BASICS

College Name

→SRM Institute of Science and Technology.

Club Name

→SRM UAV.

Domain

→Electronics.

Introduction

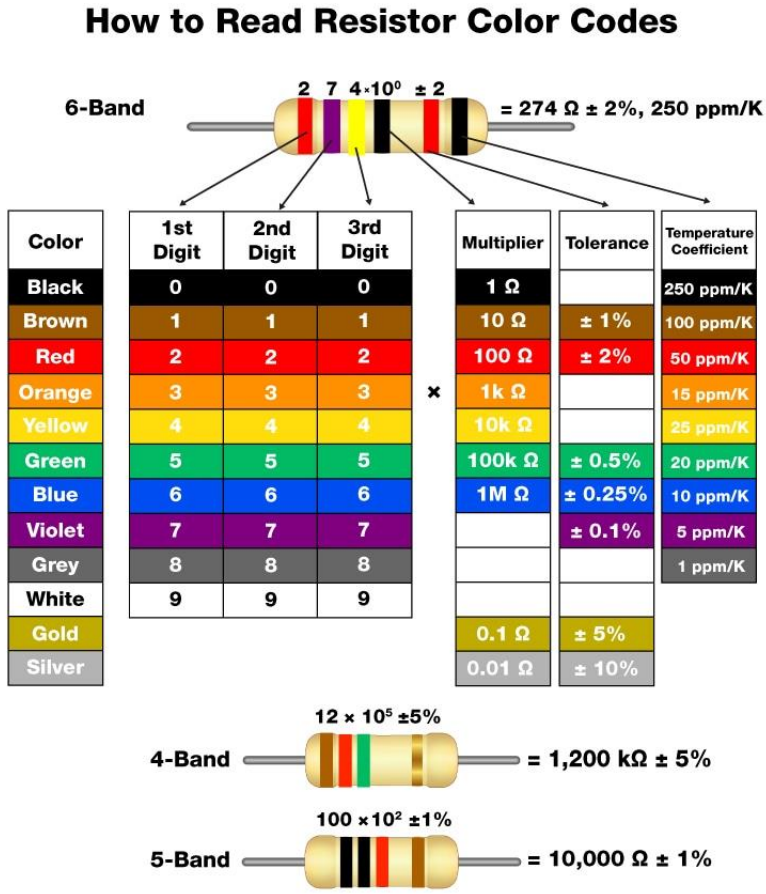
Electronics is about manipulating electricity to accomplish a particular task and is very much a hands-on endeavour. The basic electronic devices are the devices which emit and control the movement of electrons in a desirable manner used in generation of electronic appliances. All circuits need to have three basic elements. These elements are a voltage source, conductive path and a load. The voltage source, such as a battery, is needed in order to cause the current to flow through the circuit. In addition, there needs to be a conductive path that provides a route for the electricity to flow.

Basic electronic components.

1.Resistor

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. Resistors can be broadly of two types. Fixed Resistors and Variable Resistors. The carbon film resistor is a type of fixed

resistor that uses carbon film to restrict the electric current to certain level. These types of resistors are widely used in the electronic circuits. variable resistor is able to have its electrical resistance adjusted, they help connect circuits while leaving the resistance track open.



2. Capacitor

A capacitor (originally known as a condenser) is a passive two-terminal electrical component used to store energy electrostatically in an electric field. A capacitor stores energy in the form of an electrostatic field between its plates. Capacitors are divided into two mechanical groups: Fixed capacitors with fixed capacitance values and variable capacitors with variable (trimmer) or adjustable (tenable) capacitance values.

The most important group is the fixed capacitors. Many got their names from the dielectric. For a systematic classification these characteristics can't be used, because

one of the oldest, the electrolytic capacitor, is named instead by its cathode construction.

3. Diode

A diode is an electronic component with two electrodes (connectors) that allows electricity to go through it in one direction and not the other direction. Diodes can be used to turn alternating current into direct current (Diode bridge). Diodes are made from a semiconductor, most often silicon but sometimes germanium. There are various types of diodes, but the ones being discussed here are Zener, Rectifier, Schottky, Transient Voltage Suppressor, Thyristor, Silicon Controlled Rectifier, and TRIAC.

4. Transistors

Transistor, semiconductor device for amplifying, controlling, and generating electrical signals. Transistors are the active components of integrated circuits, or “microchips,” which often contain billions of these minuscule devices etched into their shiny surfaces. Transistors are basically classified into two types. They are: Bipolar Junction Transistors (BJT) and Field Effect Transistors (FET). The BJTs are again classified into NPN and PNP transistors. The FET transistors are classified into JFET and MOSFET.

5. Inductor

Inductor is an electrical component that stores energy in magnetic field.

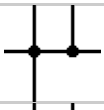
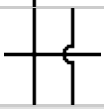
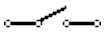
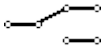
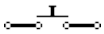
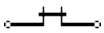
The inductor is made of a coil of conducting wire. In an electrical circuit schematic, the inductor marked with the letter L.

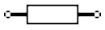
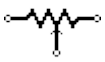
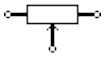
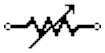
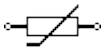
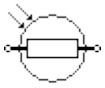
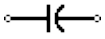
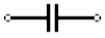
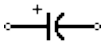
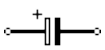
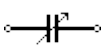
The inductance is measured in units of Henry [L].

