REMOTE NOTICE BOARD USING WIFI

A Project Report

Submitted in partial fulfilment of the Requirements

for the award of the Degree of

BACHELOR OF SCIENCE

Submitted by

Y. PHANEENDRA (Y193223031)

L. PAVAN KUMAR (Y193223026)

T. AKHIL (Y193223030)

Under the Guidance of

Smt. S. KIRANMAYI, M.Sc, M.Phil, NET.

Lecturer in Electronics

DEPARTMENT OF ELECTRONICS

V.S.R GOVERNMENT DEGREE & P.G COLLEGE

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Certificate

This is to certify that the project entitled **"REMOTE NOTICE BOARD USING WIFI"** is a bonafide work of **Y. PHANEENDRA (Y193223031), L. PAVAN KUMAR (Y193223026), T. AKHIL (Y193223030)** under my guidance and supervision in partial fulfillment of the requirement for the award of Degree of **Bachelor of Science in V.S.R GOVERNMENT DEGREE & P.G COLLEGE, MOVVA, KRISHNA DISTRICT, ANDHRA PRADESH, INDIA**. Affiliated to Krishna University, Machilipatnam, during the academic year 2019-2022.

Project Guide **Head of the Department**

DECLARATION

We hereby declare that this project titled **"REMOTE NOTICE BOARD USING WIFI".** Is a bonafide work done by us under the guidance of **Smt. S. KIRANMAYI, M.Sc, M. Phil, NET.** This project work is submitted **V.S.R GOVERNMENT DEGREE & P.G COLLEGE, MOVVA, KRISHNA DISTRICT, ANDHRA PRADESH,** in period fulfilment of the requirement for the award of BACHELOR OF SCIENCE during the academic year 2019-2022.

We also declare that this project is a result of our own effort and that it has not been submitted to any other University for the award of any degree.

Y. PHANEENDRA	**(Y193223031)**
L. PAVAN KUMAR	**(Y193223026)**
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ACKNOWLEDGEMENT

It is a great pleasure to take opportunity and express our gratitude to all those who helped us throughout our project work.

First and foremost, thankful to **Dr. S. MADHAVI Garu Principal of V.S.R Government Degree & P.G. College, Movva,** for giving us opportunity to take up the project work.

We also thank to **Smt. S. KIRANMAYI, M. Sc, M. Phil, NET., Project Guide and Head of the Department of Electronics.** For giving us opportunity to take up the project work and helping us through out.

We would like to express our sincere and heart full thanks to all the faculty of the Department for their continuous cooperation, which has given us the guidance to build up adamant aspiration over the completion of our project.

Finally, we thank one and all who directly and indirectly helped us to complete our Project successfully.

Y. PHANEENDRA (Y193223031)
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CONTENTS

Wireless communication between two PC's using RF

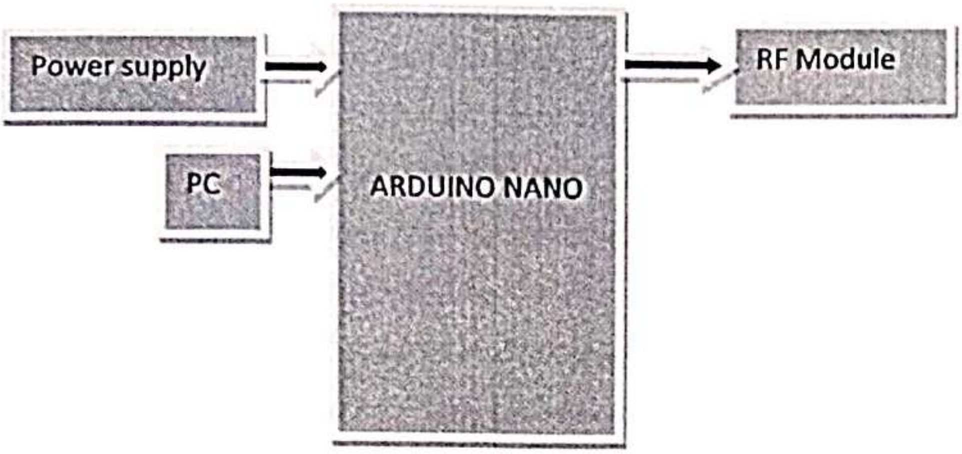
Abstract:

Personal computers are usually connected to each other through network cables in a LAN based office network. Connecting two computers using USB cable or RS – 232 cable for data communication is feasible option when the two systems are placed nearby. Also, a single network cable connects a PC to only another single PC. If computer systems in an office are made to communicate data wirelessly, the cost to install elaborate network cable wiring can be saved and the entire setup looks more neat and clean. This way any computer can be connected to any other computer without any fuss. A single computer can also be easily connected with any number of other computers at a time.

This project has illustrated wireless data communication between PCs using the 434 MHz RF module. The RF module has a range of 50-60 meter and can be extended to 300-350 meter using an antenna and increasing the transmission power of module. Therefore, the RF-based wireless data communication network can be installed to any small office or workplace. In the project, since PCs cannot directly interface with the RF module, they are interfaced through Arduino boards. The PC that has to work as data server is connected to an RF transmitter through the Arduino board while the PCs that have to work as data client in the wireless local network are connected to RF receivers through Arduino. The data communication has been illustrated using the serial monitor on both PCs

Block diagram:

TX:



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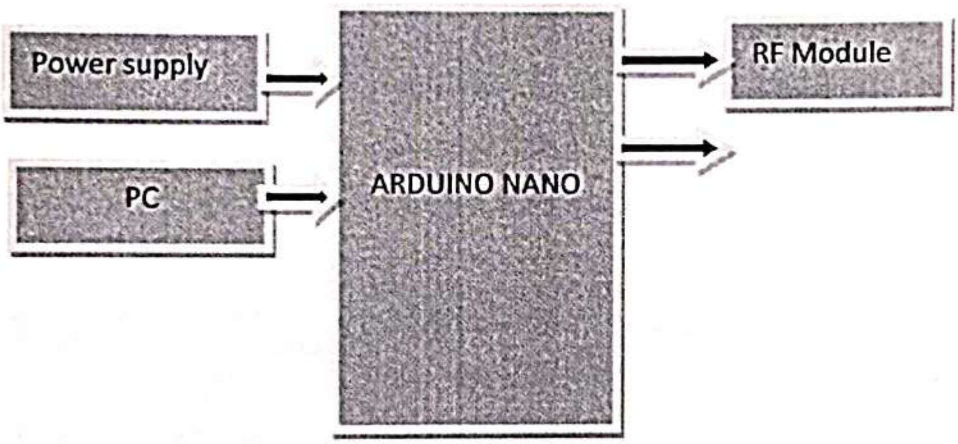
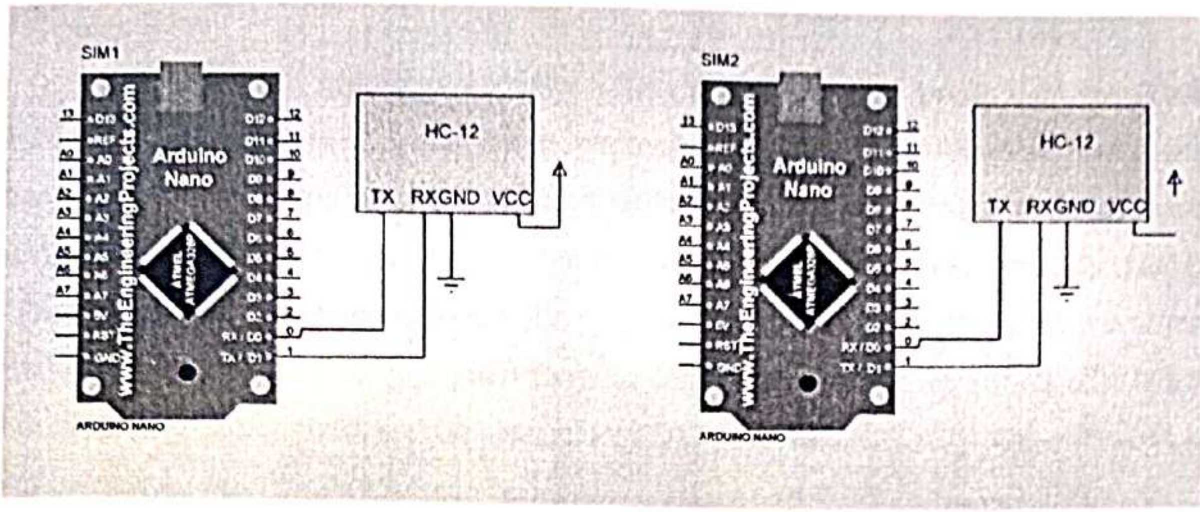
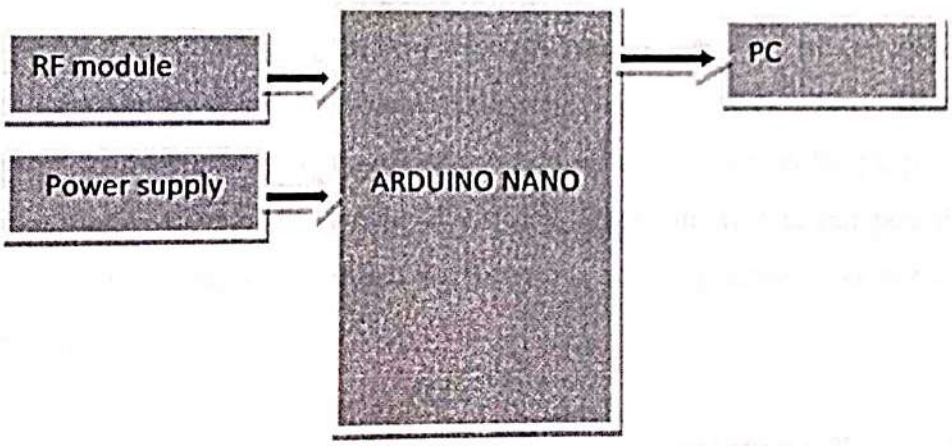


CIRCUIT:


SIM1
Arduino Nano
www.TheEngineeringProjects.com
HC-12
TX RXGND VCC
ARDUINO NANO
SIM2
Arduino Nano
www.TheEngineeringProjects.com
HC-12
TX RXGND VCC
ARDUINO NANO


RF module
Power supply
ARDUINO NANO
PC

EMBEDDED SYSTEMS:

Introduction:

An embedded system is a system which is going to do a predefined specified task is the embedded system and is even defined as combination of both software and hardware. A general-purpose definition of embedded systems is that they are devices used to control, monitor or assist the operation of equipment, machinery or plant. "Embedded" reflects the fact that they are an integral part of the system. At the other extreme a general-purpose computer may be used to control the operation of a large complex processing plant, and its presence will be obvious.

All embedded systems are including computers or microprocessors. Some of these computers are however very simple systems as compared with a personal computer.

The very simplest embedded systems are capable of performing only a single function or set of functions to meet a single predetermined purpose. In more complex systems an application program that enables the embedded system to be used for a particular purpose in a specific application determines the functioning of the embedded system. The ability to have programs means that the same embedded system can be used for a variety of different purposes. In some cases a microprocessor may be designed in such a way that application software for a particular purpose can be added to the basic software in a second process, after which it is not possible to make further changes. The applications software on such processors is sometimes referred to as firmware.

The simplest devices consist of a single microprocessor (often called a "chip"), which may itself be packaged with other chips in a hybrid system or Application Specific Integrated Circuit (ASIC). Its input comes from a detector or sensor and its output goes to a switch or activator which (for example) may start or stop the operation of a machine or, by operating a valve, may control the flow of fuel to an engine.

As the embedded system is the combination of both software and hardware

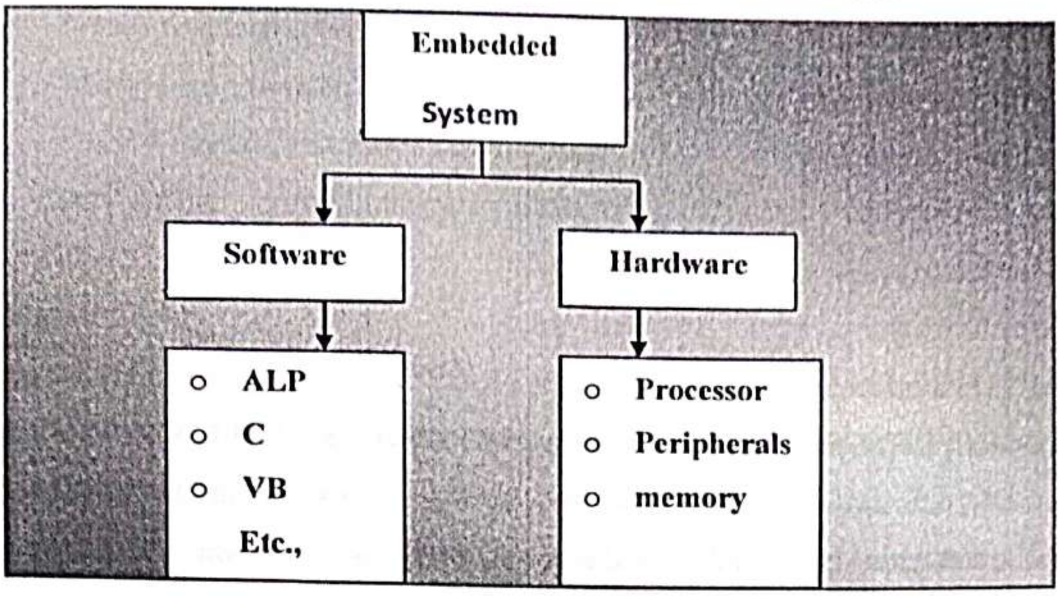


Figure: Block diagram of Embedded System

Software deals with the languages like ALP, C, and VB etc., and Hardware deals with Processors, Peripherals, and Memory.

