MUDIT AGARWAL

EM TESTED

Experimental Understanding about I/O, Counters/Timers and Interrupts of AT89C52

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The AT89C52 is a popular 8-bit microcontroller. An experimental understanding is presented by few experiments about Input/Output, Counters/Timers and Interrupts of microcontroller AT89C52. These experiments are designed and developed to understand the concepts of microcontroller AT89C52. This novel experiments are useful to clear the basic doubts of the microcontroller AT89C52. The input can be given by the switches. Large number of software based experiments can be setup on this hardware. Many projects can also be done on this hardware like, the clock, running numerical display, stopwatch, blinking display, square wave generator etc. In the present experimental setup the output can be obtain in the form of Light, Sound and an Electrical waves. The present work is useful particularly for the students and industrial learners.

Introduction

This hardware module is especially designed to learn the fundamentals of the AT89C52. The output can be seen on FNDs and LEDs. The data can be entered by using four switches. The output light can be seen on FNDs and LEDs. Many companies like Renesas, Freescale, Atmel, Intel, National, Motorola, Philips, Zilog, etc. are manufacturing many models of micro-controllers. The designer can choose the company of the microcontroller and a model as per the requirement of Port pins, Timer/Counter, RAM, ROM, etc. The cost of the system is an important aspect in system design. Software written for some small practical application is enough to get stored in most of these microcontrollers. The microcontroller AT89C52 has internal EPROM, RAM, Decoder, Ports, Timer /Counter etc.

Circuit Understanding

The schematic circuit diagram of this experimental hardware module is shown in Fig.-1. The +5 Volt is supplied to this circuit by the external power supply. This circuit is designed and developed particularly for the educational purpose. By these experiments, the students can understand microcontroller fundamentals and its applications. The AT89C52 has four ports. Here Port-0 and Port-2 are used to illuminate 6-FNDs and 2-LEDs. Common anode type LT542 FNDs are used. The single FND can be activated by providing low logic on its corresponding Port pin of Port-0 and its corresponding special code on Port-2. When low logic is given at the base of PNP transistor BC557 through 10KΩ resistor, then the transistor comes into saturation. The saturated transistor provides +5 volt at the anode of its corresponding FND. Fig.-2 shows the P.C.B. layout and Fig.-3 shows the Component Layout. All straight line segments in the overlay layer show the jumper wires in the P.C.B. and other shapes show the dimensions of the components. The pullup resistors are needed for port-0. The ladder contains pull-up resistors R6 to R13 of 10KΩ, means all resistors are having same 10KΩ value. The eight PNP transistors BC 557 (T1 to T8) are doing switching action to supply +5V at FNDs, LEDs . Eight current limiting resistors R22 to R29 of 220Ω each are used with a buffer IC 74245. Fig.-2 shows that the same track is not connected with the same segments in two consecutive FNDs. The segments are the same for the same track in FND-0, FND-2 and FND-4. Similarly, the segments are the same for the same track in FND-1, FND-3 and FND-5. By this logic in P.C.B. drawing, the single sided P.C.B. needs to develop. The Port-2 needs to send different data to display the same on two consecutive FNDs. The Port pins of Port-2 are connected with the FND segments through the buffer IC 74245 and eight 220Ω current limiting resistors R22 to R29. The Port pins P2.7, P2.6, P2.5, P2.4, P2.3, P2.2, P2.1 and P2.0 are connected with FND segments g, f, a, b, h, c, d and e respectively in FND-0, FND-2 and FND-4. Similarly, The Port pins P2.7, P2.6, P2.5, P2.4, P2.3, P2.2, P2.1 and P2.0

