SOLAR VEHICLE HAVING DC MOTORS CONTROLLED BY RF REMOTE CONTROLLER

A Project report submitted in partial fulfilment

of the requirements for the degree of B. Tech in Electrical Engineering

By

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Name and Signature of the Student

Place:
Date:

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CERTIFICATE
To whom it may concern

This is to certify that the project work entitled (**SOLAR VEHICLE HAVING DC MOTORS CONTROLLED BY RF REMOTE CONTROLLER)** is the bona fide work carried out by **(SOURAV SADHUKHAN(11701614050), SUVAM DEY (11701614057), BIDYUT DAS (11701614015), SOHAM GIRI (11701614043)** , a student of B.Tech in the Dept. of Electrical Engineering, RCC Institute of Information Technology (RCCIIT), Canal South Road, Beliaghata, Kolkata-700015, affiliated to Maulana Abul Kalam Azad University of Technology (MAKAUT), West Bengal, India, during the academic year 2017-18, in partial fulfillment of the requirements for the degree of Bachelor of Technology in Electrical Engineering and that this project has not submitted previously for the award of any other degree, diploma and fellowship.

_____ _____

Signature of the Guide
Name:
Designation

Signature of the HOD
Name:
Designation

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Signature of the External Examiner
Name:
Designation:

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1. INTRODUCTION

Energy is an important component in economic infrastructure of a country. The Sources of conventional energy is limited. They are reducing day by day. By using solar vehicle we can save conventional energy sources and control pollution.

The explosion of the fossil fuel in the motor gives power to the wheels. For the **solar car**, the sun's energy is converted to electricity with the help of the **solar** cells.It is very **important** for the **car** to be very efficient since its power source is the sun and it may not be present all the time.

A solar car is a solar vehicle used for land transport. Solar cars are usually run on only power from the sun, although some models will supplement that power using a battery, or use solar panels to recharge batteries or run auxiliary systems for a car that mainly uses battery power.

Solar cars combine technology typically used in the aerospace, bicycle, alternative energy and automotive industries. The design of a solar vehicle is severely limited by the amount of energy input into the car. Most solar cars have been built for the purpose of solar car races. Some prototypes have been designed for public use, although no cars primarily powered by the sun are available commercially.

Solar cars depend on a solar array that uses photovoltaic cells (PV cells) to convert sunlight into electricity. Unlike solar thermal energy which converts solar energy to heat, PV cells directly convert sunlight into electricity.[1] When sunlight (photons) strike PV cells, they excite electrons and allow them to flow, creating an electric current. PV cells are made of semiconductor materials such as silicon and alloys of indium, gallium and nitrogen. Crystalline silicon is the most common material used and has an efficiency rate of 15-20%.

Solar cars can accomplish this through photovoltaic cells (PVC). PVCs are the components in solar paneling that convert the sun's energy to electricity. They're made up of semiconductors, usually made of silicon, that absorb the light. The sunlight's energy then frees electrons in the semiconductors, creating a flow of electrons. That flow generates the electricity that powers the battery or the specialized car motor in solar cars. For more details about solar energy, read How Solar Cells Work.

Solar power has great potential as an energy source for many different types of residential homes and businesses. Most people know that getting energy from the sun is a "clean", environmentally-friendly and renewable way to generate energy. What most people don't know, however, is that solar power is affordable for many homeowners.

2. THEORY

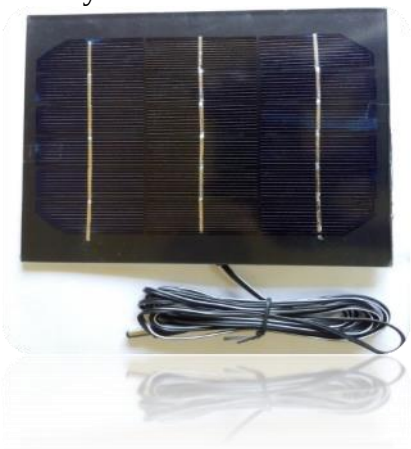
This section introduces and provides a brief description of the major components and factors that will contribute to an efficiency functioning solar vehicle. These factors are solar power, PV cell, and battery. Later sections will provide a depth look onto the essence of each factor and its function and importance to overall operation of the solar vehicle.
Solar power in India is a fast developing industry. The country's solar installed capacity reached 20 GW in February 2018. India expanded its solar-generation capacity 8 times from 2,650 MW on 26 May 2014 to over 20 GW as on 31 January 2018.The 20 GW capacities was initially targeted for 2022 but the government achieved the target four years ahead of schedule. The country added 3 GW of solar capacity in 2015-2016, 5 GW in 2016-2017 and over 10 GW in 2017-2018, with the average current price of solar electricity dropping to 18% below the average price of its coal-fired counterpart.

In January 2016, Prime Minister Narendra Modi and French President François Hollande laid the foundation stone for the headquarters of the International Solar Alliance (ISA) in Gwal Pahari, Gurgaon. The ISA will focus on promoting and developing solar energy and solar products for countries lying wholly or partially between the Tropic of Cancer and the Tropic of Capricorn. The alliance of over 120 countries was announced at the Paris COP21 climate summit. One hope of the ISA is that wider deployment will reduce production and development costs, facilitating the increased deployment of solar technologies to poor and remote regions.

Fifty-one solar radiation resource assessment stations have been installed across India by the Ministry of New and Renewable Energy (MNRE) to create a database of solar-energy potential. Data is collected and reported to the Centre for Wind Energy Technology (C-WET) to create a solar atlas. In June 2015, India began a ₹40 crore (US$6.1 million) project to measure solar radiation with a spatial resolution of 3 by 3 kilometers (1.9 mi × 1.9 mi). This solar-radiation measuring network will provide the basis for the Indian solar-radiation atlas. According to National Institute of Wind Energy officials, the Solar Radiation Resource Assessment wing (121 ground stations) would measure solar radiation's three parameters—Global Horizontal Irradiance (GHI), Direct Normal Irradiance (DNI) and Diffuse Horizontal Irradiance (DHI)—to accurately measure a region's solar radiation.

3. PV CELL

Photovoltaics (PV) is a term which covers the conversion of light into electricity using semiconducting materials that exhibit the photovoltaic effect, a phenomenon studied in physics, photochemistry, and electrochemistry.

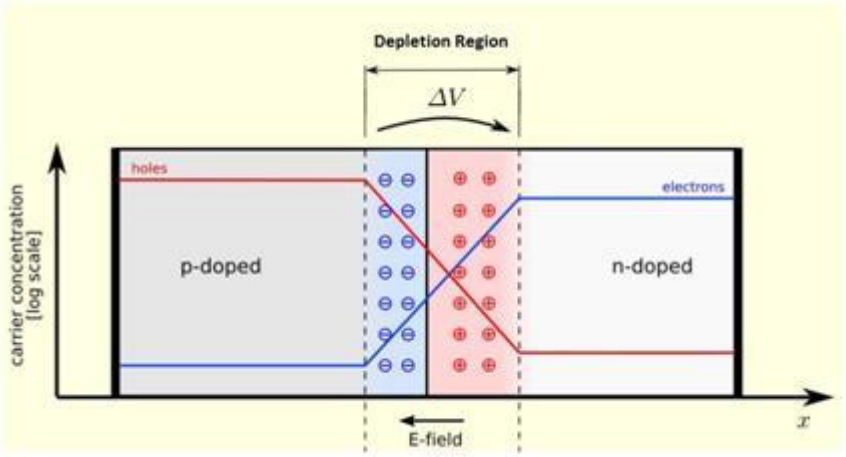


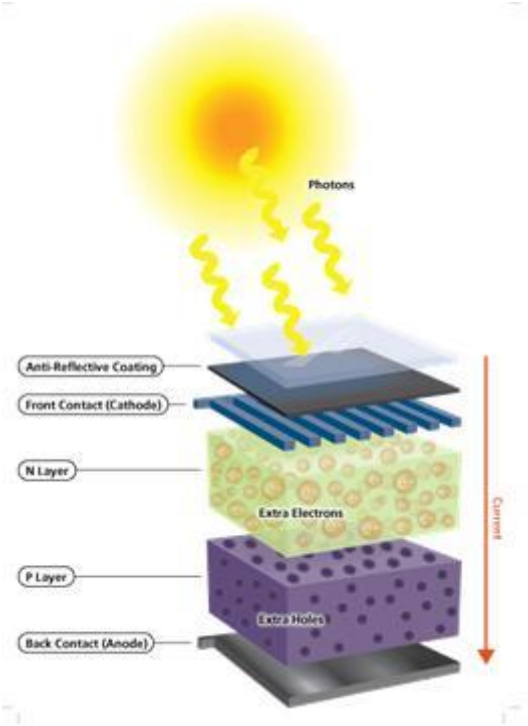
PV systems have the major disadvantage that the power output is dependent on direct sunlight, so about 10-25% is lost if a tracking system is not used, since the cell will not be directly facing the sun at all times. [2(B)]