Memory: It is used to store data or address.

Peripherals: These are the external devices connected

Processor: It is an IC which is used to perform some task

Applications of embedded systems

- Manufacturing and process control
- Construction industry
- Transport
- Buildings and premises
- Domestic service
- Communications
- Office systems and mobile equipment
- Banking, finance and commercial
- Medical diagnostics, monitoring and life support
- Testing, monitoring and diagnostic systems

Processors are classified into four types like:

- Micro Processor (µp)
- Micro controller (µc)
- Digital Signal Processor (DSP)
- Application Specific Integrated Circuits (ASIC)

Micro Processor (µp):

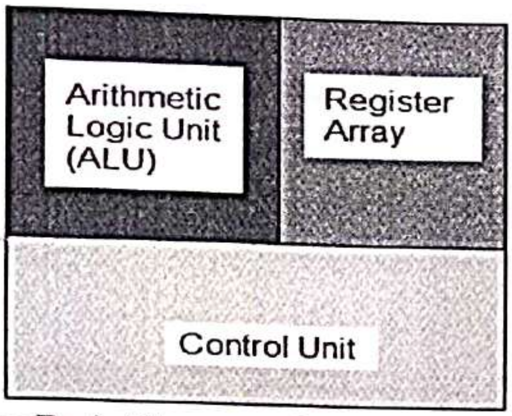
A silicon chip that contains a CPU. In the world of personal computers, the terms microprocessor and CPU are used interchangeably. At the heart of all personal computers and most workstations sits a microprocessor. Microprocessors also control the logic of almost all digital devices, from clock radios to fuel-injection systems for automobiles.

Three basic characteristics differentiate microprocessors:

- **Instruction set**: The set of instructions that the microprocessor can execute.
- **Bandwidth :** The number of bits processed in a single instruction.
- **Clock speed :** Given in megahertz (MHz), the clock speed determines how many instructions per second the processor can execute.

In both cases, the higher the value, the more powerful the CPU. For example, a 32-bit microprocessor that runs at 50MHz is more powerful than a 16-bit microprocessor that runs at 25MHz. In addition to bandwidth and clock speed, microprocessors are classified as being either RISC (reduced instruction set computer) or CISC (complex instruction set computer).

A microprocessor has three basic elements, as shown above. The ALU performs all arithmetic computations, such as addition, subtraction and logic operations (AND, OR, etc). It is controlled by the Control Unit and receives its data from the Register Array. The Register Array is a set of registers used for storing data. These registers can be accessed by the ALU very quickly. Some registers have specific functions - we will deal with these later. The Control Unit controls the entire process. It provides the timing and a control signal for getting data into and out of the registers and the ALU and it synchronizes the execution of instructions (we will deal with instruction execution at a later date).



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Micro Controller (μc):

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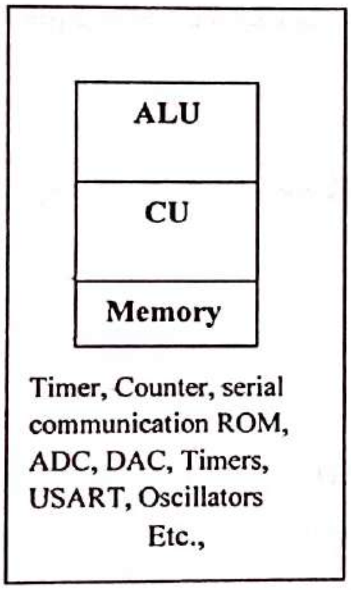

Figure: Block Diagram of Micro Controller (μc)

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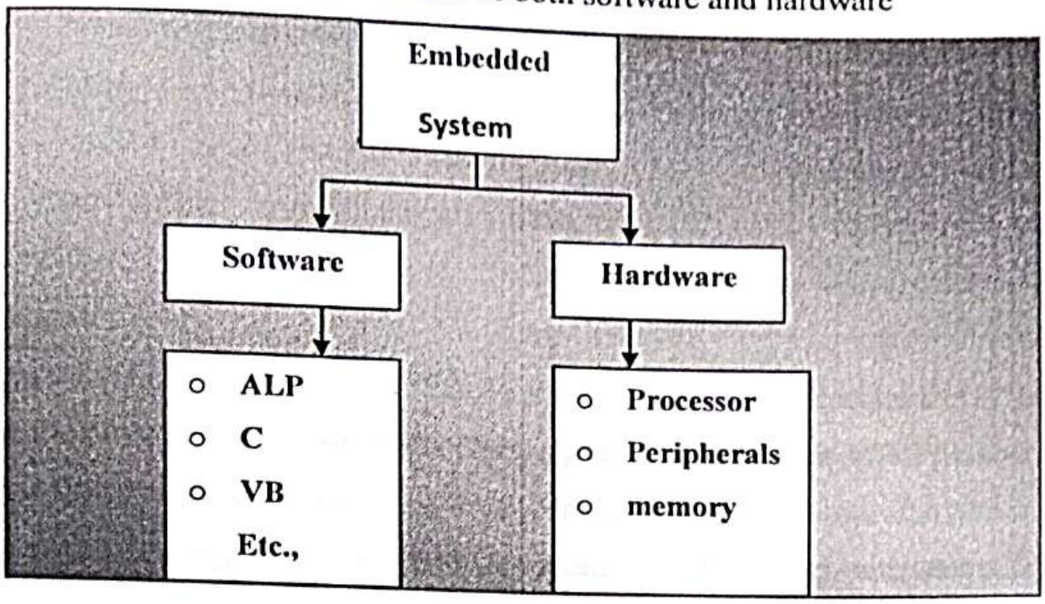

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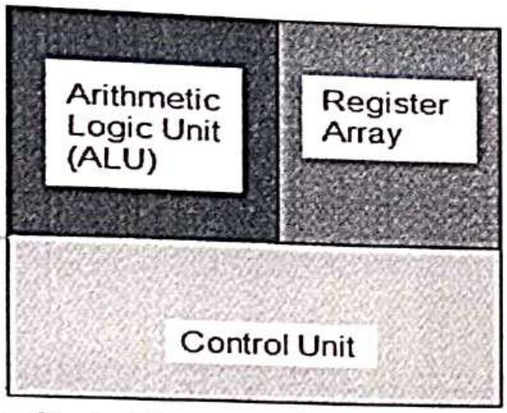

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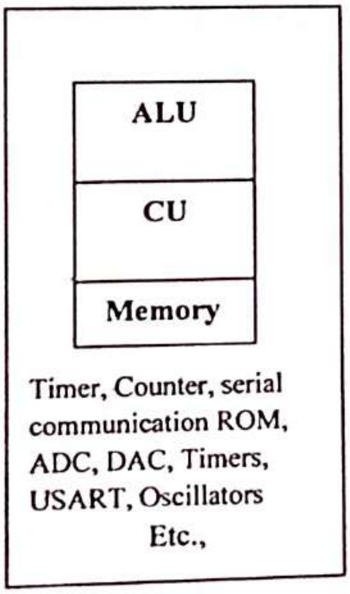

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Application Specific Integrated Circuit (ASIC)

ASIC is a combination of digital and analog circuits packed into an IC to achieve the desired control/computation function

ASIC typically contains

- CPU cores for computation and control
- Peripherals to control timing critical functions
- Memories to store data and program
- Analog circuits to provide clocks and interface to the real world which is analog in nature
- I/Os to connect to external components like LEDs, memories, monitors etc.

Computer Instruction Set

There are two different types of computer instruction set there are:

1. RISC (Reduced Instruction Set Computer) and
2. CISC (Complex Instruction Set computer)

Reduced Instruction Set Computer (RISC)

A RISC (reduced instruction set computer) is a microprocessor that is designed to perform a smaller number of types of computer instruction so that it can operate at a higher speed (perform more million instructions per second, or millions of instructions per second). Since each instruction type that a computer must perform requires additional transistors and circuitry, a larger list or set of computer instructions tends to make the microprocessor more complicated and slower in operation.

Besides performance improvement, some advantages of RISC and related design improvements are:

- A new microprocessor can be developed and tested more quickly if one of its aims is to be less complicated.
- Operating system and application programmers who use the microprocessor's instructions will find it easier to develop code with a smaller instruction set.
- The simplicity of RISC allows more freedom to choose how to use the space on a microprocessor.

Higher-level language compilers produce more efficient code than formerly because they have always tended to use the smaller set of instructions to be found in a RISC computer.

RISC characteristics

- **Simpleinstructionset:**

  In a RISC machine, the instruction set contains simple, basic instructions, from which more complex instructions can be composed.
- **Samelengthinstructions.**

  Each instruction is the same length, so that it may be fetched in a single operation.
- **1machine-cycleinstructions.**

  Most instructions complete in one machine cycle, which allows the processor to handle several instructions at the same time. This pipelining is a key technique used to speed up RISC machines.

Complex Instruction Set Computer (CISC)

CISC, which stands for **Complex Instruction Set Computer,** is a philosophy for designing chips that are easy to program and which make efficient use of memory. Each instruction in a CISC instruction set might perform a series of operations inside the processor. This reduces the number of instructions required to implement a given program, and allows the programmer to learn a small but flexible set of instructions.

The advantages of CISC

At the time of their initial development, CISC machines used available technologies to optimize computer performance.

- Microprogramming is as easy as assembly language to implement, and much less expensive than hardwiring a control unit.
- The ease of micro-coding new instructions allowed designers to make CISC machines upwardly compatible: a new computer could run the same programs as earlier computers because the new computer would contain a superset of the instructions of the earlier computers.
- As each instruction became more capable, fewer instructions could be used to implement a given task. This made more efficient use of the relatively slow main memory.
- Because micro program instruction sets can be written to match the constructs of high-level languages, the compiler does not have to be as complicated.

The disadvantages of CISC

Still, designers soon realized that the CISC philosophy had its own problems, including:

- Earlier generations of a processor family generally were contained as a subset in every new version --- so instruction set & chip hardware become more complex with each generation of computers.
- So that as many instructions as possible could be stored in memory with the least possible wasted space, individual instructions could be of almost any length--- this means that different instructions will take different amounts of clock time to execute, slowing down the overall performance of the machine.
- Many specialized instructions aren't used frequently enough to justify their existence --- approximately 20% of the available instructions are used in a typical program.
- CISC instructions typically set the condition codes as a side effect of the instruction. Not only does setting the condition codes take time, but programmers have to remember to examine the condition code bits before a subsequent instruction changes them.

Memory Architecture

There two different type's memory architectures there are:

- Harvard Architecture
- Von-Neumann Architecture

Harvard Architecture

Computers have separate memory areas for program instructions and data. There are two or more internal data buses, which allow simultaneous access to both instructions and data. The CPU fetches program instructions on the program memory bus.

The **Harvard architecture** is a computer architecture with physically separate storage and signal pathways for instructions and data. The term originated from the Harvard Mark I relay-based computer, which stored instructions on punched tape (24 bits wide) and data in electro-mechanical counters. These early machines had limited data storage, entirely contained within the central processing unit, and provided no access to the instruction storage as data. Programs needed to be loaded by an operator, the processor could not boot itself.

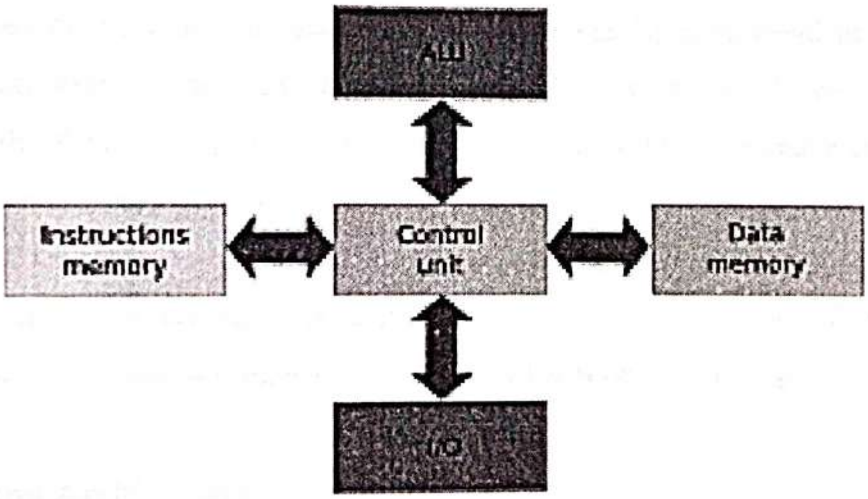


Figure: Harvard Architecture

Modern uses of the Harvard architecture:

The principal advantage of the pure Harvard architecture - simultaneous access to more than one memory system - has been reduced by modified Harvard processors using modern CPU cache systems. Relatively pure Harvard architecture machines are used mostly in applications where tradeoffs, such as the cost and power savings from omitting caches, outweigh the programming penalties from having distinct code and data address spaces.

- Digital signal processors (DSPs) generally execute small, highly-optimized audio or video processing algorithms. They avoid caches because their behavior must be extremely reproducible. The difficulties of coping with multiple address spaces are of secondary concern to speed of execution. As a result, some DSPs have multiple data memories in distinct address spaces to facilitate SIMD and VLIW processing. Texas Instruments TMS320 C55x processors, as one example, have multiple parallel data busses (two write, three read) and one instruction bus.
- Microcontrollers are characterized by having small amounts of program (flash memory) and data (SRAM) memory, with no cache, and take advantage of the Harvard architecture to speed processing by concurrent instruction and data access. The separate storage means the program and data memories can have different bit depths, for example using 16-bit wide instructions and 8-bit wide data. They also mean that instruction pre-fetch can be performed in parallel with other activities. Examples include, the AVR by Atmel Corp, the PIC by Microchip Technology, Inc. and the ARM Cortex-M3 processor (not all ARM chips have Harvard architecture).

