Cytron Technologies

IFC-MD15A
Interface Free Controller
Brush Motor Card
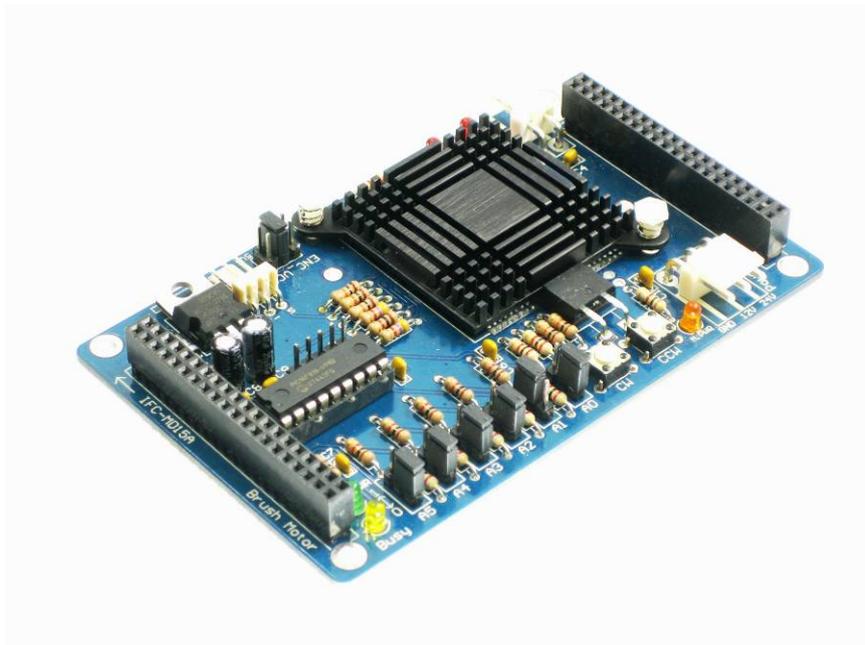
User's Manual

V1.0

Oct 2008

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 aims 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 and power card. This document will focus on the 15A Brush Motor card, IFC-MD15A. 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.
- 1 **brush motor port**.
- 1 **encoder port**.
- Selectable power source for encoder (**5V, 12V or 24V**).
- Drive brush motor in 2 different ranges of voltage (12v **or** 24 V), default is 12V.
- 2 push buttons to test motor in clockwise or counter-clockwise.
- 2 motor status indicator LED to indicate the direction of motor (CW and CCW).
- A Motor Power In status indicator LED.
- **Dimension** 11.1cm x 6.9cm
- Template and sample source code is provided for MPLAB C18 compiler.

1.2 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	
Play station 2 Controller card	
Analog Input Card	Analog sensor
Digital Input Card	Encoder, digital sensor
Output Card	Relays, etc
Brushless Motor Card	Brushless motors
Brushless Motor Card	Brushless motors
Brush Motor Card (15A)	Brush motor
Main Brain	
Power card	

Power and communication
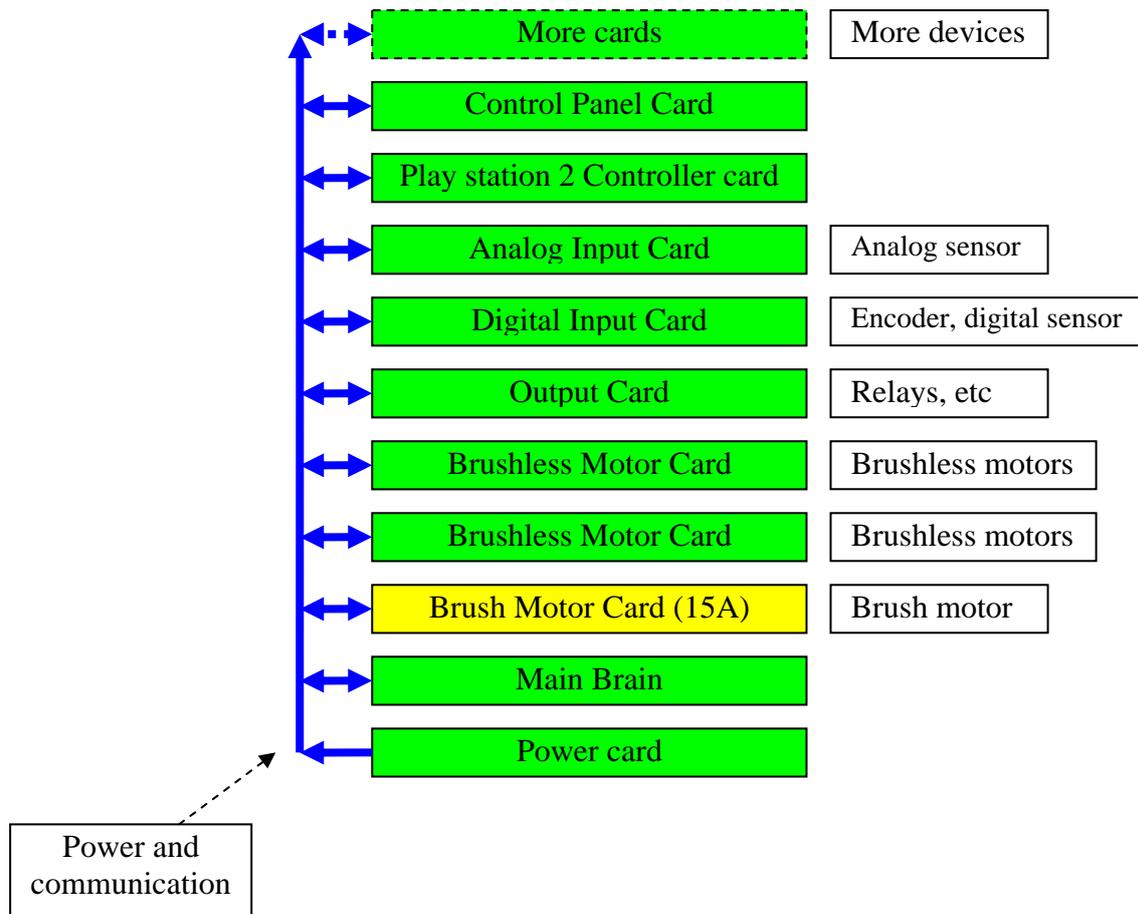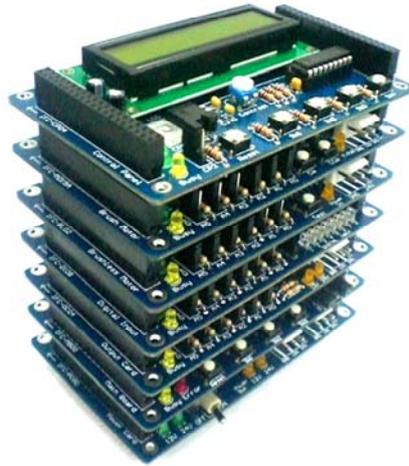
This document explains the method to use IFC-MD15A.

2. PACKAGING LIST

Please check the parts and components according to the packing list. If there are any parts missing, please contact us at sales@cytron.com.my immediately.
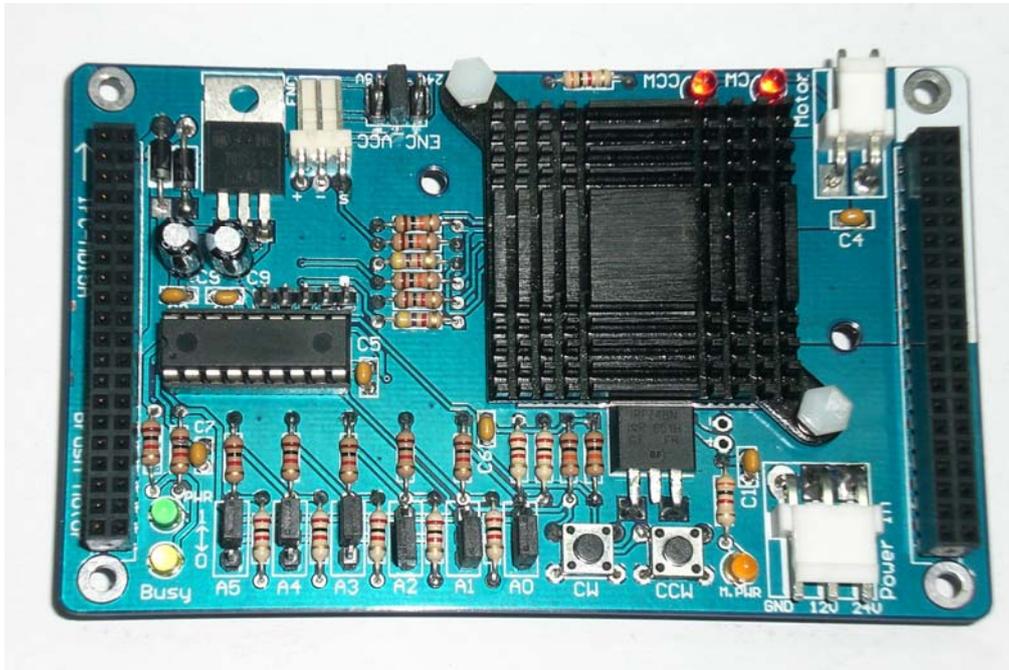
1. 1 x IFC Brush Motor Card ,IFC-MD15A with:
    - 7 x mini jumper.
    - 1 x Female Connector (3961-03)
    - 1 x Female Connector (3961-02)
    - 1 x Female Connector (2510-03)
    - 5 x iron pin (3911)
    - 3 x iron pin (2511)

3. PRODUCT SPECIFICATION

3.1 Communication Address

There are 64 (2^6) communication address of IFC-MD15A that can be selected. The 6 bits communication address is determine by selector A5 through A0 (6 set of 1x3 headers on IFC-MD15A). User may set the card address by using the mini jumper. However, user is required 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-MD15A. IFC-MD15A 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 MD15A are as below:
- 2 status indicator LED: Power and busy LED:
    - Power LED (PWR) will turn ON when power is supplied to MD15A.
    - Busy LED (Busy) will turn ON or blinking when MD15A is communicating with master card, IFC-MB00.
- Motor Power In status indicator LED.
- A brush motor port to connect brush motor. The brush motor connected can run in very high current, which is up to 15A. MD15A will **be sold fixed 12V**. However, user may de-solder the 12V pad and solder 24V pad if 24V is needed as voltage input.
- 2 motor's direction indicator LED, clockwise (CW) and counter-clockwise (CCW).

