



# 空污偵測器製作暨實務研習會

## 空氣盒子產品 DIY

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靜宜大學

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# 大綱

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# 前 言

- 中國紀錄片《穹頂之下》裡鋪天蓋地、讓人無處可逃的霧霾，不只存於中國；台灣，也在同一片穹頂之下
- 近年來，我國空氣品質嚴重惡化，民眾是否瞭解呼吸與健康息息相關？政府部門有無準備面對迷霧背後的產業轉型、污染整治等挑戰？
- 空污來自何方？
- 台灣海峽短短不到300公里，攔不住每年東北季風帶來的中國霧霾。每當台灣空氣品質下降，新聞或政府消息總是避重就輕的表示，是中國霧霾南下所致，然而，境外污染（含中國霧霾）僅占我國的空氣污染30%，50%來自工業排放，剩下20%則來自交通排放廢氣和其他空污來源。其實，空污更大的問題在於境內污染，政府無法推諉卻又不敢面對境內污染

# 空氣盒子產品介紹

# 瑞昱 空氣盒子

- 華碩雲端今日偕同臺北市政府、中研院及瑞昱半導體舉辦「空氣盒子PM2.5啟動記者會」，推出全台第一個智慧城市的空污監測計畫
- 「空氣盒子」僅手掌大小，可感測溫度、濕度與空氣中的細懸浮微粒（PM2.5）濃度等環境數據，並自動上傳到華碩雲端平台
- 手機APP或空氣盒子網站即可查詢

2016/5/25



蘋果即時



2016/5/25

# 硬體組裝

# 組裝零件一覽

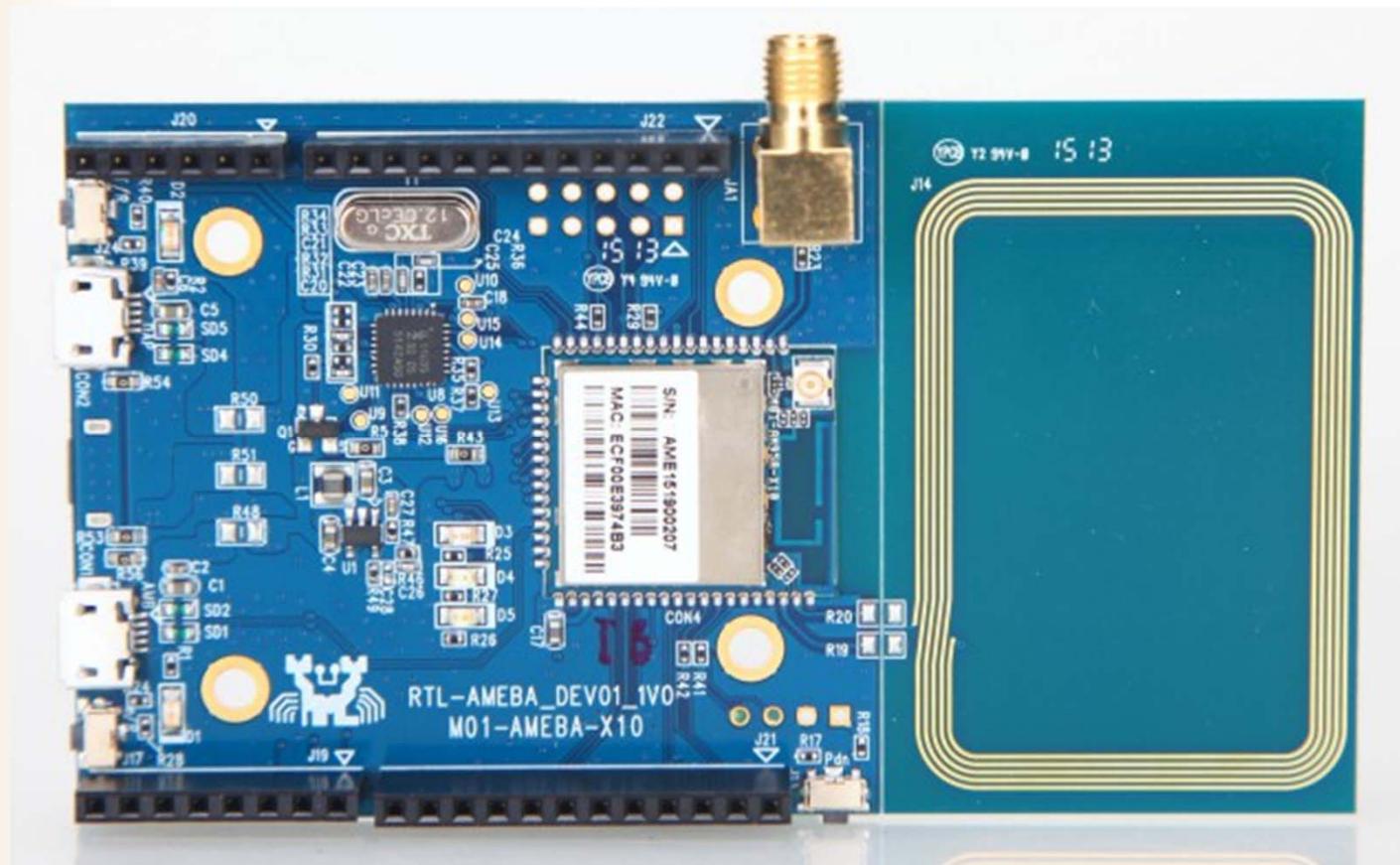
# 組裝零件一覽(1/6)

(a). 偵測空氣懸浮粒子感測器



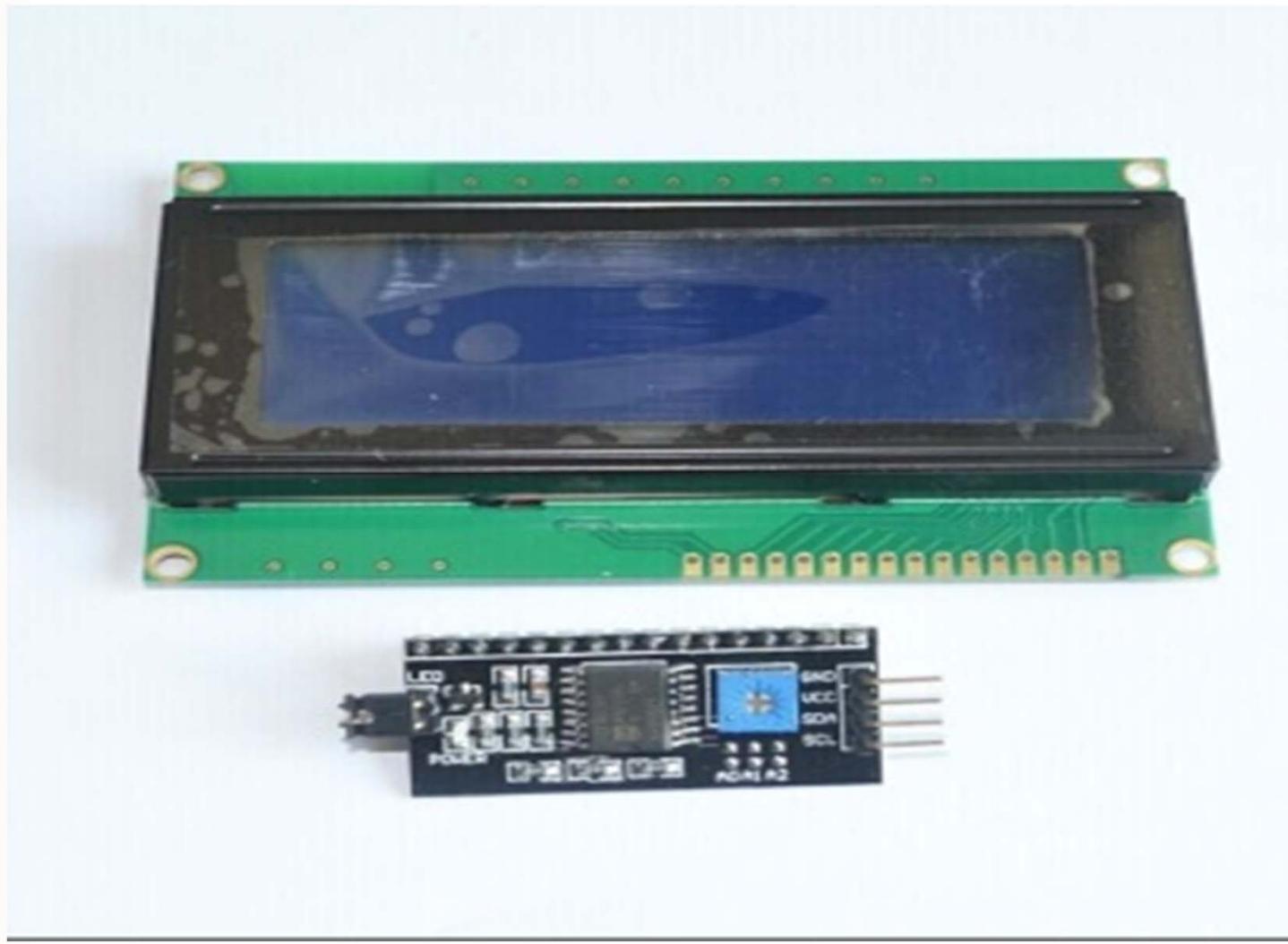
## 組裝零件一覽(2/6)

( ). Realtek阿米巴開發版



# 組裝零件一覽(3/6)

(c). 顯示模組



## 組裝零件一覽(4/6)

(d). DS1307 I2C RTC組



## 組裝零件一覽(5/6)

(e). DHT22

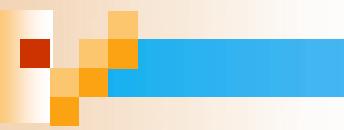


## 組裝零件一覽(6/6)



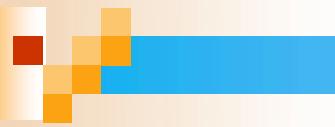
# 硬體組裝步驟

# 安裝開發版

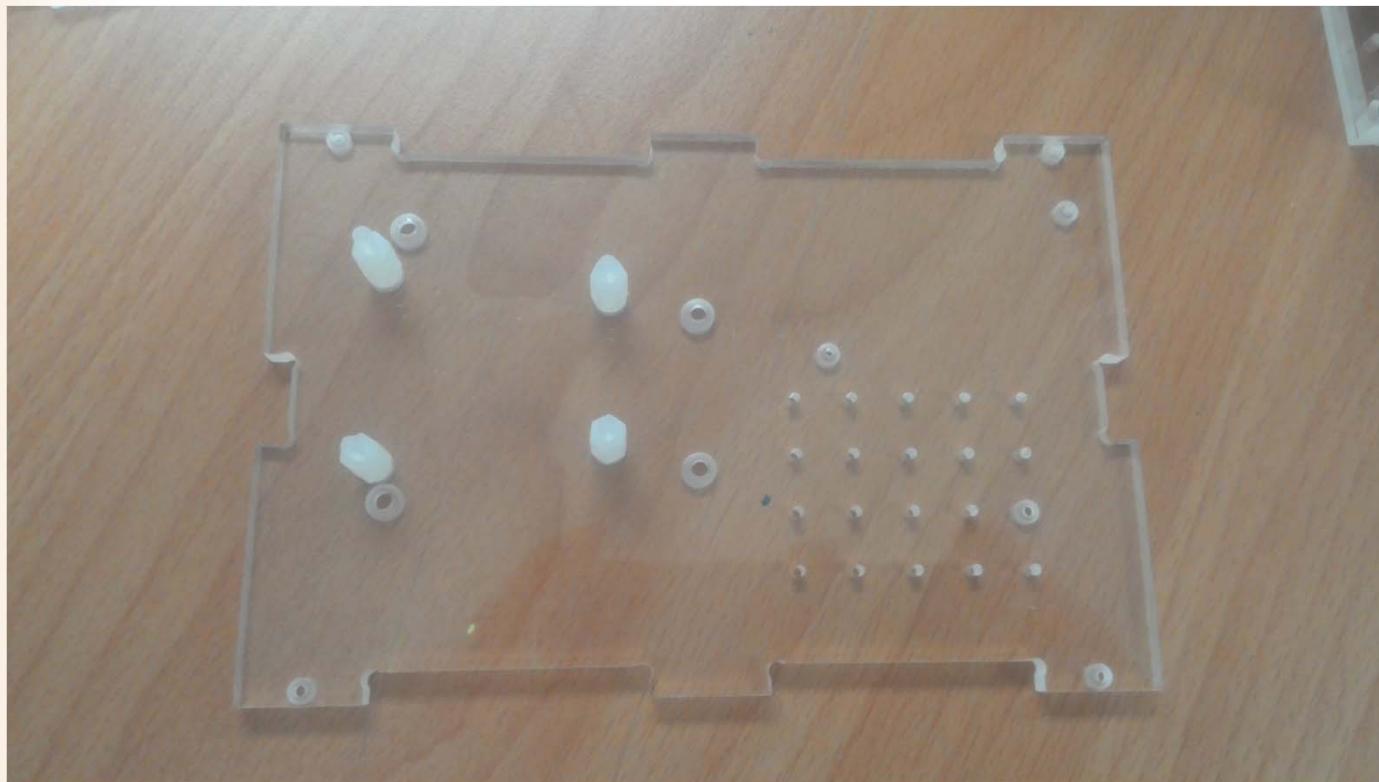


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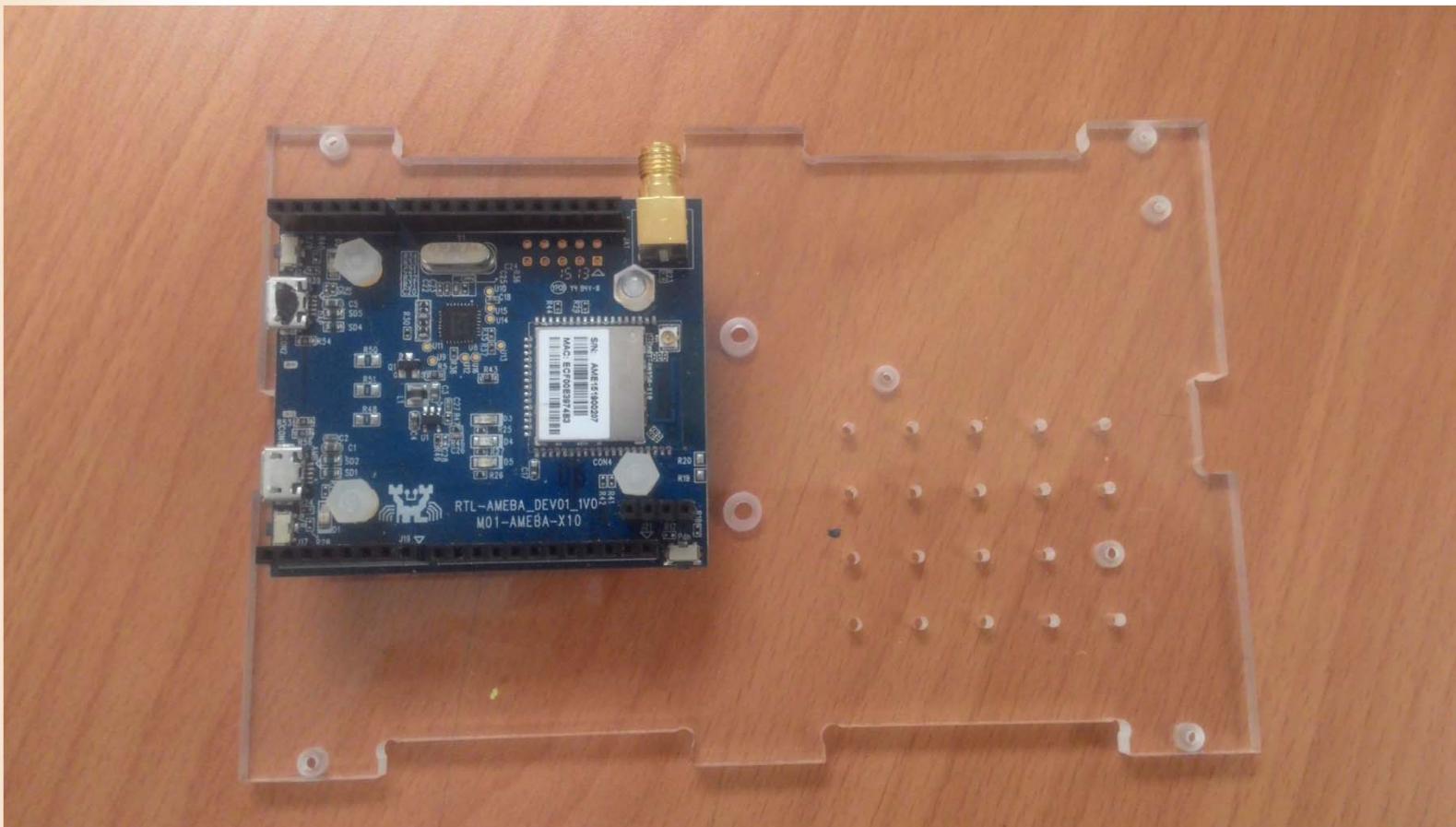




# 安裝阿米巴開發版



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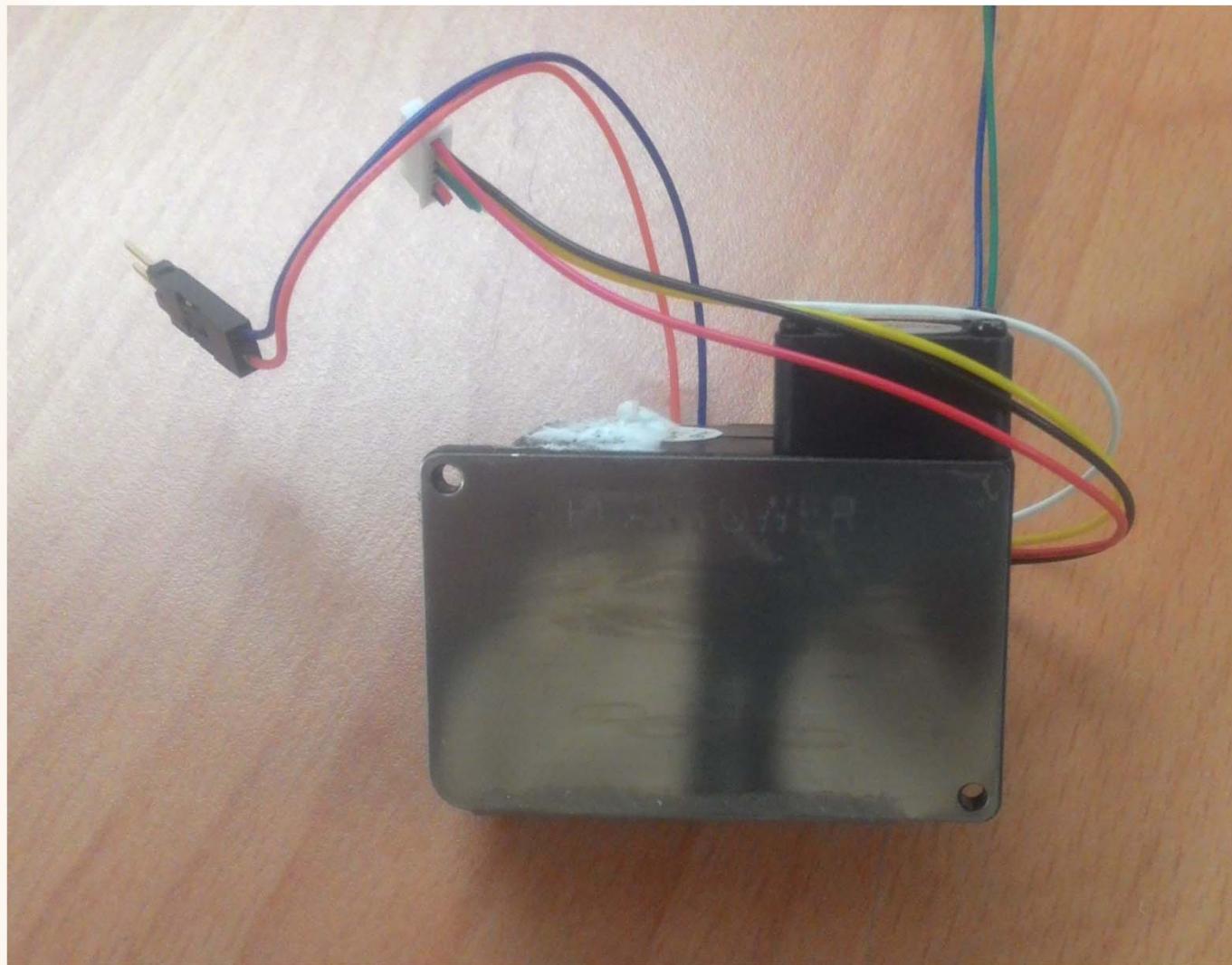


# 安裝空氣感測模組

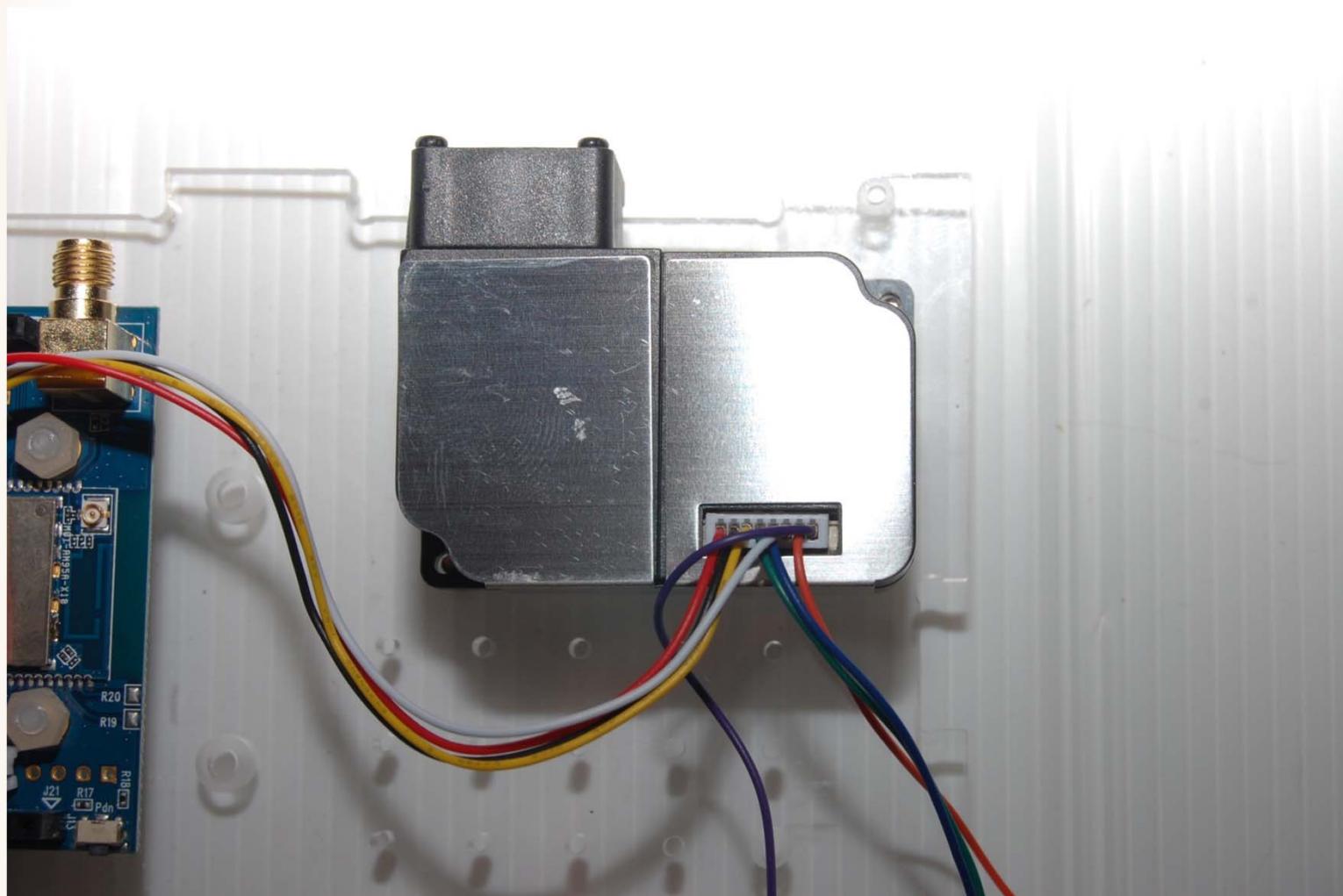
# 安裝偵測空氣懸浮粒子感測器



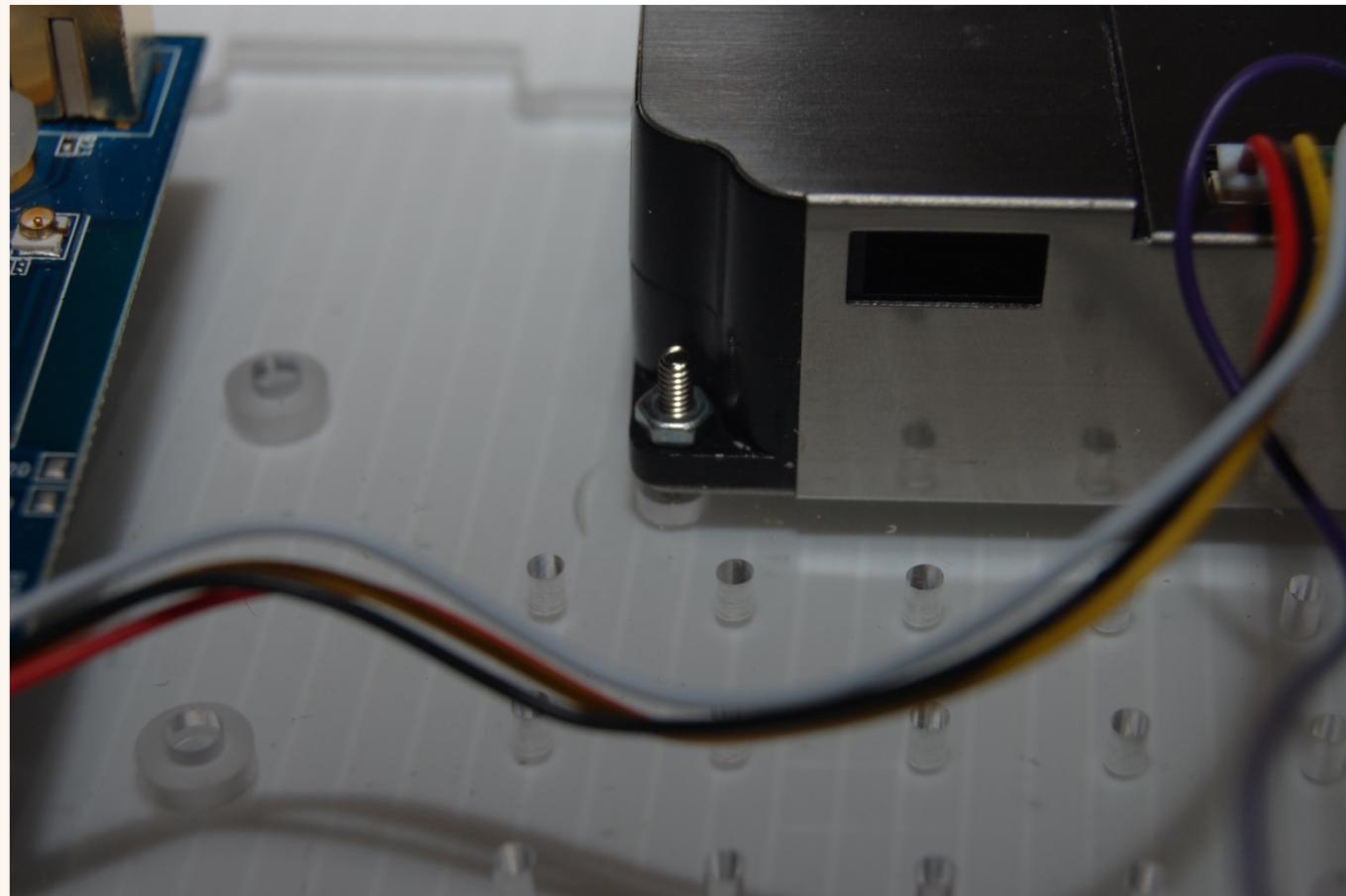
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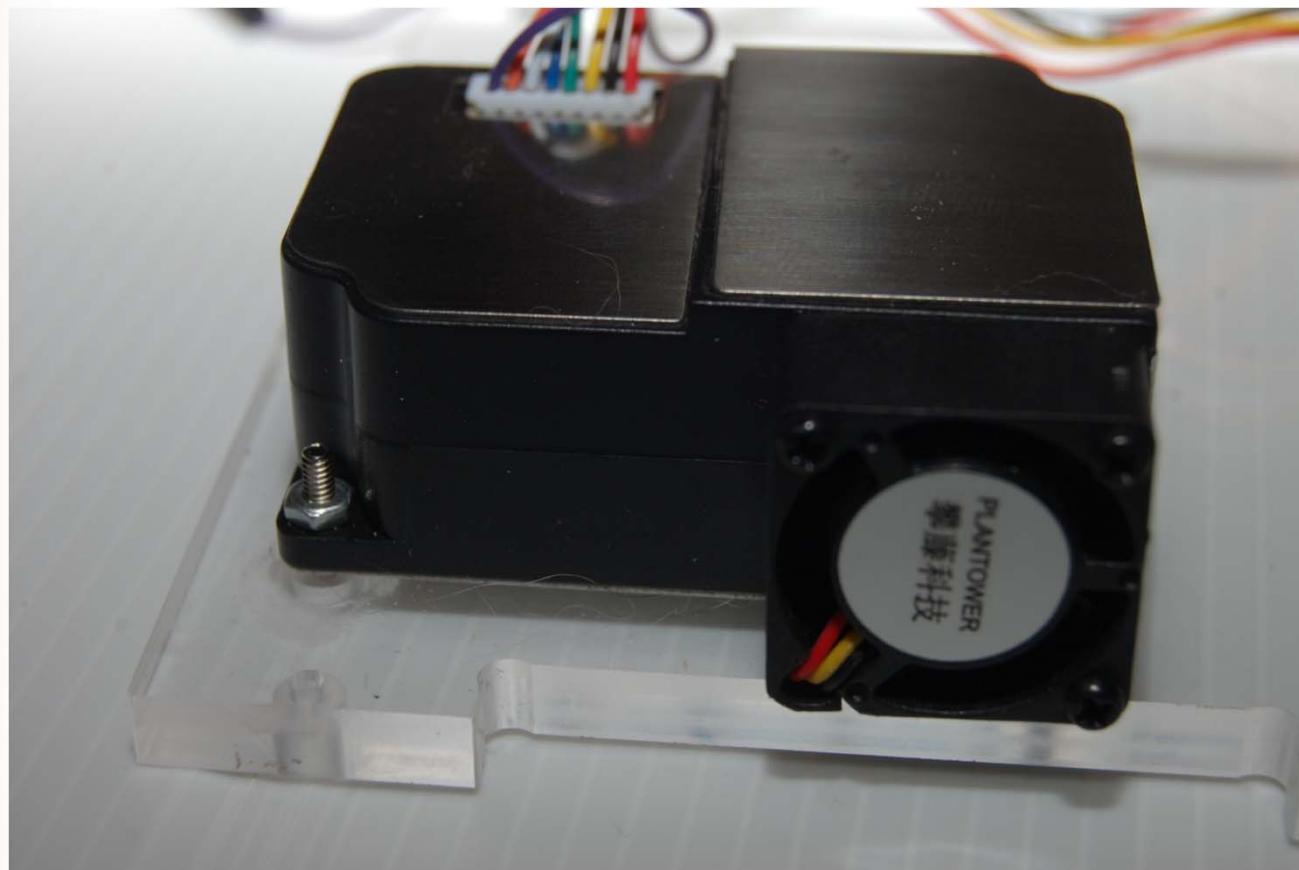
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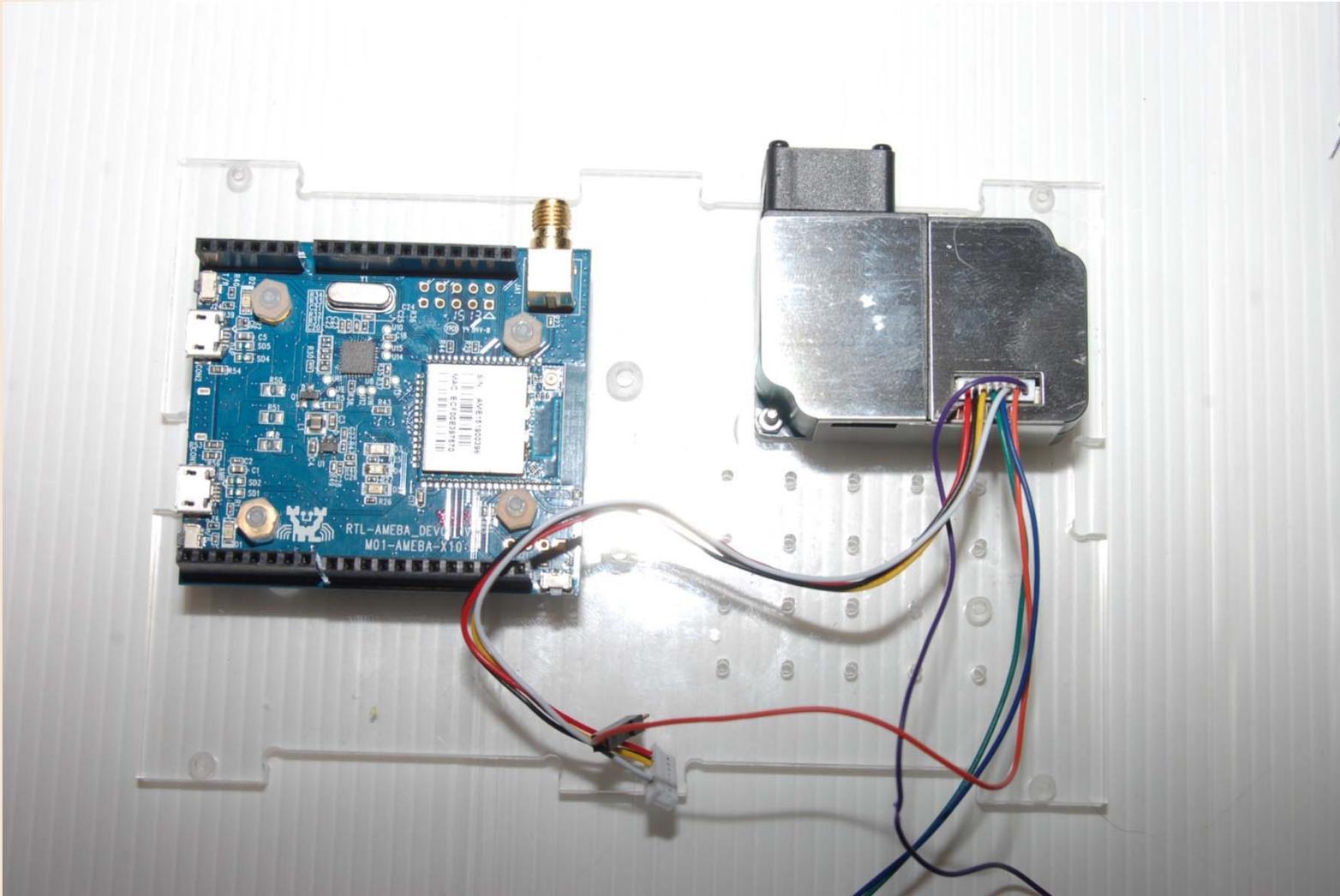
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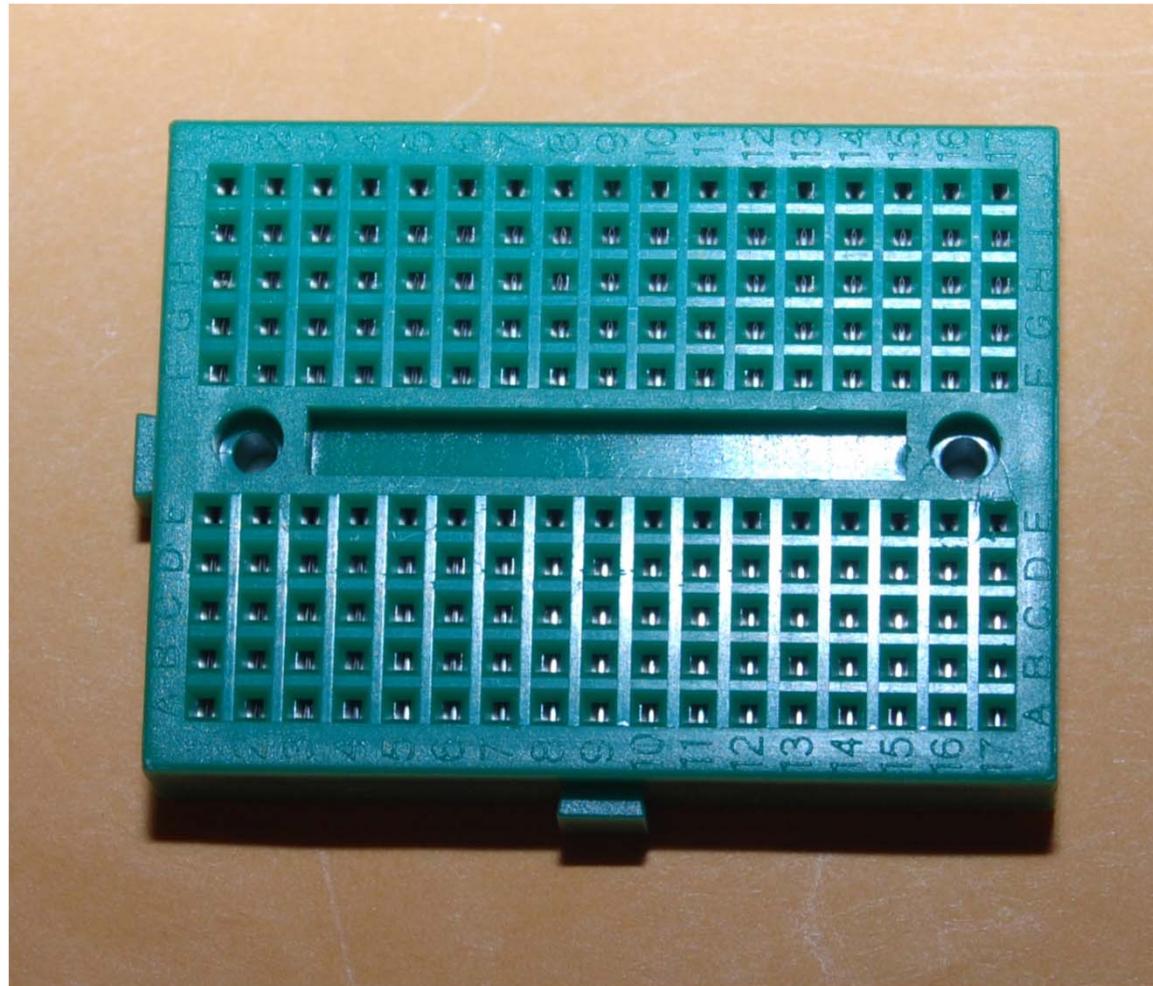


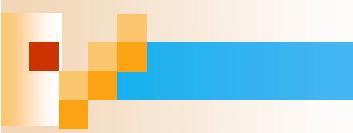
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# 安裝麵包版

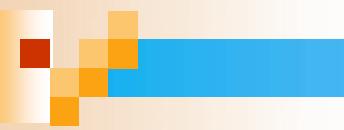
# 安裝麵包板





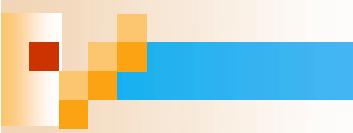
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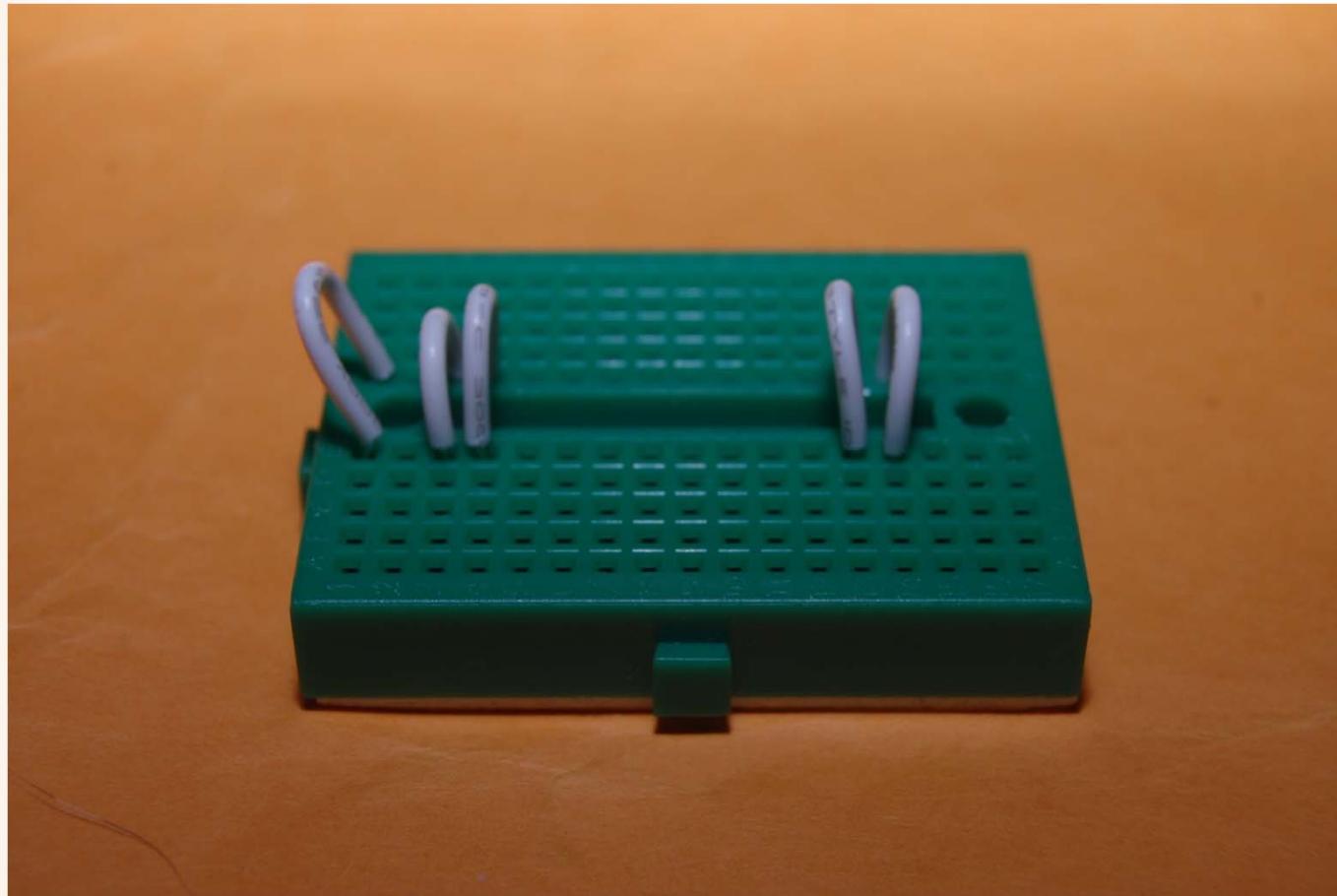


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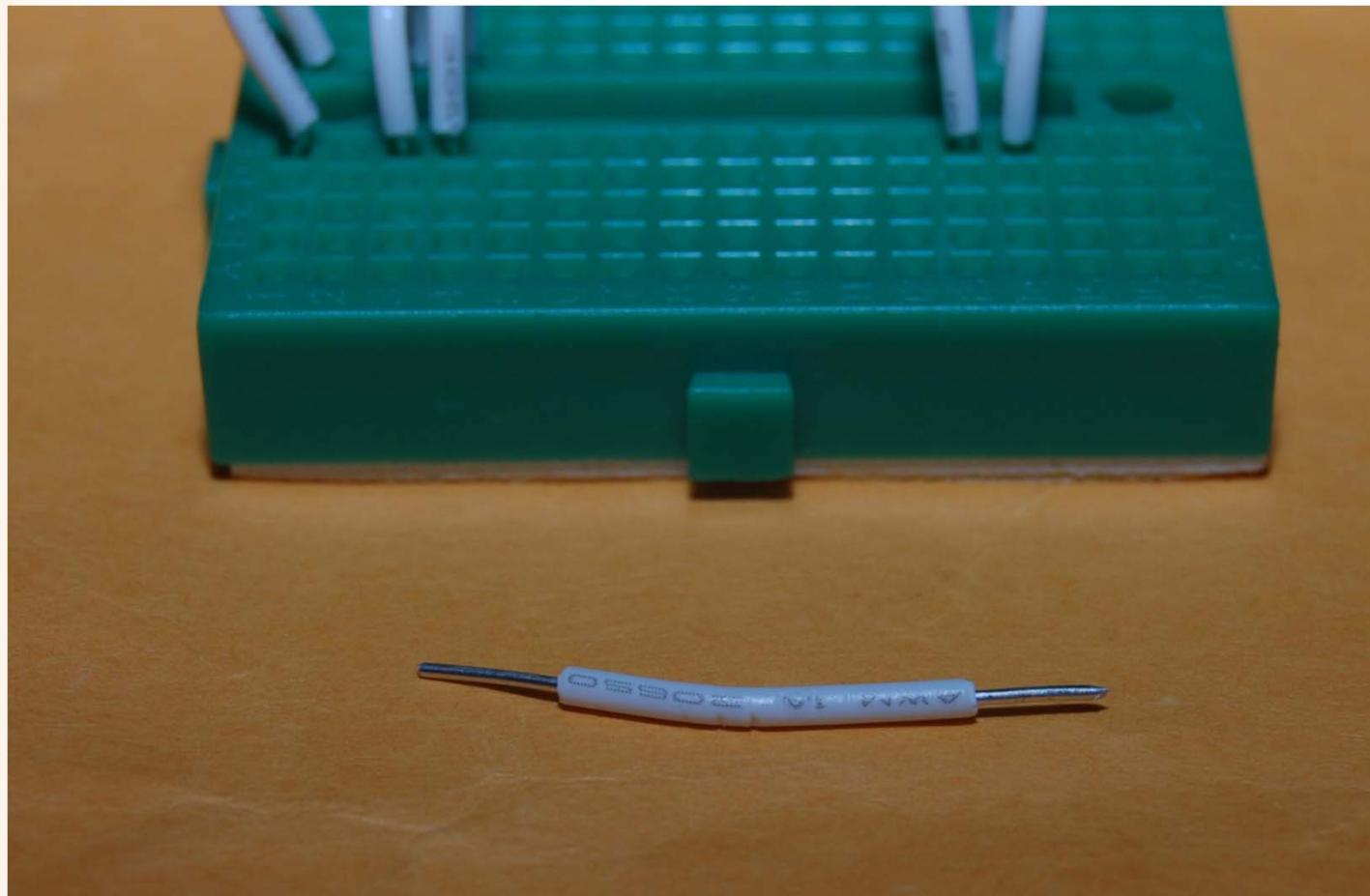




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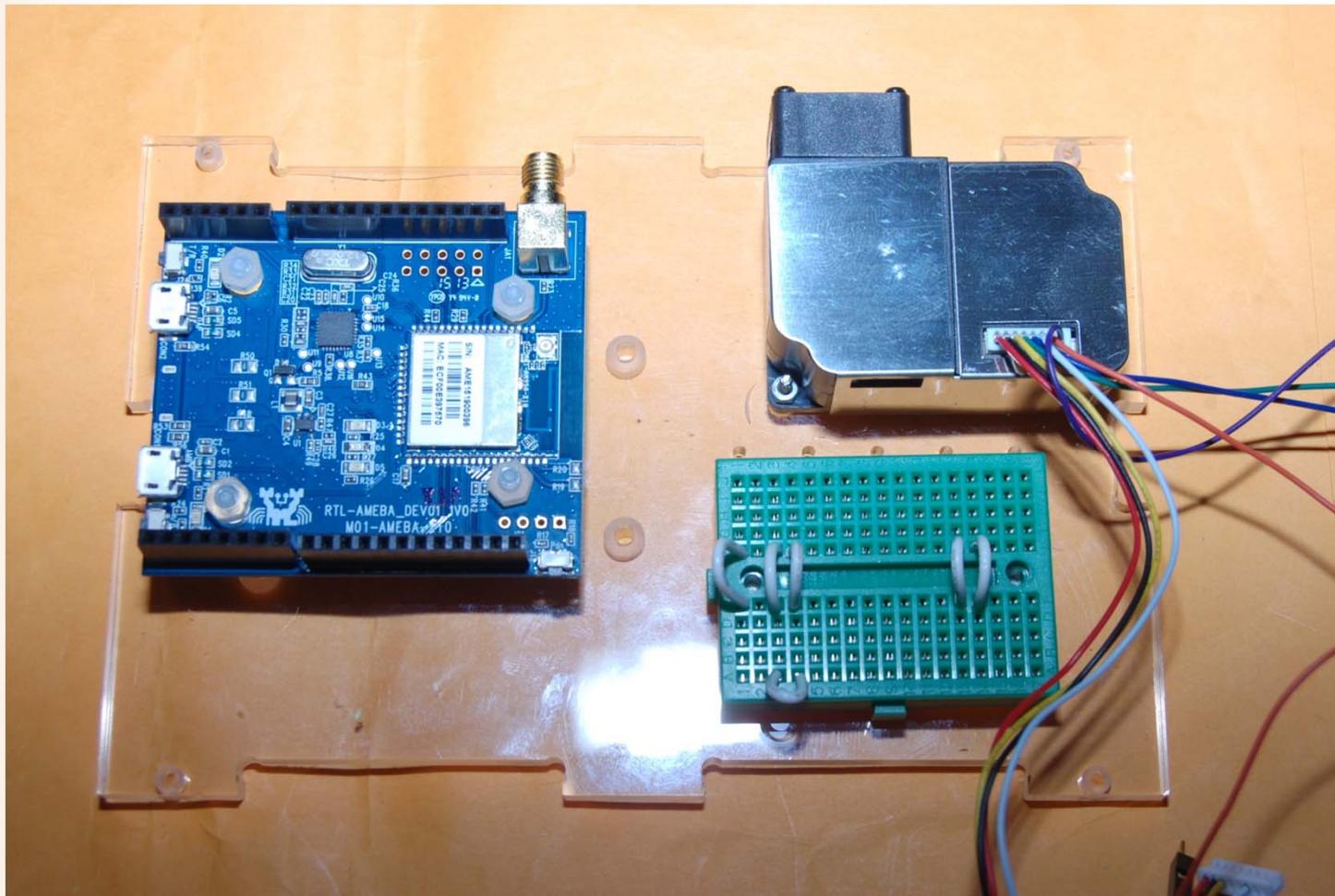