Even in these cases, it is common to have special instructions to access program memory as data for read-only tables, or for reprogramming.

Von-Neumann Architecture

A computer has a single, common memory space in which both program instructions and data are stored. There is a single internal data bus that fetches both instructions and data. They cannot be performed at the same time

The **von Neumann architecture** is a design model for a stored-program digital computer that uses a central processing unit (CPU) and a single separate storage structure ("memory") to hold both instructions and data. It is named after the mathematician and early computer scientist John von Neumann. Such computers implement a universal Turing machine and have a sequential architecture.

A **stored-program** digital computer is one that keeps its programmed instructions, as well as its data, in read-write, random-access memory (RAM). Stored-program computers were advancement over the program-controlled computers of the 1940s, such as the Colossus and the ENIAC, which were programmed by setting switches and inserting patch leads to route data and to control signals between various functional units. In the vast majority of modern computers, the same memory is used for both data and program instructions. The mechanisms for transferring the data and instructions between the CPU and memory are, however, considerably more complex than the original von Neumann architecture.

The terms "von Neumann architecture" and "stored-program computer" are generally used interchangeably, and that usage is followed in this article.

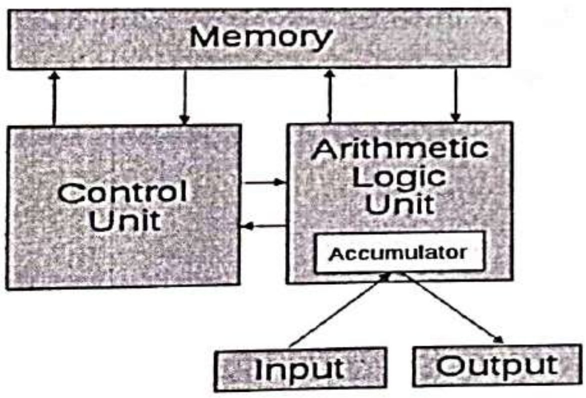


Figure: Schematic of the Von-Neumann Architecture.

Basic Difference between Harvard and Von-Neumann Architecture

- The primary difference between Harvard architecture and the Von Neumann architecture is in the Von Neumann architecture data and programs are stored in the same memory and managed by the same information handling system.
- Whereas the Harvard architecture stores data and programs in separate memory devices and they are handled by different subsystems.

- In a computer using the Von-Neumann architecture without cache; the central processing unit (CPU) can either be reading and instruction or writing/reading data to/from the memory. Both of these operations cannot occur simultaneously as the data and instructions use the same system bus.
- In a computer using the Harvard architecture the CPU can both read an instruction and access data memory at the same time without cache. This means that a computer with Harvard architecture can potentially be faster for a given circuit complexity because data access and instruction fetches do not contend for use of a single memory pathway.
- Today, the vast majority of computers are designed and built using the Von Neumann architecture template primarily because of the dynamic capabilities and efficiencies gained in designing, implementing, operating one memory system as opposed to two. Von Neumann architecture may be somewhat slower than the contrasting Harvard Architecture for certain specific tasks, but it is much more flexible and allows for many concepts unavailable to Harvard architecture such as self programming, word processing and so on.
- Harvard architectures are typically only used in either specialized systems or for very specific uses. It is used in specialized digital signal processing (DSP), typically for video and audio processing products. It is also used in many small microcontrollers used in electronics applications such as Advanced RISK Machine (ARM) based products for many vendors.

Description

The Arduino UNO R3 is the perfect board to get familiar with electronics and coding. This versatile microcontroller is equipped with the well-known ATmega328P and the ATMega 16U2 Processor.

This board will give you a great first experience within the world of Arduino.

Target areas:

Maker, introduction, industries

Features

- **ATMega328P** Processor
- **Memory**
- AVR CPU at up to 16 MHz 32KB Flash
- 2KB SRAM
- 1KB EEPROM

Security

- Power On Reset (POR)
- Brown Out Detection (BOD)

Peripherals

- 2x 8-bit Timer/Counter with a dedicated period register and compare channels
- 1x 16-bit Timer/Counter with a dedicated period register, input capture and compare channels 1x USART with fractional baud rate generator and start-of-frame detection
- 1x controller/peripheral Serial Peripheral Interface (SPI) 1x Dual mode controller/peripheral I2C
- 1x Analog Comparator (AC) with a scalable reference input Watchdog Timer with separate on-chip oscillator
- Six PWM channels
- Interrupt and wake-up on pin change

ATMega16U2 Processor

- 8-bit AVR® RISC-based microcontroller

Memory

- 16 KB ISP Flash
- 512B EEPROM
- 512B SRAM
- debugWIRE interface for on-chip debugging and programming

Power

- 2.7-5.5 volts

1. The Board

Application Examples

The UNO board is the flagship product of Arduino. Regardless if you are new to the world of electronics or will use the UNO as a tool for education purposes or industry-related tasks.

First entry to electronics: If this is your first project within coding and electronics, get started with our most used and documented board; Arduino UNO. It is equipped with the well-known ATmega328P processor, 14 digital input/output pins, 6 analog inputs, USB connections, ICSP header and reset button. This board includes everything you will need for a great first experience with Arduino.

Industry-standard development board: Using the Arduino UNO board in industries, there are a range of companies using the UNO board as the brain for their PLC's.

Education purposes: Although the UNO board has been with us for about ten years, it is still widely used for various education purposes and scientific projects. The board's high standard and top quality performance makes it a great resource to capture real time from sensors and to trigger complex laboratory equipment to mention a few examples.

Related Products

- Starter Kit
- Tinkerkit Braccio
- Robot Example

2. Ratings

Recommended Operating Conditions

Symbol	Description	Min	Max
	Conservative thermal limits for the whole board:	-40 °C (-40°F)	85 °C (185°F)

NOTE: In extreme temperatures, EEPROM, voltage regulator, and the crystal oscillator, might not work as expected due to the extreme temperature conditions

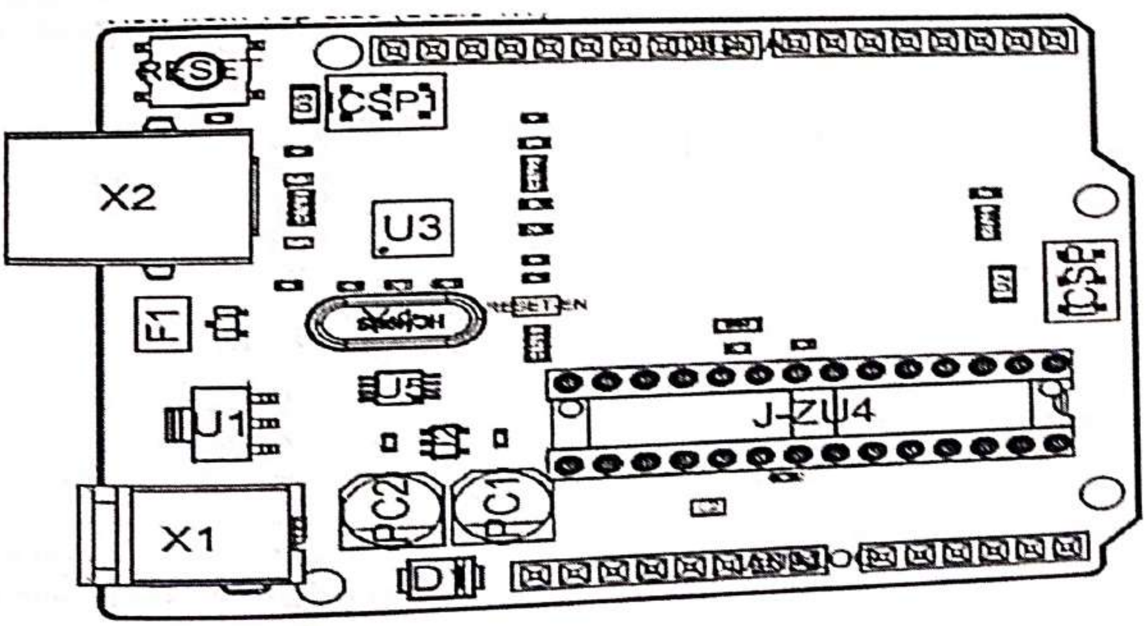
Power Consumption

Symbol	Description	Min	Typ	Max	Unit
VINMax	Maximum input voltage from VIN pad	6	-	20	V
VUSBMax	Maximum input voltage from USB connector		-	5.5	V
PMax	Maximum Power Consumption	-	-	xx	mA

3. Functional Overview

Board Topology

Top view



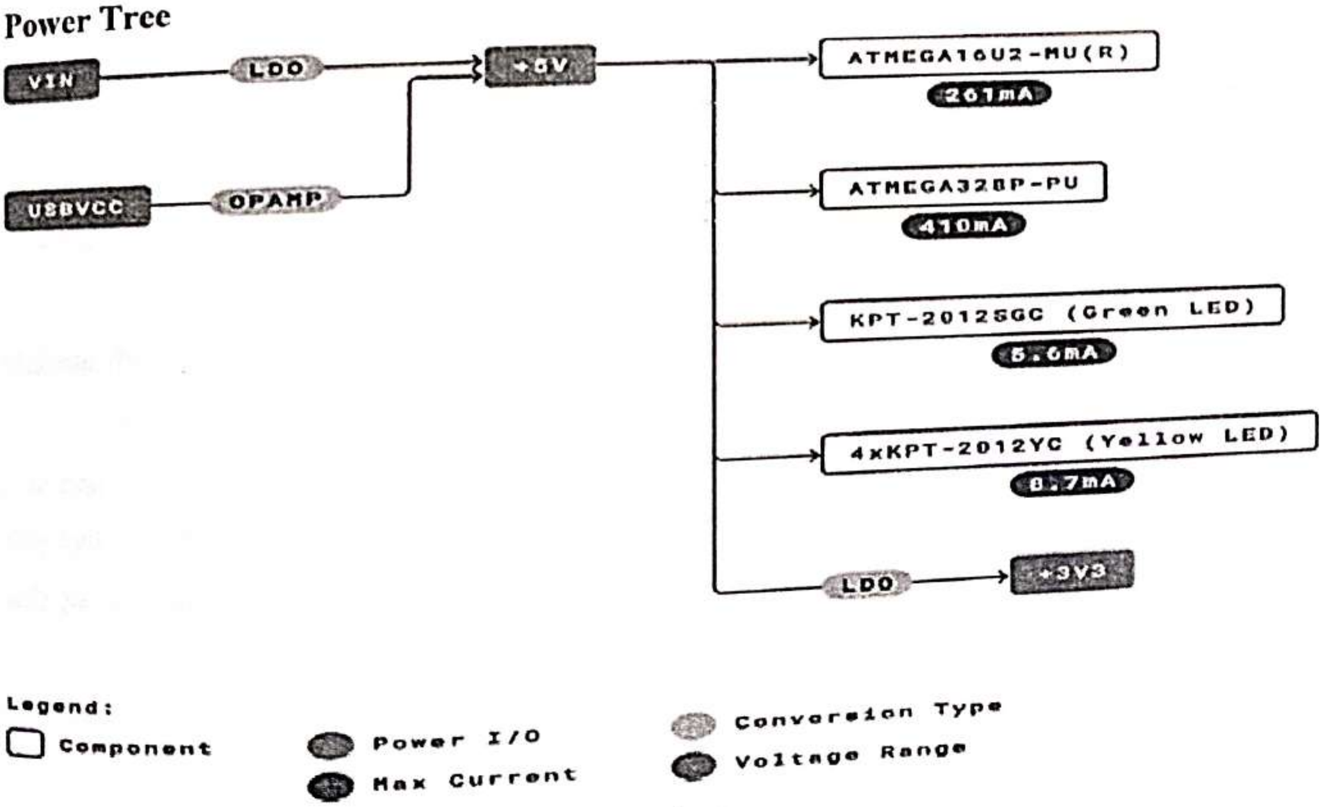
Board topology

Ref.	Description	Ref.	Description
X1	Power jack 2.1x5.5mm	U1	SPX1117M3-L-5 Regulator
X2	USB B Connector	U3	ATMEGA16U2 Module
PC1	EEE-1EA470WP 25V SMD Capacitor	U5	LMV358LIST-A.9 IC
PC2	EEE-1EA470WP 25V SMD Capacitor	F1	Chip Capacitor, High Density
D1	CGRA4007-G Rectifier	ICSP	Pin header connector (through hole 6)
J-ZU4	ATMEGA328P Module	ICSP1	Pin header connector (through hole 6)
Y1	ECS-160-20-4X-DU Oscillator		

Processor

The Main Processor is a ATmega328P running at up tp 20 MHz. Most of its pins are connected to the external headers, however some are reserved for internal communication with the USB Bridge coprocessor.

Power Tree



Power tree

4. Board Operation

Getting Started - IDE

If you want to program your Arduino UNO while offline you need to install the Arduino Desktop IDE [1] To connect the Arduino UNO to your computer, you'll need a Micro-B USB cable. This also provides power to the board, as indicated by the LED.

Getting Started - Arduino Web Editor

All Arduino boards, including this one, work out-of-the-box on the Arduino Web Editor [2], by just installing a simple plugin.

The Arduino Web Editor is hosted online, therefore it will always be up-to-date with the latest features and support for all boards. Follow [3] to start coding on the browser and upload your sketches onto your board.

Getting Started - Arduino IoT Cloud

All Arduino IoT enabled products are supported on Arduino IoT Cloud which allows you to Log, graph and analyze sensor data, trigger events, and automate your home or business.

