PROJECT REPORT

ON

AUTOMATIC PLANT WATERING SYSTEM USING GSM AND 8051 MICROCONTROLLER

Submitted by

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For the term project of

B.TECH

SEM-6

Under the guidance of

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FACULTY OF TECHNOLOGY

DHARMSINH DESAI UNIVERSITY

CERTIFICATE

This is to certify that the project on **AUTOMATIC PLANT WATERING SYSTEM USING GSM AND 8051 MICROCONTROLLER** and term work carried out in subject of Term Project is bonafide work of **TIRTH PATEL** (Roll no.: **EC 053**) of B. Tech. Semester VI in the branch of **Electronics & Communication**, during the academic year 2020-21.

Prof. Marmik B. Soni
Project Guide, EC Dept.

Dr. Purvang Dalal
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ACKNOWLEDGEMENT

This project is a result of work whereby we have been accompanied and supported by many people. It is pleasure that we now have opportunity to express gratitude towards all of them.

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At the end we are thankful to **Faculty of Technology D.D.U** to provide us such a creative work for our future scope.

ABSTRACT

The project we have undertaken is "**AUTOMATIC PLANT WATERING SYSTEM USING GSM AND 8051 MICROCONTROLLER**". This project is taken up as India is an agriculture oriented country and the rate at which water resources are depleting is a dangerous threat hence there is need of smart and efficient way of irrigation. Other reason is that in routine life, we often forget to water the plants at our house gardens. In this project we have implemented the circuit which is solution for these problems. The whole irrigation process will be done automatically. The project is 8051 microcontroller based design which controls the water supply and the field to be irrigated and GSM module for receiving data from user. Microcontroller then supply water to that particular field which has water requirement as the data received by user. This type of system is often used for general plant care, as part of caring for small and large gardens. Normally, the plants need to be watered twice daily, morning and evening. So, the microcontroller has to be coded to water the plants in the greenhouse about two times per day. People enjoy plants, their benefits and the feeling related to nurturing them. However for most people it becomes challenging to keep them healthy and alive. To solve this problem we made a project for those who cannot water the plant due to their busy schedule or when they go outside for long time. The system automation is designed to be assistive to the user. We hope that through this project people will enjoy having plants without the challenges related to absent or forgetfulness.

The project includes the use of GSM module, Charge Controller Circuit, Microcontroller-8051(AT89S52), voltage regulators ICs, relay, and Water pump.

The aim of the project is to reduce human efforts on irrigation field or irrigation in garden, with the help cheap and easy circuit formation. Another application is that it can be used in our home system to irrigate the plants automatically, there is no need to check from human side or supply the water. The project is intended for small gardens and residential environment.

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LIST OF FIGURES

CHAPTER-1 INTRODUCTION

The Plants are an integral part of nature, and in the name of development, we already have sacrificed most of the green. However, Gardening is a favorite pastime for many people and a healthy one. In fact, a recent study found that even a small home garden offers mood-boosting qualities that are similar to those provided by physical exercise.

However, one of the top concerns for many gardeners is that they forget to water their plants. Others may need to leave their garden unattended for some time and required assistance with the watering. Due to which plants suffer and their health decay. So, what if it was possible to ensure plants were watered automatically by only sending SMS through our mobile or while ensuring the ideal amount, at the ideal time.

Similarly other problem is that In present days, in the field of agriculture farmers are facing major problems in watering their crops. It's because they don't have proper idea about the availability of the power. Even if it is available, they need to pump water and wait until the field is properly watered, which compels them to stop doing other activities which are also important for them, and thus they loss their precious time and efforts. So what if they can start this pump automatically from anywhere and after proper time, it stop automatically?

Well…with the right system in place, this is possible. There is a solution – " An Automatic Plant Watering System " not only helps farmers but also others for watering their gardens as well. Healthy plants can transpire a lot of water, resulting in an increase in the humidity of the Green house air.

A proper usage of irrigation system is very important because the main reason is the shortage of land reserved water due to lack of rain, unplanned use of water as a result large amounts of water goes waste. So there is no need to remind to turn off pump for farmers after watering. Farmer can do other task at a time and haven't need to worry about irrigation. Apart from all these problems and failures, there has been a considerable evolution in the methods to perform irrigation with the help of technology. The application of technology in the areas of irrigation has proven to be of great help as they deliver efficiency and accuracy.

Similarly in House gardening, the user will only need to send SMS and watering will start. The pump will turn off automatically after specific time given by user.

What is principle of automatic water irrigation system and how does the system work?

As we know that it is very difficult in agriculture field to control the water pump manually. One has to visit in fields to switch ON and OFF.

The main objective of this auto watering system is to develop an irrigation system in the agriculture field and House farming with the help of GSM module. The required electrical and electronic components of this proposed system are GSM SIM900, 8051

series Microcontroller, water pump, Relay, Voltage Regulators, Resistors, Capacitors, Crystal and also Transistors. The SMS sent by user will be received by GSM by using AT commands. This project uses microcontroller 8051 to control the flow of water through motor in the field. Microcontroller will do it accordingly data received by GSM and back other data to user. Microcontroller is connected to the motor driver, and the driver to the water pump. The water pump supplies water to the plants and it can be driven by a 12 volt battery, and current measurements show us that battery life. The microcontroller is programmed using the KEIL software. The motor/water pump supplies water to the plants for specific time given by user.

CHAPTER-2 BLOCK DIAGRAM

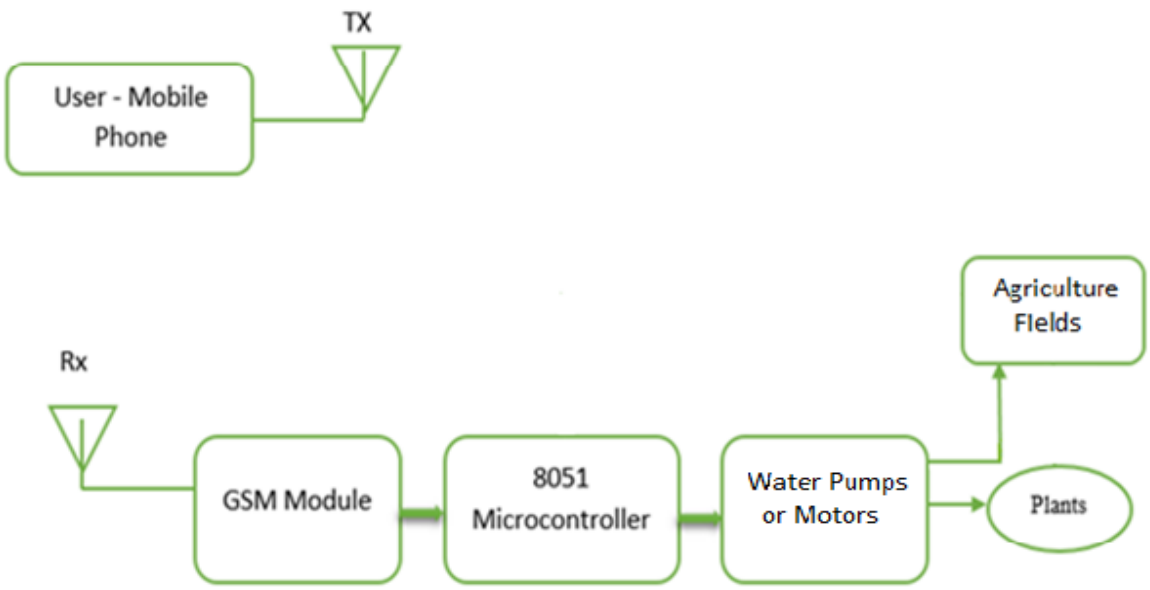


Fig. 2.1 Block Diagram of Automatic Watering System

2.1 Description of Block Diagram

As the Block Diagram Figure 2.1 shown above, the basic Block Diagrams for Automatic Plant watering system is shown. User has to send a SMS to GSM which will be containing our controlling information. For processing on GSM, AT commands are used. Some operations like read data, send data, delete data etc. could be done using AT commands in GSM module. So here it will ask user first that how much time user wants to water to plants or irrigation firm and if plants then how many plants user wants to water. After receiving data from user through GSM, microcontroller will process on that information. It will turn on the water pumps accordingly plants or agriculture field. So watering will be start. Here relays are connected to microcontroller to control high voltage circuit. After completion of time given by user through GSM, microcontroller will turn off the water pumps and watering will be stopped. So basically microcontroller will control the particular valves of plants.