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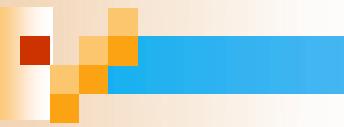




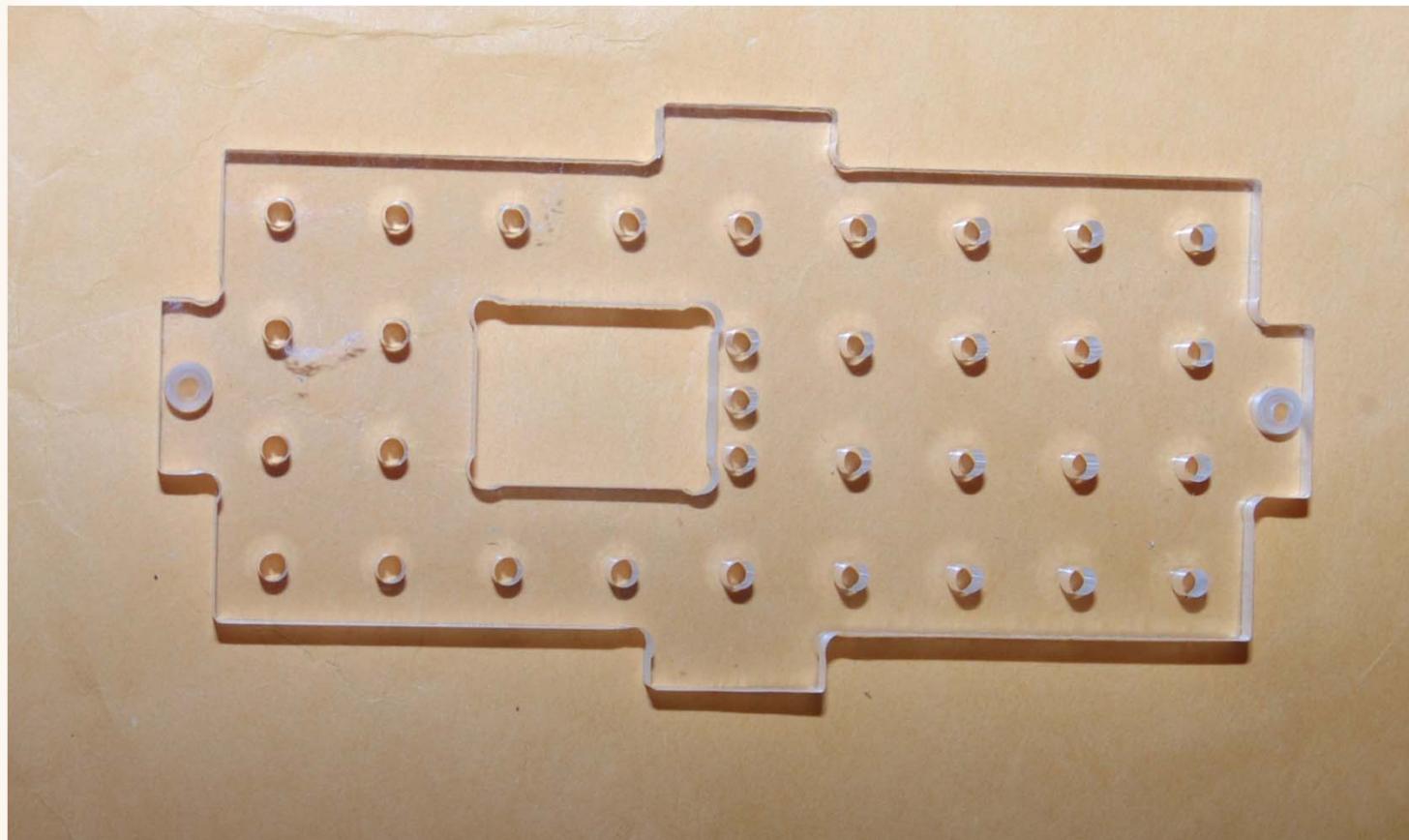
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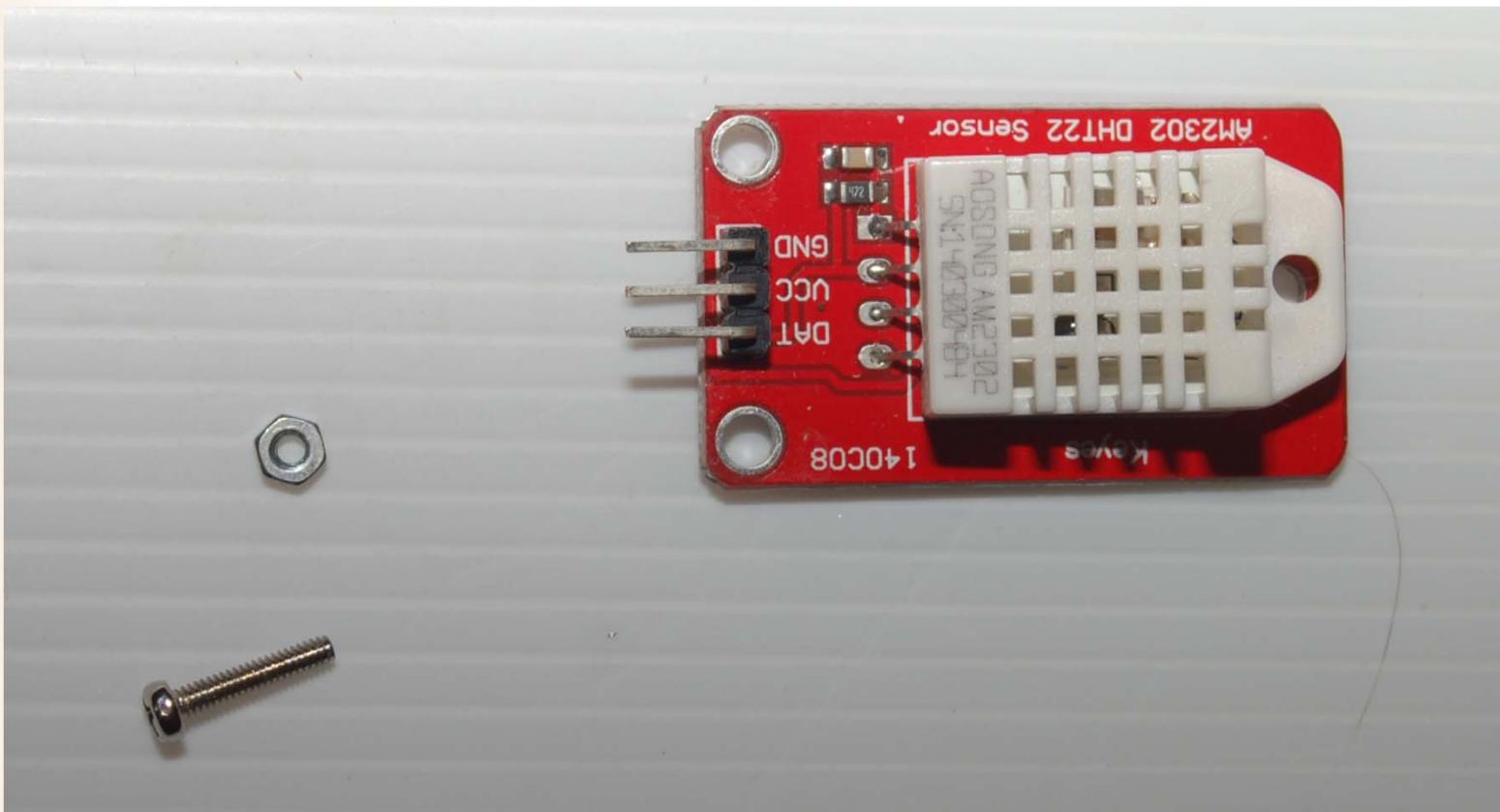
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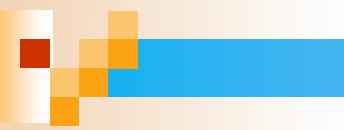


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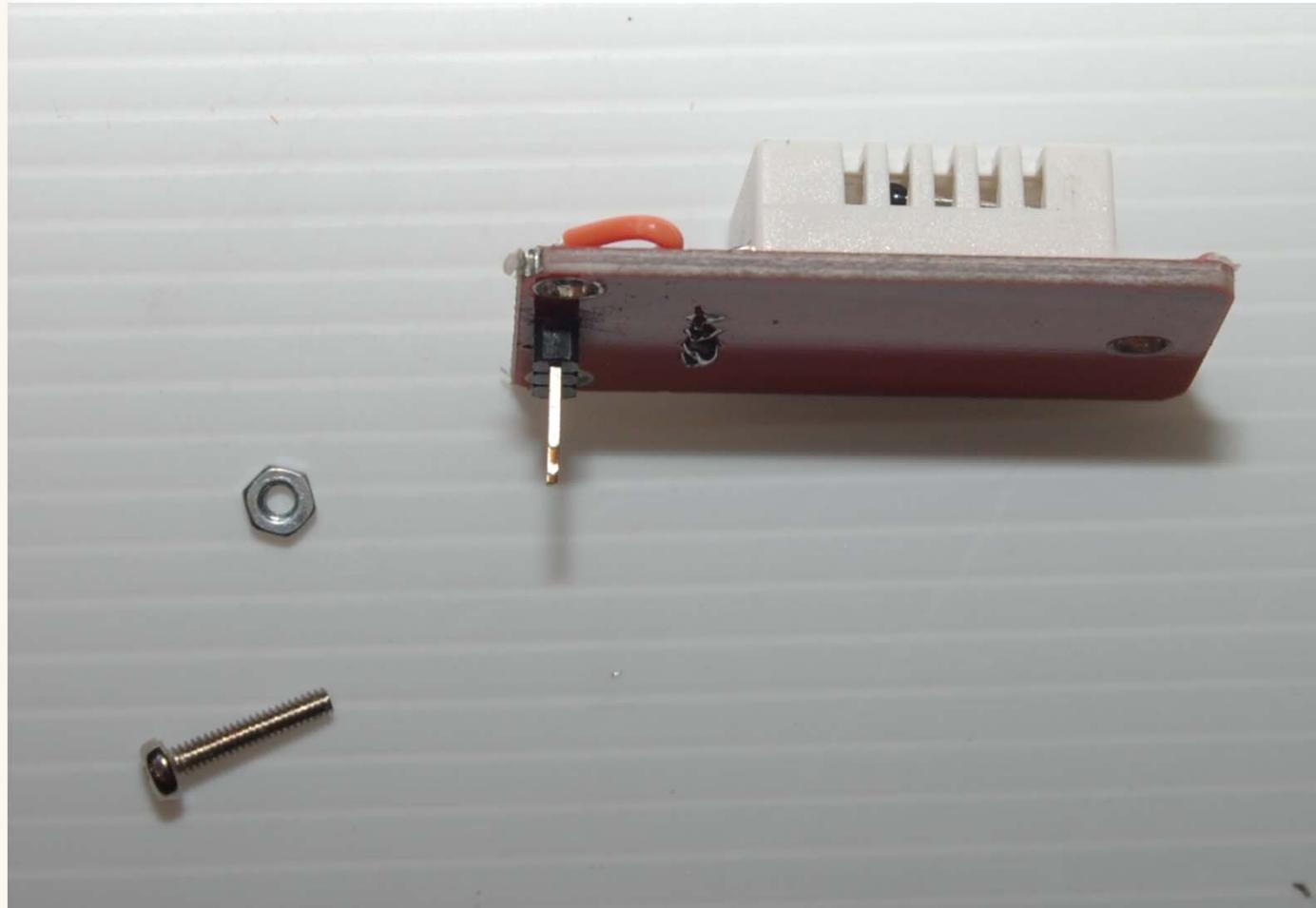


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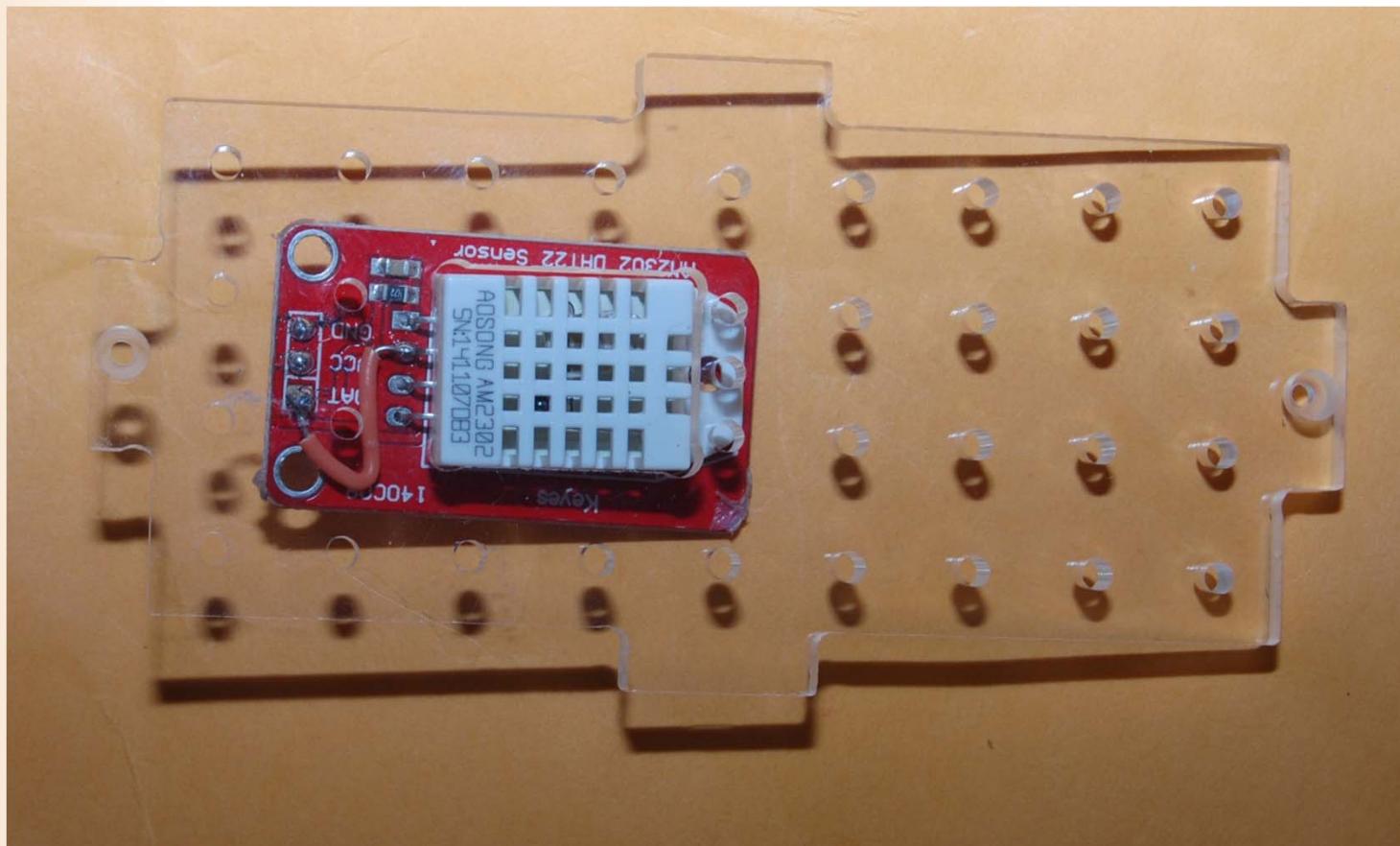


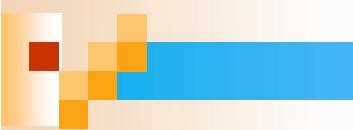


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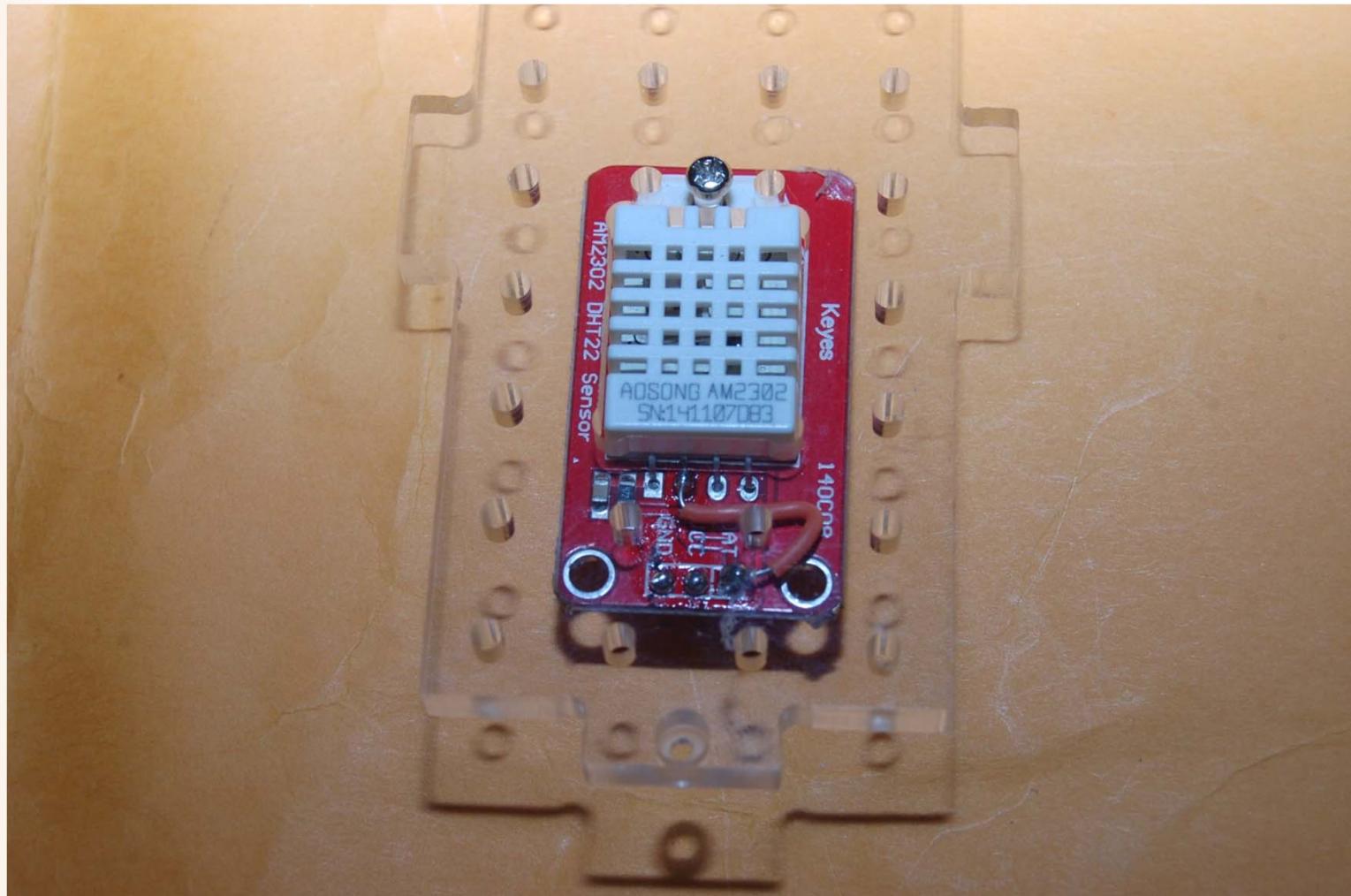


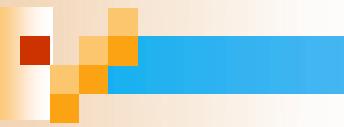
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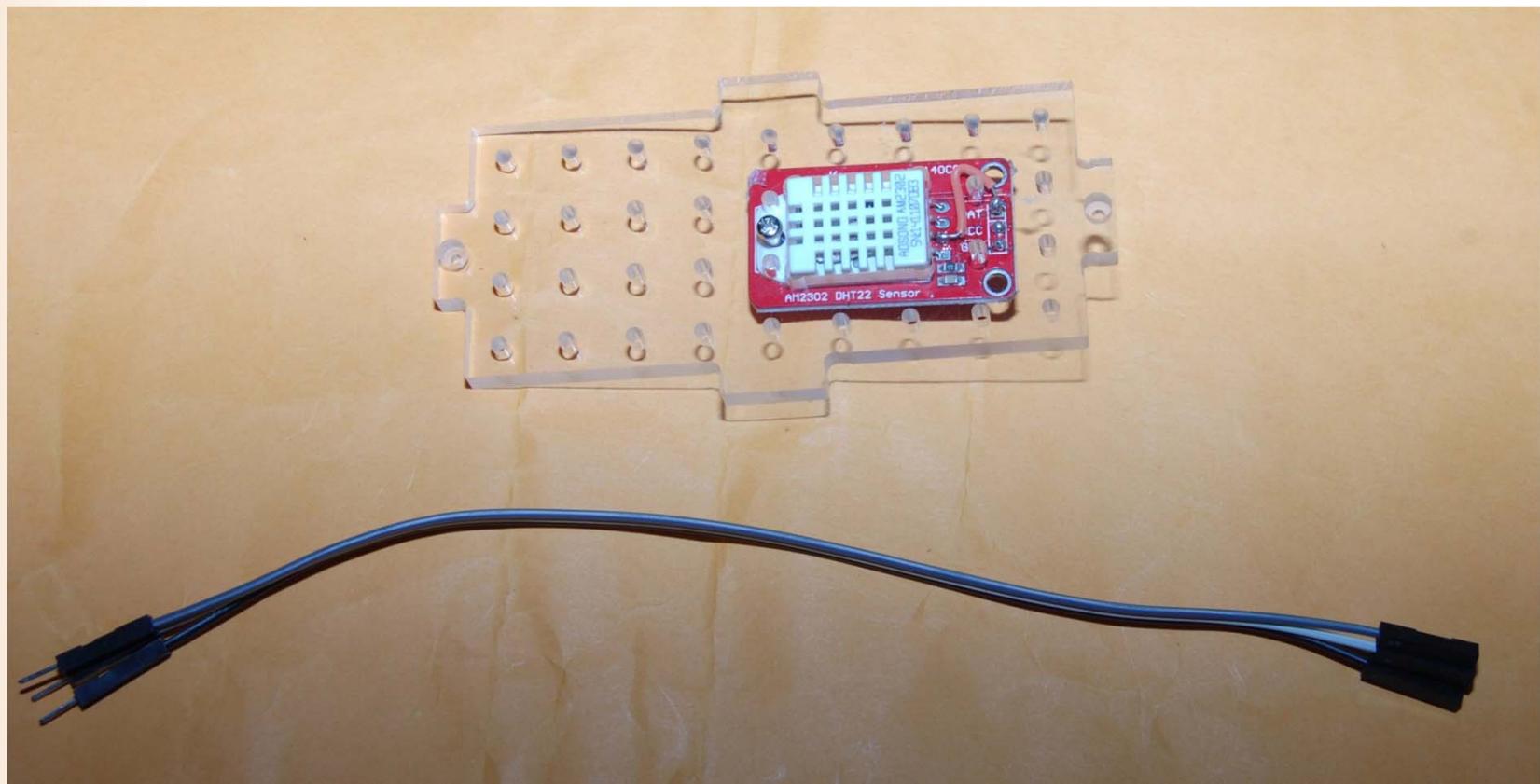


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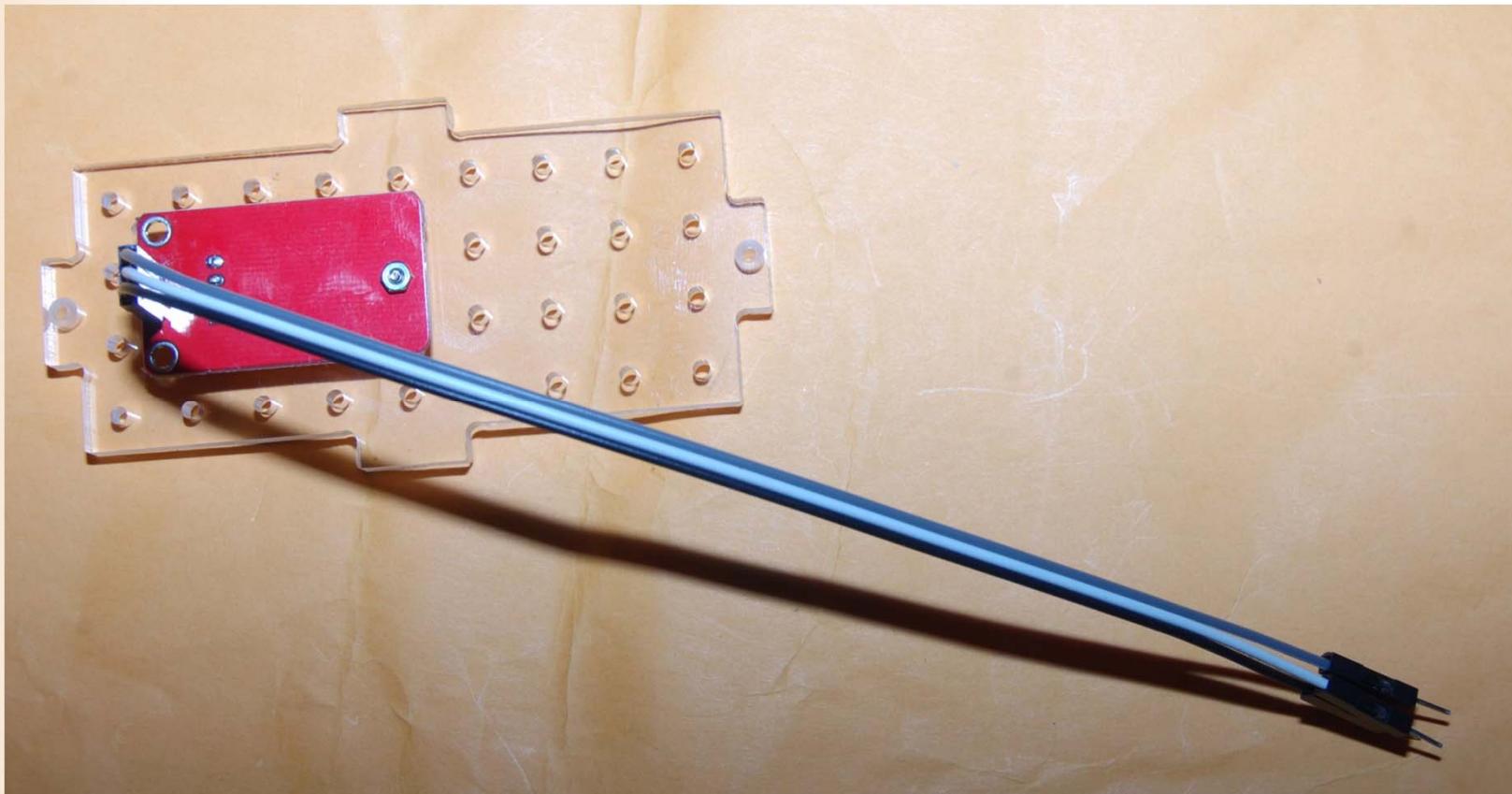




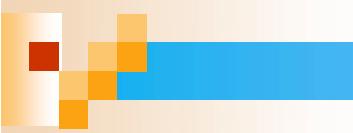
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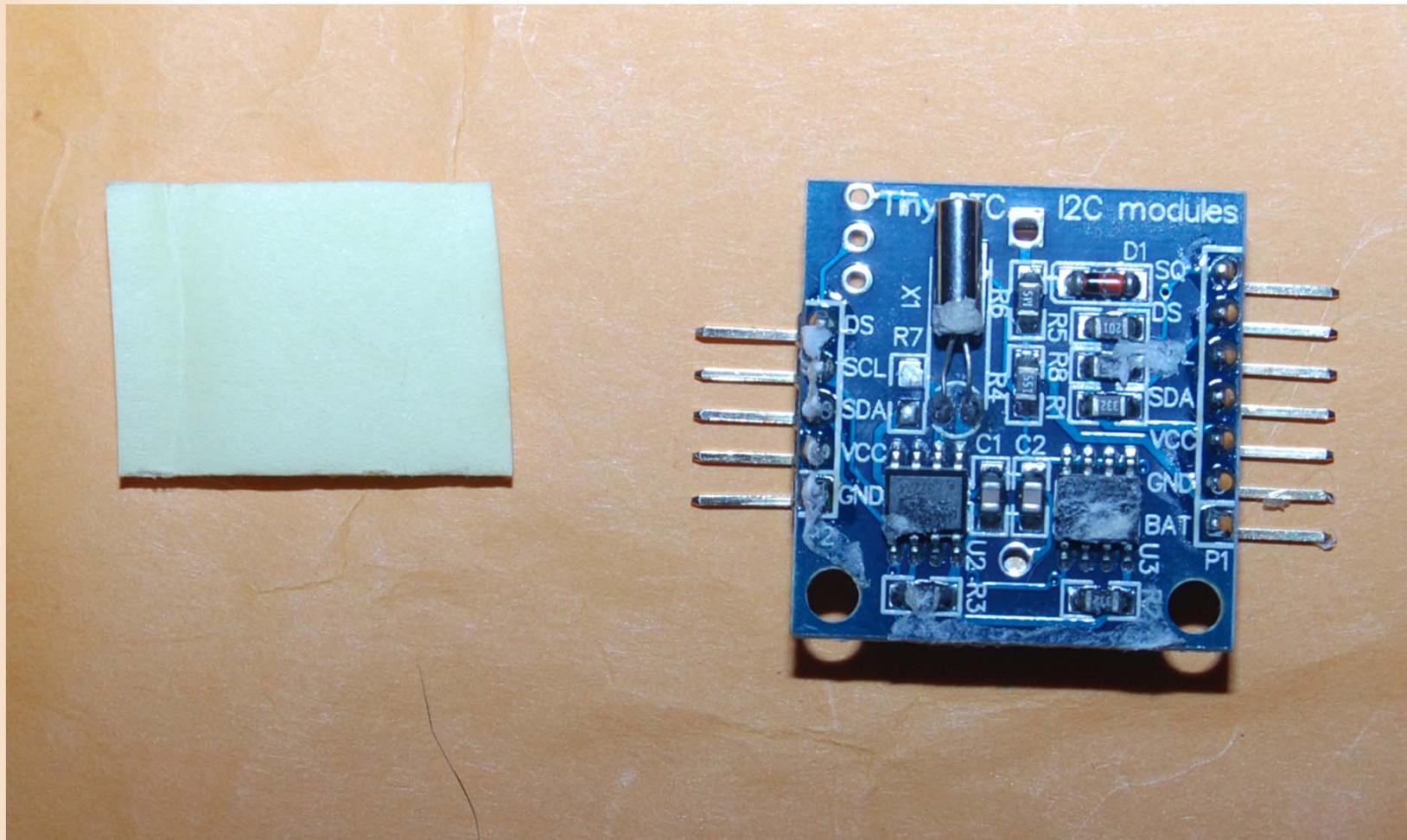
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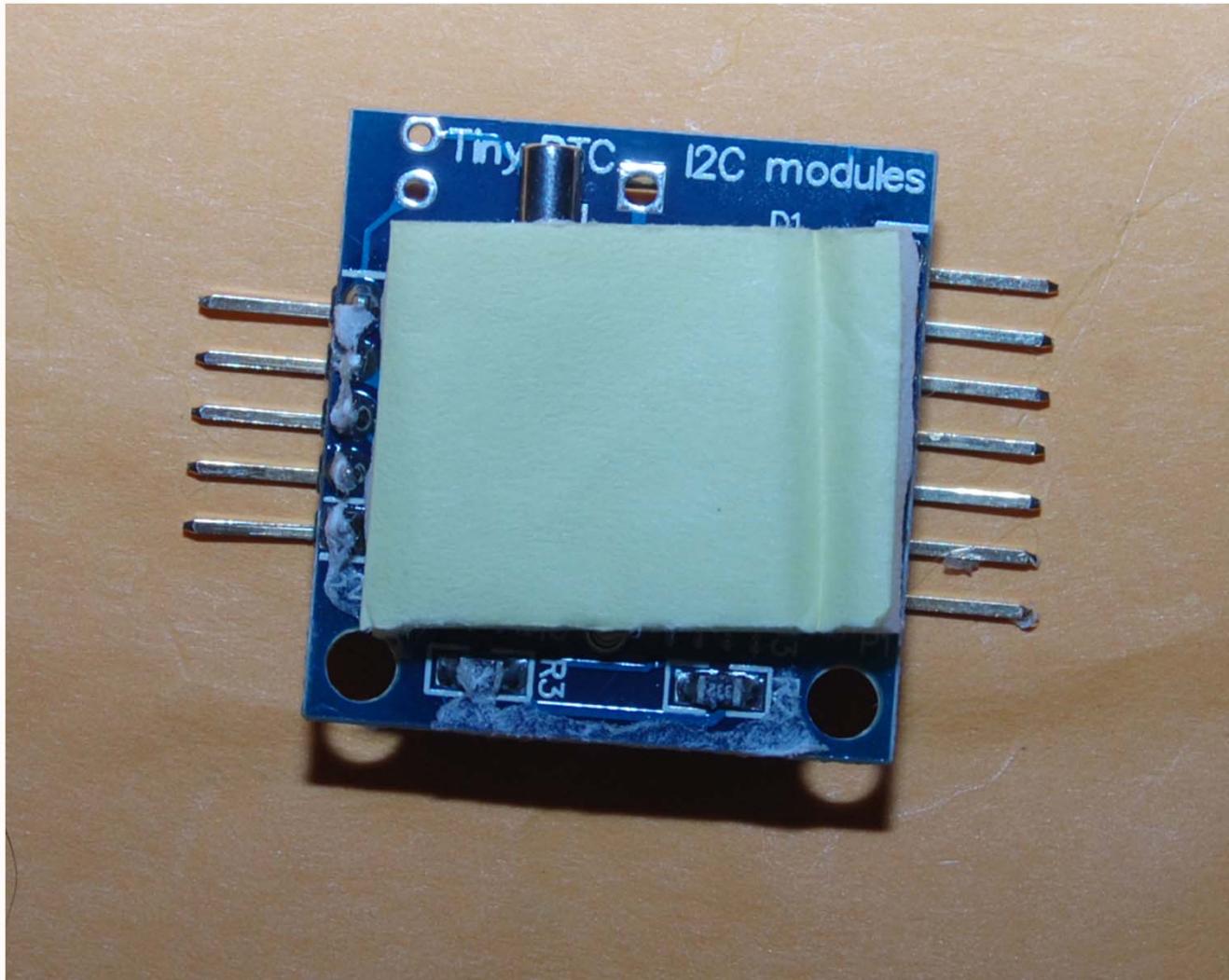
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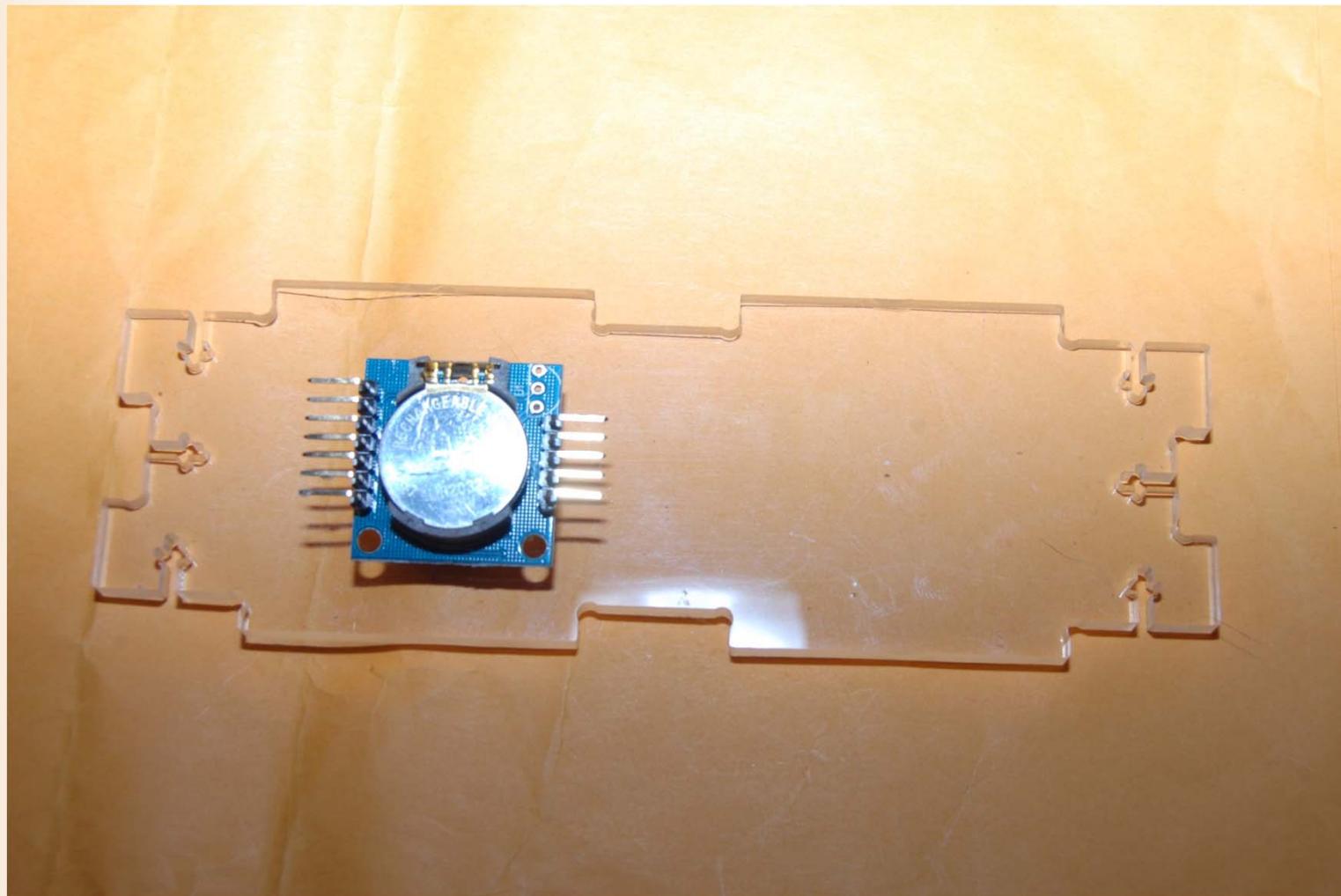
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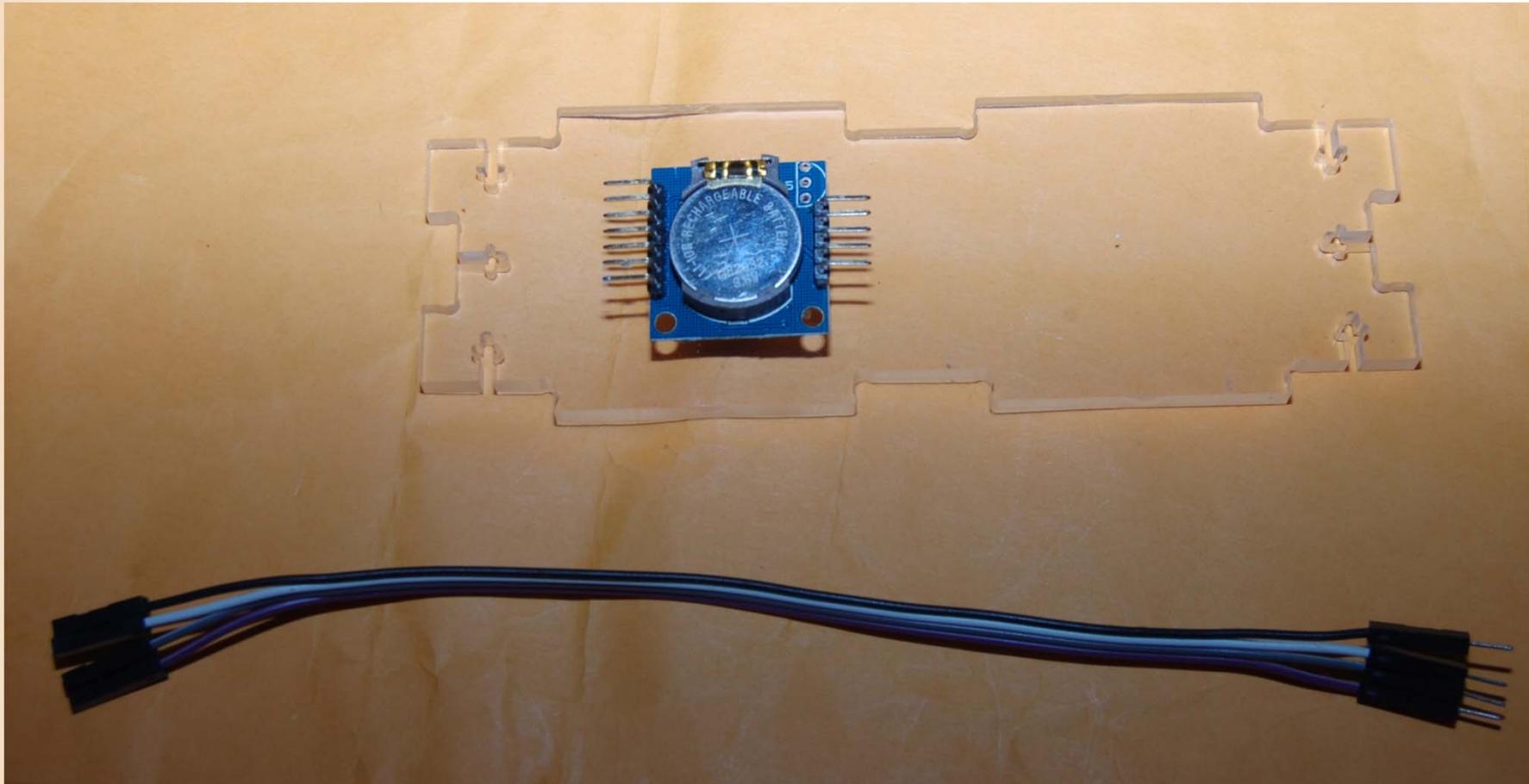
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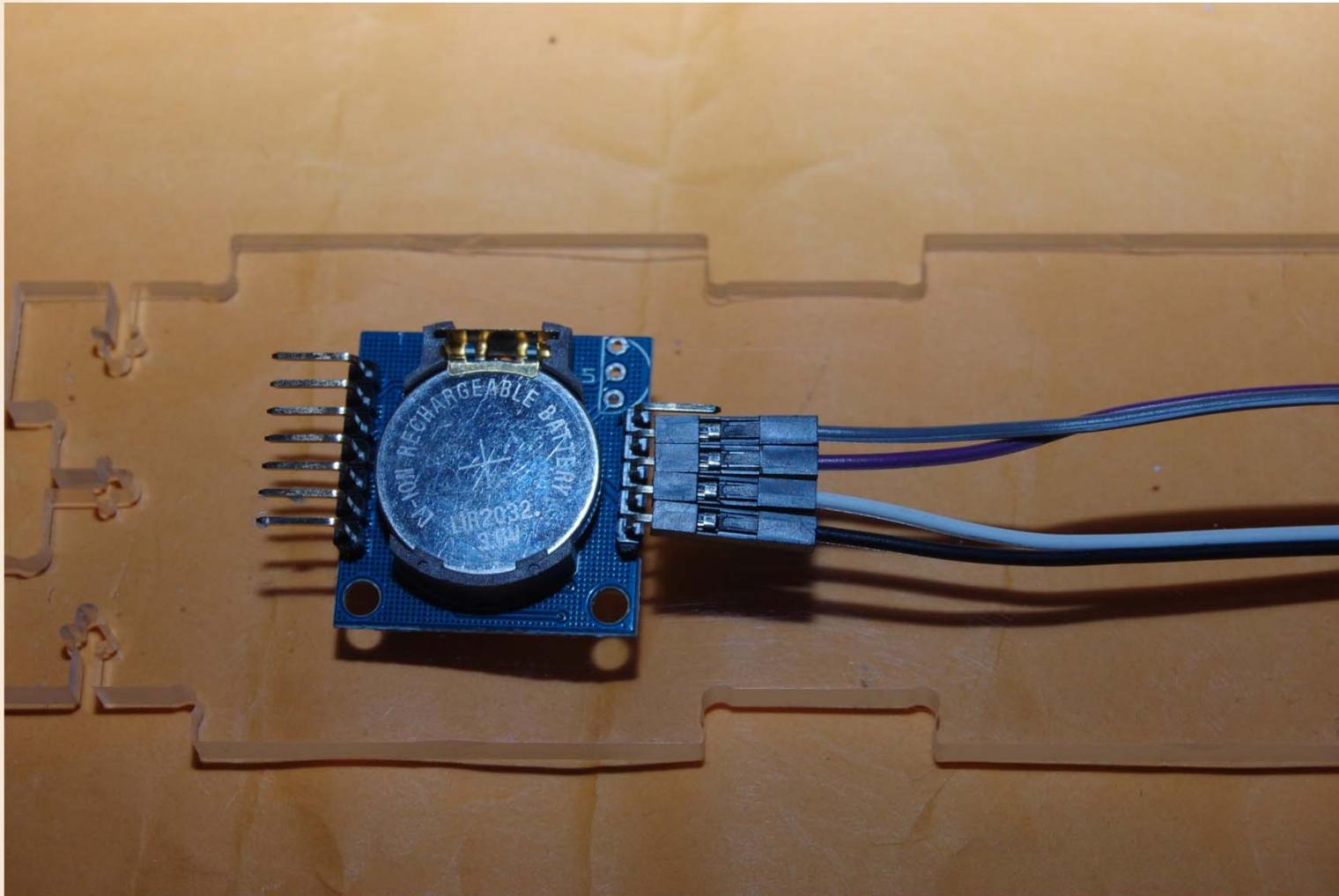
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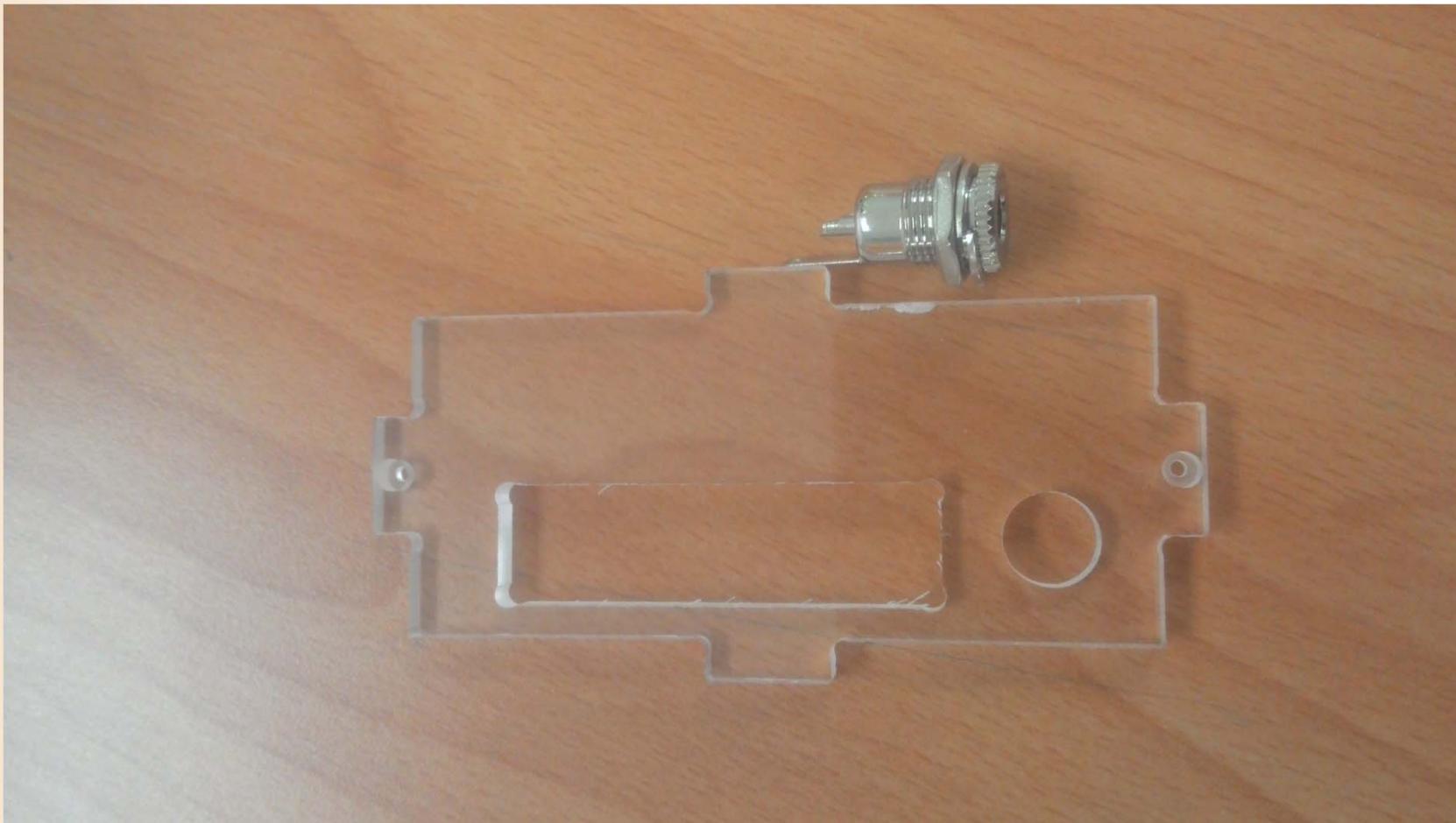


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# 安裝電力插座

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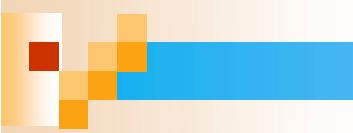


