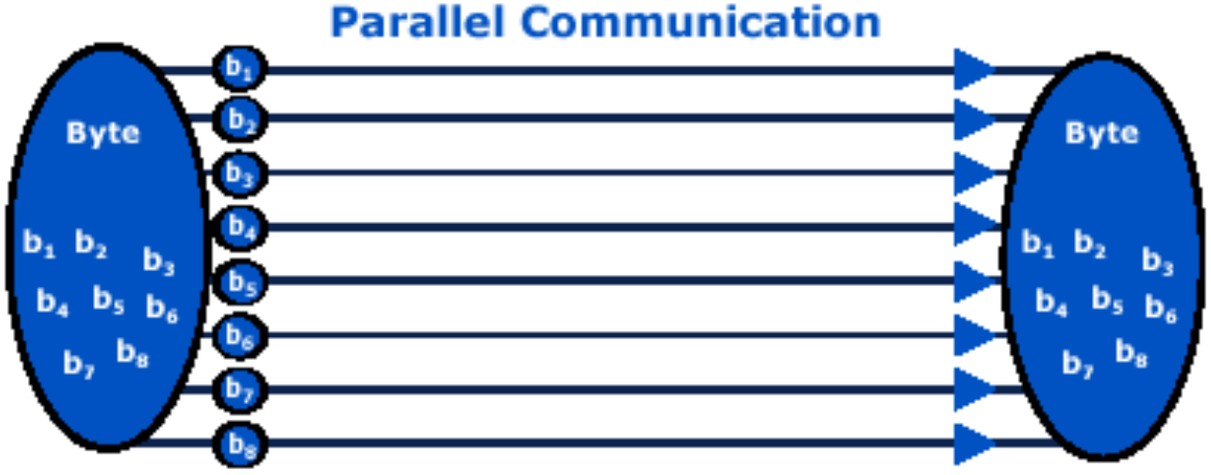
Serial 통신

Lesson 04

Serial vs. Parallel 통신

단일 와이어를 통해 한 비트씩 전송



병렬 와이어를 통해

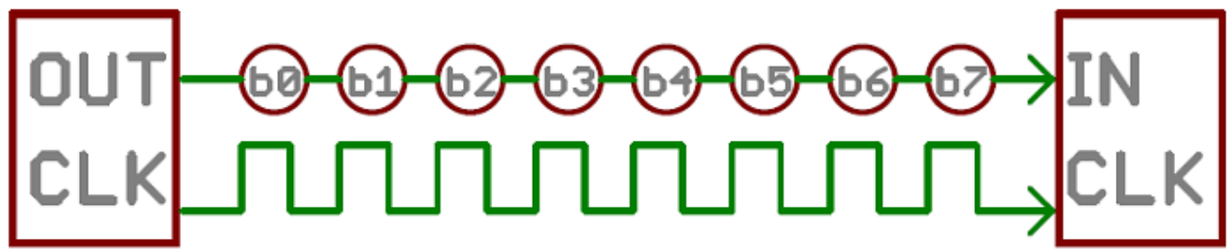
동시에 1바이트 혹은 그 이상을 전송

다양한 직렬통신 표준

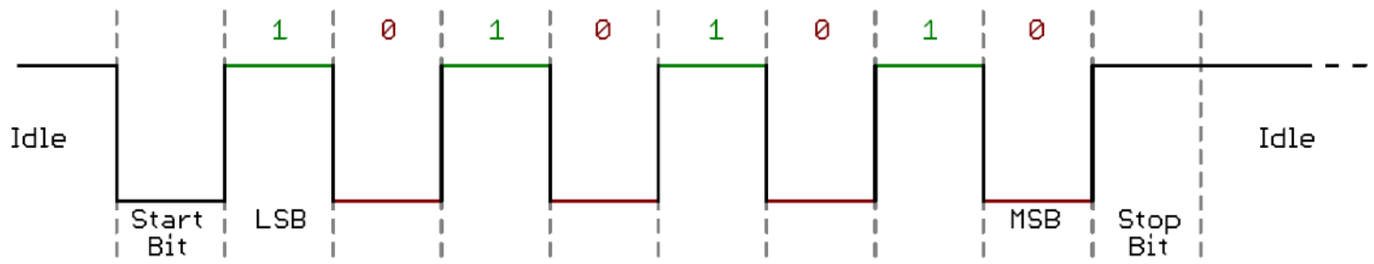
- **RS-232, TTL-serial (using UART)** ← 그냥 serial 통신이라고 부르는 경우 보통 이걸 의미하는 경우가 많음
- **I^2C Bus**
- **Serial Peripheral Interface (SPI)**
- **System Management Bus (SMBus)**
- **Universal Serial Bus (USB)**
- **Serial ATA (SATA)**
- **Ethernet**
- **FireWire**

Synchronous vs. Asynchronous

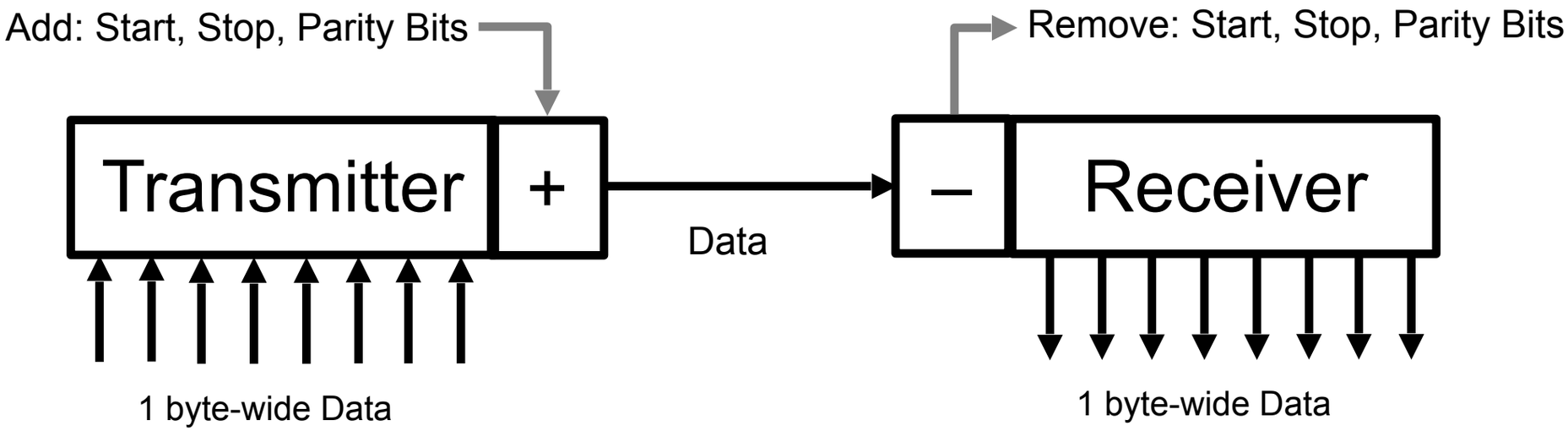
- **Synchronous serial communication**
  - 데이터 전송을 위한 선 외에 송신자/수신자간의 동기를 위해 별도의 클럭 신호 사용
  - SPI, I2C, USB



