

Raspberry Pi Introduction

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Introduction

What is the Raspberry Pi?

- ▶ The Raspberry Pi is a small, barebones computer developed by The Raspberry Pi Foundation, a UK charity, with the intention of providing low-cost computers and free software to students.
- ▶ The main operating system for the Raspberry Pi is Raspbian and is based on Debian. It is a distribution of Linux so you will probably find it a little different if you're used to a Windows computer.

Specifications

- ▶ SoC: New BCM2837 chip
- ▶ CPU: Quad-core 64-bit ARM cortex A53 CPU
 - Clocked at 1.2GHz
- ▶ GPU: Broadcom VideoCore IV
- ▶ RAM: 1GB LPDDR2(900MHz)
- ▶ Networking: 10/100 Ethernet, 2.4GHz 802.11n wireless
- ▶ Bluetooth: Bluetooth 4.1 Classic, BLE
- ▶ Storage: microSD
- ▶ GPIO: 40-pin header, populated
- ▶ Ports: HDMI, 3.5mm analogue audio-video jack, 4xUSB 2.0, Ethernet, Camera Serial Interface(CSI), Display Serial Interface(DSI)

Reference

- <https://www.raspberrypi.org/magpi/raspberry-pi-3-specs-benchmarks/>

Arduino vs Raspberry Pi

	Arduino Uno	Raspberry Pi 3
Price	\$30	\$35
Size	7.6 x 6.4x 1.9 cm	8.5 x 5.4 x 1.7 cm
Memory	0.002MB	1GB
On Board Network	None	Ethernet, 802.11n, Bluetooth 4.1, BLE
Multitasking	No	Yes
Input voltage	7 to 12V	5V
Flash	32KB	SD Card
USB	One, input only	Four USB Port
Operating System	None	Linux distributions

What is the difference between the two?



- ▶ An Arduino is a microcontroller motherboard.
A microcontroller is a simple computer that can run one program at a time, over and over again. It is very easy to use.
- ▶ A Raspberry Pi is a general-purpose computer, usually with a Linux operating system, and the ability to run multiple programs. It is more complicated to use than an Arduino.


Reference

- <http://www.makeuseof.com/tag/arduino-vs-raspberry-pi-which-is-the-mini-computer-for-you/>
- <http://www.digitaltrends.com/computing/arduino-vs-raspberry-pi/>

Settings


Raspberry Pi OS

[BLOG](#)[DOWNLOADS](#)[COMMUNITY](#)[HELP](#)[FORUMS](#)[EDUCATION](#)



NOOBS


New Out Of the Box Software - an easy Operating System installer for beginners




RASPBIAN

THIRD PARTY OPERATING SYSTEM IMAGES


Third party images are also available:




UBUNTU MATE




SNAPPY UBUNTU CORE




WINDOWS 10 IOT CORE



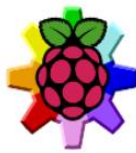
OSMC




LIBREELEC



PINET



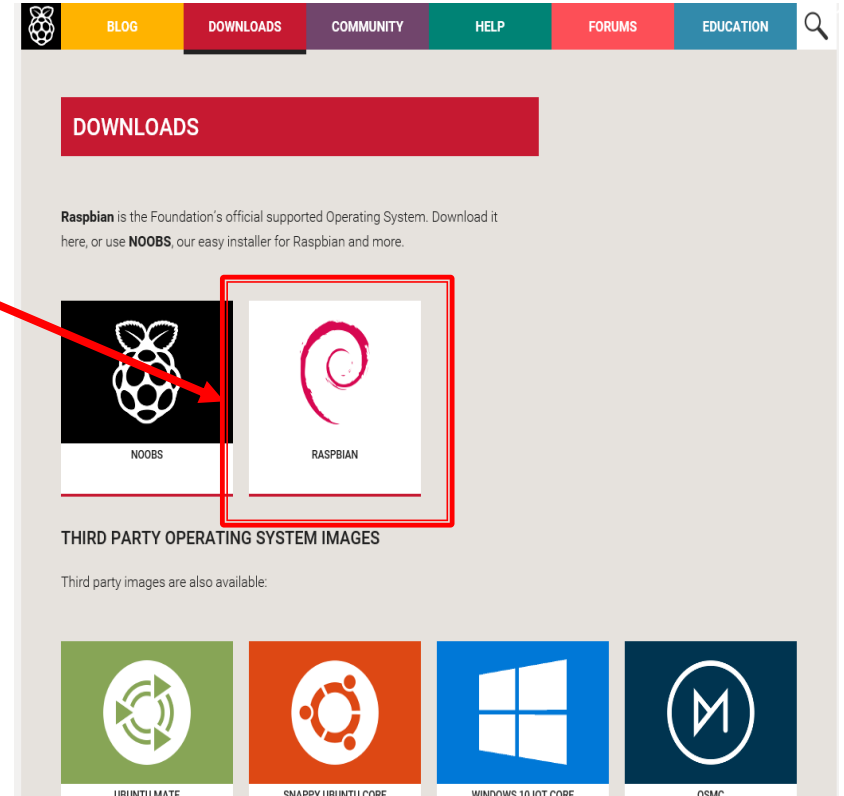
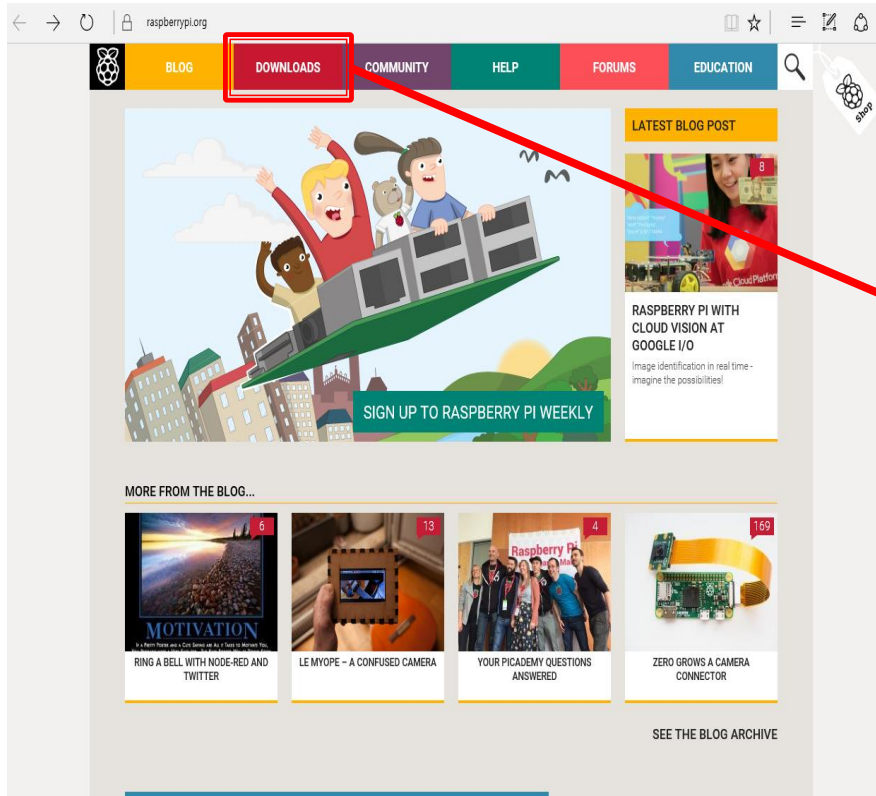
RISC OS



WEATHER STATION

Install OS

- ▶ Rasbian image Download
 - <https://www.raspberrypi.org/>




Install OS

- ▶ Rasbian image Download
 - <https://www.raspberrypi.org/>

RASPBIAN

Raspbian is the Foundation's official supported operating system. You can install it with [NOOBS](#) or download the image below and follow our [installation guide](#).