The input devices on MD15A are as below:
- 1 encoder input port ready with selectable power source:
    - Selectable power source for encoder input port (5V, 12V or 24V). User can select the encoder power source by using the mini jumper.
- 2 push buttons to test motor in two directions, clockwise (CW) and counter-clockwise (CCW).

3.4 Operating Voltage

- The operation voltage of IFC-MD15A is 12V. User needs to stack a Power Card, IFC-PC00, and connect a 12V battery on Power Card to supply 12V to the Brush Motor Card. However, user needs to connect external power source through Power In connector on IFC-MD15A to supply voltage to brush motor. The Motor Power In status indicator LED will turn ON when either 12V or 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. There are 2 types of voltage for MD15A to run brush motor, which are 12V and 24V. MD15A will be sold **fix 12V**. However, user can de-solder the 12V pad and solder 24V pad if 24V is needed as voltage input. However, please be caution! Only 1 power pad can be soldered to MD15A board.

4. BOARD OR PRODUCT LAYOUT
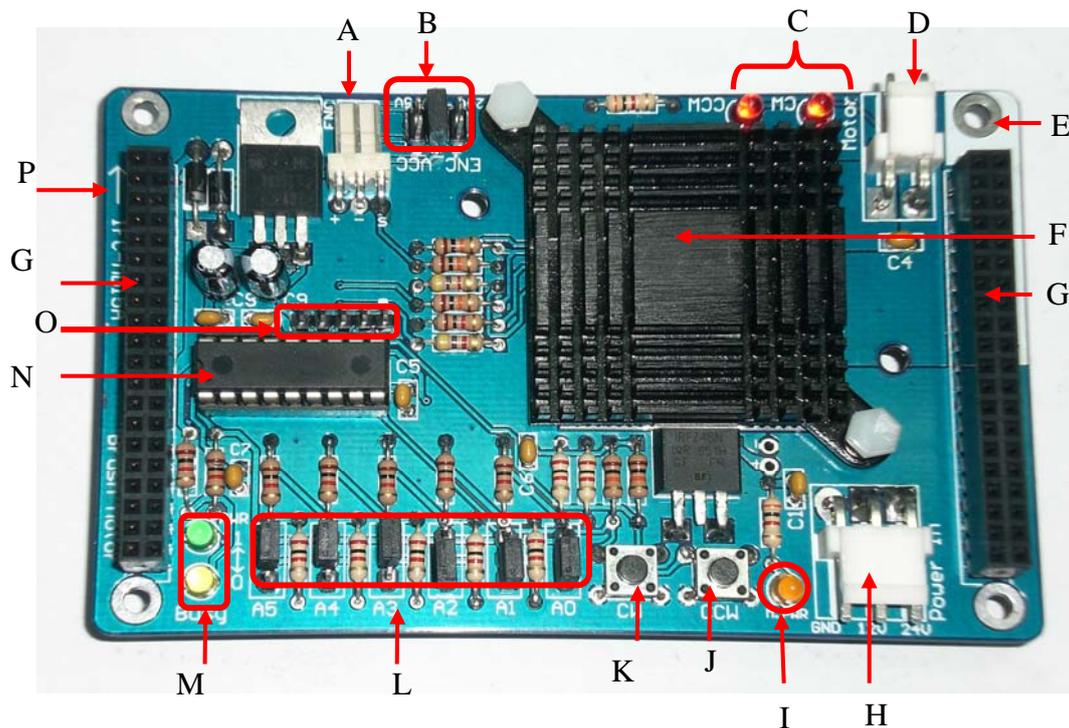
Label	Function	Label	Function
A	Encoder connector	**I**	Motor Power In status indicator LED
B	Encoder voltage selector	**J**	Motor's test button - CCW
C	Motor's direction indicator LED	**K**	Motor's test button - CW
D	Brush Motor connector	**L**	Communication address selectors
E	Orientation marking	**M**	Status indicator LED
F	Heat sink for Motor driver	**N**	PIC Microcontroller
G	Side connector	**O**	Manufacturing Test Points
H	Motor Power In connector	**P**	Arrow

A – Connector for encoder connection. User can connect 5V, 12V or 24V encoder with the suitable voltage selected. Please ensure the pins are correct when connect encoder to the board. Please refer to the marking at the back of connector for wiring polarity and signal.

B – Encoder voltage selector. User can use the mini jumper to select 5V, 12V or 24V for voltage supplied to encoder. Please ensure the voltage selected is suitable with the encoder and only ONE input voltage range (5V, 12V or 24V) selected.

C – 2 Motor's direction indicator LED. The CW LED will turn ON will motor run in clockwise while CCW LED will turn ON will motor run in counter-clockwise.

D – The connector to connect brush motor. The brush motor connected can run in very high current, which is up to 15A.

E – The orientation marking on IFC-MD15A. Every IFC card will have this orientation marking, this is to help user in ensuring the cards are stack correctly.

F – A heat sink for motor driver which help to absorbs and dissipates heat from motor driver on MD15A.

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

H – Motor Power In connector for user to connect external power source for motor. The external power source **must** be provided to IFC-MD15A in order to run motor. User may just connect the standard connector; however, the voltage for motor will depends on pad soldered on the MD15A card either 12V or 24V. **Only 1 input** can be soldered as input.

I – Motor Power In status indicator LED. The Motor Power In status indicator LED will turn ON when either 12V or 24V external power is connected.

J – Motor's test button for motor to run in counter-clockwise (CCW). User can simply test the motor connected to MD15A by pressing this test button without any programming.

K – Motor's test button for motor to run in clockwise (CW). User can simply test the motor connected to MD15A by pressing this test button without any programming.

L – 6 set of 1x3 headers use as communication address selector on IFC-MD15A. User can set the card address by using the mini jumper.

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

N – Microcontroller which used as controller for this slave card.

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

P – 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.

Cautions: Only 1 power input (12V or 24V) can be soldered to MD15A as power source for motor. If user accidently solders both pad to power input, the PC00 and battery will be damaged.

5. INSTALLATION (HARDWARE)

For the hardware installation of IFC-MD15A, 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 the IFC system while IFC-PC00 is the main power supply of the system. For the installation of IFC-MB00 and IFC-PC00 please refer to the user's manual of IFC-MB00.

After user obtain the IFC-MD15A, user can stack it on IFC system as shown in Figure.

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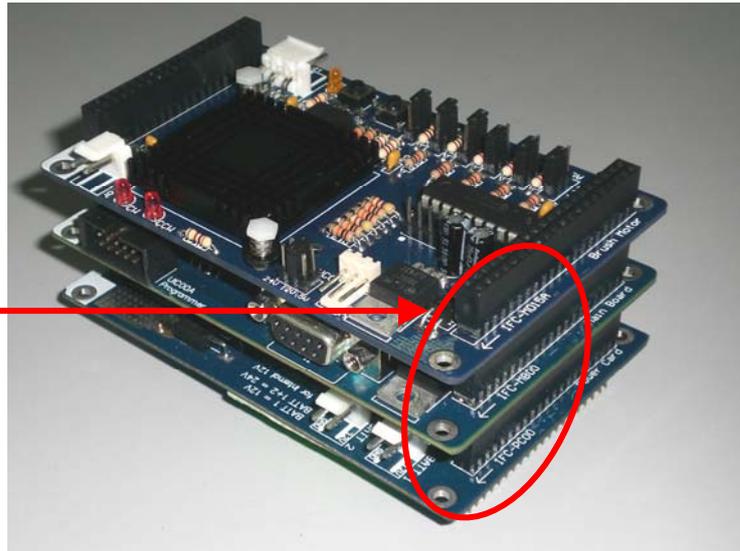
Ensure the orientation marking at the same side.
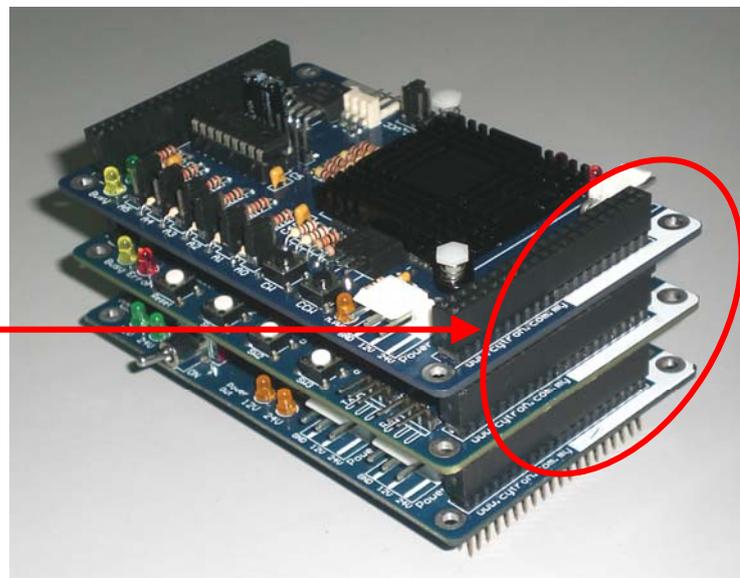
Cautions: Please ensure that every card is being stacked properly in correct orientation. Whole IFC system will be damaged if one of the cards is being stacked wrongly when it is powered up.

