

스마트시스템입문

2018년 1학기

프로젝트 조편성

- “조편성 결과” 게시판 사용

강의 개요



과목공지



질의응답



조편성 결과

- 오늘 자정까지 결과 게시
- 조편성이 아직 완료되지 않은 학생 → 수업 종료 후 확인

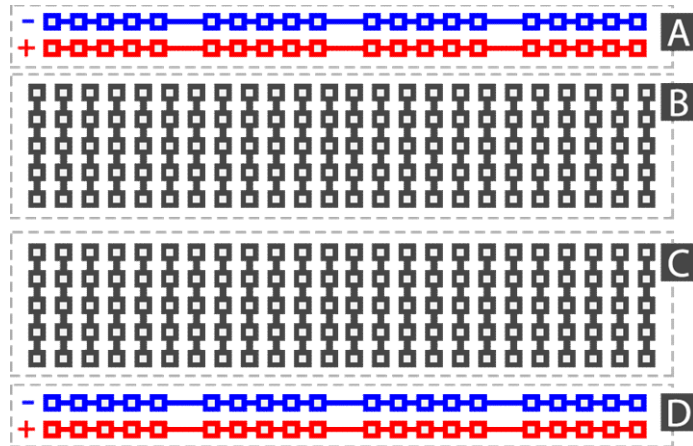
중간고사 공지 (A)

- 일시: 4월 25일
 - 필기고사 없음
 - 오후 3시: 326호
 - 아두이노 반드시 지참
- 범위: 아두이노 관련 수업 자료 (이번주 수업 포함)
- Cheat sheet : A4 1장 (앞뒷면)의 cheat sheet 작성가능.
단, 복사, 출력 금지, 반드시 필기로 직접 작성할 것.
시험 시간 중 검색이 불가할 수 있음.

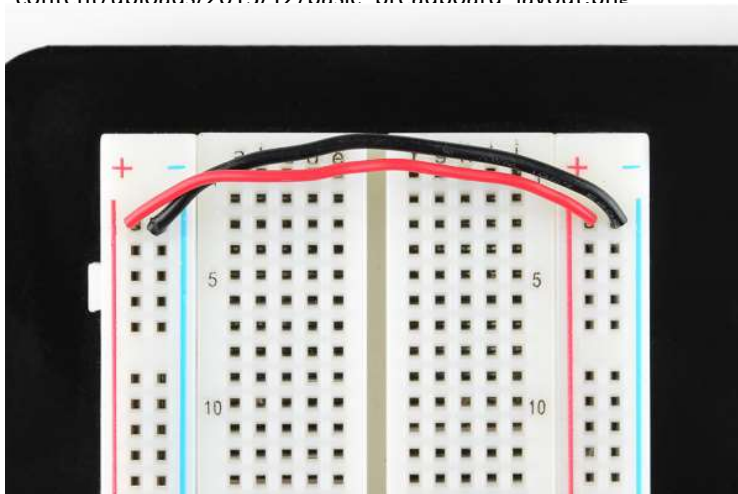
중간고사 공지 (B)

- 일시: 4월 25일
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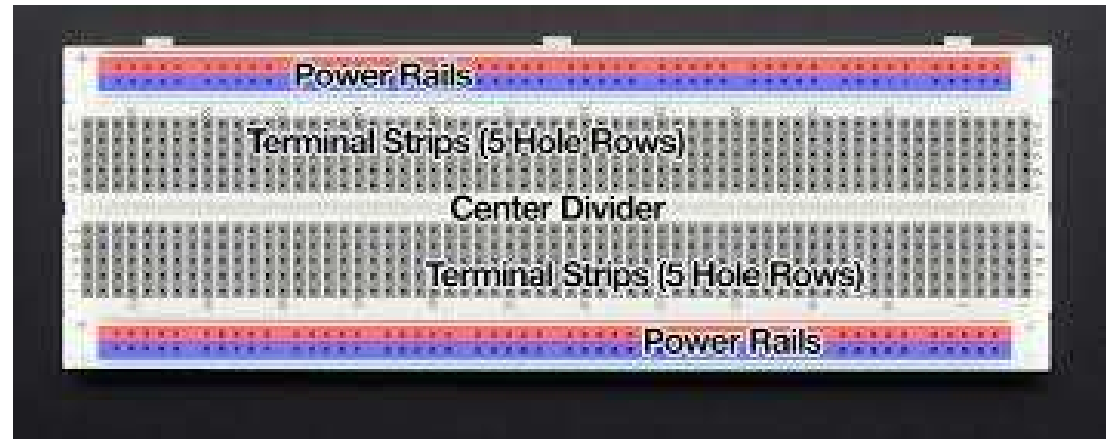
Breadboard



