DTMF BASED DC MOTOR CONTROL

SUBMITTED BY
INTRODUCTION

Our project is based on DC motor control using DTMF technology. In this project, the motor is controlled by a mobile phone that makes a call to the mobile phone attached to the robot. In the course of a call, if any button is pressed, a tone corresponding to the button pressed is heard at the other end of the call. This tone is called "Dual Tone Multiple-Frequency" (DTMF) tone. The robot perceives this DTMF tone with the help of the phone stacked on the circuit connected to dc motor. The received tone is processed by the microcontroller with the help of DTMF decoder. The microcontroller then transmits the signal to the motor driver ICs to operate the motor. Use of a mobile phone for motor control can overcome limitations which we faced in rf based technique. It provides the advantage of robust control, working range as large as the coverage area of the service provider, no interference with other controllers and up to twelve controls. In this project the motor, is controlled by a mobile phone that makes call to the mobile phone attached to the circuit in the course of the call, if any button is pressed.
control corresponding to the button pressed is heard at the other end of the call. This tone is called dual tone multi frequency tone (DTMF) circuit receives this DTMF tone with the help of phone stacked in the robot. The received tone is processed by the 89s52 microcontroller with the help of DTMF decoder MT8870 the decoder decodes the DTMF tone in to its equivalent binary digit and this binary number is send to the microcontroller, the microcontroller is preprogrammed to take a decision for any give input and outputs its decision to motor drivers in order to drive the motors for forward or backward motion or a turn. The mobile that makes a call to the mobile phone stacked in the motor acts as a remote. So this simple control project does not require the construction of receiver and transmitter units.

DTMF signaling is used for telephone signaling over the line in the voice frequency band to the call switching center. The version of DTMF used for telephone dialing is known as touch tone.

DTMF assigns a specific frequency (consisting of two separate tones) to each key s that it can easily be identified by the
electronic circuit. The signal generated by the DTMF encoder is the direct algebraic submission, in real time of the amplitudes of two sine (cosine) waves of different frequencies, i.e., pressing 5 will send a tone made by adding 1336 Hz and 770 Hz to the other end of the mobile. The important components of this robot are DTMF decoder, Microcontroller and motor driver. An MT8870 series DTMF decoder is used here. All types of the mt8870 series use digital counting techniques to detect and decode all the sixteen DTMF tone pairs in to a four bit code output. The built-in dial tone rejection circuit eliminated the need for pre-filtering. When the input signal given at pin2 (IN-) single ended input configuration is recognized to be effective, the correct four bit decode signal of the DTMF tone is transferred to Q1 (pin11) through Q4(pin14) outputs.
## COMPONENT LIST

<table>
<thead>
<tr>
<th>Sr. no</th>
<th>Equipment</th>
<th>Quantity</th>
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<tbody>
<tr>
<td>1</td>
<td>IC 8051 MC</td>
<td>1</td>
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<td>2</td>
<td>MT 8870 DTMF IC</td>
<td>1</td>
</tr>
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<td>3</td>
<td>Crystal (3.579545mhz)</td>
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<tr>
<td>4</td>
<td>VOLTAGE REGULATOR</td>
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<td>2 LINE LCD DISPLAY</td>
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<td>6</td>
<td>CRYSTAL OSCILLATOR (11.0592mhz)</td>
<td>1</td>
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<td>7</td>
<td>DIODE</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>PUSH BUTTON</td>
<td>1</td>
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<tr>
<td>9</td>
<td>LEDS</td>
<td>4</td>
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<td>10</td>
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<td>11</td>
<td>CAPACITORS (10uf, 1000uf)</td>
<td>5</td>
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<td>12</td>
<td>MOTOR1</td>
<td>1</td>
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<td>13</td>
<td>L293D</td>
<td>1</td>
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</table>
A BRIEF INTRODUCTION TO 8051 MICROCONTROLLER:

When we have to learn about a new computer we have to familiarize about the machine capability we are using, and we can do it by studying the internal hardware design (devices architecture), and also to know about the size, number and the size of the registers.

A microcontroller is a single chip that contains the processor (the CPU), non-volatile memory for the program (ROM or flash), volatile memory for input and output (RAM), a clock and an I/O control unit. Also called a "computer on a chip," billions of microcontroller units (MCUs) are embedded each year in a myriad of products from toys to appliances to automobiles. For example, a single vehicle can use 70 or more microcontrollers. The following picture describes a general block diagram of microcontroller.

AT89S52: 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 pin out. 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 freeze the oscillator, disabling all other chip functions until the next interrupt.
The hardware is driven by a set of program instructions, or software. Once familiar with hardware and software, the user can then apply the microcontroller to the problems easily.
The pin diagram of the 8051 shows all of the input/output pins unique to microcontrollers:

The following are some of the capabilities of 8051 microcontroller.

1. Internal ROM and RAM
2. I/O ports with programmable pins
3. Timers and counters
4. Serial data communication

The 8051 architecture consists of these specific features:

- 16 bit PC & data pointer (DPTR)
- 8 bit program status word (PSW)
- 8 bit stack pointer (SP)
- Internal ROM 4k
- Internal RAM of 128 bytes.
- 4 register banks, each containing 8 registers
- 80 bits of general purpose data memory
- 32 input/output pins arranged as four 8 bit ports: P0-P3
- Two 16 bit timer/counters: T0-T1
- Two external and three internal interrupt sources Oscillator and clock circuits.
Pin Description

VCC
Supply voltage.

GND
Ground.

Port 0
Port 0 is an 8-bit open drain bidirectional I/O port. As an output port, each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as high-impedance inputs.

Port 0 can also be configured to be the multiplexed low-order address/data bus during accesses to external program and data memory. In this mode, P0 has internal pull-ups.

Port 0 also receives the code bytes during Flash programming and outputs the code bytes during program verification. External pull-ups are required during program verification.

