LIGHT EMITTING DIODES (LEDS)

PROJECT BOARD & CML12S LAB EXPERIMENT

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Class

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Instructor / Professor

xiom
anufacturing

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1 GETTING STARTED

The following section has been designed to help users to quickly learn proper setup and operation of the lab experiment.

1.1 Introduction

The experiment requires a single board development system that is fully assembled and fully functional from Axiom Manufacturing. Development board CML12S and PROJECT BOARD are supported in this experiment. The system comes complete with schematic and instructions. All software, drawings, and manuals are contained on the CD.

1.2 Software

The CD comes with AxIDE, which is an integrated development environment designed exclusively for use with Axiom development boards, providing an interface to programs running on these boards. AxIDE also makes uploading programs and easy via the COM port. Read your board manual for setting up AxIDE.

1.3 Support Software

There are many useful programs on the included CD that can make developing projects easier. The CD also contains example software programs for this experiment on each board. . You can also download the latest software free from our web site at: **http://www.axman.com**.

1.4 Hardware

The following hardware is required:

Axiom CML12S256
PROJECT BOARD
Windows based PC

2.0 Visual

Devices used in this lab are static sensitive and are easy damaged by mishandling. Use caution when installing wires and devices on the breadboard to prevent the bending of leads. Experiments should be laid out in a orderly fashion. Start your lab time with the bench clean and free of metal objects. Leave the lab area in a clean condition by picking up loose parts, wires and small objects.

3.0 Theory

Axiom's development board is designed for quickly and effectively learning the basics of microcontrollers. This lab will walk the student though the steps of using the development board for its intended purpose, controlling devices. A LED is one device that is controllable by a microcontroller. In this lab four LEDS are used for the experiment. A LED is a solid state device that when current is forced though the device, will emit a light. The port on the microcontroller will output a +5 volt high signal. This signal is applied to the driver on the PROJECT BOARD. The output of the driver is connected to the cathode of the LED. The anode of the LED is connected though a resistor which is connected to +V. This limits the current flow though the LED to its rated value, otherwise the LED would over heat and possibly damage the part. LED

intensity is depended on the current flow. Driving LEDS at a higher intensity would require external drivers rated for LED being used as installed on the PROJECT BOARD. LEDS are good indicators for appliances, machinery, cars, & alarms plus many others. They come in several colors such as red, green, yellow, orange and blue. One LED can be used as power on indicator, another as a flashing alarm indicator, still another as a fault indicator.

4.0 Procedure

The procedure is arranged in a series of steps. Each step is to be completed before moving on to the next step. As each step is built on prior steps, the student's will increase their knowledge for other labs or self-study. The student should go though the steps as many times as necessary to master the subject. As an aid in keeping track of location, the check box next to each step should be checked as completed.

4.1 Description

You will be using PORT K on the DP256 microcontroller. PORT K is a multiple functional and Bi_Directional port. Bits 0,1,2,3 are connected to a HC573 latch on the PROJECT BOARD. This latch is enabled with jumpers ENABLE and JP7 in position 2 & 3. With the latch enabled, bits 0, 1, 2, 3 of port K are applied to the TD62003 darlington driver. This driver is rated high enough to drive the LED at its rated current. When a bit on PORT K goes high, it turns the driver on. The output pulls the cathode of the LED low. This forces current though the LED, which turns the LED ON. PORT K output register is located at address $0032 and its data direction register is located at $0033 on the DP256. Writing directly to this port will change the level of each pin. Writing a binary one will turn the LED on and writing a binary zero will turn LED off.

4.2 Detailed Steps

- [ ] Note in the following steps: DDRK refers to address $0033.
- [ ] Note in the following steps: PORTK refers to address $0032.
- [ ] Verify power is not applied to CML12S256 and PROJECT BOARD.
- [ ] Move jumper JP7 on PROJECT BOARD to position 2 & 3. Install ENABLE jumper.
- [ ] Apply power to the CML12S and PROJECT BOARD. See PROJECT BOARD manual.
- [ ] Write $0F to DDRK. This configures PORT K bits 0 – 3 as outputs.
- [ ] Write $00 to PORTK, verify all LEDS are off. This forces all outputs low, thus removing the drive for all the LEDS.

- [ ] Write $01 to PORTK, verify LED 1 is on. This forces PORTK bit 0 high, thus applying a drive for LED 1.

- [ ] Write $02 to PORTK, verify LED 2 is on. This forces PORTK bit 1 high, thus applying a drive for LED 2.

