DATA ACQUISITION SYSTEM

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Under the supervision of
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of the requirements for the degree of
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WAKNAGHAT

CERTIFICATE

This is to certify that project report entitled "**Data Acquisition System**", submitted by "**Rahul Slathia and Vikram Singh Thakur**" in partial fulfillment for the award of degree of Bachelor of Technology in Electronics and Communication Engineering to **Jaypee University of Information Technology, Waknaghat,** has been carried out under my supervision.

This work has not been submitted partially or fully to any other University or Institute for the award of this or any other degree or diploma.

Prof. D.C.Kulshreshtha

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Apart from our efforts , the success of this project depends largely on the encouragement and guidelines of many others. I take this opportunity to express my gratitude to the people who have been instrumental in the successful completion of this project.

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We would like to express our gratitude towards our parents and friends , for their kind co-operation and encouragement which helped us in completion of this project.

We would also like to thank our college for making many useful and necessary items available to us in the Hardware and Software labs.

Our thanks and appreciation also go to our colleagues an developing the project and people who willingly helped us out with their knowledge and abilities.

DATE : 23.05.2011

GROUP MEMBERS

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SUMMARY

Aim of this project is to make one PC interfaced Data Acquisition Hardware and its Driver Program capable of converting analog input signal into digital form.

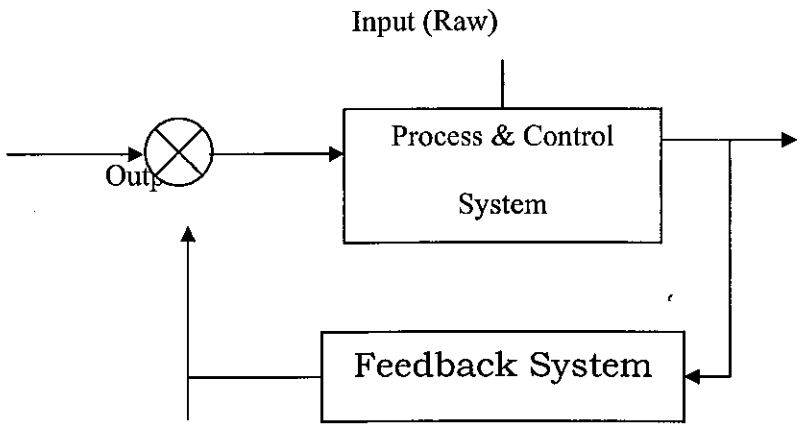
The hardware should capture data, implement control tasks at the command of driver software. Interface to the PC should be through Serial Terminal. At the PC end, Driver program should provide an easy to use, user-friendly graphic interface.
A real time application of the project must be demonstrated by acquiring data from sensors and controlling the process
Data logging systems are basically real time data monitoring systems, includes a display or monitor for displaying the measured physical quantities into their corresponding units.
The data logger will assume greater importance if the different measurement like temperature are displayed in terms of their proper units instead of mere voltage in order to have proper interpretation of data acquired from different sources.
In this project we have use four temperature sensors LM35 that would sence the temperature of the surroundings and send analog signal to ADC device so that it is converted to a digital signal.
The digital signal fron the ADC device is then send to the microcontroller on which the software is burned.
The microcontroller sends a check status command to the PC driver software and then the software sends a feedback to the microcontroller. Microcontroller then accordingly sends signal to a specific relay and hence a specific application runs.
This project has commercial as well as industrial use. Commercially it can be used in our homes to run electrical appliances such as heaters or AC's depending on the temperature of the room and the command set in the software. In industries such as chemical industries we can operatre large boilers just by sensing their temperature and then performing any specific task as per requirement,such as switching on or off the boiler.
This project finds many other applications apart from the one mentioned above .

LIST OF FIGURES

INTRODUCTION

The word quality holds out different meaning for different people, but for an industry it is most important and can be defined as "The totality of features and characteristics of a product/ services that bear on its ability to satisfy given needs". A measure of how will the final outputs of an operational unit is fit for use.

In modern industrial environment, role of data acquisition, monitoring and control system is becoming more and more important and figure out as a top priority. Any company which involve production and/ or manufacturing of any sort of products e.g. electronics, mechanical, electrical automobiles etc. use an acquisition, monitoring and control system to maintain it's product quality and cost at a level, best acceptable to the consumer and on the mean time proving to be cheap and best option in the current competitive market.



The basic constituent of a real time, data acquisition monitoring and control system is a general concept of control system as shown in figure. In a closed loop process control system, the input is manipulated by the processing system and delivered as output which is continuously checked for quality, comparing with a predefined reference standard and if there is any variation. Control system changes the processing system functioning in a way to product output in specific levels of accuracy.

PROBLEM DEFINITION

Aim of this project is to make one PC interfaced Data Acquisition Hardware & its Driver Program capable of converting any analog input signal into digital form. The hardware should capture data, implement control tasks at the command of driver software. Interface to the PC should be through Serial Terminal. At the PC end, Driver program should provide an easy to use, user-friendly graphic interface.

A real time application of the project must be demonstrated by acquiring data from transducer and controlling the process.

DAS THEORY

- Concept of DAS
- Concept of DATA LOGGER
- Digital DAS's

CONCEPT OF DATA ACQUISITION SYSTEM

Data acquisition systems via analog signals are used in communications, electronics and medical applications. Conversion to digitalized system is widely used today because complex circuits are low cost, accurate and simple to implement. In addition, there is rapid growth of microprocessors and microcomputers to perform difficult measurement and control system functions.

The demands for more and more faster information from physical systems and devices used for space and nuclear research and development, and for industrial automation, have produced many new and effective electronic systems for data acquisition and manipulation.

Data acquisition system are used to measure and record analog signal in basically two different ways:

1. Signals, which originate from direct measurement of electrical quantities. These signals may be D.C. or A.C. voltages, frequency, or resistance etc.
2. Signals, which originate from use of transducers.

TYPES OF DAS's

The data acquisition system can be classified into two distinct categories :

ANALOG SYSTEMS

These systems deal with information in analog form. An analog signal may be defined as continuous function such as a plot of voltage vs. time or displacement vs. force.

DIGITAL SYSTEMS

A digital quantity may consist of a number of discrete or discontinuous pulse whose relationship contains information about the magnitude and the nature of the quantity under measurement also termed as "BINARY LOGIC" systems.

CONCEPT OF DATA LOGGING SYSTEMS

Data logging systems are basically real time data monitoring systems, includes a display or monitor for displaying the measured physical quantities into their corresponding units.

The data logger will assume greater importance if the different measurement like temperature, pressure etc. are displayed in terms of their proper units instead of mere voltage in order to have proper interpretation of data acquired from different sources. This requires pressure be displayed in terms of KN/m^2 and temperature be displayed in ^oC and so on.

