GSM Based Electronic Notice Board Display Using LCD

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WAKNAGHAT

CERTIFICATE

This is to Certify that project report entitled "GSM Based Electronic Notice Board Display using LCD" , submitted by Archishman Latyan(111013) , Vishal Patial(111014) , Shivangi Aggarwal(111066) , in partial fulfillment for the award of degree of Bachelor of Technology in Electronics and Communication Engineering to Jaypee University of Information Technology, Waknaghat, Solan 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

Date: 25-5-15

Supervisor's Name: Dr. Sunil V. Bhooshan
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We are grateful to him for permitting us to make use of the facilities available in the department to carry out the Project successfully. Last but not the least we express our Sincere thanks to all our teachers and friends who have patiently extended all sorts of help for accomplishing this undertaking.

Date: 25-5-15

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Abstract

Conventionally there was printed notice board. Which was used to display any sort of the information but they were not much useful as it was more difficult to change the information periodically and there was a lot of paper and ink wastage to. Then came electronic notice boards which used LED's, with a particular combination to display any sort of information. But we needed to redesign the board incase to change the information. This project aims at developing a "GSM BASED MESSAGE DISPLAY" that will design such a board which will be displaying a scrolling message which is send to the board via SMS.

Introduction

It will require a specified user to send a message to the GSM modem connected to the microcontroller in a pre-defined format. After receiving this message the microcontroller will display the Message on the display and start it scrolling on the board. For example this display can be taken as a NOTICE BOARD for a school/College on which the information can be updated by simply sending a SMS via a mobile phone to the GSM Modem connected with the microcontroller. The message display is made up of array of latches to glow display the string of characters to be displayed on that display. The line driver circuit has been used to interface the GSM Modem with the microcontroller to make their voltage levels compatible to each other.

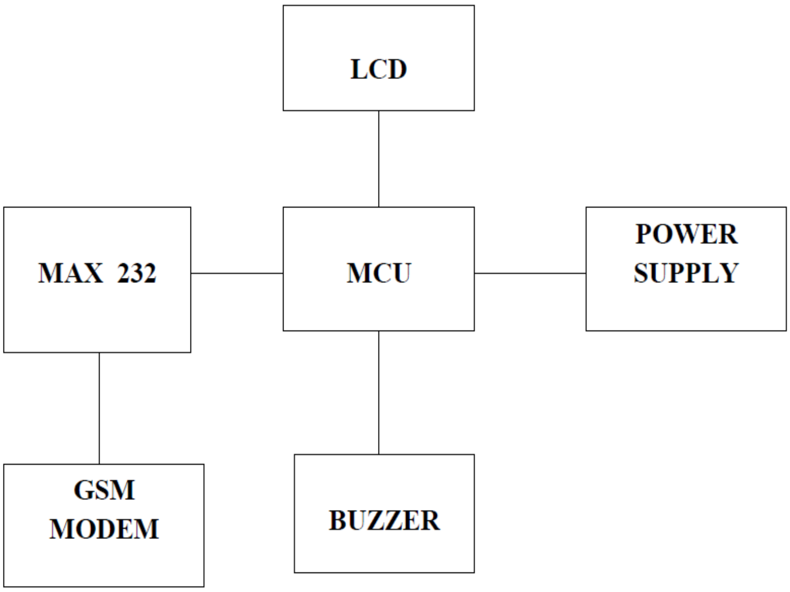


FIG.1 INITIAL BLOCK DIAGRAM

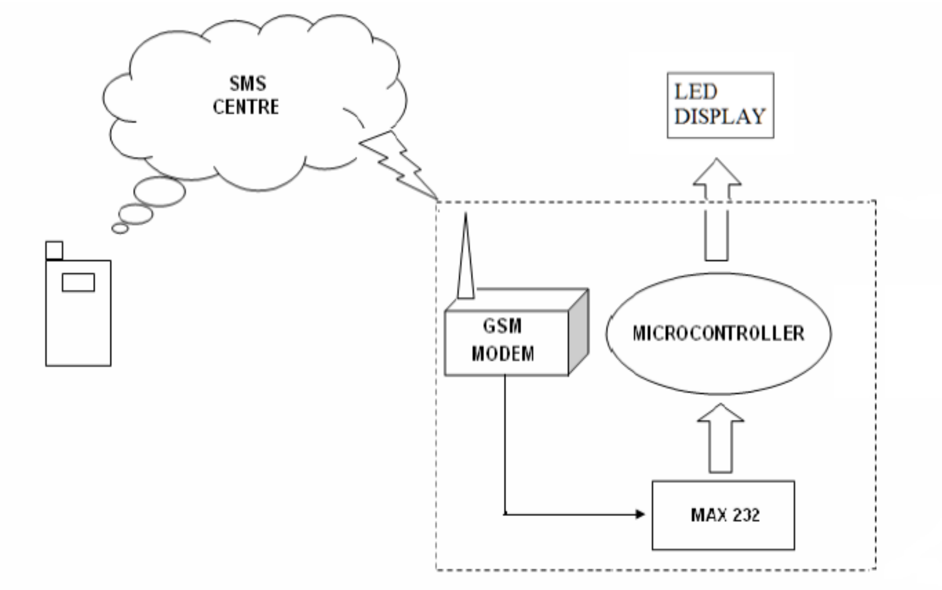


FIG.2 BLOCK DIAGRAM

Regulated Power Supply:

Power supplies are designed to convert high voltage AC mains to a suitable low voltage supply for electronic circuits and other devices. In our project the various electronic modules are being used for which power supply requirement is +5V DC. The Microcontroller unit needs a pure regulated +5V DC. A power supply can be broken down into a series of blocks, each of which performs a particular function.

For example a 5V regulated supply:

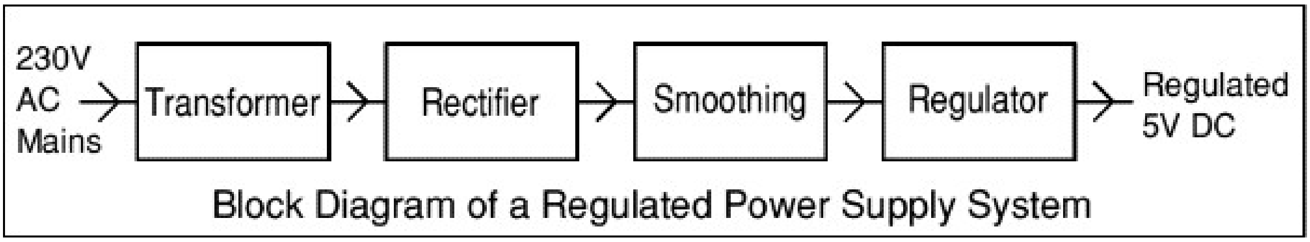


FIG.3

Each of the blocks has its own function as described below:

1. Transformer – steps down high voltage AC mains to low voltage AC. The step down transformer of 12-0-12, 750mA will be used in our project.
2. Rectifier – converts AC to DC, but the DC output is varying. The ripple factor of Bridge rectifier is than the other rectifier circuits. So here in our project we will use bridge rectifier to convert the AC into DC.
3. Smoothing – smoothest the DC from varying greatly to a small ripple. A electrolytic capacitor of 1000uF/50V will be used as a filter/smoothing circuit to get pure DC.
4. Regulator – eliminates ripple by setting DC output to a fixed voltage. There are two types of regulator series. First is positive voltage regulator series (78XX) and second is negative voltage regulator series (79XX). In our project we need positive voltage (+5V) so we will use 7805 to regulate the voltage.

Microcontroller 8051 Family

A microcontroller has a CPU (a microprocessor) in addition to the fixed amount of RAM, ROM, I/O ports, and timers are all embedded together on the chip: therefore, the designer cannot add any external memory, I/O, or timer to it. Microcontroller Unit is the heart of our project. It controls all the major activities of our project. The Microcontroller unit used in our project is based on MCS-51. In 1981, Intel Corporation introduced an 8-bit microcontroller called the 8051. This microcontroller had 128 bytes of RAM, 4K bytes of on-chip ROM, two timers, one serial port, and four ports (8-bit) all on a single chip. The other two members of MCS-51 series were 8052 and 8031 with different features. The 8051 became widely popular after Intel allowed other manufacturers to make any flavor of the 8051 they please with the condition that they remain code compatible with the 8051. This has led to many versions of the 8051 with different speeds and amount of on-chip ROM marketed by more than half a dozen manufacturers. It is important to know that although there are different flavors of the 8051, they are all compatible with the original 8051 as far as the instructions are concerned. This means that if you write your program for one, it will run on any one of them regardless of the manufacturer. The major 8051 manufacturers are Intel, Atmel, Dallas Semiconductors, Philips Corporation, Infineon. The Microcontrollers manufactured by these companies which were based on 8051 architecture are the MCS-51 based microcontrollers. In our projects we will use from Atmel corporation AT89C52/AT89S52 having similar features of 8052. The benefit of using AT89S52 is that it is In-circuit system programmable (ISP) i.e. it can be reprogrammed without removing it from the application using ISP Programmer. But if we are using AT89C52 then if we have to reprogram it then first of all we have to remove it from our application then program it using its programmer and then install it again in the application to use.

Display Unit (Liquid Crystal Display):

Display unit used in our project will be Liquid crystal display (LCD) which makes our project user friendly by displaying everything on the display. Liquid crystal displays (LCD) are widely used in recent years as compared to LEDs or seven segment displays. Because LCD can be used to display alphanumeric as well as special characters (like * @ ! # % & etc.). Also due to the declining prices of LCD, the ability to display numbers, characters and graphics, incorporation of a refreshing controller into the LCD, their by relieving the CPU of the task of refreshing the LCD and also the ease of programming for characters and graphics. HD 44780 based LCDs are most commonly used.

The LCD, which is used as a display in our project, is LMB162A. The main features of this LCD are: 16 X 2 display, intelligent LCD, used for alphanumeric characters & based on ASCII codes. This LCD contains 16 pins, in which 8 pins are used as 8-bit data I/O, which are extended ASCII. Three pins are used as control lines these are Read/Write pin, Enable pin and Register select pin. Two pins are used for Backlight and LCD voltage, another two pins are for Backlight & LCD ground and one pin is used for contrast change. It can display 32 characters at a time on the display. There are two rows (lines) and 16 characters can be displayed in each line. And it will be used in 8 bit mode i.e. its 8-bit data bus will be used to transfer the data codes from MCU to LCD. Below is the picture of our LCD:

FIG.4 LCD DISPLAY

TTL to RS232 Line-Driver Module (MAX232)

Some devices like PC, GSM Modem, and GPS Modem works on RS232voltage standards which are not compatible with MCU's TTL voltage standards. So MAX232 has to be used to make their communication compatible to each other.

RS232 Voltage Standards:

The RS-232 standard defines the voltage levels that correspond to logic alone and logical zero levels for the data transmission and the control signal lines. Valid signals are plus or minus 3 to 15 volts; the ±3 V range near zero volts is not a valid RS-232 level. The standard specifies a maximum open-circuit voltage of 25 volts: signal levels of ±5 V, ±10 V, ±12 V, and ±15 V all commonly seen depending on the power supplies available within a device. RS-232 drivers and receivers must be able to withstand indefinite short circuit to ground or to any voltage level up to ±25 volts. For data transmission lines (TxD, RxD and their secondary channel equivalents) logic one is defined as a negative voltage, the signal condition is called marking, and has the functional significance. Logic zero is positive and the signal condition is termed spacing. Control signals are logically inverted with respect to what one sees on the data transmission lines. When one of these signals is active, the voltage on the line will be between +3 to+15 volts. The inactive state for these signals is the opposite voltage condition, between −3 and −15 volts. Examples of control lines include request to send (RTS), clear to send (CTS), data terminal ready (DTR), and data set ready (DSR).
Because the voltage levels are higher than logic levels typically used by integrated circuits, special intervening driver circuits are required to translate logic levels. These also protect the device's internal circuitry from short circuits or transients that may appear on the RS-232 interface, and provide sufficient current to comply with the slew rate requirements for data transmission.

MAX232:

This chip is used when interfacing micro controller with PC to check the Baud rate and changes the voltage level because micro controller is TTL compatible whereas PC is CMOS compatible. The MAX 232 IC contains the necessary drivers {two} and receivers {two}, to adapt the RS- 232 signal voltage levels to TTL logic. It became popular, because it just needs one voltage {+5V} and generates the necessary RS-232 voltage levels {approx 10V AND +10V} internally. This greatly simplified the design of circuitry. And this made the IC so popular.MAX232 is just a driver/receiver. It does not generate the necessary RS-232 sequence of marks and spaces with the right timing, it does not decode RS-232 signal, it does not provide a serial /parallel conversion. All it does is to convert signal voltage levels.

GSM Voice & Data Transceiver (GSM MODEM)

What is a GSM Modem?

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves.

A GSM modem can be an external device or a PC Card / PCMCIA Card Typically, an external GSM modem is connected to a computer through a serial cable or a USB cable. A GSM modem in the form of a PC Card /PCMCIA Card is designed for use with a laptop computer. It should be inserted into one of the PC Card / PCMCIA Card slots of a laptop computer. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate.

Computers/MCUs use AT commands to control modems. Both GSM modems and dial-up modems support a common set of standard AT commands. You can use a GSM modem just like a dial-up modem. In addition to the standard AT commands, GSM modems support an extended set of AT commands. These extended AT commands are defined in the GSM standards. With the extended AT commands, you can do things like:

- Reading, writing and deleting SMS messages.
- Sending SMS messages.
- Monitoring the signal strength.
- Monitoring the charging status and charge level of the battery.
- Reading, writing and searching phone book entries.