- [ ] Write $04 to PORTK, verify LED 3 is on. This forces PORTK bit 2 high, thus applying drive for LED 3.

- [ ] Write $08 to PORTK, verify LED 4 is on. This forces PORTK bit 3 high, thus applying a drive for LED 4.

4.3 Conclusion

In conclusion, by using the four bits of port K as drive for the four LEDS, the LEDS are directly set on or off. Any combination of LEDS can be set. All on at once or only one , two, three LEDS on. In development, one can assign each LED a function. Maybe one LED as a “Run” indicator. One as a “FAULT” indicator. Still another as a cycle indicator, example would be “RINSE” in a washing machine. Last would indicate a “Spin” cycle. The LED brightness is dependant on the lighting conditions of where the device is used. Normally, the current limiting resistor is adjusted for the correct brightness. The darlington driver allows for setting the full brightness of the LED without overstressing the microcontroller.

5.0 Software Control of LEDS

5.1 Program Description

The program starts by setting direction register of PORT K as outputs. Using equates LED1,LED2,LED3,LED4 as a mask, bits 0,1,2,3 of port K data register are cleared. This turns all LEDS off. The next step uses mask bit “LED1” to set LED1 on. The LED is made visual by calling a delay routine. This delay is long enough for a human to see the LED as being on. The next step uses the same mask bit “LED1” to turn LED1 off. The remaining steps turn LEDS 2,3,4 on and off in the same way. Finally the program jumps back to the beginning and repeats forever.

5.2 Running LED12 Program

- [ ] Load program LEDS2D.S19 into CML12S256. This program is located at $1000, which is internal memory. The source is show below.

- [ ] Program is executed by entering “CALL 1000” on CML12S256 and pressing enter.

- [ ] LED1, LED2, LED3 and LED4 will continue to flash forever.

5.3 LED12 Source

```
      ; Hardware
      ;  Four LEDS
      ;
      :
      ;
      ;
      ; Blinking Led's
;
;
PORTK:     equ  $32       ; port K data
DDRK:      equ  $33       ; port K direction
LED1:      equ  $01       ; LED 1 select
LED2:      equ  $02       ; LED 2 select
LED3:      equ  $04       ; LED 3 select
LED4:      equ  $08       ; LED 4 select
;
           org $1000


; Setup port K
MAIN:
           movb  #$0F,DDRK   ; bits 0-3 as outputs
           bclr  PORTK,LED1+LED2+LED3+LED4   ; all bits low
           jsr   DELAY
;
; LED one

           bset  PORTK,LED1    ; LED one On
           jsr   DELAY
           bclr  PORTK,LED1    ; LED one Off
           jsr   DELAY

; LED two

           bset  PORTK,LED2    ; LED two On
           jsr   DELAY
           bclr  PORTK,LED2    ; LED two Off
           jsr   DELAY


; LED three

           bset  PORTK,LED3    ; LED three On
           jsr   DELAY
           bclr  PORTK,LED3    ; LED three Off
           jsr   DELAY


; LED four

           bset  PORTK,LED4    ; LED four On
           jsr   DELAY
           bclr  PORTK,LED4    ; LED four Off
           jsr   DELAY

;
           jmp  MAIN            ; start over
;
; Delay subroutine
DELAY:
           ldab #$0F
```

```
DELAYL1:
           ldx  #$ffff
DELAYL:
           dbne  X,DELAYL

           dbne  B,DELAYL1
           rts
```

6.0 Quiz

Question One

Where is the program LEDS2D.S19 located in memory?

A. External memory
B. Internal memory
C. Eprom
D. Rom

Question Two

Writing $04 to PORTK, turns which LED on?

A. LED1
B. LED2
C. LED3
D. LED4

Question Three

What causes a LED to emit light?

A. Current C. Voltage
B. Resistor D. Diode

Question Four

Is PORT K?

A. Input C. Bi_Directional
B. Output D. Wired Or

Question Five

How many LEDS can be on at one time?

A 1 C. 3
B. 2 D. 4

Bonus Question

What is DDRK in LEDS2D.ASM?

A. Data Register C. Direction Register
B. Program Counter D. Timer

7.0 TROUBLESHOOTING

The development system is fully tested and operational before shipping. If it fails to function properly, consult the troubleshooting section of your user manual.

8.0 Tips and Suggestions

Following are a number of tips, suggestions and answers to common questions that will solve most problems users have with the development system. You can download the latest software from the Support section of our web page at: www.axman.com