Port 1
Port 1 is an 8-bit bidirectional I/O port with internal pull-ups. The Port 1 output buffers can sink/source four TTL inputs. When 1s are written to Port 1 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 1 pins that are externally being pulled low will source current (I_L) because of the internal pull-ups.

In addition, P1.0 and P1.1 can be configured to be the timer/counter 2 external count input (P1.0/T2) and the timer/counter 2 trigger input (P1.1/T2EX), respectively, as shown in the following table.

Port 1 also receives the low-order address bytes during Flash programming and verification.

<table>
<thead>
<tr>
<th>Port Pin</th>
<th>Alternate Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1.0</td>
<td>T2 (external count input to Timer/Counter 2), clock-out</td>
</tr>
<tr>
<td>P1.1</td>
<td>T2EX (Timer/Counter 2 capture/reload trigger and direction control)</td>
</tr>
<tr>
<td>P1.5</td>
<td>MOSI (used for In-System Programming)</td>
</tr>
<tr>
<td>P1.6</td>
<td>MISO (used for In-System Programming)</td>
</tr>
<tr>
<td>P1.7</td>
<td>SCK (used for In-System Programming)</td>
</tr>
</tbody>
</table>

Port 2
Port 2 is an 8-bit bidirectional I/O port with internal pull-ups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 2 pins that are externally being pulled low will source current (I_L) because of the internal pull-ups.

Port 2 emits the high-order address byte during fetches from external program memory and during accesses to external data memory that use 16-bit addresses (MOVX @ DPTR). In this application, Port 2 uses strong internal pull-ups when emitting 1s. During accesses to external data memory that use 8-bit addresses (MOVX @ RI), Port 2 emits the contents of the P2 Special Function Register.

Port 2 also receives the high-order address bits and some control signals during Flash programming and verification.

Port 3
Port 3 is an 8-bit bidirectional I/O port with internal pull-ups. The Port 3 output buffers can sink/source four TTL inputs. When 1s are written to Port 3 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 3 pins that are externally being pulled low will source current (I_L) because of the pull-ups.
Port 3 receives some control signals for Flash programming and verification.

Port 3 also serves the functions of various special features of the AT89S52, as shown in the following table.

<table>
<thead>
<tr>
<th>Port Pin</th>
<th>Alternate Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>P3.0</td>
<td>RXD (serial input port)</td>
</tr>
<tr>
<td>P3.1</td>
<td>TXD (serial output port)</td>
</tr>
<tr>
<td>P3.2</td>
<td>INT0 (external interrupt 0)</td>
</tr>
<tr>
<td>P3.3</td>
<td>INT1 (external interrupt 1)</td>
</tr>
<tr>
<td>P3.4</td>
<td>T0 (timer 0 external input)</td>
</tr>
<tr>
<td>P3.5</td>
<td>T1 (timer 1 external input)</td>
</tr>
<tr>
<td>P3.6</td>
<td>WR (external data memory write strobe)</td>
</tr>
<tr>
<td>P3.7</td>
<td>RD (external data memory read strobe)</td>
</tr>
</tbody>
</table>

**RST**

Reset input. A high on this pin for two machine cycles while the oscillator is running resets the device. This pin drives high for 98 oscillator periods after the Watchdog times out. The DI8RT0 bit in SFR AUXR (address 8EH) can be used to disable this feature. In the default state of bit DI8RT0, the RESET HIGH out feature is enabled.

**ALE/PROG**

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

In normal operation, ALE is emitted at a constant rate of 1/6 the oscillator frequency and may be used for external timing or clocking purposes. Note, however, that one ALE pulse is skipped during each access to external data memory.

If desired, ALE operation can be disabled by setting bit 0 of SFR location 8EH. With the bit set, ALE is active only during a MOVX or MOVC instruction. Otherwise, the pin is weakly pulled high. Setting the ALE-disable bit has no effect if the microcontroller is in external execution mode.

**PSEN**

Program Store Enable (PSEN) is the read strobe to external program memory.

When the AT89S52 is executing code from external program memory, PSEN is activated twice each machine cycle, except that two PSEN activations are skipped during each access to external data memory.

**EA/VPP**

External Access Enable. EA must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up to FFFFH. Note, however, that if lock bit 1 is programmed, EA will be internally latched on reset.

EA should be strapped to Vcc for internal program executions.

This pin also receives the 12-volt programming enable voltage (VPP) during Flash programming.

**XTAL1**

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

**XTAL2**

Output from the inverting oscillator amplifier.
Special Function Registers

A map of the on-chip memory area called the Special Function Register (SFR) space is shown in Table 1.

Note that not all of the addresses are occupied, and unoccupied addresses may not be implemented on the chip. Read accesses to these addresses will in general return random data, and write accesses will have an indeterminate effect.

User software should not write 1s to these unlisted locations, since they may be used in future products to invoke new features. In that case, the reset or inactive values of the new bits will always be 0.

**Timer 2 Registers**: Control and status bits are contained in registers T2CON (shown in Table 2) and T2MOD (shown in Table 6) for Timer 2. The register pair (RCAP2H, RCAP2L) are the Capture/Reload registers for Timer 2 in 16-bit capture mode or 16-bit auto-reload mode.

**Interrupt Registers**: The individual interrupt enable bits are in the IE register. Two priorities can be set for each of the six interrupt sources in the IP register.
HARDWARE DESCRIPTION:

1. POWER SUPPLY:

**Power supply** is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a **power supply unit** or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others. Here in our application we need a 5v DC power supply for all electronics involved in the project. This requires step down transformer, rectifier, voltage regulator, and filter circuit for generation of 5v DC power. Here a brief description of all the components are given as follows:

**TRANSFORMER:**

**transformer** is a device that transfers electrical energy from one circuit to another through inductively coupled conductors — the transformer's coils or "windings". Except for air-core transformers, the conductors are commonly wound around a
single iron-rich core, or around separate but magnetically-coupled cores. A varying current in the first or "primary" winding creates a varying magnetic field in the core (or cores) of the transformer. This varying magnetic field induces a varying electromotive force (EMF) or "voltage" in the "secondary" winding. This effect is called mutual induction.