P-type and n-type materials

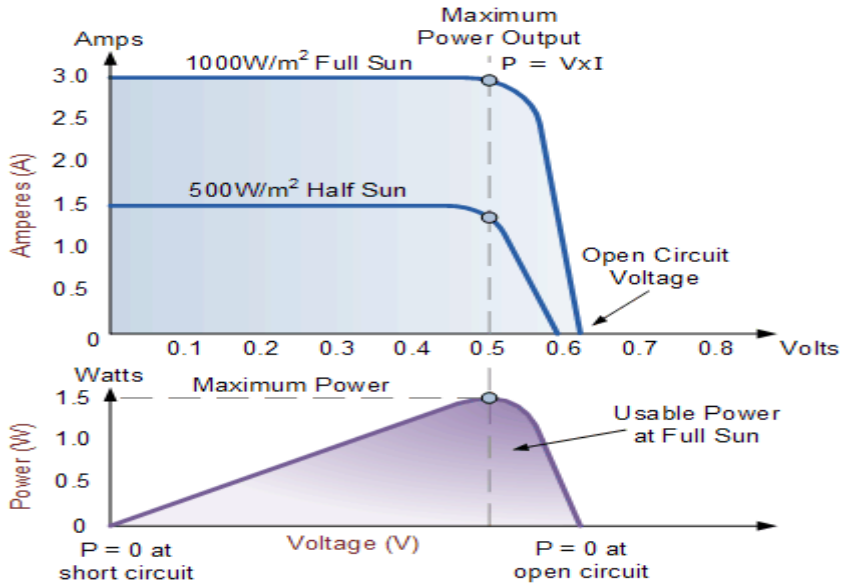
Intrinsic crystal Solar cells are running on junction effect principle. To understand junction effect, we should understand n-type and p-type material. Doping process is needed to obtain n-type or p-type material. Doping means inserting another atom into the bulk crystal. Consider silicon crystal: each silicon atom has four electrons in its valance band and these electrons make bonds with other Silicon atom. You can see the silicon crystal in the left side with valance electrons of each Si atom. Note that we call that structure as crystal since all Si atoms are perfectly aligned. We can convert this structure in to n-type or p-type by doping different atoms. For example let's dope it by boron. Boron atom has 3 electrons in its valance band. When we insert B atom instead of a Si atom, one bond between B atom and a Si atom will be very weak. To complete the perfect symmetry in this stricter, crystal will be aimed to catch an external electron. As you can see an electron is missing since B atom has 3 electrons in its PVImage6valence band. This missing bond can be treated a positively charged particle called 'hole'. This material is called p-type material. What if we dope Phosphorous atom instead of Boron atom? Phosphorous atom has 5 electrons in its valance band. [2(C)]

When P atom is inserted into the Si lattice, 4 electrons will be able make bond with neighbor Si atoms. However 5th electron will be hanged on. So, it will be in an energy level that very close to conduction band since it will be nearly free. This nearly free electron can easily leave P atom with a small thermal energy. Note that there is an extra electron in this new structure. So we call this new material n-type material. In contrast to p-type material, n-type material has a tendency to give electrons. Consequently we have two types of materials. One wants to give electrons and the other wants to receive electrons. We can create a p-n junction by bringing them together.[2(A)]

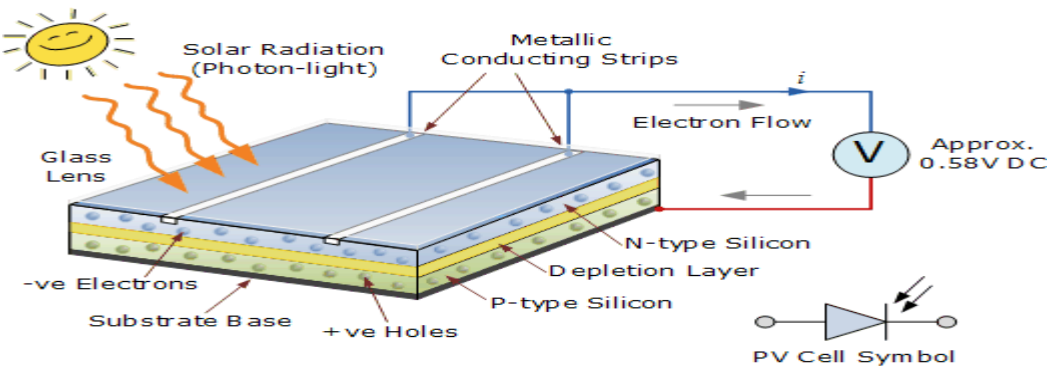




$$P_{MAX} = V_{OUT} \times I_{MAX}$$



The type of solar power produced by a photovoltaic solar cell is called direct current or DC the same as from a battery. Most photovoltaic solar cells produce a “no load” open circuit voltage (nothing connected to it) of about 0.5 to 0.6 volts when there is no external circuit connected. This output voltage (VOUT) depends very much on the load current (I) demands of the PV cell. For example on very cloudy or dull day the current demand would be low and so the cell could provide the full output voltage, VOUT but at a reduced output current. But as the current demand of the load increases a brighter light (solar radiation) is needed at the junction to maintain a full output voltage, Vout.



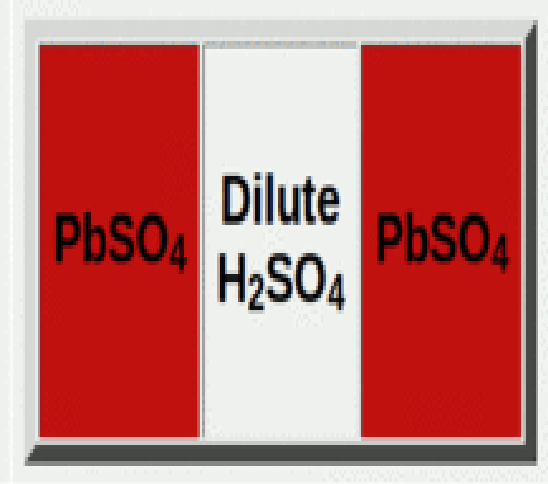
Our PV cell rating is- 6 volt 100mA
Maximum Power voltage-8.8v
Maximum Power current-0.34A

4. BATTERY

The lead–acid battery was invented in 1859 by French physicist Gaston Planet and is the oldest type of rechargeable battery. Despite having a very low energy-to-weight ratio and a low energy-to-volume ratio, its ability to supply high surge currents means that the cells have a relatively large power-to-weight ratio. These features, along with their low cost, make them attractive for use in motor vehicles to provide the high current required by automobile starter motors.

As they are inexpensive compared to newer technologies, lead–acid batteries are widely used even when surge current is not important and other designs could provide higher energy densities.

4.1 Discharge



Fully discharged: two identical lead sulfate plates
In the discharged state both the positive and negative plates become lead (II) sulfate ($PbSO_4$), and the electrolyte loses much of its dissolved sulfuric acid and becomes primarily water. The discharge process is driven by the conduction of electrons from the negative plate back into the cell at the positive plate in the external circuit.