Regulated Power Supply

Power supplies are designed to convert high voltage AC mains to a suitable low voltage supply for electronic circuits and other devices. A power supply can be broken down into a series of blocks, each of which performs a particular function .For example a 5V regulated supply:

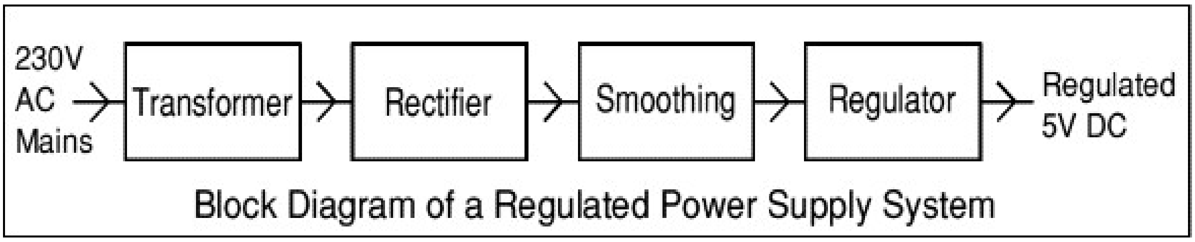


FIG.5

Each of the blocks has its own function as described below

1. Transformer – steps down high voltage AC mains to low voltage AC.
2. Rectifier – converts AC to DC, but the DC output is varying.
3. Smoothing – smoothes the DC from varying greatly to a small ripple.
4. Regulator – eliminates ripple by setting DC output to a fixed voltage.

Transformer:

Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC and this is one of the reasons why mains electricity is AC. The two types of transformers

 Step-up transformers increase voltage,

 Step-down transformers reduce voltage.

Most power supplies use a step-down transformer to reduce the dangerously high mains voltage (230V in UK) to a safer low voltage. The input coil is called the primary and the output coil is called the secondary. There is no electrical connection between the two coils, instead they are linked by an alternating magnetic field created in the soft-iron core of the transformer. The two lines in the middle of the circuit symbol represent the core. It waste very little power so the power out is (almost) equal to the power in. Note that as voltage is stepped down current is stepped up. The ratio of the number of turns on each coil, called the turn ratio, determines the ratio of the voltages. A step-down transformer has a large number of turns on its primary (input) coil which is connected to the high voltage mains supply, and a small number of turns on its secondary (output) coil to give a low output voltage.

$$\text{Turns Ratio} = \frac{Vp}{Vs} = \frac{Np}{Ns}$$

And Power Out = Power In

Vs X Is = Vp X Ip

Where

Vp = primary (input) voltage

Np = number of turns on primary coil

Ip = primary (input) current

Ns = number of turns on secondary coil

Is = secondary (output) current

Vs = secondary (output) voltage

1.1 Bridge Rectifier:

1.2

A bridge rectifier can be made using four individual diodes, but it is also available in special packages containing the four diodes required. It is called a full-wave rectifier because it uses all AC wave (both positive and negative sections). 1.4V is used up in the bridge rectifier because each diode uses 0.7V when conducting and there are always two diodes conducting, as shown in the diagram below. Bridge rectifiers are rated by the maximum current they can pass and the maximum reverse voltage they can withstand (this must be at least three times the supply RMS voltage so the rectifier can withstand the peak voltages). In this alternate pairs of diodes conduct, changing over the connections so the alternating directions of AC are converted to the one direction of DC.

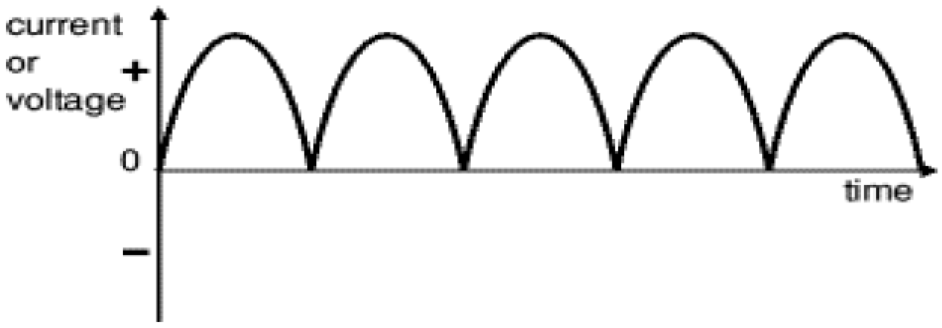
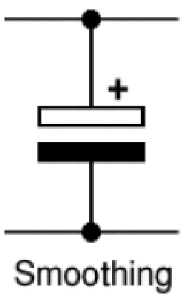


FIG.6 OUTPUT – Full-wave Varying DC

1.3 SMOOTHING:

1.4

Smoothing is performed by a large value electrolytic capacitor connected across the DC supply to act as a reservoir, supplying current to the output when the varying DC voltage from the rectifier is falling. The diagram shows the unsmoothed varying DC (dotted line) and the smoothed DC (solid line). The capacitor charges quickly near the peak of the varying DC, and then discharges as it supplies current to the output.



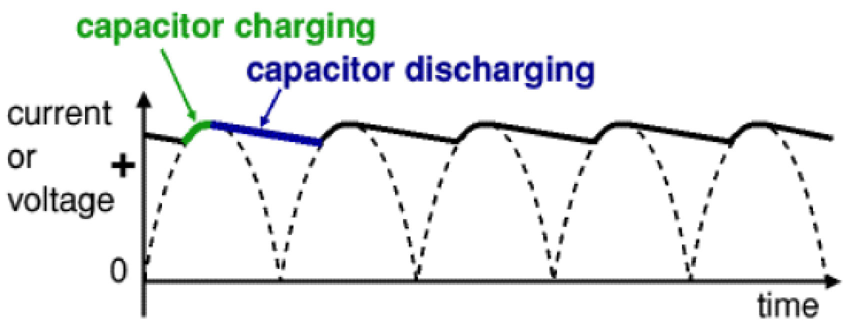


FIG.7(a)ELECTROLYTIC CAPACITOR FIG.7(b) *OUTPUT – SMOOTHING*

Note that smoothing significantly increases the average DC voltage to almost the peak value (1.4 × RMS value). For example 6V RMS AC is rectified to full wave DC of about 4.6V RMS (1.4V is lost in the bridge rectifier), with smoothing this increases to almost the peak value giving 1.4 × 4.6 = 6.4V smooth DC. Smoothing is not perfect due to the capacitor voltage falling a little as it discharges, giving a small ripple voltage. For many circuits a ripple which is 10% of the supply voltage is satisfactory and the equation below gives the required value for the smoothing capacitor. A larger capacitor will give fewer ripples. The capacitor value must be doubled when smoothing half-wave DC.

Smoothing capacitor for 10% ripple, C = 5 × Io

Vs × f

Where

C = smoothing capacitance in farads (F)

Io = output current from the supply in amps (A)

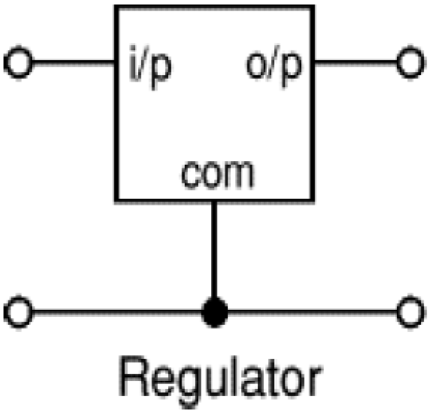
Vs = supply voltage in volts (V), this is the peak value of the unsmoothed DC

f = frequency of the AC supply in hertz (Hz), 50Hz in the UK

1.5

1.6

1.7 REGULATOR:



1.8

FIG.8(a) REGULATOR CONNECTION **FIG.8(b) REGULATOR**

Voltage regulator ICs are available with fixed (typically 5, 12 and 15V) or variable output voltages. They are also rated by the maximum current they can pass. Negative voltage regulators are available, mainly for use in dual supplies. Most regulators include some automatic protection from excessive current ('overload protection') and overheating ('thermal protection'). Many of the fixed voltage regulator ICs has 3 leads and look like power transistors, such as the 7805 +5V 1Aregulator shown on the right. They include a hole for attaching a heat sink if necessary.

1.9 Working of Power Supply

1.10

□ Transformer

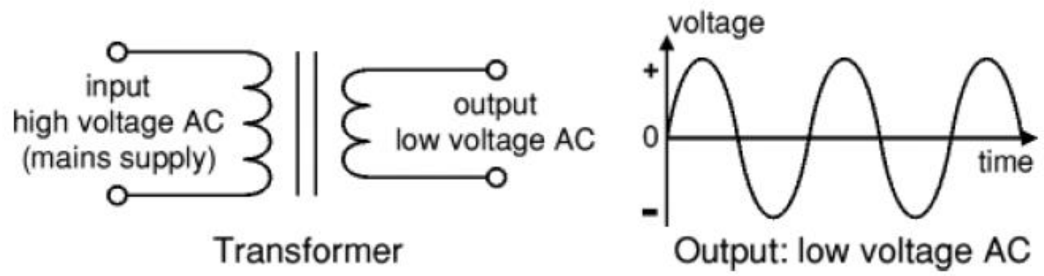


FIG.9

The low voltage AC output is suitable for lamps, heaters and special AC motors. It is not suitable for electronic circuits unless they include a rectifier and a smoothing capacitor.

□ Transformer + Rectifier

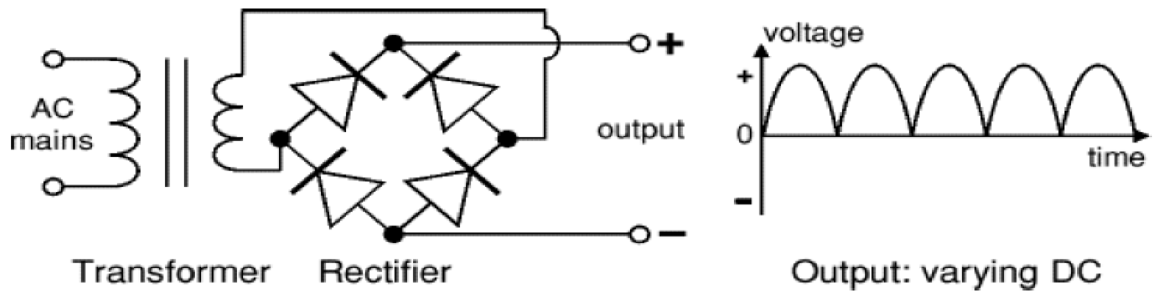


FIG.10

The varying DC output is suitable for lamps, heaters and standard motors. It is not suitable for electronic circuits unless they include a smoothing capacitor.

□ Transformer + Rectifier + Smoothing

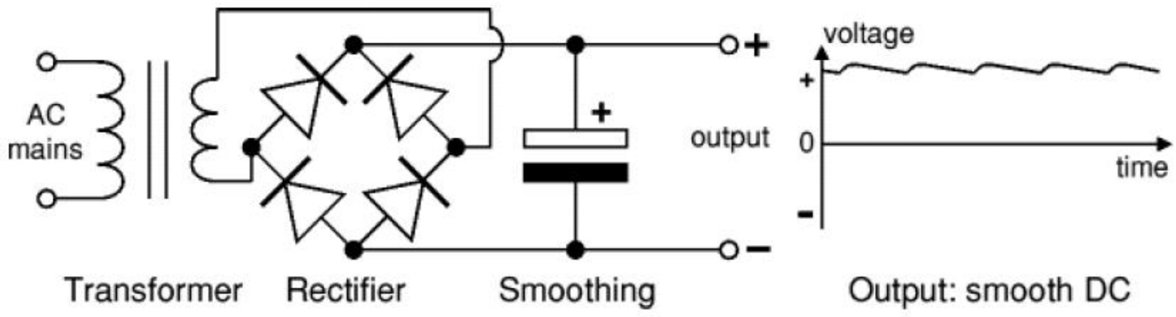


FIG.11

The smooth DC output has a small ripple. It is suitable for most electronic circuits.

 Transformer + Rectifier + Smoothing + Regulator

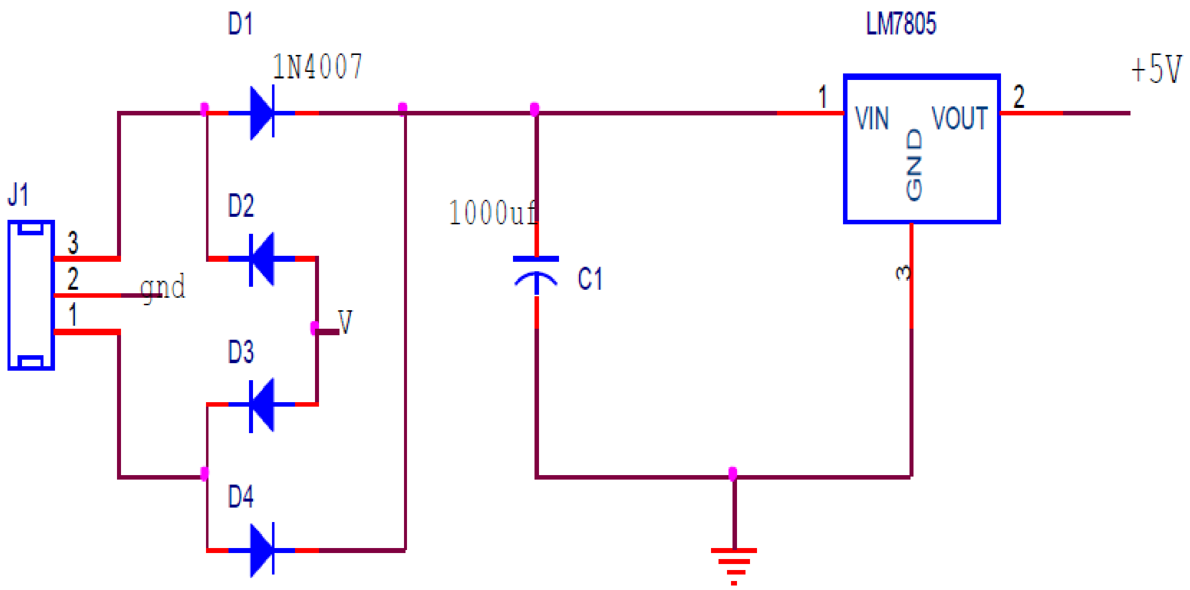


FIG.12 POWER SUPPLY CIRCUIT

The regulated DC supply is very smooth with no ripple. It is suitable for all electronic circuits.

