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## **INTRODUCTION**

In Semester III, the project was finalized. The components were decided and were tested for faults or imperfections. The faulty components were discarded and the components were finalized for use in project.

The circuit of the project was made on the bread board. The program for the project was burned into the PIC - $\mu$ c 16F84A. Changes were made in the circuit to acquire the required outputs and signals. Thus the entire project was made to work on the bread board.

In Sem-IV, the layout of the circuit was finalized and the circuit was made on the vero board. The power supply for the project (+12v and +5V) was made on a vero board. The hardware parts of the project, which include the box for U.V. chamber, curtains, doors, etc., were made and the components were fixed on them. Proper wiring was done from components to the circuit and the terminals and wires are labelled accordingly.

Addition to the proposed project idea includes incorporation of a '*Process Counter*'. This will count the number of successfully completed sterilization processes. The counter will be incremented by 1 only when the material which has undergone sterilization, is taken-off the conveyor belt after the completion of the process.

## ADDITIONS

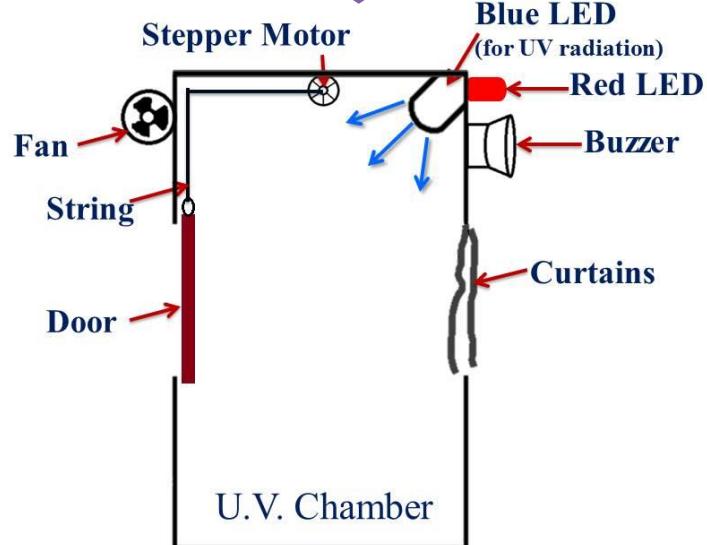
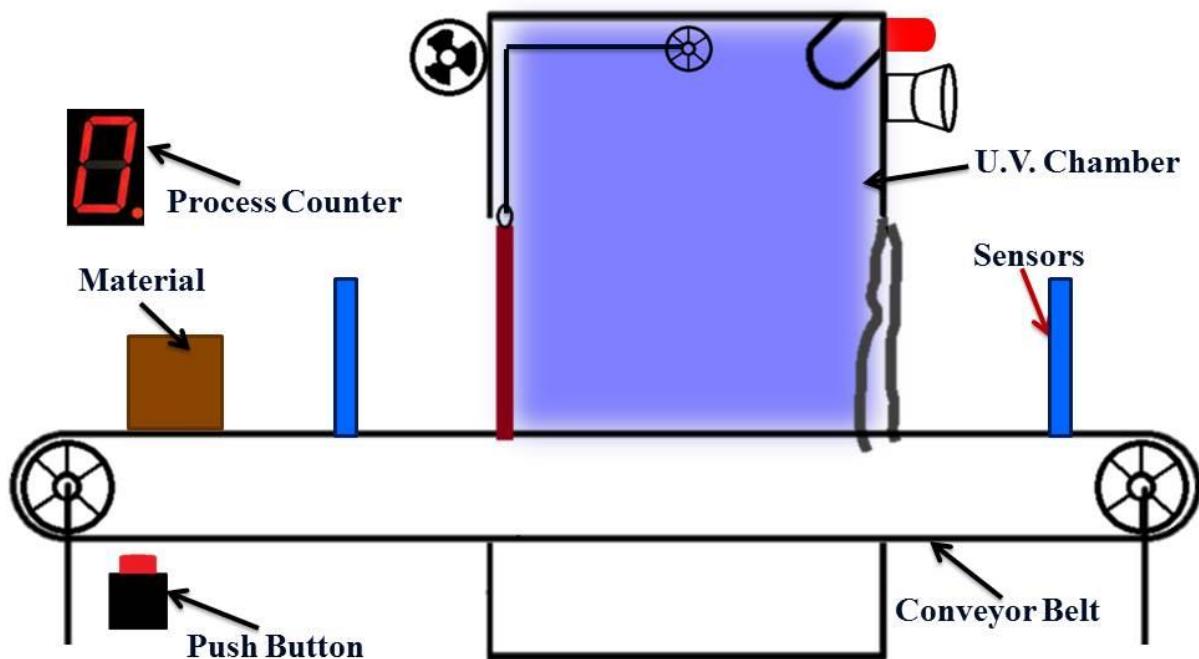
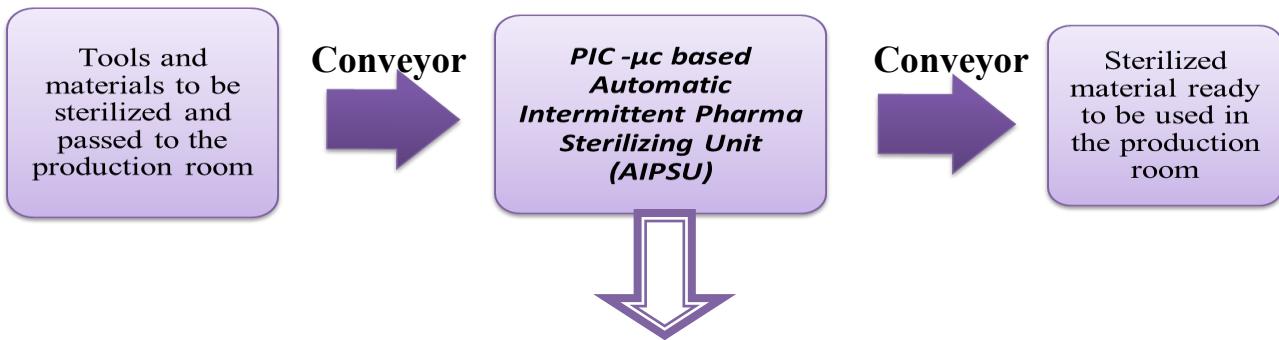
A '*Process Counter*' has been added to the project, as an extension. This helps in counting the number of processes that has completed the sterilization process. When the sterilized material reaches the last IR transmitter-receiver pair, the conveyor belt stops (thus prevent the object from falling). The buzzer is turned ON, which indicates the end of process. If the material is not picked from the conveyor belt, the Red Indication LED blinks. The counter counts (i.e. increments by 1) only when the material is picked-up from the conveyor belt or else the counter will wait till the object is picked-up. If the sterilization process is complete but the material is not lifted from the conveyor belt, the counter will not be incremented.