Raspbian comes pre-installed with plenty of software for education, programming and general use. It has Python, Scratch, Sonic Pi, Java, Mathematica and more.




RASPBIAN JESSIE

Full desktop image based on Debian Jessie

Version:	May 2016
Release date:	2016-05-10
Kernel version:	4.4
Release notes:	Link

[Download Torrent](#) [Download ZIP](#)

SHA-1: 66a50545358e80229d77ebba89ab01f1c0fb4a02



RASPBIAN JESSIE LITE

Minimal image based on Debian Jessie

Version:	May 2016
Release date:	2016-05-10
Kernel version:	4.4
Release notes:	Link

[Download Torrent](#) [Download ZIP](#)

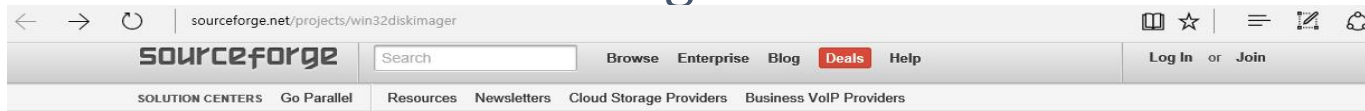
SHA-1: 333bfc855e8944ecb1142337ead8c928dc6c9d95

CLICK!

Note: Raspbian and NOOBS contain Java SE Platform Products, licensed to you under the Oracle Binary Code Licence Agreement available [here](#).

Install OS

- ▶ Win 32 Disk Imager Download
 - <https://sourceforge.net/projects/win32diskimager/>
 - SD Card에 Rasbian OS Image를 쓰기 위함.



Home / Browse / System Administration / Storage / Win32 Disk Imager

Win32 Disk Imager beta

A tool for writing images to USB sticks or SD/CF cards

Brought to you by: [gruemaster](#), [tuxinator2009](#)


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★ 4.0 Stars (73)
↓ 81,100 Downloads (This Week)
Last Update: 2015-09-22

[Download](#)
Download the unnamed sequel here

[Browse All Files](#)

[Tweet](#) [G+1](#) 45 [좋아요](#) 7



The screenshot shows the Win32 Disk Imager application window. It features a large blue play button in the center with the text 'How to use Win32 Disk Imager'. Below this, there are buttons for 'Cancel', 'Read', and 'Write'. The SourceForge logo is visible in the bottom left corner of the application window.

Recommended Projects

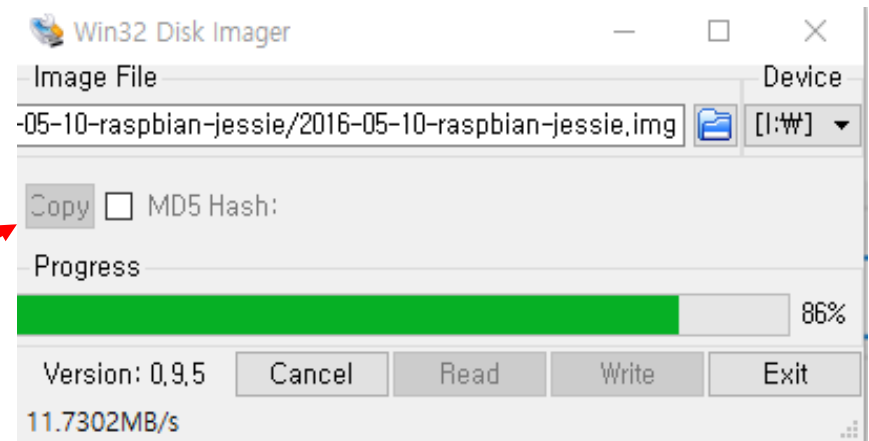
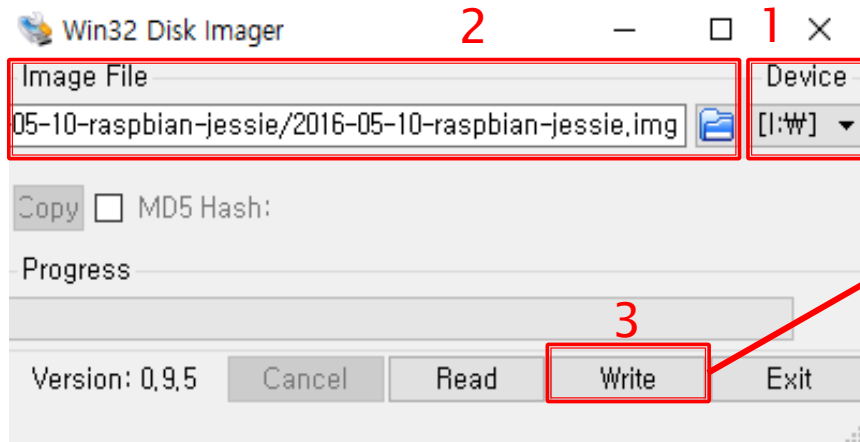
- 7-Zip**
A free file archiver for extremely high compression
- UNetbootin**
Bootable live USB creator for Ubuntu, Fedora, and Linux distributions
- XBian**
XBian is a small, fast and lightweight media center linux distro

SOURCEFORGE DEALS

Ultimate Unity3D Game Building Bundle

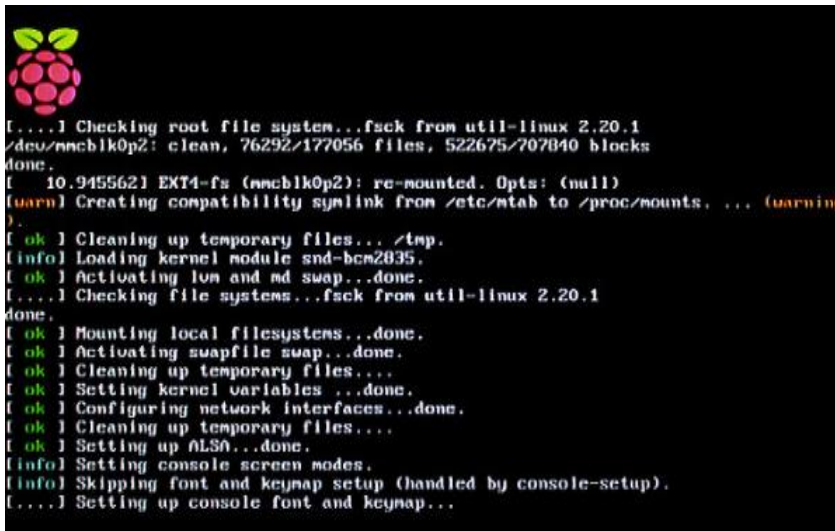
Install OS

- ▶ 1. Win32 Disk Imager를 실행 시킨 후 Device에서 SD Card의 위치 선택.
- ▶ 2. Image File에 다운받은 Rasbian OS의 Image File Path 설정
- ▶ 3. Write 버튼 누른 후 대기.