- **Asynchronous serial communication**
  - 별도의 클럭 신호 없이 데이터를 전송
  - 시작비트(start bit)와 정지비트(stop bit)를 사용, 송수신자간의 baud rate를 일치
  - RS232/TTL-serial using UART



Asynchronous Serial Communication



The Transmitter

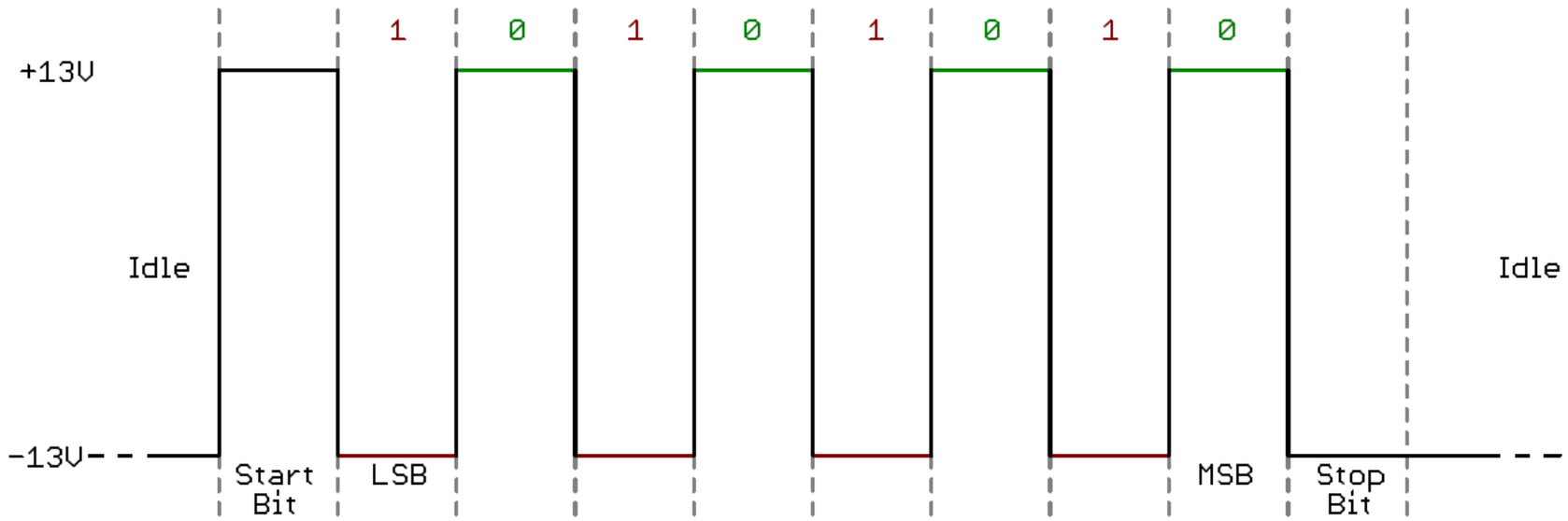
- Shifts the parallel data onto the serial line using its own clock
- Also adds the start, stop and parity check bits

The Receiver

- Extracts the data using its own clock
- Converts the serial data back to the parallel form after stripping off the start, stop and parity bits