The project requires two supply voltages:

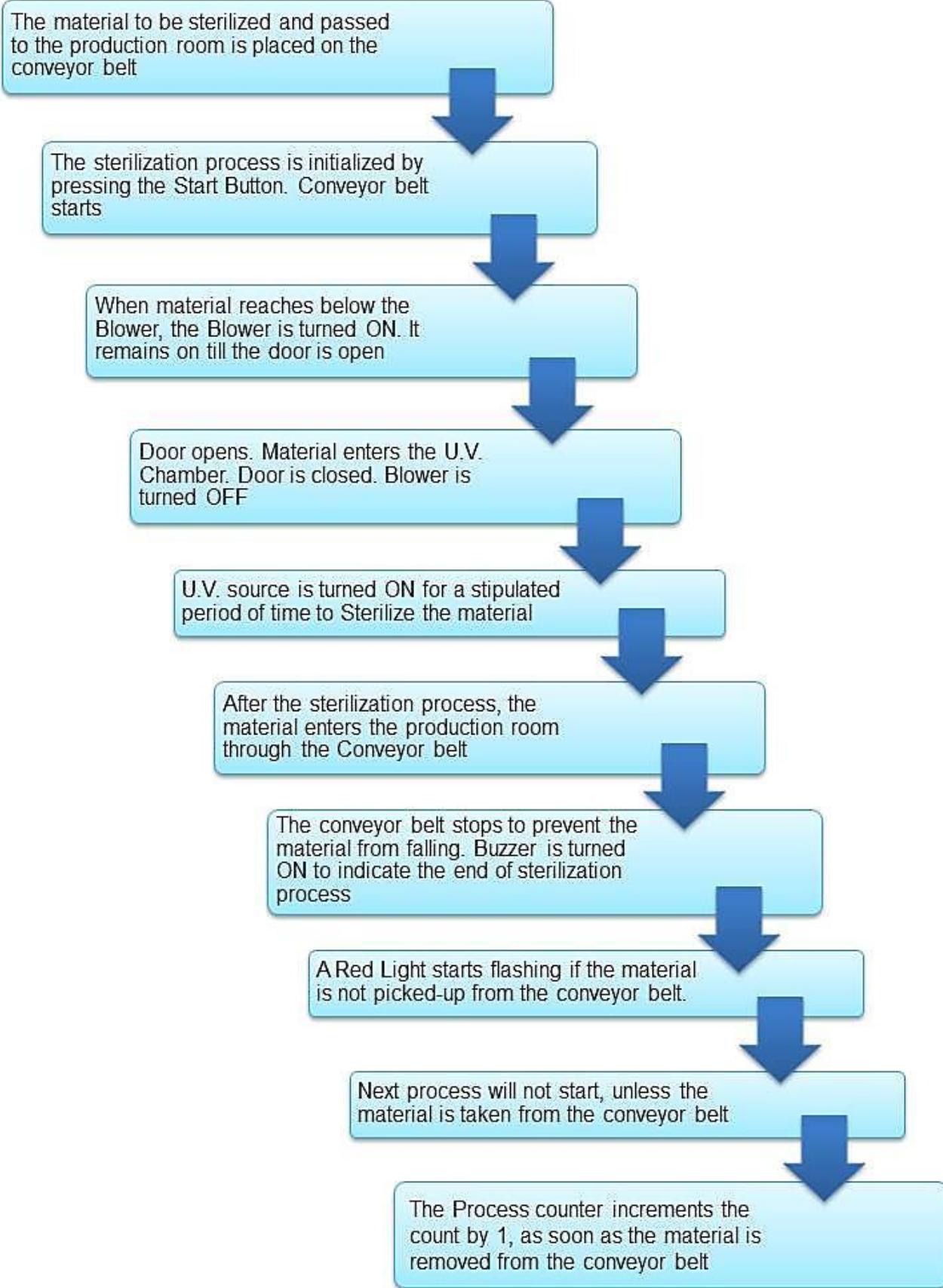
- **+5 V** : This supply is required by the µC PIC 16F32A, IC 7414, IC MCT2E, IC 7447, IC 7490, IR sensors and receivers, buzzer, fan, LED's, push buttons, seven segment display, etc.
- **+12 V**: This supply is required by ULN 2004, D.C. motor and stepper motor.

These two power supplies are made using a 24V/1A step-down transformer and voltage regulator IC 7812 and IC 7805.