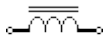
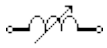
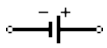
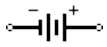
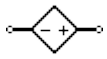
Inductor reduce current in AC circuits and short circuit in DC circuits.

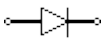
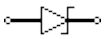
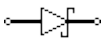
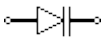
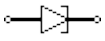
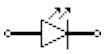
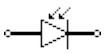
Electrical Symbols & Electronic Symbols

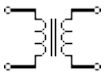
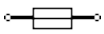
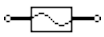
The symbols represent electrical and electronic components.

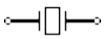
Symbol	Component name	Meaning
Wire Symbols		
	Electrical Wire	Conductor of electrical current
	Connected Wires	Connected crossing
	Not Connected Wires	Wires are not connected
Switch Symbols and Relay Symbols		
	SPST Toggle Switch	Disconnects current when open
	SPDT Toggle Switch	Selects between two connections
	Pushbutton Switch (N.O)	Momentary switch - normally open
	Pushbutton Switch (N.C)	Momentary switch - normally closed
	DIP Switch	DIP switch is used for onboard configuration
	SPST Relay	Relay open / close connection by an electromagnet
	SPDT Relay	
	Jumper	Close connection by jumper insertion on pins.
	Solder Bridge	Solder to close connection
Ground Symbols		
	Earth Ground	Used for zero potential reference and electrical shock protection.
	Chassis Ground	Connected to the chassis of the circuit

	Digital / Common Ground	
Resistor Symbols		
	Resistor (IEEE)	Resistor reduces the current flow.
	Resistor (IEC)	
	Potentiometer (IEEE)	Adjustable resistor - has 3 terminals.
	Potentiometer (IEC)	
	Variable Resistor / Rheostat (IEEE)	Adjustable resistor - has 2 terminals.
	Variable Resistor / Rheostat (IEC)	
	Trimmer Resistor	Present resistor
	Thermistor	Thermal resistor - change resistance when temperature changes
	Photoresistor / Light dependent resistor (LDR)	Photo-resistor - change resistance with light intensity change
Capacitor Symbols		
	Capacitor	Capacitor is used to store electric charge. It acts as short circuit with AC and open circuit with DC.
	Capacitor	
	Polarized Capacitor	Electrolytic capacitor
	Polarized Capacitor	Electrolytic capacitor
	Variable Capacitor	Adjustable capacitance
Inductor / Coil Symbols		

	Inductor	Coil / solenoid that generates magnetic field
	Iron Core Inductor	Includes iron
	Variable Inductor	
Power Supply Symbols		
	Voltage Source	Generates constant voltage
	Current Source	Generates constant current.
	AC Voltage Source	AC voltage source
	Generator	Electrical voltage is generated by mechanical rotation of the generator
	Battery Cell	Generates constant voltage
	Battery	Generates constant voltage
	Controlled Voltage Source	Generates voltage as a function of voltage or current of other circuit element.
	Controlled Current Source	Generates current as a function of voltage or current of other circuit element.
Meter Symbols		
	Voltmeter	Measures voltage. Has very high resistance. Connected in parallel.

	Ammeter	Measures electric current. Has near zero resistance. Connected serially.
	Ohmmeter	Measures resistance
	Wattmeter	Measures electric power
Lamp / Light Bulb Symbols		
	Lamp / light bulb	Generates light when current flows through
	Lamp / light bulb	
	Lamp / light bulb	
Diode / LED Symbols		
	Diode	Diode allows current flow in one direction only - left (anode) to right (cathode).
	Zener Diode	Allows current flow in one direction, but also can flow in the reverse direction when above breakdown voltage
	Schottky Diode	Schottky diode is a diode with low voltage drop
	Varactor / Varicap Diode	Variable capacitance diode
	Tunnel Diode	
	Light Emitting Diode (LED)	LED emits light when current flows through
	Photodiode	Photodiode allows current flow when exposed to light

Transistor Symbols		
	NPN Bipolar Transistor	Allows current flow when high potential at base (middle)
	PNP Bipolar Transistor	Allows current flow when low potential at base (middle)
	Darlington Transistor	Made from 2 bipolar transistors. Has total gain of the product of each gain.
	JFET-N Transistor	N-channel field effect transistor
	JFET-P Transistor	P-channel field effect transistor
	NMOS Transistor	N-channel MOSFET transistor
	PMOS Transistor	P-channel MOSFET transistor
Misc. Symbols		
	Motor	Electric motor
	Transformer	Change AC voltage from high to low or low to high.
	Electric bell	Rings when activated
	Buzzer	Produce buzzing sound
	Fuse	The fuse disconnects when current above threshold. Used to protect circuit from high currents.
	Fuse	

	Bus	Contains several wires. Usually for data / address.
	Bus	
	Bus	
	Optocoupler / Opto-isolator	Optocoupler isolates connection to other board
	Loudspeaker	Converts electrical signal to sound waves
	Microphone	Converts sound waves to electrical signal
	Operational Amplifier	Amplify input signal
	Schmitt Trigger	Operates with hysteresis to reduce noise.
	Analog-to-digital converter (ADC)	Converts analog signal to digital numbers
	Digital-to-Analog converter (DAC)	Converts digital numbers to analog signal
	Crystal Oscillator	Used to generate precise frequency clock signal
	Direct current	Direct current is generated from constant voltage level
Antenna Symbols		
	Antenna / aerial	Transmits & receives radio waves
	Antenna / aerial	
	Dipole Antenna	Two wires simple antenna
Logic Gates Symbols		