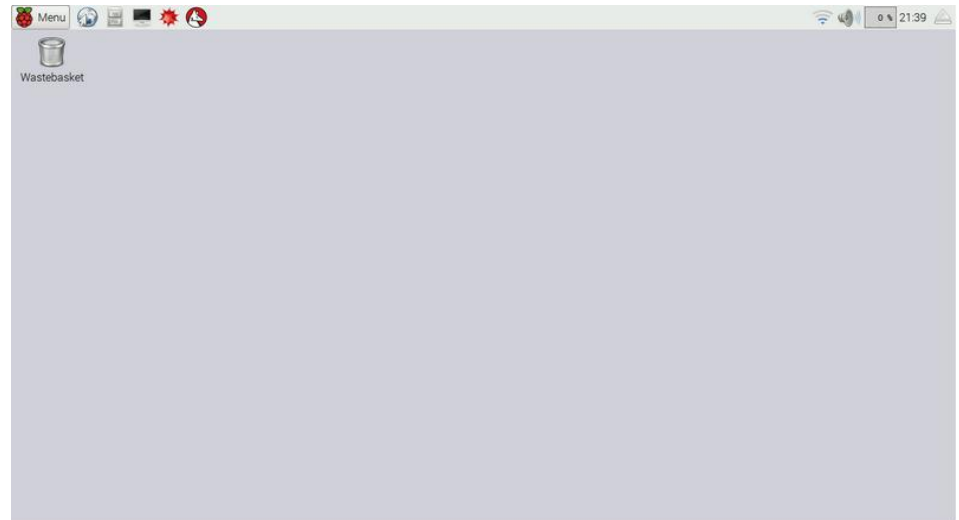


Install OS

- ▶ Rasbian OS Image File을 SD Card에 쓰는데 성공했다면, SD Card를 Raspberry Pi에 장착 후 전원 공급.
 - Basic-Kit의 HDMI Cable을 이용하여 모니터와 연결, Adapter를 이용하여 전원 공급.(Appendix 참조)



```
[....] Checking root file system...fsck from util-linux 2.20.1
/dev/mmcblk0p2: clean, 76292/177056 files, 522675/707840 blocks
done.
[ 10.945562] EXT4-fs (mmcblk0p2): re-mounted. Opts: (null)
[warn] Creating compatibility symlink from /etc/mtab to /proc/mounts, ... (warning
).
[ ok ] Cleaning up temporary files... /tmp.
[info] Loading kernel module snd-bcm2835.
[ ok ] Activating lvm and md swap...done.
[....] Checking file systems...fsck from util-linux 2.20.1
done.
[ ok ] Mounting local filesystems...done.
[ ok ] Activating swapfile swap...done.
[ ok ] Cleaning up temporary files....
[ ok ] Setting kernel variables ...done.
[ ok ] Configuring network interfaces...done.
[ ok ] Cleaning up temporary files....
[ ok ] Setting up ALSA...done.
[info] Setting console screen modes.
[info] Skipping font and keymap setup (handled by console-setup).
[....] Setting up console font and keymap...
```



Basic command

- ▶ `$ sudo apt-get update`
 - 프로그램 패키지 목록 업데이트
- ▶ `$ sudo apt-get upgrade`
 - 설치된 프로그램 중 버전 업 된 프로그램 업데이트
- ▶ `$ cat /proc/version`
 - OS version 확인
- ▶ `$ vcgencmd version`
 - 펌웨어 확인
- ▶ `$ sudo rpi-update`
 - 펌웨어 업데이트
- ▶ `$ sudo reboot`
 - 재부팅
- ▶ `$ sudo shutdown -h now`
 - 종료
- ▶ `$ ifconfig`
 - 유/무선 네트워크 확인

Wi-Fi Setting

- ▶ Raspberry Pi 3는 Wi-Fi 모듈이 내장되어 있으므로 동글 없이 Wi-Fi 연결이 가능합니다.

- ▶ \$ sudo iwlist wlan0 scan

- 현재 신호가 잡히는 AP를 스캔하여 연결한 AP의 ESSID와 password 확인

- ▶ \$ sudo nano /etc/wpa_supplicant/wpa_supplicant.conf

- Ctrl + i와 Ctrl + o를 선택
- ```
ctrl_interface=DIR=/var/run/wpa_supplicant GROUP=netdev
update_config=1

network={
 ssid="공유기 ESSID"
 psk="패스워드"
}
```

- Ctrl + x 누른 후 y를 누르면 저장 됩니다.

- ▶ 무선랜 모듈을 껐다가 켜주면 공유기와 접속

- ▶ \$ sudo ifdown wlan0

- 모듈 off

- ▶ \$ sudo ifup wlan0

- 모듈 on

- ▶ \$ ifconfig

- 아이피를 확인하여 정상적인 접속이 되는지 확인.