Negative plate reaction

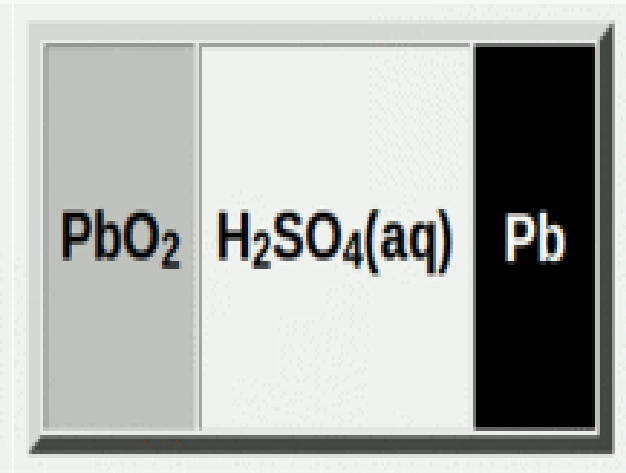
$Pb(s) + HSO_4^-(aq) \rightarrow PbSO_4(s) + H^+(aq) + 2e^-$ Release of two conducting electrons gives lead electrode a net negative charge
As electrons accumulate they create an electric field which attracts hydrogen ions and repels sulfate ions, leading to a double-layer near the surface. The hydrogen ions screen the charged electrode from the solution which limits further reactions unless charge is allowed to flow out of electrode.

Positive plate reaction

$PbO_2(s) + HSO_4^-(aq) + 3H^+(aq) + 2e^- \rightarrow PbSO_4(s) + 2H_2O(l)$
The total reaction can be written as
$Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \rightarrow 2PbSO_4(s) + 2H_2O(l)$

The sum of the molecular masses of the reactants is 642.6 g/mol, so theoretically a cell can produce two faradays of charge (192,971 coulombs) from 642.6 g of reactants, or 83.4 ampere-hours per kilogram (or 13.9 ampere-hours per kilogram for a 12-volt battery). For a 2 volts cell, this comes to 167 watt-hours per kilogram of reactants, but a lead–acid cell in practice gives only 30–40 watt-hours per kilogram of battery, due to the mass of the water and other constituent parts.

4.2 Charging

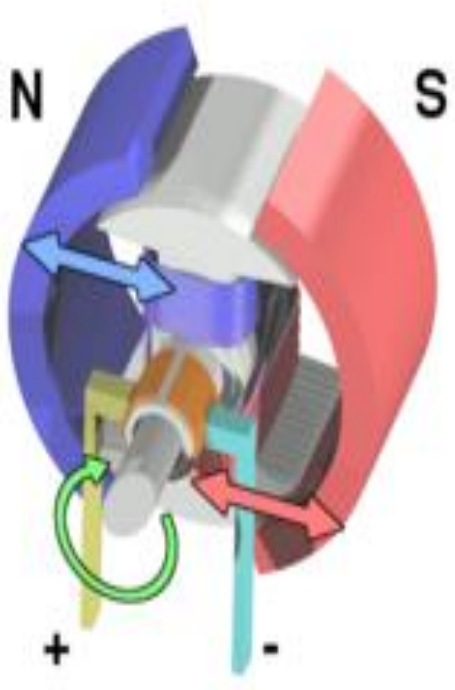


Fully recharged: Lead negative plate, Lead dioxide positive plate and sulfuric acid electrolyte
In the fully charged state, the negative plate consists of lead, and the positive plate lead dioxide, with the electrolyte of concentrated sulfuric acid.
Overcharging with high charging voltages generates oxygen and hydrogen gas by electrolysis of water, which is lost to the cell. The design of some types of lead-acid battery allows the electrolyte level to be inspected and topped up with any water that has been lost.
Rating of Battery-12v, 7.2Ah

5. DC MOTORS

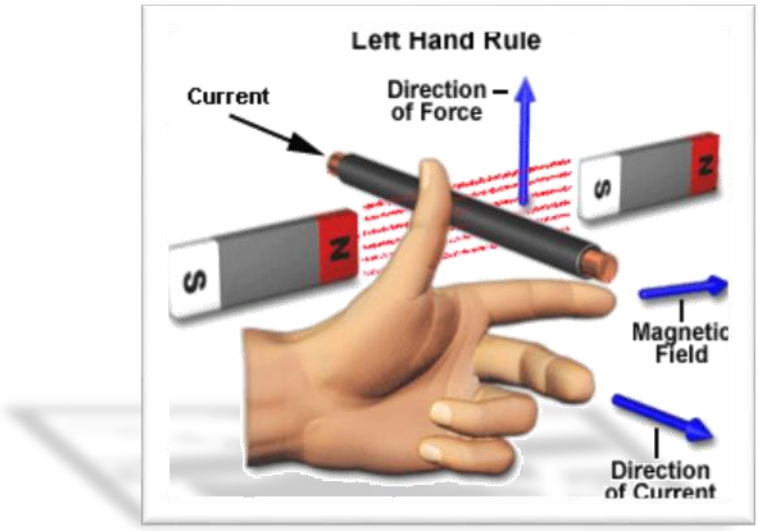
5.1 Working Principle

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic; to periodically change the direction of current flow in part of the motor. [1 (A)]



The very basic construction of a DC motor contains a current carrying armature which is connected to the supply end through commutator segments and brushes. The armature is placed in between north south poles of a permanent or an electromagnet as shown in the diagram above.

As soon as we supply direct current in the armature, a mechanical force acts on it due to the electromagnetic effect of the magnet. Now to go into the details of the operating principle of DC motor it's important that we have a clear understanding of Fleming's left-hand rule to determine the direction of the force acting on the armature conductors of DC motor. [1(D)]



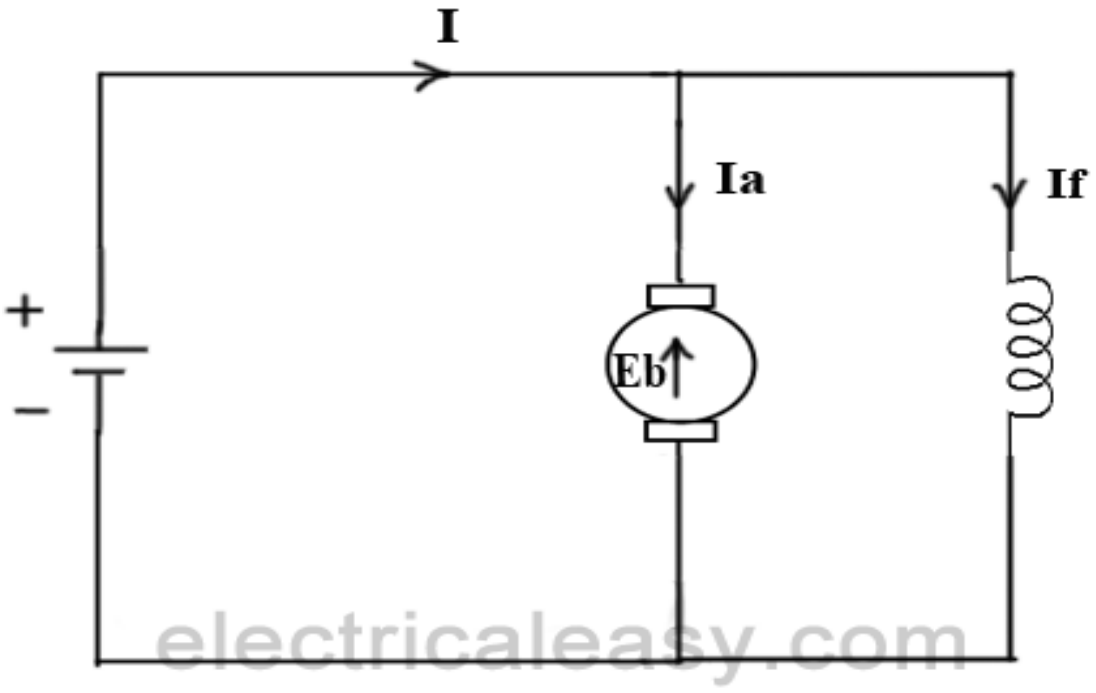
A motor is an electrical machine which converts electrical energy into mechanical energy. The principle of working of a DC motor is that "whenever a current carrying conductor is placed in a magnetic field, it experiences a mechanical force". The direction of this force is given by Fleming's left hand rule and its magnitude is given by F = BIL. Where, B = magnetic flux density, I = current and L = length of the conductor within the magnetic field.

