Part Number :   FK-FA1413

Product Name :   MULTI-FUNCTION ONE CHANNEL RELAY SHIELD

This is the experimental board for Relay Controller as the fundamental controlling programming. It can be used to connect with sensors such as Temperature Controller, Moisture Indicator, Infrared Receiver Module, Ultrasonic Module. This circuit is adaptable and is able to upgrade to the other form of circuit such as Distance measurement circuit, Moisture Indicator.

Specification

1. Power Supply direct from Microcontroller Board. (On the Relay circuit, it can be connected with internal power supply at 12VDC [from Arduino Board] or with external power supply.)

2. This circuit can be used with Microcontroller Board such as Arduino UNO R3.

3. The circuit is composed of 3 sets which are 1 piece of Relay circuit, 3 pieces of Switch and Sensor Connector such as Temperature Controller, Moisture Indicator, Infrared Receiver Module.

4.PCB dimension : 2.15"x2.07"

Circuit Function

The circuit is composed of 4 main sections:

Section1 is Infrared Receiver Module. The transmitter is connected with the port A5. The receiver is connected with the port A0.

Section2 Relay circuit which is connected with the port P5, composed of 1) Opto transistor: function as a driver for Relay circuit and 2) Relay circuit 12VDC which is supplied by two options: **A.** in case of supplying from Arduino Board (connect adaptor with the direct current at 12VDC to Arduino Board), put jumpers in J+ point and JG. **B.** In case of supplying the direct current at 12VDC from external power supply through connecting FK1413, remove jumpers from J+ point and JG point and supply the direct current at 12VDC from the external power supply to 12V point.

Section3 There are 3 switches in Switch circuit connected with the port P10,P11 and P12

Section4 is for connecting with Sensor Connectors;

-CON1 is used to connect with Moisture Indicator DHT11, DHT22 or Ultrasonic Module HC-SR04 through the port P6 and P7. To connect CON1 with Moisture Indicator, jump the jumper JP6 and JP7 but if we want to connect with Ultrasonic Module, remove the jumpers of JP6 and JP7.

-CON2 is used to connect with Moisture Indicator such as 18B20 through the port P8.

-CON3 is used to connect with Infrared Receiver Module through the port P9.
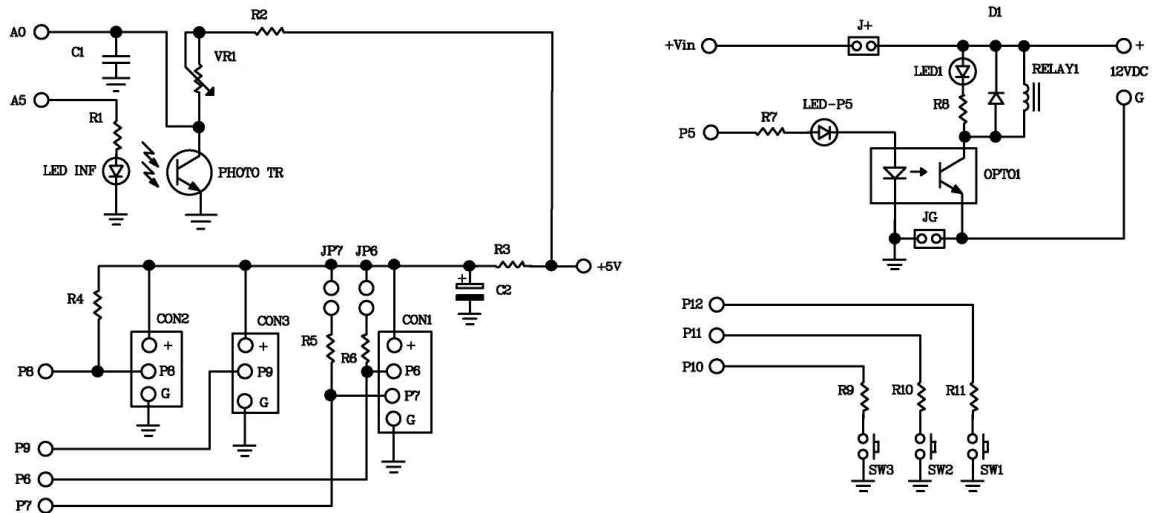
Figure 1. Circuit Diagram of FK1413