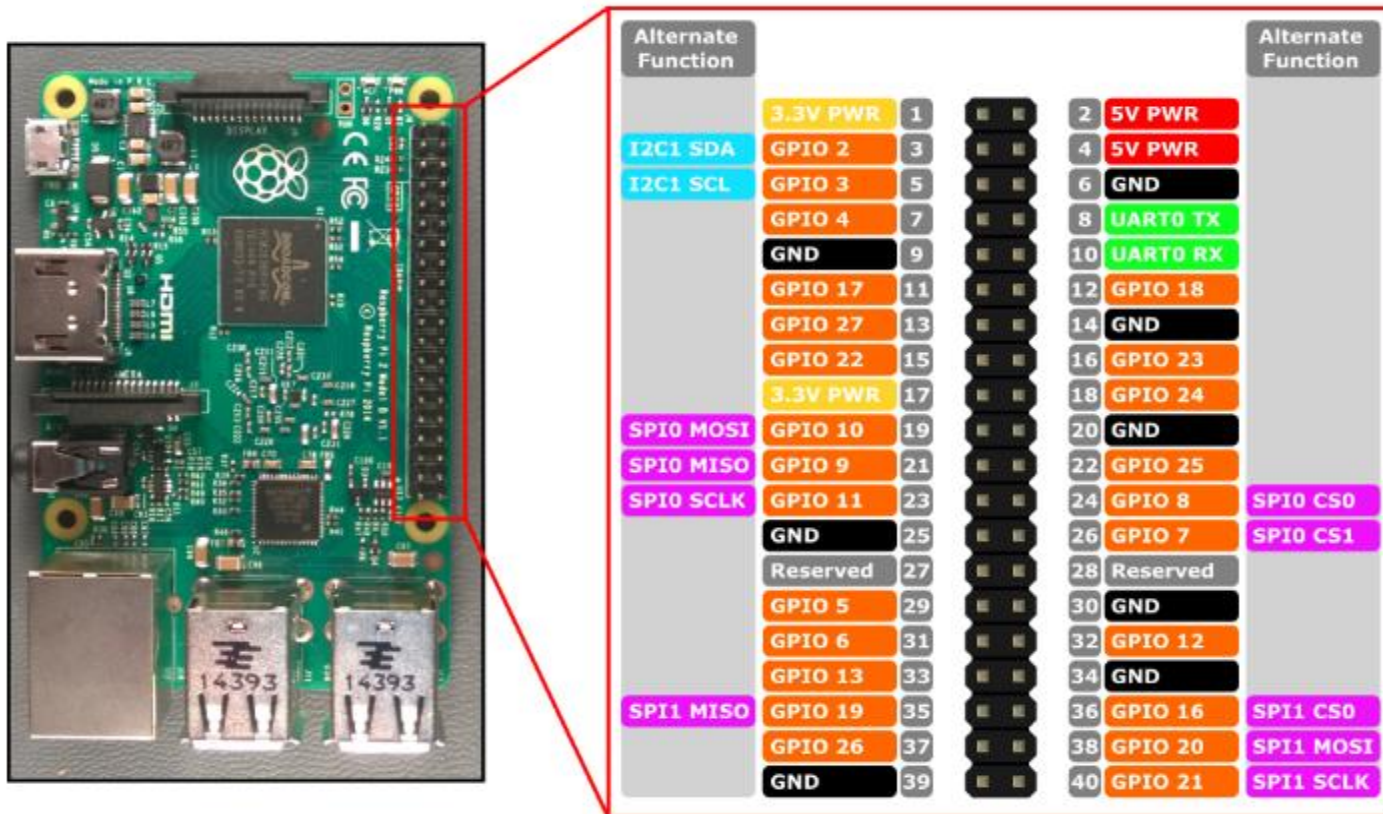
# Install Python

- ▶ Raspberry Pi에서 Python을 이용하려면 Python Package를 설치해야 한다.
- ▶ `$ dpkg -l | grep python`
  - Python 설치 확인
- ▶ `$ sudo apt-get install python-dev`
  - 설치되어있지 않다면 위의 command로 설치
  - 설치 후 'python' 또는 'python3' command를 입력하여 제대로 설치가 완료되었는지 확인하자.

# Programming Example

# GPIO

- ▶ Raspberry Pi의 Pin은 다음과 같이 Mapping되어있으며, 2와 3버전 모두 동일한 구조를 가진다.



Image

- <https://developer.microsoft.com/en-us/windows/iot/docs/pinmappingsrpi>

# GPIO

## ▶ Raspberry Pi의 GPIO를 제어하기 위한 Python 라이브러리

◦ <http://pypi.python.org/pypi/RPi.GPIO/>

▶ `$ wget \ https://pypi.python.org/packages/source/R/RPi.GPIO-0.5.9.tar.gz`

The screenshot shows the PyPI page for RPi.GPIO 0.6.2. The page includes a sidebar with navigation links like 'PACKAGE INDEX', 'Browse packages', and 'Download'. The main content area displays the package name 'RPi.GPIO 0.6.2', a description of its functionality as a module to control Raspberry Pi GPIO channels, and a 'Download' button. A 'Not Logged In' sidebar on the right offers login and registration options. The page also features a 'Change Log' section with entries for versions 0.6.2 and 0.6.1.

RPi.GPIO 0.6.2

A module to control Raspberry Pi GPIO channels

This package provides a class to control the GPIO on a Raspberry Pi.

Note that this module is unsuitable for real-time or timing critical applications. This is because you can not predict when Python will be busy garbage collecting. It also runs under the Linux kernel which is not suitable for real time applications - it is multitasking O/S and another process may be given priority over the CPU, causing jitter in your program. If you are after true real-time performance and predictability, buy yourself an Arduino <http://www.arduino.cc> !

Note that the current release does not support SPI, I2C, hardware PWM or serial functionality on the RPi yet. This is planned for the near future - watch this space! One-wire functionality is also planned.

Although hardware PWM is not available yet, software PWM is available to use on all channels.

For examples and documentation, visit <http://sourceforge.net/p/raspberry-gpio-python/wiki/Home/>

Change Log

0.6.2

- Rewrote Debian packaging mechanism
- RPi\_INFO reports Pi 3
- Changed module layout - moved C components to RPi\_GPIO

0.6.1

- Update RPi\_INFO to detect more board types
- Issue 118 - add\_event\_detect sometimes gives runtime error with unpriv user
- Issue 120 - setmode() remembers invalid mode

- ▶ `$ tar xzf Rpi.GPIO-0.5.9.tar.gz`
- ▶ `$ cd Rpi.GPIO-0.5.9`
- ▶ `$ sudo python setup.py install`

