

A REPORT ON

**STERILIZATION UNIT USING 8086 MICROPROCESSOR**

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AT



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## PROBLEM STATEMENT

Description: This unit performs sterilization by increasing temperature to maximum value (x0C). The temperature has to be maintained at the maximum value for 2 minutes before it is brought gradually to a nominal temperature value (y0C). The time taken for bringing down the temperature can be varied between four different values as decided by the user. A slider is used to decide this value

Level 1 : 2 minutes

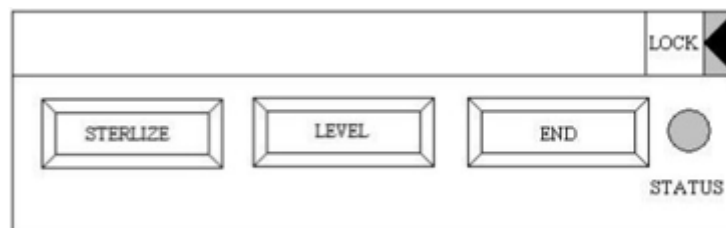
Level 2 : 4 minutes

Level 3 : 6 minutes

Level 4 : 8 minutes

While the sterilization process is taking place the door to the unit must remain locked. The Door can be opened only when user presses End.

User Interface: Status LED glows as long as the sterilization process is being done. Once 30 C has been reached then LED goes off and the door mechanism unlocks. Once the door is closed again the temperature has to be brought back to 30 C.



