



OVERTAKE ASSIST

A PROJECT REPORT

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ABSTRACT

the main objective of this project is to prevent accidents while driving four wheelers. To prevent accidents that occur due to ambiguous conditions of decision making while performing an overtake.

Most of the time people meet with accidents while performing an overtake because their perception of time taken to perform an overtake may go wrong. So we came along with a solution that would help to assist the driver in performing an overtake by ringing an alarm.

This project makes use of ultrasonic sensors so as to measure speed and distance of opposite vehicles and a microcontroller so as to perform calculation and to find the probability of the overtake and conclude if to perform an overtake or not.

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1. CHAPTER

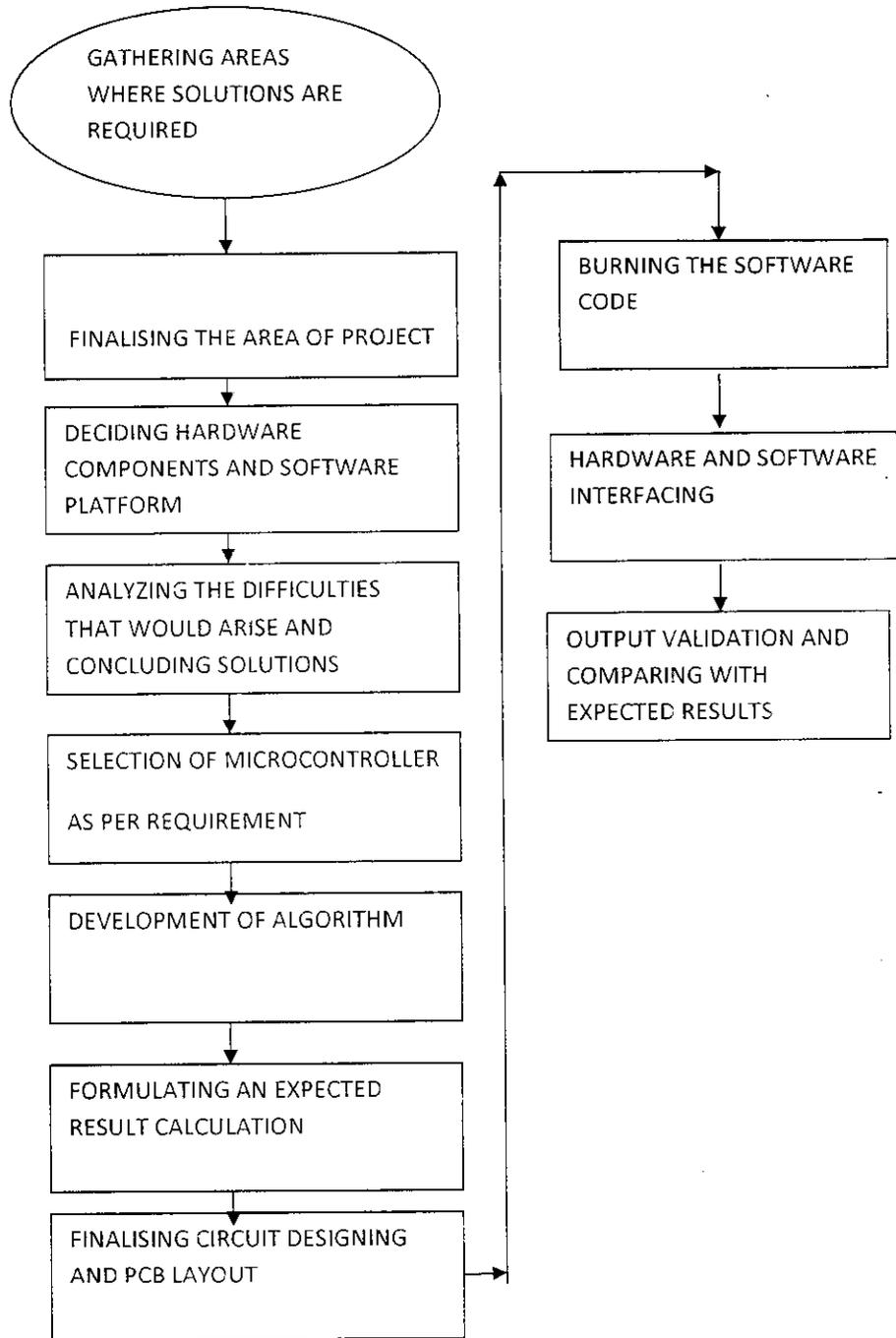
INTRODUCTION

1.1 CASE STUDY:

Incidentally, India holds the dubious distinction of registering the highest number of road accidents in the world. According to the experts at the National Transportation Planning and Research Centre (NTPRC) the number of road accidents in India is three times higher than that prevailing in developed countries. The number of accidents for 1000 vehicles in India is as high as 35 while the figure ranges from 4 to 10 in developed countries.

So, why do accidents happen? 80% of road accidents are caused human error say senior police officials, according to a news report in the TOI today. Although no nationwide study as to the causes of road accidents in India is available on the internet, there are smaller studies which confirm these findings.

1.3 STEPS IN COMPLETION OF PROJECT



2 CHAPTER

METHODOLOGY

2.1 BLOCK DIAGRAM:

the figure shown below gives a clear picture of the OVERTAKE ASSIST . the various blocks include,

- 1.ultrasonic transmitter
- 2.ultrasonic receiver
- 3.oscillator
- 4.microcontroller
- 5.driver circuit for motor
- 6.motor
- 7.speed sensor
- 8.display
- 9.alarm