CHAPTER-3 CIRCUIT DIAGRAM

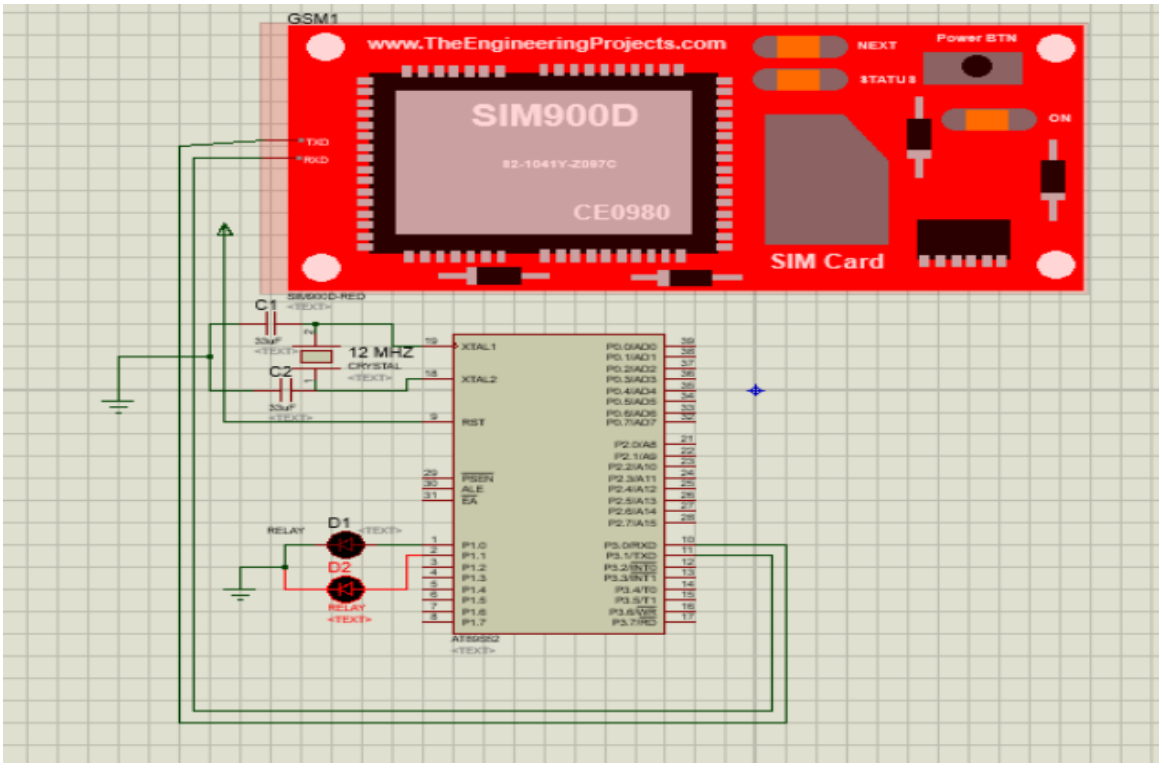


Figure 3.1: Schematic Circuit Diagram of Automatic Watering System

3.1 Working of Circuit Diagram

As the Circuit Diagram Figure 3.1 shown above, there is circuit diagram of the the project is shown, which consist of GSM module SIM900. Here first GSM will send SMS to user that how much user wants to water in terms of minutes. User have to reply by entering valid amount. Now, Microcontroller will process on received data from SMS. Here, Data transmission is done by UART communication. We stored data on SBUF temporarily and then we copy it in internal memory of 8051. We have used AT89S52 for 8051 series microcontroller. Then after microcontroller will turn on LED accordingly received data. The whole code is written in Keil uVision 5 and then we burn it in our circuit using ATMEL program loader. We used ProgISP Software to burn this code in the circuit. Further the voltage and current is control by voltage regulator IC-7805,then 5V is applied to the main circuit. Microcontroller 8051 (AT89S52) which is operated with help of parallel connection of capacitors, and Crystal Oscillator (12MHz). With the help of HEX code will operate the flow of circuit diagram, further from Microcontroller 8051 triggers the transistors which are responsible for switching and control voltage drop in the relay will switch, and Motor (Water Pump) is connected to Microcontroller in circuit with direct flow of 12V according to it the pump will on and off from relay switching.

CHAPTER-4 COMPONENT AND ITS DESCRIPTION

In this project we have use many components which are listed below:-

- GSM Module SIM900A
- Voltage Regulator (IC-LM7805)
- Microcontroller-8051 (AT89S52)
- Program loader
- Relay 5 v 2 amp
- Water Pump(12V,0.6A)
- GPB Board
- Soldering kit
- Bridge Rectifier
- Push Buttons
- Connecting Wires
- Crystal Oscillator(12 MHz)
- DMM UT33D
- LEDs
- Resistors
- Ceramic Capacitors
- Cylindric Capacitors
- 12 Volt - 2 amp power adapter

4.1 Description

The description of each of the component is explained in the next section.

4.1.1 GSM Module – SIM900A

→ Overview

Designed for global market, SIM900A is a dual-band GSM/GPRS engine that works on frequencies EGSM 900MHz and DCS 1800MHz. SIM900A features GPRS multi-slot class 10/ class 8 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. With a tiny configuration of 24mm x 24mm x 3mm, SIM900A can meet almost all the space requirements in your applications, such as M2M, smart phone, PDA and other mobile devices.

- The physical interface to the mobile application is a 68-pin SMT pad, which provides all hardware interfaces between the module and customers' boards.
- The keypad and SPI display interface will give you the flexibility to develop customized applications.
- Serial port and Debug port can help you easily develop your applications.
- One audio channel includes a microphone input and a speaker output.

Programmable General Purpose Input & Output. The SIM900A is designed with power saving technique so that the current consumption is as low as 1.5mA in SLEEP mode. The SIM900A is integrated with the TCP/IP protocol; extended TCP/IP AT commands are developed for customers to use the TCP/IP protocol easily, which is very useful for those data transfer applications.

SIM900A Key Features

Feature	Implementation
Power supply	Single supply voltage 3.4V – 4.5V
Power saving	Typical power consumption in SLEEP mode is 1.5mA (BS-PA-MFRMS=5)
Frequency Bands	SIM900A Dual-band: EGSM900, DCS1800. The SIM900A can search the 2 frequency bands automatically. The frequency bands also can be set by AT command. Compliant to GSM Phase 2/2+
GSM class	Small MS
Transmitting power	Class 4 (2W) at EGSM 900 Class 1 (1W) at DCS 1800

GPRS connectivity	GPRS multi-slot class 10 （default） GPRS multi-slot class 8 (option) GPRS mobile station class B

Temperature range	Normal operation: -30°C to +80°C Restricted operation: -40°C to -30°C and +80 °C to +85°C(1) Storage temperature -45°C to +90°C
DATA *GPRS:* *CSD:*	GPRS data downlink transfer: max. 85.6 kbps GPRS data uplink transfer: max. 42.8 kbps Coding scheme: CS-1, CS-2, CS-3 and CS-4 Supports the protocols PAP (Password Authentication Protocol) usually used for PPP connections. Integrates the TCP/IP protocol. Support Packet Switched Broadcast Control Channel (PBCCH) CSD transmission rates: 2.4, 4.8, 9.6, 14.4 kbps, non-transparent Unstructured Supplementary Services Data (USSD) support
SMS	MT, MO, CB, Text and PDU mode SMS storage: SIM card
FAX	Group 3 Class 1
SIM interface	Support SIM card: 1.8V, 3V
External antenna	Antenna pad
Audio features	Speech codec modes: Half Rate (ETS 06.20) Full Rate (ETS 06.10) Enhanced Full Rate Adaptive multi rate (AMR) Echo Cancellation Noise Suppression

Serial port and Debug port	Serial Port: 8-wire modem interface with status and control lines, unbalanced, asynchronous. 1.2kbps to 115.2kbps. Serial Port can be used for AT commands or data stream. Supports RTS/CTS hardware handshake and software ON/OFF flow control. Multiplex ability according to GSM 07.10 Multiplexer Protocol. Autobauding supports baud rate from 1200 bps to 115200bps. Debug port: 2-wire null modem interface DBG_TXD and DBG_RXD. Can be used for debugging and upgrading firmware.
Phonebook management	Support phonebook types: SM, FD, LD, RC, ON, MC.
SIM Application Toolkit	Support SAT class 3, GSM 11.14 Release 99
Real time clock	Implemented
Timer function	Programmable via AT command
Physical characteristics	Size: 24mm x 24mm x 3mm Weight: 3.4g
Firmware upgrade	Firmware upgrade by debug port.

Table 4.1.1 SIM900 Key Features

Features:-

- Single supply voltage: 3.4V – 4.5V
- Power saving mode: Typical power consumption in SLEEP mode is 1.5mA
- Frequency bands:SIM900A Dual-band: EGSM900, DCS1800. The SIM900A can search the two frequency bands automatically. The frequency bands also can be set by AT command.
- Supports CSD, USSD, SMS, FAX
- Supports MIC and Audio Input
- Speaker Input
- Features keypad interface
- Features display interface (LCD)
- Features Real Time Clock

- Supports UART interface
- Supports single SIM card
- Communication by using AT commands

→PIN Assignment of SIM900A

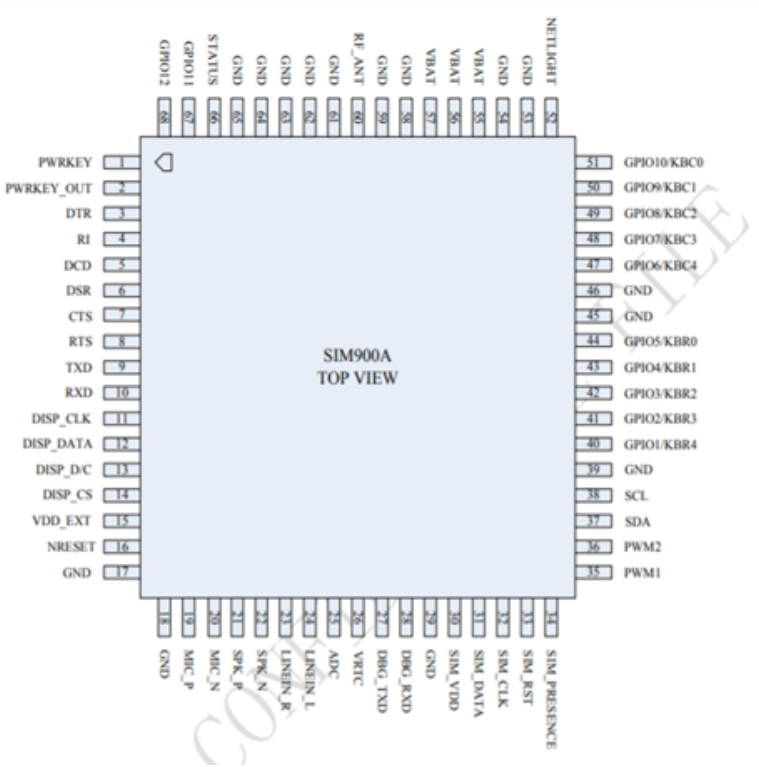


Fig. 4.1.1 SIM900 Pin Out Diagram

Pin Number	Pin Name	Pin Number	Pin Name
1	PWRKEY	**35**	PMW1
2	PWRKEY_OUT	**36**	PWM2
3	DTR	**37**	SDA
4	RI	**38**	SCL
5	DCD	**39**	GND
6	DSR	**40**	GPIO1/KBR4
7	CTS	**41**	GPIO2/KBR3
8	RTS	**42**	GPIO3/KBR2
9	TXD	**43**	GPIO4/KBR1

Table 4.1.2 Pin Assignment

SIM Card Interface

AT Command used to get information in SIM card. The SIM interface supports the functionality of the GSM Phase 1 specification and also supports the functionality of the new GSM Phase 2+ specification for FAST 64 kbps SIM (intended for use with a SIM application Tool-kit).