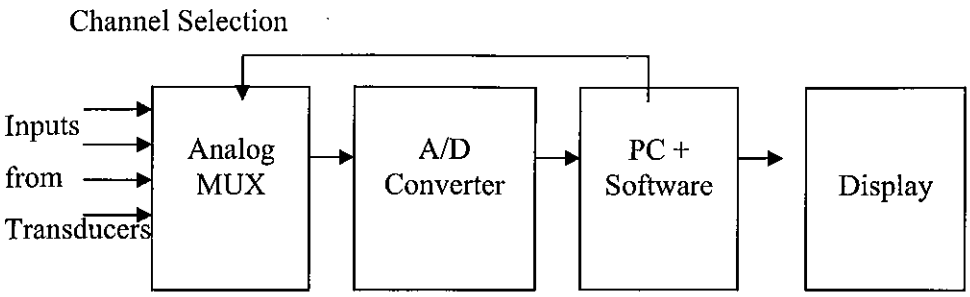


Fig. Software controlled data logging system

The hardware implemented data logging system includes various component like range unit, lineariser, limit comparators along with digitizer and channel identity assembly for displaying quantities in their respective units. While in software-controlled data logging systems, calibration is done through software. This provide greater accuracy, less complexity reduced hardware, high resolution and perfect display for the use.

DIGITAL DATA ACQUISITION SYSTEM

A generalized block diagram of digital data acquisition system is shown in figure

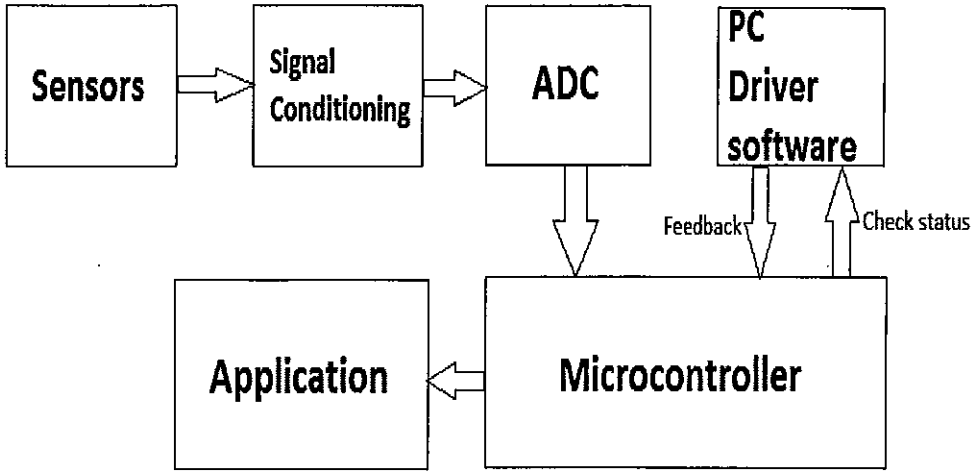


Fig. : Digital Data Acquisition System (Block Diagram)

Essential Functional Operation of A Digital DAS

a. Handling of Analog Signal.

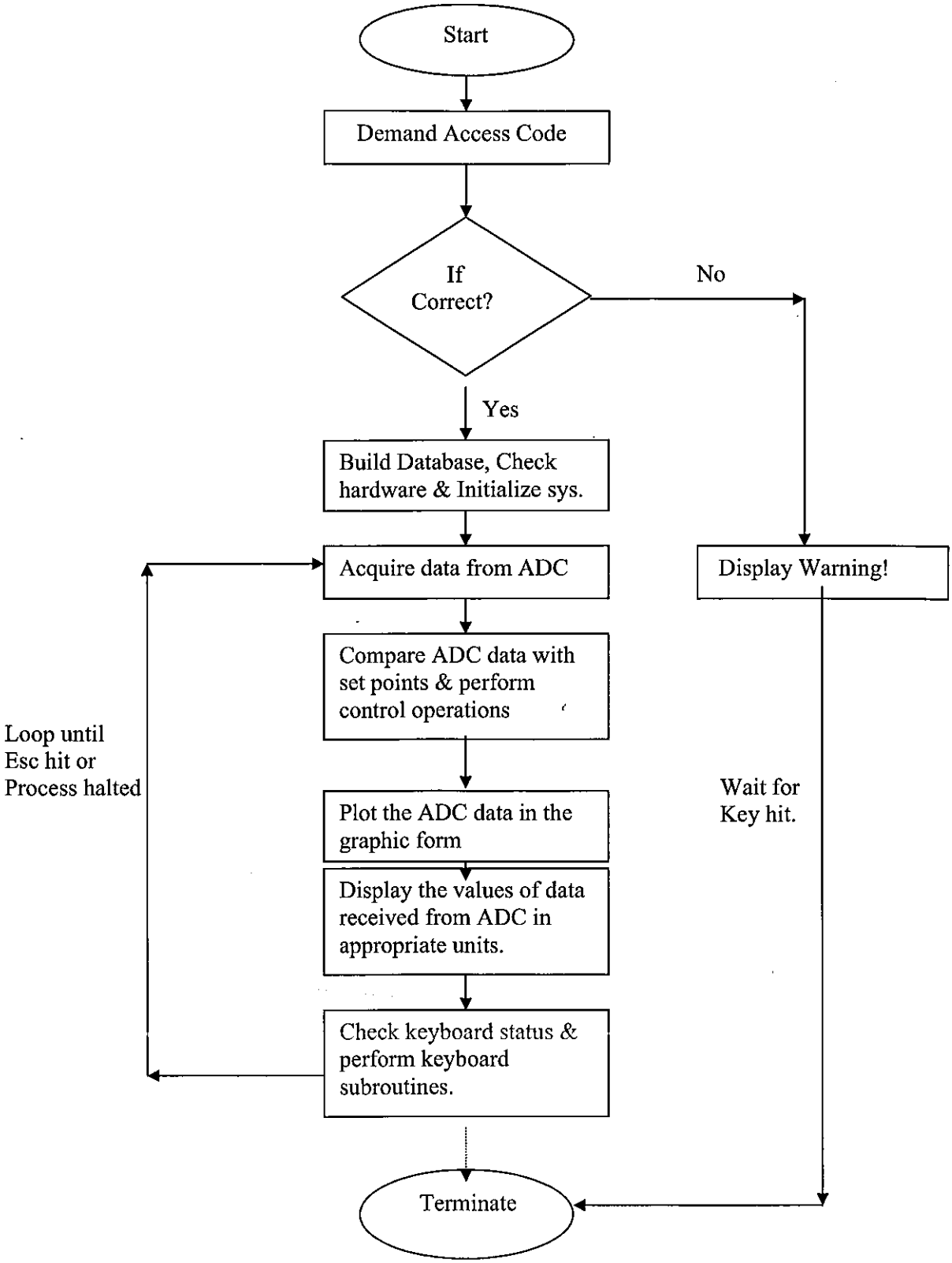
b. Making Measurement.

c. Converting data to digital form and handling it.

d. Internal programming and control.

SOFTWARE SECTION

Driver programming for hardware:



The analysis of data is done through the graph method which is easy to interpret. For this the programming is done in simple C language. The program enables choosing select inputs to be sent to analog - digital converter and then to microcontroller to be processed.

