MONITORING AND DIRECTION CONTROL OF WIND MILL

A Project Report

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BONAFIDE CERTIFICATE

Certified that this project report entitled **"MONITORING AND DIRECTION CONTROL OF WIND MILL"** is the bonafide work of

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ABSTRACT

The objective of this project is to monitor voltage and current in the windmill power generation through PC and to control the direction of wind mill based on the velocity of wind.

This project is designed with micro controller, current transformer, ADC, and PC. Depending upon the wind strength windmill generates power. The generated voltage of the windmill is rectified with a diode rectifier and given to ADC which is an analog to digital converter in which the analog voltage is converted into corresponding digital signal and it is given to micro controller.

Since the current from the wind mill is small, it is converted to DC and fed to battery and stored. Again it is converted to AC by using an inverter. This current is fed to current transformer where it is converted into voltage by shunt resistors. This voltage is then measured using precision rectifier which consists of a half wave rectifier and summing amplifier. Through ADC, it is then given to micro controller where the voltage is converted to corresponding current. Wind velocity is continuously monitored and if the wind velocity exceeds certain limit, the direction of the windmill is changed by using a stepper motor of a preset step angle.

Here we use ATMEL 89C51 microcontroller. The microcontroller is programmed so as to receive all the information from the circuit and display on the LCD display. It is also transmitted to PC. To interface the micro controller with PC we need level logic converter. Level logic converter converts from TTL compatible to RS232 voltage level and vice versa. PC receives all the information from micro controller and displays it.

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CONTENTS

APPENDIX

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

.1. IMPORTANCE OF WIND POWER:

Energy is a major input for overall socio-economic development. Use of fossil fuels is xpected to fuel the economic development process of a majority of the world population during he next two decades. However, at some time during the period 2020-2050, fossil fuels are likely o reach their maximum potential, and their price will become higher than other renewable nergy options on account of increasingly constrained production and availability. Therefore, enewable energy are expected to play a key role in accelerating development and sustainable rowth in the second half of the next century, accounting then to 50 to 60% of the total global nergy supply.

Coal, gas and oil will not be the three kings of the energy world for ever. It is no longer folly to look up to the sun and wind, down into the sea's waves".

Wind energy is freely available, widely distributed, renewable and also nature-friendly. Vind has huge potential. It is estimated that if all the available wind energy is harnessed, it can ontribute about five times the total energy demands of the world at present. Wind energy is the astest growing renewable energy source in the world. The world wide installed capacity is rowing at a rapid pace of over 30% per year.

Factors:

Declining cost (4-6 cents k/wh)

Technological advances

Revenue for landowners & tax jurisdictions

Consumer demand

For the operation of wind turbine to be commercially feasible, average wind speed should e in the range of 20-30 mi/hr, a turbine operates at full capacity, and at higher wind speeds the urbine should be shut down to avoid damage. Shutting down of the wind mill reduces the fficiency of the wind mill. So, in this project when the air velocity exceeds the limit we turn the vind mill to the direction of lesser speed and keep the wind mill operating.

In addition to direction control of wind mill, the current and voltage generated from the vind mill are also monitored and sent to PC for remote monitoring.

.2. ABOUT WIND MILL:

Wind is a form of solar energy. Winds are caused by the uneven heating of the tmosphere by the sun, the irregularities of the earth's surface, and rotation of the earth. Wind low patterns are modified by the earth's terrain, bodies of water, and vegetation. Humans use this vind flow, or motion energy, for many purposes: sailing, flying a kite, and even generating lectricity.

The terms wind energy or wind power describes the process by which the wind is used to ;enerate mechanical power or electricity. A wind turbine is a machine that converts the kinetic :nergy in wind into mechanical energy. If the mechanical energy is used directly by machinery, uch as a pump or grinding stones, the machine is usually called a windmill. If the mechanical :nergy is converted to electricity, the machine is called a wind generator, or more commonly a vind turbine (wind energy converter WEC). The wind turns the blades, which spin a shaft, which :onnects to a generator and makes electricity.

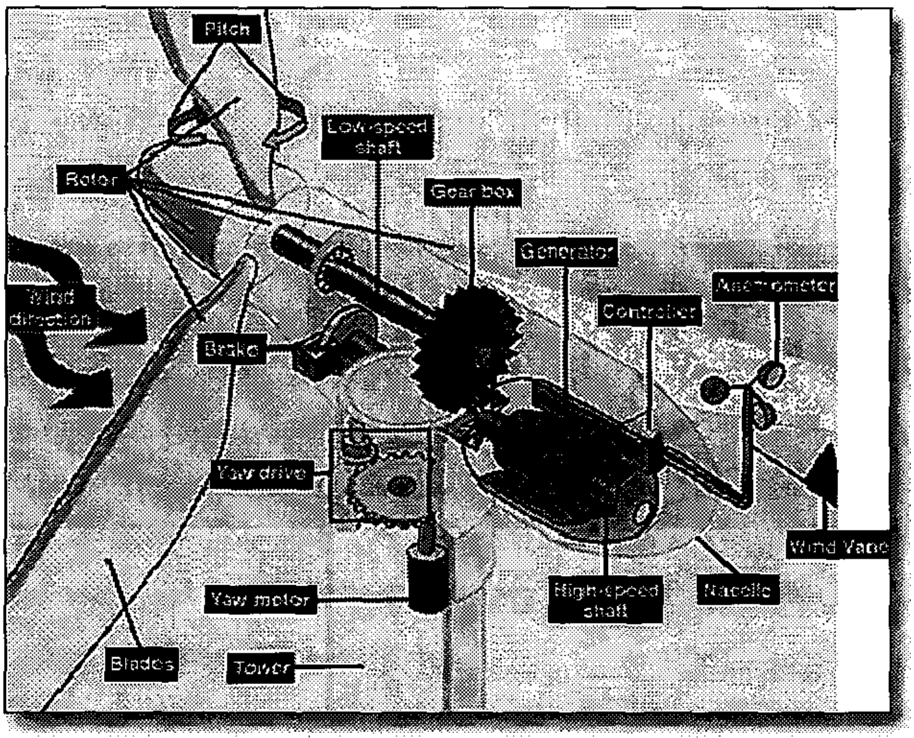


Fig 1.1. Components of wind turbine

Anemometer:

Measures the wind speed and transmits wind speed data to the controller.

Blades:

Most turbines have either two or three blades. Wind blowing over the blades causes the blades to "lift" and rotate.

Brake:

A disc brake, which can be applied mechanically, electrically, or hydraulically to stop the rotor in emergencies.

Controller:

The controller starts up the machine at wind speeds of about 8 to 16 miles per hour (mph) and shuts off the machine at about 55 mph. Turbines do not operate at wind speeds above about 55 mph because they might be damaged by the high winds.

Gear box:

Gears connect the low-speed shaft to the high-speed shaft and increase the rotational speeds from about 30 to 60 rotations per minute (rpm) to about 1000 to 1800 rpm, the rotational speed required by most generators to produce electricity. The gear box is a costly (and heavy) part of the wind turbine and engineers are exploring "direct-drive" generators that operate at lower rotational speeds and don't need gear boxes.

Generator:

Usually an off-the-shelf induction generator that produces 50-cycle AC electricity.

High-speed shaft:

Drives the generator.

Low-speed shaft:

The rotor turns the low-speed shaft at about 30 to 60 rotations per minute.

Nacelle:

The nacelle sits atop the tower and contains the gear box, low- and high-speed shafts, generator, controller, and brake. Some nacelles are large enough for a helicopter to land on.

Pitch:

Blades are turned, or pitched, out of the wind to control the rotor speed and keep the rotor from turning in winds that are too high or too low to produce electricity.

Rotor:

The blades and the hub together are called the rotor.

'ower:

Towers are made from tubular steel or steel lattice. Because wind speed increases with height, taller towers enable turbines to capture more energy and generate more electricity.

Vind direction:

This is an "upwind" turbine, so-called because it operates facing into the wind. Other turbines are designed to run "downwind," facing away from the wind.

Vind vane:

Measures wind direction and communicate with the yaw drive to orient the turbine properly with respect to the wind.

l.3. OVERSPEED PREVENTION IN WIND MILL:

A conventional windmill rotor with no load on it will rotate at a speed approximately ›roportional to the free wind speed. A rotor in high winds can turn at rotational speeds that are ;reat enough to result in structural damage and severe vibration problems. This can also cause ›ossible failure due to centrifugal forces. In such cases, the direction of the windmill has to be :hanged which is very difficult. For example, the human operators in old-time windmills have to :urn the whole rotor out of the wind when storm conditions occurred.

The more modern windmills, especially the larger ones, secure protection in high winds ısually by means which vary the pitch of the blades so as to reduce the rotor rotational speed to a ;afe range. Such systems require a complex rotor hub design which is usually associated with an ›utside power source to perform the pitch changing action. Systems of the type generally are :xpensive, and although the cost penalty may be justified in a large machine, it is not suitable for the more popular small windmills. Over speed preventers for wind motors have also taken the form of mechanical arrangements for braking the rotor shaft, but such arrangements imply increased maintenance and reliability problems. In addition, the implementation of mechanical braking systems designed for fully automatic operation introduces an undesirable level of complexity into the system and the power is interrupted.

In this project, we have implemented an over speed prevention scheme in which, during storm conditions, the stepper motor coupled to the shaft of the wind turbine rotates to a preset step angle and thus the direction of the wind turbine is changed. Thus the wind turbine is protected from damage. In this scheme, as power generation is not interrupted, efficiency of the

SYSTEM DESCRIPTION FOR CONTROL OF WINDMILL

!.1. DESCRIPTION:

The blades of the wind mill rotate and generate voltage. The voltage generated by the vind mill is AC. This AC voltage is then rectified using a diode rectifier. The output is rectified)C which is directly fed to the analog to digital converter for voltage measurement.

The rectified DC voltage is stored in a battery. The output of the battery is connected to a nverter which converts d.c to a.c. The inverted voltage is given to a current transformer. The stepped down current is then given to shunt resistor. The voltage across the shunt resistor is ectified using precision rectifier. This rectified voltage is then fed to the analog to digital converter as shown in the fig.2.1.

The output from the ADC is then given to the microcontroller, ATMEL89C51. The velocity of wind corresponding to the generated voltage is calculated in the program. The measured current, voltage and corresponding velocity of wind are displayed in LCD as show in fig2.1.

The velocity of wind is continuously monitored by the microcontroller. If the velocity of wind exceeds certain limit, the microcontroller gives pulses to the stepper driver card. This then drives the stepper motor that rotates at a preset step angle. The shaft of the stepper motor is coupled to the shaft of the windmill and so when the stepper motor rotates the direction of the wind mill changes till the velocity of wind is within the safe limit.

The measured parameters (voltage, current and velocity of wind) from the microcontroller are transmitted to the PC. The interface between the microcontroller and PC is done using Level Logic Converter as shown in fig.2.1. All the parameters from microcontroller are displayed in PC that helps in remote monitoring.

OVERALL BLOCK DIAGRAM:

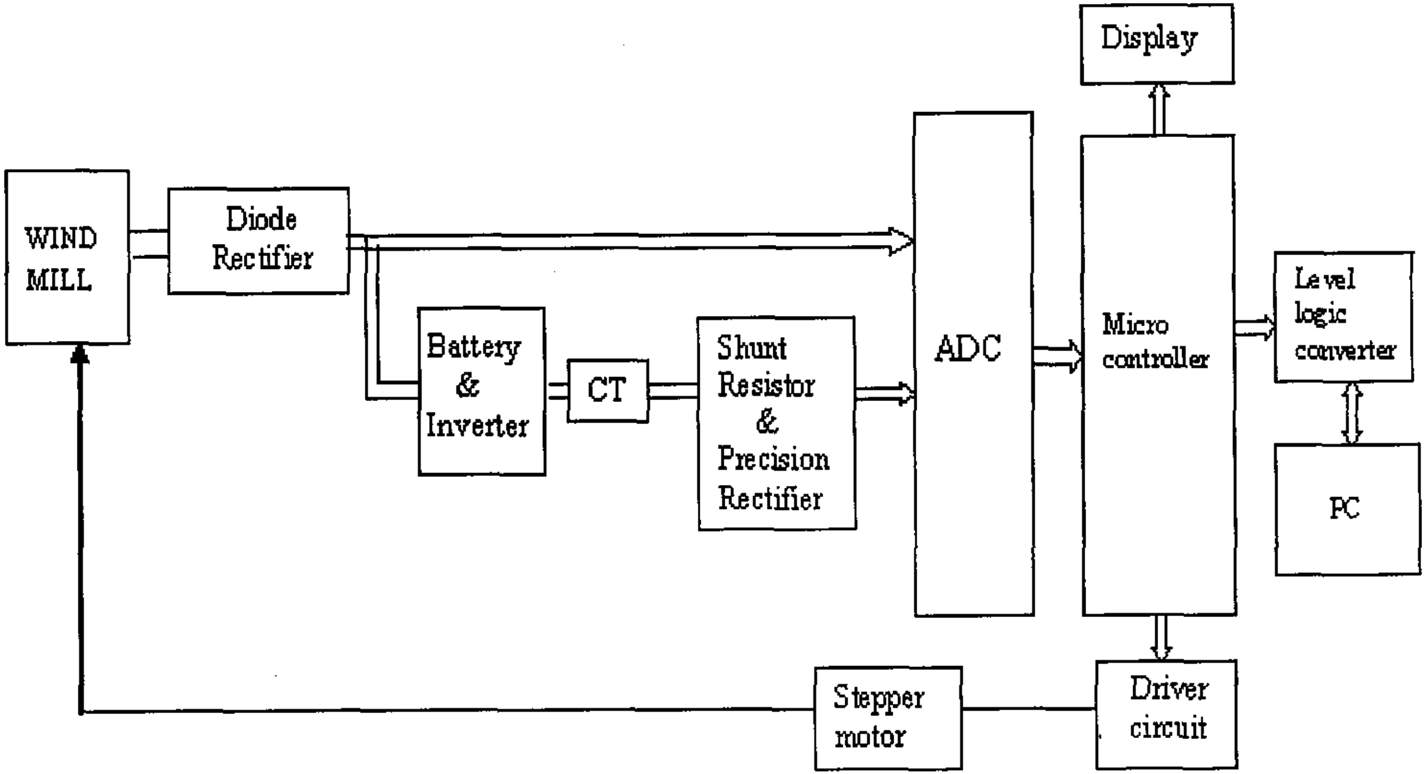


Fig.2.1. Block Diagram for control of windmill

MODULES TO MONITOR AND CONTROL A WINDMILL

3.1. POWER SUPPLY:

3.1.1. Block diagram:

The ac voltage, typically 220V rms, is connected to a transformer, which steps that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation.