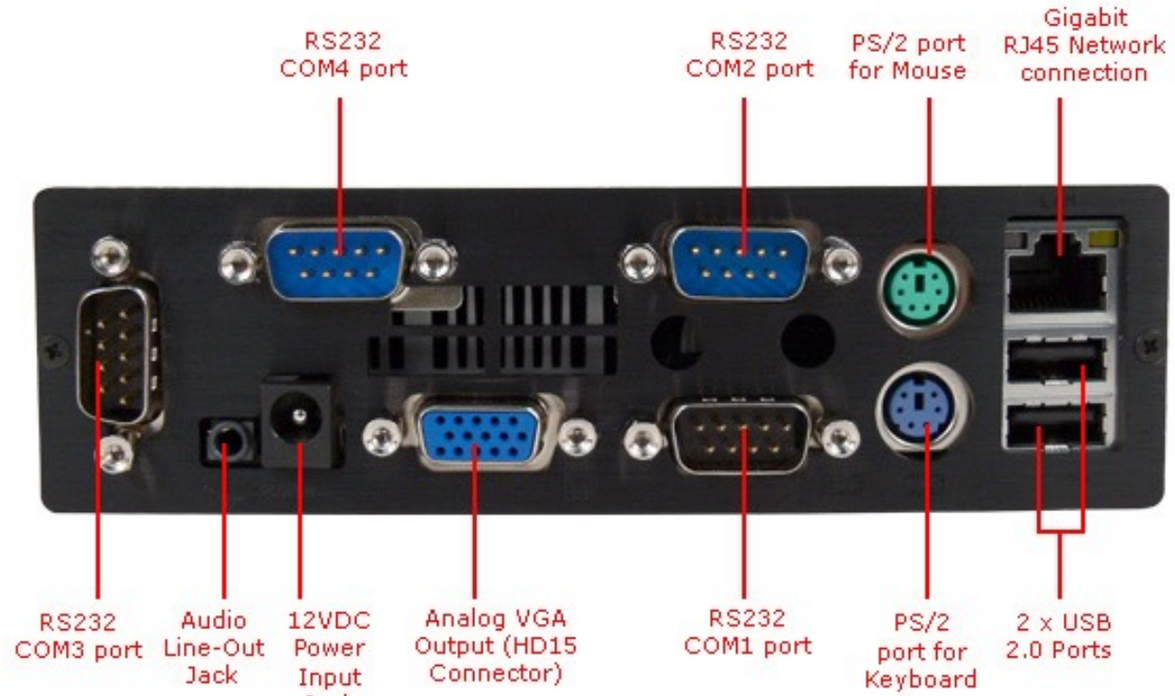
RS232

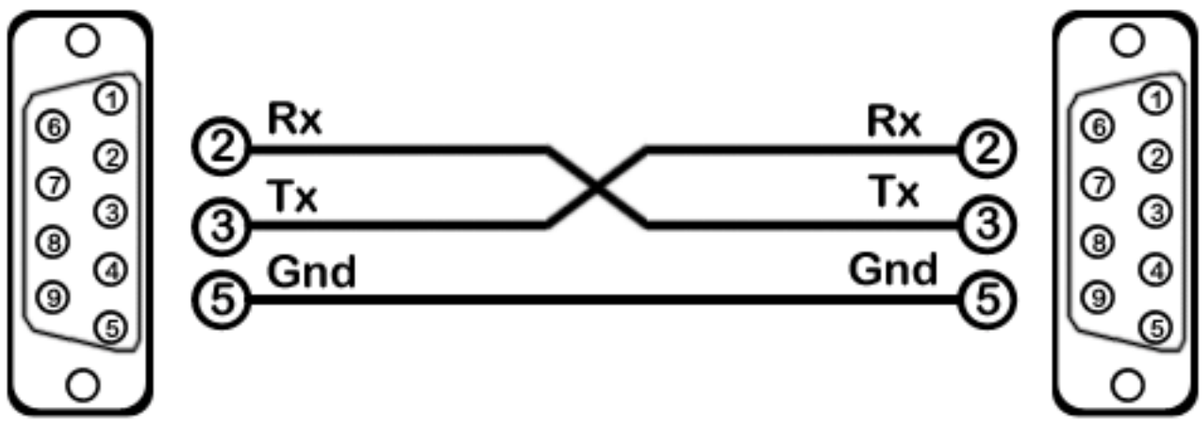
- **1960년에 EIA에 의해서 지정된 표준**
- **신호특성(signal characteristics)을 정의하는 표준**



- **Dial-up modems, Bar code scanner, Point of sale devices, 프린터, 다양한 계측기 등 다양한 기기에서 사용됨**
- **USB로 대체되는 추세**

