LIGHT EMITTING BAR (LED BAR)

PROJECT BOARD & CML12S LAB EXPERIMENT

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Class

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Instructor / Professor

xiom
anufacturing

2813 Industrial Ln. • Garland, TX 75041 • (972) 926-9303 FAX (972) 926-6063
support@axman.com Rev 1.01 • web: http://www.axman.com

CONTENTS

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 boards CML12S256 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 BAR is one device that is controllable by a microcontroller. In this lab, a four element LED BAR is 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 apply 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 to a resistor which is connected to the +V. The resistor is a current limiting resistor for the LED. This limits the current flow though the LED.to its rated value, otherwise the LED would over heat and possibly damage the LED. LED intensity is depended on the current flow. Driving LEDS at a higher intensity would require external drivers rated for the LED being used as installed on the PROJECT BOARD. A LED BAR is a good indicator for appliances, machinery, cars, & alarms plus many others. They come in several colors such as red and green. One element of the LED BAR 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 P on the DP256 microcontroller. PORT P is a multiple functional and Bi_Directional port. Bits 4, 5, 6, 7 are used as the drive for the four LEDS in the LED BAR. PORT P output register is located at address $0258 and its data direction register is located at $025A 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. Bits 4, 5, 6, 7 of PORT P are connected to a 573 latch on the PROJECT BOARD. This latch is enabled with jumpers ENABLE and JP7 in position 2 & 3. With the latch enabled, bits 4, 5, 6, 7 of PORT P 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 P 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. Turning off the LED is easy, just set PORT P output low.

4.2 Detailed Steps

☐ Note in the following steps: PTP refers to address $0258. DDRP refers to address $025A.

- [ ] 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 $F0 to DDRP. This configures PORT P bits 4 – 7 as outputs.
- [ ] Write $00 to PTP, verify all segment of the LED BAR are off. This forces all outputs low, thus removing the drive for all the LEDS.
- [ ] Write $10 to PTP, verify LB1 on the LED BAR is on. This force PORT P bit 4 high, thus applying a drive for LB1.
- [ ] Write $20 to PTP, verify LB2 on the LED BAR is on. This force PORT P bit 5 high, thus applying a drive for LB2.
- [ ] Write $40 to PTP, verify LB3 on the LED BAR is on. This force PORT P bit 6 high, thus applying drive for LB3.
- [ ] Write $80 to PTP, verify LB4 on the LED BAR is on. This force PORT P bit 7 high, thus applying a drive for LB4.

4.3 Conclusion

In conclusion, by using the four bits of PORT P as drive for the four LEDS in the LED BAR, 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 segment of the LED BAR 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 not readable in strong light levels. Normally a driver is provided between the microcontroller and LEDS. This increases the current, which increases the intensity of the LEDS.

5.0 Software Control of LEDS

5.1 Program Description

The program starts by setting direction register of PORT P to outputs. Using equates LEDB1, LEDB2, LEDB3, LEDB4 as a mask, bits 4, 5, 6, 7 of PORT P are cleared. This turns all LEDS off. The next step uses mask bit “LEDB1” to set LEDB1 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 “LEDB1” to turn LEDB1

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 LEDB2D Program

- ☐ Load program LEDB2D.S19 into CML12S. This program is located at $1000, which is internal memory. The source is show below.
- ☐ Program is executed by entering “CALL 1000” on CML12S and pressing enter.
- ☐ The program will flash each element of the LED BAR forever.

5.3 LED BAR Source

```
      * File LEDB2D.asm
      * Four Blinking LED BARS
 ; Blinking LEDS
;
;
PTP:       equ  $0258        ; port P data
DDRP:      equ  $025A        ; port P direction
LEDB1:     equ  $10          ; LB1 select
LEDB2:     equ  $20          ; LB2 select
LEDB3:     equ  $40          ; LB3 select
LEDB4:     equ  $80          ; LB4 select
;
           org $1000


; Setup port P
MAIN:
           movb  #$F0,DDRP      ; bits 4 - 7 as outputs
           bclr  PTP,LEDB1+LEDB2+LEDB3+LEDB4  ; turn all off
           jsr   DELAY
;
; LED BAR one

           bset  PTP,LEDB1      ; LB1 On
           jsr   DELAY          ; delay
           bclr  PTP,LEDB1      ; LB1 Off
           jsr   DELAY          ; delay

; LED BAR two

           bset  PTP,LEDB2      ; LB2 On
           jsr   DELAY          ; delay
           bclr  PTP,LEDB2      ; LB2 Off
           jsr   DELAY          ; delay


; LED BAR three

           bset  PTP,LEDB3      ; LB3 On
```

```
            jsr   DELAY          ; delay
            bclr  PTP,LEDB3      ; LB3 Off
            jsr   DELAY          ; delay


; LED BAR four

            bset  PTP,LEDB4      ; LB4 On
            jsr   DELAY          ; delay
            bclr  PTP,LEDB4      ; LB4 Off
            jsr   DELAY          ; 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 LEDB2D.S19 located in memory?

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

Question Two

Writing $40 to PORT P, turns what LED BAR on?

A. BAR1
B. BAR2
C. BAR3
D. BAR4

Question Three

What causes a LED to emit light?

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

Question Four

Is PORT P?

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

Question Five

How many BARS can be on at one time?

A. 1 C. 3
B. 2 D. 4

Bonus Question

What is the purpose of writing $F0 to DDRP?

A. Output C. Pulse
B. Input D. Trigger

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