A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

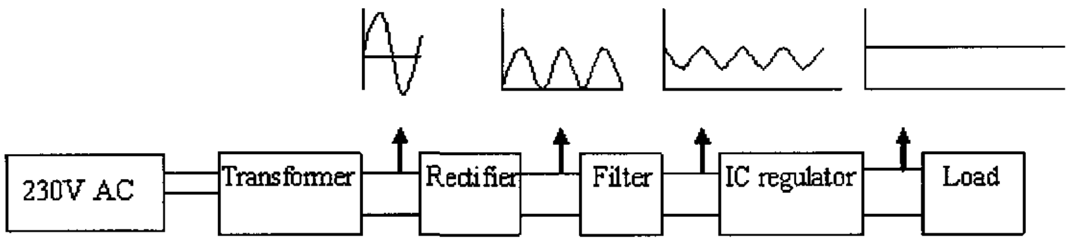


Fig.3.1. Block Diagram of Power Supply

3.1.2. Working principle:

Transformer

The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op–amp. The advantages of using precision rectifier are it will give peak voltage output as DC, rest of the circuits will give only RMS output.

Bridge rectifier

When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners.

Let us assume that the transformer is working properly and there is a positive potential, at point A and a negative potential at point B. the positive potential at point A will forward bias D3 and reverse bias D4.

The negative potential at point B will forward bias D1 and reverse D2. At this time D3 and D1 are forward biased and will allow current flow to pass through them; D4 and D2 are reverse biased and will block current flow.

The path for current flow is from point B through D1, up through RL, through D3, through the secondary of the transformer back to point B. this path is indicated by the solid arrows. Waveforms (1) and (2) can be observed across D1 and D3.

One-half cycle later the polarity across the secondary of the transformer reverse, forward biasing D2 and D4 and reverse biasing D1 and D3. Current flow will now be from point A through D4, up through RL, through D2, through the secondary of T1, and back to point A. This path is indicated by the broken arrows. Waveforms (3) and (4) can be observed across D2 and D4. The current flow through RL is always in the same direction. In flowing through RL this current develops a voltage corresponding to that shown waveform (5). Since current flows through the load (RL) during both half cycles of the applied voltage, this bridge rectifier is a full-wave rectifier.

One advantage of a bridge rectifier over a conventional full-wave rectifier is that with a given transformer the bridge rectifier produces a voltage output that is nearly twice that of the conventional full-wave circuit.

This may be shown by assigning values to some of the components shown in views A and B. assume that the same transformer is used in both circuits. The peak voltage developed between points X and y is 1000 volts in both circuits. In the conventional full-wave circuit shown—in view A, the peak voltage from the center tap to either X or Y is 500 volts. Since only one diode can conduct at any instant, the maximum voltage that can be rectified at any instant is 500 volts.

The maximum voltage that appears across the load resistor is nearly-but never exceeds-500 vOlts, as result of the small voltage drop across the diode. In the bridge rectifier shown in view B, the maximum voltage that can be rectified is the full secondary voltage, which is 1000 volts. Therefore, the peak output voltage across the load resistor is nearly 1000 volts. With both circuits using the same transformer, the bridge rectifier circuit produces a higher output voltage than the conventional full-wave rectifier circuit.

IC voltage regulators

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage. The regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from

A fixed three-terminal voltage regulator has an unregulated dc input voltage, Vi, applied to one input terminal, a regulated dc output voltage, Vo, from a second terminal, with the third terminal connected to ground.

The series 78 regulators provide fixed positive regulated voltages from 5 to 24 volts. Similarly, the series 79 regulators provide fixed negative regulated voltages from 5 to 24 volts.

- For ICs, microcontroller, LCD --------- 5 volts
- For alarm circuit, op-amp, relay circuits ---------- 12 volts

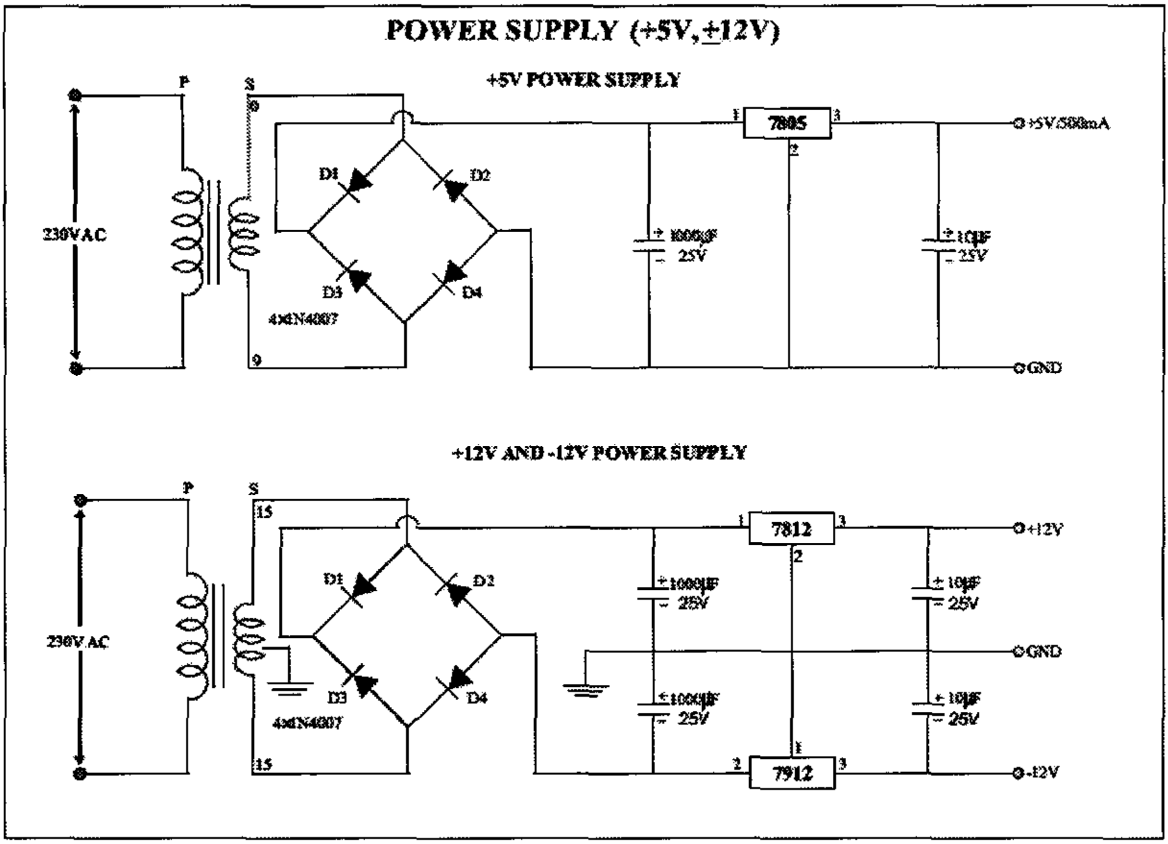


Fig 3.2. Power Supply Circuit

2. VOLTAGE MEASUREMENT:

The blades of the wind turbine start rotating when wind blows at a speed of 10 to 15 i/hour. As the blades rotate, the shaft in the nacelle also rotates. The shaft of the wind turbine is ›upled to the shaft of the generator. As the shaft rotates, it cuts the flux lines of the magnetic ›ils in the generator which in turn induces an alternating emf. This alternating emf is rectified ;ing a diode rectifier.

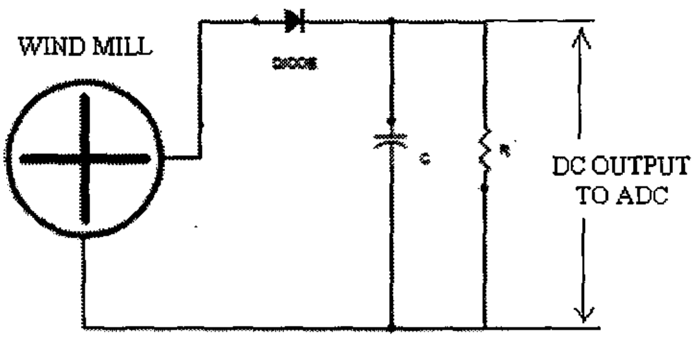


Fig.3.3. Voltage Measurement Circuit

In the diode rectifier, the AC voltage is rectified using a diode. The pulsated DC is then iltered using a capacitor to give a unidirectional DC. This is then fed to the ADC.

For large voltages, the output voltage from the wind mill is stepped down using a ›otential Transformer and then measured.

3.3. CURRENT MEASUREMENT:

. This circuit is designed to monitor the current. The output from the windmill is rectified ısing a diode rectifier and then sent to a battery (12V, 1.3A) for storage. Then it is inverted using an inverter. The inverted ac current is stepped down using current transformer and is then converted to voltage with the help of shunt resistor. Then the converted voltage is rectified by the precision rectifier. The precision rectifier is a configuration obtained with an operational amplifier in order to have a circuit behaving like an ideal diode or rectifier.

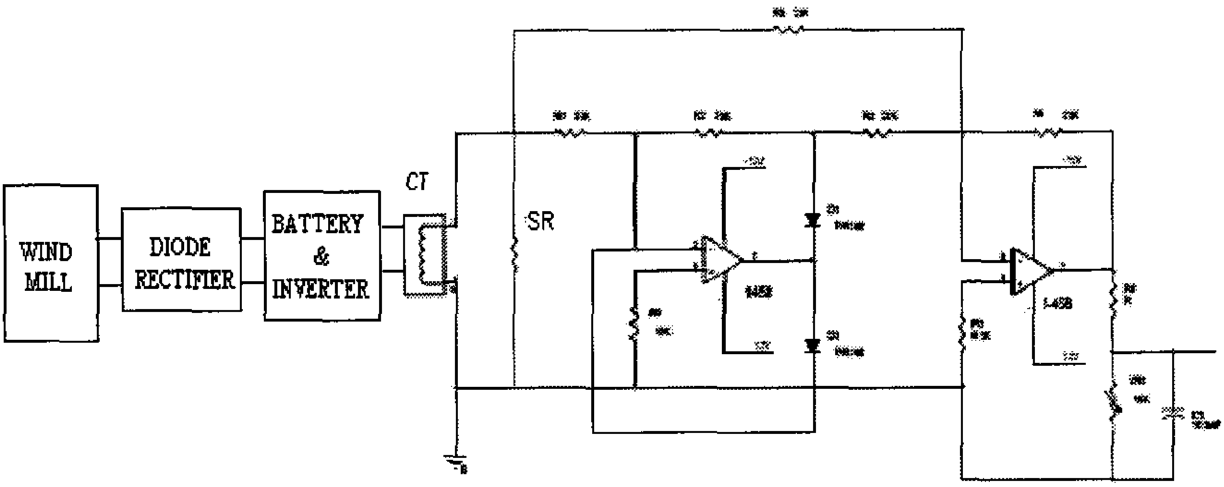


Fig 3.4. Current Measurement Circuit

The full wave rectifier is the combination of half wave precision rectifier and summing amplifier. When the input voltage is negative, there is a negative voltage on the diode, too, so it works like an open circuit, there is no current in the load and the output voltage is zero. When the input is positive, it is amplified by the operational amplifier and it turns the diode on. There is current in the load and, because of the feedback, the output voltage is equal to the input.

In this case, when the input is greater than zero, D2 is ON and D1 is OFF, so the output is zero. When the input is less than zero, D2 is OFF and D1 is ON, and the output is like the input with an amplification of $- R_2 / R_1$. The full-wave rectifier depends on the fact that both the half-wave *rectifier* and the *summing amplifier are precision circuits. It operates by producing* an inverted half-wave-rectified signal and then adding that signal at double amplitude to the original signal in the summing amplifier. The result is a reversal of the selected polarity of the input signal.

Then the output of the rectified voltage is adjusted to 0-5v with the help of variable resistor VR1. Then given to ripples are filtered by the C1 capacitor. After the filtration the corresponding DC voltage is given to ADC or other related circuit.

INVERTER:

This circuit is designed for taking 230V AC from the 12V DC input. An AC load can be powered from a DC source by using a converter to change DC to AC. This is efficiently done through below circuit with the use of two transistors Q1 & Q2 and one Transformer (T). The wattage of output depends on these three equipments.

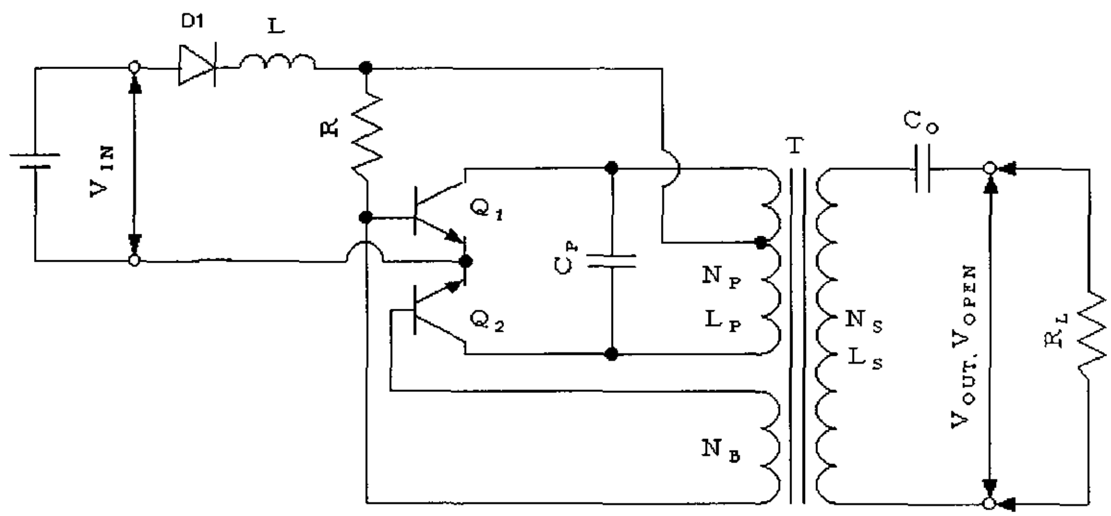


Fig 3.5. Inverter Circuit

A DC-to-AC inverter energized from a 12-volt DC input signal uses a single stage nverter circuit to produce a quasi-sine wave output signal. When we are giving 12v DC input to he circuit, initially it goes to diode D1 which is used to produce reverse voltage. Then Q1 will onduct first, at that time we can get the positive cycle of 230v output in the output transformer ide. It will prolong some seconds and gets saturated then Q2 will conduct this time. This witching makes the reverse polarity in the output side with constant 230v output. Then Q2 will onduct some seconds and gets saturated and Q1 will conduct. Likewise this switching makes lternating 230v output in the transformer output side. This will continue up to the input given to he circuit, which makes constant 230V AC output in the transformer side. The output voltage of he inverter is decided only in the transformer.