1.11

1.12 Microcontroller 8051 Family

In our day to day life the role of micro-controllers has been immense. They are used in a variety of applications ranging from home appliances, FAX machines, Video games, Camera, Exercise equipment, Cellular phones musical Instruments to Computers, engine control, aeronautics, security systems and the list goes on.

1.13 Microcontroller versus Microprocessors

1.14

What is the difference between a microprocessor and microcontroller? The microprocessors (such as 8086, 80286, 68000 etc.) contain no RAM, no ROM and no I/O ports on the chip itself. For this reason they are referred as general- purpose microprocessors. A system designer using general- purpose microprocessor must add external RAM, ROM, I/O ports and timers to make them functional. Although the addition of external RAM, ROM, and I/O ports make the system bulkier and much more expensive, they have the advantage of versatility such that the designer can decide on the amount of RAM, ROM and I/o ports needed to fit the task at hand. This is the not the case with microcontrollers. A microcontroller has a CPU (a microprocessor) in addition to the fixed amount of RAM, ROM, I/O ports, and timers are all embedded together on the chip: therefore, the designer cannot add any external memory, I/O, or timer to it. The fixed amount of on chip RAM, ROM, and number of I/O ports in microcontrollers make them ideal for many applications in which cost and space are critical. In many applications, for example a TV remote control, there is no need for the computing power of a 486 or even a 8086microprocessor. In many applications, the space it takes, the power it consumes, and the price per unit are much more critical considerations than the computing power. These applications most often require some I/O operations to read signals and turn on and off certain bits.

It is interesting to know that some microcontroller's manufactures have gone as far as integrating an ADC and other peripherals into the microcontrollers.

1.15 Microcontrollers for Embedded Systems

In the literature discussing microprocessors, we often see a term embedded system. Microprocessors and microcontrollers are widely used in embedded system products. An embedded product uses a microprocessor (or microcontroller) to do one task and one task only. A printer is an example of embedded system since the processor inside it performs one task only: namely, get data and print it. Contrasting this with a IBM PC which can be used for a number of applications such as word processor, print server, network server, video game player, or internet terminal. Software for a variety of applications can be loaded and run. Of course the reason a PC can perform myriad tasks is that it has RAM memory and an operating system that loads the application software into RAM and lets the CPU run it.

In an embedded system, there is only one application software that is burned into ROM. A PC contains or is connected to various embedded products such as the keyboard, printer, modem, disk controller, sound card, CD-ROM drive, mouse and so on. Each one of these peripherals has a microcontroller inside it that performs only one task. For example, inside every mouse there is a microcontroller to perform the task of finding the mouse position and sending it to the PC. Although microcontrollers are the preferred choice for many embedded systems, there are times that a microcontroller is inadequate for the task. For this reason, in many years the manufacturers for general-purpose microprocessors have targeted their microprocessor for the high end of the embedded market.

A brief history of 8051 Family

In 1981, Intel Corporation introduced an 8-bit microcontroller called the 8051.This microcontroller had 128 bytes of RAM, 4K bytes of on-chip ROM, two timers, one serial port, and four ports (8-bit) all on a single chip. The 8051 is an 8-bit processor, meaning the CPU can work on only 8- bit pieces to be processed by the CPU. The 8051 has a total of four I/O ports, each 8- bit wide. Although 8051can have a maximum of 64K bytes of on-chip ROM, many manufacturers put only4K bytes on the chip.

The 8051 became widely popular after Intel allowed other manufacturers to make any flavor of the 8051 they please with the condition that they remain code compatible with the 8051. This has led to many versions of the 8051 with different speeds and amount of on-chip ROM marketed by more than half a dozen manufacturers. It is important to know that although there are different flavors of the 8051, they are all compatible with the original 8051 as far as the instructions are concerned. This means that if you write your program for one, it will run on any one of them regardless of the manufacturer. The major 8051 manufacturers are Intel, Atmel, Dallas Semiconductors, Philips Corporation, Infineon.

1.16

1.17 8051 microcontroller

The 8051 is the original member of the 8051 family. Intel refers to it as MCS-51.

Other members of the 8051 family

There are two other members in the 8051 family of microcontrollers. They are the8052 and the 8031.

Comparison of 8051 Family Members

Feature	8051	8052	8031
ROM (On Chip)	4K	8K	0K
RAM (Bytes)	128	256	128
Timers	2	3	2
I/O Pins	32	32	32
Serial Port	1	1	1
Interrupt Sources	6	8	6

FIG.13

1.18 Versions of 8051 from Atmel

Part Number	ROM	RAM	I/O Pins	Timers	Interrupts	Vcc
AT89C51	4K	128	32	2	6	5V

AT89LV51	4k	128	32	2	6	3V
AT89C1051	1K	64	15	1	3	3V
AT89C2051	2K	128	15	2	6	3V
AT89C52	8K	128	32	3	8	5V

FIG.14

AT89C51 from ATMEL Corporation:

This popular 8051 chip has on-chip ROM in the form of flash memory. This is ideal for fast development since flash memory can be erased in seconds compared to twenty minutes or more needed for the earlier versions of the 8051. To use theAT89C51 to develop a microcontroller-based system requires a ROM burner that supports flash memory: However, a ROM eraser is not needed. Notice that in flash memory you must erase the entire contents of ROM in order to program it again.

The PROM burner does this erasing of flash itself and this is why a separate burner is not needed. To eliminate the need for a PROM burner Atmel is working on a version of the AT89C51 that can be programmed by the serial COM port of the PC.

FIG.15 Atmel Microcontroller AT89C51

1.21 Hardware features

1.22

- 40 pin IC
- 4 Kbytes of Flash
- 128 Bytes of RAM
- 32 I/O lines
- Two16-Bit Timer/Counters
- Two-Level Interrupt Architecture
- Full Duplex Serial Port
- On Chip Oscillator and Clock Circuitry

1.23

1.24 Software features

1.25

- Bit Manipulations
- Single Instruction Manipulation
- Separate Program And Data Memory
- 4 Bank Of Temporary Registers
- Direct, Indirect, Register and Relative Addressing.

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.

The Atmel Flash devices are ideal for developing, since they can be reprogrammed easy and fast. If we need more code space for our application, particularly for developing 89Cxx projects with C language. Atmel offers a broad range of microcontrollers based on the 8051 architecture, with on-chip Flash program memory.

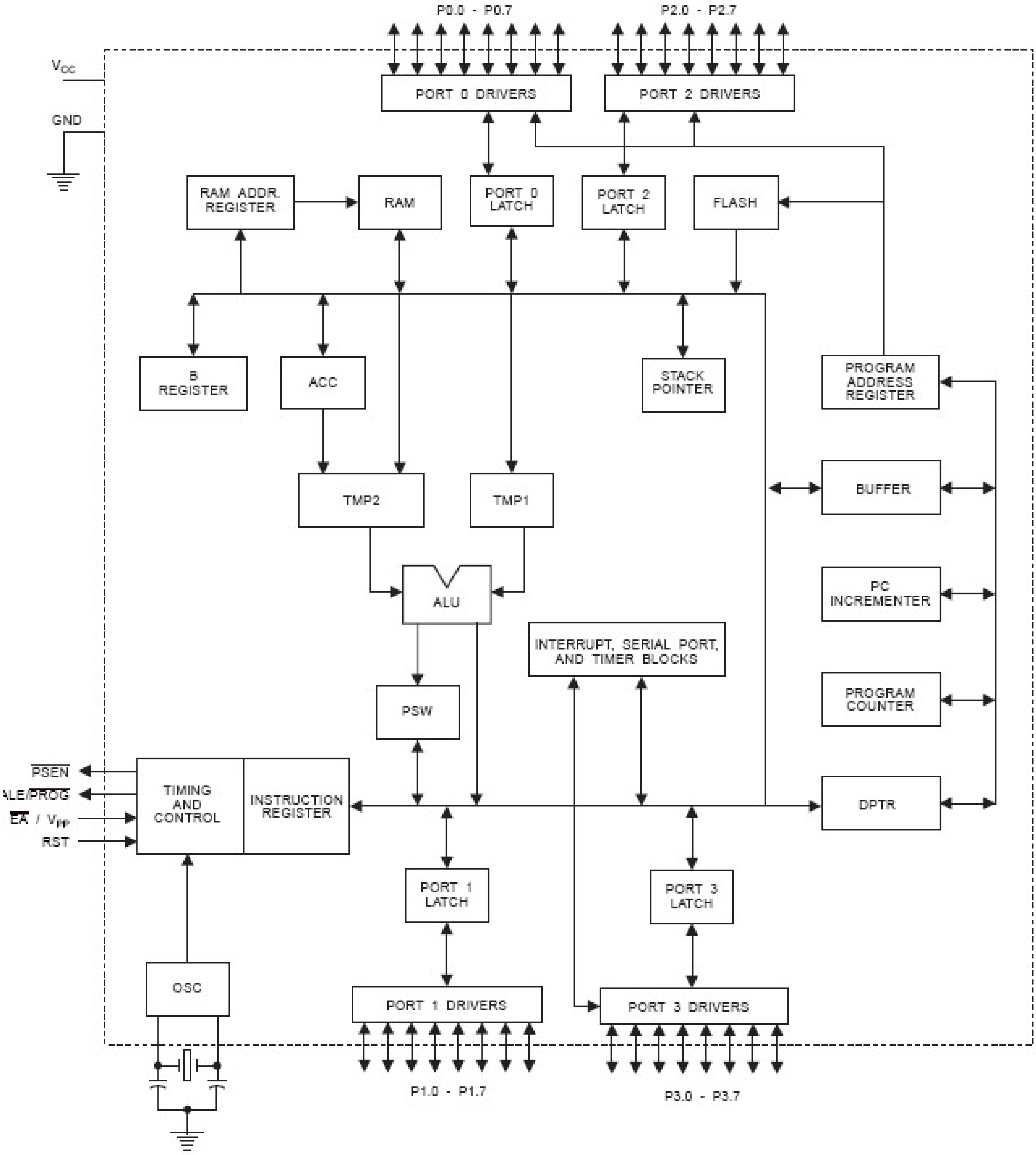


FIG.16 Internal Architecture of AT89C51

1.26

1.27

1.28

1.29

1.30 Pin description

1.31

The 89C51 have a total of 40 pins that are dedicated for various functions such as I/O, RD, WR, address and interrupts. Out of 40 pins, a total of 32 pins are set aside for the four ports P0, P1, P2, and P3, where each port takes 8 pins. The rest of the pins are designated as Vcc, GND, XTAL1, XTAL, RST, EA, and PSEN. All these pins except PSEN and ALE are used by all members of the 8051 and 8031families. In other words, they must be connected in order for the system to work, regardless of whether the microcontroller is of the 8051 or the 8031 family. The other two pins, PSEN and ALE are used mainly in 8031 based systems.

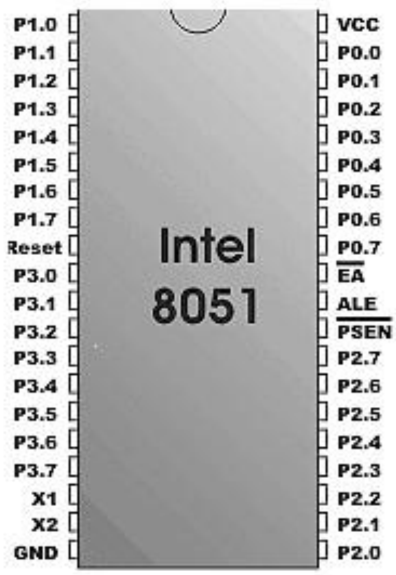


FIG.17 PIN DIAGRAM OF 8051

1.32

1.33 Vcc

Pin 40 provides supply voltage to the chip. The voltage source is +5V.

1.34 GND

Pin 20 is the ground.

1.35

1.36 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. Either a quartz crystal or ceramic resonator may be used. To drive the device from an external clock source, XTAL2 should be left unconnected whileXTAL1 is driven as shown in Figure.

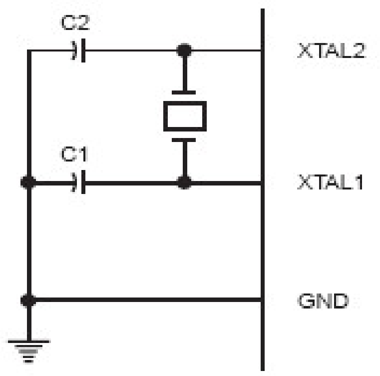


FIG.18 Oscillator Connections

It must be noted that there are various speeds of the 8051 family. Speed refers to the maximum oscillator frequency connected to the XTAL. For example, a 12MHz chip must be connected to a crystal with 12 MHz frequency or less. Likewise, a 20 MHz microcontroller requires a crystal frequency of no more than20 MHZ. When the 8051 is connected to a crystal oscillator and is powered up, we can observe the frequency on the XTAL2 pin using oscilloscope.