Sample Sketches

Sample sketches for the Arduino XXX can be found either in the "Examples" menu in the Arduino IDE or in the "Documentation" section of the Arduino Pro website [4]

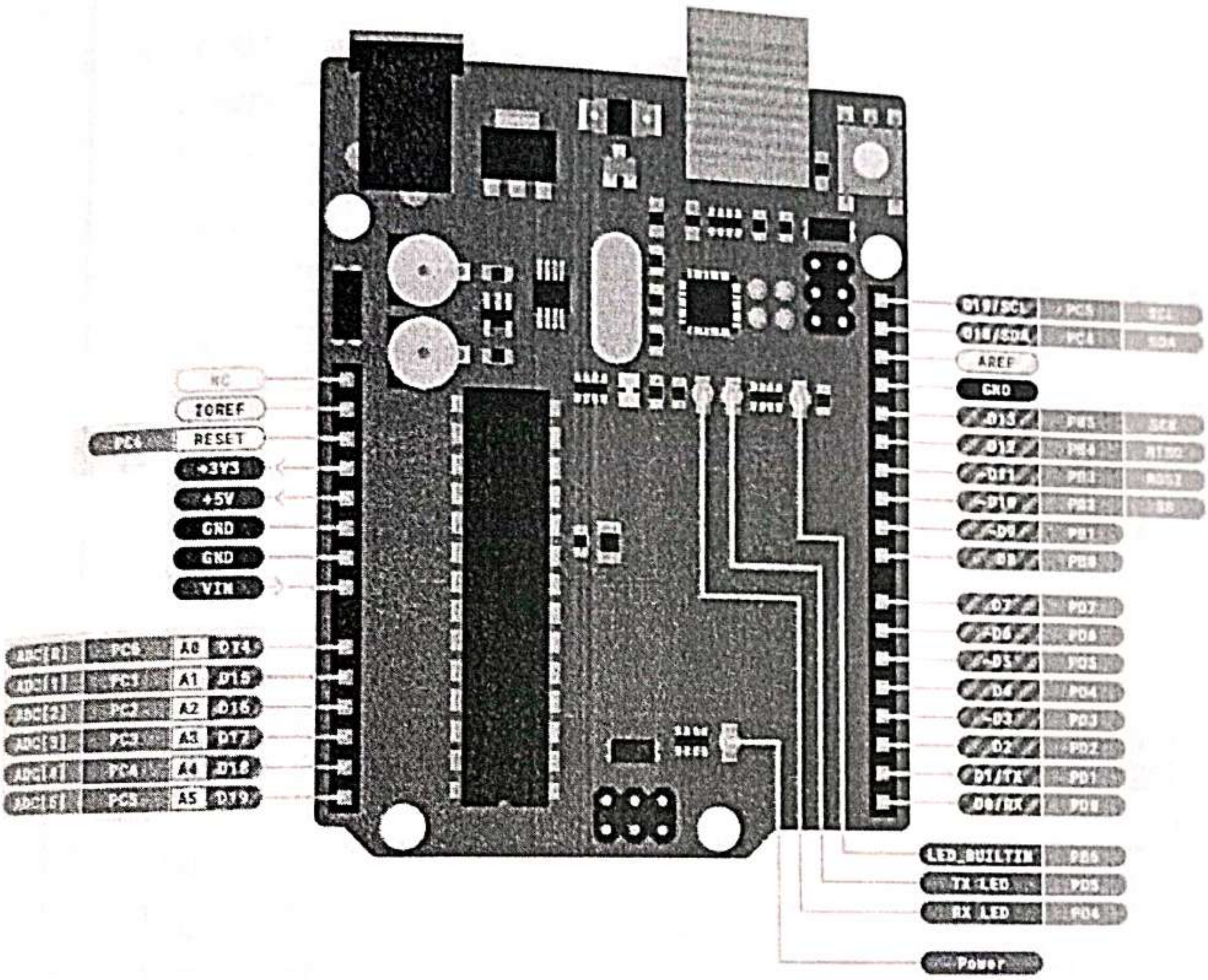
Online Resources

Now that you have gone through the basics of what you can do with the board you can explore the endless possibilities it provides by checking exciting projects on ProjectHub [5], the Arduino Library Reference [6] and the online store [7] where you will be able to complement your board with sensors, actuators and more

Board Recovery

All Arduino boards have a built-in bootloader which allows flashing the board via USB. In case a sketch locks up the processor and the board is not reachable anymore via USB it is possible to enter bootloader mode by double- tapping the reset button right after power up.

5. Connector Pinouts



Pinout

JANALOG

Pin	Function	Type	Description
1	NC	NC	Not connected
2	IOREF	IOREF	Reference for digital logic V - connected to 5V
3	Reset	Reset	Reset
4	+3V3	Power	+3V3 Power Rail
5	+5V	Power	+5V Power Rail
6	GND	Power	Ground
7	GND	Power	Ground
8	VIN	Power	Voltage Input
9	A0	Analog/GPIO	Analog input 0 /GPIO
10	A1	Analog/GPIO	Analog input 1 /GPIO
11	A2	Analog/GPIO	Analog input 2 /GPIO
12	A3	Analog/GPIO	Analog input 3 /GPIO
13	A4/SDA	Analog input/I2C	Analog input 4/I2C Data line
14	A5/SCL	Analog input/I2C	Analog input 5/I2C Clock line

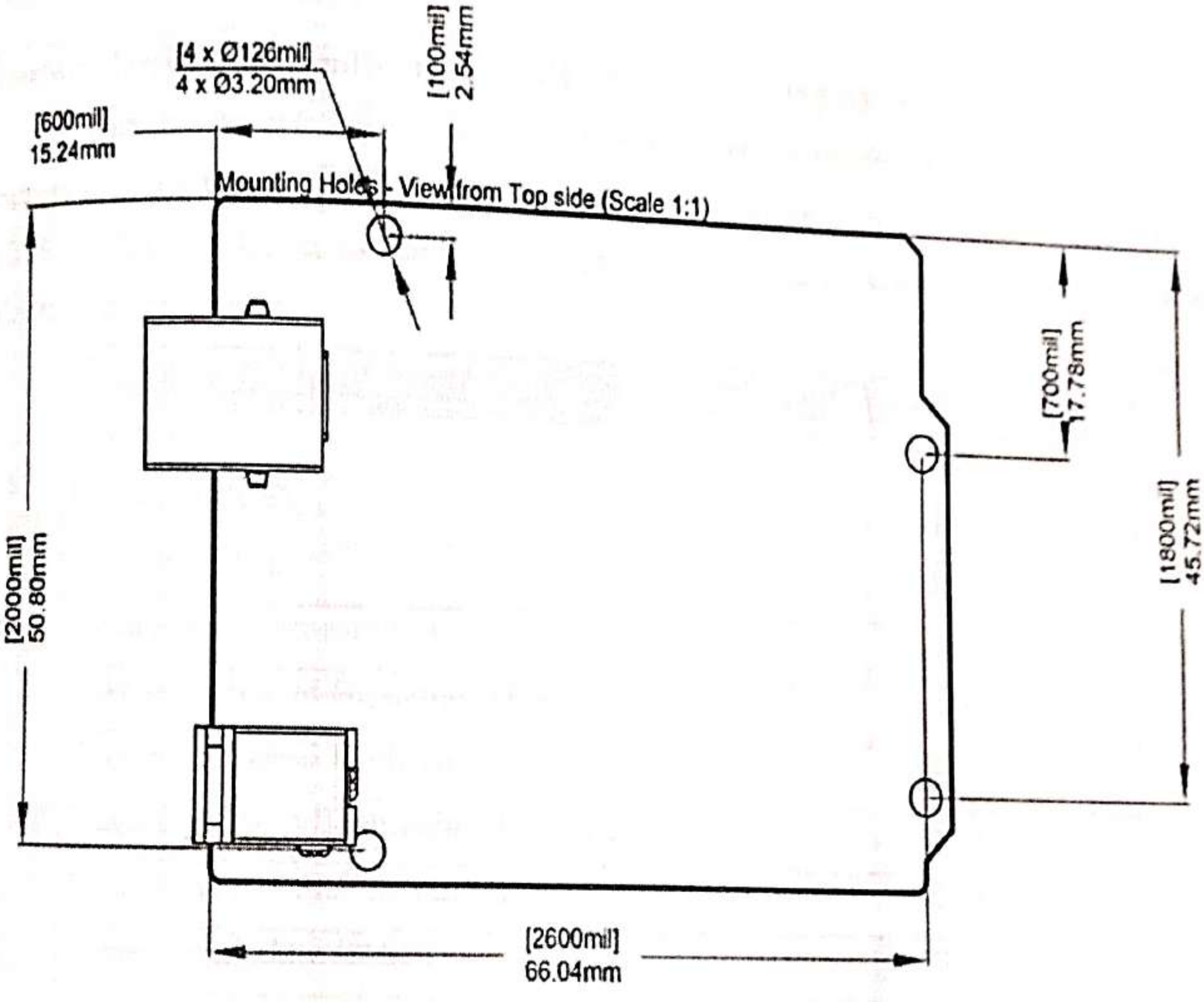
JDIGITAL

Pin	Function	Type	Description
1	D0	Digital/GPIO	Digital pin 0/GPIO
2	D1	Digital/GPIO	Digital pin 1/GPIO
3	D2	Digital/GPIO	Digital pin 2/GPIO
4	D3	Digital/GPIO	Digital pin 3/GPIO
5	D4	Digital/GPIO	Digital pin 4/GPIO
6	D5	Digital/GPIO	Digital pin 5/GPIO
7	D6	Digital/GPIO	Digital pin 6/GPIO
8	D7	Digital/GPIO	Digital pin 7/GPIO
9	D8	Digital/GPIO	Digital pin 8/GPIO
10	D9	Digital/GPIO	Digital pin 9/GPIO
11	SS	Digital	SPI Chip Select
12	MOSI	Digital	SPI1 Main Out Secondary In

13	MISO	Digital	SPI Main In Secondary Out
14	SCK	Digital	SPI serial clock output
15	GND	Power	Ground
16	AREF	Digital	Analog reference voltage
17	A4/SD4	Digital	Analog input 4/I2C Data line (duplicated)
18	A5/SD5	Digital	Analog input 5/I2C Clock line (duplicated)

Mechanical Information

Board Outline & Mounting Holes



Board outline

6. Certifications

Declaration of Conformity CE DoC (EU)

We declare under our sole responsibility that the products above are in conformity with the essential requirements of the following EU Directives and therefore qualify for free movement within markets comprising the European Union (EU) and European Economic Area (EEA).

ROHS 2 Directive 2011/65/EU	
Conforms to:	EN50581:2012
Directive 2014/35/EU. (LVD)	
Conforms to:	EN 60950-1:2006/A11:2009/A1:2010/A12:2011/AC:2011
Directive 2004/40/EC & 2008/46/EC & 2013/35/EU, EMF	
Conforms to:	EN 62311:2008

Declaration of Conformity to EU RoHS & REACH 211 01/19/2021

Arduino boards are in compliance with RoHS 2 Directive 2011/65/EU of the European Parliament and RoHS 3 Directive 2015/863/EU of the Council of 4 June 2015 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

Substance	Maximum limit (ppm)
Lead (Pb)	1000
Cadmium (Cd)	100
Mercury (Hg)	1000
Hexavalent Chromium (Cr6+)	1000
Poly Brominated Biphenyls (PBB)	1000
Poly Brominated Diphenyl ethers (PBDE)	1000
Bis(2-Ethylhexyl} phthalate (DEHP)	1000
Benzyl butyl phthalate (BBP)	1000
Dibutyl phthalate (DBP)	1000
Diisobutyl phthalate (DIBP)	1000

Exemptions: No exemptions are claimed.

Arduino Boards are fully compliant with the related requirements of European Union Regulation (EC) 1907 /2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH). We declare none of the SVHCs (https://echa.europa.eu/web/guest/candidate-list-table), the Candidate List of Substances of Very High Concern for authorization currently released by ECHA, is present in all products (and also package) in quantities totaling in a concentration equal or above 0.1%. To the best of our knowledge, we also declare that our products do not contain any of the substances listed on the "Authorization List" (Annex XIV of the REACH regulations) and Substances of Very High Concern (SVHC) in any significant amounts as specified by the Annex XVII of Candidate list published by ECHA (European Chemical Agency) 1907 /2006/EC.

Conflict Minerals Declaration

As a global supplier of electronic and electrical components, Arduino is aware of our obligations with regards to laws and regulations regarding Conflict Minerals, specifically the Dodd-Frank Wall Street Reform and Consumer Protection Act, Section 1502. Arduino does not directly source or process conflict minerals such as Tin, Tantalum, Tungsten, or Gold. Conflict minerals are contained in our products in the form of solder, or as a component in metal alloys. As part of our reasonable due diligence Arduino has contacted component suppliers within our supply chain to verify their continued compliance with the regulations. Based on the information received thus far we declare that our products contain Conflict Minerals sourced from conflict-free areas.

7. FCC Caution

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference

(2) this device must accept any interference received, including interference that may cause undesired operation.

FCC RF Radiation Exposure Statement:

1. This Transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
2. This equipment complies with RF radiation exposure limits set forth for an uncontrolled environment.
3. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

English: User manuals for license-exempt radio apparatus shall contain the following or equivalent notice in a conspicuous location in the user manual or alternatively on the device or both. This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

(1) This device may not cause interference

(2) This device must accept any interference, including interference that may cause undesired operation of the device.

French: Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

(1) l' appareil nedoit pas produire de brouillage

(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

IC SAR Warning:

English This equipment should be installed and operated with minimum distance 20 cm between the radiator and your body.

French: Lors de l' installation et de l' exploitation de ce dispositif, la distance entre le radiateur et le corps est d 'au moins 20 cm.

Important: The operating temperature of the EUT can't exceed 85°C and shouldn't be lower than -40°C.

Hereby, Arduino S.r.l. declares that this product is in compliance with essential requirements and other relevant provisions of Directive 2014/53/EU. This product is allowed to be used in all EU member states.