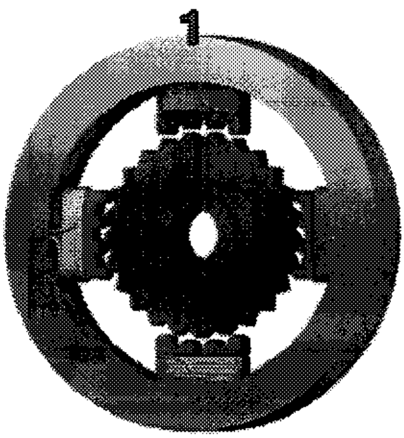
In DC to AC converters, a direct current voltage is applied to a so-called half bridge with wo power transistors connected in series. The power transistors are gated alternatively onducting and generate at their connection point an alternating voltage for the load. DC-to-AC oltage converters have many uses, such as the supply of power to gas discharge lamps or, after ectifying and smoothing the AC voltage, supplying power to electronic circuits, motors, relays, nagnetic valves, magnetic clutches, etc. DC-to-AC power converters are often used in ninterruptible power supplies.

3.4. STEPPER MOTOR:

A **stepper motor** is a brushless, synchronous electric motor that can divide a full rotation into a large number of steps, for example, 200 steps. Thus the motor can be turned to a precise angle.

3.4.1. Fundamentals of Operation:

Stepper motors operate much differently from normal DC motors, which simply spin when voltage is applied to their terminals. Stepper motors, on the other hand, effectively have multiple "toothed" electromagnets arranged around a central metal gear, as shown at right. To make the motor shaft turn, first one electromagnet is given power, which makes the gear's teeth magnetically attracted to the electromagnet's teeth. When the gear's teeth are thus aligned to the first electromagnet, they are slightly offset from the next electromagnet. So when the next electromagnet is turned on and the first is turned off, the gear rotates slightly to align with the next one, and from there the process is repeated. Each of those slight rotations is called a "step." In that way, the motor can be turned a precise angle. There are two basic arrangements for the electromagnetic coils: bipolar and unipolar.



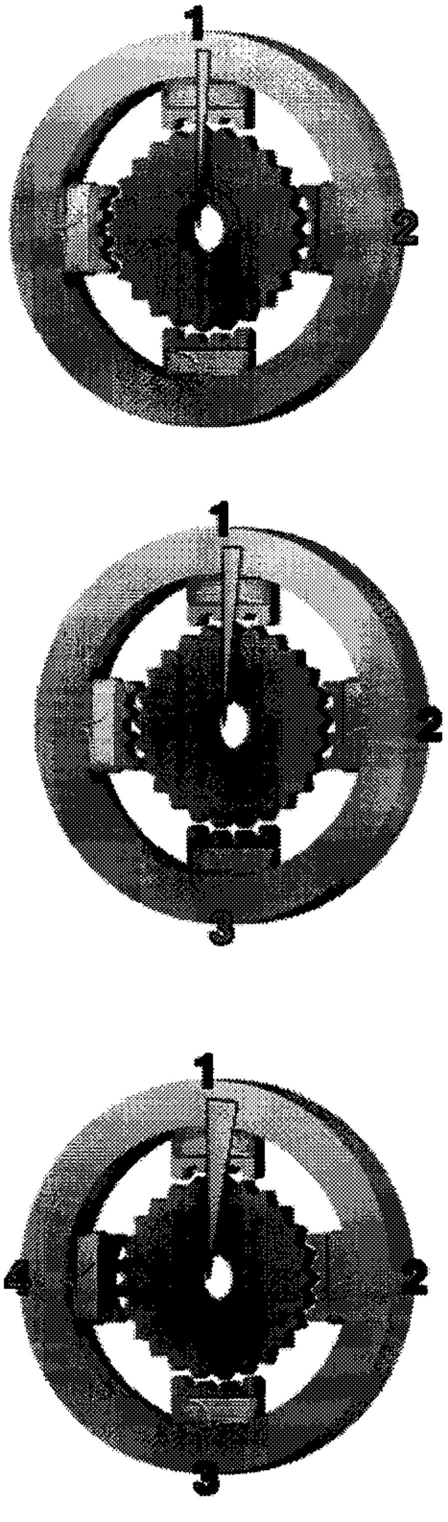


Fig.3.6. Stepper Motor- Modes of Operation

A step motor can be viewed as a DC motor with the number of poles (on both rotor and stator) increased, taking care that they have no common denominator. Additionally, soft magnetic material with many teeth on the rotor and stator cheaply multiplies the number of poles allowing a stepless operation, but this puts some burden on the controller. When using an 8-bit digital controller, 256 microsteps per step are possible. As a digital-to-analog converter produces unwanted ohmic heat in the controller, pulse-width modulation is used instead to regulate the mean current. Simpler models switch voltage only for doing a step, thus needing an extra current limiter: for every step, they switch a single cable to the motor. Bipolar controllers can switch between supply voltage, ground, and unconnected. Unipolar controllers can only connect or disconnect a cable, because the voltage is already hard wired. Unipolar controllers need center-tapped windings.

It is possible to drive unipolar stepper motors with bipolar drivers. The idea is to connect the output pins of the driver to 4 transistors. The transistor must be grounded at the emitter and the driver pin must be connected to the base. Collector is connected to the coil wire of the motor.

Stepper motors are rated by the torque they produce. Synchronous electric motors using soft magnetic materials (having a core) have the ability to provide position holding torque (called *detent torque*, and sometimes included in the specifications) while not driven electrically. To achieve full rated torque, the coils in a stepper motor must reach their full rated current during each step. The voltage rating (if there is one) is almost meaningless. The motors also suffer from EMF, which means that once the coil is turned off it starts to generate current because the motor is still rotating. There needs to be an explicit way to handle this extra current in a circuit otherwise it can cause damage and affect performance of the motor.

3.4.2. Stepper Driver Card:

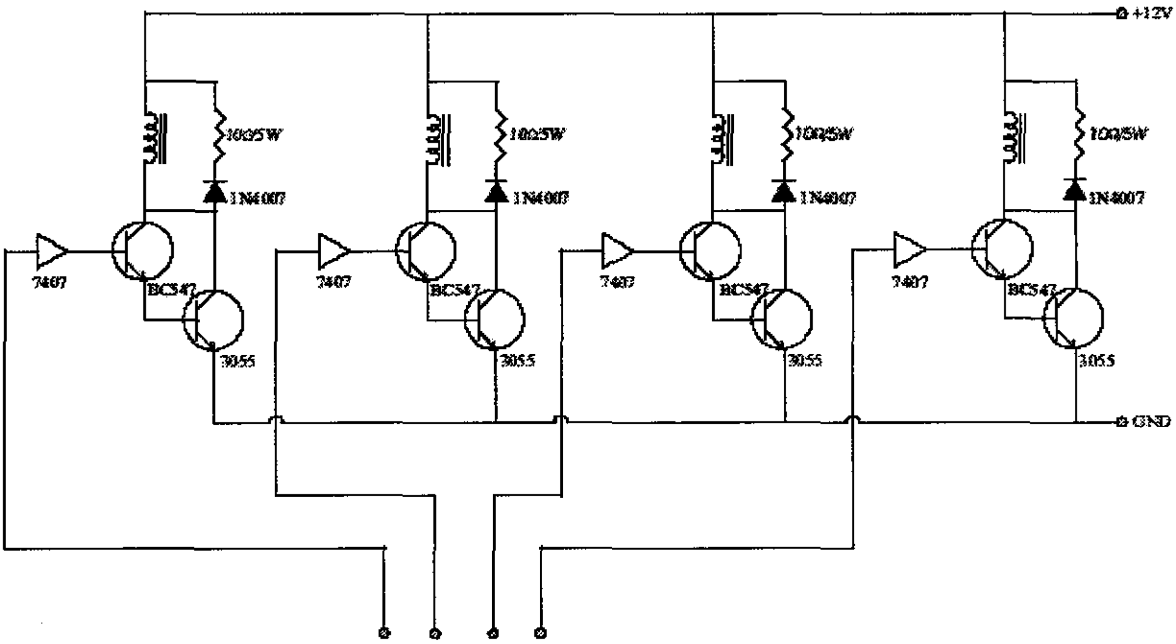


Fig 3.7 Stepper Driver Card

The stepper motor is having four windings named as A, B, C, D, which are energized by he separate driver circuit. The driver circuit consists of transistor network BC547 and 3055, lywheel diode and current booster 7047.

The stepper motor windings are energized sequentially which is controlled by the nicrocontroller. If the microcontroller sends the binary data in the order of 5, 9, A, and 6 the tepper motor is rotating in the forward direction. If the microcontroller sends the binary data in he order of 6, A, 9, and 5 the stepper motor is rotating in the reverse direction.

For an example if the binary data 5 (0101) given to driver circuit, the winding A and C re energized through transistor networks. The 7047 is used to boost the current signal. If vindings are energized and de-energized continuously it generating the back EMF it may lamage the windings. The flywheel diode is used to avoid the damage from the back EMF.

ADC0808

4.1. GENERAL DESCRIPTION:

The ADC0808 data acquisition component is a monolithic CMOS device with an 8 bit analog-to-digital converter, 8-channel multiplexer and microprocessor compatible control logic. The 8-bit A/D converter uses successive approximation as the conversion technique. The converter features a high impedance chopper stabilized comparator, a 256R voltage divider with analog switch tree and a successive approximation register. The 8-channel multiplexer can directly access any of 8-single-ended analog signals. The device eliminates the need for external zero and full-scale adjustments. Easy interfacing to microprocessors is provided by the latched and decoded multiplexer address inputs and latched TTL TRI-STATE® outputs. The design of the ADC0808 has been optimized by incorporating the most desirable aspects of several A/D conversion techniques. The ADC0808 offers high speed, high accuracy, minimal temperature dependence, excellent long-term accuracy and repeatability, and consumes minimal power. These features make this device ideally suited to applications from process and machine control to consumer and automotive applications. For 16-channel multiplexer with common output (sample/hold port) see ADC0816 data sheet.

4.2. FEATURES:

* Easy interface to all microprocessors
* Operates ratio metrically or with 5 VDC or analog span adjusted voltage reference
* No zero or full-scale adjust required
* 8-channel multiplexer with address logic
* 0V to 5V input range with single 5V power supply
* Outputs meet TTL voltage level specifications
* Standard hermetic or molded 28-pin DIP package
* 28-pin molded chip carrier package
* ADC0808 equivalent to MM74C949
* ADC0809 equivalent to MM74C949-1

4.3. KEY SPECIFICATIONS:

* Resolution	8 Bits
* Total Unadjusted Error	±1/2 LSB and ±1 LSB
* Single Supply	5 VDC
* Low Power	15 mW
* Conversion Time	100 μs

4.4. BLOCK DIAGRAM:

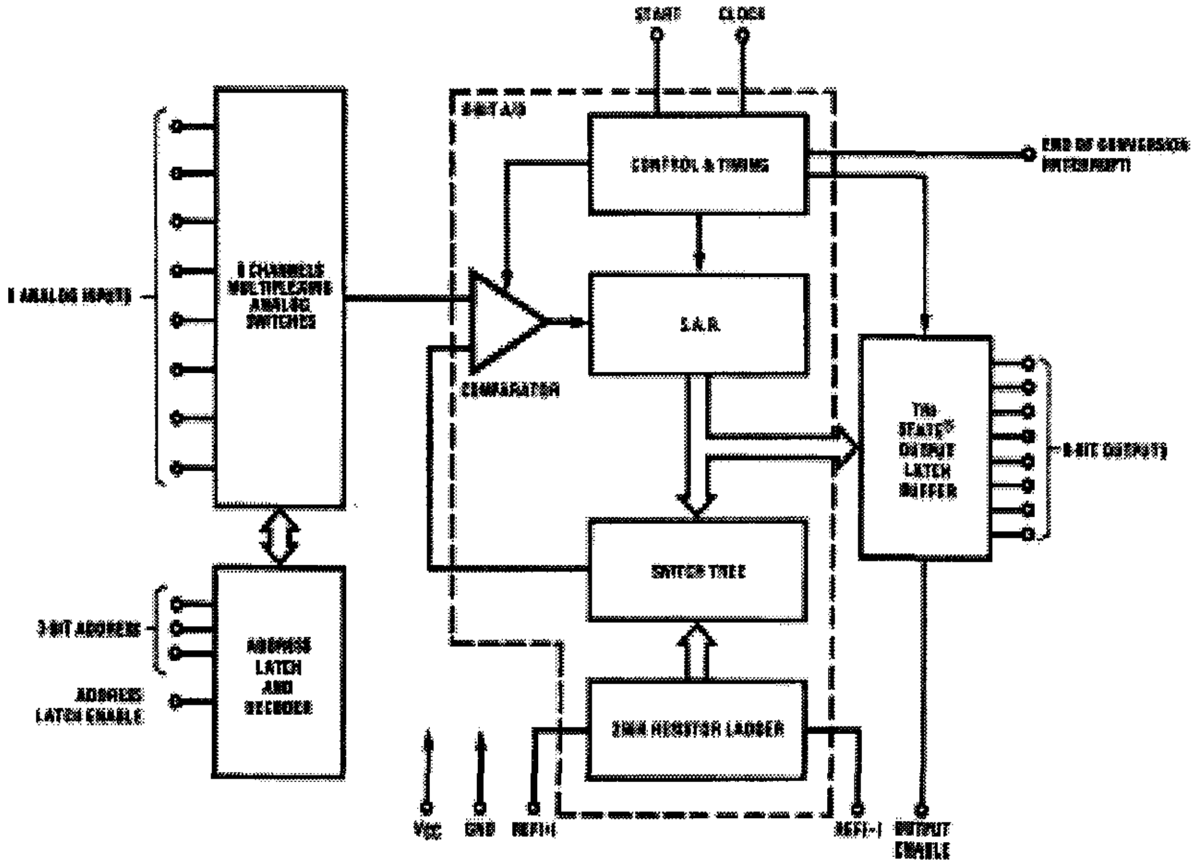


Fig 4.1. Block Diagram of ADC

4.5. CONNECTION DIAGRAM:

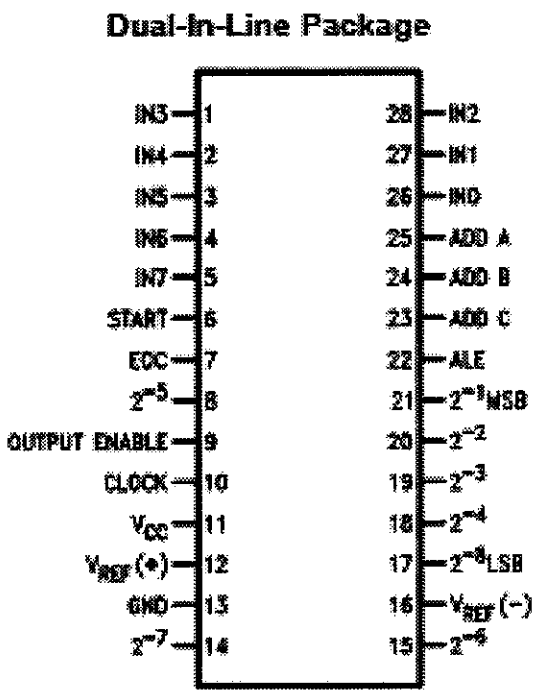


Fig 4.2. Connection diagram of ADC

4.6. FUNCTIONAL DESCRIPTION:

Multiplexer:

The device contains an 8-channel single-ended analog signal multiplexer. A particular input channel is selected by using the address decoder. Table 4.1 shows the input states for the address lines to select any channel. The address is latched into the decoder on the low-to-high transition of the address latch enable signal.