Both 1.8V and 3.0V SIM Cards are supported. The SIM interface is powered from an internal regulator in the module having normal voltage 3V.

All pins reset as outputs driving low. Logic levels are as described in table.

Pin define of the SIM interface

Pin Name	Pin Number	Function
SIM_VDD	30	SIM Card Power output automatic output on SIM mode， one is 3.0V±10%, another is 1.8V±10%. Current is about 10mA.
SIM_DATA	31	SIM Card data I/O
SIM_CLK	32	SIM Card Clock
SIM_RST	33	SIM Card Reset
SIM_PRESENCE	34	SIM Card detection

Table 4.1.3 Pin definre of the SIM

AT Commands for GSM:

AT stands for Attention and these commands are used for controlling GSM Modules.GSM module only understands AT commands, and can respond accordingly.

There are various AT commands like,

- ATA for answer a call
- ATD to dial a call
- AT+CMGR to read the message,
- AT+CMGS to send the sms

AT+CMGF Select SMS Message Format	
Test Command **AT+CMGF=?**	Response **+CMGF: (**list of supported **<mode>**s**)** **OK**
	Parameter See Write Command
Read Command **AT+CMGF?**	Response **+CMGF: <mode>** **OK**
	Parameter See Write Command
Write Command **AT+CMGF=[<mode>]**	Response TA sets parameter to denote which input and output format of messages to use. **OK**
	Parameter
	<mode> 0 PDU mode 1 Text mode
Reference GSM 07.05	Note

Table 4.1.4 AT Command

SIM900A Evaluation Board

For the application of SIM900A, An Evaluation Board (EVB) that interfaces the SIM900A directly with appropriate power supply, SIM card holder, RS232 serial port, handset port, earphone port, line in port, antenna and all GPIO of the SIM900A.

Fig. 4.1.2 GSM Module SIM900

4.1.2 Voltage Regulator (IC-LM7805)

Voltage sources in a circuit may have fluctuations resulting in not providing fixed voltage outputs. A voltage regulator IC maintains the output voltage at a constant value. It will output voltage equal to 5V from the input of 12V, 6.6A Chargeable batteries.

Specifications:-

1. Output Voltage = 5 V
2. Biasing Current = 8 mA
3. Peak Output Current = 2.2 A

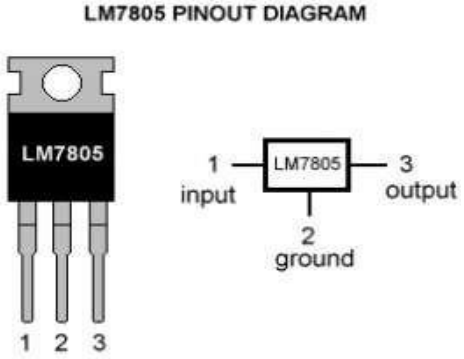


Fig. 4.1.3 LM7805 Pinout Diagram

4.1.3 Microcontroller-8051 (AT89S52)

A microcontroller (MCU for microcontroller unit, or UC for μ-controller) is a small computer on a single integrated circuit. In modern terminology, it is similar to, but less sophisticated than, a system on a chip (SoC); an SoC may include a microcontroller as one of its components. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. Program memory in the form of ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications consisting of various discrete chips.

The Intel MCS-51 (commonly termed 8051) is a single chip microcontroller (MCU) series developed by Intel in 1980 for use in embedded systems. The architect of the instruction set of the Intel MCS-51 was John H. Wharton. Intel's original versions were popular in the 1980s and early 1990s and enhanced binary compatible derivatives remain popular today. It is an example of a complex instruction set computer, and has separate memory spaces for program instructions and data (Harvard architecture).

Intel's original MCS-51 family was developed using N-type metal-oxide-semiconductor (NMOS) technology like its predecessor Intel MCS-48, but later versions, identified by a letter C in their name (e.g., 80C51) used complementary metal–oxide–semiconductor (CMOS) technology and consume less power than their NMOS predecessors. This made them more suitable for battery-powered devices.

The family was continued in 1996 with the enhanced 8-bit MCS-151 and the 8/16/32-bit MCS-251 family of binary compatible microcontrollers. While Intel no longer manufactures the MCS-51, MCS-151 and MCS-251 family, enhanced binary compatible derivatives made by numerous vendors remain popular today. Some derivatives integrate a digital signal processor (DSP). Beyond these physical devices, several companies also offer MCS-51 derivatives as IP cores for use in field-programmable gate array (FPGA) or application-specific integrated circuit (ASIC) designs.

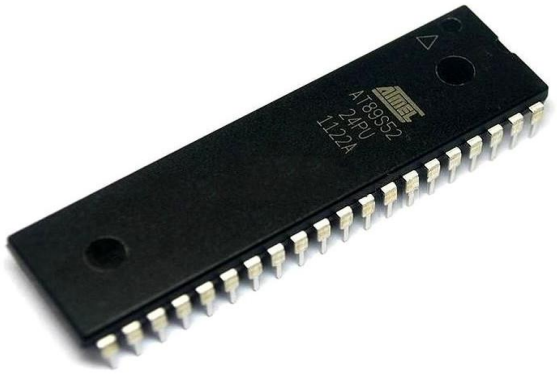


Fig. 4.1.4 Microcontroller AT89S52

Features:-

1. 4K Bytes of In-System Reprogrammable Flash Memory
2. Endurance: 1,000 Write/Erase Cycles
3. Fully Static Operation: 0 Hz to 24 MHz
4. Three-level Program Memory Lock
5. 128 x 8-bit Internal RAM
6. 32 Programmable I/O Lines
7. Two 16-bit Timer/Counters
8. Six Interrupt Sources
9. Programmable Serial Channel
10. Low-power Idle and Power-down Modes.

Specification:-

1. Maximum Operating Voltage = 6.6 V
2. DC Output Current = 15 mA
3. Operating Temperature Range = -55°C to +125°C

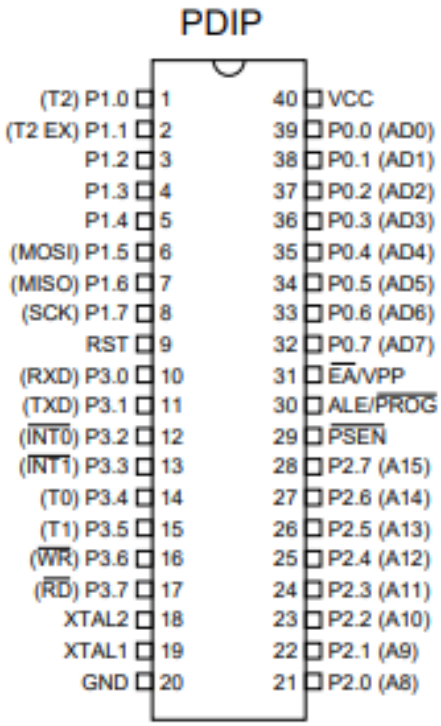


Fig. 4.1.5 AT89S52 Pinout Diagram

UART

To interface a microcontroller with the serial data lines, the serial data must be converted in to parallel and vice versa. Serial-in parallel-out and parallel-in serial-out shift registers can be used to perform above conversions. Also, handshaking circuitry is required to synchronize the transmitter and receiver. Many devices are available which contain circuitry required to handle serial communications. Intel 8251 is capable to handle both synchronous as well as asynchronous serial communications. The 8251 is more popularly known as USART (Universal Synchronous Asynchronous Receiver Transmitter). National Semiconductor INS 8250 is a device capable of handling only asynchronous systems and is commonly referred as UART. Serial Communications 265 The 8051 has a built-in UART; thus, the 8051 chip is capable of handling asynchronous transmission and reception of serial data. The 8051 has two pins TXD (P3.1) and RXD (P3.0) for transmission and reception of serial data respectively. The UART hardware is more commonly referred as serial port. A typical illustration of serial connection between two microcontrollers is shown in Figure 15.6. The serial-data-output pin (TXD–transmit) of one microcontroller is connected to serial-data-input pin (RXD–receive) of the other microcontroller and vice versa. The square box named UART in Figure 15.6 indicates that 8051 has on-chip (within chip) dedicated hardware to handle asynchronous transmission and reception activities. The serial link is a conducting wire and interface circuits are driver circuits to allow long-distance communication. Note that a short-distance serial communication between two 8051 chips do not require any driver circuit.

UART Features

The 8051 UART has the following features: Supports full-duplex serial communication, i.e. transmission and reception of data is simultaneously possible Transmit and receive buffer registers along with transmitting and receiving shift registers Logic for generating the timing signal, i.e. clock Status bit showing that data byte has been sent Ê Status bit to indicate that data byte has been received Serial port of the 8051 is controlled by two registers: SBUF and SCON.