Source Code of the flow chart:

```
#include <reg51.h>
unsigned char temp;
unsigned char aray[]={'0','1','2','3','4','5','6','7','8','9'};
void delay()
{
   int k,l;
   for(k=0;k<40;k++)
         for(l=0;l<80;l++);
}
void initSerial()
{
   TMOD=0x22;
   TH1=0xFD;
   SCON=0x50;
   TR1=1;
```

```
    EA=1;
    ES=1;
}
void usDelay(int a)
{
    TH0=256-(a/1.085);
    TR0=1;
    ET0=1;
}
void timerRoutine() interrupt 1
{
    clock=~clock;
}
void sendChar(unsigned char ch)
{
    SBUF=ch;
    while(!TI);
    TI=0;
}
void serialRoutine() interrupt 4
{
    if(RI==1)
    {
```

```
temp=SBUF;
switch(temp)
{
        case('a'):
                relay1=1;
                break;
        case('b'):
                relay1=0;
                break;
        case('c'):
                relay2=1;
                break;
        case('d'):
                relay2=0;
                break;
        case('e'):
                relay3=1;
                break;
        case('f'):
                relay3=0;
                break;
        case('g'):
                relay4=1;
```

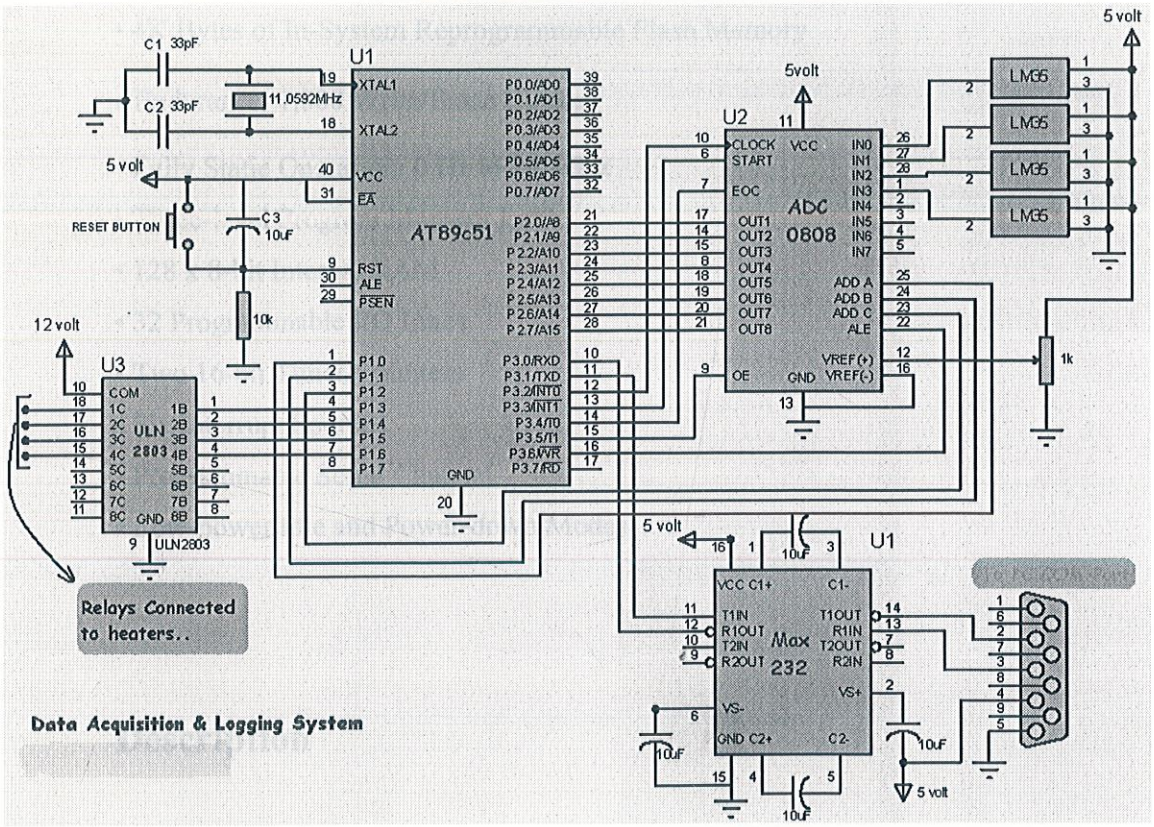
```
                    break;
                case('h'):
                    relay4=0;
            }
            RI=0;
        }
}
void sendReading(unsigned char val)
{
    unsigned char l,m;
    l=val10;
    m=(val/10)10;
    sendChar(aray[m]);
    sendChar(aray[l]);
    sendChar(',');
}
void latch()
{
    ale=0;
    delay();
    ale=1;
}
void startConv()
```

```
{
    delay();
    start=0;
    delay();
    start=1;
}
void wait()
{
    while(end==1);
}
void get()
{
    delay();
    oe=0;
    delay();
    oe=1;
}
void main()
{

    unsigned char sensor=0,reading;
    P1=0;
    initSerial();
```

```
    usDelay(50);
    while(1)
    {
        if(sensor==8)
            sensor=0;
        if(sensor==0)
            sendChar('N');
        P1=(P1&0xf8)sensor;
        latch();
        startConv();
        wait();
        get();
        reading=P2;
        sendReading(reading);
        sensor++;
    }
}
```

CIRCUIT DIAGRAM



MICROCONTROLLER

Features

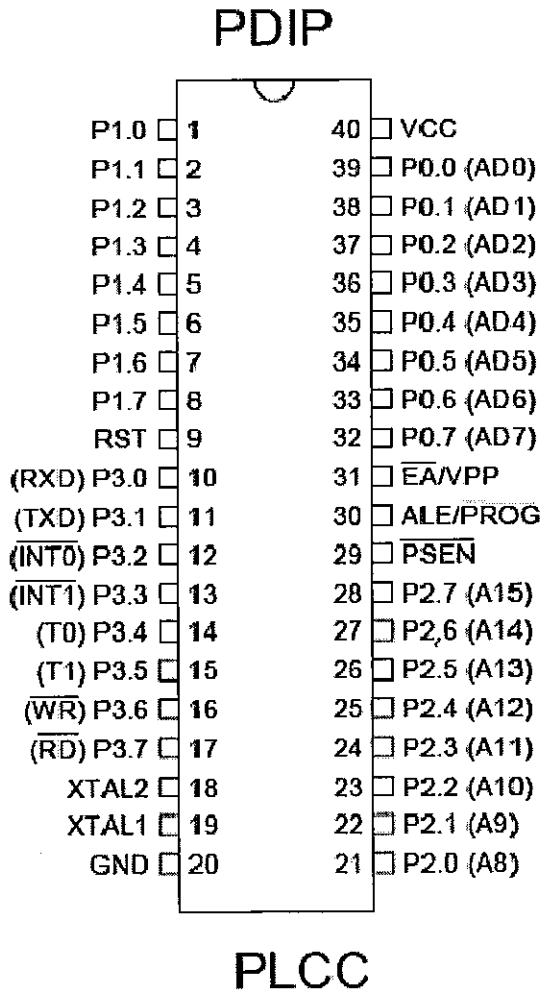
- Compatible with MCS-51™ Products
- 4K Bytes of In-System Reprogrammable Flash Memory
- Endurance: 1,000 Write/Erase Cycles
- Fully Static Operation: 0 Hz to 24 MHz
- Three-level Program Memory Lock
- 128 x 8-bit Internal RAM
- 32 Programmable I/O Lines
- Two 16-bit Timer/Counters
- Six Interrupt Sources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

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

The AT89C51 provides the following standard features: 4Kbytes of Flash, 128 bytes of RAM, 32 I/O lines, two 16-bit timer/counters, a five vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator and clock circuitry. In addition, the AT89C51 is 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.