	NOT Gate (Inverter)	Outputs 1 when input is 0
	AND Gate	Outputs 1 when both inputs are 1.
	NAND Gate	Outputs 0 when both inputs are 1. (NOT + AND)
	OR Gate	Outputs 1 when any input is 1.
	NOR Gate	Outputs 0 when any input is 1. (NOT + OR)
	XOR Gate	Outputs 1 when inputs are different. (Exclusive OR)
	D Flip-Flop	Stores one bit of data
	Multiplexer / Mux 2 to 1	Connects the output to selected input line.
	Multiplexer / Mux 4 to 1	
	Demultiplexer / Demux 1 to 4	Connects selected output to the input line.

All about Arduino

Introduction

A decade ago, working around electronics involved knowledge in physics and math, expensive lab equipment, a laboratory type setup and important of all, love for electronics. But the picture has changed over the decade or so where the above-mentioned factors became irrelevant to work around electronics except for the last part: love for electronics.

There are many reasons which made this possible like rapid growth in the field of information technology, lower cost of electronic components and equipment and widespread availability of the internet.

Arduino is an open-source prototyping platform in electronics based on easy-to-use hardware and software. Subtly speaking, Arduino is a microcontroller based prototyping board which can be used in developing digital devices that can read inputs like finger on a button, touch on a screen, light on a sensor etc. and turning it in to output like switching on an LED, rotating a motor, playing songs through a speaker etc.

Arduino boards are generally based on microcontrollers from Atmel Corporation like 8 , 16 or 32-bit AVR architecture-based microcontrollers.

The important feature of the Arduino boards is the standard connectors. Using these connectors, we can connect the Arduino board to other devices like LEDs or add-on modules called Shields.

The Arduino boards also consists of on-board voltage regulator and crystal oscillator. They also consist of USB to serial adapter using which the Arduino board can be programmed using USB connection.

In order to program the Arduino board, we need to use IDE provided by Arduino. The Arduino IDE is based on Processing programming language and supports C and C++.

Types of Arduino Boards

here are many types of Arduino boards available in the market but all the boards have one thing in common: they can be programmed using the Arduino IDE. The reasons for different types of boards are different power supply requirements, connectivity options, their applications etc.

Arduino boards are available in different sizes, form factors, different no. of I/O pins etc. Some of the commonly known and frequently used Arduino boards are Arduino UNO, Arduino Mega, Arduino Nano, Arduino Micro and Arduino Lilypad.

There are add-on modules called Arduino Shields which can be used to extend the functionalities of the Arduino boards. Some of the commonly used shields are Arduino Proto shield, Arduino Wi-Fi Shield and Arduino Yun Shield.

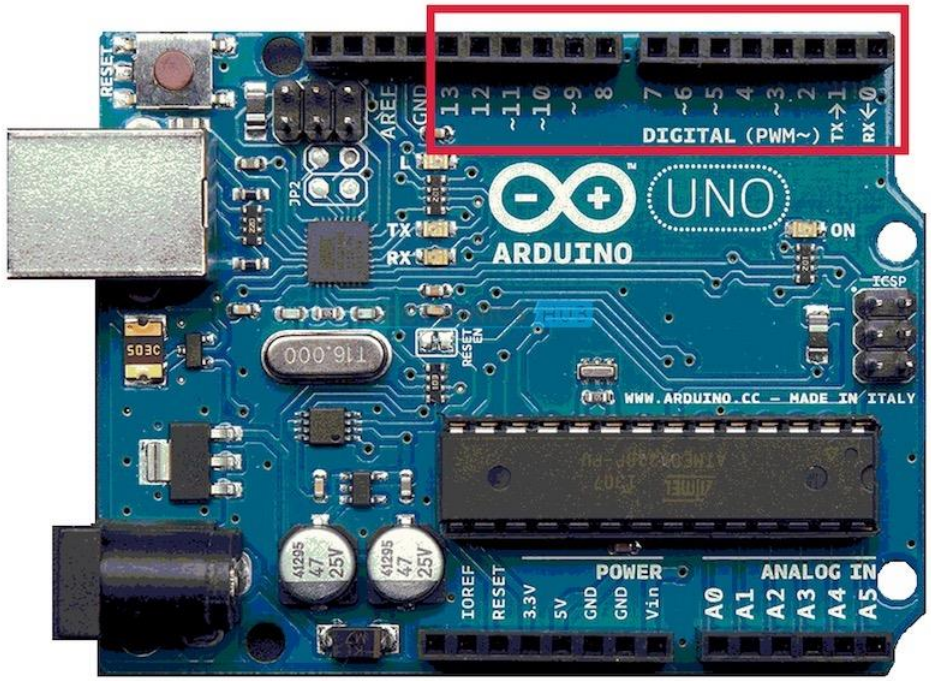
Arduino UNO

In this report, we will be discussing the Arduino UNO board. Arduino UNO is a basic and inexpensive Arduino board and is the most popular of all the Arduino boards with a market share of over 50%. Arduino UNO is considered to be the best prototyping board for beginners in electronics and coding.