Circuit Assembling

According to Figure 2, the easy assembling should be started with putting the smallest part on the circuit which is Resistor. Caution, all parts must be on the right electrodes such as LED. Please see Figure 3 for putting parts on electrodes. On the soldering, use a soldering iron max. 40 watts and tin/lead at 60/40 with flux. After assembling and soldering, re-check the positions of each part. In case some parts are on the wrong positions, use solder suction or solder wick to correct the positioning of those parts.
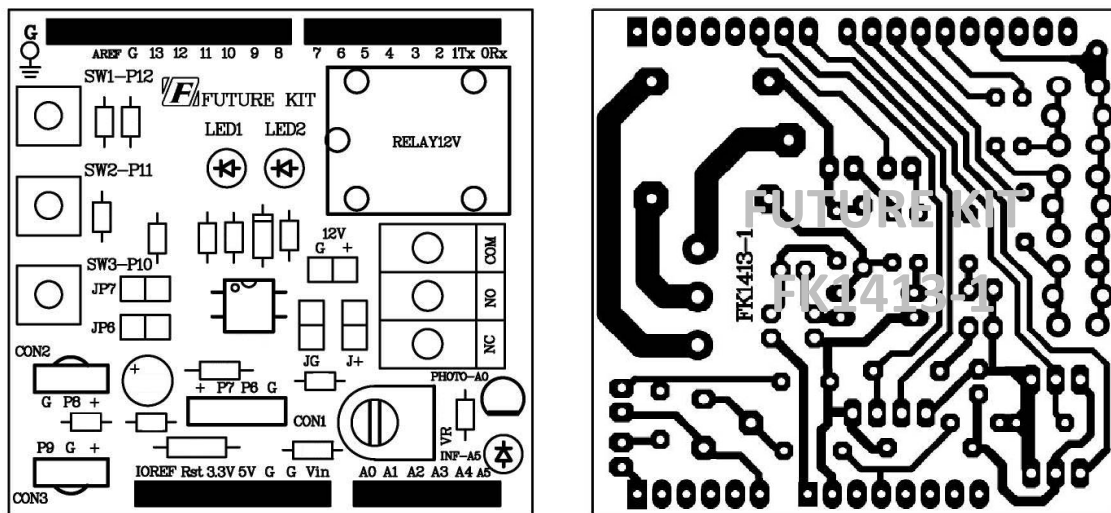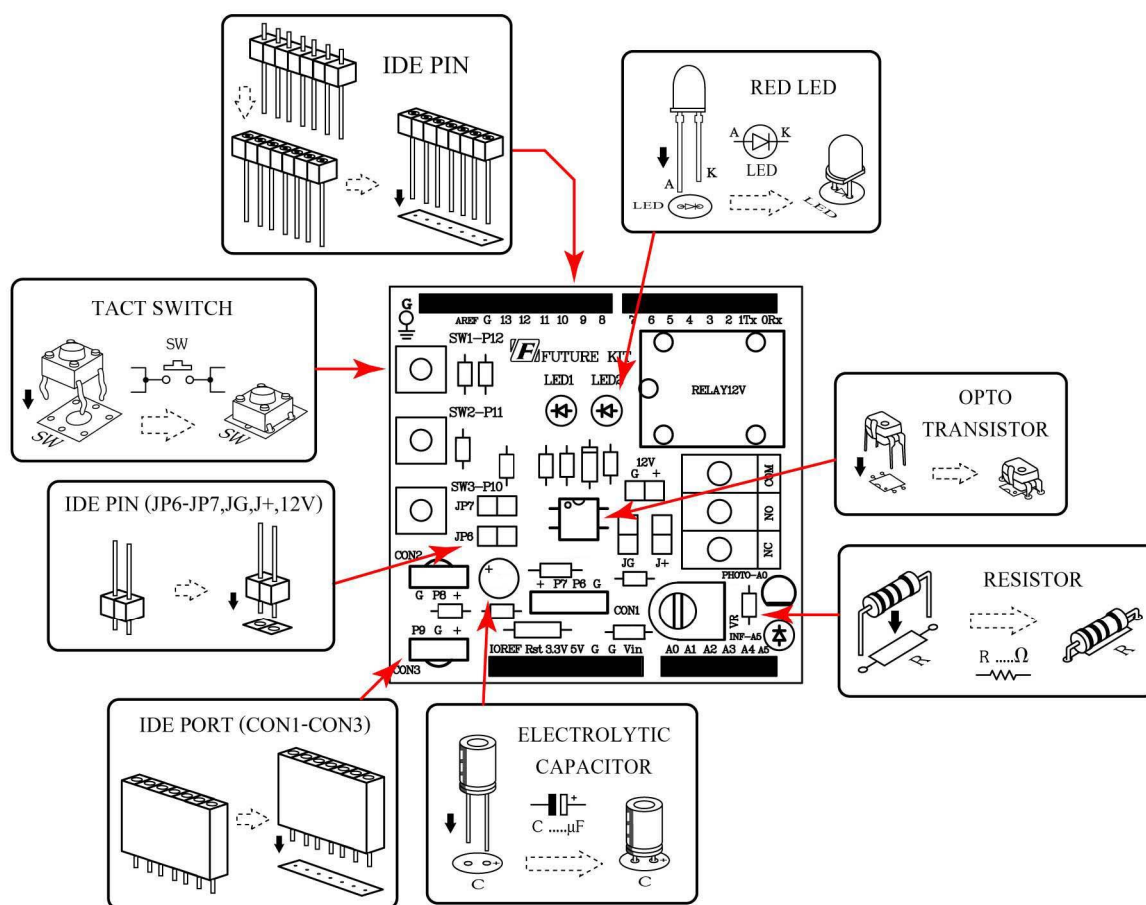