Pin Diagram


PDIP
P1.0 1
P1.1 2
P1.2 3
P1.3 4
P1.4 5
P1.5 6
P1.6 7
P1.7 8
RST 9
(RXD) P3.0 10
(TXD) P3.1 11
(INT0) P3.2 12
(INT1) P3.3 13
(T0) P3.4 14
(T1) P3.5 15
(WR) P3.6 16
(RD) P3.7 17
XTAL2 18
XTAL1 19
GND 20
40 VCC
39 P0.0 (AD0)
38 P0.1 (AD1)
37 P0.2 (AD2)
36 P0.3 (AD3)
35 P0.4 (AD4)
34 P0.5 (AD5)
33 P0.6 (AD6)
32 P0.7 (AD7)
31 EA/VPP
30 ALE/PROG
29 PSEN
28 P2.7 (A15)
27 P2.6 (A14)
26 P2.5 (A13)
25 P2.4 (A12)
24 P2.3 (A11)
23 P2.2 (A10)
22 P2.1 (A9)
21 P2.0 (A8)
PLCC

Pin Description

VCC

Supply voltage.

GND

Ground.

Port 0

Port 0 is an 8-bit open-drain bi-directional 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 bi-directional 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 bi-directional 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 bi-directional 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 low will source current (IIL) because of the pullups. Port 3 also serves the functions of various special features of the AT89C51 as listed below

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

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

RST

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

ALE/PROG

Address Latch Enable output pulse for latching the low byte of the address during accesses to external memory. This pin is also the program pulse input (PROG) during Flash programming.

In normal operation ALE is emitted at a constant rate of 1/6 the oscillator frequency, 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 be disabled by setting bit 0 of SFR location 8EH. With the bit set, ALE is active only during a MOVX or MOVC instruction. Otherwise, the pin is weakly pulled high. Setting the ALE-disable bit 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 fetch code from external program memory locations starting at 0000H up to FFFFH. Note, however, that if lock bit 1 is programmed, EA will be internally latched on reset. EA should be strapped to VCC for internal program executions. This pin also receives the 12-volt programming enable voltage
(VPP) during Flash programming, for parts that require 12-volt VPP.

XTAL1

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

XTAL2

Output from the inverting oscillator amplifier.

Oscillator Characteristics

XTAL1 and XTAL2 are the input and output, respectively, of an inverting amplifier which can be configured for use as an on-chip oscillator, as shown in Figure 1. Either a quartz crystal or ceramic resonator may be used. To drive the device from an external clock source, XTAL2 should be left unconnected while XTAL1 is driven as shown in Figure 2. There are no requirements on the duty cycle of the external clock signal, since the input to the internal clocking circuitry is through a divide-by-two flip-flop, but minimum and maximum voltage high and low time specifications must be observed.

Idle 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 registers remain unchanged during this mode. The idle mode can be terminated by any enabled interrupt or by a hardware reset. It should be noted that when idle is terminated by a hard

ware reset, the device normally resumes program execution, from where it left off, up to two machine cycles 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

Power supply

The term power supply is more commonly abbreviated to PSU, this will be used from hereon in.

Telecommunications equipment is designed to operate on voltages lower than the domestic Mains voltage. In order to reduce this voltage a PSU is used.

To provide a useable low voltage the PSU needs to do a number of things:-

- Reduce the Mains AC (Alternating current) voltage to a lower level.
- Convert this lower voltage from AC to DC (Direct current)
- Regulate input/output voltages. the DC output to compensate for varying load (current demand)
- Provide protection against excessive

Reduction of AC Mains

This is achieved by using a device known as a Transformer an electromagnetic device consisting of an ferrous iron core which has a large number of turns of wire wound around it, known as the Primary Winding

The ends of these turns of wire being connected to the input voltage (in this case Mains AC).

A second number of turns of wire are wound around the Primary Winding, this set being known as the Secondary Winding.

The difference between the number of turns provides us with a way of reducing (in our case) a high AC voltage to a lower one.

Conversion of AC to DC

To convert our now low AC voltage to DC we use a Rectifier Diode connected to the Secondary Winding.

This is a silicon diode, which has operation analogous to a bicycle tyre valve (as the valve only allows air to flow into the tyre, the diode only allows current to flow in one direction)

As our low AC voltage will be working at a frequency of 50Hz (Mains AC frequency) it is desirable to reduce the inherent hum on this to a lower level.

This is achieved by a technique known as Smoothing ("Ironing" out the bumps in the AC).

A simple way to reduce the hum is to use Full Wave Rectification.

Today this is usually done by four diodes in a bridge configuration known as a Bridge Rectifier. (This can be four individual diodes or a dedicated self contained package)

Regulation of Output Voltage

The Electrolytic Capacitor is a device capable of storing energy the amount of energy and the time it remains stored depending on the value.

In a simple PSU the easiest way to provide regulation to compensate for varying load conditions is to use a pair of relatively high value Electrolytic Capacitors.

Their values in this case being in the region of 470uF to 2000uF depending on the application and the amount of current required from the output of the unit.

One of these capacitors is connected across the DC output of the rectifier diode(s) or bridge, this capacitor also providing an extra degree of smoothing the output waveform.

The second capacitor is connected via a low value, medium to high wattage resistor, which assists in limiting the current demand.

Protection against excessive voltages

In a simple PSU the easiest way to do this is by providing fuses at the input to the transformer, generally in the live side of the mains supply, also at the DC outputs.

In the event of an excessive input voltage, or excessive current being drawn from the output, one of these fuses should normally blow protecting the PSU and the equipment connected to it.

The transformer may also be fitted with an internal or external thermal fuse, which will open if the transformer becomes hot due to the aforementioned conditions.

Transformers

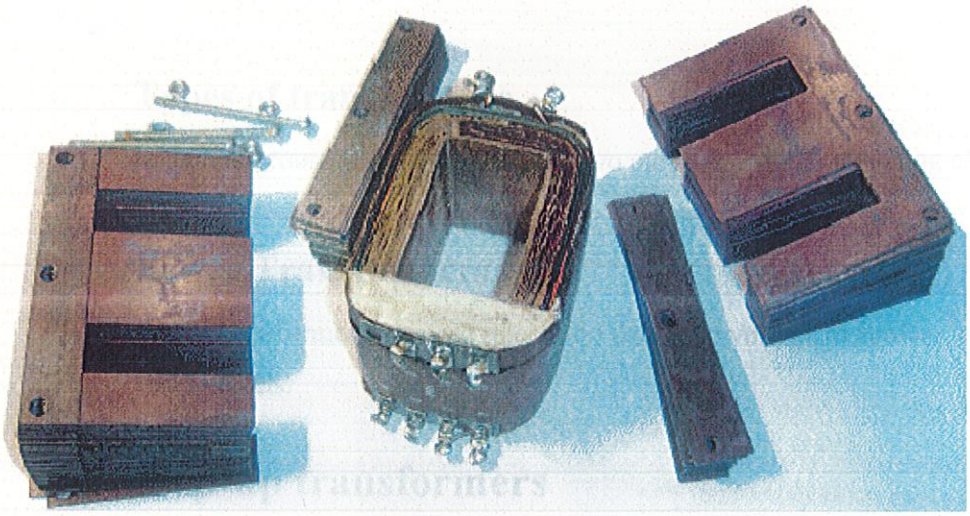
A "transformer" takes one voltage and changes it into another.