### **Design Specifications:**

#### ***Simple DC Motor:***

Nominal Voltage: 12 V

Coil Resistance: 12

Coil Inductance: 100mH

Zero load RPM: 2200

Max Torque%: 1

Effective mass: 0.0000001

#### ***Heater:***

Ambient temperature: 25

Thermal Resistance to Ambient: 0.05

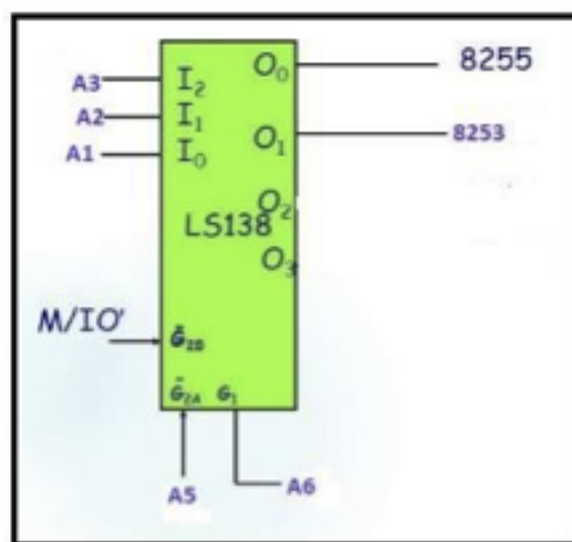
Oven Time Constant: 6

Heater Time Constant: 0.0001

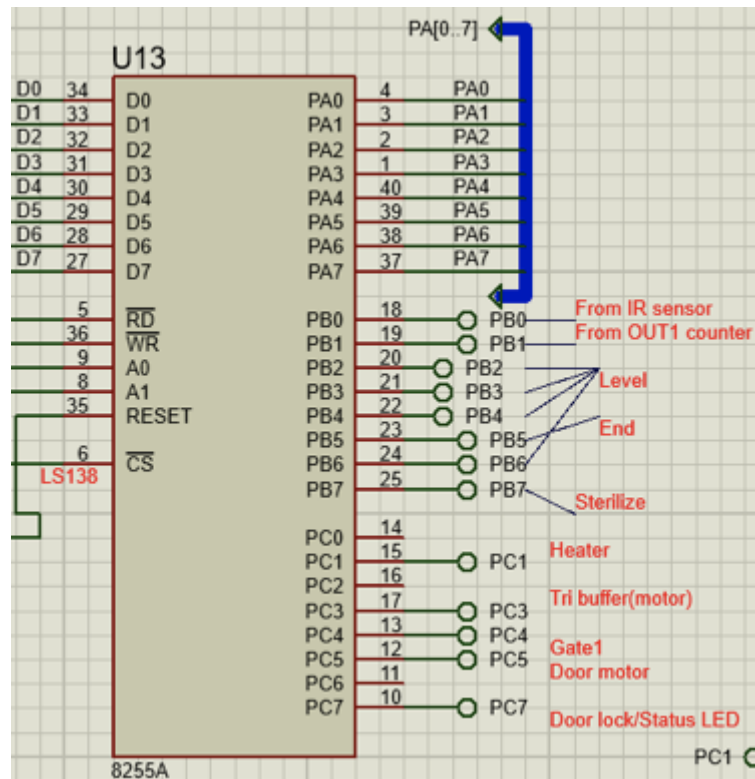
Temperature coefficient: 1

Heating power: 2.3 kW

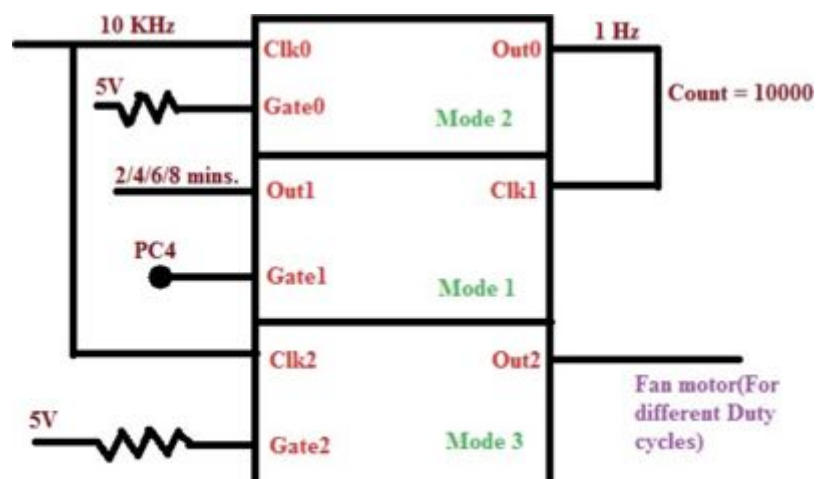
#### ***74LS138(Decoder):***

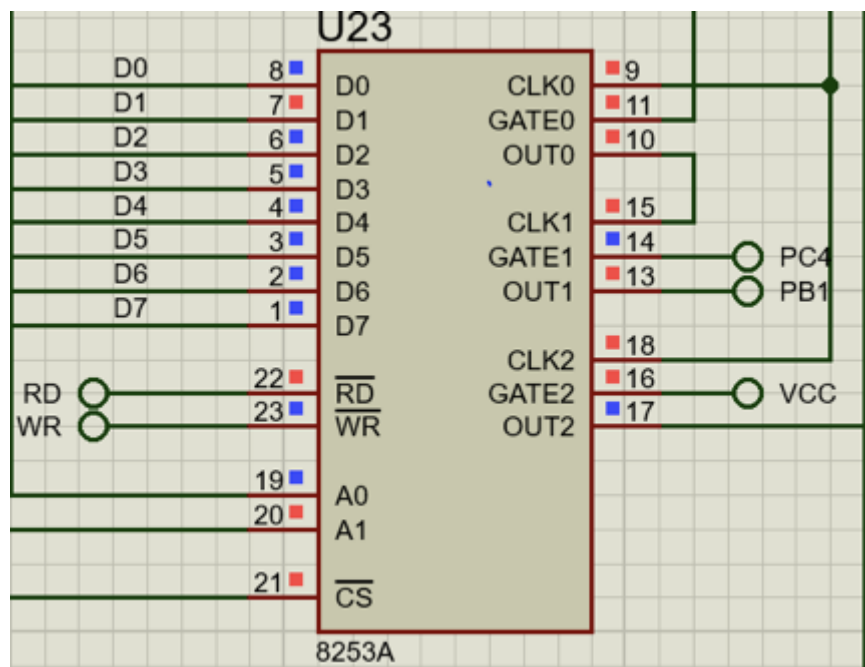


8255:

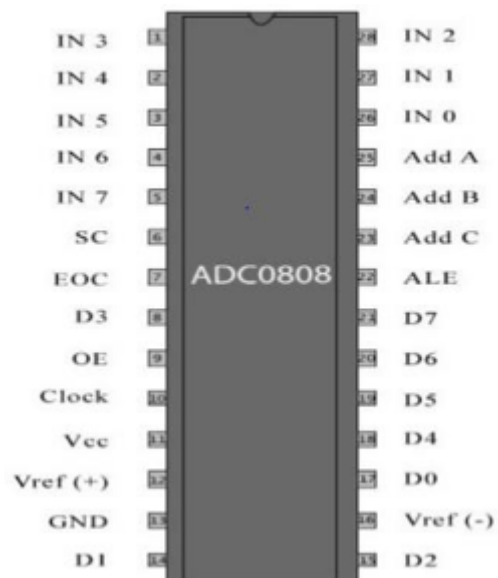


8253(Counter):





***ADC 0808(AC to DC Converter):***



**Components Used:**

1. 8086(1) - Microprocessor
2. 8255(1) - Programmable Peripheral Interface
3. 8253(1) - Programmable Interval Timer
4. 2732(2) - 4K ROM
5. 6116(2) - 2K SRAM
6. ADC0808 (1) - Analog to Digital Converter
7. 74LS373 (3) – Latch
8. 74LS245 (2) - Bidirectional Buffer
9. 74LS138 (1) - Decoder (3 : 8)
10. 2- Simple DC motors
11. L293D (1) – Motor Driver
12. 1 - Heater
13. 1 – Tri-state buffer
14. 1 – Toggle Switch
15. 6 – Button Switches
16. 3 - LEDs
17. 6 – OR Gates
18. 4 – NOT Gates

**LED Status Values and meanings:**

1. ‘TIMER’ LED – Used to count the time when the temperature reaches 80 deg. C. Along with this, the user chosen time is also displayed here.
  - a. 1 = Counting
  - b. 0 = Not Counting
2. ‘STATUS’ LED –
  - a. 1 = Sterilization process going on
  - b. 0 = Sterilization process stopped
3. ‘DOOR’ LED –
  - a. 1 = Door is locked
  - b. 0 = Door is unlocked

### **Input/Output port matching**

1. Port A: 00h
2. Port B: 02h
3. Port C: 04h
4. Control Register: 06h
5. Counter 0: 08h
6. Counter 1: 0Ah
7. Counter 2: 0Ch
8. Counter Control Register: 0Eh

### **Memory Matching**

1. ROM 1E => 00000H -01FFEh (4K)
2. ROM 1O => 00001H-01FFFh (4K)
3. RAM 1E => 02000H – 02FFEh (2K)
4. RAM 2O => 02001H – 02FFFh (2K)

### **Assumptions**

1. Assuming x=80 deg. cel.
2. Sterilization takes place at 80 deg. cel.
3. Open the door only when 'END' is pressed and the door opening is done using Motor. IR (toggle switch) =0 => Door closed and IR (toggle switch) =1 => Door open (Done manually)
4. Level of sterilization is selected using 4 switches over which a slider will move and as it hovers over the switches it will press the switches.