Figure 2. The positions for assembling and PCB copper line.

Figure 3. Positioning the parts on PCB

Programming instrument for the experimental board

1. FK-FA1413 MULTI-FUNCTION ONE CHANNEL RELAY SHIELD   1   set

2. 12VDC 500mA. Power Adaptor   1   Piece

3. Microcontroller Board ex. Arduino UNO R3   1   set

4. USB Cable   1   Piece

5. Computer Set   1   Set

6. Arduino Software   1   Piece

Testing Arduino UNO R3 Board

1. Connect USB cable with USB port of computer and USB port of Arduino UNO R3 Board.

Figure 4. Connecting USB cable with USB port of Arduino Board

2. Open Arduino program by double-click on Arduino icon. Go to the menu bar, click on File and choose Open. Go to "EX" folder, open "TEST" folder and click on "Test" file.
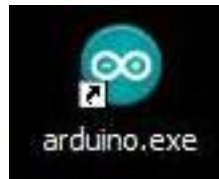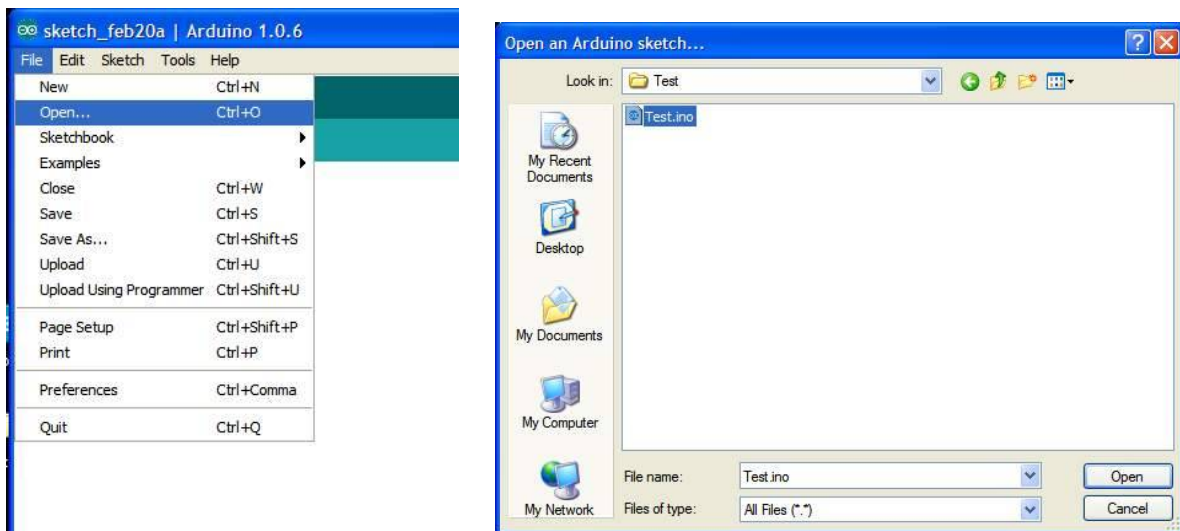