UNO is based on ATmega328P microcontroller. There are two variants of the Arduino UNO: one which consists of through – hole microcontroller connection and other with surface mount type. Through-hole model will be beneficial as we can take the chip out in case of any problem and swap in with a new one.

Arduino UNO comes with different features and capabilities. As mentioned earlier, the microcontroller used in UNO is ATmega328P, which is an 8-bit microcontroller based on the AVR architecture.

UNO has 14 digital input – output (I/O) pins which can be used as either input or output by connecting them with different external devices and components. Out of these 14 pins, 6 pins are capable of producing PWM signal. All the digital pins operate at 5V and can output a current of 20mA.



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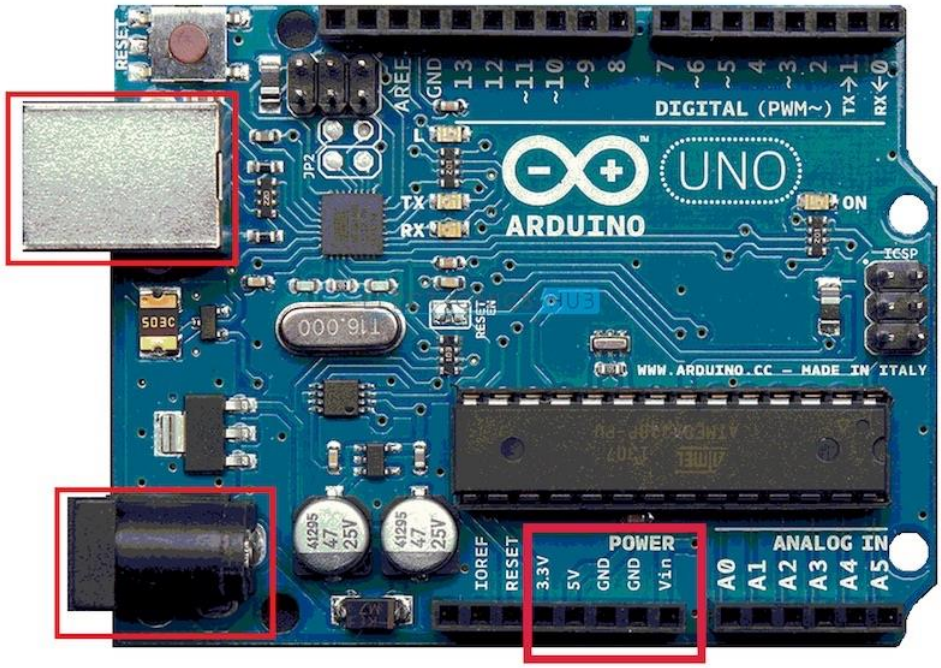
By default, all the analog pins can measure from ground to 5V. Arduino UNO has a feature, where it is possible to change the upper end of the range by using the AREF pin but the value should be less than 5V.

Additionally, some analog pins have specialized functionality. Pins A4 and A5 are used for I2C communication.

There are different ways in which we can power the Arduino UNO board. The USB cable, which is used to program the microcontroller, can be used as a source of power.



There is a power jack, using which an external regulated power supply in the range of 7V – 12V can be supplied. Additionally, the power can also be supplied from a battery through the VIN pin.

The UNO board has on-board voltage regulators for 5V and 3.3V, which can be used as power supply for small external devices like LEDs.

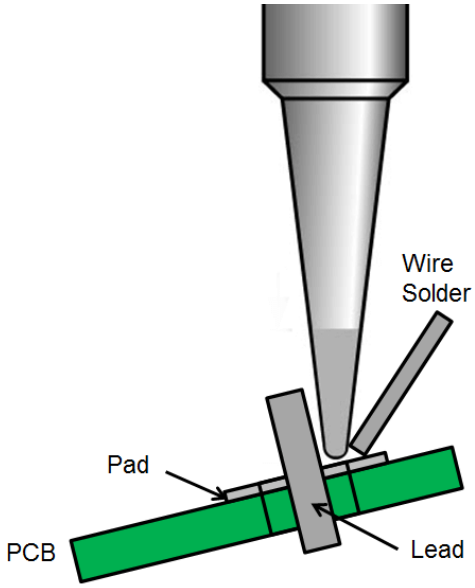
This is a brief introduction to Arduino and Arduino UNO board. In the next tutorial, we'll see the installation and setup of the Arduino IDE.

All about Soldering

Introduction

Soldering is the joining of two metal surfaces mechanically and electrically, with the use of metal called solder. Solder secures the connection so it doesn't break loose due to vibration or other mechanical forces. It also provides electrical continuity, so that the electronic signal can travel through the connection without interruption. The

solder is melted using a soldering iron. Flux is used to clean and prep the surfaces, which allows the melted solder to flow (or “wet”) and bond with the metal surfaces.



Metals which are Used

Filler metals used in soldering were once lead based (lead solder), however, owing to regulations, lead-based solders are increasingly replaced with lead free solders, which may consist of antimony, bismuth, brass, copper, indium, tin or silver.

Flux that can be used for soldering

Occasionally at the site of the joint, there are impurities such as oil, dirt or oxidation, the flux helps prevent oxidation and can sometimes chemically clean the metal. The flux used is rosin flux which helps the mechanical strength and electrical contact of electrical joints. Sometimes it is also possible to apply a ‘wetting agent’ to reduce the surface tension.