BLOCK DIAGRAM

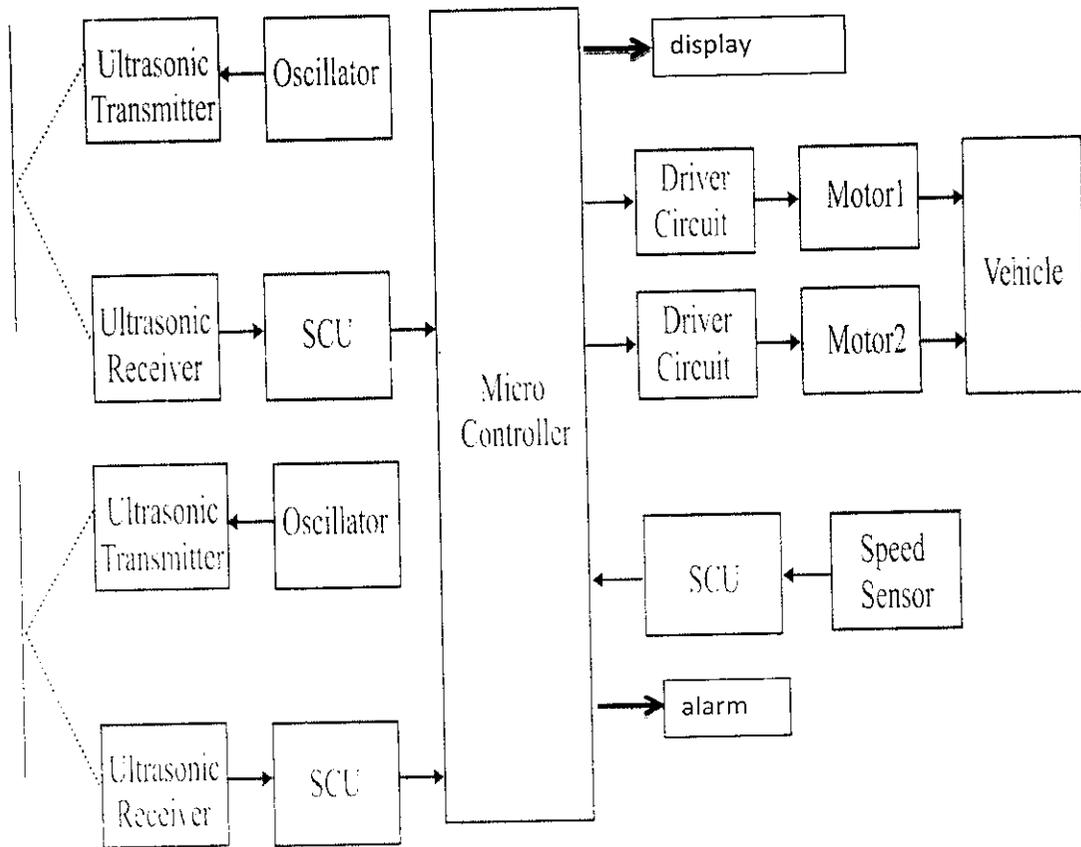


FIG 1 BLOCK DIAGRAM

2.2 SENSORS

2.2.1 DIFFICULTIES ENCOUNTERED IN CHOOSING SENSORS

This project started after we looked at the Polaroid Ultrasonic Ranging module. It has a number of disadvantages for use in small robots etc.

1. The maximum range of 10.7 meter is far more than is normally required, and as a result
2. The current consumption, at 2.5 Amps during the sonic burst is truly horrendous.
3. The 150mA quiescent current is also far too high.
4. The minimum range of 26cm is useless. 1-2cm is more like it.
5. The module is quite large to fit into small systems, and
6. It's EXPENSIVE.

2.2.2 ULTRASONIC SENSORS:

Considering the various disadvantages of the polaroid ultrasonic ranging module we analysed the ultrasonic sensor module which proved to satisfy our requirements and had the following advantages.

It is less expensive and gave us a wide range of around starting from 1 inch to 80 inches and it was also a power efficient module and had a quicker response time.

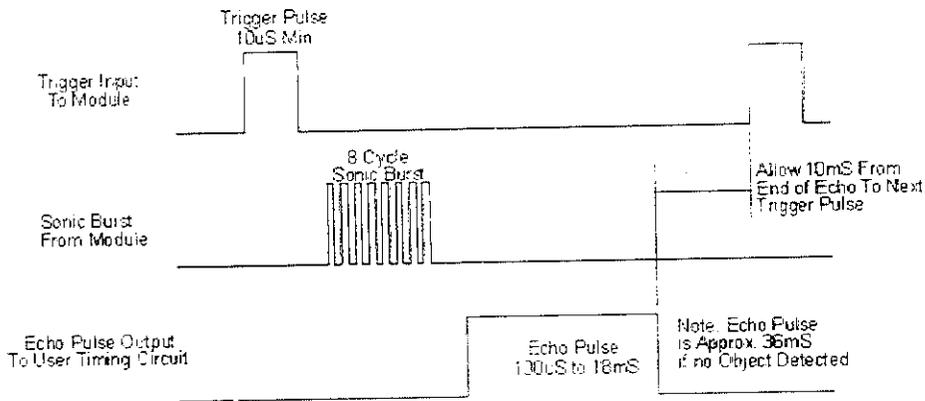
2.2.2.1 INTRODUCTION TO ULTRASONIC SENSORS

Ultrasonic sensors (also known as **transceivers** when they both send and receive) work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object.

This technology can be used for measuring: wind speed and direction (anemometer), fullness of a tank and speed through air or water. For measuring speed or direction a device uses multiple detectors and calculates the speed from the relative distances to particulates in the air or water. To measure the amount of liquid in a tank, the sensor measures the distance to the surface of the fluid. Further applications include: humidifiers, sonar, medical ultrasonography, burglar alarms and non-destructive testing.

Systems typically use a transducer which generates sound waves in the ultrasonic range, above 18,000 hertz, by turning electrical energy into sound, then upon receiving the echo turn the sound waves into electrical energy which can be measured and displayed.

The technology is limited by the shapes of surfaces and the density or consistency of the material. For example foam on the surface of a fluid in a tank could distort a reading.



The circuit is designed to be low cost. It uses a PIC12C508 to perform the control functions and standard 40KHz piezo transducers. The drive to the transmitting transducer could be simplest driven directly from the PIC. The 5v drive can give a useful range for large objects, but can be problematic detecting smaller objects. The transducer can handle 20v of drive, so I decided to get up close to this level. A MAX232 IC, usually used for RS232 communication makes an ideal driver, providing about 16v of drive.

The receiver is a classic two stage op-amp circuit. The input capacitor C8 blocks some residual DC which always seems to be present. Each gain stage is set to 24 for a total gain of 576-ish. This is close to the 25 maximum gain available using the LM1458. The gain bandwidth product for the LM1458 is 1Mhz. The maximum gain at 40KHz is $1000000/40000 = 25$. The output of the amplifier is fed into an LM311 comparator. A small amount of positive feedback provides some hysteresis to give a clean stable output.

The problem of getting operation down to 1-2cm is that the receiver will pick up direct coupling from the transmitter, which is right next to it. To make matters

worse the piezo transducer is a mechanical object that keeps resonating some time after the drive has been removed. Up to 1mS depending on when you decide it has stopped. It is much harder to tell the difference between this direct coupled ringing and a returning echo, which is why many designs, including the Polaroid module, simply blank out this period. Looking at the returning echo on an oscilloscope shows that it is much larger in magnitude at close quarters than the cross-coupled signal. I therefore adjust the detection threshold during this time so that only the echo is detectable. The 100nF capacitor C10 is charged to about -6v during the burst. This discharges quite quickly through the 10k resistor R6 to restore sensitivity for more distant echo's.

A convenient negative voltage for the op-amp and comparator is generated by the MAX232. Unfortunately, this also generates quite a bit of high frequency noise. I therefore shut it down whilst listening for the echo. The 10uF capacitor C9 holds the negative rail just long enough to do this.

In operation, the processor waits for an active low trigger pulse to come in. It then generates just eight cycles of 40KHz. The echo line is then raised to signal the host processor to start timing. The raising of the echo line also shuts off the MAX232. After a while - no more than 10-12mS normally, the returning echo will be detected and the PIC will lower the echo line. The width of this pulse represents the flight time of the sonic burst. If no echo is detected then it will automatically time out after about 30mS (Its two times the WDT period of the PIC). Because the MAX232 is shut down during echo detection, you must wait at least 10mS between measurement cycles for the +/- 10v to recharge.

Performance of this design is, I think, quite good. It will reliably measure down to 3cm and will continue detecting down to 1cm or less but after 2-3cm the pulse width doesn't get any smaller.

Maximum range is a little over 3m. As an example of the sensitivity of this design, it will detect a 1inch thick plastic broom handle at 2.4m. Average current consumption is reasonable at less than 50mA and typically about 30mA.

2.2.2.3 Calculating the Distance

The sensor provides an echo pulse proportional to distance. If the width of the pulse is measured in μs , then dividing by 58 will give you the distance in cm, or dividing by 148 will give the distance in inches. $\mu\text{s}/58=\text{cm}$ or $\mu\text{s}/148=\text{inches}$.