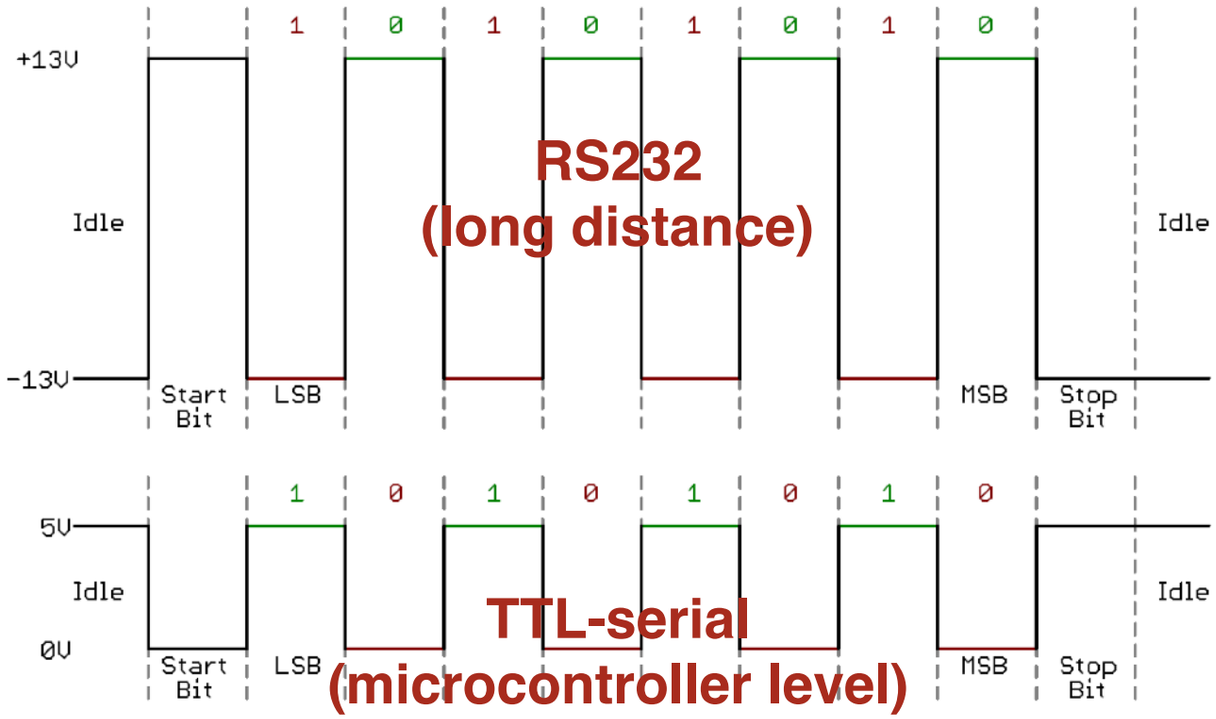
RS232 Port and Connector

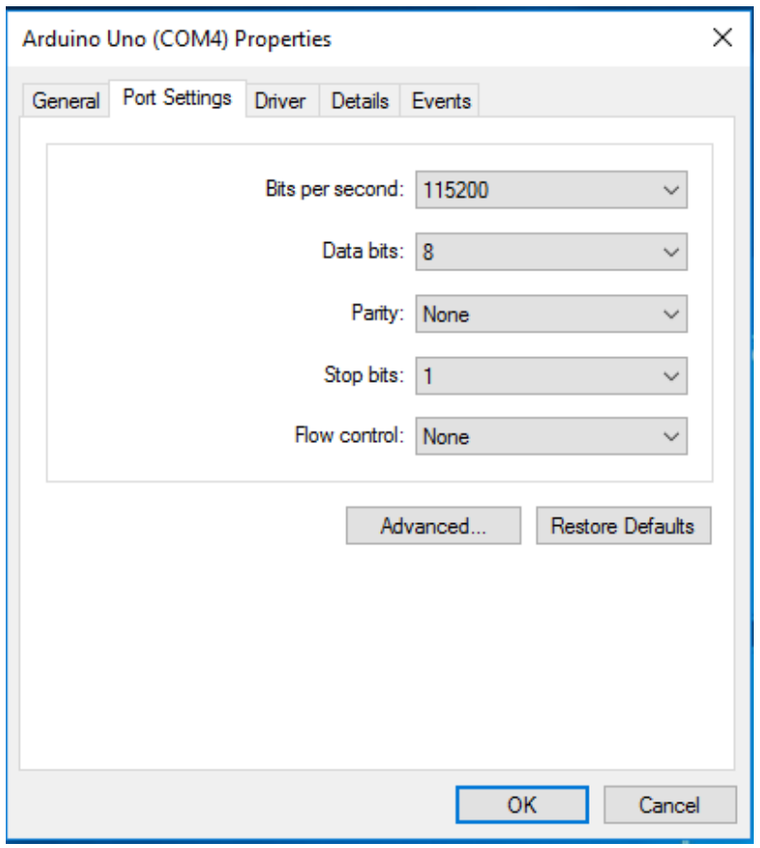




RS232 vs. TTL-Serial

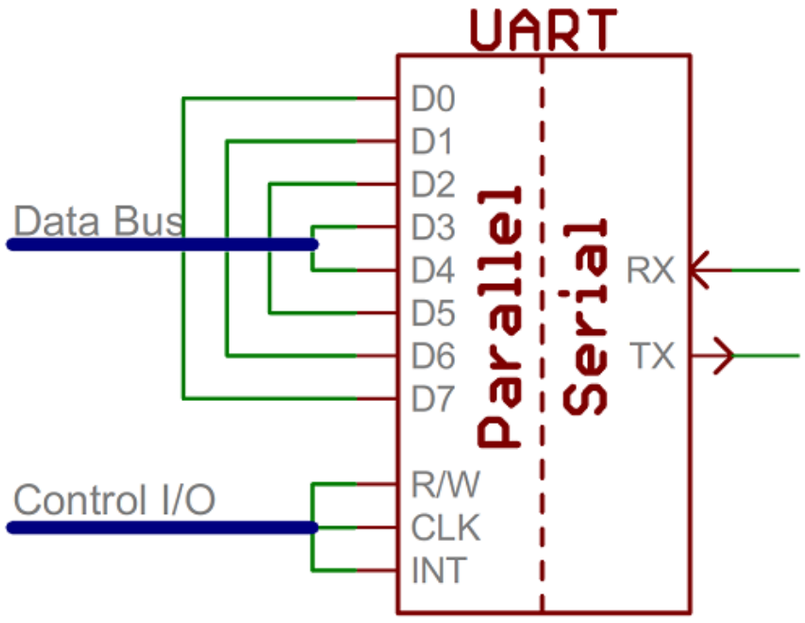
- **RS232는 마이크로컨트롤러의 TTL Logic과 호환되지 않는 전압 레벨을 사용**
- **마이크로컨트롤러와 주변 디바이스들 간의 통신은 주로 TTL-serial임**
- **마이크로컨트롤러에서 RS232 통신을 위해서는 MAX232나 MAX233과 같은 컨버터가 필요함 (line driver라고 불림)**