1.37 RST

1.38

Pin 9 is the reset pin. It is an input and is active high (normally low). Upon applying a high pulse to this pin, the microcontroller will reset and terminate all activities. This is often referred to as a power –on reset. Activating a power-on will cause all values in the registers to be lost. Notice that the value of Program Counter is 0000 upon reset, forcing the CPU to fetch the first code from ROM memory location 0000. This means that we must place the first line of source code in ROM location 0000 that is where the CPU wakes up and expects to find the first instruction. In order to RESET input to be effective, it must have a minimum duration of 2 machine cycles. In other words, the high pulse must be high for a minimum of 2 machine cycles before it is allowed to go low.

1.39 EA

1.40

All the 8051 family members come with on-chip ROM to store programs. In such cases, the

EA pin is connected to the Vcc. For family members such as 8031 and 8032 in which there is no on-chip ROM, code is stored on an external ROM and is fetched by the 8031/32. Therefore for the 8031 the EA pin must be connected to ground to indicate that the code is stored externally. EA, which stands for "external access," is pin number 31 in the DIP packages. It is input pin and must be to either Vcc or GND. In other words, it cannot be left unconnected.

1.41

1.42

1.43 PSEN

1.44

This is an output pin. PSEN stands for "program store enable." It is the read strobe to external program memory. When the microcontroller is executing from external memory, PSEN is activated twice each machine cycle.

1.45 ALE

Address latch enable is an output pin and is active high. When connecting a microcontroller to external memory, port 0 provides both address and data. In other words the microcontroller multiplexes address and data through port 0 to save pins. The ALE pin is used for de-multiplexing the address and data by connecting to the G pin of 74LS373 chip.

I/O port pins and their functions

The four ports P0, P1, P2, and P3 each use 8 pins, making them 8-bit ports. All the ports upon RESET are configured as output, ready to be used as output ports. To use any of these as input port, it must be programmed.

1.46 Port 0

1.47

Port 0 occupies a total of 8 pins (pins 32 to 39). It can be used for input or output. To use the pins of port 0 as both input and output ports, each pin must be connected externally to a 10K-ohm pull-up resistor. This is due to fact that port 0 is an open drain, unlike P1, P2 and P3. With external pull-up resistors connected upon reset, port 0 is configured as output port. In order to make port 0 an input Port, the port must be programmed by writing 1 to all the bits of it. Port 0 is also designated as AD0-AD7, allowing it to be used for both data and address. When connecting a microcontroller to an external memory, port 0 provides both address and data. The microcontroller multiplexes address and data through port 0 to save Pins. ALE indicates if P0 has address or data. When ALE=0, it provides data D0-D7, but when ALE=1 it has address A0-A7. Therefore, ALE is used for de-Multiplexing address and data with the help of latch 74LS373.

1.48

1.49 Port 1

Port 1 occupies a total of 8 pins (pins 1 to 8). It can be used as input or output. In contrast to port 0, this port does not require pull-up resistors since it has already pull-up resistors internally. Upon reset, port 1 is configures as an output port. Similar to port 0, port 1 can be used as an input port by writing 1 to all its bits.

1.50

1.51 Port 2

1.52

Port 2 occupies a total of 8 pins (pins 21 to 28). It can be used as input or output. Just like P1, port 2 does not need any pull-up resistors since it has pull-up resistors internally. Upon reset port 2 is configured as output port. To make port 2 as input port, it must be programmed as such by writing 1s to it.

1.53

1.54

1.55 Port 3

1.56

Port 3 occupies a total of 8 pins (pins 10 to 17). It can be used as input or output.P3 does not need any pull-up resistors, the same as P1 and P2 did not. Although port 3 is configured as output port upon reset, this is not the way it is most commonly used. Port 3 has an additional function of providing some extremely important signals such as interrupts. Some of the alternate functions of P3 are

Listed below:

P3.0 RXD (Serial input)

P3.1 TXD (Serial output)

P3.2 INT0 (External interrupt 0)

P3.3 INT1 (External interrupt 1)

P3.4 T0 (Timer 0 external input)

P3.5 T1 (Timer 1 external input)

P3.6 WR (External memory write strobe)

P3.7 RD (External memory read strobe)

Memory Space Allocation

1.57 Internal ROM

1.58

The 89C51 has 4K bytes of on-chip ROM. This 4K bytes ROM memory has memory addresses of 0000 to 0FFFh. Program addresses higher than 0FFFh, which the internal ROM capacity, will cause the microcontroller too automatically fetch code bytes from external memory. Code bytes can also be fetched exclusively an external memory, addresses 0000h to FFFF h, by connecting the external access pin to ground. The program counter doesn't care where the code is: the circuit designer decides whether the code is found totally in internal ROM, totally in external ROM or in a combination of internal and external ROM.

1.59 Internal RAM

1.60

The 128 bytes of RAM inside the 8051 are assigned addresses 00 to 7Fh. These 128 bytes can be divided into three different groups as follows:

1. A total of 32 bytes from locations 00 to 1Fh are set aside for register banks and the stack.

2. A total of 16 bytes from locations 20h to 2Fh are set aside for bit addressable read/write

memory and instructions. A total of 80 bytes from locations 30h to 7Fh are used for read and write storage, or what is normally called a scratch pad. These 80 locations of RAM are widely used for the purpose of storing data and parameters by 8051 programmers.

Serial Communication

1.61

1.62 Data Communication Concepts

1.63

Within a microcomputer data is transferred in parallel, because that is the fastest way to do it. For transferring data over long distances, however, parallel data transmission requires too many wires. Therefore, data to be sent long distances is usually converted from parallel form to serial form so that it can be sent on a single wire or pair of wires. Serial data received from a distant source is converted to parallel form so that it can be easily transferred on the microcomputer buses.

1.64 Serial Interface

1.65

Basic concepts concerning the serial communication can be classified into
Categories below:

- Interfacing requirements
- Transmission format
- Error check in data communication
- Standards in serial I/O

Interfacing Requirements:

The serial interface requirement is very much similar to parallel interface requirement. Computer identifies the peripheral through port address and enable if using the read and write signals. The primary difference between the parallel I/O and serial I/O is the number of lines used for data transfer. Parallel I/O requires the entire bus while the serial I/O requires only one or pair of data lines for communication.

Transmission Format:

Transmission format for communication is concerned with the issues such as synchronization, direction of data flow, speed, errors and medium of transmission. Serial data can be sent synchronously or asynchronously.

1.66

1.67

1.68 Serial Transmission Methods

1.69

Serial Communication, like any data transfer, requires coordination between the sender and receiver. For example, when to start the transmission and when to end it, when one particular bit or byte ends and another begins, when the receiver's capacity has been exceeded, and so on. A protocol defines the specific methods of coordinating transmission between a sender and receiver.

Two serial transmission methods are used that correct serial bit errors. The first one is synchronous communication, the sending and receiving ends of the communication are synchronized using a clock that precisely times the period separating each bit. By checking the clock the receiving end can determine if a bit is missing or if an extra bit (usually electrically induced) has been introduced in the stream. Here is an example of this method of communication, lets say that on a conveyor belt a product is passing through a sensing device every 5 seconds, if the sensing device senses something in between the 5 second lap it assumes that whatever is passing is a foreign object of some sorts and sounds an alarm, if on the 5 second lap nothing goes by it assumes that the product is missing and sounds an alarm . One important aspect of this method is that if either end of the communication loses its clock signal, the communication is terminated. The alternative method (used in PCs) is to add markers within the bit stream to help track each data bit. By introducing a start bit which indicates the start of a short data stream, the position of each bit can be determined by timing the bits at regular intervals, by sending start bits in front of each 8 bit streams, the two systems don't have to be synchronized by a clock signal, the only important issue is that both systems must be set at the same port speed. When the receiving end of the communication receives the start bit it starts a short term timer. By keeping streams short, there's not enough time for the timer to get out of sync. This method is known as asynchronous communication because the sending and receiving end of the communication are not precisely synchronized by the means of a signal line.

Each stream of bits are broke up in 5 to 8 bits called words. Usually in the PC environment you will find 7 or 8 bit words, the first is to accommodate all upper and lower case text characters in ASCII codes (the 127characters) the latter one is used to exactly correspond to one byte. By convention, the least significant bit of the word is sent first and the most significant bit is sent last. When communicating the sender encodes the each word by adding a start bit in front and 1 or 2 stop bits at the end. Sometimes it will add a parity bit between the last bit of the word and the first stop bit, this used as a data integrity check.

This is often referred to as a data frame. Five different parity bits can be used, the mark parity bit is always set at a logical 1, the space parity bit is always set at a logical 0, the even parity bit is set to logical 1 by counting the number of bits in the word and determining if the result is even, in the odd parity bit, the parity bit is set to logical 1 if the result is odd. Later two methods offer a means of detecting bit level transmission errors. Note that you don't have to use parity bits, thus eliminating 1 bit in each frame, this is often referred to as non parity bit frame.

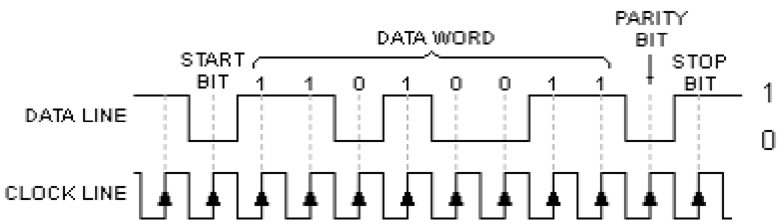


FIG.19 Asynchronous Serial Data Frame (8E1)

In the example above you can see how the data frame is composed of and synchronized with the clock signal. This example uses an 8 bit word with even parity and 1 stop bit also referred to as an 8E1 setting.

1.70 Bit Rates

1.71

Another important part of every asynchronous serial signal is the bit rate at which the data is transmitted. The rates at which the data is sent is based on the minimum speed of 300 bps (bits per second), you may find some slower speeds of 50, 100and 150 bps, but these are not used in today's technologies. Faster speeds are all based on the 300 bps rate, you merely double the preceding rate, so the rates are as follows, 600, 1200, 2400, 4800, 9600, 19200 and 38400 which is the fastest speed supported by today's BIOS's.

Asynchronous Serial Communication:

This section provides an overview of the protocol that governs the lowest level of data transmission--how serialized bits are sent over a single electrical line. The standard rests on more than a century of evolution in teleprinter technology. A sender is connected to a receiver over an electrical connecting line, there is an initial state in which communication has not yet begun, called the idle or mark state. Because older electromechanical devices operate more reliably with current continually passing through them, the mark state employs a positive voltage level.

Changing the state of the line by shifting the voltage to a negative value is called a space. Once this change has occurred, the receiver interprets a negative voltage level as a 0 bit, and a positive voltage level as a 1 bit. These transitions are shown in figure. The change from mark to space is known as the start bit, and this triggers the synchronization necessary for asynchronous serial transmission. The start bit delineates the beginning of the transmission unit defined as a character frame. The receiver then samples the voltage level at periodic intervals known as the bit time, to determine whether a 0-bit or a 1-bit is present on the line.

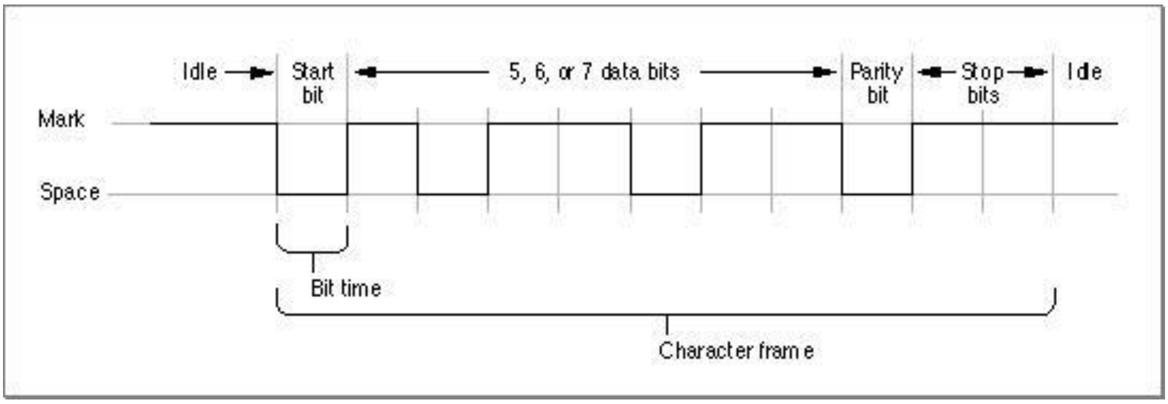


FIG.20 The Format of Serialized Bits [Missing Image]

The bit time is expressed in samples per second, known as baud (in honor of telecommunication pioneer Emile Baudot). This sampling rate must be agreed upon by sender and receiver prior to start of transmission in order for a successful transfer to occur. Common values for the sampling rate are 1200 baud and 2400 baud. In the case where one sampling interval can signal a single bit, a baud rate of
1200 results in a transfer rate of 1200 bits per second (bps). Note that because modern protocols can express more than one bit value within the sampling interval, the baud rate and the data rate (bps) are not always identical. Prior to transmission, the sender and receiver agree on a serial data format; that is, how many bits of data constitute a character frame, and what happens after those bits are sent. The Serial Driver supports frames of 5, 6, 7, or 8 bits in length. Character frames of 7 or 8 data bits are commonly used for transmitting ASCII characters.

After the data bits in the frame are sent, the sender can optionally transmit a parity bit for error-checking. There are various parity schemes, which the sender and receiver must agree upon prior to transmission. In odd parity, a bit is sent so that the entire frame always contains an odd number of 1 bit. Conversely, in even parity, the parity bit results in an even number of 1 bit. No parity means that no additional bit is sent. Other less-used parity schemes include mark parity, in which the extra bit is always 1, and space parity, in which its value is always 0. Using parity bits for error checking, regardless of the scheme, is now considered a rudimentary approach to error detection. Most communication systems employ more reliable techniques for error detection and correction.