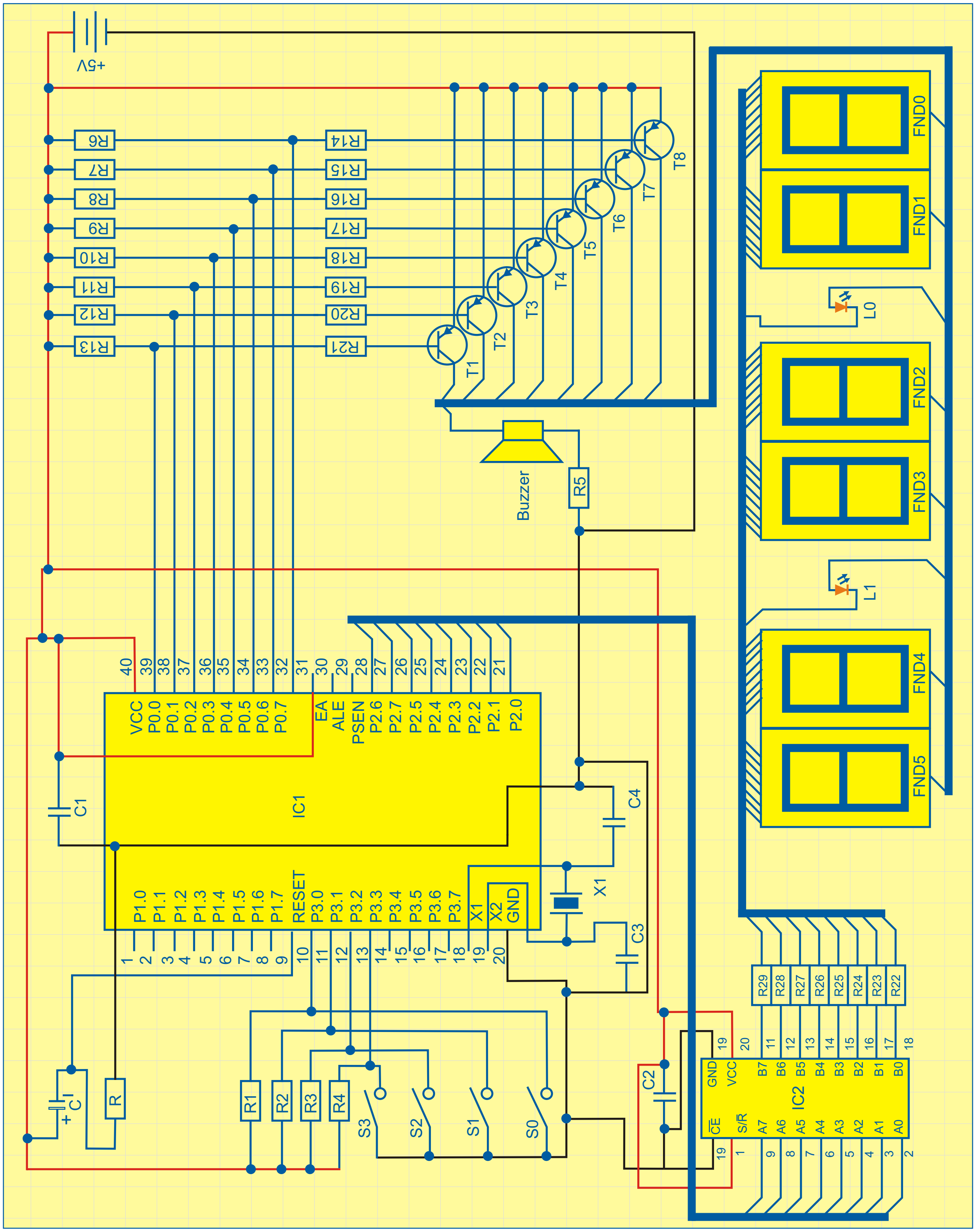

Fig. 1 Circuit Diagram of AT89C52 Experimental Board

are connected with FND segments b, a, f, g, e, d, c and h respectively in FND-1, FND-3 and FND-5. The special codes to see the digit on FNDs are different for FND-0 and FND-1. The codes remain same for FND-0, FND-2 and FND-4, and same for FND-1, FND-3 and FND-5. These special codes are shown in Table-1.

TABLE-1 : FND CODE FOR DISPLAY		
To see on FND	Special codes for FND-0,FND-2 & FND-4	Special codes for FND-1,FND-3 & FND-5
0	88H	11H
1	EBH	7DH
2	4CH	23H
3	49H	29H
4	2BH	DH
5	19H	89H
6	18H	81H
7	CBH	3DH
8	08H	01H
9	09H	09H
A	0AH	05H
B	38H	C1H
C	9CH	93H
D	68H	61H
E	1CH	83H
F	1EH	87H
Blank	FFH	FFH
T	3CH	C3H
R	7EH	E7H
N	7AH	E5H

The R and C are used to reset the microcontroller at starting. The four pushbutton keys S0, S1, S2 and S3 are connected between ground and Port-3 pins P3.0, P3.1, P3.2 and P3.3 respectively. The four 10KΩ resistors R1 to R4 are connected between +5 Volt and Port-3 pins P3.0, P3.1, P3.2 and P3.3. This arrangement provides low logic at port pin when the key is pressed, and high when key remains unpressed or released. The 12MHz crystal is connected between pins X1 and X2 of AT89C52. Two 33pf capacitors C3 and C4 are connected between pins X2 and X1(respectively) and ground. Other capacitors C1 and C2 of 10pf are for the better performance of the circuit. The buzzer is connected through emitter of the PNP transistor T8 and 1KΩ current limiting resistor R5.