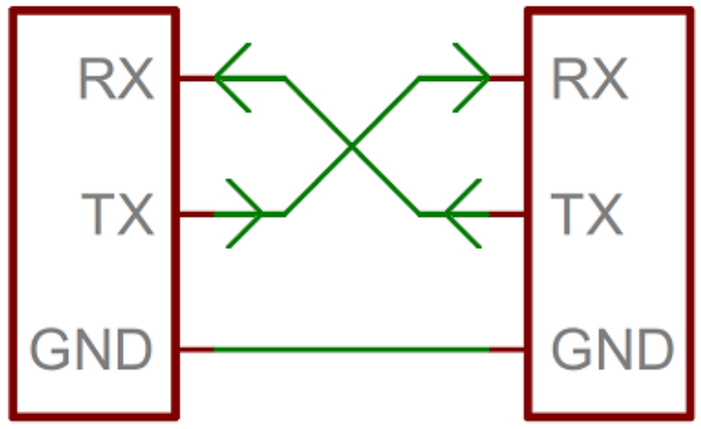




UARTs

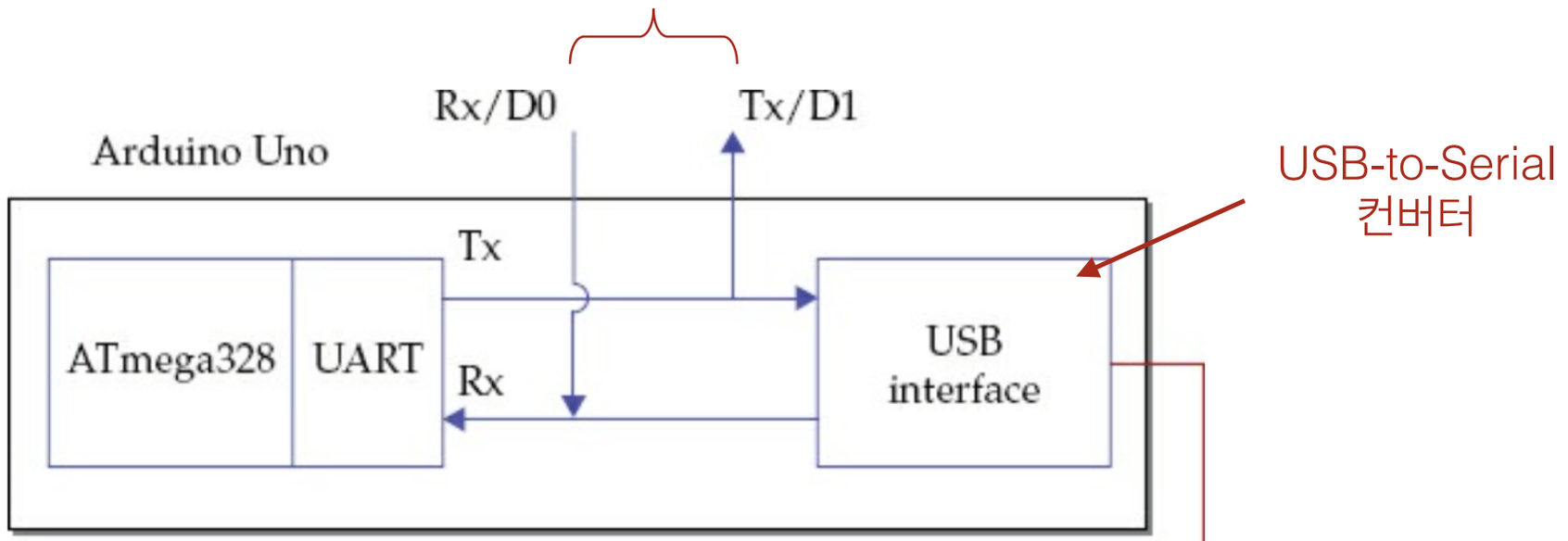
- **Universal Asynchronous Receiver/Transmitter**
- **RS232, TTL-serial등 비동기 직렬통신 인터페이스를 구현하는 디바이스**

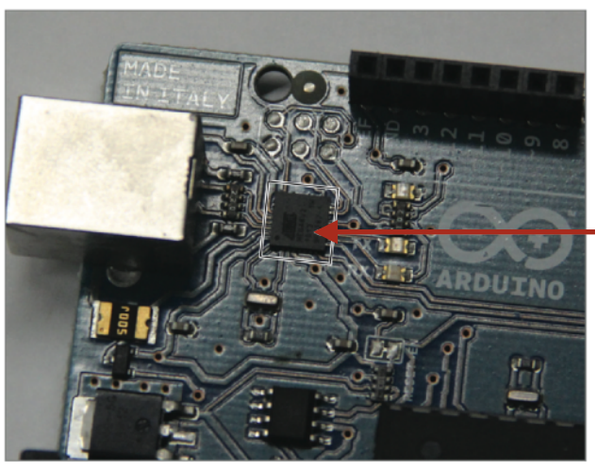




Arduino의 경우

UART의 Tx, Rx는 USB 인터페이스와 0번과 1번 핀에 동시에 연결되어 있음
이 핀들에 MAX232 등을 연결하여 RS232 디바이스와 통신이 가능함





Atmel 8U2 or 16U2
USB-to-Serial
converter

PC와 Arduino간의 Serial 통신

Arduino의 Serial API

available()	**parseFloat()**	**println()**
begin()	**parseInt()**	**write()**
end()	**peek()**	**read()**
find()	**setTimeout()**	**readBytes()**
findUntil()	**serialEvent()**	**readBytesUntil()**
flush()	**print()**	

Serial Terminals

- **Hyperterminal in Windows XP**
- **Arduino serial monotor**
- **Putty in Linux**
- **Tera Term, Real-Term, YAT 등 다양한 프로그램들이 있음**
  - https://learn.sparkfun.com/tutorials/terminal-basics

Java

- **Sun이 JavaComm이라는 serial communication API를 정의하였으나 Java 표준으로 구현되어 있지는 않음**
- **Third party 라이브러리**
  - RxTx: Java 8 미지원
  - jSSC (Java Simple Serial Connector)
    - http://code.google.com/p/java-simple-serial-connector/
  - jSerialComm
    - http://fazecast.github.io/jSerialComm/

jSerialComm

```
import com.fazecast.jSerialComm.*;

public class SerialTest {
    public static void main(String[] args) {
        SerialPort[] ports = SerialPort.getCommPorts();
        System.out.println("Select a port:");
        int i = 1;
        for(SerialPort port : ports)
            System.out.println(i++ +  ": " + port.getSystemPortName());
        Scanner s = new Scanner(System.in);
        int chosenPort = s.nextInt();

        SerialPort serialPort = ports[chosenPort - 1];
        if(serialPort.openPort())
            System.out.println("Port opened successfully.");
        else {
            System.out.println("Unable to open the port.");
            return;
        }
        serialPort.setComPortParameters(9600, 8, 1, SerialPort.NO_PARITY);
        serialPort.setComPortTimeouts(SerialPort.TIMEOUT_READ_SEMI_BLOCKING, 100, 0);
       try {
            while (true)   {
               byte[] readBuffer = new byte[1024];
               int numRead = serialPort.readBytes(readBuffer, readBuffer.length);
               System.out.println("Read " + numRead + " bytes.");
            }
       } catch (Exception e) { e.printStackTrace(); }
       serialPort.closePort();
    }
}
```

jSSC

```
import jssc.SerialPort;
import jssc.SerialPortException;

public class JSSCTest {
    public static void main(String[] args) {
        SerialPort serialPort = new SerialPort("com11");
        try {
            System.out.println("Port opened: " + serialPort.openPort());
            System.out.println("Params setted: " + serialPort.setParams(9600, 8, 1, 0));
            System.out.println("\"Hello World!!!\" successfully writen to port: " +
            serialPort.writeBytes("Hello World!!!".getBytes()));
            byte[] buffer = serialPort.readBytes(10);//Read 10 bytes from serial port
            for (byte b : buffer)
                System.out.print(b+" ");
            System.out.println("\nPort closed: " + serialPort.closePort());
        }
        catch (SerialPortException ex){
            System.out.println(ex);
        }
    }
}
```