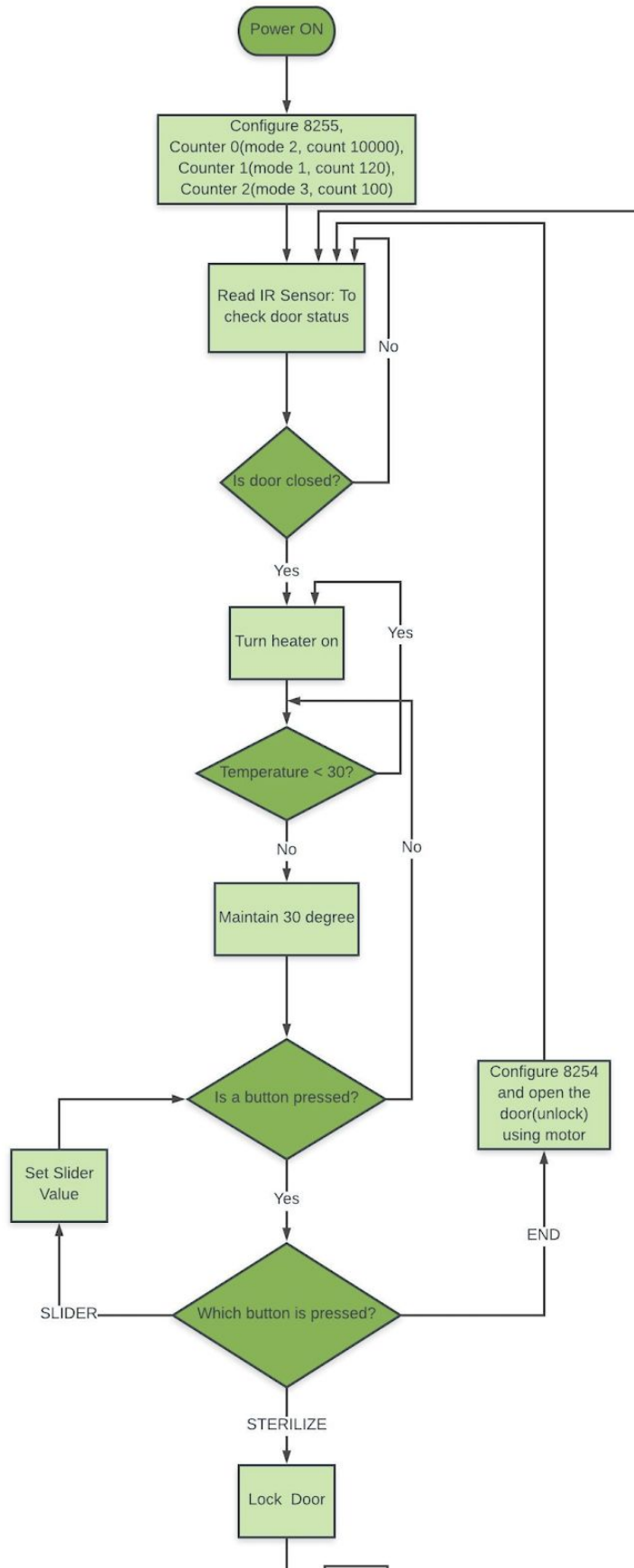
### **Cooling methods**

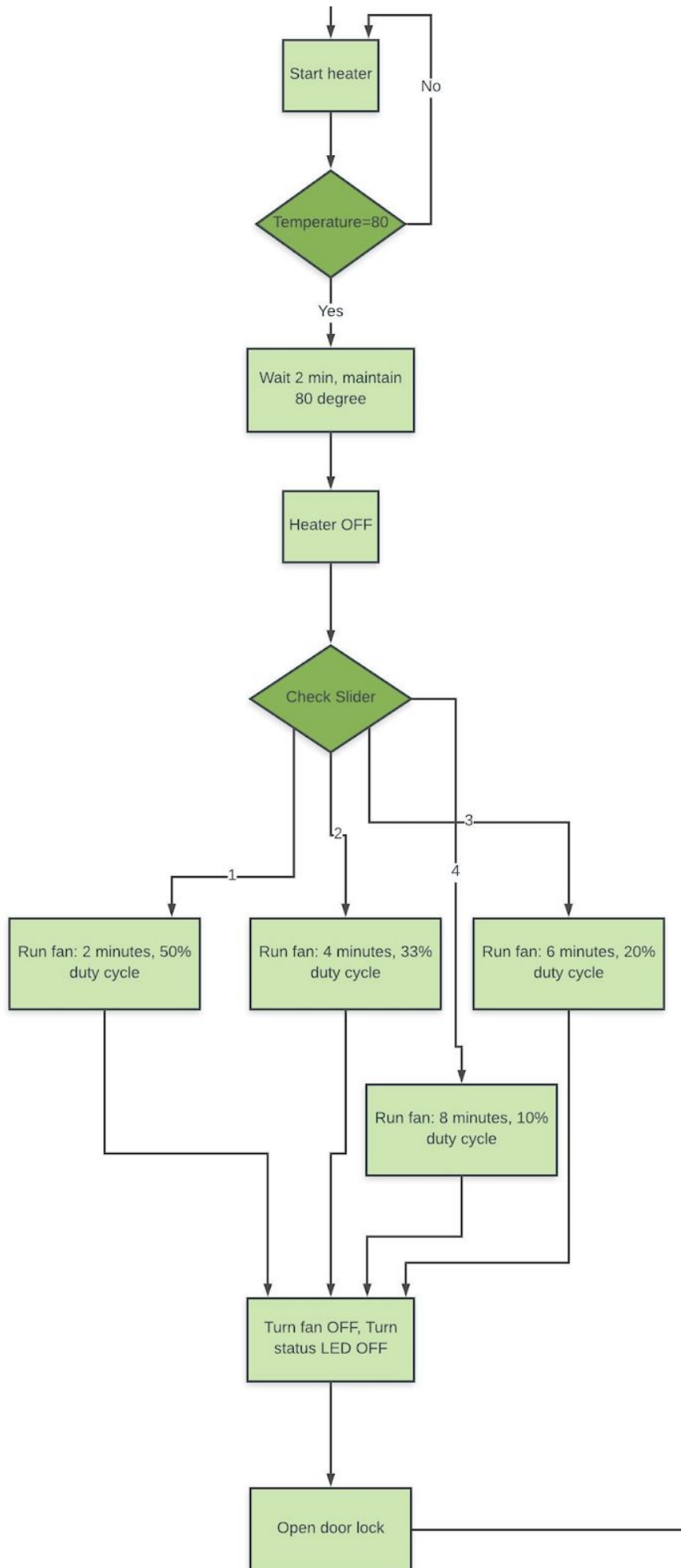
1. LEV1: Fan motor cools the sterilization unit from 80oC to 30 oC in 2 mins at 50% duty cycle.
2. LEV2: Fan motor cools the sterilization unit from 80oC to 30 oC in 4 mins at 33% duty cycle.
3. LEV3: Fan motor cools the sterilization unit from 80oC to 30 oC in 6 mins at 20% duty cycle.