2.2.3 INFRARED SENSORS

Infrared transmitter is one type of LED which emits infrared rays generally called as IR Transmitter. Similarly IR Receiver is used to receive the IR rays transmitted by the IR transmitter. One important point is both IR transmitter and receiver should be placed straight line to each other.

The transmitted signal is given to IR transmitter whenever the signal is high, the IR transmitter LED is conducting it passes the IR rays to the receiver. The IR receiver is connected with comparator. The comparator is constructed with LM 358 operational amplifier. In the comparator circuit the reference voltage is given to inverting input terminal. The non inverting input terminal is connected IR receiver. When interrupt the IR rays between the IR transmitter and receiver, the IR receiver is not conducting. So the comparator non inverting input terminal voltage is higher than inverting input. Now the comparator output is in the range of +5V. This voltage is given to microcontroller or PC and led so led will glow.

When IR transmitter passes the rays to receiver, the IR receiver is conducting due to that non inverting input voltage is lower than inverting input. Now the comparator output is GND so the output is given to microcontroller or PC. This circuit is mainly used to for counting application, intruder detector etc.

2.2.3.1 CIRCUIT DIAGRAM

IR TRANSMITTER AND RECEIVER

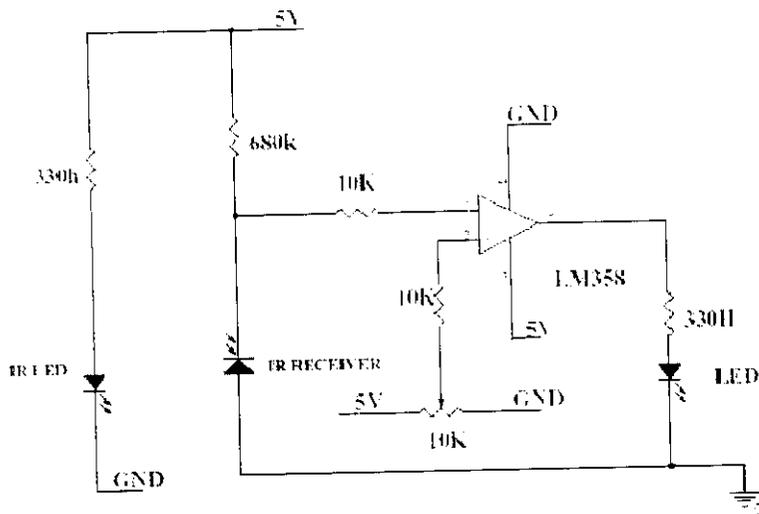


FIG 2 IR TRANSMITTER AND RECEIVER

CHAPTER 3

COMPONENTS DESCRIPTION

3.1 DC MOTOR FORWARD /REVERSE CONTROL

3.1.1 CIRCUIT DIAGRAM

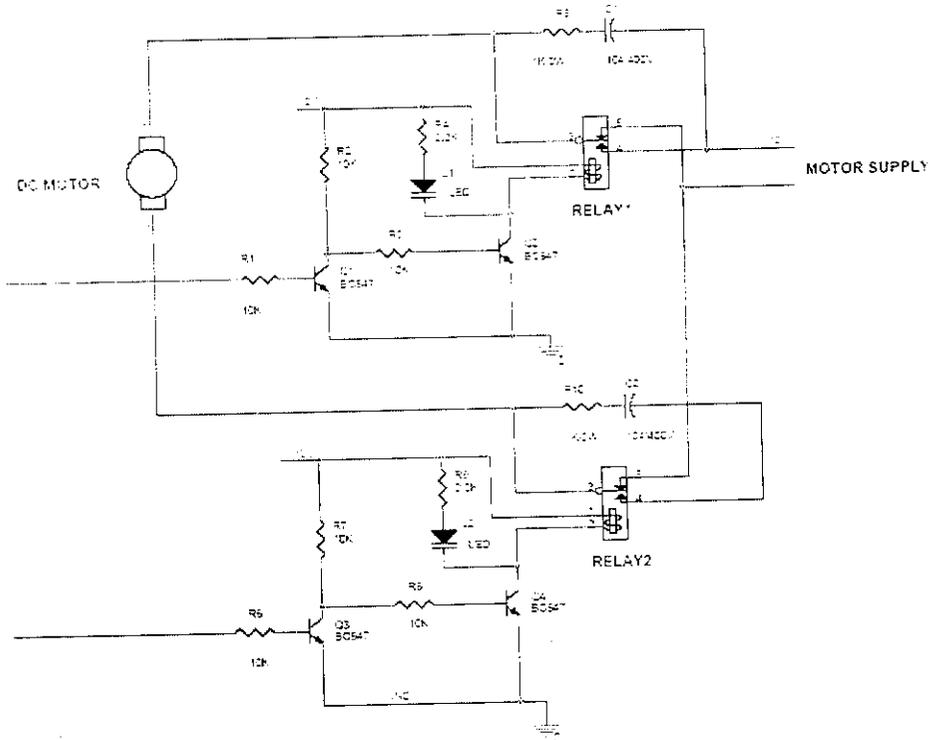


FIG 3 DC motor forward /reverse control

3.1.2 CIRCUIT WORKING DESCRIPTION

This circuit is designed to control the motor in the forward and reverse direction. It consists of two relays named as relay1, relay2. The relay ON and OFF is controlled by the pair of switching transistors. A Relay is nothing but electromagnetic switching device which consists of three pins. They are Common, Normally close (NC) and normally open (NO). The common pin of two relay is connected to positive and negative terminal of motor through

snubber circuit respectively. The relays are connected in the collector terminal of the transistors T2 and T4.

When high pulse signal is given to either base of the T1 or T3 transistors, the transistor is conducting and shorts the collector and emitter terminal and zero signals is given to base of the T2 or T4 transistor. So the relay is turned OFF state.

When low pulse is given to either base of transistor T1 or T3 transistor, the transistor is turned OFF. Now 12v is given to base of T2 or T4 transistor so the transistor is conducting and relay is turn ON. The NO and NC pins of two relays are interconnected so only one relay can be operated at a time.

The series combination of resistor and capacitor is called as snubber circuit. When the relay is turn ON and turn OFF continuously, the back emf may fault the relays. So the back emf is grounded through the snubber circuit.

- When relay 1 is in the ON state and relay 2 is in the OFF state, the motor is running in the forward direction.
- When relay 2 is in the ON state and relay 1 is in the OFF state, the motor is running in the reverse direction.