# GPIO

## ▶ LED Control

```
import RPi.GPIO as GPIO
import time

GPIO.setmode(GPIO.BCM)

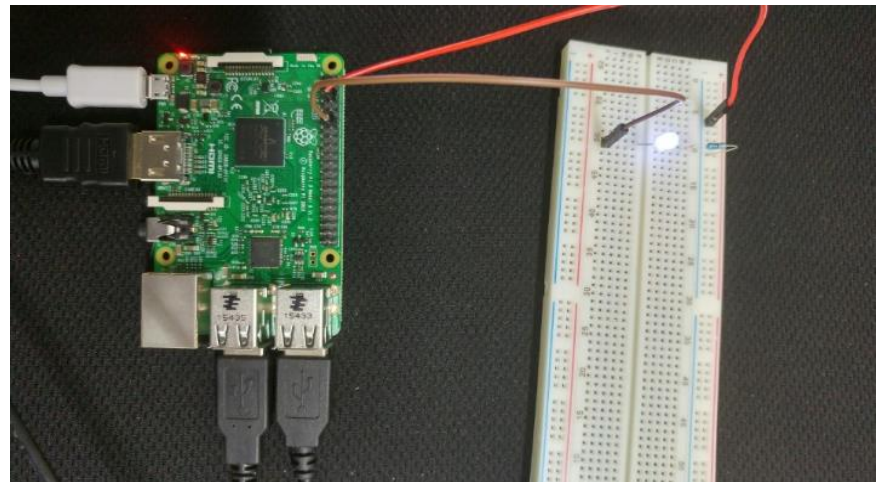
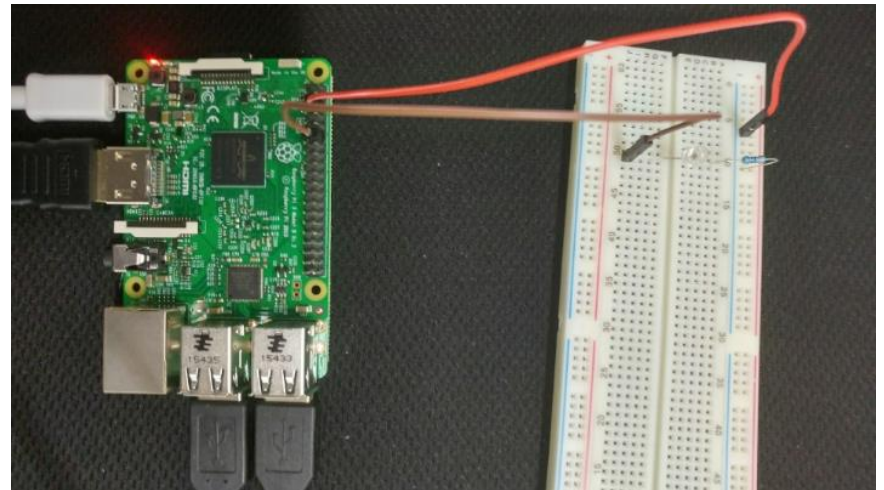
LED = 18

GPIO.setup(LED, GPIO.OUT)

try:
 while(True):
 GPIO.output(LED, GPIO.HIGH)
 time.sleep(1)
 GPIO.output(LED, GPIO.LOW)
 time.sleep(1)
except KeyboardInterrupt:
 GPIO.output(LED, GPIO.LOW)
 GPIO.cleanup()
```

## Run

- \$ sudo python filename.py





# GPIO

## ▶ LED 밝기 조절(using PWM)

```
import RPi.GPIO as GPIO
import time
```

```
LED = 18
GPIO.setmode(GPIO.BCM)
GPIO.setup(LED, GPIO.OUT)
```

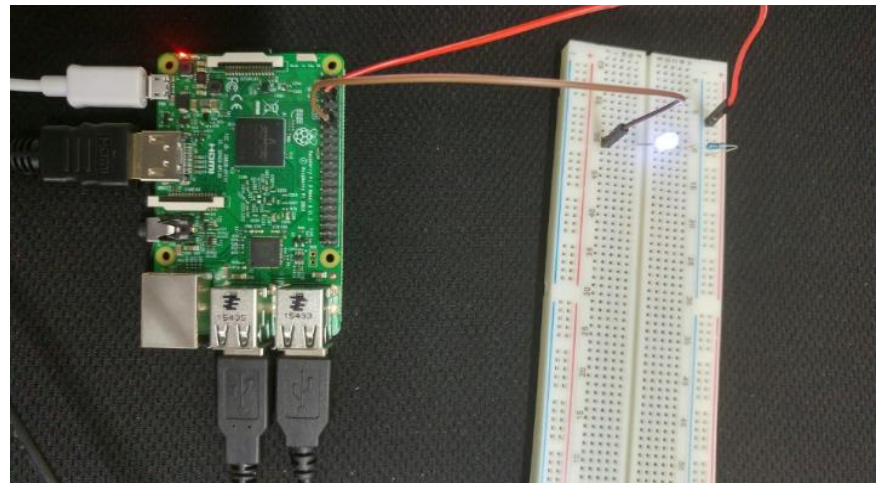
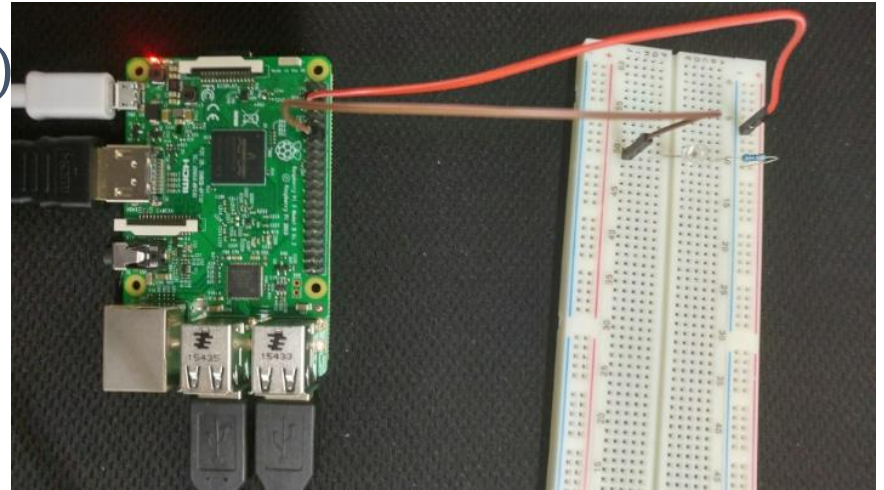
```
LED.start(0)
```

```
delay = 0.1
```

```
try:
 for i in range(0, 101):
 LED.ChangeDutyCycle(i)
 time.sleep(delay)

 for i in range(100, -1, -1):
 LED.ChangeDutyCycle(i)
 time.sleep(delay)
```

```
except KeyboardInterrupt:
 LED.stop()
 GPIO.cleanup()
```