Figure 5. Opening Arduino program

Figure 6. TEST Program

3 Download TEST program to Arduino Board.

Figure 7. Downloading TEST program

3. After downloading, the LED L on Arduino Board will blink which means Arduino board is working.

Figure 8. The position of LED L on Arduino Board circuit

The details of TEST program, Flashing Light Program, Arduino UNO R3 experiment.

void setup() {

  pinMode(13, OUTPUT);   // Set the pin 13 is OUTPUT pin.

}

void loop() {

  digitalWrite(13, HIGH);   // LED at the pin 13 is light-on.

  delay(1000);   // delay time 1 second

  digitalWrite(13, LOW);   // LED at the pin 13 is light-off.

  delay(1000);   // delay time 1 second

}

The method to connect the circuit with Arduino UNO R3 board

Connect FK1410 board with Arduino UNO R3 board by following Figure 9.
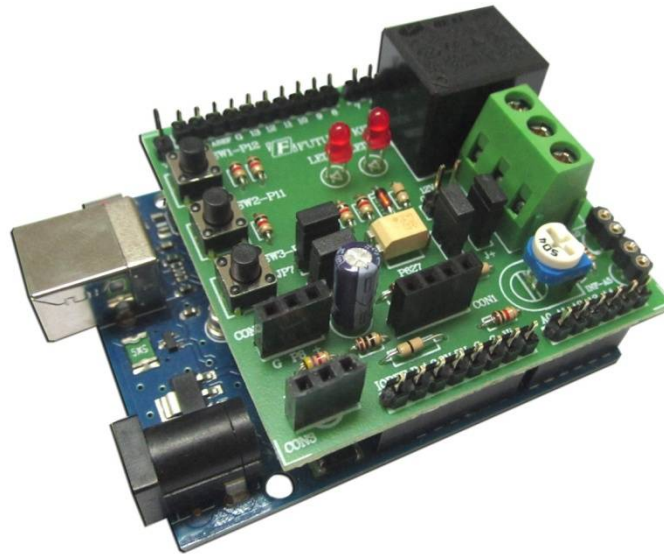

Figure 9. Connecting FK1413 board with Arduino UNO R3 board

Programming

1. Connect Arduino UNO R3 board with experimental board by following the instruction of the method to connect the circuit with Arduino UNO R3 board. Then jumping the jumper at J+ point and JG point and connect the power adaptor to DC-IN on Arduino board.

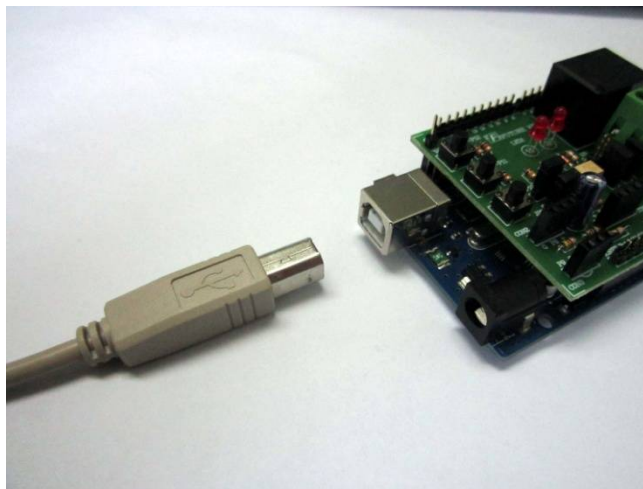2. Connect the USB cable with USB port of computer and USB port of Arduino UNO R3 board.