What is a transformer, and why should I care?

A "transformer" changes one voltage to another. This attribute is useful in many ways.

A transformer doesn't change power levels. If you put 100 Watts into a transformer, 100 Watts come out the other end. [Actually, there are minor losses in the transformer because nothing in the real world is 100% perfect. But transformers come pretty darn close; perhaps 95% efficient.]

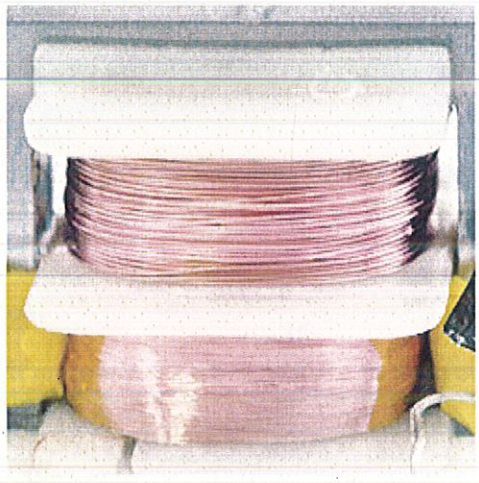
A transformer is made from two coils of wire close to each other (sometimes wrapped around an iron or ferrite "core"). Power is fed into one coil (the "primary"), which creates a magnetic field. The magnetic field causes current to flow in the other coil (the "secondary"). Note that this doesn't work for direct current (DC): the incoming voltage needs to change over time - alternating current (AC) or pulsed DC.



Iron core

The number of times the wires are wrapped around the core ("turns") is very important and determines how the transformer changes the voltage.

- If the primary has fewer turns than the secondary, you have a step-up transformer that increases the voltage.
- If the primary has more turns than the secondary, you have a step-down transformer that reduces the voltage.
- If the primary has the same number of turns as the secondary, the outgoing voltage will be the same as what comes in. This is the case for an isolation transformer.
- In certain exceptional cases, one large coil of wire can serve as both primary and secondary. This is the case with variable auto-transformers and xenon strobe trigger transformers.



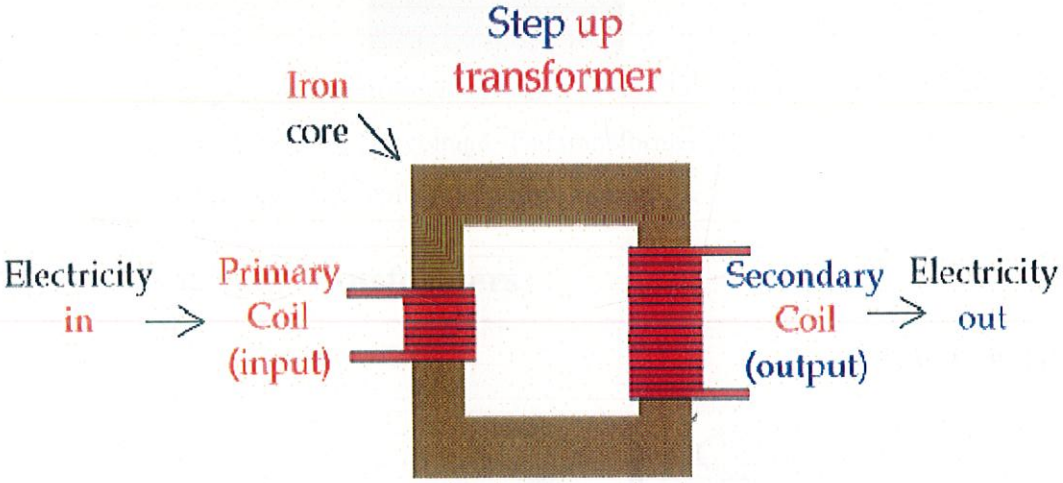
Types of transformers

In general, transformers are used for two purposes: signal matching and power supplies.

Power Transformers

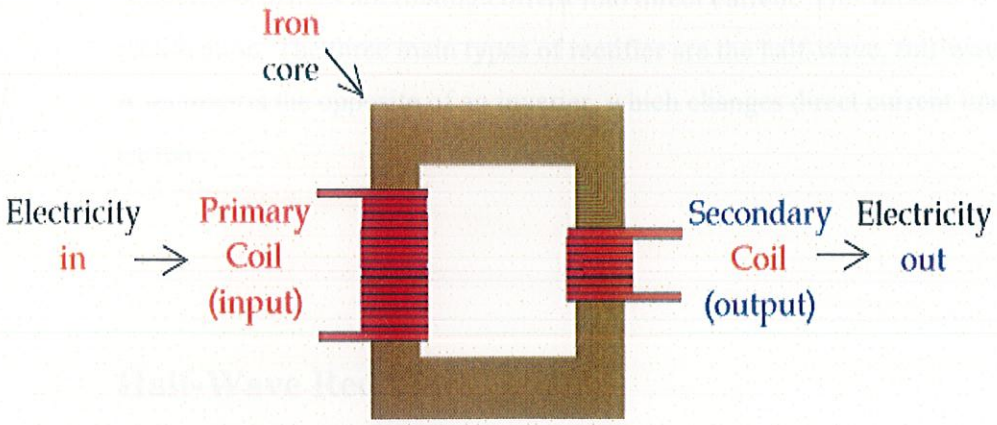
Power transformers are used to convert from one voltage to another, at significant power levels.

Step-up transformers



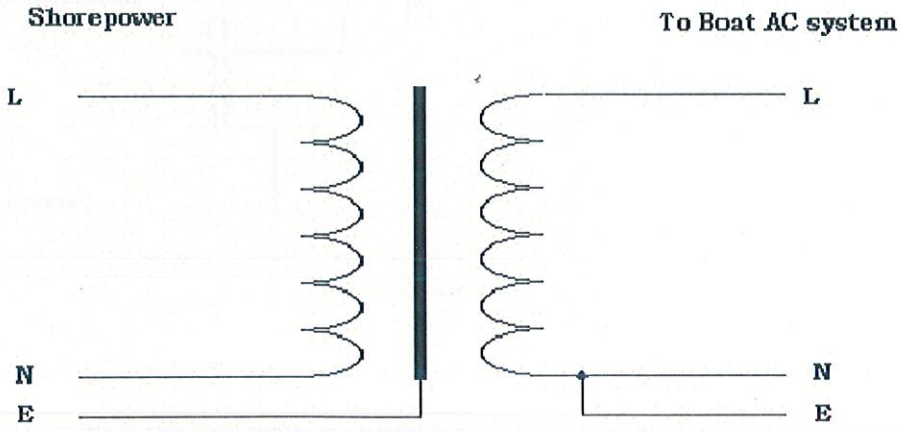
A "step-up transformer" allows a device that requires a high voltage power supply to operate from a lower voltage source. The transformer takes in the low voltage at a high current and puts out the high voltage at a low current.