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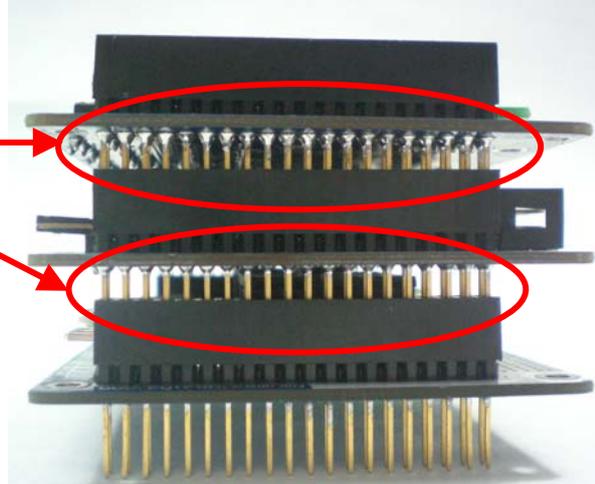
Examples of stacking cards with shifted pins. Please AVOID this!
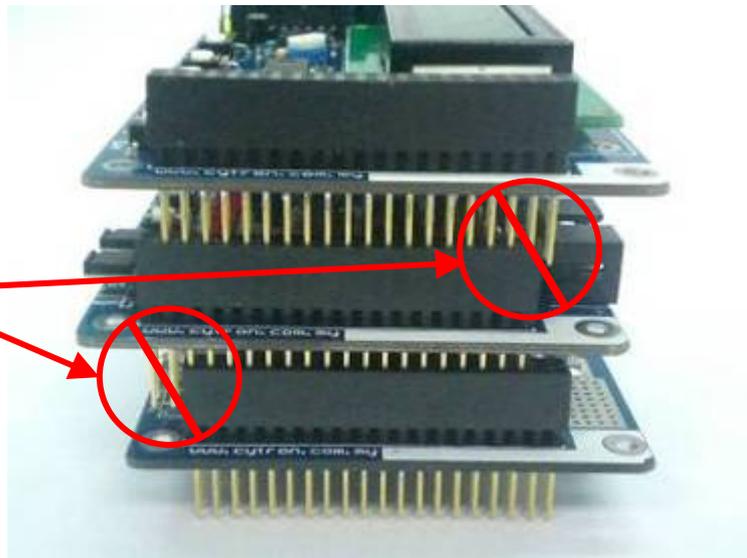
Ensure that all card pins are not shifted when stacking.

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.

User can use the mini jumper provided on IFC-MD15A to select the communication address of IFC-MD15A. For example, figure below shows the communication address, 000011 selected. Please make sure the address selected is compatible with the program. Each slave card must have unique address. Please refer chapter 7 for details of writing program for IFC-MD15A.
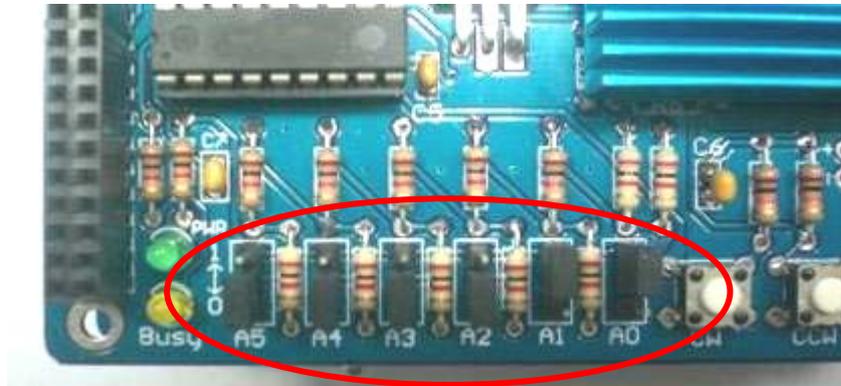
User also needs to select power source for the encoder if it is connected to MD15A. There is an encoder voltage selector beside the encoder connector. User can use the mini jumper to select 5V, 12V or 24V for voltage supplied to encoder. Please ensure the voltage selected is suitable with the encoder and only ONE input voltage (5V, 12V or 24V) is selected. Figure below shows that 12V was selected for encoder voltage.

12V was selected for Encoder.
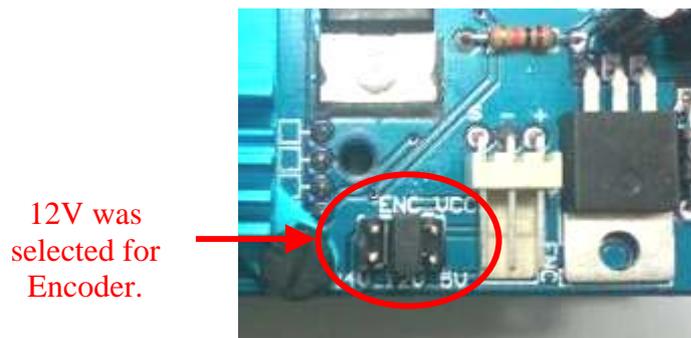
Caution: Please ensure that only ONE input voltage range (5V, 12V or 24V) selected for encoder voltage selector. If user need to supply 24V to encoder, 2 x 12V batteries must be connected to Power Card or to provide 24V.

Figure below shows how to connect an Encoder and motor to MD15A. The encoder voltage is selected as 12V.
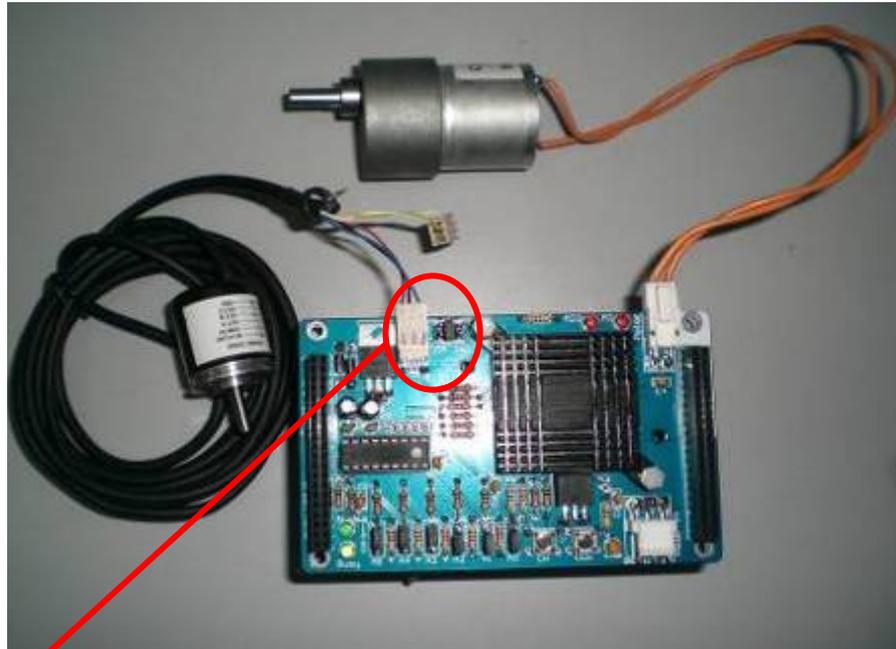
Do ensure that the pins connected to encoder are correct. (+) for VCC, (-) for GND and (s) for signal.

User should connect external power source from IFC Power Card, IFC-PC00, IFC Extension Board, IFC-EB02 or external battery. There are 2 types of voltage for MD15A to run brush motor, which are 12V and 24V. **Please ensure supply the suitable voltage for the motor.** MD15A will be sold **fix 12V**. However, user may de-solder the 12V pad and solder 24V pad if 24V is wanted as power source for brush motor.

24V pad is soldered on MD15A board.
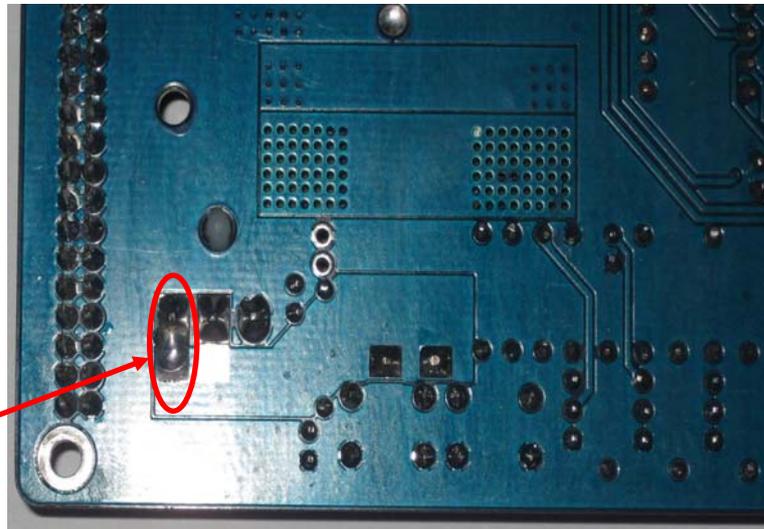
Unsolder 24V pad and solder 12V pad to supply 12V to brush motor.
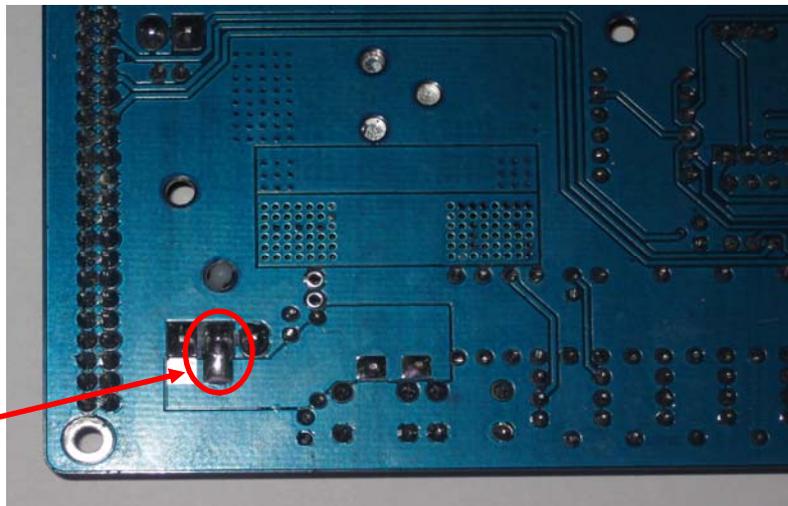
The following figures show the connection of external Power In from Power Card, Extension Board and external battery. **User needs to make sure the polarity is correct when connect external power source for Brush Motor Card.**