If a load is connected to the secondary circuit, electric charge will flow in the secondary winding of the transformer and transfer energy from the primary circuit to the load connected in the secondary circuit.

The secondary induced voltage $V_s$, of an ideal transformer, is scaled from the primary $V_p$ by a factor equal to the ratio of the number of turns of wire in their respective windings:
By appropriate selection of the numbers of turns, a transformer thus allows an alternating voltage to be stepped up — by making \( N_S \) more than \( N_P \) — or stepped down, by making it

\[
\frac{V_S}{V_P} = \frac{N_S}{N_P}
\]

BASIC PARTS OF A TRANSFORMER

In its most basic form a transformer consists of:

- A primary coil or winding.
- A secondary coil or winding.
- A core that supports the coils or windings.

Refer to the transformer circuit in figure as you read the following explanation: The primary winding is connected to a 60-hertz ac voltage source. The magnetic field (flux) builds up (expands) and collapses (contracts) about the primary winding. The expanding and contracting magnetic field around the primary winding cuts the secondary winding and induces an alternating voltage into the winding. This voltage causes alternating current to flow through the load. The voltage may be
stepped up or down depending on the design of the primary and secondary windings.

THE COMPONENTS OF A TRANSFORMER

Two coils of wire (called windings) are wound on some type of core material. In some cases the coils of wire are wound on a cylindrical or rectangular cardboard form. In effect, the core material is air and the transformer is called an AIR-CORE TRANSFORMER. Transformers used at low frequencies, such as 60 hertz and 400 hertz, require a core of low-reluctance magnetic material, usually iron. This type of transformer is called an IRON-CORE TRANSFORMER. Most power
transformers are of the iron-core type. The principle parts of a transformer and their functions are:

- The CORE, which provides a path for the magnetic lines of flux.
- The PRIMARY WINDING, which receives energy from the ac source.
- The SECONDARY WINDING, which receives energy from the primary winding and delivers it to the load.
- The ENCLOSURE, which protects the above components from dirt, moisture, and mechanical damage.

**BRIDGE RECTIFIER**

A bridge rectifier makes use of four diodes in a bridge arrangement to achieve full-wave rectification. This is a widely used configuration, both with individual diodes wired as shown and with single component bridges where the diode bridge is wired internally.
**Basic operation**

According to the conventional model of current flow originally established by Benjamin Franklin and still followed by most engineers today, current is *assumed* to flow through electrical conductors from the **positive** to the **negative** pole. In actuality, free electrons in a conductor nearly always flow from the **negative** to the **positive** pole. In the vast majority of applications, however, the *actual* direction of current flow is irrelevant. Therefore, in the discussion below the conventional model is retained.

In the diagrams below, when the input connected to the **left** corner of the diamond is **positive**, and the input connected to the **right** corner is **negative**, current flows from the **upper** supply terminal to the right along the **red** (positive) path to the output, and returns to the **lower** supply terminal via the **blue** (negative) path.
When the input connected to the left corner is negative, and the input connected to the right corner is positive, current flows from the lower supply terminal to the right along the red path to the output, and returns to the upper supply terminal via the blue path.

In each case, the upper right output remains positive and lower right output negative. Since this is true whether the input is AC
or DC, this circuit not only produces a DC output from an AC input, it can also provide what is sometimes called "reverse polarity protection". That is, it permits normal functioning of DC-powered equipment when batteries have been installed backwards, or when the leads (wires) from a DC power source have been reversed, and protects the equipment from potential damage caused by reverse polarity.

Prior to availability of integrated electronics, such a bridge rectifier was always constructed from discrete components. Since about 1950, a single four-terminal component containing the four diodes connected in the bridge configuration became a standard commercial component and is now available with various voltage and current ratings.

**OUTPUT SMOOTHING**

For many applications, especially with single phase AC where the full-wave bridge serves to convert an AC input into a DC output, the addition of a capacitor may be desired because the bridge alone supplies an output of fixed polarity but
continuously varying or "pulsating" magnitude (see diagram above).

The function of this capacitor, known as a reservoir capacitor (or smoothing capacitor) is to lessen the variation in (or 'smooth') the rectified AC output voltage waveform from the bridge. One explanation of 'smoothing' is that the capacitor provides a low impedance path to the AC component of the output, reducing the AC voltage across, and AC current through, the resistive load. In less technical terms, any drop in the output voltage and current of the bridge tends to be canceled by loss of charge in the capacitor. This charge flows out as additional current through the load. Thus the change of load current and voltage is reduced relative to what would occur without the capacitor. Increases of
voltage correspondingly store excess charge in the capacitor, thus moderating the change in output voltage / current.

The simplified circuit shown has a well-deserved reputation for being dangerous, because, in some applications, the capacitor can retain a lethal charge after the AC power source is removed. If supplying a dangerous voltage, a practical circuit should include a reliable way to safely discharge the capacitor. If the normal load cannot be guaranteed to perform this function, perhaps because it can be disconnected, the circuit should include a bleeder resistor connected as close as practical across the capacitor. This resistor should consume a current large enough to discharge the capacitor in a reasonable time, but small enough to minimize unnecessary power waste.

Because a bleeder sets a minimum current drain, the regulation of the circuit, defined as percentage voltage change from minimum to maximum load, is improved. However in many cases the improvement is of insignificant magnitude.

The capacitor and the load resistance have a typical time constant $\tau = RC$ where $C$ and $R$ are the capacitance and load
resistance respectively. As long as the load resistor is large enough so that this time constant is much longer than the time of one ripple cycle, the above configuration will produce a smoothed DC voltage across the load.

In some designs, a series resistor at the load side of the capacitor is added. The smoothing can then be improved by adding additional stages of capacitor–resistor pairs, often done only for sub-supplies to critical high-gain circuits that tend to be sensitive to supply voltage noise.