## Run

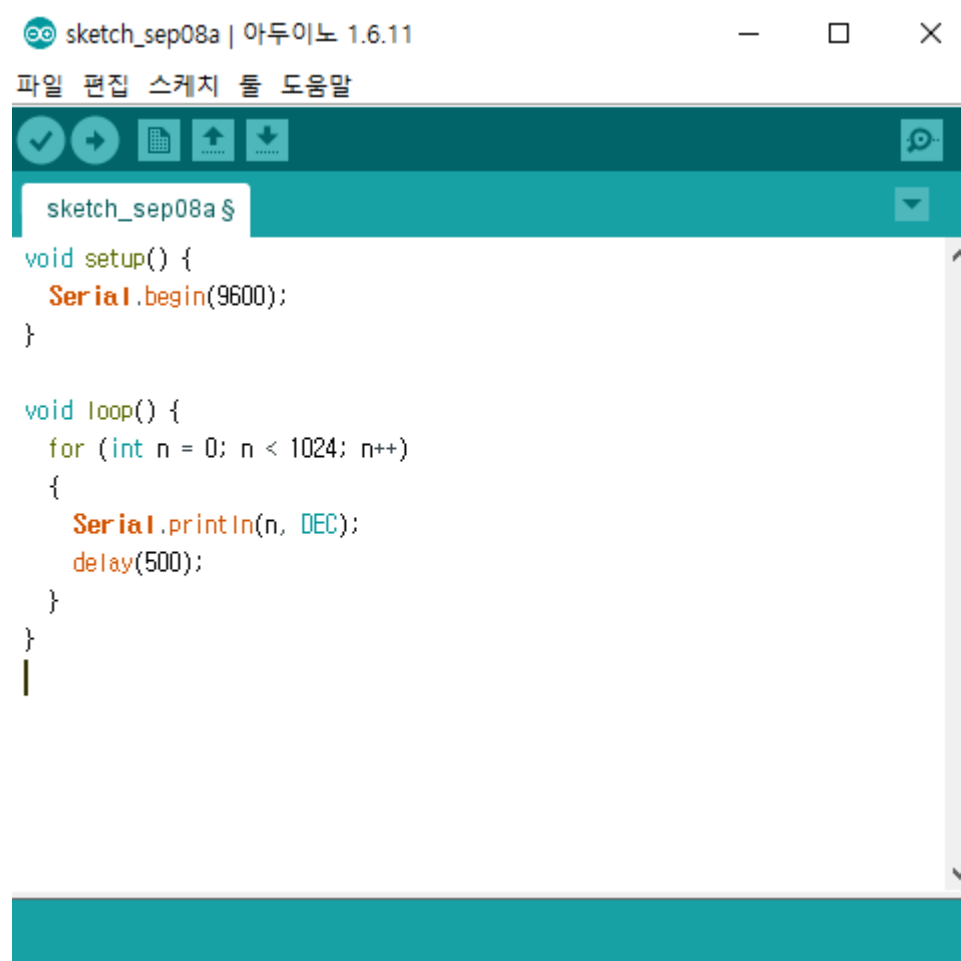
- \$ sudo python filename.py

# Arduino & Pi

- ▶ Arduino와 Raspberry Pi 시리얼 통신하기
- ▶ `$ sudo apt-get install Arduino`
  - Arduino IDE 설치
- ▶ 시리얼 통신으로 0~100까지 출력

# Arduino & Pi

## ▶ Arduino



The image shows the Arduino IDE interface. The title bar reads "sketch\_sep08a | 아두이노 1.6.11". Below the title bar is a menu bar with "파일", "편집", "스케치", "툴", and "도움말". A toolbar with icons for check, run, serial monitor, upload, and download is visible. The main text area contains the following C++ code:

```
sketch_sep08a $
void setup() {
 Serial.begin(9600);
}

void loop() {
 for (int n = 0; n < 1024; n++)
 {
 Serial.println(n, DEC);
 delay(500);
 }
}
```



# Arduino & Pi

## ► Raspberry Pi

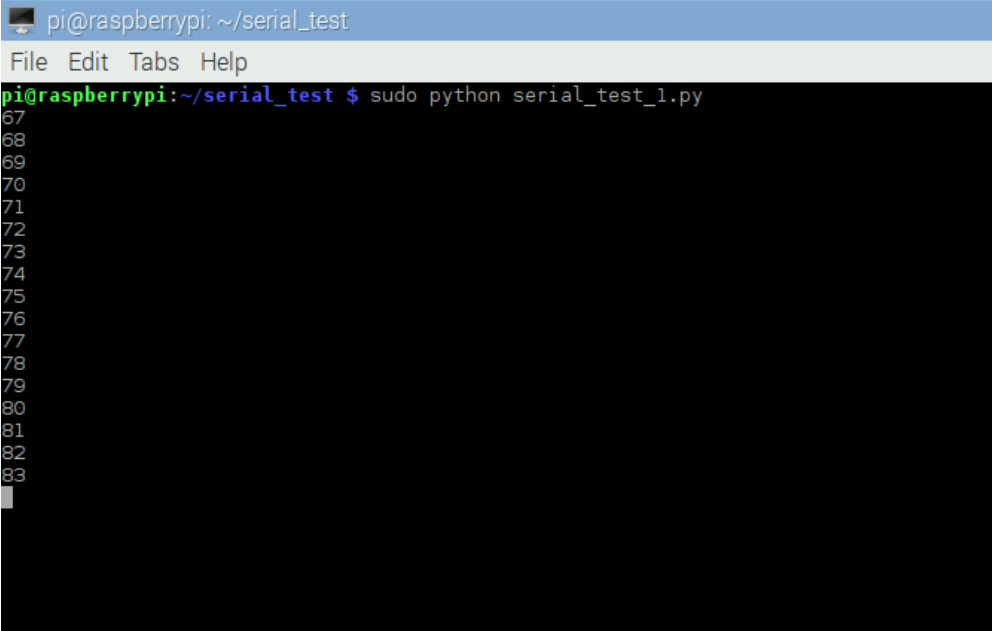
```
import serial

port="/dev/ttyACM0"

serialFromArduino = serial.Serial(port, 9600)

serialFromArduino.flushInput()

while True:
 input_s = serialFromArduino.readline()
 input = int(input_s)
 print(input*10)
```



The screenshot shows a terminal window titled 'pi@raspberrypi: ~/serial\_test'. The window has a menu bar with 'File', 'Edit', 'Tabs', and 'Help'. The command prompt shows the user has run 'sudo python serial\_test\_1.py'. The terminal output shows line numbers 67 through 83 on the left side, with a cursor at line 83.

## Run

- \$ sudo python filename.py

# Assignment

# Assignment

- ▶ 1. Example Program을 수행 후 보고서 작성
- ▶ 2.
  - 2개의 Arduino와 하나의 Raspberry Pi를 연결
  - 1번 Arduino에는 온도센서, 2번 Arduino에는 Servo motor, Raspberry Pi에는 LED 회로 구성.
  - 온도센서의 온도가 특정온도이상 올라갈 경우 Raspberry Pi의 LED가 켜지면서 2번 Arduino의 Servo motor가 움직이도록 하세요.
  - 온도센서의 Threshold는 임의로 정한 후 보고서에 명시하세요.
- ▶ 제출형식
  - <과제명>\_<학번1, 학번2>.pdf
  - 보고서에는 과제 수행 내용, 코드, 사진 및 동영상의 URL이 들어가야 합니다.

# Appendix

Raspberry Pi 3 Basic-kit & Premium-kit

# Basic-kit



# Basic-kit



- ▶ Raspberry Pi 3
- ▶ LAN cable
- ▶ SD card(16 GB)
- ▶ HDMI cable
- ▶ 2500mA 가정용 직류 전원 어댑터
- ▶ Micro SD(USB 2.0)
- ▶ Raspberry Pi 3 휴대용 케이스
- ▶ Heat sink(알루미늄 쿨러)
- ▶ 설명서
- ▶ Kit 케이스

SD Card는  
Raspberry Pi 또는  
Micro SD USB 2.0  
에 꽂아 사용할 수  
있습니다.