Experiment-1

TABLE 2		
Observation no.	Key Pressed	Output on FND or LED
1	S0	0 on FND-0
2	S1	0 on FND-1
3	S2	0 on FND-2
4	S3	0 on FND-3
5	S0 & S1	0 on FND-4
6	S2 & S3	0 on FND-5
7	S0 & S1 & S2 & S3	Both LEDs are illuminated.

Develop the program to understand the I/O function in the AT89C52 by developing the proper software to see the output for proper input key pressing as shown in Table-2.

Assembly Code for Experiment-1

```
START  EQU     0600H
ORG 0000H
LJMP START
ORG START
MOV P0,#00H
;TO INITIALIZE PORT-0 AS OUTPUT PORT
MOV P2,#00H
;TO INITIALIZE PORT-2 AS OUTPUT PORT
MOV P3,#0FFH
;TO INITIALIZE PORT-3 AS INPUT PORT
AGAIN: MOV A,#0FH
ANL A,P3
CJNE A,#0EH,FND1;1110
FND0: MOV P0,#7FH  ;TO ACTIVATE FND0
MOV P2,#88H  ;TO DISPLAY 0 ON FND0
JMP AGAIN
FND1: CJNE A,#0DH,FND2        ;1101
MOV P0,#0BFH ;TO ACTIVATE FND1
MOV P2,#11H
JMP AGAIN
FND2: CJNE A,#0BH,FND3;1011
MOV P0,#0DFH ;TO ACTIVATE FND2
MOV P2,#88H
JMP AGAIN
FND3: CJNE A,#07H,FND4;0111
MOV P0,#0EFH  ;TO ACTIVATE FND3
MOV P2,#11H
JMP AGAIN
FND4: CJNE A,#0CH,FND5;1100
MOV P0,#0F7H  ;TO ACTIVATE FND4
MOV P2,#88H
JMP AGAIN
FND5: CJNE A,#03H,LED0_1;0011
MOV P0,#0FBH  ;TO ACTIVATE FND5
MOV P2,#11H
JMP AGAIN
LED0_1: CJNE A,#00H,OFF_ALL      ;0000
MOV P0,#0FDH  ;TO ACTIVATE LED0 AND LED1
MOV P2,#00H
JMP AGAIN
OFF_ALL: MOV P0,#0FFH     ;TO CUTOFF ALL TRANSISTORS
JMP AGAIN
END
```

Experiment-2

Develop the program to activate FND-0 and FND-1 one by one and the delay set by Timer-0.

Assembly Code for Experiment-2

```
START       EQU     1700H
TIMER_0     EQU     000BH
TI_0        EQU     0100H

ORG 0000H
JMP START
ORG TIMER_0
JMP TI_0
ORG TI_0
DJNZ R2,NEXT
MOV R2,#20H
NEXT:CJNE R2,#10H,CARRY_CHK
CARRY_CHK: JC FND0
MOV P0,#0BFH
MOV P2,#11H
SJMP END_T0
FND0:MOV P0,#7FH
MOV P2,#88H
END_T0: SETB TR0
RETI
```

```
ORG START
MOV P0,#00H
MOV P2,#00H
MOV TL0,#00H
MOV TH0,#00H
MOV TMOD,#81H
MOV IE,#82H
MOV R2,#20H
SETB TR0
HERE:SJMP HERE
END
```

Experiment-3

Develop the program for the decade counter using Timer-0 on FND-0.

Assembly Code for Experiment-3

```
START      EQU    1700H
TIMER_0    EQU    000BH
TI_0       EQU    0100H
FND024     EQU    0200H
 ORG 0000H
 JMP START
ORG TIMER_0
JMP TI_0
ORG TI_0
INC R2
CJNE R2,#10H,END_T0
MOV R2,#00H
 MOV A,R0
 MOVC A,@A+DPTR
 MOV P2,A
INC R0
 CJNE R0,#0AH,END_T0
MOV R0,#00H
END_T0: SETB TR0
RETI
ORG FND024
DB 88H
DB 0EBH
DB 4CH
DB 49H
DB 2BH
 DB 19H
 DB 18H
 DB 0CBH
 DB 08H
DB 09H
ORG START
 MOV P0,#00H
 MOV P2,#00H
 MOV TL0,#00H
 MOV TH0,#00H
MOV TMOD,#81H
MOV IE,#82H
MOV R0,#00H
MOV R2,#00H
 MOV DPTR,#FND024
 MOV P0,#7FH
 MOV P2,#0FFH
 SETB TR0
HERE:
 SJMP HERE
 END
```