Table 4.1. Input states to select analog channel

SELECTED ANALOG CHANNEL	ADDRESS LINE		
	C	B	A
IN0	L	L	L
IN1	L	L	H
IN2	L	H	L
IN3	L	H	H
IN4	H	L	L
IN5	H	L	H
IN6	H	H	L
IN7	H	H	H

4.7. CONVERTER CHARACTERISTICS:

Converter

The converter is partitioned into 3 major sections: the 256R ladder network, the successive approximation register, and the comparator. The converter's digital outputs are positive true.

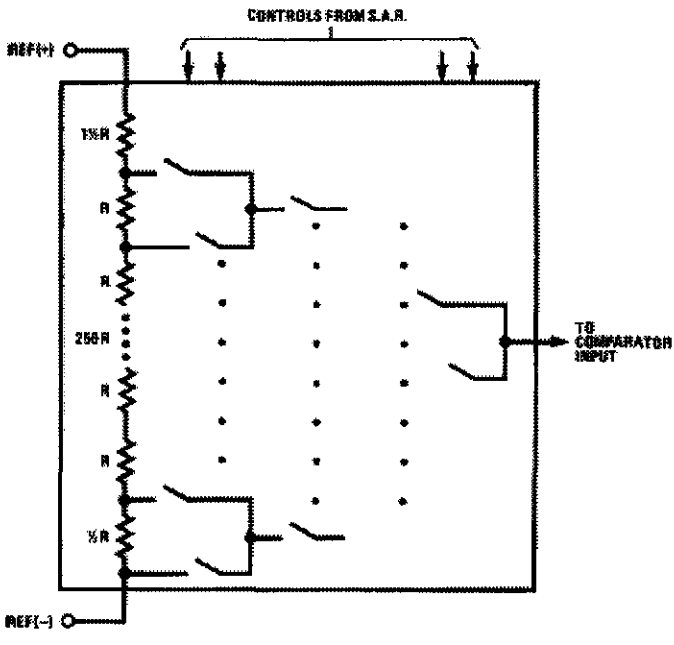


Fig. 4.3. Resistor Ladder and Switch Tree

The 256R ladder network approach (Figure 3.3) was chosen over the conventional '2R ladder because of its inherent monotonicity, which guarantees no missing digital codes. .onotonicity is particularly important in closed loop feedback control systems. A non monotonic lationship can cause oscillations that will be catastrophic for the system. Additionally, the 256R :twork does not cause load variations on the reference voltage.

The bottom resistor and the top resistor of the ladder network in Figure 3.3 are not e same value as the remainder of the network. The difference in these resistors causes the ıtput characteristic to be symmetrical with the zero and full-scale points of the transfer curve. he first output transition occurs when the analog signal has reached +1/2 LSB and succeeding ıtput transitions occur every 1 LSB later up to full-scale. The successive approximation register ;AR) performs 8 iterations to approximate the input voltage. For any SAR type converter, n-erations are required for an n-bit converter.

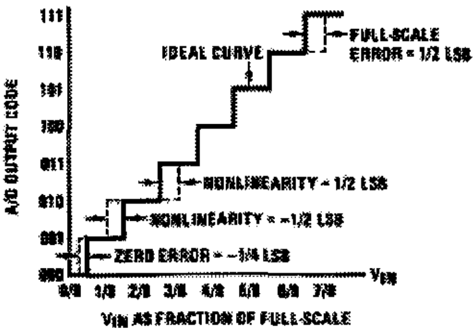


Fig 4.4. 3-bit A/D transfer curve

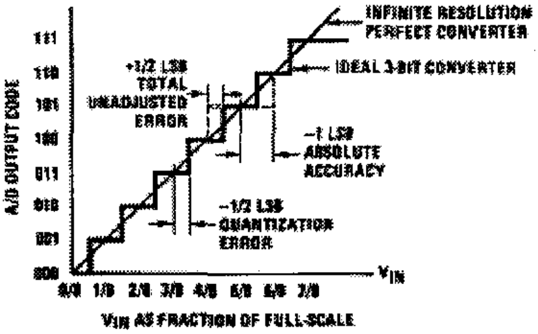


Fig 4.5. 3-bit A/D Absolute Accuracy Curve

Figure 3.4 shows a typical example of a 3-bit converter. In the ADC0808, ADC0809, the pproximation technique is extended to 8 bits using the 256R network. The A/D converter's ıccessive approximation register (SAR) is reset on the positive edge of the start conversion (SC) ulse. The conversion is begun on the falling edge of the start conversion pulse. A conversion in rocess will be interrupted by receipt of a new start conversion pulse. Continuous conversion ıay be accomplished by tying the end-of-conversion (EOC) output to the SC input. If used in ıis mode, an external start conversion pulse should be applied after power up. End-of-onversion will go low between 0 and 8 clock pulses after the rising edge of start conversion. The ıost important section of the A/D converter is the comparator. It is this section which is esponsible for the ultimate accuracy of the entire converter. It is also the comparator drift which as the greatest influence on the repeatability of the device. A chopper-stabilized comparator stabilized comparator converts the DC input signal into an AC signal. This signal is then fed through a high gain AC amplifier and has the DC level restored. This technique limits the drift component of the amplifier since the drift is a DC component which is not passed by the AC amplifier. This makes the entire A/D converter extremely insensitive to temperature, long term drift and input offset errors.

4.8. TIMING DIAGRAM:

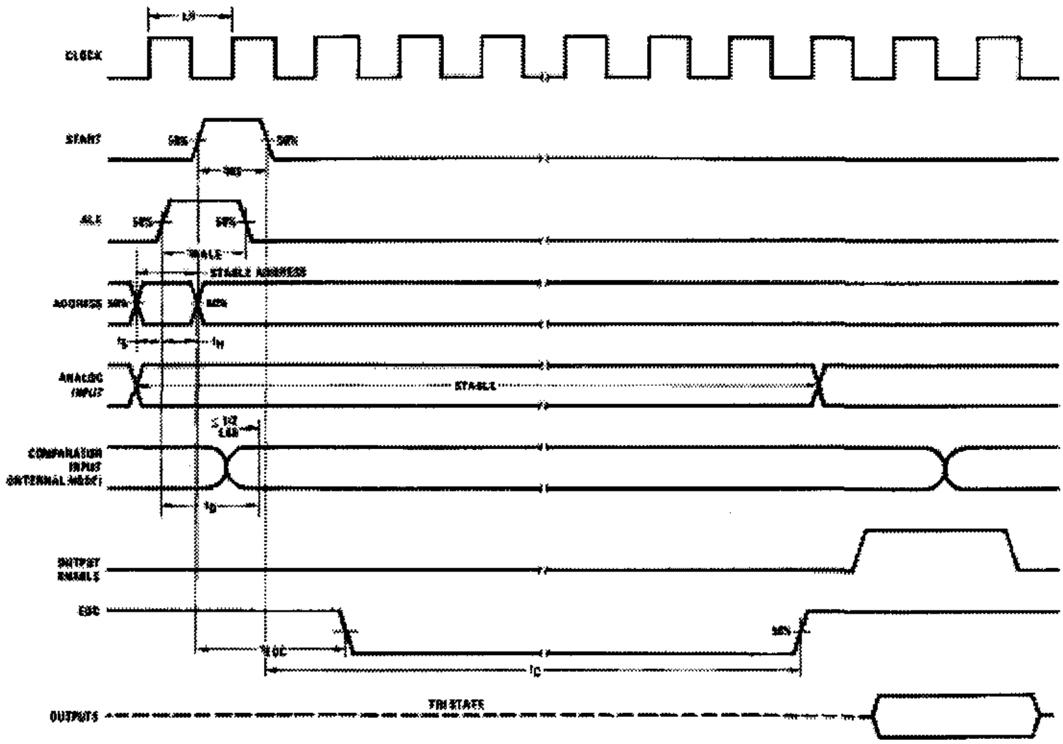


Fig 4.6. Timing diagram of ADC

ATMEL 89C51

5.1. FEATURES

- Compatible with MCS-51™ Products
- 4K Bytes of In-System Reprogrammable Flash Memory – Endurance: 1,000 Write/Erase Cycles
- Fully Static Operation: 0 Hz to 24 MHz
- Three-Level Program Memory Lock
- 128 x 8-Bit Internal RAM
- 32 Programmable I/O Lines
- Two 16-Bit Timer/Counters
- Six Interrupt Sources
- Programmable Serial Channel
- Low Power Idle and Power Down Modes

5.2. DESCRIPTION

The AT89C51 is a low-power, high-performance CMOS 8-bit microcomputer with 4K bytes of Flash Programmable and Erasable Read Only Memory (PEROM). The device is manufactured using Atmel's high density nonvolatile memory technology and is compatible with the industry standard MCS-51™ instruction set and pinout. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C51 is a powerful microcomputer which provides a highly flexible and cost effective solution to many embedded control applications.

In addition to the standard features, the AT89C51 is also designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port and interrupt system to continue functioning. The Power Down Mode saves the RAM contents but freezes the oscillator disabling all other chip functions until the next hardware reset.

5.3. PIN CONFIGURATION:

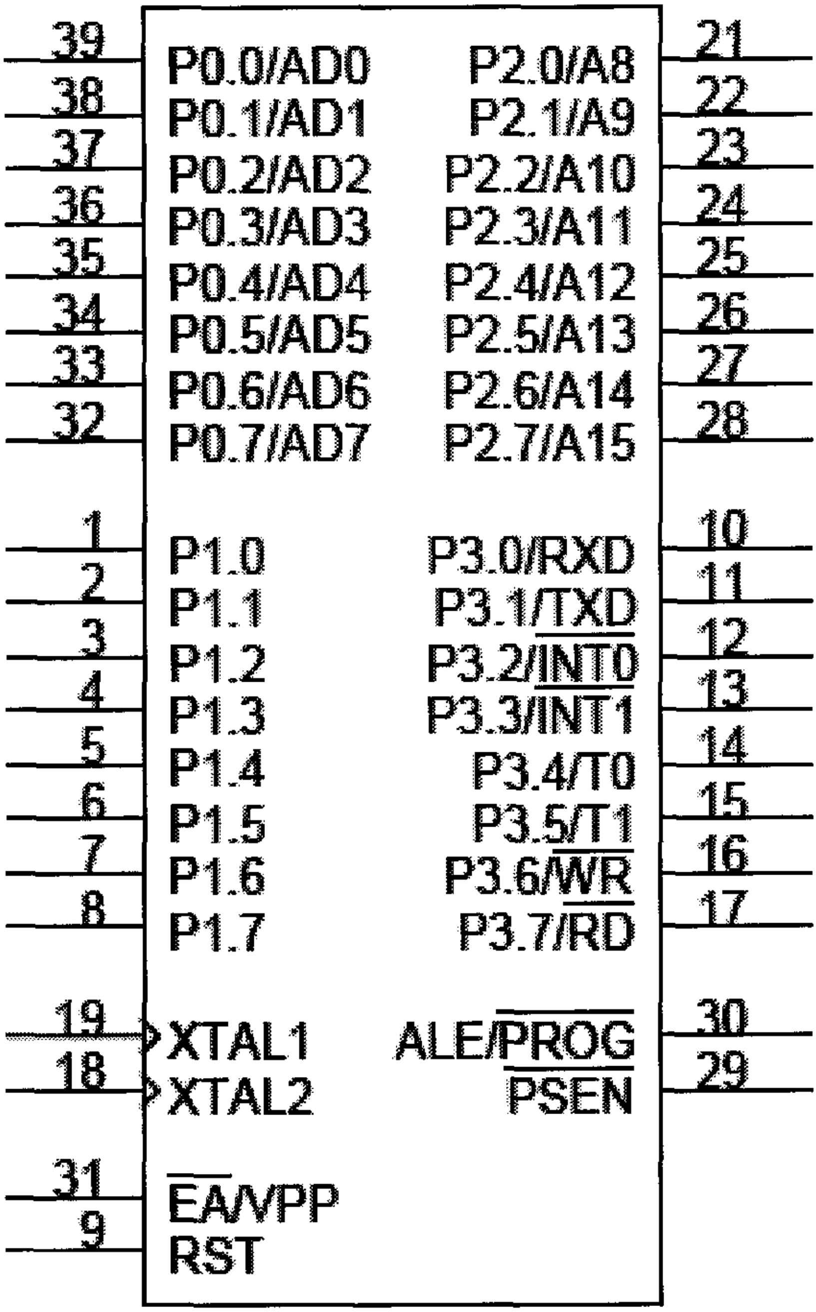


Fig 5.1. Pin diagram of AT89C51

5.4. PROGRAMMING THE FLASH:

The AT89C51 is normally shipped with the on-chip Flash memory array in the erased state (that is, contents = FFH) and ready to be programmed. The programming interface accepts either a high-voltage (12-volt) or a low-voltage (VCC) program enable signal. The low voltage programming mode provides a convenient way to program the AT89C51 inside the user's system, while the high-voltage programming mode is compatible with conventional third party Flash or EPROM programmers. The AT89C51 is shipped with either the high-voltage or low-voltage programming mode enabled. The respective top-side marking and device signature codes are listed in the following table.

Table 5.1. Top-side marking and signature codes

	V_{PP} = 12V	V_{PP} = 5V
Top-Side Mark	AT89C51 xxxx yyww	AT89C51 xxxx-5 yyww
Signature	(030H)=1EH (031H)=51H (032H)=FFH	(030H)=1EH (031H)=51H (032H)=05H

The AT89C51 code memory array is programmed byte-by-byte in either programming mode. To program any nonblank byte in the on-chip Flash Memory, the entire memory must be erased using the Chip Erase Mode.

Programming Algorithm: Before programming the AT89C51, the address, data and control signals should be set up according to the Flash programming mode table.

To program the AT89C51, take the following steps.

1. Input the desired memory location on the address lines.
2. Input the appropriate data byte on the data lines.
3. Activate the correct combination of control signals.
4. Raise EA/VPP to 12V for the high-voltage programming mode.
5. Pulse ALE/PROG once to program a byte in the Flash array or the lock bits. The byte-write cycle is self-timed and typically takes no more than 1.5 ms. Repeat steps 1 through 5, changing the address and data for the entire array or until the end of the object file is reached.

Data Polling: The AT89C51 features Data Polling to indicate the end of a write cycle. During a write cycle, an attempted read of the last byte written will result in the complement of the written datum on PO.7. Once the write cycle has been completed, true data are valid on all outputs, and the next cycle may begin. Data Polling may begin any time after a write cycle has been initiated.

Ready/Busy: The progress of byte programming can also be monitored by the RDY/BSY output signal. P3.4 is pulled low after ALE goes high during programming to indicate BUSY. P3.4 is pulled high again when programming is done to indicate READY.

Program Verify: If lock bits LB1 and LB2 have not been programmed, the programmed code data can be read back via the address and data lines for verification. The lock bits cannot be verified directly. Verification of the lock bits is achieved by observing that their features are enabled.