To signify the end of the character frame, the sender places the line back to the mark state (positive voltage) for a minimum specified time interval. This interval has one of several possible values: 1 bit time, 2 bit times, or 1-1/2 bit times. This signal is known as the stop bit, and returns the transmission line back to idle status.

Electrical lines are always subject to environmental perturbations known as noise. This noise can cause errors in transmission, by altering voltage levels so that a bit is reversed (flipped), shortened (dropped), or lengthened (added). When this occurs, the ability of the receiver to distinguish a character frame may be affected, resulting in a framing error. The break signal is a special signal that falls outside the character frame. The break signal occurs when the line is switched from mark (positive voltage) to space (negative voltage) and held there for longer than a character frame. The break signal resembles an ASCII NUL character (a string of 0-bits), but exists at a lower level than the ASCII encoding scheme (which governs the encoding of information within the character frame.

1.72 Error Check In Data Communication

1.73

During transmission, various types of errors can occur. These errors need to be checked, therefore, additional information for error checking is sent during transmission the receiver can check the received data against the error check information, and if the error is detected, the receiver can request there retransmission of that data segment. Three methods generally used for this purpose are parity check, checksum and redundancy check

Standard in Serial I/O

The serial I/O technique is commonly used to interface terminals, printers etc. a standard is normally defined by a professional organization (such as IEEE). A standard may include such items as assignment of pin positions for signals, voltage levels, speed of data transfer, length of cable and mechanical specifications. When data are transmitted as voltage, the commonly used standard is known as RS232C.

It is defined as reference to data terminal equipment (DTE) and data communication equipment (DCE). The rate of transmission is RS232C is restricted to a maximum of 20k baud and a distance of 50 feet.

1.74 8051 Serial Communication Programming

1.75 Baud Rate in The 8051

1.76

The 8051 transfers and receives data serially at many different baud rates. The baud rate in the 8051 is programmable. This is done with the help of timer 1

Frequency of XTAL = 11.0592 MHZ

Machine cycle frequency = 11.0592/12= 921.6 KHZ.

The 8051's serial communication UART circuitry divides the machine cycle frequency of 921.6 kHz by 32 once more before it is used by timer1 to set the baud rate .result is 28,800 HZ. This value is used to find the timer 1 value to set the bad rate. When timer 1 is used to set the baud rate it must be programmed in mode 2, that is 8 bit, auto-reload.

Counter/Timer Programming

The 8051 has two timers/counters. They can be used either as timers to generate a time delay or as counters to count events happening outside the microcontroller.

These timers are, timer 0 and timer 1.both are 16 bits wide, and each 16 bit timer is accessed as two separate registers of low byte and high byte.

1.77

1.78

1.79 Timer 0 Register

1.80

The low byte register is called TL0 and the high byte register is referred to as TH0.

For e.g.: the instruction "MOV TL0, # 4FH"moves the value 4FH in to TL0, the low byte of timer 0.

D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0

FIG.21

1.81 Timer 1 Register

1.82

Timer 1 is also 16 bits, and it is split in to TL1 & TH1.

D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0

FIG.22

TMOD (Timer Mode) Register (20h)

Both timers 0 & 1 use the same register, called TMOD, to set the various timer operation modes. TMOD is an 8-bit register in which the lower 4 bits are set aside for timer 0 and the upper 4 bits are set aside for timer 1. In each case, the lower 2 bits are used to set the timer mode and upper 2 bits to specify the operation.

(MSB) (LSB)

GATE	C/T	M1	M0	GATE	C/T	M1	M0

← Timer 1 → ← Timer 0 →

FIG.23

M1	M0	Mode	Operating Mode
0	0	M0	13-Bit Timer Mode
0	1	M1	16-Bit Timer Mode
1	0	M2	8-Bit auto reload
1	1	M3	Split timer mode

1.83

FIG.24 TRUTH TABLE

C/T = 0 for Timer

= 1 for Counter

GATE = 0 When on/off is done by software

= 1 when additional hardware is needed for on/off.

1.84 SBUF Register

1.85

SBUF is an 8 bit register used solely for special communication in the 8051.for a byte of data to be transferred via the TxD line; it must be placed in the SBUF register. Similarly, SBUF holds the byte of data when it is received by the 8051's RxD line. SBUF can be accessed like any other register in the 8051.

SCON (Serial Control) Register (50 H)

The SCON register is an 8 bit register used to program the start bit, stop bit, and data bits of data framing, among other things. The following describes various bits of the SCON register.

SM0	SM1	SM2	REN	TB8	RB8	T1	R1

FIG.25

SM0 Serial port mode spécifier

SM1 Serial port mode spécifier

SM2 Used for multiprocessor communication

REN Set/cleared by software to enable/disable reception

TB8 Not widely used

RB8 Not widely used

T1 Transmit interrupt flag

R1 Receive interrupt flag

1.86

SM1	SM0	Mode	Operating Mode
0	0	Serial Mode 0	8-bit fixed Baud rate m
0	1	Serial Mode 1, 8 bit data, 1 stop bit, 1 start bit	8-bit variable Baud mode
1	0	Serial Mode 2	9-bit fixed Baud rate m
1	1	Serial Mode 3	9-bit variable Baud mode

1.86.1

FIG.26

1.87 Display Unit (Liquid Crystal Display)

Liquid crystal displays (LCD) are widely used in recent years as compares to LEDs. This is due to the declining prices of LCD, the ability to display numbers, characters and graphics, incorporation of a refreshing controller into the LCD, their by relieving the CPU of the task of refreshing the LCD and also the ease of programming for characters and graphics. HD 44780 based LCDs are most commonly used.

The LCD, which is used as a display in the system, is LMB162A. The main features of this LCD are: 16 X 2 display, intelligent LCD, used for alphanumeric characters & based on ASCII codes. This LCD contains 16 pins, in which 8 pins are used as 8-bit data I/O, which are extended ASCII. Three pins are used as control lines these are Read/Write pin, Enable pin and Register select pin. Two pins are used for Backlight and LCD voltage, another two pins are for Backlight & LCD ground and one pin is used for contrast change.

LCD pin description

Pin	Symbol	I/O	Description
1	VSS	-	Ground
2	VCC	-	+5V power supply
3	VEE	-	Power supply to control contrast
4	RS	I	RS=0 to select command register, RS=1 to select data register.
5	R/W	I	R/W=0 for write, R/W=1 for read
6	E	I/O	Enable
7	DB0	I/O	The 8 bit data bus

8	DB1	I/O	The 8 bit data bus
9	DB2	I/O	The 8 bit data bus
10	DB3	I/O	The 8 bit data bus
11	DB4	I/O	The 8 bit data bus
12	DB5	I/O	The 8 bit data bus
13	DB6	I/O	The 8 bit data bus
14	DB7	I/O	The 8 bit data bus

FIG.27

The LCD discuss in this section has the most common connector used for the Hitachi 44780 based LCD is 14 pins in a row and modes of operation and how to program and interface with microcontroller is describes in this section.

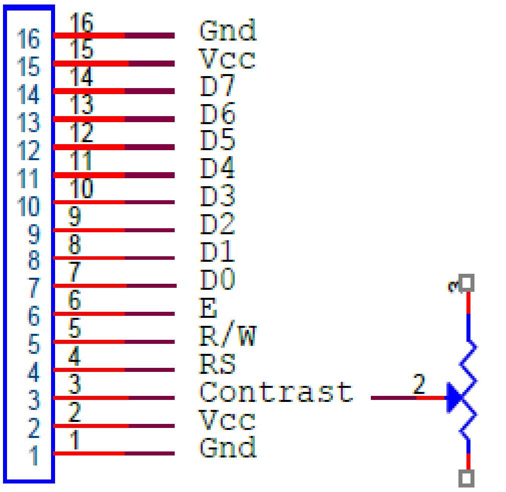


FIG.28 LCD Pin Description Diagram

VCC, VSS, VEE

The voltage VCC and VSS provided by +5V and ground respectively while VEE is used for controlling LCD contrast. Variable voltage between Ground and Vcc is used to specify the contrast (or "darkness") of the characters on the LCD screen.

RS (register select)

There are two important registers inside the LCD. The RS pin is used for their selection as follows. If RS=0, the instruction command code register is selected, then allowing to user to send a command such as clear display, cursor at home etc.. If RS=1, the data register is selected, allowing the user to send data to be displayed on the LCD.

R/W (read/write)

The R/W (read/write) input allowing the user to write information from it. R/W=1, when it read and R/W=0, when it writing.

EN (enable)

The enable pin is used by the LCD to latch information presented to its data pins. When data is supplied to data pins, a high power, a high-to-low pulse must be applied to this pin in order to for the LCD to latch in the data presented at the data pins.

D0-D7 (data lines)

The 8-bit data pins, D0-D7, are used to send information to the LCD or read the contents of the LCD’s internal registers. To displays the letters and numbers, we send ASCII codes for the letters A-Z, a-z, and numbers 0-9 to these pins while making RS =1. There are also command codes that can be sent to clear the display or force the cursor to the home position or blink the cursor.

We also use RS =0 to check the busy flag bit to see if the LCD is ready to receive the information. The busy flag is D7 and can be read when R/W =1 and RS =0, as follows: if R/W =1 and RS =0, when D7 =1(busy flag =1), the LCD is busy taking care of internal operations and will not accept any information. When D7 =0, the LCD is ready to receive new information.

Interfacing of micro controller with LCD display

In most applications, the "R/W" line is grounded. This simplifies the application because when data is read back, the microcontroller I/O pins have to be alternated between input and output modes.

In this case, "R/W" to ground and just wait the maximum amount of time for each instruction (4.1ms for clearing the display or moving the cursor/display to the "home position", 160µs for all other commands) and also the application software is simpler, it also frees up a microcontroller pin for other uses. Different LCD execute instructions at different rates and to avoid problems later on (such as if the

LCD is changed to a slower unit). Before sending commands or data to the LCD module, the Module must be initialized. Once the initialization is complete, the LCD can be written to with data or instructions as required. Each character to display is written like the control bytes, except that the "RS" line is set. During initialization, by setting the "S/C" bit during the "Move Cursor/Shift Display" command, after each character is sent to the LCD, the cursor built into the LCD will increment to the next position (either right or left). Normally, the "S/C" bit is set (equal to "1")

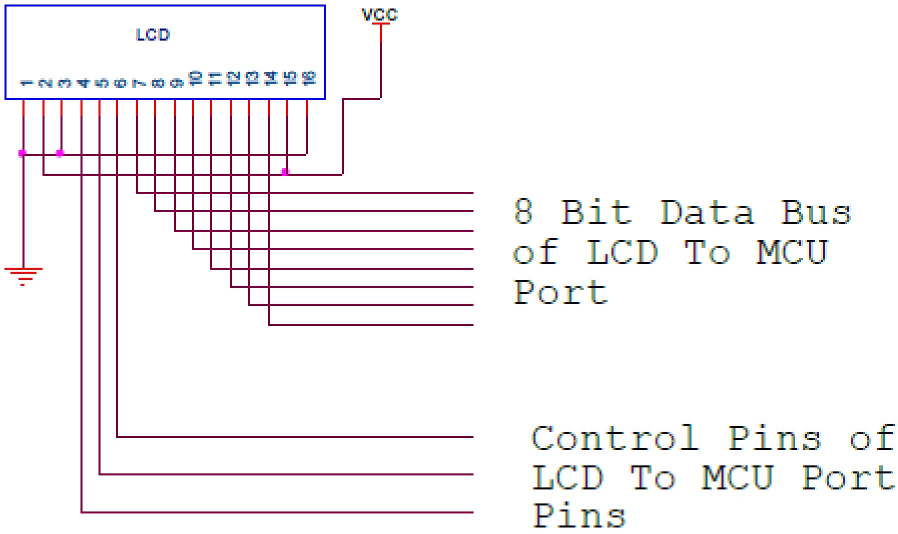


FIG.29 Interfacing of Microcontroller with LCD

1.88

1.89 LCD Command Code

Code (HEX)	Command to LCD Instruction Register
1	Clear the display screen
2	Return home
4	Decrement cursor(shift cursor to left)
6	Increment cursor(shift cursor to right)
7	Shift display right
8	Shift display left
9	Display off, cursor off
A	Display off, cursor on
C	Display on, cursor off
E	Display on, cursor blinking
F	Display on, cursor blinking
10	Shift cursor position to left
14	Shift cursor position to right

18	Shift the entire display to left
1C	Shift the entire display to right
80	Force cursor to the beginning of 1st line
C0	Force cursor to the beginning of 2nd line
38	2 line and 5×7 matrix

FIG.30

TTL to RS232 Line-Driver Module

1.90 Data Communication Concepts

1.91

Within a microcomputer data is transferred in parallel, because that is the fastest way to do it. For transferring data over long distances, however, parallel data transmission requires too many wires. Therefore, data to be sent long distances is usually converted from parallel form to serial form so that it can be sent on a single wire or pair of wires. Serial data received from a distant source is converted to parallel form so that it can be easily transferred on the microcomputer buses.

1.92

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1.94 Serial Interface

1.95

Basic concepts concerning the serial communication can be classified into categories below:

- Interfacing requirements
- Transmission format
- Error check in data communication
- Standards in serial I/O

1.96

1.97

1.98 **Interfacing Requirements**

1.99

The serial interface requirement is very much similar to parallel interface requirement. Computer identifies the peripheral through port address and enable if using the read and write signals. The primary difference between the parallel I/O and serial I/O is the number of lines used for data transfer.

Parallel I/O requires the entire bus while the serial I/O requires only one or pair of data lines for communication.