Fleming's left hand rule: If we stretch the first finger, second finger and thumb of our left hand to be perpendicular to each other AND direction of magnetic field is represented by the first finger, direction of the current is represented by second finger then the thumb represents the direction of the force experienced by the current carrying conductor. [1(C)]

5.2 Back EMF

According to fundamental laws of nature, no energy conversion is possible until there is something to oppose the conversion. In case of generators this opposition is provided by magnetic drag, but in case of dc motors there is back emf.

When the armature of the motor is rotating, the conductors are also cutting the magnetic flux lines and hence according to the Faraday's law of electromagnetic induction, an emf induces in the armature conductors. The direction of this induced emf is such that it opposes the armature current (Ia) . The circuit diagram below illustrates the direction of the back emf and armature current. Magnitude of Back emf can be given by the emf equation of DC generator.[1(B)]



Our DC motor rating is 12v, 300 rpm

6. RF MODULE 434 Mhz (1Transmitter + 1 receiver)

This 434MHz Transmitter is an ASK Hybrid transmitter module. It uses saw resonator for frequency stability. The receiver is an ASK super heterodyne receiver with PLL synthesizer and crystal oscillator. This transmitter and receiver in conjunction with HT12E and HT12D ICs can be used to build remote control

- Transmitter: Saw filter based ASK hybrid transmitter
- Transmitter supply voltage: 3~12V.
- Receiver Supply voltage: 5V
- Frequency: 434 MHz.
- Receiver IF frequency: 500 KHz
- Receiver Sensitivity: -105dBm
- Receiver Supply current: 2.3mA
- Output power: 4~16dBm
- Turn on time: 20mS from power is switched on.
- Data rate: 200bps to 3Kbps depending on the supply.

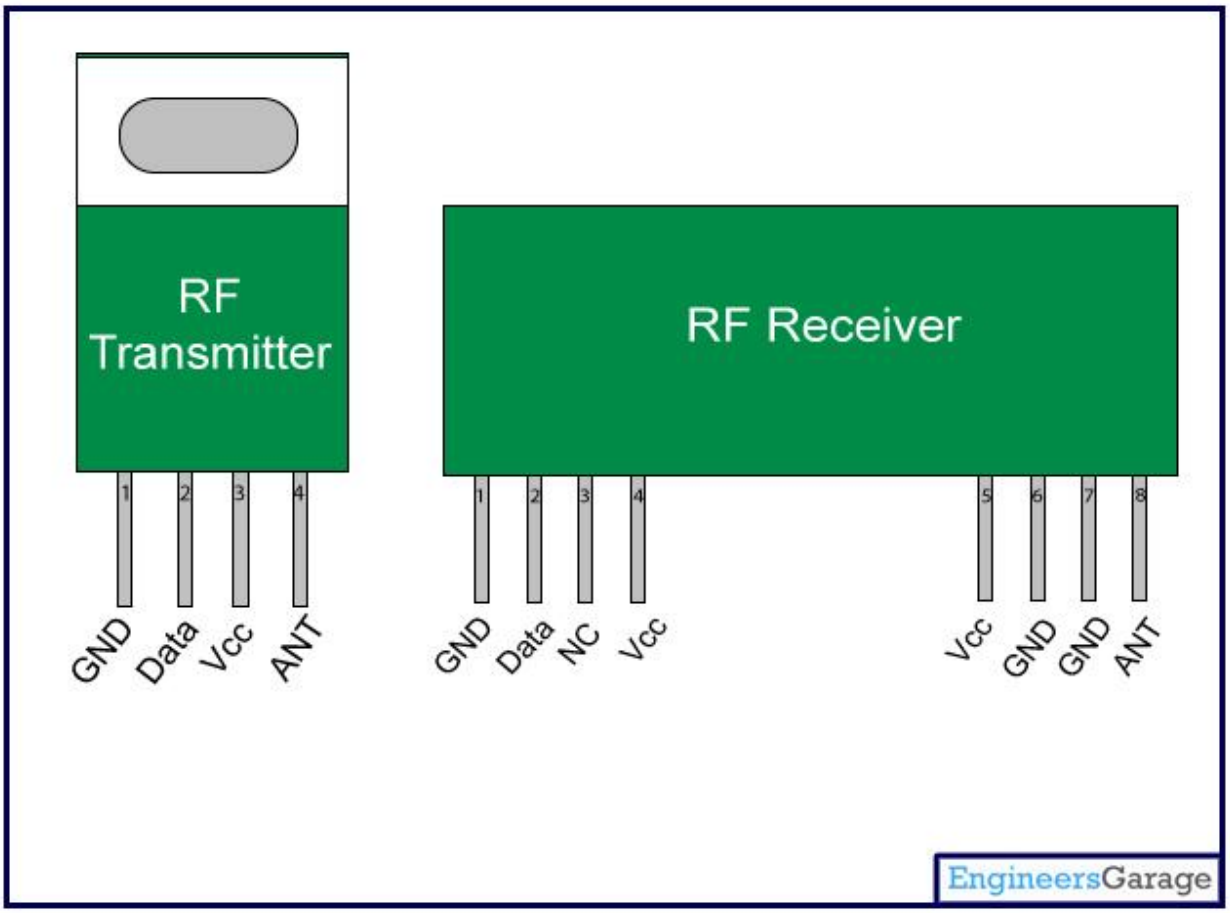
Features:

- Low power consumption.
- Easy for application.
- On-Chip VCO with integrated PLL using crystal oscillator reference
- Integrated IF and data filters.
- Operating temperature range: -40 to 80 °C
- Operating voltage: 5 Volts [3(A)]

An RF module (radio frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless

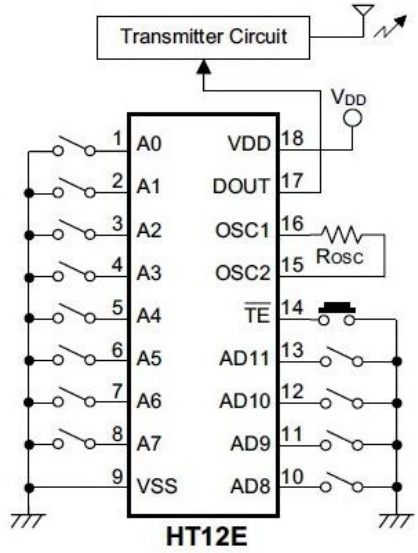
communication may be accomplished through optical communication or through radio frequency (RF) communication. For many applications the medium of choice is RF since it does not require line of sight. RF communications incorporate a transmitter and a receiver. They are of various types and ranges. Some can transmit up to 500 feet.