If user need to supply 24V to Brush Motor from Power Card, 2 x 12V batteries must be connected to provide 24V. Besides that, user needs to ensure 24V pad on MD15A board is soldered. Please refer User's Manual for IFC-MB00 for the connection of battery to Power Card.
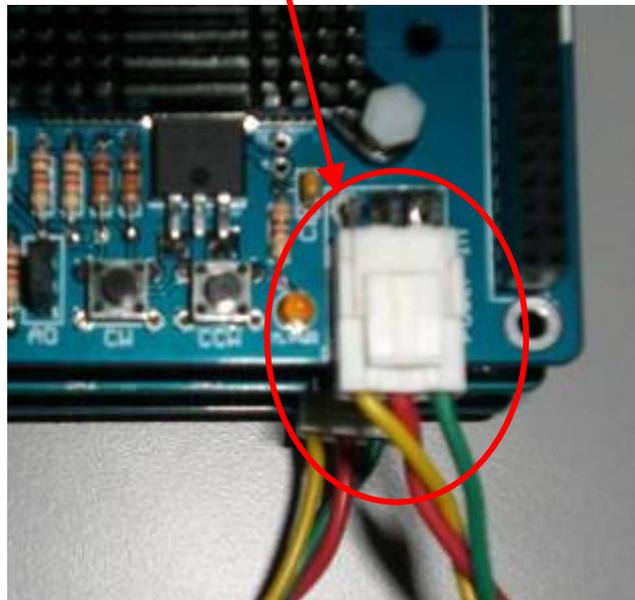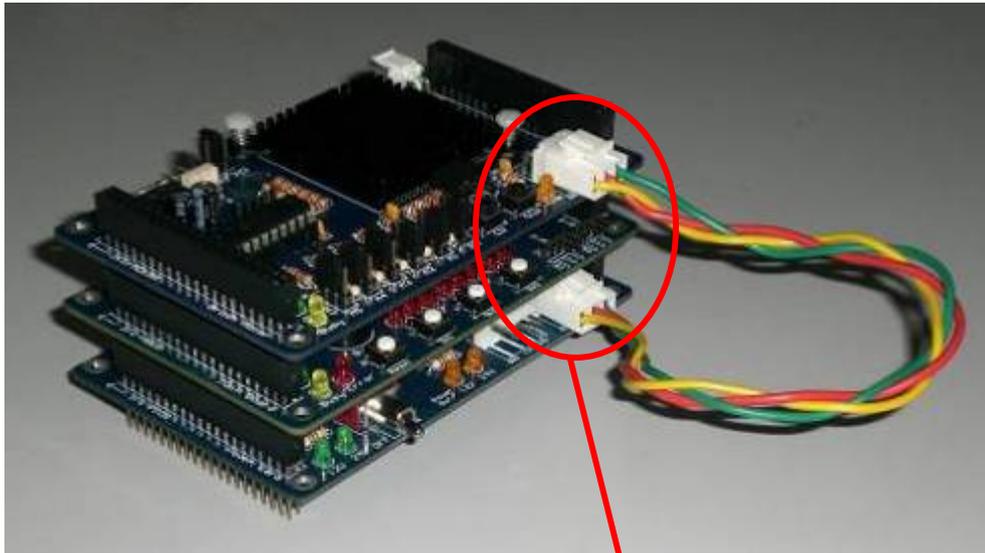
Do ensure that the polarity and connection of cables are correct.

24V pad is soldered
on MD15A board.
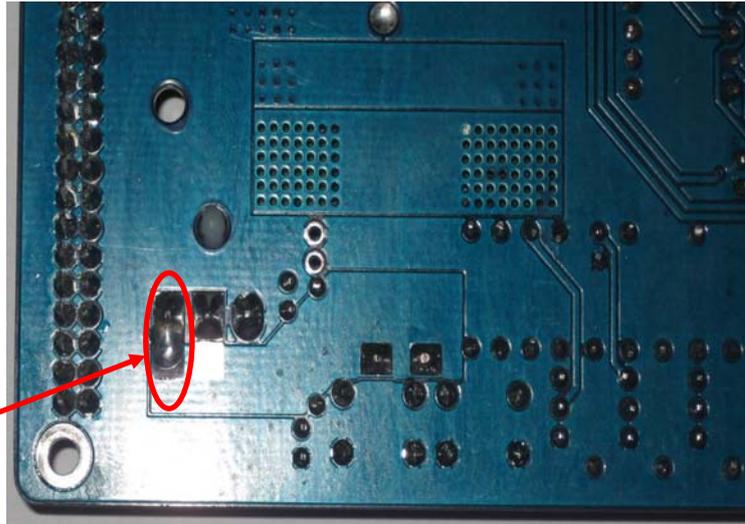
Following figure shows the example of connect external power source from IFC Extension Board. Please refer User's Manual for IFC-EB02 for the more details.
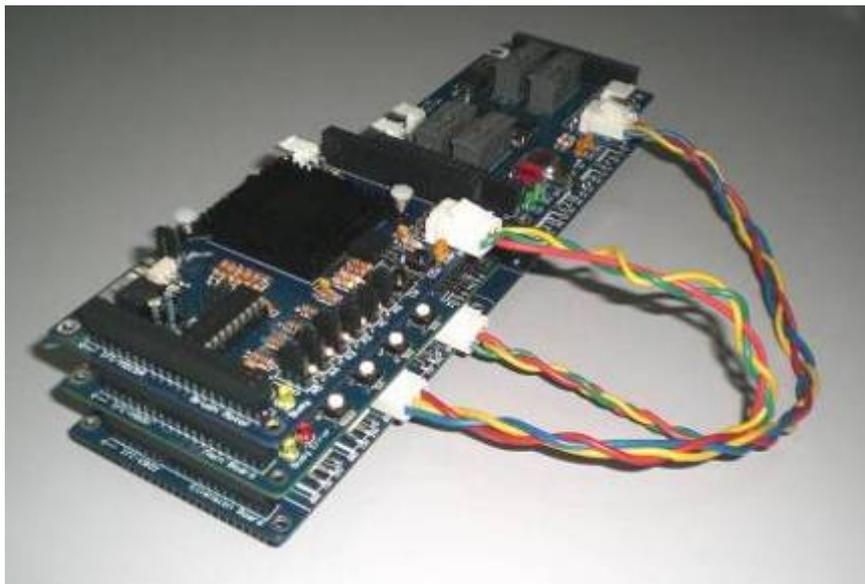
Note: User is recommended not to use external power source from IFC Power Card if the brush motor is running at more than 10A.

User can connect the external power source from external battery as shown in figures below. If user needs to supply 24V from external battery, ensure 24V pad is soldered on MD15A board.

24V pad is soldered on MD15A board.
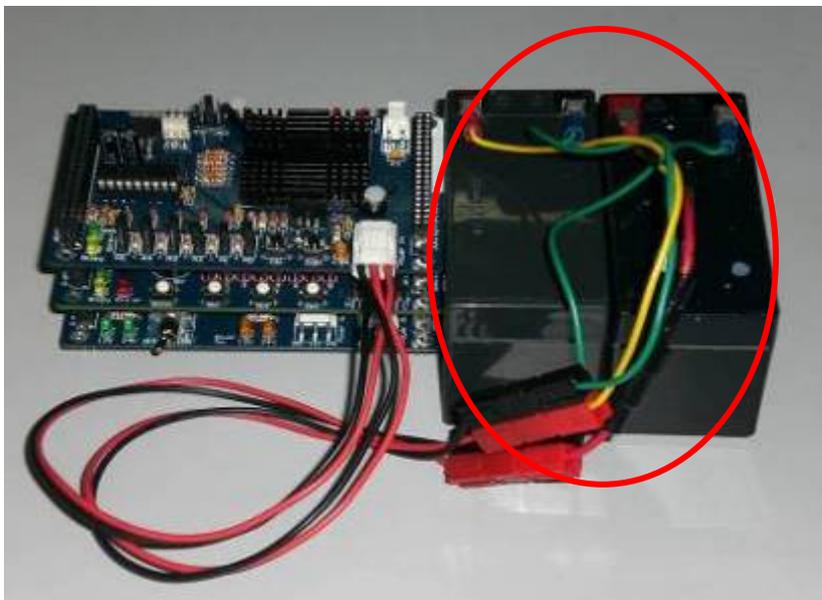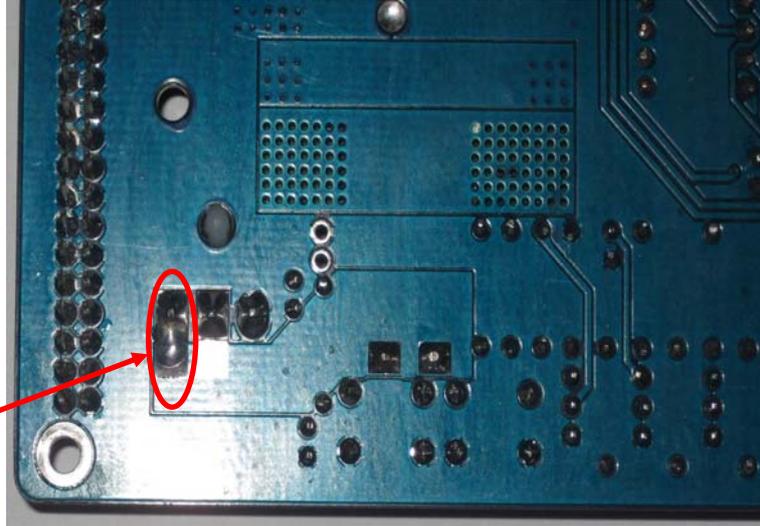
There are 24V (2 x 12V Batteries) connected. The batteries connected in figure are Sealed Lead Acid Battery. However, user is free to connect any type of 12V battery as external power source.

If user needs to supply 12V from external battery, user may de-solder the 24V pad and solder 12V pad to MD15A board.