4.1.4 Program Loader

It's a Serial Program loader. We used it to burn our code in 8051 microcontroller. We can not program 89S52 directly. We have to upload hex file via USB ATMEGA programmer.

Fig. 4.1.6 ATMEL Program Loader

4.1.5 Relay (12V)

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

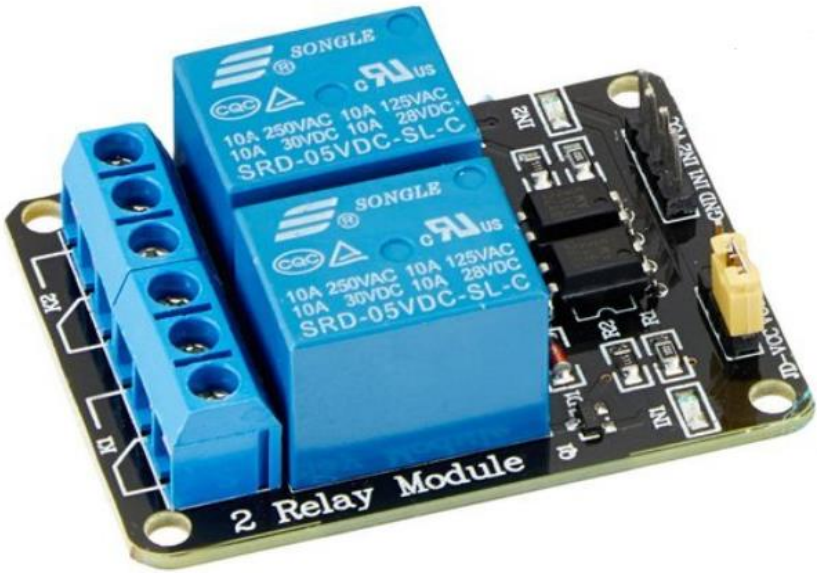


Fig. 4.1.7 Relay Module

4.1.6 Water Pump

A pump is a device that moves fluids (liquids or gases), or sometimes slurries, by mechanical action. Pumps can be classified into three major groups according to the method they use to move the fluid: direct lift, displacement, and gravity pumps. Pumps operate by some mechanism (typically reciprocating or rotary), and consume energy to perform mechanical work moving the fluid. Pumps operate via many energy sources, including manual operation, electricity, engines, or wind power, come in many sizes, from microscopic for use in medical applications to large industrial pumps.

Mechanical pumps serve in a wide range of applications such as pumping water from wells, aquarium filtering, pond filtering and aeration, in the car industry for water- cooling and fuel injection, in the energy industry for pumping oil and natural gas or for operating cooling towers. In the medical industry, pumps are used for biochemical processes in developing and manufacturing medicine, and as artificial replacements for body parts, in particular the artificial heart and penile prosthesis. When a casing contains only one revolving impeller, it is called a single-stage pump. When a casing contains two or more revolving impellers, it is called a double- or multi-stage pump.

Fig. 4.1.8 Water Pump

4.1.7 GPB Board

General purpose board is a multipurpose copper clad laminated PCB used in various electronic fields for circuit designing and testing. The holes on the PCB in grid pattern provide the means to hold all the components together in one place as a single unit. It is used for rapid prototyping design. The size is 140mm*90mm (14 CM x 9 CM). Copper layer is laminated for easy soldering and to prevent corrosion. It is ideal for hobbyists, School / College and Engineering projects etc.

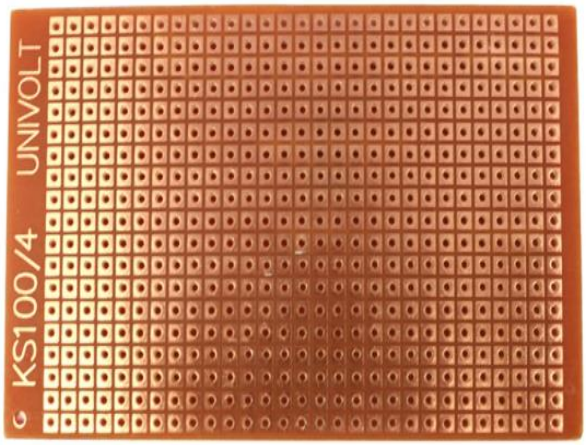


Fig. 4.1.9 GPB Board

4.1.8 Soldering kit

We used soldering iron, soldering flux and soldering wire to solder the circuit in GPB board.

Fig. 4.1.10 Soldering Iron, Soldering Flux and Soldering Wire

4.1.9 Bridge Rectifier MIC W10

A bridge rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as rectification. The primary application of rectifiers is to derive DC power from an AC supply. Virtually all electronic devices require DC, so rectifiers are used inside the power supplies of virtually all electronic equipment.

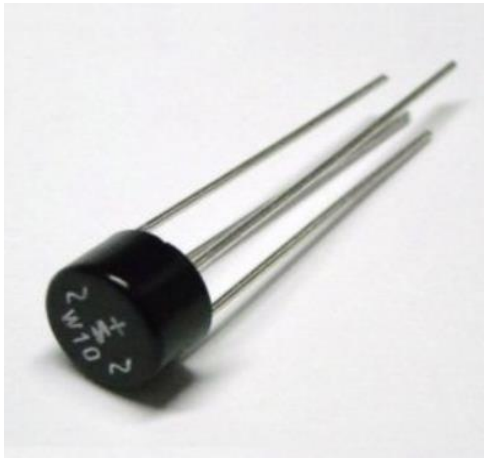


Fig. 4.1.11 Bridge Rectifier MICW10

4.1.10 Push Button

A push-button (also spelled pushbutton) or simply button is a simple switch mechanism for controlling some aspect of a machine or a process. Buttons are typically made out of hard material, usually plastic or metal. The surface is usually flat or shaped to accommodate the human finger or hand, so as to be easily depressed or pushed. Here we used two push buttons, one for reset the circuit and another one is for switch on-off the circuit.

Fig. 4.1.12 Push Button

4.1.11 Connecting Wires

Wire is use to connect to points in circuits. We also used Jumper wires m-m, f-m, f-f.

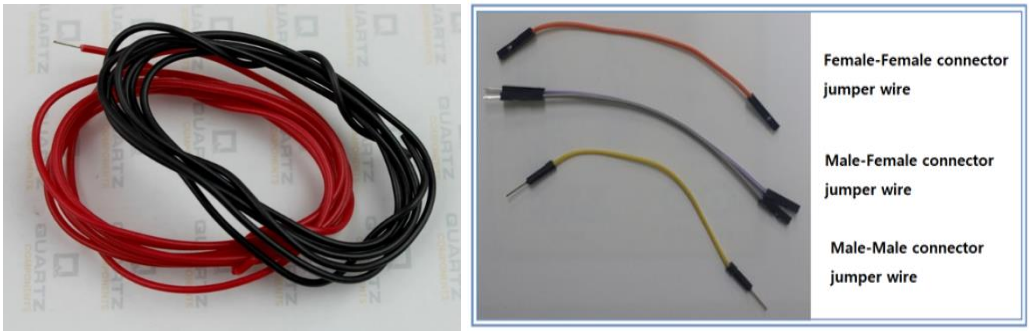


Fig. 4.1.13 Different types of Jumper Wires and Connecting Wires

4.1.12 Crystal Oscillator(12MHz)

A crystal oscillator is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a precise frequency. This frequency is often used to keep track of time, as in quartz wristwatches, to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers. The most common type of piezoelectric resonator used is the quartz crystal, so oscillator circuits incorporating them became known as crystal oscillators, but other piezoelectric materials including polycrystalline ceramics are used in similar circuits. A crystal oscillator, particularly one using a quartz crystal, works by distorting the crystal with an electric field, when voltage is applied to an electrode near or on the crystal. This property is known as electrostriction or inverse piezoelectricity. When the field is removed, the quartz - which oscillates in a precise frequency - generates an electric field as it returns to its previous shape, and this can generate a voltage. The result is that a quartz crystal behaves like an RLC circuit, but with a much higher Q.Quartz crystals are manufactured for frequencies from a few tens of kilohertz to hundreds of megahertz. More than two billion crystals are manufactured annually. Most are used for consumer devices such as wristwatches, clocks, radios, computers,

and cellphones. Quartz crystals are also found inside test and measurement equipment, such as counters, signal generators, and oscilloscopes.

4.1.13 DMM UT33D

We used DMM UT33D to check voltage level and current level. It has better accuracy.

Fig. 4.1.14 DMM UT33D

4.1.14 LEDs

Here, We used some LEDs to verify the output.

Fig. 4.1.15 Different LEDs

4.1.15 Resistors:

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. Here it is use to drop voltage from inverter then fed to transistor.

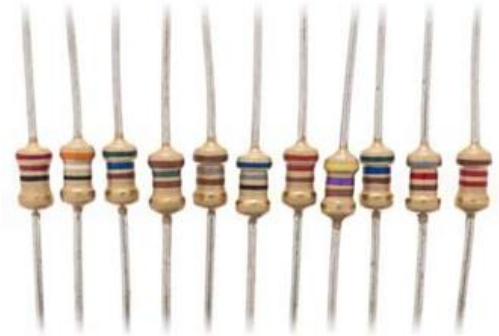


Fig. 4.1.16 Resistors

4.1.16 Ceramic Capacitors

A ceramic capacitor is a fixed-value capacitor where the ceramic material acts as the dielectric. It is constructed of two or more alternating layers of ceramic and a metal layer acting as the electrodes. The composition of the ceramic material defines the electrical behavior and therefore applications. Ceramic capacitors are divided into two application classes: Class 1 ceramic capacitors offer high stability and low losses for resonant circuit applications. Class 2 ceramic capacitors offer high volumetric efficiency for buffer, by- pass, and coupling applications. Ceramic capacitors, especially multilayer ceramic capacitors (MLCCs), are the most produced and used capacitors in electronic equipment that incorporate approximately one trillion (10^{12}) pieces per year.

