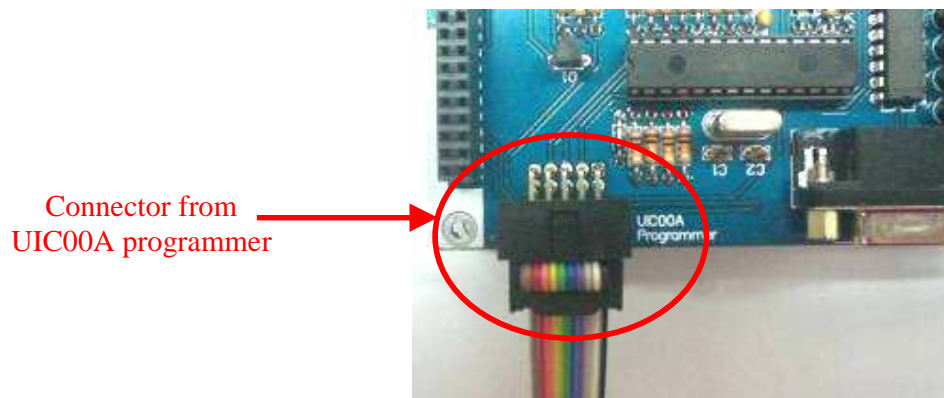
l. Load the hex file generated to UIC00A using PICkit2 window (refer to UIC00A User's Manual for details). Power up IFC system if it is OFF.

m. There are 2 modes for user to select in program "sample1_RS.c". User may press SW1 button on IFC-MB00 to enable all servo motors.

Mode	Push Button	Function
1	SW1	Press SW1 to enable all servo motors. Servo motors will not run unless is enabled. It is because before SW1 is pressed, servo motors are at the loose condition.
2	SW2	Drive all the RC servo to position with speed rate. After delay for some times servos will rotate to different steps with different speed rate.

n. User also can add the "sample2_RS.c" to project opened in chapter 7.1 without creating a new project for sample2_RS.c. Remove sample1_RS.c and add sample2_RS.c. Compile the program once again to generate new hex code.

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-RS08 Card Technical Info for the program function list. It will help user in writing program for IFC-RS08.

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.

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