Python

```
import serial #Import Serial Library
from visual import * #Import all the vPython library

#Create an object for the Serial port.
#Adjust 'com11' to whatever port your arduino is sending to.
arduinoSerialData = serial.Serial('com11', 9600)
measuringRod = cylinder( radius= .1, length=6, color=color.yellow, pos=(-3,-2,0))
lengthLabel = label(pos=(0,5,0), text='Target Distance is: ', box=false, height=30)
target=box(pos=(0,-.5,0), length=.2, width=3, height=3, color=color.green)
while (1==1):
    rate(20) #Tell vpython to run this loop 20 times a second
    if (arduinoSerialData.inWaiting()>0):
        myData = arduinoSerialData.readline()
        print myData
        distance = float(myData)
        measuringRod.length=distance
        target.pos=(-3+distance,-.5,0)
        myLabel= 'Target Distance is: ' + myData
        lengthLabel.text = myLabel
```

실습과제

- **Python VR 라이브러리를 이용하여 흥미로운 응용을 만들어본다.**
- **참고:**
  - http://www.toptechboy.com/using-python-with-arduino-lessons/ (Lesson3 까지)

Arduino’s Software Serial Library

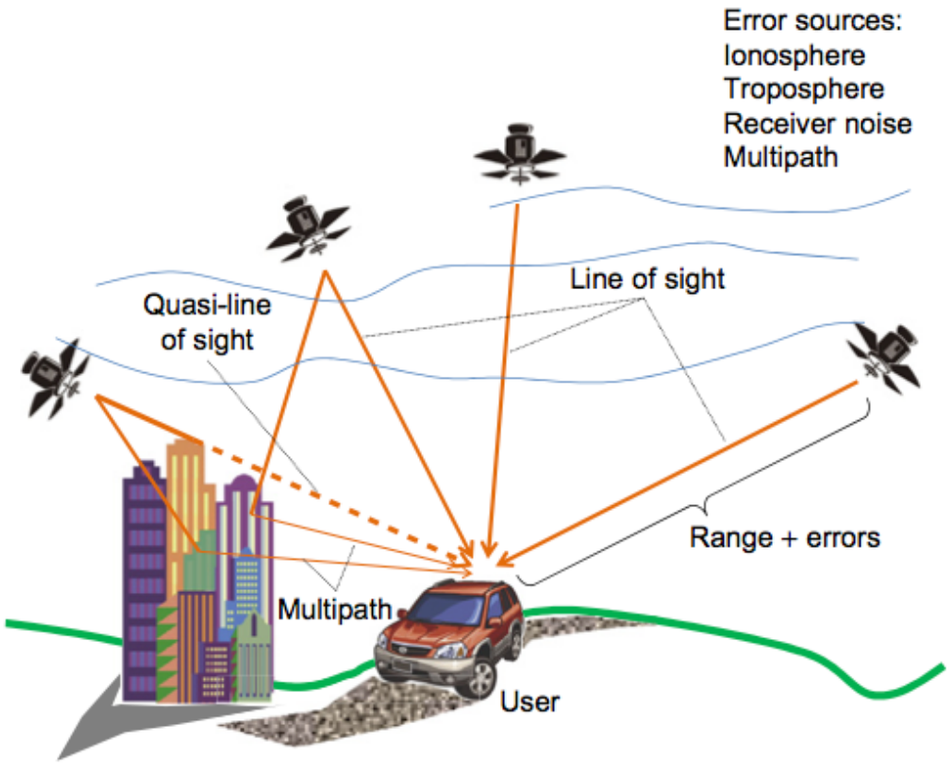
SoftwareSerial Library

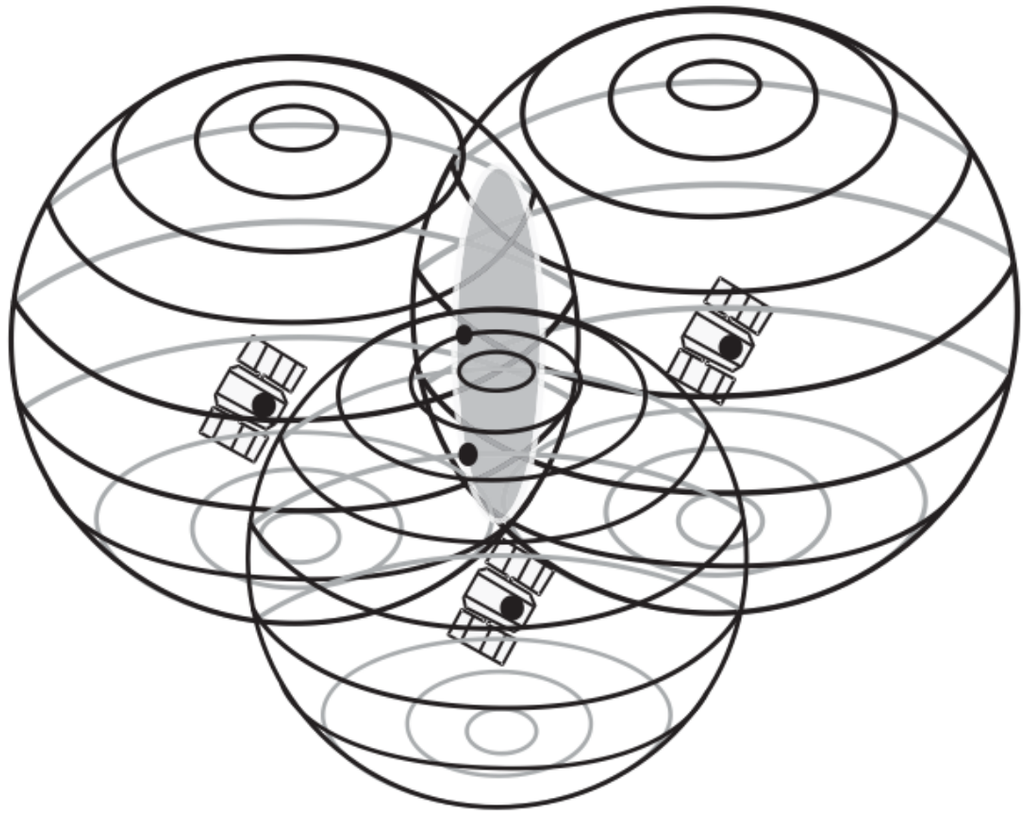
- **Arduino의 built-in UART는 0번과 1번 핀, 그리고 USB와 연결됨**
- **SoftwareSerial library는 다른 핀들을 이용해 serial 통신을 할 수 있도록 UART의 기능을 소프트웨어로 구현한 라이브러리**
- **SoftwareSerial 라이브러리를 이용하면 Arduino를 2개 이상의 serial device와 연결 가능**