3.2 MICROCONTROLLER ATMEL 89C51

3.2.1 Features

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

3.2.2 Description

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

(continued)

2.3 PIN DIAGRAM - AT89C51

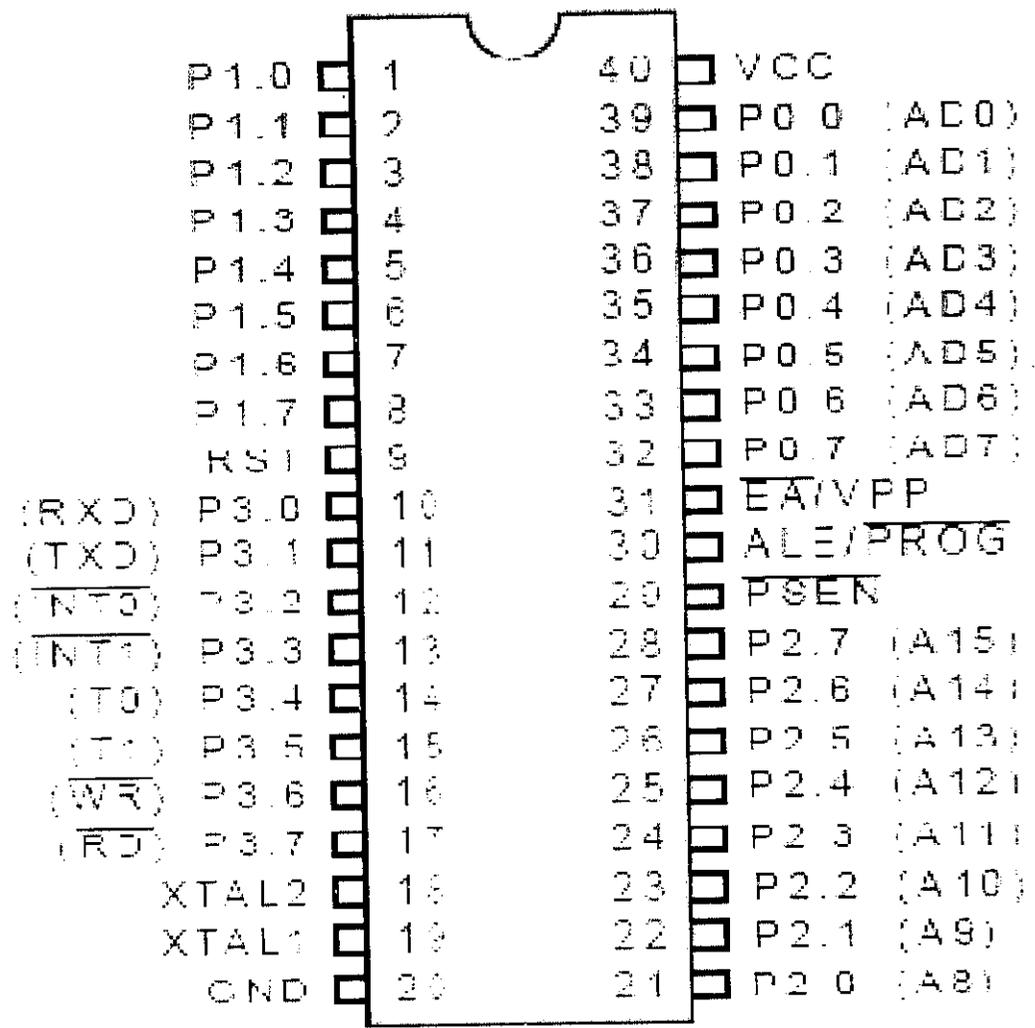


FIG 3 PIN DIAGRAM

4 STANDARD FEATURES

The AT89C51 provides the following **standard features**: 4K bytes of Flash, 128 bytes of RAM, 32 I/O lines, two 16-bit timer/counters, a five vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator and clock circuitry. In addition, the AT89C51 is **designed with static logic** for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port and interrupt system to continue functioning. The Power Down Mode saves the RAM contents but freezes the oscillator disabling all other chip functions until the next hardware reset.

3.2.5 PIN DESCRIPTION

V_{CC}

Supply voltage.

GND

Ground.

Port 0

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

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

Port 0 also receives the code bytes during Flash programming, and outputs the code bytes during program verification. External pullups are required during program verification.

Port 1

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

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

Port 2

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

Port 2 emits the high-order address byte during fetches from external program memory and during accesses to external data memory that use 16-bit addresses (MOVX @ DPTR). In this application it uses strong internal pullups

Port 3

Port 3 is an 8-bit bidirectional I/O port with internal pullups. The Port 3 output buffers can sink/source four TTL inputs. When 1s are written to Port 3 pins they are pulled high by the internal pullups and can be used as inputs. As inputs, Port 3 pins that are externally being pulled low will source current (I_{IL}) because of the pullups.

Port 3 also serves the functions of various special features of the AT89C51 as listed below:

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

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

RST

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

ALE/ $\overline{\text{PROG}}$

Address Latch Enable output pulse for latching the low byte of the address during accesses to external memory. This pin is also the program pulse input ($\overline{\text{PROG}}$) 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.

$\overline{\text{PSEN}}$

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

When the AT89C51 is executing code from external program memory, $\overline{\text{PSEN}}$ is activated twice each machine cycle, except that two $\overline{\text{PSEN}}$ activations are skipped during each access to external data memory.

$\overline{\text{EA}}/V_{\text{PP}}$

External Access Enable. $\overline{\text{EA}}$ 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, $\overline{\text{EA}}$ will be internally latched on reset.

$\overline{\text{EA}}$ should be strapped to V_{CC} for internal program executions.

This pin also receives the 12-volt programming enable voltage (V_{PP}) during Flash programming, for parts that require 12-volt V_{PP} .