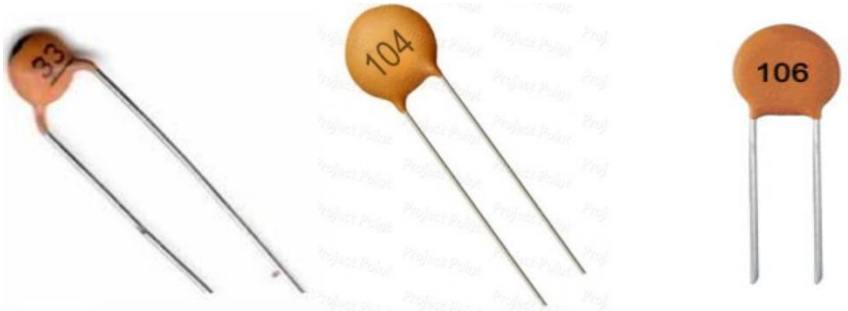


Fig. 4.1.17 Ceramic Capacitors

4.1.17 Cylindric Capacitors

Cylindric capacitors of 10uF is used as a part of quarts crystal oscillator and 1000uF is used at voltage regulator to smoothen DC.

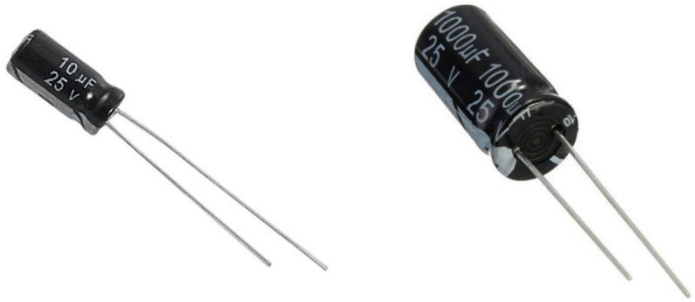


Fig. 4.1.18 Cylendric Capacitors of 10uF and 1000uF

4.1.18 Battery

12 V and 5 V DC power supply is required in this circuit. Here we use battery as a power supply.

Fig. 4.1.19 Battery

After Components are described, now the components are needed to assemble in the circuit, as we assembled the components now we should know the working of circuit with its proper explanation is listed below step by step, Some of PC software are listed below which helped us to create project .

PC SOFTWARE REQUIREMENTS:-

1. PROTEUS (Designing of Circuit)
2. KEIL uVISION 5 (C Code Formation and for creating HEX file)
3. Universal Microcontroller Programmer & Loader (Used for Loading HEX file Loading in Chip).

CHAPTER 5 TROUBLESHOOTING

While implementing the project on hardware, we encountered lots of problem at each stage. All the problems along with their troubleshoot solutions have been listed below:

- Since we are working with microcontrollers, we have to make our own development board. It is essential to read the data sheet of AT89S52. This microcontroller requires a clock. So to achieve that we are supposed to connect one quartz crystal oscillator and 2 capacitors along with it. We connected an oscillator and two cylindrical capacitors accordingly but it was not oscillating. Then we learned that cylindrical capacitors are not stable at higher frequencies; we have to use ceramic capacitors instead. They are very stable at high frequencies.
- To burn a program into microcontroller we required a USB programmer which is connected to microcontroller and personal computer. Look wise, this USB programmer is not properly packaged into box. Whole PCB copper layouts and its components are open to environment. Due to leakage current from home supplies, a surface leakage current was flowing through my PC body. This leakage current is harmless until it finds ground path but without these precautions, I touched my USB programmer and leakage current flew through my body and made USB programmer's copper path short-circuited. So this short circuit led to permanent damage of USB programmer.
- Before burning code into the microcontroller we didn't realized that USB programmer requires Additional driver installation into PC. After few search we installed drivers for USB programmer.
- After Connecting programmer with microcontroller, we tried to burn simple LED blinking program to test out the setup. But every time code burner (ProgISP) was giving "chip enable error". This error occurs when designer might left one of the connection loose or disconnected or improper soldering. After fixing that we faced another error, "Flash verify error"; we found that this kind of error occurs when your microcontroller is not properly erased from earlier execution. Even after manually pressing 'Erase' button from ProgISP burner it was able to erase the microcontroller. After so many attempts, I realized that pressing Erase button 2-3 at once in ProgISP burner software it flashes the microcontroller completely.
- We are using GSM SIM900A module for serial communication. We can control GSM by using AT commands. In our project we are using Text SMS for controlling the relay. We were trying to read SMS from GSM and send it back to my mobile phone. But instead sending me full SMS it was sending me just blank SMS. After debugging for long time we found that, GSM module have its own SMS storage and also SIM card have its own storage. Every time it was reading SMS from GSM storage which was blank always. After using some AT commands we concluded our result.

CHAPTER 6 LIMITATION OF THE CIRCUIT

This project has some features but with few limitation.

- **Reliability**:
  We are watering the plants with user interface. There is no feedback system for the checking that whether soil is dry or not. In monsoon season, even if plants are being fed by rain water microcontroller will again feed the water.

- **Power Supply**:
  This project needs two power supply, 12 volt and 5 volt. Microcontroller works on 5volt with minimum current requirement but relay requires 5 volt with 1 Amp current and also GSM module requires 12 volt and min. 1.5 Ampere current. This may consume more power as well as it will dissipate more heat.

- **Durability**:
  Since we are using GSM and GPB with Microcontroller, if it falls down, it is possible that GSM module may get damaged and entire system will fail. Also it is not water resistant so user have to take care of that.

- **Miscellaneous Costs:**
  In order to send message to doctor, a GSM module is used which contains a SIM card. This SIM card should contain enough balance in order to send the message. Also based on number of plants and distance between water sources to plants user has to purchase pipelines. Which will add additional costs.

CHAPTER 7 APPLICATION AND FUTURE WORK

7.1 APPLICATION

There are some application of automatic watering system which is useful in routine life.

7.1.1 For Gardening Purpose

This project is more useful in watering plants automatically without any human interference. We know that people do not pour the water to the plants in their gardens when they go to vacation or often forget to water plants. As a result, there is a chance to get the plants damaged. This project is an excellent solution for such kind of problems. We have used GSM here so user has only needed to send the message. Watering can be done from anywhere. Even if someone forgot to water, it will start watering automatically to default time.

7.1.2 For Irrigation Purpose

As the irrigator is not required to constantly monitor the progress of an irrigation, the irrigator is available to perform other tasks. The irrigator is able to be away from the property, relax with the family and sleep through the night. Irrigators with automation are more inclined to irrigate when the plants need water, not when it suits the irrigator. Automation of the irrigation system allows cut-off of water at the appropriate point in the bay. This is usually more accurate than manual checking because mistakes can occur if the operator is too late or too early in making a change of water flow.

7.1.3 For Cleaning Solar Panel:-

People who have solar panel at home will definitely know that you have to wash your solar panel regularly. We can use this system to wash solar panel. We can use sprinkler in place of water pump in our system. And then we can turn on-off when we need to wash our panels by simply sending SMS. Here we haven't need to go at terrace and turn on it manually. It can also used in commercial solar plants where large number of MW produced.

7.2 FUTURE WORK:

- This system is totally working on text SMS via using GSM modem. But by using NODE MCU - ESP8266 we connect and control whole system via wireless network communication.
- Instead of using SMS text, we can develop one Android Application to control whole system with GUI support. This can be developed via "MIT APP INVENTOR 2" and for cloud server we can "GOOGLE FIREBASE". This two tools are open source and freely available on Internet.
- Here we do not have any feedback mechanism so it may be possible that in rainy season it will feed the water even soil is not dry. By introducing soil moisture system we can improve this project

CONCLUSION

This project can be used as a home automation. Even if garden size is large this project can be implemented easily. Now Garden Owner/User can feed water from any corner of the country. This project is going to feed the water to plants whether user forgets. This project also conserves the water from wastage. So in water crises, it can be lifesaving. It proves that embedded system can be useful for saving lives for upcoming generation.