Chip Erase: The entire Flash array is erased electrically by using the proper combination of control signals and by holding ALE/PROG low for 10 ms. The code array is written with all "1"s. The chip erase operation must be executed before the code memory can be re-programmed.

Reading the Signature Bytes: The signature bytes are read by the same procedure as a normal verification of locations 030H, 031H, and 032H, except that P3.6 and P3.7 must be pulled to a logic low. The values returned are as follows.

(030H) = 1EH indicates manufactured by Atmel

(031H) = 51H indicates 89C51

(032H) = FFH indicates 12V programming

(032H) = 05H indicates 5V programming

Program Status Word:

7	6	5	4	3	2	1	0
CY	**AC**	**F0**	**RS1**	**RS0**	**OV**	**---**	**P**

PSW 0: Parity of Accumulator Set By Hardware To 1 if it contains an Odd number of 1s, Otherwise it is reset to 0.

PSW1: User Definable Flag

PSW2: Overflow Flag Set By Arithmetic Operations

PSW3: Register Bank Select

PSW4: Register Bank Select

PSW5: General Purpose Flag.

PSW6: Auxiliary Carry Flag Receives Carry Out from Bit 1 of Addition Operands

PSW7: Carry Flag Receives Carry Out From Bit 1 of ALU Operands.

Table 5.2.Flash Programming Modes

Mode		RST	$\overline{PSEN}$	ALE/$\overline{PROG}$	$\overline{EA}/V_{pp}$	P2.6	P2.7	P3.6	P3.7
Write Code Data		H	L		H/12V	L	H	H	H
Read Code Data		H	L	H	H	L	L	H	H
Write Lock	Bit - 1	H	L		H/12V	H	H	H	H
	Bit - 2	H	L		H/12V	H	H	L	L
	Bit - 3	H	L		H/12V	H	L	H	L
Chip Erase		H	L	(1)	H/12V	H	L	L	L
Read Signature Byte		H	L	H	H	L	L	L	L

Note: 1. Chip Erase requires a 10-ms PROG pulse.

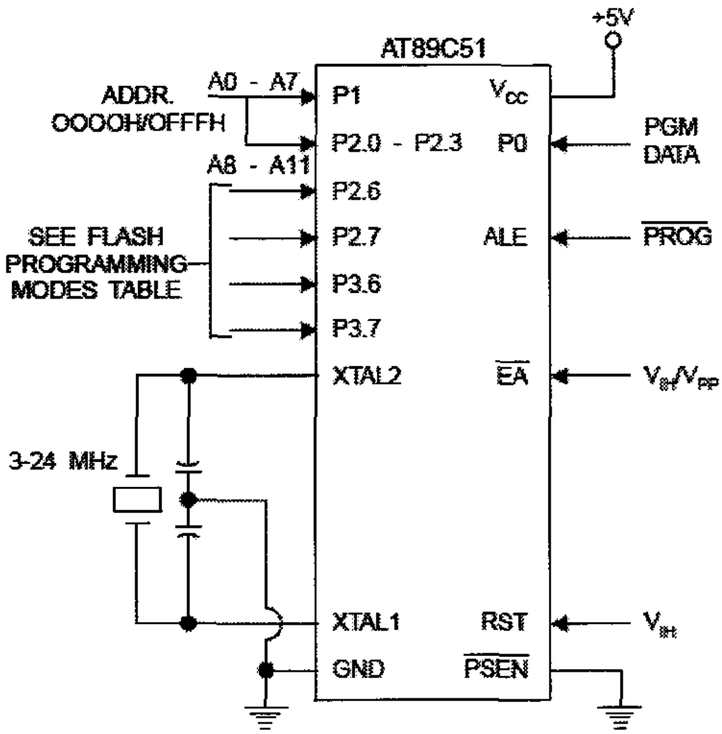


Fig 5.2. Programming the Flash

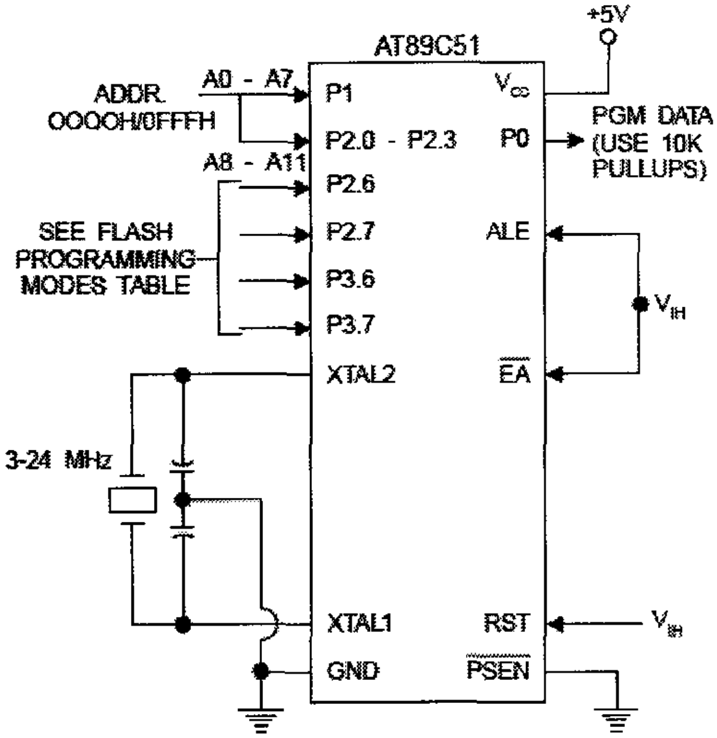


Fig.5.3. Verifying the flash

SOFTWARE

Keil C software is used in AT89C51 to program its memory. The program is coded to ɔntrol the ports and peripherals of AT89C51. The algorithm for the program is as follows:

.1. ALGORITHM:

tep 1: Initialise LCD and serial communication.

tep 2: Select ADC channel for current and voltage.

tep 3: Calculate wind velocity using measured voltage.

tep 4: If wind velocity greater than 150 kmph, then goes to Step 5 else go to Step 6.

tep 5: Give pulses to stepper driver card.

tep 6: Display all the parameters in LCD and send data serially to PC through hyper terminal.

tep 7: Go to Step 1.

).2. FLOW CHART:

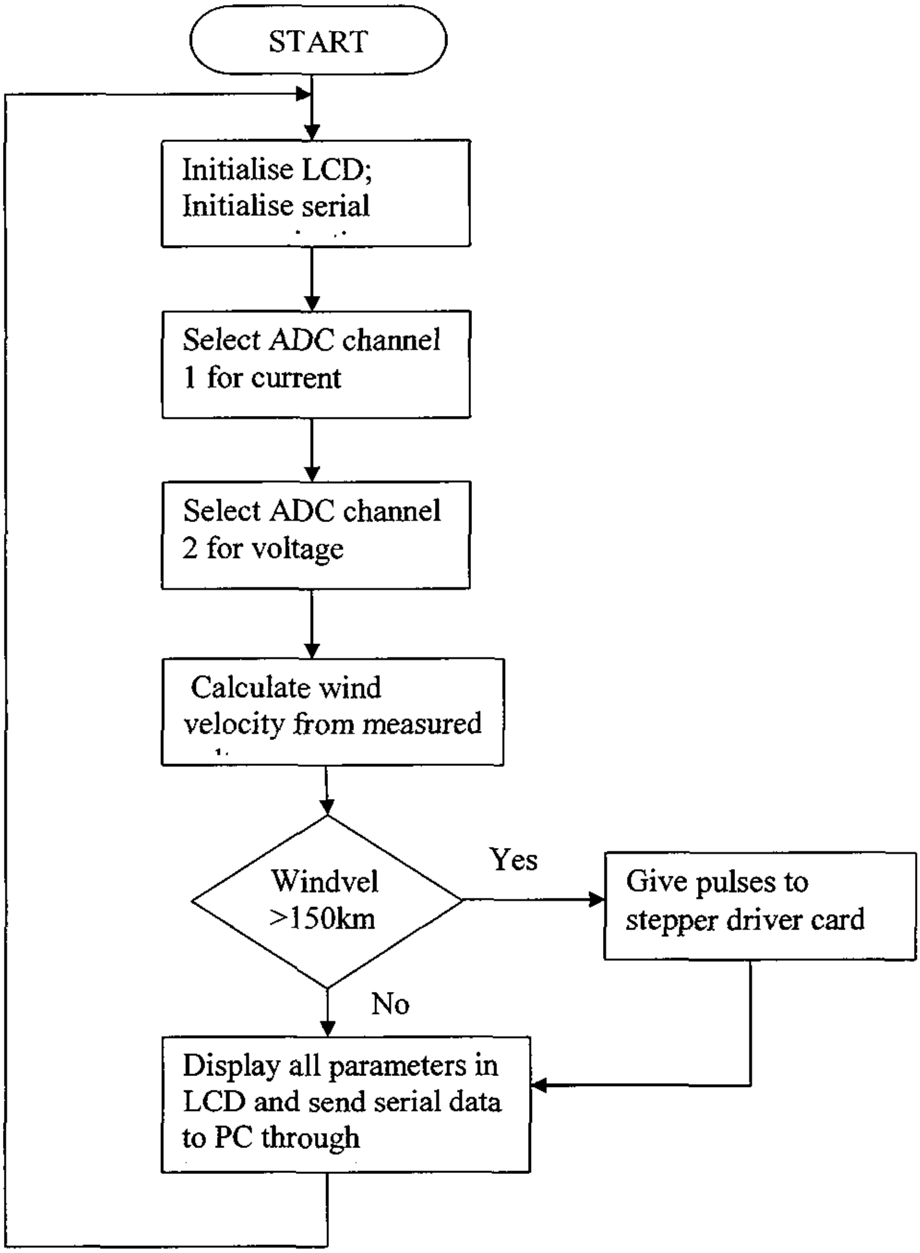


Fig.4.1. Flowchart for the control of windmill

3. PROGRAM:

```
nclude <AT89X51.H>

lata unsigned char ch0 _at_ 0x08;
lata unsigned char ch1 _at_ 0x09;
lata unsigned char ch2 _at_ 0x0a;
lata unsigned char soc _at_ 0x10;
lata unsigned char porta _at_ 0x18;
lata unsigned char portc _at_ 0x20;

it lim1=P2^0;
it lim2=P2^1;

oid delay(unsigned int);
oid read(unsigned char);
oid write(unsigned char);
oid lcd_dis(unsigned char *dis,unsigned char rr);
oid lcd_init(void);
oid serial(unsigned char);
oid del();
oid adc1();
oid adc2();

oid ser_tmr_init();
oid ser_out(unsigned char);
oid forward();
oid merge();
oid hex_dec1(unsigned int);
oid hx_curr(unsigned int);

nsigned char a,ak,bk,i,dd;
```

```
unsigned char volt,curr,fan,j,vv,g,str[5],msec;
unsigned int avg,reg,speed;



void main()
{
 lcd_init();
 read(0x80);
 lcd_dis(" WINDMILL CONTROL ",16);
del();
 read(0x01);
 read(0x80);
 lcd_dis("  I:     FV:    ",16);
 read(0xc0);
 lcd_dis("Speed:000 Km/hr ",16);
 g=0;
 ser_tmr_init();
 while(1)
 {
         adc1();
         read(0x84);
         hx_curr(curr);

         adc2();
         read(0x8c);
         hex_dec1(fan);

         read(0xc6);
         speed=fan*15;
         hex_dec1(speed);

         if(fan>10) forward();
 }
```

```
void ser_int(void) interrupt 4
{
 if (RI)
 {
    RI=0;
    str[g]=SBUF;
     g++;
 }
}

void forward()
{
        P1=0x05;
        delay(4000);
        P1=0x09;
        delay(4000);
        P1=0x0a;
        delay(4000);
        P1=0x06;
        delay(4000);
}

void tmr_inpt() interrupt 1
{
        TR0=0;
        msec++;
        if(msec>=20)
        {
                ser_out('*');
                ser_out('I');
                serial(curr);
                ser_out('F');
                ser_out('V');
```

```
            ser_out('S');
            serial(speed);
            ser_out('#');
            msec=0;
        }
        TH0=0X4B;TL0=0XFD;
        TR0=1;
}

void ser_out(unsigned char rr)
{
        ES=0;
        SBUF=rr;
   delay(2000);
        ES=1;
}

void ser_tmr_init()
{
        TMOD=0X21;TH0=0X4B;TL0=0XFD;
        TR1=TR0=1;ET0=EA=1;
        SCON=0X50;TH1=0XFD;//ES=1;
}

void serial(unsigned char yy)
{
   ser_out(yy/100+0x30);
   ser_out(yy%100/10+0x30);
   ser_out(yy%10+0x30);
}


void hex_dec1(unsigned int yz)
```

```
        write(yz%1000/100+0x30);
        write(yz%100/10+0x30);
        write(yz%10+0x30);
}

void hx_curr(unsigned int za)
{
        write(za%1000/100+0x30);
        write(za%100/10+0x30);
        write('.');
        write(za%10+0x30);
}

void lcd_init()
{
 read(0x38);
 read(0x06);
 read(0x0c);
 read(0x01);
}

void read(unsigned char i)
  {
  porta=i;
  portc=0x04;
  delay(125);
  portc=0x00;
  delay(125);
  }

void write(unsigned char i)
 {
 porta=i;
```

```
delay(125);
portc=0x01;
delay(125);
}

void delay(unsigned int count)
{
while(count--);
}


void lcd_dis (unsigned char *mess,unsigned char n)
{
unsigned char i;
for(i=0;i<n;i++)
{
 write(mess[i]);
}
}

void del()
{
        delay(65000);
        delay(40000);
}
void adc1()
{
unsigned char chan2;

avg=0;
for(j=0;j<2;j++)
{
         delay(100);
         chan2=ch1;
```

```
        curr=soc;
        delay(50);

urr=0;

or(j=0;j<20;j++)

        delay(100);
        chan2=ch1;
        delay(50);
        curr=soc;
        delay(50);
        avg=avg+curr;

urr=avg/20;


oid adc2()

nsigned char chan3;
vg=0;
or(j=0;j<2;j++)
{
lelay(100);
han3=ch2;
lelay(50);
an=soc;
lelay(50);
}
an=0;

or(j=0;j<20;j++)
{
```

```
chan3=ch2;
delay(50);
fan=soc;
delay(50);
avg=avg+fan;
}
fan=avg/20;
fan=fan/10;
}
```

LCD DISPLAY

7.1. INTRODUCTION:

LCD display is used to display the voltage and current of the windmill. Its also used to display the wind velocity.

Liquid crystal displays (LCDs) have materials, which combine the properties of both liquids and crystals. Rather than having a melting point, they have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered form similar to a crystal.

An LCD consists of two glass panels, with the liquid crystal material sand witched in between them. The inner surface of the glass plates are coated with transparent electrodes which define the character, symbols or patterns to be displayed polymeric layers are present in between the electrodes and the liquid crystal, which makes the liquid crystal molecules to maintain a defined orientation angle.