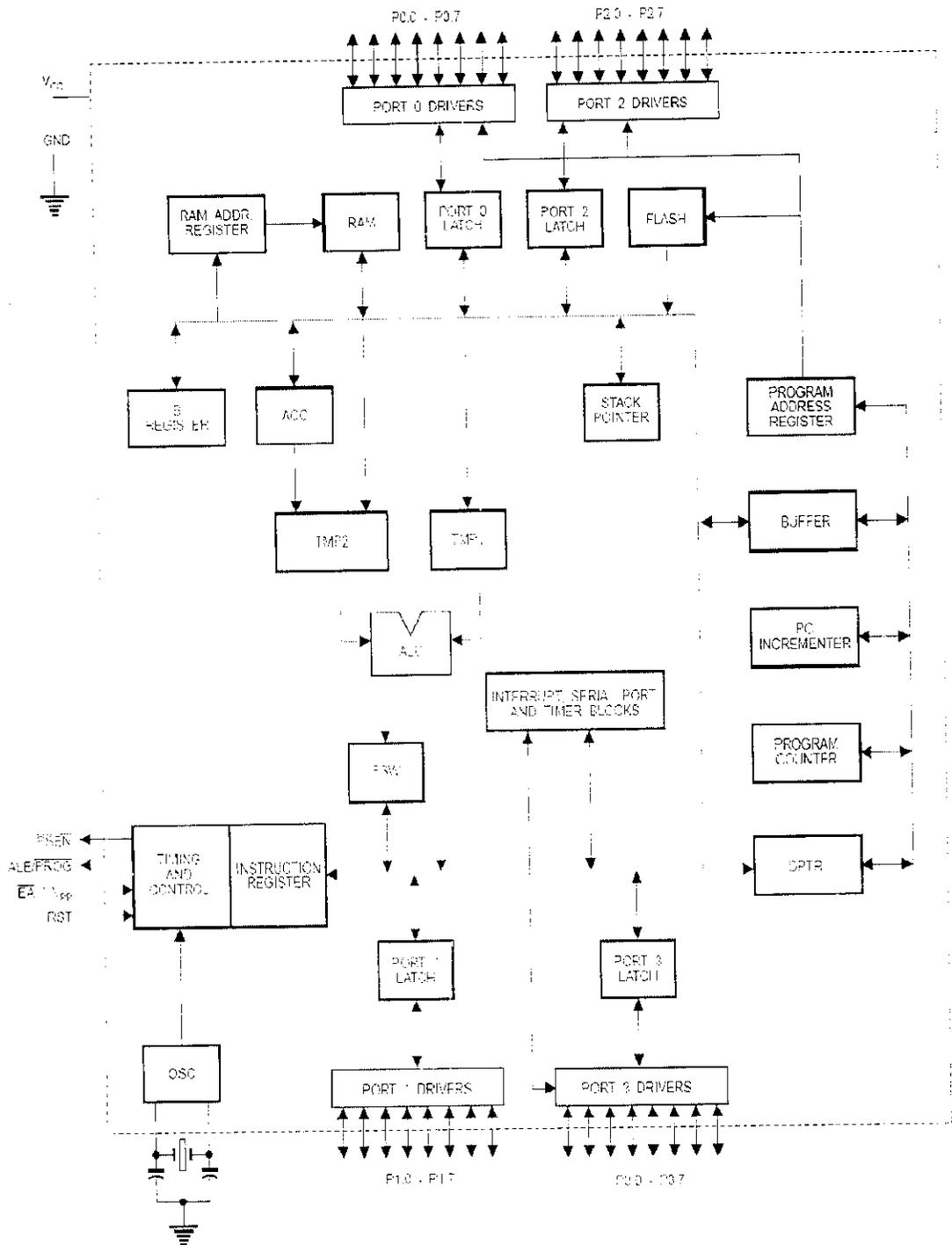
XTAL1

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

XTAL2

Output from the inverting oscillator amplifier.

3.2.6 BLOCK DIAGRAM OF ATMEL 89C51



3.3 POWER SUPPLY

3.3.1 Block diagram

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

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

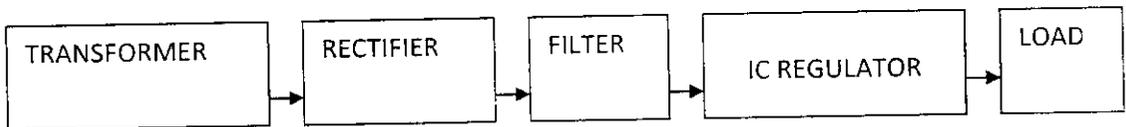


Figure 4: Block diagram (Power supply)

3.3.2 Working principle

3.3.2.1 Transformer

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

3.3.2.2 Bridge rectifier

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

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

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

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

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

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

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

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

3.3.2.3 IC voltage regulators

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

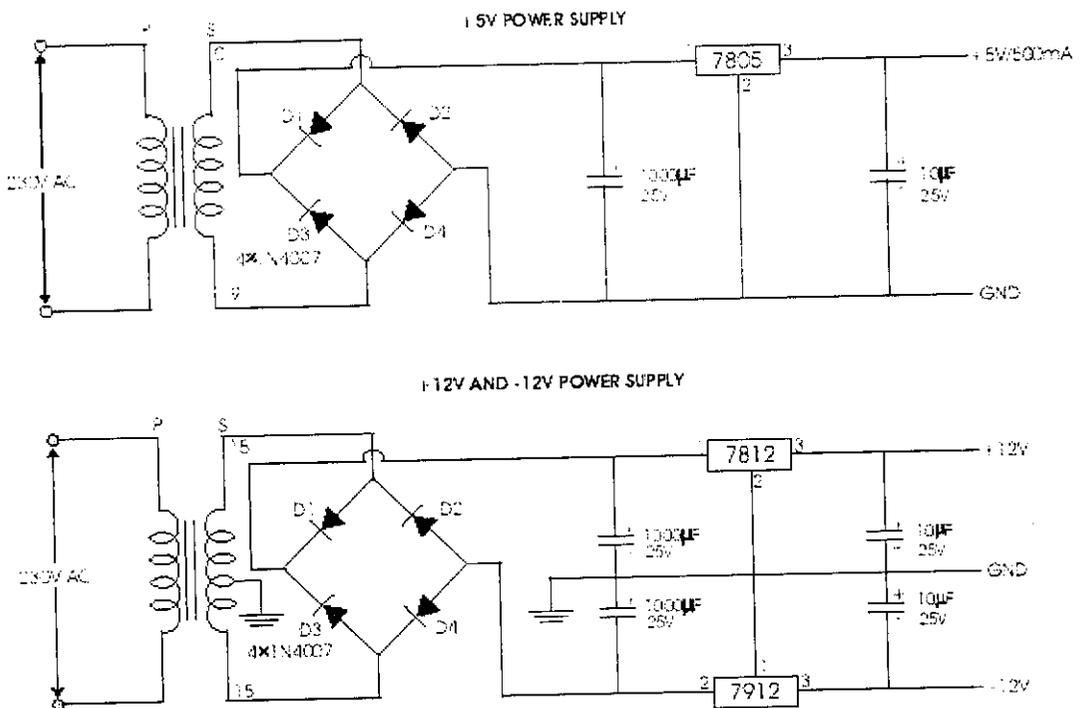


Figure 3.3: Circuit diagram (Power supply)