Figure 10. Wiring the USB cable

3.Double-click on Arduino icon to open Arduino program. Go to "File" in menu bar and choose "Open". Then click on "Ex" folder, choose "FK1413" folder, choose "LAB1413-1" folder and click on "LAB1413-1" file.
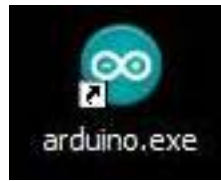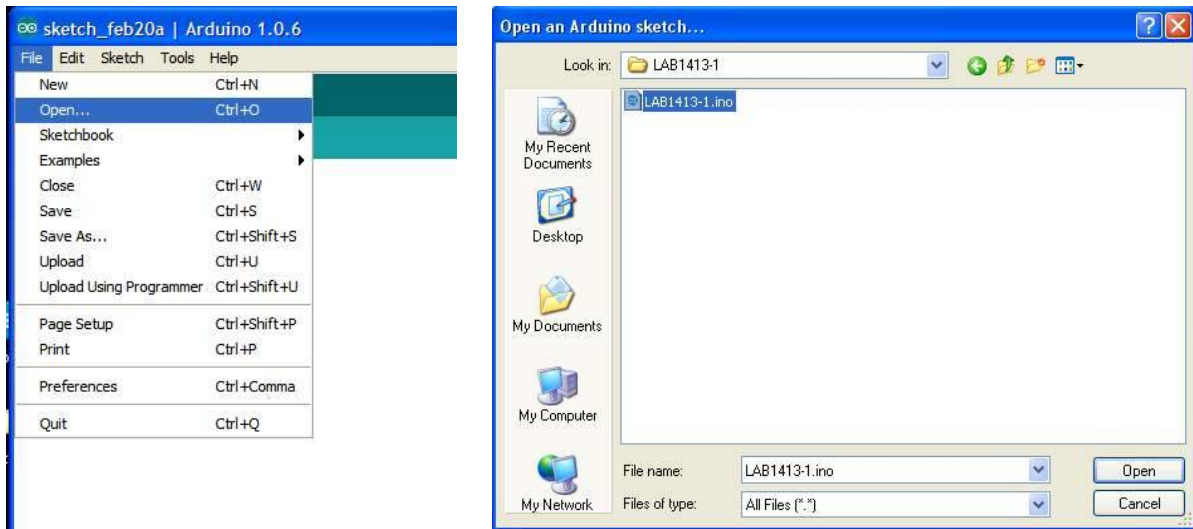
Figure 11. Opening Arduino Program

Figure 12. LAB1413-1 program

4. Download LAB1413-1 program to Arduino board.

Figure 13. Downloading LAB1413-1 program

5. After completing downloading, if the LED at FK1413 board displays light-on, relay-on and light-off, relay-off alternately, it means the Relay circuit section is working.

6. Connect LED TEST with CON3 point. The pin of Resistor must be connected with G point and the pin of LED TEST must be connected with P9. Open LAB1413-2 program in "FK1413" folder. Afterwards, download LAB1413-2 program to Arduino board, LED TEST will blink. Remove LED TEST and connect it with CON2 point, do it in the same way as connecting with CON3 point but change

the pin's position from P9 to P8. LED TEST will blink. Again remove LED TEST and connect it with CON1 point and put the pin that's no connection with Resistor in P7, then P6. If LED blinks, it means the connector point is working.
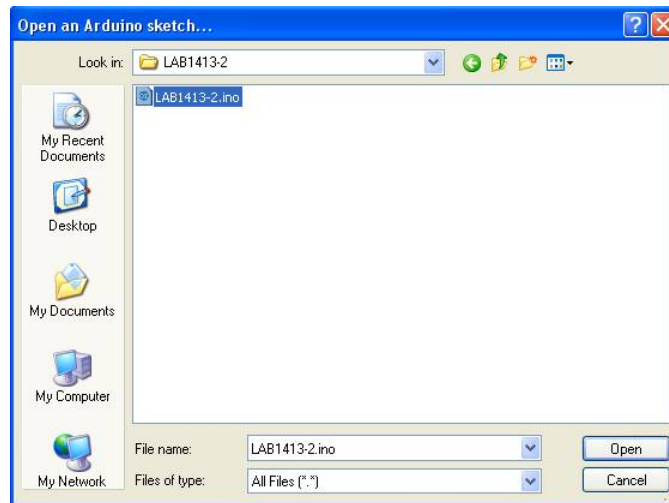