Unsolder 24V pad then solder 12V pad to supply 12V from external
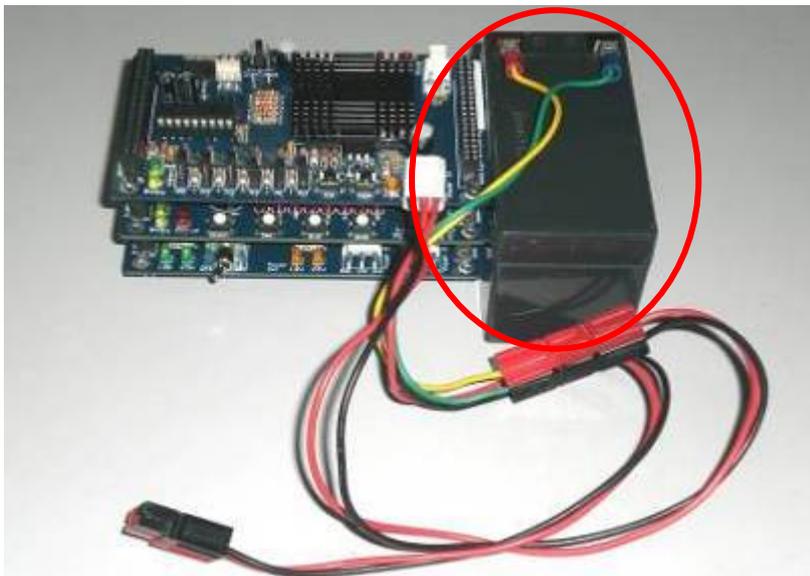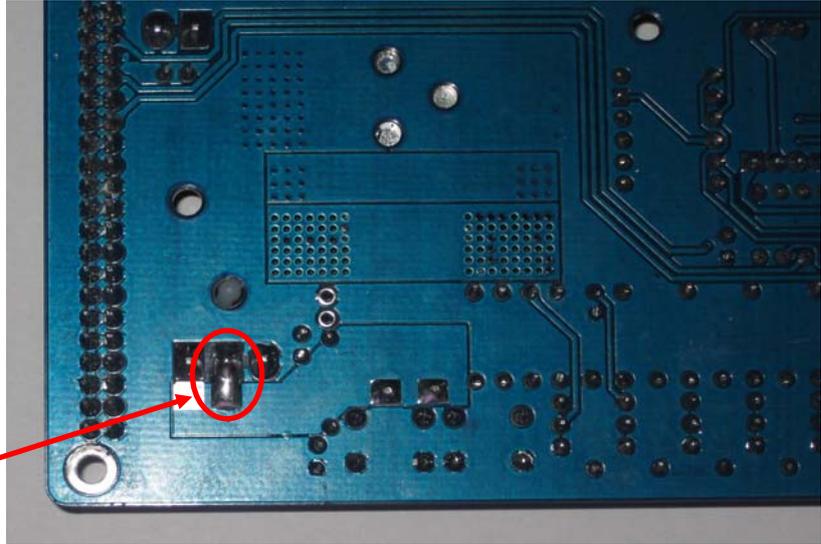
There are 12V (1 x 12V Battery) connected. **This connection is only suitable for MD15A which will drive brush motor with 12V.** The battery connected in this figure is Sealed Lead Acid Battery. However, user is free to connect any type of 12V battery as external power source.

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

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

1	2	3
	Solder some lead on it.	**Insert into 3961 connector.**

4	5	6
		Solder some lead on it.

7	8	9
Solder another cable on it.	**Insert into 3961 connector.**	

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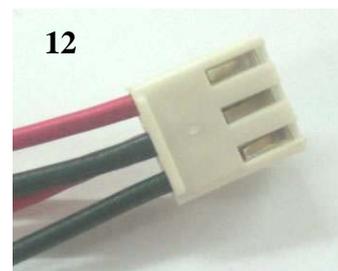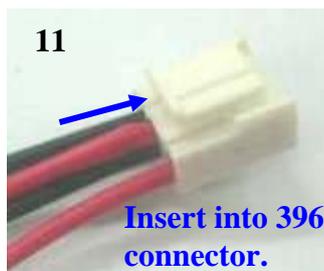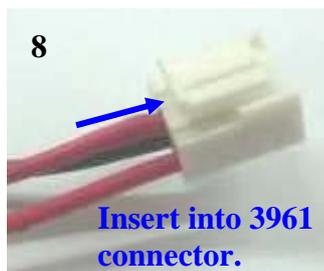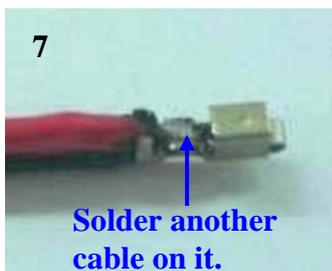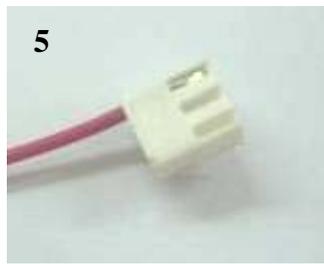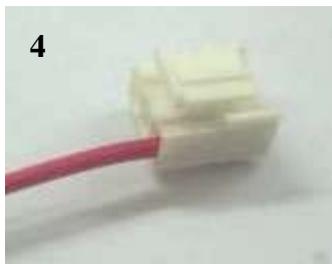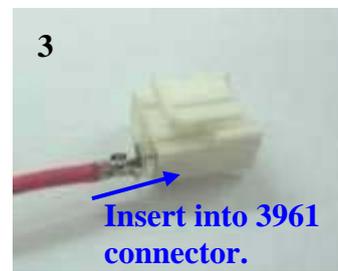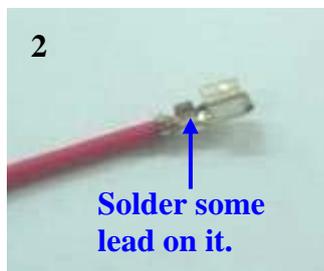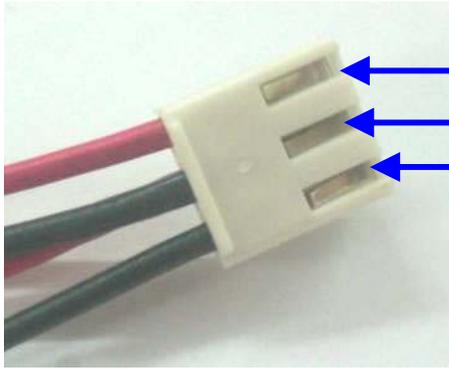
Ensure the iron pins are fully inserted to the connector
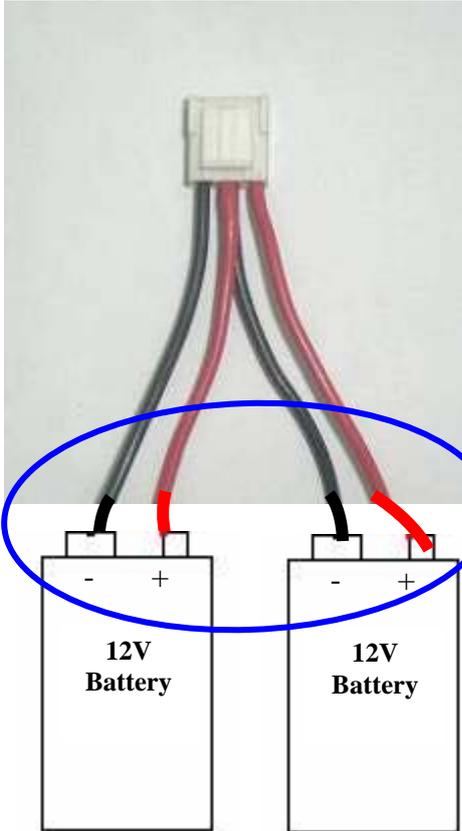
Connect the cable to batteries. **Please ensure the polarity is correct.** Red for positive (+) while black for negative (-).

After power is connected to Motor Power in, the Motor Power In status indicator LED will turn ON. The Motor Power In status indicator LED will turn ON no matter 12V or 24V external power is connected. If the indicator LED does not turn ON when power is connected, please check the polarity and connection, DO NOT simply on the IFC system.

The Motor Power In status indicator LED turn ON when either 12V or 24V external power is connected.
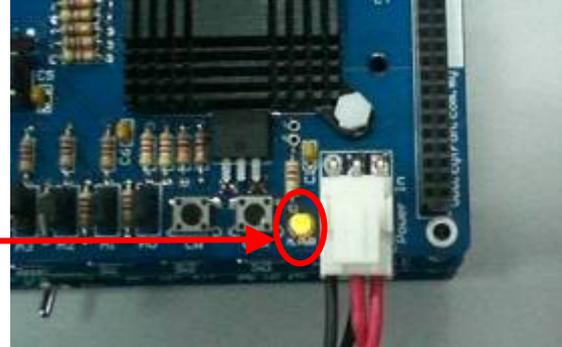
Next, please turn ON the power on Power Card, the PWR LED of IFC-MD15A will ON as shown in Figure. Initially, if there are no functions related to IFC-MD15A being called in Main Board's program, the busy LED will not ON or blink.