The idealized waveforms shown above are seen for both voltage and current when the load on the bridge is resistive. When the load includes a smoothing capacitor, both the voltage and the current waveforms will be greatly changed. While the voltage is smoothed, as described above, current will flow through the bridge only during the time when the input voltage is greater than the capacitor voltage. For example, if the load draws an average current of n Amps, and the diodes conduct for 10% of the time, the average diode current during conduction must be 10n Amps. This non-sinusoidal current leads to harmonic distortion and a poor power factor in the AC supply.
In a practical circuit, when a capacitor is directly connected to the output of a bridge, the bridge diodes must be sized to withstand the current surge that occurs when the power is turned on at the peak of the AC voltage and the capacitor is fully discharged. Sometimes a small series resistor is included before the capacitor to limit this current, though in most applications the power supply transformer's resistance is already sufficient.

Output can also be smoothed using a choke and second capacitor. The choke tends to keep the current (rather than the voltage) more constant. Due to the relatively high cost of an effective choke compared to a resistor and capacitor this is not employed in modern equipment.

Some early console radios created the speaker's constant field with the current from the high voltage ("B +") power supply, which was then routed to the consuming circuits, (permanent magnets were then too weak for good performance) to create the speaker's constant magnetic field. The speaker field coil thus performed 2 jobs in one: it acted as a choke, filtering the power supply, and it produced the magnetic field to operate the speaker.
REGULATOR IC (78XX)

It is a three pin IC used as a voltage regulator. It converts unregulated DC current into regulated DC current.

Normally we get fixed output by connecting the voltage regulator at the output of the filtered DC (see in above diagram). It can also be used in circuits to get a low DC voltage from a high DC voltage (for example we use 7805 to get 5V from 12V). There are two types of voltage regulators 1. fixed voltage
regulators (78xx, 79xx) 2. variable voltage regulators (LM317)
In fixed voltage regulators there is another classification 1. +ve voltage regulators 2. -ve voltage regulators POSITIVE VOLTAGE REGULATORS This include 78xx voltage regulators. The most commonly used ones are 7805 and 7812. 7805 gives fixed 5V DC voltage if input voltage is in (7.5V, 20V).

The Capacitor Filter

The simple capacitor filter is the most basic type of power supply filter. The application of the simple capacitor filter is very limited. It is sometimes used on extremely high-voltage, low-current power supplies for cathode-ray and similar electron tubes, which require very little load current from the supply. The capacitor filter is also used where the power-supply ripple frequency is not critical; this frequency can be relatively high. The capacitor (C1) shown in figure 4-15 is a simple filter connected across the output of the rectifier in parallel with the load.
Full-wave rectifier with a capacitor filter.

When this filter is used, the RC charge time of the filter capacitor (C₁) must be short and the RC discharge time must be long to eliminate ripple action. In other words, the capacitor must charge up fast, preferably with no discharge at all. Better filtering also results when the input frequency is high; therefore, the full-wave rectifier output is easier to filter than that of the half-wave rectifier because of its higher frequency.

For you to have a better understanding of the effect that filtering has on $E_{\text{avg}}$, a comparison of a rectifier circuit with a filter and one without a filter is illustrated in views A and B of figure 4-16. The output waveforms in figure 4-16 represent the unfiltered and filtered outputs of the half-wave rectifier circuit. Current pulses flow through the load resistance ($R_L$) each time a diode conducts. The dashed line indicates the average value of output voltage. For the half-wave rectifier, $E_{\text{avg}}$ is less than half (or
approximately 0.318) of the peak output voltage. This value is still much less than that of the applied voltage. With no capacitor connected across the output of the rectifier circuit, the waveform in view A has a large pulsating component (ripple) compared with the average or dc component. When a capacitor is connected across the output (view B), the average value of output voltage ($E_{avg}$) is increased due to the filtering action of capacitor C1.

**UNFILTERED**

Half-wave rectifier with and without filtering.
The value of the capacitor is fairly large (several microfarads), thus it presents a relatively low reactance to the pulsating current and it stores a substantial charge.

The rate of charge for the capacitor is limited only by the resistance of the conducting diode, which is relatively low. Therefore, the RC charge time of the circuit is relatively short. As a result, when the pulsating voltage is first applied to the circuit, the capacitor charges rapidly and almost reaches the peak value of the rectified voltage within the first few cycles. The capacitor attempts to charge to the peak value of the rectified voltage anytime a diode is conducting, and tends to retain its charge when the rectifier output falls to zero. (The capacitor cannot discharge immediately.) The capacitor slowly
discharges through the load resistance ($R_L$) during the time the rectifier is non-conducting.

The rate of discharge of the capacitor is determined by the value of capacitance and the value of the load resistance. If the capacitance and load-resistance values are large, the RC discharge time for the circuit is relatively long.

A comparison of the waveforms shown in figure 4-16 (view A and view B) illustrates that the addition of C1 to the circuit results in an increase in the average of the output voltage ($E_{avg}$) and a reduction in the amplitude of the ripple component ($E_r$) which is normally present across the load resistance.

Now, let's consider a complete cycle of operation using a half-wave rectifier, a capacitive filter (C1), and a load resistor ($R_L$). As shown in view A of figure 4-17, the capacitive filter (C1) is assumed to be large enough to ensure a small reactance to the pulsating rectified current. The resistance of $R_L$ is assumed to be much greater than the reactance of C1 at the input frequency. When the circuit is energized, the diode conducts on the positive half cycle and current flows through the circuit, allowing C1 to
charge. C1 will charge to approximately the peak value of the input voltage. (The charge is less than the peak value because of the voltage drop across the diode (D1)). In view A of the figure, the charge on C1 is indicated by the heavy solid line on the waveform. As illustrated in view B, the diode cannot conduct on the negative half cycle because the anode of D1 is negative with respect to the cathode. During this interval, C1 discharges through the load resistor (R\textsubscript{L}). The discharge of C1 produces the downward slope as indicated by the solid line on the waveform in view B. In contrast to the abrupt fall of the applied ac voltage from peak value to zero, the voltage across C1 (and thus across R\textsubscript{L}) during the discharge period gradually decreases until the time of the next half cycle of rectifier operation. Keep in mind that for good filtering, the filter capacitor should \textit{charge} up as \textit{fast} as possible and \textit{discharge} as \textit{little} as possible.