Experiment-4

Develop the program to understand both the external interrupts. Initially display 0 on FND-0. Display 1 on FND-0 by low level triggered interrupt-0 (by Pressing S2) and display 2 on FND-0 by falling edge triggered interrupt-1 (by Pressing S3).

Assembly Code for Experiment-4

```
START      EQU    1700H
INT_0      EQU    0003H
INT_1      EQU    0013H
I_0        EQU    0100H
I_1        EQU    0200H
ORG 0000H
JMP START
 ORG INT_0
 JMP I_0
ORG INT_1
JMP I_1
ORG I_0
 MOV P2,#0EBH
RETI
 ORG I_1
 MOV P2,#4CH
 RETI
 ORG START
 MOV SP,#30H
 MOV TCON,#04H
 MOV P0,#00H
 MOV P2,#00H
 MOV IE,#85H
MOV P0,#7FH
 MOV P2,#88H
HERE: SJMP HERE
 END
```

Experiment-5

Develop the program to hear some sound on the Buzzer.

Assembly Code for Experiment-5

```
ORG 0000H
          MOV P0,#00H
          MOV P2,#00H
          MOV P0,#0FFH
HERE:     CPL P0.0
          CALL DELAY
          SJMP HERE

DELAY:    MOV R0,#0FFH
LOOP1:    DJNZ R0,LOOP1
          RET
          END
```

COMPONENT LIST

SEMICONDUCTOR DEVICES

IC1	At89c52
IC2	74245
FND0 to FND5	Common Anode FNDs LT542
L0 & L1	Red LEDs
T1 to T8	BC557 PNP Transistors

CAPACITORS

C	10µf
C1 & C2-	0.1uf
C3 & C4-	33pf

RESISTOR

R, R1 to R4, R14 to R21	10KΩ
R6 to R13	10KΩ
R5	1KΩ
R22-R29	220 ohm

MISCELLANEOUS

X1	12MHZ CRYSTAL
Buzzer	+5 volt operated buzzer
+5 volt/ 1 Amp. D.C. Regulated Power supply	
A Computer with Programmer	