8. Company Information

Company name	Arduino S.r.l
Company Address	Via Andrea Appiani 25 20900 MONZA Italy

9. Reference Documentation

Reference	Link
Arduino IDE (Desktop)	https://www.arduino.cc/en/Main/Software
Arduino IDE (Cloud)	https://create.arduino.cc/editor
Cloud IDE Getting Started	https://create.arduino.cc/projecthub/Arduino_Genuino/getting-started-with-arduino- web-editor-4b3e4a
Arduino Pro Website	https://www.arduino.cc/pro
Project Hub	https://create.arduino.cc/projecthub?by=part&part_id=11332&sort=trending
Library Reference	https://www.arduino.cc/reference/en/
Online Store	https://store.arduino.cc/

10. Revision History

Date	Revision	Changes
xx/06/2021	1	Datasheet release

ARDUINO IDE

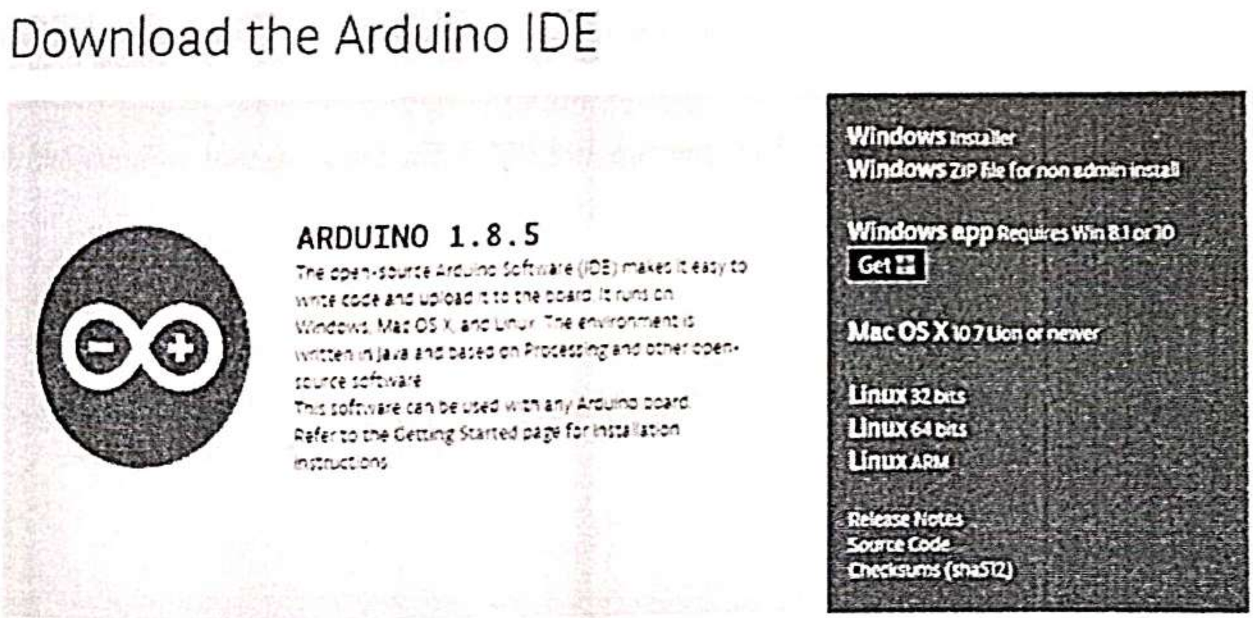
You decided to go and buy yourself an Arduino, but once it arrived, you realized you have no idea what to do with it. Do not panic, for help is at hand! In this how-to, we will look at how to get started with Arduino microcontroller boards. We'll cover software installation, as well as connecting and configuring the Arduino IDE.

You Will Need

- Arduino Uno
- USB B Cable
- Windows 10, Windows 8, Windows 7, Mac, or Linux OS
- Arduino IDE
- About 15 minutes

Step 1: Download and Install the IDE

You can download the IDE from the official Arduino website. Since the Arduino uses a USB to serial converter (which allow it to communicate with the host computer), the Arduino board is compatible with most computers that have a USB port. Of course, you will need the IDE first. Luckily, the Arduino designers have released multiple versions of the IDE for different operating systems, including Windows, Mac, and Linux. In this tutorial, we will use Window 10, so ensure that you download the correct version of the IDE if you do not have Windows 10.



Once downloaded, install the IDE and ensure that you enable most (if not all) of the options, INCLUDING the drivers.

Step 2: Get the Arduino COM Port Number

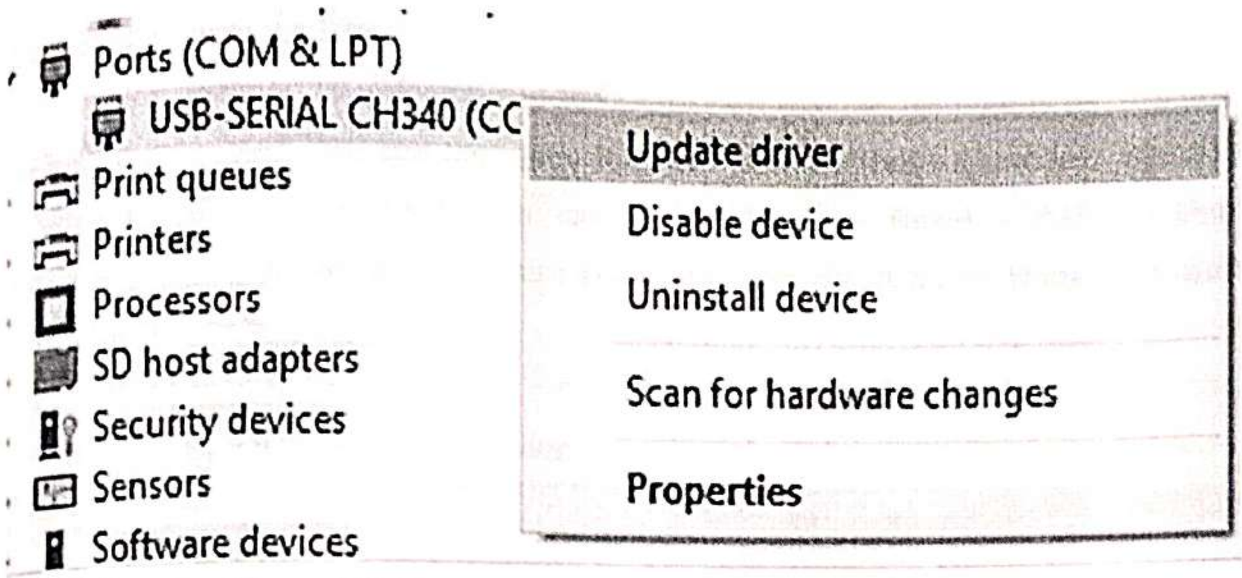
Next, you'll need to connect the Arduino Uno board to the computer. This is done via a USB B connection. Thanks to the wonderful world of USB, we do not need to provide power to the Arduino, as the USB provides 5V up to 2A. When the Arduino is connected, the operating system should recognize the board as a generic COM port (for example, my Arduino Uno uses a CH340G, which is an RS-232 serial to USB converter). Once it's recognized, we will need to find out what port number it has been assigned. The easiest way to do this is to type "device manager" into Windows Search and select Device Manager when it shows.

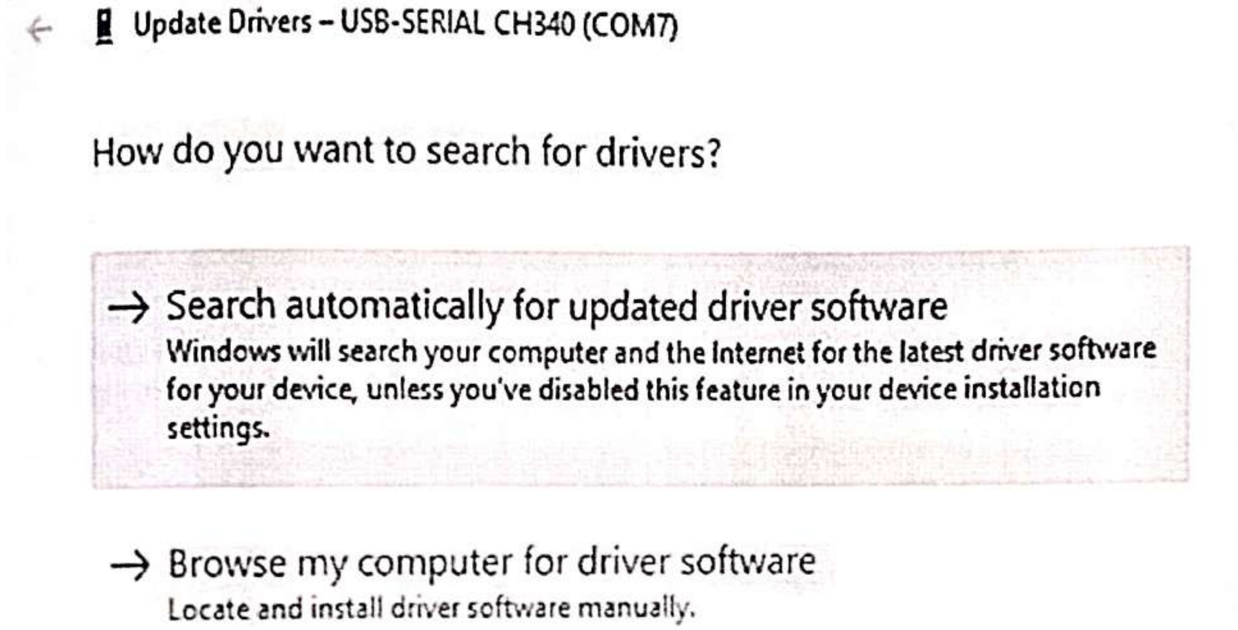
In the Device Manager window, look for a device under "Ports (COM & LPT)", and chances are the Arduino will be the only device on the list. In my Device Manager, the Arduino shows up as COM7 (I know this because CH340 is in the device name).

Be warned, the Arduino won't always be recognized automatically. If your Arduino is not recognized. then uninstall the driver, remove the Arduino, reinsert the Arduino, find the unrecognized device, right click "Update driver", and then click "Search automatically". This should fix 99 out of 100 problems.

If the Arduino is not recognized, update the driver.

In the window that appears, click "Search automatically".





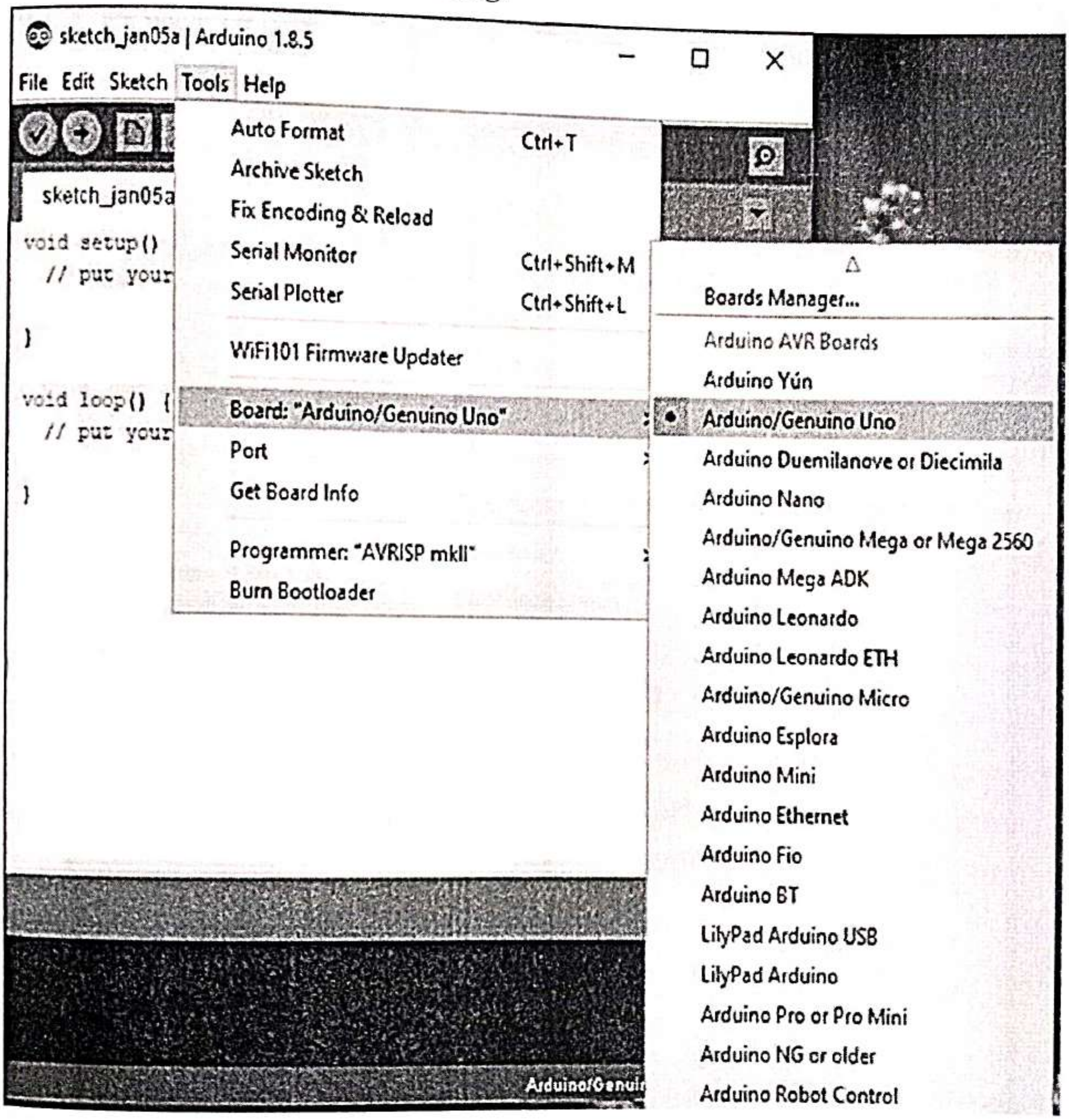
Windows can be a real pain sometimes with COM ports, as it can magically change their numbers between connections. In other words, one day, your Arduino may be on port 7 (as shown here), but then on other days, Windows may shift it to a different port number. As I understand it, this happens when you connect other COM ports to your system (which I do frequently).