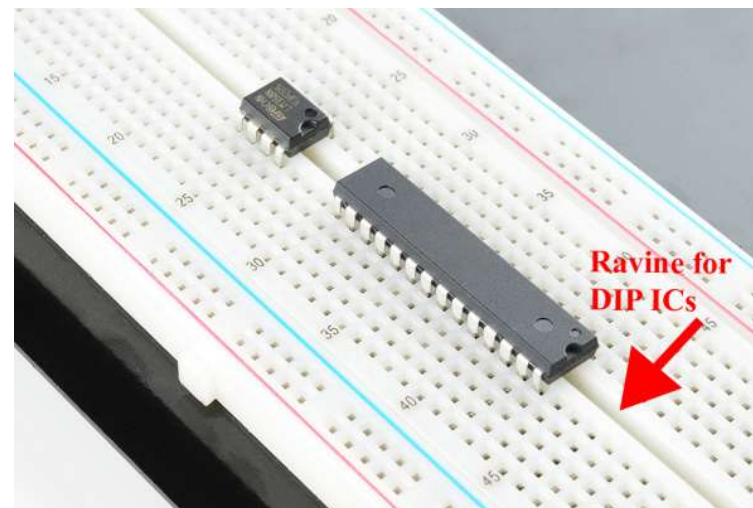
https://www.tweaking4all.com/wp-content/uploads/2013/12/basic_breadboard_layout.png



<https://learn.sparkfun.com/tutorials/how-to-use-a-breadboard>

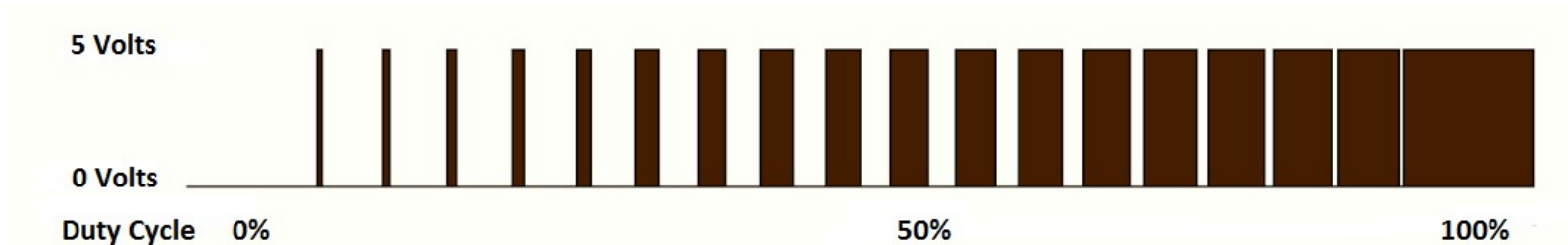


https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcQVr2BtZ8enjA-ZTOF_HiVY0yTD5LTdsiOpa7-6rPuPEAoXy3pSLA

