EMBEDDED HARDWARE DESIGN

Experiment 1B **Microcontroller Sleep Mode with LCD** **2009-10/I**

This experiment will demonstrate the working and usage of reducing power consumption in microcontroller by using various sleep mode options available. The aim is to develop a transistor based circuit which senses the current consumption of microcontroller and in cases of low current consumption by microcontroller switches off the LCD.

The program running in ATMega16 will manage LCD and taking microcontroller into sleep mode if no activity is detected on an input pin for certain time and waking it up from sleep mode when the input pin is activated again.

1. Programming requirements

While writing the program do the following things:-

(a) Include a LCD header file to perform print on LCD. Write a routine to continuously print character “a’ from (0,0) to (2,16) position,then clear the screen and start printing ‘a’ again.

(b) Write a routine to start 16-bit Timer/Counter1, in normal mode in which counter counts up from 0000 to FFFF, overflows, clears counter and start again. Select a prescaler to have an overflow time of a few seconds.

(c) Write a routine and select power-down mode.

(d) Write a routine to enable external interrupt 1 at low level.

(e) Write an external interrupt routine ISR(INT1_vect). In the interrupt routine clear the value of Timer Counter Register.

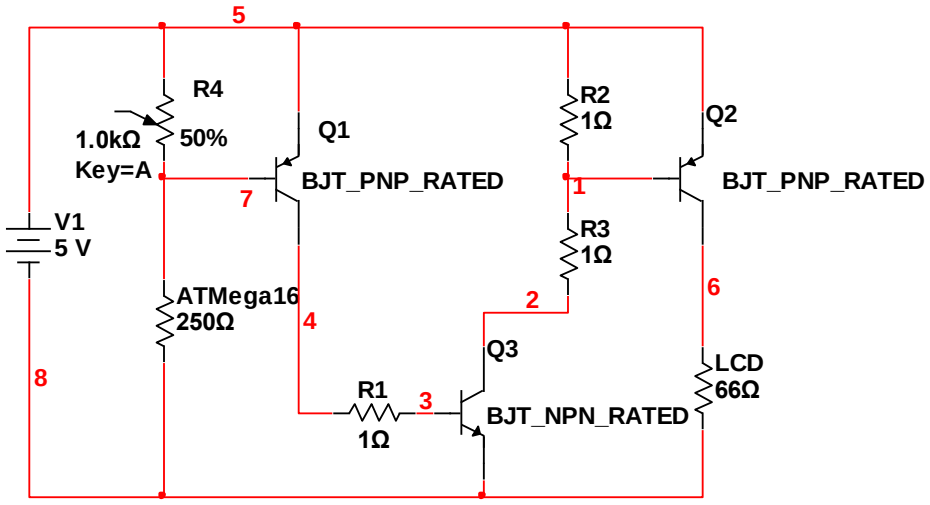
(f) Write a routine for Timer/Counter1 overflow interrupt. In this routine issue Sleep command by using asm(“sleep”); . Take caution to enable sleep mode just before issuing SLEEP instruction and immediately after SLEEP instruction disable Sleep enable, to prevent accidental issuing of SLEEP.

Relevant registers are – MCUCR, TCCR1A, TCCR1B, TCNT1, TIMSK.

Connection:- Connect a wire to pin PD3 to a pull up resistance and use a switch to connect it to ground to manually trigger External Interrupt 1.

2. LCD Switch-Off Circuit

R1, R2, R3 are unknown. R4 is a variable resistance. Q1, Q2 is 2N3904,Q3 is C547 transistor. The load ATMega16 and LCD are denoted by 250ohm and 66ohm resistances



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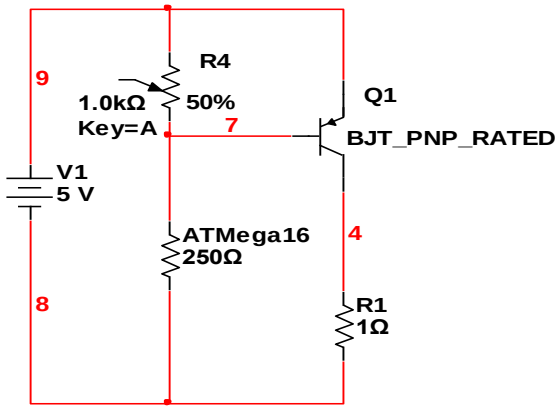
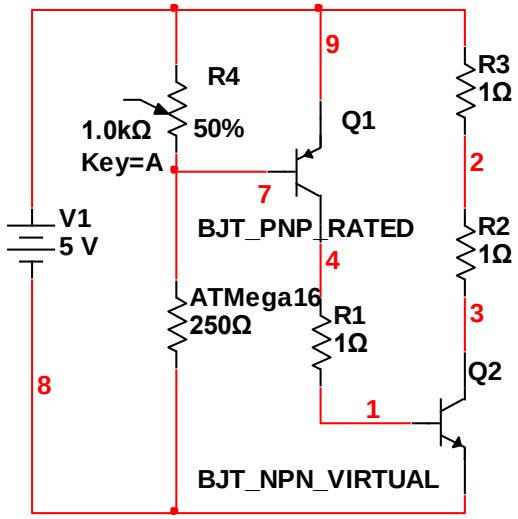
(a) Disconnect USB cable. Put 3 pin female connecting wire on LCD-JMP. The Pin1 (next to '+' sign) needs to be connected to base of Q1. The Pin2 needs to be connected to collector of Q2 and connect Pin3 is connected to GND of this circuit.

(b) Make Partial circuit like this. Check the current flowing in ATMega16 in normal operation and Power-down mode. Change the value of R4 such that when ATMega16 is in Power-down mode, the transistor Q1 is cutoff i.e. V_c is close to 0 V. When ATMega16 is in normal mode, then Transistor Q1 is active.



(c) Add transistor Q2 to the circuit. You have to adjust the values of R1, R2,R3, such that when ATMega16 is in Power-down mode, transistor Q2 is in cut-off region. When ATMega16 is in normal mode, than Q2 is in saturated region.



(d) Add transistor Q2 to the circuit and again set the values of R3 and R2 such that, When ATMega16 is in Power-down mode, than Q2 is cut-off and when ATMega16 is in normal mode, Q2 is in saturated region.

(e) Finally when the values of all resistances have been decided, demonstrate that the LCD power is turned off, when ATMega16 goes into Power-down mode and LCD is turned on again when ATMega16 is waked up from Power-down mode.

(f) Combine the Steps 1 and 2 and show that the LCD turns off when external interrupt switch not pressed within a few sec. time, and it again turns on with the interrupt switch.