## BLOCK DIAGRAM:



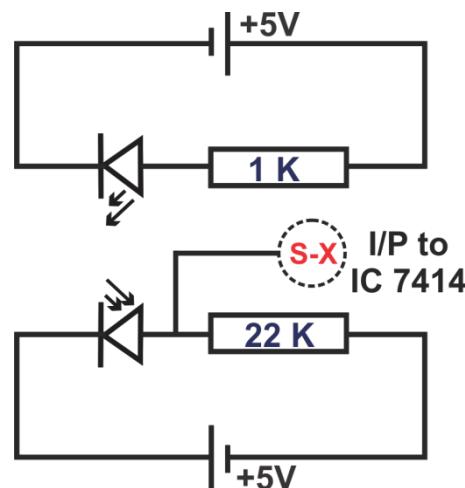
## **FLOW CHART**



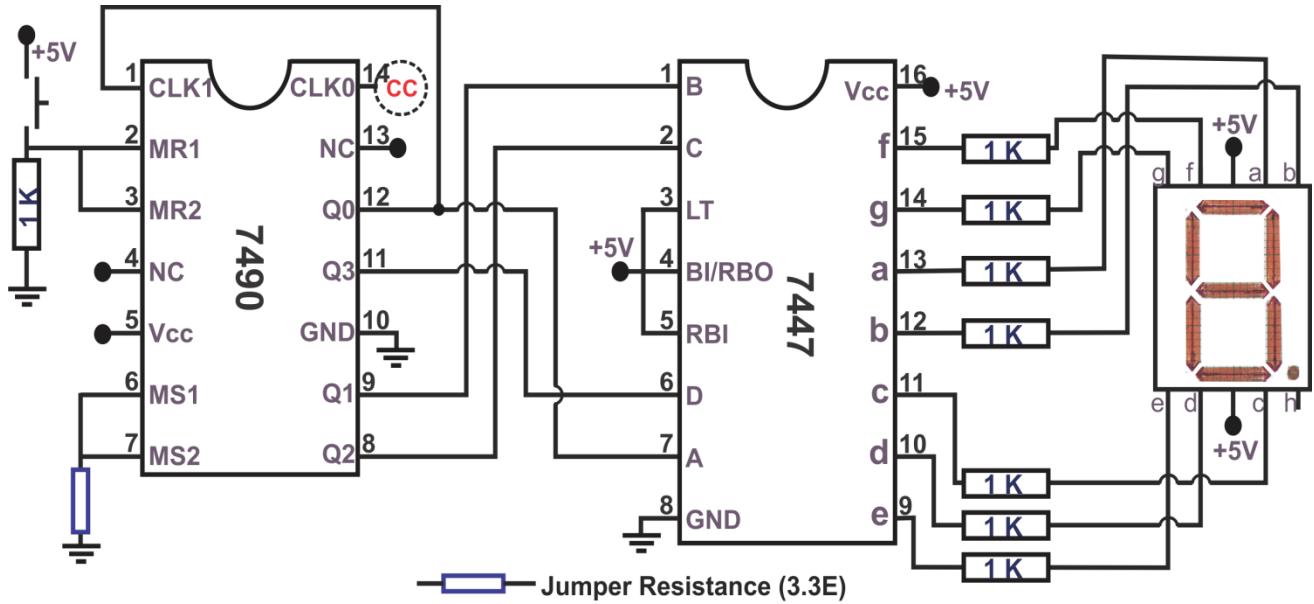
## PORT ASSIGNMENT AND CIRCUIT DIAGRAM

<b>Port A.0</b>	<b>O/P</b>	DC Motor (Conveyor belt)
<b>Port A.1</b>	<b>I/P</b>	Start Button
<b>Port A.2</b>	<b>I/P</b>	Front I.R. sensor
<b>Port A.3</b>	<b>I/P</b>	Middle I.R. sensor
<b>Port A.4</b>	<b>I/P</b>	Back I.R. sensor

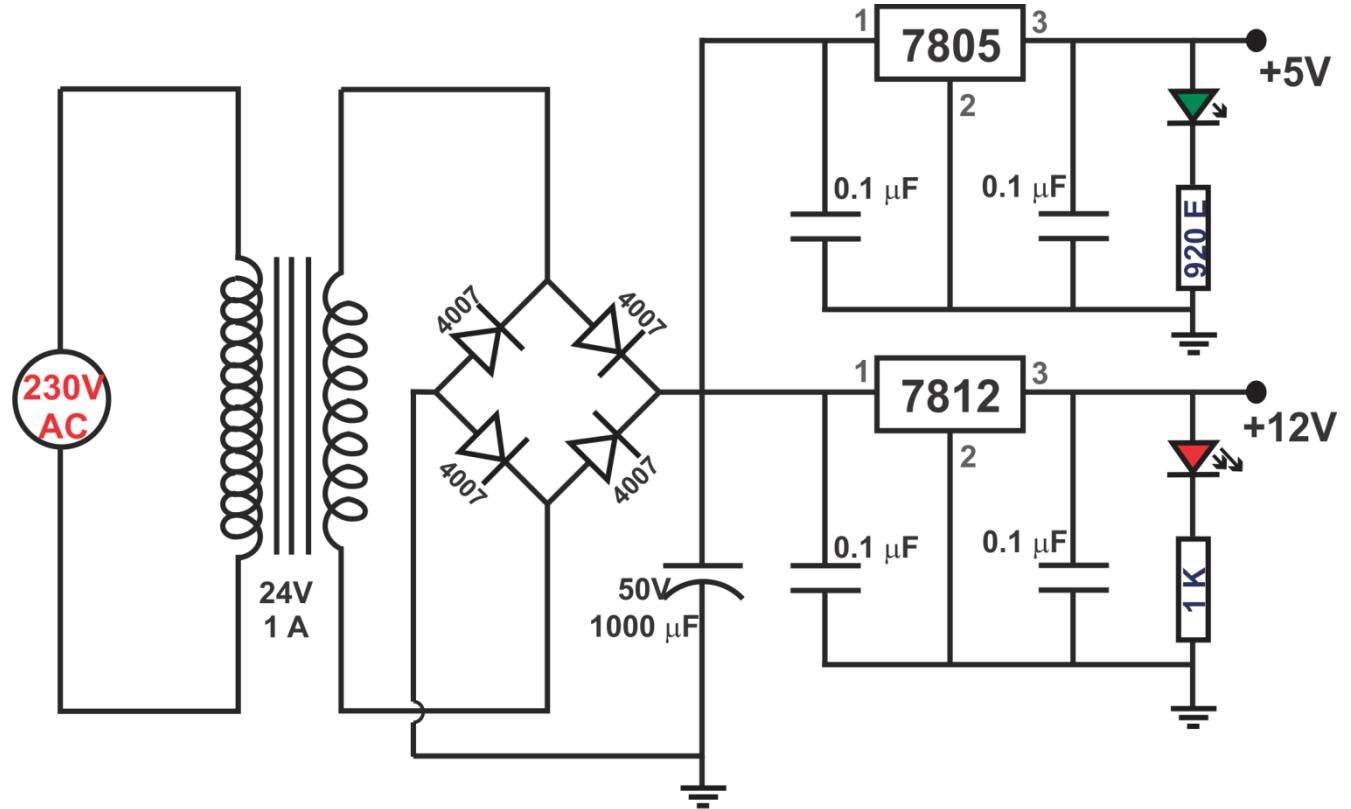
<b>Port B.0</b>	<b>O/P</b>	Stepper Motor (for opening and closing Door)
<b>Port B.1</b>		
<b>Port B.2</b>		
<b>Port B.3</b>		
<b>Port B.4</b>	<b>O/P</b>	Blue LED (U.V. source)
<b>Port B.5</b>	<b>O/P</b>	Buzzer
<b>Port B.6</b>	<b>O/P</b>	Flashing Red LED
<b>Port B.7</b>	<b>O/P</b>	DC Fan (Blower)