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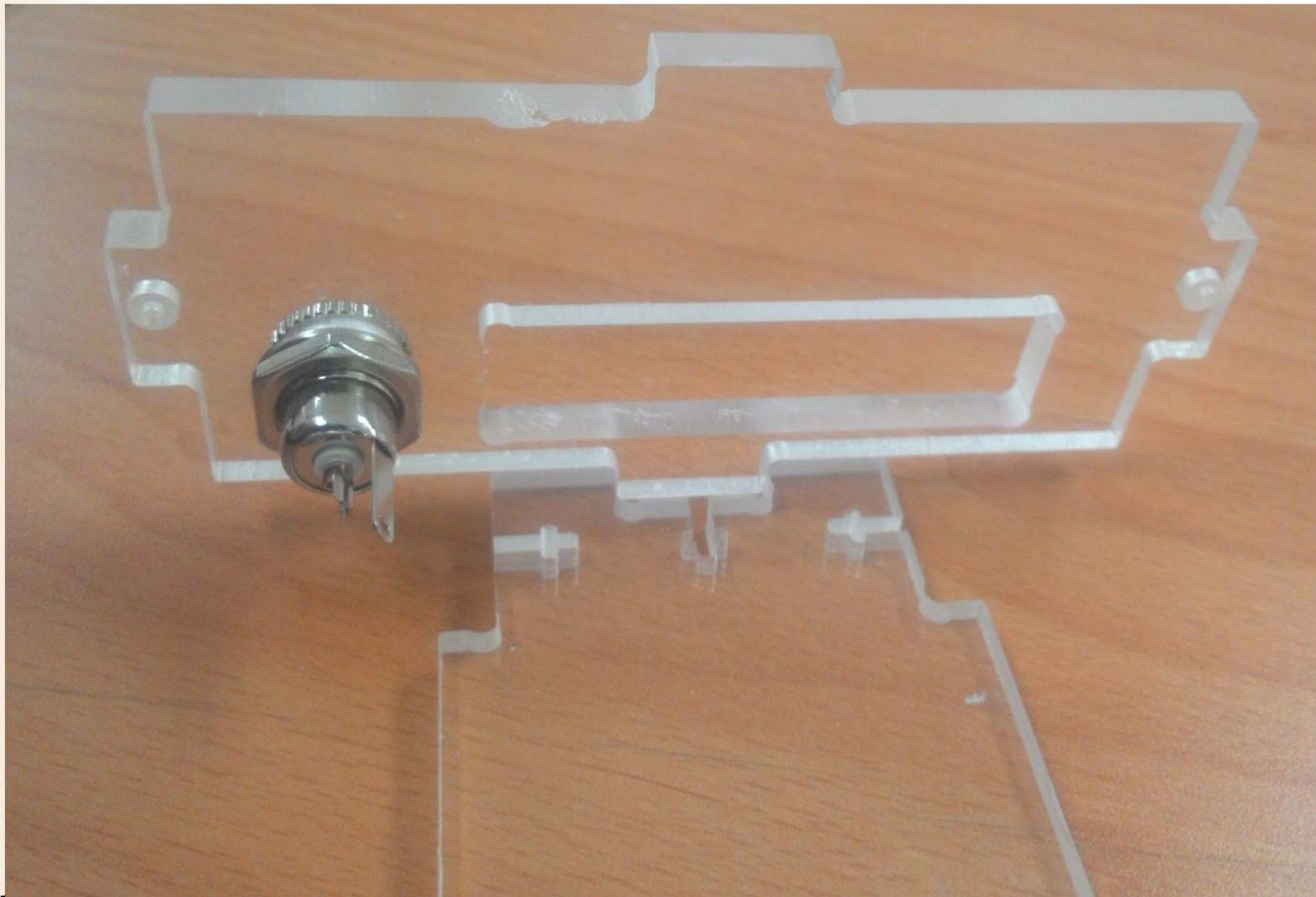


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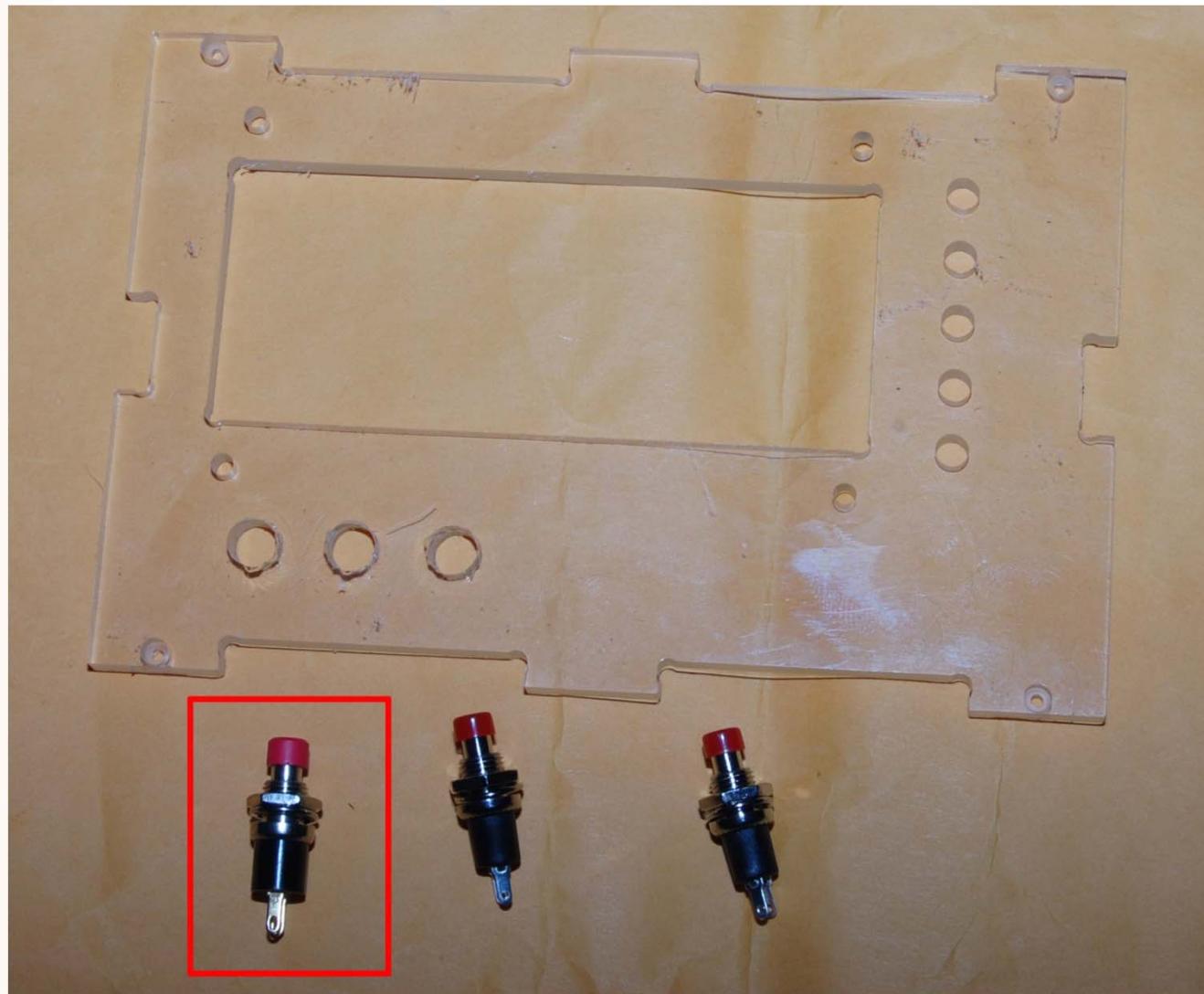


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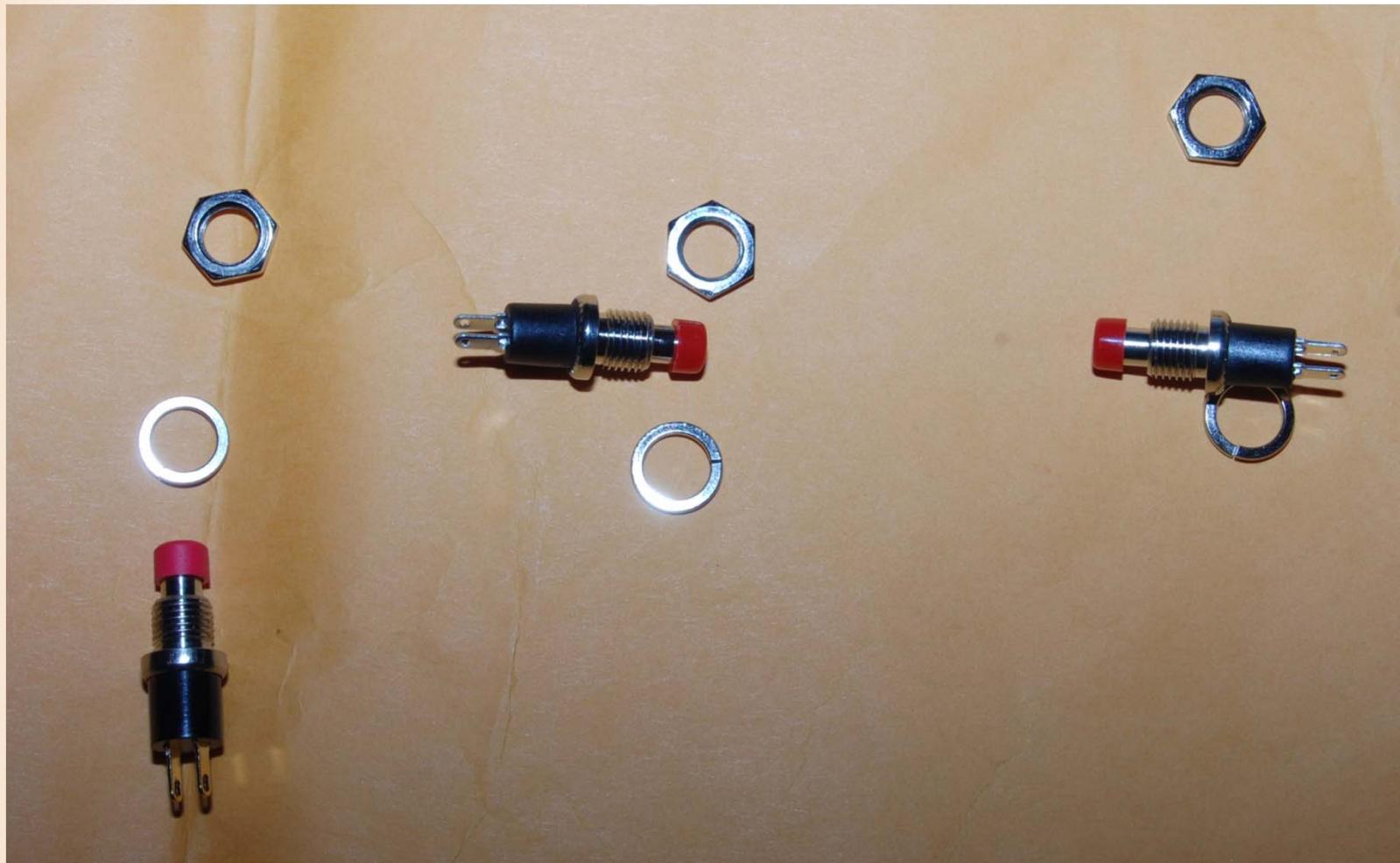


# 安裝面板按鈕

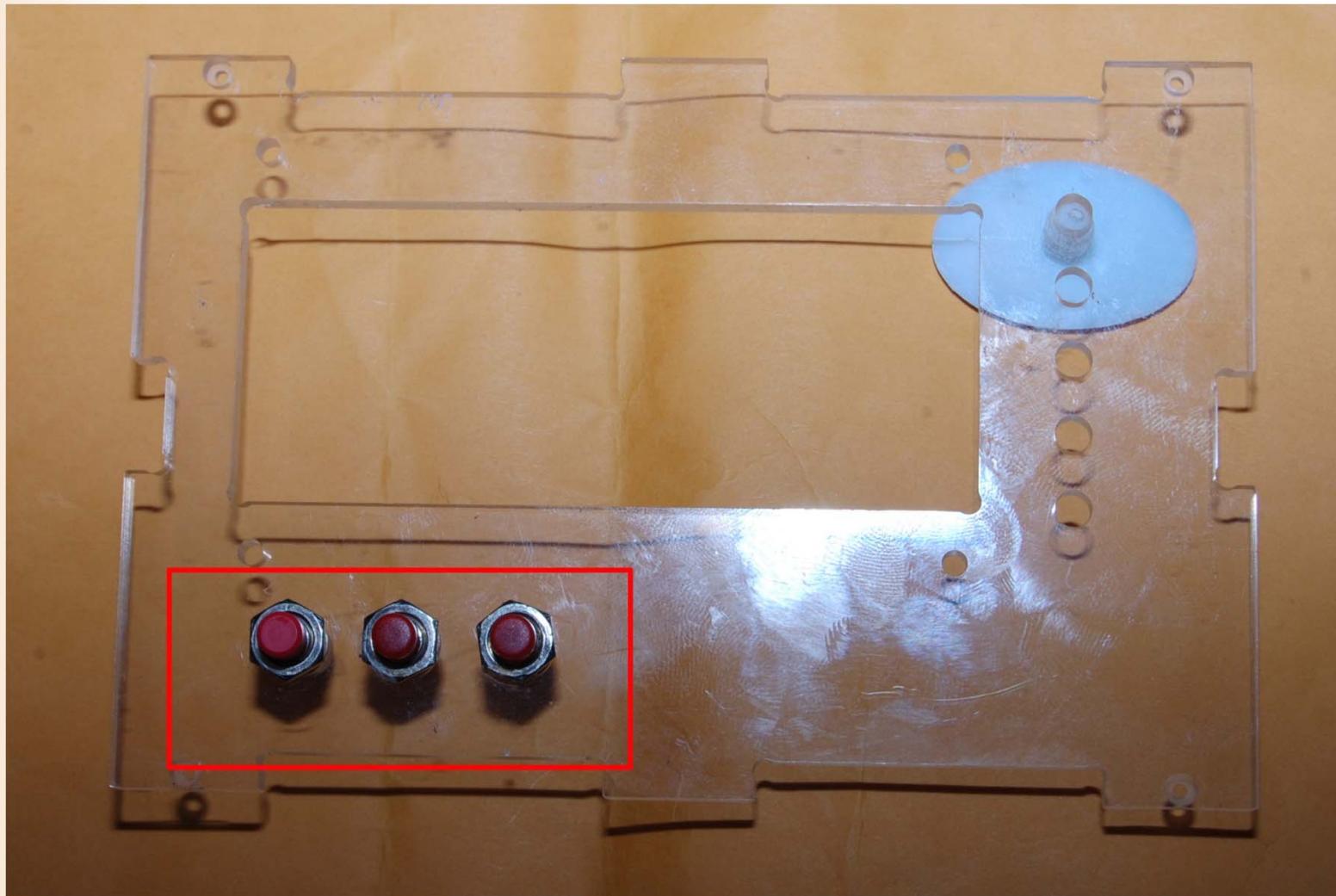
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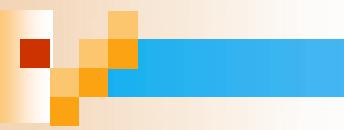
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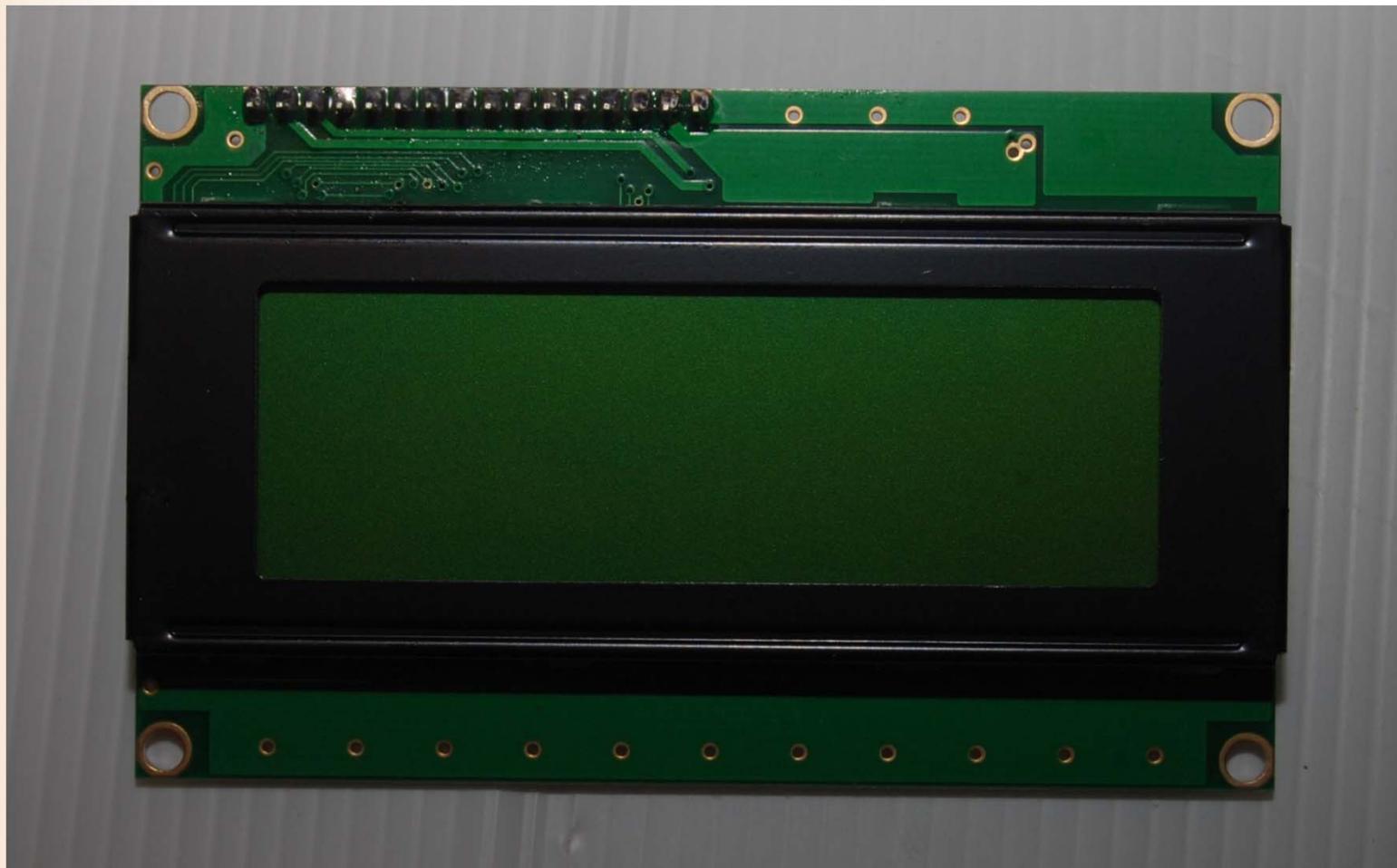
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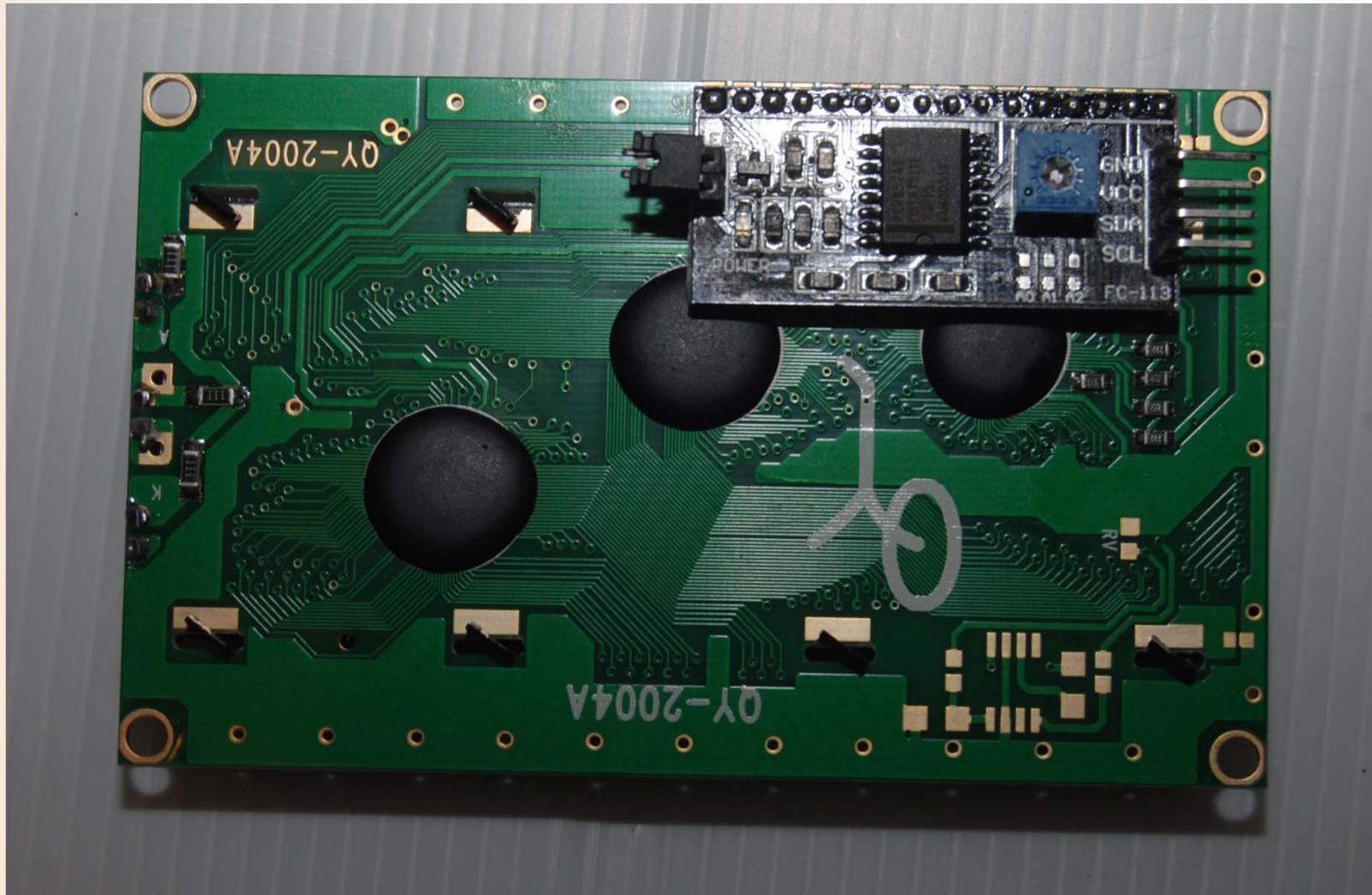
# 安裝LCD顯示器



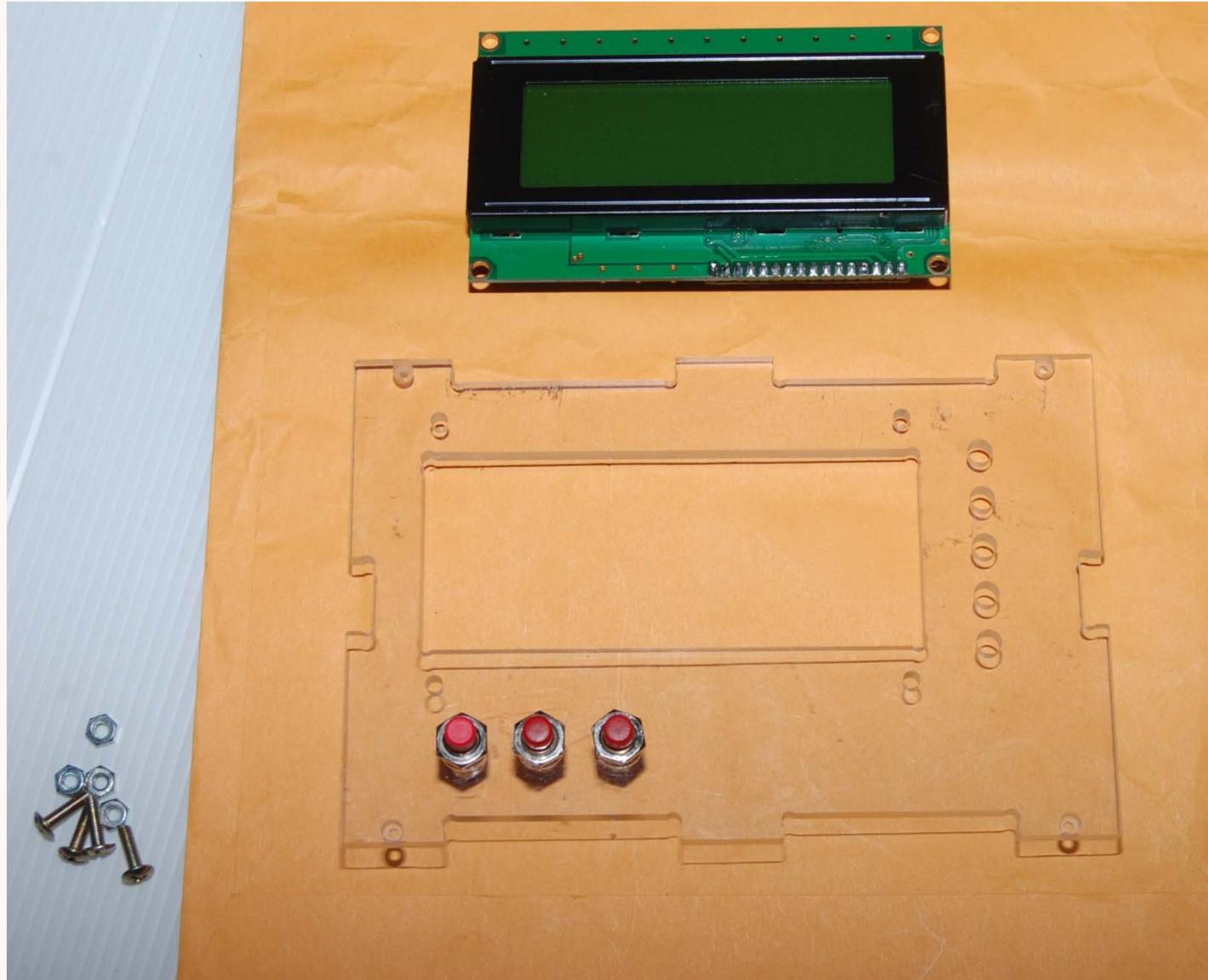
# 安裝LCD2004顯示器



# 安裝LCD2004顯示器

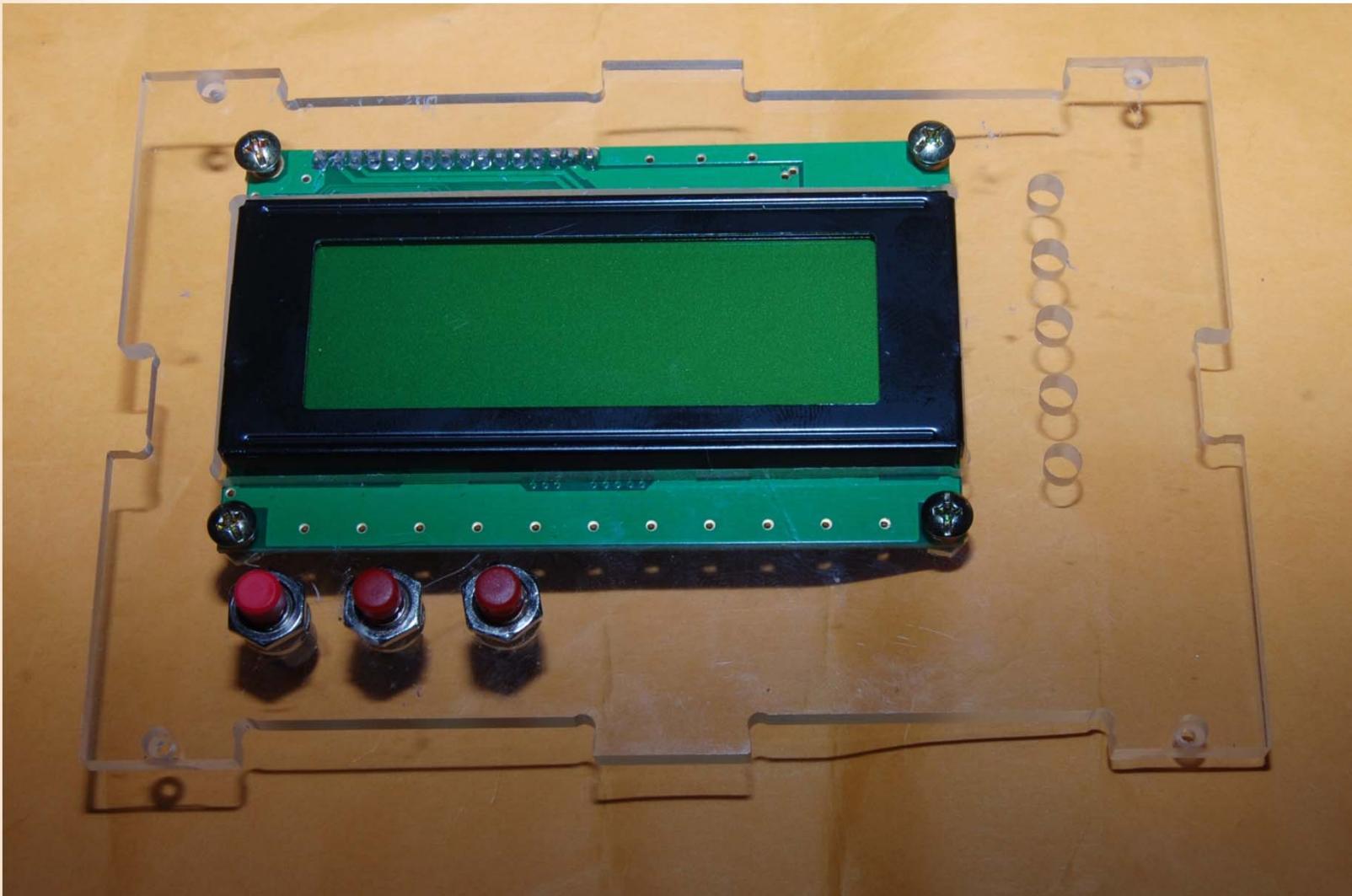


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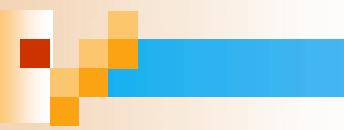




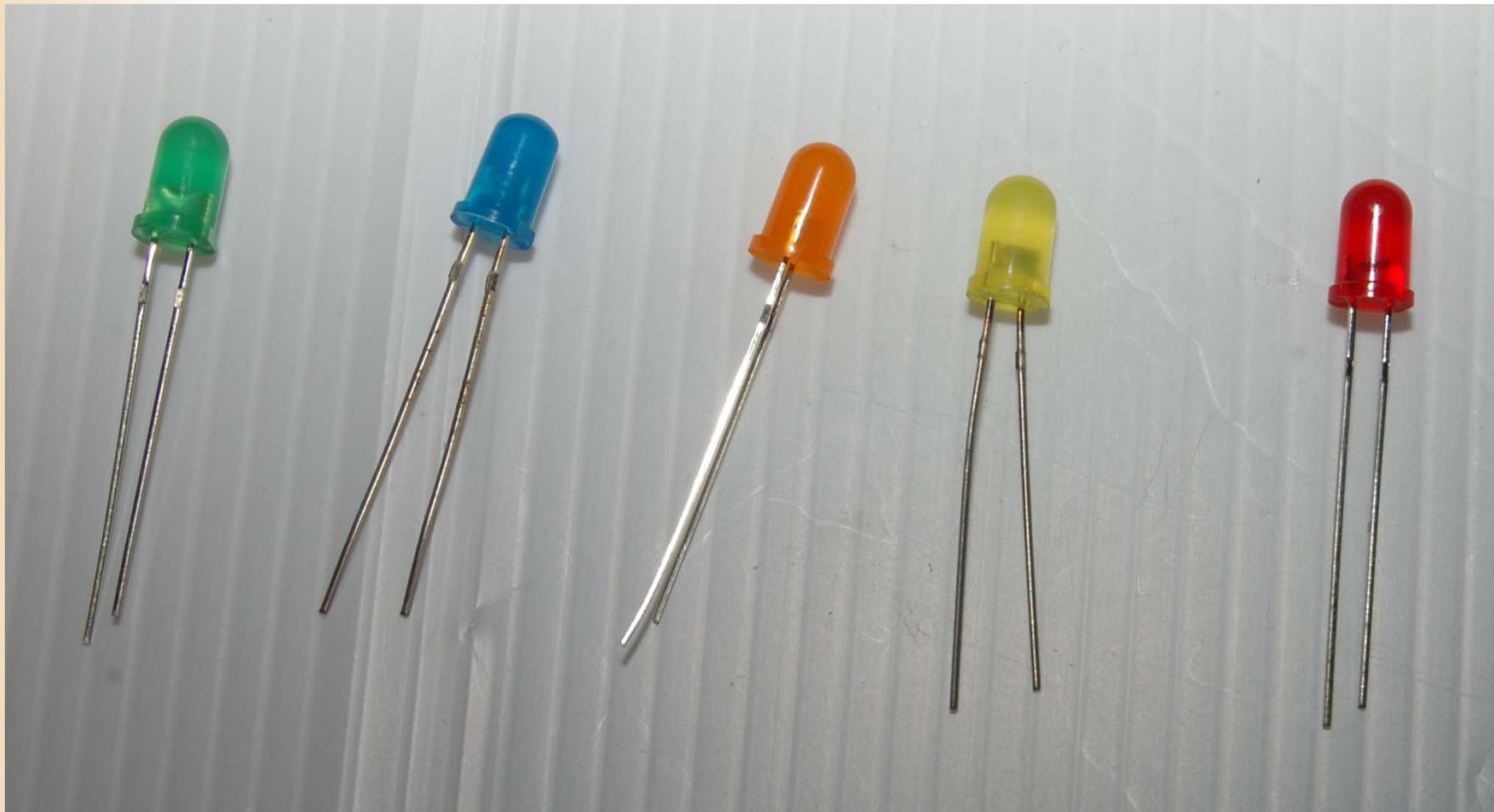
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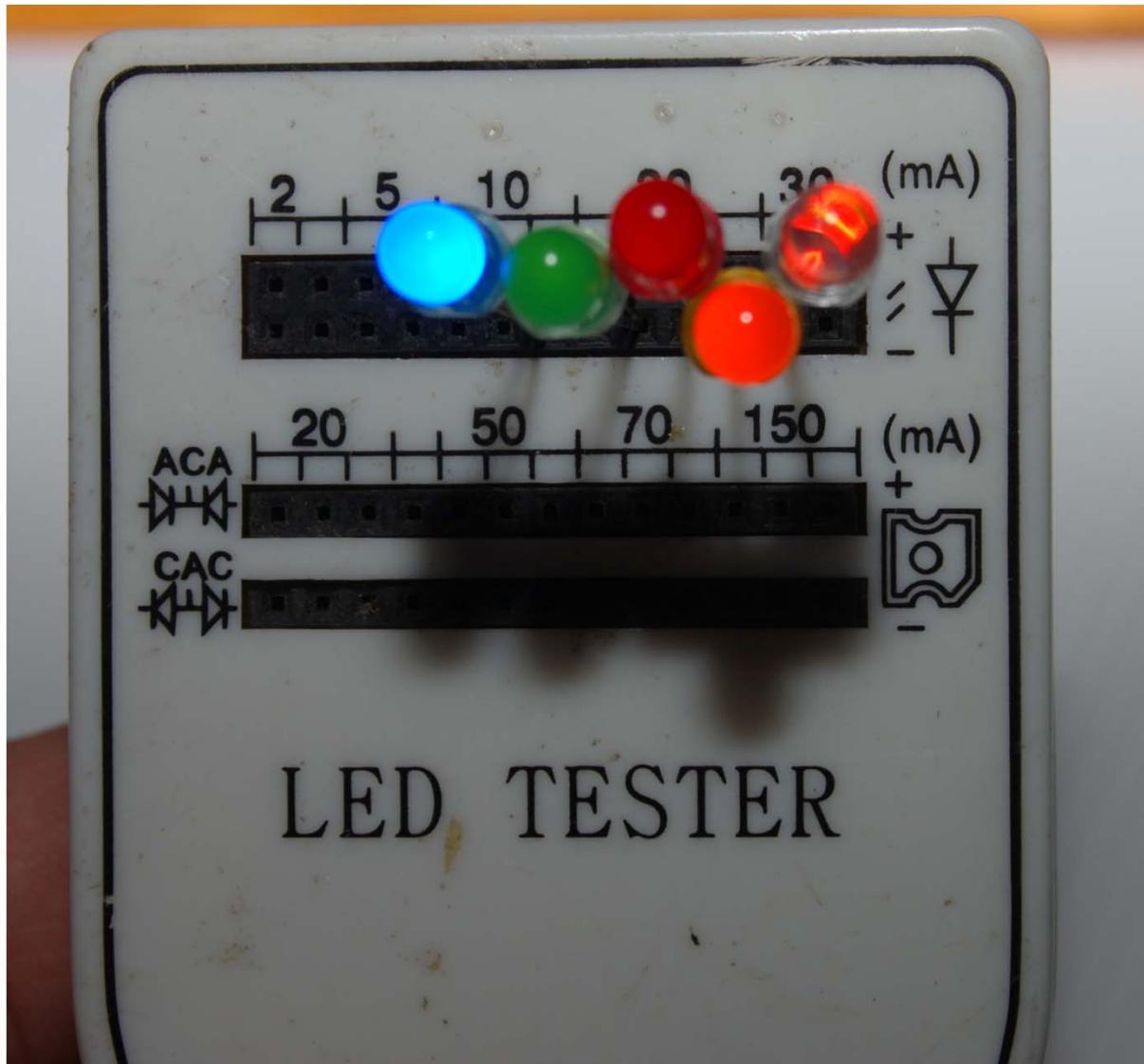
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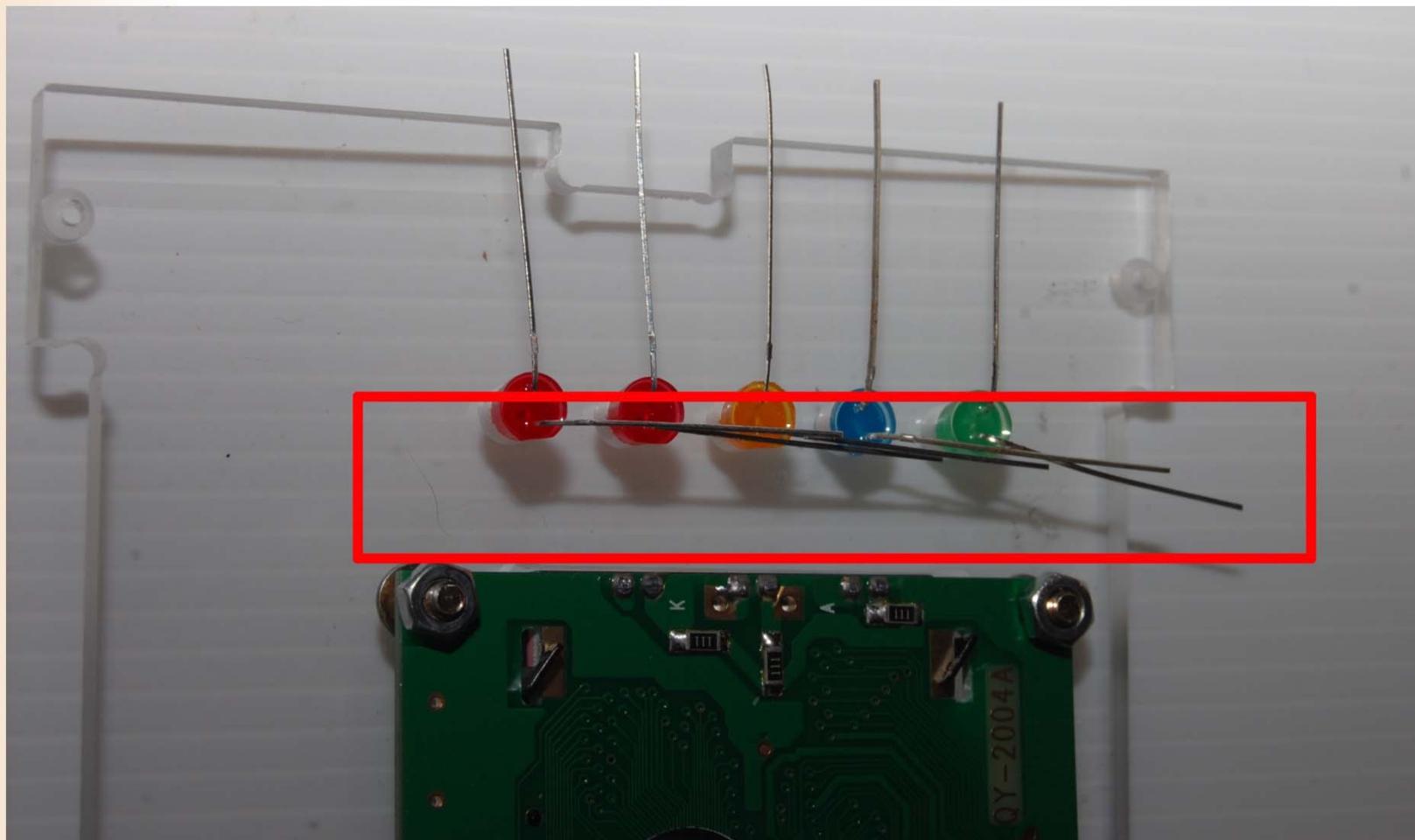
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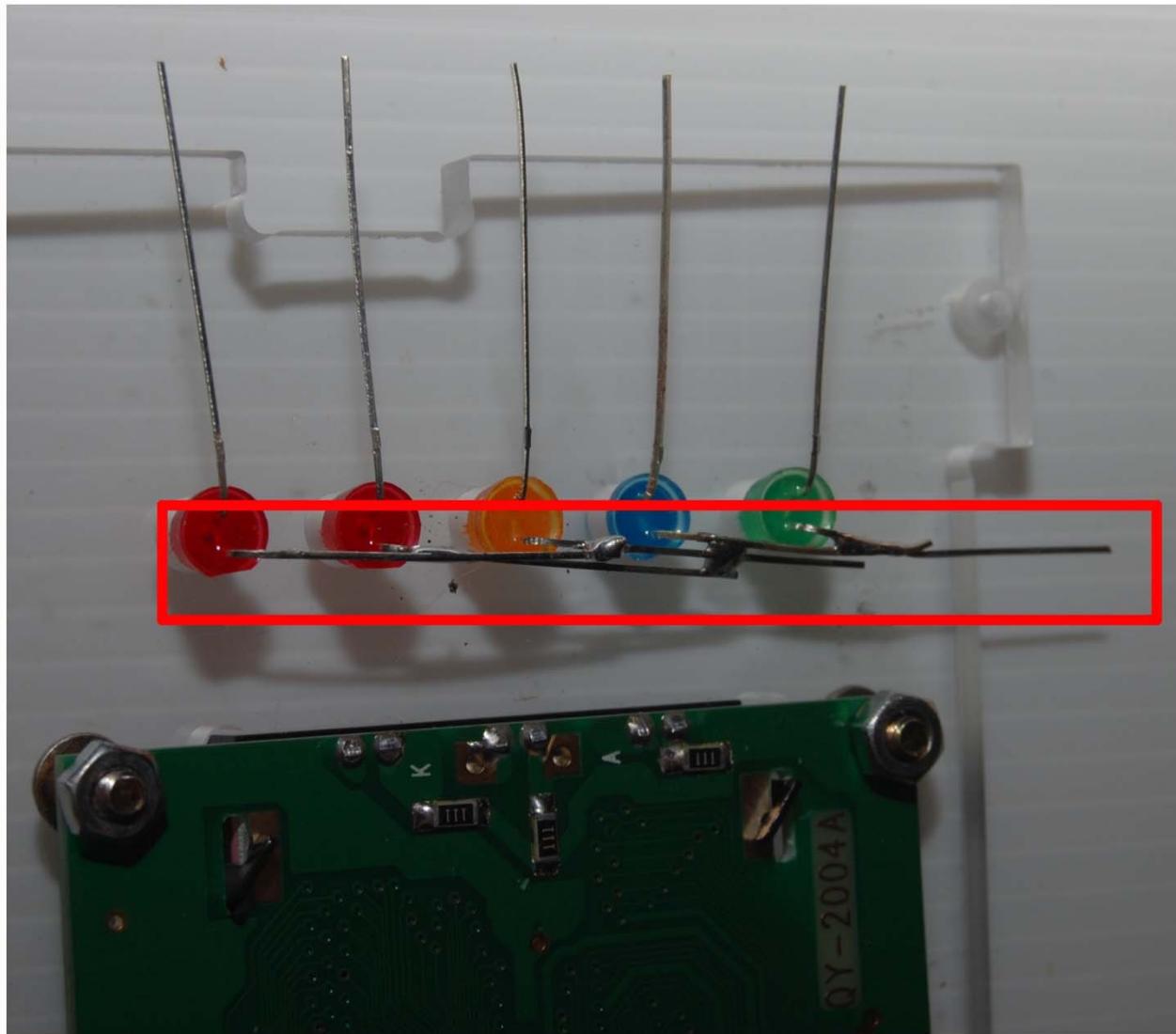


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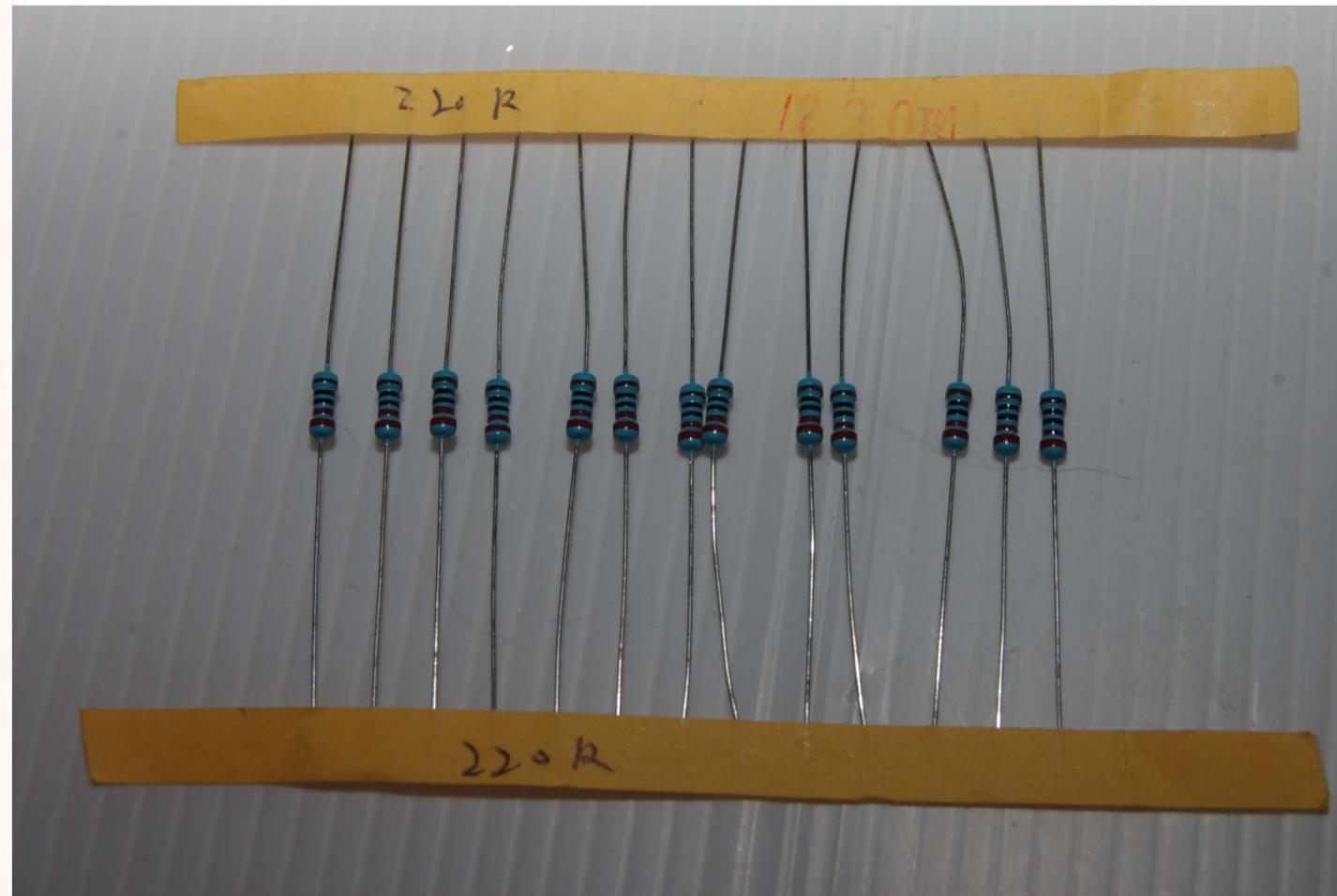