PWR LED on
IFC – MD15A

PWR LED on
IFC - MB00

12V LED on
IFC - PC00
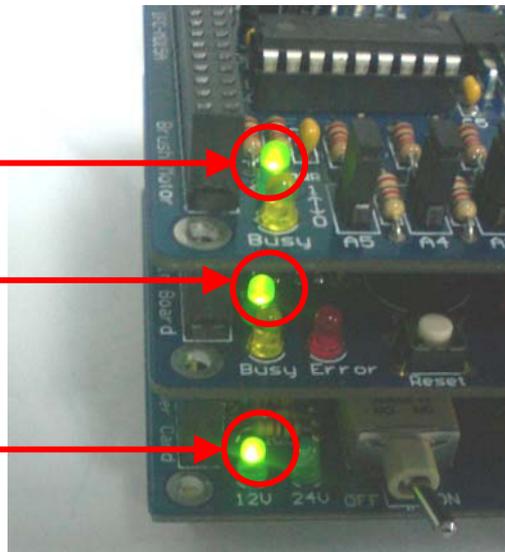
To open the cards, user should use the IFC card's opener to open the stacked cards. Figure shows the method to open cards with the opener. Please **turn OFF** the IFC system before open IFC cards.
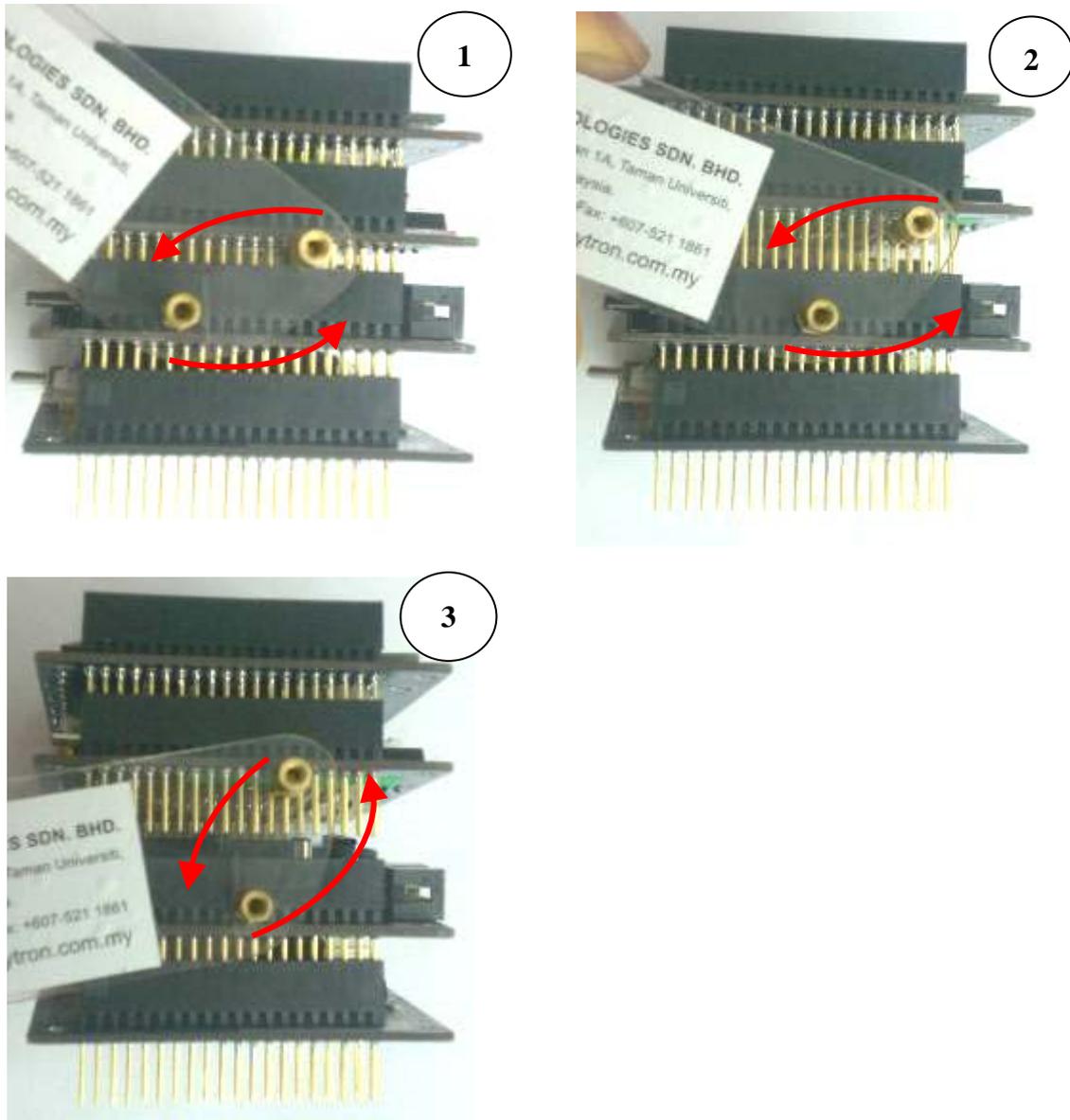
Caution: Please use the opener to open IFC cards to avoid damage of the pins or cards.

6. INSTALLATION (SOFTWARE)

User need only to write program for IFC-MB00 in order to send data and communicate with IFC-MD15A. 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 Brush Motor Card, IFC-MD15A.

> **1st step: Address**
> - Configure Card's address

> **2nd step: Stacking**
> - Stack the card/s
> - Connect the necessary battery
> - Connect necessary sensor or motor
> - Turn it ON

> **3rd step: Program**
> - Include the necessary header and object file/s
> - Write program using template given
> - Call necessary function referring to Program Reference Notes
> - Compile and Load Program through UIC00A
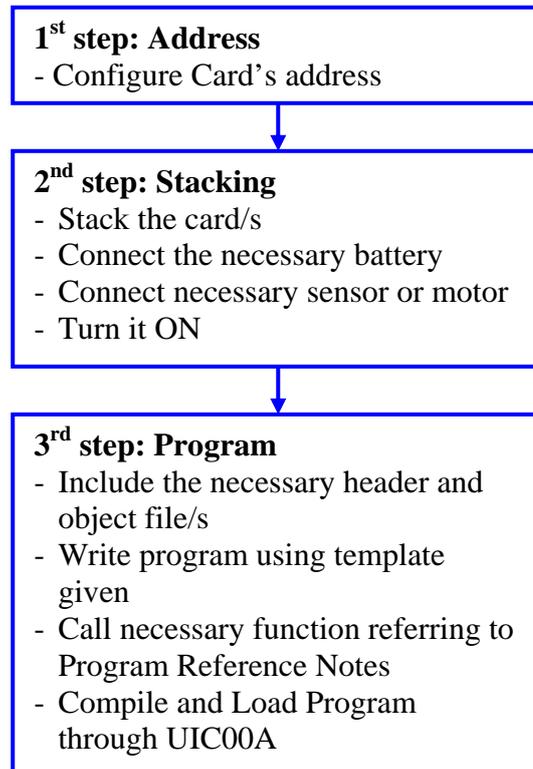
There are 2 basic setups in this chapter for IFC-MD15A, the 1st example includes 3 cards, IFC-PC00, IFC-MB00 and IFC-MD15A, while 2nd example includes one extra card, which is IFC-CP04. Please refer to the following section of this chapter for setup details.

7.1 Basic Setup (IFC-PC00 + IFC-MB00 + IFC-MD15A)

This is the basic and minimum setup for IFC-MD15A which comes with 1 brush motor terminal and one encoder terminal. Though without other card, this basic setup can still perform some task such as drive a brush 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. Brush 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 Brush Motor Card (IFC-MD15A) at top layer as shown in following figure.
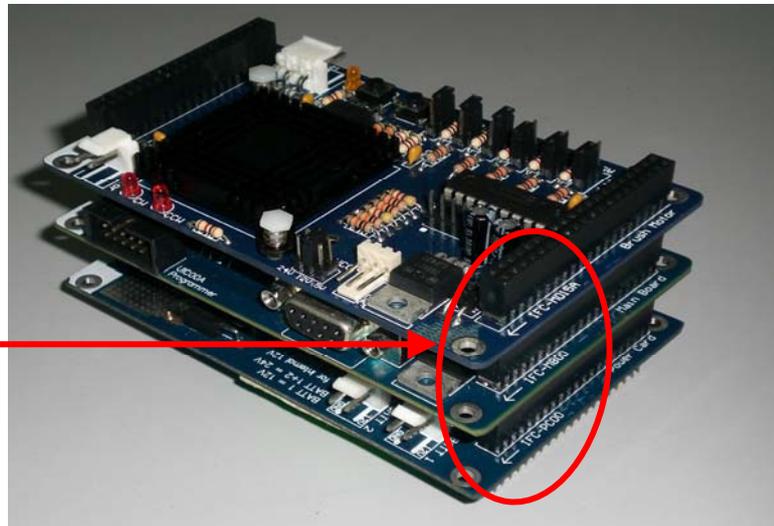
Ensure the arrow points to the same direction.

Ensure the orientation marking at the same side.

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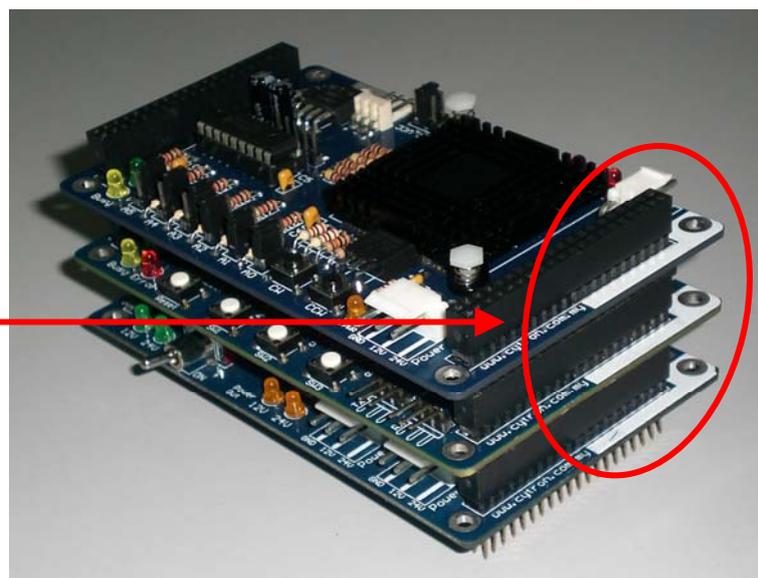
Ensure that all card pins are not shifted when stacking.