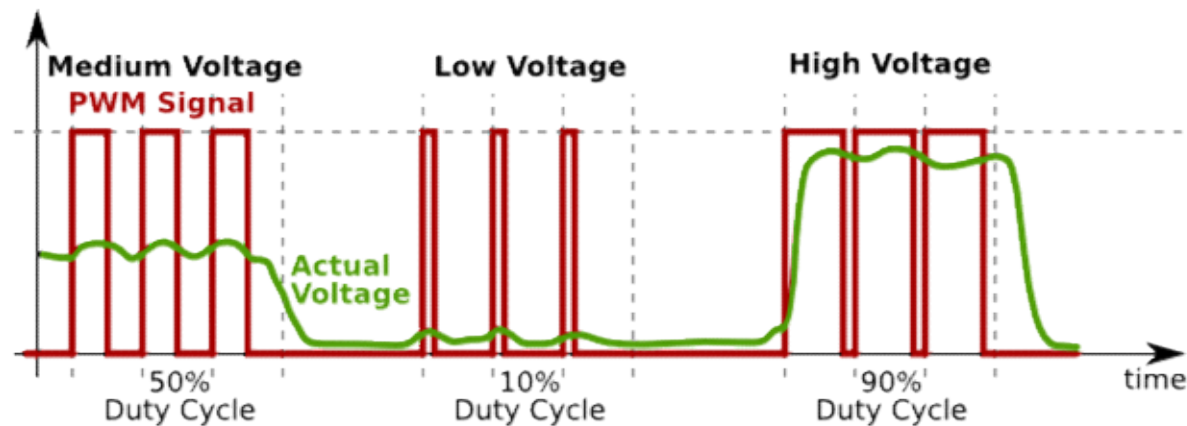


PWM

- Control duty cycle → control average voltage



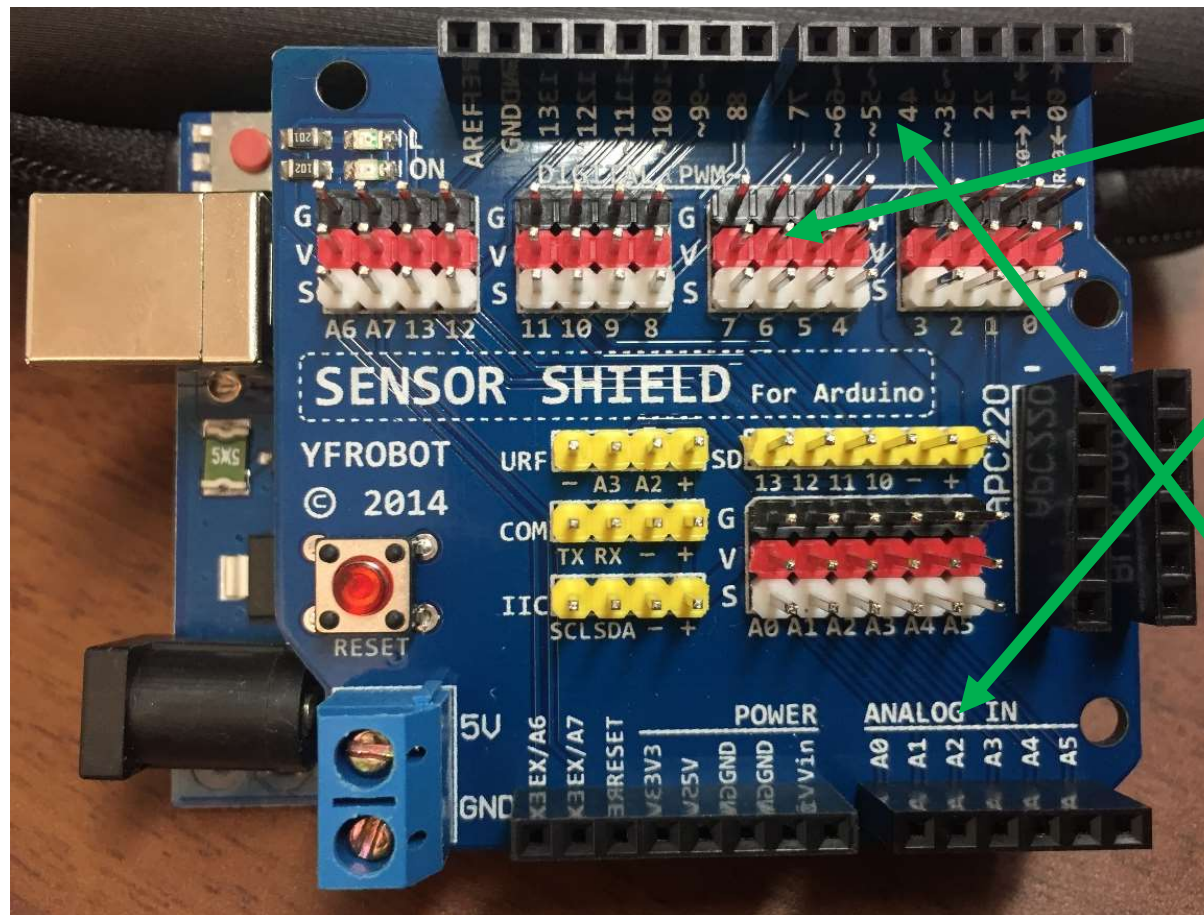
<https://electrosome.com/pwm-pulse-width-modulation/>



<https://www.wayneandlayne.com/projects/video-game-shield/design/>

PWM from Arduino

- Can Arduino generate analog signal?