4. LEV4: Fan motor cools the sterilization unit from 80oC to 30 oC in 8 mins at 10% duty cycle.

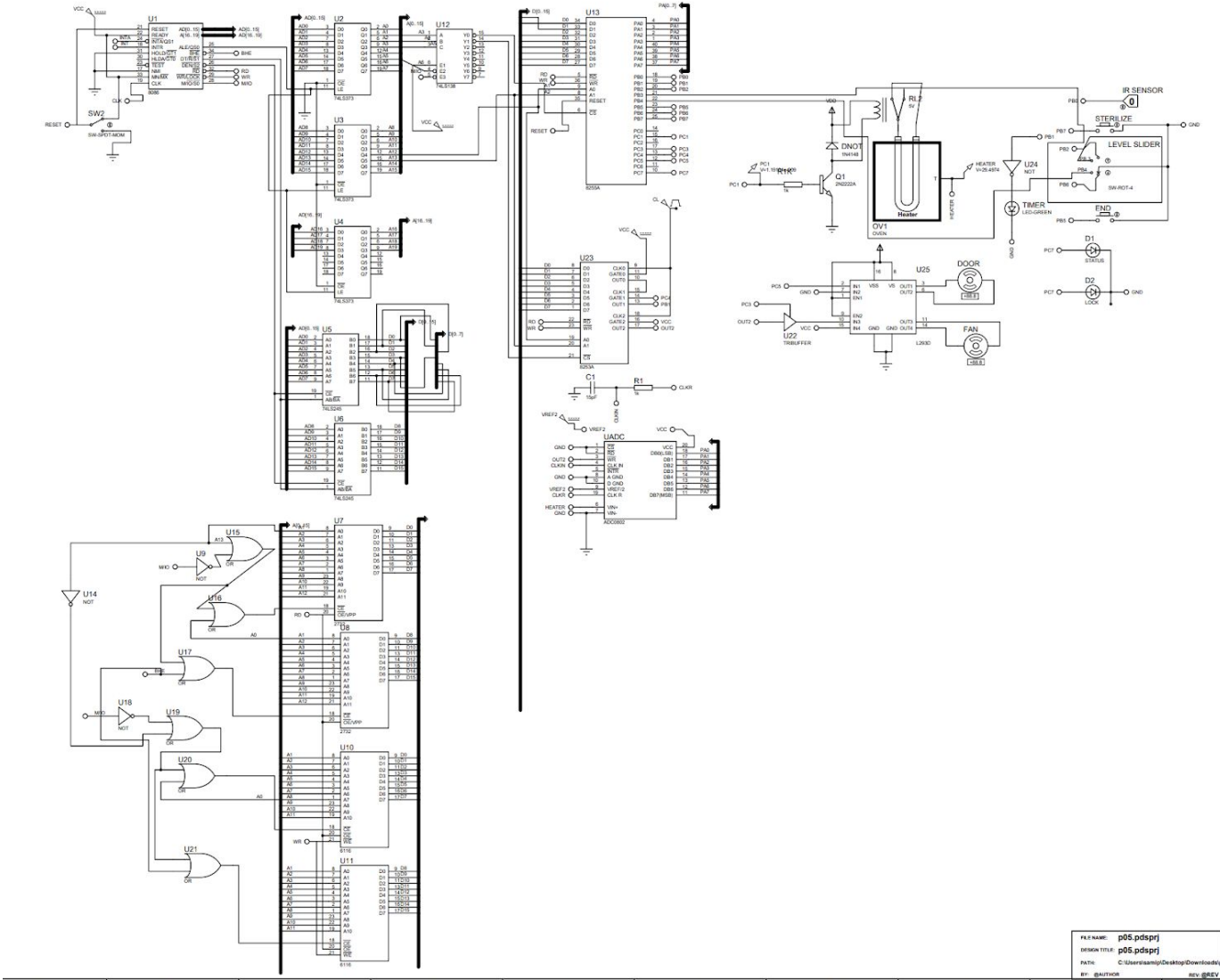
#### **ASM CHART**







Circuit Diagram



## ASM CODE

#make\_bin#

#LOAD\_SEGMENT=FFFFh#

#LOAD\_OFFSET=0000h#

#CS=0100h#

#IP=03feh#

#DS=0100h#

#ES=0100h#

#SS=0100h#

#SP=9FFFh#

#AX=0000h#

#BX=0000h#

#CX=0000h#

#DX=0000h#

#SI=0000h#

#DI=0000h#

#BP=0000h#

```
    jmp  st1
    db   509 dup(0)
```

;IVT entry for 80H

```
    dw   0000
    db   508 dup(0)
```

;main program

; initialize ds, es,ss to start of RAM

st1: cli

```
mov ax,0200h
mov ds,ax
mov es,ax
mov ss,ax
mov sp,0FFFEH
```

```
MOV AL,92H
OUT 06H,AL ;config 8255
MOV AL,00110100B ;config 8254 (Counter 0, Mode 2)
OUT 0Eh,AL
MOV AL,64H ;08H – 2710h(10,000)
OUT 08H,AL
MOV AL,00H ;08H – 2710h(10,000)
OUT 08H,AL
```

```
MOV AL,01110010B ;config 8254 (Counter 1, Mode 1)
OUT 0Eh,AL
MOV AL,0Ch ;0Ah – 78h(120)
OUT 0Ah,AL
MOV AL,00H ;0Ah – 78h(120)
OUT 0Ah,AL
MOV AL,10110110B ;config 8254 (Counter 2, Mode 3)
OUT 0Eh,AL
MOV AL,64H ;0Ch( To be given to SOC) – 064h(100)
OUT 0Ch,AL
MOV AL,00H
OUT 0Ch,AL
```

```
IR1:
IN AL,02h ; (PB 0 – IR Sensor)
AND AL,01H
JNZ IR1
```

```
MOV CL,0
```

```
MOV AL,00000000B ;( PC4- GATE1 =0)
OUT 04H,AL
MOV AL,00000000B ;( PC1- heater =0)
OUT 04H,AL
```