d. Connect the brush motor and encoder (if necessary) to Brush Motor Card. Please refer hardware setup for connecting input devices to Brush 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**.
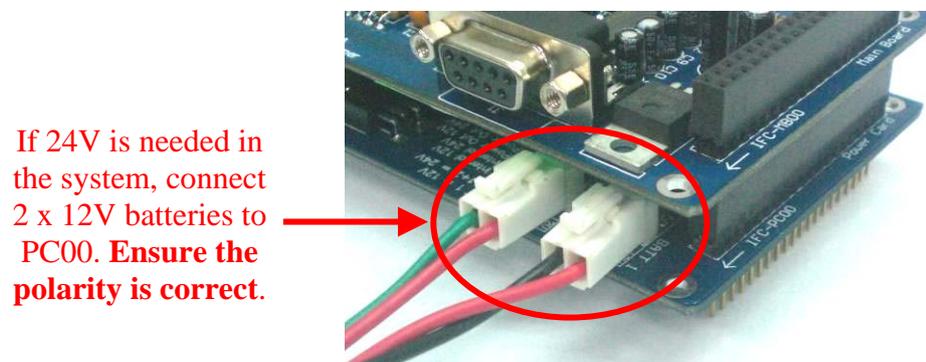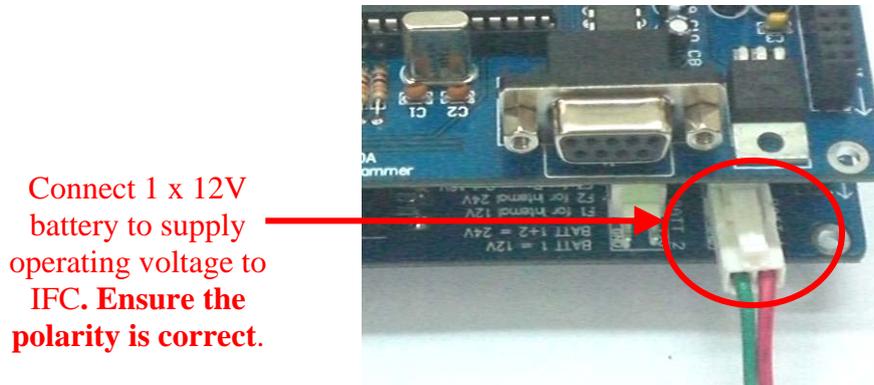
f. Connect the External power source for Brush Motor Card. Please refer hardware setup in chapter 5.0 Installation (hardware) for connecting power to Brush Motor Card. Please ensure the external power source pad soldered on MD15A board is compatible with external power source.(12V or 24V)

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 Brush Motor Card) light up as shown.
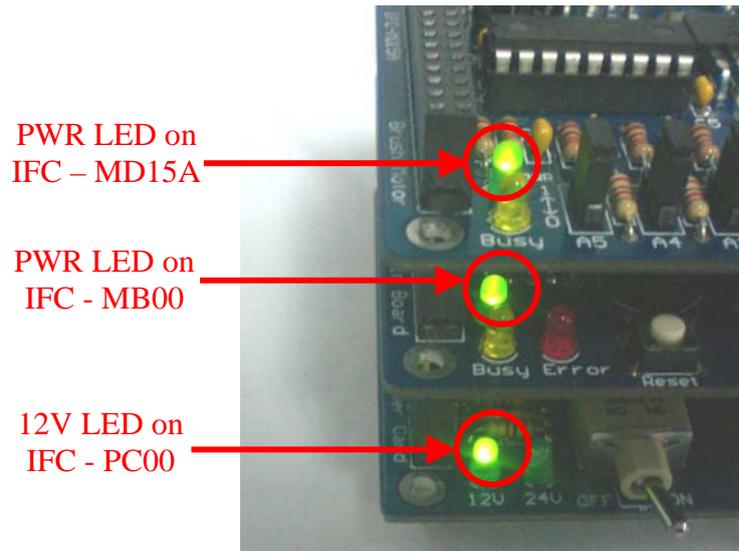
PWR LED on
IFC – MD15A

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_MD" for IFC Brush Motor Card. Please note that the header file (iic.h and iic_md.h) and object file (iic.o and iic_md.o) for IFC-MB00 and IFC-MD15A have to be included in the project. If user did not use the provided sample source code, "Sample1_MD.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.
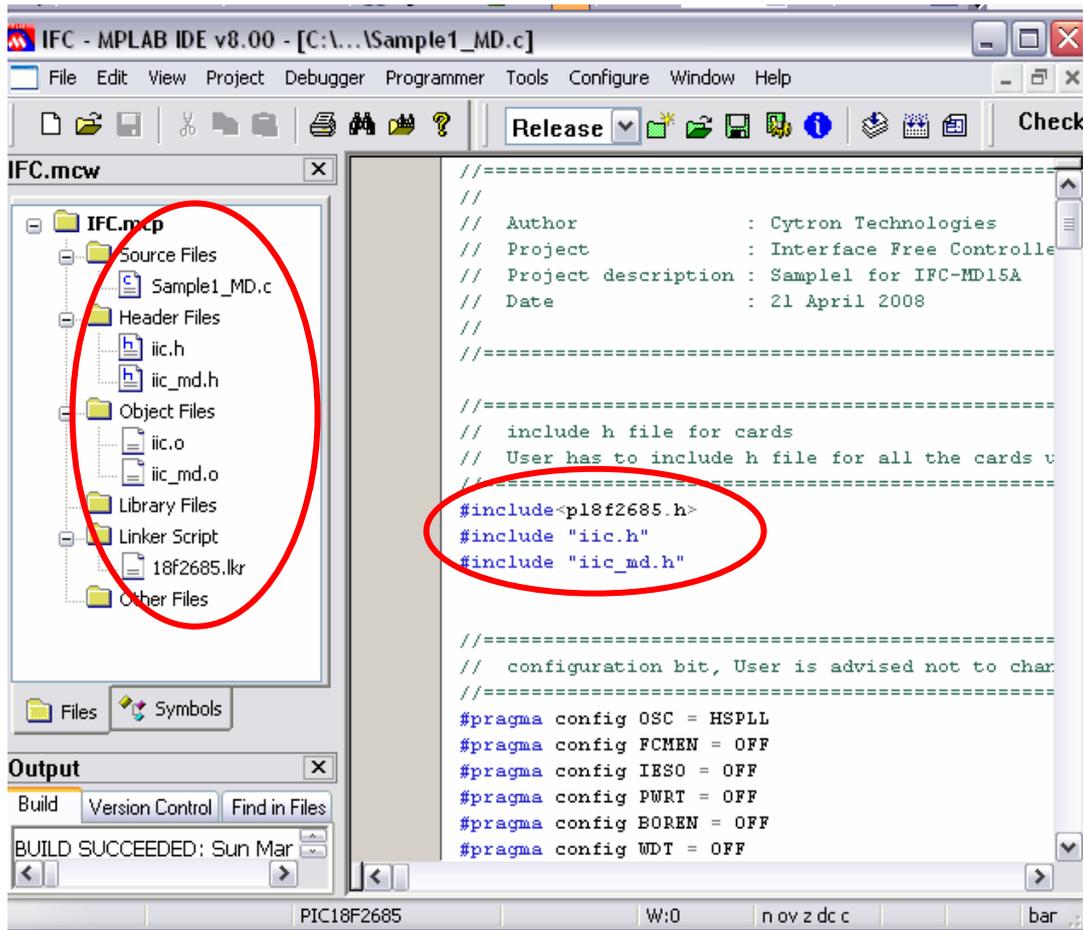
j. For those wanted to understand the program, please refer to c file named "Sample1_MD.c" which is provided with this card.

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

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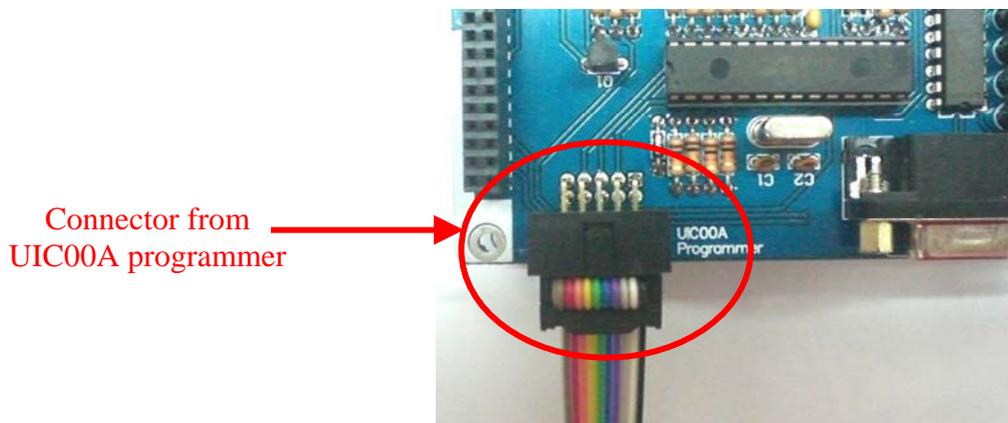
l. Load the hex file generated to UIC00A using PICkit2 window (refer to UIC00A User's Manual for details). Power up IFC system if it is OFF.

