LIGHT EMITTING DIODES (LEDS)

PROJECT BOARD & EVBU LAB EXPERIMENT

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Class

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Instructor / Professor

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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 boards CME11E9 EVBU and PROJECT BOARD are required for this experiment. The system comes complete with parts, 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 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 CME11E9 EVBU
PROJECT BOARD

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 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 voltage. 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 B on the HC11E9 microcontroller. This port is located at address $1004. In single chip mode, PORT B is a output only port. 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 0,1,2,3 of PORT B 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 0, 1, 2, 3 of port B 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 B 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 B output low.

4.2 Detailed Steps

- [ ] Note in the following steps: PORTB refers to address $1004
- [ ] Verify power is not applied to EVBU or PROJECT BOARD.
- [ ] Move jumper JP7 on PROJECT BOARD to position 2 & 3. Install ENABLE jumper.
- [ ] Install ModA jumper. Disable ModB jumper. Disable MEM_EN jumper. This will configure EVBU for single chip operation.
- [ ] Apply power to the EVBU and PROJECT BOARD. See PROJECT BOARD manual.
- [ ] Write $00 to PORTB, verify all LEDS are off. This forces all outputs low, thus removing the drive for all the LEDS.
- [ ] Write $01 to PORTB, verify LED 1 is on. This forces PORTB bit 0 high, thus applying a drive for LED 1.
- [ ] Write $02 to PORTB, verify LED 2 is on. This forces PORTB bit 1 high, thus applying a drive for LED 2.
- [ ] Write $04 to PORTB, verify LED 3 is on. This forces PORTB bit 2 high, thus applying drive for LED 3.
- [ ] Write $08 to PORTB, verify LED 4 is on. This forces PORTB bit 3 high, thus applying a drive for LED 4.

4.3 Conclusion

In conclusion, by using the four bits of port B 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 my loading X register with the address of port B. Using equates LED1, LED2, LED3, LED4 as a mask, bits 0,1,2,3 of port B 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. Final the program jumps back to the beginning and repeats forever.

5.2 Running LED11 Program

- ☐ Load program LED11.S19 into EVBU. This program is located at $0100, which is internal memory. The source is show below.
- ☐ Program is executed by entering “CALL 0100” on EVBU and pressing enter.
- ☐ The LEDS will flash forever.

5.3 LED11 Source

```
* File Led11.asm
* Four Blinking LEDS
* Using Port B bit 0 thru 3
*          equates
PORTB:     equ $1004
Led1:      equ $01          * PB0 select
Led2:      equ $02          * PB1 select
Led3:      equ $04          * PB2 select
Led4:      equ $08          * PB3 select
*
           org $0100
*
Main:
           ldx  #PORTB      * load x with address of PortB
           bclr 0,x Led1+Led2+Led3+Led4   * turn all LEDS off
LED1ON:                     * turn led one on
           bset 0,x Led1
           bsr  Delay
LED1OFF:                    * turn led two off
           bclr 0,x Led1
           bsr  Delay
```

```
* Turn on Led Two
LED2ON:                     * turn led two on
           bset 0,x Led2
           bsr  Delay


* Turn off Led Two
LED2OFF:                    * turn led two off
           bclr 0,x Led2
           bsr  Delay
LED3ON:                     * turn led three on
           bset 0,x Led3
           bsr  Delay
LED3OFF:                    * turn led three off
           bclr 0,x Led3
           bsr  Delay
LED4ON:                     * turn led four on
           bset 0,x Led4
           bsr  Delay
LED4OFF:                    * turn led 4 off
           bclr 0,x Led4
           bsr  Delay
           bra  Main        * loop forever
*
* Delay
Delay:
           ldy  #$ffff
DelayA:
           dey
           bne  DelayA
           rts              * return
```

6.0 Quiz

Question One

Where is the program LED11.S19 located in memory?

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

Question Two

Writing $04 to PORTB, turns what LED on?

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

Question Three

What causes a LED to emit light?

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

Question Four

Is PORTB a?

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 the purpose of X register in Led11.ASM?

A. Counter C. Pointer
B. Adder D. Faults

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 CME11E9 development system. You can download the latest software from the Support section of our web page at: www.axman.com