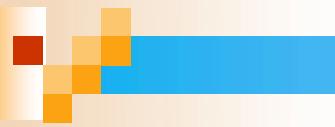


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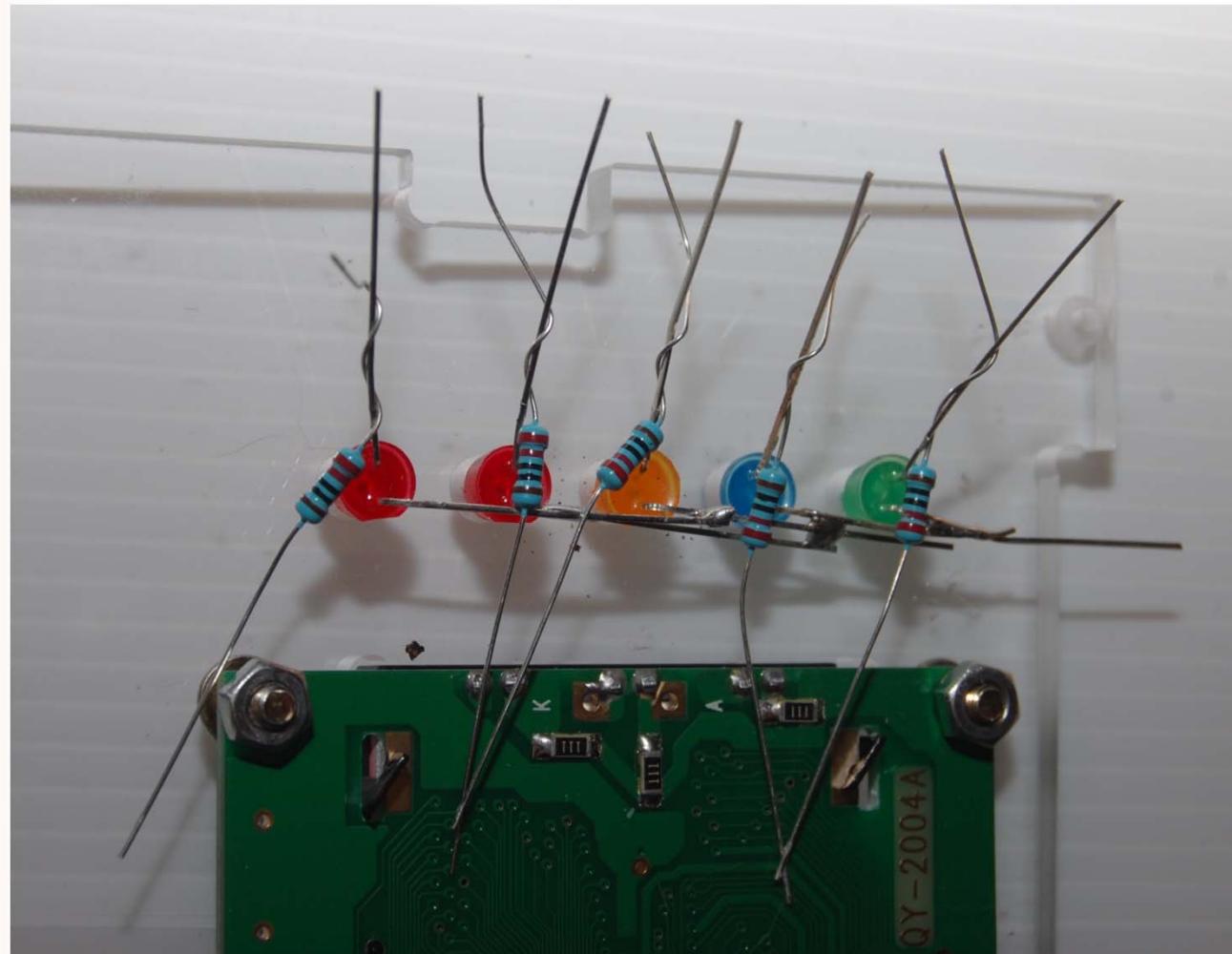


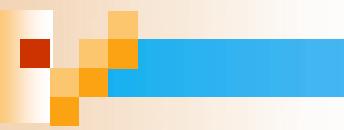


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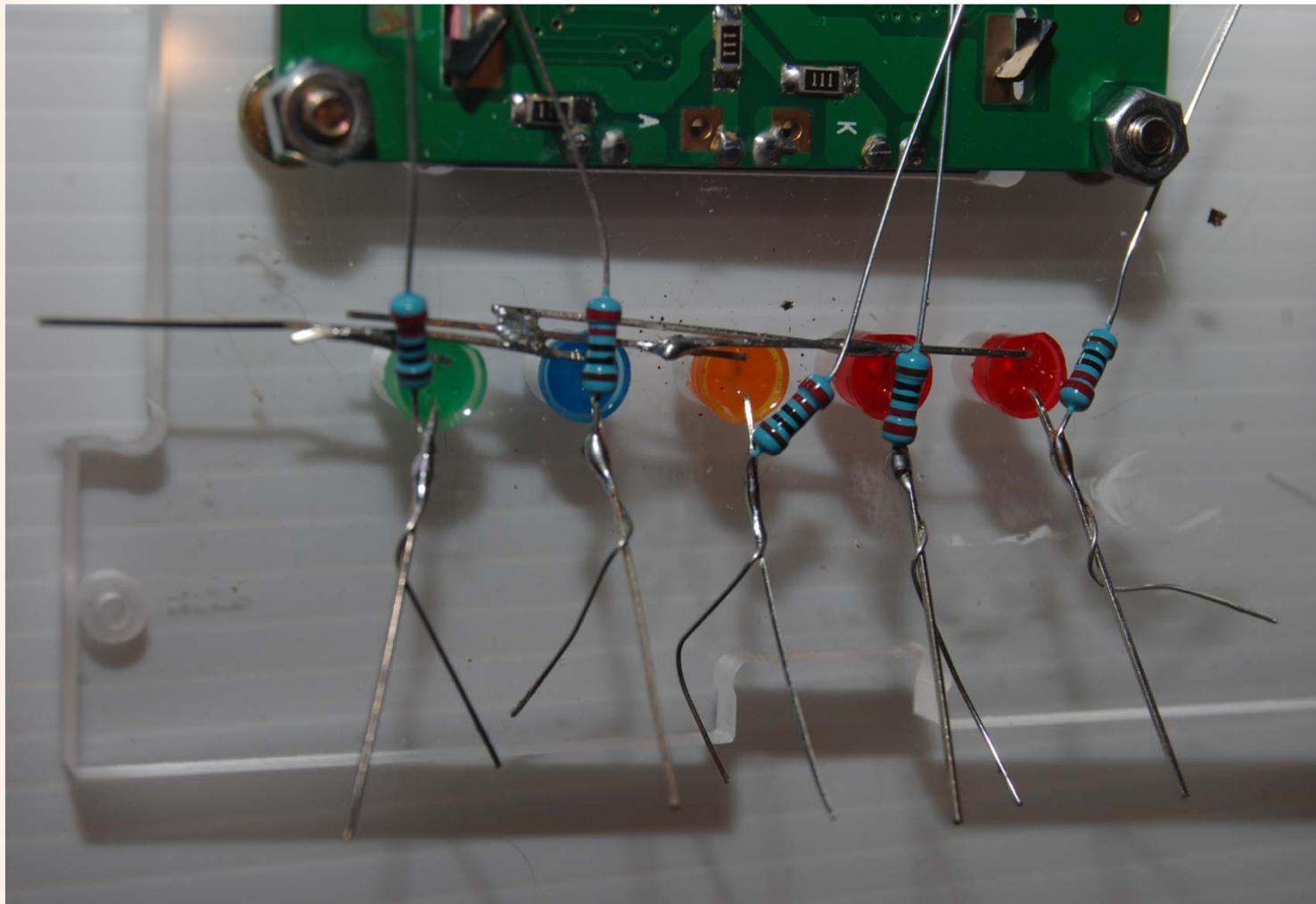


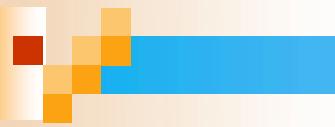
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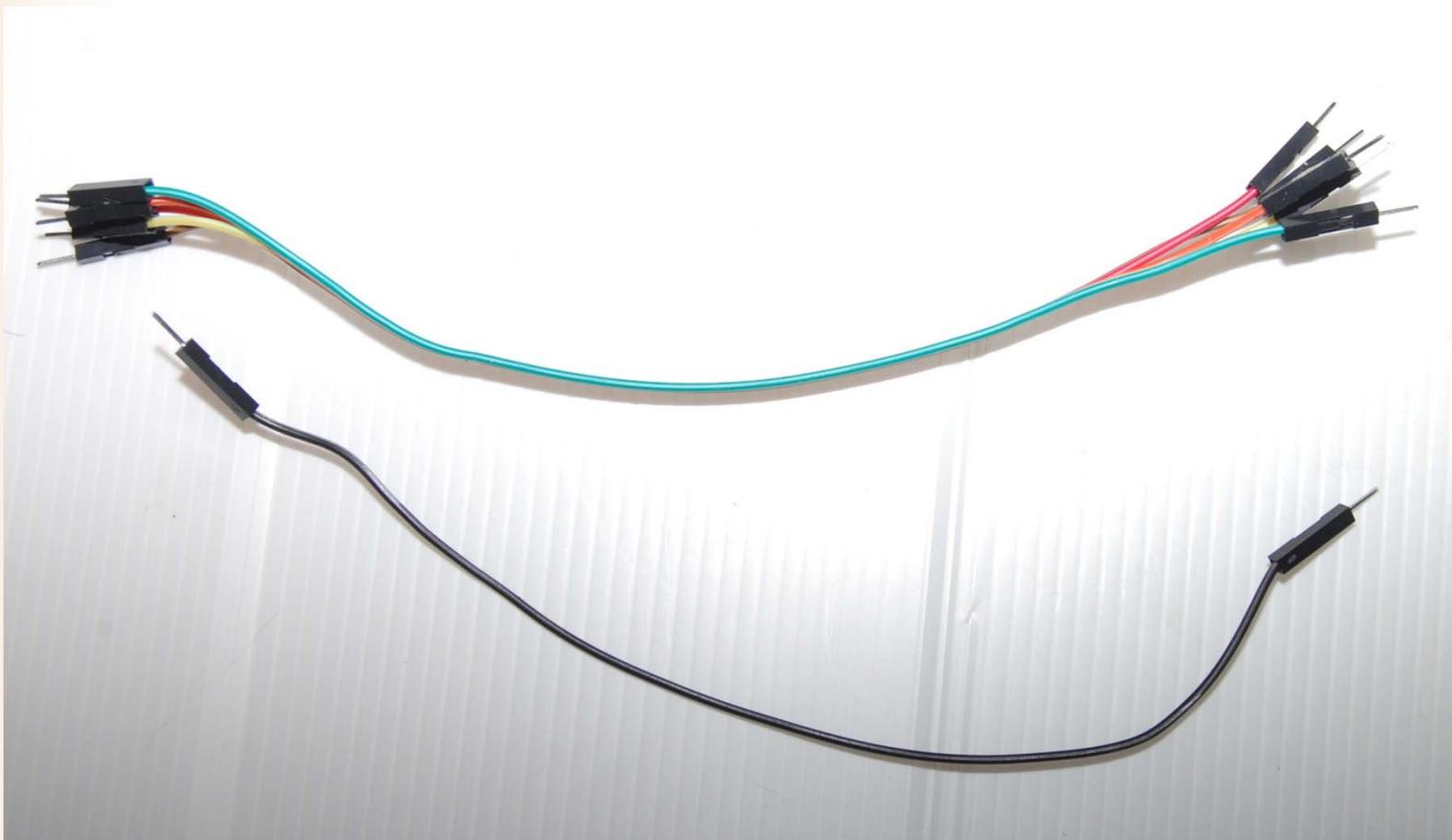


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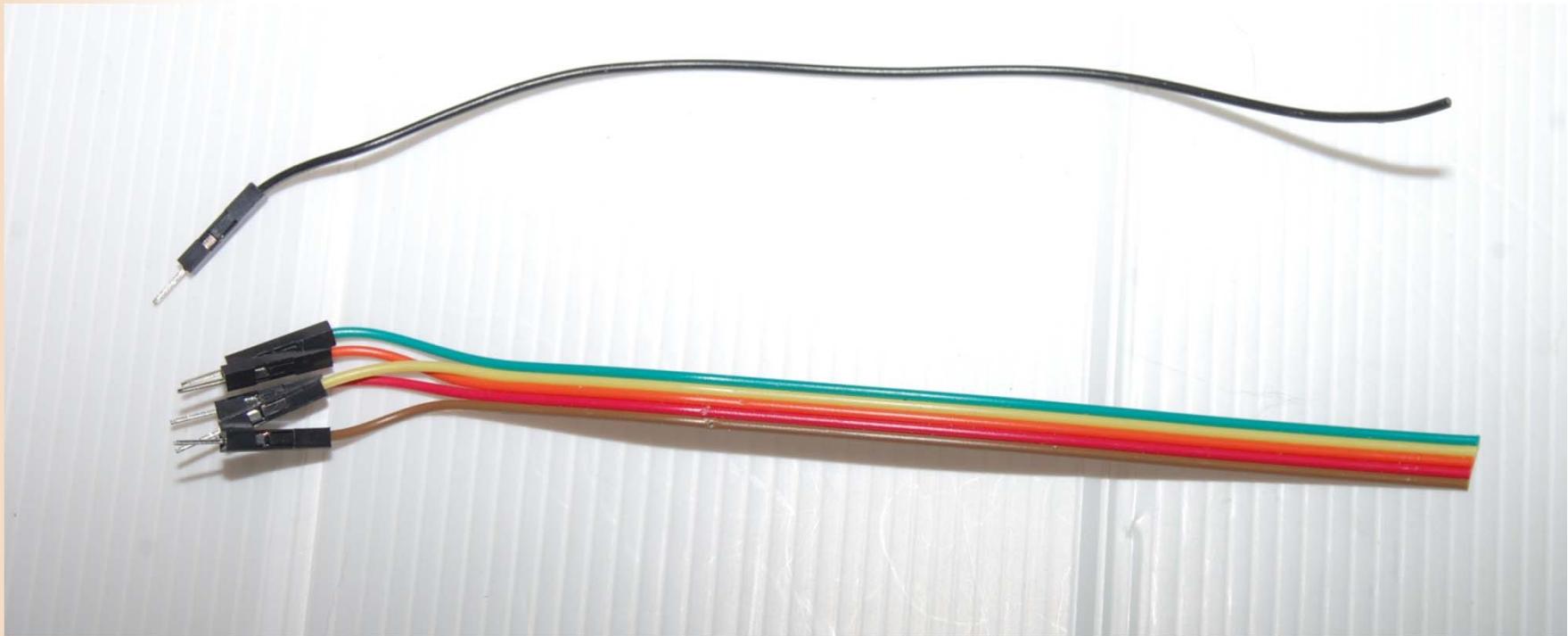




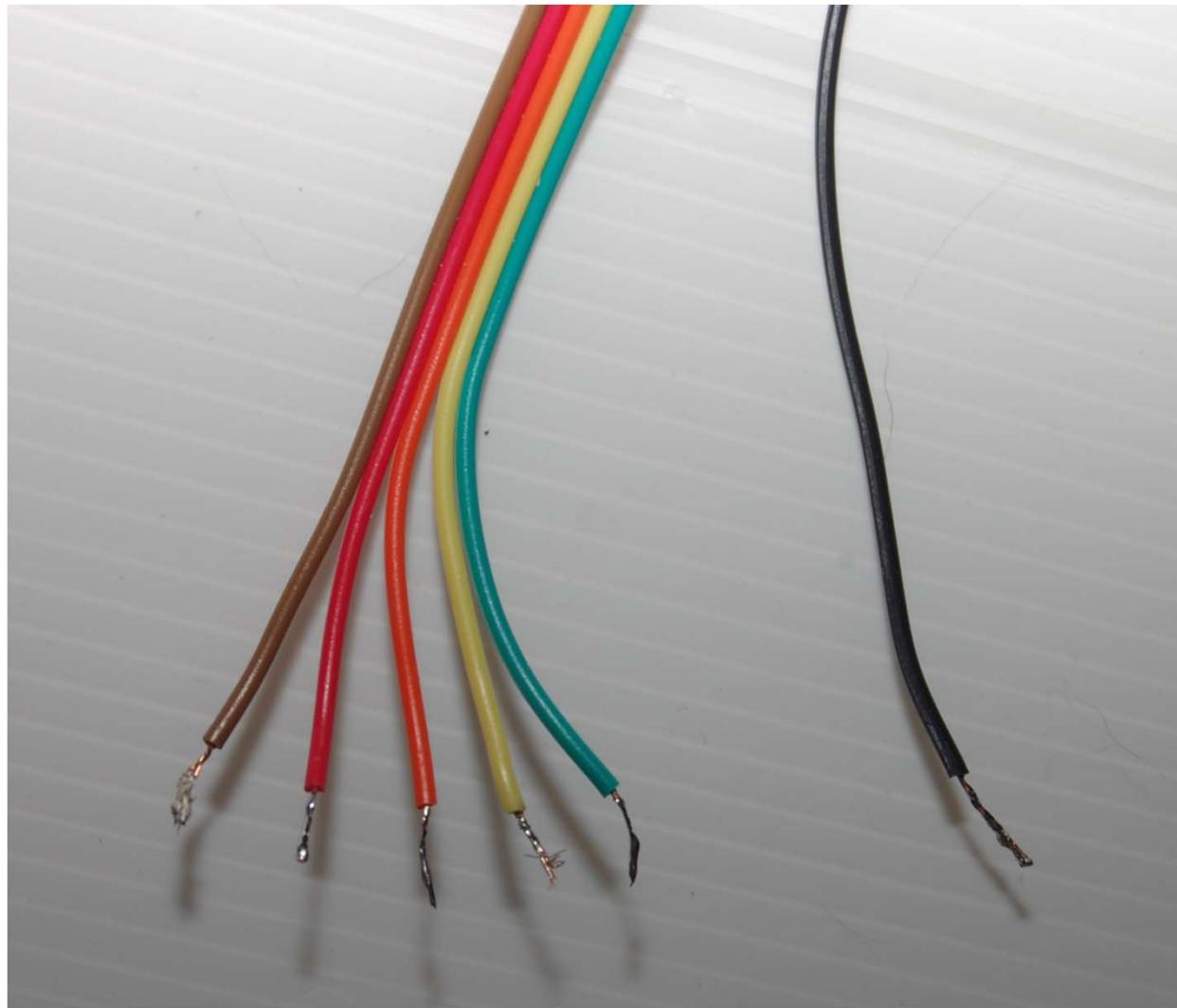
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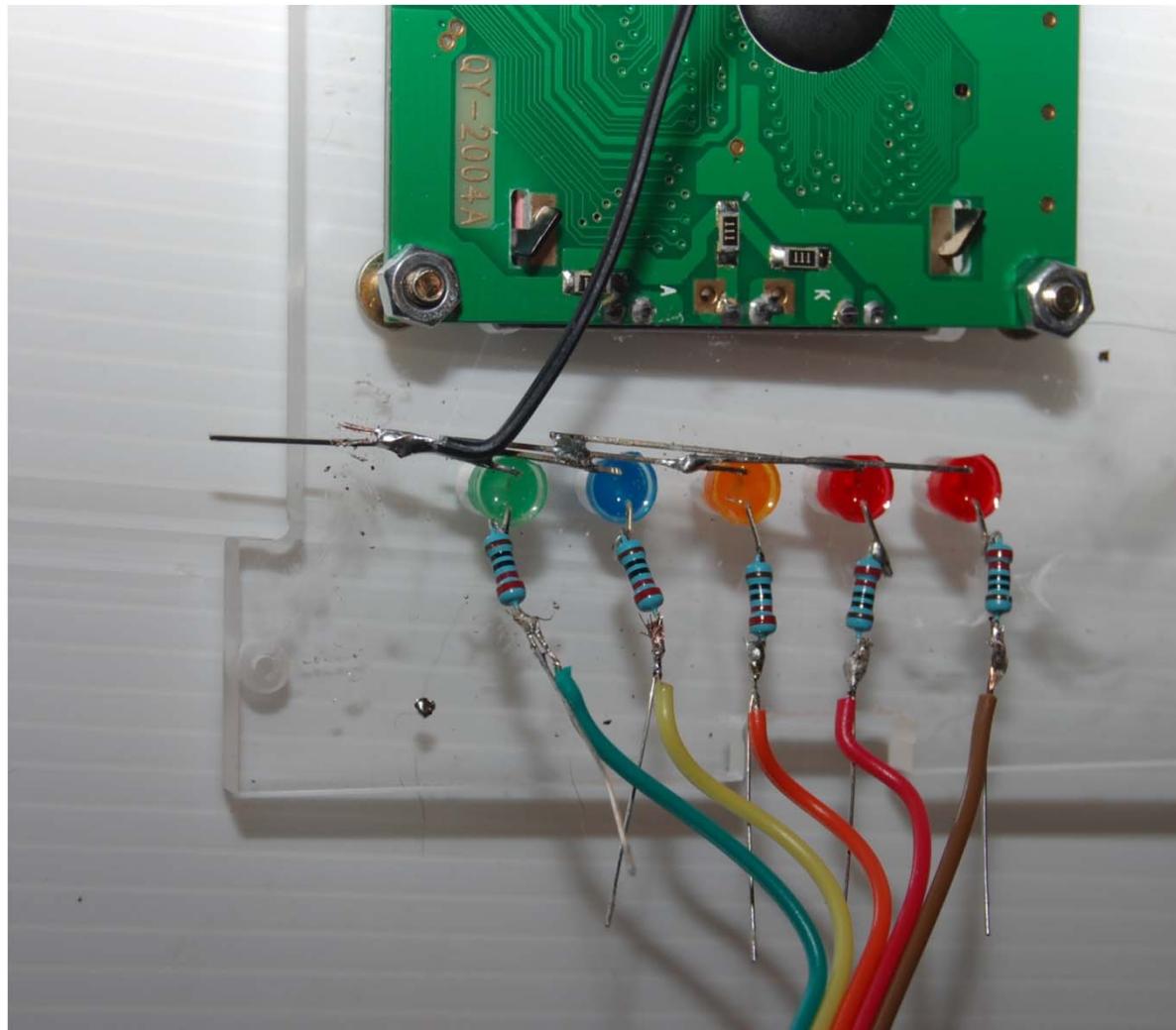
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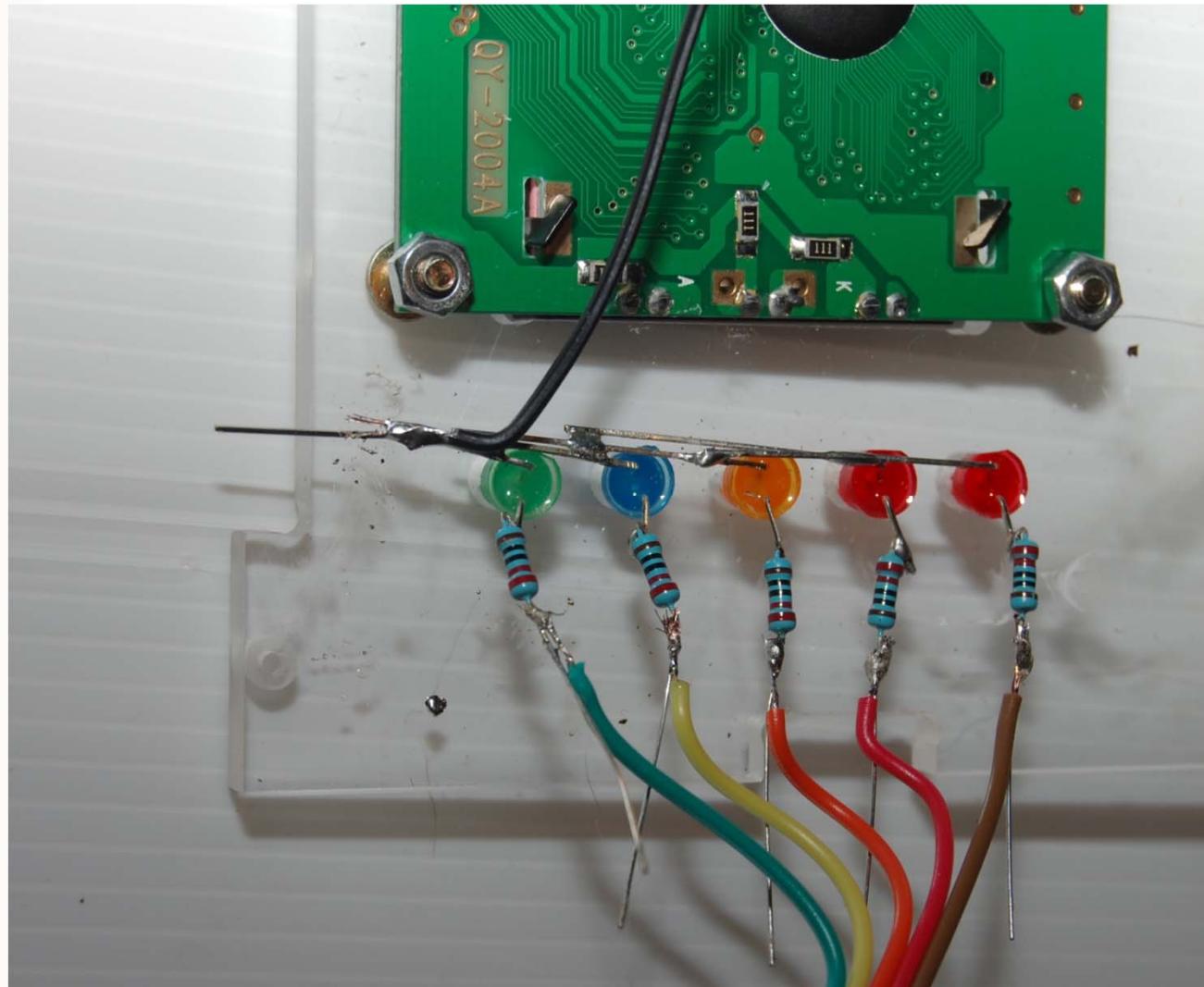
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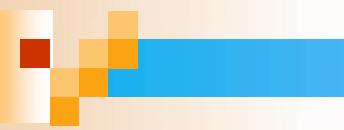


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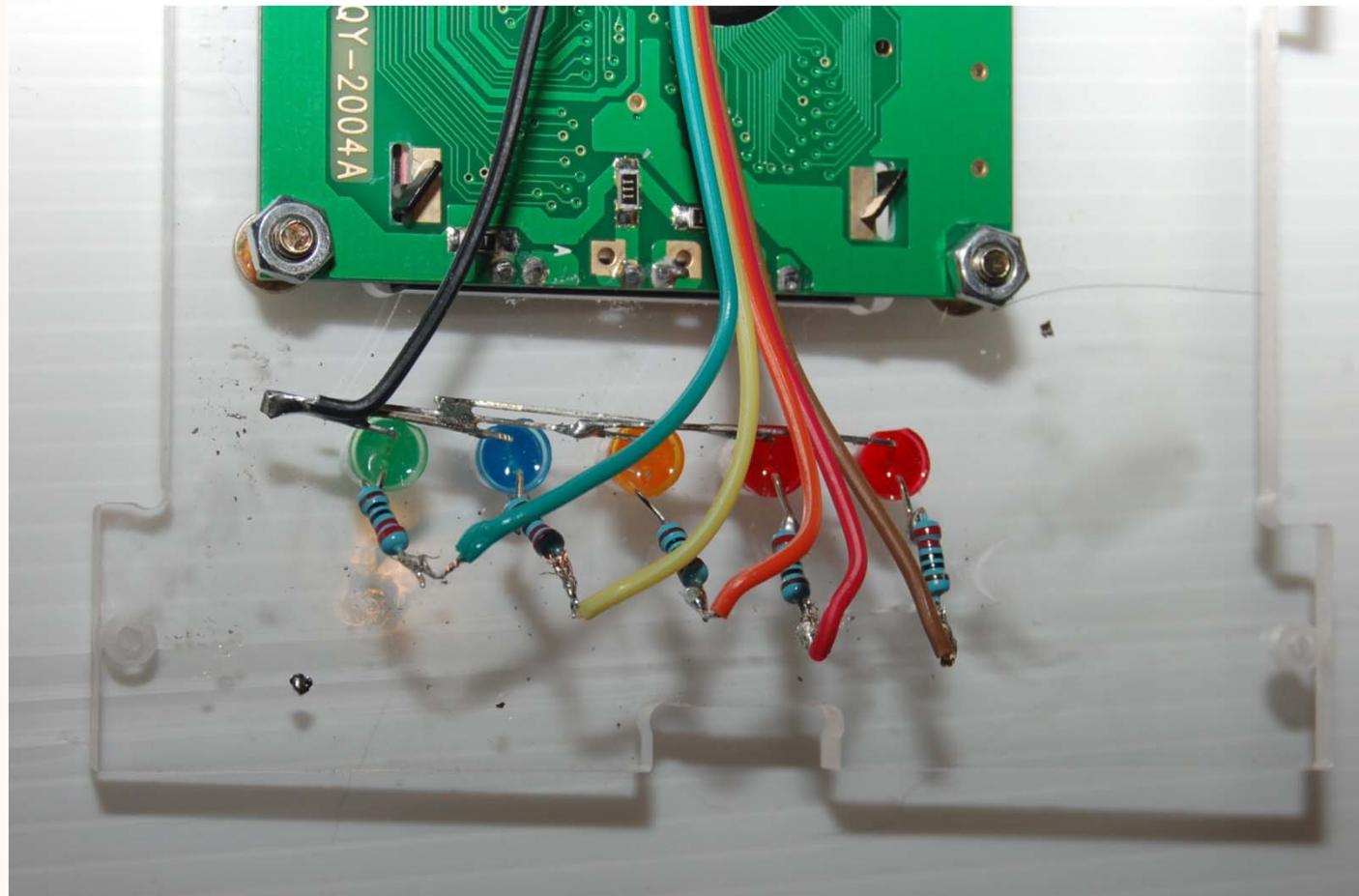


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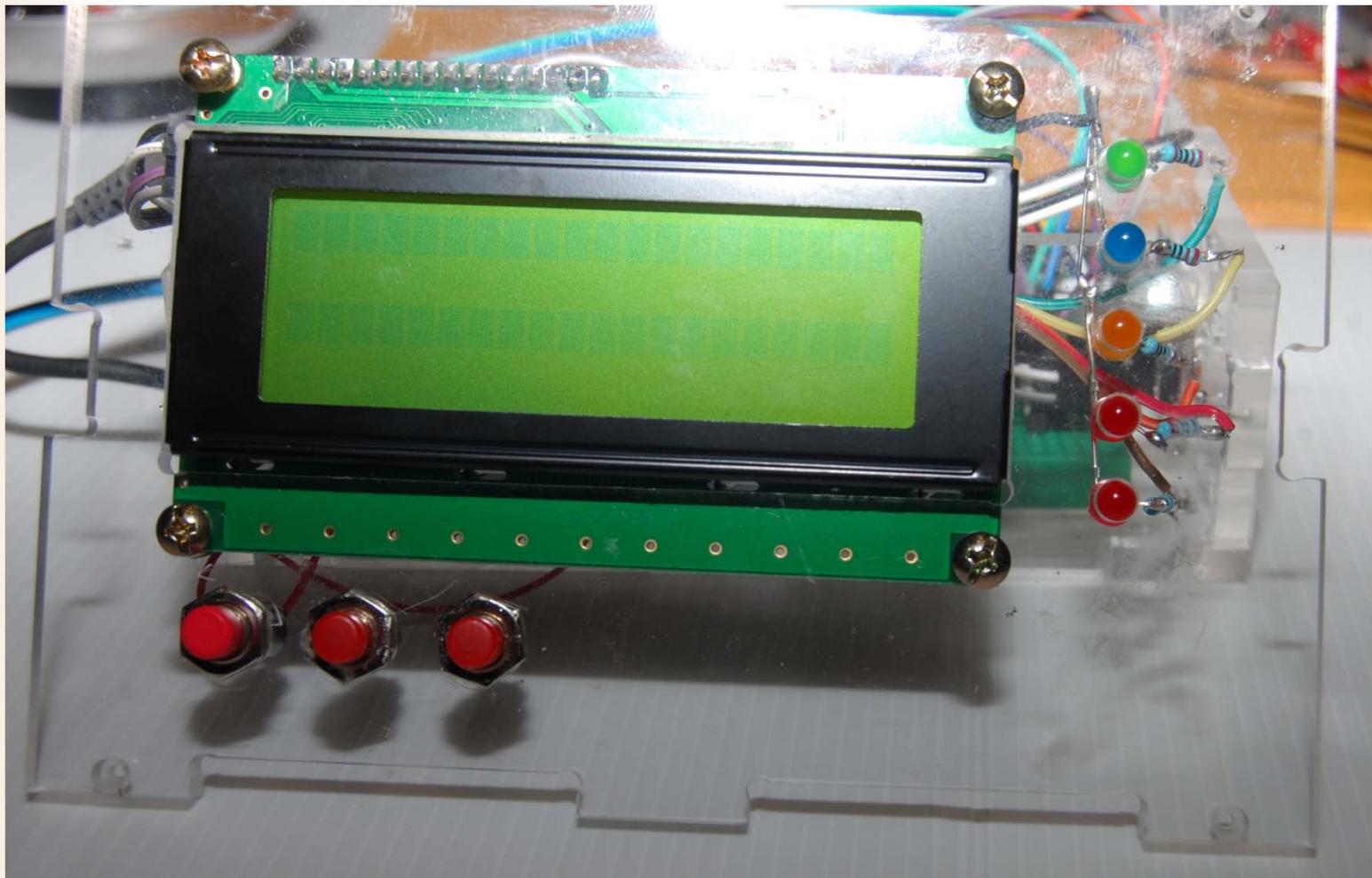




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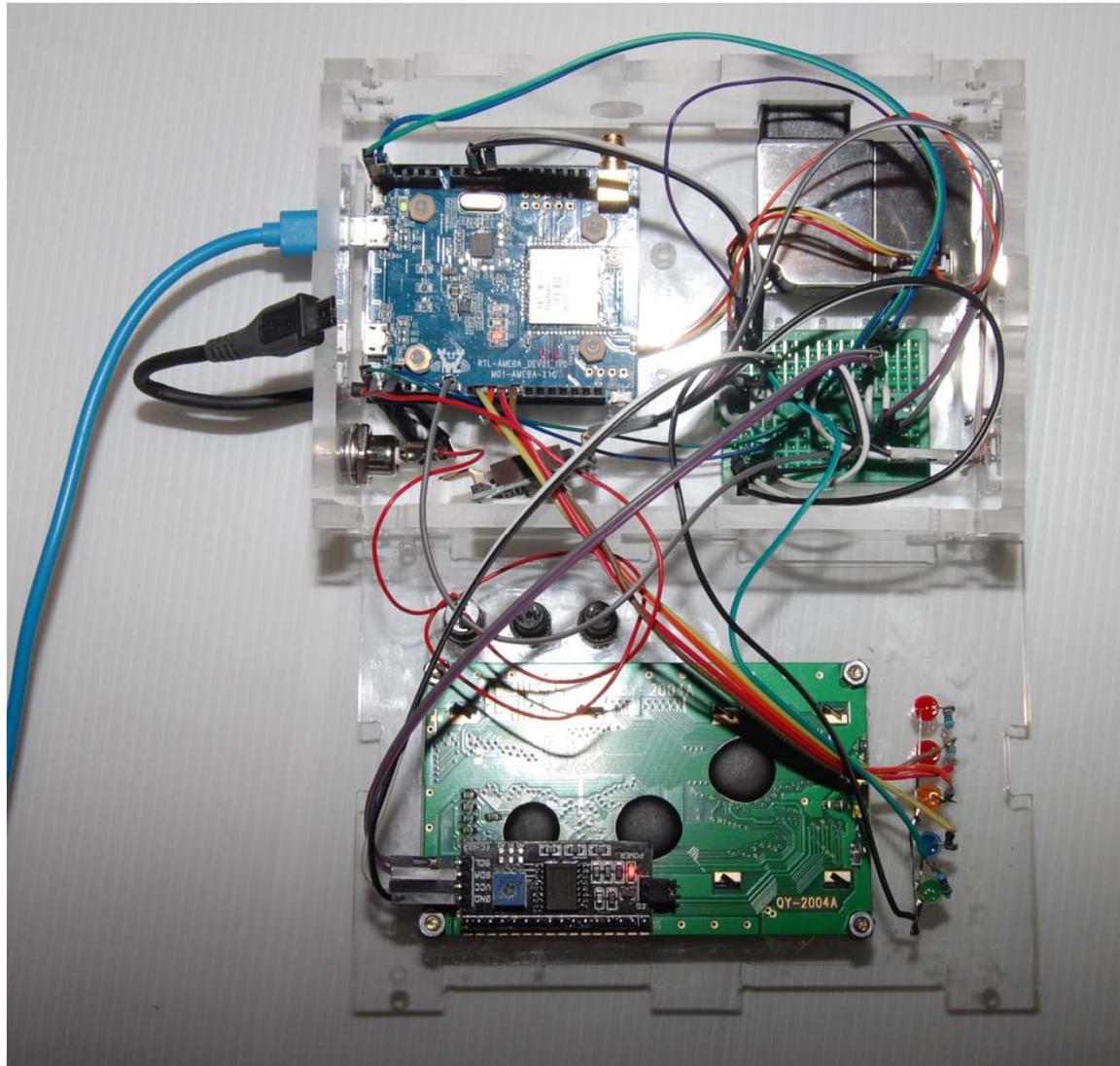
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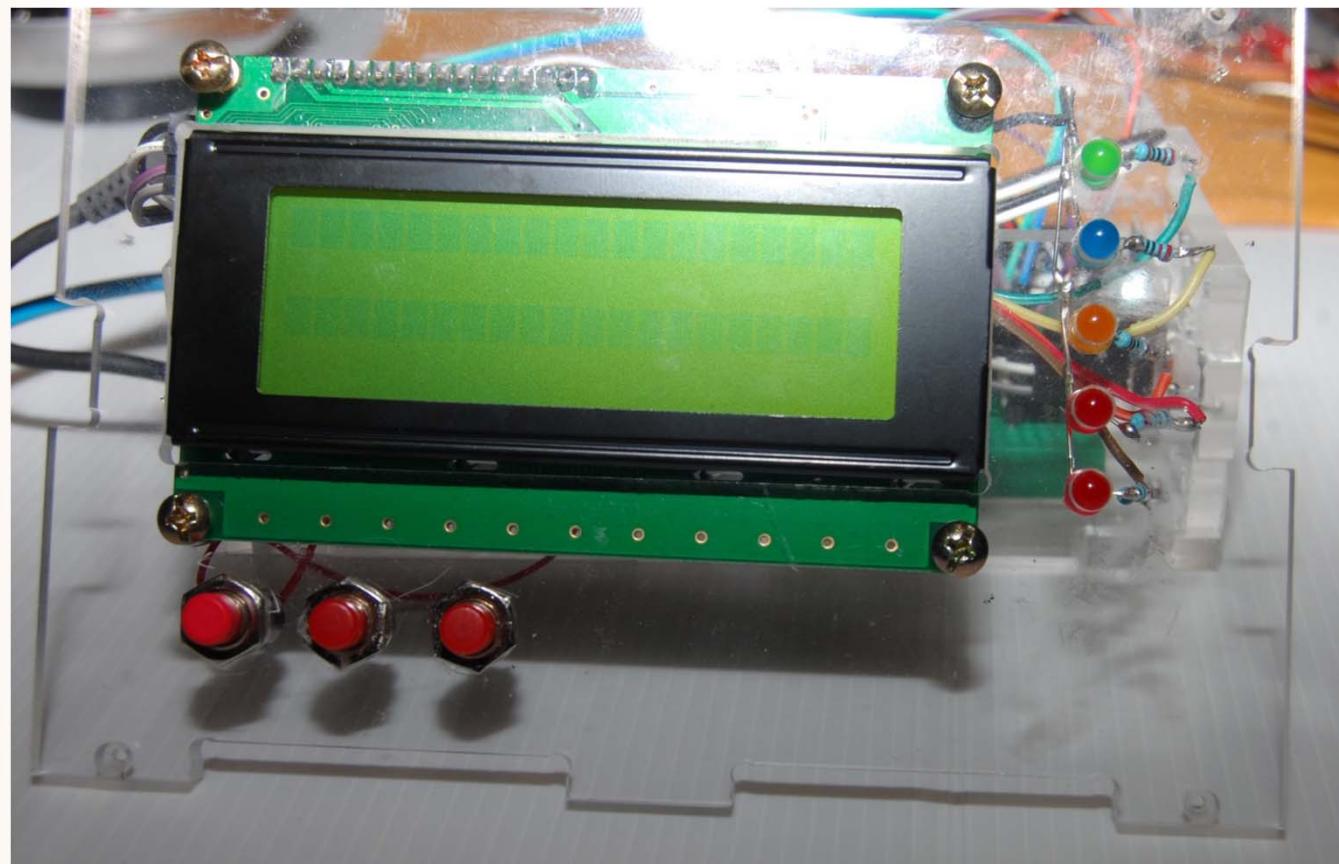
# 整體組裝



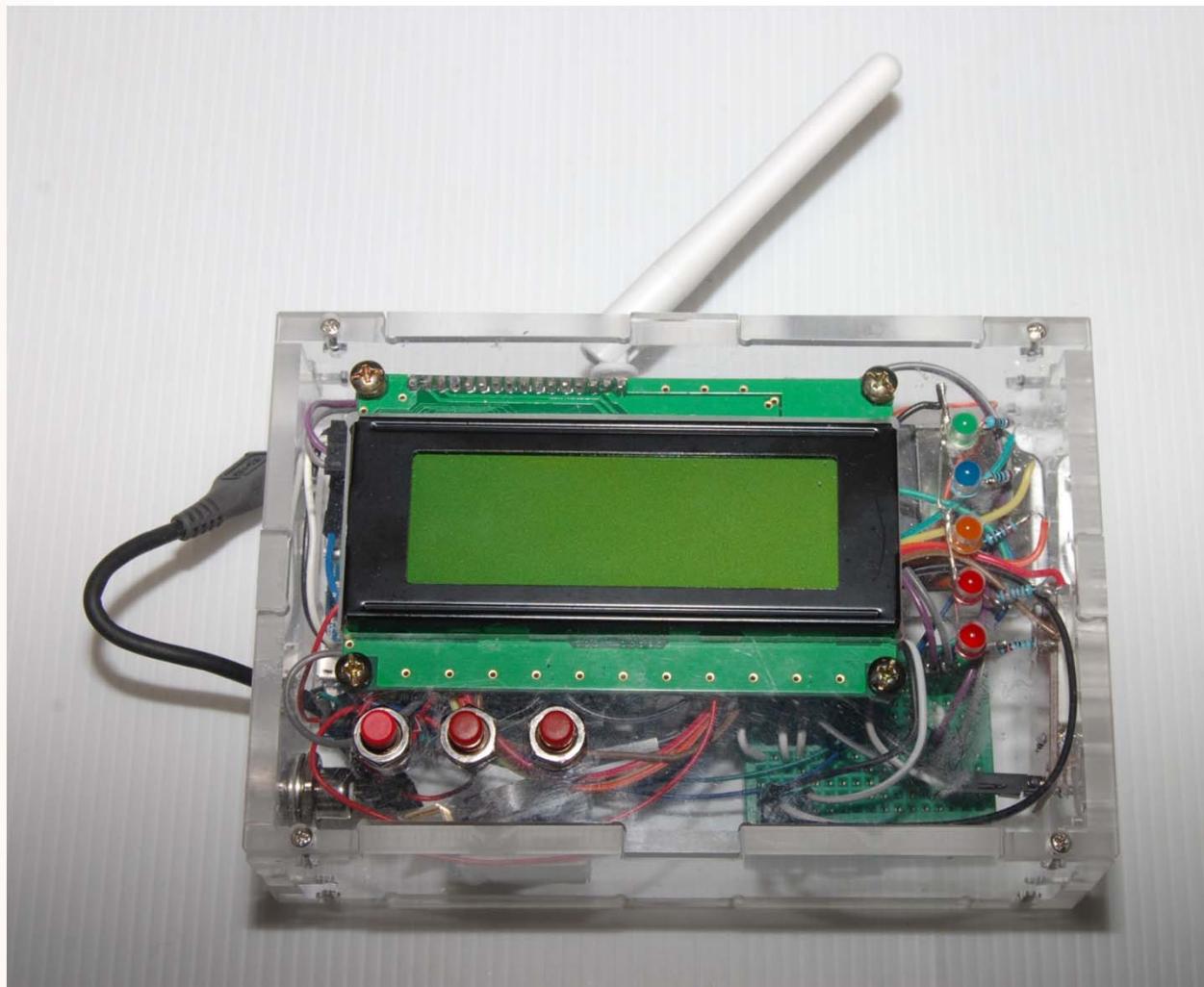
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# 整體組裝



# 整體組裝



# 電路組裝

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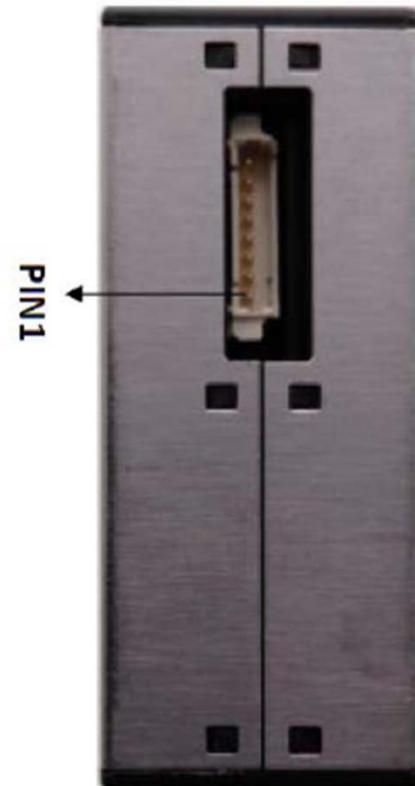
## Digital interface definition

Pin number	Function	Explain
PIN1	VCC	Power supply DC5V
PIN2	GND	Negative power supply
PIN3	SET(Internal 50K pull-up)	Set pin 3.3V level
PIN4	RXD/I2C_SCL	Digital pin 3.3V level
PIN5	TXD/I2C SDL	Digital pin 3.3V level
PIN6	RESET	Module reset signal 3.3V level
PIN7	PWM output	3.3V level only for single sensor output
PIN8	Mode selection (Internal 50K pull-up)	High or NC      Serial port mode 3.3V level      Low level      I2C model

Note: SET=1 module is in the working state, and the module is electrically active to send data

Instruction change working mode

SET=0 module into low power standby mode



# 安裝偵測空氣懸浮粒子感測器

pin1，供電輸入接腳，要輸入5V電壓的電力。

pin2，接地接腳，接上0V。

pin3，設定輸入接腳，接收到0時感測器處於待備狀態（減少感測器的耗電），接收到1則為運作狀態。

pin4，串列埠接收接腳(Rx)，邏輯準位3.3V。

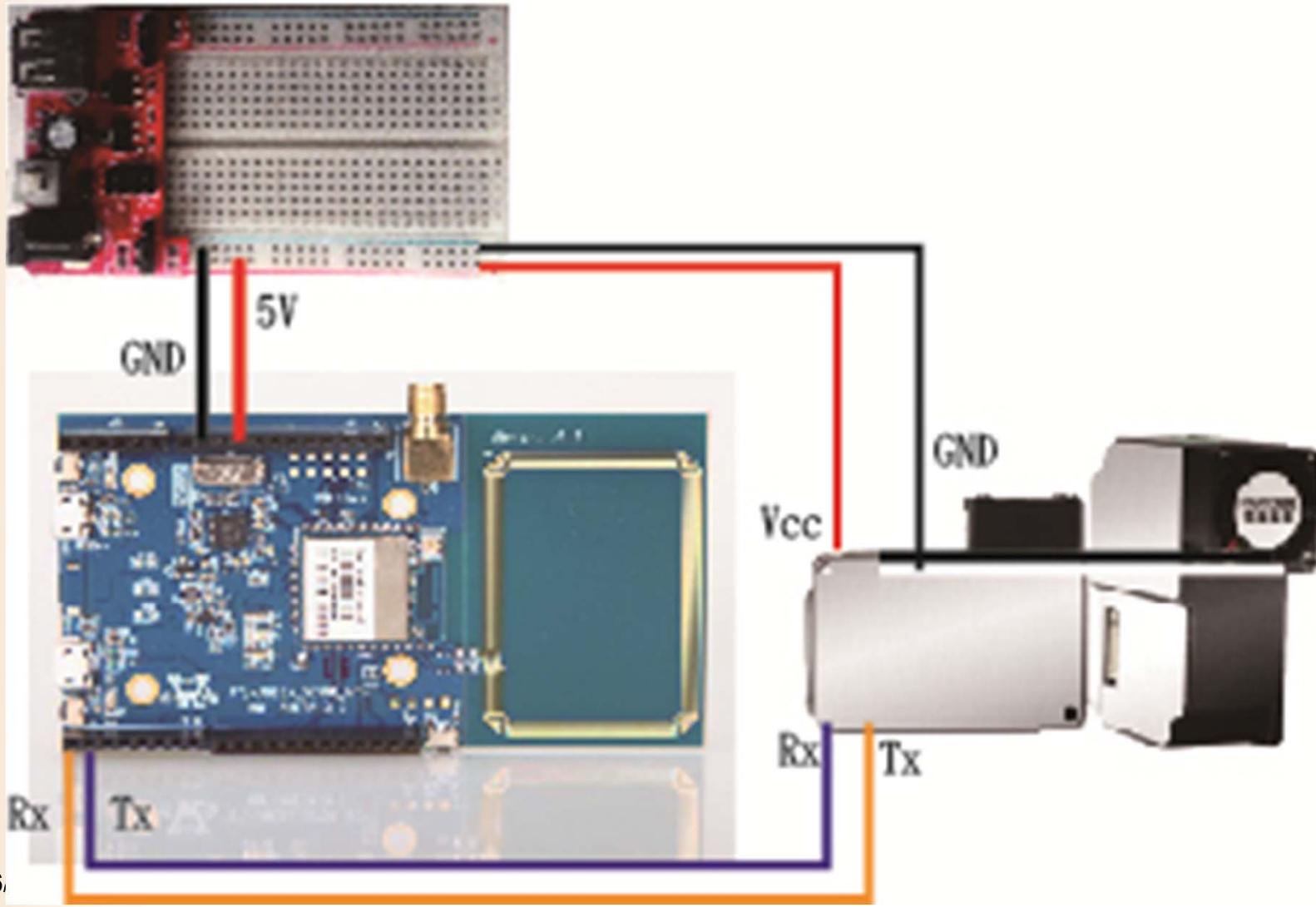
pin5，串列埠輸出接腳(Tx)，邏輯準位3.3V。

pin6，重置、重新開機輸入接腳，接收到3.3V  
則重新開機。

pin7，還沒用到。

pin8，還沒用到。

# 安裝偵測空氣懸浮粒子感測器

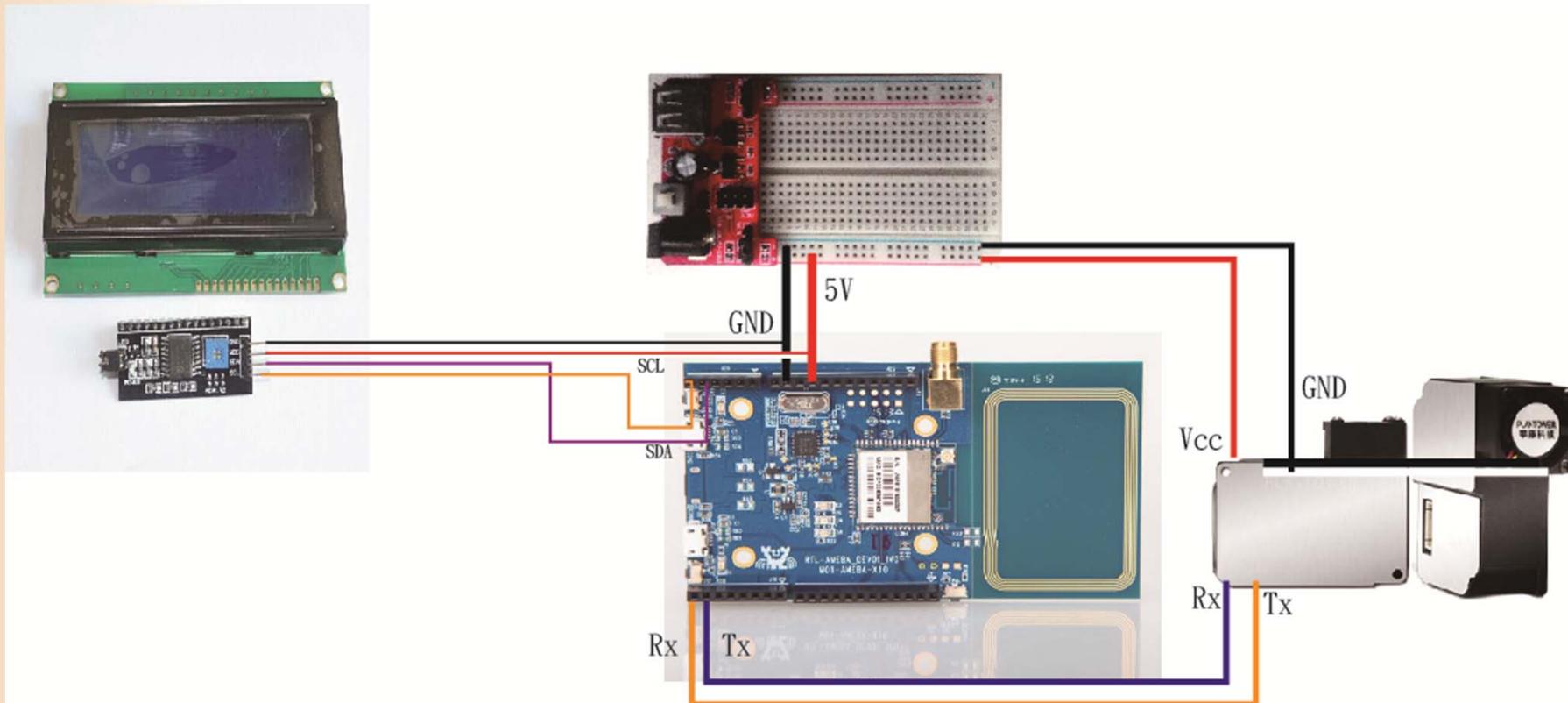


# 安裝偵測空氣懸浮粒子感測器

PMS3003感測模組	開發板接腳	解說
pin1，供電輸入接腳	Ameba pin 5V	5V 陽極接點
pin2，接地接腳	Ameba pin Gnd	共地接點
pin4，串列埠接收接腳(Rx)	Ameba Tx(D1)	串列埠傳送端
pin5，串列埠輸出接腳(Tx)	Ameba Rx(D0)	串列埠接收端