REFERENCES

- The 8051 Microcontroller Based Embedded Systems by **Manish K Patel**
- Basic Interfacing of 8051 with USB programmer
  - https://www.youtube.com/watch?v=Z-cOZJkqAEo&t=154s
  - http://www.alselectro.com/
- About GSM SIM900A
  - https://components101.com/wireless/sim900a-gsm-module#:~:text=The%20SIM900A%20is%20a%20readily,EGSM%20900MHz%20and%20DCS%201800MHz
- Interfacing of GSM with AT89S52
  - https://www.electronicshub.org/gsm-interfacing-8051-microcontroller/

APPENDIX – A

C language Code:-

```
#include<reg52.h>

#include<stdlib.h>

#include<string.h>

sbit a = P1^3;

sbit b = P1^2;

sbit c = P1^1;

sbit d = P1^0;


unsigned char *command_ATE0 = "ATE0\r";

unsigned char *command_AT = "AT\r";

unsigned char *command_CMGF = "AT+CMGF=1\r";

unsigned char *command_CMGS = "AT+CMGS=\"+919427582346\"\r";

unsigned char *message = "GSM Report: GSM is active, Reply/Enter duration in minutes which
will feed the water to plants\r ";       /*Msg 2 be send*/

unsigned char CTRLZ = 0x1A;

unsigned char *command_CMGR = "AT+CMGR=1\r";

//unsigned char *command_CMGDA = "AT+CMGDA=\"DEL ALL\"\r";

//unsigned char *command_CPMS = "AT+CPMS=SM\r";

unsigned char *command_CNMI = "AT+CNMI=1,2,0,0,0\r";

unsigned char dataa[90];
```

```
void puts(unsigned char* ptr);
void putc(unsigned char chr);
void sendsms(void);
void initialize();
void delay(unsigned int time);

void rec_sms();
void read_gsm(void);
void verify();
void control();



void main()
{
  a=0;
  b=0;
          c=0;
          d=0;

 initialize();
 sendsms();

          delay(2000);
          a=0;
```

```
 rec_sms();
          c=1;
          //strcat(dataa,"tmp");
          verify();
          b = 1;
          a =0;
          delay(1000);
          control();

          while(1);

}
void initialize()
{
          a=0;
          SCON  = 0x50;   /*SCON: mode 1, 8-bit UART, enable receive      */
 TMOD  = 0x20;   /*TMOD: timer 1, mode 2, 8-bit                */
 TH1   = 0xFD;   /*TH1:  for 9600 baud                         */
 TR1   = 1;      /*TR1:  timer 1 run                          */
}

void sendsms()
{
 puts(command_ATE0);
```

```
 delay(60);
 puts(command_AT);
 delay(60);
 //puts(command_CPMS);
 //delay(60);
//puts(command_CMGDA);
// delay(60);
 puts(command_CMGF);
 delay(60);
 puts(command_CMGS);
 delay(60);
 puts(message);
 delay(60);
 putc(CTRLZ);
}

void puts(char* p)
{
 char *temp = p;          /*temp pointer so that the actual pointer is not displaced */
 while(*temp != 0x00)
 {
  putc(*temp);
  temp++;
 }
```

```
}

void putc(unsigned char chr)
{
 SBUF = chr;
 while(TI==0) {};            /*Wait until the character is completely sent */
 TI=0;                    /*Reset the flag */
}

void rec_sms()
{
  d = 1;//          puts(command_CNMI);//       // delay(60);//
          // puts(command_CMGS);//
//delay(60);
          puts(command_CMGR);
          read_gsm();
          d=0;
}

void read_gsm()
{ int i=0;

          delay(50);
          while(i < 80)
```

```
        {
                while(RI == 0);
                dataa[i] = SBUF;
          i++;
                RI=0;
                }
}
void verify()
{
 puts(command_CMGF);
 delay(60);
 puts(command_CMGS);
 delay(60);
        puts(dataa);
 delay(60);
 putc(CTRLZ);
}
void delay(unsigned int time)
{
unsigned int y,z;
for(y=0;y<=time;y++)
for(z=0;z<2400;z++)
{
;
```

```
}
}

void control()
{
        int sec1,sec2,sec3;      // 3 duration data will be stored in sec1,sec2,sec3
        int j;
        int flag = 0;
        for( j = 0; j<90;j++)
        {
                if (dataa[j] == "")
                {
                        flag++;
                        if( flag == 6 )
                        {sec1 = dataa[j+2];
                                sec2 = dataa[j+4];
                                sec3 = dataa[j+6];

                                a = 1;
                                delay((sec1*83));//send this to relay
                                a =0;

                                c = 1;
                                delay((sec2*83));//send this to second relay
```

```
                    c=0;


                        d = 1;
                    delay((sec3*83));//send this to 3rd relay
                    d=0;
                }
            }

        }


    }
```

KEIL WINDOW:

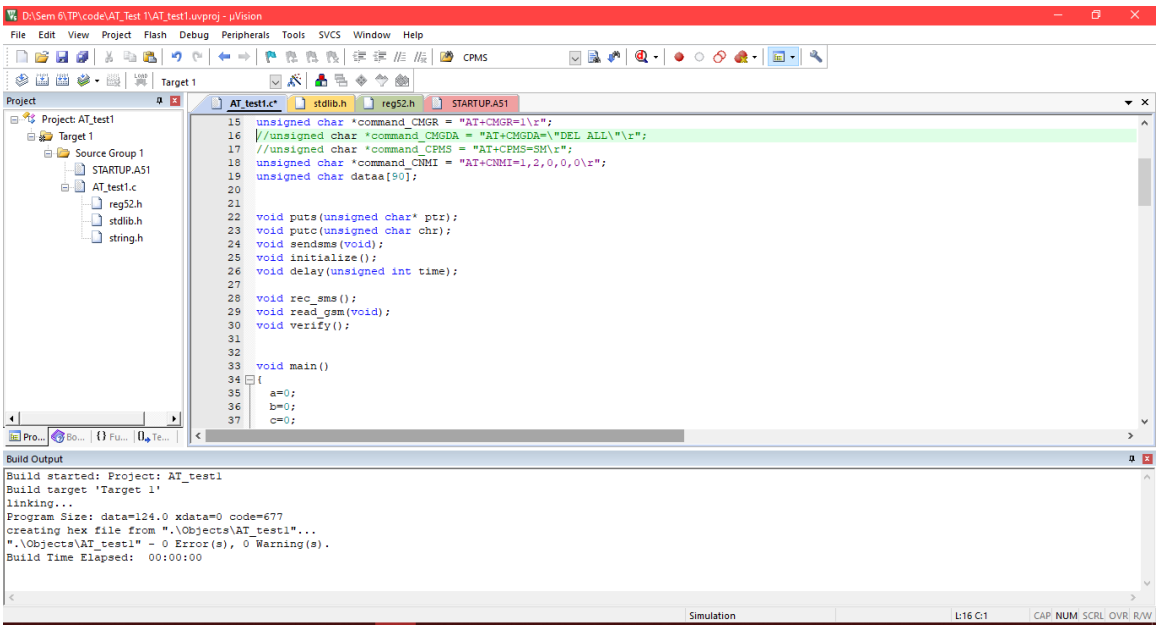


Figure 9.1 Keil Window

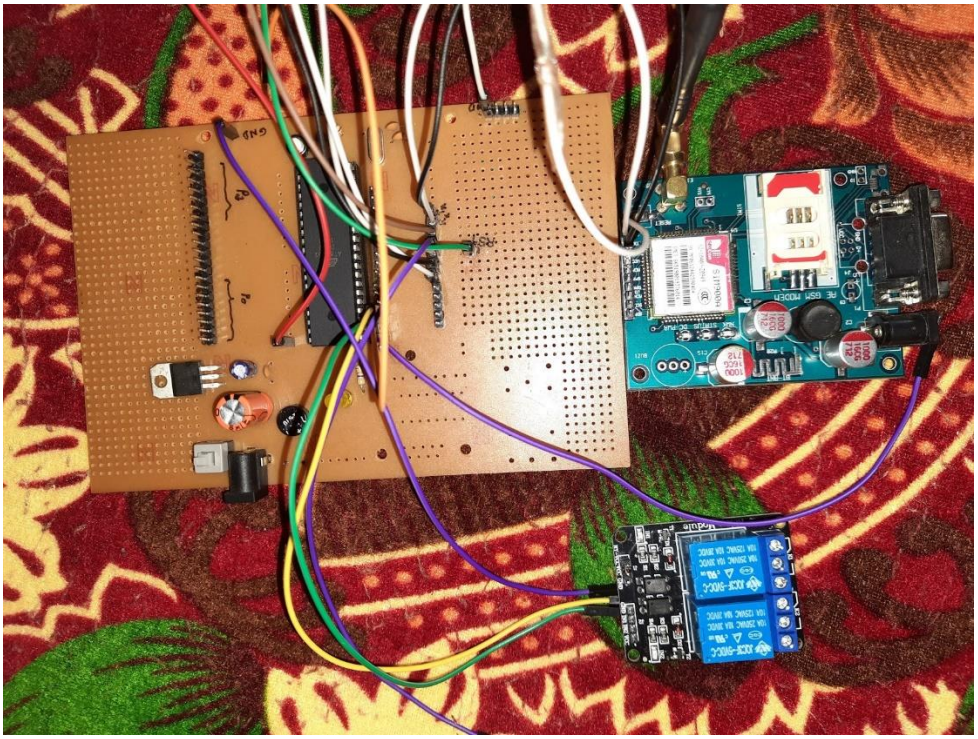


Figure 9.2 Practical Setup

APPENDIX – B

Table B.1 – Component Cost

Sr. No	Component Name	Approx. Price (INR)
1	GPB of Microcontroller AT89S51	100 /-
2	12 MHz – Quartz Crystal Oscillator	10/-
3.	GSM Module (SIM 900A)	900/-
5.	Connecting wires(male-male, female–male, female - female)	50/-
6	Voltage Regulator LM7805	15/-
7.	Resistors and capacitors	20/-
8.	ATMEGA USB Programmer	300/-
9.	12 Volt – 2 Amp Adapter	90/-
10.	AT89S52 Microcontroller	70/-
11.	LEDs 5X	10/-
12.	Barrel jack power connector	5/-
13.	Push-Buttons – 2X	10/-
14	Soldering Iron	110/-
15	Solder and Flux	35/-

APPENDIX – C

Here, two partial data sheets are shown.

Microcontroller AT89S52

Features

- Compatible with MCS-51® Products
- 8K Bytes of In-System Programmable (ISP) Flash Memory
  - Endurance: 1000 Write/Erase Cycles
- 4.0V to 5.5V Operating Range
- Fully Static Operation: 0 Hz to 33 MHz
- Three-level Program Memory Lock
- 256 x 8-bit Internal RAM
- 32 Programmable I/O Lines
- Three 16-bit Timer/Counters
- Eight Interrupt Sources
- Full Duplex UART Serial Channel
- Low-power Idle and Power-down Modes
- Interrupt Recovery from Power-down Mode
- Watchdog Timer
- Dual Data Pointer
- Power-off Flag

Description

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard 80C51 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 in-system programmable Flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller which provides a highly-flexible and cost-effective solution to many embedded control applications.