One each polarisers are pasted outside the two glass panels. These polarisers would rotate the light rays passing through them to a definite angle, in a particular direction

When the LCD is in the off state, light rays are rotated by the two polarisers and the liquid crystal, such that the light rays come out of the LCD without any orientation, and hence the LCD appears transparent.

When sufficient voltage is applied to the electrodes, the liquid crystal molecules would be aligned in a specific direction. The light rays passing through the LCD would be rotated by the polarisers, which would result in activating / highlighting the desired characters.

The LCD's are lightweight with only a few millimeters thickness. Since the LCD's consume less power, they are compatible with low power electronic circuits, and can be powered for long durations.

The LCDs don't generate light and so light is needed to read the display. By using backlighting, reading is possible in the dark. The LCD's have long life and a wide operating temperature range.

Changing the display size or the layout size is relatively simple which makes the LCD's more customer friendly.

POWER SUPPLY:

The power supply should be of +5V, with maximum allowable transients of 10mv. To achieve a better / suitable contrast for the display, the voltage (VL) at pin 3 should be adjusted

7.2. INTERFACING:

Liquid Crystal Display has 16 pins in which first three and 15th pins are used for power supply. 4th pin is RS (Register Selection) if it is low data and if it is high command will be displayed. 5th pin is R/W if it is low it performs write operation. 6th pin act as enable and remaining pins are data lines

Here we interface LCD display to microcontroller via port 0 and port 2. LCD control lines are connected in port 2 and Data lines are connected in port 0.

RS232 COMMUNICATION

.1. INTRODUCTION:

In telecommunications, **RS-232** is a standard for serial binary data interconnection ɜtween a *DTE* (Data terminal equipment) and a *DCE* (Data Circuit-terminating Equipment). It is ɔmmonly used in computer serial ports.

cope of the Standard:

he Electronic Industries Alliance (EIA) standard RS-232-C [3] as of 1969 defines:

- Electrical signal characteristics such as voltage levels, signaling rate, timing and slew-rate of signals, voltage withstand level, short-circuit behavior, maximum stray capacitance and cable length
- Interface mechanical characteristics, pluggable connectors and pin identification
- Functions of each circuit in the interface connector
- Standard subsets of interface circuits for selected telecom applications

The standard does not define bit rates for transmission, although the standard says it is ıtended for bit rates lower than 20,000 bits per second. Many modern devices can exceed this peed (38,400 and 57,600 bit/s being common, and 115,200 and 230,400 bit/s making occasional ppearances) while still using RS-232 compatible signal levels.

)etails of character format and transmission bit rate are controlled by the serial port hardware, ften a single integrated circuit called a UART that converts data from parallel to serial form. A ypical serial port includes specialized driver and receiver integrated circuits to convert between ıternal logic levels and RS-232 compatible signal levels.

ł.2. CIRCUIT WORKING DESCRIPTION:

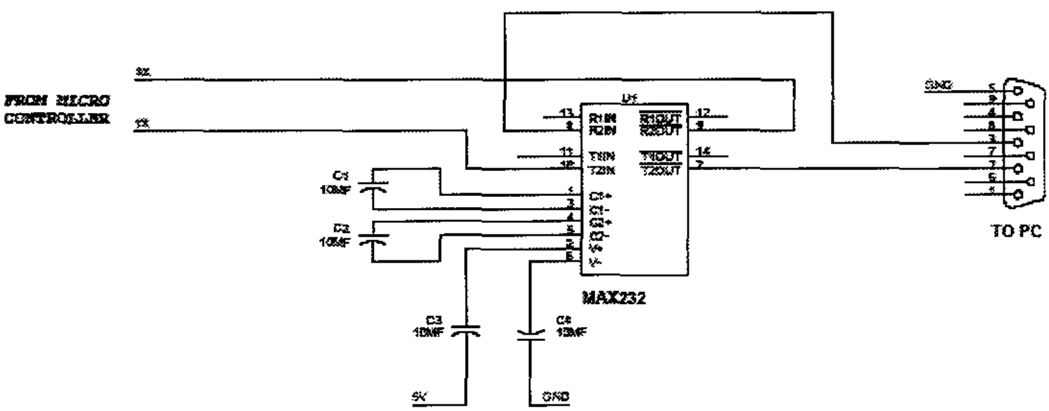


Fig 8.1. RS232 Circuit diagram

In this circuit the MAX 232 IC used as level logic converter. The MAX232 is a dual iver/receiver that includes a capacitive voltage generator to supply EIA 232 voltage levels from single 5v supply. Each receiver converts EIA-232 to 5v TTL/CMOS levels. Each driver ınverts TTL/CMOS input levels into EIA-232 levels.

Table 8.1. Function Tables (RS232)

EACH DRIVER

INPUT TIN	OUTPUT TOUT
L	H
H	L

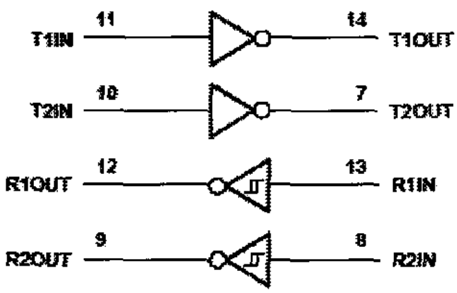
H = high level, L = low level

EACH RECEIVER

INPUT RIN	OUTPUT ROUT
L	H
H	L

H = high level, L = low level

logic diagram (positive logic)



In this circuit the CONTROLLER transmitter pin is connected in the MAX232 T2IN pin vhich converts input 5v TTL/CMOS level to RS232 level. Then T2OUT pin is connected to eceiver pin of 9 pin D type serial connector which is directly connected to PC.

In PC the transmitting data is given to R2IN of MAX232 through transmitting pin of 9 pin) type connector which converts the RS232 level to 5v TTL/CMOS level. The R2OUT pin is onnected to receiver pin of the CONTROLLER. Likewise the data is transmitted and received ıetween the CONTROLLER and PC or other device vice versa.

CONCLUSION

CONCLUSION:

The speed control mechanism designed in this project can be implemented in practical wind mills by using stepper motor of high torque. If stepper motor cannot be implemented, gear mechanism can be used to turn the wind mill. Thus, the wind turbine of the present invention can be made to respond very quickly to sudden excess wind speed and can be constructed relatively inexpensively.

Most wind power turbines are still installed on land, but the future could lie offshore. In such cases, parameters can be monitored in PC as done in this project and hence this enables remote monitoring.

In this project, the stepper motor is made to rotate through a preset step angle. Instead, the step angle can also be given from the PC. Thus, control can be done remote.

APPENDIX A
PCB DESIGNING PROCESS

PRINTED CIRCUIT BOARD:

Making of printed circuit boards is as much an art as a technique, particularly when they are to be fabricated in very small numbers. They are several ways of drawing PCB patterns and making the final boards, but the methods most likely to interest people in need of just a few PCBs has to be simple and economical.

The making of a PCB essentially involves two steps:

1. Preparing the PCB drawing.
2. Fabricating the PCB itself from the drawing.

The industrial method of making a PCB drawing with complete placement of parts, taking a photographic negative of the drawing, developing the image of the negative formed on photosensitized copperplate, and dissolving the excess copper by etching is a standard practice being followed in large scale operations. How ever, for small scale operations where large numbers of copies are not required, the cost saving procedure presented here may be adopted.

The procedure has its own advantages, as the lateral inversion problem (discussed later) is over come. Also, tracing of the circuit and fault finding is made easy, as the PCB exactly matches with the original circuit so that one does not have to constantly look for positions to drill holes and place various components.

PCB DRAWING:

Making of the PCB drawing involves some preliminary considerations such as placement of components (in the same order as the circuit diagram) on a piece of paper, location of holes, deciding the diameters of various holes, the optimum areas each components should occupy, the shape and location of islands for connecting two or more components at a place, full space utilization, and prevention of overcrowding of components at a particularly place. There is no other way to arrive at the correct conclusions than by trail and error. For anchoring leads of components 1mm dia holes, and for fixing PCB holding screws to the chassis 3mm dia holes, are recommended.

This sketch may be redrawing neatly on a fresh piece of paper, if desired. This sketch is the mirror image of the PCB pattern desired; it shows the components Placements on the other side of the PCB laminate.

The mirror image of this sketch, the PCB pattern, can now be drawn with the help of a thick tracing paper. The sketch is redrawn on a tracing paper wouldn't appears as a PCB pattern when viewed from the other side. To save time and effort, the sketch may be made on the tracing paper itself right in the beginning.

Alternatively, the PCB pattern can be drawn from the sketch with the help of a carbon paper. A fresh carbon paper may be placed face up on a flat surface and covered with a plain sheet of paper. On this sheet the sketch may be placed. Now, by carefully tracing the sketch with a ball pen or a hard pencil, the, mirror image of the sketch may be obtained on the lower sheet of paper.

PCB FABRICATION:

The copper-clad PCB laminate may now be prepared by rubbing away the oxide, grease and dirt etc with a fine emery paper or sandpaper. On this the final PCB drawing may be traced this time by using the carbon paper in the normal way (face down on the laminate). Clips should be used to prevent the carbon and the paper from slipping while the PCB pattern is being traced on the laminate. Only the connecting lines in PCB islands and holds should be traced the positions of Components a need not be traced. The components positions can be marked on the PCB reverses side, if desired.

APPENDIX B
HARDWARE

MICROCONTROLLER (ATMEL89C51)

ARCHITECTURE:

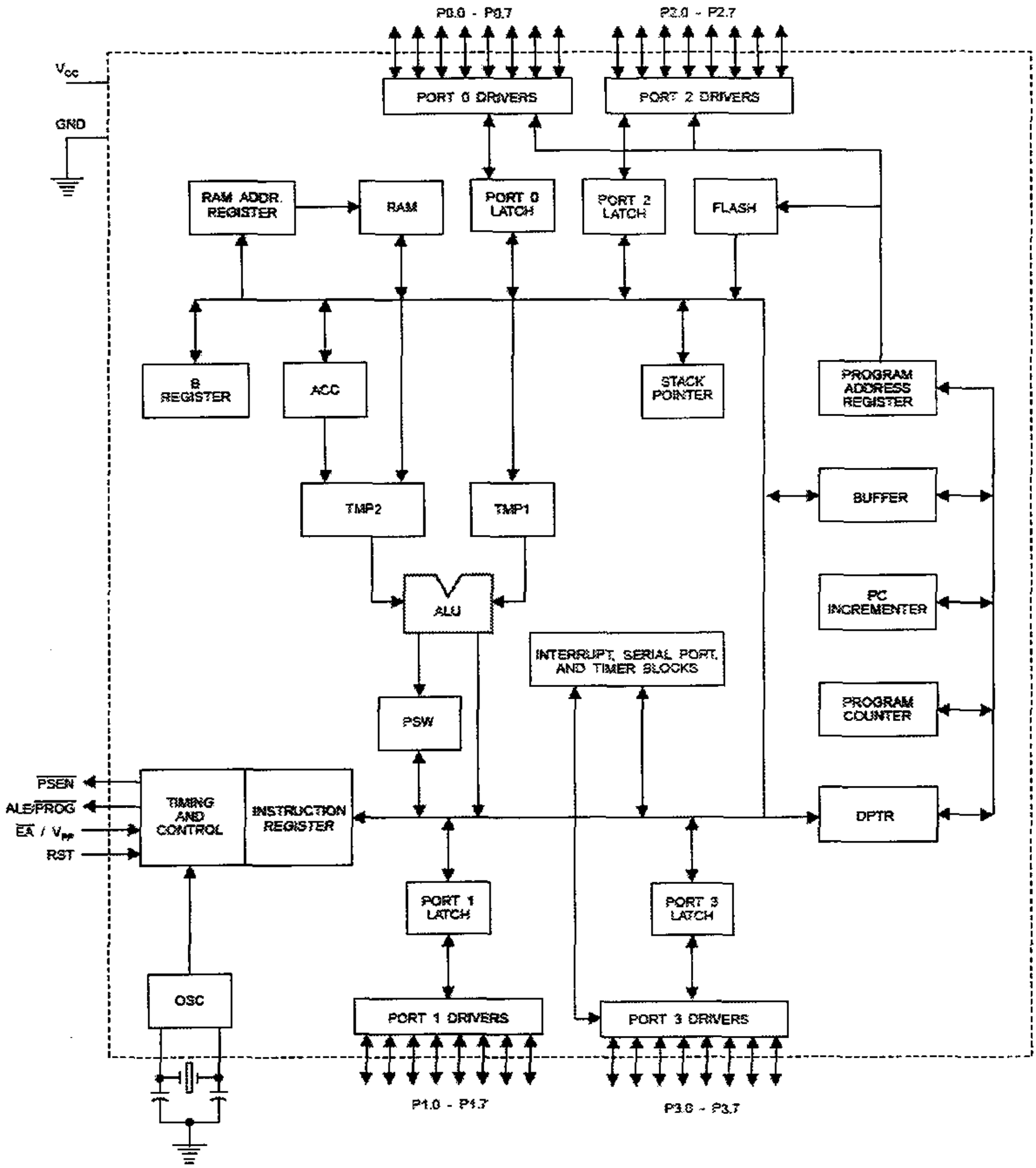


Fig.B.1. Architecture of AT89C51

PIN DIAGRAM:

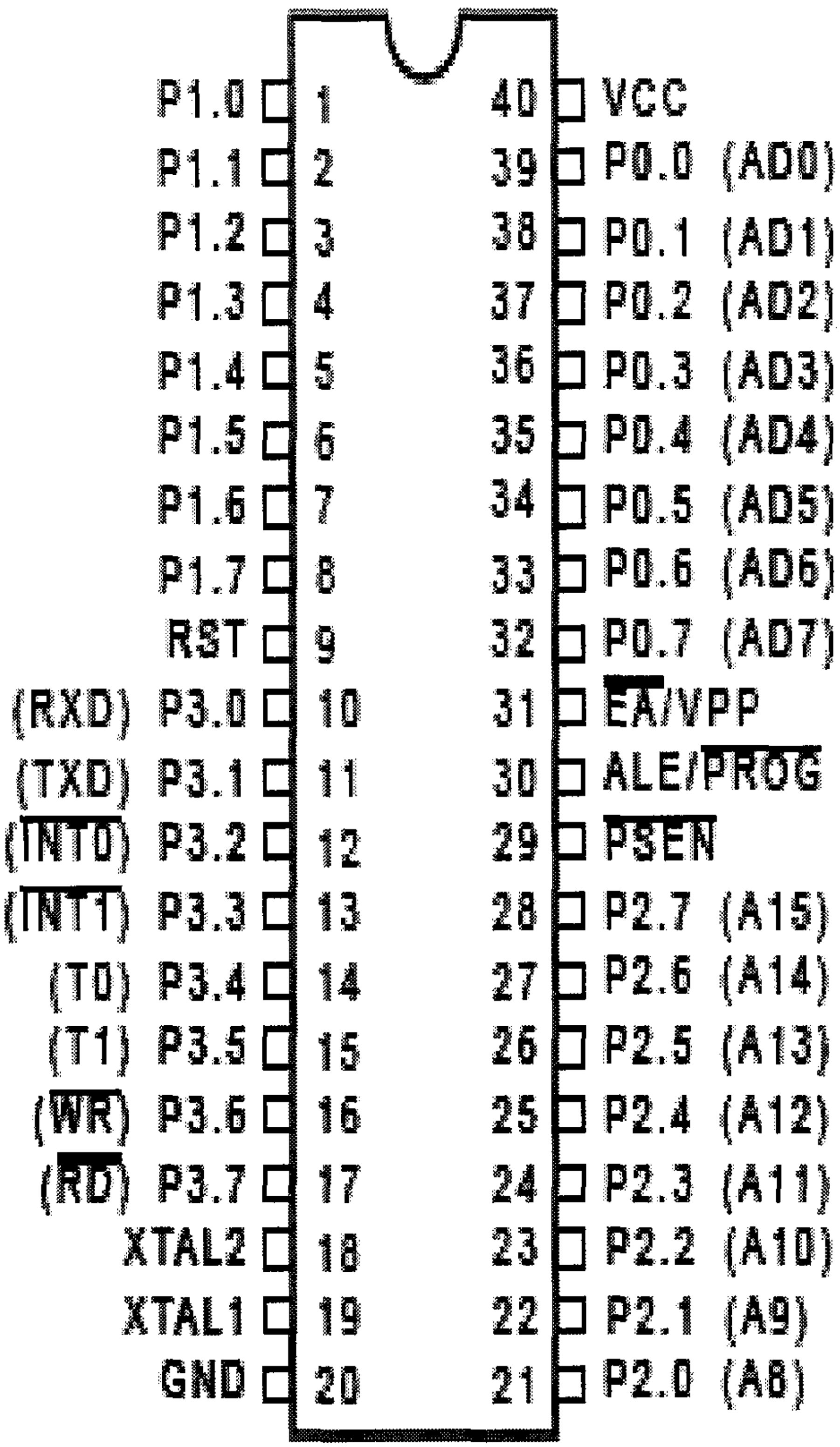


Fig.B.2.Pin diagram of AT89C51

PIN DESCRIPTION:

VCC

Supply voltage.