So, if you can't find your Arduino on the port that you usually use, just go to your Device Manager and check what port it's actually on and, if necessary, update your driver.

Step 3: Configure the IDE

Now that we have determined the COM port that the Arduino is on, it's time to load the Arduino IDE and configure it to use the same device and port. Start by loading the IDE. Once it's loaded, navigate to Tools > Board > Arduino Uno. However, if you are using a different board (i.e., not the Arduino Uno), you must select the proper board!

Tell the IDE which board you are using.

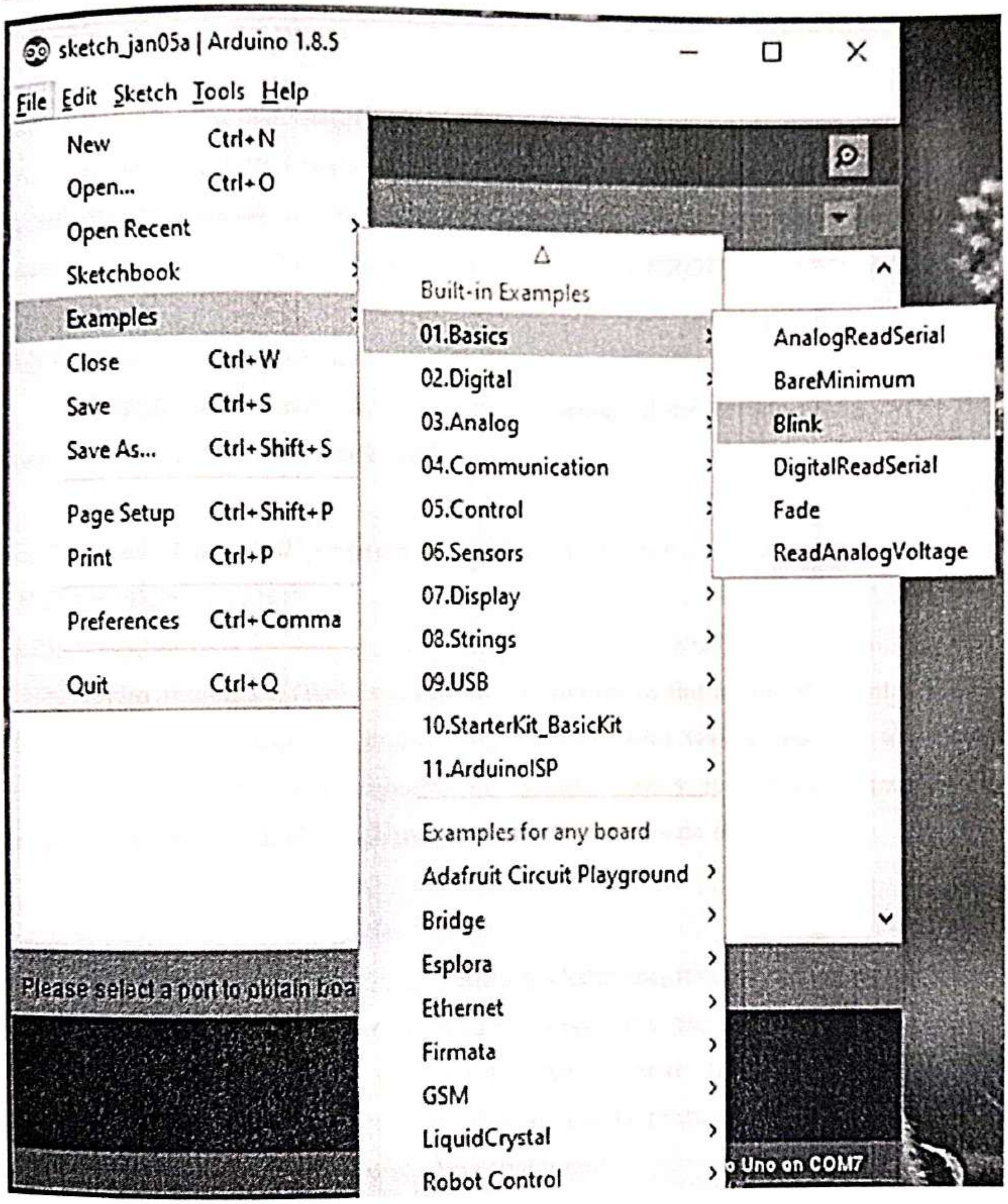


Next, you must tell the IDE which COM port the Arduino is on. To do this, navigate to Tools > Port > COM7. Obviously, if your Arduino is on a different port, select that port instead.

Step 4: Loading a Basic Example

For the sake of simplicity, we will load an example project that the Arduino IDE comes with. This example will make the onboard LED blink for a second continuously. To load this example, click File > Examples > 01.Basics > Blink.

Load the blink example.



With the example loaded, it's time to verify and upload the code. The verify stage checks the code for errors, then compiles the ready-for-uploading code to the Arduino. The upload stage actually takes the binary data, which was created from the code, and uploads it to the Arduino via the serial port.

To verify and compile the code, press the check mark button in the upper left window.

The "Verify" button will compile the Arduino code.

If the compilation stage was successful, you should see the following message in the output window at the bottom of the IDE. You might also see a similar message—just it's one that does not have words like "ERROR" and "WARNING".

This is a successful compilation.

With the code compiled, you must now upload it the Arduino Uno. To do this, click the arrow next to the check mark.

The "Upload" button will program the Arduino with your code.

RF COMMUNICATION:

Radio frequency:

Radio frequency (RF) is a rate of oscillation in the range of about 3 kHz to 300 GHz, which corresponds to the frequency of radio waves, and the alternating currents which carry radio signals. RF usually refers to electrical rather than mechanical oscillations, although mechanical RF systems do exist.

General physics of radio signals:

RF communication works by creating electromagnetic waves at a source and being able to pick up those electromagnetic waves at a particular destination. These electromagnetic waves travel through the air at near the speed of light. The wavelength of an electromagnetic signal is inversely proportional to the frequency; the higher the frequency, the shorter the wavelength.

Frequency is measured in Hertz (cycles per second) and radio frequencies are measured in kilohertz (KHz or thousands of cycles per second), megahertz (MHz or millions of cycles per second) and gigahertz (GHz or billions of cycles per second). Higher frequencies result in shorter wavelengths. The wavelength for a 900 MHz device is longer than that of a 2.4 GHz device.

In general, signals with longer wavelengths travel a greater distance and penetrate through, and around objects better than signals with shorter wavelengths.

RF COMMUNICATION:

RF communication stands for Radio Frequency communication in which communication is purely based on radio frequency (3khz to 300ghz).we can send and receive data using Radio frequency.

- RF section consists of two units i.e.,
- TRANSMITTER UNIT
- RECEIVER UNIT
- TRANSMITTER UNIT: In this unit we have RF transmitter with antenna connected to encoder inorder to encode the digital data which is to be transmitted in the form of radio waves.
- RECEIVER UNIT : In this unit we have RF receiver with antenna connected to decoder inorder to decode the digital data which is transmitted by the transmitter unit is received by this unit using radio waves

How does an RF communication system work?

Imagine an RF transmitter wiggling an electron in one location. This wiggling electron causes a ripple effect, somewhat akin to dropping a pebble in a pond. The effect is an electromagnetic (EM) wave that travels out from the initial location resulting in electrons wiggling in remote locations. An RF receiver can detect this remote electron wiggling.

The RF communication system then utilizes this phenomenon by wiggling electrons in a specific pattern to represent information. The receiver can make this same information available at a remote location; communicating with no wires.

In most wireless systems, a designer has two overriding constraints: it must operate over a certain distance (range) and transfer a certain amount of information within a time frame (data rate). Then the economics of the system must work out (price) along with acquiring government agency approvals (regulations and licensing).

How is range determined?

In order to accurately compute range – it is essential to understand a few terms:

dB - Decibels

Decibels are logarithmic units that are often used to represent RF power. To convert from watts to dB: Power in dB = 10* (log x) where x is the power in watts. Another unit of measure that is encountered often is dBm (dB milliwatts). The conversion formula for it is Power in dBm = 10* (log x) where x is the power in milliwatts.

Line-of-site (LOS)

Line-of-site when speaking of RF means more than just being able to see the receiving antenna from the transmitting antenna. In, order to have true line-of-site no objects (including trees, houses or the ground) can be in the Fresnel zone. The Fresnel zone is the area around the visual line-of-sight that radio waves spread out into after they leave the antenna. This area must be clear or else signal strength will weaken. There are essentially two parameters to look at when trying to determine range.

Transmit Power

Transmit power refers to the amount of RF power that comes out of the antenna port of the radio. Transmit power is usually measured in Watts, milliwatts or dBm. (For conversion between watts and dB see below.)

Receiver sensitivity

Receiver sensitivity refers to the minimum level signal the radio can demodulate. It is convenient to use an example with sound waves; Transmit power is how loud someone is yelling and receive sensitivity would be how soft a voice someone can hear. Transmit power and receive sensitivity together constitute what is know as "link budget". The link budget is the total amount of signal attenuation you can have between the transmitter and receiver and still have communication occur.

Example:

Maxstream 9XStream TX Power: 20dBm

Maxstream 9XStream RX Sensitivity: -110dBm

Total Link budget: 130dBm.

For line-of-site situations, a mathematical formula can be used to figure out the approximate range for a given link budget. For non line-of-site applications range calculations are more complex because of the various ways the signal can be attenuated.

Frequency: 2.4 GHz :

2.4 GHz systems present the best option for wireless networks for supply chain managers. This band has significantly greater bandwidth and hence supports higher data rates well above 11 Mbps. The power output varies between 35-100 mW depending on the manufacturer, and the range is 50 to 200 meters (165 to 660 feet) depending on the technology used. The advantages of using the higher bandwidth available at 2.4 GHz is that response times are reduced and a host of new applications are possible. These include speech input (e.g. the use of headsets by operators), the integration of telephone systems, the use of buzzers and beepers with single-line displays, and the incorporation of devices such as laptops, desktops and printers.

RF communications and data rate

Data rates are usually dictated by the system - how much data must be transferred and how often does the transfer need to take place. Lower data rates, allow the radio module to have better receive sensitivity and thus more range. In the XStream modules the 9600 baud module has 3dB more sensitivity than the 19200 baud module. This means about 30% more distance in line-of-sight conditions. Higher data rates allow the communication to take place in less time, potentially using less power to transmit.

POWER SUPPLY:

Block diagram:

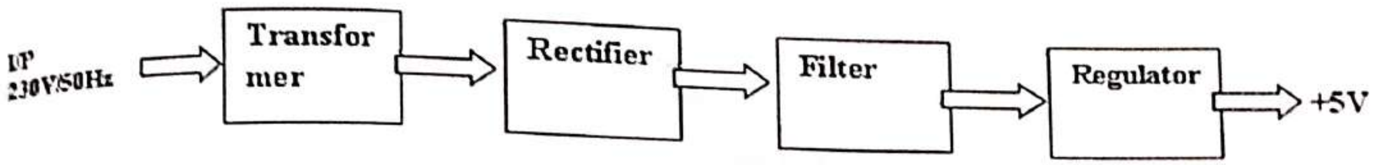
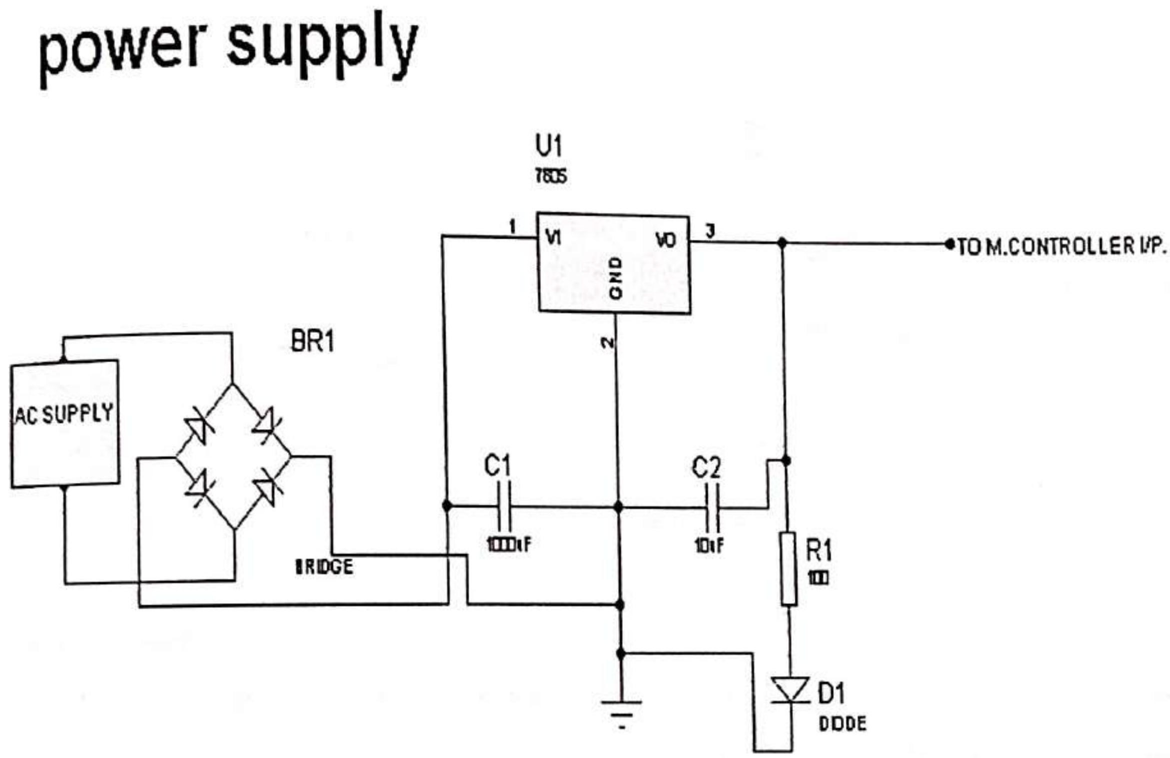


Figure: Power Supply

Circuitdiagram:



Description:

Transformer:

A **transformer** is a device that transfers electrical energy from one circuit to another through inductively coupled conductors—the transformer's coils. A varying current in the first or *primary* winding creates a varying magnetic flux in the transformer's core, and thus a varying magnetic field through the *secondary* winding. This varying magnetic field induces a varying electromotive force (EMF) or "voltage" in the secondary winding. This effect is called mutual induction.