The AT89S52 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry. In addition, the AT89S52 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 interrupt or hardware reset.

ATMEL®

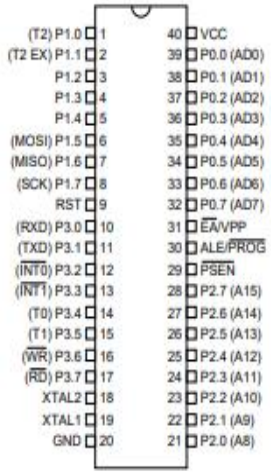
8-bit Microcontroller with 8K Bytes In-System Programmable Flash

AT89S52

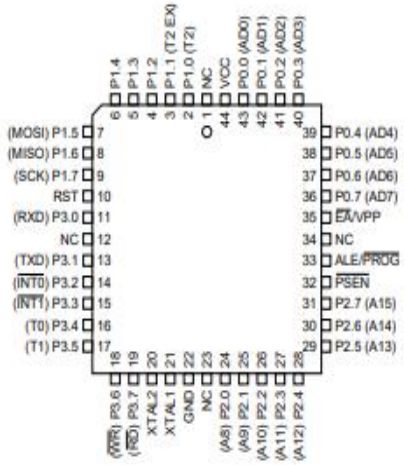
Rev. 1919A-07/01

Pin Configurations

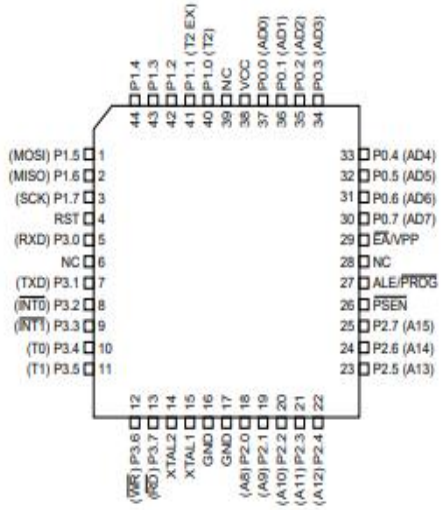
PDIP



PLCC



TQFP



Baud Rate Generator

Timer 2 is selected as the baud rate generator by setting TCLK and/or RCLK in T2CON (Table 2). Note that the baud rates for transmit and receive can be different if Timer 2 is used for the receiver or transmitter and Timer 1 is used for the other function. Setting RCLK and/or TCLK puts Timer 2 into its baud rate generator mode, as shown in Figure 8.

The baud rate generator mode is similar to the auto-reload mode, in that a rollover in TH2 causes the Timer 2 registers to be reloaded with the 16-bit value in registers RCAP2H and RCAP2L, which are preset by software.

The baud rates in Modes 1 and 3 are determined by Timer 2's overflow rate according to the following equation.

$$\text{Modes 1 and 3 Baud Rates} = \frac{\text{Timer 2 Overflow Rate}}{16}$$

The Timer can be configured for either timer or counter operation. In most applications, it is configured for timer operation (CP/$\overline{T2}$ = 0). The timer operation is different for Timer 2 when it is used as a baud rate generator. Normally, as a timer, it increments every machine cycle (at 1/12 the oscillator frequency). As a baud rate generator, however, it increments every state time (at 1/2 the oscillator frequency). The baud rate formula is given below.

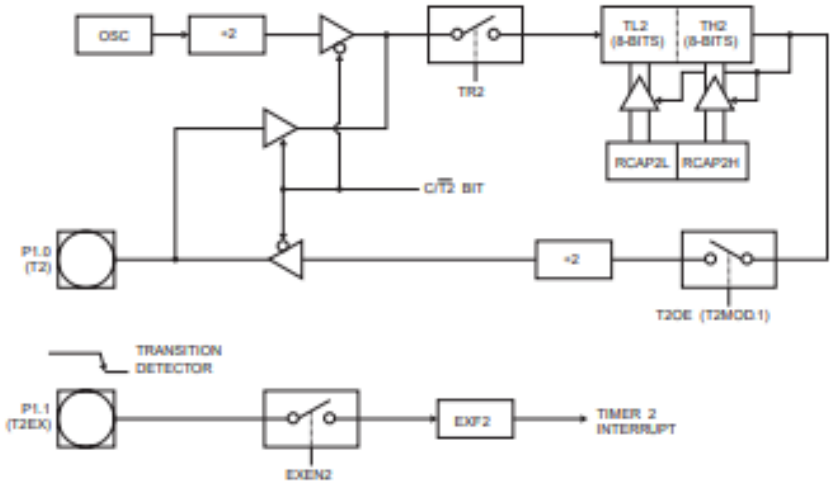
$$\frac{\text{Modes 1 and 3}}{\text{Baud Rate}} = \frac{\text{Oscillator Frequency}}{32 \times [65536\text{-RCAP2H,RCAP2L})]}$$

where (RCAP2H, RCAP2L) is the content of RCAP2H and RCAP2L taken as a 16-bit unsigned integer.

Timer 2 as a baud rate generator is shown in Figure 8. This figure is valid only if RCLK or TCLK = 1 in T2CON. Note that a rollover in TH2 does not set TF2 and will not generate an interrupt. Note too, that if EXEN2 is set, a 1-to-0 transition in T2EX will set EXF2 but will not cause a reload from (RCAP2H, RCAP2L) to (TH2, TL2). Thus, when Timer 2 is in use as a baud rate generator, T2EX can be used as an extra external interrupt.

Note that when Timer 2 is running (TR2 = 1) as a timer in the baud rate generator mode, TH2 or TL2 should not be read from or written to. Under these conditions, the Timer is incremented every state time, and the results of a read or write may not be accurate. The RCAP2 registers may be read but should not be written to, because a write might overlap a reload and cause write and/or reload errors. The timer should be turned off (clear TR2) before accessing the Timer 2 or RCAP2 registers.

Figure 9. Timer 2 in Clock-Out Mode

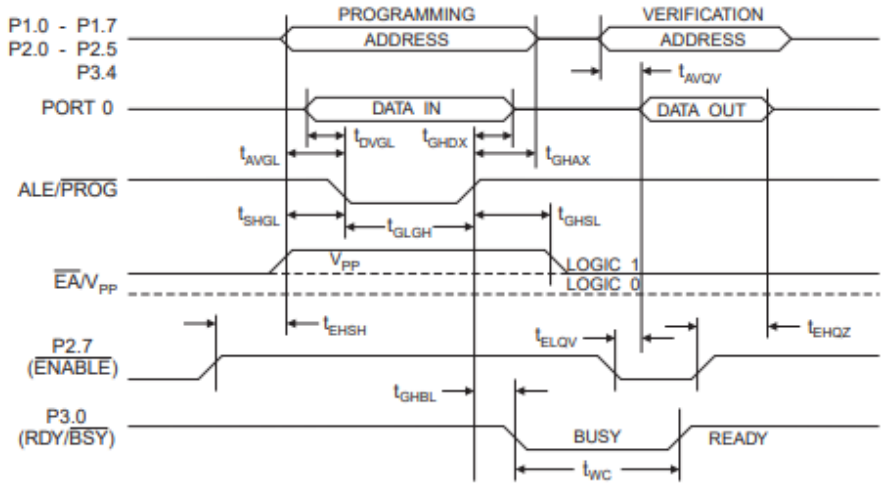


Flash Programming and Verification Characteristics (Parallel Mode)

T_A = 20°C to 30°C, V_{CC} = 4.5 to 5.5V

Symbol	Parameter	Min	Max	Units
V_{PP}	Programming Supply Voltage	11.5	12.5	V
I_{PP}	Programming Supply Current		10	mA
I_{CC}	V_{CC} Supply Current		30	mA
$1/t_{CLCL}$	Oscillator Frequency	3	33	MHz
t_{AVGL}	Address Setup to $\overline{PROG}$ Low	$48t_{CLCL}$		
t_{GHAX}	Address Hold After $\overline{PROG}$	$48t_{CLCL}$		
t_{DVGL}	Data Setup to $\overline{PROG}$ Low	$48t_{CLCL}$		
t_{GHDX}	Data Hold After $\overline{PROG}$	$48t_{CLCL}$		
t_{EHSH}	P2.7 ($\overline{ENABLE}$) High to V_{PP}	$48t_{CLCL}$		
t_{SHGL}	V_{PP} Setup to $\overline{PROG}$ Low	10		µs
t_{GHSL}	V_{PP} Hold After $\overline{PROG}$	10		µs
t_{GLGH}	$\overline{PROG}$ Width	0.2	1	µs
t_{AVQV}	Address to Data Valid		$48t_{CLCL}$	
t_{ELQV}	$\overline{ENABLE}$ Low to Data Valid		$48t_{CLCL}$	
t_{EHQZ}	Data Float After $\overline{ENABLE}$	0	$48t_{CLCL}$	
t_{GHBL}	$\overline{PROG}$ High to $\overline{BUSY}$ Low		1.0	µs
t_{WC}	Byte Write Cycle Time		50	µs

Figure 15. Flash Programming and Verification Waveforms – Parallel Mode



1 Introduction

This document describes the hardware interface of the SIMCom SIM900A module that connects to the specific application and the air interface. As SIM900A can be integrated with a wide range of applications, all functional components of SIM900A are described in great detail.

This document can help you quickly understand SIM900A interface specifications, electrical and mechanical details. With the help of this document and other SIM900A application notes, user guide, you can use SIM900A module to design and set-up mobile applications quickly.