START:

```
IN AL, 00h
CMP AL,38 ; Maintaining Temperature= 30 degrees
JGE X1
MOV AL,00000010b ;Heater(PC 1) on
OUT 04H,AL
JMP START
```

X1:

```
MOV AL,00000000b ;Heater(PC 1) off
OUT 04H,AL
```

GETLEVEL:

```
IN AL,02H
MOV AH,AL
AND AH,01000000B
JNZ LVL3
MOV CL,04H
JMP END10
```

LVL3:

```
MOV AH,AL
AND AH,00010000B
JNZ LVL2
MOV CL,03H
JMP END10
```

LVL2:

```
MOV AH,AL
AND AH,00001000B
```

```
JNZ LVL1
MOV CL,02H
JMP END10
LVL1:
MOV AH,AL
AND AH,00001000B
MOV CL,01H
END10:
```

```
IN AL,02h
MOV AH,AL
AND AH,80H
;CMP AH,80H           ;80h = sterlize
JZ STER
MOV AH,AL
AND AH,20H
;CMP AH,20H           ;20H=END
JZ END1
JMP START
```

```
END1:           ;end pressed
```

```
CALL DELAY_20MS ;de-bounce
```

```
IN AL,02h
AND AL,20H
;CMP AL,20H
JNZ START
```

```
MOV AL,10110110B ;config 8254 (Counter 2, Mode 3) "reinitialize for adc "
OUT 0Eh,AL
MOV AL,64H       ;0Ch( To be given to SOC) – 064h(100)
OUT 0Ch,AL
MOV AL,00H
```

```

OUT 0Ch,AL
MOV AL,01110010B ;COUNTER 1 MODE 1
OUT 0Eh,AL
MOV AL,03H ; COUNT =3 (3 sec)
OUT 0Ah,AL
MOV AL,00H
OUT 0Ah,AL

MOV AL,00010000B ; PULSE TO GATE 1 (PC4)
OUT 04H,AL
NOP;??
NOP
MOV AL,00000000B ;PULSE
OUT 04H,AL

DOOR:
MOV AL,00100000B
OUT 04H,AL ;Switching motor on( PC 5)
IN AL,02h ;OUT 1 (PB1)
AND AL,02H
JZ DOOR

MOV AL,00000000B ;Switching motor off( PC 5)
OUT 04H,AL

JMP IR1

STER: ;sterilize pressed

CALL DELAY_20MS ;de-bounce
IN AL,02h
AND AL,80H
;CMP AL,80H
JNZ START
MOV AL,10000000b ;lock door( PC 7)/ STATUS ON

```



OUT 04H,AL

X5:

MOV AL,10000010b ; HEATER (PC 1)-ON

OUT 04H,AL

WAIT1: IN AL, 00h

CMP AL,102 ; Waiting for 80 degree Celsius ???

JLE WAIT1

MOV AL,10010010B ; PULSE TO GATE 1 (PC4)

OUT 04H,AL

NOP

NOP

MOV AL,10000010B ;PULSE

OUT 04H,AL

TEMP100:

IN AL, 00h

CMP AL,102 ; Maintaining Temperature=80 degrees

JLE HTRON

MOV AL,10000000b ;Heater(PC 1) oFF

OUT 04H,AL

NOP ;NOP given to calibrate heater's rate of cooling with  
heating

NOP

NOP

NOP

NOP

NOP

NOP



CMP AL,0  
JZ TEMP100

MOV AL,01110010B ;COUNTER 1 MODE 1  
OUT 0Eh,AL  
CMP CL,1 ;Count of level button  
JZ S1  
CMP CL,2  
JZ S2  
CMP CL,3  
JZ S3  
CMP CL,4  
JZ S4