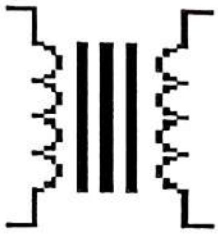


Figure: Transformer Symbol

(or)

Transformer is a device that converts the one form energy to another form of energy like a transducer.

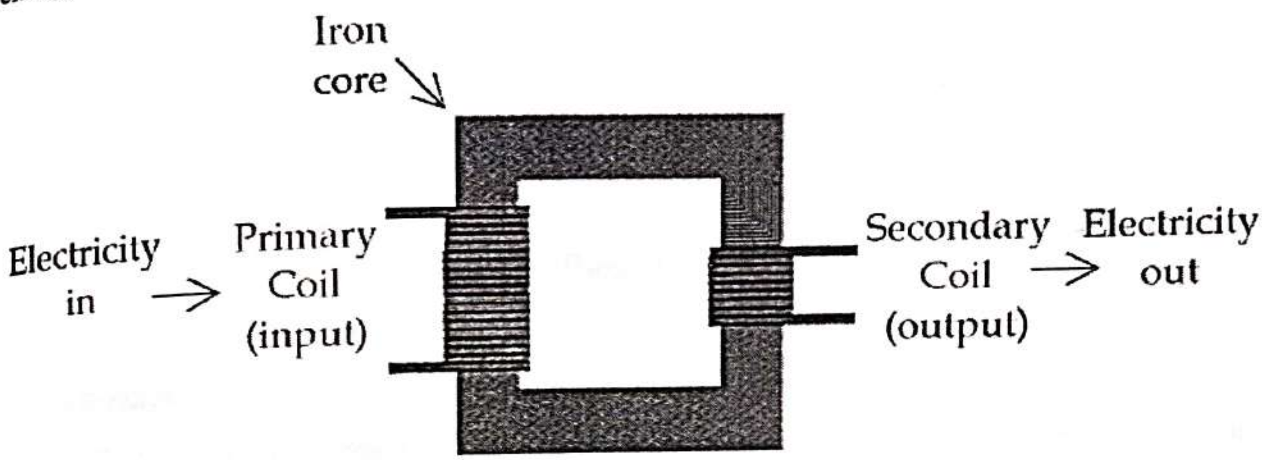


Figure: Transformer

Basic Principle :

A transformer makes use of Faraday's law and the ferromagnetic properties of an iron core to efficiently raise or lower AC voltages. It of course cannot increase power so that if the voltage is raised, the current is proportionally lowered and vice versa.

From Faraday's Law

$$\frac{V_S}{V_P} = \frac{N_S}{N_P}$$

For ideal transformer

The voltage ratio is equal to the turns ratio, and power in equals power out.

From conservation of energy

$$P_P = V_P I_P = V_S I_S = P_S$$

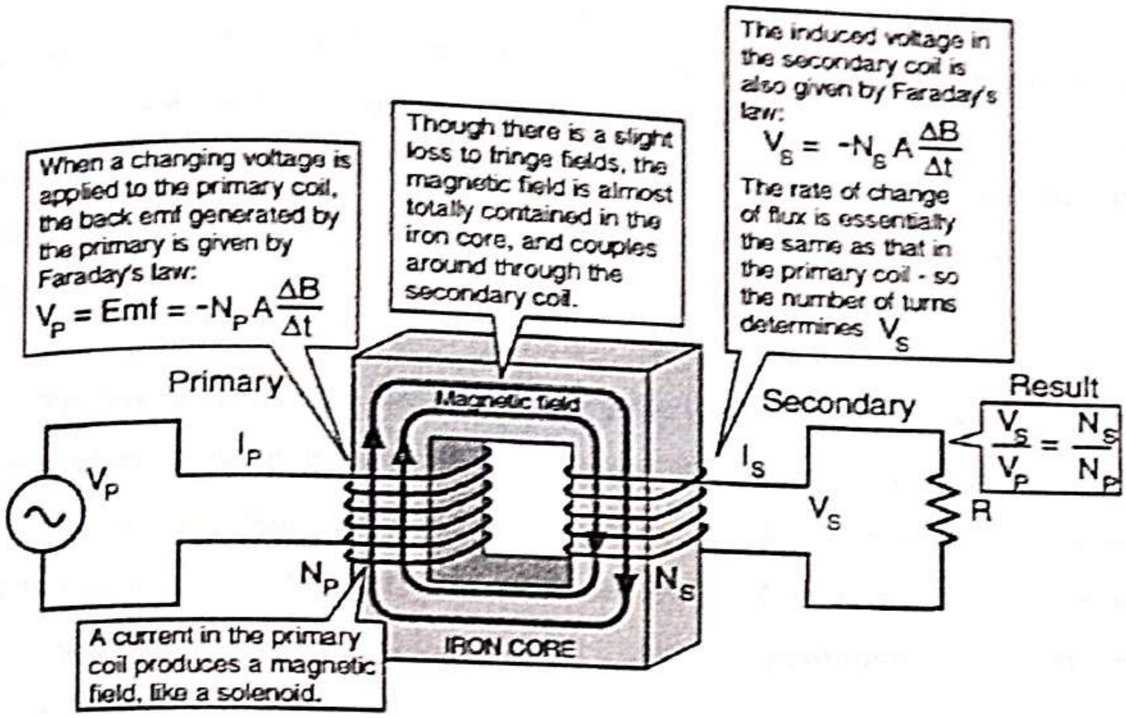


Figure: Basic Principle

Transformer Working:

A transformer consists of two coils (often called 'windings') linked by an iron core, as shown in figure below. There is no electrical connection between the coils, instead they are linked by a magnetic field created in the core.

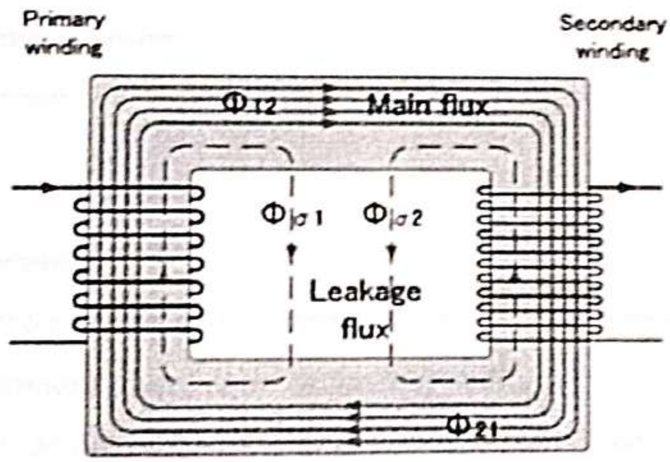


Figure: Basic Transformer

Transformers are used to convert electricity from one voltage to another with minimal loss of power. They only work with AC (alternating current) because they require a changing magnetic field to be created in their core. Transformers can increase voltage (step-up) as well as reduce voltage (step-down).

Alternating current flowing in the primary (input) coil creates a continually changing magnetic field in the iron core. This field also passes through the secondary (output) coil and the changing strength of the magnetic field induces an alternating voltage in the secondary coil. If the secondary coil is connected to a load the induced voltage will make an induced current flow. The correct term for the induced voltage is 'induced electromotive force' which is usually abbreviated to induced e.m.f.

The iron core is laminated to prevent 'eddy currents' flowing in the core. These are currents produced by the alternating magnetic field inducing a small voltage in the core, just like that induced in the secondary coil. Eddy currents waste power by needlessly heating up the core but they are reduced to a negligible amount by laminating the iron because this increases the electrical resistance of the core without affecting its magnetic properties.

Transformers have two great advantages over other methods of changing voltage:

1. They provide total electrical isolation between the input and output, so they can be safely used to reduce the high voltage of the mains supply.
2. Almost no power is wasted in a transformer. They have a high efficiency (power out / power in) of 95% or more.

Classification of Transformer:

- Step-Up Transformer
- Step-Down Transformer

Step-Down Transformer:

Step down transformers are designed to reduce electrical voltage. Their primary voltage is greater than their secondary voltage. This kind of transformer "steps down" the voltage applied to it. For instance, a step down transformer is needed to use a 110v product in a country with a 220v supply.

Step down transformers convert electrical voltage from one level or phase configuration usually down to a lower level. They can include features for electrical isolation, power distribution, and control and instrumentation applications. Step down transformers typically rely on the principle of magnetic induction between coils to convert voltage and/or current levels.

Step down transformers are made from two or more coils of insulated wire wound around a core made of iron. When voltage is applied to one coil (frequently called the primary or input) it magnetizes the iron core, which induces a voltage in the other coil, (frequently called the secondary or output). The turn's ratio of the two sets of windings determines the amount of voltage transformation.

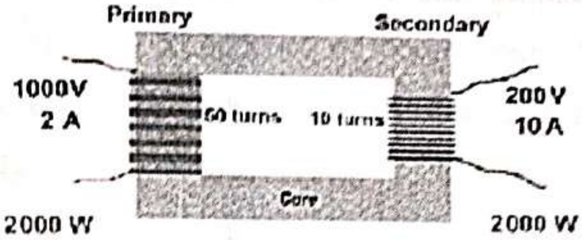


Figure: Step-Down Transformer

An example of this would be: 100 turns on the primary and 50 turns on the secondary, a ratio of 2 to 1.

Step down transformers can be considered nothing more than a voltage ratio device.

With step down transformers the voltage ratio between primary and secondary will mirror the "turn's ratio" (except for single phase smaller than 1 kva which have compensated secondary). A practical application of this 2 to 1 turn's ratio would be a 480 to 240 voltage step down. Note that if the input were 440 volts then the output would be 220 volts. The ratio between input and output voltage will stay constant. Transformers should not be operated at voltages higher than the nameplate rating, but may be operated at lower voltages than rated. Because of this it is possible to do some non-standard applications using standard transformers.

Single phase step down transformers 1 kva and larger may also be reverse connected to step-down or step-up voltages. (Note: single phase step up or step down transformers sized less than 1 KVA should not be reverse connected because the secondary windings have additional turns to overcome a voltage drop when the load is applied. If reverse connected, the output voltage will be less than desired.)

Step-Up Transformer:

A step up transformer has more turns of wire on the secondary coil, which makes a larger induced voltage in the secondary coil. It is called a step up transformer because the voltage output is larger than the voltage input.

Step-up transformer 110v 220v design is one whose secondary voltage is greater than its primary voltage. This kind of transformer "steps up" the voltage applied to it. For instance, a step up transformer is needed to use a 220v product in a country with a 110v supply.

A step up transformer 110v 220v converts alternating current (AC) from one voltage to another voltage. It has no moving parts and works on a magnetic induction principle; it can be designed to "step-up" or "step-down" voltage. So a step up transformer increases the voltage and a step down transformer decreases the voltage. The primary components for voltage transformation are the step up transformer core and coil. The insulation is placed between the turns of wire to prevent shorting to one another or to ground. This is typically comprised of Mylar, nomex, Kraft paper, varnish, or other materials. As a transformer has no moving parts, it will typically have a life expectancy between 20 and 25 years.

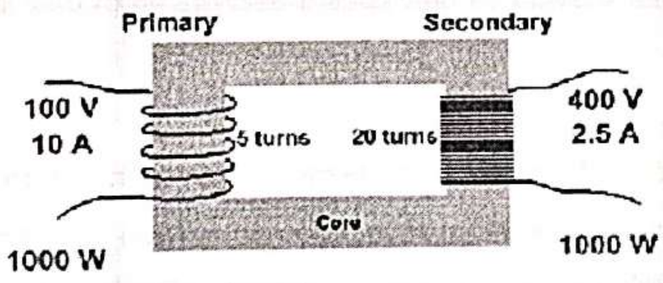


Figure: Step-Up Transformer

Applications

Generally these **Step-Up Transformers** are used in industries applications only.

Turns Ratio and Voltage

The ratio of the number of turns on the primary and secondary coils determines the ratio of the voltages...

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

...where V_p is the primary (input) voltage, V_s is the secondary (output) voltage, N_p is the number of turns on the primary coil, and N_s is the number of turns on the secondary coil.

Diodes:

Diodes allow electricity to flow in only one direction. The arrow of the circuit symbol shows the direction in which the current can flow. Diodes are the electrical version of a valve and early diodes were actually called valves.

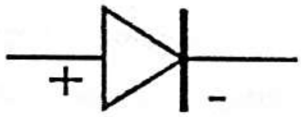


Figure: Diode Symbol

A **diode** is a device which only allows current to flow through it in one direction. In this direction, the diode is said to be 'forward-biased' and the only effect on the signal is that there will be a voltage loss of around 0.7V. In the opposite direction, the diode is said to be 'reverse-biased' and no current will flow through it.