**IR Transmitter – Receiver Circuit**

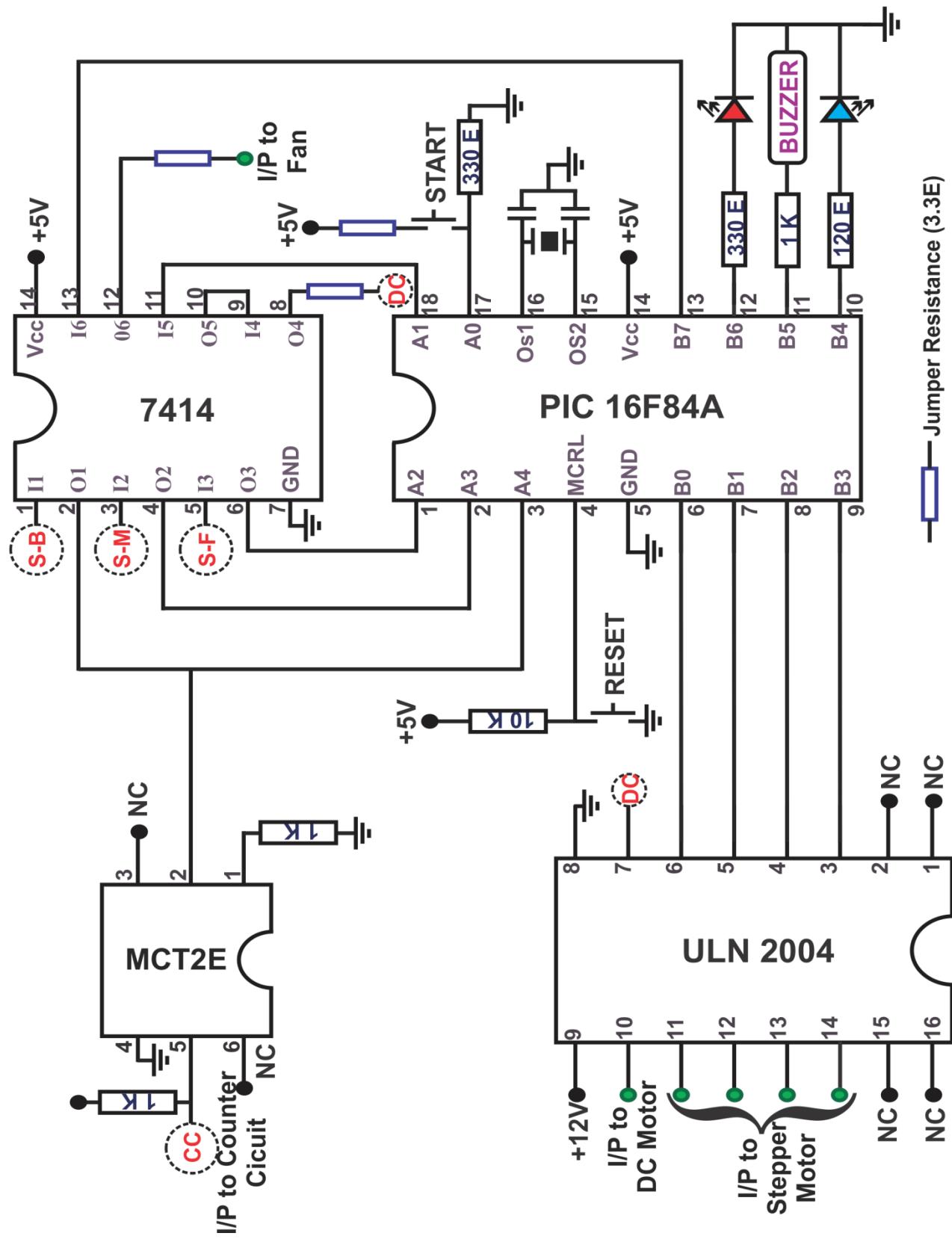


*Circuit Diagram of Counter Circuit*

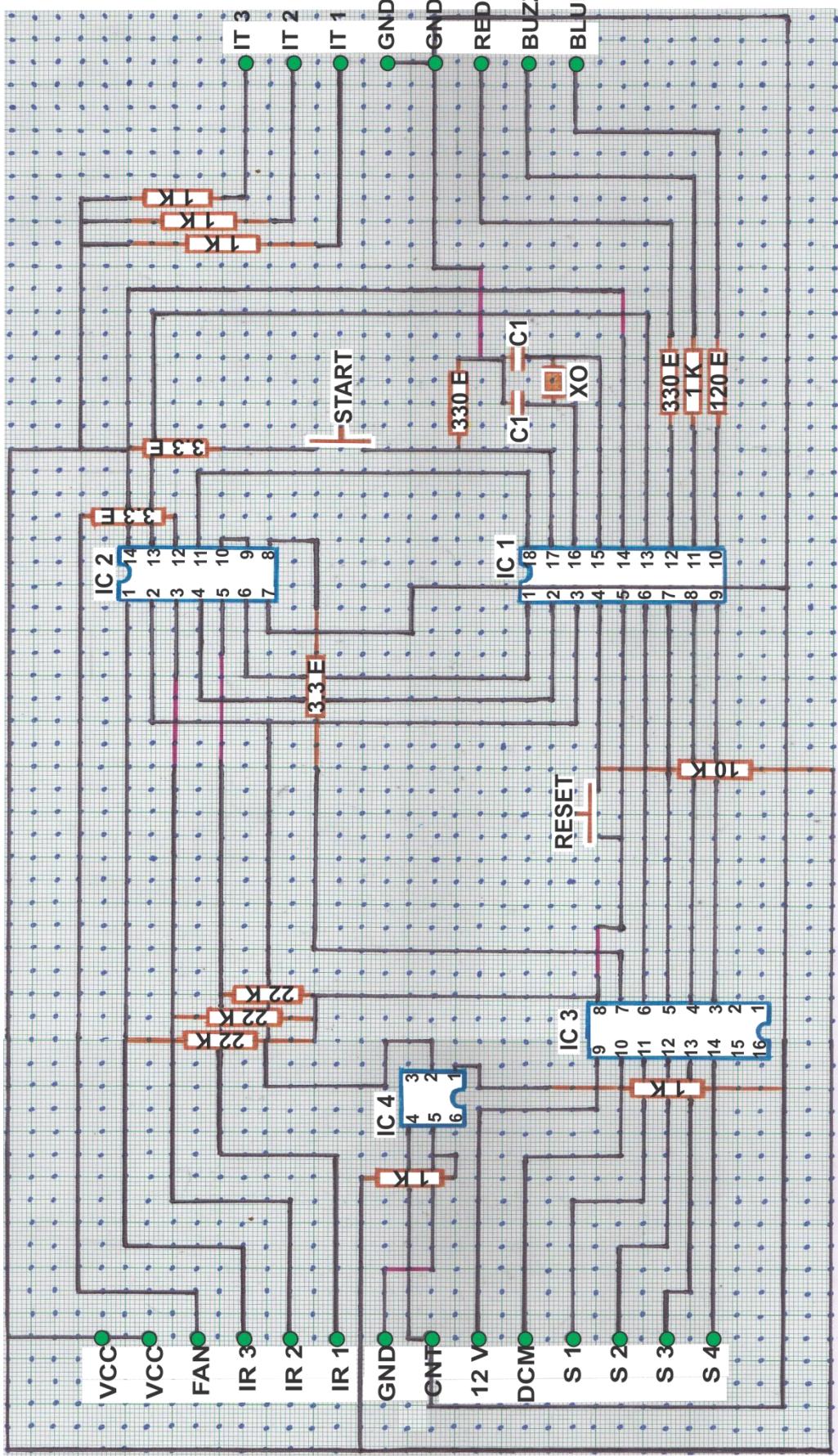


*Circuit Diagram of Power Supply*

## Connections of Components with PIC 16F84a Micro-Controller



## LAYOUT:

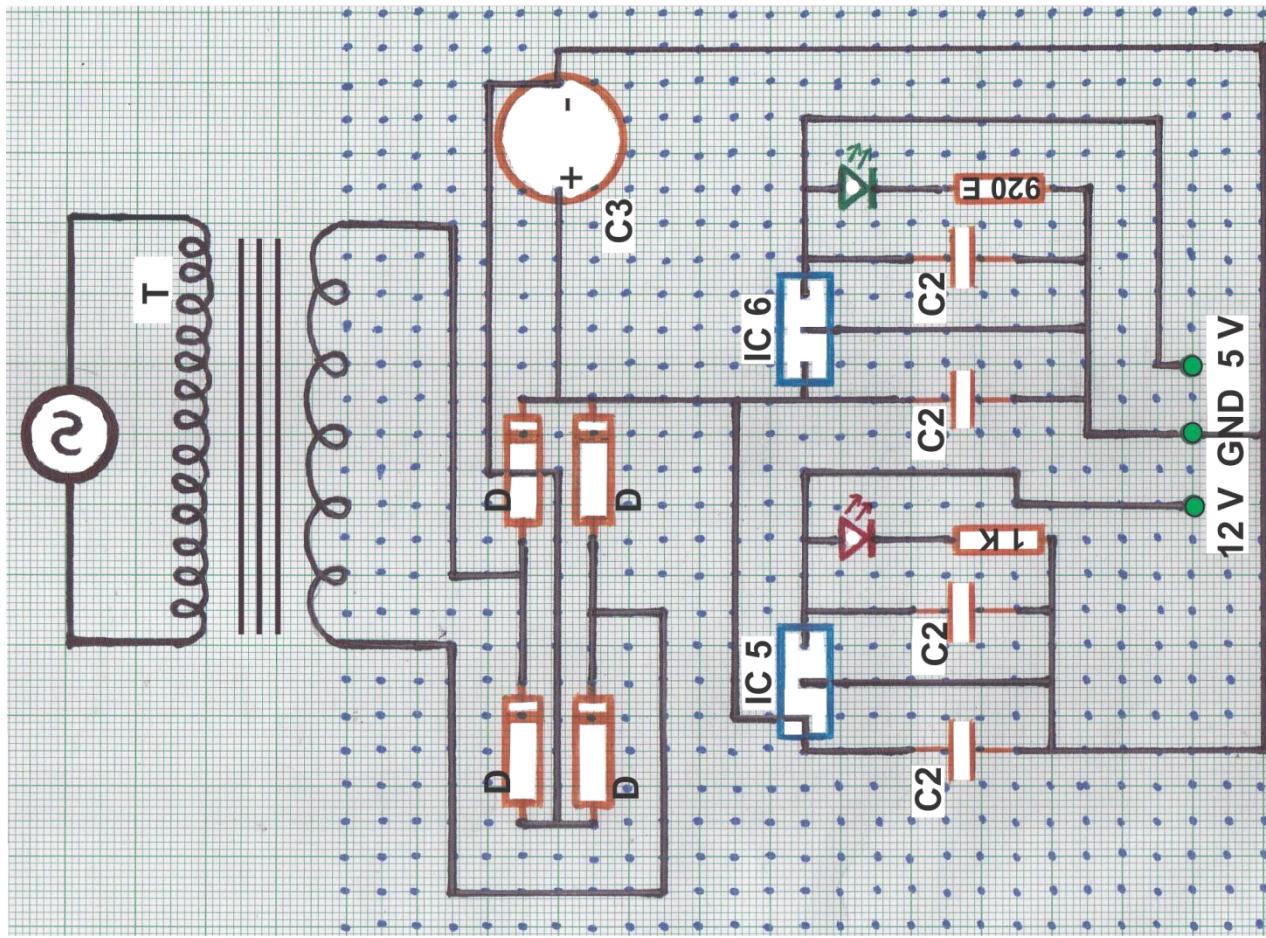


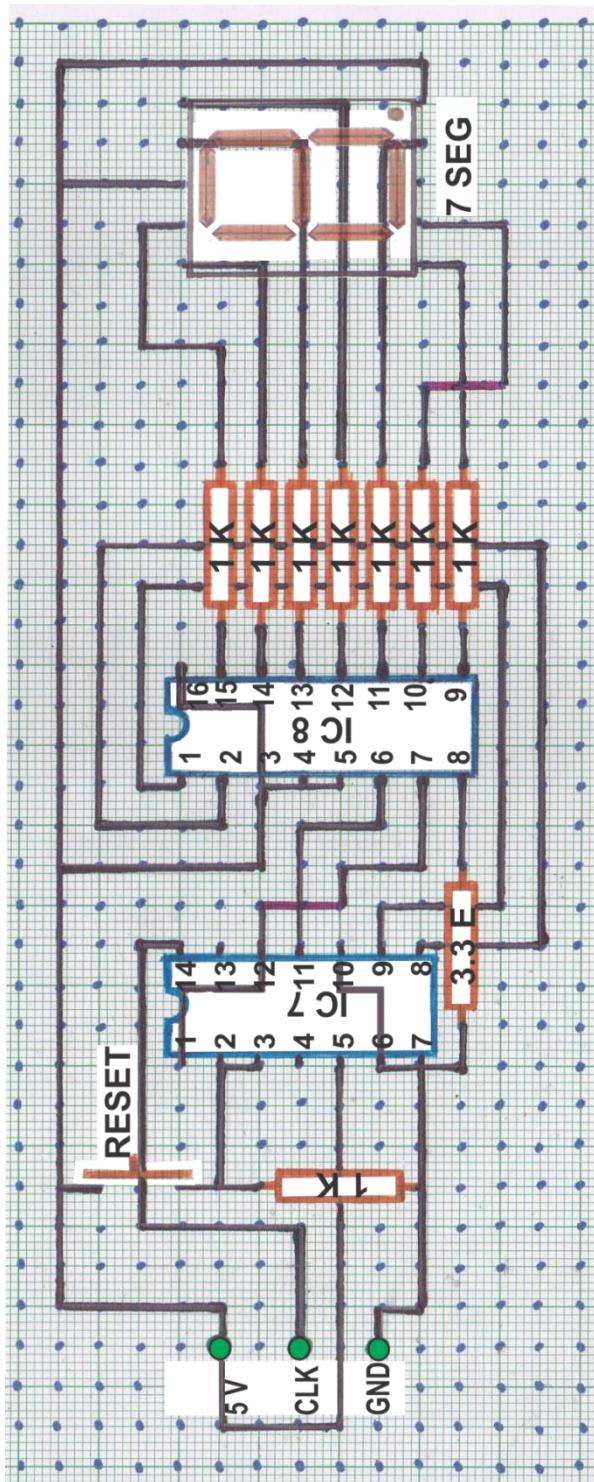
## **MAIN CIRCUIT BOARD**

- |                          |                                     |
|--------------------------|-------------------------------------|
| <b>IC 1</b> - PIC 16F84A | <b>XO</b> - 4MHz Crystal Oscillator |
| <b>IC 2</b> - 7414       | <b>C1</b> - 330pF Capacitor         |
| <b>IC 3</b> - ULN 2004   | <b>●</b> - PCB Connectors           |
| <b>IC 4</b> - MCT2E      | <b>—</b> - Jumpers                  |

## POWER SUPPLY CIRCUIT BOARD

- T - 24V/ 1A Step Down Transformer
- IC 5 - 7812 Voltage Regulator IC
- IC 6 - 7805 Voltage Regulator IC
- D - 4007 Diode
- C2 - 0.1  $\mu$ F Capacitor
- C3 - 50V/1000  $\mu$ F Capacitor
- - PCB Connectors
- - Jumpers





PROCESS COUNTER CIRCUIT BOARD

- IC 7 - 7490 Decade Counter IC
  - IC 8 - 7447 7 Segment Decoder/Driver IC
  - 7 SEG - Common Anode 7 Segment Display
    - PCB Connectors
    - - Jumper