Digital in/out

Analog in

**Where's
analog out?**
**~ 11, ~10,
~9, ~6, ~5,
~3 (PWM)**

digitalWrite()

```
const int LED=9;

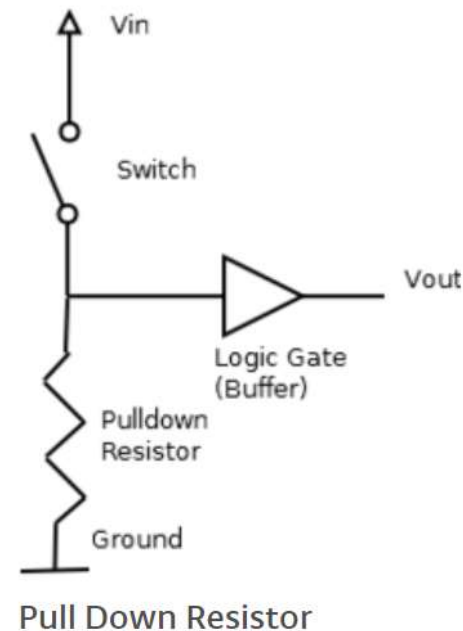
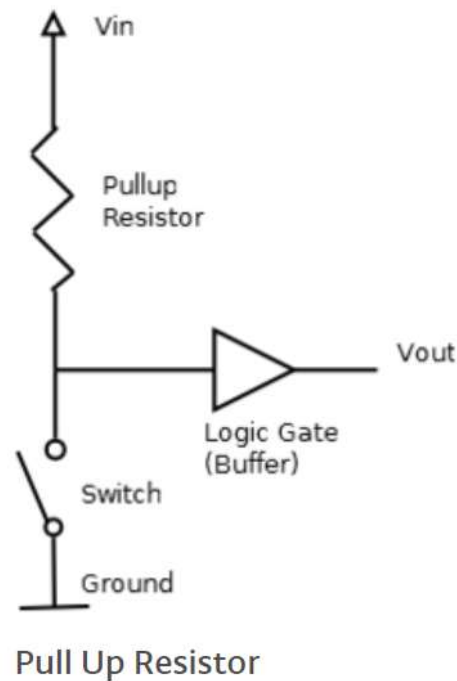
void setup() {
  pinMode(LED,OUTPUT);
  digitalWrite(LED,HIGH);
}

void loop() {
  // put your main code here, to run repeatedly:
}
```

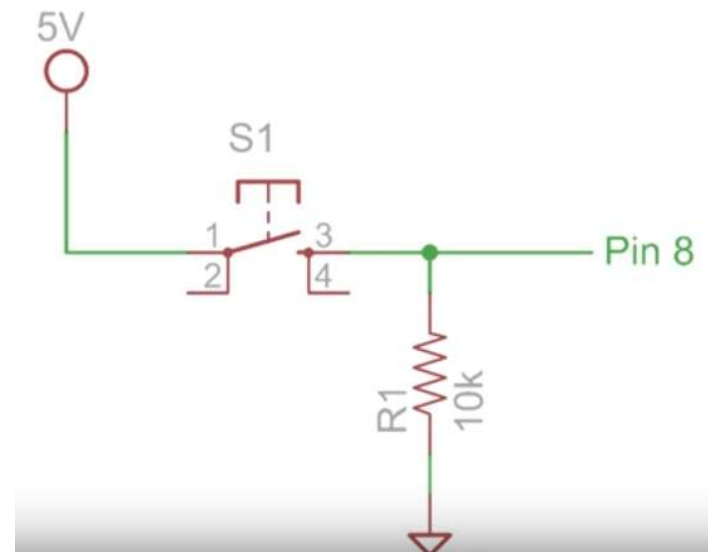
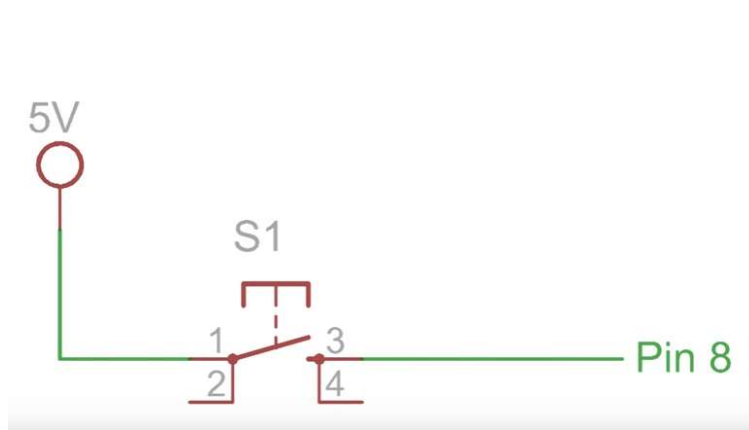
- A variable type must be declared.
- General variables can be changed.
- “const” : constant variable → no change
- pinMode: OUTPUT or INPUT
- digitalWrite: HIGH = 5V, LOW = 0V

digitalRead()