Figure 14. LAB1413-2 program

Figure 15. Downloading LAB1413-2 program

7. Open LAB1413-3 in "FK1413" folder and download this program to Arduino UNO R3 board.
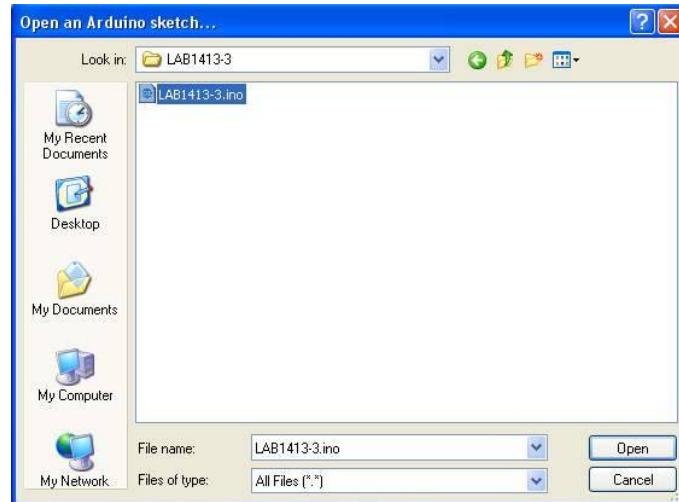
Figure 16. LAB1413-3 program

8. Press and hold switch SW1, LED1 and LED2 will be light-on, release switch SW1, LED1 and LED2 will be light-off.

9. Press and hold switch SW2, LED1 and LED2 will be light-on, release switch SW2, LED1 and LED2 will be light-off.

10.Press and hold switch SW3, LED1 and LED2 will be light-on, release switch SW3, LED1 and LED2 will be light-off.

11. If the test in step 8 to step 10 works, it means the switch circuit is functional.

12. Insert LED Infrared with INF point and photo transistor with PHOTO point as shown in Figure 17. Open LAB1413-4 program in "FK1413" folder. Download LAB1413-4 program to Arduino board. Adjust the value of resistor until the LED lights off. Hide the front side of TX-RX Infrared by using paper. The width of gap between TX-RX Infrared and paper is 1 inch approximately. To test the Infrared circuit if it is working, notice that when the paper is hiding TX-RX Infrared, the LED must be light-on and when putting of the paper, the LED must be light-off.
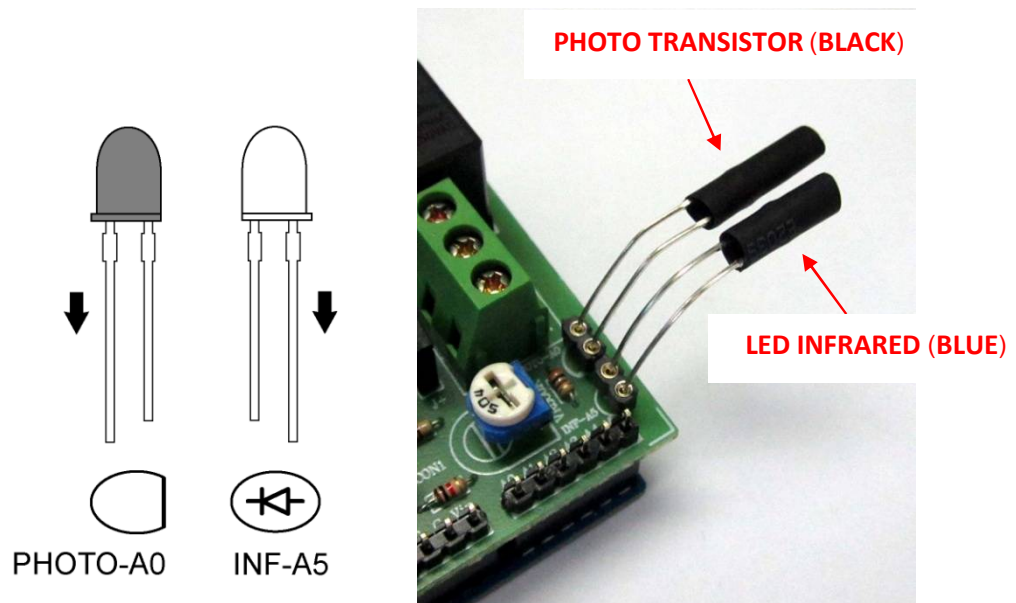
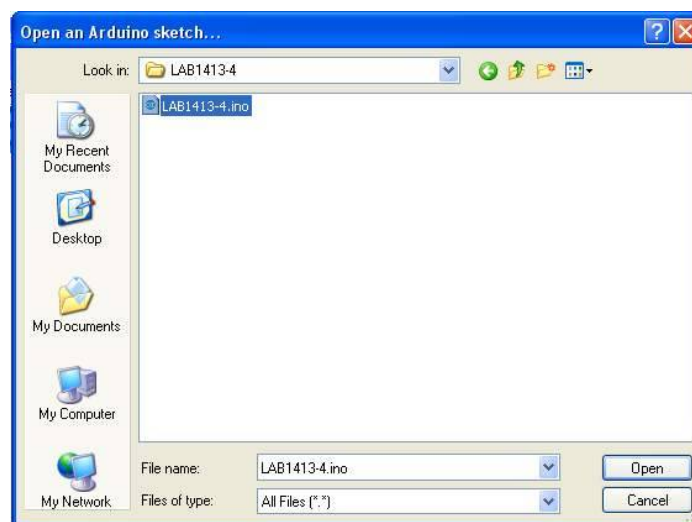Figure 17. Inserting the infrared LED and the photo transistor