Types of Soldering

There are three types of soldering which use increasingly higher temperatures, which in turn produce progressively stronger joints:

→ Soft soldering (90 °C - 450 °C) - This process has the lowest filler metal melting point of all the soldering types at less than around 400°C these filler metals are usually alloys, often containing lead with liquidus temperatures under 350°C. Because of the low temperatures used in soft soldering it thermally stresses components the least but does not make strong joints and is then therefore unsuitable for mechanical load-bearing applications. It is also not suited for high temperature use as this type of solder loses strength and melts.

→ Hard (silver) soldering (>450 °C) – Brass or silver is the bonding metal used in this process, and requires a blowtorch to achieve the temperatures at which the solder metals.

→ Brazing(>450 °C) – This type of soldering uses a metal with a much higher melting point than those used in hard and soft soldering. However, similarly to hard soldering, the metal being bonded is heated as opposed to being melted. Once both the materials are heated sufficiently, you can then place the soldering metal between them which melts and acts as a bonding agent.

Uses of a Soldering Iron

A soldering iron is a hand tool used to heat solder, usually from an electrical supply at high temperatures above the melting point of the metal alloy. This allows for the solder to flow between the workpieces needing to be joined.

This soldering tool is made up of an insulated handle and a heated pointed metal iron tip. Good soldering is influenced by how clean the tip of your soldering iron is. To maintain cleanliness, a user will hold the soldering iron and use a wet sponge to clean the soldering iron tip prior to soldering components or making soldered connections.

Soldering gun use

Soldering guns are used for applications where more heat is required as irons use lower power. This tool is used for joining stained glass, light sheet metal and heavy

electronic soldering work. When you need to solder intermittently, the soldering gun is much more practical as it cools much quicker.

Modulation

Introduction

Modulation in electronics, technique for impressing information (voice, music, picture, or data) on a radio-frequency carrier wave by varying one or more characteristics of the wave in accordance with the intelligence signal. There are various forms of modulation, each designed to alter a particular characteristic of the carrier wave. The most commonly altered characteristics include amplitude, frequency, phase, pulse sequence, and pulse duration.

TYPES

Amplitude modulation.

In amplitude modulation (AM), auditory or visual information is impressed on a carrier wave by varying the amplitude of the carrier to match the fluctuations in the audio or video signal being transmitted. AM is the oldest method of broadcasting radio programs. Commercial AM stations operate at frequencies spaced 10 kHz apart between 535 and 1,605 kHz. Radio waves in this frequency range are effectively reflected back to the Earth's surface by the ionosphere and can be detected by receivers hundreds of miles away. In addition to its use in commercial radiobroadcasting, AM is employed in long-distance shortwave radio broadcasts and in transmitting the video portion of television programs.

Frequency modulation.

In frequency modulation (FM), unlike AM, the amplitude of the carrier is kept constant, but its frequency is altered in accordance with variations in the audio signal being sent. This form of modulation was developed by the American electrical

engineer Edwin H. Armstrong during the early 1930s in an effort to overcome interference and noise that affect AM radio reception. FM is less susceptible than is AM to certain kinds of interference, such as that caused by thunderstorms as well as random electrical currents from machinery and other related sources. These noise-producing signals affect the amplitude of a radio wave but not its frequency, and so an FM signal remains virtually unchanged.

Phase modulation.

The phase of a carrier wave is varied in response to the vibrations of the sound source in phase modulation (PM). This form of modulation is often considered a variation of FM. The two processes are closely related because phase cannot be changed without also varying frequency, and vice versa. Also, the rate at which the phase of a carrier changes is directly proportional to the frequency of the audio signal.

Pulse-coded modulation.

In pulse-coded modulation (PCM), the intelligence signal converts the carrier into a series of constant-amplitude pulses spaced in such a manner that the desired intelligence is contained in coded form. Continuous signals, such as voice messages, television pictures, and computer data, are commonly transformed into the Baudot Code or its variations, which are composed of patterns of 5 or 7 “on” and “off” pulses. PCM minimizes transmission losses and eliminates noise and interference problems because the receiving unit need only detect and identify simple pulse patterns. Moreover, the pulses, unlike continuous signals, can be regenerated electronically by repeater stations along the transmission route with virtually no distortion.

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Pulse-duration modulation.

Another kind of pulse modulation is pulse-duration modulation (PDM), in which intelligence is represented by the length and order of regularly recurring pulses. A familiar example of PDM is the International Morse Code, used in ship-to-shore communications, amateur radio, and certain other forms of radiotelegraphy.

PDM was devised by the American physicist Raymond A. Heising in 1924. Besides its use in telegraphic communications by means of microwave radio relay systems, its chief application is telemetering.

PWM and PPM

PWM

Pulse width modulation (PWM) is a modulation technique that generates variable-width pulses to represent the amplitude of an analog input signal. The output switching transistor is on more of the time for a high-amplitude signal and off more of the time for a low-amplitude signal. The digital nature (fully on or off) of the PWM circuit is less costly to fabricate than an analog circuit that does not drift over time.