- digitalRead() : read HIGH or LOW
- Example: pushbutton, switch
- Noise by unstable button → **floating**
- Use pull-up or pull-down resistor



digitalRead(): Floating & Pull-down resistor



https://www.youtube.com/watch?v=abWCy_aOSwY&t=770s

Button/switch	ON	OFF
Without pull down	5 V (HIGH)	Floating
With pull down	5 V (HIGH)	0 V (LOW)

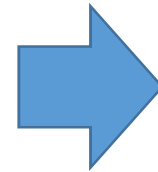
digitalRead(): Control LED with button / switch

```
int switchPin = 8;
int ledPin = 13;

void setup()
{
  pinMode(switchPin, INPUT);
  pinMode(ledPin, OUTPUT);
}

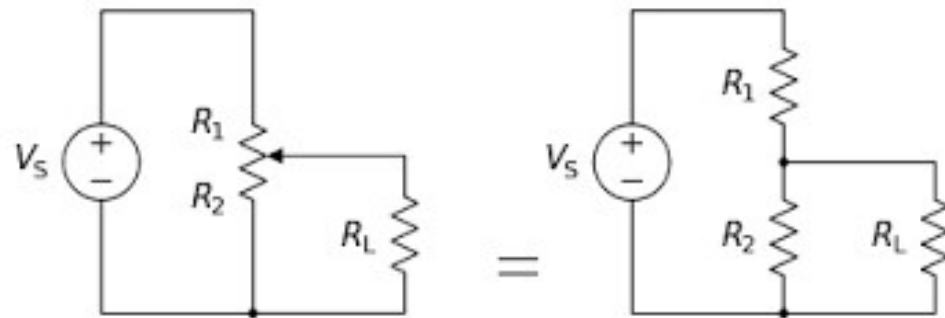
void loop()
{
  if (digitalRead(switchPin) == HIGH)
  {
    digitalWrite(ledPin, HIGH);
  }
  else
  {
    digitalWrite(ledPin, LOW);
  }
}
```

버튼을 찾아 연결 → pin 13
LED를 제어

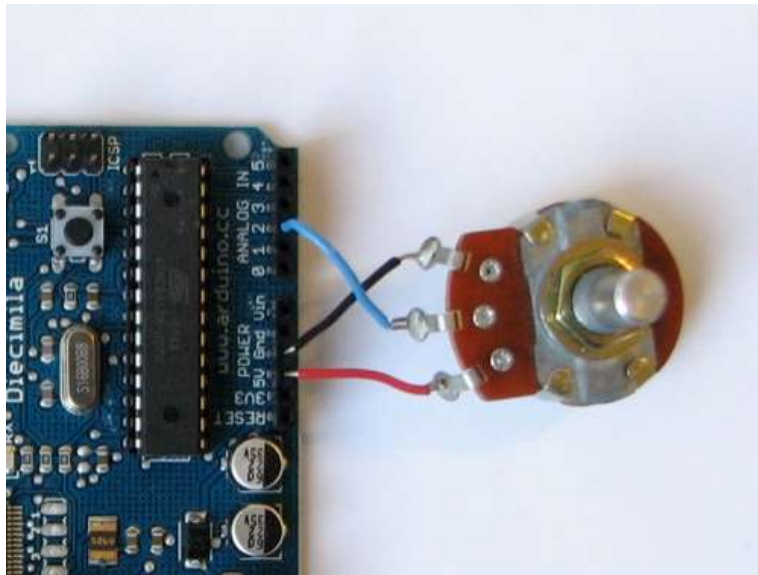


Bouncing issue will
be covered later

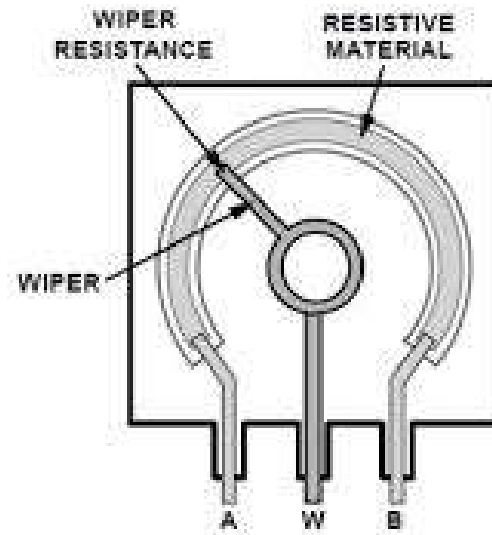
analogRead: Voltage divider & potentiometer