# 安裝LCD顯示器

# 安裝LCD2004顯示器



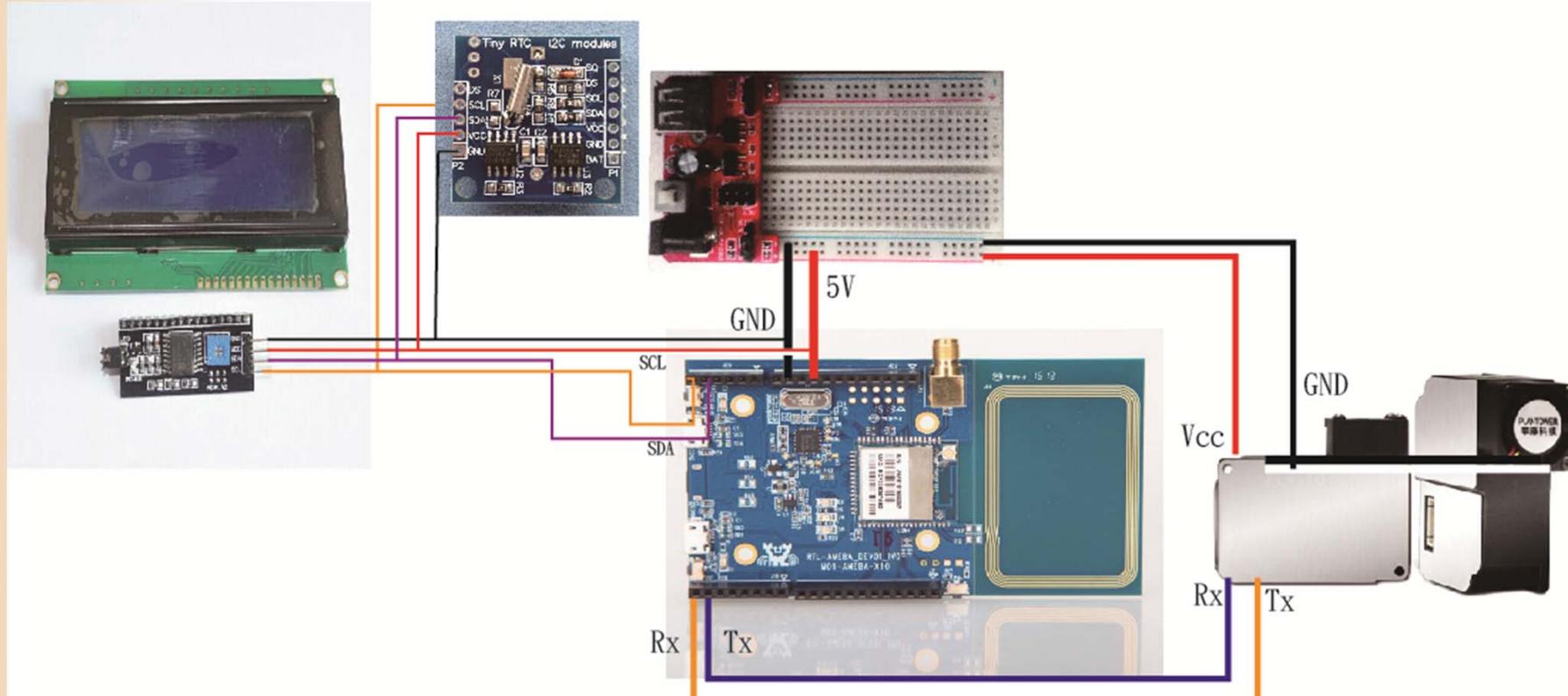
# 安裝LCD2004顯示器

## LCD 2004顯示模組接腳表(累加接腳表)

PMS3003感測模組	開發板接腳	解說
pin1，供電輸入接腳	Ameba pin 5V	5V 陽極接點
pin2，接地接腳	Ameba pin Gnd	共地接點
pin4，串列埠接收接腳(Rx)	Ameba Tx(D1)	串列埠傳送端
pin5，串列埠輸出接腳(Tx)	Ameba Rx(D0)	串列埠接收端
LCD2004顯示模組	開發板接腳	解說
VCC	Ameba pin 5V	5V 陽極接點
GND	Ameba pin Gnd	共地接點
SCL	Ameba I2C_SCL	I2C SCL
SDA	Ameba I2C_SDA	I2C SDA

# 安裝RTC時鐘模組

# 安裝RTC時鐘模組

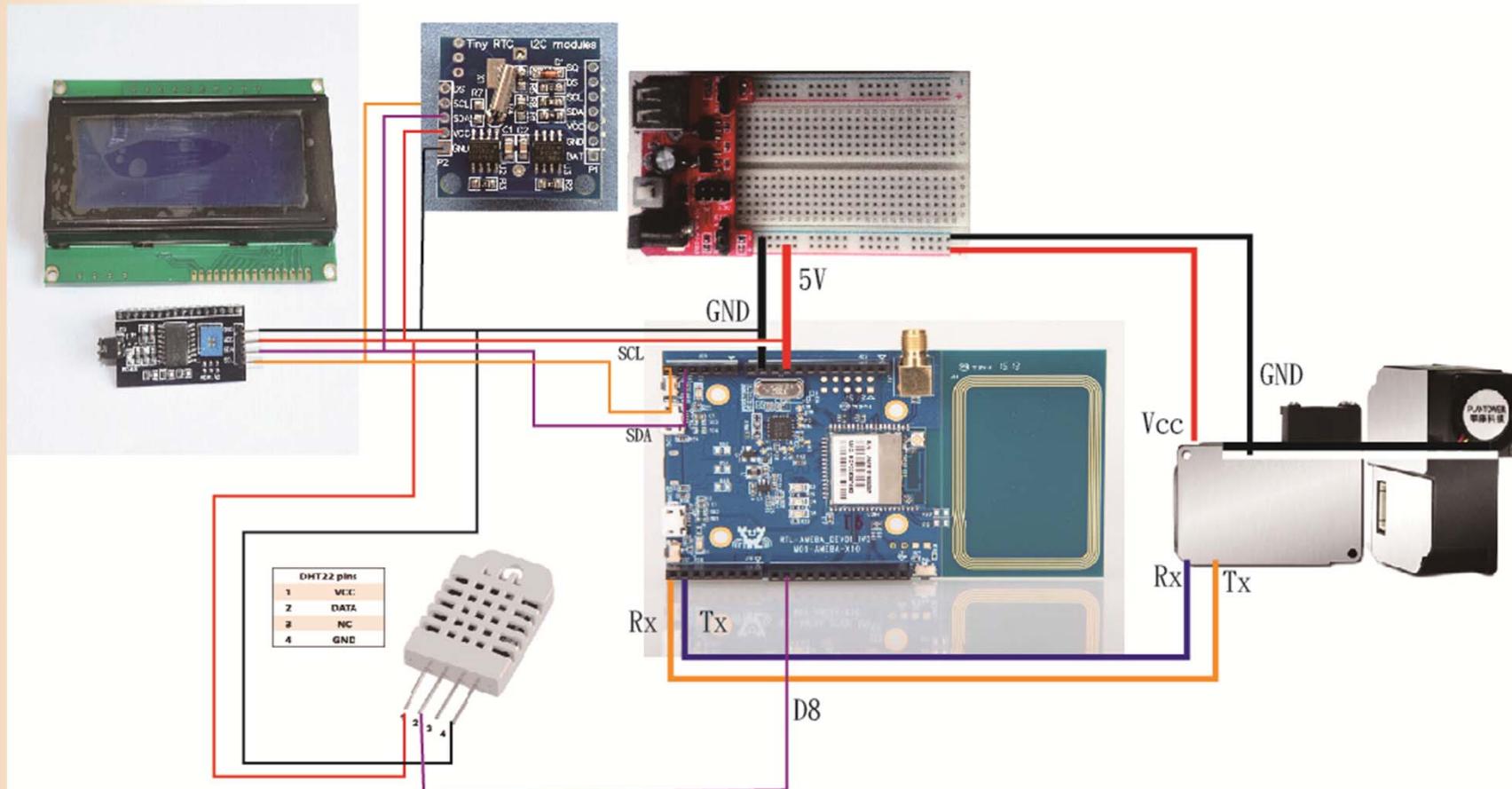


# 安裝RTC時鐘模組

RTC時鐘模組	開發板接腳	解說
VCC	Ameba pin 5V	5V 陽極接點
GND	Ameba pin Gnd	共地接點
SCL	Ameba I2C_SCL	I2C SCL
SDA	Ameba I2C_SDA	I2C SDA

# 安裝溫溼度感測模組

# 溫溼度感測器

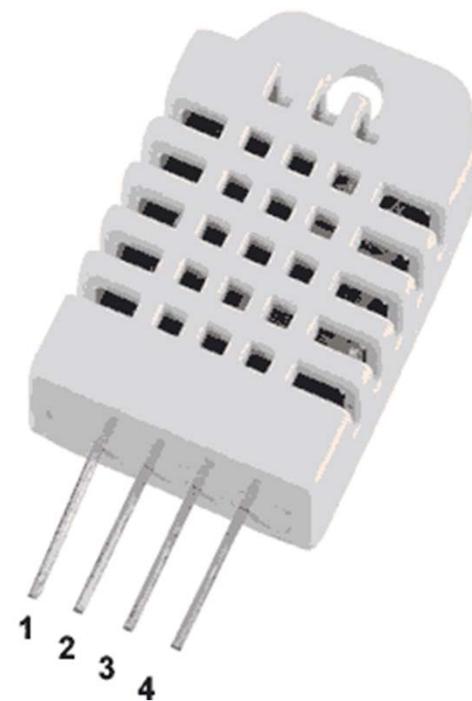


# 溫溼度感測器

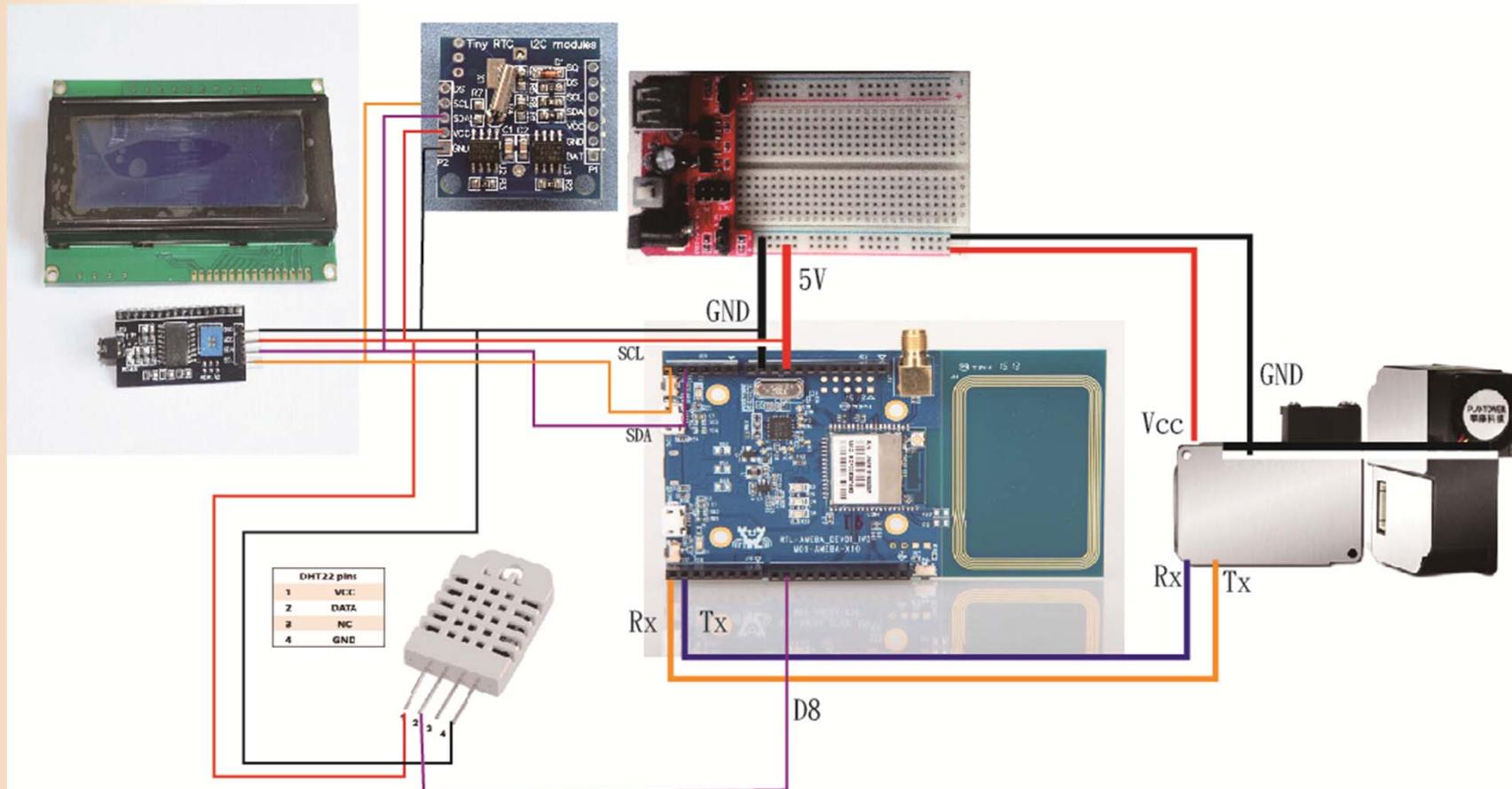
溫溼度感測器	開發板接腳	解說
VCC	Ameba pin 5V	5V 陽極接點
GND	Ameba pin Gnd	共地接點
Data(Signal)	Ameba D8	溫溼度資料輸出腳

# 溫溼度感測器

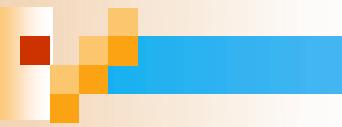
DHT22 pins	
1	VCC
2	DATA
3	NC
4	GND



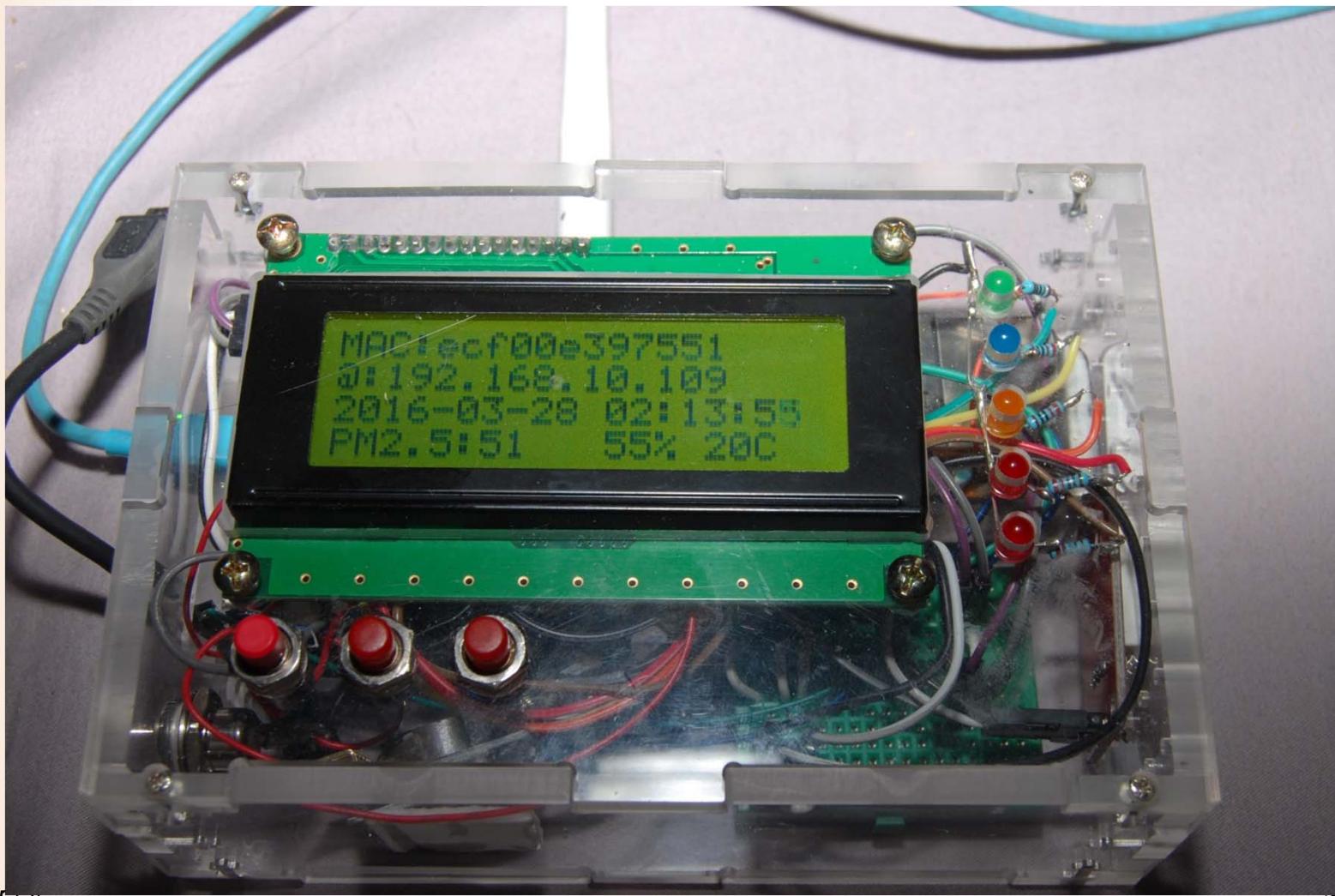
# 溫溼度感測器



# 最後成品

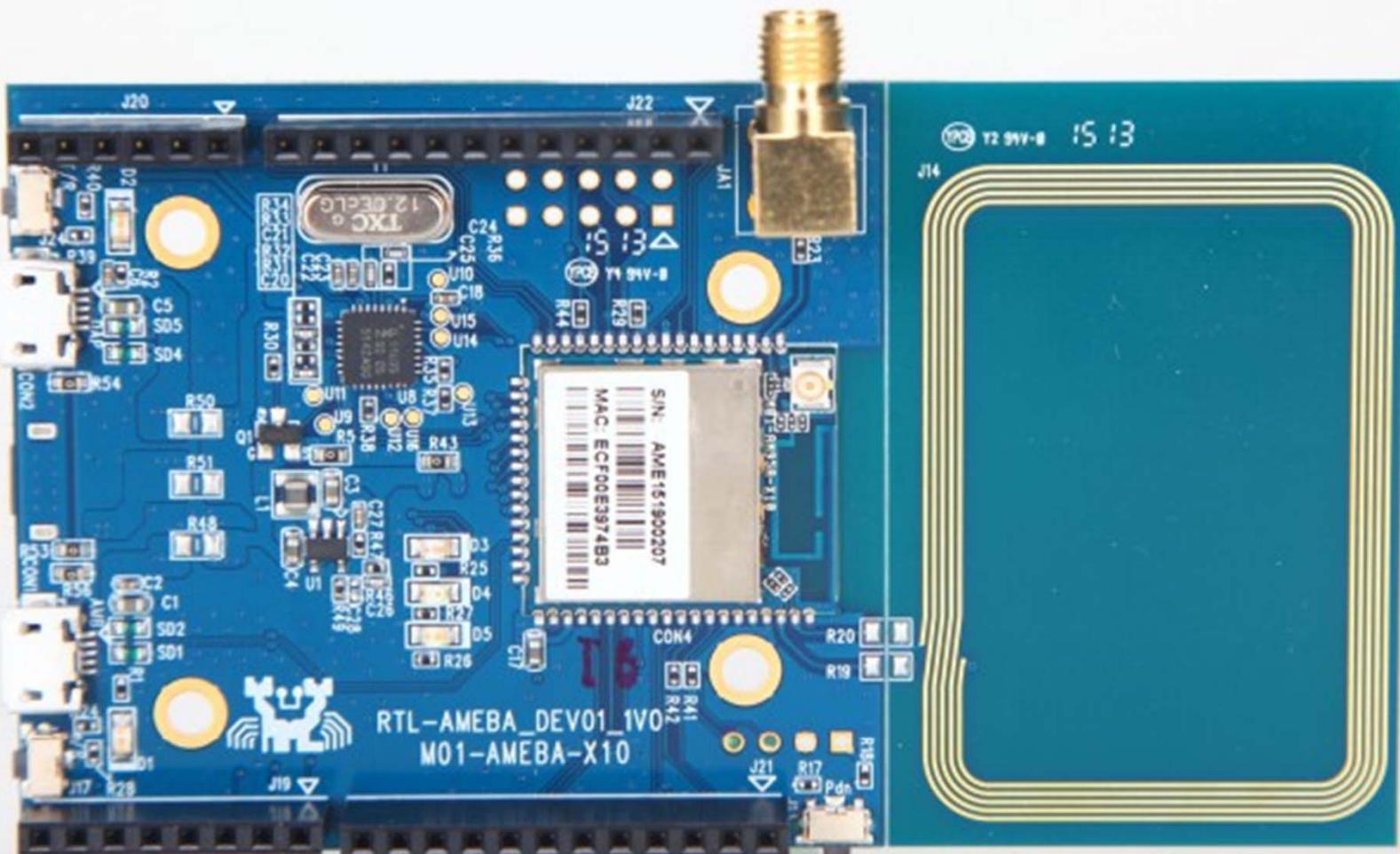


# 最後成品



# 軟體開發環境介紹

# Ameba



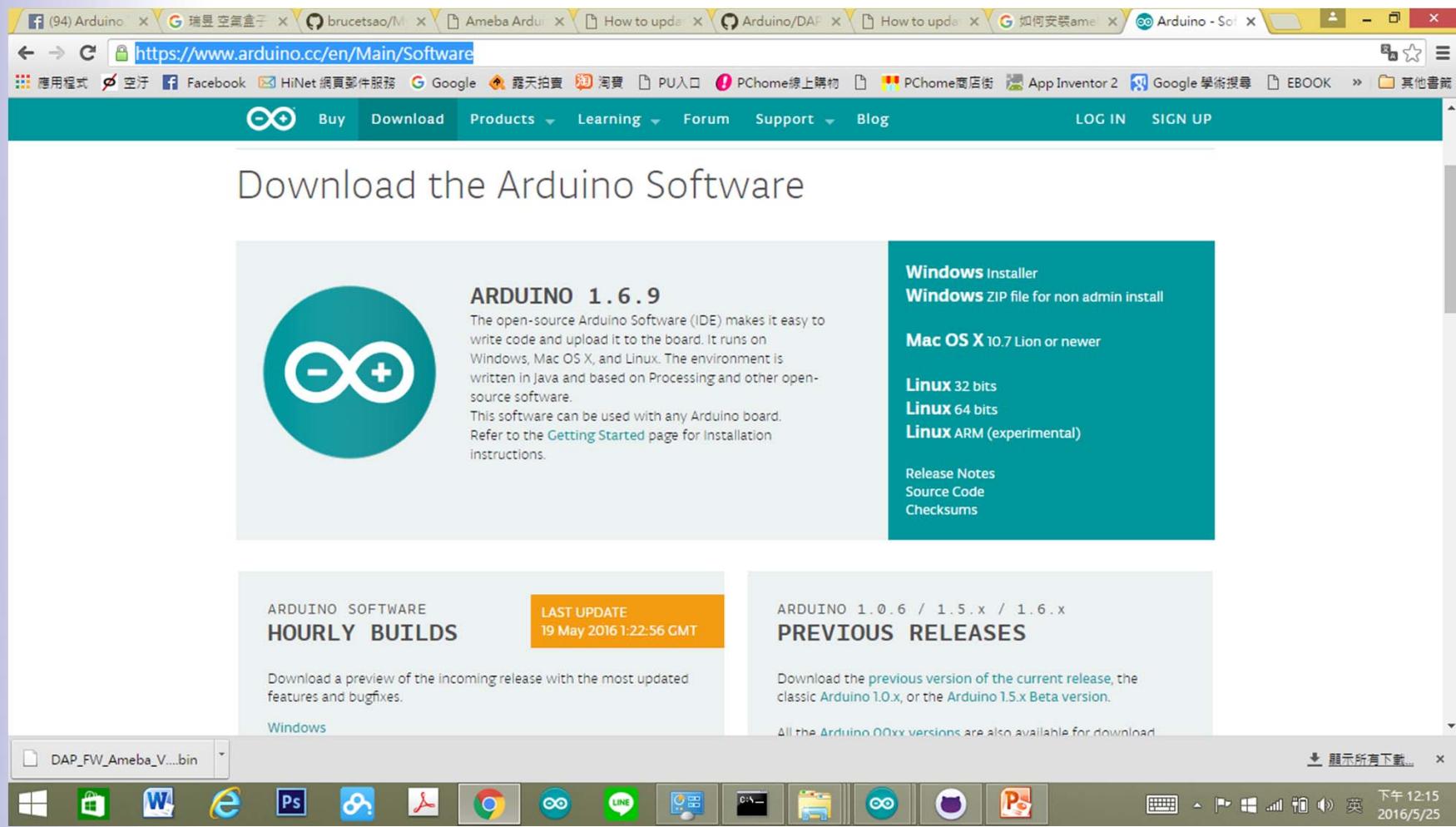


# 開發工具

- Arduino 的官網：<https://www.arduino.cc/>
- 下載網站<https://www.arduino.cc/en/Main/Software>
- 壓縮軟體WinRAR請到：  
<https://briian.com/5480/winrar.html>

# 軟體下載

- <https://www.arduino.cc/en/Main/Software>



The screenshot shows the Arduino Software download page. At the top, there's a navigation bar with links for Buy, Download, Products, Learning, Forum, Support, and Blog, along with Log In and Sign Up buttons. Below the navigation bar, the main heading is "Download the Arduino Software". To the left, there's a large circular icon with the Arduino logo (an infinity symbol made of minus and plus signs). To the right of the icon, the text "ARDUINO 1.6.9" is displayed, followed by a brief description of the software: "The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software. This software can be used with any Arduino board. Refer to the [Getting Started](#) page for installation instructions." On the far right, there are download links for Windows (Windows Installer and ZIP file), Mac OS X (10.7 Lion or newer), and Linux (32 bits, 64 bits, ARM experimental). Below these links are links for Release Notes, Source Code, and Checksums. At the bottom of the page, there are sections for "ARDUINO SOFTWARE HOURLY BUILDS" (last update: 19 May 2016 1:22:56 GMT) and "PREVIOUS RELEASES" (links to Arduino 1.0.6, 1.5.x, and 1.6.x). The Windows taskbar at the bottom shows various pinned icons and the date/time as 12:15 PM on May 25, 2016.

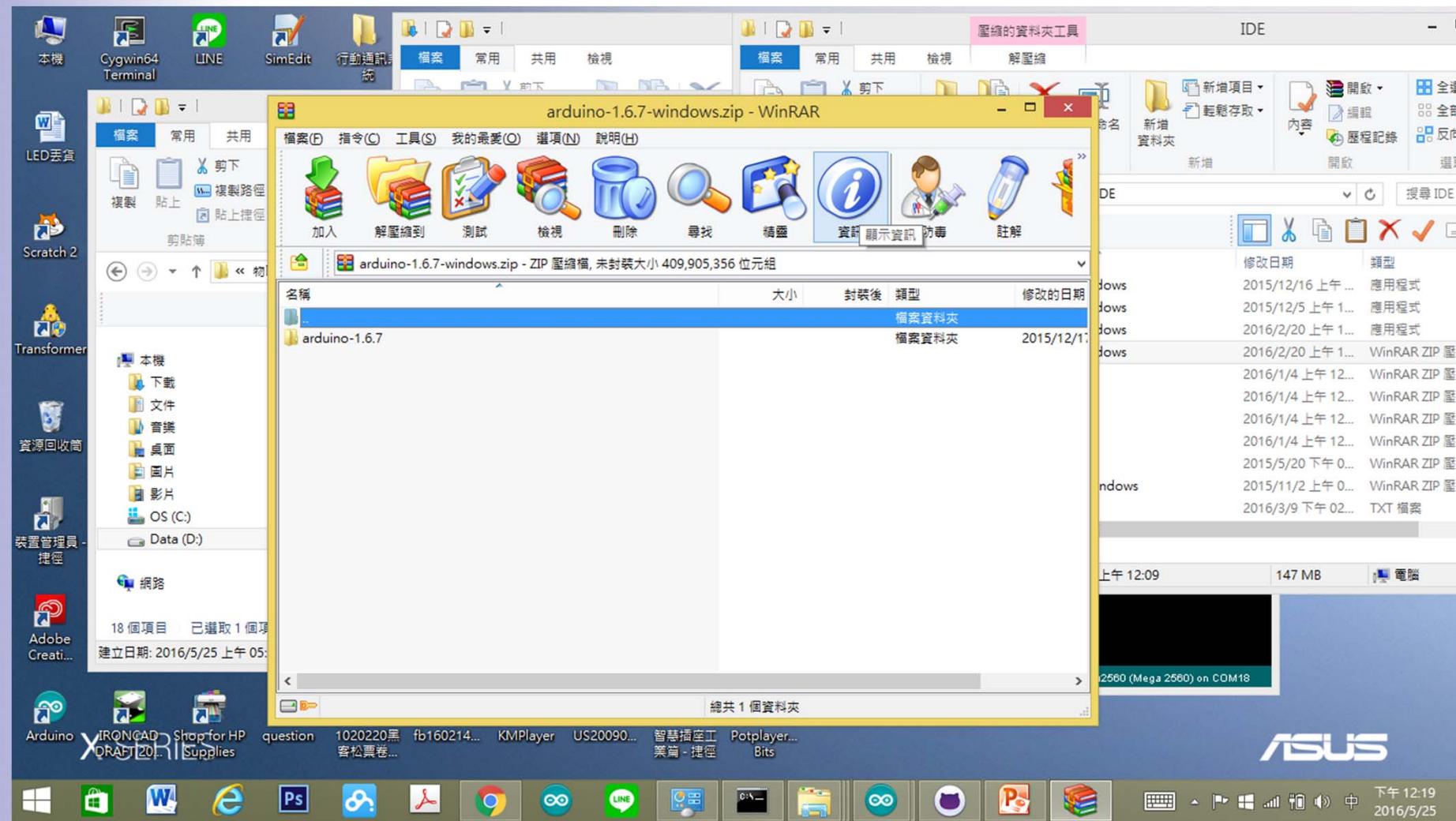
# 找1.6.7版本

<https://www.arduino.cc/en/Main/OldSoftwareReleases#previous>

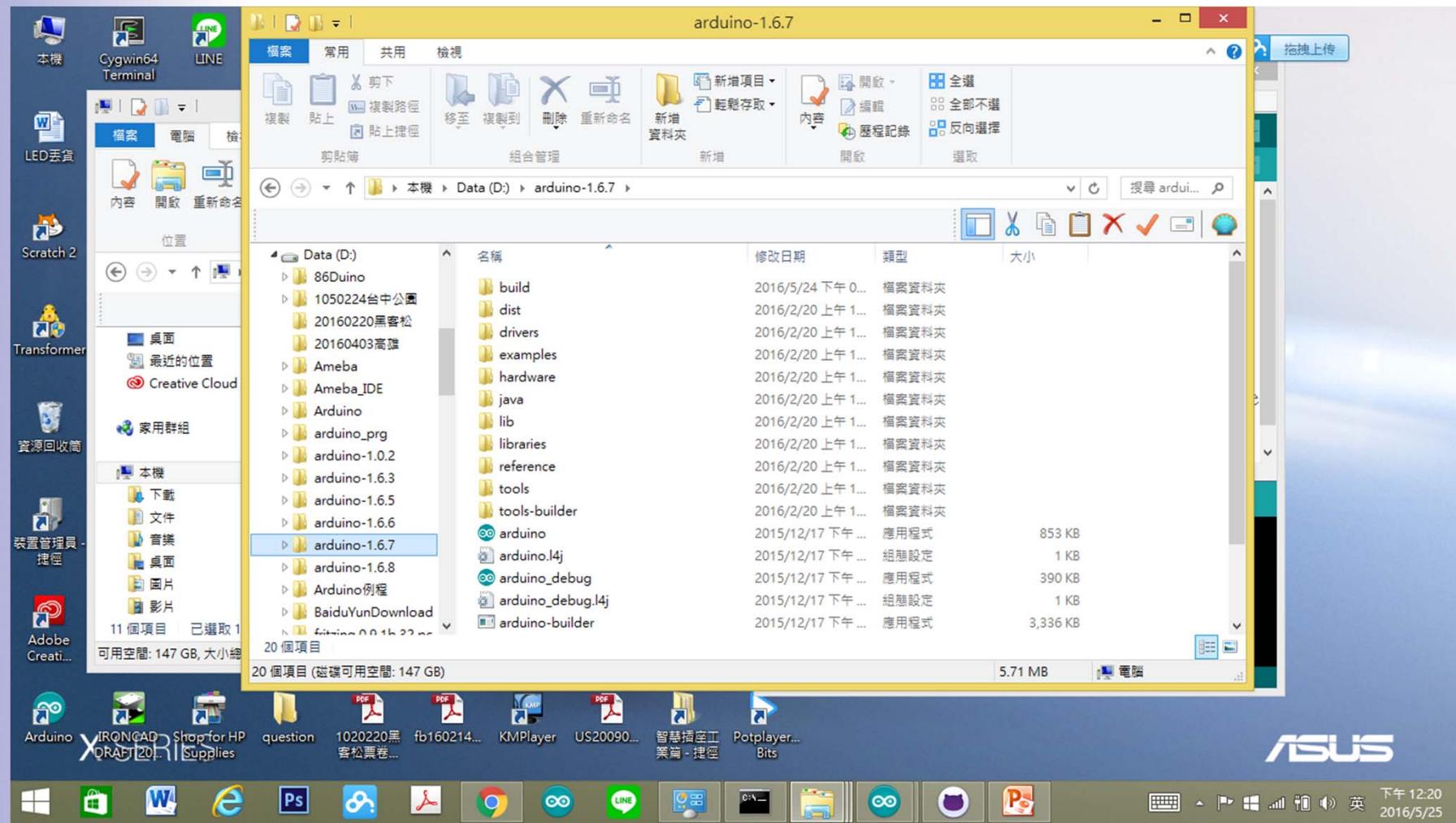
The screenshot shows a web browser window displaying the Arduino website at <https://www.arduino.cc/en/Main/OldSoftwareReleases#previous>. The page title is "Arduino 1.6.x, 1.5.x BETA". A note below the title states, "These packages are no longer supported by the development team." Below this, a table lists software packages for various Arduino versions across different operating systems.

Version	Windows	MAC OS X	Linux 32 Bit	Source code on Github
1.6.7	Windows Installer		Linux 32 Bit Linux 64 Bit	
1.6.6	Windows Windows Installer	MAC OS X	Linux 32 Bit Linux 64 Bit	Source code on Github
1.6.5	Windows Windows Installer	MAC OS X	Linux 32 Bit Linux 64 Bit	Source code on Github
1.6.4	Windows Windows Installer	MAC OS X	Linux 32 Bit Linux 64 Bit	Source code on Github
1.6.3	Windows Windows Installer	MAC OS X	Linux 32 Bit Linux 64 Bit	Source code on Github
1.6.2	Windows Windows Installer	MAC OS X	Linux 32 Bit Linux 64 Bit	Source code on Github
1.6.1	Windows Windows Installer	MAC OS X MAC OS X Java 7+	Linux 32 Bit Linux 64 Bit	Source code on Github

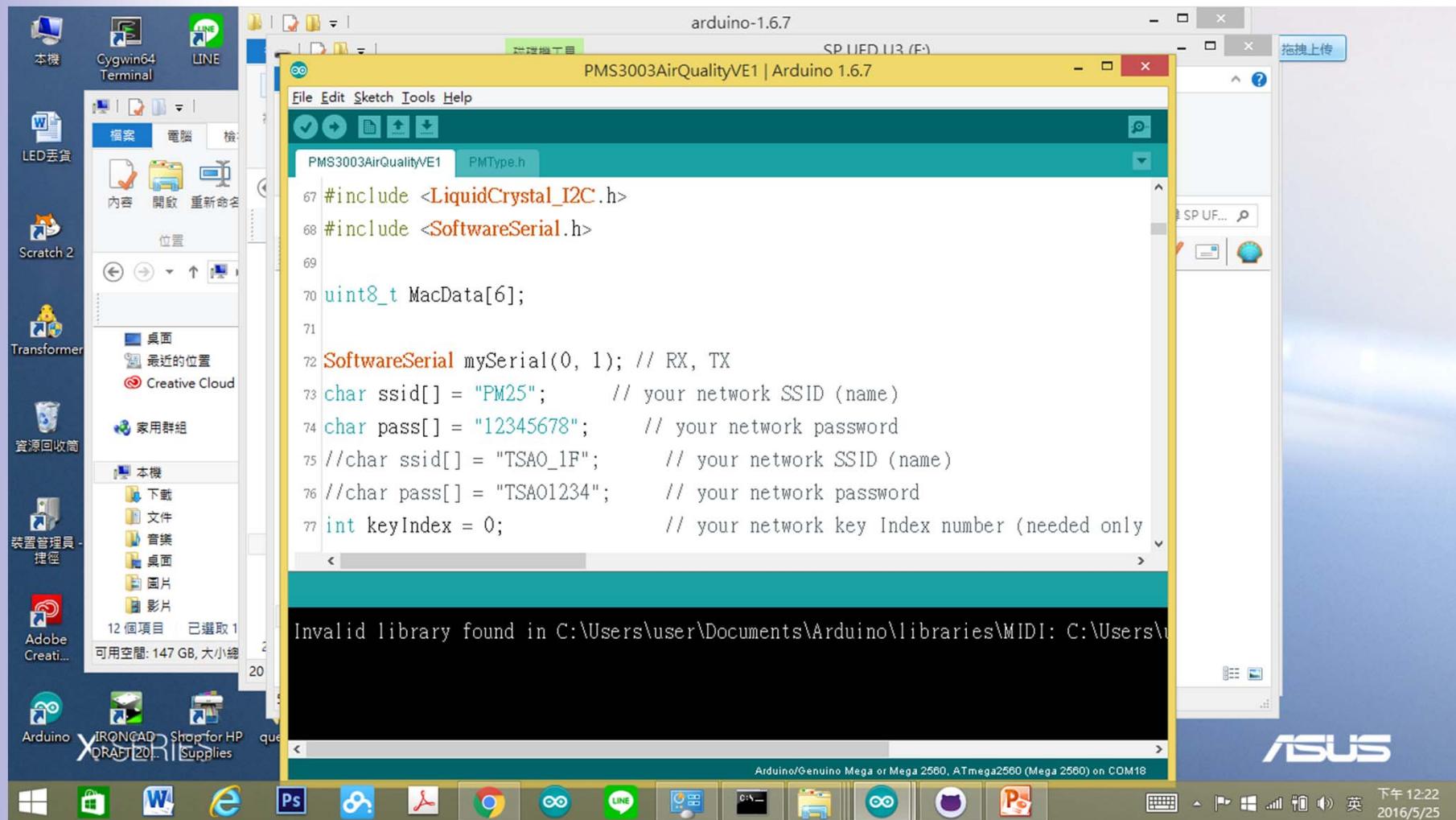
# 解開壓縮檔



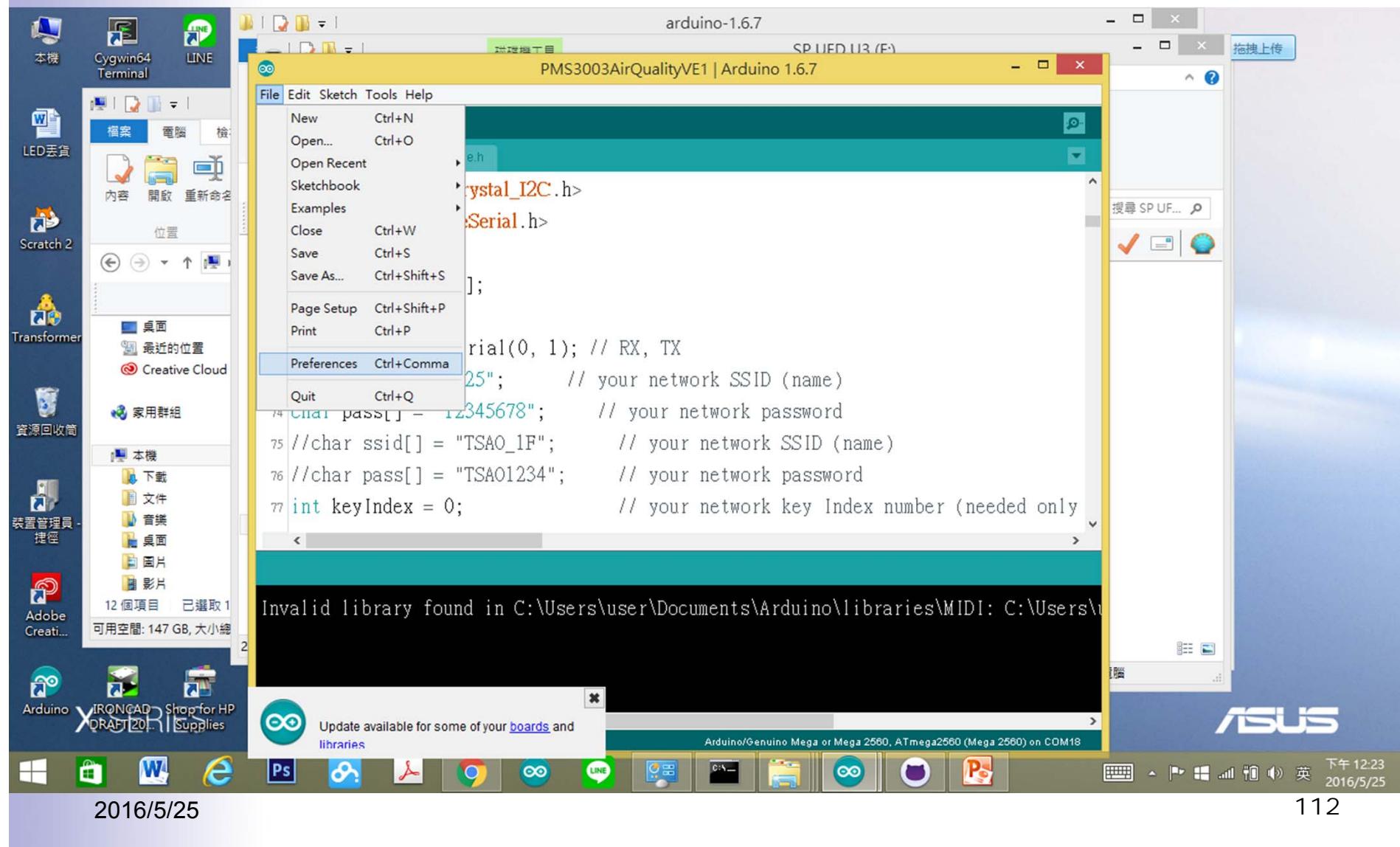
# 解到D:\arduino-1.6.7



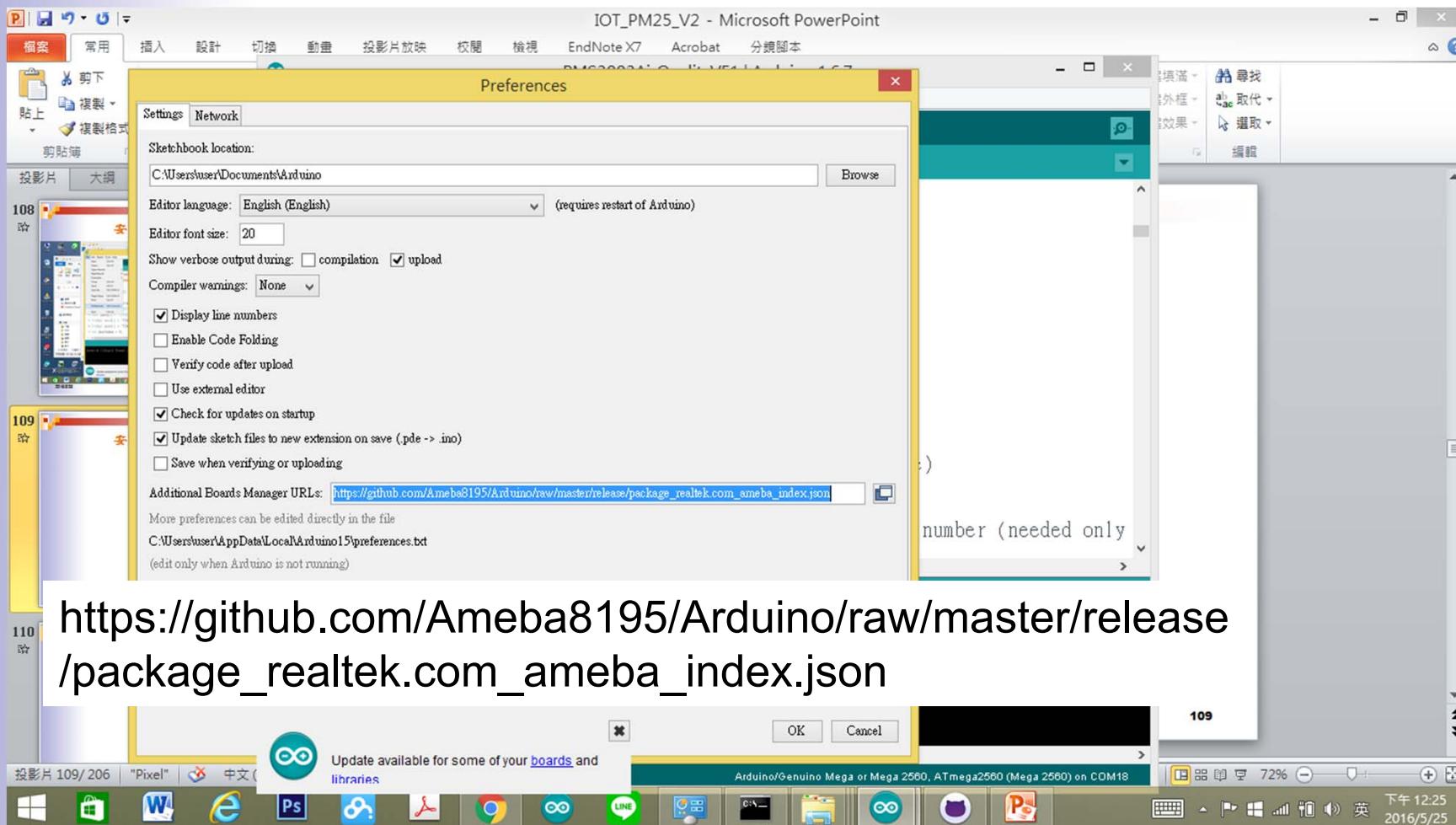
# 開啟Arduino

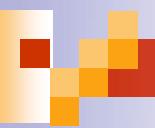


# 安裝Ameba 開發版



# 安裝Ameba 開發版



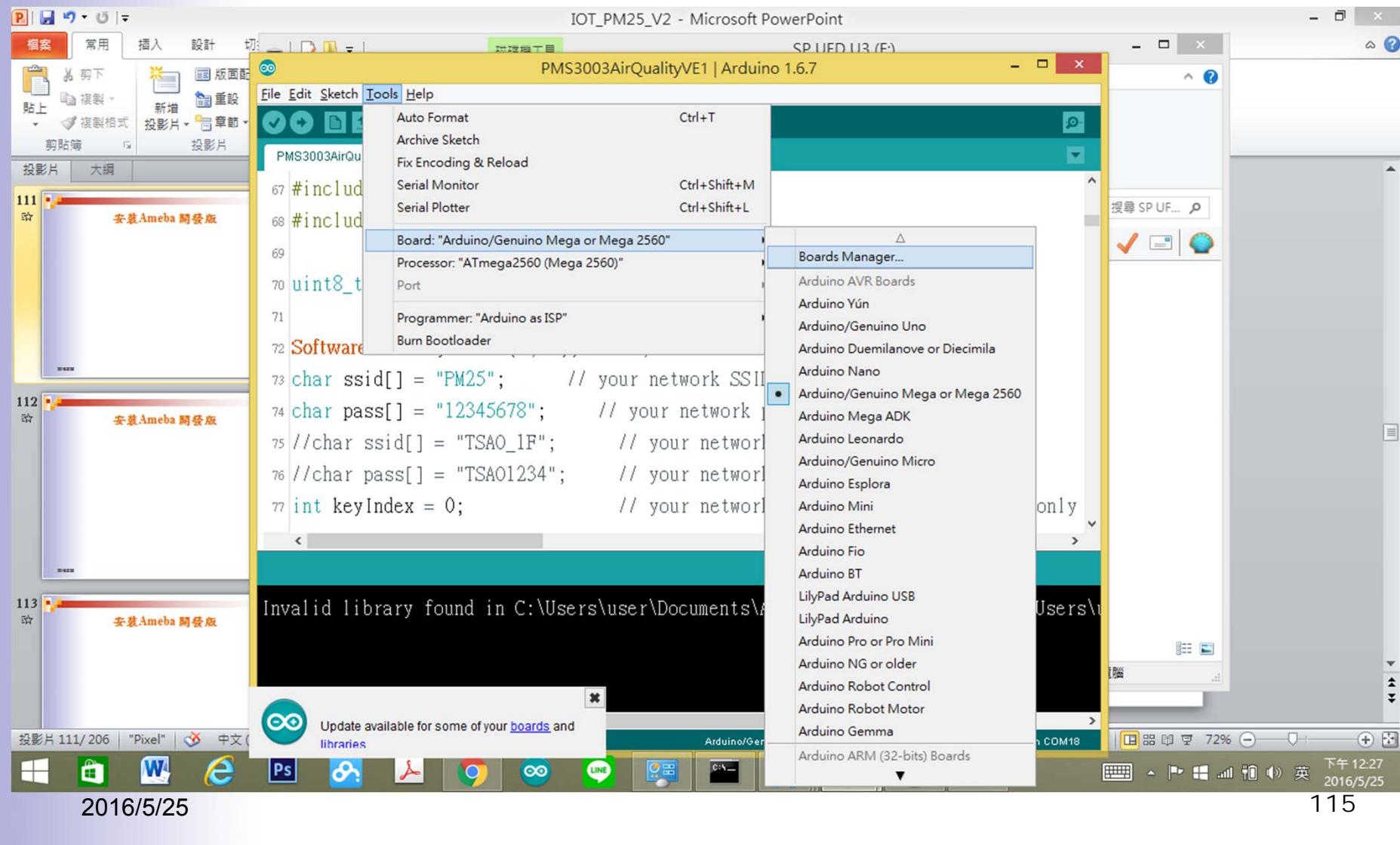


## 安裝Ameba 開發版

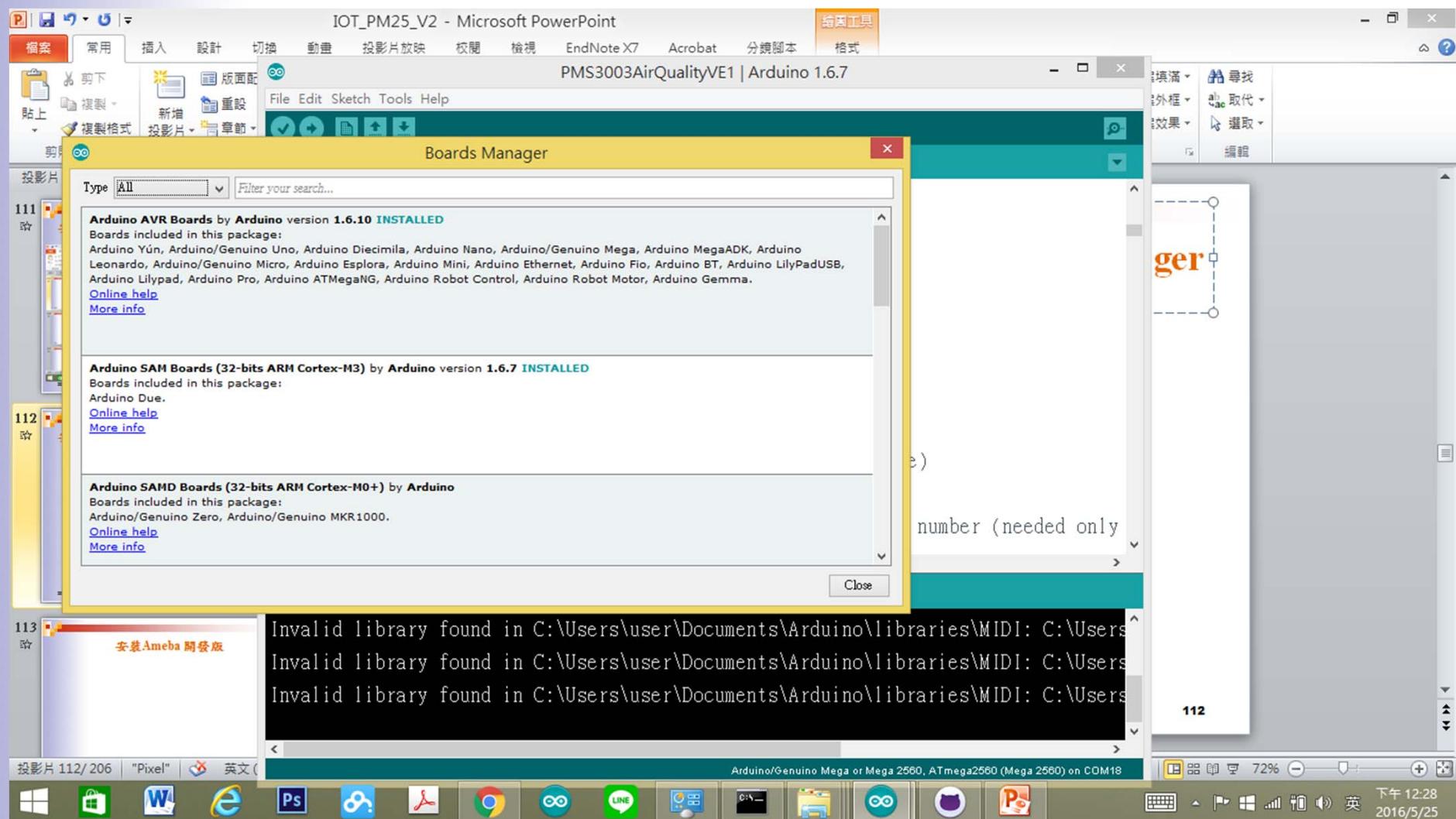
填入：

[https://github.com/Ameba8195/Arduino/raw/master/release/package\\_realtek.com\\_ameba\\_index.json](https://github.com/Ameba8195/Arduino/raw/master/release/package_realtek.com_ameba_index.json)