GND

Ground.

Port 0

Port 0 is an 8-bit open drain bidirectional I/O port. As an output port each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as high impedance inputs. Port 0 may also be configured to be the multiplexed loworder address/data bus during accesses to external program and data memory. In this mode P0 has internal pullups. Port 0 also receives the code bytes during Flash programming, and outputs the code bytes during program verification. External pullups are required during program verification.

Port 1

Port 1 is an 8-bit bidirectional I/O port with internal pullups. The Port 1 output buffers can sink/source four TTL inputs. When 1s are written to Port 1 pins they are pulled high by the internal pullups and can be used as inputs. As inputs, Port 1 pins that are externally being pulled low will source current (IIL) because of the internal pullups. Port 1 also receives the low-order address bytes during Flash programming and verification.

Port 2

Port 2 is an 8-bit bidirectional I/O port with internal pullups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins they are pulled high by the internal pullups and can be used as inputs. As inputs, Port 2 pins that are externally being pulled low will source current (IIL) because of the internal pullups. Port 2 emits the high-order address byte during fetches from external program memory and during accesses to external data memory that use 16-bit addresses (MOVX @ DPTR). In this application it uses strong internal pull-ups when emitting 1s. During accesses to external data memory that use 8-bit addresses (MOVX @ RI), Port 2 emits the contents of the P2 Special Function Register. Port 2 also receives the high-order address bits and some control signals during Flash programming and verification.

Port 3

Port 3 is an 8-bit bidirectional I/O port with internal pullups. The Port 3 output buffers can sink/source four TTL inputs. When 1s are written to Port 3 pins they are pulled high by the internal pullups and can be used as inputs. As inputs, Port 3 pins that are externally being pulled ɪw will source current (IIL) because of the pullups. Port 3 also serves the functions of various ɔecial features of the AT89C51 as listed below:

Table.B.1.Functions of Port 3 (AT89C51)

Port Pin	Alternate Functions
P3.0	RXD (serial input port)
P3.1	TXD (serial output port)
P3.2	$\overline{INT0}$ (external interrupt 0)
P3.3	$\overline{INT1}$ (external interrupt 1)
P3.4	T0 (timer 0 external input)
P3.5	T1 (timer 1 external input)
P3.6	$\overline{WR}$ (external data memory write strobe)
P3.7	$\overline{RD}$ (external data memory read strobe)

ʾort 3 also receives some control signals for Flash programming and verification.

ʀST

Reset input. A high on this pin for two machine cycles while the oscillator is running esets the device.

ᴀLE/PROG

Address Latch Enable output pulse for latching the low byte of the address during ɩccesses to external memory. This pin is also the program pulse input (PROG) during Flash ɔrogramming. In normal operation ALE is emitted at a constant rate of 1/6 the oscillator ꞙrequency, and may be used for external timing or clocking purposes. Note, however, that one ᴬLE pulse is skipped during each access to external Data Memory. If desired, ALE operation can ɔe disabled by setting bit 0 of SFR location 8EH. With the bit set, ALE is active only during a ᴍOVX or MOVC instruction. Otherwise, the pin is weakly pulled high. Setting the ALE-disable ɔit has no effect if the microcontroller is in external execution mode.

PSEN

Program Store Enable is the read strobe to external program memory. When the AT89C51 is executing code from external program memory, PSEN is activated twice each machine cycle, except that two PSEN activations are skipped during each access to external data memory.

EA/VPP

External Access Enable. EA must be strapped to GND in order to enable the device to

›wever, that if lock bit 1 is programmed, EA will be internally latched on reset. EA should be rapped to VCC for internal program executions. This pin also receives the 12-volt programming ıable voltage (VPP) during Flash programming, for parts that require 12-volt VPP.

TAL1

Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

TAL2

Output from the inverting oscillator amplifier.

›scillator Characteristics

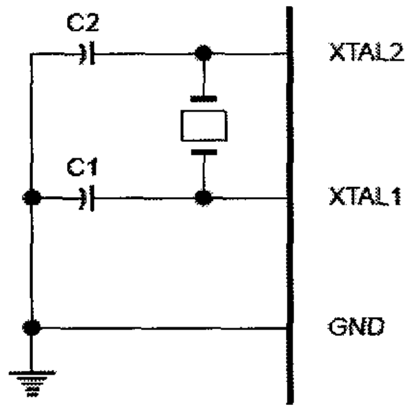
XTAL1 and XTAL2 are the input and output, respectively, of an inverting amplifier /hich can be configured for use as an on-chip oscillator, as shown in Figure 5.3. Either a quartz rystal or ceramic resonator may be used. To drive the device from an external clock source, TAL2 should be left unconnected while XTAL1 is driven as shown in Figure 5.4. There are no equirements on the duty cycle of the external clock signal, since the input to the internal locking circuitry is through a divide-by-two flip-flop, but minimum and maximum voltage high nd low time specifications must be observed.

dle Mode

In idle mode, the CPU puts itself to sleep while all the onchip peripherals remain active. The mode is invoked by software. The content of the on-chip RAM and all the special functions egisters remain unchanged during this mode. The idle mode can be terminated by any enabled nterrupt or by a hardware reset. It should be noted that when idle is terminated by a hard ware eset, the device normally resumes program execution, from where it left off, up to two machine ycles before the internal reset algorithm takes control. On-chip hardware inhibits access to internal RAM in this event, but access to the port pins is not inhibited. To eliminate the possibility of an unexpected write to a port pin when Idle is terminated by reset, the instruction following the one that invokes Idle should not be one that writes to a port pin or to external memory.

Table B.2. Status of External Pins during Idle and Power Down Modes

Mode	Program Memory	ALE	$\overline{PSEN}$	PORT0	PORT1	PORT2	PORT3
Idle	Internal	1	1	Data	Data	Data	Data
Idle	External	1	1	Float	Data	Address	Data
Power Down	Internal	0	0	Data	Data	Data	Data
[illegible]	[illegible]	0	0	Float	Data	Data	Data



Note: C1, C2 = 30 pF ± 10 pF for Crystals
= 40 pF ± 10 pF for Ceramic Resonators

Fig B.3. Oscillator Connections

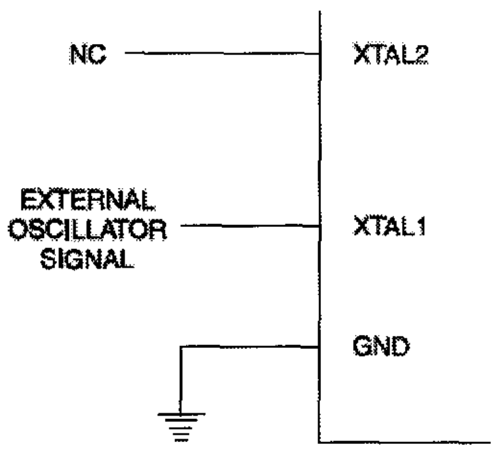


Fig B.4. External Clock Drive Configuration

MEMORY ORGANIZATION:

All Atmel Flash micro controllers have separate address spaces for program and data memory. The logical separation of program and data memory allows the data memory to be accessed by 8 bit addresses which can be more quickly stored and manipulated by an 8 bit CPU. Nevertheless 16 Bit data memory addresses can also be generated through the DPTR register.

Up to 64K bytes of external memory can be directly addressed in the external data memory accesses. External program memory and external data memory can be combined by a applying the RD and PSEN signals to the inputs of AND gate and using the output of the fate as the read strobe to the external program/data memory.

Program Memory:

Program memory can only be read. There can be up to 64K bytes of directly addressable program memory. The read strobe for external program memory is the Program Store Enable Signal (PSEN) Data memory occupies a separate address space from program memory. After reset, the CPU begins execution from location 0000h. Each interrupt is assigned a fixed location in program memory. The interrupt causes the CPU to jump to that location, where it executes the service routine. External Interrupt 0 for example, is assigned to location 0003h. If external Interrupt 0 is used, its service routine must begin at location 0003h. If the interrupt in not used its service location is available as general-purpose program memory. The interrupt service locations are spaced at 8 byte intervals 0003h for External interrupt 0, 000Bh for Timer 0, 0013h for External interrupt 1,001Bh for Timer1, and so on. If an Interrupt service routine is short enough (as is often the case in control applications) it can reside entirely within that 8-byte interval. Longer service routines can use a jump instruction to skip over subsequent interrupt locations. If other interrupts are in use. The lowest addresses of program memory can be either in the on-chip Flash or in an external memory. To make this selection, strap the External Access (EA) pin to either Vcc or GND. For example, in the AT89C51 with 4K bytes of on-chip Flash, if the EA pin is strapped to Vcc, program fetches to addresses 0000h through 0FFFh are directed to internal Flash. Program fetches to addresses 1000h through FFFFh are directed to external memory.

Data Memory:

The Internal Data memory is dived into three blocks namely,

- The lower 128 Bytes of Internal RAM.
- The Upper 128 Bytes of Internal RAM.
- Special Function Register.

Internal Data memory Addresses are always 1 byte wide, which implies an address space of only 256 bytes. However, the addressing modes for internal RAM can in fact accommodate 384 bytes. Direct addresses higher than 7Fh access one memory space, and indirect addresses higher than 7Fh access a different Memory Space.

The lowest 32 bytes are grouped into 4 banks of 8 registers. Program instructions call out register bank, are in use. This architecture allows more efficient use of code space, since register instructions are shorter than instructions that use direct addressing.

The next 16-bytes above the register banks form a block of bit addressable memory space. The micro controller instruction set includes a wide selection of single - bit instructions and this instruction can directly address the 128 bytes in this area. These bit addresses are 00h through 7Fh. Either direct or indirect addressing can access all of the bytes in lower 128 bytes. Indirect addressing can only access the upper 128. The upper 128 bytes of RAM are only in the devices with 256 bytes of RAM.

The Special Function Register includes Port latches, timers, peripheral controls etc., direct addressing can only access these register. In general, all Atmel micro controllers have the same SFRs at the same addresses in SFR space as the AT89C51 and other compatible micro controllers. However, upgrades to the AT89C51 have additional SFRs. Sixteen addresses in SFR space are both byte and bit Addressable. The bit Addressable SFRs are those whose address ends in 000B. The bit addresses in this area are 80h through FFh.

TIMING DIAGRAM:

External Program Memory Read Cycle

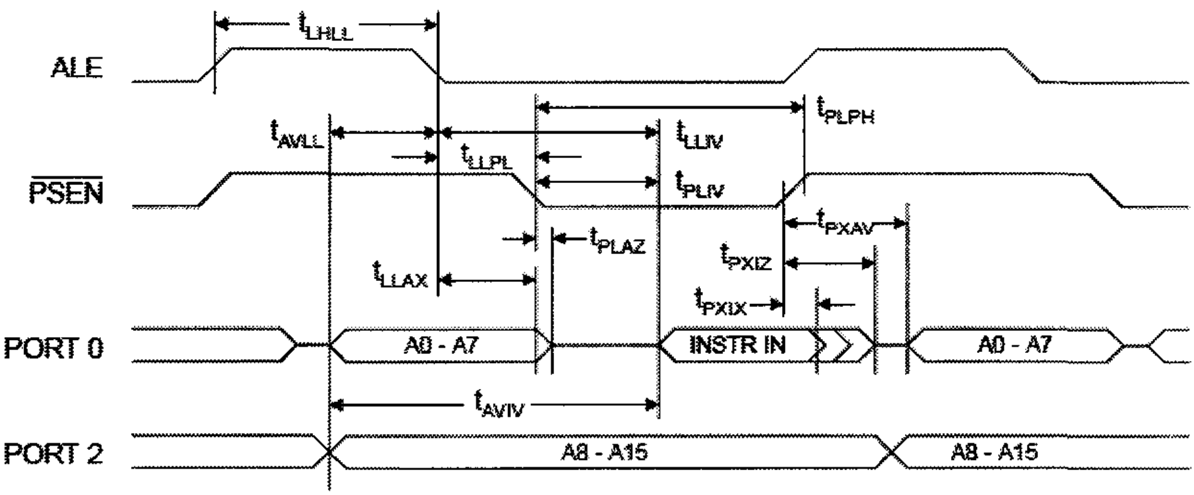


Fig.B.5 External program memory read cycle

External Data Memory Read Cycle

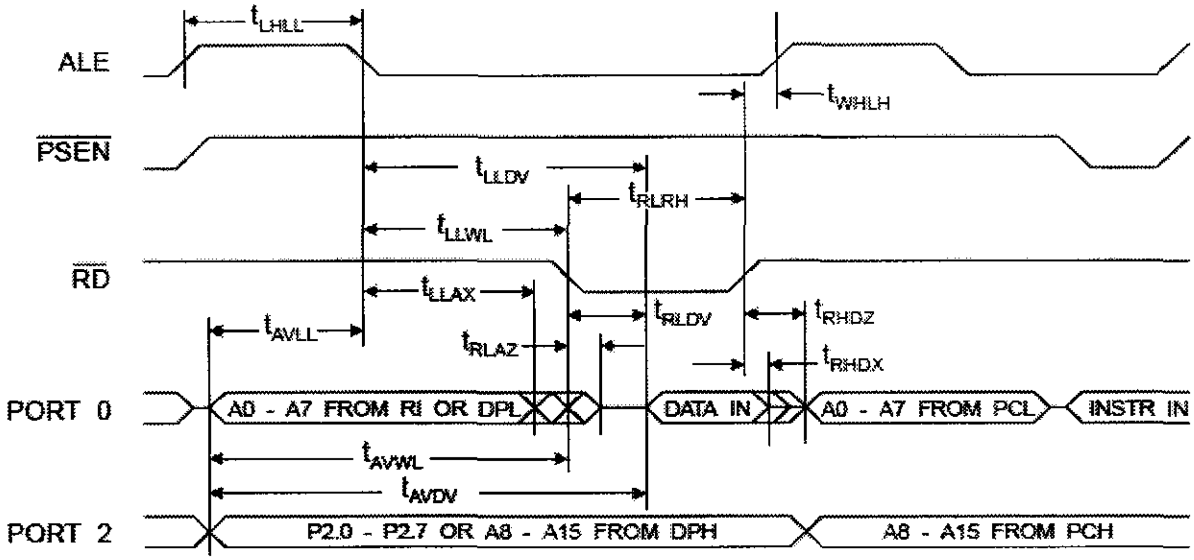


Fig B.6. External data memory read cycle

External Data Memory Write Cycle

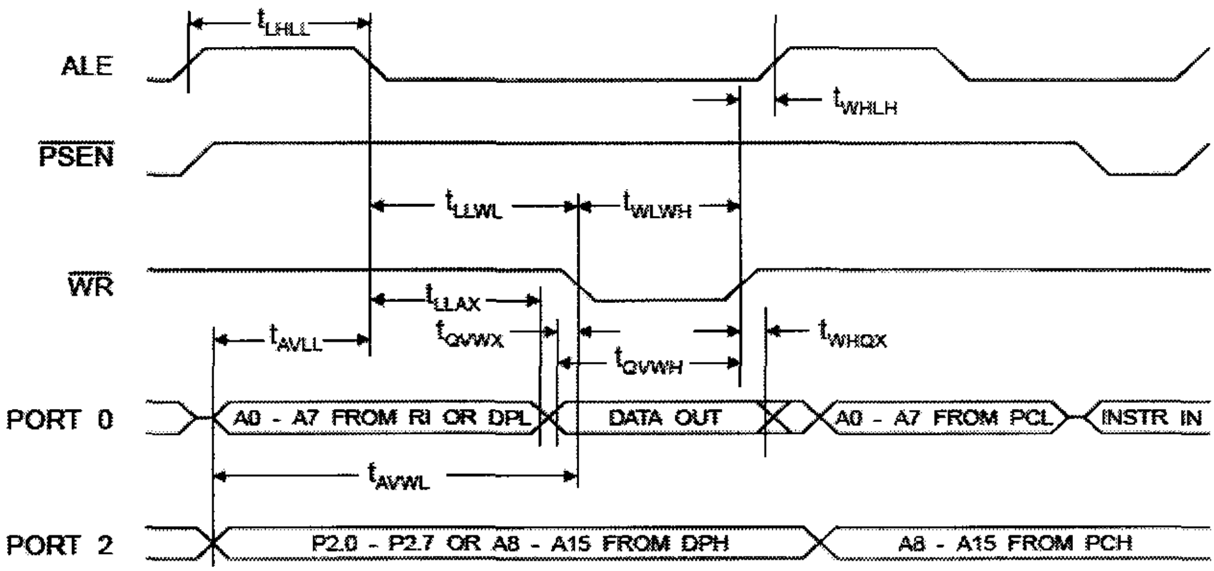


Fig B.7. External data memory write cycle

:xternal Clock Drive Waveforms

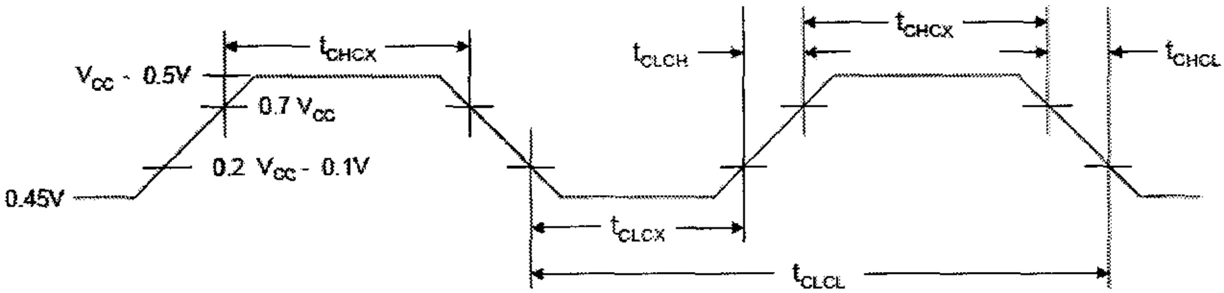


Fig B.8. External Clock Drive Waveforms

Table B.3.External Clock Drive

Symbol	Parameter	Min	Max	Units
$1/t_{CLCL}$	Oscillator Frequency	0	24	MHz
t_{CLCL}	Clock Period	41.6		ns
t_{CHCX}	High Time	15		ns
t_{CLCX}	Low Time	15		ns
t_{CLCH}	Rise Time		20	ns
t_{CHCL}	Fall Time		20	ns

DECODERS DM74LS138

General Description

These Schottky-clamped circuits are designed to be used in high-performance memory-decoding or data-routing applications, requiring very short propagation delay times. In high-performance memory systems these decoders can be used to minimize the effects of system decoding. When used with high-speed memories, the delay times of these decoders are usually less than the typical access time of the memory. This means that the effective system delay introduced by the decoder is negligible. The LS138 decodes one-of-eight lines, based upon the conditions at the three binary select inputs and the three enable inputs. Two active-low and one active-high enable inputs reduce the need for external gates or inverters when expanding. A 24-line decoder can be implemented with no external inverters, and a 32-line decoder requires only one inverter. An enable input can be used as a data input for demultiplexing applications. The LS139 comprises two separate two-line-to-four-line decoders in a single package. The active-low enable input can be used as a data line in demultiplexing applications. All of these decoders/demultiplexers feature fully buffered inputs, presenting only one normalized load to its driving circuit. All inputs are clamped with high-performance Schottky diodes to suppress line-ringing and simplify system design.

Features

*Designed specifically for high speed: Memory decoders
Data transmission systems

* LS138 3-to-8-line decoders incorporates 3 enable inputs to simplify cascading and/or data reception

*LS139 contains two fully independent 2-to-4-line decoders/demultiplexers

* Schottky clamped for high performance

*Typical propagation delay (3 levels of logic)

LS138 21 ns

LS139 21 ns

*Typical power dissipation

LS138 32 mW

LS139 34 mW

Connection Diagram:

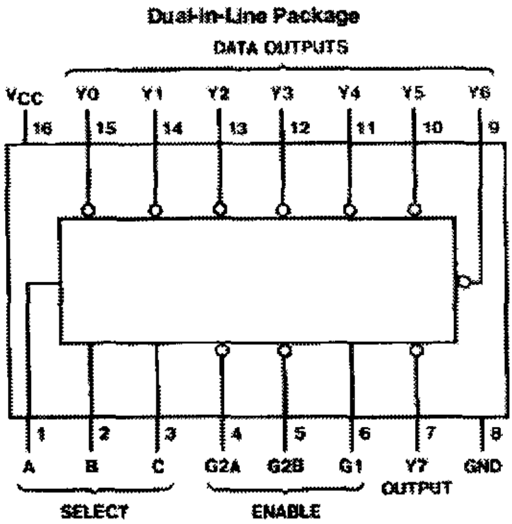


Fig. B.9. DM74LS138-Connection Diagram

Logic Diagram:

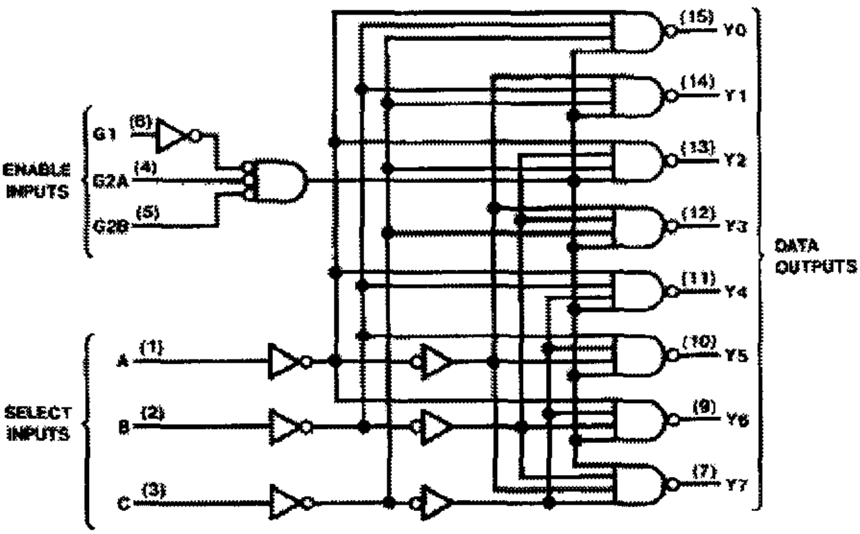


Fig.B.10. DM74LS138- Logic Diagram

8-BIT REGISTER WITH CLEAR (DM74LS273)

General Description:

The 'LS273 is a high speed 8-bit register, consisting of eight D-type flip-flops with a common Clock and an asynchronous active LOW Master Reset. This device is supplied in a 20- pin package featuring 0.3 inch row spacing.

Features:

*Edge-triggered

*8-bit high speed register

*Parallel in and out

*Common clock and master reset

Connection Diagram:

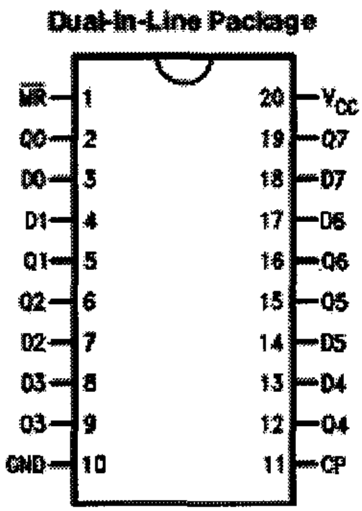


Fig.B.11. DM74LS273- Connection Diagram

Table.B.4. DM74LS273-Pin Description

Pin Names	Description
CP	Clock Pulse Input (Active Rising Edge)
D0–D7	Data Inputs
$\overline{MR}$	Asynchronous Master Reset Input (Active LOW)
Q0–Q7	Flip-Flop Outputs

APPENDIX C
CIRCUIT DIAGRAM

OVERALL CIRCUIT DIAGRAM

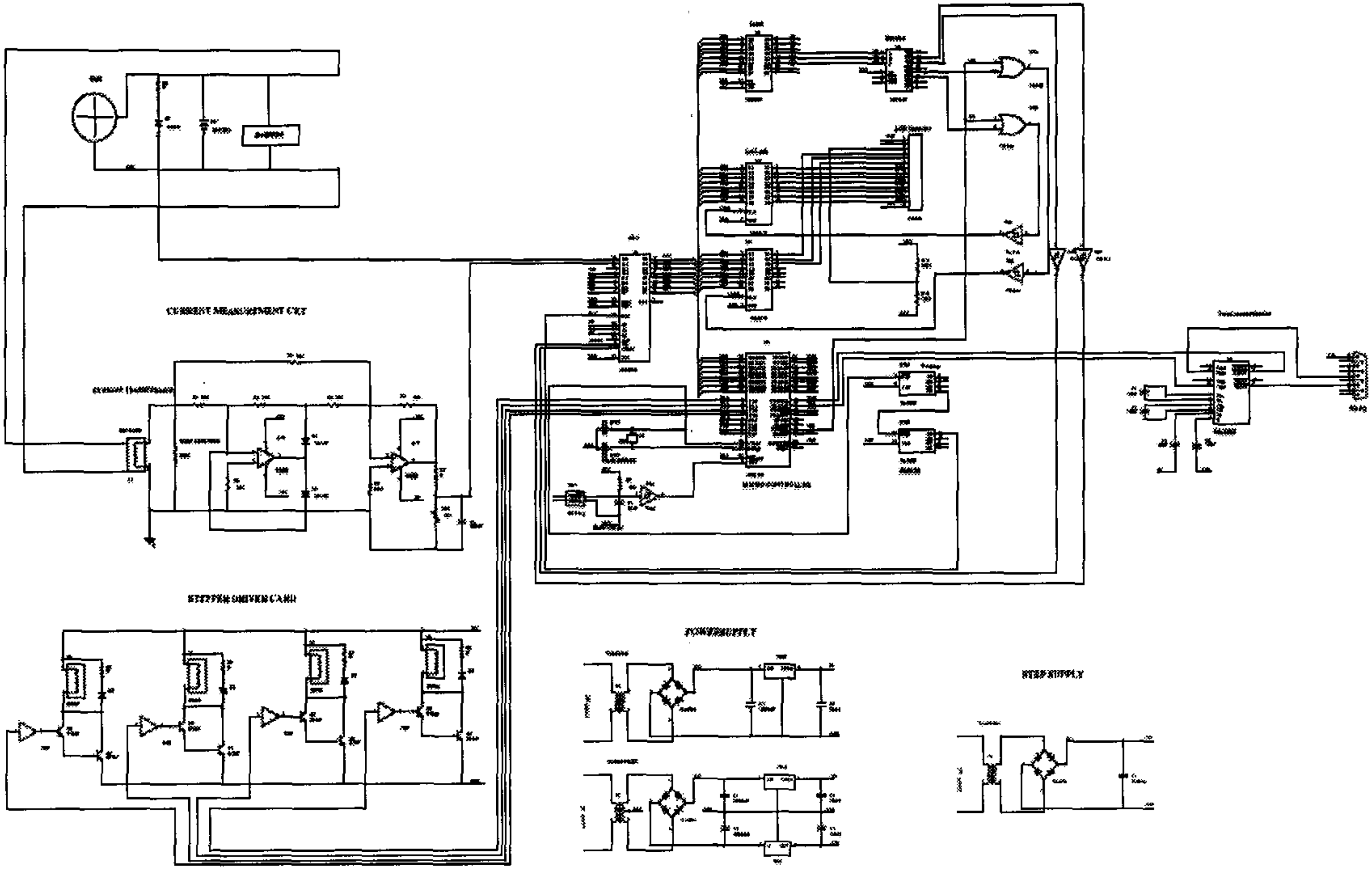


Fig.C.1.Circuit Diagram for monitoring and control of windmill

PHOTOGRAPH:

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