Wikipedia



<https://www.arduino.cc/en/tutorial/potentiometer>

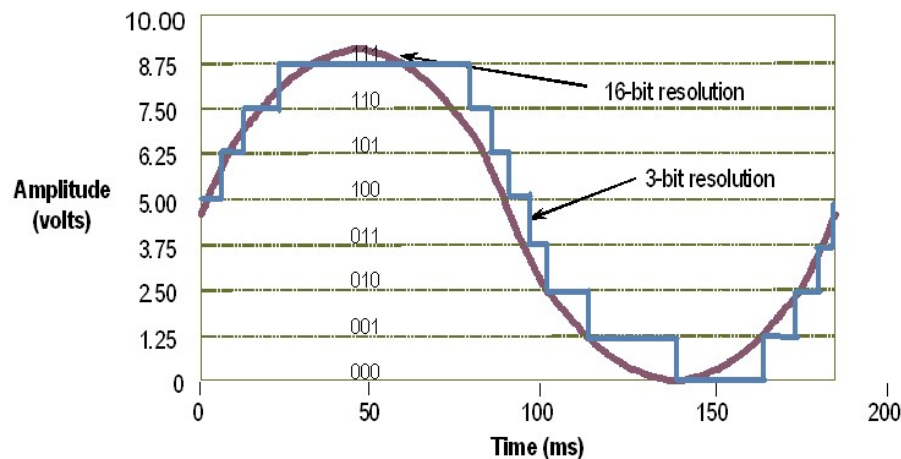


<https://www.quora.com/What-is-potentiometer>

analogRead: ADC (analog to digital converter)

What is “resolution”? For example, 10-bit resolution.

Resolution: Examples

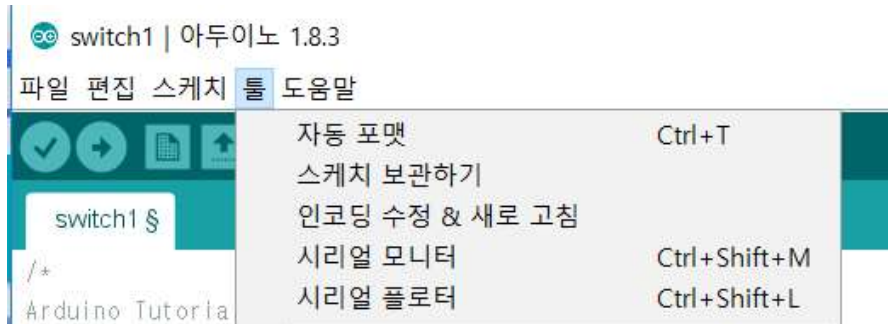


	Formula	4-bit DAC
Number of bits	n	4
Number of output codes	2^n	16
Number of steps in the output	$2^n - 1$	15
Percentage resolution	$1 / (2^n - 1)$	1/15
Step size (assuming 5 V reference voltage)	$V_{ref} / 2^n - 1$	$V_{ref} / 15$

http://www.globalspec.com/learnmore/data_acquisition_signal_conditioning/signal_converting/digital_to_analog_converters