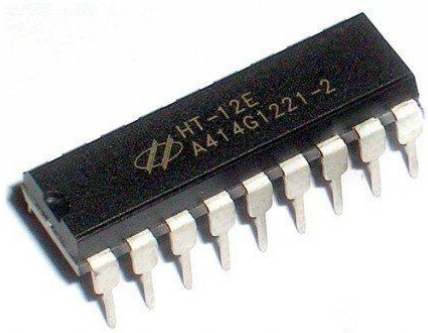
PIN DIAGRAM OF RF 434 MHz



This RF module comprises of an RF Transmitter and an RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434 MHz. An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4. The transmission occurs at the rate of 1Kbps - 10Kbps.The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitted. [3(B)]

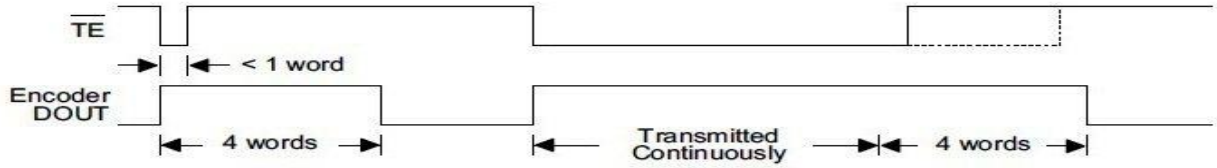
7. HT 12E ENCODER





HT12E is able to operate in a wide voltage range from 2.4V to 12V and has a built in oscillator which requires only a small external resistor. Its power consumption is very low, standby current is 0.1µA at 5V VDD and has high immunity against noise. It is available in 18 pin DIP (Dual Inline Package) and 20 pin SOP (Small Outline Package) as given below.

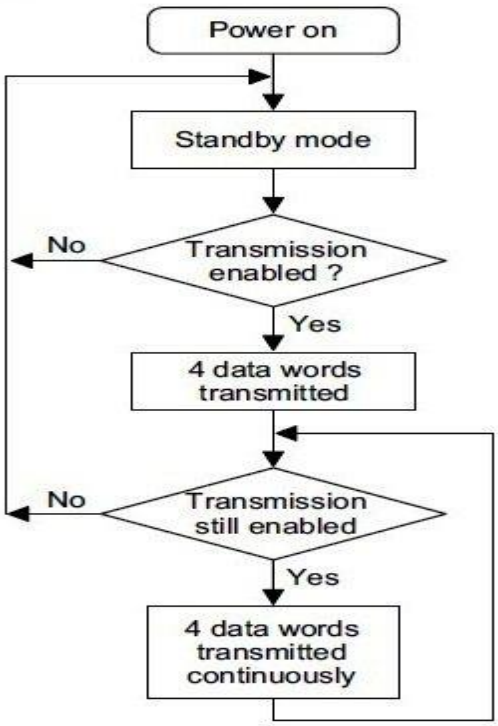
- **VDD and VSS** are power supply pins which are used to connect positive and negative of the power supply respectively.
- **OSC1 and OSC2** are used to connect external resistance for the internal oscillator. OSC1 is the oscillator input pin and OSC2 is the oscillator output pin.
- **TE** is used for enabling the transmission and is an active low input.
- **A0 – A7** are the input address pins. By using these pins we can provide a security code for the data. These pins can be connected to VSS or left open.
- **D8 – D11** are the input data pins. These pins can be connected to VSS or may left open for sending LOW and HIGH respectively.
- **DOUT** – It is the serial data output of the encoder and can be connected to a RF transmitter. [4(A)]



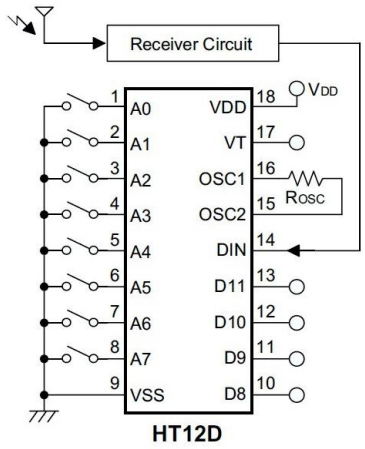
Transmission timing for the HT12E

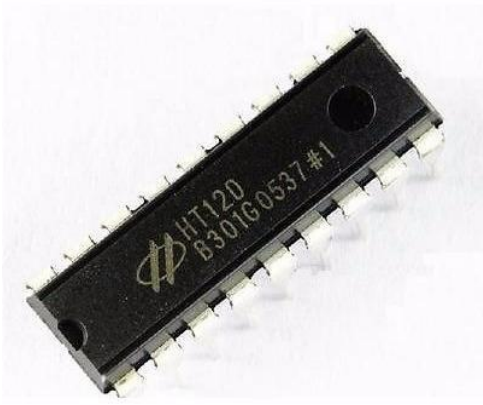
7.1 Data flow diagram of HT 12E ENCODER

The HT12E 212 series encoder starts a 4 word transmission cycle upon receiving transmission enable signal on TE input. This output cycle will repeat as long as the transmission is enabled. When the transmission enable (TE) signal switches to HIGH, the encoder output completes the current cycle and stops as shown above. The encoder will be in the Standby mode when the transmission is disabled.



8. HT 12D DECODER





- **VDD and VSS** are used to provide power to the IC, Positive and Negative of the power supply respectively. As I said earlier its operating voltage can be in the range 2.4V to 12V

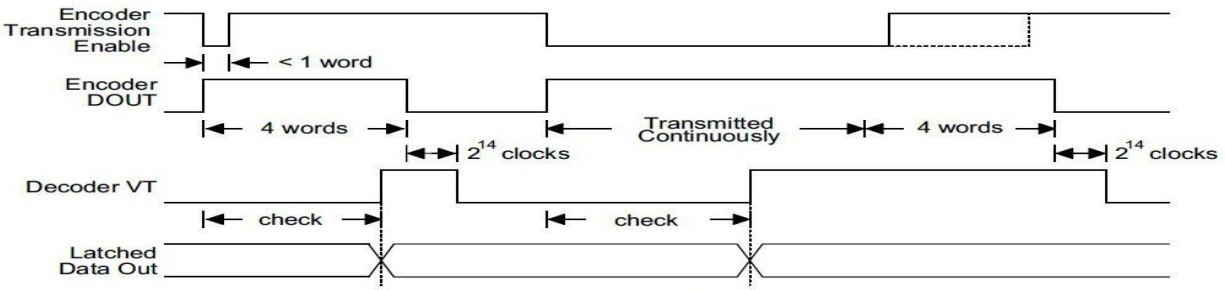
- **OSC1 and OSC2** are used to connect external resistor for internal oscillator of HT12D. OSC1 is the oscillator input pin and OSC2 is the oscillator output pin as shown in the figure below.

- **A0 – A7** are the address input pins. Status of these pins should match with status of address pin in HT12E (used in transmitter) to receive the data. These pins can be connected to VSS or left open.

- **DIN** is the serial data input pin and can be connected to a RF receiver output.

- **D8 – D11** are the data output pins. Status of these pins can be VSS or VDD depending upon the received serial data through pin **DIN**.

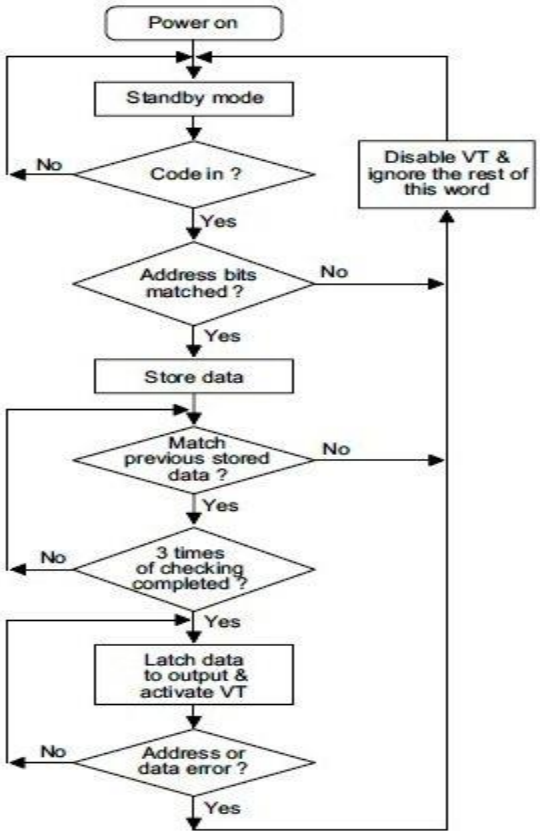
- **VT** stand for Valid Transmission. This output pin will be HIGH when valid data is available at D8 – D11 data output pins. [4(B)]