SoftwareSerial Library

SoftwareSerial()	overflow()	println()
available()	peek()	listen()
begin()	read()	write()
isListening()	print()	

Example: GPS


Error sources:
Ionosphere
Troposphere
Receiver noise
Multipath
Line of sight
Quasi-line
of sight
Range + errors
Multipath
User



$$\sqrt{(x_i - x)^2 + (y_i - y)^2 + (z_i - z)^2} + b = \rho_i$$

(x_i, y_i, z_i) : position of satellite i

(x, y, z) : position of the receiver

$\rho_i = c(T_i - t_i)$: pseudorange

t_i : the time of signal transmission

T_i : the time of signal reception

c : speed of light

$b = c\Delta t$: receiver clock error

4 unknowns, therefore, at least 4 satellite

- 미국의 **The National Marine Electronics Association**에서 정의된 시간, 위치, 방위 등의 정보를 전송하기위한 규격

```
$ELEXTECH, Inc G1800s
$HW Version 1.6
$SW Version 231.000.100
$Startup 4
$TOW: 0
$WK: 1192
$POS: 6378137 0 0
$Baud rate: 9600 System clock: 24.553MHz
$GPGGA,114455.532,3735.0079,N,12701.6446,E,1,03,7.9,48.8,M,19.6,M,0.0,0000*48
$GPGSA,A,2,19,25,15,,,,,,,,,21.5,7.9,20.0*32
$GPGSV,3,1,10,03,86,244,00,19,51,218,38,16,51,057,00,07,40,048,00*77
$GPGSV,3,2,10,13,34,279,00,23,33,236,00,15,29,076,40,25,25,143,38*71
$GPGSV,3,3,10,21,18,051,,27,12,315,*77
$GPRMC,114455.532,A,3735.0079,N,12701.6446,E,0.000000,121.61,110706,,*0A
```

GPGGA

- **Global Positioning System Fix Data라고 한다. 시간, 위도, 경도, 고도 등의 정보를 포함**

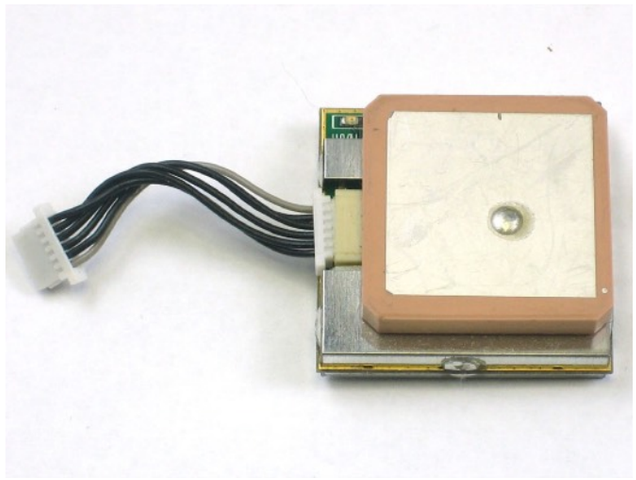
3735.0079는 위도로서 37도 35.0079분을 뜻한다. 도(degree) 단위로 환산시, 대략 37.5도가 된다. N은 북위를 의미한다.

*$GPGGA,114455.532,3735.0079,N,12701.6446,E,1,03,7.9,48.8,M,19.6,M,0.0,0000*48*

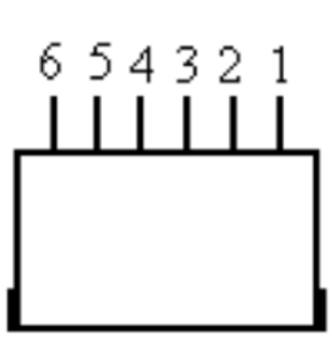
114455.532는 시간으로서 그리니치 표준시 기준으로 11시 44분 55.532초를 뜻한다

12701.6446은 경도로서 127도 1.6446분을 뜻한다. 도(degree) 단위로 환산시, 대략 127.도가 된다. E는 동경을 뜻한다.