PWM is widely used in ROV applications to control the speed of a DC motor and/or the brightness of a lightbulb. For example, if the line were closed for 1 μs, opened for 1 μs, and continuously repeated, the target would receive an average of 50% of the voltage and run at half speed or the bulb at half brightness. If the line were closed for 1 μs and open for 3 μs, the target would receive an average of 25%.

There are other methods by which analog signals are modulated for motor control, but OCROV and MSROV systems predominate with the PWM mode due to cost and simplicity of design.

PPM

Pulse Position Modulation (PPM) is an analog modulating scheme in which the amplitude and width of the pulses are kept constant, while the position of each pulse, with reference to the position of a reference pulse varies according to the instantaneous sampled value of the message signal.

The transmitter has to send synchronizing pulses (or simply sync pulses) to keep the transmitter and receiver in synchronism. These sync pulses help maintain the position of the pulses. The following figures explain the Pulse Position Modulation

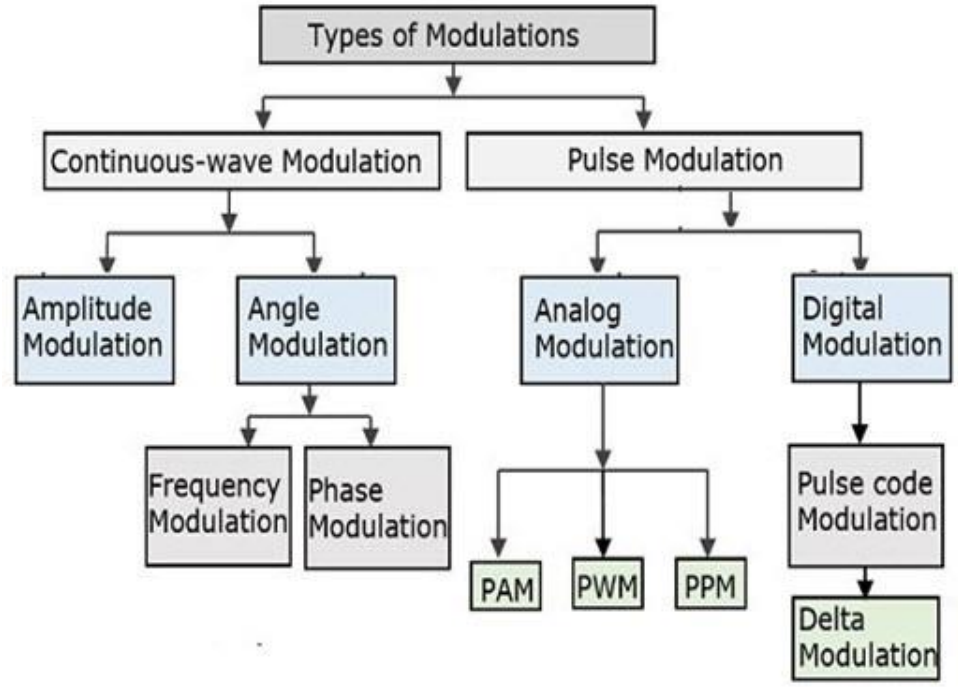
Pulse position modulation is done in accordance with the pulse width modulated signal. Each trailing of the pulse width modulated signal becomes the starting point for pulses in PPM signal. Hence, the position of these pulses is proportional to the width of the PWM pulses.

Difference Between PWM, and PPM

The below table gives a detailed difference between PWM and PPM.

Sr. No.	Parameter	PWM	PPM
1	Type of Carrier	Train of Pulses	Train of Pulses
2	Variable Characteristic of the Pulsed Carrier	Width	Position
3	Bandwidth Requirement	High	High
4	Noise Immunity	High	High
5	Information Contained in	Width Variations	Position Variations
6	Power efficiency (SNR)	Moderate	High
7	Transmitted Power	Varies with variation in width	Remains Constant
8	Need to transmit synchronizing pulses	Not needed	Necessary
9	Bandwidth depends on	Bandwidth depends on the rise time of the pulse	Bandwidth depends on the rise time of the pulse
10	Transmitter power	Instantaneous transmitter power varies with the	Instantaneous transmitter

		amplitude and width of the pulses	power remains constant with the width of the pulses
11	The complexity of generation and detection	Easy	Complex
12	Similarity with other Modulation Systems	Similar to FM	Similar to PM



Reading PPM with Arduino

All RC receiver is made to drive servo motors. so there are 3 pins for each channel: ground, Vcc, and signal. here special kind of signal is used. It sends pulses at some interval. When servo receives 1.5ms pulse it sets to 90 degrees and by varying this

value from 1-2ms servo goes to minimum and maximum value.
(In above photo a 6 channel receiver is shown with PPM pin)