1.100

1.101 **Transmission Format**

1.102

Transmission format for communication is concerned with the issues such as synchronization, direction of data flow, speed, errors and medium of transmission. Serial data can be sent synchronously or asynchronously.

1.103 **Synchronous Data Transmission**

1.104

For synchronous data transmission data is sent in blocks at a constant rate. The start and end of the block are identified with specific bytes or bit patterns.

1.105 **Asynchronous Data Transmission**

1.106

For asynchronous transmission each data character has a bit which identifies its start and 1 or 2 bits, which identifies its end. Since each character is individually identified, characters can be sent at any time (asynchronously), in the same way that a person types on a keyboard.

The asynchronous format is character oriented. Each character carries the information of the start and stop bits. When no data is being transferred, a receiver stage high at the logic 1 called mark; logic 0 is called space. The transmission of data begins with one start bit (low) followed by a character and one or two stop bits (high). This is known as framing. The asynchronous format is generally used in low speed transmission (less than 20k bits/sec) in serial I/O one bit is sent out at a time. Therefore how long the bit stays on or off is determined by the speed at which bits are transmitted. The receiver should be set up to receive the bits at the same rate of transmission; otherwise the receiver may not be able to differentiate between the two consecutive 0s and 1s.

The rate at which the bits are transmitted (bits/sec) is called baud. Each equipment has its own baud requirements. The figure shown below shows how the ASCII character ―A‖ (41) will be transmitted with the 1200 baud with the framing information of one start and one stop bit. The bit time (delay between any two successive bits) is 0.83ms; this is determined by the baud as follows.

FIG.31

1.107 Error Check In Data Communication

1.108

During transmission, various types of errors can occur. These errors need to be checked, therefore, additional information for error checking is sent during transmission the receiver can check the received data against the error check information, and if the error is detected, the receiver can request there retransmission of that data segment. Three methods generally used for this purpose are parity check, checksum and redundancy check.

Standard in Serial I/O

The serial I/O technique is commonly used to interface terminals, printers etc. a standard is normally defined by a professional organization (such as IEEE). A standard may include such items as assignment of pin positions for signals, voltage levels, speed of data transfer, length of cable and mechanical specifications. When data are transmitted as voltage, the commonly used standard is known as RS232C. it is defined as reference to data terminal equipment (DTE) and data communication equipment (DCE). The rate of transmission is RS232C is restricted to a maximum of 20k baud and a distance of 50 feet.

Serial Port Description

The electrical speifications of the serial port are contained in the EIA (Electronics industry Association) RS232 standard

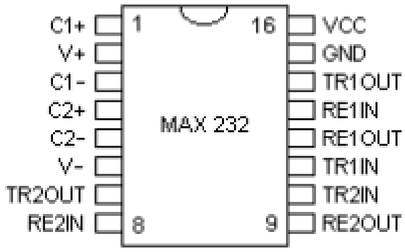
It states many parameters such as

1. A ―Space‖ {logic 0} will between +3 and +25 Volts.
2. A ―Mark‖ {logic 1} will between -3 and -25 Volts.
3. The region between +3 and -3 volts is undefined.
4. An open circuit voltage should never exceed 25 volts.{In Reference to GND}
5. A short circuit current should not exceed 500 ma.The driver should be able to handle this without damage.

These connectors come in two forms: A male and a female connector. There are the D-Type 9 pin connector and D-Type pin connector both of which are male on the back of the PC.The female connector has holes that allow the pins on the male end to be inserted into the connector.

TTL to RS232 Line-Driver (MAX 232) (communication interface)

This chip is used when interfacing micro controller with PC to check the Baud rate and changes the voltage level because micro controller is TTL compatible whereas PC is CMOS compatible. The MAX 232 IC contains the necessary drivers{two} and receivers {two}, to adapt the RS- 232 signal voltage levels to TTL logic. It became popular, because it just needs one voltage{+5V} and generates the necessary RS-232 voltage levels{approx - 10V AND +10V} internally. This greatly simplified the design of circuitry. And this made the IC so popular.MAX232 is just a driver/receiver. It does not generate the necessary RS-232 sequence of marks and spaces with the right timing, it does not decode RS-232 signal, it does not provide a serial /parallel conversion. All it does is to convert signal voltage levels.



1.109 **FIG.32 PIN DIAGRAM OF MAX-232**

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1.112 General Description

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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.

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1.116 Applications

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 Portable Computers

 Low-Power Modems

 Interface Translation

 Battery-Powered RS-232 Systems

 Multi-drop RS-232 Networks

1.118

1.119

1.120 Features

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1. Superior to bipolar
2. Low-power receive mode in shutdown
3. Meet all EIA/TIA-232E and v.28 specifications.
4. 3-state driver and receiver output.

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.

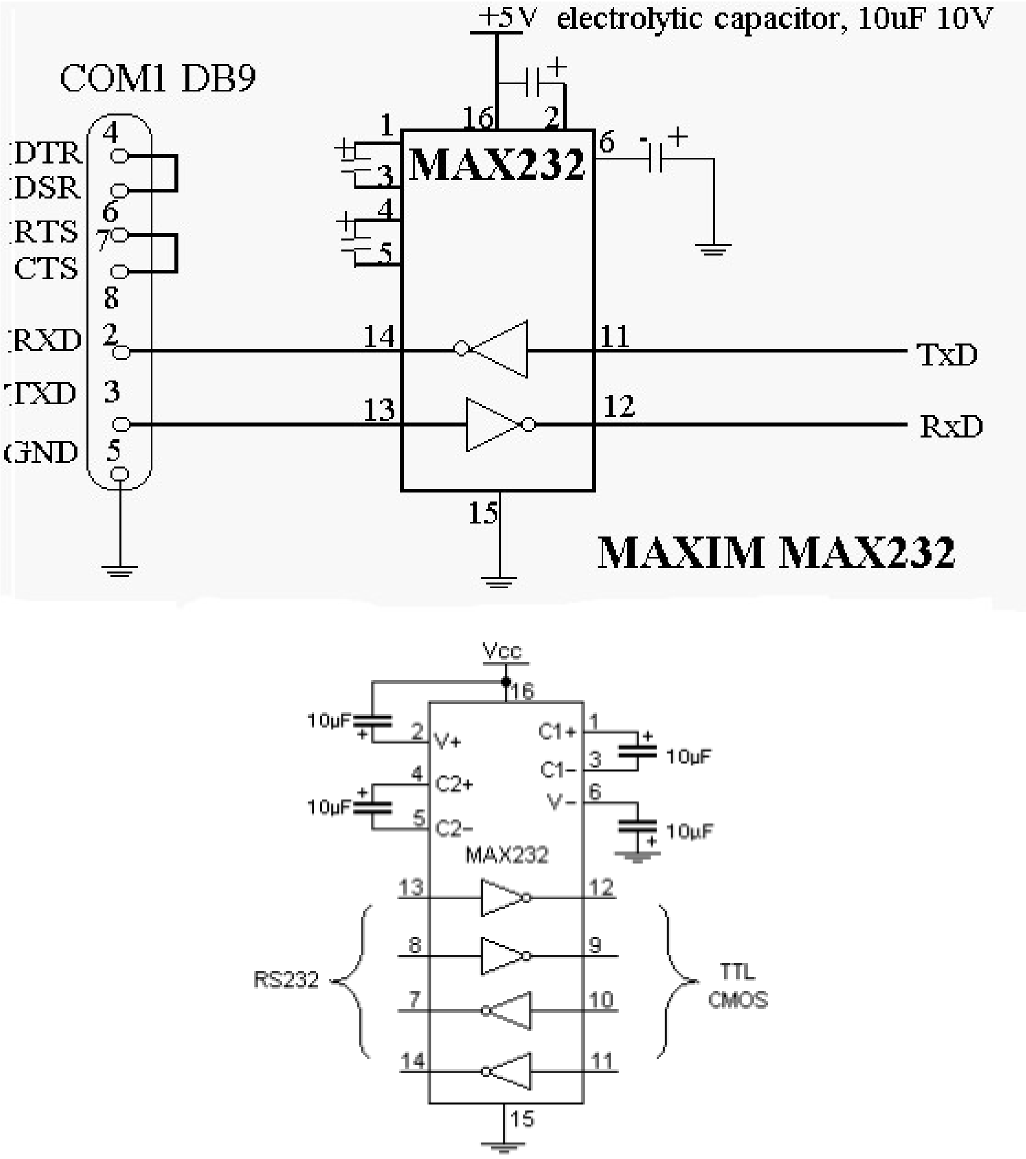

FIG.33 PIN CONNECTIONS OF MAX-232

Dual Charge-Pump Voltage Converter

The MAX220–MAX249 has 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 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. When using the shutdown feature in the MAX222, MAX225, MAX230, MAX235, MAX236, MAX240, MAX241, and MAX245– MAX249, avoid using V+ and V to power external circuitry. When these parts are shut down, V- falls to 0V, and V+ falls to +5V. For applications where a +10V external supply is applied to the V+ pin (instead of using the internal charge pump to generate +10V), the C1 capacitor must not be installed and the SHDN pin must be tied to VCC. This is because V+ is internally connected to VCC in shutdown mode.

RS-232 Drivers

The typical driver output voltage swing is ±8V when loaded with a nominal 5kΩ RS-232 receiver and VCC = +5V. Output swing is guaranteed to meet the EIA/TIA- 232E and V.28 specification, which calls for ±5V minimum driver output levels under worst-case conditions. These include a minimum 3kΩ load, VCC = +4.5V, and maximum operating temperature. Unloaded driver output voltage ranges from (V+ -1.3V) to (V- +0.5V). Input thresholds are both TTL and CMOS compatible. The inputs of unused drivers can be left unconnected since 400kΩ 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, or when in three-state mode, device power is removed. Outputs can be driven to ±15V. The power supply current typically drops to 8µA in shutdown mode.

The MAX220 does not have pull-up resistors to force the outputs of the unused drivers low. Connect unused inputs to GND or VCC. The MAX239 has a receiver three-state control line, and the MAX223, MAX225, MAX235, MAX236, MAX240, and MAX241 have both a receiver three- state control line and a low-power shutdown control. The receiver TTL/CMOS outputs are in a high-impedance, three-state mode whenever the three-state enable line is high (for the MAX225/MAX235/MAX236/MAX239– MAX241), and are also high- impedance whenever the shutdown control line is high. When in low-power shutdown mode, the driver outputs are turned off and their leakage current is less than 1µA with the driver output pulled to ground. The driver output leakage remains less than 1µA, even if the transmitter output is back driven between 0V and (VCC + 6V). Below -0.5V, the transmitter is diode clamped to ground with 1kΩ series impedance. The transmitter is also zener clamped to approximately VCC + 6V, with a series impedance of 1kΩ. The driver output slew rate is limited to less than 30V/µs as required by the EIA/TIA- 232E and V.28 specifications. Typical slew rates are 24V/µs unloaded and 10V/µs loaded with 3Ω and 2500pF.

RS-232 Receivers

EIA/TIA-232E and V.28 specifications define a voltage level greater than 3V as logic 0, so all receivers invert. Input thresholds are set at 0.8V and 2.4V, so receivers respond to TTL level inputs as well as EIA/TIA-232E and V.28 levels. The receiver inputs withstand an input over voltage up to ±25V and provide input terminating resistors with nominal 5kΩ values. The receivers implement Type 1 interpretation of the fault conditions of V.28 and EIA/TIA-232E. The receiver input hysteresis is typically 0.5V with a guaranteed minimum of 0.2V. This produces clear output transitions with slow-moving input signals, even with moderate amounts of noise and ringing. The receiver propagation delay is typically 600ns and is independent of input swing direction.

GSM Voice & Data Transceiver (GSM MODEM)

What is a GSM Modem?

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. A GSM modem can be an external device or a PC Card / PCMCIA Card.

Typically, an external GSM modem is connected to a computer through a serial cable or a USB cable. A GSM modem in the form of a PC Card / PCMCIA Card is designed for use with a laptop computer. It should be inserted into one of the PC Card / PCMCIA Card slots of a laptop computer. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate.

As mentioned in earlier sections of this SMS tutorial, computers use AT commands to control modems. Both GSM modems and dial-up modems support a common set of standard AT commands. You can use a GSM modem just like a dial-up modem.

In addition to the standard AT commands, GSM modems support an extended set of AT commands. These extended AT commands are defined in the GSM standards. With the extended AT commands, you can do things like:

- Reading, writing and deleting SMS messages.
- Sending SMS messages.
- Monitoring the signal strength.
- Monitoring the charging status and charge level of the battery.
- Reading, writing and searching phone book entries.

The number of SMS messages that can be processed by a GSM modem per minute is very low -- only about six to ten SMS messages per minute.