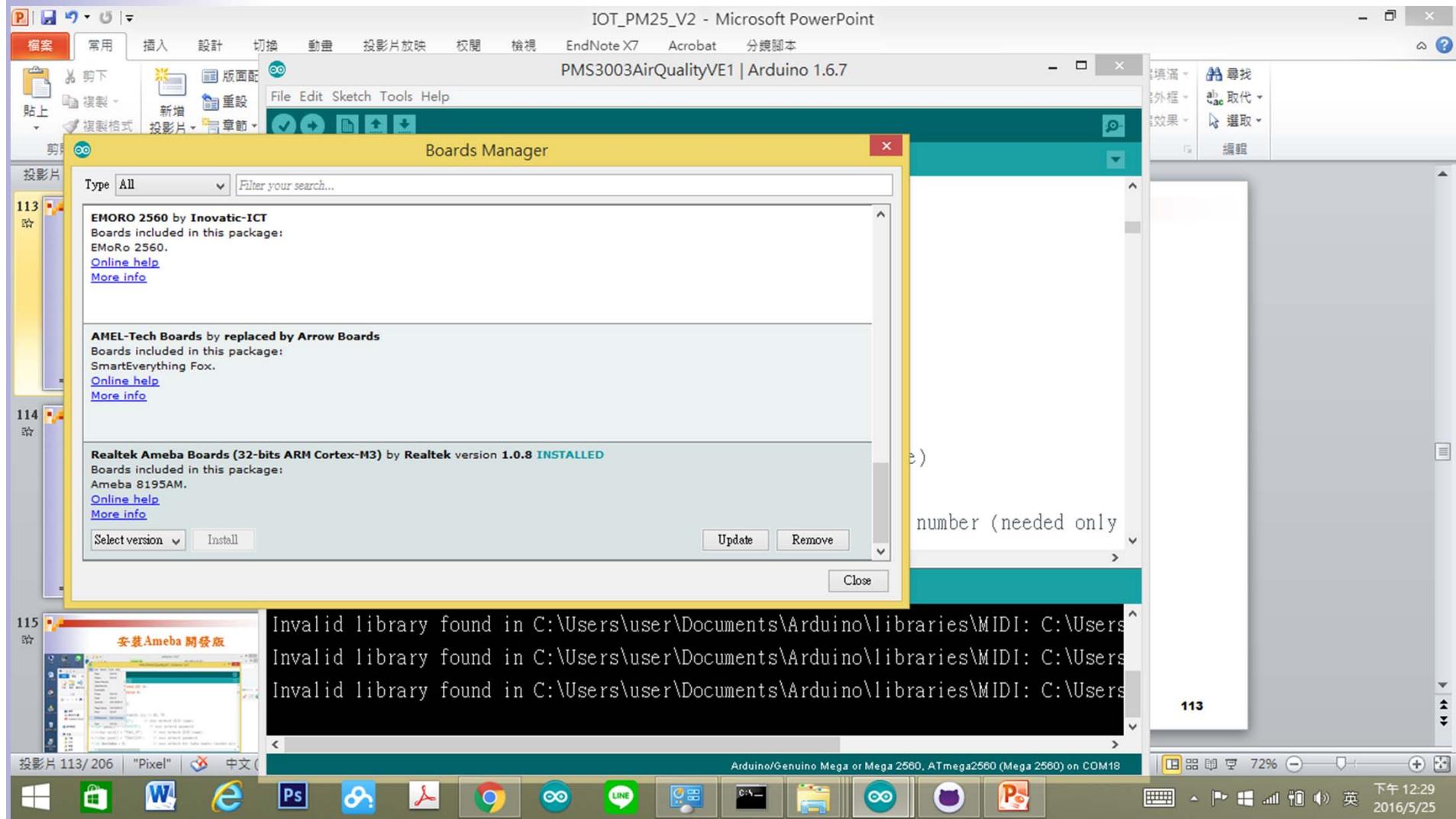
# 安裝Ameba 開發版-開啟Board Manager



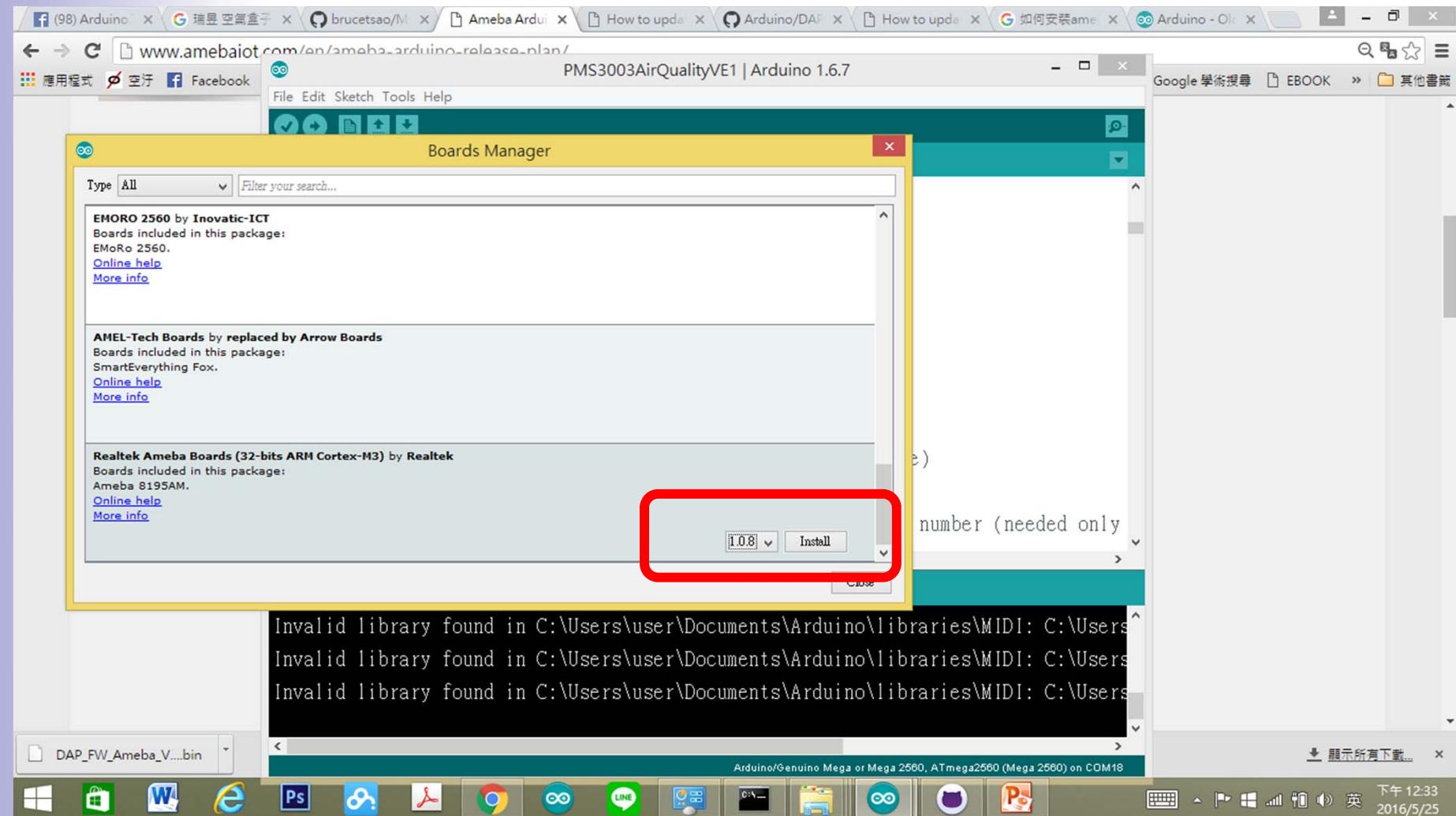
# 安裝Ameba 開發版-開啟Board Manager



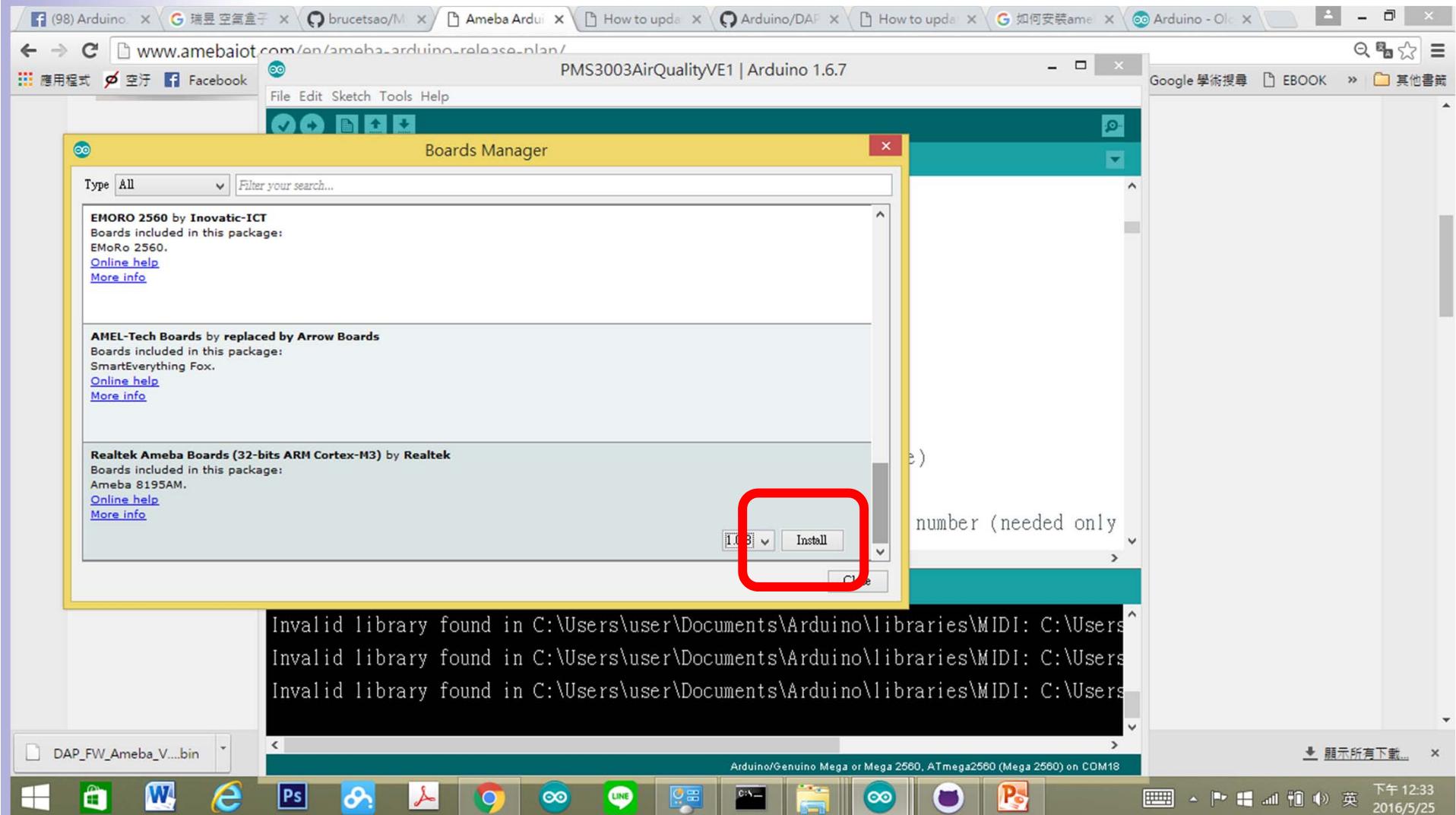
# 安裝Ameba 開發版-拉到最下面



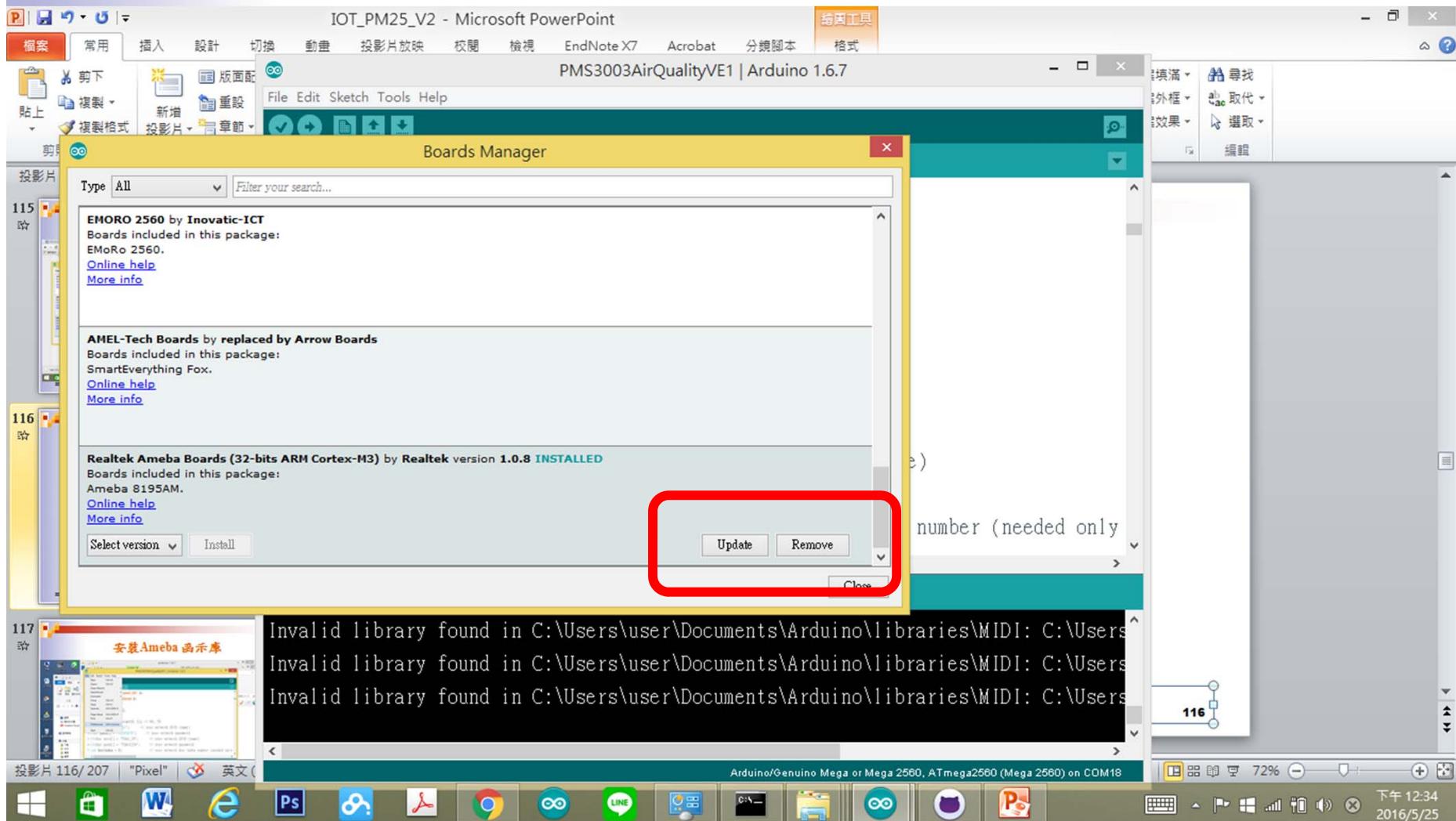
# 安裝Ameba 開發版Version 1.0.8



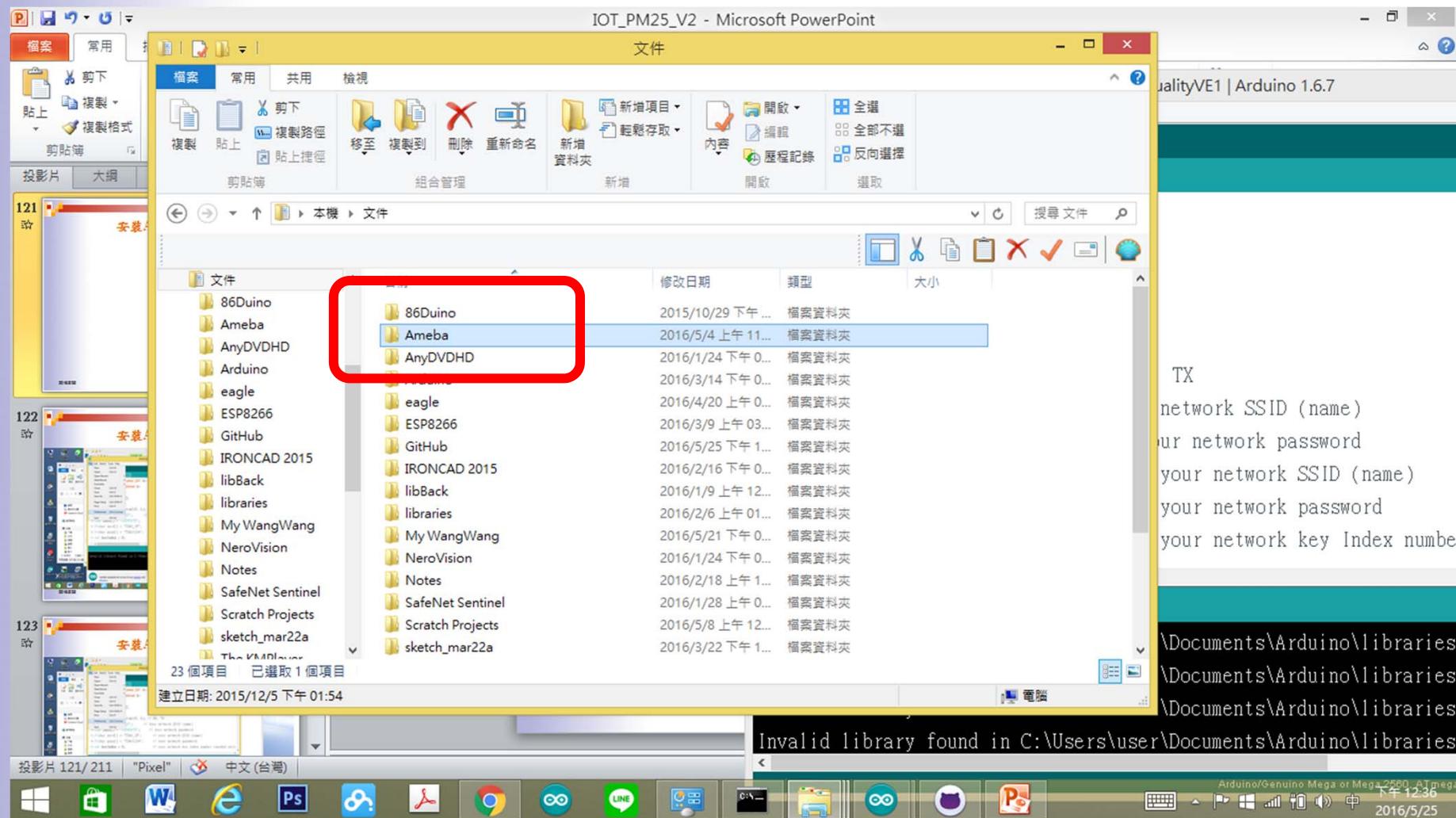
# 安裝Ameba 開發版



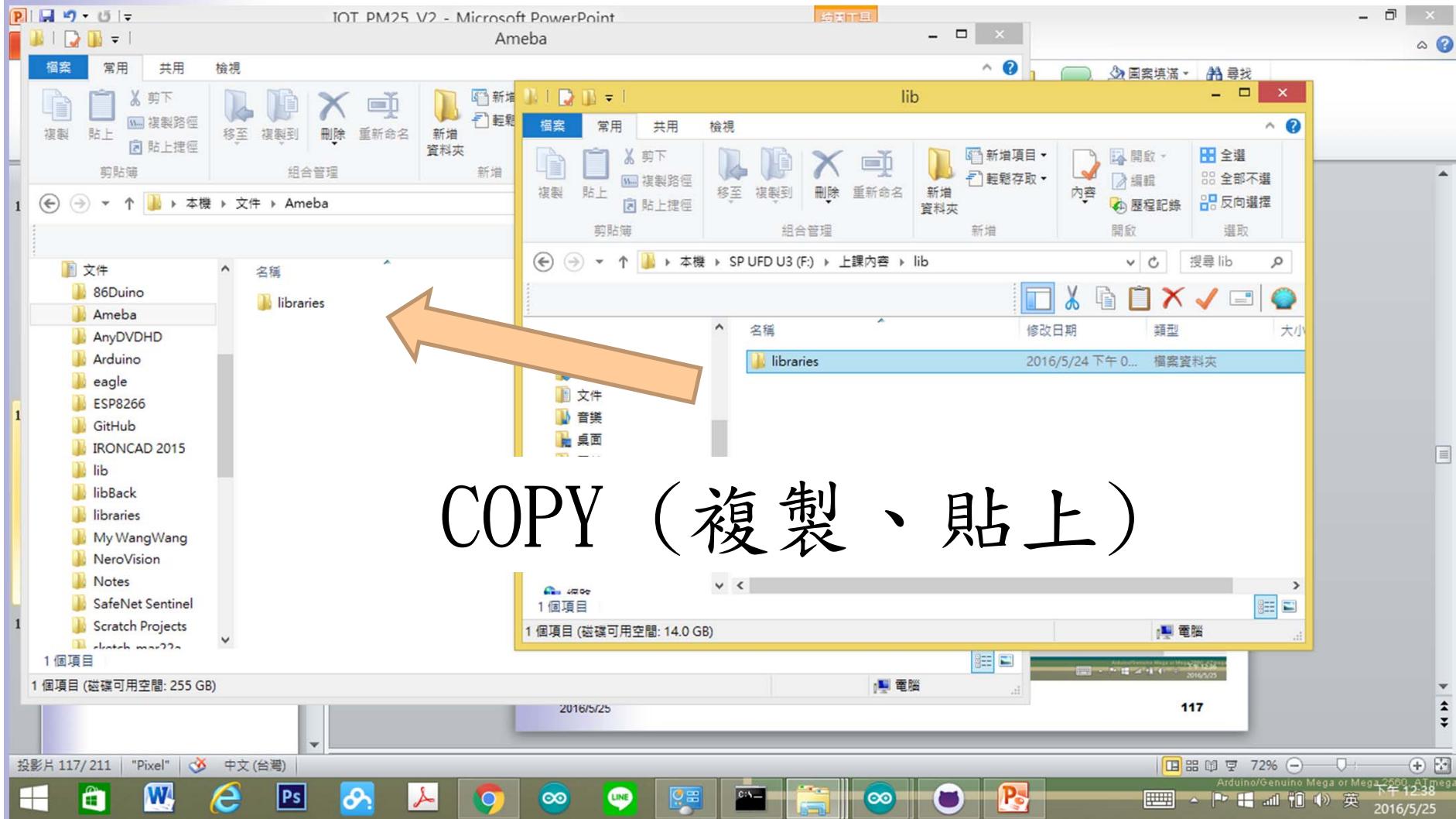
# 安裝Ameba 開發版-安裝完成



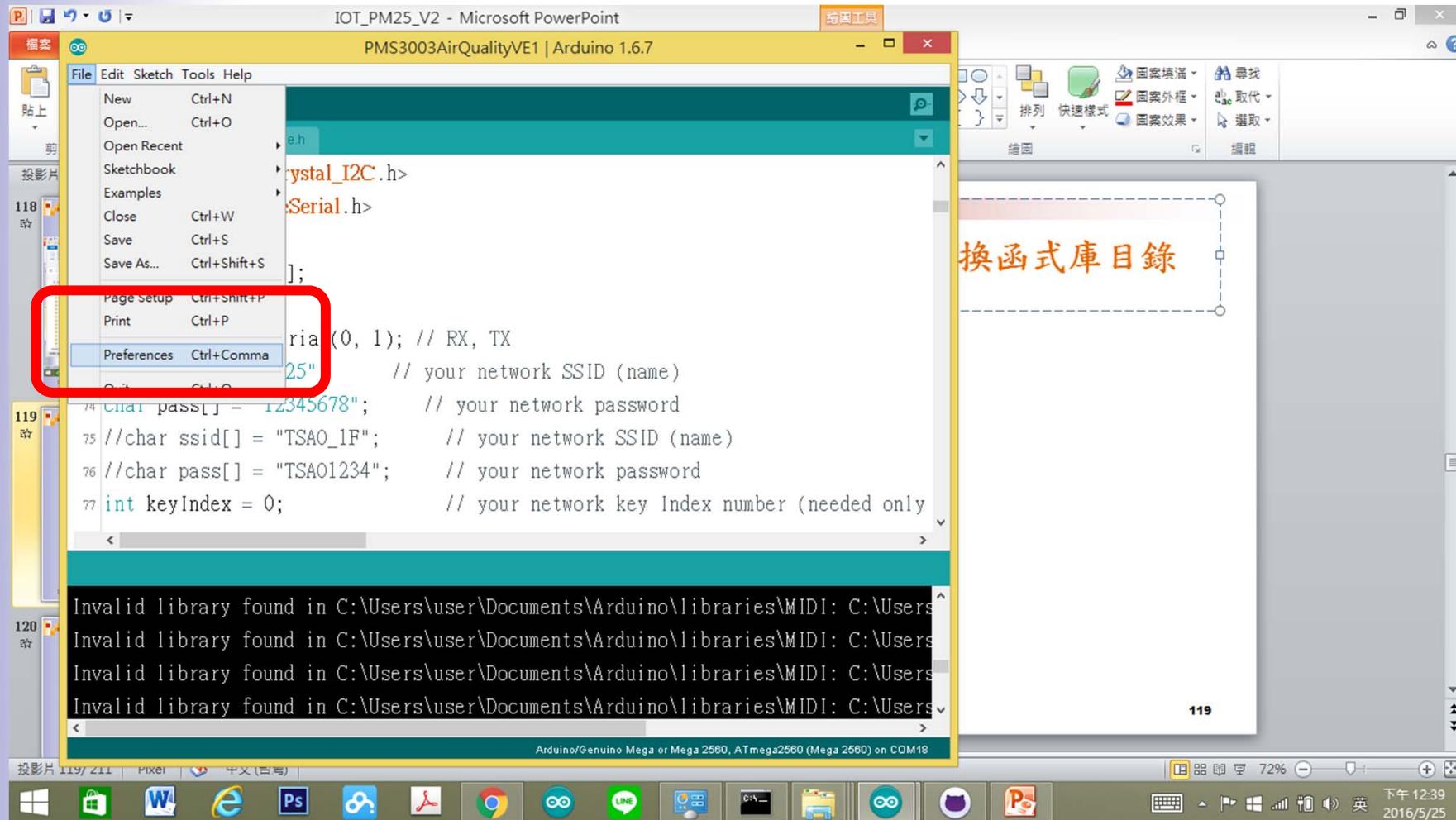
# 安裝Ameba函式庫



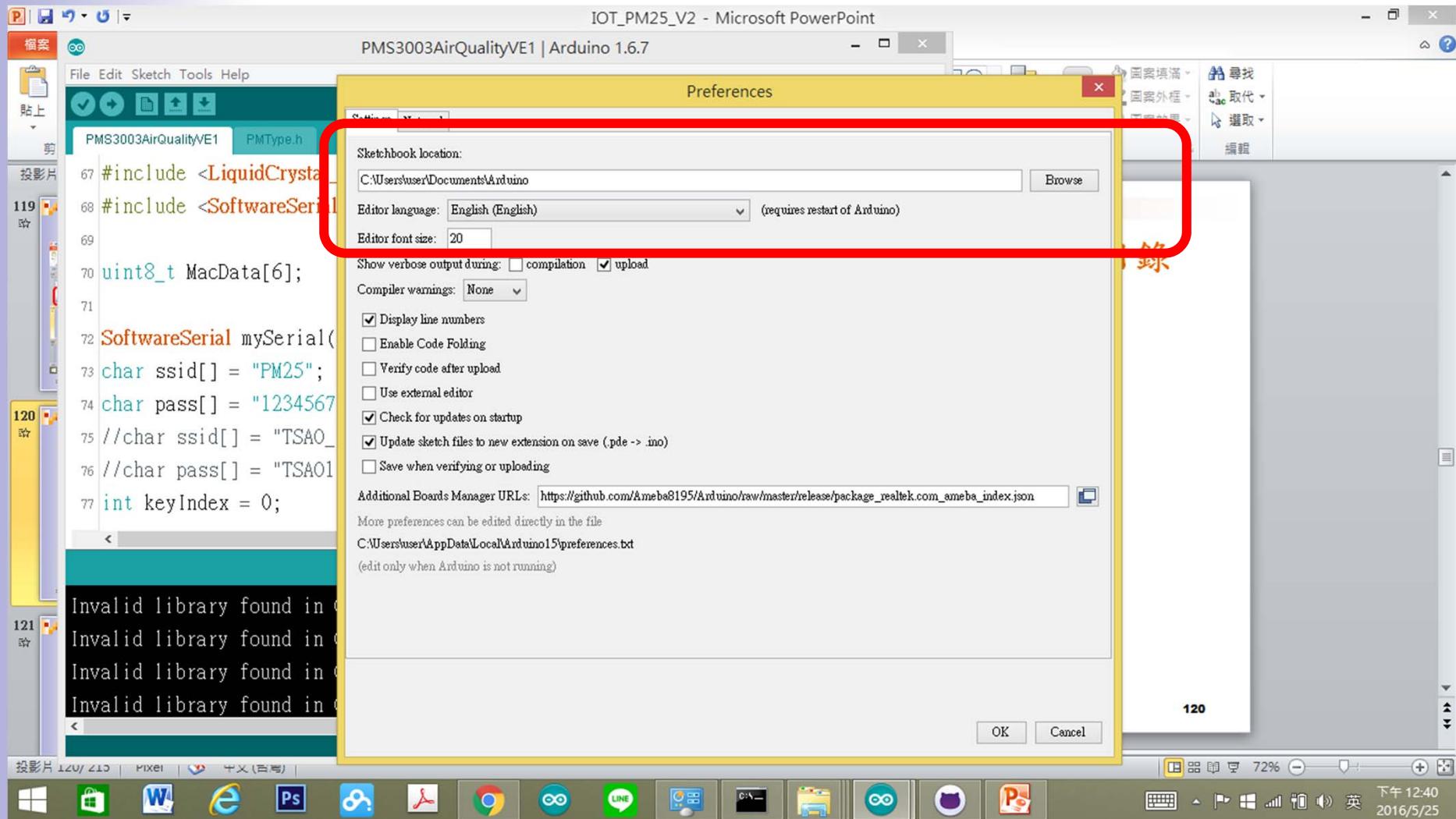
# 安裝Ameba函式庫



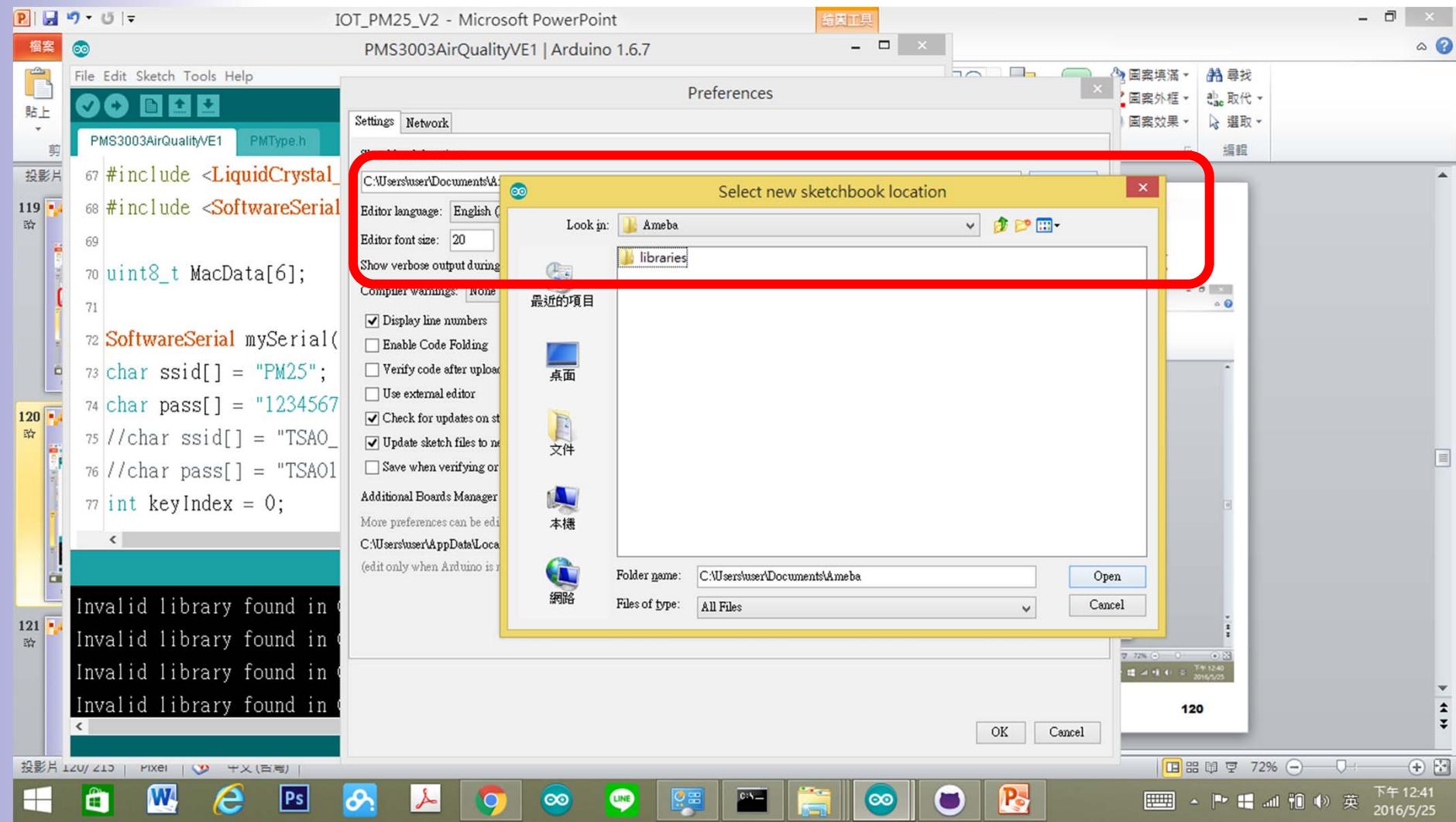
# 安裝Ameba函式庫-切換函式庫目錄



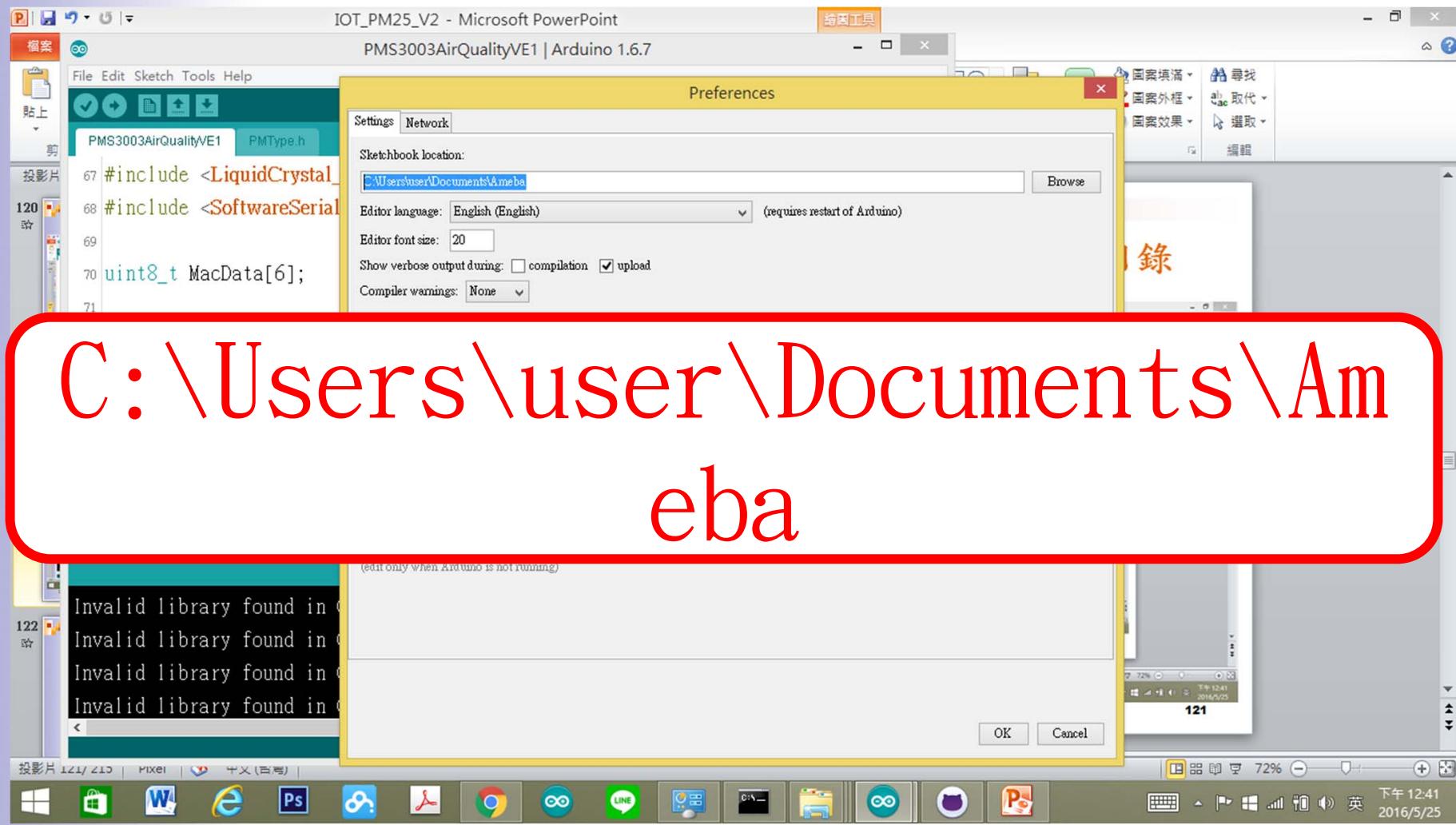
# 安裝Ameba函式庫-切換函式庫目錄



# 安裝Ameba函式庫-切換函式庫目錄

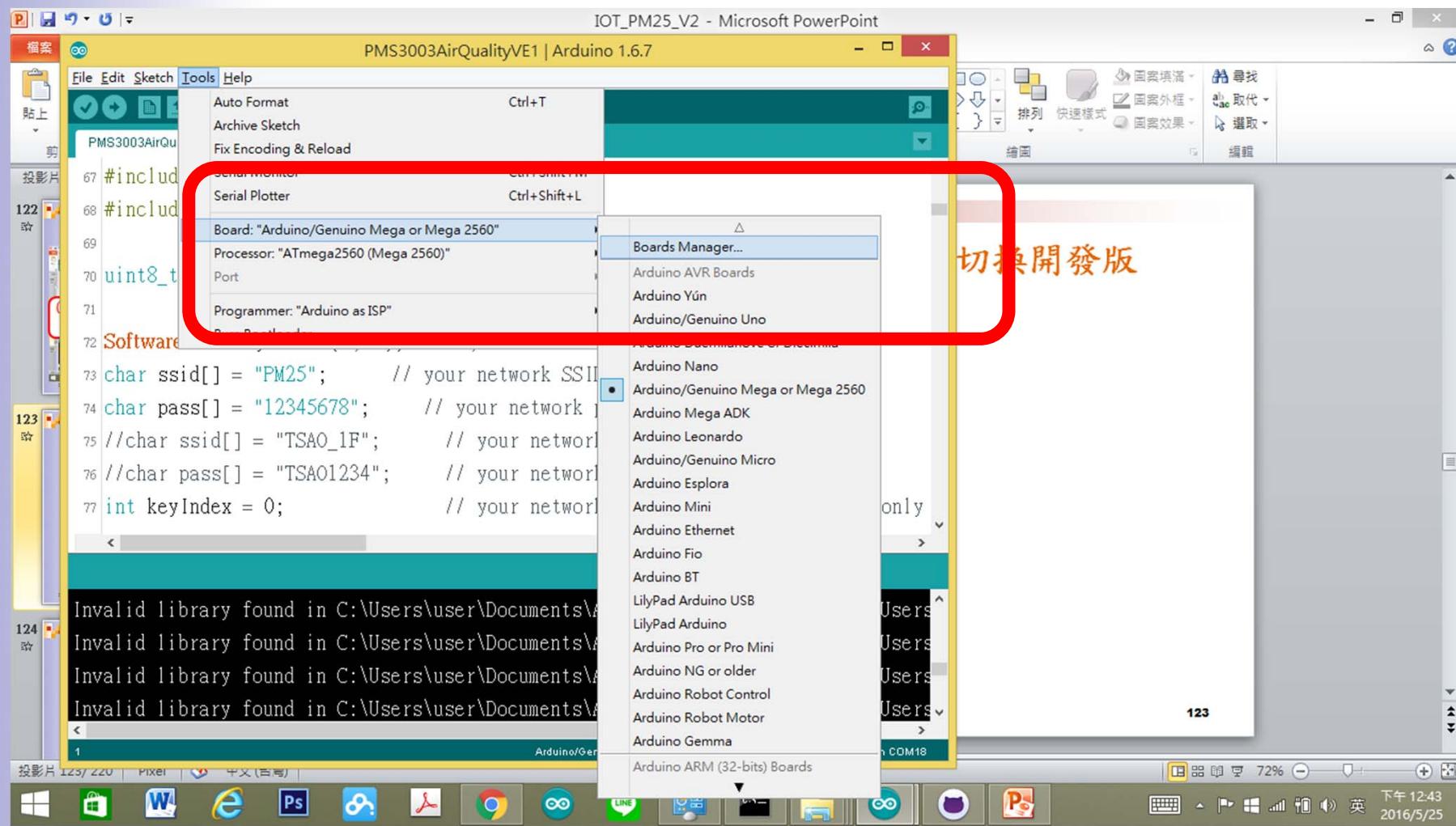


# 安裝Ameba函式庫-切換函式庫目錄

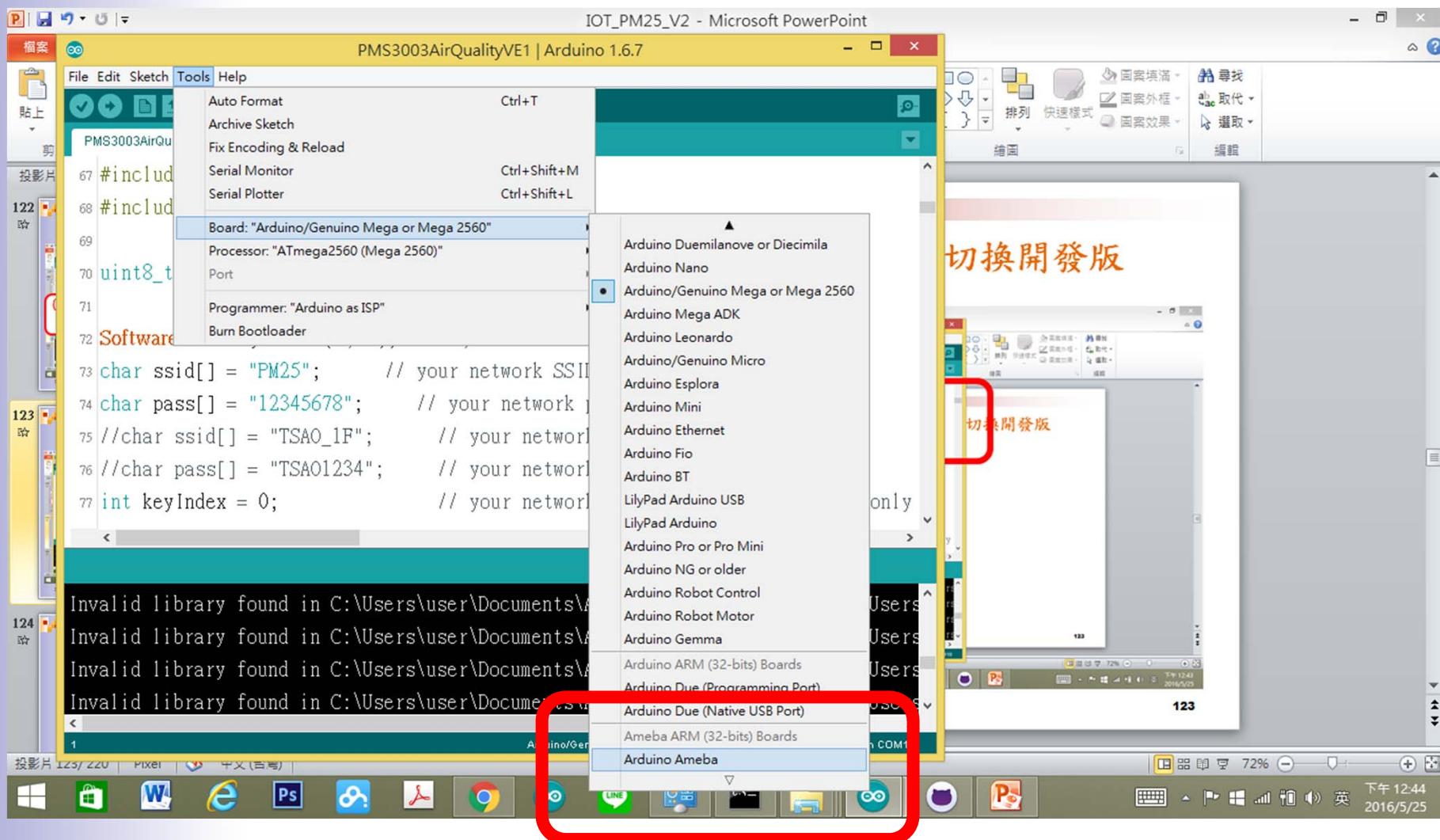


C:\Users\user\Documents\Ameba

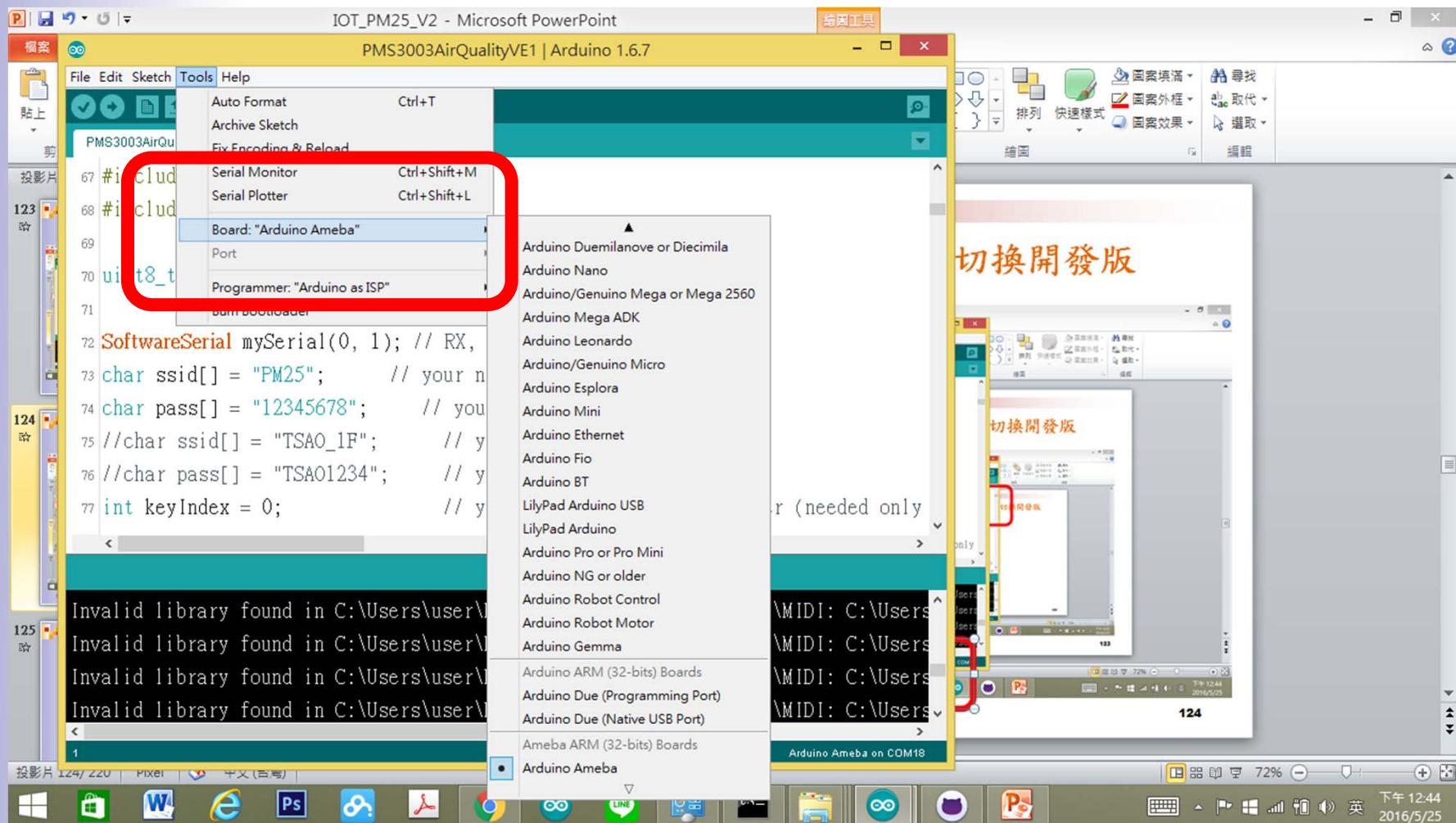
# 安裝Ameba函式庫-選擇開發版



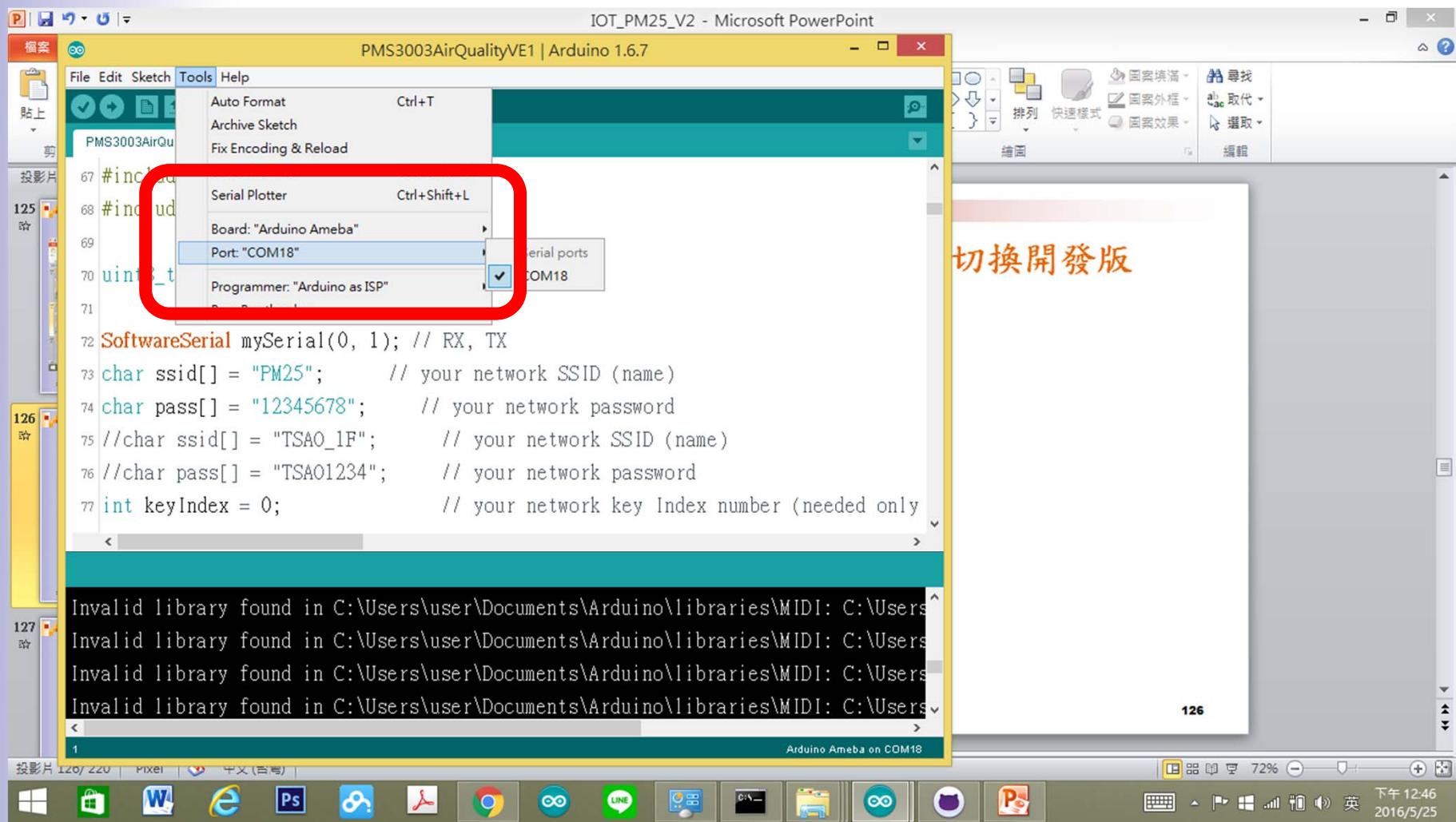
# 安裝Ameba函式庫-選擇Amaba開發版



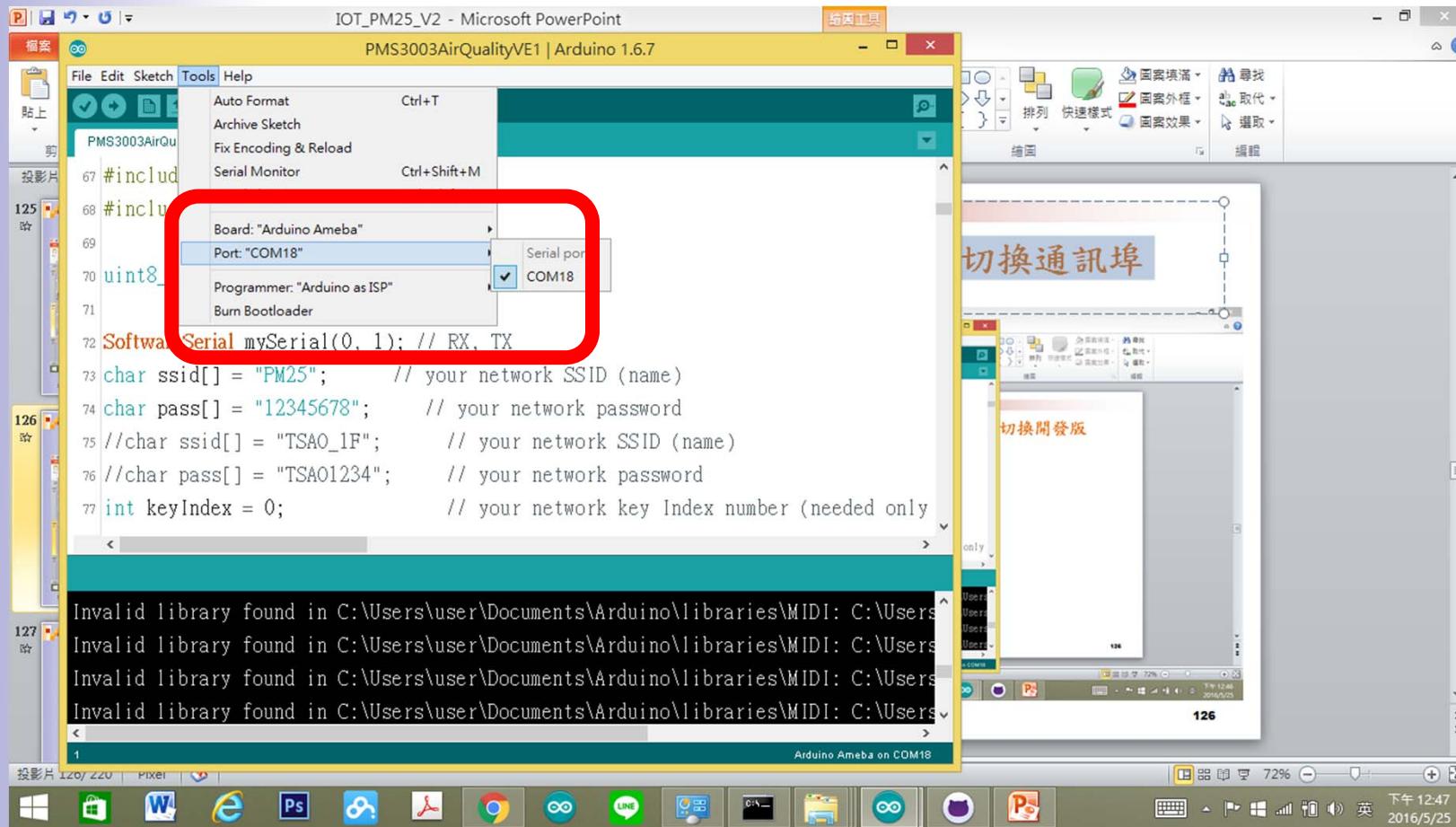
# 安裝Ameba 函式庫-檢核開發版正確否



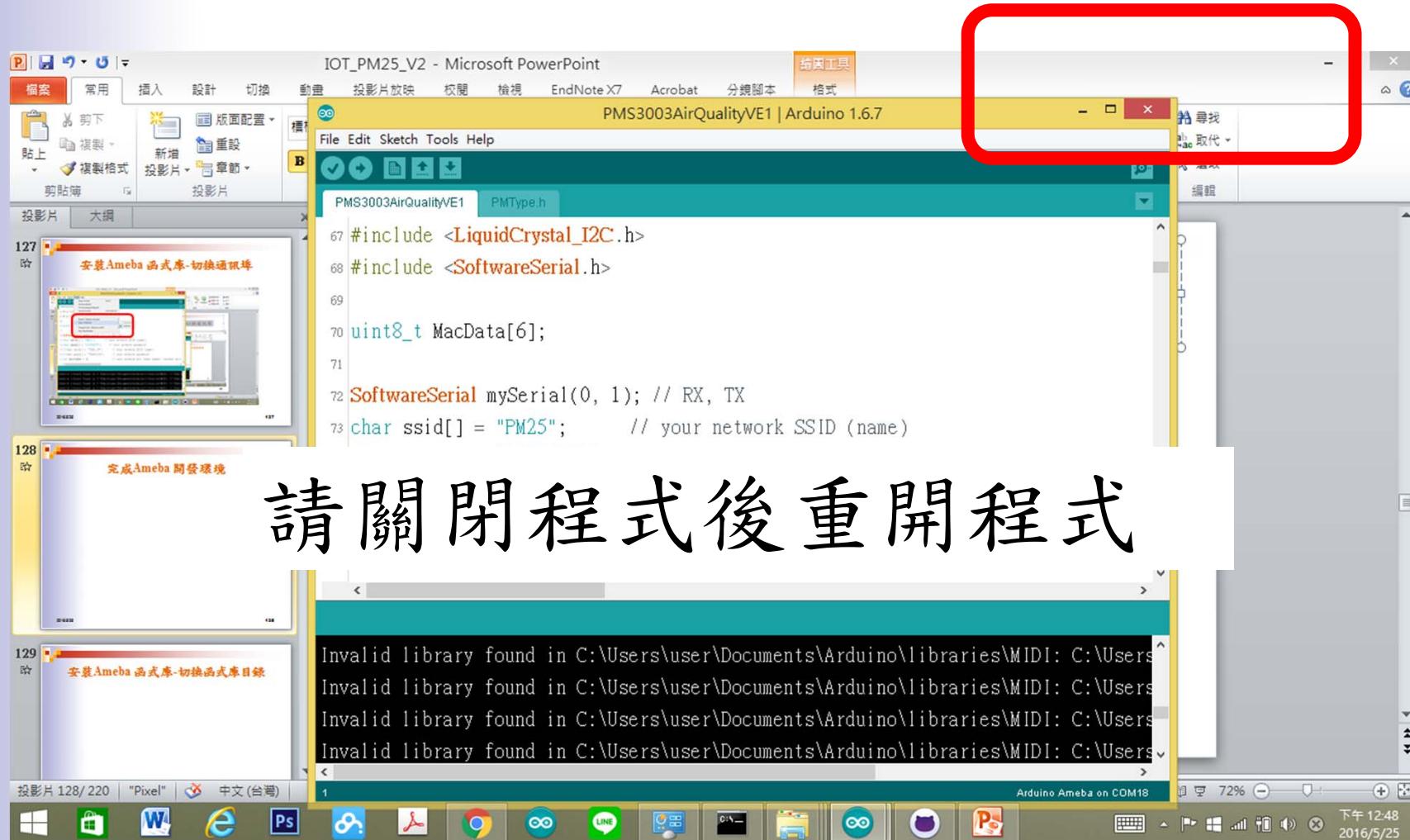
# 安裝Ameba 函式庫-切換通訊埠



# 安裝Ameba函式庫-檢核通訊埠正確否



# 完成Ameba 開發環境



請關閉程式後重開程式

# Arduino語法

# Arduino程式的基本架構

Setup()函數

語法：

```
void setup()  
{  
}  
}
```

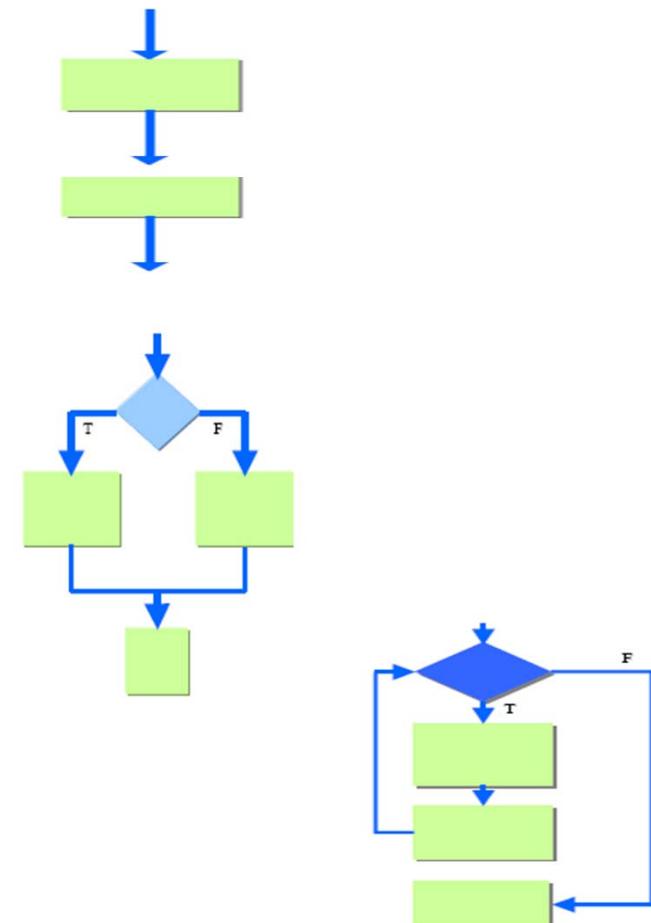
Loop()函數

語法：

```
void loop()  
{  
}  
}
```

# 程式的基本控制結構

- 循序結構(Sequence)
- 選擇結構(Selection)
- 重複結構(Iteration)



# 什麼是選擇結構

Arduino的選擇結構語法：

**if ( 條件判斷式 )**

{

**// action A**

}

**else**

{

**// action B**

}

# 什麼是變數

- 變數宣告語法：

資料型態 變數名稱；

```
int score ;
```

- 變數的使用

- 將資料指定給變數儲存起來

```
score = 90 ;
```

- 將儲存在變數中的資料讀取出來應用

```
grade = score / 10 ;
```

# 什麼是重複結構FOR

- For重複結構的主要功能為重複執行一定次數撰寫在{}中的程式碼，其中包含一個累加變數，用以累加計數次數及終止迴圈，For迴圈的語法及運作如下：

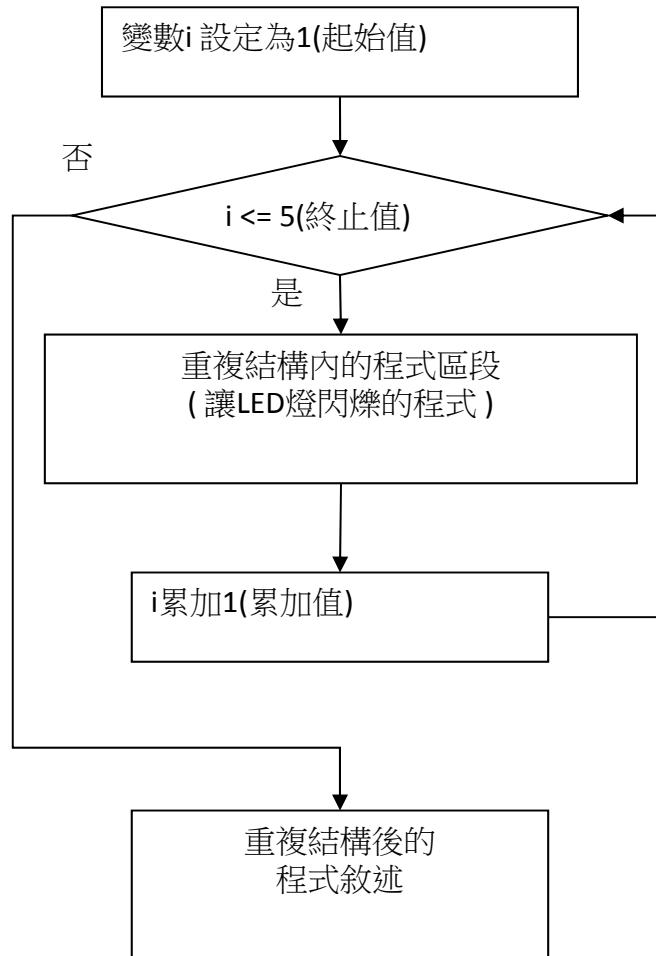
for (初始設定；繼續執行的條件；累加運算)

{

    欲重複執行的程式碼

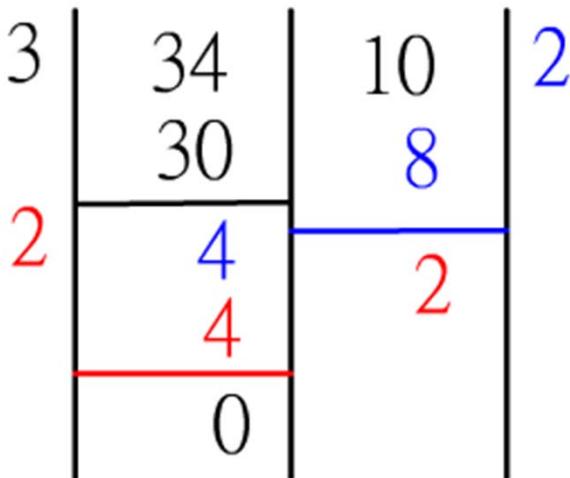
}

# 重複結構FOR



# 條件式重複結構While

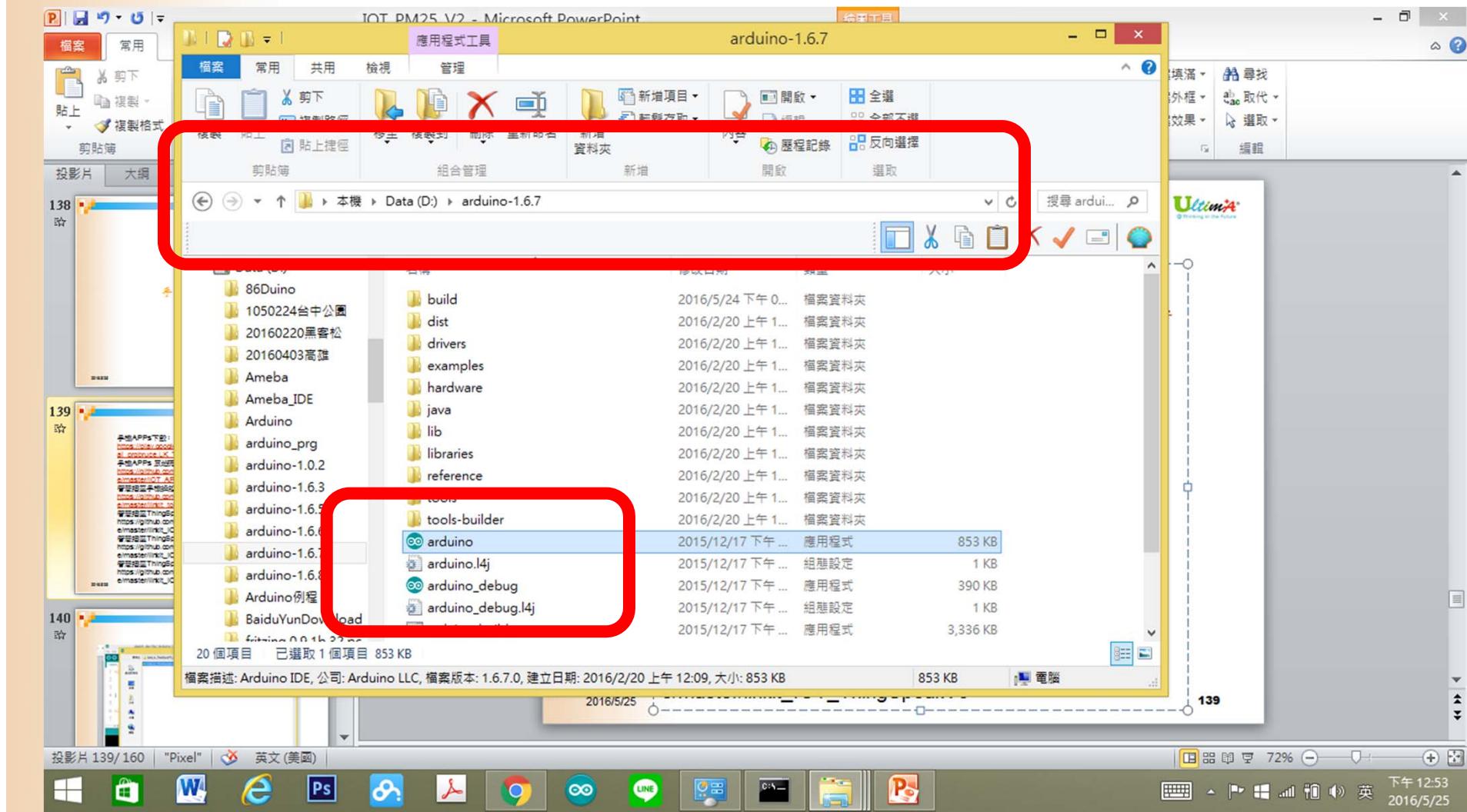
- 所謂條件式重複結構，就是依據條件判斷的結果是否為真（True），來決定重複結構中的程式區塊是否繼續反覆執行。
  -
- 例：輾轉相除法