Figure 4-17A. - Capacitor filter circuit (positive and negative half cycles). POSITIVE HALF-CYCLE
Figure 4-17B. - Capacitor filter circuit (positive and negative half cycles). NEGATIVE HALF-CYCLE

Since practical values of C1 and RL ensure a more or less gradual decrease of the discharge voltage, a substantial charge remains on the capacitor at the time of the next half cycle of operation. As a result, no current can flow through the diode until the rising ac input voltage at the anode of the diode exceeds
the voltage on the charge remaining on C1. The charge on C1 is the cathode potential of the diode. When the potential on the anode exceeds the potential on the cathode (the charge on C1), the diode again conducts, and C1 begins to charge to approximately the peak value of the applied voltage.

After the capacitor has charged to its peak value, the diode will cut off and the capacitor will start to discharge. Since the fall of the ac input voltage on the anode is considerably more rapid than the decrease on the capacitor voltage, the cathode quickly become more positive than the anode, and the diode ceases to conduct.

Operation of the simple capacitor filter using a full-wave rectifier is basically the same as that discussed for the half-wave rectifier. Referring to figure 4-18, you should notice that because one of the diodes is always conducting on either alternation, the filter capacitor charges and discharges during each half cycle. (Note that each diode conducts only for that portion of time when the peak secondary voltage is greater than the charge across the capacitor.)
Another thing to keep in mind is that the ripple component \( (E_r) \) of the output voltage is an ac voltage and the average output voltage \( (E_{avg}) \) is the dc component of the output. Since the filter capacitor offers a relatively low impedance to ac, the majority of the ac component flows through the filter capacitor. The ac component is therefore bypassed (shunted) around the load resistance, and the entire dc component (or \( E_{avg} \)) flows through the load resistance. This statement can be clarified by using the formula for \( X_C \) in a half-wave and full-wave rectifier. First, you must establish some values for the circuit.
HALFWAVE RECTIFIER

FREQUENCY AT
RECTIFIER OUTPUT: 60 Hz

VALUE OF FILTER
CAPACITOR: 30μF

LOAD RESISTANCE: 10kΩ

\[ X_c = \frac{1}{2\pi fC} \]
\[ X_c = \frac{0.159}{\text{fC}} \]
\[ X_c = \frac{0.159}{60 \times 0.000030} \]
\[ X_c = \frac{0.159}{0.0018} \]
\[ X_c = 88.3\Omega \]

FREQUENCY AT
RECTIFIER OUTPUT: 120Hz

VALUE OF FILTER
CAPACITOR: 30μF

LOAD RESISTANCE: 10kΩ

\[ X_c = \frac{1}{2\pi fC} \]
\[ X_c = \frac{159}{\text{fC}} \]
\[ X_c = \frac{159}{120 \times 0.000030} \]
\[ X_c = \frac{159}{0.0036} \]
\[ X_c = 44.16\Omega \]
As you can see from the calculations, by doubling the frequency of the rectifier, you reduce the impedance of the capacitor by one-half. This allows the ac component to pass through the capacitor more easily. As a result, a full-wave rectifier output is much easier to filter than that of a half-wave rectifier. Remember, the smaller the $X_C$ of the filter capacitor with respect to the load resistance, the better the filtering action. Since

$$X_C = \frac{1}{2\pi fC}$$

the largest possible capacitor will provide the best filtering.

Remember, also, that the load resistance is an important consideration. If load resistance is made small, the load current increases, and the average value of output voltage ($E_{avg}$) decreases. The RC discharge time constant is a direct function of the value of the load resistance; therefore, the rate of capacitor voltage discharge is a direct function of the current through the load. The greater the load current, the more rapid the discharge of the capacitor, and the lower the average value of output voltage. For this reason, the simple capacitive filter is seldom used with rectifier circuits that must supply a relatively large
load current. Using the simple capacitive filter in conjunction with a full-wave or bridge rectifier provides improved filtering because the increased ripple frequency decreases the capacitive reactance of the filter capacitor.

CIRCUIT DIAGRAM OF POWER SUPPLY
DTMF DECODER

Today, most telephone equipment use a DTMF receiver IC. One common DTMF receiver IC is the Motorola MT8870 that is widely used in electronic communications circuits. The MT8870 is an 18-pin IC. It is used in telephones and a variety of other applications. When a proper output is not obtained in projects using this IC, engineers or technicians need to test this IC separately. A quick testing of this IC could save a lot of time in re-search labs and manufacturing industries of communication instruments. Here’s a small and handy tester circuit for the DTMF IC. It can be assembled on a multipurpose PCB with an 18-pin IC base. One can also test the IC on a simple breadboard.

For optimum working of telephone equipment, the DTMF receiver must be designed to recognize a valid tone pair greater than 40 ms in duration and to accept successive digit tone-pairs that are greater than 40 ms apart. However, for other applications like remote controls and radio communications, the tone duration may differ due to noise considerations. Therefore, by adding an extra resistor and steering diode the tone duration
can be set to different values. The circuit is configured in balanced-line mode. To reject common-mode noise signals, a balanced differential amplifier input is used. The circuit also provides an excellent bridging interface across a properly terminated telephone line. Transient protection may be achieved by splitting the input resistors and inserting ZENER diodes (ZD1 and ZD2) to achieve voltage clamping. This allows the transient energy to be dissipated in the resistors and diodes, and limits the maximum voltage that may appear at the inputs.