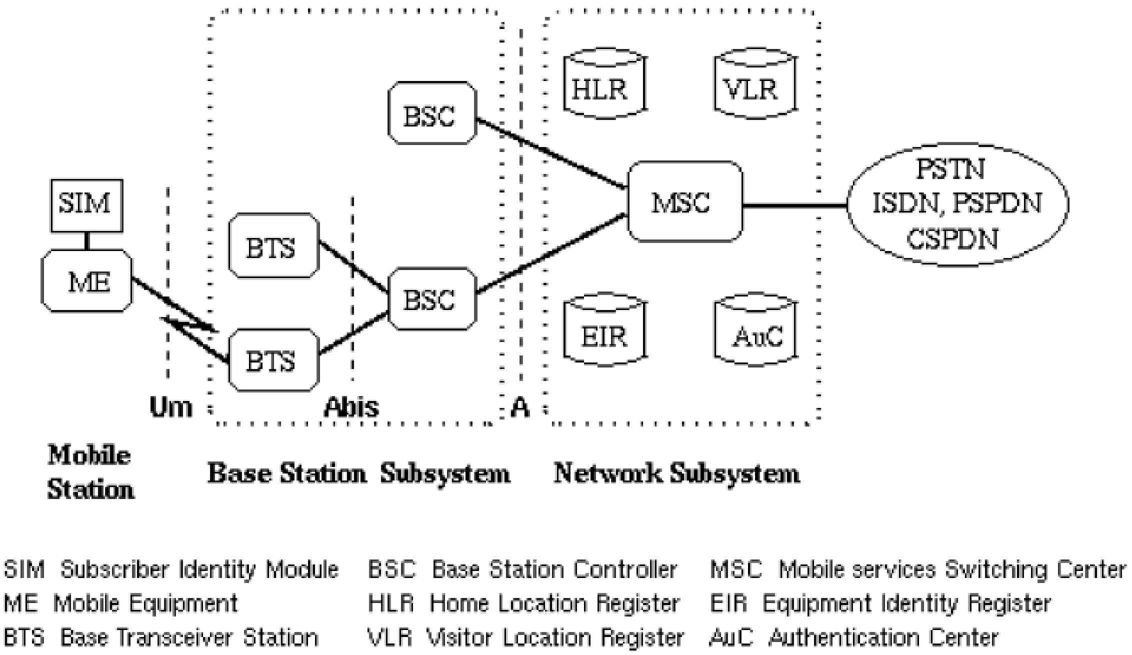

FIG.34 General Architecture of GSM Modem

What is a GPRS Modem?

A GPRS modem is a GSM modem that additionally supports the GPRS technology for data transmission. GPRS stands for General Packet Radio Service. It is a packet-switched technology that is an extension of GSM. (GSM is a circuit-switched technology.) A key advantage of GPRS over GSM is that GPRS has a higher data transmission speed. GPRS can be used as the bearer of SMS. If SMS over GPRS is used, an SMS transmission speed of about 30 SMS messages per minute may be achieved. This is much faster than using the ordinary SMS over GSM, whose SMS transmission speed is about 6 to 10 SMS messages per minute.

A GPRS modem is needed to send and receive SMS over GPRS. Note that some wireless carriers do not support the sending and receiving of SMS over GPRS.

If you need to send or receive MMS messages, a GPRS modem is typically needed.

Which is better? Mobile Phone or GSM / GPRS Modem?

In general, a GSM/GPRS modem is recommended for use with a computer to send and receive messages. This is because some mobile phones have certain limitations comparing to GSM/GPRS modems. Some of the limitations are described below:

- Some mobile phone models (example: Ericsson R380) cannot be used with a computer to receive concatenated SMS messages.

What is a concatenated SMS message?

A concatenated SMS message is a message that contains more than 140 bytes. (A normal SMS message can only contain at most 140 bytes.) Concatenated SMS works like this: the sender's mobile device breaks a message longer than 140 bytes into smaller parts. Each of these parts are then fitted in a single SMS message and sent to the recipient. When these SMS messages reach the destination, the recipient's mobile device will combine them back to one message.

What is the cause of the problem?

When the mobile phone receives the SMS messages that are parts of a concatenated SMS message, it combines them to one message automatically. The correct behavior should be: when the mobile phone receives the SMS messages that are parts of a concatenated SMS message, it forwards them to the computer without combining them.

 Many mobile phone models cannot be used with a computer to receive MMS messages. Because when they receive a MMS notification, they handle it automatically instead of forwarding it to the computer.

 A mobile phone may not support some AT commands, command parameters and parameter values. For example, some mobile phones do not support the sending and receiving of SMS messages in text mode. So, the AT command "AT+CMGF=1" (it instructs the mobile phone to use text mode) will cause an error message to be returned. Usually GSM/GPRS modems support a more complete set of AT commands than mobile phones.

 Most SMS messaging applications have to be available 24 hours a day. (For example, an SMS messaging application that provides ringtone downloading service should be running all the time so that a user can download ringtones any time he/she wants.) If such SMS messaging applications use mobile phones to send and receive SMS messages, the mobile phones have to be switched on all the time.

However, some mobile phone models cannot operate with the battery removed even when an AC adaptor is connected, which means the battery will be charged 24 hours a day.

Besides the above issues, mobile phones and GSM/GPRS modems are more or less the same for sending and receiving SMS messages from a computer. Actually, you can consider an AT-command-enabled mobile phone as "GSM/GPRS modem + keypad + display + ..."

There is not much difference between mobile phones and GSM/GPRS modems in terms of SMS transmission rate, since the determining factor for the SMS transmission rate is the wireless network.

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1.124 SMS Introduction

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The Short Message Service (SMS) allows text messages to be sent and received to and from mobile telephones. The text can comprise words or numbers or an alphanumeric combination. SMS was created as part of the GSM Phase 1 standard. The first short message is believed to have been sent in December 1992 from a PC to a mobile phone on the Vodafone GSM network in the UK. Each short message is up to 160 characters in length when Latin alphabets are used and 70 characters in length when non-Latin alphabets such as Arabic and Chinese are used.

There is no doubting the success of SMS. The market in Europe alone had reached over three billion short messages per month as of December 1999, despite little in proactive marketing by network operators and phone manufacturers.

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1.128 SMS Technology

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SMS is essentially similar to paging, but SMS messages do not require the mobile phone to be active and within range, as they will be held for a number of days until the phone is active and within range. SMS messages are transmitted within the same cell or to anyone with roaming capability.

They can also be sent to digital phones from a web site equipped with a PC Link or from one digital phone to another. The SMS is a store and forward service. In other words, short messages are not sent directly from sender to recipient, but via an SMS Center. Each mobile telephone network that supports SMS has one or more messaging centers to handle and manage the short messages.

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1.134 SMS Text Mode

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The Short Message Service SMS, as defined within the GSM 900 / 1800 / 1900 digital mobile phone standard has several unique features. A single short message can be up to 160 characters (7bit coded) or 140 characters (8 bit coded) of text in length. Those 140 / 160 characters can comprise of words or numbers or an alphanumeric combination. Non-text based short messages (for example, in binary format) are also supported.

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1.138 About SMS PDU Mode

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The PDU mode offers to send binary information in 7 bit or 8 bit format. That is helpful if you have to send compressed data, binary data or like to build your own encoding of the characters in the binary bit stream. If you go back on the old encoding of a Fern Schreiber, then there is only 5 bit needed to send an alphanumeric text. By 5 bit coding you can contain 224 characters instant of 160 characters in 7 bit Text mode. An others reason could be the sending of integer data.

1.140 The PDU format

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There are two ways of sending and receiving SMS messages: by text mode and by PDU (protocol description unit) mode. The text mode is just an encoding of the bit stream represented by the PDU mode. Alphabets may differ and there are several encoding alternatives when displaying an SMS message. The most common options are "PCCP437", "PCDN", "8859-1", "IRA" and "GSM". These are all set by the AT-command AT+CSCS, when read the message in a computer application. An application capable of reading incoming SMS messages can thus use text mode or PDU mode. If text mode is used, the application is bound to (or limited by) the set of preset encoding options. If PDU mode is used, any encoding can be implemented. The PDU string contains not only the message, but also a lot of meta-information about the sender, his SMS service center, the time stamp etc. It is all in the form of hexa-decimal octets or decimal semi-octets.

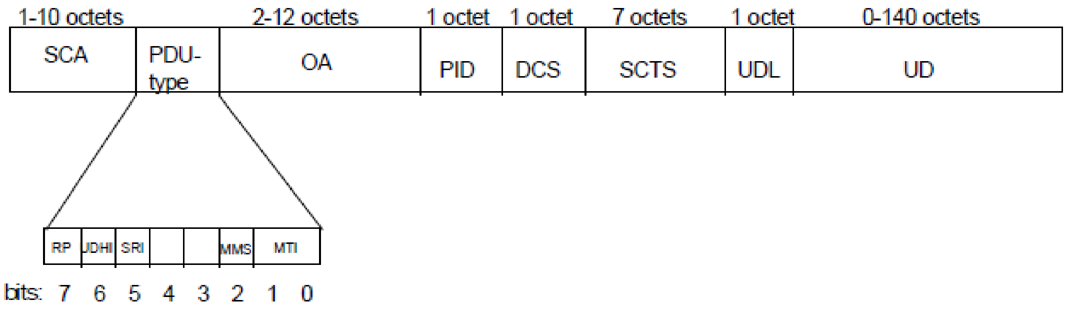
07 917238010010F5 040BC87238880900F100009930925161958003C16010 This octet sequence consists of three parts: An initial octet indicating the length of the SMSC information ("07"), the SMSC information itself ("917238010010F5"), and the SMS_DELIVER part. All the octets above are hexa-decimal 8-bit octets, except the Service center number, the sender number and the timestamp; they are decimal semi-octets. The message part in the end of the PDU string consists of hexa-decimal 8-bit octets, but these octets represent 7-bit data .The semi-octets are decimal, and e.g. the sender number is obtained by performing internal swapping within the semi-octets from "72 38 88 09 00 F1" to "27 83 88 90 00 1F". The length of the phone number is odd, so a proper octet sequence cannot be formed by this number. This is the reason why the trailing F has been added. The time stamp, when parsed, equals "99 03 29 15 16 59 08", where the 6 first characters represent date, the following 6 represents time, and

the last two represents time-zone related to GMT.

SMSC: Short Message Service Centre
MMI: Man Machine Interface
PDUS: Protocol Data Units
SM-AL: Short Message Application Layer
SM-TL: Short Message Transport Layer
SM-RL: Short Message Relay Layer
SM-LL: Short Message Link Layer

The MMI is based on the command set of AT+ Cellular, and could be realized by means of a terminal (for example Win-Terminal, HyperTerminal, etc) or the display of a handy. The SM-TL provides a service to the Short Message Application Layer. This service enables the SM-AL to transfer short messages to its peer entity, receive short messages from its peer entity and receive reports about earlier requests for short messages to be transferred.
The SM-TL communicates with its peer entity with six several PDUs:
SMS-DELIVER - conveying a short message from the SMSC to the MS
SMS-DELIVER-REPOR- conveying a failure cause (if necessary)
SMS-SUBMIT- conveying a short message from the MS to the SMSC
SMS-SUBMIT-REPORT- conveying a failure cause (if necessary)
SMS-STATUS-REPORT- conveying a status report from the SMSC to the MS
SMS-COMMAN- conveying a command from the MS to the SMSC.

SMS-Deliver (Mobile Terminated)



MTI Bit 1 = 0

Bit 0 = 0

FIG.35

SMS-Submit (Mobile Originated)

SMS-Deliver (Mobile Terminated)

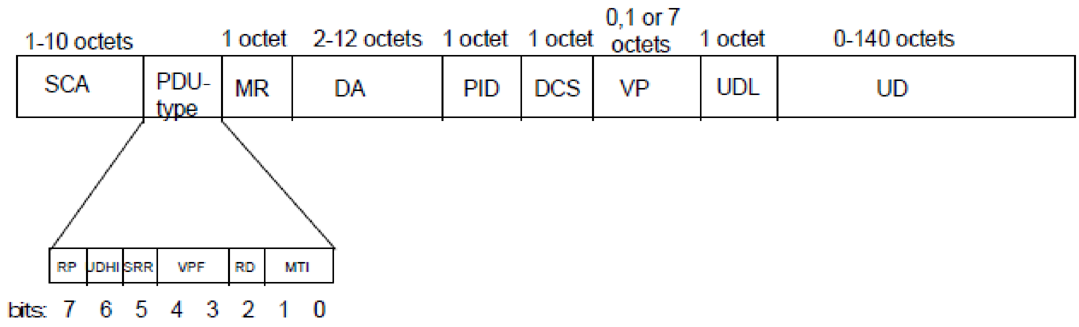


FIG.36

MTI bit 1 = 0

bit 0 = 1

SMS-Submit (Mobile Originated)

Service Centre Address Specifications

SCA	**Service Centre Address information element**	**Telephone number of the Service Centre**
PDU	Protocol Data Unit Type	

Type		
MR	Message Reference	Sucessive number (0..255) of all SMS-SUBMIT Frames set by the M20
OA	Originator Address	Address of the originating SME
DA	Destination Address	Address of the destination SME
PID	Protocol Identifier	Parameter showing the SMSC how to process the SM (as FAX, Voice etc)
DCS	Data Coding Scheme	Parameter identifying the coding scheme within the User Data (UD)
SCTS	Service Centre Time Stamp	Parameter identifying time when the SMSC received the message
VP	Validity Period	Parameter identifying the time from where the message is no longer valid in the SMSC
UDL	User Data Length	Parameter indicating the length of the UD-field
UD	User Data	Data of the SM
RP	Reply Path	Parameter indicating that Reply Path exists
UDHI	User Data Header Indicator	Parameter indicating that the UD field contains a header
SRI	Status Report Indication	Parameter indicating if the SME has requested a status report
SRR	Status Report Request	Parameter indicating if the MS has

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		requested a status report
VPF	Validity Period Format	Parameter indicating whether or not the VP field is present
MMS	More Messages to Send	Parameter indicating whether or not there are more messages to send
RD	Reject Duplicate	
MTI	Message Type Indicator	Parameter describing the message type 00 means SMS-DELIVER 01 means SMS-SUBMIT