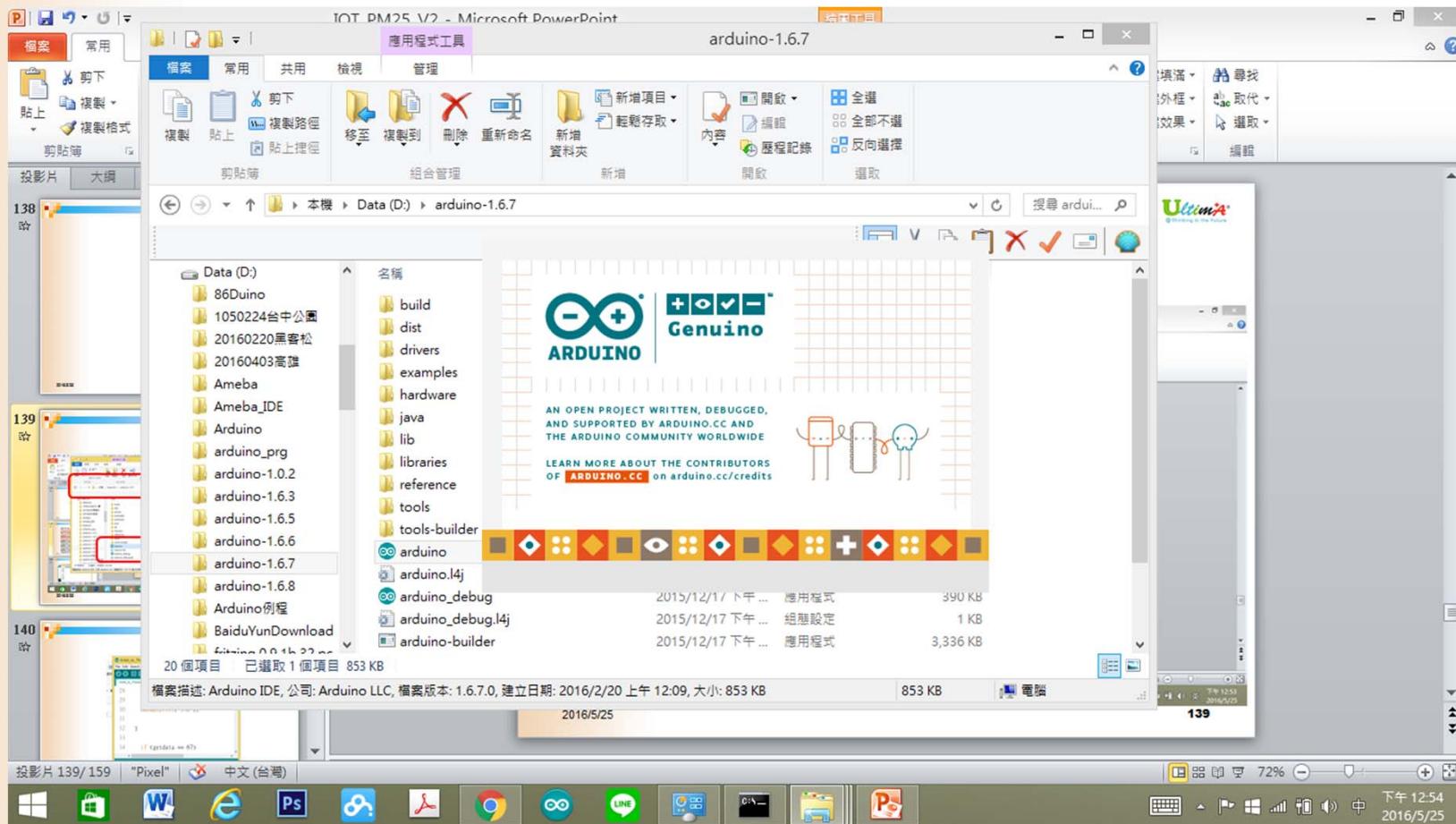
# PM 2.5 程式開發與上傳

# 啟動開發環境

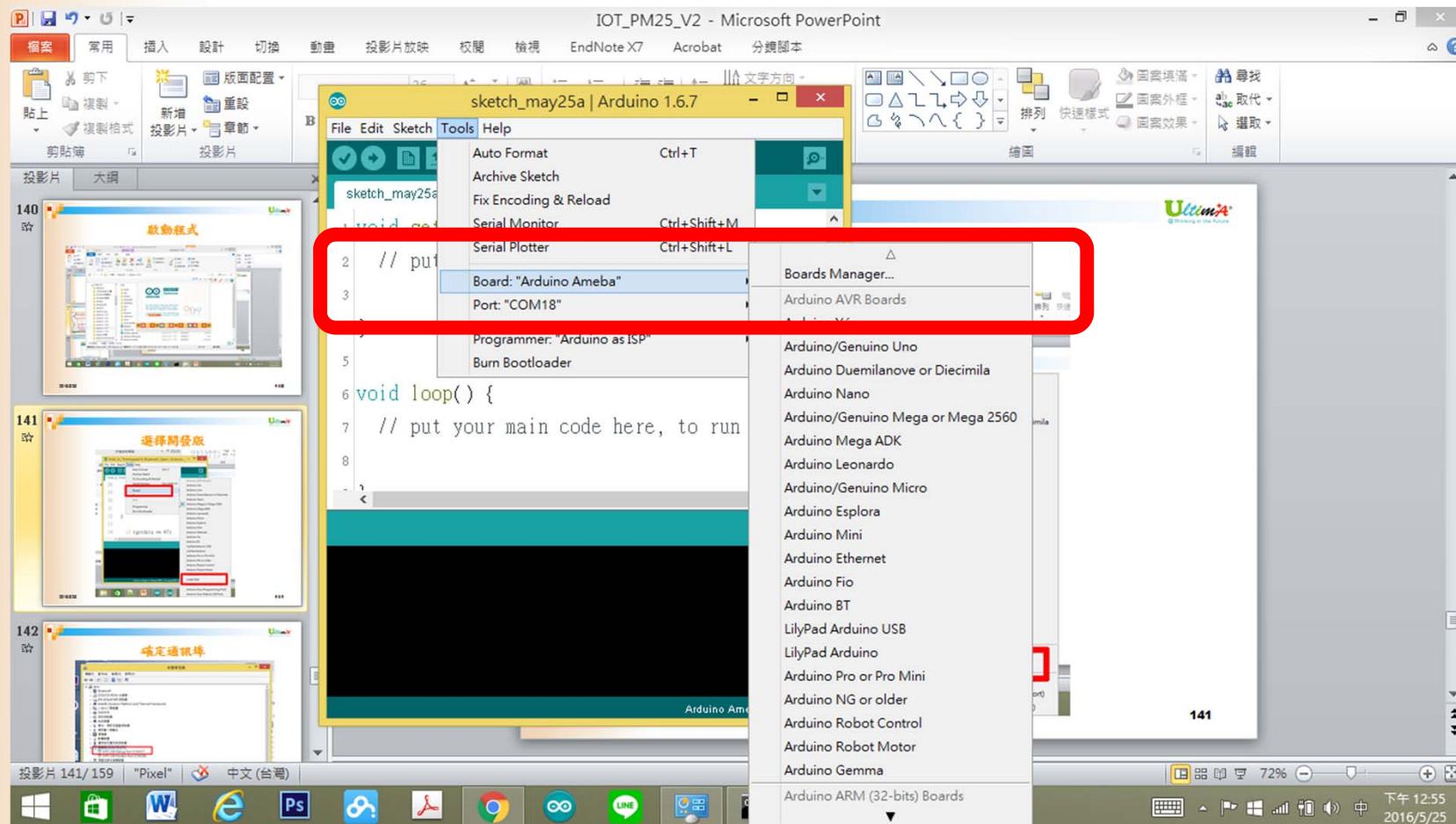
# 開啟程式



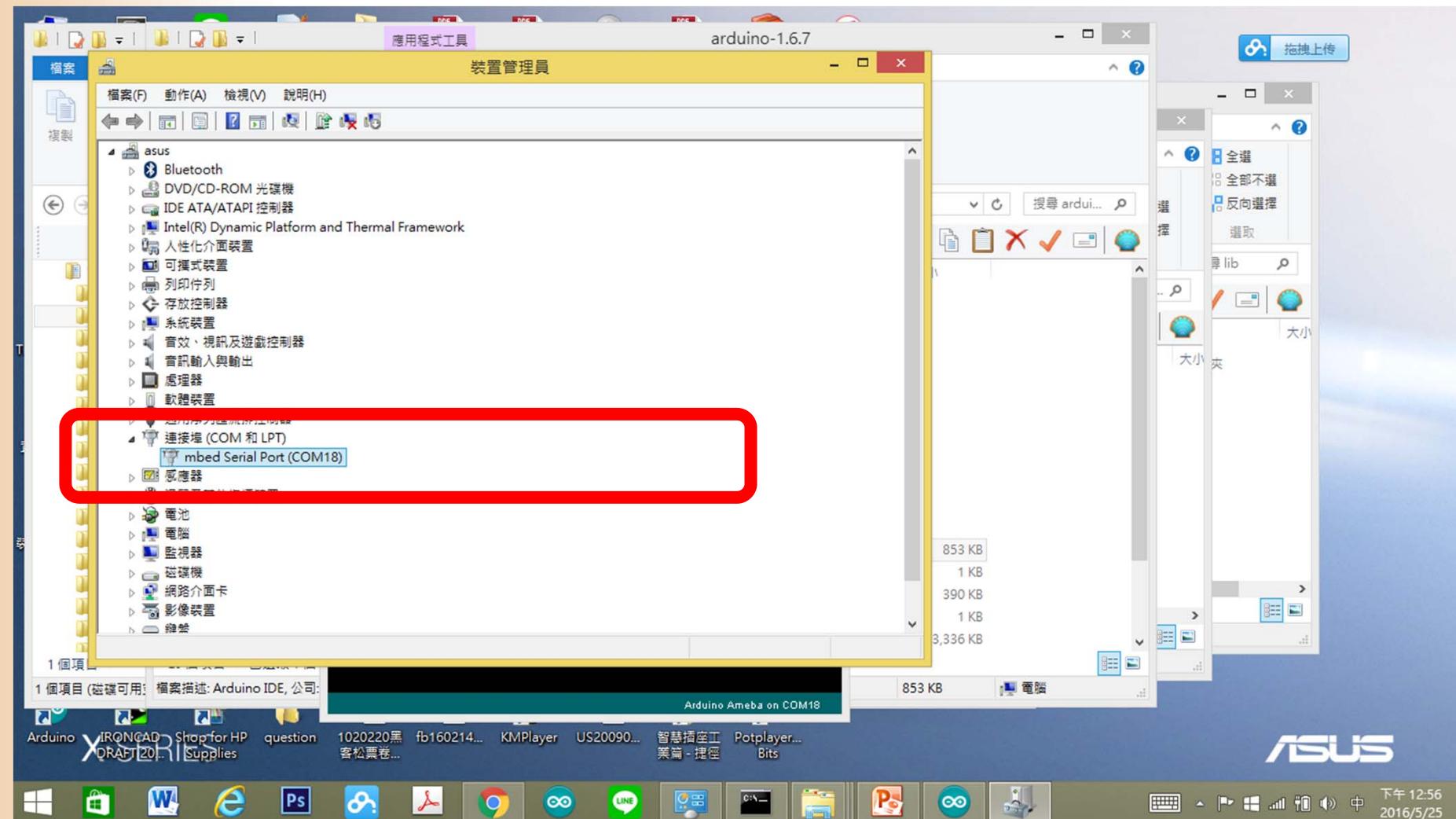
# 啟動程式



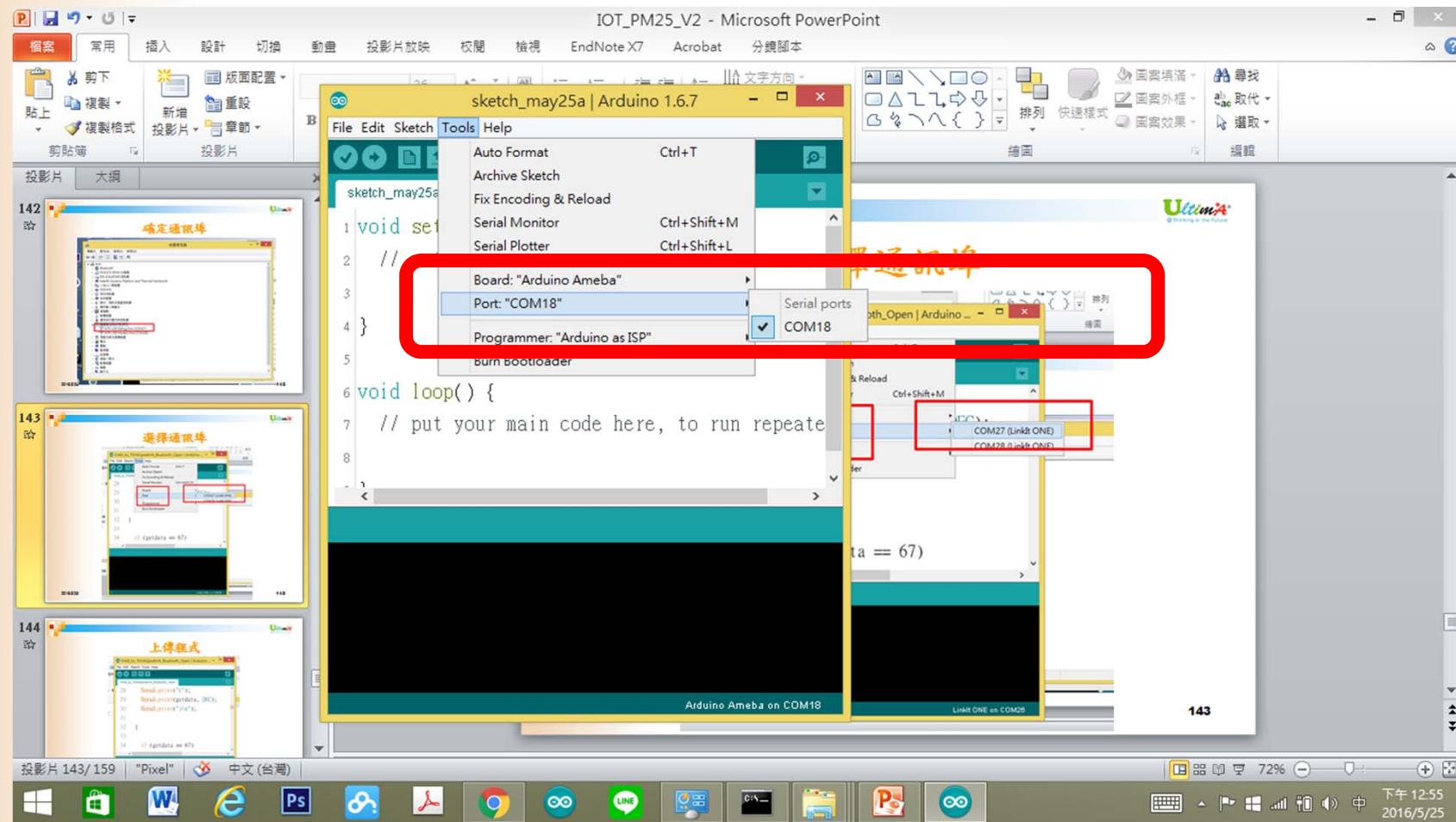
# 選擇開發版



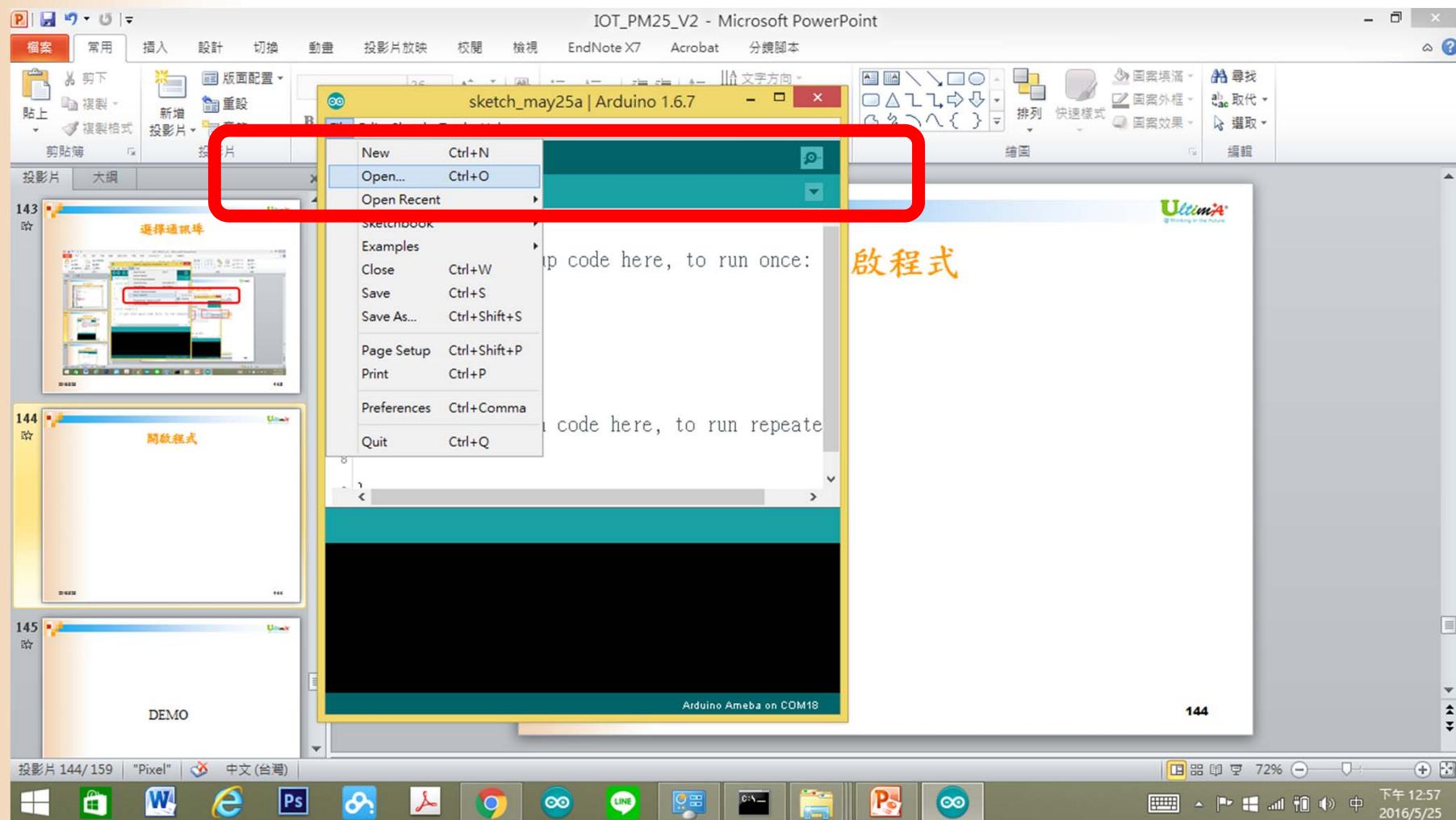
# 確定通訊埠



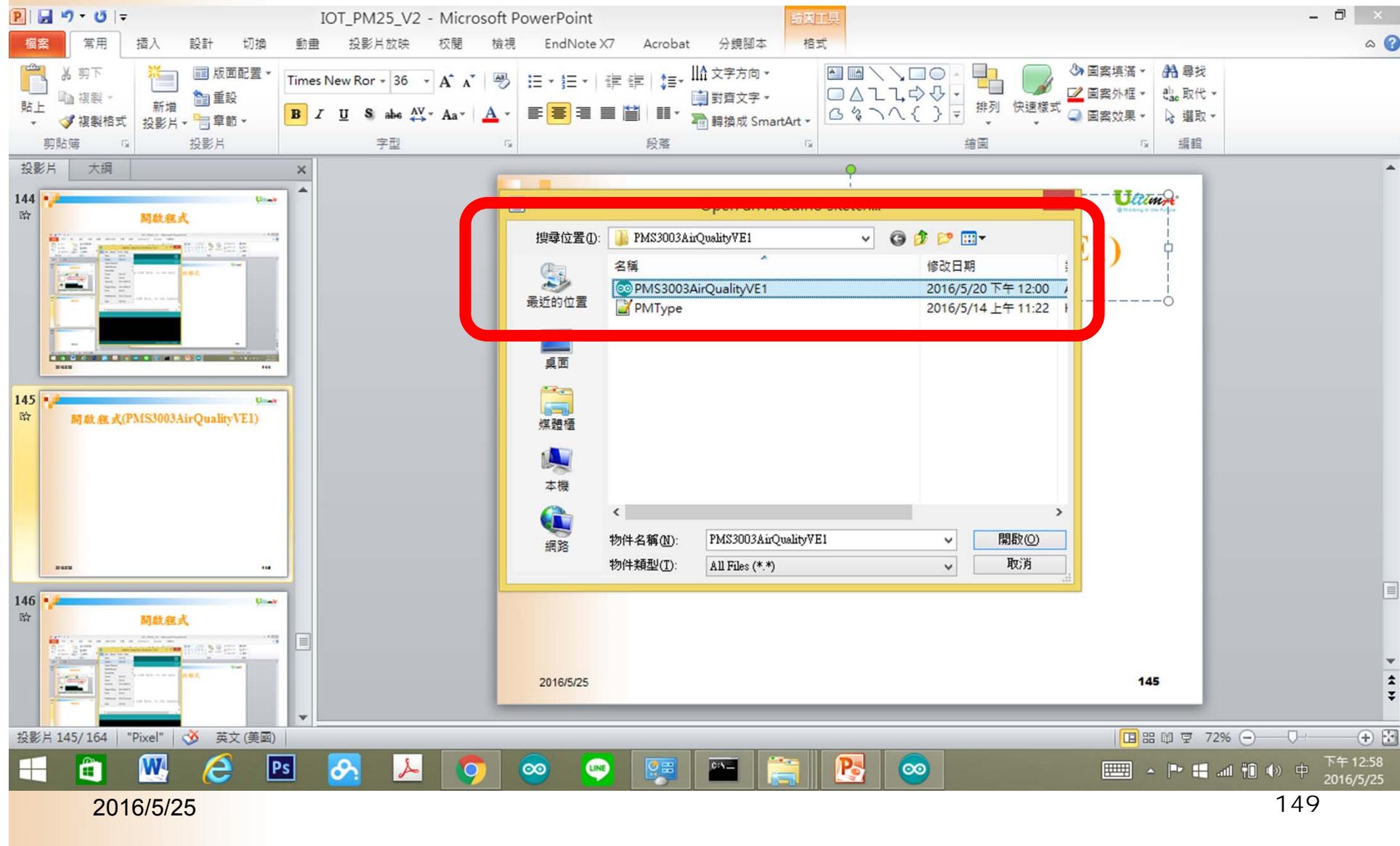
# 選擇通訊埠



# 開啟程式

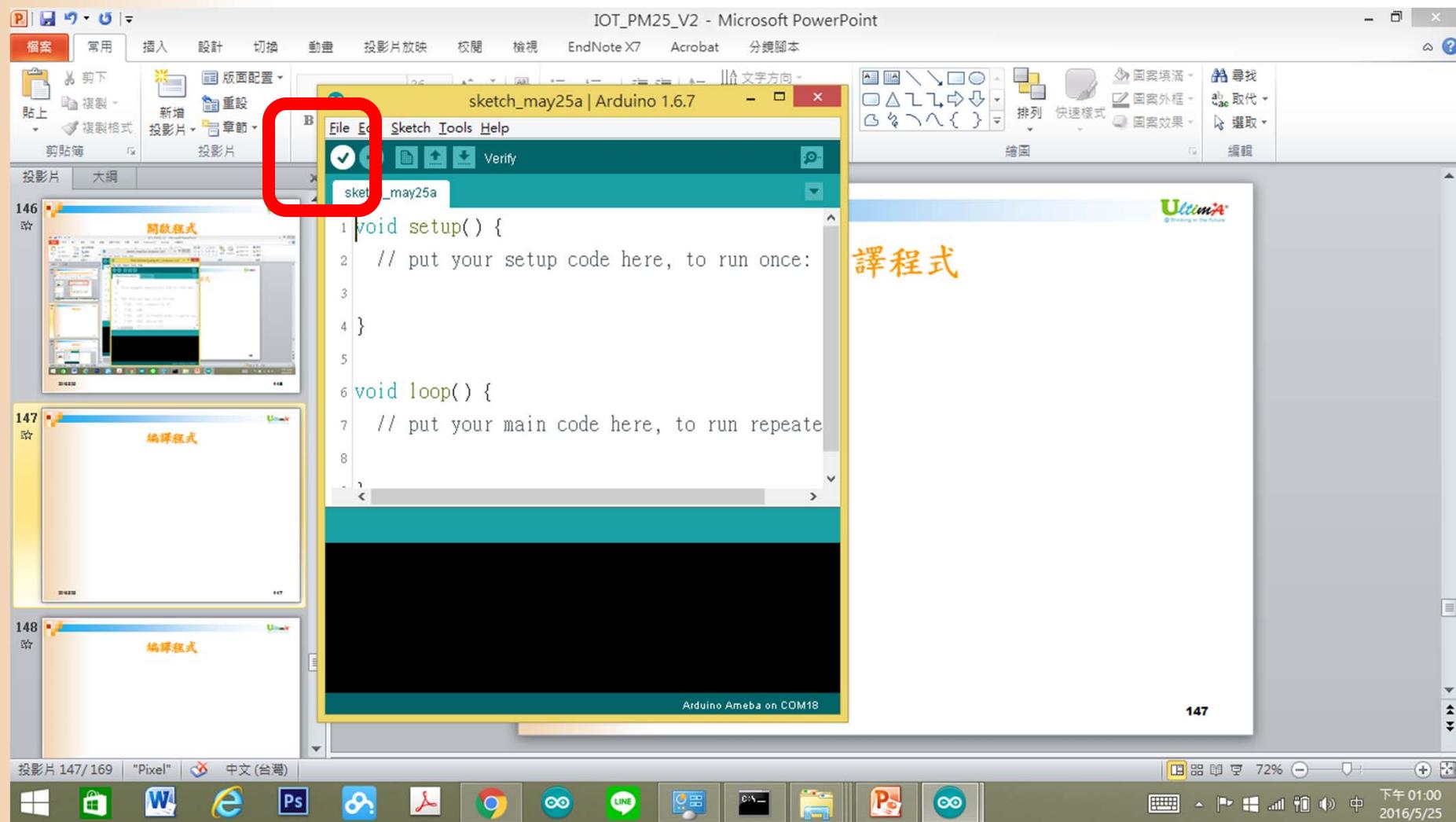


# 開啟程式(PMS3003AirQualityVE1)

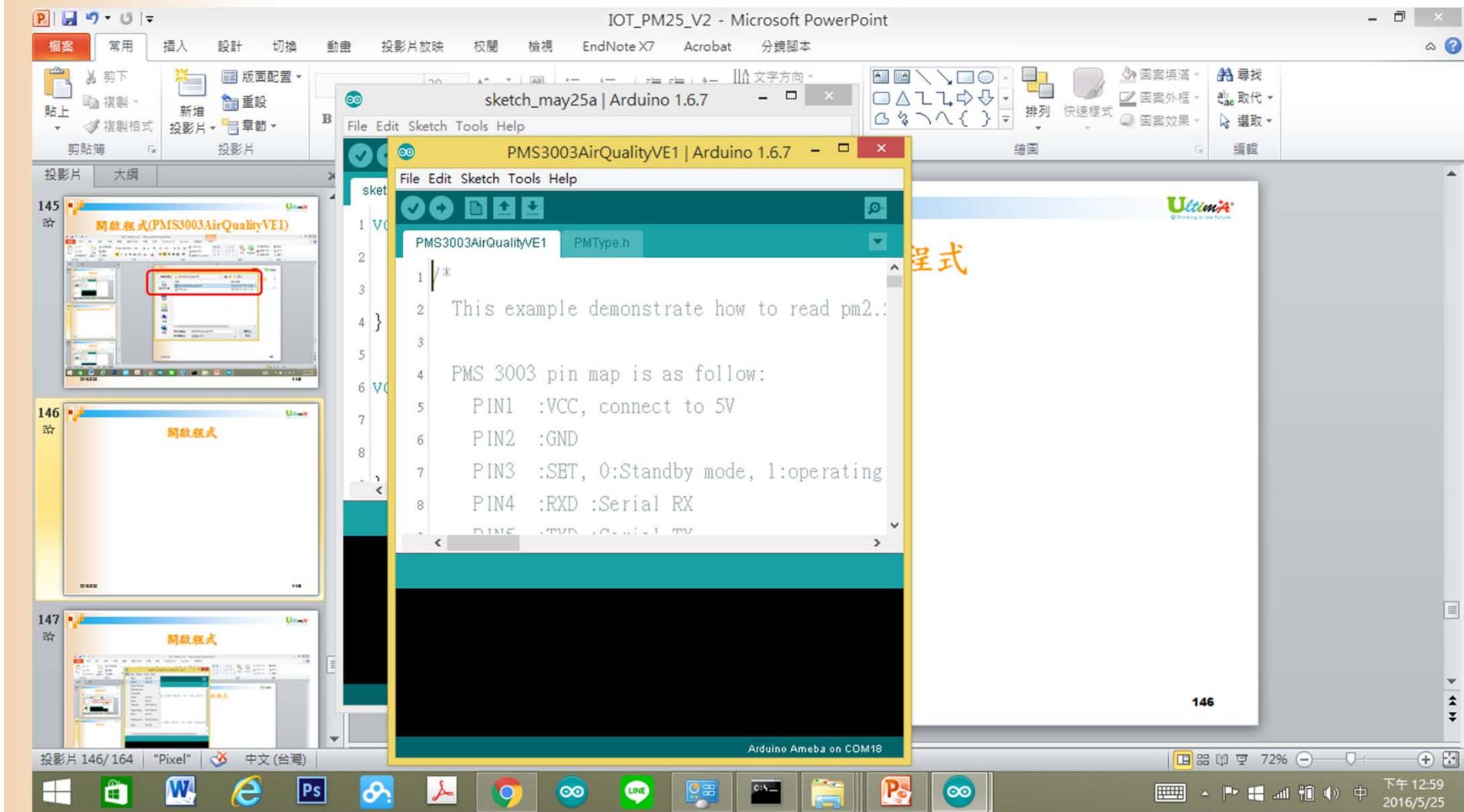


# 依不同裝置修改程式

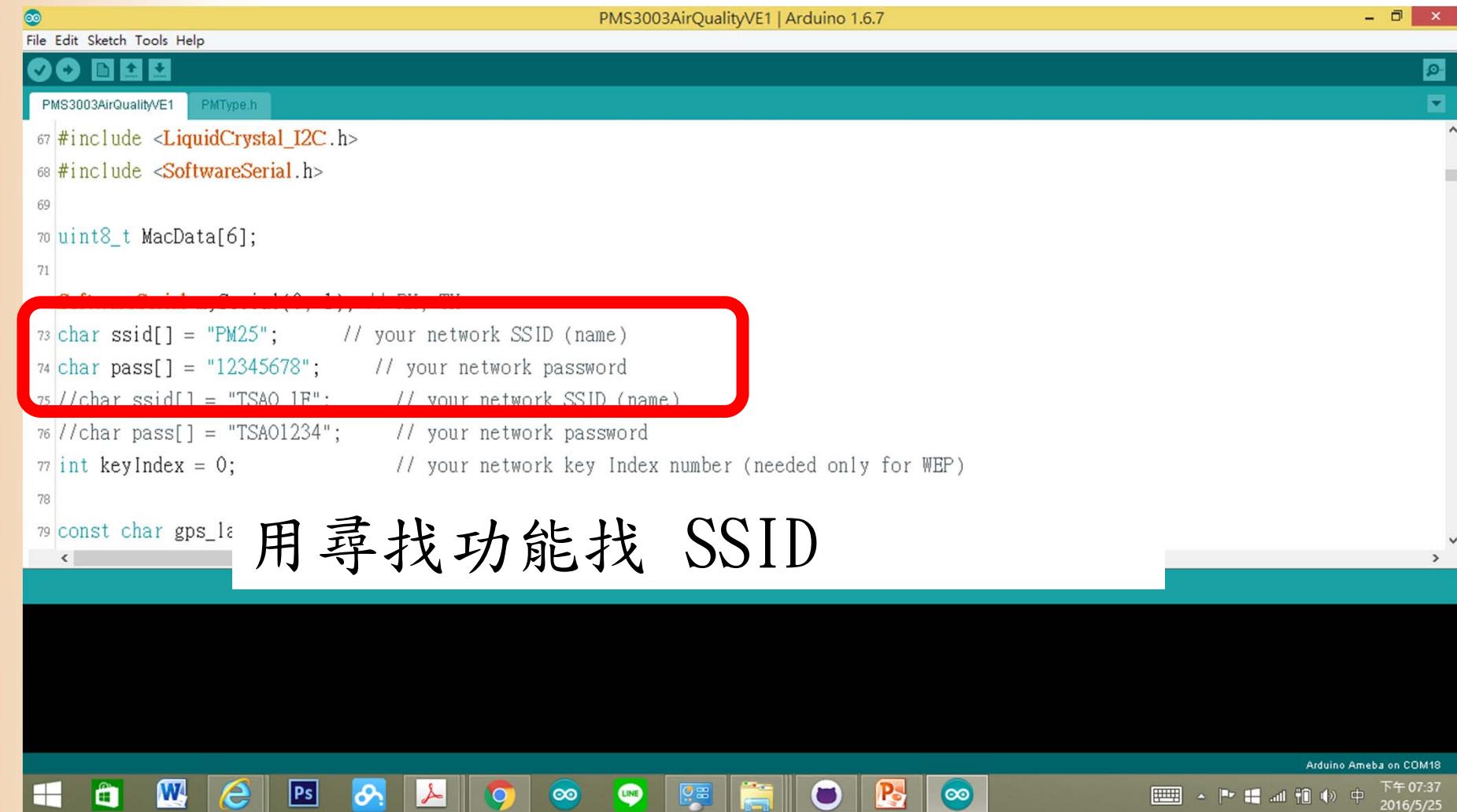
# 編譯PM2.5程式碼



# 開啟程式PM2.5程式碼



# 修改熱點



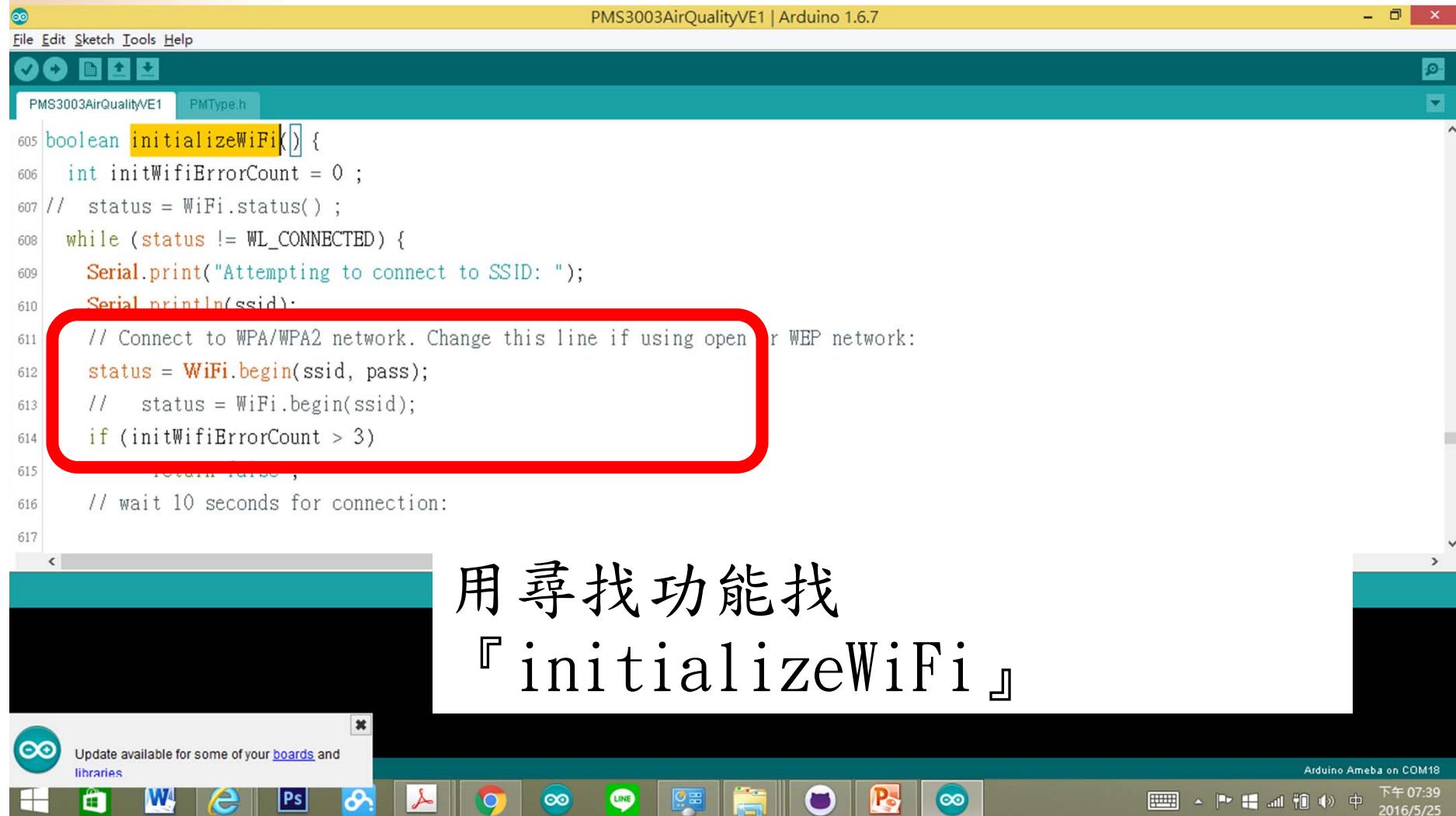
PMS3003AirQualityVE1 | Arduino 1.6.7

```
File Edit Sketch Tools Help
PMS3003AirQualityVE1 PMType.h
67 #include <LiquidCrystal_I2C.h>
68 #include <SoftwareSerial.h>
69
70 uint8_t MacData[6];
71
72 SoftwareSerial mySerial(2, 1); // D2, D1
73 char ssid[] = "PM25";      // your network SSID (name)
74 char pass[] = "12345678";   // your network password
75 //char ssid[] = "TSAO_1F";    // your network SSID (name)
76 //char pass[] = "TSAO1234";   // your network password
77 int keyIndex = 0;           // your network key Index number (needed only for WEP)
78
79 const char gps_1@
```

用尋找功能找 SSID

Arduino Ameba on COM18  
下午 07:37  
2016/5/25

# 修改熱點連線方式



PMS3003AirQualityVE1 | Arduino 1.6.7

```
File Edit Sketch Tools Help
PMS3003AirQualityVE1 PMType.h
605 boolean initializeWiFi() {
606     int initWifiErrorCount = 0 ;
607 //    status = WiFi.status( ) ;
608     while (status != WL_CONNECTED) {
609         Serial.print("Attempting to connect to SSID: ");
610         Serial.println(ssid);
611         // Connect to WPA/WPA2 network. Change this line if using open or WEP network:
612         status = WiFi.begin(ssid, pass);
613         //    status = WiFi.begin(ssid);
614         if (initWifiErrorCount > 3)
615             return false ;
616         // wait 10 seconds for connection:
617 }
```

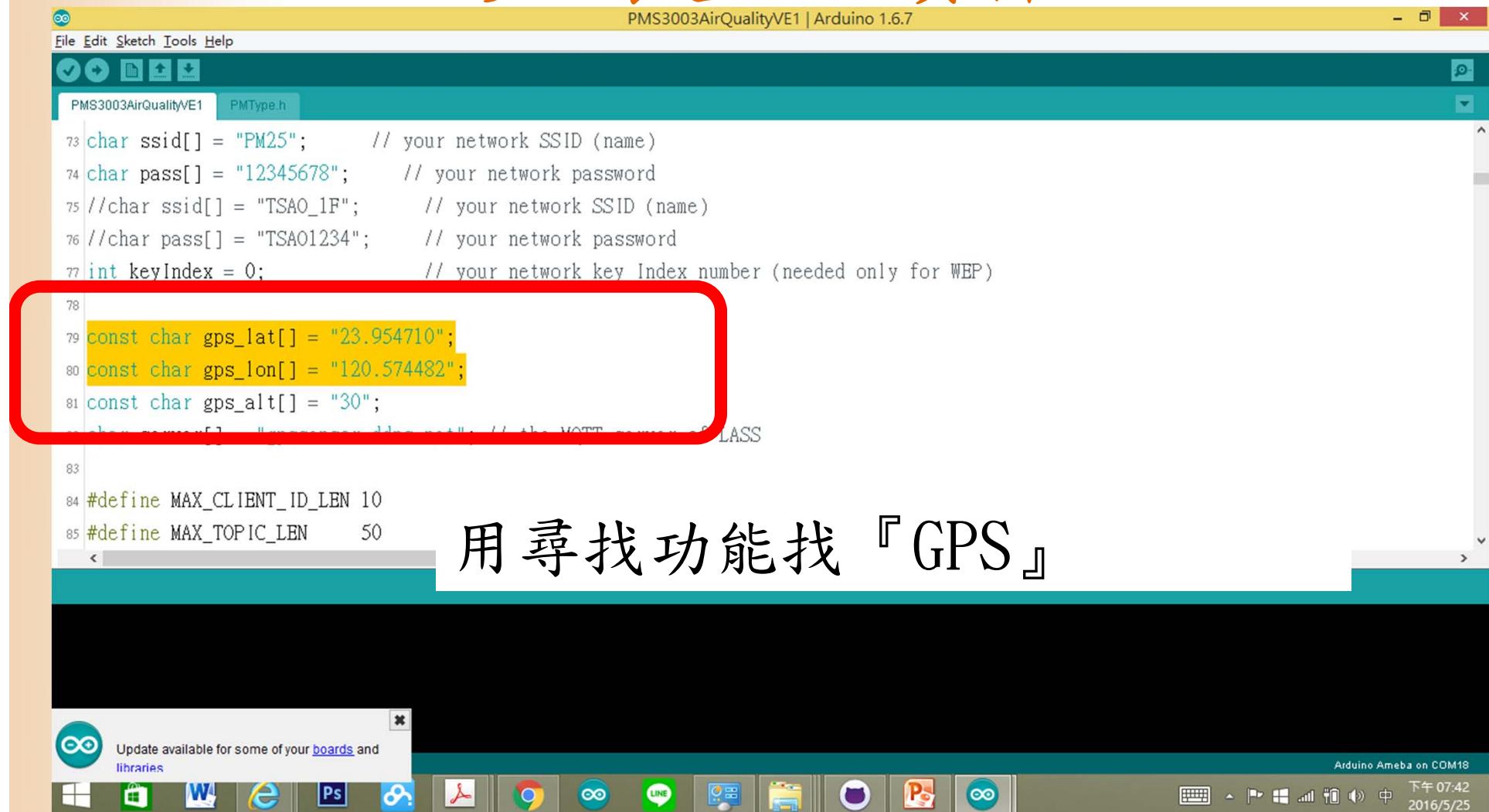
用尋找功能找  
『initializeWiFi』

Update available for some of your boards and libraries

Arduino Ameba on COM18

下午 07:39  
2016/5/25

# 修改裝置GPS資料



```
PMS3003AirQualityVE1 | Arduino 1.6.7

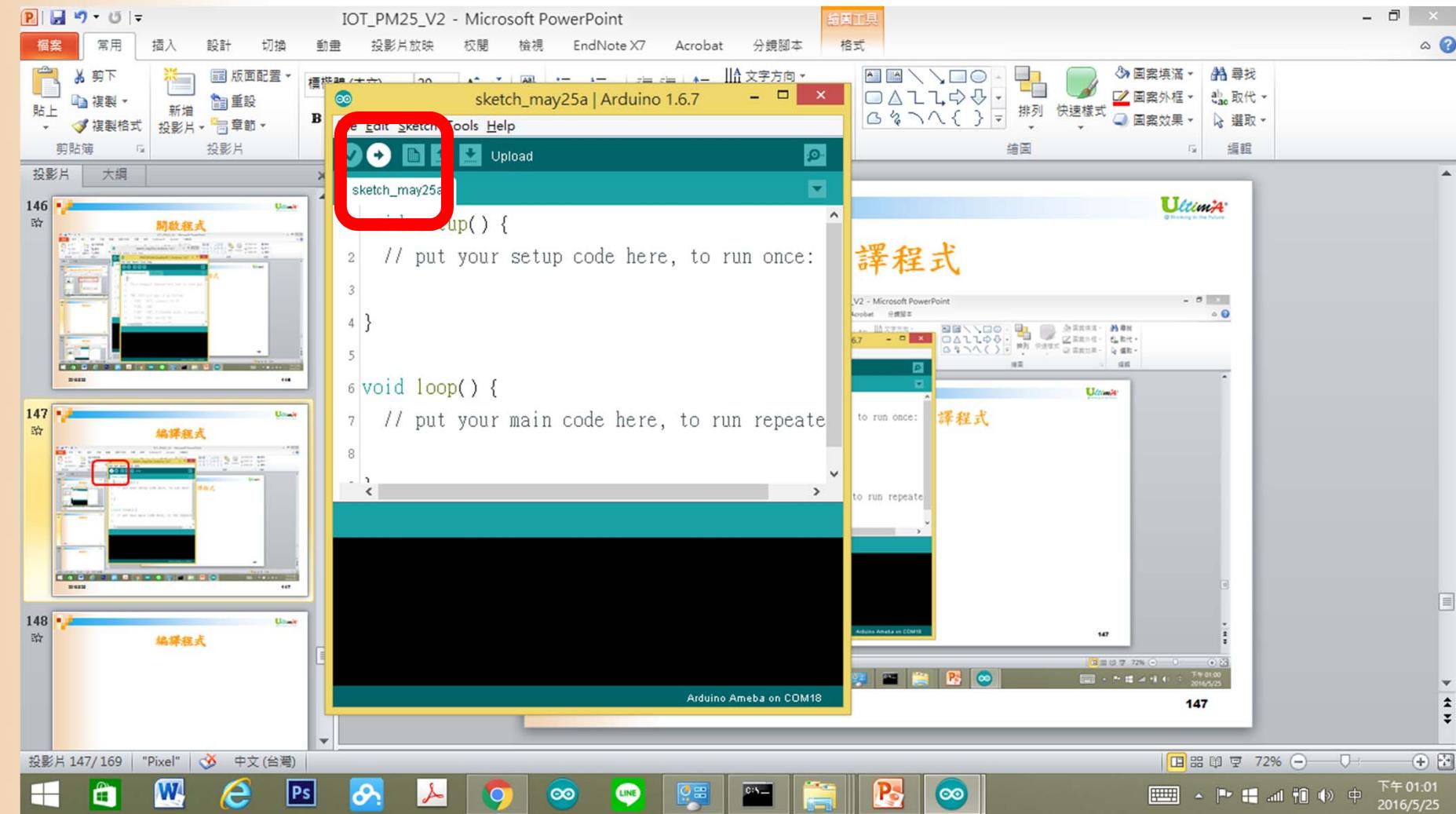
File Edit Sketch Tools Help
PMS3003AirQualityVE1 PMType.h