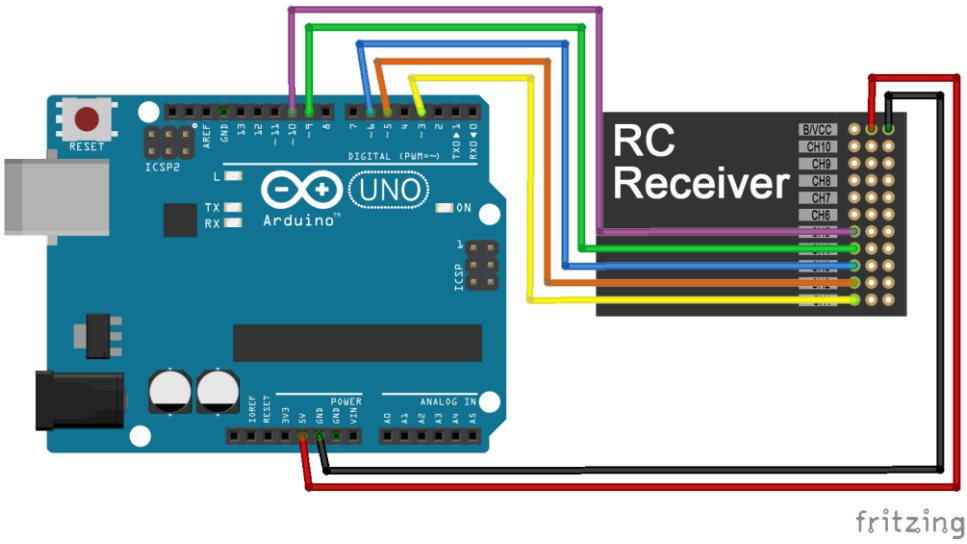
So easy method is to measuring pulse width on each pin and map that data as per requirement. but here problem is that:

→ For each channel of the receiver, we need to connect a wire to Arduino pin.

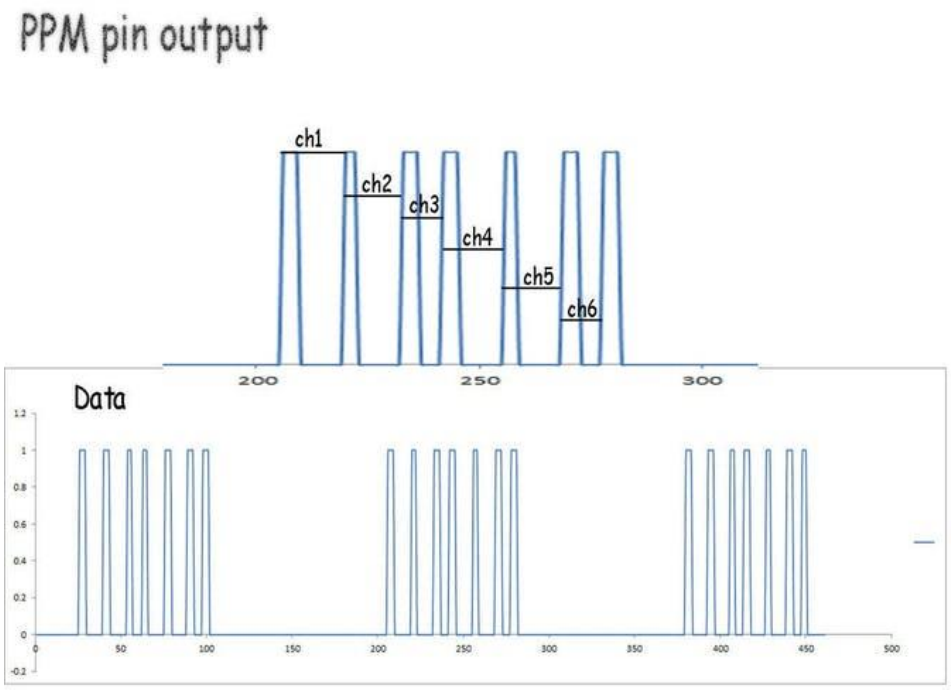
→ this not only requires lots of connection but also consume lots of pins on an Arduino.

→ Most of Arduino just has 2 interrupt pin so if we uses more than 2 channel read it add some delay to our code which may be problematic for some application.

To solve this problem many receivers comes with an extra pin called PPM. this PPM pin transmits data of all channel in a single signal.