Whenever you press any key on your local telephone keypad, the delayed steering (Std) output of the IC goes high on receiving the tone-pair, causing LED5 (connected to pin 15 of IC via resistor R15) to glow. It will be high for a duration depending on the values of capacitor and resistors at pins 16 and 17. The optional circuit shown within dot-ted line is used for guard time adjustment.

The LEDs connected via resistors R11 to R14 at pins 11 through 14, respectively, indicate the output of the IC. The tone-pair DTMF (dual-tone multi-frequency) generated by pressing the telephone button is converted into bi-nary values internally in
the IC. The binary values are indicated by glowing of LEDs at
the output pins of the IC. LED1 represents the lowest signifi-
cant bit (LSB) and LED4 represents the most significant bit
(MSB). So, when you dial a number, say, 5, LED1 and LED3
will glow, which is equal to 0101. Similarly, for every other
number dialed on your telephone, the corresponding LEDs will
glow. Thus, a non-defective IC should indicate proper bi-nary
values corresponding to the decimal number pressed on your
telephone key-pad.

To test the DTMF IC 8870/KT3170, proceed as follows:

- Connect local telephone and the circuit in parallel to the
  same telephone line.

- Switch on S1. (Switch on auxiliary switch S2 only if keys
  A, B, C, and D are to be used.)

- Now push key ‘*’ to generate DTMF tone.

- Push any decimal key from the telephone keypad.
• Observe the equivalent binary as shown in the table.

• If the binary number implied by glowing of LED1 to LED4 is equivalent to the pressed key number (decimal/A, B, C, or D), the DTMF IC 8870 is correct.

Keys A, B, C, and D on the telephone keypad are used for special signaling and are not available on standard pushbutton telephone keypads. Pin 5 of the IC is pulled down to ground through resistor R8. Switch on auxiliary switch S2. Now the high logic at pin 5 enables the detection of tones representing characters A, B, C, and D.
**DIODE**

The diode is a p-n junction device. Diode is the component used to control the flow of the current in any one direction. The diode widely works in forward bias.

![Diode Symbol](image)

Figure No. 1.13: Diode

Diode When the current flows from the P to N direction. Then it is in forward bias. The Zener diode is used in reverse bias function i.e. N to P direction. Visually the identification of the diode`s terminal can be done by identifying he silver/black line. The silver/black line is the negative terminal (cathode) and the other terminal is the positive terminal (cathode).

**APPLICATION**

• Diodes: Rectification, free-wheeling, etc

• Zener diode: Voltage control, regulator etc.
• Tunnel diode: Control the current flow, snobbier circuit, etc

**RESISTORS**

The flow of charge through any material encounters an opposing force similar in many respects to mechanical friction. This opposing force is called resistance of the material. In some electric circuit resistance is deliberately introduced in form of resistor. Resistor used fall in three categories, only two of which are color coded which are metal film and carbon film resistor. The third category is the wire wound type, where value are generally printed on the vitreous paint finish of the component. Resistors are in ohms and are represented in Greek letter omega, looks as an upturned horseshoe. Most electronic circuit require resistors to make them work properly and it is obliviously important to find out something about the different types of resistors available. Resistance is measured in ohms, the symbol for ohm is an omega ohm. 1 ohm is quite small for electronics so resistances are often given in kohm and Mohm.

Resistors used in electronics can have resistances as low as 0.1 ohm or as high as 10 Mohm.
**FUNCTION**

Resistor restrict the flow of electric current, for example a resistor is placed in series with a light-emitting diode (LED) to limit the current passing through the LED.

**TYPES OF RESISTORS**

**FIXED VALUE RESISTORS**

It includes two types of resistors as carbon film and metal film. These two types are explained under

**CARBON FILM RESISTORS**

During manufacture, at in film of carbon is deposited onto a small ceramic rod. The resistive coating is spiraled away in an automatic machine until the resistance between there two ends of the rods is as close as possible to the correct value. Metal leads and end caps are added, the resistors is covered with an
insulating coating and finally painted with colored bands to indicate the resistor value

Carbon Film Resistors

Another example for a Carbon 22000 Ohms or 22 Kilo-Ohms also known as 22K at 5% tolerance: Band 1 = Red, 1st digit Band 2 = Red, 2nd digit Band 3 = Orange, 3rd digit, multiply with zeros, in this case 3 zero's Band 4 = Gold, Tolerance, 5%

METAL FILM RESISTORS

Metal film and metal oxides resistors are made in a similar way, but can be made more accurately to within ±2% or ±1% of their nominal value there are some difference in performance between these resistor types, but none which affects their use in simple circuit.
WIRE WOUND RESISTOR

A wire wound resistor is made of metal resistance wire, and because of this, they can be manufactured to precise values. Also, high wattage resistors can be made by using a thick wire material. Wire wound resistors cannot be used for high frequency circuits. Coils are used in high frequency circuit. Wire wound resistors in a ceramic case, strengthened with special cement. They have very high power rating, from 1 or 2 watts to dozens of watts. These resistors can become extremely hot when used for high power application, and this must be taken into account when designing the circuit.

TESTING

Resistors are checked with an ohm meter/millimeter. For a defective resistor the ohm-meter shows infinite high reading.

CAPACITORS

In a way, a capacitor is a little like a battery. Although they work in completely different ways, capacitors and batteries both store electrical energy. If you have read How Batteries Work,
then you know that a battery has two terminals. Inside the battery, chemical reactions produce electrons on one terminal and absorb electrons at the other terminal.

**BASIC**

Like a battery, a capacitor has two terminals. Inside the capacitor, the terminals connect to two metal plates separated by a dielectric. The dielectric can be air, paper, plastic or anything else that does not conduct electricity and keeps the plates from touching each other. You can easily make a capacitor from two pieces of aluminum foil and a piece of paper. It won't be a particularly good capacitor in terms of its storage capacity, but it will work.

In an electronic circuit, a capacitor is shown like this:
When you connect a capacitor to a battery, here’s what happens:

• The plate on the capacitor that attaches to the negative terminal of the battery accepts electrons that the battery is producing.