FIG.37

Hardware Profile

Block Diagram Of Wireless Notice Board

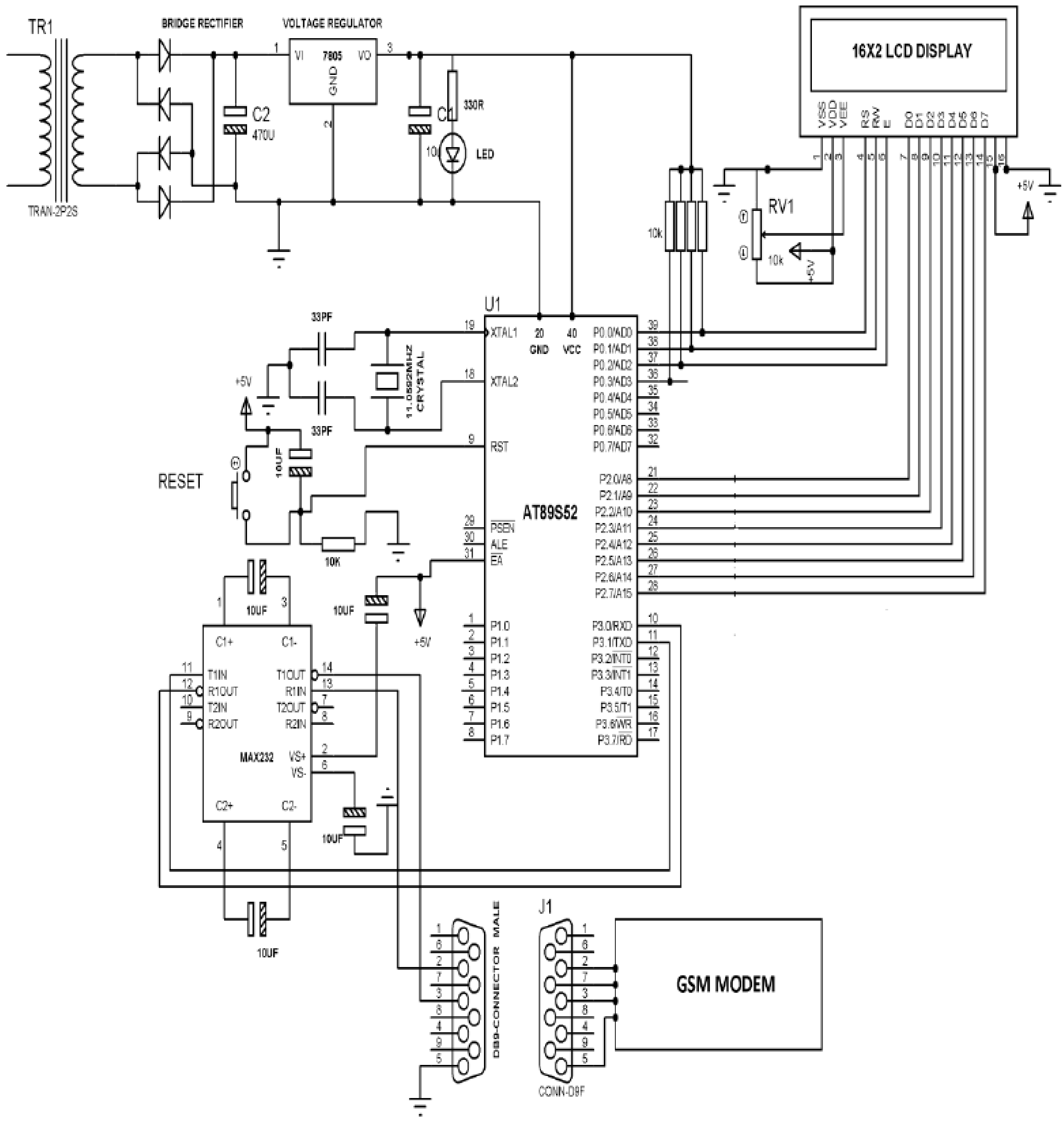

FIG.38

Software Profile

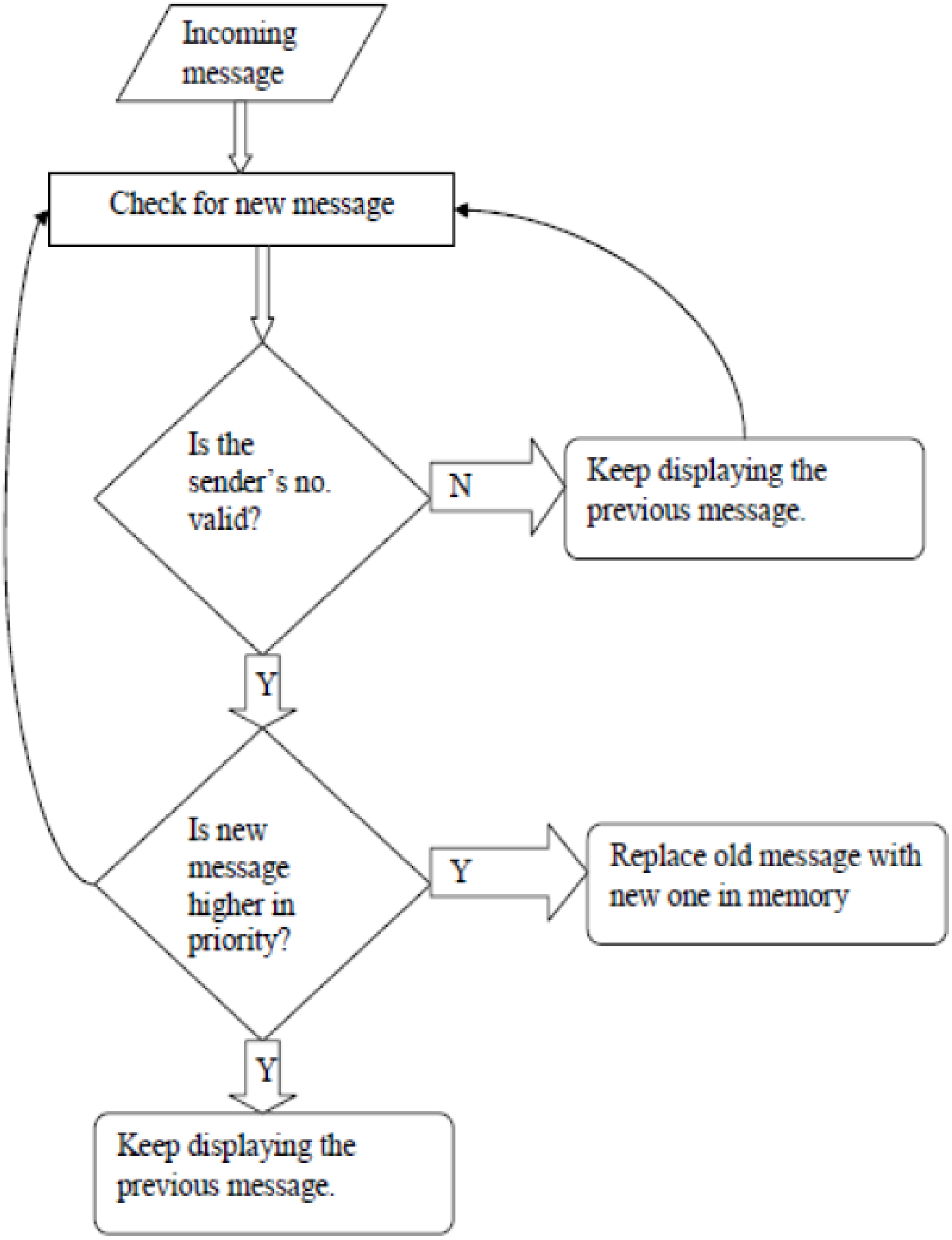

FIG.39: User Perspective

Operational Flowchart:

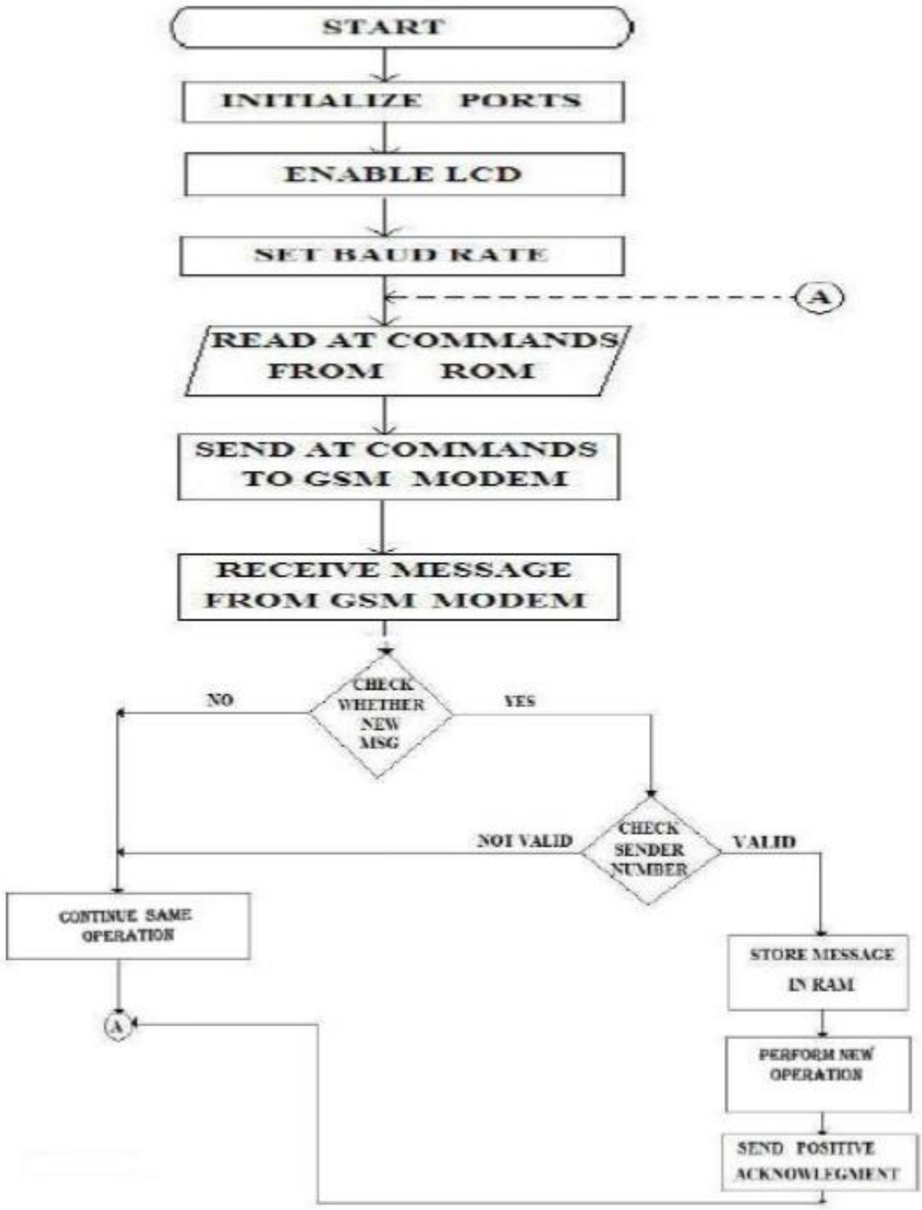

FIG.40

Programming Code

```
#include<stdio.h>
#include<lcdsms.h>
#include<serial.h>
#include<string.h>


unsigned char idata Buffer[105];

void main()
{
        unsigned char val,i;
        lcd_init();
        lcd_puts("SMS NOTICE BOARD");
        at_init();
        DeleteMsg();

while(1)
{

while(!flag)
         {

                lcd_cmd1(0x18);
                ms_delay(200);


         }

if(flag==1)
{
Buffer=rec_msg();
 for(in=0;in<=strlen(Buffer);in++)
 {
  if(Buffer[in]=='1'&&Buffer[in+1]=='3'&&Buffer[in+2]=='1'&&Buffer[in+3]=='3')
```

```
 {
  i=in+4;
  lcd_cmd1(0x01);
  lcd_cmd1(0x80);
  while(Buffer[i]!=13)
  {
   lcd_data(Buffer[i]);
   i++;
  }

  in=strlen(Buffer)+1;

 }
}


}
}
}
```

CONCLUSION

The project “wireless electronic notice board using GSM technology” has been successfully completed and tested with integration of the features of every hardware component for its development. Presence of every block has been reasoned out and placed carefully thus contributing to the best working of the unit.

The project was finished using very simple and easily available components making it lightweight and portable. This helps for wireless notice board application with the help of

GSM Technology. We believe that our step is towards complete automation for notice board application which can be used in colleges,

Finally we can conclude that this project application gives a very good feature and there is huge scope for further research and development for using the same with the help of advanced technology.

FUTURE WORK

The use of microcontroller in place of a general purpose computer allows us to theorize on many further improvements on this project prototype. Temperature display during periods wherein no message buffers are empty is one such theoretical improvement that is very possible.

The ideal state of the microcontroller is when the indices or storage space in the SIM memory are empty and no new message is there to display. With proper use of interrupt routines the incoming message acts as an interrupt, the temperature display is halted and the control flow jumps over to the specific interrupt service routine which first validates the sender's number and then displays the information field. Another very interesting and significant improvement would be to accommodate multiple receiver MODEMS at the different positions in a geographical area carrying duplicate SIM cards.

With the help of principles of TDMA technique, we can choose to simulcast and /or broadcast important notifications. After a display board receives the valid message through the MODEM and displays it, it withdraws its identification from the network & synchronously another nearby MODEM signs itself into the network and starts to receive the message. The message is broadcast by the mobile switching center for a continuous time period during which as many possible display board

MODEMS "catch" the message and display it as per the constraint of validation. Multilingual display can be another added variation of the project. The display boards are one of the single most important media for information transfer to the maximum number of end users. This feature can be added by programming the 40 microcontroller to use different encoding decoding schemes in different areas as per the local language. This will ensure the increase in the number of informed users. Graphical display can also be considered as a long term but achievable and target able output. MMS technology along with relatively high end microcontrollers to carry on the tasks of graphics encoding and decoding along with a more expansive bank of usable memory can make this task a walk in the park.

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