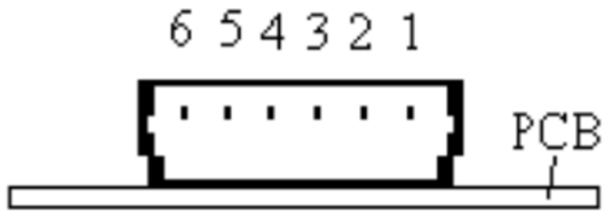
EM-406A



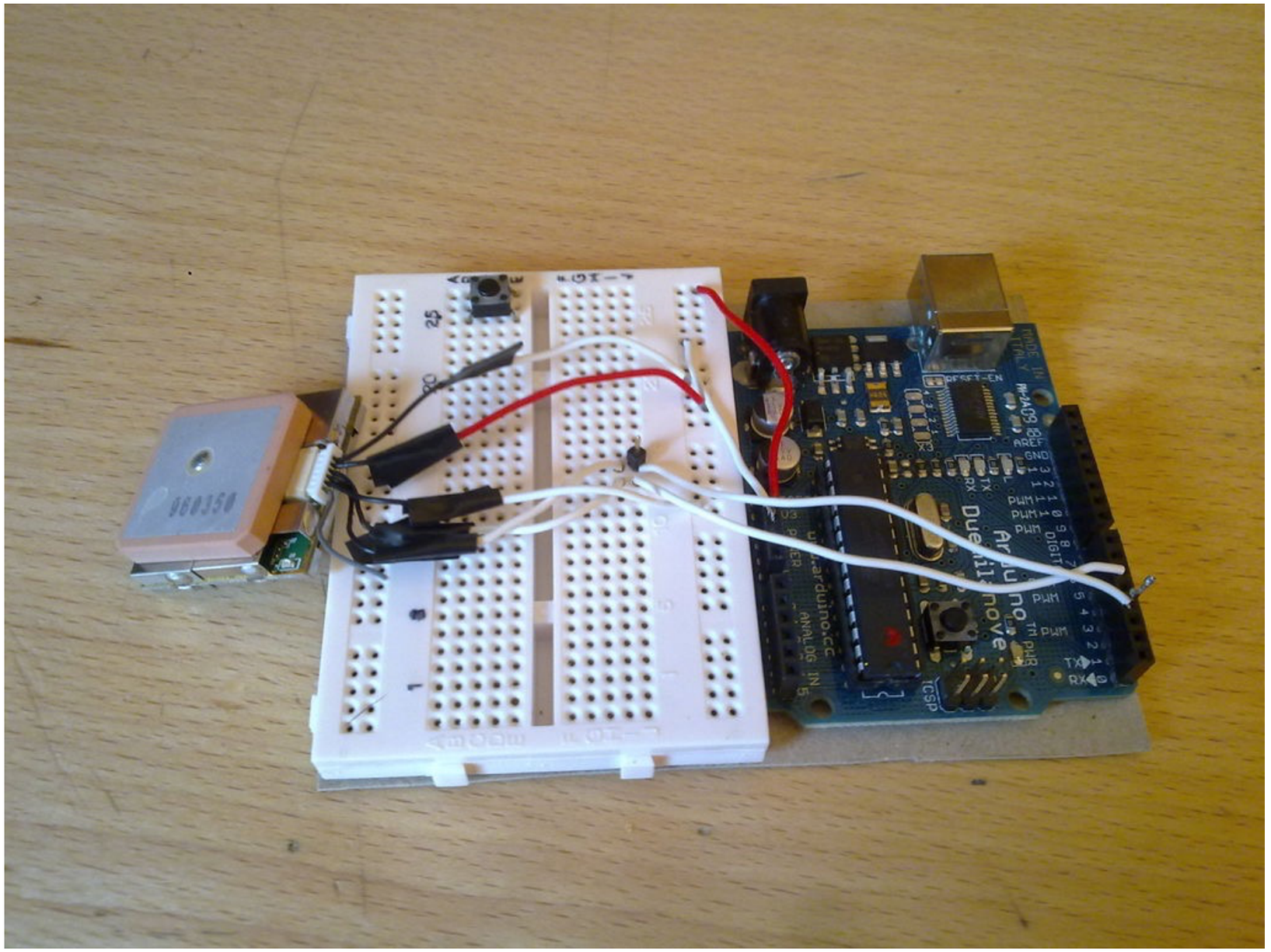
GPS Receiver	
Chipset	SiRF Star III/LP Single
Frequency	L1, 1575.42 MHz
Code	1.023 MHz chip rate
Protocol	Electrical Level: TTL level, Output Voltage Level: 0V~2.85V Baud Rate: 4800 bps Output Message: NMEA 0183 GGA, GSA, GSV, RMC (VTG, GLL optional)
Channels	20



1 : GND
2 : VIN
3 : RX
4 : TX
5 : GND
6 : 1PPS



연결


ARDUINO.CC
ANALOG IN
Arduino
Due
RESET-EN
AREF
GND
PWM
TX
RX
TGSP

Sketch

```
#include <SoftwareSerial.h>

#define rxGPS 3
#define txGPS 5
SoftwareSerial serialGPS = SoftwareSerial(rxGPS, txGPS);
String stringGPS = "";

void setup() {
  pinMode(rxGPS, INPUT);
  pinMode(txGPS, OUTPUT);

  Serial.begin(9600);
  Serial.println("Started");

  serialGPS.begin(4800);
  digitalWrite(txGPS,HIGH);

  // Cut first gibberish
  while(serialGPS.available())
    if (serialGPS.read() == '\r')
      break;
}
```

Sketch (계속)

```
void loop()
{
  String s = checkGPS();
  //if(s && s.substring(0, 6) == "$GPGGA")
  if(s && s.length()>0)
  {
    Serial.println(s);
  }
}

String checkGPS()
{
  if (serialGPS.available())
  {
    char c = serialGPS.read();
    if (c != '\n' && c != '\r')
    {
      stringGPS  += c;
    }
    else
    {
      if (stringGPS != "")
      {
        String tmp = stringGPS;
        stringGPS = "";
        return tmp;
      }
    }
  }
  return "";
}
```

Google Static Map

```
import urllib
import cStringIO
from PIL import Image

def get_static_google_map(filename_wo_extension, center=None, zoom=None, imgsize="500x500", imgformat="jpeg",
                          maptype="roadmap", markers=None ):

    request =  "http://maps.google.com/maps/api/staticmap?" # base URL, append query params, separated by &

    if center != None:
        request += "center=%s&" % center
    if center != None:
        request += "zoom=%i&" % zoom  # zoom 0 (all of the world scale ) to 22 (single buildings scale)
    request += "size=%ix%i&" % (imgsize)  # tuple of ints, up to 640 by 640
    request += "format=%s&" % imgformat
    request += "maptype=%s&" % maptype  # roadmap, satellite, hybrid, terrain

    # add markers (location and style)
    if markers != None:
        for marker in markers:
                request += "%s&" % marker

    request += "sensor=false&"   # must be given, deals with getting loction from mobile device

    urllib.urlretrieve(request, filename_wo_extension+"."+imgformat) # Option 1: save image directly to disk

    # Option 2: read into PIL
    web_sock = urllib.urlopen(request)
    imgdata = cStringIO.StringIO(web_sock.read()) # constructs a StringIO holding the image
    try:
        PIL_img = Image.open(imgdata)
    except IOError:
        print ("IOError:", imgdata.read()) # print error (or it may return a image showing the error"
    else:
        PIL_img.show()

if __name__ == '__main__':
    get_static_google_map("google_map_example1", center="35.134764, 129.103390", zoom=18, imgsize=(640,640),
imgformat="png", maptype="hybrid")
```