### **LIST OF COMPONENTS USED:**

1. Conveyor belt and U.V. Chamber
2. Infra-red transmitter receiver pair (3)
3. 5V Buzzer
4. 5V DC Fan
5. 12V stepper motor
6. 12V DC geared motor
7. Resistances
8. IC's: 16F84A PIC, 7414, , ULN 2003, MCT2E, 7812, 7805, 7490, 7447
9. 24V/1A Step-down Transformer
10. LED's: blue, red
11. 7 Segment Display (common anode type)
12. Reset button (3)
13. Zif socket, IC base, connectors
14. Capacitors
15. Diodes
16. Crystals
17. Door, curtain, string

## PROGRAM

```
;*****declaring and configuring the microcontroller***  
list P=PIC16F84A, R=DEC  
include "p16f84.inc"  
_CONFIG _CP_OFF & _WDT_OFF & _PWRTE_ON & _XT_OSC  
  
;*****Equates*****  
  
;*****variables*****  
cblock      H'0c'  
count1  
count2  
count3  
COUNTER2  
counter  
endc  
  
;*****Vectors*****  
org          000  
goto        Mainline  
org          004  
goto        Mainline  
  
;*****Tables*****  
  
;*****Mainline*****  
  
Mainline  
;*****Port setting*****  
bsf          STATUS, RP0  
movlw       h'1D'  
movwf       TRISA  
clrf         TRISB  
bcf          STATUS, RP0
```

```

;*****Checking for Task Initializations*****
AGAIN      bcf      PORTA, 1
           movlw    h'80'
           movwf    PORTB
REPEAT1    btfss   PORTA, 0
           goto    AGAIN

;*****Motion of Conveyor Belt*****
REPEAT2    bsf      PORTA, 1
           btfss   PORTA, 2
           goto    REPEAT2
           bcf      PORTA,1

;*****Blower On*****
           bcf      PORTB, 7
           call    DELAY2

;*****Door Open*****
           call    CLOCK

;*****Motion of Conveyor Belt*****
REPEAT3    bsf      PORTA, 1
           btfss   PORTA, 3
           goto    REPEAT3
           bcf      PORTA, 1

;*****Door Closed*****
           call    ANTICLOCK

;*****Blower Off*****
           bsf      PORTB, 7

```

```

;*****U.V. Light*****
    bsf      PORTB, 4
    call     DELAY2
    call     DELAY2
    bcf      PORTB, 4

;*****Motion of Conveyor Belt*****
REPEAT4      bsf      PORTA, 1
              btfss   PORTA, 4
              goto    REPEAT4
              bcf      PORTA, 1

;*****Buzzer On*****
REPEAT5      movlw   h'0A'
              movwf   COUNTER2
              bsf      PORTB, 5
              call    DELAY1
              call    DELAY1
              bcf      PORTB, 5
              call    DELAY1
              call    DELAY1
              decfsz COUNTER2,1
              goto    REPEAT5

;*****Flashing of LED*****
REPEAT6      btfsc   PORTA, 4
              goto    LED
              goto    AGAIN
LED          bsf      PORTB, 6
              call    DELAY1
              call    DELAY1
              bcf      PORTB, 6
              call    DELAY1
              call    DELAY1
              goto    REPEAT6

```

\*\*\*\*\*Clock Wise Motion\*\*\*\*\*

CLOCK

	movlw	h'28'
	movwf	counter
NEXT1	movlw	h'08'
	movwf	PORTB
	call	DELAY1
	movlw	h'04'
	movwf	PORTB
	call	DELAY1
	movlw	h'02'
	movwf	PORTB
	call	DELAY1
	movlw	h'01'
	movwf	PORTB
	call	DELAY1
	decfsz	counter,1
	goto	NEXT1
	return	

;\*\*\*\*\*Anti-Clock Wise Motion\*\*\*\*\*

ANTICLOCK

	movlw	h'28'
	movwf	counter
NEXT2	movlw	h'01'
	movwf	PORTB
	call	DELAY1
	movlw	h'02'
	movwf	PORTB
	call	DELAY1
	movlw	h'04'
	movwf	PORTB
	call	DELAY1
	movlw	h'08'
	movwf	PORTB
	call	DELAY1
	decfsz	counter,1
	goto	NEXT2
	return	
	END	

;\*\*\*\*\*Delay For Stepper Motor\*\*\*\*\*

DELAY1

	movlw	h'70'
	movwf	count1
up	movwf	count2
down	decfsz	count2,1
	goto	down
	decfsz	count1,1
	goto	up
	return	

;\*\*\*\*\*Delay 5 Seconds\*\*\*\*\*

DELAY2

	movlw	h'77'
	movwf	count1
up1	movwf	count2
up2	movwf	count3
up3	decfsz	count3,1
	goto	up3
	decfsz	count2,1
	goto	up2
	decfsz	count1,1
	goto	up1
	return	



## DATA SHEETS of COMPONENTS USED:



**MICROCHIP**

# PIC16F84A

## 18-pin Enhanced FLASH/EEPROM 8-Bit Microcontroller

### High Performance RISC CPU Features:

- Only 35 single word instructions to learn
- All instructions single-cycle except for program branches which are two-cycle
- Operating speed: DC - 20 MHz clock input  
DC - 200 ns instruction cycle
- 1024 words of program memory
- 68 bytes of Data RAM
- 64 bytes of Data EEPROM
- 14-bit wide instruction words
- 8-bit wide data bytes
- 15 Special Function Hardware registers
- Eight-level deep hardware stack
- Direct, indirect and relative addressing modes
- Four interrupt sources:
  - External RB0/INT pin
  - TMR0 timer overflow
  - PORTB<7:4> interrupt-on-change
  - Data EEPROM write complete

### Peripheral Features:

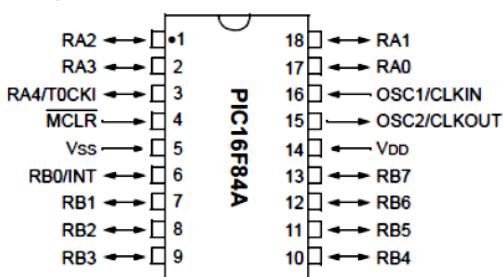
- 13 I/O pins with individual direction control
- High current sink/source for direct LED drive
  - 25 mA sink max. per pin
  - 25 mA source max. per pin
- TMR0: 8-bit timer/counter with 8-bit programmable prescaler