S1:  
MOV AL,120 ;COUNT =120 (2 MIN)  
OUT 0Ah,AL  
MOV AL,00H  
OUT 0Ah,AL  
MOV AL,10010000B ;PULSE TO GATE 1 (PC4)  
OUT 04H,AL  
NOP  
NOP  
MOV AL,10000000B ;PULSE  
OUT 04H,AL  
FAN1:  
MOV AL,10001000B ;Switching motor on (PC 3)  
OUT 04H,AL  
IN AL,02h ;OUT 1 (PB1)  
AND AL,02H  
JZ FAN1  
JMP OUT1  
S2:  
MOV AL,10110100B ;COUNTER 2, MODE 2

```

OUT 0Eh,AL
MOV AL,02H           ;GIVEN COUNT 2 (Duty cycle:50%)??
OUT 0Ch,AL
MOV AL,00H
OUT 0Ch,AL
MOV AL,0f0H         ; COUNT =240 (4 MIN)
OUT 0Ah,AL
MOV AL,00H
OUT 0Ah,AL
MOV AL,10010000B    ; PULSE TO GATE 1 (PC4)
OUT 04H,AL
NOP
NOP
MOV AL,10000000B    ;PULSE
OUT 04H,AL
FAN2:
MOV AL,10001000B    ;Switching motor on (PC 3)
OUT 04H,AL
IN AL,02h           ;OUT 1 (PB1)
AND AL,02H
CMP AL,0
JZ FAN2
JMP OUT1
S3:
MOV AL,10110100B    ;COUNTER 2, MODE 2
OUT 0Eh,AL
MOV AL,03H           ;GIVEN COUNT 3 (Duty cycle:33%)
OUT 0Ch,AL
MOV AL,00H
OUT 0Ch,AL
MOV AL,68H           ; COUNT =360 (6 MIN)
OUT 0Ah,AL
MOV AL,01H
OUT 0Ah,AL
MOV AL,10010000B    ; PULSE TO GATE 1 (PC4)

```

```

OUT 04H,AL
NOP
NOP
MOV AL,10000000B ;PULSE
OUT 04H,AL
FAN3:
MOV AL,10001000B ;Switching motor on (PC 3)
OUT 04H,AL
IN AL,02h ;OUT 1 (PB1)
AND AL,02H
CMP AL,0
JZ FAN3
JMP OUT1
S4:
MOV AL,10110100B ;COUNTER 2, MODE 2
OUT 0Eh,AL
MOV AL,04H ;GIVEN COUNT 4 (Duty cycle:25%)
OUT 0Ch,AL
MOV AL,00H
OUT 0Ch,AL
MOV AL,0e0H ; COUNT =480 (8 MIN)
OUT 0Ah,AL
MOV AL,01H
OUT 0Ah,AL
MOV AL,10010000B ; PULSE TO GATE 1 (PC4)
OUT 04H,AL
NOP
NOP
MOV AL,10000000B ;PULSE
OUT 04H,AL
FAN4:
MOV AL,10001000B ;Switching motor on (PC 3)
OUT 04H,AL
IN AL,02h ;OUT 1 (PB1)
AND AL,02H

```

```
CMP AL,0
JZ FAN4
JMP OUT1
```

```
OUT1:
```

```
MOV AL,10000000B ;Switching motor off (PC 3)
OUT 04H,AL
MOV AL,00000000b ;Unlock door( PC 7)/ STATUS OFF
OUT 04H,AL
MOV AL,10110110B ;config 8254 (Counter 2, Mode 3)
OUT 0Eh,AL
MOV AL,0E8H ;0Ch( To be given to SOC) – 03E8h(1000)
OUT 0Ch,AL
MOV AL,03H ;0Ch( To be given to SOC) –03E8h(1000)
OUT 0Ch,AL
JMP START
```

```
DELAY_20MS PROC NEAR ;subroutine
MOV DX,CX
MOV CX,10
X2:
NOP
NOP
LOOP X2
MOV CX,DX
RET
DELAY_20MS ENDP
```