73 char ssid[] = "PM25";      // your network SSID (name)
74 char pass[] = "12345678";    // your network password
75 //char ssid[] = "TSAO_1F";    // your network SSID (name)
76 //char pass[] = "TSA01234";   // your network password
77 int keyIndex = 0;           // your network key Index number (needed only for WEP)

78
79 const char gps_lat[] = "23.954710";
80 const char gps_lon[] = "120.574482";
81 const char gps_alt[] = "30";
82 char message[5] = "my message available now"; // the MQTT message payload CLASS

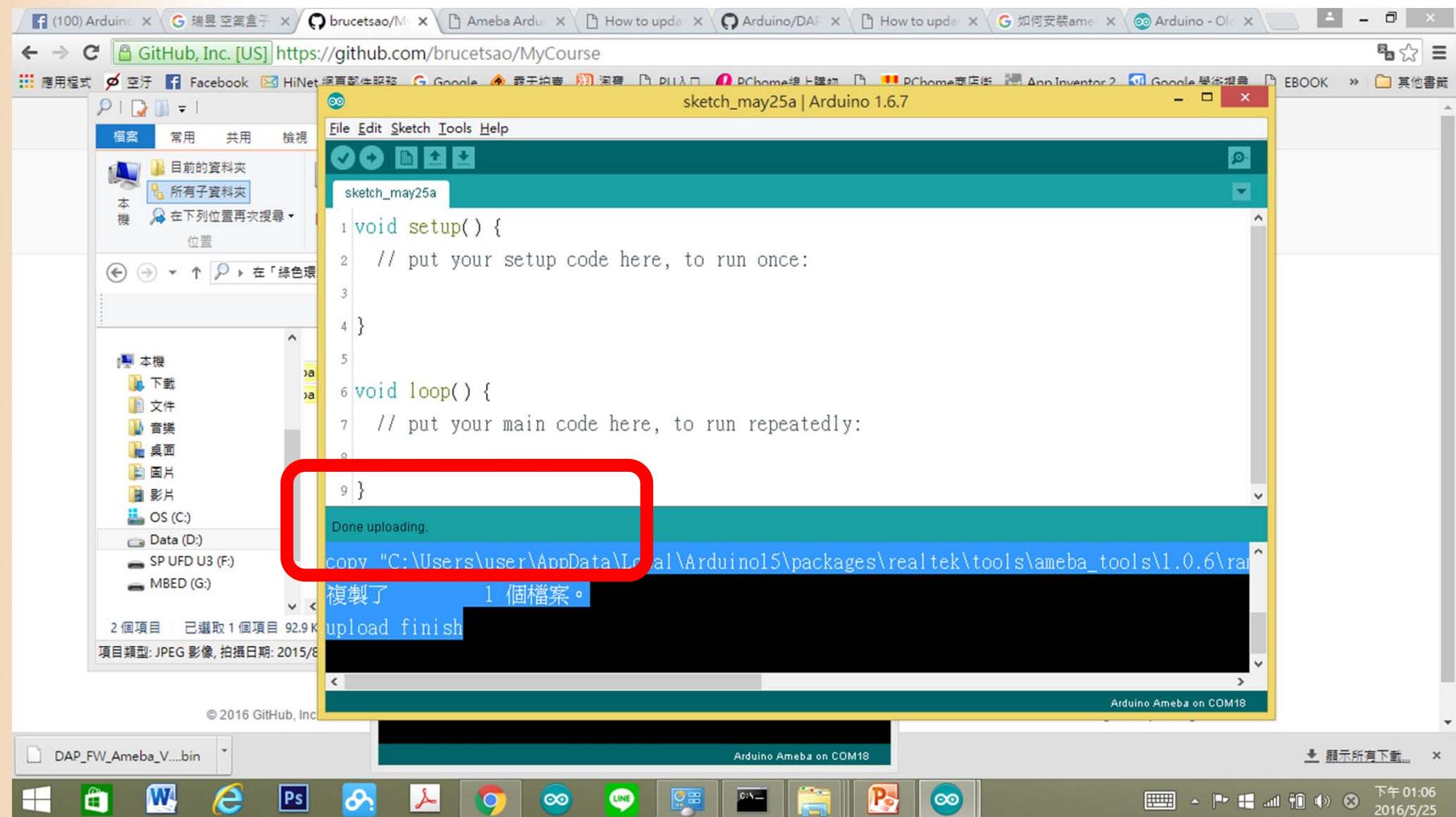
83
84 #define MAX_CLIENT_ID_LEN 10
85 #define MAX_TOPIC_LEN      50
```

用尋找功能找『GPS』

# 上傳編譯後PM2.5程式碼



# 完成PM2.5程式上傳



# DEMO

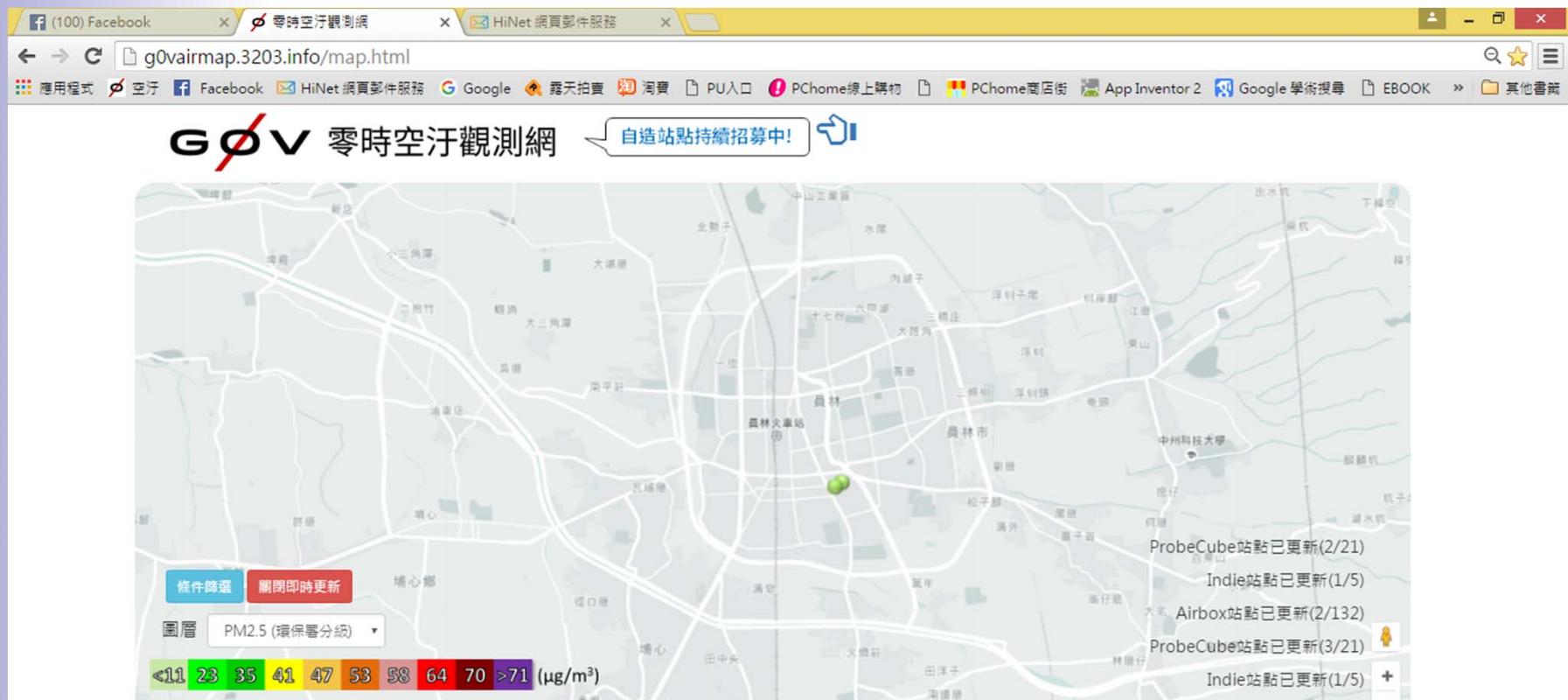
# 使用地圖模式查詢資料

# 使用地圖模式查看裝置



<http://g0vairmap.3203.info/map.html>

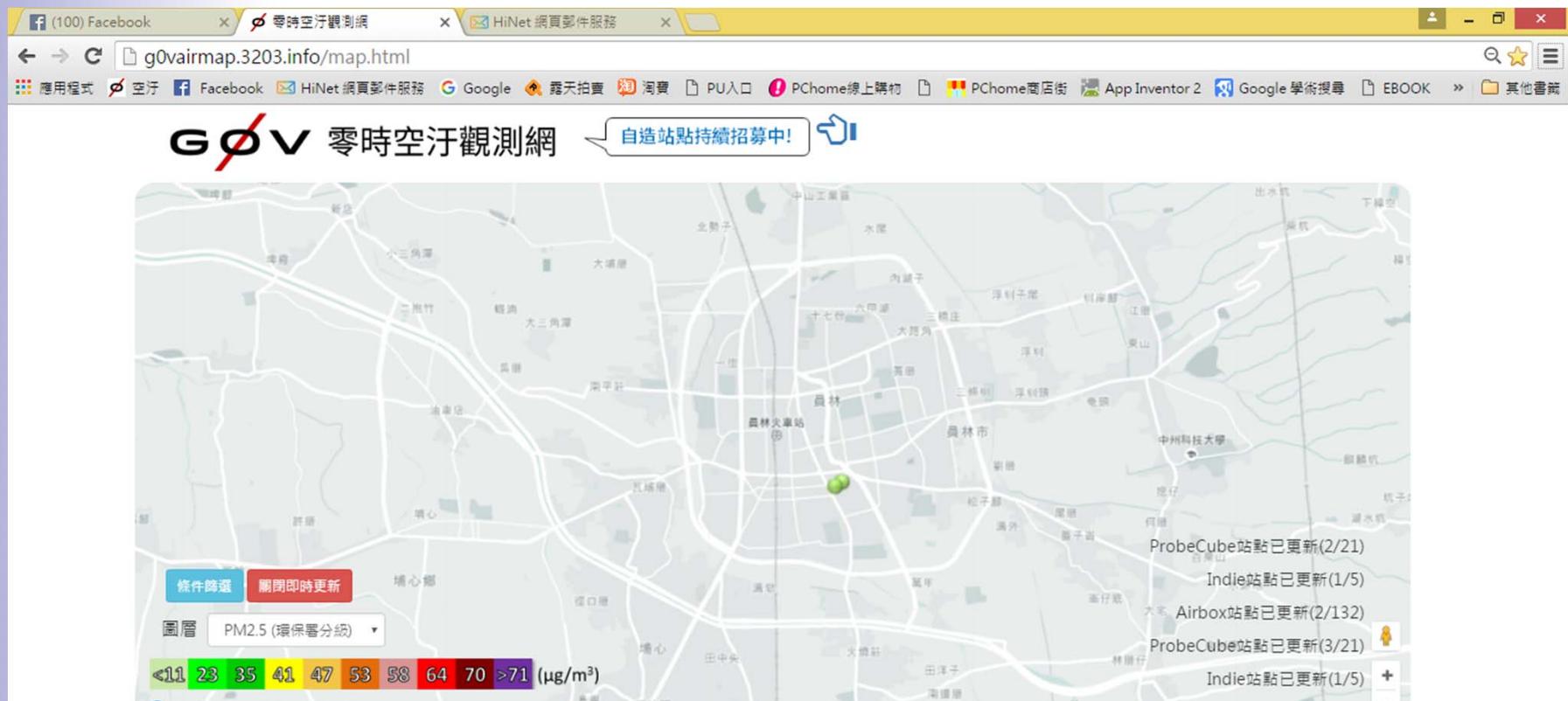
# 使用地圖模式查看裝置



可用滑鼠滾輪上下調整地圖大小



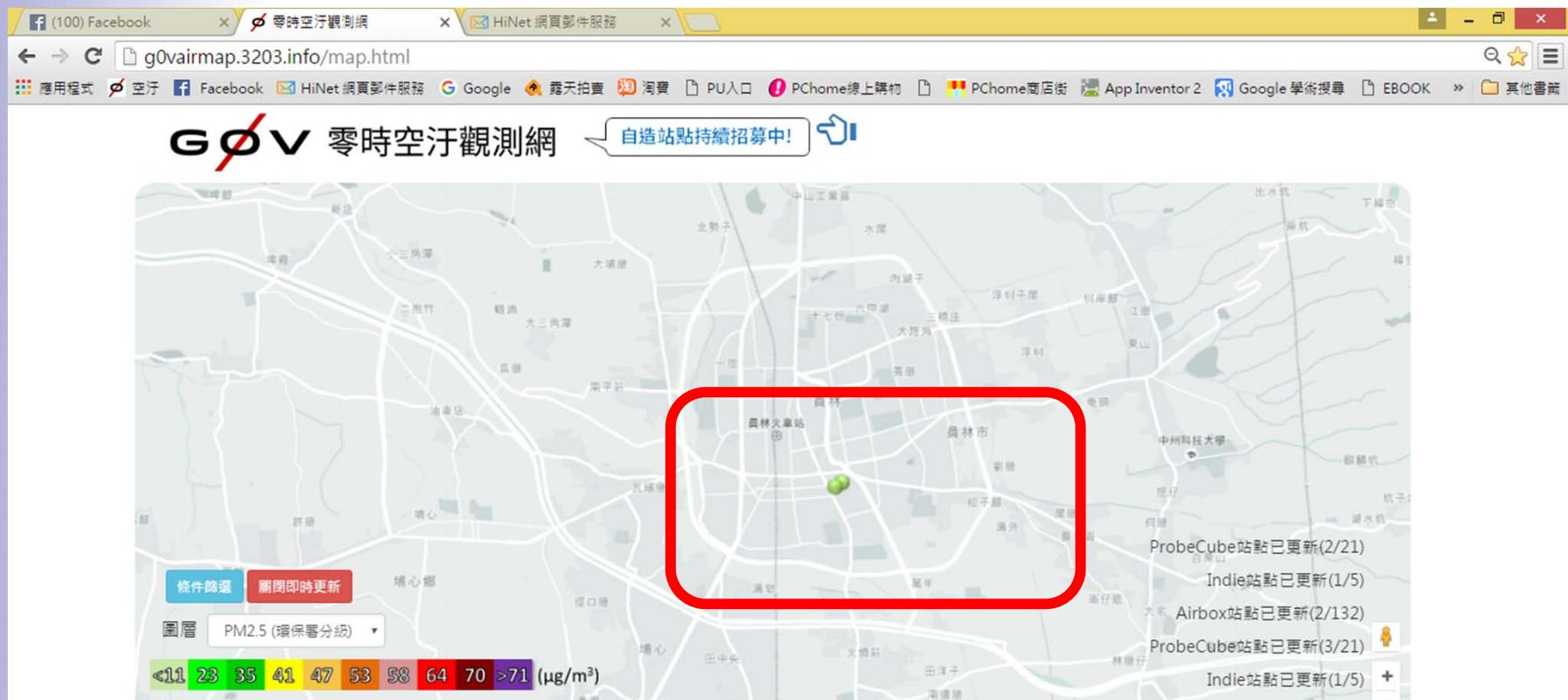
# 使用地圖模式查看裝置



可用按下滑鼠左鍵平移地圖位置



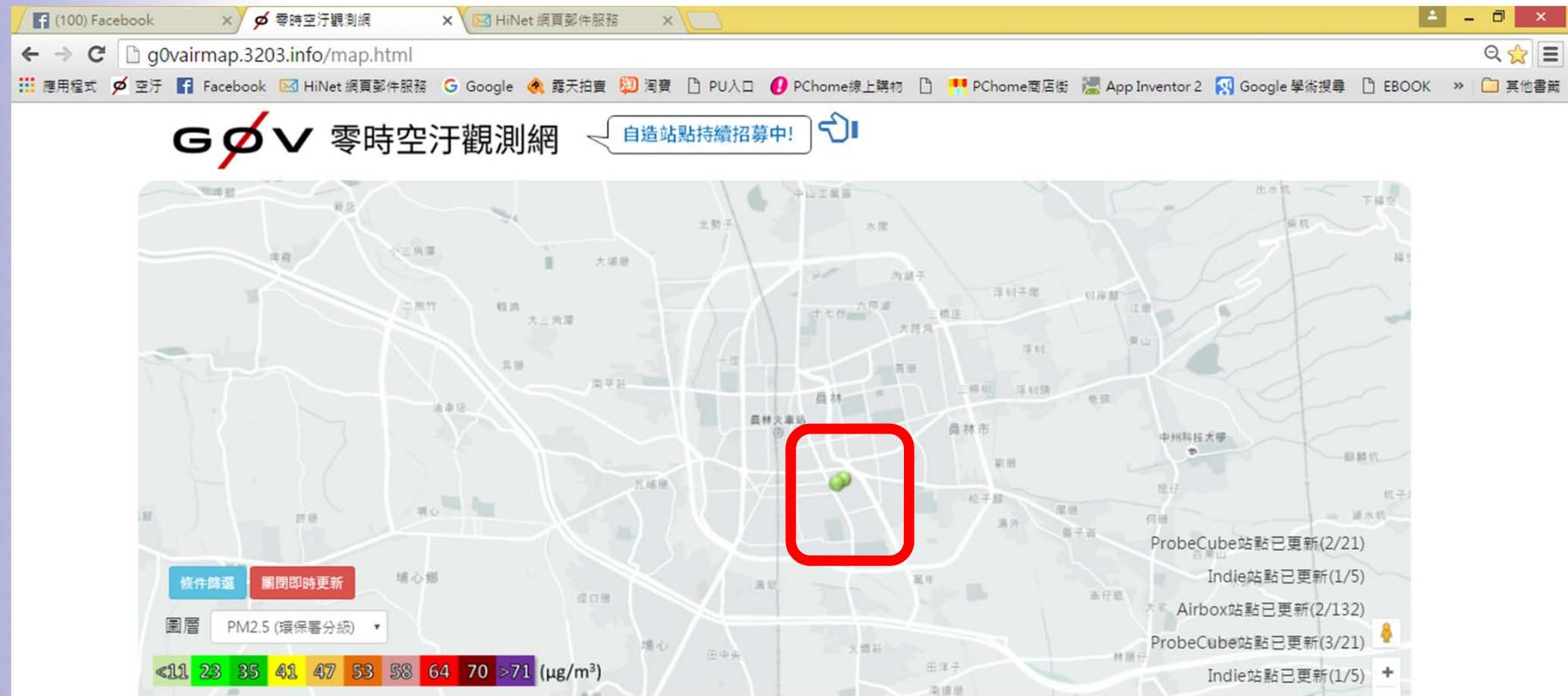
# 使用地圖模式查看裝置



# 選到您的裝置盒子的GPS位置



# 使用GPS查看裝置



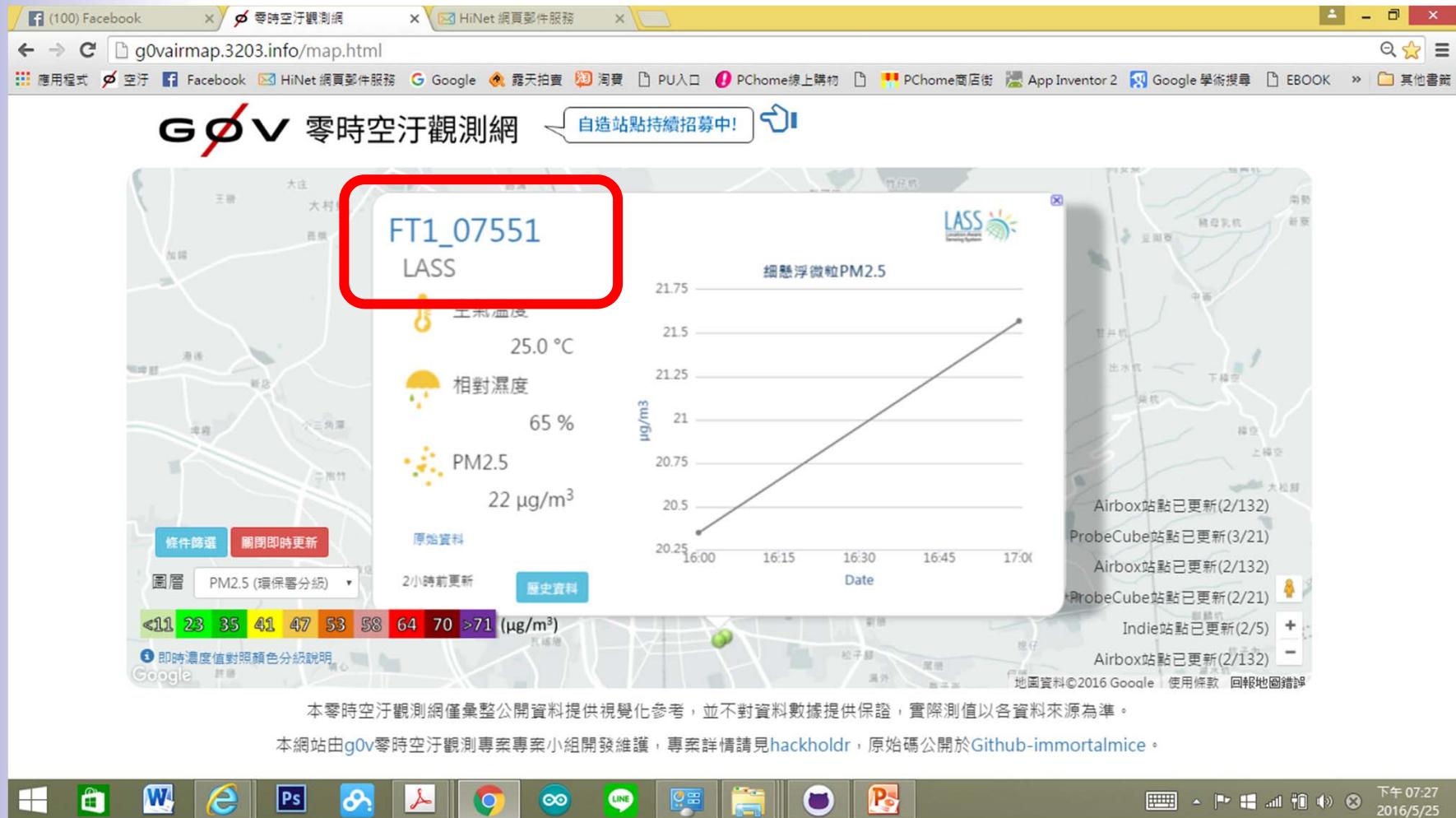
點選您的裝置



# 查看裝置資料



# 檢核網路資料-點選裝置

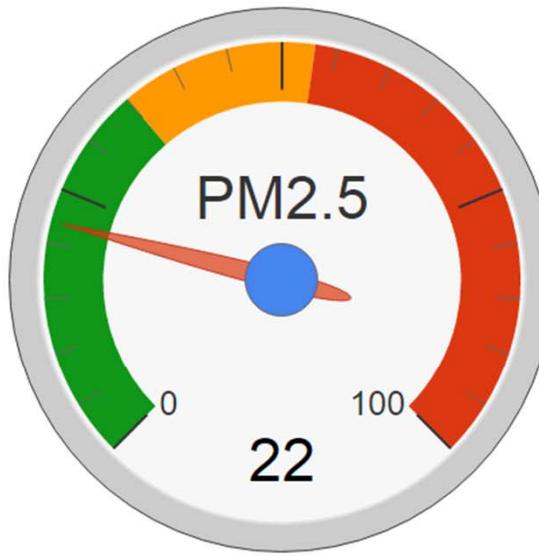


# 檢核網路資料-視覺化資料

PM2.5 即時資訊：

時間：Wed May 25 2016 17:17:35 GMT+0800 (台北標準時間)

溫度：25°C；濕度：65%



- 針對一般民眾的活動建議：正常戶外活動。
- 針對敏感性族群的活動建議：正常戶外活動。

75

2016/5/25

# 檢核網路資料-查看歷史資料



# 檢核網路資料：歷史資料



# 使用網址輸入查詢資料

# 檢核網路資料

Facebook PM2.5 即時資訊 HiNet 網頁郵件服務

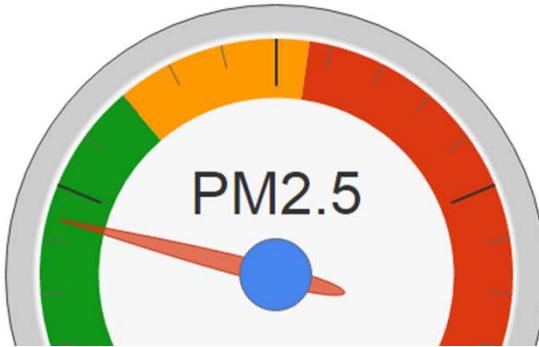
nrl.iis.sinica.edu.tw/LASS/show.php?device\_id=FT1\_07551

應用程式 空汎 Facebook HiNet 網頁郵件服務 Google 露天拍賣 淘寶 PU 入口 PChome 線上購物 PChome 商店街 App Inventor 2 Google 學術搜尋 EBOOK 其他書籤

## PM2.5 即時資訊：

時間：Wed May 25 2016 17:17:35 GMT+0800 (台北標準時間)

溫度：25°C；濕度：65%



- 針對一般民眾的活動建議：正常戶外活動。
- 針對敏感性族群的活動建議：正常戶外活動。

使用網址輸入查看裝置：

[http://nrl.iis.sinica.edu.tw/LASS/show.php?device\\_id=FT1\\_0](http://nrl.iis.sinica.edu.tw/LASS/show.php?device_id=FT1_0)+裝置MAC後四個字

如：

 [http://nrl.iis.sinica.edu.tw/LASS/show.php?device\\_id=FT1\\_07551](http://nrl.iis.sinica.edu.tw/LASS/show.php?device_id=FT1_07551)



## Q & A

感謝聆聽  
恭請指教

# 自我介紹

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- 活動官網：<http://Arduino.kktix.cc/>
- Youtube：<https://www.youtube.com/channel/UCcYG2yYu0m1aotcA4hrRgQ>



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