### Special Microcontroller Features:

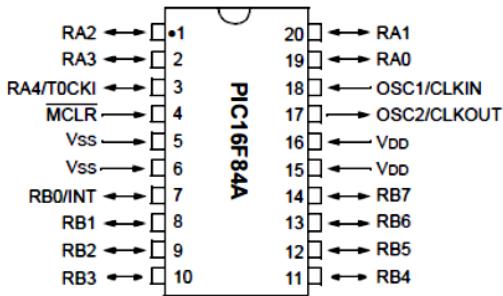
- 10,000 erase/write cycles Enhanced FLASH Program memory typical
- 10,000,000 typical erase/write cycles EEPROM Data memory typical
- EEPROM Data Retention > 40 years
- In-Circuit Serial Programming™ (ICSP™) - via two pins
- Power-on Reset (POR), Power-up Timer (PWRT), Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own On-Chip RC Oscillator for reliable operation
- Code protection
- Power saving SLEEP mode
- Selectable oscillator options

### Pin Diagrams

PDIP, SOIC



SSOP



### CMOS Enhanced FLASH/EEPROM Technology:

- Low power, high speed technology
- Fully static design
- Wide operating voltage range:
  - Commercial: 2.0V to 5.5V
  - Industrial: 2.0V to 5.5V
- Low power consumption:
  - < 2 mA typical @ 5V, 4 MHz
  - 15 µA typical @ 2V, 32 kHz
  - < 0.5 µA typical standby current @ 2V

**SN5414, SN54LS14,  
SN7414, SN74LS14**  
**HEX SCHMITT-TRIGGER INVERTERS**  
SDLS049B – DECEMBER 1983 – REVISED FEBRUARY 2002

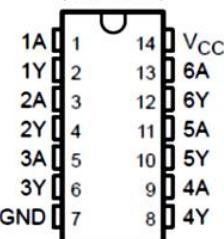
- Operation From Very Slow Edges
- Improved Line-Receiving Characteristics
- High Noise Immunity

#### description

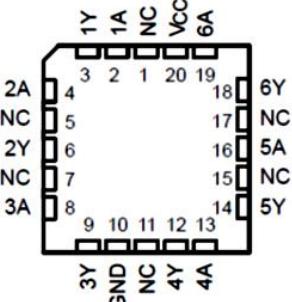
Each circuit functions as an inverter, but because of the Schmitt action, it has different input threshold levels for positive-going ( $V_{T+}$ ) and negative-going ( $V_{T-}$ ) signals.

These circuits are temperature compensated and can be triggered from the slowest of input ramps and still give clean, jitter-free output signals.

**SN5414, SN54LS14 . . . J OR W PACKAGE**  
**SN7414 . . . D, N, OR NS PACKAGE**  
**SN74LS14 . . . D, DB, OR N PACKAGE**  
(TOP VIEW)



**SN54LS14 . . . FK PACKAGE**  
(TOP VIEW)



NC – No internal connection

#### ORDERING INFORMATION

TA	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	PDIP – N	Tube	SN7414N	SN7414N
		Tube	SN74LS14N	SN74LS14N
	SOIC – D	Tube	SN7414D	7414
		Tape and reel	SN7414DR	
		Tube	SN74LS14D	LS14
		Tape and reel	SN74LS14DR	
	SOP – NS	Tape and reel	SN7414NSR	SN7414
	SSOP – DB	Tape and reel	SN74LS14DBR	LS14
	CDIP – J	Tube	SN5414J	SN5414J
		Tube	SNJ5414J	SNJ5414J
		Tube	SN54LS14J	SN54LS14J
		Tube	SNJ54LS14J	SNJ54LS14J
–55°C to 125°C	CFP – W	Tube	SNJ5414W	SNJ5414W
		Tube	SNJ54LS14W	SNJ54LS14W
	LCCC – FK	Tube	SNJ54LS14FK	SNJ54LS14FK

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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INSTRUMENTS**  
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On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

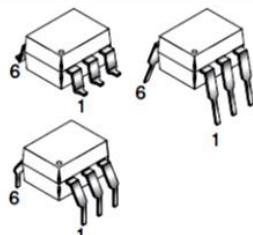
**MCT2  
MCT2200**

**MCT2E  
MCT2201**

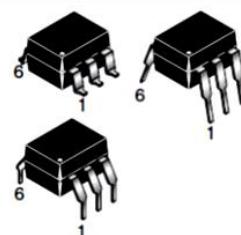
**MCT210  
MCT2202**

**MCT271**

**WHITE PACKAGE (-M SUFFIX)**



**BLACK PACKAGE (NO -M SUFFIX)**



## DESCRIPTION

The MCT2XXX series optoisolators consist of a gallium arsenide infrared emitting diode driving a silicon phototransistor in a 6-pin dual in-line package.

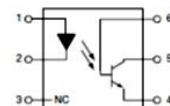
## FEATURES

- UL recognized (File # E90700)
- VDE recognized (File # 94766)
  - Add option V for white package (e.g., MCT2V-M)
  - Add option 300 for black package (e.g., MCT2.300)
- MCT2 and MCT2E are also available in white package by specifying -M suffix, eg. MCT2-M

## APPLICATIONS

- Power supply regulators
- Digital logic inputs
- Microprocessor inputs

**SCHEMATIC**



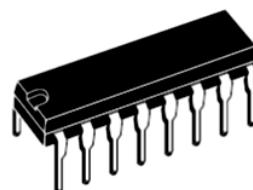
PIN 1: ANODE  
2: CATHODE  
3: NO CONNECTION  
4: Emitter  
5: Collector  
6: Base



# ULN2001A-ULN2002A ULN2003A-ULN2004A

## SEVEN DARLINGTON ARRAYS

- SEVEN DARLINGTONS PER PACKAGE
- OUTPUT CURRENT 500mA PER DRIVER (600mA PEAK)
- OUTPUT VOLTAGE 50V
- INTEGRATED SUPPRESSION DIODES FOR INDUCTIVE LOADS
- OUTPUTS CAN BE PARALLELED FOR HIGHER CURRENT
- TTL/CMOS/PMOS/DTL COMPATIBLE INPUTS
- INPUTS PINNED OPPOSITE OUTPUTS TO SIMPLIFY LAYOUT



DIP16

ORDERING NUMBERS: ULN2001A/2A/3A/4A



SO16

ORDERING NUMBERS: ULN2001D/2D/3D/4D

### DESCRIPTION

The ULN2001A, ULN2002A, ULN2003 and ULN2004A are high voltage, high current darlington arrays each containing seven open collector darlington pairs with common emitters. Each channel rated at 500mA and can withstand peak currents of 600mA. Suppression diodes are included for inductive load driving and the inputs are pinned opposite the outputs to simplify board layout.