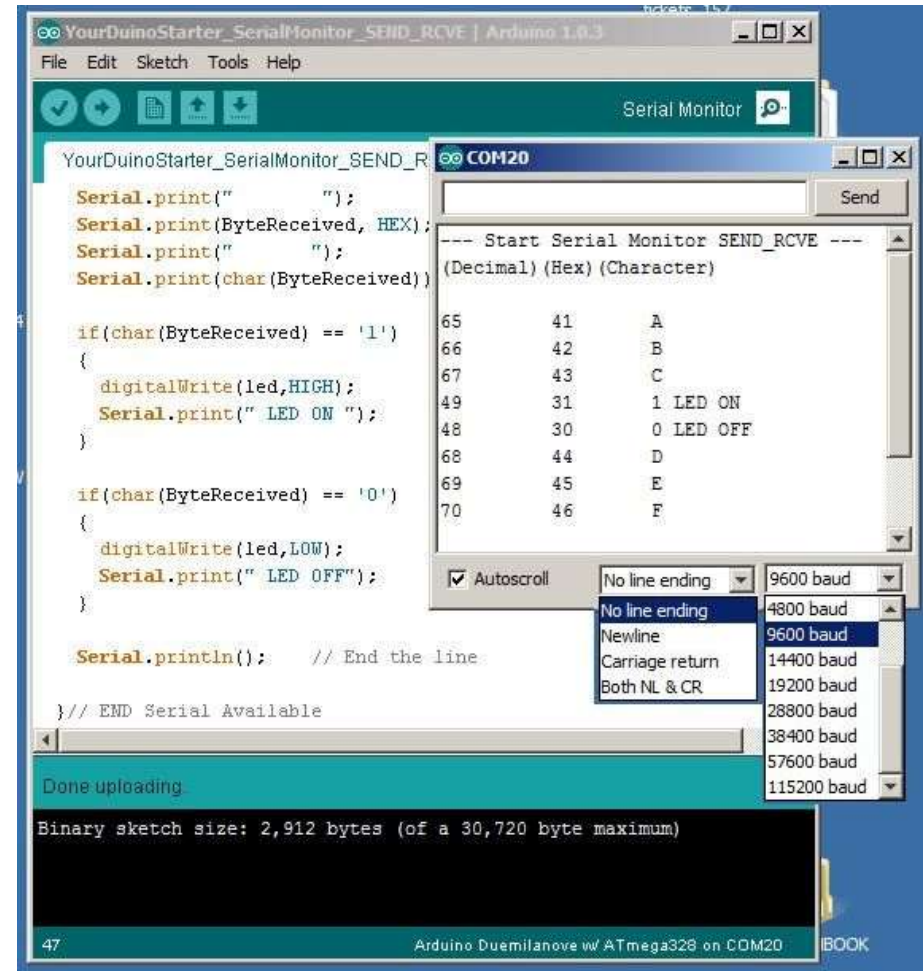
<https://image.slidesharecdn.com/group1-141018102550-conversion-gate01/95/dacdigital-to-analog-converter-11-638.jpg?cb=1486790152>

Serial monitor



- Baud rate : 9600
- Speed of communication

디버깅할 때 유용하게
사용됨



Serial Communication: functions

- Serial.begin (baud rate) : define the baud rate
- Serial.print("text")
- Serial.println("text") : new line
- \n : new line
- \t : tab
- \\n : print \n
- \\ t : print \t
- Exmpale:
 - Serial.println("\nOut1\tOut2\tOut3");

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함수

구분	함수	매개변수	주요 기능
Digital I/O	pinMode(pin, mode)	pin : 핀 번호 mode : INPUT/OUTPUT	특정 핀을 INPUT/ OUTPUT으로 설정
	digitalWrite(pin, value)	pin : 핀 번호 value : HIGH/LOW	Digital pin에 HIGH/LOW를 출력
	digitalRead(pin)	pin : 핀 번호	특정 핀의 값 HIGH/LOW로 읽기
Analog I/O	analogRead(pin)	pin : 핀 번호 (Arduino Uno 경우 : #3, #5, #6, #9, #10, #11 핀 해당)	아날로그 핀의 값 읽기(0~1023) 6-channel 10-bit A/D converter 아날로그 입력 1개 100 μ s (1초 최대 10,000개 입력)
	analogWrite(pin, value) - PWM	pin : 핀 번호 (Arduino Uno 경우 : #3, #5, #6, #9, #10, #11 핀 해당) value : duty cycle (0~255)	아날로그 값(PWM)을 출력 (주파수 : 약 490Hz, 단, #5, #6 핀 980Hz)

함수

Library	함수	매개변수	기능
Time	millis()	unsigned long 형으로 return	Arduino board가 현재 프로그램을 시작한 후의 시간(msec) 약 50일 이후는 0값 return (overflow)
	micros()	unsigned long 형으로 return	Arduino board가 현재 프로그램을 시작한 후의 시간(μs) 약 70분 이후는 0값 리턴 (overflow)
	delay(ms)	ms : 정지하는 msec 수	지정 시간만큼 프로그램을 정지
	delayMicroseconds(μs)	μs : 정지하는 msec 수	지정 시간만큼 프로그램을 정지