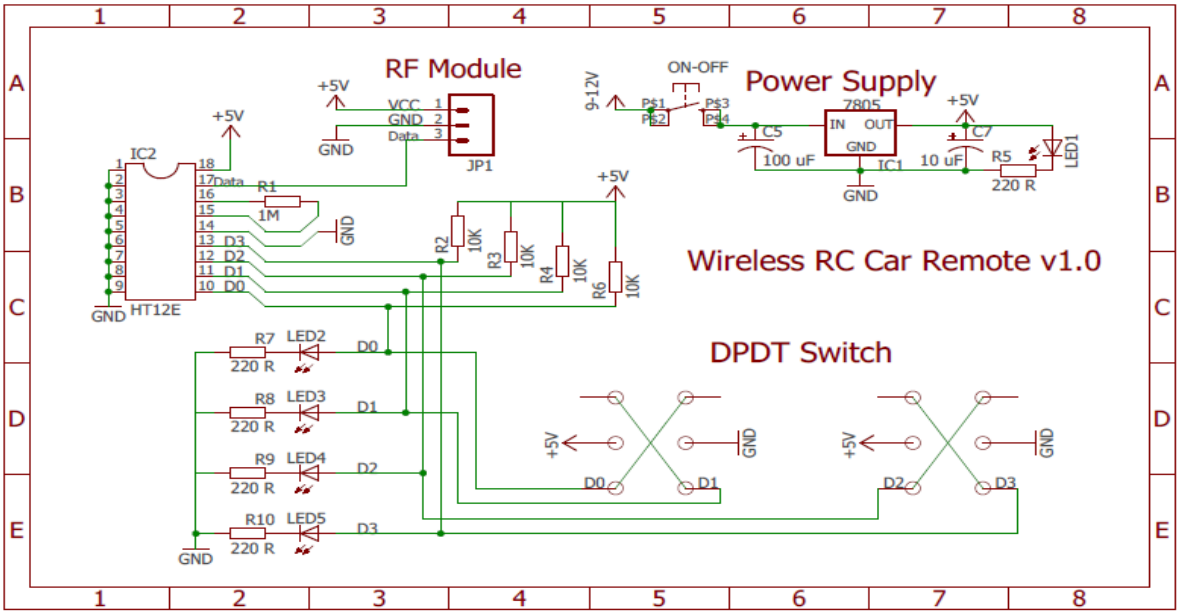
HT12D Decoder Timing

8.1 Data flow diagram of HT 12D DECODER

HT12D decoder will be in standby mode initially ie, oscillator is disabled and a HIGH on DIN pin activates the oscillator. Thus the oscillator will be active when the decoder receives data transmitted by an encoder. The device starts decoding the input address and data. The decoder matches the received address three times continuously with the local address given to pin A0 – A7. If all matches, data bits are decoded and output pins D8 – D11 are activated. This valid data is indicated by making the pin VT (Valid Transmission) HIGH. This will continue till the address code becomes incorrect or no signal is received.



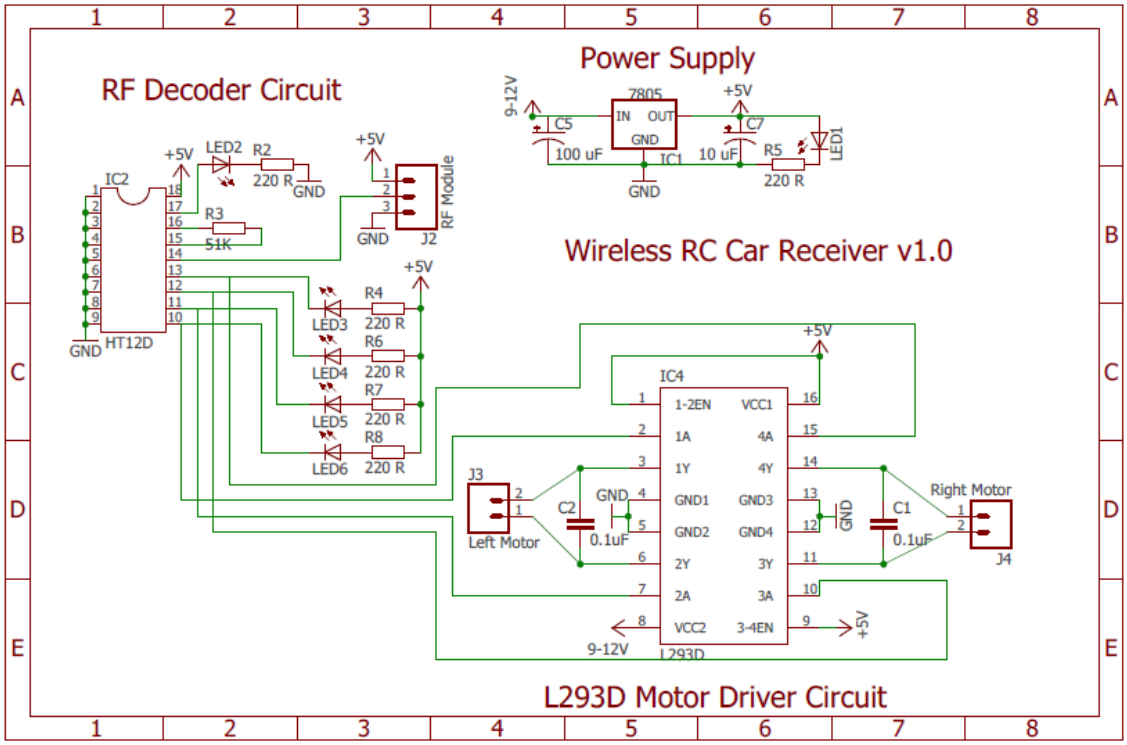
9. Remote Circuit



RF modules are most often used in medium and low volume products for consumer applications such as garage door openers, wireless alarm or monitoring systems, industrial remote controls, smart sensor applications, and wireless home automation systems. They are sometimes used to replace older infrared communication designs as they have the advantage of not requiring line-of-sight operation.

Several carrier frequencies are commonly used in commercially available RF modules, including those in the industrial, scientific and medical (ISM) radio bands such as 433.92 MHz, 915 MHz, and 2400 MHz these frequencies are used because of national and international regulations governing the use of radio for communication. Short Range Devices may also use frequencies available for unlicensed such as 315 MHz and 868 MHz [4(D)]

10. Receiver Circuit



An RF module (radio frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through radio frequency (RF) communication. For many applications the medium of choice is RF since it does not require line of sight. RF communications incorporate a transmitter and a receiver. They are of various types and ranges. Some can transmit up to 500 feet. RF modules are widely used in electronic design owing to the difficulty of designing radio circuitry. Good electronic radio design is notoriously complex because of the sensitivity of radio circuits and the accuracy of components and layouts required achieving operation on a specific frequency. In addition, reliable RF communication circuit requires careful monitoring of the manufacturing process to ensure that the RF performance is not adversely affected. Finally, radio circuits are usually subject to limits on radiated emissions, and require Conformance testing and certification by a standardization organization such as ETSI or the U.S. Federal Communications Commission (FCC). For these reasons, design engineers will often design a circuit for an application which requires radio communication and then "drop in" a pre-made radio module rather than attempt a discrete design, saving time.[4(D)]

11.7805 IC

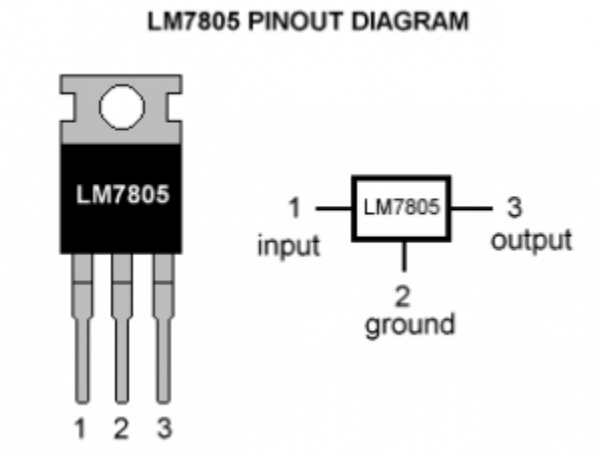
Voltage sources in a circuit may have fluctuations resulting in not providing fixed voltage outputs. A voltage regulator IC maintains the output voltage at a constant value. 7805 IC, a member of 78xx series of fixed linear voltage regulators used to maintain such fluctuations, is a popular voltage regulator integrated circuit (IC). The xx in 78xx indicates the output voltage it provides. 7805 IC provides +5 volts regulated power supply with provisions to add a heat sink.