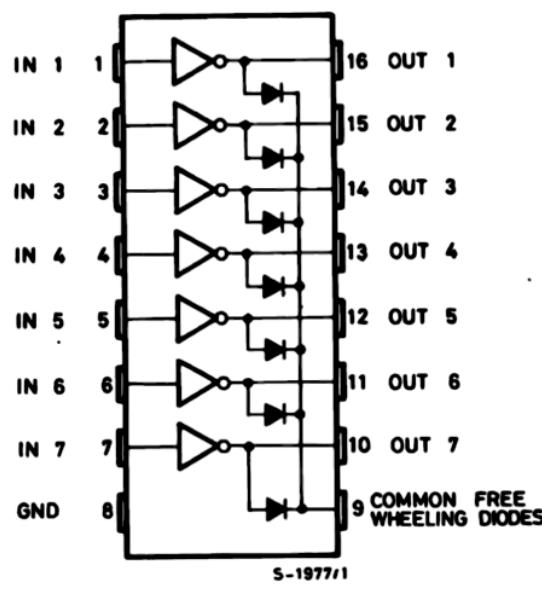
The four versions interface to all common logic families :

ULN2001A	General Purpose, DTL, TTL, PMOS, CMOS
ULN2002A	14-25V PMOS
ULN2003A	5V TTL, CMOS
ULN2004A	6-15V CMOS, PMOS

These versatile devices are useful for driving a wide range of loads including solenoids, relays DC motors, LED displays filament lamps, thermal print-heads and high power buffers.

The ULN2001A/2002A/2003A and 2004A are supplied in 16 pin plastic DIP packages with a copper leadframe to reduce thermal resistance. They are available also in small outline package (SO-16) as ULN2001D/2002D/2003D/2004D.

### PIN CONNECTION





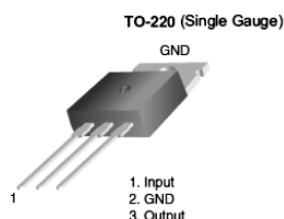
## LM78XX / LM78XXA 3-Terminal 1 A Positive Voltage Regulator

### Features

- Output Current up to 1 A
- Output Voltages: 5, 6, 8, 9, 10, 12, 15, 18, 24 V
- Thermal Overload Protection
- Short-Circuit Protection
- Output Transistor Safe Operating Area Protection

### Description

The LM78XX series of three-terminal positive regulators is available in the TO-220 package and with several fixed output voltages, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut-down, and safe operating area protection. If adequate heat sinking is provided, they can deliver over 1 A output current. Although designed primarily as fixed-voltage regulators, these devices can be used with external components for adjustable voltages and currents.

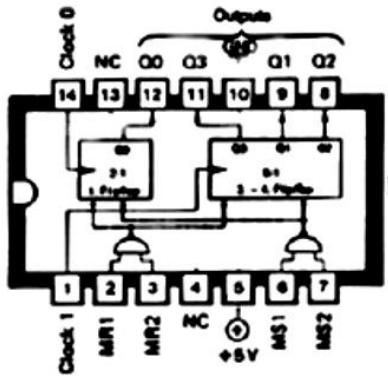


### Ordering Information<sup>(1)</sup>

Product Number	Output Voltage Tolerance	Package	Operating Temperature	Packing Method
LM7805CT	$\pm 4\%$	TO-220 (Single Gauge)	-40°C to +125°C	Rail
LM7806CT				
LM7808CT				
LM7809CT				
LM7810CT				
LM7812CT				
LM7815CT				
LM7818CT				
LM7824CT				
LM7805ACT				
LM7809ACT	$\pm 2\%$		0°C to +125°C	
LM7810ACT				
LM7812ACT				
LM7815ACT				

#### Note:

1. Above output voltage tolerance is available at 25°C.



#### Description:

This package contains a divide-by-two and a divide-by-five counter.

#### Mode of operation:

The device consists of 4 flip-flops which are connected internally to create one divide-by-2 and one divide-by-5 counters.

All flip-flops have a common reset line controlled by two inputs MR1 and MR2. When both MR1 and MR2 are high the counters are cleared.

Flip-flop 1 is not internally connected to the other stages, thus providing a variety of counter sequences:

- Counting to 10 (BCD): Output Q0 is connected to the Clock 1 input. The input pulses are applied to the Clock 0 input and the divided signal is extracted at Q3. The device counts in binary code up to 9, with the outputs returning to zero on the 10th clock pulse. Pins 2, 3 and 6, 7 must be grounded.
- Divide by 2 and divide by 5: Flip-flop 1 is used as a 2:1 divider and flip-flops 2,3 and 4 are used as a 5:1 divider.
- Symmetrical biquinary divider 10:1: Q3 is connected to Clock 0. Clock 1 is used as the clock input. A symmetrical square-wave with a frequency 1/10 that of the input signal is obtained at output Q0.

The flip-flops are triggered on the falling edge of the clock pulse.

When inputs MS1 and MS2 are both high the counter is preset to 9.

Reset/set inputs		Outputs		
MR1	MR2	MS1	MS2	Q0 Q1 Q2 Q3
H	H	L	X	L L L L
H	H	X	L	L L L L
X	X	H	H	H L L H
L	X	L	X	Counting
X	L	X	L	Counting
L	X	X	L	Counting
X	L	L	X	Counting

#### Application:

Counters and dividers 2:1, 5:1 and 10:1

#### Data:

Min. guaranteed clock frequency flip-flop 1

MHz 32

3 32

Min. guaranteed clock frequency flip-flops 2-4

MHz 16

3 16

Supply Current

mA 32

3.2 9

#### Families:

	Std	ALS	AS	F	H	L	LS	S
	●					●	●	

## DECADE COUNTER

7490



June 1989

## DM7446A, DM5447A/DM7447A BCD to 7-Segment Decoders/Drivers

### General Description

The 46A and 47A feature active-low outputs designed for driving common-anode LEDs or incandescent indicators directly. All of the circuits have full ripple-blanking input/output controls and a lamp test input. Segment identification and resultant displays are shown on a following page. Display patterns for BCD input counts above nine are unique symbols to authenticate input conditions.

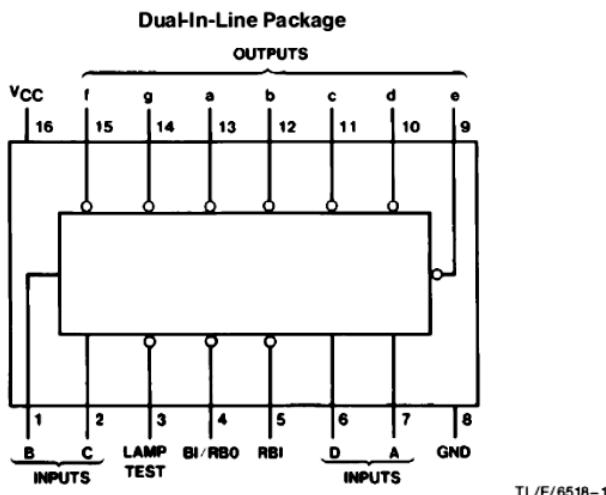
All of the circuits incorporate automatic leading and/or trailing-edge, zero-blanking control (RBI and RBO). Lamp test (LT) of these devices may be performed at any time when the BI/RBO node is at a high logic level. All types contain

an overriding blanking input (BI) which can be used to control the lamp intensity (by pulsing) or to inhibit the outputs.

### Features

- All circuit types feature lamp intensity modulation capability
- Open-collector outputs drive indicators directly
- Lamp-test provision
- Leading/trailing zero suppression

### Connection Diagram



Order Number DM5447AJ, DM7446AN or DM7447AN  
See NS Package Number J16A or N16E