m. There are also 3 modes for user to select in program "Sample1_MD.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. Brush Motor is activated and run based on program.
2	SW2	Buzzer on IFC-MB00 'beeps' for 2 times. Brush Motor is activated. The motor will change the running direction to counter-clockwise and speed to 100 when encoder value = 1000.
3	SW3	Buzzer on IFC-MB00 'beeps' for 3 times. Brush Motor is activated. The motor's 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-MD15A + 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-MD15A and IFC-CP04. Brush 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, Brush Motor Card (IFC-MD15A) 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
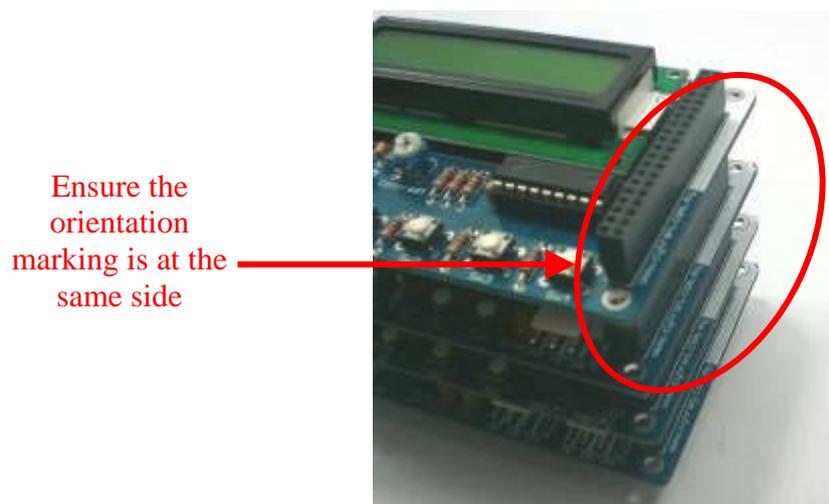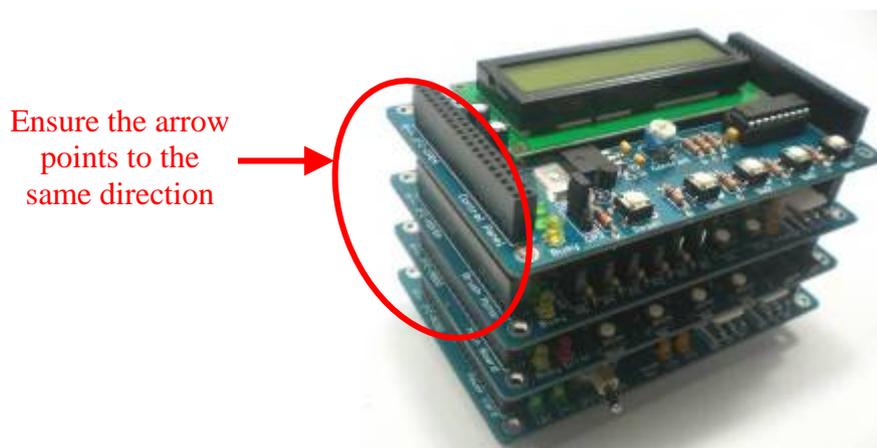
c. Besides stacking every card in correct orientation, user also needs to ensure that all the pins when stacking are not shifted and inserted to correct location.

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

d. Connect the brush motor and encoder (if necessary) to Brush Motor Card. Please refer hardware setup for connecting input devices to Brush 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 External power source for Brush Motor Card. Please refer hardware setup in chapter 5.0 Installation (hardware) for connecting power to Brush Motor Card. Please ensure the external power source pad soldered on MD15A board is compatible with external power source.(12V or 24V)

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 and PWR LED on Brush Motor Card and PWR LED on Control Panel) light up as show.
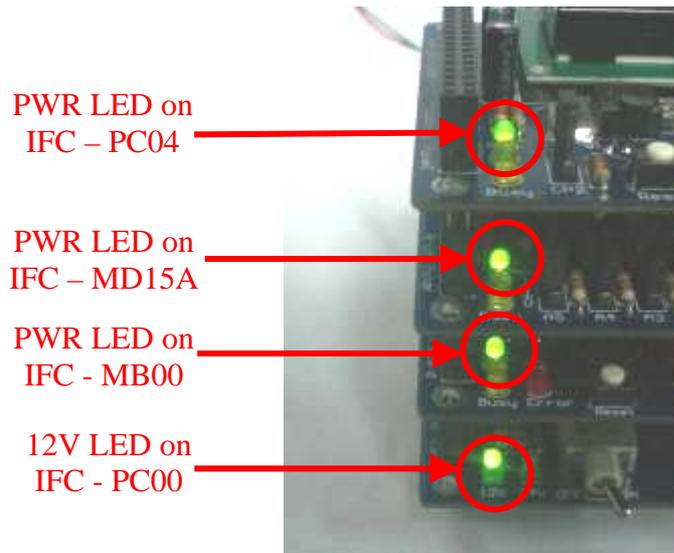
PWR LED on
IFC – PC04

PWR LED on
IFC – MD15A

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_MD15A" for IFC Brush Motor Card. Please note that the header file (iic.h, iic_md.h and iic_cp.h) and object file (iic.o, iic_md.o and iic_cp.o) for IFC-MB00, IFC-MD15A and IFC-CP04 have to be included in the project. If user did not use the provided sample source code, "Sample2_MD.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.
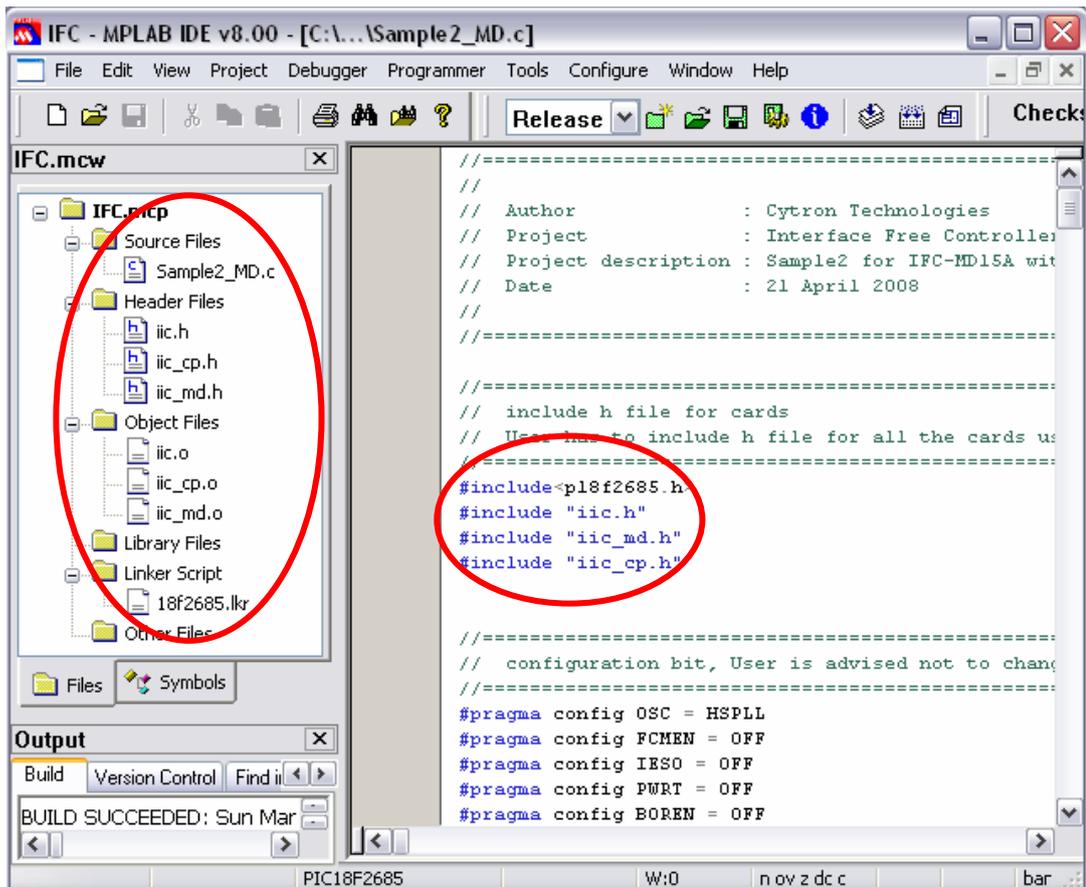
j. For those wanted to understand the program, please refer to c file named "Sample2_MD.c" which is provided with this card.

k. Compile this project to generate hex file. Connect UIC00A IDC connector to IFC-MB00 as show. The hex file generated is named "IFC_MD2.hex".

Connector from
UIC00A programmer
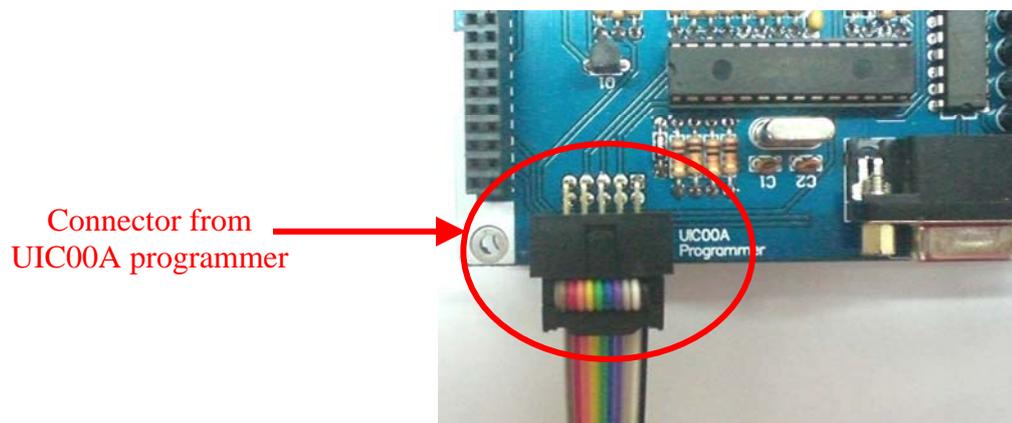
l. However, user can also add the "iic_cp.h" and "iic_cp.o" in project opened in chapter 7.1, remove the C file, "Sample1_MD.c", in the project and replace it with "Sample2_MD.c" without creating a new project for Control Panel.

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_MD.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. Brush Motor is 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 motor will change the status based on program. The motor's status will be display on Control Panel.
3	SW3	Buzzer on IFC-MB00 'beeps' for 3 times. Brush Motor is activated. The motor's speed will increase gradually. The motor's 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 can refer to IFC-MD15A Card Function Library for the program function list. It will help user in writing program for IFC-MD15A.

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.

Prepared by
Cytron Technologies Sdn. Bhd.
19, Jalan Kebudayaan 1A,
Taman Universiti,
81300 Skudai,
Johor, Malaysia.

Tel: *+607-521 3178*
Fax: *+607-521 1861*

URL: *www.cytron.com.my*
Email: support@cytron.com.my
     sales@cytron.com.my