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

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

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

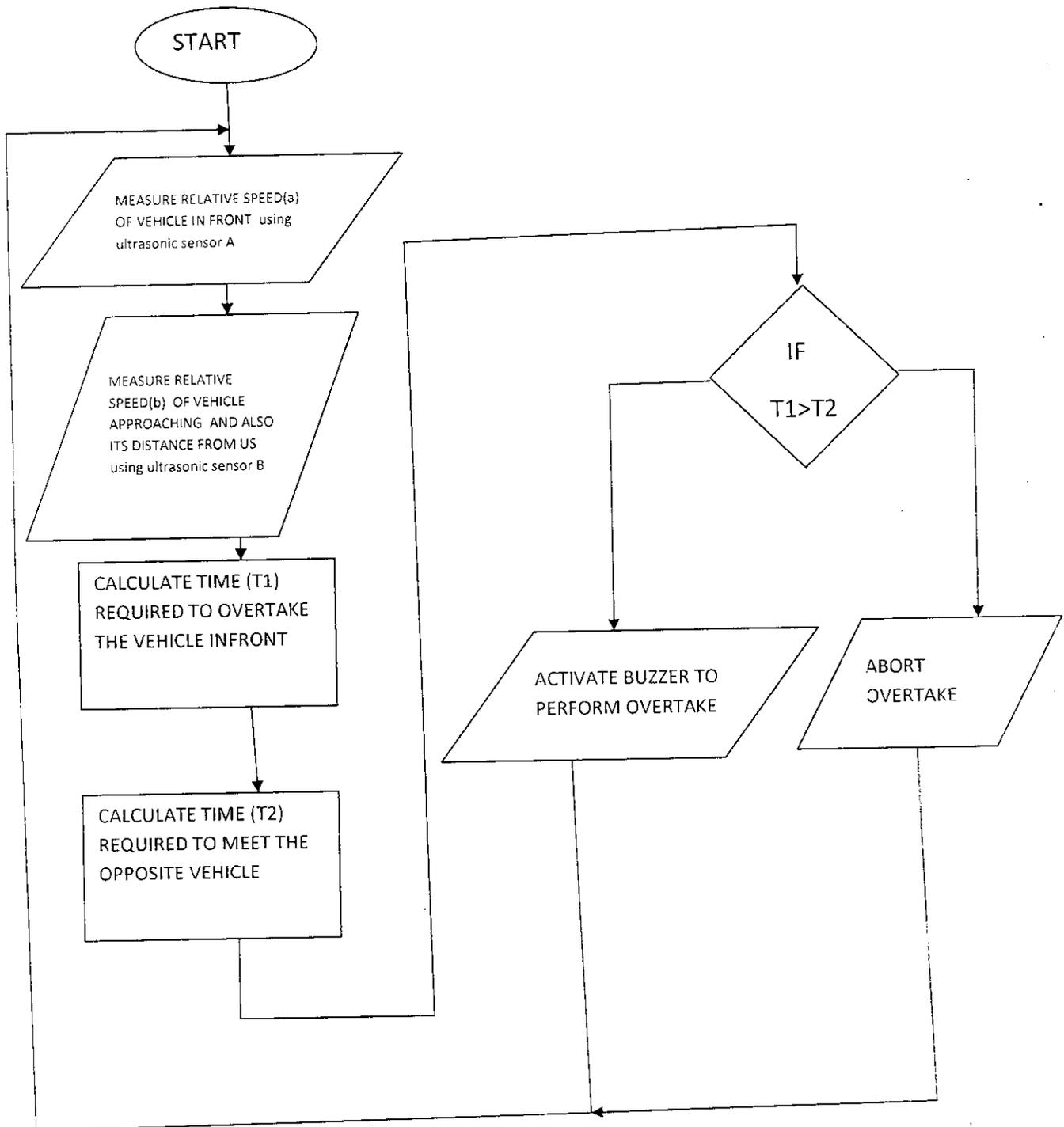
4 CHAPTER

SOFTWARE IMPLEMENTATION

4.1 ALGORITHM FOR OVERTAKE ASSIST:

- Step 1: the ultrasonic sensor gives the distance between the vehicle in front and approaching vehicle
- Step 2: the relative speed is calculated by using a PIC microcontroller
- Step 3: the time taken to overtake the vehicle in front is determined
- Step 4: the time taken to meet the approaching vehicle is calculated.
- step 5: the comparison is made between the two time.
- Step 6: in case of impossible overtake the system remains silent.
- Step 7: in case of possible overtake a buzzer is activated

4.2 FLOWCHART FOR THE OVERTAKE ASSIST



4.3 TEST RESULTS

Distance between leading and our vehicle	D	10 inches
Distance between our and leading vehicle at 0th	D1 at 0th sec	10 inches
Distance between our and leading vehicle at 1st	D2 at 1st sec	9 inches
Relative speed of our and leading vehicle :	b	1 inch/sec
Distance between our and vehicle in front 0th sec:	D3 at 0th sec	6 inches
Distance between our and vehicle in front 1st sec:	D4 at 1st sec	3 inches
Relative speed of our and vehicle in front:	a	3 inch /sec
Width of our vehicle	X1	1 INCH
Width of vehicle in front	Y1	1 INCH
Time taken to cross the vehicle in front	T1	0.67 SEC
Time taken to meet the leading vehicle	T2	10 sec
Conclusion	T1 < T2	OVERTAKE ALLOWED

5. CONCLUSION AND FUTURE SCOPE:

The overtake assist has been successfully implemented and is said to give an assist which is said to be of almost precision. The device can be further enhanced by using components quick response as time is a very important factor.

In future the device can also be integrated with a automatic speed control and a steering assist too.

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Conditioning", 2nd Ed., John Wiley & Sons, 2001

5 Article Posted by Nita under A Mutineer speaks, Crime, India, Law, Life,
Society

7.APPENDICES

```
#include<at89x52.h>
```

```
#include"smcl_lcd8_.h"
```

```
#define buz P1_1
```

```
#define r1 P1_2
```

```
#define r2 P1_3
```

```
#define r3 P1_4
```

```
#define r4 P1_5
```

```
#define TX1 P1_6
```

```
#define RX1 P1_7
```

```
#define TX2 P3_0
```

```
#define RX2 P3_1
```

```
#define key P3_2
```

```
void Distance_Measure1();
```

```
void Distance_Measure2();
```

```
unsigned char i,inch1,inch2,result,rept,sec,obj1,obj2;
```

```
unsigned char speed1,speed2,t1,t2;
```

```
unsigned long int count=0,count1=0;
```

```
bit x,y;
```

```
void main()
```

```
{
```

```
    Lcd8_Init();
```

```
    Display(0x80,"----OVERTAKE----",16);
```

```
    Display(0xC0,"-----ASSIST-----",16);
```

```
    buz=0;
```

```
    Delay_(65000,2); clear;
```

```
    TMOD=0x11;
```

```
    TH1=TL1=0x00;
```

```
    EA=ET1=TR1=1;
```

```
    Display(0x80,"Dis1: Dis2: ",16);
```

```
    Display(0xC0,"          ",16);
```

```
    while(1)
```

```
    {
```

```
Distance_Measure1();
```

```
Distance_Measure2();
```

```
r1=r4=1;
```

```
r2=r3=0;
```

```
if(!key)
```

```
{
```

```
    while(!key) Display(0xc0,"ASSIST    ",16);
```

```
    Display(0xc0,"    ",7);
```

```
    sec=x=y=0;
```

```
    while(!y)
```

```
    {
```

```
        Distance_Measure1();
```

```
        Distance_Measure2();
```

```
        if(sec>=2)
```

```
        {
```

```
            if(!x)
```

```
            {
```

```
                speed1=obj1;
```

```
                speed2=obj2;
```

```
        sec=0;
    }
    if(x)
    {
        speed1=obj1;
        speed2=obj2;

        sec=0;    y=1;
        goto finish;
    }
    x=1;
}
//Delay(65000);

finish:

t1=30/speed1;

t2=(obj2*3.0)/speed2;

clear;

if(t1<t2)    buz=1,Display(0x80,"OVERTAKE",8);
```

```
else      buz=0,Display(0x80,"ABORT  ",8);
```

```
Display(0x89,"D2:",3);
```

```
Decimal_Digit2(0xc0,speed1);
```

```
Decimal_Digit2(0xc3,speed2);
```

```
Decimal_Digit2(0xc6,t1);
```

```
Decimal_Digit2(0xc9,t2);
```

```
Decimal_Digit2(0x8D,obj2);
```

```
while(1);
```

```
}
```

```
}
```

```
}
```

```
void Distance_Measure1()
```

```
{
```

```
count=count1=0;
```

```
TH0=0x00;TL0=0x00;
```

```
TR0=0;
```

```
for(i=0;i<15;i++)
```

```
{
```