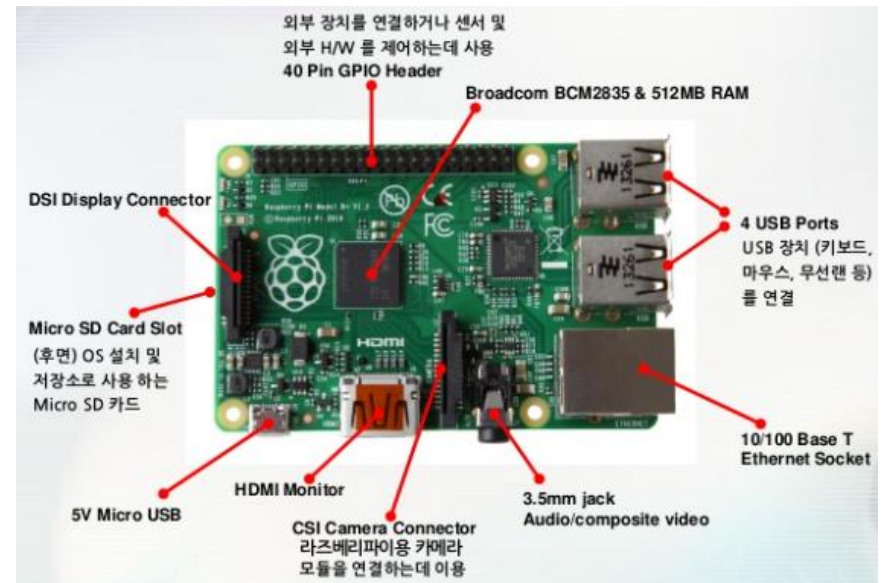
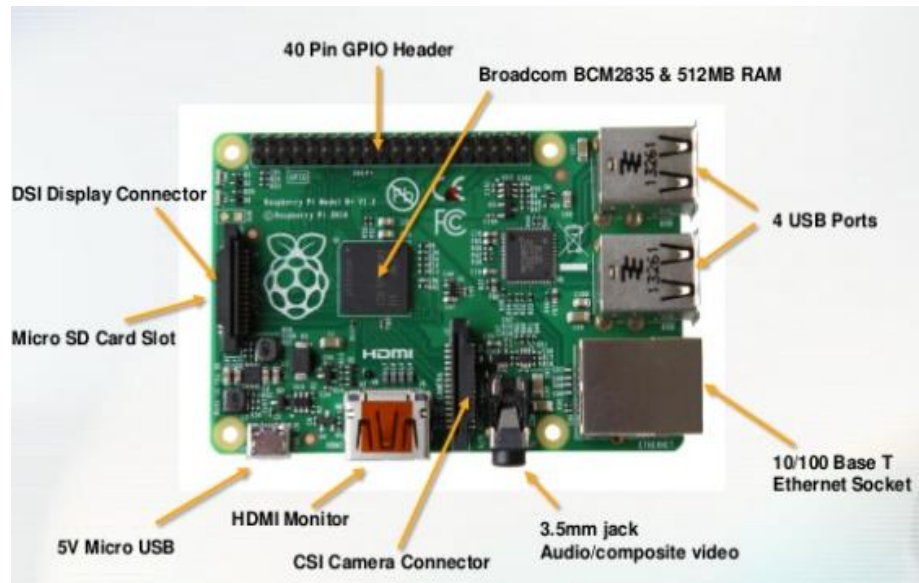
Raspberry Pi 3  
휴대용 케이스

Raspberry Pi 3

HDMI cable

어댑터

# Basic-kit



# Premium-kit

| 번호 | ▼ 품목                     | ▼ 개수 | ▼ |
|----|--------------------------|------|---|
| 1  | 1k 저항                    | 5    |   |
| 2  | 10k 저항                   | 5    |   |
| 3  | 220R 저항                  | 10   |   |
| 4  | LED 빨강                   | 5    |   |
| 5  | LED 노랑                   | 5    |   |
| 6  | LED 파랑                   | 5    |   |
| 7  | LM35 센서                  | 1    |   |
| 8  | 불꽃센서                     | 1    |   |
| 9  | 조도센서                     | 2    |   |
| 10 | IR 센서 수광부                | 1    |   |
| 11 | 부저                       | 2    |   |
| 12 | RFID 키 체인                | 1    |   |
| 13 | NFC 카드 리더 모듈             | 1    |   |
| 14 | 16버튼 터치 스위치 모듈           | 1    |   |
| 15 | SR04 초음파센서 모듈            | 1    |   |
| 16 | 라즈베리 파이 LED 매트릭스 모듈      | 1    |   |
| 17 | 라즈베리 파이 GPIO 확장 보드 (V3)  | 1    |   |
| 18 | 가변저항 50K                 | 1    |   |
| 19 | dhseh alc 습도 DHT11 모듈    | 1    |   |
| 20 | ADCL345 센서모듈             | 1    |   |
| 21 | 10mm RGB LED 모듈          | 1    |   |
| 22 | 0.96인치 OLED LCD 모듈       | 1    |   |
| 23 | 점퍼와이어(30 in 1)           | 1    |   |
| 24 | GPIO 40P 무지개 케이블         | 1    |   |
| 25 | 테스트점퍼소켓 케이블 M/F(20 in 1) | 1    |   |
| 26 | 브레드보드                    | 1    |   |
| 27 | 노랑 버튼 택트스위치              | 4    |   |
| 28 | ULN2003 스테퍼 보터 드라이버 모듈   | 1    |   |
| 29 | 5V 릴레이 모듈                | 1    |   |
| 30 | 수위 센서 모듈                 | 1    |   |
| 31 | 9g 서보                    | 1    |   |
| 32 | PCF8591 모듈               | 1    |   |
| 33 | 7 세그먼트                   | 1    |   |
| 34 | 7 세그먼트 (4단)              | 1    |   |
| 35 | 74HC595 IC               | 1    |   |
| 36 | 로터리 엔코더                  | 1    |   |
| 37 | DS3231 RTC 모듈            | 1    |   |
| 38 | 5V 스테핑모터                 | 1    |   |
| 39 | PS2 조이스틱 모듈              | 1    |   |
| 40 | MQ-5 가스 센서 모듈            | 1    |   |
| 41 | KEYES-345                | 1    |   |
| 42 | HC-05                    | 1    |   |
| 43 | Fan Motor                | 1    |   |
| 44 | YL-40                    | 1    |   |



# Premium-kit



MQ-5 가스 센서 모듈



5V 소형 DC모터



5V 스텝핑모터



PS2 조이스틱 모듈



Fan Motor



1,10K x 5 / 220R 저항 x8



LED 빨강, 파랑, 노랑 x5



NFC 카드 리더 모듈



SR04 초음파센서 모듈



0.96인치 OLED LCD모듈



점퍼와이어 (30in)



5V 릴레이 모듈



수위 센서 모듈



LM35 센서



불꽃센서



16버튼 터치 스위치 모듈



라즈베리 파이 GPIO 확장 보드 (V3)



GPIO 40P 무지개 케이블



테스트점퍼소켓 케이블  
M/F (20in)