7805 IC RATING

Input voltage range 7V- 35V

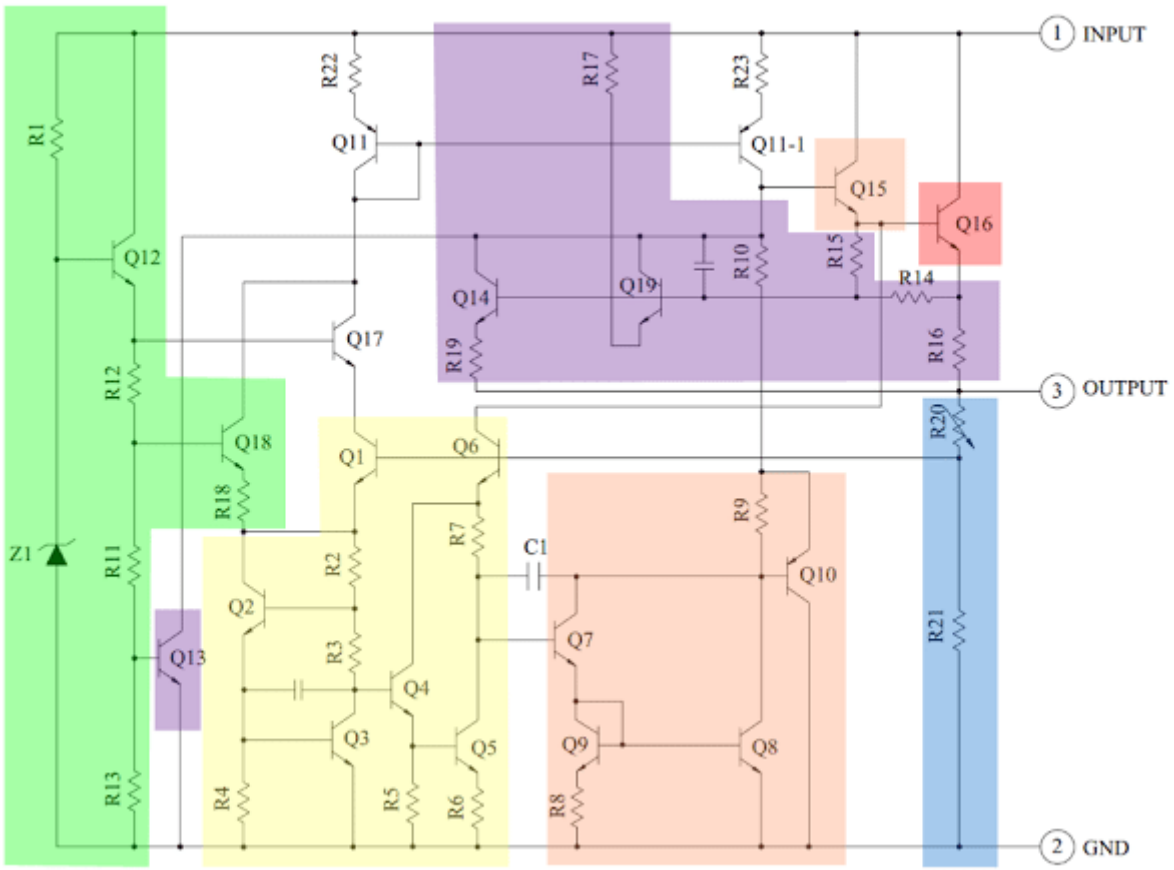
Current rating IC = 1A

Output voltage range VMax=5.2V, VMin=4.8V



Pin No.	Pin	Function	Description
1	INPUT	Input voltage (7V-35V)	In this pin of the IC positive unregulated voltage is given in regulation.
2	GROUND	Ground (0V)	In this pin where the ground is given. This pin is neutral for equally the input and output.
3	OUTPUT	Regulated output; 5V (4.8V-5.2V)	The output of the regulated 5V volt is taken out at this pin

11.1 Schematic of 7805 IC



The heart of the 7805 IC is a transistor (Q16) that controls the current between the input and output and thus controlling the output voltage. The band gap reference (yellow) keeps the voltage stable. It takes the scaled output voltage as input (Q1 and Q6) and provides an error signal (to Q7) for indication if the voltage is too high or low. The key task of the band gap is to provide a stable and accurate reference, even as the chip's temperature changes.

The error signal from the band gap reference is amplified by the error amplifier (orange). This amplified signal controls the output transistor through Q15. This closes the negative feedback loop controlling the output voltage. The startup circuit (green) provides initial current to the band gap circuit, so it doesn't get stuck in an "off" state. The circuit in purple provides protection against overheating (Q13), excessive input voltage (Q19) and excessive output current (Q14). These circuits reduce the output current or shutdown the regulator,

protecting it from damage in case of a fault. The voltage divider (blue) scales down the voltage on the output pin for use by the band gap reference.

Scaling the output

The 7805's scaled output provides the input voltage (Vin) to the band gap reference and the band gap provides an error signal as the output. The 7805's band gap circuit removes the feedback loop that exists inside a traditional band gap reference. Instead, the entire chip becomes the feedback loop.

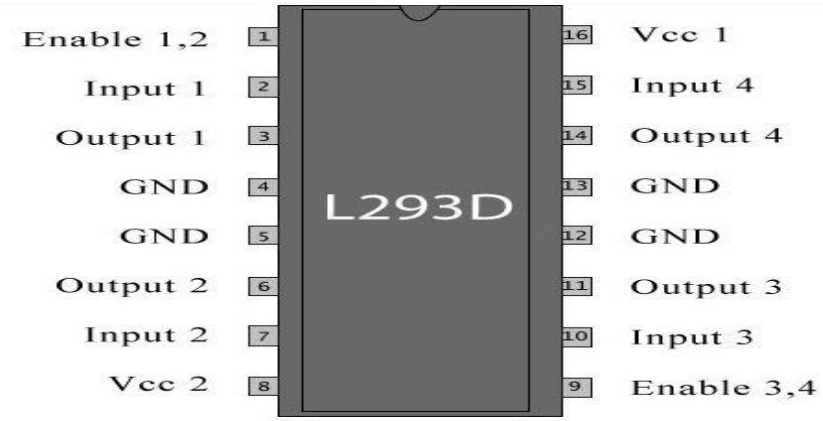
If the output voltage is correct (5V), then the voltage divider provides 3.75V at Vin. Any change in output voltage propagates through Q6 and R7, causing the voltage at the base of Q7 to rise or fall accordingly. This change is amplified by Q7 and Q8, generating the error output. The error output, in turn, decreases or increases the current through the output transistor. The negative feedback loop adjusts the output voltage until it is correct.