• The plate on the capacitor that attaches to the positive terminal of the battery loses electrons to the battery.

![Figure No. 1.18: Capacitor & Battery Connection](image)

**TESTING**

To test the capacitors, either analog meters or special digital meters with the specified function are used. The non-electrolyte capacitor can be tested by using the digital meter.

- **Multi – meter mode** : Continuity
- **Positive probe** : One end
- **Negative probe** : Second end
- **Display** : `0` (beep sound occur) `OL`
- **Result** : Faulty OK
**LED**

LED falls within the family of P-N junction devices. The light emitting diode (LED) is a diode that will give off visible light when it is energized. In any forward biased P-N junction there is, with in the structure and primarily close to the junction, a recombination of hole and electrons. This recombination requires that the energy possessed by the unbound free electron be transferred to another state. The process of giving off light by applying an electrical source is called electroluminescence.

![LED diagram](image)

Figure No. 1.19: LED & LED Symbol

LED is a component used for indication. All the functions being carried out are displayed by led. The LED is diode which glows when the current is being flown through it in forward bias.
condition. The LEDs are available in the round shell and also in the flat shells. The positive leg is longer than negative leg.

**DC MOTOR**

DC Motor has two leads. It has bidirectional motion

- If we apply +ve to one lead and ground to another motor will rotate in one direction, if we reverse the connection the motor will rotate in opposite direction.

- If we keep both leads open or both leads ground it will not rotate (but some inertia will be there).

- If we apply +ve voltage to both leads then braking will occurs.
H-BRIDGE

This circuit is known as H-Bridge because it looks like "H".

Working principle of H-Bridge.

- If switch (A1 and A2) are on and switch (B1 and B2) are off, then motor rotates in clockwise direction.
- If switch (B1 and B2) are on and switch (A1 and A2) are off, then motor rotates in anti-clockwise direction.
- We can use transistor, MOSFETs as a switch (Study the transistor as a switch).

**H-Bridge I.C (L293D)**

L293D is a H-Bridge I.C. Its contain two H-Bridge pair.
**Truth Table**

<table>
<thead>
<tr>
<th>Input 1</th>
<th>Input 2</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>No rotation</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>Clockwise rotation</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>Anti clockwise rotation</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>break</td>
</tr>
</tbody>
</table>

**Note:**

- Connect motors pins on output 1 and output 2 and control signal at input 1 and input 2 will control the motion
- Connect another motor pins on output 3 and output 4 and control signal at input 3 and input 4
- Truth table for i/p 3 and i/p 4 is same as above shown
- 0 means 0 V or Low
- 1 means High or +5V
• In Enable 1 and Enable 2 if you give high then you observe hard stop in condition 0 0 and 11. Unless slow stop of motor on low signal
• Required Motor voltage has given on pin 8 (Vs) i.e 12V DC – 24V DC

SCHEMATIC OF L293D WITH DC MOTOR
The μ Vision IDE is, for most developers, the easiest way to create embedded system programs. This chapter describes commonly used μ Vision features and explains how to use them.

**General Remarks and Concepts**

Before we start to describe how to use μVision, some general remarks, common to many screens and to the behavior of the development tool, are presented. In our continuous effort to deliver best-in-class development tools, supporting you in your daily work, μVision has been built to resemble the look-and-feel of widespread applications. This approach decreases your learning curve, such that you may start to work with μ Vision right away.

Based on the concept of windows:
μVision windows can be re-arranged, tiled, and attached to other screen areas or windows respectively. It is possible to drag and drop windows, objects, and variables.

A Context Menu, invoked through the right mouse button, is provided for most objects. You can use keyboard shortcuts and define your own shortcuts. You can use the abundant features of a modern editor. Menu items and Toolbar buttons are greyed out when not available in the Current context.

Graphical symbols are used to resemble options, to mark unsaved changes, or reveal objects not included into the project. Status Bars display context-driven information. You can associate μVision to third-party tools.
The **Project Windows** area is that part of the screen in which, by default, the Project Window, Functions Window, Books Window, and Registers Window are displayed.

Within the **Editor Windows** area, you are able to change the source code, view performance and analysis information, and check the disassembly code.

The **Output Windows** area provides information related to debugging, memory, symbols, call stack, local variables, commands, browse information, and find in files results.

If, for any reason, you do not see a particular window and have tried displaying/hiding it several times, please invoke the default layout of μVision through the **Window – Reset Current Layout** Menu.

**Positioning Windows**

The μVision windows may be placed onto any area of the screen, even outside of the μVision frame, or to another physical screen.
Click and hold the **Title Bar** of a window with the left mouse button

Drag the window to the preferred area, or onto the preferred control, and release the mouse button

Please note, source code files cannot be moved outside of the **Editor Windows**. Invoke the **Context Menu** of the window’s **Title Bar** to change the docking attribute of a window object. In some cases, you must perform this action before you can drag and drop the window.

µVision displays docking helper controls, emphasizing the area where the window will be attached. The new docking area is represented by the section highlighted in blue. Snap the window to the Multiple Document Interface (MDI) or to a Windows area by moving the mouse over the preferred control.
Keil software converts the C-codes into the Intel Hex code.

A view of Keil uVision 3
A view of Keil uVision 3
8051 Burner Software

PRO51 BURNER provides you with software burning tools for 8051 based Microcontrollers in their Flash memory. The 51 BURNER tools, you can burn AT89SXXXX series of ATMEL microcontrollers.
PRO 51

PRO51 - Programmer for C51 family

Features of PRO51

- Flash Programmer for 89C1051, 89C2051, 89C4051, 89S51, 89S52, 89C51 and 89C52 micros.
- Operates on single 5V supply which can be taken from USB Port of PC.
- User friendly windows based Graphics User Interface.
- Interfaces with PC through COM1 or COM2 serial ports.