함수

Library	함수	매개변수	기능
Math	min(x, y)	x, y : 숫자	2개 수 가운데 더 작은 값 리턴
	max(x, y)	x, y : 숫자	2개 수 가운데 더 큰 값 리턴
	abs(x)	x : 숫자	절대값 리턴
	constrain(x, a, b)	x : 제한될 숫자 a : 제한 범위의 하한 b : 제한 범위의 상한	수를 범위에 제한되어 리턴 a < x < b 경우 x 리턴 x < a 경우 a 리턴 b < x 경우 b 리턴
	map(value, fromLow, fromHigh, toLow, toHigh)	value : 매핑할 숫자	현 범위에서 다른 범위로 재매핑 fromLow : 현 범위의 하한 fromHigh : 현 범위의 상한 toLow : 다른 범위의 하한 toHigh : 다른 범위의 상한
	pow(base, exponent)	base : 숫자(float) exponent : 지수(float)	지수 값을 계산
	sqrt(x)	x : 숫자	제곱근 값을 계산

연산자

- 산술연산자
 - = (assignment operator)
 - + (addition)
 - - (subtraction)
 - * (multiplication)
 - / (division)
 - % (modulo)
- 관계연산자
 - == (equal to)
 - != (not equal to)
 - < (less than)
 - > (greater than)
 - <= (less than or equal to)
 - >= (greater than or equal to)
- 논리연산자
 - && (and)
 - || (or)
 - ! (not)

제어문

- 선택문
 - if
 - if...else
 - switch case
- 반복문
 - for
 - while
 - do...while
- 점프문
 - break
 - continue
 - return
 - goto

선택문: if

- 비교연산자(comparison operator) : == != < , >
 - x == y (equal to)
 - x != y (not equal to)
 - x < y (less than)
 - x > y (greater than)
 - x <= y (less than or equal to)
 - x >= y (greater than or equal to)

```
if (x > 500) digitalWrite(LEDpin, HIGH);  
  
if (x > 500)  
  digitalWrite(LEDpin, HIGH);  
  
if (x > 500){ digitalWrite(LEDpin, HIGH); }  
  
if (x > 500){  
  digitalWrite(LEDpin1, HIGH);  
  digitalWrite(LEDpin2, HIGH);  
}
```

bracket { } 생략 가능

```
if (x > 500)  
{  
  // do A  
}  
else  
{  
  // do B  
}
```

```
if (x > 500)  
{  
  // do A  
}  
else if (x <= 1000)  
{  
  // do B  
}  
else  
{  
  // do C  
}
```

선택문: switch - case

- switch – case

Syntax

```
switch (var) {  
  case label1:  
    // statements  
    break;  
  case label2:  
    // statements  
    break;  
  default:  
    // statements  
}
```

<https://www.arduino.cc/reference/en/language/structure/control-structure/switchcase/>

```
switch (inByte) {  
  case 'a':  
    digitalWrite(2, HIGH);  
    break;  
  case 'b':  
    digitalWrite(3, HIGH);  
    break;  
  case 'c':  
    digitalWrite(4, HIGH);  
    break;  
  case 'd':  
    digitalWrite(5, HIGH);  
    break;  
  case 'e':  
    digitalWrite(6, HIGH);  
    break;  
  default:  
    // turn all the LEDs off:  
    for (int thisPin = 2; thisPin < 7; thisPin++) {  
      digitalWrite(thisPin, LOW);  
    }  
}
```

<https://www.arduino.cc/en/Tutorial/SwitchCase2>

반복문: for

Syntax

```
for (initialization; condition; increment) {  
    //statement(s);  
}
```

```
// Dim an LED using a PWM pin  
int PWMpin = 10; // LED in series with 470 ohm resistor on pin 10  
  
void setup()  
{  
    // no setup needed  
}  
  
void loop()  
{  
    for (int i=0; i <= 255; i++){  
        analogWrite(PWMpin, i);  
        delay(10);  
    }  
}
```

<https://www.arduino.cc/reference/en/language/structure/control-structure/for/>

반복문: while

Syntax

```
while(condition){  
  // statement(s)  
}
```

```
var = 0;  
while(var < 200){  
  // do something repetitive 200 times  
  var++;  
}
```

<https://www.arduino.cc/reference/en/language/structure/control-structure/while/>

do...while

Description: The do...while loop works in the same manner as the while loop, with the exception that the **condition is tested at the end of the loop**, so the do loop will always run at least once.

Syntax

```
do  
{  
  // statement block  
} while (condition);
```

```
do  
{  
  delay(50);           // wait for sensors to stabilize  
  x = readSensors();   // check the sensors  
} while (x < 100);
```