Step-down transformers



A "step-down transformer" allows a device that requires a low voltage power supply to operate from a higher voltage. The transformer takes in the high voltage at a low current and puts out a low voltage at a high current. .

Isolation transformers



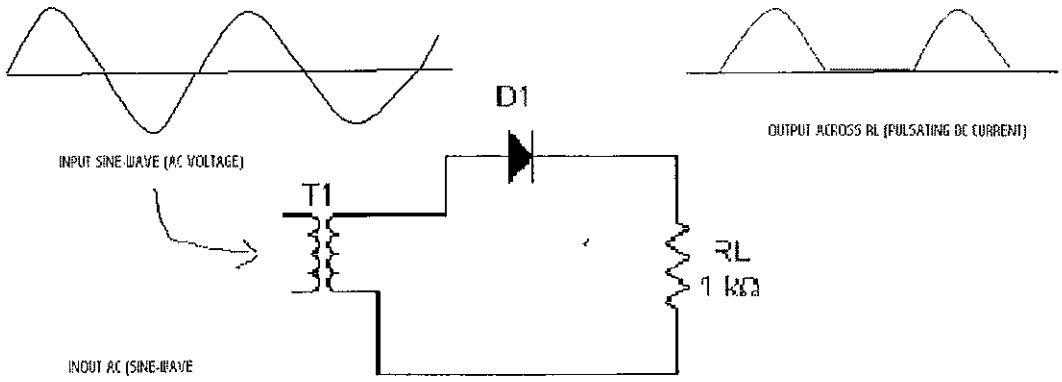
An "isolation transformer" does not raise or lower a voltage; whatever voltage comes in is what goes out. An isolation transformer prevents current from flowing directly from one side to the other. This usually serves as a safety device to prevent electrocution.

Rectifier

What is a Rectifier?

A rectifier changes alternating current into direct current. This process is called rectification. The three main types of rectifier are the half-wave, full-wave, and bridge. A rectifier is the opposite of an inverter, which changes direct current into alternating current.

Half-Wave Rectifier

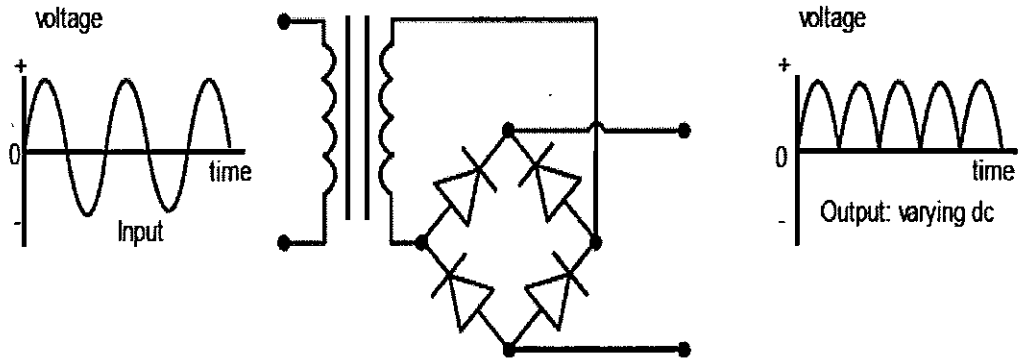


HALF-WAVE RECTIFIRE CIRCUIT

The simplest type is the half-wave rectifier, which can be made with just one diode. When the voltage of the alternating current is positive, the diode becomes forward-biased and current flows through it. When the voltage is negative, the diode is reverse-biased and the current stops. The result is a clipped copy of the alternating current waveform with only positive voltage, and an average voltage that is one third of the

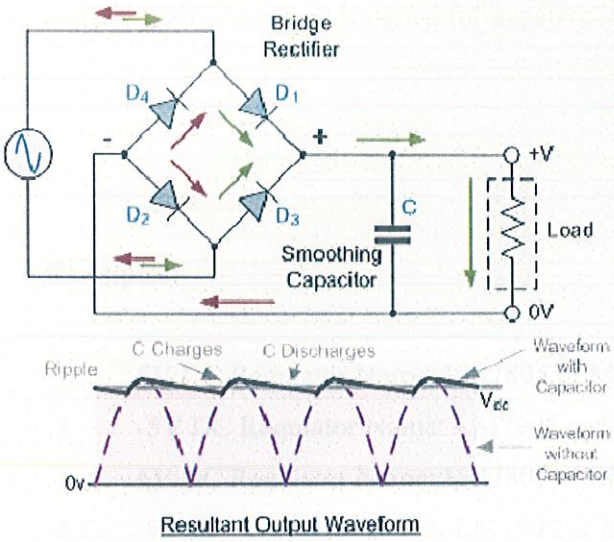
peak input voltage. This pulsating direct current is adequate for some components, but others require a more steady current. This requires a full-wave rectifier that can convert both parts of the cycle to positive voltage.

Bridge Rectifier

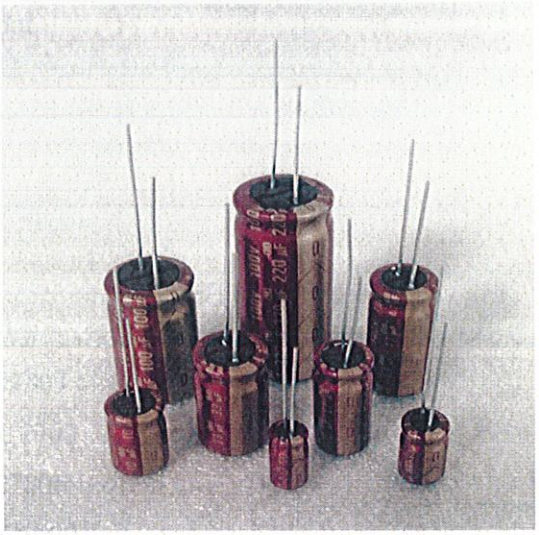


The bridge rectifier, also called a diode bridge, consists of four diodes connected together in a square. Two diodes are connected at their anodes, and the other two are connected at their cathodes. These form the rectified output terminals. The remaining ends are joined to form two input terminals. It it usually packaged as one component with four terminals. The bridge rectifier allows for full-wave rectification without the need for an earthed center tap on the transformer.

Smoothing



Resultant Output Waveform



Even the bridge rectifier has some variation in it's output voltage, so a filter is required to smooth out this ripple. A capacitor connected across the output terminals acts as a basic filter by storing energy during the peak voltage, and releasing it when the voltage falls. This removes most of the ripple but does not result in a steady voltage. A choke and second capacitor are usually added to further smooth the ripple.

Rectifier Uses

Rectifiers are used mostly in power adapters and alternators to convert alternating current to direct current. They are also used in radios to demodulate signals from the antenna.