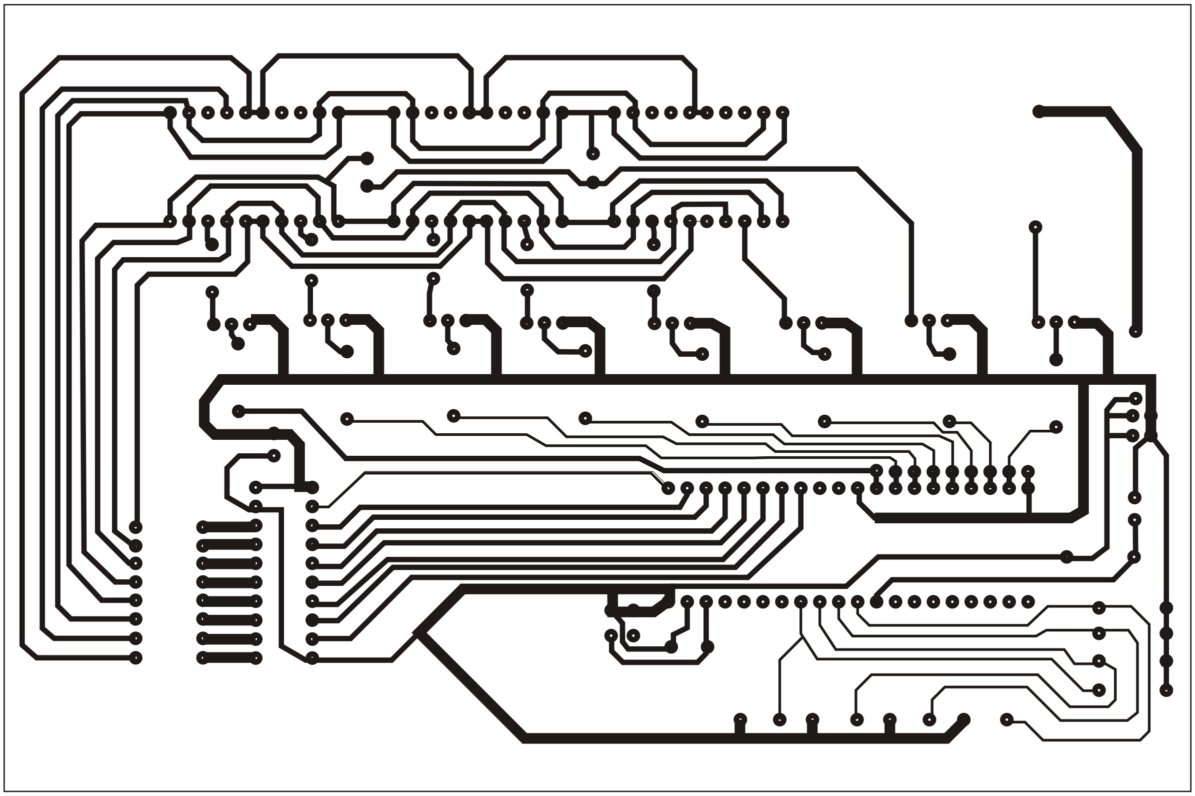

Fig. 2. PCB Layout of AT89C52 Experimental Board

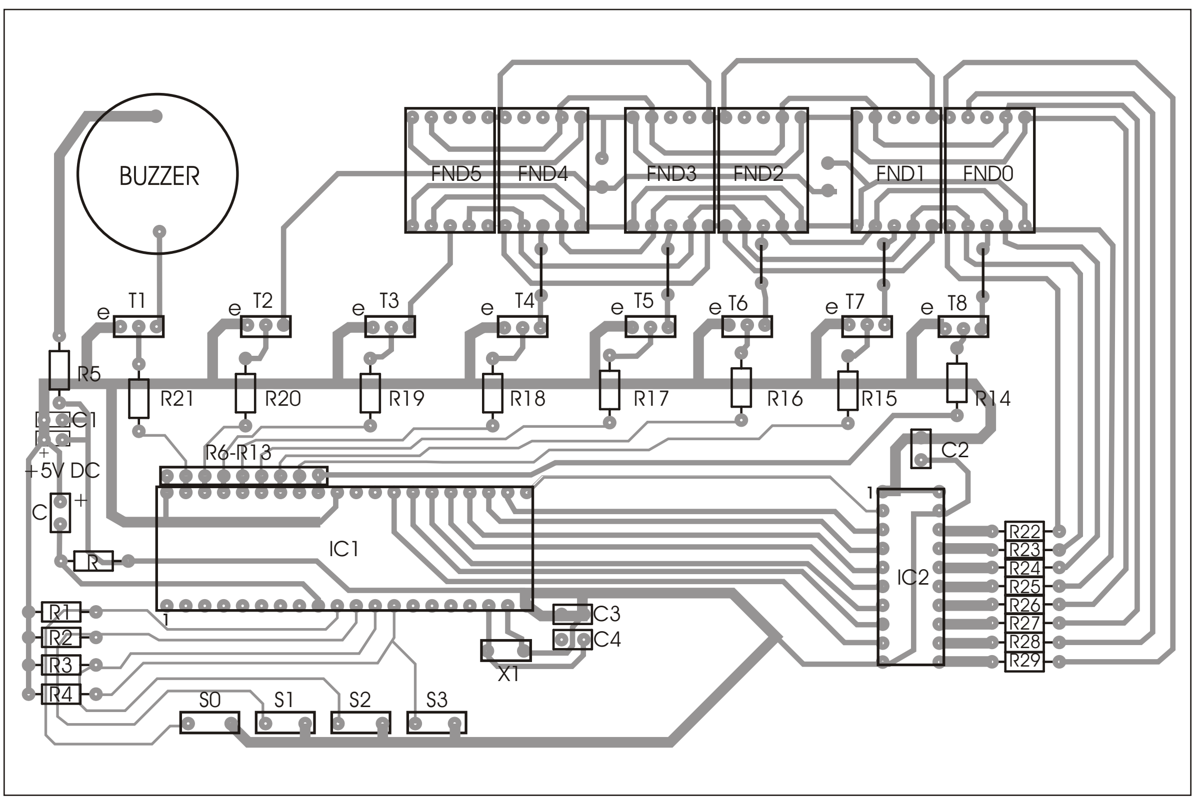

Fig. 3.Component Layout of AT89C52 Experimental Board