9g 서보



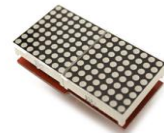
7세그먼트



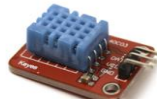
조도센서 x3



IR센서 수광부



라즈베리 파이 LED 매트릭스 모듈



온도 및 습도 DHT11 모듈



브레드보드



리모컨



PCF8591 모듈



74HC595 IC



부저 x2



RFID 키 체인



가변저항 50K



10mm RGB LED 모듈



노랑 버튼 매트릭스위치 x4



ULN2003 스텝퍼 모터  
드라이버 모듈



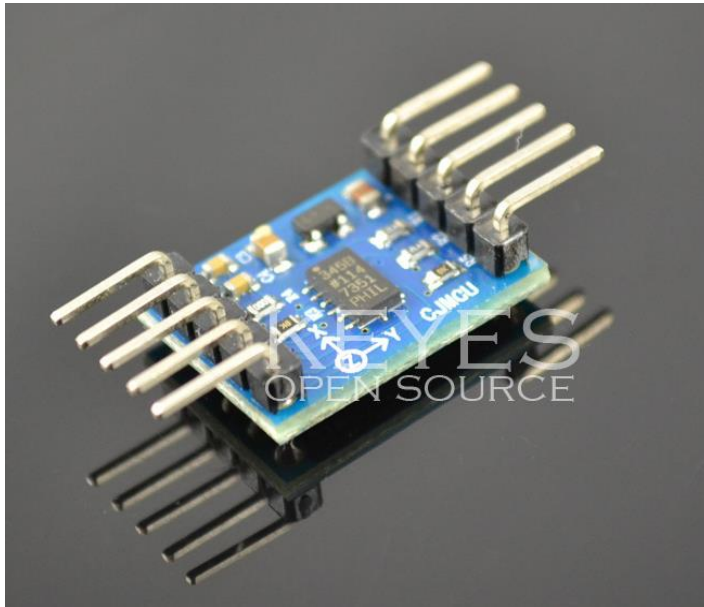
7세그먼트 (4단)



DS3231 RTC 모듈

# Premium-kit

## ► KEYES-345: Digital 3-Axis Gravity Acceleration Sensor Module



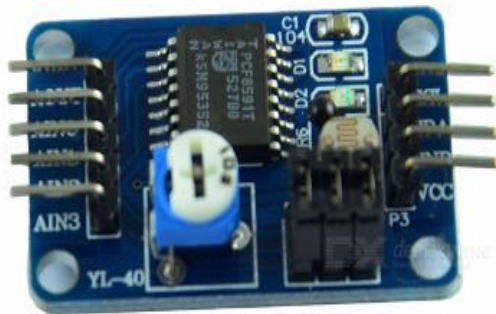
### Specifications

ADXL345 Digital 3-Axis Gravity Acceleration Sensor Module

- Material: Circuit board
- Power supply: 3~5V
- Resolution: 13bit, 4 mg / LSB
- Measurement range: +/- 16g
- Communication type: SPI / IIC
- The digital output data is 16-bit two's complement format
- ADXL345 is low power consumption and a 3-axis accelerometer
- Suitable for portable device application.
- Great for microcontroller's experiment
- Capable of measuring less than 1 degree inclination angle change
- With freefall detection function
- Activity and non-activity detection function, and detects if arbitrary axis acceleration exceeds a user-set limits
- Packing list:
- 1 x Sensor module

# Premium-kit

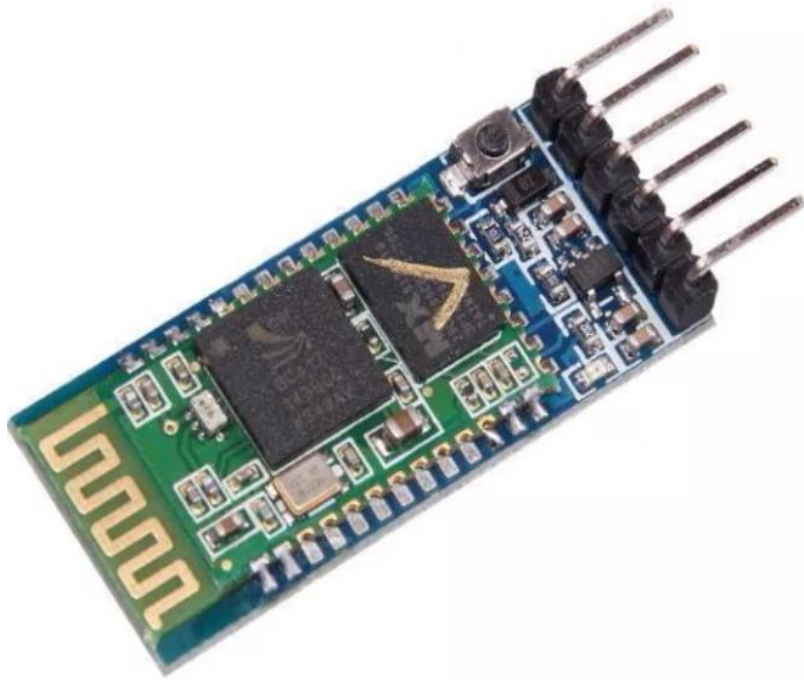
## ► YL-40: 8-bit A/D D/A Converter Module



- Model: PCF8591
- Color: Blue + black
- Material: PCB + metal
- The PCF8591 is a single-chip, single-supply low power 8-bit CMOS data acquisition device with four analog inputs, one analog output and a serial I2C-bus interface
- Three address pins A0, A1 and A2 are used for programming the hardware address, allowing the use of up to eight devices connected to the I2C-bus without additional hardware
- Address, control and data to and from the device are transferred serially via the two-line bidirectional I2C-bus
- Single power supply
- Operating supply voltage 2.5 V to 6 V
- Low standby current
- Serial input/output via I2C-bus
- Address by 3 hardware address pins
- Sampling rate given by I2C-bus speed
- 4 analog inputs programmable as single-ended or differential inputs
- Auto-incremented channel selection
- Analog voltage range from VSS to VDD
- On-chip track and hold circuit
- 8-bit successive approximation A/D conversion
- Multiplying DAC with one analog output
- Applications:
  - Closed loop control systems
  - Low power converter for remote data acquisition
  - Battery operated equipment
  - Acquisition of analog values in automotive, audio and TV applications
- Packing list:
  - 1 x A/D D/A converter module
  - 4 x Dupont cables (21cm)

# Premium-kit

## ▶ HC-05: Bluetooth 2.0/2.1 Module



### HC-05 Specifications

- **2.45Ghz Frequency**
- Asynchronous **Speed** 2.1Mbps (max) .160Kbps
- **Security:** Authentication
- **Profile:** Bluetooth Serial Port
- **Power Supply:** +3.3 VDC
- **Working Temperature:** >20C
- **Cost :** Around INR 300