Figure 18. LAB1413-4 program

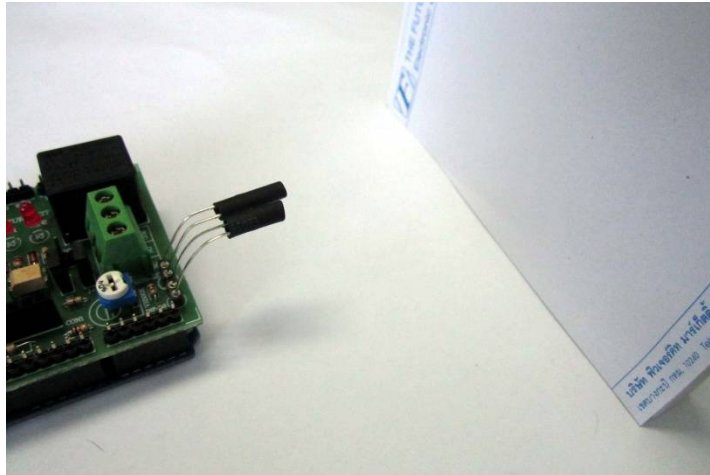Figure 19. Downloading LAB1413-4 program

Figure 20. Testing the distance between TX-RX infrared and White paper

The details of LAB1413-1 RELAY TEST program

```
void setup() {

  pinMode(5, OUTPUT);          // Set the pin 5 is OUTPUT pin.

}
void loop() {

  digitalWrite(5, HIGH);       // RELAY at the pin 5 is working.

  delay(1000);                 // delay time 1 second

  digitalWrite(5, LOW);        // RELAY at the pin 5 is stop working.

  delay(1000);                 // delay time 1 second

}
```

Function of LAB1413-1 program

The program will determine pin 5 as OUTPUT pin. The relay at pin 5 will work at 1 second and will be extinguished at 1 second, the program will start repeating the relay at pin 5.

Remark: In case we want LED ON/OFF frequently, we can reduce the value in the parentheses by commanding "delay". The unit of the digit is millisecond.

The details of LAB1413-2 CON1-CON3 CONNECTOR TEST program

```
void setup() {

  pinMode(6, OUTPUT);          // Set the pin 6 is OUTPUT pin.
```

```
    pinMode(7, OUTPUT);          // Set the pin 7 is OUTPUT pin.

    pinMode(8, OUTPUT);          // Set the pin 8 is OUTPUT pin.

    pinMode(9, OUTPUT);          // Set the pin 9 is OUTPUT pin.

  }
  void loop() {

    digitalWrite(6, HIGH);        // LED at the pin 6 is light-on.

    digitalWrite(7, HIGH);        // LED at the pin 7 is light-on.

    digitalWrite(8, HIGH);       // LED at the pin 8 is light-on.

    digitalWrite(9, HIGH);       // LED at the pin 9 is light-on.

    delay(1000);                 // delay time 1 second

    digitalWrite(6, LOW);        // LED at the pin 6 is light-off.

    digitalWrite(7, LOW);        // LED at the pin 7 is light-off.

    digitalWrite(8, LOW);        // LED at the pin 8 is light-off.

    digitalWrite(9, LOW);        // LED at the pin 9 is light-off.

    delay(1000);                 // delay time 1 second

  }
```