System Requirements

- PC with at least one serial and one USB ports and at least 600x800 VGA resolution.
- If USB port is not available you need a regulated +5V supply.
- Windows operating system
Package Contents

- PRO51 unit
- Interface Cable between PC and PRO51
- CD containing PROG51 software

Getting Started

1. Install PROG51 programs using setup from the CD. This would normally create these programs in a program group INFONICS. You may like to create a separate folder like INFONICS on your disk where these programs will be installed.
2. Connect PRO51 to COM port and USB on your PC using the Y cable provided with PRO51. Follow instruction given in the following sections.

PROG51 User Interface
Prog51 is used for programming the 89C1051, 89C2051 and 89C4051 Microcontrollers. User interface includes:

- Load Hex/Binary file in Buffer
- Save Buffer as Binary File
- Display / Specify Target Device to be Programmed.
- Com Port Selection.
- Identify Target Device with the device specified by you in the designated area.
- Read Microcontroller Program in Buffer
- Erase Microcontroller Program Memory
- Check if Target Device is Erased
- Program Buffer Contents in Target device
- Verify the Device contents with data in the buffer

3. Lock Target Device. Once the device is locked it can not be read or verified.
Procedure to Program a Chip

1. Connect the PRO51 to COM port and USB port on your PC. USB is used for +5V power supply only. You can use regulated 5V supply and connect it on pin 4 of the 9 Pin connector.
2. Start PROG51 from your program menu.
3. Select appropriate com port on your PC.
4. Insert desired device in the ZIF socket on PRO51. 20 Pin devices like 89C2051 should be aligned with the bottom side,
i.e., pin 10 on the 89C2051 should be inserted in Pin 20 of the socket.

5. Specify the device in the target device text box.

6. Click Identify button to check if the device inserted matches with the one you specified in the Target Device text box.

7. Load Hex or Binary file generated using compiler or assembler in the buffer.

8. Click on Erase button to erase the contents of the flash memory of the microcontroller. Erase process will automatically be followed by a blank check.

9. Click on Program button to write the buffer contents in to the program memory of the microcontroller. Program action will automatically be followed by a verify cycle.

10. If you wish click on Lock button to secure the device.

11. Remove the device from ZIF socket.
Block Diagram of PRO51
### Pin description of 9 PIN male connector on PRO51

<table>
<thead>
<tr>
<th>Pin</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NC</td>
<td>Not connected</td>
</tr>
<tr>
<td>2</td>
<td>RXD</td>
<td>Serial Port Receive Data. This pin should be connected to TXD pin of COM port on PC.</td>
</tr>
<tr>
<td>3</td>
<td>TXD</td>
<td>Serial Port Transmit Data. This pin should be connected to RXD pin of COM port on PC.</td>
</tr>
<tr>
<td>4</td>
<td>VCC</td>
<td>+5V supply for the PRO51. It must be regulated supply. Cable supplied with the device draws power from the USB port of your PC. If you wish to use any other source of power the same should be connected to this pin.</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Signal and power ground for serial port and 5V power supply.</td>
</tr>
<tr>
<td>Pin</td>
<td>Description</td>
<td>Notes</td>
</tr>
<tr>
<td>-----</td>
<td>-------------</td>
<td>-------</td>
</tr>
<tr>
<td>6</td>
<td>RXDEN</td>
<td>If this pin is left open or pulled up (&gt;3V) then RXD signal received at PIN 2 above is sent to the CPU. If you wish to disable the RXD signal then this PIN should be pulled –Ve. With the standard cable supplied by Infonics this pin is connected to the DSR signal of COM port. Therefore, the DSR must high to enable the RXD.</td>
</tr>
<tr>
<td>7</td>
<td>NC</td>
<td>Not connected</td>
</tr>
<tr>
<td>8</td>
<td>RESET</td>
<td>A high (&gt; 3V) on this pin will reset the PRO51. With the standard cable supplied by Infonics this pin is connected to the RTS signal of COM port. Therefore, the RTS must be kept low for proper operation of the PRO51. A high pulse on RTS can be used to reset the device.</td>
</tr>
<tr>
<td>9</td>
<td>NC</td>
<td>Not connected</td>
</tr>
</tbody>
</table>
CONSTRUCTION AND TESTING

CONSTRUCTION

In the process of realizing this project, the construction was initially carried out on a breadboard to allow for checking and to ascertain that it is functioning effectively. All irregularities were checked then tested and found to have a satisfactory output. The component were then removed and transferred to a Vero board strip and soldered into place and all discontinuous point were cut out to avoid short-circuiting.

PRECAUTIONS

SOLDERING PRECAUTIONS

The construction was carried out with care. The precautions taken during the soldering were:

- The tip of soldering iron was kept clean with the help of a file from time to time.
- The solder wire was of smaller thickness.
• Extra solder was not used in order to avoid a cause of short circuit in the conductive path.
• The overheating of components was avoided to prevent component damage as a result of excessive heat on the components due to the heat from the soldering iron.
• The leads of the components were kept clean before soldering, with the use of sand paper.

COMPONENTS PRECAUTION:

• IR sensor used should be sensitive. Before using in the circuit it should be tested with a multi-meter.
• I.C should not be heated much while soldering; too much heat can destroy the I.C. For safety and ease of replacement, the use of I.C socket is suggested.
• While placing the I.C pin no 1 should be made sure at right hole.
• Opposite polarity of battery can destroy I.C so please check the polarity before switching ON the circuit. One
should use diode in series with switch for safety since diode allows flowing current in one direction only.

- Each component was soldered neatly and clean.
- We should use insulated wires.

**TESTING OF PROJECT**

With the knowledge of operation of the system was tested step by step to the transistor output and the load was connected across the collector terminal of the transistor.

**ASSEMBLING**

The whole system was packed in a plastic casing and provision was made for the IR to sense light from the outside.
REFERENCES

➤ “8051 and embedded system” by Mazidi and Mazidi
➤ All datasheets from www.datasheetcatalog.com
➤ About AT89s8252 from www.atmel.com

And www.triindia.co.in