1.1 Related Documents

Table 1: Related documents

SN	Document name	Remark
[1]	SIM900A_ATC	SIM900A_ATC
[2]	ITU-T Draft new recommendation V.25ter:	Serial asynchronous automatic dialing and control
[3]	GSM 07.07:	Digital cellular telecommunications (Phase 2+); AT command set for GSM Mobile Equipment (ME)
[4]	GSM 07.10:	Support GSM 07.10 multiplexing protocol
[5]	GSM 07.05:	Digital cellular telecommunications (Phase 2+); Use of Data Terminal Equipment – Data Circuit terminating Equipment (DTE – DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)
[6]	GSM 11.14:	Digital cellular telecommunications system (Phase 2+); Specification of the SIM Application Toolkit for the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[7]	GSM 11.11:	Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[8]	GSM 03.38:	Digital cellular telecommunications system (Phase 2+); Alphabets and language-specific information
[9]	GSM 11.10	Digital cellular telecommunications system (Phase 2)； Mobile Station (MS) conformance specification； Part 1: Conformance specification
[10]	AN_Serial Port	AN_Serial Port

1.2 Terms and Abbreviations

Table 2: Terms and Abbreviations

2 SIM900A Overview

Designed for global market, SIM900A is a dual-band GSM/GPRS engine that works on frequencies EGSM 900MHz and DCS 1800MHz. SIM900A features GPRS multi-slot class 10/ class 8 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4.

With a tiny configuration of 24mm x 24mm x 3mm, SIM900A can meet almost all the space requirements in your applications, such as M2M, smart phone, PDA and other mobile devices.

The physical interface to the mobile application is a 68-pin SMT pad, which provides all hardware interfaces between the module and customers' boards.

- The keypad and SPI display interface will give you the flexibility to develop customized applications.
- Serial port and Debug port can help you easily develop your applications.
- One audio channel includes a microphone input and a speaker output.
- Programmable General Purpose Input & Output.

The SIM900A is designed with power saving technique so that the current consumption is as low as 1.5mA in SLEEP mode.

The SIM900A is integrated with the TCP/IP protocol; extended TCP/IP AT commands are developed for customers to use the TCP/IP protocol easily, which is very useful for those data transfer applications.

2.1 SIM900A Key Features

Table 3: SIM900A key features

Feature	Implementation
Power supply	Single supply voltage 3.4V – 4.5V
Power saving	Typical power consumption in SLEEP mode is 1.5mA (BS-PA-MFRMS=5)
Frequency Bands	● SIM900A Dual-band: EGSM900, DCS1800. The SIM900A can search the 2 frequency bands automatically. The frequency bands also can be set by AT command. ● Compliant to GSM Phase 2/2+
GSM class	Small MS
Transmitting power	● Class 4 (2W) at EGSM 900 ● Class 1 (1W) at DCS 1800
GPRS connectivity	● GPRS multi-slot class 10 （default） ● GPRS multi-slot class 8 (option) ● GPRS mobile station class B

Temperature range	● Normal operation: -30°C to +80°C ● Restricted operation: -40°C to -30°C and +80 °C to +85°C(1) ● Storage temperature -45°C to +90°C
DATA *GPRS:* *CSD:*	● GPRS data downlink transfer: max. 85.6 kbps ● GPRS data uplink transfer: max. 42.8 kbps ● Coding scheme: CS-1, CS-2, CS-3 and CS-4 ● Supports the protocols PAP (Password Authentication Protocol) usually used for PPP connections. ● Integrates the TCP/IP protocol. ● Support Packet Switched Broadcast Control Channel (PBCCH) ● CSD transmission rates: 2.4, 4.8, 9.6, 14.4 kbps, non-transparent ● Unstructured Supplementary Services Data (USSD) support
SMS	● MT, MO, CB, Text and PDU mode ● SMS storage: SIM card
FAX	Group 3 Class 1
SIM interface	Support SIM card: 1.8V, 3V
External antenna	Antenna pad
Audio features	Speech codec modes: ● Half Rate (ETS 06.20) ● Full Rate (ETS 06.10) ● Enhanced Full Rate (ETS 06.50 / 06.60 / 06.80) ● Adaptive multi rate (AMR) ● Echo Cancellation ● Noise Suppression
Serial port and Debug port	Serial Port: ● 8-wire modem interface with status and control lines, unbalanced, asynchronous. ● 1.2kbps to 115.2kbps. ● Serial Port can be used for AT commands or data stream. ● Supports RTS/CTS hardware handshake and software ON/OFF flow control. ● Multiplex ability according to GSM 07.10 Multiplexer Protocol. ● Autobauding supports baud rate from 1200 bps to 115200bps. Debug port: ● 2-wire null modem interface DBG_TXD and DBG_RXD. ● Can be used for debugging and upgrading firmware.
Phonebook management	Support phonebook types: SM, FD, LD, RC, ON, MC.
SIM Application Toolkit	Support SAT class 3, GSM 11.14 Release 99
Real time clock	Implemented
Timer function	Programmable via AT command
Physical characteristics	Size: 24mm x 24mm x 3mm Weight: 3.4g
Firmware upgrade	Firmware upgrade by debug port.

Table 10: MIC Input Characteristics

Parameter	Min	Typ	Max	Unit
Working Voltage	1.2	1.5	2.0	V
Working Current	200		500	uA
External Microphone Load Resistance	1.2	2.2		k Ohms

Table 11: Audio Output Characteristics

Parameter	Conditions	Min	Typ	Max	Unit
Normal Output(SPK)	RL=32 Ohm THD=0.1%	-	91	-	mW
	RL=32 Ohm THD=1%	-	96	-	mW

3.10 SIM Card Interface

3.10.1 SIM Card Application

You can use AT Command to get information in SIM card. For more information, please refer to *document [1]*.

The SIM interface supports the functionality of the GSM Phase 1 specification and also supports the functionality of the new GSM Phase 2+ specification for FAST 64 kbps SIM (intended for use with a SIM application Tool-kit).
Both 1.8V and 3.0V SIM Cards are supported.
The SIM interface is powered from an internal regulator in the module having normal voltage 3V. All pins reset as outputs driving low. Logic levels are as described in table

Table 12: Pin define of the SIM interface

Pin Name	Pin Number	Function
SIM_VDD	30	SIM Card Power output automatic output on SIM mode，one is 3.0V±10%, another is 1.8V±10%. Current is about 10mA.
SIM_DATA	31	SIM Card data I/O
SIM_CLK	32	SIM Card Clock
SIM_RST	33	SIM Card Reset
SIM_PRESENCE	34	SIM Card detection

Following is the reference circuit about SIM interface. We recommend an Electro-Static discharge device ST (www.st.com) ESDA6V1W5 or ON SEMI (www.onsemi.com) SMF05C for "ESD ANTI". The 22Ω resistors

showed in the following figure should be added in series on the IO line between the module and the SIM card for protecting the SIM I/O port. The pull up resistor (about 15KΩ) on the SIM_DATA line already added in the module. Note that the SIM peripheral circuit should be close to the SIM card socket.

The SIM_PRESENCE pin is used for detecting the SIM card insert or removal. You can use the AT command "AT+CSDT" to set the SIMCARD configuration. For detail of this AT command, please refer to *document [1]*:

You can select the 8 pins SIM card holder. The reference circuit about 8 pins SIM card holder illustrates as following figure.

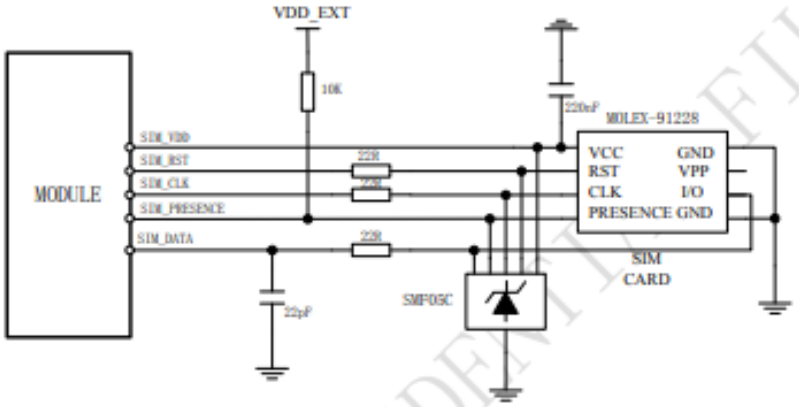


Figure 27: Reference circuit of the 8 pins SIM card

If you don't use the SIM card detection function, you can leave the SIM_PRESENCE pin open. The reference circuit about 6 pins SIM card illustrates as following figure.

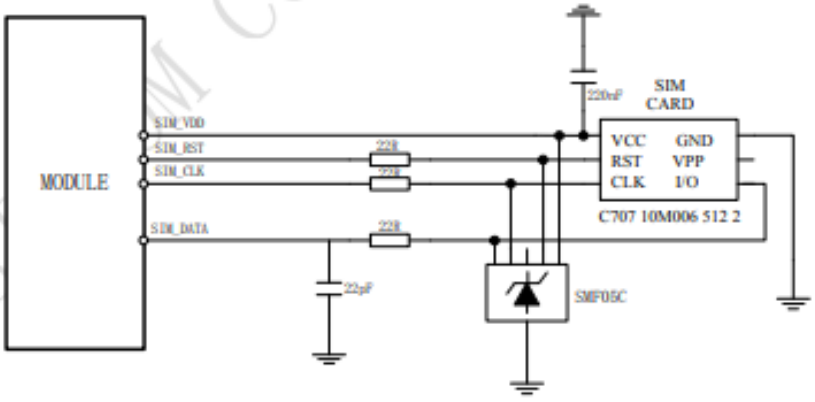


Figure 28: Reference circuit of the 6 pins SIM card