Function of LAB1413-2 program

The program will determine pin 6 to pin 9 as OUTPUT pin. It will light up the LED at pin 6 to pin 9 at 1 second and will extinguished at 1 second, the program will start repeating the all LED.

Remark: In case we want LED ON/OFF frequently, we can reduce the value in the parentheses by commanding "delay". The unit of the digit is millisecond.

The details of LAB1413-3 SWITCH TEST program

```
  void setup() {

    pinMode(A0, OUTPUT);         // Set the pin A0 is OUTPUT pin.

    pinMode(12, INPUT_PULLUP);   // Set the pin 12 is INPUT pin and using the PULL UP
function.

    pinMode(11, INPUT_PULLUP);   // Set the pin 11 is INPUT pin and using the PULL UP
function.
```

```
        pinMode(10, INPUT_PULLUP);  // Set the pin 10 is INPUT pin and using the PULL UP
function.

        }

        void loop() {

          int SW3 = digitalRead(10);              // Set "SW3" word is the variable of value at pin 10.

          int SW2 = digitalRead(11);              // Set "SW2" word is the variable of value at pin 11.

          int SW1 = digitalRead(12);              // Set "SW1" word is the variable of value at pin 12.

          if (SW3 == LOW) { digitalWrite(A0, HIGH); } else { digitalWrite(A0, LOW); }
```

// If press the switch SW3 (LOW status), LED at pin A0 will be light-on. But if no press the switch SW3 (HIGH status), LED at pin A0 will be light-off.

```
          if (SW2 == LOW) { digitalWrite(A0, HIGH); } else { digitalWrite(A0, LOW); }
```

// If press the switch SW2 (LOW status), LED at pin A0 will be light-on. But if no press the switch SW2 (HIGH status), LED at pin A0 will be light-off.

```
          if (SW1 == LOW) { digitalWrite(A0, HIGH); } else { digitalWrite(A0, LOW); }
```

// If press the switch SW1 (LOW status), LED at pin A0 will be light-on. But if no press the switch SW1 (HIGH status), LED at pin A0 will be light-off.

```
        }
```

Function of LAB1413-3 program

The program will determine pin A0 as OUTPUT pin and pin 10 to pin 12 as INPUT pin. Besides INPUT pin, pin 10 to pin 12 can be used for activating the function PULL UP as well.

Press and hold switch SW3 at pin 10, LED will light up, release switch SW3, LED will be light-off.

Press and hold switch SW2 at pin 11, LED will light up, release switch SW2, LED will be light-off.

Press and hold switch SW1 at pin 12, LED will light up, release switch SW1, LED will be light-off.

The details of LAB1413-4 TX-RX INFRARED TEST program

```
void setup() {

  pinMode(5, OUTPUT);    // Set the pin 5 is OUTPUT pin.

  pinMode(A0, INPUT);    // Set the pin A0 is INPUT pin.

}

void loop() {
```

```
    int PHOTO = digitalRead(A0);              // Set "PHOTO" word is the variable of value at pin
A0.

    if (PHOTO == LOW) { digitalWrite(5, HIGH); } else { digitalWrite(5, LOW); }
```

// If there is the light into the PHOTO TRANSISTOR (LOW status), LED at pin 5 will be light-on. But if there is no the light into the PHOTO TRANSISTOR (HIGH status), LED at pin 5 will be light-off.

```
    }
```

Function of LAB1413-4 program

The program will determine pin 5 as OUTPUT pin and pin A0 as INPUT pin. Besides INPUT pin, pin A0 can be used for activating the function PULL UP as well.

Set "PHOTO" word is the variable of value at pin A0. If there is the light shine into the PHOTO TRANSISTOR, LED at pin 5 will be light-on. But if there is no the light into the PHOTO TRANSISTOR, LED at pin 5 will be light-off.