ATMEL 89C51 DATA SHEETS

Symbol	Parameter	12 MHz Oscillator		16 to 24 MHz Oscillator		Units
		Min	Max	Min	Max	
$f_{t_{CLCL}}$	Oscillator Frequency			0	24	MHz
t_{LHLL}	ALE Pulse Width	127		$2t_{CLCL}-40$		ns
t_{AVLL}	Address Valid to ALE Low	43		$t_{CLCL}-13$		ns
t_{LLAX}	Address Hold After ALE Low	46		$t_{CLCL}-20$		ns
t_{LLIV}	ALE Low to Valid Instruction In		233		$4t_{CLCL}-65$	ns
t_{LLPL}	ALE Low to \overline{PSEN} Low	43		$t_{CLCL}-13$		ns
t_{PLPH}	\overline{PSEN} Pulse Width	205		$3t_{CLCL}-20$		ns
t_{PLIV}	\overline{PSEN} Low to Valid Instruction In		145		$3t_{CLCL}-45$	ns
t_{PIX}	Input Instruction Hold After \overline{PSEN}	0		0		ns
t_{PIXZ}	Input Instruction Float After \overline{PSEN}		59		$t_{CLCL}-10$	ns
t_{PXAV}	\overline{PSEN} to Address Valid	75		$t_{CLCL}-8$		ns
t_{PXIV}	Address to Valid Instruction In		312		$5t_{CLCL}-65$	ns
t_{PLAZ}	\overline{PSEN} Low to Address Float		10		10	ns
t_{RLRH}	\overline{RD} Pulse Width	400		$6t_{CLCL}-100$		ns
t_{WLWH}	\overline{WR} Pulse Width	400		$6t_{CLCL}-100$		ns
t_{RLDV}	\overline{RD} Low to Valid Data In		252		$5t_{CLCL}-90$	ns
t_{RLDH}	Data Hold After \overline{RD}	0		0		ns
t_{RLDF}	Data Float After \overline{RD}		97		$2t_{CLCL}-28$	ns
t_{RLDV}	ALE Low to Valid Data In		517		$8t_{CLCL}-150$	ns
t_{RLDV}	Address to Valid Data In		585		$9t_{CLCL}-165$	ns
t_{RLWL}	ALE Low to \overline{RD} or \overline{WR} Low	200	300	$3t_{CLCL}-50$	$3t_{CLCL}-50$	ns
t_{RLWL}	Address to \overline{RD} or \overline{WR} Low	203		$4t_{CLCL}-75$		ns
t_{RLVX}	Data Valid to \overline{WR} Transition	23		$t_{CLCL}-20$		ns
t_{RLVH}	Data Valid to \overline{WR} High	433		$7t_{CLCL}-120$		ns
t_{RLVH}	Data Hold After \overline{WR}	33		$t_{CLCL}-20$		ns
t_{RLAZ}	\overline{RD} Low to Address Float		0		0	ns
t_{RLHL}	\overline{RD} or \overline{WR} High to ALE High	43	123	$t_{CLCL}-20$	$t_{CLCL}-25$	ns

DATA SHEETS- IR SENSORS

Electrical Characteristics

($V_{CC} = 5.0V$, $V_{EE} = GND$, $T_A = 25^\circ C$, unless otherwise specified)

Parameter	Symbol	Conditions	LM258			LM358			LM2904			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Input Offset Voltage	V_{IO}	$V_{CM} = 0V$ to V_{CC} -1.5V $V_{O(P)} = 1.4V$, $R_S = 0\Omega$	-	2.9	5.0	-	2.9	7.0	-	2.9	7.0	mV
Input Offset Current	I_{IO}	-	-	3	30	-	5	50	-	5	50	nA
Input Bias Current	I_{BIAS}	-	-	45	150	-	45	250	-	45	250	nA
Input Voltage Range	$V_{I(R)}$	$V_{CC} = 30V$ (LM2904, $V_{CC}=26V$)	0	-	V_{CC} -1.5	0	-	V_{CC} -1.5	0	-	V_{CC} -1.5	V
Supply Current	I_{CC}	$R_L = \infty$, $V_{CC} = 30V$ (LM2904, $V_{CC}=26V$)	-	0.8	2.0	-	0.8	2.0	-	0.8	2.0	mA
		$R_L = \infty$, $V_{CC} = 5V$	-	0.5	1.2	-	0.5	1.2	-	0.5	1.2	mA
Large Signal Voltage Gain	G_V	$V_{CC} = 15V$, $R_L = 2k\Omega$ $V_{O(P)} = 1V$ to $11V$	50	100	-	25	100	-	25	100	-	V/mV
Output Voltage Swing	$V_{O(H)}$	$V_{CC}=30V$, $R_L = 2k\Omega$	26	-	-	26	-	-	22	-	-	V
		$V_{CC} = 26V$ for LM2904)	27	26	-	27	26	-	23	24	-	V
	$V_{O(L)}$	$V_{CC} = 5V$, $R_L = 10k\Omega$	-	5	20	-	5	20	-	5	20	mV
Common-Mode Rejection Ratio	CMRR	-	70	85	-	65	80	-	60	80	-	dB
Power Supply Rejection Ratio	PSRR	-	65	100	-	65	100	-	50	100	-	dB
Channel Separation	CS	$f = 1kHz$ to $20kHz$ (Note1)	-	120	-	-	120	-	-	120	-	dB
Short Circuit to GND	I_{SC}	-	-	40	60	-	40	60	-	40	60	mA
Output Current	I_{SOURCE}	$V_{I(+)} = 1V$, $V_{I(-)} = 0V$, $V_{CC} = 15V$, $V_{O(P)} = 2V$	20	30	-	20	30	-	20	30	-	mA
		$V_{I(+)} = 0V$, $V_{I(-)} = 1V$, $V_{CC} = 15V$, $V_{O(P)} = 2V$	10	15	-	10	15	-	10	15	-	mA
	I_{SINK}	$V_{I(+)} = 0V$, $V_{I(-)} = 1V$, $V_{CC} = 15V$, $V_{O(P)} = 200mV$	12	100	-	12	100	-	-	-	-	μA
Differential Input Voltage	$V_{I(DIFF)}$	-	-	V_{CC}	-	-	V_{CC}	-	-	V_{CC}	-	V

DATA SHEET- POWER SUPPLY

Absolute Maximum Ratings (Note 3)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Input Voltage ($V_O = 5V, 12V$ and $15V$)	35V
Internal Power Dissipation (Note 1)	Internally Limited
Operating Temperature Range (T_A)	0°C to $+70^\circ\text{C}$

Maximum Junction Temperature (K Package)	150°C
(T Package)	150°C
Storage Temperature Range	-65°C to $+150^\circ\text{C}$
Lead Temperature (Soldering, 10 sec.)	
TO-3 Package K	300°C
TO-220 Package T	230°C

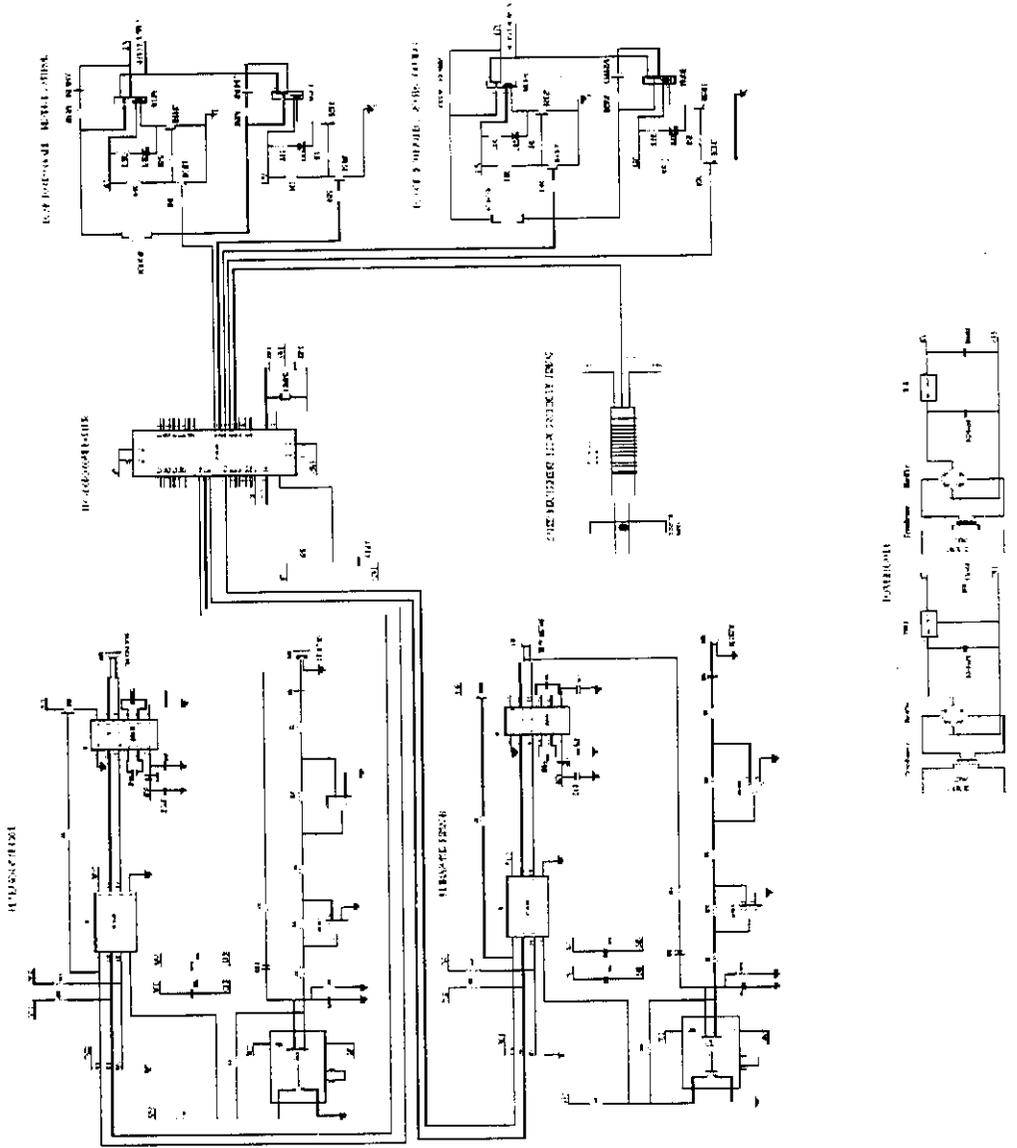
Electrical Characteristics LM78XXC (Note 2)