Rectifier

The purpose of a rectifier is to convert an AC waveform into a DC waveform (OR) Rectifier converts AC current or voltages into DC current or voltage. There are two different rectification circuits, known as **'half-wave'** and **'full-wave' rectifiers.** Both use components called **diodes** to convert **AC into DC.**

The Half-wave Rectifier

The half-wave rectifier is the simplest type of rectifier since it only uses one diode, as shown in figure .

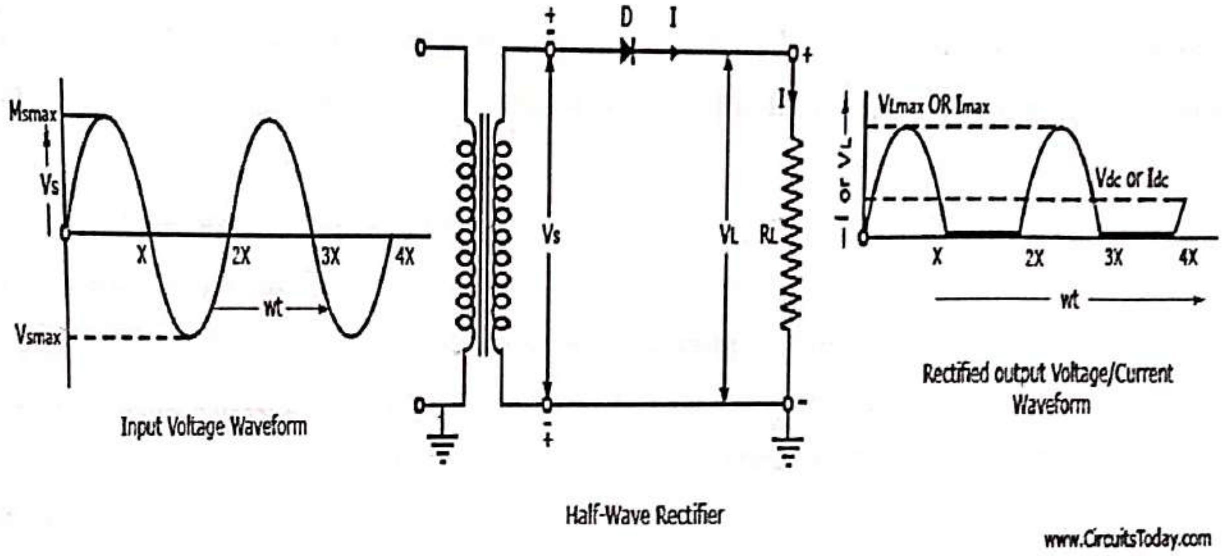


Figure: Half Wave Rectifier

Figure 2 shows the AC input waveform to this circuit and the resulting output. As you can see, when the AC input is positive, the diode is forward-biased and lets the current through. When the AC input is negative, the diode is reverse-biased and the diode does not let any current through, meaning the output is 0V. Because there is a 0.7V voltage loss across the diode, the peak output voltage will be 0.7V less than Vs.

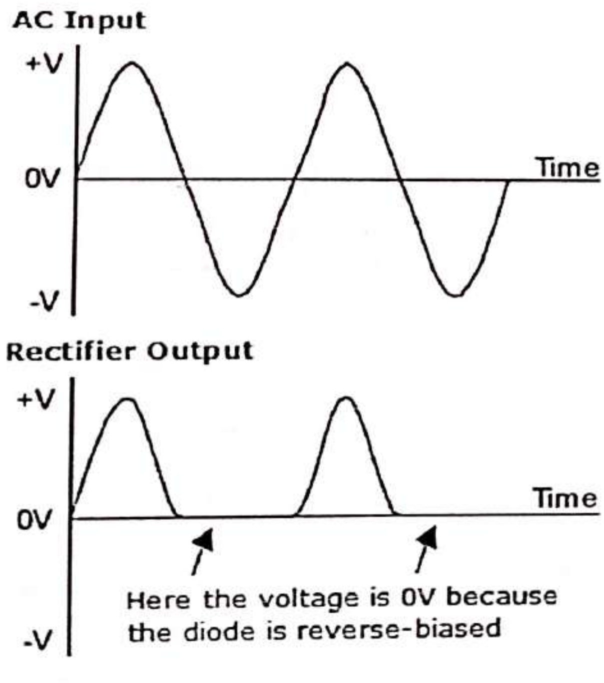


Figure: Half-Wave Rectification

While the output of the half-wave rectifier is DC (it is all positive), it would not be suitable as a power supply for a circuit. Firstly, the output voltage continually varies between 0V and Vs-0.7V, and secondly, for half the time there is no output at all.

The Full-wave Rectifier

The circuit in figure 3 addresses the second of these problems since at no time is the output voltage 0V. This time four diodes are arranged so that both the positive and negative parts of the AC waveform are converted to DC. The resulting waveform is shown in figure 4.

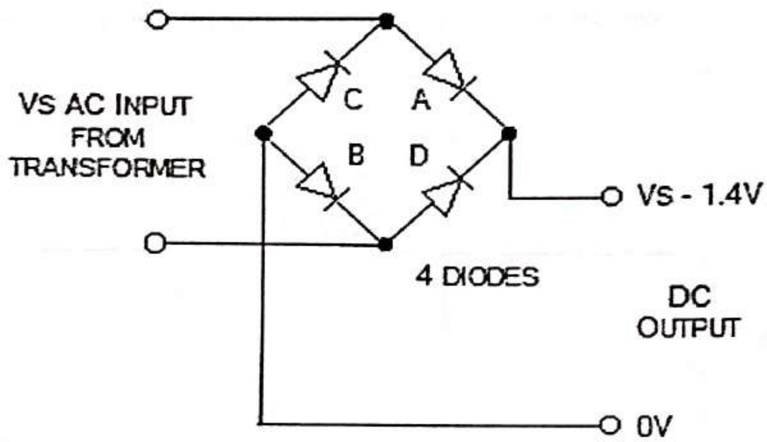


Figure: Full-Wave Rectifier

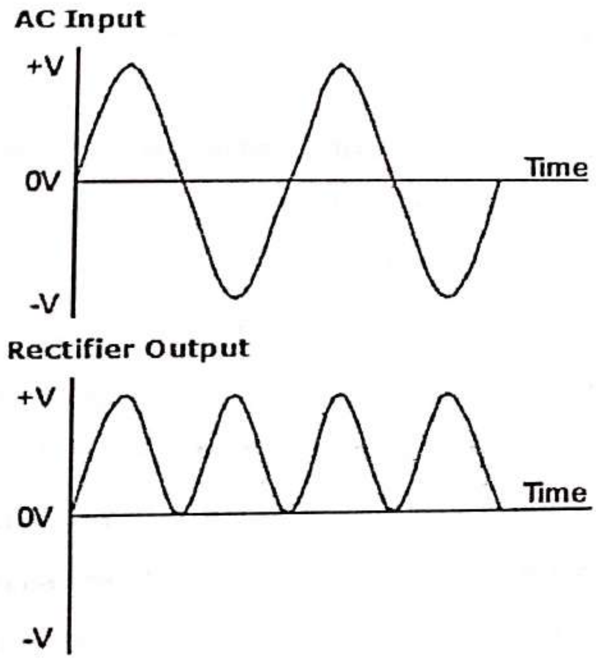


Figure: Full-Wave Rectification

When the AC input is positive, diodes A and B are forward-biased, while diodes C and D are reverse-biased. When the AC input is negative, the opposite is true - diodes C and D are forward-biased, while diodes A and B are reverse-biased.

While the full-wave rectifier is an improvement on the half-wave rectifier, its output still isn't suitable as a power supply for most circuits since the output voltage still varies between 0V and Vs-1.4V. So, if you put 12V AC in, you will 10.6V DC out.

Capacitor Filter

The **capacitor-input filter**, also called "Pi" filter due to its shape that looks like the Greek letter pi, is a type of electronic filter. Filter circuits are used to remove unwanted or undesired frequencies from a signal.

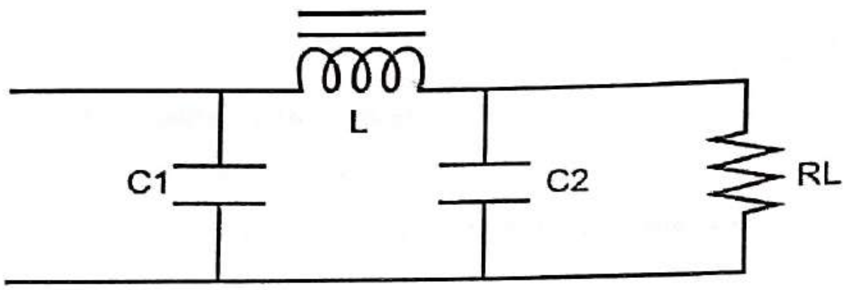


Figure: Capacitor Filter

A typical capacitor input filter consists of a filter capacitor C1, connected across the rectifier output, an inductor L, in series and another filter capacitor connected across the load.

1. The capacitor C1 offers low reactance to the AC component of the rectifier output while it offers infinite reactance to the DC component. As a result the capacitor shunts an appreciable amount of the AC component while the DC component continues its journey to the inductor L
2. The inductor L offers high reactance to the AC component but it offers almost zero reactance to the DC component. As a result the DC component flows through the inductor while the AC component is blocked.
3. The capacitor C2 bypasses the AC component which the inductor had failed to block. As a result only the DC component appears across the load RL.

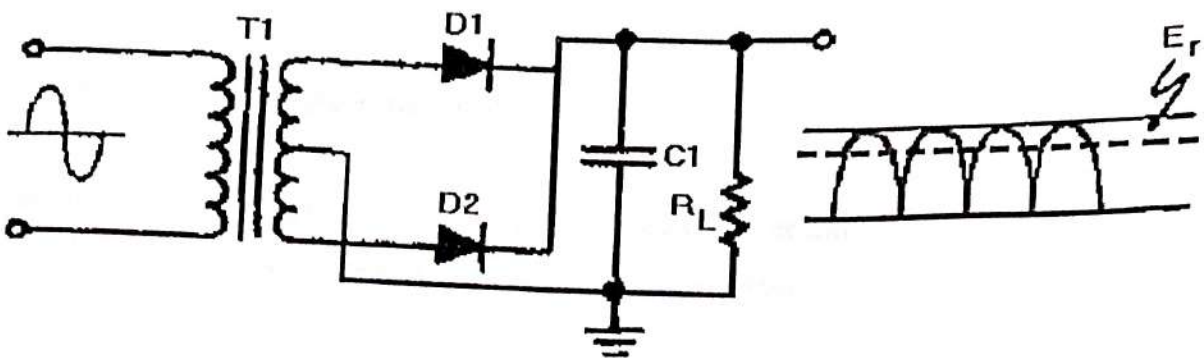


Figure: Centered Tapped Full-Wave Rectifier with a Capacitor Filter

Voltage Regulator:

A **voltage regulator** is an electrical regulator designed to automatically maintain a constant voltage level. It may use an electromechanical mechanism, or passive or active electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages. There are two types of regulator are they.

- Positive Voltage Series (78xx) and
- Negative Voltage Series (79xx)

78xx:'78' indicate the positive series and 'xx'indicates the voltage rating. Suppose 7805 produces the maximum 5V.'05'indicates the regulator output is 5V.

79xx:'78' indicate the negative series and 'xx'indicates the voltage rating. Suppose 7905 produces the maximum -5V.'05'indicates the regulator output is -5V.

These regulators consists the three pins there are

Pin1: It is used for input pin.

Pin2: This is ground pin for regulator

Pin3: It is used for output pin. Through this pin we get the output.

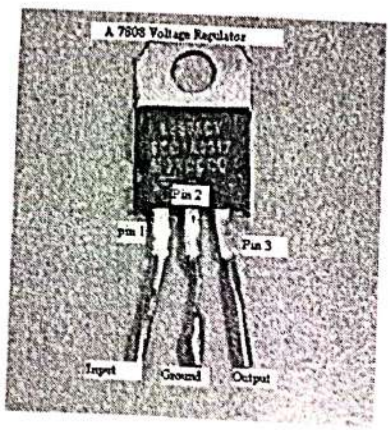


Figure: Regulator

Code:

```
/*
 Software serial multple serial test

 Receives from the hardware serial, sends to software serial.
 Receives from software serial, sends to hardware serial.

 The circuit:
 * RX is digital pin 10 (connect to TX of other device)
 * TX is digital pin 11 (connect to RX of other device)

 Note:
 Not all pins on the Mega and Mega 2560 support change interrupts,
 so only the following can be used for RX:
 10, 11, 12, 13, 50, 51, 52, 53, 62, 63, 64, 65, 66, 67, 68, 69

 Not all pins on the Leonardo and Micro support change interrupts,
 so only the following can be used for RX:
 8, 9, 10, 11, 14 (MISO), 15 (SCK), 16 (MOSI).

 created back in the mists of time
 modified 25 May 2012
 by Tom Igoe
 based on Mikal Hart's example

 This example code is in the public domain.

 */
#include <SoftwareSerial.h>

SoftwareSerial mySerial(10, 11); // RX, TX

void setup() {
 // Open serial communications and wait for port to open:
```

```
  Serial.begin(57600);
  while (!Serial) {
   ; // wait for serial port to connect. Needed for native USB port only
  }


  Serial.println("Goodnight moon!");

  // set the data rate for the SoftwareSerial port
  mySerial.begin(4800);
  mySerial.println("Hello, world?");
}

void loop() { // run over and over
  if (mySerial.available()) {
   Serial.write(mySerial.read());
  }
  if (Serial.available()) {
   mySerial.write(Serial.read());
  }
}
```