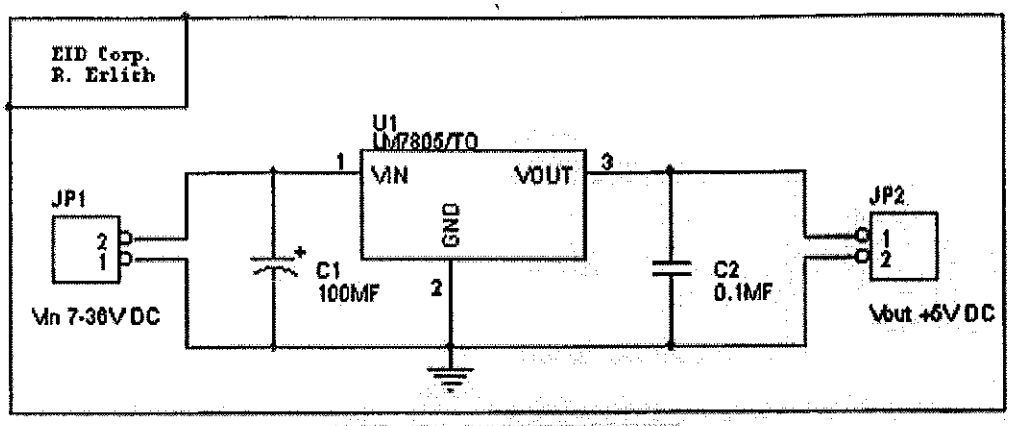
Voltage Regulator (regulator), usually having three legs, converts varying input voltage and produces a constant regulated output voltage. They are available in a variety of outputs.

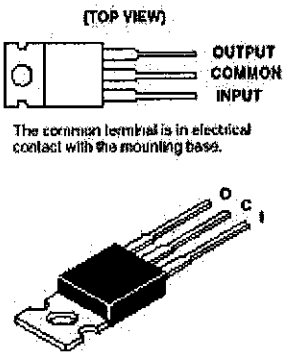
The most common part numbers start with the numbers 78 or 79 and finish with two digits indicating the output voltage. The number 78 represents positive voltage and 79 negative one. The 78XX series of voltage regulators are designed for positive input. And the 79XX series is designed for negative input.

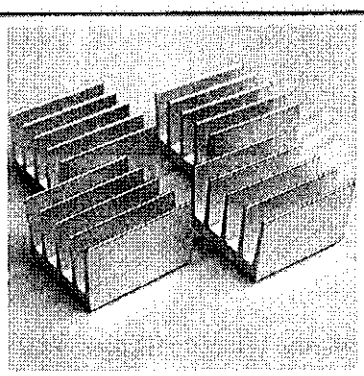
Examples:

- 5V DC Regulator Name: LM7805 or MC7805
- -5V DC Regulator Name: LM7905 or MC7905
- 6V DC Regulator Name: LM7806 or MC7806
- -9V DC Regulator Name: LM7909 or MC7909

The LM78XX series typically has the ability to drive current up to 1A. For application requirements up to 150mA, 78LXX can be used. As mentioned above, the component has three legs: Input leg which can hold up to 36VDC Common leg (GND) and an output leg with the regulator's voltage. For maximum voltage regulation, adding a capacitor in parallel between the common leg and the output is usually recommended. Typically a 0.1MF capacitor is used. This eliminates any high frequency AC voltage that could otherwise combine with the output voltage. See below circuit diagram which represents a typical use of a voltage regulator.







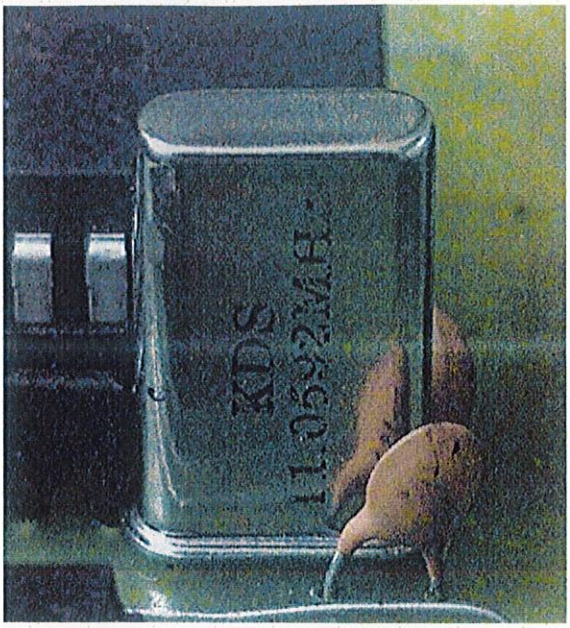
Lm7805 **Heat sink**

Note:

As a general rule the input voltage should be limited to 2 to 3 volts above the output voltage. The LM78XX series can handle up to 36 volts input, be advised that the power difference between the input and output appears as heat. If the input voltage is unnecessarily high, the regulator will overheat. Unless sufficient heat dissipation is provided through heat sinking, the regulator will shut down.

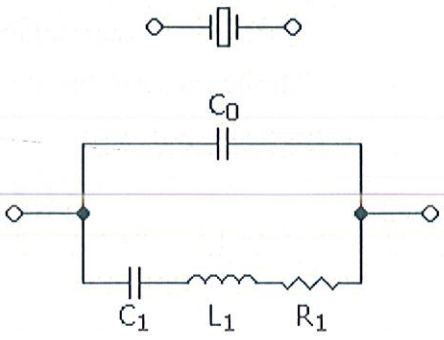
CRYSTAL OSCILLATOR

It is used to generate the clock needed.The crystal oscillator circuit sustains oscillation by taking a voltage signal from the quartz resonator, amplifying it, and feeding it back to the resonator. The rate of expansion and contraction of the quartz is the resonant frequency, and is determined by the cut and size of the crystal.



Crystal Oscillator

A regular timing crystal contains two electrically conductive plates, with a slice or tuning fork of quartz crystal sandwiched between them. During startup, the circuit around the crystal applies a random noise AC signal to it, and purely by chance, a tiny fraction of the noise will be at the resonant frequency of the crystal. The crystal will therefore start oscillating in synchrony with that signal. As the oscillator amplifies the signals coming out of the crystal, the crystal's frequency will become stronger, eventually dominating the output of the oscillator. Natural resistance in the circuit and in the quartz crystal filter out all the unwanted frequencies



Equivalent Diagram of Crystal oscillator

STABLIZING CAPACITOR

The role of this capacitor is normalize the fluctuating voltage

Stabilizing capacitor

MAX232 (communication interface)

The MAX220–MAX249 family of line drivers/receivers is intended for all EIA/TIA-232E and V.28/V.24 communications interfaces, particularly applications where ±12V is not available.

These parts are especially useful in battery-powered systems, since their low-power shutdown mode reduces power dissipation to less than 5µW. The MAX225,MAX233, MAX235, and MAX245/MAX246/MAX247 use no external components and are recommended for applications

where printed circuit board space is critical.