$0^\circ\text{C} \leq T_J \leq 125^\circ\text{C}$ unless otherwise noted.

		Output Voltage			5V			12V			15V			Units
		Input Voltage (unless otherwise noted)			10V			19V			23V			
Symbol	Parameter	Conditions		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max		
V_O	Output Voltage	$T_J = 25^\circ\text{C}, 5\text{ mA} \leq I_O \leq 1\text{ A}$		4.8	5	5.2	11.5	12	12.5	14.4	15	15.6	V	
		$P_D \leq 15\text{ W}, 5\text{ mA} \leq I_O \leq 1\text{ A}$		4.75		5.25	11.4		12.6	14.25		15.75	V	
		$V_{\text{MIN}} \leq V_{\text{IN}} \leq V_{\text{MAX}}$		$(7.5 \leq V_{\text{IN}} \leq 20)$			$(14.5 \leq V_{\text{IN}} \leq 27)$			$(17.5 \leq V_{\text{IN}} \leq 30)$			V	
ΔV_O	Line Regulation	$I_O = 500\text{ mA}$	$T_J = 25^\circ\text{C}$	3	50		4	120		4	150	mV		
			ΔV_{IN}	$(7.5 \leq V_{\text{IN}} \leq 25)$			$(14.5 \leq V_{\text{IN}} \leq 30)$			$(17.5 \leq V_{\text{IN}} \leq 30)$			V	
			$0^\circ\text{C} \leq T_J \leq +125^\circ\text{C}$		50			120			150	mV		
			ΔV_{IN}	$(6 \leq V_{\text{IN}} \leq 20)$			$(15 \leq V_{\text{IN}} \leq 27)$			$(18.5 \leq V_{\text{IN}} \leq 30)$			V	
			$I_O \leq 1\text{ A}$	$T_J = 25^\circ\text{C}$		50		120		150		150	mV	
		ΔV_{IN}		$(7.5 \leq V_{\text{IN}} \leq 20)$			$(14.6 \leq V_{\text{IN}} \leq 27)$			$(17.7 \leq V_{\text{IN}} \leq 30)$			V	
V_L	Load Regulation	$T_J = 25^\circ\text{C}$	$5\text{ mA} \leq I_O \leq 1.5\text{ A}$		10	50		12	120		12	150	mV	
					250 mA $\leq I_O \leq$ 750 mA		25		60		75		75	mV
			$5\text{ mA} \leq I_O \leq 1\text{ A}, 0^\circ\text{C} \leq T_J \leq$ -125°C			50		120		150		150	mV	
		ΔV_{IN}		$(8 \leq V_{\text{IN}} \leq 12)$			$(15 \leq V_{\text{IN}} \leq 22)$			$(20 \leq V_{\text{IN}} \leq 26)$			V	
			$I_O = 500\text{ mA}, 0^\circ\text{C} \leq T_J \leq$ -125°C			1.0		1.0		1.0		1.0	mA	
		ΔV_{IN}		$(7 \leq V_{\text{IN}} \leq 25)$			$(14.5 \leq V_{\text{IN}} \leq 30)$			$(17.5 \leq V_{\text{IN}} \leq 30)$			V	
I_Q	Quiescent Current	$I_O = 1\text{ A}$	$T_J = 25^\circ\text{C}$		2			3			3	mA		
			$0^\circ\text{C} \leq T_J \leq -125^\circ\text{C}$		3.5			8.5			8.5	mA		
		$5\text{ mA} \leq I_O \leq 1\text{ A}$		0.5			0.5			0.5	mA			
ΔI_Q	Quiescent Current Change	$T_J = 25^\circ\text{C}, I_O \leq 1\text{ A}$			1.0			1.0			1.0	mA		
			$V_{\text{MIN}} \leq V_{\text{IN}} \leq V_{\text{MAX}}$	$(7.5 \leq V_{\text{IN}} \leq 20)$			$(14.3 \leq V_{\text{IN}} \leq 27)$			$(17.9 \leq V_{\text{IN}} \leq 30)$			V	
			$I_O = 500\text{ mA}, 0^\circ\text{C} \leq T_J \leq$ -125°C			1.0		1.0		1.0		1.0	mA	
ΔV_{IN}	$(7 \leq V_{\text{IN}} \leq 25)$			$(14.5 \leq V_{\text{IN}} \leq 30)$			$(17.5 \leq V_{\text{IN}} \leq 30)$			V				
V_{RIPPLE}	Output Noise Voltage	$T_A = 25^\circ\text{C}, 10\text{ Hz} < f \leq 100\text{ kHz}$			40			75			90	μV		
ΔV_{IN} ΔV_{OUT}	Ripple Rejection	$I_O \leq 1\text{ A}, T_J = 25^\circ\text{C}$ or $f = 120\text{ Hz}$	$I_O \leq 500\text{ mA}$		62	80		55	72		54	70	dB	
				$0^\circ\text{C} \leq T_J \leq +125^\circ\text{C}$		62		55		54		dB		
		$V_{\text{MIN}} \leq V_{\text{IN}} \leq V_{\text{MAX}}$	$(6 \leq V_{\text{IN}} \leq 18)$			$(15 \leq V_{\text{IN}} \leq 25)$			$(18.5 \leq V_{\text{IN}} \leq 28.5)$			V		
R_{DROPOUT}	Dropout Voltage	$T_J = 25^\circ\text{C}, I_{\text{OUT}} = 1\text{ A}$			2.0			2.0			2.0	V		
	Output Resistance	$f = 1\text{ kHz}$			2			18			19	m Ω		

8.CIRCUIT DIAGRAM

OVERTAKE ASSIST



9.SNAP SHOTS