Application areas for 7805 IC

7805 IC is used in a wide range of circuits. The major ones being:

- Fixed-Output Regulator
- Positive Regulator in Negative Configuration
- Adjustable Output Regulator
- Current Regulator
- Adjustable DC Voltage Regulator
- Regulated Dual-Supply
- Output Polarity-Reversal-Protection Circuit
- Reverse bias projection Circuit [4(C)]

12. L293D MOTOR DRIVER MODULE

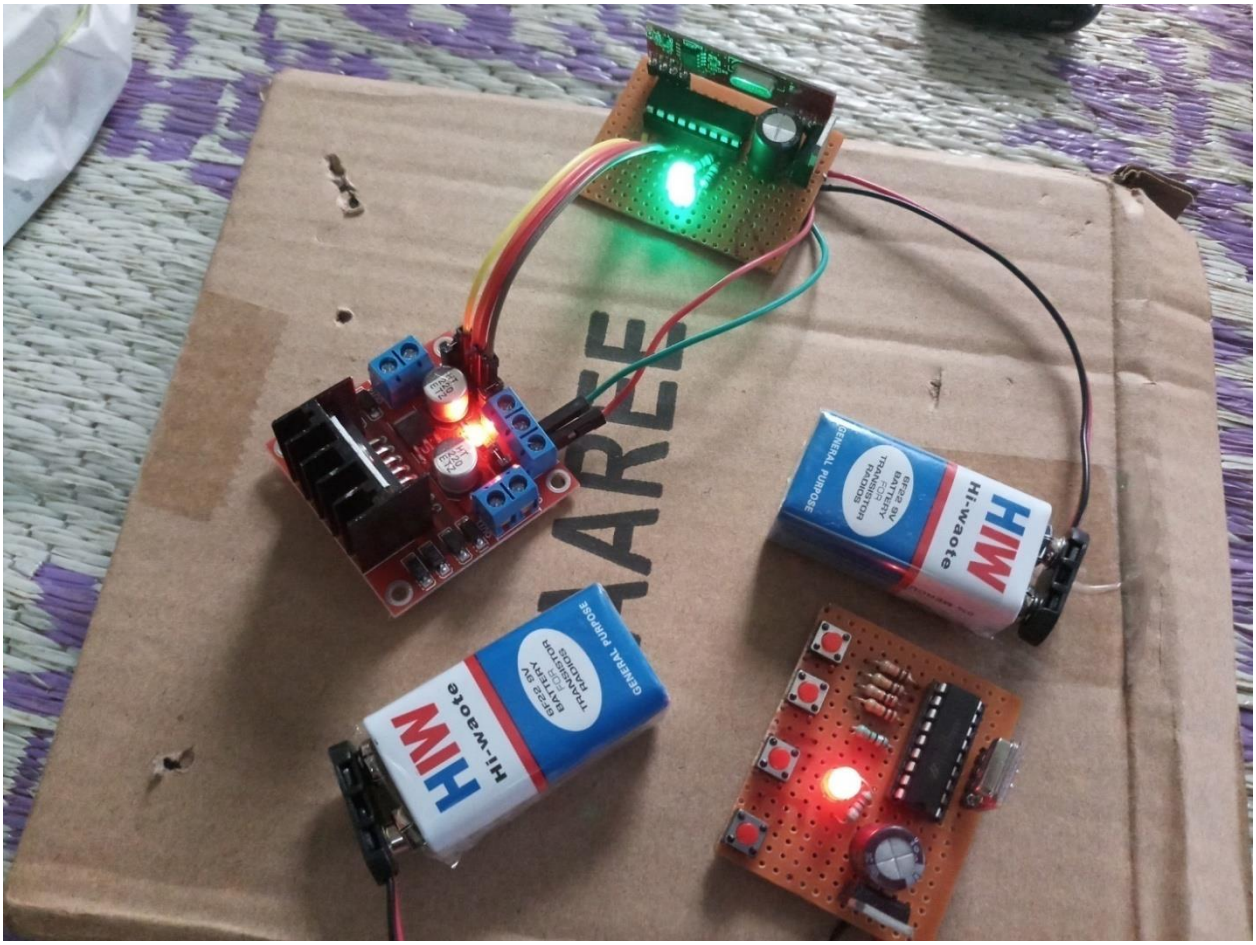


A motor driver is an integrated circuit chip which is usually used to control motors in autonomous robots. Motor driver act as an interface between Arduino and the motors. The most commonly used motor driver IC's are from the L293 series such as L293D, L293NE, etc. These ICs are designed to control 2 DC motors simultaneously. L293D consist of two H-bridge. H-bridge is the simplest circuit for controlling a low current rated motor. We will be referring the motor driver IC as L293D only. L293D has 16 pins. [4(C)]

13. Pin No. - Pin Characteristics

1 - Enable 1-2, when this is HIGH the left part of the IC will work and when it is low the left part won't work.
2 - INPUT 1, when this pin is HIGH the current will flow though output 1
3 - OUTPUT 1, this pin should be connected to one of the terminal of motor
4,5 - GND, ground pins
6 - OUTPUT 2, this pin should be connected to one of the terminal of motor
7 - INPUT 2, when this pin is HIGH the current will flow though output 2
8 - VCC2, this is the voltage which will be supplied to the motor.
16 - VCC1, this is the power source to the IC. So, this pin should be supplied with 5 V
15 - INPUT 4, when this pin is HIGH the current will flow though output 4
14 - OUTPUT 4, this pin should be connected to one of the terminal of motor
13, 12 - GND, ground pins
11 - OUTPUT 3, this pin should be connected to one of the terminal of motor
10 - INPUT 3, when this pin is HIGH the current will flow though output 3
9 - Enable 3-4, when this is HIGH the right part of the IC will work and when it is low the right part won't work.
The L293D is a 16 pin IC, with eight pins, on each side, dedicated to the controlling of a motor. There are 2 INPUT pins, 2 OUTPUT pins and 1 ENABLE pin for each motor.

14. TOTAL WIRELESS SYSTEM



A remote control vehicle is defined as any vehicle that is teleported by a means that does not restrict its motion with an origin external to the device. This is often a radio control device, cable between control and vehicle, or an infrared controller. A remote control vehicle or RCV differs from a robot in that the RCV is always controlled by a human and takes no positive action autonomously.

Radio controlled (or R/C) cars are battery/gas-powered model cars or trucks that can be controlled from a distance using a specialized transmitter or remote. The term "R/C" has been used to mean both "remote controlled" and "radio controlled", where "remote controlled" includes vehicles that are connected to their controller by a wire, but common use of "R/C" today usually refers to vehicles controlled by a radio-frequency link. This article focuses on radio-controlled vehicles only.

15. REFERENCES

1)DC Motor:(A) Ashfaq Hussain, Haroon Ashfaq ' Electric machines' Dhanpat Rai & CO, 2016 (B) Electric Machinery P.S Bhimra ,6th Edition Khanna Publishers

(C) Electric machine Desine A.K Sawhney Dhanpat Rai & CO.

(D) Electrical Machine, Nagthrath & Kothari, TMH

2)PV CELL:

(A) Non Conventional Energy Sources ,GD Rai, Khanna Publishers

(B) Renwable Energy Sources and Conversion Technology ,Bhansal Publishers,Tata Mc Graw Hill,

(C) Nonconventional Energy, Ashok v Desai,New Age International Publishers Ltd

3)RADIO FREQUENCY ,

(A)Microwave Engineering 3rd Edition David M.pozar, Willy & Sons

(B) Microwaves, KC Gupta , New Age Publishers

(C) Microwave Engineering , A das & S Das TMH (D) Microwave Devices and Circuit, Sy Liao , Pearson education

4)DIGITAL ELECTRONICS

(A)Digital Principal & Application,5th Edition, Leach & Malvino, Mc Graw Hill Company.

(B)Modern Digital Electronics, 2nd Edition, R.P. Jain, Tata Mc Graw Hill Company.

(C)Fundamental of Digital Circuits, A, Anand Kumar, PHI.

(D)Digital Logic Design, Morries Mano,PHI.

Conclusion

Solar energy more specifically solar car would be an amazing advancement in future technology. They would allow a free travel and unlimited accessibility. They would allow a free and pollution less travel. Solar powered cars are running without burning fossil fuels makes them a possible solution to our energy crisis. Solar energy is clean, renewable and free energy that can supply all the energy needs of the world. This energy is pollutant free with no emissions or greenhouse gases released into the air whatsoever. With the rising concerns over global warming and climate change, this is one of the most important reasons to pursue developing more ways to utilize solar energy. After the initial investment has been recovered, the energy from the sun is practically free. But solar cars are not successful at all places near polar region and in cloudy environment. If the hurdles are eliminated then solar cars will be the future of the next generation transport.