Features of MAX 232

- Superior to Bipolar
- Operate from Single +5V Power Supply

(+5V and +12V—MAX231/MAX239)

- Low-Power Receive Mode in Shutdown

  (MAX223/MAX242)
- Meet All EIA/TIA-232E and V.28 Specifications
- Multiple Drivers and Receivers
- 3-State Driver and Receiver Outputs
- Open-Line Detection (MAX243)

Applications

Portable Computers

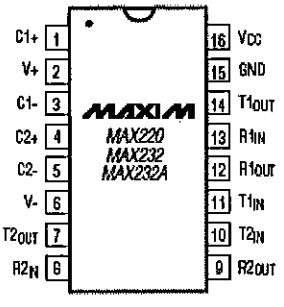
Low-Power Modems

Interface Translation

Battery-Powered RS-232 Systems

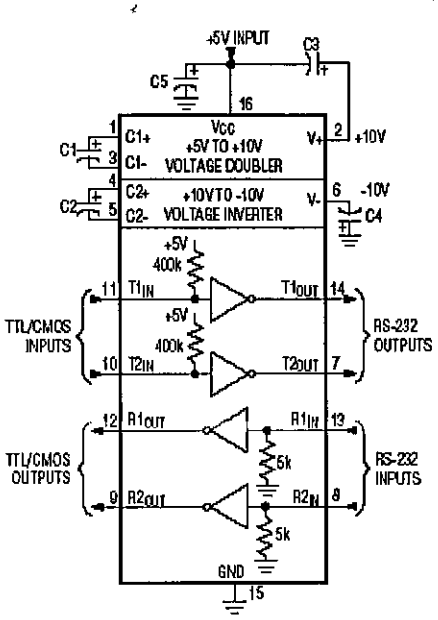
Multidrop RS-232 Networks

TOP VIEW



DIP/SO

CAPACITANCE (µF)					
DEVICE	C1	C2	C3	C4	C5
MAX220	4.7	4.7	10	10	4.7
MAX232	1.0	1.0	1.0	1.0	1.0
MAX232A	0.1	0.1	0.1	0.1	0.1



DESCRIPTION

The MAX220–MAX249 contain four sections: dual charge-pump DC-DC voltage converters, RS-232 drivers, RS-232 receivers, and receiver and transmitter enable control inputs. Dual Charge-Pump Voltage Converter The MAX220–MAX249 have two internal charge-pumps that convert +5V to ±10V (unloaded) for RS-232 driver operation. The first converter uses capacitor C1 to double the +5V input to +10V on C3 at the V+ output. The second converter uses capacitor C2 to invert +10V to -10V on C4 at the V- output.

A small amount of power may be drawn from the +10V (V+) and -10V (V-) outputs to power external circuitry (see the Typical Operating Characteristics section), except on the MAX225 and MAX245–MAX247, where these pins are not available. V+ and V- are not regulated, so the output voltage drops with increasing load current. Do not load V+ and V- to a point that violates the minimum ±5V EIA/TIA-232E driver output voltage when sourcing current from V+ and V- to external circuitry.

Input thresholds are both TTL and CMOS compatible. The inputs of unused drivers can be left unconnected since 400kO input pull-up resistors to VCC are built in (except for the MAX220). The pull-up resistors force the outputs of unused drivers low because all drivers invert. The internal input pull-up resistors typically source 12μA, except in shutdown mode where the pull-ups are disabled. Driver outputs turn off and enter a high-impedance state—where leakage current is typically microamperes (maximum 25μA)—when in shutdown mode, in three-state mode, or when device power is removed. Outputs can be driven to ±15V. The power-supply current typically drops to 8μA in shutdown mode. Basically IC MAX232 gives compatibility between TTL and RS 232.

RELAYS

A relay is an electrical switch that opens and closes under control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts. It was invented by Joseph Henry in 1835. Because a relay is able to control an output circuit of higher power than the input circuit, it can be considered, in a broad sense, to be a form of electrical amplifier.

These contacts can be either Normally Open (NO), Normally Closed (NC), or change-over contacts.

- Normally-open contacts connect the circuit when the relay is activated; the circuit is disconnected when the relay is inactive. It is also called Form A contact or "make" contact. Form A contact is ideal for applications that require to switch a high-current power source from a remote device.
- Normally-closed contacts disconnect the circuit when the relay is activated; the circuit is connected when the relay is inactive. It is also called Form B contact or "break" contact. Form B contact is ideal for applications that require the circuit to remain closed until the relay is activated.
- Change-over contacts control two circuits: one normally-open contact and one normally-closed contact with a common terminal. It is also called Form C contact.

Relay is used for

- To control a high-voltage circuit with a low-voltage signal, as in some types of modems,
- to control a high-current circuit with a low-current signal

ADC0808

The ADC0808, ADC0809 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, ADC0809 has been optimized

by incorporating the most desirable aspects of several A/Dconversion techniques. The ADC0808, ADC0809 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)

Features

- Easy interface to all microprocessors
- Operates ratiometrically 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 VCC input range
- Outputs meet TTL voltage level specifications
- ADC0808 equivalent to MM74C949
- ADC0809 equivalent to MM74C949-1

Key Specifications

- Resolution 8 Bits
- Total Unadjusted Error ±½ LSB and ±1 LSB
- Single Supply 5 VDC
- Low Power 15 mW
- Conversion Time 100 μs

LM35

Features

- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10.0 mV/°C scale factor
- 0.5°C accuracy guaranteeable (at +25°C)
- Rated for full -55° to +150°C range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than 60 μA current drain
- Low self-heating, 0.08°C in still air
- Nonlinearity only ±¼°C typical
- Low impedance output, 0.1 Ohm for 1 mA load

Description

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full -55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 μA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a -55° to +150°C temperature range, while the LM35C is rated for a -40° to +110°C range (-10° with improved accuracy).

CONCLUSION

Hardware implementation

After much brainstorming regarding the circuit diagram and component specifications the PCB was laid.
We divided the entire circuit into smaller modules and checking each one's functioning before connecting it to other one.
Here we are using iterative waterfall model to make sure our end product is free of connection and layout mistakes.

Software development

The C language code intends to show the user how data is being acquired and what changes are taking place. It targets to show the graphical display of changes.

REFERENCES

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- "Parallel port Unleashed", Book Author: Matsuhito Si Fung.
- "ADC Data book", Publisher: Analog Devices.
- "Turbo C++ Documentation", Publisher: Borland.
- "Advanced C Concepts", Source: BD Automation Inc., US.
- "Signal Processing In C", Source: www.astalavista.com
- "Guide to Ethical Hacking", By: tKC.
- "Hardware Hell", Book Author: Ralf Brown.
- "Access To Ports, Networks & ATMs", Book Author: Zatang.
- #IRC group "Designer's Den".
- "The Diary Of A Programmer", Author: Patricia Richardson.
- "Designers Handbook", Author: Augustus Brooks.
- "Fundamentals Of PC", Author: Raymond Burron.

WEB RESOURCES

Most of the research and comparisons were made online.
Here's the list of websites that were really helpful in gaining understanding and for implementation .

- www.ni.com
- www.national.com
- www.signatec.com
- www.omega.com
- www.agilent.com
- www.mstarslab.com
- www.lds-group.com
- www.temperatures.com
- www.azeotech.com
- www.microcontroller.com
- www.electronicscircuit.com
- www.kmitl.ac.th
- www.wenzel.com
- www.howstuffswork.com