PPM signal structure

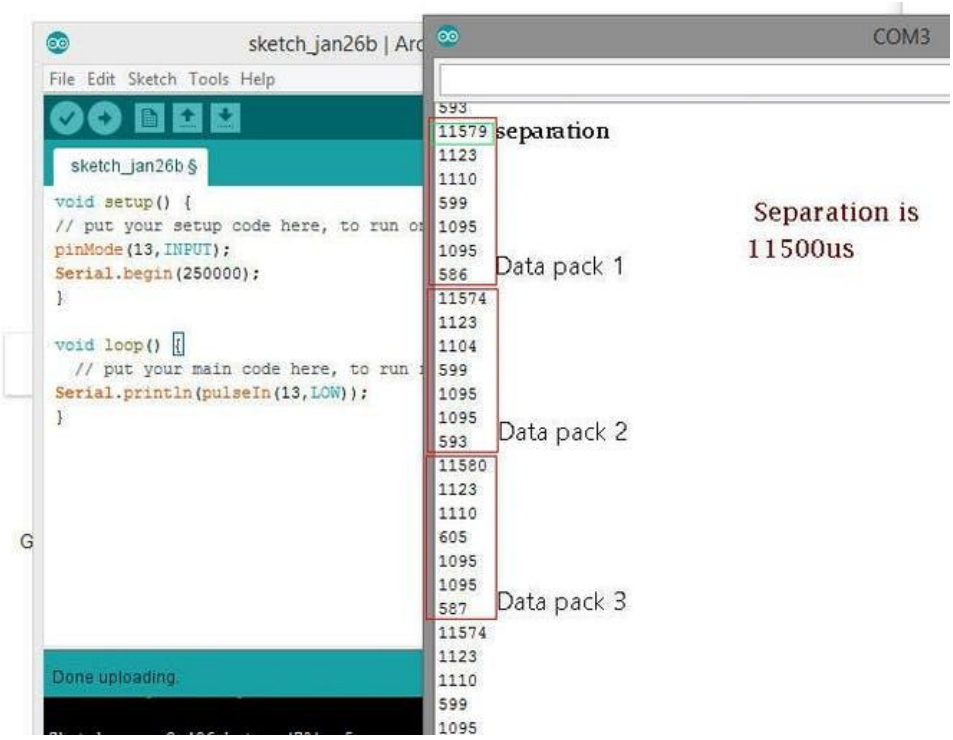


This signal consists of data packets separated by blank space. Here space in between peaks represents the value of the channel. in this case, I have used 6 channel receivers so there are 7 pulses.

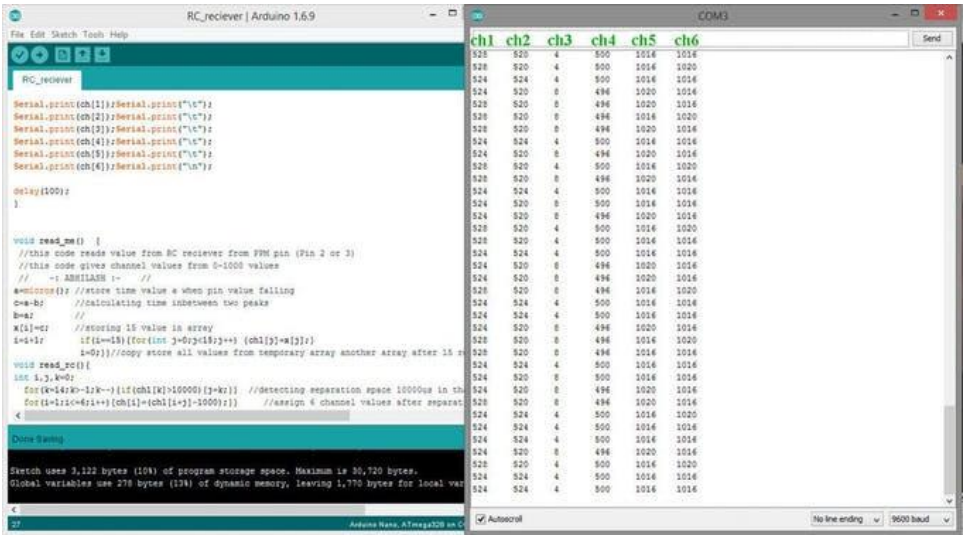
So in our code first, we need to detect separation space and then start recording data from the pulses for each channel.

As can be seen in the second image,

all data is separated with approx 11500 microseconds of time. than 6 values are for each channel.



CODE



Here read_me() specified as function:

a=micros(); c=a-b; b=a; x[i]=c; i=i+1; if(i==15){for(int j=0;j<15;j++) {ch1[j]=x[j];} i=0;

} }

this part runs on interrupt pin and take 15 time values and store it in an array.

another function read_rc()

this part looks for any space which is higher than 10000microsecond, in our case it detects separation space, and as it detects that space code moves to the next section.

after this space next 6 values are for each channel position it is stored in array named ch[channel no], here ch[1], ch[2], ch[3], ch[4], ch[5], ch[6] represents value of each channel.

```
unsigned long int a,b,c;
int x[15],ch1[15],ch[7],I;//specifing arrays and variables to store values
void setup()
{
Serial.begin(9600);
  pinMode(2, INPUT_PULLUP);
  attachInterrupt(digitalPinToInterrupt(2), read_me, FALLING);  // enabling interrupt at pin 2
}
void loop()
 {
read_rc();
Serial.print(ch[1]);
Serial.print("\t");
Serial.print(ch[2]);
Serial.print("\t");
Serial.print(ch[3]);
Serial.print("\t");
Serial.print(ch[4]);
Serial.print("\t");
Serial.print(ch[5]);
Serial.print("\t");
Serial.print(ch[6]);
Serial.print("\n");
delay(100);
}
void read_me()
```

```
 { //this code reads value from RC reciever from PPM pin (Pin 2 or 3) //this
code gives channel values from 0-1000 values  //    -: ABHILASH :-    //

a=micros(); //store time value a when pin value fallingc=a-b;
//calculating time inbetween two peaks

b=a;        // x[i]=c;     //storing 15 value in arrayi=i+1;

if(i==15){for(int j=0;j<15;j++) {ch1[j]=x[j];

}             i=0;

}

}//copy store all values from temporary array another array after 15 reading
void read_rc()

{int i,j,k=0;  for(k=14;k>-1;k--){if(ch1[k]>10000){j=k;

}

}  //detecting separation space 10000us in that another array
for(i=1;i<=6;i++){ch[i]=(ch1[i+j]-1000);

}

}     //assign 6 channel values after separation space
```

Reference

https://www.rapidtables.com/electric/electrical_symbols.html

https://www.allaboutcircuits.com/worksheets/soldering/

https://www.arduino.cc/reference/en/libraries/ppm-reader/

https://www.britannica.com/technology/modulation-communications